



**WORKSHOP REPAIR MANUAL**

**WIRING DIAGRAMS**



## FOREWORD

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# 2011.0 Kuga

## Workshop Manual



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**GROUP**

**1**

# General Information

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## SECTION 100-00 General Information

### VEHICLE APPLICATION: 2008.50 Kuga

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**DESCRIPTION AND OPERATION****About This Manual****Introduction**

This manual covers diagnosis and testing and repair procedures.

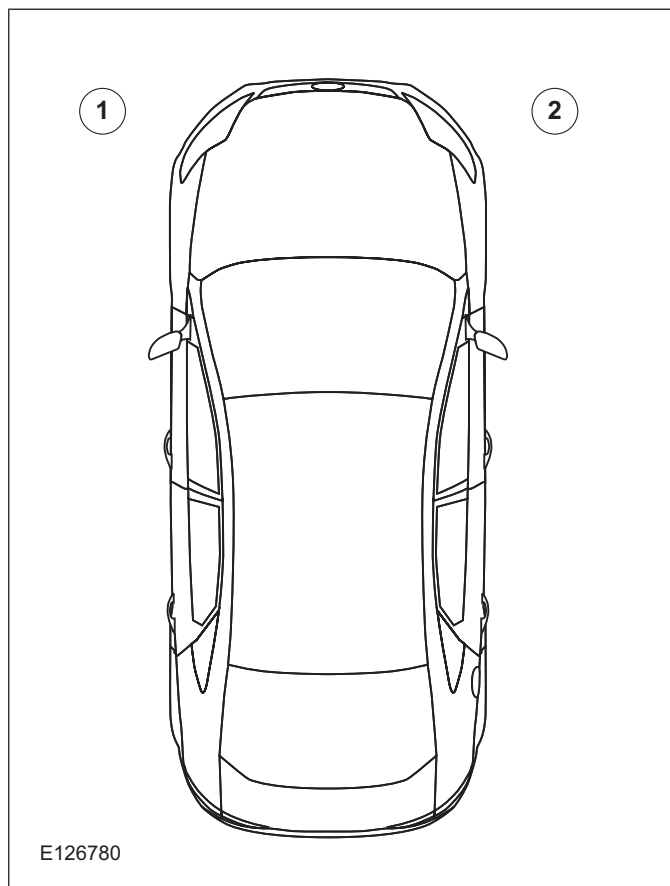
It is structured into groups and sections, with specific system sections grouped together under their relevant group.

A group covers a specific portion of the vehicle. The manual is divided into five groups, General Information, Chassis, Powertrain, Electrical and Body and Paint. The number of the group is the first number of a section number.

Within Etis, the navigation tree will list the groups. After selecting a group the navigation tree will then list the sections within that group. Each section has a contents list detailing Specifications, Description and Operation, Diagnosis and Testing, General Procedures, Disassembly and Assembly, Removal and Installation.

**References to LH (left-hand) and RH (right-hand)**

All LH and RH references to the vehicle are taken from a position sitting in the driver seat looking forward.

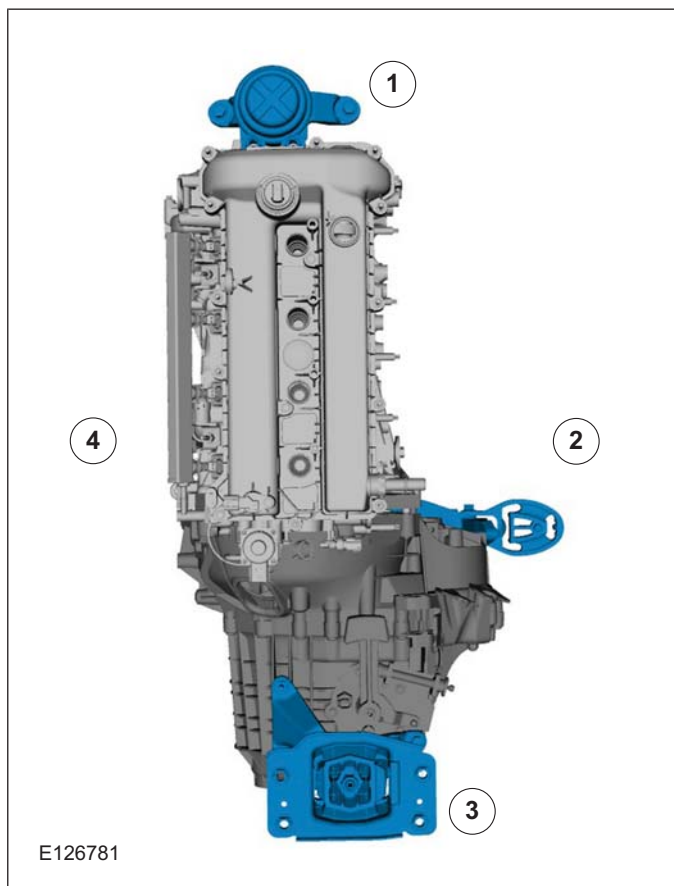
**Vehicle LH and RH definition**

Item	Description
1	LH
2	RH

All LH and RH references to the engine are taken from a position at the flywheel looking towards the crankshaft pulley.

## DESCRIPTION AND OPERATION

## Powertrain LH and RH definition



Item	Description
1	front
2	right hand
3	rear
4	left hand

## How to use Repair Procedures

This manual has been written in a format that is designed to meet the needs of technicians worldwide. It provides general descriptions for accomplishing repair work with tested and effective techniques.

## Important Safety Instructions

Appropriate service methods and correct repair procedures are essential for the safe and reliable operation of all vehicles as well as the personal safety of the individual carrying out the work.

Anyone who departs from the instructions provided in this manual must first establish that personal

safety or vehicle integrity is not compromised by the choice of method, tools or components.

## Warnings, Cautions and Notes in This Manual

**WARNING:** Warnings are used to indicate that failure to follow a procedure correctly may result in personal injury.

**CAUTION:** Cautions are used to indicate that failure to follow a procedure correctly may result in damage to the vehicle or equipment being used.

**NOTE:** Notes are used to provide additional essential information required to carry out a complete and satisfactory repair.

Generic warnings or cautions are in their relevant description and operation procedure within section 100-00. If the generic warnings or cautions are required for a procedure, there will be a referral to the appropriate description and operation procedure.

If a warning, caution or note only applies to one step, it is placed at the beginning of the specific step.

## Global Authoring Standards (GAS) Repair Procedures

**NOTE:** GAS style procedures can be identified by steps that have no accompanying step text and the magenta color of the electrical connectors and fasteners such as nuts, bolts, clamps or clips.

A GAS removal and installation procedure uses a sequence of color illustrations to indicate the order to be followed when removing/disassembling or installing/assembling a component.

Many of the GAS procedures will have the installation information within the removal steps. These procedures will have the following note at the beginning of the procedure:

**NOTE:** Removal steps in this procedure may contain installation details.

## Reuse of fasteners and seals and gaskets

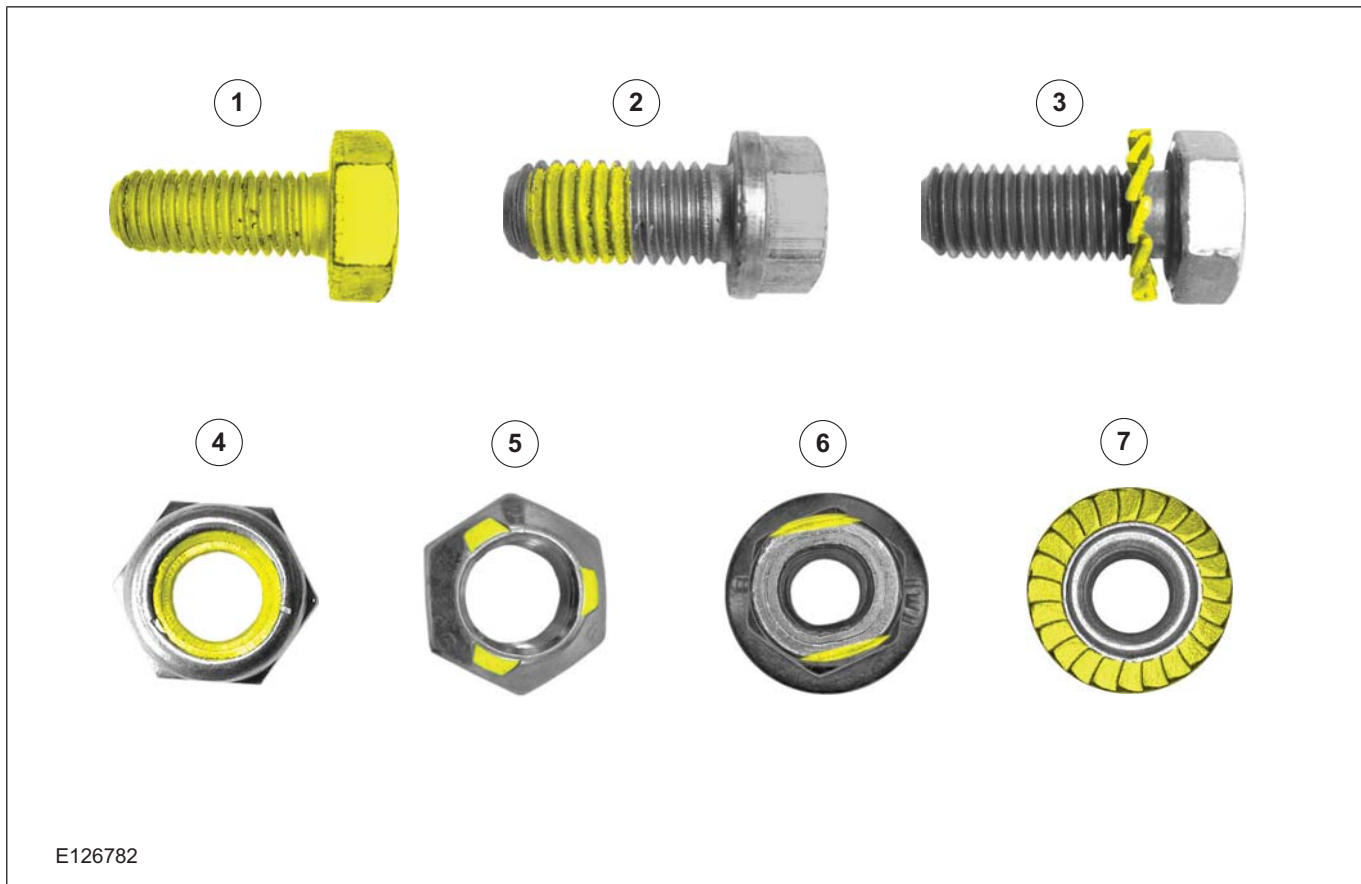
The following list details the general policy for the reuse of fasteners and seals and gaskets.



**DESCRIPTION AND OPERATION**

**Types of self-locking nuts and bolts**

**NOTE:** There are more types of self-locking fasteners available than shown in following illustration.



E126782

Item	Description
1	Completely coated self-locking bolt
2	Partially coated self-locking bolt
3	Self-locking bolt with a locking washer
4	Self-locking nut with a plastic locking insert
5	Self-locking nut with thread deformation (3 indentations)
6	Self-locking nut with thread deformation (to oval shape)
7	Self-locking nut with integrated locking ring

- All types of seals and gaskets must be discarded and new seals and gaskets installed unless otherwise stated within the procedure.
- Nuts and bolts with a chemical coating for locking and/or sealing and/or antiseize must be discarded unless the procedure advises to reapply the coating with a specified material.

- Nuts and bolts with a mechanical locking such as thread inserts, thread deformation or locking washers must be discarded and new nuts and bolts installed unless otherwise stated within the procedure.
- Torque to yield bolts must be discarded and new torque to yield bolts installed unless otherwise stated within the procedure, recognizable by a tightening torque with more than one stage together with a torque angle.

**Reuse of exterior trim parts**

All type of glued exterior trim parts or parts fastened with adhesive tape must be discarded and new parts installed unless otherwise stated within the procedure.

**Specification data**

Specification procedures will only contain technical data that is not already part of a repair procedure.

**Sequence of tasks**

If components must be removed or installed in a specific sequence, the sequence will be identified



**DESCRIPTION AND OPERATION**

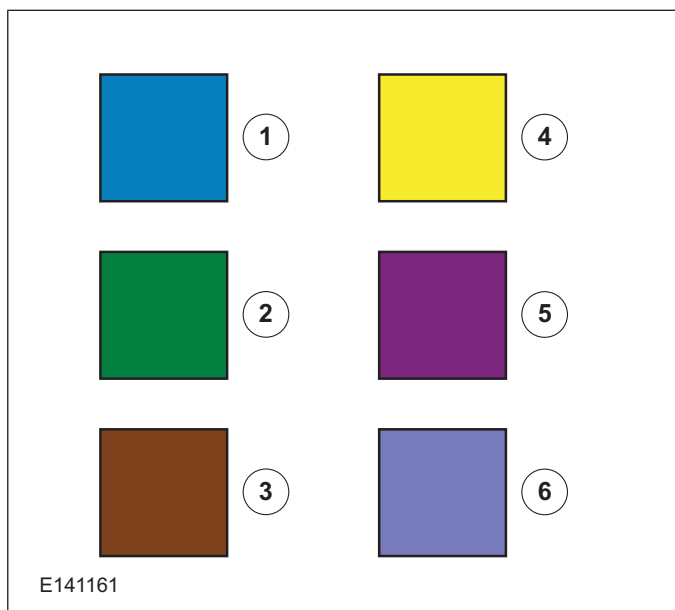
numerically in a graphic and the corresponding text will be numbered accordingly.

**Special Tools, Equipment, Materials and Torque Figures**

Special tools will be shown with the tool numbers in the illustration. The special tool numbers, general equipment, materials and torque figures used for the procedure step will be shown in the text column.

**GAS Graphics**

**NOTE:** Colors used in the graphic are as follows:



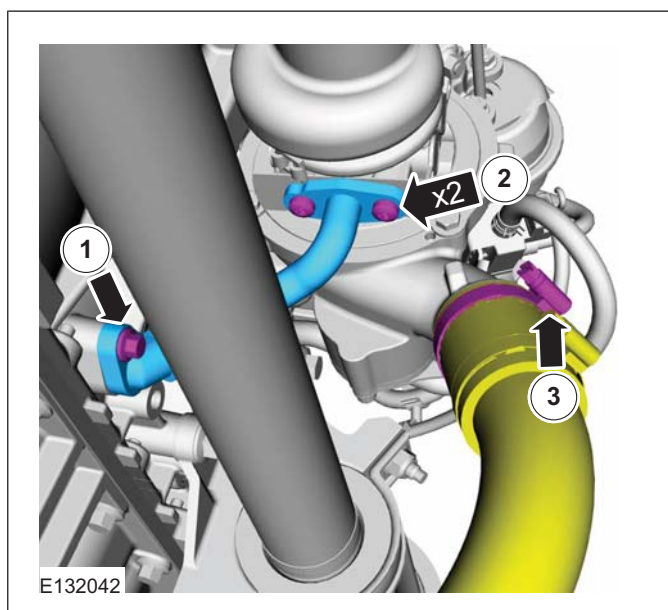
Item	Description
1	Blue - Target or primary component to be removed/installed (or disassembled/assembled).
2	Green - Components that need to be removed prior to or installed after the target/primary.

Item	Description
3	Brown - Components that need to be removed prior to or installed after the target/primary.
4	Yellow - Components to be set aside only, that remains in the vehicle. Also highlighted areas to inspect or adjust.
5	Magenta - Electrical connectors and fasteners such as nuts, bolts, clamps, or clips to be: detached, attached, loosened, moved, removed or installed.
6	Pale Blue - Special tool(s), general equipment, or common tools (used in an uncommon way).

One illustration may have multiple steps assigned to it.

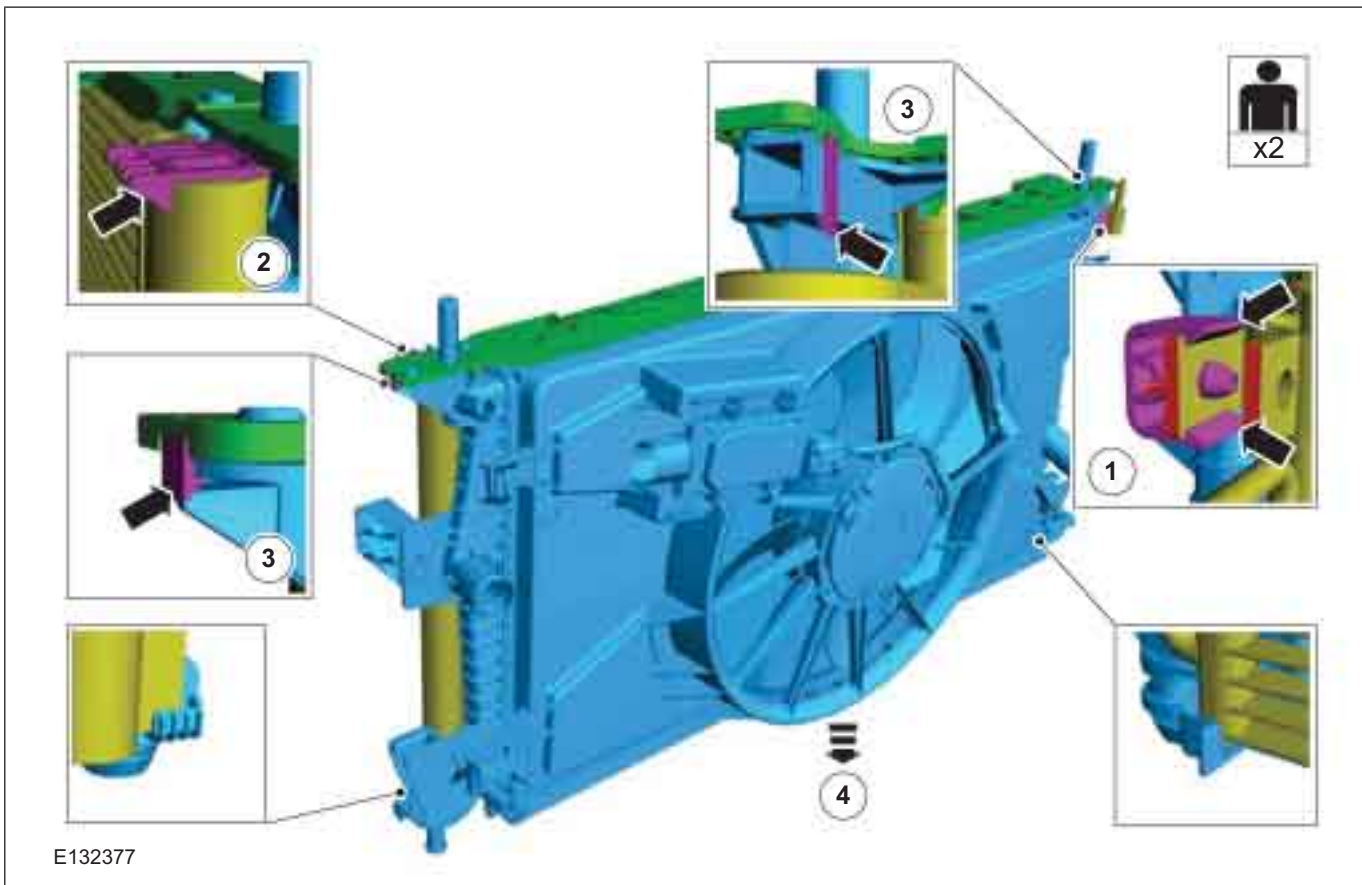
Numbered pointers are used to indicate the number of electrical connectors and fasteners such as nuts, bolts, clamps and clips.

Items in the illustration can be transparent or use cutouts to show hidden details.



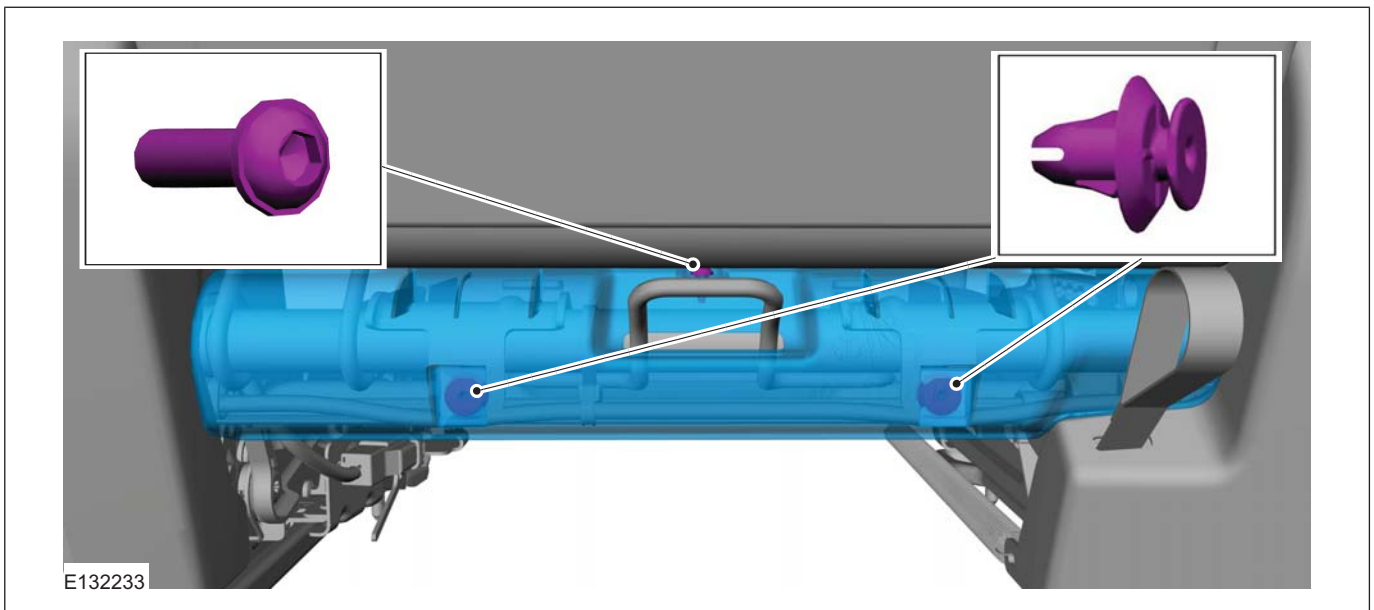
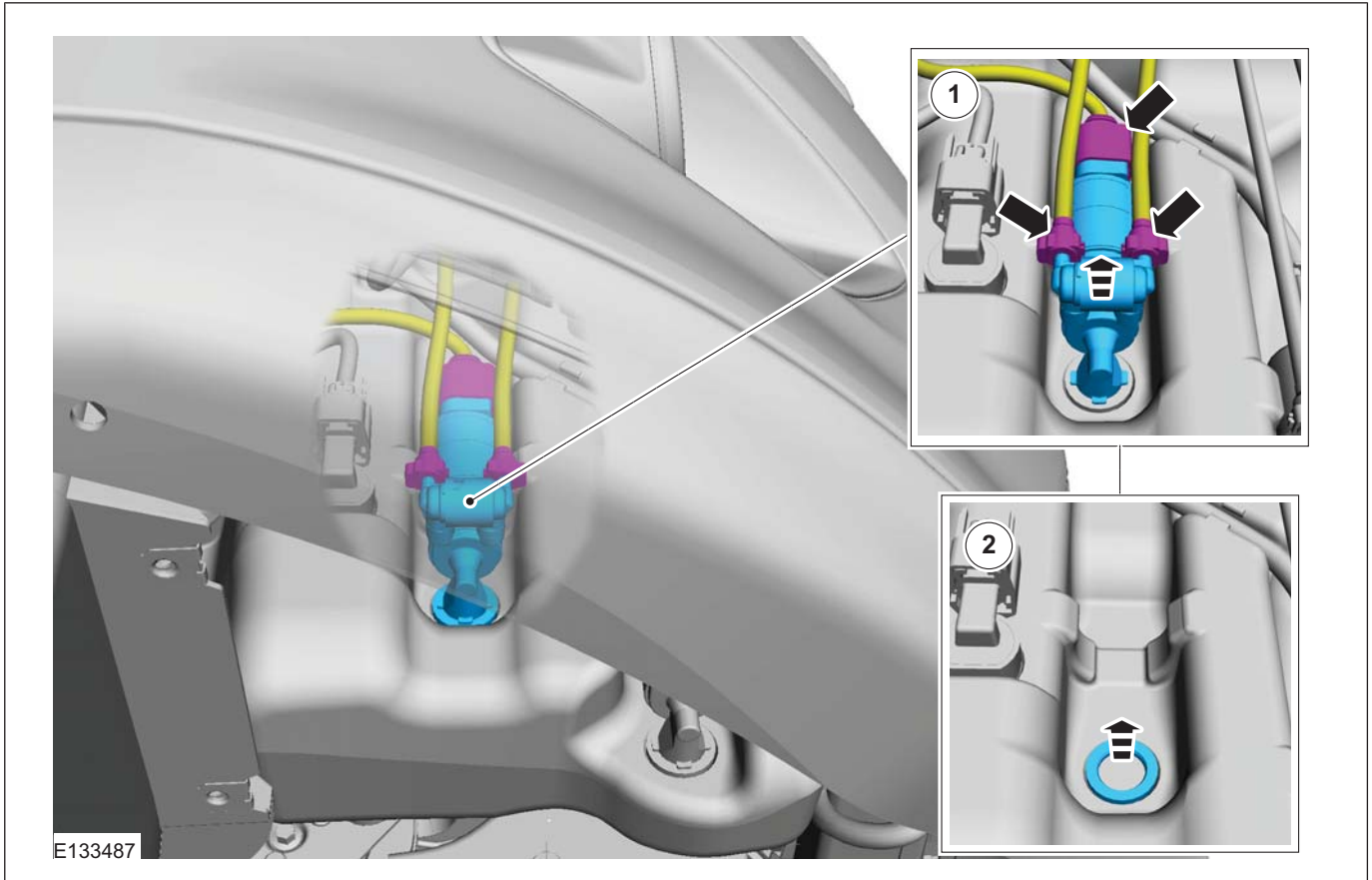


DESCRIPTION AND OPERATION



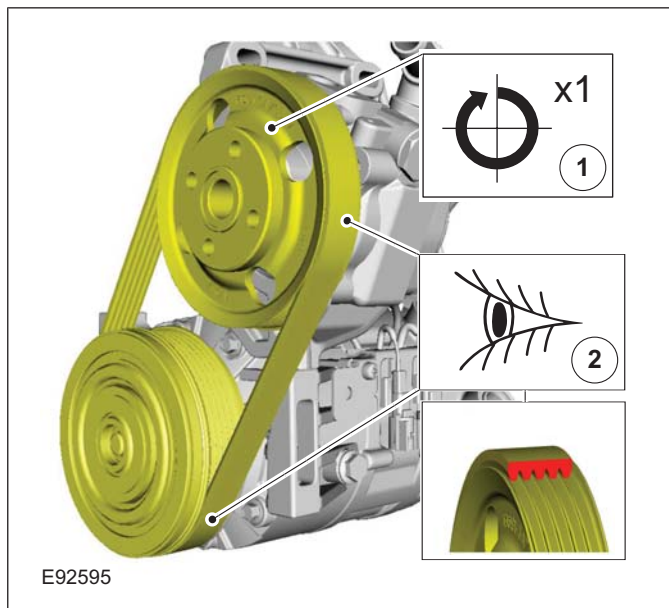
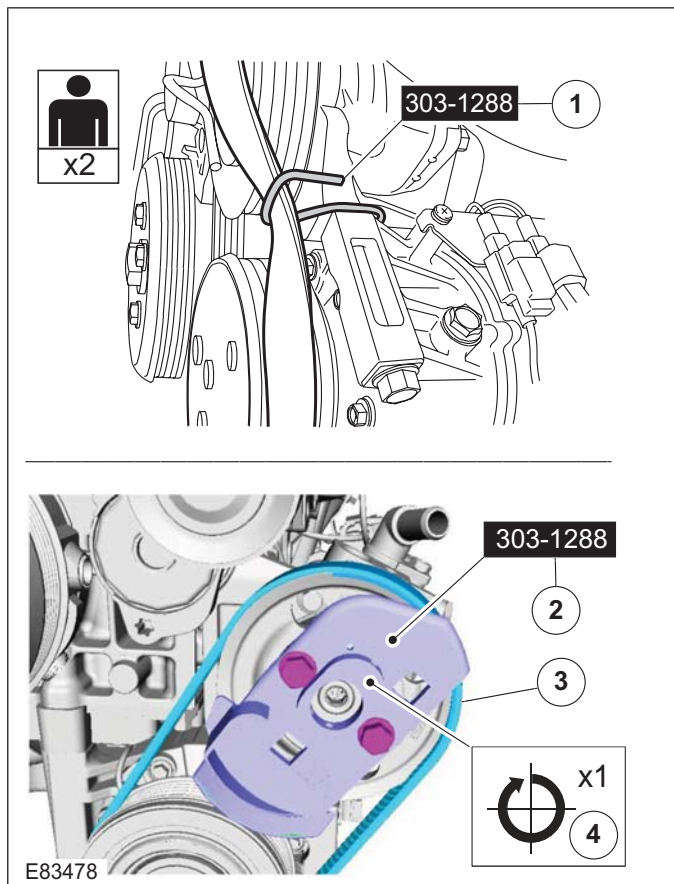


DESCRIPTION AND OPERATION





DESCRIPTION AND OPERATION



**GAS Service Action Icon**

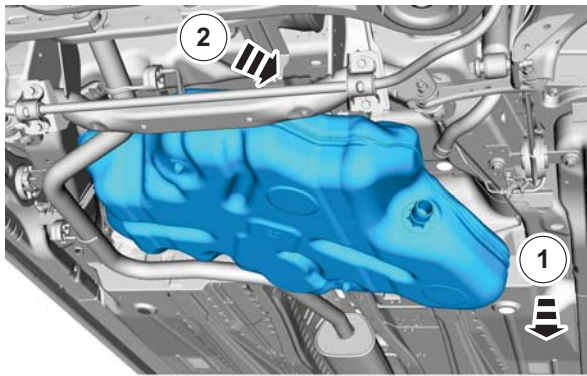
Symbols are used inside the graphics and in the text area to enhance the information display. The following paragraphs describe the various types and categories of symbols.

For additional information, refer to: **Symbols Glossary** (100-00 General Information, Description and Operation).

Prohibition symbols advise on prohibited actions to either avoid damage or health and safety related risks. These symbols are:



DESCRIPTION AND OPERATION



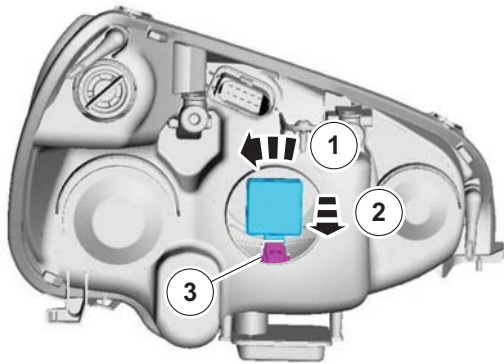
E85026

Health and Safety symbols recommend the use of particular protection equipment to avoid or at least reduce the risk or severity of possible injuries.





DESCRIPTION AND OPERATION

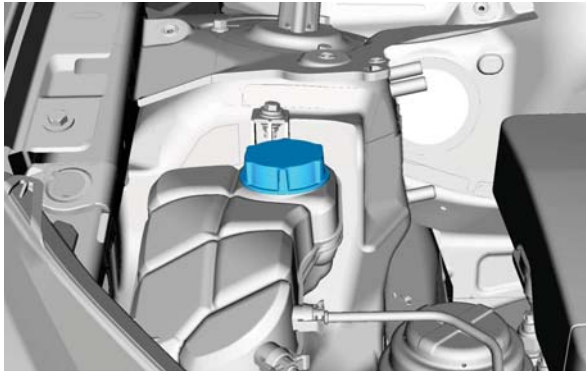


2.



E85027

Warning symbols are used to indicate potential risks resulting from a certain component or area.



3.



E85028





**DESCRIPTION AND OPERATION**

Instruction symbols are used to apply sealer, lubricant, weight, tape or cleaning detergent to a component.

Ø XXmm

Ø 10mm

Ø 10mm

XX ml

Kg xx Kg

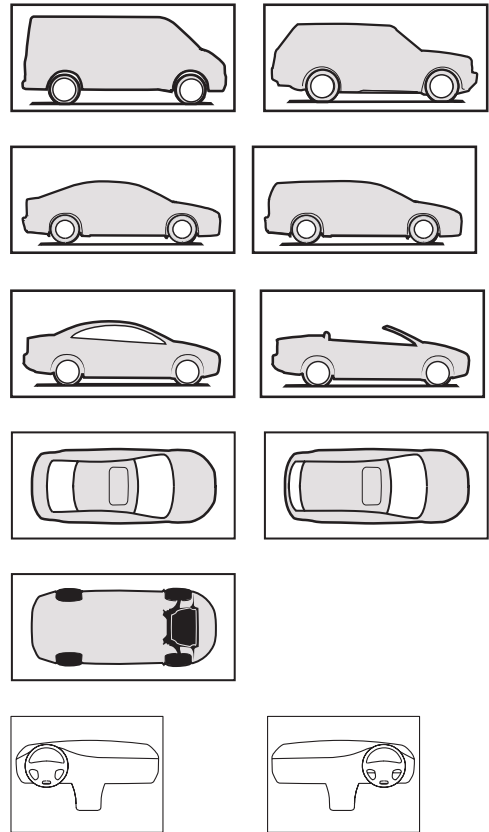
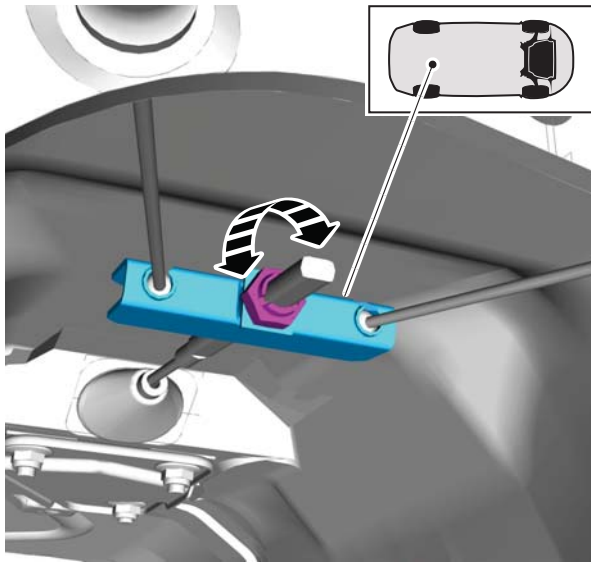
E84834

Location symbols are used to show the location of a component or system within the vehicle.





DESCRIPTION AND OPERATION



E84835

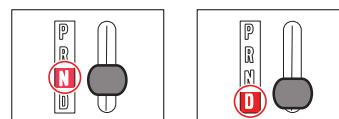
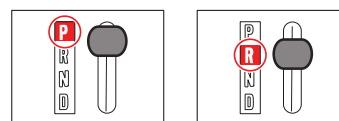
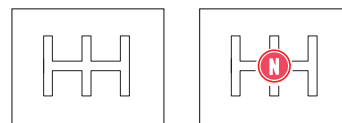
Gearshift lever or selector lever position symbols are used to show which gearshift lever or selector lever position is to be set.







DESCRIPTION AND OPERATION



E84836

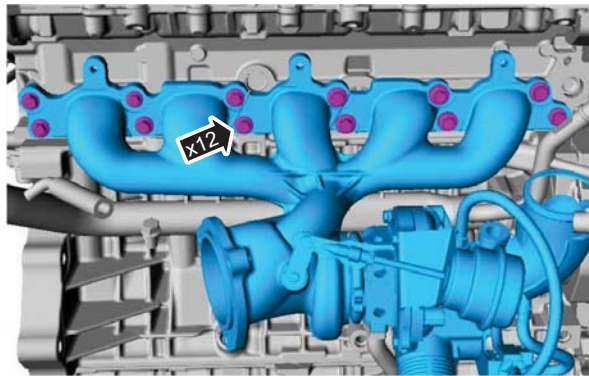
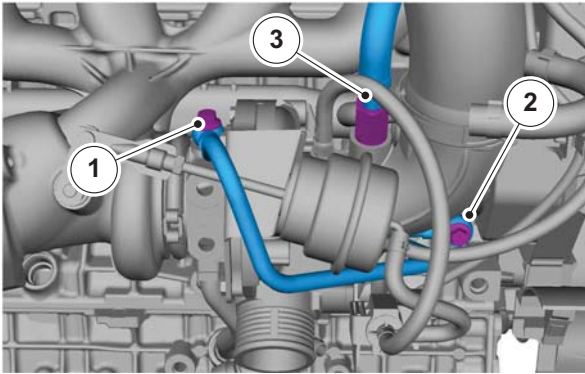
Pointer symbols are used to draw attention to components and give special instructions such as a required sequence or number of components. The number of components is reflected by the value inside the luty arrow. A sequence number is

located inside the circle. Numbers inside circles are also used to allocate special information such as tightening torques or chemicals to a particular component.

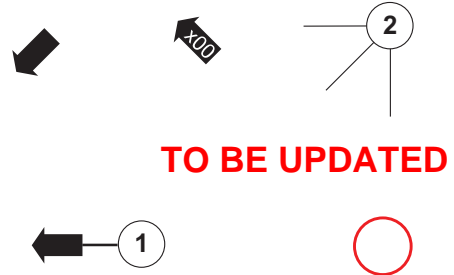




DESCRIPTION AND OPERATION

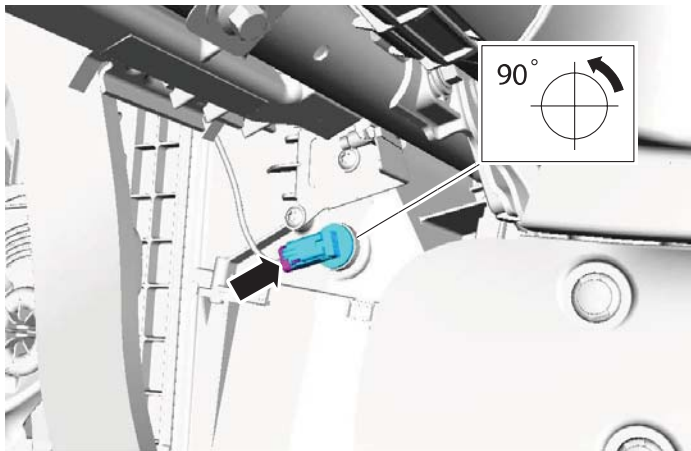


E84837

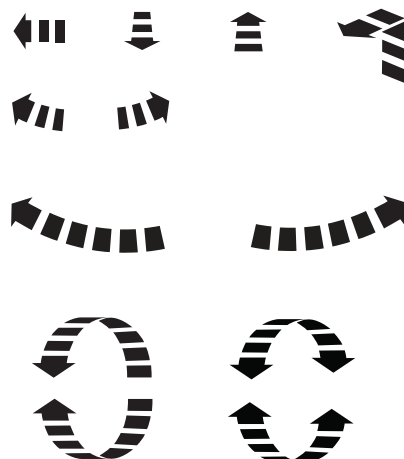
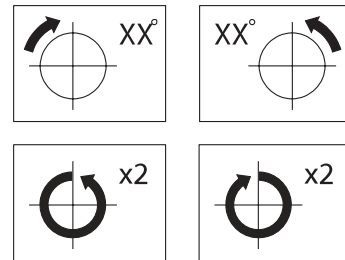


Movement arrows are used to show three dimensional or rotational movements. These

movements can include specific values inside the symbol if required.



E84838





**DESCRIPTION AND OPERATION**

Standard tool symbols recommend the use of certain standard tools. These tools can include

dimension values if required.

E84839

The following graphic illustrates a set of symbols that are used to provide detailed information on where to apply a material.



DESCRIPTION AND OPERATION

Item	Description
1	Steering wheel in straight ahead position
2	Steering column lock locked
3	Steering column lock unlocked
4	Turn the steering wheel to the 90° left position

Item	Description
5	Turn the steering wheel to the 90° right position
6	Turn the steering wheel to the left-hand end position
7	Turn the steering wheel to the right-hand end position

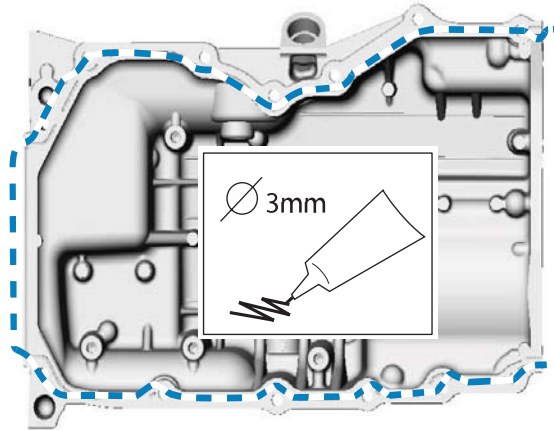
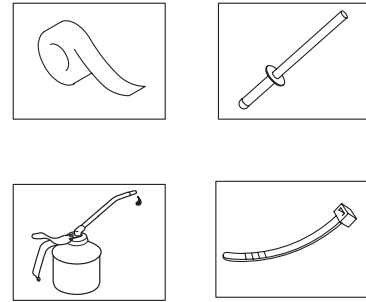
E88971

Item	Description
1	3, 4, 5-door body style
2	Wagon body style

Item	Description
3	Sports utility vehicle body style
4	Coupe body style



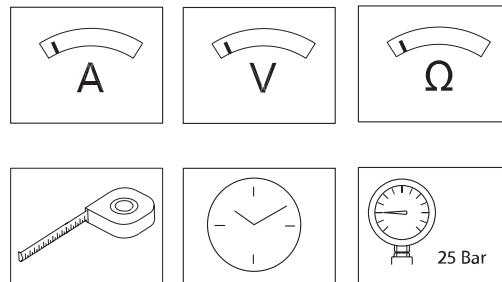
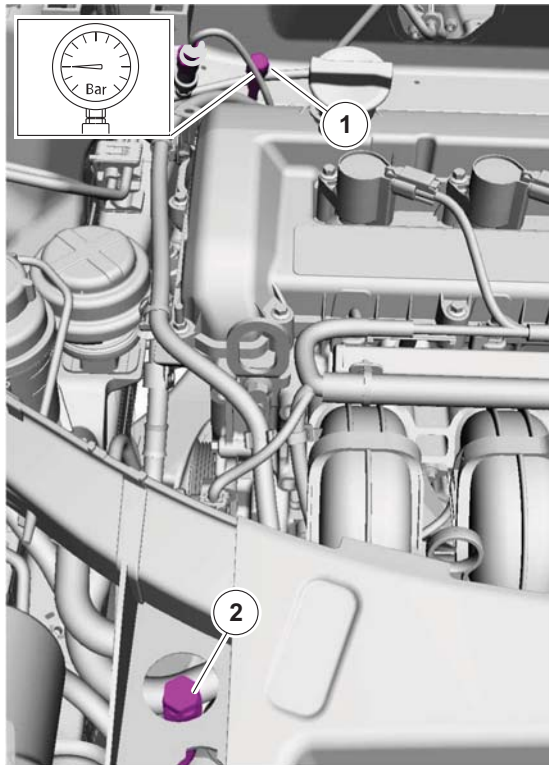
DESCRIPTION AND OPERATION



E84840

Measurement symbols provide detailed information on where to carry out a specific measurement.

These symbols can include specific values if required.



E84841



## DESCRIPTION AND OPERATION

### How to use Diagnosis and Testing procedures

#### Inspection and Verification

Visual Inspection Charts, Symptom Charts and other information charts (such as diagnostic routines) or supplement test procedures with technical specifications will navigate the user to a specific test procedure.

#### Symptom Chart

The symptom chart indicates symptoms, sources and actions to address a condition.

#### Pinpoint Tests

For electrical systems, pinpoint test steps are used to identify the source of a concern in a logical, step-by-step manner. Pinpoint tests have two columns: CONDITIONS and DETAILS/RESULTS/ACTIONS.

The CONDITIONS column is used exclusively for graphics and icons (with or without captions) and the DETAILS/RESULTS/ACTIONS column provides direction to another test step or specific corrective actions.

The boxed numbers indicate the order in which the described action is to be carried out.

#### Component Tests

A component test is used when a component is tested in multiple pinpoint tests, or if a procedure is too complicated to be formatted within a single page of the pinpoint test.

#### Graphics

Test graphics show the measurement or test to be carried out in a test step.

A representative tester graphic is used for voltmeters and ohmmeters.

If multiple measurements are made in a single graphic, the test leads are drawn with a solid line until the test lead splits to indicate the multiple measurements, at which point dashed lines are used.

Breakout box type testers are represented by a double circle test pin. Test pins are labeled with the pin number.

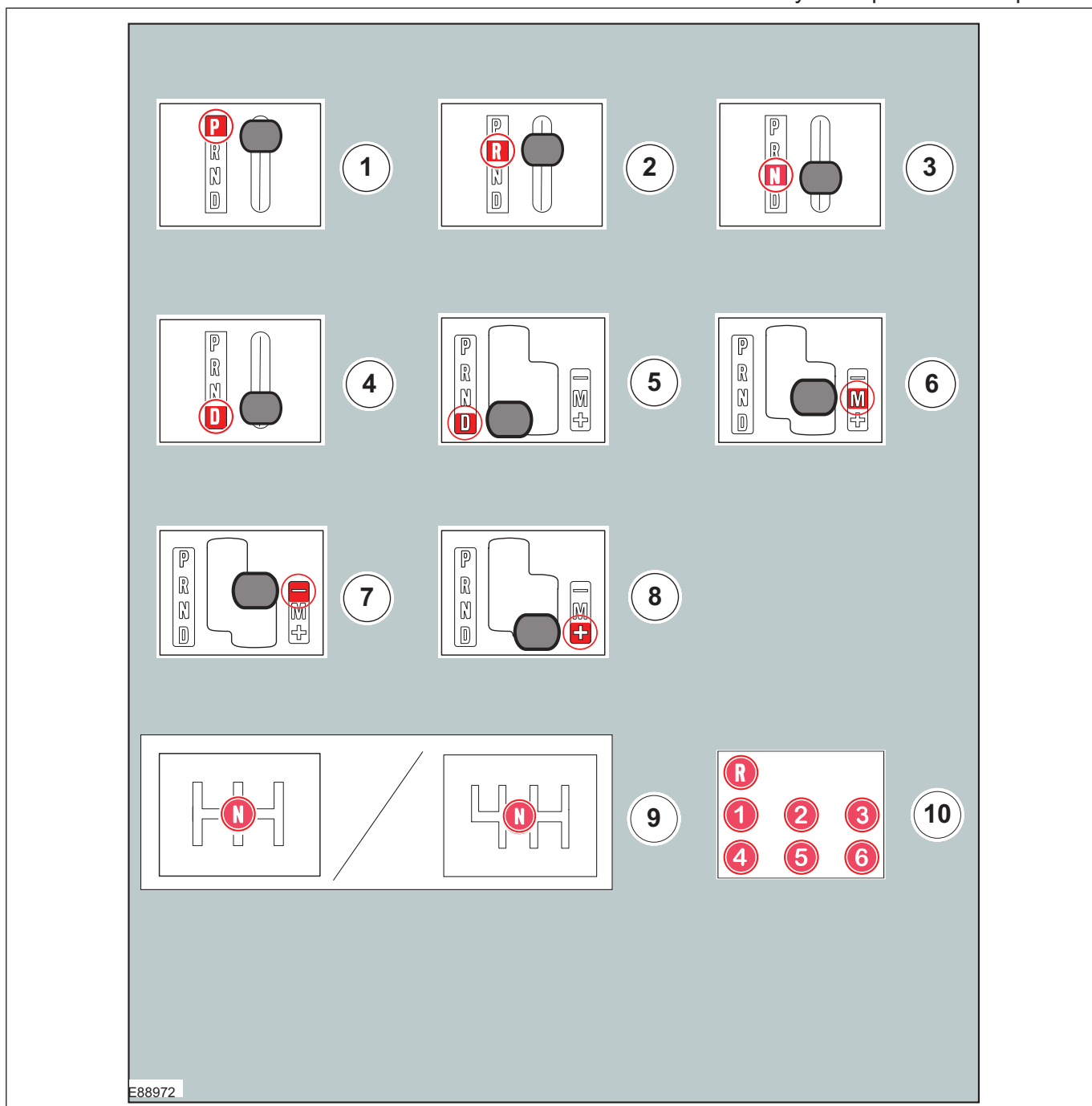
DESCRIPTION AND OPERATION

Item	Description
5	Convertible body style
6	Van body style
7	3, 4, 5-door body style - Top View
8	Wagon body style - Top View
9	Underview

Item	Description
10	Right-hand drive (RHD) vehicle
11	Left-hand drive (LHD) vehicle

**Gearshift lever and selector lever position symbols**

Gearshift lever and selector lever position symbols are used to show the lever position that is required to be selected to carry out a procedure step.



E88972



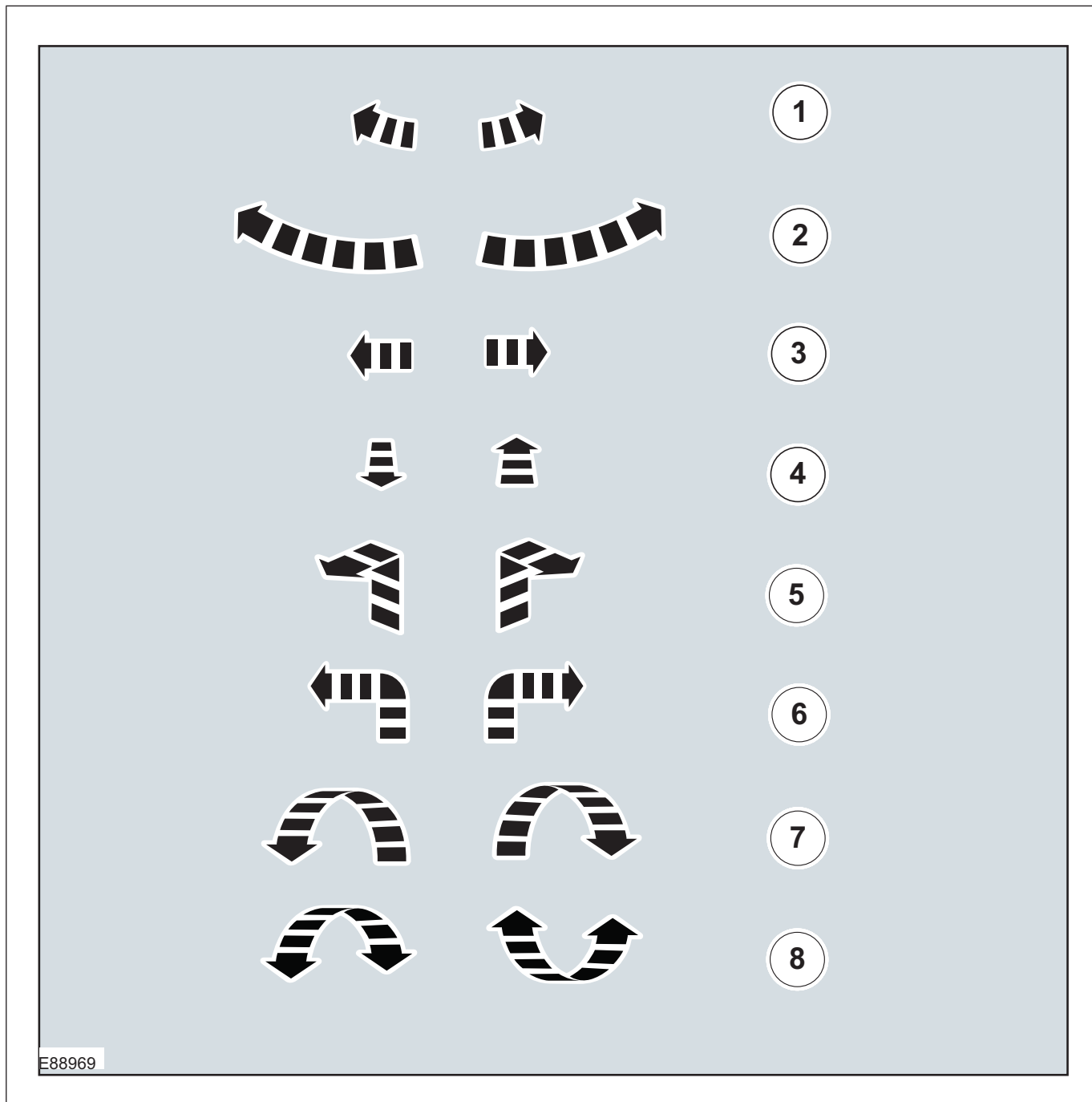
DESCRIPTION AND OPERATION

# Symbols Glossary

Symbols are used inside the graphics and in the text area to enhance the information display.

## Movement Symbols

Movement symbols provide detailed information to a required component movement. These component movements can be rotational or 1-3 dimensional movements.



E88969





DESCRIPTION AND OPERATION

Item	Description
1	Minor component movement clockwise/counterclockwise
2	Major component movement clockwise/counterclockwise
3	Component movement to the left/right/up/down
4	Component movement towards/away
5	3 dimensional component movement

Item	Description
6	2 dimensional component movement
7	3 dimensional component rotation
8	3 dimensional component cycling

Turn Symbols

Turn symbols are used to provide further information on the direction or angle of component turns.

The diagram illustrates eight turn symbols, numbered 1 through 8, arranged in two columns. Each symbol consists of a circle with a vertical and horizontal crosshair, and a curved arrow indicating the direction of rotation. The symbols are as follows:

- Symbol 1:** A circle with a crosshair and a curved arrow pointing clockwise. The angle  $45^\circ$  is written to the right of the circle.
- Symbol 2:** A circle with a crosshair and a curved arrow pointing counter-clockwise. The angle  $45^\circ$  is written to the left of the circle.
- Symbol 3:** A circle with a crosshair and a curved arrow pointing clockwise. The angle  $90^\circ$  is written to the right of the circle.
- Symbol 4:** A circle with a crosshair and a curved arrow pointing counter-clockwise. The angle  $90^\circ$  is written to the left of the circle.
- Symbol 5:** A circle with a crosshair and a curved arrow pointing clockwise. The angle  $180^\circ$  is written to the right of the circle.
- Symbol 6:** A circle with a crosshair and a curved arrow pointing counter-clockwise. The angle  $180^\circ$  is written to the left of the circle.
- Symbol 7:** A circle with a crosshair and a thick curved arrow pointing clockwise. The multiplier  $x2$  is written to the right of the circle.
- Symbol 8:** A circle with a crosshair and a thick curved arrow pointing counter-clockwise. The multiplier  $x2$  is written to the right of the circle.

E88970

## DESCRIPTION AND OPERATION

Item	Description
1	Set the selector lever to the park (P) position
2	Set the selector lever to the reverse ( R ) position
3	Set the selector lever to the neutral (N) position
4	Set the selector lever to the drive (D) position
5	Set the selector lever with manual shift pattern to the park (D) position
6	Set the selector lever with manual shift pattern to the manual (M) position

Item	Description
7	Set the selector lever with manual shift pattern to the shift down (-) position
8	Set the selector lever with manual shift pattern to the shift up (+) position
9	Set the gearshift lever to the neutral (N) position
10	Further gearshift lever positions that may appear in illustrations

**Screwdriver symbols**

The screwdriver symbols are used to show which screwdriver bit is recommended to carry out a procedure step.

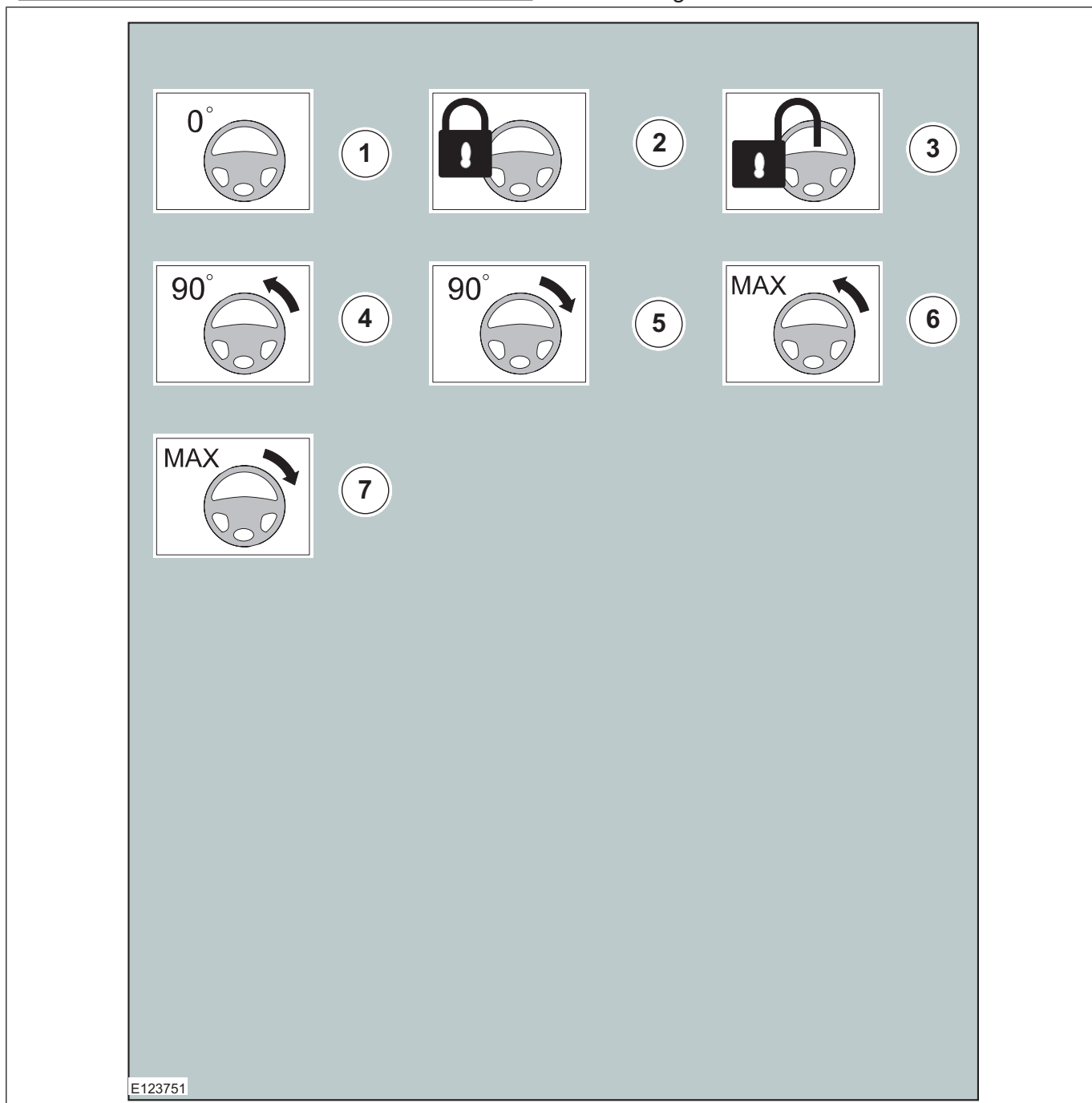
DESCRIPTION AND OPERATION

Item	Description
1	Turn the component clockwise through 45°
2	Turn the component counterclockwise through 45°
3	Turn the component clockwise through 90°
4	Turn the component counterclockwise through 90°
5	Turn the component clockwise through 180°

Item	Description
6	Turn the component counterclockwise through 180°
7	Turn the component clockwise through 2 complete turns
8	Turn the component counterclockwise through 2 complete turns

**Steering Wheel Symbols**

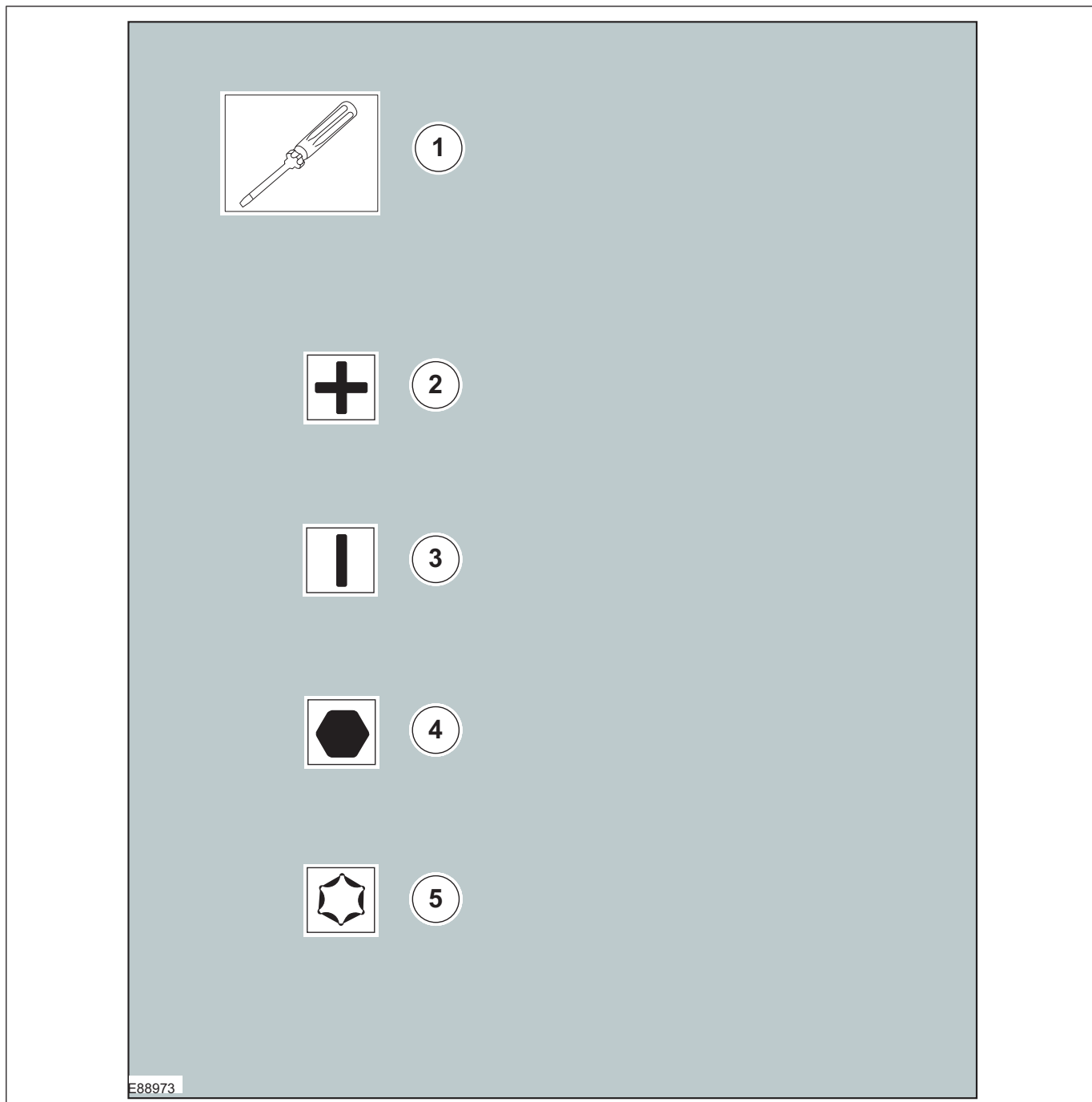
Steering wheel symbols are used to provide further information to a required steering wheel position or steering column lock status.



E123751



DESCRIPTION AND OPERATION



E88973

Item	Description
1	Screwdriver
2	Cross bladed screwdriver
3	Flat bladed screwdriver

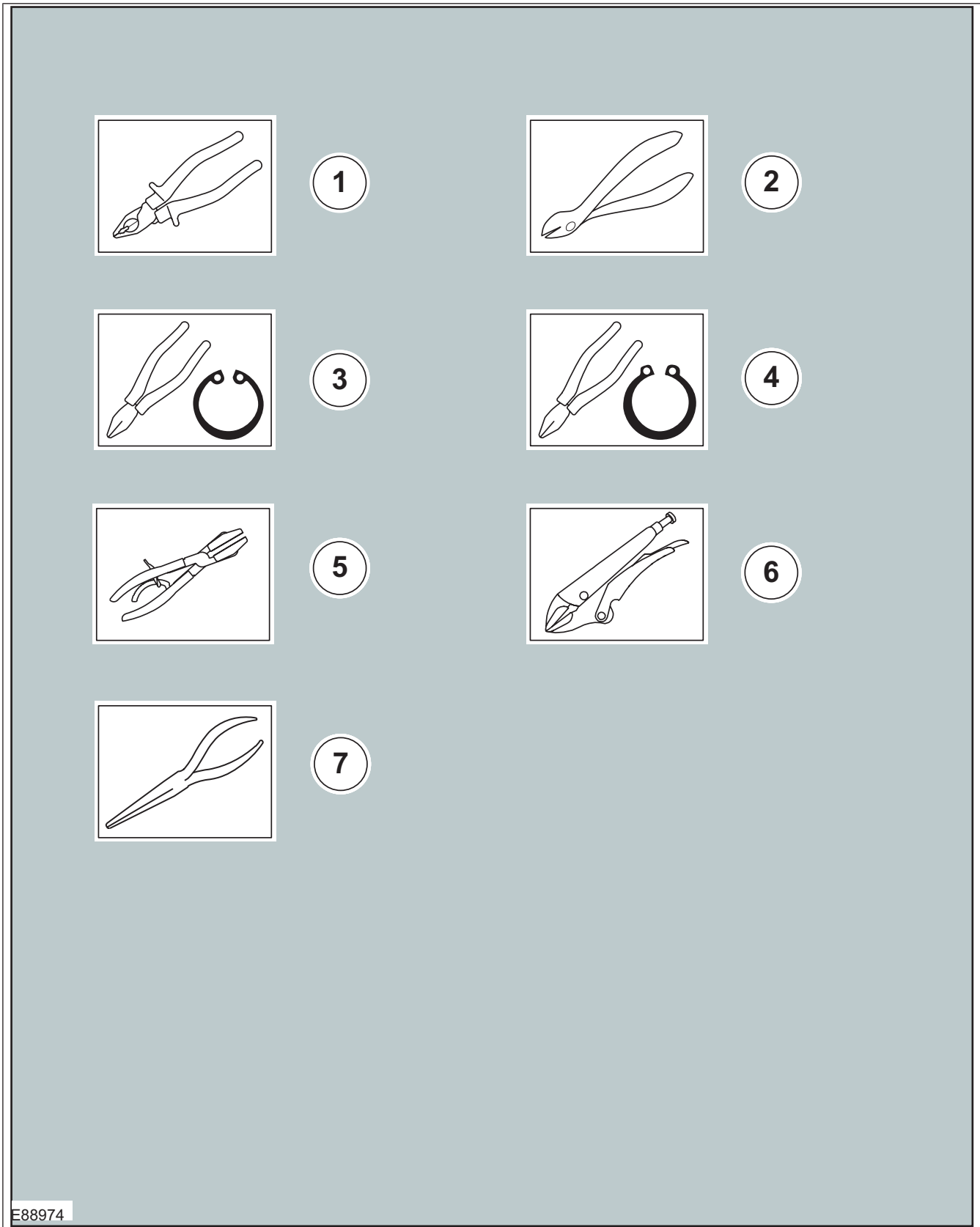
Item	Description
4	Hexagonal screwdriver
5	TORX screwdriver

**Pliers symbols**

The pliers symbols are used to show which pliers is recommended to carry out a procedure step.



DESCRIPTION AND OPERATION



E88974

Item	Description
1	Combination pliers
2	Side cutter pliers

Item	Description
3	Securing ring pliers - inner
4	Securing ring pliers - outer

**DESCRIPTION AND OPERATION**

Item	Description
5	Hose clamp pliers
6	Locking pliers
7	Long nose pliers

**Drill symbols**

The drill symbols are used to show which type and size of drill bit is recommended to carry out a procedure step.

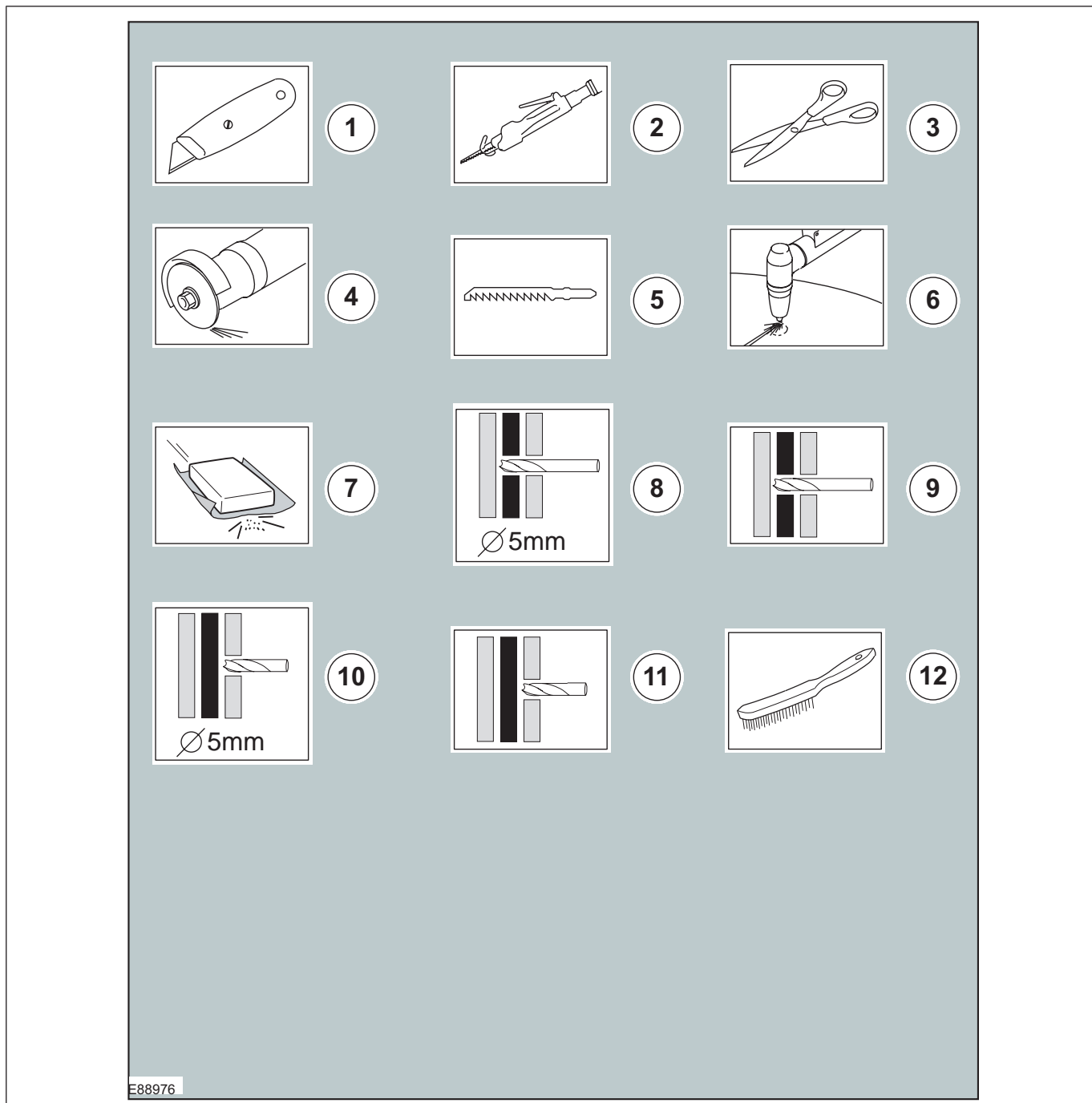
Item	Description
1	Drill bit with a specified diameter
2	Hole saw with a specified diameter
3	Stepped drill bit with a specified diameter
4	Tap with a specified diameter
5	Die with a specified diameter

Item	Description
6	Scraper for circular holes
7	Scraper for straight edges

**Cutting tool symbols**

The cutting tool symbols are used to show which type of cutting tool is recommended to carry out a procedure step.

DESCRIPTION AND OPERATION



E88976

Item	Description
1	Cutting knife
2	Air body saw
3	Scissors
4	Grinder
5	Jig saw
6	Plasma cutter
7	Sanding Paper

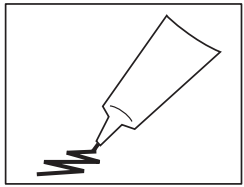
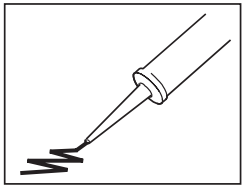
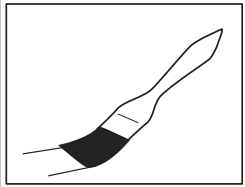
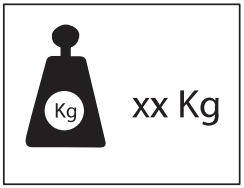
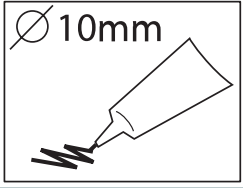
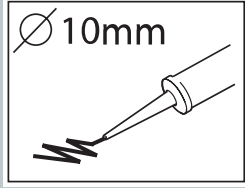
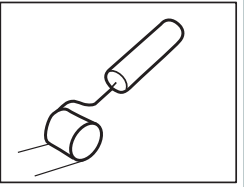
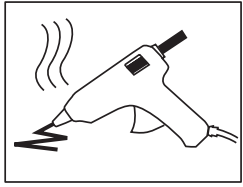

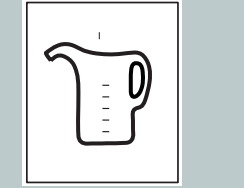
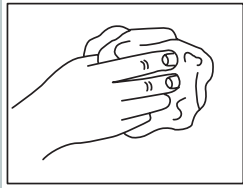
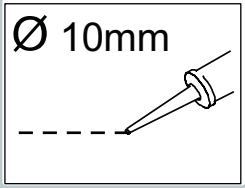
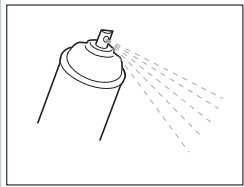
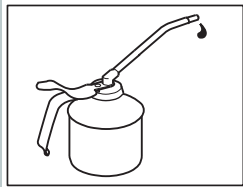
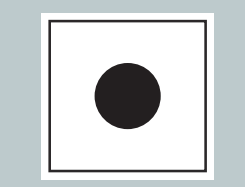
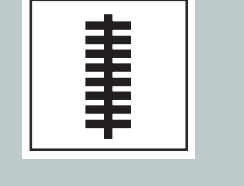


Item	Description
8	Drill through the shown number of body panel layers with a specified diameter
9	Drill through the shown number of body panel layers with a suitable diameter
10	Drill through 1 body panel layer with a specified diameter
11	Drill through 1 body panel layer with a suitable diameter
12	Wire brush

DESCRIPTION AND OPERATION

Apply Chemical or load symbols

show where to apply which type of chemical or load to carry out a procedure step.

The apply chemical or load symbols are used to

	<b>1</b>		<b>2</b>		<b>3</b>
	<b>4</b>		<b>5</b>		<b>6</b>
	<b>7</b>		<b>8</b>		<b>9</b>
	<b>10</b>		<b>11</b>		<b>12</b>
	<b>13</b>		<b>14</b>		<b>15</b>
	<b>16</b>		<b>17</b>		<b>18</b>

E88977



## DESCRIPTION AND OPERATION

Item	Description
1	Apply the substance from the specified tube
2	Apply the substance from the specified cartridge
3	Apply the specified chemical with a brush
4	Apply the specified load to the specified component
5	Apply a bead with a specific diameter from the specified tube
6	Apply a bead with a specific diameter from the specified cartridge
7	Apply the specified chemical with a roller
8	Apply hot glue to the specified component
9	Apply the specified amount of fluid from the fluid can
10	Apply fluid from the fluid can
11	Clean the specified component with the specified material

Item	Description
12	Apply a broken bead from the specified tube
13	Apply the specified chemical from a spray can
14	Apply the specified lubricant to the specified component
15	Apply spot welds to the specified component
16	Apply a continuous weld to the specified component
17	Handle the fluid using a syringe
18	Extract the specified amount of fluid using a syringe

**Measurement symbols**

The measurement symbols are used to show where to measure which type of measurement to carry out a procedure step.

## DESCRIPTION AND OPERATION

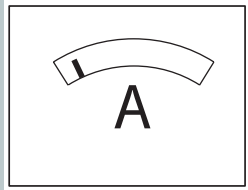
Item	Description
4	Self contained breathing apparatus
5	General prohibition used in combination with another symbol
6	Do not use power tools
7	Visual check
8	Noise check
9	Dispose the specified component
10	Replaced by item 9 (Dispose the specified component)
11	Set the engine speed to the specified value

Item	Description
12	Fully apply the parking brake lever
13	Fully release the parking brake lever
14	Do not dispose of batteries into the waste bin
15	Visual check using a mirror
16	Area/component must be dry

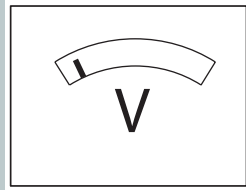
**Mandatory Protective equipment - Health and safety symbols**

The protective equipment symbols advise to use a mandatory protective equipment to avoid or at least reduce possible health and safety risks.

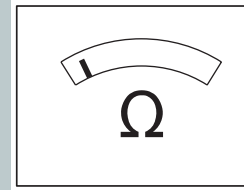
DESCRIPTION AND OPERATION



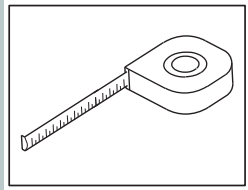
1



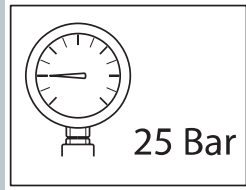
2



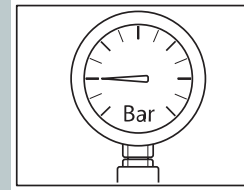
3



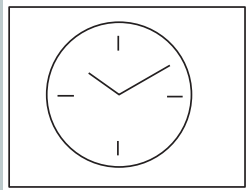
4



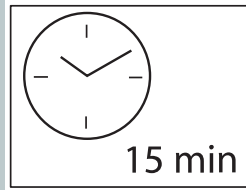
5



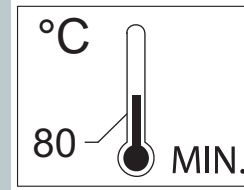
6



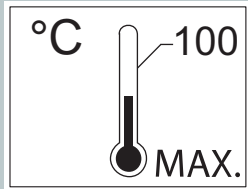
7



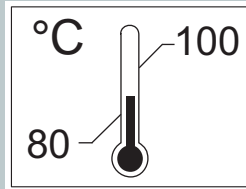
8



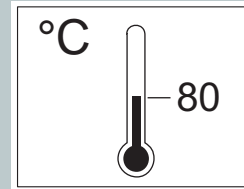
9



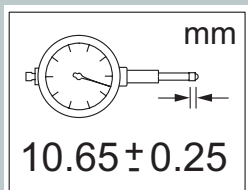
10



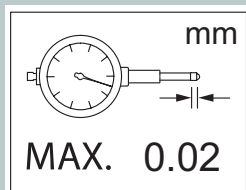
11



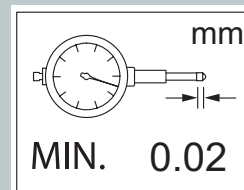
12



13



14



15

E88978

## DESCRIPTION AND OPERATION

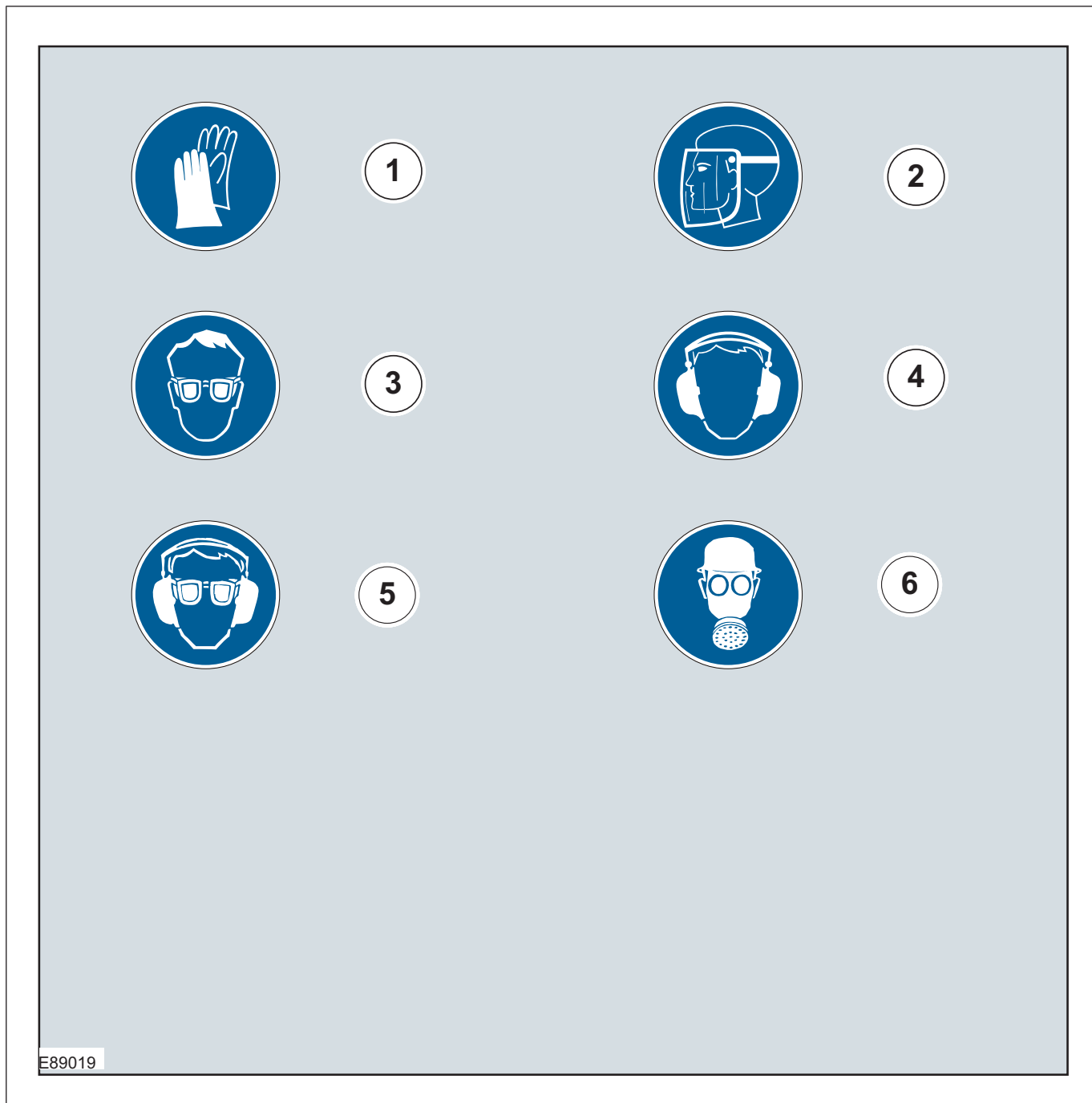
Item	Description
1	Measure the current using a digital multimeter
2	Measure the voltage using a digital multimeter
3	Measure the resistance using a digital multimeter
4	Measure the length/distance
5	Check that the specified pressure is available using a suitable pressure gauge
6	Measure the pressure at the specified port using a suitable pressure gauge
7	Measure the time using a suitable stopwatch
8	Wait for the specified period of time
9	The specified task requires the specified minimum temperature

Item	Description
10	The specified task requires the specified maximum temperature not to be exceeded
11	The specified task requires the specified temperature range
12	The specified task requires the specified temperature
13	Measure and check for the specified value using a dial indicator gauge
14	Measure and check for the specified MAX value using a dial indicator gauge
15	Measure and check for the specified MIN value using a dial indicator gauge

**General equipment symbols**

The general equipment symbols are used to show where to use which type of general equipment to carry out a procedure step.

DESCRIPTION AND OPERATION

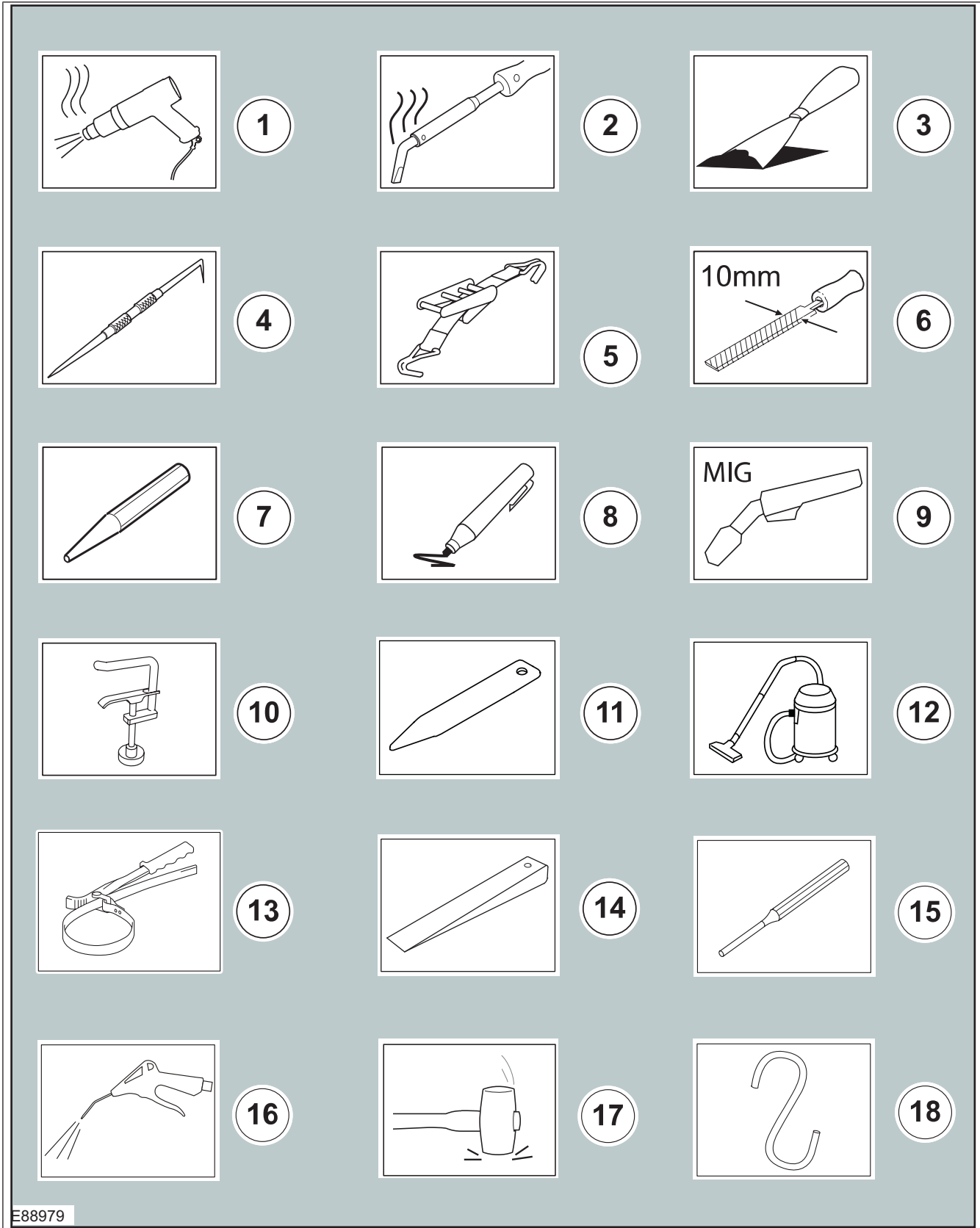


Item	Description
1	Wear protective gloves
2	Wear face guard
3	Wear safety goggles
4	Wear ear protectors
5	Wear safety goggles and ear protectors
6	Wear a respirator

**Prohibition - Health and safety symbols and component damage**

The prohibition symbols are used to prohibit the specified actions to avoid or at least reduce possible component damage and health and safety risks.

DESCRIPTION AND OPERATION



E88979

Item	Description
1	Hot air gun
2	Soldering iron

Item	Description
3	Scraper
4	Scriber

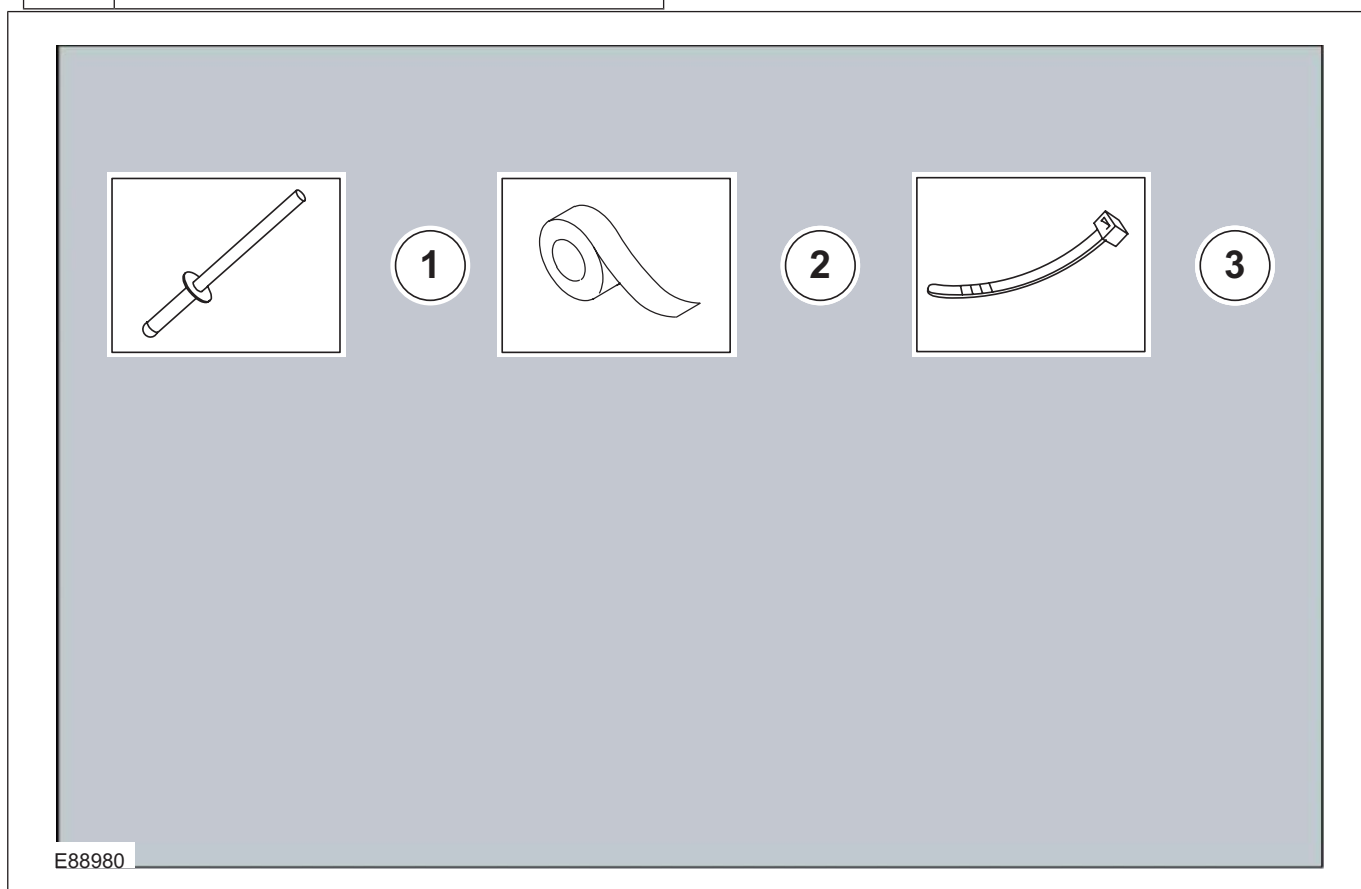
**DESCRIPTION AND OPERATION**

Item	Description
5	Securing strap
6	File with a specified size
7	Center punch
8	Marker
9	Metal inert gas (MIG) welding equipment
10	Hose clamp
11	Interior trim remover
12	Vacuum cleaner
13	Strap wrench

Item	Description
14	Wedge
15	Pin Punch
16	Air blow gun
17	Mallet
18	Relocate and support the component

**Material symbols**

The material symbols are used to show where to use which type of material to carry out a procedure step.



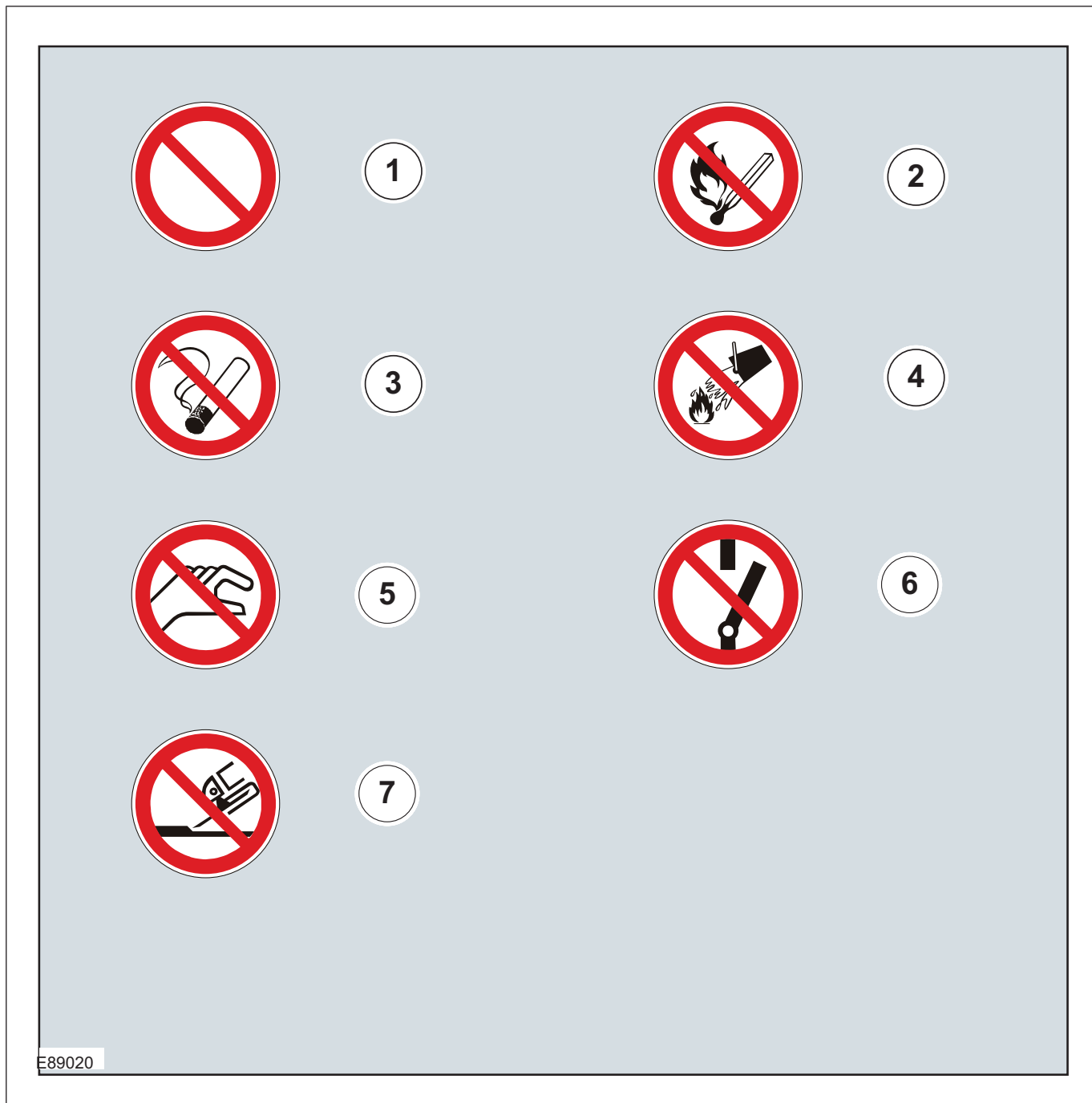
Item	Description
1	Remove/Install the specified blind rivet
2	Apply tape to the specified component/area
3	Remove/Install the specified cable tie

**Miscellaneous symbols**

These symbols provide further information that is required to carry out a procedure step.



DESCRIPTION AND OPERATION



Item	Description
1	General prohibition symbol
2	No naked flames
3	No smoking
4	No water
5	Do not touch

Item	Description
6	Do not switch
7	No grinding

**Warning symbols - Health and safety and component damage**

The warning symbols are used to advise on hazardous conditions to avoid or at least reduce possible component damage and health and safety risks.

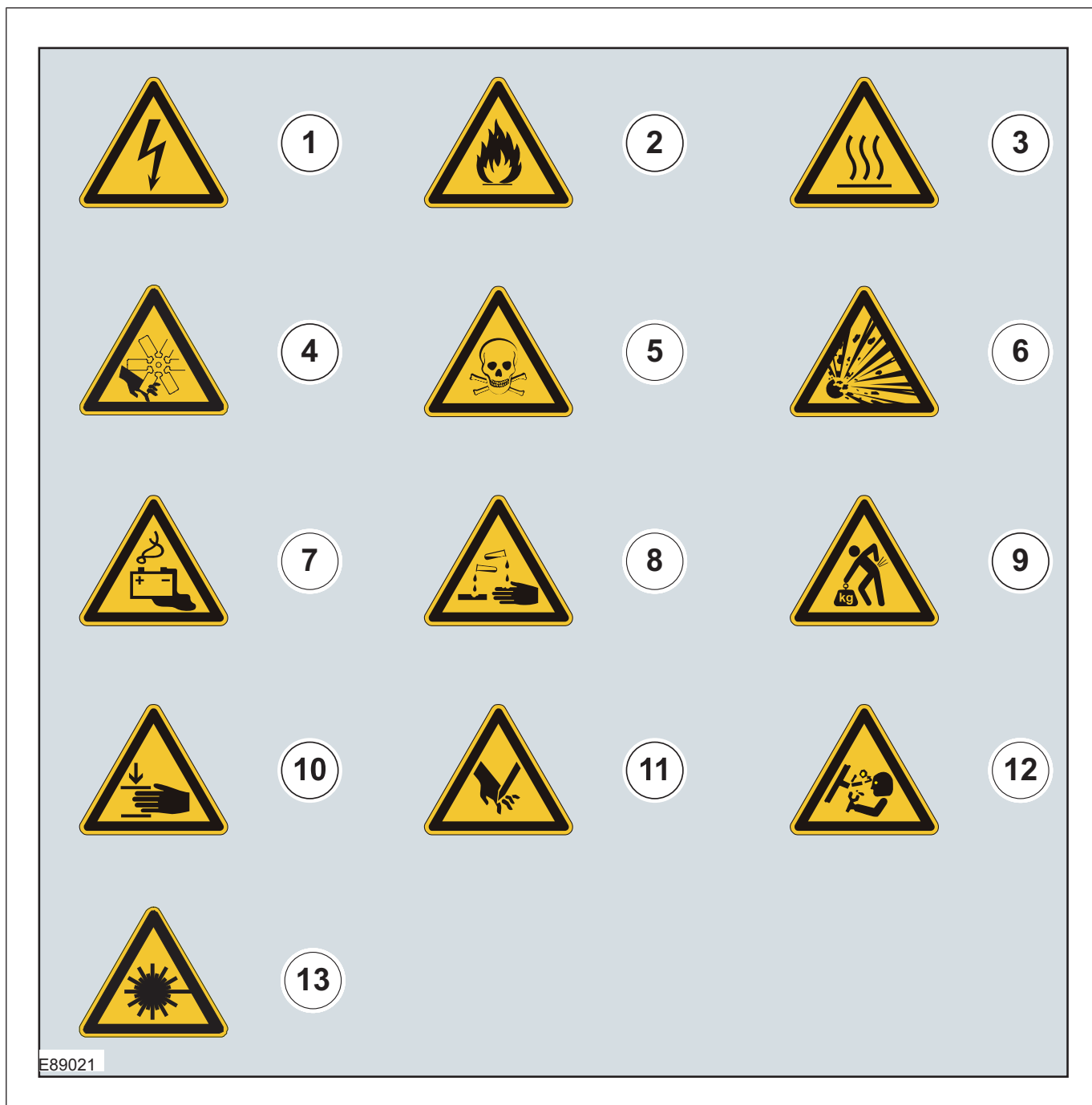
DESCRIPTION AND OPERATION

E88981

Item	Description
1	Set the ignition switch to the 0 position
2	Set the ignition switch to the II position

Item	Description
3	The procedure step requires the aid of the specified number of supporting technicians

DESCRIPTION AND OPERATION



E89021

Item	Description
1	Hazardous voltage/Electrical shock/Electrocution
2	Fire Hazard/Highly flammable
3	Burn hazard/Hot surface
4	Automatic start-up
5	Toxic
6	Explosive material
7	Battery hazard

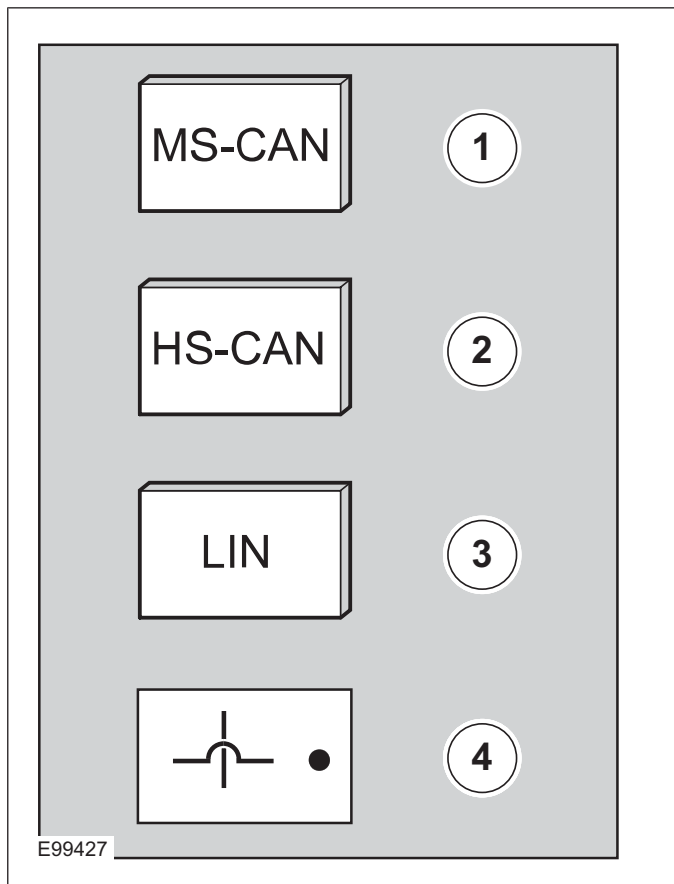
Item	Description
8	Corrosive material
9	Lifting hazard
10	Hand crush/Force from above
11	Cutting of fingers or hand
12	Pressure hazard
13	Invisible laser radiation. Do not view directly with optical instruments (magnifiers). Class 1M laser product



**DESCRIPTION AND OPERATION**

**Control Diagram symbols - Description and Operation procedures**







These symbols provide further information on the type of connectivity, direction of flow or type of data bus of a system.



Item	Description
1	Mid-speed Controller Area Network (CAN)
2	High-speed Controller Area Network (CAN)
3	Local Interconnect Network (LIN)
4	Wires crossing not connected



**DESCRIPTION AND OPERATION****Steering System Health and Safety Precautions****WARNINGS:**

-  **When handling the power steering fluid, always wear protective goggles and gloves made of nitril.**
-  **EYE CONTACT:** Power steering fluid contains long chain alkyl amine thiophosphate. Avoid contact with the eyes. Wash hands thoroughly after handling. If power steering fluid comes into contact with the eyes, flush the eyes with plenty of cold running water for 15 minutes. Seek medical attention for any persistent eye irritation or abnormality.
-  **SKIN CONTACT:** If power steering fluid comes into contact with the skin, remove contaminated clothing. Wash affected areas of skin with soap and water. Seek medical attention for any persistent skin irritation or abnormality.
-  **INHALED:** If oil mist is inhaled, move a victim to fresh air. Keep a victim warm and at rest. Seek immediate medical attention in cases of throat irritation or coughing.
-  **SWALLOWED:** Power steering fluid contains long chain alkyl amine thiophosphate. If swallowed, drink plenty of water. Seek immediate medical attention.
-  **CAUTION:** If the power steering fluid is spilled on the paintwork, the affected area must be immediately washed down with cold water.

**DESCRIPTION AND OPERATION****Exhaust Fumes**

These contain asphyxiating, harmful and toxic chemicals and particles such as carbon oxides, nitrogen oxides, aldehydes, lead and aromatic hydrocarbons. Engines should be run only under conditions of adequate exhaust extraction or general ventilation and not in confined spaces.

**Gasoline (petrol) engine**

There may not be adequate warning of odor or of irritation before toxic or harmful effects arise. These may be immediate or delayed.

**Diesel engine**

Soot, discomfort and irritation usually give adequate warning of hazardous fume concentrations.

**Fibre Insulation**

See also **Dusts**.

Used in noise and sound insulation.

The fibrous nature of surfaces and cut edges can cause skin irritation. This is usually a physical and not a chemical effect.

Precautions should be taken to avoid excessive skin contact through careful organization of work practices and the use of gloves.

**Fire**

See also **Welding**, **Foams**, **Legal Aspects**.

Many of the materials found on or associated with the repair of vehicles are highly flammable. Some give off toxic or harmful fumes if burnt.

Observe strict fire safety when storing and handling flammable materials or solvents, particularly near electrical equipment or welding processes.

Make sure, before using electrical or welding equipment, that there is no fire hazard present.

Have a suitable fire extinguisher available when using welding or heating equipment.

**First Aid**

Apart from meeting any legal requirements it is desirable for someone in the workshop to be trained in First Aid procedures.

Splashes in the eye should be flushed carefully with clean water for at least ten minutes.

Soiled skin should be washed with soap and water.

In case of cold burns, from alternative fuels, place affected area in cool to cold water.

Individuals affected by inhalation of gases and fumes should be removed to fresh air immediately. If effects persist, consult a doctor.

If liquids are swallowed inadvertently, consult a doctor giving him the information on the container or label. Do not induce vomiting unless this action is indicated on the label.

**Fluoroelastomer**

See **Viton**.

**Foams - Polyurethane**

See also **Fire**.

Used in sound and noise insulation. Cured foams used in seat and trim cushioning.

Follow manufacturers instructions.

Unreacted components are irritating and may be harmful to the skin and eyes. Wear gloves and goggles.

Individuals with chronic respiratory diseases, asthma, bronchial medical problems, or histories of allergic diseases should not work in or near uncured materials.

The components, vapors or spray mists can cause direct irritation, sensitivity reactions and may be toxic or harmful.

Vapors and spray mists must not be inhaled. These materials must be applied with adequate ventilation and respiratory protection. Do not remove the respirator immediately after spraying; wait until the vapors/mists have cleared.

Burning of the uncured components and the cured foams can generate toxic and harmful fumes. Smoking, naked flames or the use of electrical equipment during foaming operations and until vapors/mists have cleared should not be allowed. Any heat cutting of cured foams or partially cured

**DESCRIPTION AND OPERATION****Health and Safety Precautions****Introduction**

Many of the procedures associated with vehicle maintenance and repair involve physical hazards or other risks to health. This subsection lists, alphabetically, some of these hazardous operations and the materials and equipment associated with them. Precautions necessary to avoid these hazards are identified.

The list is not exhaustive and all operations and procedures, and the handling of materials, should be carried out with health and safety in mind.

Before using any product the Materials Safety Data Sheet supplied by the manufacturer or supplier should be consulted.

**Acids and Alkalis**

See also **Battery Acids**.

For example caustic soda, sulphuric acid.

Used in batteries and cleaning materials.

Irritant and corrosive to the skin, eyes, nose and throat. Cause burns. Can destroy ordinary protective clothing.

Avoid splashes to the skin, eyes and clothing. Wear suitable protective impervious apron, gloves and goggles. Do not breath mists.

Make sure access to eye wash bottles, shower and soap are readily available for splashing accidents.

Display Eye Hazard sign.

**Air Bags**

See also **Fire, Chemical Materials**.

Highly flammable, explosive – observe No Smoking policy.

Used as a safety restraint system mounted in the steering wheel and passenger side of the instrument panel.

The inflator contains a high-energetic propellant which, when ignited, produces a VERY HOT GAS (2500°C).

The gas generant used in air bags is Sodium Azide. This material is hermetically sealed in the module and is completely consumed during deployment. No attempt should be made to open an air bag

inflator as this will lead to the risk of exposure to Sodium Azide. If a gas generator is ruptured, full protective clothing should be worn when dealing with the spillage.

After normal deployment, gloves and safety goggles must be worn during the handling process.

Deployed air bags should be disposed of in a plastic bag in accordance with local regulations at an approved chemical waste site.

For additional information, refer to: **Supplemental Restraint System (SRS) Health and Safety Precautions** (100-00 General Information, Description and Operation).

**Air Conditioning Refrigerant**

See also **Chlorofluorocarbon, Chemical Materials**

Highly flammable, combustible – observe No Smoking policy.

Skin contact may result in frostbite.

Instructions given by the manufacturer must be followed. Avoid naked lights, wear suitable protective gloves and goggles.

If refrigerant comes into contact with the skin or eyes, immediately rinse the affected areas with water. Eyes should also be rinsed with an appropriate irrigation solution and should not be rubbed. SEEK MEDICAL ASSISTANCE IF NECESSARY.

For additional information, refer to: **Air Conditioning (A/C) System Health and Safety Precautions** (100-00 General Information, Description and Operation).

**Adhesives and Sealers**

See also **Fire, Chemical Materials**.

Highly flammable, flammable, combustible – observe No Smoking policy.

Generally should be stored in No Smoking areas. Cleanliness and tidiness in use should be observed, for example disposable paper covering benches; should be dispensed from applicators where possible; containers, including secondary containers, should be labeled appropriately.



**DESCRIPTION AND OPERATION****Solvent-based Adhesives/Sealers - See Solvents**

Follow manufacturers instructions.

**Water-based Adhesives/Sealers**

Those based on polymer emulsions and rubber latexes may contain small amounts of volatile toxic and harmful chemicals. Skin and eye contact should be avoided and adequate ventilation provided during use.

**Hot Melt Adhesives**

In the solid state, they are safe. In the molten state they may cause burns and health hazards may arise from the inhalation of toxic fumes.

Use appropriate protective clothing and a thermostatically controlled heater with a thermal cut-out and adequate extraction.

**Resin-based Adhesives/Sealers, for example Epoxide and Formaldehyde Resin-based**

Mixing should be carried out in well ventilated areas, as harmful or toxic volatile chemicals may be released.

Skin contact with uncured resins and hardeners can result in irritation, dermatitis, and absorption of toxic or harmful chemicals through the skin. Splashes can damage the eyes.

Provide adequate ventilation and avoid skin and eye contact.

**Anaerobic, Cyanoacrylate (super-glues) and other Acrylic Adhesives**

Many are irritant, sensitizing or harmful to the skin and respiratory tract. Some are eye irritants.

Skin and eye contact should be avoided and the manufacturers instructions followed.

Cyanoacrylate adhesives (super-glues) **MUST NOT** contact the skin or eyes. If skin or eye tissue is bonded, cover with a clean moist pad and **SEEK IMMEDIATE MEDICAL ATTENTION**. Do not attempt to pull tissue apart. Use in well ventilated areas as vapors can cause irritation to the nose and eyes.

For two-pack systems see Resin-based and Isocyanate Adhesives/Sealers.

**Isocyanate (Polyurethane) Adhesives/Sealers**

See also [Resin-based Adhesives](#).

Individuals suffering from asthma or respiratory allergies should not work with or near these materials as sensitivity reactions can occur.

Over exposure is irritating to the eyes and respiratory system. Excessive concentrations may produce effects on the nervous system including drowsiness. In extreme cases, loss of consciousness may result. Long term exposure to vapor concentrations may result in adverse health effects.

Prolonged contact with the skin may have a defatting effect which may lead to skin irritation and in some cases, dermatitis.

Splashes entering the eye will cause discomfort and possible damage.

Any spraying should preferably be carried out in exhaust ventilated booths, removing vapors and spray droplets from the breathing zone.

Wear appropriate gloves, eye and respiratory protection.

**Antifreeze**

See also [Fire, Solvents](#).

For example isopropanol, ethylene glycol, methanol.

Highly flammable, flammable, combustible.

Used in vehicle coolant systems, brake air pressure systems, screenwash solutions.

For additional information, refer to: [Engine Cooling System Health and Safety Precautions](#) (100-00 General Information, Description and Operation).

**Asbestos**

See also [Warning Symbols on Vehicles](#) at the end of this subsection.

Breathing asbestos dust may cause lung damage or, in some cases, cancer.

Used in brake and clutch linings, transmission brake bands and gaskets.

## DESCRIPTION AND OPERATION

foams should be conducted with extraction ventilation. See also the vehicle Body Repair Manual.

### Freon

See [Air Conditioning Refrigerant](#).

### Fuels

See also, [Fire, Legal Aspects](#), Chemicals and [Solvents](#).

Avoid skin contact with fuel where possible. Should contact occur, wash the affected skin with soap and water.

### Gasoline (Petrol)

Highly flammable - observe No Smoking policy.

For additional information, refer to: [Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions](#) (100-00 General Information, Description and Operation).

### Gas-oil (Diesel Fuel)

### Kerosene (Paraffin)

Used also as heating fuel, solvent and cleaning agent.

Flammable - observe No Smoking policy.

Irritation of the mouth and throat may result from swallowing. The main hazard from swallowing arises if liquid aspiration into the lungs occurs.

Liquid contact dries the skin and can cause irritation or dermatitis. Splashes in the eye may be slightly irritating.

In normal circumstances the low volatility does not give rise to harmful vapors. Exposure to mists and vapors from kerosene at elevated temperature should be avoided (mists may arise in dewaxing). Avoid skin and eye contact and make sure there is adequate ventilation.

### Gas Cylinders

See also [Fire](#).

Gases such as oxygen, acetylene, argon and propane are normally stored in cylinders at pressures of up to 138 bar (2000 psi) and great care should be taken in handling these cylinders to avoid mechanical damage to them or to the valve gear attached. The contents of each cylinder should be clearly identified by appropriate markings.

Cylinders should be stored in well-ventilated enclosures, and protected from ice and snow, or direct sunlight. Fuel gases, for example acetylene and propane, should not be stored in close proximity to oxygen cylinders.

Care should be exercised to prevent leaks from gas cylinders and lines, and to avoid sources of ignition.

Only trained personnel should undertake work involving gas cylinders.

### Gases

See [Gas Cylinders](#).

### Gaskets (Fluoroelastomer)

See [Viton](#).

## General Workshop Tools and Equipment

It is essential that all tools and equipment are maintained in good condition and that the correct safety equipment is used where required.

Never use tools or equipment for any purpose other than that for which they were designed. Never overload equipment such as hoists, jacks, axle and chassis stands or lifting slings. Damage caused by overloading is not always immediately apparent and may result in a fatal failure the next time that the equipment is used.

Do not use damaged or defective tools or equipment, particularly high-speed equipment such as grinding wheels. A damaged grinding wheel can disintegrate without warning and cause serious injury.

Wear suitable eye protection when using grinding, chiseling or sand blasting equipment.

Wear a suitable breathing mask when using abrasive blasting equipment, working with asbestos-based materials or using spraying equipment.

**DESCRIPTION AND OPERATION**

The use of drum cleaning units, vacuum cleaning or damp wiping is preferred.

Asbestos dust waste should be dampened, placed in a sealed container and marked for safe disposal. If any cutting or drilling is attempted on materials containing asbestos the item should be dampened and only hand tools or low speed power tools used.

**Battery Acids**

See also [Acids and Alkalis](#).

For additional information, refer to: [Battery and Battery Charging Health and Safety Precautions](#) (100-00 General Information, Description and Operation).

**Brake and Clutch Linings and Pads**

See [Asbestos](#).

**Brake Fluids (Polyalkylene Glycols)**

See also [Fire](#).

For additional information, refer to: [Brake System Health and Safety Precautions](#) (100-00 General Information, Description and Operation).

**Brazing**

See [Welding](#).

**Chemical Materials**

See also [Legal Aspects](#).

Chemical materials such as solvents, sealers, adhesives, paints, resin foams, battery acids, antifreeze, brake fluids, fuels, oils and grease should always be used with caution and stored and handled with care. They may be toxic, harmful, corrosive, irritant or highly flammable and give rise to hazardous fumes and dusts.

The effects of excessive exposure to chemicals may be immediate or delayed; briefly experienced or permanent; cumulative; superficial; life threatening; or may reduce life expectancy.

**Chemical Materials - Do's**

- Do carefully read and observe hazard and precaution warnings given on material containers (labels) and in any accompanying leaflets, posters or other instructions. Material health and safety data sheets can be obtained from manufacturers.
- Do remove chemical materials from the skin and clothing as soon as practicable after soiling. Change heavily soiled clothing and have it cleaned.
- Do organize work practices and protective clothing to avoid soiling of the skin and eyes; breathing vapors, aerosols, dusts or fumes; inadequate container labeling; fire and explosion hazards.
- Do wash before job breaks, before eating, smoking, drinking or using toilet facilities when handling chemical materials.
- Do keep work areas clean, uncluttered and free of spills.
- Do store chemical materials according to national and local regulations.
- Do keep chemical materials out of the reach of children.

**Chemical Materials - Do Nots**

- Do not mix chemical materials except under the manufacturers instructions; some chemicals can form other toxic or harmful chemicals, give off toxic or harmful fumes or become explosive when mixed together.
- Do not spray chemical materials, particularly those based on solvents, in confined spaces, for example when people are inside a vehicle.
- Do not apply heat or flame to chemical materials except under the manufacturers instructions. Some are highly flammable and some may release toxic or harmful fumes.
- Do not leave containers open. Fumes given off can build up to toxic, harmful or explosive concentrations. Some fumes are heavier than air and will accumulate in confined areas such as pits.
- Do not transfer chemical materials to unlabelled containers.
- Do not clean hands or clothing with chemicals. Chemicals, particularly solvents and fuels, will dry the skin and may cause irritation leading to

**DESCRIPTION AND OPERATION**

dermatitis or be absorbed through the skin in toxic or harmful quantities.

- Do not use emptied containers for other materials except when they have been cleaned under supervised conditions.
- Do not sniff or smell chemical materials. Brief exposure to high concentrations of fumes can be toxic or harmful.

**Chlorofluorocarbons (CFC)**

There is concern in the scientific community that CFCs and Halons are depleting the upper ozone layer which filters out harmful ultraviolet radiation. Decreased filtration of ultraviolet radiation may result in increases in skin cancer, cataracts and immune system suppression in humans, as well as decreased productivity of crops and aquatic systems.

CFCs are used primarily as refrigerants in vehicle air conditioning systems and as aerosol propellants. Halons are used as fire extinguishants.

**Clutch Fluids**

See **Brake fluids**.

**Clutch Linings and Pads**

See **Asbestos**.

**Corrosion Protection Materials**

See also **Solvents, Fire**.

Highly flammable, flammable – observe No Smoking policy.

These materials are varied and the manufacturers instructions must be followed. They may contain solvents, resins or petroleum products. Skin and eye contact should be avoided. They should only be sprayed in conditions of adequate ventilation and not in confined spaces.

**Cutting**

See **Welding**.

**Dewaxing**

See **Solvents** and **Fuels** (Kerosene).

**Dusts**

Powder, dusts or clouds may be irritant, harmful or toxic. Avoid breathing dusts from powdery chemical materials or those arising from dry abrasion operations. Wear respiratory protection if ventilation is inadequate.

Fine dusts of combustible material can present an explosion hazard. Avoid explosive limits and sources of ignition.

**Electric Shock**

Electric shock can result from the use of faulty electrical equipment or from the misuse of equipment in good condition.

Make sure that electrical equipment is maintained in good condition and frequently tested. Faulty equipment should be labeled and preferably removed from the workstation.

Make sure that flexes, cables, plugs and sockets are not frayed, kinked, cut, cracked or otherwise damaged.

Make sure that electrical equipment and flexes do not come into contact with water.

Make sure that electrical equipment is protected by the correct rated fuse.

Never misuse electrical equipment and never use equipment that is in any way faulty. The results could be fatal.

Make sure that the cables of mobile electrical equipment cannot get trapped and damaged, such as in a vehicle hoist.

Make sure that the designated electrical workers are trained in basic First Aid.

In cases of electrocution:

- switch off the power supply before approaching the victim.
- if this is not possible push or drag the victim from the source of electricity using dry non-conductive material.
- commence resuscitation if trained to do so.
- SUMMON MEDICAL ASSISTANCE.

**Engine Oils**

See **Lubricants and Grease**.



## DESCRIPTION AND OPERATION

Make sure there is adequate ventilation to control dusts, mists and fumes.

### High Pressure Air, Lubrication and Oil Test Equipment

See also **Lubricants and Greases**.

Always keep high-pressure equipment in good condition, and regularly maintained, particularly at joints and unions.

Never direct a high-pressure nozzle, for example diesel injector, at the skin as the fluid may penetrate to the underlying tissue, and cause serious injury.

### Halon

See **CFCs**.

### Legal Aspects

There are many laws and regulations relating to health and safety in the use and disposal of materials and equipment in a workshop.

For a safe working environment and to avoid environmental pollution, workshops should be familiar, in detail, with the many health and safety laws and regulations within their country, published by both national and local authorities.

### Lubricants and Greases

Avoid all prolonged and repeated contact with mineral oils. All lubricants and greases may be irritating to the eyes and skin.

### Transmission Fluids

#### Safety instructions

Certain Transmission and Power Steering fluids supplied to Ford may contain additives which have the potential to cause skin disease (dermatitis) to exposed persons. The dermatitis may be irritant or allergic in nature. Risks are higher where prolonged or repeated skin contact with a fluid may occur. These fluids are used for vehicle initial fill and service purposes. This sub-section is to:

- Inform Service personnel who may come into contact with these vehicle fluids (hazard communication).
- Summarise appropriate workplace control measures and personal protective equipment requirements.
- Draw attention to the existence of Material Safety Datasheets (MSDS's) for the fluids (available from Ford Customer Service Division). These MSDS's contain detailed information on hazards and appropriate controls.

#### Control measures

Workplace risk assessments made under national chemical control regulations should identify operations involving the fluids as potentially hazardous and specify workplace control and worker awareness measures. In such circumstances, the relevant Material Safety Datasheet (see the details specified below) which specifies hazards and control measures in detail should be made available for guidance.

Avoid unprotected skin contact with the fluids, and in particular, avoid prolonged or repeated skin contact. Work practices should be organised so as to minimise the potential for skin contact. This may include the use of drip trays, absorbents, correct fluid handling equipment (funnels etc), and workplace housekeeping measures such as the cleaning of contaminated surfaces.

Personnel engaged in operations where skin contact could occur (such as fluid draining or filling) should wear impervious gloves made from nitrile rubber, certified to a chemical protection standard, e.g. Europe Standard EN374. This glove type is widely available from reputable suppliers of gloves for chemical protection [including the manufacturers Ansell-Admont (Solvex Range), North Safety products (North Nitrile Latex Gloves range), and Marigold Industrial (Blue Nitrile range)]. If gloves become torn or contaminated on the inside they should be replaced. Eye protection with safety glasses is appropriate. Use of an impervious apron and arm protectors may be necessary if more extensive exposure is possible. Use of skin barrier creams suitable for work with mineral oil products may offer some supplementary protection, but such barrier creams should not be used in place of protective clothing.

If accidental skin contact occurs with the fluids, wash the area thoroughly with soap or skin cleanser and water.

**DESCRIPTION AND OPERATION**

Accidental eye contact should be dealt with as per normal first aid practices, by flushing the eyes with an eye wash or clean cool water for 10 minutes, after which medical attention should be obtained.

Remove and launder clothing which becomes contaminated with the fluids. Do not place rags contaminated with fluid in clothing pockets.

Wash thoroughly after completing operations where skin exposure may have occurred.

It is important that personnel do not smoke, eat or drink whilst handling the fluids or affected transmissions. These measures are designed to limit the risk from accidental ingestion.

Label any decanted fluid properly/use an equivalent label to that on original product containers.

Clean up any spills promptly using an inert absorbent and wash down contaminated surfaces with detergent and water.

Dispose of any waste fluids safely as hazardous waste.

**Safety Data Sheets**

Safety Data Sheets, which detail specific material handling instructions and precautions are available from the respective national sales company, and via internet [www.msds.ford.com](http://www.msds.ford.com).

**Used Engine Oil**

Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants, which may cause skin cancer. Adequate means of skin protection and washing facilities must be provided.

Do not employ used engine oils as lubricants or for any application where appreciable skin contact is likely to occur.

**Environmental Precautions**

Burning used engine oil in small space heaters or boilers can be recommended only for units of approved design. If in doubt check with the appropriate local authority and manufacturer of approved appliances.

Dispose of used oil and used oil filters through authorized waste disposal contractors or licensed

waste disposal sites, or to the waste oil reclamation trade. If in doubt, contact the relevant local authority for advice on disposal facilities.

It is illegal to pour used oil on to the ground, down sewers or drains, or into watercourses.

**Noise**

Some operations may produce high noise levels, which could, in time, damage hearing. In these cases, suitable ear protection must be worn.

**Noise Insulation Materials**

See [Foams, Fibre Insulation](#).

**O-Rings (Fluoroelastomer)**

See [Viton](#).

**Paints**

See also [Solvents, Chemical Materials](#).

Highly flammable, flammable - observe No Smoking policy

**One Pack**

Can contain harmful or toxic pigments, driers and other components as well as solvents. Spraying should be carried out only with adequate ventilation.

**Two Pack**

Can also contain harmful and toxic unreacted resins and resin hardening agents. The manufacturers instructions should be followed. See also Resin-based Adhesives and Isocyanate Adhesives and Sealers under Adhesives and Sealers.

Spraying should preferably be carried out in exhausted ventilated booths removing vapor and spray mists from the breathing zone. Individuals working in booths should wear appropriate respiratory protection. Those doing small-scale repair work in the open workshop should wear air-fed respirators.

**DESCRIPTION AND OPERATION****Pressurized Equipment**

See High **Pressure Air, Lubrication and Oil Test Equipment**.

**Solder**

Solders are mixtures of metals such that the melting point of the mixture is below that of the constituent metals (normally lead and tin). Solder application does not normally give rise to toxic lead fumes, provided a gas/air flame is used.

Oxy-acetylene flames should not be used, as they are much hotter and will cause lead fumes to be produced.

Some fumes may be produced by the application of any flame to surfaces coated with grease, and inhalation of these should be avoided.

Removal of excess solder should be undertaken with care, to make sure that fine lead dust is not produced, which can give toxic effects if inhaled. Respiratory protection may be necessary.

Solder spillage and filings should be collected and removed promptly to prevent general air contamination by lead.

High standards of personal hygiene are necessary in order to avoid ingestion of lead or inhalation of solder dust from clothing.

**Solvents**

See also **Chemical Materials, Fuels** (Kerosene), **Fire**.

For example acetone, white spirit, toluene, xylene, trichloroethane.

Used in cleaning and dewaxing materials, paints, plastics, resins and thinners.

Some may be highly flammable or flammable.

Skin contact will degrease the skin and may result in irritation and dermatitis following repeated or prolonged contact. Some can be absorbed through the skin in toxic or harmful quantities.

Splashes in the eye may cause severe irritation and could lead to loss of vision.

Brief exposure of high concentrations of vapors or mists will cause eye and throat irritation, drowsiness, dizziness, headaches and, in the worst circumstances, unconsciousness.

Repeated or prolonged exposure to excessive but lower concentrations of vapors or mists, for which

there might not be adequate warning indications, can cause more serious toxic or harmful effects.

Aspiration into the lungs, for example through vomiting, is the most serious consequence of swallowing.

Avoid splashes to the skin, eyes and clothing. Wear protective gloves, goggles and clothing if necessary.

Make sure there is good ventilation when in use, avoid breathing fumes, vapors and spray mists and keep containers tightly sealed. Do not use in confined spaces.

When spraying materials containing solvents, for example paints, adhesive, coatings, use extraction ventilation or personal respiratory protection in the absence of adequate general ventilation.

Do not apply heat or flame except under specific and detailed manufacturers instructions.

**Sound Insulation**

See **Fibre Insulation, Foams**.

**Suspended Loads**

 **CAUTION: Never improvise lifting tackle.**

There is always a danger when loads are lifted or suspended. Never work under an unsupported, suspended or raised load, for example a suspended engine.

Always make sure that lifting equipment such as jacks, hoists, axle stands and slings are adequate and suitable for the job, in good condition and regularly maintained.

**Transmission Brake Bands**

See **Asbestos**.

**Underseal**

See **Corrosion Protection**.

**Viton**

In common with many other manufacturers vehicles, some components have O-rings, seals or gaskets, which contain a material known as 'Viton'.



**DESCRIPTION AND OPERATION**

Viton is a fluoroelastomer, that is a synthetic rubber type material, which contains Fluorine. It is commonly used for O-rings, gaskets and seals of all types. Although Viton is the most well known fluoroelastomer, there are others, including Fluorel and Tecmoflon.

When used under design conditions fluoroelastomers are perfectly safe. If, however, they are exposed to temperatures in excess of 400°C, the material will not burn, but will decompose, and one of the products formed is hydrofluoric acid.

This acid is extremely corrosive and may be absorbed directly, through contact, into the general body system.

O-rings, seals or gaskets which have been exposed to very high temperatures will appear charred or as a black sticky substance.

DO NOT; under any circumstances touch them or the attached components.

Enquiries should be made to determine whether Viton or any other fluoroelastomer has been used in the affected O-ring, seal or gasket. If they are of natural rubber or nitrile there is no hazard. If in doubt, be cautious, as the material may be Viton or any fluoroelastomer.

If Viton or any other fluoroelastomers have been used, the affected area should be decontaminated before the commencement of work.

Disposable heavy duty plastic gloves should be worn at all times, and the affected area washed down using wire wool and a limewater (calcium hydroxide) solution to neutralize the acid before disposing of the decomposed Viton residue and final cleaning of the area. After use, the plastic gloves should be discarded carefully and safely.

**Welding**

See also **Fire, Electric Shock, Gas Cylinders**.

Welding processes include Resistance Welding (Spot Welding), Arc Welding and Gas Welding.

**Resistance Welding**

This process may cause particles of molten metal to be emitted at a high velocity, and the eyes and skin must be protected.

**Arc Welding**

This process emits a high level of ultra-violet radiation, which may cause arc-eye, and skin burns to the operator and to other persons nearby. Gas-shielded welding processes are particularly hazardous in this respect. Personal protection must be worn, and screens used to shield other people.

CONTACT LENS WEARERS ARE ADVISED TO REVERT TO ORDINARY SPECTACLES WHEN ARC WELDING as the arc spectrum is believed to emit microwaves which dry out the fluid between the lens and the eye. This may result in blindness when the lens is removed from the eye.

Metal spatter will also occur, and appropriate eye and skin protection is necessary.

The heat of the welding arc will produce fumes and gases from the metals being welded, the rods and from any applied coatings or contamination on the surfaces being worked on. These gases and fumes may be toxic and inhalation of these should be avoided. The use of extraction ventilation to remove the fumes from the working area may be necessary particularly in cases where the general ventilation is poor, or where considerable welding work is anticipated. In extreme cases or confined spaces where adequate ventilation cannot be provided, air-fed respirators may be necessary.

**Gas Welding (and Cutting)**

Oxy-acetylene torches may be used for welding and cutting, and special care must be taken to prevent leakage of these gases, with consequent risk of fire and explosion.

The process will produce metal spatter and eye and skin protection is necessary.

The flame is bright, and eye protection should be used, but the ultra-violet emission is much less than that from arc welding, and lighter filters may be used.

The process itself produces few toxic fumes, but such fumes and gases may be produced from coatings on the work, particularly during cutting away of damaged body parts, and inhalation of the fumes should be avoided.

In brazing, toxic fumes may be produced from the metals in the brazing rod, and a severe hazard may arise if brazing rods containing cadmium are used. In this event particular care must be taken to avoid inhalation of fumes and expert advice may be required.

## DESCRIPTION AND OPERATION

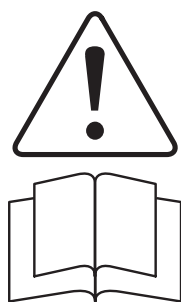
SPECIAL PRECAUTIONS MUST BE TAKEN BEFORE ANY WELDING OR CUTTING TAKES PLACE ON VESSELS, WHICH HAVE CONTAINED COMBUSTIBLE MATERIALS, FOR EXAMPLE BOILING OR STEAMING OUT OF FUEL TANKS.

## Warning Symbols on Vehicles

Decals showing warning symbols will be found on various vehicle components.

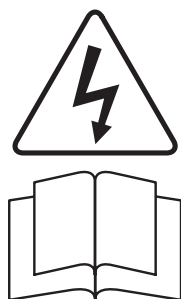
These decals must not be removed. The warnings are for the attention of owners/operators and persons carrying out service or repair operations on the vehicle.

The most commonly found decals are reproduced below together with an explanation of the warnings.



TIM0101001

1. Components or assemblies displaying the caution triangle and open book symbol advise consultation of the relevant section of the owner literature before touching or attempting adjustments of any kind.



TIM0101002

2. Components or assemblies displaying the warning triangle with the 'electrified' arrow and open book symbol give warning of inherent high voltages. Never touch these with the engine running or the ignition switched on. See Electric Shock in this subsection.



TIM0101003

3. Vehicles and replacement components which contain asbestos are identified by this symbol. See Asbestos in this subsection.



TIM0101004

4. Components or assemblies displaying this symbol give warning that the component contains a corrosive substance. See Acids and Alkalis in this subsection.



TIM0101005

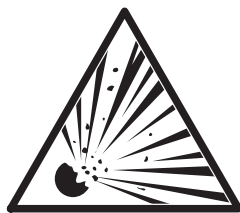
5. Displaying the caution circle with a deleted lighted match symbol, caution against the use of naked lights or flames within the immediate vicinity due to the presence of highly flammable or explosive liquids or vapors. See Fire in this subsection.

**DESCRIPTION AND OPERATION**

**instructions. Failure to follow this instruction may result in personal injury or damage to components.**

It is of fundamental importance that certain essential equipment, for example torque wrenches, multimeters, exhaust gas analyzers or rolling roads, are regularly calibrated in accordance with the manufacturers instructions.

## DESCRIPTION AND OPERATION



TIM0101006

6. Displaying this symbol (normally in conjunction with 5 above) warn of the presence of potentially explosive matter within the immediate vicinity.



TIM0101008

7. Displaying this symbol warn that children should not be allowed in the immediate vicinity unsupervised.

## White Spirit

See [Solvents](#).

## DESCRIPTION AND OPERATION

## Standard Workshop Practices

## Vehicle in Workshop

When working on a vehicle in the workshop always make sure that:

- the parking brake is applied or the wheels are securely chocked to prevent the vehicle moving forwards or backwards.
- the key is removed from key operated hood locks before any work is carried out around the front of the vehicle.
- if the engine is to be run, there is adequate ventilation, or an extraction hose to remove exhaust fumes.
- there is adequate room to raise the vehicle and remove the wheels, if necessary.
- fender covers are always fitted if any work is to be carried out in the engine compartment.
- the battery is disconnected if working on the engine, underneath the vehicle, or if the vehicle is raised.

**CAUTION:** When electric arc welding on a vehicle, always disconnect the generator wiring to prevent the possibility of a surge of current causing damage to the internal components of the generator.

- if using welding equipment on the vehicle, a suitable fire extinguisher is readily available.

## Towing the Vehicle

**WARNING:** When the vehicle is being towed, the ignition switch must be in position II (steering lock released and warning lamps illuminated). Only then will the steering, turn signal lamps, horn and stop lamps be operational. Failure to follow these instructions may result in personal injury.

**NOTE:** The removable towing eye (if equipped), has a left-hand thread and must be fully tightened before towing can commence.

When towing is necessary, the vehicle towing eyes should be used. The rope must be securely fastened to the towing eyes and must also be attached to the other vehicle such that the rope will not foul the bodywork.

When a vehicle with automatic transmission is towed, the gear selector must be in position N

(Neutral). Never tow a vehicle with automatic transmission at a speed greater than 30 mph (50 km/h) or for a distance greater than 30 miles (50 km). If it is necessary to tow the vehicle a greater distance, the drive wheels must be lifted clear off the ground.

Alternatively the vehicle can be transported on a low loader or a trailer.

## Connecting a Slave Battery Using Jumper Cables

**WARNING:** If the slave battery has recently been charged and is gassing, cover the vent plugs or covers with a damp cloth to reduce the risk of explosion should arcing occur when connecting the jumper cables. Failure to follow these instructions may result in personal injury.


## CAUTIONS:


**CAUTION:** A discharged battery condition may have been caused by an electrical short circuit. If this condition exists there will be an apparently live circuit on the vehicle even when all normal circuits are switched off. This can cause arcing when the jumper cables are connected.

**CAUTION:** While it is not recommended that the vehicle is jump started, it is recognized that this may occasionally be the only practical way to mobilize a vehicle. In such an instance, the discharged battery must be recharged immediately after jump starting to avoid permanent damage.

- Always make sure that the jumper cables are adequate for the task. Heavy duty cables must be used.
- Always make sure that the slave battery is of the same voltage as the vehicle battery. The batteries must be connected in parallel.
- Always make sure that switched electric circuits are switched off before connecting jumper cables. This reduces the risk of arcing occurring when the final connection is made.

**DESCRIPTION AND OPERATION****Solvents, Sealants and Adhesives****Introduction**

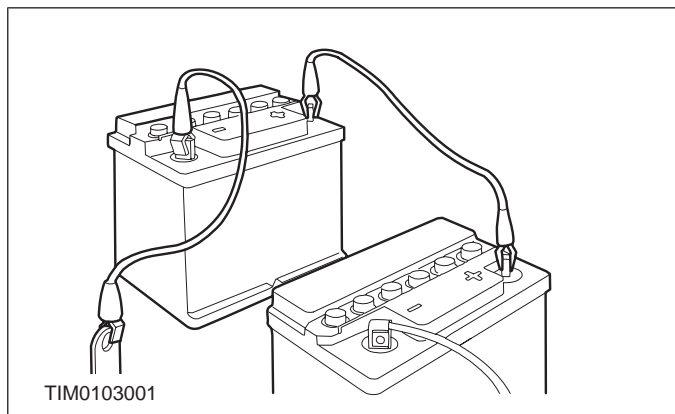
 **WARNING:** Always handle all solvents, sealers and adhesives with extreme care. Some contain chemicals or give off fumes which can be dangerous to health. Always follow the manufacturers instructions. If in doubt about any substance, particularly a solvent, DO NOT use it.

 **CAUTION:** If in doubt about the suitability of any proprietary solvent or sealer for a particular application, contact the manufacturer of the product for information regarding storage, handling and application.

The Health and Safety Precautions subsection refers to some commonly used chemicals and materials, hazards associated with their use, and safety measures to be taken.



## DESCRIPTION AND OPERATION



**WARNING:** Make sure that the ends of the jumper cables do not touch each other or ground against the vehicle body at any time while the cables are attached to the battery. A fully charged battery, if shorted through jumper cables, can discharge at a rate well above 1000 amps causing violent arcing and very rapid heating of the jumper cables and terminals, and can even cause the battery to explode. Failure to follow these instructions may result in personal injury.

Always connect the jumper cables in the following sequence:

- Slave battery positive first and then vehicle battery positive.
- Slave battery negative next and then vehicle ground at least 12 inches (300 mm) from the battery terminal, for example engine lifting eye.

Always reduce the engine speed to idle before disconnecting the jumper cables.

Before removing the jumper cables from the vehicle that had the discharged battery, switch on the heater blower (high) or the heated rear window, to reduce the voltage peak when the cables are removed.

Always disconnect the jumper cables in the reverse order to the connecting sequence and do not short the ends of the cables.

Do not rely on the generator to restore a discharged battery. For a generator to recharge a battery, it would take in excess of eight hours continuous driving with no additional loads placed on the battery.

### Component Cleaning

To prevent the ingress of dirt, accumulations of loose dirt and greasy deposits should be removed

before disconnecting or dismantling components or assemblies.

Components should be thoroughly cleaned before inspection prior to reassembly.

### Cleaning Methods:

- Dry cleaning.
- Removal of loose dirt with soft or cable brushes.
- Scraping dirt off with a piece of metal or wood.
- Wiping off with a rag.

**WARNING:** Wear eye protection when cleaning vehicle components with compressed air, a steam cleaner or a power washer. Failure to follow this instruction may result in personal injury.

### CAUTIONS:

**CAUTION:** Compressed air is sometimes 'wet' so use with caution, especially on hydraulic systems.

**CAUTION:** To prevent damage to the electrical connectors in the engine compartment, do not use a steam cleaner or a power washer to clean the engine compartment.

- Blowing dirt off with compressed air.
- Removal of dry dust using vacuum equipment. This method must always be used to remove friction lining material dust (asbestos particles).
- Steam cleaning.

**WARNING:** Most solvents require careful handling and some are harmful. Refer to Health and Safety Precautions and to the manufacturers literature for the relevant safety precautions. Failure to follow these instructions may result in personal injury.

Various solvents are available which are suitable for component cleaning. Some components, such as brake hydraulic parts and electrical assemblies should be cleaned only with recommended solvents — refer to Solvents, Sealers and Adhesives or to the section of the manual relevant to the component.

### Calibration of Essential Measuring Equipment

**WARNING:** Equipment, which requires regular calibration, must be calibrated in accordance with the manufacturers

## DESCRIPTION AND OPERATION

## Road/Roller Testing

Road or roller testing may be carried out for various reasons and a procedure detailing pre-test checks, engine starting and stopping, pre-driving checks, on-test checks and final checks to be completed on completion of the test is given below.

Unless complete vehicle performance is being checked, the full road test procedure need not be carried out. Instead, those items particularly relevant to the system(s) being checked can be extracted.

## Pre-Test Checks

**▲ WARNING: If the brake system hydraulic fluid level is low, pedal travel is excessive or a hydraulic leak is found, do not attempt to road test the vehicle until the reason for the low fluid level, excessive pedal travel or hydraulic leak is found and rectified.**

It is suggested that pre-test checks and functional tests of those systems and circuits which affect the safe and legal operations of the vehicle, such as brakes, lights and steering, should always be carried out before the road or roller test.

With the ignition switched off, check:

- the engine oil level.
- the engine coolant level.
- the tires, for correct pressure, compatible types and tread patterns, and wear within limits.
- that there is sufficient fuel in the tank to complete the test.
- all around the engine, transmission and under the vehicle for oil, coolant, hydraulic and fuel leaks. Make a note of any apparent leaks and wipe off the surrounding areas to make it easier to identify the extent of the leak on completion of the test.

## Starting the Engine

**NOTE:** On initial drive away from cold and within the first 1.5 km (1 mile), do not depress the accelerator pedal beyond half travel until the vehicle has attained a minimum speed of 25 km/h (15 miles/h). Never operate at high engine speed or with the accelerator pedal at full travel whilst the engine is cold.

With the ignition switched off, check:

- that the parking brake is applied.
- that the gear lever is in the neutral position.
- that all instrument gauges (except fuel gauge) read zero.

With the ignition switched on, check:

- that the ignition controlled warning lamps are illuminated.
- that the engine temperature gauge registers a reading compatible with the engine temperature.
- that the fuel gauge registers a reading appropriate to the fuel level in the tank.
- the operation of the parking brake warning lamp and fluid level warning indicator.

## Road or Roller Testing

**▲ CAUTION: If road testing, check the brake operation while still traveling at low speed before continuing with the test. If the brakes pull to one side, or appear to be otherwise faulty, do not continue with the road test until the fault has been found and rectified.**

During the road or roller test, check:


- that the clutch pedal operation is not stiff or heavy.
- that the initial gear engagement is smooth and there is no evidence of clutch drag.
- that the parking brake control operates smoothly and releases quickly and completely.
- that the clutch takes up the drive smoothly, without slip or judder.
- that gear changing is smooth with no abnormal noises or vibrations from the transmission.
- the engine power output is satisfactory, full power is achieved, acceleration is smooth and pedal operation is not stiff or heavy, and engine speed returns to idle correctly.
- there is no excessive or abnormally colored smoke from the engine under normal driving, heavy load or overrun conditions.
- that steering operation, including power steering (if equipped), is smooth, accurate, not excessively heavy or with excessive free play or vibration.
- that the steering does not pull to one side and self centers smoothly after cornering.



## DESCRIPTION AND OPERATION


- that the speedometer, coolant temperature gauge and tachometer (if equipped) register the correct readings and operate correctly.
- that the switches and controls operate smoothly and positively, warning and indicator lamps operate correctly and the direction indicator control self cancels when the steering is returned to the straight ahead position.
- that the heating and ventilation systems operate correctly and effectively.
- the brake operation and efficiency.
- oil, coolant, hydraulic, air and fuel leaks.
- abnormal temperature of any moving components or assemblies, for example wheel hubs, transmission and axle, which might indicate over tightness or lack of lubrication.


## Brake Testing

 **WARNING:** When brake testing, avoid breathing the fumes from hot brakes, this may contain asbestos dust which is hazardous to health. Failure to follow this instruction may result in personal injury.

For additional information, refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).

### CAUTIONS:

 **Avoid brake testing on busy roads where it may cause inconvenience or danger to other road users.**

 **Brake testing which includes heavy brake applications should not be carried out with new brake pads/discs or linings/drums until the components have bedded-in. New brake friction components will not reach full efficiency until the bedding-in process is complete.**

Test the brakes at several speeds within the normal operating range using both light and heavy pedal pressure. Note any tendency to snatch, pull or drag, and any undue delay in application or release.

Allow the vehicle to coast and note any tendency to pull to one side, or evidence that the brakes are binding.















After stopping the vehicle (not immediately after a period of heavy braking), carefully check the brake temperature. A brake disc or brake drum that feels hot or is appreciably hotter than the others, indicates that the brake is binding.



After completion of the test, check for:

## DESCRIPTION AND OPERATION









## Air Conditioning (A/C) System Health and Safety Precautions

## WARNINGS:

-  Only qualified technicians are allowed to work on air conditioning (A/C) systems.
-  Air conditioning (A/C) system components can become particularly hot or cold.
-  Make sure that the air conditioning (A/C) system is at ambient temperature before carrying out any repair.
-  When handling refrigerants, always wear protective goggles and gloves made of fluoroelastomer. Leather or fabric gloves are not suitable.
-  **SKIN CONTACT:** If liquid refrigerant comes into contact with the skin, it produces severe frostbite. Immediately flush affected areas with plenty of cold running water for 15 minutes. Seek medical attention.
-  **EYE CONTACT:** If refrigerant comes into contact with the eyes, immediately flush the eyes with plenty of running water for 15 minutes. Seek medical attention.
-  **INHALED:** Toxic gases generated when refrigerant is heated are hazardous to health. The gases have an irritating smell and can cause lung damage. The symptoms can continue for a long time after having been in contact with the gases. The gases can cause lung damage even if the amount of gas in the air is too small to smell.
-  Refrigerant is flammable and explosive.
-  Make sure that refrigerant bottles are not exposed to temperatures greater than 45°C.
-  Make sure that the local regulations regarding work on air conditioning (A/C) systems are adhered to.
-  Make sure that refrigerant bottles are closed properly.
-  Gaseous refrigerant has a higher density than air. There is a danger of suffocation when working close to the ground or in workshop pits.
-  Provide adequate ventilation when handling refrigerant.
-  Never release refrigerant into the atmosphere.

-  Only use special tools, equipment and lubricants that are approved for the type of refrigerant being used.
-  Always follow the manufacturer's instructions for the correct servicing unit operating procedure.








## CAUTIONS:

-  Do not mix refrigerant oils for different types of refrigerant.
-  Never mix different types of refrigerant or equipment intended for them.
-  Only use refrigerant in gas form when filling the system through the low-pressure connection.
-  Only use refrigerant in liquid form when filling the system through the high-pressure connection.
-  Refrigerant attacks certain plastics. Only use seals suitable for refrigerant.
-  If the air conditioning (A/C) compressor is damaged, the fixed orifice tube can become blocked with metal particles.
-  Any sort of blockage in the refrigerant circuit will damage the air conditioning (A/C) compressor irreparably.
-  If the air conditioning (A/C) system has been opened for a period greater than 2 hours, a new receiver drier must be installed and the evacuating time to be increased by a minimum of 2 hours.

**NOTE:** New air conditioning (A/C) compressors are delivered prefilled.

**NOTE:** Refrigerant oil in new air conditioning (A/C) compressors can contain Teflon, visible as white particles, which will not harm the system.






**DESCRIPTION AND OPERATION****Battery and Battery Charging Health and Safety Precautions****WARNINGS:**

-  Batteries contain sulphuric acid, avoid contact with skin, eyes or clothing. Wear safety goggles when working near the battery to protect against possible splashing of the acid solution.
-  **EYE CONTACT:** If acid comes into contact with the eyes, flush immediately with plenty of running water for a minimum of 15 minutes. Seek immediate medical attention.
-  **SKIN CONTACT:** If acid comes into contact with the skin, flush immediately with plenty of running water for a minimum of 15 minutes. Seek immediate medical attention.
-  **SWALLOWED:** If acid is swallowed, rinse the mouth with plenty of water and then drink plenty of water or milk. Do not induce vomiting. Seek immediate medical attention.
-  Batteries normally produce explosive gases. Do not allow naked flames, sparks or lighted substances to come near the battery.
-  When charging the battery shield your face and wear safety goggles. Provide adequate ventilation.
-  **CAUTION:** Boost charging with excessive current or voltage above 16 volts will damage the battery.

**DESCRIPTION AND OPERATION****Brake System Health and Safety Precautions****WARNINGS:**

-  **EYE CONTACT:** Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with the eyes. Wash hands thoroughly after handling. If brake fluid comes into contact with the eyes, flush the eyes with plenty of cold running water for 15 minutes. Seek medical attention for any persistent eye irritation or abnormality.
-  **SWALLOWED:** Brake fluid contains polyglycol ethers and polyglycols. If swallowed, drink plenty of water. Seek immediate medical attention.
-  **INHALED:** Dust from friction materials can be harmful if inhaled.
-  **Only use new specified brake fluid from airtight containers.**
-  **CAUTION:** If brake fluid is spilled on the paintwork, the affected area must be immediately washed down with cold water.








**DESCRIPTION AND OPERATION****Engine Cooling System Health and Safety Precautions****WARNINGS:**

-  **Extreme care must be exercised when handling hot fluids. Always wash off spilled fluids from affected areas of skin immediately.**
-  **Vapors may be given off from antifreeze when heated. Avoid breathing these vapors.**
-  **SKIN CONTACT:** Antifreeze may be absorbed through the skin in toxic or harmful quantities.
-  **SWALLOWED:** If antifreeze is swallowed, drink plenty of water, induce vomiting. Seek immediate medical attention.
-  **Antifreeze must not be used in any cooling or industrial water system that is connected or linked to general water supplies.**



**DESCRIPTION AND OPERATION**

## Window Glass Health and Safety Precautions

**WARNINGS:**

-  Cured polyurethane (PU) adhesive can degrade if subjected to high temperatures. Isocyanide compounds can be released when grinding or welding in close proximity to cured PU adhesive.
-  **SKIN CONTACT:** Prolonged exposure to polyurethane (PU) adhesive may cause skin irritation. If PU adhesive comes into contact with the skin, remove any contaminated clothing. Immediately wash the skin with soap and water. Seek medical attention for any persistent skin irritation or abnormality.
-  **EYE CONTACT:** Polyurethane (PU) adhesive may cause severe irritation or damage. If PU adhesive comes into contact with the eyes, immediately flush eyes with plenty of running water for at least 15 minutes. Seek immediate medical attention.
-  **SWALLOWED:** If polyurethane (PU) adhesive is swallowed, flush the mouth thoroughly. Do not induce vomiting. Provide rest, warmth and fresh air. Seek immediate medical attention.
-  **INHALED:** Persons having a respiratory allergy may have an allergic reaction when handling polyurethane (PU) adhesive.
-  **INHALED:** Polyurethane (PU) adhesive can cause asthma like symptoms. Isocyanate vapor from primer or PU adhesive can cause allergies in the respiratory tract.
-  **INHALED:** If polyurethane (PU) adhesive fumes are inhaled, move victim to fresh air. Provide oxygen if necessary. If breathing stops, provide artificial respiration. Keep a victim warm and at rest. Seek immediate medical attention.











**CAUTIONS:**

-  Make sure that the direct glazing for bonded glass cutting blades are changed where the cutting depth changes to avoid damage to the body and trim panels.
-  During the curing period of the PU adhesive, the door windows must be left open to avoid a build up of pressure when the doors are opened and closed.


## DESCRIPTION AND OPERATION

Petrol and Petrol-Ethanol Fuel Systems Health and Safety  
Precautions



## WARNINGS:

-  Fuel may not give adequate warning before toxic or harmful effects arise.
-  Exposure to fuel can be harmful and can cause severe health damage or death.
-  Extreme care must be exercised when handling hot fluids. Always wash off spilled fluids from affected areas of skin immediately.
-  Highly flammable mixtures are always present and may ignite when working on fuel systems. Do not allow naked flames, sparks or lighted substances to come near fuel related components.
-  Fuel must not be used as a cleaning agent.
-  Keep fuel containers tightly closed, out of direct sunlight and in a cool area. Keep away from heat sources, ignition sources and oxidizing agents.
-  **SKIN CONTACT:** Excessive or prolonged skin contact with diesel fuel may cause serious skin disorders including skin cancer.
-  **SKIN CONTACT:** Fuel is mildly irritating to the skin and may cause dermatitis due to defatting effect. Remove contaminated clothing. Wash affected areas of skin with soap and water. Seek medical attention for any persistent skin irritation or abnormality. Wash contaminated clothing before reuse.
-  **EYE CONTACT:** Fuel is mildly irritating to the eyes. Flush with plenty of running water, blinking as often as possible. Do not force the eyelid open. Seek medical attention for any persistent eye irritation or abnormality.
-  **SWALLOWED:** Fuel is moderately toxic and tends to foam on vomiting. If drawn into the lungs, inflammation may develop. Do not induce vomiting. If spontaneous vomiting occurs place the victim in a forward position to reduce the risk of fuel being drawn into the lungs. Give nothing by mouth. If breathing but unconscious, place in the recovery position. If breathing

has stopped, apply artificial respiration. Seek immediate medical attention.

-  **INHALED:** Fuel is toxic to the respiratory and other body systems. Exposure may result in various symptoms including drowsiness, unconsciousness or severe health damage. Move a victim to fresh air. Keep a victim warm and at rest. If unconscious, place in the recovery position. If not breathing, apply artificial respiration. Give cardiac massage if necessary. Seek immediate medical attention.

## CAUTIONS:






















-  Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components.
-  Make sure that the workshop area in which the vehicle is being worked on is as clean and as dust free as possible.





## DESCRIPTION AND OPERATION

Supplemental Restraint System (SRS) Health and Safety  
Precautions

## WARNINGS:

-  Only qualified technicians are allowed to work on pyrotechnic components.
-  **INHALED:** Exposure to pyrotechnic residue may cause low blood pressure, severe headache, irritation of mucous membranes, fainting, shortness of breath or rapid pulse. Move a victim to fresh air. Seek immediate medical attention.
-  **EYE CONTACT:** Exposure to unburned pyrotechnic residue may cause irritation, burning and etching of the eyes. Flush immediately with plenty of cold running water for at least 15 minutes. Seek immediate medical attention.
-  **EYE CONTACT:** Exposure to burned pyrotechnic residue may cause irritation, burning and etching of the eyes. Flush immediately with diluted boric acid solution. Seek immediate medical attention.
-  **SKIN CONTACT:** Unburned pyrotechnic residue may be rapidly absorbed through the skin in toxic quantities. Wash immediately with plenty of soap and water. Seek medical attention.
-  **SKIN CONTACT:** Burned pyrotechnic residue may be rapidly absorbed through the skin in toxic quantities. Wash with plenty of water. Do not use soap. Seek medical attention.
-  **SWALLOWED:** Unburned pyrotechnic residue is extremely toxic. If conscious drink plenty of water then induce vomiting. Seek immediate medical attention. If unconscious, or in convulsions do not attempt to induce vomiting or give anything by mouth. Seek immediate medical attention.
-  **SWALLOWED:** Burned pyrotechnic residue is extremely toxic. Drink plenty of water and seek immediate medical attention.
-  The deployment key must only be accessible to authorized personnel.
-  Make sure that the deployment key remains removed from the deployment equipment except during deployment.
-  If permanently disabling or enabling the passenger air bag a new seat belt for vehicles without or with a passenger air bag must be installed.
-  Undeployed pyrotechnic components must not be deployed in the vehicle.
-  Pyrotechnic components must be deployed following local regulations.
-  Check thoroughly that no loose objects can be spread during the deployment of pyrotechnic components.
-  Pyrotechnic components must be transported following local regulations.
-  Never carry out any electrical measurement on disconnected, undeployed pyrotechnic components.
-  Pyrotechnic components must not be disassembled.
-  Pyrotechnic components are not interchangeable between vehicles.
-  Always carry a live air bag module away from the body with the air bag or trim cover pointing upwards.
-  Live air bag modules must be placed in a suitable cage when removed from the vehicle. The air bag or trim cover must be facing upwards.
-  Do not install a rearward facing child safety seat to the passenger seat with an activated passenger air bag.

## CAUTIONS:

-  Pyrotechnic components must not be subjected to temperatures higher than 110°C.
-  Never install aftermarket accessories to the vehicle on or adjacent to the supplemental restraint system module.

## DESCRIPTION AND OPERATION

## Body Repair Health and Safety and General Precautions

## General

Appropriate repair methods and carrying out repair and paint jobs correctly is particularly important to the operating safety of vehicles and the safety of people.

**▲ WARNING: There is danger of injury through:**

- High voltage when electrical welding.
  - Do not perform welding work in a damp environment or on a wet substrate. Use suitable insulation underneath.
- Welding spatter and UV radiation.
  - Wear protective clothing, gloves and welding mask or welding goggles.
- Fire, explosion and hot surfaces in the work area.
  - Always have a suitable fire extinguisher available when using welding or heating equipment.
  - Remove flammable substances from the danger area. Remove the fuel tank and fuel pipes and hoses.
  - Welding and grinding near the battery presents the danger of explosion. Remove the battery before you start working.
  - During paint work there is an increased danger of fire or explosion. Prevent any sparks being created. Fire, open light and smoking are forbidden.
  - Always ventilate the workplace well and use an extraction system.
  - Wear protective footwear made from anti-static material.
  - Only use tools made of wood, brass or copper to clean stands and extraction ducts. Do not use tools made of steel.
  - Only fill or decant paint materials in a specially marked area.
- Inhalation and/or absorption through the skin of harmful substances.
  - Welding fumes grinding dusts and solvent vapours can be extremely harmful to the health.
  - Sealants, underbody protection and paint residues must not be burnt down with an unshielded flame, as this will produce harmful substances.
  - Always ventilate the workplace well and use an extraction system.
  - Wear protective clothing.
- Pyrotechnic components.
  - Disconnect the battery negative clamp and cover the battery terminal.
  - Remove any airbag components.
- Noise
  - Cutting, grinding and alignment work can cause a noise level over 85 dB (A).
  - Always wear ear protection.
- High Forces.
  - The various body areas are subject to very high forces during realignment work. Should any component suddenly become detached during this process, there is a very great danger of injury.
  - Pulling chains and pulling shackles must be secured with arrester cables.

As well as these general instructions on the dangers in body and paint shops, you must observe:

- All valid local national and international regulations governing Health and Safety at Work
- Safety instructions of material equipment and tool manufacturers

For additional information, refer to: (100-00 General Information)

**Solvents, Sealants and Adhesives** (Description and Operation),  
**Air Conditioning (A/C) System Health and Safety Precautions** (Description and Operation),  
**Supplemental Restraint System (SRS) Health and Safety Precautions** (Description and Operation).

## DESCRIPTION AND OPERATION

## Personal protection

Besides the body and limbs, several organs vital to life are in very particular danger. Because damage is mostly irreparable, special attention and comprehensive protection is necessary.

## Protective equipment

Always use the appropriate protective equipment:

- Protective helmet or welding mask
- Breathing protection
- Protective clothes gloves and safety boots
- Ear defenders
- Extraction systems

Always carry out an operational check on your protective equipment every time before you start working!

## Breathing protection

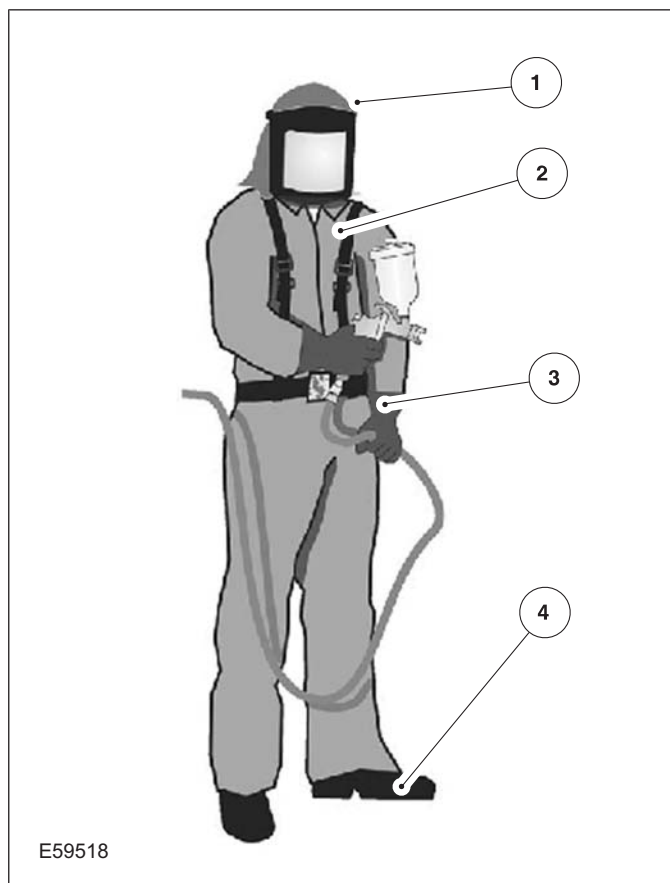
**▲ WARNING: Vapor or spray mist containing isocyanates as a paint base or hardener can cause toxic respiratory disease (conditions similar to asthma) leading to permanent damage, even when inhaled in the lowest concentrations**

The instructions for use provided by the manufacturer must be observed when working with breathing protection equipment.

During painting work and in the preparations for painting, gases, vapors, mists or dusts can appear in dangerous concentrations.

Breathing protection devices which are independent of the local atmosphere are most suitable.

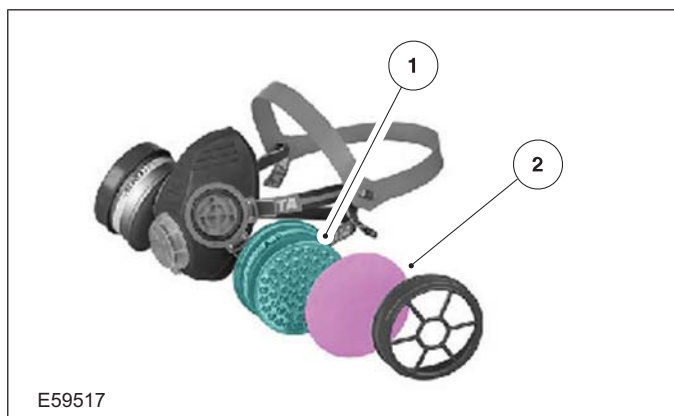
In these types of isolation systems, a compressed air hose carries natural air from the compressor line into the protective mask. During supply, the air undergoes pressure reduction, water removal, fine filtration and usually warming to natural breath temperature.



Item	Description
1	Protective hood with fresh air supply
2	Protective clothing
3	Protective gloves
4	Protective footwear

Only for short periods of work or minimal concentrations of hazardous substances breathing protection devices with a combination filter is suitable as breathing protection equipment.

## DESCRIPTION AND OPERATION



Item	Description
1	Activated charcoal filter
2	Coarse filter

Filter masks with wadding, sponge or colloid filters and also paper masks are all unsuitable for working with coating materials because they do not stop solvent vapors.

**Eye protection**

Cutting grinding welding solvents and paint bear fundamental risks for your eyes.

Damage ranging from irritation of the cornea to incurable illnesses is possible.

Solvents and paint – even water based – could not only be absorbed via your skin but also via your eyes.

Therefore always wear the appropriate eye protection for your work.

Protective goggles must be inert toward splashes of solvent, and must have side protection. Best protection during spray painting is offered by full mask respirators or helmet respirators with built-in visor.

**Skin protection**

Spray painters must wear suitable protective work clothing (flame-proof and anti-static). Also, when working with water based materials, comprehensive skin protection must be worn, because these materials are very easily absorbed through the skin.

Change your protective clothing at proper intervals. Clothes contaminated with coating materials can easily catch fire.

Do not choose clothes or underwear with a large content of easy melting synthetic fiber, because this material considerably increases the danger and degree of injuries (melted plastic on the skin!).

For areas of the skin which are not covered by protective clothing suitable skin protection cleaning and care agents must be used.

**Ear protection**

Cutting grinding compressors and extractor fans and ducts are the main sources of noise in body and paint shops.

Always wear suitable ear protection like ear plugs or ear defenders.

**Protection of the vehicle**

Protect affected areas from weld spatter and dust during all welding and grinding work on the vehicle. If metallic dust stays on the vehicle for some time, there is the likelihood of film rust formation.

Grinding produces tiny spots of damage to the paint surface, which may cause corrosion. Also use suitable protective measures to protect the interior when performing repair operations which relate to the inside of the vehicle.

For this reason, make sure to:

- Use carbon fiber blankets to protect the vehicle body and the interior.
- Use covering film to protect the vehicle body from grinding dust and metal dust.
- Use covering paper to protect the interior from grinding dust.

In addition, take into account:

- Remove fuel supply components as necessary.
- Protect working areas which are in danger of catching fire with a fireproof blanket.
- Keep heat away from all components of the air conditioning system.
- Remove all components in the space adjoining the repair area.

**Electronic components**

Increased use of comfort and safety electronics in modern vehicles requires additional attention to be paid during body work.

Over voltages produced during welding can cause electronic systems to be damaged. In particular, the safety instructions for performing welding work on vehicles with airbag systems must be adhered to.

**▲ WARNING: After disconnecting the power supply and before performing further work, a wait time of up to 15 minutes must be**

**DESCRIPTION AND OPERATION**

maintained, depending on the vehicle.  
**Work on airbag systems may only be performed by persons who have a relevant certificate of competence.**

For additional information, refer to: (501-20 Supplemental Restraint System)

**Driver Air Bag Module** (Removal and Installation),

**Passenger Air Bag Module** (Removal and Installation),

**Side Air Bag Module** (Removal and Installation),

**Side Air Curtain Module** (Removal and Installation),

**Restraints Control Module (RCM)** (Removal and Installation).

Pay attention to the following points:

- Disconnect the battery negative clamp and cover the battery terminal.
- Disconnect the electrical connector at the airbag control module.
- If welding is to be performed directly near a control module, it must be disconnected or removed.
- Never connect the negative cable of the welder near an airbag or a control module.
- Connect the negative cable of the welder close to the location of the weld.



# SECTION 100-02 Jacking and Lifting

VEHICLE APPLICATION: 2008.50 Kuga

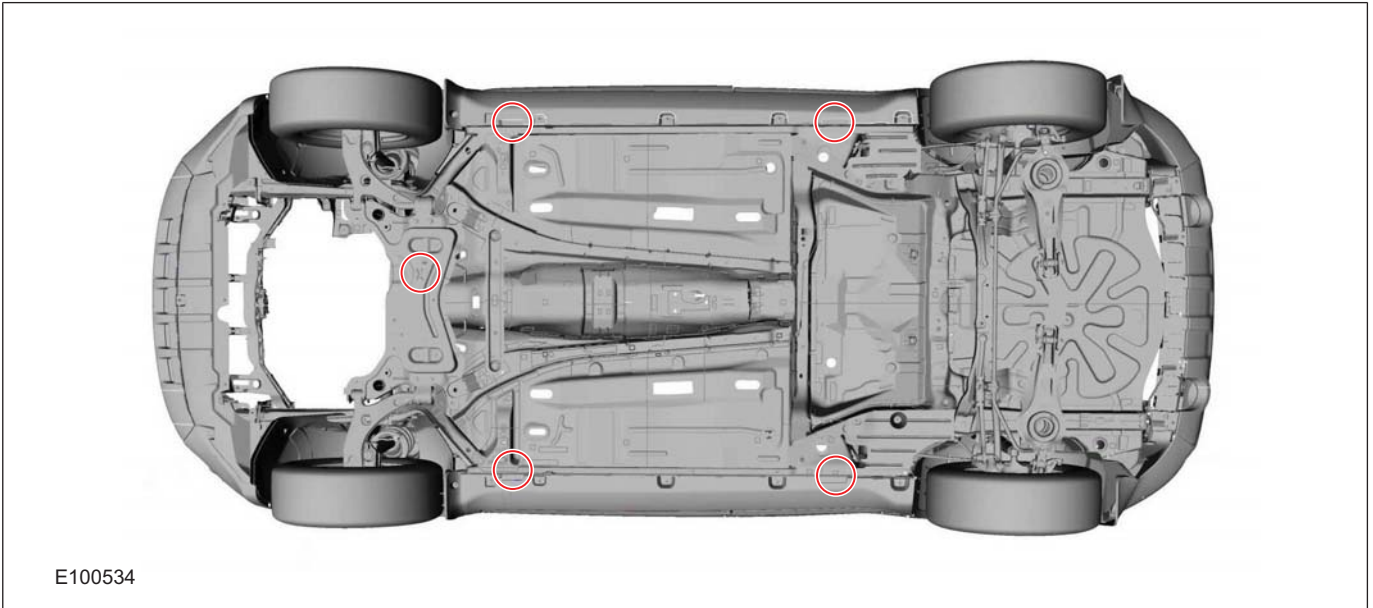
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DESCRIPTION AND OPERATION

Jacking

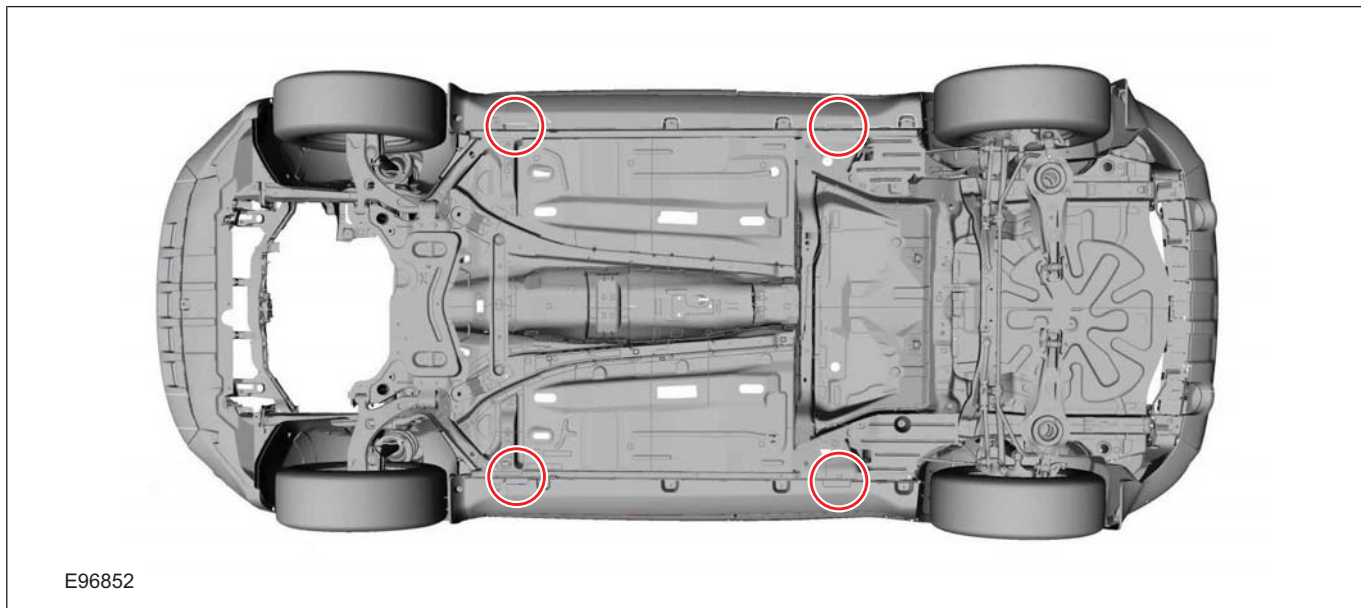






DESCRIPTION AND OPERATION

Lifting



## SECTION 100-04 Noise, Vibration and Harshness

**VEHICLE APPLICATION: 2008.50 Kuga**

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**DIAGNOSIS AND TESTING****Noise Conditions**

- Gear noise is typically a howling or whining due to gear damage or incorrect bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.
- Chuckle is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 64 km/h (40 mph) and can usually be heard all the way to a stop. The frequency varies with vehicle speed.
- Knock is very similar to chuckle, though it may be louder and occurs on acceleration or deceleration. The teardown will disclose what has to be corrected.

Clicking, popping or grinding noises may be caused by the following:

- worn, damaged or incorrectly installed wheel bearing, suspension or brake component.

Check and rule out tires, exhaust and trim items before disassembling the transmission to diagnose and correct gear noise.

The noises described under Road Test usually have specific causes that can be diagnosed by observation as the unit is disassembled. The initial clues are the type of noise heard on the road test and driving conditions.

**Vibration Conditions**

Vibration at highway speeds may be caused by the following:

- out-of-balance front or rear wheels.
- out-of-round tires.

Shudder or vibration during acceleration may be caused by the following:

- damaged powertrain/drivetrain mounts.
- excessively high constant velocity (CV) joint operating angles caused by incorrect ride height. Check ride height, verify correct spring rate and check items under inoperative conditions.

**Road Test**

A gear-driven unit will produce a certain amount of noise. Some noise is acceptable and may be audible at certain speeds or under various driving conditions, as on a newly paved asphalt road. The

slight noise is in no way detrimental and must be considered normal.

The road test and customer interview (if available) provide information needed to identify the condition and give direction to the correct starting point for diagnosis.

1. Make notes throughout the diagnosis routine. Make sure to write down even the smallest bit of information, because it may turn out to be the most important.
2. Do not touch anything until a road test and a thorough visual inspection of the vehicle have been carried out. Leave the tire pressures and vehicle load just where they were when the condition was first observed. Adjusting tire pressures, vehicle load or making other adjustments may reduce the condition(s) intensity to a point where it cannot be identified clearly. It may also inject something new into the system, preventing correct diagnosis.
3. Make a visual inspection as part of the preliminary diagnosis routine, writing down anything that does not look right. Note tire pressures, but do not adjust them yet. Note leaking fluids, loose nuts and bolts, or bright spots where components may be rubbing against each other. Check the load space for unusual loads.
4. Road test the vehicle and define the condition by reproducing it several times during the road test.
5. Carry out the Road Test Quick Checks as soon as the condition is reproduced. This will identify the correct diagnostic procedure. Carry out the Road Test Quick Checks more than once to verify they are providing a valid result. Remember, the Road Test Quick Checks may not tell where the concern is, but they will tell where it is not.

**Road Test Quick Checks**

1. 24-80 km/h (15-50 mph): with light acceleration, a moaning noise is heard and possibly a vibration felt in the front floor panel. It is usually worse at a particular engine speed and at a particular throttle setting during acceleration at that speed. It may also produce a moaning sound, depending on what component is causing it. REFER to Tip-in Moan in the Driveline Noise and Vibration Symptom Chart.
2. Acceleration/Deceleration: With slow acceleration and deceleration, a shake is

**DIAGNOSIS AND TESTING****Noise, Vibration and Harshness (NVH)****Inspection and Verification**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and REFER to the Symptom Chart.

**How to Use this Diagnostic Procedure Section**

- Noise, vibration and harshness (NVH) concerns have become more important as vehicles have become more sensitive to these vibrations. This section is designed to aid in identifying these concerns.
- The section provides diagnostic procedures based on symptom. If the condition occurs at high speed, for instance, the most likely place to start is under Shake and Vibration While Driving.
- The road test procedure will tell how to sort the conditions into categories and how to tell a vibration from a shake.
- A series of Road Test Quick Checks are provided to make sure that a cause is either pinpointed or eliminated.
- Name the condition, proceed to the appropriate section and locate the correct diagnosis. When the condition is identified, the job is partly done.
- Follow the diagnostic procedure as outlined.
- Quick Checks are described within the step, while more involved tests and adjustments are outlined in General Procedures.
- Always follow each step exactly and make notes to recall important findings later.

**Customer Interview**

The road test and customer interview (if available) provide information that will help identify the concern and will provide direction to the correct starting point for diagnosis.

**Identify the Condition**

NVH usually occur in four areas:

- tires
- engine accessories
- suspension
- driveline

It is important, therefore, that an NVH concern be isolated into its specific area(s) as soon as possible. The easiest and quickest way to do this is to carry out the Road Test as outlined. To assist in the diagnosis and testing procedure(s), use a suitable approved NVH diagnosis tester.

**Noise Diagnostic Procedure****Non-Axle Noise**

The five most common sources of non-axle noise are exhaust, tires, roof racks, trim panels and transmission.

Therefore, make sure that none of the following conditions are the cause of the noise before proceeding with a driveline teardown and diagnosis.

- In certain conditions, the pitch of the exhaust may sound very much like gear noise. At other times, it can be mistaken for a wheel bearing rumble.
- Tires, especially snow tires, can have a high pitched tread whine or roar, similar to gear noise. Radial tires may have this characteristic. Also, any non-standard tire with an unusual tread construction may emit a roar or whine noise.
- Trim panels can also cause whistling or whining noise.
- Clunk may be a metallic noise heard when the automatic transaxle is engaged in "R" (REVERSE) or "D" (DRIVE) or it may occur when the throttle is applied or released. It is caused by backlash somewhere in the driveline.
- Bearing rumble sounds like marbles being tumbled. This condition is usually caused by a damaged wheel bearing.

**DIAGNOSIS AND TESTING**

sometimes noticed in the steering wheel/column, seats, front floor panel, front door trim panel or front end sheet metal. It is a low frequency vibration (around 9-15 cycles per second). It may or may not be increased by applying the brakes lightly. REFER to Idle Boom/Shake/Vibration in the Driveline Noise and Vibration Symptom Chart.

3. High Speed: A vibration is felt in the front floor panel or seats with no visible shake, but with an accompanying sound or rumble, buzz, hum, drone or booming noise. Coast with the clutch pedal depressed (manual transmission) or shift control selector lever in "N" (NEUTRAL) (automatic transmission) and engine idling. If vibration is still evident, it may be related to wheels, tires, front brake discs, wheel hubs or front wheel bearings. REFER to Shake and Vibration While Driving in the Driveline Noise and Vibration Symptom Chart.
4. Engine rpm Sensitive: A vibration is felt whenever the engine reaches a particular rpm. It will disappear in neutral coasts. The vibration can be duplicated by operating the engine at the problem rpm while the vehicle is stationary. It can be caused by any component, from the accessory drive belt to the clutch or torque converter which turns at engine speed when the vehicle is stopped. REFER to Shake and Vibration While Driving in the Driveline Noise and Vibration Symptom Chart.
5. Noise and Vibration While Turning: Clicking, popping or grinding noises may be due to the following:
  - worn, damaged or incorrectly installed front wheel bearing.
  - damaged powertrain/drivetrain mounts.

**Road Conditions**

An experienced technician will always establish a route that will be used for all NVH diagnosis road tests. The road selected should be reasonably smooth, level and free of undulations (unless a particular condition needs to be identified). A smooth asphalt road that allows driving over a range of speeds is best. Gravel or bumpy roads are unsuitable because of the additional road noise produced. Once the route is established and

consistently used, the road noise variable is eliminated from the test results.

**NOTE:** Some concerns may be apparent only on smooth asphalt roads.

If a customer complains of a noise or vibration on a particular road and only on a particular road, the source of the concern may be the road surface. If possible, try to test the vehicle on the same type of road.

**Vehicle Preparation**

Carry out a thorough visual inspection of the vehicle before carrying out the road test. Note anything which is unusual. Do not repair or adjust any condition until the road test is carried out, unless the vehicle is inoperative or the condition could pose a hazard to the technician. After verifying that the condition has been corrected, make sure all components removed have been installed.

**Power Steering Conditions**

Check for the noise in the following conditions to verify the customer concern.

- Check for the noise in several temperature conditions.
- Is the noise from when the vehicle was new?
- Can the noise be repeated constantly or is it random?
- Check the condition of the vehicle age, mileage and service record.
- Interview the customer to find the operating condition in which the noise will occur. Test the vehicle based on the detail(s) from the customer interview.
- Follow the power steering operation noise condition tables below, to find which condition the noise will occur.

**Power Steering Operation Noise Check**

Step 1: Check for NVH concerns from non-steering components, which may sound like noises coming from the steering system.

## DIAGNOSIS AND TESTING

Power assisted steering operating condition			
Parking		Driving	
Steering central/slightly off center	Steering at a steering lock stop	Driving straight ahead	Cornering condition
REFER to NVH concerns from other components column A	REFER to NVH concerns from other components column B	REFER to NVH concerns from other components column C	REFER to NVH concerns from other components column D

## NVH concerns from other components

NVH concerns from other condition (column A to D)					
Noise	Driving Condition	A	B	C	D
Pedal box knocking	Drive off, stop driving and slow cornering over uneven roads	X	X	O	X
Stabilizer bar link knocking	Drive off, driving and cornering	X	O	O	X
Engine support insulator knocking	Drive off, driving, acceleration and deceleration	X		X	
Air conditioning knocking	Engine on, activate switch for air conditioning	X	X	O	O
Suspension knocking (Subframe, Springs)	Drive off, driving, cornering, acceleration and deceleration	X		O	X
Constant velocity (CV) joint knocking	Drive off, driving, cornering, acceleration and deceleration	X	O		X
Washer bottle	Deceleration, acceleration and single impact	O		X	
Loose suspension bolts	All driving conditions	O		O	X
Instrument panel rattle/squeak	All driving conditions. Engine rpm dependant	X	X	X	X

- X = Noise will most likely occur in this operating condition.
- O = Noise can possibly occur in this operating condition.
- Blank = Noise is unlikely to occur in this operating condition.

Step 2: Check for steering system NVH concerns according to operation condition described at the customer interview.

Power assisted steering operating condition					
Parking		Driving		Vehicle stationary with engine off	
Steering central/slightly off center	Steering at a steering lock stop	Steering central/slightly off center	Steering at a steering lock stop	Steering central/slightly off centre	Steering at a steering lock stop



**DIAGNOSIS AND TESTING**

Power assisted steering operating condition					
Parking		Driving		Vehicle stationary with engine off	
REFER to steering system NVH concerns column A	REFER to steering system NVH concerns column B	REFER to steering system NVH concerns column C	REFER to steering system NVH concerns column D	REFER to steering system NVH concerns column E	REFER to steering system NVH concerns column F

**Steering system NVH concerns**

Steering System operation condition (column A to F)							
Noise	Driving condition	A	B	C	D	E	F
Moan	Parking between lock stops, at engine idle and also increased engine speed	X	O				
Whine	Driving, high engine rpm. Must be present from new	O	O	X	X		
Hiss	a) Parking between lock stops. Must be present from new	X	X	O	O		
	b) Holding steering wheel against lock stops. Must be present from new		X				
Lock stop impact knock	a) Parking at lock stop. Must be present from new		X				X
Mechanical knock (power assisted steering (PAS) off)	b) Parking between lock stops, engine OFF. Must be present from new					X	
Mechanical Knock (PAS on)	c) Parking between lock stops, engine ON (ball joint knock)	X					
Hammer knock	d) Parking into lock stop and release (vehicle with hydraulic power assisted steering (HPAS) only, not for vehicles with electro-hydraulic power assisted steering (EHPAS))		X				
Hydraulic knock (clonk)	e) Driving, cobble stones, rough road (clonk). Must be present from new			O	X		
Column knock	f) Parking, driving. cobble stones and rough roads	X	X	O	X	X	X
Column rattle	Mainly driving on rough roads	O		X	X	O	
Toc-toc	Steering left and right at high frequency. Must be present from new	X					
Grinding	When turning steering wheel	X			O	X	
Zip	At engine start, low temperatures below -10°C only	X	O				

- X = Noise will most likely occur in this operating condition.
- O = Noise can possibly occur in this operating condition.
- Blank = Noise is unlikely to occur in this operating condition.

Step 3: According to each identified operating condition (Column A, B, C, D, E, F), check each

possible Steering System NVH concern with the detail symptom charts below.



**DIAGNOSIS AND TESTING**

Before conducting a vehicle test to identify a NVH concern carry out the following checks.

1. Check the tire pressures and adjust to specification, as necessary.
2. Make sure the steering system fluid is correct, the system is free of leaks and is operating correctly.
3. Make sure the vehicle steering system temperature is the same as described at the customer interview.
4. All evaluations must take place in a relatively quiet location.
5. The heating - air conditioning (A/C) fan and radio must be turned off during evaluations and the windows closed.

**Symptom Chart**

**Power Steering Moan Noise**

**Test Condition**

Listen for steering moan noise with the vehicle parked, transmission in neutral and all windows closed in the following test conditions.

1. Engine speed at idle with no steering action.
2. Engine speed at idle with slow 90 degrees per second turning of the steering wheel.
3. Engine speed at 1250 +/- 50 rpm with no steering action.
4. Engine speed at 1250 +/- 50 rpm with slow 90 degrees per second turning of the steering wheel.

Symptom	Possible Sources	Action
Power steering system moan noise – A continuous low pitched humming noise occurs when the steering wheel is turned and the steering system is loaded. Noise frequency changes with engine rpm changes. Particularly annoying at lower engine speed.	Power steering lines.	<ul style="list-style-type: none"> <li>• CHECK the routing of the power steering lines.</li> <li>• CHECK the power steering line clamps are secure.</li> <li>• CHECK the power steering lines for clearance from the vehicle body, front axle cross-member and steering gear.</li> </ul>
	Incorrect power steering fluid.	<p>FLUSH the power steering system.</p> <p>REFER to: <b>Power Steering System Flushing</b> (211-00 Steering System - General Information, General Procedures).</p>
	Power steering pump.	Pressure pulses from the power steering pump. Certain amount of noise level acceptable, not a safety critical item.

**Power Steering Whine Noise**

**Test Condition**

Listen for steering whine noise with the vehicle parked, transmission in neutral and all windows closed in the following test conditions.

1. Engine speed at 1800 +/- 50 rpm with no steering action.
2. Engine speed at 1800 +/- 50 rpm with slow 90 degrees turning of the steering wheel.
3. Engine speed at 3000 +/- 50 rpm with no steering action.
4. Engine speed at 3000 +/- 50 rpm with slow 90 degrees turning of the steering wheel.

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
Power steering system whine noise – a high pitched buzzing sound like an electric motor or drill. Whine occurs at the higher engine rpm, 1500 - 5000 rpm, frequency does not change if system is loaded or not loaded.	Power steering fluid aeration.	BLEED the power steering system. REFER to: <b>Power Steering System Vacuum Bleeding</b> (211-00 Steering System - General Information, General Procedures).
	Incorrect power steering fluid.	FLUSH the power steering system. REFER to: <b>Power Steering System Flushing</b> (211-00 Steering System - General Information, General Procedures).
	Overheated power steering fluid.	FLUSH the power steering system. REFER to: <b>Power Steering System Flushing</b> (211-00 Steering System - General Information, General Procedures).
	Hydraulic operating condition of the power steering pump.	Certain amount of noise level acceptable, not a safety critical item.

**Power Steering Hiss Noise****Test Condition**

Listen for steering hiss noise with the vehicle parked, transmission in neutral and all windows closed in the following test conditions.

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
<p><b>NOTE:</b> Engine speed at idle turning the steering wheel slowly lock to lock.</p>	Floor seal.	CHECK the installation and potential damage of the floor seal.
<p>Power steering system hiss noise – a high frequency, continuous rush or swish noise like escaping air from a balloon. Hiss occurs while turning between the steering lock stops, all steering angles. Noise does not change with engine rpm and is worse at high operating temperatures.</p>	Power steering gear valve design.	Certain amount of noise level acceptable, not a safety critical item.
	Power steering system hydraulic design.	Certain amount of noise level acceptable, not a safety critical item.
<p><b>NOTE:</b> Engine speed at idle holding the steering wheel against a steering lock for three seconds. Do not hold for more than five seconds.</p> <p>Power steering system hiss noise – a continuous noise like escaping air occurs while holding the steering against a steering lock stop.</p>	Power steering pump pressure relief valve.	Certain amount of noise level acceptable, not a safety critical item.

**Power Steering Lock Stop Impact Knock Noise**

1. Turn the steering wheel to the left-hand and right-hand steering locks and listen for the impact noise.

**Test Condition**

Listen for steering knock noise with the engine speed at idle in the following test conditions (noise also apparent with engine off).

Symptom	Possible Sources	Action
Power steering system knock noise – a heavy loud sound like a knock on a door that occurs in parking condition when hitting the lock stop.	Power steering gear mechanical noise, metal to metal at end of steering travel.	Certain amount of noise level acceptable, not a safety critical item.

**Power Steering Mechanical Knock Noise (PAS off)**

1. Turn the steering wheel 90 degrees to the right, hold and then quickly release.
2. Turn the steering wheel 90 degrees to the left, hold and then quickly release.

**Test Condition**

Listen for steering knock noise with the engine off in the following test conditions (no power assist).

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
Power steering system knock noise – a heavy loud repeating sound like a knock on a door that occurs in several driving and steering conditions.	Power steering system knock noise – a damped, metallic knock noise which only occurs at steering condition with engine off (very high efforts).	Certain amount of noise level acceptable, not a safety critical item.
	Tolerances in the steering gear components.	Certain amount of noise level acceptable, not a safety critical item.

**Power Steering Mechanical Knock Noise (PAS on)**

1. Turn the steering wheel to a steering lock and return to center quickly.
2. Turn the steering wheel 90 degrees to the left and then 90 degrees to the right quickly.

**Test Condition**

Listen for steering knock noise with the engine speed at idle in the following test conditions (power assist).

Symptom	Possible Sources	Action
Power steering system knock noise – clear knock noise from steering gear linkage area.	Worn tie-rod ball joints (inner and outer ball joints).	REFER to Steering System. REFER to: <b>Steering System</b> (211-00 Steering System - General Information, Diagnosis and Testing).

**Power Steering Hammer Knock (Hydraulic) Noise**

vehicles with hydraulic power assisted steering only, not electro-hydraulic power steering).

**Test Condition**

Listen for steering knock noise with the engine speed at idle in the following test conditions (for

1. Turn the steering wheel to a steering lock position and return quickly.

Symptom	Possible Sources	Action
Power steering system knock noise – loud, metallic sound if hitting the suspension cross-member with a hammer (sounds like metallic noise but is created by pressure impulse in gear and return line).	Hydraulic noise created by pressure impulses.	Certain amount of noise level acceptable, not a safety critical item.

**Power Steering Hydraulic Knock/Clonk Noise**

1. Drive over cobbled roads at low speed 10-30 km/h (6-20 mph) with and without turning.
2. Drive over straight tar strips road rails or 25 mm tall harshness strips at low speed 10-30 km/h (6-20 mph) both driving straight and with moderate turning.

**Test Condition**

Listen for steering knock/clonk noise in the following test conditions with the windows closed.

**DIAGNOSIS AND TESTING**

Symptom	Possible Sources	Action
Power steering system knock/clonk noise – sounds almost identical to column knock that occurs when driving and cornering over cobbled stones or rough roads. Noise may appear to emanate from a location closer to the floor than that for column knock (Sounds like metallic noise but is created by pressure impulse in gear and return line – similar to a sound like quickly turning off a water tap).	Power steering return lines.	Certain amount of noise level acceptable, not a safety critical item.
	High power assist gain of power steering gear valve (steering gear design - no quality issue).	Certain amount of noise level acceptable, not a safety critical item.
	High power steering pump flow rate (by design).	Certain amount of noise level acceptable, not a safety critical item.

**Power Steering Column Knock Noise**

**Test Condition**

Listen for steering knock noise in the following test conditions with windows closed.

1. Drive over cobbled stones at low speed 16-40 km/h (10-25 mph) with and without steering input carefully listening for knock sounds.
2. Drive over straight tar strips, road rails or 25 mm tall harshness strips at low speed 16-40 km/h (10-25 mph) both driving straight and with moderate cornering.

Symptom	Possible Sources	Action
Power steering system column knock noise – a loose sounding rattle or vibration coming from the column. Noticeable by hearing and touch.	Steering column or steering column shaft.	CHECK the steering column retaining bolts and attachments to the steering column and secure if necessary.
		Check steering column and intermediate shaft for free play or loose components. REFER to: <b>Steering System</b> (211-00 Steering System - General Information, Diagnosis and Testing).

**Power Steering Toc-Toc Noise**

**Test Condition**

Listen for steering toc-toc noise with the engine speed at idle and the vehicle parked, automatic transmission in "P" (PARK) or manual transmission in neutral and the windows closed.

1. Turn the steering wheel from left to right abruptly changing direction.
2. Drive the vehicle for low speed parking manoeuvres constantly changing steering direction.

**DIAGNOSIS AND TESTING**

Symptom	Possible Sources	Action
Power steering system toc-toc noise – a metallic noise created when changing direction of steering wheel rotation during parking manoeuvre or at stand-still.	Steering gear (design tolerance in steering rack).	Certain amount of noise level acceptable, not a safety critical item.

**Power Steering Grinding Noise****Test Condition**

Listen for steering grinding noise with the engine speed at idle and the vehicle parked, automatic

transmission in "P" (PARK) or manual transmission in neutral and the windows closed.

1. Slowly turn the steering wheel from lock to lock.
2. Tilt and extend the steering column in various positions and slowly turn the steering wheel from lock to lock.

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Noise, Vibration and Harshness

100-04-13

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
Power steering system grinding noise – an abrasive noise (like sand paper rubbing against wood) occurs between moving components such as steering wheel and the steering column shroud.	Steering wheel to shroud interference.	Certain amount of noise level acceptable, not a safety critical item.
	Steering column bearing.	Certain amount of noise level acceptable, not a safety critical item.
	Foreign material in contact with the steering column shaft.	CHECK if floor covering is obstructing the steering gear pinion.
		CHECK the installation of the floor seal.
Clockspring.	CHECK the clockspring and secure if necessary. REFER to: <b>Clockspring</b> (501-20 Supplemental Restraint System, Removal and Installation).	

## Power Steering Zip Noise

Symptom	Possible Sources	Action
Power steering system zip noise – occurs when hydraulic fluid does not flow freely through the power steering pump supply hose from steering fluid reservoir to power steering pump causing cavitation at the pump. Zip is primarily a cold weather start-up phenomenon (below -10°C).	High viscosity of power steering fluid at low temperature.	Certain amount of noise level acceptable, not a safety critical item.
	Aeration of the power steering fluid.	BLEED the power steering system. REFER to: <b>Power Steering System Vacuum Bleeding</b> (211-00 Steering System - General Information, General Procedures).

## Driveline Noise and Vibration

Symptom	Possible Sources	Action
Shake and vibration while driving	<ul style="list-style-type: none"> <li>Wheel end vibration.</li> <li>Engine/transmission.</li> </ul>	GO to <b>Pinpoint Test A.</b>
Tip-in moan	<ul style="list-style-type: none"> <li>Air cleaner.</li> <li>Power assisted steering.</li> <li>Powertrain.</li> <li>Powertrain/drivetrain mounts.</li> <li>Exhaust system.</li> </ul>	GO to <b>Pinpoint Test B.</b>



## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
Idle boom/shake/vibration/shudder	<ul style="list-style-type: none"> <li>• Cable(s)/hose(s).</li> <li>• Powertrain/drivetrain mounts.</li> <li>• Exhaust system.</li> <li>• Belt/pulleys.</li> </ul>	GO to <b>Pinpoint Test C.</b>

## Suspension Noise and Vibration

Symptom	Possible Sources	Action
Wheel end vibration analysis	<ul style="list-style-type: none"> <li>• Suspension.</li> <li>• Wheel bearings.</li> </ul>	GO to <b>Pinpoint Test D.</b>
Non-axle noise	<ul style="list-style-type: none"> <li>• Trim panels.</li> <li>• Air conditioning (A/C) system.</li> <li>• Accessories.</li> </ul>	GO to <b>Pinpoint Test E.</b>

## Pinpoint Tests

**NOTE:** These Pinpoint Tests are designed to take the technician through a step-by-step diagnosis procedure to determine the cause of a condition. It may not always be necessary to follow the chart to its conclusion. Carry out only the pinpoint test

**PINPOINT TEST A : SHAKE AND VIBRATION WHILE DRIVING**

steps necessary to correct the condition. Then check the operation of the system to make sure the condition has been corrected.

After verifying that the condition has been corrected, make sure all components removed have been installed.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A1: NEUTRAL COAST</b>	
	<ol style="list-style-type: none"> <li>1 Carry out the neutral coast test. <ul style="list-style-type: none"> <li>• Does the vibration disappear during the neutral coast test? <ul style="list-style-type: none"> <li>→ <b>Yes</b> GO to A2.</li> <li>→ <b>No</b> GO to <b>Pinpoint Test D.</b></li> </ul> </li> </ul> </li> </ol>
<b>A2: CHECK THE POWERTRAIN/DRIVETRAIN MOUNTS</b>	
	<ol style="list-style-type: none"> <li>1 Carry out the powertrain/drivetrain mount neutralizing procedure <ul style="list-style-type: none"> <li>• Are the mounts OK? <ul style="list-style-type: none"> <li>→ <b>Yes</b> Vehicle condition corrected. ROAD TEST as necessary.</li> <li>→ <b>No</b> INSTALL new powertrain/drivetrain mounts as necessary. ROAD TEST as necessary.</li> </ul> </li> </ul> </li> </ol>

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Noise, Vibration and Harshness

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## DIAGNOSIS AND TESTING

## PINPOINT TEST B : TIP-IN MOAN

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B1: CHECK THE AIR CLEANER</b>	
	<p>1 Check the condition of the air cleaner mounts, inlet tube, outlet tube, resonators and all other components associated with the air induction system for correct installation and tightness of all connections.</p> <ul style="list-style-type: none"> <li>• Are the components OK?</li> </ul> <p>→ <b>Yes</b> GO to B2.</p> <p>→ <b>No</b> REPAIR or INSTALL new components as necessary. ROAD TEST as necessary.</p>
<b>B2: CHECK THE EXHAUST SYSTEM</b>	
	<p>1 Carry out the exhaust system neutralizing procedure.</p> <ul style="list-style-type: none"> <li>• Is the exhaust system OK?</li> </ul> <p>→ <b>Yes</b> GO to B3.</p> <p>→ <b>No</b> REPAIR as necessary. ROAD TEST as necessary.</p>
<b>B3: CHECK THE POWER STEERING</b>	
	<p>1 Remove the accessory drive belt and test for tip-in moan. REFER to: <b>Accessory Drive Belt</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation),</p> <ul style="list-style-type: none"> <li>• Is the tip-in moan OK?</li> </ul> <p>→ <b>Yes</b> REPAIR the power steering as necessary. REFER to: <b>Steering System</b> (211-00 Steering System - General Information, Diagnosis and Testing).</p> <p>→ <b>No</b> GO to B4.</p>

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B4: CHECK THE POWERTRAIN/DRIVETRAIN MOUNTS</b>	
	<p>1 Carry out the powertrain/drivetrain mount neutralizing procedure</p> <ul style="list-style-type: none"> <li>Are the powertrain/drivetrain mounts OK?</li> </ul> <p>→ <b>Yes</b> Vehicle condition corrected. ROAD TEST as necessary.</p> <p>→ <b>No</b> INSTALL new powertrain/drivetrain mounts as necessary. ROAD TEST as necessary.</p>

## PINPOINT TEST C : IDLE BOOM/SHAKE/VIBRATION/SHUDDER

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>C1: CHECK THE CABLE/HOSES</b>	
	<p>1 Check the engine compartment for any component that may have a touch condition between the engine and body or chassis. For example: control cable, air conditioning (A/C) hoses, acceleration cable.</p> <ul style="list-style-type: none"> <li>Are the components OK?</li> </ul> <p>→ <b>Yes</b> GO to C2.</p> <p>→ <b>No</b> REPAIR or INSTALL new components as necessary. ROAD TEST as necessary.</p>
<b>C2: CHECK THE ENGINE COOLING RADIATOR</b>	
	<p>1 Check the engine cooling radiator mountings and bushings for security and condition. Check the radiator installation for any component that may have a touch condition.</p> <ul style="list-style-type: none"> <li>Is the installation and bushings OK?</li> </ul> <p>→ <b>Yes</b> GO to C3.</p> <p>→ <b>No</b> REPAIR or INSTALL new components as necessary. ROAD TEST as necessary.</p>

100-04-17

Noise, Vibration and Harshness

100-04-17

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>C3: CHECK THE EXHAUST SYSTEM</b>	
	<p>1 Carry out the exhaust system neutralizing procedure.</p> <ul style="list-style-type: none"> <li>Is the exhaust system OK?</li> </ul> <p>→ <b>Yes</b> GO to C4.</p> <p>→ <b>No</b> REPAIR as necessary. ROAD TEST as necessary.</p>
<b>C4: CHECK THE POWERTRAIN/DRIVETRAIN MOUNTS</b>	
	<p>1 Carry out the powertrain/drivetrain mount neutralizing procedure</p> <ul style="list-style-type: none"> <li>Are the powertrain/drivetrain mounts OK?</li> </ul> <p>→ <b>Yes</b> Vehicle condition corrected. ROAD TEST as necessary.</p> <p>→ <b>No</b> INSTALL new powertrain/drivetrain mounts as necessary. ROAD TEST as necessary.</p>

## PINPOINT TEST D : WHEEL END VIBRATION ANALYSIS

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>D1: INSPECT THE WHEELS AND TIRES</b>	
	<p>1 Inspect the wheels and tires.</p> <p>REFER to: <b>Wheels and Tires</b> (204-04 Wheels and Tires, Diagnosis and Testing).</p> <ul style="list-style-type: none"> <li>Are the wheels and tires OK?</li> </ul> <p>→ <b>Yes</b> <b>GO to D2.</b></p> <p>→ <b>No</b> INSTALL new wheels or tires as necessary. REFER to: <b>Wheel and Tire</b> (204-04 Wheels and Tires, Removal and Installation). ROAD TEST as necessary.</p>

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>D2: INSPECT THE WHEEL BEARINGS</b>	
	<p>1 Inspect the wheel bearings.</p> <ul style="list-style-type: none"> <li>Are the wheel bearings OK?</li> </ul> <p>→ <b>Yes</b> GO to D3.</p> <p>→ <b>No</b> INSTALL new wheel bearings as necessary. REFER to: <b>Front Wheel Bearing</b> (204-01 Front Suspension, Removal and Installation). ROAD TEST as necessary.</p>
<b>D3: INSPECT THE WHEEL AND TIRE RUNOUT</b>	
	<p>1 Inspect the wheel and tire runout.</p> <ul style="list-style-type: none"> <li>Is the wheel and tire runout OK?</li> </ul> <p>→ <b>Yes</b> Balance the wheels and tires. Refer to the wheel balance equipment manufacturer's instructions. ROAD TEST as necessary.</p> <p>→ <b>No</b> INSTALL new wheels or tires as necessary. REFER to: <b>Wheel and Tire</b> (204-04 Wheels and Tires, Removal and Installation). ROAD TEST as necessary.</p>

## PINPOINT TEST E : NON-AXLE NOISE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>E1: INSPECT THE VEHICLE TRIM</b>	
	<p>1 Check the radiator grille and trim panels to see if they are the source of the noise.</p> <ul style="list-style-type: none"> <li>Are the vehicle trim components causing the noise?</li> </ul> <p>→ <b>Yes</b> INSTALL new trim components or REPAIR as necessary. ROAD TEST as necessary.</p> <p>→ <b>No</b> GO to E2.</p>
<b>E2: CHECK THE AIR CONDITIONING (A/C) SYSTEM FOR NOISE</b>	
	<p>1 Ignition switch in position III.</p> <p>2 Ignition switch in position II.</p>

100-04-19

Noise, Vibration and Harshness

100-04-19

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
	<p>3 Check the A/C system components for noise by turning the A/C system on and off.</p> <ul style="list-style-type: none"> <li>• Is the A/C system causing the noise?</li> </ul> <p>→ <b>Yes</b> INSPECT the A/C system. REFER to: <b>Climate Control System</b> (412-00 Climate Control System - General Information, Diagnosis and Testing). ROAD TEST as necessary.</p> <p>→ <b>No</b> GO to E3.</p>
<b>E3: CHECK NON-FACTORY FITTED ACCESSORIES</b>	
	<p>1 Check any non-factory installed accessories for being the source of the noise. For example: touch condition body-to-frame, antennas, deflectors and fog lights.</p> <ul style="list-style-type: none"> <li>• Are the accessories the cause of the noise?</li> </ul> <p>→ <b>Yes</b> ADJUST, REPAIR, or INSTALL new accessories or fasteners as required. ROAD TEST as necessary.</p> <p>→ <b>No</b> VERIFY the customer concern.</p>

## GROUP

## 2

## Chassis

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SECTION TITLE	PAGE
<b>Suspension</b>	
Suspension System - General Information.....	204-00
Front Suspension.....	204-01
Rear Suspension.....	204-02
Wheels and Tires.....	204-04
<b>Driveline</b>	
Driveshaft.....	205-01
Rear Drive Axle/Differential.....	205-02
Front Drive Halfshafts.....	205-04
Rear Drive Halfshafts.....	205-05
<b>Brake System</b>	
Brake System - General Information.....	206-00
Front Disc Brake.....	206-03
Rear Disc Brake.....	206-04
Parking Brake and Actuation.....	206-05
Hydraulic Brake Actuation.....	206-06
Power Brake Actuation.....	206-07
Anti-Lock Control.....	206-09A
Anti-Lock Control - Stability Assist.....	206-09B
<b>Steering System</b>	
Steering System - General Information.....	211-00
Power Steering.....	211-02
Steering Linkage.....	211-03
Steering Column.....	211-04
Steering Column Switches.....	211-05

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## SECTION 204-00 Suspension System - General Information

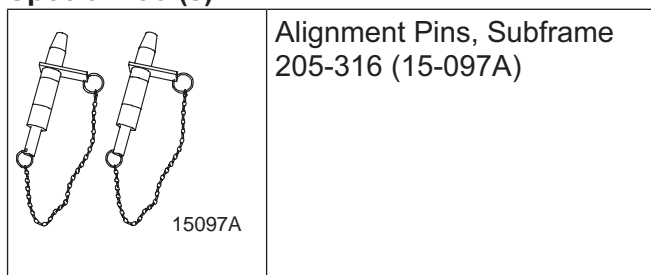
VEHICLE APPLICATION: **2008.50 Kuga**

CONTENTS	PAGE
<b>DIAGNOSIS AND TESTING</b>	
Suspension System.....	204-00-2
Inspection and Verification.....	204-00-2
Symptom Chart.....	204-00-2
Pinpoint Tests.....	204-00-5
Component Tests.....	204-00-12
<b>GENERAL PROCEDURES</b>	
Front Toe Adjustment.....	(14 117 3) 204-00-15
Rear Toe Adjustment.....	(15 211 3) 204-00-16

DIAGNOSIS AND TESTING

Suspension System

Special Tool(s)



Mechanical
Wheel knuckles
Tie-rod ends
Front suspension lower arm ball joints
Front suspension lower arm bushings
Front strut and spring assemblies
Front and rear stabilizer bar and connecting links
Rear springs
Rear shock absorbers
Rear suspension lower arms

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
Tire pressure(s)
Wheel and tires

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

Symptom Chart

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>• Drift left or right</li> </ul>	<ul style="list-style-type: none"> <li>• Vehicle attitude incorrect (front or rear / left or right is high or low).</li> </ul>	<ul style="list-style-type: none"> <li>• Vehicles without load levelling shock absorbers, CHECK for abnormal loading, spring sag or non-standard springs.</li> <li>• Vehicles with load levelling shock absorbers, GO to <b>Pinpoint Test C</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>• Steering gear or linkage worn or damaged.</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK the steering system. REFER to: <b>Steering System</b> (211-00 Steering System - General Information, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>• Brake system.</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK the brake system. REFER to: <b>Brake System</b> (206-00 Brake System - General Information, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>• Incorrect front crossmember alignment.</li> </ul>	<ul style="list-style-type: none"> <li>• Using the special tool, CHECK the front subframe alignment..</li> </ul>
	<ul style="list-style-type: none"> <li>• Worn front wheel bearings.</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK the wheel bearings.</li> </ul>
	<ul style="list-style-type: none"> <li>• Wheel and tires.</li> </ul>	<ul style="list-style-type: none"> <li>• GO to <b>Pinpoint Test A</b>.</li> </ul>

## REMOVAL AND INSTALLATION

## Condenser

## General Equipment

Cable Ties

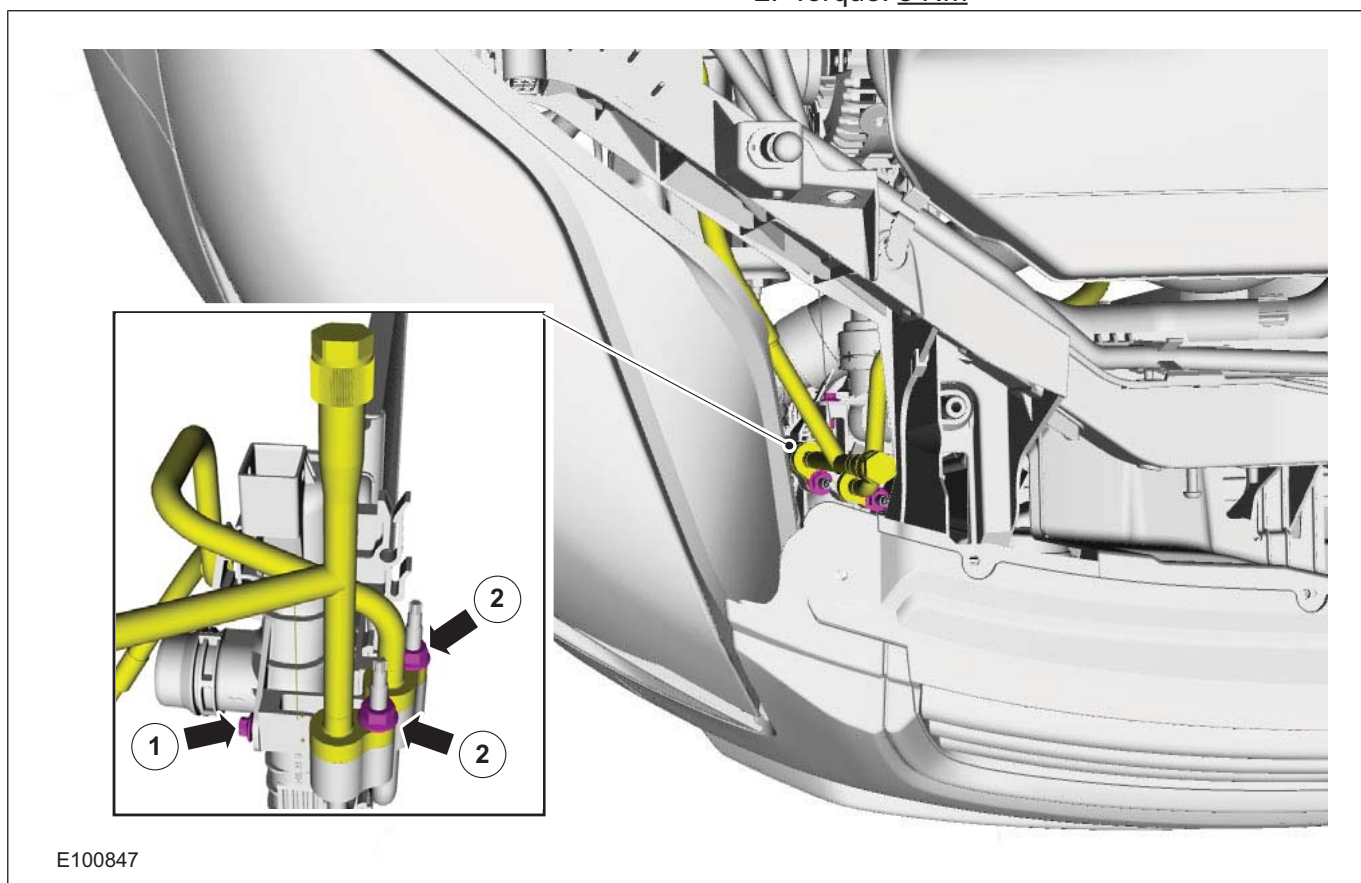
## Materials

Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

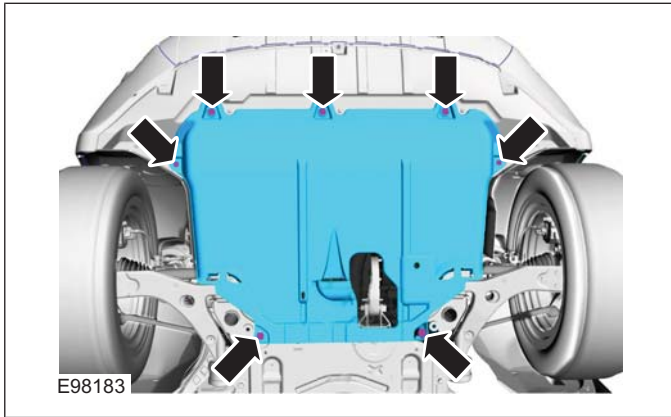
1. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).
2. **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.
  1. Torque: 5 Nm
  2. Torque: 8 Nm



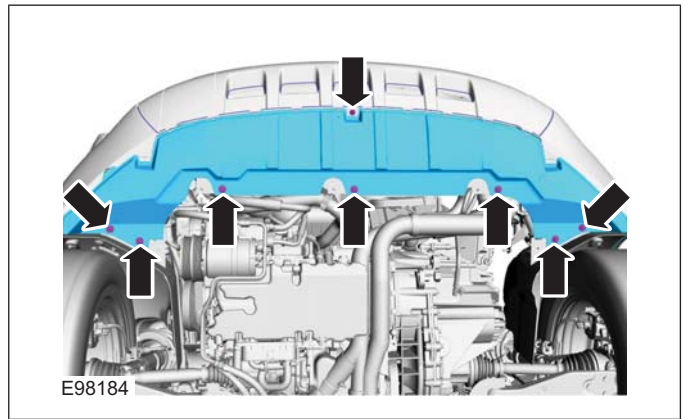
REMOVAL AND INSTALLATION

3. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

4.

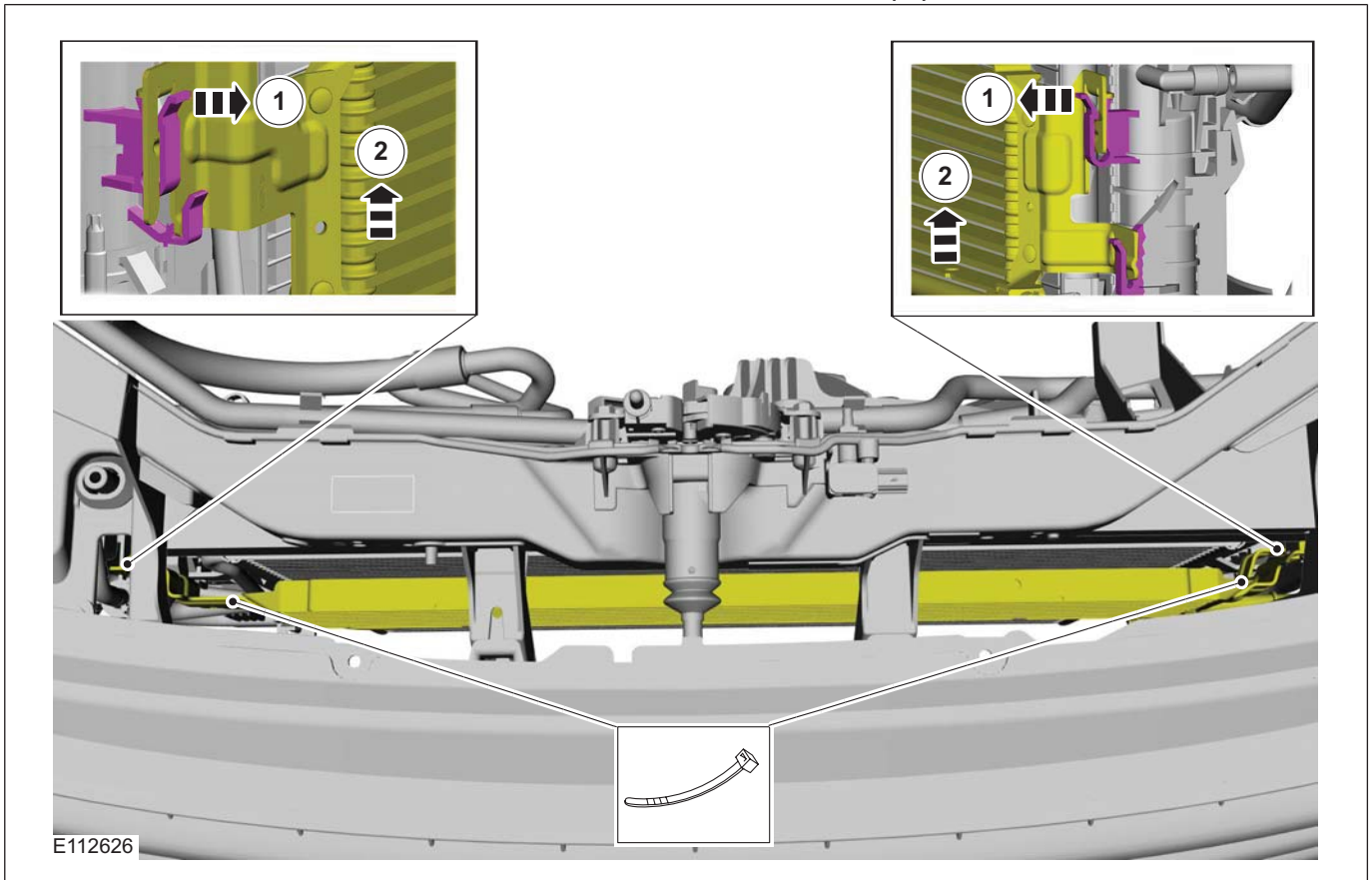


5.



Vehicles with automatic transmission

6. General Equipment: Cable Ties

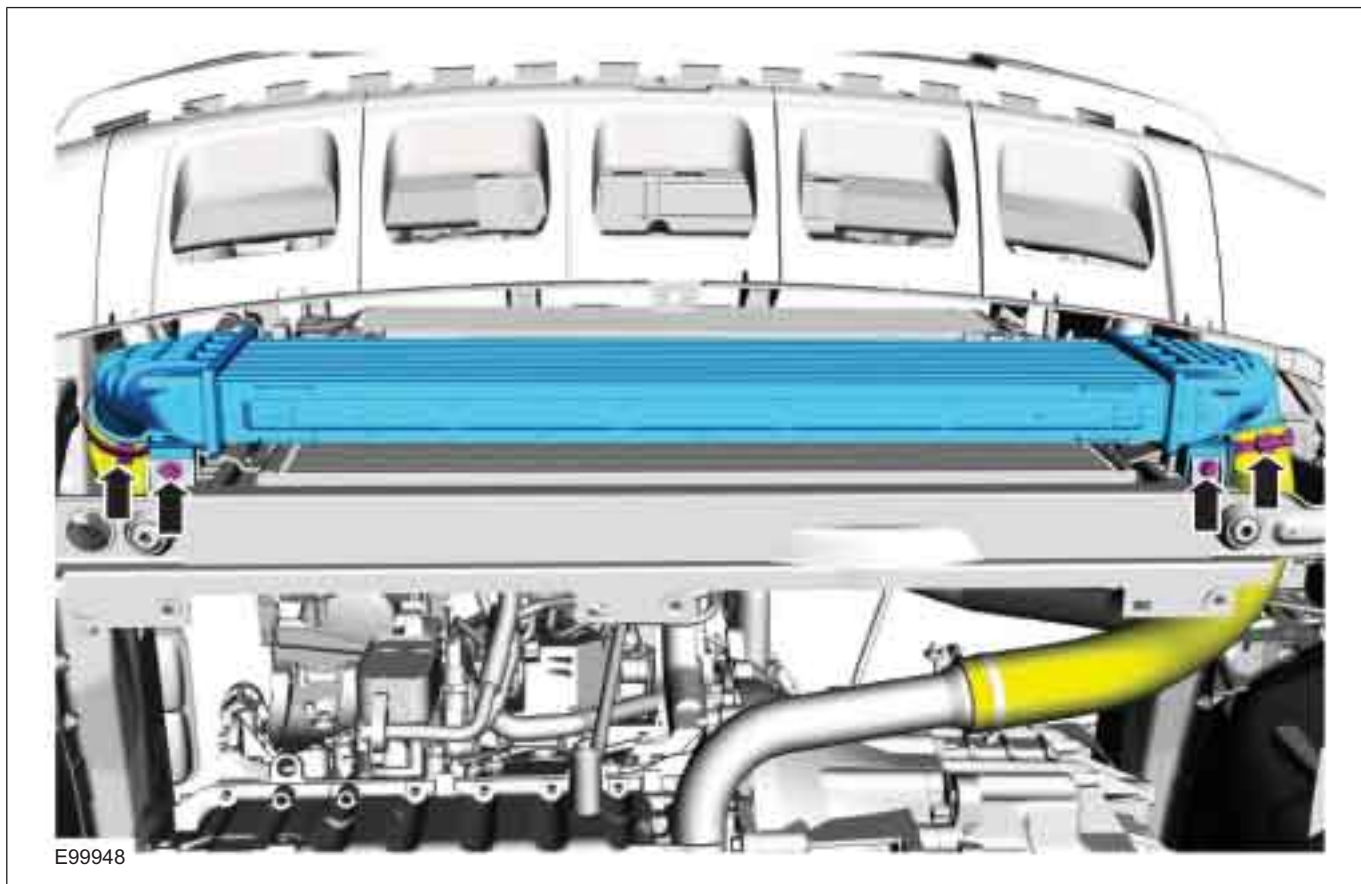


All vehicles

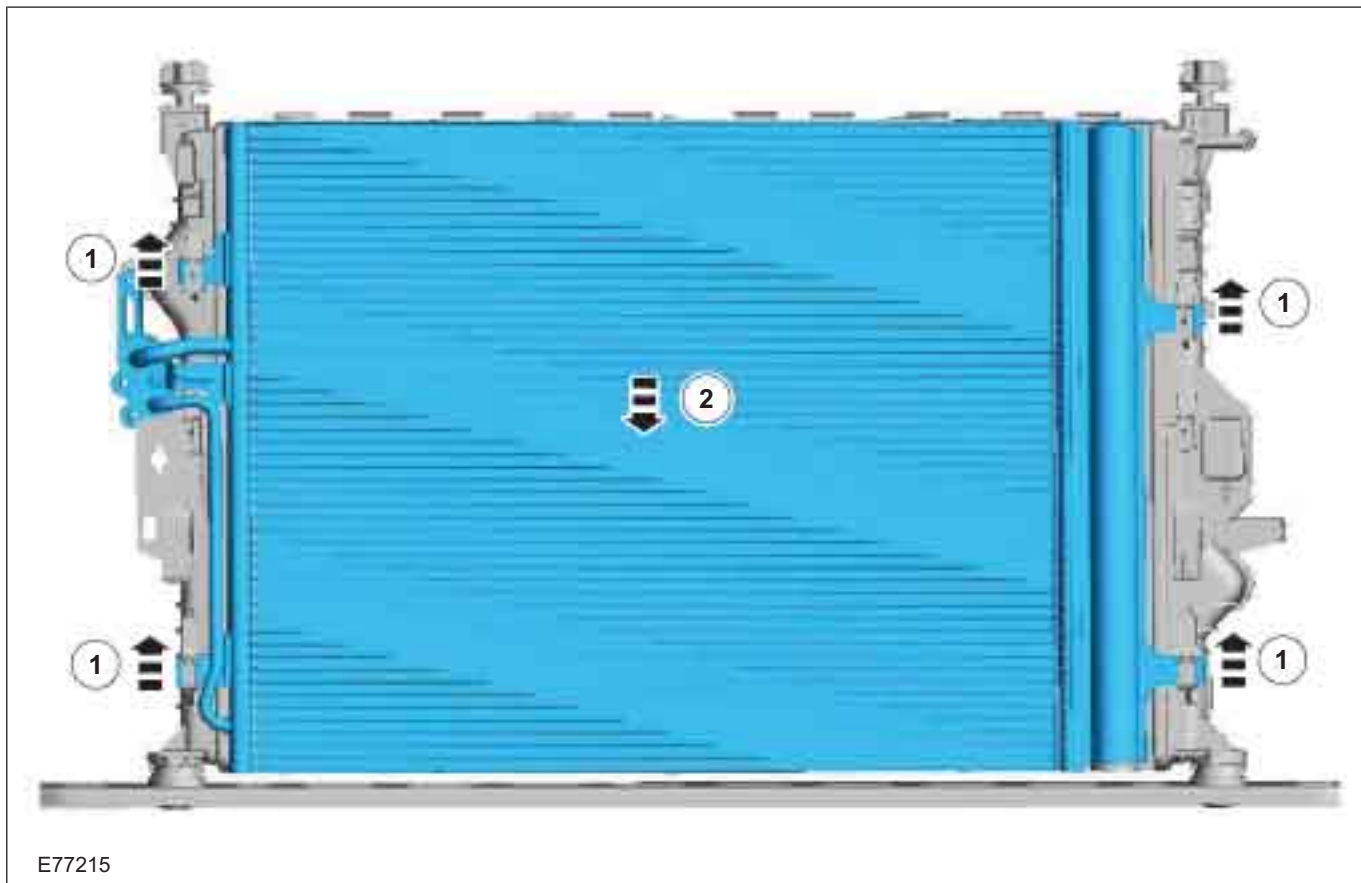
7. Torque: 5 Nm



REMOVAL AND INSTALLATION



8.



**REMOVAL AND INSTALLATION**

## Installation

1. To install, reverse the removal procedure.
2. Coat the O-ring seals on the refrigerant lines.

Material: Compressor Oil - Air Conditioning  
(WSH-M1C231-B / 6U7J-M1C231-AA)  
refrigerant oil



412-01-35

Climate Control

412-01-35

## REMOVAL AND INSTALLATION

## Clutch and Clutch Field Coil

## General Equipment

Puller

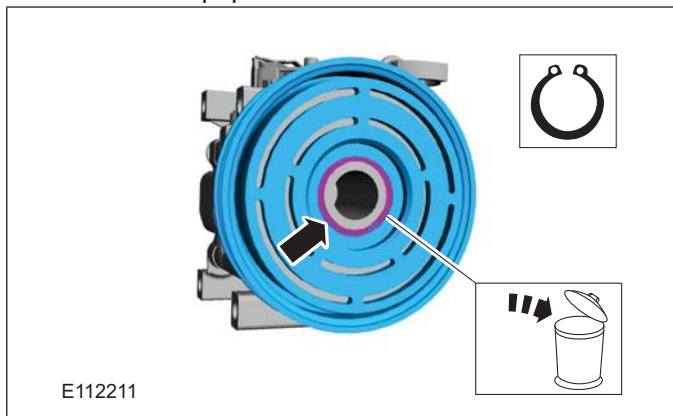
## Removal

1. Refer to: **Air Conditioning (A/C) Compressor - 2.5L Duratec (147kW/200PS) - VI5** (412-01 Climate Control, Removal and Installation).

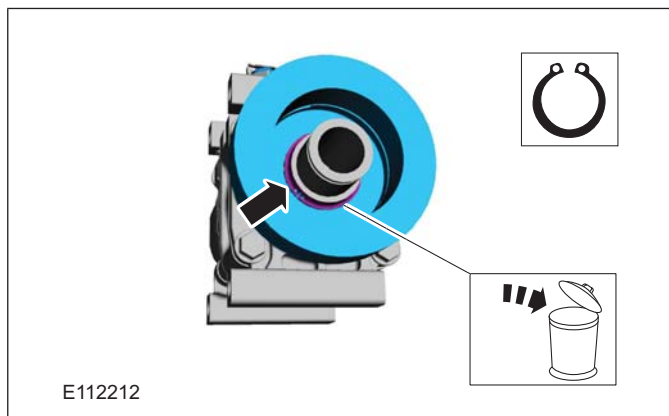
2. Torque: 13 Nm



3. General Equipment: Puller



4. **NOTE:** Note the position of the component before removal.



## Installation

1. **NOTE:** Make sure that the component is installed to the position noted before removal. To install, reverse the removal procedure.
2. Refer to: **Air Conditioning (A/C) Clutch Air Gap Adjustment** (412-00 Climate Control System - General Information, General Procedures).

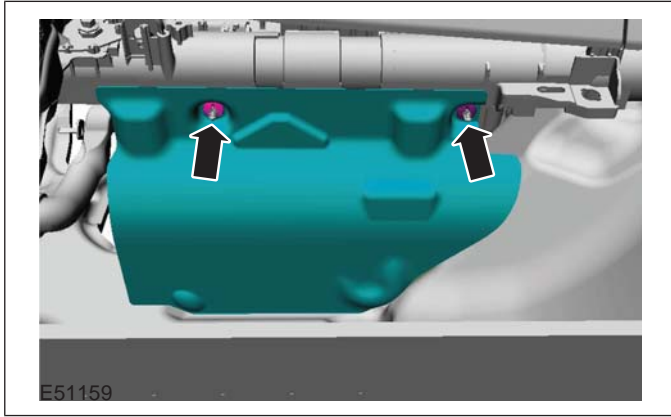


REMOVAL AND INSTALLATION

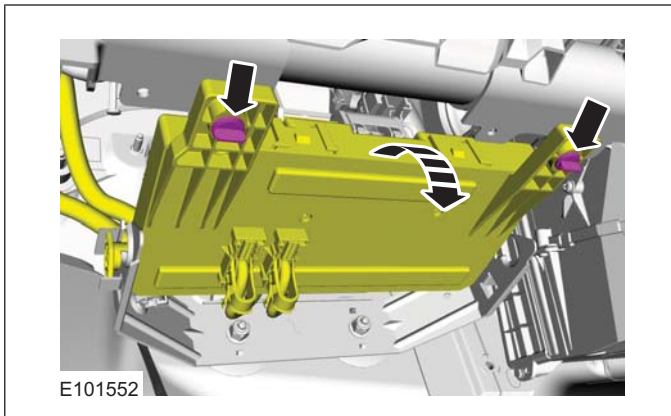
Pollen Filter — RHD

Removal

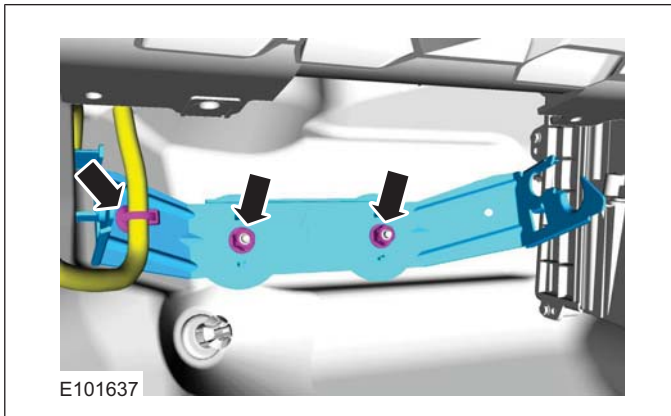
1.



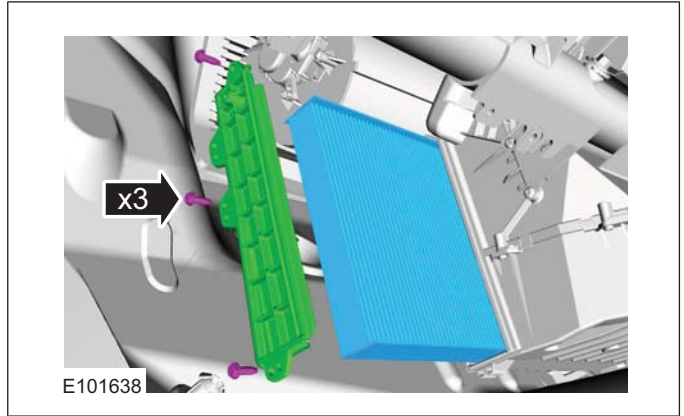
2.



3.



4.



Installation

1. To install, reverse the removal procedure.

412-01-37

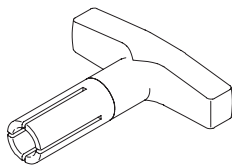
Climate Control

412-01-37

## REMOVAL AND INSTALLATION

## Blower Motor — RHD(34 374 0)

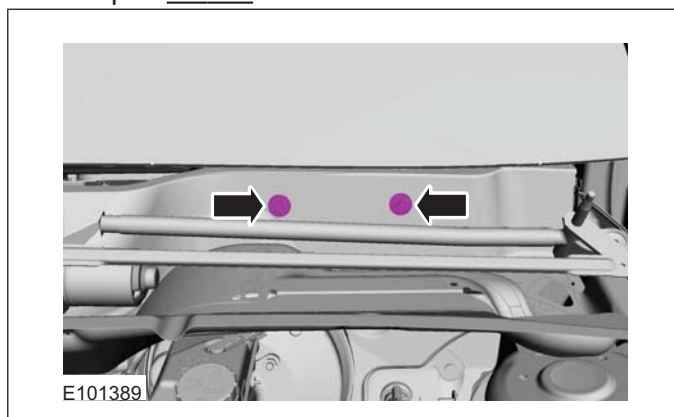
## Special Tool(s)

 <p>E42948</p>	<p>412-131 Remover/Installer, Blower Engine</p>
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## Removal

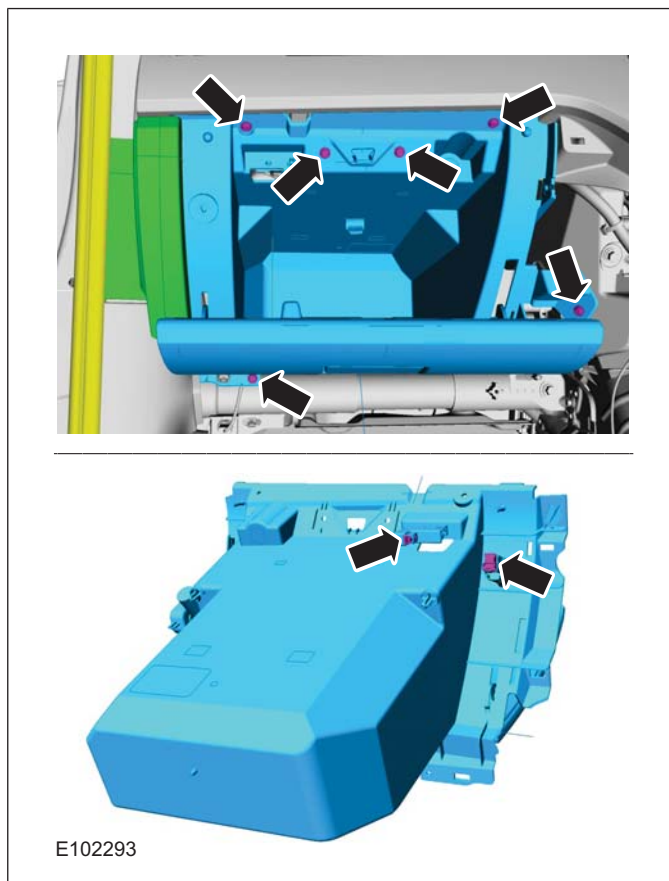
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
2. Torque: 25 Nm



3. Refer to: **Steering Column** (211-04 Steering Column, Removal and Installation).
4. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).

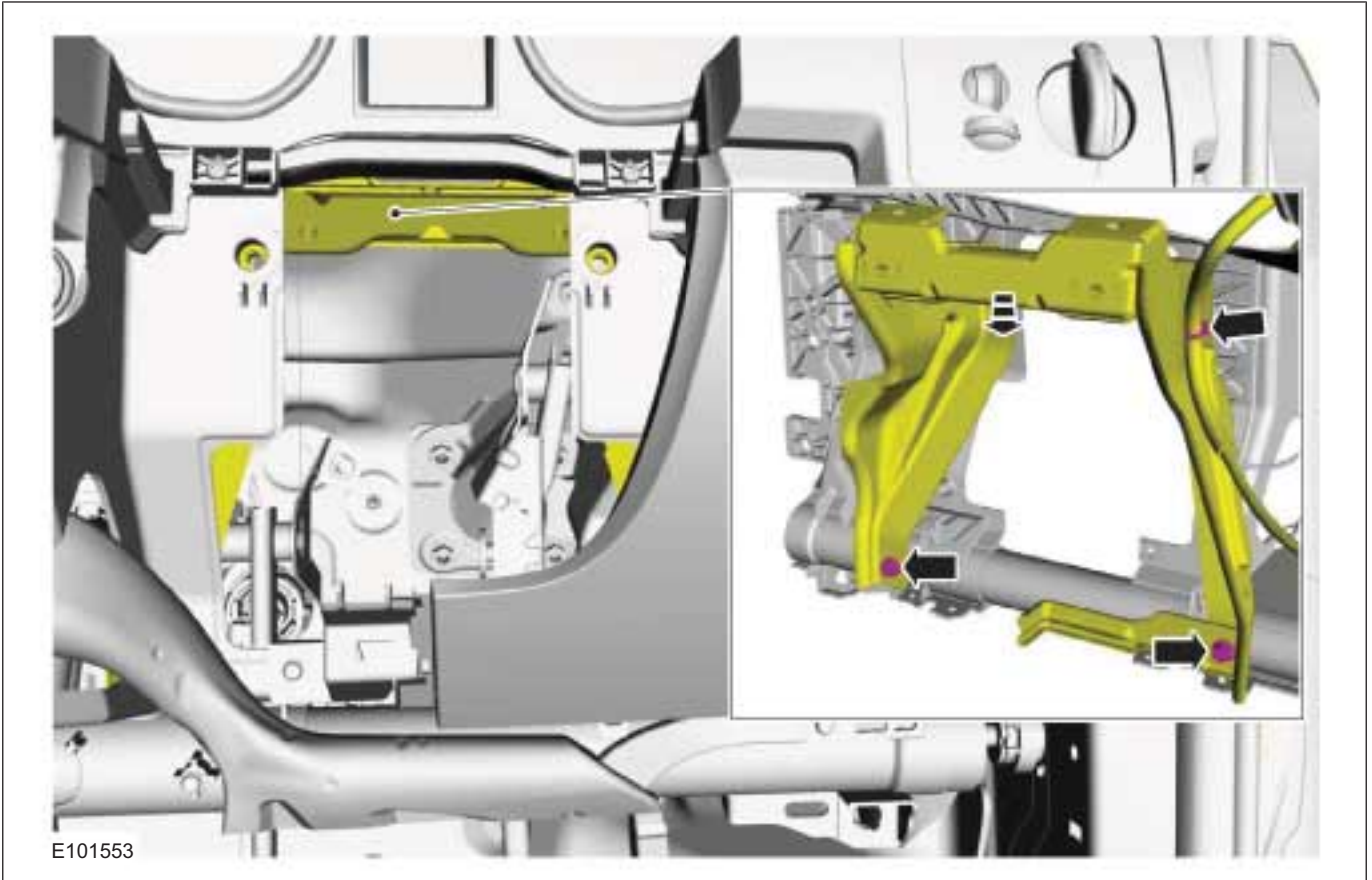
5.



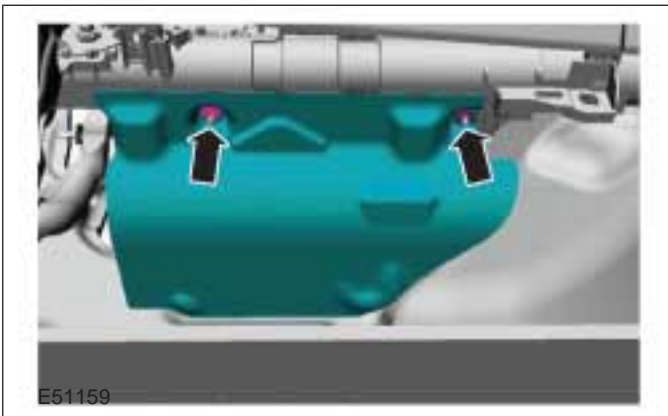
6. Torque: 25 Nm



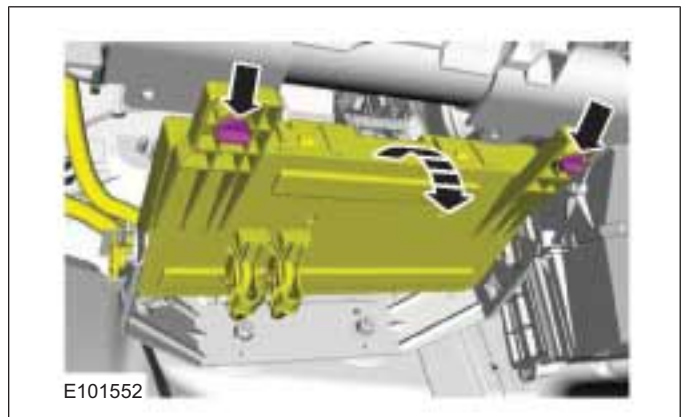
REMOVAL AND INSTALLATION



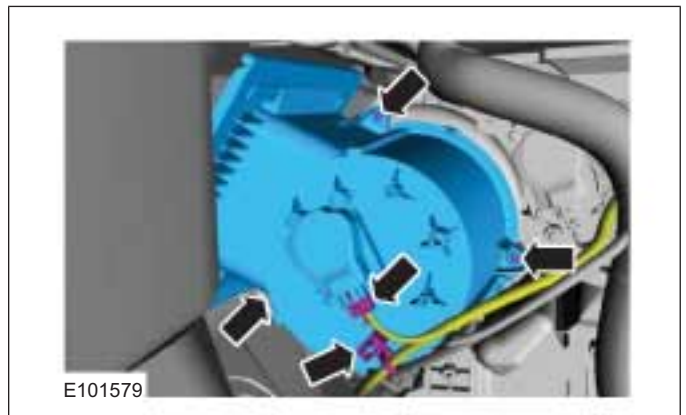
7.



8.



9.



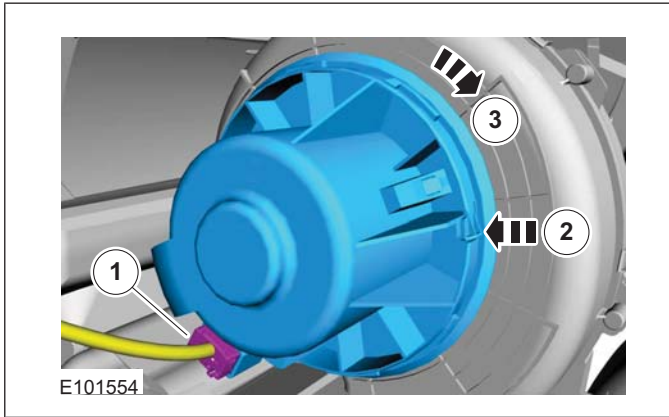
412-01-39

Climate Control

412-01-39

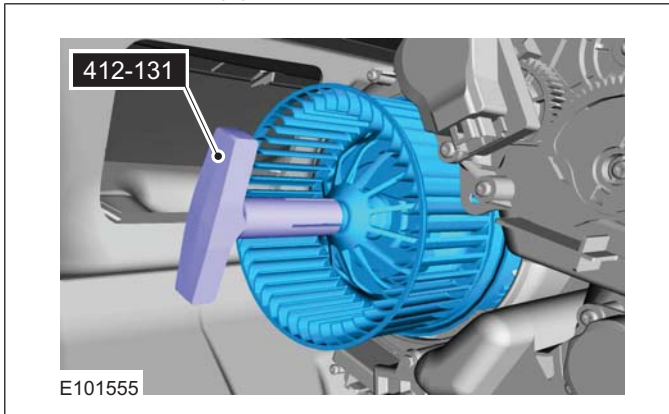
## REMOVAL AND INSTALLATION

10.



11. **CAUTION:** Make sure that the blower motor and fan assembly is placed on the bench with the fan pointing upwards.

Special Tool(s): 412-131



## Installation

1. **NOTE:** The component can only be installed in 1 position.

To install, reverse the removal procedure.

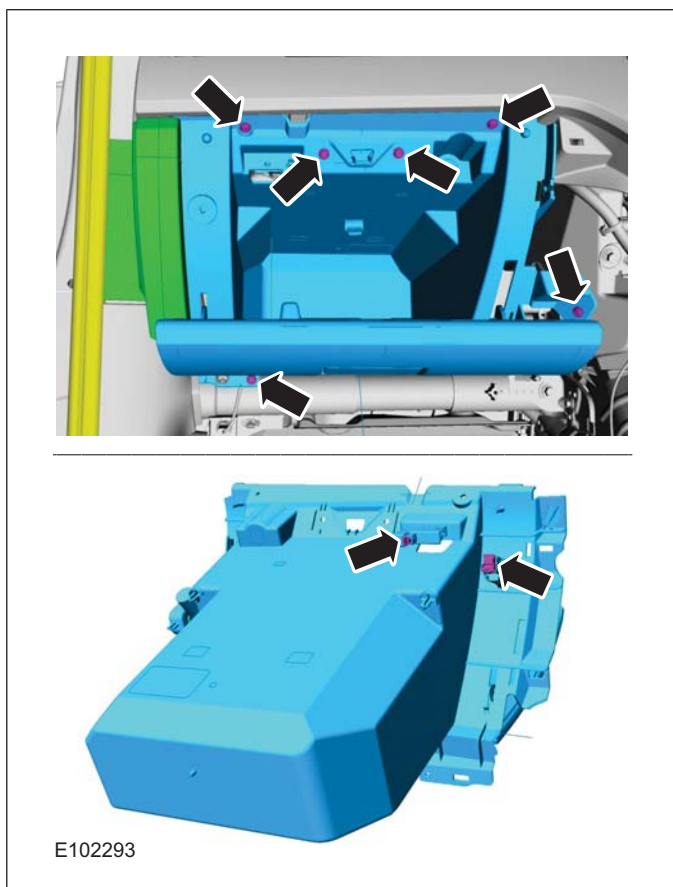


## REMOVAL AND INSTALLATION

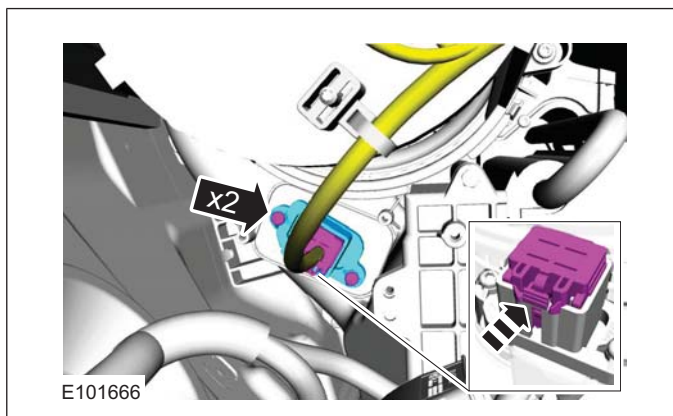
## Blower Motor Resistor — Vehicles With: Manual Temperature Control, RHD(34 382 0)

## Removal

1. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).
- 2.



## 3.



## Installation

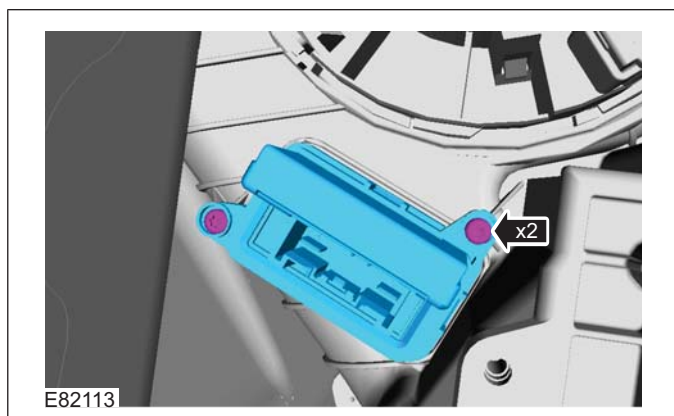
1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

Blower Motor Resistor — Vehicles With: Dual Automatic  
Temperature Control(34 382 0)

## Removal

1. Refer to: **In-Vehicle Crossbeam** (501-12 Instrument Panel and Console, Removal and Installation).
- 2.



## Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

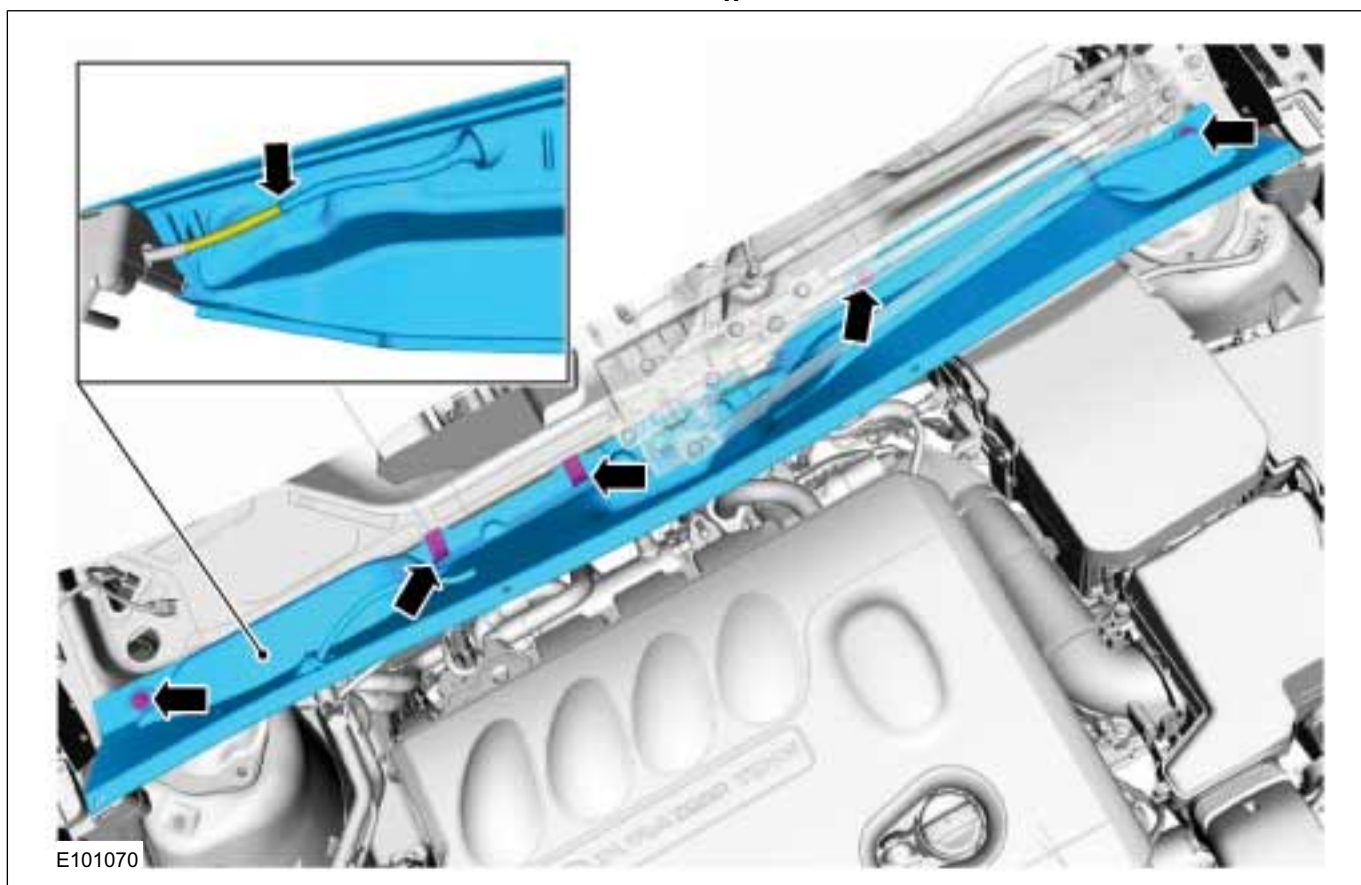
## Heater Core and Evaporator Core Housing

Materials	
Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).
2. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).
3. Refer to: **In-Vehicle Crossbeam** (501-12 Instrument Panel and Console, Removal and Installation).
- 4.



5. **CAUTION:** Make sure that all openings are sealed.

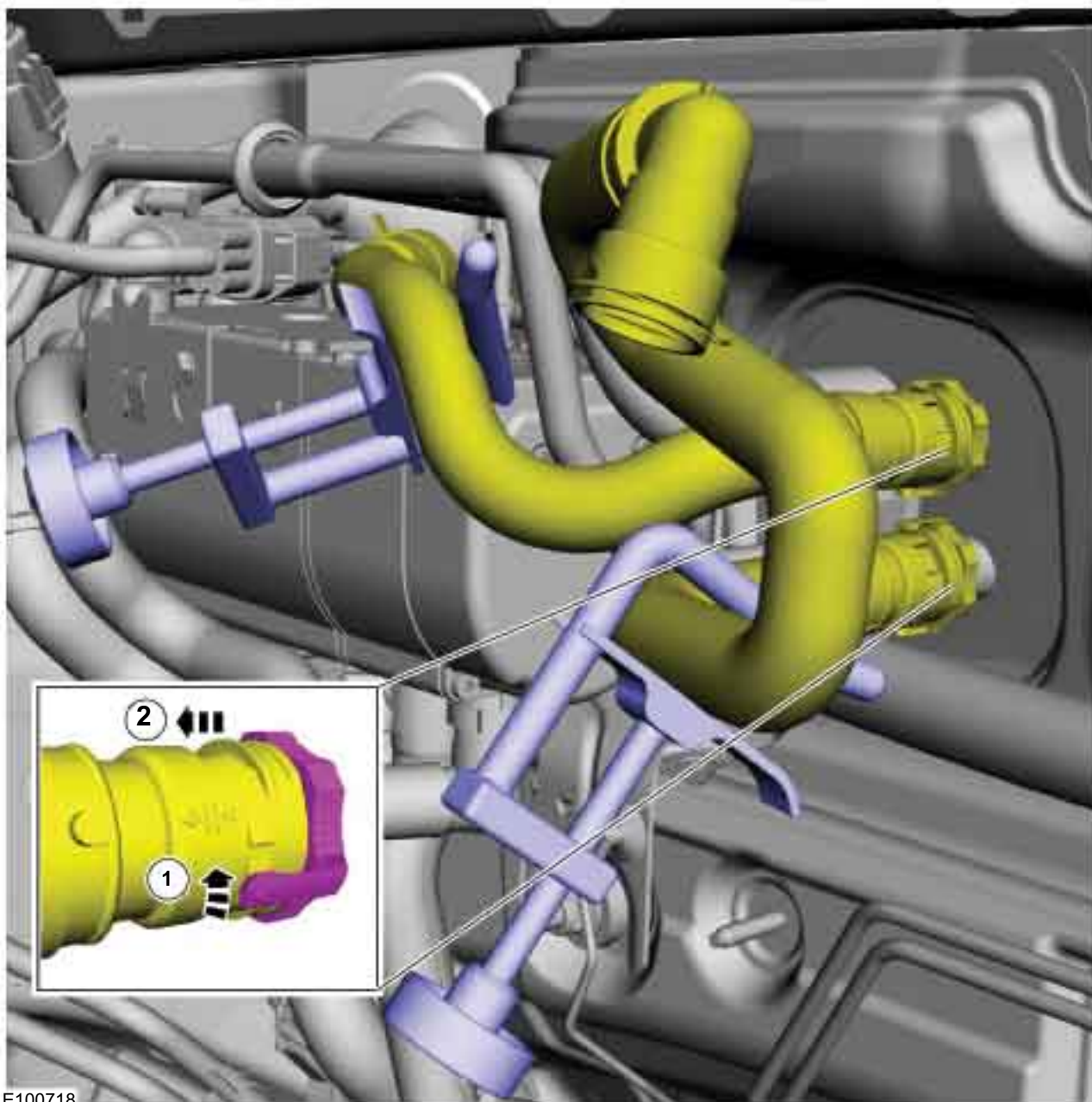


412-01-43

Climate Control

412-01-43

## REMOVAL AND INSTALLATION

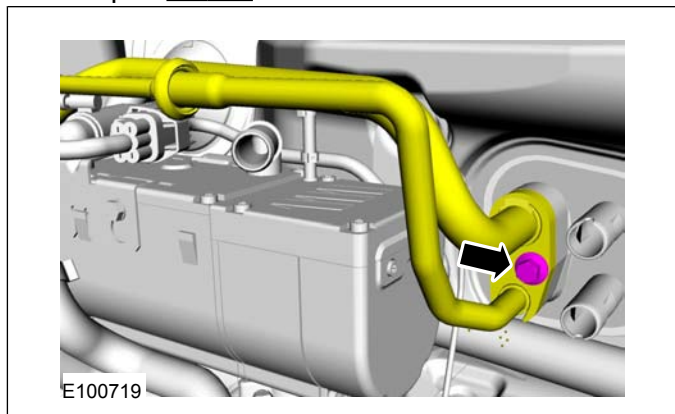


E100718

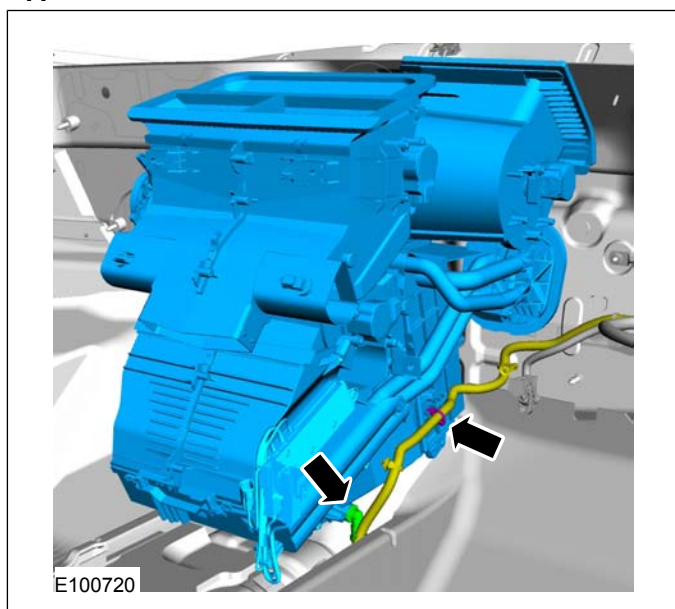
**REMOVAL AND INSTALLATION**

6.  **CAUTION:** Make sure that all openings are sealed.

Torque: 25 Nm



7.

**Installation**

1. To install, reverse the removal procedure.
2. Coat the O-ring seals on the refrigerant lines.

Material: Compressor Oil - Air Conditioning  
(WSH-M1C231-B / 6U7J-M1C231-AA)  
refrigerant oil

## REMOVAL AND INSTALLATION

## Heater Core — RHD(34 364 0)

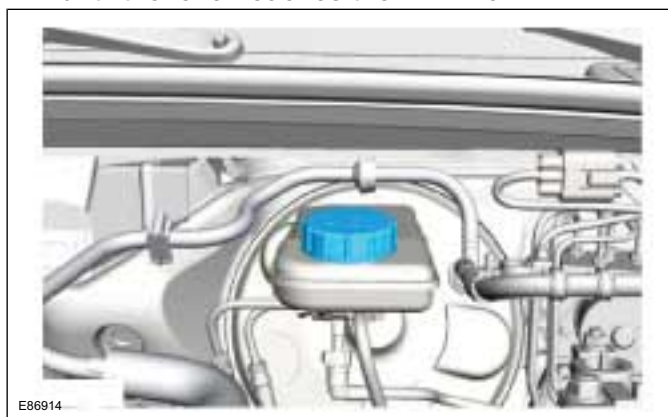
## General Equipment

Air Body Saw
Hose Clamp(s)

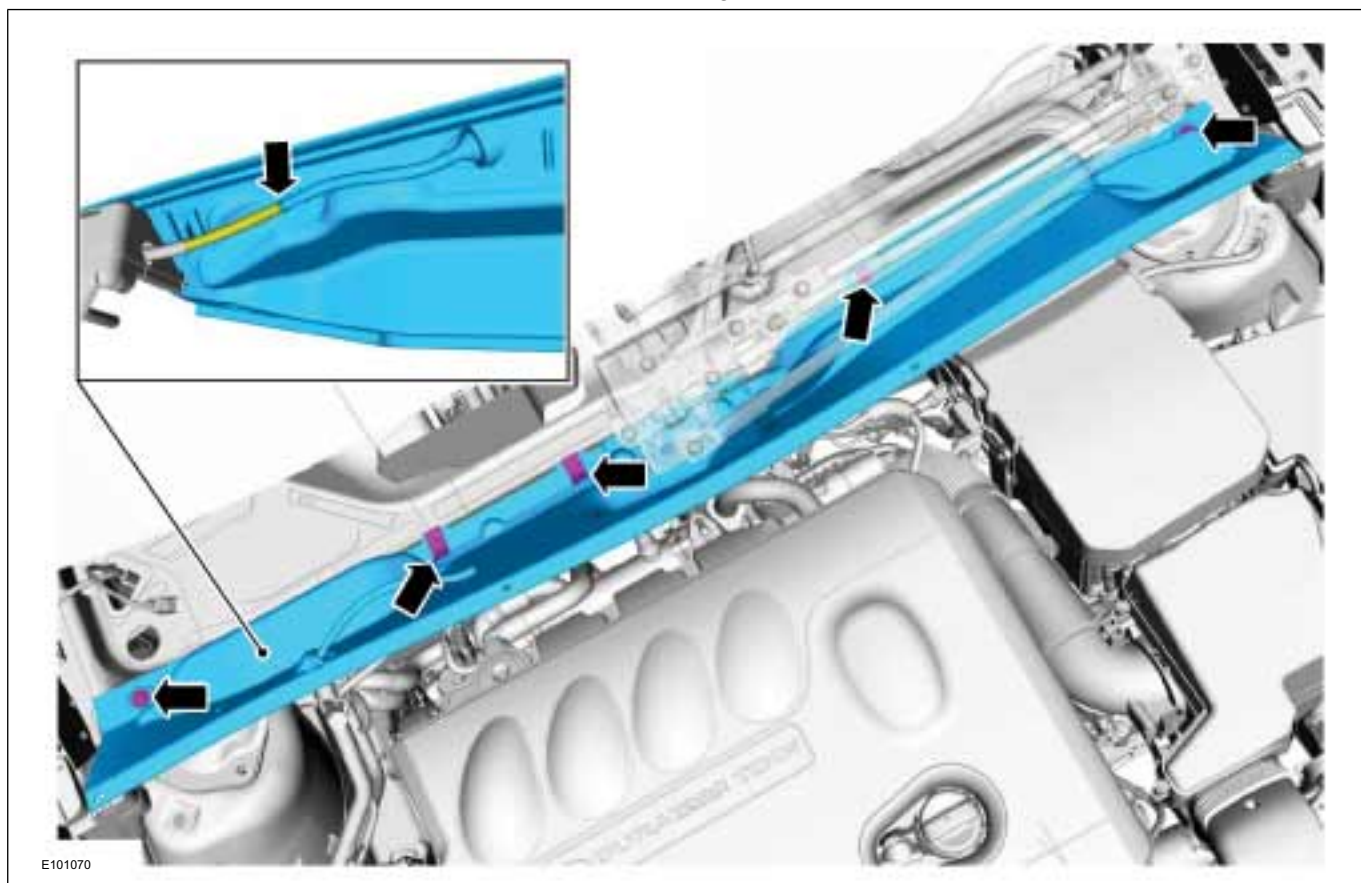
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Engine Cooling System Health and Safety Precautions** (100-00 General Information, Description and Operation).
3. Extract brake fluid from the brake fluid reservoir until the level reaches the MIN mark.



4. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
- 5.





412-01-46

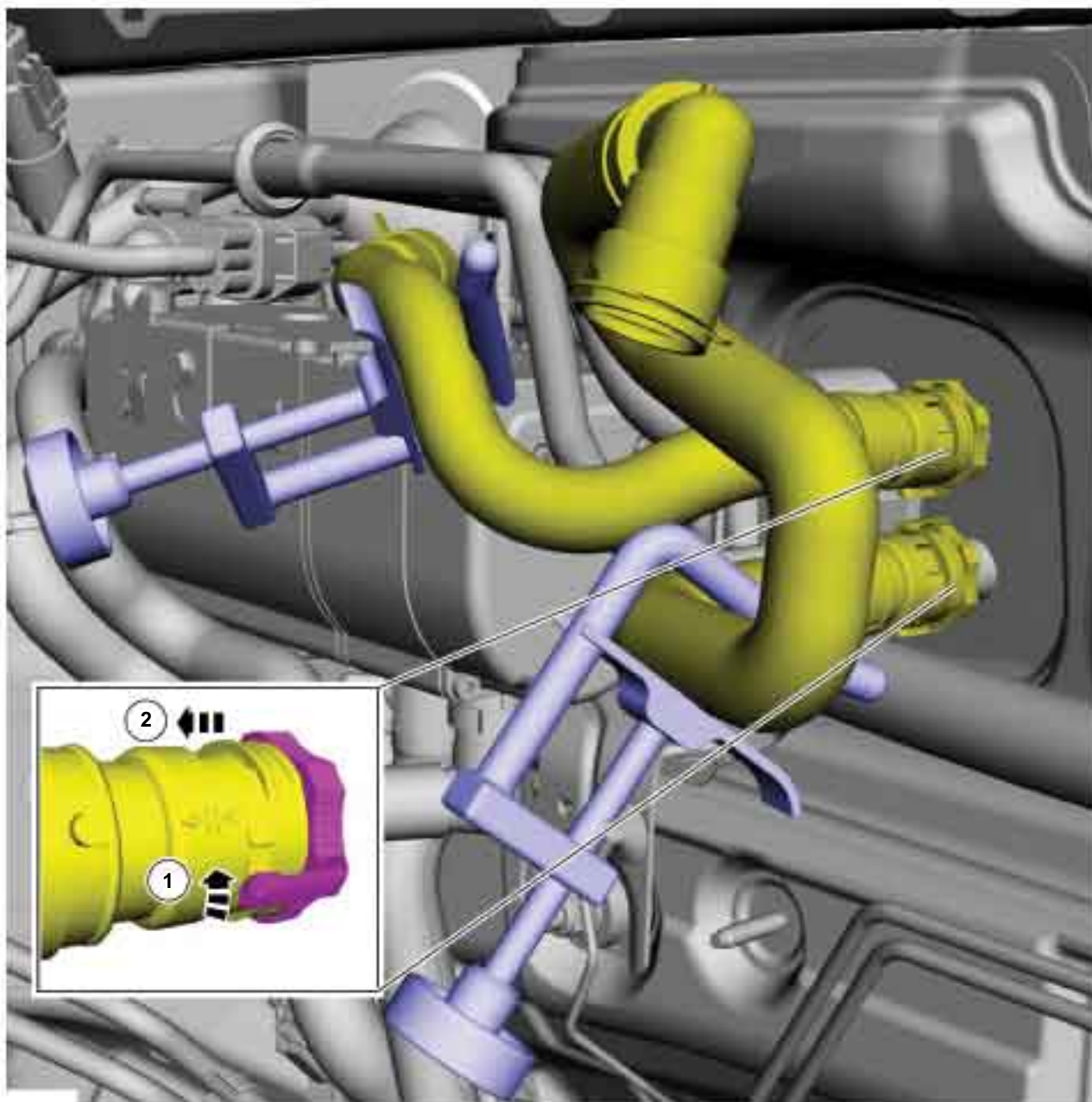
Climate Control

412-01-46

## REMOVAL AND INSTALLATION

6.  **CAUTION:** Make sure that all openings are sealed.

General Equipment: Hose Clamp(s)



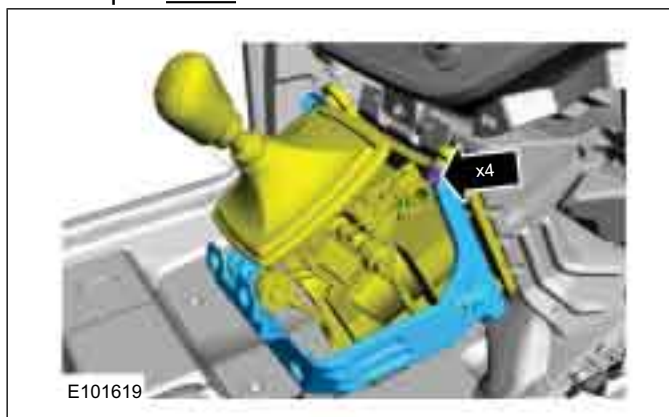
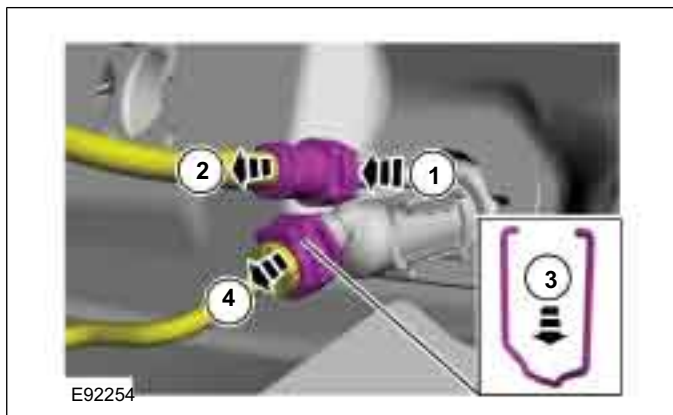
E100718

REMOVAL AND INSTALLATION

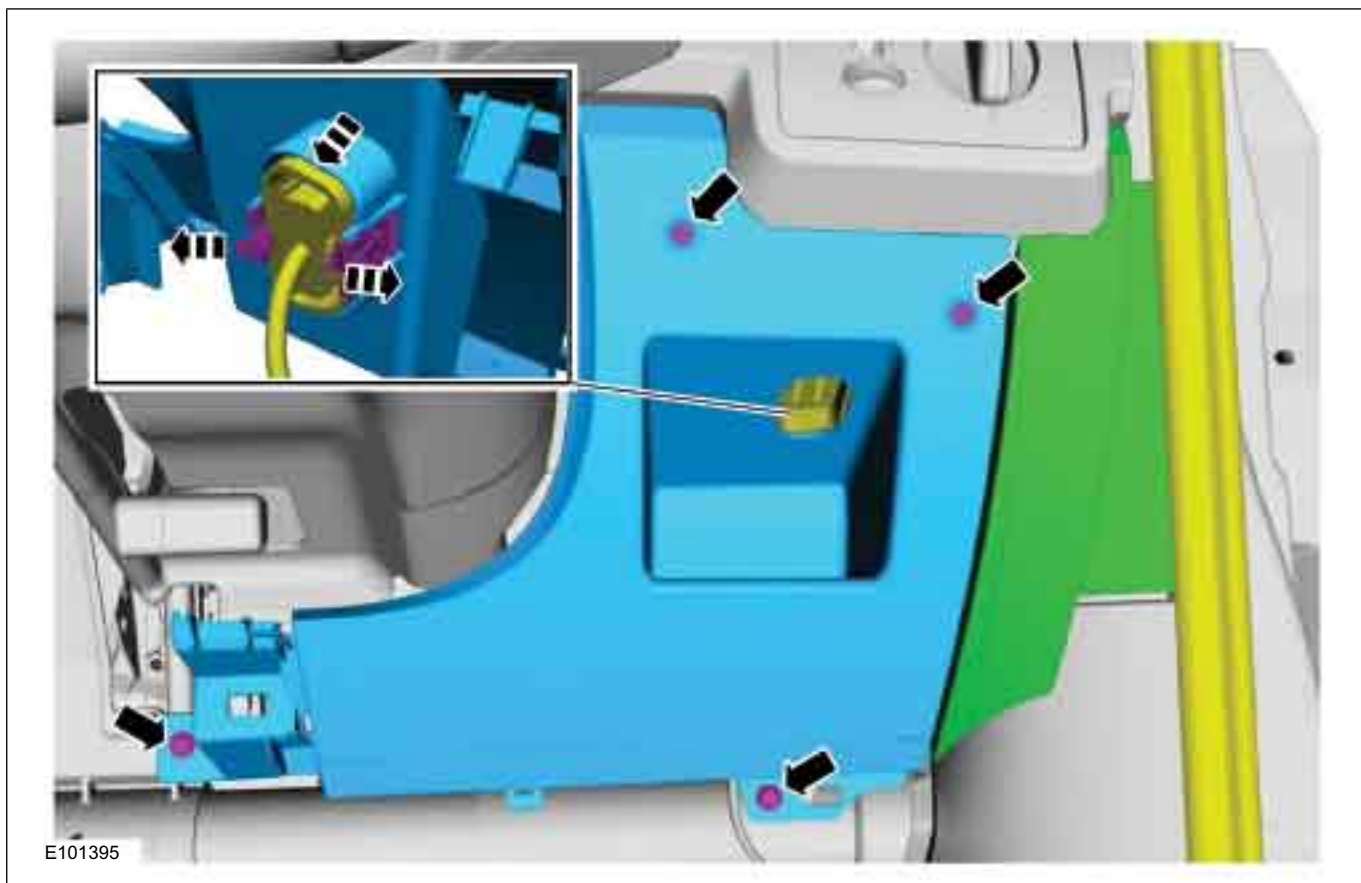
7.  **CAUTION:** Make sure that all openings are sealed.

8. Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation).

9. Torque: 9 Nm



10.

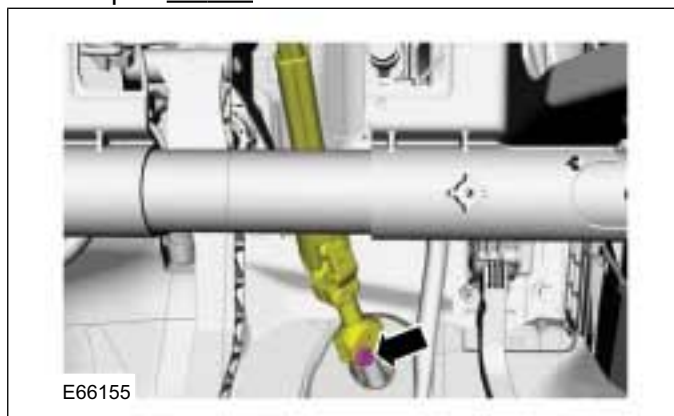
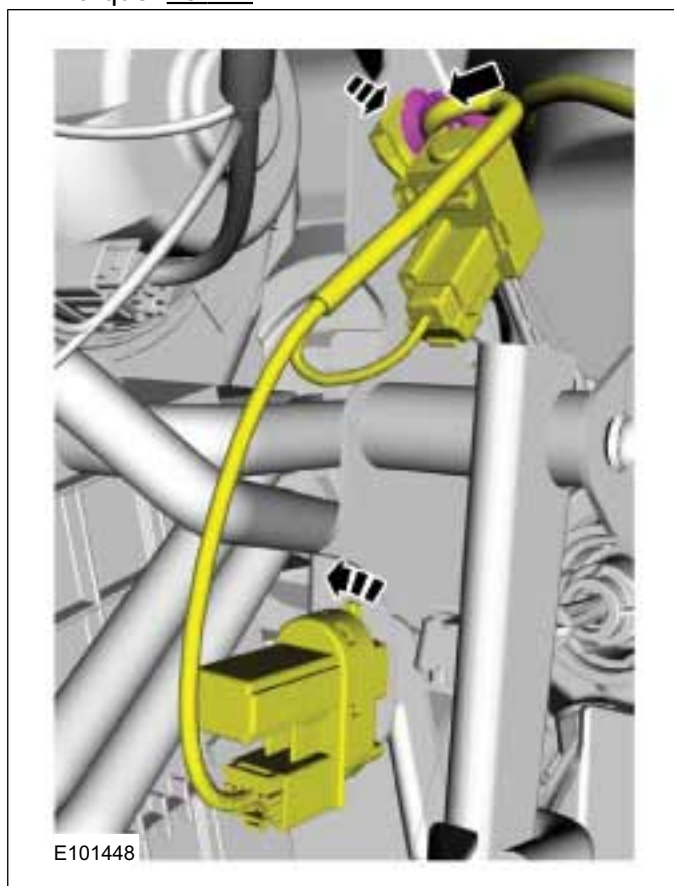
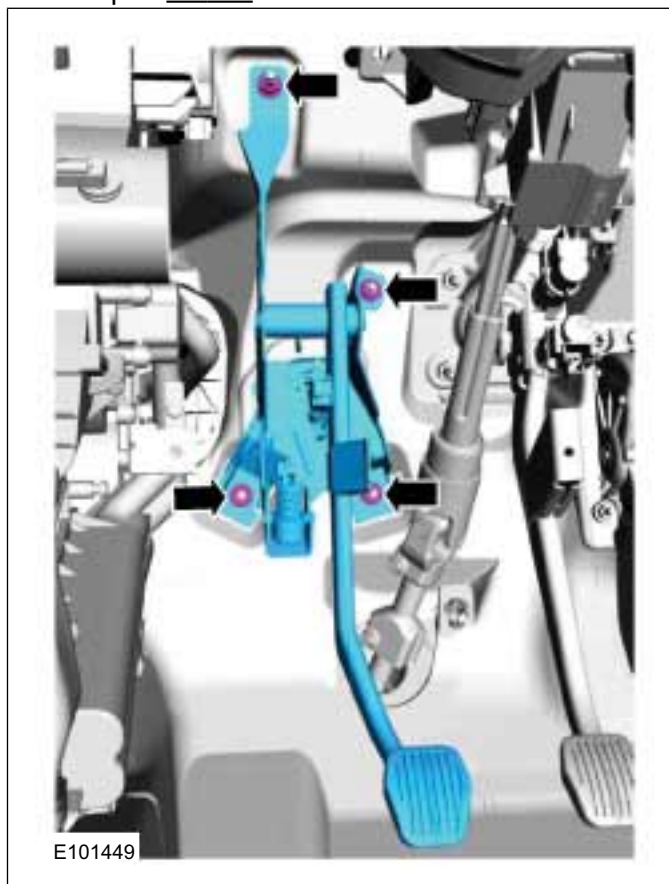


412-01-48

Climate Control

412-01-48

## REMOVAL AND INSTALLATION

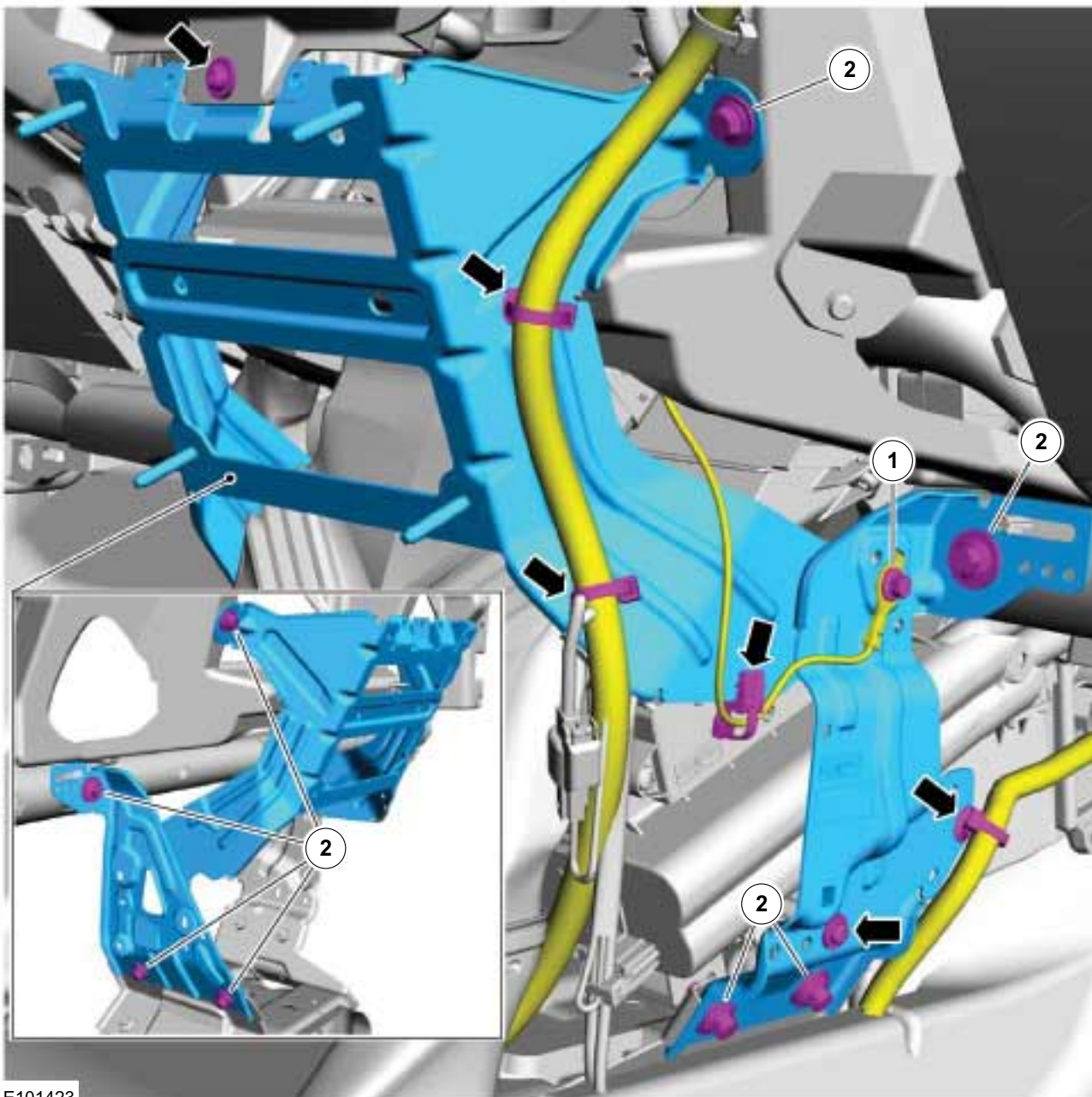
11. Torque: 28 Nm12. Torque: 28 Nm13. Torque: 25 Nm

14. Refer to: **Climate Control Assembly - Vehicles With: Manual Temperature Control** (412-01 Climate Control, Removal and Installation).  
Refer to: **Climate Control Assembly - Vehicles With: Automatic Temperature Control** (412-01 Climate Control, Removal and Installation).

15. 1. Torque: 10 Nm  
2. Torque: 25 Nm



REMOVAL AND INSTALLATION



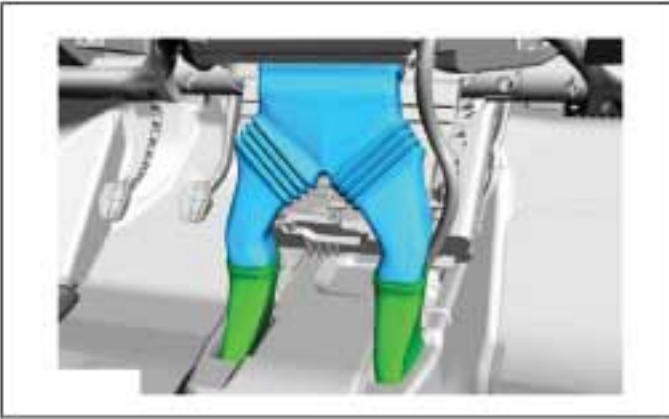
E101423



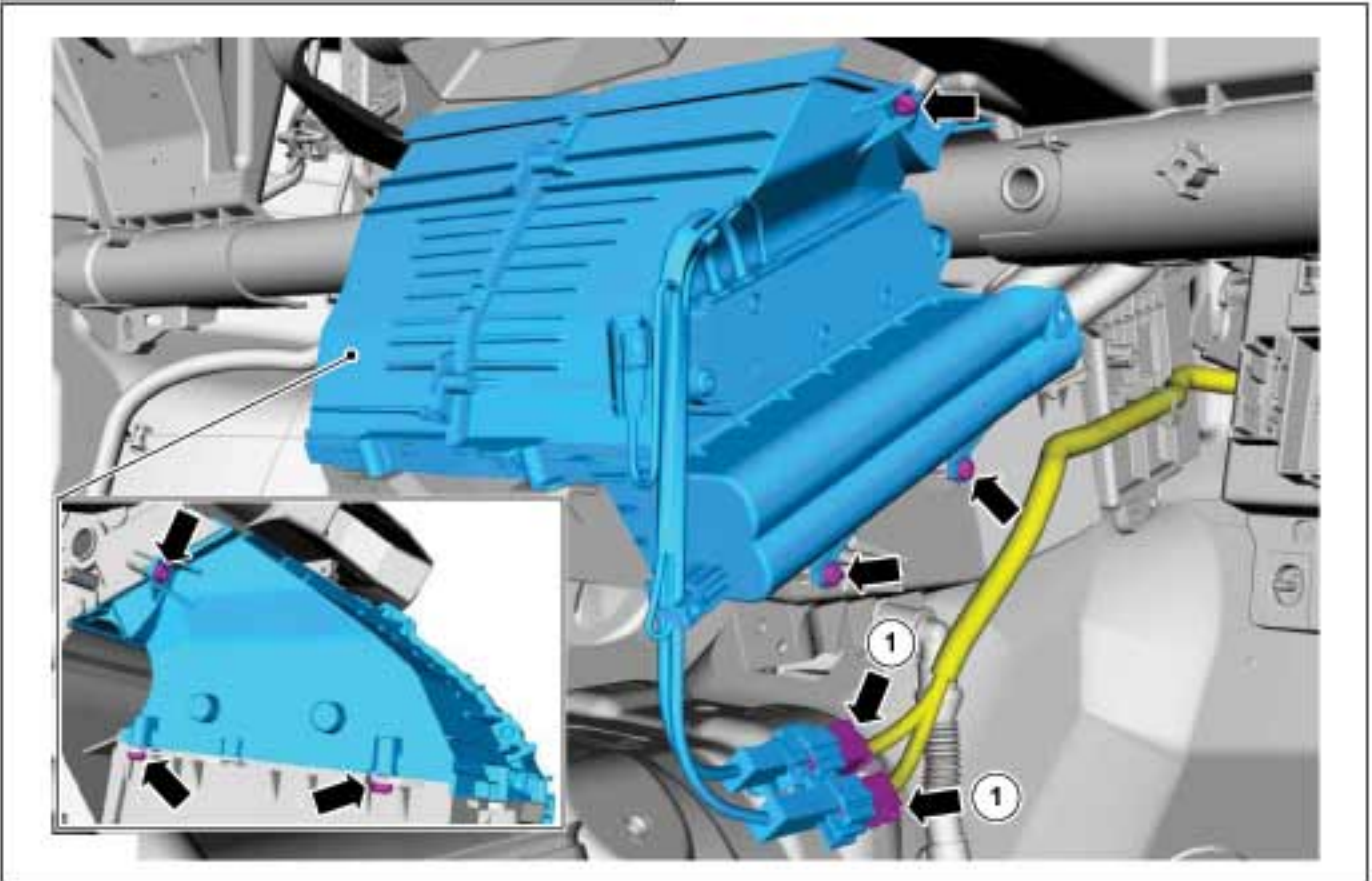


REMOVAL AND INSTALLATION

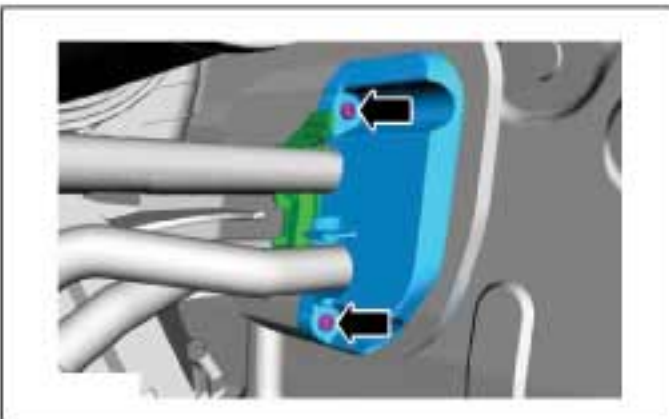
16.



17. 1. If equipped.



18.

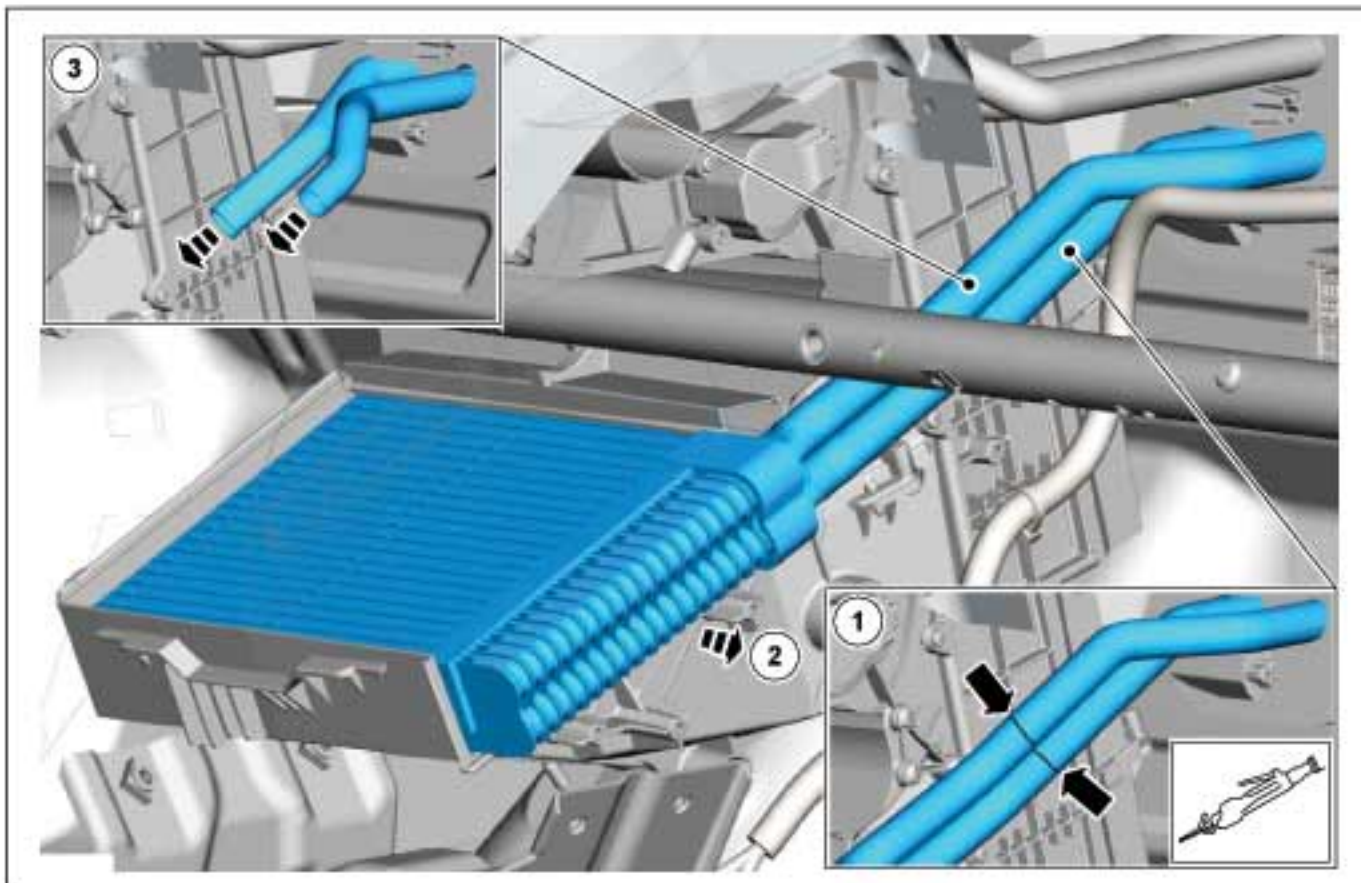


19. **WARNING:** Be prepared to collect escaping fluid.

General Equipment: Air Body Saw



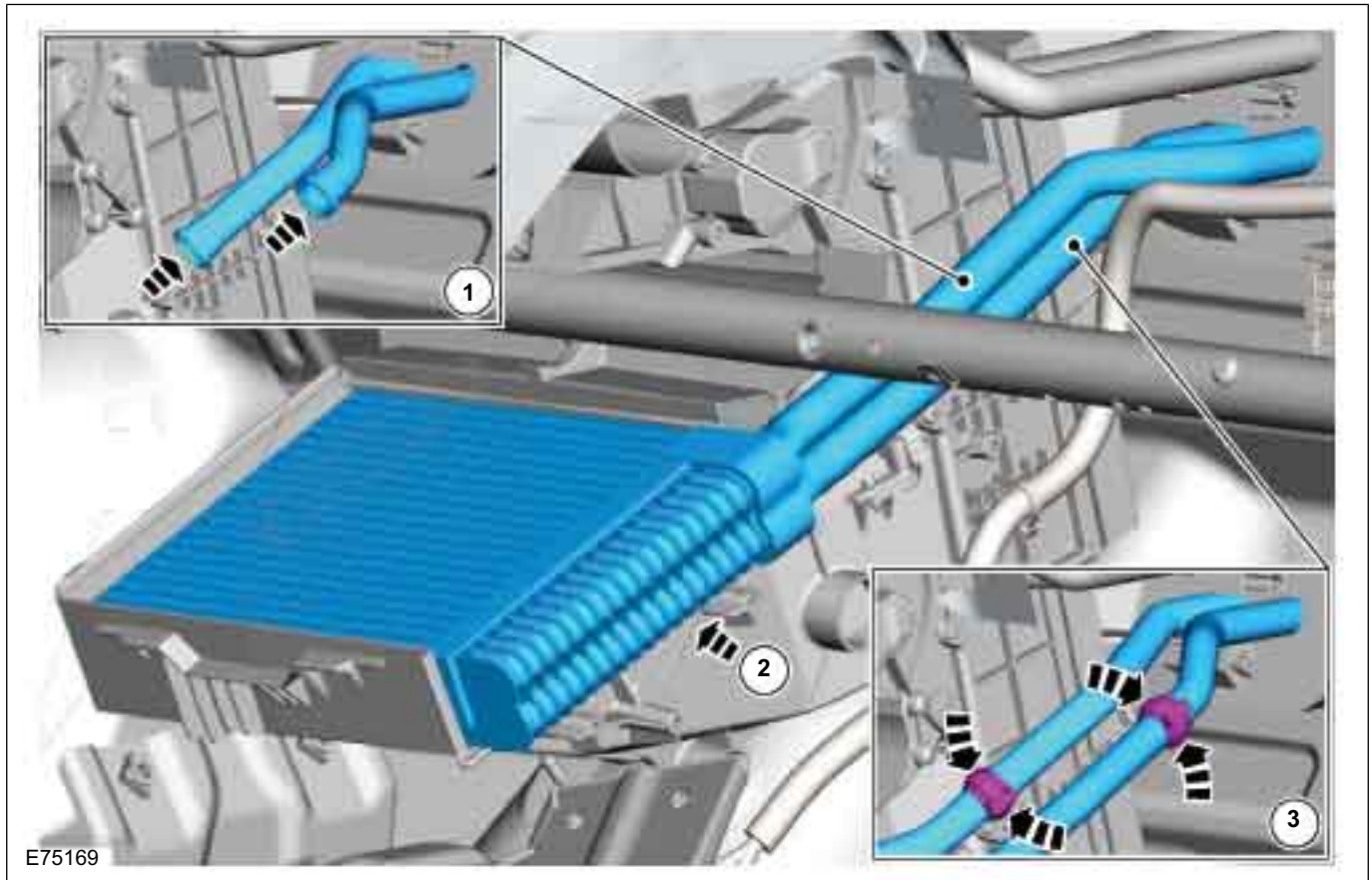
## REMOVAL AND INSTALLATION



## Installation

1.

## REMOVAL AND INSTALLATION



2. To install, reverse the removal procedure.
3. Check the coolant level.

Refer to: **Cooling System Draining and Vacuum Filling** (303-03 Engine Cooling, General Procedures).

## REMOVAL AND INSTALLATION

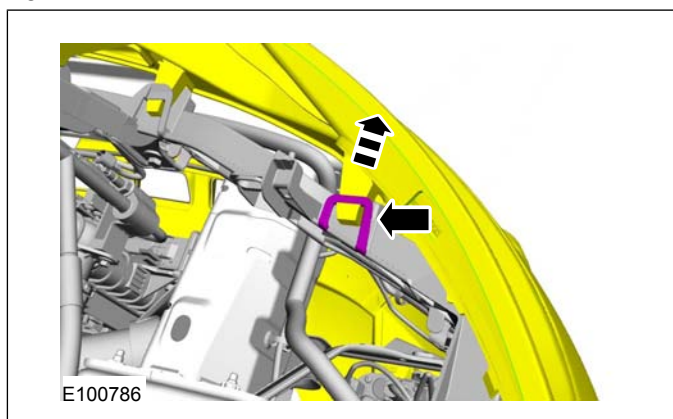
## Suction Accumulator

Materials	
Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

## Removal

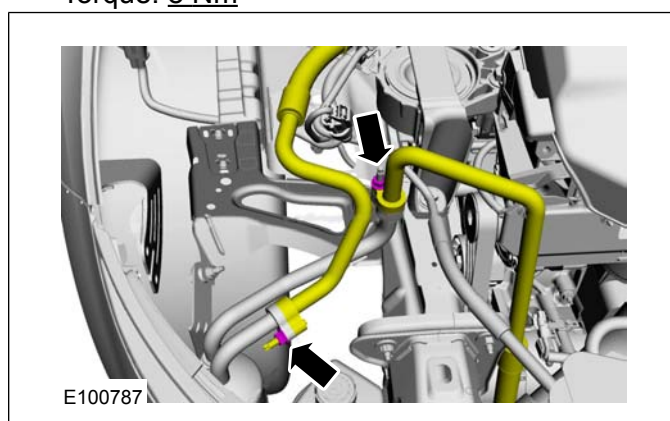
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).
2. Remove the right-hand headlamp.
- 3.



4. **CAUTION:** Make sure that all openings are sealed.

Torque: 8 Nm

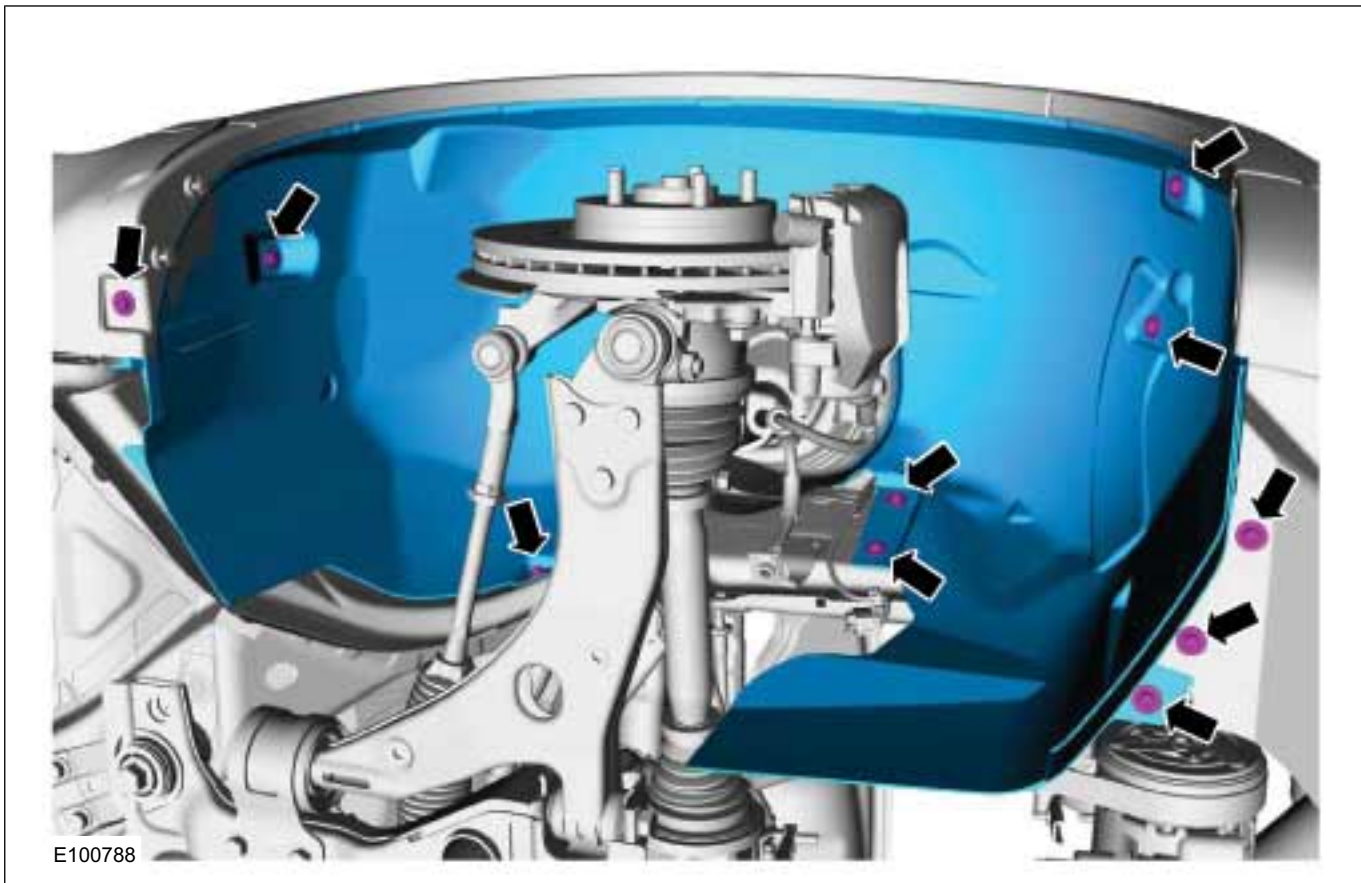


5. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
- 6.

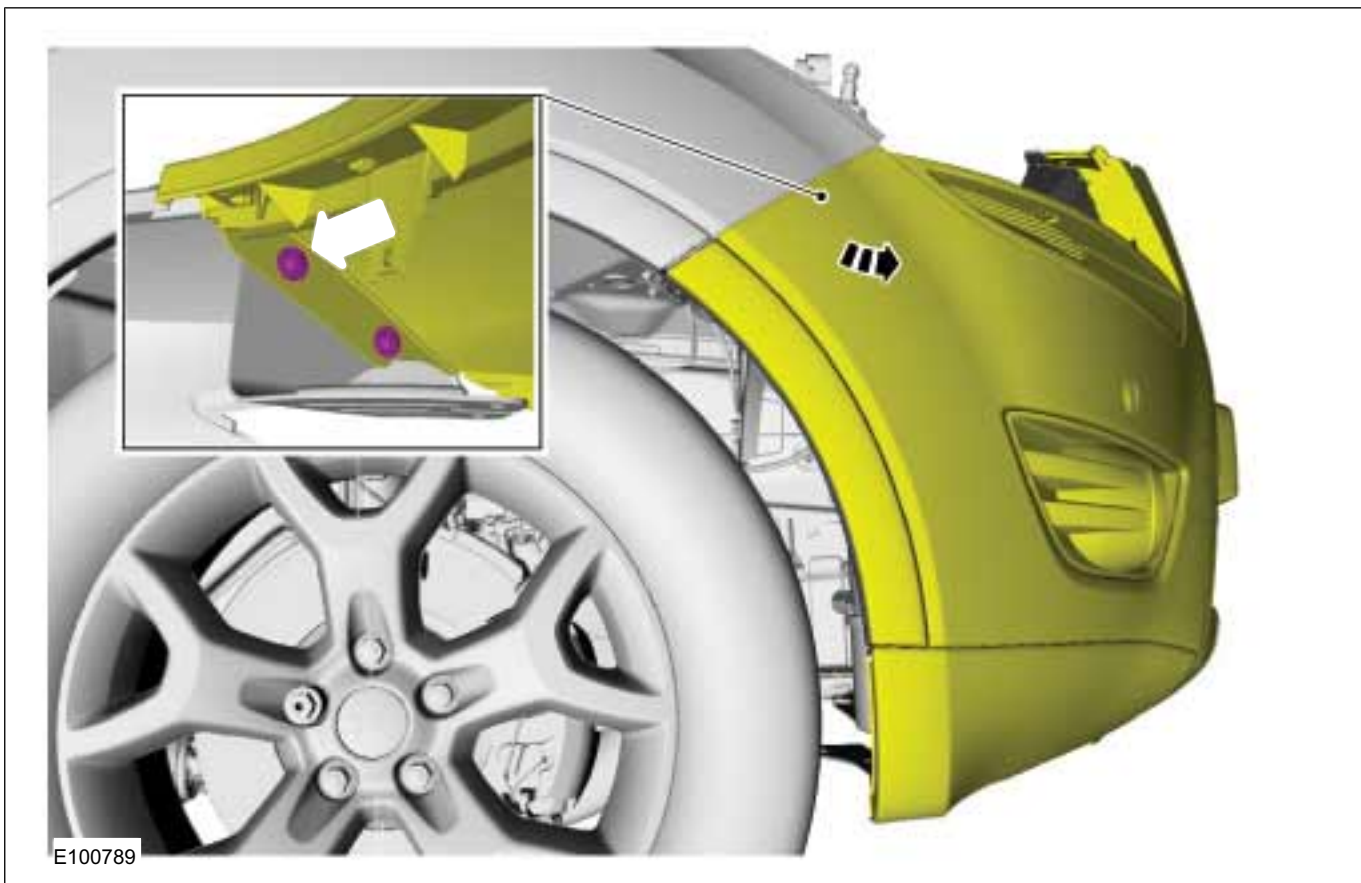


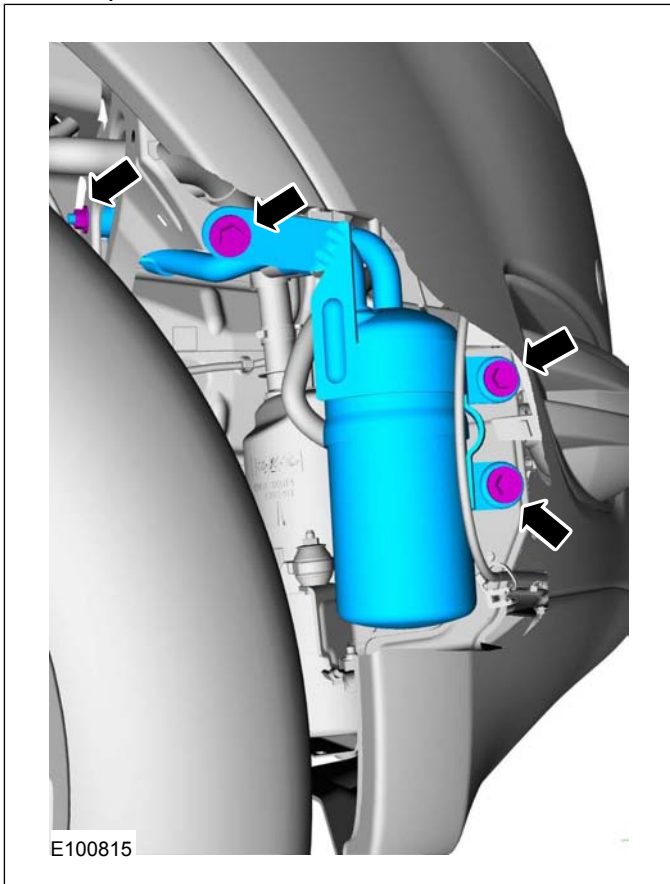


REMOVAL AND INSTALLATION



7.



**REMOVAL AND INSTALLATION**8. Torque: 18 Nm**Installation**

1. To install, reverse the removal procedure.
2. Coat the O-ring seals on the refrigerant lines.

Material: Compressor Oil - Air Conditioning  
(WSH-M1C231-B / 6U7J-M1C231-AA)  
refrigerant oil



## REMOVAL AND INSTALLATION

## Suction Accumulator to Air Conditioning (A/C) Compressor Line

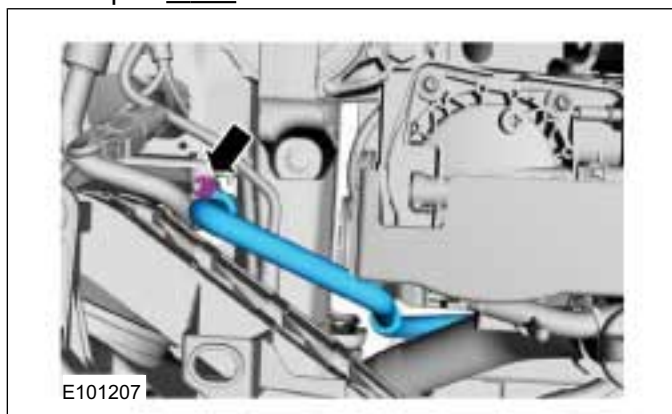
Materials	
Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

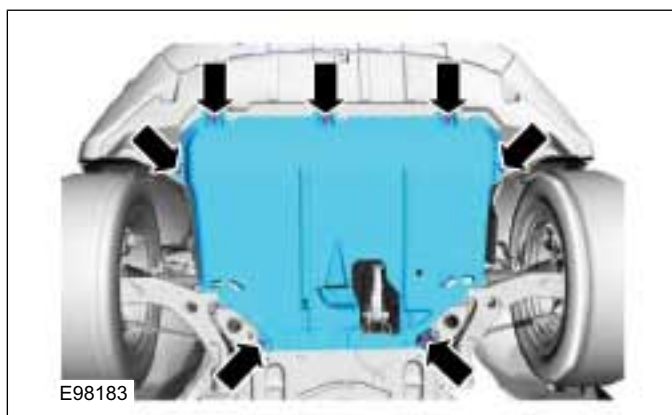
1. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).
2. **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Torque: 8 Nm



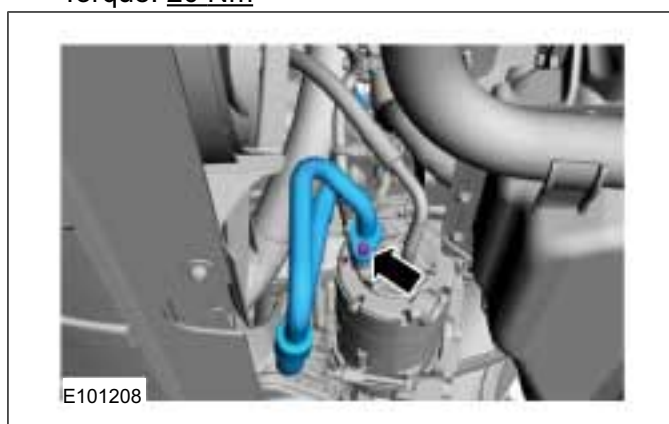
3. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

4.



5. **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Torque: 20 Nm



## Installation

1. To install, reverse the removal procedure.
2. Coat the O-ring seals on the refrigerant lines.

Material: Compressor Oil - Air Conditioning (WSH-M1C231-B / 6U7J-M1C231-AA) refrigerant oil

## REMOVAL AND INSTALLATION

Suction Accumulator to Air Conditioning (A/C) Compressor Line  
— 2.5L Duratec (147kW/200PS) - VI5

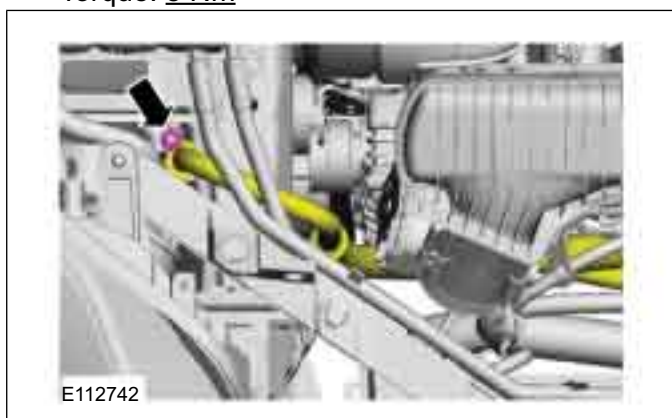
Materials	
Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

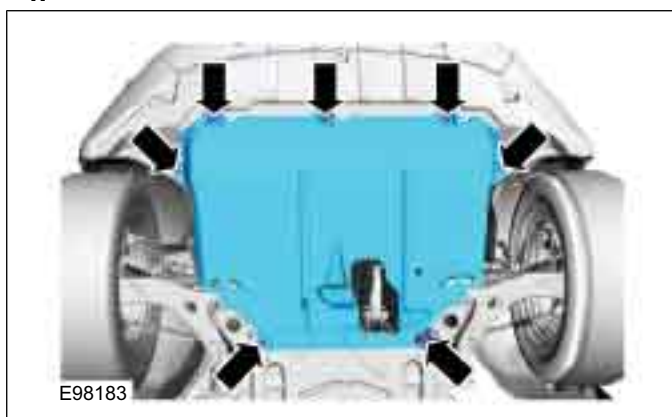
1. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).
2. **CAUTION:** Make sure that all openings are sealed.

Torque: 8 Nm



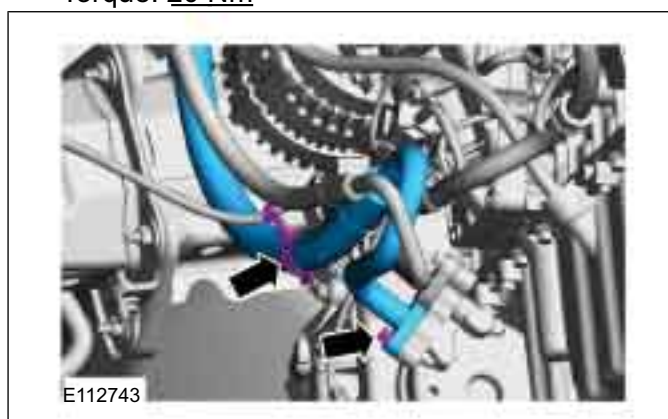
3. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

4.



5. **CAUTION:** Make sure that all openings are sealed.

Torque: 20 Nm



## Installation

1. To install, reverse the removal procedure.
2. Coat the O-ring seals on the refrigerant lines.

Material: Compressor Oil - Air Conditioning (WSH-M1C231-B / 6U7J-M1C231-AA) refrigerant oil

## REMOVAL AND INSTALLATION

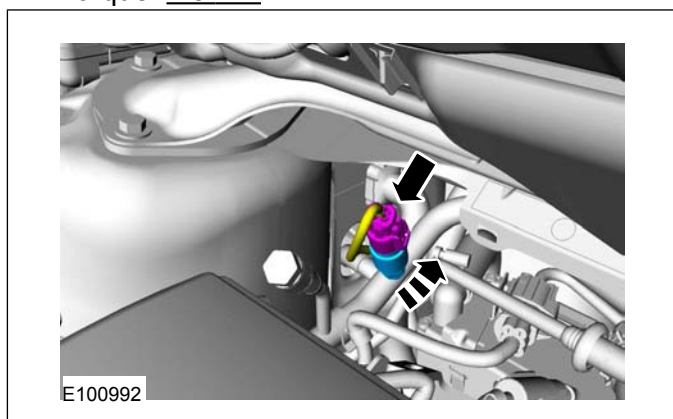
## Low-Pressure Cutoff Switch

Materials	
Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Air Conditioning (A/C) System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Torque: 2.5 Nm



## Installation

1. To install, reverse the removal procedure.
2. Coat the o-ring seals.

Material: Compressor Oil - Air Conditioning (WSH-M1C231-B / 6U7J-M1C231-AA) refrigerant oil

## REMOVAL AND INSTALLATION

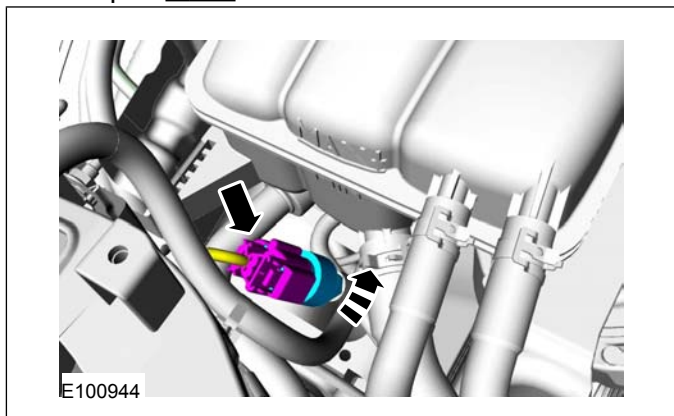
## High-Pressure Cutoff Switch

Materials	
Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: [Air Conditioning \(A/C\) System Health and Safety Precautions](#) (100-00 General Information, Description and Operation).
2. Torque: 8 Nm



## Installation

1. To install, reverse the removal procedure.
2. Coat the o-ring seals.

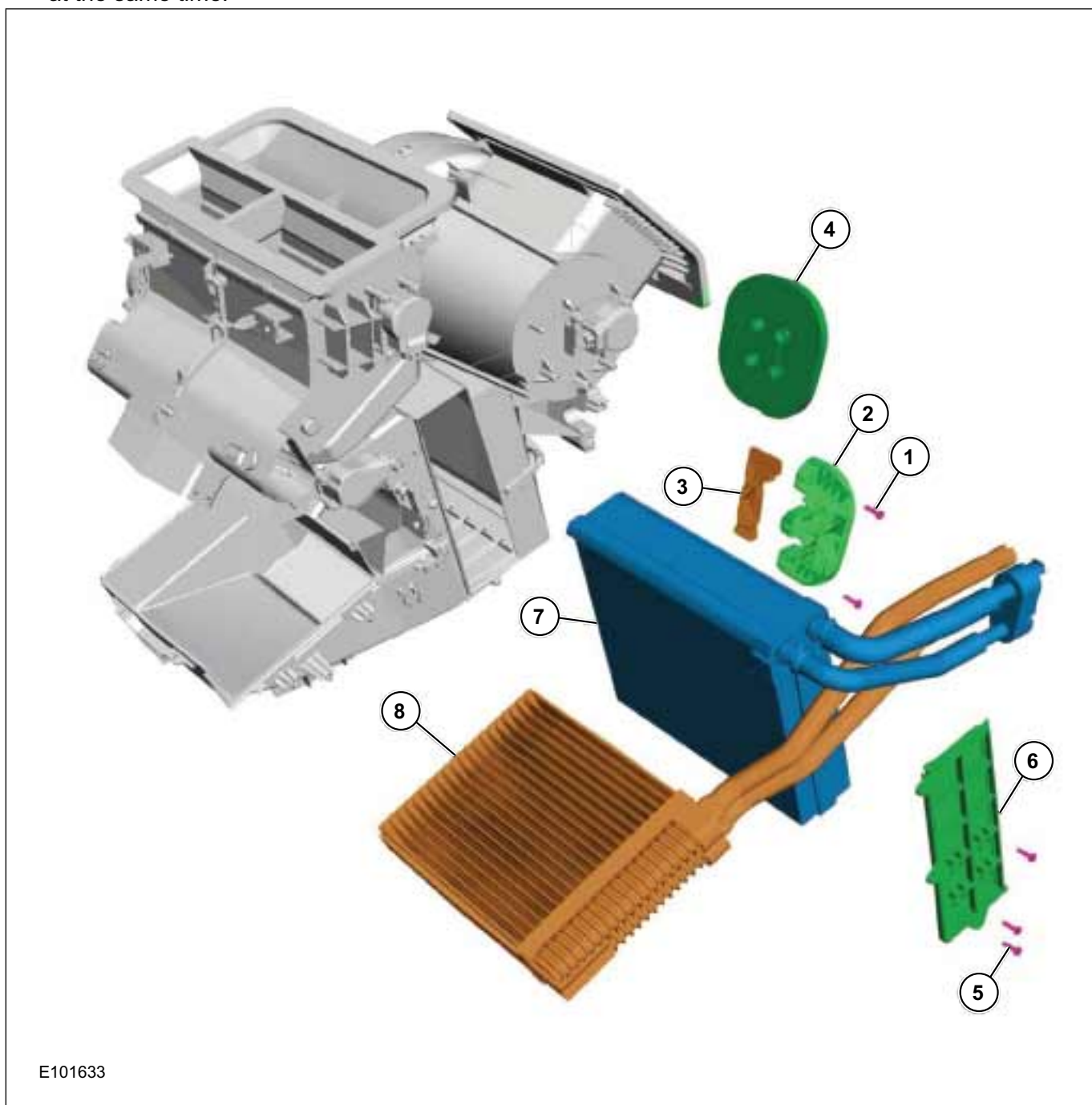
Material: Compressor Oil - Air Conditioning (WSH-M1C231-B / 6U7J-M1C231-AA) refrigerant oil

## REMOVAL AND INSTALLATION

## Evaporator

## Removal

1. Refer to: **Heater Core and Evaporator Core Housing** (412-01 Climate Control, Removal and Installation).
2. **NOTE:** Pull out the evaporator and heater core at the same time.



E101633



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## REMOVAL AND INSTALLATION

### Installation

1. To install, reverse the removal procedure.





## REMOVAL AND INSTALLATION

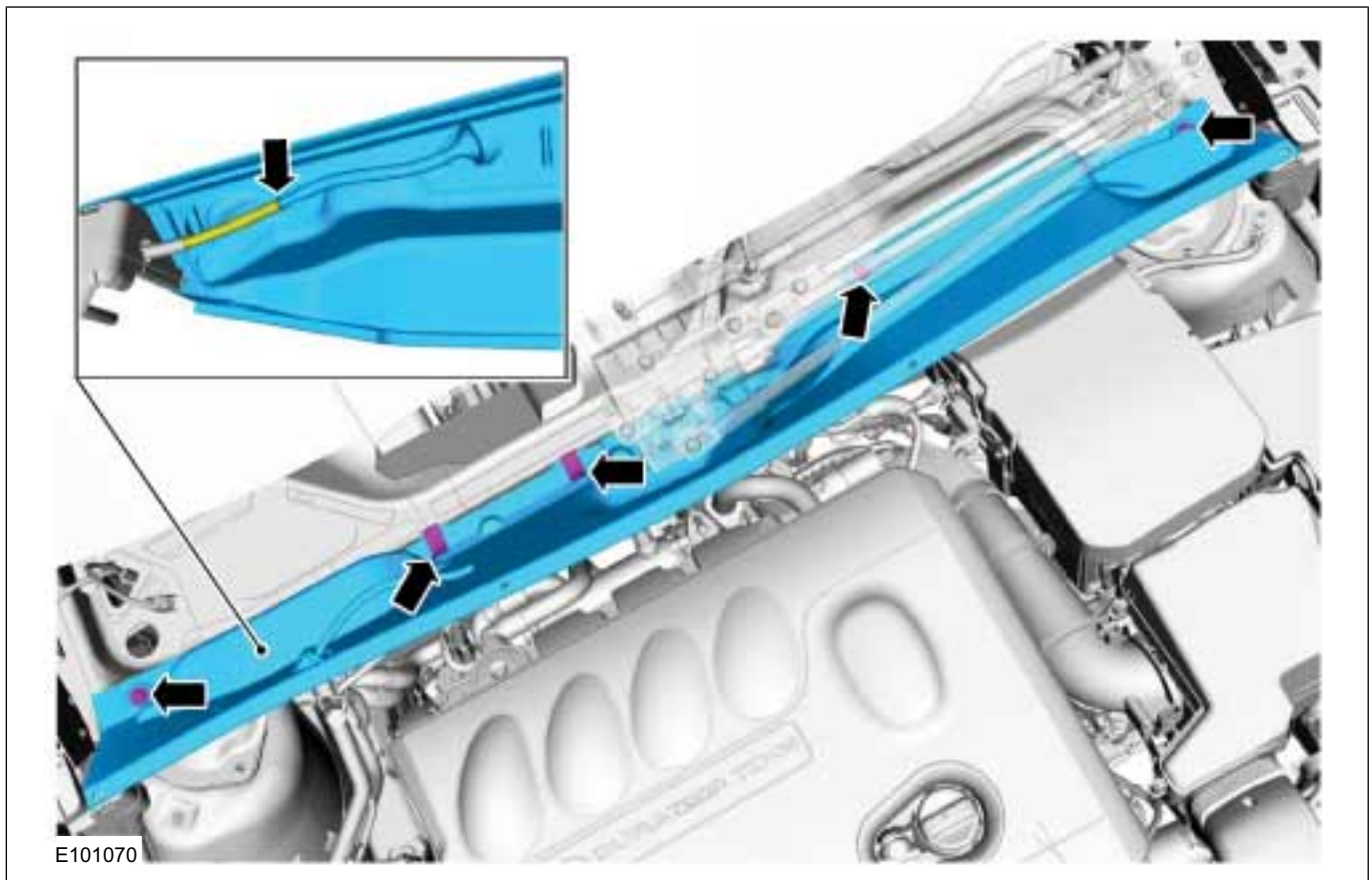
## Evaporator Outlet Line

Materials	
Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

## Removal

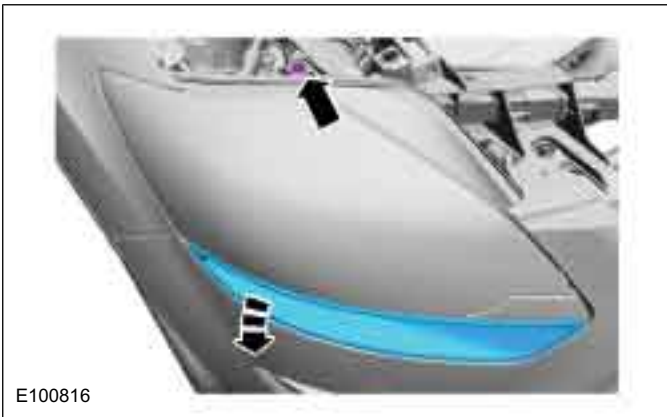
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).
2. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
- 3.

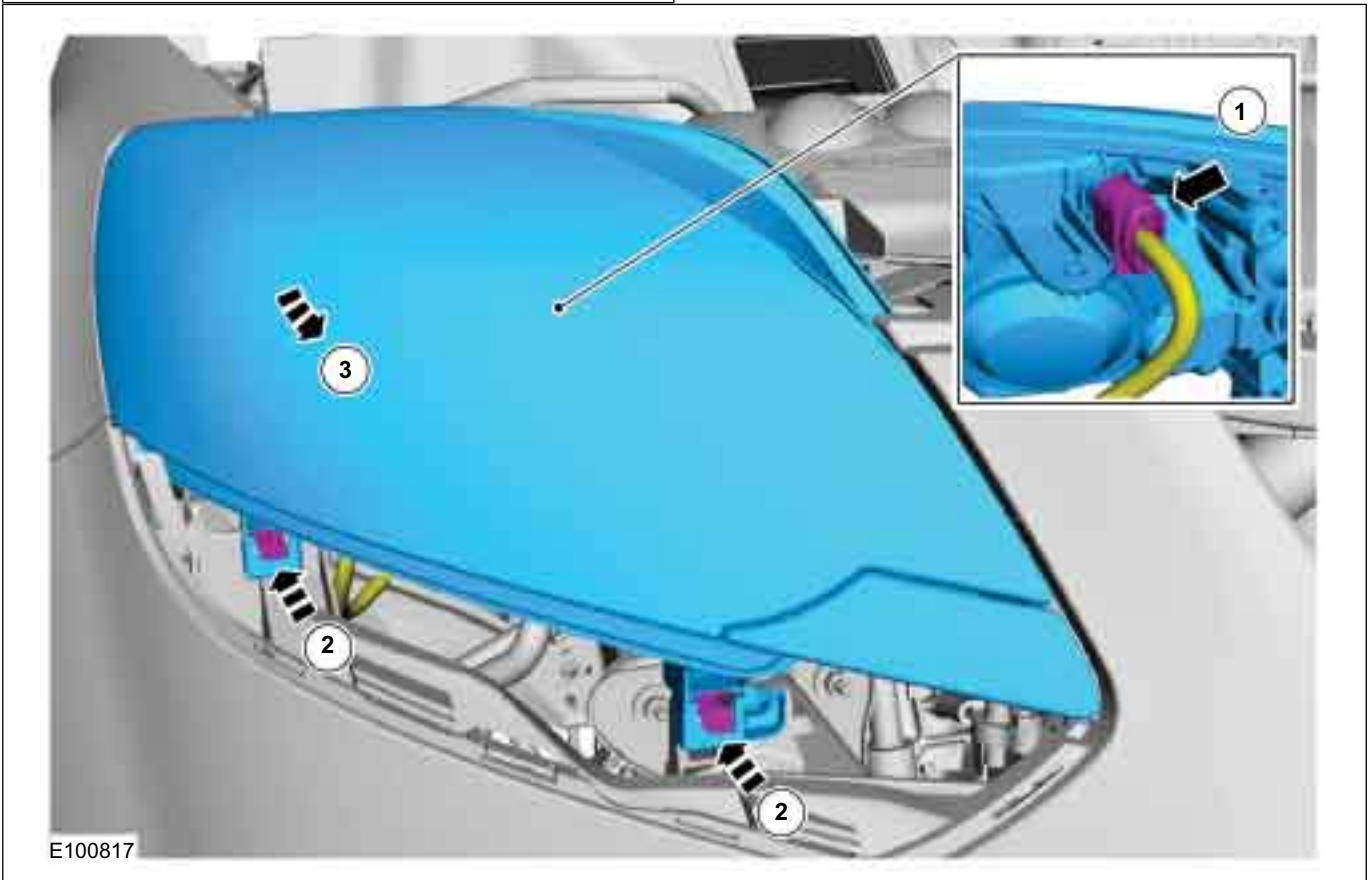


REMOVAL AND INSTALLATION

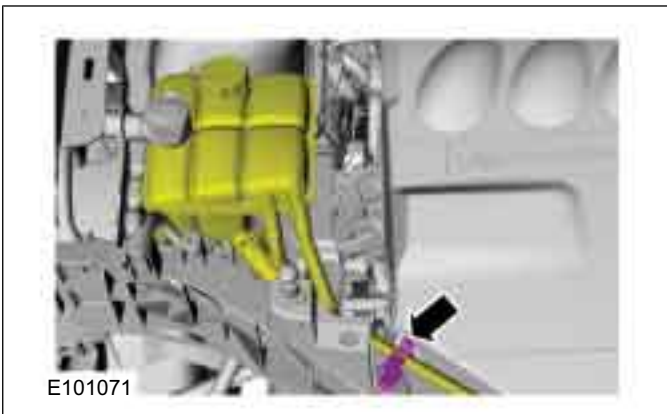
4.



5.



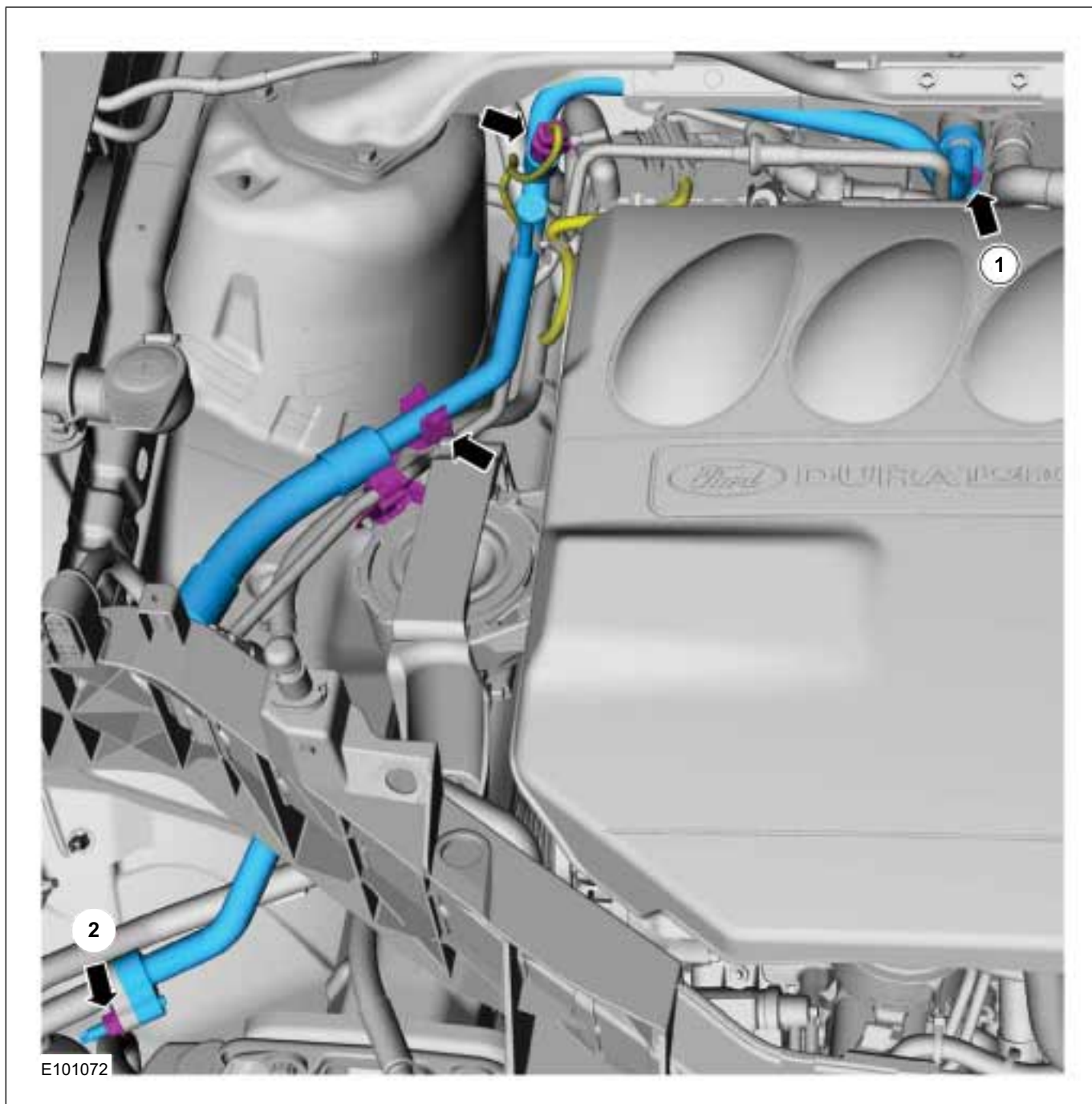
6.



7. **⚠ CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

- 8. 1. Torque: 25 Nm
- 2. Torque: 8 Nm

## REMOVAL AND INSTALLATION



## Installation

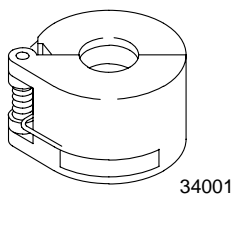
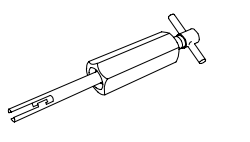
1. To install, reverse the removal procedure.
2. Coat the O-ring seals on the refrigerant lines.

Material: Compressor Oil - Air Conditioning  
(WSH-M1C231-B / 6U7J-M1C231-AA)  
refrigerant oil

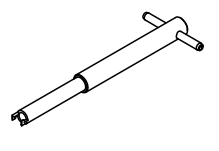
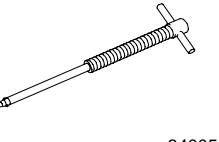
REMOVAL AND INSTALLATION

Evaporator Core Orifice

Special Tool(s)

 <p>34001</p>	<p>412-027 Disconnect Tool, Spring Lock Coupling (1/2" blue)</p>
 <p>34004</p>	<p>412-034 Remover/Installer, Evaporator Core Orifice</p>

Special Tool(s)

 <p>E129004</p>	<p>412-034-01 Adapter for 412-034</p>
 <p>34005</p>	<p>412-035 Remover, Damaged Evaporator Core Orifice</p>

Materials

Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

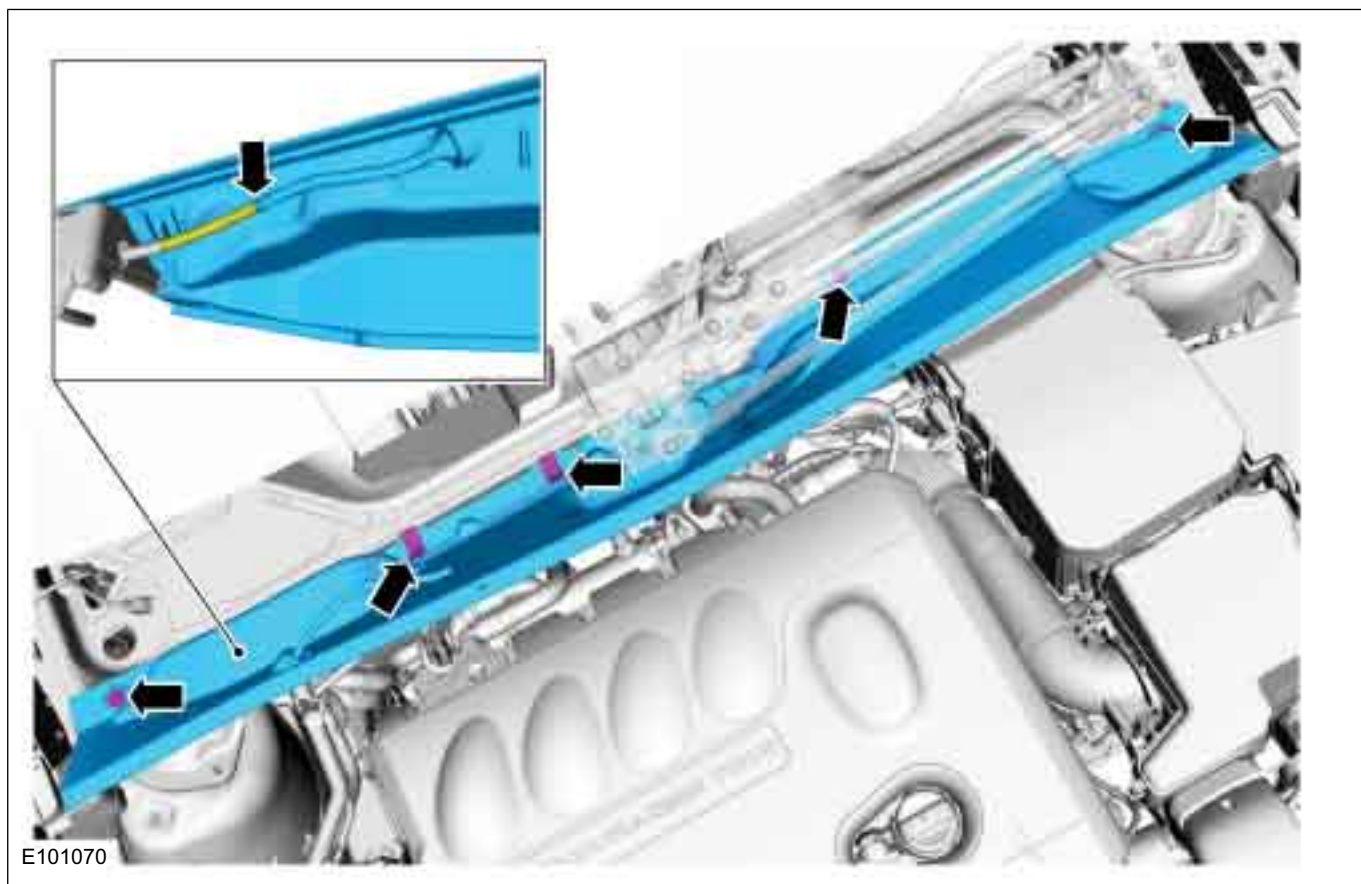
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).
2. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
- 3.

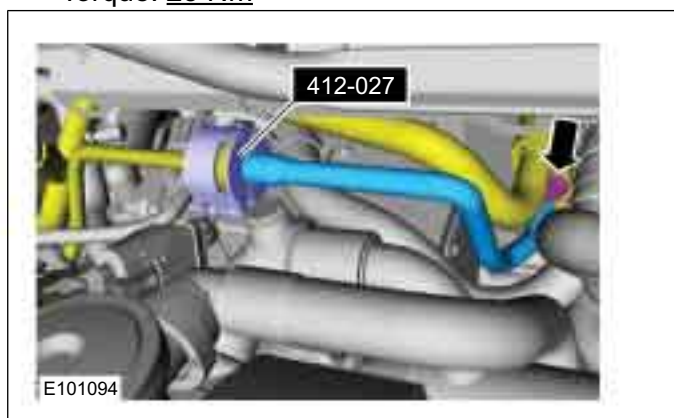


REMOVAL AND INSTALLATION



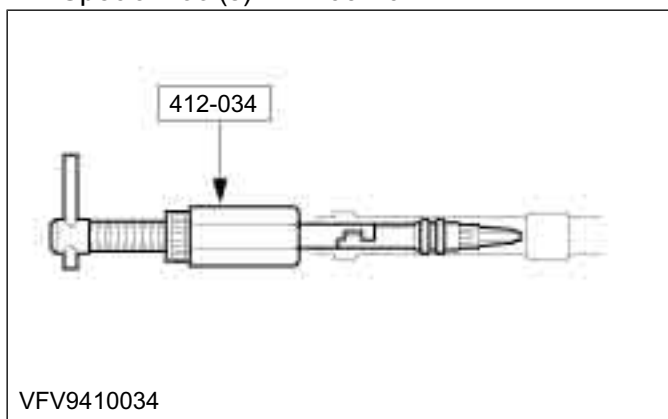
4. **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Special Tool(s): 412-027  
Torque: 25 Nm



5. Hook the special tool into the fixed orifice tube, turn it clockwise and remove the fixed orifice tube.

Special Tool(s): 412-034-01

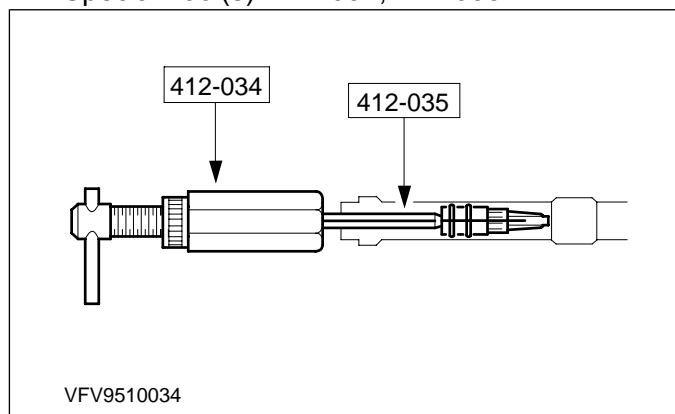


6. **NOTE:** This step is necessary if the evaporator core orifice is broken.

**REMOVAL AND INSTALLATION**

Using the special tools, remove the broken fixed orifice tube.

Special Tool(s): 412-034, 412-035

**Installation**

1. To install, reverse the removal procedure.
2. Coat the O-ring seals on the refrigerant lines.

Material: Compressor Oil - Air Conditioning  
(WSH-M1C231-B / 6U7J-M1C231-AA)  
refrigerant oil



412-01-68

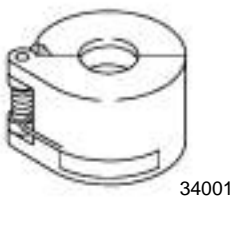
Climate Control

412-01-68

## REMOVAL AND INSTALLATION

## Condenser to Evaporator Line

## Special Tool(s)

	<p>412-027 Disconnect Tool, Spring Lock Coupling (1/2" blue)</p>
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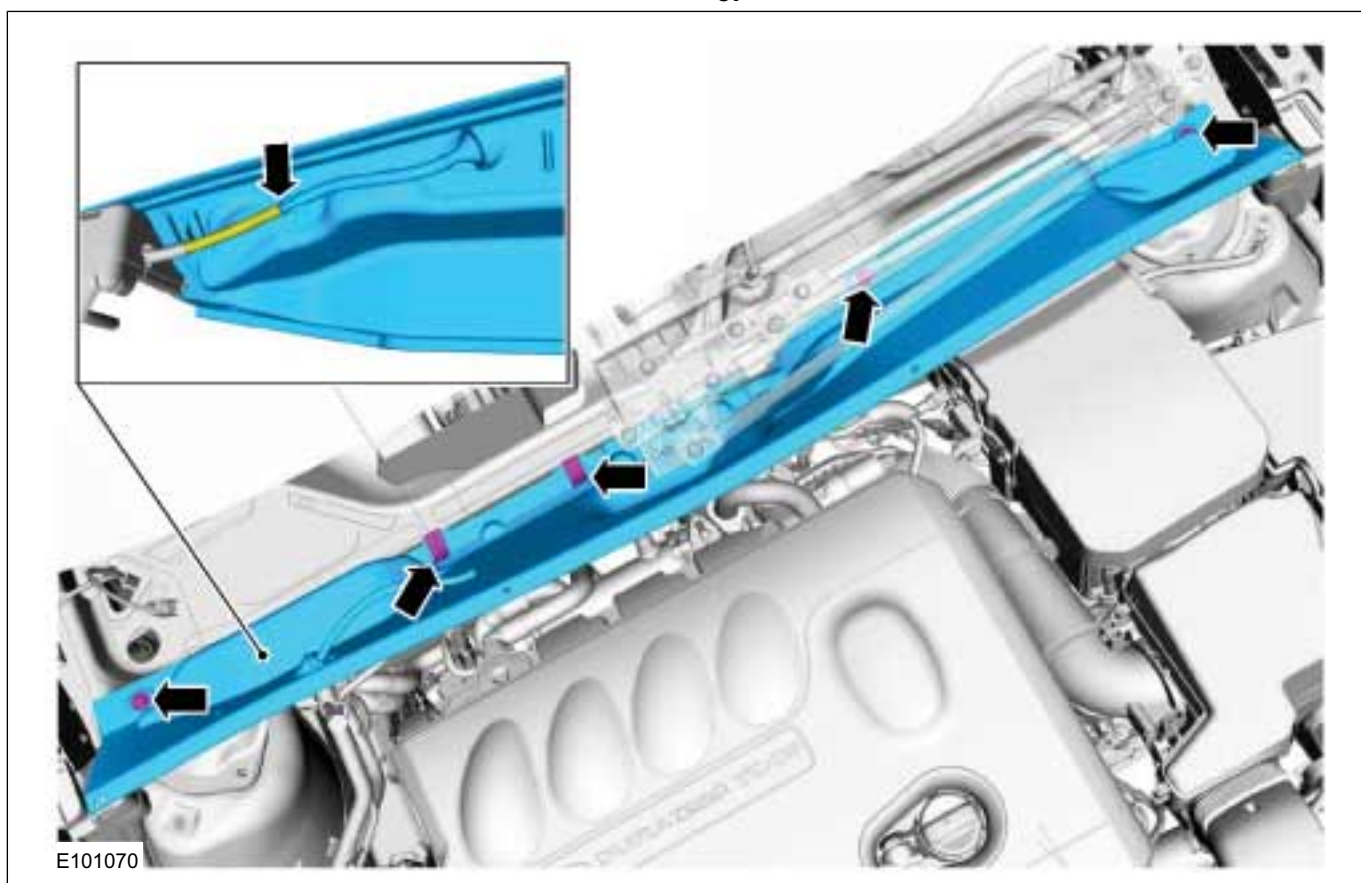
## Materials

Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).
2. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
- 3.

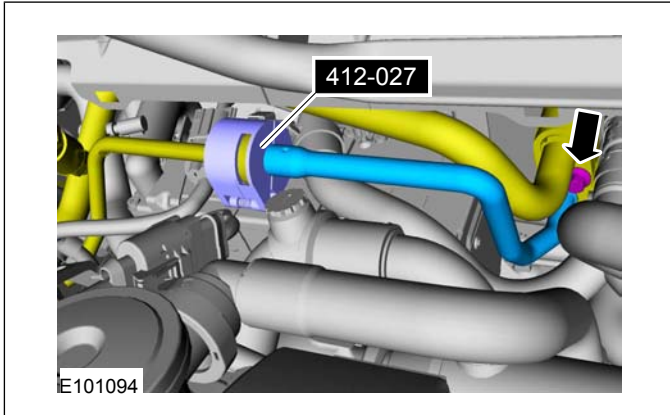




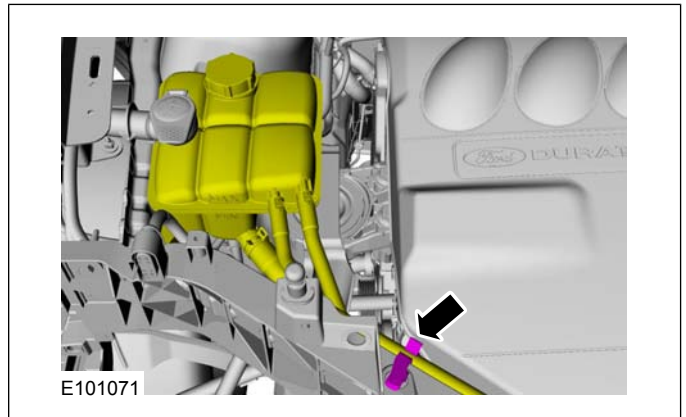
REMOVAL AND INSTALLATION

4. **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Special Tool(s): 412-027  
Torque: 25 Nm



- 5.

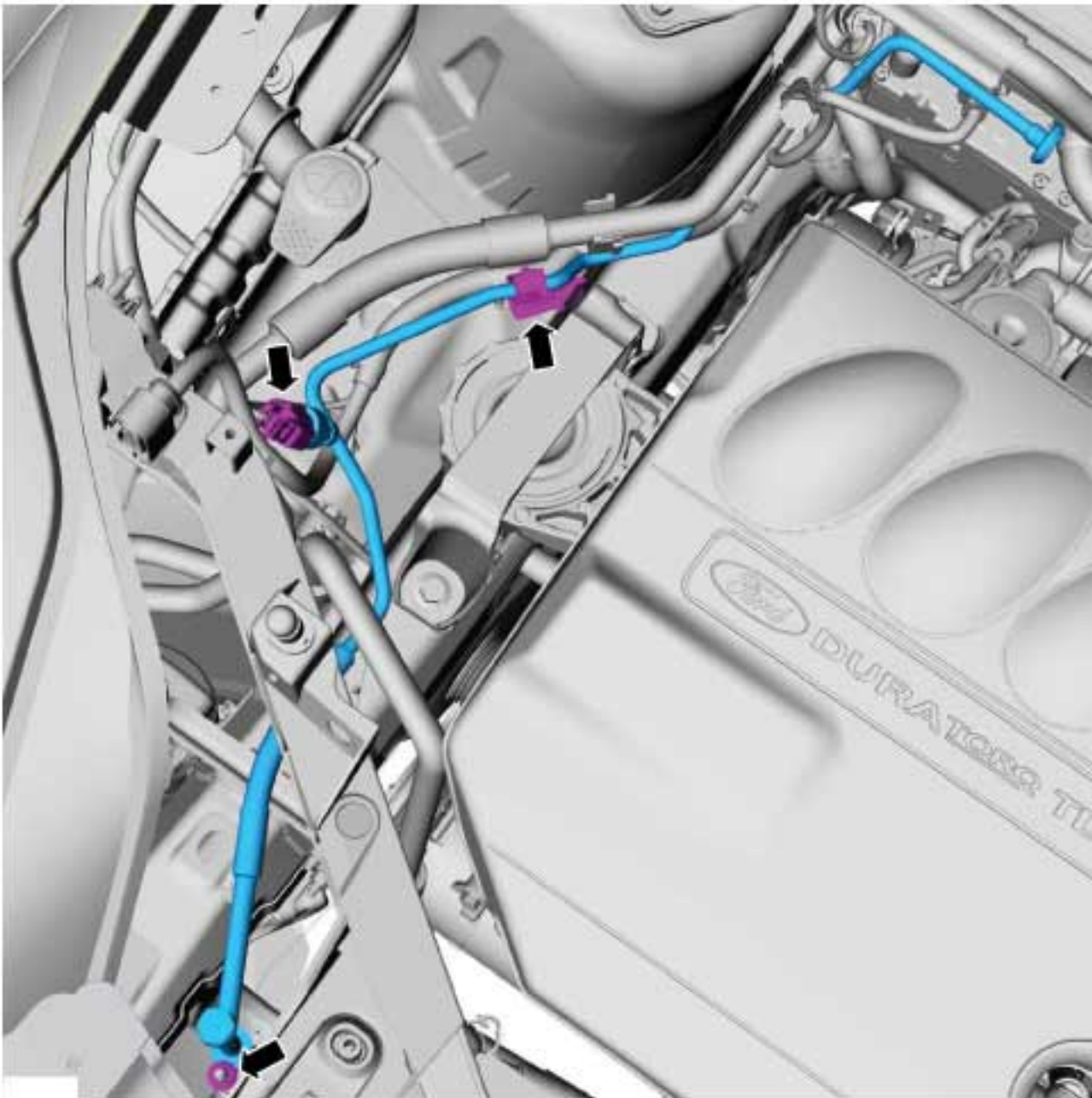


6. **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Torque: 8 Nm



## REMOVAL AND INSTALLATION



E101095

### Installation

1. To install, reverse the removal procedure.
2. Coat the O-ring seals on the refrigerant lines.

Material: Compressor Oil - Air Conditioning  
(WSH-M1C231-B / 6U7J-M1C231-AA)  
refrigerant oil

412-01-71

Climate Control

412-01-71

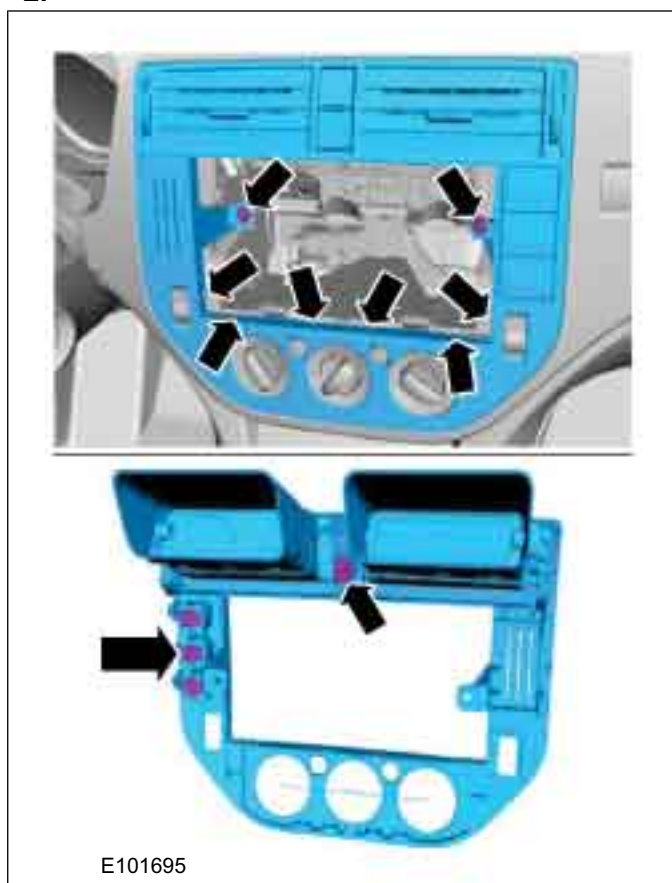
## REMOVAL AND INSTALLATION

## Climate Control Assembly — Vehicles With: Manual Temperature Control(34 300 0)

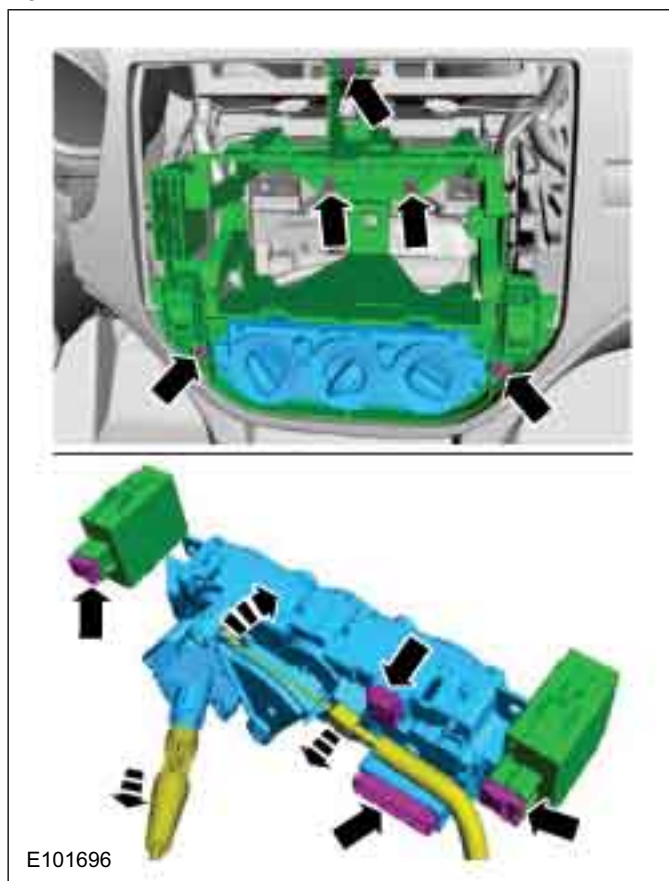
## Removal

1. Refer to: **Audio Unit** (415-01 Information and Entertainment System, Removal and Installation).

2.



3.



## Installation

1. To install, reverse the removal procedure.



412-01-72

Climate Control

412-01-72

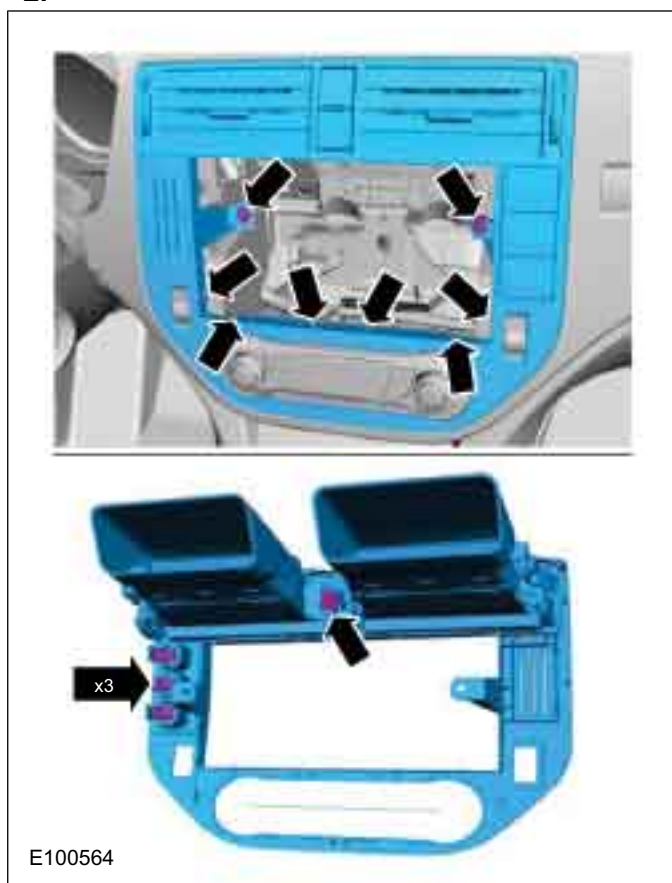
## REMOVAL AND INSTALLATION

Climate Control Assembly — Vehicles With: Automatic  
Temperature Control(34 300 0)

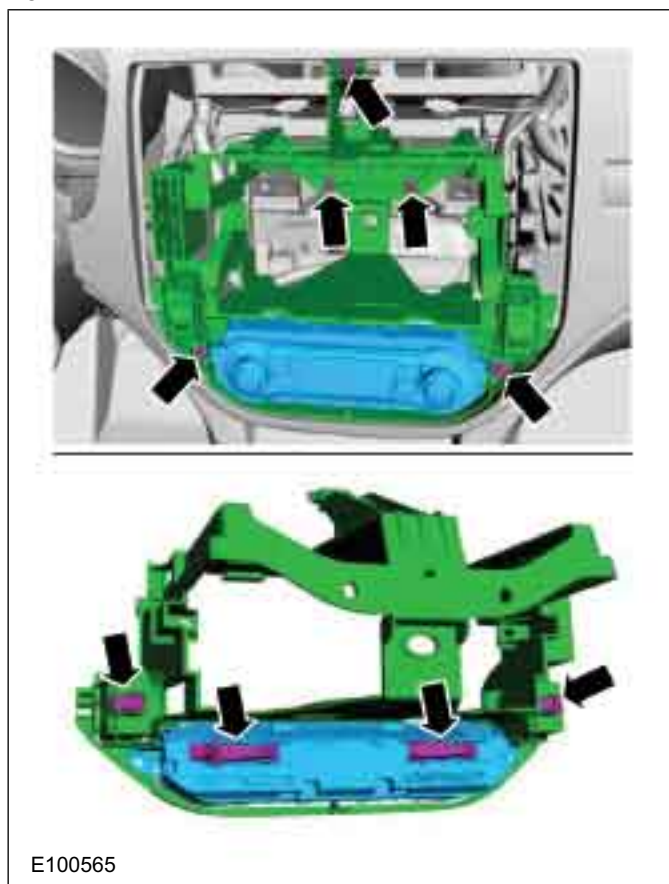
## Removal

1. Refer to: **Audio Unit** (415-01 Information and Entertainment System, Removal and Installation).

2.



3.



## Installation

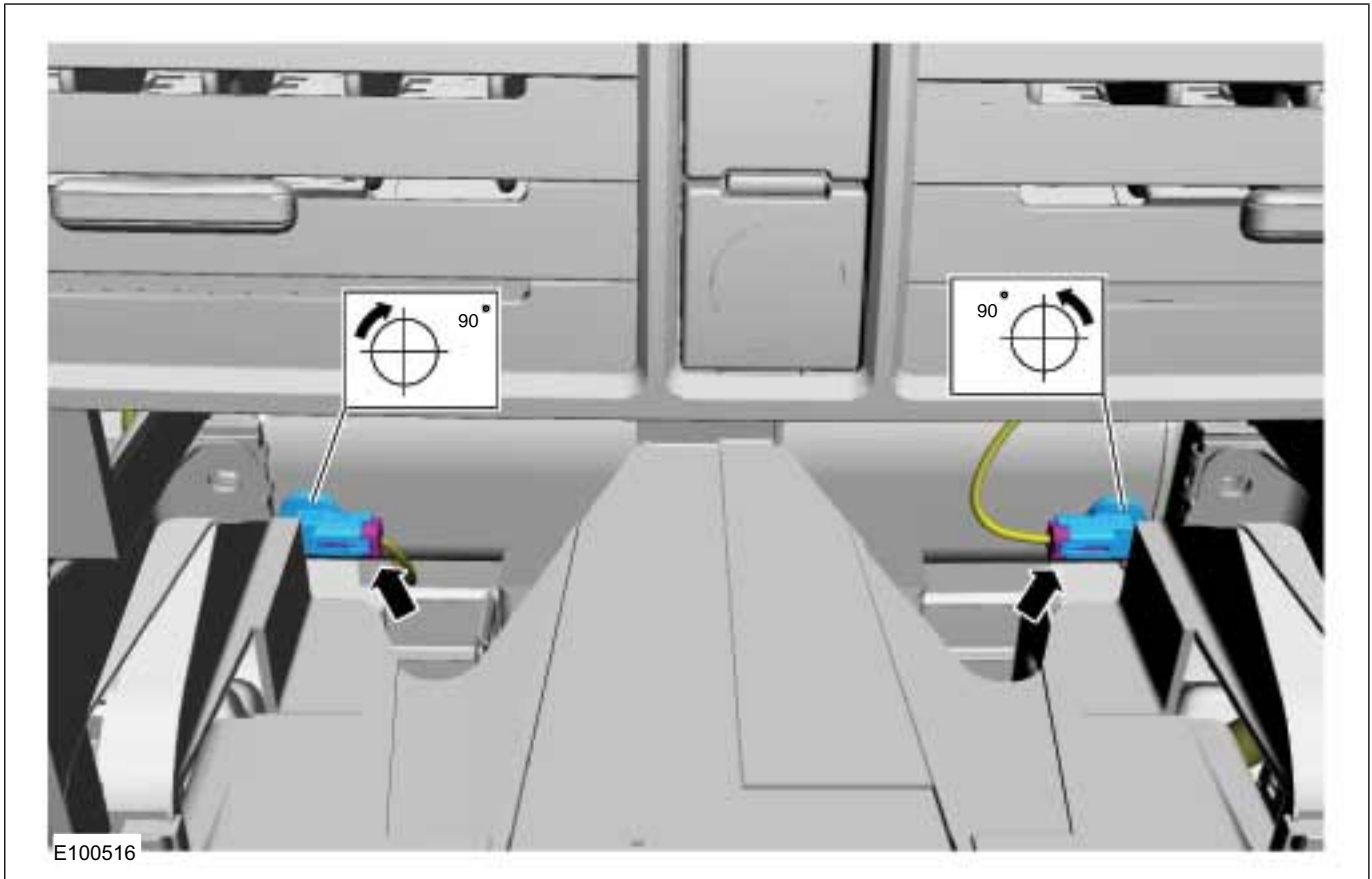
1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Footwell Air Discharge Temperature Sensor(34 485 4)

## Removal

1. Refer to: **Audio Unit** (415-01 Information and Entertainment System, Removal and Installation).
- 2.



## Installation

1. To install, reverse the removal procedure.



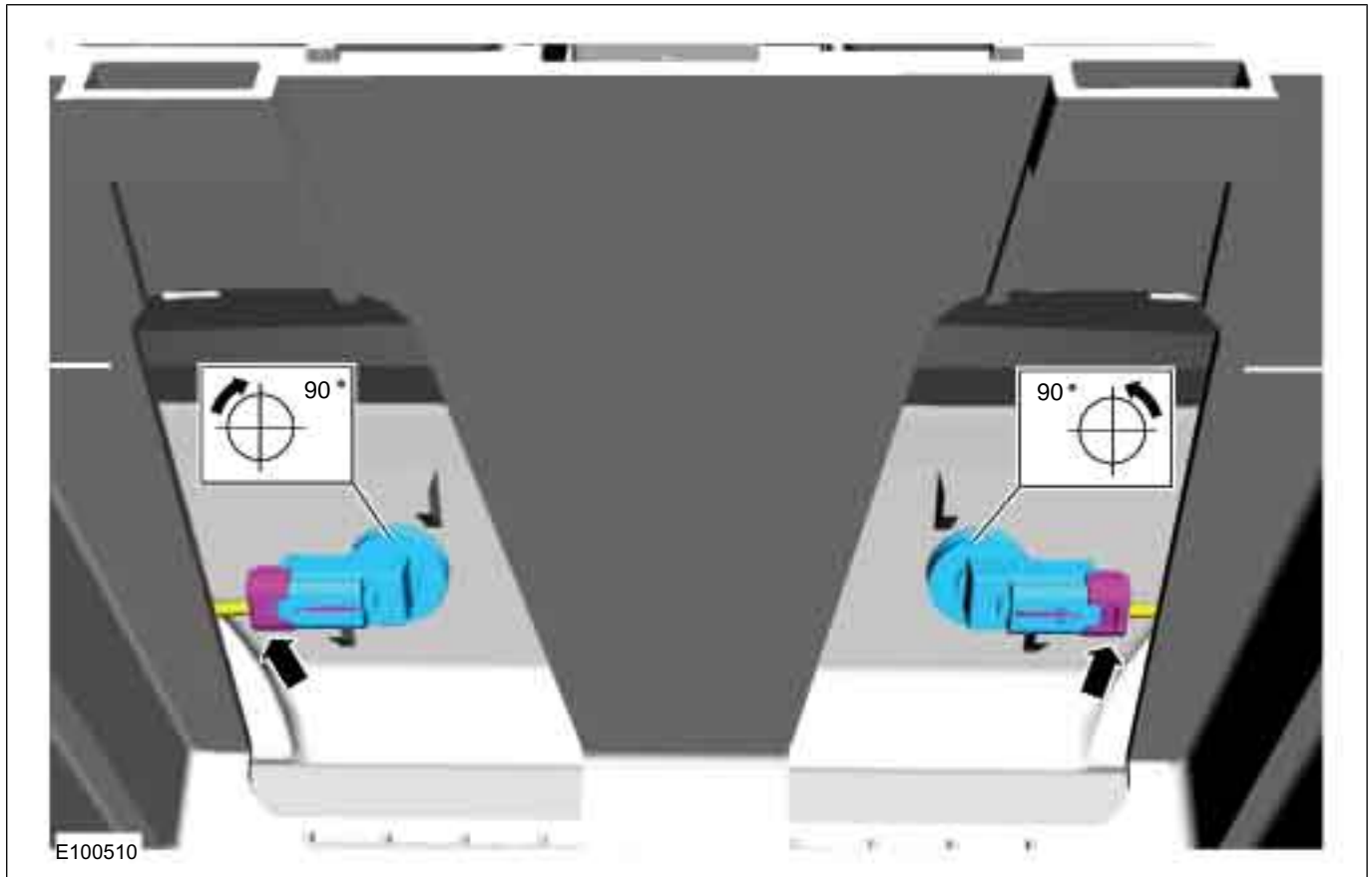
## REMOVAL AND INSTALLATION

## Center Register Air Discharge Temperature Sensor

## Removal

1. Refer to: **Audio Unit** (415-01 Information and Entertainment System, Removal and Installation).

- 2.



## Installation

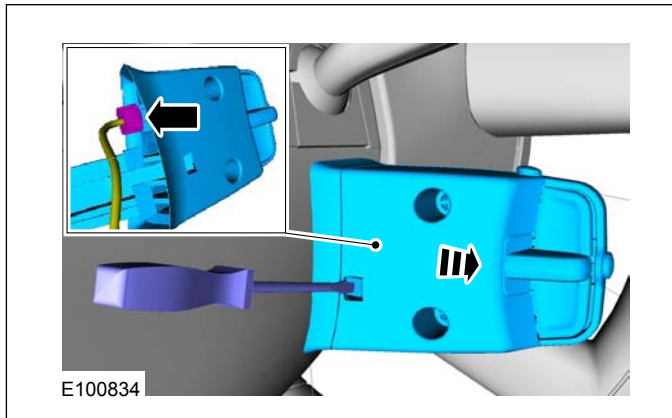
1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

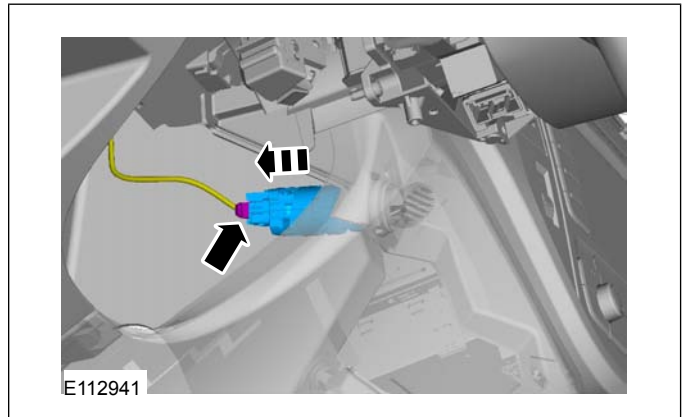
In-Vehicle Temperature Sensor

Removal

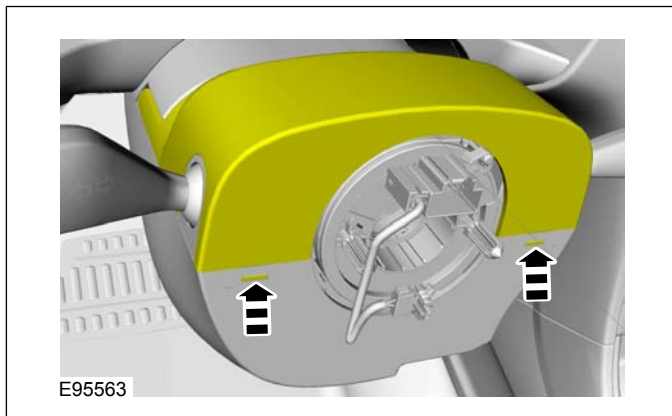
1.



4.



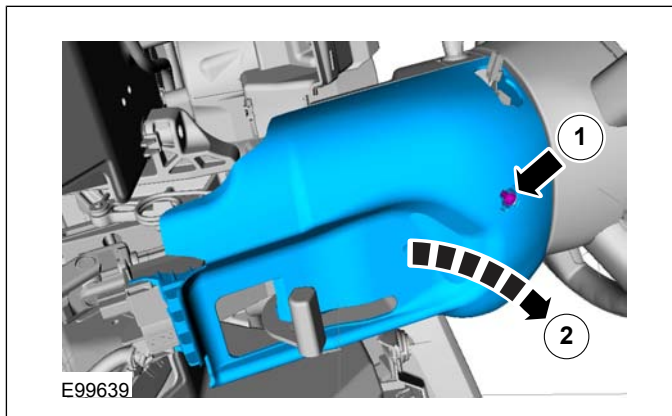
2.



Installation

1. To install, reverse the removal procedure.

3.

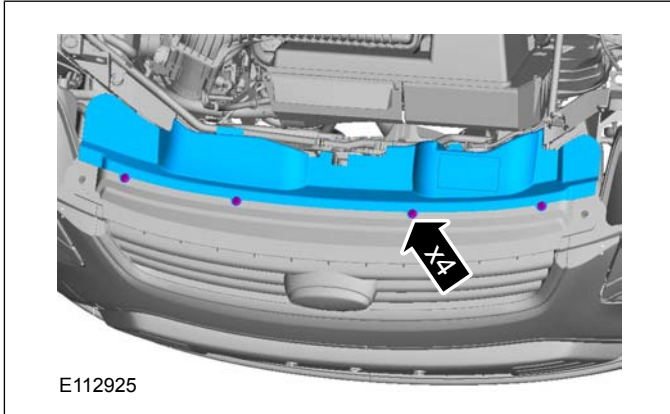


## REMOVAL AND INSTALLATION

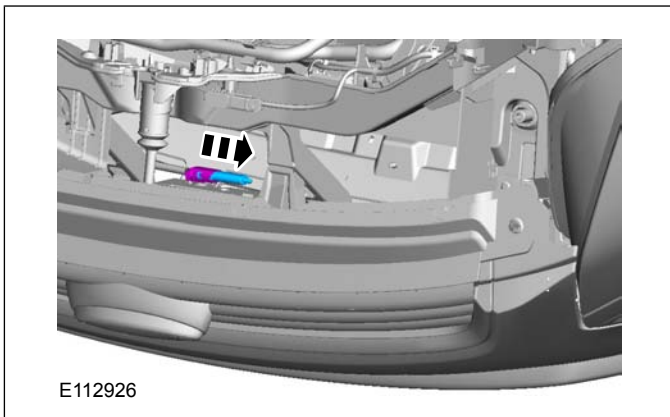
## Ambient Air Temperature Sensor(34 676 0)

## Removal

1.



2.



## Installation

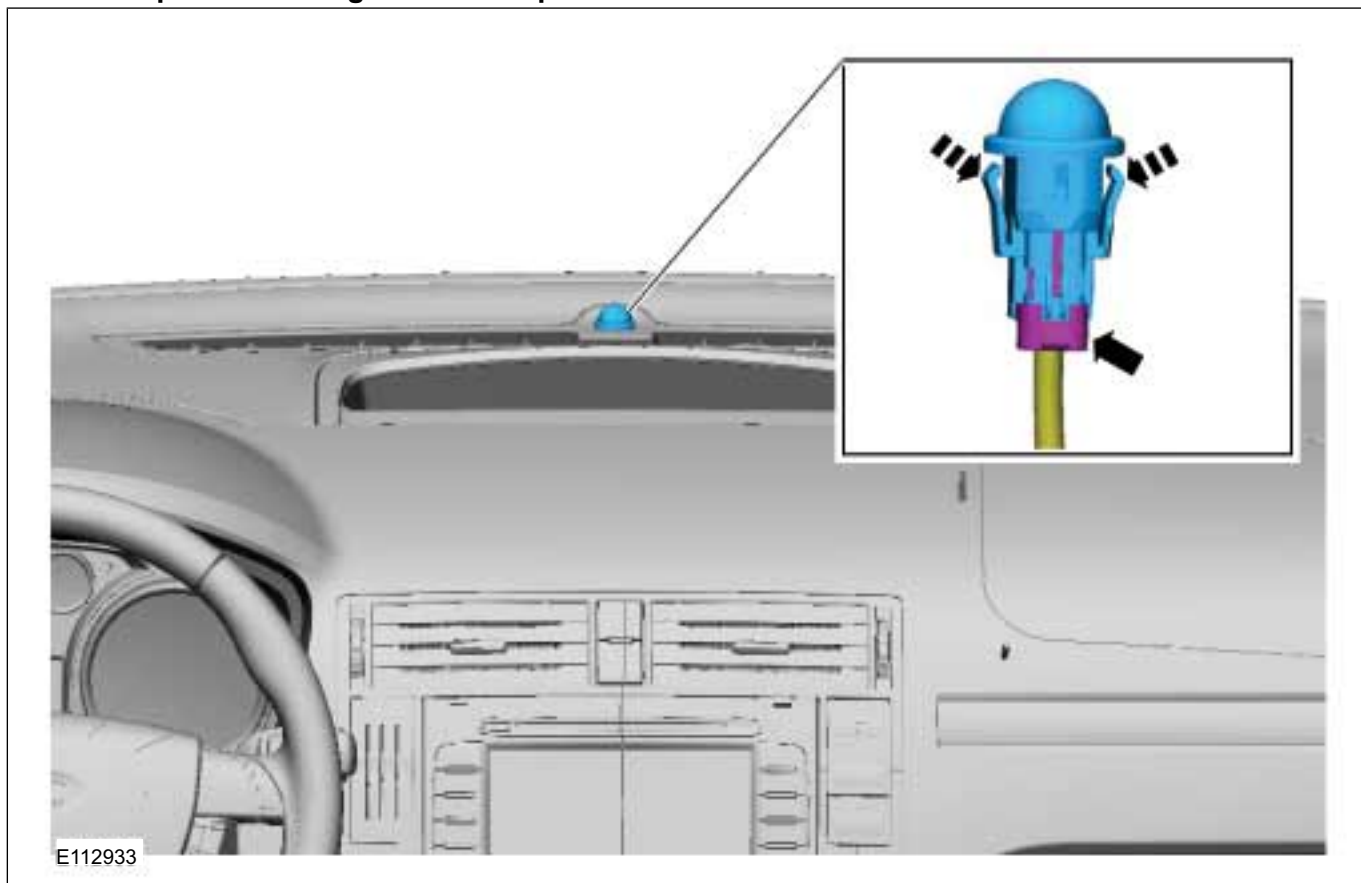
1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Sunload Sensor(34 665 0)

## Removal

1.  **CAUTION:** Use suitable packing material to prevent damage to the component.



## Installation

1. To install, reverse the removal procedure.

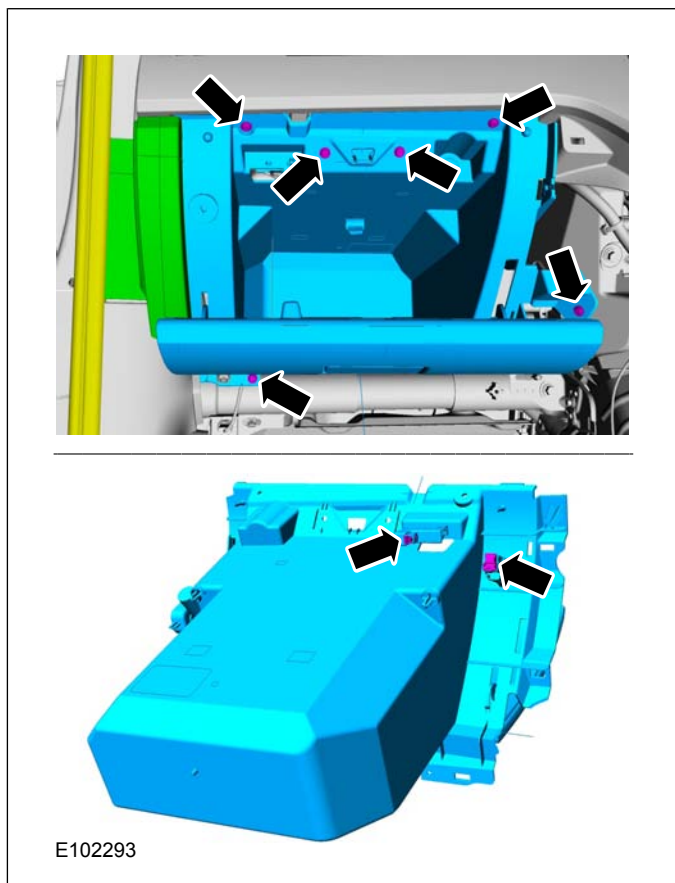
## REMOVAL AND INSTALLATION

## Footwell Vent/Duct Blend Door Actuator — RHD(34 591 0)

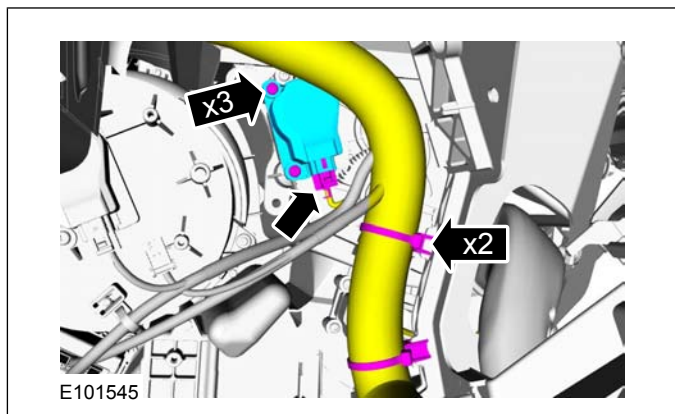
## Removal

1. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).

- 2.



- 3.



## Installation

1. To install, reverse the removal procedure.

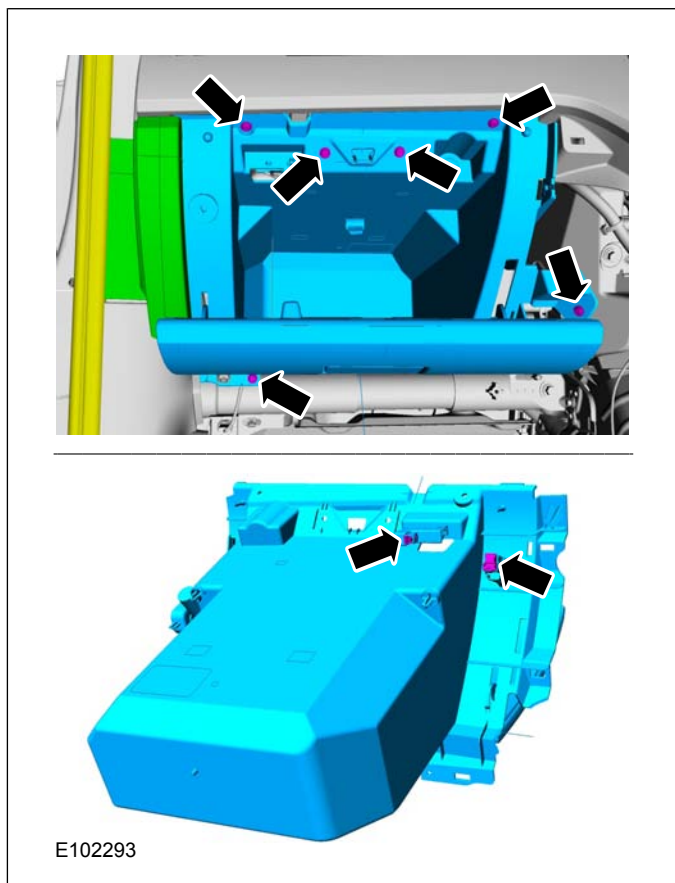
## REMOVAL AND INSTALLATION

## Air Inlet Blend Door Actuator(34 606 0)

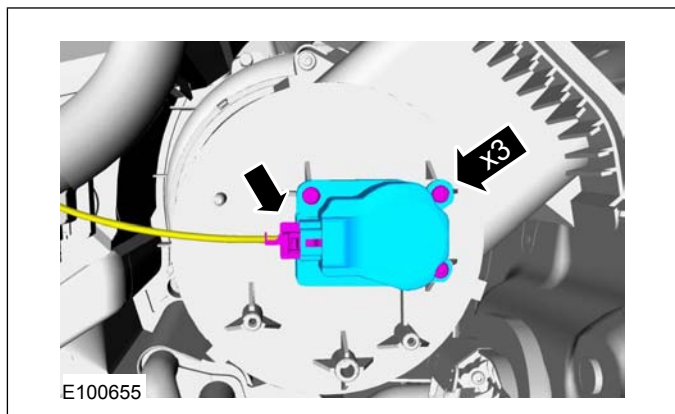
## Removal

1. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).

- 2.



- 3.



## Installation

1. To install, reverse the removal procedure.



412-01-80

Climate Control

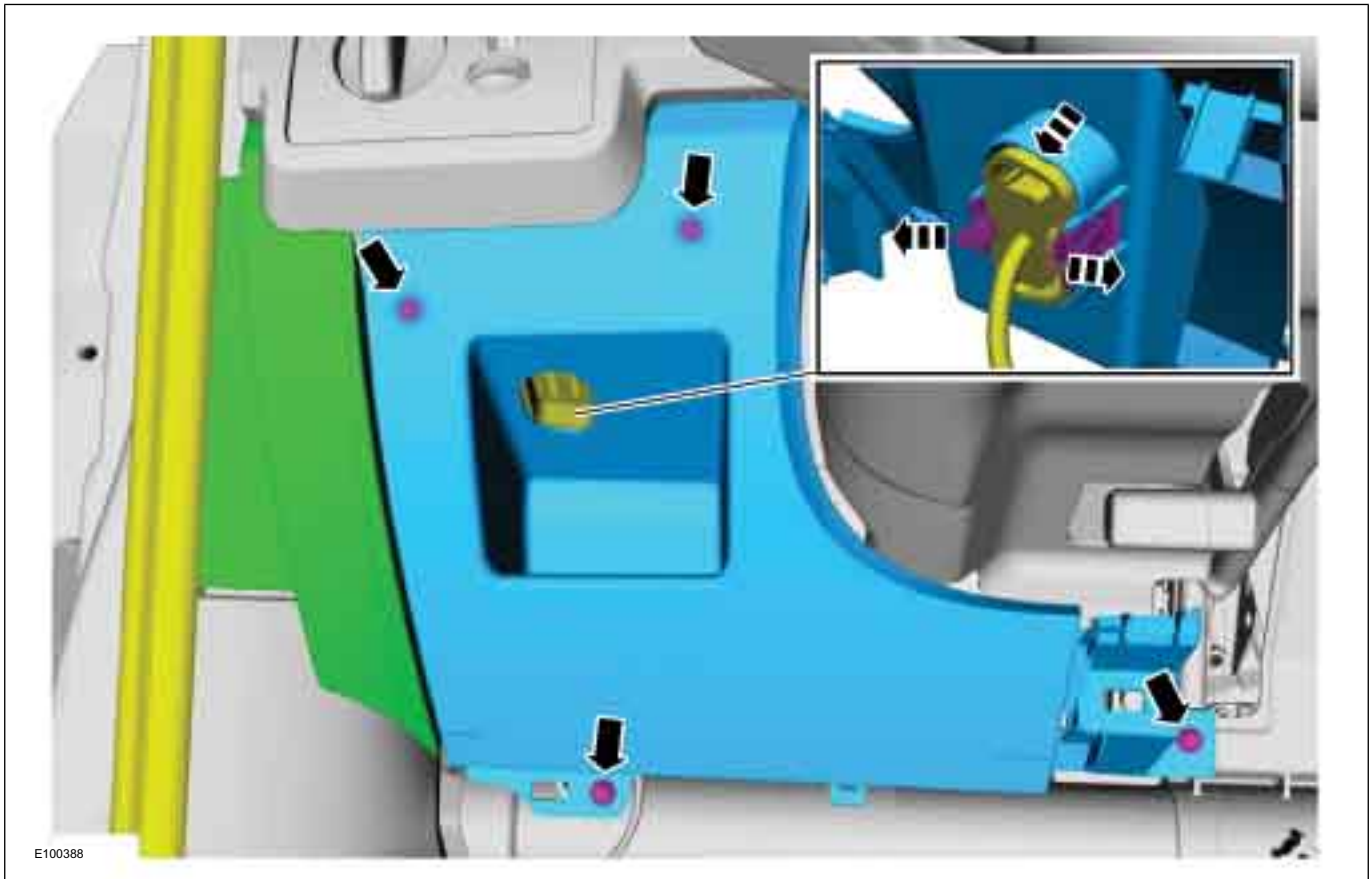
412-01-80

## REMOVAL AND INSTALLATION

## Driver Side Temperature Blend Door Actuator(34 608 0)

## Removal

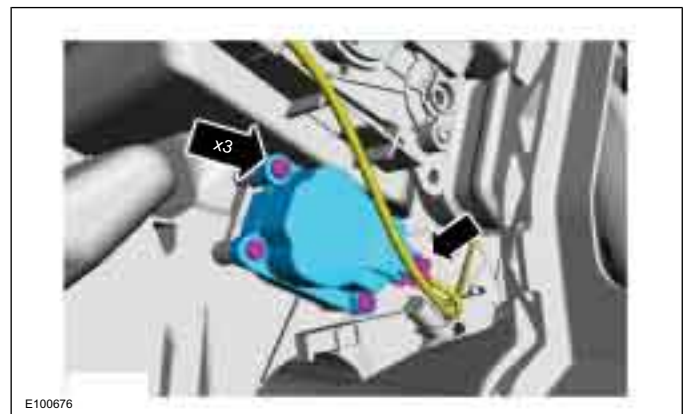
1. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).
- 2.



3.



4.



## Installation

1. To install, reverse the removal procedure.



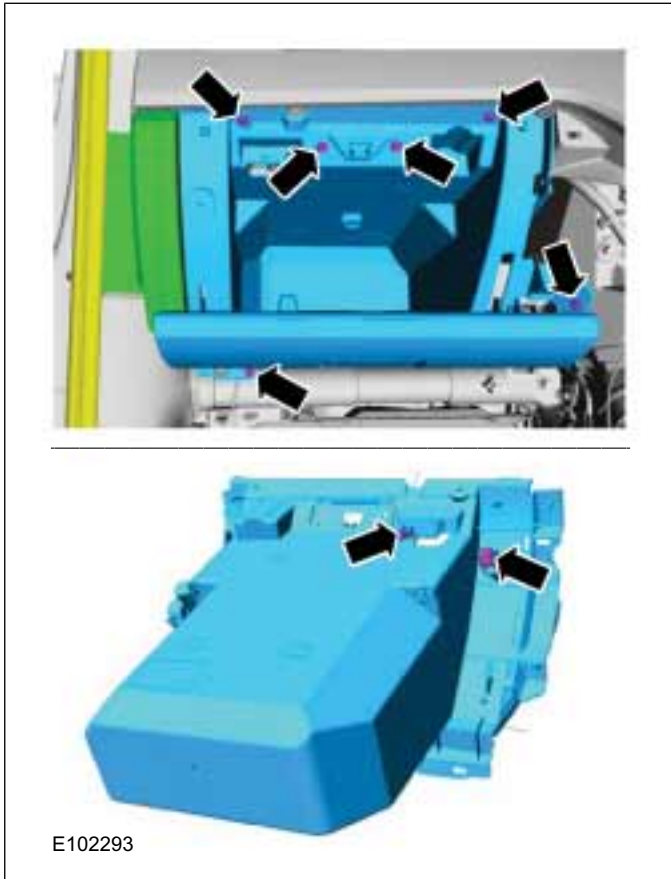
REMOVAL AND INSTALLATION

Passenger Side Temperature Blend Door Actuator(34 608 0)

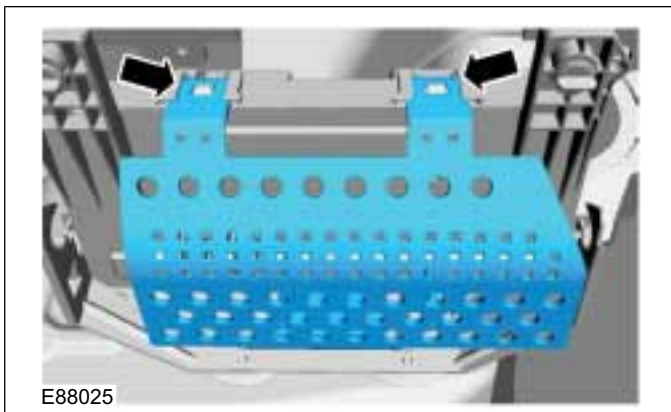
Removal

1. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).

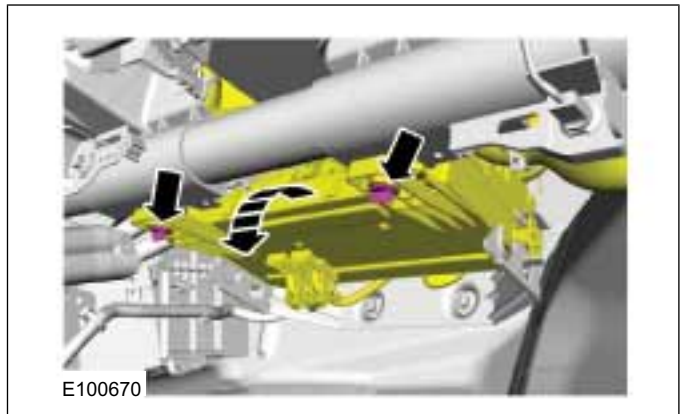
2.



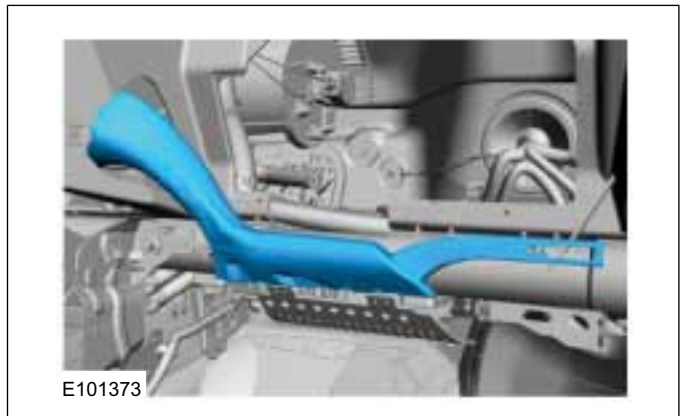
3.



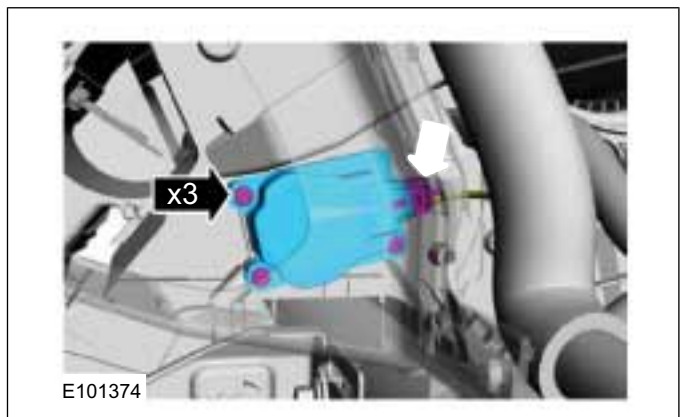
4.



5.



6.



Installation

1. To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

## Defrost Vent/Register Blend Door Actuator — RHD(34 591 0)

## Removal

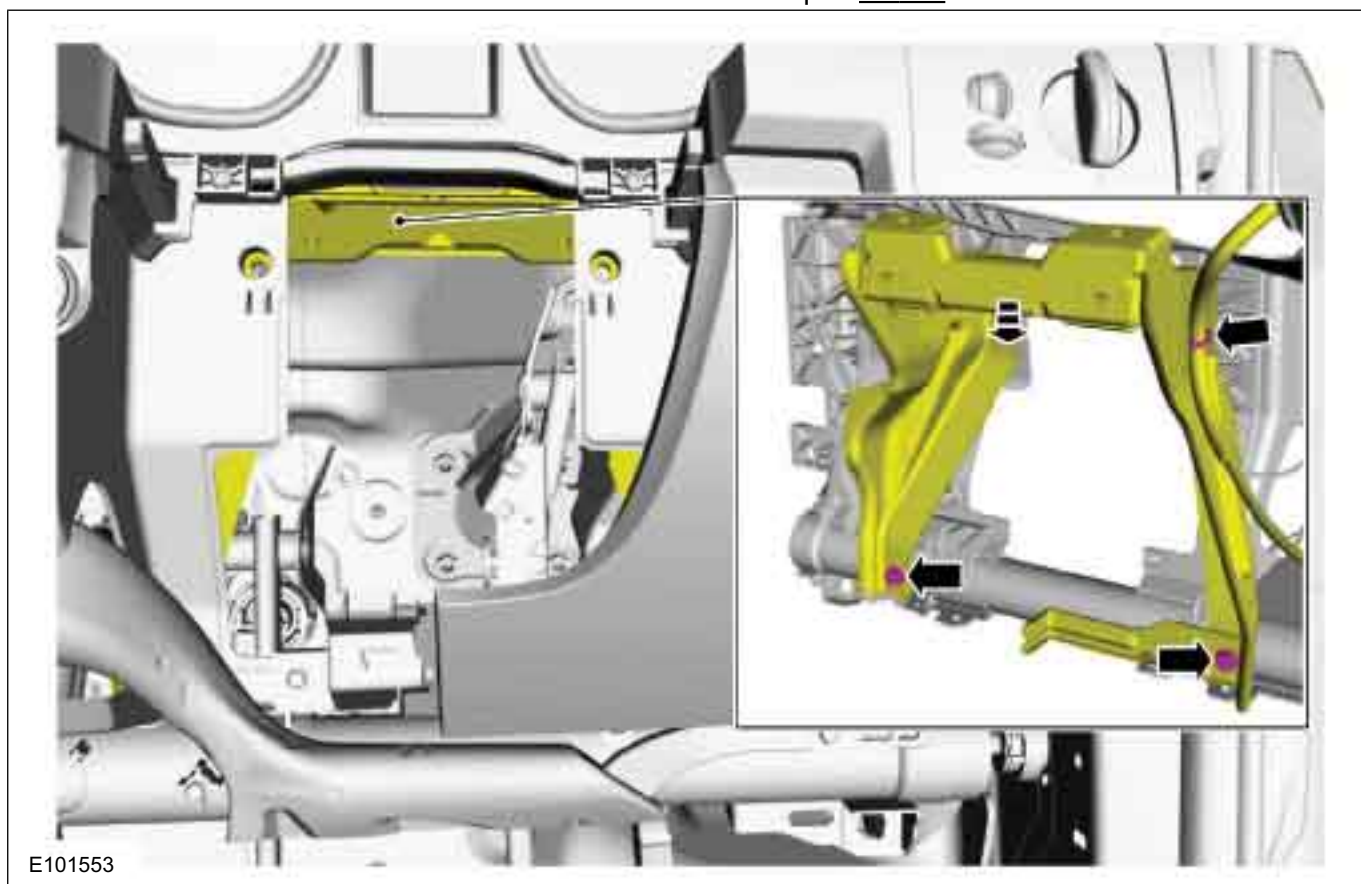
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
2. Torque: 25 Nm



E101389

3. Refer to: **Steering Column** (211-04 Steering Column, Removal and Installation).
4. Torque: 25 Nm



E101553

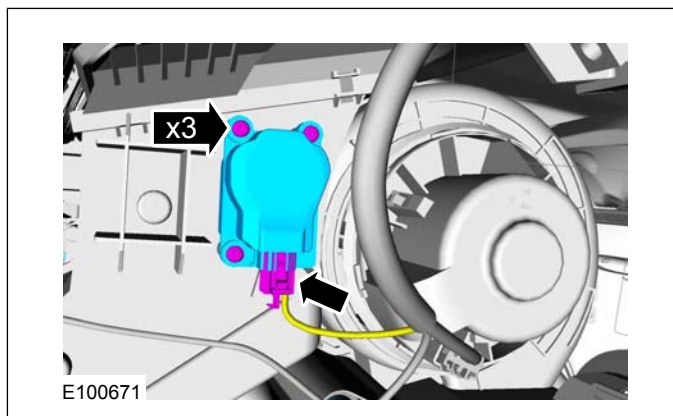
412-01-83

Climate Control

412-01-83

**REMOVAL AND INSTALLATION**

5.

**Installation**

1. To install, reverse the removal procedure.

## SECTION 412-02 Auxiliary Climate Control

**VEHICLE APPLICATION: 2008.50 Kuga**

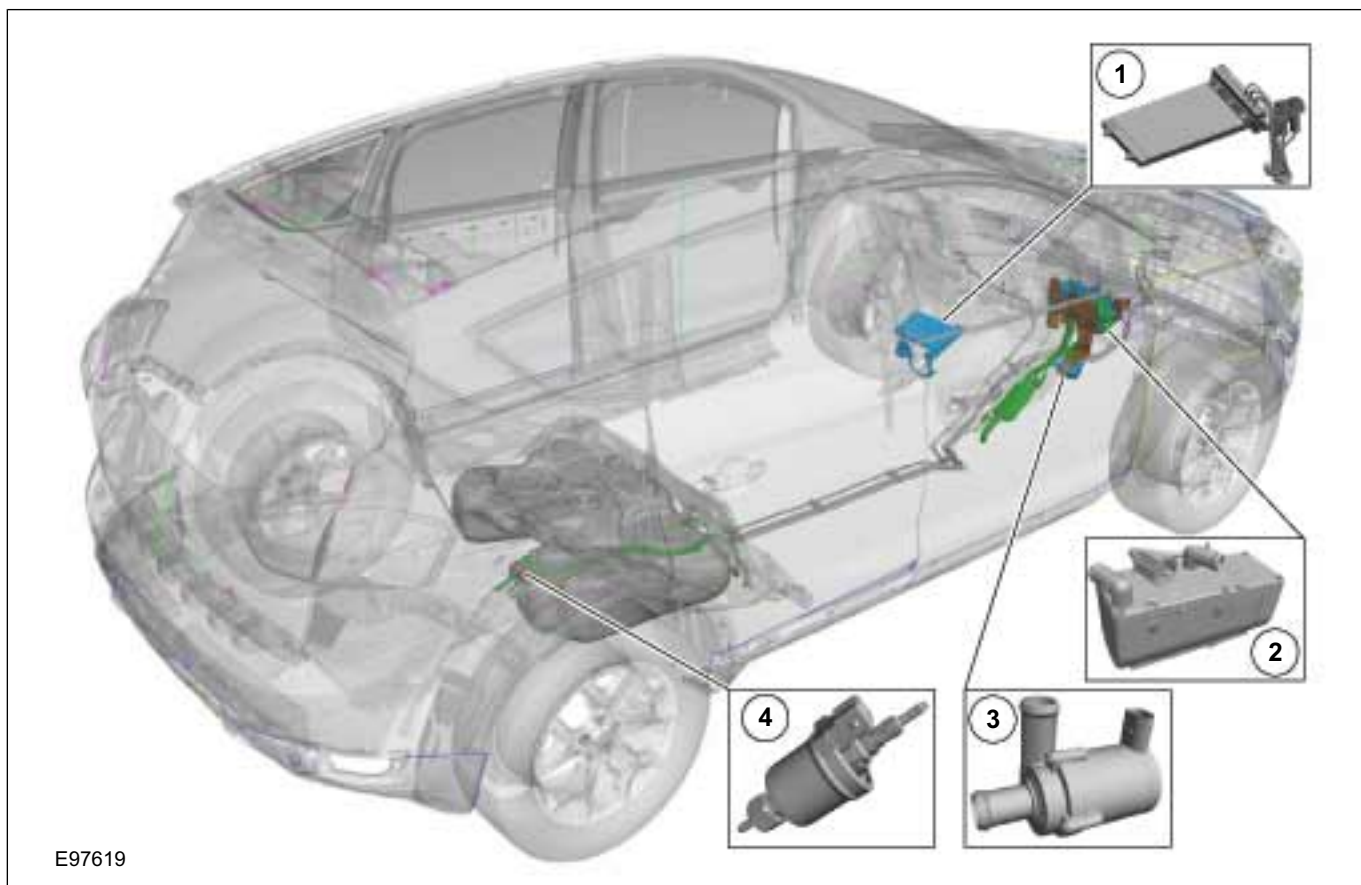
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Auxiliary Climate Control (Overview).....	412-02-4
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DESCRIPTION AND OPERATION

Auxiliary Climate Control – Component Location

Auxiliary Climate Control



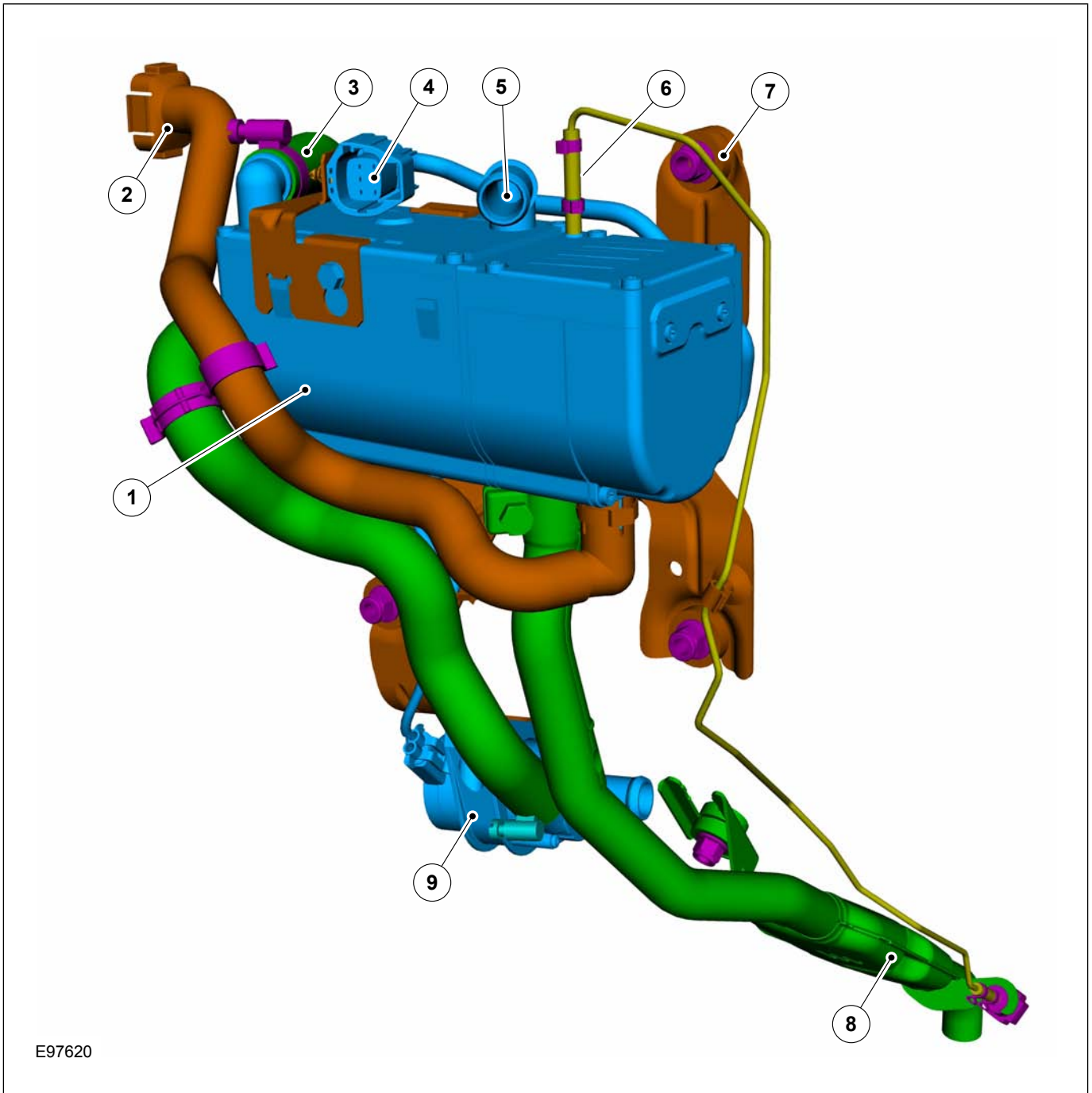
Item	Description
1	Electric Booster Heater
2	Fuel powered booster heater

Item	Description
3	Coolant Pump
4	Fuel pump



DESCRIPTION AND OPERATION

Programmable fuel fired booster heater



E97620

Item	Description
1	Fuel powered booster heater
2	Fresh air inlet
3	Coolant intake
4	Connector for the booster heater

Item	Description
5	Coolant exhaust
6	Fuel intake
7	Holder for the fuel-fired booster heater
8	Exhaust System
9	Coolant Pump

**DESCRIPTION AND OPERATION**

## Auxiliary Climate Control – Overview

### Initial start-up of the fuel-fired booster heater

The fuel-fired booster heater needs to be filled before being taken into operation for the first time. Activation of the fuel pump for the fuel-fired booster heater is controlled by the Ford diagnostic unit.

### Lockout

#### Flame sensor

If the flame goes out independently during operation of the booster heater, a restart is carried out. If the booster heater does not ignite within 90 seconds of fuel delivery or if the flame goes out within 15 minutes of starting, a lockout will be implemented by the flame sensor.

Lockout can be cancelled by switching the booster heater off then on again, although this may only be repeated at most 2 times.

#### Overheating sensor

In the event of overheating (water shortage, poorly ventilated coolant circuit), the fuel supply to the booster heater is interrupted and a lockout occurs. After the cause of the overheating has been eliminated, the booster heater can be started again by switching it off and on, if the coolant temperature is below 70°C. If the booster heater overheats ten times in a row, the control unit will be locked.

### Unlocking the control unit

Delete the fault memory of the fuel-fired booster heater after eliminating the cause of the fault using the Ford diagnostic unit.



---

**DESCRIPTION AND OPERATION**

Auxiliary Climate Control – System Operation and Component Description

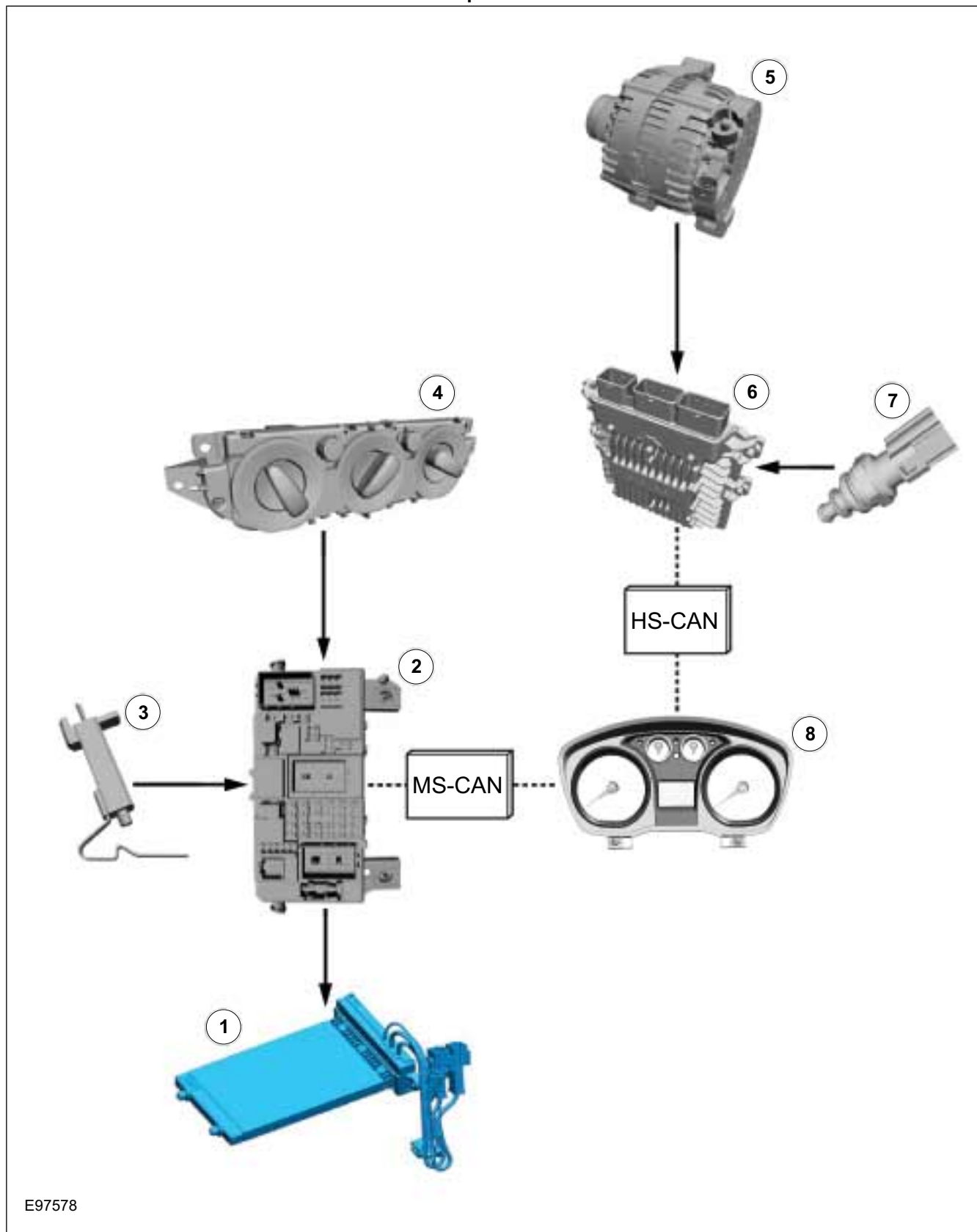
**System Diagram**

**VIEW DIAGRAM ON THE NEXT PAGE**



DESCRIPTION AND OPERATION

Electric booster heater - vehicles with manual temperature control



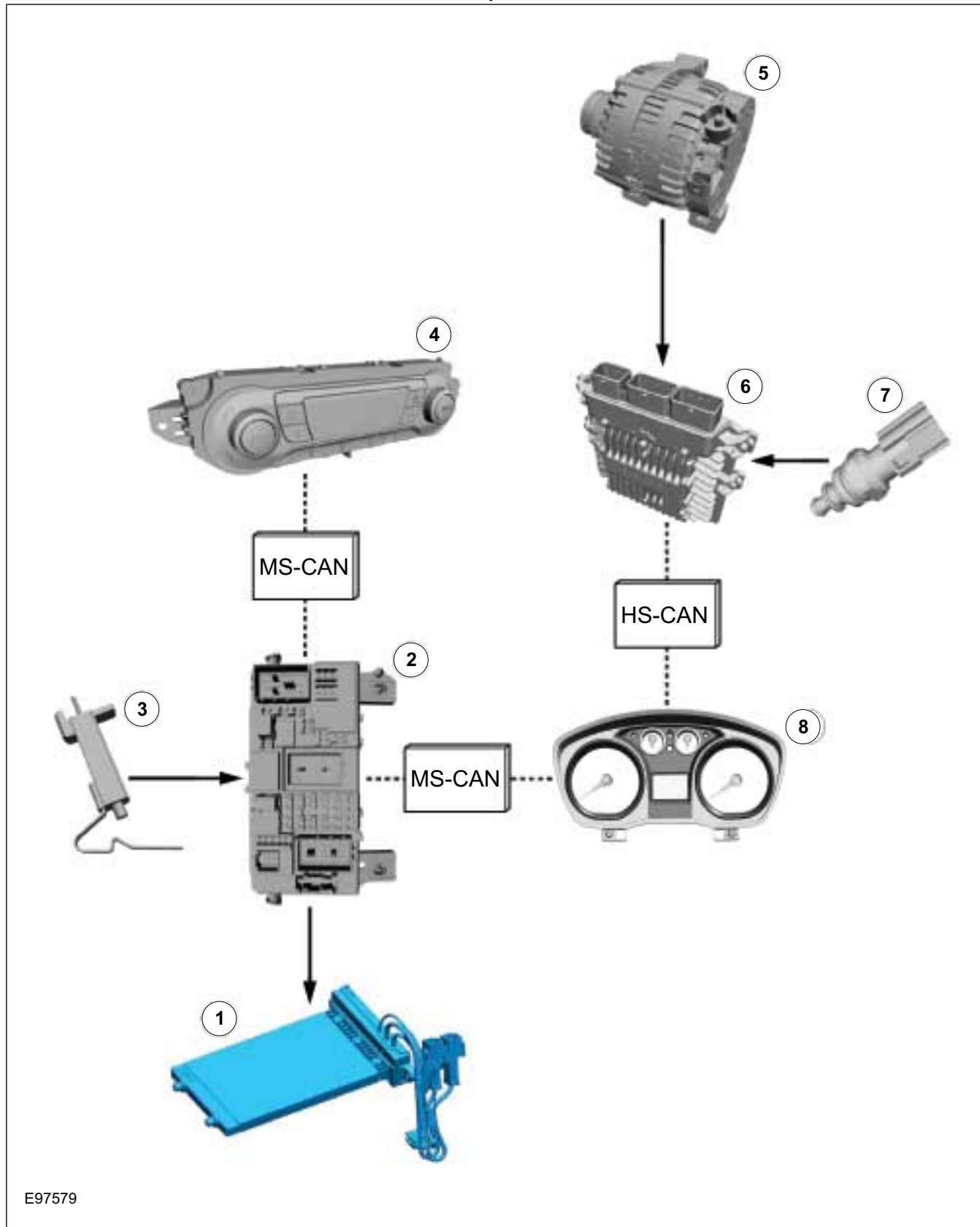
**DESCRIPTION AND OPERATION**

Item	Description
1	Electric Booster Heater Refer to Component Description: (page ?)
2	GEM (generic electronic module)
3	Outside temperature sensor
4	Climate control system control assembly

Item	Description
5	Generator and Alternator
6	PCM (powertrain control module)
7	Coolant temperature sensor (ECT (engine coolant temperature) sensor) Refer to Component Description: ECT (page ?)
8	instrument cluster

DESCRIPTION AND OPERATION

Electric booster heater - vehicles with automatic temperature control



E97579



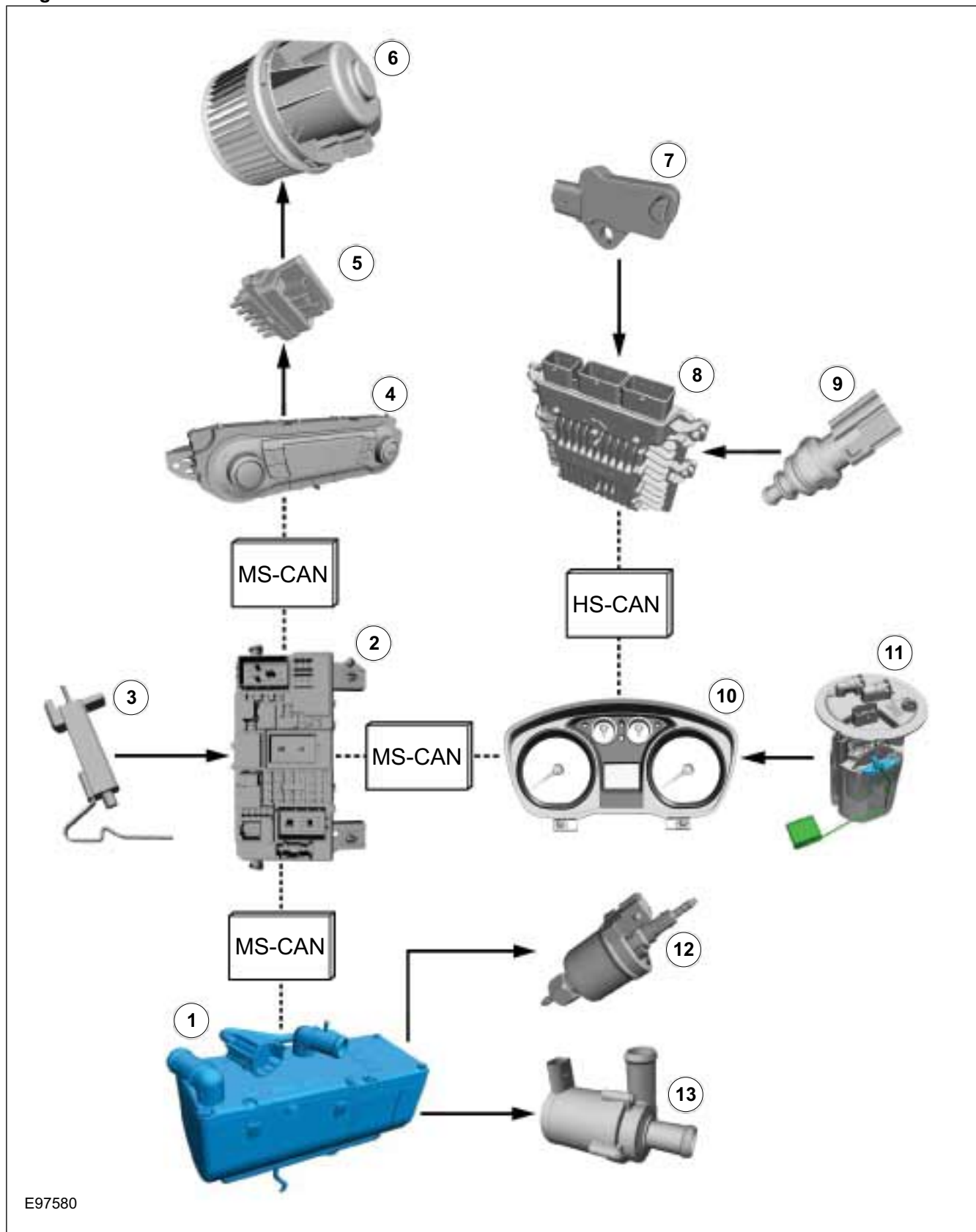
**DESCRIPTION AND OPERATION**

Item	Description
1	Electric Booster Heater Refer to Component Description: (page ?)
2	GEM
3	Outside temperature sensor
4	Climate control system control assembly

Item	Description
5	Generator and Alternator
6	PCM
7	Coolant temperature sensor (ECT sensor) Refer to Component Description: ECT (page ?)
8	instrument cluster

DESCRIPTION AND OPERATION

Programmable fuel fired booster heater



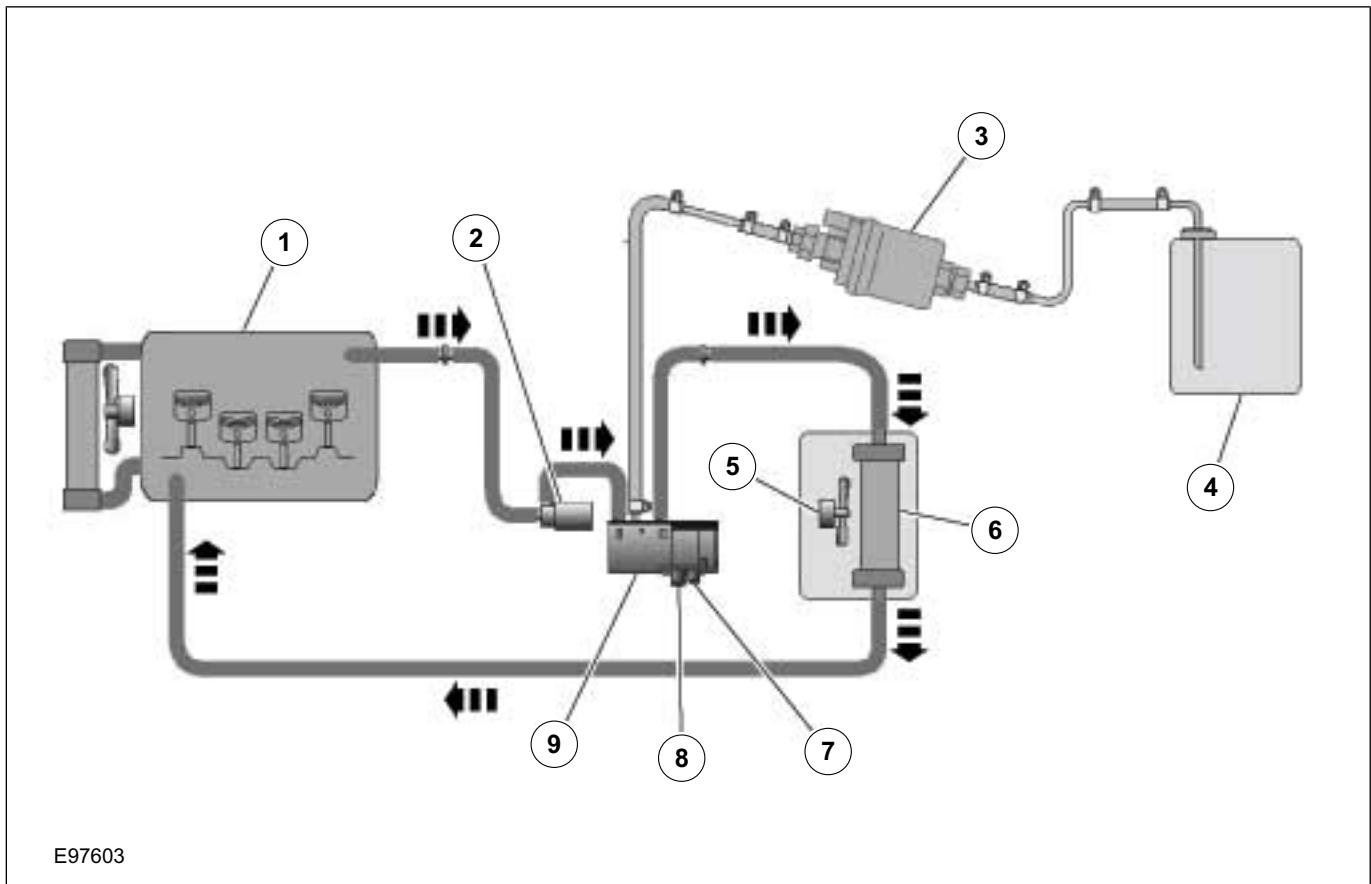
E97580

DESCRIPTION AND OPERATION

Item	Description
1	Fuel powered booster heater Refer to Component Description: Detailed illustration of fuel-fired heater (page ?)
2	GEM
3	Outside temperature sensor
4	Climate control system control assembly
5	Blower control module
6	Blower motor
7	Crankshaft position (CKP) sensor
8	PCM

Item	Description
9	Coolant temperature sensor (ECT sensor) Refer to Component Description: ECT (page ?)
10	instrument cluster
11	Fuel level sensor
12	Fuel pump Refer to Component Description: (page ?)
13	Water pump Refer to Component Description: (page ?)

Coolant circuit - Programmable fuel fired booster heater



Item	Description
1	Engine
2	Water pump
3	Fuel pump
4	Fuel tank

Item	Description
5	Blower motor
6	Heat exchanger
7	Air Intake
8	Exhaust pipe
9	Auxiliary Heaters

## DESCRIPTION AND OPERATION

## System Operation

## Electric Booster Heater

In diesel vehicles which give off little residual heat, a booster heater is used to heat the passenger compartment rapidly in the case of low ambient temperatures.

If the interior temperature has been set to HI, or if the heater controls have been switched to the highest setting, the two-zone air conditioning system sends an "electric booster heater ON" request signal to the CAN (controller area network) via the medium speed GEM bus. If a manual air conditioning system is installed, the signal is transmitted via a conventional cable connection.

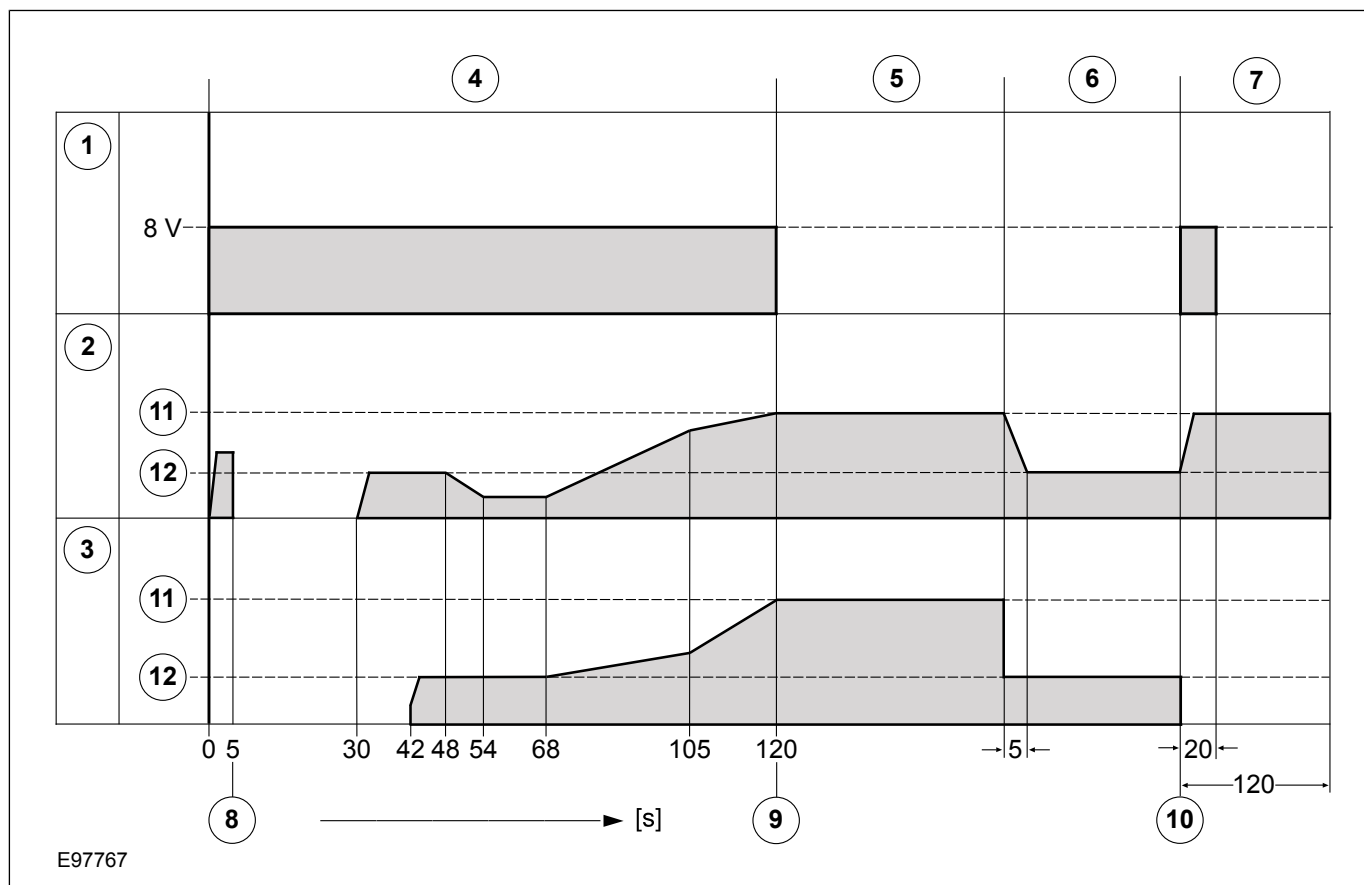
The GEM switches on the electric booster heater depending on the following parameters:

- Engine coolant temperature is below 60 °C.
- Ambient air temperature is below 10 °C.
- Sufficient generator capacity is available.

The electric booster heater electronics activate three output stages as a function of a pulse width modulated signal PWM (pulse width modulation) generated by the GEM. The output stages switch the three heating elements of the electric booster heater ON or OFF individually, whereby the heating periods of the individual elements can overlap. Due to the variable switch-on duration, continuously variable temperature control is possible. The overall heating power of the three heating elements is linearly proportional to the PWM signal. If the PWM signal is below 10% or above 95%, the electric booster heater is not activated.

The electric booster heater is switched off when an engine coolant temperature of 70°C or an ambient air temperature of 20°C is exceeded.

## Fuel-fired heater - function diagram



## DESCRIPTION AND OPERATION

Item	Description
1	Glow plug
2	Combustion Air Blower
3	Fuel pump
4	Fuel-fired heater on
5	Fuel-fired heater - large regulating step
6	Fuel-fired heater - small regulating step

Item	Description
7	Fuel-fired heater off
8	Blower motor on
9	Flame detection
10	Blower motor off
11	Large regulating step
12	Small regulating step

**Boost heat mode**

When the engine is running, the booster heater helps the engine to heat the passenger compartment at low ambient temperatures.

When the coolant temperature reaches 30 °C, the control unit transmits a switch-on signal for the passenger compartment blower via the CAN bus. When the coolant temperature drops, the blower remains on until the temperature reaches 20 °C whereupon it is deactivated.

The fuel tank must be filled to at least 14% for the system to be switched on. If the fuel level drops below 8% then the system is switched off.

In boost mode, the fuel fired booster heater is only switched on if all of the following criteria are met:

- Engine speed above 500 rpm. The fuel fired booster heater is not allowed to start up while the engine is being cranked; this prevents a shut-down due to low voltage if the battery charge is low.
- Ambient temperature below 5 °C.
- Fuel level above 14% of total capacity.
- Function is active on the trip computer menu.

One of the following conditions is sufficient to switch off the booster heater in boost heat mode:

- Engine speed below 500 rpm.
- Ambient temperature above 11 °C.
- Function is active on the trip computer menu.
- Fuel level below 8% of total capacity.

**Programmable fuel fired booster heater**

The programmable fuel fired booster heater has two operating modes:

- Instant start
- Programmed start

The heater status is displayed on the instrument cluster display. The parking heater mode is

controlled via a menu in the message centre. The fuel fired booster heater can be activated and deactivated via the message centre. (If set to 'Auto' the system is activated, if set to 'Off' the system is completely deactivated)

**Immediate start-up of the booster heater**

This function enables the fuel-fired booster heater to be switched on manually when the engine is not running. This function is activated via the menu on the driver information system.

The ignition key must be in the II" position before this menu can be accessed. The timer function of the booster heater remains active when the ignition key is in position "0".

After an immediate start-up of the booster heater it is switched off again after 30 minutes (or if the fuel level in the fuel tank drops below 8%). The booster heater stops within 2 minutes of the engine starting. This leaves enough time to check whether the switch-on conditions for boost heat mode have been met, thus preventing the booster heater from having to switch off and switch back on again. The heater can be switched off manually at any time from the menu.

**Programmed start-up of the booster heater**

The driver can use a menu to adjust the time at which the vehicle is to be pre-heated. The following options are available:

- Time setting. One or two times can be programmed for each day of the week. It is possible to program days either individually or together in groups (Mon-Sun/Mon-Sat/Mon-Fri).
- Time and data setting

With the first option, the fuel-fired booster heater will start repeatedly without needing to be

**DESCRIPTION AND OPERATION**

reprogrammed. However, if the engine hasn't been run since the last programmed start, the fuel-fired booster heater will not start up the second time so as to prevent the battery from being discharged.

The length of time required to pre-heat the vehicle is calculated in the control unit of the fuel-fired booster heater and is based on two temperature values:

- Ambient air temperature: this message is taken from the GEM via the CAN bus.
- Coolant temperature: this is determined via an internal sensor in the fuel-fired booster heater.

The maximum heating time is 30 minutes at an outside air temperature of  $-10\text{ }^{\circ}\text{C}$  or lower. The heating time decreases proportionally with increasing ambient temperature until the ambient temperature is between  $+15\text{ }^{\circ}\text{C}$  and  $+20\text{ }^{\circ}\text{C}$ . Then the minimum heating time is 10 minutes. The parking heater is deactivated at temperatures above  $+20\text{ }^{\circ}\text{C}$ .

The sequence for a programmed start of the booster heater is as follows:

- Two minutes before the start of the maximum heating time the driver information system/instrument cluster sends an activation message to the fuel-fired booster heater via the CAN bus.
- The fuel-fired booster heater calculates the required heating time and, if necessary, sends a delay request on the CAN bus.
- At the calculated time, the fuel-fired booster heater starts up. The conditions for start-up are: engine not running and amount of fuel in the fuel tank is above 14% of maximum.
- When the coolant temperature reaches  $+30\text{ }^{\circ}\text{C}$ , the control unit of the fuel-fired booster heater sends a request to switch on the passenger compartment blower.
- Eight minutes after the programmed switch-off time, the booster heater stops heating mode and starts a run-on operation to clean the system's spark plugs.
- Ten minutes after the switch-off time, the post-cleaning operation is complete. The additional ten minutes run-on time provides some leeway in case the driver is late arriving.

After a programmed start-up of the booster heater it is switched off again after the heating time has elapsed (or if the fuel level in the fuel tank drops below 8%). The booster heater stops within 2

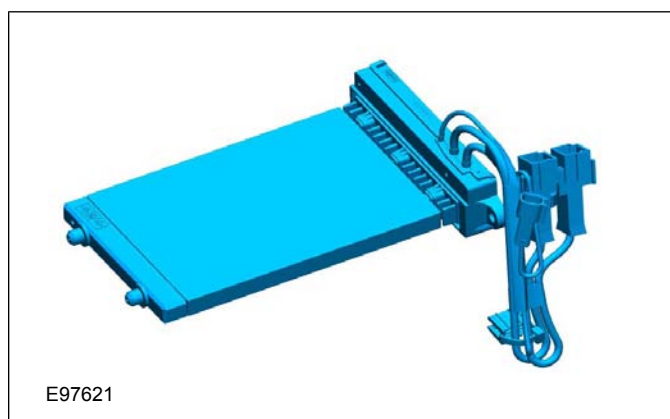
minutes of the engine starting. This leaves enough time to check whether the switch-on conditions for boost heat mode have been met, thus preventing the booster heater from having to switch off and switch back on again. The heater can be switched off manually at any time from the menu.

Whilst the fuel-fired booster heater is in additional heating mode and/or parking heating mode, the instrument cluster receives a fuel consumption signal; this is used to re-calculate the vehicle's remaining range and fuel consumption data.

**Emergency shutoff**

In the event of an accident in which the airbags are deployed, the control unit of the fuel-fired booster heater receives a message on the CAN bus from the restraints control module (RCM). When this message is received, the booster heater system switches off immediately.

The booster heater control module deactivates the system and does not respond to further messages on the CAN bus. The booster heater control module needs to be activated with WDS.

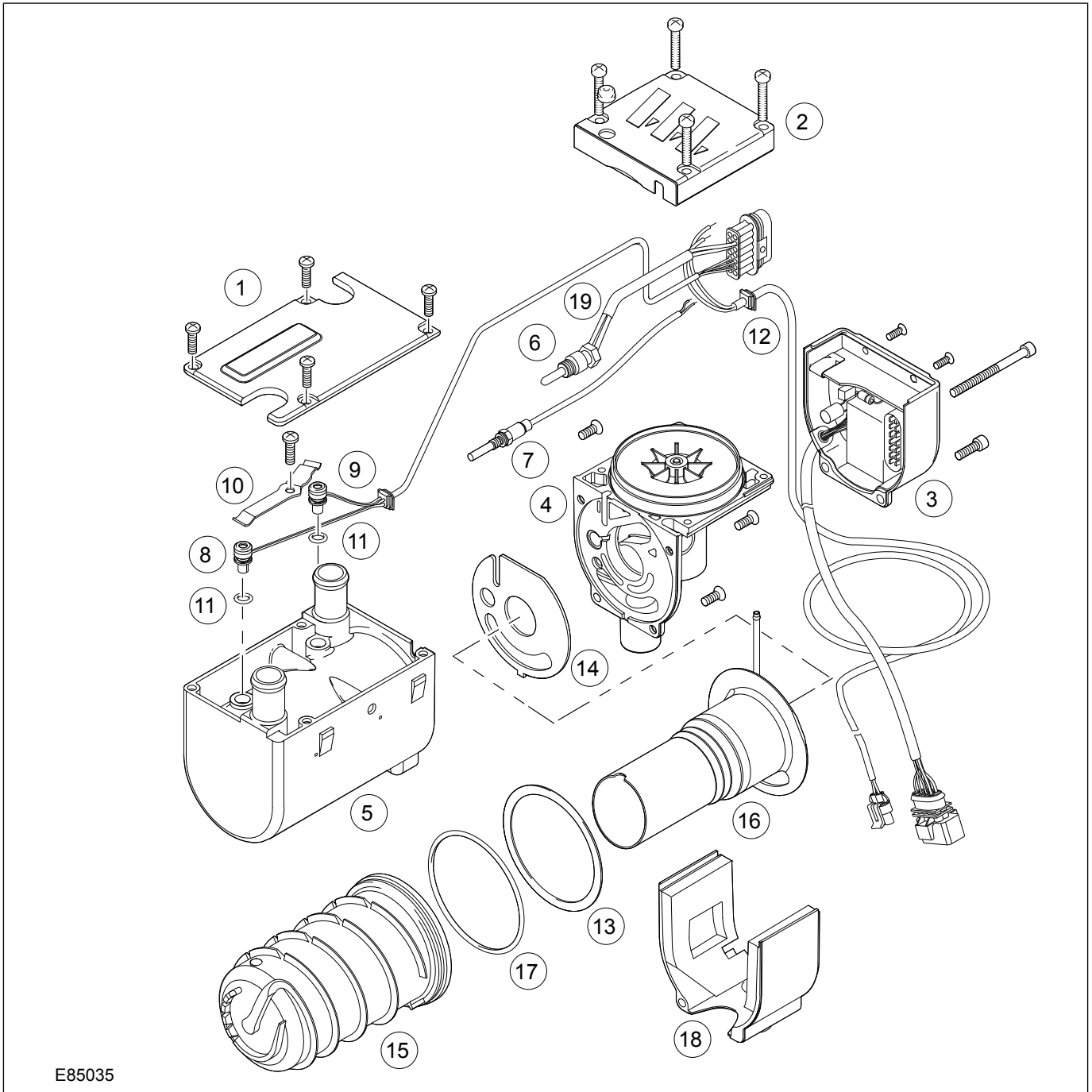
**Component Description****Electric Booster Heater**

The electric booster heater consists of three individual heating elements, which are incorporated into a single housing. It is controlled by the generic electronic module (GEM), taking into account the following factors:

**Detailed illustration of fuel-fired heater**



DESCRIPTION AND OPERATION



E85035

Item	Description
1	Cooling sleeve cover
2	Combustion air blower cover
3	Fuel fired additional heater module
4	Combustion Air Blower
5	Cooling sleeve
6	Glow plug
7	Flame sensor
8	Overheat Sensor

Item	Description
9	ECT
10	Compression spring
11	'O' Ring
12	Internal wiring harness - fuel fired additional heater
13	Gasket
14	Gasket
15	Heat exchanger

**DESCRIPTION AND OPERATION**

Item	Description
16	Combustion chamber
17	'O' Ring

Item	Description
18	Combustion blower motor cover
19	Glow plug wiring harness

**Flame sensor**

If the flame goes out independently during operation of the booster heater, a restart is carried out. If the booster heater does not ignite within 90 seconds of fuel delivery or if the flame goes out within 15 minutes of starting, a lockout will be implemented by the flame sensor.

Lockout can be cancelled by switching the booster heater off then on again, although this may only be repeated at most 2 times.

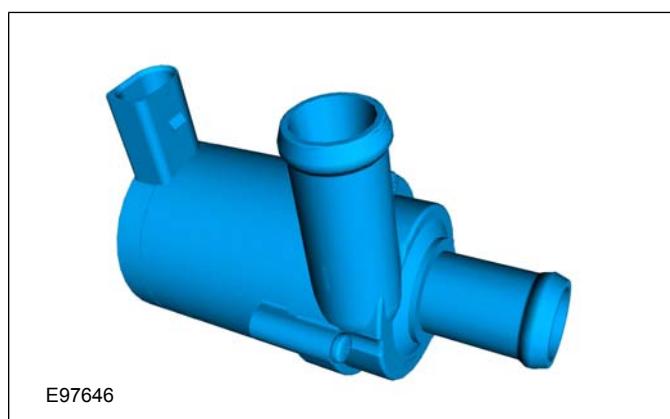
**Overheat Sensor**

The overheating sensor enables the fuel-fired booster heater module to determine the coolant temperature, protecting the heater from overheating. The overheating sensor is installed next to the coolant temperature sensor under a cover on the top of the fuel-fired heater.

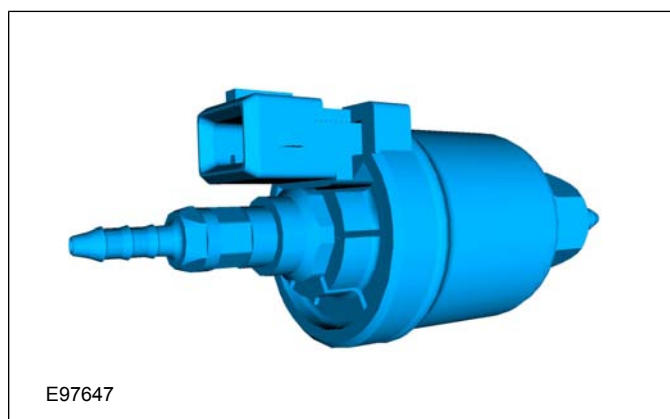
In the event of overheating (lack of water, poorly ventilated coolant circuit), the fuel supply to the heater is interrupted and a lockout occurs. After the cause of the overheating has been eliminated, the heater can be restarted by switching it off and on again, if the coolant temperature is below 70°C. If the heater overheats ten times in a row, the control unit is locked.

**ECT**

The fuel-fired booster heater module uses the temperature sensor to determine the coolant temperature, which it then uses to set the starting and stopping time. The coolant temperature sensor is installed next to the overheating sensor under a cover on the top of the fuel-fired heater.

**Water pump**

The coolant pump is located on the holder for the fuel-fired heater on the bulkhead in the rear of the engine compartment. The coolant pump is driven by a built-in electric motor and circulates the coolant in the engine cooling system. The delivery rate for the pump is 820l/h at a delivery pressure of 0.1 bar.

**Fuel pump**

The fuel required for the fuel-fired heater is taken from the fuel system by a fuel pump fitted in the fuel tank and is delivered to the heater via a fuel line.

The fuel pump is an electric piston pump which meters the corresponding fuel volume for the fuel-fired heater according to a cycle set by the fuel-fired heater module.

## REMOVAL AND INSTALLATION

## Auxiliary Coolant Flow Pump

## General Equipment

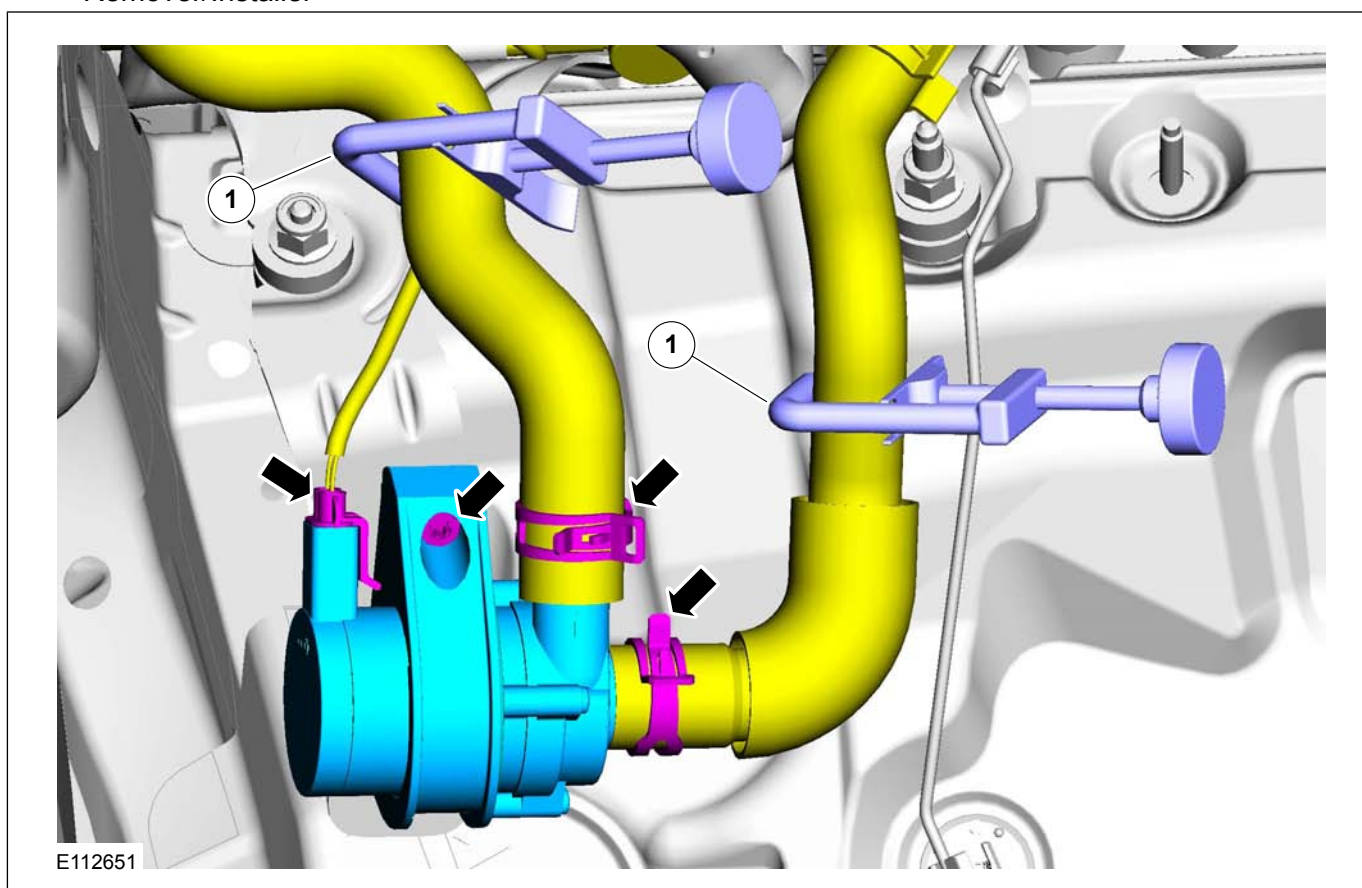
Hose Clamp(s)

## General Equipment

Hose Clamp Remover/Installer

## Removal

1. Refer to: **Engine Cooling System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Jacking** (100-02 Jacking and Lifting, Description and Operation).
3. General Equipment: Hose Clamp(s)  
General Equipment: Hose Clamp Remover/Installer



## Installation

1. To install, reverse the removal procedure.
2. Check the coolant level.

Refer to: **Cooling System Draining and Vacuum Filling** (303-03 Engine Cooling, General Procedures).

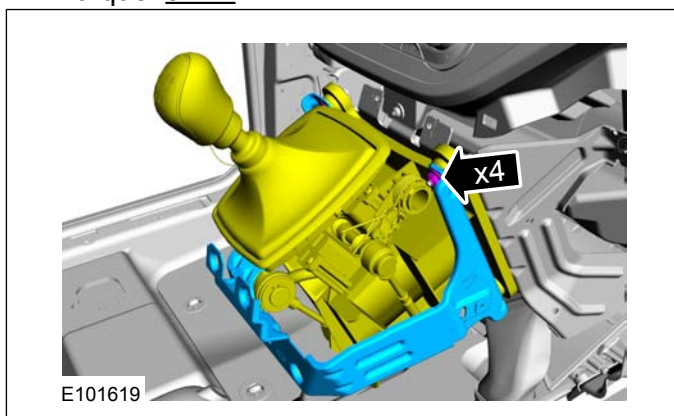
## REMOVAL AND INSTALLATION

## Electric Booster Heater

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

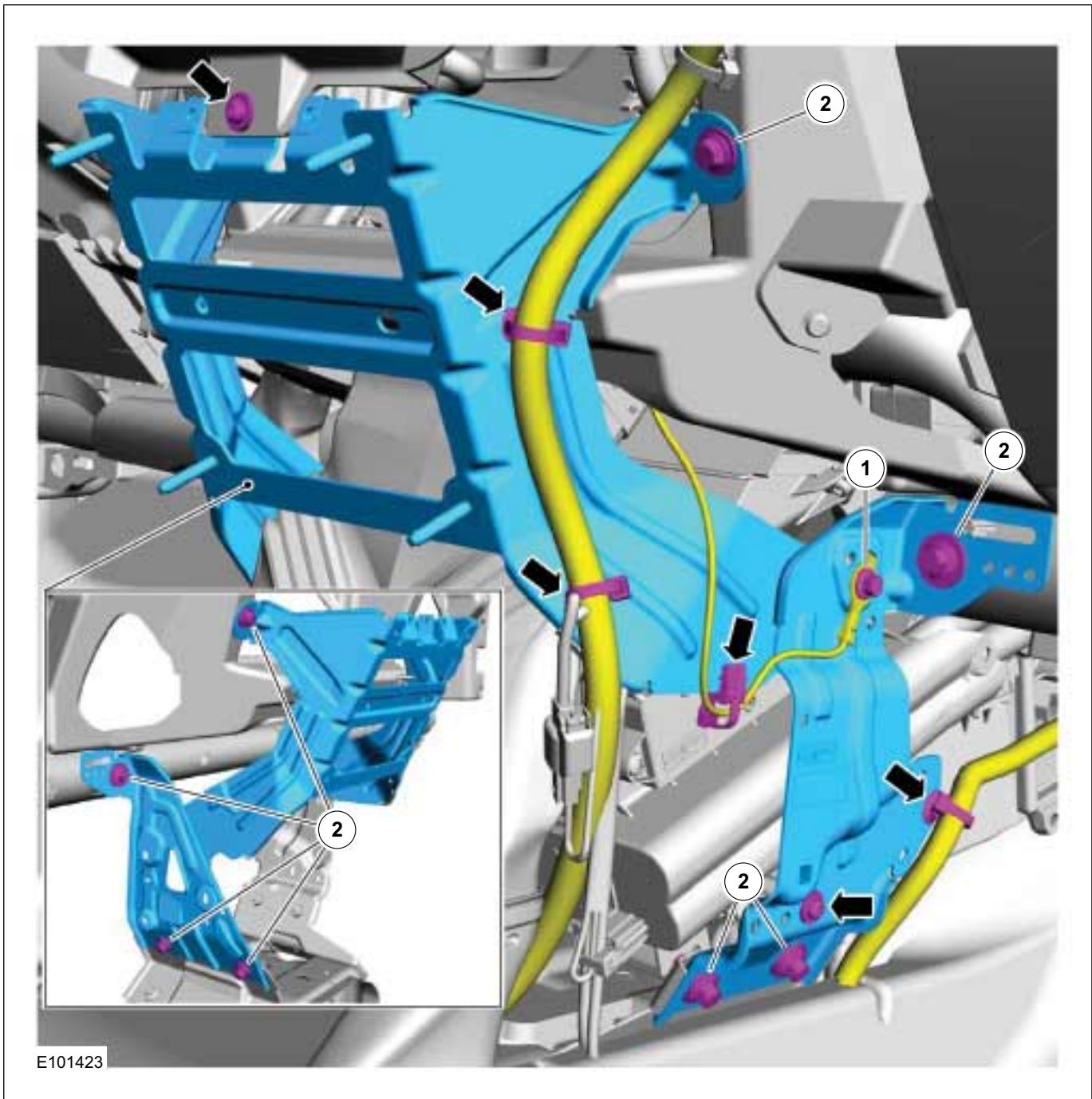
1. Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation).
2. Torque: 9 Nm



3. Refer to: **Climate Control Assembly - Vehicles With: Manual Temperature Control** (412-01 Climate Control, Removal and Installation). Refer to: **Climate Control Assembly - Vehicles With: Automatic Temperature Control** (412-01 Climate Control, Removal and Installation).
4. 1. Torque: 10 Nm  
2. Torque: 25 Nm



REMOVAL AND INSTALLATION



E101423

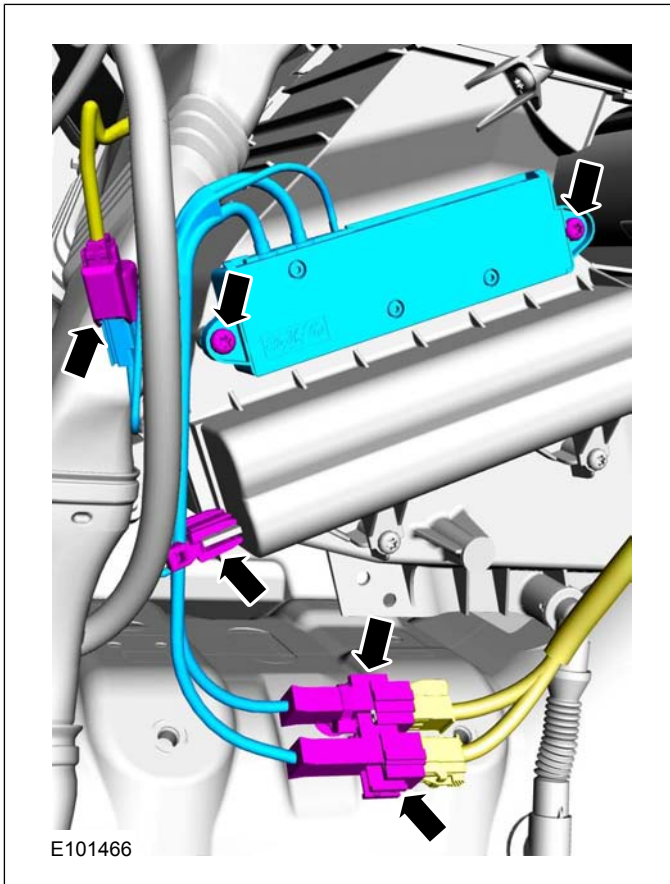
412-02-20

Auxiliary Climate Control

412-02-20

## REMOVAL AND INSTALLATION

5.



## Installation

1. To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

## Fuel Fired Booster Heater — 2.5L Duratec (147kW/200PS) - VI5

## General Equipment

Hose Clamp(s)

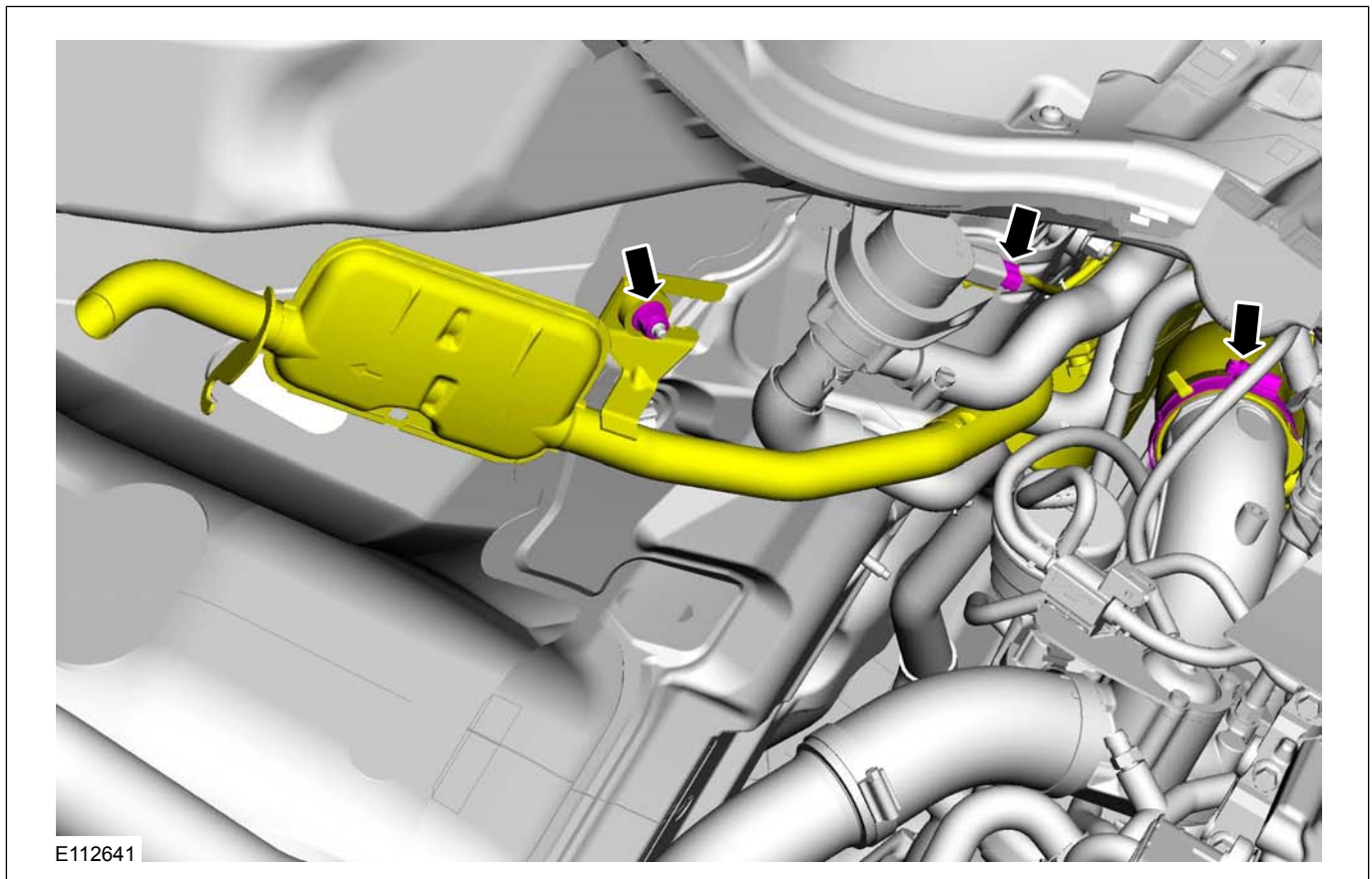
## General Equipment

Hose Clamp Remover/Installer

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Engine Cooling System Health and Safety Precautions** (100-00 General Information, Description and Operation).  
Refer to: **Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
- 3.



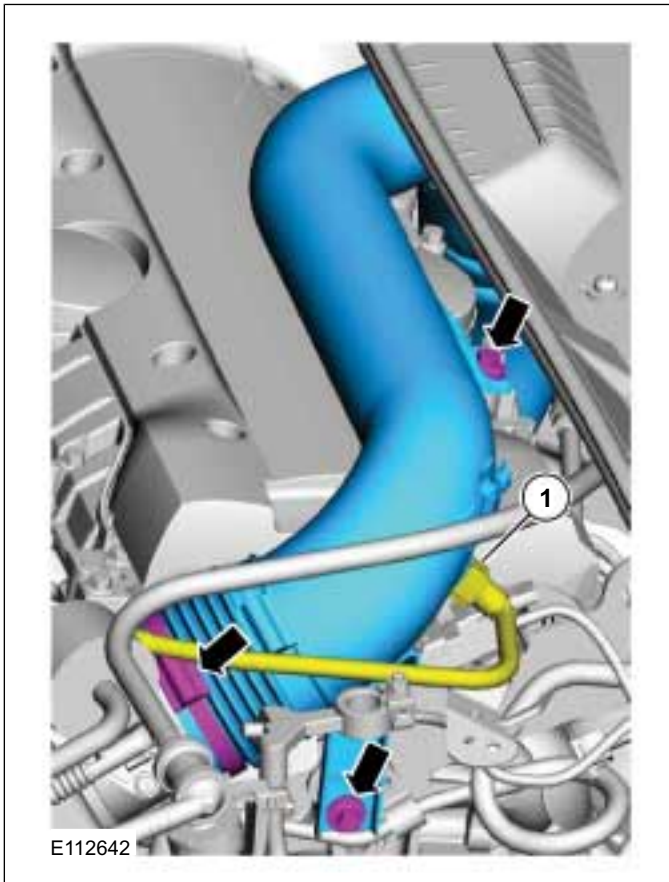
412-02-22

## Auxiliary Climate Control

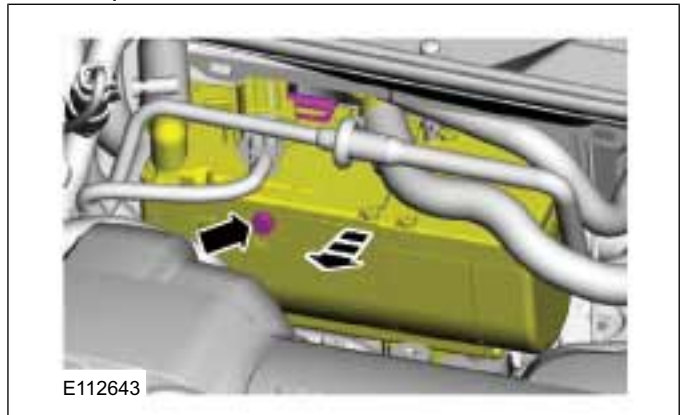
412-02-22

## REMOVAL AND INSTALLATION

1. Refer to: **Quick Release Coupling** (310-00 Fuel System - General Information, General Procedures).

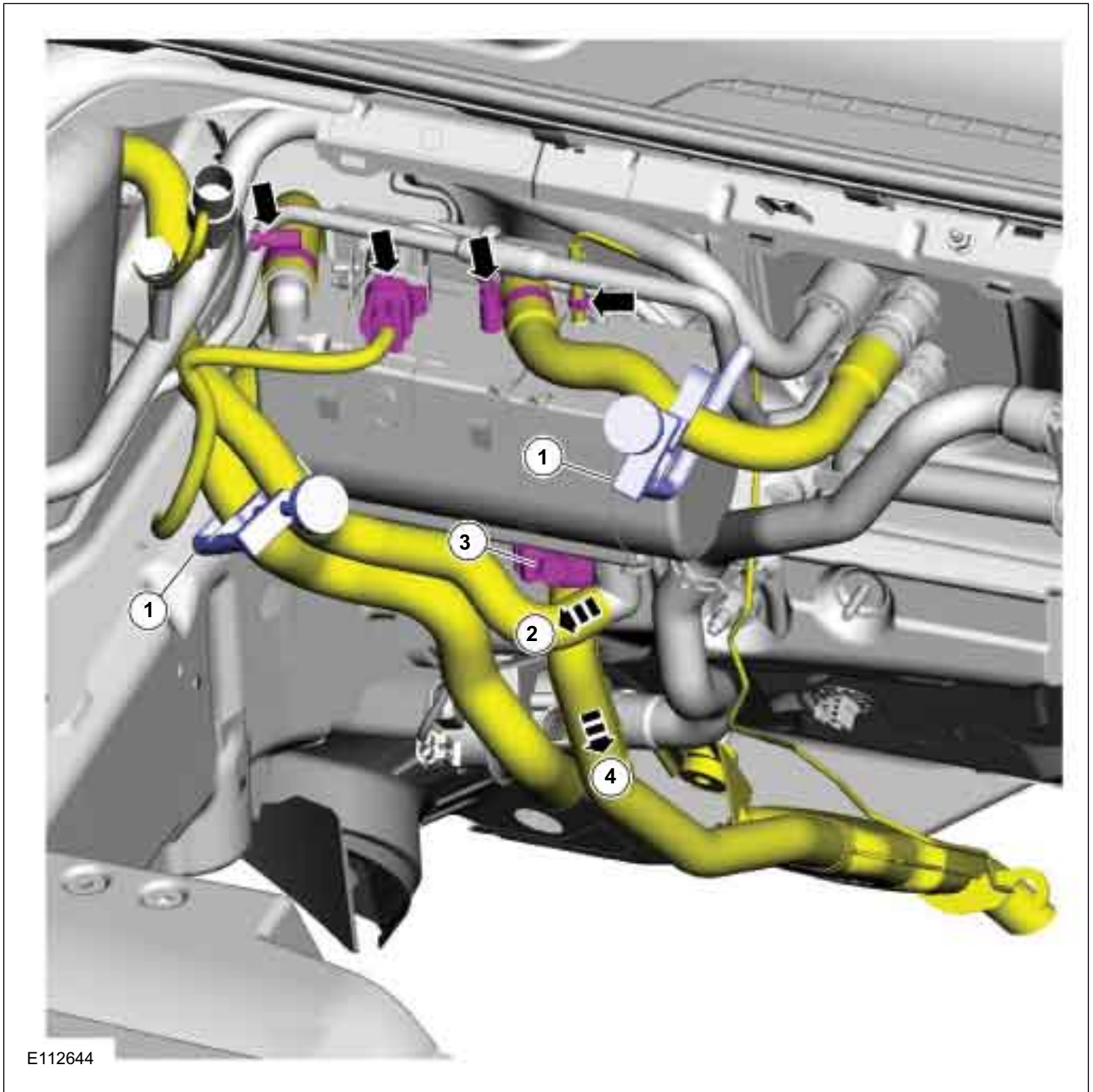


5. Torque: 6 Nm



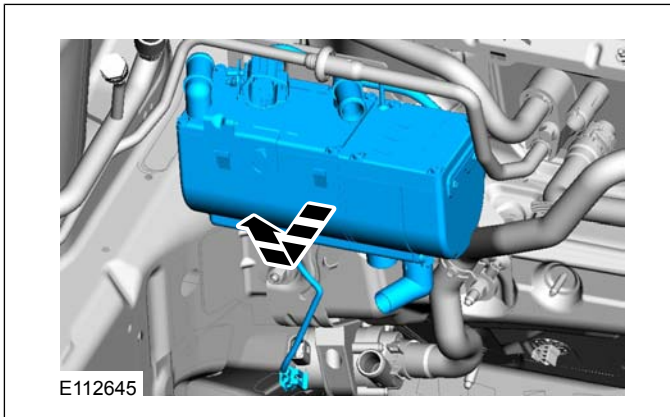
6. 1. General Equipment: Hose Clamp(s)  
General Equipment: Hose Clamp  
Remover/Installer
3. Torque: 6 Nm

REMOVAL AND INSTALLATION



**REMOVAL AND INSTALLATION**

7.

**Installation**

1. To install, reverse the removal procedure.
2. Check the coolant level.

Refer to: **Cooling System Draining and Vacuum Filling** (303-03 Engine Cooling, General Procedures).

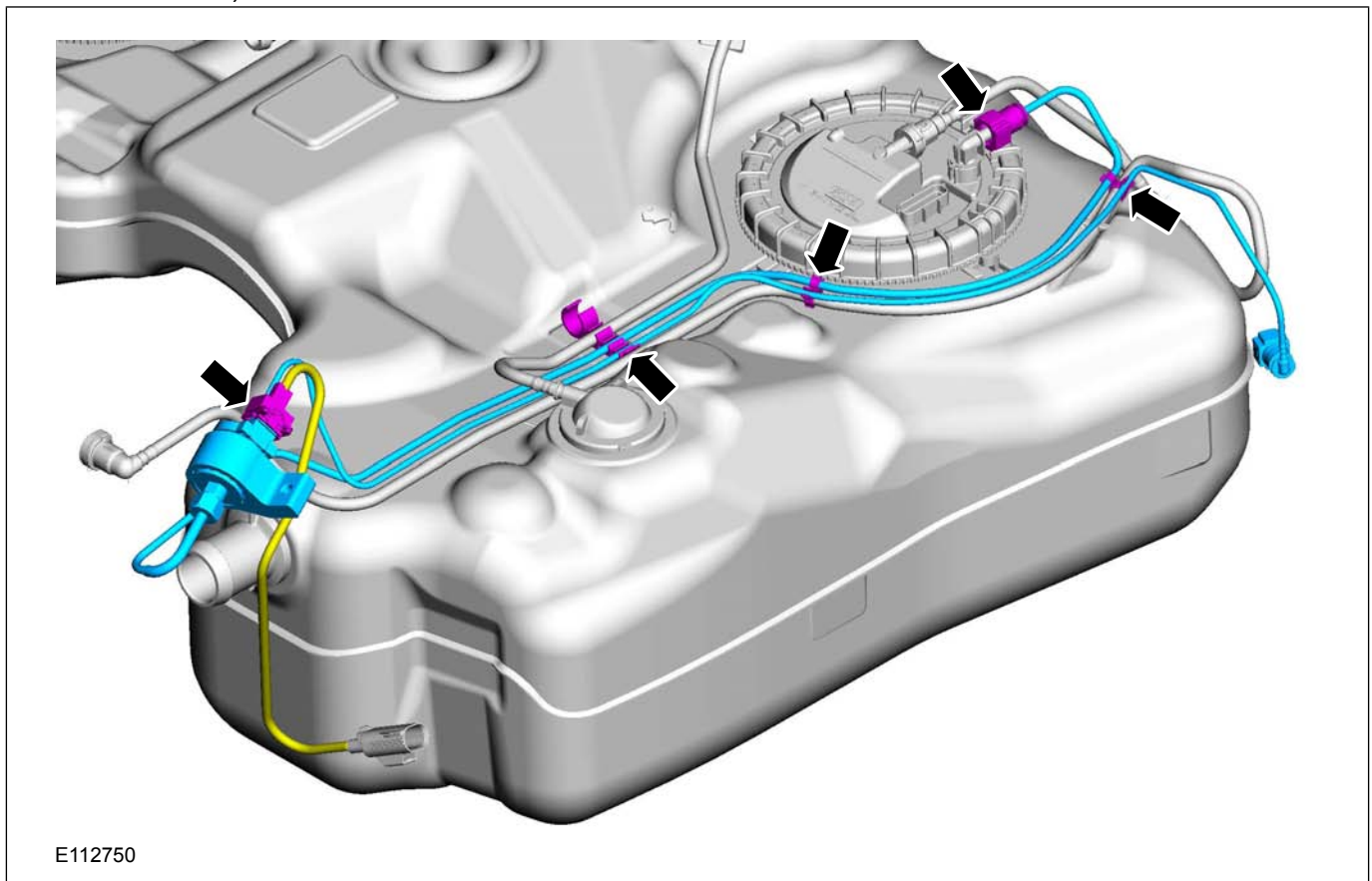


## REMOVAL AND INSTALLATION

## Fuel Fired Booster Heater Fuel Pump

## Removal

1. Refer to: **Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Fuel Tank - 2.5L Duratec (147kW/200PS) - VI5** (310-01 Fuel Tank and Lines, Removal and Installation).
3. Refer to: **Quick Release Coupling** (310-00 Fuel System - General Information, General Procedures).



## Installation

1. To install, reverse the removal procedure.

DISASSEMBLY AND ASSEMBLY

Fuel Fired Booster Heater

General Equipment

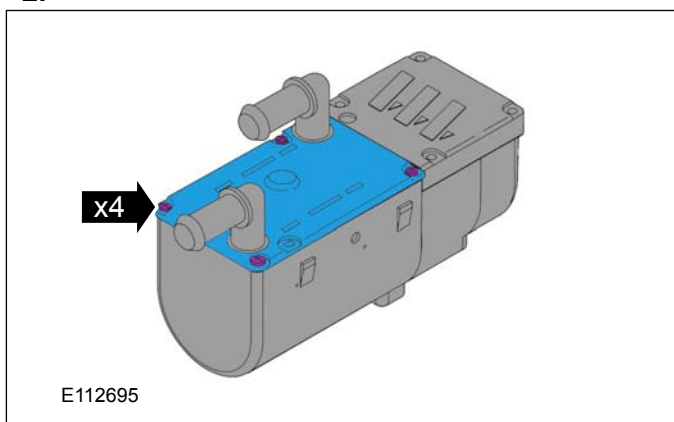
Flat-bladed screwdriver

Disassembly

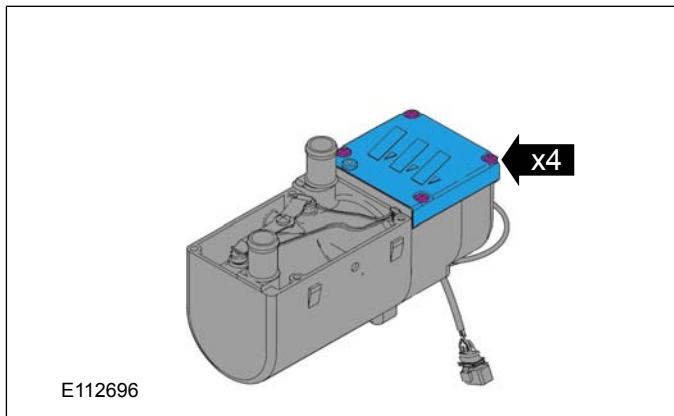
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Engine Cooling System Health and Safety Precautions** (100-00 General Information, Description and Operation).

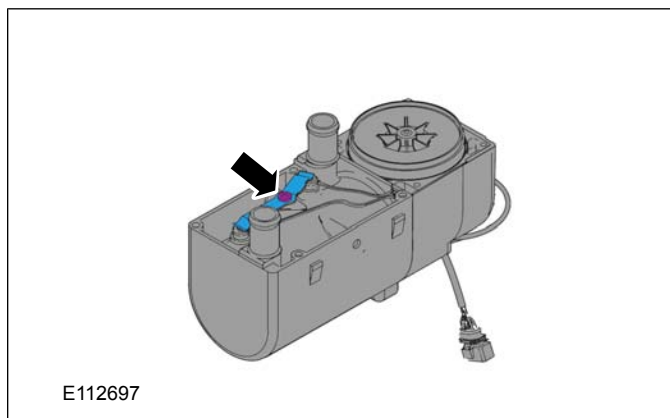
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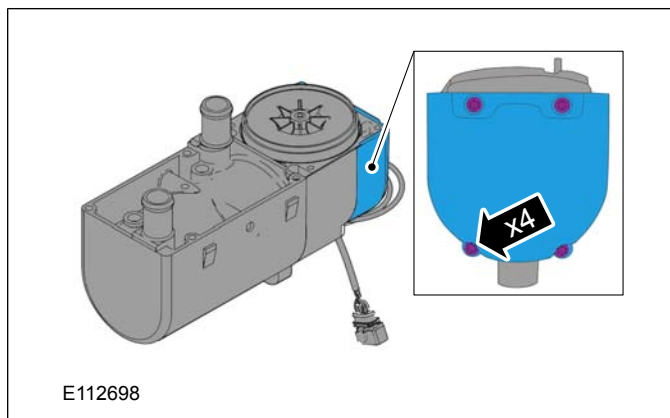
3.



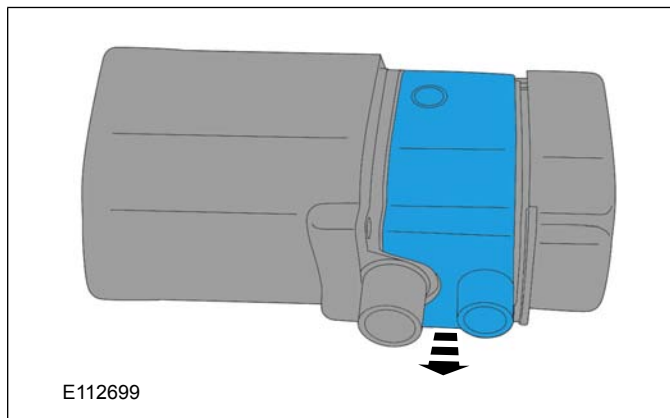
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5.



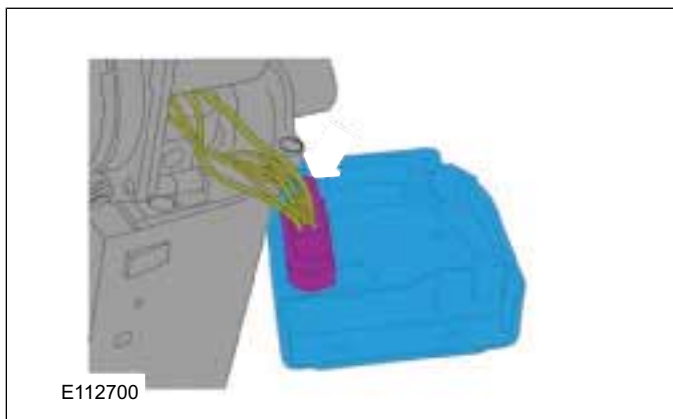
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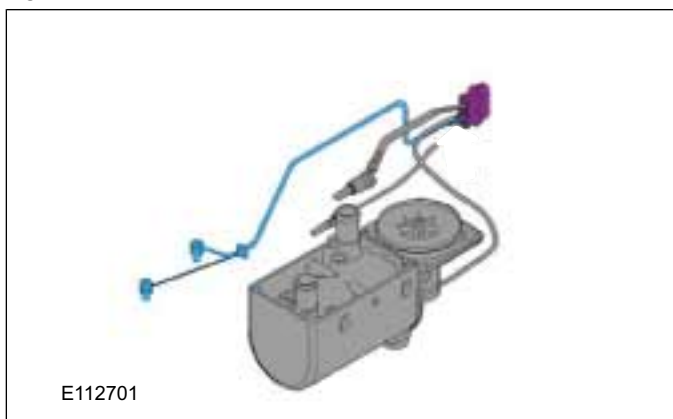


DISASSEMBLY AND ASSEMBLY

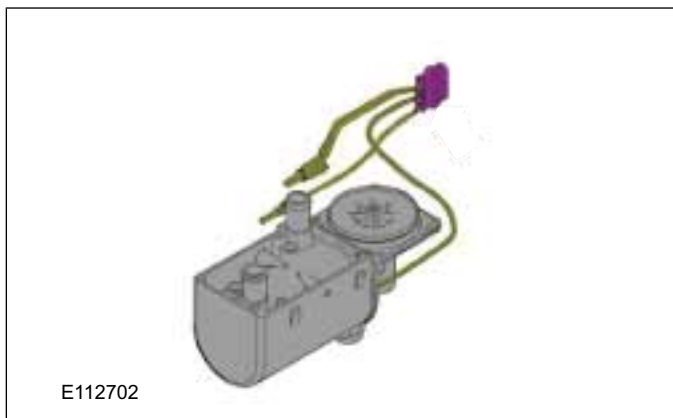
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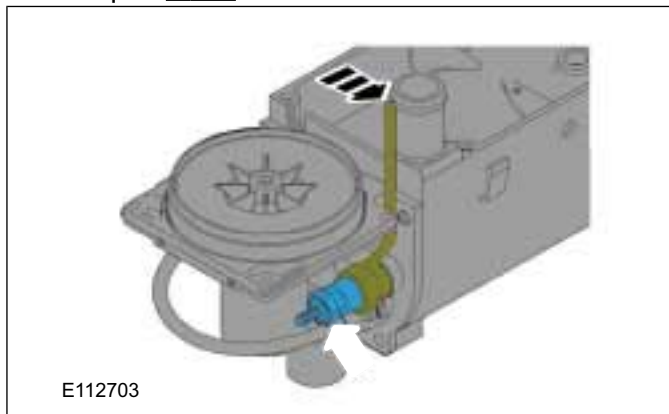
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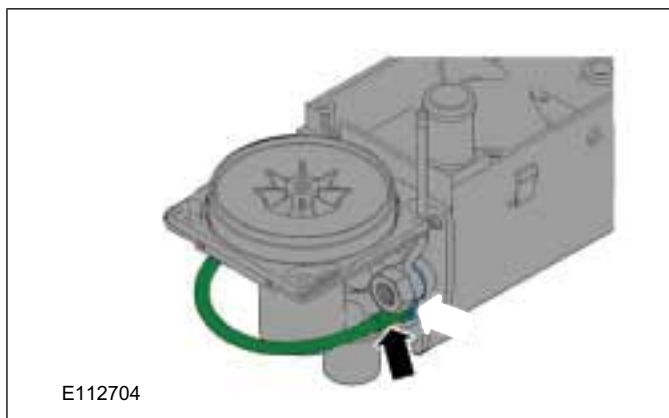
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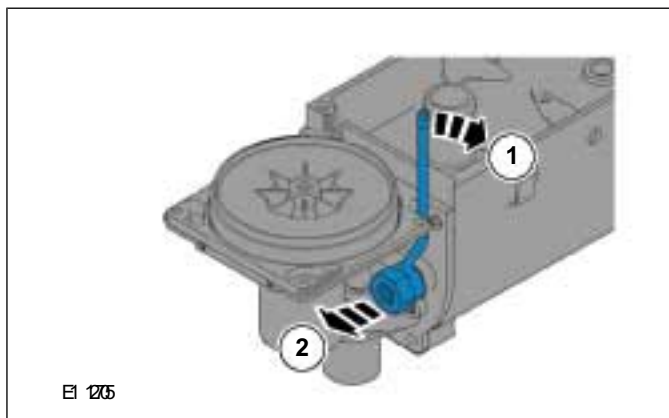
10. **⚠ CAUTION:** Use an open-ended wrench to prevent the component from turning.  
Torque: 6 Nm



11.



12.



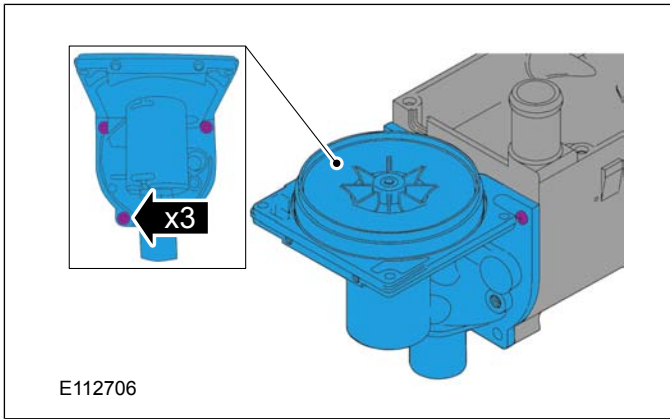
412-02-28

Auxiliary Climate Control

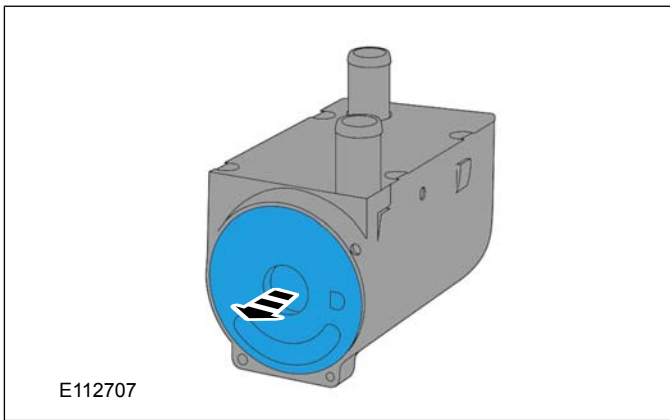
412-02-28

DISASSEMBLY AND ASSEMBLY

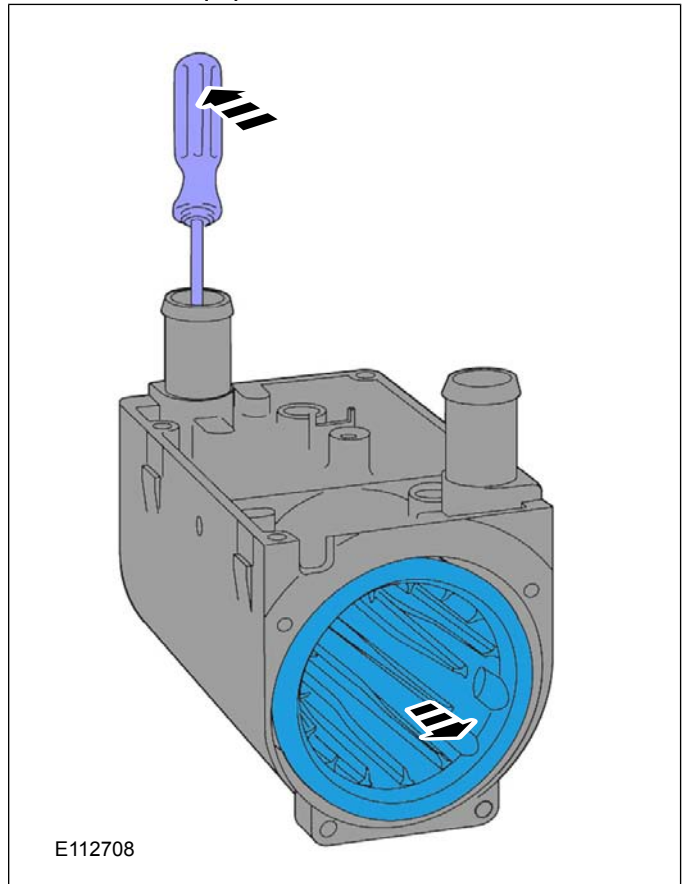
13.



14.



15. General Equipment: Flat-bladed screwdriver



Assembly

16. To assemble, reverse the disassembly procedure.

## SECTION 413-00 Instrument Cluster and Panel Illumination

VEHICLE APPLICATION: **2008.50 Kuga**

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Instrument Cluster and Dimmable Backlighting .....	413-00-2
Inspection and Verification.....	413-00-2

## DIAGNOSIS AND TESTING

## Instrument Cluster and Panel Illumination

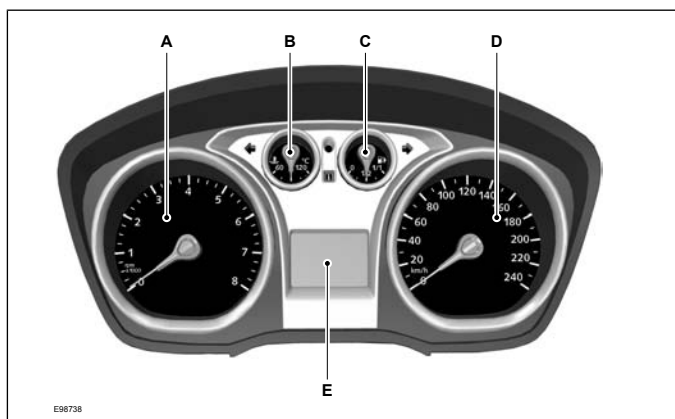
Refer to **Wiring Diagrams Section 413-00**, for schematic and connector information.

## Principles of Operation

**NOTE:** A new instrument cluster must be configured.

The instrument cluster and panel illumination consists of dimmable and non-dimmable illumination. The dimmable panel illumination is controlled by the panel illumination switch (part of the headlamp switch), which allows the brightness level of the backlights to be adjusted dependent on the customer preference. When the headlamp switch is in the parking lamps ON or headlamps ON position, the intensity of the backlighting can be adjusted using the panel dimmer switch. The non dimmable illumination allows for full intensity dependant on the ignition switch position.

## Instrument Cluster and Dimmable Backlighting



- A Tachometer
- B Engine coolant temperature gauge
- C Fuel gauge
- D Speedometer
- E Information display

The dimmable illumination utilizes light emitting diodes (LEDs) and bulb(s). The following dimmable components are backlight using LEDs only:

- ashtray
- cigar lighter
- transmission control lever
- heater control panel
- audio unit

- navigation system display module
- instrument cluster
- climate control module
- hazard switch
- traction control system disable switch
- right-hand and left-hand heated front seat switch(es)

## Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

## Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> <li>– Engine/engine compartment or underbody components</li> <li>– Fluid levels</li> <li>– Accessory installation</li> </ul>	<ul style="list-style-type: none"> <li>– Fuse(s)</li> <li>– Loose or corroded connector(s)</li> <li>– Instrument cluster</li> <li>– Wiring Harness</li> <li>– Circuit</li> <li>– LED(s)</li> <li>– Bulb(s)</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

## SECTION 413-01 Instrument Cluster

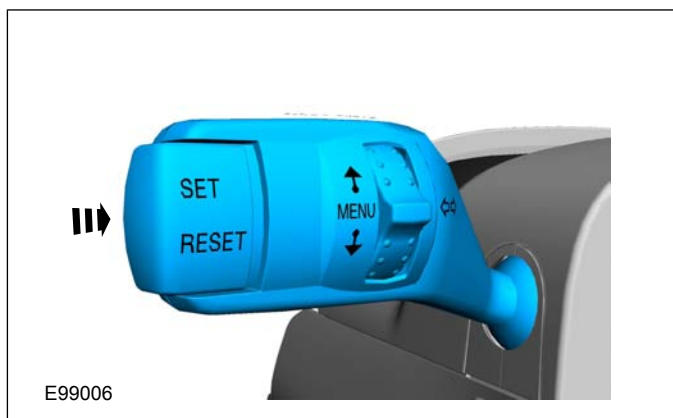
**VEHICLE APPLICATION: 2008.50 Kuga**

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**DESCRIPTION AND OPERATION****Instrument Cluster – Overview****Replacing the instrument cluster**

When installing a new instrument cluster, the Ford diagnostics device must be connected before dismantling the instrument cluster, in order to load the configuration data of the defective instrument cluster using the "Installation of programmable modules" routine. In addition, the value on the odometer of the defective instrument cluster must be noted, as this is required for configuration of the new instrument cluster. If the odometer value cannot be obtained from the instrument cluster (display failure), the customer should supply the approximate value.

When installing a new instrument cluster, the Ford diagnostics device must be connected after installation in order to download the configuration data of the defective instrument cluster into the new instrument cluster using the "Installation of programmable modules" routine, and to configure the newly installed instrument cluster to the PATS system.

**Self-diagnostic mode**

1. To enter the instrument cluster self-diagnostic mode, simultaneously press and hold the set button and turn the ignition switch from position 0 to position II.
2. Entry to self-diagnostic mode is confirmed when 'TEST' is displayed in the odometer's liquid crystal display (LCD). The instrument cluster set button must be released within 3 seconds of TEST being displayed in the tripmeter LCD (liquid crystal display) display. Otherwise the system will exit self-diagnostic mode.
3. To navigate through or skip any of the instrument cluster self-diagnostic mode tests, press the SET button. If the SET button is

pressed for more than 3 seconds between tests, the instrument cluster will exit self-diagnostic mode.

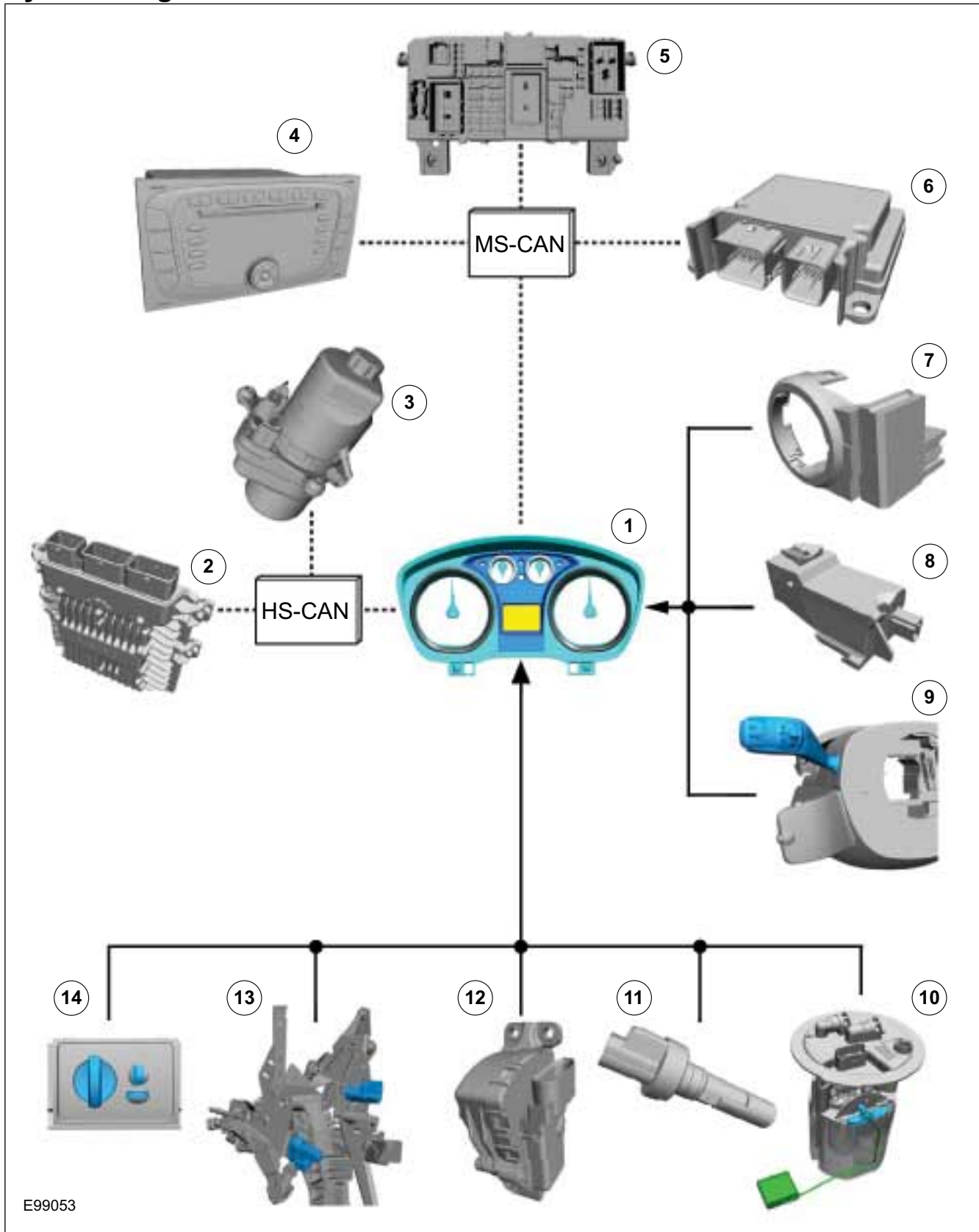
4. Self-diagnostic mode is deactivated when the ignition switch is turned to the OFF position or low battery voltage is detected.
5. If input data to the instrument cluster is missing or invalid, the tripmeter LCD will display '----'.
6. If the self-diagnostic mode cannot be activated, test the instrument cluster using the Ford diagnostic device.



DESCRIPTION AND OPERATION

Instrument Cluster – System Operation and Component Description

System Diagram



E99053

**DESCRIPTION AND OPERATION**

Item	Description
1	Instrument Cluster
2	PCM (powertrain control module)
3	EHPS (electro-hydraulic power steering) control module
4	Audio unit
5	GEM (generic electronic module)
6	RCM (restraints control module)
7	PATS transceiver

Item	Description
8	Steering wheel lock module
9	Left-hand steering column switch
10	Fuel level sensor
11	Washer water level warning lamp switch
12	Accelerator pedal position sensor
13	CPP (clutch pedal position) sensor/BPP (brake pedal position) sensor
14	Lighting control switch

**System Operation****Instrument Cluster**

The instrument cluster contains analog displays as well as warning and control lamps for displaying the system status; in addition, there is an LCD indicator field for driver information.

The instrument cluster receives the following signals from the PCM via the high speed CAN (controller area network) Bus (HS-CAN):

- Vehicle speed
  - The PCM receives the necessary signals from the ABS (anti-lock brake system) wheel sensors from the ABS control unit on the HS-CAN.
- Engine Coolant Temperature
- Engine oil pressure.
- Engine speed

The instrument cluster receives the following signals from the GEM via the medium speed CAN Bus (MS-CAN):

- Ambient temperature
- Brake fluid level
- Handbrake control
- Door latch control
- Liftgate latch control
- High beam control
- Headlamp flasher control
- Direction indicator control

The fuel level signal is sent by the two fuel level sensors in the fuel pumps in the semitrailer tank, which is wired to the instrument cluster. The sensors are connected in series, and the total resistance is determined from the two individual

resistors. The instrument cluster converts the raw fuel level signal into a damped fuel level value.

The odometer shows the total distance travelled by the vehicle and is based on the same signal as is processed for the daily mileage counter. The value is recorded by the instrument cluster and stored in a protected EEPROM (Electrically Erasable Programmable Read Only Memory) area. This area is a memory protected against manipulation. If the instrument cluster detects an error in this memory area, e.g. through damage, the driver is notified with the "Odometer error" message.

**Message center**

The message center is operated using the left-hand switch on the steering column.

The SET/RESET button is activated to select a submenu and change the settings. If signal tones have been activated, a short acoustic signal will sound each time a button is pressed.

By turning the rotary switch, the different menu displays can be scrolled through or a setting selected.

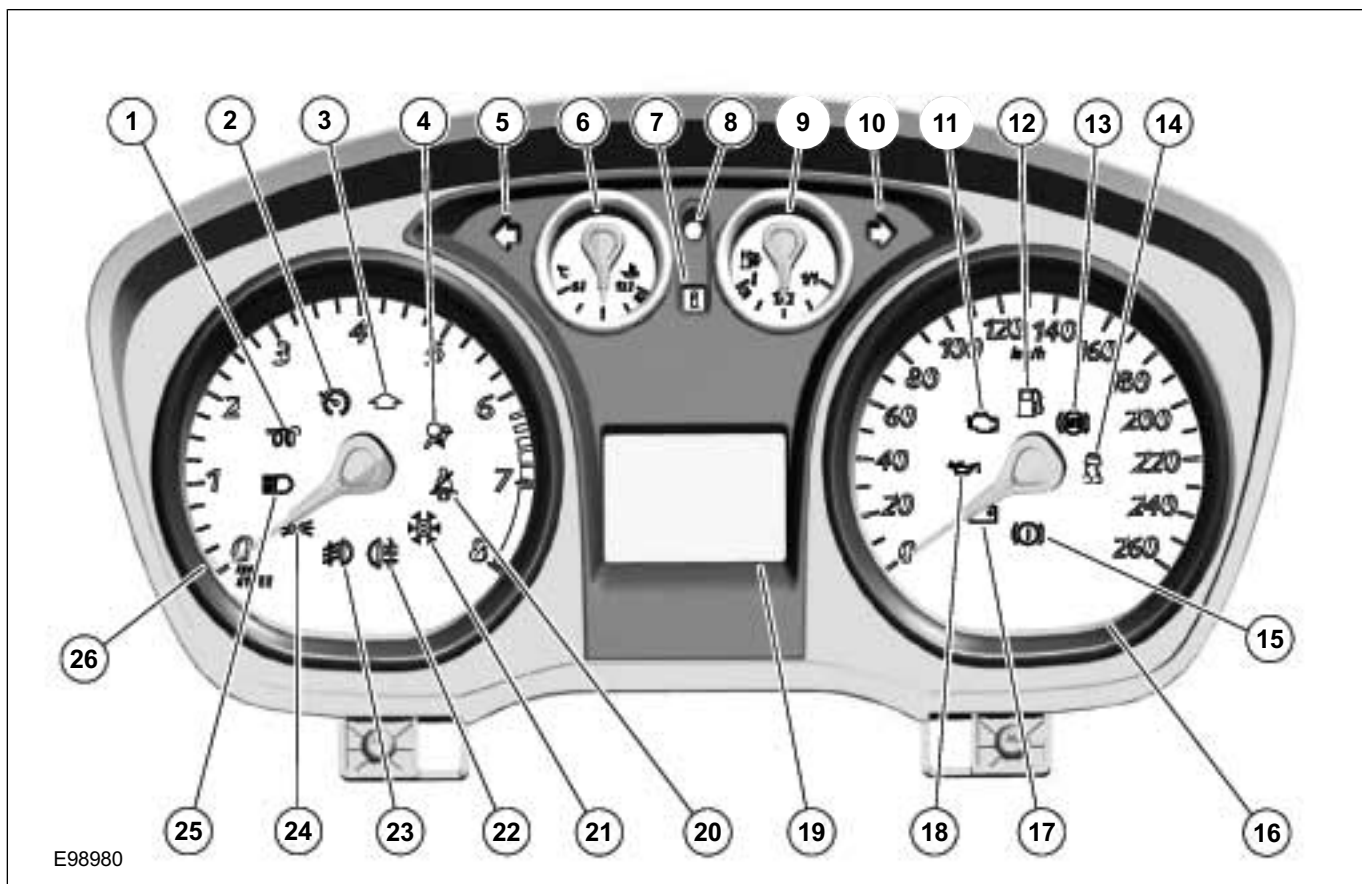
In this display, the navigation system can also display direction and distance information.

In addition, safety and warning messages can be displayed in this system, such as "Coolant overheating", "Engine system error" or "Washer fluid level too low". In addition to a safety message, a general warning light (red/yellow) lights up.

DESCRIPTION AND OPERATION

Component Description

Vehicles with low series instrument cluster



E98980

Item	Description
1	Glow plug indicator
2	Speed control system indicator
3	Gear shift indicator
4	Air bag warning indicator
5	Left-hand turn signal indicator
6	Coolant temperature gauge
7	Generic warning indicator (red/amber)
8	PATS (passive anti-theft system) control
9	Fuel Level Gauge
10	Right-hand turn signal indicator
11	Malfunction Indicator Lamp (MIL)
12	Low fuel warning indicator
13	Anti-lock Braking system (ABS) Warning Indicator

Item	Description
14	Stability assist indicator
15	Brake warning indicator
16	Speedometer
17	Charging system indicator
18	Low oil pressure warning indicator
19	Message center
20	Seat belt indicator
21	Ice warning indicator
22	Rear Fog Lamp Indicator
23	Front fog lamp indicator
24	Headlamp indicator
25	High beam indicator
26	Tachometer

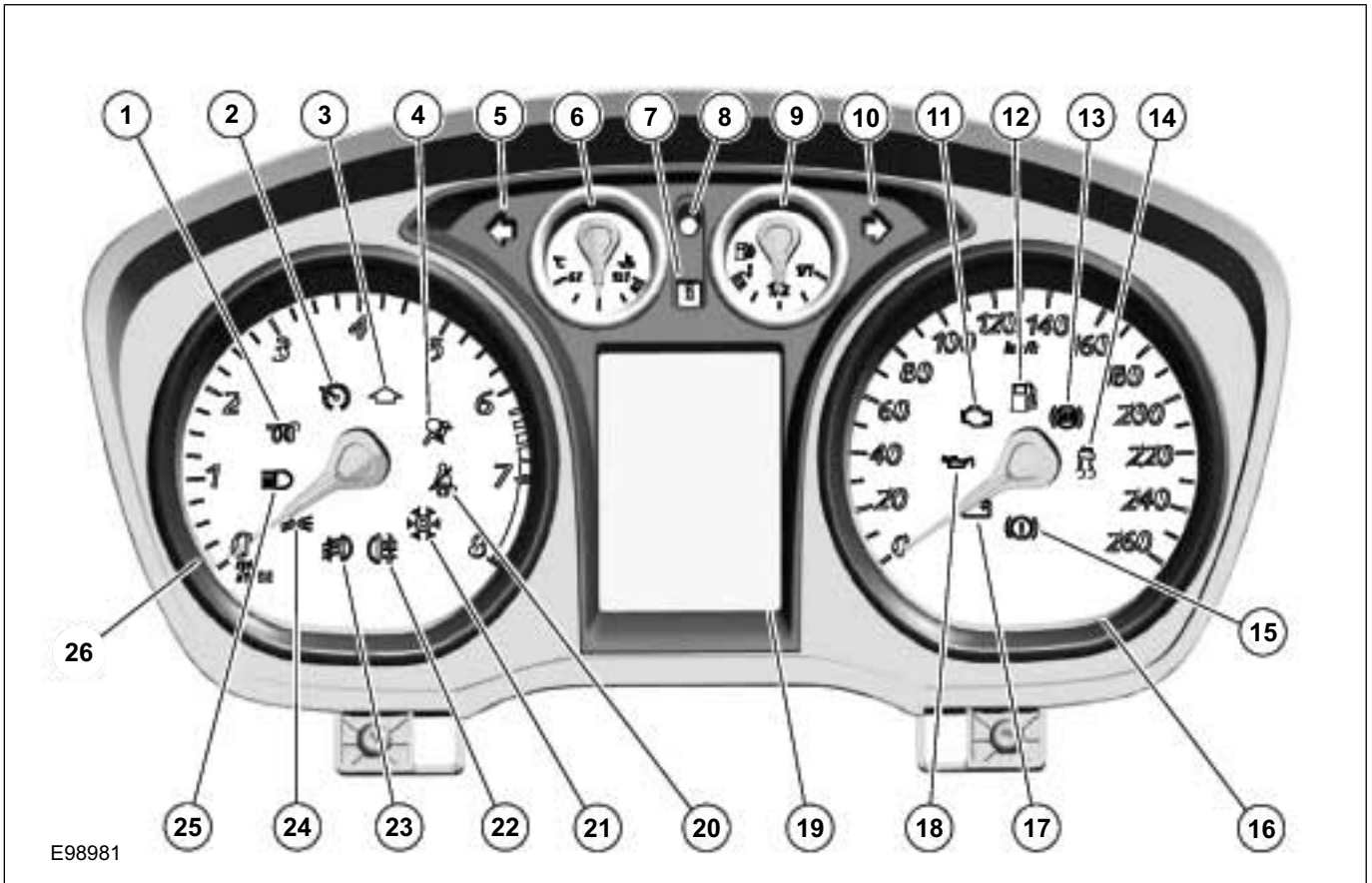
413-01-6

Instrument Cluster

413-01-6

DESCRIPTION AND OPERATION

Vehicles with high series instrument cluster



E98981

Item	Description
1	Glow plug indicator
2	Speed control system indicator
3	Gear shift indicator
4	Air bag warning indicator
5	Left-hand turn signal indicator
6	Coolant temperature gauge
7	Generic warning indicator (red/amber)
8	PATS control
9	Fuel Level Gauge
10	Right-hand turn signal indicator
11	Malfunction Indicator Lamp (MIL)
12	Low fuel warning indicator
13	Anti-lock Braking system (ABS) Warning Indicator

Item	Description
14	Stability assist indicator
15	Brake warning indicator
16	Speedometer
17	Charging system indicator
18	Low oil pressure warning indicator
19	Message center
20	Seat belt indicator
21	Ice warning indicator
22	Rear Fog Lamp Indicator
23	Front fog lamp indicator
24	Headlamp indicator
25	High beam indicator
26	Tachometer



## DIAGNOSIS AND TESTING

## Instrument Cluster

Refer to **Wiring Diagrams Section 413-01**, for schematic and connector information.

**General Equipment**

The Ford approved diagnostic tool
-----------------------------------

**Inspection and Verification**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

Mechanical	Electrical
– Engine oil filter	– Fuse(s)
– Engine oil level	– Wiring harness
– Engine coolant level	– Electrical connector(s)
– Oil pressure switch	– Instrument cluster
– Engine coolant level	– Light emitting diode(s) (LED)(s)
– Coolant thermostat	
– Engine coolant temperature (ECT) sensor	
– Fuel gauge	
– Collapsed or damaged fuel tank	
– Recirculation hose	
– Fuel tank filler pipe/hose	
– Indicated fuel level	
– Fuel lines	
– Fuel tank filler cap	
– Fuel filter (external to the fuel tank)	
– Fuel tank	
– Door adjustment	

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **NOTE: If none of the following warning indicators are operating correctly this may indicate a concern with the central junction box (CJB). If only one or two of the following warning indicators are not operating correctly this may indicate an instrument cluster concern.**

Verify the following warning indicators are working correctly:

- Charging.
  - Turn signals.
  - Headlamps.
5. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

**Configuration of the Instrument Cluster**

The instrument cluster is a programmable module, which must be configured by selecting the Programmable Module Installation Routine on the Ford approved diagnostic tool.

**NOTE:** When the new instrument cluster has been configured with the odometer value, its configuration cannot be decreased or matched. A new configuration will result in an increase in the displayed odometer value by a minimum of two units.

**NOTE:** The odometer value must be recorded from the original instrument cluster before removal.

**If the odometer value cannot be obtained from the original instrument cluster (display failure) the customer should supply the approximate value.**

The following features will need to be configured when a new instrument cluster is installed:

- Anti-lock Brake System (ABS)
- All wheel drive
- Keyless vehicle entry
- Electronic power assisted steering
- Trip computer
- Voice control
- Parking aid
- Belt minder
- Safety belt not fastened
- Right hand drive
- Overspeed warning
- Reverse warning
- Turbocharger boost pressure
- Speed control
- Auxiliary heater
- Suspension control
- Washer fluid sensor

## DIAGNOSIS AND TESTING

- Navigation
- Fuel cap release
- Engine type
- Display language

In addition the new instrument cluster will require the original odometer value to be entered.

After the installation and configuration of a new instrument cluster. The passive anti-theft system (PATS) will require programming by selecting the Security Access routine on the Ford approved diagnostic tool.



## REMOVAL AND INSTALLATION

## Instrument Cluster

## General Equipment

Ford Diagnostic Equipment

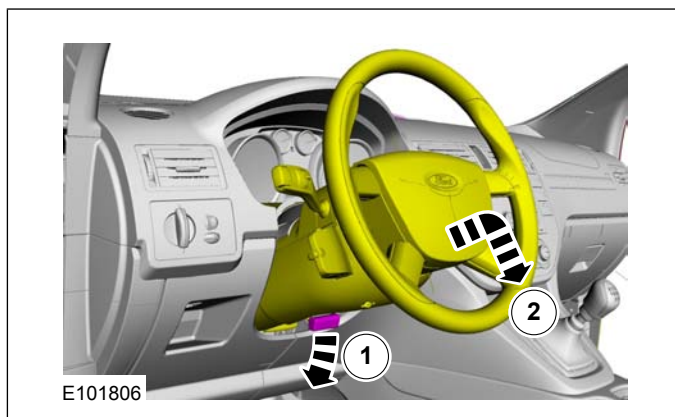
## General Equipment

Round-Ended Steel Rule

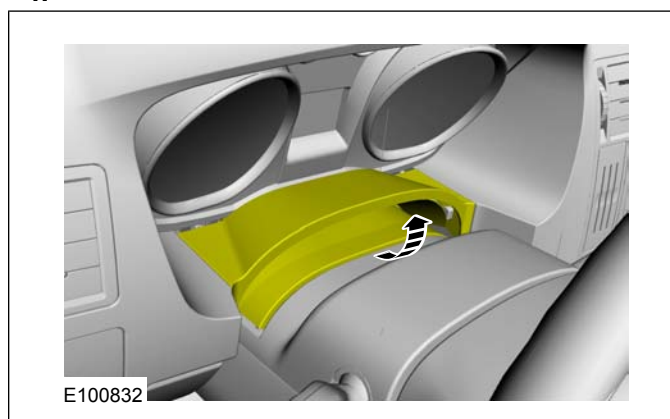
## Removal

- NOTE:** This step is only necessary when installing a new component.  
Upload the instrument cluster configuration information using the Programmable Modules Installation Routine.  
General Equipment: Ford Diagnostic Equipment
- NOTE:** This step is only necessary when installing a new component.  
Record the odometer value from the original instrument cluster. If the odometer value cannot be obtained from the instrument cluster (display failure), the customer should supply the approximate odometer value.

3.

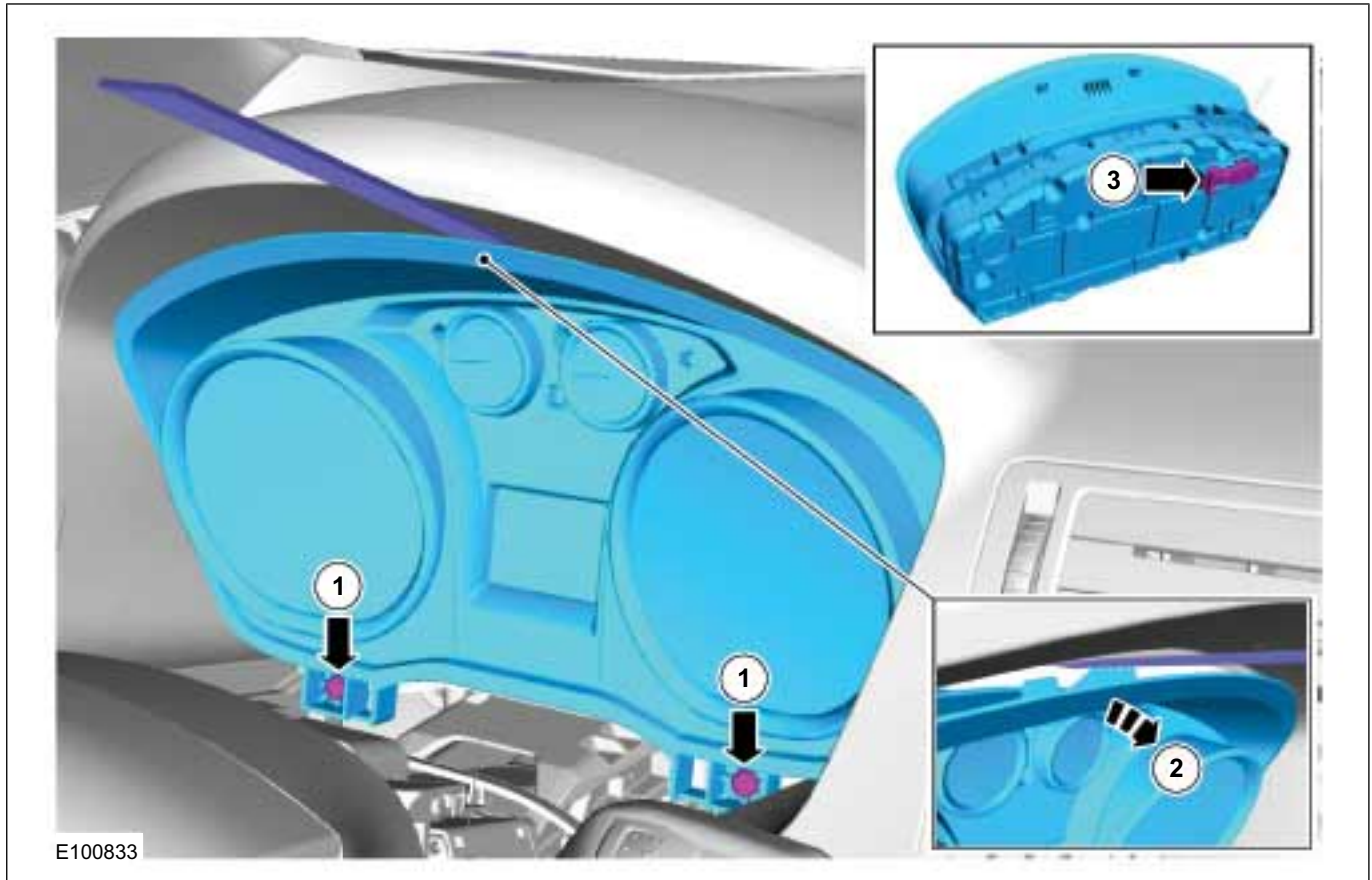


4.



5. General Equipment: Round-Ended Steel Rule

## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.
2. **NOTE:** This step is only necessary when installing a new component.

Download the instrument cluster configuration information to the newly installed instrument cluster using the programmable modules installation routine.



# SECTION 413-06 Horn

VEHICLE APPLICATION: 2008.50 Kuga

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## DIAGNOSIS AND TESTING

### Horn

#### Principles of Operation

The horn system consists of a relay, a steering wheel switch and either one or two horns. The horn(s) receives voltage from the switched side of the relay, and the relay switch is controlled on its ground side by the steering wheel switch.

The horn relay, is located in the Battery junction box (BJB) and is supplied with a permanent voltage from the battery.

The steering wheel horn switch shares the steering wheel clockspring circuit with the air-bag circuit. Each of these systems work completely independent of each other.

#### Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

#### Visual Inspection Chart

Electrical
<ul style="list-style-type: none"><li>• Fuse(s)</li><li>• Wiring harness</li><li>• Electrical connector(s)</li><li>• Horn switch</li><li>• Horn</li><li>• Clockspring</li><li>• Horn relay</li><li>• BJB</li></ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

## SECTION 413-09 Warning Devices

VEHICLE APPLICATION: 2008.50 Kuga

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**DIAGNOSIS AND TESTING**

## Warning Devices

Refer to **Wiring Diagrams Section 501-20B**, for schematic and connector information.

**General Equipment**

Ford diagnostic equipment
---------------------------

**Inspection and Verification**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

<b>Mechanical</b>	<b>Electrical</b>
– Safety belt buckle	– Wiring harness – Electrical connector(s) – Safety belt buckle switch – Restraints control module

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Ford diagnostic equipment to diagnose the system.



**GENERAL PROCEDURES****Safety Belt Minder Deactivating/Activating****Preparation**

1. Apply the parking brake.
2. Place the transmission selector lever in P (Park) - vehicles with automatic transmission or the neutral position - vehicles with manual transmission.
3. Turn the ignition switch to the 0 position.
4. Close all the vehicle doors from the inside of the vehicle.

**Deactivating/Activating**

**NOTE:** Deactivation of the belt minder may also be carried out using IDS. Follow the instructions on the screen.

1. Unbuckle the drivers safety belt.
2. Turn the ignition switch to position II. (Do not start the engine).
3. Wait at least 15 seconds.
4. **NOTE:** This step must be completed within 60 seconds or the procedure must be repeated.  
**Buckle then unbuckle the safety belt nine times, ending with the safety belt unbuckled. Release the red unbuckle switch completely every cycle.**
5. The safety belt warning indicator flashes three times to confirm the belt minder status change.
6. Turn the ignition switch to position 0. The deactivation/activation procedure is now complete.

**GENERAL PROCEDURES****Oil Change Indicator Reset**

1. Turn the ignition key to position II without cranking the engine.
2. Simultaneously press and hold the accelerator pedal and the brake pedal for approximately 15 seconds until the oil change reminder indicator starts to flash or the "Service Oil Reset Complete" message appears in the information and message center (if equipped).
3. Release the pedals.
4. Check that the oil change reminder indicator has turned off or that there is no "Service Oil" message in the information and message center (if equipped). If the oil change reminder indicator is still illuminated or the "Service Oil" message is still displayed, turn the ignition key to position 0 and repeat the procedure from Step 1. If it has turned off or the "Service Oil" message has disappeared, proceed to Step 5.
5. Turn the ignition key to position 0 and leave it there for at least 2 minutes so that the powertrain control module (PCM) fully powers down and updates the non-volatile memory (NVM) in the PCM.
6. Turn the ignition key to position II without cranking the engine and check that the oil change reminder indicator is not illuminated or that there is no "Service Oil" message displayed.
7. Turn the ignition key to position 0.

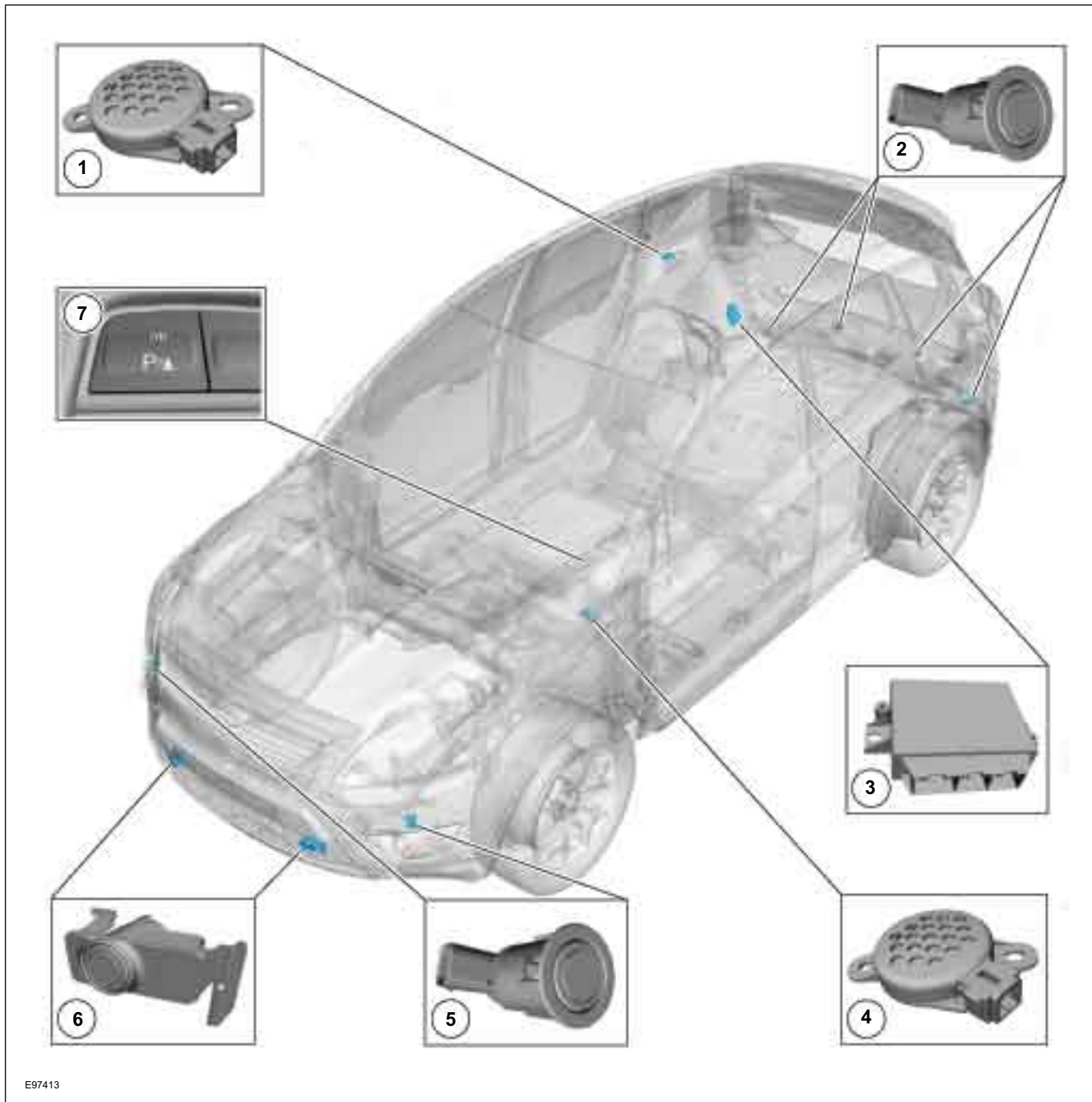
## SECTION 413-13 Parking Aid

### VEHICLE APPLICATION: 2008.50 Kuga

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DESCRIPTION AND OPERATION

Parking Aid – Component Location



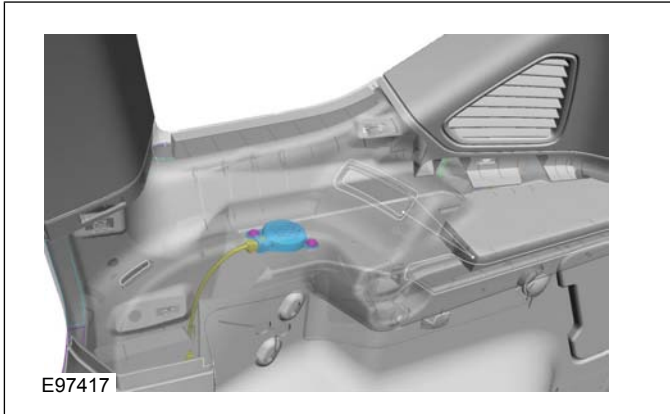
E97413

Item	Description
1	Rear parking aid speaker
2	Rear parking aid sensors
3	Parking aid module
4	Front parking aid speaker (if available)

Item	Description
5	Front parking aid external sensors (if available)
6	Front parking aid internal sensors (if available)
7	Parking aid with LED switch (if available)

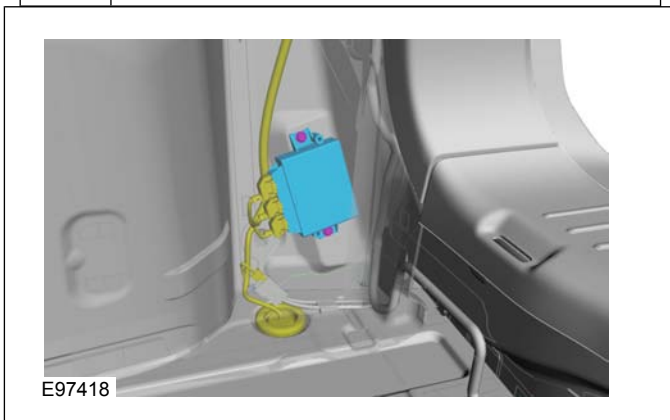


DESCRIPTION AND OPERATION



Item	Description
1	Rear parking aid speaker

Item	Description
4	Front parking aid speaker (if available)



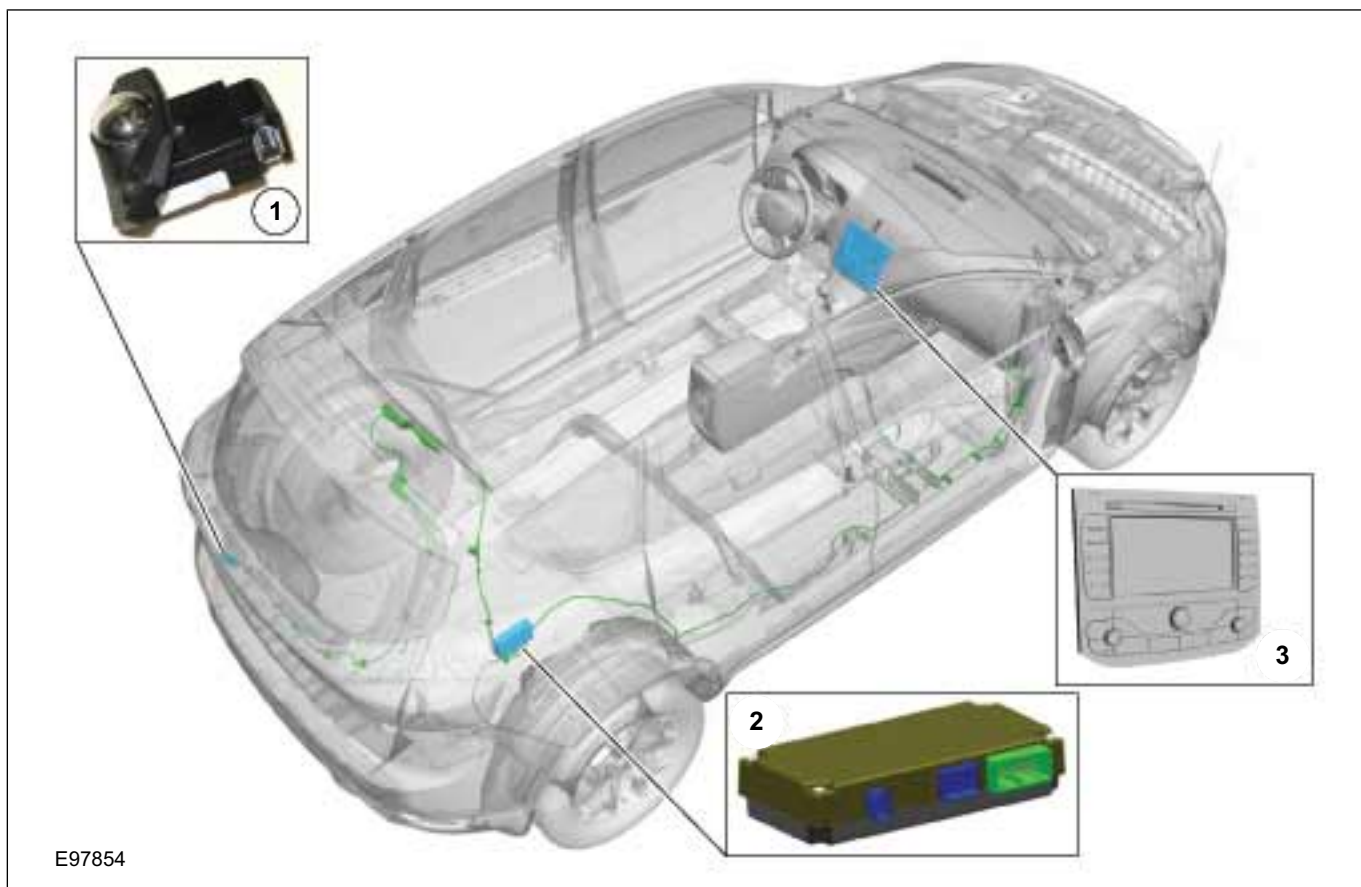
Item	Description
3	Parking aid module

Item	Description
7	Parking aid with LED switch (if available)



DESCRIPTION AND OPERATION

Parking Aid Camera



Item	Description
1	Parking Aid Camera
2	Parking aid camera module
3	Navigation device



## DESCRIPTION AND OPERATION

## Parking Aid – Overview

## Parking aid sensors

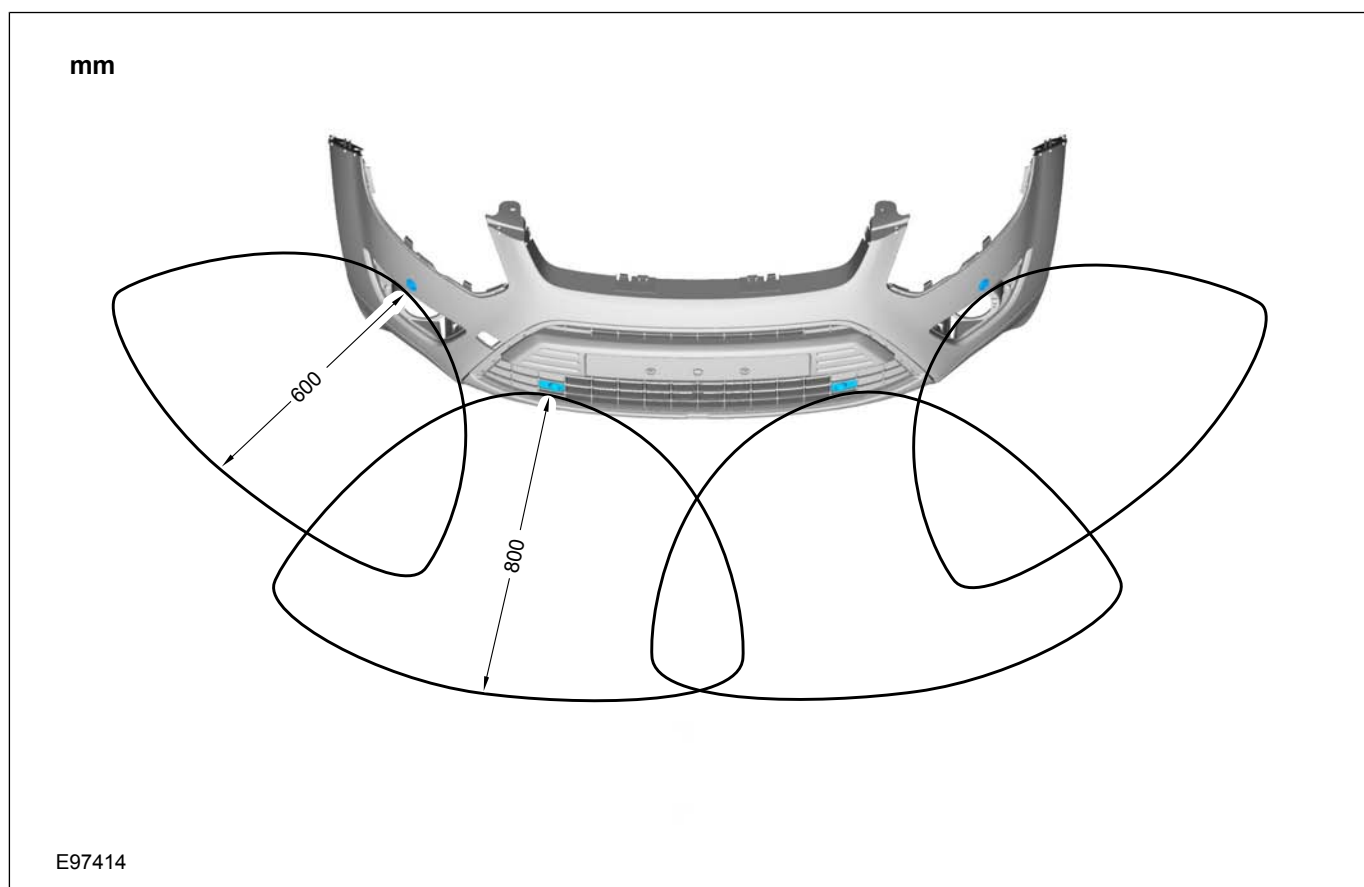
## CAUTIONS:

⚠ Always keep sensors free from dirt, ice and snow. Do not use any sharp objects to clean the sensors.

⚠ If a high-pressure cleaner is used to wash the vehicle, the jet must only be aimed at the sensors briefly at a distance of at least 20 cm.

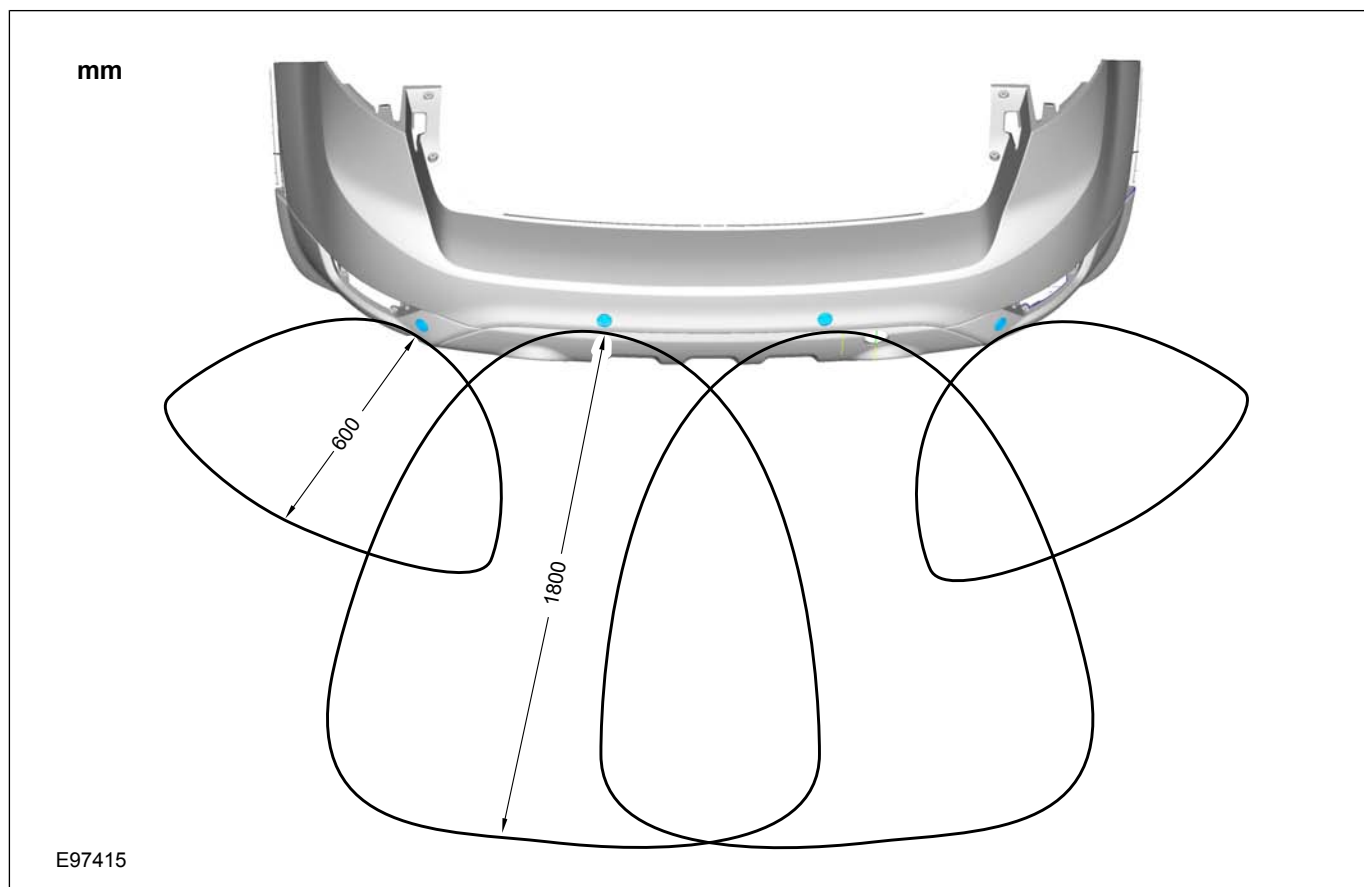
The parking aid sensors have a separate decoupling ring, which must be removed before painting the sensors, and then refitted.

## Front sensors detection range



## DESCRIPTION AND OPERATION

## Rear sensors detection range



## Parking aid camera module

It is not necessary to programme the module after changing it.

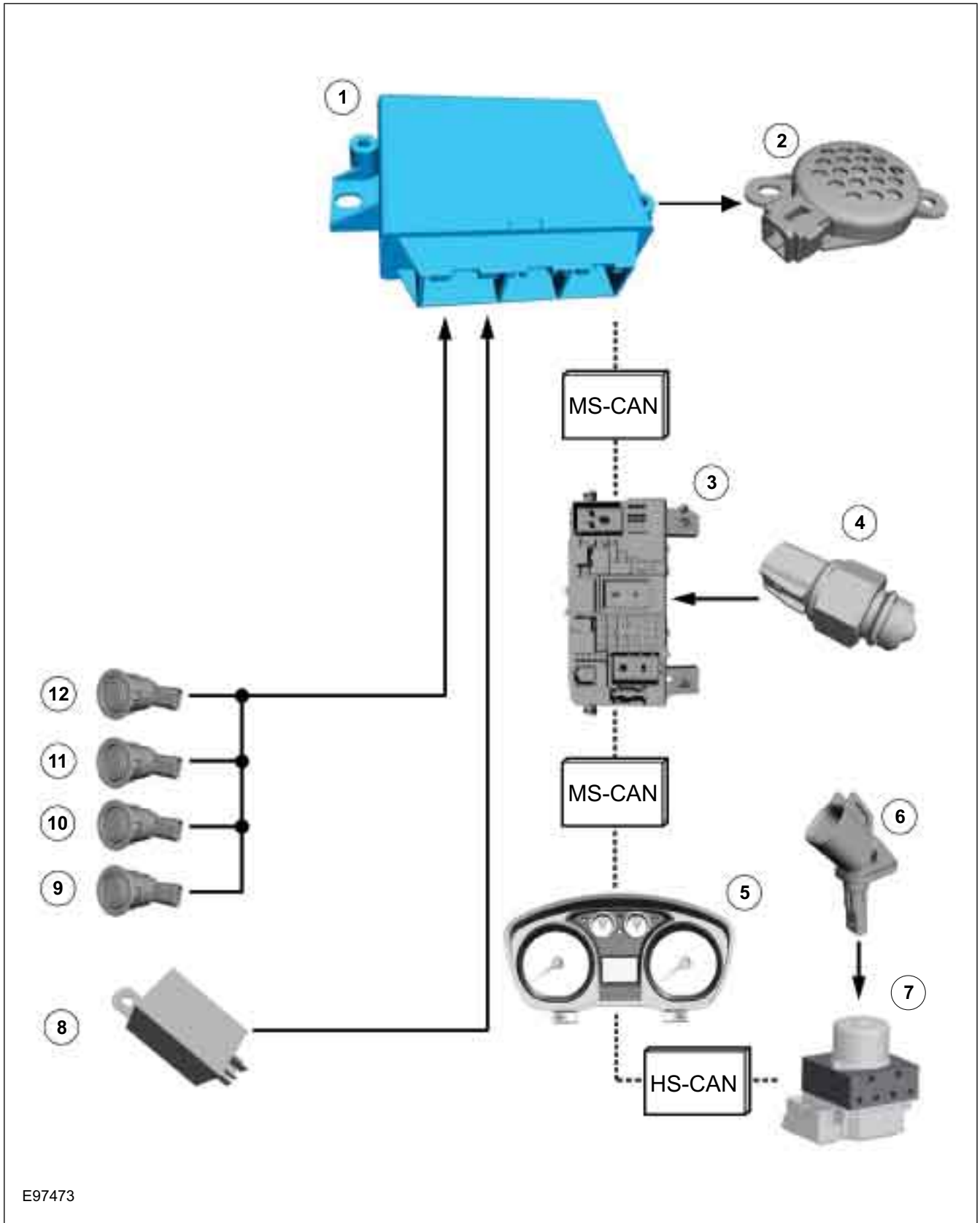
## Parking Aid Camera

## CAUTIONS:

- ⚠ Always keep the reversing camera free from dirt, ice and snow. Do not clean with sharp objects, fat solvents, wax or organic media. Only use a damp cloth for cleaning.
- ⚠ If a high-pressure cleaner is used to wash the vehicle, the jet must only be aimed at the reversing camera briefly at a distance of at least 20 cm.
- ⚠ The reversing camera is sensitive to pressure. The position and angle of the camera can be changed with increased pressure.

It is not necessary to programme the camera after changing it.

DESCRIPTION AND OPERATION



E97473

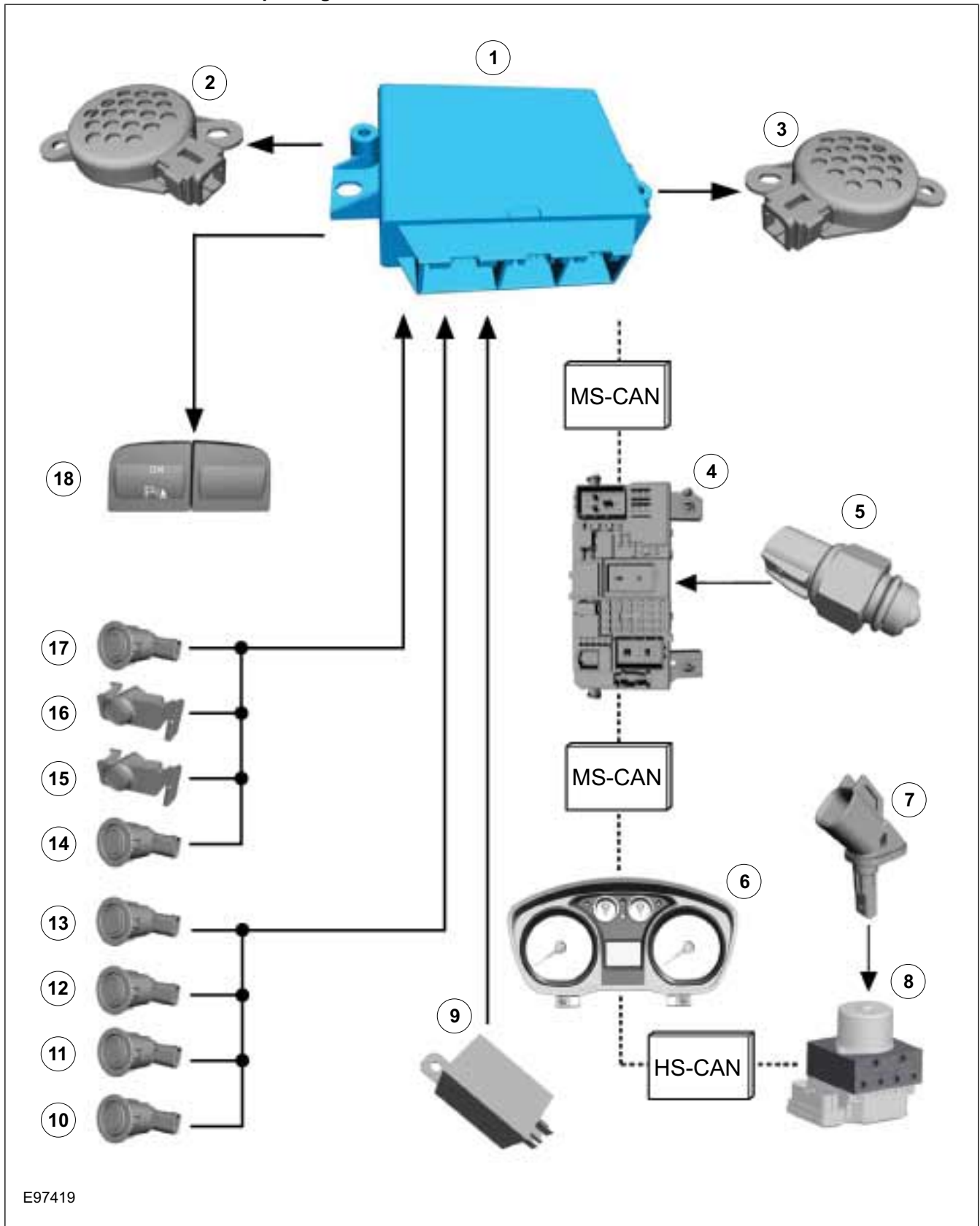
## DESCRIPTION AND OPERATION

Item	Description
1	Parking aid module Refer to Component Description: (page 15)
2	Rear parking aid speaker Refer to Component Description: (page 15)
3	Generic Electronic Module (GEM)
4	Reverse gear switch
5	Instrument cluster
6	ABS sensor assembly
7	ABS

Item	Description
8	Trailer relay
9	Rear parking aid sensor Refer to Component Description: Parking aid sensors (page 15)
10	Rear parking aid sensor Refer to Component Description: Parking aid sensors (page 15)
11	Rear parking aid sensor Refer to Component Description: Parking aid sensors (page 15)
12	Rear parking aid sensor Refer to Component Description: Parking aid sensors (page 15)

DESCRIPTION AND OPERATION

Vehicles with front and rear parking aid



E97419

## DESCRIPTION AND OPERATION

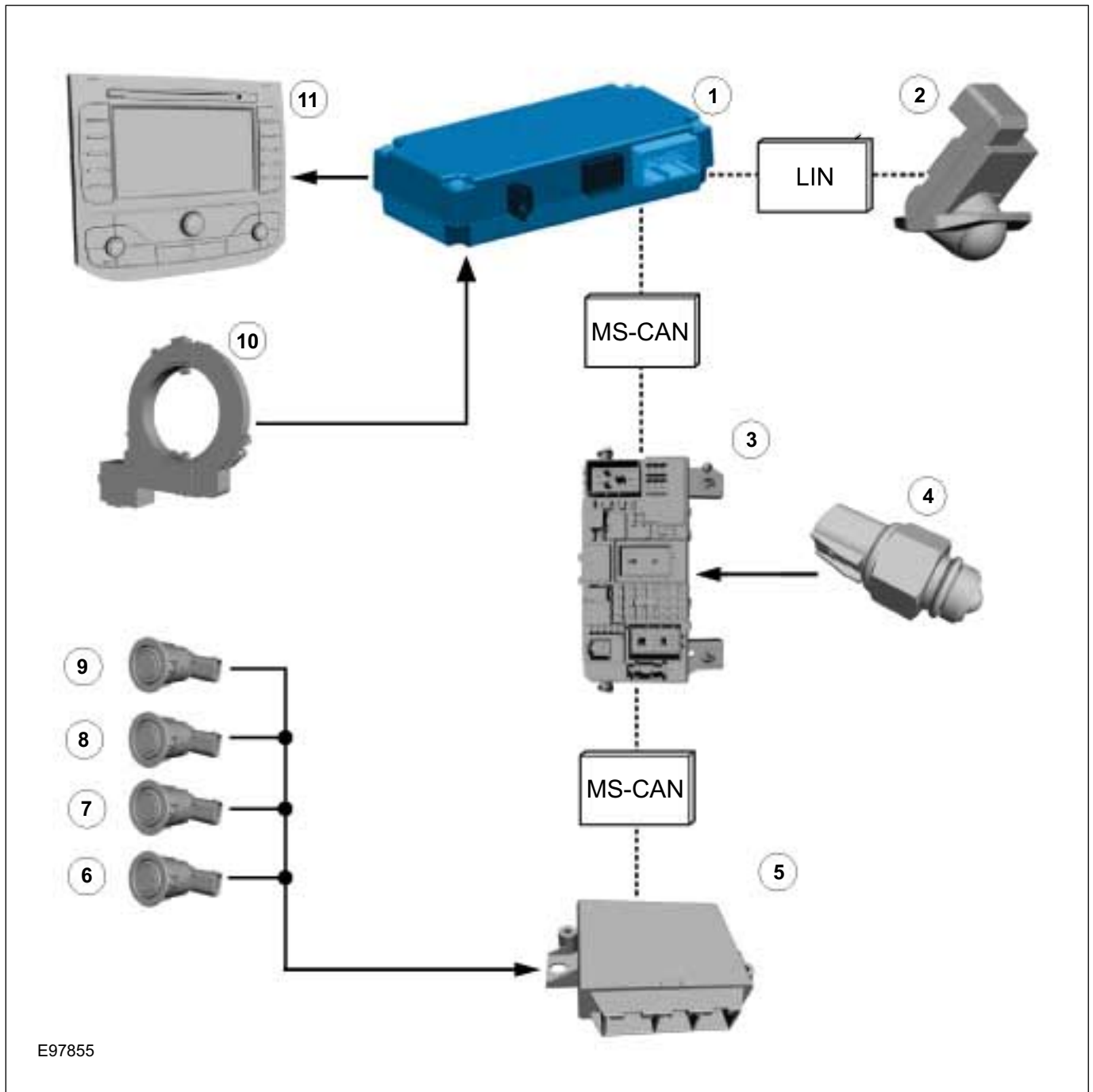
Item	Description
1	Parking aid module Refer to Component Description: (page 15)
2	Front parking aid speaker Refer to Component Description: (page 16)
3	Rear parking aid speaker Refer to Component Description: (page 15)
4	Generic Electronic Module (GEM)
5	Reverse gear switch
6	Instrument cluster
7	ABS sensor assembly
8	ABS
9	Trailer relay
10	Rear parking aid sensor Refer to Component Description: Parking aid sensors (page 15)
11	Rear parking aid sensor Refer to Component Description: Parking aid sensors (page 15)

Item	Description
12	Rear parking aid sensor Refer to Component Description: Parking aid sensors (page 15)
13	Rear parking aid sensor Refer to Component Description: Parking aid sensors (page 15)
14	Front parking aid sensor Refer to Component Description: Parking aid sensors (page 15)
15	Front parking aid sensor Refer to Component Description: Parking aid sensors (page 15)
16	Front parking aid sensor Refer to Component Description: Parking aid sensors (page 15)
17	Front parking aid sensor Refer to Component Description: Parking aid sensors (page 15)
18	Parking aid switch (with light emitting diode (LED)) Refer to Component Description: Parking aid switch (page 16)



DESCRIPTION AND OPERATION

Vehicles with parking aid camera



E97855

Item	Description
1	Parking aid camera module Refer to Component Description: Parking aid camera module (page 6) (page 16)
2	Parking Aid Camera Refer to Component Description: Parking aid camera module (page 6) (page 16)
3	Generic Electronic Module (GEM)
4	Reverse gear switch

Item	Description
5	Parking aid module Refer to Component Description: (page 15)
6	Rear parking aid sensor Refer to Component Description: Parking aid sensors (page 15)

## DESCRIPTION AND OPERATION

Item	Description
7	Rear parking aid sensor Refer to Component Description: Parking aid sensors (page ?)
8	Rear parking aid sensor Refer to Component Description: Parking aid sensors (page ?)

Item	Description
9	Rear parking aid sensor Refer to Component Description: Parking aid sensors (page ?)
10	steering angle sensor
11	Navigation device

## System Operation

## Parking Aid

**WARNING:** It is the driver's responsibility to stay alert during reversing procedures. The system may fail to detect small children or animals.

**CAUTION:** The driver is responsible for detecting obstacles and judging the distance between these and the vehicle. The system may fail to detect some hanging objects, barriers, narrow obstacles or painted surfaces, which could damage the vehicle. Always pay attention when parking.

The parking aid provides an audible warning to the driver if there are any obstacles in front of or behind the vehicle during reverse parking maneuvers.

At low speeds, the parking aid module uses the parking aid sensors to monitor the area around the vehicle. If an object is detected within a monitored area, the parking aid module emits a warning tone using the respective parking aid speaker.

The rear parking aid is switched on with the ignition. However, it is only enabled when reverse gear is selected.

The front and rear parking aid is always switched off when the ignition is switched on. It is switched on when reverse gear is selected or if the parking aid switch in the center console is actuated up to a speed of 16 km/h.

The parking aid is switched off when the vehicle is travelling forwards at more than 16 km/h or if the parking aid switch in the center console is actuated again.

When the parking aid module activates the system, the parking aid switch LED is illuminated. If the vehicle is only fitted with the rear parking aid, there is no switch.

The parking aid sensors emit a series of ultrasonic impulses and switch to receiver mode to receive

the echo reflected by an obstacle within the detection range. The received echo signals are amplified and converted from an analog signal to a digital signal by the sensor. The digital signal is passed to the parking aid module and compared with pre-programmed data stored in an EEPROM within the module. The module calculates the distance to the obstacle by measuring the time taken between the emitted and received impulses.

If no objects are detected there are no further warning tones. If an object is detected, repeated audible tones are emitted from either parking aid speaker(s) as appropriate. The time delay between the tones decreases as the distance between the object and the vehicle decreases, until at approximately 250 mm (10 inches), the audible tone becomes continuous.

If the distance between the obstacle and the vehicle does not decrease, the warning tone remains constant if the object has been detected by an internal parking aid sensor. If the obstacle was detected by an external sensor and the distance remains unchanged, the warning tone stops after 3 seconds.

The parking aid module continues to monitor the distance and will resume the warning tones if a decrease in distance is detected.

If a trailer is connected to the vehicle, a signal is sent to the GEM (generic electronic module) via the trailer relay. This signal is sent to the parking aid module via the MS CAN bus. When the parking aid module detects that a trailer is connected to the vehicle, the rear parking aid sensors are disabled to prevent constant warnings due to the close proximity of the trailer.

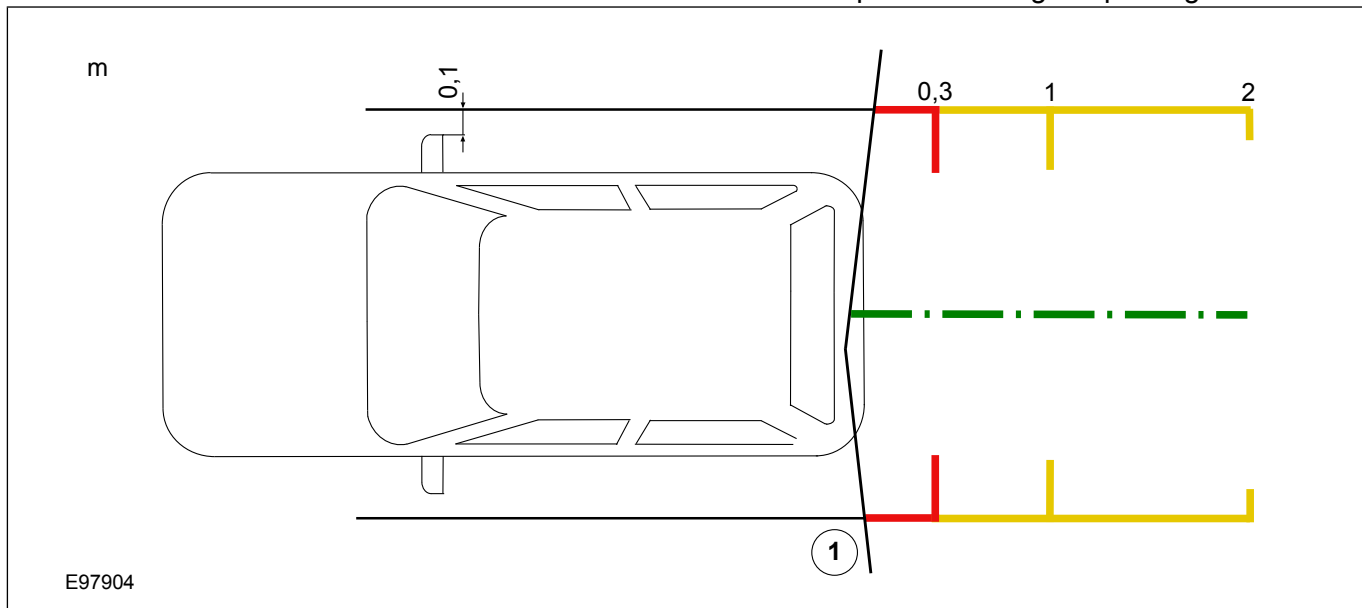
**DESCRIPTION AND OPERATION**

**Parking Aid Camera**

For vehicles with a DVD navigation system with a touch screen, the parking aid camera is supplied as standard. For vehicles with a standard navigation system, the camera can be ordered as an optional extra. The system essentially consists of a camera with a wide angle lens, a control unit and a wiring harness which is not integrated in the vehicle wiring harness.

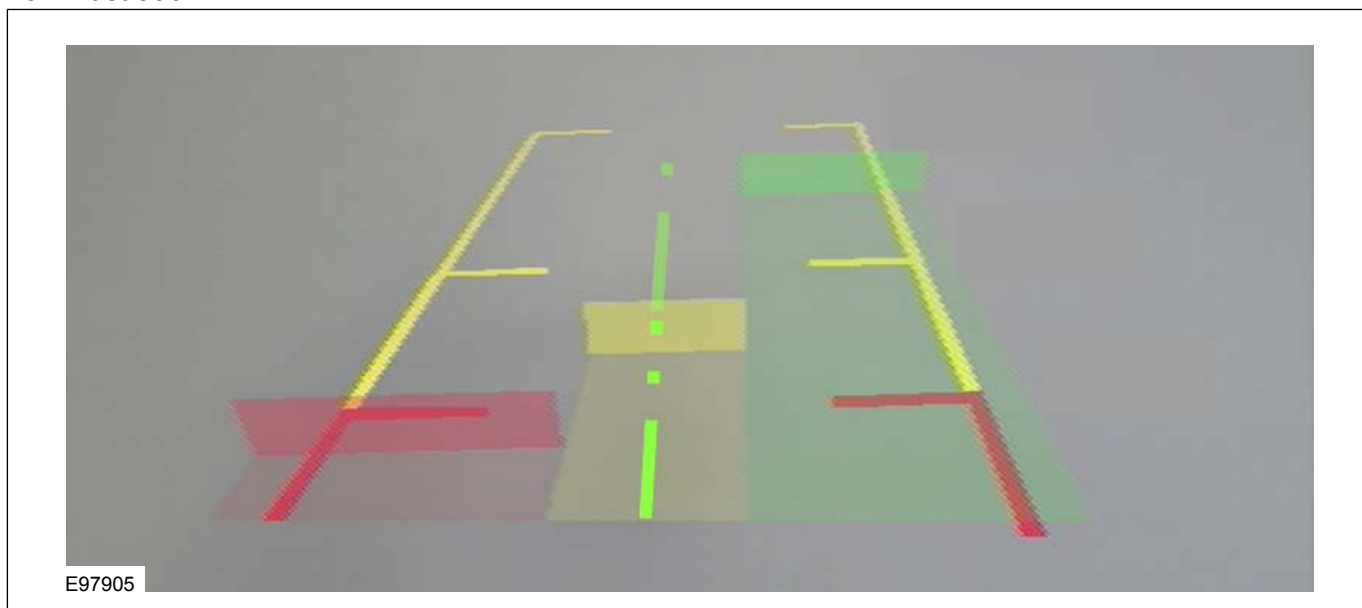
On the navigation display screen, the drivers sees a video image of the area behind the vehicle. Guides integrated in the camera images by the parking aid camera module and displayed on the screen help the driver to find out about the steering angle, vehicle width, cornering and driving straight ahead. The system generates these guides using:

- Vehicle parameters (length, width)
- Steering Angle
- Vehicle position during the parking maneuver



Item	Description
1	Monitoring angle

If the vehicle is also fitted with a rear parking aid, the distances to the obstacle are displayed as a 3D illustration.



413-13-14

Parking Aid

413-13-14

DESCRIPTION AND OPERATION

The area behind the vehicle is shown on the navigation display screen when the ignition is switched on and reverse gear is engaged (1). The

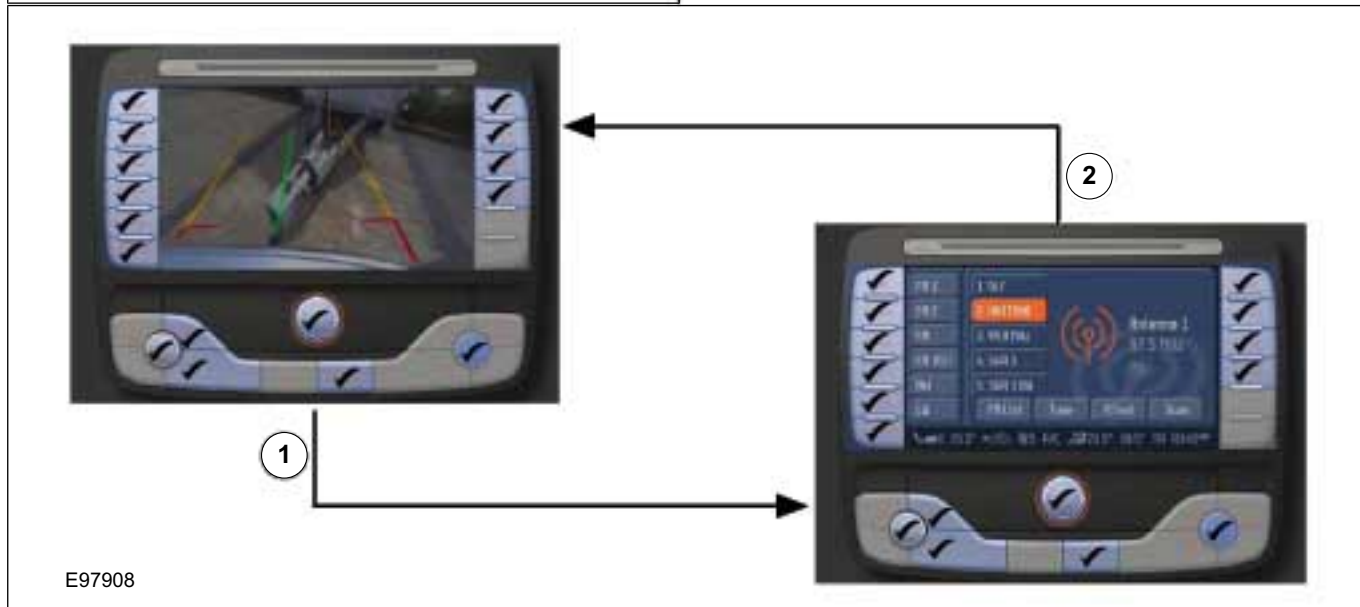
rear view is always given priority, regardless of what is currently being shown on the display.

The camera view is automatically disabled 10 seconds after disengaging reverse gear (2).



If the blue button is pressed during operation of the reversing camera, the camera view disappears from the screen. When reverse gear is engaged again, the system returns to the camera view. Exception: For incoming telephone calls, the screen shows the corresponding menu and then automatically returns to the camera view.

The green buttons can be pressed during operation of the reversing camera, and the screen retains the camera view.



## DESCRIPTION AND OPERATION

## Component Description

## Rear parking aid speaker





The rear parking aid speaker, in addition to its actual function, is also used for audible indication of various types of error in the front and rear parking aids. If the rear parking aid speaker becomes defective, the front parking aid speaker will then be used to indicate failure modes.

If an error is detected in the system, a signal tone is emitted via the speaker for 3 seconds.

## Parking aid sensors

## CAUTIONS:

-  **Always keep sensors free from dirt, ice and snow. Do not use any sharp objects to clean the sensors.**
-  **If a high-pressure cleaner is used to wash the vehicle, the jet must only be aimed at the sensors briefly at a distance of at least 20 cm.**

The parking aid sensor consists of the following:

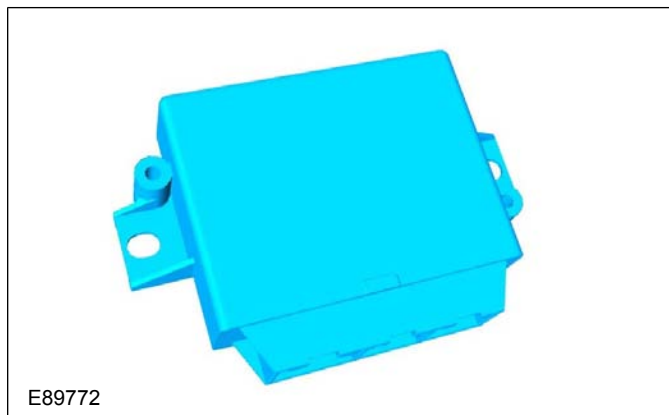
- Plastic housing
- Aluminum membrane with Piezo disc
- Decoupling ring
- Printed circuit board (PCB)

The parking aid sensor consists of a sensor and a holder. The holder makes sure that each parking aid sensor is correctly orientated in relation to its location in the rear bumper.

The sensors have a 3-pin connector which is connected to the wiring harness of the front bumper. This in turn is connected to the main body wiring harness. Three pins provide for power supply, ground and signal lines to and from the parking aid module.

The disc resonates at a frequency of ca. 50kHz, producing the ultrasonic output. The disc also receives the reflected echo signal from any objects within range.

## Parking aid module



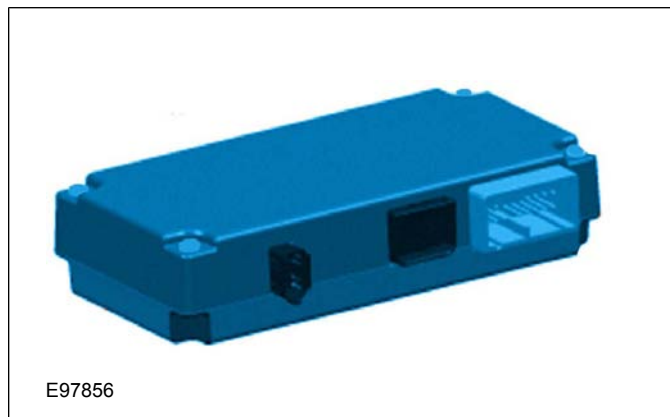
The parking aid module has three connectors which provide for power, ground and MS CAN bus connections, as well as the front and rear parking aid sensors, the parking aid switch and parking aid speaker.

The parking aid module carries out self-check routines and when the parking aid is active, checks the parking aid sensor wiring for short or open circuits. If a concern is detected, a diagnostic trouble code (DTC) is stored in a memory in the parking aid module and the front and rear parking aid sensors will be disabled until the DTC is cleared and the ignition cycled. The driver recognizes a problem through the flashing LED and a shrill continuous tone, which is emitted for 3 seconds when the parking aid is activated. If the parking aid is working properly, short tones are emitted instead of this continuous tone. DTCs can be read using the Ford approved diagnostic tool through the data link connector (DLC).

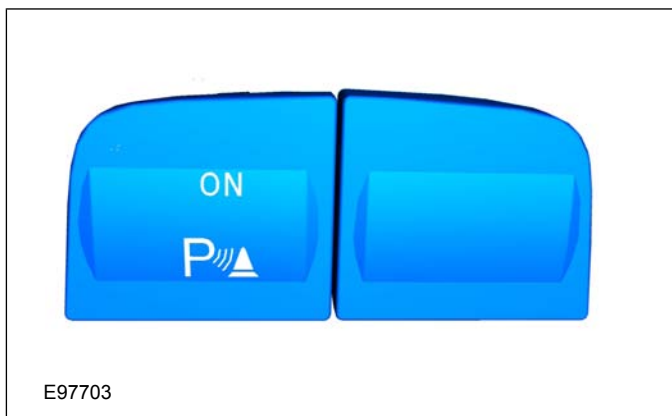


**DESCRIPTION AND OPERATION****Front parking aid speaker**

The front parking aid speaker, in addition to its actual function, is also used for audible indication of various types of error in the front and rear parking aids when the rear parking aid speaker fails.

**Parking aid camera module**

The data from the optional parking aid is sent to the module via the Mid Speed CAN data bus. The signals from the steering angle sensor are sent to the module via cable. The module is connected to the navigation device via a video-in/out cable.

**Parking aid switch**

The parking aid switch is a non-locking switch with an integrated LED for switching the parking aid on and off. When pressed, the parking aid switch momentarily connects a ground to the parking aid module. The LED indicates when the parking aid is active. The LED is controlled by the parking aid module.

The parking aid switch allows the driver to disable the parking aid when reverse gear is selected or to activate the parking aid sensors when not in reverse gear.

If a high tone is emitted for 3 seconds and the lights in the switch flash, this indicates that there is a fault. The system is then deactivated.

**Parking Aid Camera**

The wide angle lens camera is fixed in the handle strip of the tailgate. It is connected to the parking aid camera module via a separate line.



## DIAGNOSIS AND TESTING

## Parking Aid — Vehicles With: Front Parking Aid

Refer to Wiring Diagrams Section 413-13, for schematic and connector information.

## General Equipment

Ford diagnostic equipment

## Principles of Operation

The ultrasonic parking aid system activates when the ignition switch is turned to the RUN and when the parking brake is OFF. If a front parking aid switch is fitted the system will be de-activated and a light emitting diode (LED) will indicate the state of the system. A lit LED will indicate that the system is currently deactivated. The parking aid system will be disabled if a fault is detected in one of the four front parking aid sensors, the parking aid speaker or the parking aid module. An error tone approximately 3 seconds long will be emitted from the rear parking aid speaker if a fault is detected. If the rear parking aid speaker is inoperative the error tone will sound from the front parking aid speaker.

## Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of electrical damage.

## Visual Inspection Chart

Electrical
<ul style="list-style-type: none"> <li>– Fuse(s)</li> <li>– Wiring harness(s)</li> <li>– Electrical connector(s)</li> <li>– Battery junction box (BJB)</li> <li>– Front parking aid sensor(s)</li> <li>– Front parking aid speaker</li> <li>– Parking aid module</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. If the cause is not visually evident, connect the Ford diagnostic equipment to the data link connector (DLC) and select the vehicle system to be tested from the diagnostic menu.
5. Retrieve the Diagnostic Trouble Code (DTC)s and refer to the DTC Index.
6. If no DTCs are retrieved or there is no communication with the module, proceed to the Symptom Chart to continue diagnostics.

## Diagnostic Trouble Codes (DTC) Index

## DTC Index

DTC	Description	Possible Source	Action
C1711	Front outer left sensor signal circuit short to battery	<ul style="list-style-type: none"> <li>• Parking aid sensor signal circuit.</li> <li>• Parking aid module.</li> </ul>	Check the circuit 8-GN9 (WH/GN) for short to battery. IF the circuit is OK, INSTALL a new parking aid module.  REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation).  TEST the system for normal operation.
C1712	Front outer left sensor signal circuit open or short to ground	<ul style="list-style-type: none"> <li>• Parking aid sensor signal circuit.</li> <li>• Parking aid sensor.</li> <li>• Parking aid module.</li> </ul>	GO to <b>Pinpoint Test C</b> .

## DIAGNOSIS AND TESTING

DTC	Description	Possible Source	Action
C1713	Concern with front outer left parking aid sensor	Front outer left parking aid sensor.	CHECK parking aid sensor for contamination. IF parking aid sensor is OK. INSTALL a new parking aid sensor. TEST the system for normal operation.
C1714	Front outer right sensor signal circuit short to battery	<ul style="list-style-type: none"> <li>• Parking aid sensor signal circuit.</li> <li>• Parking aid module.</li> </ul>	CHECK the circuit 8-GN6 (WH) for short to battery. IF the circuit is OK, INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
C1715	Front outer right sensor signal circuit open or short to ground	<ul style="list-style-type: none"> <li>• Parking aid sensor signal circuit.</li> <li>• Parking aid sensor.</li> <li>• Parking aid module.</li> </ul>	GO to <b>Pinpoint Test D</b> .
C1716	Concern with front outer right parking aid sensor	Front outer right parking aid sensor.	CHECK parking aid sensor for contamination. IF parking aid sensor is OK. INSTALL a new parking aid sensor. TEST the system for normal operation.
C1717	Front inner left sensor signal circuit short to battery	<ul style="list-style-type: none"> <li>• Parking aid sensor signal circuit.</li> <li>• Parking aid module.</li> </ul>	CHECK the circuit 8-GN8 (WH/BU) for short to battery. IF the circuit is OK, INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
C1718	Front inner left sensor signal circuit open or short to ground	<ul style="list-style-type: none"> <li>• Parking aid sensor signal circuit.</li> <li>• Parking aid sensor.</li> <li>• Parking aid module.</li> </ul>	GO to <b>Pinpoint Test E</b> .
C1719	Concern with front inner left parking aid sensor	Front inner left parking aid sensor.	CHECK parking aid sensor for contamination. IF parking aid sensor is OK. INSTALL a new parking aid sensor. TEST the system for normal operation.

## DIAGNOSIS AND TESTING

DTC	Description	Possible Source	Action
C5739	Front inner right sensor signal circuit short to battery	<ul style="list-style-type: none"> <li>Parking aid sensor signal circuit.</li> <li>Parking aid module.</li> </ul>	CHECK the circuit 8-GN7 (WH/RD) for short to battery. IF the circuit is OK, INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
C5740	Front inner right sensor signal circuit open or short to ground	<ul style="list-style-type: none"> <li>Parking aid sensor signal circuit.</li> <li>Parking aid sensor.</li> <li>Parking aid module.</li> </ul>	GO to <b>Pinpoint Test F</b> .
C5741	Concern with front inner right parking aid sensor	Front inner right parking aid sensor.	CHECK parking aid sensor for contamination. IF parking aid sensor is OK. INSTALL a new parking aid sensor. TEST the system for normal operation.
B1299	Sensor voltage supply short to ground	Parking aid sensors voltage supply circuits.	GO to <b>Pinpoint Test G</b> .
C1744	Parking aid speaker circuit short to ground	Parking aid module.	INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
C1745	Parking aid speaker circuit short to battery	Parking aid module.	INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
B1342	RAM Error	Parking aid module.	INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.

## DIAGNOSIS AND TESTING

DTC	Description	Possible Source	Action
B2207	ROM Error	Parking aid module.	INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
B2477	ROM/EEPROM Error	Parking aid module.	INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
B2373	LED circuit short to battery	<ul style="list-style-type: none"> <li>• Parking aid sensor signal circuit.</li> <li>• Parking aid switch</li> </ul>	Check the circuit for short to battery. IF the circuit is OK, INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
C1748	Parking aid switch input circuit short to ground.	<ul style="list-style-type: none"> <li>• Parking aid sensor signal circuit.</li> <li>• Parking aid switch</li> </ul>	Check the parking aid switch circuit for short to battery. IF the circuit is OK, INSTALL a new parking aid switch. IF the switch is OK, INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
C1920	Parking aid circuit failure.	Parking aid module.	INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.

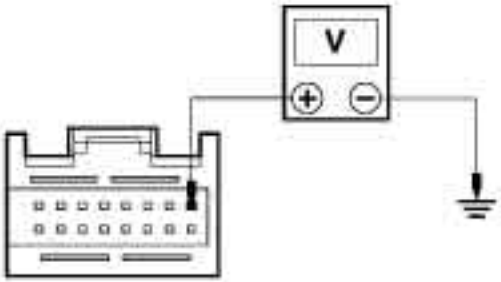
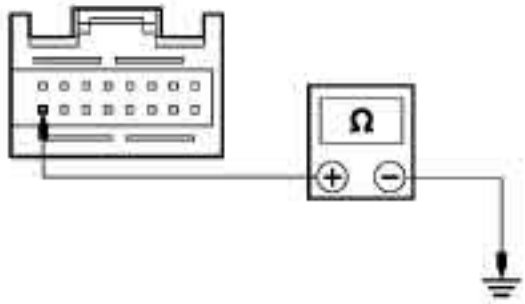
DIAGNOSIS AND TESTING

Symptom Chart

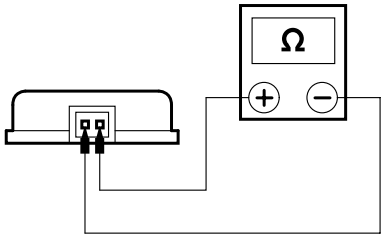
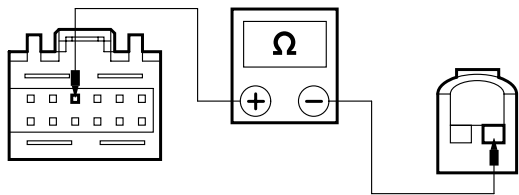
Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>The front parking aid is inoperative/does not operate correctly</li> </ul>	<ul style="list-style-type: none"> <li>Fuse.</li> <li>Circuit(s).</li> <li>Parking aid module.</li> </ul>	<ul style="list-style-type: none"> <li>GO to Pinpoint Test A.</li> </ul>
<ul style="list-style-type: none"> <li>No communication with the parking aid module</li> </ul>	<ul style="list-style-type: none"> <li>DLC.</li> <li>Circuit(s).</li> <li>Parking aid module.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B.</b></li> </ul>

Pinpoint Tests

PINPOINT TEST A : THE FRONT PARKING AID IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A1: CHECK FOR VOLTAGE TO THE PARKING AID MODULE</b>	
 <p>E41122</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C622.</li> <li>2 Ignition switch in position II.</li> </ol>
	<ol style="list-style-type: none"> <li>3 Measure the voltage between the parking aid module C622 pin 1, circuit 15-GN10 (GN/YE), harness side and ground.                             <ul style="list-style-type: none"> <li>Is the voltage greater than 10 volts?                                     <ul style="list-style-type: none"> <li>→ <b>Yes</b> GO to A2.</li> <li>→ <b>No</b> REPAIR the circuit 15-GN10 (GN/YE). TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>
<b>A2: CHECK THE PARKING AID MODULE GROUND CIRCUIT</b>	
 <p>E41123</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance between the parking aid module C622 pin 16, circuit 31-GN10 (BK), harness side and ground.                             <ul style="list-style-type: none"> <li>Is the resistance less than 5 Ohms?                                     <ul style="list-style-type: none"> <li>→ <b>Yes</b> <b>GO to A3.</b></li> <li>→ <b>No</b> REPAIR the circuit 31-GN10 (BK/YE). TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A3: CHECK THE FRONT PARKING AID SPEAKER FOR CORRECT OPERATION</b>	
	<ol style="list-style-type: none"> <li>1 Remove the front parking aid speaker. REFER to: <b>Front Parking Aid Speaker</b> (413-13 Parking Aid, Removal and Installation).</li> </ol>
 <p>E41163</p>	<ol style="list-style-type: none"> <li>2 Measure the resistance between the front parking aid speaker pin 1, and pin 2.                     <ul style="list-style-type: none"> <li>• Is the resistance 50 Ohms?</li> <li>→ <b>Yes</b> GO to A4.</li> <li>→ <b>No</b> INSTALL a new front parking aid speaker. TEST the system for normal operation.</li> </ul> </li> </ol>
<b>A4: CHECK THE CIRCUIT 8-GN25 FOR OPEN</b>	
 <p>E41164</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C624.</li> <li>2 Measure the resistance between the parking aid module C624 pin 4, circuit 8-GN25 (WH/VT), harness side and parking aid speaker C961 pin 1, circuit 8-GN25 (WH/VT), harness side.                     <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms?</li> <li>→ <b>Yes</b> GO to A5.</li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul> </li> </ol>

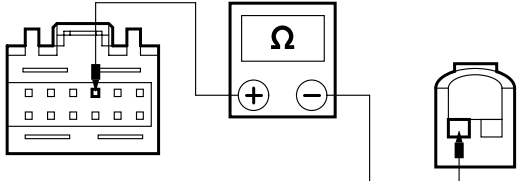


413-13-23

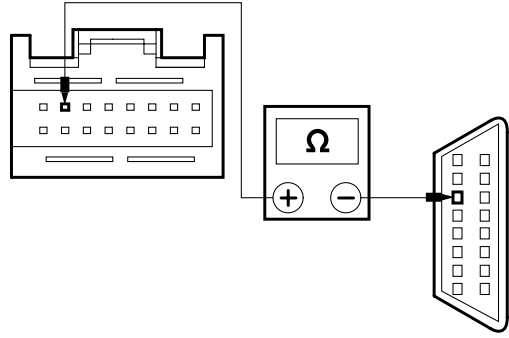
Parking Aid

413-13-23

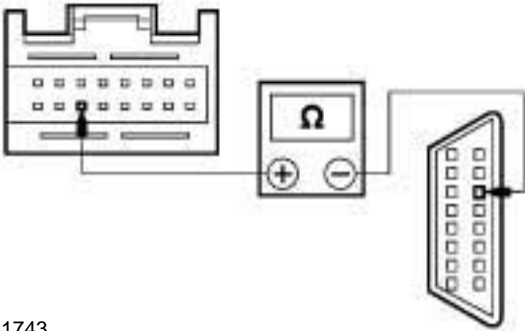
## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A5: CHECK THE CIRCUIT 10-GN25 FOR OPEN</b>	
 <p>E41165</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance between the parking aid module C624 pin 3, circuit 10-GN25 (GY/WH), harness side and parking aid speaker C961 pin 2, circuit 10-GN25 (GY/WH), harness side. <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms? <ul style="list-style-type: none"> <li>→ <b>Yes</b> INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.</li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

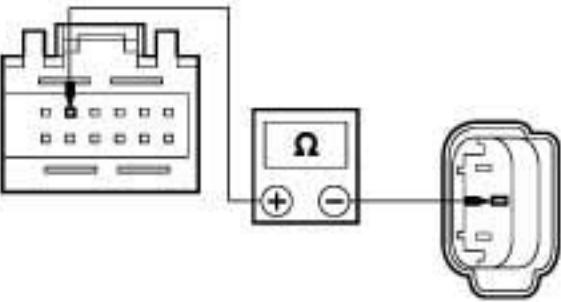
## PINPOINT TEST B : NO COMMUNICATION WITH THE PARKING AID MODULE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B1: CHECK THAT THE FORD DIAGNOSTIC EQUIPMENT IS COMMUNICATING THROUGH THE DLC</b>	
	<ol style="list-style-type: none"> <li>1 Select an alternative system to check the DLC. <ul style="list-style-type: none"> <li>• Is the Ford diagnostic equipment able to communicate with the selected system. <ul style="list-style-type: none"> <li>→ <b>Yes</b> GO to B2.</li> <li>→ <b>No</b> CHECK the DLC. For additional information, refer to the Wiring Diagrams.</li> </ul> </li> </ul> </li> </ol>
<b>B2: CHECK THE CIRCUIT 8-EE13 FOR OPEN</b>	
 <p>E41124</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C622.</li> <li>2 Measure the resistance between the data link connector (DLC) pin 11 and the parking aid module C622 pin 7, circuit 8-EE13 (WH/RD), harness side. <ul style="list-style-type: none"> <li>• Is the resistance less the 5 Ohms? <ul style="list-style-type: none"> <li>→ <b>Yes</b> <b>GO to B3.</b></li> <li>→ <b>No</b> REPAIR the circuit 8-EE13 (WH/RD). TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

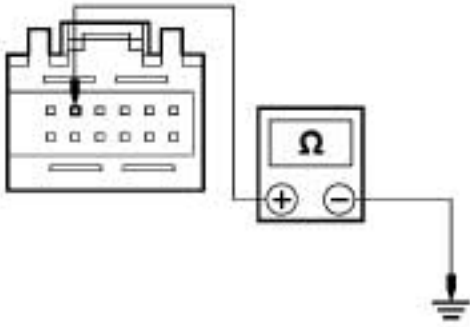
DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B3: CHECK THE DLC CIRCUIT FOR OPEN</b>	
 <p>E41743</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance between the DLC pin 3 and the parking aid module C622 pin 14, harness side.                     <ul style="list-style-type: none"> <li>• Is the resistance less the 5 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.</li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

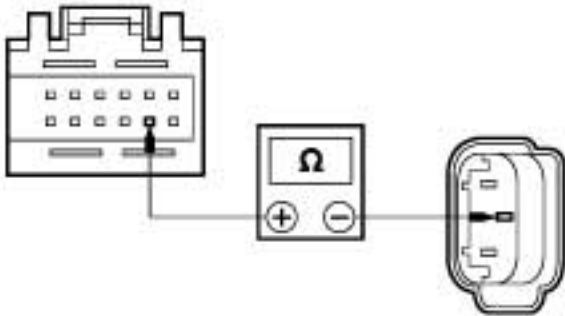
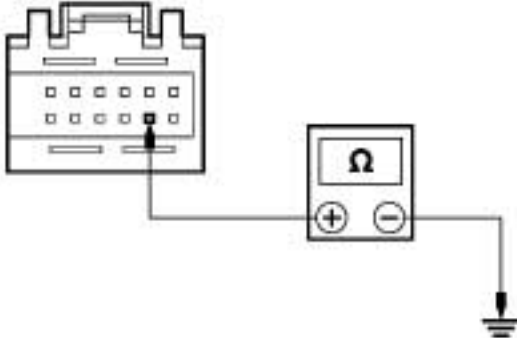
**PINPOINT TEST C : DTC C1712 : FRONT OUTER LEFT SENSOR SIGNAL CIRCUIT OPEN OR SHORT TO GROUND**

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>C1: CHECK CIRCUIT 8-GN9 (WH/GN) FOR OPEN</b>	
 <p>E41125</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C624.</li> <li>2 Disconnect Parking aid sensor C629.</li> <li>3 Measure the resistance between the parking aid module C624 pin 5, circuit 8-GN9 (WH/GN), harness side and parking aid sensor C629 pin 2, circuit 8-GN9 (WH/GN), harness side.                     <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> <b>GO to C2.</b></li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

DIAGNOSIS AND TESTING

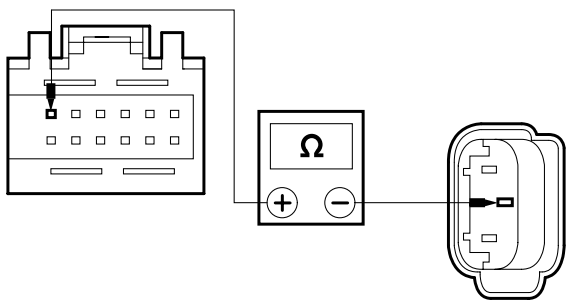
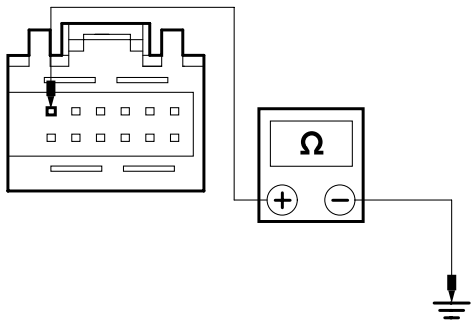
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>C2: CHECK CIRCUIT 8-GN9 (WH/GN) FOR SHORT TO GROUND</b>	
 <p>E41126</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance between the parking aid module C624 pin 5, circuit 8-GN22 (WH/GN), harness side and ground.</li> </ol> <ul style="list-style-type: none"> <li>• Is the resistance greater than 10,000 Ohms?</li> </ul> <p>→ <b>Yes</b> INSTALL a new parking aid sensor. If the concern persists, INSTALL a new parking aid module.</p> <p>→ <b>No</b> REPAIR the short to ground. TEST the system for normal operation.</p>

**PINPOINT TEST D : DTC C1715 : FRONT OUTER RIGHT SENSOR SIGNAL CIRCUIT OPEN OR SHORT TO GROUND**

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>D1: CHECK CIRCUIT 8-GN6 (WH) FOR OPEN</b>	
 <p>E41148</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C624.</li> <li>2 Disconnect Parking aid sensor C626.</li> <li>3 Measure the resistance between the parking aid module C624 pin 8, circuit 8-GN6 (WH), harness side and parking aid sensor C626 pin 2, circuit 8-GN6 (WH), harness side.</li> </ol> <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms?</li> </ul> <p>→ <b>Yes</b> GO to D2.</p> <p>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</p>
<b>D2: CHECK CIRCUIT 8-GN6 (WH) FOR SHORT TO GROUND</b>	
 <p>E41149</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance between the parking aid module C624 pin 8, circuit 8-GN6 (WH), harness side and ground.</li> </ol> <ul style="list-style-type: none"> <li>• Is the resistance greater than 10,000 Ohms?</li> </ul> <p>→ <b>Yes</b> INSTALL a new parking aid sensor. If the concern persists, INSTALL a new parking aid module.</p> <p>→ <b>No</b> REPAIR the short to ground. TEST the system for normal operation.</p>

DIAGNOSIS AND TESTING

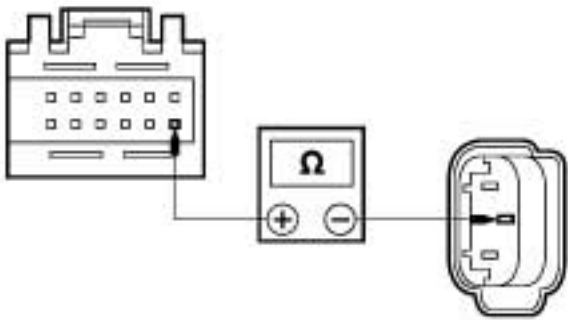
PINPOINT TEST E : DTC C1718 : FRONT INNER LEFT SENSOR SIGNAL CIRCUIT OPEN OR SHORT TO GROUND

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>E1: CHECK CIRCUIT 8-GN8 (WH/BU) FOR OPEN</b>	
 <p>E41144</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C624.</li> <li>2 Disconnect Parking aid sensor C628.</li> <li>3 Measure the resistance between the parking aid module C624 pin 6, circuit 8-GN8 (WH/BU), harness side and parking aid sensor C628 pin 2, circuit 8-GN8 (WH/BU), harness side.                     <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> GO to E2.</li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>
<b>E2: CHECK CIRCUIT 8-GN8 (WH/BU) FOR SHORT TO GROUND</b>	
 <p>E41145</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance between the parking aid module C624 pin 6, circuit 8-GN8 (WH/BU), harness side and ground.                     <ul style="list-style-type: none"> <li>• Is the resistance greater than 10,000 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> INSTALL a new parking aid sensor. If the concern persists, INSTALL a new parking aid module.</li> <li>→ <b>No</b> REPAIR the short to ground. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

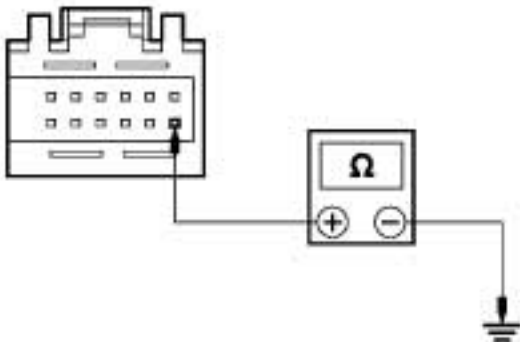
PINPOINT TEST F : DTC C5740 : FRONT INNER RIGHT SENSOR SIGNAL CIRCUIT OPEN OR SHORT TO GROUND

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>F1: CHECK CIRCUIT 8-GN7 (WH/RD) FOR OPEN</b>	
	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C624.</li> <li>2 Disconnect Parking aid sensor C627.</li> </ol>

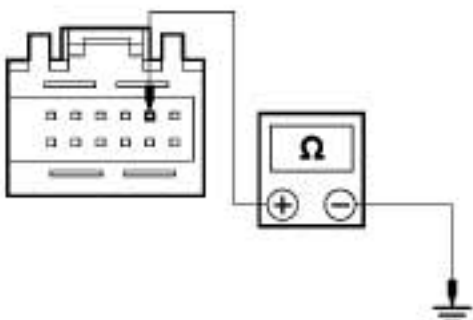
DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
 <p>E41146</p>	<p>3 Measure the resistance between the parking aid module C624 pin 7, circuit 8-GN7 (WH/RD), harness side and parking aid sensor C627 pin 2, circuit 8-GN7 (WH/RD), harness side.</p> <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms?</li> <li>→ <b>Yes</b> GO to F2.</li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul>

F2: CHECK CIRCUIT 8-GN7 (WH/RD) FOR SHORT TO GROUND

 <p>E41147</p>	<p>1 Measure the resistance between the parking aid module C624 pin 7, circuit 8-GN7 (WH/RD), harness side and ground.</p> <ul style="list-style-type: none"> <li>• Is the resistance greater than 10,000 Ohms?</li> <li>→ <b>Yes</b> INSTALL a new parking aid sensor. If the concern persists, INSTALL a new parking aid module.</li> <li>→ <b>No</b> REPAIR the short to ground. TEST the system for normal operation.</li> </ul>
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PINPOINT TEST G : DTC B1299 : SENSOR VOLTAGE SUPPLY SHORT TO GROUND

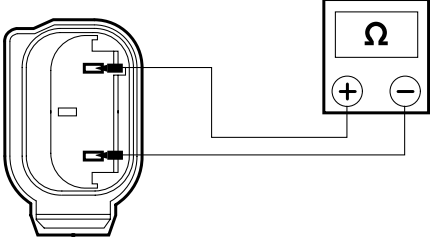
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<p>G1: CHECK THE CIRCUIT 7-GN19 (YE/RD) FOR SHORT TO GROUND</p>	
	<p>1 Disconnect Parking aid sensors C626, C627, C628, C629.</p>
	<p>2 Disconnect Parking aid module C624.</p>
 <p>E41132</p>	<p>3 Measure the resistance between the parking aid module C624 pin 2, circuit 7-GN6 (YE), harness side and ground.</p> <ul style="list-style-type: none"> <li>• Is the resistance greater than 10,000 Ohms?</li> <li>→ <b>Yes</b> GO to G2.</li> <li>→ <b>No</b> REPAIR the short to ground. TEST the system for normal operation.</li> </ul>

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Parking Aid

413-13-28

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>G2: CHECK EACH PARKING AID SENSOR FOR SHORT BETWEEN PINS 1 AND 3</b>	
 <p>E38442</p>	<p>1 Measure the resistance of each parking aid sensor between pins 1 and 3 component side.</p> <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms?</li> </ul> <p>→ <b>Yes</b> INSTALL a new parking aid sensor(s). TEST the system for normal operation.</p> <p>→ <b>No</b> INSTALL a new parking aid module.</p> <p>REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.</p>



## DIAGNOSIS AND TESTING

## Parking Aid — Vehicles With: Rear Parking Aid

Refer to **Wiring Diagrams Section 413-13**, for schematic and connector information.

## General Equipment

Ford diagnostic equipment
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## Principles of Operation

**NOTE:** The rear parking aid system will be de-activated when a Ford rear trailer tow module is attached to the vehicle.

The ultrasonic parking aid system will default to enabled when the ignition switch is turned to the RUN position, the system is activated by selecting reverse gear. The parking aid system will be disabled if a fault is detected in one of the four rear parking aid sensors, the parking aid speaker or the parking aid module. An error tone approximately 3 seconds long will be emitted from the rear parking aid speaker if a fault is detected. The rear parking aid speaker will also sound for approximately 3 seconds if an error is detected at each ignition cycle or if an error is detected when the system has been activated.

## Inspection and Verification

1. Verify the customer concern.

## Diagnostic Trouble Codes (DTC) Index

## DTC Index

DTC	Description	Possible Source	Action
C1699	Rear outer left sensor signal circuit short to battery	<ul style="list-style-type: none"> <li>• Parking aid sensor signal circuit.</li> <li>• Parking aid module.</li> </ul>	<p>Check the circuit 8-GN22 (WH/GN) for short to battery. IF the circuit is OK, INSTALL a new parking aid module.</p> <p>REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation).</p> <p>TEST the system for normal operation.</p>
C1700	Rear outer left sensor signal circuit open or short to ground	<ul style="list-style-type: none"> <li>• Parking aid sensor signal circuit.</li> <li>• Parking aid sensor.</li> <li>• Parking aid module.</li> </ul>	<p>GO to <b>Pinpoint Test C</b>.</p>

2. Visually inspect for obvious signs of electrical damage.

## Visual Inspection Chart

Electrical
<ul style="list-style-type: none"> <li>– Fuse(s)</li> <li>– Wiring harness(s)</li> <li>– Electrical connector(s)</li> <li>– Battery junction box (BJB)</li> <li>– Rear parking aid sensor(s)</li> <li>– Rear parking aid speaker</li> <li>– Parking aid module</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. If the cause is not visually evident, connect the Ford diagnostic equipment to the data link connector (DLC) and select the vehicle system to be tested from the diagnostic menu.
5. Retrieve the Diagnostic Trouble Code (DTC)s and refer to the DTC Index.
6. If no DTCs are retrieved or there is no communication with the module, proceed to the Symptom Chart to continue diagnostics.

## DIAGNOSIS AND TESTING

DTC	Description	Possible Source	Action
C1701	Concern with rear outer left parking aid sensor	<ul style="list-style-type: none"> <li>Rear outer left parking aid sensor.</li> </ul>	CHECK parking aid sensor for contamination. IF a parking sensor is OK. INSTALL a new parking aid sensor. TEST the system for normal operation.
C1702	Rear outer right sensor signal circuit short to battery	<ul style="list-style-type: none"> <li>Parking aid sensor signal circuit.</li> <li>Parking aid module.</li> </ul>	CHECK the circuit 8-GN19 (WH) for short to battery. IF the circuit is OK, INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
C1703	Rear outer right sensor signal circuit open or short to ground	<ul style="list-style-type: none"> <li>Parking aid sensor signal circuit.</li> <li>Parking aid sensor.</li> <li>Parking aid module.</li> </ul>	GO to <b>Pinpoint Test D</b> .
C1704	Concern with rear outer right parking aid sensor	<ul style="list-style-type: none"> <li>Rear outer right parking aid sensor.</li> </ul>	CHECK parking aid sensor for contamination. IF a parking sensor is OK. INSTALL a new parking aid sensor. TEST the system for normal operation.
C1705	Rear inner left sensor signal circuit short to battery	<ul style="list-style-type: none"> <li>Parking aid sensor signal circuit.</li> <li>Parking aid module.</li> </ul>	CHECK the circuit 8-GN21 (WH/BU) for short to battery. IF the circuit is OK, INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
C1706	Rear inner left sensor signal circuit open or short to ground	<ul style="list-style-type: none"> <li>Parking aid sensor signal circuit.</li> <li>Parking aid sensor.</li> <li>Parking aid module.</li> </ul>	GO to <b>Pinpoint Test E</b> .
C1707	Concern with rear inner left parking aid sensor	<ul style="list-style-type: none"> <li>Rear inner left parking aid sensor.</li> </ul>	CHECK parking aid sensor for contamination. IF a parking sensor is OK. INSTALL a new parking aid sensor. TEST the system for normal operation.

## DIAGNOSIS AND TESTING

DTC	Description	Possible Source	Action
C1708	Rear inner right sensor signal circuit short to battery	<ul style="list-style-type: none"> <li>• Parking aid sensor signal circuit.</li> <li>• Parking aid module.</li> </ul>	CHECK the circuit 8-GN20 (WH/RD) for short to battery. IF the circuit is OK, INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
C1709	Rear inner right sensor signal circuit open or short to ground	<ul style="list-style-type: none"> <li>• Parking aid sensor signal circuit.</li> <li>• Parking aid sensor.</li> <li>• Parking aid module.</li> </ul>	GO to <b>Pinpoint Test F.</b>
C1710	Concern with rear inner right parking aid sensor	<ul style="list-style-type: none"> <li>• Rear inner right parking aid sensor.</li> </ul>	CHECK parking aid sensor for contamination. IF a parking sensor is OK. INSTALL a new parking aid sensor. TEST the system for normal operation.
B1299	Parking aid sensor voltage supply short to ground	<ul style="list-style-type: none"> <li>• Parking aid sensors voltage supply circuits.</li> </ul>	GO to <b>Pinpoint Test G.</b>
C1742	Parking aid speaker circuit short to ground	<ul style="list-style-type: none"> <li>• Parking aid module.</li> <li>• circuit(s).</li> </ul>	GO to <b>Pinpoint Test H.</b>
C1743	Parking aid speaker circuit short to battery	<ul style="list-style-type: none"> <li>• Parking aid module.</li> <li>• circuit(s).</li> </ul>	GO to <b>Pinpoint Test I.</b>
B1342	RAM Error	<ul style="list-style-type: none"> <li>• Parking aid module.</li> </ul>	INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.
B2477	ROM/EEPROM Error	<ul style="list-style-type: none"> <li>• Parking aid module.</li> </ul>	INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.

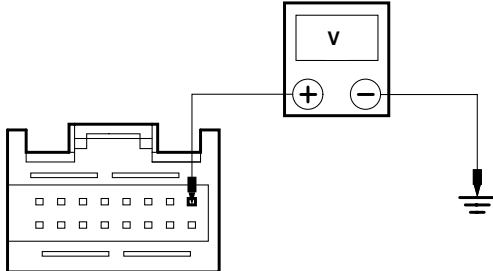
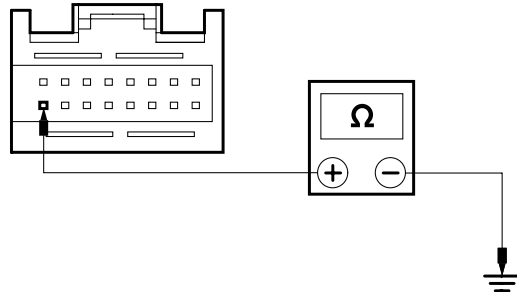
DIAGNOSIS AND TESTING

Symptom Chart

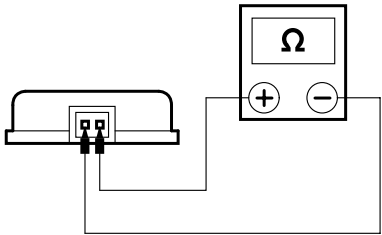
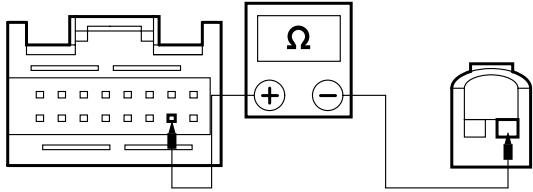
Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>The rear parking aid is inoperative/does not operate correctly</li> </ul>	<ul style="list-style-type: none"> <li>Fuse.</li> <li>Circuit(s).</li> <li>Parking aid module.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test A.</b></li> </ul>
<ul style="list-style-type: none"> <li>No communication with the parking aid module</li> </ul>	<ul style="list-style-type: none"> <li>DLC.</li> <li>Circuit(s).</li> <li>Parking aid module.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B.</b></li> </ul>
<ul style="list-style-type: none"> <li>The parking aid system does not deactivate when a trailer is attached</li> </ul>	<ul style="list-style-type: none"> <li>Circuit(s).</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test J.</b></li> </ul>

Pinpoint Tests

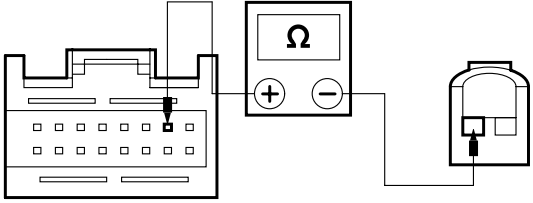
PINPOINT TEST H : THE REAR PARKING AID IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A1: CHECK FOR VOLTAGE TO THE PARKING AID MODULE</b>	
 <p>E41122</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C622.</li> <li>2 Ignition switch in position II.</li> </ol>
	<ol style="list-style-type: none"> <li>3 Measure the voltage between the parking aid module C622 pin 1, circuit 15-GN10 (GN/YE), harness side and ground.                     <ul style="list-style-type: none"> <li>Is the voltage greater than 10 volts?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> GO to A2.</li> <li>→ <b>No</b> REPAIR the circuit 15-GN10 (GN/YE). TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>
<b>A2: CHECK THE PARKING AID MODULE GROUND CIRCUIT</b>	
 <p>E41123</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance between the parking aid module C622 pin 16, circuit 31-GN10 (BK), harness side and ground.                     <ul style="list-style-type: none"> <li>Is the resistance less than 5 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> <b>GO to A3.</b></li> <li>→ <b>No</b> REPAIR the circuit 31-GN10 (BK/YE). TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

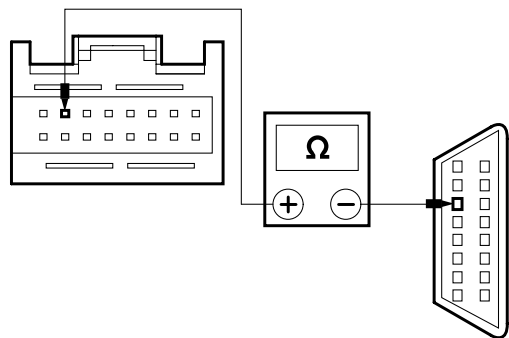
## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A3: CHECK THE REVERSE LAMP FOR CORRECT OPERATION</b>	
	<ol style="list-style-type: none"> <li>1 Select REVERSE.</li> <li>2 Check the reverse lamps for correct operation. <ul style="list-style-type: none"> <li>• Do the reversing lamps illuminate?</li> <li>→ <b>Yes</b> GO to A4.</li> <li>→ <b>No</b> REFER to: <b>Reversing Lamps</b> (417-01 Exterior Lighting, Diagnosis and Testing). TEST the system for normal operation.</li> </ul> </li> </ol>
<b>A4: CHECK THE REAR PARKING AID SPEAKER FOR CORRECT OPERATION</b>	
	<ol style="list-style-type: none"> <li>1 Remove the rear parking aid speaker. REFER to: <b>Rear Parking Aid Speaker</b> (413-13 Parking Aid, Removal and Installation).</li> </ol>
 <p>E41163</p>	<ol style="list-style-type: none"> <li>2 Measure the resistance between the rear parking aid speaker C947 pin 1, and pin 2, component side. <ul style="list-style-type: none"> <li>• Is the resistance 50 Ohms +/- 7.5 Ohms?</li> <li>→ <b>Yes</b> GO to A5.</li> <li>→ <b>No</b> INSTALL a new rear parking aid speaker. TEST the system for normal operation.</li> </ul> </li> </ol>
<b>A5: CHECK THE CIRCUIT 8-GN26 FOR OPEN</b>	
 <p>E41162</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C622.</li> <li>2 Measure the resistance between the parking aid module C622 pin 10, circuit 8-GN26 (WH), harness side and the rear parking aid speaker C947 pin 1, circuit 8-GN26 (WH), harness side. <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms?</li> <li>→ <b>Yes</b> <b>GO to A6.</b></li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul> </li> </ol>

DIAGNOSIS AND TESTING

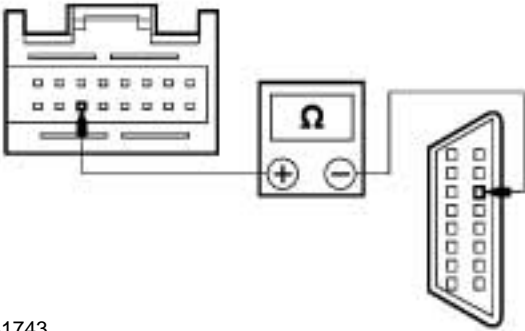
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A6: CHECK THE CIRCUIT 10-GN26 FOR OPEN</b>	
 <p>E41167</p>	<p>1 Measure the resistance between the parking aid module C622 pin 2, circuit 10-GN26 (GY), harness side and the rear parking aid speaker C947 pin 2, circuit 10-GN26 (GY), harness side.</p> <ul style="list-style-type: none"> <li>Is the resistance less than 5 Ohms?</li> </ul> <p>→ <b>Yes</b> For vehicles fitted with a rear trailer tow module. GO to <b>Pinpoint Test J</b>. For vehicles fitted without a rear trailer tow module. INSTALL a new parking aid module.</p> <p>REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.</p> <p>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</p>

PINPOINT TEST I : NO COMMUNICATION WITH THE PARKING AID MODULE

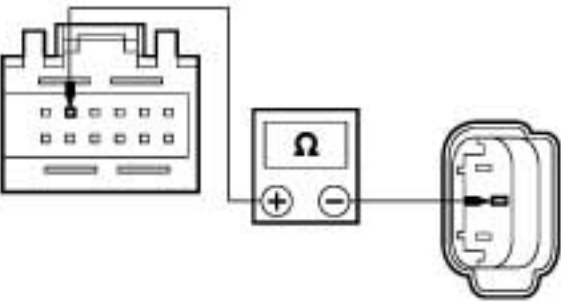
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B1: CHECK THAT THE FORD DIAGNOSTIC EQUIPMENT IS COMMUNICATING THROUGH THE DLC</b>	
	<p>1 Select an alternative system to check the DLC.</p> <ul style="list-style-type: none"> <li>Is the Ford diagnostic equipment able to communicate with the selected system.</li> </ul> <p>→ <b>Yes</b> GO to B2.</p> <p>→ <b>No</b> CHECK the DLC. For additional information, refer to the Wiring Diagrams.</p>
<b>B2: CHECK THE CIRCUIT 8-EE13 FOR OPEN</b>	
 <p>E41124</p>	<p>1 Disconnect Parking aid module C622.</p> <p>2 Measure the resistance between the DLC pin 11 and parking aid module C622 pin 7, circuit 8-EE13 (WH/RD), harness side.</p> <ul style="list-style-type: none"> <li>Is the resistance less the 5 Ohms?</li> </ul> <p>→ <b>Yes</b> <b>GO to B3.</b></p> <p>→ <b>No</b> REPAIR the circuit 8-EE13 (WH/RD). TEST the system for normal operation.</p>



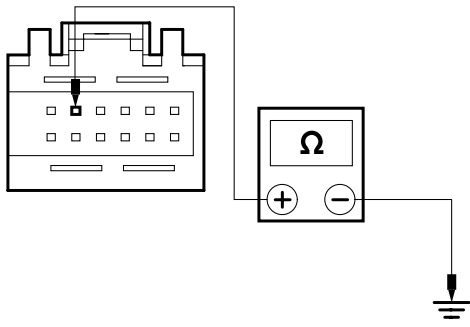
DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B3: CHECK THE DLC CIRCUIT FOR OPEN</b>	
 <p>E41743</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance between the DLC pin 3 and parking aid module C622 pin 14, harness side.                     <ul style="list-style-type: none"> <li>• Is the resistance less the 5 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.</li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

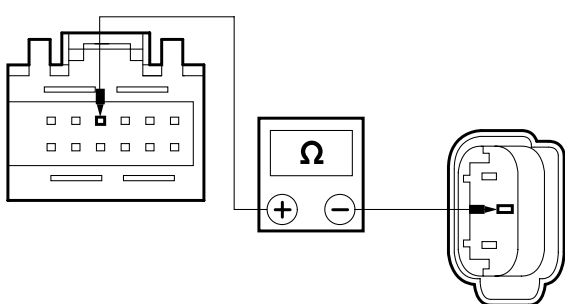
**PINPOINT TEST J : DTC C1700 : REAR OUTER LEFT SENSOR SIGNAL CIRCUIT OPEN OR SHORT TO GROUND**

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>C1: CHECK CIRCUIT 8-GN22 (WH/GN) FOR OPEN</b>	
 <p>E41125</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C623.</li> <li>2 Disconnect Parking aid sensor C607.</li> <li>3 Measure the resistance between the parking aid module C623 pin 5, circuit 8-GN22 (WH/GN), harness side and parking aid sensor C607 pin 2, circuit 8-GN22 (WH/GN), harness side.                     <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> <b>GO to C2.</b></li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

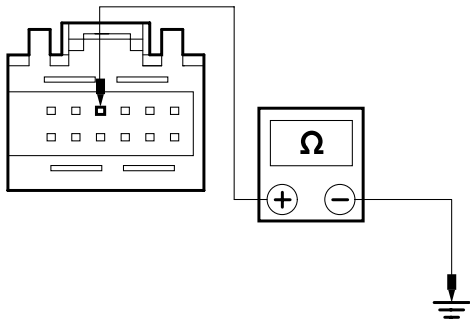
DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>C2: CHECK CIRCUIT 8-GN22 (WH/GN) FOR SHORT TO GROUND</b>	
 <p>E41126</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance between the parking aid module C623 pin 5, circuit 8-GN22 (WH/GN), harness side and ground.                     <ul style="list-style-type: none"> <li>• Is the resistance greater than 10,000 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> INSTALL a new parking aid sensor. If the concern persists, INSTALL a new parking aid module.</li> <li>REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation).</li> </ul> </li> <li>→ <b>No</b> REPAIR the short to ground. TEST the system for normal operation.</li> </ul> </li> </ol>

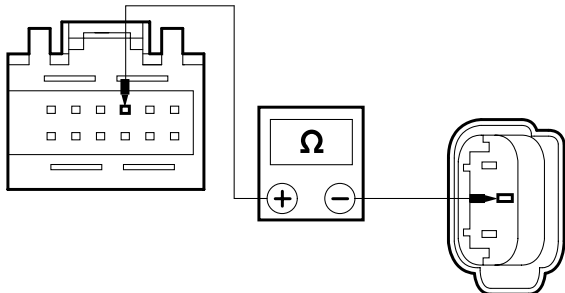
**PINPOINT TEST K : DTC C1703 : REAR OUTER RIGHT SENSOR SIGNAL CIRCUIT OPEN OR SHORT TO GROUND**

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>D1: CHECK CIRCUIT 8-GN19 (WH) FOR OPEN</b>	
 <p>E41127</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C623.</li> <li>2 Disconnect Parking aid sensor C604.</li> <li>3 Measure the resistance between the parking aid module C623 pin 4, circuit 8-GN19 (WH), harness side and parking aid sensor C604 pin 2, circuit 8-GN19 (WH), harness side.                     <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> <b>GO to D2.</b></li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

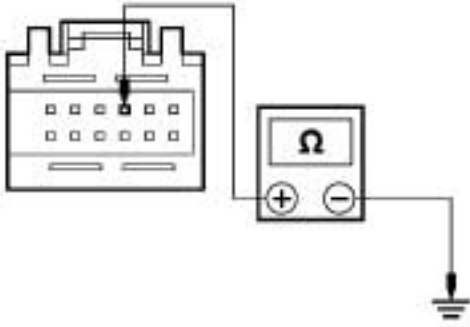
DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>D2: CHECK CIRCUIT 8-GN19 (WH) FOR SHORT TO GROUND</b>	
 <p>E41128</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance between the parking aid module C623 pin 4, circuit 8-GN19 (WH), harness side and ground.                     <ul style="list-style-type: none"> <li>• Is the resistance greater than 10,000 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> INSTALL a new parking aid sensor. If the concern persists, INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation).</li> <li>→ <b>No</b> REPAIR the short to ground. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

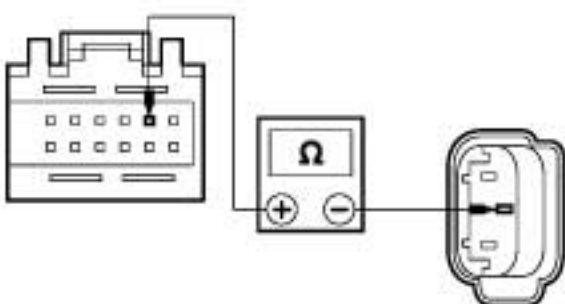
**PINPOINT TEST L : DTC C1706 : REAR INNER LEFT SENSOR SIGNAL CIRCUIT OPEN OR SHORT TO GROUND**

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>E1: CHECK CIRCUIT 8-GN21 (WH/BU) FOR OPEN</b>	
 <p>E41129</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C623.</li> <li>2 Disconnect Parking aid sensor C606.</li> <li>3 Measure the resistance between the parking aid module C623 pin 3, circuit 8-GN21 (WH/BU), harness side and parking aid sensor C606 pin 2, circuit 8-GN21 (WH/BU), harness side.                     <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> <b>GO to E2.</b></li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

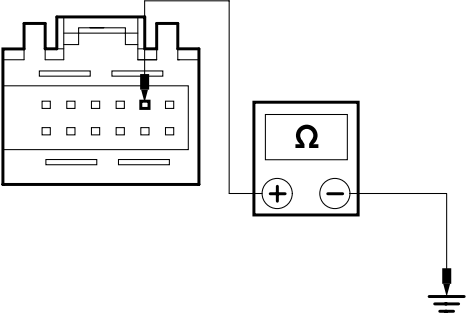
DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>E2: CHECK CIRCUIT 8-GN21 (WH/BU) FOR SHORT TO GROUND</b>	
 <p>E41130</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance between the parking aid module C623 pin 3, circuit 8-GN21 (WH/BU), harness side and ground.                     <ul style="list-style-type: none"> <li>• Is the resistance greater than 10,000 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> INSTALL a new parking aid sensor. If the concern persists, INSTALL a new parking aid module. REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation).</li> <li>→ <b>No</b> REPAIR the short to ground. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

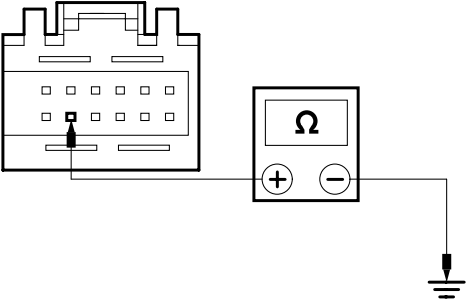
**PINPOINT TEST M : DTC C1709 : REAR INNER RIGHT SENSOR SIGNAL CIRCUIT OPEN OR SHORT TO GROUND**

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>F1: CHECK CIRCUIT 8-GN20 (WH/RD) FOR OPEN</b>	
 <p>E41131</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C623.</li> <li>2 Disconnect Parking aid sensor C605.</li> <li>3 Measure the resistance between the parking aid module C623 pin 2, circuit 8-GN20 (WH/RD), harness side and parking aid sensor C605 pin 2, circuit 8-GN20 (WH/RD), harness side.                     <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> <b>GO to F2.</b></li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

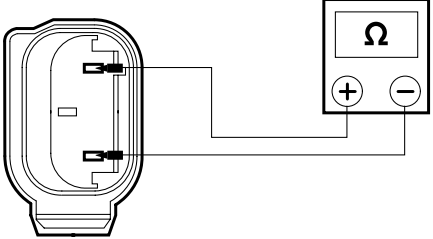
DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>F2: CHECK CIRCUIT 8-GN20 (WH/RD) FOR SHORT TO GROUND</b>	
 <p>E41132</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance between the parking aid module C623 pin 2, circuit 8-GN20 (WH/RD), harness side and ground.                     <ul style="list-style-type: none"> <li>• Is the resistance greater than 10,000 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> INSTALL a new parking aid sensor. If the concern persists, INSTALL a new parking aid module.</li> <li>REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation).</li> </ul> </li> <li>→ <b>No</b> REPAIR the short to ground. TEST the system for normal operation.</li> </ul> </li> </ol>

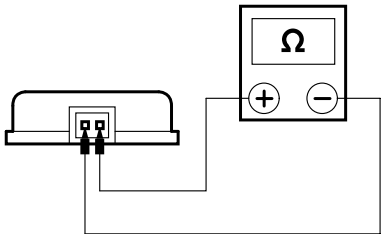
**PINPOINT TEST N : DTC B1299 : PARKING AID SENSOR VOLTAGE SUPPLY SHORT TO GROUND**

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>G1: CHECK THE CIRCUIT 7-GN19 (YE/RD) FOR SHORT TO GROUND</b>	
	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid sensors C604, C605, C606, C607.</li> </ol>
	<ol style="list-style-type: none"> <li>2 Disconnect Parking aid module C623.</li> </ol>
 <p>E41133</p>	<ol style="list-style-type: none"> <li>3 Measure the resistance between the parking aid module C623 pin 11, circuit 7-GN19 (YE), harness side and ground.                     <ul style="list-style-type: none"> <li>• Is the resistance greater than 10,000 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> <b>GO to G2.</b></li> <li>→ <b>No</b> REPAIR the short to ground. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

DIAGNOSIS AND TESTING

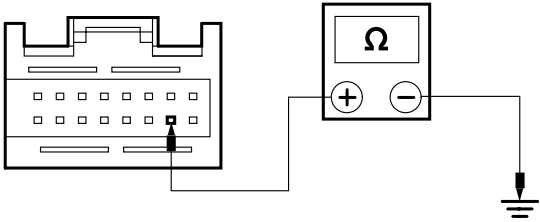
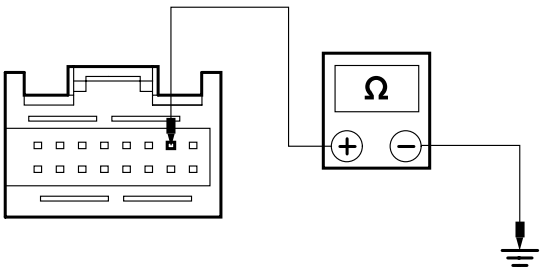
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>G2: CHECK EACH PARKING AID SENSOR FOR SHORT BETWEEN PINS 1 AND 3</b>	
 <p>E38442</p>	<ol style="list-style-type: none"> <li>1 Measure the resistance of each parking aid sensor between pins 1 and 3 component side.                     <ul style="list-style-type: none"> <li>• Is the resistance less than 5 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> INSTALL a new parking aid sensor(s). TEST the system for normal operation.</li> <li>→ <b>No</b> INSTALL a new parking aid module. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

**PINPOINT TEST O : DTC C1742 PARKING AID SPEAKER CIRCUIT SHORT TO GROUND**

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>H1: CHECK THE REAR PARKING AID SPEAKER FOR CORRECT OPERATION</b>	
 <p>E41163</p>	<ol style="list-style-type: none"> <li>1 Remove the rear parking aid speaker. REFER to: <b>Rear Parking Aid Speaker</b> (413-13 Parking Aid, Removal and Installation).</li> <li>2 Measure the resistance between the rear parking aid speaker C947 pin 1, and pin 2, component side.                     <ul style="list-style-type: none"> <li>• Is the resistance 50 Ohms +/- 7.5 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> GO to H2.</li> <li>→ <b>No</b> INSTALL a new rear parking aid speaker. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>
<b>H2: CHECK THE CIRCUIT 8-GN26 (WH) FOR SHORT TO GROUND</b>	
	<ol style="list-style-type: none"> <li>1 Disconnect Parking Aid Module C622.</li> </ol>



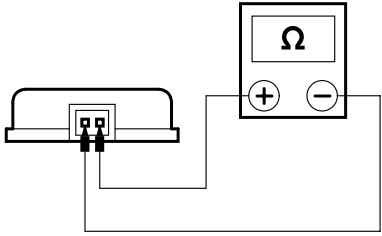
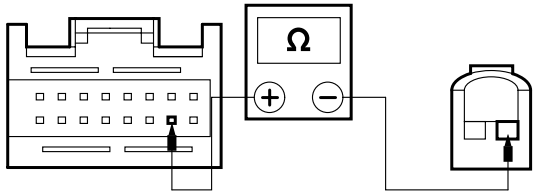
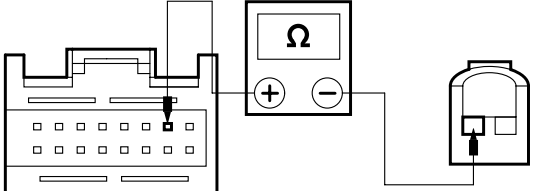
DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
 <p>E59860</p>	<p>2 Measure the resistance between the parking aid module C622 pin 10, circuit 8-GN26 (WH), harness side and ground.</p> <ul style="list-style-type: none"> <li>Is the resistance greater than 10,000 Ohms?</li> </ul> <p>→ <b>Yes</b> INSTALL a new rear parking aid speaker. TEST the system for normal operation. If the concern persists, INSTALL a new parking aid module.</p> <p>REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.</p> <p>→ <b>No</b> GO to H3.</p>
<p><b>H3: CHECK THE CIRCUIT 10-GN26 (GY) FOR SHORT TO GROUND</b></p>	
 <p>E59861</p>	<p>1 Measure the resistance between the parking aid module C622 pin 2, circuit 10-GN26 (GY), harness side and ground.</p> <ul style="list-style-type: none"> <li>Is the resistance greater than 10,000 Ohms?</li> </ul> <p>→ <b>Yes</b> For vehicles fitted with a rear trailer tow module. GO to <b>Pinpoint Test J</b>. For vehicles fitted without a rear trailer tow module. INSTALL a new parking aid module.</p> <p>REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.</p> <p>→ <b>No</b> REPAIR the short to ground. TEST the system for normal operation.</p>

**PINPOINT TEST P : DTC C1743 PARKING AID SPEAKER CIRCUIT SHORT TO BATTERY**

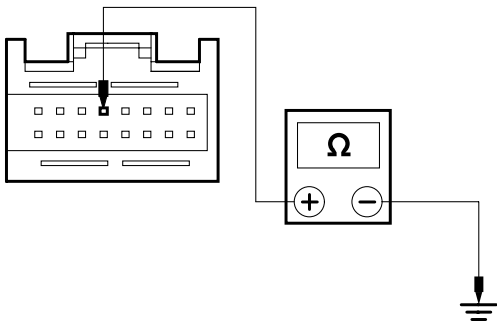
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<p><b>I1: CHECK THE REAR PARKING AID SPEAKER FOR CORRECT OPERATION</b></p>	
	<p>1 Remove the rear parking aid speaker.</p> <p>REFER to: <b>Rear Parking Aid Speaker</b> (413-13 Parking Aid, Removal and Installation).</p>

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
 <p>E41163</p>	<p>2 Measure the resistance between the rear parking aid speaker C947 pin 1, and pin 2, component side.</p> <ul style="list-style-type: none"> <li>Is the resistance 50 Ohms +/- 7.5 Ohms?</li> </ul> <p>→ <b>Yes</b> GO to I2.</p> <p>→ <b>No</b> INSTALL a new rear parking aid speaker. TEST the system for normal operation.</p>
<b>I2: CHECK THE CIRCUIT 8-GN26 (WH) FOR OPEN</b>	
 <p>E41162</p>	<p>1 Disconnect Parking aid module C622.</p> <p>2 Measure the resistance between the parking aid module C622 pin 10, circuit 8-GN26 (WH), harness side and the rear parking aid speaker C947 pin 1, circuit 8-GN26 (WH), harness side.</p> <ul style="list-style-type: none"> <li>Is the resistance less than 5 Ohms?</li> </ul> <p>→ <b>Yes</b> GO to I3.</p> <p>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</p>
<b>I3: CHECK THE CIRCUIT 10-GN26 (GY) FOR OPEN</b>	
 <p>E41167</p>	<p>1 Measure the resistance between the parking aid module C622 pin 2, circuit 10-GN26 (GY), harness side and the rear parking aid speaker C947 pin 2, circuit 10-GN26 (GY), harness side.</p> <ul style="list-style-type: none"> <li>Is the resistance less than 5 Ohms?</li> </ul> <p>→ <b>Yes</b> For vehicles fitted with a rear trailer tow module. <b>GO to Pinpoint Test J</b>. For vehicles fitted without a rear trailer tow module. INSTALL a new parking aid module.</p> <p>REFER to: <b>Parking Aid Module</b> (413-13 Parking Aid, Removal and Installation). TEST the system for normal operation.</p> <p>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</p>

DIAGNOSIS AND TESTING

**PINPOINT TEST Q : THE PARKING AID SYSTEM DOES NOT DEACTIVATE WHEN A TRAILER IS ATTACHED**

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>J1: CHECK PARKING AID MODULE CIRCUIT 9-GN18 (BN/BU) FOR SHORT TO GROUND</b>	
 <p>E41770</p>	<ol style="list-style-type: none"> <li>1 Disconnect Parking aid module C622.</li> <li>2 Measure the resistance between the parking aid module C622 pin 5, circuit 9-GN18 (BN/BU), harness side and ground.                     <ul style="list-style-type: none"> <li>• Is the resistance greater than 10,000 Ohms?                             <ul style="list-style-type: none"> <li>→ <b>Yes</b> TEST the system for normal operation.</li> <li>→ <b>No</b> REPAIR the short to ground. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

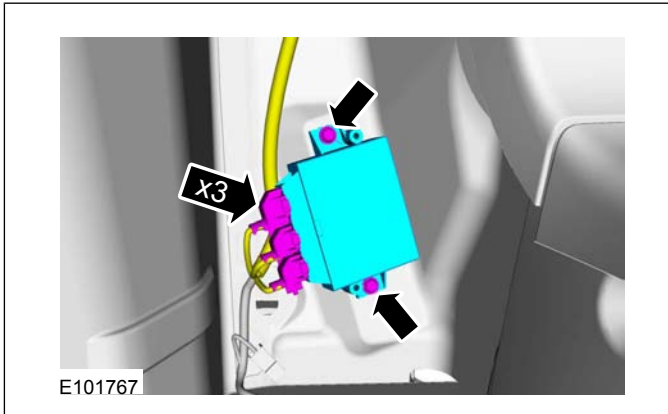
## REMOVAL AND INSTALLATION

## Parking Aid Module

## Removal

1. Refer to: **Loadspace Trim Panel RH** (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



## Installation

1. To install, reverse the removal procedure.

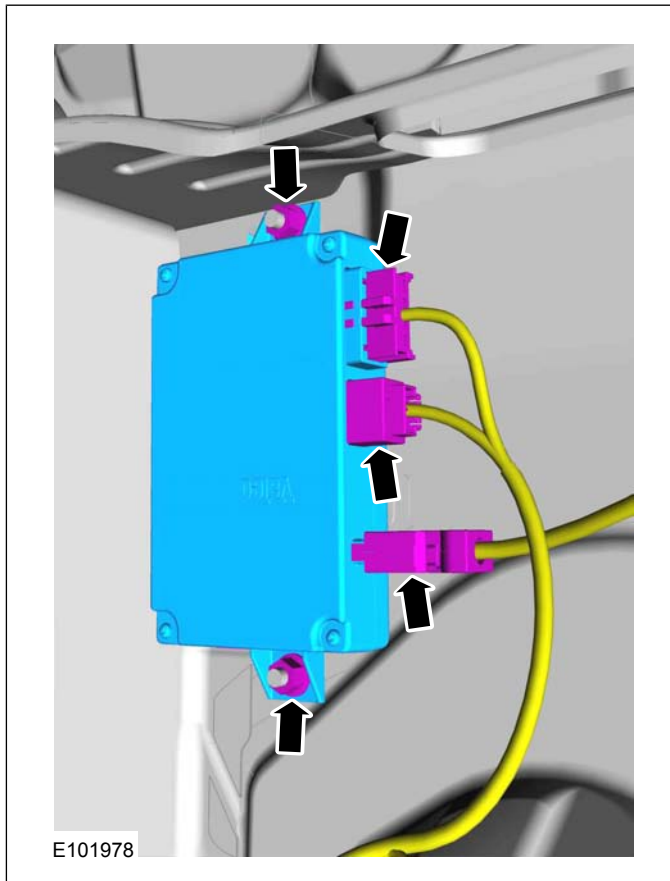
## REMOVAL AND INSTALLATION

## Parking Aid Camera Module

## Removal

1. Refer to: **Loadspace Trim Panel RH** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- 2.



## Installation

1. To install, reverse the removal procedure.

413-13-46

Parking Aid

413-13-46

## REMOVAL AND INSTALLATION

## Parking Aid Camera

## General Equipment

4 mm Drill Bit

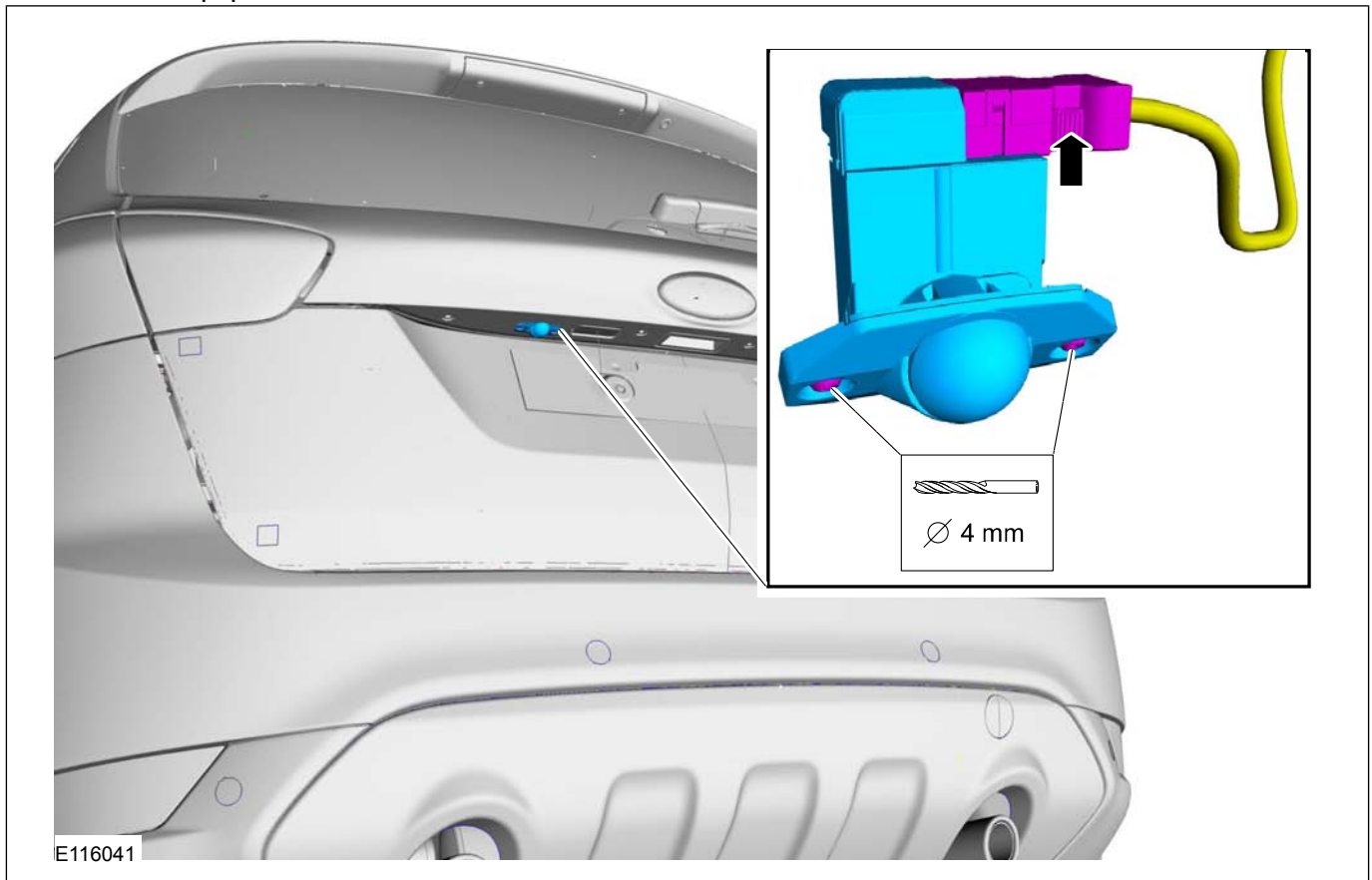
## General Equipment

Blind Rivet Gun

Electric Drill

## Removal

1. General Equipment: Electric Drill  
General Equipment: 4 mm Drill Bit



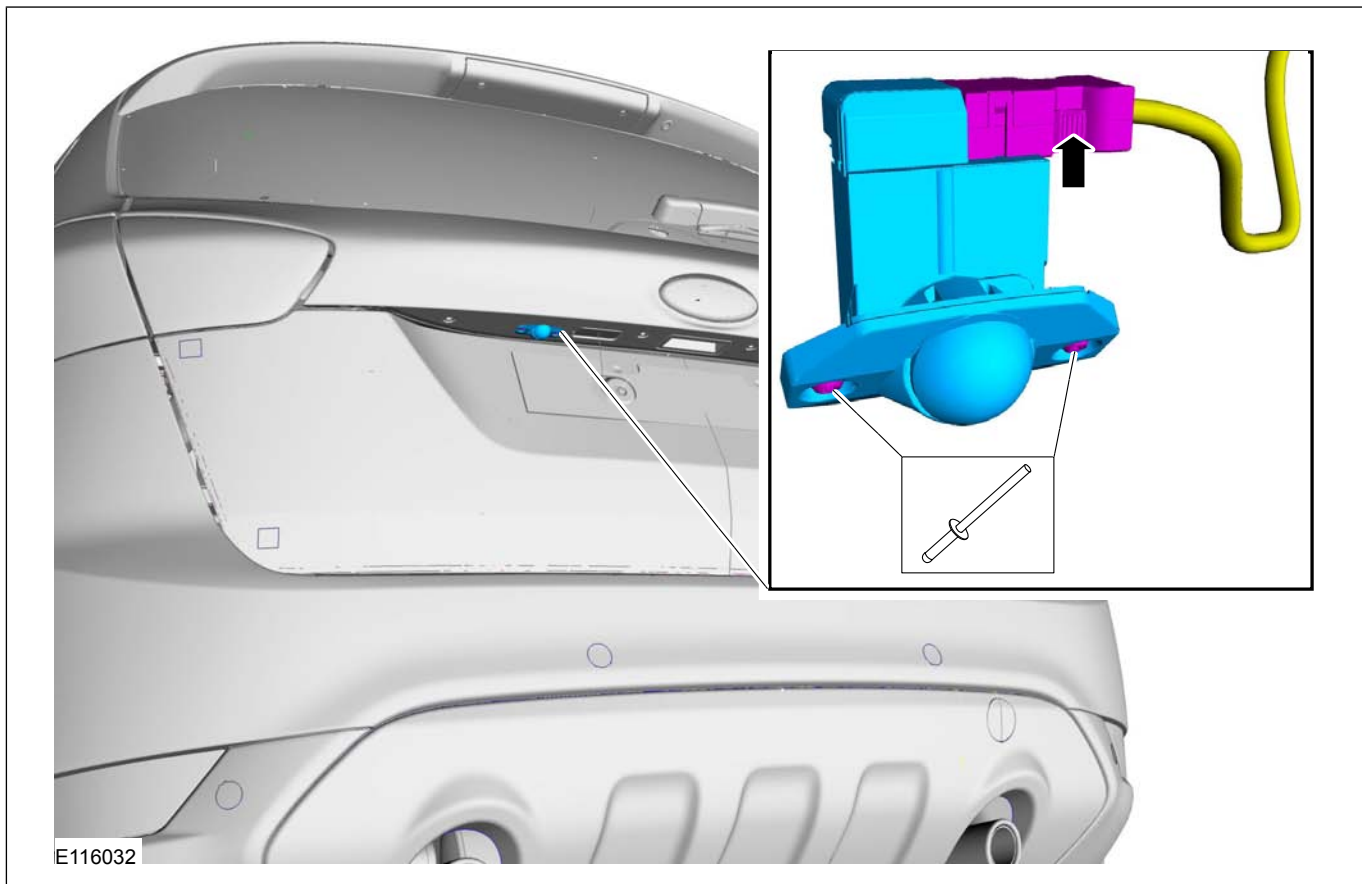
## Installation

1. General Equipment: Blind Rivet Gun





REMOVAL AND INSTALLATION



413-13-48

Parking Aid

413-13-48

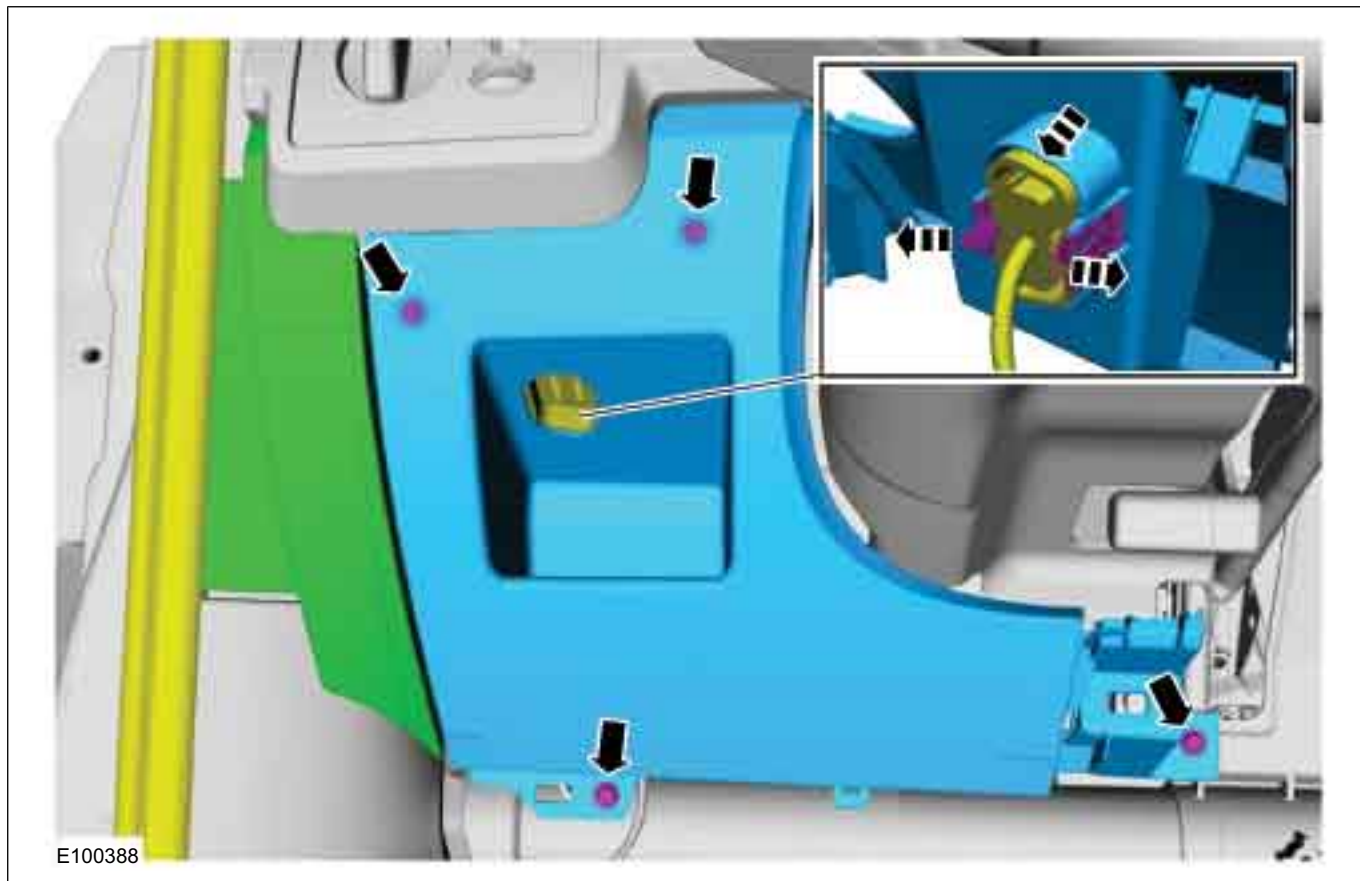
## REMOVAL AND INSTALLATION

## Front Parking Aid Speaker

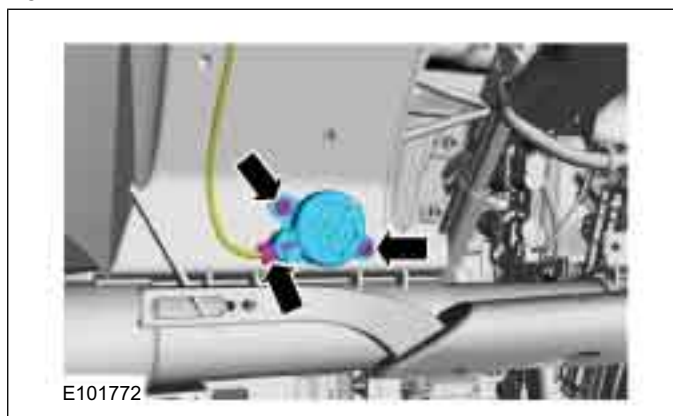
## Removal

1. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).

2.



3.



## Installation

1. To install, reverse the removal procedure.

413-13-49

Parking Aid

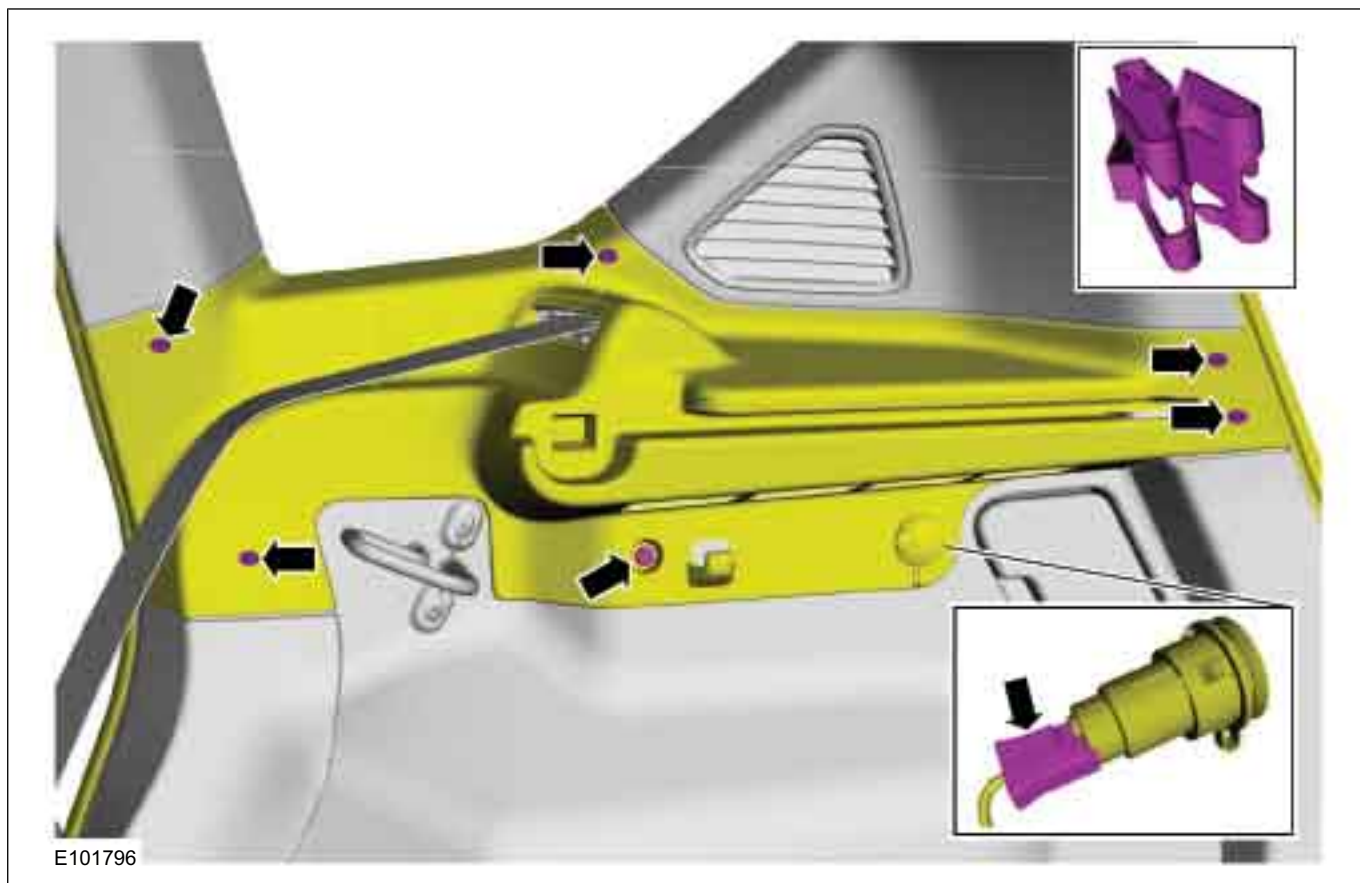
413-13-49

## REMOVAL AND INSTALLATION

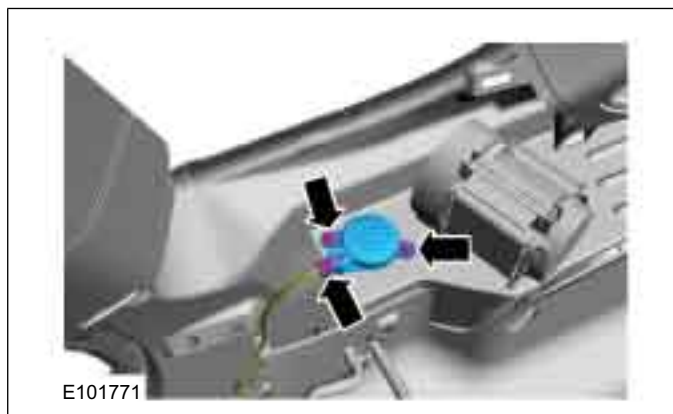
## Rear Parking Aid Speaker

## Removal

1.



2.



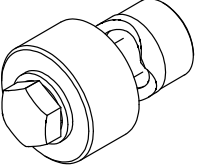
## Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Parking Aid Sensor

Special Tool(s) / General Equipment

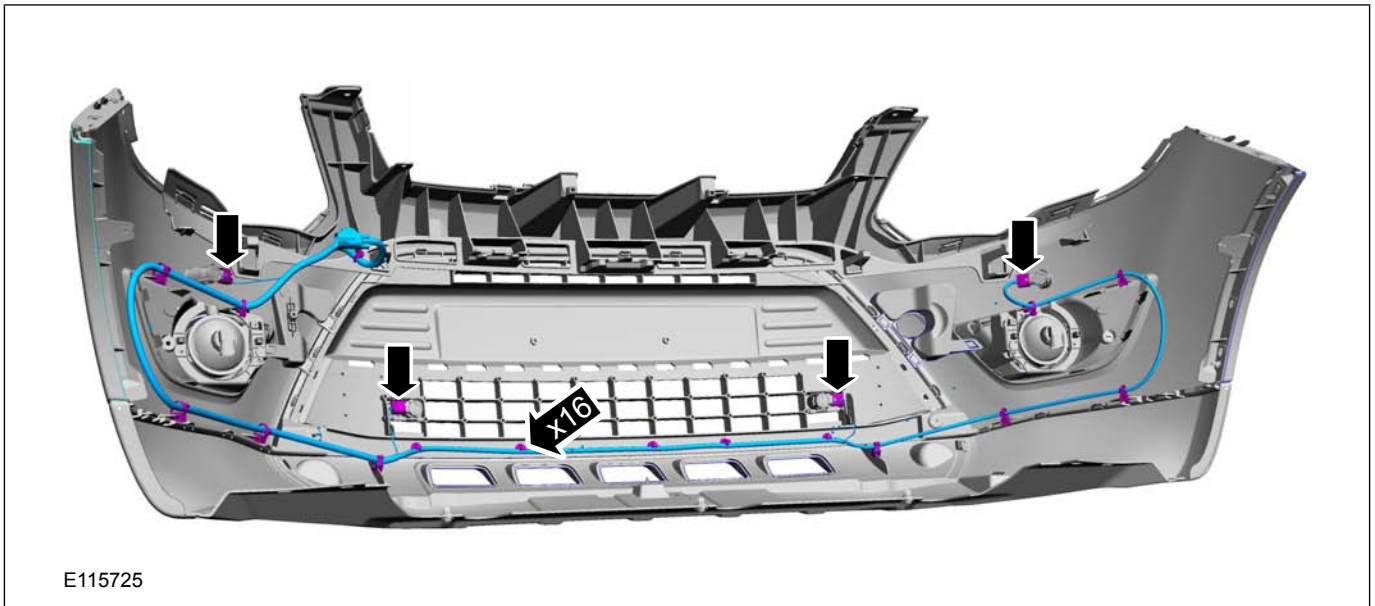
 <p>E92959</p>	<p>501-135 Punching Tool, Parking Aid Sensor</p>
---	--

Special Tool(s) / General Equipment

<p>12 mm Drill Bit</p>
<p>Electric Drill</p>
<p>Flat File</p>

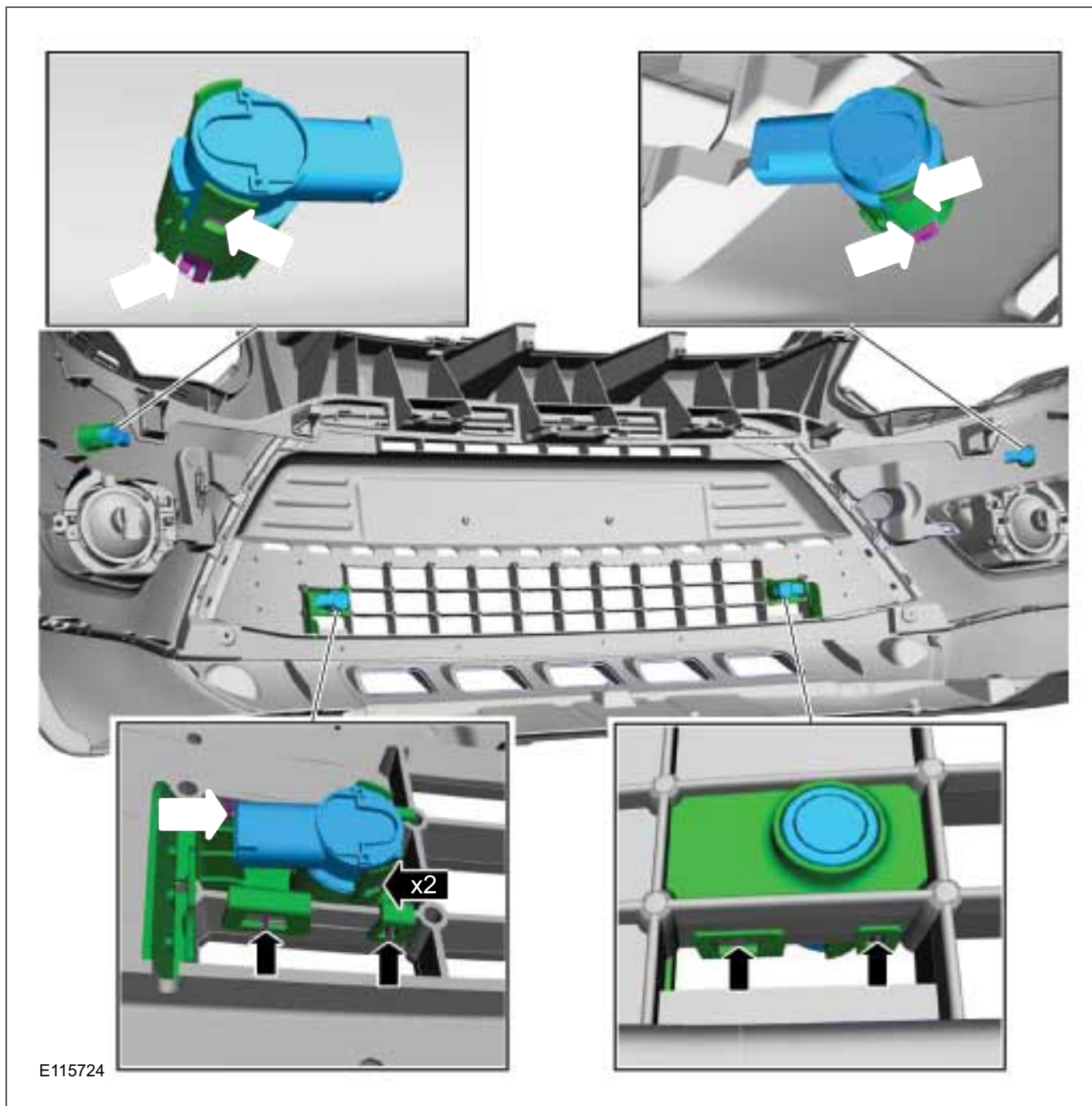
Removal

1.



2.

REMOVAL AND INSTALLATION



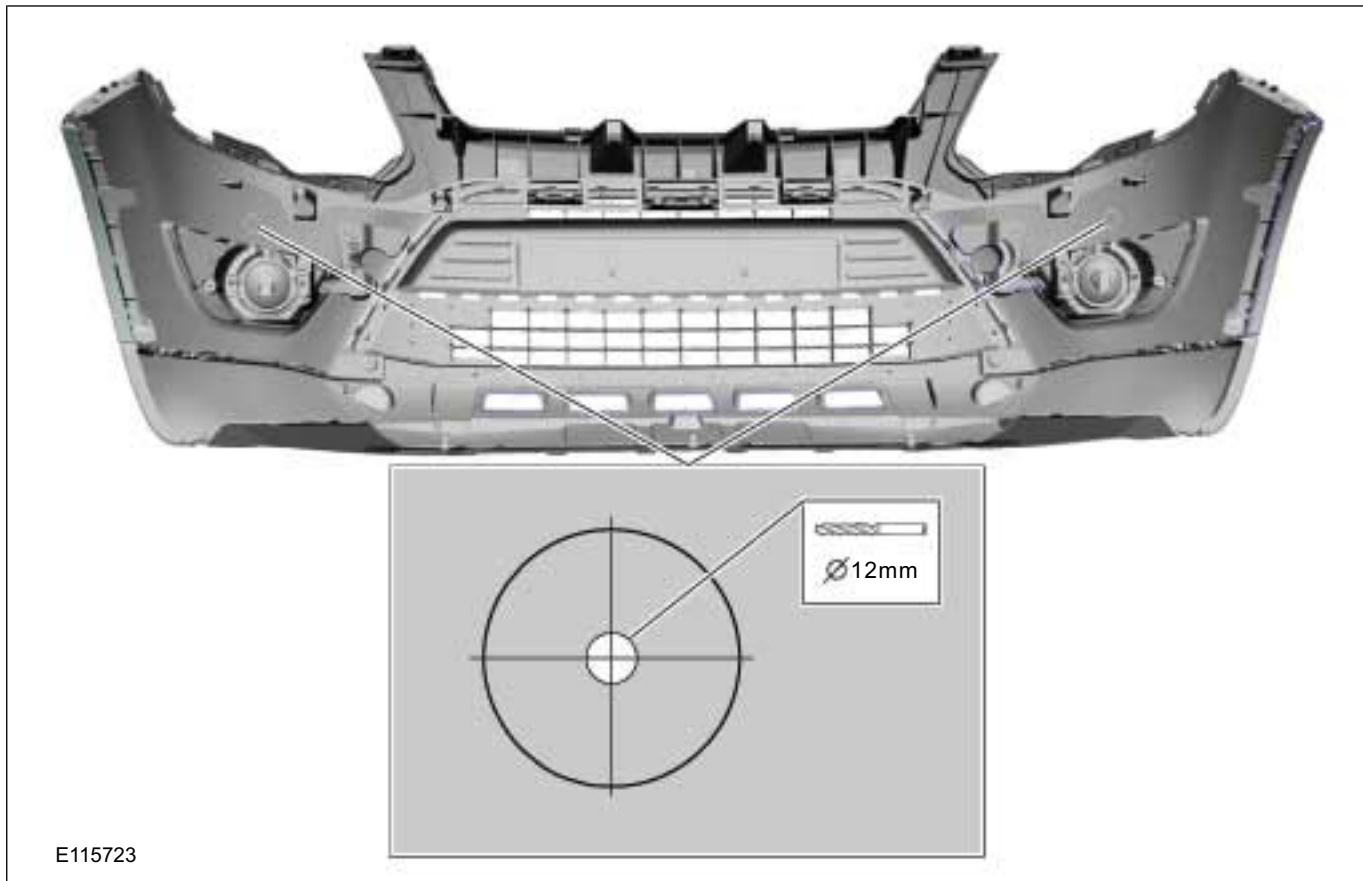
Installation

1. General Equipment: Electric Drill  
General Equipment: 12 mm Drill Bit

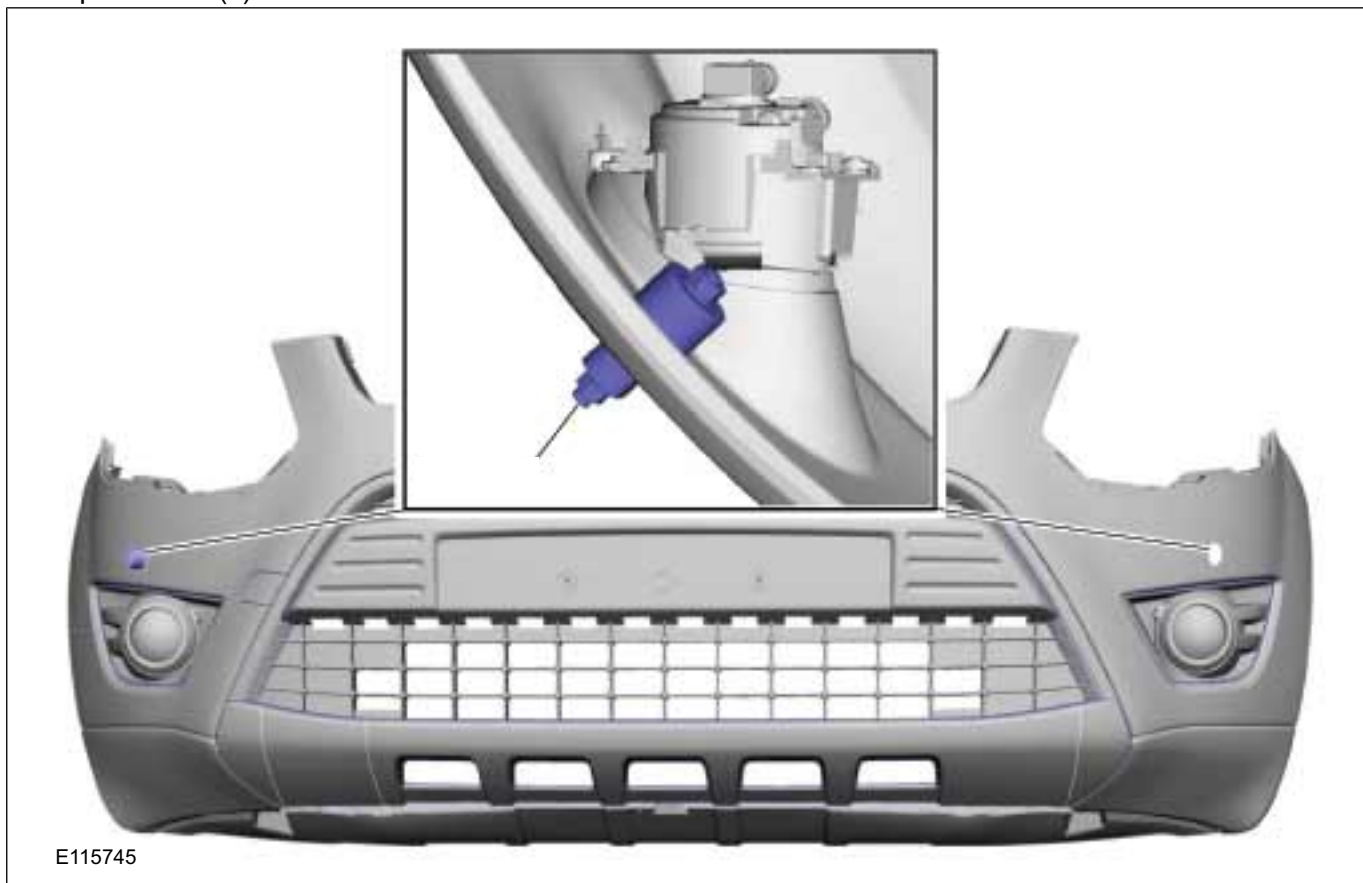




REMOVAL AND INSTALLATION



2. Special Tool(s): 501-135

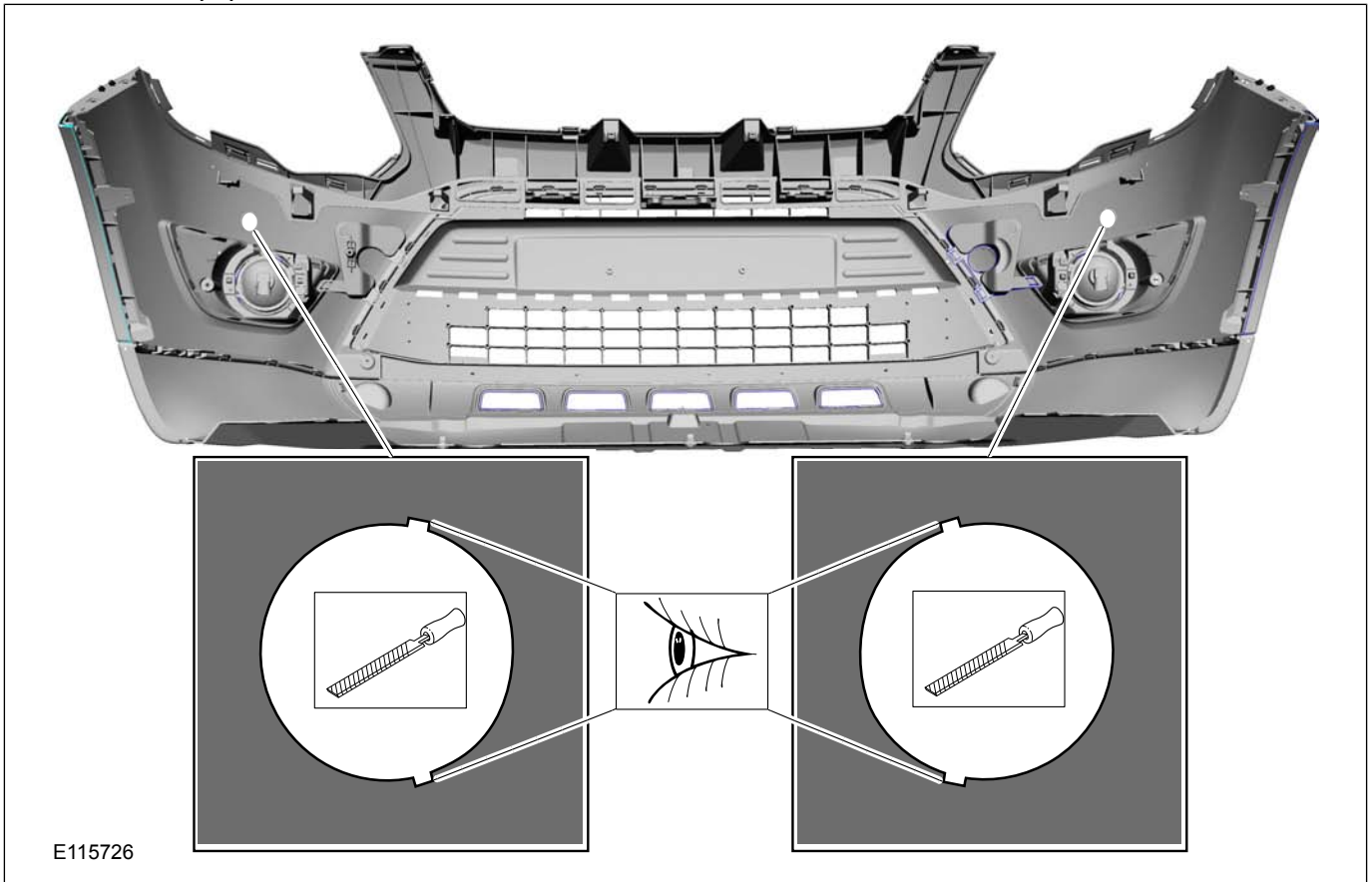






REMOVAL AND INSTALLATION

3. General Equipment: Flat File

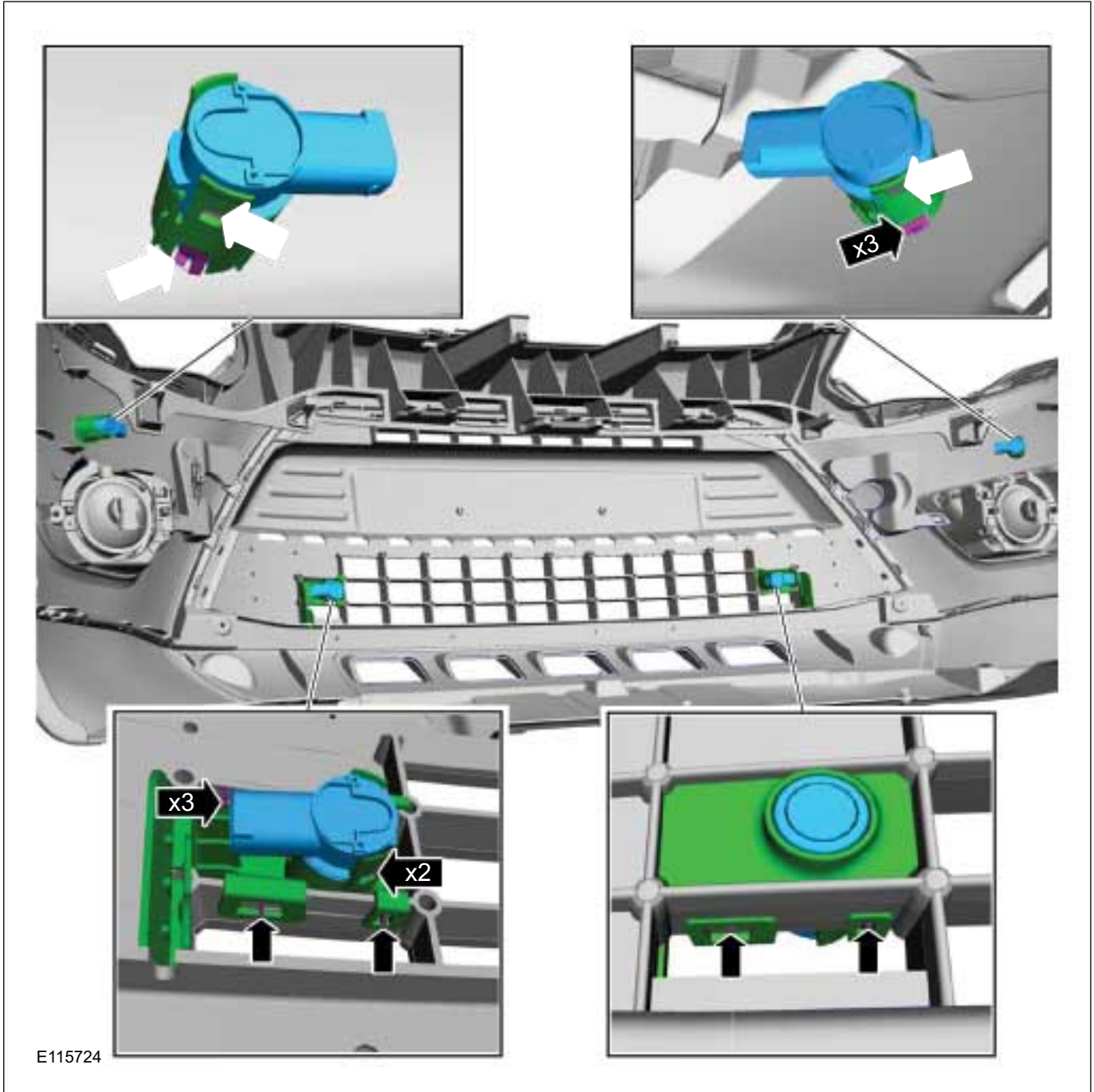


E115726

4.



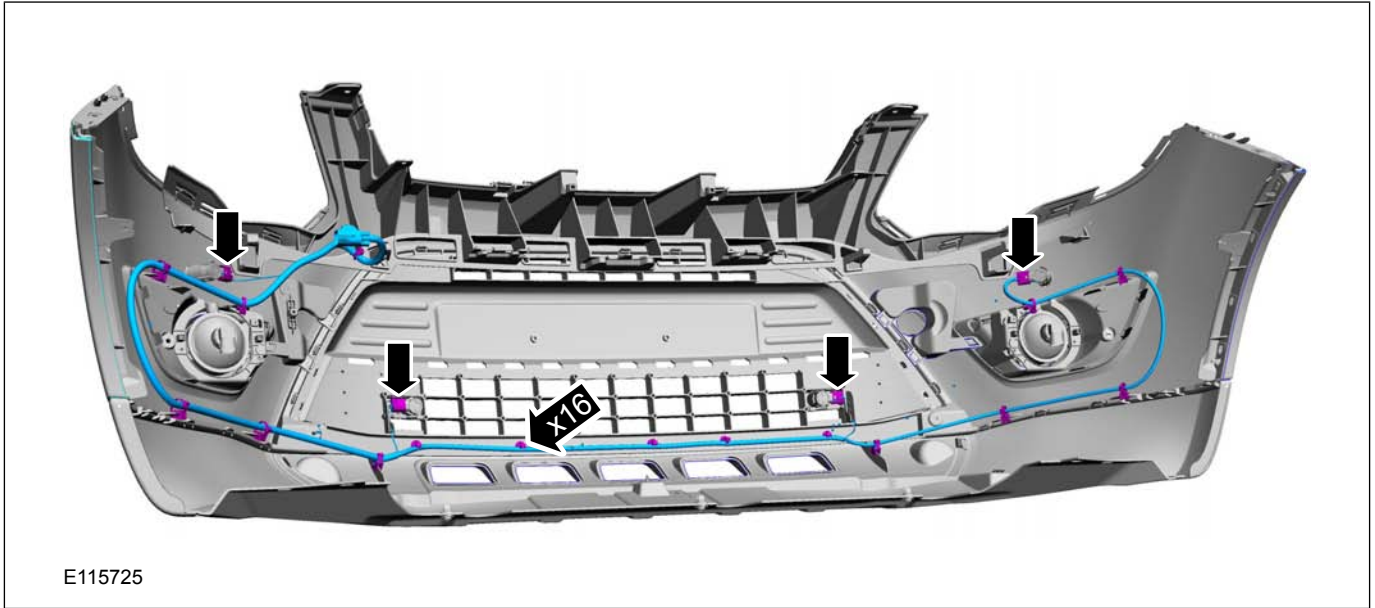
REMOVAL AND INSTALLATION



E115724

5.

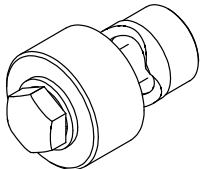
REMOVAL AND INSTALLATION



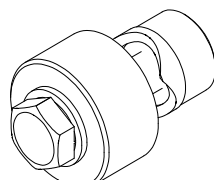
REMOVAL AND INSTALLATION

Rear Parking Aid Sensor

Special Tool(s) / General Equipment

 <p>E92959</p>	<p>501-135 Punching Tool, Parking Aid Sensor</p>
---	--

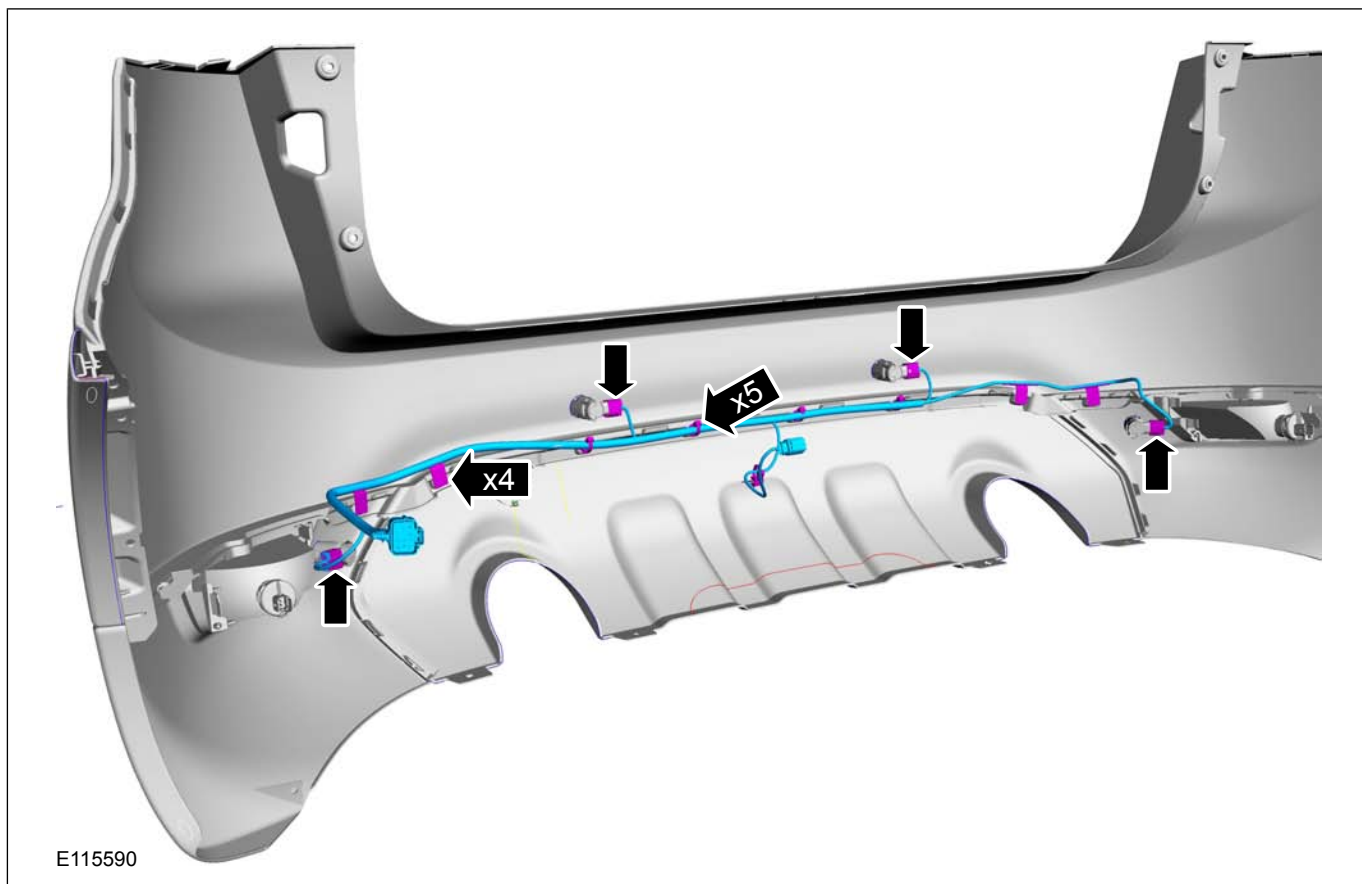
Special Tool(s) / General Equipment

 <p>E116749</p>	<p>501-160 Punching Tool, Parking Aid Sensor</p>
<p>12 mm Drill Bit</p>	
<p>Electric Drill</p>	
<p>Flat File</p>	

Removal

1. Refer to: **Rear Bumper Cover** (501-19 Bumpers, Removal and Installation).

2.



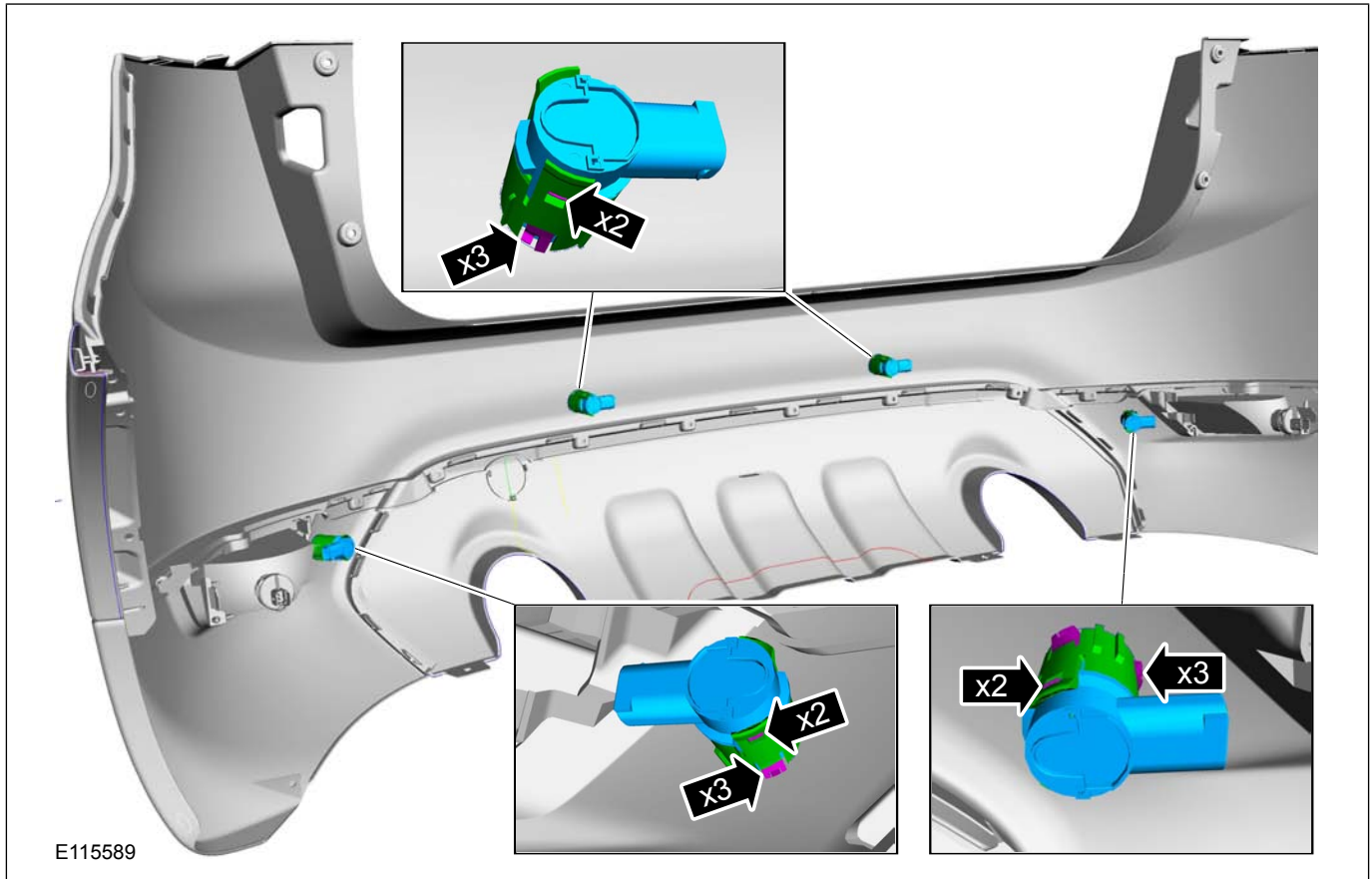
3.

413-13-57

Parking Aid

413-13-57

## REMOVAL AND INSTALLATION



## Installation

- NOTE:** Cutlines may already exist on the inner surface of a new bumper cover.

General Equipment: Electric Drill

General Equipment: 12 mm Drill Bit



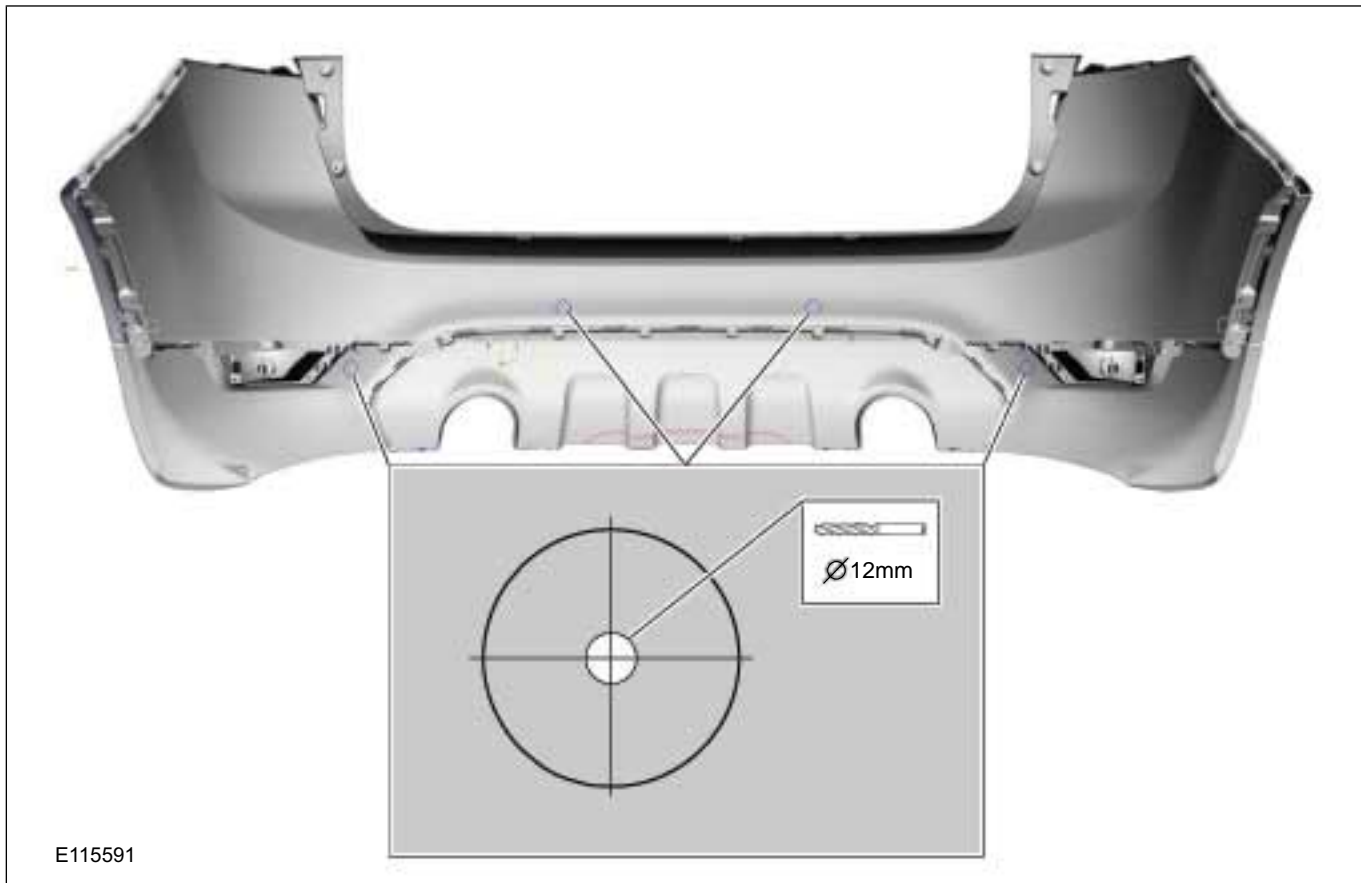
413-13-58

Parking Aid

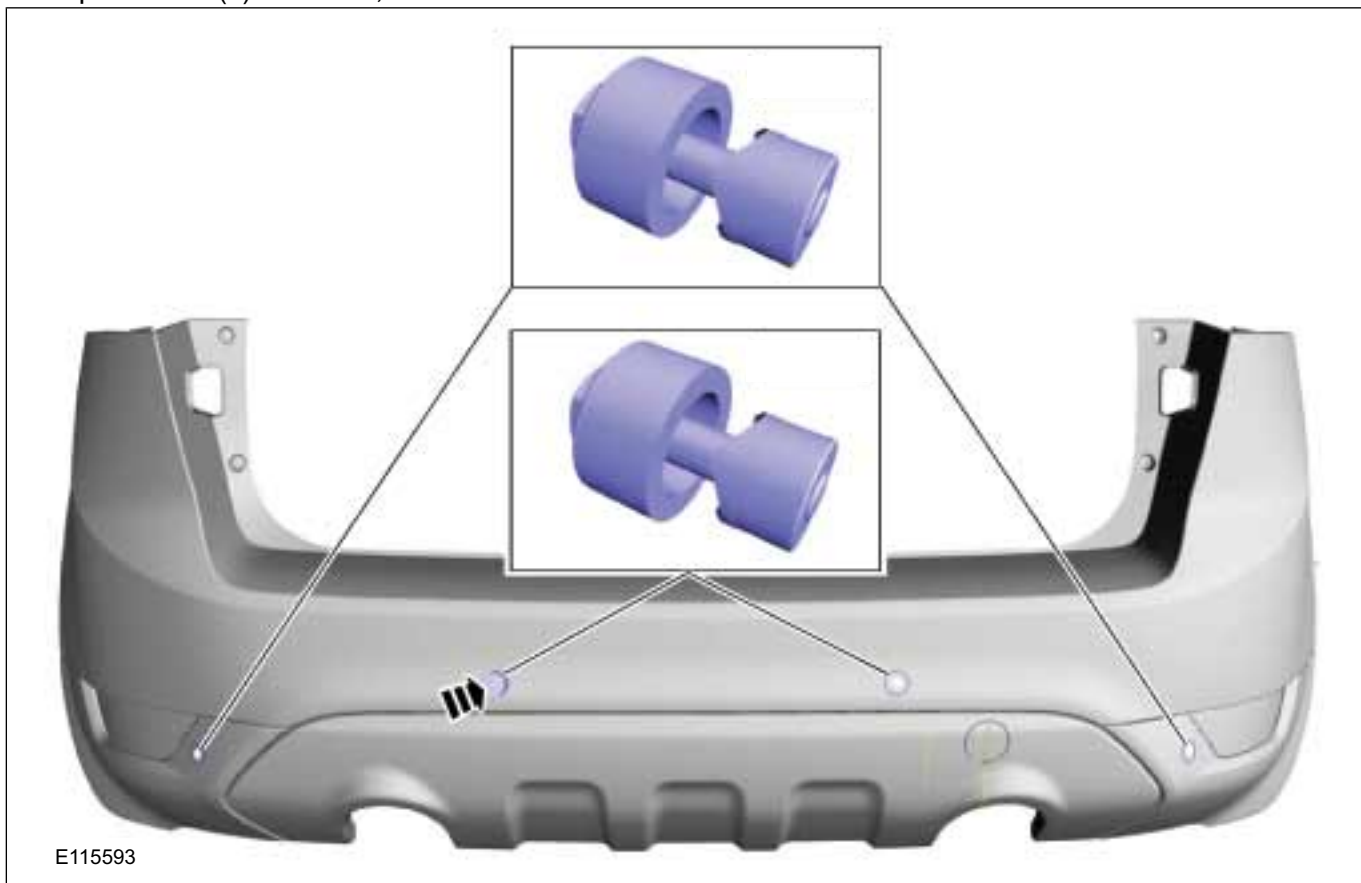
413-13-58



REMOVAL AND INSTALLATION



2. Special Tool(s): 501-160, 501-135



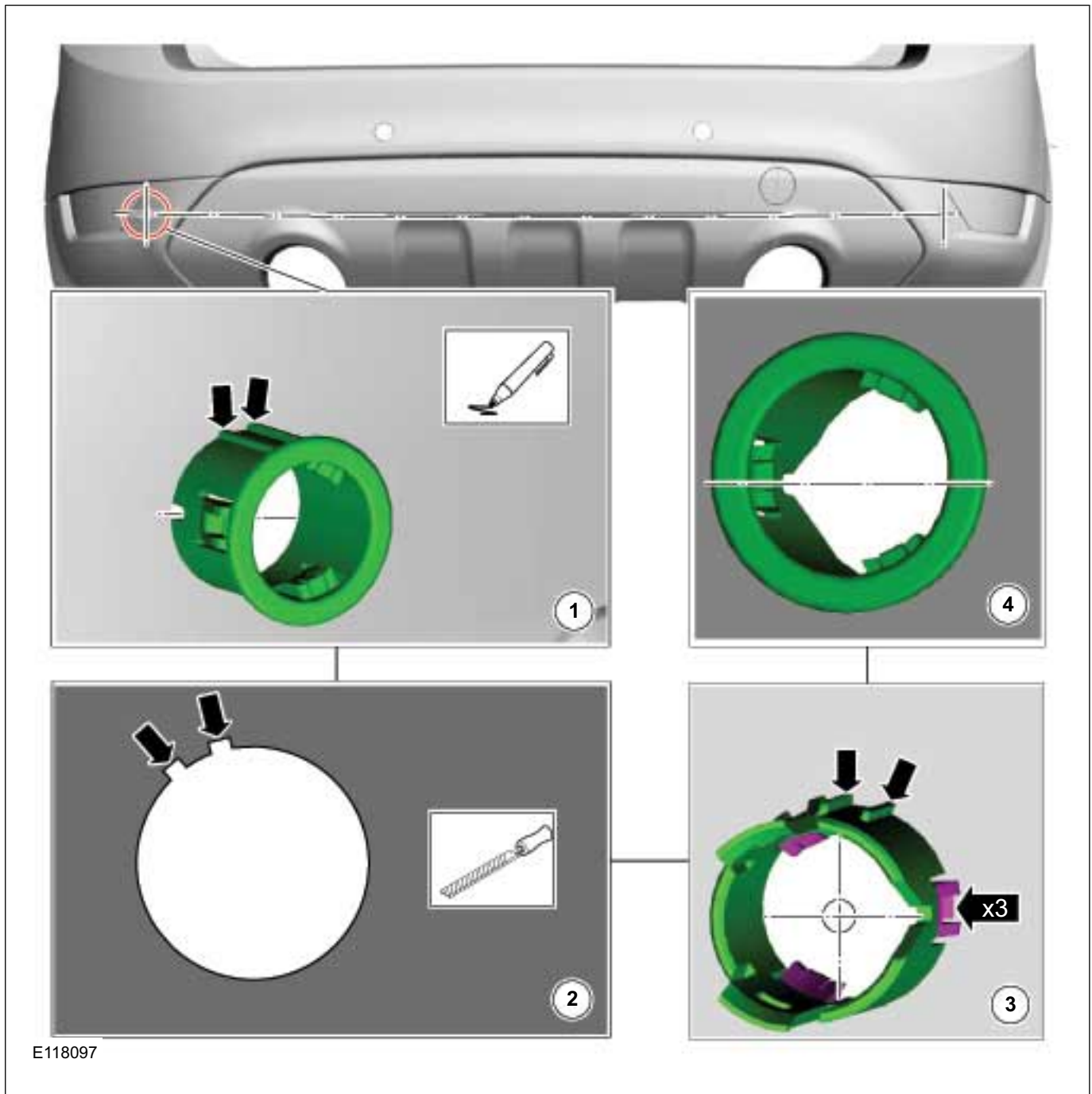




REMOVAL AND INSTALLATION

3. Do not use the preprinted cutlines.

General Equipment: Flat File

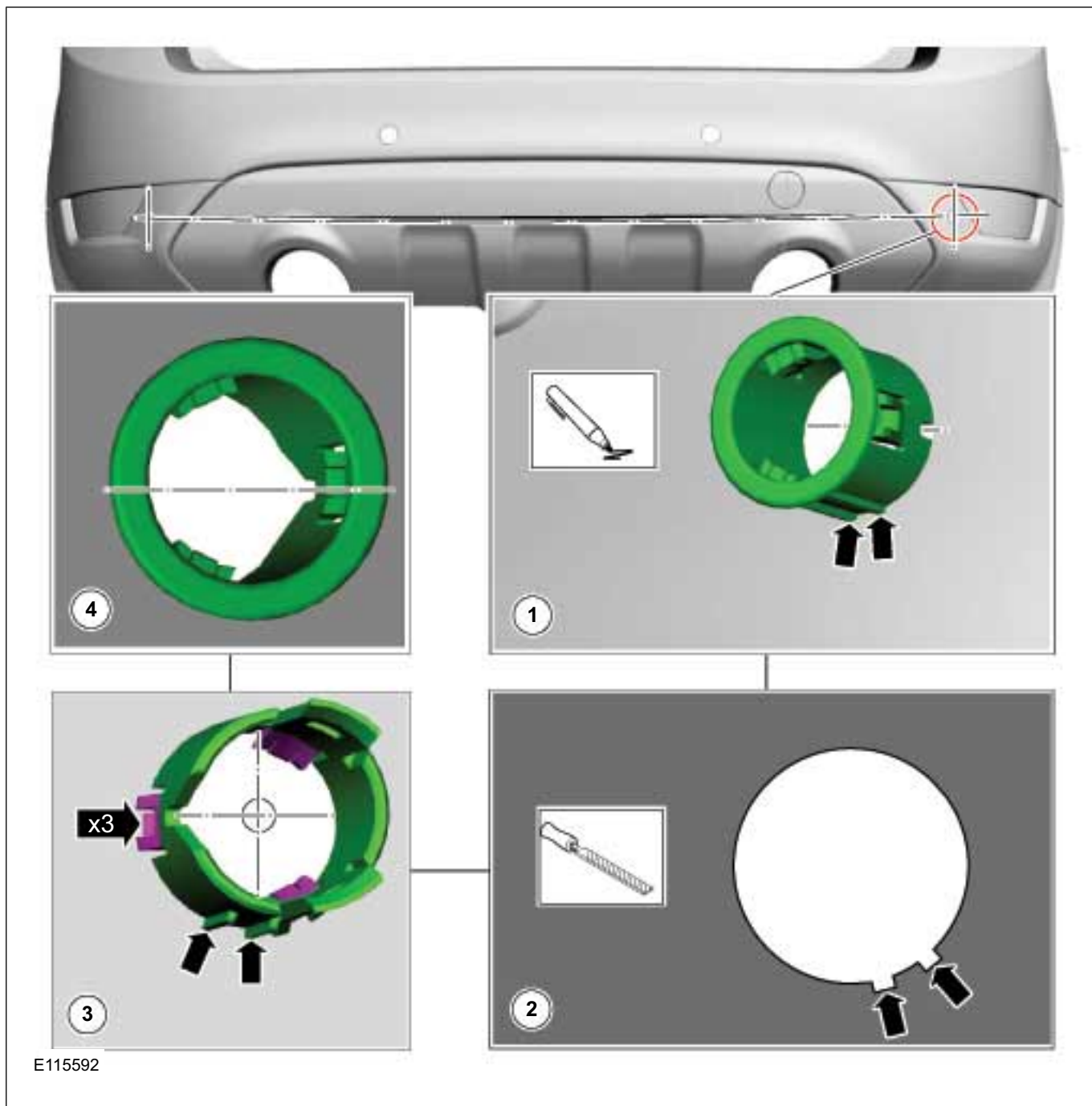


4. Do not use the preprinted cutlines.

General Equipment: Flat File

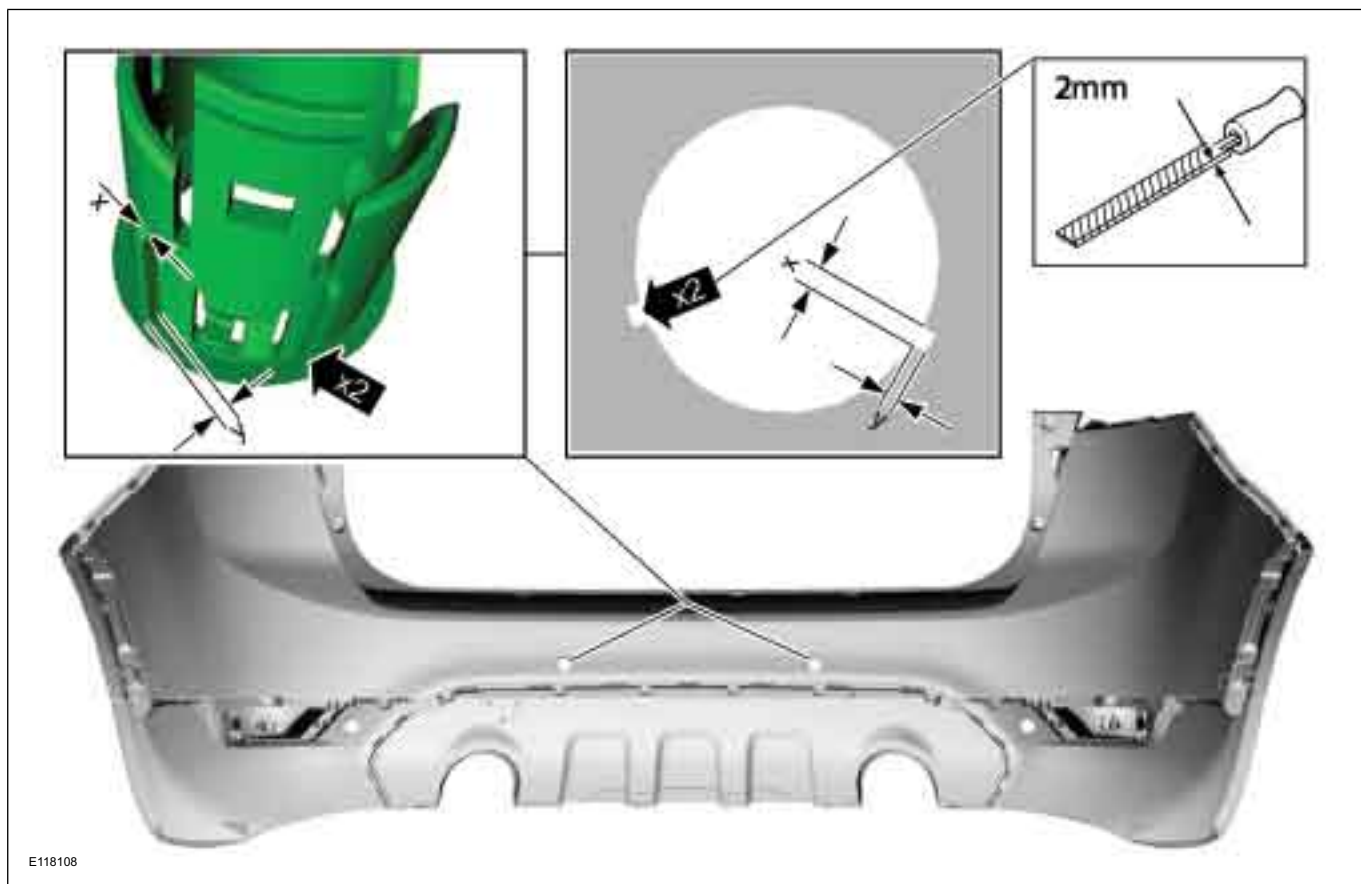


REMOVAL AND INSTALLATION

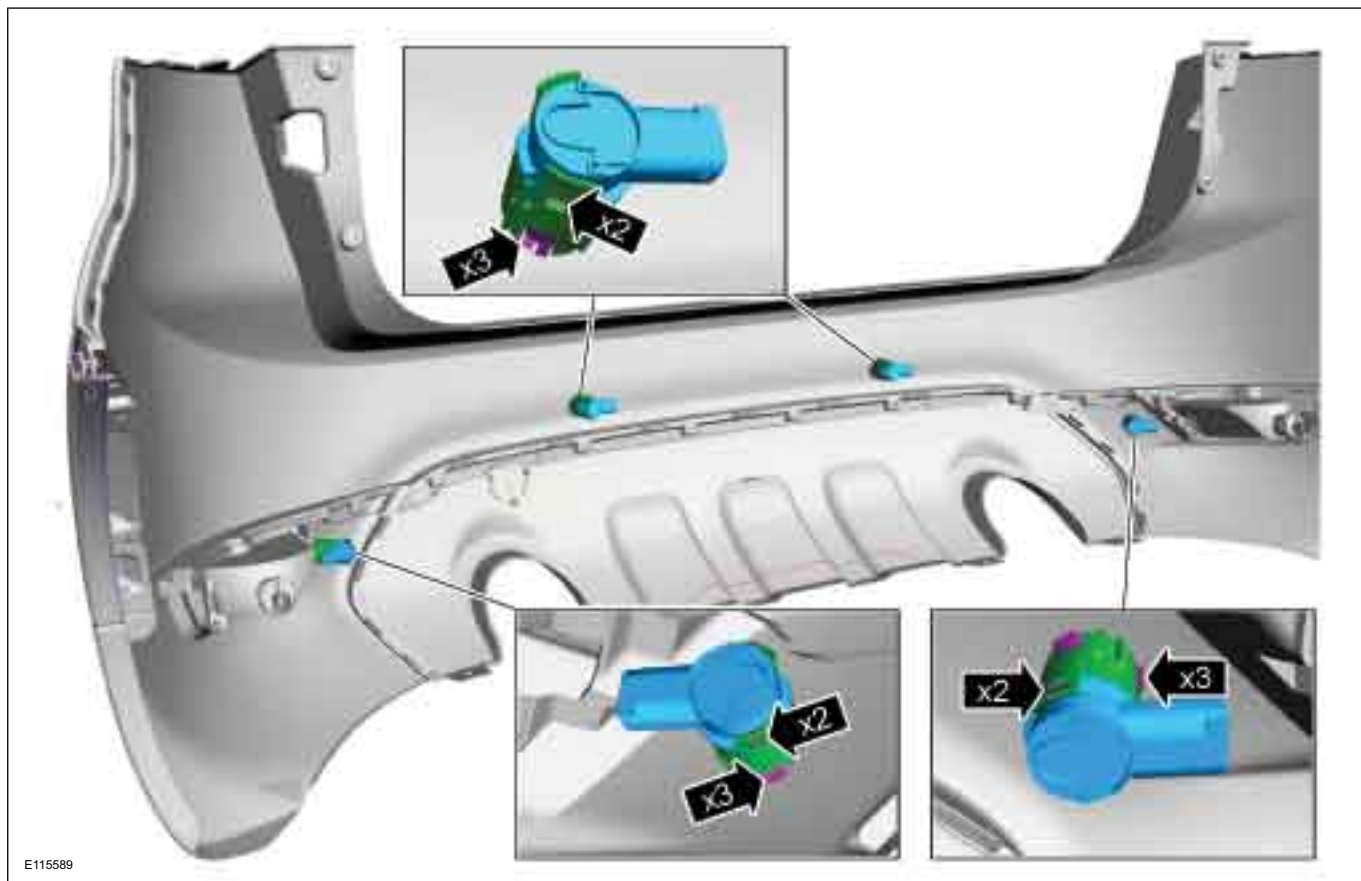


5.

REMOVAL AND INSTALLATION



6.



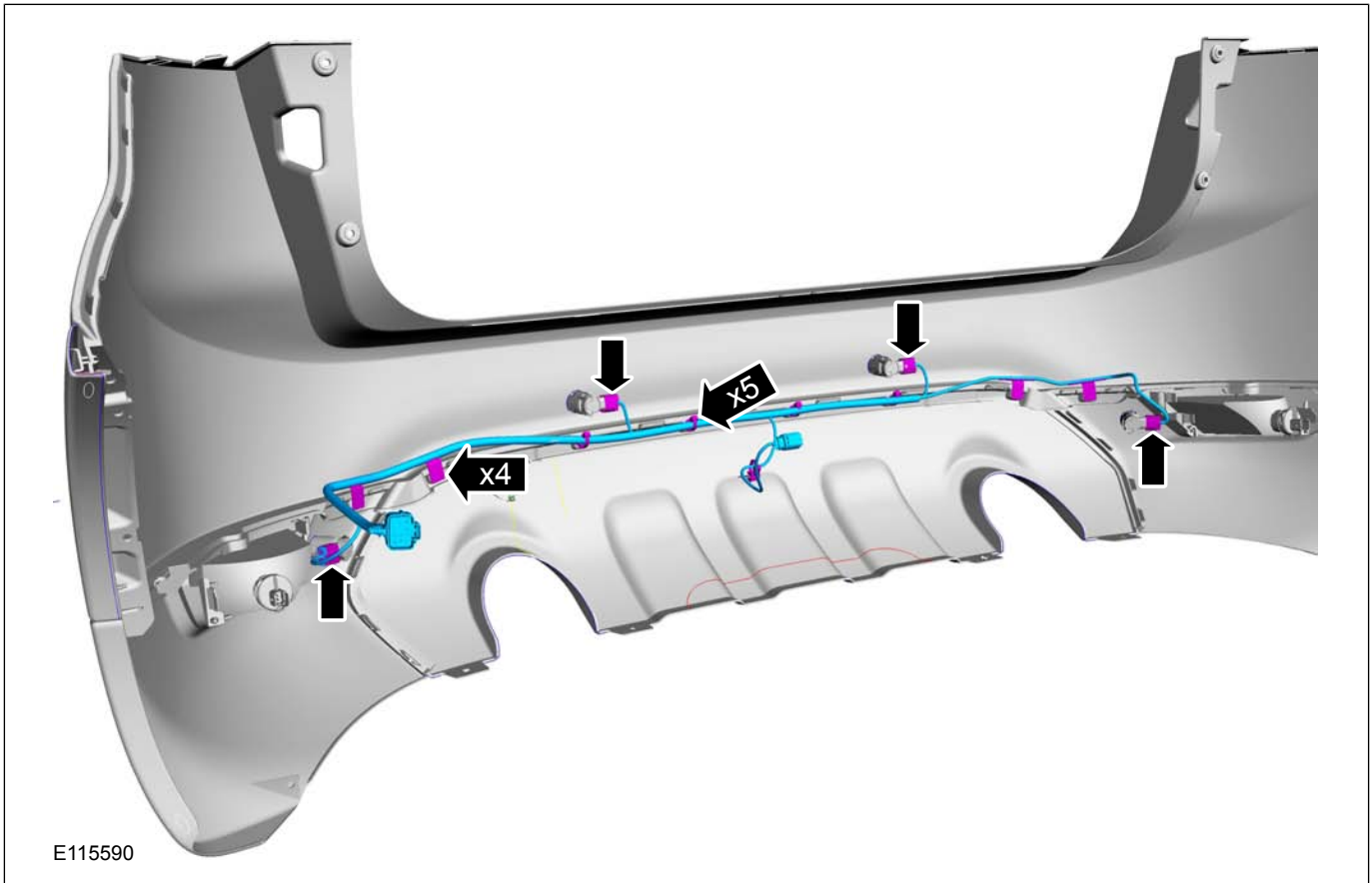
413-13-62

Parking Aid

413-13-62

## REMOVAL AND INSTALLATION

7.



8. Refer to: **Rear Bumper Cover** (501-19 Bumpers, Removal and Installation).

# SECTION 414-00 Charging System - General Information

VEHICLE APPLICATION: **2008.50 Kuga**

CONTENTS	PAGE
<b>DIAGNOSIS AND TESTING</b>	
Charging System.....	414-00-2
Inspection and Verification.....	414-00-2
Component Tests.....	414-00-2

## DIAGNOSIS AND TESTING

## Charging System

Refer to Wiring Diagrams Section 414-02, for schematic and connector information.

## General Equipment

Midtronics EXP-1050 battery tester
Midtronics GR590-2
Ford diagnostic equipment

## Inspection and Verification

## WARNINGS:

**▲ Batteries contain sulphuric acid. Avoid contact with skin, eyes, or clothing. Also, shield your eyes when working near batteries to protect against possible splashing of the acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in personal injury.**

**▲ Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. Always provide**

**ventilation. Failure to follow these instructions may result in personal injury.**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

## Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> <li>- Accessory drive belt</li> <li>- Generator</li> </ul>	<ul style="list-style-type: none"> <li>- Fuse(s)</li> <li>- Wiring harness(es)</li> <li>- Generator</li> <li>- Electrical connector(s)</li> <li>- Battery junction box (BJB)</li> <li>- Battery</li> <li>- Battery cables</li> <li>- Battery monitoring sensor (BMS)</li> <li>- Charging system warning indicator</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. Check the operation of the charging system warning indicator lamp, located in the instrument cluster. Normal operation is as follows:

## Normal Charging System Voltages

Ignition Switch Position	I Circuit	Generator B+ Circuit	Battery	Engine to battery ground	Charging System Warning Indicator Operation
Position 0	0V	10-12V	10-12V	0V	OFF
Position II	0V	10-12V	10-12V	0V	Illuminated
Position II with the engine running	13-15V	13-15V	13-15V	0V	OFF

5. If the cause is not visually evident, verify the symptom and refer to the Component Tests.

## Component Tests

## Generator On-Vehicle Tests - No-Load Test

1. Turn off all electrical loads and the ignition switch.



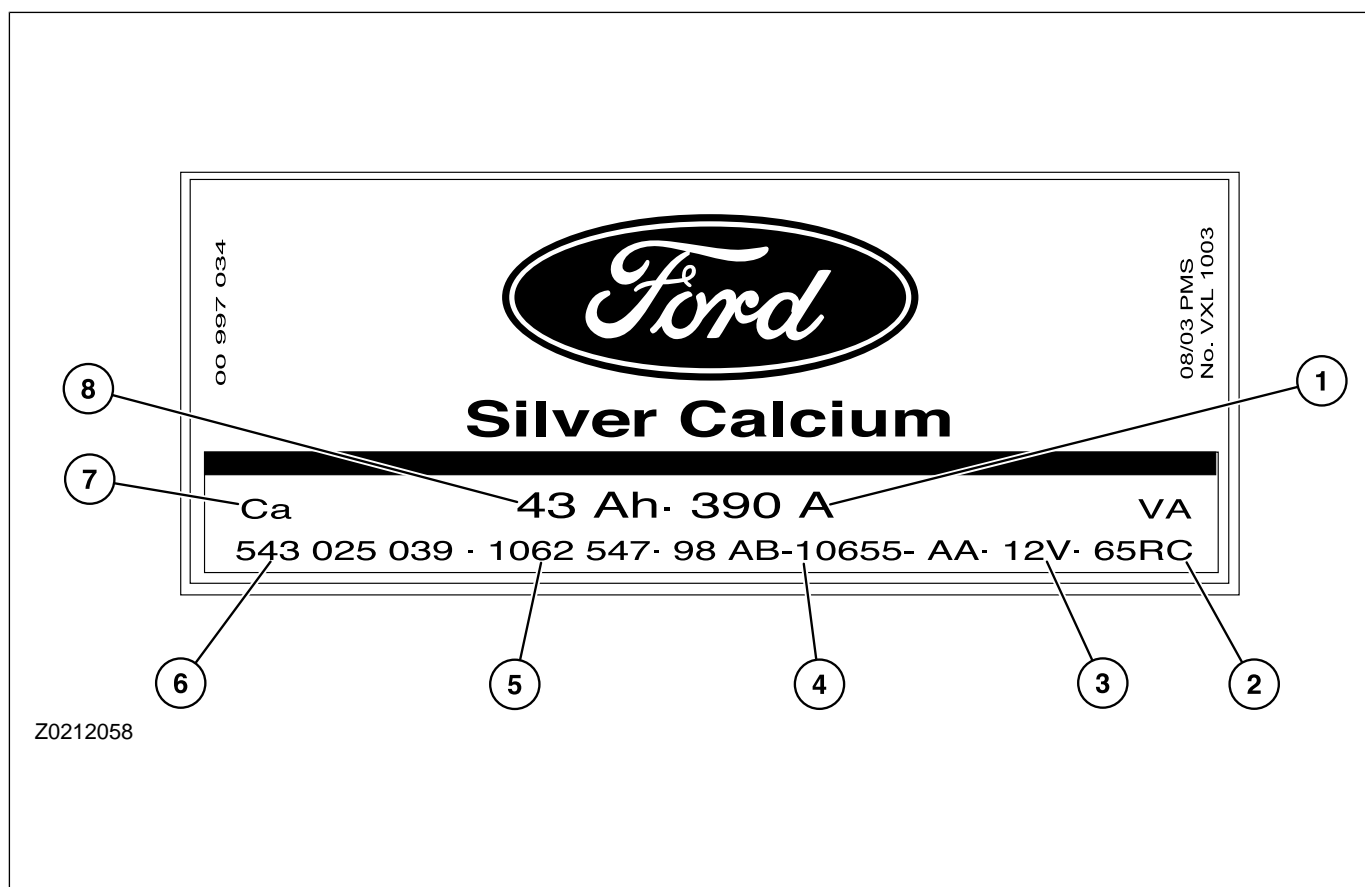
**DIAGNOSIS AND TESTING**

2. Switch the multimeter to the voltage function.
3. Connect the leads of the multimeter across the battery terminals.
4. Read the voltage (base voltage).
5. Start the engine.
6. Run the engine at 1500 rpm with no electrical load.
7. Read the voltage. The voltage should be in the range of 14.1 volts to 15.1 volts. If the voltage increase is less than 2.5 volts above the base voltage, carry out the Load Test. If the voltage increase is greater than 2.5 volts, REFER to the Ford diagnostic equipment.

**Generator On-Vehicle Tests - Load Test**

1. With the engine running, turn on the air conditioning (if equipped), turn the blower motor to high speed and the headlamps to high beam.
2. Increase the engine speed to 2000 rpm. The voltage should increase a minimum of 0.5 volts above the base voltage. If the voltage does not increase as specified, REFER to the Ford approved diagnostic tool. If the voltage increases as specified, the charging system is charging correctly.

**Battery Identification**



Z0212058

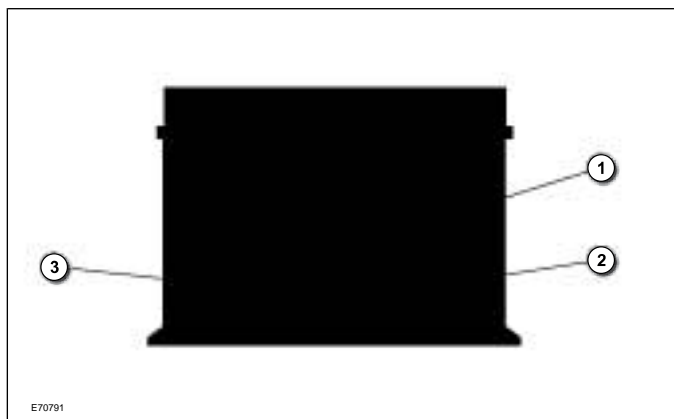
Item	Description
1	Cold crank amp (CCA) rating
2	Reserve capacity (RC) rating (minutes)
3	Battery voltage
4	Ford Part number
5	FINIS code
6	EN number (European Norm)

Item	Description
------	-------------

## DIAGNOSIS AND TESTING

Item	Description
7	Battery type: Ca = Silver/Calcium; Sb = Lead/Antimony
8	Amp hour rating

- The second and third digits (58) indicates the battery capacity is 58 Ah, which means it could power a 58 amp load for 1 hour.
- The last two digits (11) is a sequential serial number.



Item	Description
1	Battery performance data
2	Motorcraft internal labelling
3	DIN labelling

## Battery performance data

**NOTE:** The data only applies to a new fully-charged battery.

- The first group of digits (12V) indicates the battery voltage (12 volts).
- The second group of digits (590A) indicates that the battery delivers a current of 590 amps at -18°C without the terminal voltage falling below 7.2 volts.
- The third group of digits (90RC) indicates the time in minutes in which the battery voltage falls to 10.5 volts in the case of a 25 amp load and an ambient temperature of 22°C.

## DIN Labelling

- The first group of letters (WF) indicates that the battery is maintenance-free.
- The first digit (5) indicates that the battery is 12 volts.

## Midtronics EXP-1050 battery tester

The Midtronics EXP-1050 battery tester is the only battery tester recommended by Ford to test latest technology batteries including AGM (Absorbent Glass Mat) and EFB (Enhanced Flooded Battery), previously known as IFB (Improved Flooded Battery) used on Ford Start-Stop vehicles.



Main specifications of the Midtronics EXP-1050 battery tester

- Tests 6/12V batteries
- Tests discharged batteries down to 1V both in and out of the vehicle
- Ratings in battery tester: CCA, JIS, EN, DIN, IEC, SAE
- CCA range: By Ford battery type 100-1700 A SAE / EN / CCA 100-1000 A DIN / IEC All current JIS codes
- Large LCD display with adjustable backlight
- Detects short-circuited cells

**DIAGNOSIS AND TESTING**

- Surface charge removal procedure
- Dynamic Response procedure for refined decisiveness on battery diagnostics
- Upgradeable by SD card
- Export data feature to send data to infra red printer
- Voltmeter function
- Date and time indication with every test
- 23 languages included within the battery tester

**Using the Midtronics EXP-1050 battery tester**

- Disconnect the battery ground cable at the battery negative (-) post. Note: if using this battery tester on models where the ground cable is not accessible, the battery does not have to be removed from the vehicle and may be tested using the vehicle's 'jump start post' if the battery tester is set to the correct mode. In this case, the battery must be disconnected at the positive (+) post before testing.
- Connect the positive red clamp of the Midtronics EXP-1050 battery tester to the battery positive (+) post.
- Connect the negative black clamp of the Midtronics EXP-1050 battery tester to the battery negative (-) post or jump start post as appropriate.

A poor connection will prevent testing and the battery tester will display the message CHECK CONNECTION. If this message appears after you

have correctly reconnected the clamps, clean the terminals and reconnect.

It is recommended that batteries are always tested using both battery posts. However, if used in 'jump start post' mode, the Midtronics EXP-1050 battery tester will compensate for the extra resistance of the additional cable.

1. Select BATTERY TEST or START-STOP BATTERY TEST.
  - Press the NEXT key to continue.
2. Select the BATTERY LOCATION
  - UNDER HOOD
  - UNDER SEAT
  - OUT OF VEHICLE
  - Press the NEXT key to continue.
3. Select the negative POST TYPE (IN-VEHICLE ONLY)
  - BATTERY POST
  - JUMP START POST
  - JUMP START POST (Battery Monitoring Sensor)
  - Press the NEXT key to continue.
4. Select the BATTERY RATING from the drop down list.
  - Press the NEXT key to test the battery.
5. If the battery under test is not listed in the drop down list, it can still be selected with the MANUAL ENTRY mode. This is item 11 of 11 in the list.

The Midtronics EXP-1050 battery tester will display the word TESTING while it evaluates the battery.

**Battery tester results and required actions**

Battery Tester Reading	Action
GOOD BATTERY	Return the battery to service
GOOD - RECHARGE	Fully recharge the battery and return it to service
CHARGE & RETEST	Fully charge the battery and retest (failure to fully charge the battery before retesting may cause false readings)

## DIAGNOSIS AND TESTING

Battery Tester Reading	Action
REPLACE BATTERY or BAD CELL BATTERY	<p><b>▲ WARNING: Do not recharge the battery.</b></p> <p>Make sure that the surface charge was removed. A "REPLACE BATTERY" result could also mean a poor connection between the battery cables and the battery. Check the connections are OK and retest. If the result remains the same, <b>INSTALL a NEW battery</b></p> <p>REFER to: <b>Battery</b> (414-01 Battery, Mounting and Cables, Removal and Installation).</p>
<p>In addition it is advisable to check the vehicle electrical system. Check that the generator is functioning correctly and the vehicle does not have an excessive key-off load (in general this should be under 20mA after 40 minutes of key off).</p>	

**Midtronics EXP-1050 Battery Tester Test Code**

At the end of the test, use the arrow keys to scroll down the screens to see additional information. One of these is the TEST CODE.

The TEST CODE has 11 digits, for example: 0021U-B88WKX.

**Using the Midtronics GR-590-2**

E136266

The Midtronics GR-590-2 is both a battery charger and battery tester and automatically removes the surface charge as part of the normal operating procedure.

The Midtronics GR-590-2 can be used on a battery in-vehicle or out-of-vehicle.

- Disconnect the battery ground cable.
- Connect the positive red clamp from the Midtronics GR-590-2 to the battery positive terminal.
- Connect the negative black clamp from the Midtronics GR-590-2 to the battery negative terminal.
- Connect the AC power cable to the mains outlet and switch ON.
- Follow the instructions supplied with the Midtronics GR-590-2 to charge the battery.
- To disconnect the Midtronics GR-590-2, reverse the connection procedure.

The Midtronics GR-590-2 will automatically carry out a charge cycle before giving the resulting test code. It will bring the battery into a serviceable condition and if required can proceed to fully charge the battery.

**Functions on the front panel of the Midtronics GR-590-2**

- UP and DOWN button: The UP and DOWN buttons allow the operator to scroll through selections on the display and increase or decrease values.
- ENTER button: The ENTER button allows the operator to accept a selection and continue to the next step.

**DIAGNOSIS AND TESTING**

- INFO button: The INFO button allows the operator to enter the Options menu to access feature such as Languages, BMC Code, Last Test Data and Print.
- STOP button: The STOP button allows the operator to abort a charging cycle or go back to previous steps in the menus.

**Midtronics GR-590-2 Test Code**

At the end of the test, use the arrow keys to scroll down the screens to see additional information. One of these is the TEST CODE.

The TEST CODE has 13 digits, for example:  
Y74NH-58R36-ESV.



## SECTION 414-01 Battery, Mounting and Cables

VEHICLE APPLICATION: 2008.50 Kuga

CONTENTS	PAGE
<b>GENERAL PROCEDURES</b>	
Battery Disconnect and Connect.....	414-01-2
Disconnect.....	414-01-2
Connect.....	414-01-3
<b>REMOVAL AND INSTALLATION</b>	
Battery.....	414-01-4





## GENERAL PROCEDURES

## Battery Disconnect and Connect

## Disconnect

## WARNINGS:

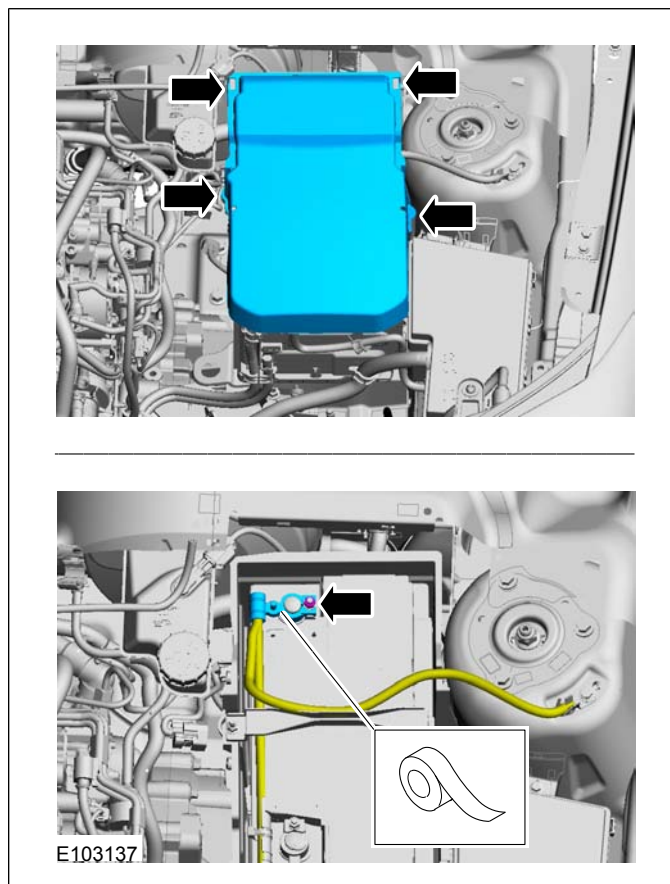
- ▲ Batteries normally produce explosive gases which may cause personal injury, therefore do not allow flames, sparks or lighted substances to come near the battery. When charging or working near the battery always shield your face and protect your eyes. Always provide adequate ventilation. Failure to follow these instructions may result in personal injury.
- ▲ The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.
- ▲ Audio unit key code saving devices must not be used when working on supplemental restraint or fuel systems. When using these devices the vehicle electrical system is still live but with a reduced current flow. Failure to follow this instruction may result in personal injury.
- ⚠ CAUTION: Make sure the engine is not running before disconnecting the battery ground cable to avoid damage to the vehicle electrical system.

**NOTE:** Disconnecting the battery will erase fault codes, drive values and customer data stored in the modules.

**NOTE:** This procedure should be used to disconnect the battery while carrying out repairs that refer to the battery being disconnected.

1. Refer to: **Battery and Battery Charging Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Obtain and record the audio unit keycode and preset radio frequencies.

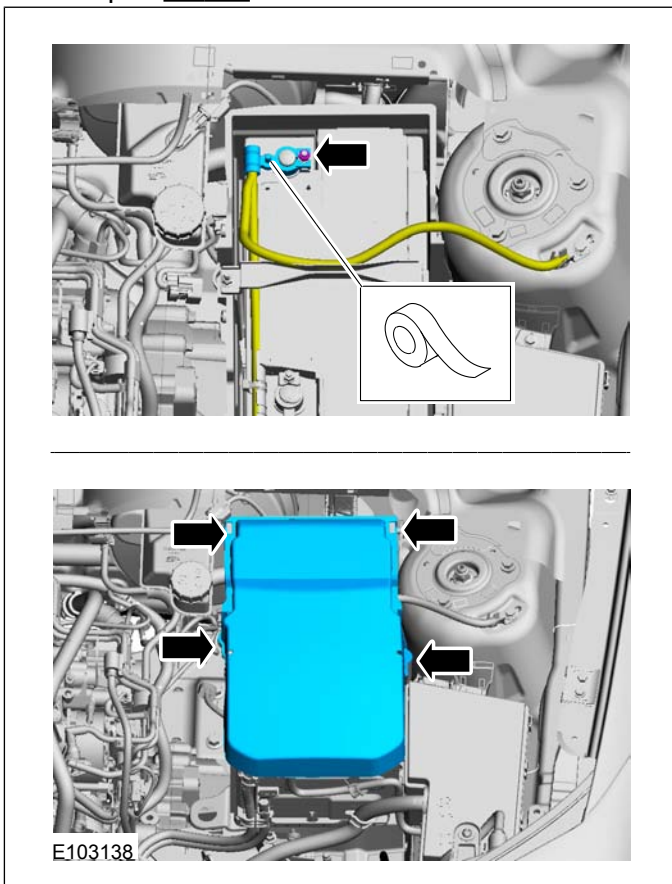
3.



GENERAL PROCEDURES

Connect

1. Torque: 15 Nm



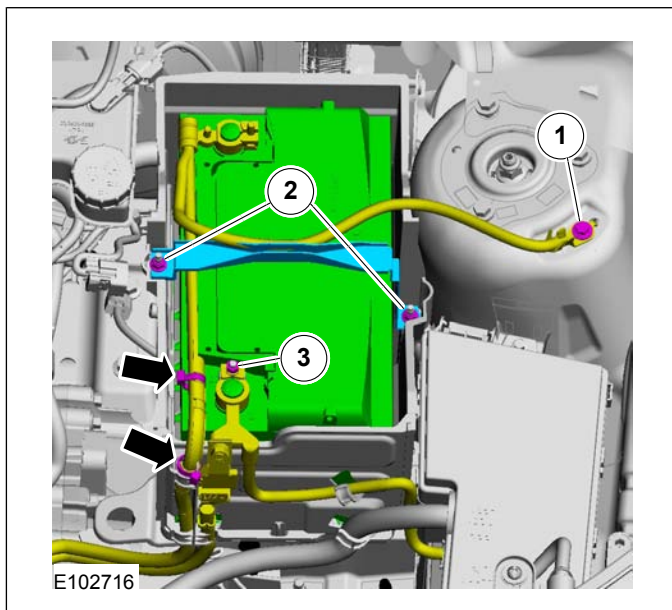
E103138

## REMOVAL AND INSTALLATION

## Battery

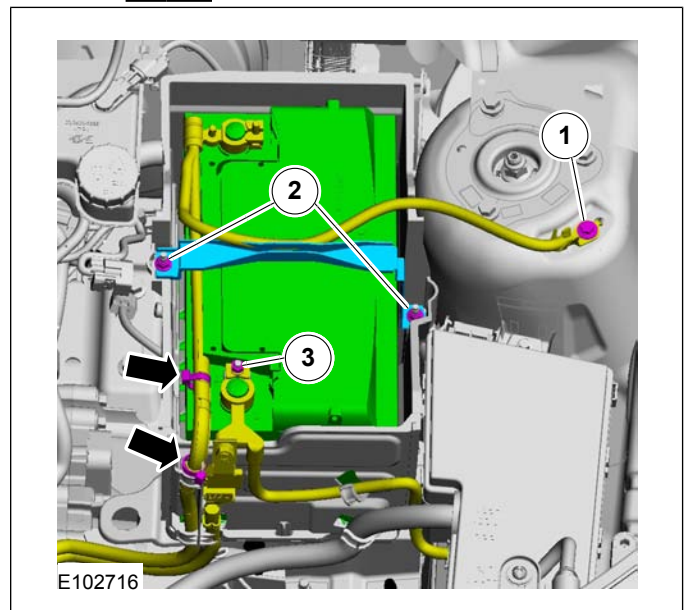
## Removal

1. Refer to: **Battery and Battery Charging Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
- 3.



## Installation

1. Torque:
  - 1 15 Nm
  - 2 10 Nm
  - 3 12 Nm



2. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).



## SECTION 414-02 Generator and Regulator

**VEHICLE APPLICATION: 2008.50 Kuga**

CONTENTS	PAGE
<b>DESCRIPTION AND OPERATION</b>	
Generator.....	414-02-2
Smart Charge system.....	414-02-2
<b>REMOVAL AND INSTALLATION</b>	
Generator — 2.5L Duratec (147kW/200PS) - VI5..... (31 414 0)	414-02-3



**DESCRIPTION AND OPERATION**

## Generator

### General information

The powertrain control module (PCM) controls the alternator charging voltage. The connection between the PCM and the generator is made via the control module subnetwork (LIN) bus.

If the load on the alternator is high, the PCM can increase the idle speed.

The alternator is temporarily deactivated during engine starting so that the engine drag moment is minimized and it is reactivated again after the starting procedure.

The PCM controls the charge control lamp in the instrument cluster via the controller area network (CAN) bus.

### Smart Charge system

In addition to the familiar functions, the Smart Charge system also performs the following functions:

- Automatic deactivation of non-critical high power electrical consumers when the battery voltage is low in order to reduce the level of current drawn.
- Automatic activation of non-critical high power electrical consumers when the battery voltage is excessively high in order to protect components which are sensitive to increased voltages.

The battery charging current is optimized through continuous calculation of the battery temperature and monitoring of the alternator output voltage.

By receiving the forwarded alternator load signal, the PCM is given early warning whenever an electric consumer is switched on or off. This means that the PCM receives information about imminent changes in the torque drawn by the alternator. By evaluating this information the PCM can provide a higher level of idling stability.

The two remaining functions of the Smart Charge System are controlled by the GEM.

Electrical consumers are switched off due to low voltage when the GEM determines (on the basis of the message received from the PCM on the CAN bus via the instrument cluster) that the battery voltage has dropped below the threshold.

When the threshold for low battery voltage is reached the GEM automatically deactivates the

following consumers - in this order and with a gap of 5 seconds between each:

- Electric booster heater (vehicles with diesel engines)
- Heated exterior mirrors
- Heated rear window
- Heated windscreen

If the battery voltage rises back above the lower threshold then the GEM re-enables all of the electrical consumers which were previously disabled. They then have switched off status and must be switched back on by the driver.

Electrical consumers are switched on due to excessively high voltage if the GEM determines that the battery voltage is above the threshold for overvoltage and the charge control lamp has been switched on.

When the threshold is reached the GEM automatically activates the following consumers - in this order and with a gap of 5 seconds between each:

- Heated rear window
- Heated exterior mirrors
- Electric booster heater (vehicles with diesel engines)
- Blower motor

If the battery voltage drops back below the threshold then the GEM automatically deactivates any consumers that were switched on. However, if they were switched on by the driver before the automatic activation, they will then be switched on again in turn with a 5-second time interval.



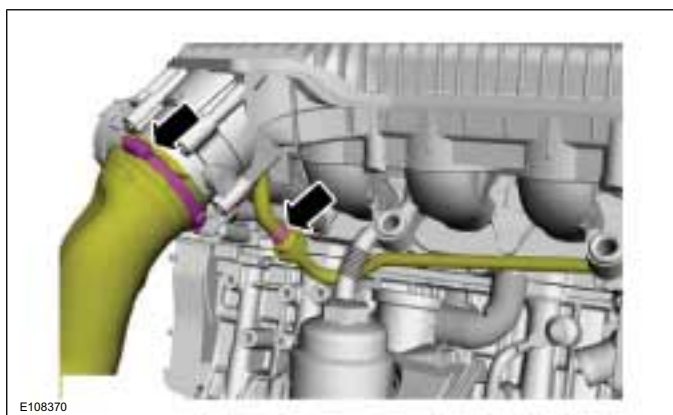
## REMOVAL AND INSTALLATION

## Generator — 2.5L Duratec (147kW/200PS) - VI5(31 414 0)

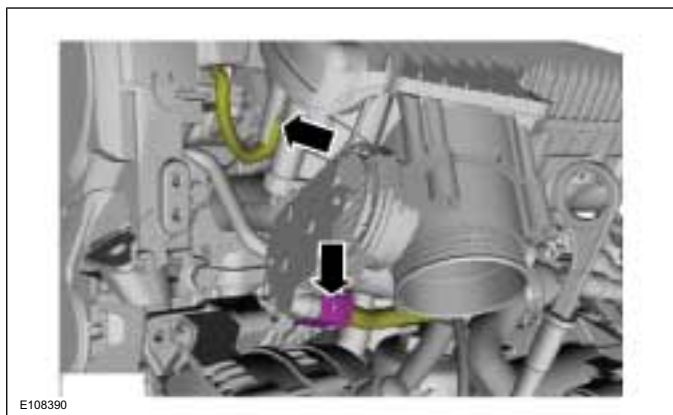
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the following items:
  1. Refer to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
  2. Refer to: **Air Cleaner** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
3. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

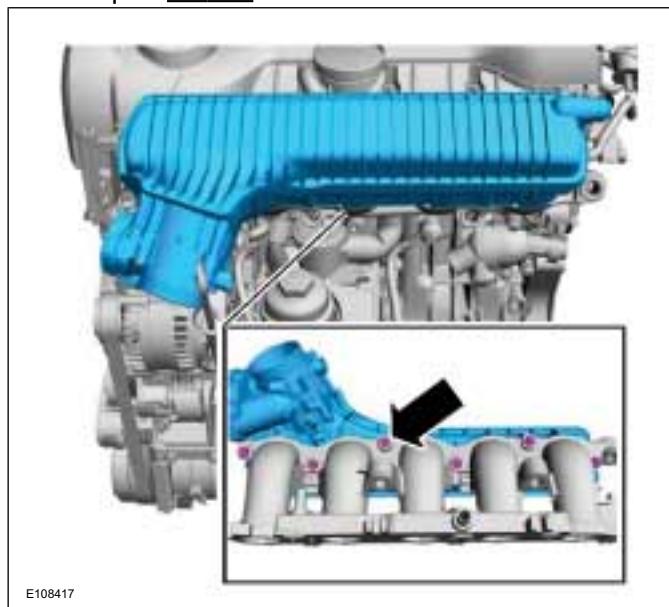


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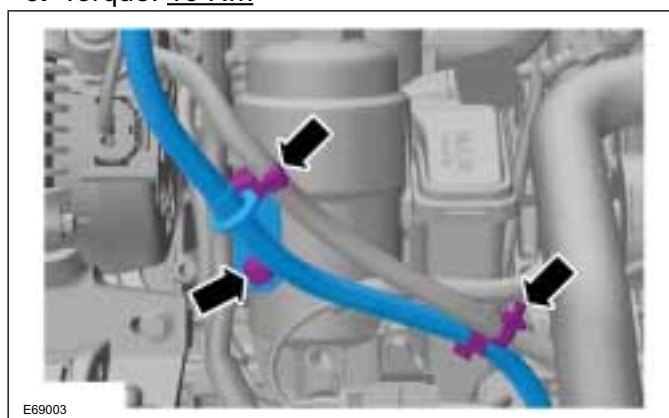


5. **NOTE:** The O-ring seals are to be reused unless damaged.

Torque: 10 Nm



6. Torque: 10 Nm

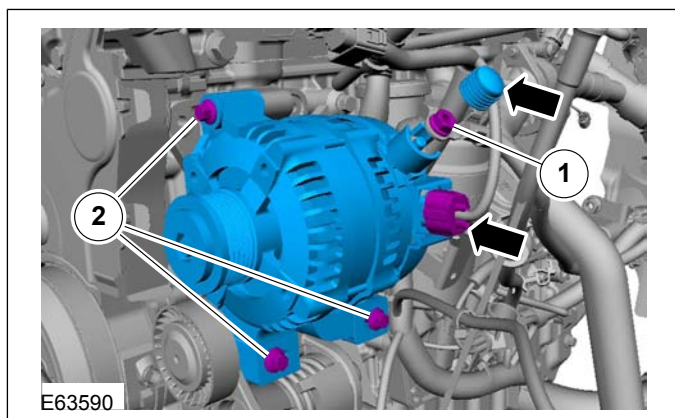




**REMOVAL AND INSTALLATION**

7. **NOTE:** Install all the bolts finger tight before final tightening.

1. Torque: 15 Nm
2. Torque: 25 Nm

**Installation**

1. To install, reverse the removal procedure.
2. Refer to: **Door Window Motor Initialization** (501-11 Glass, Frames and Mechanisms, General Procedures).

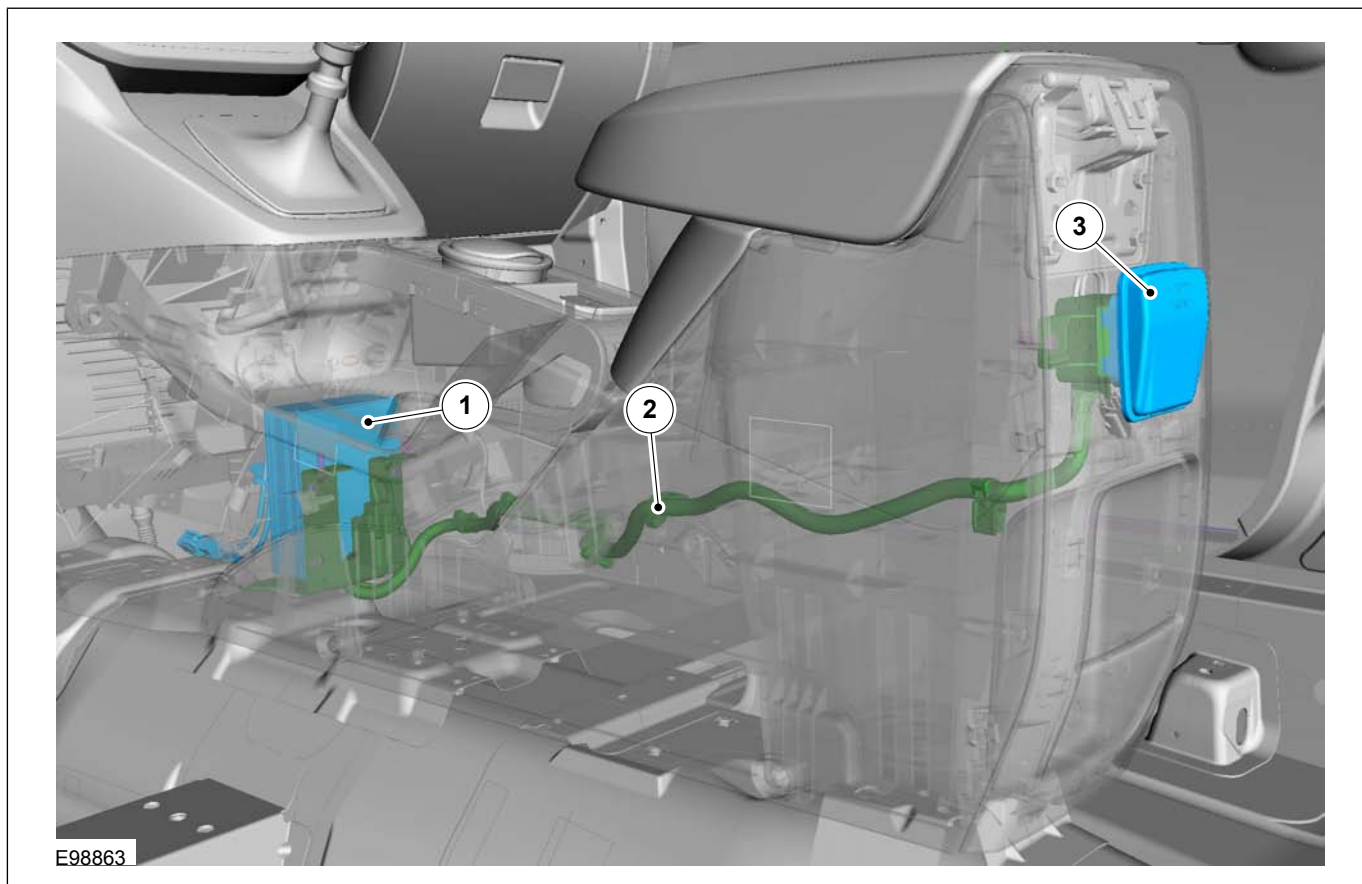
## SECTION 414-05 Voltage Converter/Inverter

**VEHICLE APPLICATION: 2008.50 Kuga**

CONTENTS	PAGE
<b>DESCRIPTION AND OPERATION</b>	
Direct Current/Alternating Current (DC/AC) Inverter (Component Location).....	414-05-2
Direct Current/Alternating Current (DC/AC) Inverter (Overview).....	414-05-3
Function indicator.....	414-05-3
Direct Current/Alternating Current (DC/AC) Inverter (System Operation and Component Description).....	414-05-4
System Diagram.....	414-05-4
System Operation.....	414-05-4
DC/AC converter.....	414-05-4
Component Description.....	414-05-5
DC/AC converter.....	414-05-5
AC mains outlet.....	414-05-5
<b>REMOVAL AND INSTALLATION</b>	
Direct Current/Alternating Current (DC/AC) Inverter.....	414-05-7

DESCRIPTION AND OPERATION

Direct Current/Alternating Current (DC/AC) Inverter – Component Location



Item	Description
1	DC/AC converter
2	AC mains outlet wiring harness
3	AC mains outlet

**DESCRIPTION AND OPERATION****Direct Current/Alternating Current (DC/AC) Inverter – Overview****Function indicator**

**▲ WARNING:** For workshop repairs, it is only permissible to replace the converter as a complete unit together with the wiring harness and the socket. The component must not be opened, as charged capacitors inside can still carry dangerously high residual voltages.

The LED in the socket lights up orange when the converter is supplying a voltage.

In the event of a fault the system switches off and indicates the cause of the fault by flashing a trouble code via the LED in the socket:

- 1x flash
  - High temperature
- 2x flashes
  - Overload
- 3x flashes
  - Internal overvoltage
- 4x flashes
  - Internal undervoltage
- Continuous flashing
  - Short circuit to power

If the converter switches off due to high temperature then it switches back on again automatically once the temperature has cooled down sufficiently.

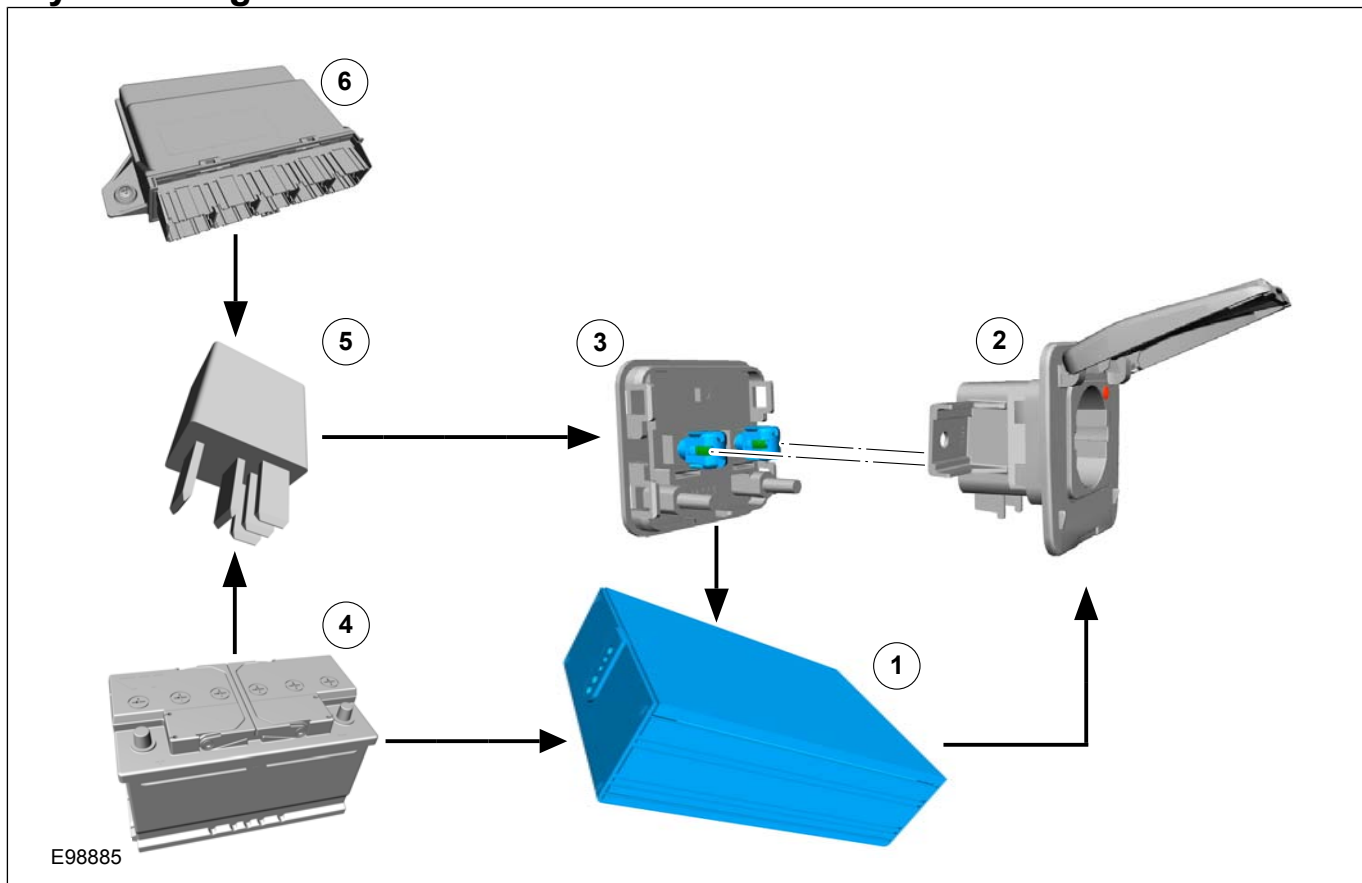
With all of the other faults which are displayed, the converter can be reset by switching the ignition off and back on again or by unplugging and reinserting the consumer in the socket.

If these measures are unsuccessful then there are no further options for directly influencing the function yourself.

DESCRIPTION AND OPERATION

Direct Current/Alternating Current (DC/AC) Inverter – System Operation and Component Description

System Diagram



Item	Description
1	DC/AC converter Refer to Component Description: (page ?)
2	AC mains outlet Refer to Component Description: (page ?)

Item	Description
3	AC mains outlet switch
4	Battery
5	Ignition relay
6	Keyless vehicle module

System Operation

DC/AC converter

In the rear part of the center console there is an optional 230 V socket instead of the outlet of the standard 12 V electrical system.

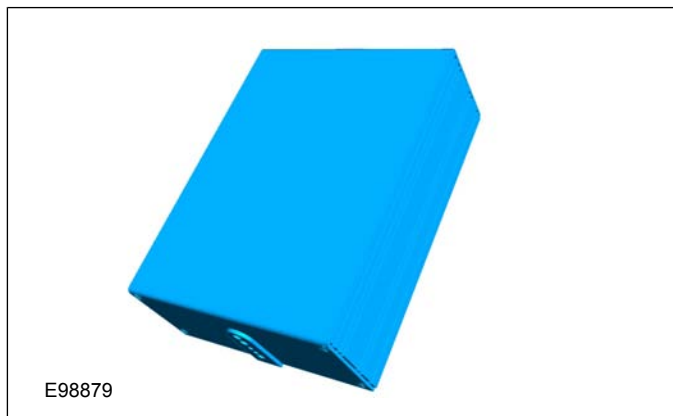
In this case a DC/AC converter supplies a continuous power of 150 W at 230 V/50 Hz. It can also absorb temporary power peaks of up to 300 W when consumers are switched on.

For example, an output of 150 W is sufficient to run laptops, games consoles and mobile phone chargers.

## DESCRIPTION AND OPERATION

## Component Description

## DC/AC converter



The converter operates with a series connection of two power converter circuits. The primary power converter here is a push-pull converter. It converts the 12 V supply from the electrical system of the vehicle to an intermediate direct current link of approx. 320 V.

From this intermediate direct current link, the downstream full H-bridge circuit generates a pulse-width modulated output voltage with 230 V/50 Hz.

A controller modulates the pulse width of the square-wave output voltage and maintains an effective output voltage of 230 V under varying load conditions and under different input voltages. Here, the rising and falling edge of the positive and negative square wave pulse are controlled symmetrically to the ideal shape of a sine wave, which - among other things - also makes a positive contribution to electromagnetic compatibility.

DC/AC converters which supply a modified square wave output voltage are referred to as "Modified Sine Wave Inverters".

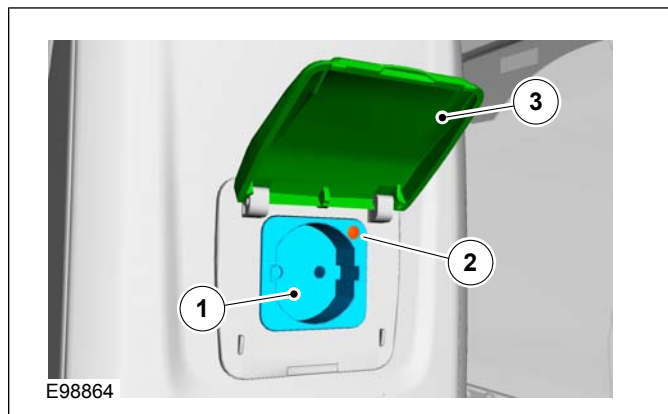
With this type of system there is no need for a residual current operated device for protection in the event of accidental contact, as all of the 230 V lines are double-insulated. Potential-free separation of the entire 230 V voltage part from the vehicle is provided (electrical isolation).

The output voltage of 230 V/50 Hz is not generated until the switching voltage is present at terminal 1 of the converter via the AC mains outlet switch.

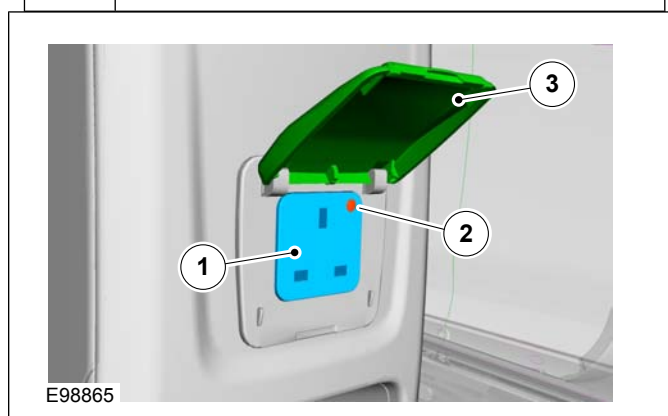
The converter operates with the ignition switched on and a vehicle electrical supply of between 11 V and 16 V. Internal voltage monitoring in the

converter deactivates the system if the input voltage is outside this range.

## AC mains outlet



Item	Description
1	230 V/50 Hz outlet
2	LED (light emitting diode)
3	Cover



Item	Description
1	230 V/50 Hz outlet (for UK vehicles)
2	LED
3	Cover

In order to prevent accidents and the risk of electrical shock, the outlet is protected with a child safety device and the AC outlet switch.

In order to make the system safer for children, the safety catches for the 230 V contacts can only be pushed to one side by pressing a Euro plug evenly into both of the connector openings.

The AC mains outlet switch only activates the system when a consumer is connected to the outlet.



 **414-05-6****Voltage Converter/Inverter****414-05-6** 

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**DESCRIPTION AND OPERATION**

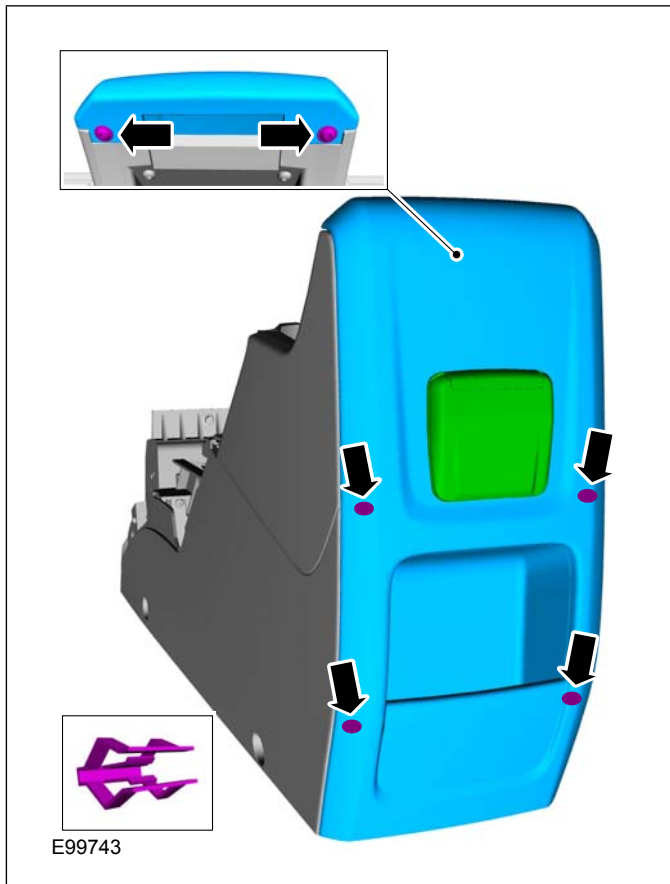
The contacts of the outlet exert a more powerful grip on the plug so that it does not shake loose on poor road surfaces. An orange LED lights up to show that the unit has been activated.

## REMOVAL AND INSTALLATION

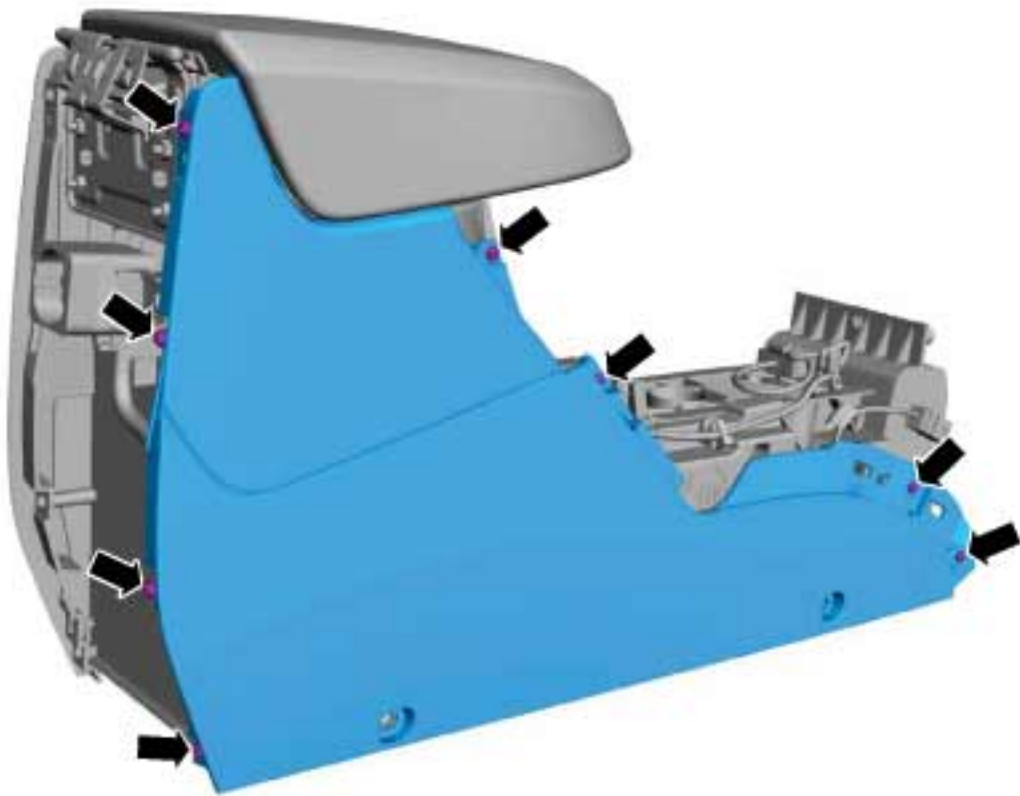
## Direct Current/Alternating Current (DC/AC) Inverter

## Removal

1. Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation).
- 2.
- 3.

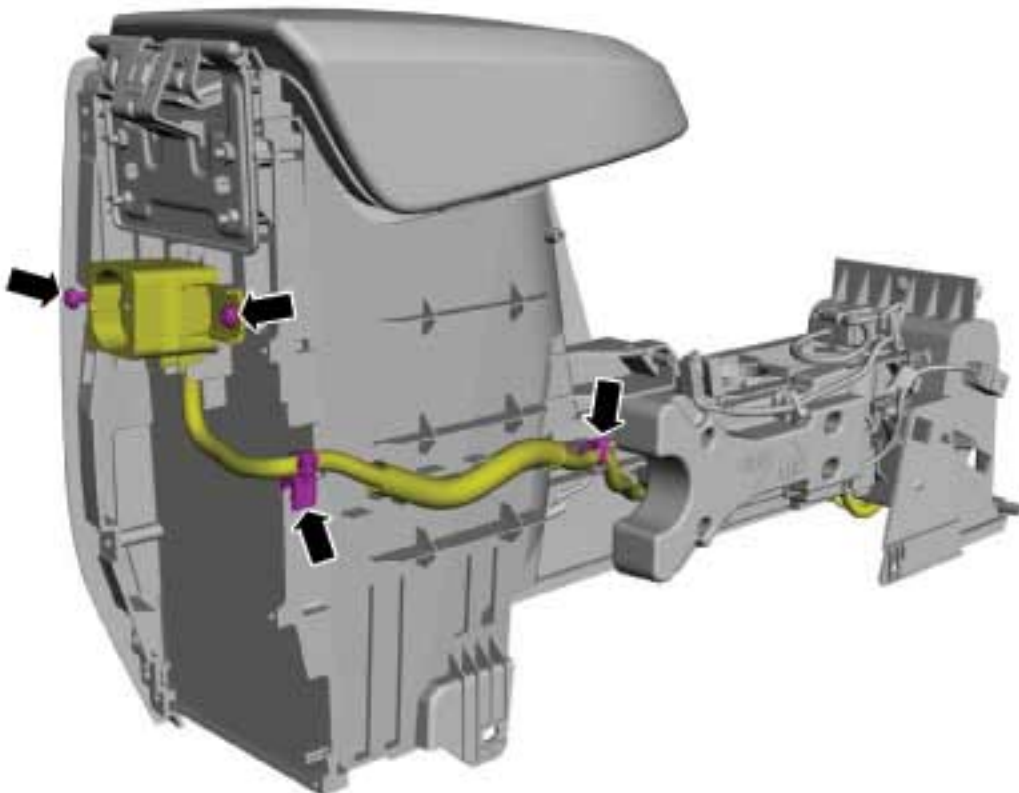


REMOVAL AND INSTALLATION



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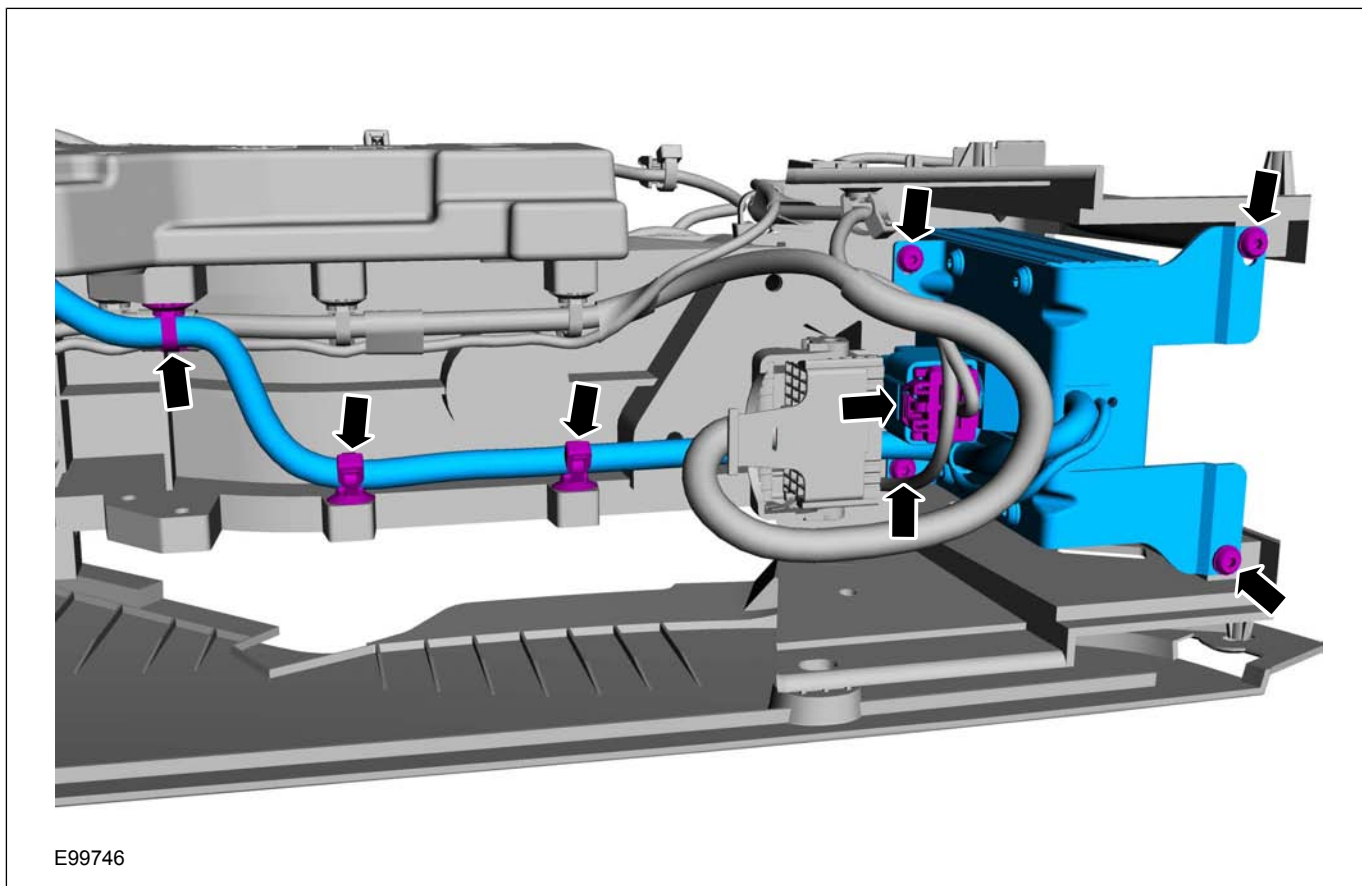
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REMOVAL AND INSTALLATION

5.



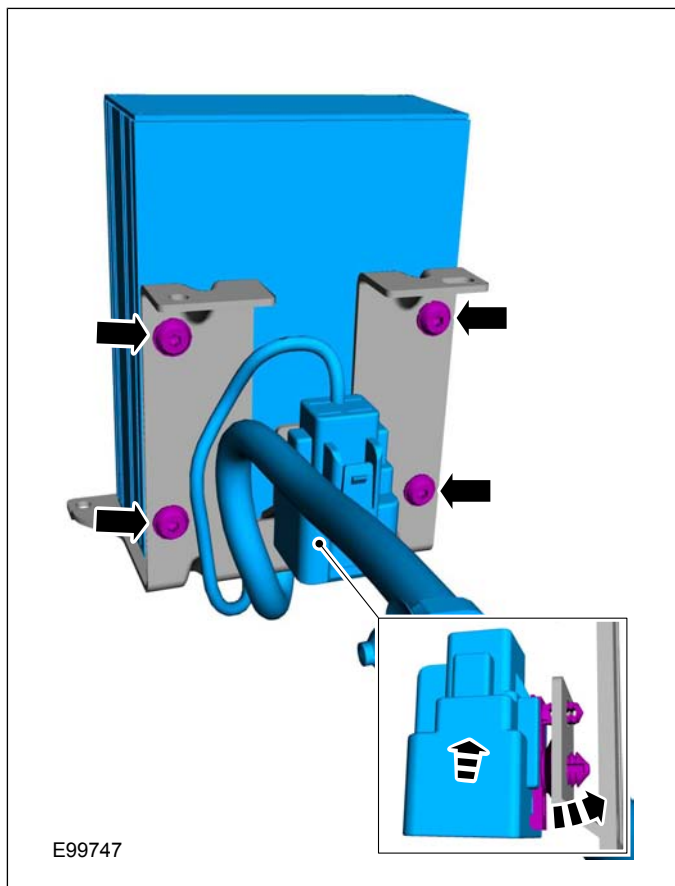
414-05-10

Voltage Converter/Inverter

414-05-10

## REMOVAL AND INSTALLATION

6.



## Installation

1. To install, reverse the removal procedure.

## SECTION 415-00 Information and Entertainment System - General Information

VEHICLE APPLICATION: **2008.50 Kuga**

CONTENTS	PAGE
<b>DIAGNOSIS AND TESTING</b>	
Audio System.....	415-00-2
Inspection and Verification.....	415-00-2
Self-Diagnostic Mode - Low Series Audio Unit.....	415-00-2
Self-Diagnostic Mode - High Series Audio Unit GEN 2.....	415-00-2
Cellular Phone.....	415-00-4
Principles of Operation.....	415-00-4
Inspection and Verification.....	415-00-4
Diagnostic Trouble Code (DTC) Index Chart.....	415-00-5
Symptom Chart.....	415-00-6
Pinpoint Tests.....	415-00-7



Information and Entertainment System -  
General Information

415-00-2

415-00-2

DIAGNOSIS AND TESTING

Audio System

Refer to Wiring Diagrams Section 415-01, for schematic and connector information.  
Refer to Wiring Diagrams Section 415-03, for schematic and connector information.

General Equipment

The Ford approved diagnostic tool

Inspection and Verification

**NOTE:** If the keycode is entered incorrectly 3 times, the system will allow the next keycode in 30 minutes. After entering the keycode the 10th time incorrectly the system will lock out. The component can only be unlocked by the manufacturer.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> <li>- Audio unit</li> <li>- Antenna</li> <li>- Foreign objects contacting speaker</li> <li>- Trim poorly fitted/resonance</li> <li>- Audio control switch (if equipped)</li> <li>- Compact disc (CD) changer</li> </ul>	<ul style="list-style-type: none"> <li>- Fuse(s)</li> <li>- Wiring harness</li> <li>- Electrical connector(s)</li> <li>- Audio unit</li> <li>- Audio control switch (if equipped)</li> <li>- CD changer</li> <li>- Central junction box (CJB)</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Self-Diagnostic Mode.

Self-Diagnostic Mode - Low Series Audio Unit

**NOTE:** The audio unit must be in radio mode before entering the Self-Diagnostic Mode.

1. To enter the audio unit Self-Diagnostic Mode, switch the audio unit ON. Within four seconds depress the preset buttons 3 and 6 together.
2. Release the preset buttons 3 and 6 and the audio unit will enter the Self-Diagnostic Mode.

3. The Self-Diagnostic Mode will automatically stop after one iteration or to interrupt it , switch the audio unit OFF.

Self-Diagnostic Mode

Message Displayed	Circuit Tested
1. 4CH RF low	Right hand front woofer circuit
2. 4CH RF high	Right hand front tweeter circuit.
3. 4CH LF low	Left hand front woofer circuit.
3. 4CH LF High	Left hand front tweeter circuit.
1. 4CH RR low	Right hand rear woofer circuit
2. 4CH RR high	Right hand rear tweeter circuit
3. 4CH LR low	Left hand rear woofer circuit
3. 4CH LR High	Left hand rear tweeter circuit.
Seek 87.5 - 108.0	Antenna connection

4. If the cause is not evident after the Self-Diagnostic Mode, connect the Ford approved diagnostic tool to the data link connector (DLC).

Self-Diagnostic Mode - High Series Audio Unit GEN 2

**NOTE:** The audio unit must be in radio mode before entering the Self-Diagnostic Mode.

1. To enter the audio unit Self-Diagnostic Mode, switch the audio unit ON. Within four seconds depress the preset button 3 and 6 together.
2. Release the preset button 3 and 6 and the audio unit will enter the Self-Diagnostic Mode.
3. The Self-Diagnostic Mode will automatically stop after one iteration or to interrupt it , switch the audio unit OFF.

Self-Diagnostic Mode

Message Displayed	Circuit Tested
RF speaker 600Hz	Right hand front woofer circuit

**DIAGNOSIS AND TESTING**

Message Displayed	Circuit Tested
RF speaker 8kHz	Right hand front tweeter circuit.
LF speaker 600Hz	Left hand front woofer circuit.
LF speaker 8kHz	Left hand front tweeter circuit.
RR speaker 600Hz	Right hand rear woofer circuit
RR speaker 8kHz	Right hand rear tweeter circuit
LR speaker 600Hz	Left hand rear woofer circuit
LR speaker 8kHz	Left hand rear tweeter circuit.
Seek 87.5 - 108.0	Antenna connection

4. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

## Information and Entertainment System - General Information

415-00-4

415-00-4

### DIAGNOSIS AND TESTING

## Cellular Phone

Refer to **Wiring Diagrams Section 415-00**, for schematic and connector information.

### General Equipment

Ford diagnostic equipment
---------------------------

### Principles of Operation

**NOTE:** Voice control will only operate with the audio unit and components required switched ON.

#### Voice Control

The portable support electronics (PSE) module has a voice control system. The customer will be able to push the VOICE button on the audio control switch located on the steering column lower shroud, this will activate the PSE module and allow voice control. An audible tone will be heard through the audio unit speakers after which, a voice command can then be spoken into the microphone located in the overhead console.

The incoming calls and voice confirmation can be heard through the audio system speakers.

When a voice command is spoken into the microphone it will be sent as a signal to the PSE module. The signal is then sent from the PSE module to the relevant components on the medium-speed controller area network (CAN) bus network. The component will then convert the signal back into the original voice command.

The components that the PSE module interacts with are as follows:

- audio unit
- navigation system display module
- cellular phone

For additional information on the cellular phone system, REFER to the cellular phone Owner's Guide.

#### Bluetooth

An input can be given through the cellular phone with or without the cellular phone connected to the handset holder. Providing that the cellular phone is one of the recommended cellular phones for the system, is supplied with the Bluetooth technology and the cellular phone is programmed to the PSE module.

When selected as active the Bluetooth technology is a wireless system that interacts with the relevant

component modules through the PSE module. The general operation of the Bluetooth is similar to the voice control.

Bluetooth technology cannot transfer the cellular phone's PHONEBOOK or recent outgoing and incoming call details to the audio unit or navigation system display module. If the cellular phone is placed into the handset holder the PHONEBOOK data and recent outgoing and incoming call information will be transferred to the audio unit or navigation system display module.

For additional information, REFER to the cellular phone Owner's Guide.

### Inspection and Verification

**NOTE:** Make sure that the cellular phone is featured on the list of recommended cellular phones for the system.

**Make sure that the PSE module and cellular phone are configured to each other before starting a system diagnosis. ENTER the following PIN number on the cellular phone to configure the cellular phone to the PSE module: 0000.**

**Make sure that the MUTE symbol is not displayed on the audio unit when trying to operate the cellular phone system. If the MUTE symbol is displayed, this indicates that the PSE module requires configuring to the vehicle and the cellular phone requires programming to the PSE module. GO to **Pinpoint Test C**.**

1. Verify the customer concern by operating the system using the customers cellular phone.
2. Visually inspect for obvious signs of electrical damage.

#### Visual Inspection Chart

Electrical
<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Wiring harness</li> <li>• Electrical connector(s)</li> <li>• Cellular phone</li> <li>• Microphone</li> <li>• PSE module</li> <li>• Audio unit</li> <li>• Instrument cluster</li> <li>• Navigation system display module</li> </ul>

## Information and Entertainment System - General Information

415-00-5

415-00-5

### DIAGNOSIS AND TESTING

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, connect the Ford diagnostic equipment to the data link connector (DLC).
5. SELECT the **TOOLBOX** menu.
6. SELECT the **ENTERTAINMENT/COMMUNICATION** menu.
7. SELECT the **SPEECH RECOGNITION MODULE** option and follow the instructions on the display.
8. Retrieve the diagnostic trouble codes (DTC)s and refer to the Diagnostic Trouble Code (DTC) Index Chart.
9. If no DTCs are retrieved or there is no communication with the module, proceed to the Symptom Chart to continue diagnostics.

### Diagnostic Trouble Code (DTC) Index Chart

DTC	Description/Condition	Possible Source	Action
B1038	Microphone input circuit failure	Microphone defect or short to ground	GO to <b>Pinpoint Test B.</b>
B1317	Battery voltage high	Battery voltage above 16 volts	REFER to: <b>Charging System</b> (414-00 Charging System - General Information, Diagnosis and Testing).
B1318	Battery voltage low	Battery voltage below 9 volts	REFER to: <b>Charging System</b> (414-00 Charging System - General Information, Diagnosis and Testing).
B1342	PSE module failure	PSE module	INSTALL a new PSE module. TEST the system for normal operation.
B1899	Microphone input signal circuit open	Microphone defect or not connected	GO to <b>Pinpoint Test B.</b>
B2272	Microphone bias circuit failure	No supply to microphone	GO to <b>Pinpoint Test B.</b>
B2477	Faulty module configuration	PSE module	REFER to the Ford diagnostic equipment.

## DIAGNOSIS AND TESTING

DTC	Description/Condition	Possible Source	Action
U0074	Bluetooth communication failure to cellular phone	PSE module or cellular phone	CHECK the cellular phone Bluetooth function with another application to determine if the cellular phone is the concern. If the Bluetooth function operates correctly with the other application, INSTALL a new PSE module. TEST the system for normal operation. If the Bluetooth function does not operate with other application, REFER to the cellular phone Owner's Guide.
U2050	No application present	PSE module	INSTALL a new PSE module. TEST the system for normal operation.

1. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

## Symptom Chart

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>No communication with the portable support electronics (PSE) module</li> </ul>	<ul style="list-style-type: none"> <li>PSE module not configured to the vehicle.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test C.</b></li> </ul>
	<ul style="list-style-type: none"> <li>Fuse(s).</li> <li>Circuit(s).</li> <li>PSE module.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test A.</b></li> </ul>
	<ul style="list-style-type: none"> <li>DLC.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to: <b>Communications Network</b> (418-00 Module Communications Network, Diagnosis and Testing).</li> </ul>
<ul style="list-style-type: none"> <li>The audio unit display does not display PHONE</li> </ul>	<ul style="list-style-type: none"> <li>PSE module not configured to the vehicle.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test C.</b></li> </ul>
	<ul style="list-style-type: none"> <li>Audio unit.</li> <li>Navigation system display module.</li> <li>PSE module.</li> <li>Instrument cluster.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK all communication between the instrument cluster, audio unit, navigation system display module and PSE module. REFER to the Ford diagnostic equipment.</li> </ul>
<ul style="list-style-type: none"> <li>The cellular phone microphone is not operating correctly</li> </ul>	<ul style="list-style-type: none"> <li>Circuit(s).</li> <li>Microphone.</li> <li>PSE module.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B.</b></li> </ul>

## Information and Entertainment System - General Information

415-00-7

415-00-7

### DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>Reduced sound or no sound through the speakers</li> </ul>	<ul style="list-style-type: none"> <li>Audio unit.</li> <li>PSE module.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK all communication between the audio unit and PSE module. REFER to the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Circuit(s).</li> <li>Audio unit.</li> <li>PSE module.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to the Ford diagnostic equipment.</li> </ul>
<ul style="list-style-type: none"> <li>The cellular phone information is not displayed</li> </ul>	<ul style="list-style-type: none"> <li>Audio unit.</li> <li>Navigation system display module.</li> <li>PSE module.</li> <li>Instrument cluster.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK all communication between the instrument cluster, audio unit, navigation system display module and PSE module. REFER to the Ford diagnostic equipment.</li> </ul>
<ul style="list-style-type: none"> <li>The voice activated phone functions are inoperative</li> </ul>	<ul style="list-style-type: none"> <li>Circuit(s).</li> <li>Cellular Phone.</li> <li>Audio unit.</li> <li>Navigation system display module.</li> <li>PSE module.</li> <li>Instrument cluster.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK all communication between the instrument cluster, audio unit, navigation system display module and PSE module. REFER to the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Cellular phone is not featured on the list of recommended cellular phones for the system</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the make and model of the cellular phone against those on the list of recommended cellular phones for the system.</li> </ul>

### Pinpoint Tests

**NOTE:** Use a digital multimeter for all electrical measurements.

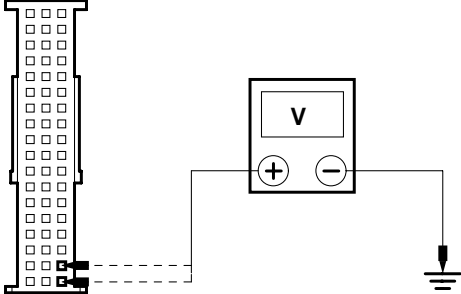
**NOTE:** ENTER the following PIN number on the cellular phone to configure the cellular phone to the PSE module: 0000.

#### PINPOINT TEST A : NO COMMUNICATION WITH THE PORTABLE SUPPORT ELECTRONICS (PSE) MODULE

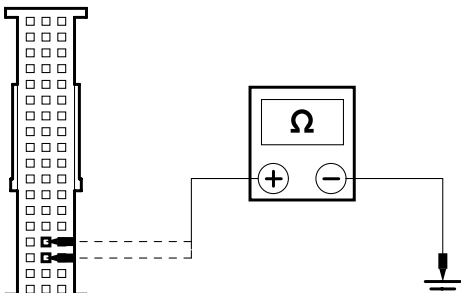
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A1: CHECK FOR VOLTAGE AT THE PSE MODULE</b>	
	1 Disconnect PSE Module C432.



**DIAGNOSIS AND TESTING**

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
 <p>E53363</p>	<p>2 Measure the voltage between the PSE module C432 pin 17, circuit 29-MC12C (OG/YE), harness side and ground; and the PSE module C432 pin 18, circuit 29-MC12B (OG/YE), harness side and ground.</p> <ul style="list-style-type: none"> <li>• Are the voltages greater than 10 volts?</li> </ul> <p>→ <b>Yes</b> GO to A2.</p> <p>→ <b>No</b> REPAIR circuit 29-MC12C (OG/YE) or circuit 29-MC12B (OG/YE) as necessary. TEST the system for normal operation.</p>

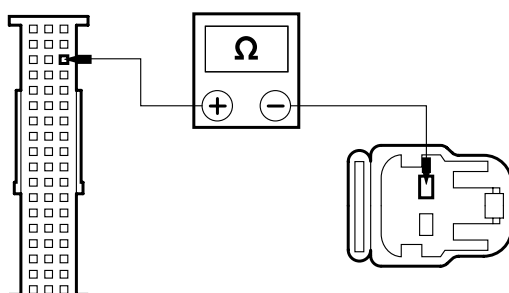
**A2: CHECK THE PSE MODULE GROUND CIRCUIT(S)**

 <p>E53364</p>	<p>1 Measure the resistance between the PSE module C432 pin 33, circuit 91-MC12 (BK/YE), harness side and ground; and the PSE module C432 pin 34, circuit 91-MC12A (BK/YE), harness side and ground.</p> <ul style="list-style-type: none"> <li>• Are the resistances less than 1 ohm?</li> </ul> <p>→ <b>Yes</b> INSTALL a new PSE module. TEST the system for normal operation.</p> <p>→ <b>No</b> REPAIR circuit 91-MC12 (BK/YE) or circuit 91-MC12A (BK/YE) as necessary. TEST the system for normal operation.</p>
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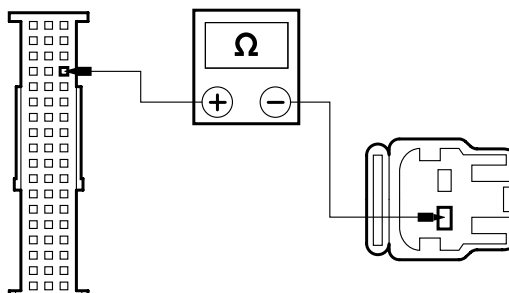
**PINPOINT TEST B : THE CELLULAR PHONE MICROPHONE IS NOT OPERATING CORRECTLY**

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<p><b>B1: CHECK THAT THE VOICE IS BEING TRANSMITTED DURING A TELEPHONE CONVERSATION OUTSIDE OF THE VEHICLE</b></p>	
<p><b>NOTE:</b> Make sure that the Bluetooth functionality is disabled for this test.</p>	
	<p>1 Operate the cellular phone outside the vehicle.</p> <ul style="list-style-type: none"> <li>• Does the cellular phone transmit the voice during a telephone conversation outside of the vehicle?</li> </ul> <p>→ <b>Yes</b> GO to B2.</p> <p>→ <b>No</b> REFER to the cellular phone Owner's Guide.</p>
<p><b>B2: CHECK CIRCUIT 8-MC8 (WH/RD) FOR OPEN</b></p>	
	<p>1 Disconnect PSE Module C432.</p>

DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
 <p>E83447</p>	<p>2 Disconnect Microphone C493.</p> <p>3 Measure the resistance between the PSE module C432 pin 3, circuit 8-MC8 (WH/RD), harness side and the microphone C493 pin 1, circuit 8-MC8 (WH/RD), harness side.</p> <ul style="list-style-type: none"> <li>Is the resistance less than 1 ohm?</li> <li>→ <b>Yes</b> GO to B3.</li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation.</li> </ul>

**B3: CHECK CIRCUIT 3-MC8 (BK) FOR OPEN**

 <p>E83448</p>	<p>1 Measure the resistance between the PSE module C432 pin 4, circuit 3-MC8 (BK), harness side and the microphone C493 pin 2, circuit 3-MC8 (BK), harness side.</p> <ul style="list-style-type: none"> <li>Is the resistance less than 1 ohm?</li> <li>→ <b>Yes</b> INSTALL a new microphone. TEST the system for normal operation.</li> <li>→ <b>No</b> REPAIR the circuit. TEST the system for normal operation. If the concern persists, INSTALL a new PSE module. TEST the system for normal operation.</li> </ul>
--	---

**PINPOINT TEST C : THE MUTE SYMBOL IS DISPLAYED ON THE AUDIO UNIT WHEN TRYING TO OPERATE THE CELLULAR PHONE SYSTEM**

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>C1: CONFIGURE THE PSE MODULE TO THE VEHICLE</b>	
	<p>1 Ignition switch in position 0.</p> <p>2 Connect the Ford diagnostic equipment to the DLC.</p> <p>3 Select the <b>TOOLBOX</b> menu.</p> <p>4 Select the <b>MODULE PROGRAMMING</b> menu.</p> <p>5 Select the <b>MODULE REPROGRAMMING</b> menu.</p> <p>6 Select the <b>SPEECH RECOGNITION MODULE</b> option and follow the instructions on the display.</p> <p>7 Ignition switch in position II.</p>

DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
	8 Ignition switch in position 0.
	9 Ignition switch in position II.
	10 Ignition switch in position 0.
	11 Ignition switch in position II.
	12 Ignition switch in position 0. <ul style="list-style-type: none"> <li>• Is the MUTE symbol displayed on the audio unit when the cellular phone system is operated?</li> <li>→ <b>Yes</b> Carry out the PSE module configuration procedure again. If the concern persists, <b>INSTALL</b> a new PSE module. <b>TEST</b> the system for normal operation.</li> <li>→ <b>No</b> <b>TEST</b> the system for normal operation.</li> </ul>

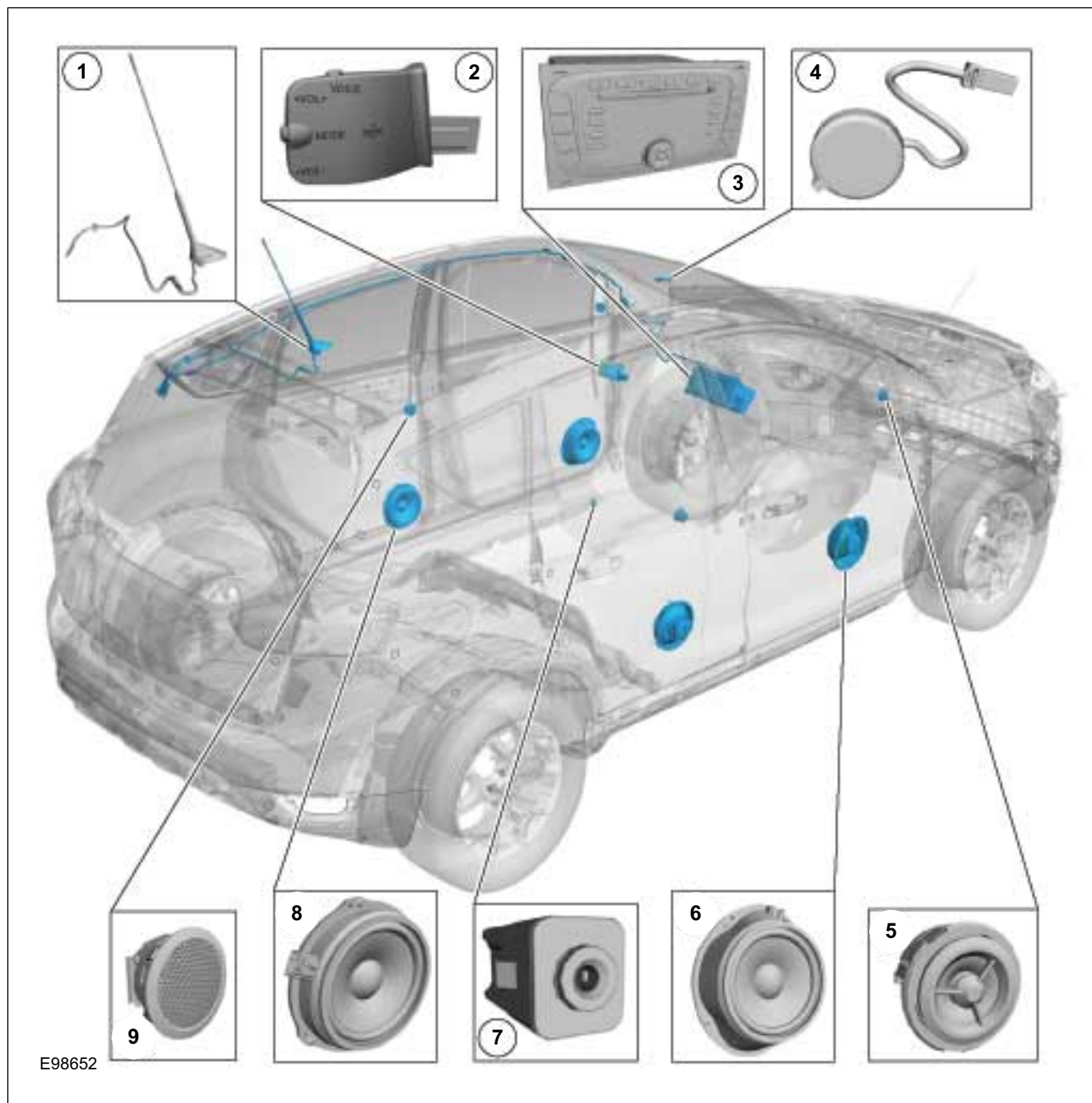
## SECTION 415-01 Information and Entertainment System

### VEHICLE APPLICATION: 2008.50 Kuga

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DESCRIPTION AND OPERATION

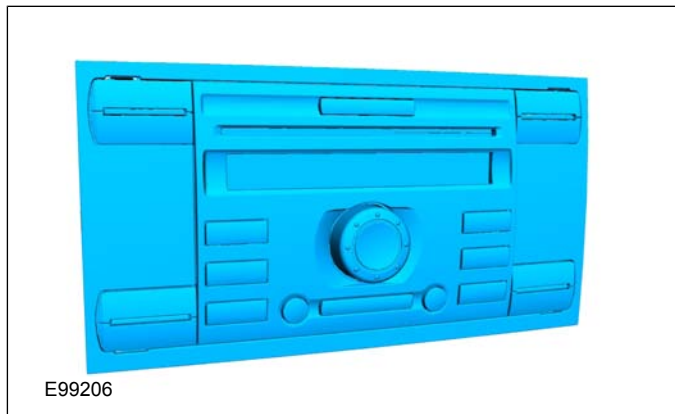
Audio System – Component Location



E98652

Item	Description
1	FM/AM antenna
2	Radio remote control.
3	Audio unit.
4	Microphone.

Item	Description
5	Front tweeter
6	Front mid/bass speaker
7	AUX port
8	Rear mid/bass speaker
9	Rear tweeter

**DESCRIPTION AND OPERATION****Audio System – Overview****Keycode entry - vehicle with standard audio system**

E99206

The keycode is entered via the MENU button and the arrow buttons. The keycode is then confirmed with the rotary/pushbutton in the middle of the unit.

Only a limited number of attempts to enter the correct keycode are allowed. The number of attempts already made is shown in the display.

Following every subsequent unsuccessful attempt, an uninterrupted waiting period must be observed before a further attempt can be made.

The display then shows "WAIT XX" and counts down to "0", provided the ignition remains switched on. Once this time has expired, a new attempt can be made to enter the keycode.

After a certain number of unsuccessful attempts at entering the keycode, the display will show "LOCKED" or "SAFE". The customer will now be unable to switch on the device.

The authorized Ford dealer can remove the lock and can make up to three further attempts.

**Vehicle Identification Number (VID) - entry - vehicle with standard audio system**

It is often extremely difficult to return stolen audio units which have been seized by the police to their owners.

Therefore, many Ford audio units offer the option of, for example, entering a vehicle identification number into the unit.

For Ford audio systems, the abbreviation VID is used to refer to the Vehicle Identification Number. The VIN (chassis number) or, for instance, the

number plate number can be entered and this fulfills the security function.

The VIN is programmed ex works. If the unit is replaced, the VIN is automatically transferred by the diagnostics system during configuration.

**Self-check routine - vehicles with standard audio system.**

The audio unit must be in radio mode before entering the Self-Diagnostic Mode.

To enter the audio unit Self-Diagnostic Mode, switch the audio unit ON. Press pre-set buttons 3 and 6 simultaneously and then release them again.

**Keycode entry - vehicles with upgraded audio system**

E99207

The station keys are used to enter the keycode. Station key 5 is used to confirm the keycode.

Only a limited number of attempts to enter the correct keycode are allowed. The number of attempts already made is shown in the display.

After the second unsuccessful attempt, the person entering the keycode will have to wait for an uninterrupted period of time before making the next attempt.

The display then shows "WAIT XX" and counts down to "0", provided the ignition remains switched on. Once this time has expired, a new attempt can be made to enter the keycode.

After a certain number of unsuccessful attempts at entering the keycode, the display will show "LOCKED" or "SAFE". The customer will now be unable to switch on the device.



**415-01-4****Information and Entertainment System****415-01-4**

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**DESCRIPTION AND OPERATION**

The authorized Ford dealer can remove the lock and can make up to three further attempts.

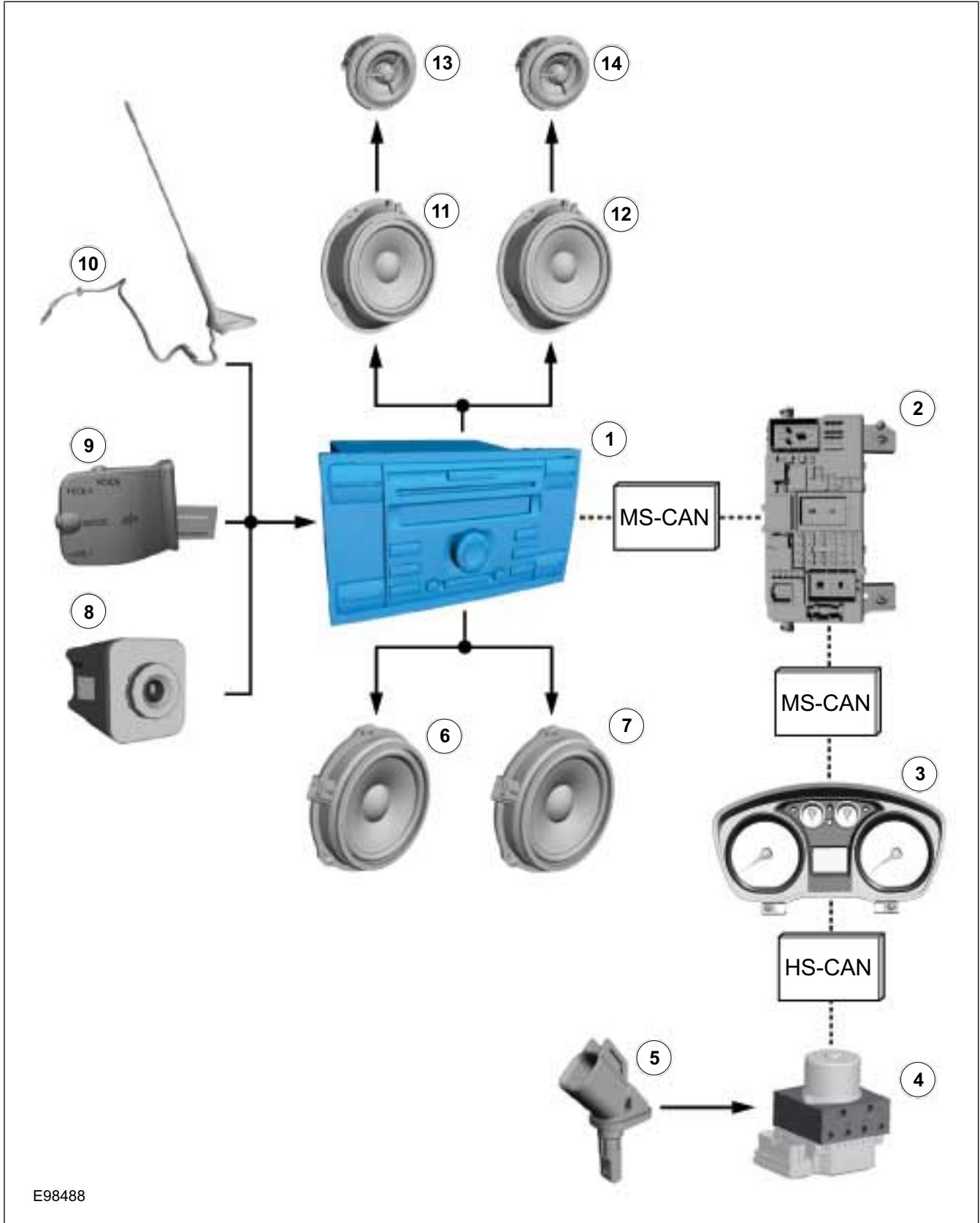


DESCRIPTION AND OPERATION

Audio System – System Operation and Component Description

System Diagram

Vehicles with standard audio system.



E98488

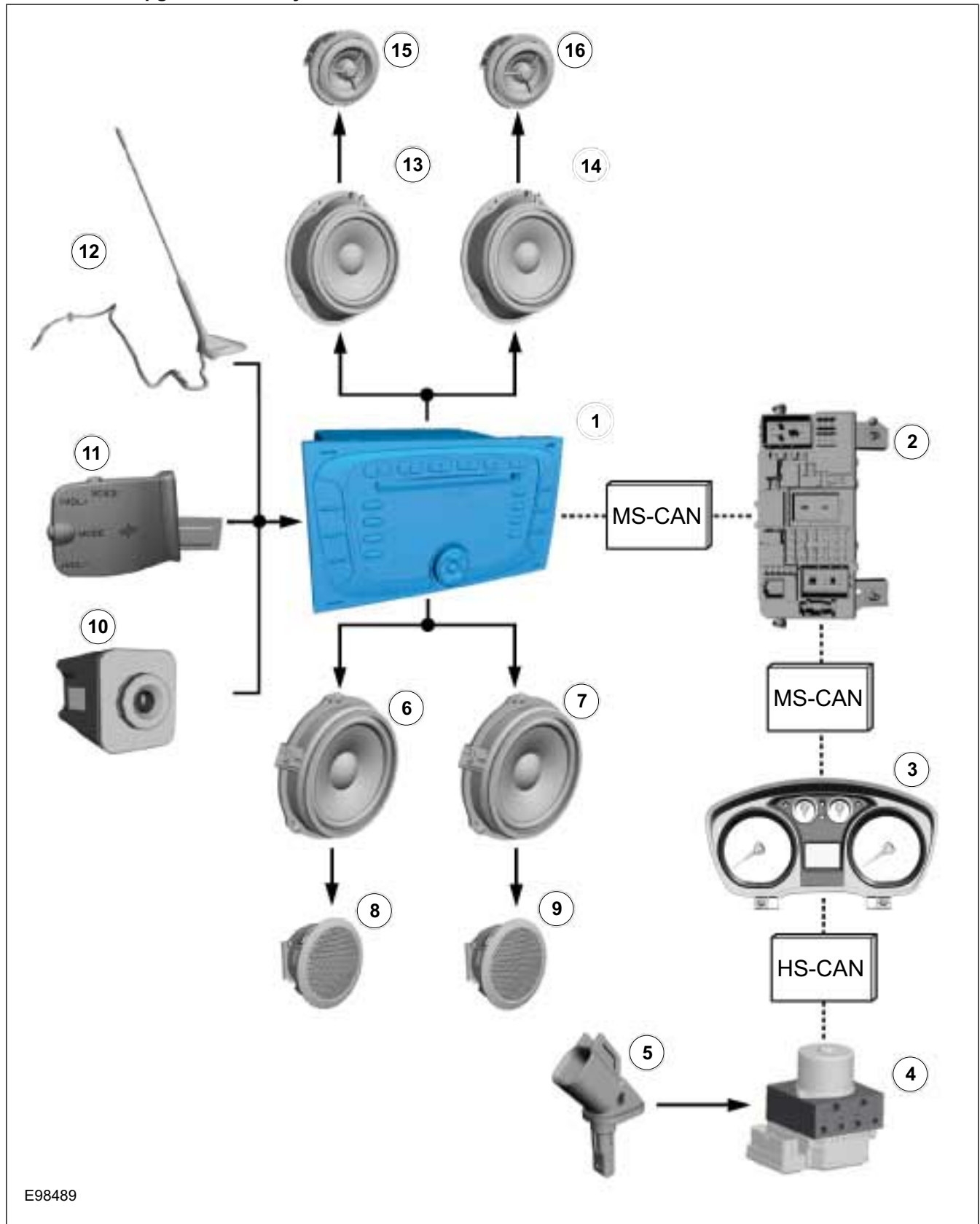
**DESCRIPTION AND OPERATION**

Item	Description
1	In-car entertainment
2	Genetic electronic module (GEM).
3	instrument cluster
4	ABS
5	ABS sensor assembly
6	Rear LH mid/bass range speaker
7	Rear RH mid/bass range speaker

Item	Description
8	AUX port
9	Radio remote control.
10	FM/AM antenna
11	Front LH mid/bass speaker
12	Front RH mid/bass speaker
13	Front LH tweeter
14	Front RH tweeter

DESCRIPTION AND OPERATION

Vehicles with upgraded audio system.



E98489

**DESCRIPTION AND OPERATION**

Item	Description
1	In-car entertainment
2	Genetic electronic module (GEM).
3	instrument cluster
4	ABS
5	ABS sensor assembly
6	Rear LH mid/bass range speaker
7	Rear RH mid/bass range speaker
8	Rear LH tweeter

Item	Description
9	Rear RH tweeter
10	AUX port
11	Radio remote control.
12	FM/AM antenna
13	Front LH mid/bass speaker
14	Front RH mid/bass speaker
15	Front LH tweeter
16	Front RH tweeter

**System Operation****In-car entertainment**

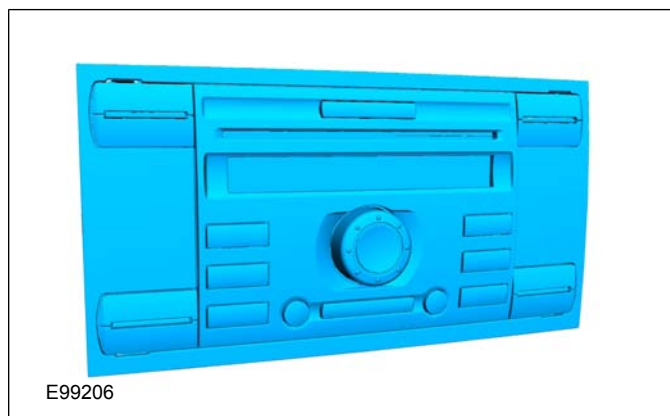
The audio system is connected to the MS CAN network and uses an internal amplifier which directly drives the system speakers. It can only be operated via the head unit and the radio remote control. The head unit is connected to the vehicle on the medium speed CAN bus. This allows the unit to be interrogated for diagnostic purposes.

The automatic volume control (AVC) adjusts the audio volume depending on the driving speed. The audio device receives the necessary signals for the ABS (anti-lock brake system) wheel sensors from the instrument cluster on the MS-CAN. As vehicle speed increases the audio level is adjusted to compensate for extra road and vehicle noise. Eight AVC settings are possible.

To choose the setting for automatic volume control, press the MENU button until the AVC display appears.

The required adjustment level is determined by the Infotainment control unit based on the driving speed signal. The vehicle speed signal is received over the CAN. The signal is an average of the four wheel speed sensor signals. Should an invalid speed signal be received the AVC will not alter the output volume.

AVC is controlled by the audio amplifier.

**Component Description****Vehicles with standard audio system**

The standard audio system can only be used via the head unit, the radio remote control and the mobile electronic accessories module.

**DESCRIPTION AND OPERATION****Vehicles with upgraded audio system.**

The upgraded audio system is available with the following equipment:

- Radio/individual CD player with MP3
- Radio/individual CD player with MP3 and Digital Audio Broadcasting (DAB)
- Radio with integrated 6x CD changer with MP3
- Radio with integrated 6x CD changer with MP3 and DAB

**DAB radio**

DAB is a procedure for digital transmission of radio programs.

The DAB system was developed in Europe within the framework of a European development program and in recent years has been introduced in many European countries.

The audio signals from up to 12 radio stations are packaged into a multiplex and bundled into a single data stream. This is then broadcast via one or more terrestrial transmitters. This means that individual transmitters are no longer needed for each radio station.

In addition to the much larger range of stations that can be provided to radio listeners through DAB, there are also several big technical advantages over the current FM, MW, LW and SW transmission:

- Provided the receiver can receive the signal from the DAB transmitter, sound reproduction is guaranteed. There is no fading, as is typical for AM and mobile FM reception.
- Interference, such as crackling noises caused by high voltage lines, is filtered out by the DAB receiver.

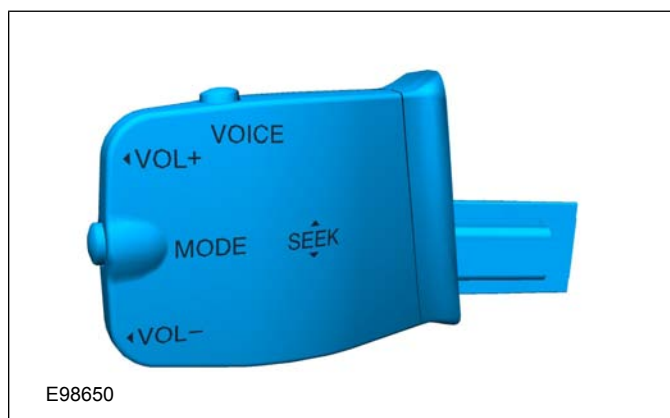
- With DAB, there is no overlapping of different stations.
- If the transmission signal is reflected by natural obstacles or buildings while en route, this causes interference with FM. With DAB, however, reception is significantly improved by this.

**Service linking**

As soon as the audio device no longer receives the FM signal in sufficient quality, it automatically switches to the corresponding DAB transmitter, but the FM display in the audio device remains active. When the FM signal becomes available again in sufficient quality, the device automatically switches back.

**AUX port**

The audio systems have an auxiliary device input (AUX IN) which enables the playback of auxiliary devices such as MiniDisc or MP3 players via the vehicle's audio system. Sounds is played back through the vehicle loudspeakers.

**Radio remote control.**

The following functions can be controlled with the remote control:



**DESCRIPTION AND OPERATION**

- Volume adjustment
  - To increase the volume, press the top rear button on the remote control.
  - To lower the volume: Press the bottom rear button on the remote control.
- Search
  - During radio operation, the station search is started upwards or downwards within the frequency band.
  - During CD operation, this skips to the next or previous track.
- Mode
  - During radio operation, the next saved station is called up (if pressed briefly).
  - During radio operation, to switch wave range (if pressed and held).
  - During CD operation, provided a CD changer is installed, the next CD is played.

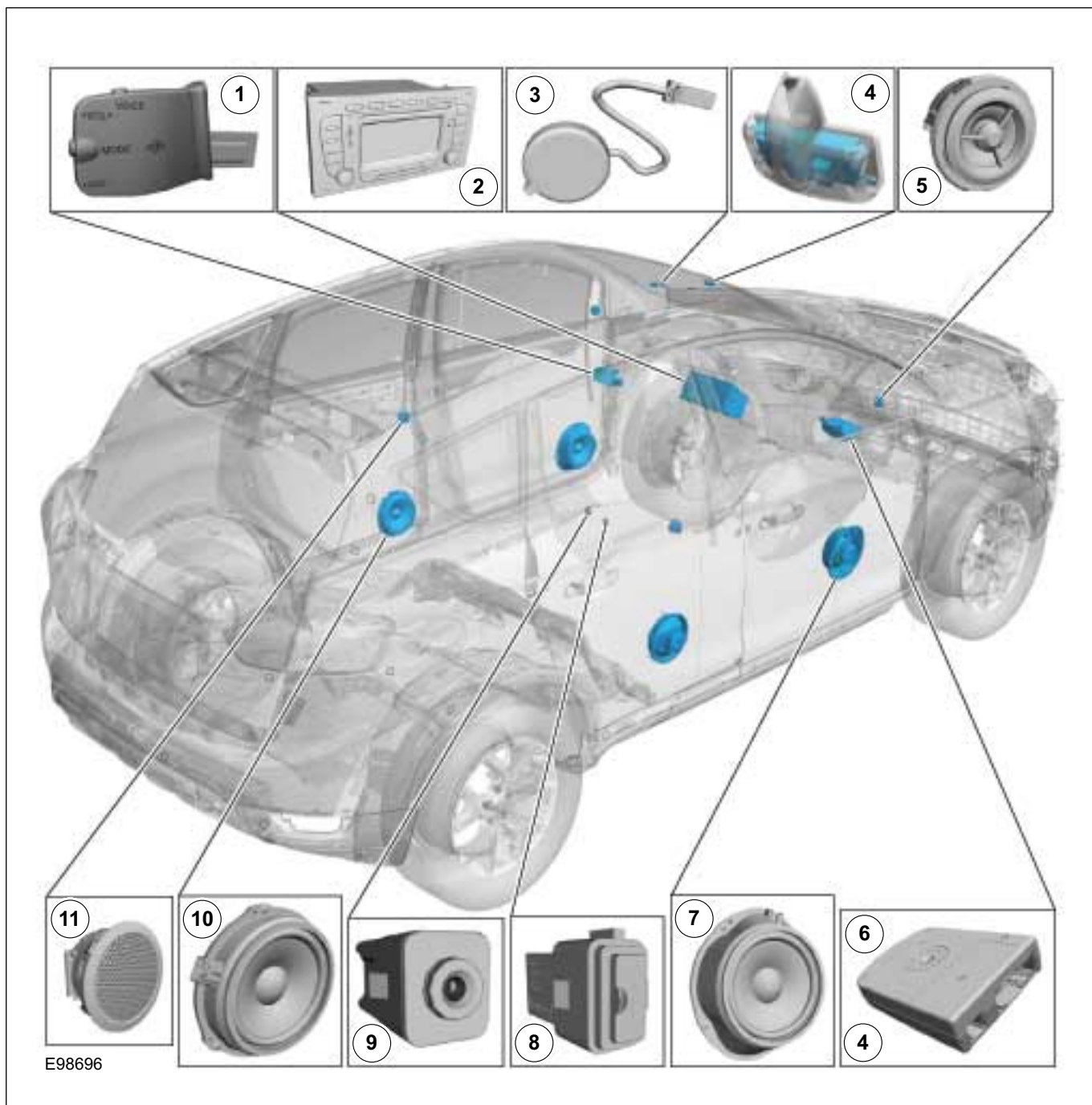
**Antenna systems**

The antenna systems fitted to the vehicle comprise:

- AM/FM roof antennal
- AM/FM/GPS roof antenna
- Roof antenna for digital radio system (vehicles with DAB radio)

DESCRIPTION AND OPERATION

Cellular Phone – Component Location



Item	Description
1	Radio remote control
2	Audio unit/navigation unit
3	Microphone.
4	GPS (global positioning system) antenna
5	Front door tweeters

Item	Description
6	Control module for mobile electronic auxiliary equipment
7	Front door mid range speakers/woofers
8	USB jack
9	AUX port
10	Rear door mid range speakers/woofers
11	Rear door trim panel tweeter speaker

---

**DESCRIPTION AND OPERATION**

## Cellular Phone – Overview

### **Software update - control module for mobile electronic auxiliary equipment (variant 1)**

There is a USB port near the central electrical module. Software updates for the control module for mobile electronic auxiliary equipment can be carried out here.

### **Software update - control module for mobile electronic auxiliary equipment (variants 2 and 3)**

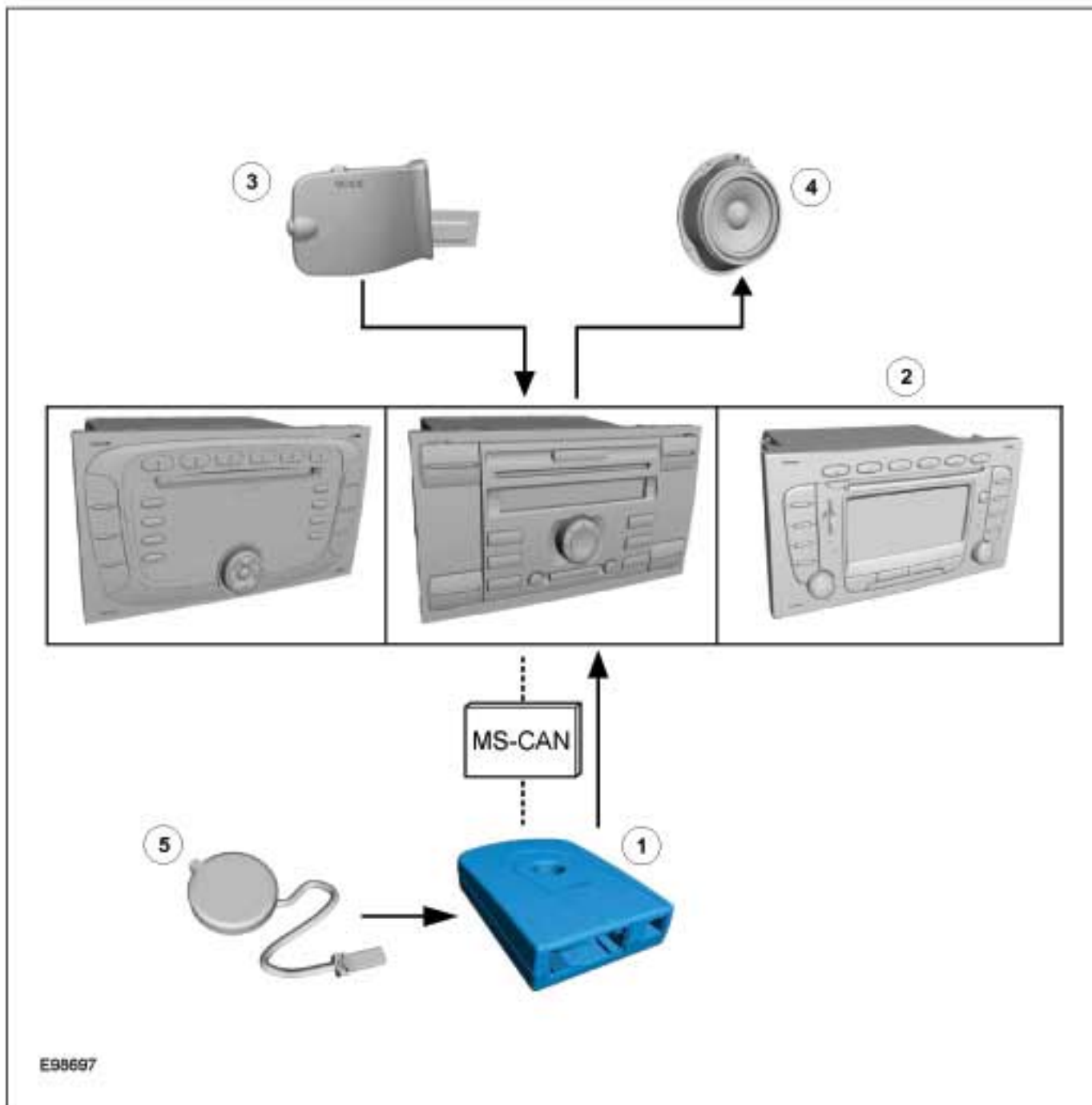
Software updates for the mobile electronic auxiliary equipment control module can be performed via the USB port which is integrated into the center console.

DESCRIPTION AND OPERATION

Cellular Phone – System Operation and Component Description

System Diagram

Version 1



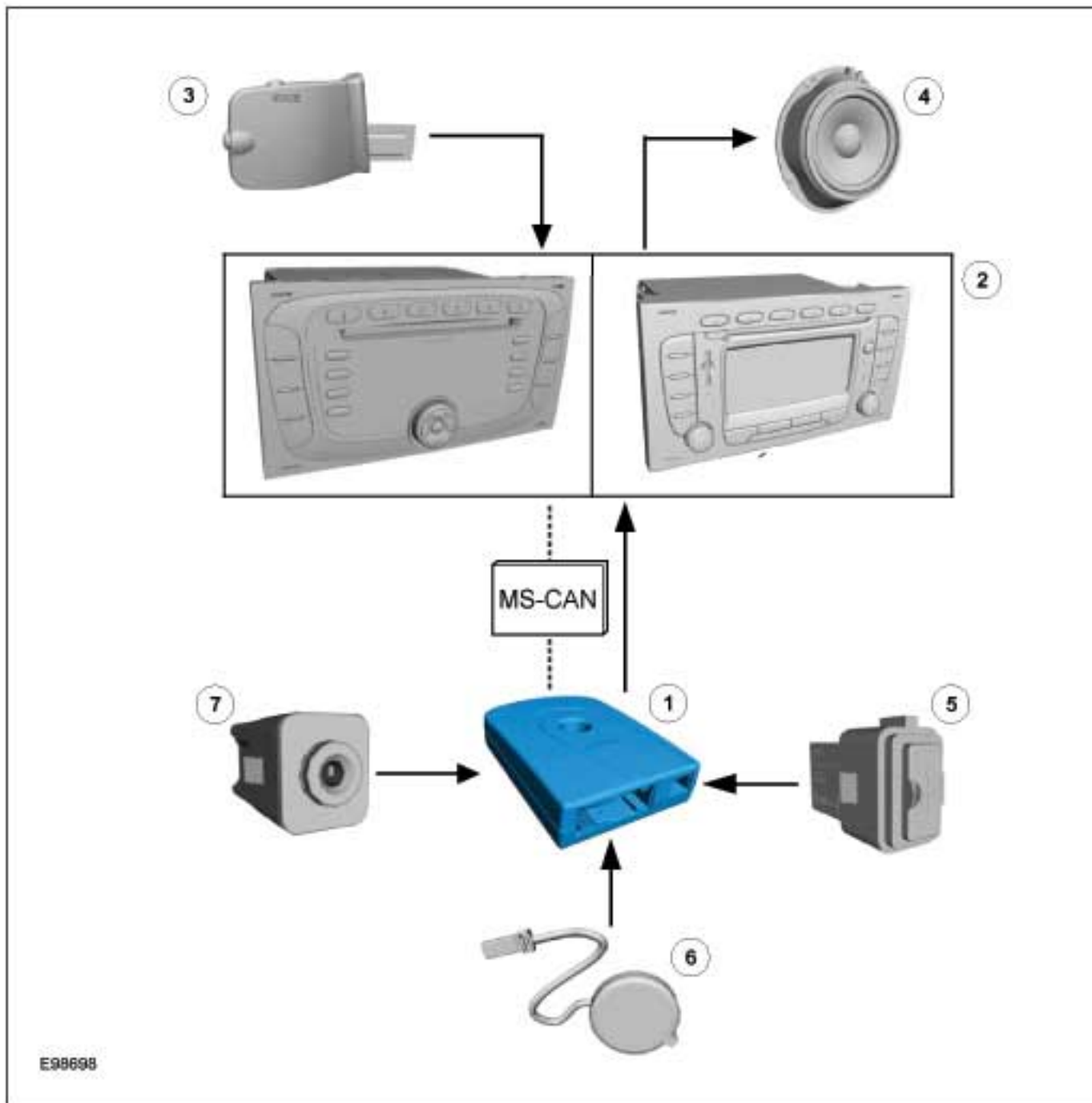
E98697

Item	Description
1	Control module for mobile electronic auxiliary equipment Refer to Component Description: (page 415-01-18)
2	Audio unit/navigation unit

Item	Description
3	Radio remote control Refer to Component Description: (page 415-01-19)
4	Speakers
5	Microphone.

DESCRIPTION AND OPERATION

Version 2



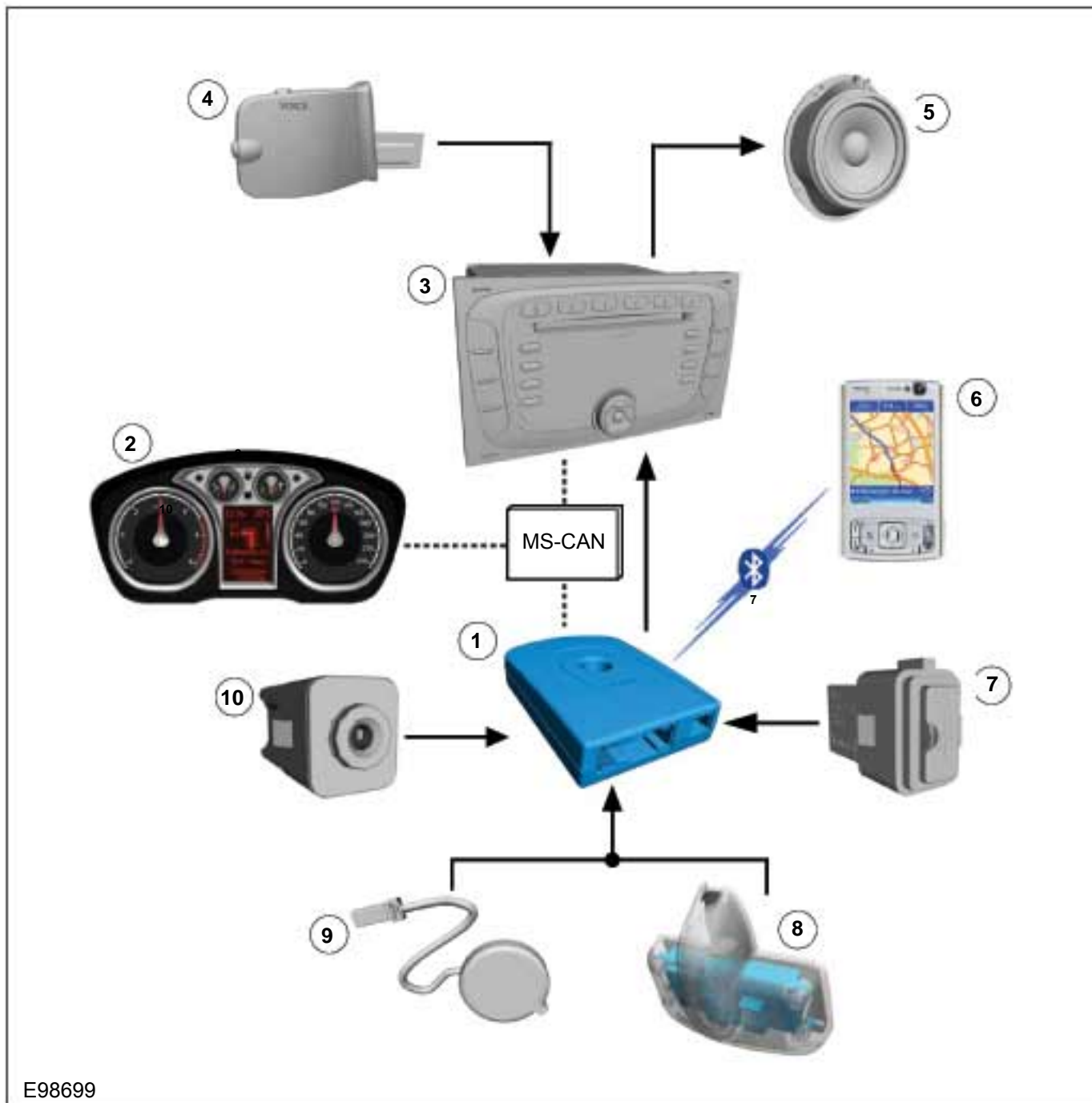
E98698

Item	Description
1	Control module for mobile electronic auxiliary equipment Refer to Component Description: (page 415-01-18)
2	Audio unit/navigation unit
3	Radio remote control Refer to Component Description: (page 415-01-19)

Item	Description
4	Speakers
5	USB jack Refer to Component Description: USB port/AUX socket (page 415-01-19)
6	Microphone.
7	AUX port Refer to Component Description: USB port/AUX socket (page 415-01-9)

DESCRIPTION AND OPERATION

Version 3



E98699

Item	Description
1	Control module for mobile electronic auxiliary equipment Refer to Component Description: (page 415-01-9)
2	instrument cluster
3	Audio unit.

Item	Description
4	Radio remote control Refer to Component Description: (page 415-01-19)
5	Speakers
6	Symbian telephone
7	USB jack Refer to Component Description: USB port/AUX socket (415-01-19)



415-01-16

Information and Entertainment System

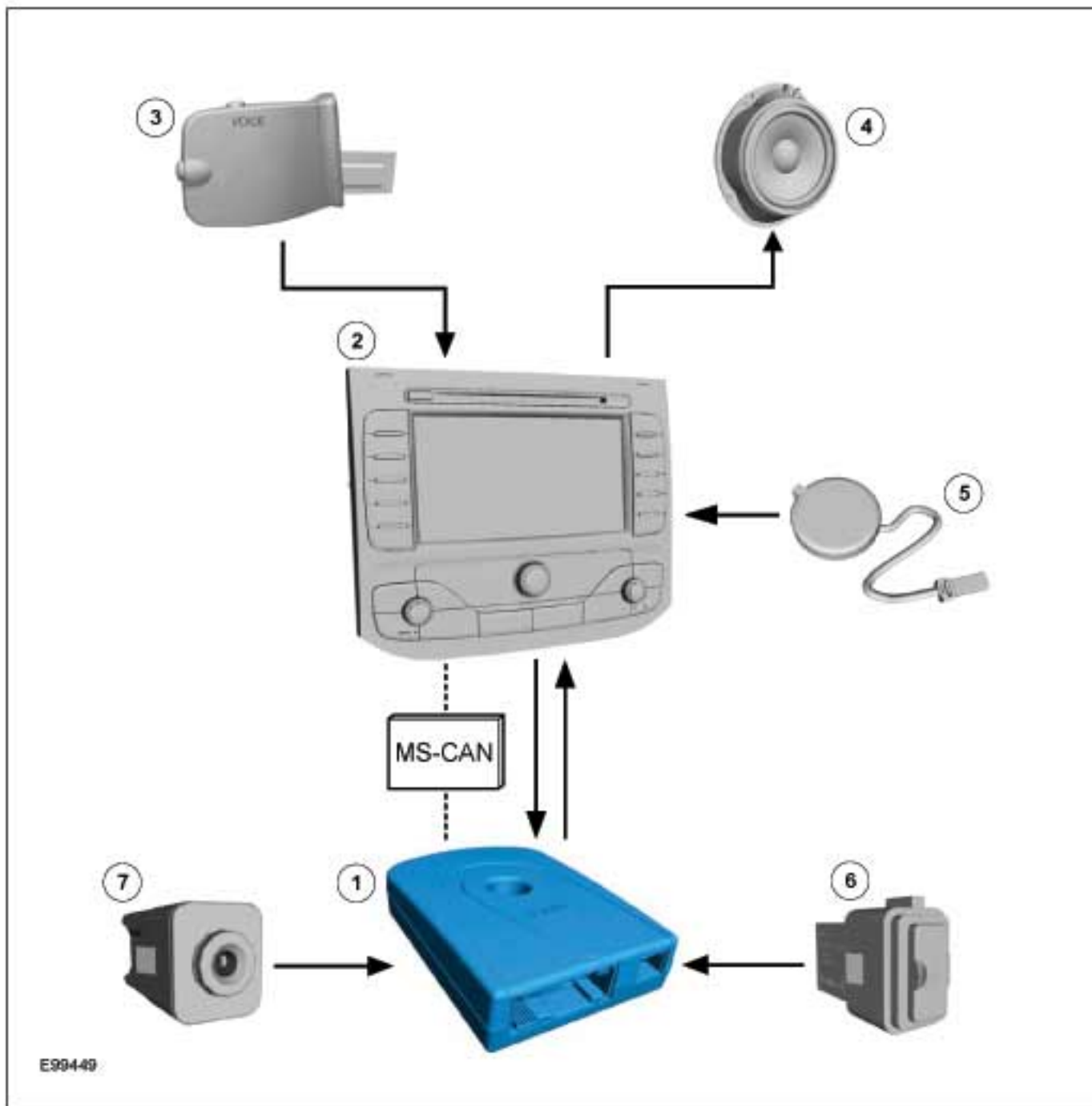
415-01-16

DESCRIPTION AND OPERATION

Item	Description
8	GPS antenna

Item	Description
9	Microphone.
10	AUX port Refer to Component Description: USB port/AUX socket (415-01-19)

Vehicles equipped with touchscreen DVD navigation system



E99449

## DESCRIPTION AND OPERATION

Item	Description
1	Control module for mobile electronic auxiliary equipment Refer to Component Description: (page 415-01-18)
2	DVD navigation system with touchscreen
3	Radio remote control Refer to Component Description: (page 415-01-9)

Item	Description
4	AUX port Refer to Component Description: USB port/AUX socket (page 415-01-9)
5	Speakers
6	Microphone.
7	USB jack Refer to Component Description: USB port/AUX socket (page 415-01-19)

## System Operation

## Overview

**NOTE:** In order to prevent discharge of the battery, if the vehicle is stationary, the Bluetooth mobile phone and the voice control should only be used for long periods when the engine is running.

**NOTE:** For certain mobile phones with the Symbian operating system, a particular file must be installed to allow full access to the telephone directory via Bluetooth. This file is referred to as an SIS file and can be downloaded from the Ford website. You can obtain more detailed information from your Ford dealer.

The system allows the driver to use a Bluetooth equipped cellular phone handset through the vehicles Information and Entertainment system.

A physical connection (adapter) between the phone handset and the telephone control module is not necessary and is therefore not available. Communications between the two components are purely Bluetooth. This can limit the available functions dependant on the handset used.

The mobile phone system comprises the following components:

- Control module for mobile electronic auxiliary equipment
- Microphone.

The control module for the mobile electronic auxiliary equipment is connected to the Infotainment system via the CAN bus and the audio line. This enables audio and control signals to be passed to and from the auxiliary equipment. The mobile electronic auxiliary equipment control module is equipped with a built-in Bluetooth antenna.

Using Bluetooth it is possible to transfer audio files from Bluetooth compatible storage media to the

audio system and replay them (audio streaming). This function will however only be available at a later date.

## Voice Control

Voice control makes it possible to operate the audio system without the driver being distracted from the traffic situation.

When the system is active, if the driver issues a pre-defined order, the voice recognition system converts this command into a control signal for the various multimedia systems. The input can take the form of dialogues or commands. The driver is guided through the dialogues by announcements or questions.

The following systems can be controlled using the voice recognition system:

- Mobile phone
- Radio function
- CD player/CD changer
- EATC (electronic automatic temperature control)
- DVD navigation system with touchscreen
  - Voice control via the mobile electronic auxiliary equipment control module is unnecessary for the DVD navigation system with touchscreen because this system has its own integrated voice control function.

## DESCRIPTION AND OPERATION

## Component Description

## Control module for mobile electronic auxiliary equipment



E98651

The control module for mobile electronic auxiliary equipment controls the operation of the mobile phone and transfers the appropriate information to the audio equipment.

## Variant 1

Can be combined with all audio and navigation systems. The functionality includes a hands-free facility via Bluetooth and voice control.

There is a USB port near the central electrical module. Software updates for the control module for mobile electronic auxiliary equipment can be carried out here. The adapter cable does not extend to the USB functions as in variants 2 and 3.

## Variant 2

This version can be combined with all high-end audio systems and all navigation systems.

In addition to the functions offered by version 1, version 2 also offers a USB port with power supply built into the floor console. Various storage media can be connected to this, such as USB sticks or external fixed disks with MP3 audio files. These files can be played via the audio system. The USB port also enables control of an iPod via the audio system.

Software updates for the mobile electronic auxiliary equipment control module can be performed via the USB port which is integrated into the center console.

## Variant 3

This variant can be combined with all luxury audio systems and is always supplied together with a

high equipment level instrument cluster. However, it will only be available at a later date.

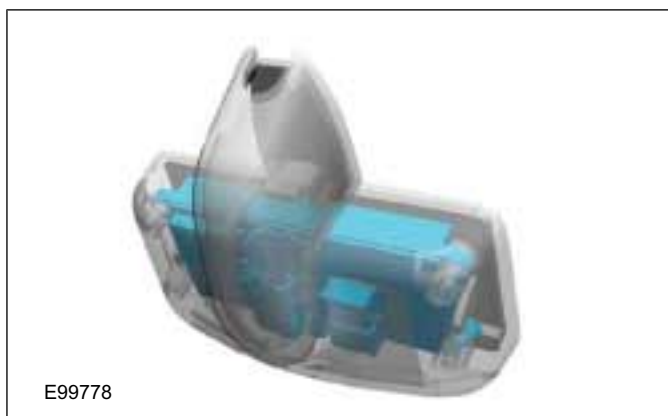
In addition to the functions offered by version 2, this design offers control of mobile navigation systems which are equipped with special navigation software for Symbian telephones, obtainable from Ford.

Software updates for the mobile electronic auxiliary equipment control module can be performed via the USB port which is integrated into the center console.



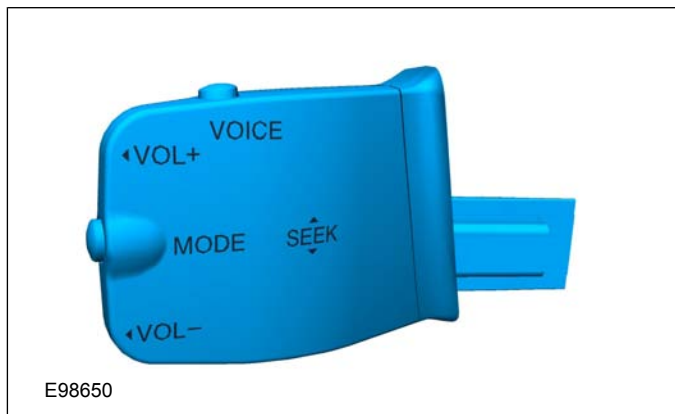
E99776

Direction arrows, the distance to the next change of direction (actual and as a bar graph) and the street name are shown in the message centre, in a similar way to in the telephone display. In addition, navigation instructions are given over the audio system.



E99778

The GPS antenna is located on the windscreen and is hard-wired to the control module for mobile electronic auxiliary equipment.

**DESCRIPTION AND OPERATION****Radio remote control**

On vehicles with hands-free kit and voice control, the radio remote control has a Voice button for activating the voice control and for picking up and hanging up a telephone call.

**USB port/AUX socket**

A USB port and an AUX socket are provided in the center console for variants 2 and 3. These can be used to adapt external audio sources such as an iPod to the on-board audio system. After it is connected, the iPod is recognized as such and can be controlled over the audio system. The audio signal is received via the AUX socket.

## REMOVAL AND INSTALLATION

## Audio Unit

## General Equipment

Audio Unit Removal Tools (GV3301)

## General Equipment

Ford Diagnostic Equipment

## Removal

- NOTE:** Make sure that any media is ejected from the unit.

**NOTE:** This step is only necessary when installing a new component.

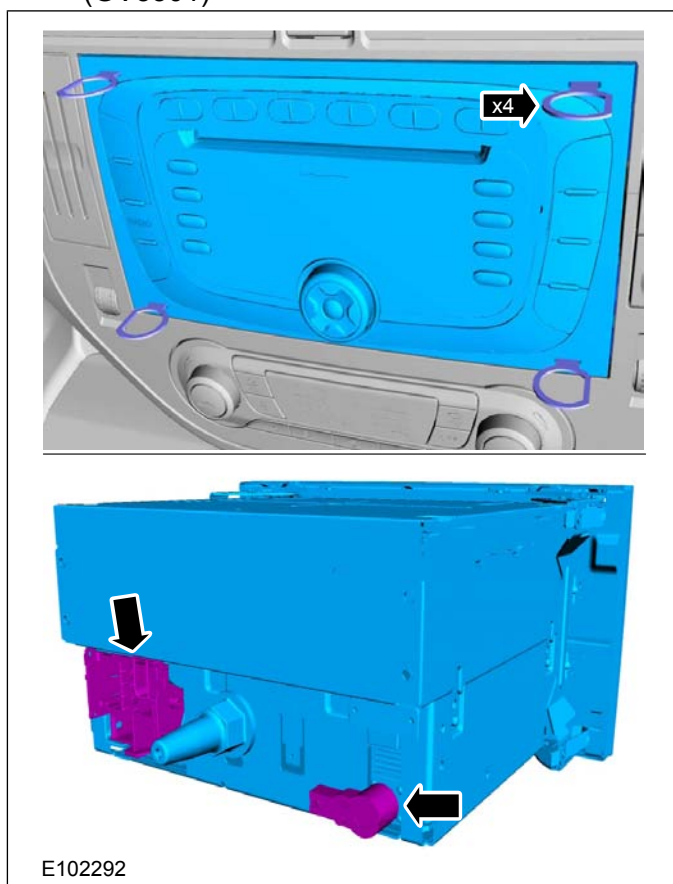
Connect the diagnostic tool and upload the audio unit configuration information using the Programmable Modules Installation Routine, prior to commencing the removal of the audio unit.

General Equipment: Ford Diagnostic Equipment

- General Equipment: Audio Unit Removal Tools (GV3301)

To install, reverse the removal procedure.

General Equipment: Ford Diagnostic Equipment



## Installation

- NOTE:** New units must be configured using the Programmable Module Installation Routine in the diagnostic tool.

415-01-21

Information and Entertainment System

415-01-21

## REMOVAL AND INSTALLATION

## Audio Unit Antenna — Vehicles With: Glass Roof Panel

## Removal

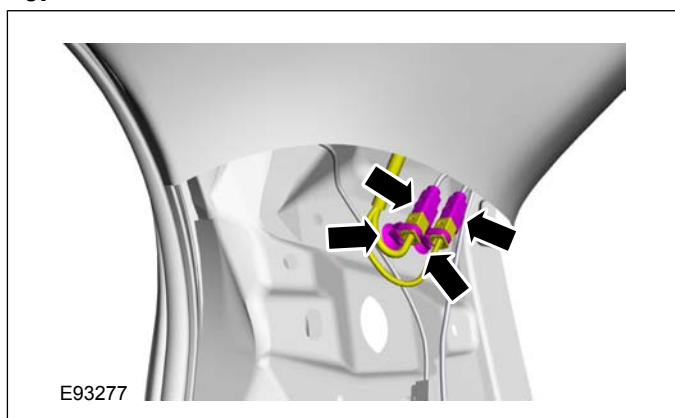
1. On both sides.

Refer to: **C-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

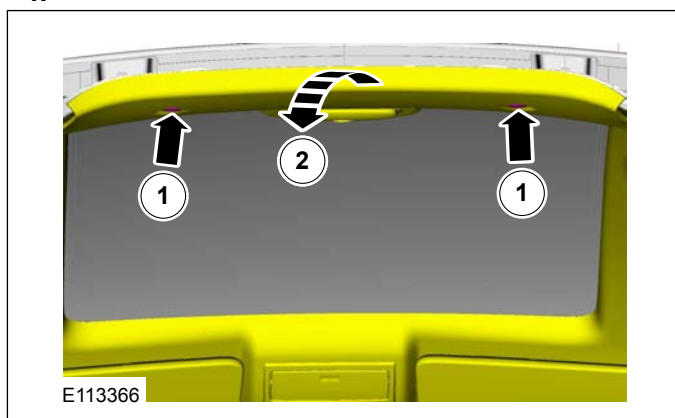
2. On both sides.

Refer to: **D-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

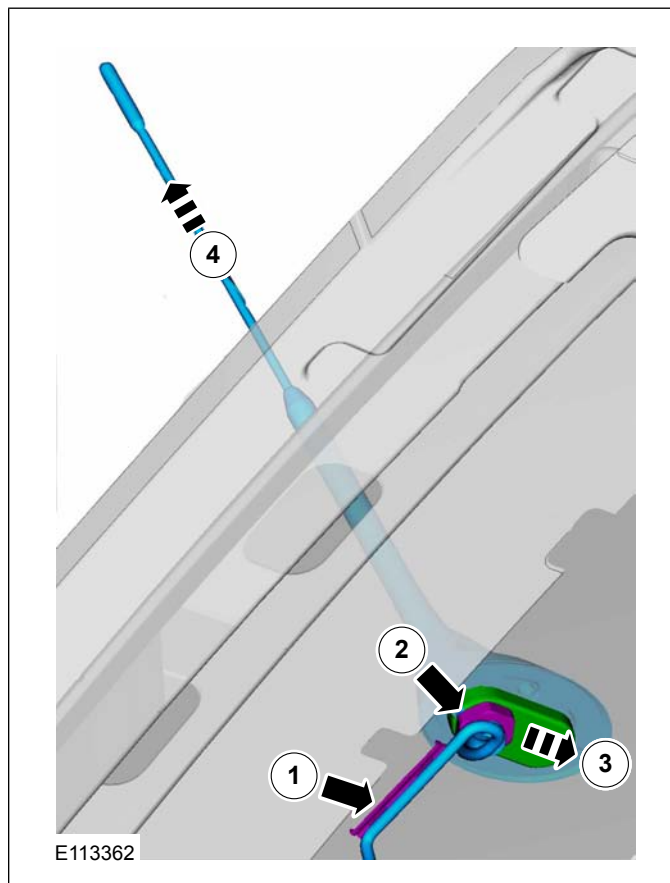
- 3.



- 4.



- 5.



## Installation

1. To install, reverse the removal procedure.



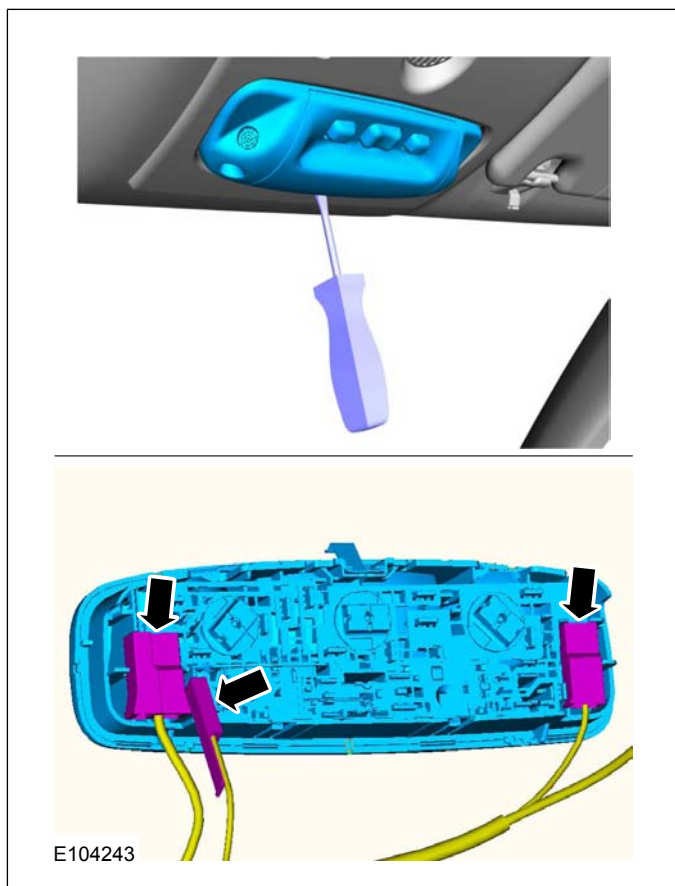
REMOVAL AND INSTALLATION

Audio Unit Antenna — Vehicles Without: Glass Roof Panel

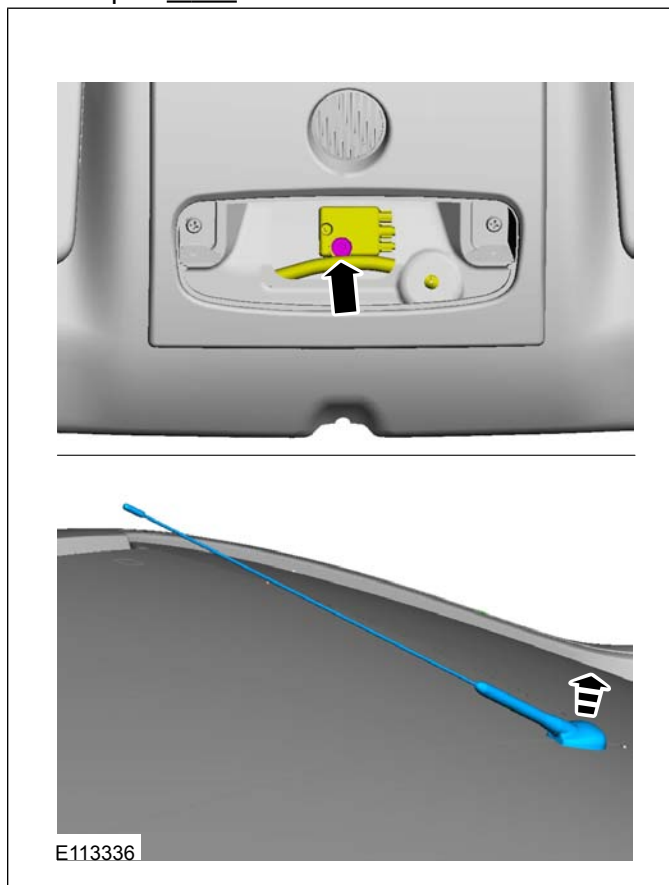
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1.



2. Torque: 3 Nm



Installation

1. To install, reverse the removal procedure.

415-01-23

Information and Entertainment System

415-01-23

## REMOVAL AND INSTALLATION

## Audio Unit Antenna to Connector Cable — Vehicles With: Glass Roof Panel

## General Equipment

Flat-bladed screwdriver

## General Equipment

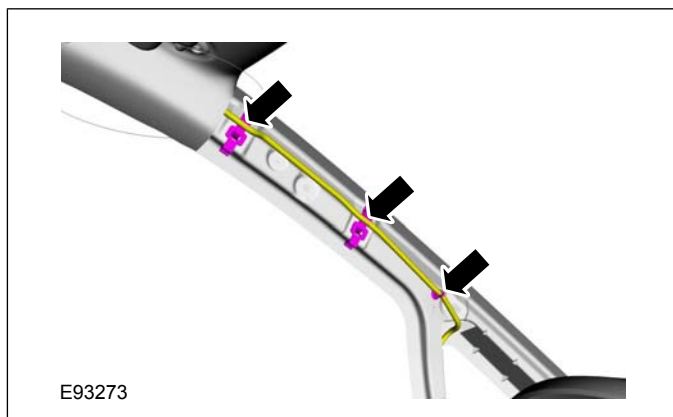
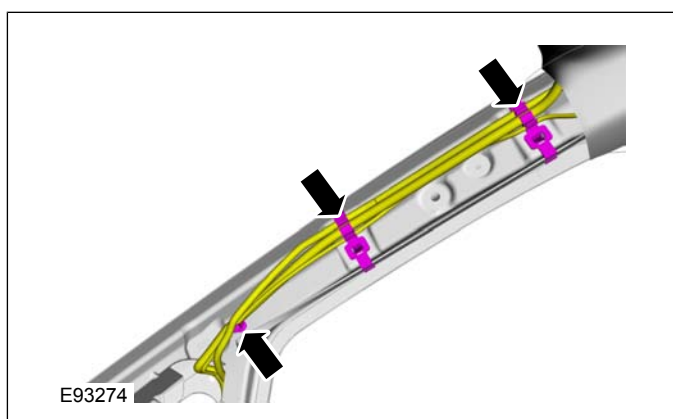
Hot Glue Gun

## Removal

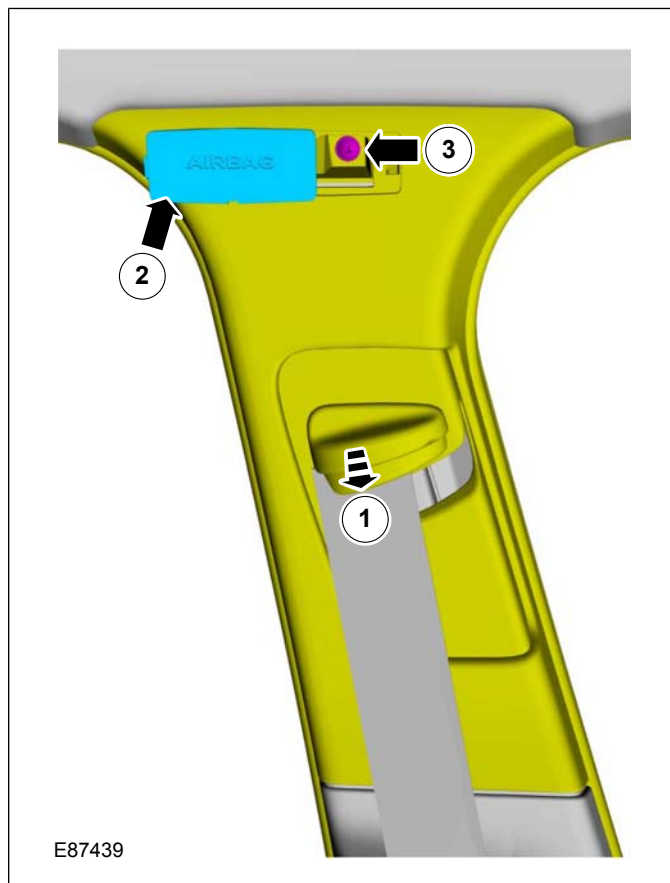
**NOTE:** Removal steps in this procedure may contain installation details.

## 1. All.

Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

2. **NOTE:** Make sure that new clips are installed.3. **NOTE:** Make sure that new clips are installed.

## 4. All.

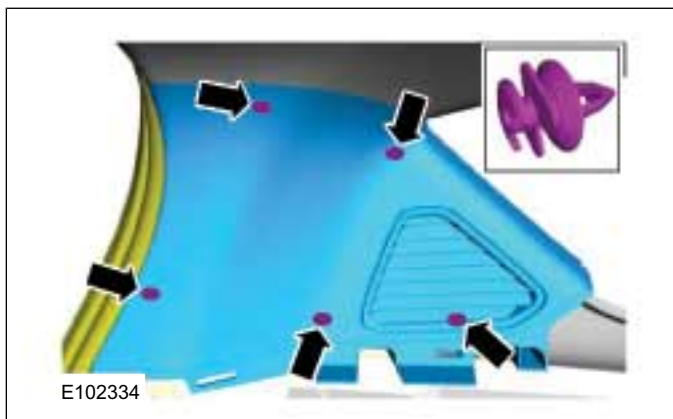


## 5. All.

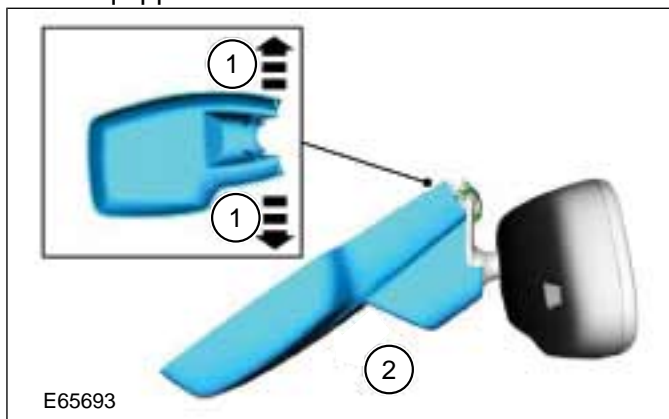
Refer to: **C-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

REMOVAL AND INSTALLATION

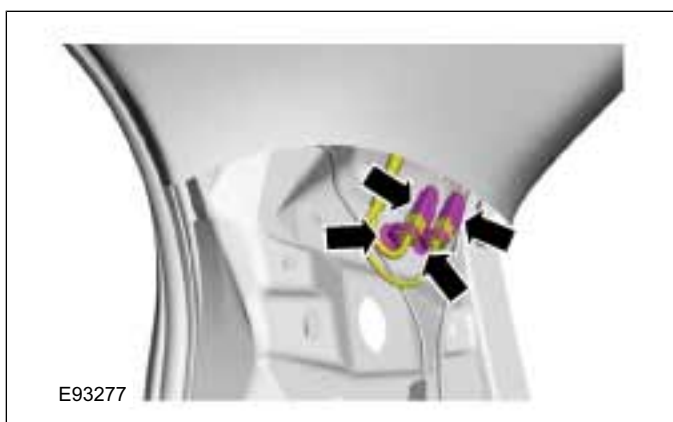
6. All.



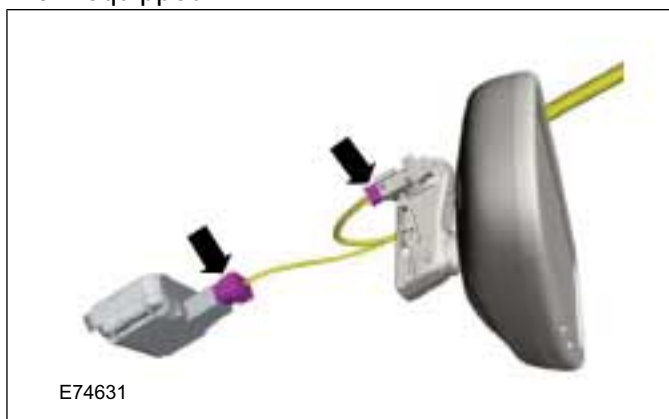
9. If equipped.



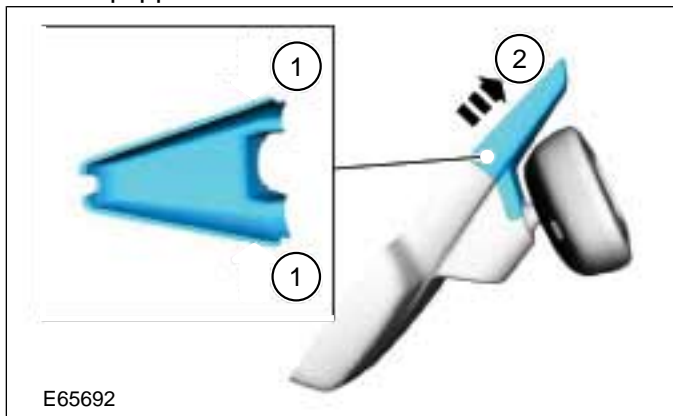
7. **NOTE:** Vehicles with glass roof panel



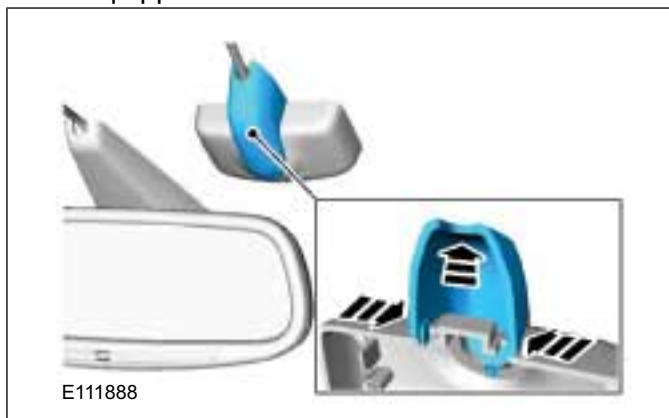
10. If equipped.



8. If equipped.

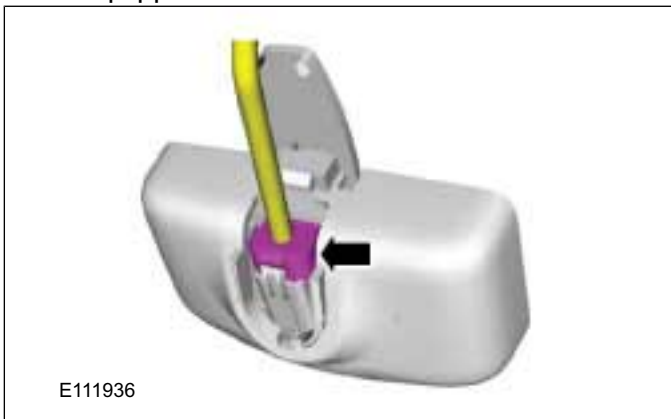


11. If equipped.



REMOVAL AND INSTALLATION

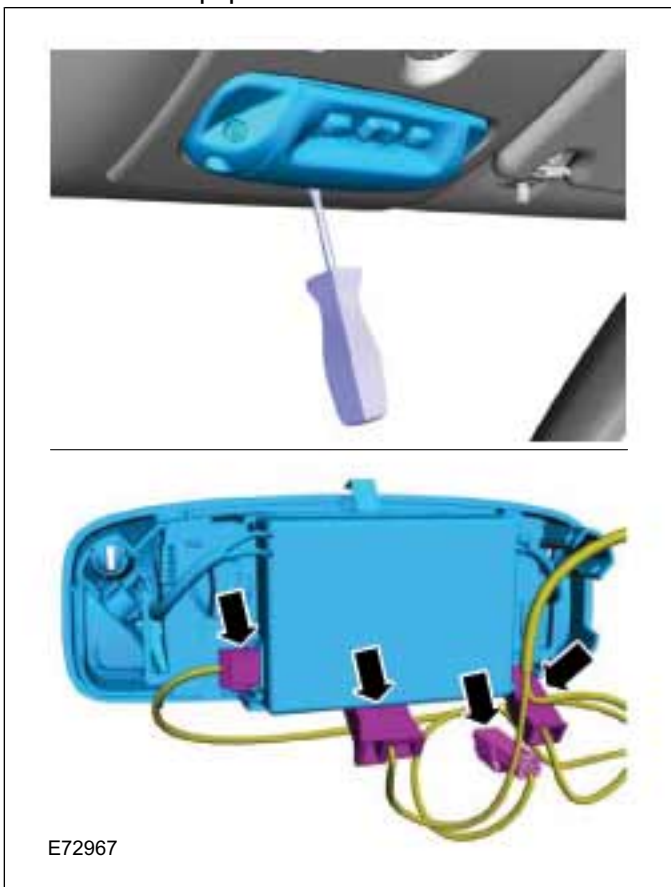
12. If equipped.



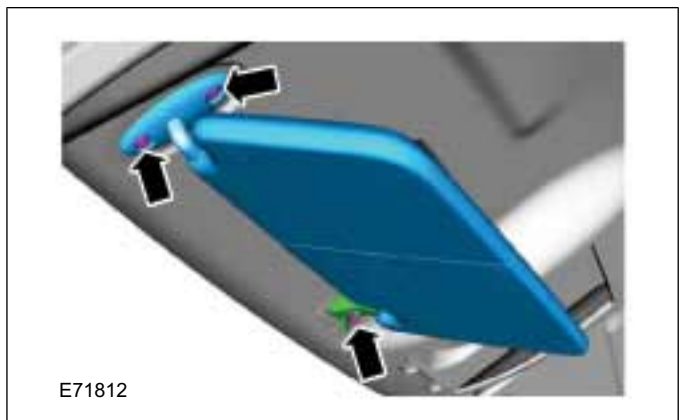
14.



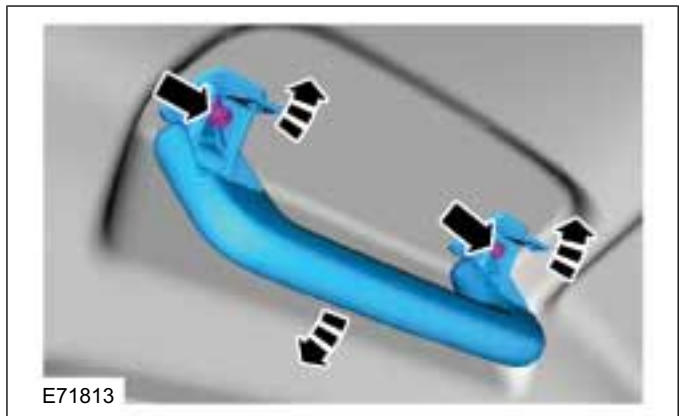
13. General Equipment: Flat-bladed screwdriver



15. All.



16. All.



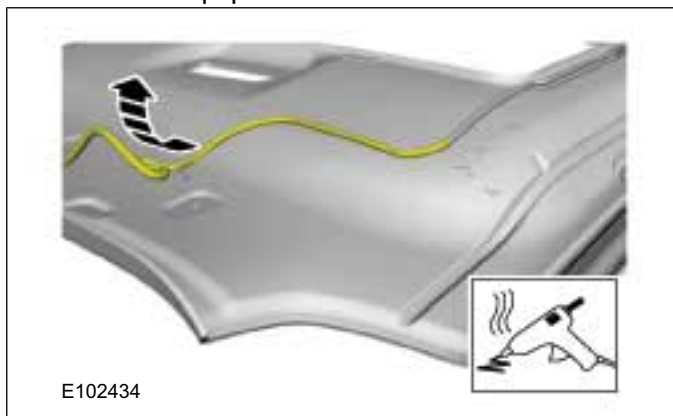
17. NOTE: Make sure that new clips are installed.



REMOVAL AND INSTALLATION



18. General Equipment: Hot Glue Gun



19.

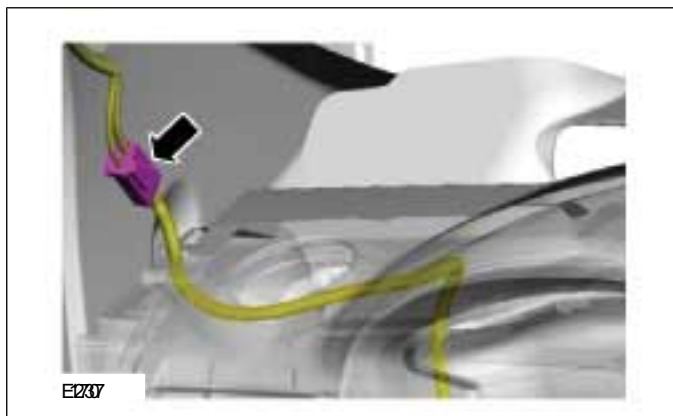




## REMOVAL AND INSTALLATION



20.



Left-hand drive vehicles

**21. NOTE:** Note the position of the component before removal.

General Equipment: Hot Glue Gun

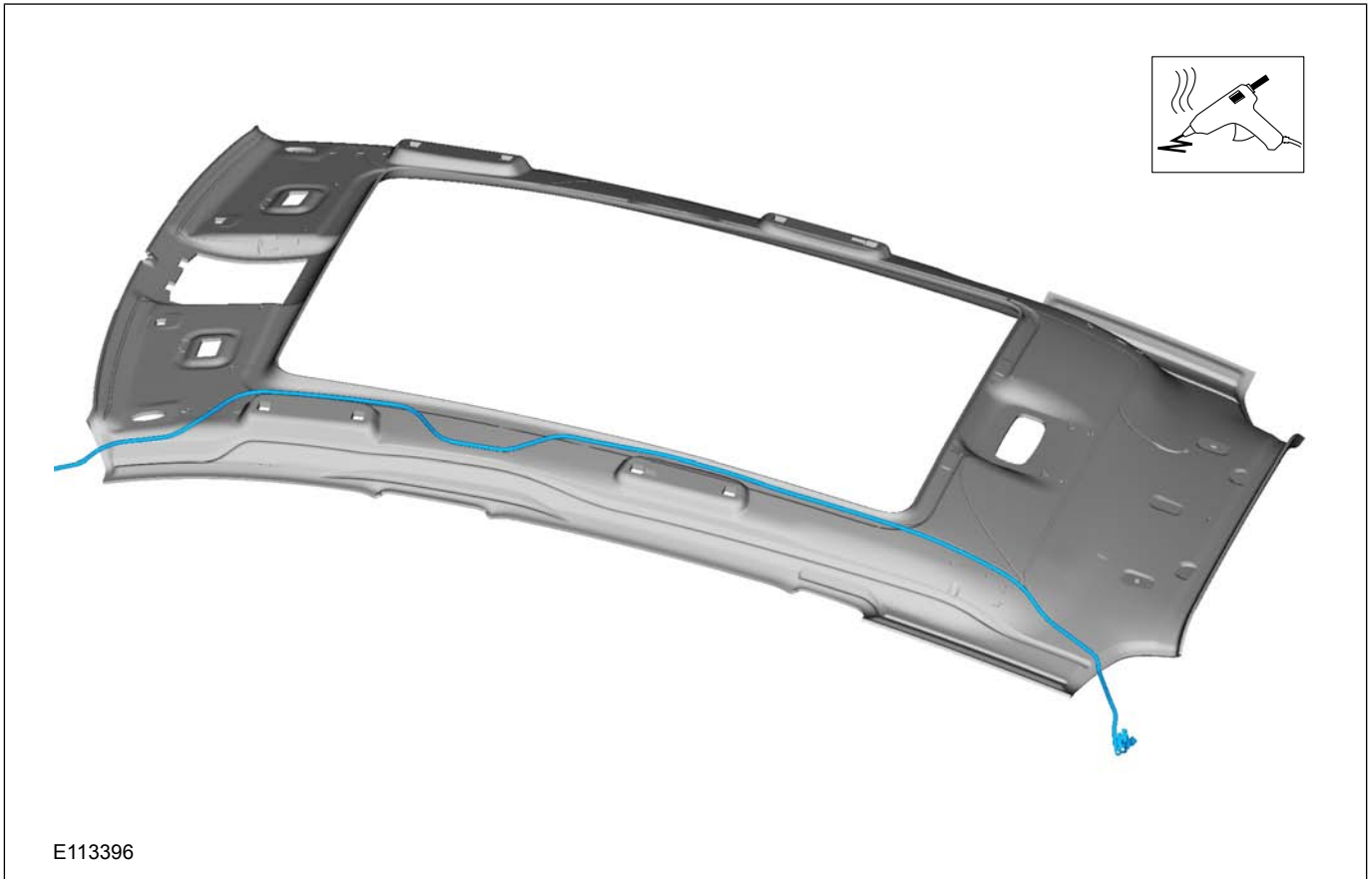


415-01-28

Information and Entertainment System

415-01-28

## REMOVAL AND INSTALLATION



Right-hand drive vehicles

**22 NOTE:** Note the position of the component before removal.

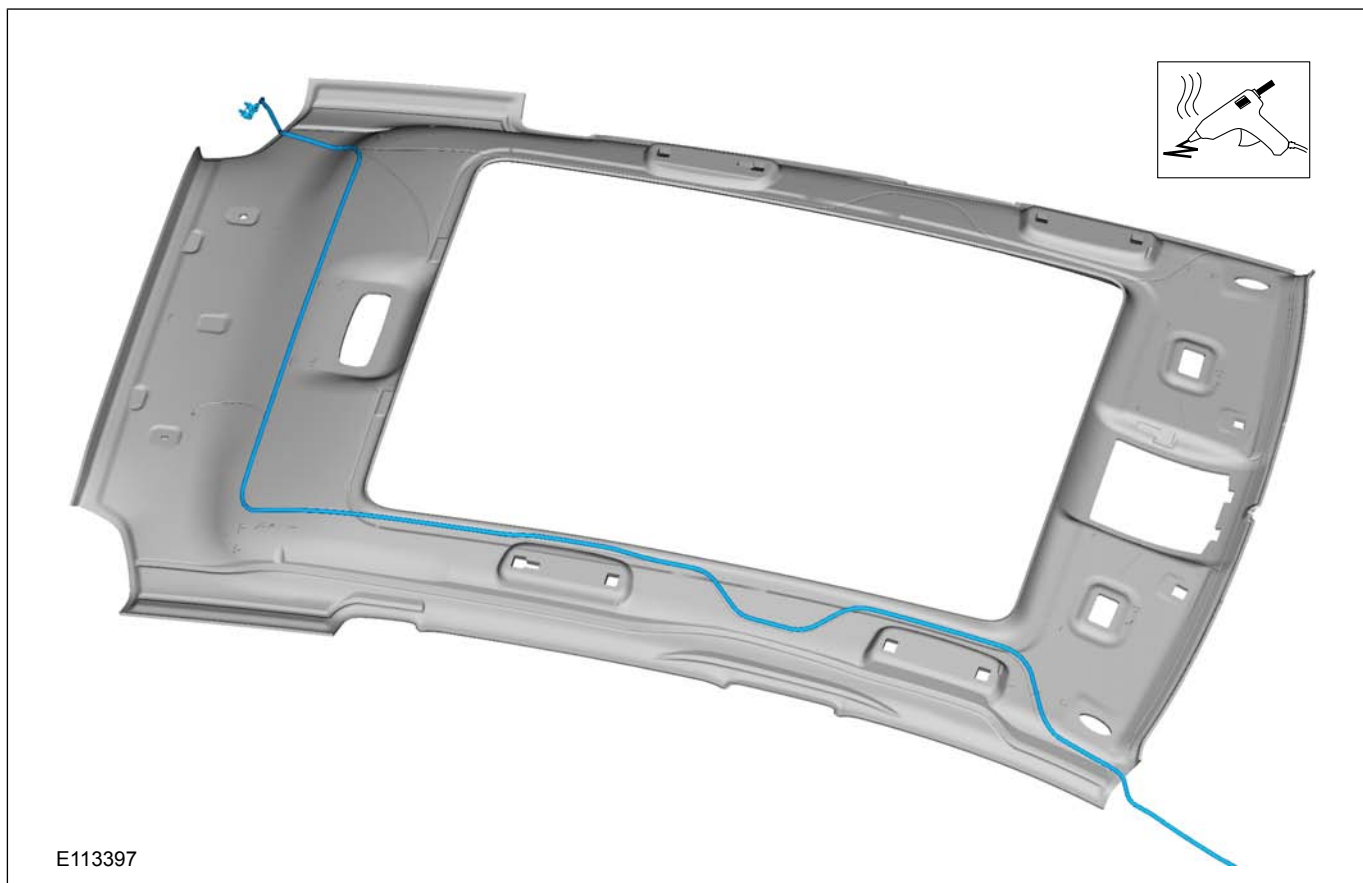
General Equipment: Hot Glue Gun

415-01-29

Information and Entertainment System

415-01-29

## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Audio Unit Antenna to Connector Cable — Vehicles Without: Glass Roof Panel

General Equipment

Draw Cord

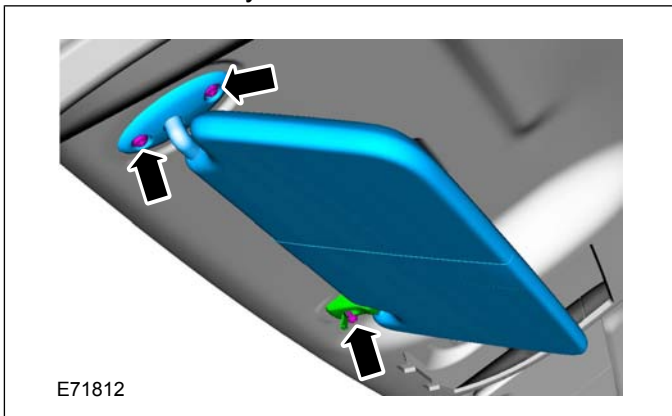
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

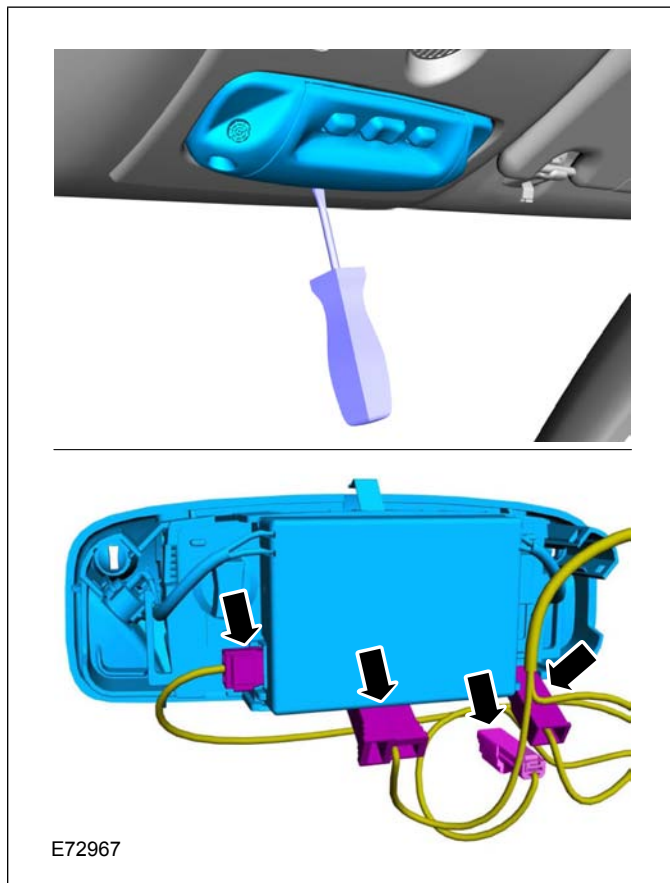
1. Driver side only.

Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

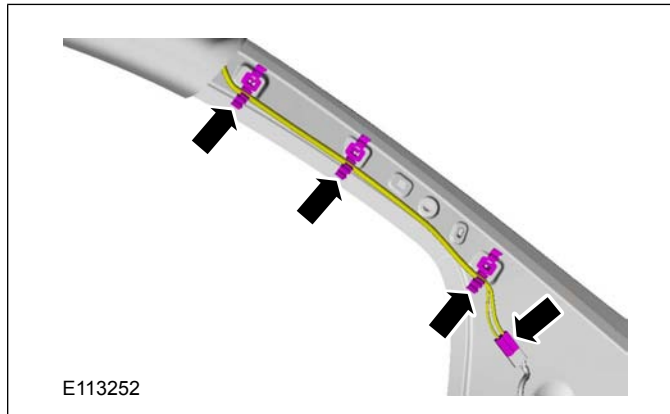
2. Driver side only.



3.



4.

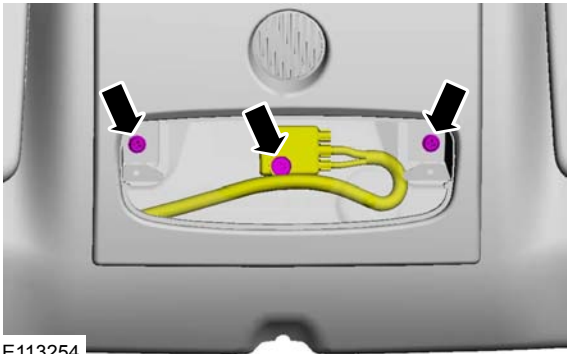


REMOVAL AND INSTALLATION

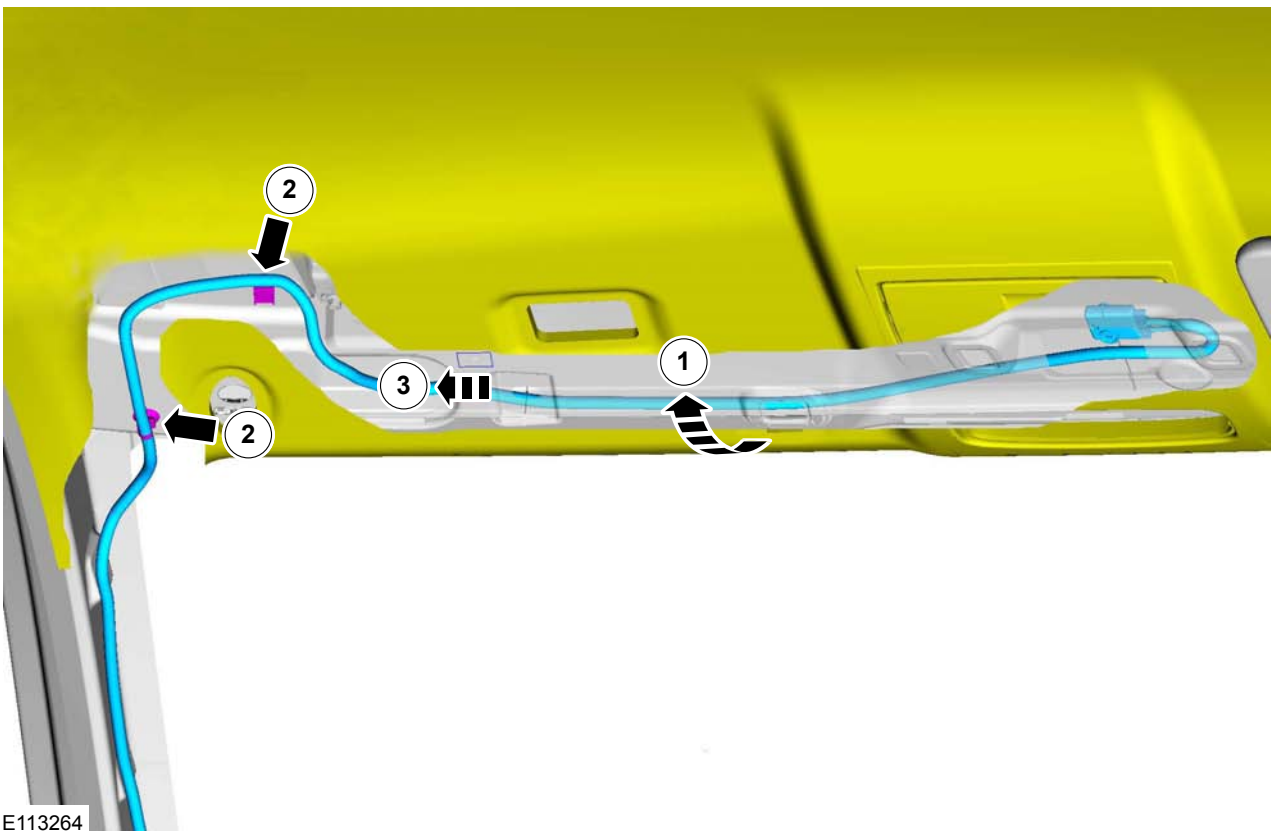
5. Torque: 3 Nm

6. 3. Attach a suitable draw cord to the antenna cable.

General Equipment: Draw Cord



E113254



E113264

Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Connector to Audio Unit Antenna Cable

## General Equipment

Draw Cord

## General Equipment

Round-Ended Steel Rule

## Removal

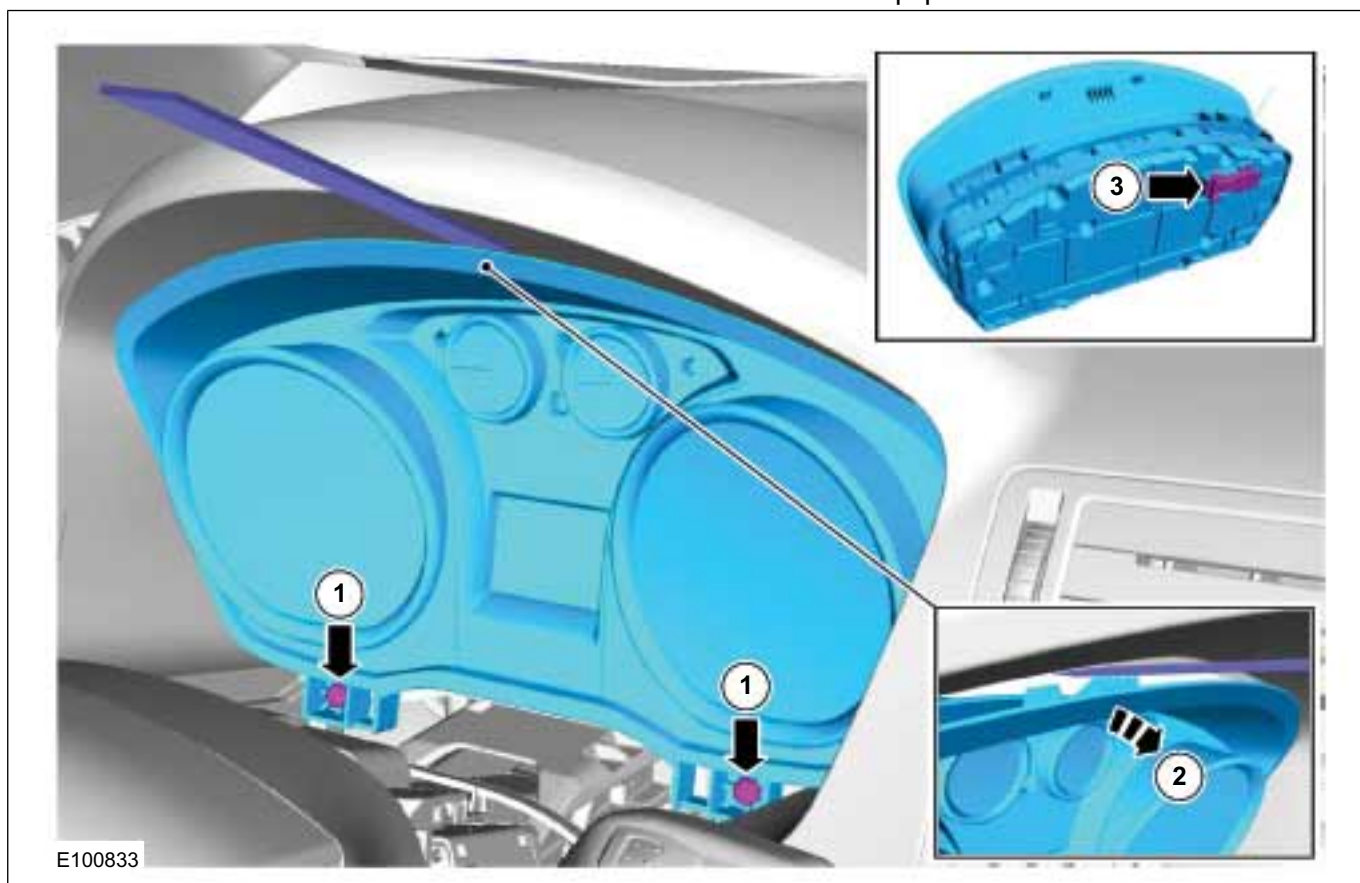
## 1. Driver side only.

Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

2. Refer to: **Steering Column** (211-04 Steering Column, Removal and Installation).

3. Refer to: **Audio Unit** (415-01 Information and Entertainment System, Removal and Installation).

4. General Equipment: Round-Ended Steel Rule

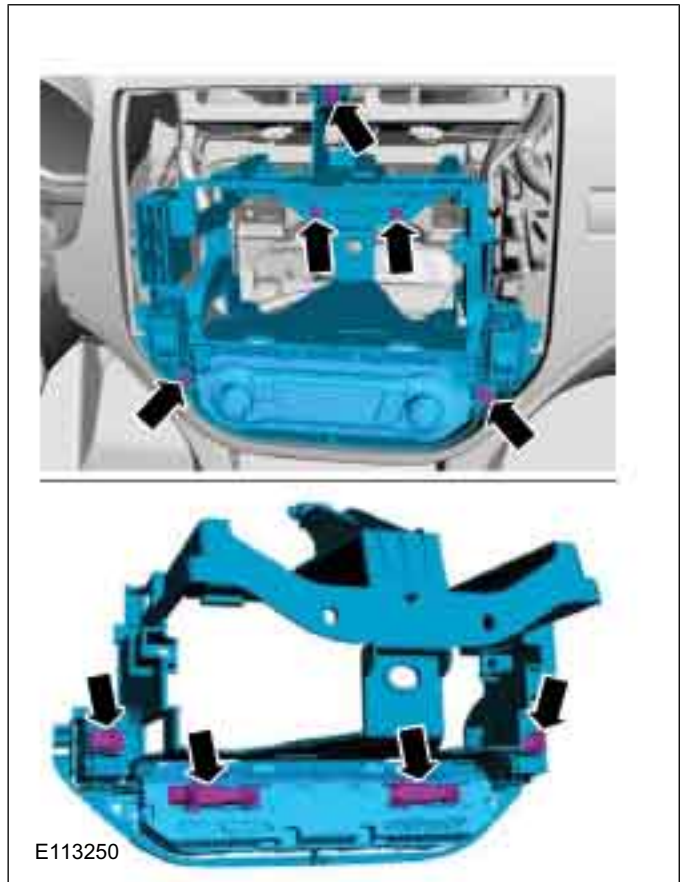


REMOVAL AND INSTALLATION

5.



6.

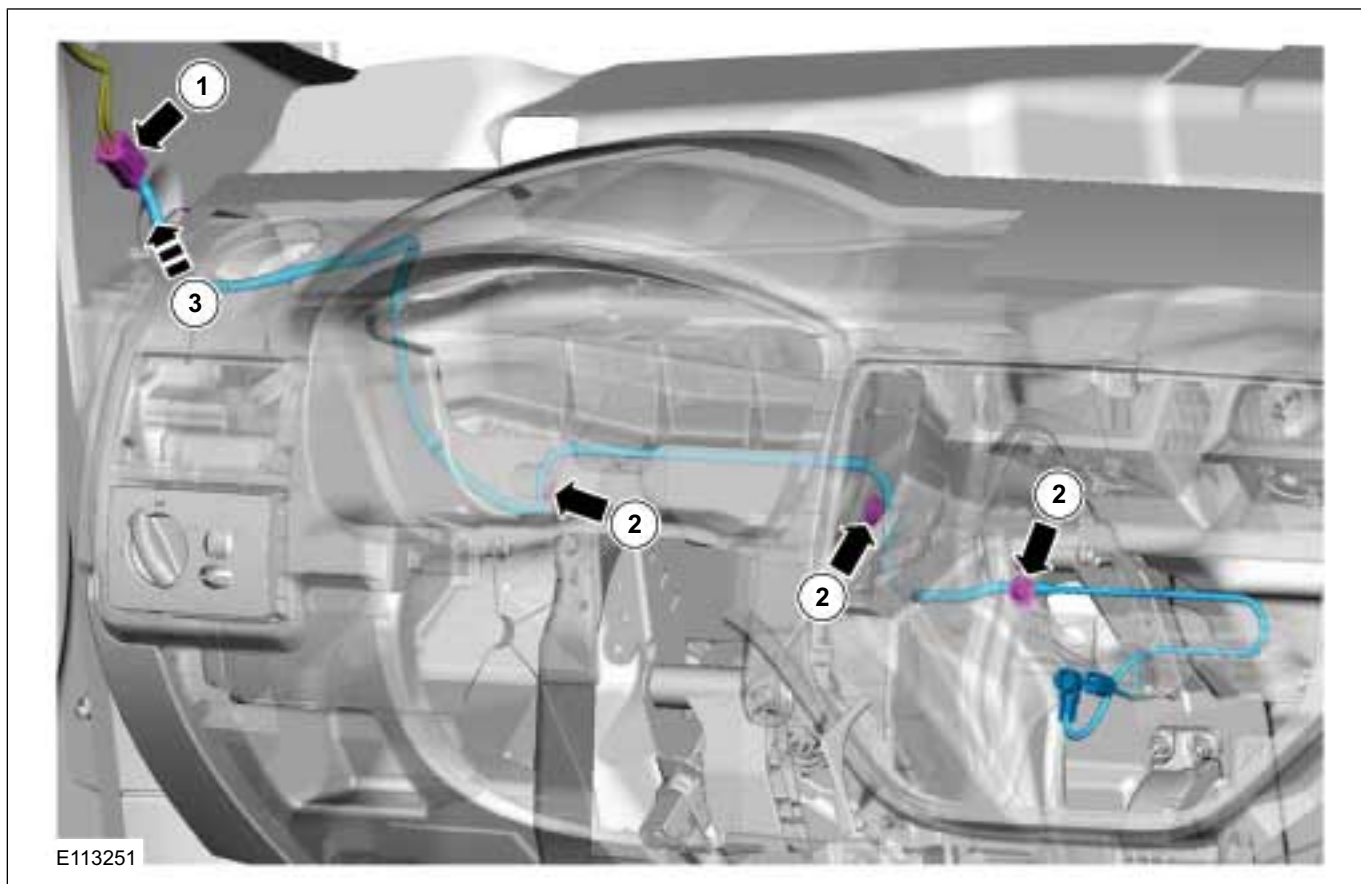


7. 3. Attach a suitable draw cord to the antenna cable.

General Equipment: Draw Cord

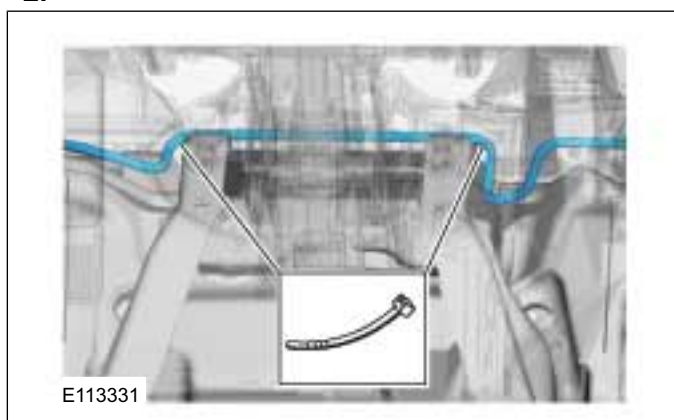


REMOVAL AND INSTALLATION



Installation

1. To install, reverse the removal procedure.
- 2.



415-01-35

Information and Entertainment System

415-01-35

## REMOVAL AND INSTALLATION

## Compact Disc (CD) Changer

## General Equipment

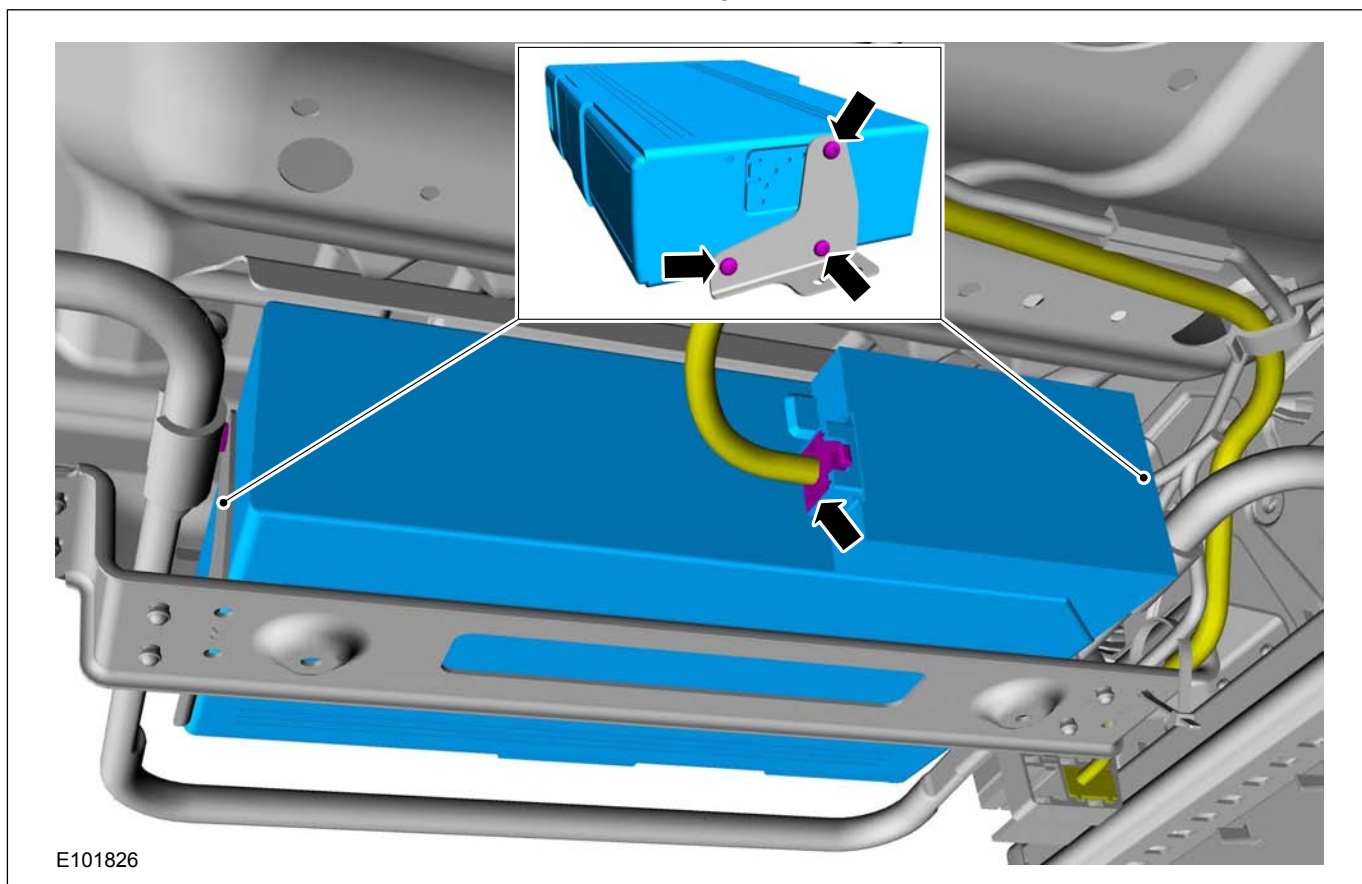
Ford Diagnostic Equipment

## Removal

1. Remove the passenger side front seat.  
Refer to: **Front Seat** (501-10 Seating, Removal and Installation).

2. **NOTE:** This step is only necessary when installing a new component.  
Eject any media from the unit.

3.



## Installation

1. **CAUTION:** Make sure that the horizontal/vertical orientation setting on the CD changer is in the horizontal position.

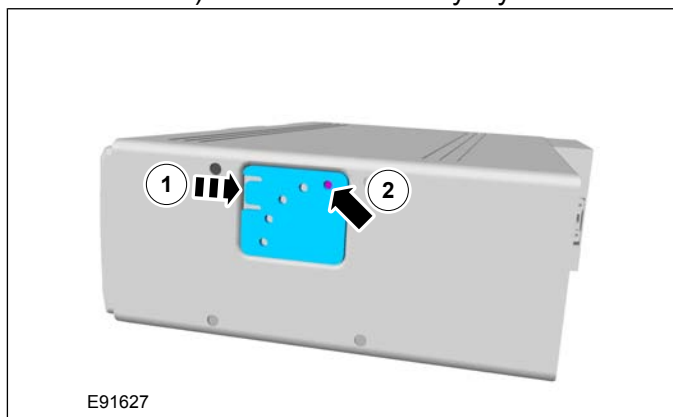
415-01-36

Information and Entertainment System

415-01-36

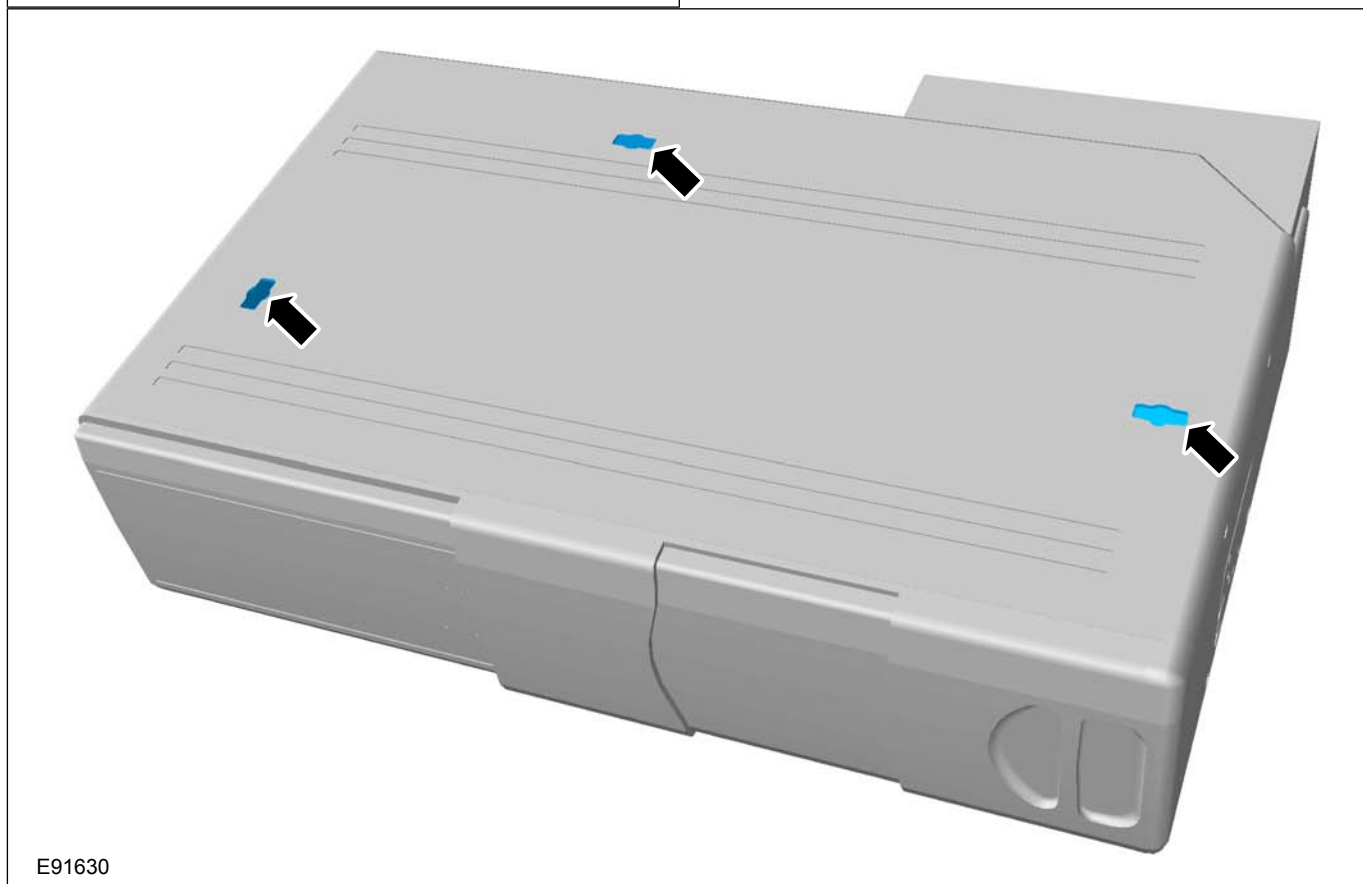
## REMOVAL AND INSTALLATION

Position the spring in the correct position (on both sides) for the vehicle body style.



**2. NOTE:** This step is only necessary when installing a new component.

Remove the CD changer transportation retaining clips.



**3.** To install, reverse the removal procedure.

**4. NOTE:** This step is only necessary when installing a new component.

Configure the CD changer by selecting the Programmable Module Installation Routine.

General Equipment: Ford Diagnostic Equipment

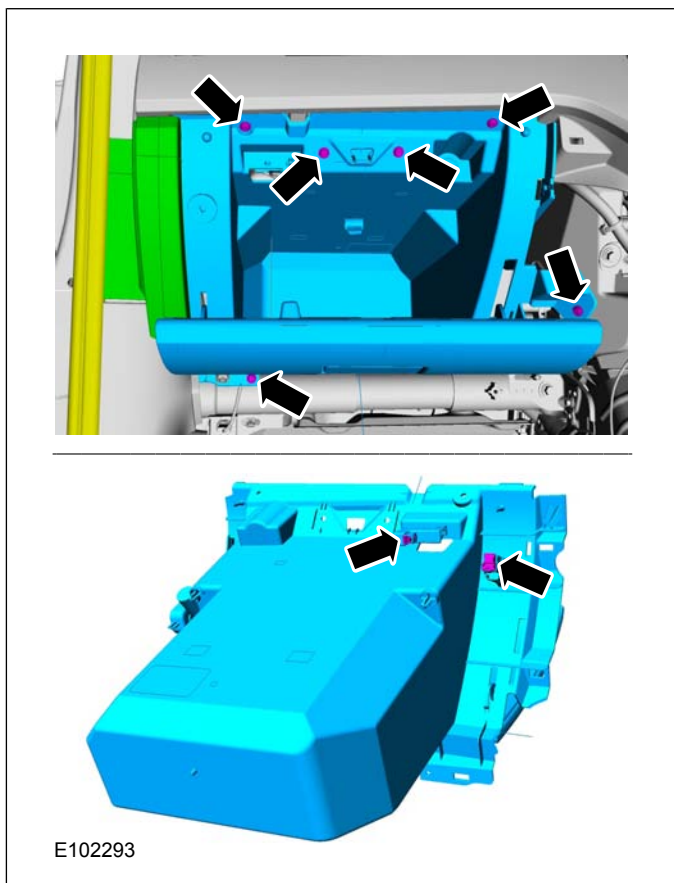
## REMOVAL AND INSTALLATION

## Portable Support Electronics (PSE) Module(33 635 0)

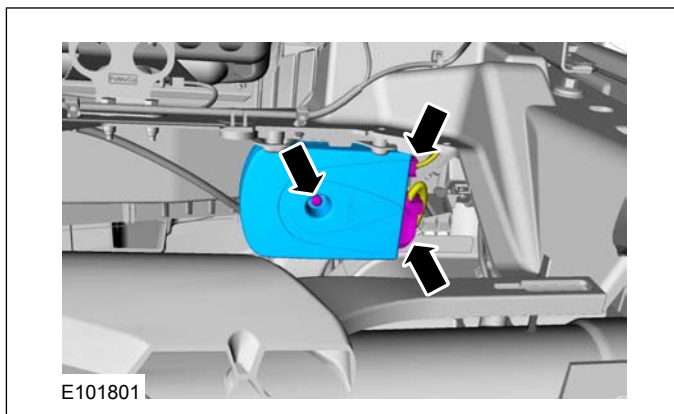
## Removal

1. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).

- 2.



- 3.



## Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

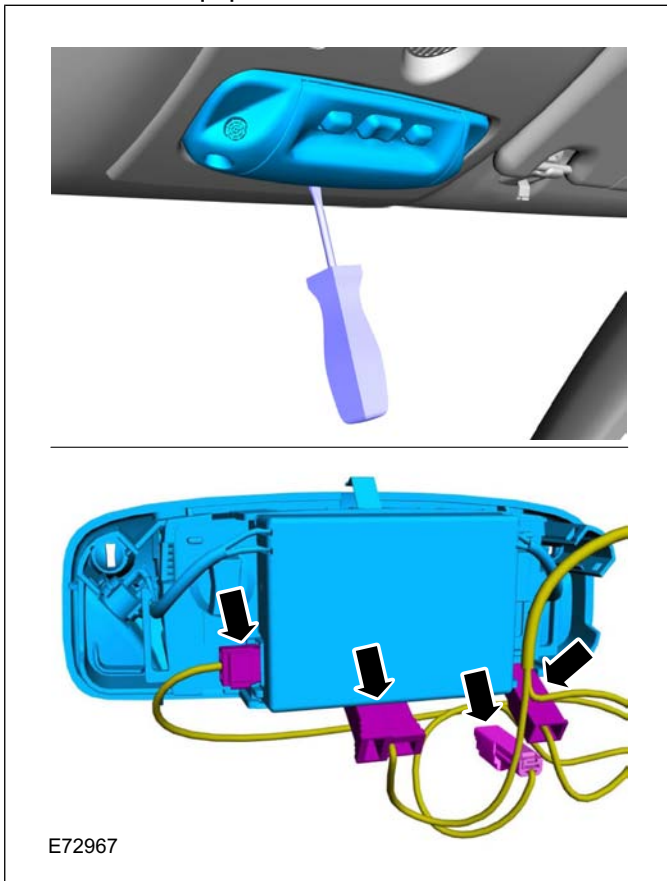
Cellular Phone Microphone

General Equipment

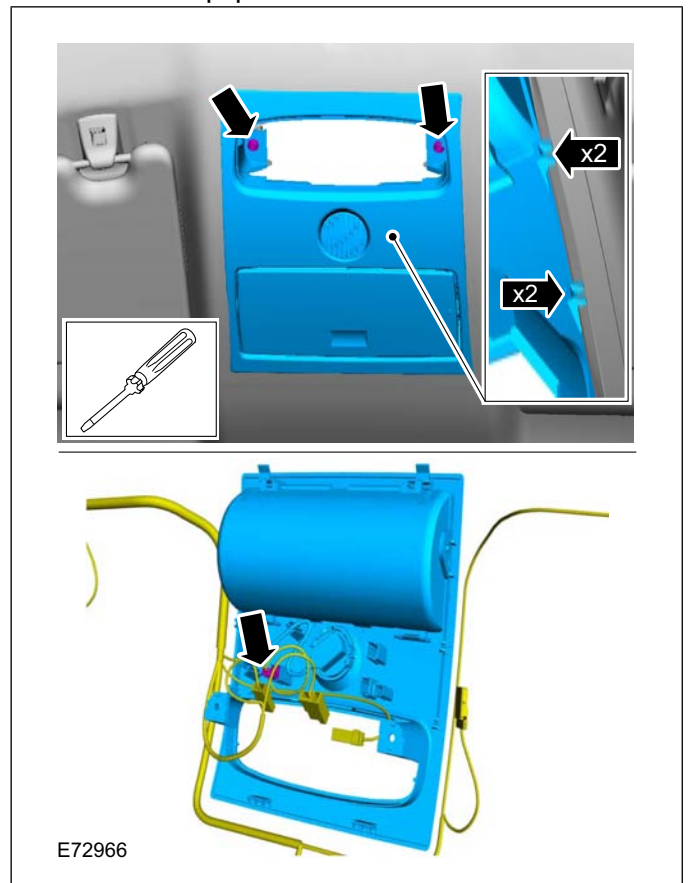
Flat-bladed screwdriver

Removal

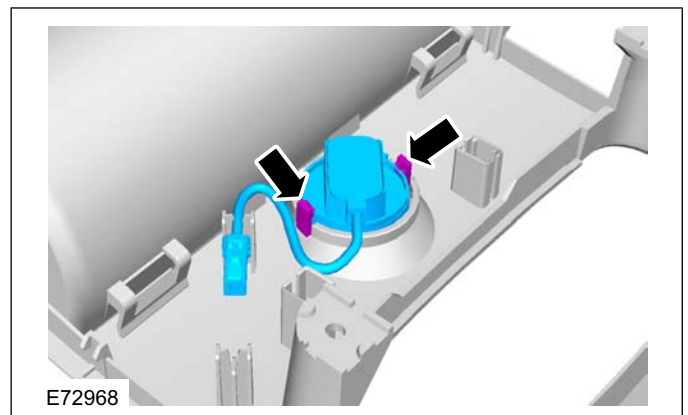
1. General Equipment: Flat-bladed screwdriver



2. General Equipment: Flat-bladed screwdriver



3.



Installation

1. To install, reverse the removal procedure.



## SECTION 417-01 Exterior Lighting

### VEHICLE APPLICATION: 2008.50 Kuga

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**REMOVAL AND INSTALLATION**

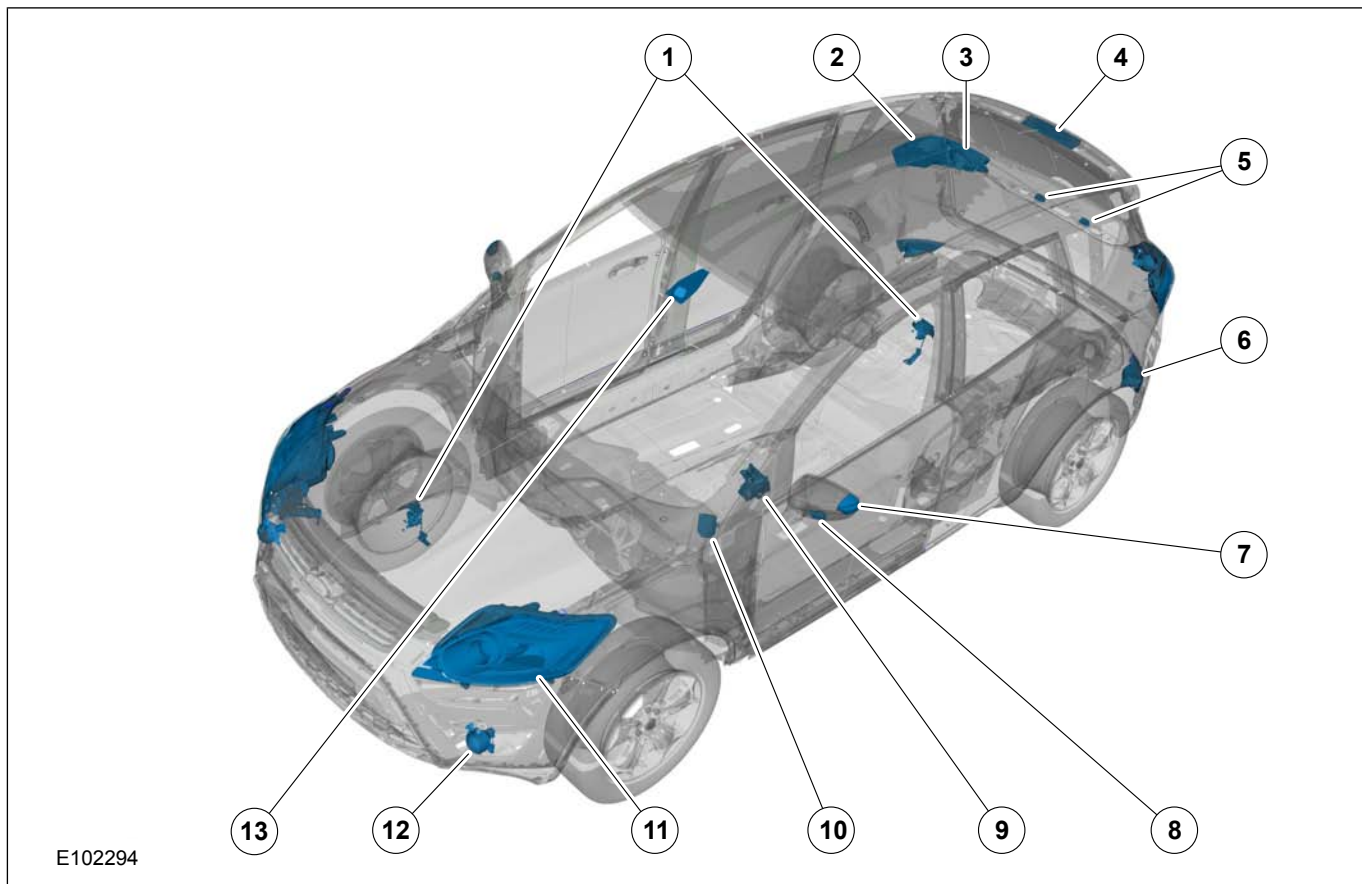
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**SPECIFICATIONS****Headlamp adjustment**

Component	X value
Headlamp	$X = 10 \text{ cm}/10 \text{ m} = 0^{\circ}34' = 1.0\%$
Front fog lamp	$X = 22 \text{ cm}/10 \text{ m} = 1^{\circ}16' = 2.2\%$

DESCRIPTION AND OPERATION

Exterior Lighting – Component Location



E102294

Item	Description
1	Vehicle level sensors on the front and rear axles
2	Side lamp/stoplamp, turn signal lamp
3	Reversing Lamp
4	Additional high-mounted stoplamp
5	Number plate lamp
6	Rear fog lamp
7	Front side turn light

Item	Description
8	Door entry illumination (courtesy lamps)
9	Lighting switch
10	Control module for the automatic headlamp leveling system
11	Dipped beam headlamp, main beam headlamp, turn signal lamp, side lamp
12	Fog lamp
13	Combined rain sensor/light sensor

## DESCRIPTION AND OPERATION

## Exterior Lighting – Overview

## Front headlamps

## Conventional Headlamps



The headlamp units are primarily made of plastic and make use of free-form reflectors in order to optimize light distribution.

The transparent plastic cover is made of polycarbonate, and it is surface-hardened to protect it against scratches and cracks.

In the event of damage to the cover the entire headlamp unit needs to be replaced.

The turn signal lamps and side lights are also integrated in the headlamp unit.

The headlamps can be adapted to different traffic requirements in different countries (e.g. driving on the left/right) by applying pre-cut adhesive template strips to specific areas of the headlamps.

All conventional headlamps use 12 V bulbs with a spiral-wound filament.

Lamp	Bulb	Current draw	Bulb color
Low-beams	H7	55W	Clear
High beam headlamp	H7	55W	Clear
Turn signal indicator	H21W	21W	Clear
Side lamp	W5W	5W	Clear

## Xenon headlamp



**NOTE:** Certain safety measures need to be followed, as the circuits of the gas discharge headlamps may carry voltages of up to 30 kV.

High intensity discharge headlamps are optionally available.

A single xenon lamp located in the inner reflector generates a light beam which is used for both the dipped beam and the main beam.

In order to avoid dazzling oncoming traffic while driving with dipped beam, the light beam is modified by a masking screen which is inserted into the beam. An additional reflector is provided for the main beam, which is generated using a conventional bulb with a spiral-wound filament. This bulb is switched on when the headlamps are switched to main beam and when the headlamp flasher is operated.

The headlamp flasher operates as follows:

- When the dipped beam is switched off the headlamp flasher function is provided solely by means of the conventional bulb in the additional reflector.
- When the dipped beam is switched on the headlamp flasher function is provided by moving the masking screen away from the main reflector and switching on the conventional bulb in the additional reflector.

The headlamps can be adapted to different traffic requirements in different countries (e.g. driving on the left/right) by applying pre-cut adhesive template strips to specific areas of the headlamps.

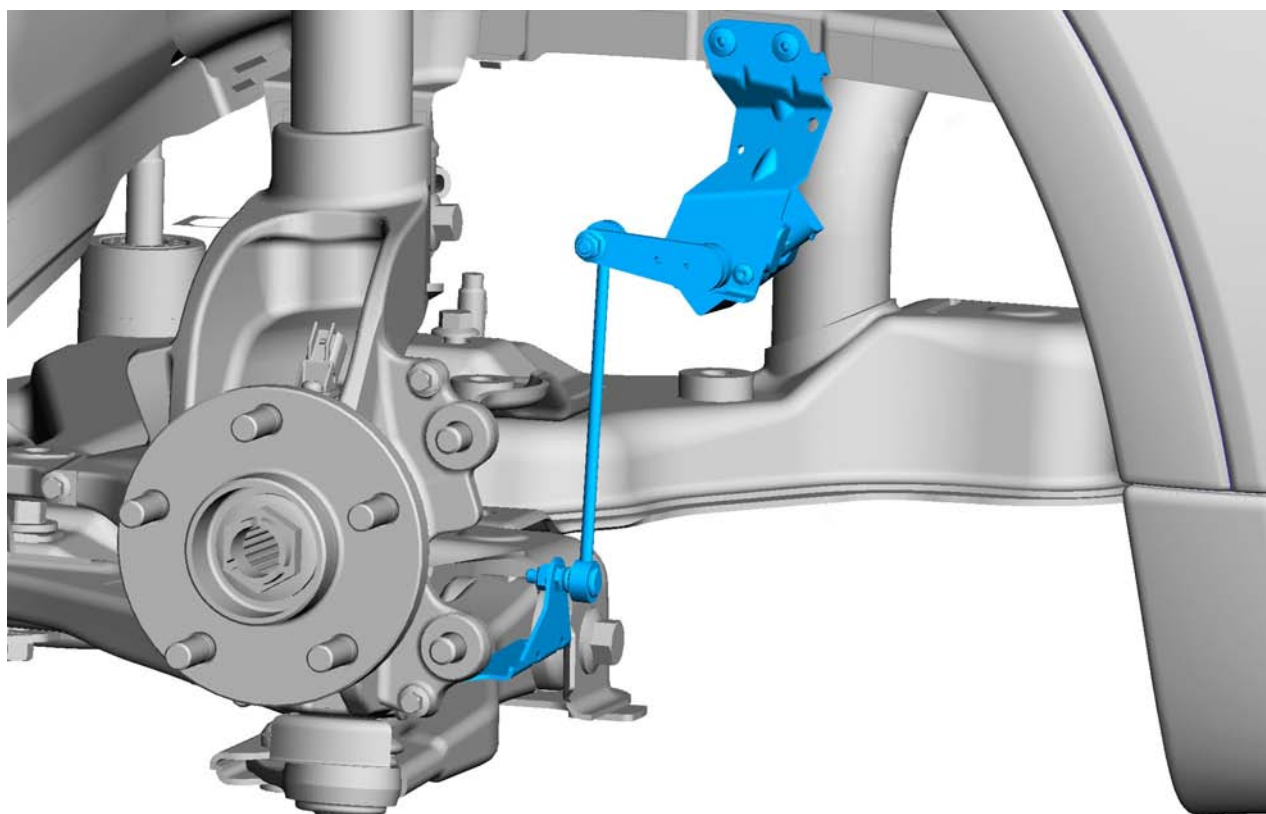
**DESCRIPTION AND OPERATION**

The turn signal lamps and side lights are the same as in conventional headlamps.

Lamp	Bulb	Current draw	Bulb color
Low-beams	D1S	35W	Clear
High beam headlamp	H1	55W	Clear
Turn signal indicator	H21W	21W	Clear
Side lamp	W5W	5W	Clear

**Headlamp levelling**

Vehicles with conventional headlamps are equipped with a manual headlamp leveling system.



E101614

An automatic headlamp leveling system is a legal requirement for vehicles with gas discharge headlamps.

The automatic headlamp levelling system is a dynamic system which provides additional benefits for the driver in terms of improved illumination of the road due to improved control over the headlamp beam.

In a static system, the vehicle is only considered as a stationary object, whereas a dynamic system also takes into account the dynamic changes to the inclination of the vehicle whilst driving.

In order to prevent unnecessary changes in the height of the headlamp beam, the system filters out surface irregularities and any pitching of the vehicle under braking and acceleration.



The system is designed to respond to changes in the inclination of the vehicle caused by load changes or long-term effects of aerodynamic forces acting on the vehicle (e.g. due to continuous driving at high speeds).

Accordingly, the system needs to be set up with the aid of WDS (Worldwide Diagnostic System) after any components are replaced or any other repairs are carried out.

## DESCRIPTION AND OPERATION

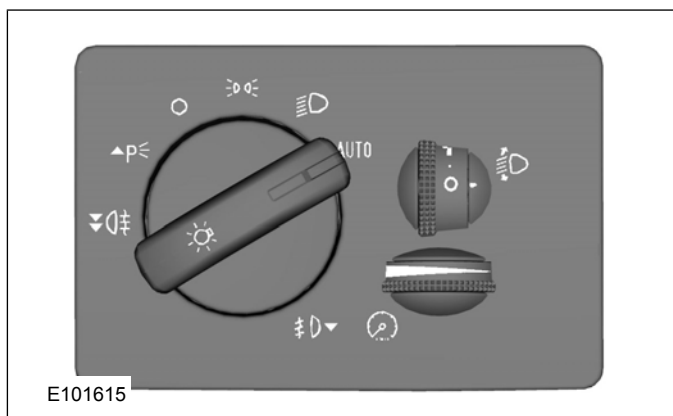
## Combined rain sensor/light sensor

## CAUTIONS:

-  **On vehicles with autolamps, retrofitting with daytime running lamps is not permissible, as otherwise, the engine cannot be stopped when the lighting is switched on.**
-  **On vehicles with autolamps, the daytime running lamp fuse must not be fitted, as otherwise, the engine cannot be stopped when the lighting is switched on.**

The combined rain sensor/light sensor is located behind the interior rear view mirror.

## autolamps



The low beams, side lamps, license plate lamps as well as the instrument cluster and instrument panel illumination are switched on automatically if all the following conditions are met:

- Ignition ON
- Light switch in the "AUTO" position
- Detected ambient light conditions below a stored threshold value

These are switched on and off by the GEM (generic electronic module) in accordance with the input signals from the combined rain/light sensor.

## Headlamp switch-off delay

In vehicles with mid to high-end equipment, the headlamp switch-off delay uses the dipped beam headlamps and the door entry illumination (if equipped) to illuminate the vehicle surroundings. This function is activated by operating the main beam headlamp lever with the ignition switched off.

After the last door has been closed, the function remains active for a further 30 seconds and then switches off automatically.

When a door or the tailgate is open, the switch-off time is extended to 180 seconds. After the last door has been closed, the switch-off time is reset to 30 seconds.

The headlamp switch-off delay can be deactivated prematurely by operating the high beam lever again or by switching on the ignition.

The switch-off time is adjusted to fixed values at the factory and can **not** be re-programmed using WDS.

## Turn signals



The turn signals and the warning lamp flash at a specified frequency and, in the case of failure of a turn signal, the frequency is doubled.

The turn signal lamps also have a one-touch lane change function. If the multifunction lever is pressed just slightly then the relevant turn signal lamp is actuated 3 times.

## Door entry illumination





**DESCRIPTION AND OPERATION**

On some models, the door entry lamps are installed in the external mirrors.

The door entry lamps should illuminate the ground in the immediate vicinity of the front doors; they are equipped with white bulbs, which are installed in the underside of the mirror.

The door entry illumination is switched on when one of the doors or the tailgate are opened, or if an unlocking command is detected and the following conditions are satisfied:

- Vehicle Ignition is off.
- Reverse gear is not engaged.
- The vehicle speed is below 7 km/h.

The door entry illumination is switched off if one of the following conditions is satisfied:

- The ignition is selected on.
- Reverse gear is engaged.
- The vehicle speed exceeds 7 km/h.
- More than 25 seconds have elapsed since the tailgate was closed or a central locking command was determined.
- The time set for the battery protection function for the interior lighting has elapsed.
- More than 5 seconds have elapsed since the doors and the tailgate were closed.
- More than 5 seconds have elapsed since a central locking command was received and the all doors and the tailgate were closed.

**Rear Lighting**

The rear lamps are each divided into three units.

The reversing lamps are located in the units in the liftgate.

The outer units in the D-pillars contain the side lamp as well as the turn signal and stoplamp.

The rear fog lamp is integrated in the lower area of the bumper.

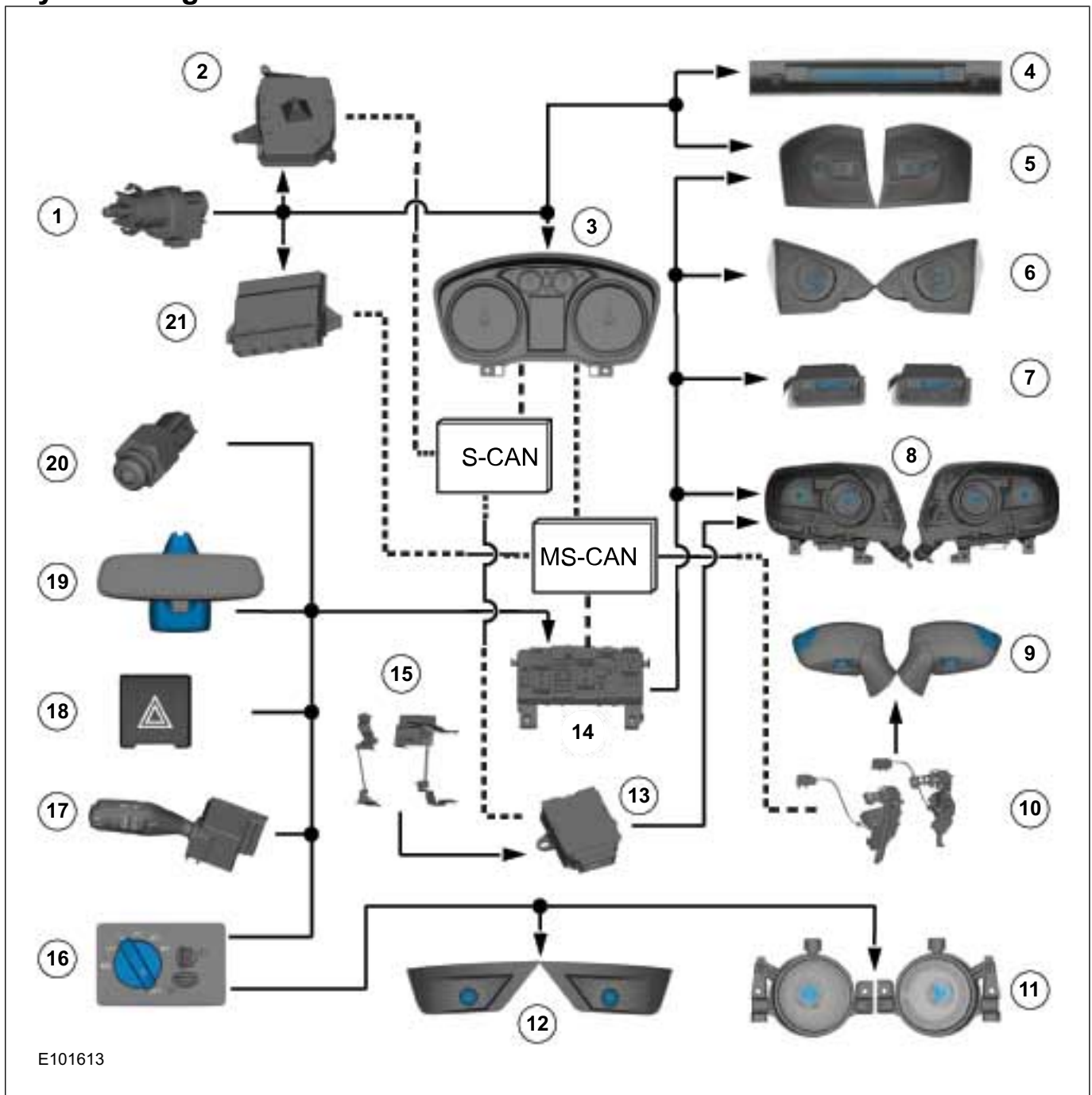
The high-mounted additional stop lamp is installed in the middle of the roof spoiler.

Lamp	Bulb	Current draw	Bulb color
Turn signal indicator	PSY19W	19W	Orange
Reversing Lamp	P21W	21W	Clear
Stoptlamp/side lamp	W21/5W	21/5W	Clear
Rear fog lamp	P21W	21W	Clear
Additional high-mounted stoplamp	1 x LED board	1,4W	–

DESCRIPTION AND OPERATION

Exterior Lighting – System Operation and Component Description

System Diagram



Item	Description
1	BPP (brake pedal position)/stoplamp switch
2	PCM (powertrain control module)
3	Gateway (instrument cluster)
4	Additional high-mounted stoplamp

Item	Description
5	Rear lamp assemblies on the D-pillar with side lamp/stoplamp and turn signal lamp
6	Rear lamp assemblies on the liftgate with backup lamp
7	Number plate lamp

**DESCRIPTION AND OPERATION**

Item	Description
8	Headlamp units with turn signal lamp, side lamp, dipped beam headlamp, main beam headlamp, positioning motor for headlamp leveling system
9	External mirror with side turn signal lamps and door entry lamp
10	Door locking units for the front doors
11	Fog lamp
12	Rear fog lights
13	Gas discharge headlamp control module

Item	Description
14	GEM
15	Vehicle level sensors
16	Lighting switch
17	Multifunction lever
18	Hazard flasher switch
19	Combined rain sensor/light sensor
20	Reverse gear switch
21	Keyless Vehicle Module

**System Operation**

**Headlamp levelling**

**Xenon headlamp**

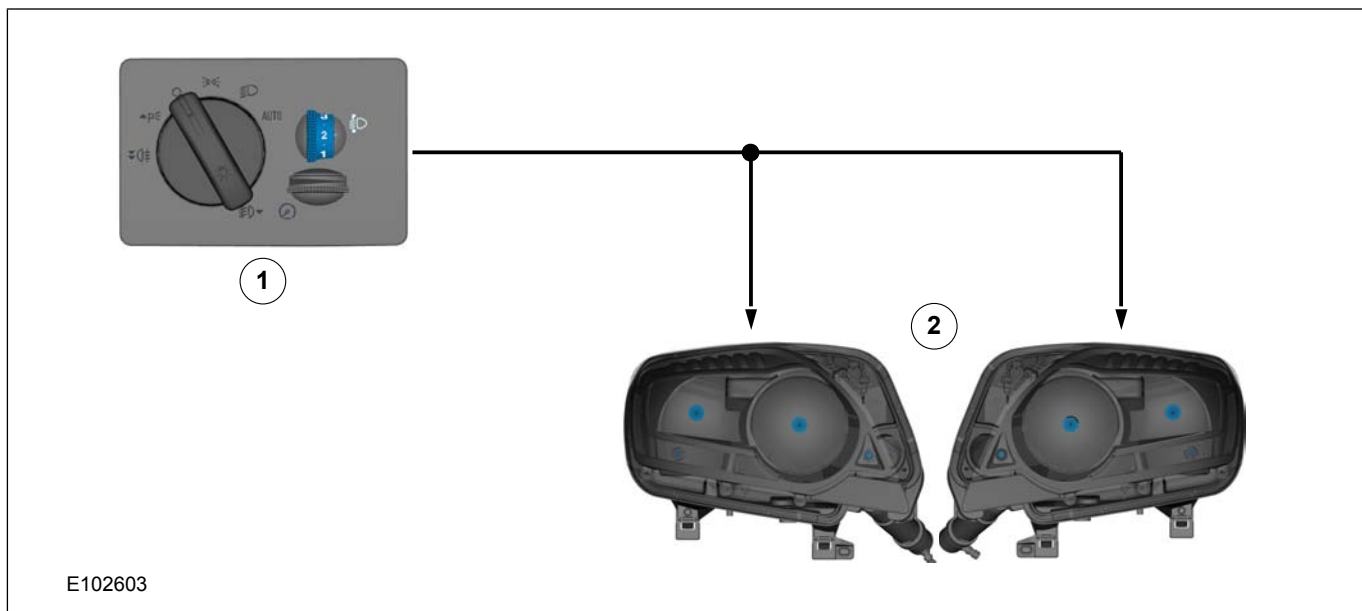
The following components are part of the automatic headlamp leveling system:

- Vehicle level sensors on the front and rear axles
- Control module
- Actuator motors for headlamp leveling

Accordingly, the system needs to be set up with the aid of WDS after any components are replaced or any other repairs are carried out.

The front and rear sensors are Hall sensors which send a digital signal to the control unit.

**Conventional Headlamps**



E102603

Item	Description
1	Light switch with manual headlamp leveling system
2	Headlamp units with positioning motors for headlamp leveling system

**DESCRIPTION AND OPERATION**

The manual headlamp levelling system operates with an electric motor which is controlled via a rotary control in the instrument cluster.

**Turn signals**

The GEM switches the direction indicators and the direction indicator side repeaters on.

The GEM sends a signal to the instrument cluster via the CAN (controller area network) bus to switch on the relevant turn indicator and the acoustic signal.

The signals from the hazard flasher switch and from the multifunction switch are transmitted to the GEM via a wiring connection.

**Combined rain sensor/light sensor**

The ambient light sensor determines the general light intensity.

For this purpose, it detects the light over as wide an angle as possible, without taking the direction of incidence into account.

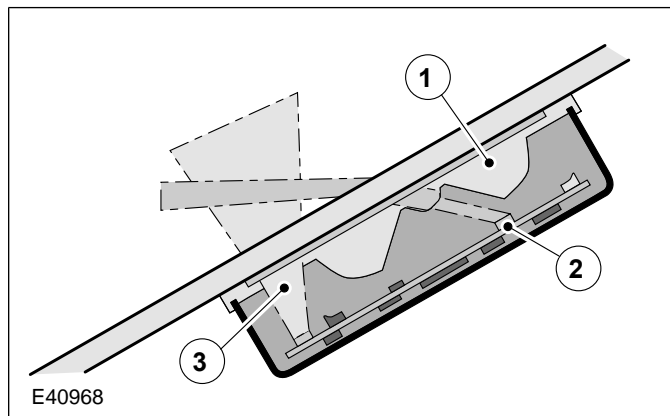
The front light sensor determines the light intensity directly in front of the vehicle.

If both the ambient light sensor and the front light sensor detect a sudden reduction in light intensity at the same time, then an algorithm-based calculation is used to determine the fact that the vehicle has entered a tunnel, a multi-storey car park or a long underpass.

In this case the request for switching on the external lighting and the indicator in the instrument cluster is transmitted to the GEM.

If the vehicle enters into the shade thrown by a large truck, the two sensors will register different light intensities.. In this case, the algorithm-based calculation will not result in the lights being switched on.

The GEM incorporates a stepped switch-off of the dipped beam headlamps, side lamps, license plate illumination and the instrument cluster and instrument panel illumination. If the ambient light changes from dark to bright, the GEM first switches off the low beams. The side lamps, license plate lamps as well as the instrument cluster and instrument panel illumination are switched off approx. 6 seconds after the low beams have been switched off.

**Component Description****Combined rain sensor/light sensor**

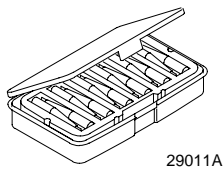
Item	Description
1	Lens
2	Front light sensor
3	Ambient light sensor

## DIAGNOSIS AND TESTING

## Fog Lamps

Refer to Wiring Diagrams Section 417-01, for schematic and connector information.

## Special Tool(s)

 <p>29011A</p>	<p>Terminal Probe Kit 29-011A</p>
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## Description of operation

A diagnosis of the generic electronic module (GEM) can be performed with the Ford approved diagnostic tool. Furthermore, an integrated service mode enables testing of the input and output signals without the need for further tools. To enable activation of service mode:

- switch off the ignition,
- switch off all other electrical consumers,
- apply the handbrake,
- shift to neutral
- and close the doors.

## Activating the service mode

Proceed as follows to activate the service mode:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- Turn on the ignition.
- RELEASE the switch of the heated rear window

A signal sounds and the turn signal lamps come on to indicate that service mode has been successfully activated.

**NOTE:** If the alarm is activated (in vehicles fitted with an anti-theft alarm system), service mode cannot be activated.

## Inputs

SWITCH the windshield wiper switch to the "Off" position to test the input signals. The following is a list of the switch signals to be tested, in no particular order:

- Turn signals (right, left, hazard warning lights)
- Windshield wiper stage I
- Windshield wiper stage II
- Windshield washer system

- Rear window wiper
- Rear window washer system
- Doors open/closed
- Remote control for central locking with double locking
- Hood open/closed (in vehicles equipped with an anti-theft alarm system)
- Tailgate open/closed
- A/C request signal
- Heated windscreen (if fitted)
- Parking Brake
- Brake reservoir fluid level
- Speed control system
- Autolamps
- dipped beam
- main beam
- headlamp flasher
- Marker Lamps
- Reversing lamp
- Liftgate release
- Ignition switch, terminal 15 (turn key to 0 position, then turn key to II position.)

An acoustic signal sounds and the turn signal lamps flash to indicate receipt of each input signal by the generic electronic module.

#### Test the windshield wiper "intermittent mode" stage input signal (only vehicles with adjustable intermittent mode)

The windshield wiper switch must be switched to "intermittent mode" in order to test the input signal. The delay times of the input signals can then be tested by operating the rotary switch. Each change of the rotary switch position is indicated by an acoustic signal and illumination of the turn signals.

## Output signals

SWITCH the wiper switch to the "intermittent" position to test the output signals. PRESSING the heated rear window switch activates the output signals in the following order:

- Turn Indicator Left Hand
- Turn Indicator Right Hand
- main beam
- dipped beam
- Windshield wiper stage I
- Windshield wiper stage II



**DIAGNOSIS AND TESTING**

- g. Heated rear window
- h. Heater blower motor
- i. Headlamp washer system (vehicles with gas discharge headlamps)
- j. Electric booster heater (if fitted)
- k. Autolamps (if fitted)
- l. Alarm horn (vehicles with alarm system)
- m. Rear window wiper
- n. Rear heated window relay

When the heated rear window switch is pressed again, the test of the relevant signal is terminated. When the heated rear window switch is pressed once more, the test for the next signal in the list is started.

**Ending the service mode**

The GEM automatically ends service mode 20 seconds after the last input or at a driving speed of over 7 km/h. However, service mode can be manually ended at any time by proceeding as follows:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- SWITCH OFF the ignition
- RELEASE the switch of the heated rear window

3 signals sound and the turn signal lamps illuminate to indicate that service mode has ended.

**Reset service mode**

If, after completion of service mode, some functions do not operate or do not operate properly, check the following functions:

- Instrument cluster illumination, side lamps and license plate lamp in autolamps mode
- Rear wiper
- Headlamp Washers
- Electric booster heater
- Active anti-theft sounder
- Heated windshield

If one or more of the listed functions is not OK, it's possible that the cause of the fault is due to not exiting service mode properly. To reactivate the functions correctly, perform the following steps:

1. SWITCH OFF the ignition
2. SWITCH OFF the switch for the windscreen wash/wipe system
3. OPERATE the switch of the heated rear window and HOLD IT THERE
4. Turn on the ignition.

5. RELEASE the heated rear window switch (an acoustic signal will sound if activation has been performed correctly)
6. SWITCH the windscreen wash/wipe switch to the "Intermittent wipe" position
7. OPERATE the heated rear window switch 6 times (the main beam headlamps switch on and off automatically)
8. SWITCH OFF the switch for the windscreen wash/wipe system
9. OPERATE the switch of the heated rear window and HOLD IT THERE
10. SWITCH OFF the ignition
11. RELEASE the heated rear window switch (three acoustic signals will sound if activation has been performed correctly)

After completion of the work, check all the functions.

**Inspection and Checking**

**NOTE:** The generic electronic module (GEM) forms part of the central junction box (CJB).

**NOTE:** If the instrument cluster is changed, it must be re-configured. For this purpose, the vehicle-specific data is read out of the module to be replaced using the Ford approved diagnostic tool and is transferred to the new module.

**NOTE:** Before reading out the vehicle-specific data, remake all the separated electrical connections in the vehicle, so that communication between the module and the Ford approved diagnostic tool is ensured.

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

**Visual Inspection**

Electrical
<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Lamp(s)</li> <li>• Bulb(s)</li> <li>• Connector(s)</li> <li>• Switch(s)</li> <li>• Wiring harness</li> </ul>

3. Resolve any obvious causes or concerns found during the visual inspection before carrying out any further tests.



**417-01-14****Exterior Lighting****417-01-14****DIAGNOSIS AND TESTING**

4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.



**DIAGNOSIS AND TESTING****Headlamps**

Refer to **Wiring Diagrams Section 417-1**, for schematic and connector information.

**Description of operation**

A diagnosis of the generic electronic module (GEM) can be performed with the Ford approved diagnostic tool. Furthermore, an integrated service mode enables testing of the input and output signals without the need for further tools. To enable activation of service mode:

- switch off the ignition,
- switch off all other electrical consumers,
- apply the handbrake,
- shift to neutral
- and close the doors.

**Activating the service mode**

Proceed as follows to activate the service mode:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- Turn on the ignition.
- RELEASE the switch of the heated rear window

A signal sounds and the turn signal lamps come on to indicate that service mode has been successfully activated.

**NOTE:** If the alarm is activated (in vehicles fitted with an anti-theft alarm system), service mode cannot be activated.

**Inputs**

SWITCH the windshield wiper switch to the "Off" position to test the input signals. The following is a list of the switch signals to be tested, in no particular order:

- Turn signals (right, left, hazard warning lights)
- Windshield wiper stage I
- Windshield wiper stage II
- Windshield washer system
- Rear window wiper
- Rear window washer system
- Doors open/closed
- Remote control for central locking with double locking
- Hood open/closed (in vehicles equipped with an anti-theft alarm system)
- Tailgate open/closed

- A/C request signal
- Heated windscreen (if fitted)
- Parking Brake
- Brake reservoir fluid level
- Speed control system
- Autolamps
- dipped beam
- main beam
- headlamp flasher
- Marker Lamps
- Reversing lamp
- Liftgate release
- Ignition switch, terminal 15 (turn key to 0 position, then turn key to II position.)

An acoustic signal sounds and the turn signal lamps flash to indicate receipt of each input signal by the generic electronic module.

**Test the windshield wiper "intermittent mode" stage input signal (only vehicles with adjustable intermittent mode)**

The windshield wiper switch must be switched to "intermittent mode" in order to test the input signal. The delay times of the input signals can then be tested by operating the rotary switch. Each change of the rotary switch position is indicated by an acoustic signal and illumination of the turn signals.

**Output signals**

SWITCH the wiper switch to the "intermittent" position to test the output signals. PRESSING the heated rear window switch activates the output signals in the following order:

- Turn Indicator Left Hand
- Turn Indicator Right Hand
- main beam
- dipped beam
- Windshield wiper stage I
- Windshield wiper stage II
- Heated rear window
- Heater blower motor
- Headlamp washer system (vehicles with gas discharge headlamps)
- Electric booster heater (if fitted)
- Autolamps (if fitted)
- Alarm horn (vehicles with alarm system)

**DIAGNOSIS AND TESTING**

- m. Rear window wiper
- n. Rear heated window relay

When the heated rear window switch is pressed again, the test of the relevant signal is terminated. When the heated rear window switch is pressed once more, the test for the next signal in the list is started.

**Ending the service mode**

The GEM automatically ends service mode 20 seconds after the last input or at a driving speed of over 7 km/h. However, service mode can be manually ended at any time by proceeding as follows:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- SWITCH OFF the ignition
- RELEASE the switch of the heated rear window

3 signals sound and the turn signal lamps illuminate to indicate that service mode has ended.

**Reset service mode**

If, after completion of service mode, some functions do not operate or do not operate properly, check the following functions:

- Instrument cluster illumination, side lamps and license plate lamp in autolamps mode
- Rear wiper
- Headlamp Washers
- Electric booster heater
- Active anti-theft sounder
- Heated windshield

If one or more of the listed functions is not OK, it's possible that the cause of the fault is due to not exiting service mode properly. To reactivate the functions correctly, perform the following steps:

1. SWITCH OFF the ignition
2. SWITCH OFF the switch for the windscreen wash/wipe system
3. OPERATE the switch of the heated rear window and HOLD IT THERE
4. Turn on the ignition.
5. RELEASE the heated rear window switch (an acoustic signal will sound if activation has been performed correctly)
6. SWITCH the windscreen wash/wipe switch to the "Intermittent wipe" position
7. OPERATE the heated rear window switch 6 times (the main beam headlamps switch on and off automatically)

8. SWITCH OFF the switch for the windscreen wash/wipe system
9. OPERATE the switch of the heated rear window and HOLD IT THERE
10. SWITCH OFF the ignition
11. RELEASE the heated rear window switch (three acoustic signals will sound if activation has been performed correctly)

After completion of the work, check all the functions.

**Inspection and Checking**

**NOTE:** The generic electronic module (GEM) forms part of the central junction box (CJB).

**NOTE:** If the instrument cluster is changed, it must be re-configured. For this purpose, the vehicle-specific data is read out of the module to be replaced using the Ford approved diagnostic tool and is transferred to the new module.

**NOTE:** Before reading out the vehicle-specific data, remake all the separated electrical connections in the vehicle, so that communication between the module and the Ford approved diagnostic tool is ensured.

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

**Visual Inspection**

Mechanical	Electrical
<ul style="list-style-type: none"> <li>• Headlamp</li> </ul>	<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Bulb(s)</li> <li>• Lamp(s)</li> <li>• Connector(s).</li> <li>• Switch(s)</li> <li>• Wiring loom</li> </ul>

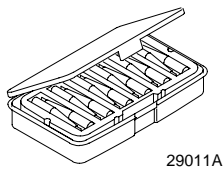
3. Resolve any obvious causes or concerns found during the visual inspection before carrying out any further tests.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

## DIAGNOSIS AND TESTING

## Headlamp Leveling

Refer to Wiring Diagrams Section 417-01, for schematic and connector information.

## Special Tool(s)

 <p>29011A</p>	<p>Terminal Probe Kit 29-011A</p>
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## Description of operation

A diagnosis of the generic electronic module (GEM) can be performed with the Ford approved diagnostic tool. Furthermore, an integrated service mode enables testing of the input and output signals without the need for further tools. To enable activation of service mode:

- switch off the ignition,
- switch off all other electrical consumers,
- apply the handbrake,
- shift to neutral
- and close the doors.

## Activating the service mode

Proceed as follows to activate the service mode:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- Turn on the ignition.
- RELEASE the switch of the heated rear window

A signal sounds and the turn signal lamps come on to indicate that service mode has been successfully activated.

**NOTE:** If the alarm is activated (in vehicles fitted with an anti-theft alarm system), service mode cannot be activated.

## Inputs

SWITCH the windshield wiper switch to the "Off" position to test the input signals. The following is a list of the switch signals to be tested, in no particular order:

- Turn signals (right, left, hazard warning lights)
- Windshield wiper stage I
- Windshield wiper stage II
- Windshield washer system

- Rear window wiper
- Rear window washer system
- Doors open/closed
- Remote control for central locking with double locking
- Hood open/closed (in vehicles equipped with an anti-theft alarm system)
- Tailgate open/closed
- A/C request signal
- Heated windscreen (if fitted)
- Parking Brake
- Brake reservoir fluid level
- Speed control system
- Autolamps
- dipped beam
- main beam
- headlamp flasher
- Marker Lamps
- Reversing lamp
- Liftgate release
- Ignition switch, terminal 15 (turn key to 0 position, then turn key to II position.)

An acoustic signal sounds and the turn signal lamps flash to indicate receipt of each input signal by the generic electronic module.

#### Test the windshield wiper "intermittent mode" stage input signal (only vehicles with adjustable intermittent mode)

The windshield wiper switch must be switched to "intermittent mode" in order to test the input signal. The delay times of the input signals can then be tested by operating the rotary switch. Each change of the rotary switch position is indicated by an acoustic signal and illumination of the turn signals.

## Output signals

SWITCH the wiper switch to the "intermittent" position to test the output signals. PRESSING the heated rear window switch activates the output signals in the following order:

- Turn Indicator Left Hand
- Turn Indicator Right Hand
- main beam
- dipped beam
- Windshield wiper stage I
- Windshield wiper stage II

**DIAGNOSIS AND TESTING**

- g. Heated rear window
- h. Heater blower motor
- i. Headlamp washer system (vehicles with gas discharge headlamps)
- j. Electric booster heater (if fitted)
- k. Autolamps (if fitted)
- l. Alarm horn (vehicles with alarm system)
- m. Rear window wiper
- n. Rear heated window relay

When the heated rear window switch is pressed again, the test of the relevant signal is terminated. When the heated rear window switch is pressed once more, the test for the next signal in the list is started.

**Ending the service mode**

The GEM automatically ends service mode 20 seconds after the last input or at a driving speed of over 7 km/h. However, service mode can be manually ended at any time by proceeding as follows:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- SWITCH OFF the ignition
- RELEASE the switch of the heated rear window

3 signals sound and the turn signal lamps illuminate to indicate that service mode has ended.

**Reset service mode**

If, after completion of service mode, some functions do not operate or do not operate properly, check the following functions:

- Instrument cluster illumination, side lamps and license plate lamp in autolamps mode
- Rear wiper
- Headlamp Washers
- Electric booster heater
- Active anti-theft sounder
- Heated windshield

If one or more of the listed functions is not OK, it's possible that the cause of the fault is due to not exiting service mode properly. To reactivate the functions correctly, perform the following steps:

1. SWITCH OFF the ignition
2. SWITCH OFF the switch for the windscreen wash/wipe system
3. OPERATE the switch of the heated rear window and HOLD IT THERE
4. Turn on the ignition.

5. RELEASE the heated rear window switch (an acoustic signal will sound if activation has been performed correctly)
6. SWITCH the windscreen wash/wipe switch to the "Intermittent wipe" position
7. OPERATE the heated rear window switch 6 times (the main beam headlamps switch on and off automatically)
8. SWITCH OFF the switch for the windscreen wash/wipe system
9. OPERATE the switch of the heated rear window and HOLD IT THERE
10. SWITCH OFF the ignition
11. RELEASE the heated rear window switch (three acoustic signals will sound if activation has been performed correctly)

After completion of the work, check all the functions.

**Inspection and Checking**

**NOTE:** The generic electronic module (GEM) forms part of the central junction box (CJB).

**NOTE:** Before reading out the vehicle-specific data, remake all the separated electrical connections in the vehicle, so that communication between the module and the Ford approved diagnostic tool is ensured.

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical (or mechanical) damage.

**Visual Inspection**

Mechanical	Electrical
<ul style="list-style-type: none"> <li>• Headlamp</li> <li>• Headlamp adjuster unit</li> </ul>	<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Connector(s).</li> <li>• Switch(s)</li> <li>• Wiring loom</li> <li>• Headlamp levelling sensors</li> <li>• Gas discharge headlamp control module</li> </ul>

3. Resolve any obvious causes or concerns found during the visual inspection before carrying out any further tests.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

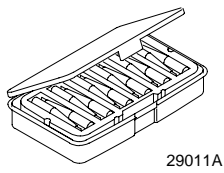


## DIAGNOSIS AND TESTING

## Parking, Rear and License Plate Lamps

Refer to Wiring Diagrams Section 417-01, for schematic and connector information.

**Special Tool(s)**

 <p>29011A</p>	<p>Terminal Probe Kit 29-011A</p>
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**Description of operation**

A diagnosis of the generic electronic module (GEM) can be performed with the Ford approved diagnostic tool. Furthermore, an integrated service mode enables testing of the input and output signals without the need for further tools. To enable activation of service mode:

- switch off the ignition,
- switch off all other electrical consumers,
- apply the handbrake,
- shift to neutral
- and close the doors.

**Activating the service mode**

Proceed as follows to activate the service mode:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- Turn on the ignition.
- RELEASE the switch of the heated rear window

A signal sounds and the turn signal lamps come on to indicate that service mode has been successfully activated.

**NOTE:** If the alarm is activated (in vehicles fitted with an anti-theft alarm system), service mode cannot be activated.

**Inputs**

SWITCH the windshield wiper switch to the "Off" position to test the input signals. The following is a list of the switch signals to be tested, in no particular order:

- Turn signals (right, left, hazard warning lights)
- Windshield wiper stage I
- Windshield wiper stage II
- Windshield washer system

- Rear window wiper
- Rear window washer system
- Doors open/closed
- Remote control for central locking with double locking
- Hood open/closed (in vehicles equipped with an anti-theft alarm system)
- Tailgate open/closed
- A/C request signal
- Heated windscreen (if fitted)
- Parking Brake
- Brake reservoir fluid level
- Speed control system
- Autolamps
- dipped beam
- main beam
- headlamp flasher
- Marker Lamps
- Reversing lamp
- Liftgate release
- Ignition switch, terminal 15 (turn key to 0 position, then turn key to II position.)

An acoustic signal sounds and the turn signal lamps flash to indicate receipt of each input signal by the generic electronic module.

**Test the windshield wiper "intermittent mode" stage input signal (only vehicles with adjustable intermittent mode)**

The windshield wiper switch must be switched to "intermittent mode" in order to test the input signal. The delay times of the input signals can then be tested by operating the rotary switch. Each change of the rotary switch position is indicated by an acoustic signal and illumination of the turn signals.

**Output signals**

SWITCH the wiper switch to the "intermittent" position to test the output signals. PRESSING the heated rear window switch activates the output signals in the following order:

- Turn Indicator Left Hand
- Turn Indicator Right Hand
- main beam
- dipped beam
- Windshield wiper stage I
- Windshield wiper stage II



**DIAGNOSIS AND TESTING**

- g. Heated rear window
- h. Heater blower motor
- i. Headlamp washer system (vehicles with gas discharge headlamps)
- j. Electric booster heater (if fitted)
- k. Autolamps (if fitted)
- l. Alarm horn (vehicles with alarm system)
- m. Rear window wiper
- n. Rear heated window relay

When the heated rear window switch is pressed again, the test of the relevant signal is terminated. When the heated rear window switch is pressed once more, the test for the next signal in the list is started.

**Ending the service mode**

The GEM automatically ends service mode 20 seconds after the last input or at a driving speed of over 7 km/h. However, service mode can be manually ended at any time by proceeding as follows:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- SWITCH OFF the ignition
- RELEASE the switch of the heated rear window

3 signals sound and the turn signal lamps illuminate to indicate that service mode has ended.

**Reset service mode**

If, after completion of service mode, some functions do not operate or do not operate properly, check the following functions:

- Instrument cluster illumination, side lamps and license plate lamp in autolamps mode
- Rear wiper
- Headlamp Washers
- Electric booster heater
- Active anti-theft sounder
- Heated windshield

If one or more of the listed functions is not OK, it's possible that the cause of the fault is due to not exiting service mode properly. To reactivate the functions correctly, perform the following steps:

1. SWITCH OFF the ignition
2. SWITCH OFF the switch for the windscreen wash/wipe system
3. OPERATE the switch of the heated rear window and HOLD IT THERE
4. Turn on the ignition.

5. RELEASE the heated rear window switch (an acoustic signal will sound if activation has been performed correctly)
6. SWITCH the windscreen wash/wipe switch to the "Intermittent wipe" position
7. OPERATE the heated rear window switch 6 times (the main beam headlamps switch on and off automatically)
8. SWITCH OFF the switch for the windscreen wash/wipe system
9. OPERATE the switch of the heated rear window and HOLD IT THERE
10. SWITCH OFF the ignition
11. RELEASE the heated rear window switch (three acoustic signals will sound if activation has been performed correctly)

After completion of the work, check all the functions.

**Inspection and Checking**

**NOTE:** The generic electronic module (GEM) forms part of the central junction box (CJB).

**NOTE:** Before reading out the vehicle-specific data, remake all the electrical connections which were separated in the vehicle, so that communication between the module and the Ford approved diagnostic tool is ensured.

1. Verify the customer concern.
2. Visually check the following electrical causes for the concern:

**Visual Inspection**

Electrical
<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Bulb(s)</li> <li>• Lamp(s)</li> <li>• Connector(s).</li> <li>• Switches</li> <li>• Wiring loom</li> </ul>

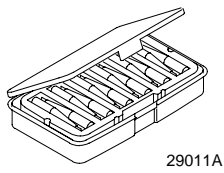
3. Resolve any obvious causes or concerns found during the visual inspection before carrying out any further tests.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

## DIAGNOSIS AND TESTING

## Reversing Lamps

Refer to Wiring Diagrams Section 417-01, for schematic and connector information.

**Special Tool(s) / General Equipment**

 <p>29011A</p>	<p>Terminal Probe Kit 29-011A</p>
<p>The Ford approved diagnostic tool</p>	

**Description of operation**

A diagnosis of the generic electronic module (GEM) can be performed with the Ford approved diagnostic tool. Furthermore, an integrated service mode enables testing of the input and output signals without the need for further tools. To enable activation of service mode:

- switch off the ignition,
- switch off all other electrical consumers,
- apply the handbrake,
- shift to neutral
- and close the doors.

**Activating the service mode**

Proceed as follows to activate the service mode:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- Turn on the ignition.
- RELEASE the switch of the heated rear window

A signal sounds and the turn signal lamps come on to indicate that service mode has been successfully activated.

**NOTE:** If the alarm is activated (in vehicles fitted with an anti-theft alarm system), service mode cannot be activated.

**Inputs**

SWITCH the windshield wiper switch to the "Off" position to test the input signals. The following is a list of the switch signals to be tested, in no particular order:

- Turn signals (right, left, hazard warning lights)
- Windshield wiper stage I

- Windshield wiper stage II
- Windshield washer system
- Rear window wiper
- Rear window washer system
- Doors open/closed
- Remote control for central locking with double locking
- Hood open/closed (in vehicles equipped with an anti-theft alarm system)
- Tailgate open/closed
- A/C request signal
- Heated windscreen (if fitted)
- Parking Brake
- Brake reservoir fluid level
- Speed control system
- Autolamps
- dipped beam
- main beam
- headlamp flasher
- Marker Lamps
- Reversing lamp
- Liftgate release
- Ignition switch, terminal 15 (turn key to 0 position, then turn key to II position.)

An acoustic signal sounds and the turn signal lamps flash to indicate receipt of each input signal by the generic electronic module.

**Test the windshield wiper "intermittent mode" stage input signal (only vehicles with adjustable intermittent mode)**

The windshield wiper switch must be switched to "intermittent mode" in order to test the input signal. The delay times of the input signals can then be tested by operating the rotary switch. Each change of the rotary switch position is indicated by an acoustic signal and illumination of the turn signals.

**Output signals**

SWITCH the wiper switch to the "intermittent" position to test the output signals. PRESSING the heated rear window switch activates the output signals in the following order:

- Turn Indicator Left Hand
- Turn Indicator Right Hand
- main beam
- dipped beam

**DIAGNOSIS AND TESTING**

- e. Windshield wiper stage I
- f. Windshield wiper stage II
- g. Heated rear window
- h. Heater blower motor
- i. Headlamp washer system (vehicles with gas discharge headlamps)
- j. Electric booster heater (if fitted)
- k. Autolamps (if fitted)
- l. Alarm horn (vehicles with alarm system)
- m. Rear window wiper
- n. Rear heated window relay

When the heated rear window switch is pressed again, the test of the relevant signal is terminated. When the heated rear window switch is pressed once more, the test for the next signal in the list is started.

**Ending the service mode**

The GEM automatically ends service mode 20 seconds after the last input or at a driving speed of over 7 km/h. However, service mode can be manually ended at any time by proceeding as follows:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- SWITCH OFF the ignition
- RELEASE the switch of the heated rear window

3 signals sound and the turn signal lamps illuminate to indicate that service mode has ended.

**Reset service mode**

If, after completion of service mode, some functions do not operate or do not operate properly, check the following functions:

- Instrument cluster illumination, side lamps and license plate lamp in autolamps mode
- Rear wiper
- Headlamp Washers
- Electric booster heater
- Active anti-theft sounder
- Heated windshield

If one or more of the listed functions is not OK, it's possible that the cause of the fault is due to not exiting service mode properly. To reactivate the functions correctly, perform the following steps:

1. SWITCH OFF the ignition
2. SWITCH OFF the switch for the windscreen wash/wipe system

3. OPERATE the switch of the heated rear window and HOLD IT THERE
4. Turn on the ignition.
5. RELEASE the heated rear window switch (an acoustic signal will sound if activation has been performed correctly)
6. SWITCH the windscreen wash/wipe switch to the "Intermittent wipe" position
7. OPERATE the heated rear window switch 6 times (the main beam headlamps switch on and off automatically)
8. SWITCH OFF the switch for the windscreen wash/wipe system
9. OPERATE the switch of the heated rear window and HOLD IT THERE
10. SWITCH OFF the ignition
11. RELEASE the heated rear window switch (three acoustic signals will sound if activation has been performed correctly)

After completion of the work, check all the functions.

**Inspection and Checking**

**NOTE:** The generic electronic module (GEM) forms part of the central junction box (CJB).

**NOTE:** If the generic electronic module (GEM) is changed, the new one must be reconfigured. For this purpose, the vehicle-specific data is read out of the module to be replaced using the Ford approved diagnostic tool and is transferred to the new module. REFER to: (418-00 Module Communications Network)

**Communications Network** (Description and Operation),

**Communications Network** (Description and Operation).

**NOTE:** Before reading out the vehicle-specific data, remake all the electrical connections which were separated in the vehicle, so that communication between the module and the Ford approved diagnostic tool is ensured.

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage:

**NOTE:** Ensure correct engagement of the wiring harness connectors.

**DIAGNOSIS AND TESTING****Visual Inspection**

Electrical
<ul style="list-style-type: none"><li>• Fuse(s)</li><li>• Lamp(s)</li><li>• Bulb(s)</li><li>• Connector(s)</li><li>• Switches</li><li>• Relay</li><li>• Wiring harness</li></ul>

3. Resolve any obvious causes or concerns found during the visual inspection before carrying out any further tests.
4. If the concern persists after the visual inspection, **PERFORM** a fault diagnosis with the Ford approved diagnostic tool and **RECTIFY** any displayed faults in accordance with the displayed fault description. **CHECK** the operation of the system.

**DIAGNOSIS AND TESTING****Stoplamps****Description of operation**

A diagnosis of the generic electronic module (GEM) can be performed with the Ford approved diagnostic tool. Furthermore, an integrated service mode enables testing of the input and output signals without the need for further tools. To enable activation of service mode:

- switch off the ignition,
- switch off all other electrical consumers,
- apply the handbrake,
- shift to neutral
- and close the doors.

**Activating the service mode**

Proceed as follows to activate the service mode:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- Turn on the ignition.
- RELEASE the switch of the heated rear window

A signal sounds and the turn signal lamps come on to indicate that service mode has been successfully activated.

**NOTE:** If the alarm is activated (in vehicles fitted with an anti-theft alarm system), service mode cannot be activated.

**Inputs**

SWITCH the windshield wiper switch to the "Off" position to test the input signals. The following is a list of the switch signals to be tested, in no particular order:

- Turn signals (right, left, hazard warning lights)
- Windshield wiper stage I
- Windshield wiper stage II
- Windshield washer system
- Rear window wiper
- Rear window washer system
- Doors open/closed
- Remote control for central locking with double locking
- Hood open/closed (in vehicles equipped with an anti-theft alarm system)
- Tailgate open/closed
- A/C request signal
- Heated windscreen (if fitted)

- Parking Brake
- Brake reservoir fluid level
- Speed control system
- Autolamps
- dipped beam
- main beam
- headlamp flasher
- Marker Lamps
- Reversing lamp
- Liftgate release
- Ignition switch, terminal 15 (turn key to 0 position, then turn key to II position.)

An acoustic signal sounds and the turn signal lamps flash to indicate receipt of each input signal by the generic electronic module.

**Test the windshield wiper "intermittent mode" stage input signal (only vehicles with adjustable intermittent mode)**

The windshield wiper switch must be switched to "intermittent mode" in order to test the input signal. The delay times of the input signals can then be tested by operating the rotary switch. Each change of the rotary switch position is indicated by an acoustic signal and illumination of the turn signals.

**Output signals**

SWITCH the wiper switch to the "intermittent" position to test the output signals. PRESSING the heated rear window switch activates the output signals in the following order:

- Turn Indicator Left Hand
- Turn Indicator Right Hand
- main beam
- dipped beam
- Windshield wiper stage I
- Windshield wiper stage II
- Heated rear window
- Heater blower motor
- Headlamp washer system (vehicles with gas discharge headlamps)
- Electric booster heater (if fitted)
- Autolamps (if fitted)
- Alarm horn (vehicles with alarm system)
- Rear window wiper
- Rear heated window relay



**DIAGNOSIS AND TESTING**

When the heated rear window switch is pressed again, the test of the relevant signal is terminated. When the heated rear window switch is pressed once more, the test for the next signal in the list is started.

**Ending the service mode**

The GEM automatically ends service mode 20 seconds after the last input or at a driving speed of over 7 km/h. However, service mode can be manually ended at any time by proceeding as follows:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- SWITCH OFF the ignition
- RELEASE the switch of the heated rear window

3 signals sound and the turn signal lamps illuminate to indicate that service mode has ended.

**Reset service mode**

If, after completion of service mode, some functions do not operate or do not operate properly, check the following functions:

- Instrument cluster illumination, side lamps and license plate lamp in autolamps mode
- Rear wiper
- Headlamp Washers
- Electric booster heater
- Active anti-theft sounder
- Heated windshield

If one or more of the listed functions is not OK, it's possible that the cause of the fault is due to not exiting service mode properly. To reactivate the functions correctly, perform the following steps:

1. SWITCH OFF the ignition
2. SWITCH OFF the switch for the windscreen wash/wipe system
3. OPERATE the switch of the heated rear window and HOLD IT THERE
4. Turn on the ignition.
5. RELEASE the heated rear window switch (an acoustic signal will sound if activation has been performed correctly)
6. SWITCH the windscreen wash/wipe switch to the "Intermittent wipe" position
7. OPERATE the heated rear window switch 6 times (the main beam headlamps switch on and off automatically)
8. SWITCH OFF the switch for the windscreen wash/wipe system

9. OPERATE the switch of the heated rear window and HOLD IT THERE
10. SWITCH OFF the ignition
11. RELEASE the heated rear window switch (three acoustic signals will sound if activation has been performed correctly)

After completion of the work, check all the functions.

**Inspection and Checking**

**NOTE:** The generic electronic module (GEM) forms part of the central junction box (CJB).

**NOTE:** If the instrument cluster is changed, it must be re-configured. For this purpose, the vehicle-specific data is read out of the module to be replaced using the Ford approved diagnostic tool and is transferred to the new module.

**NOTE:** Before reading out the vehicle-specific data, remake all the separated electrical connections in the vehicle, so that communication between the module and the Ford approved diagnostic tool is ensured.

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

**Visual Inspection**

Electrical
<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Lamp(s)</li> <li>• Bulb(s)</li> <li>• Connector(s)</li> <li>• Switches</li> <li>• Wiring harness</li> </ul>

3. Resolve any obvious causes or concerns found during the visual inspection before carrying out any further tests.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

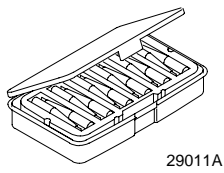


## DIAGNOSIS AND TESTING

## Turn Signal and Hazard Lamps

Refer to Wiring Diagrams Section 417-01, for schematic and connector information.

**Special Tool(s) / General Equipment**

 <p>29011A</p>	<p>Terminal Probe Kit 29-011A</p>
<p>The Ford approved diagnostic tool</p>	

**Description of operation**

A diagnosis of the generic electronic module (GEM) can be performed with the Ford approved diagnostic tool. Furthermore, an integrated service mode enables testing of the input and output signals without the need for further tools. To enable activation of service mode:

- switch off the ignition,
- switch off all other electrical consumers,
- apply the handbrake,
- shift to neutral
- and close the doors.

**Activating the service mode**

Proceed as follows to activate the service mode:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- Turn on the ignition.
- RELEASE the switch of the heated rear window

A signal sounds and the turn signal lamps come on to indicate that service mode has been successfully activated.

**NOTE:** If the alarm is activated (in vehicles fitted with an anti-theft alarm system), service mode cannot be activated.

**Inputs**

SWITCH the windshield wiper switch to the "OFF" position to test the input signals. The following is a list of the switch signals to be tested, in no particular order:

- Turn signals (right, left, hazard warning lights)
- Windshield wiper stage I

- Windshield wiper stage II
- Windshield washer system
- Rear window wiper
- Rear window washer system
- Doors open/closed
- Remote control for central locking with double locking
- Hood open/closed (in vehicles equipped with an anti-theft alarm system)
- Tailgate open/closed
- A/C request signal
- Heated windscreen (if fitted)
- Parking Brake
- Brake reservoir fluid level
- Speed control system
- Autolamps
- Low beam
- High beam
- Headlamp flasher
- Marker Lamps
- Reversing lamp
- Liftgate release
- Ignition switch, terminal 15 (turn key to 0 position, then turn key to II position.)

An acoustic signal sounds and the turn signal lamps flash to indicate receipt of each input signal by the generic electronic module.

**Test the windshield wiper "intermittent mode" stage input signal (only vehicles with adjustable intermittent mode)**

The windshield wiper switch must be switched to "intermittent mode" in order to test the input signal. The delay times of the input signals can then be tested by operating the rotary switch. Each change of the rotary switch position is indicated by an acoustic signal and illumination of the turn signals.

**Output signals**

SWITCH the wiper switch to the "intermittent" position to test the output signals. PRESSING the heated rear window switch activates the output signals in the following order:

- Turn Indicator Left Hand
- Turn Indicator Right Hand
- High beam
- Low beam

**DIAGNOSIS AND TESTING**

- e. Windshield wiper stage I
- f. Windshield wiper stage II
- g. Heated rear window
- h. Heater blower motor
- i. Headlamp washer system (vehicles with gas discharge headlamps)
- j. Electric booster heater (if fitted)
- k. Automatic headlamps (if equipped)
- l. Alarm horn (vehicles with alarm system)
- m. Rear window wiper
- n. Rear heated window relay

When the heated rear window switch is pressed again, the test of the relevant signal is terminated. When the heated rear window switch is pressed once more, the test for the next signal in the list is started.

**Ending the service mode**

The GEM automatically ends service mode 20 seconds after the last input or at a driving speed of over 7 km/h. However, service mode can be manually ended at any time by proceeding as follows:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- SWITCH OFF the ignition
- RELEASE the switch of the heated rear window

3 signals sound and the turn signal lamps illuminate to indicate that service mode has ended.

**Reset service mode**

If, after completion of service mode, some functions do not operate or do not operate properly, check the following functions:

- Instrument cluster illumination, side lamps and license plate lamp in autolamps mode
- Rear wiper
- Headlamp Washers
- Electric booster heater
- Active anti-theft sounder
- Heated windshield

If one or more of the listed functions is not OK, it's possible that the cause of the fault is due to not exiting service mode properly. To reactivate the functions correctly, perform the following steps:

1. SWITCH OFF the ignition
2. SWITCH OFF the switch for the windscreen wash/wipe system

3. OPERATE the switch of the heated rear window and HOLD IT THERE
4. Turn on the ignition.
5. RELEASE the heated rear window switch (an acoustic signal will sound if activation has been performed correctly)
6. SWITCH the windscreen wash/wipe switch to the "Intermittent wipe" position
7. OPERATE the heated rear window switch 6 times (the main beam headlamps switch on and off)
8. SWITCH OFF the switch for the windscreen wash/wipe system
9. OPERATE the switch of the heated rear window and HOLD IT THERE
10. SWITCH OFF the ignition
11. RELEASE the heated rear window switch (three acoustic signals will sound if activation has been performed correctly)

After completion of the work, check all the functions.

**Inspection and Checking**

**NOTE:** The generic electronic module (GEM) forms part of the central junction box (CJB).

**NOTE:** If the generic electronic module (GEM) is changed, the new one must be reconfigured. For this purpose, the vehicle-specific data is read out of the module to be replaced using the Ford approved diagnostic tool and is transferred to the new module.

**NOTE:** Before reading out the vehicle-specific data, remake all the electrical connections which were separated in the vehicle, so that communication between the module and the Ford approved diagnostic tool is ensured.

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

**Visual Inspection**

Electrical
<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Lamp(s)</li> <li>• Connector(s).</li> <li>• Switches</li> <li>• Wiring harness</li> </ul>

**DIAGNOSIS AND TESTING**

3. Resolve any obvious causes or concerns found during the visual inspection before carrying out any further tests.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

## GENERAL PROCEDURES

## Front Fog Lamp Adjustment

## General Equipment

Headlamp Beam Setter

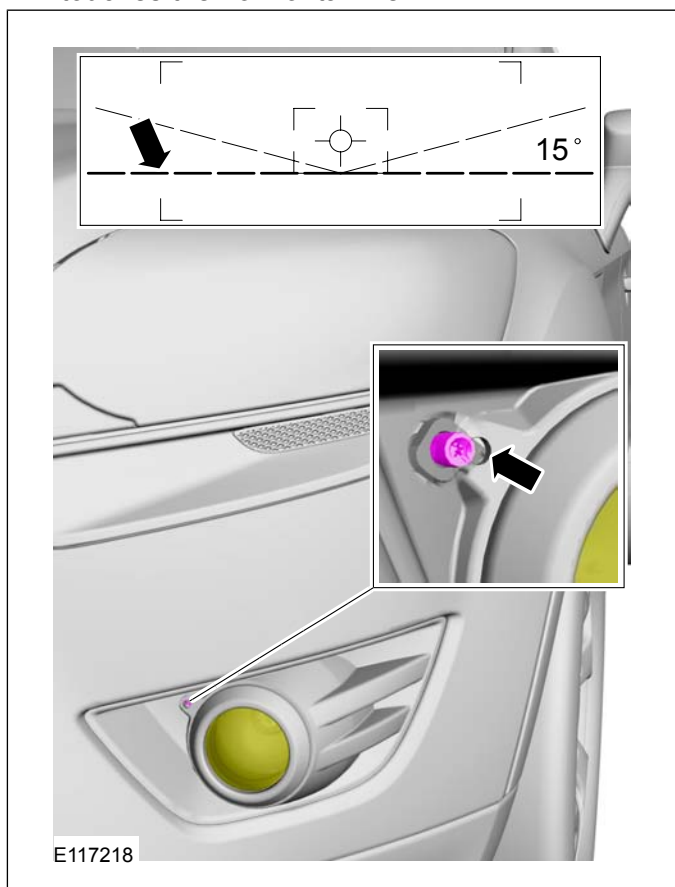
## Activation

1. Place the vehicle on a level surface.
2. Ensure that the tire pressures are to specification and that the vehicle is not overloaded.
3. Switch on the front fog lamps.
4. Set the measuring screen of the beam setting equipment to the correct front fog lamp adjustment setting.

Refer to: **Specifications** (417-01 Exterior Lighting, Specifications).

General Equipment: Headlamp Beam Setter

5. Adjust the fog lamp so that the cut-off line touches the horizontal line.



## GENERAL PROCEDURES

## Headlamp Adjustment

## General Equipment

Headlamp Beam Setter

## All Vehicles

- NOTE:** Make sure that the tire pressures are to specification and that the vehicle is unladen.

**NOTE:** Only use a damp cloth to clean the headlamp lens to avoid any electrostatic charging.

**Ensure that the adjustment is made with the suspension set up.**

- Place the vehicle on a level surface.

## Vehicles with conventional headlamps

- Repeatedly operate the headlamp leveling switch and then set it to "0".

## Vehicles with adaptive front lighting

- Use the diagnostic tool to make certain that the front wheels are in the straight ahead position.

## Vehicles with gas discharge headlamps

- Calibrate the headlamp leveling system using the diagnostic tool.

## All Vehicles

- NOTE:** Always follow the manufacturer's instructions when handling the equipment.

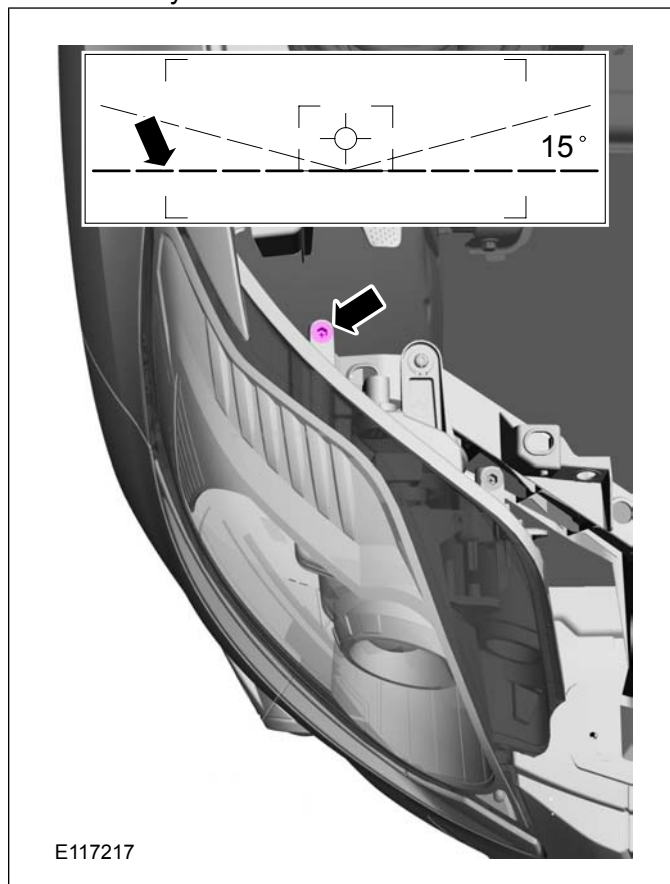
Set the measuring screen of the beam setting equipment to the correct headlamp adjustment setting.

Refer to: **Specifications** (417-01 Exterior Lighting, Specifications).

General Equipment: Headlamp Beam Setter

- Switch on dipped beam.

- Adjust the dipped beams so that the light/dark boundary touches the horizontal line.



- NOTE:** It is acceptable for a stray portion of the low beam to cross the 15° line.

Adjust the headlamps so that the rising line of the boundary line lies at the intersection of

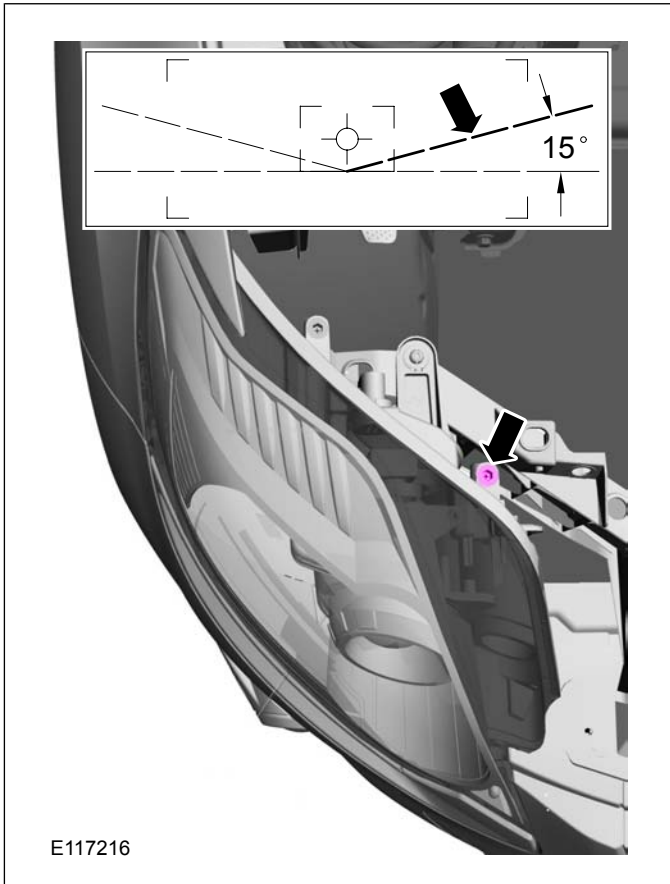
417-01-31

Exterior Lighting

417-01-31

## GENERAL PROCEDURES

horizontal line and the 15 degree line (left-hand drive vehicle shown).

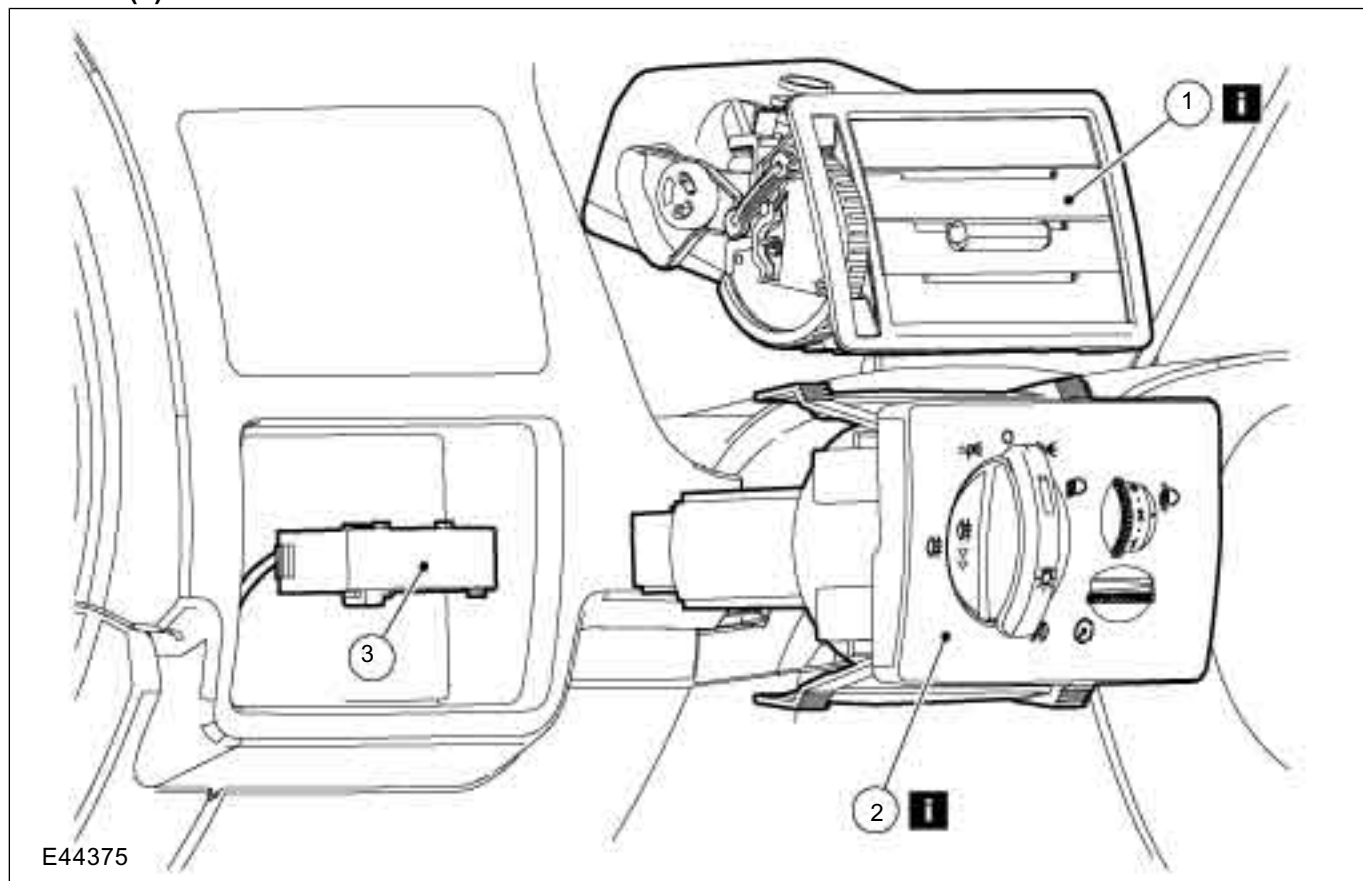




## REMOVAL AND INSTALLATION

## Headlamp Switch

1. Remove the components in the order indicated in the following illustration(s) and table(s).



Item	Description
1	Driver side air vent See Removal Detail
2	Dipped beam switch See Removal Detail
3	Dipped beam switch connector

2. To install, reverse the removal procedure.

## Removal Details

## Item 1 Driver side air vent

1. Remove the passenger side air vent.

1. Push the driver side air vent upwards.

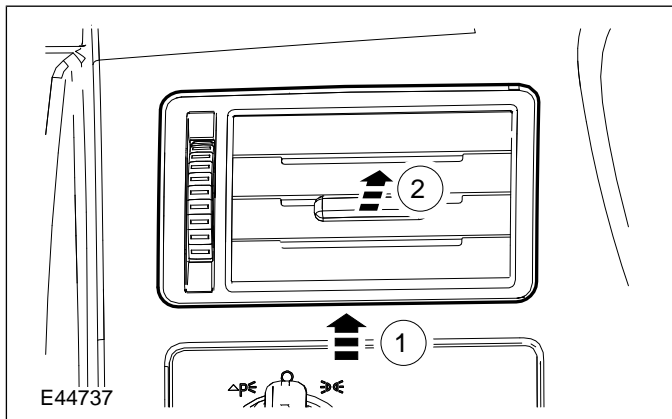
417-01-33

Exterior Lighting

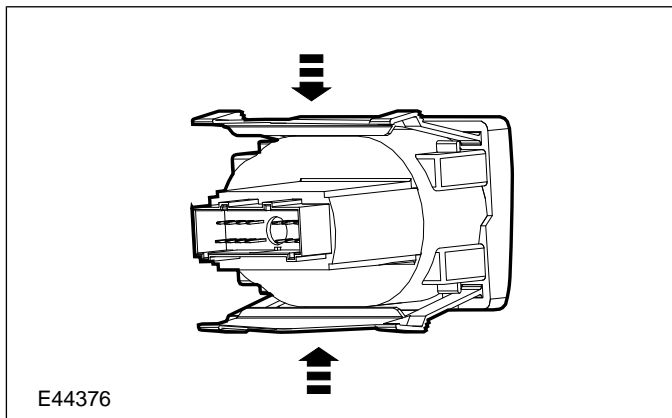
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**REMOVAL AND INSTALLATION**

2. Pull out the passenger side air vent.

**Item 2 Dipped beam switch**

1. Unclip the dipped beam switch through the driver side air vent cut-out.

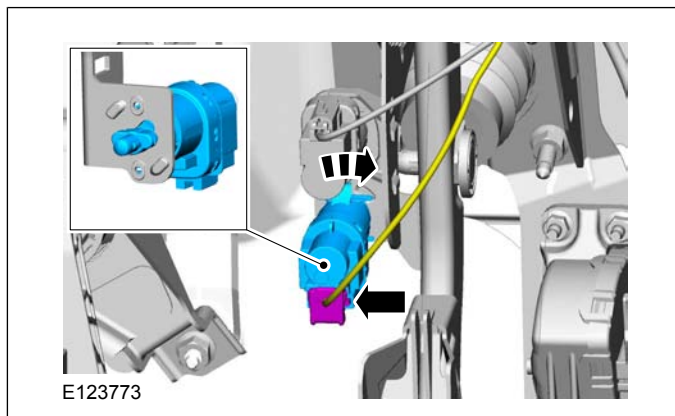


## REMOVAL AND INSTALLATION


## Stoplamp Switch

## Removal

1.  **CAUTION:** Make sure that the brake pedal remains in the rest position.



## Installation

1.  **CAUTION:** Make sure that the brake pedal remains in the rest position.  
To install, reverse the removal procedure.

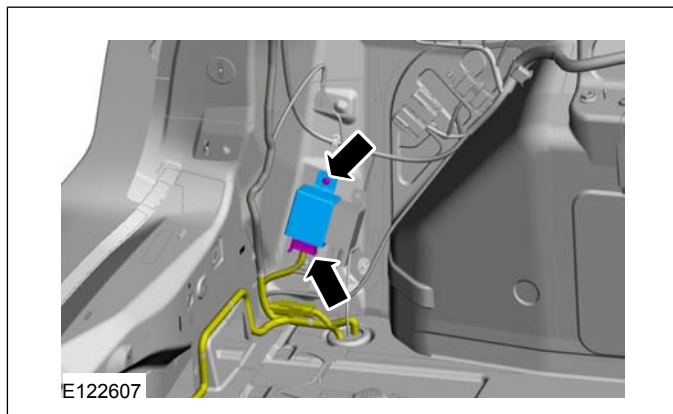
## REMOVAL AND INSTALLATION

## Trailer Module

## Removal

1. Refer to: **Loadspace Trim Panel LH** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- 2.



## Installation

1. To install, reverse the removal procedure.

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Exterior Lighting

417-01-36

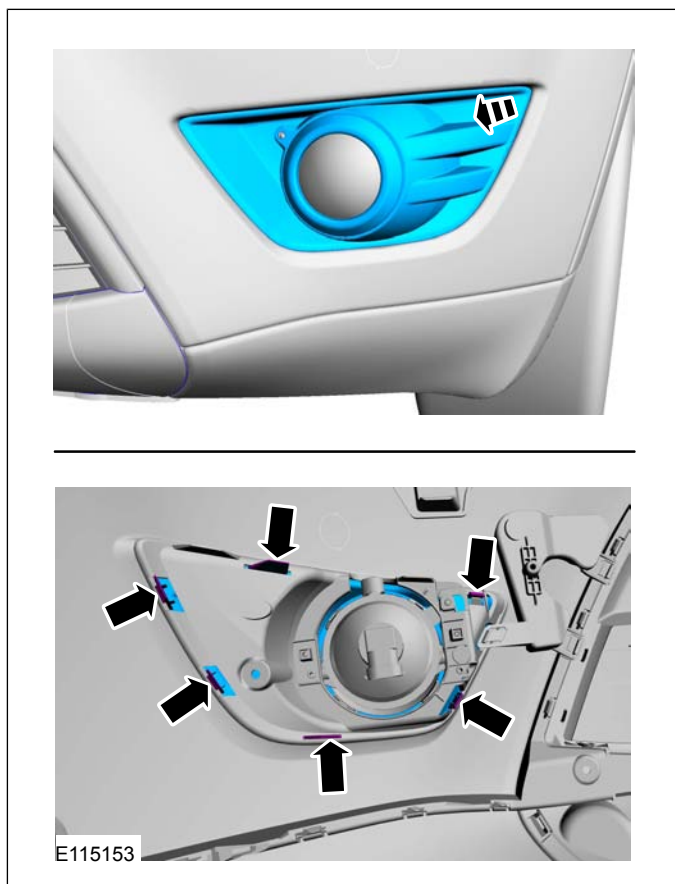
## REMOVAL AND INSTALLATION

## Front Fog Lamp

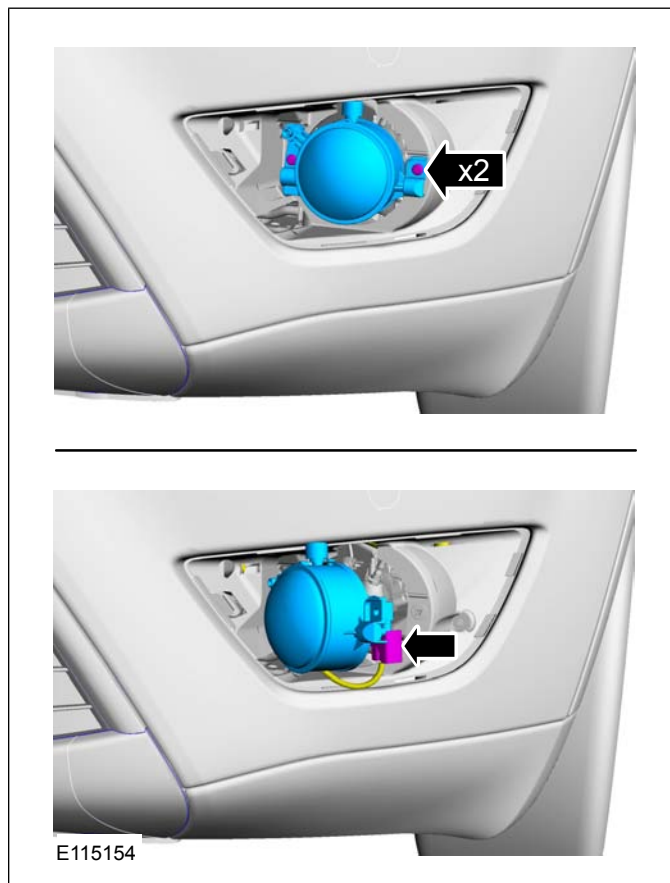
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1.



2.



## Installation

1. To install, reverse the removal procedure.
2. Refer to: [Front Fog Lamp Adjustment](#) (417-01 Exterior Lighting, General Procedures).

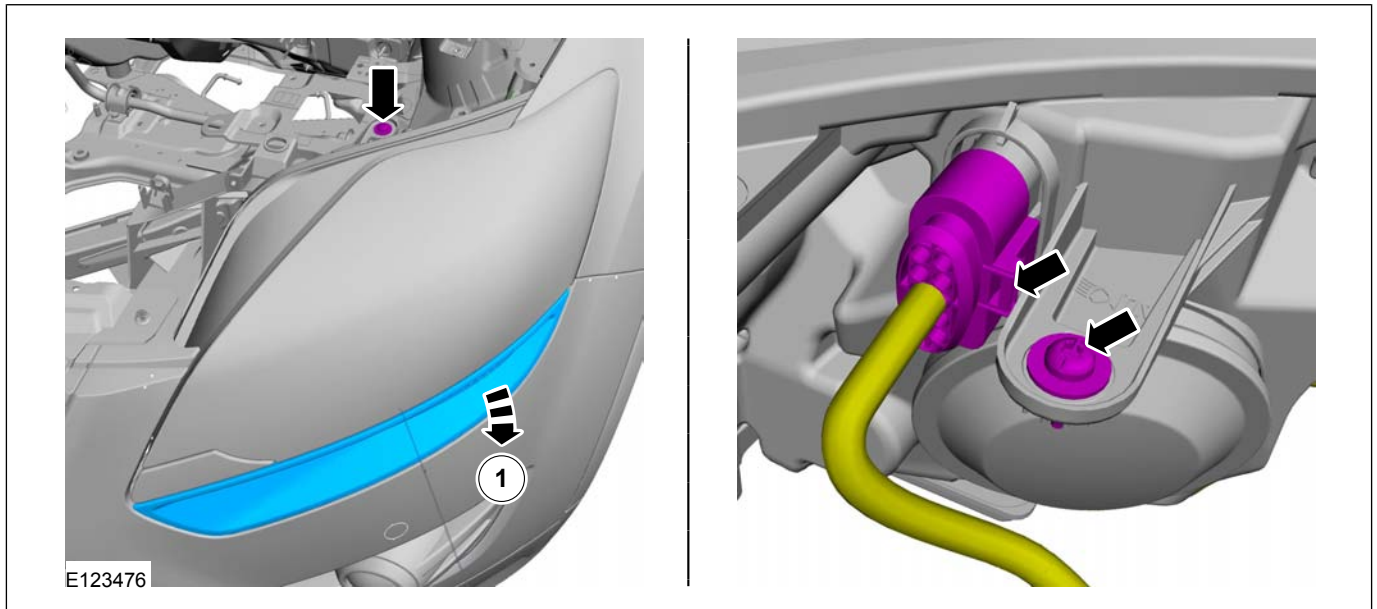


REMOVAL AND INSTALLATION

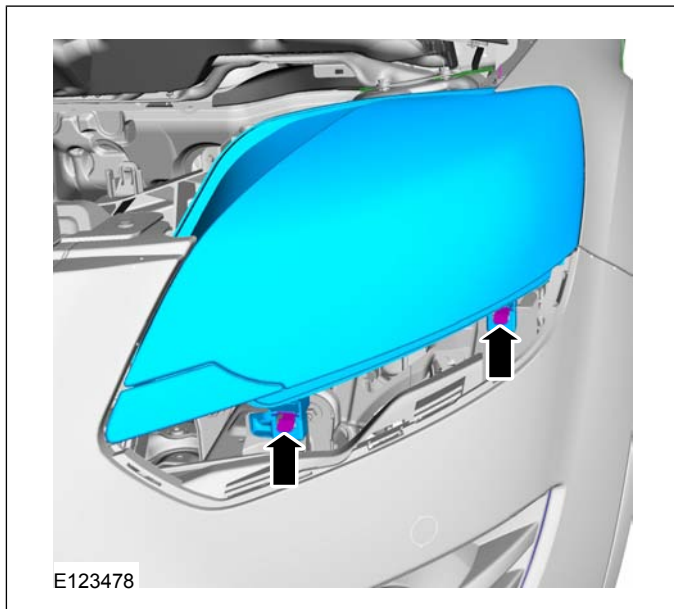
Headlamp Assembly

Removal

1.



2.



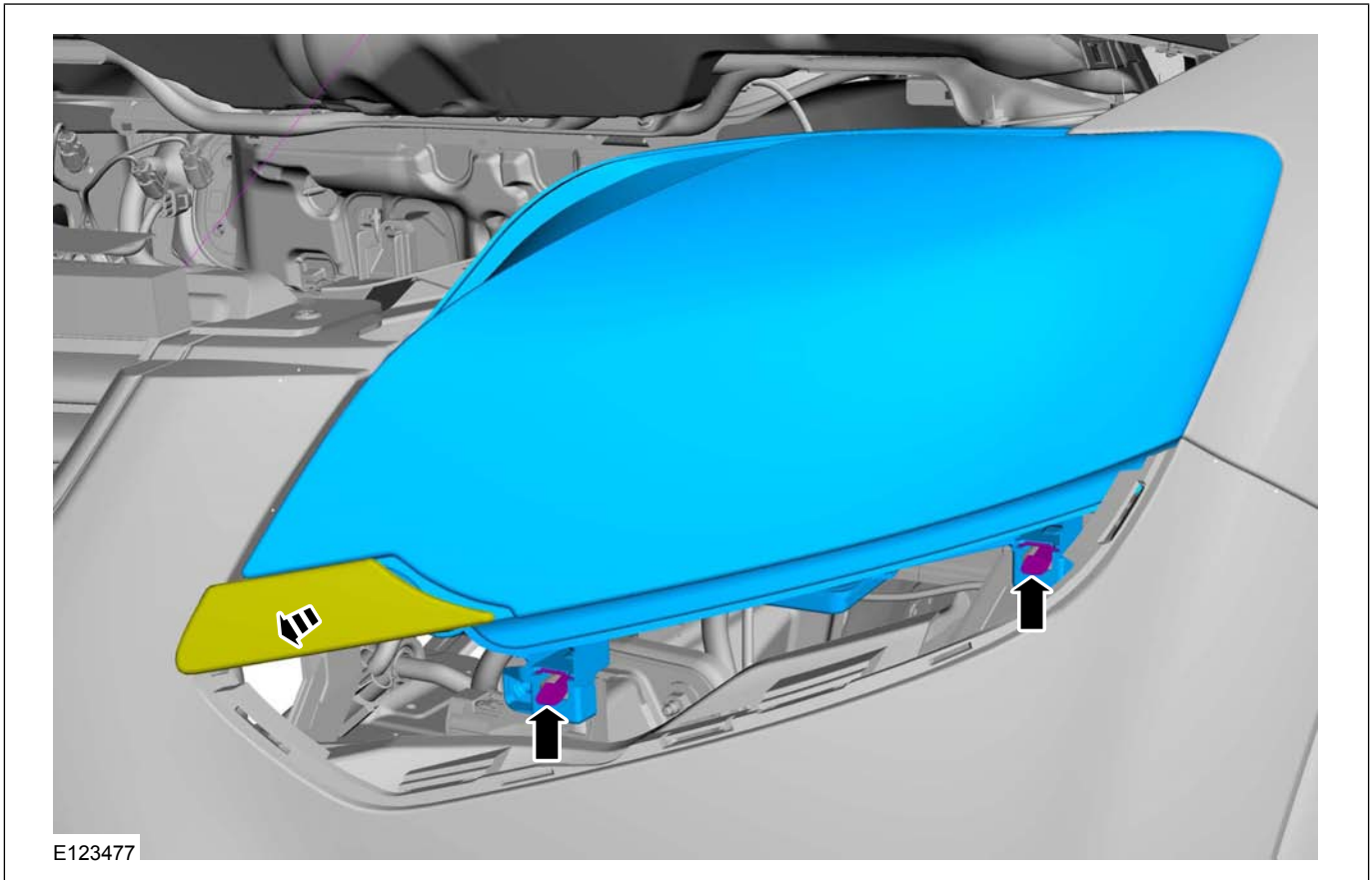
Vehicles with headlamp washers

3.





## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.
2. Refer to: [Headlamp Adjustment](#) (417-01 Exterior Lighting, General Procedures).



# SECTION 417-02 Interior Lighting

VEHICLE APPLICATION: 2008.50 Kuga

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<b>DIAGNOSIS AND TESTING</b>	
Interior Lighting.....	417-02-2
Inspection and Verification.....	417-02-2



**DIAGNOSIS AND TESTING****Interior Lighting**

Refer to **Wiring Diagrams Section 417-02**, for schematic and connector information.

**General Equipment**

The Ford approved diagnostic tool

**Inspection and Verification**

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

**Visual Inspection Chart**

Electrical
<ul style="list-style-type: none"><li>– Fuse(s)</li><li>– Bulb(s)</li><li>– Switch(es)</li><li>– Wiring harness</li><li>– Electrical connector(s)</li><li>– Interior lamp(s)</li><li>– Battery saver relay</li><li>– Door</li><li>– Central junction box (CJB)</li></ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

## SECTION 417-04 Daytime Running Lamps (DRL)

VEHICLE APPLICATION: **2008.50 Kuga**

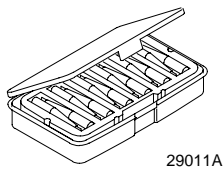
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Description of operation.....	417-04-2
Inspection and Checking.....	417-04-3

## DIAGNOSIS AND TESTING

## Daytime Running Lamps (DRL)

Refer to Wiring Diagrams Section 417-04, for schematic and connector information.

## Special Tool(s)

 <p>29011A</p>	<p>Terminal Probe Kit 29-011A</p>
---	---------------------------------------

## Description of operation

A diagnosis of the generic electronic module (GEM) can be performed with the Ford approved diagnostic tool. Furthermore, an integrated service mode enables testing of the input and output signals without the need for further tools. To enable activation of service mode:

- switch off the ignition,
- switch off all other electrical consumers,
- apply the handbrake,
- shift to neutral
- and close the doors.

## Activating the service mode

Proceed as follows to activate the service mode:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- Turn on the ignition.
- RELEASE the switch of the heated rear window

A signal sounds and the turn signal lamps come on to indicate that service mode has been successfully activated.

**NOTE:** If the alarm is activated (in vehicles fitted with an anti-theft alarm system), service mode cannot be activated.

## Inputs

SWITCH the windshield wiper switch to the "Off" position to test the input signals. The following is a list of the switch signals to be tested, in no particular order:

- Turn signals (right, left, hazard warning lights)
- Windshield wiper stage I
- Windshield wiper stage II
- Windshield washer system

- Rear window wiper
- Rear window washer system
- Doors open/closed
- Remote control for central locking with double locking
- Hood open/closed (in vehicles equipped with an anti-theft alarm system)
- Tailgate open/closed
- A/C request signal
- Heated windscreen (if fitted)
- Parking Brake
- Brake reservoir fluid level
- Speed control system
- Autolamps
- dipped beam
- main beam
- headlamp flasher
- Marker Lamps
- Reversing lamp
- Liftgate release
- Ignition switch, terminal 15 (turn key to 0 position, then turn key to II position.)

An acoustic signal sounds and the turn signal lamps flash to indicate receipt of each input signal by the generic electronic module.

#### Test the windshield wiper "intermittent mode" stage input signal (only vehicles with adjustable intermittent mode)

The windshield wiper switch must be switched to "intermittent mode" in order to test the input signal. The delay times of the input signals can then be tested by operating the rotary switch. Each change of the rotary switch position is indicated by an acoustic signal and illumination of the turn signals.

## Output signals

SWITCH the wiper switch to the "intermittent" position to test the output signals. PRESSING the heated rear window switch activates the output signals in the following order:

- Turn Indicator Left Hand
- Turn Indicator Right Hand
- main beam
- dipped beam
- Windshield wiper stage I
- Windshield wiper stage II

**DIAGNOSIS AND TESTING**

- g. Heated rear window
- h. Heater blower motor
- i. Headlamp washer system (vehicles with gas discharge headlamps)
- j. Electric booster heater (if fitted)
- k. Autolamps (if fitted)
- l. Alarm horn (vehicles with alarm system)
- m. Rear window wiper
- n. Rear heated window relay

When the heated rear window switch is pressed again, the test of the relevant signal is terminated. When the heated rear window switch is pressed once more, the test for the next signal in the list is started.

**Ending the service mode**

The GEM automatically ends service mode 20 seconds after the last input or at a driving speed of over 7 km/h. However, service mode can be manually ended at any time by proceeding as follows:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- SWITCH OFF the ignition
- RELEASE the switch of the heated rear window

3 signals sound and the turn signal lamps illuminate to indicate that service mode has ended.

**Reset service mode**

If, after completion of service mode, some functions do not operate or do not operate properly, check the following functions:

- Instrument cluster illumination, side lamps and license plate lamp in autolamps mode
- Rear wiper
- Headlamp Washers
- Electric booster heater
- Active anti-theft sounder
- Heated windshield

If one or more of the listed functions is not OK, it's possible that the cause of the fault is due to not exiting service mode properly. To reactivate the functions correctly, perform the following steps:

1. SWITCH OFF the ignition
2. SWITCH OFF the switch for the windscreen wash/wipe system
3. OPERATE the switch of the heated rear window and HOLD IT THERE
4. Turn on the ignition.

5. RELEASE the heated rear window switch (an acoustic signal will sound if activation has been performed correctly)
6. SWITCH the windscreen wash/wipe switch to the "Intermittent wipe" position
7. OPERATE the heated rear window switch 6 times (the main beam headlamps switch on and off automatically)
8. SWITCH OFF the switch for the windscreen wash/wipe system
9. OPERATE the switch of the heated rear window and HOLD IT THERE
10. SWITCH OFF the ignition
11. RELEASE the heated rear window switch (three acoustic signals will sound if activation has been performed correctly)

After completion of the work, check all the functions.

**Inspection and Checking**

**NOTE:** The generic electronic module (GEM) forms part of the central junction box (CJB).

**NOTE:** Before reading out the vehicle-specific data, remake all the separated electrical connections in the vehicle, so that communication between the module and the Ford approved diagnostic tool is ensured.

1. Verify the customer concern.
2. Visually check the following electrical causes for the concern:

**Visual Inspection**

Mechanical	Electrical
<ul style="list-style-type: none"> <li>• Headlamp</li> </ul>	<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Connector(s).</li> <li>• Switch(es)</li> <li>• Wiring loom</li> </ul>

3. Resolve any obvious causes or concerns found during the visual inspection before carrying out any further tests.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.



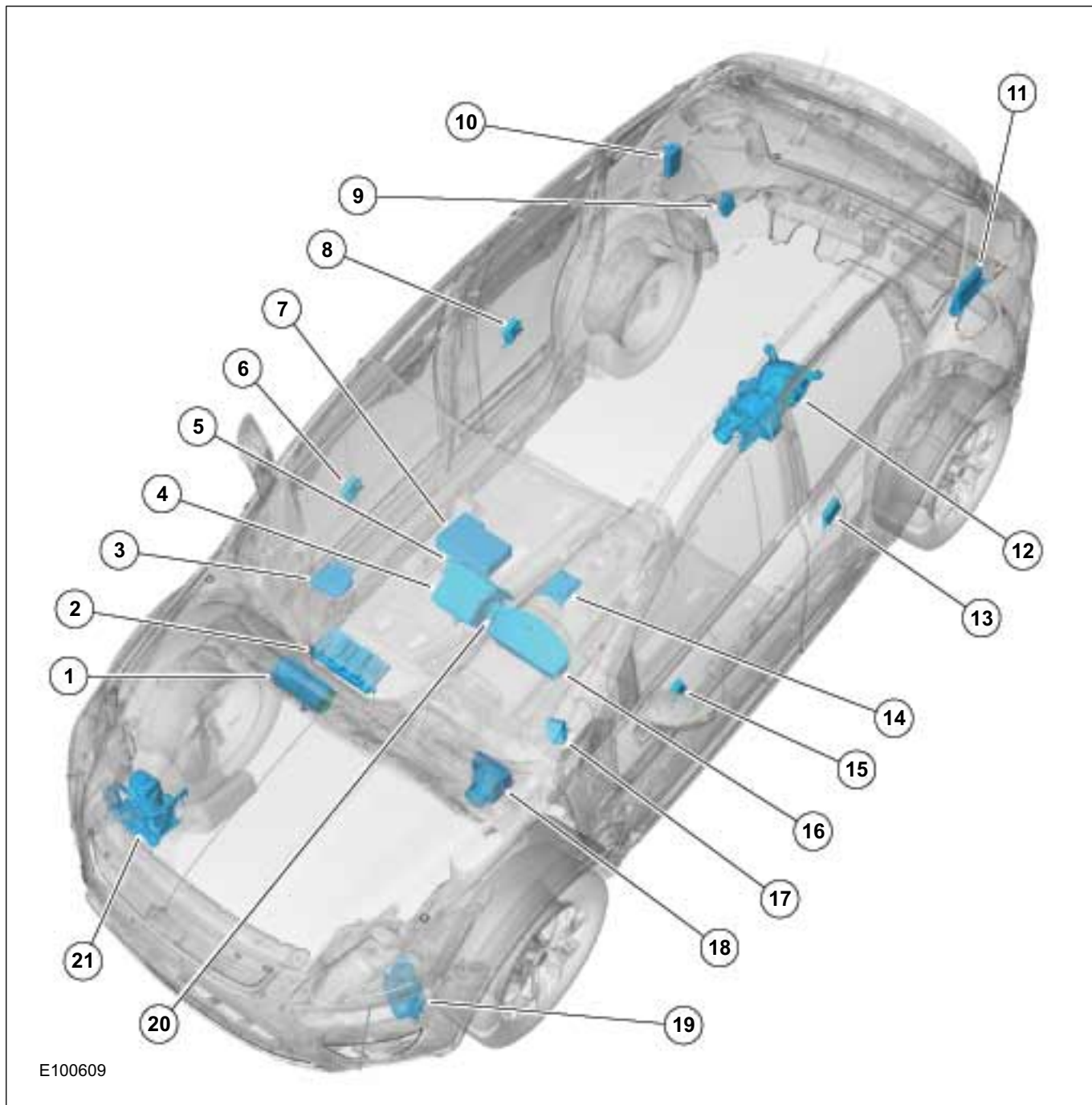
## SECTION 418-00 Module Communications Network

**VEHICLE APPLICATION: 2008.50 Kuga**

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<b>DESCRIPTION AND OPERATION</b>	
Communications Network (Component Location).....	418-00-2
Communications Network (Overview).....	418-00-4
Communications Network (System Operation and Component Description).....	418-00-5
System Diagram.....	418-00-5
System Operation.....	418-00-6
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Data bus systems.....	418-00-7
Component Description.....	418-00-8
ABS.....	418-00-8
<b>DIAGNOSIS AND TESTING</b>	
Communications Network.....	418-00-9
Inspection and Checking.....	418-00-9

DESCRIPTION AND OPERATION

Communications Network – Component Location



E100609

Item	Description
1	Fuel fired booster heater /programmable fuel fired booster heater
2	GEM (generic electronic module)
3	Control module for electronic auxiliary equipment (BVC)
4	Navigation system module - vehicles equipped with DVD navigation system with touchscreen

Item	Description
5	Navigation system display - vehicles equipped with DVD navigation system with touchscreen
6	PDM (Passenger Door Module)
7	CD changer
8	RDM (rear door module) - Passenger side
9	Parking aid module (PAM)

**DESCRIPTION AND OPERATION**

Item	Description
10	Reversing camera module (RVC)
11	Keyless vehicle module (KVM)
12	All-wheel drive control unit
13	RDM - Driver's side
14	RCM (restraints control module)
15	DDM (driver door module)
16	Instrument Cluster

Item	Description
17	High intensity discharge headlamp module (optional)
18	ABS (anti-lock brake system) module or electronic stability program module
19	PCM (powertrain control module)
20	The EATC (electronic automatic temperature control) control module
21	Electrohydraulic power steering module

**DESCRIPTION AND OPERATION**

## Communications Network – Overview

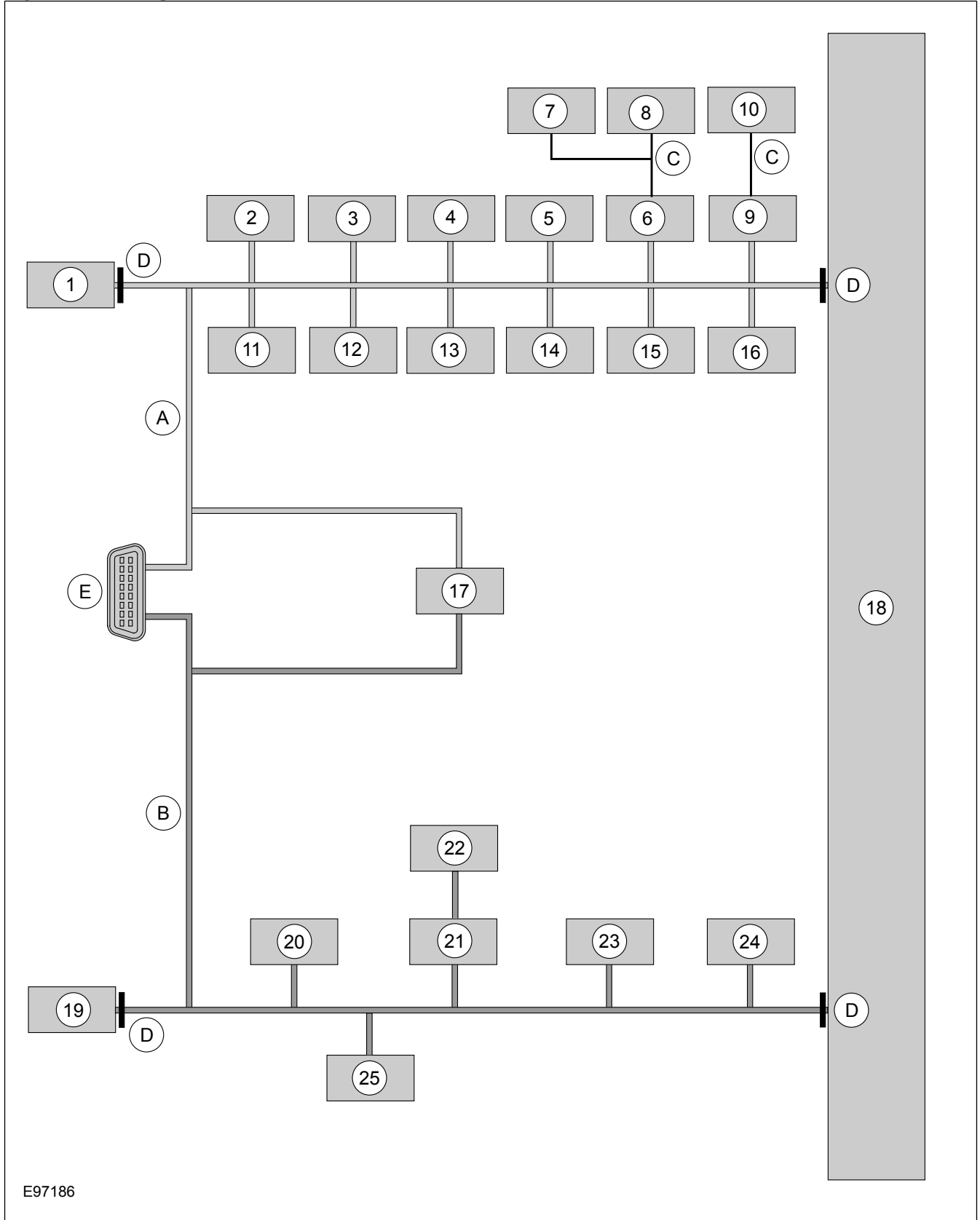
In order to minimize module variations, different equipment levels and functionalities are incorporated in the same module. For this reason, modules must be programmed following replacement. For this purpose, the vehicle-specific data are read out of the module to be replaced using "Install programmable modules" routine in the Ford diagnostic unit and transferred to the new module. In the process, it is also possible to replace older software versions with more up-to-date versions, for example.

If it was not possible to read out any vehicle-specific data with the Ford diagnostic unit before replacing a module (the module to be replaced does not respond), the data available in the OASIS system (ASBUILT data) must be entered manually using the Ford diagnostic unit when programming the module.

DESCRIPTION AND OPERATION

Communications Network – System Operation and Component Description

System Diagram



E97186

## DESCRIPTION AND OPERATION

Item	Description
A	Medium speed CAN (controller area network) bus (MS-CAN)
B	High speed CAN bus (HS-CAN)
C	LIN (local interconnect network) bus
Drive	Terminating resistors
E	DLC (data link connector)
1	GEM Refer to Component Description: ABS (page ?)
2	Fuel fired booster heater /programmable fuel fired booster heater
3	The EATC control module
4	Reversing camera module (RVC)
5	Parking aid module (PAM)
6	DDM
7	Front driver's side switch unit
8	Driver's side RDM
9	PDM (Passenger Door Module)
10	Passenger side RDM
11	Audio unit/navigation unit
12	CD changer

Item	Description
13	Navigation system module - vehicles equipped with DVD navigation system with touch screen (not communicating with the diagnostic unit)
14	Navigation system display - vehicles equipped with DVD navigation system with touch screen (not communicating with the diagnostic unit)
15	Control module for electronic auxiliary equipment (BVC)
16	RCM
17	Keyless vehicle module (KVM)
18	Instrument Cluster
19	PCM
20	Fuel additive system module.
21	ABS module or electronic stability program module
22	Yaw rate sensor/lateral acceleration sensor
23	Headlamp Leveling Module
24	All-wheel drive control unit
25	Electrohydraulic power steering module

## System Operation

### General

In a communications network (data bus system), various modules of different systems are connected to one another via one or several lines.

The data bus system is used exclusively for transmitting data between the connected modules, as well as between the connected modules and the Ford diagnostic unit.

In a data bus system, complete data blocks are transmitted instead of single on/off pulses. In addition to the actual information, these data blocks also contain data regarding the address of the module to be addressed, the size of the data block and information for monitoring the content of each individual data block.

Data bus systems offer various advantages:

- Simplified data transmission between the modules due to a standardized protocol
- Fewer sensors and connectors
- Improved diagnostic options
- Lower costs

The DLC is connected to the various data bus systems and to the power supply via the standard 16-pin GEM. The signal for the module programming is also transferred via the DLC.

In a data bus system, if there is a break in one or both lines or there is a short to ground or to voltage, then communication between the modules and with the Ford diagnostic unit is disturbed or is no longer possible at all.

In order to be able to establish communication with one another, the modules of the individual systems



**DESCRIPTION AND OPERATION**

must use the same language. This language is called a protocol.

At present, Ford uses three different data bus systems. Depending upon model and equipment level, all three data bus systems are used. Each of these data bus systems has its own protocol.

**Data bus systems****ISO 9141 bus**

The International Organisation for Standardisation ISO 9141 bus. This consists of a single wire and is used exclusively for communication between the modules and the Ford diagnostic unit. The fault memories of the various modules are read out via the ISO 9141 bus.

**Local Interconnect Network (LIN) bus**

The LIN bus is a standard specifically designed for cost-effective communication between intelligent sensors and actuators in vehicles. The LIN control unit subnet is used in every situation where the bandwidth and versatility of CAN is not needed. The LIN specification comprises the LIN protocol, a standard format for describing a complete LIN and the interface between an LIN and the application. An LIN comprises a LIN master and one or more LIN slaves. The LIN utilizes the master/slave principle for the purpose of bus access control. This has the significant advantage that few resources (CPU performance, ROM, RAM) are required for bus management in the slave module. The master is implemented in a control module or a gateway which has the necessary resources. All communication is initiated by the master. Consequently, a message always consists of a header, which is generated by the master, and a response from the slave. The data transfer rate is in the region of up to 20 Kbit/s. The LIN master knows the time sequence of all data which are to be transmitted. These data are transmitted by the corresponding LIN slaves (e.g. ultrasonic sensors) if they are requested to do so by the LIN master. LIN is a single-wire bus, i.e. the data are transmitted in the cable via one wire. Usually the same cable is also used to provide the supply voltage. The ground connection of the supply voltage also acts as the ground connection of the data transmission. An LIN does not use a terminating resistor.

**Controller Area Network (CAN) bus**

This consists of two twisted wires and operates serially (data is transmitted sequentially). It is used for communication between the modules

themselves and between the modules and the Ford diagnostic unit. The modules are connected to the data bus in parallel. New modules can be incorporated easily, without modifying the other wiring or modules. The transmitted data is received by every module connected to the control unit network (CAN). As each data packet has an identifier (label), in which the priority of the message is determined as well as the content identification, each module can detect whether or not the data is relevant for its own information processing. This enables several modules to be addressed with a particular data packet and supplied with data simultaneously. For this purpose, it is ensured that important data (for example from the ABS) is transmitted first. The other modules are only able to submit their data to the data bus after the high-priority messages have been received.

The advantages of the CAN bus are:

- Minimization of wiring requirements
- High degree of error protection (fault / fail-proof)
- Robustness
- Good extendibility
- Prioritization of messages
- Inexpensive
- Automatic repetition of faulty messages
- Independent system monitoring and the ability to disconnect faulty modules from the data bus automatically

Due to the increased number of modules and the resulting continued increase in data transfer, two different CAN bus systems are used. Essentially, they only differ in terms of their data transmission rates and application areas.

To be able to distinguish between the individual CAN bus systems, the CAN bus system with the high transfer speed is called the high speed CAN bus (HS-CAN). The data are transmitted at a baud rate of 500 kB/s.

The CAN bus system with the medium transfer speed is called the medium speed CAN bus (MS-CAN) and is mainly used for communication in the comfort electronics or the multimedia system. The data are transmitted at a baud rate of 125 kB/s. An interface (gateway) is used to exchange data between the HS-CAN and the MS-CAN. This provides the connection between the three CAN databus systems and is installed in the GEM and in the electronic instrument cluster. The number of modules which are connected to the three databus

## DESCRIPTION AND OPERATION

systems depends on the equipment level of the vehicle.

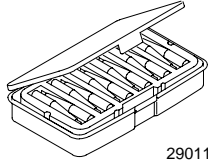
In order to guarantee a high degree of error protection, two 120 Ohm terminating resistors are installed in the CAN. These are integrated in the first module connected to the CAN and in the last module connected to the CAN respectively and are used for suppression as well as the elimination of voltage peaks. In order to ensure correct functioning of the data bus system, the modules must always be connected with an integral terminating resistor. In order to enable communication between the modules on the HS-CAN and the modules on the MS-CAN, one module is connected to both data bus systems. The connection of both data bus systems is designated as a gateway. In this gateway, the received data is converted to the transmission rate required for the relevant data bus and is transmitted. This ensures an optimal distribution of information between both data bus systems.

## Component Description

### ABS

The GEM is integrated in the CJB (central junction box) and cannot be replaced as a separate unit.

**DIAGNOSIS AND TESTING****Communications Network****Special Tool(s) / General Equipment**

 <p>29011A</p>	<p>Terminal Probe Kit 418-S035</p>
<p>Digital multimeter</p>	
<p>The Ford approved diagnostic tool</p>	

**Inspection and Checking**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**NOTE:** Ensure correct locking of wiring harness connectors.

**Visual Inspection Chart**

<b>Electrical</b>
- Fuse(s)
- Wiring harness
- Connector

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.



# SECTION 418-01 Module Configuration

VEHICLE APPLICATION: 2008.50 Kuga

CONTENTS	PAGE
<b>GENERAL PROCEDURES</b>	
Module Configuration.....	418-01-2
Programmable Module Installation.....	418-01-3



**GENERAL PROCEDURES****Module Configuration****Activation**

1. Install the most up-to-date software version in the integrated diagnostic system (IDS).
2. In IDS, select the "Module reprogramming" submenu in the "Module programming" menu tool box and then follow the instructions.
3. Transfer a new software version (if available) to the powertrain control module (PCM) using IDS, if a module-reprogramming of the PCM may be required in the case of engine running concerns.
4. Following installation of a wheel/tire combination, for which the tire-tread circumference does not correspond to that of standard tires, the tire size must be changed in the PCM using IDS. Therefore select the "Programmable parameters" submenu and enter the corresponding tire size under the "tire size" menu item.

**GENERAL PROCEDURES****Programmable Module Installation****Activation**

5. Install the most up-to-date software version in IDS.
6. If, before replacing a module, it was not possible to read out the vehicle-specific data using the integrated diagnostic system (IDS) (the module to be replaced does not respond) then, during programming of the new module, the vehicle-specific data must be entered manually via a selection list in IDS or via a code which can be obtained from the Technical Hotline.
7. In order to program, select the "Install programmable module" submenu in the "Module programming" menu tool box and then follow the instructions.
8.
  - The following modules must be programmed after replacement:
    - Anti-lock braking system module (ABS)
    - Audio system module (ACM)
    - CD player (CDP)
    - Driver's door control unit (D-DCU)
    - Passenger's door control unit (P-DCU)
    - Rear left door control unit (RL-DCU)
    - Rear right door control unit (RR-DCU)
    - Electrical power steering (EPS)
    - Generic Display Module (GDM) (vehicles with DVD navigation system with touchscreen)
    - Generic electronic module (GEM)
    - Headlamp control module (HCM) (vehicles with gas discharge headlamps)
    - Instrument cluster (IC)
    - Navigation system (NAV) (vehicles with navigation system)
    - Parking aid module(PAM)
    - Powertrain control module (PCM)
    - Restraint control module (RCM)
    - Rear entertainment system module (RETM) (vehicles with rear seat entertainment system)
9. In order to configure the PCM, select the "Programmable parameters" submenu in the "Module programming" menu tool box and then follow the instructions.
10. For vehicles with anti-lock braking system and electronic stability program, these must also be

configured using IDS following replacement of the lateral acceleration sensor, yaw rate sensor or pressure sensor. Configuration is performed in the "Programmable parameters" menu tool box.



## SECTION 418-02 Wiring Harnesses

VEHICLE APPLICATION: 2008.50 Kuga

CONTENTS	PAGE
<b>DIAGNOSIS AND TESTING</b>	
Wiring Harness.....	418-02-2
Inspection and Verification.....	418-02-2
<b>REMOVAL AND INSTALLATION</b>	
Passenger Compartment Wiring Harness.....	418-02-4
Instrument Panel Wiring Harness.....	418-02-24
Engine Compartment Wiring Harness.....	418-02-37

## DIAGNOSIS AND TESTING

## Wiring Harness

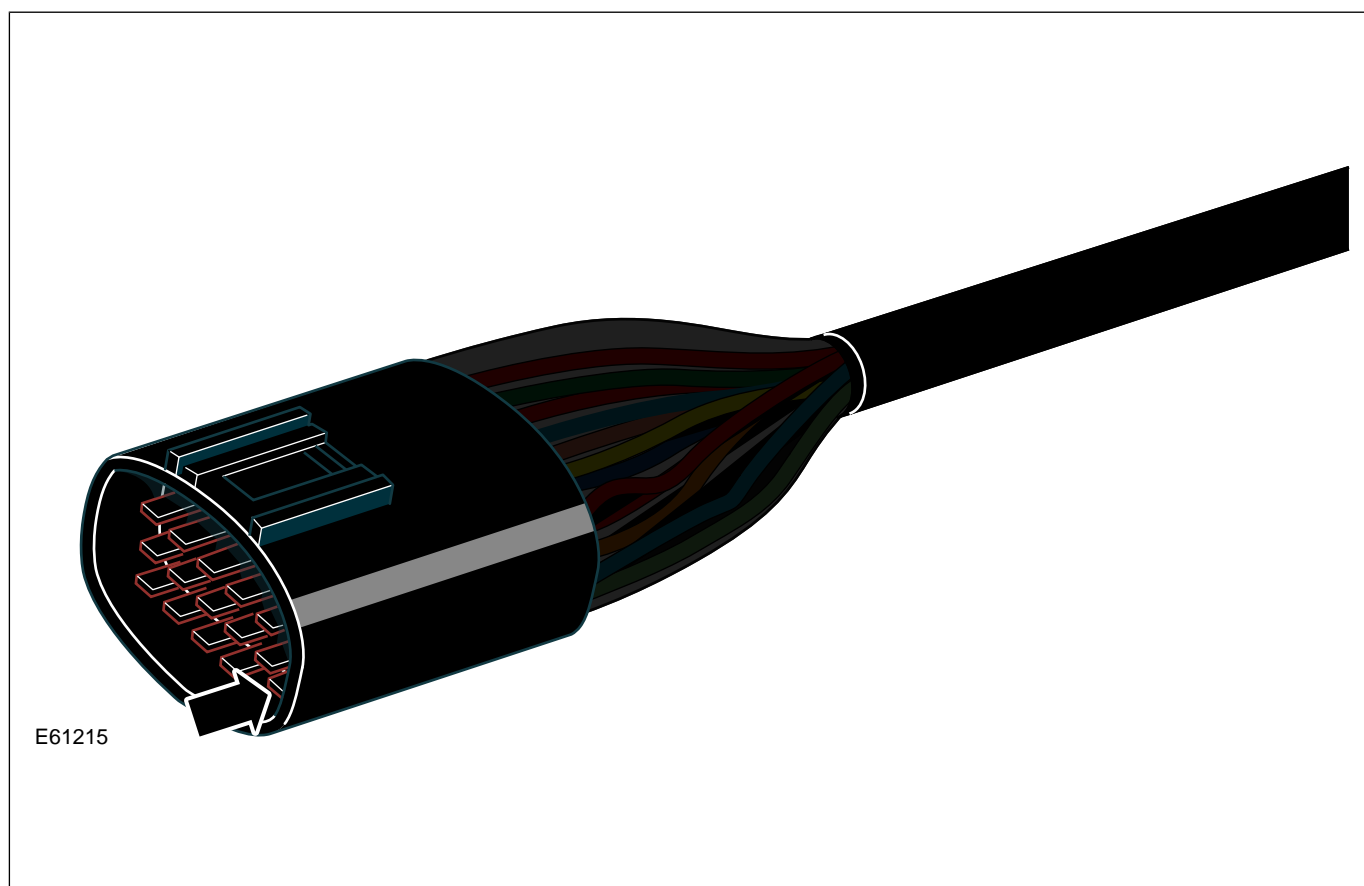
## General Equipment

Ford approved diagnostic tool

## Inspection and Verification

1. Verify the customer concern.

2. Check the electrical connectors for security, damage and incorrect connection. If the electrical connectors are broken, damaged or incorrectly connected, repair or replace the components as required. TEST the system for normal operation before proceeding to the next step.

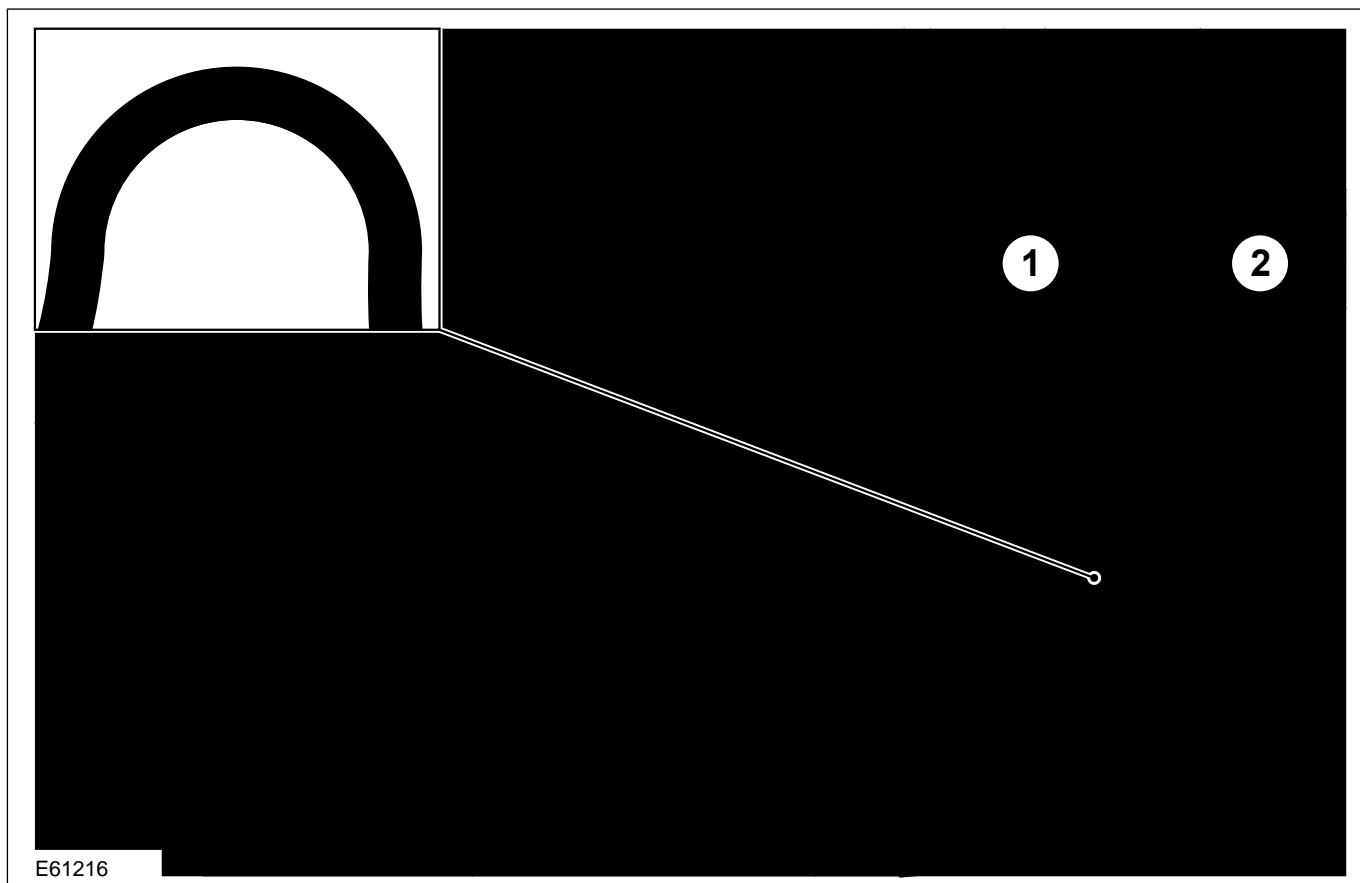


3. Disconnect the electrical connectors and check for the following:

- Moisture in the connector due to misaligned, damaged or missing seals.
- Contamination from leaking fluids in the region of the connector.

- Damaged or oxidised connector pins.
  - Disengaged connector pins (this can be checked by carefully pressing on the individual pins).
4. If any of the conditions listed are present, repair or replace the components as required. TEST the system for normal operation before proceeding to the next step.

## DIAGNOSIS AND TESTING



1. Wiring harness.
2. Component.
5. Check the wiring harness for the following:
  - Incorrect routing or installed too tightly.
  - Pinched or kinked sections.
  - Chafed insulation.
  - Security and orientation of retaining clips.
  - Damage in areas where the wiring harness is subjected to noise, vibration and harshness (NVH). For example, transmission or suspension systems.
6. If any of the conditions listed are present, repair or replace the components as required. TEST the system for normal operation. If the concern persists, REFER to the digital multimeter function of the Ford approved diagnostic tool to check the integrity of the wiring harness and electrical connectors.

REMOVAL AND INSTALLATION

Passenger Compartment Wiring Harness

General Equipment

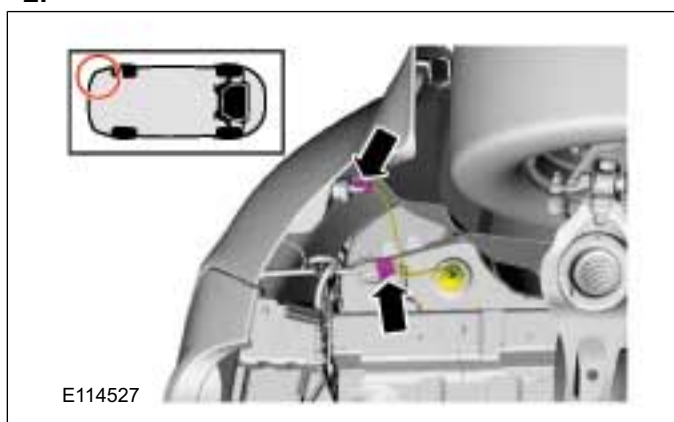
Hot Air Gun

Removal

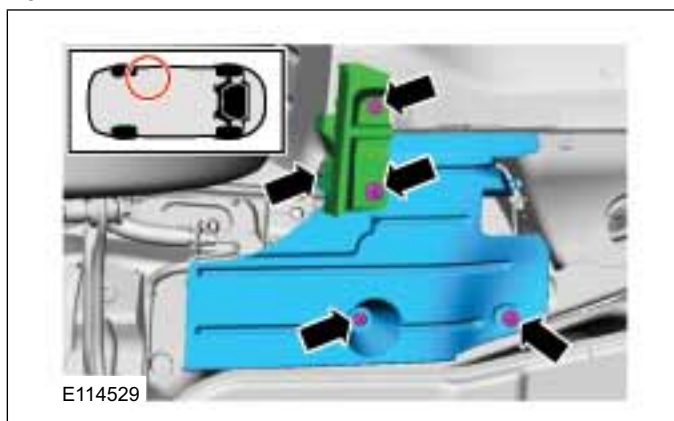
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

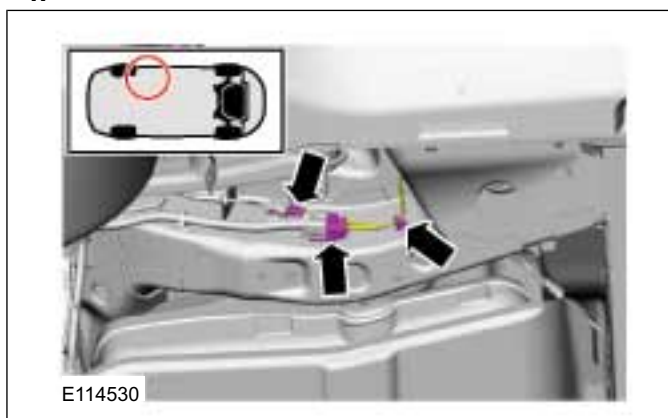
2.



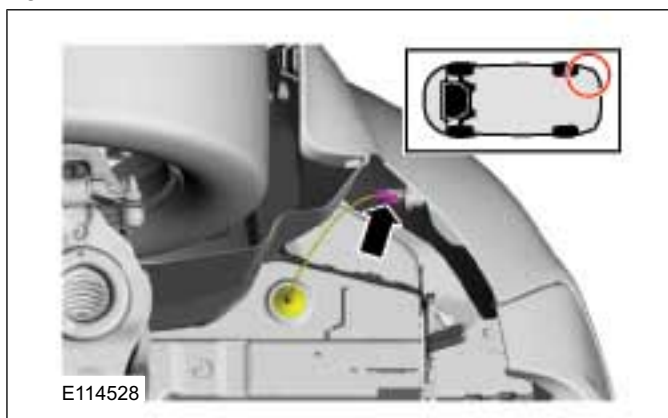
3.



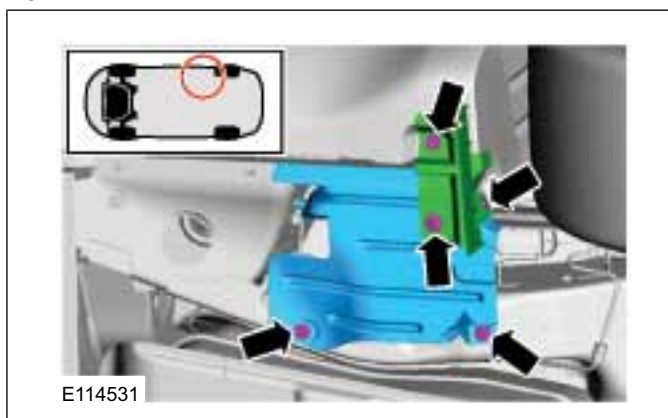
4.



5.

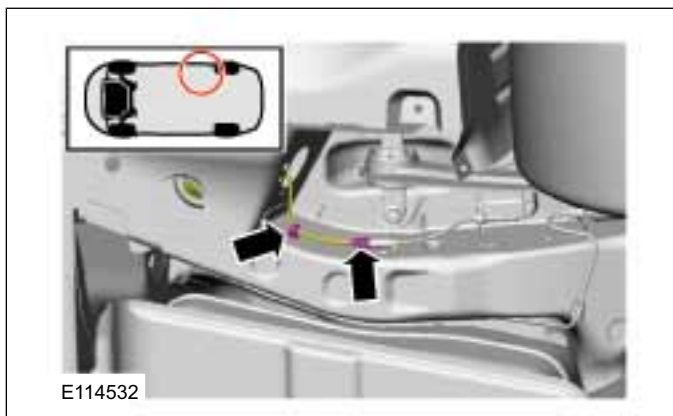


6.



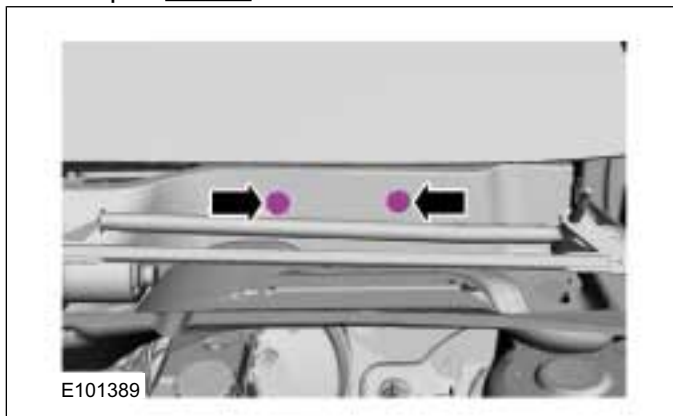
REMOVAL AND INSTALLATION

7.



8. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).

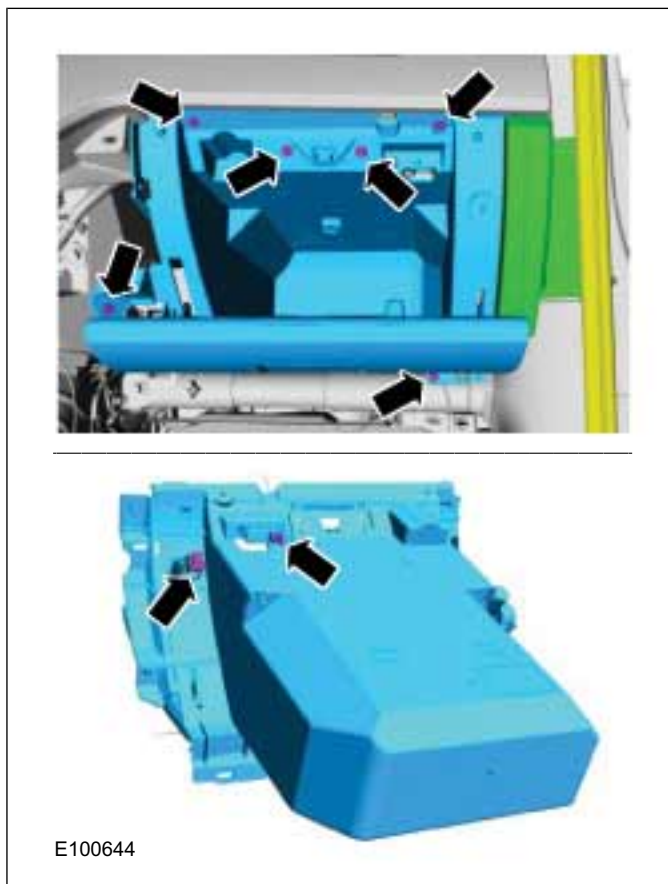
9. Torque: 25 Nm



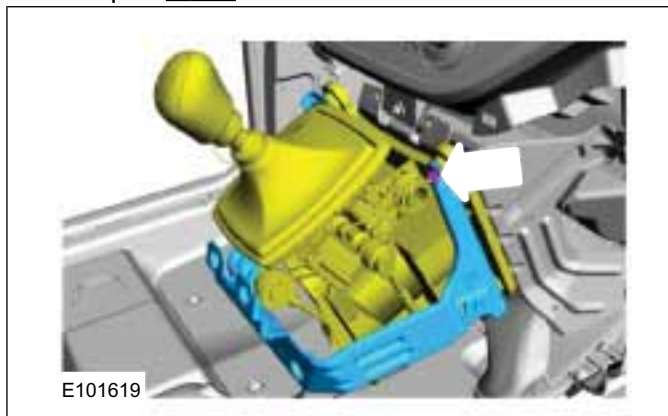
10. Remove the front doors.

11. Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation).

12

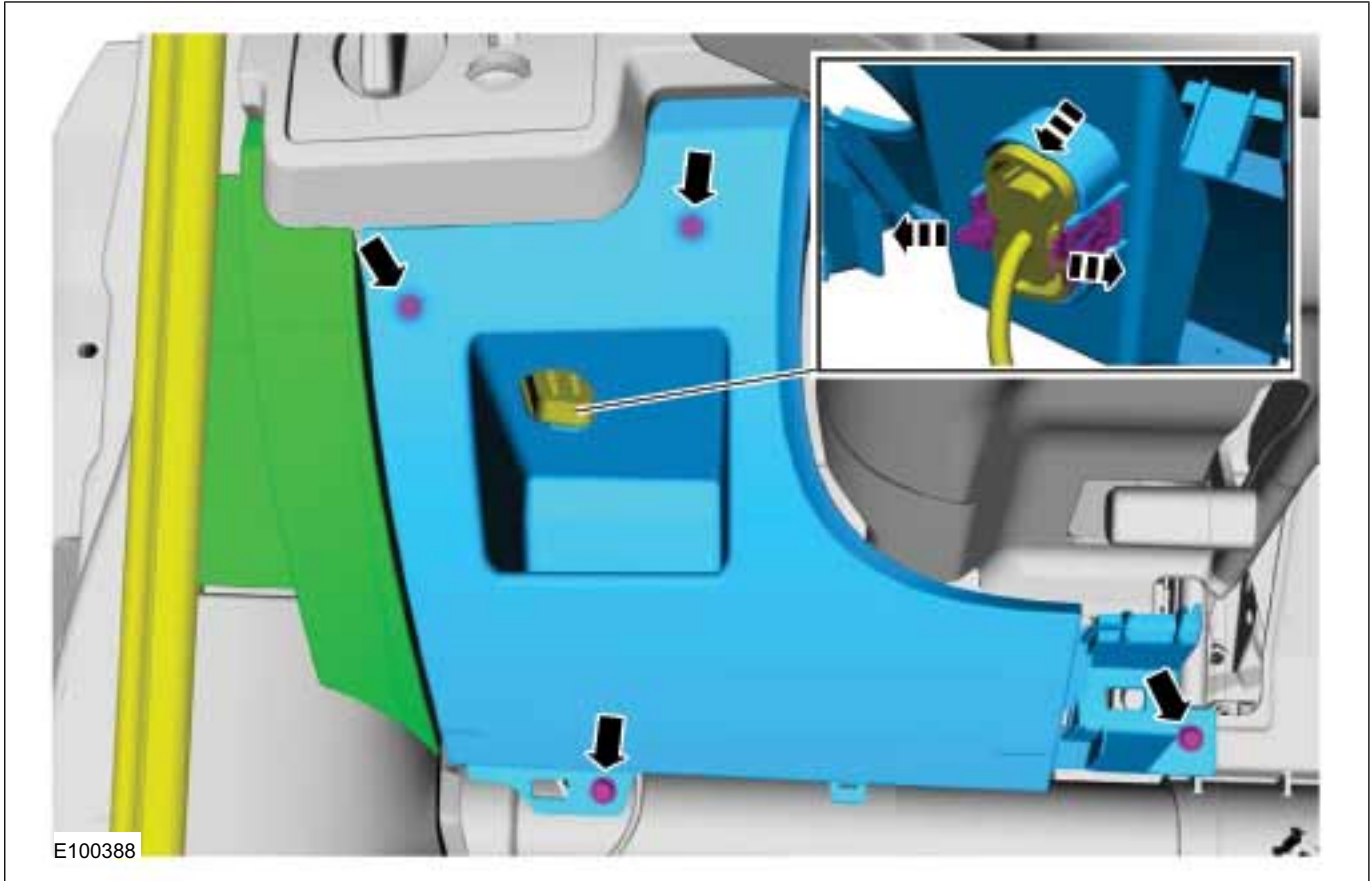


13. Torque: 9 Nm



14.

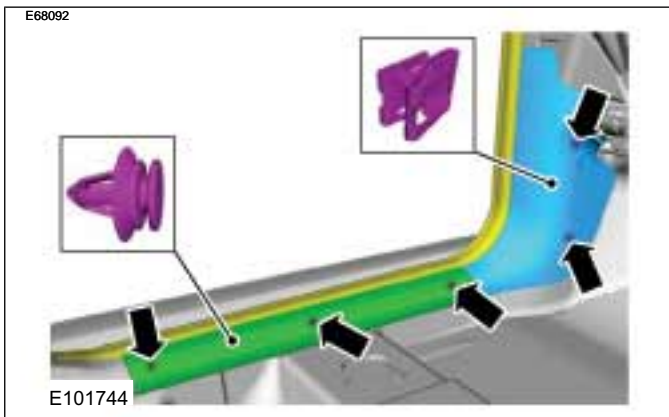
REMOVAL AND INSTALLATION



15. On both sides.

Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

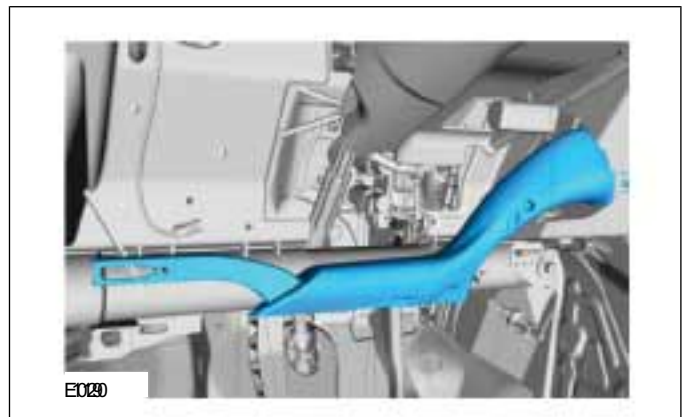
16. On both sides.



17.



18.



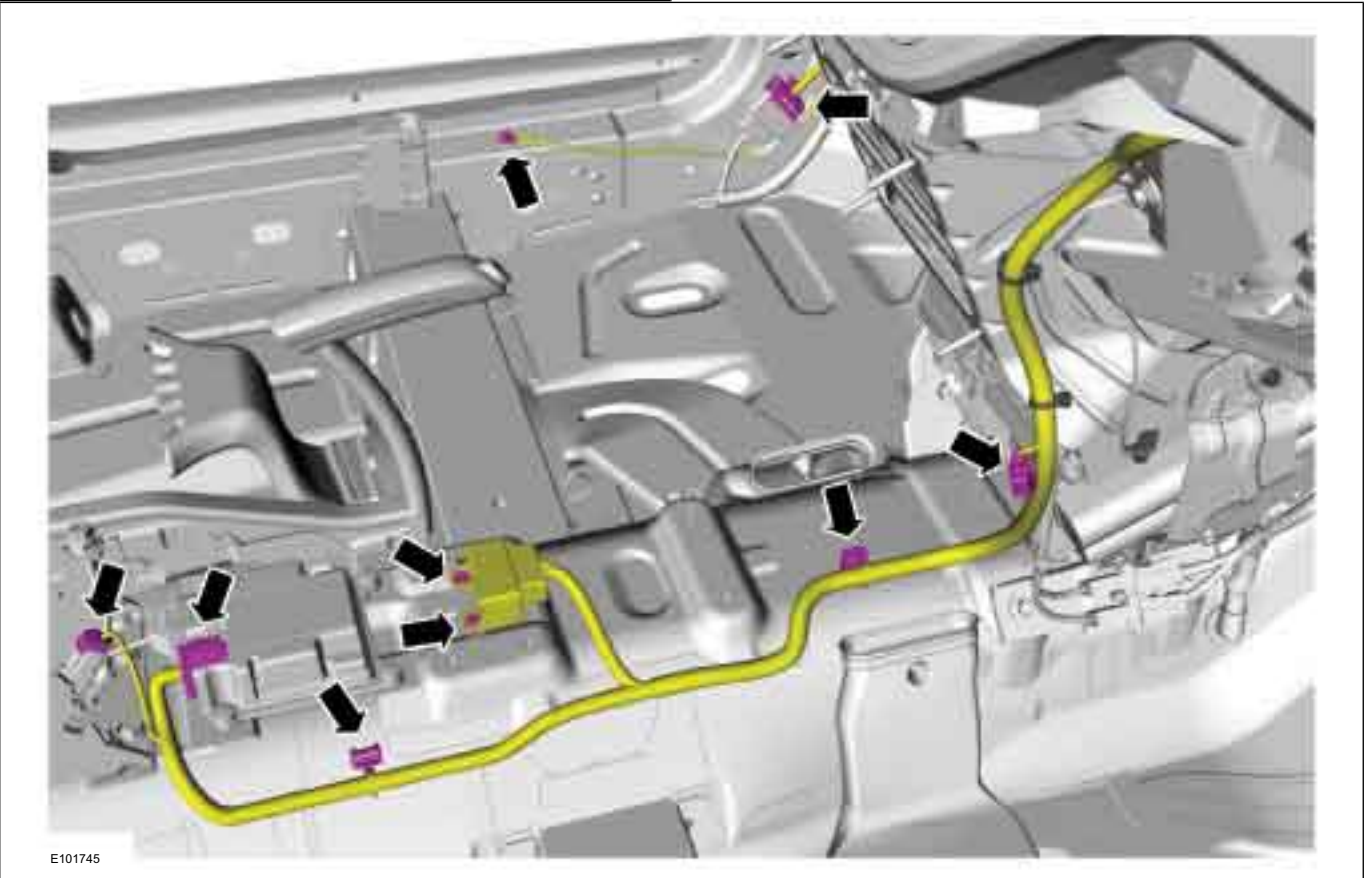
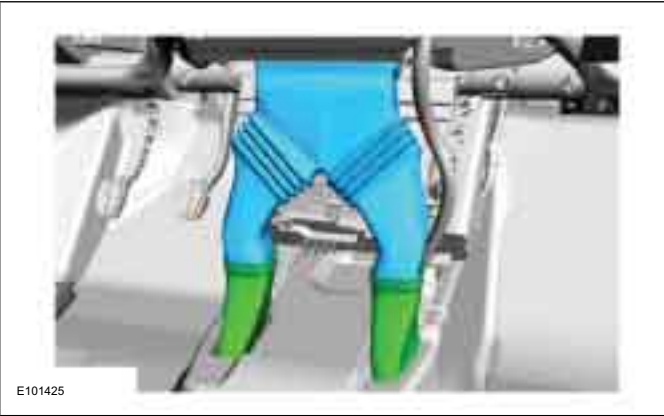




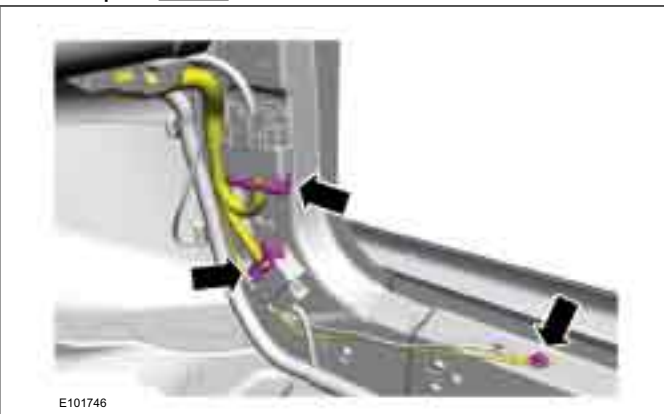
REMOVAL AND INSTALLATION

19.

20. Torque: 9 Nm



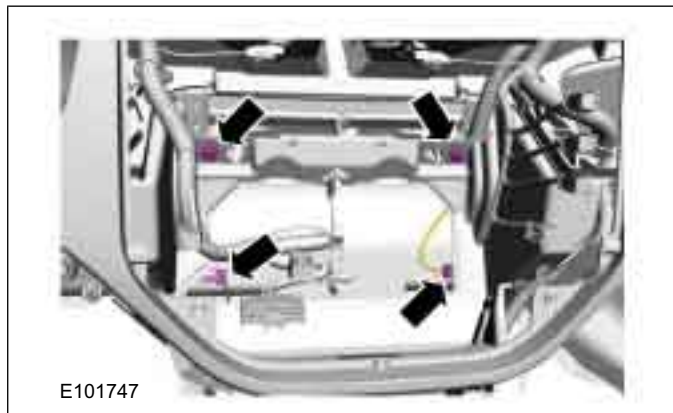
21. Torque: 9 Nm



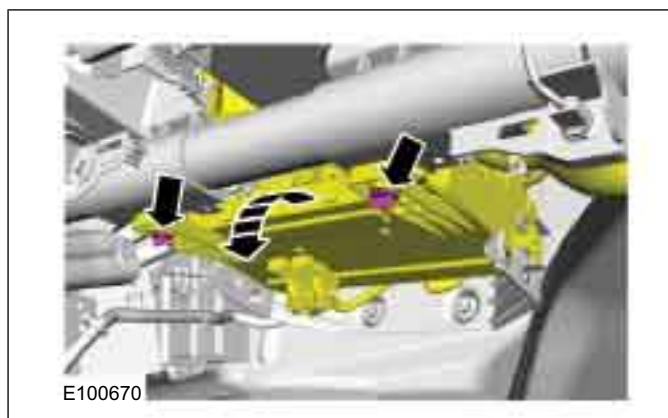
## REMOVAL AND INSTALLATION

- 22 Refer to: **Climate Control Assembly - Vehicles With: Manual Temperature Control** (412-01 Climate Control, Removal and Installation).  
Refer to: **Climate Control Assembly - Vehicles With: Automatic Temperature Control** (412-01 Climate Control, Removal and Installation).

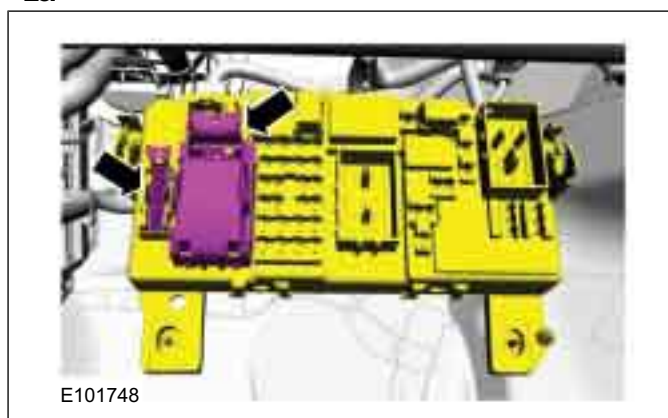
23.



24.

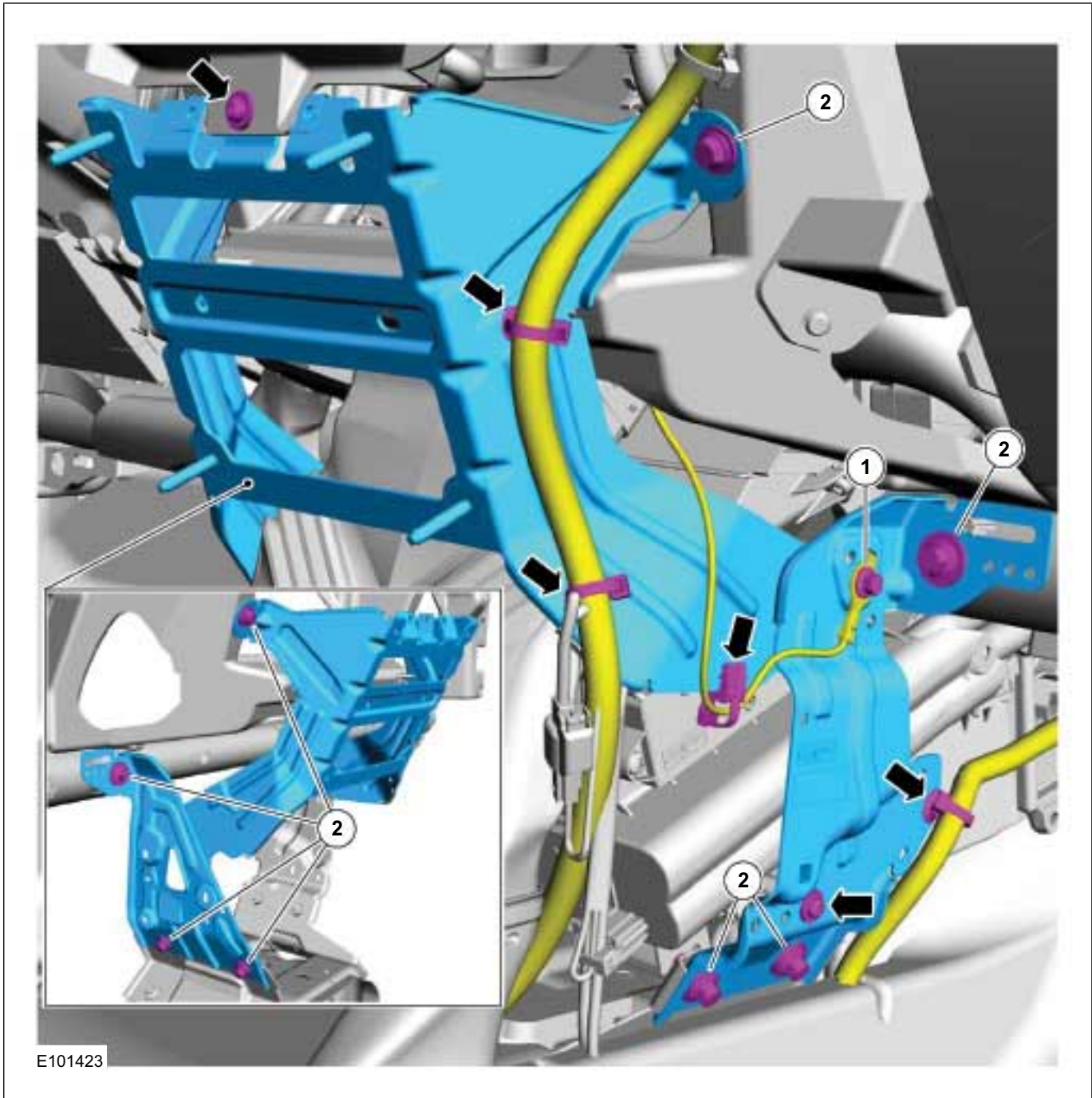


25.



26. 1. Torque: 9 Nm  
2. Torque: 25 Nm

REMOVAL AND INSTALLATION

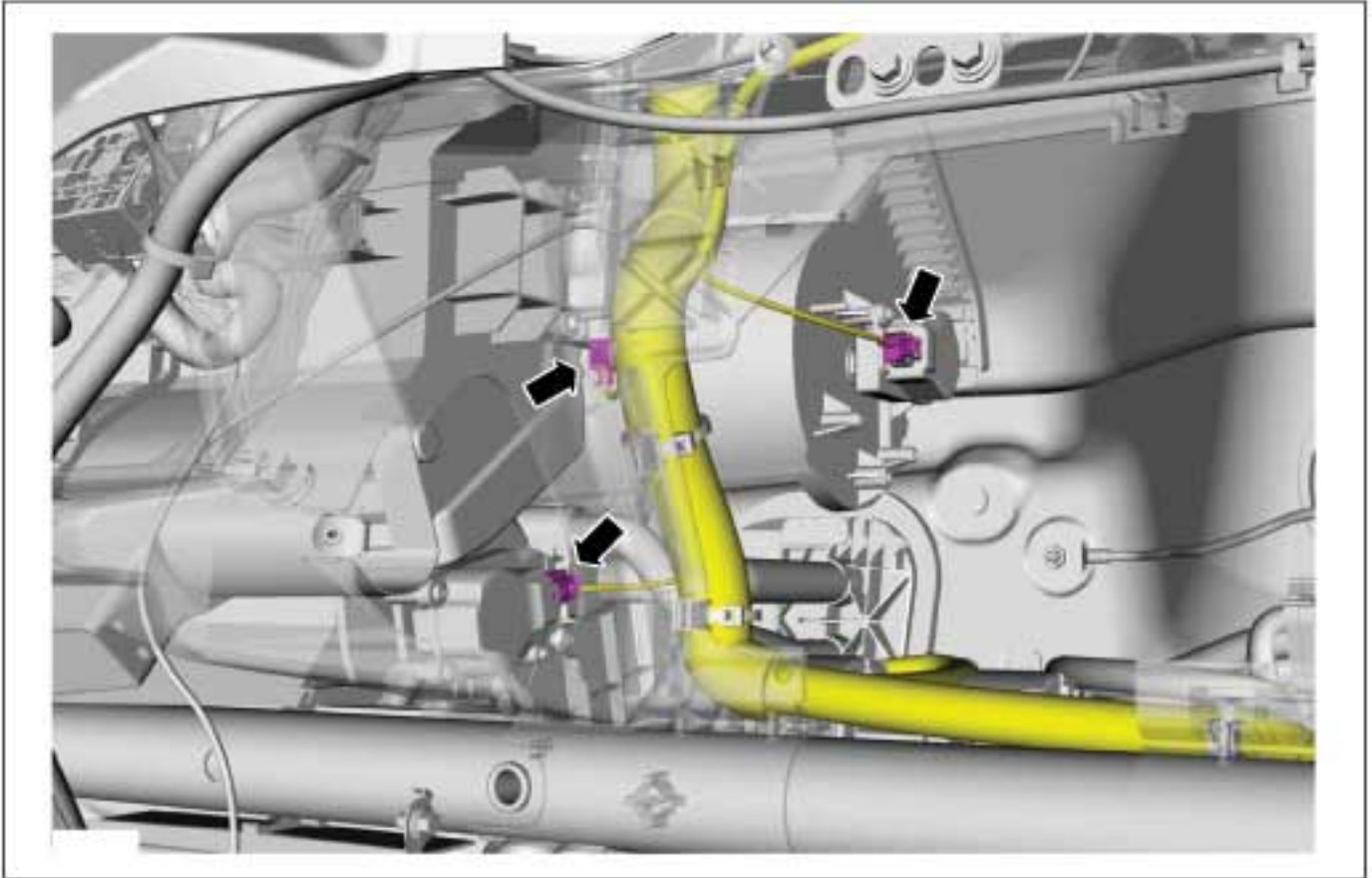


27.





REMOVAL AND INSTALLATION



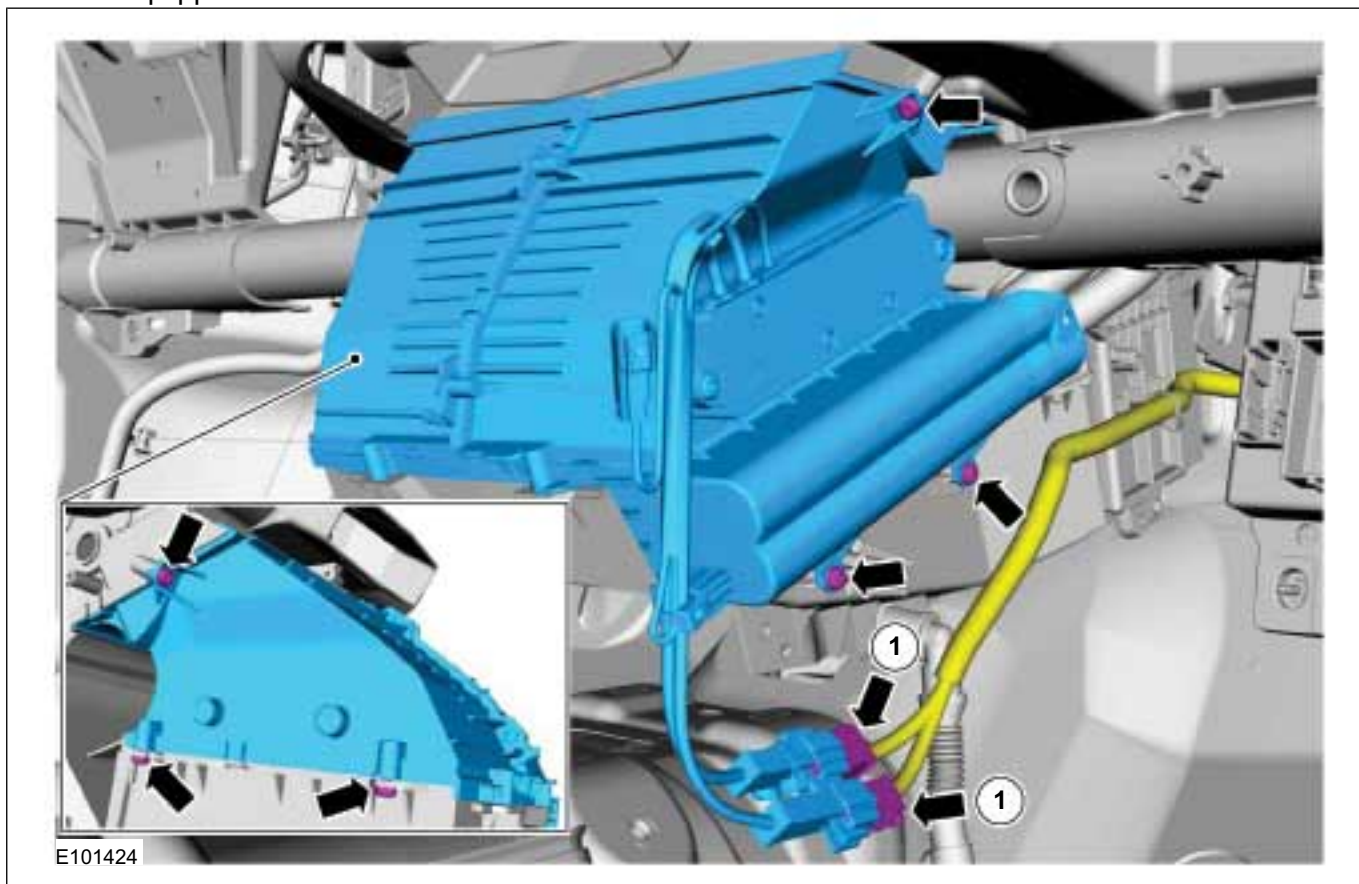
28.



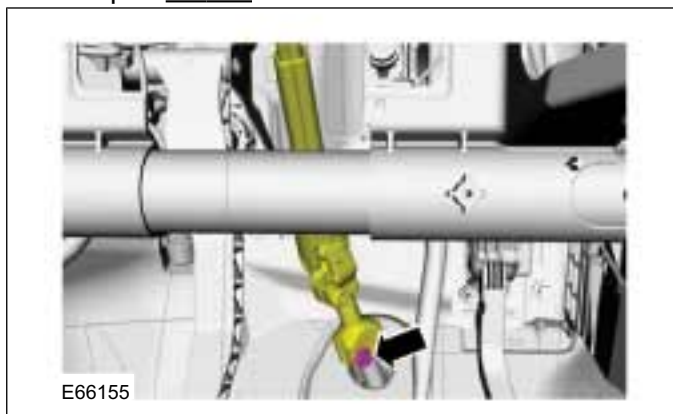


REMOVAL AND INSTALLATION

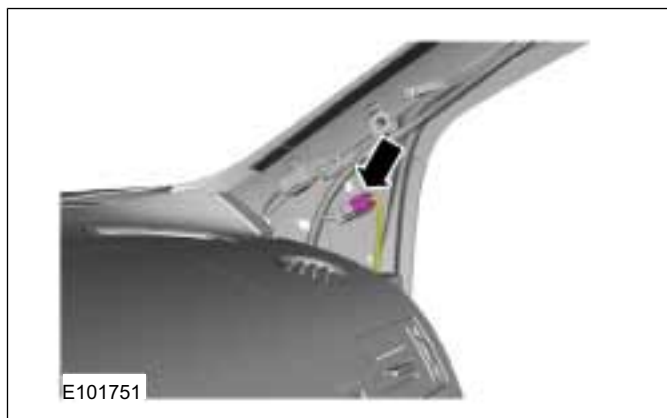
29. 1. If equipped.



30. Torque: 28 Nm



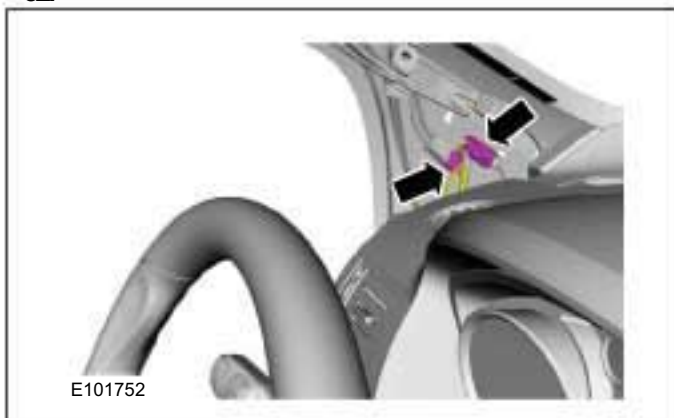
31.



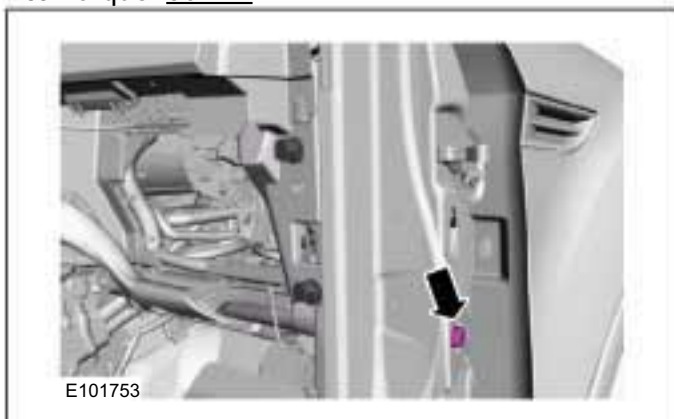


REMOVAL AND INSTALLATION

32.

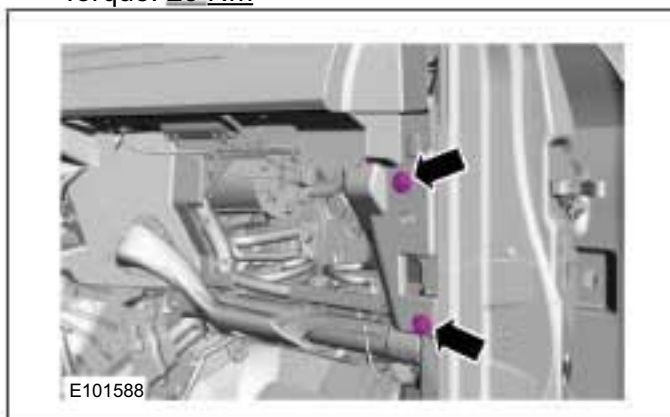


33. Torque: 80 Nm

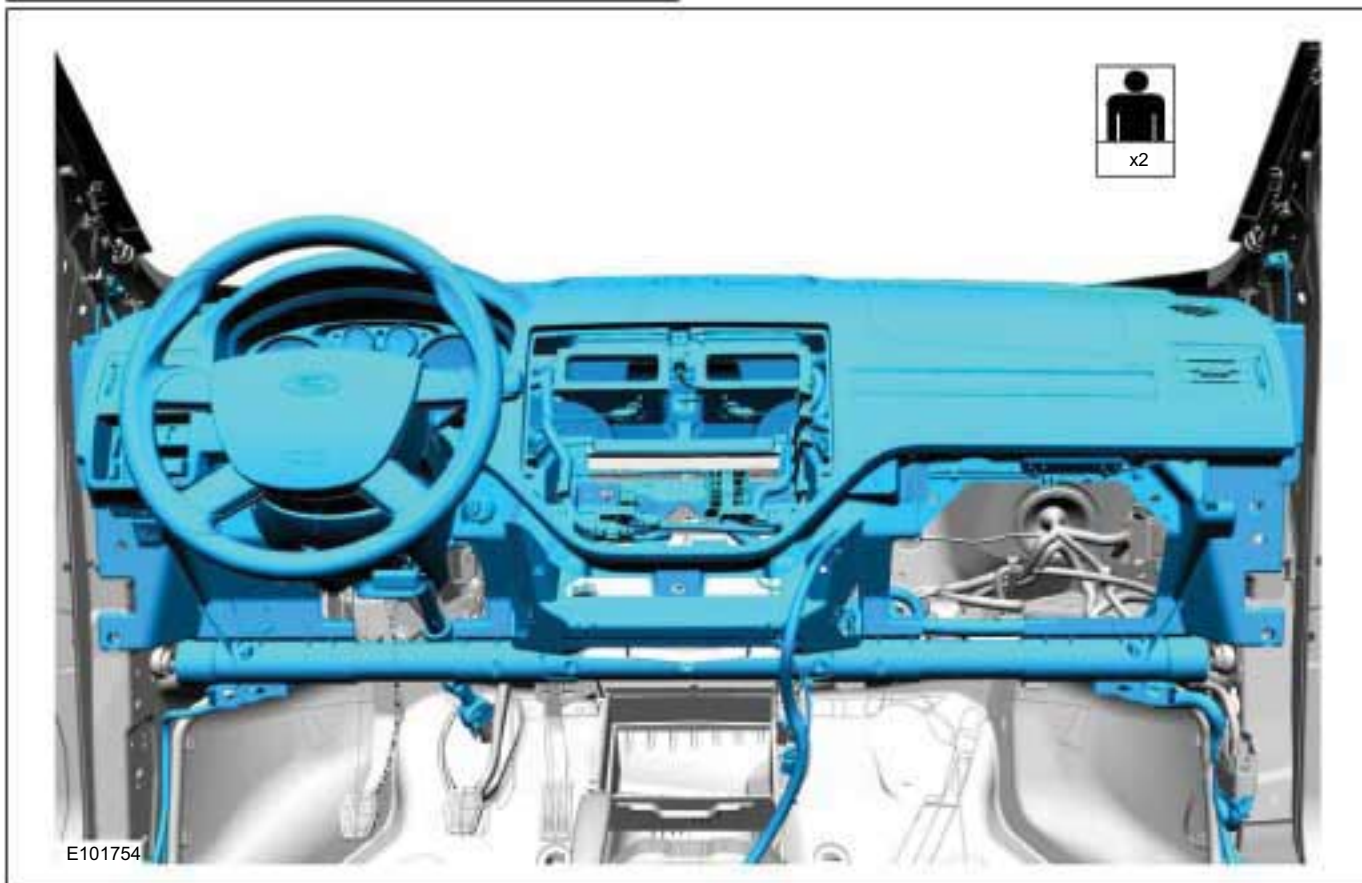


34. **NOTE:** Note the position of the component before removal.

On both sides.  
Torque: 25 Nm



35.





**REMOVAL AND INSTALLATION**

**36.** On both sides.

Refer to: **B-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

**37.** On both sides.

Refer to: **C-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

**38.** On both sides.

Refer to: **D-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

**39.** Refer to: **Loadspace Trim Panel LH** (501-05 Interior Trim and Ornamentation, Removal and Installation).

Refer to: **Loadspace Trim Panel RH** (501-05 Interior Trim and Ornamentation, Removal and Installation).

**40.** Remove the rear lamps.

**41.** On both sides.

Refer to: **Front Seat** (501-10 Seating, Removal and Installation).

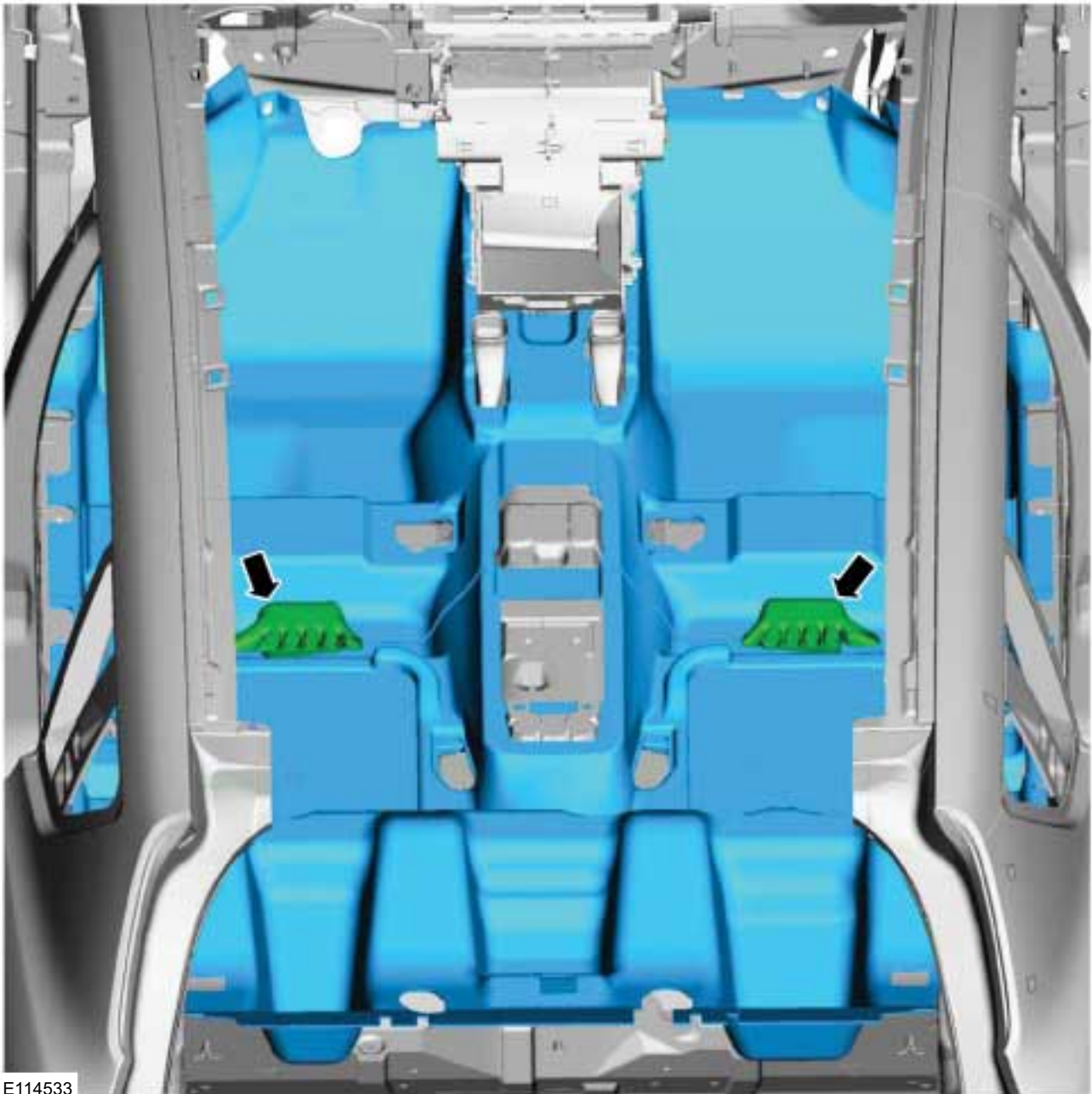
**42.** Refer to: **Rear Seat Backrest** (501-10 Seating, Removal and Installation).

**43.** Refer to: **Rear Seat Cushion** (501-10 Seating, Removal and Installation).

**44.**



REMOVAL AND INSTALLATION



E114533

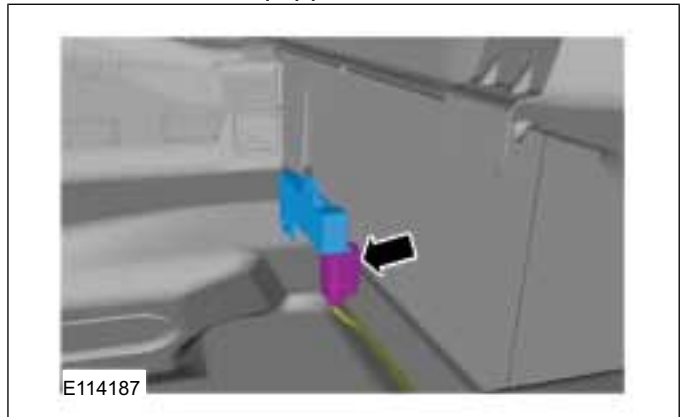


REMOVAL AND INSTALLATION

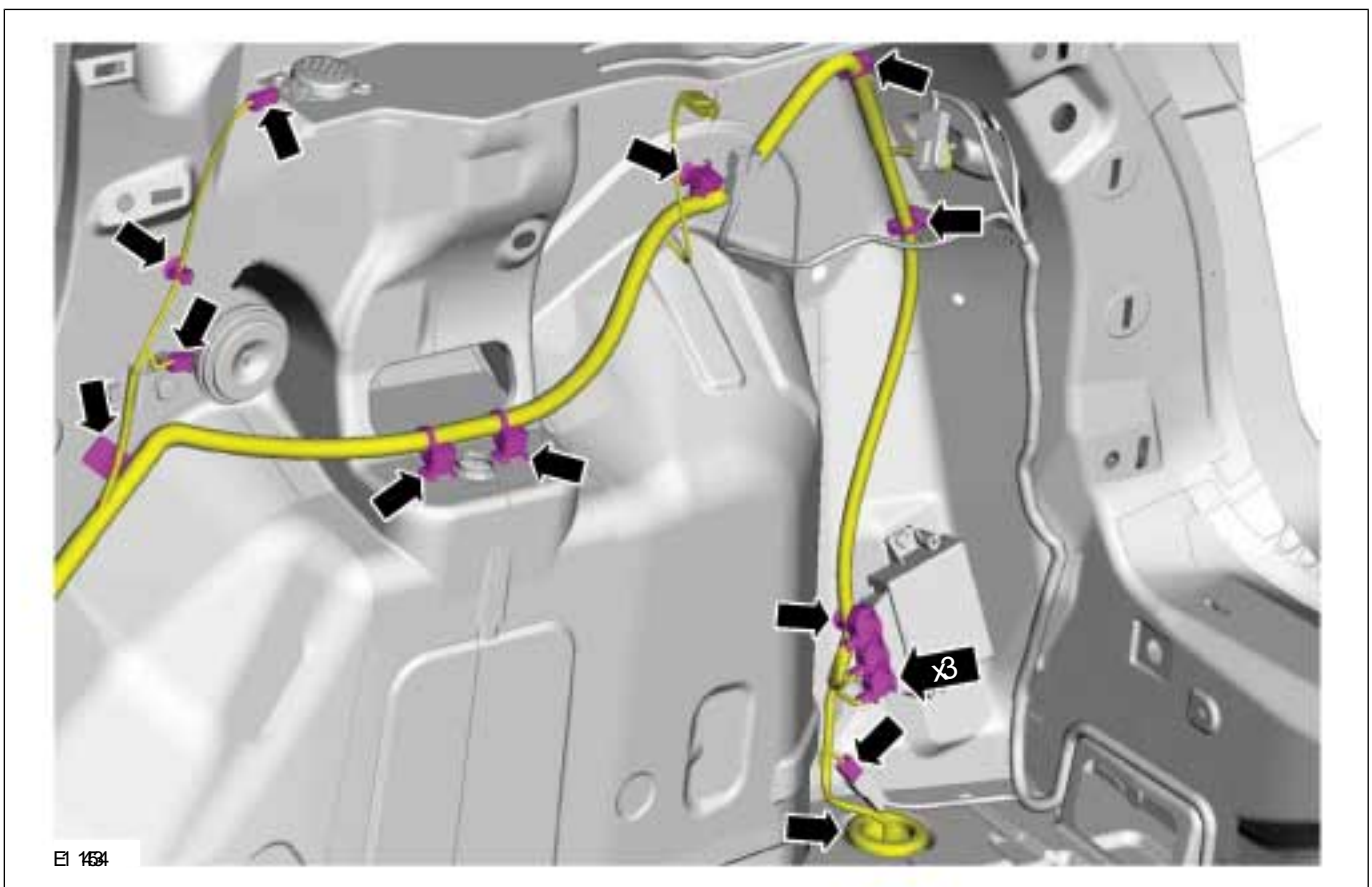
45. Both sides, If equipped.



46. Both sides, If equipped.



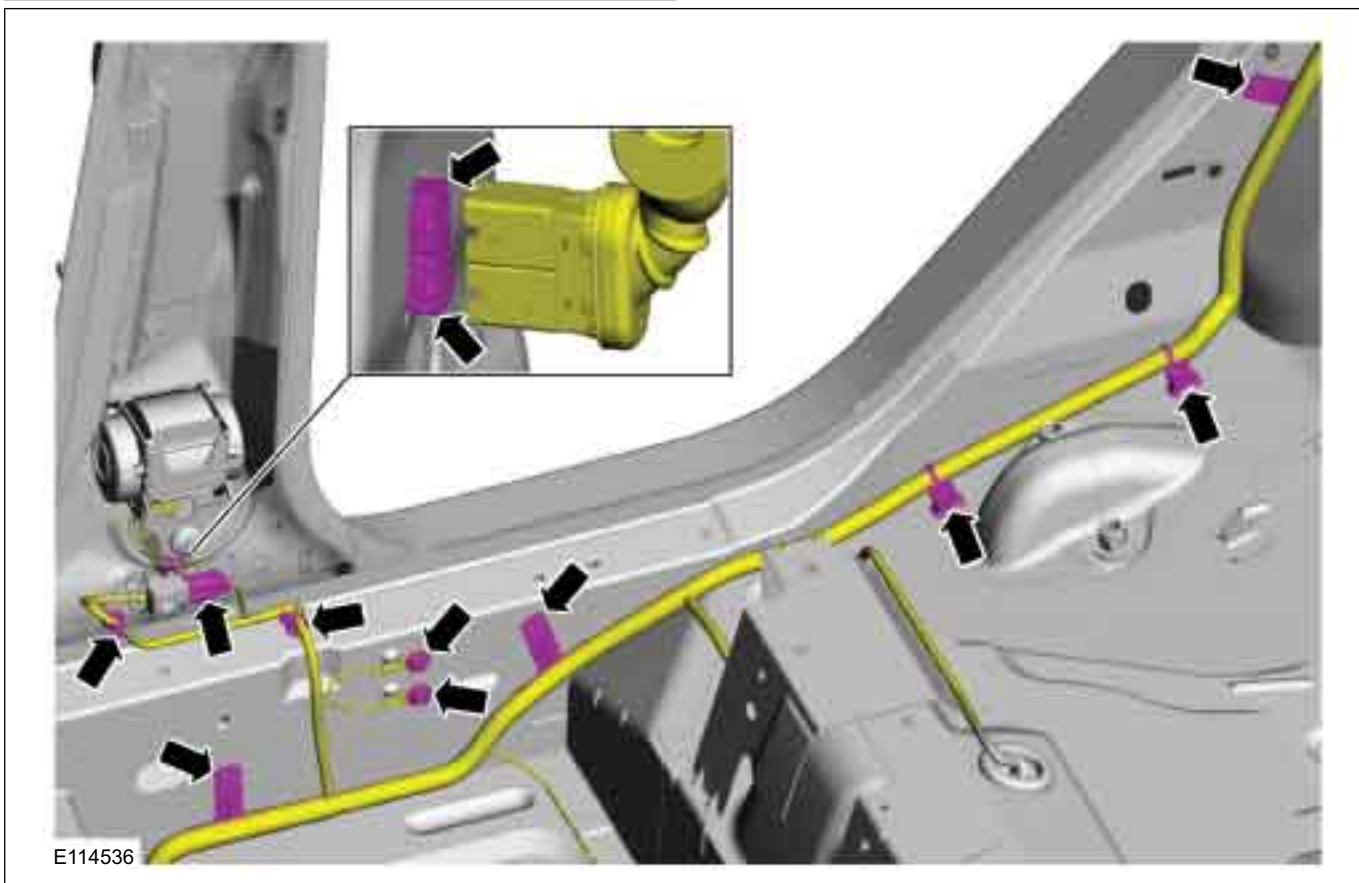
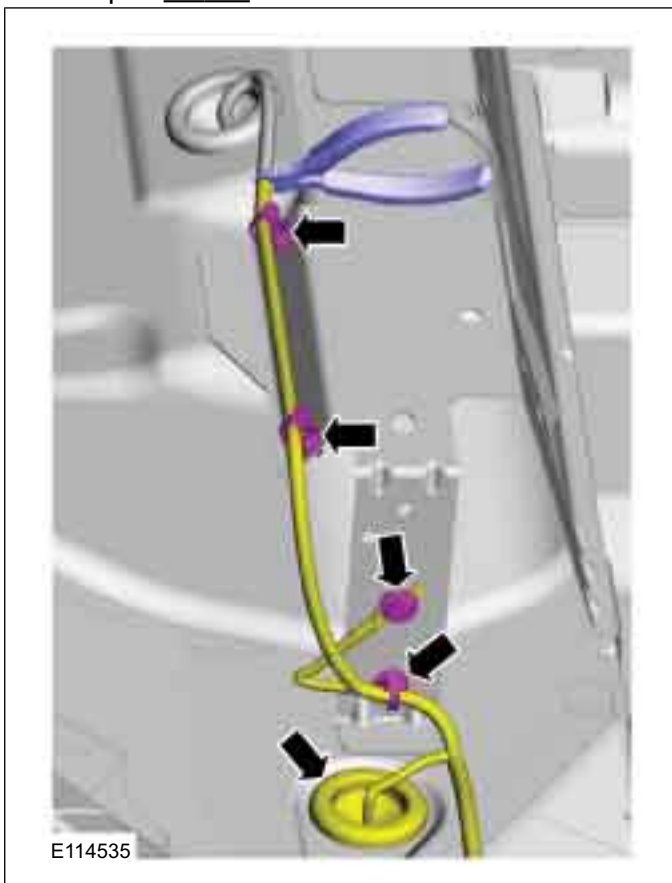
47.



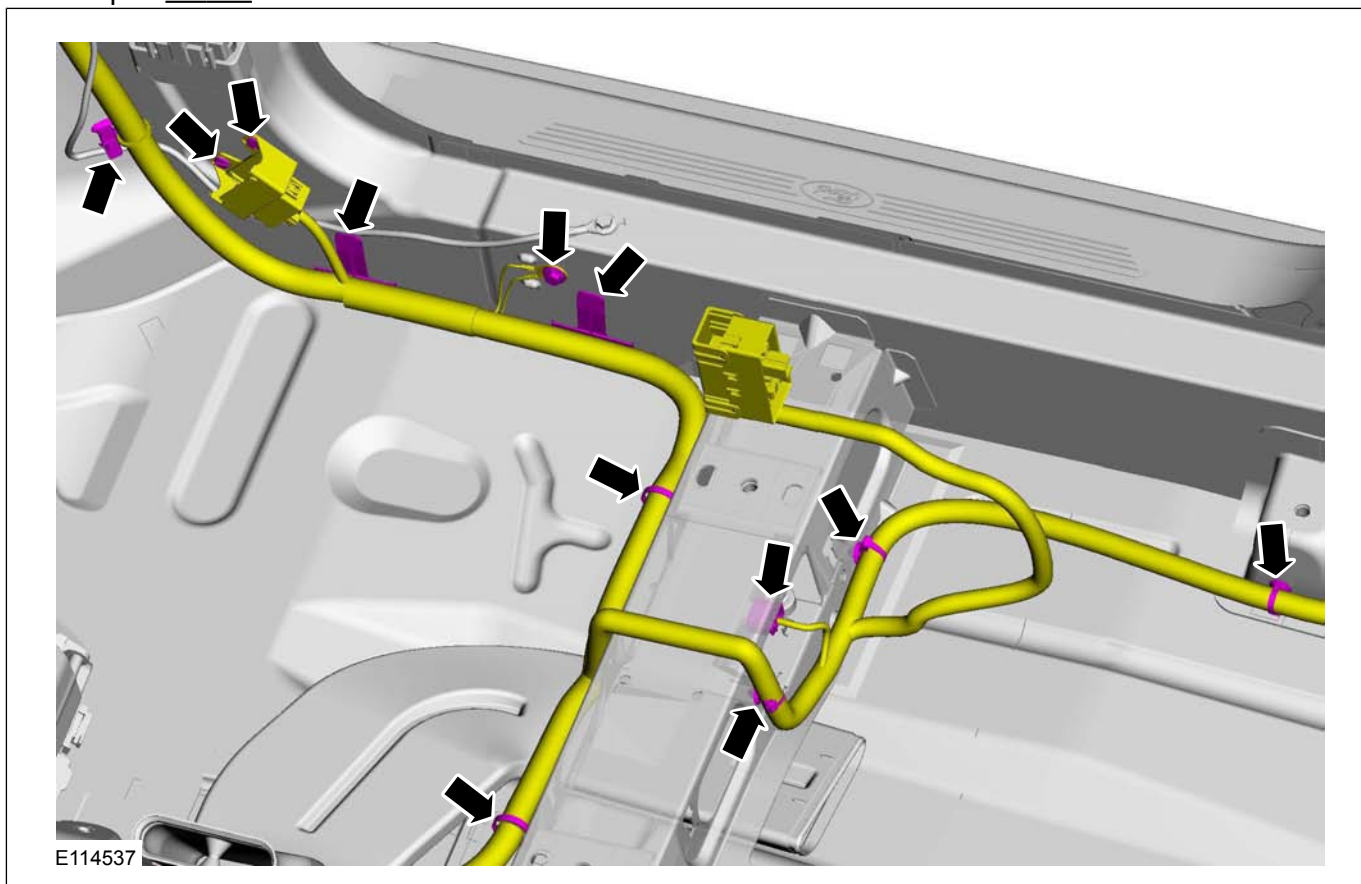
REMOVAL AND INSTALLATION

48. Torque: 12 Nm

49. Torque: 12 Nm



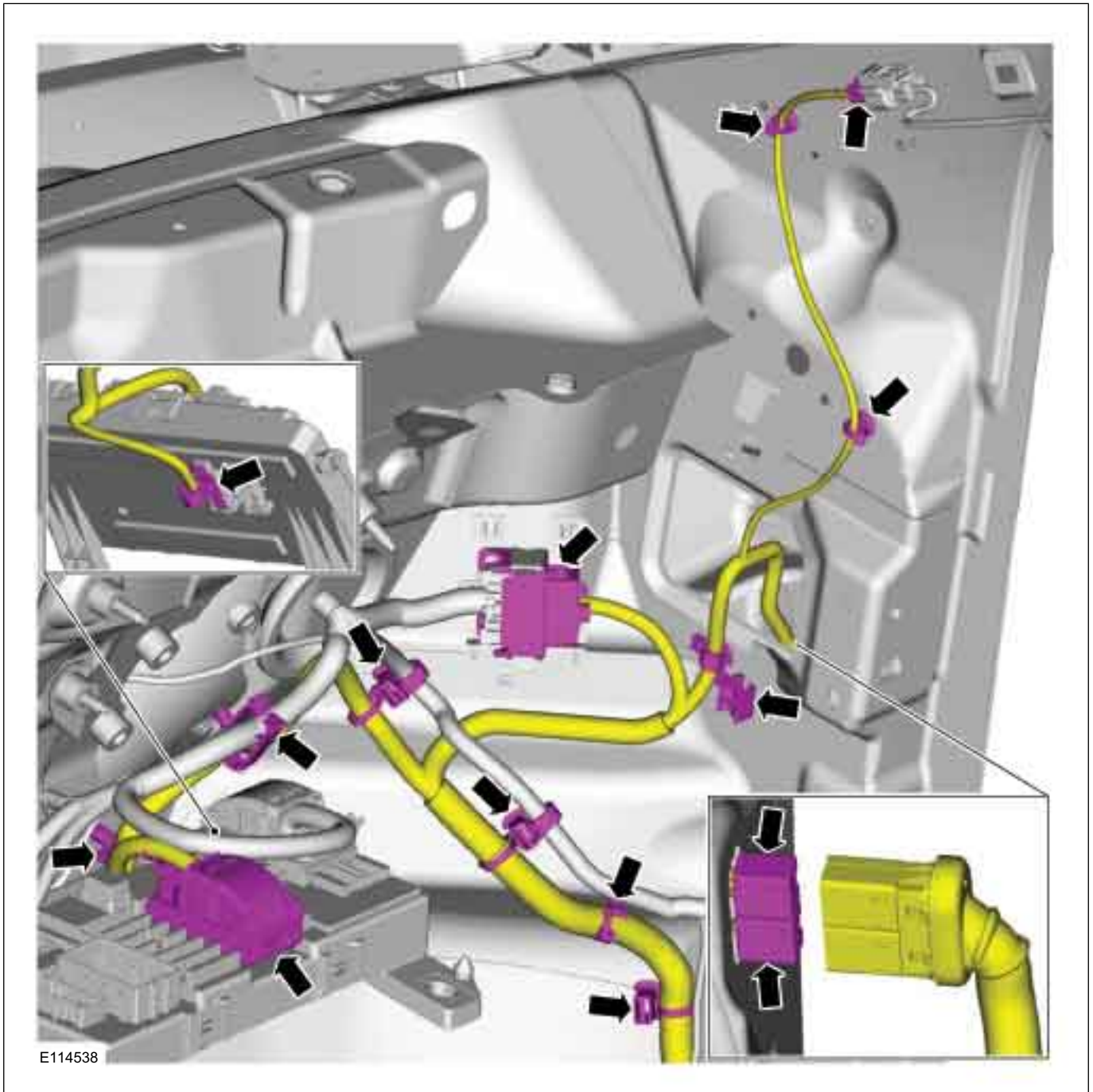
## REMOVAL AND INSTALLATION

50. Torque: 12 Nm

51.



REMOVAL AND INSTALLATION

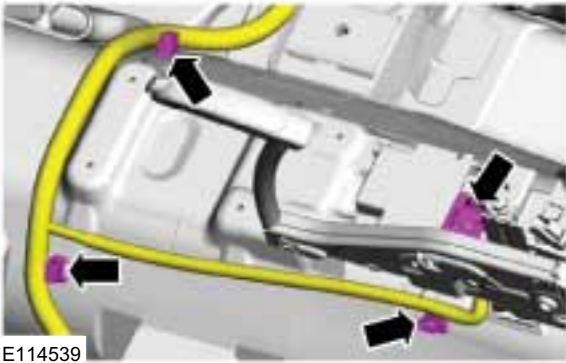




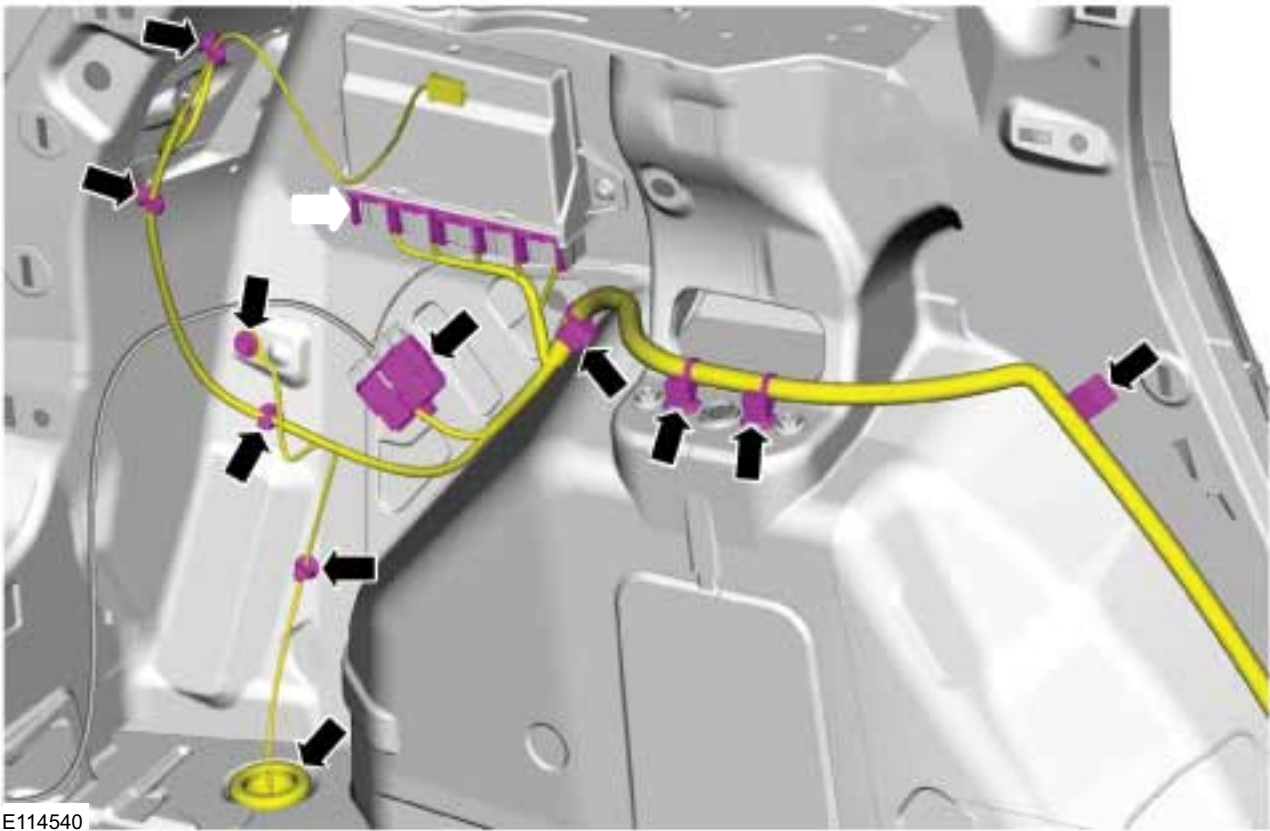
REMOVAL AND INSTALLATION

52

53. Torque: 12 Nm



E114539

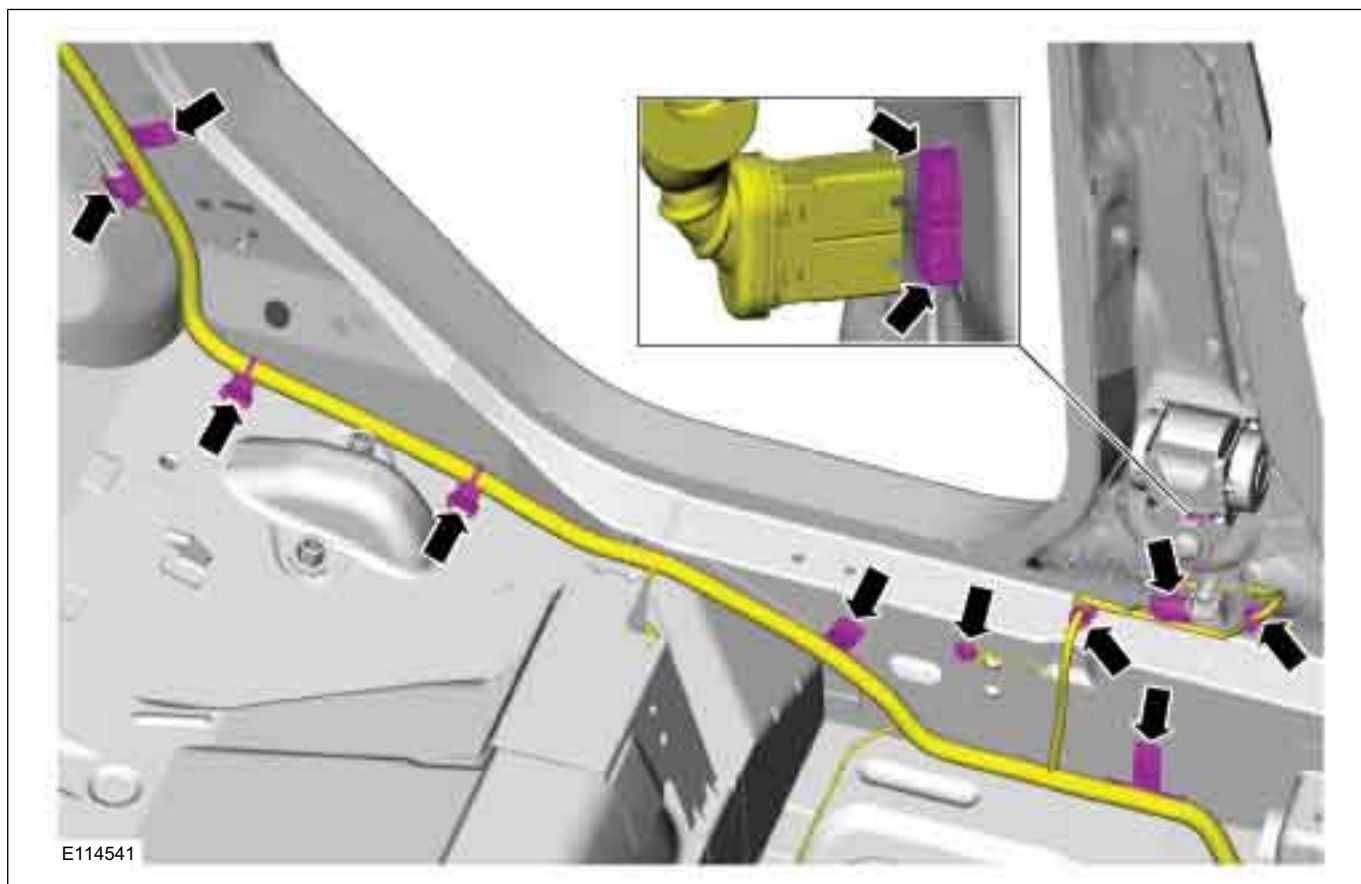


E114540

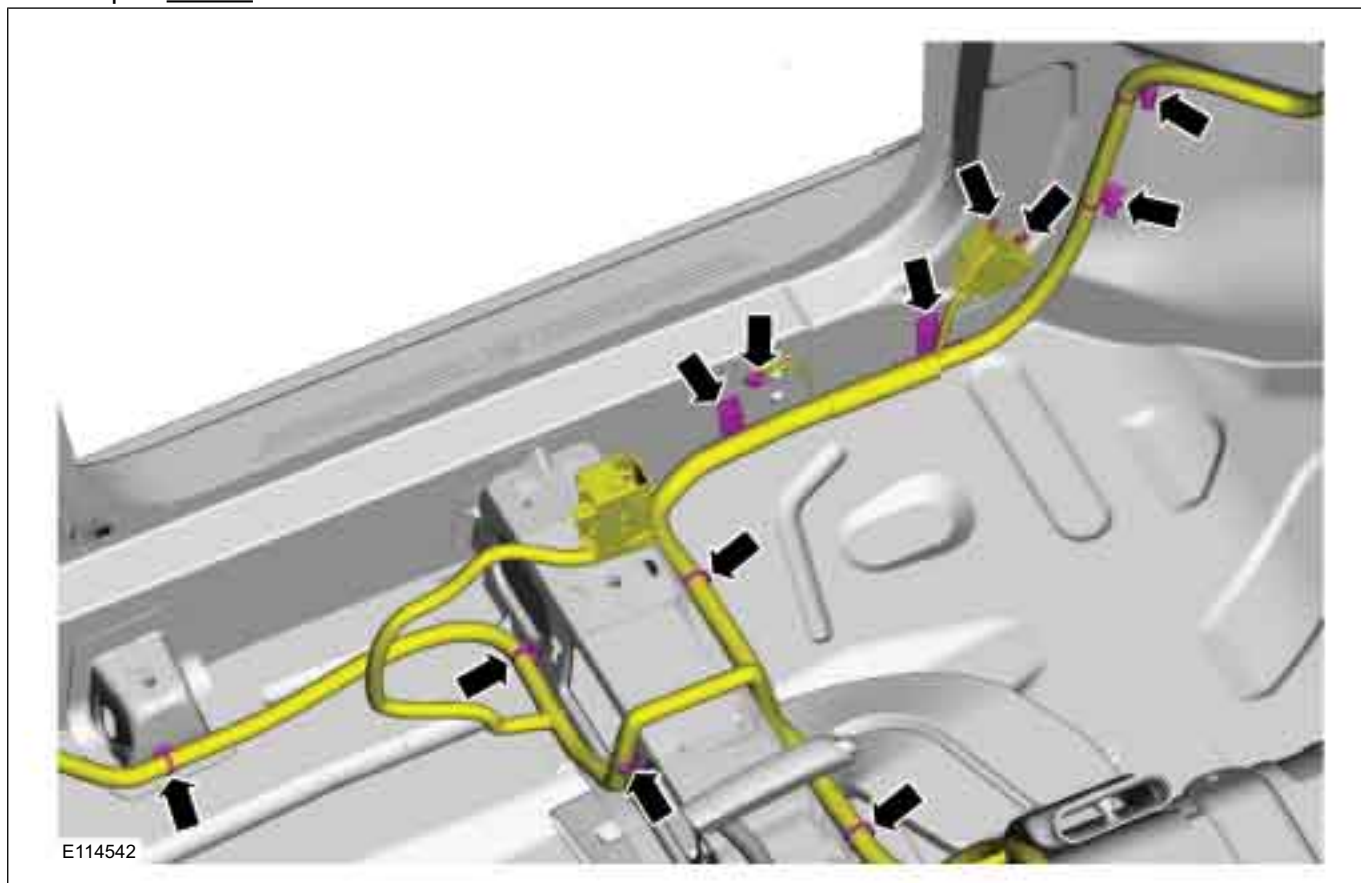
54. Torque: 12 Nm



REMOVAL AND INSTALLATION

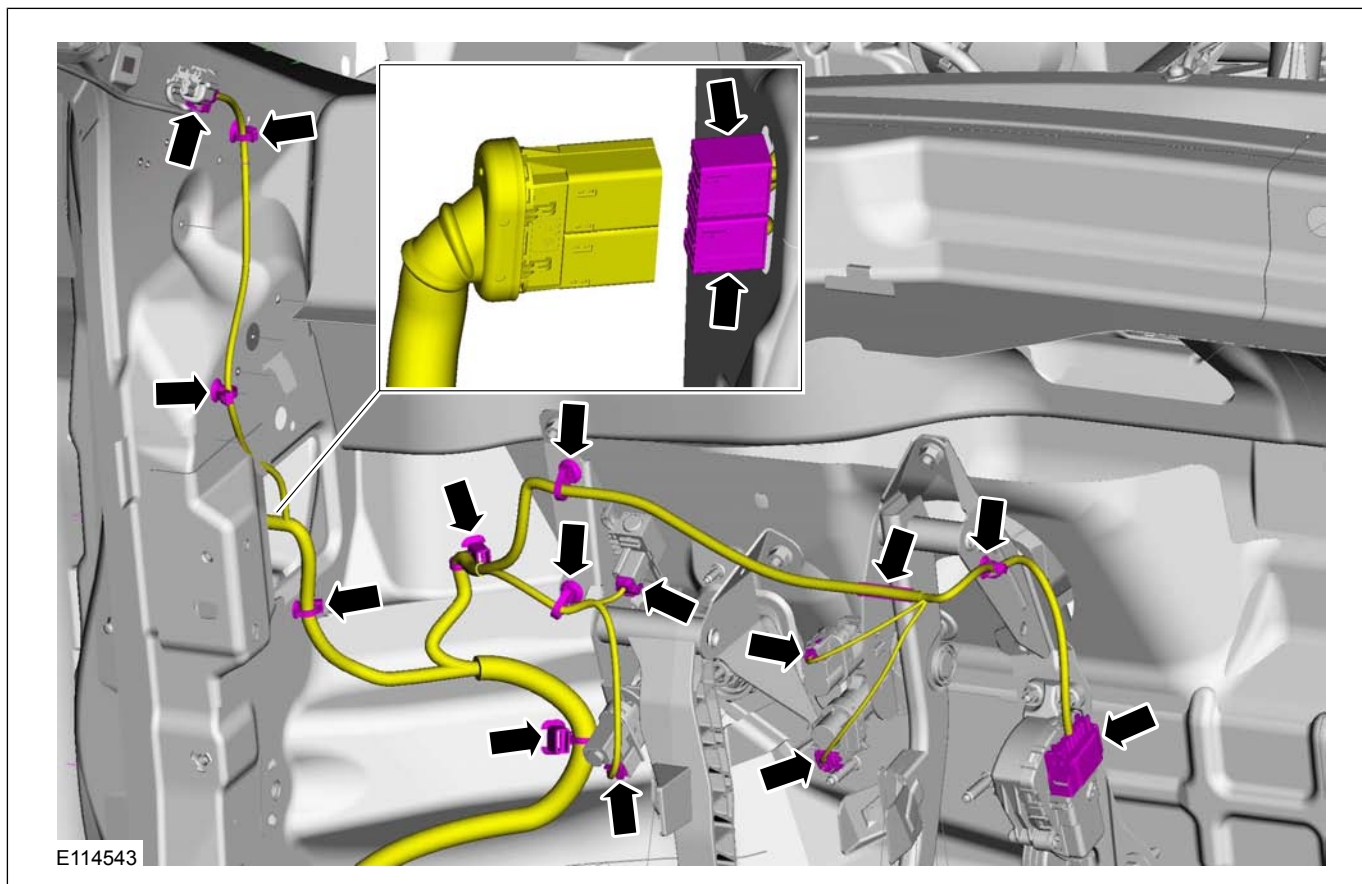


55. Torque: 12 Nm



REMOVAL AND INSTALLATION

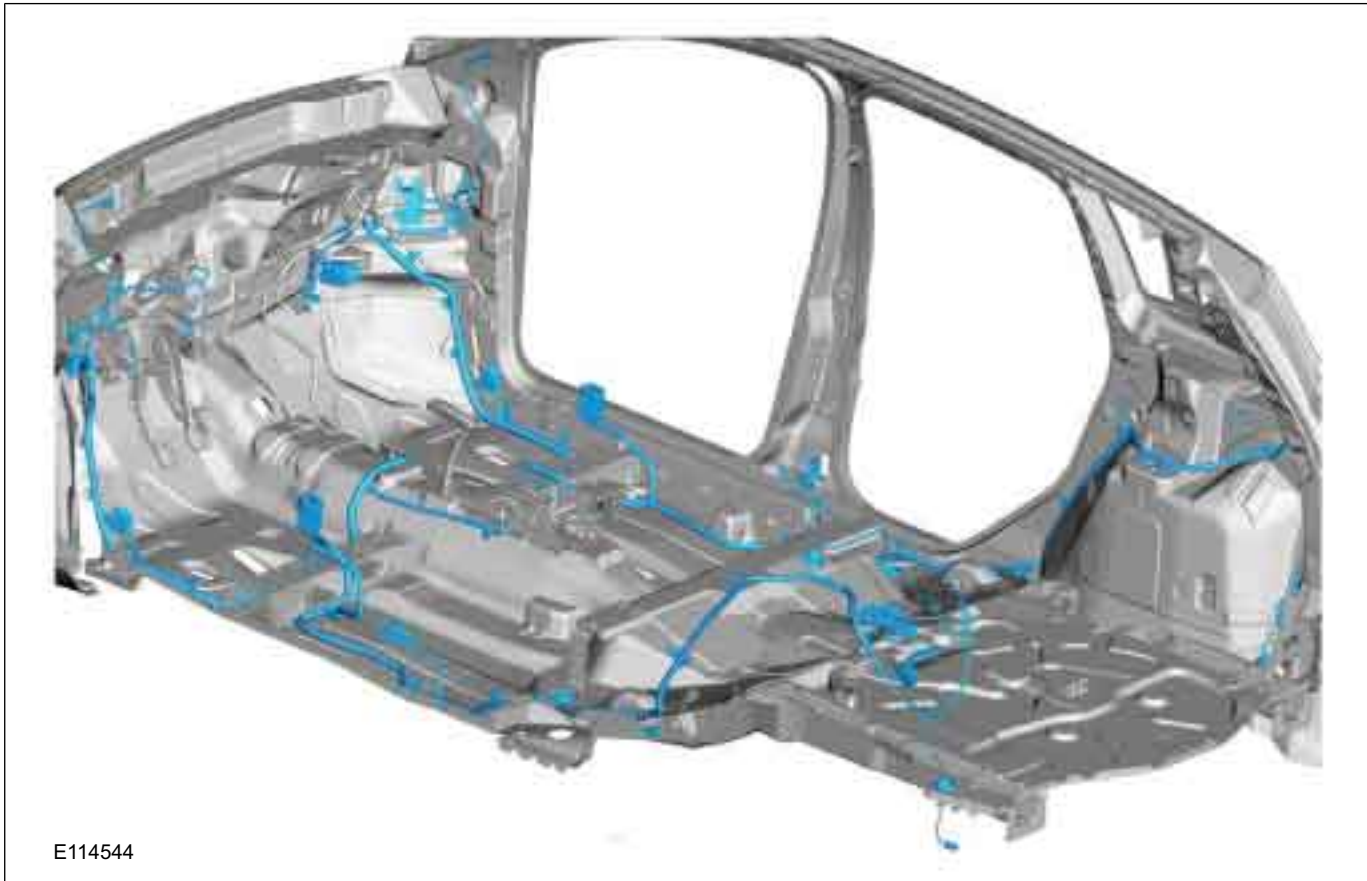
56.



57.



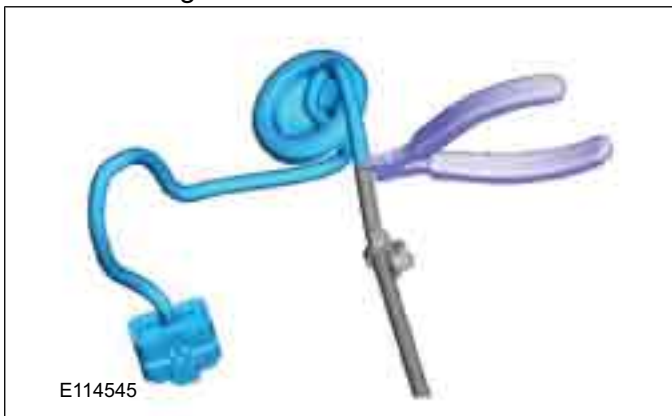
REMOVAL AND INSTALLATION



E114544

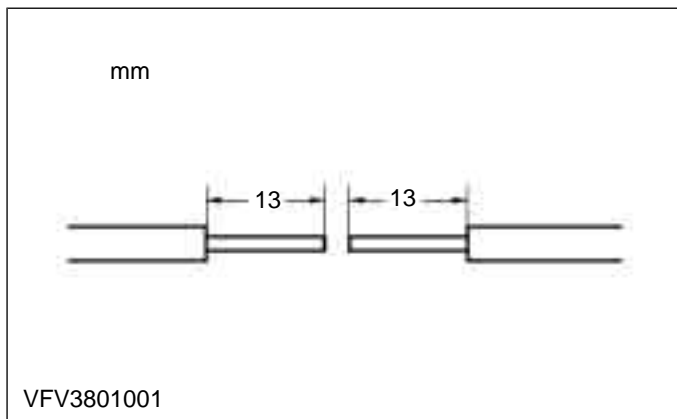
Installation

1. To install, reverse the removal procedure.
2. Cut the fuel pump module connector from the new wiring harness.



E114545

3. Remove the insulation at the cable ends.

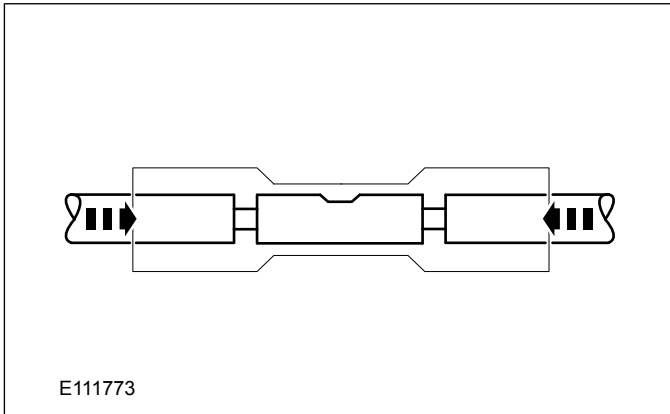


VFV3801001

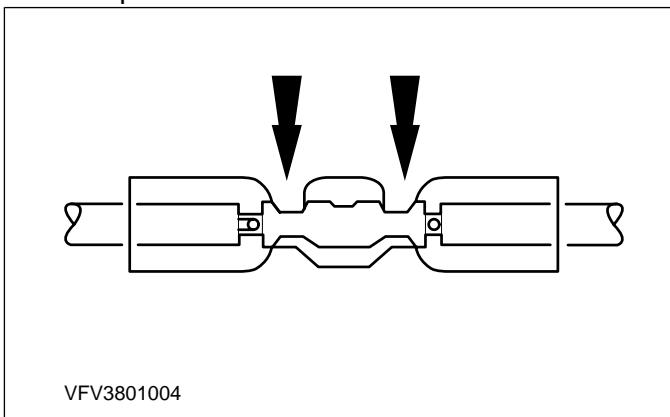


**REMOVAL AND INSTALLATION**

4. Insert the stripped ends of the wires into the crimp connector.

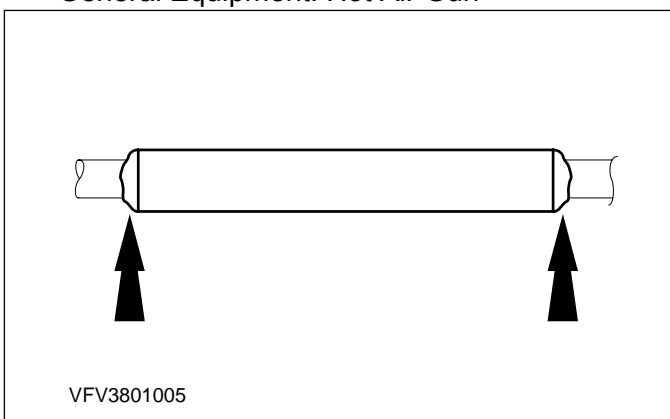


5. Crimp the connection.



6. Heat the shrink sleeving.

General Equipment: Hot Air Gun





REMOVAL AND INSTALLATION

Instrument Panel Wiring Harness

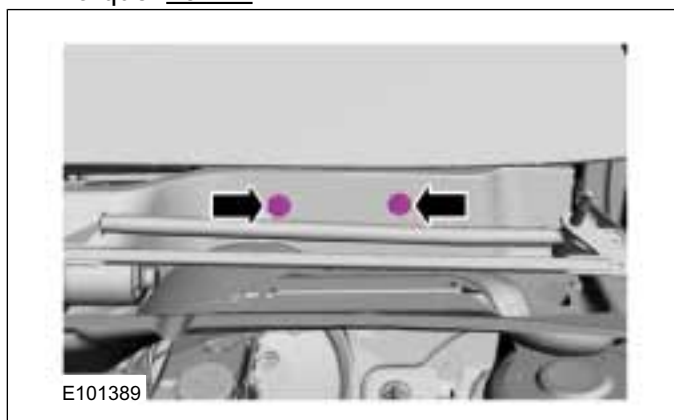
General Equipment

Flat-bladed screwdriver

Removal

**NOTE:** Removal steps in this procedure may contain installation details.

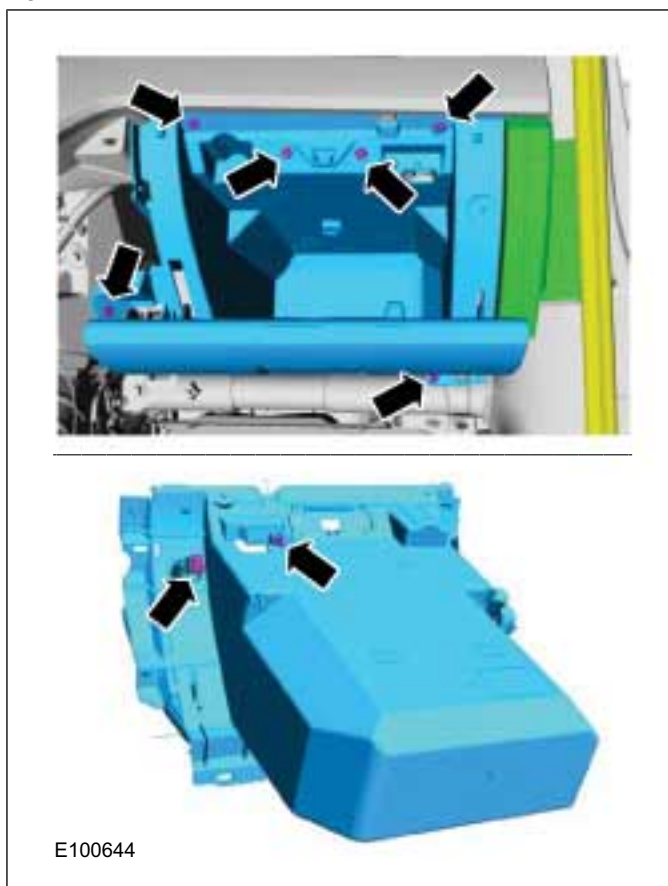
1. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
2. Torque: 25 Nm



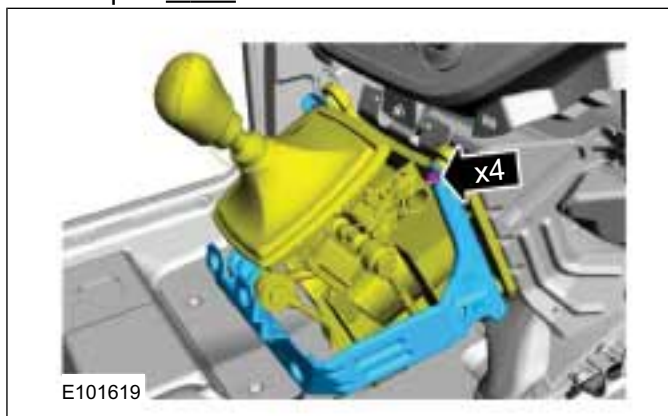
3. Remove the front doors.

4. Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation).

- 5.



6. Torque: 9 Nm

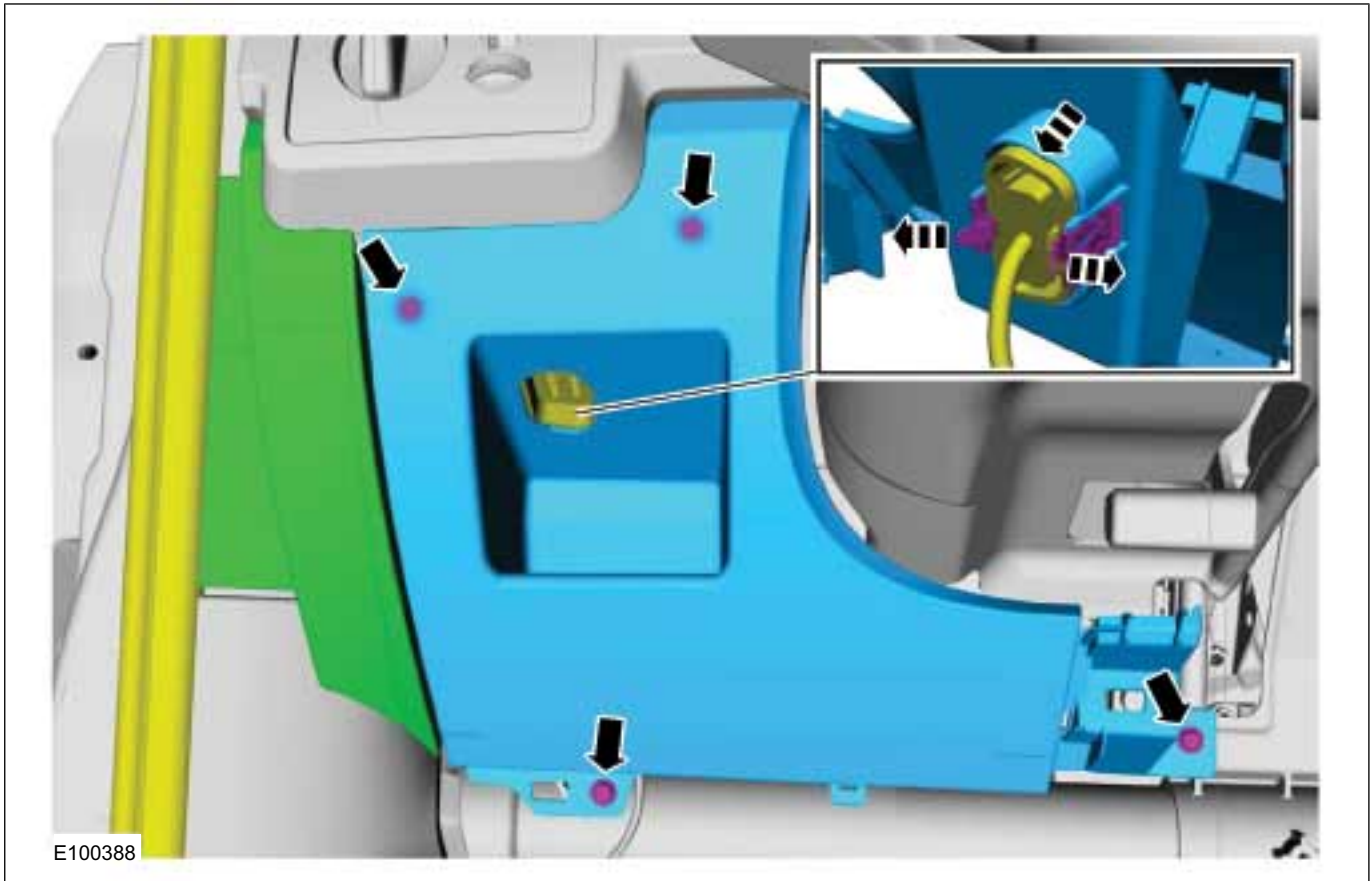


- 7.





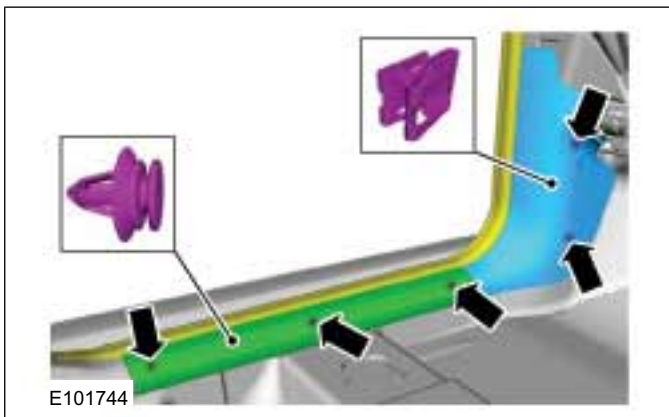
REMOVAL AND INSTALLATION



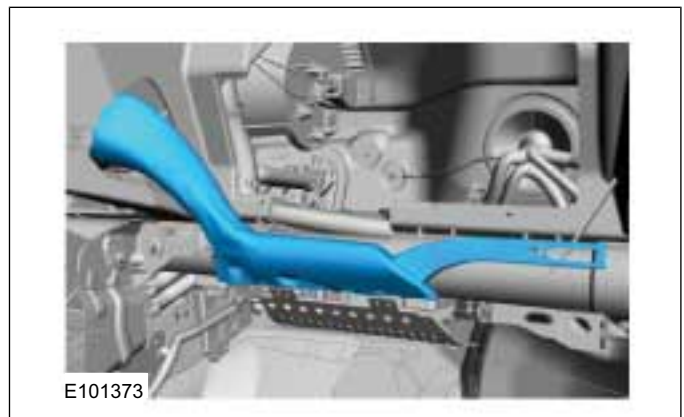
8. On both sides.

Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

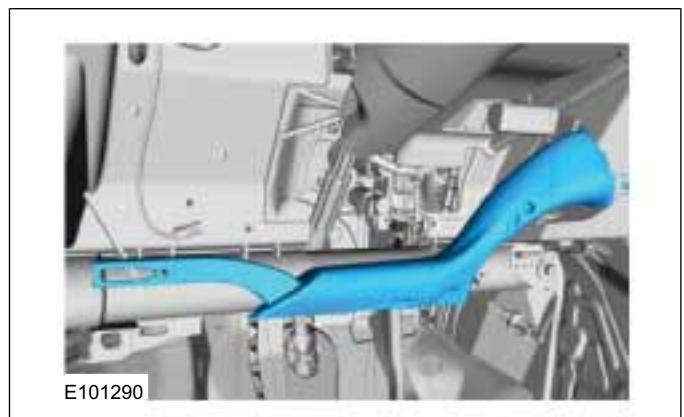
9. On both sides.



10.



11.

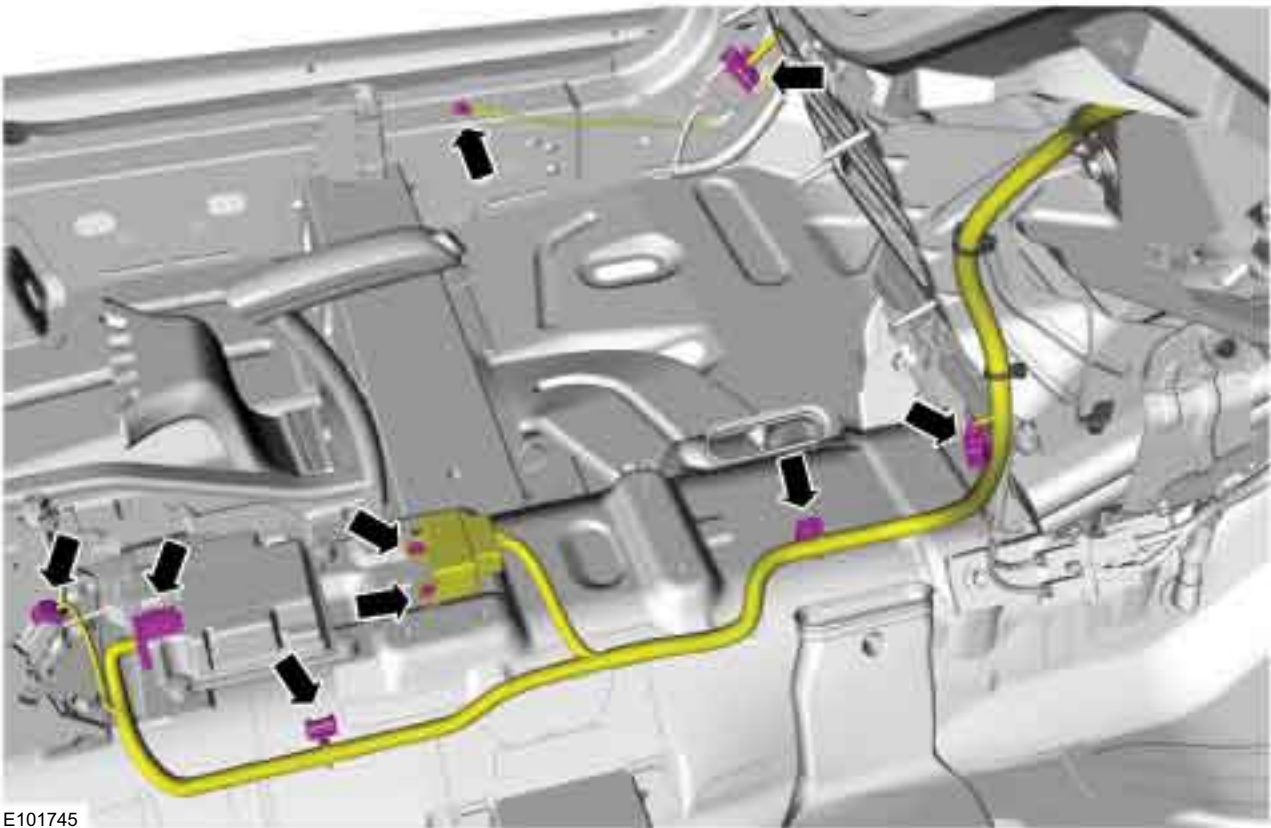
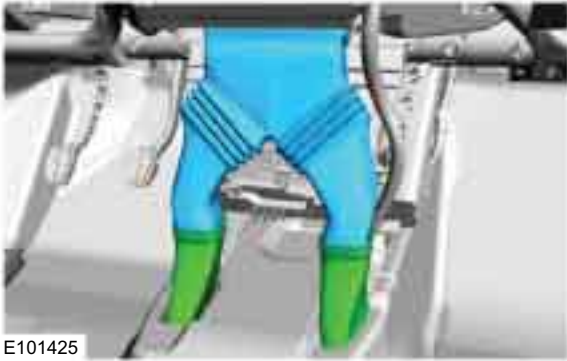




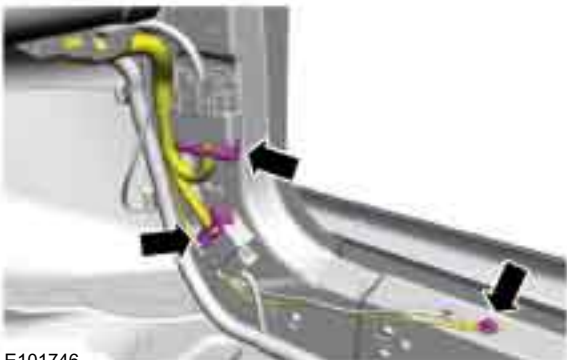
REMOVAL AND INSTALLATION

12

13. Torque: 9 Nm



14. Torque: 9 Nm



418-02-27

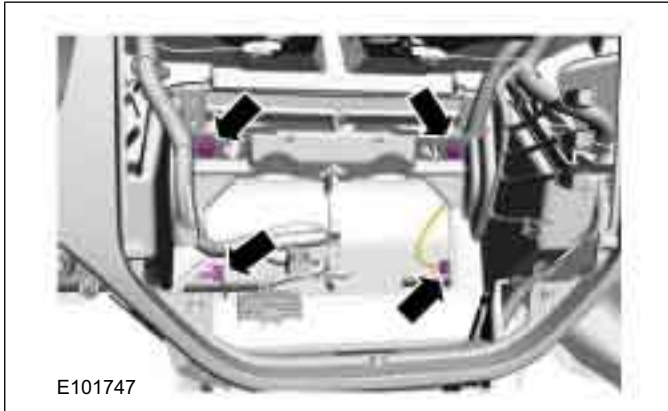
Wiring Harnesses

418-02-27

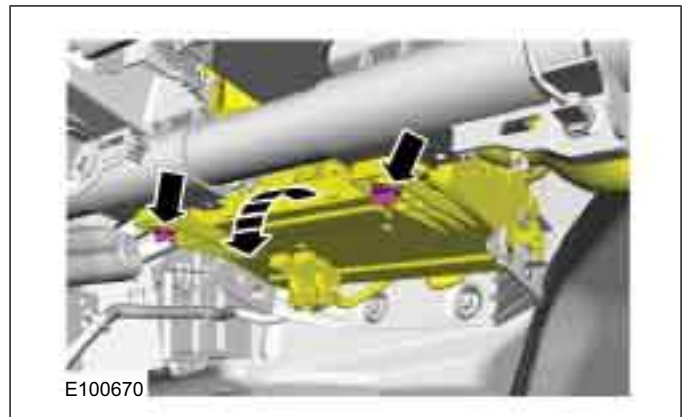
## REMOVAL AND INSTALLATION

15. Refer to: **Climate Control Assembly - Vehicles With: Manual Temperature Control** (412-01 Climate Control, Removal and Installation).  
Refer to: **Climate Control Assembly - Vehicles With: Automatic Temperature Control** (412-01 Climate Control, Removal and Installation).

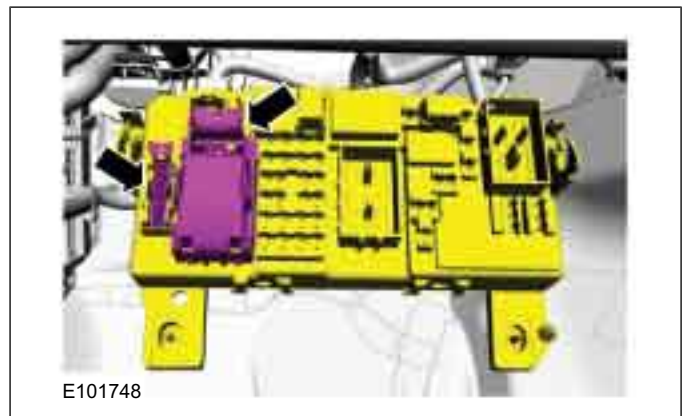
16.



17.



18.

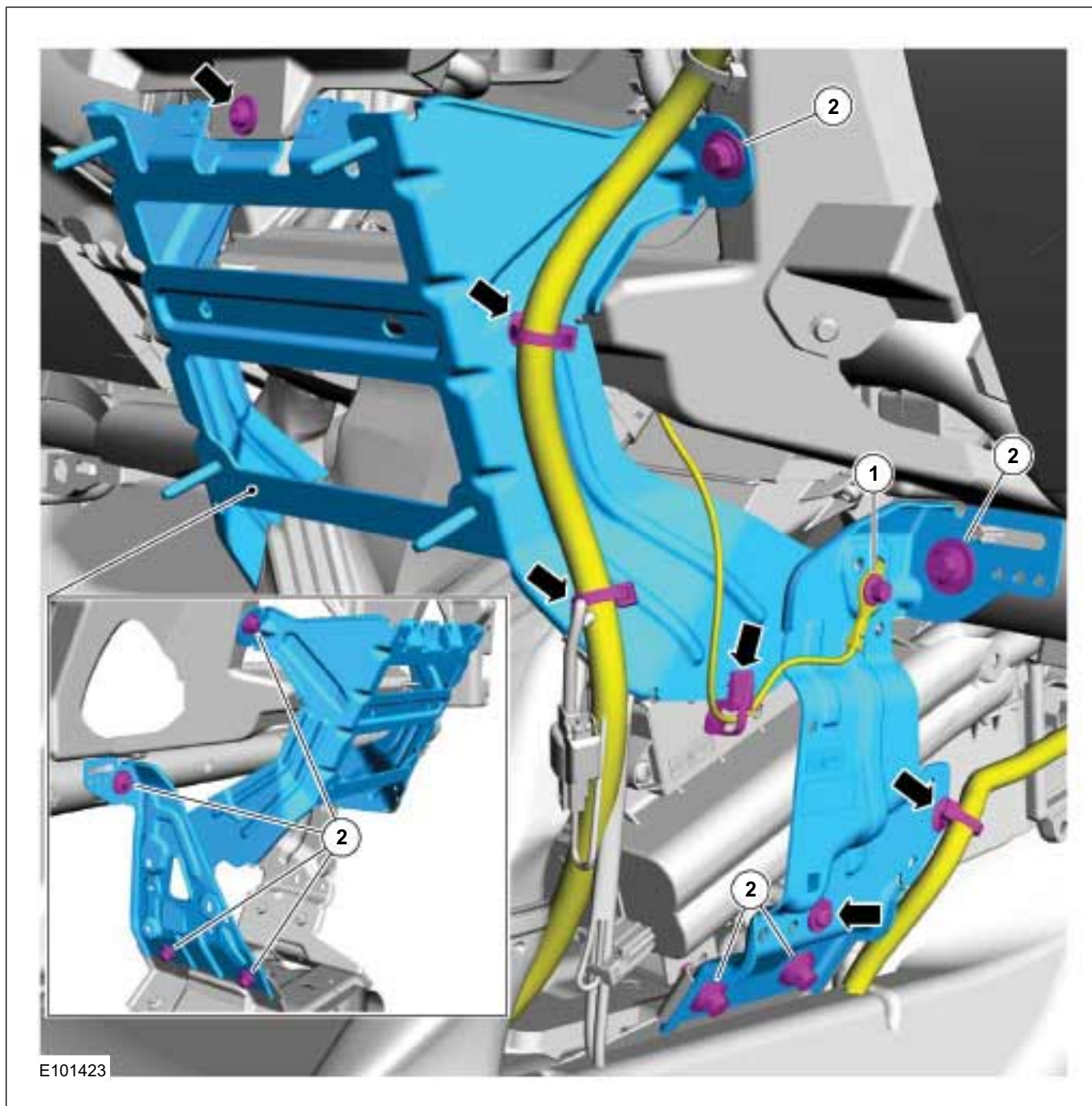


19. 1. Torque: 9 Nm  
2. Torque: 25 Nm





REMOVAL AND INSTALLATION

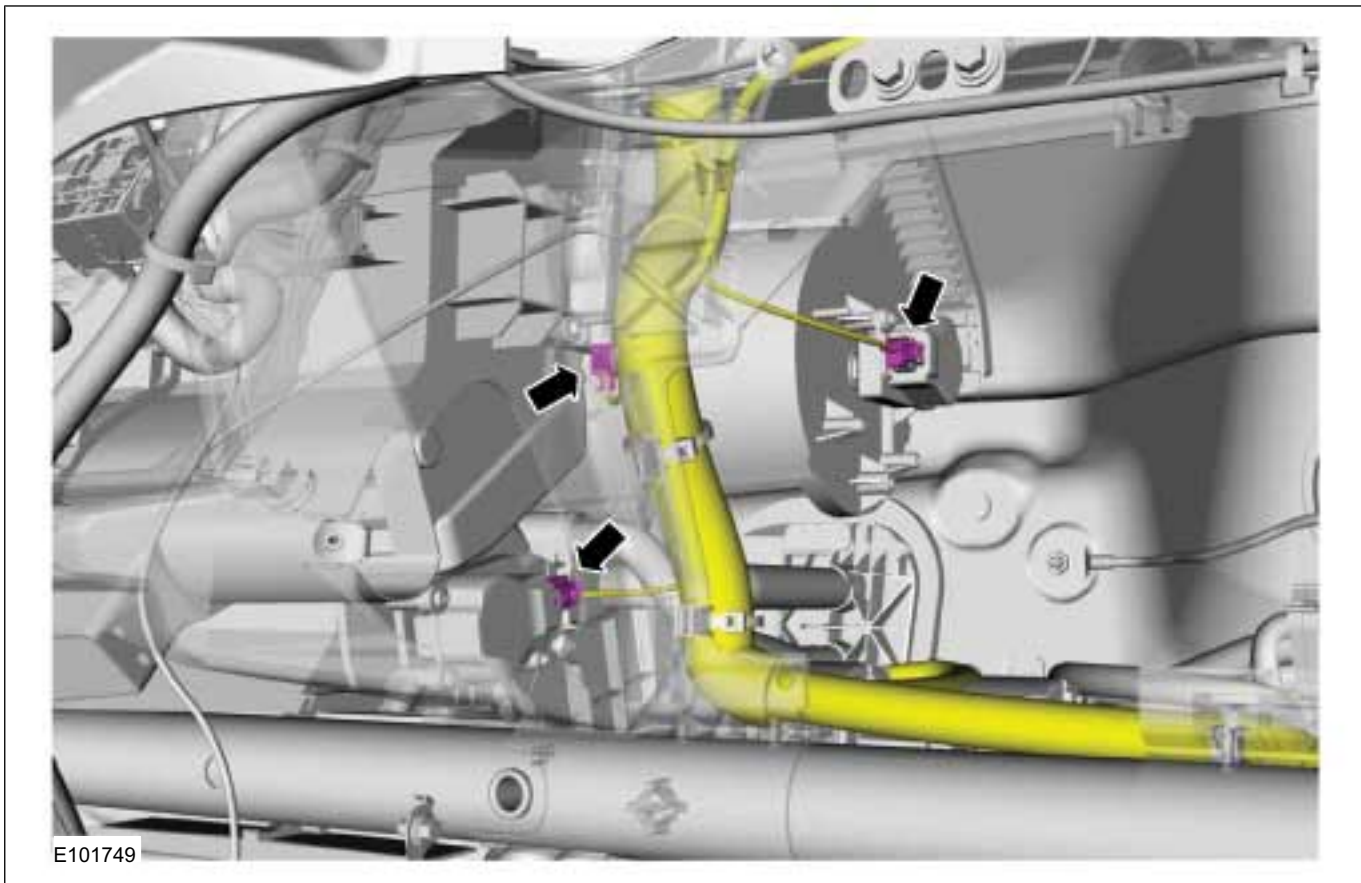


20.

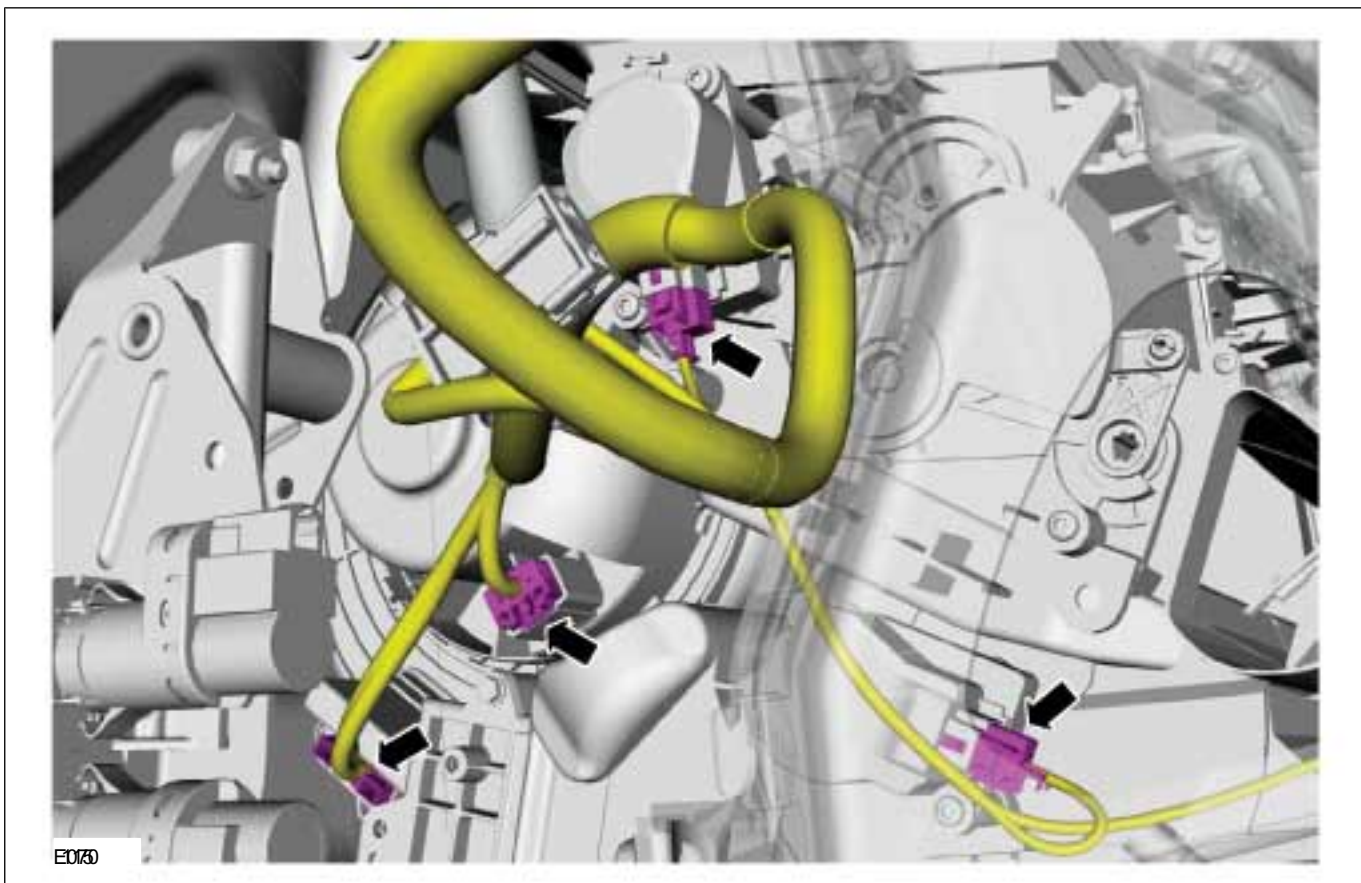




REMOVAL AND INSTALLATION



21.

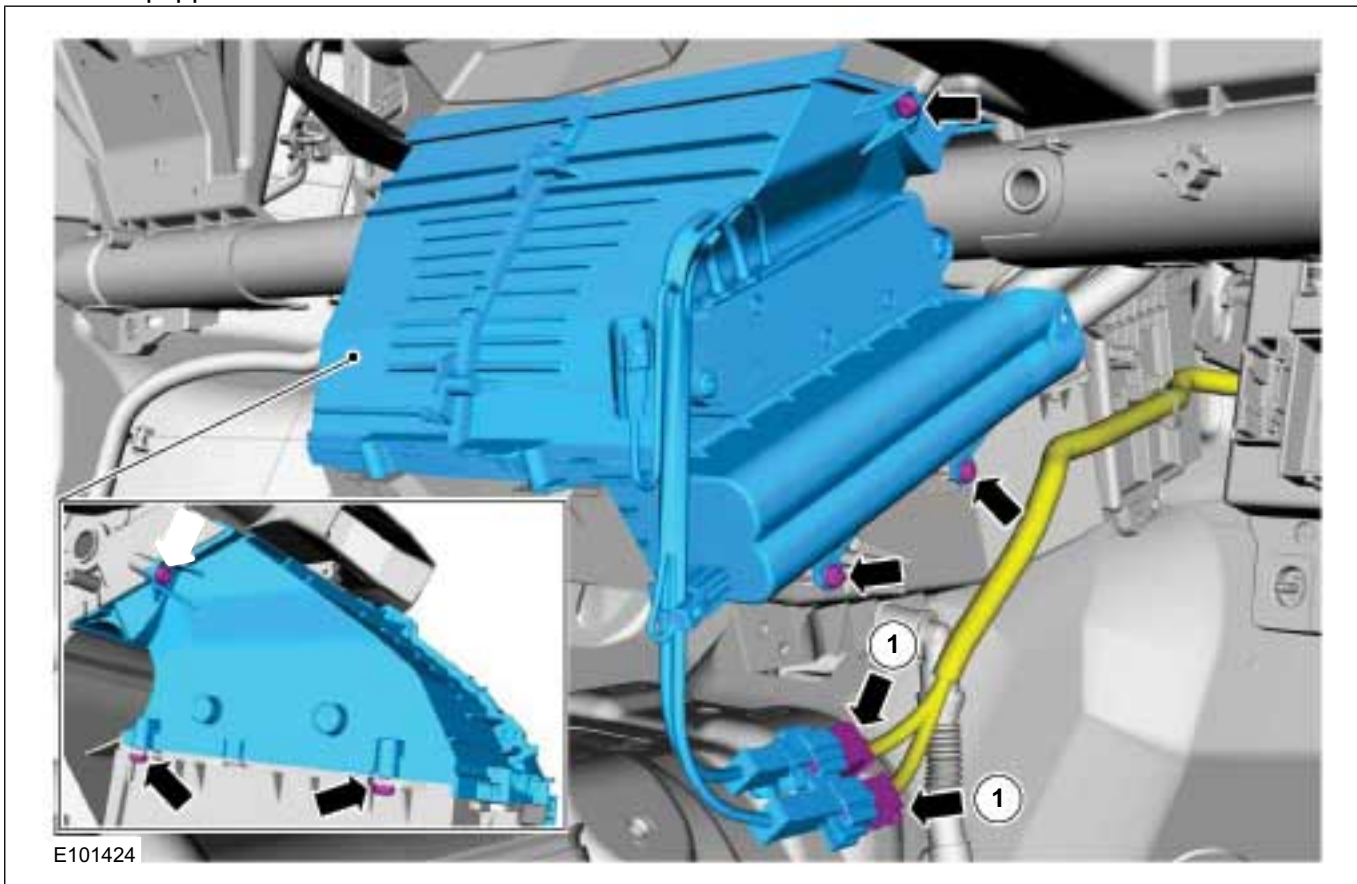




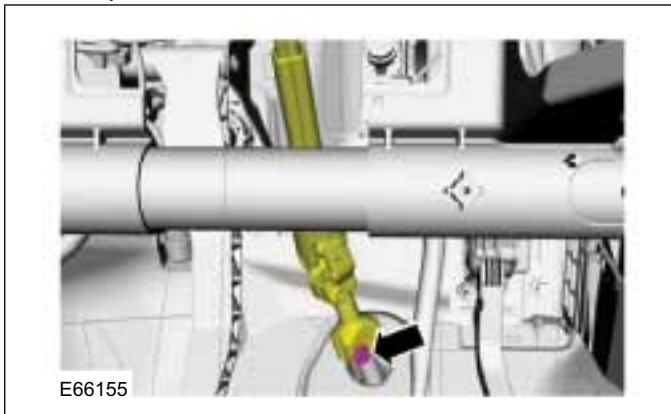


REMOVAL AND INSTALLATION

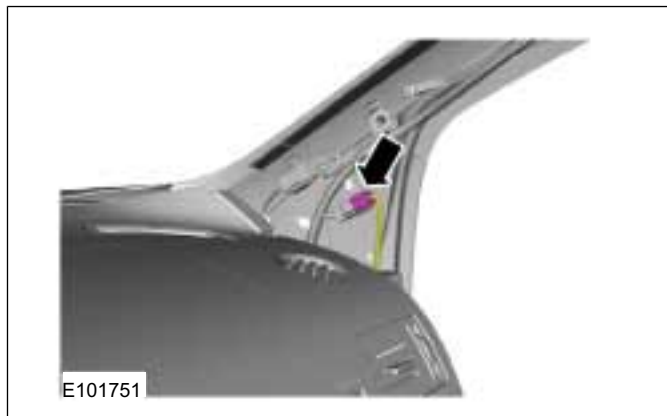
22 1. If equipped.



23. Torque: 28 Nm



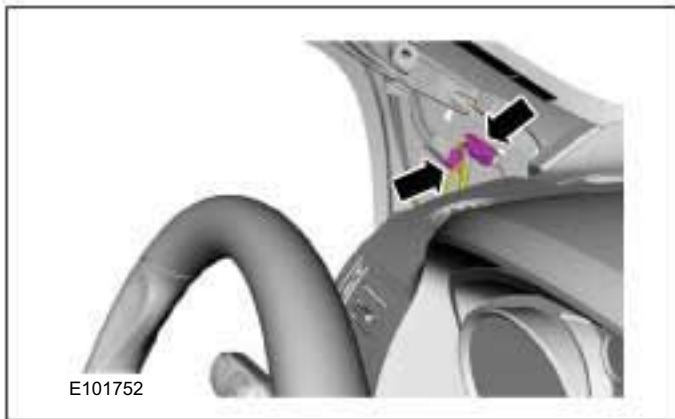
24.





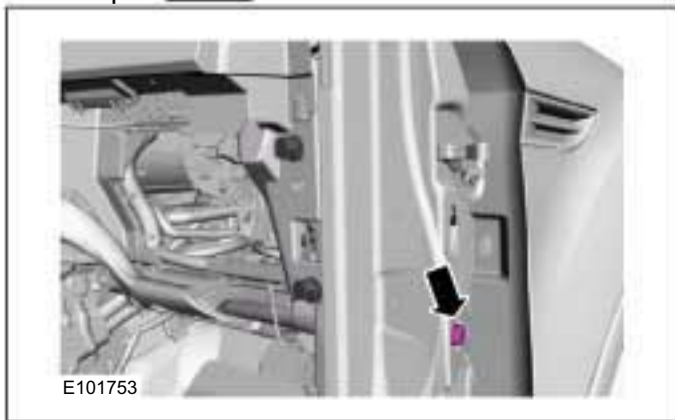
REMOVAL AND INSTALLATION

25.



E101752

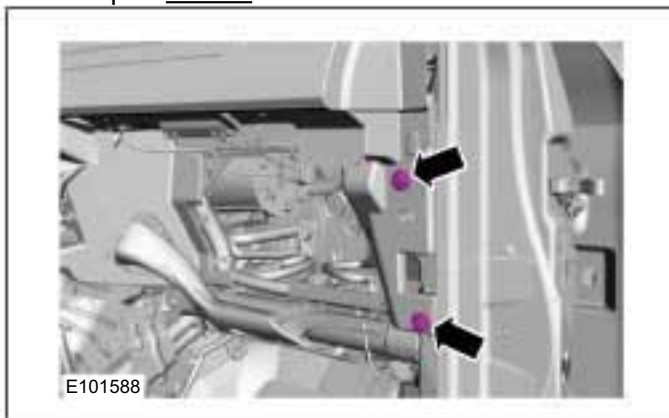
26. Torque: 80 Nm



E101753

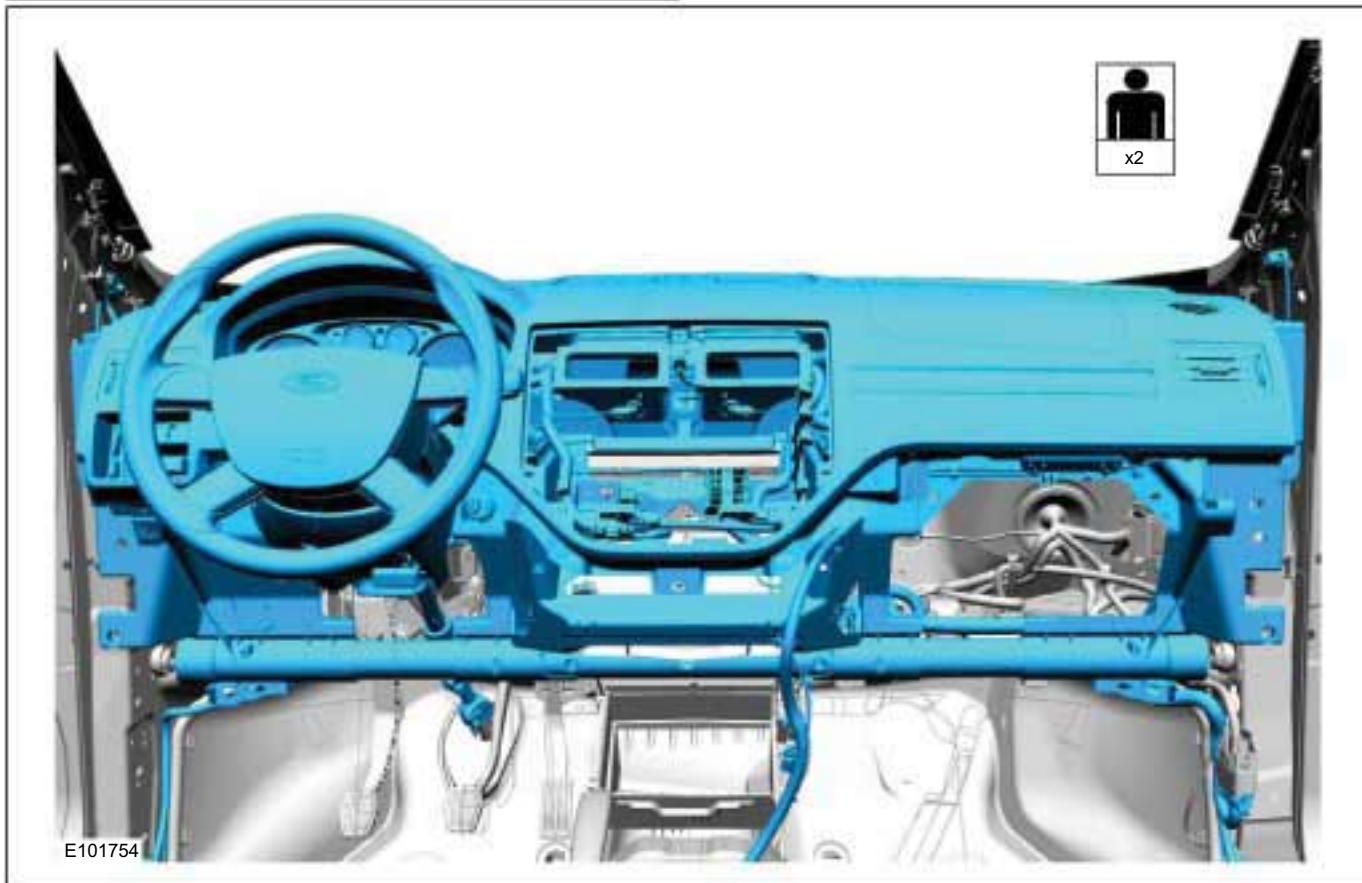
27. **NOTE:** Note the position of the component before removal.

On both sides.  
Torque: 25 Nm



E101588

28.



E101754

418-02-32

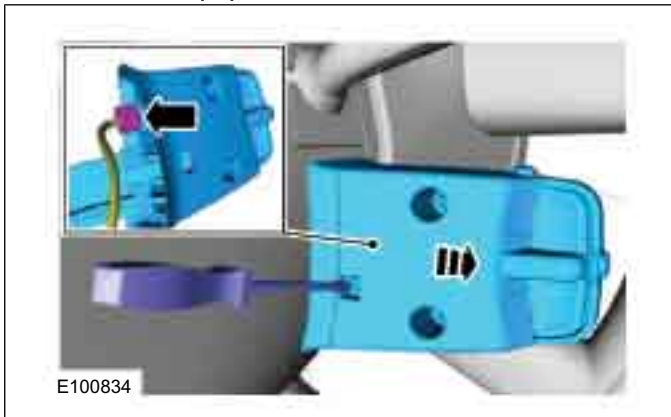
Wiring Harnesses

418-02-32

REMOVAL AND INSTALLATION

29. Refer to: **Instrument Cluster** (413-01 Instrument Cluster, Removal and Installation).

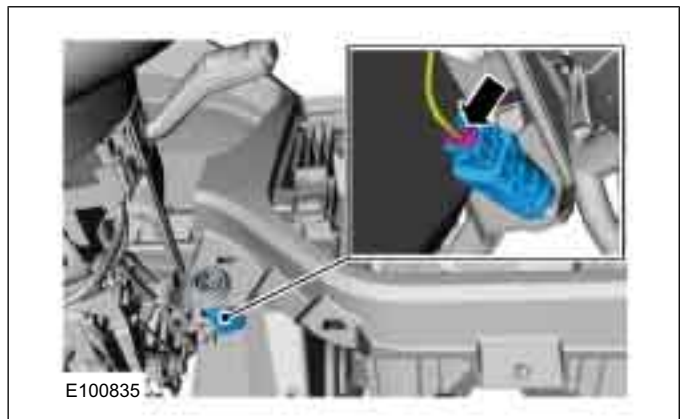
30. General Equipment: Flat-bladed screwdriver



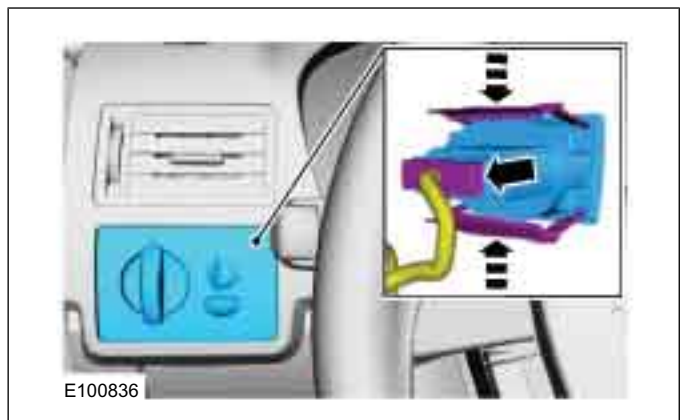
31.



32.



33.



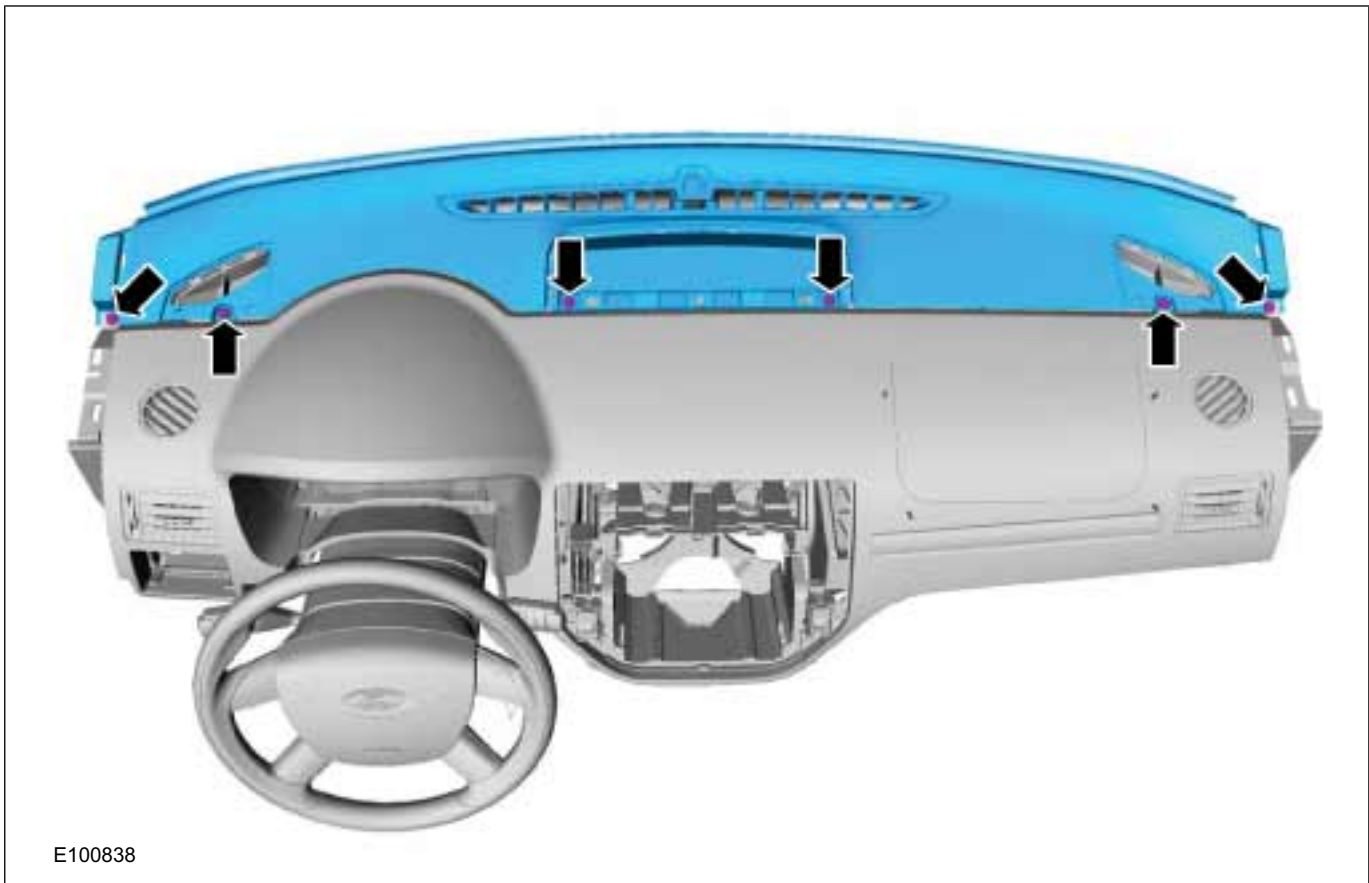
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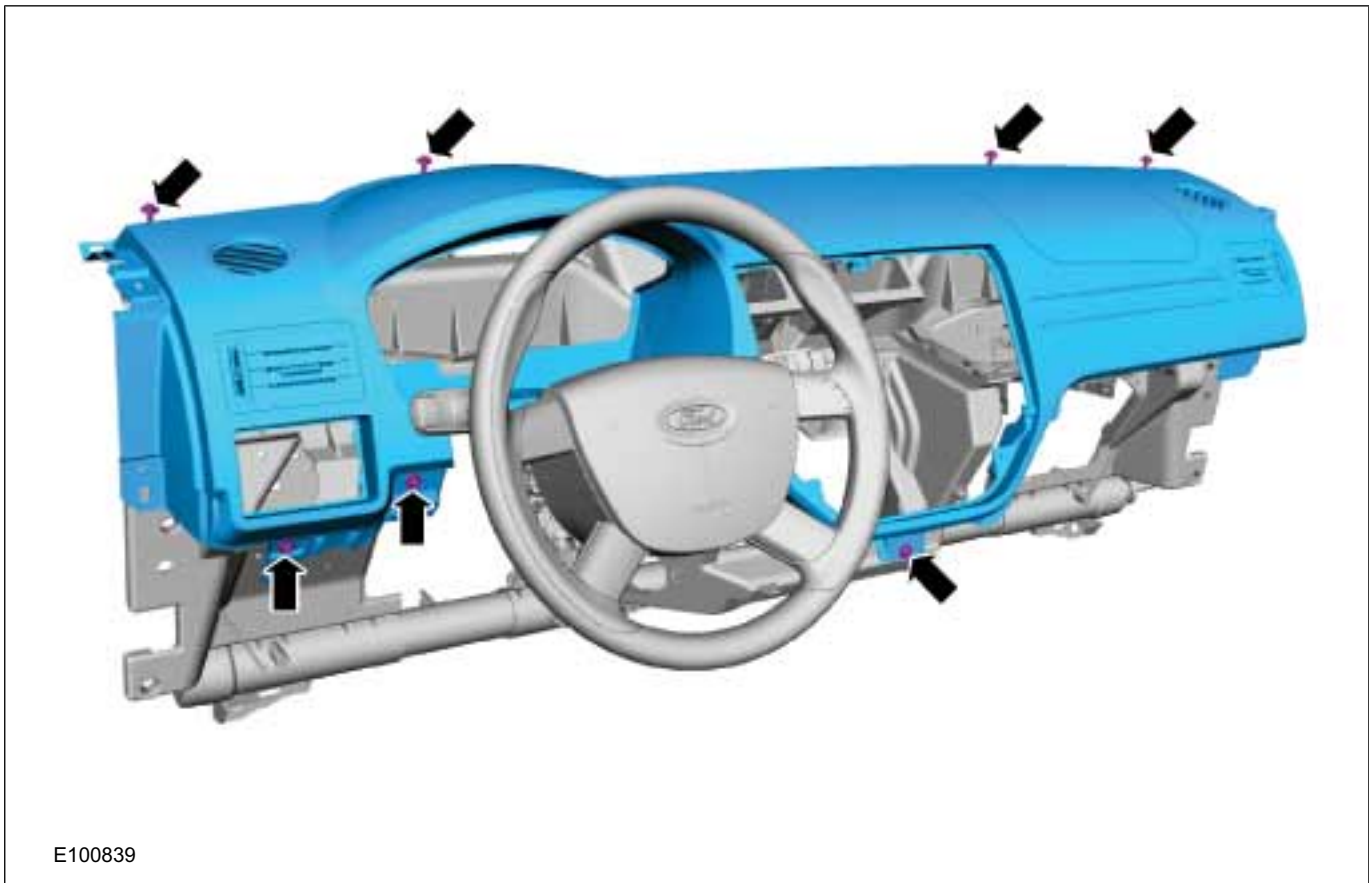
35.



REMOVAL AND INSTALLATION



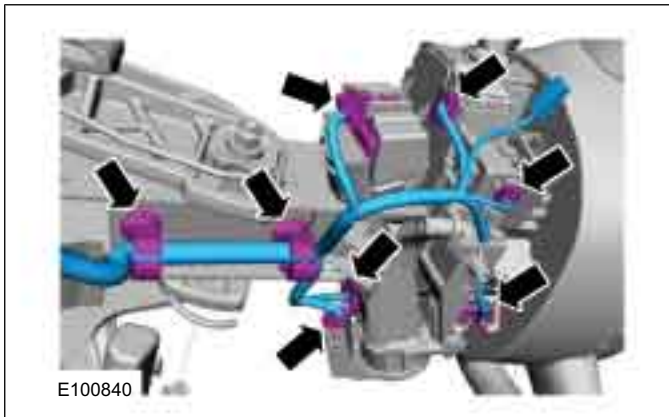
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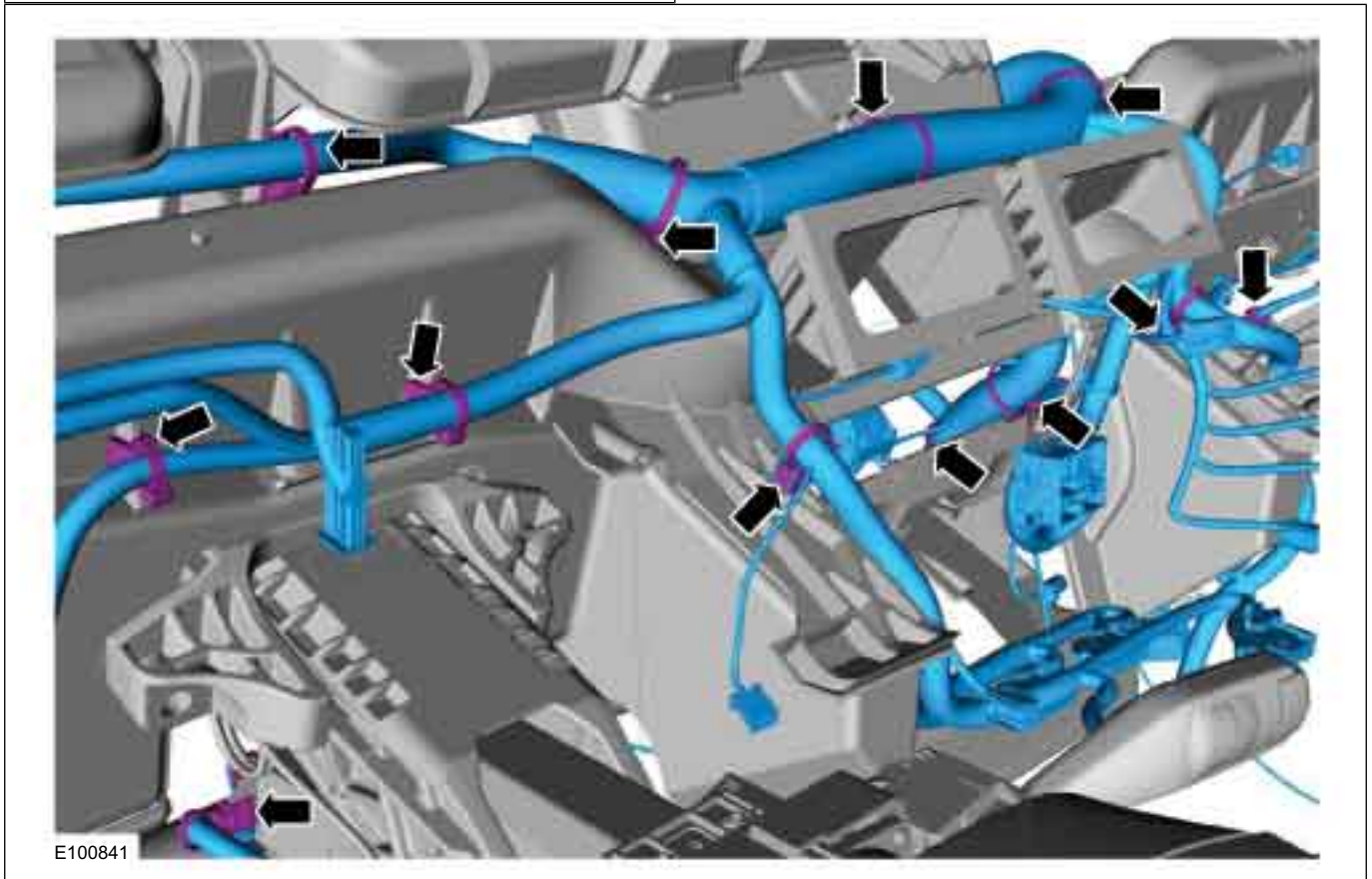


REMOVAL AND INSTALLATION

37.



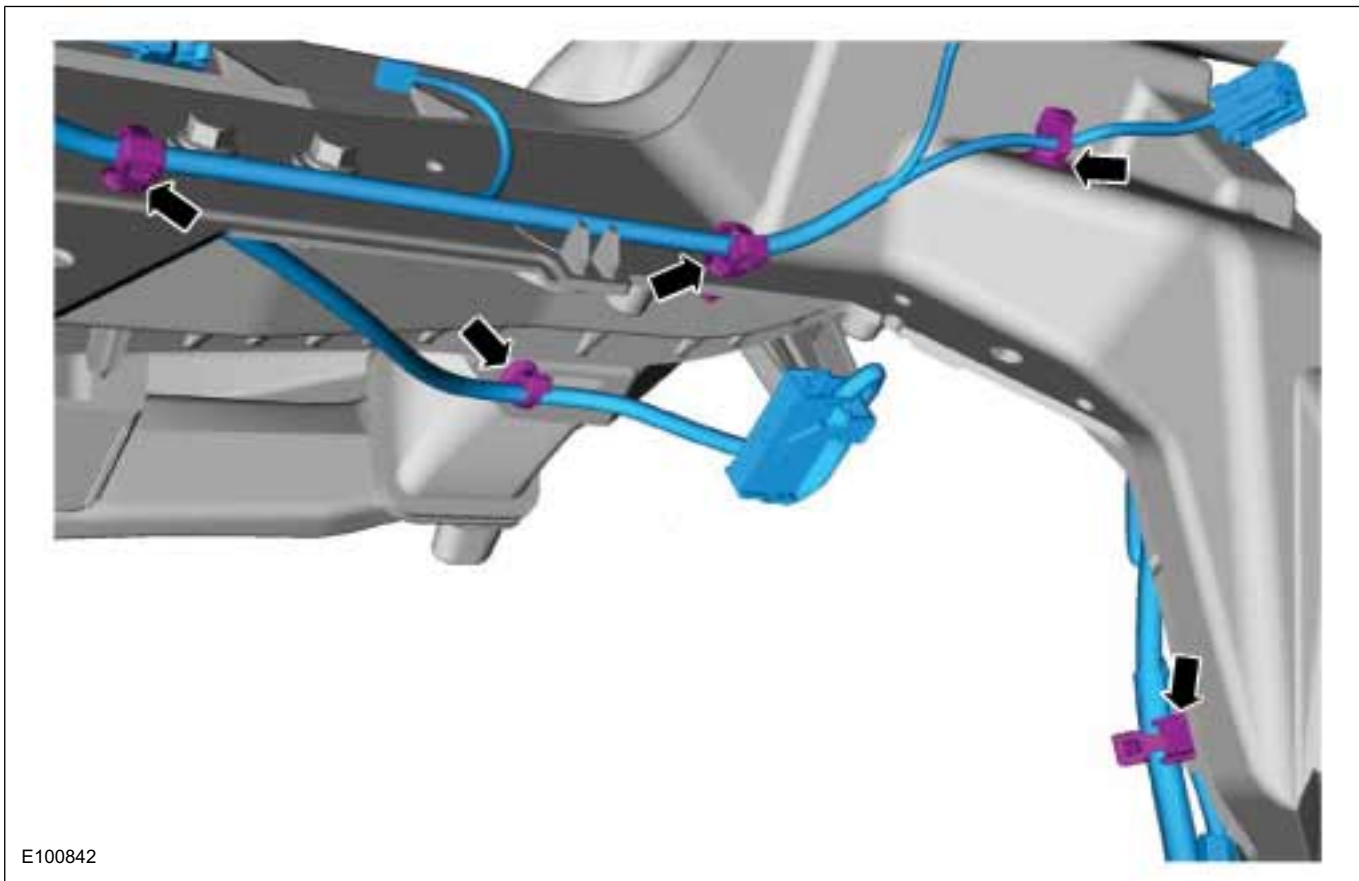
38.



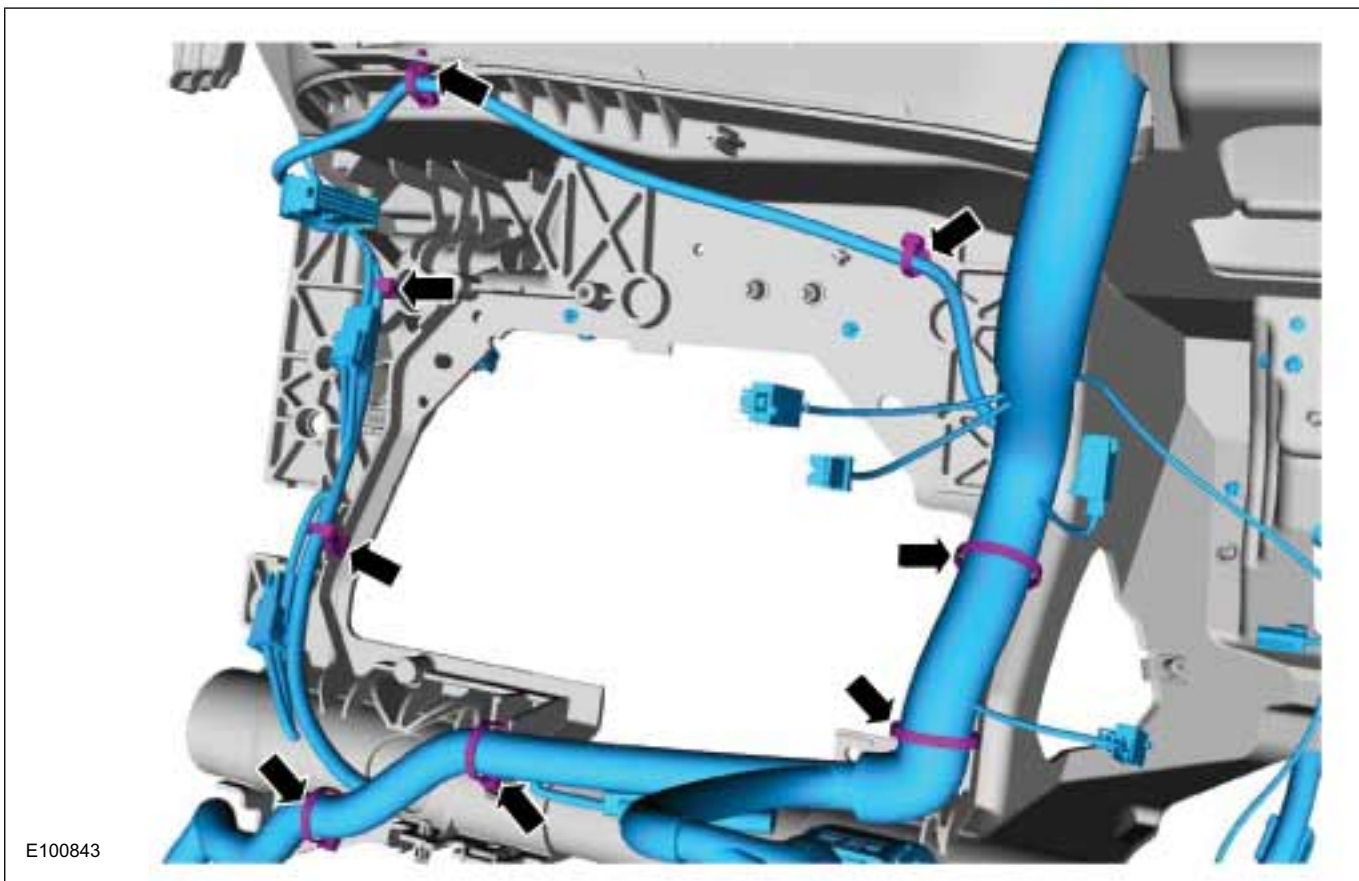
39.



REMOVAL AND INSTALLATION

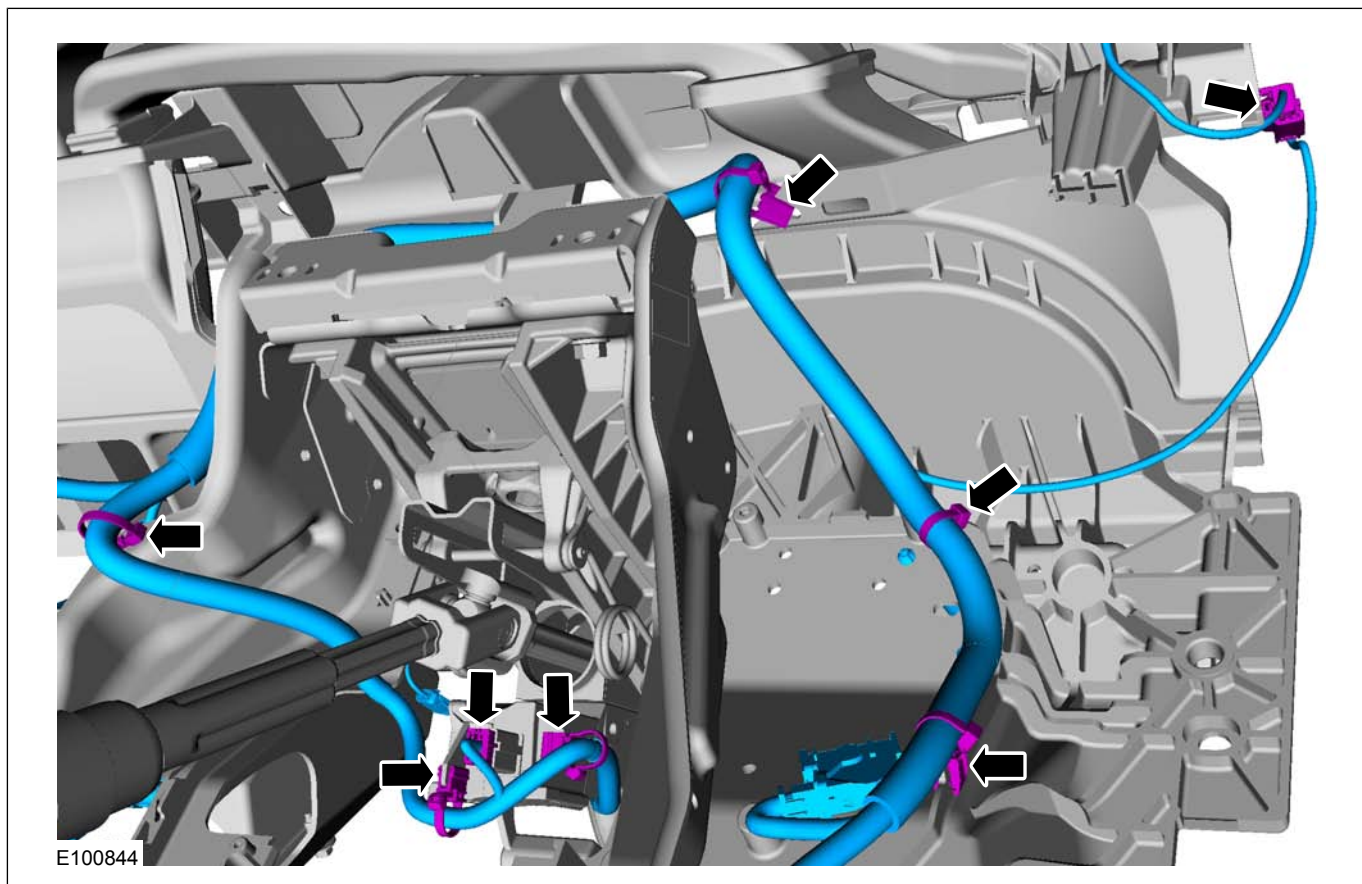


40.



## REMOVAL AND INSTALLATION

41.



## Installation

1. To install, reverse the removal procedure.



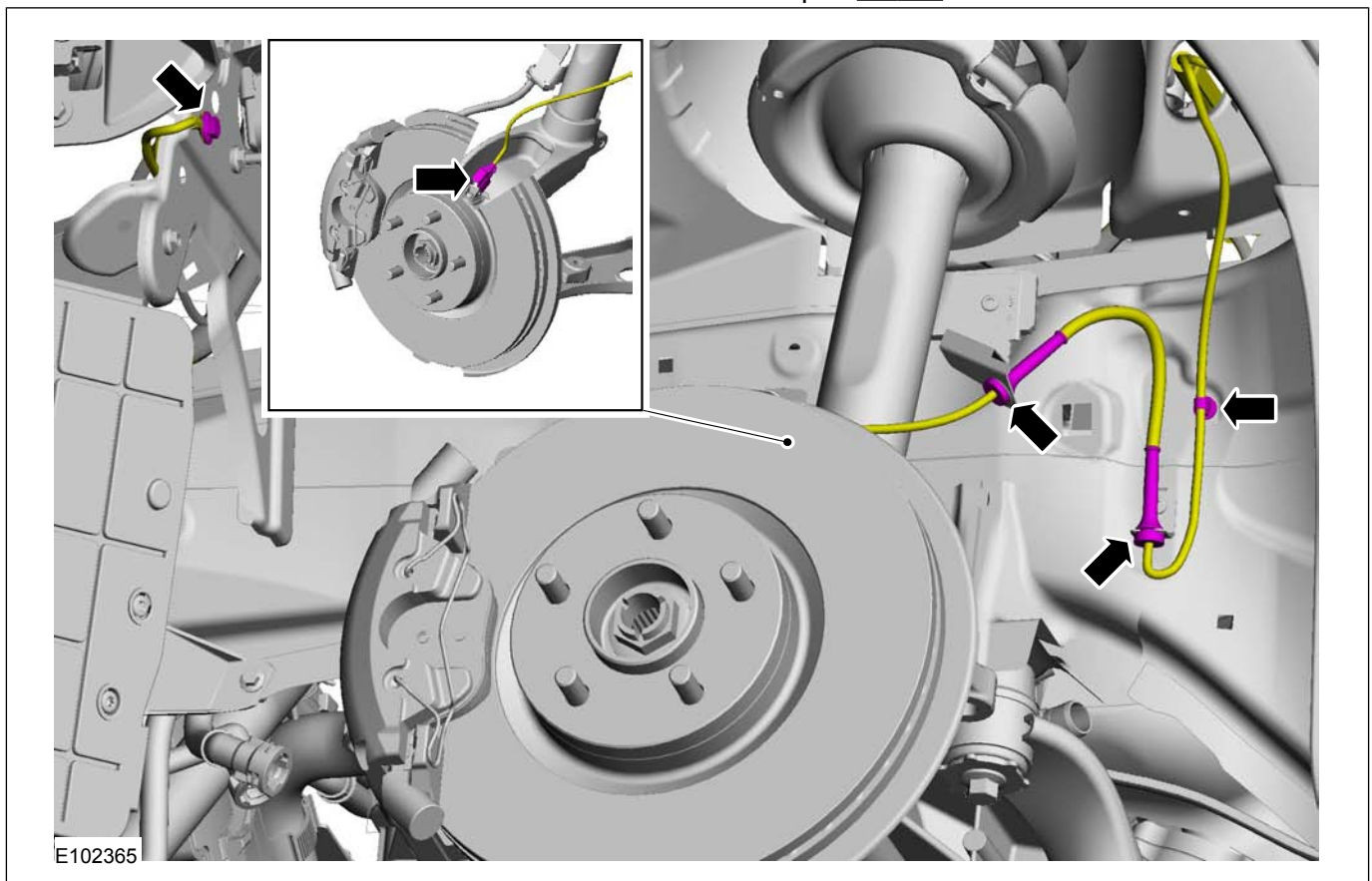
## REMOVAL AND INSTALLATION

## Engine Compartment Wiring Harness

## Removal

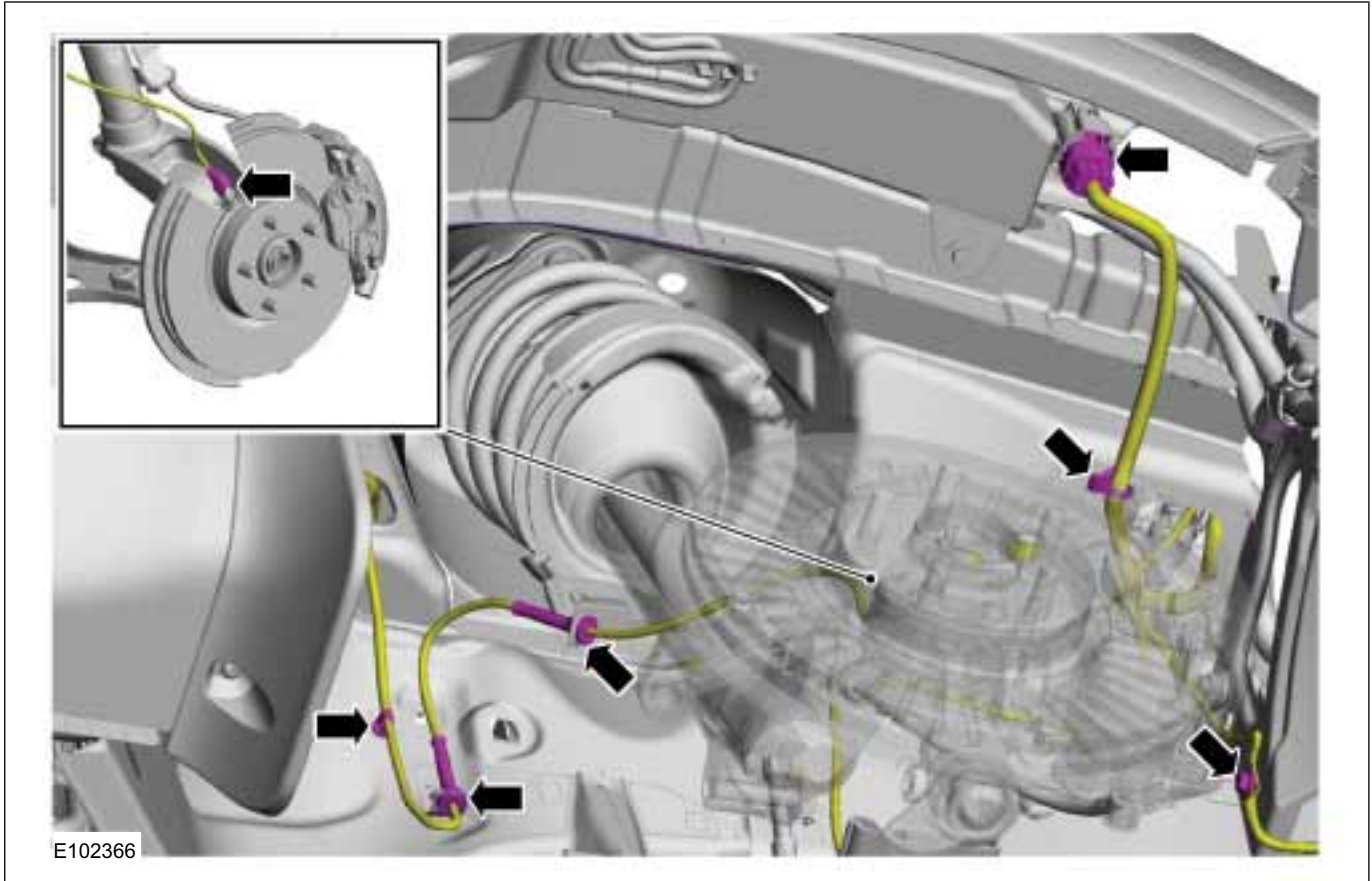
**NOTE:** Removal steps in this procedure may contain installation details.

- 1.
2. Refer to: **Headlamp Assembly** (417-01 Exterior Lighting, Removal and Installation).
3. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
4. Refer to: **Fender Splash Shield** (501-02 Front End Body Panels, Removal and Installation).
5. Refer to: **Front Bumper Cover** (501-19 Bumpers, Removal and Installation).
6. Torque: 10 Nm



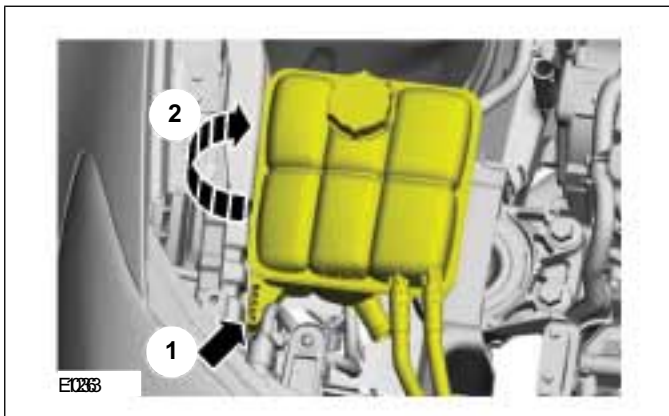
7. Torque: 10 Nm

REMOVAL AND INSTALLATION

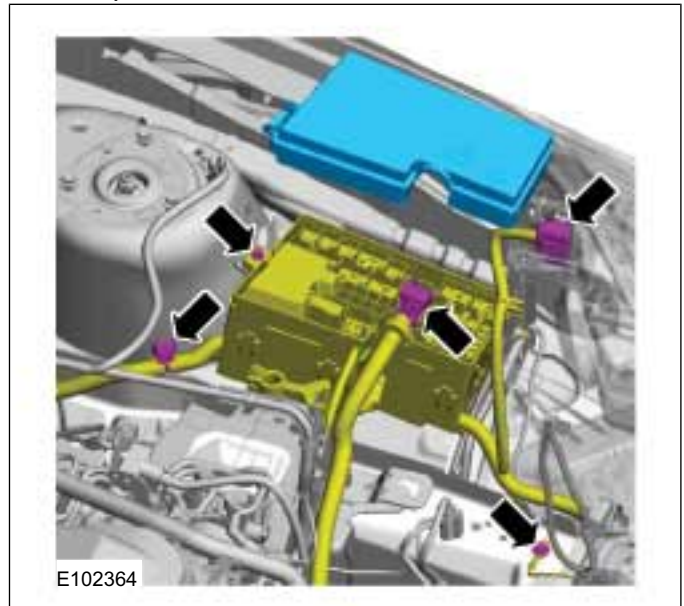


- 8. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
- 9. Refer to: **Hydraulic Control Unit (HCU)** (206-09 Anti-Lock Control - Stability Assist, Removal and Installation).

10.



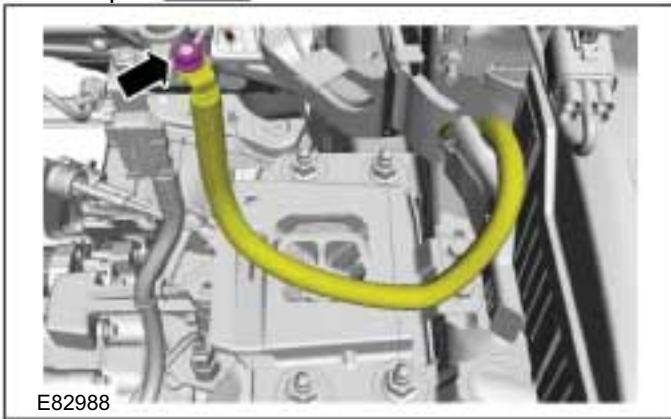
11. Torque: 10 Nm



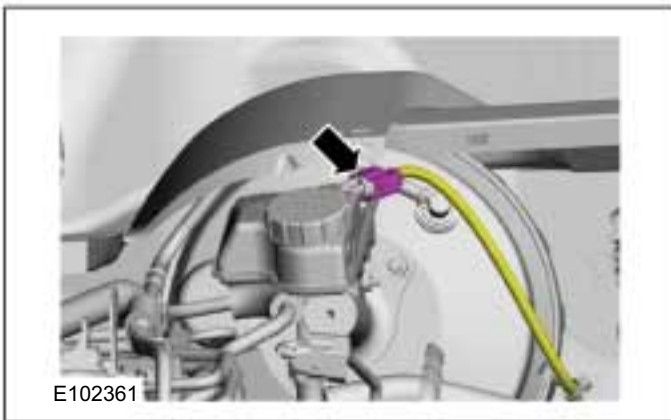


REMOVAL AND INSTALLATION

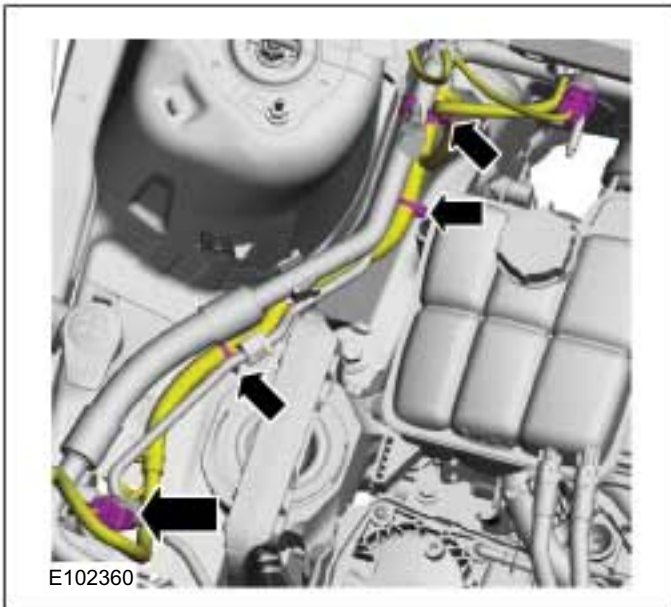
12 Torque: 24 Nm



13.



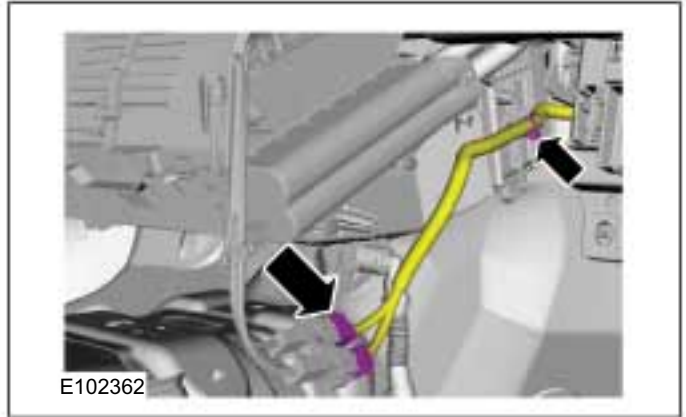
14.



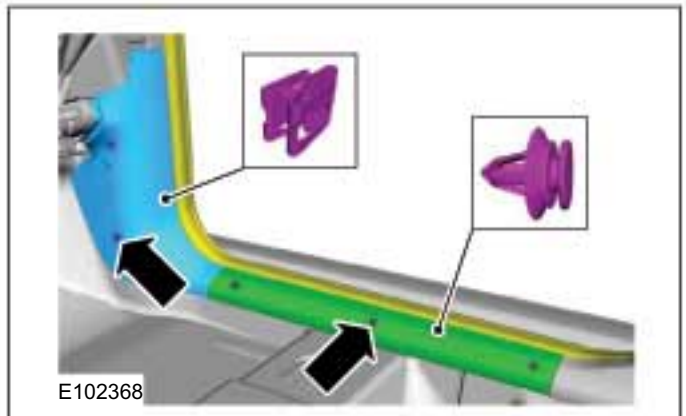
15. Refer to: Glove Compartment - Removal - RHD (501-12 Instrument Panel and Console, Removal and Installation).

16. Refer to: Floor Console (501-12 Instrument Panel and Console, Removal and Installation).

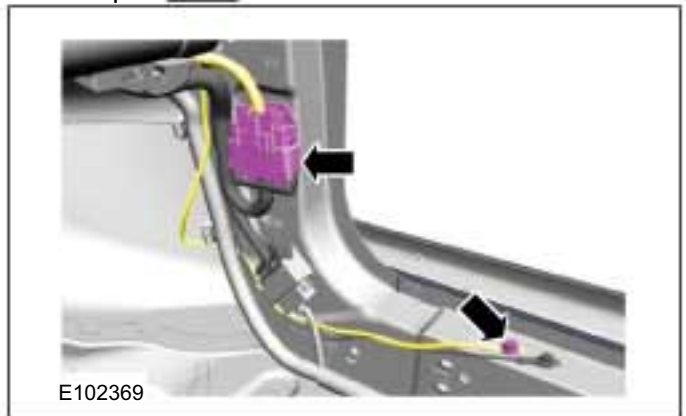
17.



18.



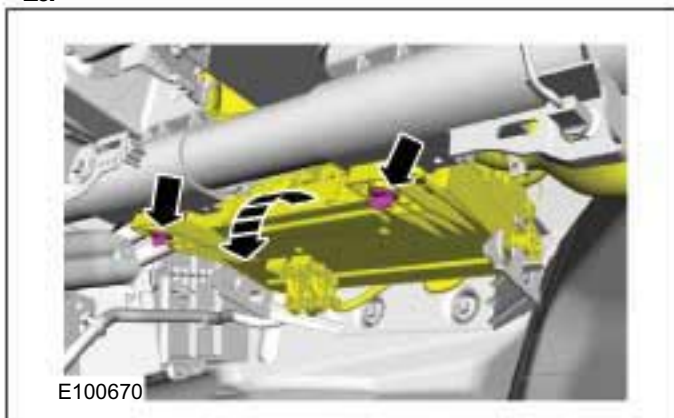
19. Torque: 9 Nm



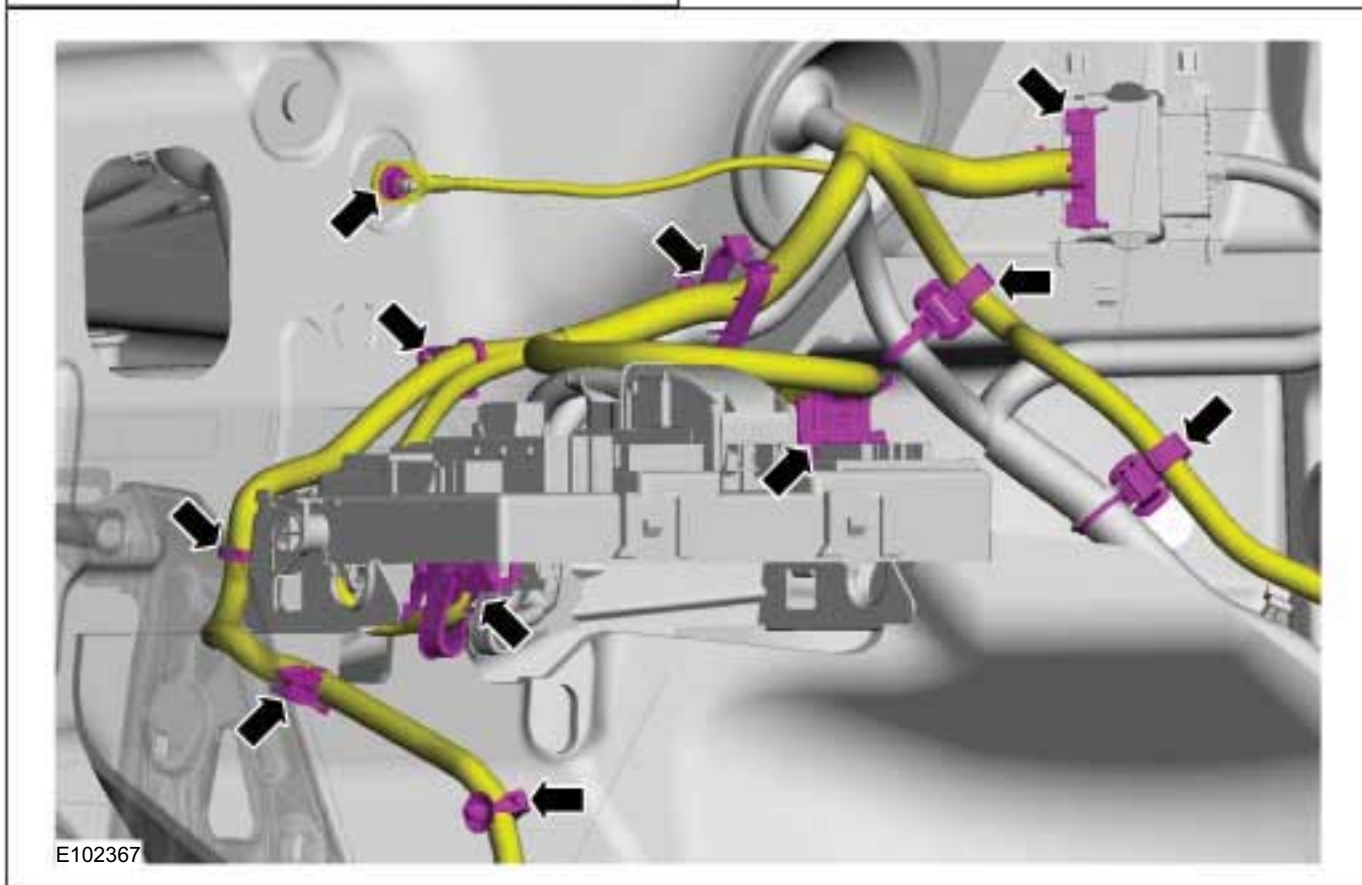


REMOVAL AND INSTALLATION

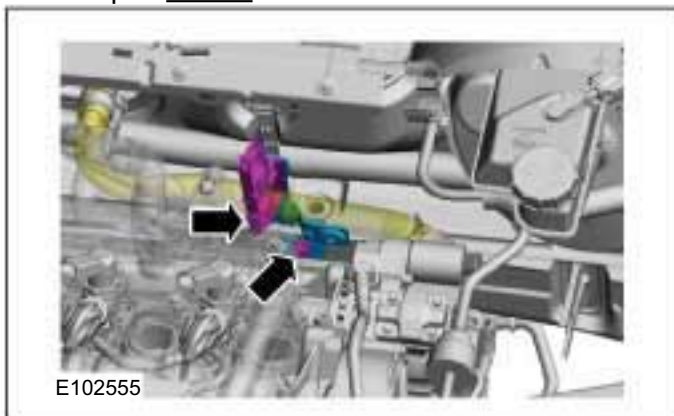
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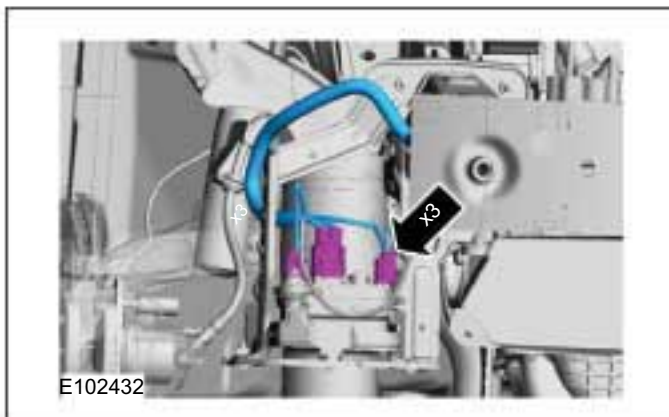
21. Torque: 9 Nm



22 Torque: 10 Nm



23.



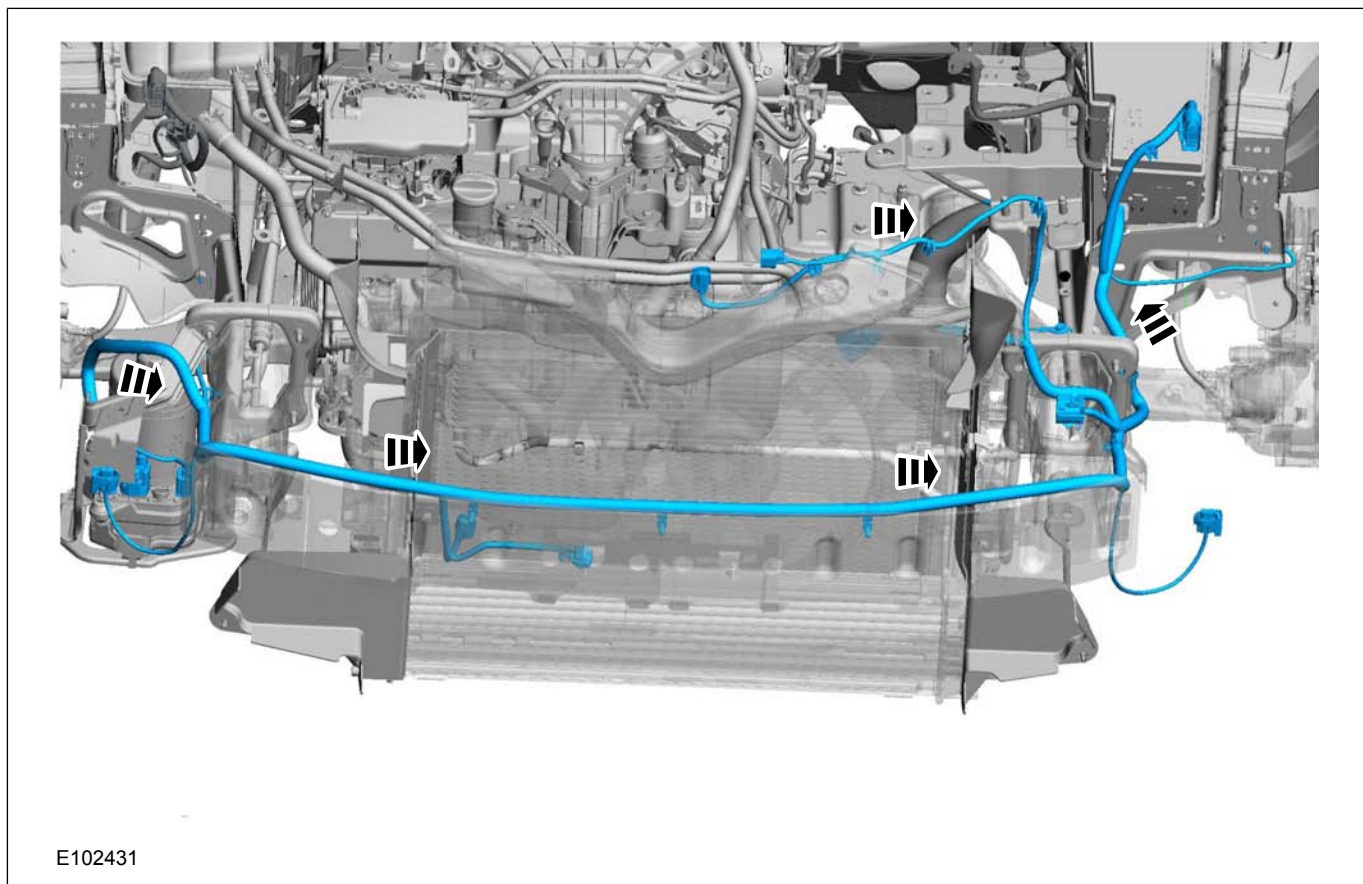
418-02-41

Wiring Harnesses

418-02-41

## REMOVAL AND INSTALLATION

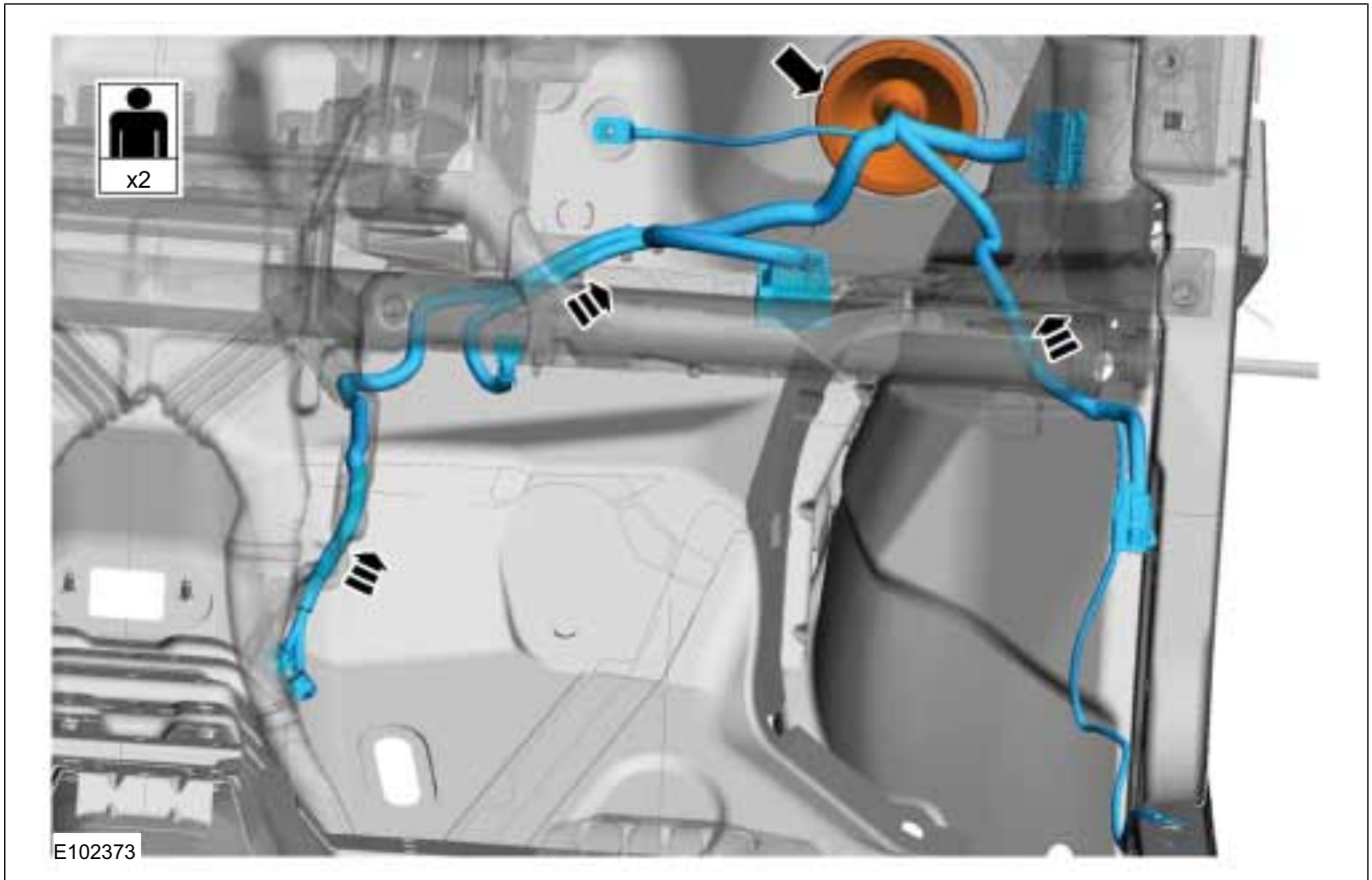
24.



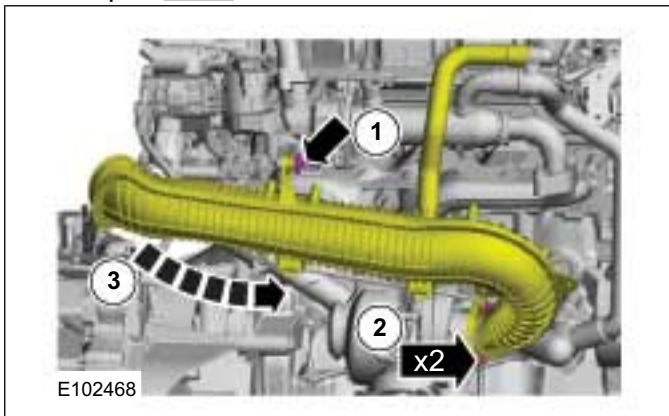
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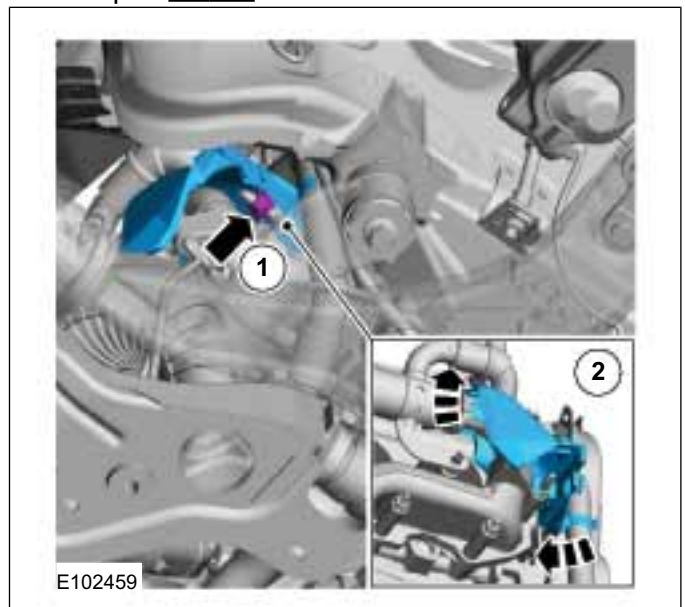
REMOVAL AND INSTALLATION



26. Torque: 9 Nm



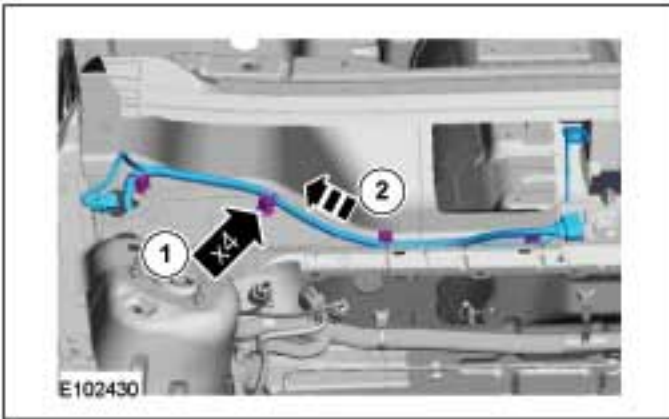
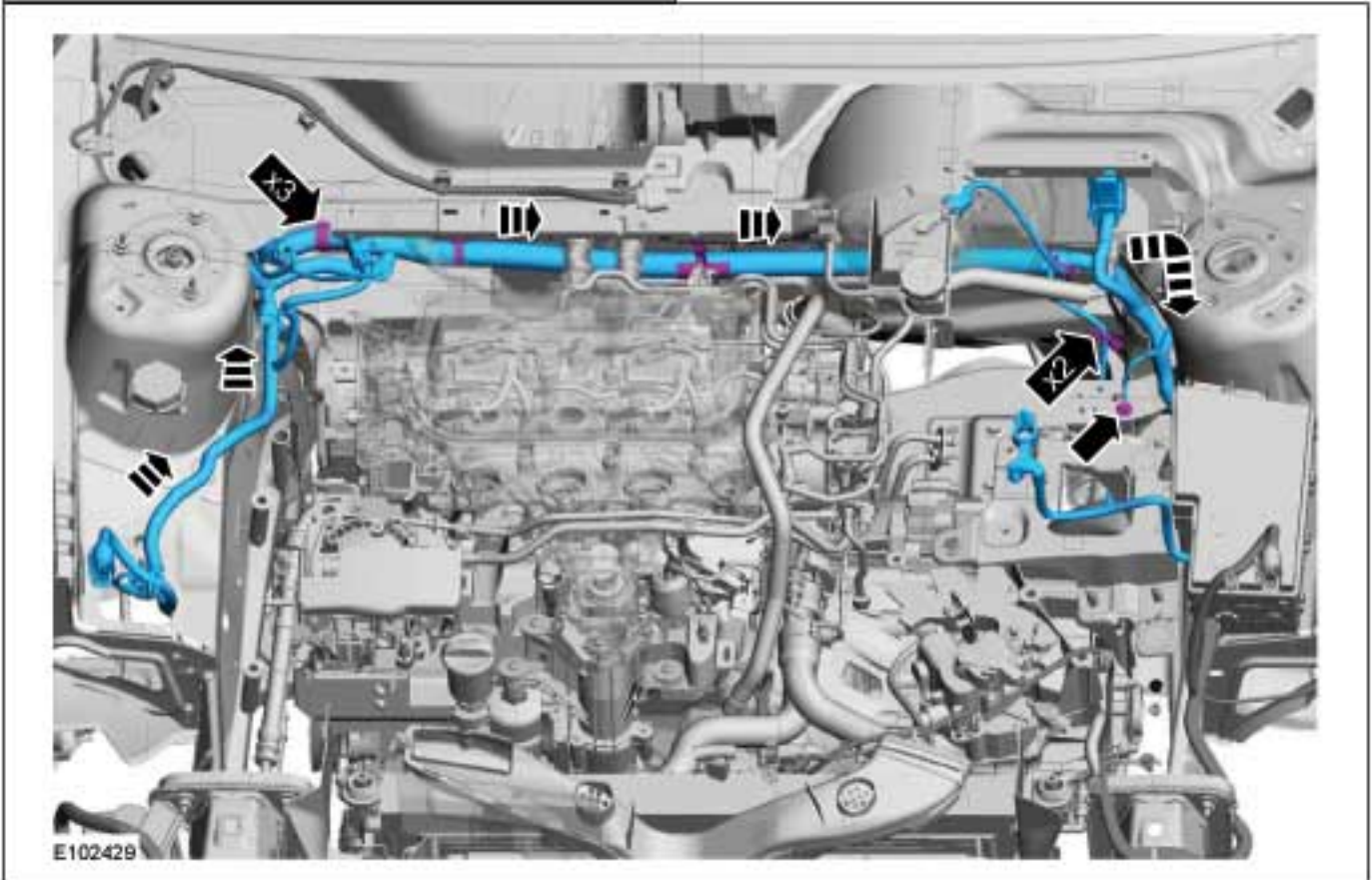
27. Torque: 10 Nm





## REMOVAL AND INSTALLATION

28.

29. Torque: 10 Nm

## Installation

1. To install, reverse the removal procedure .

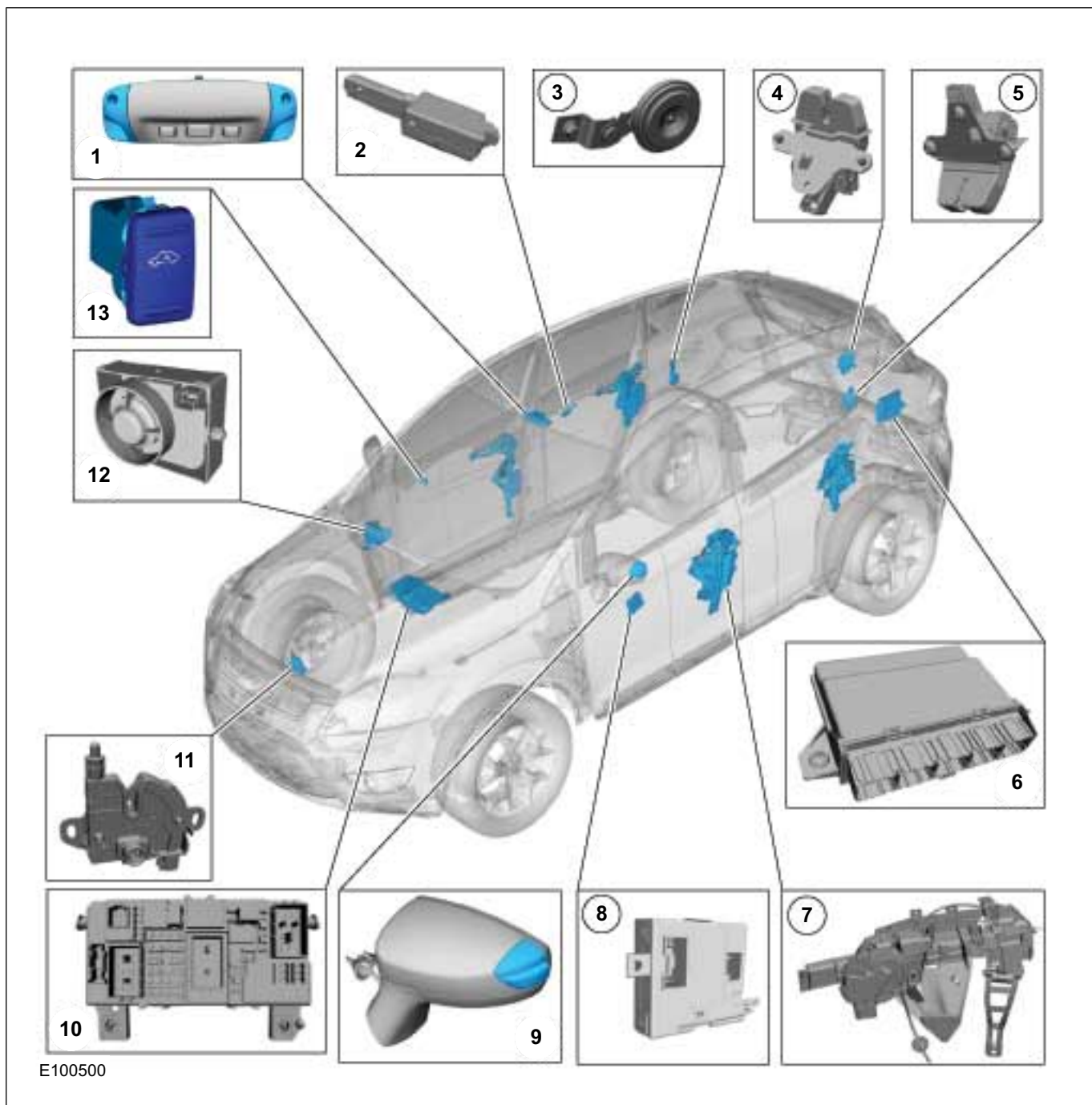
## SECTION 419-01A Anti-Theft - Active

**VEHICLE APPLICATION: 2008.50 Kuga**

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DESCRIPTION AND OPERATION

Anti-Theft - Active – Component Location



E100500

Item	Description
1	Interior scanning sensors
2	Remote control receiver
3	Anti-theft alarm system signal horn (left-hand drive vehicles)
4	Folding rear window contact switch
5	Liftgate contact switch
6	Keyless vehicle module (KVM)

Item	Description
7	Door latch units in all four doors
8	Driver's door door module
9	Hazard warning lights
10	GEM (generic electronic module)
11	Hood contact switch



**DESCRIPTION AND OPERATION**

Item	Description
12	Anti-theft alarm system horn with integrated battery (right-hand drive vehicles)

Item	Description
13	Switch for deactivation of interior scanning sensors (right-hand drive vehicles)



**DESCRIPTION AND OPERATION**

## Anti-Theft - Active – Overview

The function of the anti-theft alarm system components can be checked using the GEM's service mode.

If an exact diagnosis is not possible using the service mode, a system diagnosis must be carried out with the Ford diagnostic unit. The last four trigger signals from the anti-theft alarm signal can also be read out during this process.

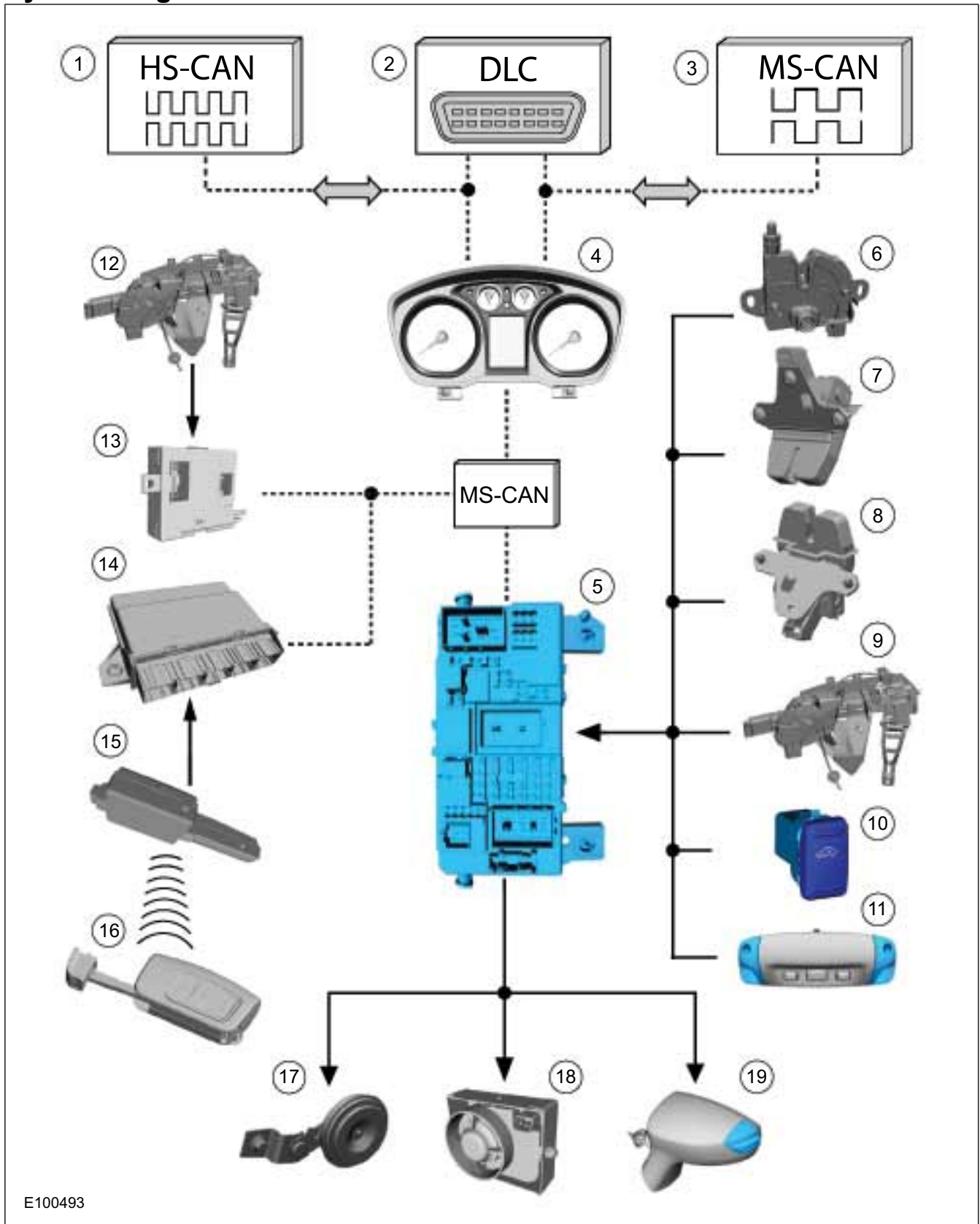
### Function check - Intrusion sensors

Activate the anti-theft alarm system is check the function of the intrusion sensors. After a waiting time of approx. 30 seconds, perform movements on both sides of the vehicle interior through the open side windows. Each movement that is detected is acknowledged through triggering of the anti-theft alarm system.

DESCRIPTION AND OPERATION

Anti-Theft - Active – System Operation and Component Description

System Diagram



E100493



## DESCRIPTION AND OPERATION

Item	Description
1	High speed CAN (controller area network) bus (HS-CAN)
2	DLC (data link connector)
3	Medium speed CAN bus (MS-CAN)
4	Instrument cluster (gateway)
5	GEM
6	Hood contact switch
7	Folding rear window contact switch
8	Liftgate contact switch
9	Door ajar switch in all four doors
10	Switch for deactivation of interior scanning sensors (right-hand drive vehicles)
11	Interior scanning sensors Refer to Component Description: (page ?)

Item	Description
12	Driver's door set/reset switch
13	Driver's door door module
14	Keyless vehicle module (KVM)
15	RF receiver
16	Radio remote control
17	Anti-theft alarm system signal horn (left-hand drive vehicles)
18	Anti-theft alarm system horn with integrated battery (right-hand drive vehicles) Refer to Component Description: Anti-theft alarm horn with integral battery (page ?)
19	Hazard warning lights

## System Operation

## Anti-theft warning system

Three anti-theft alarm systems are available, depending on the market and model version:

- The system with perimeter monitoring detects whenever the doors, the hood, the folding rear window and the liftgate are opened.
- The system with perimeter and interior monitoring in addition detects unauthorised access, for example, through a broken window.
- A Thatcham category I anti-theft alarm system (mainly for the British market) is fitted with a horn that has its own battery power supply; it also uses slightly different detection strategies.

The anti-theft alarm system outputs an acoustic and visual signal if unauthorised persons attempt to gain access to the vehicle.

As a visual warning, the system switches on the hazard warning lights, whilst the acoustic warning is done with the anti-theft alarm system horn or the horn with its own battery power supply.

When the ignition is switched off, the anti-theft alarm system is activated 20 seconds after any latch is activated, i.e. the hood, all doors, the folding rear window and the liftgate are alarmed, provided that they are fully closed.

If the hood, one of the doors, the folding rear window or the liftgate is not completely closed, it can be opened without the alarm being triggered since the system was not activated.

The anti-theft alarm system can be switched off by unlocking the vehicle either via the remote controls or the door lock.

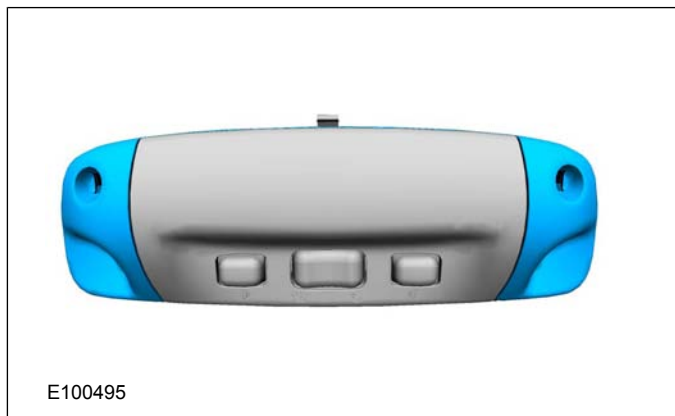
**NOTE:** To switch off the alarm on a Thatcham category I anti-theft alarm system, the ignition must be switched on within 12 seconds of the door being unlocked with the key.

If the folding rear window or the liftgate is opened via the remote control, the anti-theft alarm system blocks the trigger for the alarm system or the interior monitoring (if fitted) for 20 seconds after closing.

**NOTE:** If a window is not fully closed, there is a risk that a false alarm will be triggered.

**DESCRIPTION AND OPERATION****Component Description**

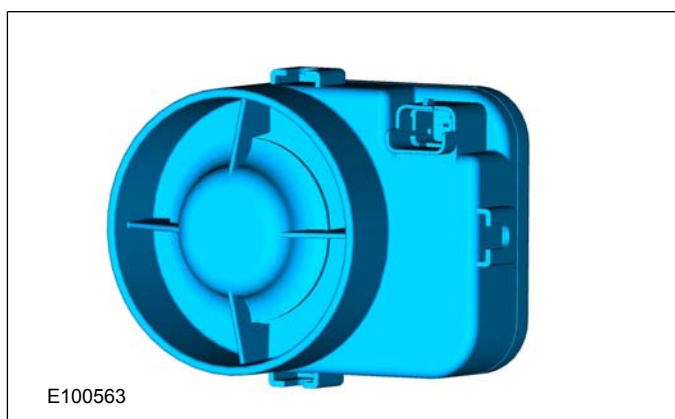
This ensures that the alarm horn will still be powered even if the vehicle battery has been disconnected.

**Interior scanning sensors**

The interior monitoring is an additional security system that triggers the alarm if unauthorised access to the vehicle is detected in the area of the windows.

The transceivers work ultrasonically. The transmitter transmits at a specific frequency into the monitoring area. The receiver receives the corresponding echo signal. Here, the signals are converted into digital values and compared with the values from the signals received previously. If there are significant differences between the two, a trigger signal is sent to the GEM.

As the period during which no movement is detected increases, so the sensitivity of the sensors increases.

**Anti-theft alarm horn with integral battery**

A special horn is installed for vehicles that have to comply with the Thatcham category I (CAT 1) insurance standard. This horn has its own voltage supply from an integrated battery.

**DIAGNOSIS AND TESTING****Anti-Theft - Active**

Refer to **Wiring Diagrams Section 419-01A**, for schematic and connector information.

**General Equipment**

The Ford approved diagnostic tool
-----------------------------------

**Inspection and Verification**

1. Verify the customer concern, perform a full alarm function test
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

<b>Mechanical</b>	<b>Electrical</b>
– Misaligned door(s), hood or tailgate	– Fuse(s)
– Door ajar switch(es)	– Wiring harness
– Latch(es)	– Electrical connector(s)
– Cable(s)	– Relay(s)
– Lock cylinder(s)	– Generic electronic module (GEM)
– Set/reset switch(s)	– Anti-theft alarm horn
– Linkage(s)	– Anti-theft alarm horn with integral battery (if equipped)
– Remote key	
– Passive key	
– Interior scanning system	
– Interior scanning system disable button (if equipped)	

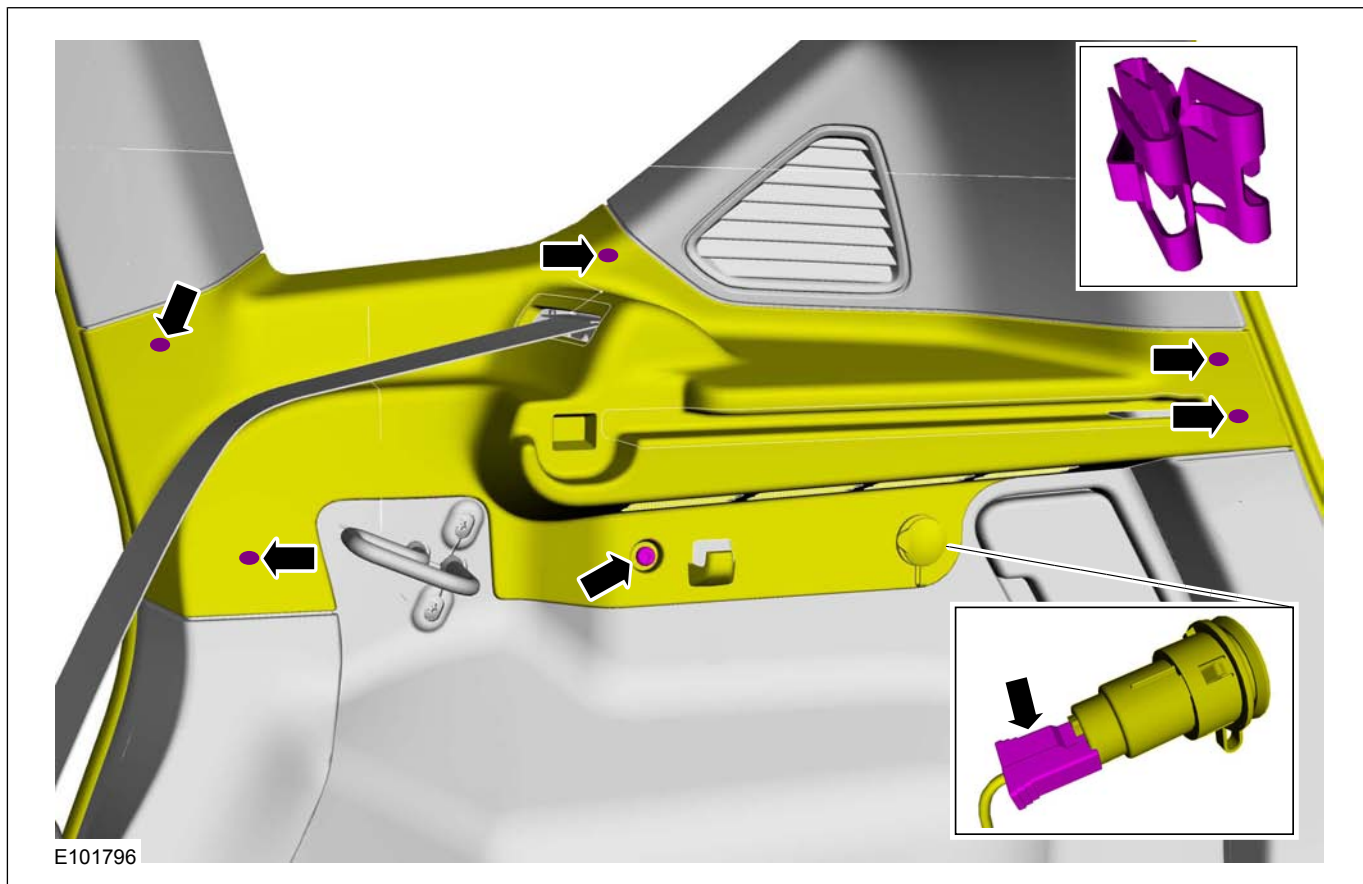
3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Ford approved diagnostic tool to diagnose the system.

REMOVAL AND INSTALLATION

Anti-Theft Alarm Horn

Removal

1.



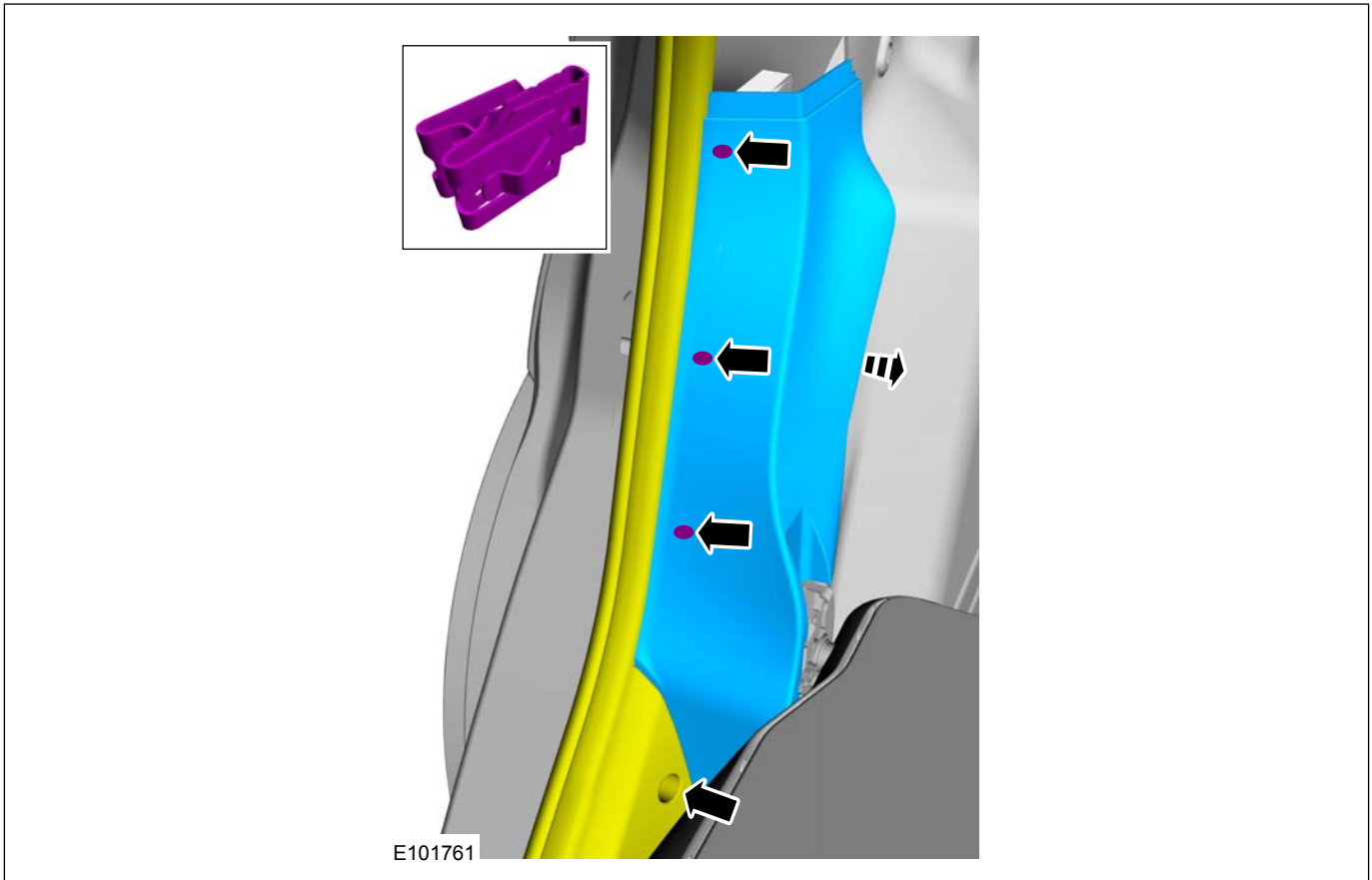
2.

419-01A-10

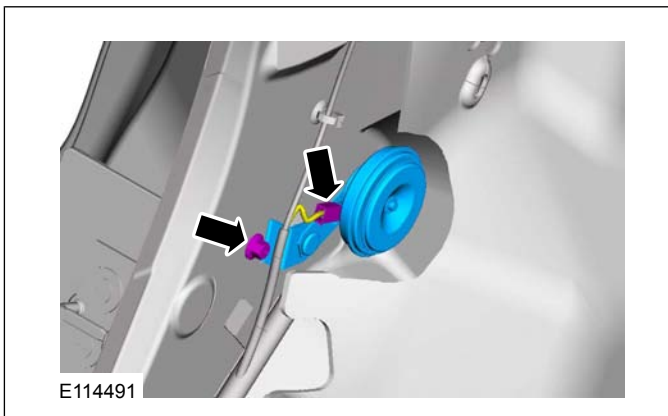
Anti-Theft - Active

419-01A-10

## REMOVAL AND INSTALLATION



3.



## Installation

1. To install, reverse the removal procedure.

419-01A-11

Anti-Theft - Active

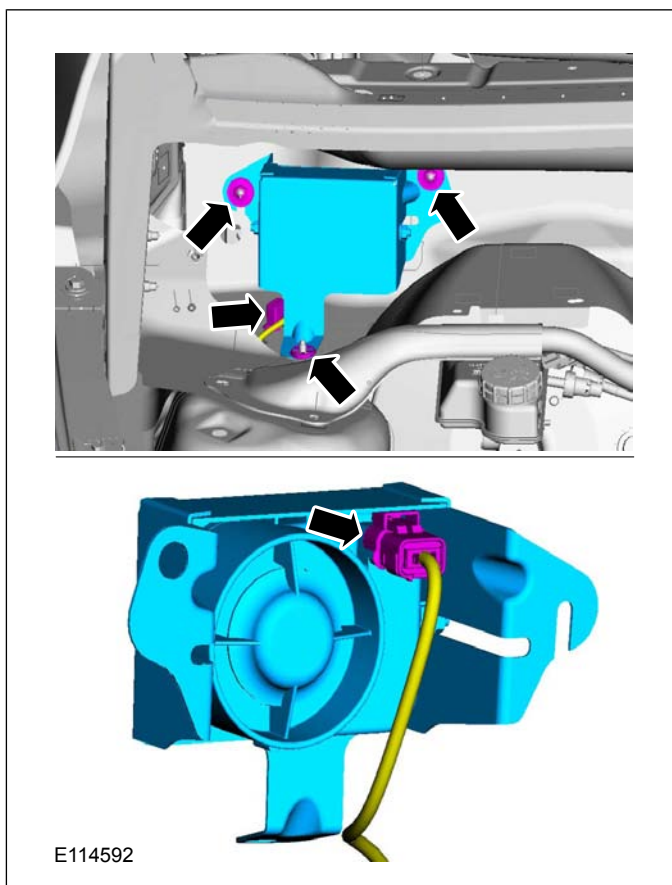
419-01A-11

## REMOVAL AND INSTALLATION

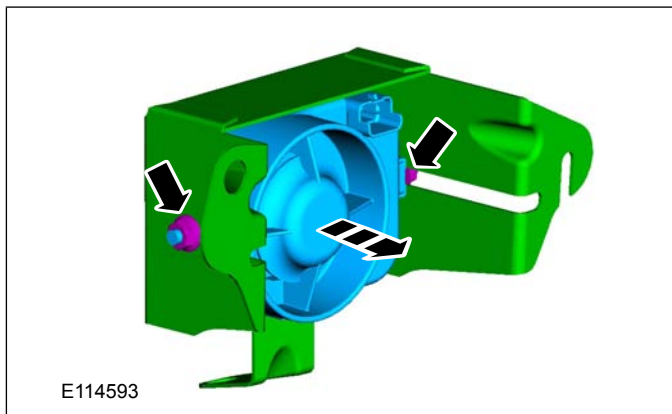
## Anti-Theft Alarm Horn with Integral Battery

## Removal

1. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
- 2.



3.



## Installation

1. To install, reverse the removal procedure.



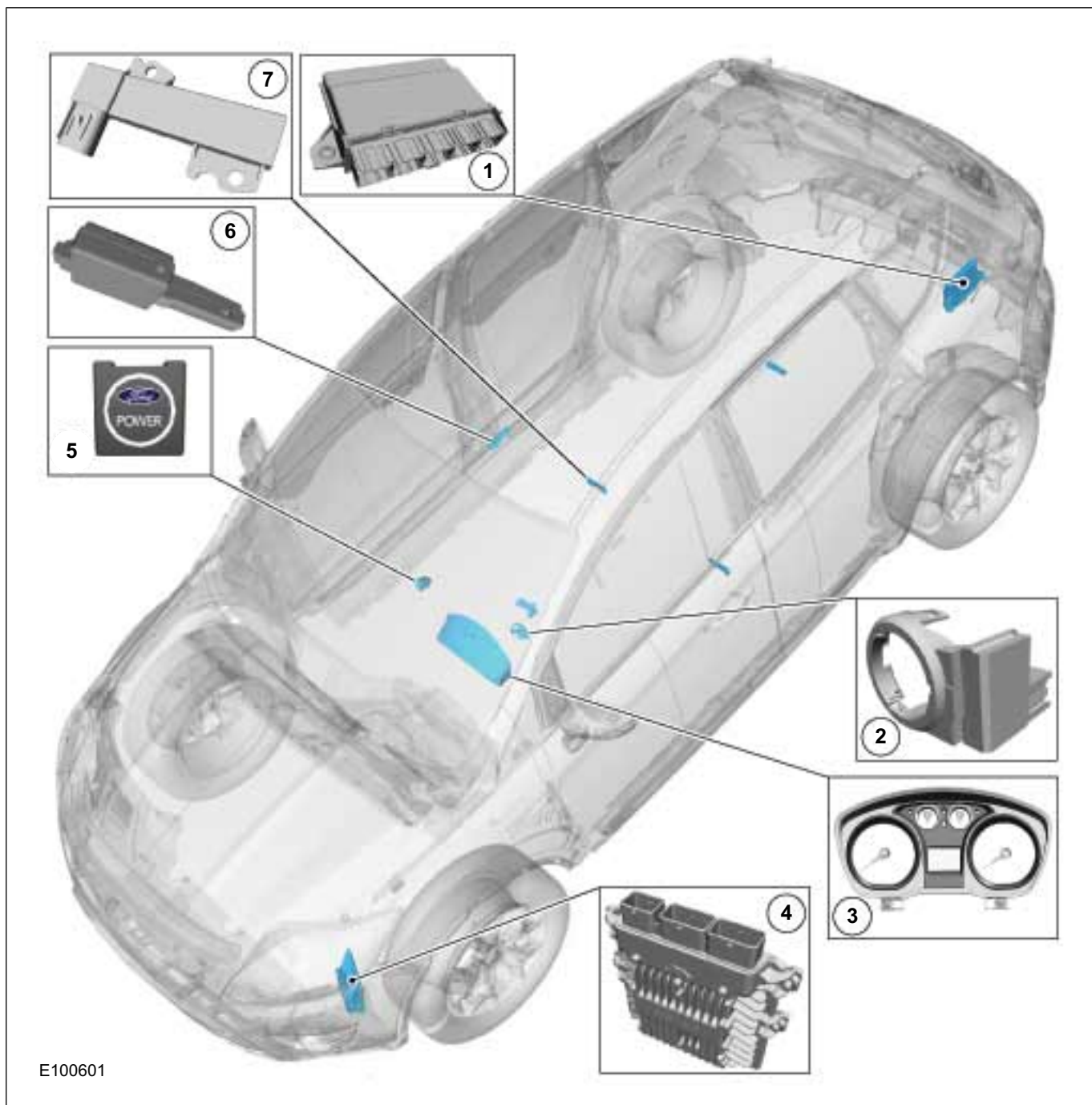
## SECTION 419-01B Anti-Theft - Passive

**VEHICLE APPLICATION: 2008.50 Kuga**

CONTENTS	PAGE
<b>DESCRIPTION AND OPERATION</b>	
Anti-Theft - Passive (Component Location).....	419-01B-2
Anti-Theft - Passive (Overview).....	419-01B-3
Programming the key.....	419-01B-3
Transceiver of passive anti-theft system (emergency start function).....	419-01B-3
Anti-Theft - Passive (System Operation and Component Description).....	419-01B-4
System Diagram.....	419-01B-4
System Operation.....	419-01B-5
Passive Anti-theft System.....	419-01B-5
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Keyless vehicle module (KVM).....	419-01B-5
Interior antennas.....	419-01B-5
Passive key (radio remote control with integrated emergency key).....	419-01B-5
RF receiver.....	419-01B-6
Transceiver of passive anti-theft system (emergency start function).....	419-01B-6
Instrument cluster.....	419-01B-6
<b>DIAGNOSIS AND TESTING</b>	
Anti-Theft - Passive.....	419-01B-7
Inspection and Verification.....	419-01B-7

DESCRIPTION AND OPERATION

Anti-Theft - Passive – Component Location



E100601

Item	Description
1	Keyless vehicle module (KVM)
2	Transceiver of passive anti-theft system (emergency start function)
3	Instrument cluster

Item	Description
4	PCM (powertrain control module)
5	Start/stop button
6	RF receiver
7	Four internal antennas

**DESCRIPTION AND OPERATION****Anti-Theft - Passive – Overview****Programming the key**

After exchanging the keyless vehicle module (KVM), all available keys must be reprogrammed using the Ford diagnostic unit. Both the passive key and the emergency key must be reprogrammed.

In addition, the KVM must be initialized with the following modules using the Ford diagnostic unit:

- PCM
- Steering Lock Unit

If a new key has to be added, only this key must be programmed using the Ford diagnostic unit.

If a key is to be deleted, all keys must first be deleted and the remaining keys reprogrammed.

Up to 8 keys can be programmed.

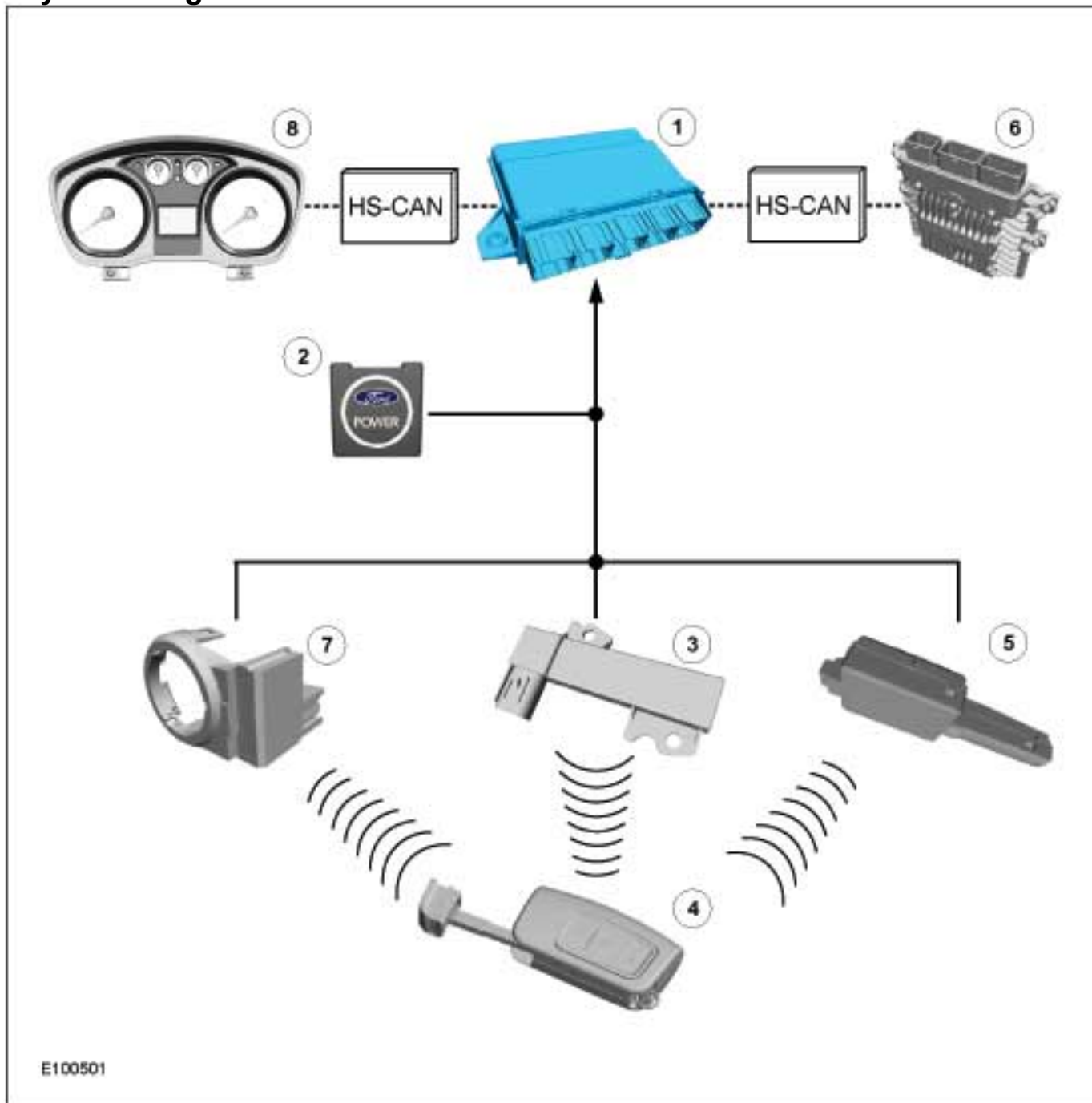
**Transceiver of passive anti-theft system (emergency start function)**

Between the emergency key holder and the passive anti-theft system transceiver, there is a copper ring that ensures the resonant frequency of the transceiver. If this copper ring is not in the correct position, the function of the emergency key cannot be guaranteed.

DESCRIPTION AND OPERATION

Anti-Theft - Passive – System Operation and Component Description

System Diagram



Item	Description
1	Keyless vehicle module (KVM) Refer to Component Description: (page ?)
2	Start/stop button

Item	Description
3	Interior antennas Refer to Component Description: (page ?)

**DESCRIPTION AND OPERATION**

Item	Description
4	Passive key (radio remote control with integrated emergency key) Refer to Component Description: (page ?)
5	RF receiver Refer to Component Description: (page ?)
6	PCM

Item	Description
7	Transceiver of passive anti-theft system (emergency start function) Refer to Component Description: (page ?)
8	Instrument cluster Refer to Component Description: (page ?)

**System Operation**

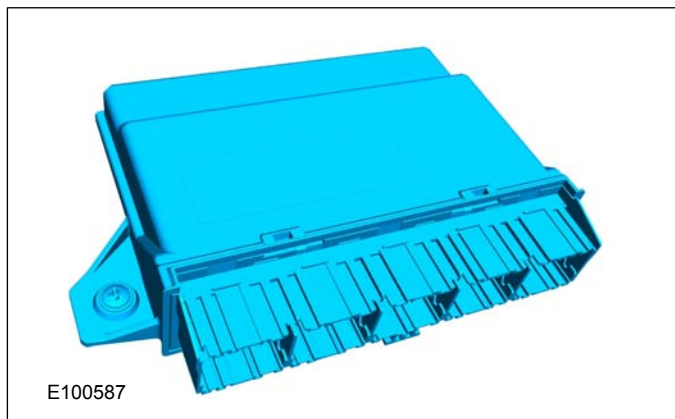
**Passive Anti-theft System**

The passive anti-theft system PATS (passive anti-theft system) is based on an electronic engine immobiliser.

The driver does not need to intervene in any way to protect the vehicle, since PATS is automatically activated when the ignition is switched off.

**Component Description**

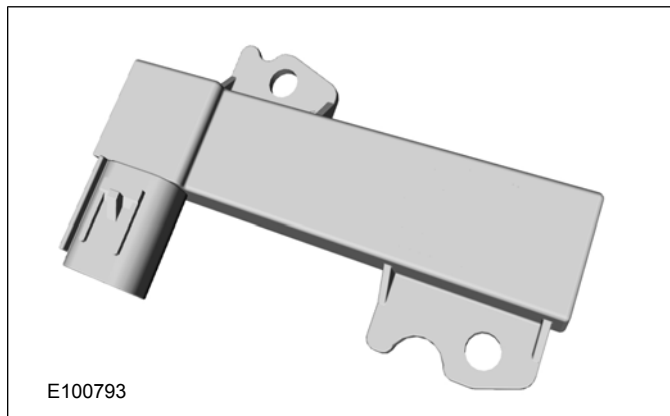
**Keyless vehicle module (KVM)**



The PATS functionality is saved in the KVM. After pressing the start/stop button, the KVM activates the interior antennas, which then transmit a signal. If there is a valid passive key in the vehicle interior, it sends an encrypted signal to the radio frequency receiver. The radio receiver forwards this signal to the KVM via a fixed wire. The KVM then forwards a corresponding identification query via the HS CAN (controller area network) to the PCM.

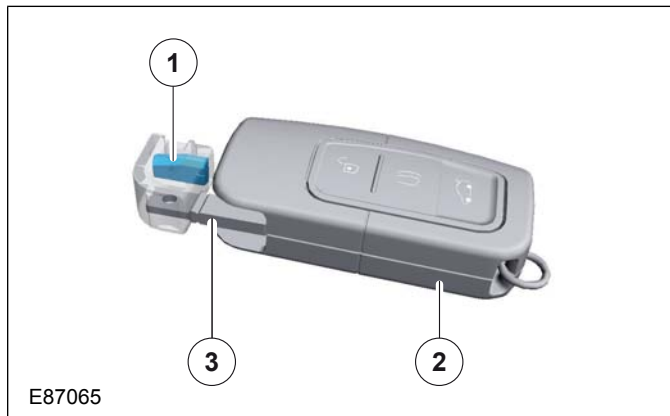
If a valid code was received to this query, then the engine can be started.

**Interior antennas**



The four interior antennas transmit an LF signal which is identified by the passive key.

**Passive key (radio remote control with integrated emergency key)**



**DESCRIPTION AND OPERATION**

Item	Description
1	PATS transponder (emergency start function)
2	Passive key (radio remote control with integrated emergency key)
3	Emergency key blade

A valid passive key must be present in the vehicle interior to start the engine.

The identification code is stored in the electronics of the passive key.

In addition, the emergency key contains the conventional PATS transponder for the emergency starting function.

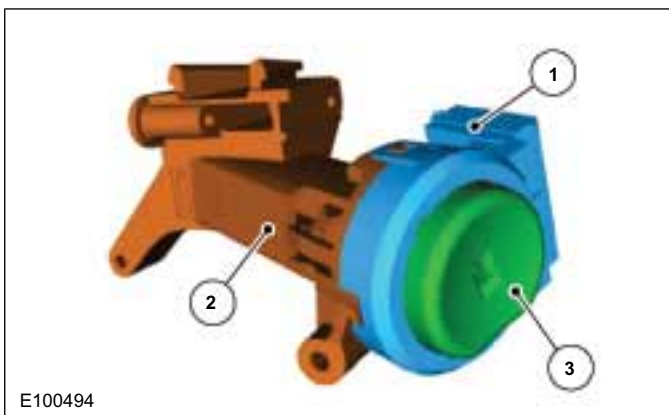
The passive key sends an encrypted signal to the radio frequency receiver.

**RF receiver**



The high frequency RF signal of the passive key is identified by the radio receiver and forwarded to the KVM via a fixed wire.

**Transceiver of passive anti-theft system (emergency start function)**



x2

Item	Description
1	PATS transceiver
2	Transceiver holder
3	Emergency key holder

If the keyless start system is unable to recognise the passive key, the vehicle can be started via the emergency starting function.

To do this, there is a transceiver holder on the steering column. A conventional PATS transceiver is fixed to this holder.

To start the engine, the emergency key must be held against the transceiver cover in the lower steering column trim and the start/stop button pressed.

Alternatively, the emergency key can be inserted in the emergency key holder after removing the transceiver cover, and the start/stop button pressed.

The information from the PATS transponder of the emergency key is read out.

**Instrument cluster**



If the PATS system malfunctions, the general warning indicator lights up (yellow) and the corresponding fault is displayed in the message center.



**DIAGNOSIS AND TESTING****Anti-Theft - Passive**

Refer to Wiring Diagrams Section 419-01B, for schematic and connector information.

**General Equipment**

The Ford approved diagnostic tool
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**Inspection and Verification**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

<b>Mechanical</b>	<b>Electrical</b>
– Ignition lock cylinder	– Fuse(s)
– Passive anti-theft system (PATS) transceiver	– Wiring harness
– PATS ignition key	– Electrical connector(s)
– Use of a non-encoded PATS ignition key	– Relay(s)
– More than one PATS key in close proximity of the PATS transceiver	– PCM
– Powertrain control module (PCM)	– PATS transceiver
– Keyless vehicle module	– Ignition switch
– Instrument cluster	– Instrument cluster
	– Keyless vehicle module
	– PATS ignition key

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Ford approved diagnostic tool to diagnose the system.

## SECTION 419-10 Multifunction Electronic Modules

### VEHICLE APPLICATION: 2008.50 Kuga

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## DESCRIPTION AND OPERATION

## Module Controlled Functions – Overview

## Generic electronics module (GEM)

## CAUTIONS:

 **Never swap the GEM (generic electronic module) between two vehicles.**

 **Compare the number of relays and fuses in the defective GEM and the new GEM. Transfer from the defective GEM any relays and fuses which are not in the new GEM. In doing so, pay attention that fuses with the correct Ampere rating are used, by referring to the wiring diagrams.**

**NOTE:** The GEM is integrated in the CJB (central junction box) and cannot be replaced as a separate unit.

For repair work during a service, vehicle-specific configuration is necessary if a new GEM is installed.

## Emergency function

The GEM is equipped with restricted emergency running functions on vehicles with mid or high-end equipment levels.

The microcontroller sends a control signal to a monitoring function within the GEM at regular intervals. If the battery voltage falls below a value of approx. 7.5 volts, this check signal is not present and the GEM switches to emergency function after a predetermined time.

In this case, the low beam is permanently switched on, regardless of the light switch position. The windshield wiper can only be operated in stage 1; the wiper switch must however be in the stage I or II position. The wiper park position is not recognized. Intermittent wiping is not available.

When the control signal recurs, the GEM switches back to normal operation.

## Service mode

## Description of operation

Diagnosis of the GEM can be carried out using the Ford diagnostic unit. Furthermore, an integrated service mode enables testing of the input and output signals without the need for further tools. To enable activation of service mode:

- switch off the ignition,
- switch off all other electrical consumers,
- apply the handbrake,
- Shift to neutral
- and close the doors.

## Activating the service mode

**NOTE:** If the alarm is activated (in vehicles fitted with an anti-theft alarm system), service mode cannot be activated.

Proceed as follows to activate the service mode:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- SWITCH ON the ignition.
- RELEASE the switch of the heated rear window

A signal sounds and the turn signal lamps come on to indicate that service mode has been successfully activated.

## Inputs

SWITCH the windshield wiper switch to the "OFF" position to test the input signals. The following is a list of the switch signals to be tested, in no particular order:

- Windshield wiper stage I
- Windshield wiper stage II
- Windshield washer system
- Rear window wiper
- Rear window washer system
- Doors open/closed
- Remote control for central locking with double locking
- Hood open/closed (in vehicles equipped with an anti-theft alarm system)
- Tailgate open/closed
- A/C request signal
- Heated windscreen (if fitted)
- Parking brake
- Brake fluid level
- Cruise control system
- Autolamps
- Dipped beam
- Main beam
- Headlamp flasher
- Side lights
- Turn signals (right, left, hazard warning lights)

**DESCRIPTION AND OPERATION**

- Reversing lamp
- Liftgate release
- Folding liftgate release
- Ignition switch, terminal 15 (turn key to 0 position, then turn key to II position.)

An acoustic signal sounds and the turn signal lamps flash to indicate receipt of each input signal by the generic electronic module.

**Test the windshield wiper "intermittent mode" stage input signal (only vehicles with adjustable intermittent mode):**

The windshield wiper switch must be switched to "intermittent mode" in order to test the input signal. The delay times of the input signals can then be tested by operating the rotary switch. Each change of the rotary switch position is indicated by an acoustic signal and illumination of the turn signals.

**Output signals**

SWITCH the wiper switch to the "Intermittent" position to test the output signals. PRESSING the heated rear window switch activates the output signals in the following order:

- Left-hand turn signal
- Right-hand turn signal
- Main beam
- Dipped beam
- Windshield wiper stage I
- Windshield wiper stage II
- Heated rear window
- Heater blower motor
- Headlamp washer system (vehicles with HID headlamps)
- Electric booster heater (if fitted)
- Autolamps (if fitted)
- Alarm horn (vehicles with alarm system)
- Rear window wiper
- Heated rear window relay

When the heated rear window switch is pressed again, the test of the relevant signal is terminated. When the heated rear window switch is pressed once more, the test for the next signal in the list is started.

**Ending the service mode**

The GEM automatically ends service mode 20 seconds after the last input or at a driving speed of over 7km/h. However, service mode can be manually ended at any time by proceeding as follows:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- Switch off the ignition.
- RELEASE the switch of the heated rear window

3 signals sound and the turn signal lamps illuminate to indicate that service mode has ended.

**Resetting service mode**

If, after completion of service mode, some functions do not operate or do not operate properly, check the following functions:

- Instrument cluster illumination, side marker lamps (side lights) and licence plate lamp in automatic headlamps mode
- Rear wiper
- Headlamp washer assembly
- Electric booster heater
- Alarm horn
- Heated windshield

If one or more of the listed functions is not OK, it's possible that the cause of the fault is due to not exiting service mode properly. To reactivate the functions correctly, perform the following steps:

1. Switch off the ignition.
2. SWITCH OFF the switch for the windscreen wash/wipe system
3. OPERATE the switch of the heated rear window and HOLD IT THERE
4. SWITCH ON the ignition.
5. RELEASE the heated rear window switch (an acoustic signal will sound if activation has been performed correctly)
6. SWITCH the windscreen wash/wipe switch to the "Intermittent wipe" position
7. OPERATE the heated rear window switch 6 times (the main beam headlamps switch on and off automatically)
8. SWITCH OFF the switch for the windscreen wash/wipe system
9. OPERATE the switch of the heated rear window and HOLD IT THERE
10. Switch off the ignition.
11. RELEASE the heated rear window switch (three acoustic signals will sound if activation has been performed correctly)

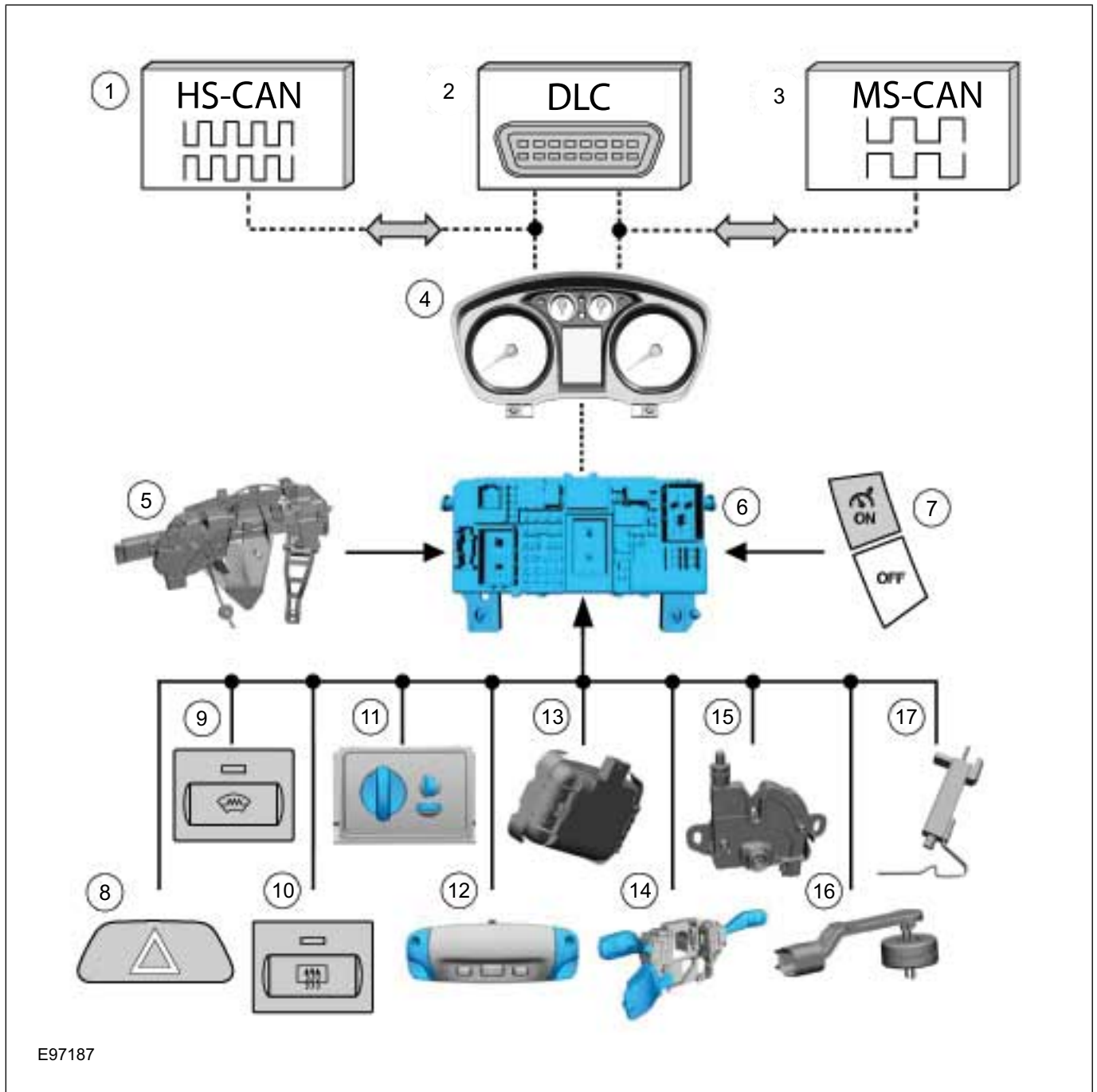
After completion of the work, check all the functions.

DESCRIPTION AND OPERATION

Module Controlled Functions – System Operation and Component Description

System Diagram

Generic Electronic Module (GEM) input signals



E97187

Item	Description
1	High speed CAN (controller area network) bus (HS-CAN)
2	DLC (data link connector)
3	Medium speed CAN bus (MS-CAN)

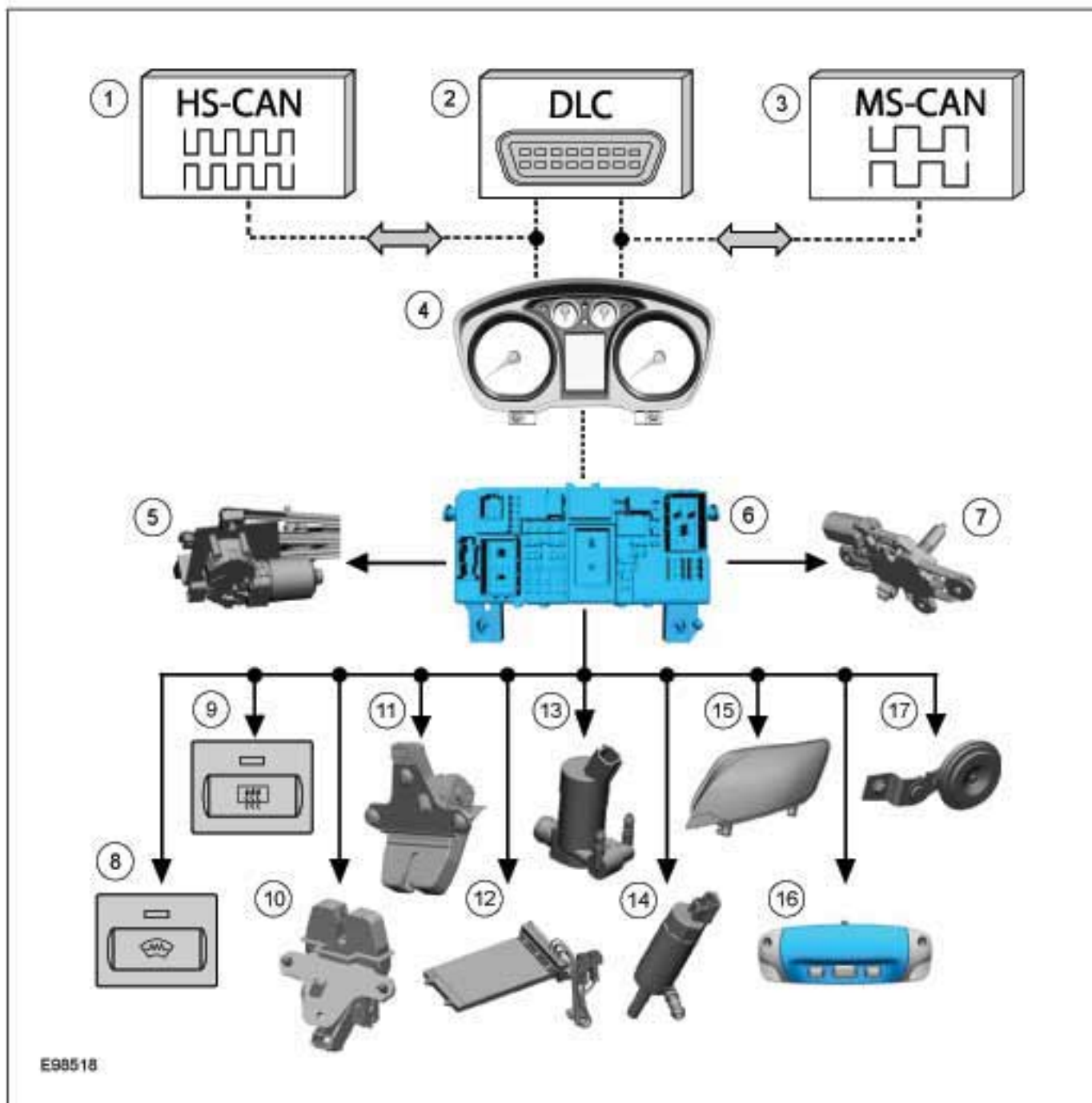
Item	Description
4	Instrument cluster (gateway)
5	Door contact switch
6	GEM

DESCRIPTION AND OPERATION

Item	Description
7	Speed control switch
8	Hazard flasher switch
9	Windscreen heater switch
10	Rear window heater switch
11	Light switch
12	Interior scanning sensors - anti-theft alarm system

Item	Description
13	Light/rain sensor
14	Multifunction switch
15	Hood switch
16	Brake fluid level switch
17	Outside air temperature sensor

GEM output signals





## DESCRIPTION AND OPERATION

Item	Description
1	HS CAN
2	DLC
3	MS CAN
4	Instrument cluster (gateway)
5	Front windshield wiper motors
6	GEM
7	Rear window wiper motors
8	Indicator/heated windshield
9	Indicator/heated rear window

Item	Description
10	Mini-liftgate latch motor
11	Liftgate latch motor
12	Electric booster Heater
13	Front wiper windscreen washer pump
14	Rear wiper windscreen washer pump
15	Headlamp
16	Courtesy Lighting
17	Alarm horn

## System Operation

## GEM.

The following functions are controlled or performed by the GEM at a battery voltage of between 9 and 16 volts:

- Current distribution
- Battery charging (Smart Charge)
- Ignition overload protection
- Headlamp switch-off delay
- Turn signals
- Interior lighting
- Heated windscreen
- Heated rear window and heated external mirrors
- Ambient air temperature
- Brake fluid level
- Automatic headlamps
- Combined rain sensor/light sensor
- Windshield wash/wipe system
- Speed control
  - reads the speed control switches and transmits signals on the CAN data bus
- central door locking
  - transmits signals on the CAN data bus
- Anti-theft
- Electric booster Heater
- Climate control
- Parking brake
  - (monitors the switch and transmits the signal on the CAN data bus
- Communication via the medium-speed CAN data bus

## Component Description

## Battery charging (Smart Charge)

In addition to the familiar functions, the Smart Charge system also performs the following functions:

- Automatic deactivation of non-critical high power electrical consumers when the battery voltage is low in order to reduce the level of current drawn.
- Automatic activation of non-critical high power electrical consumers when the battery voltage is excessively high in order to protect components which are sensitive to increased voltages.

The battery charging current is optimized through continuous calculation of the battery temperature and monitoring of the alternator output voltage.

The alternator load is signaled to the PCM (powertrain control module) in order to provide it with an early indication when an electric component is to be switched on or off, thereby also providing information about imminent changes to the amount of torque demanded by the alternator. By evaluating this information the PCM is capable of increasing the stability of the engine under idling.

The two remaining functions of the Smart Charge system are controlled by the GEM.

**DESCRIPTION AND OPERATION**

Electrical consumers are switched off when the battery voltage is low if the GEM determines (as a result of the message received from the PCM on the CAN bus via the instrument cluster) that the battery voltage has dropped below the threshold value.

When the threshold for low battery voltage is reached the GEM switches off the following consumers in this order at intervals of 5 seconds:

- Heated windscreen
- Heated rear window
- Electric booster Heater
- A/C system

If the battery voltage increases back above the lower threshold then all of the consumers which were previously switched off are reactivated by the GEM.

Once the electric consumers have been reactivated their status is "switched off", i.e. the consumers are switched off and await an input signal provided from the relevant switch via the GEM; this means that the driver needs to switch these components back on again.

Electrical consumers are switched on when the battery voltage is excessively high if the GEM determines that the battery voltage has increased above the threshold for overvoltage and the charging system warning indicator has come on.

When the threshold is reached the GEM switches on the following consumers in this order at intervals of 5 seconds:

- Heated windscreen
- Heated rear window

When these components are deactivated again their status is "switched off". This means that the consumers are waiting for an input signal provided from the relevant switch via the GEM.

**Ignition overload protection**

The ignition overload protection intermittently disconnects certain circuits in order to restrict the current being drawn from the battery while the starter motor is operating.

The position of the ignition switch is broadcast by the instrument cluster on the medium speed CAN bus.

The ignition overload protection relay which is integrated in the battery junction box is activated

by the GEM if the message "ignition switch in position III" is received from the instrument cluster.

All of the electric consumers controlled by the ignition overload protection relay are then switched off.

The following consumers (among others) are controlled by the ignition overload protection relay:

- Fog lamps
- Windscreen/rear window wash/wipe systems
- Backup lamps
- Heated washer nozzles
- Heating blower motor
- Seat heating

**Headlamp switch-off delay**

The headlamp switch-off delay utilizes the low beam together with the peripheral lights (if equipped) to illuminate the area surrounding the vehicle. The function is activated by operating the high beam lever when the ignition switch is in the "0" position.

After the last door has been closed, the function remains active for a further 30 seconds and then switches off automatically.

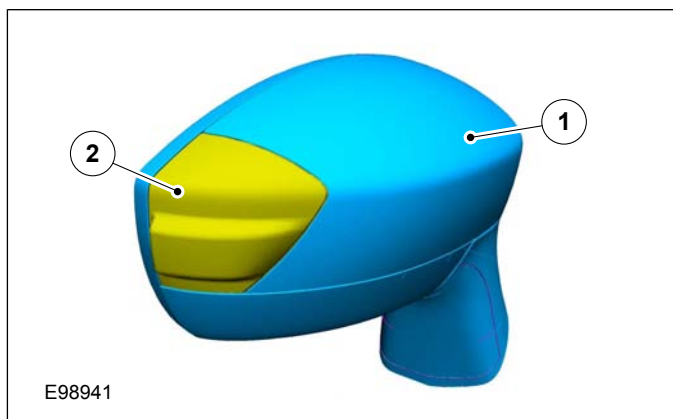
When a door or the tailgate is open, the switch-off time is extended to 180 seconds. After the last door has been closed, the switch-off time is reset to 30 seconds.

The headlamp switch-off delay can be deactivated prematurely by operating the high beam lever again or by switching on the ignition.

The switch-off time is adjusted to set values at the factory and cannot be re-programmed using the Ford diagnostic unit.

## DESCRIPTION AND OPERATION

## Turn signals



Item	Description
1	External mirror housing
2	Turn signals

The GEM switches the direction indicators and the direction indicator side repeaters on.

The GEM sends a signal to the instrument cluster via the CAN bus to switch on the relevant turn indicator and the acoustic signal.

The signals from the hazard flasher switch and from the multifunction switch are transmitted to the GEM via a wiring connection.

The turn signals and the warning lamp flash at a specified frequency and, in the case of failure of a turn signal, the frequency is doubled.

The turn signal lamps also have a one-touch lane change function. If the multifunction lever is pressed just slightly then the relevant turn signal lamp is actuated 3 times by the GEM.

## Interior lighting

Depending on the vehicle specification, the interior lighting includes:

- Left and right-hand footwell lamps
- Overhead lights at front and rear

Depending on the vehicle specification, the switchable interior lighting includes:

- Map lights
- Mirror lights in sun visors
- Glove compartment lamp
- Luggage compartment lamp

The front and rear overhead lights are switched on by the GEM.

The interior lighting is switched on if one of the following conditions is satisfied:

One of the vehicle's doors is opened.

The ignition key is in the "0" or "I" position and the vehicle is unlocked.

The ignition key is turned from the "II" to the "I" or "0" position.

The interior lighting is switched off when all of the doors are closed and one of the following conditions is satisfied:

- 25 seconds have elapsed since the last door was closed.
- The ignition key is turned from the "0" or "I" to the "II" position.
- The ignition key is in the "0" or "I" position while the vehicle is locked.

The dimmer function is not used if the interior lighting is switched off via the battery protection function.

## Heated windscreen

The heated windshield is switched on by the GEM under the following conditions:

- The heated windshield switch is operated, the ignition switch is in position "II" and the charge warning lamp is switched off.
- The "Defrost" function of the two-zone air conditioning has been activated, the ignition switch is in the position "II" and the charge warning lamp is off.
- The battery voltage has exceeded 16 V for more than 20 seconds (power management strategy). Manual requests for switching off the heated windshield by pressing the switch are ignored at this time.
- The engine was started at an outside air temperature below 4°C and an engine temperature below 65°. Manual requests for switching off the heated windshield by pressing the switch are accepted.

**NOTE:** If the battery voltage returns to the normal range, the disabling of the heated windshield is switched off. It is then switched off.

The heated windshield is switched off by the GEM under the following conditions:

**DESCRIPTION AND OPERATION**

- 4 minutes have elapsed since the button for the heated windshield was pressed.
- The ignition switch is turned to the "I" or "0" position.
- The "Defrost" function is deactivated or the switch for the heated windscreen is pressed again while the heated windscreen is still switched on.
- The charging system warning indicator is switched on.
- The battery voltage falls below the threshold value for low battery voltage for more than 20 seconds (power management strategy). Manual requests for switching on the heated windshield by pressing the switch are ignored at this time.
- More than 4 minutes have passed since starting the engine.

**Heated rear window and heated external mirrors**

The GEM transmits a request signal via the CAN bus to the door modules to switch on the heated exterior mirrors.

The heated rear window and the heated exterior mirrors are switched on by the GEM under the following conditions:

- The switch for the heated rear window is pressed and the ignition switch is in the "II" position.
- The "defrost" function of the air conditioning is activated and the ignition switch is in the position "II".
- The battery voltage has exceeded 16 V for more than 20 seconds (power management strategy). Manual requests to switch off the heated rear window by pressing the button are ignored at this time.
- The engine was started at an outside air temperature below 4°C and an engine temperature below 65°. Manual requests for switching off the heated rear window by pressing the switch are accepted.

**NOTE:** If the battery voltage returns to the normal range then the disabling of the heated rear window is cancelled - the heated rear window is then in a switched-off state.

The GEM transmits a request signal via the CAN bus to the door modules to switch off the heated exterior mirrors.

The heated rear window and the heated exterior mirrors are switched off by the GEM under the following conditions

- 14 minutes have elapsed since the button for the heated rear window was pressed.
- The ignition switch is turned to the position "0", "I" or "III".
- The switch for the heated rear window is pressed or the "defrost" function of the air conditioning is deactivated while the heated rear window is switched on.
- The battery voltage has dropped below 10.3 V for more than 20 seconds (power management strategy). Manual requests for switching on the heated rear window by pressing the switch are ignored at this time.
- More than 14 minutes have passed since starting the engine.

**Ambient air temperature**

The ambient air temperature sensor is connected via a cable to the GEM. It measures the outside air temperature to an accuracy of around  $\pm 0.5$  °C. The GEM broadcasts the ambient air temperature on the medium speed CAN bus, where it can be evaluated by various systems.

**Brake fluid level**

The brake fluid level switch is connected via a cable to the GEM.

The GEM transmits a message on the medium speed CAN bus. The instrument cluster then transfers this message to the high speed CAN bus where it is made available for various other functions.

**Automatic headlamps**

Refer to: **Exterior Lighting** (417-01 Exterior Lighting, Description and Operation).

**Combined rain sensor/light sensor**

Refer to: **Exterior Lighting** (417-01 Exterior Lighting, Description and Operation).

**DESCRIPTION AND OPERATION****Windshield wash/wipe system**

Refer to: **Wipers and Washers** (501-16 Wipers and Washers, Description and Operation).

**Anti-theft**

Refer to: **Anti-Theft - Active** (419-01 Anti-Theft - Active, Description and Operation).

**Electric booster Heater**

Refer to: **Auxiliary Climate Control** (412-02 Auxiliary Climate Control, Description and Operation).

**Climate control**

Refer to: **Climate Control** (412-01 Climate Control, Description and Operation).

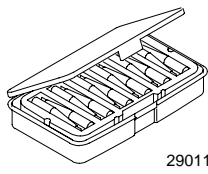


## DIAGNOSIS AND TESTING

## Generic Electronic Module (GEM)

Refer to Wiring Diagrams Section 419-10, for schematic and connector information.

**Special Tool(s) / General Equipment**

 <p>29011A</p>	<p>Terminal Probe Kit 418-S035</p>
<p>Digital multimeter</p>	
<p>Ford approved diagnostic tool</p>	

**Description of operation**

A diagnosis of the generic electronic module (GEM) can be performed with the Ford approved diagnostic tool. Furthermore, an integrated service mode enables testing of the input and output signals without the need for further tools. To enable activation of service mode:

- Switch off the ignition
- Switch off all other electrical consumers
- Apply the handbrake
- Shift to neutral
- Close the doors.

**Activate service mode**

Proceed as follows to activate service mode:

- PRESS and HOLD the switch of the heated rear window
- SWITCH ON the ignition.
- RELEASE the switch of the heated rear window

A signal sounds and the turn signal lamps illuminate to indicate that service mode has been successfully activated.

**NOTE:** If the alarm is armed (in vehicles fitted with an anti-theft alarm system), service mode cannot be activated.

**Input signals**

SWITCH the windshield wiper switch to the "Off" position to test the input signals. The following is a list of the switch signals to be tested, in no particular order:

- Turn signals (right, left, hazard warning lights)
- Windshield wiper stage I
- Windshield wiper stage II
- Windshield washer system
- Rear window wiper
- Rear window washer system
- Doors open/closed
- Door key cylinder set/reset switch
- Remote control for central locking with double locking
- Hood up/down (in vehicles fitted with anti-theft alarm system)
- Tailgate open/closed
- Mini liftgate open/closed
- Manual A/C request signal
- Manual AUX heater request signal
- Heated windshield (if fitted)
- Parking brake
- Brake fluid level
- Cruise control system
- Autolamps
- Dipped beam
- Main beam
- Headlamp flasher
- Side lights
- Reversing lamp
- Tailgate release
- Mini liftgate release
- Interior scanning system
- Ignition switch, terminal 15 (turn key to 0 position, then turn key to II position.)

An acoustic signal sounds and the turn signal lamps flash to indicate receipt of each input signal by the generic electronic module.

**Test the windshield wiper "intermittent mode" stage input signal (only vehicles with adjustable intermittent mode)**

The windshield wiper switch must be switched to "intermittent mode" in order to test the input signal. The delay times of the input signals can then be tested by operating the rotary switch. Each change of the rotary switch position is indicated by an acoustic signal and illumination of the turn signals.



**DIAGNOSIS AND TESTING****Output signals**

SWITCH the wiper switch to the "intermittent" position to test the output signals. PRESSING the heated rear window switch activates the output signals in the following order:

- a. Left-hand turn signal
- b. Right-hand turn signal
- c. Main beam
- d. Dipped beam
- e. Windshield wiper stage I
- f. Windshield wiper stage II
- g. Heated rear windshield
- h. Heater blower motor
- i. Headlamp washer system (vehicles with HID headlamps)
- j. Electric booster heater (if fitted)
- k. Autolamps (position lamps only if fitted)
- l. Alarm horn (vehicles with alarm system)
- m. Rear window wiper
- n. Heated front window relay

When the heated rear window switch is pressed again, the test of the relevant signal is terminated. When the heated rear window switch is pressed once more, the test for the next signal in the list is started.

**End service mode**

The GEM automatically ends service mode 20 seconds after the last input or at a driving speed of over 7km/h. However, service mode can be manually ended at any time by proceeding as follows:

- PRESS and HOLD the switch of the heated rear window
- SWITCH OFF the ignition.
- RELEASE the switch of the heated rear window

3 signals sound and the turn signal lamps illuminate to indicate that service mode has ended.

**Reset service mode**

If, after completion of service mode, some functions do not operate or do not operate properly, check the following functions:

- Instrument cluster illumination, side marker lamps (side lights) and licence plate lamp in automatic headlamps mode
- Rear wiper
- Headlamp washer assembly
- Electric booster heater

- Alarm horn
- Heated windshield

If one or more of the listed functions is not OK, it's possible that the cause of the fault is due to not exiting service mode properly. To reactivate the functions correctly, perform the following steps:

1. Switch off the ignition.
2. SWITCH OFF the switch for the windscreen wash/wipe system
3. OPERATE the switch of the heated rear window and HOLD IT THERE
4. SWITCH ON the ignition.
5. RELEASE the heated rear window switch (an acoustic signal will sound if activation has been performed correctly)
6. SWITCH the windscreen wash/wipe switch to the "Intermittent wipe" position
7. OPERATE the heated rear window switch 6 times (the main beam headlamps switch on and off automatically)
8. SWITCH OFF the switch for the windscreen wash/wipe system
9. OPERATE the switch of the heated rear window and HOLD IT THERE
10. Switch off the ignition.
11. RELEASE the heated rear window switch (three acoustic signals will sound if activation has been performed correctly)

After completion of the work, check all the functions.

**Inspection and Checking**

**NOTE:** The generic electronic module (GEM) is integrated into the central junction box (CJB).

1. VERIFY customer concern.
2. Visually CHECK for any obvious mechanical or electrical damage.

**NOTE:** Ensure correct locking of the wiring harness connector.

**Visual Inspection**

<b>Electrical</b>
Fuses
Wiring harness
Connectors

**DIAGNOSIS AND TESTING**

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

## REMOVAL AND INSTALLATION





## Generic Electronic Module (GEM)

## General Equipment

Ford Diagnostic Equipment

## Removal

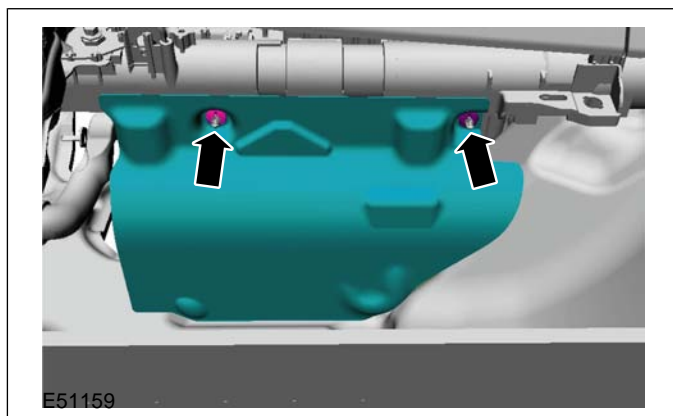
## CAUTIONS:

-  Modules must not be swapped between vehicles.
-  Compare the number of relays and fuses in the defective GEM and the new GEM. Transfer from the defective GEM any relays and fuses which are not in the new GEM. In doing so, pay attention that fuses with the correct Ampere rating are used, by referring to the wiring diagrams.
-  When installing a new GEM on vehicles with a diesel engine, make sure that a fuel pump fuse (F111) with 5A is used.
-  When installing a new GEM on vehicles with a petrol engine, make sure that a fuel pump fuse (F111) with 15A is used.

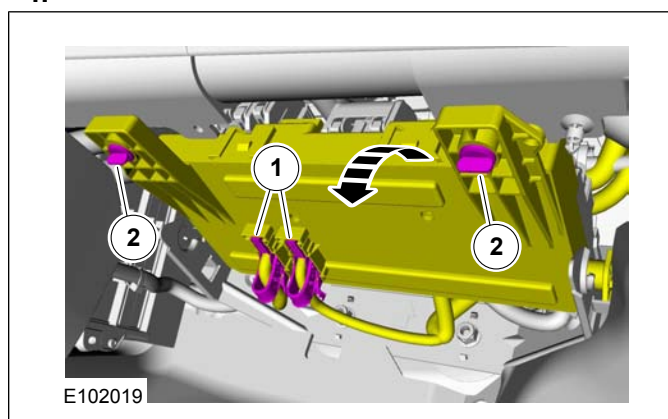
**NOTE:** GEM is integrated into the central junction box (CJB) and cannot be removed individually.

1. **NOTE:** This step is only necessary when installing a new component.  
Upload the GEM configuration information using the Programmable Modules Installation Routine.  
General Equipment: Ford Diagnostic Equipment
2. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).

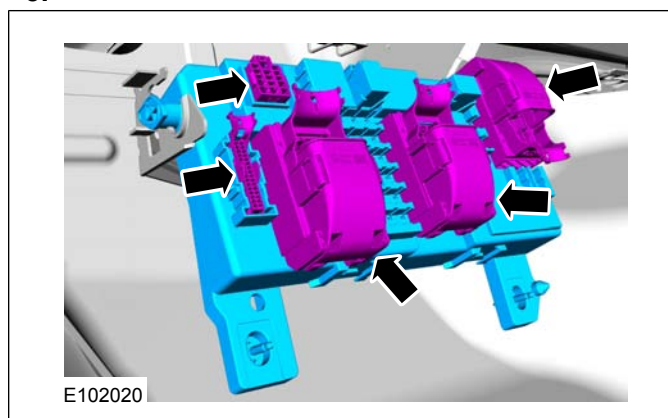
3.



4.



5.



## Installation

1. To install, reverse the removal procedure.
2. **NOTE:** This step is only necessary when installing a new component.  
Download the GEM configuration information to the newly installed GEM using the programmable modules installation routine.
3. **NOTE:** This step is only necessary when installing a new component.  
Program all keys using the Key Programming Routine.  
General Equipment: Ford Diagnostic Equipment

419-10-15

Multifunction Electronic Modules

419-10-15

## REMOVAL AND INSTALLATION

## Lighting Control Module (LCM)

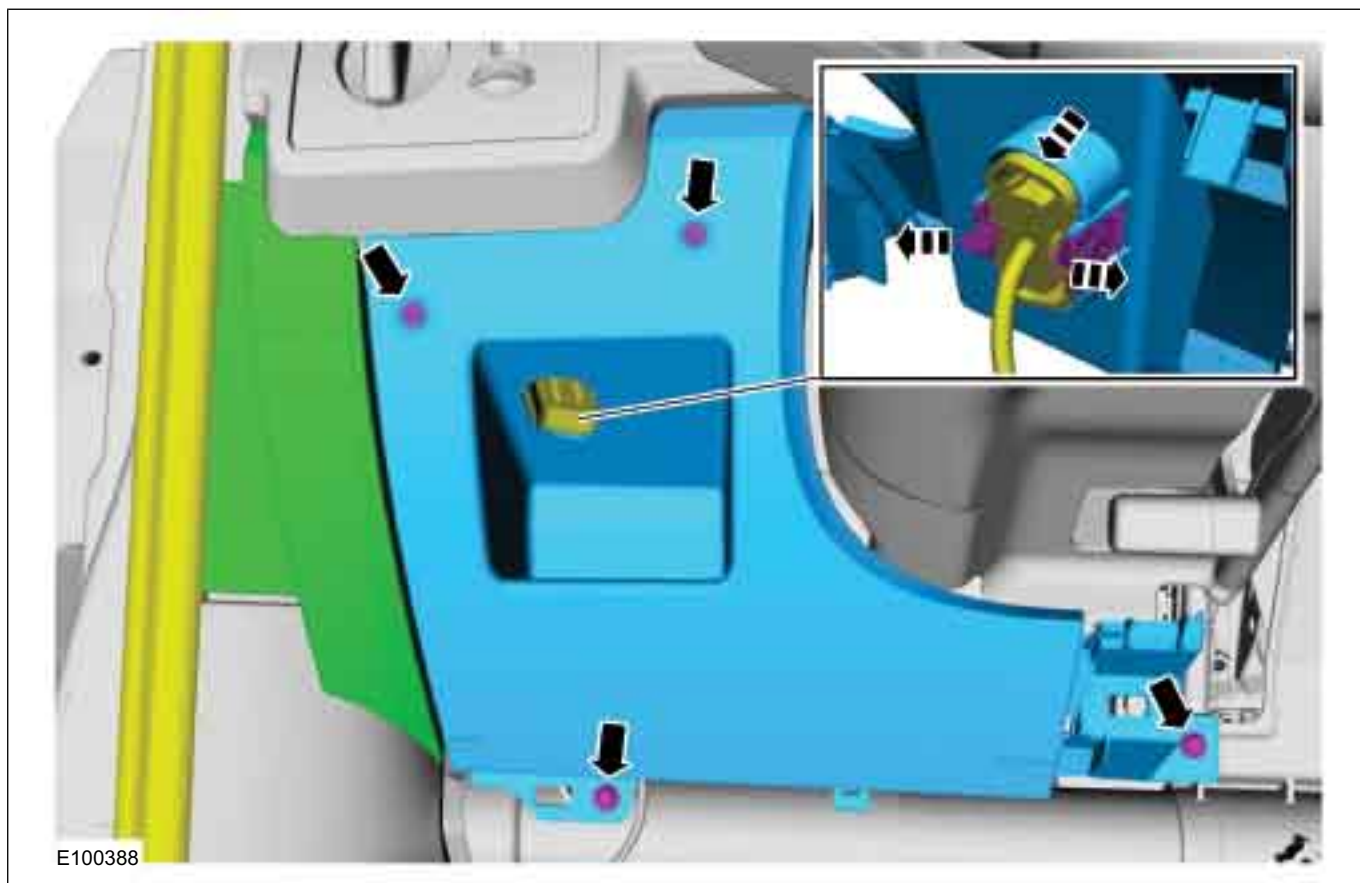
## General Equipment

Ford Diagnostic Equipment

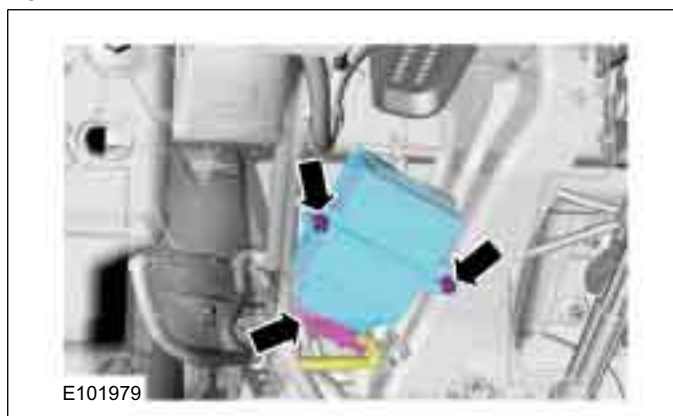
## Removal

1. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).

2.



3.



## Installation

1. To install, reverse the removal procedure.
2. **NOTE:** This step is only necessary when installing a new component.  
Initialize the LCM using the Programmable Modules Installation Routine.  
General Equipment: Ford Diagnostic Equipment
3. **NOTE:** This step is only necessary when installing a new component.

**REMOVAL AND INSTALLATION**

Calibrate the headlamp leveling system.

General Equipment: Ford Diagnostic Equipment

- 4. NOTE:** This step is only necessary when installing a new component.

Refer to: [Headlamp Adjustment](#) (417-01 Exterior Lighting, General Procedures).

## GROUP

## 5

# Body and Paint

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# SECTION 501-02 Front End Body Panels

VEHICLE APPLICATION: 2008.50 Kuga

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Cowl Panel Grille.....	501-02-2
Fender Splash Shield.....	501-02-3



## REMOVAL AND INSTALLATION

## Cowl Panel Grille

## General Equipment

Two Leg Puller

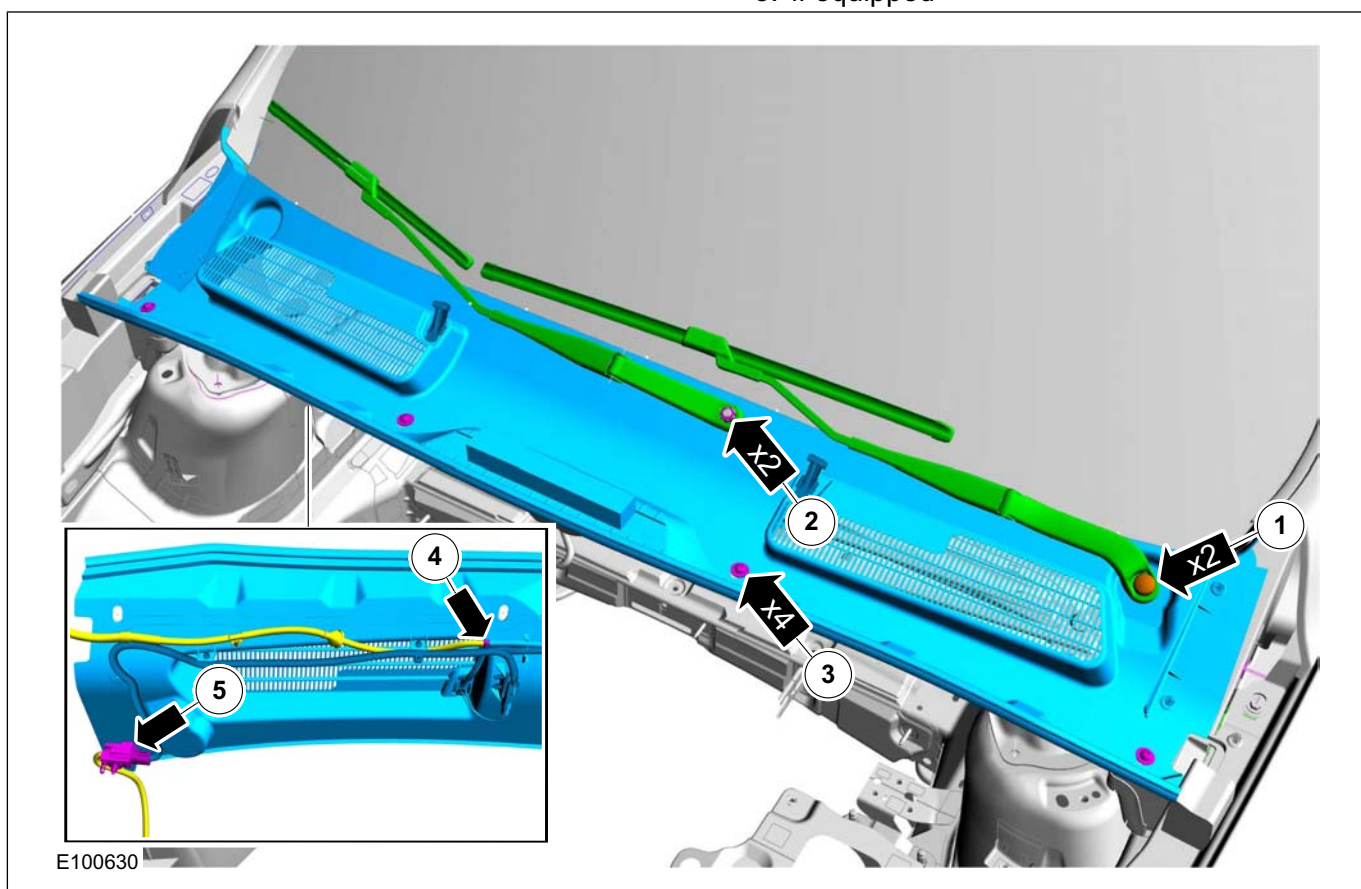
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. **CAUTION:** Make sure that the motor is in the park position.

Remove the following items:

- 1.
2. General Equipment: Two Leg Puller  
Torque: 22 Nm
- 3.
- 4.
5. if equipped



## Installation

1. **CAUTION:** Make sure that the motor is in the park position.  
To install, reverse the removal procedure.
2. Refer to: [Wiper Blade Angle Adjustment](#) (501-16 Wipers and Washers, General Procedures).

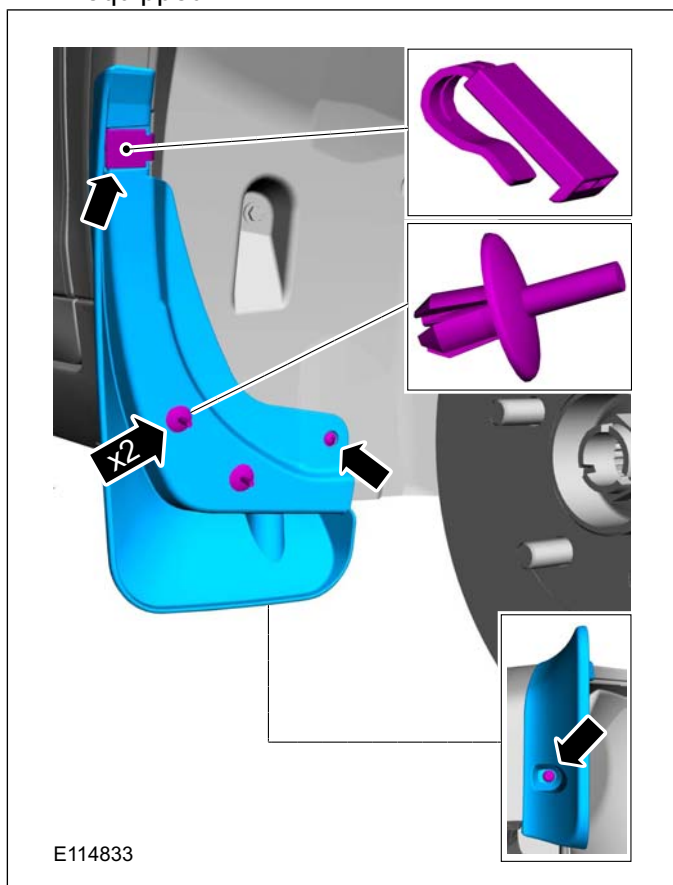
## REMOVAL AND INSTALLATION

## Fender Splash Shield

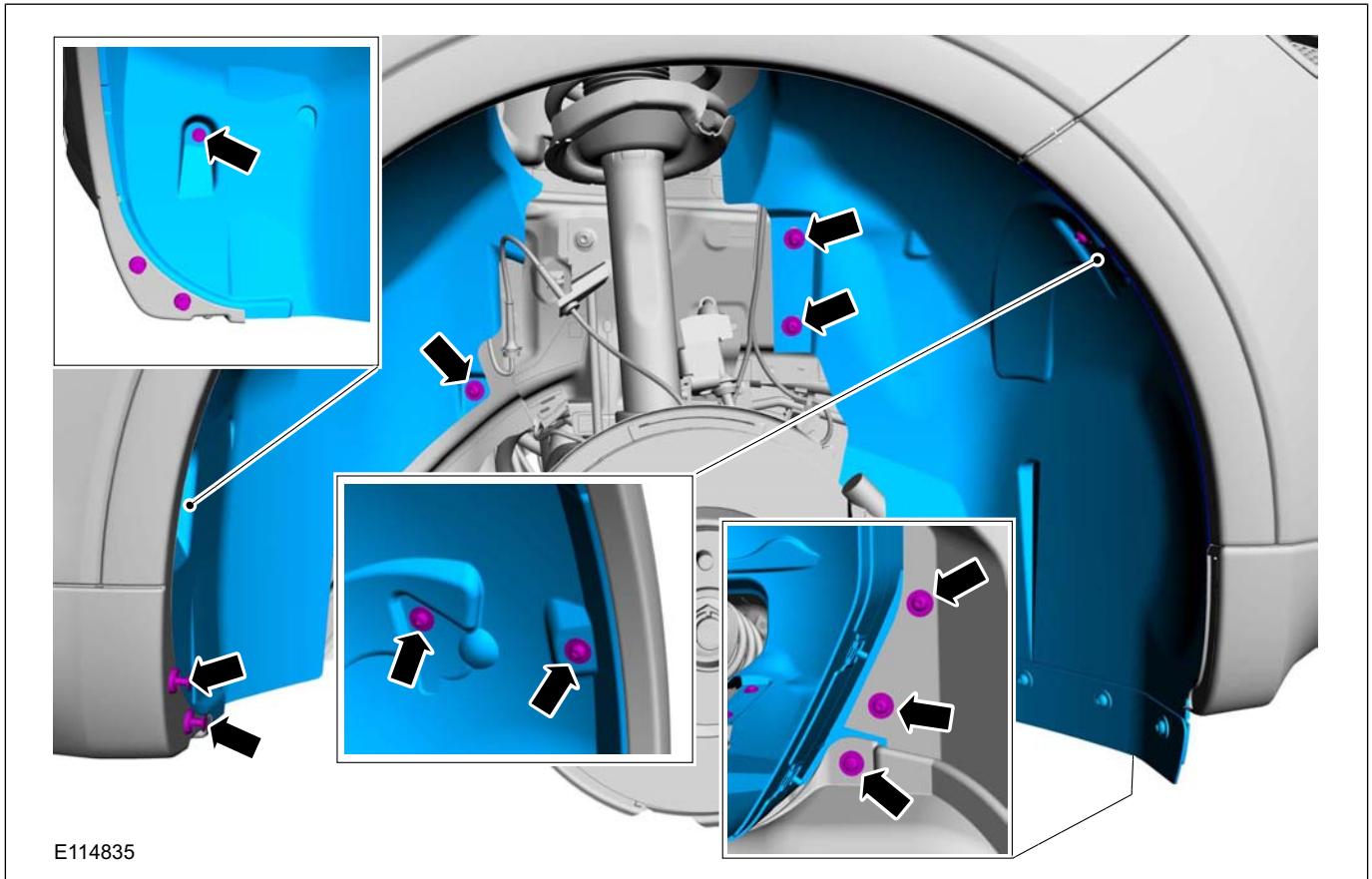
## Removal

1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
2. If equipped.

3.



## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.



# SECTION 501-03 Body Closures

VEHICLE APPLICATION: 2008.50 Kuga

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Front Door Alignment.....	501-03-2
Rear Door Alignment.....	501-03-6
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Hood Alignment.....	501-03-14
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Liftgate.....	501-03-18
Upper Liftgate.....	501-03-21
<b>DISASSEMBLY AND ASSEMBLY</b>	
Upper Liftgate.....	501-03-22

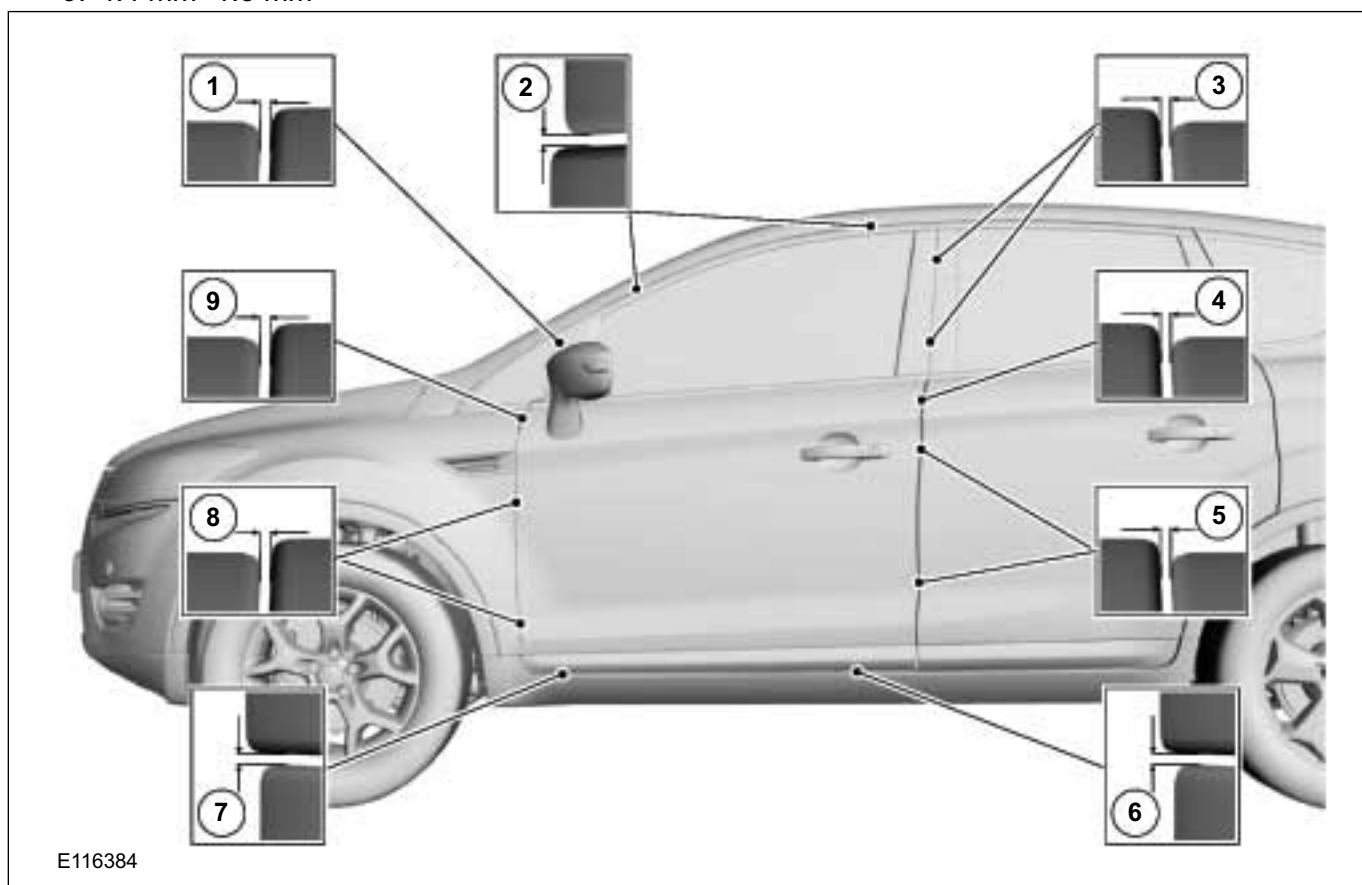


## GENERAL PROCEDURES

## Front Door Alignment

## Check

1. 4.5 mm -1.5 mm
2. 5.8 mm -1.5 mm
3. 4.6 mm -1.5 mm
4. 4 mm -1.5 mm
5. 4.1 mm -1.5 mm
6. 4 mm -1.5 mm
7. 3.9 mm -1.5 mm
8. 4 mm -1.5 mm
9. 4.4 mm -1.5 mm

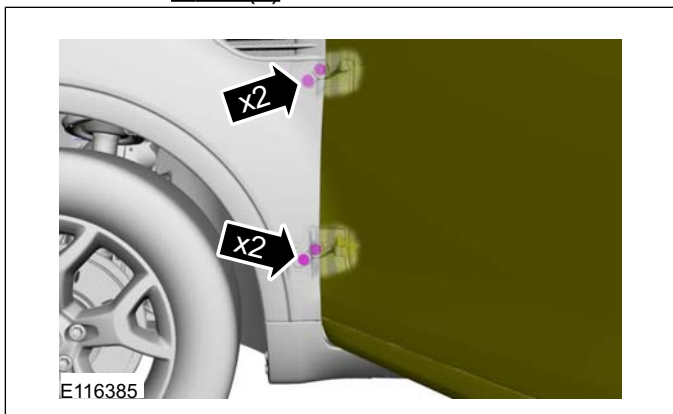




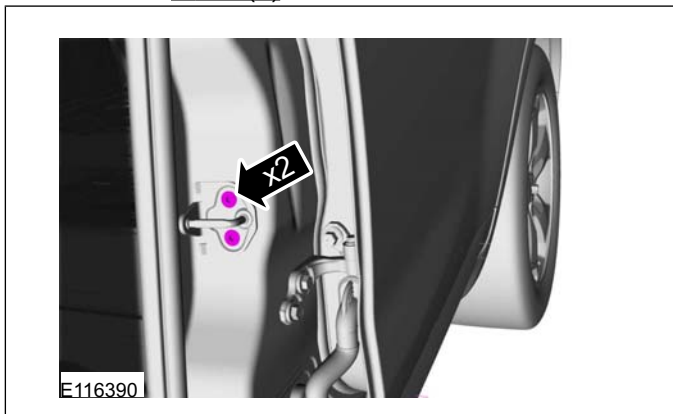
GENERAL PROCEDURES

Adjustment

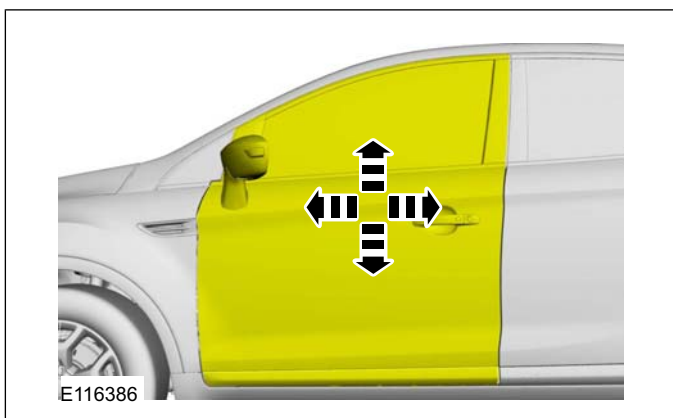
2. Loosen: 1 turn(s)



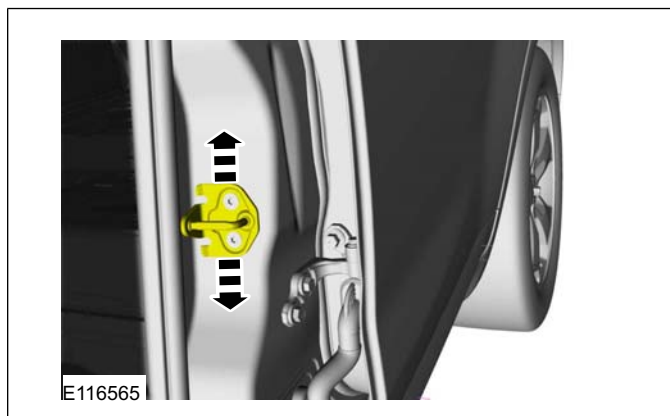
3. Loosen: 1 turn(s)



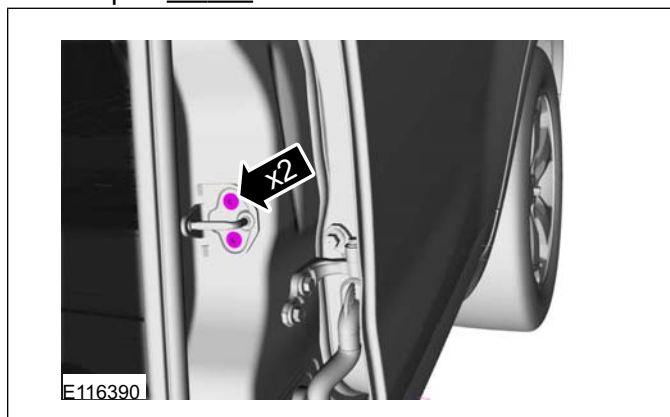
4.



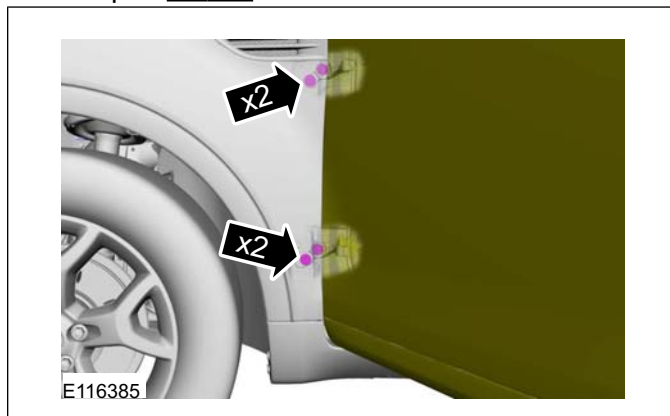
5.



6. Torque: 20 Nm



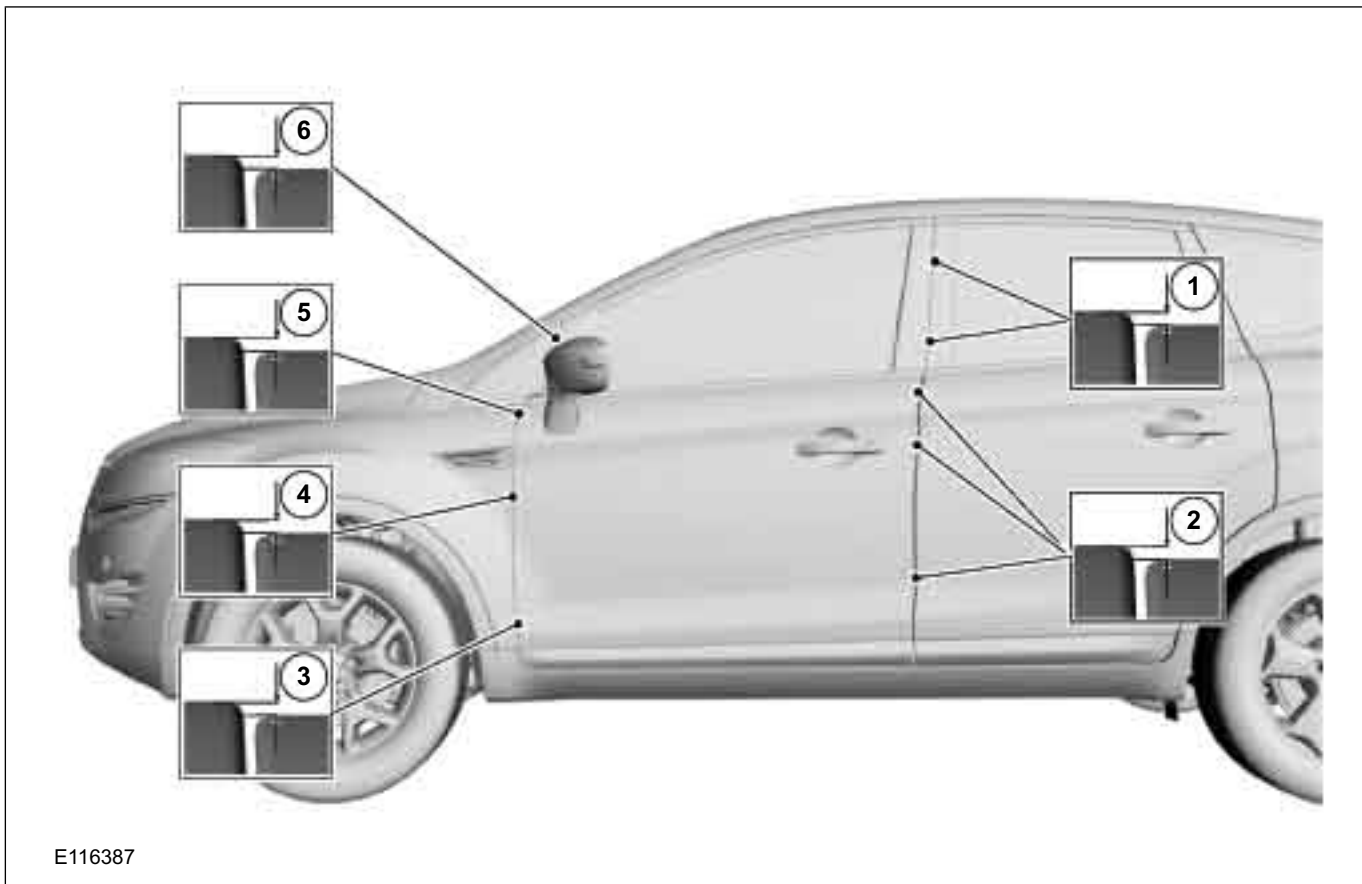
7. Torque: 30 Nm



Check

8. 1. 0.2 mm -1 mm
2. 0 mm -1 mm
3. 0.1 mm -1 mm
4. 1 mm -1 mm
5. 1.1 mm -1 mm
6. 1.4 mm -1 mm

GENERAL PROCEDURES



E116387

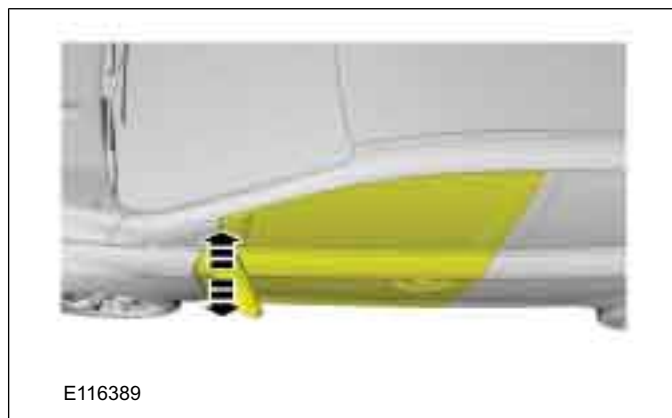
Adjustment

9. Loosen: 1 turn(s)



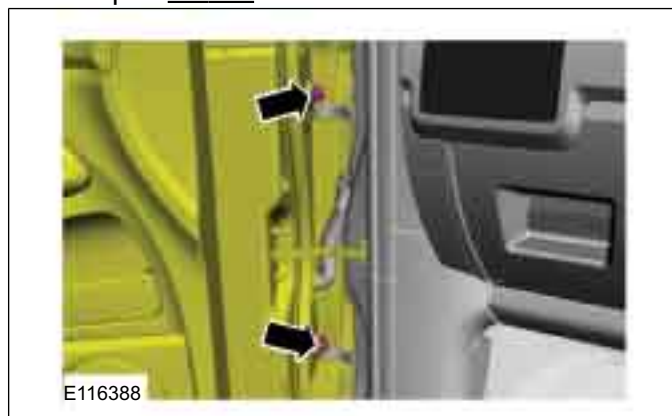
E116388

10.



E116389

11. Torque: 48 Nm



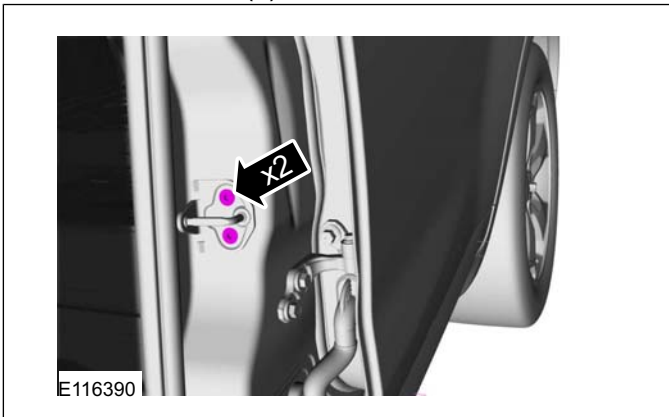
E116388

501-03-5

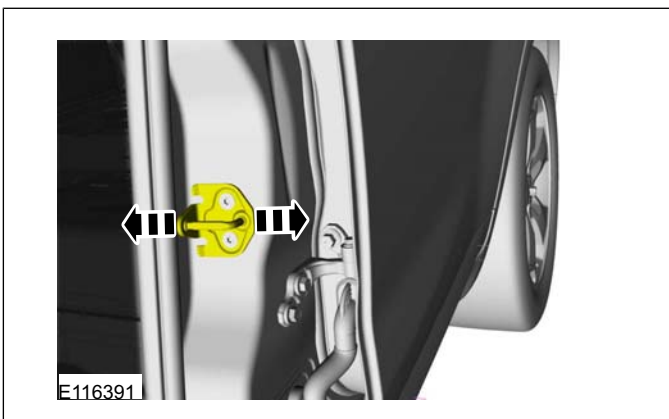
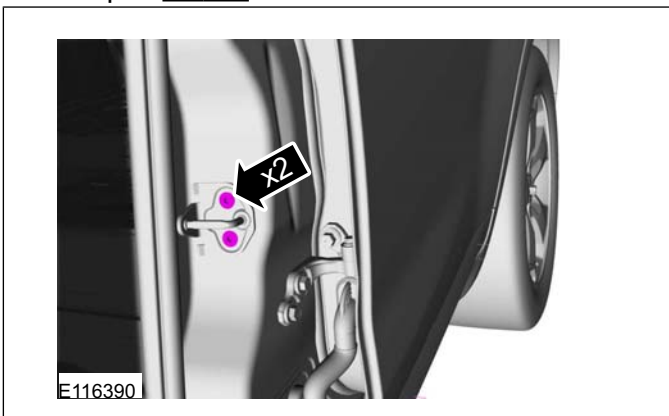
Body Closures

501-03-5

## GENERAL PROCEDURES

12 Loosen: 1 turn(s)

13.

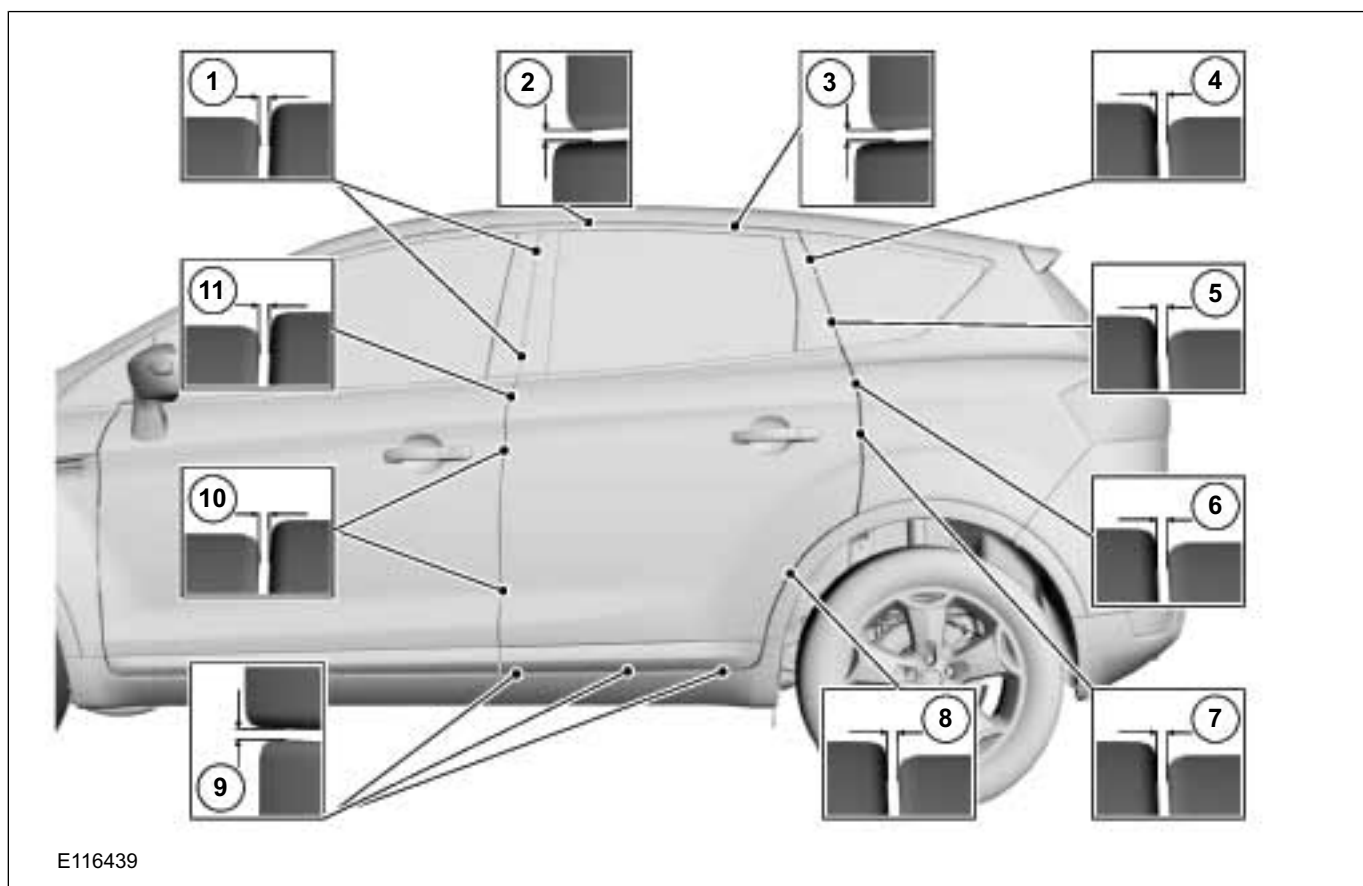
14. Torque: 20 Nm

## GENERAL PROCEDURES

## Rear Door Alignment

## Check

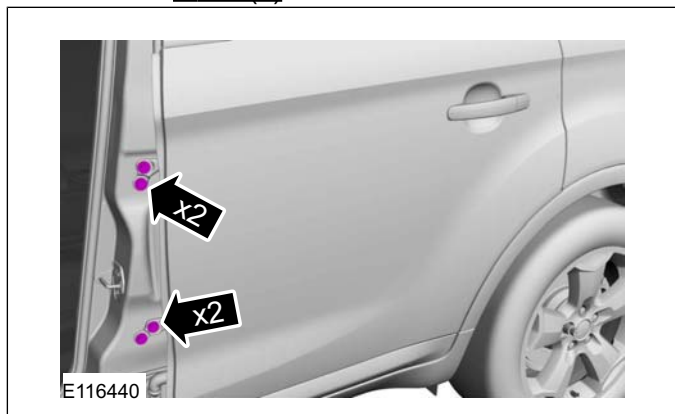
15. 1. 4.6 mm -1.5 mm
2. 5.8 mm -1.5 mm
3. 5.7 mm -1.5 mm
4. 4.6 mm -1 mm
5. 4.5 mm -1 mm
6. 3.6 mm -1.5 mm
7. 3.8 mm -1.5 mm
8. 4 mm -1.5 mm
9. 4 mm -1.5 mm
10. 4.1 mm -1.5 mm
11. 4 mm -1.5 mm



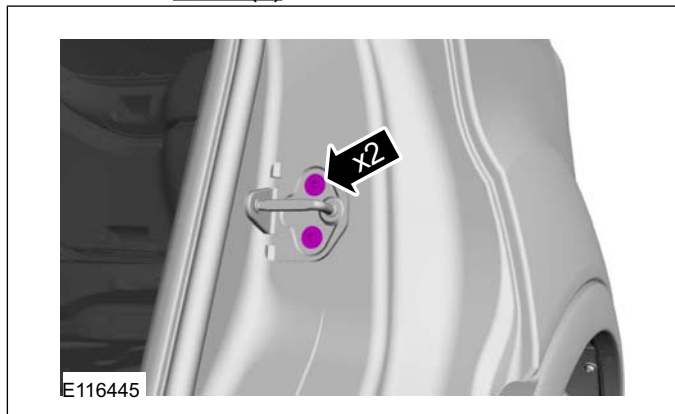
GENERAL PROCEDURES

Adjustment

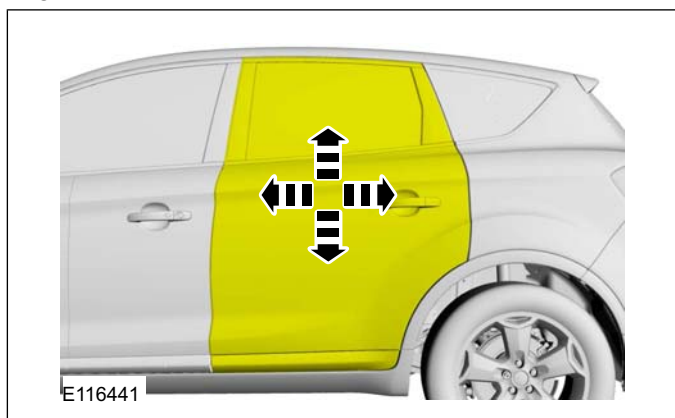
16. Loosen: 1 turn(s)



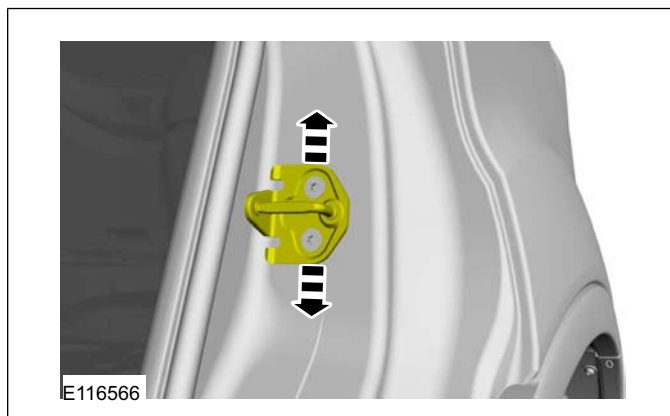
17. Loosen: 1 turn(s)



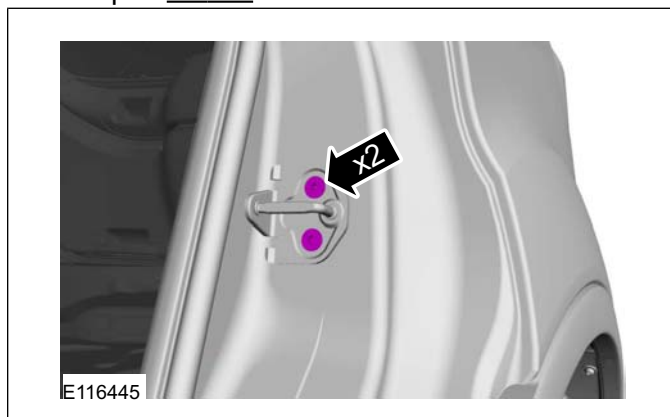
18.



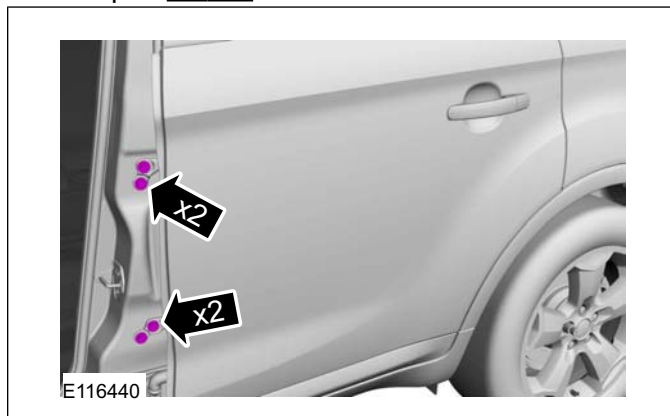
19.



20. Torque: 20 Nm



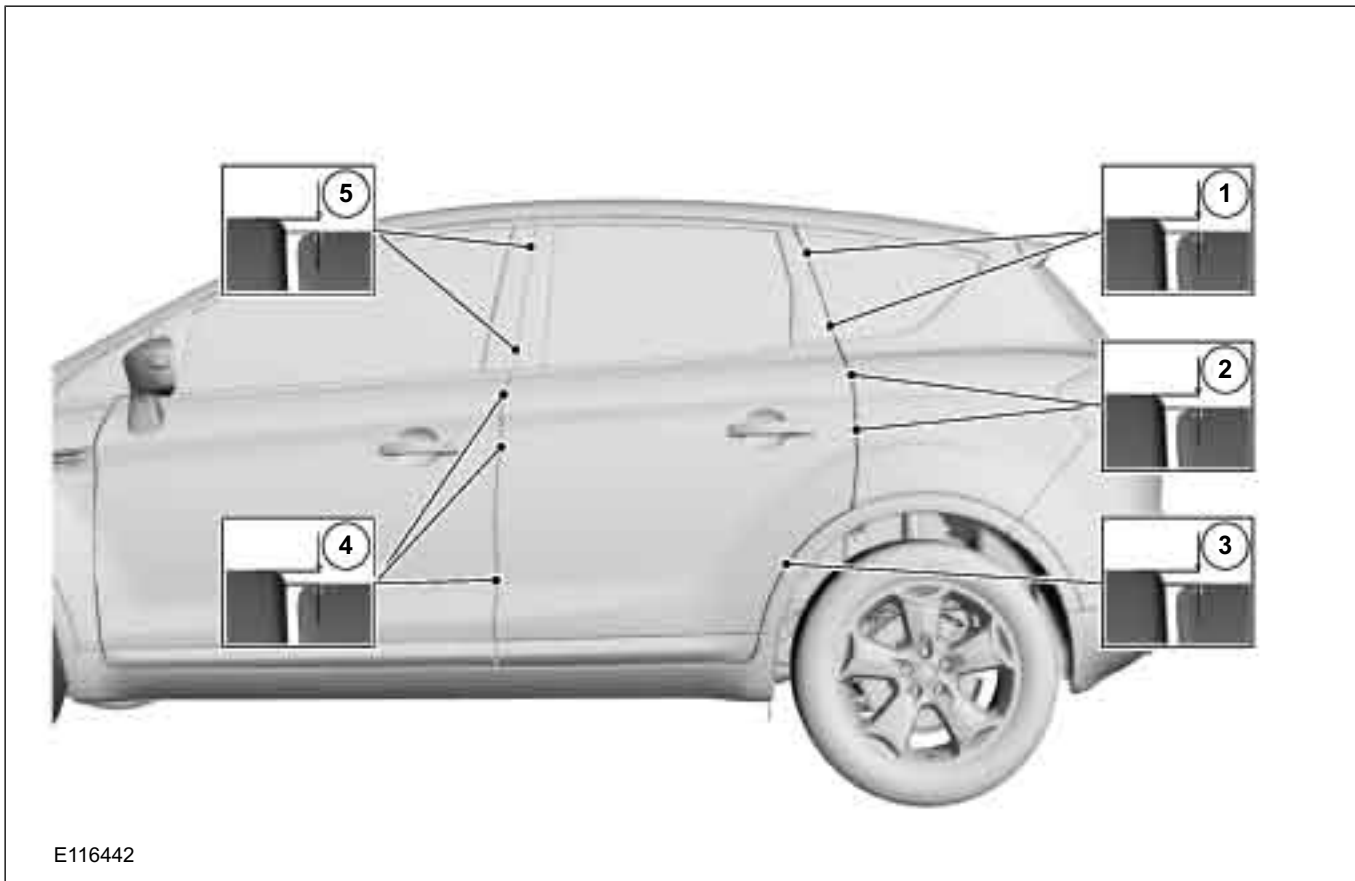
21. Torque: 30 Nm



Check

- 22 1. 2.3 mm -1.5 mm
- 2. 0 mm -1 mm
- 3. 1.5 mm -1 mm
- 4. 0 mm -1 mm
- 5. 0.2 mm -1 mm

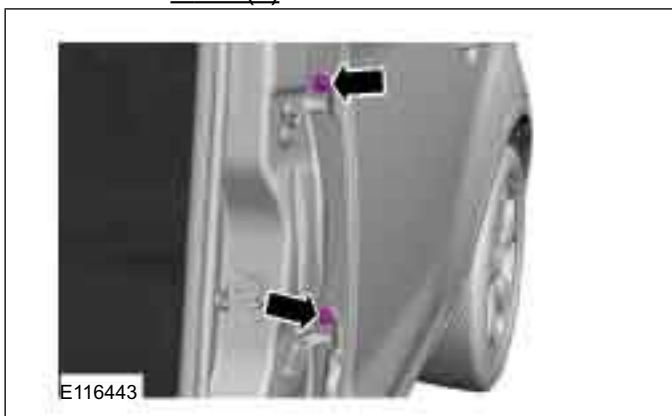
GENERAL PROCEDURES



E116442

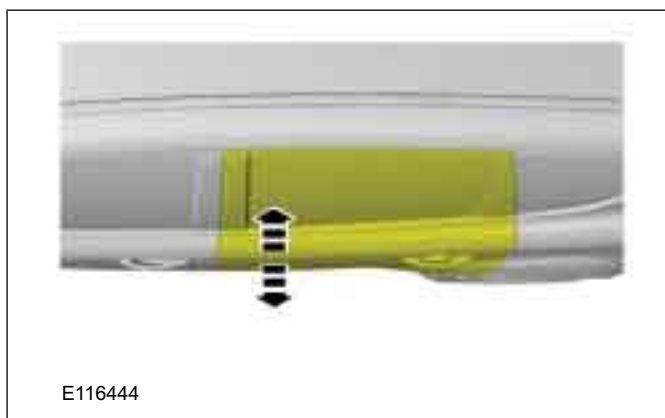
Adjustment

23. Loosen: 1 turn(s)



E116443

24.



E116444

25. Torque: 48 Nm



E116443

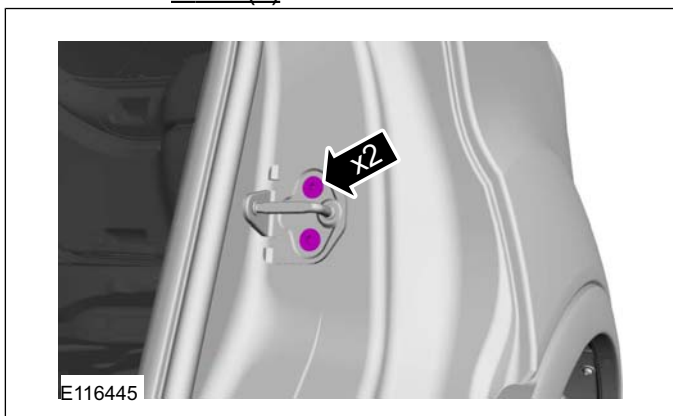


501-03-9

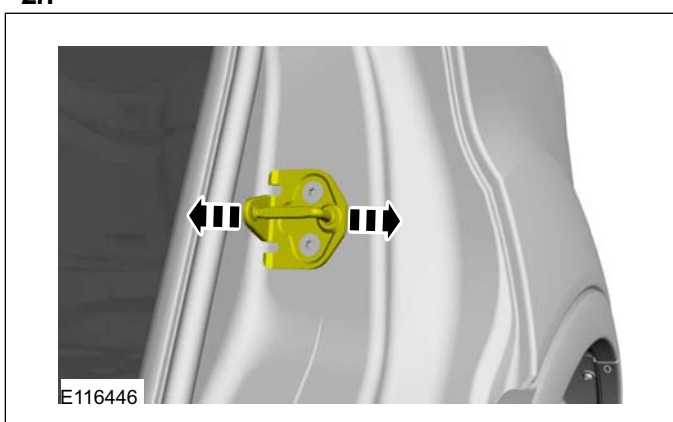
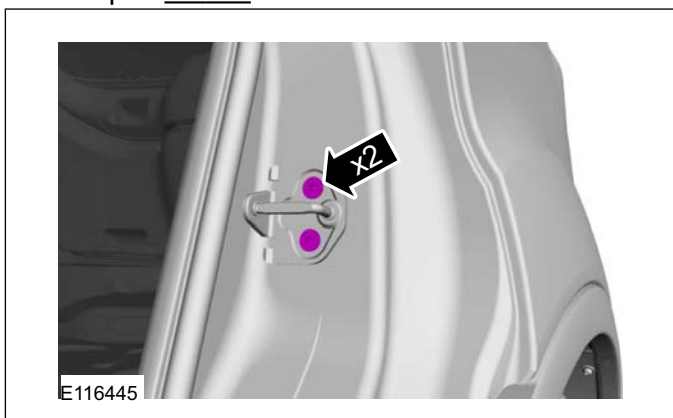
Body Closures

501-03-9

## GENERAL PROCEDURES

26. Loosen: 1 turn(s)

27.

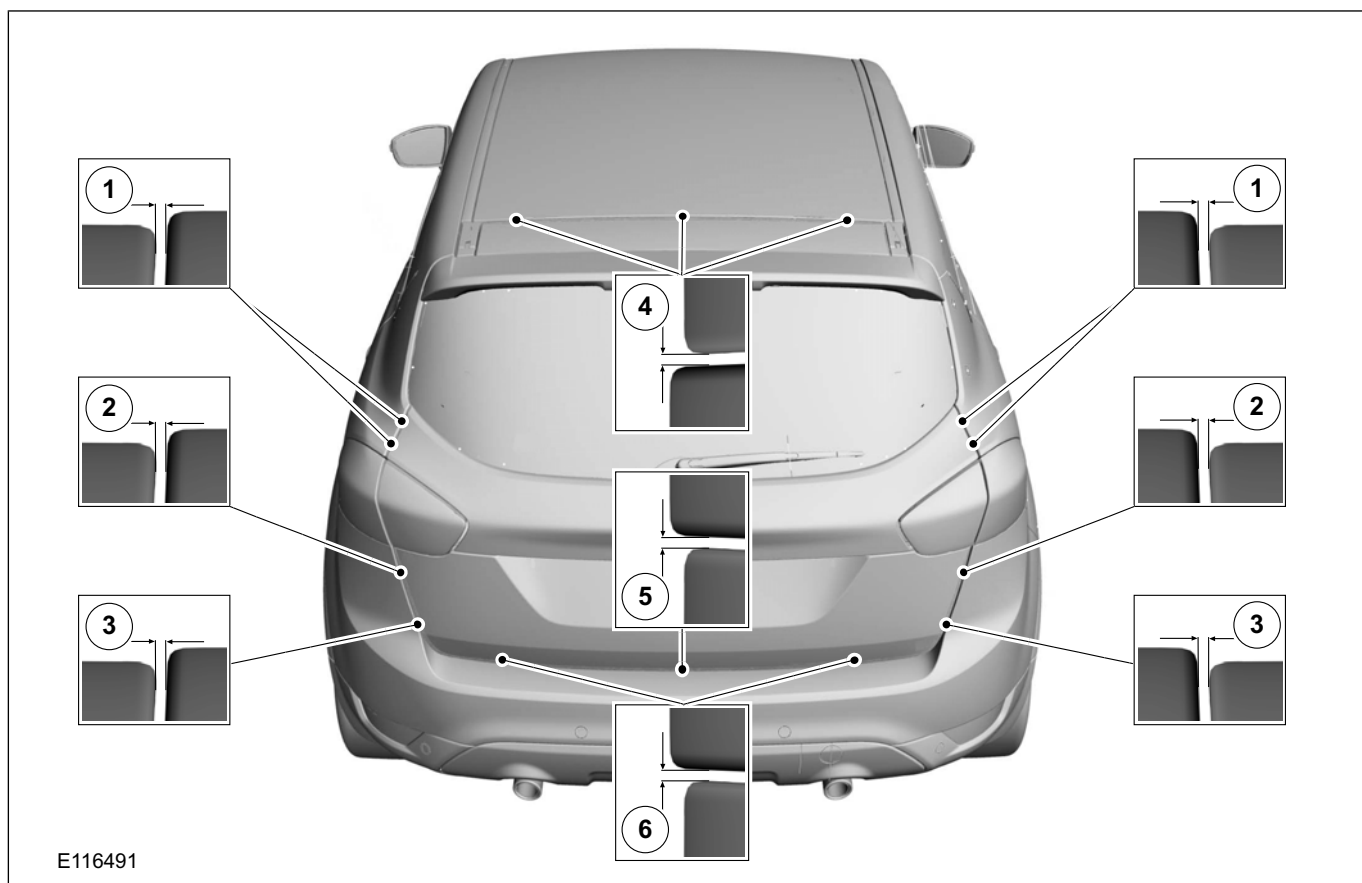
28. Torque: 20 Nm

## GENERAL PROCEDURES

## Liftgate Alignment

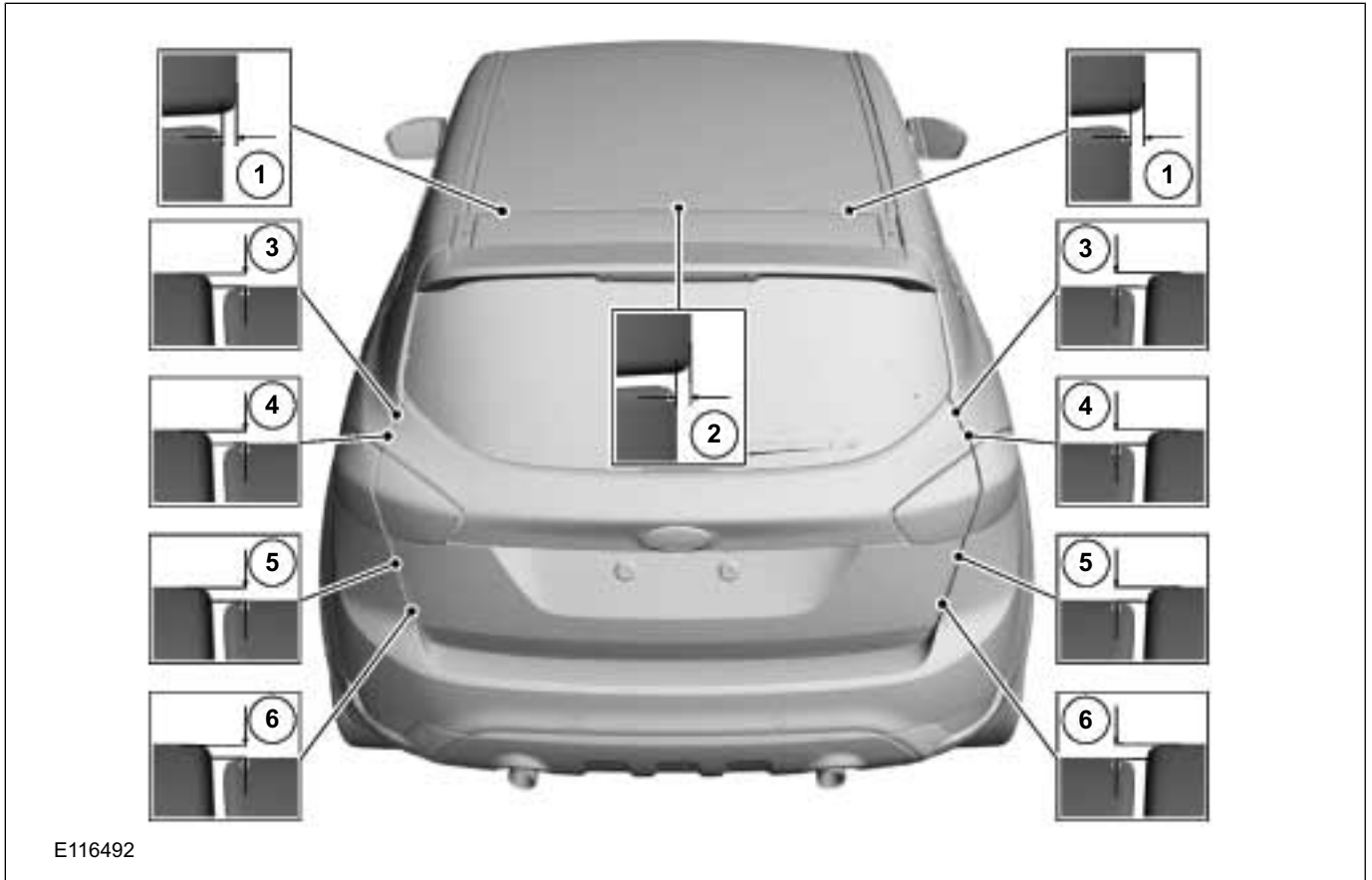
## Check

29. 1. 4.1 mm -1.5 mm  
 2. 5 mm -1.5 mm  
 3. 4 mm -1.5 mm  
 4. 4 mm -1.5 mm  
 5. 6 mm -1.5 mm  
 6. 6 mm -2 mm



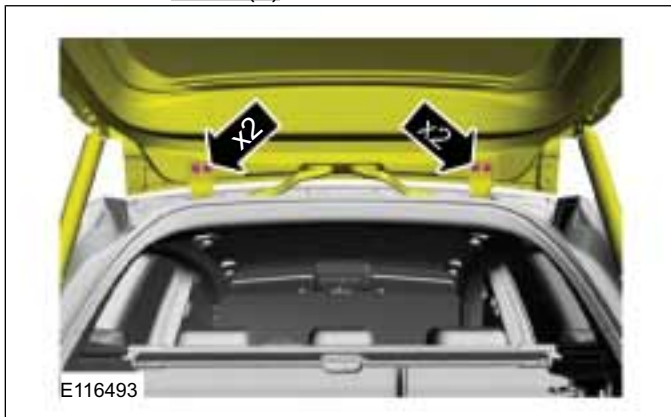
30. 1. 1.4 mm -1.5 mm  
 2. 1.3 mm -1.5 mm  
 3. 3.3 mm -1.5 mm  
 4. 2.1 mm -1.5 mm  
 5. 1.7 mm -1.5 mm  
 6. 1.2 mm -1.5 mm

GENERAL PROCEDURES

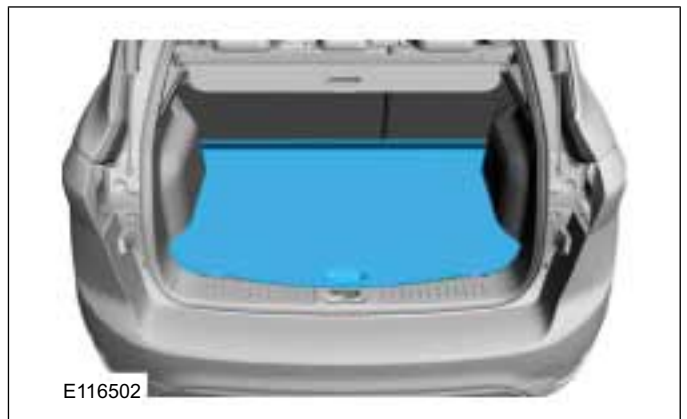


Adjustment

31. Loosen: 1 turn(s)



32

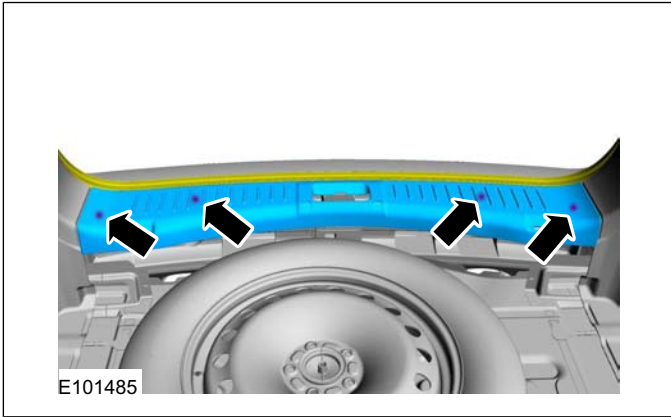


33

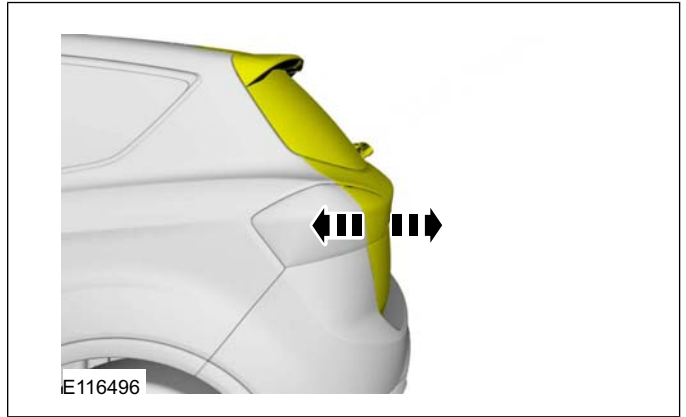


GENERAL PROCEDURES

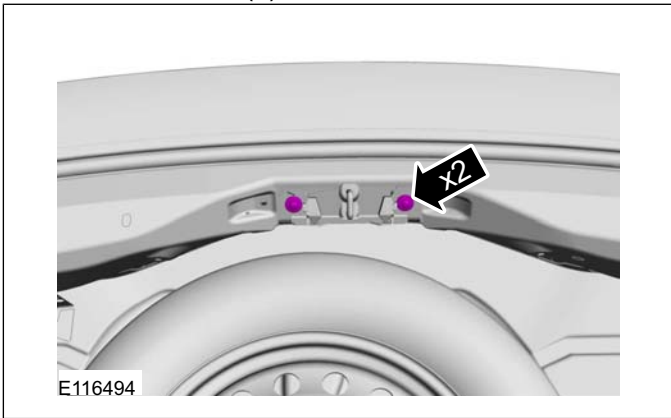
34.



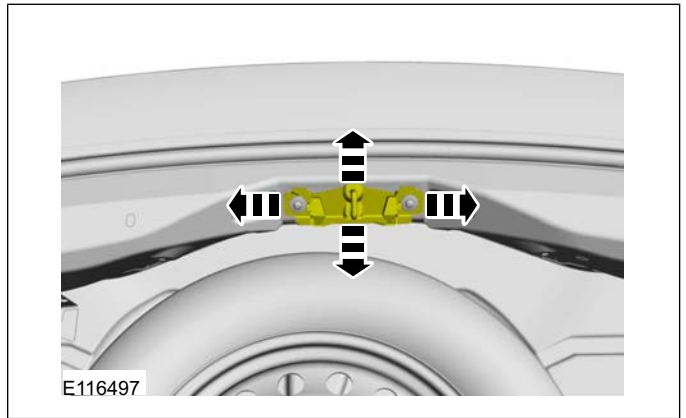
37.



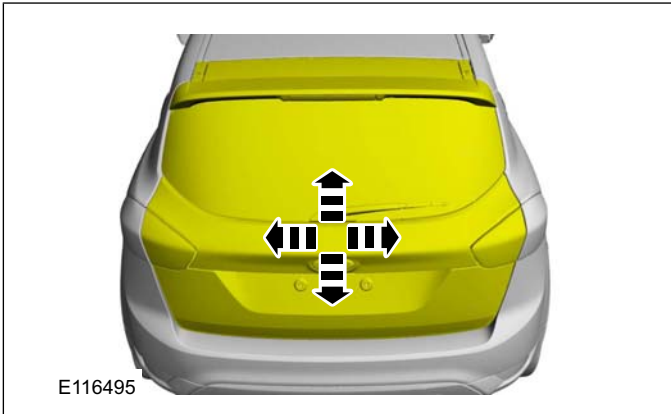
35. Loosen: 1 turn(s)



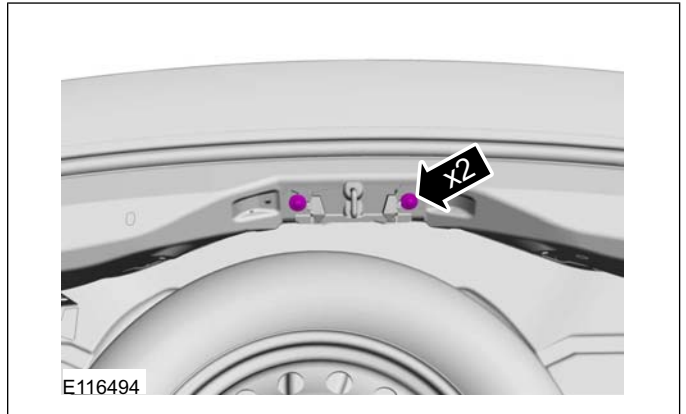
38.



36.

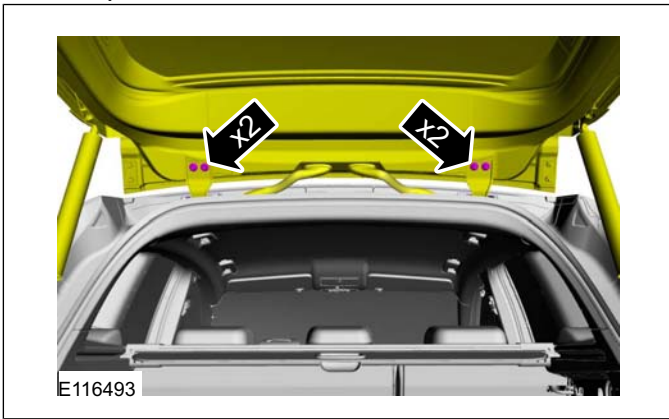


39. Torque: 26 Nm

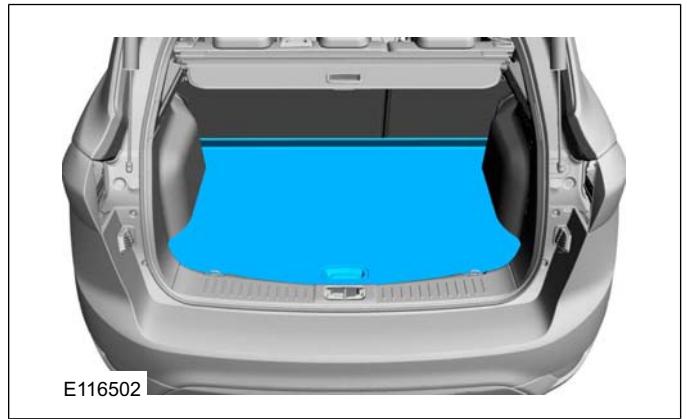


GENERAL PROCEDURES

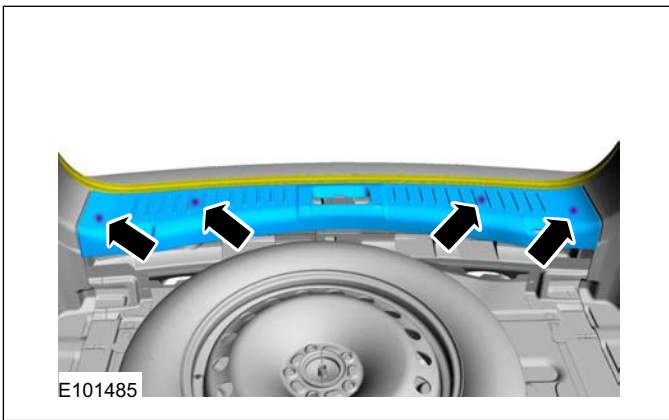
40. Torque: 23 Nm



43.



41.



42.

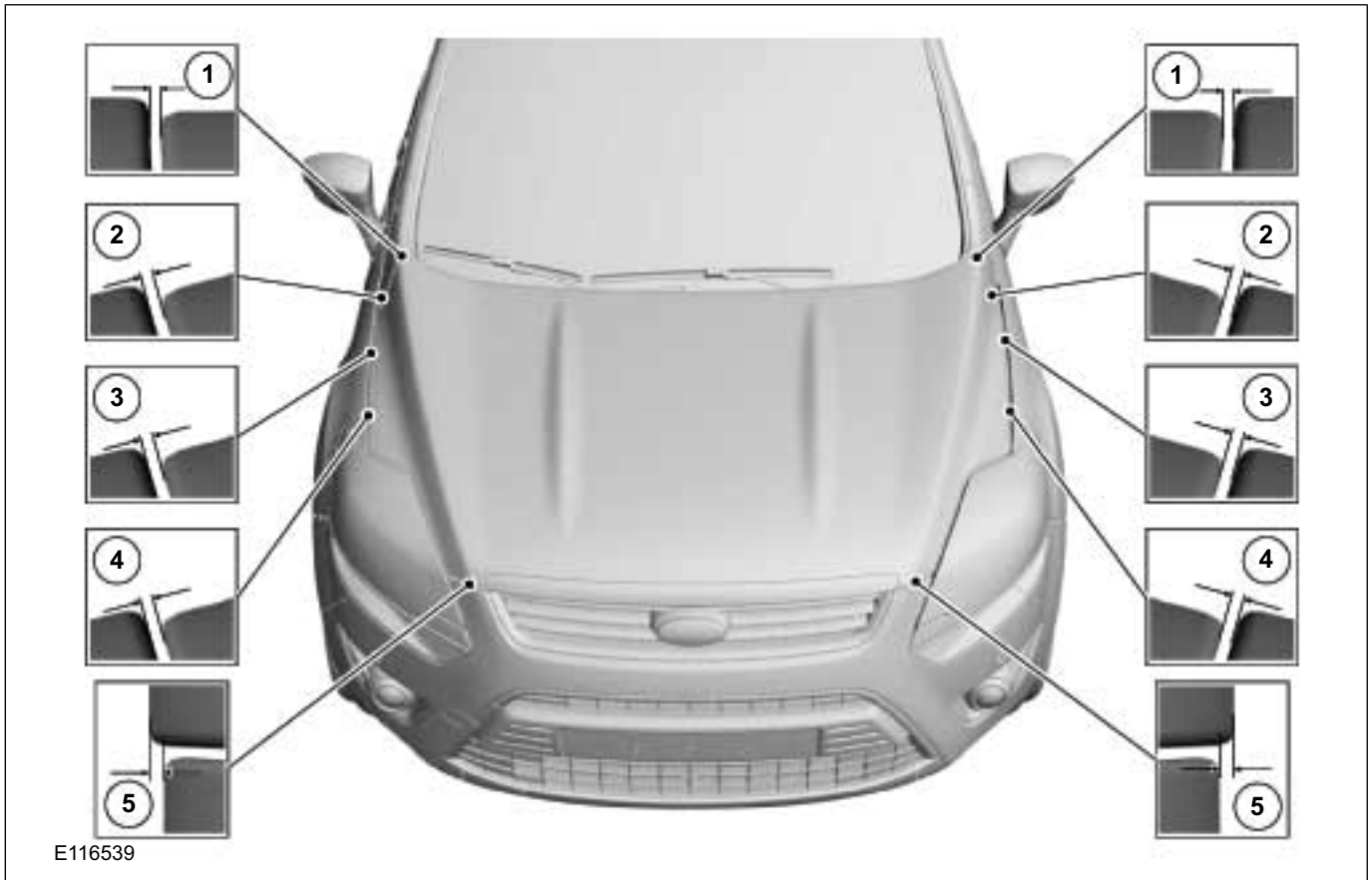


GENERAL PROCEDURES

Hood Alignment

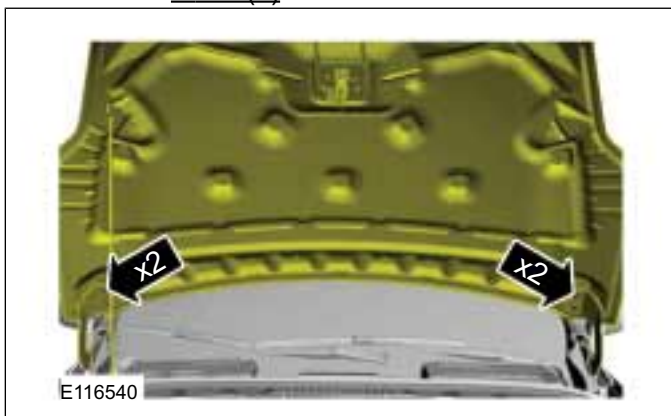
Check

- 44. 1. 3.5 mm -1.5 mm
- 2. 3.5 mm -1.5 mm
- 3. 3.8 mm -1.5 mm
- 4. 3.9 mm -1.5 mm
- 5. 0.3 mm -1.5 mm

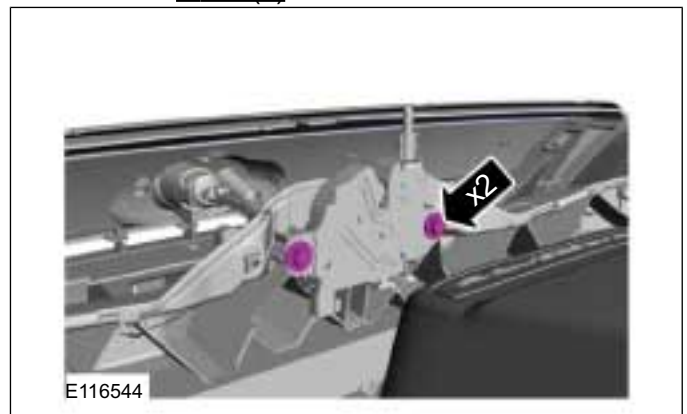


Adjustment

45. Loosen: 1 turn(s)



46. Loosen: 1 turn(s)





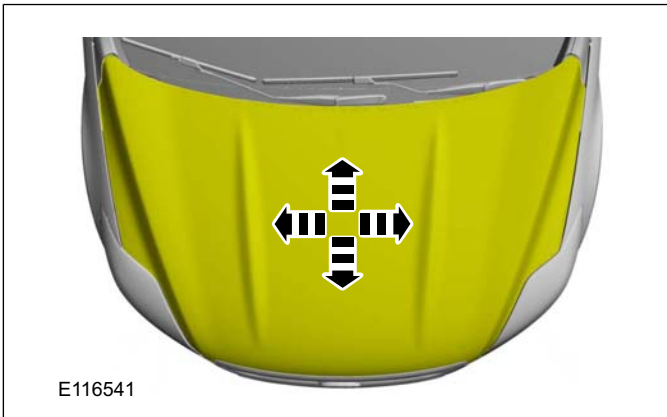
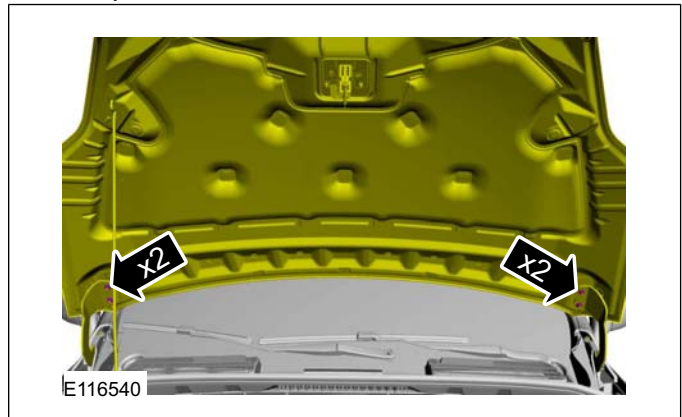
501-03-15

Body Closures

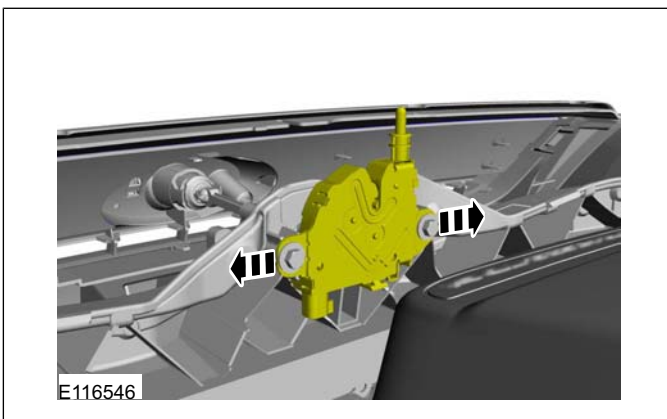
501-03-15

## GENERAL PROCEDURES

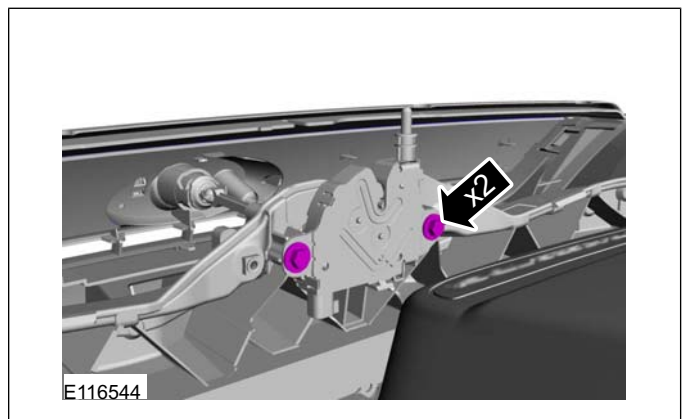
47.

49. Torque: 9 Nm

48.



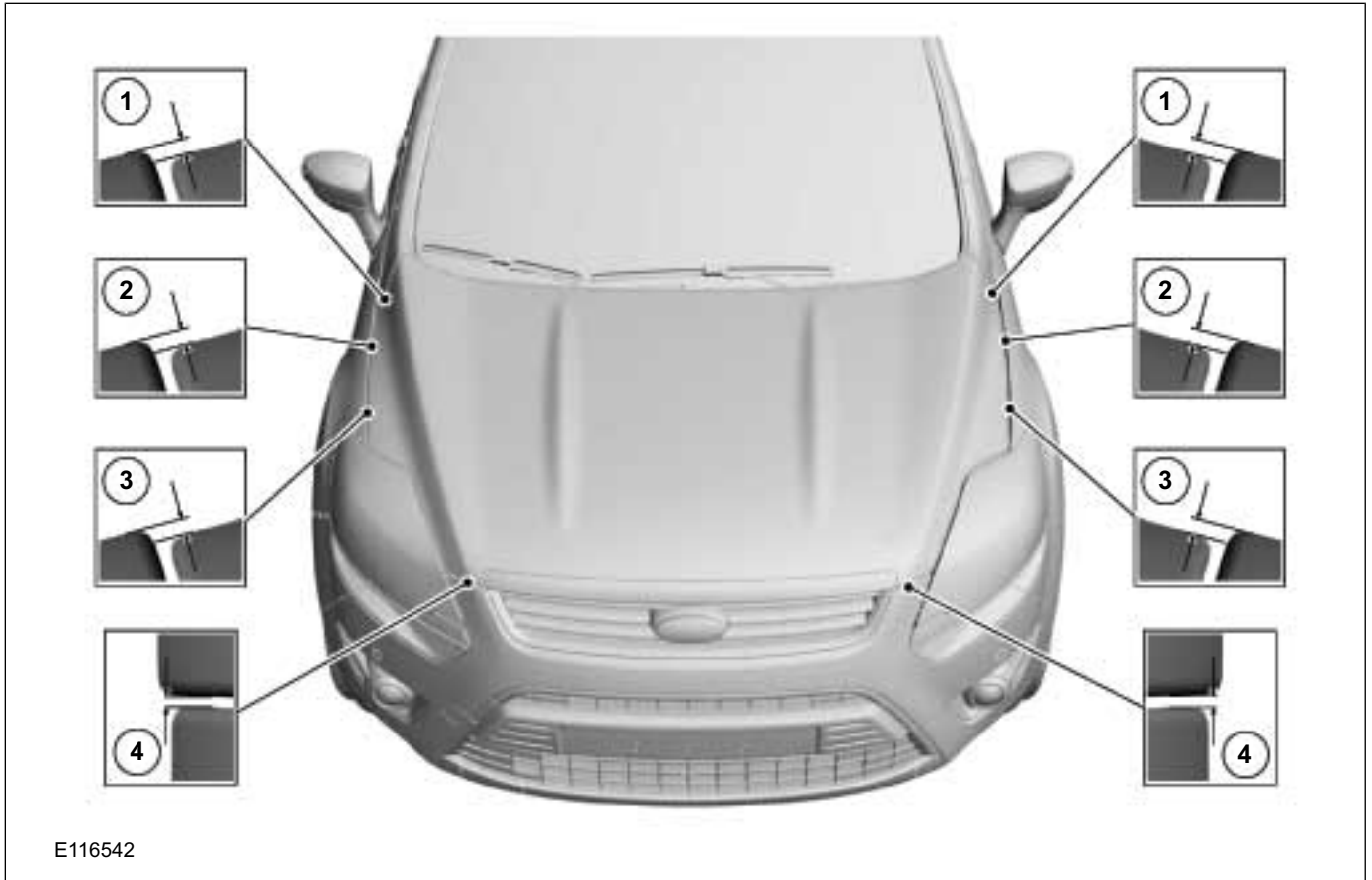
50.



## Check

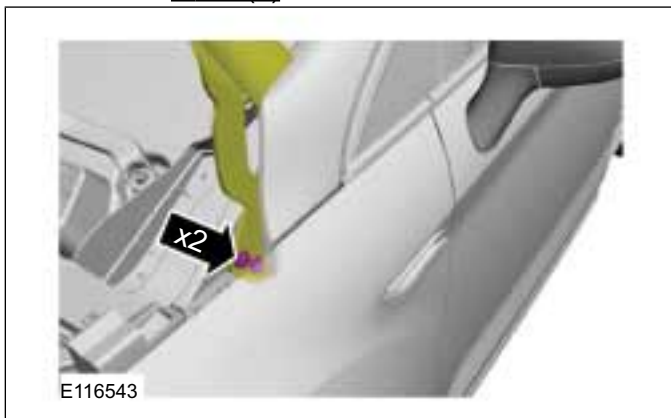
51. 1. 0.1 mm +1 mm / -2 mm  
 2. 4.4 mm -1.5 mm  
 3. 1.4 mm -1.5 mm  
 4. 6.1 mm -1.5 mm

GENERAL PROCEDURES

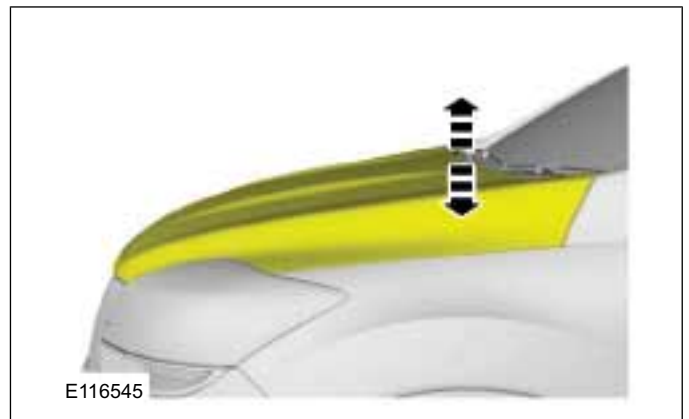


Adjustment

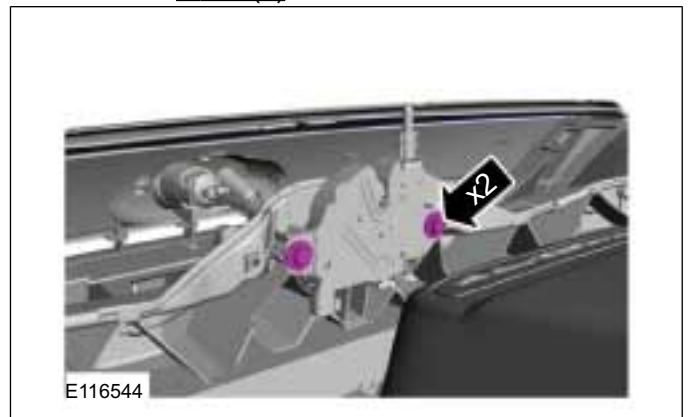
52. On both sides.  
Loosen: 1 turn(s)



53.

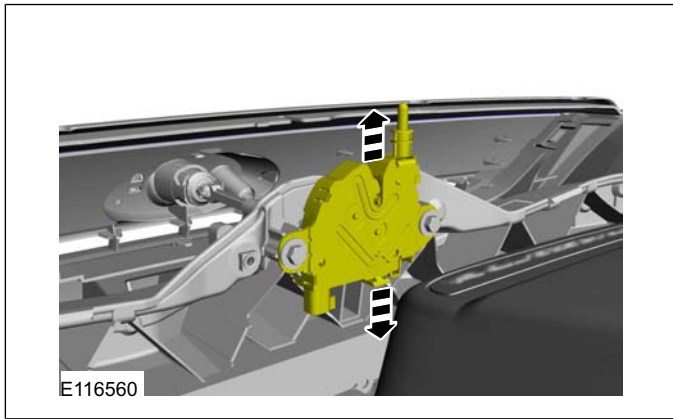


54. Loosen: 1 turn(s)

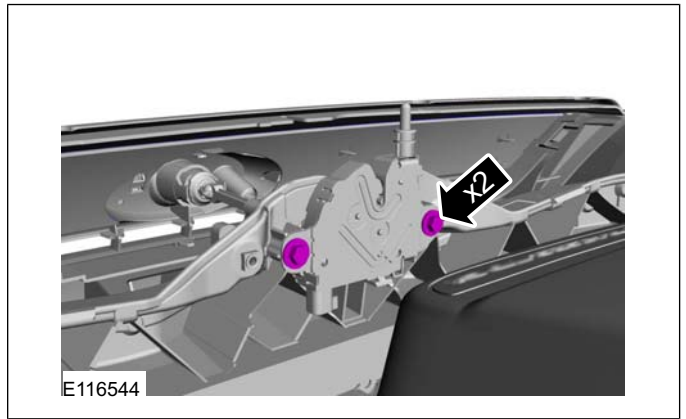


GENERAL PROCEDURES

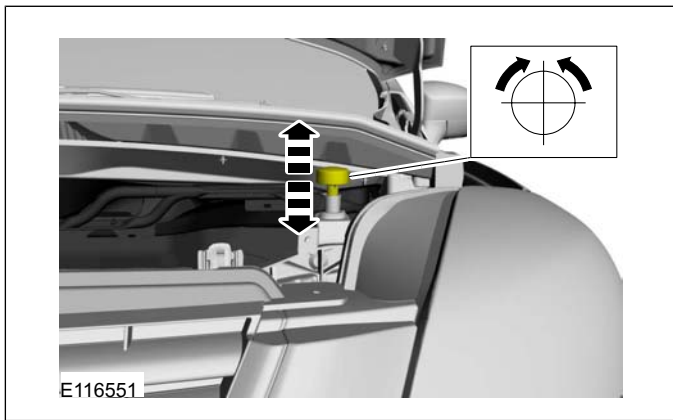
55.



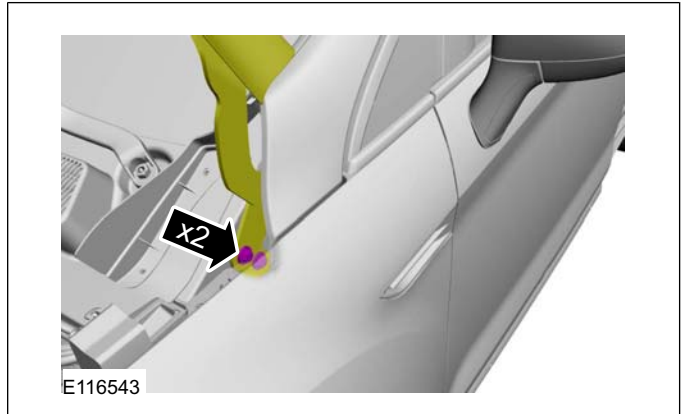
58.



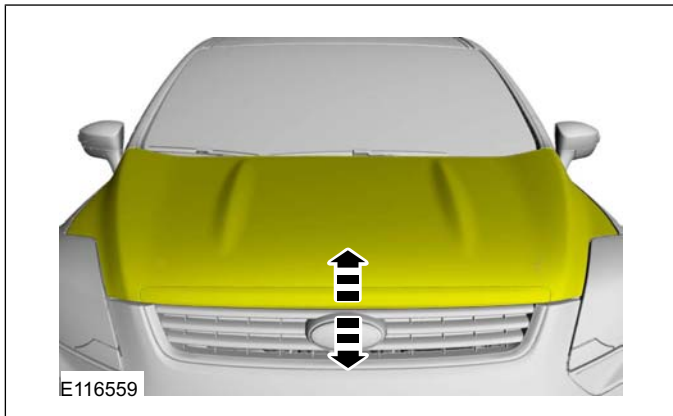
56. On both sides.



59. On both sides.  
Torque: 23 Nm



57.





REMOVAL AND INSTALLATION

Liftgate

General Equipment

5 mm Drill Bit
----------------

General Equipment

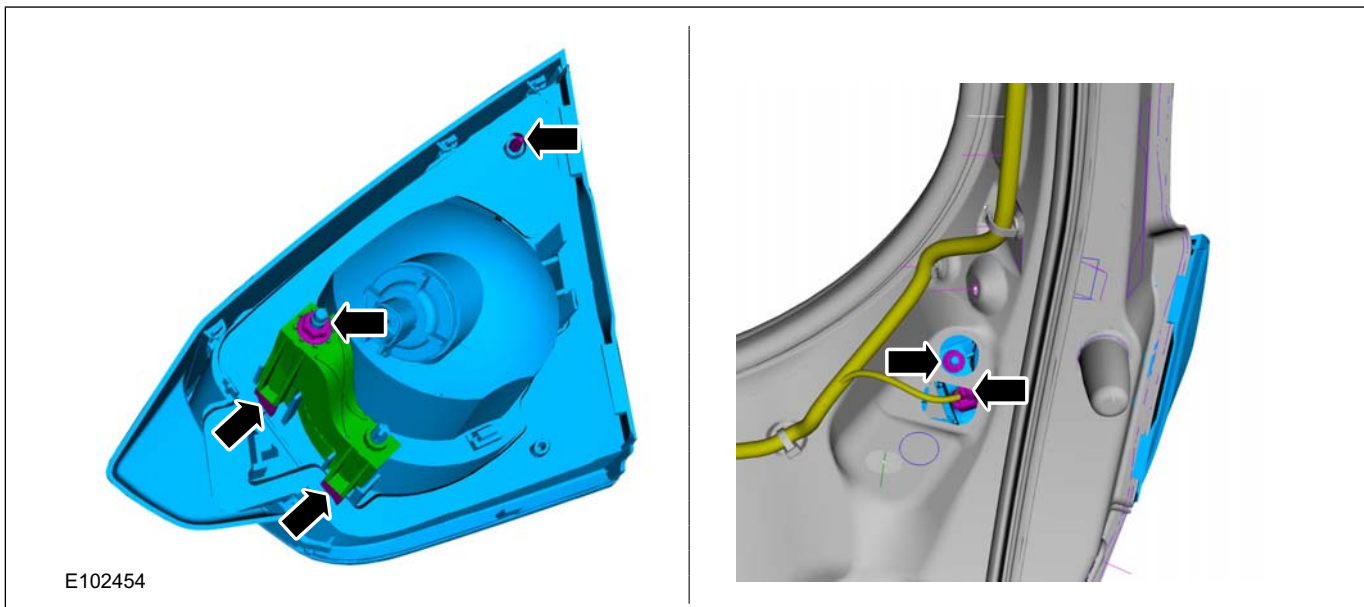
Blind Rivet Gun
Electric Drill

Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Upper Liftgate** (501-03 Body Closures, Removal and Installation).  
Refer to: **Liftgate Lower Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



E102454

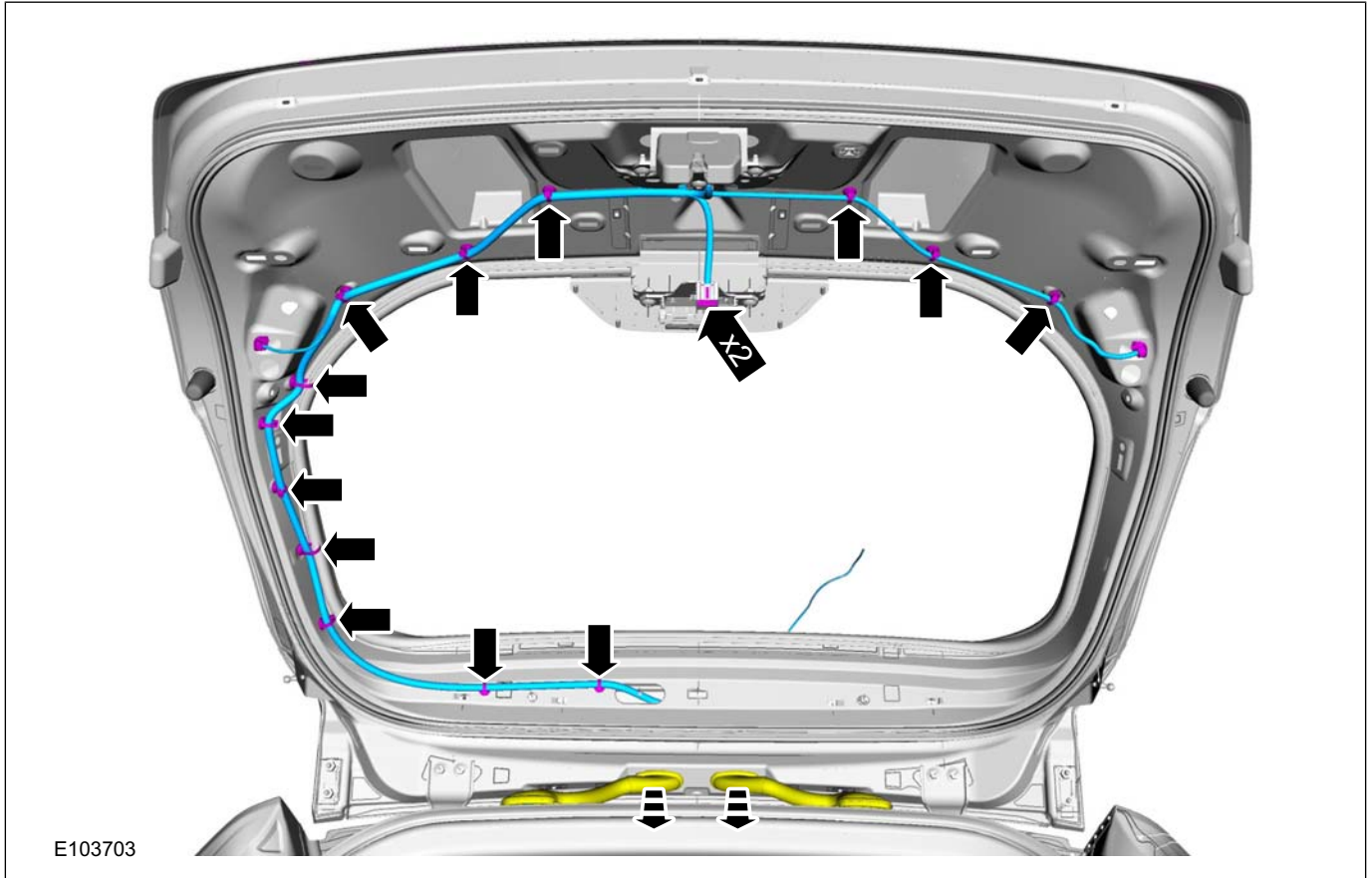
3.



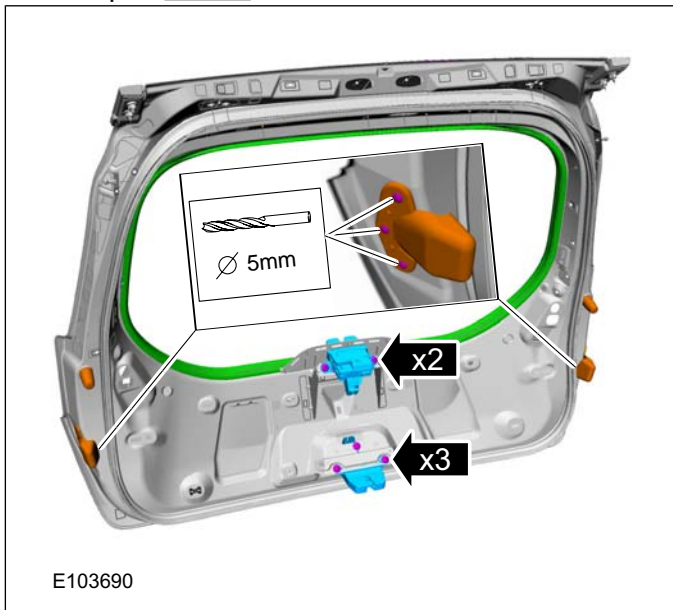




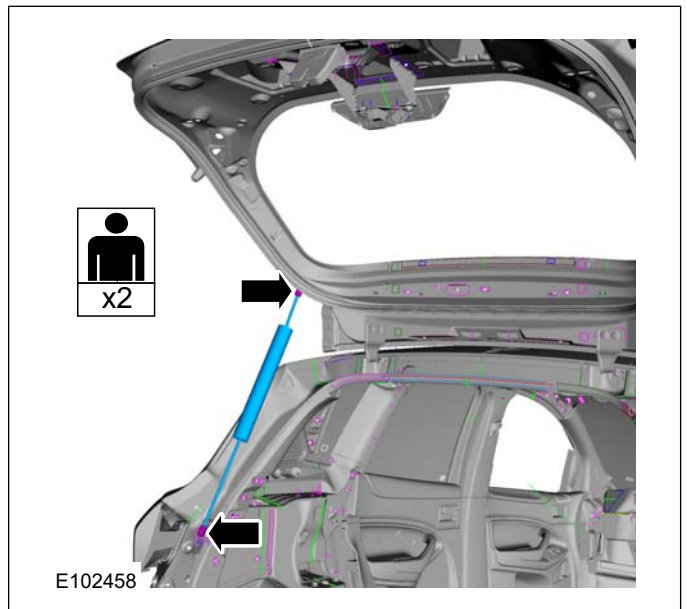
REMOVAL AND INSTALLATION



- 4. General Equipment: Electric Drill
- General Equipment: 5 mm Drill Bit
- General Equipment: Blind Rivet Gun
- Torque: 20 Nm



- 5. On both sides.

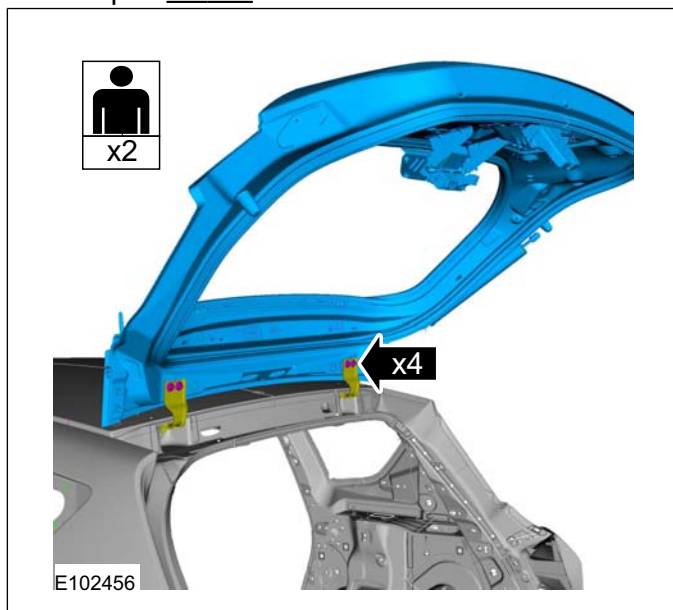


501-03-20

Body Closures

501-03-20

## REMOVAL AND INSTALLATION

6. Torque: 23 Nm

## Installation

1. To install, reverse the removal procedure.





REMOVAL AND INSTALLATION

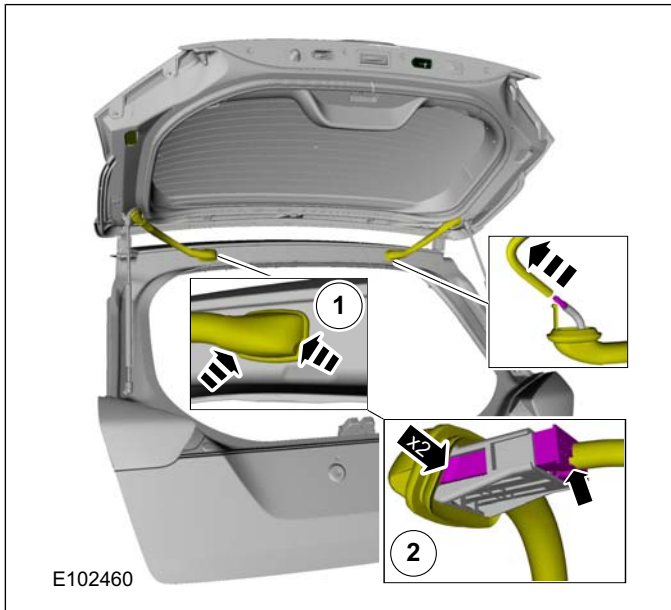
Upper Liftgate

Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Rear Spoiler** (501-08 Exterior Trim and Ornamentation, Removal and Installation).

2.



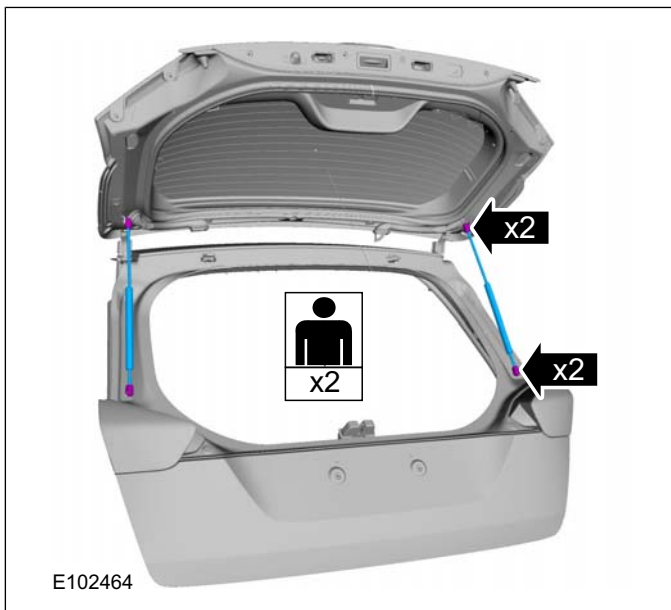
4. Torque: 30 Nm



Installation

1. To install, reverse the removal procedure.

3.



## DISASSEMBLY AND ASSEMBLY

## Upper Liftgate

## General Equipment

5 mm Drill Bit

Adhesive Tape

## General Equipment

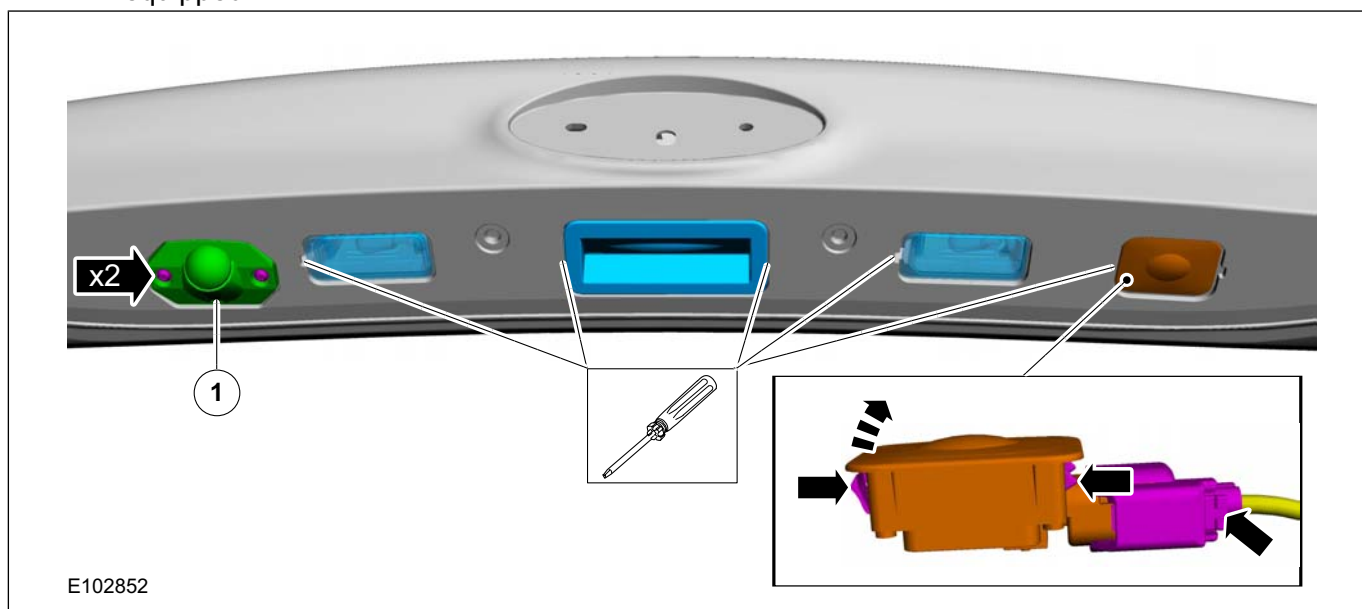
Air Body Saw

Blind Rivet Gun

Electric Drill

## Disassembly

1. Refer to: **Upper Liftgate** (501-03 Body Closures, Removal and Installation).  
Refer to: **Liftgate Window Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).
2. 1. If equipped



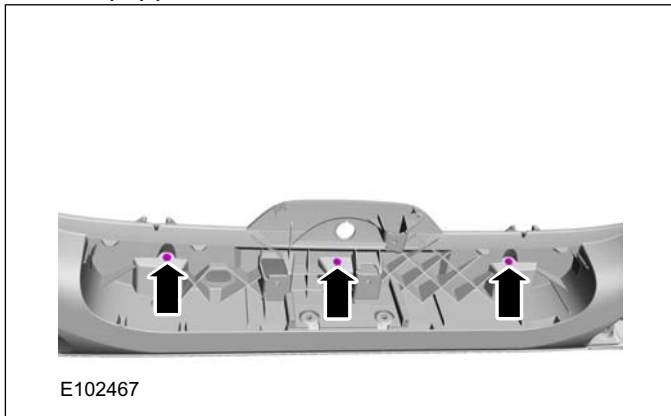
3. General Equipment: Electric Drill  
General Equipment: 5 mm Drill Bit

DISASSEMBLY AND ASSEMBLY

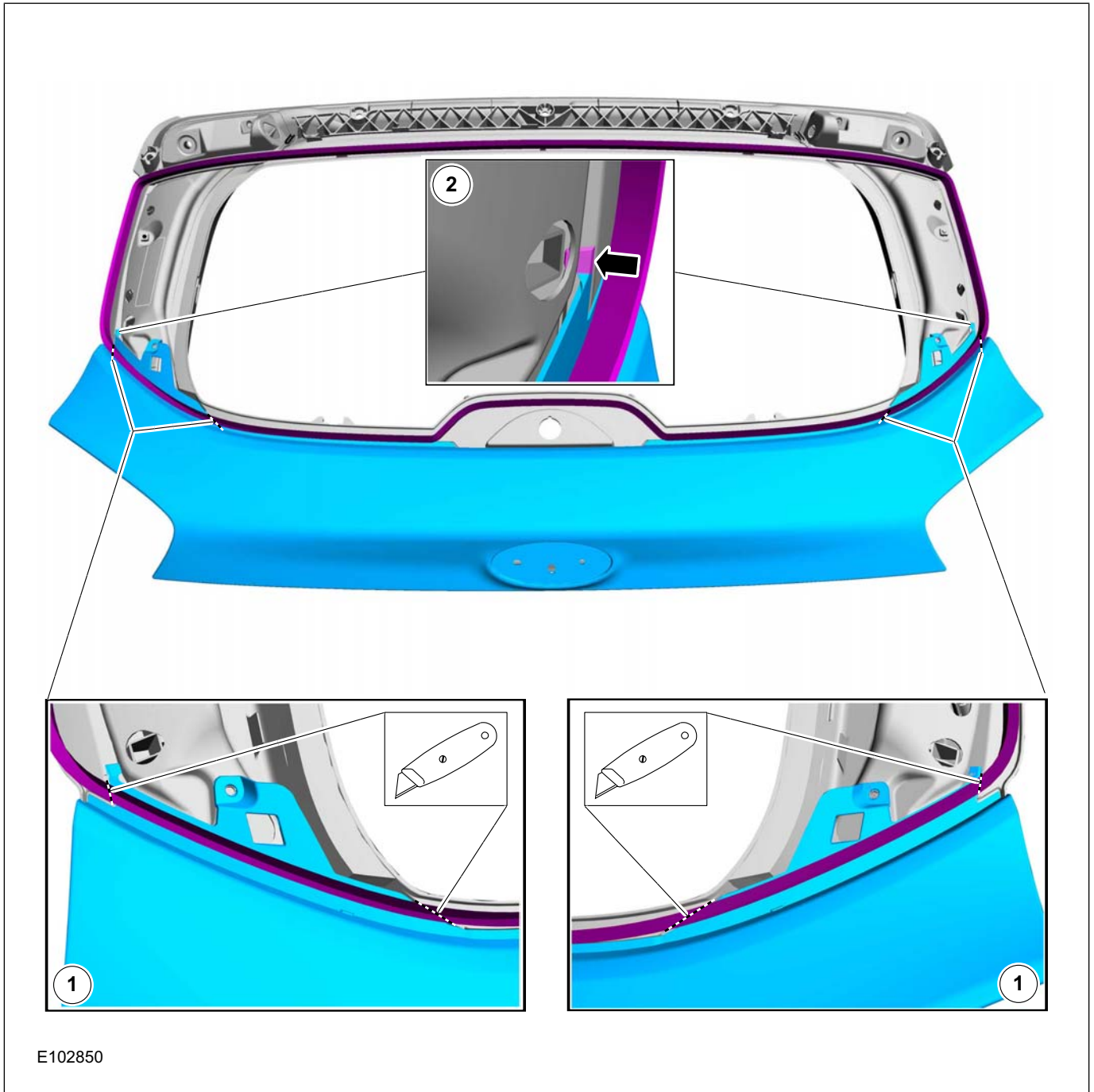


4. If equipped.

5.



DISASSEMBLY AND ASSEMBLY

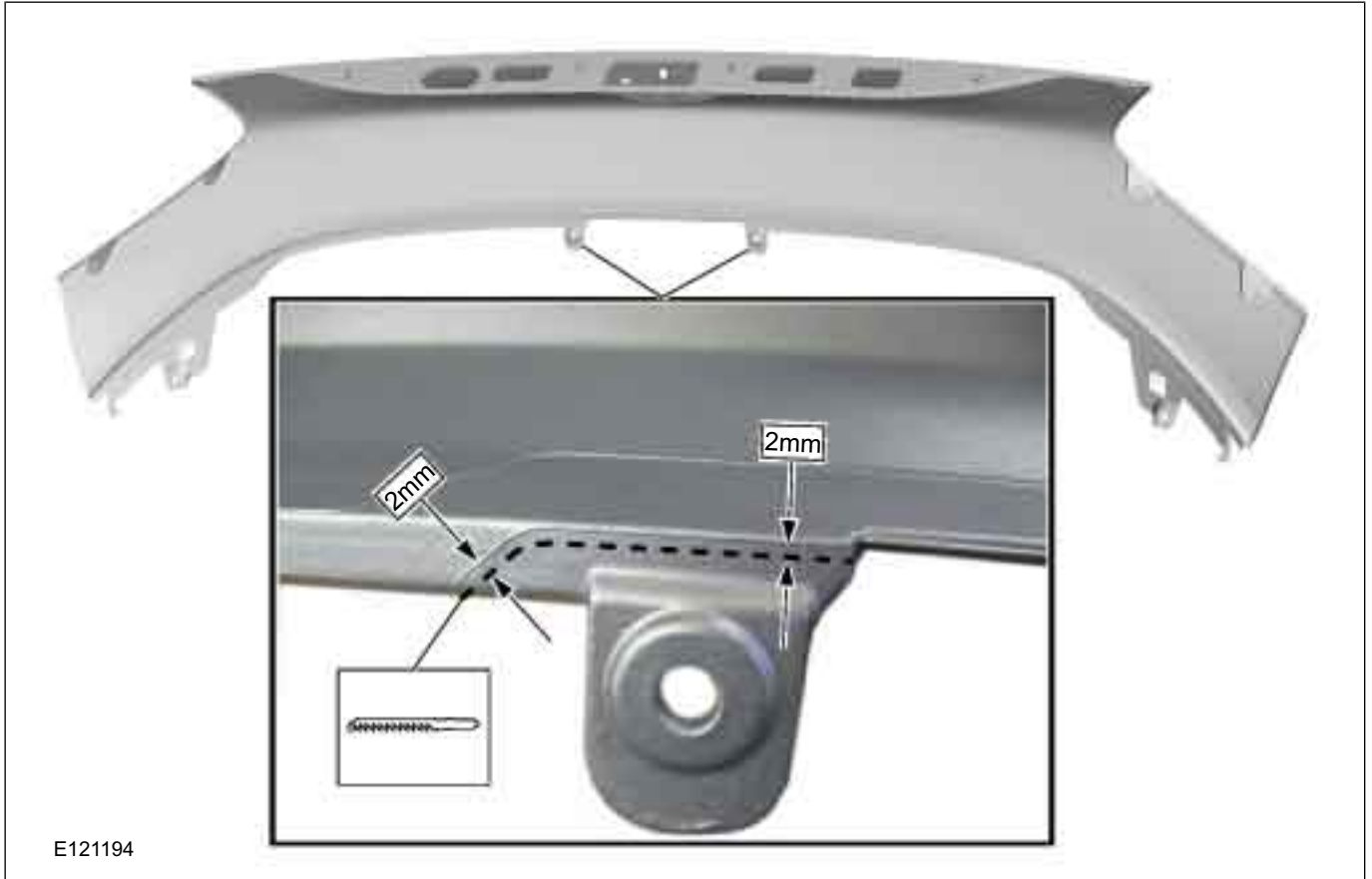


Assembly

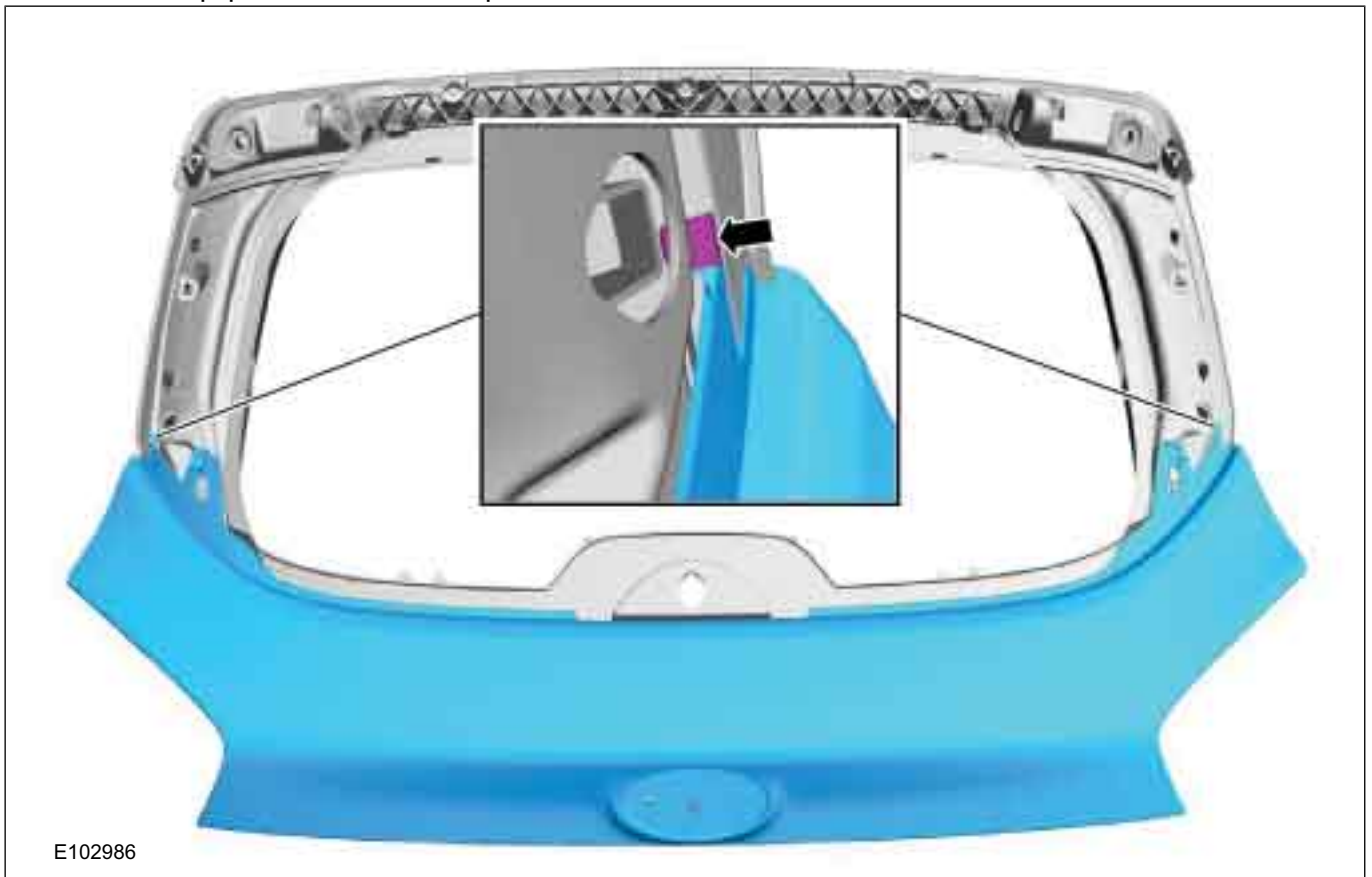
Vehicles built up to 11/08/2008

6. General Equipment: Air Body Saw

DISASSEMBLY AND ASSEMBLY

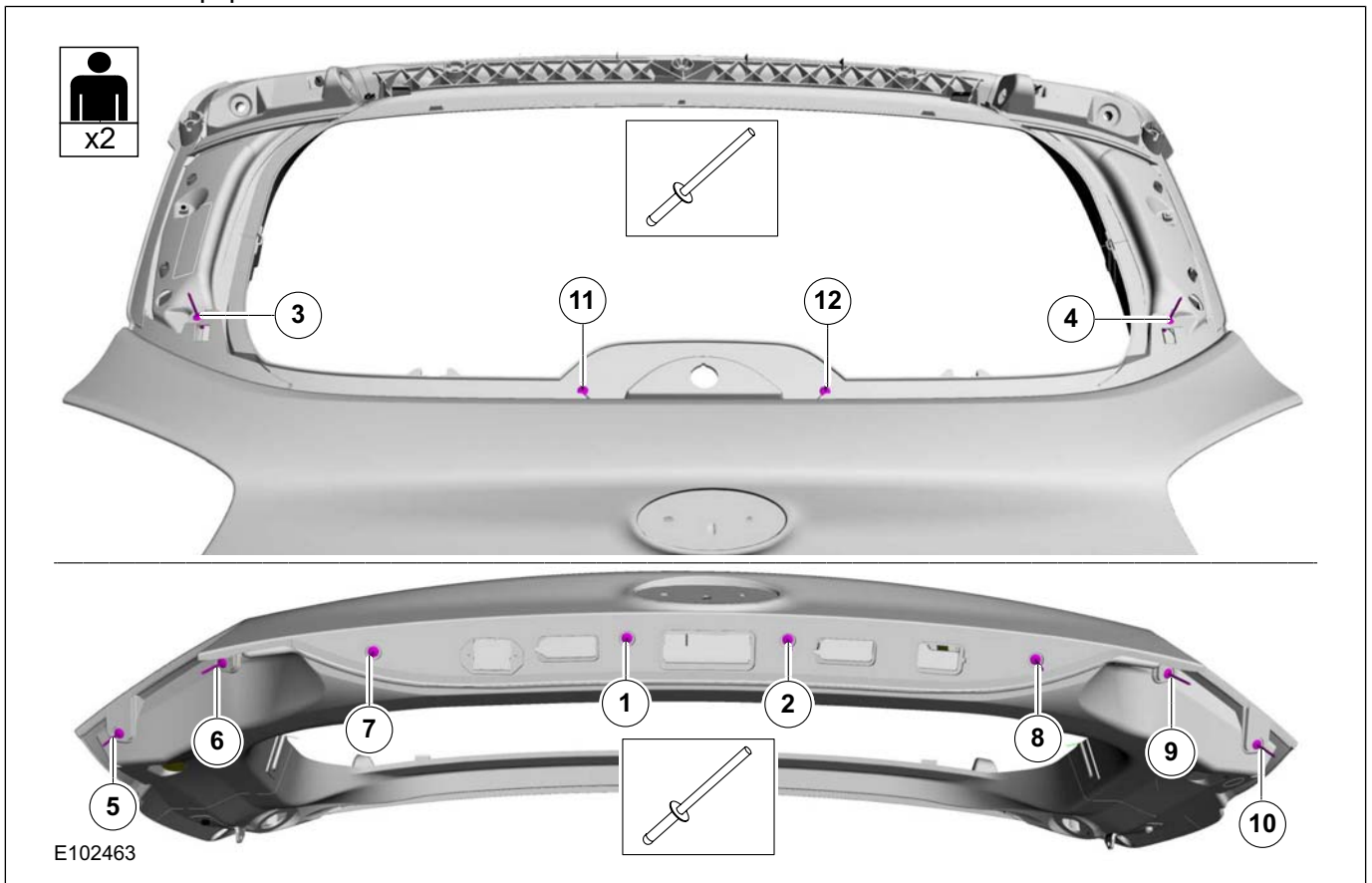


7. General Equipment: Adhesive Tape

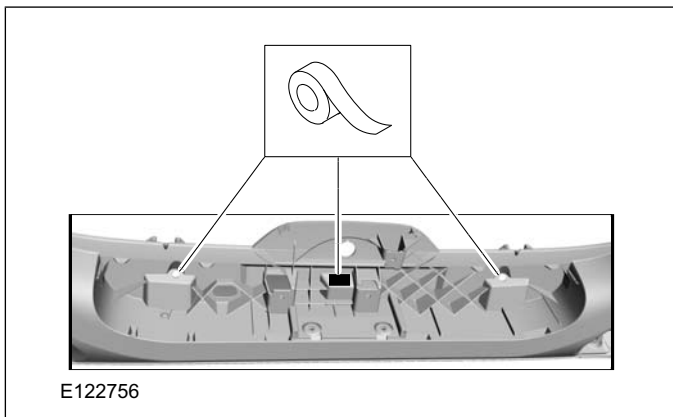


DISASSEMBLY AND ASSEMBLY

8. General Equipment: Blind Rivet Gun



9.



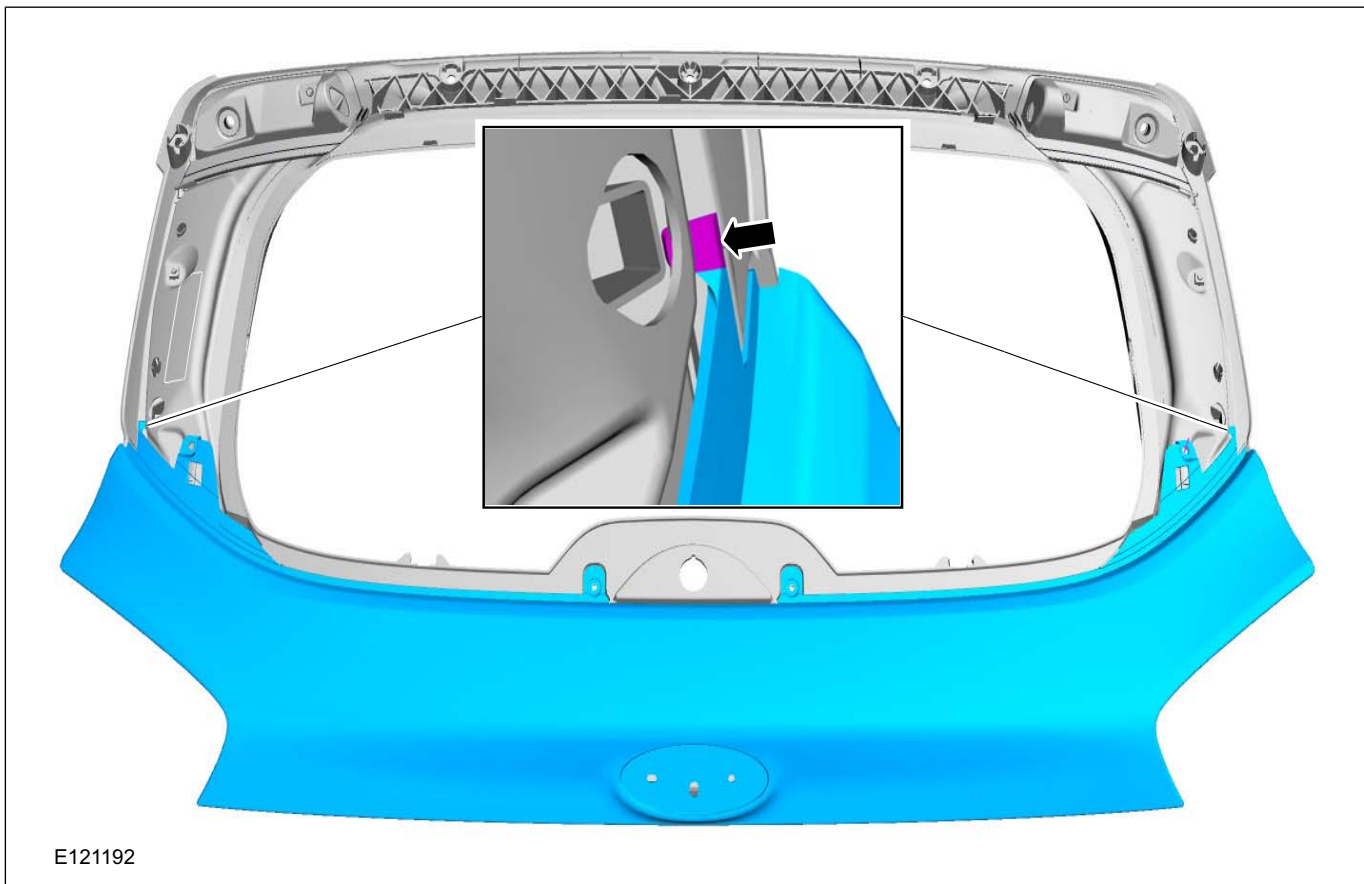
Vehicles built 11/08/2008 onwards

10.

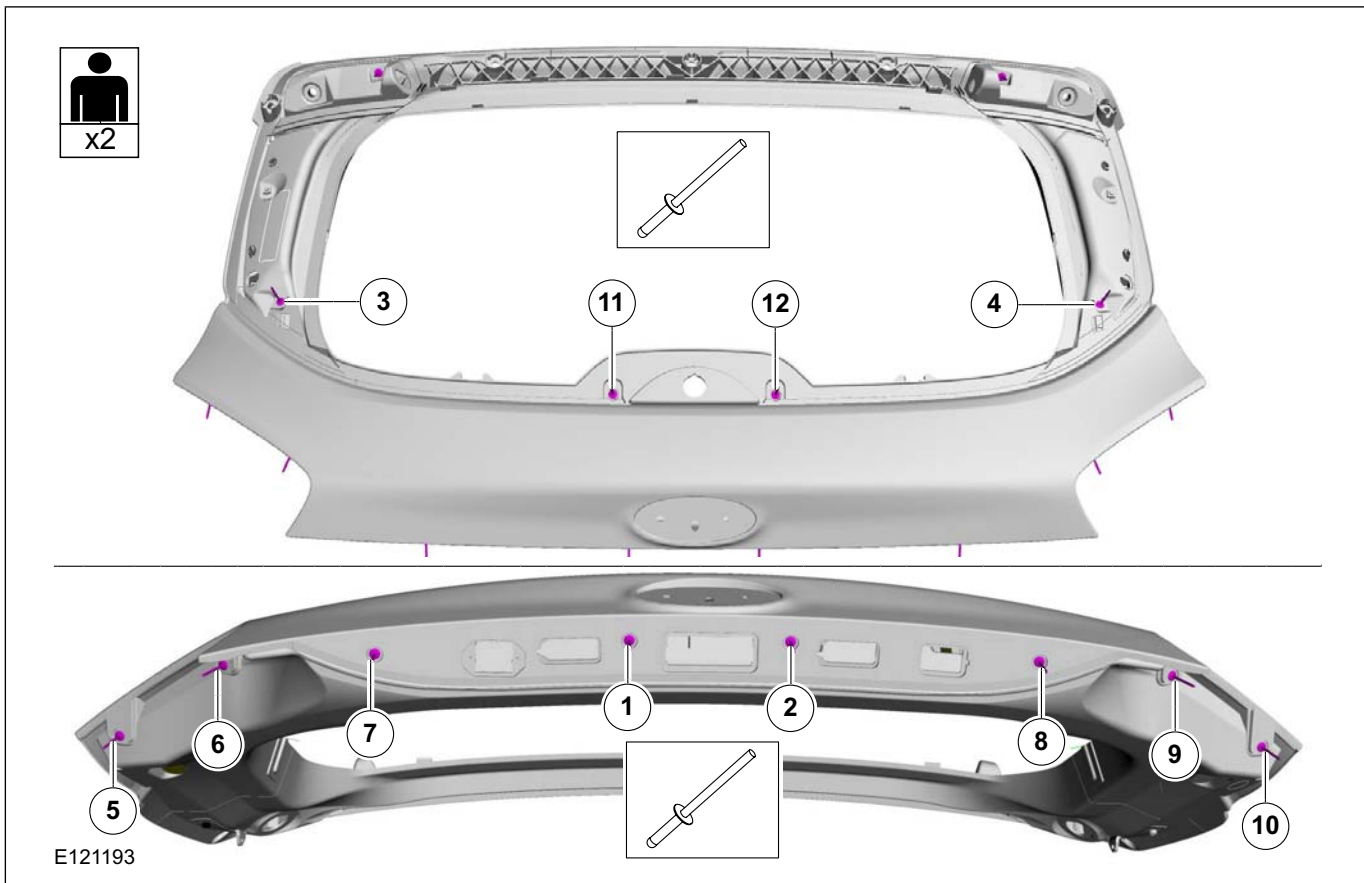




DISASSEMBLY AND ASSEMBLY



11.



501-03-28

## Body Closures

501-03-28

## DISASSEMBLY AND ASSEMBLY

All vehicles

12 1. If equipped



E102991

13. Refer to: **Liftgate Window Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).  
Refer to: **Upper Liftgate** (501-03 Body Closures, Removal and Installation).

## SECTION 501-05 Interior Trim and Ornamentation

VEHICLE APPLICATION: 2008.50 Kuga

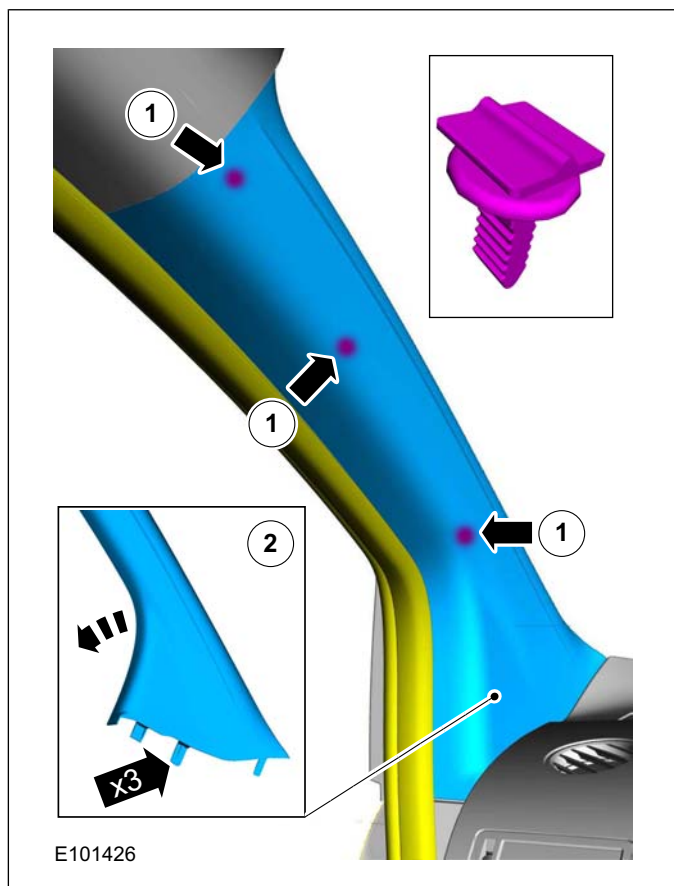
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<b>REMOVAL AND INSTALLATION</b>	
A-Pillar Trim Panel.....	501-05-2
B-Pillar Trim Panel.....	501-05-3
C-Pillar Trim Panel.....	501-05-5
D-Pillar Trim Panel.....	501-05-6
Loadspace Trim Panel LH.....	501-05-7
Loadspace Trim Panel RH.....	501-05-10
Front Scuff Plate Trim Panel.....	501-05-13
Rear Scuff Plate Trim Panel.....	501-05-14
Headliner.....	501-05-15
Glass Roof Panel Blind..... (43 626 0)	501-05-28
Front Door Trim Panel.....	501-05-37
Rear Door Trim Panel.....	501-05-39
Liftgate Upper Trim Panel.....	501-05-44
Liftgate Lower Trim Panel.....	501-05-45

## REMOVAL AND INSTALLATION

## A-Pillar Trim Panel

## Removal

1.



## Installation

1. To install, reverse the removal procedure.



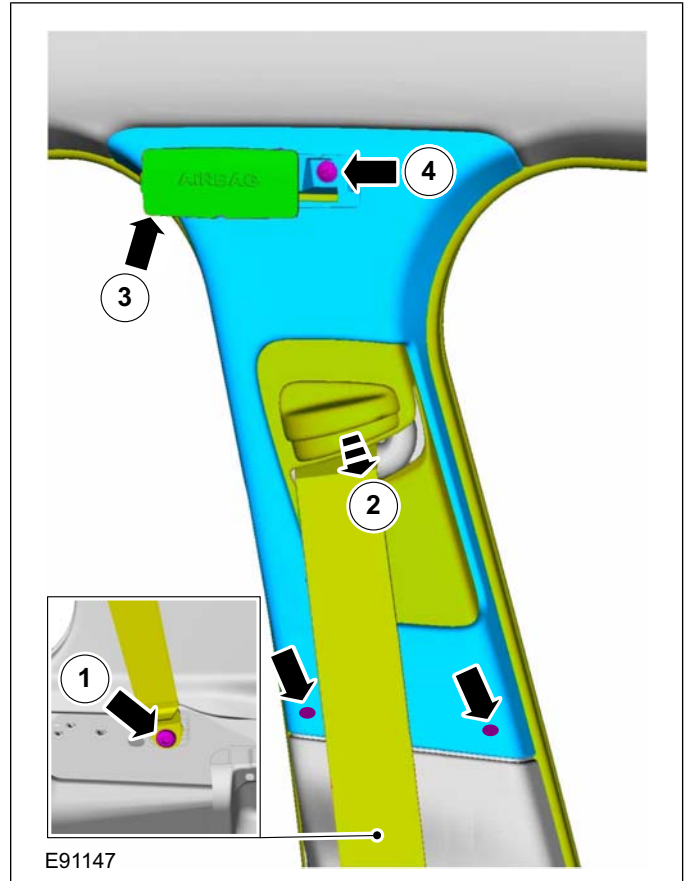
REMOVAL AND INSTALLATION

B-Pillar Trim Panel

Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. 1. Torque: 38 Nm



2.

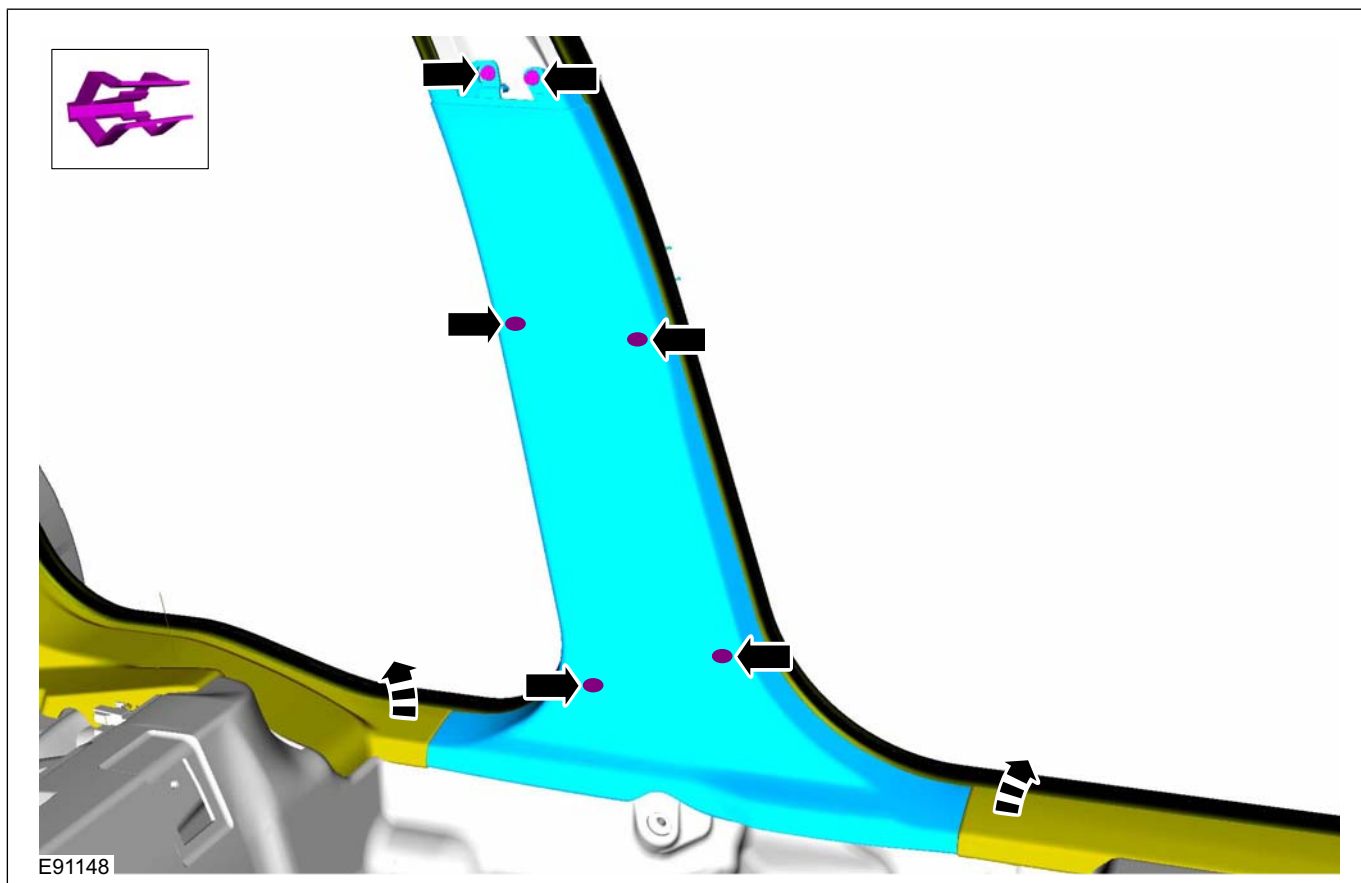


501-05-4

Interior Trim and Ornamentation

501-05-4

## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.



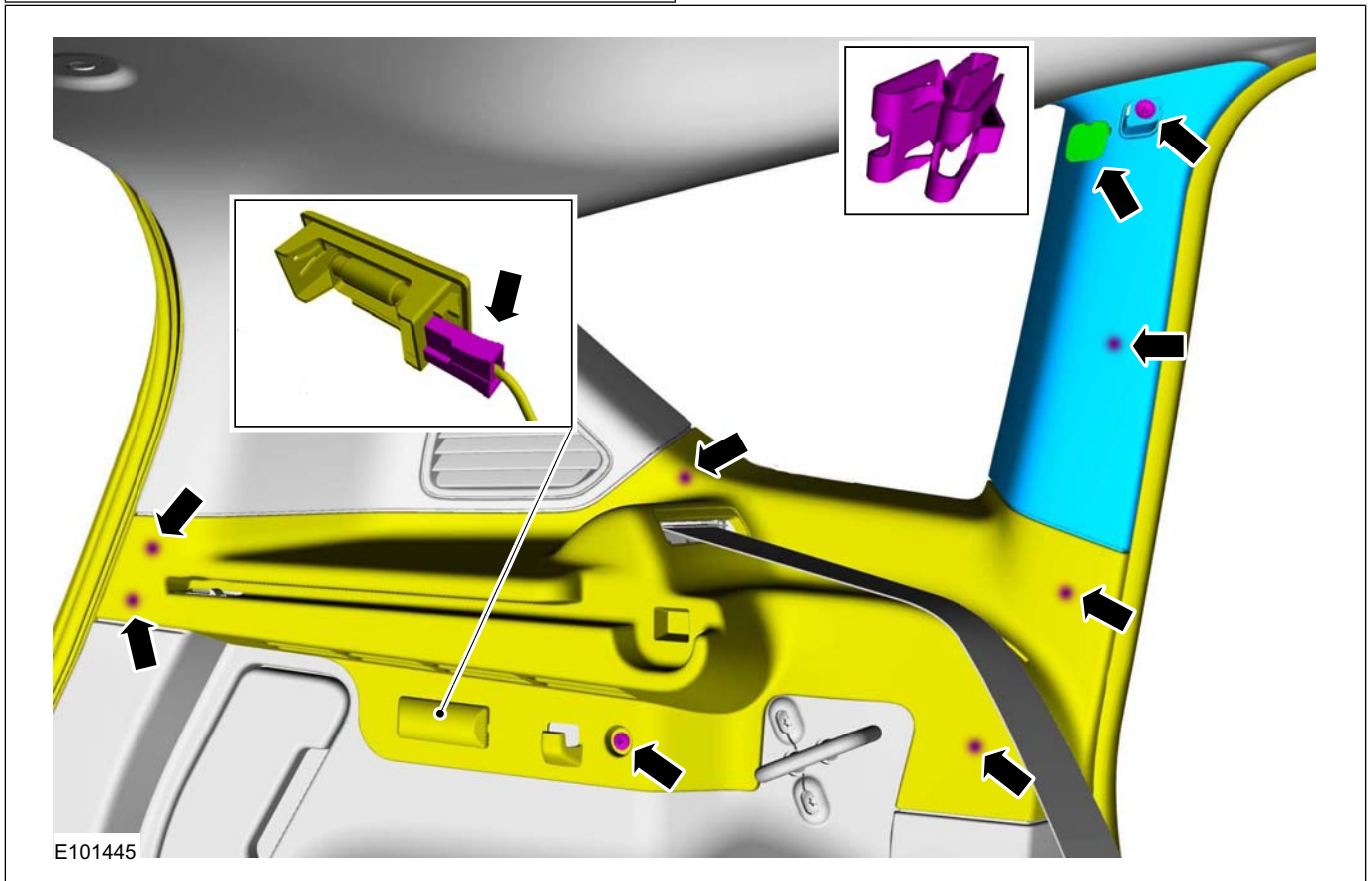
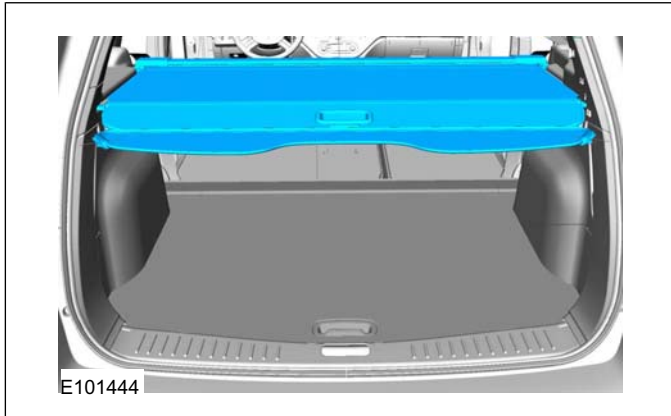
REMOVAL AND INSTALLATION

C-Pillar Trim Panel

Removal

1.

2. All.



Installation

1. To install, reverse the removal procedure.

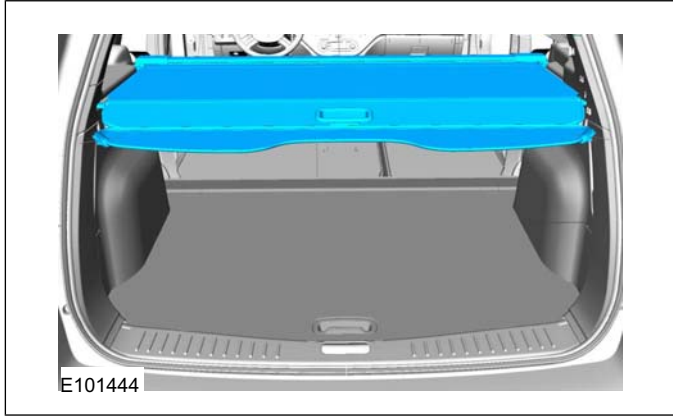


REMOVAL AND INSTALLATION

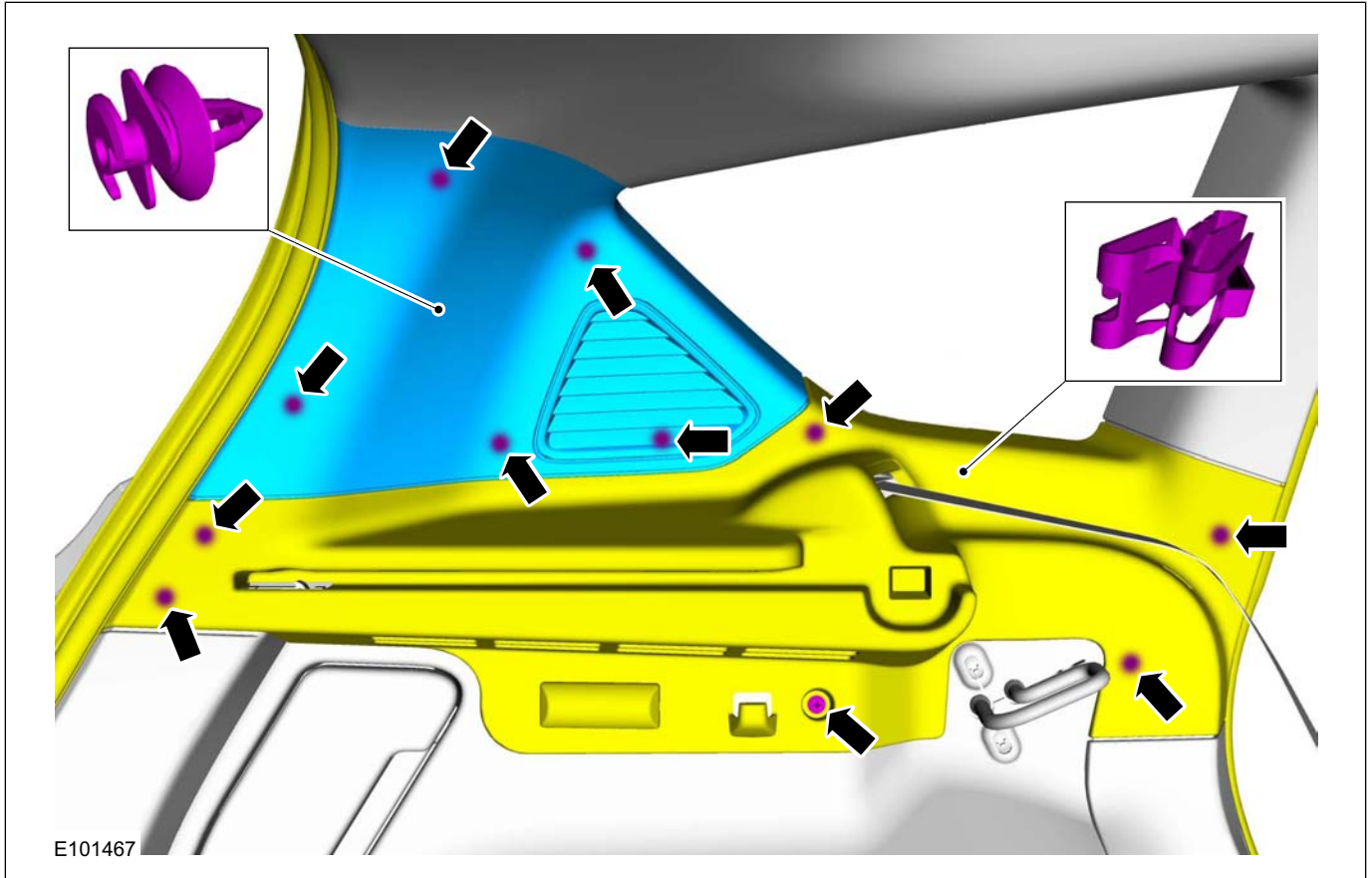
D-Pillar Trim Panel

Removal

1.



2.



Installation

1. To install, reverse the removal procedure.



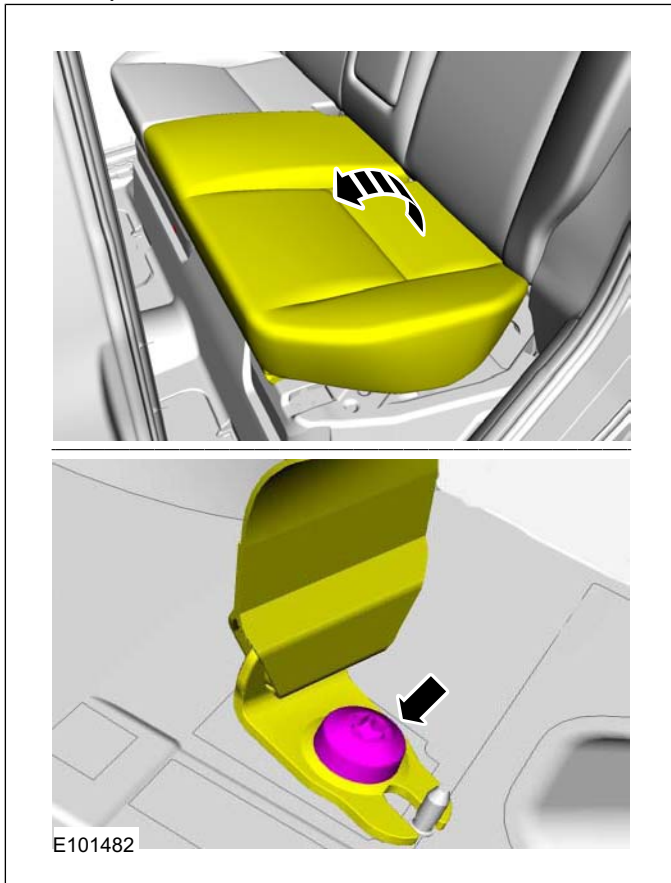
REMOVAL AND INSTALLATION

Loadspace Trim Panel LH

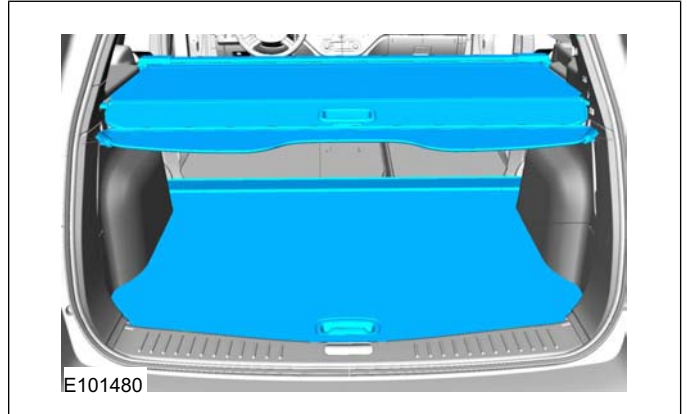
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

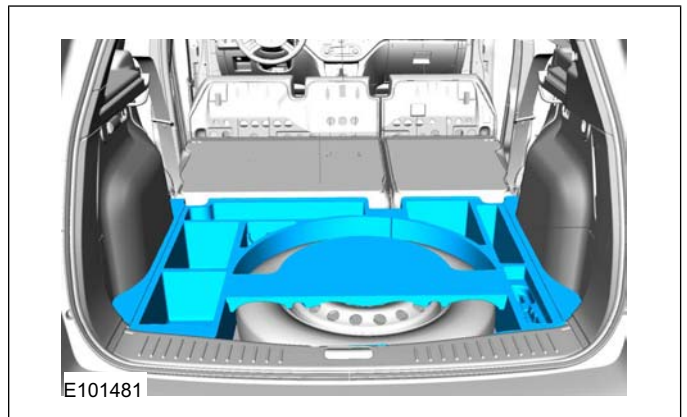
1. Torque: 38 Nm



2.



3.



4.



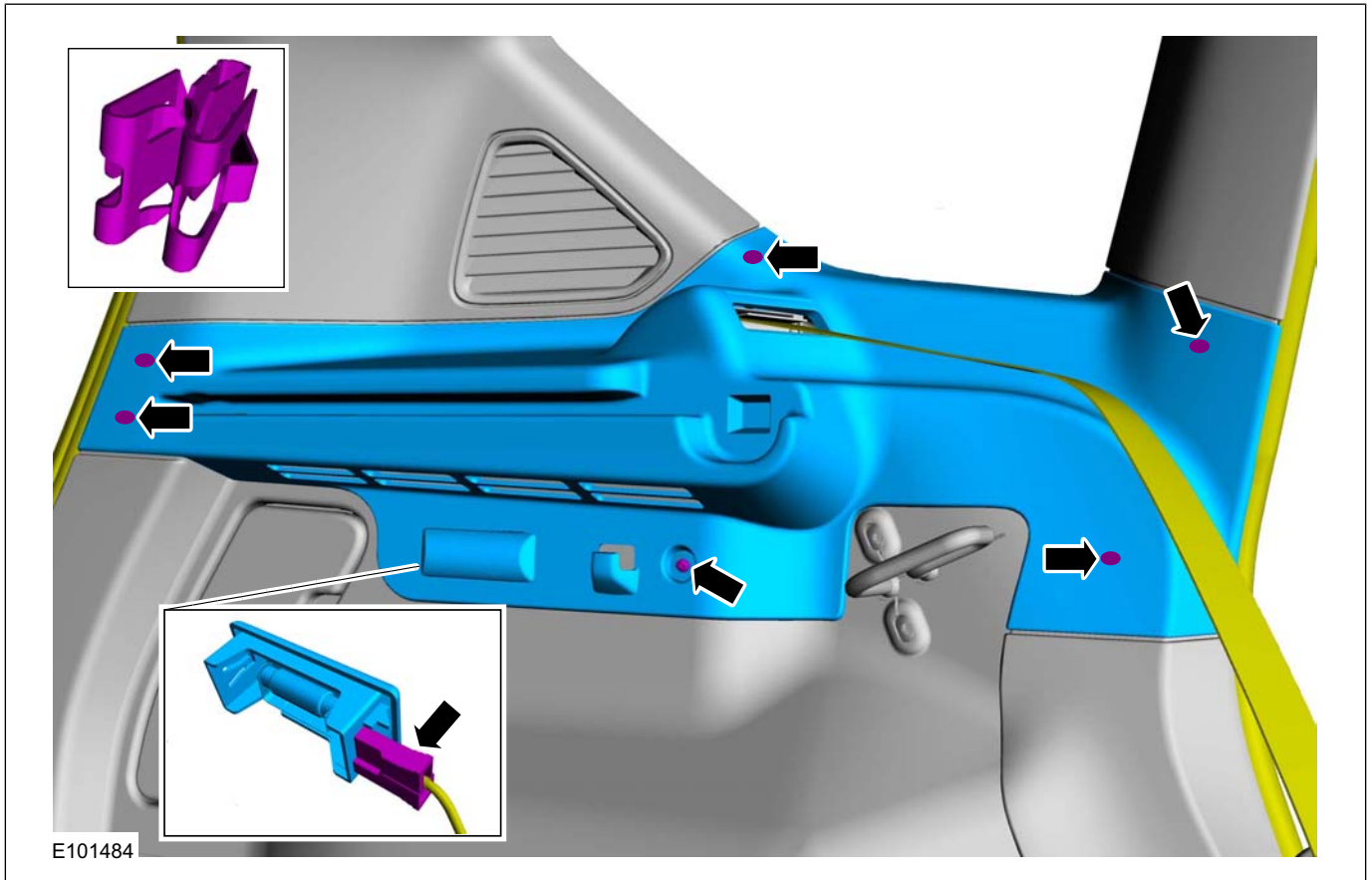
501-05-8

Interior Trim and Ornamentation

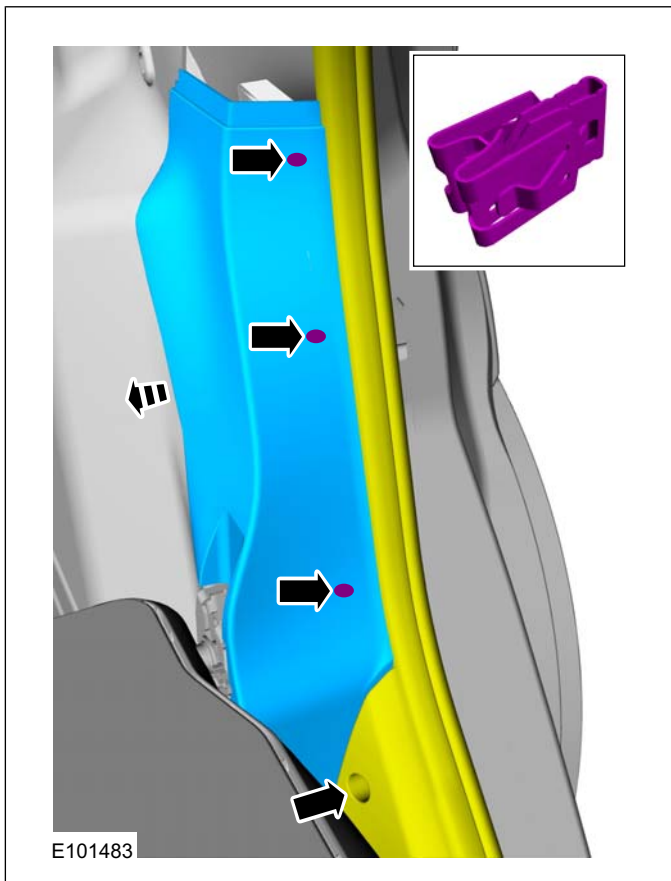
501-05-8



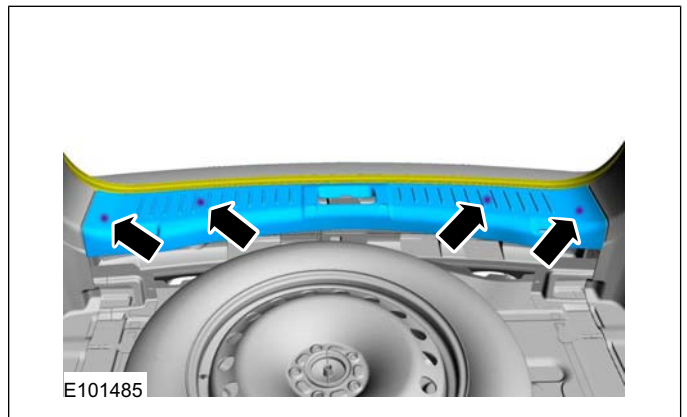
REMOVAL AND INSTALLATION



5.



6.



7.



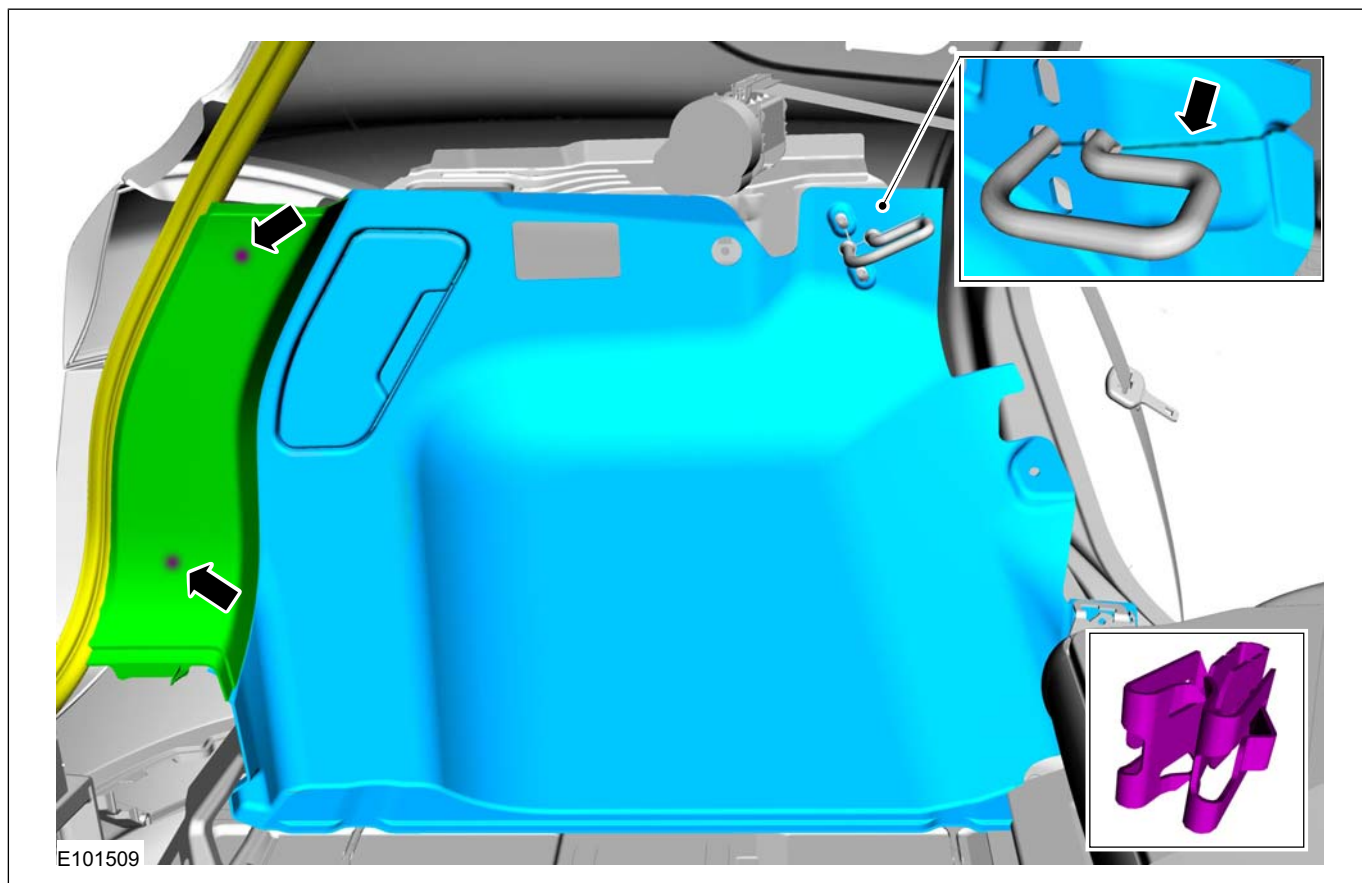


501-05-9

Interior Trim and Ornamentation

501-05-9

## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.



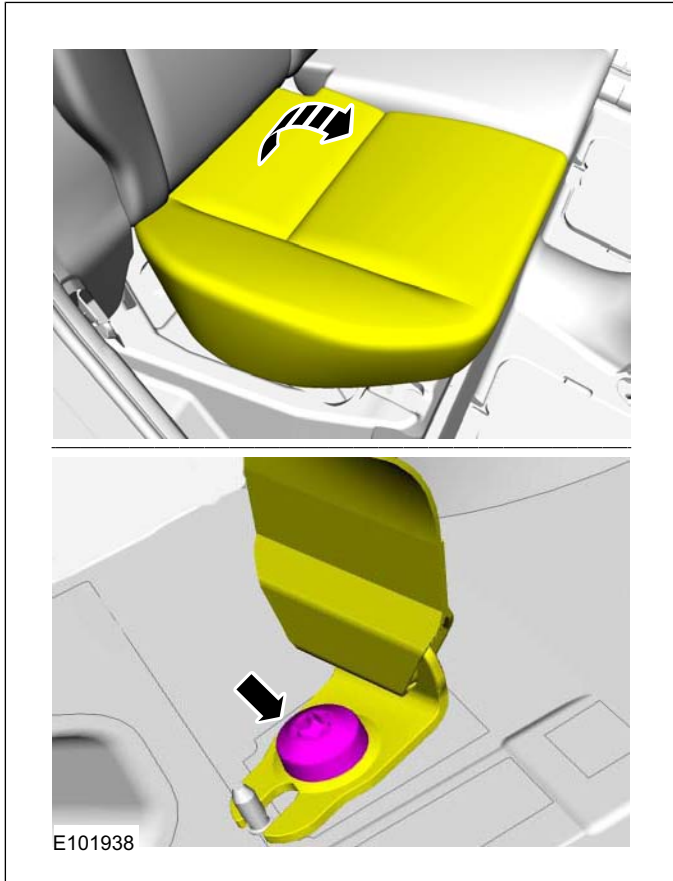
REMOVAL AND INSTALLATION

Loadspace Trim Panel RH

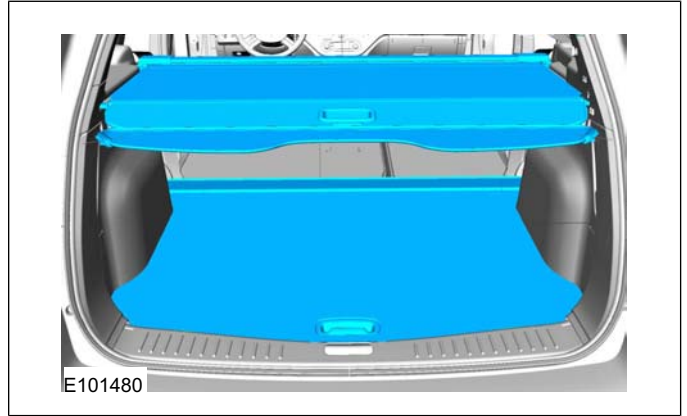
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

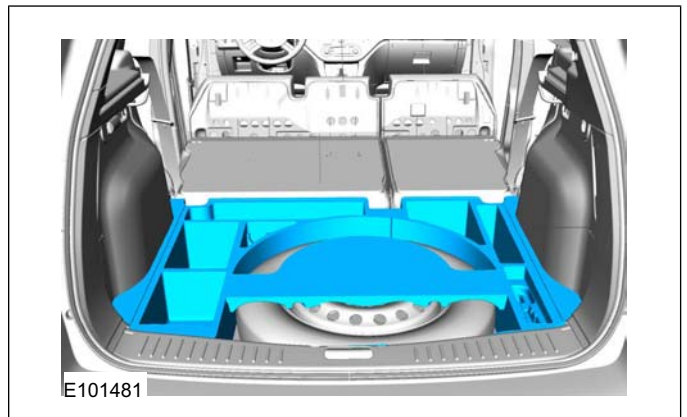
1. Torque: 35 Nm



2.



3.

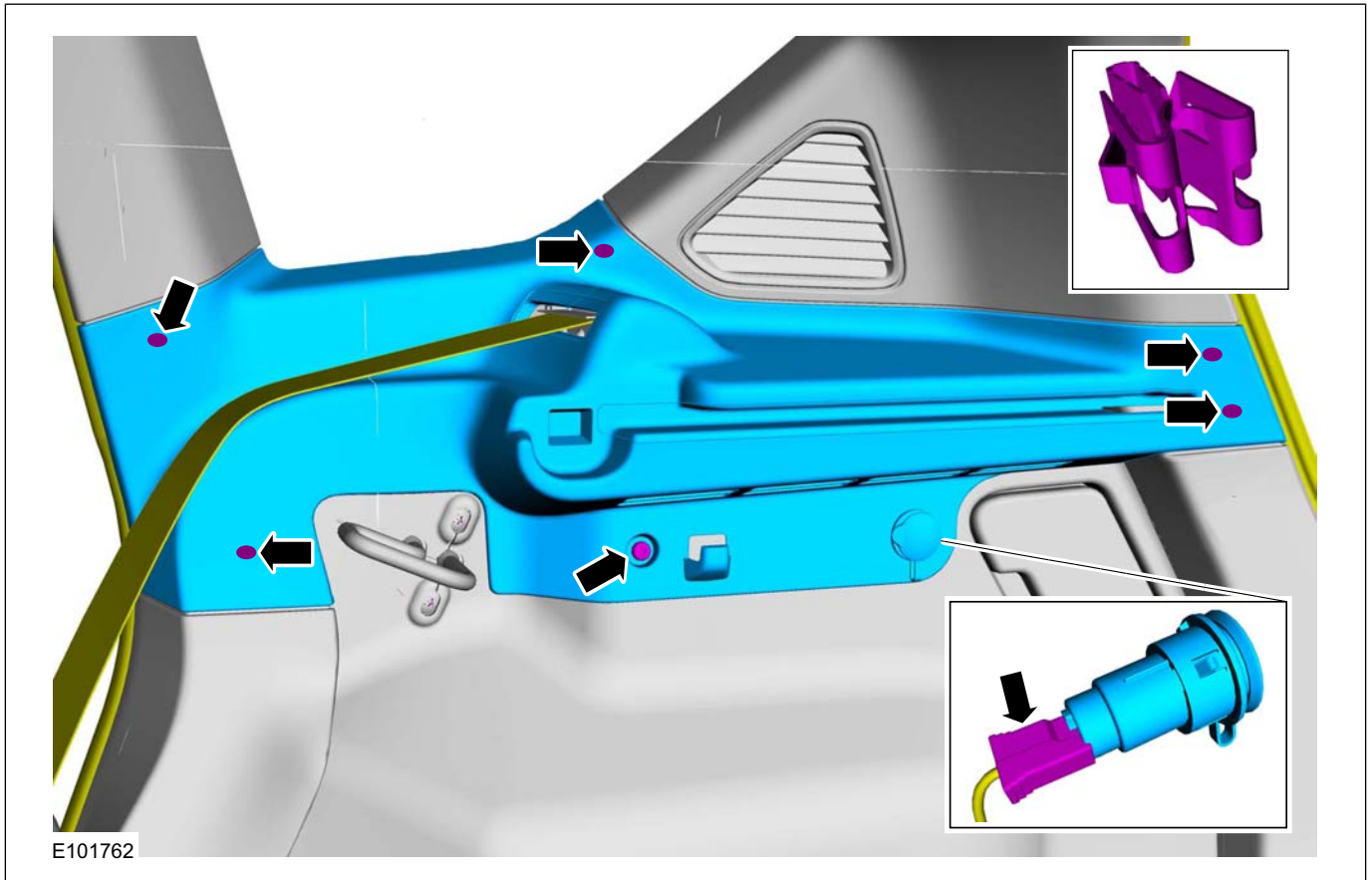


4.

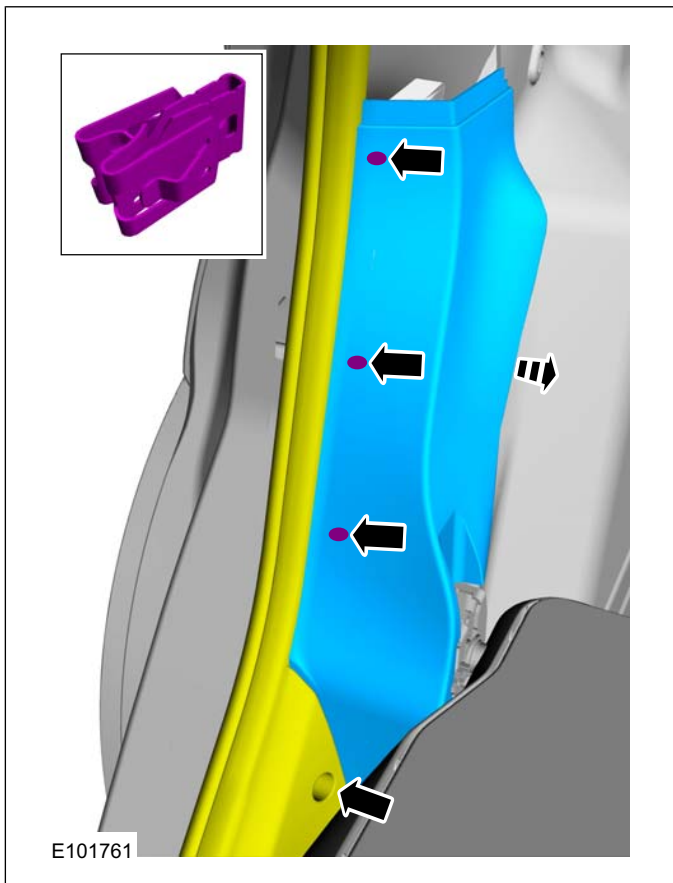




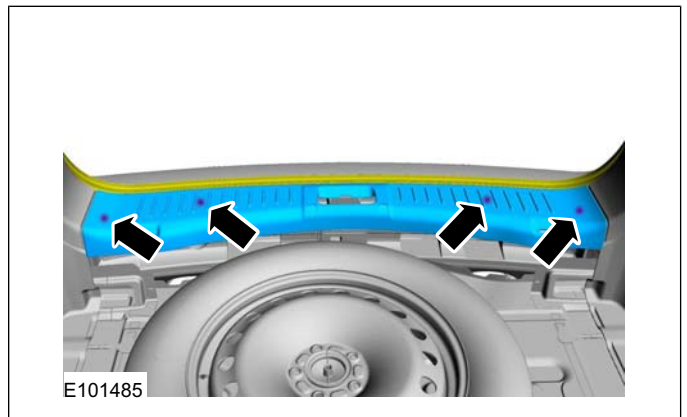
REMOVAL AND INSTALLATION



5.



6.



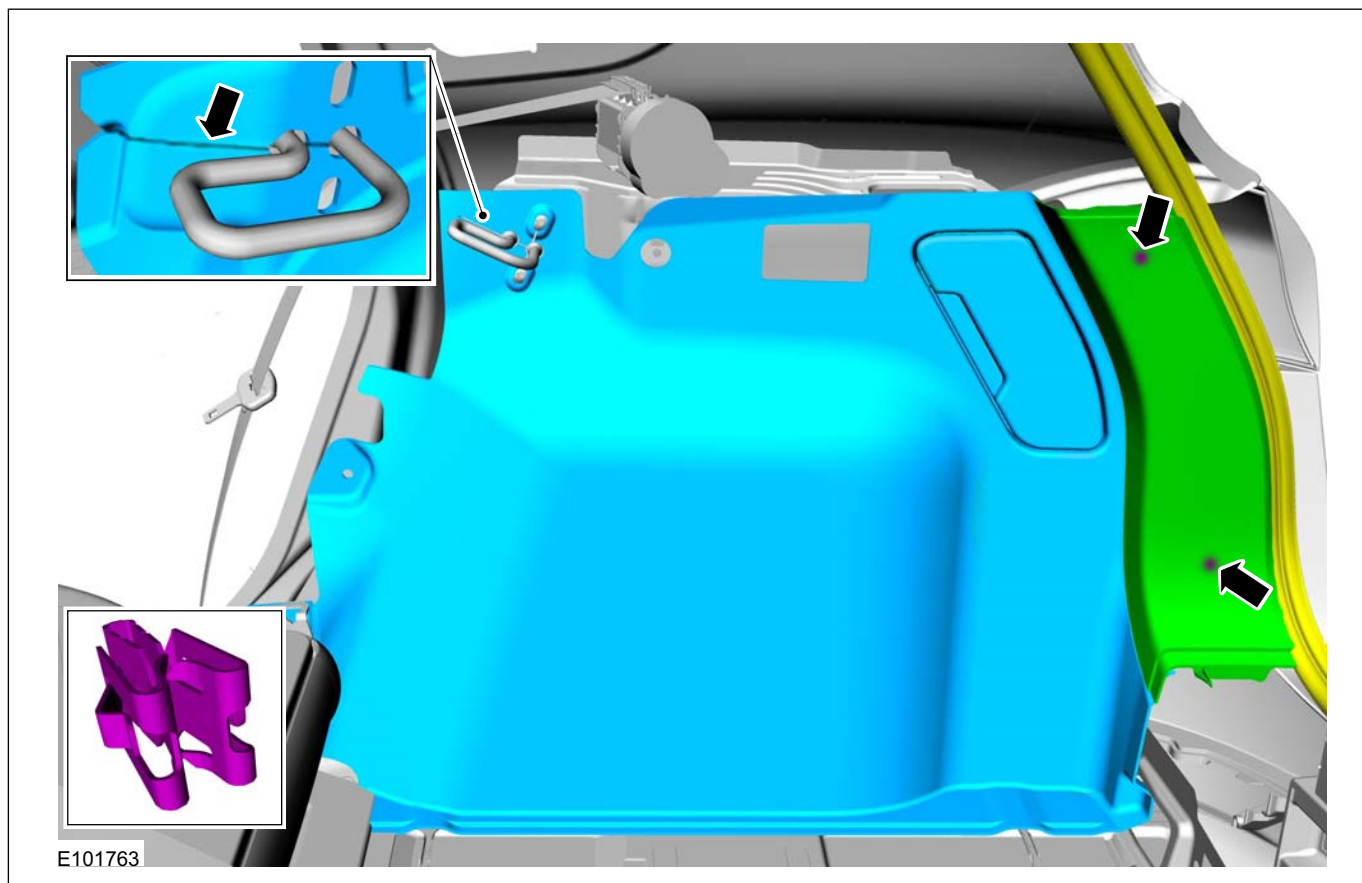
7.

501-05-12

Interior Trim and Ornamentation

501-05-12

## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.

501-05-13

Interior Trim and Ornamentation

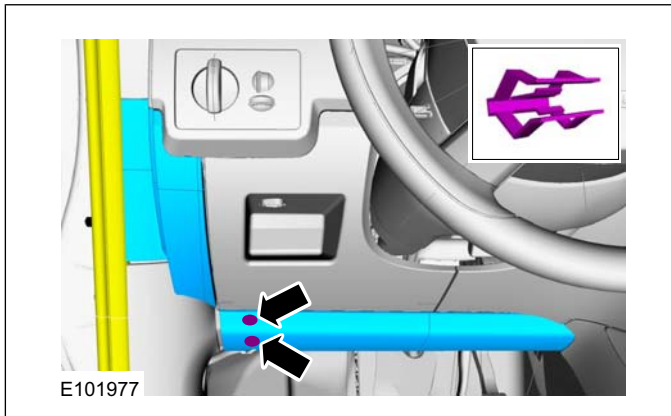
501-05-13

## REMOVAL AND INSTALLATION

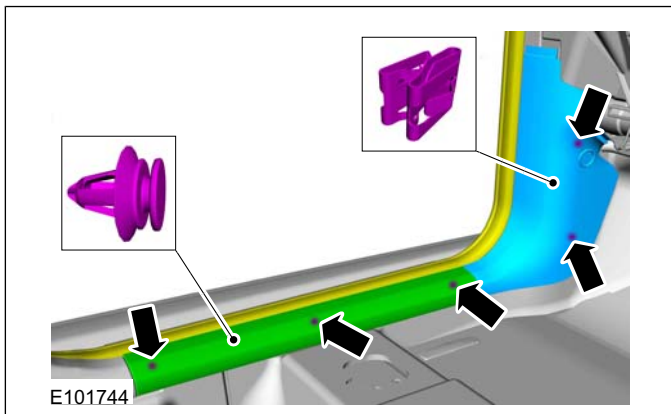
## Front Scuff Plate Trim Panel

## Removal

1.



2.



## Installation

1. To install, reverse the removal procedure.

501-05-14

Interior Trim and Ornamentation

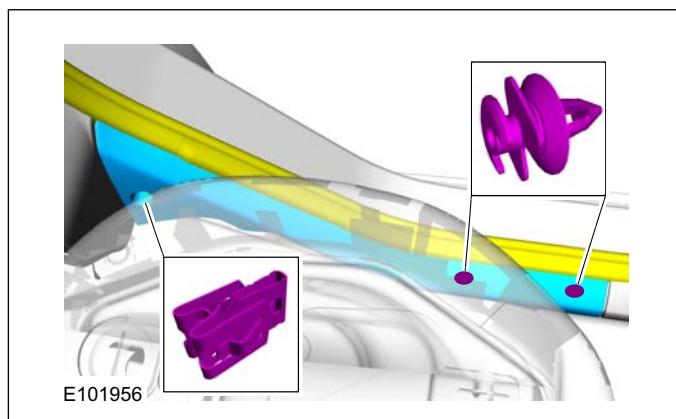
501-05-14

## REMOVAL AND INSTALLATION

## Rear Scuff Plate Trim Panel

## Removal

1.



## Installation

1. To install, reverse the removal procedure.



REMOVAL AND INSTALLATION

Headliner

General Equipment

Flat-bladed screwdriver

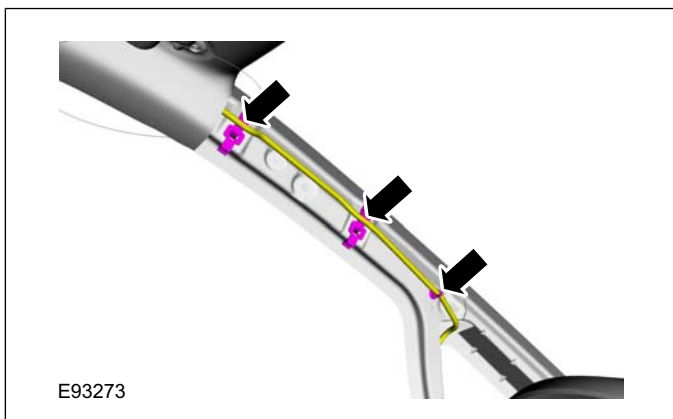
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

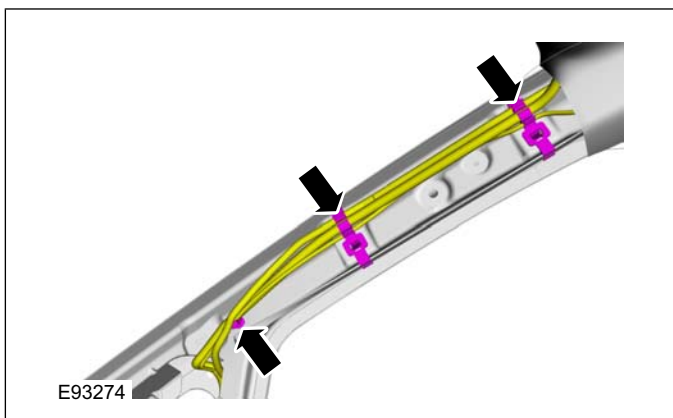
1. All.

Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

2. **NOTE:** Make sure that new clips are installed.



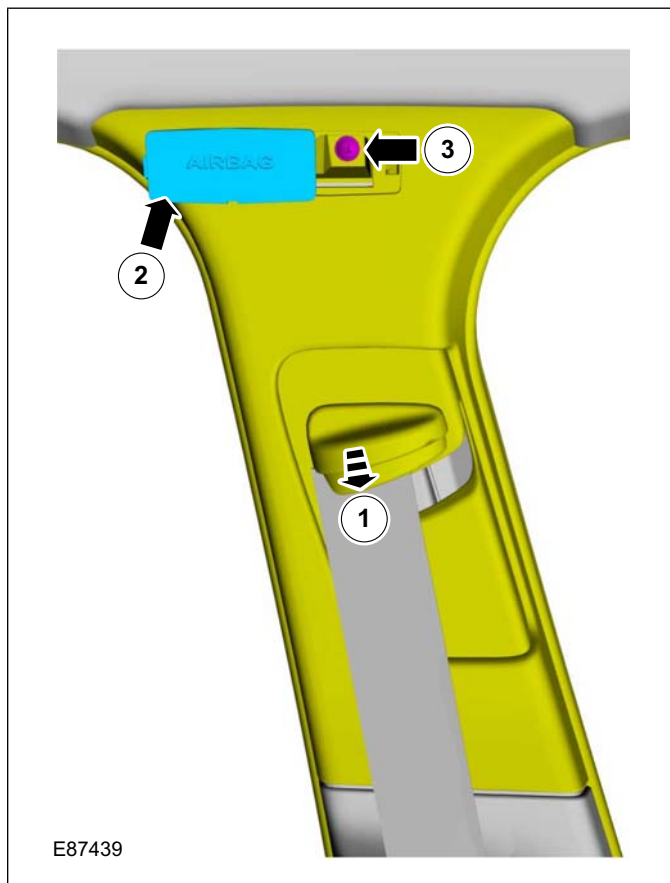
3. **NOTE:** Make sure that new clips are installed.



General Equipment

Hot Glue Gun

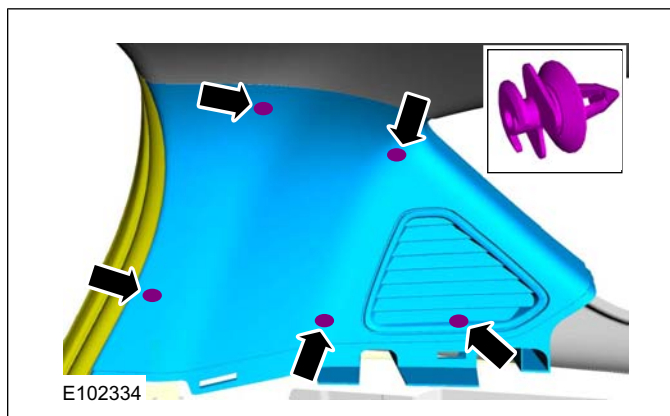
4. All.



5. All.

Refer to: **C-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

6. All.



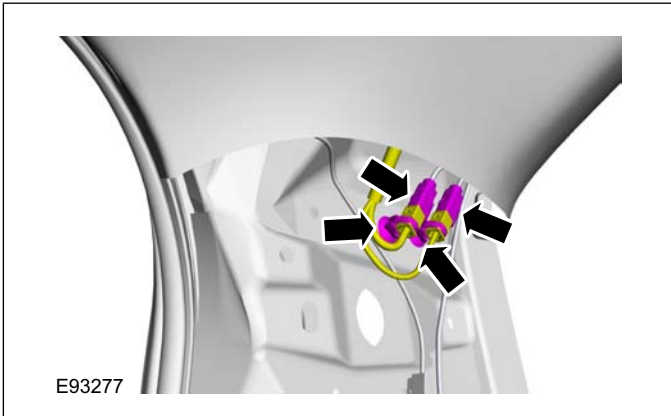
501-05-16

Interior Trim and Ornamentation

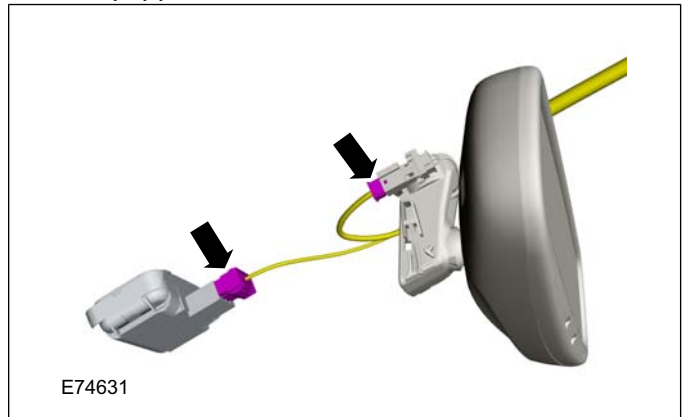
501-05-16

REMOVAL AND INSTALLATION

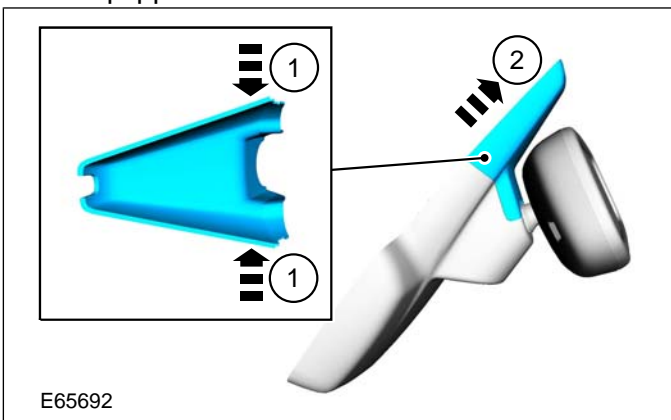
7. NOTE: Vehicles with glass roof panel



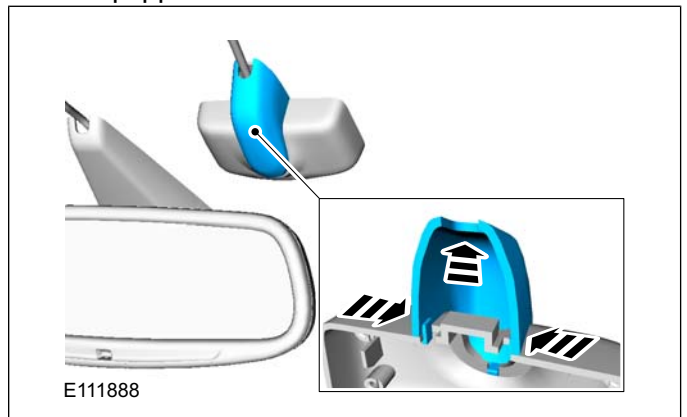
10. If equipped.



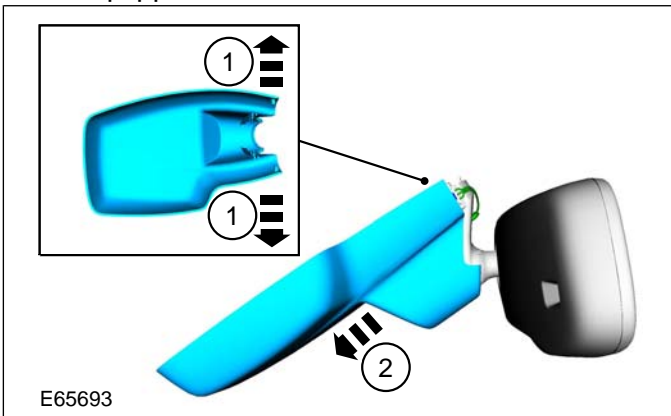
8. If equipped.



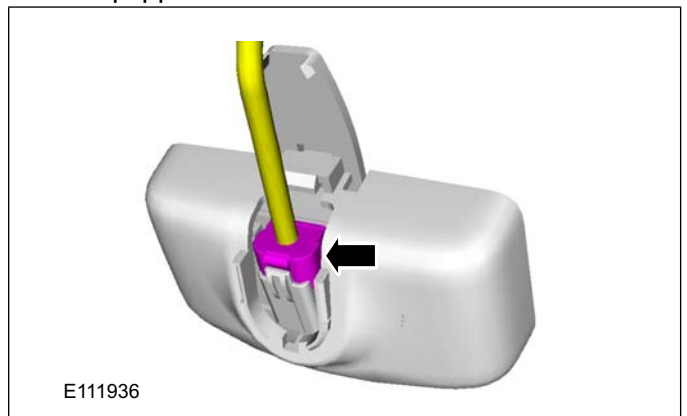
11. If equipped.



9. If equipped.



12. If equipped.

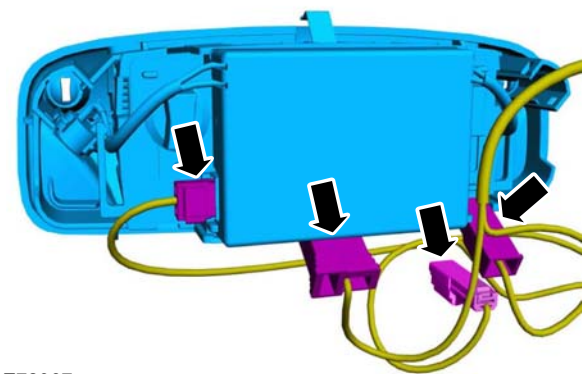
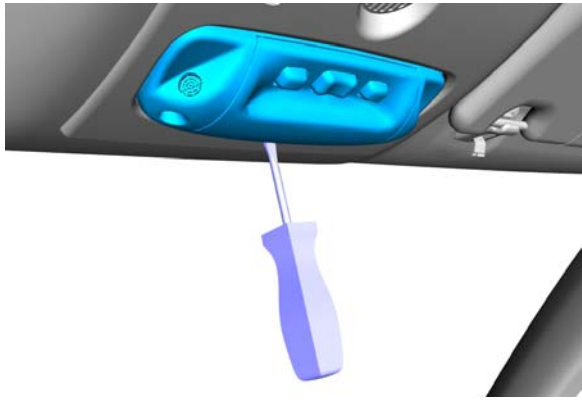






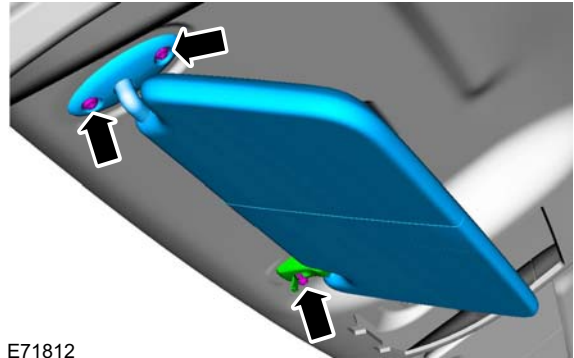
REMOVAL AND INSTALLATION

13. General Equipment: Flat-bladed screwdriver



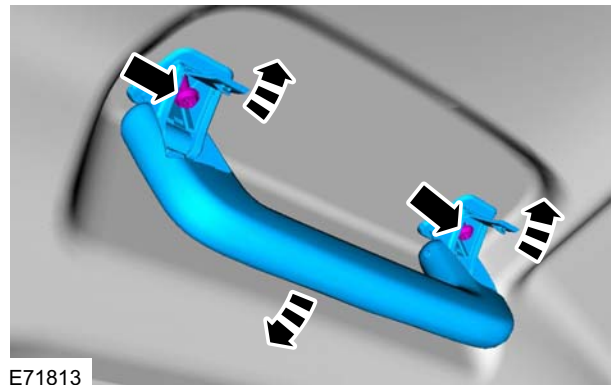
E72967

15. All.



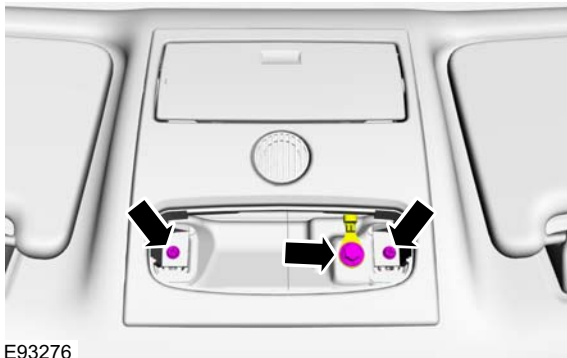
E71812

16. All.



E71813

14.



E93276

17. NOTE: Make sure that new clips are installed.



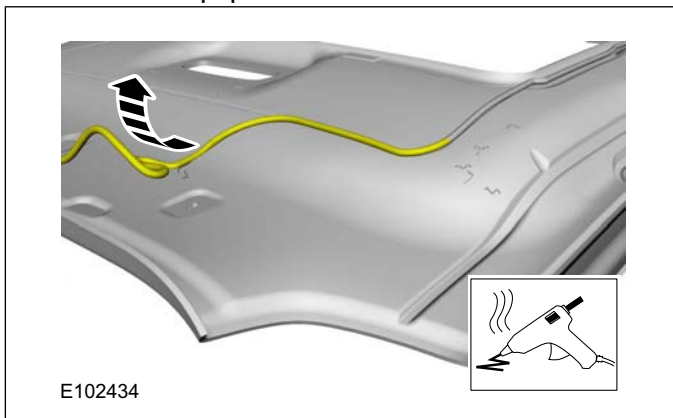


REMOVAL AND INSTALLATION



18. General Equipment: Hot Glue Gun

19.

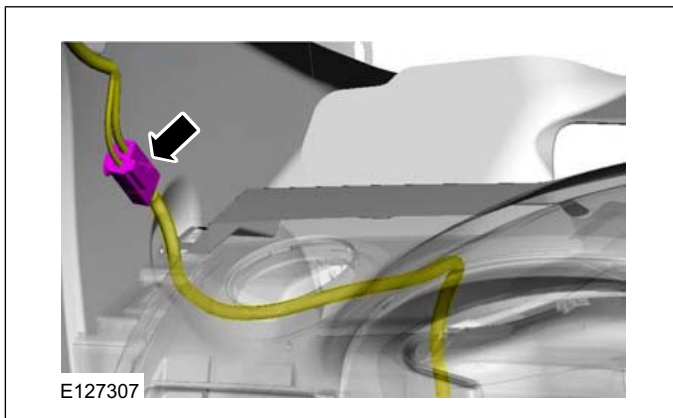




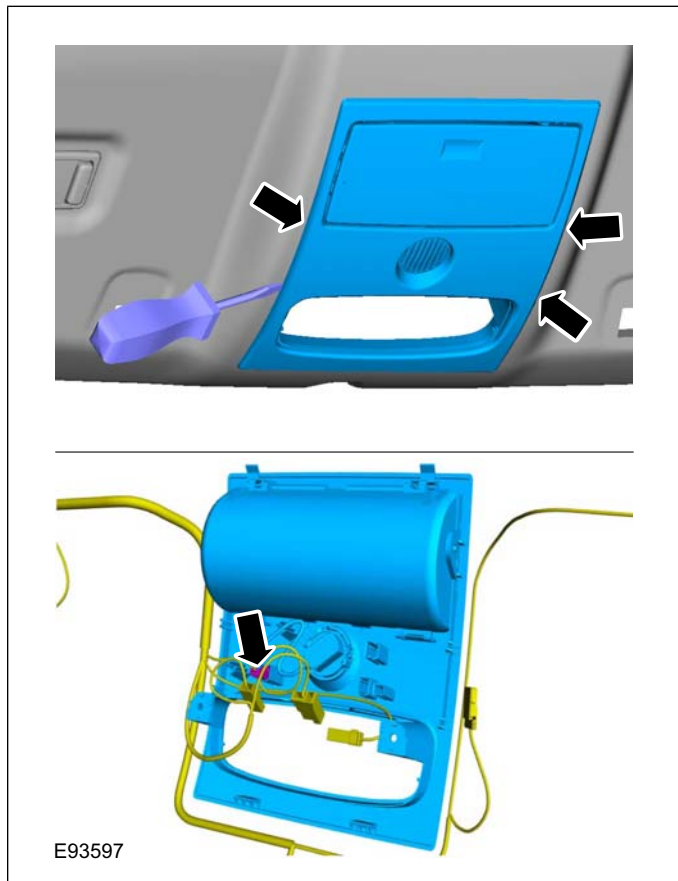
REMOVAL AND INSTALLATION



20.



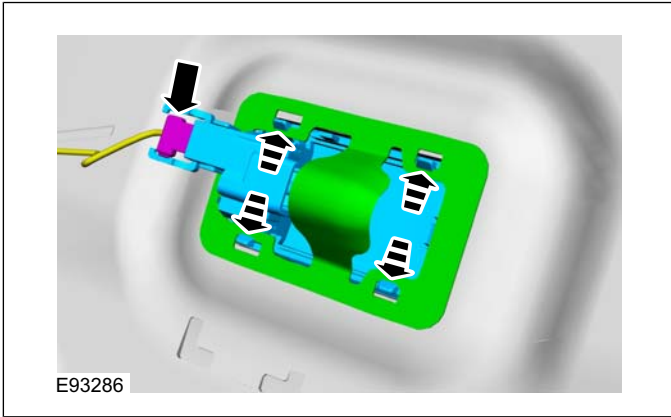
21.



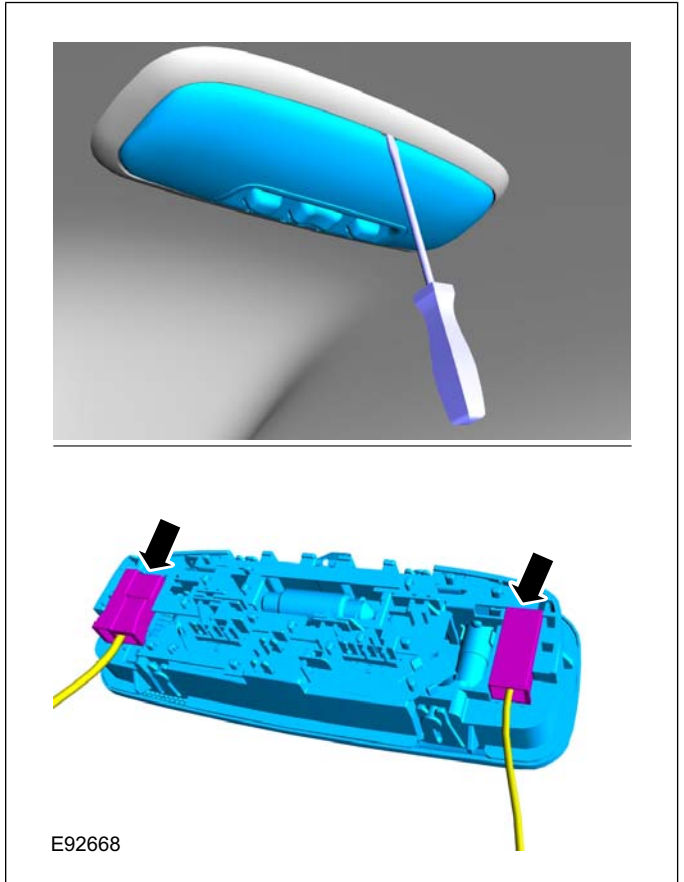


REMOVAL AND INSTALLATION

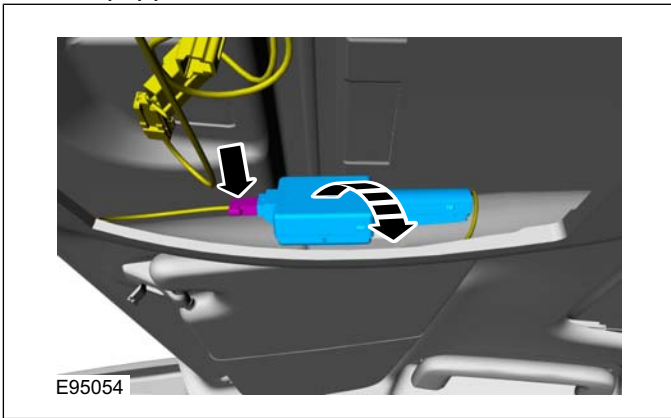
22. All.



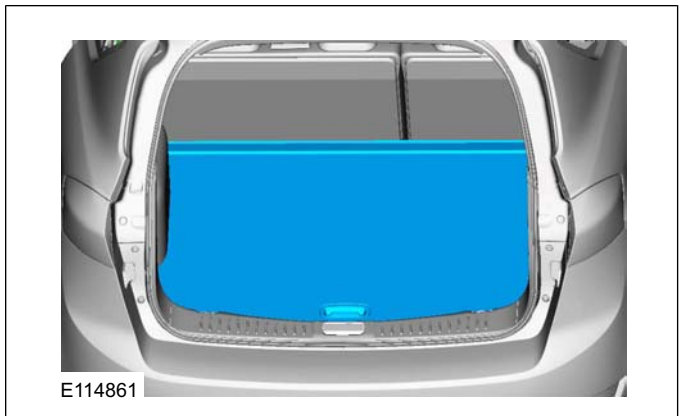
24.



23. If equipped.



25.

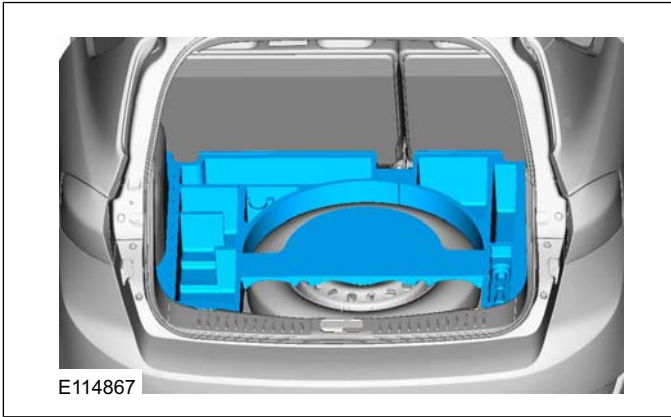




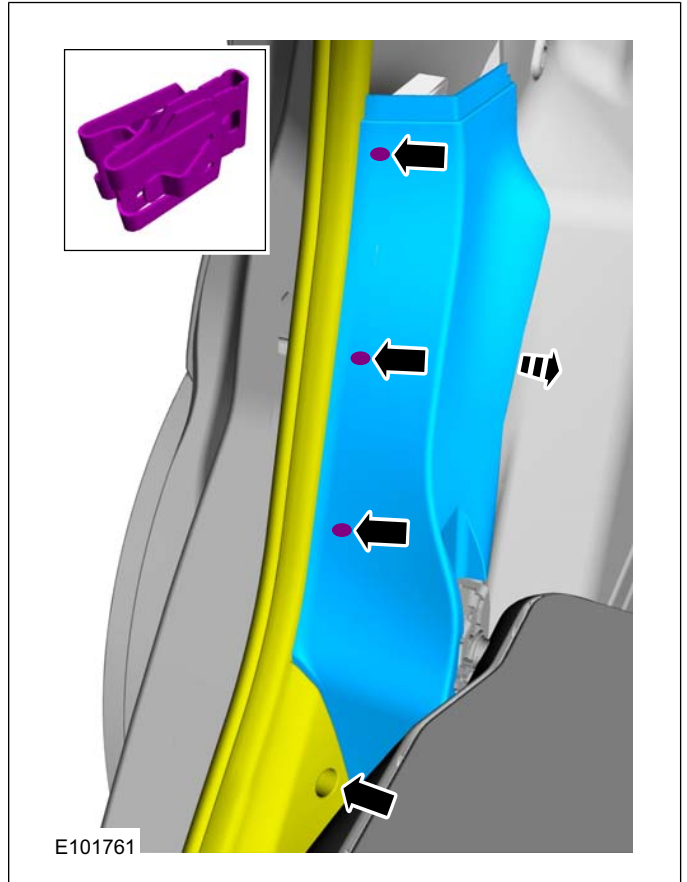


REMOVAL AND INSTALLATION

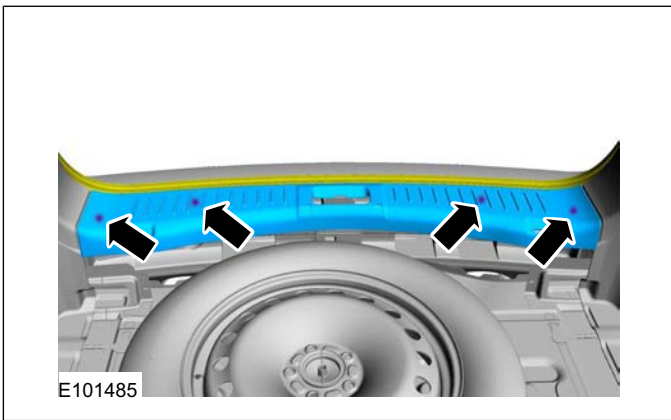
26.



29.



27.

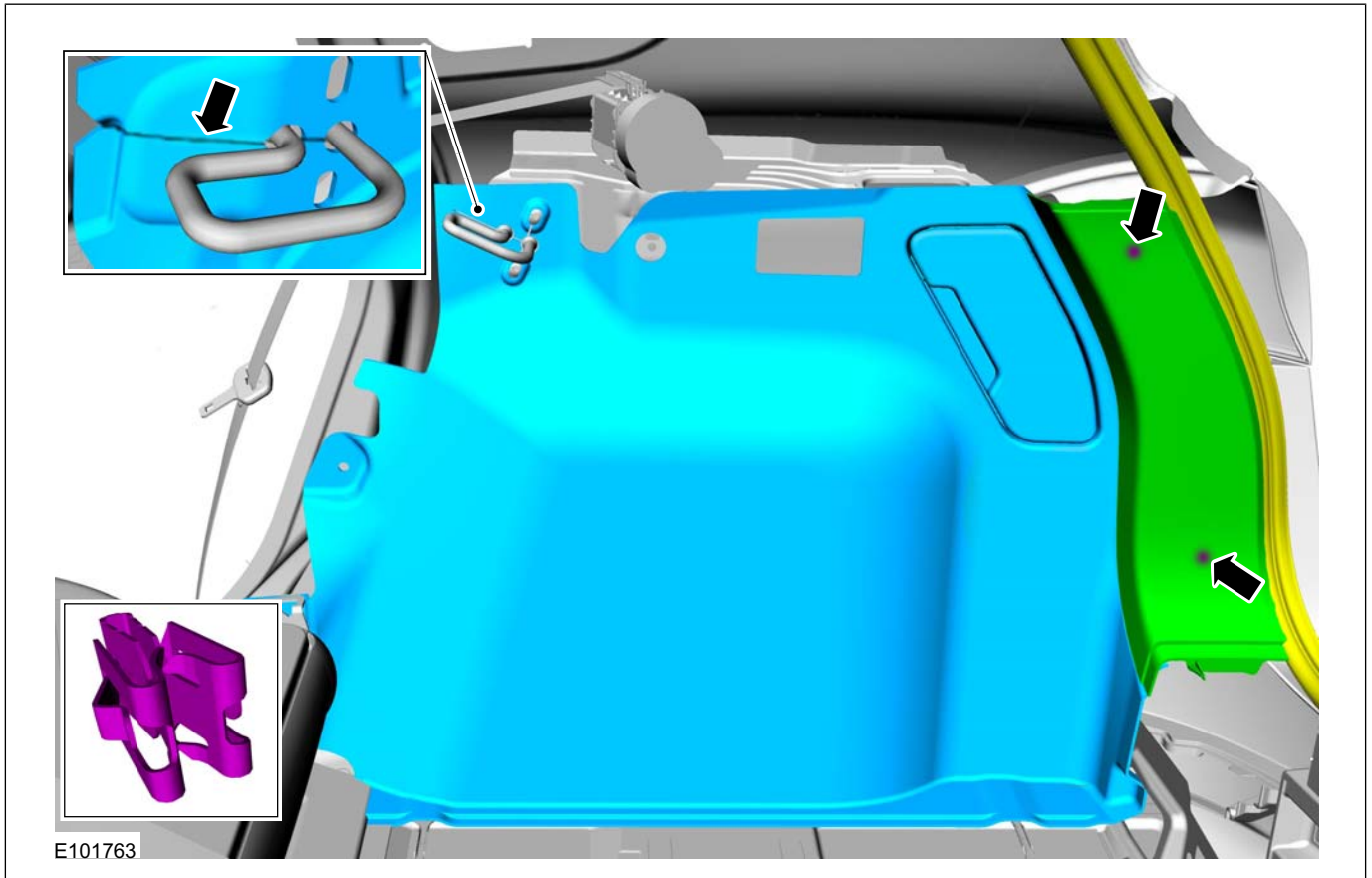


28. Fold the rear seat backrests.

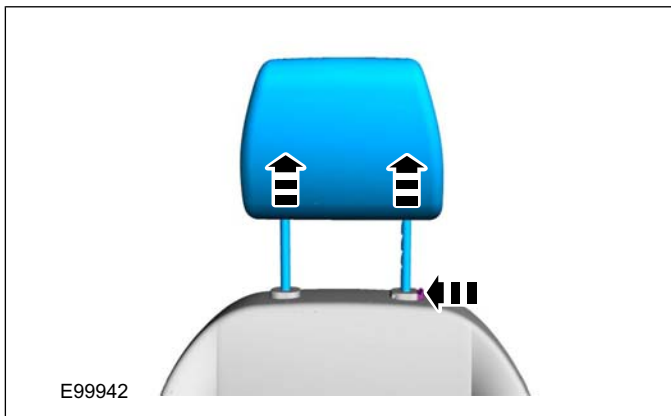
30.



REMOVAL AND INSTALLATION



31. On both sides.



32. Fold the front seat backrests rearward.

Vehicles without glass roof panel

33. **NOTE:** Left-hand drive vehicles.

**NOTE:** Note the position of each component before removal.

General Equipment: Hot Glue Gun

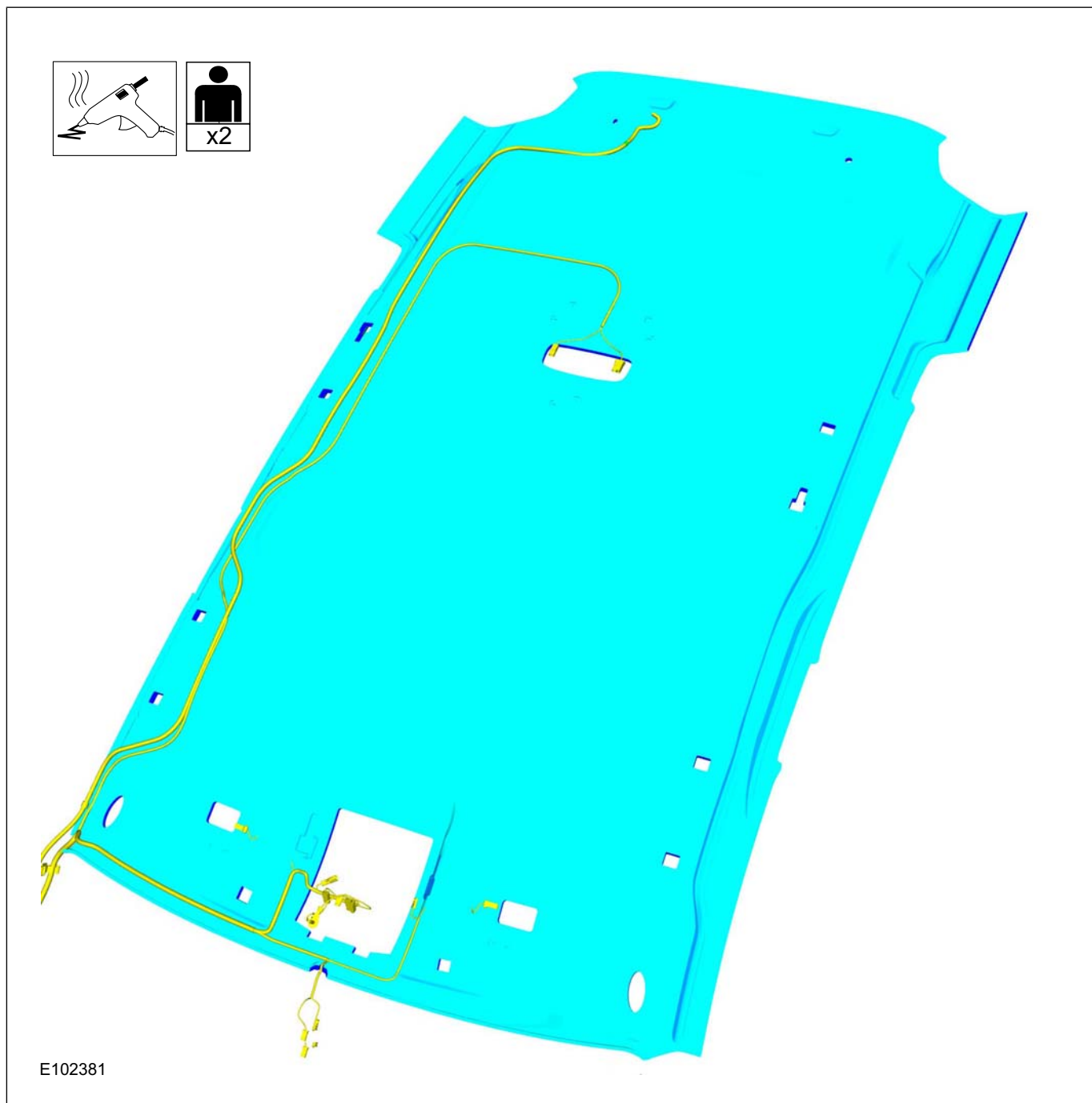


501-05-23

Interior Trim and Ornamentation

501-05-23

## REMOVAL AND INSTALLATION



**34. NOTE:** Right-hand drive vehicles.

**NOTE:** Note the position of each component before removal.

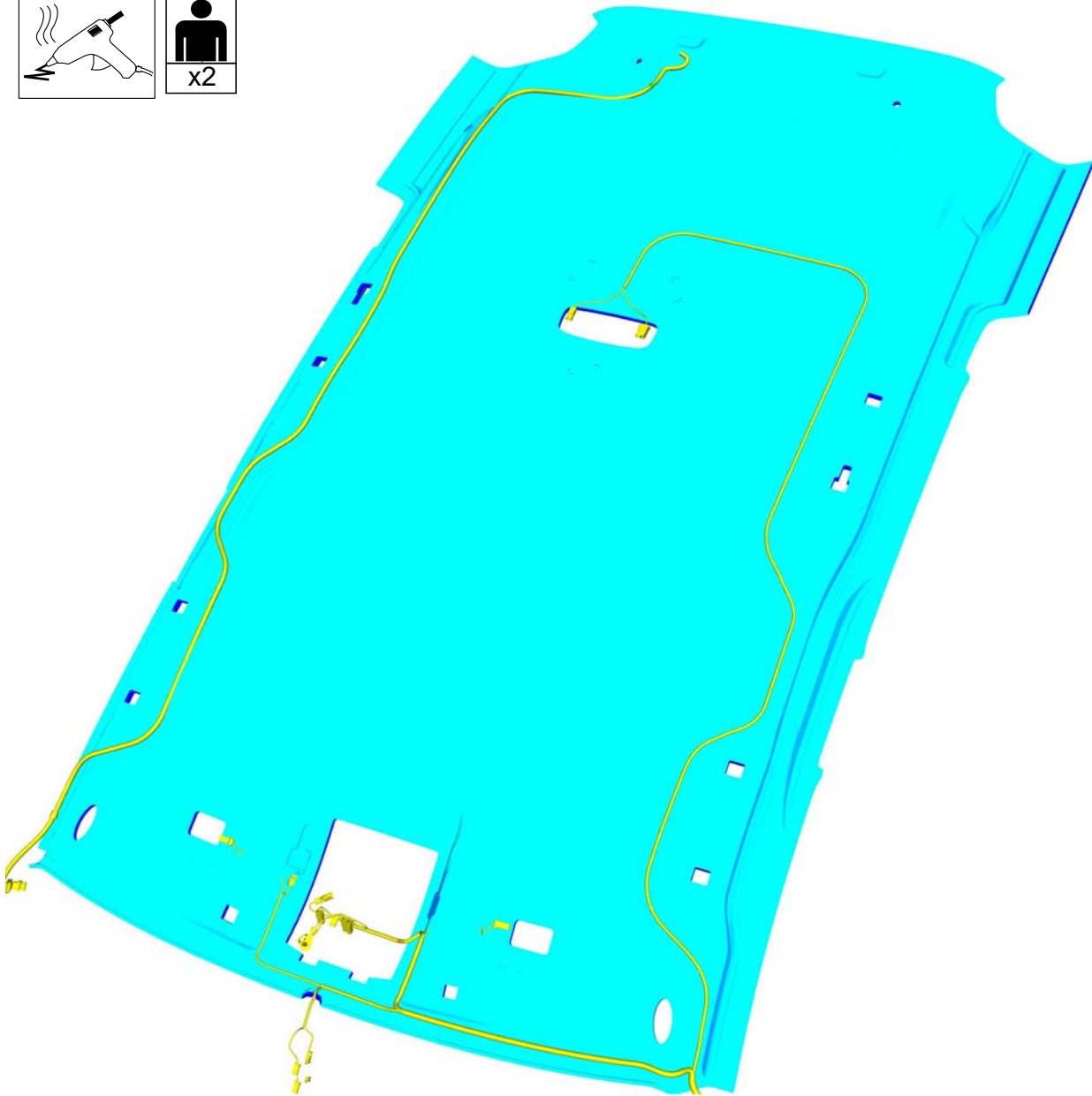
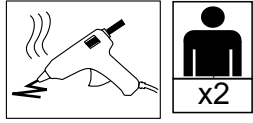
General Equipment: Hot Glue Gun

501-05-24

Interior Trim and Ornamentation

501-05-24

## REMOVAL AND INSTALLATION



E102384

Vehicles with glass roof panel

**35. NOTE:** Left-hand drive vehicles.**NOTE:** Note the position of each component before removal.

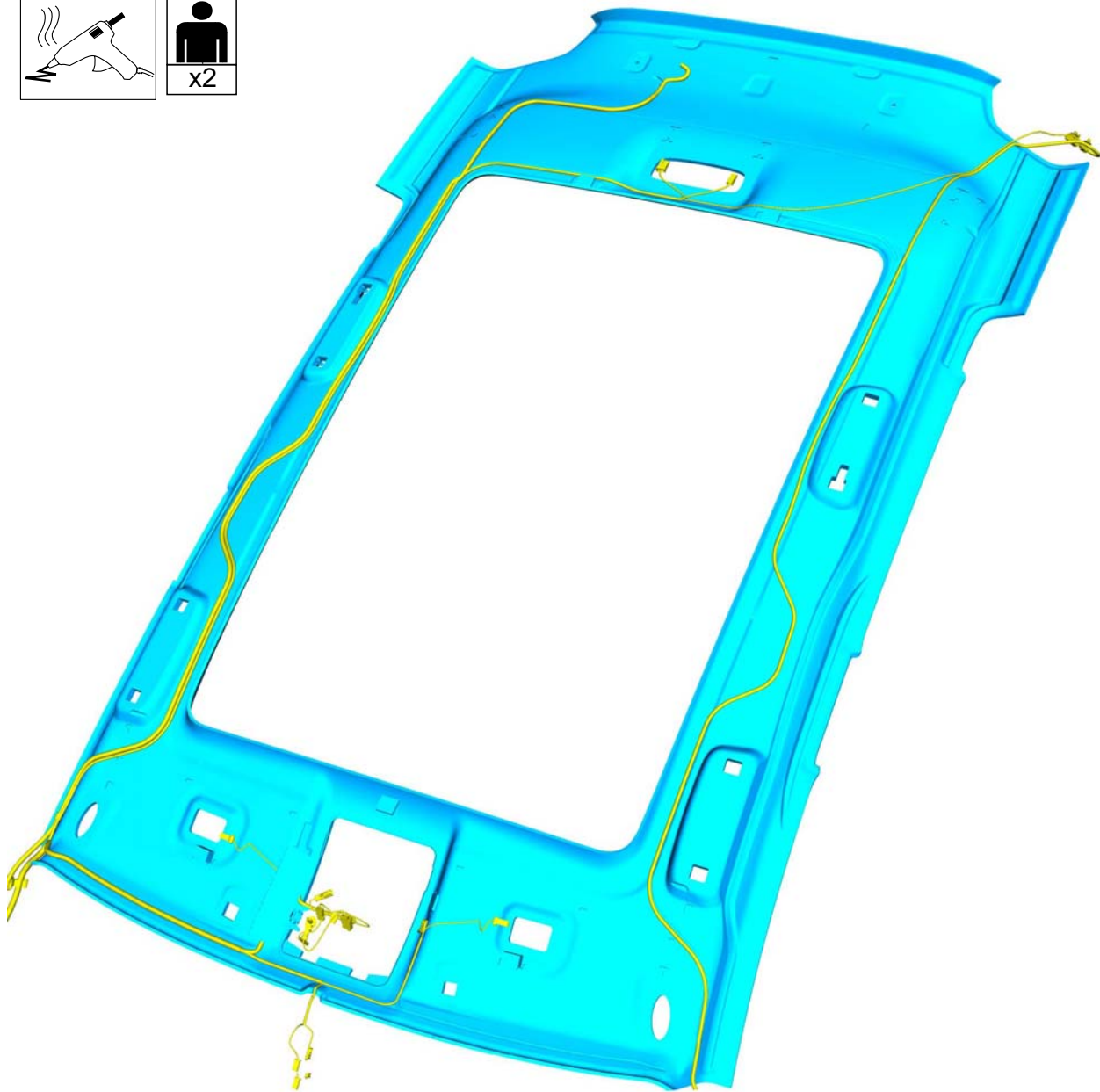
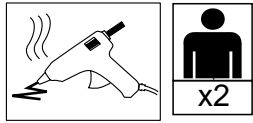
General Equipment: Hot Glue Gun

501-05-25

Interior Trim and Ornamentation

501-05-25

## REMOVAL AND INSTALLATION



E102382

**36. NOTE:** Right-hand drive vehicles.**NOTE:** Note the position of each component before removal.

General Equipment: Hot Glue Gun



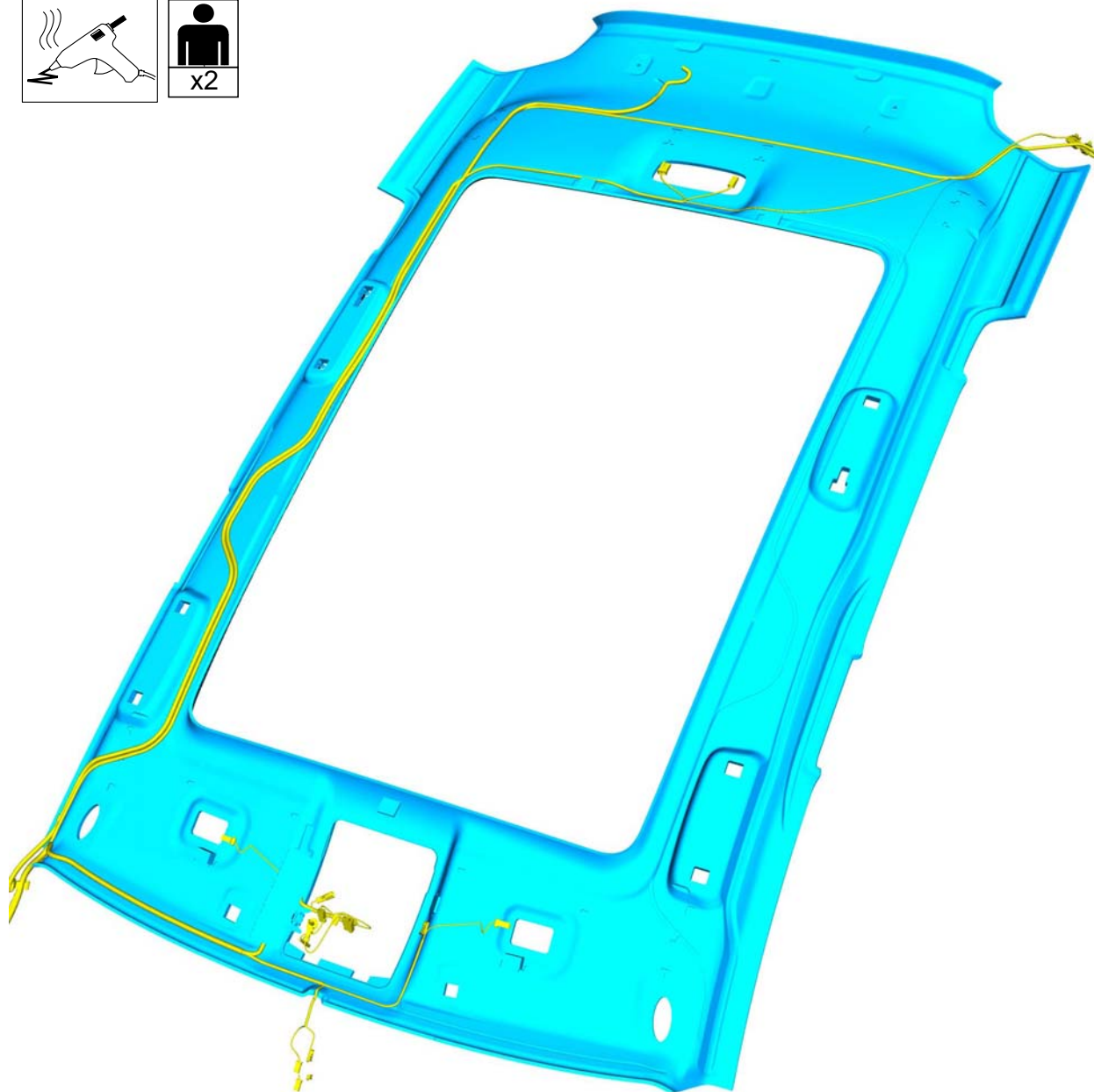
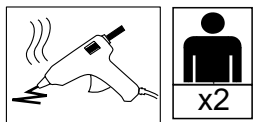
501-05-26

Interior Trim and Ornamentation

501-05-26



REMOVAL AND INSTALLATION



E102383



501-05-27

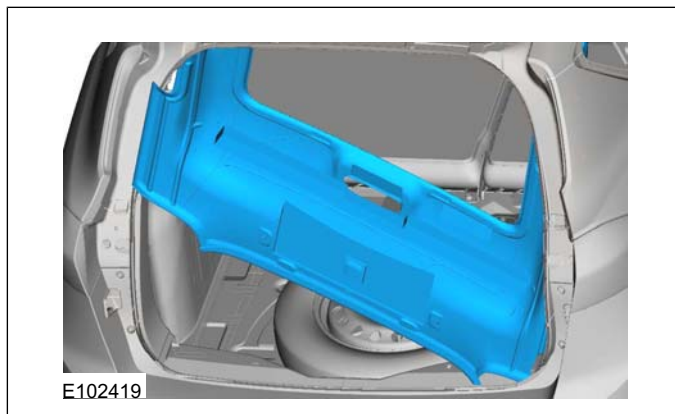
## Interior Trim and Ornamentation

501-05-27

## REMOVAL AND INSTALLATION

All vehicles

37.



## Installation

1. **NOTE:** Make sure that these components are installed to the noted removal position.  
To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Glass Roof Panel Blind(43 626 0)

General Equipment

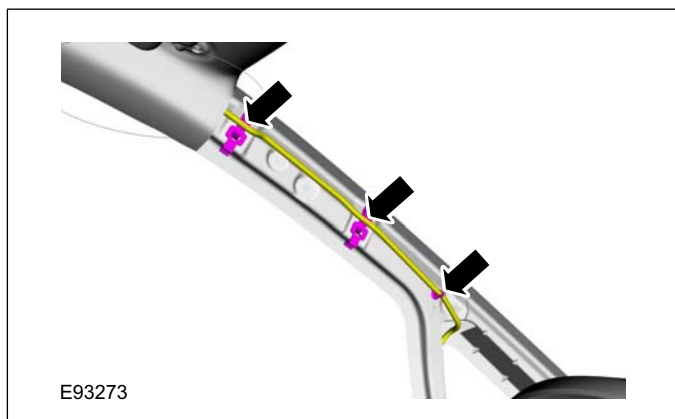
Flat-bladed screwdriver
Hot Glue Gun

Removal

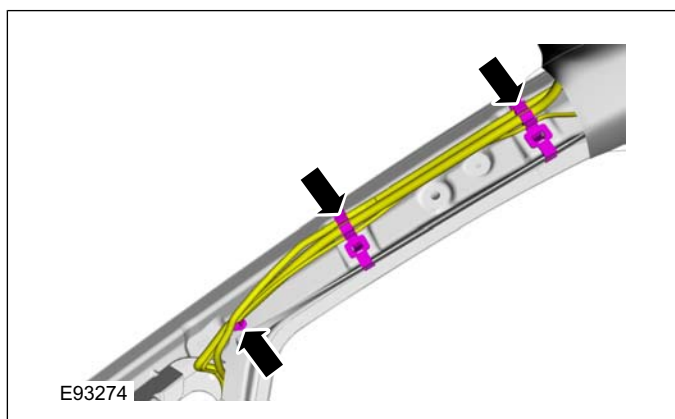
1. All.

Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

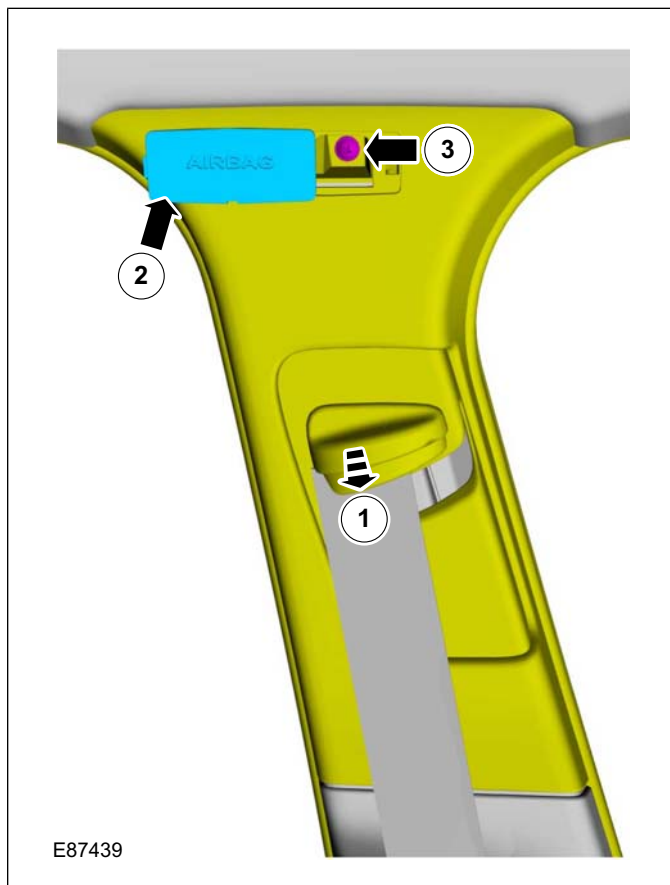
2. **NOTE:** Make sure that new clips are installed.



3. **NOTE:** Make sure that new clips are installed.



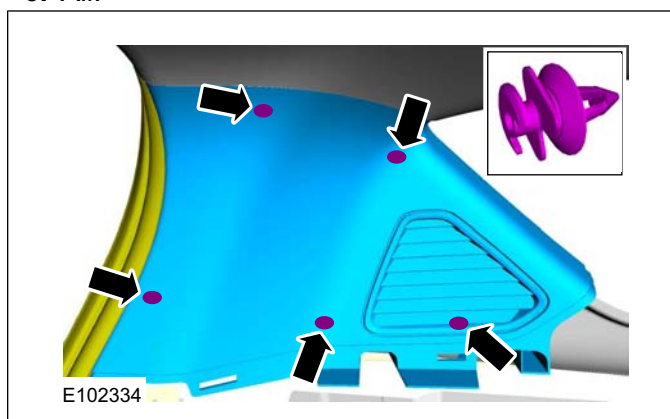
4. All.



5. All.

Refer to: **C-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

6. All.





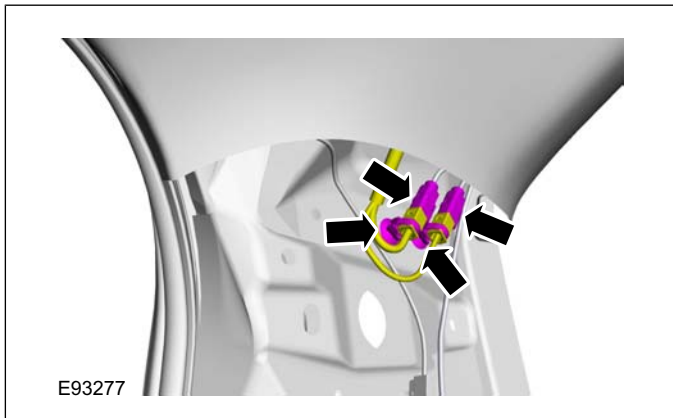
501-05-29

Interior Trim and Ornamentation

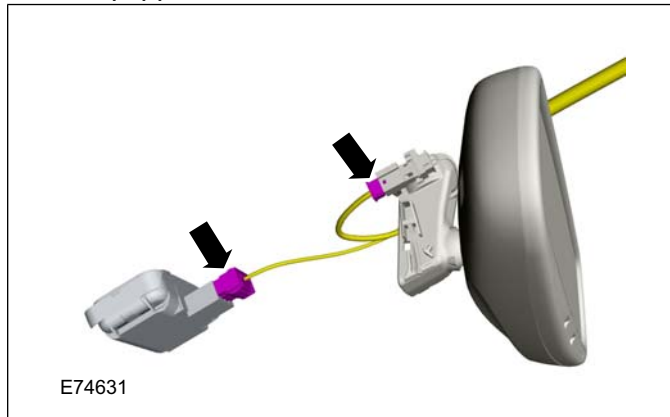
501-05-29

REMOVAL AND INSTALLATION

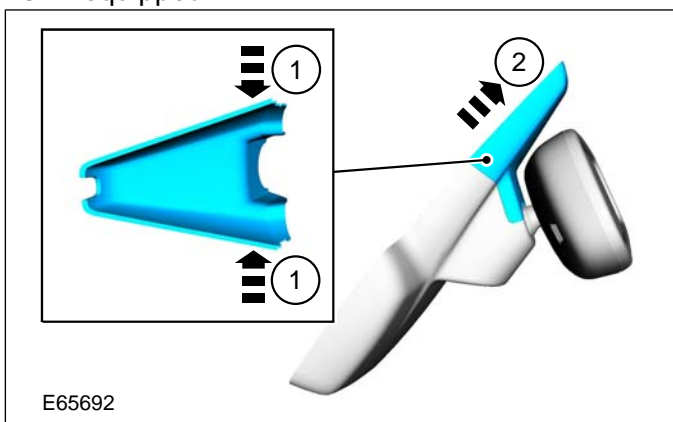
7. NOTE: Vehicles with glass roof panel



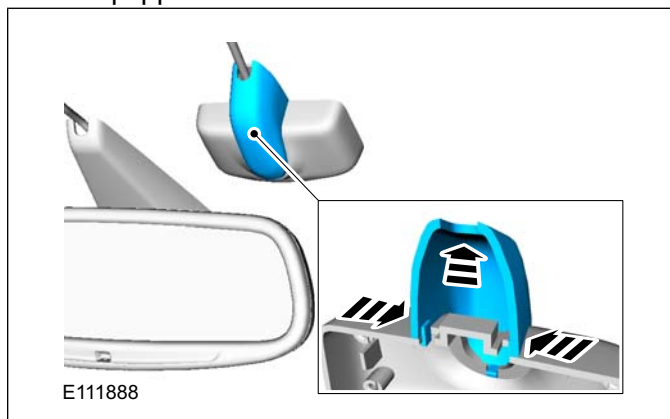
10. If equipped.



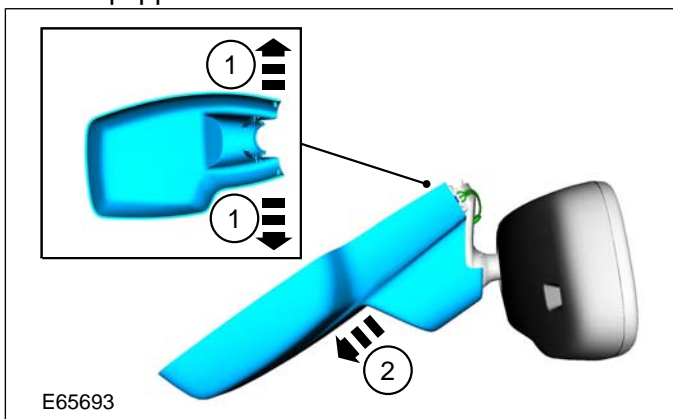
8. If equipped.



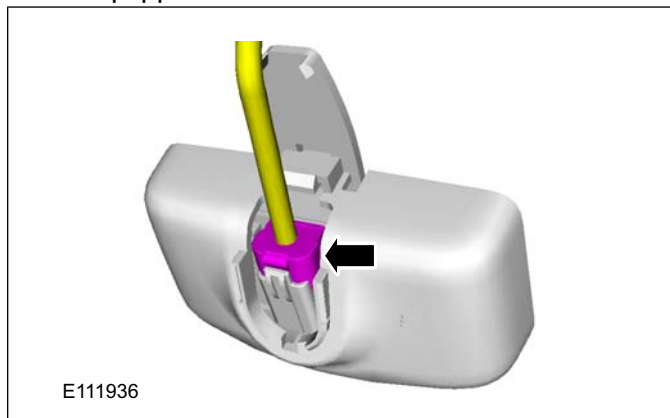
11. If equipped.



9. If equipped.



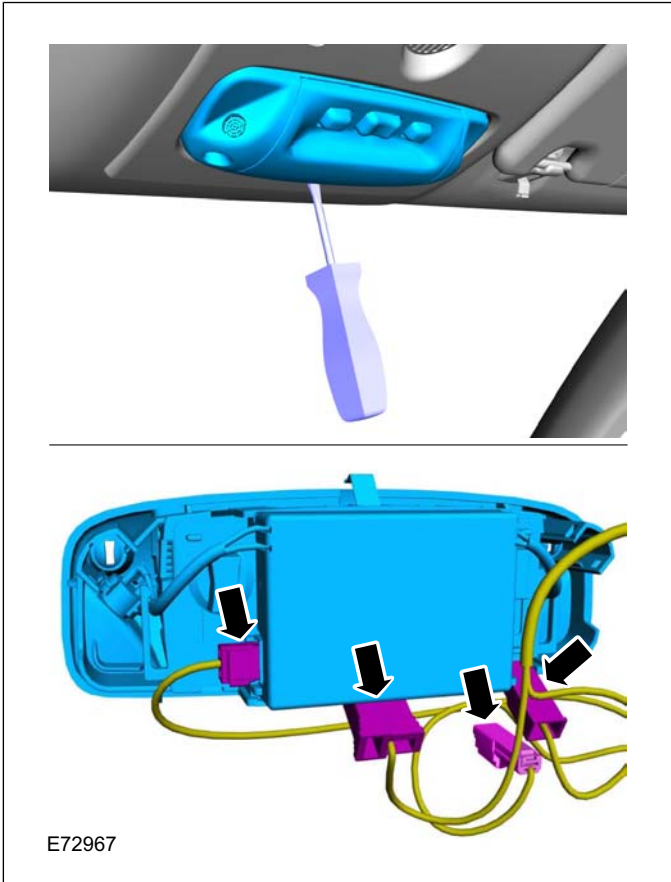
12. If equipped.



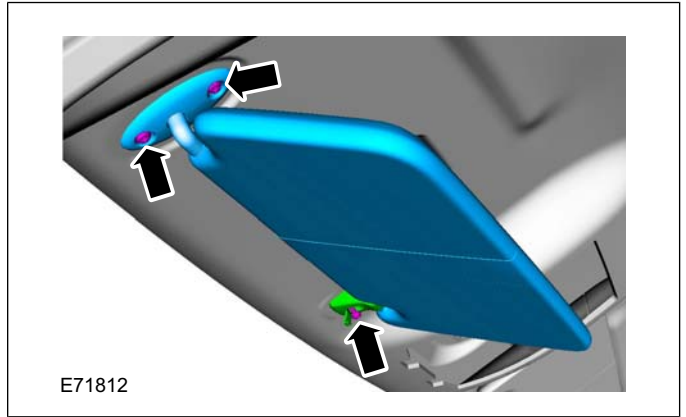


REMOVAL AND INSTALLATION

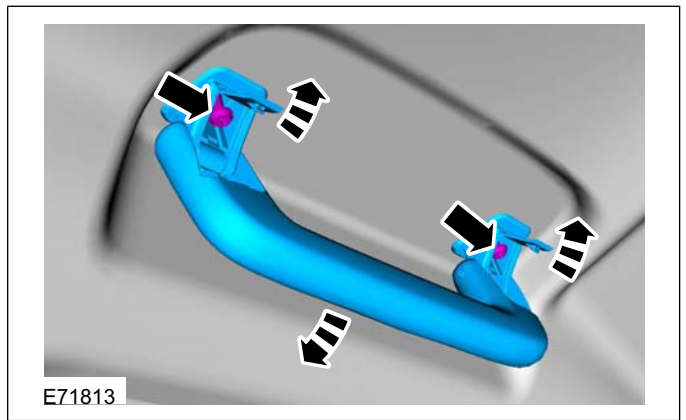
13. General Equipment: Flat-bladed screwdriver



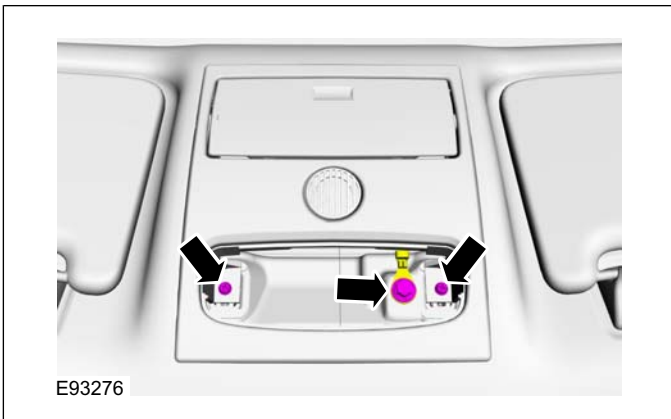
15. All.



16. All.



14.



17. NOTE: Make sure that new clips are installed.

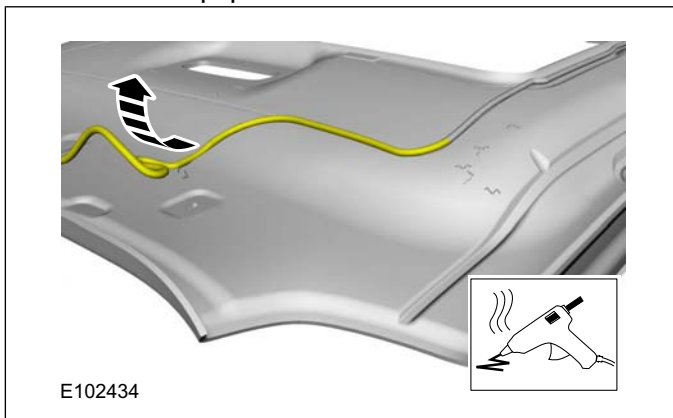




REMOVAL AND INSTALLATION



18. General Equipment: Hot Glue Gun



19.

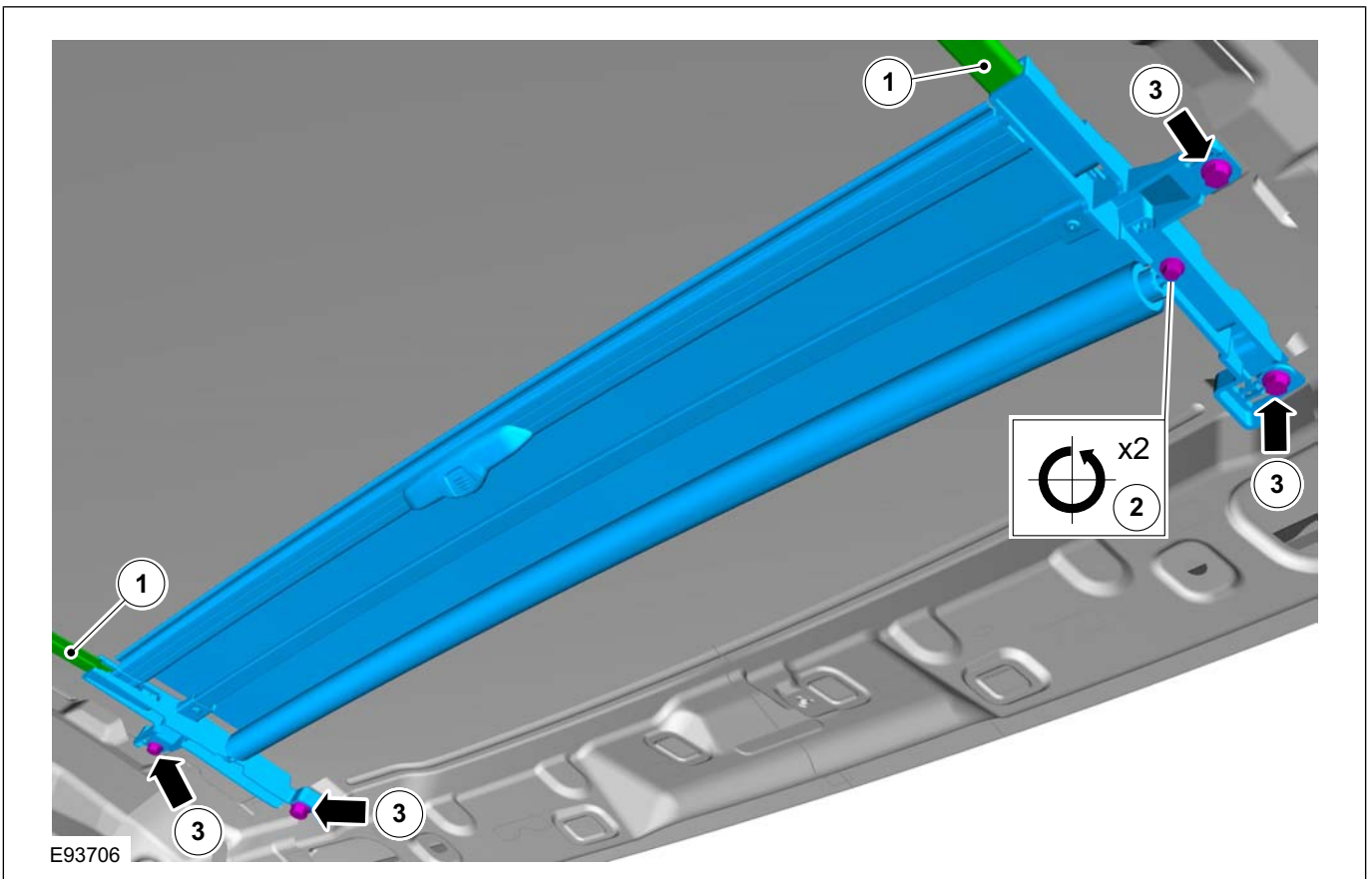




REMOVAL AND INSTALLATION



20.

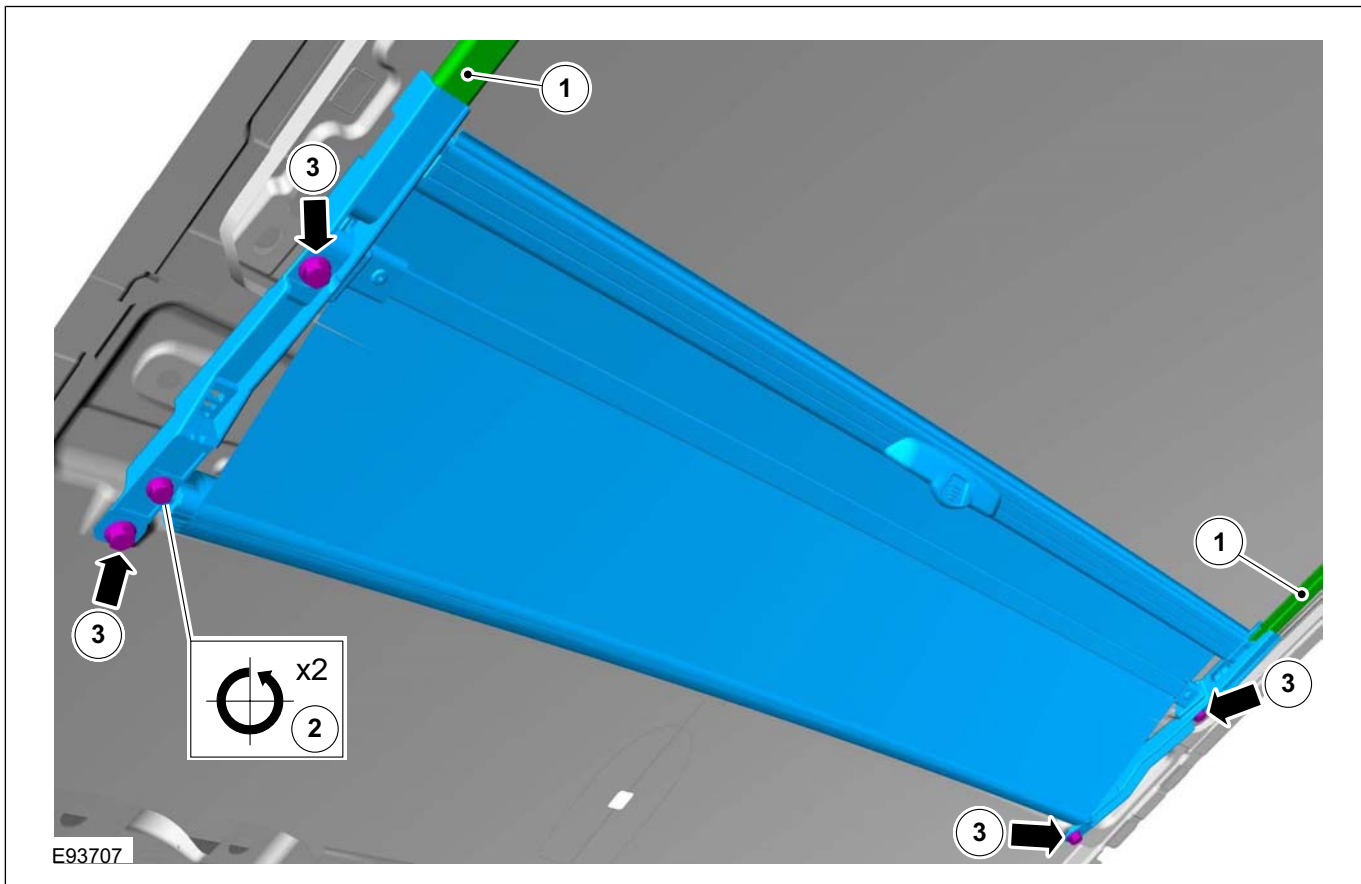






REMOVAL AND INSTALLATION

21.



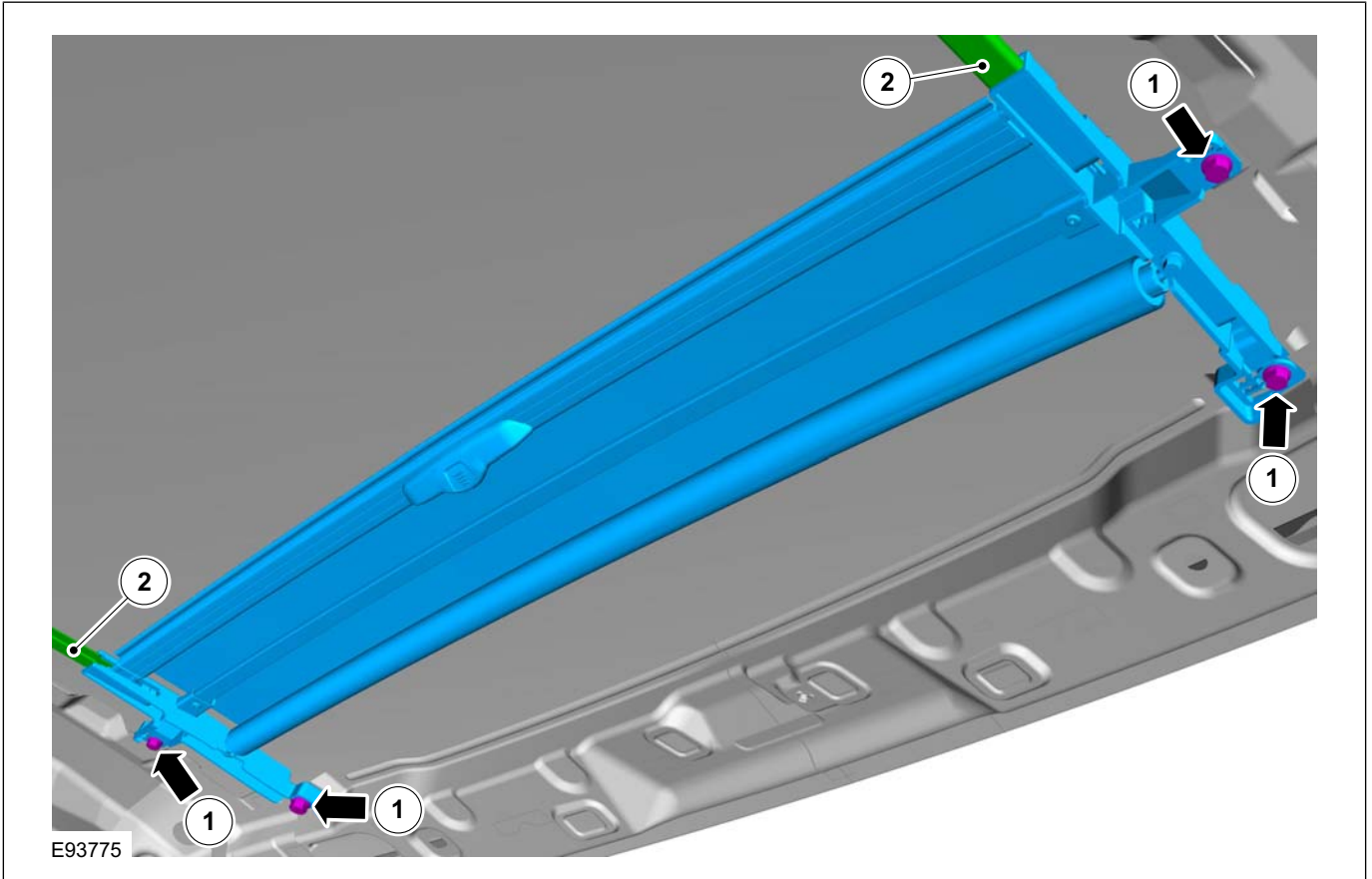
Installation

1.

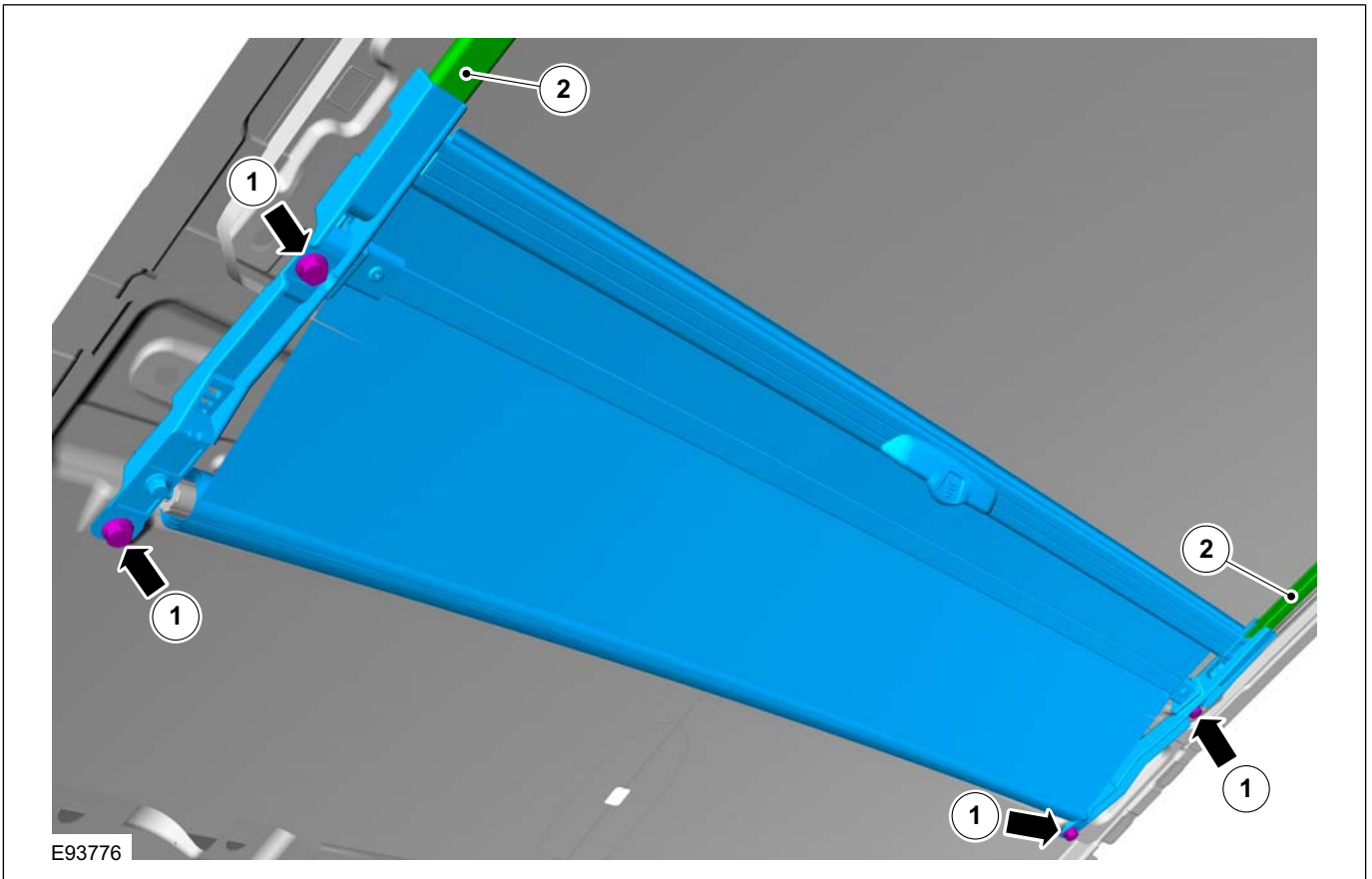




REMOVAL AND INSTALLATION



2.

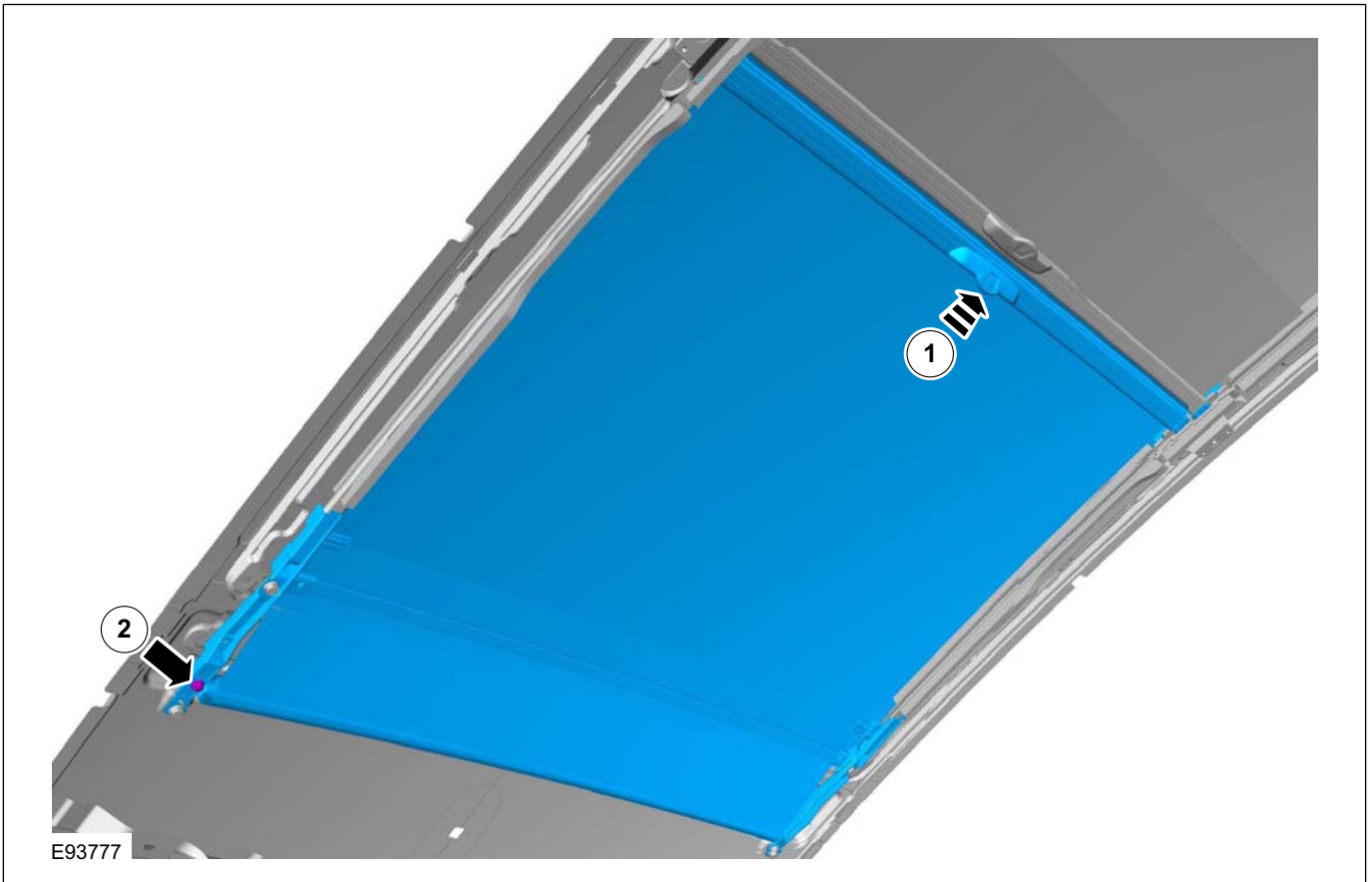






REMOVAL AND INSTALLATION

3.



4.

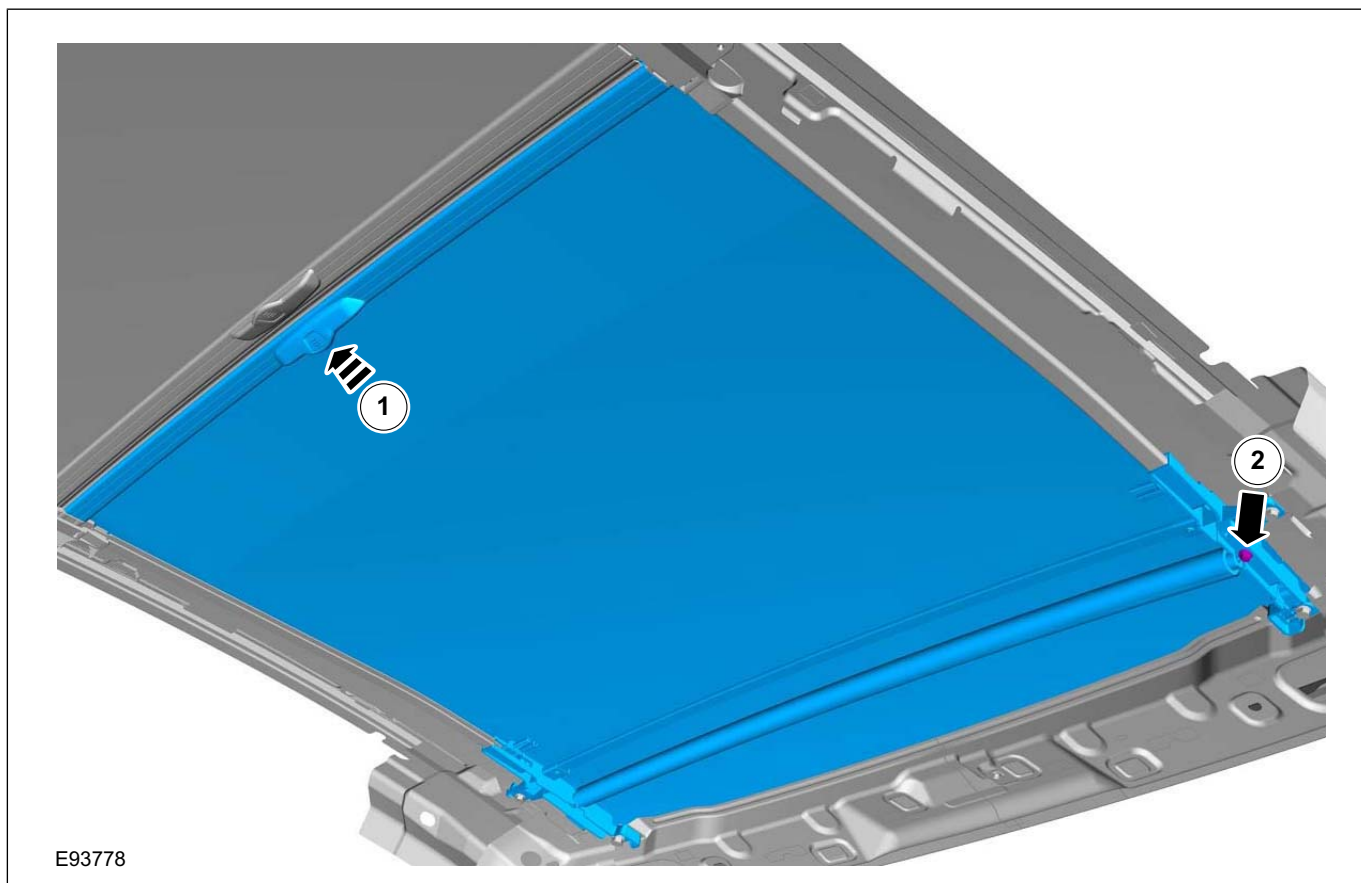


501-05-36

Interior Trim and Ornamentation

501-05-36

## REMOVAL AND INSTALLATION



5. Install the headliner.

REMOVAL AND INSTALLATION

Front Door Trim Panel

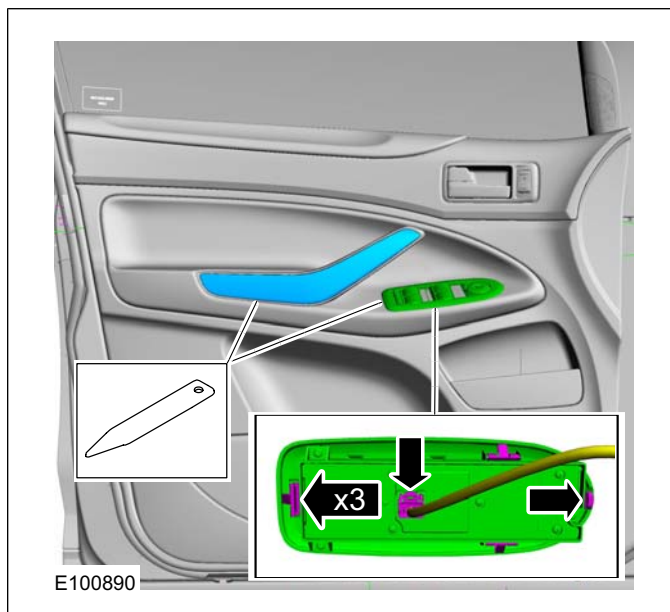
General Equipment

Interior Trim Remover

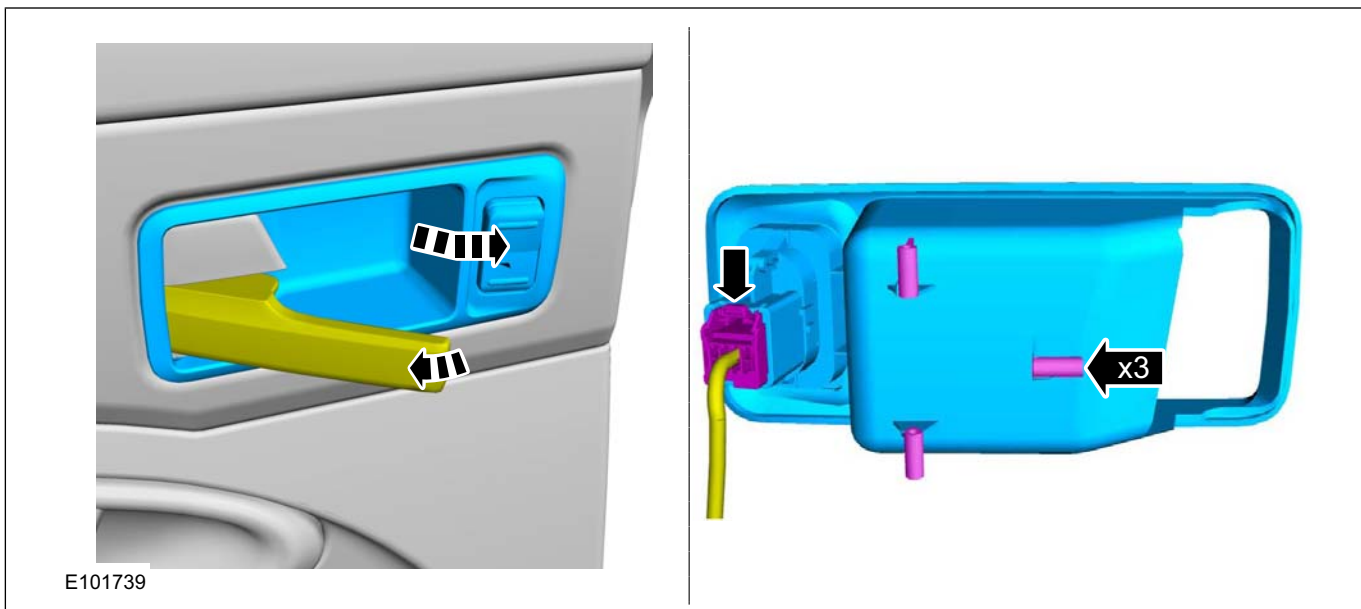
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1.



2.



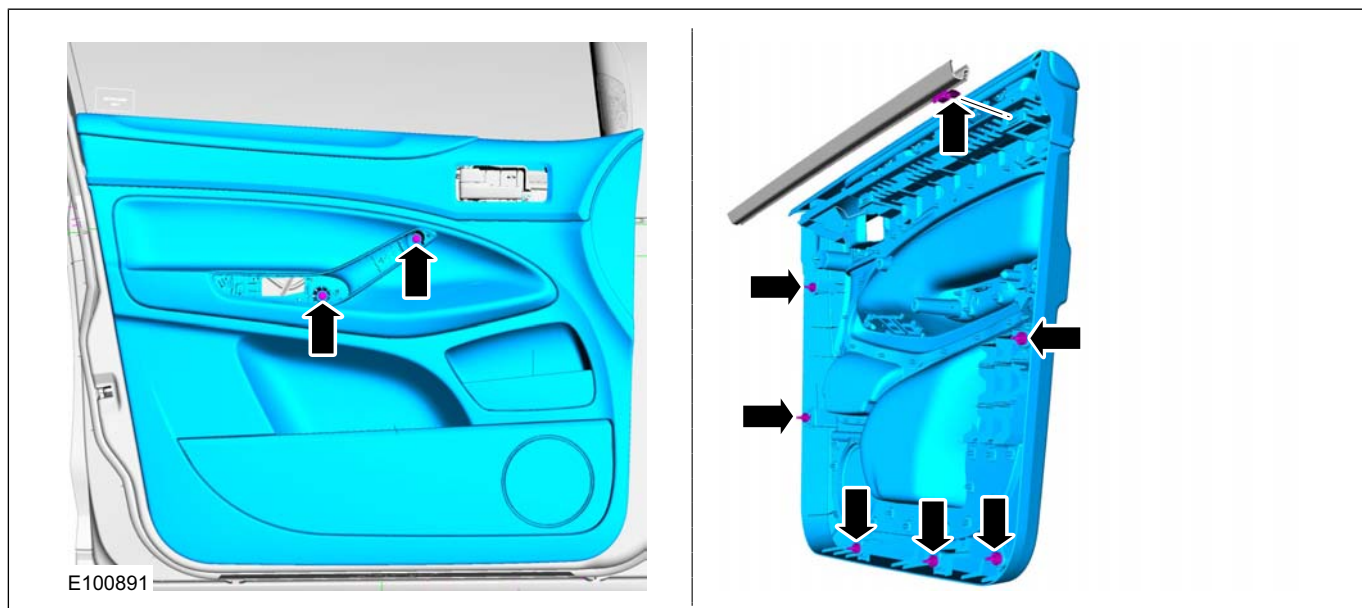
3. General Equipment: Interior Trim Remover

501-05-38

Interior Trim and Ornamentation

501-05-38

## REMOVAL AND INSTALLATION



## Installation

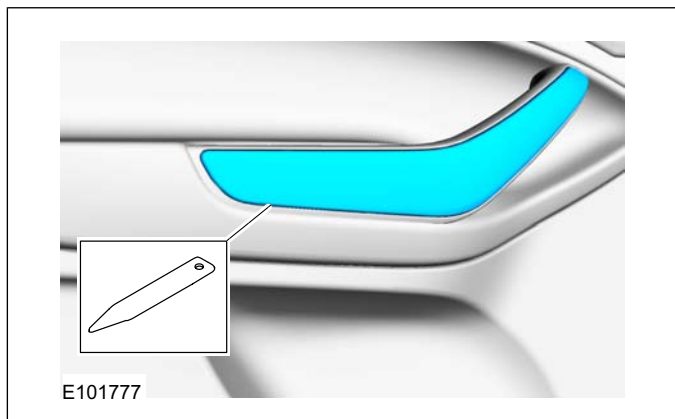
1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

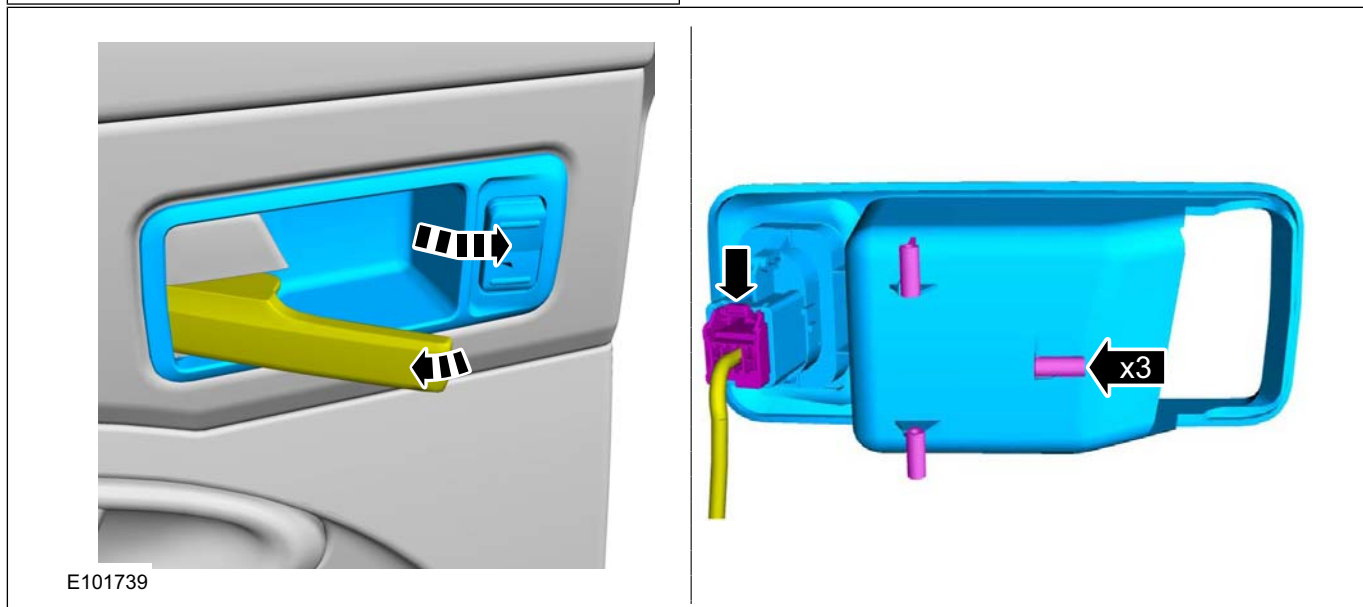
Rear Door Trim Panel

Removal

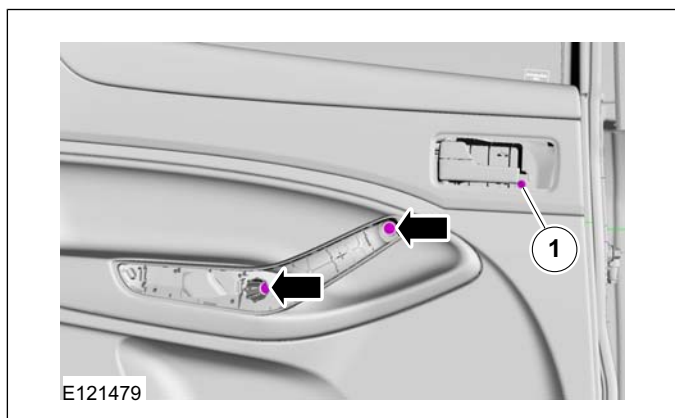
1.



2.



3. 1. Loosen: 1 turn(s)



4. CAUTIONS:

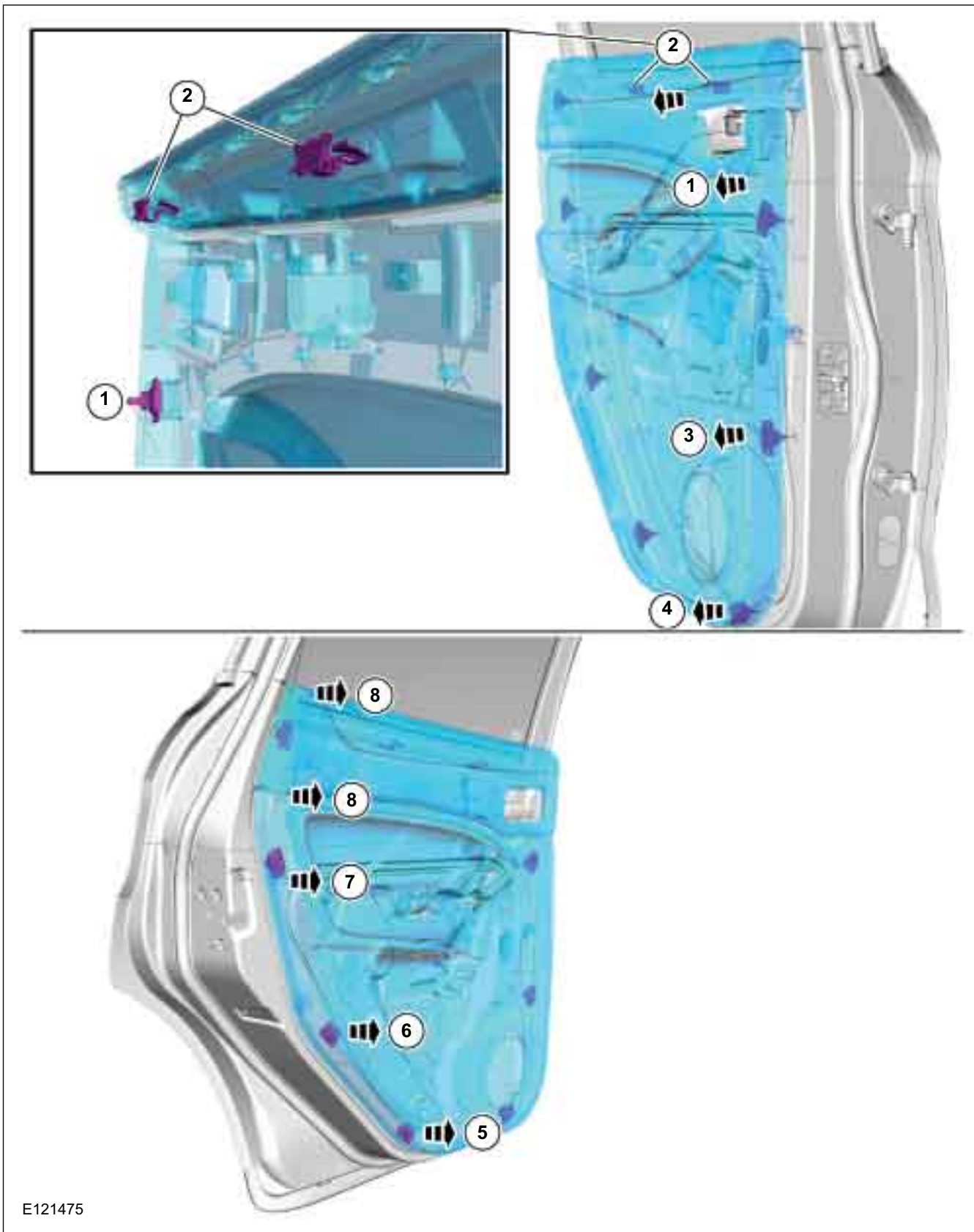
- ⚠ Only use moderate force.
- ⚠ Take extra care not to damage the clips.

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Interior Trim and Ornamentation

501-05-40

REMOVAL AND INSTALLATION





501-05-41

Interior Trim and Ornamentation

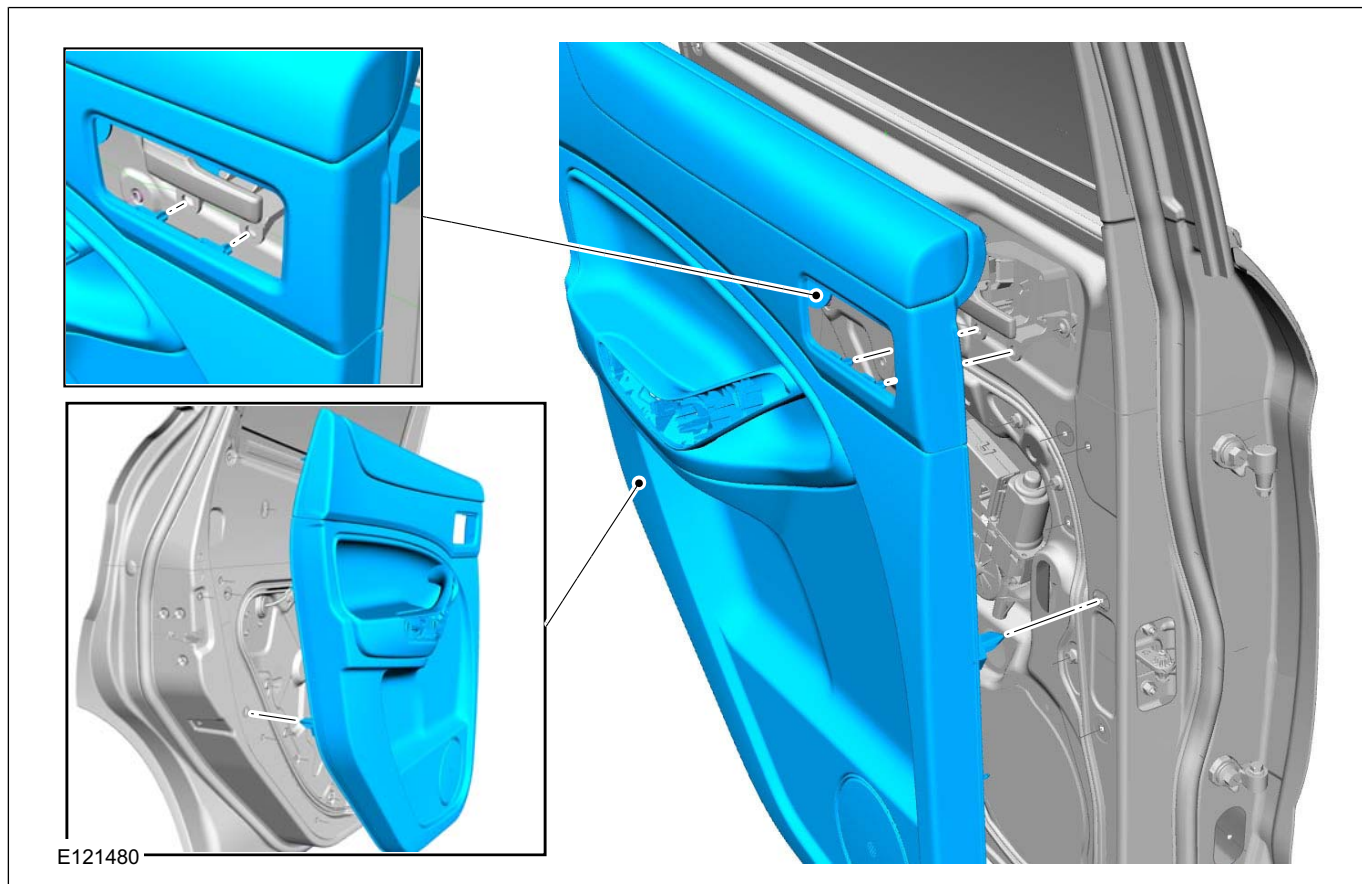
501-05-41

## REMOVAL AND INSTALLATION

Installation

 component is correctly located on the locating dowels.

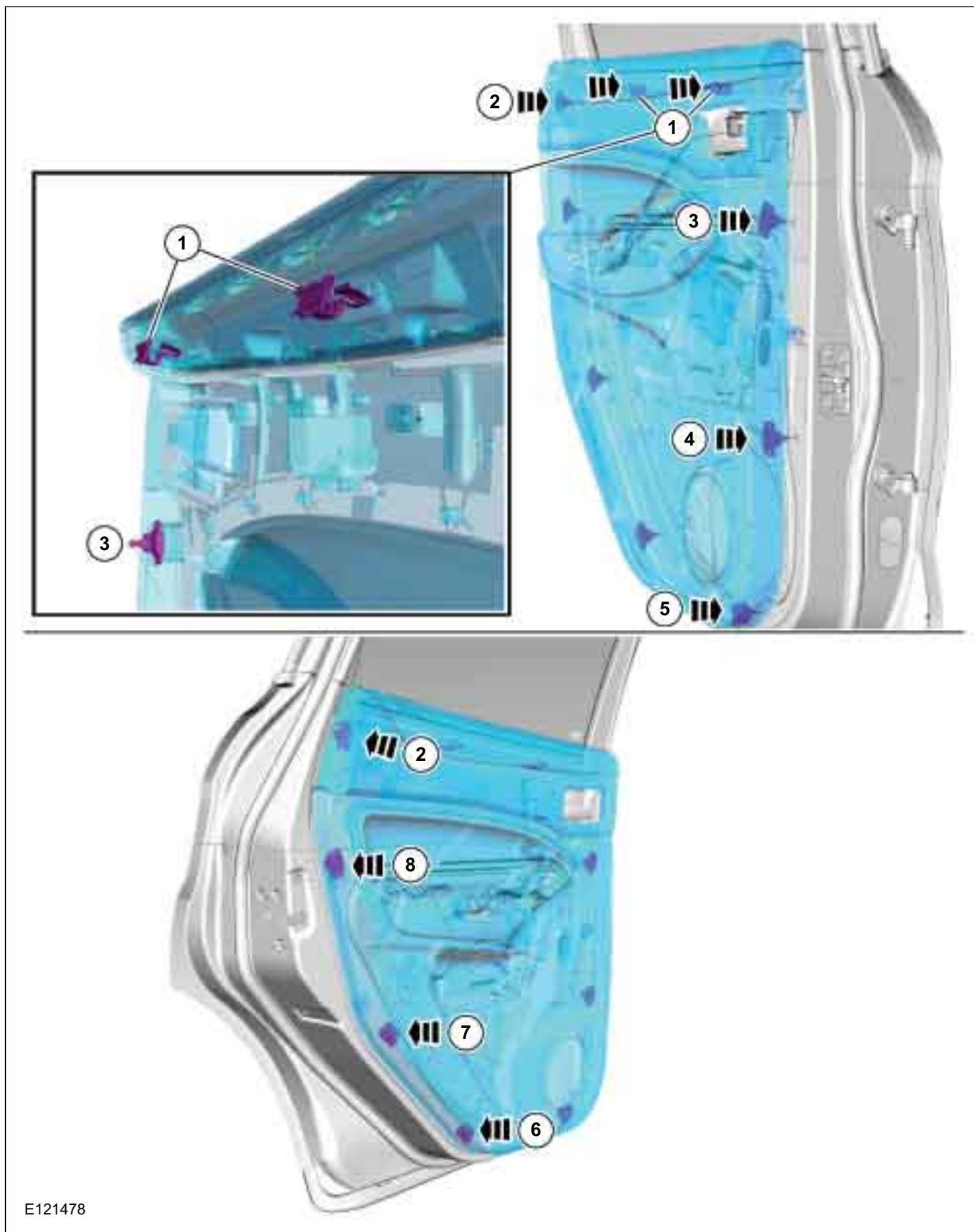
1. CAUTION: Make sure that the



2. CAUTIONS:

 Only use moderate force. Make sure that the clips are correctly located.

REMOVAL AND INSTALLATION





501-05-43

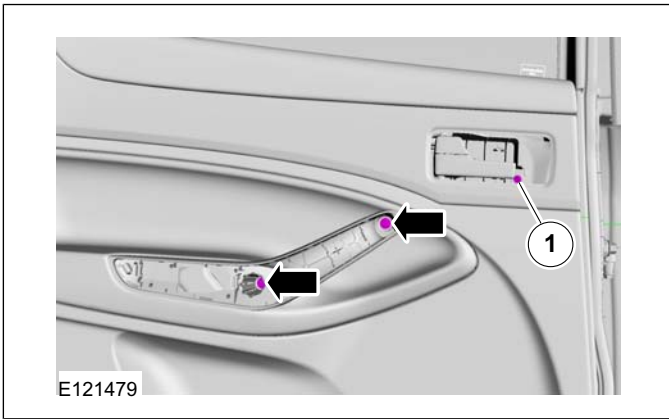
Interior Trim and Ornamentation

501-05-43

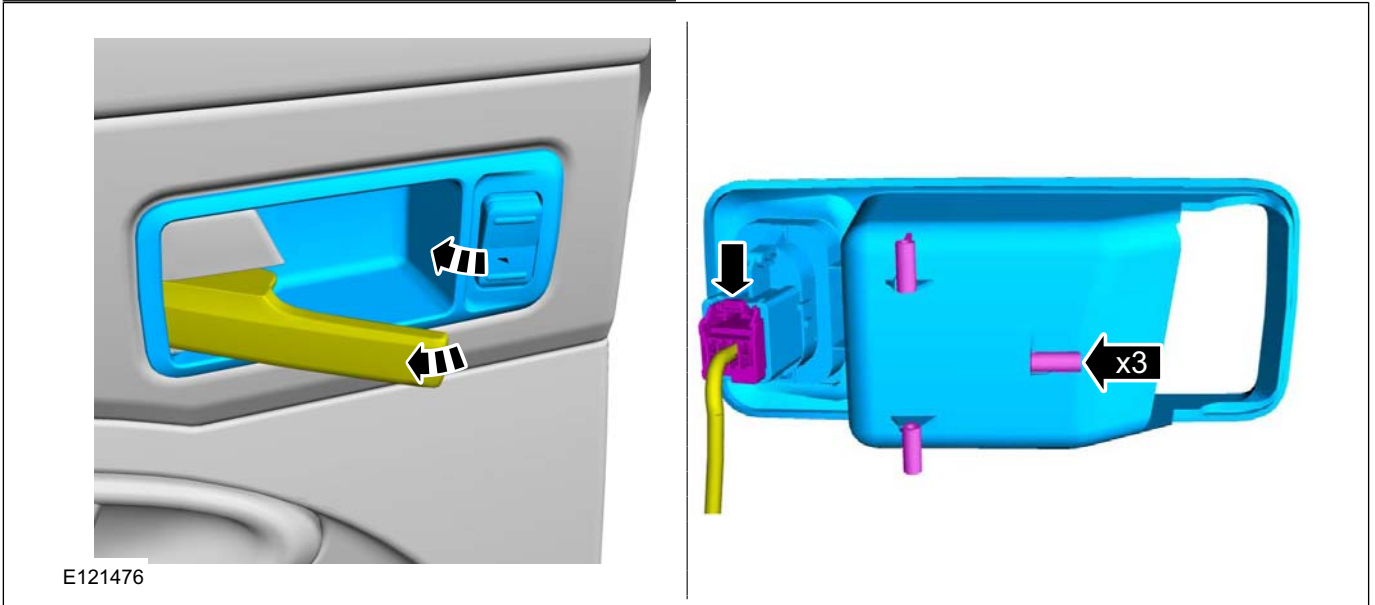


REMOVAL AND INSTALLATION

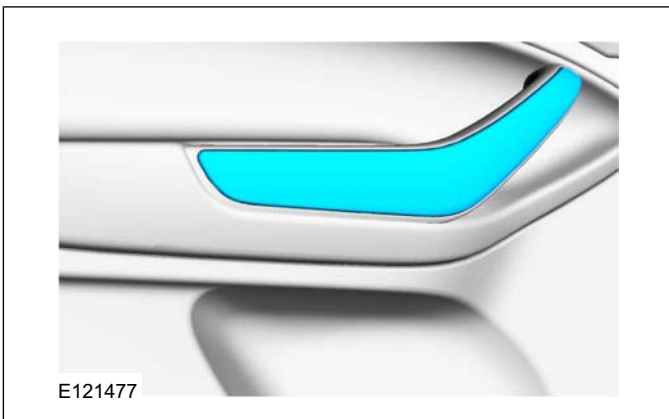
3.



4.



5.



501-05-44

Interior Trim and Ornamentation

501-05-44

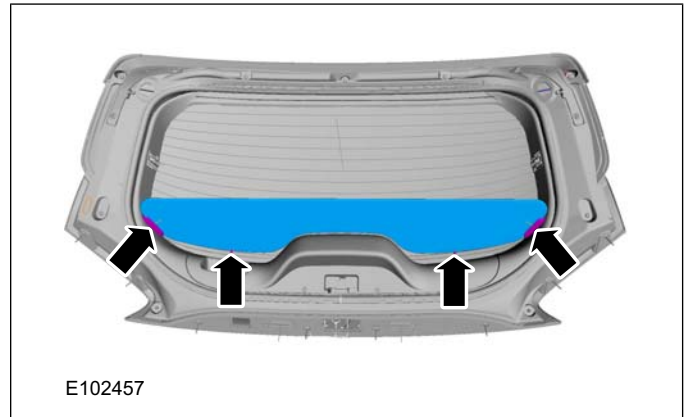
## REMOVAL AND INSTALLATION

## Liftgate Upper Trim Panel

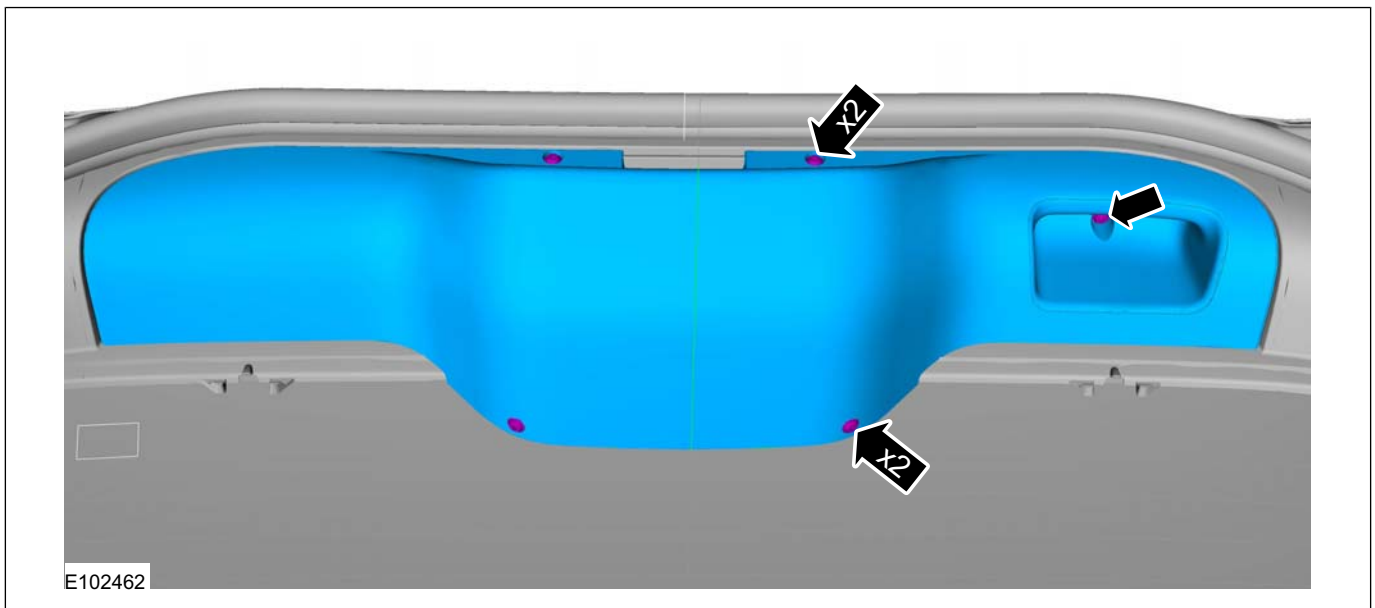
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1.



2.



## Installation

1. To install, reverse the removal procedure.





### REMOVAL AND INSTALLATION

## Liftgate Lower Trim Panel

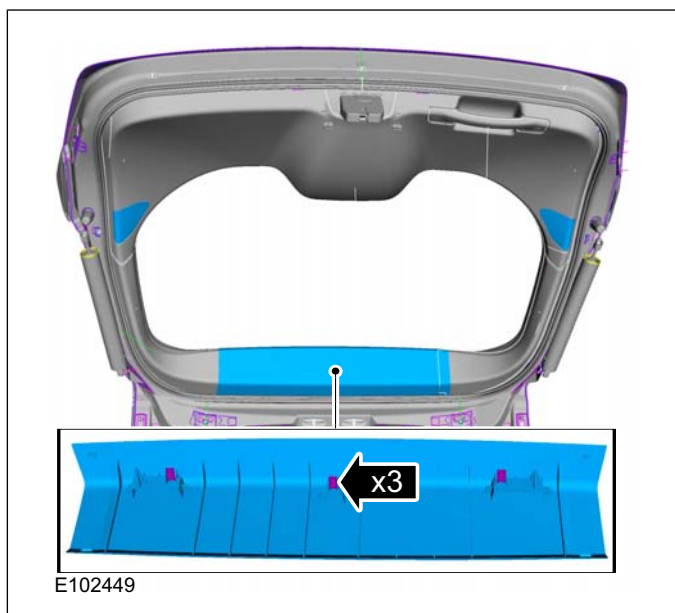
#### General Equipment

Interior Trim Remover

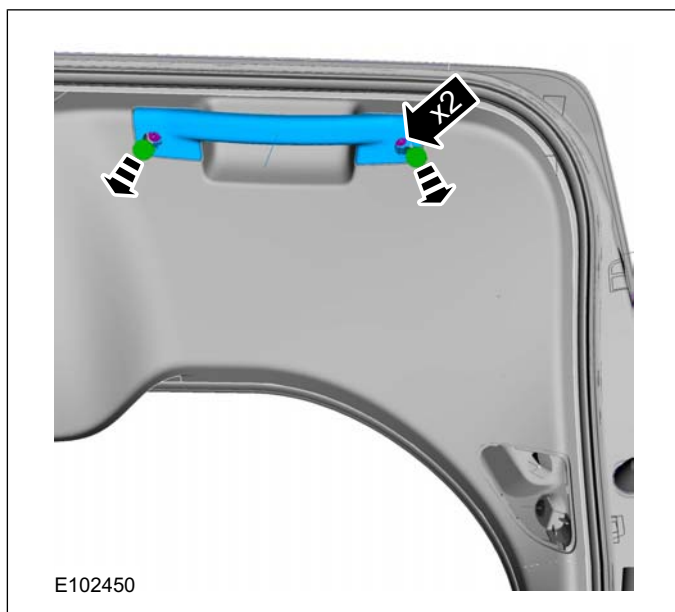
#### Removal

**NOTE:** Removal steps in this procedure may contain installation details.

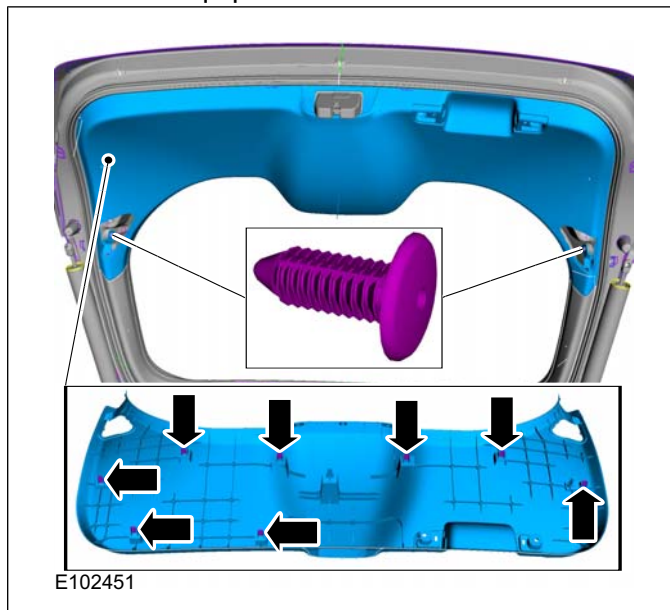
1.



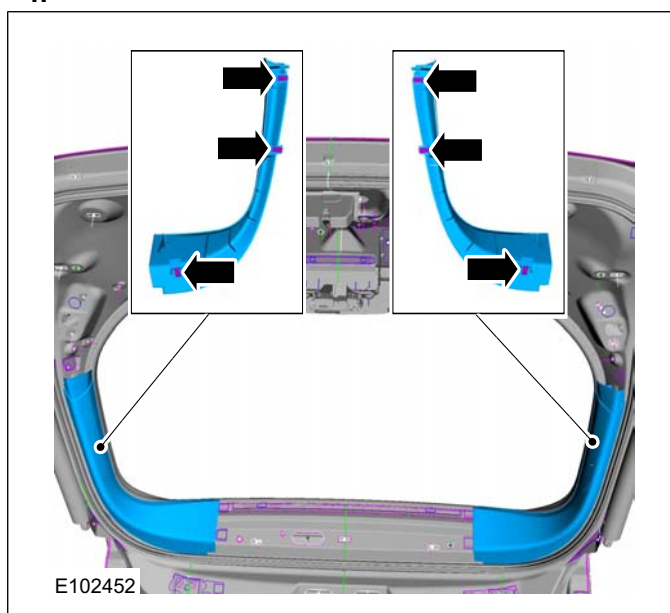
2.



3. General Equipment: Interior Trim Remover



4.



#### Installation

1. To install, reverse the removal procedure.



## SECTION 501-08 Exterior Trim and Ornamentation

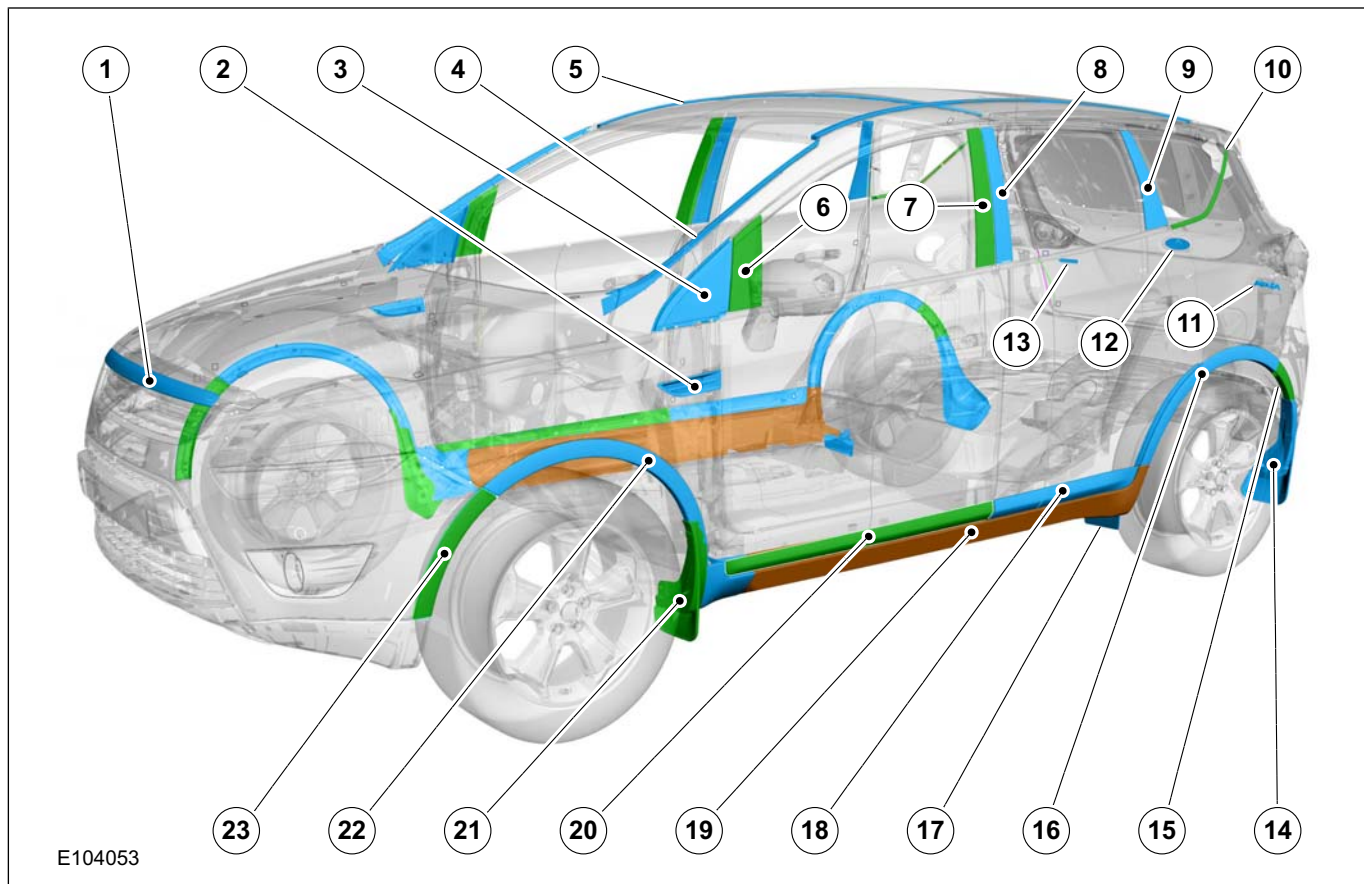
**VEHICLE APPLICATION: 2008.50 Kuga**

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DESCRIPTION AND OPERATION

Exterior Trim – Component Location



E104053

Item	Description
1	Engine hood trim strip
2	Fender trim cover
3	Cover, front door window
4	Windshield strip
5	Roof strip
6	Front trim strip, front door window
7	Rear trim strip, front door window
8	Front trim strip, rear door window
9	Rear trim strip, rear door window
10	Trim strip, rear side window
11	Tailgate lettering

Item	Description
12	Tailgate emblem
13	Tailgate variant sign
14	Rear fender flap in rear wheel arch
15	Rear trim strip, rear wheel arch
16	Front trim strip, rear wheel arch
17	Front fender flap in rear wheel arch
18	Door trim strip, rear
19	Rocker panel moulding
20	Door trim strip, front
21	Front flap
22	Rear trim strip, front wheel arch
23	Front trim strip, front wheel arch

## DESCRIPTION AND OPERATION

## Exterior Trim – System Operation and Component Description

## System Operation

Depending on the way in which they are attached, the components can either be reused or need to be replaced.

Components which are attached with adhesive take should be detached with a plastic wedge.

## Component Description

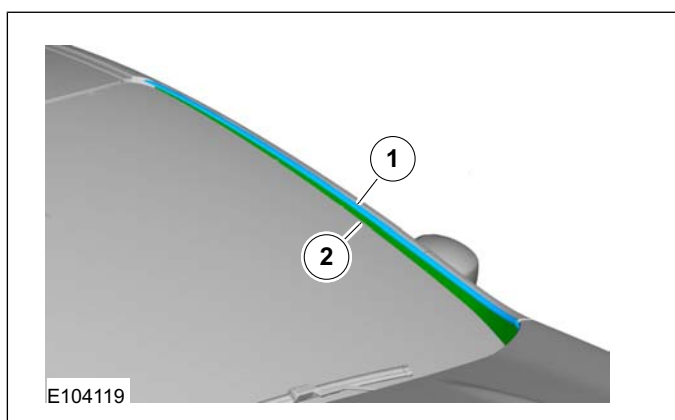
## Engine hood trim strip



The trim strip is glued.

A new one will need to be fitted after the old one has been removed.

## Windshield strip

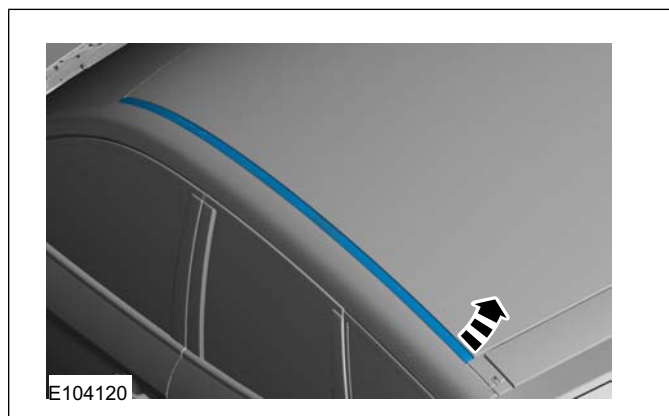


The trim strip comes in two parts. Part 1 is inserted in part 2 and can be pulled out to the top.

Part 2 is glued and only becomes accessible once the windshield has been removed.

Both parts will need to be replaced with new ones after the old ones have been removed.

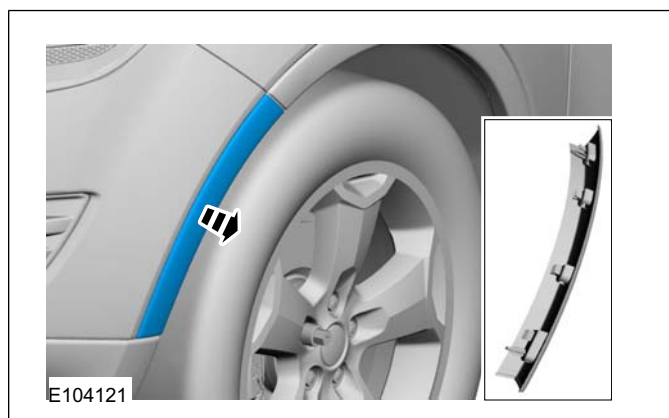
## Roof strip



The strip is secured with adhesive tape.

A new trim strip will need to be fitted after the old one has been removed.

## Front trim strip, front wheel arch

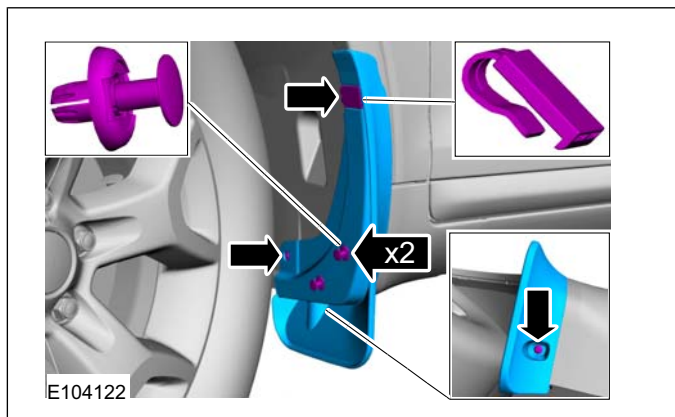


The trim strip is a push-fit.

The trim strip can be reused after it has been removed.

DESCRIPTION AND OPERATION

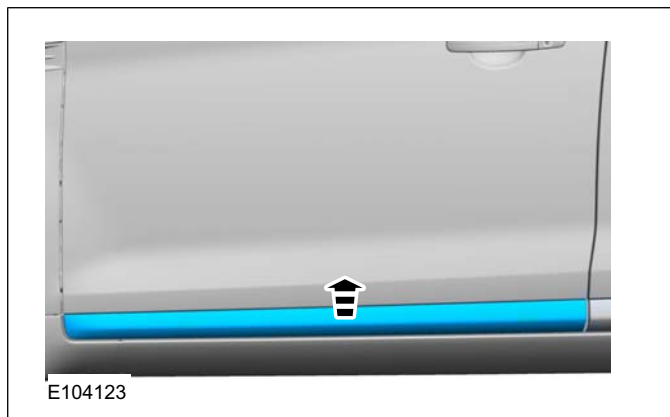
Front flap



The front fender flap is attached with clips and screws.

It can be reused after it has been removed.

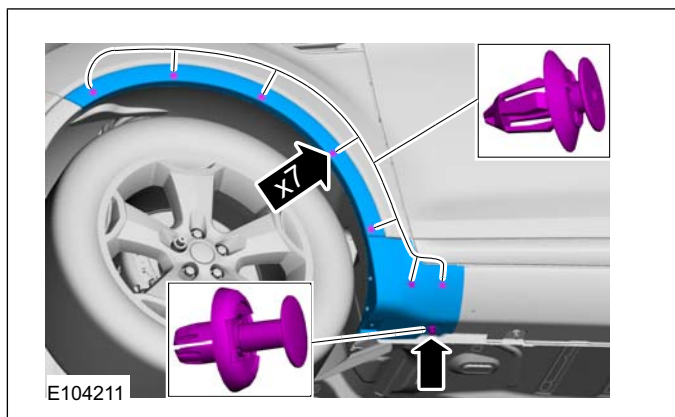
Door trim strip, front



The strip is secured with adhesive tape.

A new trim strip will need to be fitted after the old one has been removed.

Rear trim strip, front wheel arch

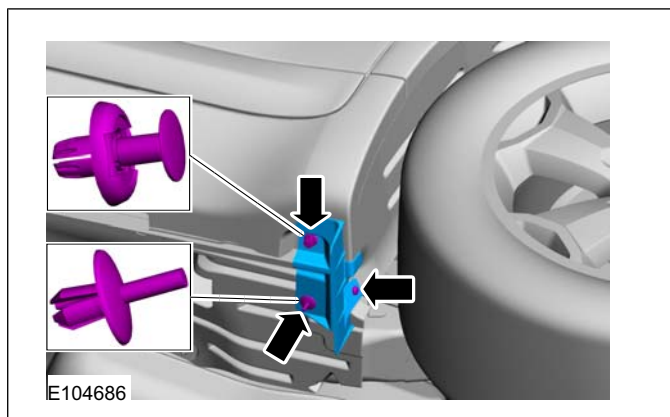


First detach the front fender flap.

The strip is secured with clips.

The trim strip can be reused after it has been removed.

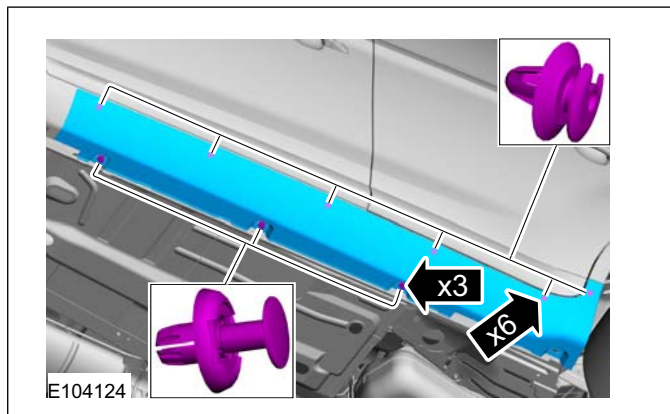
Front fender flap in rear wheel arch



The fender flap is attached with clips and one screw.

It can be reused after it has been removed.

Rocker panel moulding



## 501-08-5

## Exterior Trim and Ornamentation

## 501-08-5

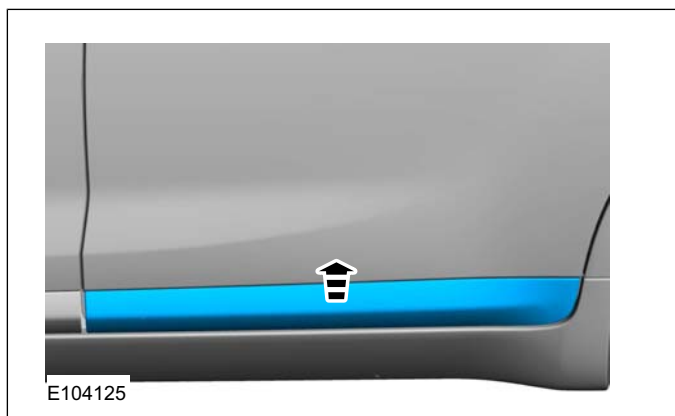
## DESCRIPTION AND OPERATION

First detach the front fender flap in the rear wheelhouse.

The strip is secured with clips.

The trim strip can be reused after it has been removed.

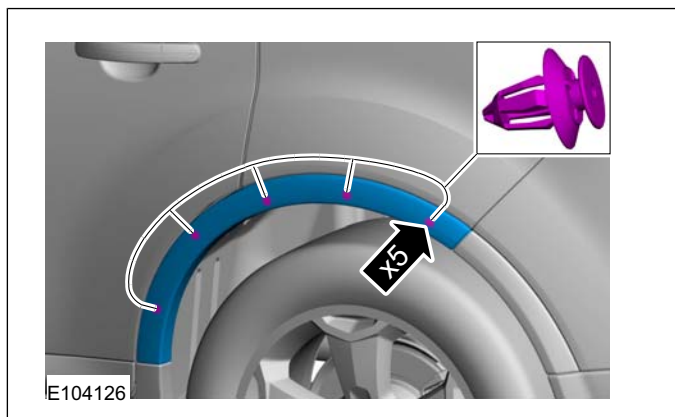
## Door trim strip, rear



The strip is secured with adhesive tape.

A new trim strip will need to be fitted after the old one has been removed.

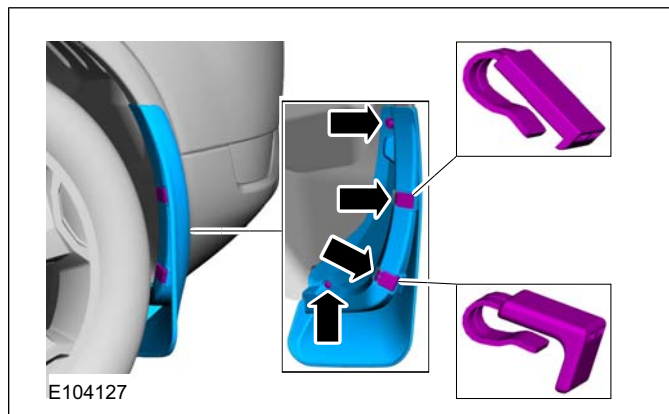
## Front trim strip, rear wheel arch



The strip is secured with clips.

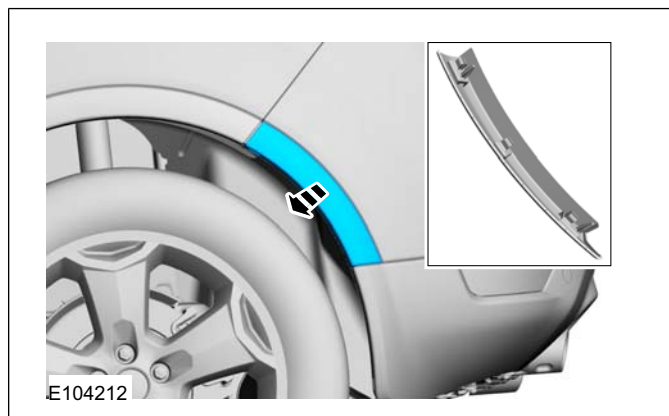
The trim strip can be reused after it has been removed.

## Rear fender flap in rear wheel arch



The fender flap is attached with clips and screws. It can be reused after it has been removed.

## Rear trim strip, rear wheel arch



First detach the rear fender flap in the rear wheelhouse.

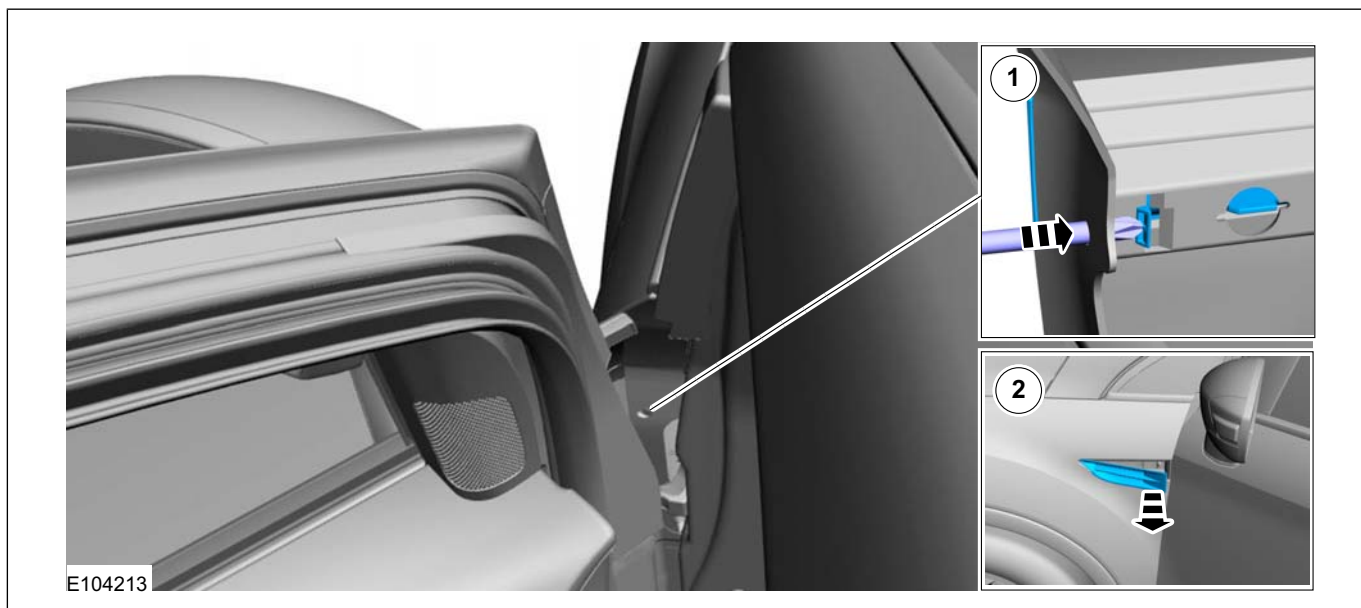
The trim strip is a push-fit.

The trim strip can be reused after it has been removed.

## Fender trim cover

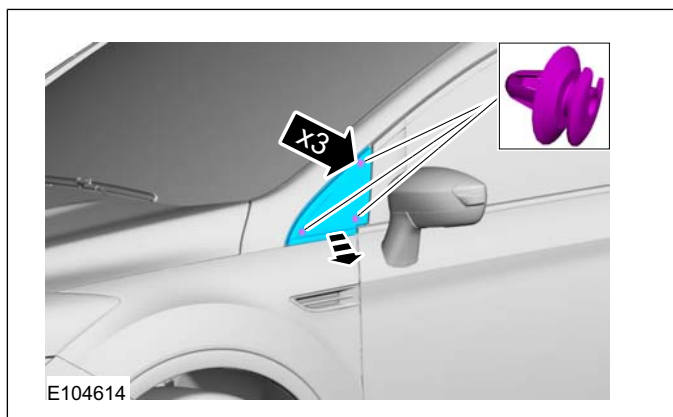


## DESCRIPTION AND OPERATION



1. With the front door open, guide a screwdriver through the indicated opening and lightly press the tab forwards to unhook the insert.
2. Take out the cover from the outside.

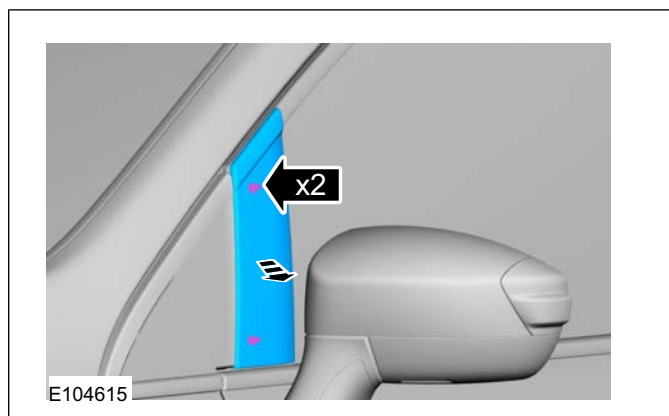
The cover can be reused after it has been removed.

**Cover, front door window**

The cover is secured with clips.

**CAUTION:** Take extra care not to damage the clips.

The cover can be reused after it has been removed.

**Front trim strip, front door window**

First remove the inner trim of the side window in order to gain access to the fastening screws of the trim strip.

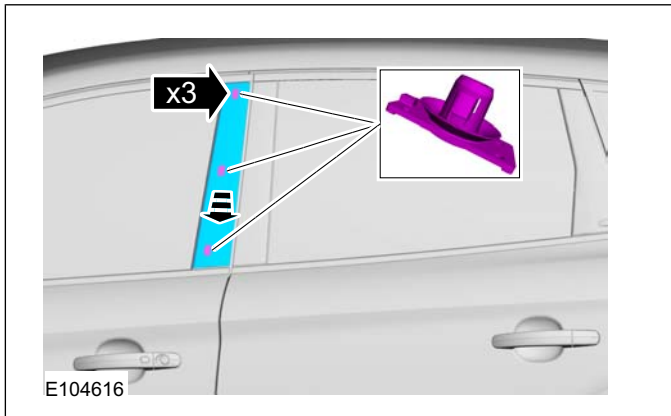
Refer to: **Front Door Window Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).

The trim strip is secured with screws.

The trim strip can be reused after it has been removed.

DESCRIPTION AND OPERATION

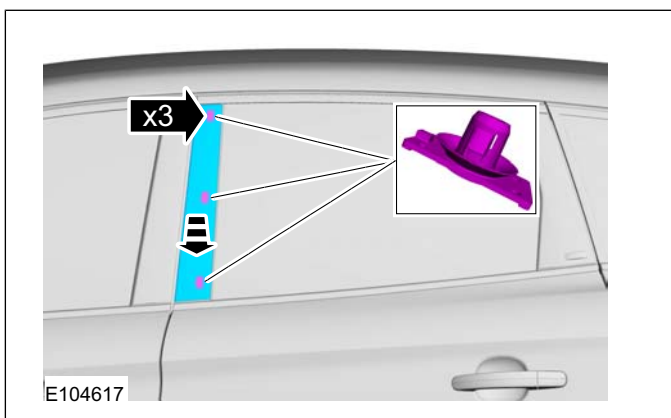
Rear trim strip, front door window



The trim strip is secured with clips and glued as well.

A new trim strip will need to be fitted after the old one has been removed.

Front trim strip, rear door window



The trim strip is secured with clips and glued as well.

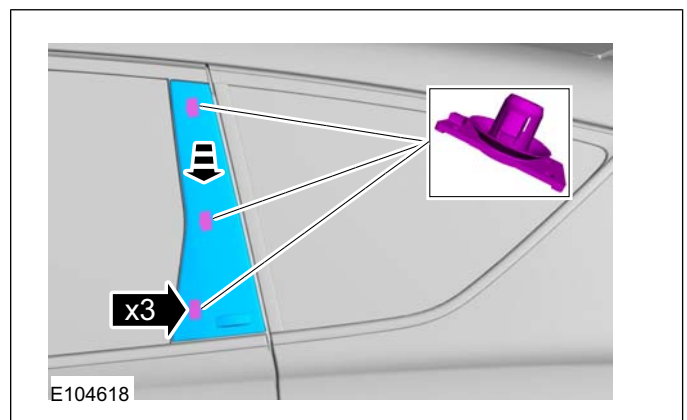
Remove the window seal prior to removal.

Refer to: **Rear Door Window Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).

The window seal cannot be refitted until the trim strip has been installed.

A new trim strip will need to be fitted after the old one has been removed.

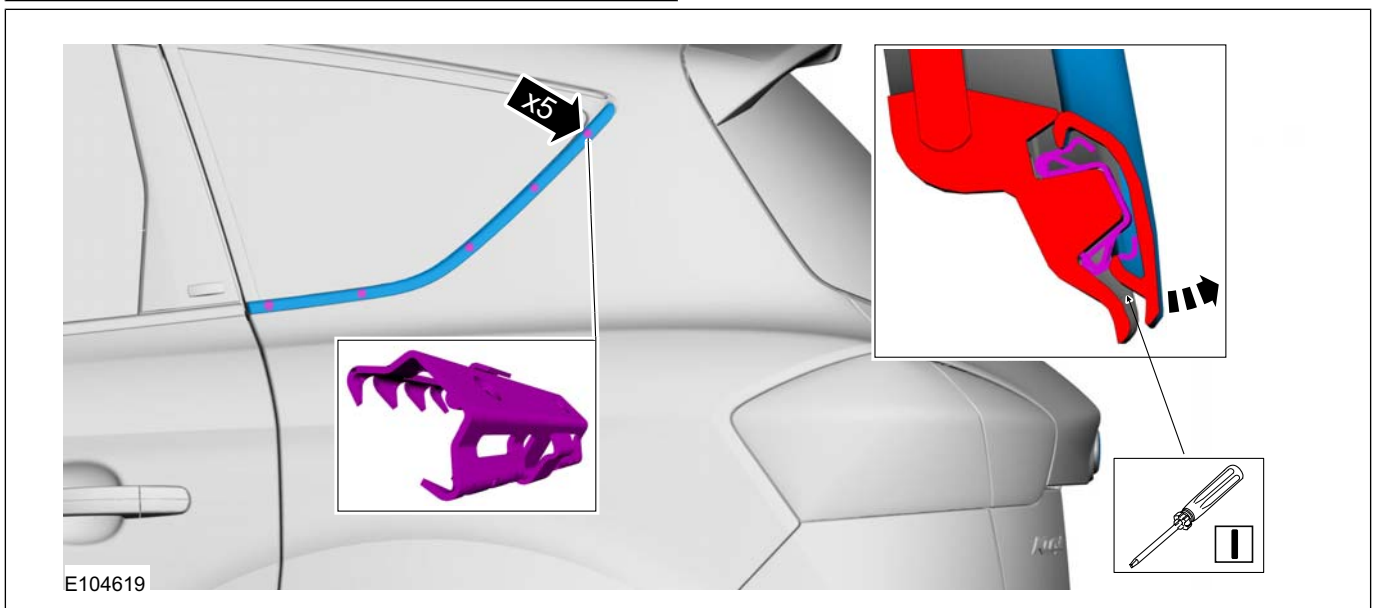
Rear trim strip, rear door window



The trim strip is secured with clips and glued as well.

A new trim strip will need to be fitted after the old one has been removed.

Trim strip, rear side window



The strip is secured with clips.



## DESCRIPTION AND OPERATION

**⚠ CAUTION:** Take extra care when handling the component.

To remove the strip:

1. Using a screwdriver, press against the lower hook at the rear clip and unhook the strip from the lower edge.
2. Unhook the upper edge of the strip at the rear clip.
3. Repeat these steps on the remaining clips (working from the rear to the front).

The trim strip can be reused after it has been removed.

For installation:

1. Hook in the strip at the upper hook on the front clip and then allow it to clip into the lower hook.
2. Repeat this step on the remaining clips (working from the front to the rear).

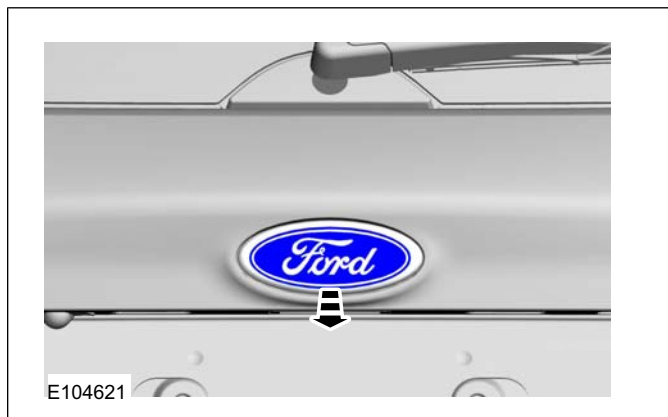
## Tailgate lettering



The lettering is glued.

A new replacement will be needed after the old one has been removed.

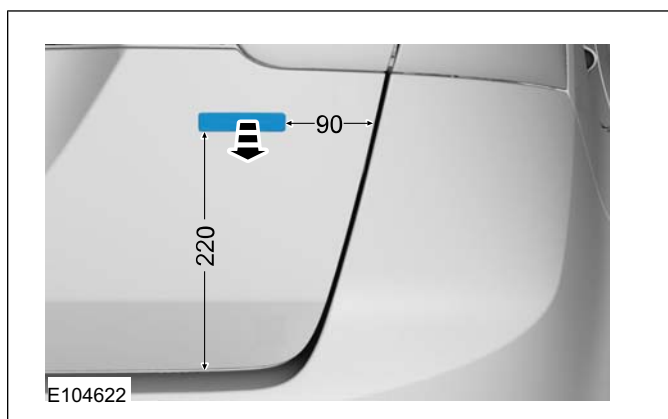
## Tailgate emblem



The emblem is secured with adhesive tape.

A new one will need to be fitted after the old one has been removed.

## Tailgate variant sign



The sign is secured with adhesive tape.

A new one will need to be fitted after the old one has been removed.

501-08-9

Exterior Trim and Ornamentation

501-08-9

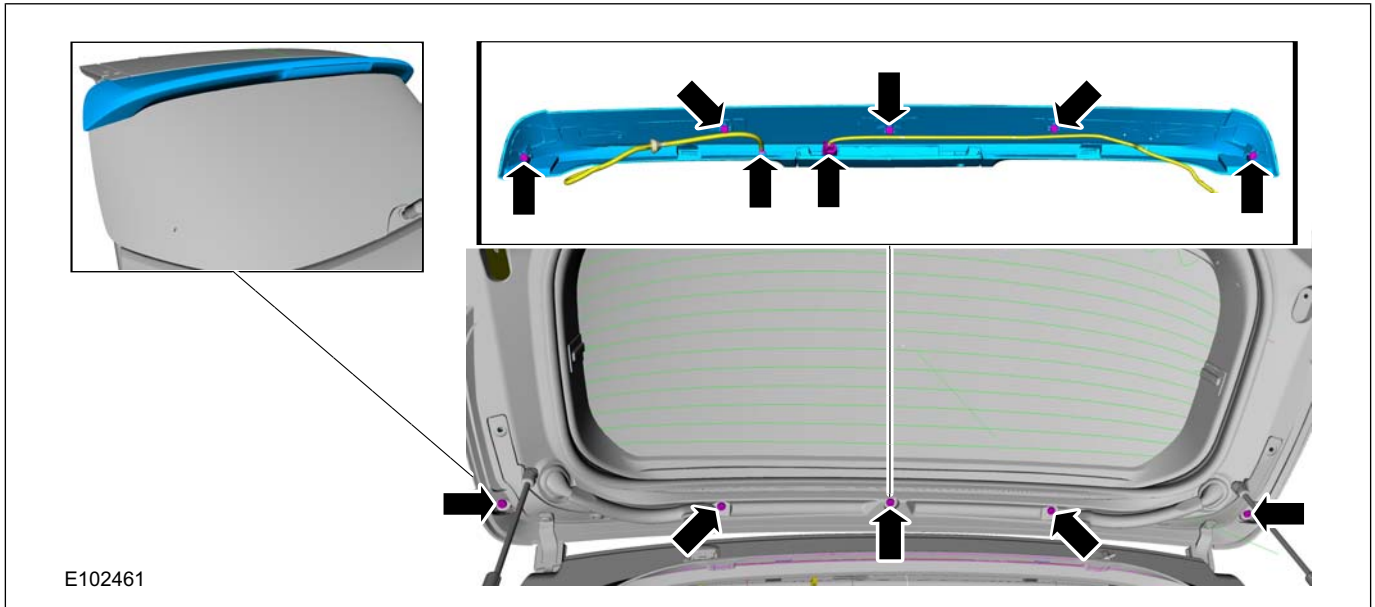
## REMOVAL AND INSTALLATION

## Rear Spoiler

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Torque: 1,9 Nm



## Installation

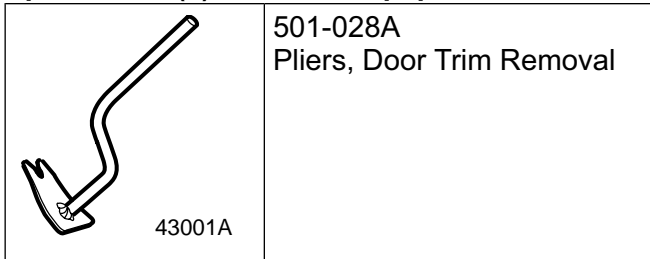
1. To install, reverse the removal procedure.



REMOVAL AND INSTALLATION

Roof Rail

Special Tool(s) / General Equipment



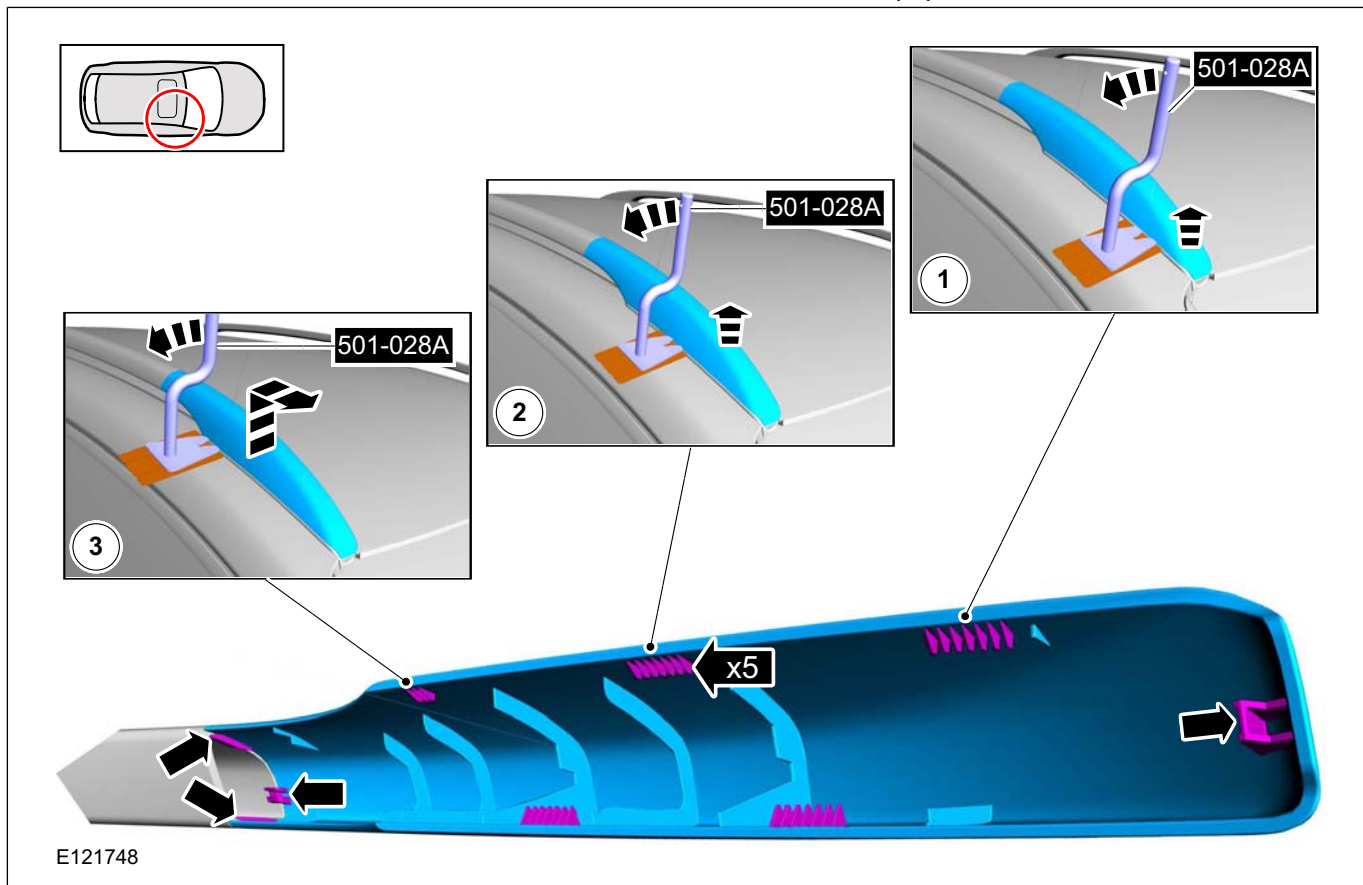
Special Tool(s) / General Equipment



Removal

**NOTE:** Removal steps in this procedure may contain installation details.

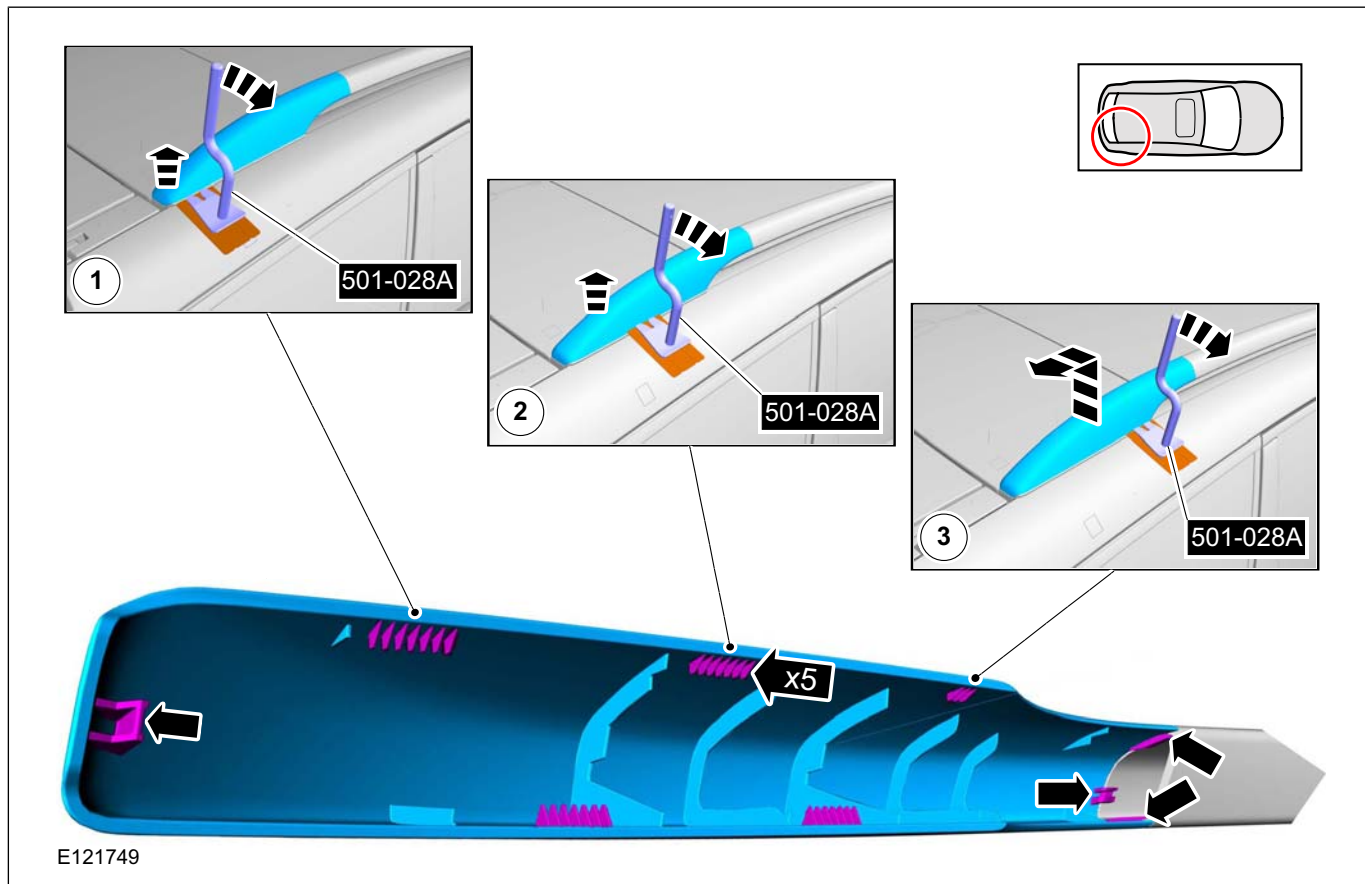
1. Special Tool(s): 501-028A  
General Equipment: Laminated Card



2. Special Tool(s): 501-028A  
General Equipment: Laminated Card

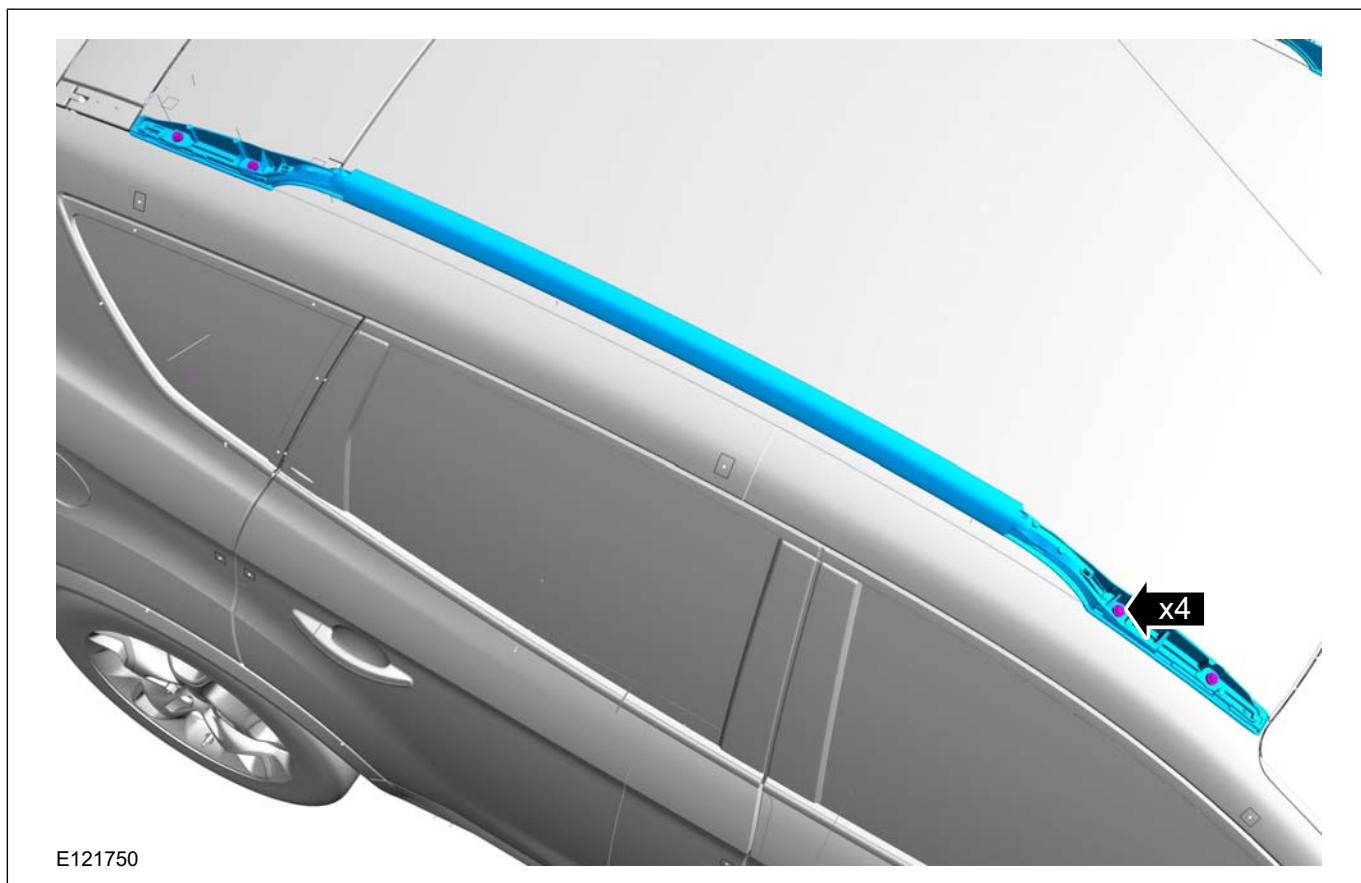


REMOVAL AND INSTALLATION



- 3. On both sides.  
Torque: 12 Nm

## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.

501-08-13

Exterior Trim and Ornamentation

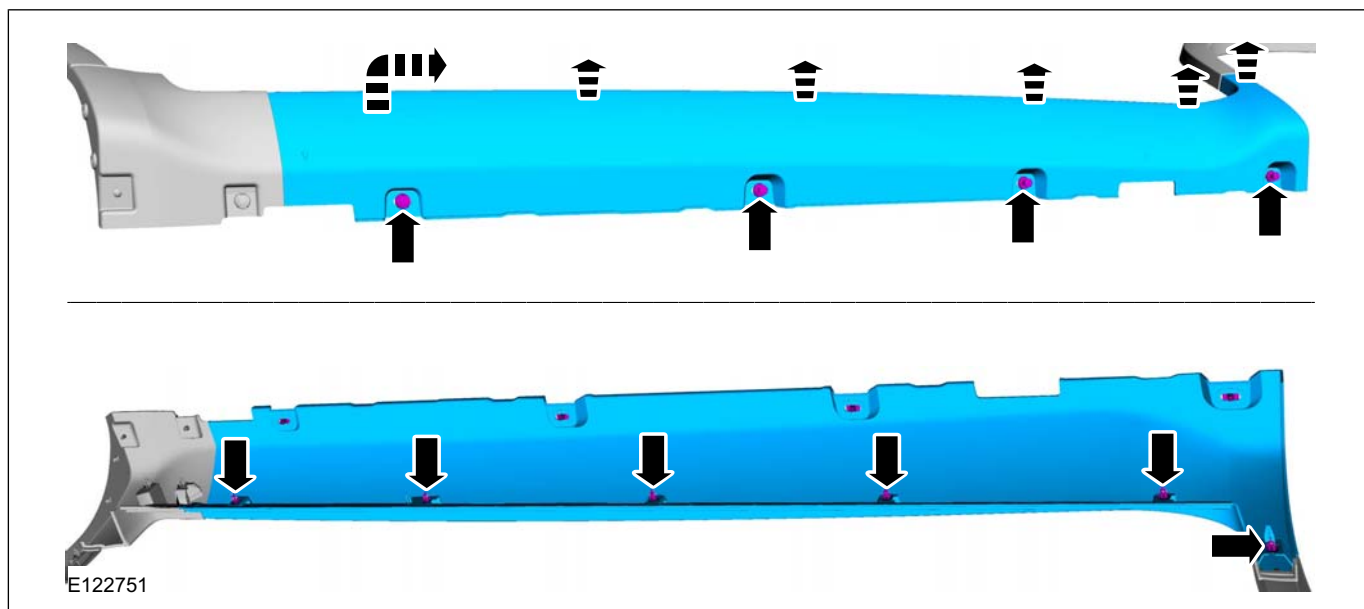
501-08-13

## REMOVAL AND INSTALLATION

## Rocker Panel Moulding

## Removal

1.



## Installation

1. To install, reverse the removal procedure.



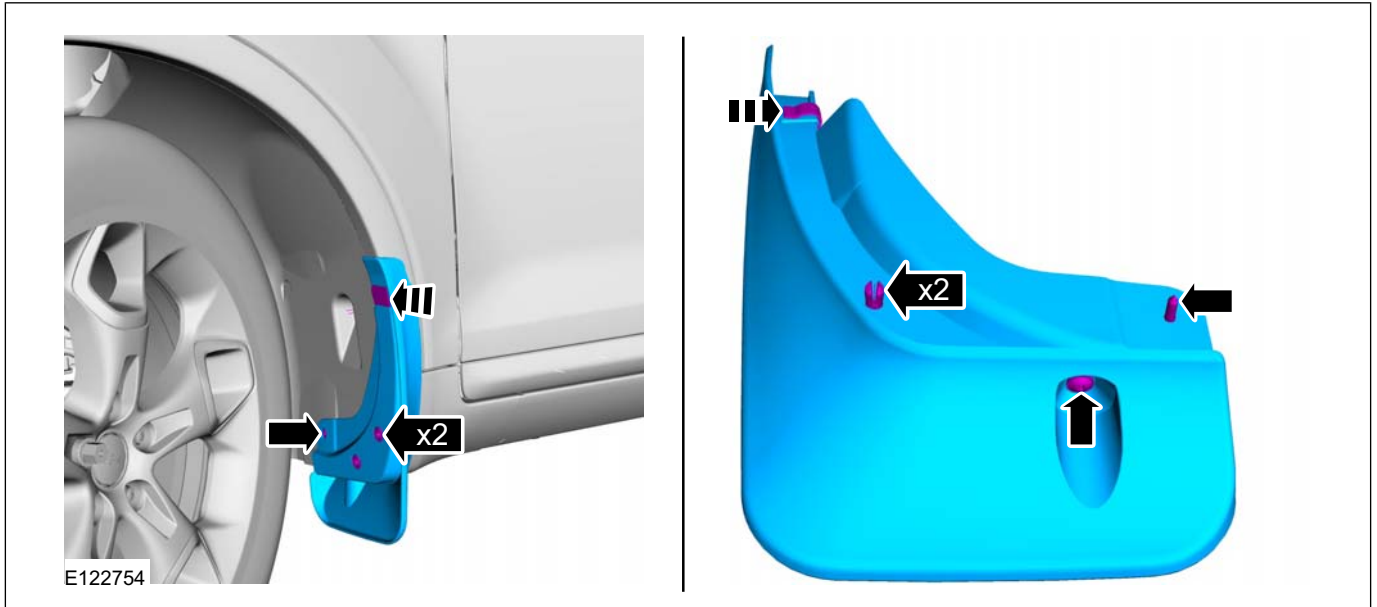


REMOVAL AND INSTALLATION

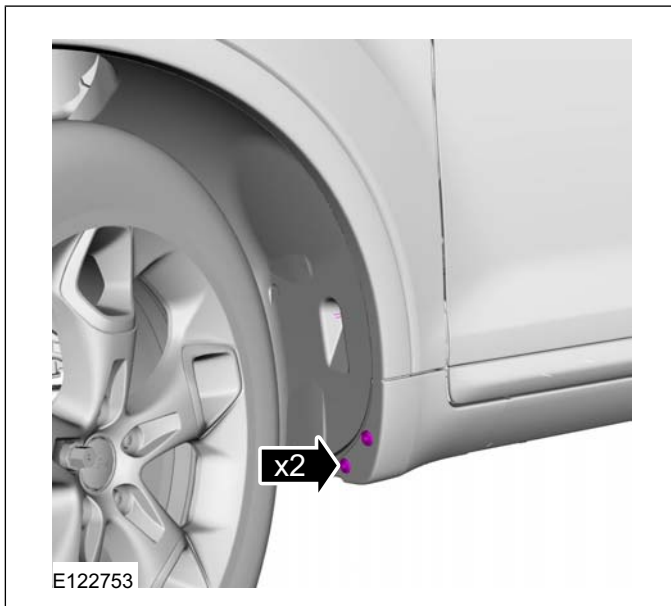
Front Fender Moulding

Removal

1. If equipped.



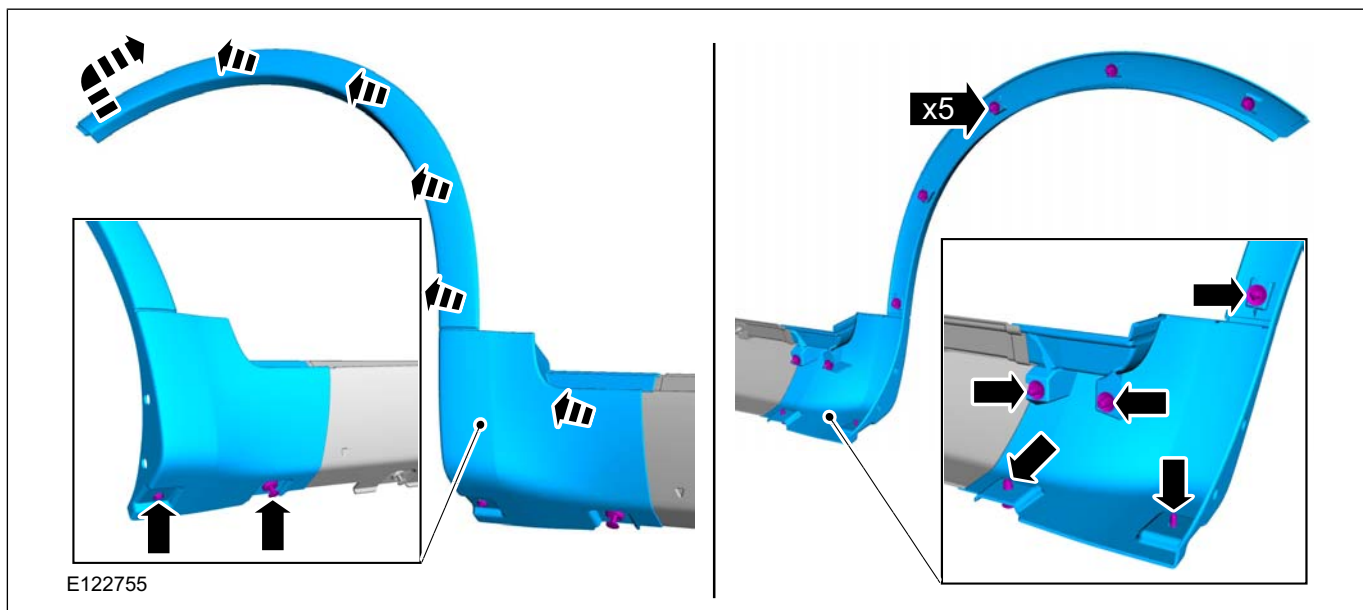
2.



3.



REMOVAL AND INSTALLATION



Installation

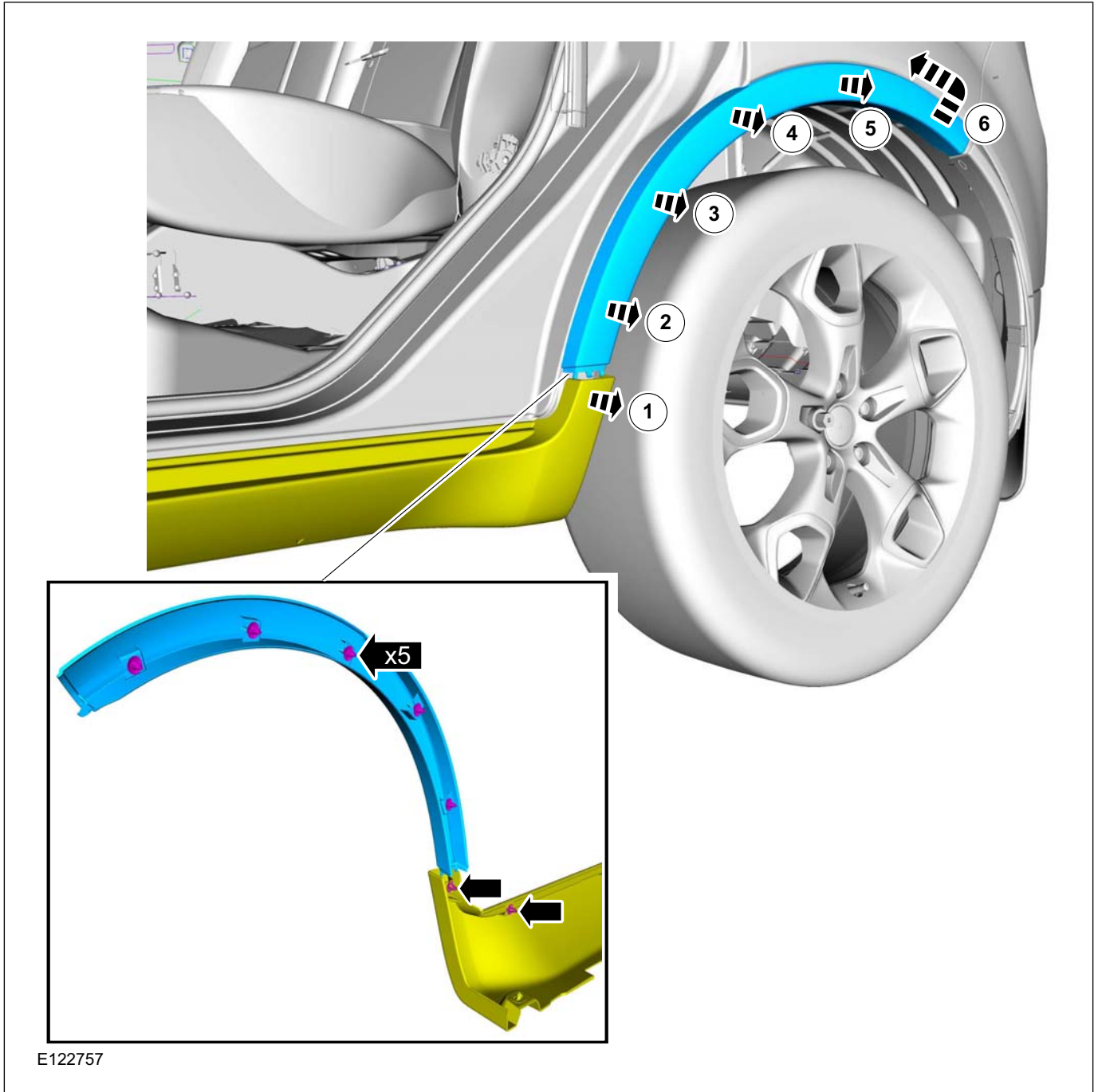
1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Rear Quarter Panel Moulding

Removal

1.



Installation

1. To install, reverse the removal procedure.



# SECTION 501-09 Rear View Mirrors

VEHICLE APPLICATION: 2008.50 Kuga

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REMOVAL AND INSTALLATION

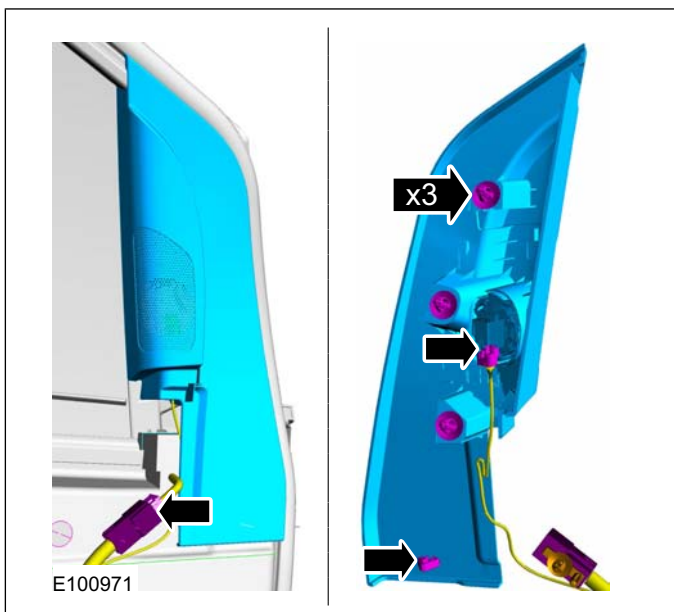
Exterior Mirror

Removal

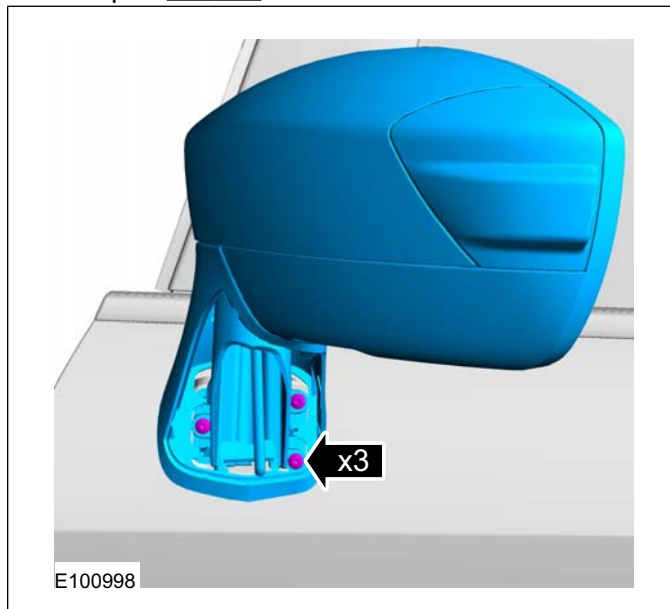
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Door Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



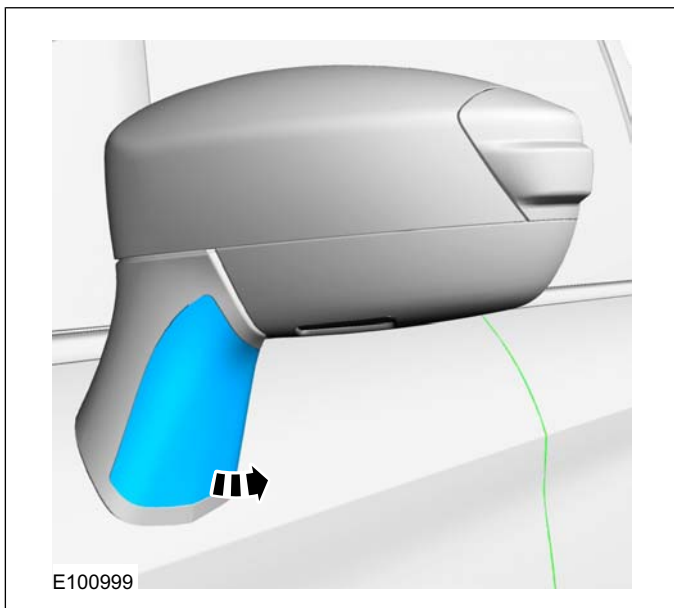
4. Torque: 4.1 Nm



Installation

1. To install, reverse the removal procedure.

3.



## SECTION 501-10 Seating

VEHICLE APPLICATION: 2008.50 Kuga

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Seat warmer unit.....	501-10-5
Seat occupancy sensor, passenger side.....	501-10-5
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Driver Seat Track.....	501-10-13
Front Seat Control Switch.....	(33 580 0; 33 583 0; 33 585 0) 501-10-16
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Front Seat Cushion Heater Mat.....	(33 401 0; 33 401 4) 501-10-20
Front Seat Cushion.....	(40 104 0) 501-10-21
Front Seat Backrest Cover.....	(40 108 0) 501-10-22
Front Seat Backrest Heater Mat.....	(33 402 0; 33 402 4) 501-10-26
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Front Seat Recliner Motor.....	(33 785 0; 33 785 4) 501-10-30
Front Seat Height Adjustment Motor.....	(33 797 0; 33 797 4) 501-10-33
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Rear Seat Armrest.....	501-10-43

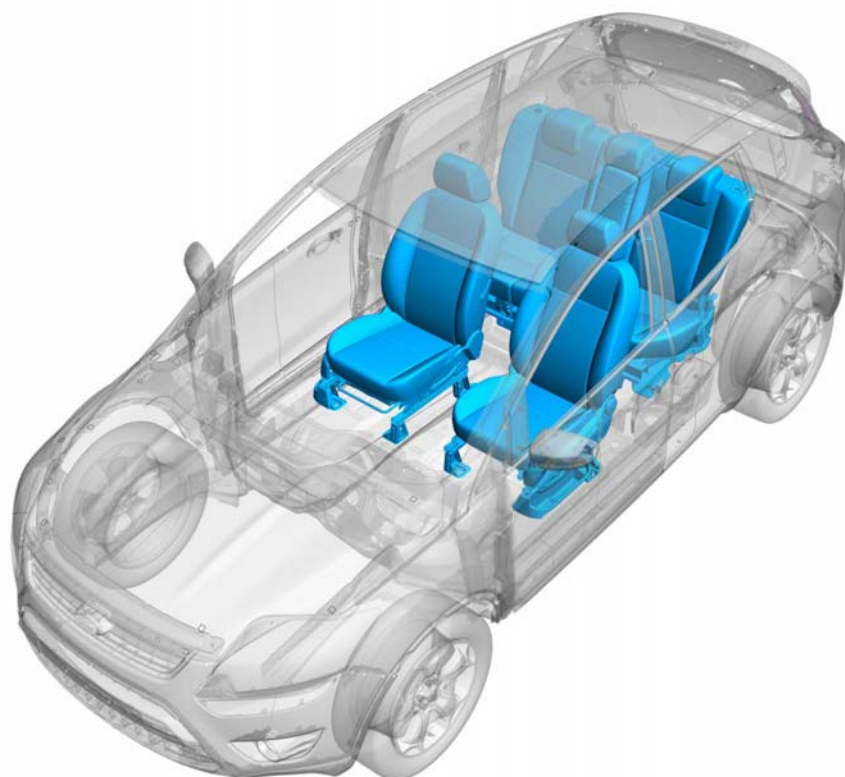
**DISASSEMBLY AND ASSEMBLY**

Front Seat Backrest.....	501-10-44
Rear Seat Cushion.....	501-10-50
Rear Seat Backrest.....	501-10-51



## DESCRIPTION AND OPERATION

## Seats – Component Location

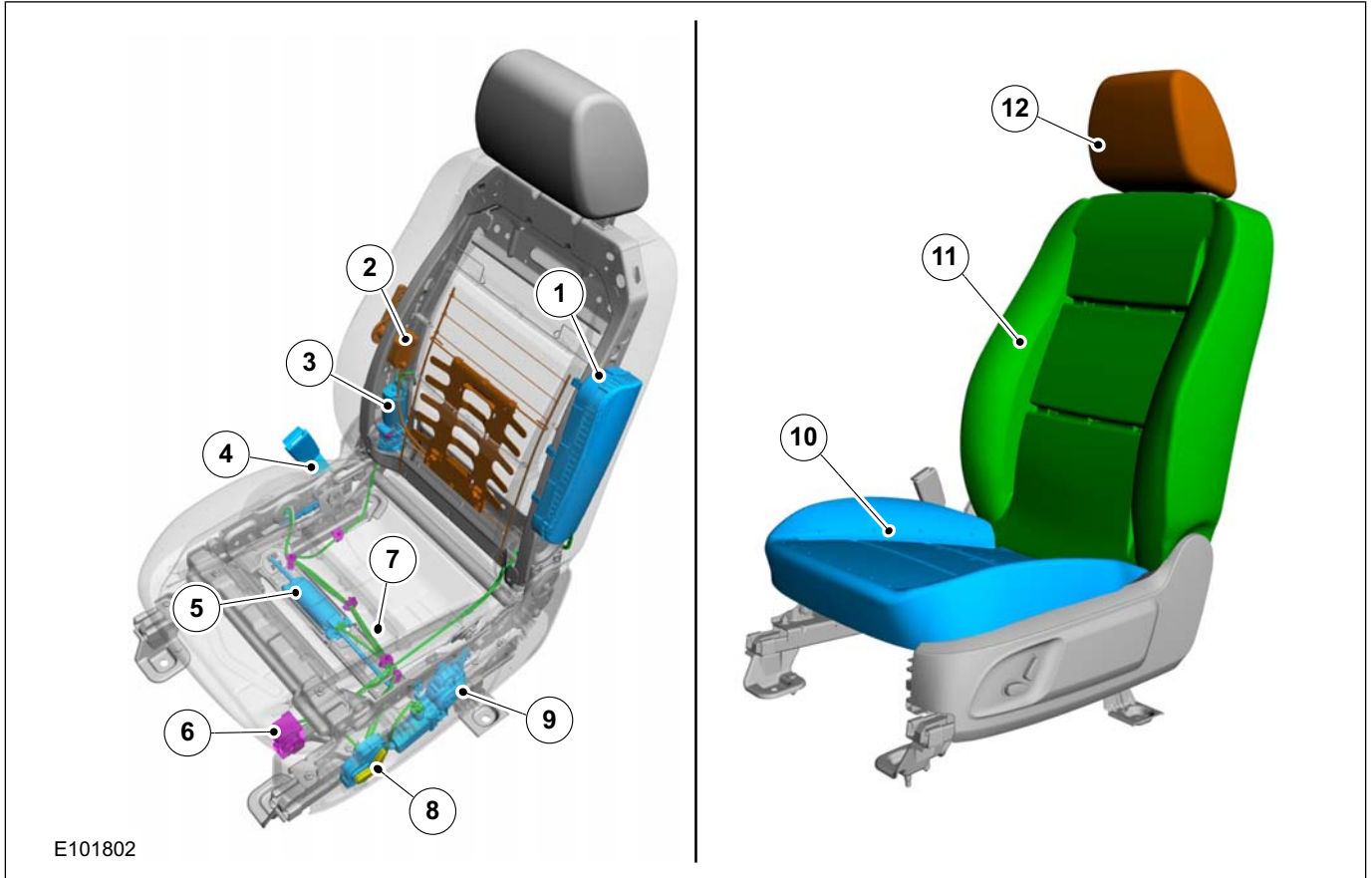


E101821

DESCRIPTION AND OPERATION

Seats – Overview

Seat



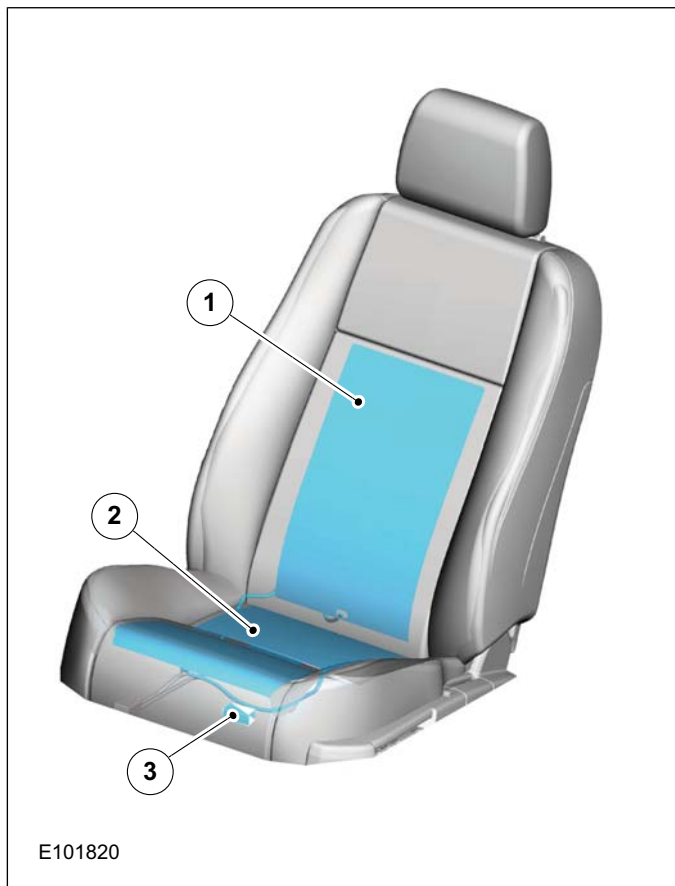
E101802

Item	Description
1	Side airbag module Refer to: <b>Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)</b> (501-20 Supplemental Restraint System, Description and Operation).
2	Manually adjustable lumbar supports
3	Servo motor for electrically adjustable driver's seat backrest
4	Front belt buckle Refer to: <b>Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)</b> (501-20 Supplemental Restraint System, Description and Operation).

Item	Description
5	Servo motor, seat rails, forward and rearward motion
6	Compact wiring harness connector
7	Wiring harness.
8	Switch group for electrically adjustable driver's seat
9	Servo motor for electrical seat height adjustment
10	Front seat cushion
11	Front seat backrest
12	Head restraint adjustment.

DESCRIPTION AND OPERATION

Seat warmer unit



E101820

Item	Description
1	Heating mat, front seat backrest
2	Front seat cushion heating mat
3	Seat heating module

The following components can be replaced separately or as a unit:

- Heating mat, front seat backrest
- Front seat cushion heating mat
- Seat heating module

Seat occupancy sensor, passenger side

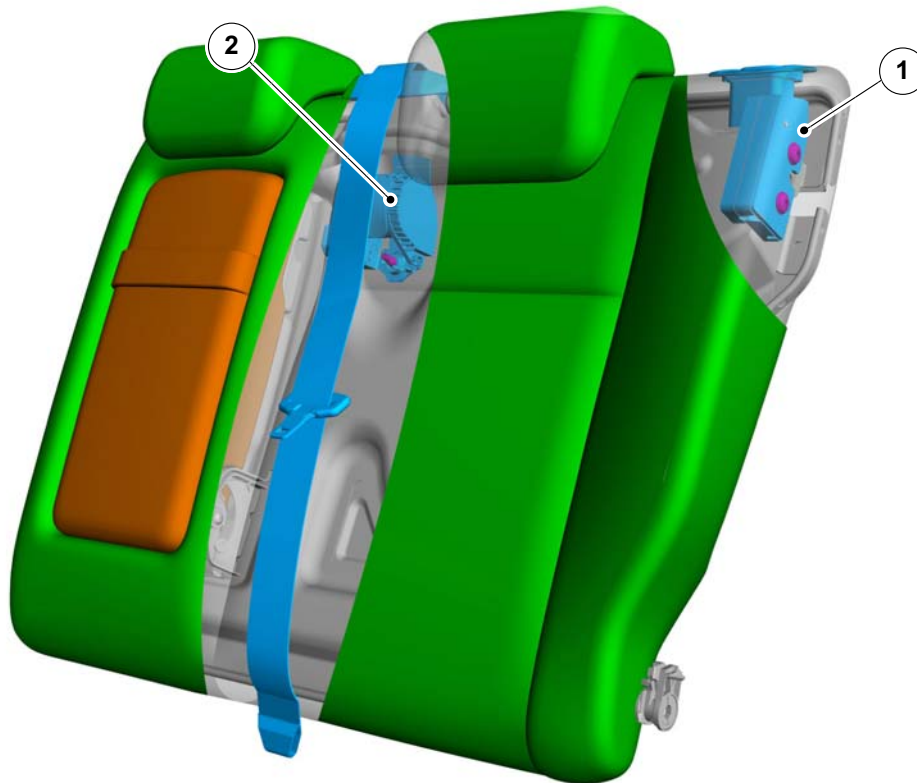


E101824

Item	Description
1	Seat occupancy sensor, passenger side

## DESCRIPTION AND OPERATION

## Rear Seat



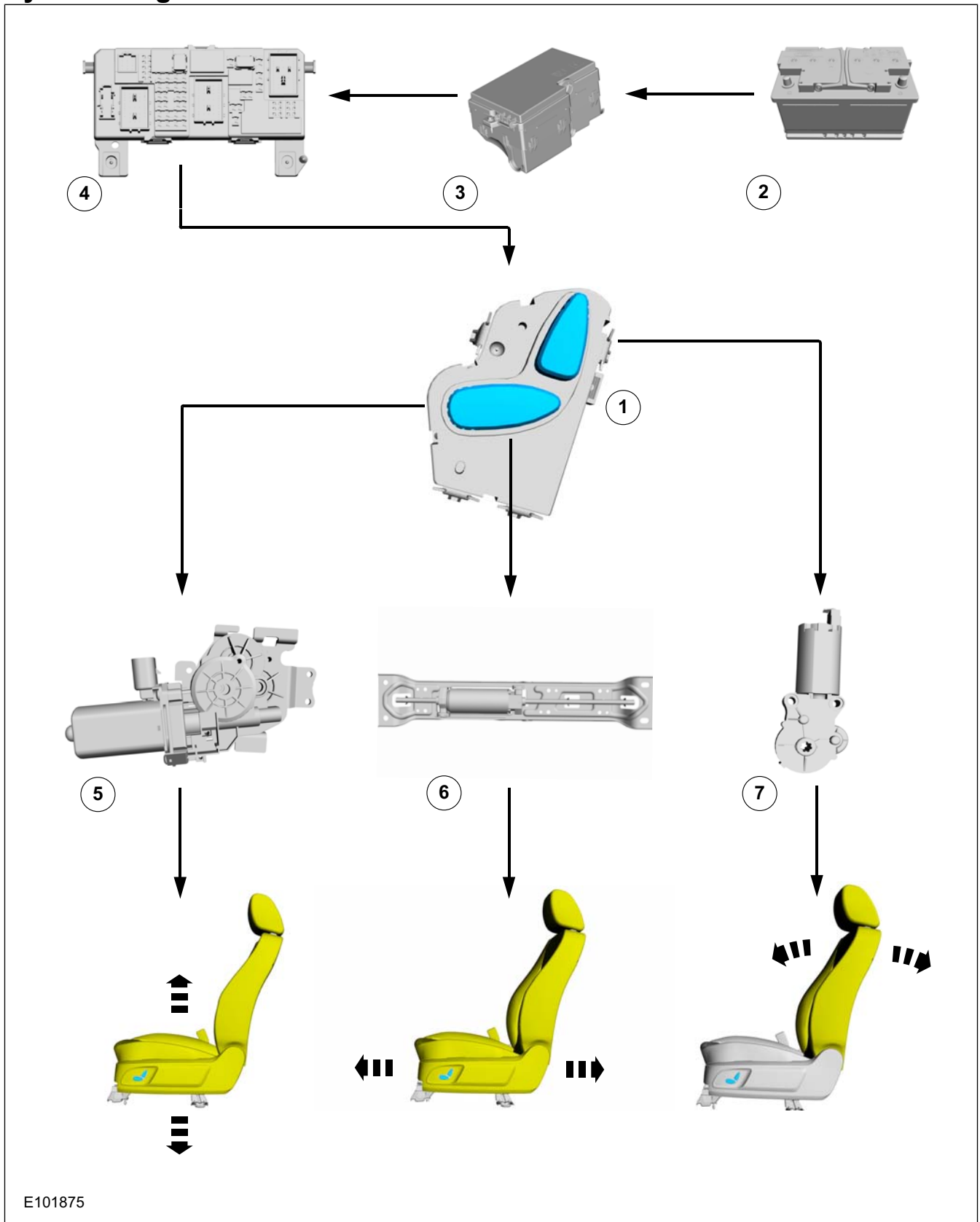
E101853

Item	Description
1	Roll-up mechanism, rear centre seat belt
2	Locking mechanism, rear seat backrest

DESCRIPTION AND OPERATION

Seats – System Operation and Component Description

System Diagram





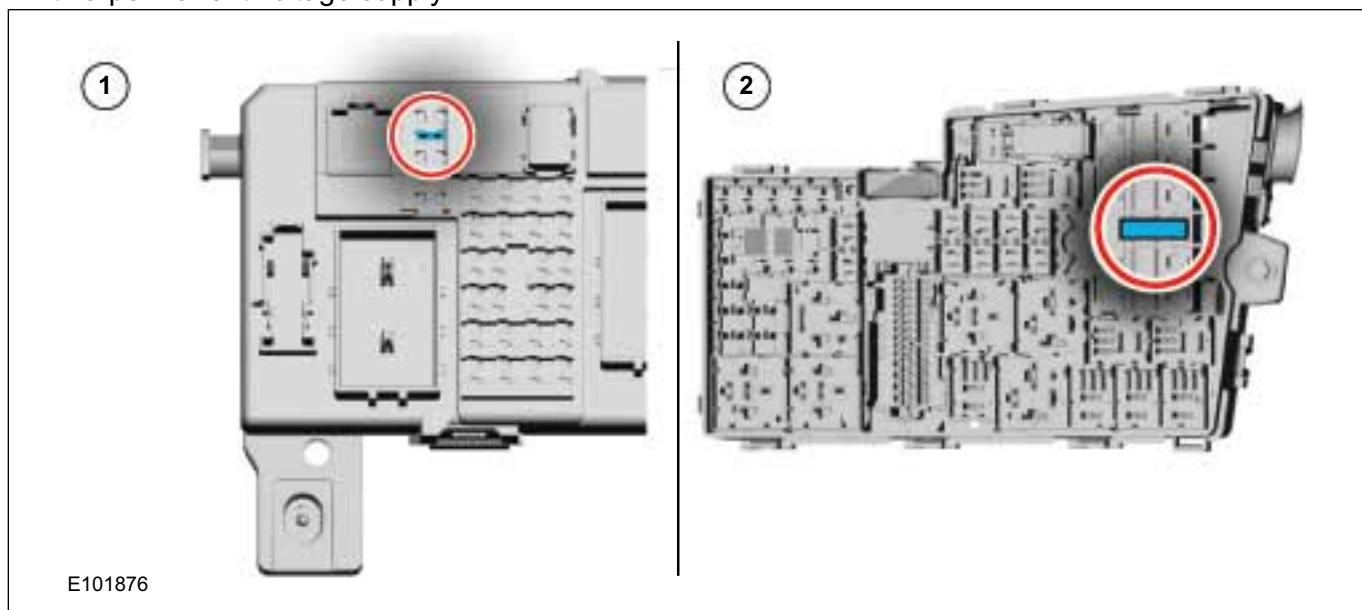
**DESCRIPTION AND OPERATION**

Item	Description
1	Switch group, electrically adjustable seat
2	B+ (battery positive voltage)
3	EJB (engine junction box)
4	GEM (generic electronic module)

Item	Description
5	Seat servo motor, up/down
6	Driver's seat servo motor, forward/back
7	Backrest servo motor, forward/back

**System Operation**

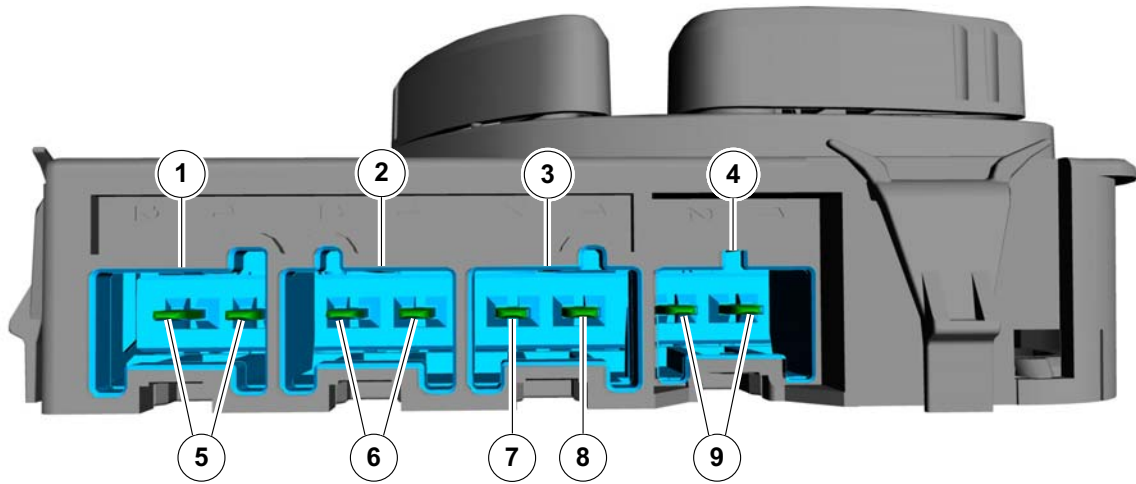
The switch group for the electrically adjustable driver's seat is supplied by the GEM and the EJB with a permanent voltage supply.



Item	Description
1	Fuse GEM
2	Fuse EJB

Both supply lines of all three servo motors are separately connected to the switch group for the electrically adjustable driver's seat.

DESCRIPTION AND OPERATION



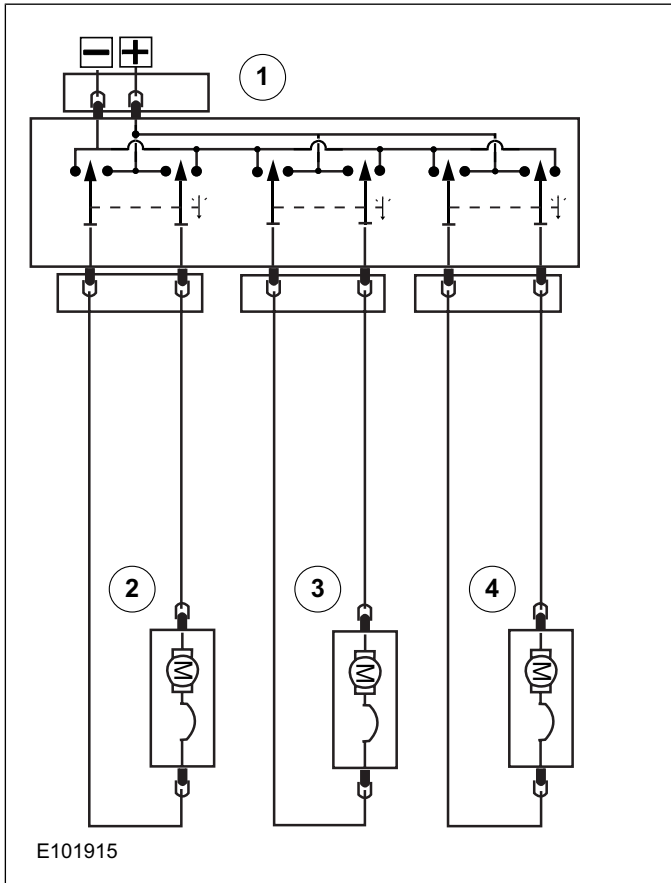
E101916

Item	Description
1	Output, seat servo motor, forward/back
2	Output, backrest servo motor, forward/back
3	Input, switch group for electrically adjustable driver's seat
4	Output, seat servo motor, up/down
5	Supply lines, seat servo motor, forward/back

Item	Description
6	Supply lines, backrest servo motor, forward/back
7	Ground supply, switch group for electrically adjustable driver's seat
8	Voltage supply, switch group for electrically adjustable driver's seat
9	Supply lines, seat servo motor, up/down

When the switch is pressed, voltage and ground are connected to both of the supply lines of the selected servo motor. In the process, the polarity changes depending on the switch position and therefore the direction of rotation of the relevant servo motor.

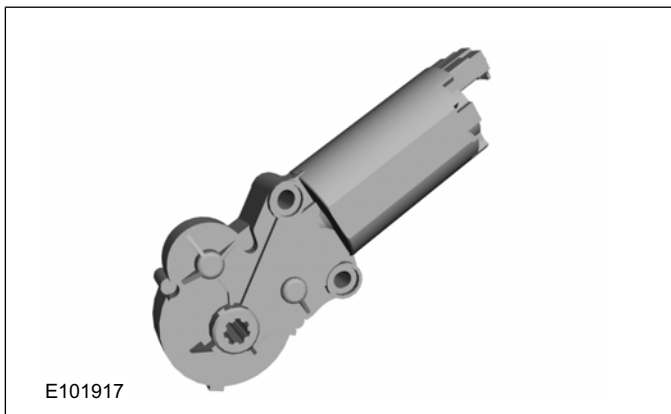
**DESCRIPTION AND OPERATION**



Item	Description
1	Switch group for electrically adjustable driver's seat
2	Seat servo motor, up/down
3	Backrest servo motor, forward/back
4	Seat servo motor, forward/back

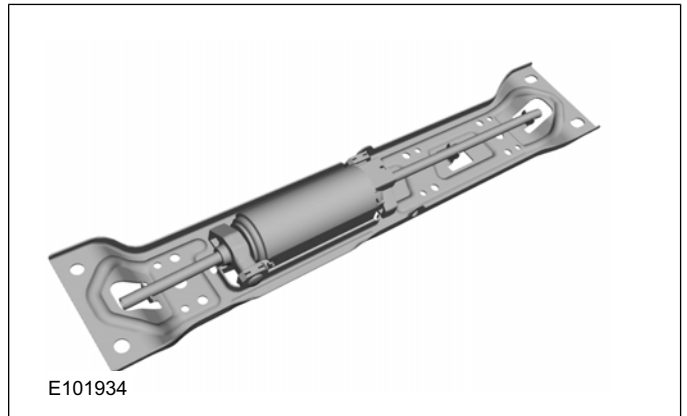
**Component Description**

**Backrest servo motor, forward/back**



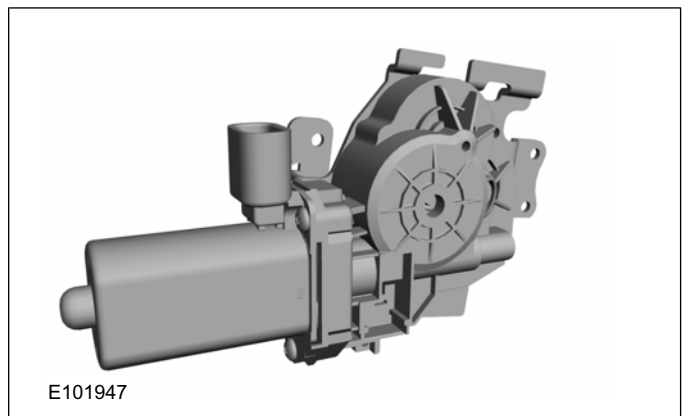
The forward/backward servo motor for the backrest comprises a DC motor with integrated gearing (worm gear) and thermal cutout. In the event that the servo motor seizes up under braking or jams, an internal thermal cutout is tripped in order to interrupt the power supply to the servo motor.

**Seat servo motor, forward/back**



The forward/back servo motor for the seat comprises a DC motor with thermal cutout. In the event that the servo motor seizes up under braking or jams, an internal thermal cutout is tripped in order to interrupt the power supply to the servo motor.

**Seat servo motor, up/down**



The up/down servo motor for the seat comprises a DC motor with integrated gearing (worm gear) and thermal cutout. In the event that the servo motor seizes up under braking or jams, an internal thermal cutout is tripped in order to interrupt the power supply to the servo motor.

**DIAGNOSIS AND TESTING****Seats**

Refer to **Wiring Diagrams Section 501-10**, for schematic and connector information.

**Inspection and Verification**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

<b>Mechanical</b>	<b>Electrical</b>
<ul style="list-style-type: none"><li>• Damaged switch(es)</li></ul>	<ul style="list-style-type: none"><li>• Fuse(s)</li><li>• Wiring harness</li><li>• Electrical connector(s)</li><li>• Motor(s)</li><li>• Switch(es)</li></ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

501-10-12

Seating

501-10-12

## REMOVAL AND INSTALLATION

## Front Seat(40 100 0; 40 100 4; 40 101 0)

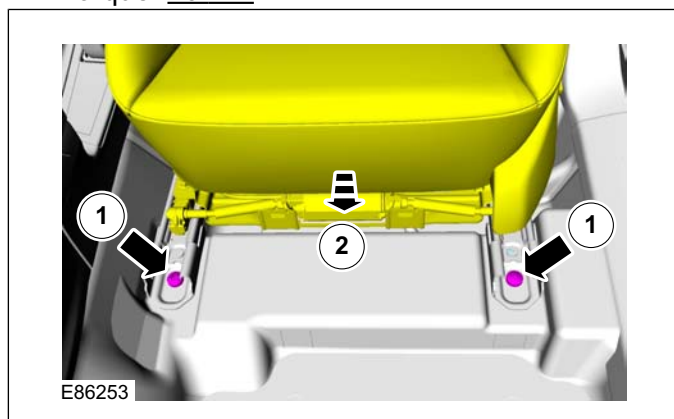
## Removal

## WARNINGS:

- ▲ The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.
- ▲ Make sure that the vehicle electrical system is fully depowered and no other power source is connected.
- ▲ Wear safety goggles.
- ▲ Refer to: **Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).**

**NOTE:** Removal steps in this procedure may contain installation details.

1. Torque: 40 Nm



2. Refer to: **Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).**

3. Torque: 40 Nm



4. 2. If equipped.



## Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Driver Seat Track

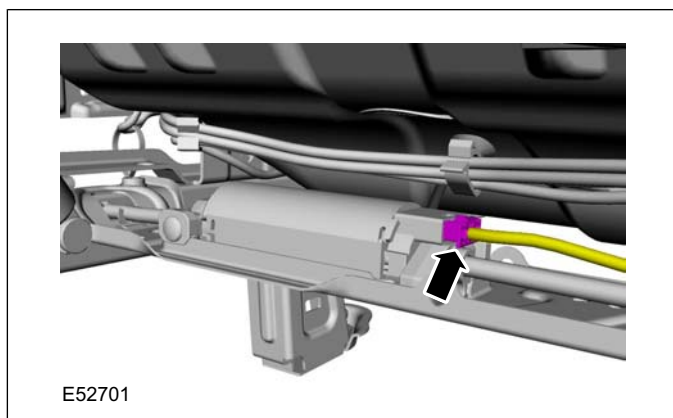
Materials	
Name	Specification
Universal bonder	SK-M2G9518-A / A77SX-19554-GA

## Removal

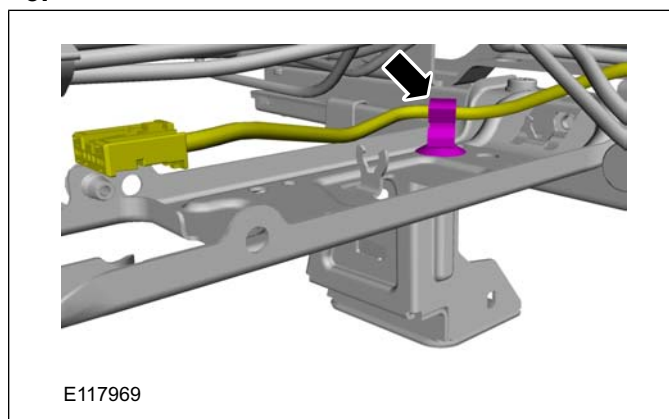
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Seat** (501-10 Seating, Removal and Installation).

2.



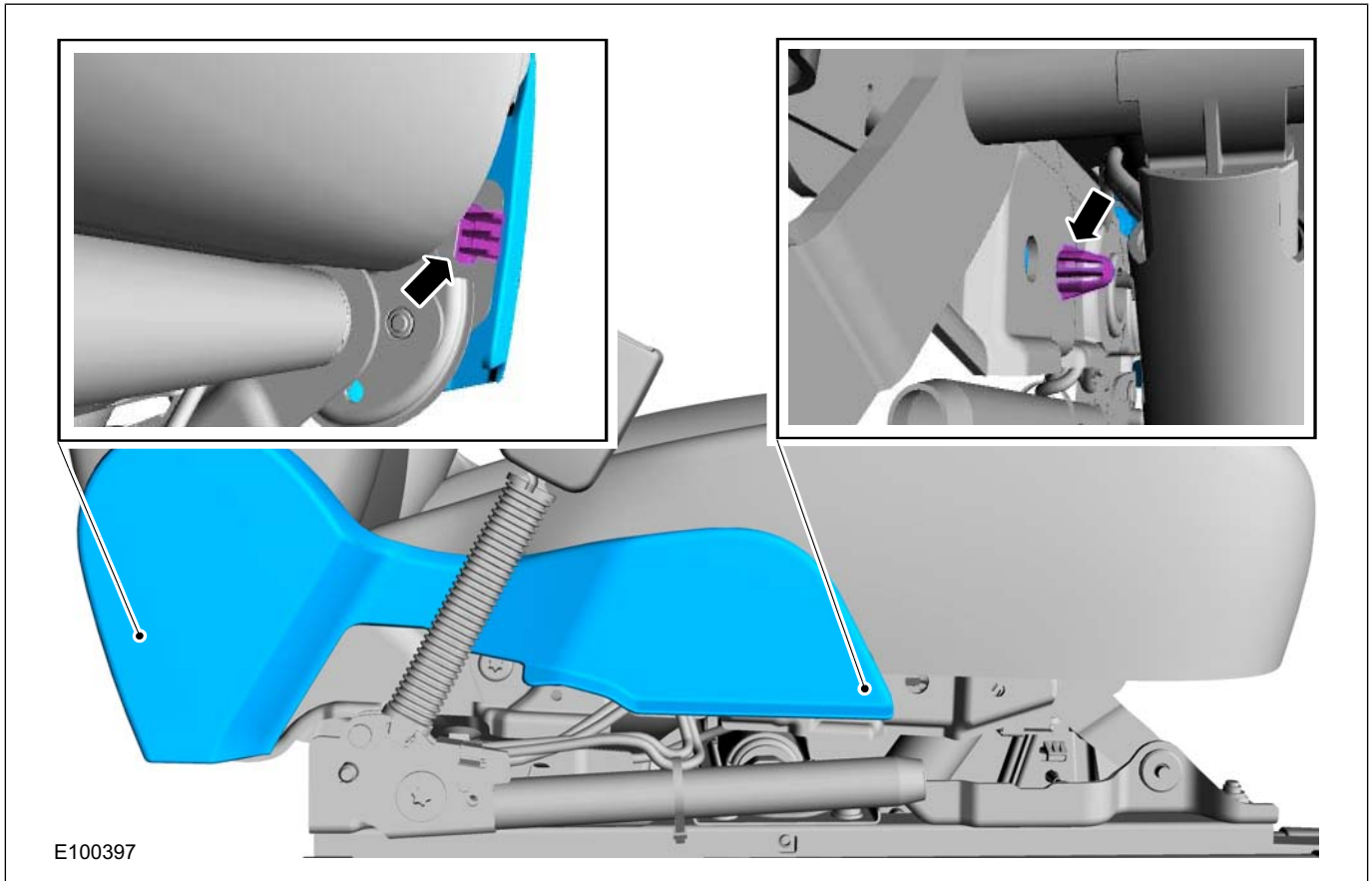
3.



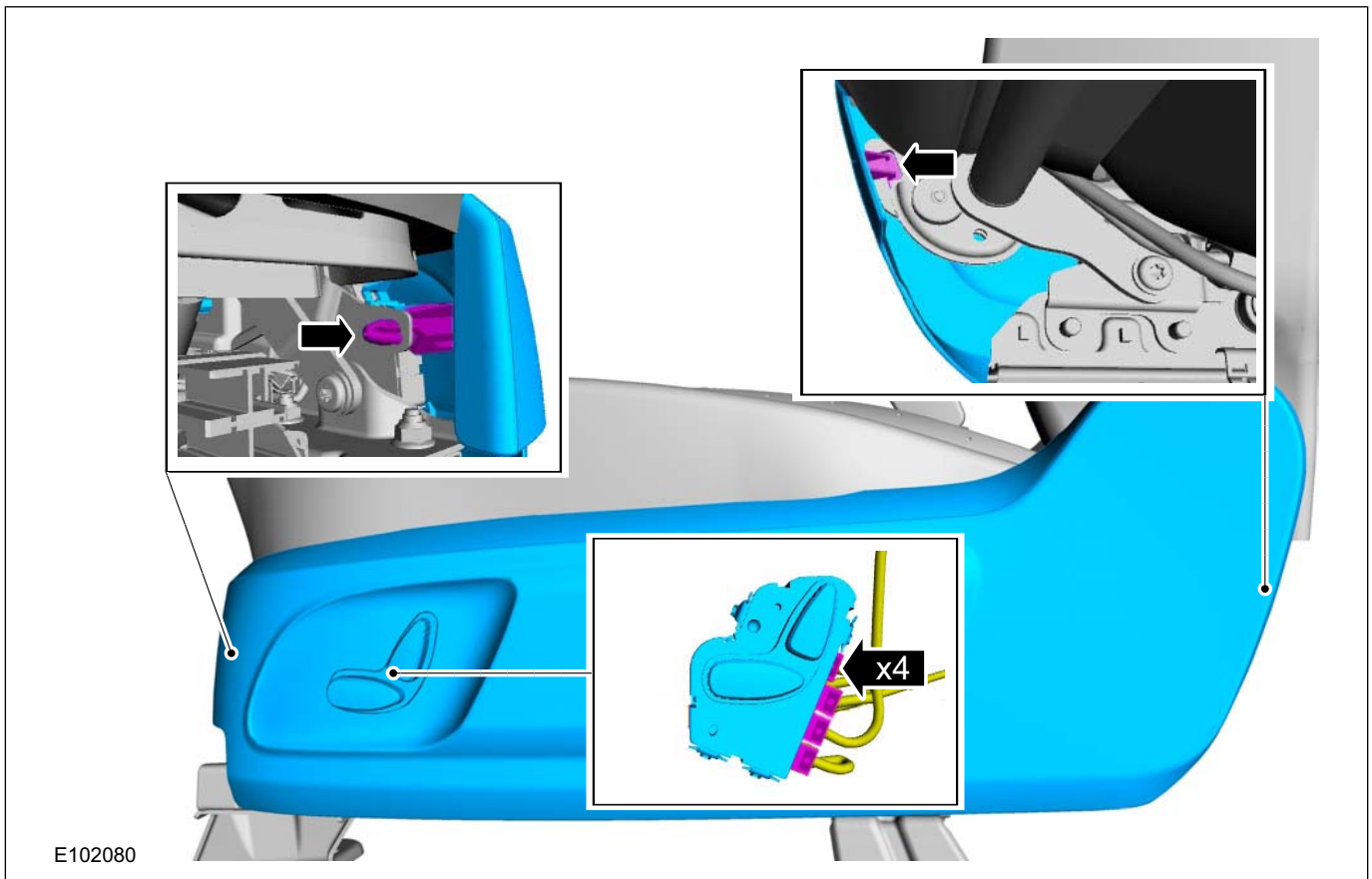
4.



REMOVAL AND INSTALLATION



5.



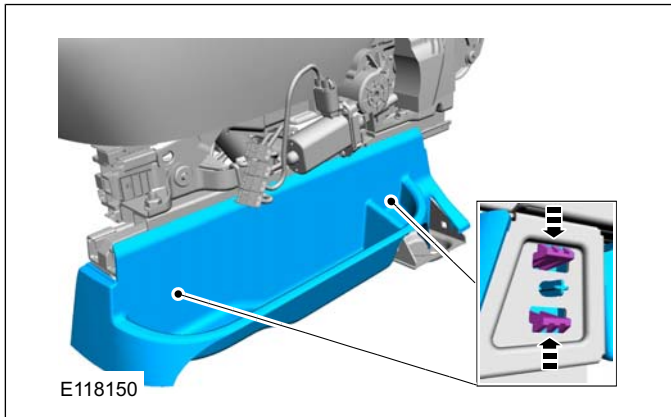
501-10-15

Seating

501-10-15

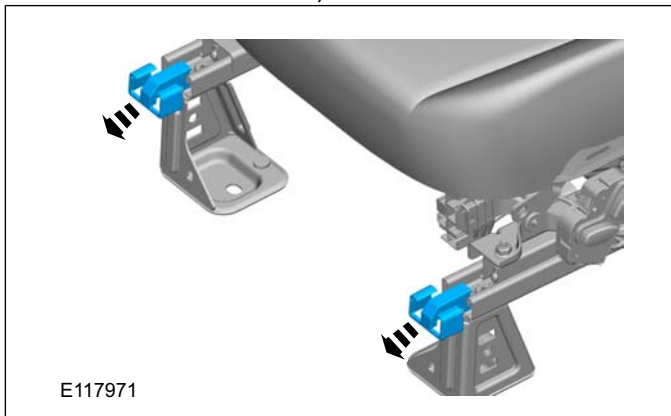
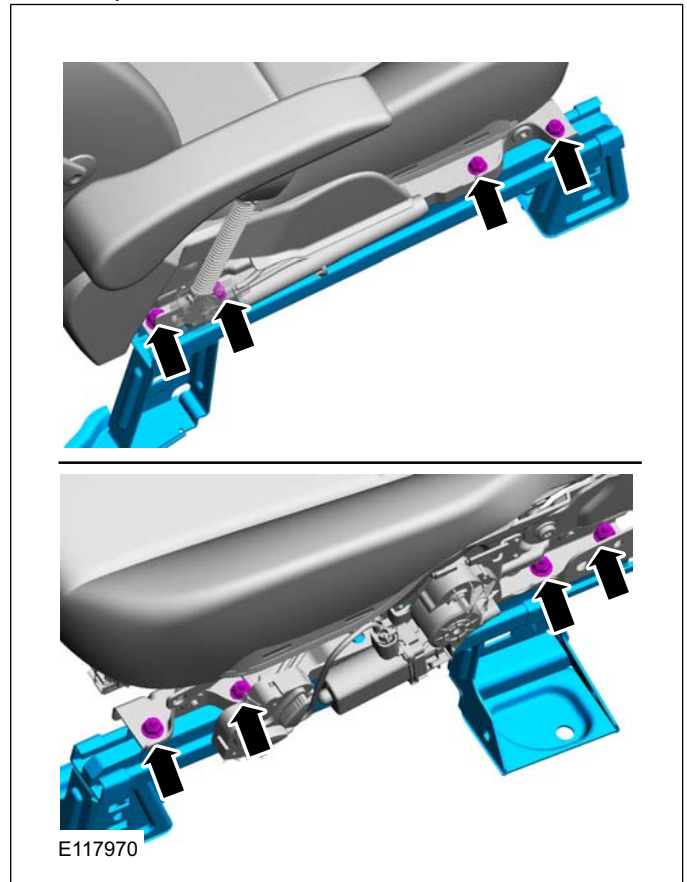
## REMOVAL AND INSTALLATION

6.



7. On both sides.

Material: Universal bonder (SK-M2G9518-A /  
A77SX-19554-GA) adhesive

8. Torque: 20 Nm

## Installation

1. To install, reverse the removal procedure.

501-10-16

Seating

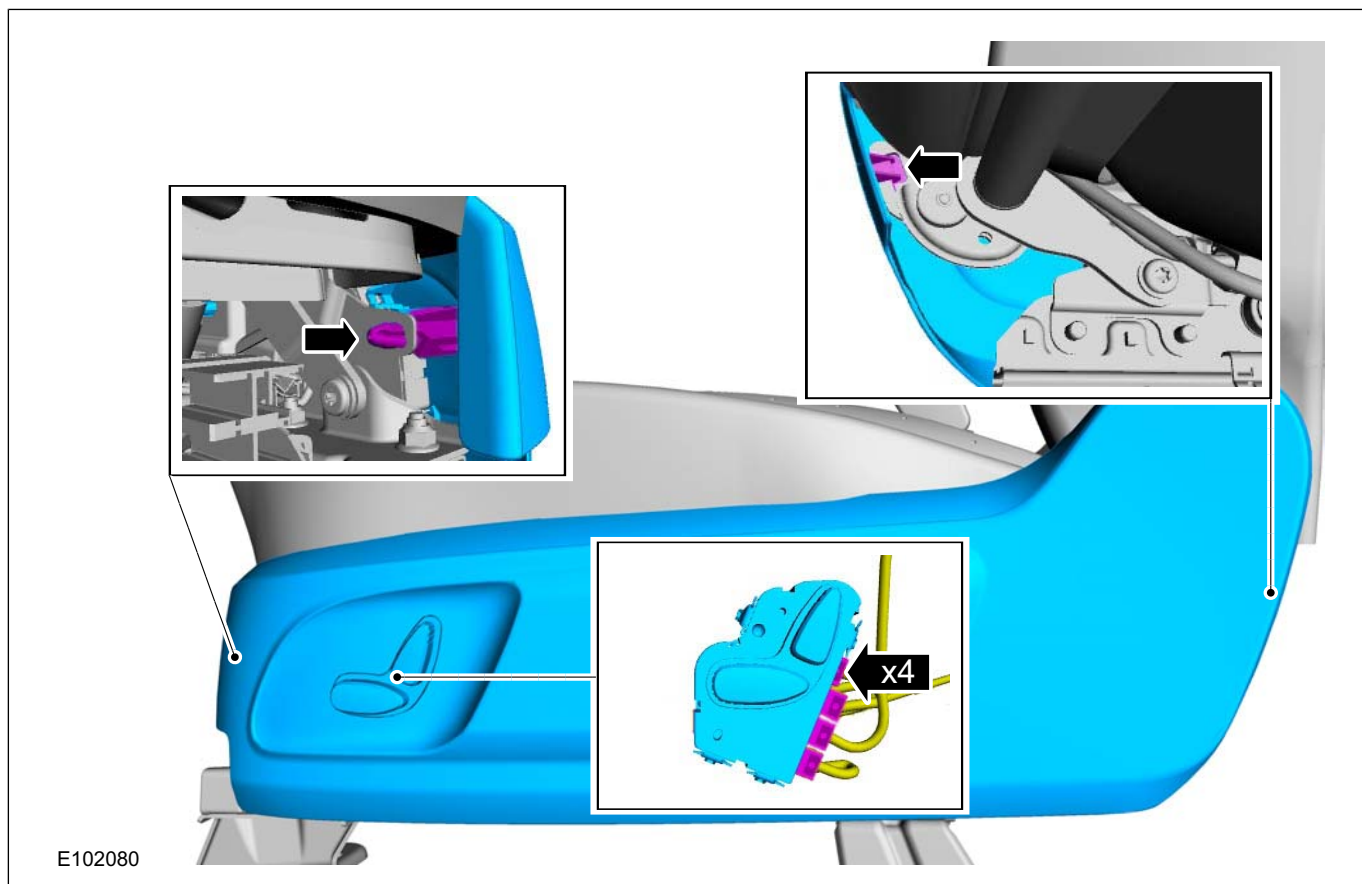
501-10-16

## REMOVAL AND INSTALLATION

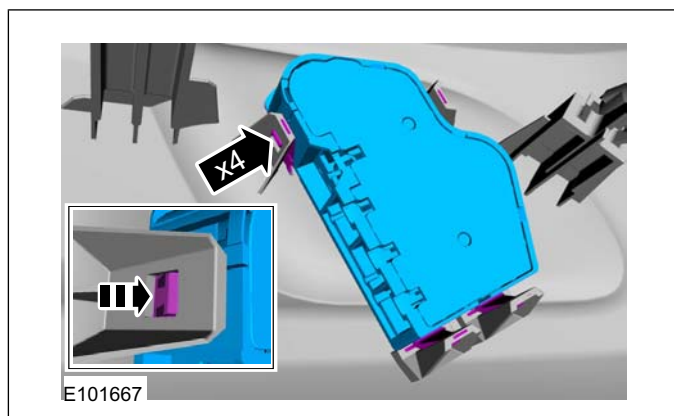
## Front Seat Control Switch(33 580 0; 33 583 0; 33 585 0)

1.

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

2.



## Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Seat Cushion Cover(40 105 0)

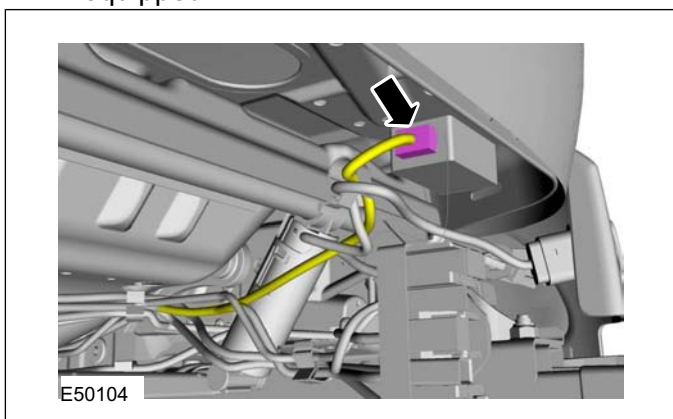
General Equipment

Hog Ring Plier

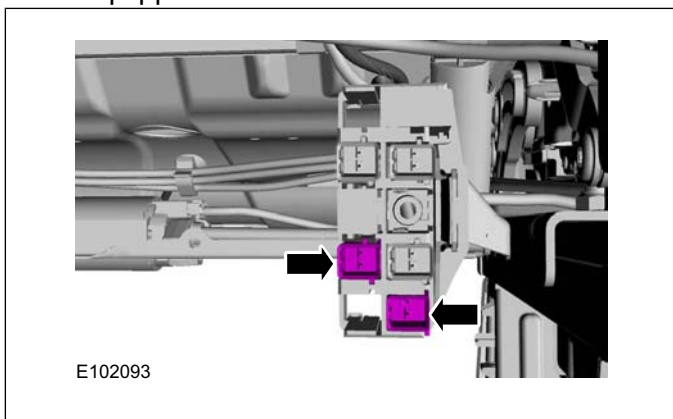
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

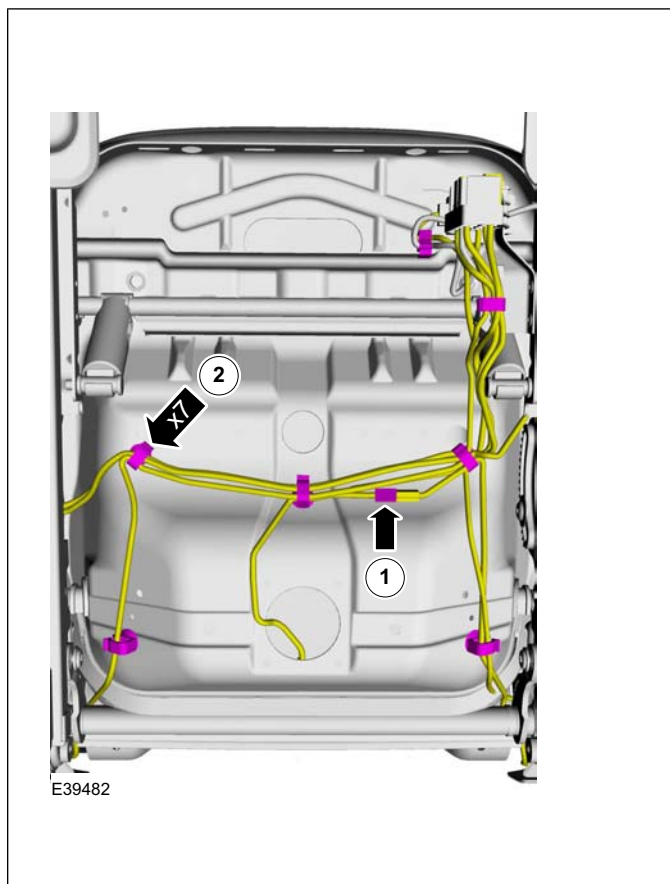
1. Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
2. If equipped.



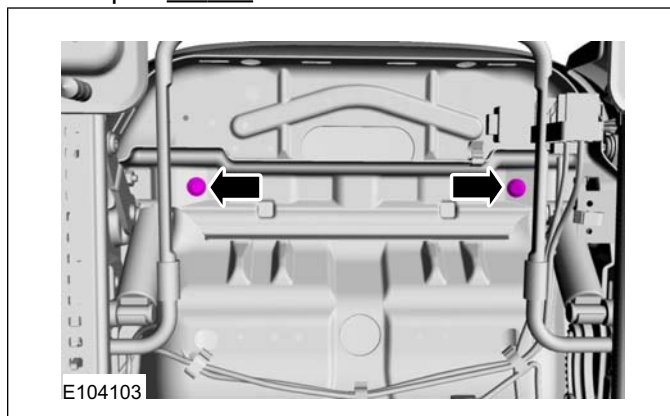
3. If equipped.



4. 1. If equipped.



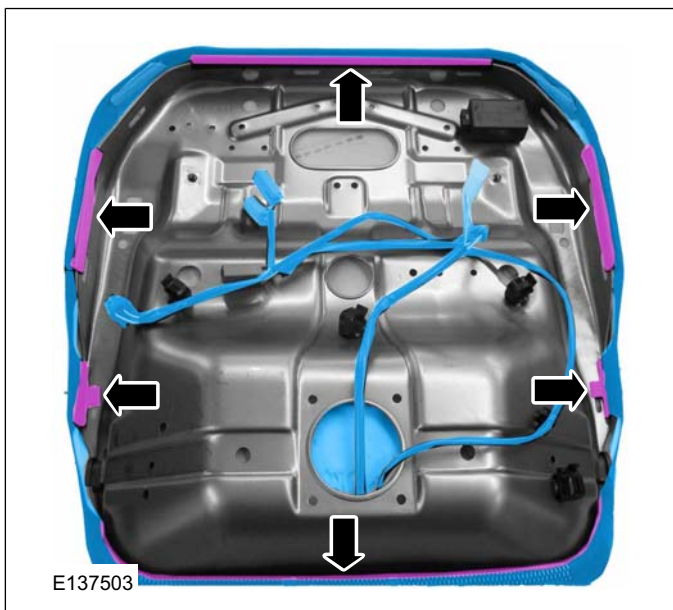
5. Torque: 23 Nm



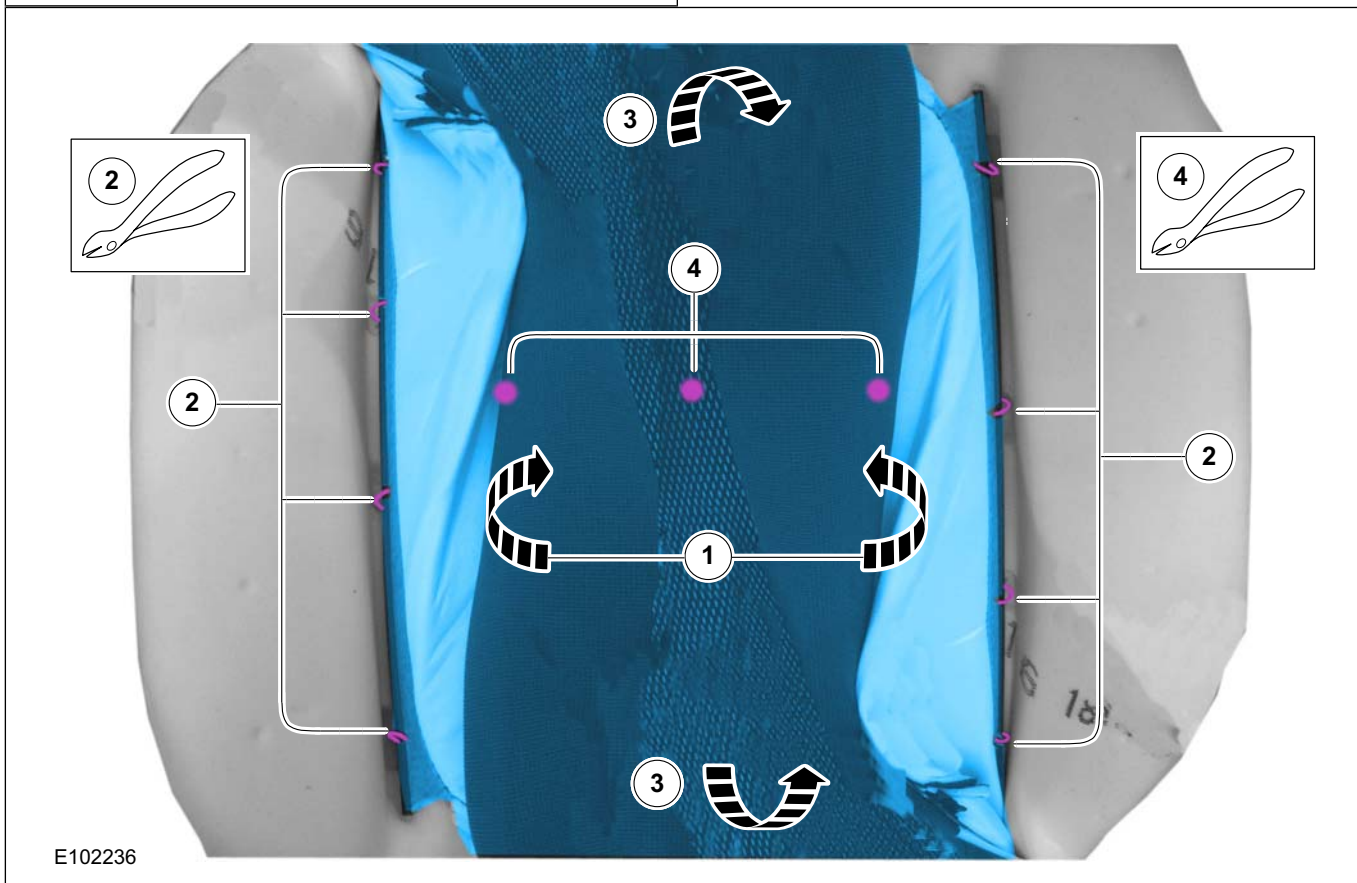


REMOVAL AND INSTALLATION

6.

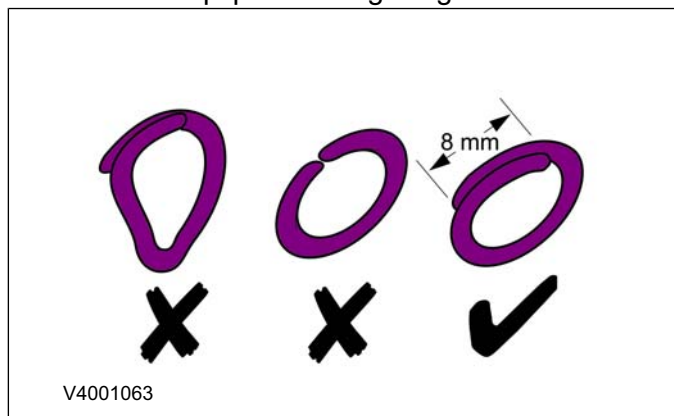


7. **⚠ CAUTION:** Make sure that the seat cushion heater mat (if equipped) is correctly located with the seat cushion cover hook and loop tape.



Installation

1. To install, reverse the removal procedure.

**REMOVAL AND INSTALLATION****2. General Equipment: Hog Ring Plier**

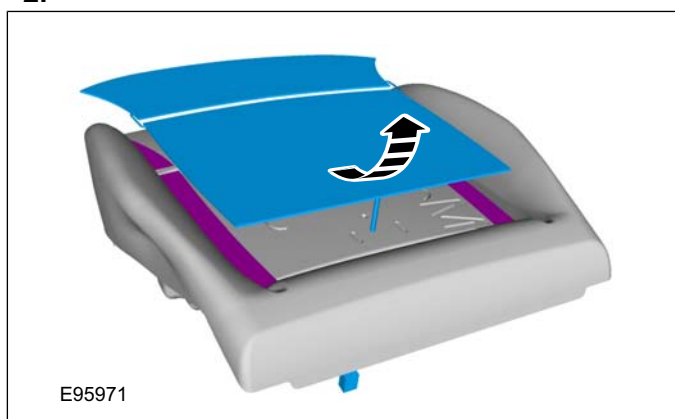


## REMOVAL AND INSTALLATION

## Front Seat Cushion Heater Mat(33 401 0; 33 401 4)

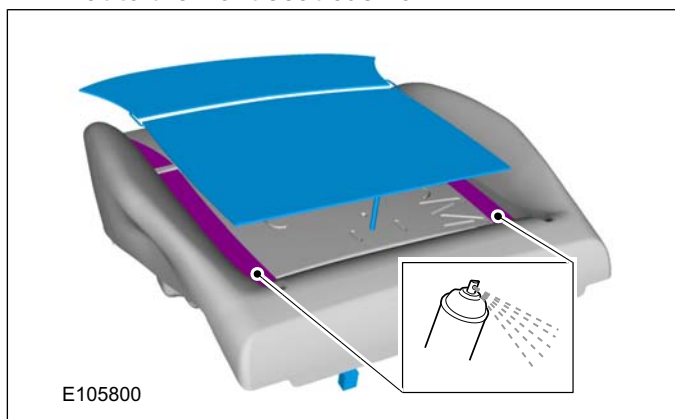
## Removal

1. Refer to: **Front Seat Cushion Cover** (501-10 Seating, Removal and Installation).
- 2.



## Installation

1. Using adhesive, secure the front seat heater mat to the front seat cushion.



2. Refer to: **Front Seat Cushion Cover** (501-10 Seating, Removal and Installation).

**REMOVAL AND INSTALLATION****Front Seat Cushion(40 104 0)****Removal**

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Seat Cushion Cover** (501-10 Seating, Removal and Installation).
2. If equipped.  
Refer to: **Front Seat Cushion Heater Mat** (501-10 Seating, Removal and Installation).
3. If equipped.  
Refer to: **Seat Occupant Sensor** (501-10 Seating, Removal and Installation).

**Installation**

1. To install, reverse the removal procedure.



REMOVAL AND INSTALLATION

Front Seat Backrest Cover(40 108 0)

General Equipment

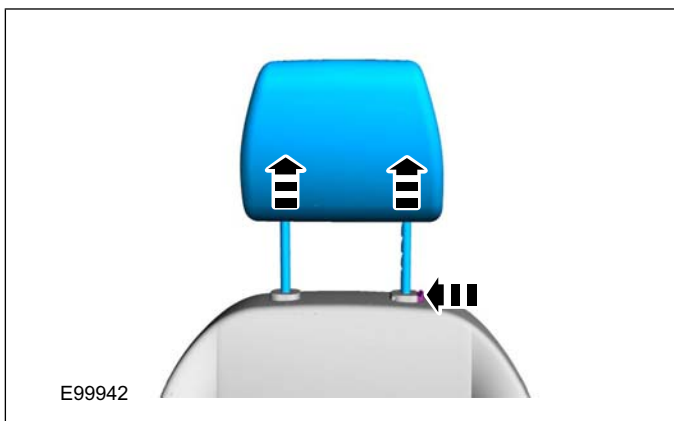
Blind Rivet Gun
Electric Drill
Hog Ring Plier

Removal

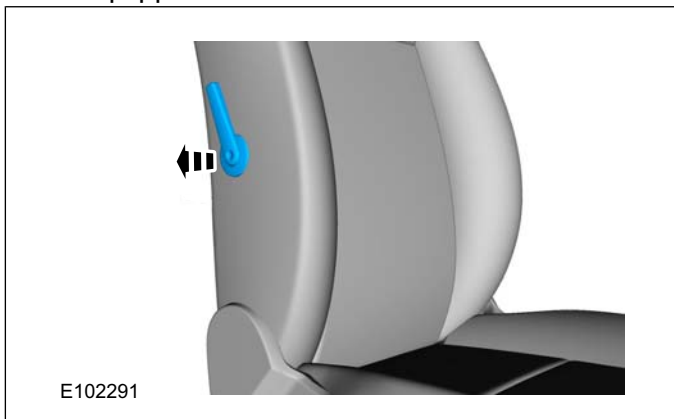
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Seat** (501-10 Seating, Removal and Installation).

2.

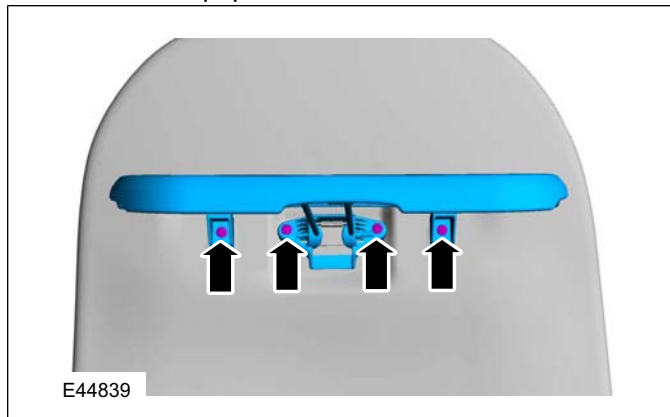


3. If equipped.

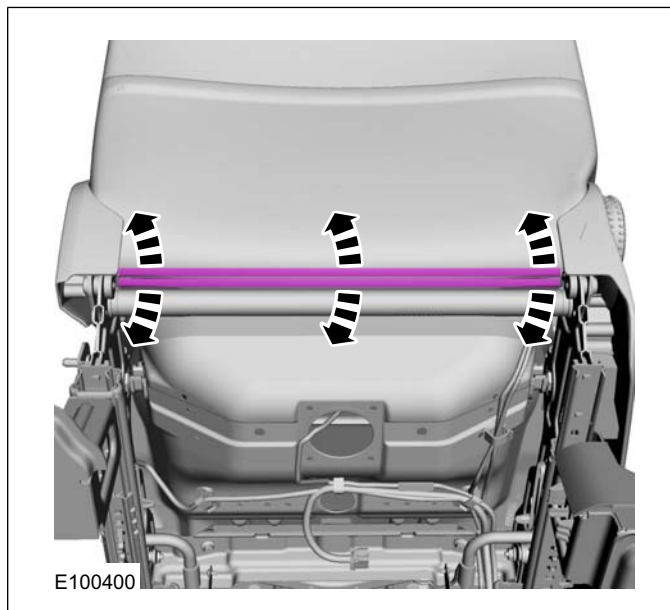


4. If equipped.

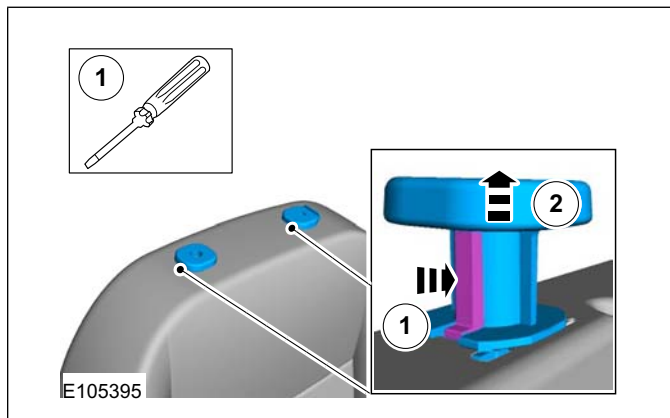
General Equipment: Electric Drill  
General Equipment: Blind Rivet Gun



5.



6.

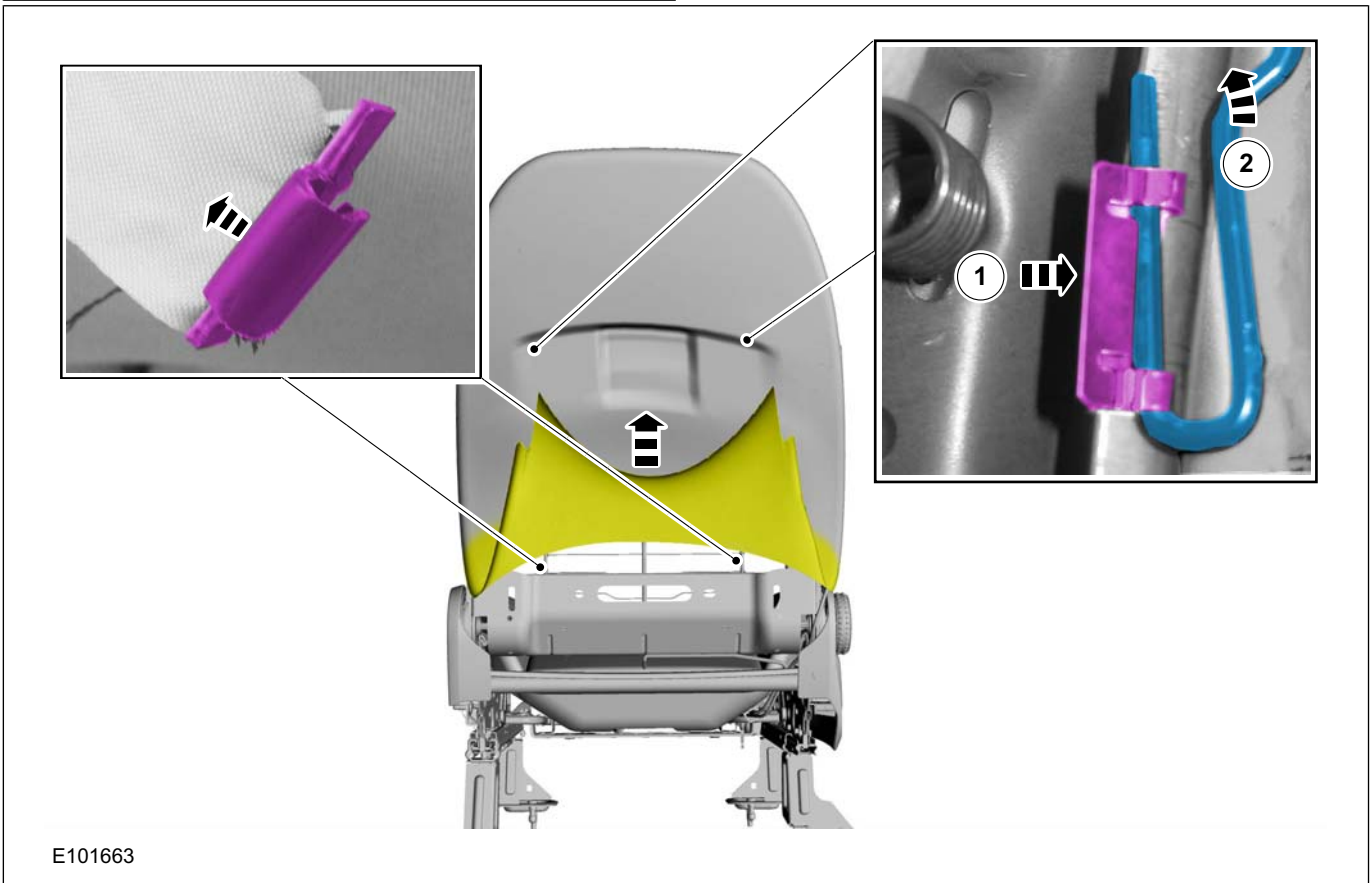
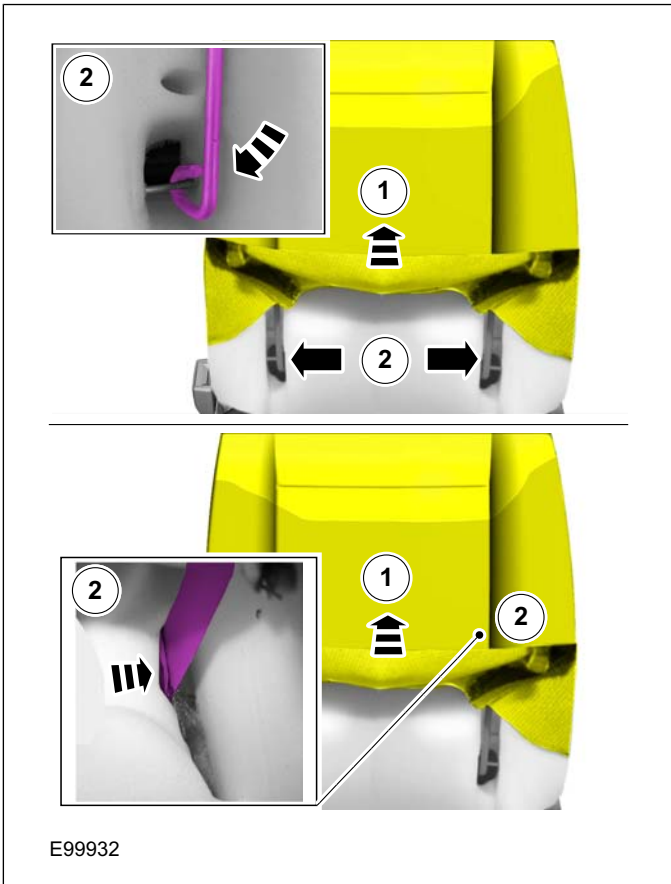


REMOVAL AND INSTALLATION

7.


Vehicles with leather seats

8.

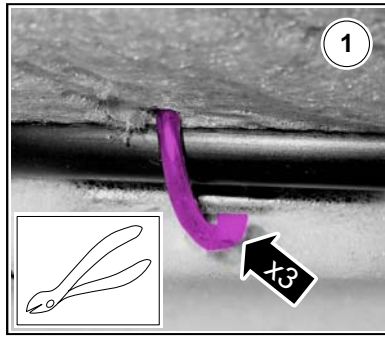
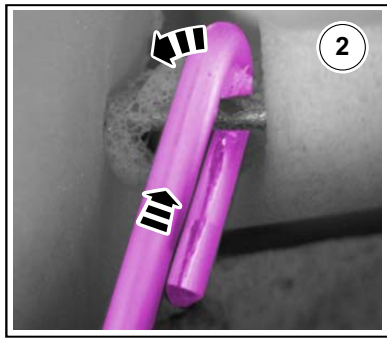


REMOVAL AND INSTALLATION

All vehicles

 backrest heater mat (if equipped) is correctly located with the seat backrest cover hook and loop tape.

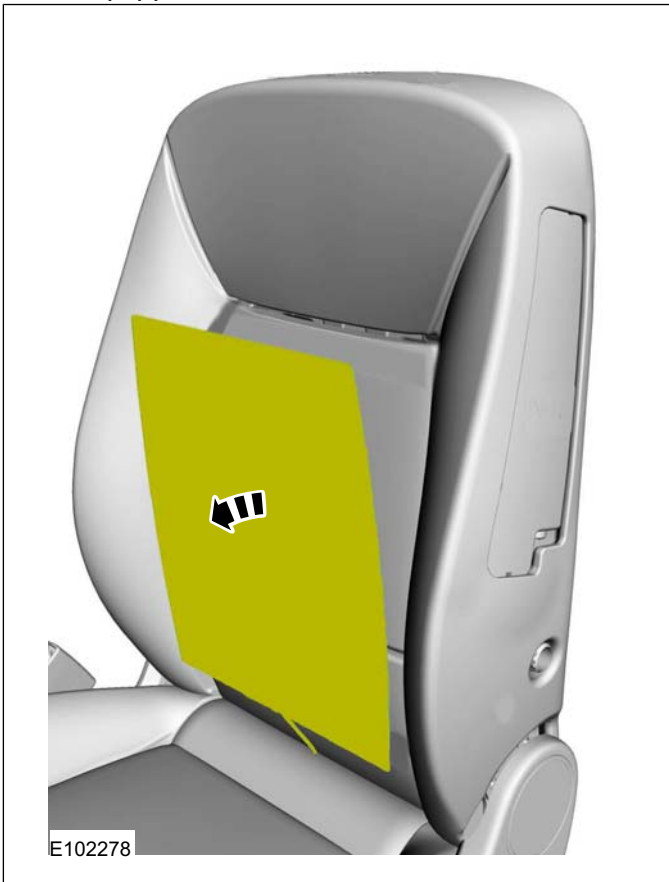
9. CAUTION: Make sure that the seat



E100401

## REMOVAL AND INSTALLATION

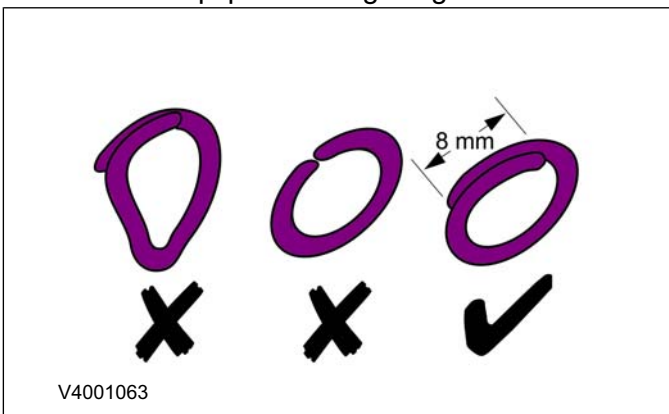
10. If equipped.



## Installation

1. To install, reverse the removal procedure.
2. **NOTE:** This step is only necessary when installing a new component.  
**NOTE:** Use the original seat backrest cover as a template.

3. General Equipment: Hog Ring Plier





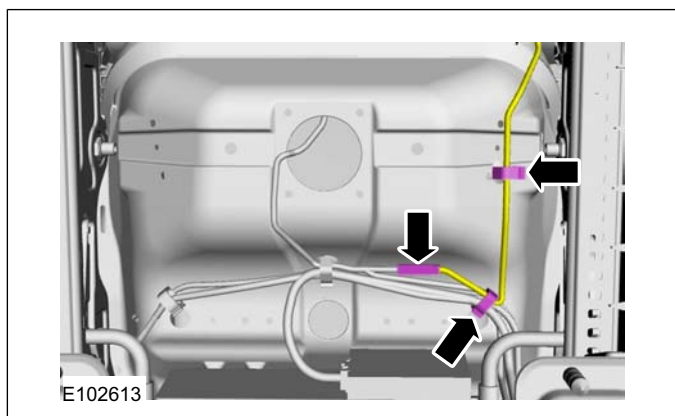
## REMOVAL AND INSTALLATION

## Front Seat Backrest Heater Mat(33 402 0; 33 402 4)

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Seat Backrest Cover** (501-10 Seating, Removal and Installation).
- 2.



- 3.



## Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Lumbar Assembly

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

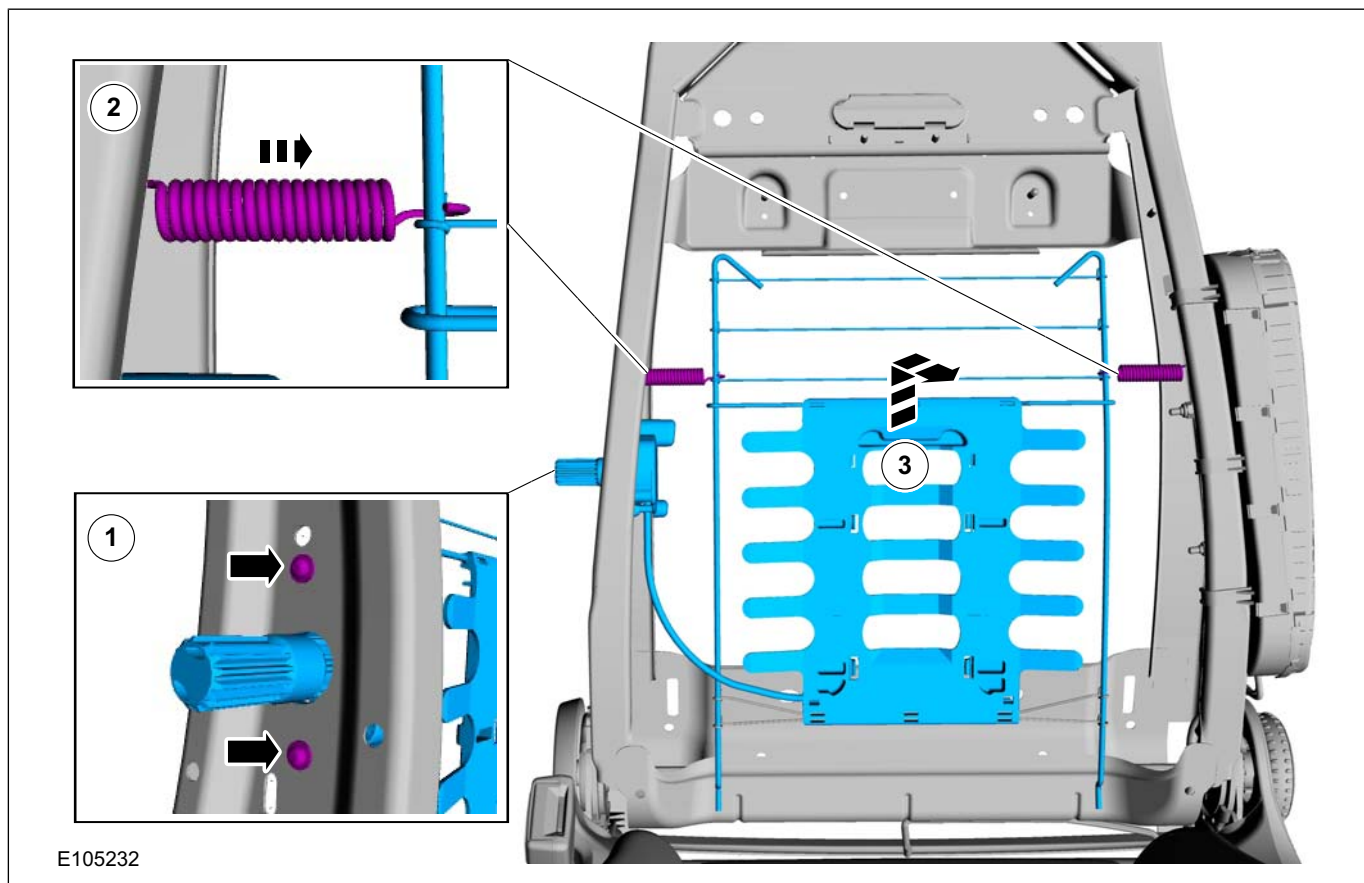
1. Refer to: **Front Seat Backrest Cover** (501-10 Seating, Removal and Installation).

- 2.



- 3.

REMOVAL AND INSTALLATION



Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

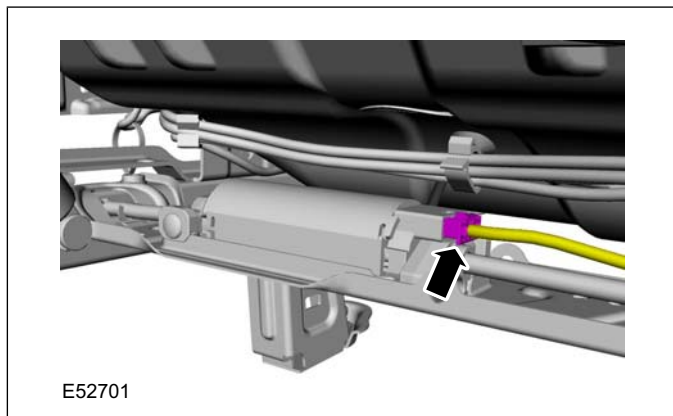
## Front Seat Track Motor(33 784 0; 33 784 4)

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

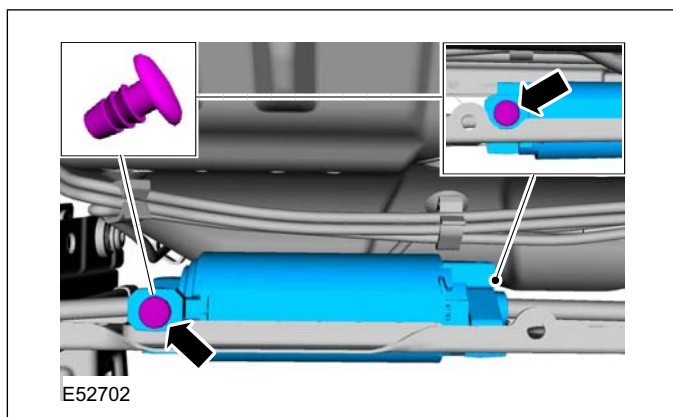
1. Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
2. If equipped.  
Refer to: **Compact Disc (CD) Changer** (415-01 Information and Entertainment System, Removal and Installation).

3.



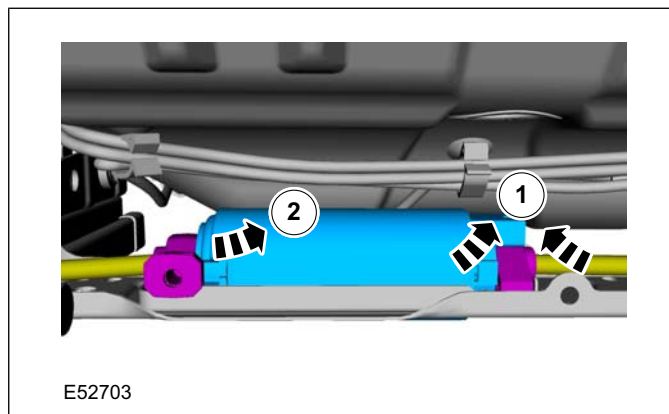
E52701

4.



E52702

5.



E52703

## Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Seat Recliner Motor(33 785 0; 33 785 4)

Removal

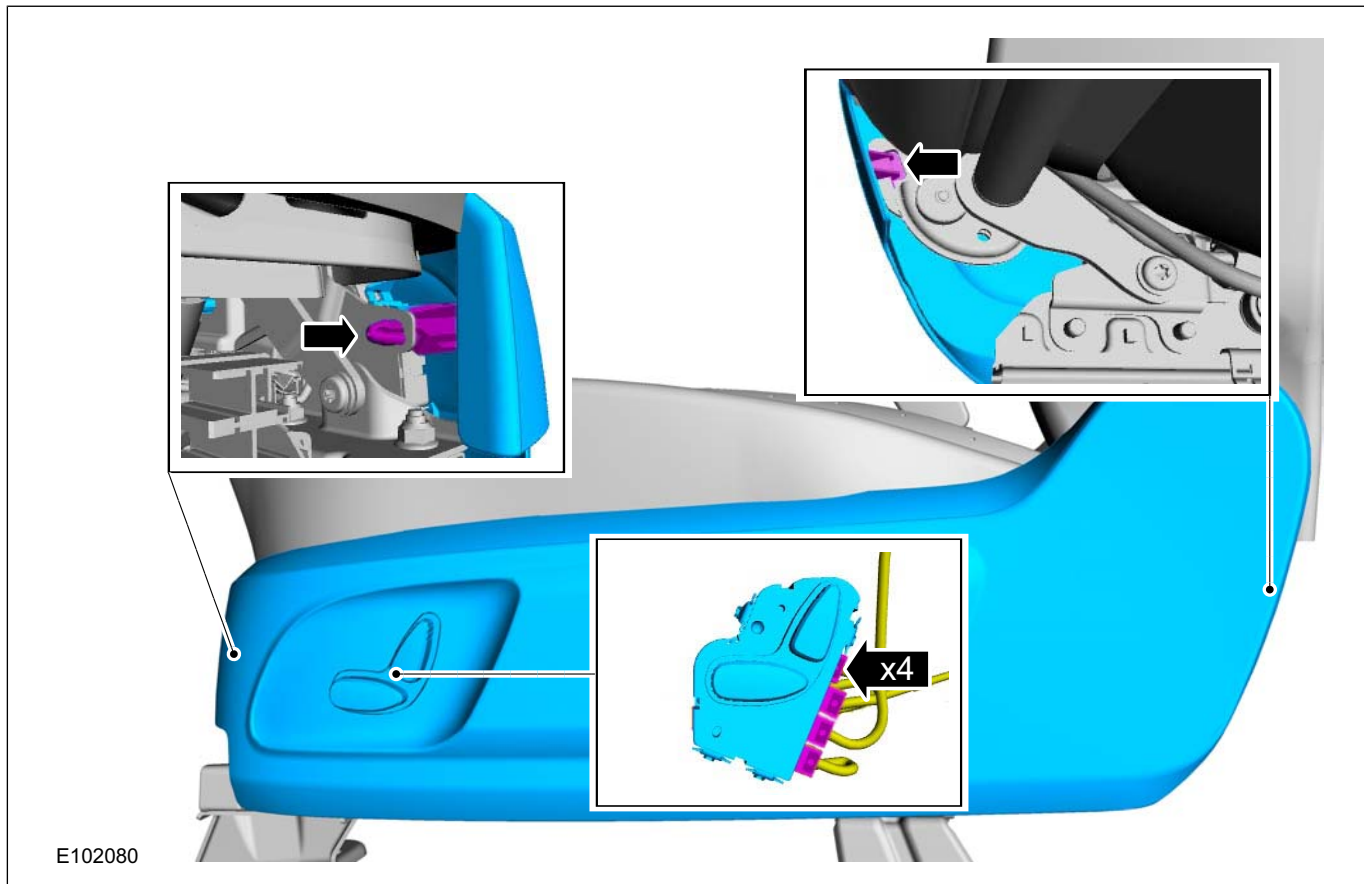
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Seat Backrest Cover** (501-10 Seating, Removal and Installation).

2.

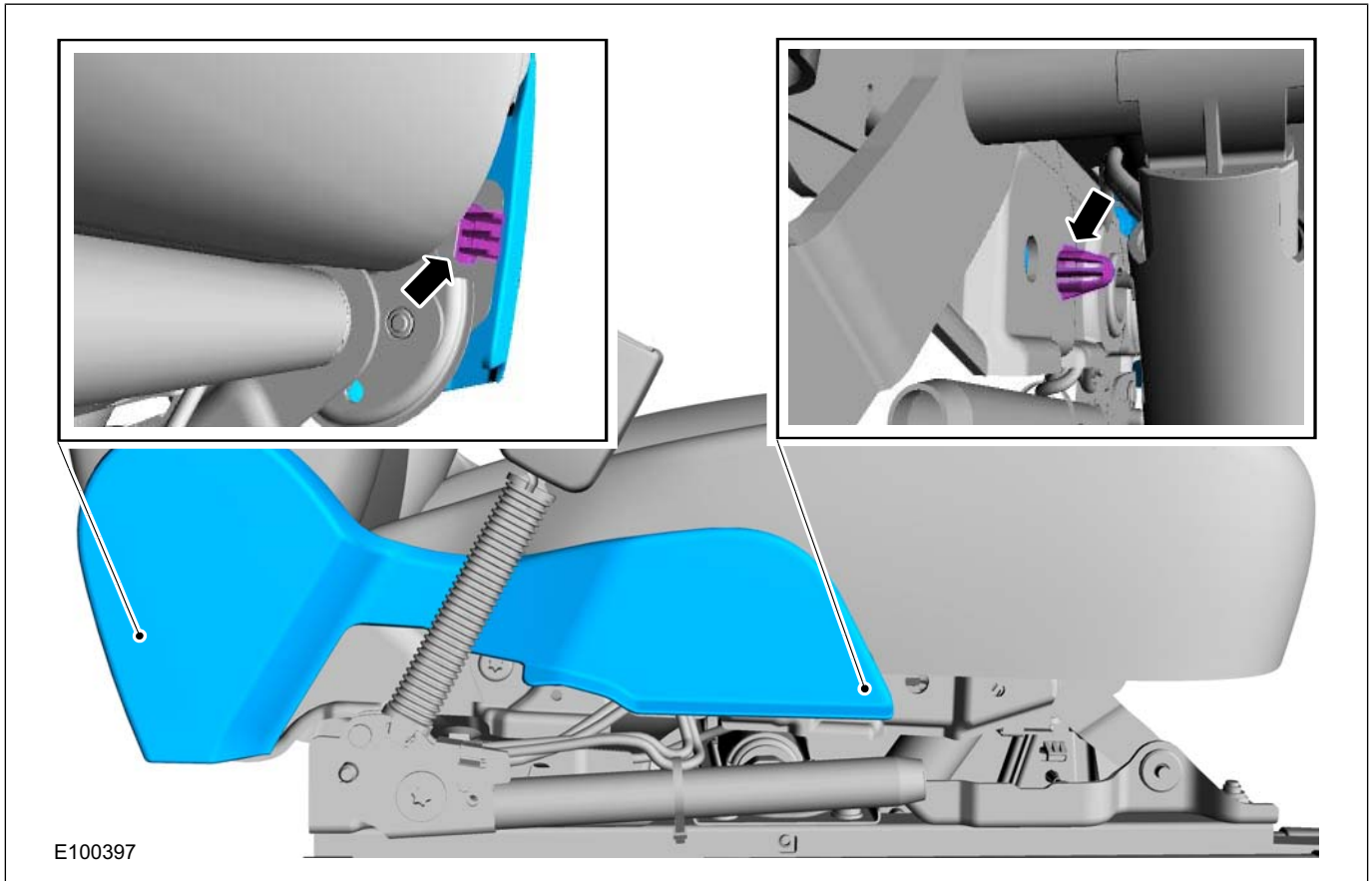


3.

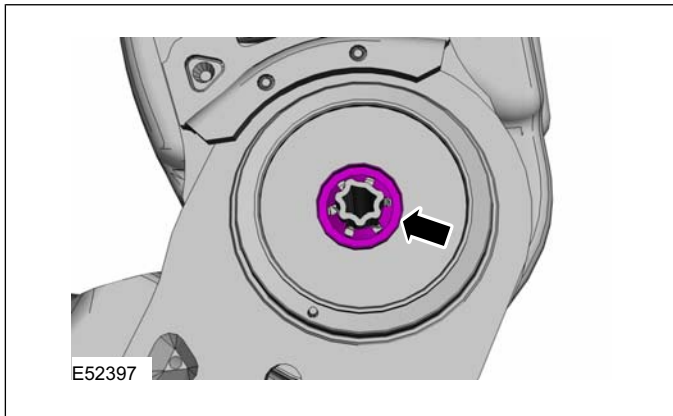


4.

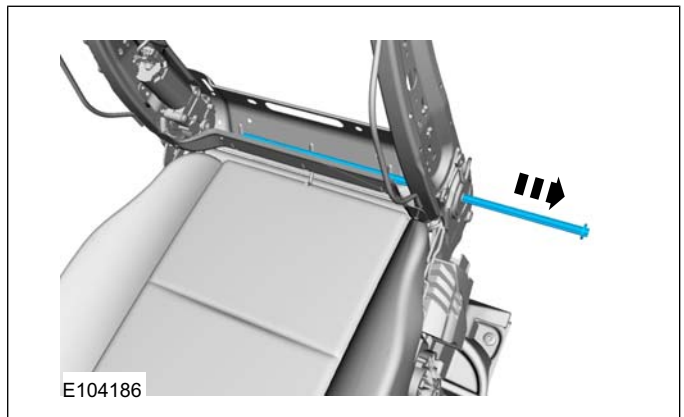
REMOVAL AND INSTALLATION



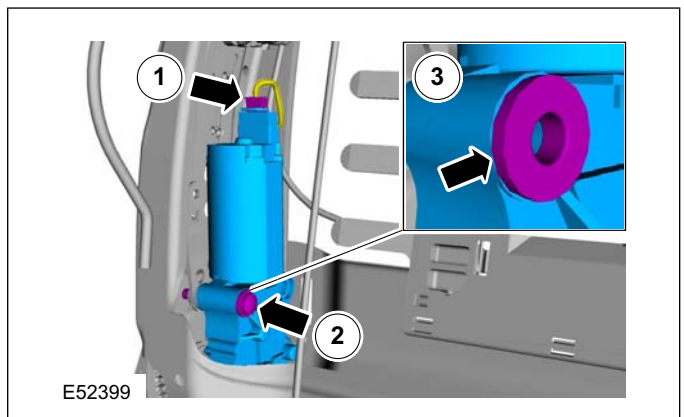
5.



6.



7.





---

**REMOVAL AND INSTALLATION****Installation**

1. To install, reverse the removal procedure.



REMOVAL AND INSTALLATION

Front Seat Height Adjustment Motor(33 797 0; 33 797 4)

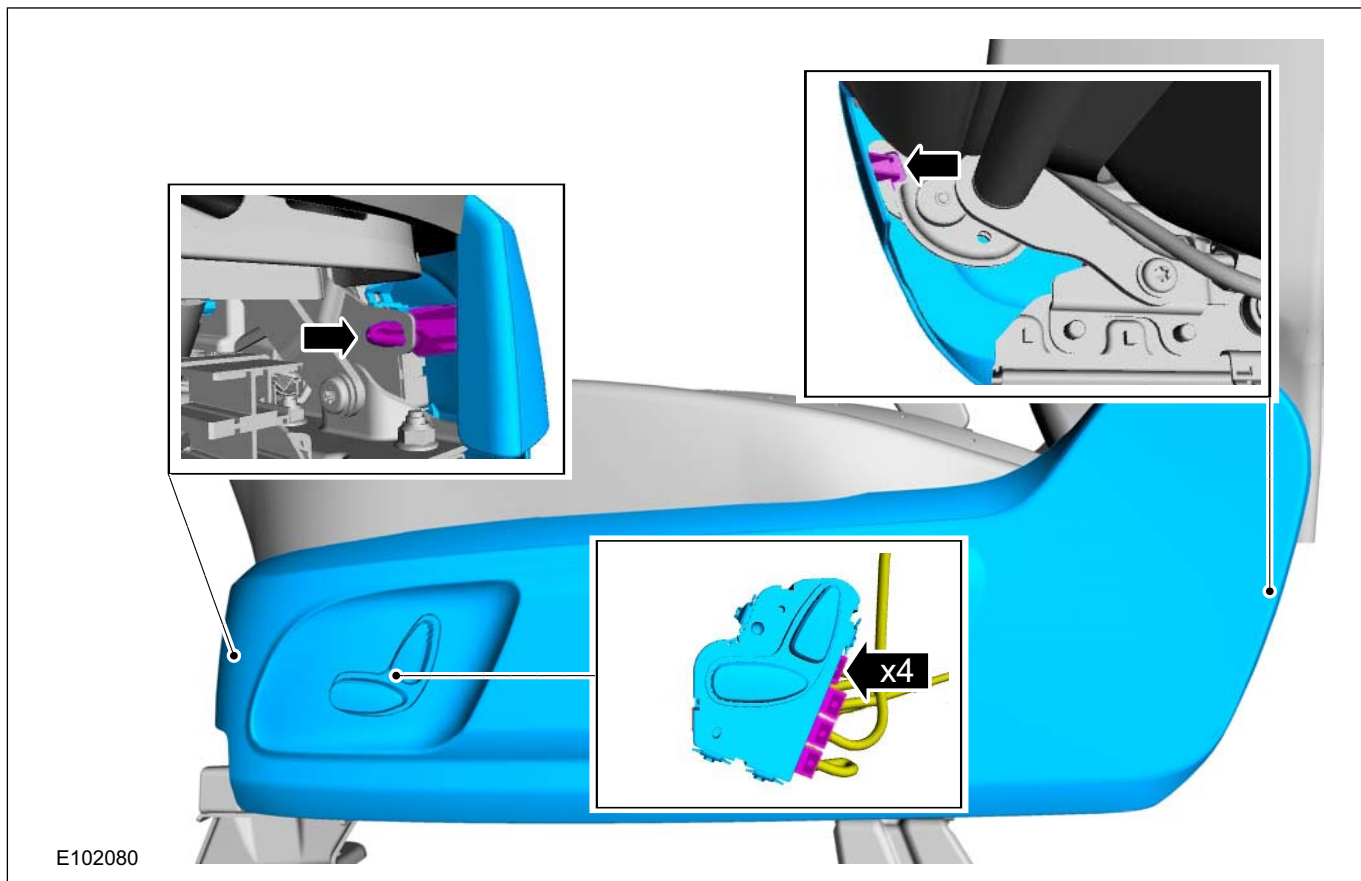
General Equipment

Electric Drill

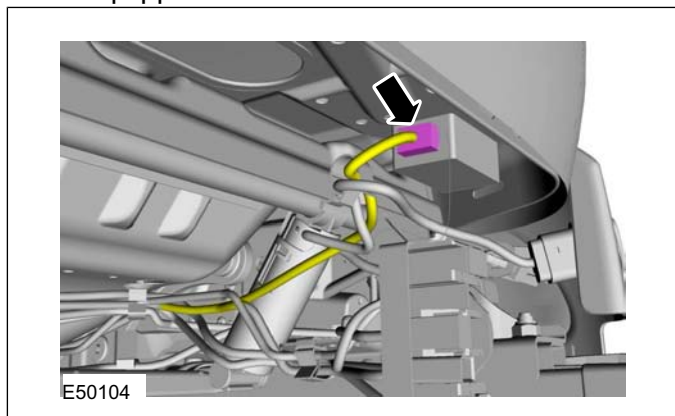
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

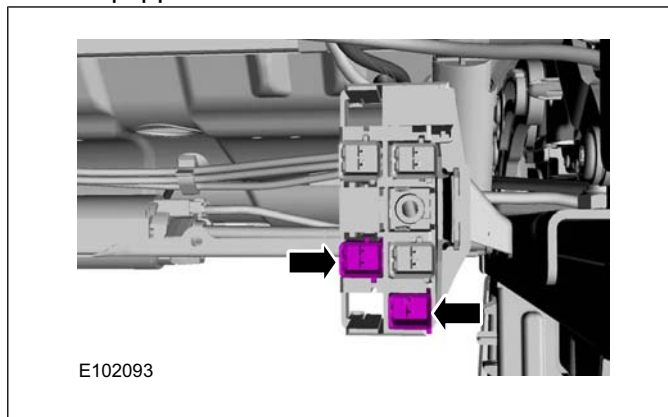
1. Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
2. If equipped.  
Refer to: **Compact Disc (CD) Changer** (415-01 Information and Entertainment System, Removal and Installation).
- 3.



4. If equipped.

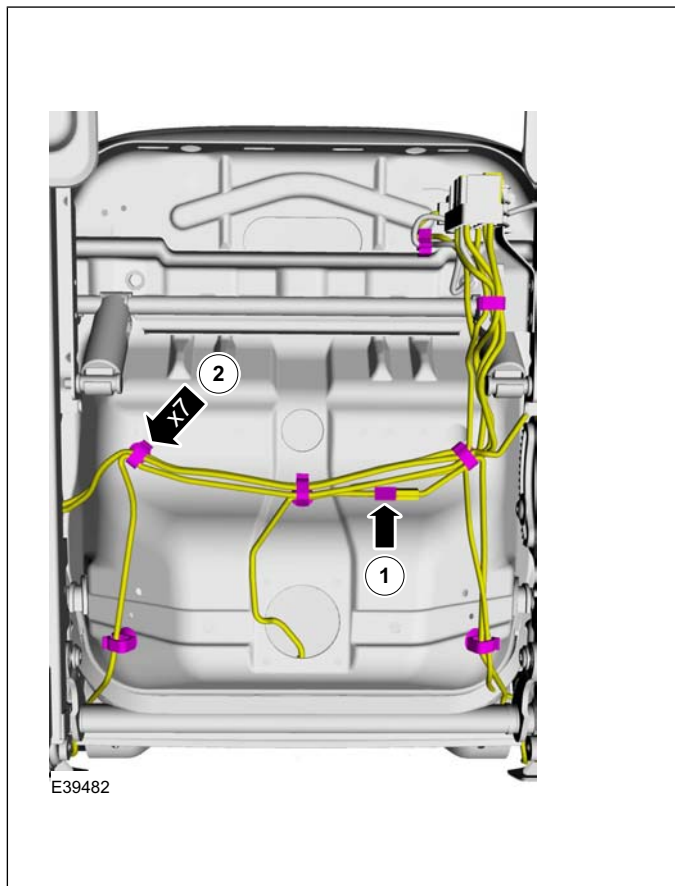


5. If equipped.

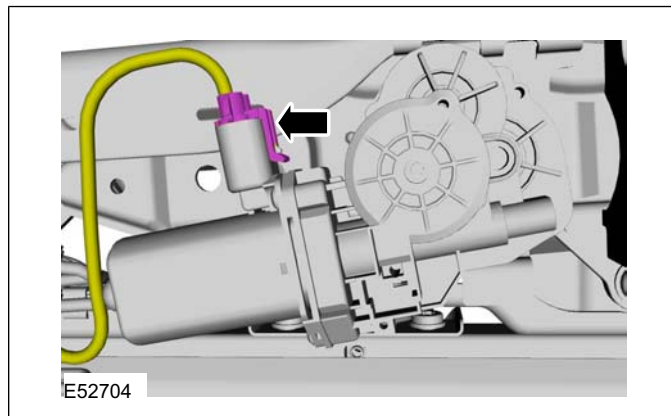


### REMOVAL AND INSTALLATION

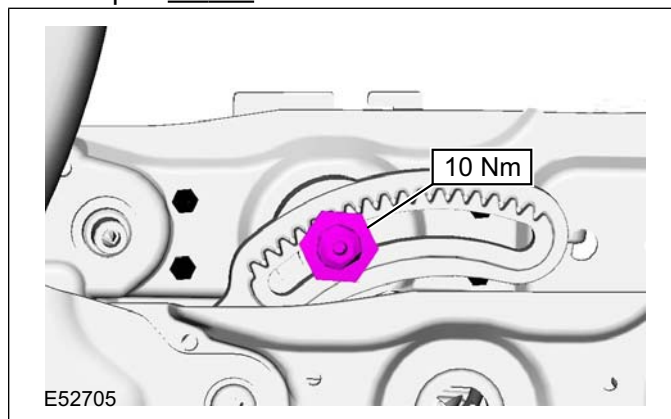
6. 1. If equipped.



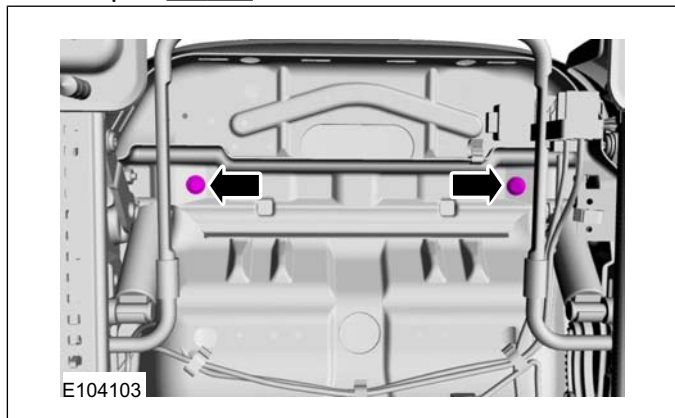
8.



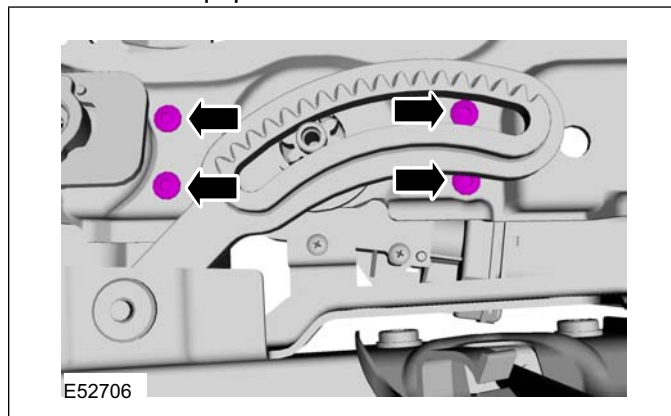
9. Torque: 10 Nm



7. Torque: 23 Nm

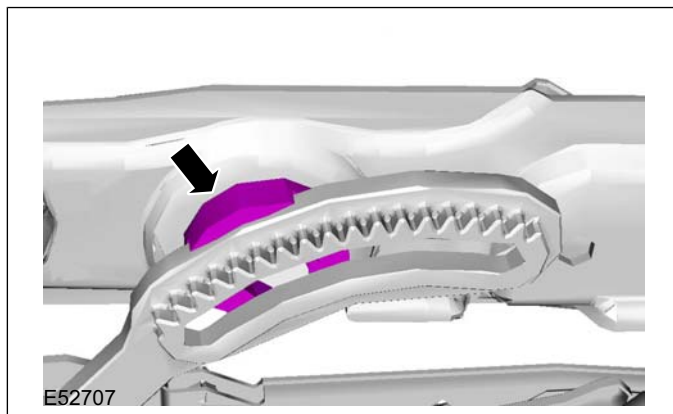


10. General Equipment: Electric Drill



**REMOVAL AND INSTALLATION**

11. **NOTE:** Note the position of the component before removal.

**Installation**

1. To install, reverse the removal procedure.

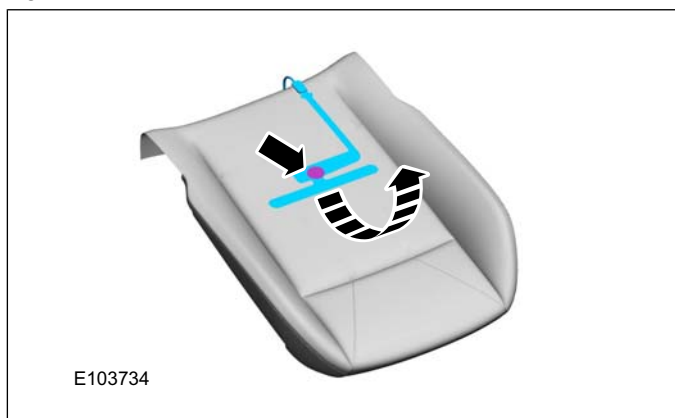
## REMOVAL AND INSTALLATION

## Seat Occupant Sensor

## Removal

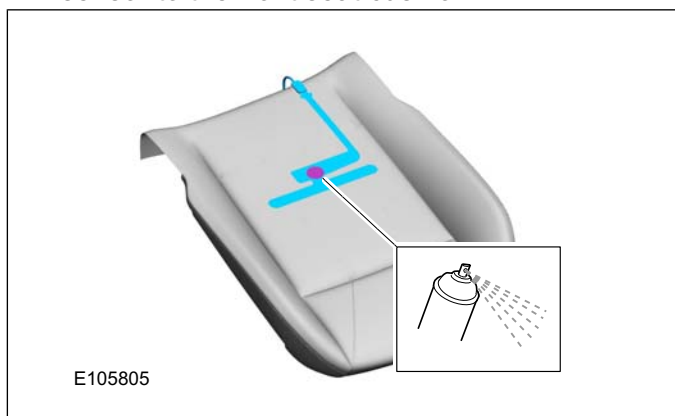
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Seat Cushion Cover** (501-10 Seating, Removal and Installation).
2. If equipped.  
Refer to: **Front Seat Cushion Heater Mat** (501-10 Seating, Removal and Installation).
- 3.



## Installation

1. To install, reverse the removal procedure.
2. Using adhesive, secure the occupant detection sensor to the front seat cushion.



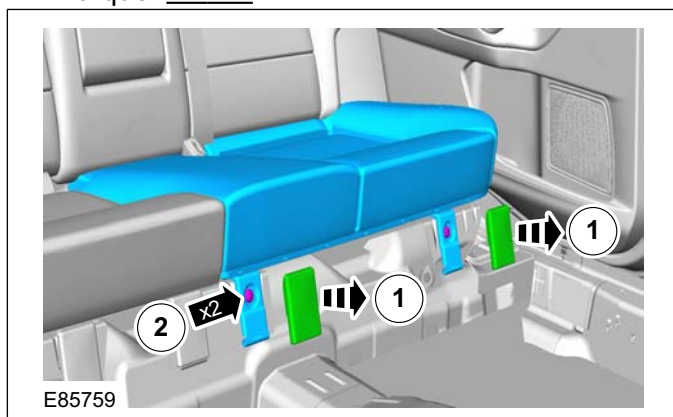
## REMOVAL AND INSTALLATION

## Rear Seat Cushion

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Torque: 24 Nm



## Installation

1. To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

## Rear Seat Backrest Latch

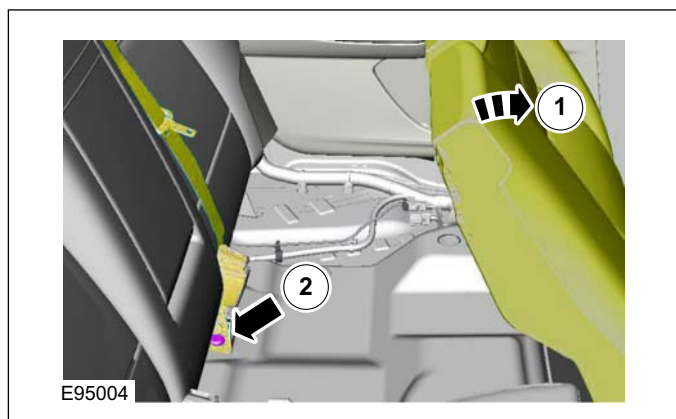
## General Equipment

Flat-bladed screwdriver
-------------------------

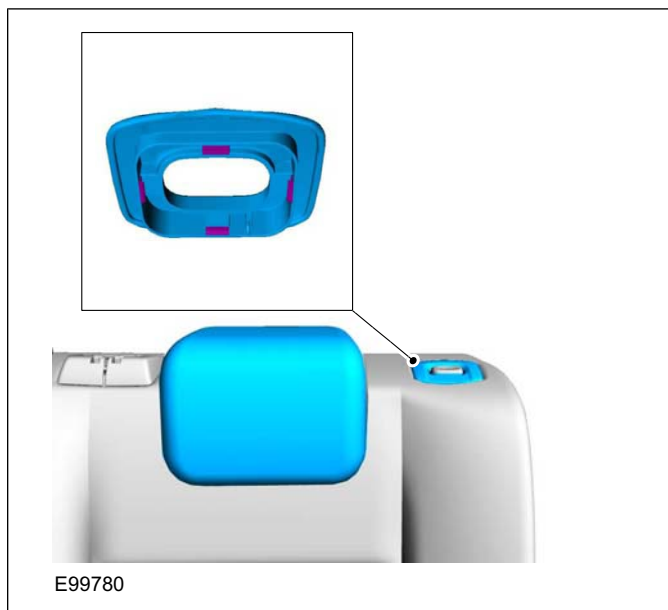
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. On both sides.
2. Torque: 55 Nm

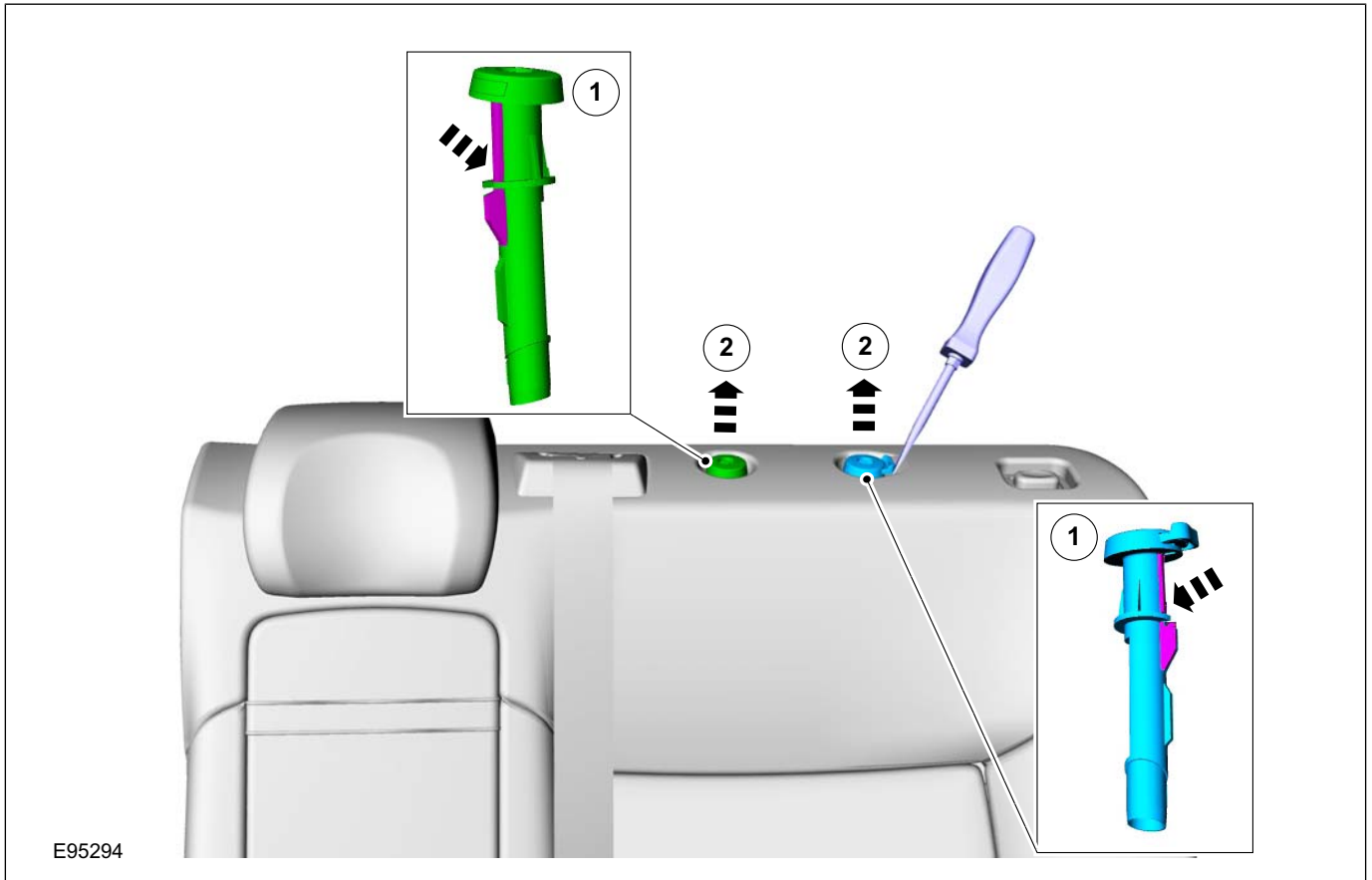


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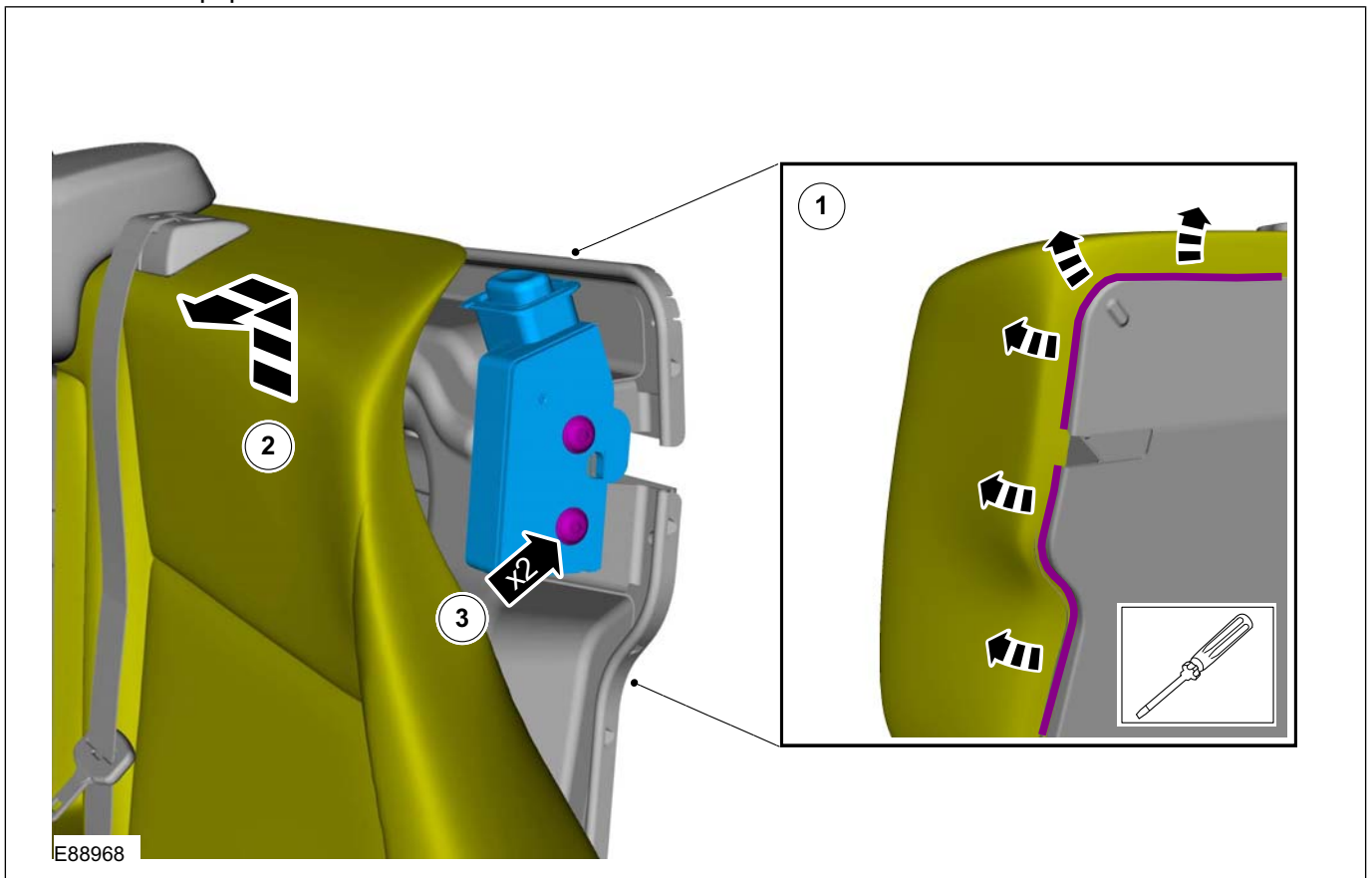


3. General Equipment: Flat-bladed screwdriver

REMOVAL AND INSTALLATION



4. General Equipment: Flat-bladed screwdriver



---

**REMOVAL AND INSTALLATION****Installation**

1. To install, reverse the removal procedure.



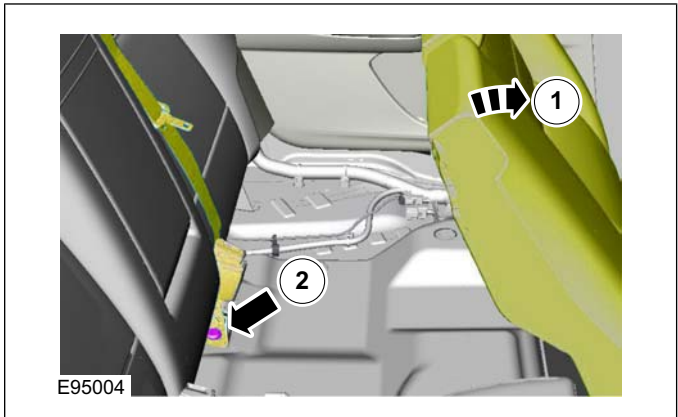
REMOVAL AND INSTALLATION

Rear Seat Backrest

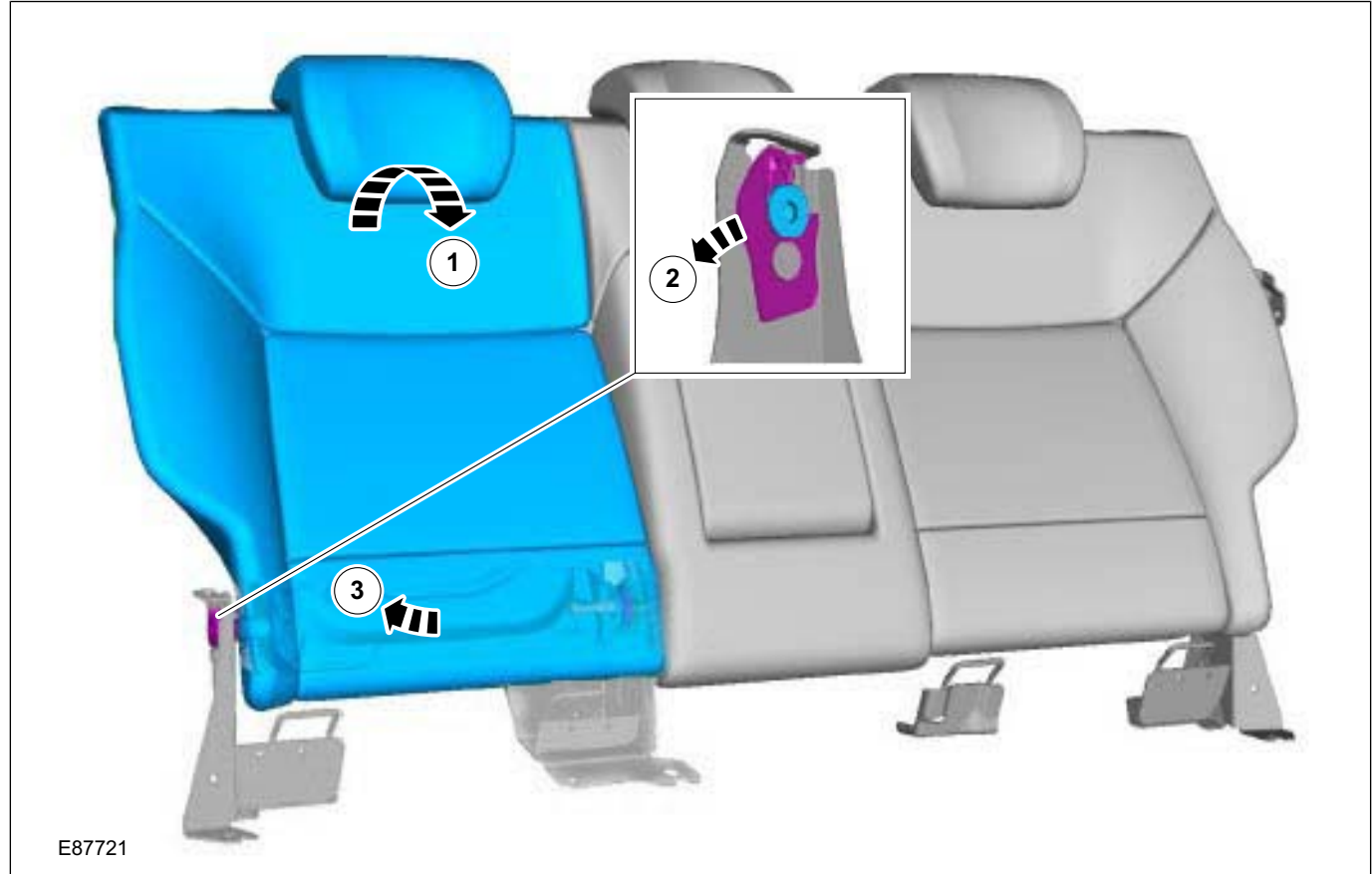
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

- 1. 1. On both sides.
- 2. Torque: 55 Nm



2.



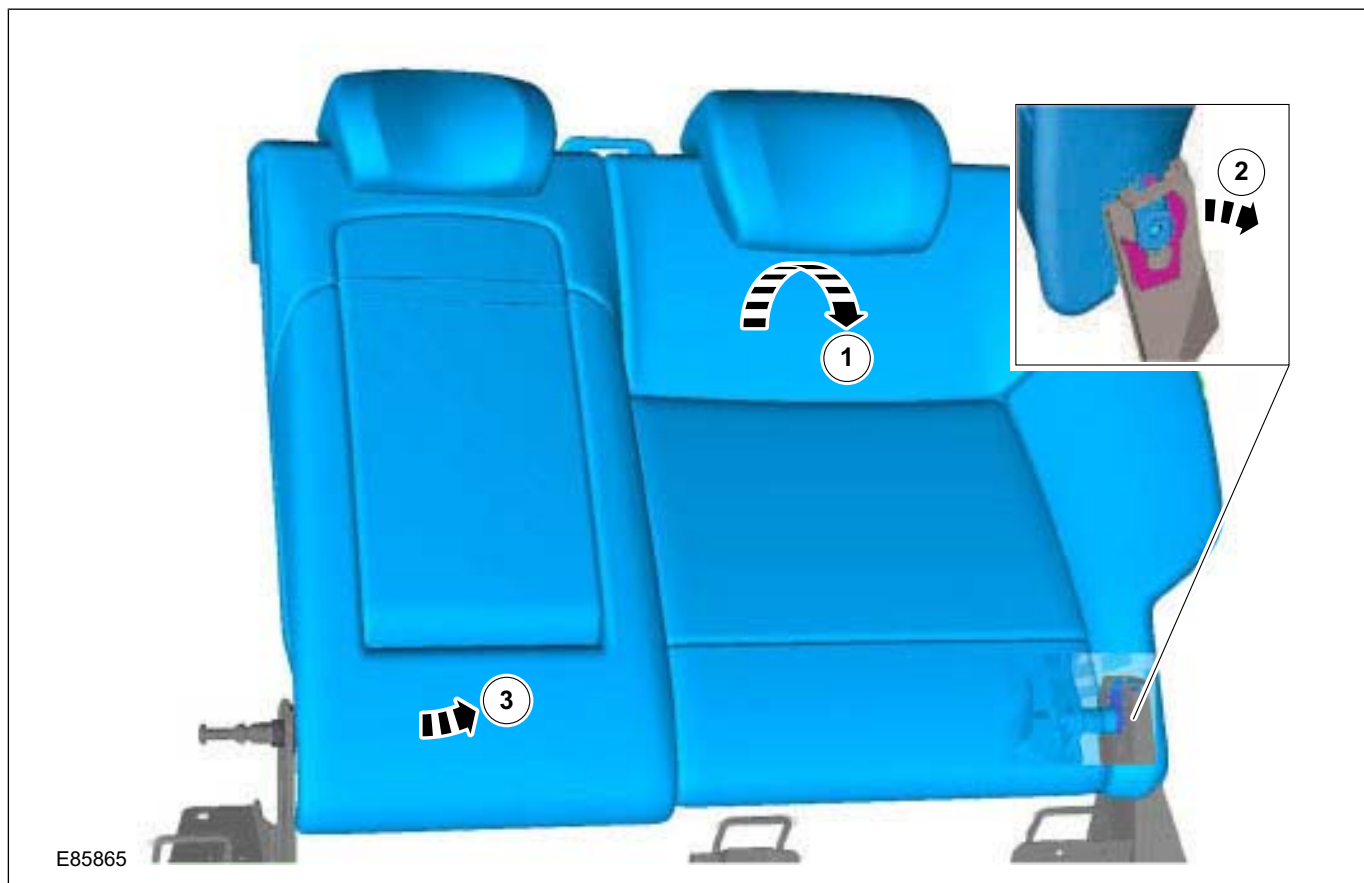
3.

501-10-42

Seating

501-10-42

## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.

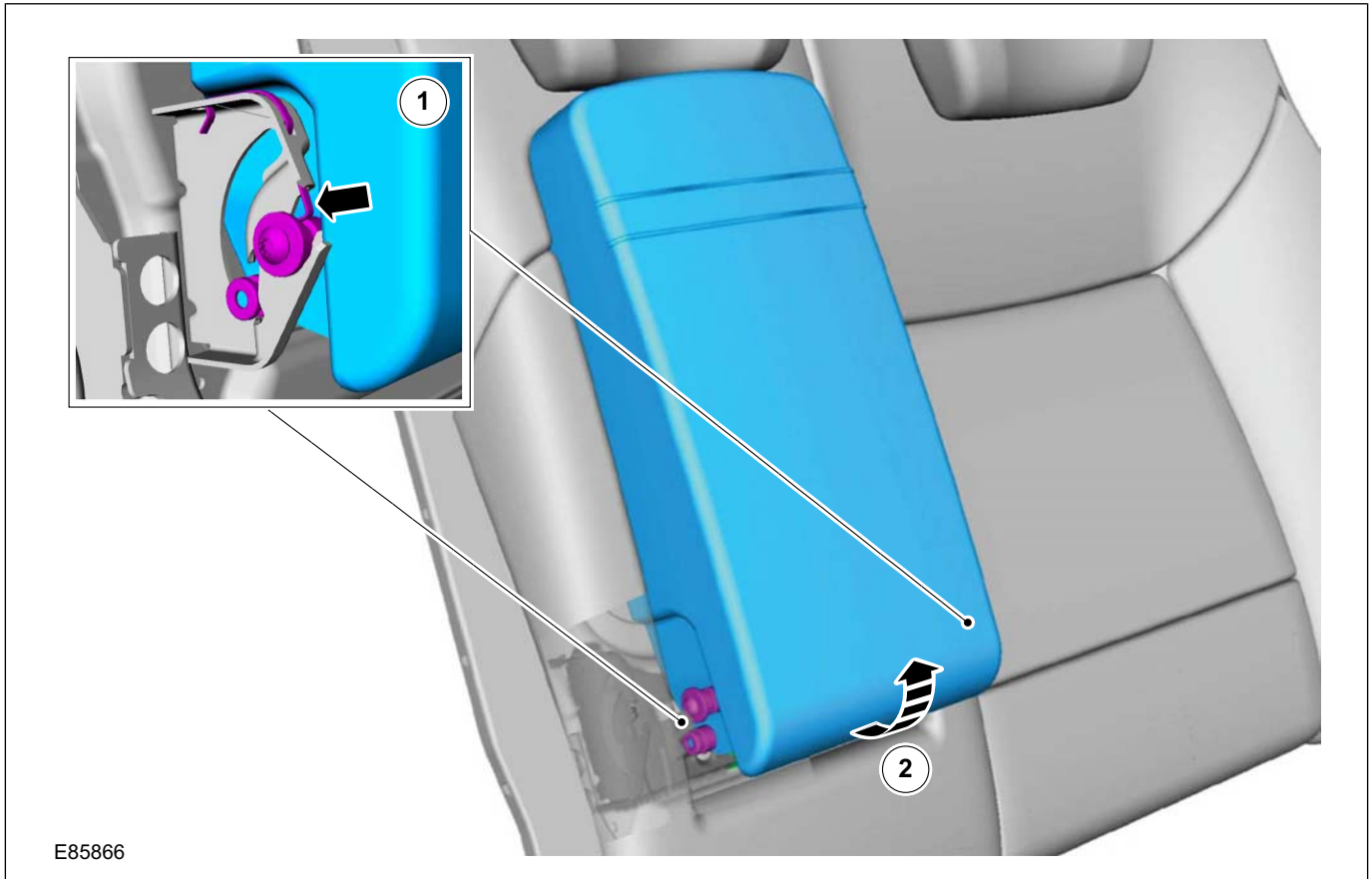
## REMOVAL AND INSTALLATION

## Rear Seat Armrest

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1.



## Installation

1. To install, reverse the removal procedure.



DISASSEMBLY AND ASSEMBLY

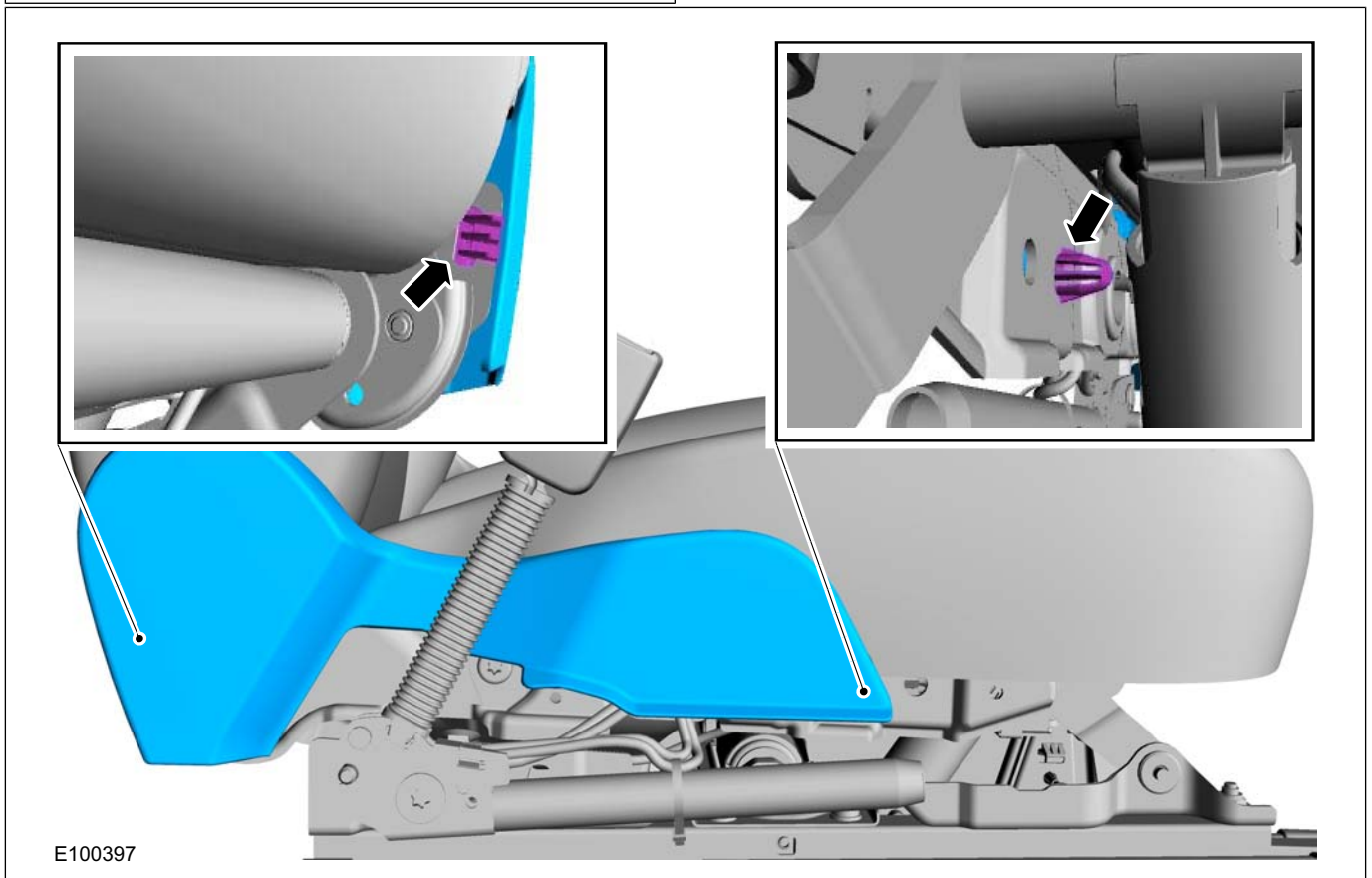
Front Seat Backrest

Disassembly

1. Refer to: **Front Seat Backrest Cover** (501-10 Seating, Removal and Installation).

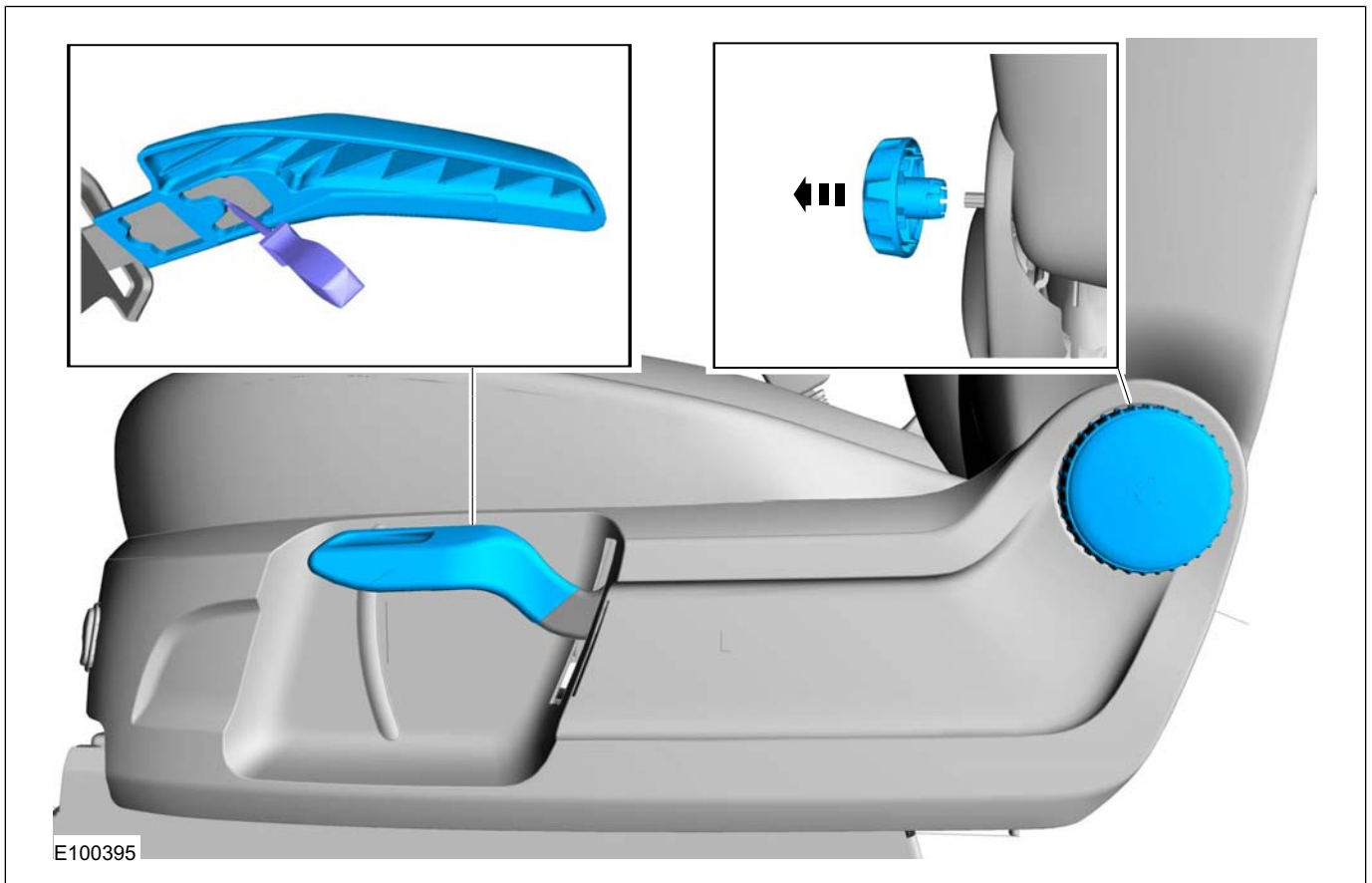
3.

2.



DISASSEMBLY AND ASSEMBLY

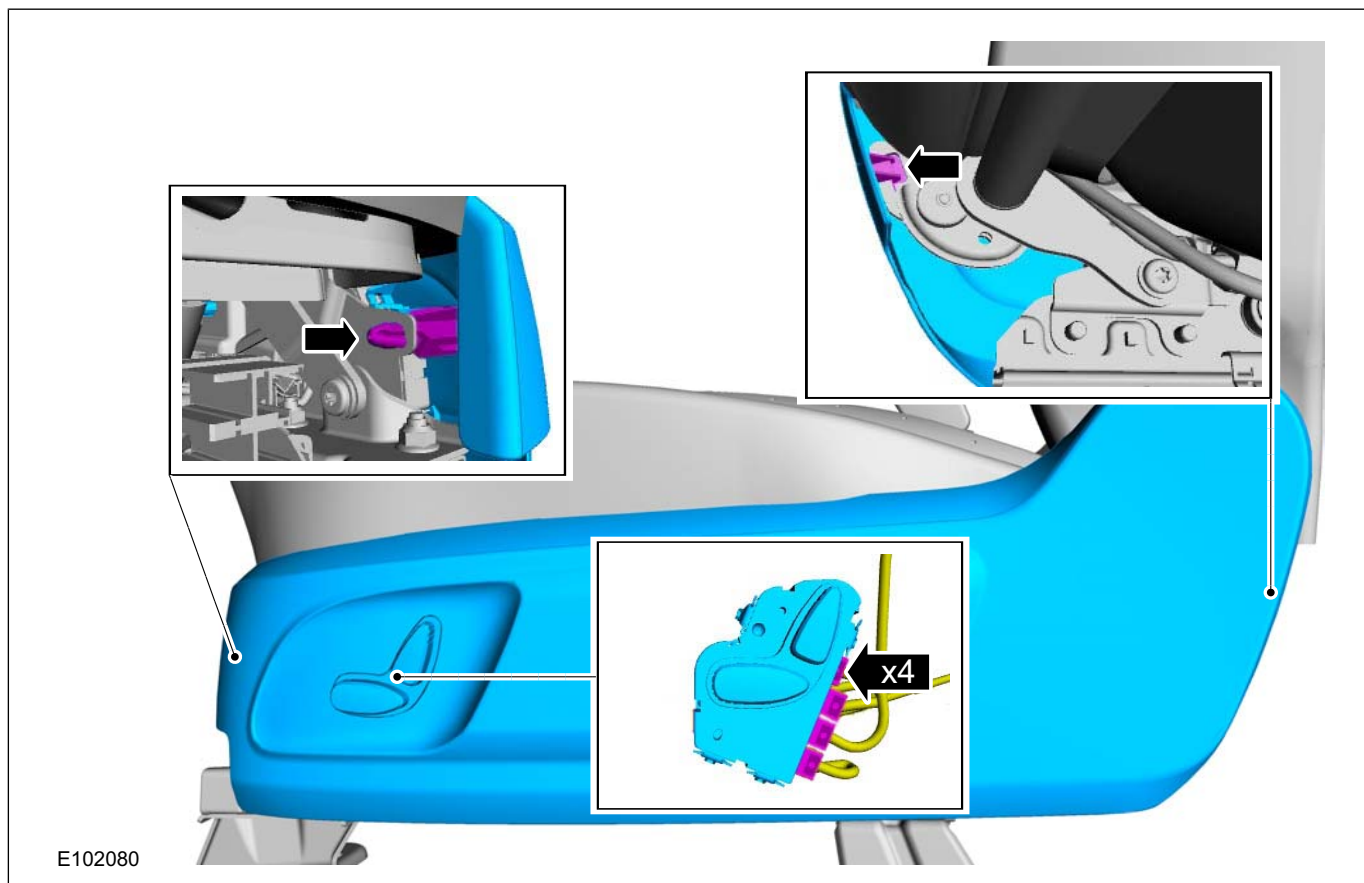
4.



Vehicles with power seats

5.

DISASSEMBLY AND ASSEMBLY

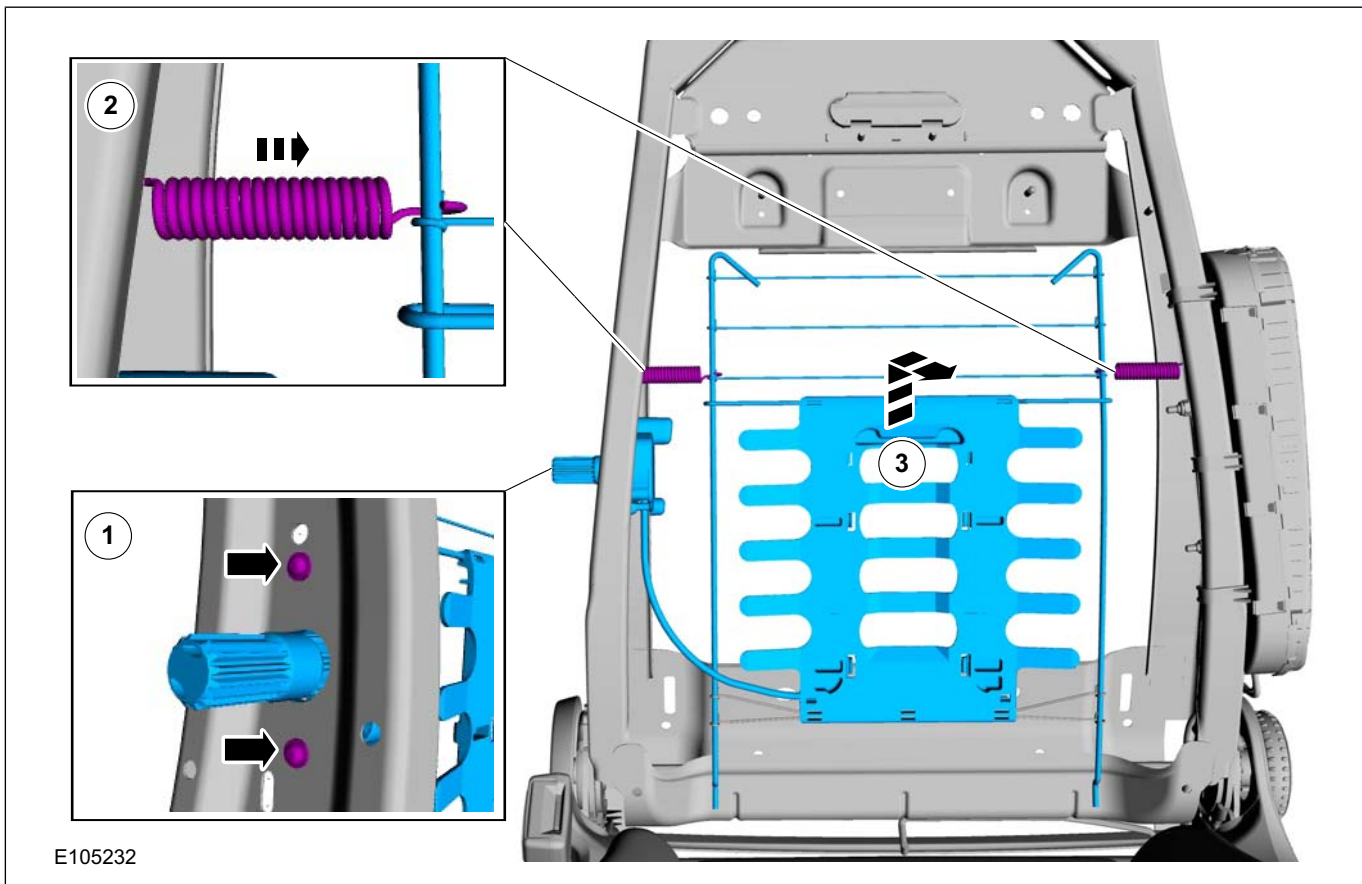


E102080

All vehicles

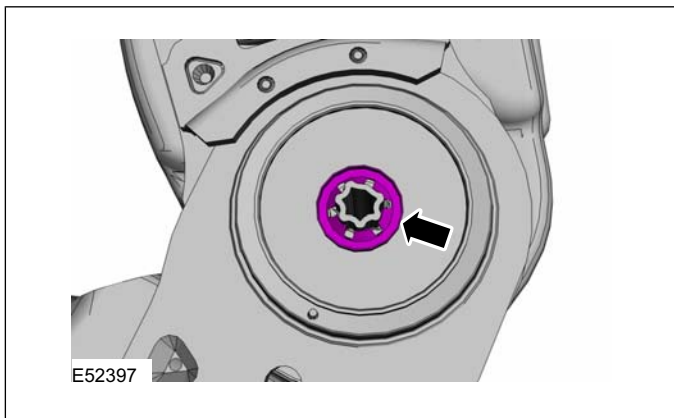
6. If equipped.

DISASSEMBLY AND ASSEMBLY



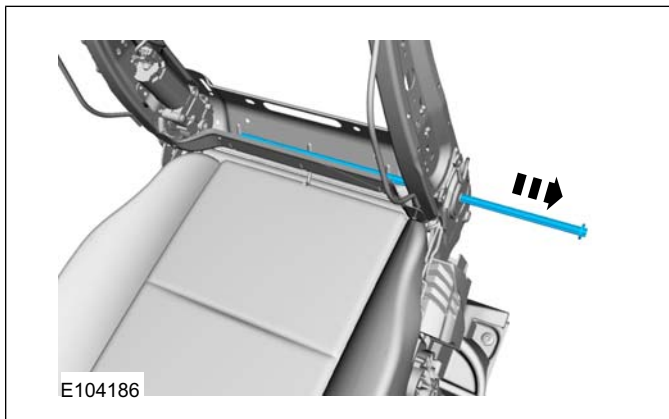
E105232

7.



E52397

8.

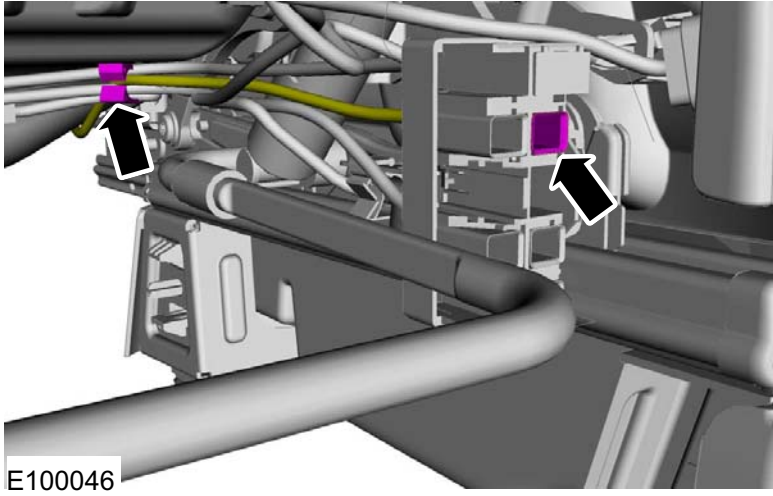


E104186

9.

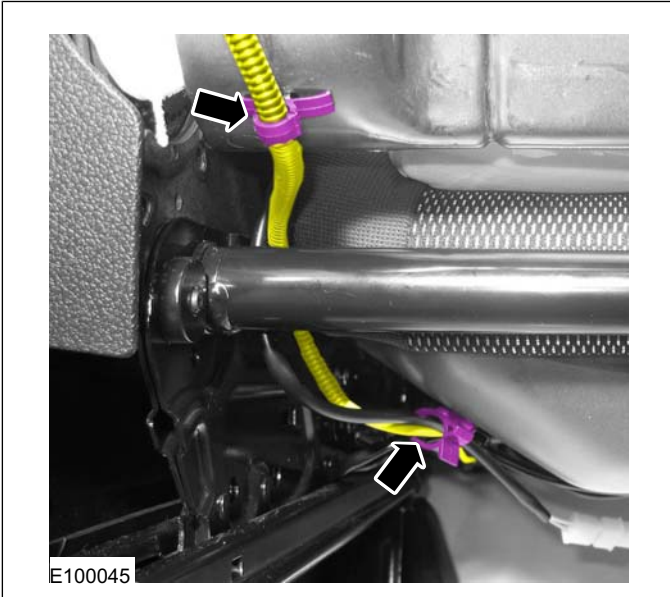


DISASSEMBLY AND ASSEMBLY



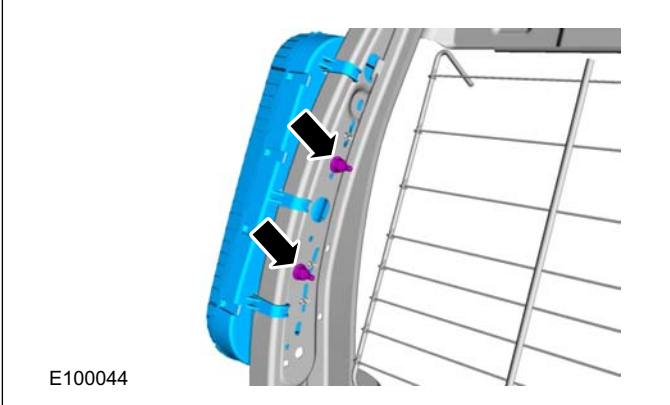
E100046

10.



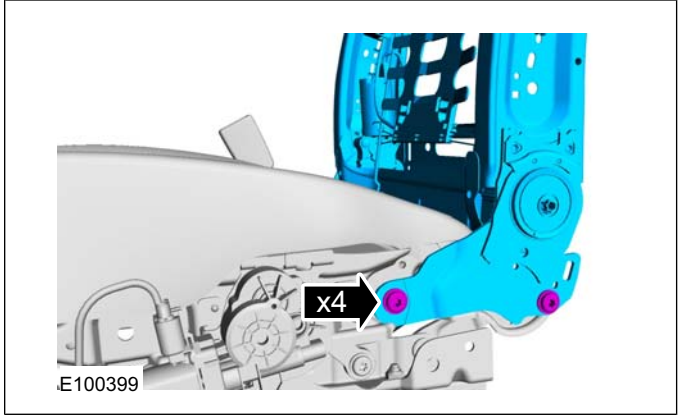
E100045

11. Torque: 5 Nm



E100044

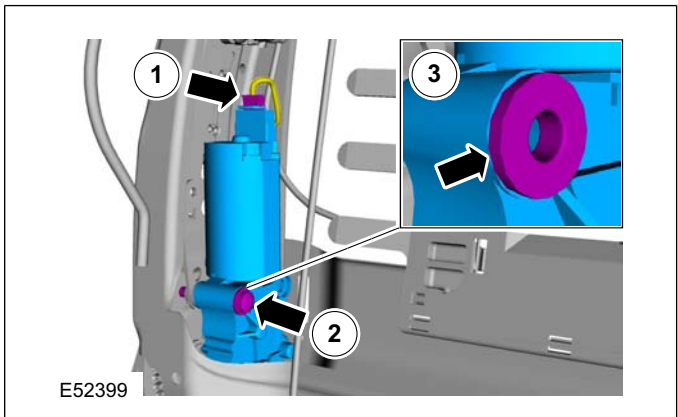
12 Torque: 27 Nm



E100399

Vehicles with power seats

13.



E52399

Assembly

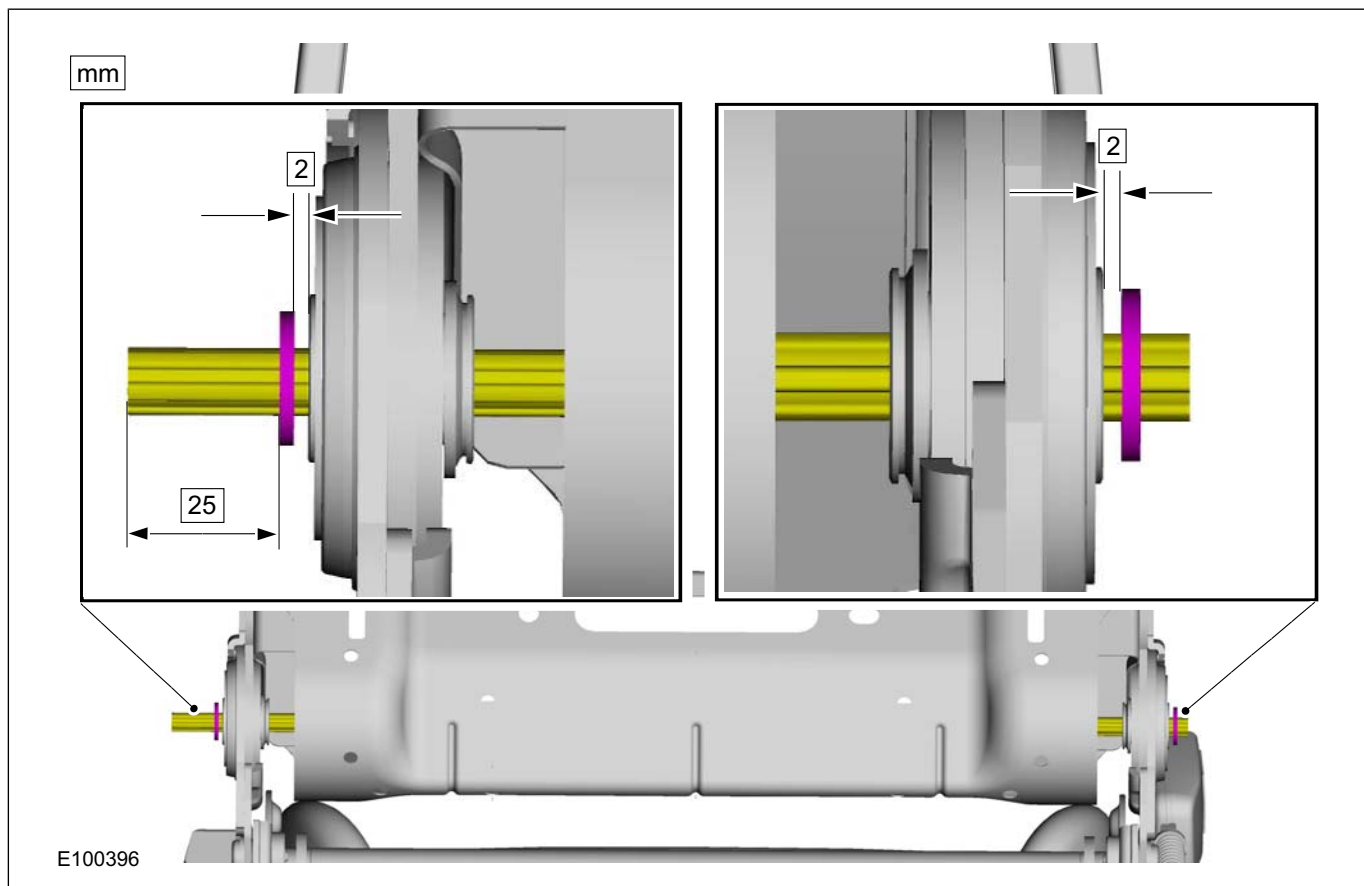
14. To install, reverse the disassembly procedure.

15. **NOTE:** This step is only necessary when installing a new component.





DISASSEMBLY AND ASSEMBLY





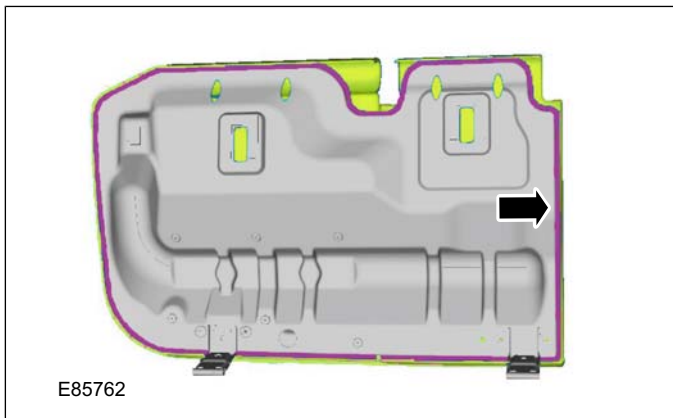
DISASSEMBLY AND ASSEMBLY

Rear Seat Cushion

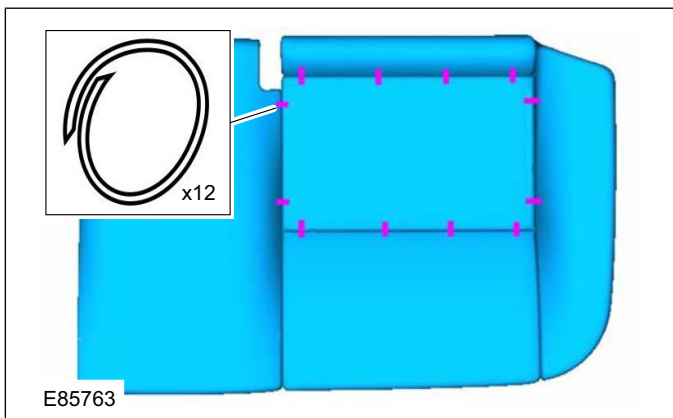
Disassembly

**NOTE:** Removal steps in this procedure may contain installation details.

1.

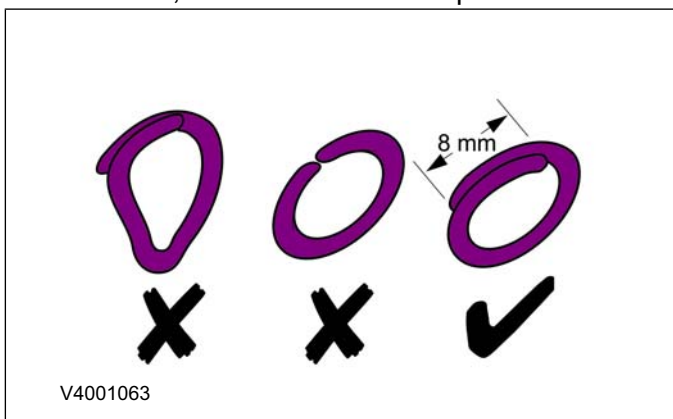


2.



Assembly

3. To install, reverse the removal procedure.

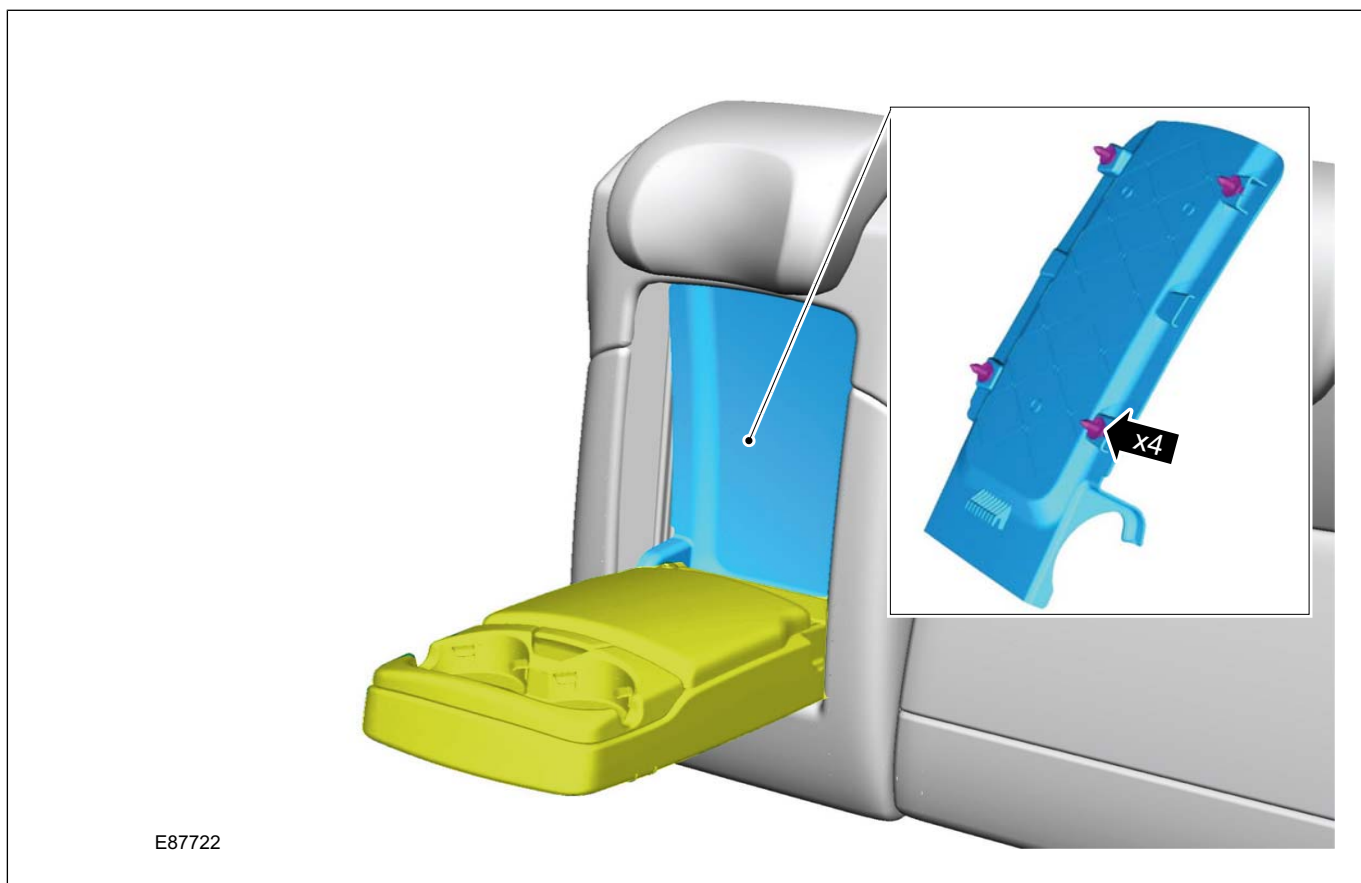


## DISASSEMBLY AND ASSEMBLY

## Rear Seat Backrest

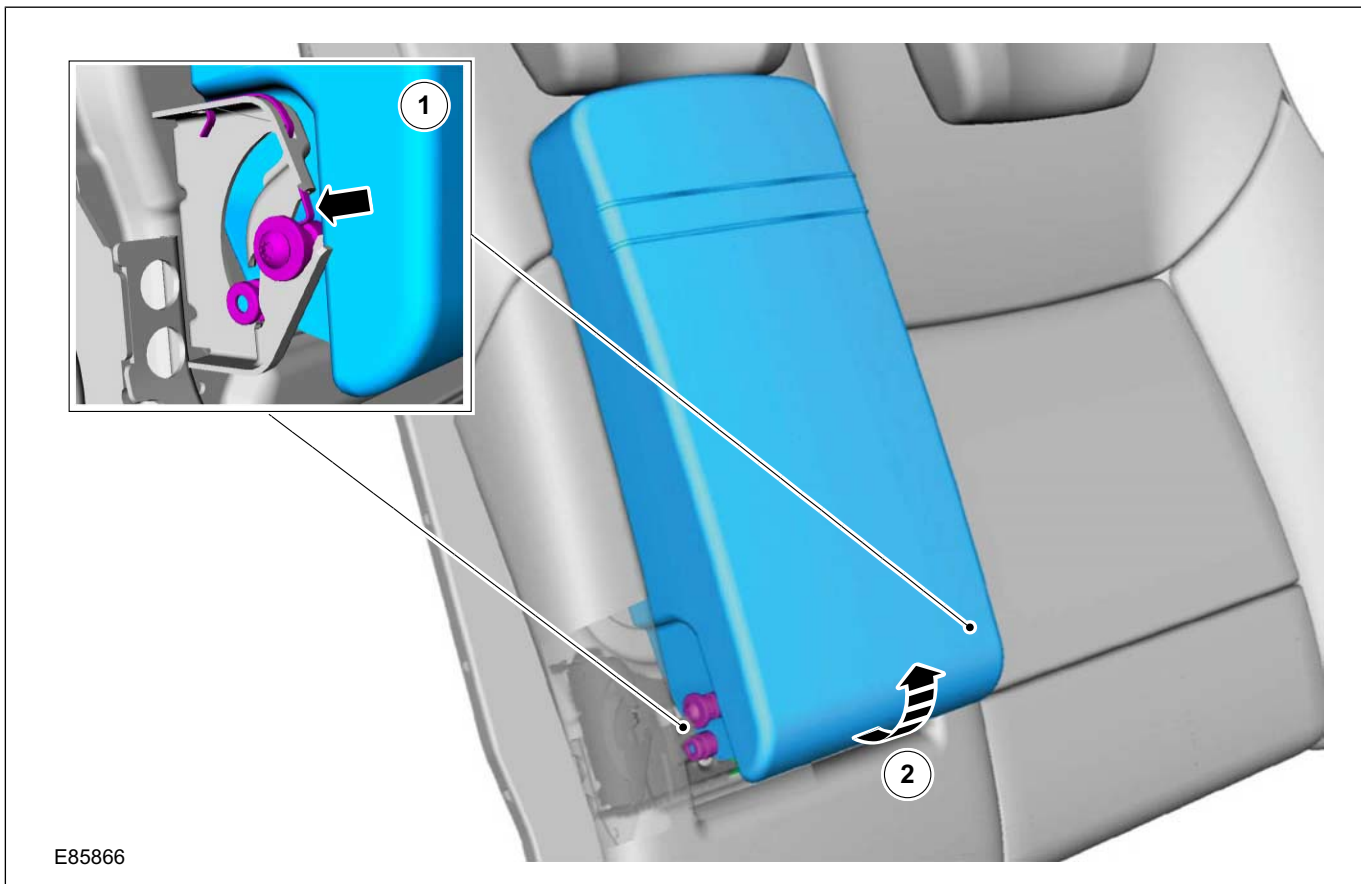
## Disassembly

1. Refer to: **Rear Seat Backrest** (501-10 Seating, Removal and Installation).
- 2.

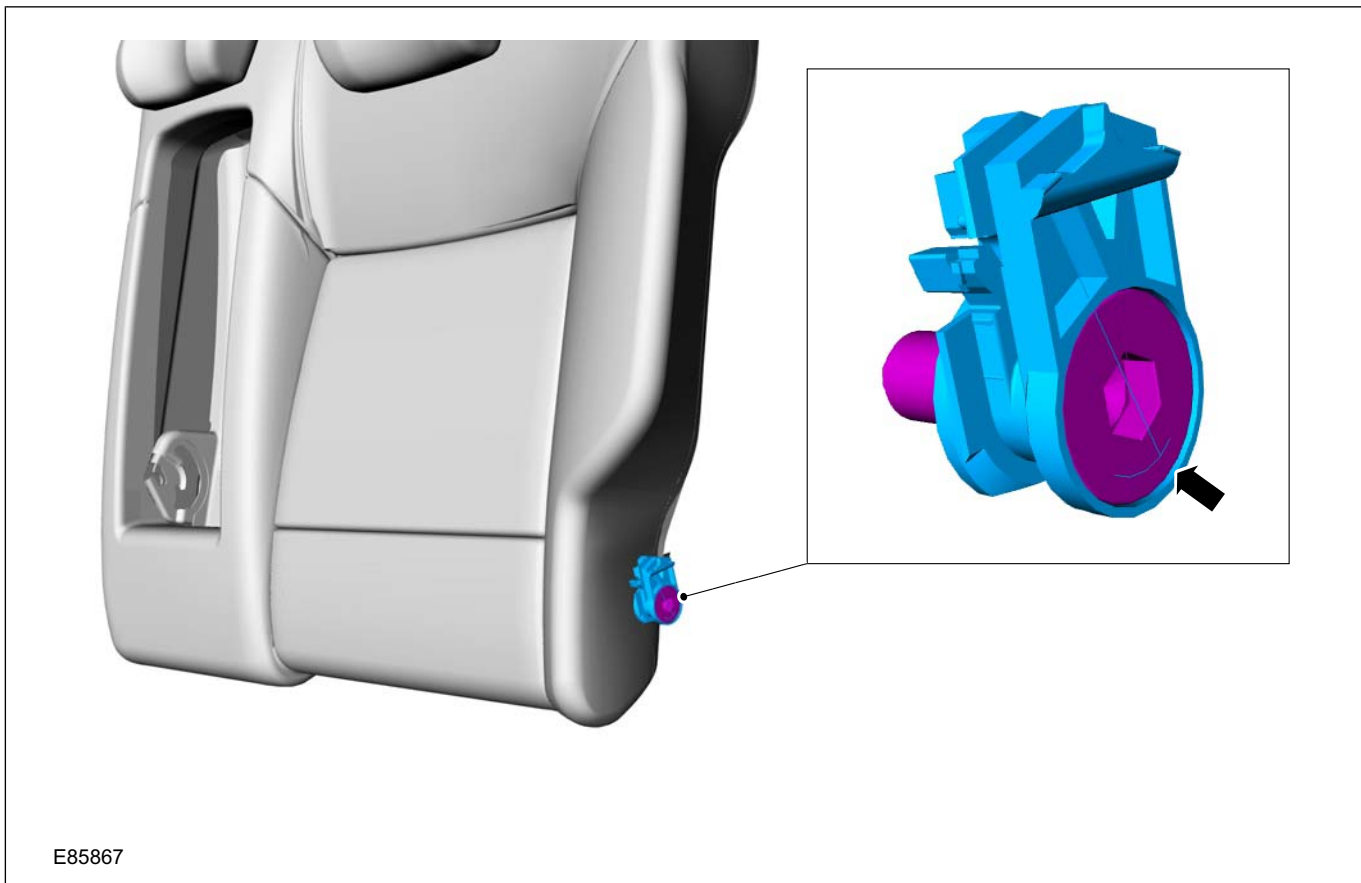


- 3.

DISASSEMBLY AND ASSEMBLY

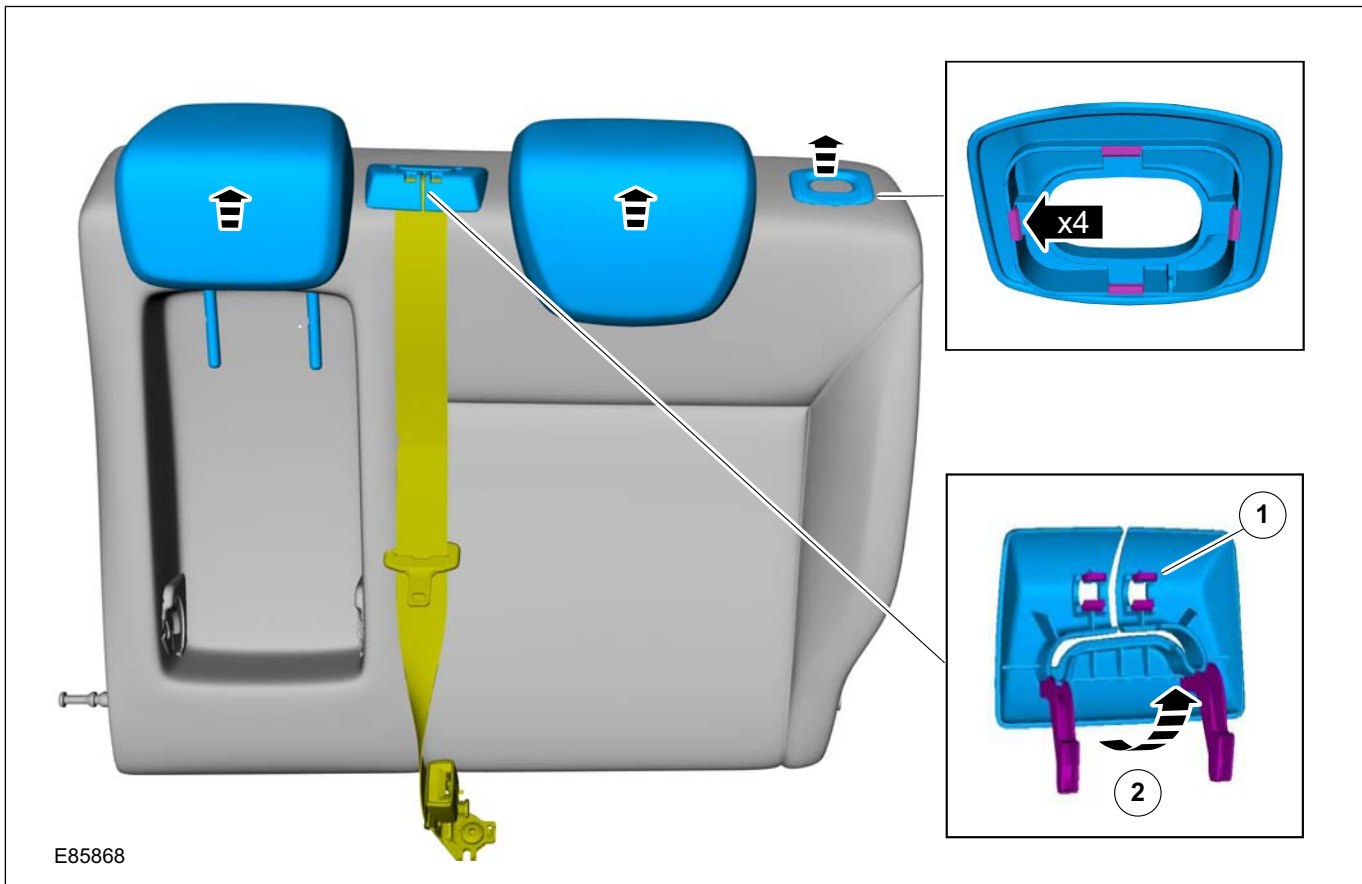


4.



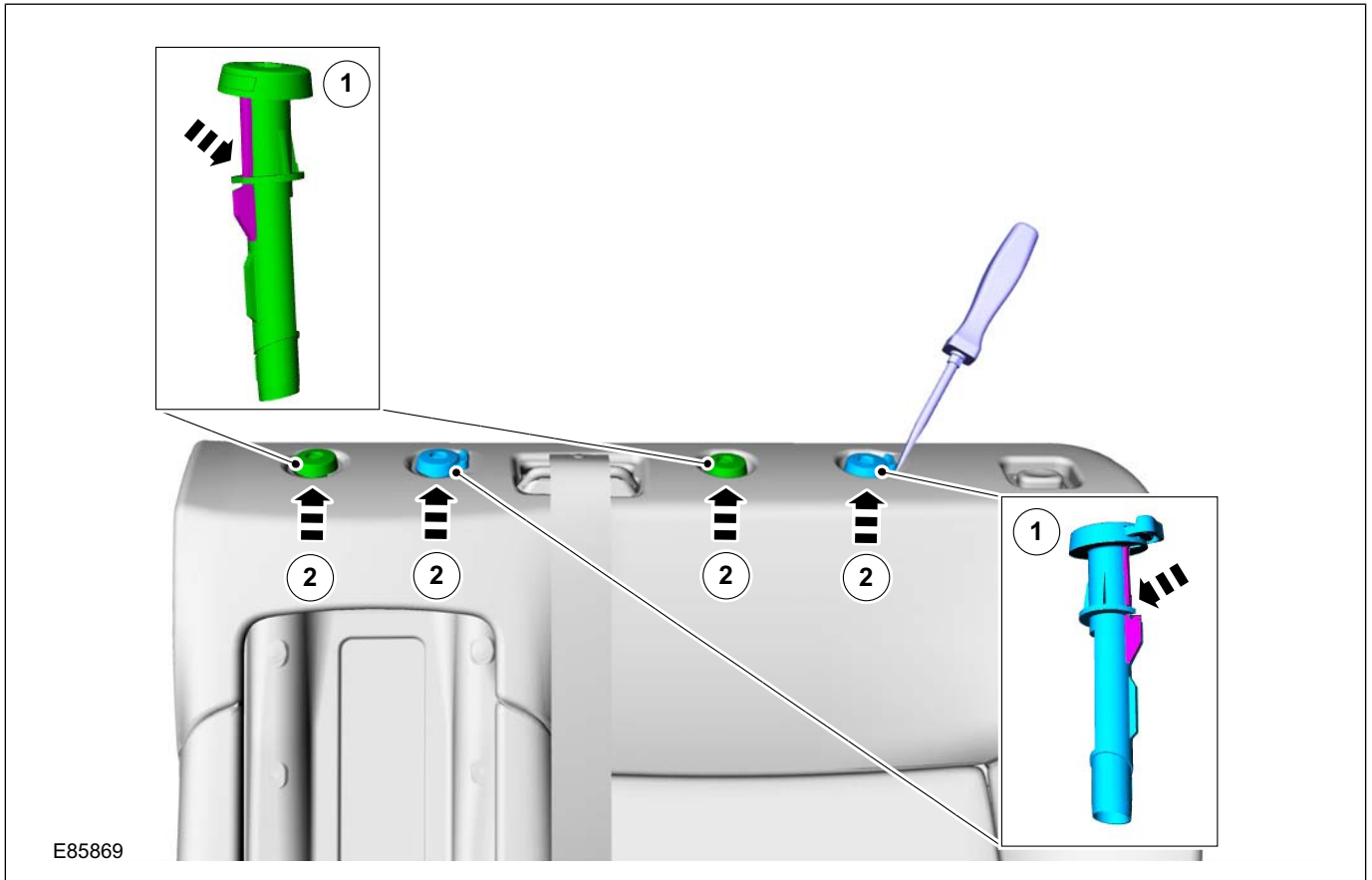
DISASSEMBLY AND ASSEMBLY

5.



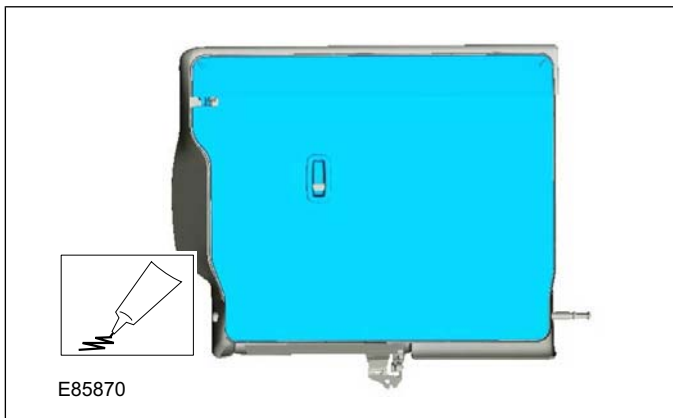
6.

DISASSEMBLY AND ASSEMBLY



7.

8.

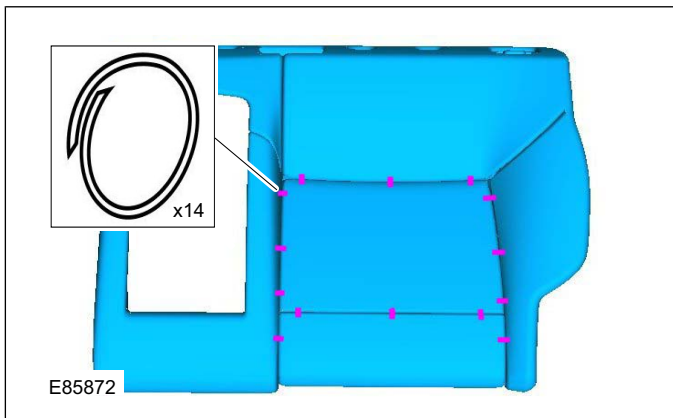


DISASSEMBLY AND ASSEMBLY



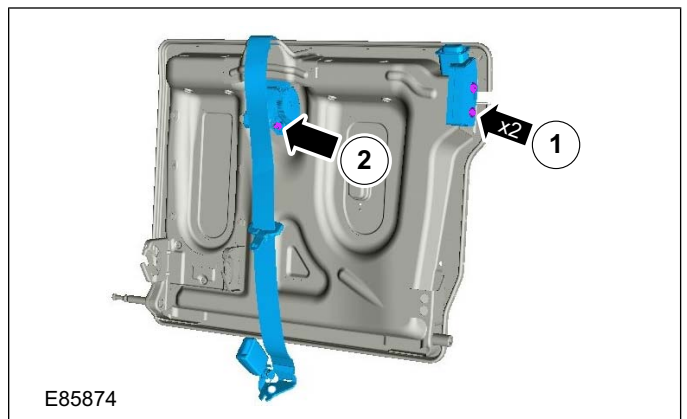
E85871

9.



E85872

- 10. 1. Torque: 24 Nm
- 2. Torque: 38 Nm



E85874

Assembly

- 11. To assemble, reverse the disassembly procedure.



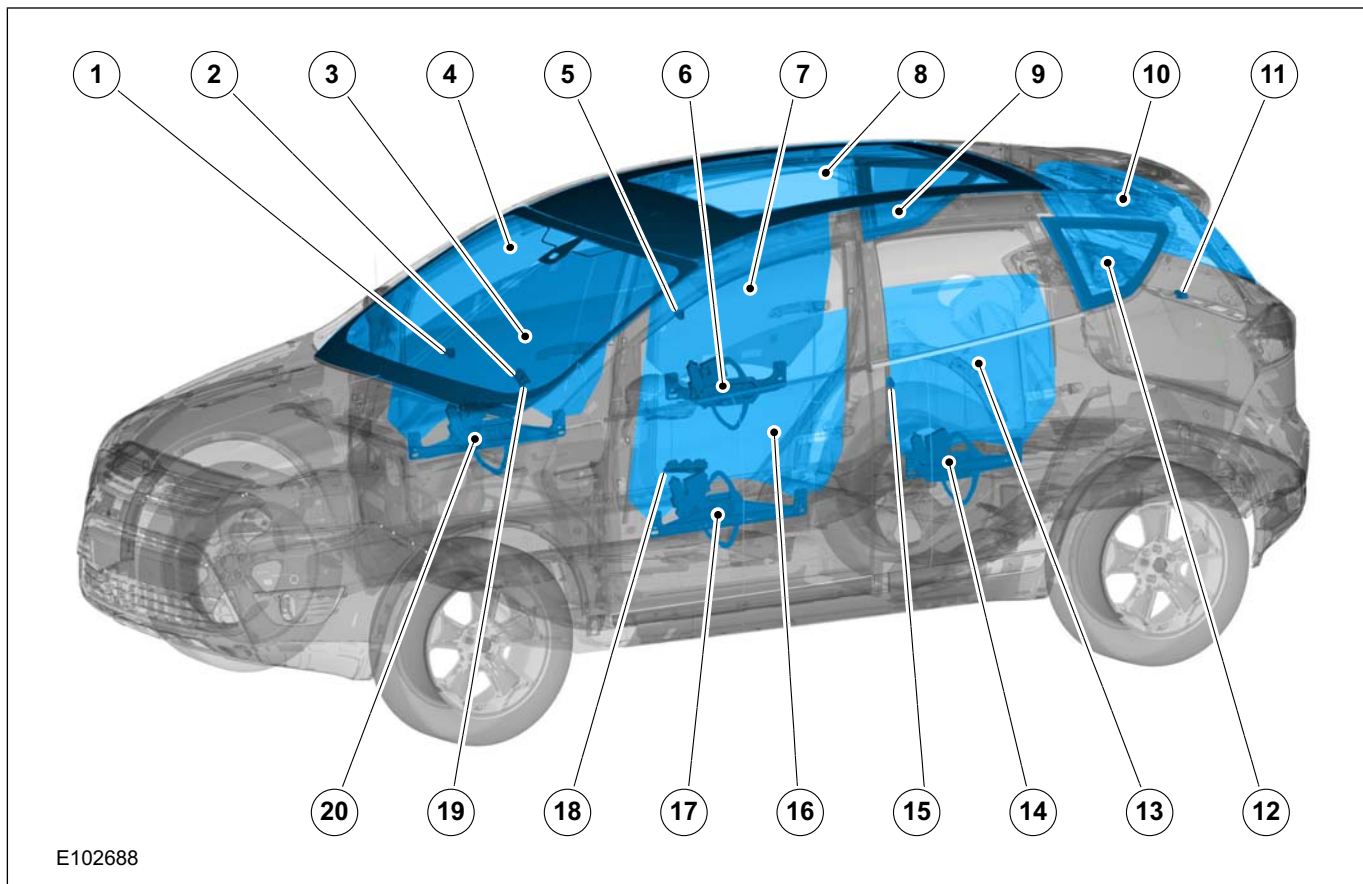
## SECTION 501-11 Glass, Frames and Mechanisms

**VEHICLE APPLICATION: 2008.50 Kuga**

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DESCRIPTION AND OPERATION

Glass, Frames and Mechanisms – Component Location



E102688

Item	Description
1	Passenger front window switch
2	Windshield heater switch
3	Front right door window
4	Front Screen
5	Rear right window switch
6	Rear power window with right RDM (rear door module)
7	Rear right door window
8	Panoramic roof
9	Right quarter panel window
10	Heated rear window

Item	Description
11	Rear window release switch
12	Left quarter panel window
13	Rear left door window
14	Rear power window with left RDM
15	Rear left window switch
16	Front left door window
17	Front left power window with driver's door module
18	Driver's door window switch
19	Heated rear window switch
20	Front right power window with passenger door module

## DESCRIPTION AND OPERATION

## Glass, Frames and Mechanisms – Overview

## Fixed Glass

Fixed window glass is directly glazed to the window opening flange by means of a polyurethane (PU) adhesive bead. In addition to fixing the glass to the opening flange, the adhesive bead also forms a water tight seal around the inner edge of the glass.

All vehicles have a heated rear window, a heated windshield is available as an option.

Vehicles have green or blue tinted glass as standard, depending on the version. Privacy glass is an option for all variants on all glass installed rear of the B-pillar.

An infrared-reflecting windshield is available as an option.

## Electric window regulators

Power windows have a one-touch down and a one-touch up function, combined with anti-trap protection, which is active whenever the window is closing.

After anti-trap protection is initiated two times in quick succession, the anti-trap protection is automatically deactivated. Press and hold the window switch to close the window completely. Anti-trap protection is automatically reactivated when the ignition is turned off and on again, or 10 seconds after the window has been completely closed.

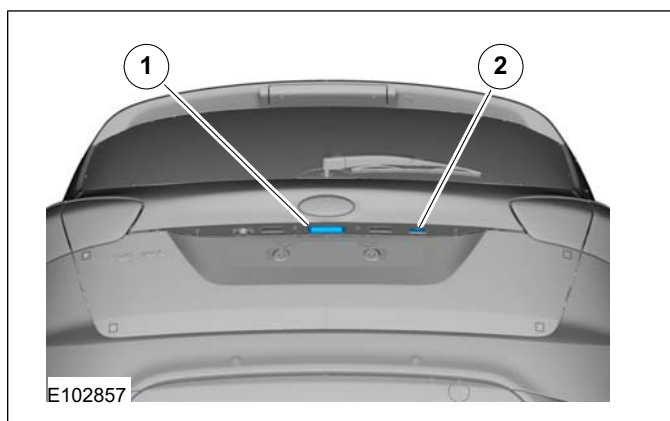
Front and rear electric windows and global closing of electric windows are standard features. Global closing can only be operated by using the remote key.

Vehicles equipped with front and rear power windows require an initialization process to be carried out on each window motor. The initialization is carried out before the vehicle leaves the production plant. However the initialization process will need to be carried out again whenever the power supply has been disconnected.

The multiple switch on the driver door incorporates a safety switch which, when operated, prevents the rear windows from being opened by the rear door window switches. However, the rear power windows can still be operated from the driver switch.

## Folding Rear Window

A special feature is the two-part liftgate. Integrated in this liftgate is a folding rear window. This can be opened separately from the liftgate for fast and convenient loading and unloading of small items. Hydraulic dampers hold the rear window in the open position.



Item	Description
1	Liftgate release switch
2	Rear window release switch

To open the folding rear window, the luggage compartment release button on the remote control must be pressed for more than 1.6 seconds or the rear window release switch in the lower area of the rear window must be pressed. The folding rear window is then unlocked and can be opened by hand.

To open the whole liftgate, the luggage compartment release button on the remote control must be briefly pressed twice within 3 seconds or the rear window release switch in the lower area of the rear window must be pressed. The liftgate is then unlocked and can be opened by hand.

If one entryway is open, the other remains locked and cannot be opened. Both entryways are locked while the vehicle is in motion and can only be unlocked after the vehicle comes to a stop and a door is opened.

Refer to: [Handles, Locks, Latches and Entry Systems](#) (501-14 Handles, Locks, Latches and Entry Systems, Description and Operation).

**DESCRIPTION AND OPERATION****Panoramic roof**

A panoramic roof over the first and second seat row is available as an option. The panoramic roof is made of laminated glass which is treated with a heat-repellent Solar Reflect coating.

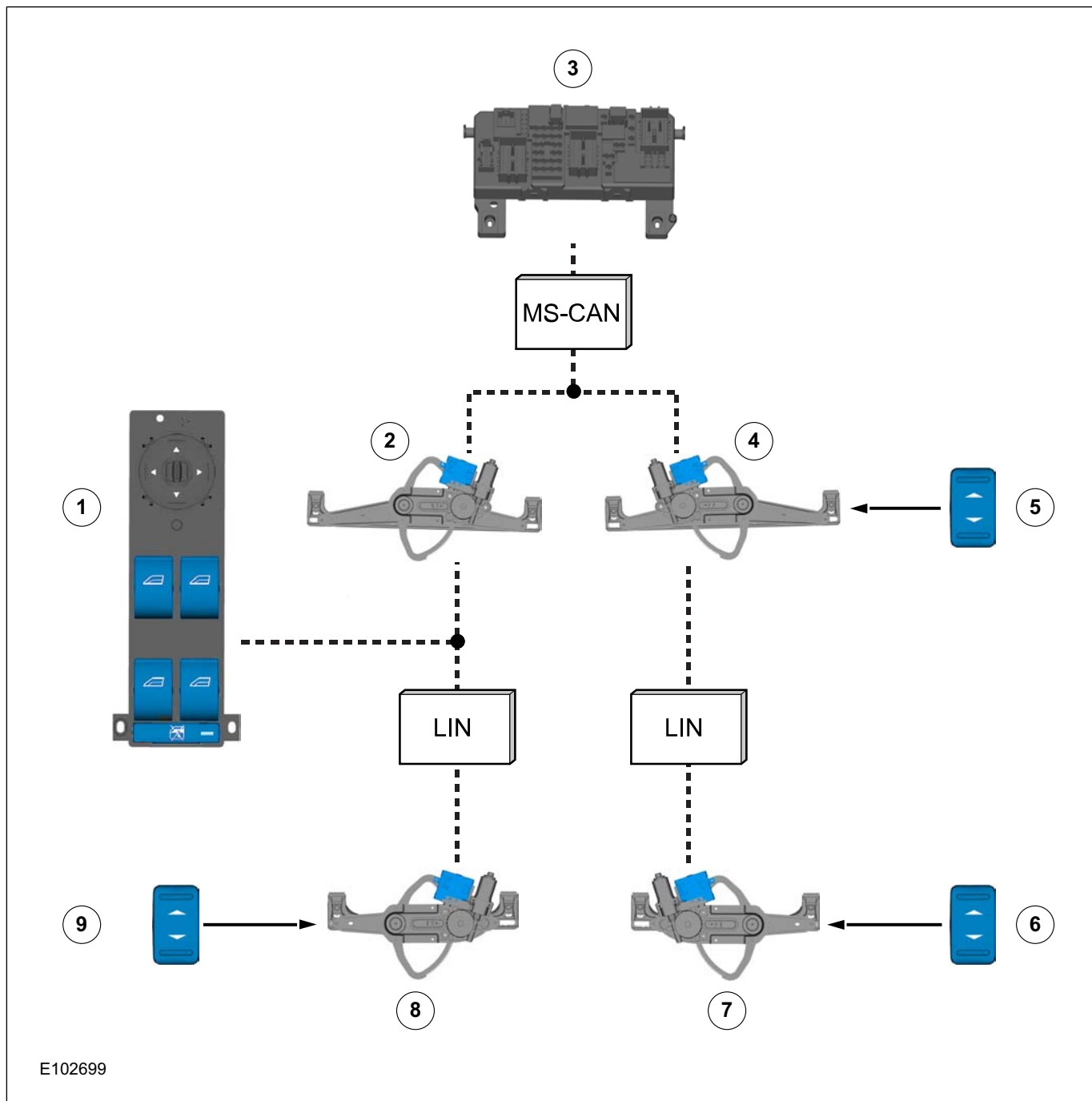
The sun blinds are located at the front and rear trim panels and are pulled out towards the centre and fastened into the end position by means of hooks.

DESCRIPTION AND OPERATION

Glass, Frames and Mechanisms – System Operation and Component Description

System Diagram

Electrically operated side windows



E102699

Item	Description
1	Driver's door window switch
2	Power window with driver's door module
3	GEM (generic electronic module)

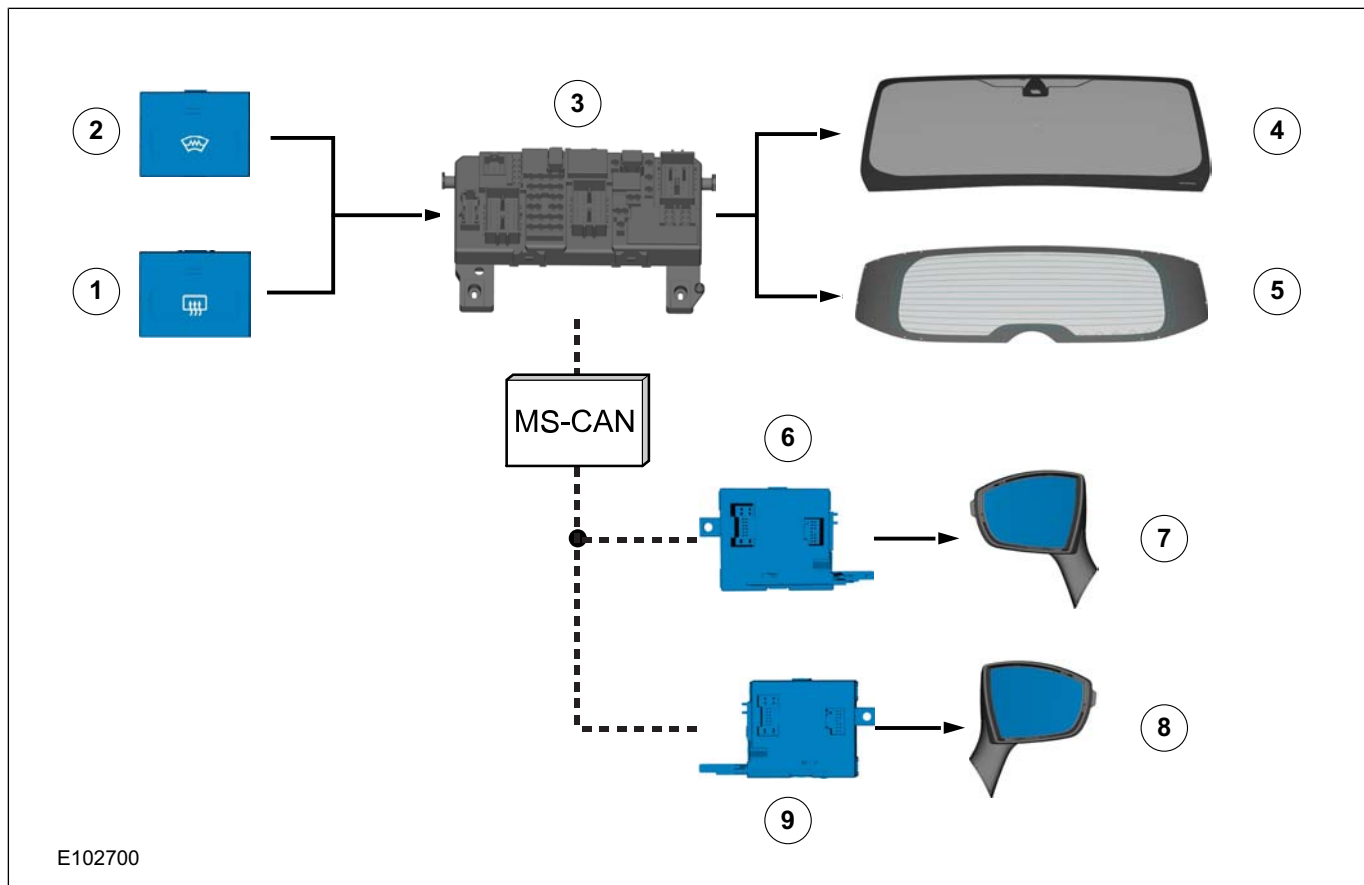
Item	Description
4	Power window with passenger door module
5	Passenger front window switch
6	Rear passenger side window switch

DESCRIPTION AND OPERATION

Item	Description
7	Power window with passenger side RDM

Item	Description
8	Power window with driver's side RDM
9	Rear driver's side window switch

Heated windows



E102700

Item	Description
1	Heated rear window switch
2	Windshield heater switch
3	GEM
4	Heated windshield

Item	Description
5	Heated rear window
6	Left FDM (front door module)
7	Heated exterior mirror, left
8	Heated exterior mirror, right
9	Right FDM

System Operation

Electrically operated side windows

The window switch in the driver's door is connected to both door modules on the driver's side using an LIN (local interconnect network).

The driver's door module is also connected to the CAN (controller area network) and the passenger door module using the MS GEM.

The window switches in the passenger door and the rear doors are directly connected to the relevant door module.

On the passenger side, the FDM and RDM are connected using an LIN.



**DESCRIPTION AND OPERATION****The windshield heater**

The windshield heater can only be operated when the engine is running.

The windshield heater is deactivated automatically after 4 minutes if the windshield heater switch has not already been pressed or the engine switched off.

**Heated Rear Window**

The heated rear window can only be operated when the engine is running.

When the heated rear window is turned on, the GEM sends a signal to the right and left FDM using MS CAN, which activates the heating elements in the exterior mirrors.

The heated rear window is deactivated automatically after 14 minutes if the heated rear window switch has not already been pressed or the engine switched off.

**DIAGNOSIS AND TESTING****Glass, Frames and Mechanisms — Vehicles With: Front and Rear Power Windows**

Refer to Wiring Diagrams Section 501-11, for schematic and connector information.

**General Equipment**

The Ford approved diagnostic tool
-----------------------------------

**Inspection and Verification**


1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

<b>Mechanical</b>	<b>Electrical</b>
<ul style="list-style-type: none"> <li>• Window seal</li> <li>• Door window frame</li> </ul>	<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Electrical connector(s)</li> <li>• Switch(es)</li> <li>• Circuit(s)</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

**GENERAL PROCEDURES****Door Window Motor Initialization**

 **WARNING:** The anti-trap function will not operate during the initialization procedure.

 **CAUTION:** Make sure that the door window opening is free of all foreign material.

**NOTE:** If the power to a window regulator motor has been disconnected, it is necessary to initialize that window regulator motor.

**NOTE:** Wait for a minimum of 1 minute before connecting the battery, fuse or electrical connector.

All vehicles

1. Switch on the ignition.
2. Pull and hold the window control switch to the second detent until the door window is fully closed.
3. Briefly release the window control switch and pull again to the second detent for three seconds.
4. Press and hold the window control switch to the second detent until the door window is fully opened.
5. Briefly release the window control switch and press again to the second detent for three seconds.
6. Pull and hold the window control switch to the second detent until the door window is fully closed.
7. Repeat the power door window initialization for each power door window.

Convertible

8. Press and hold the convertible top switch in the close position until the convertible top is fully closed. Hold the switch in the close position for further three seconds.

All vehicles

9. Switch off the ignition.



REMOVAL AND INSTALLATION

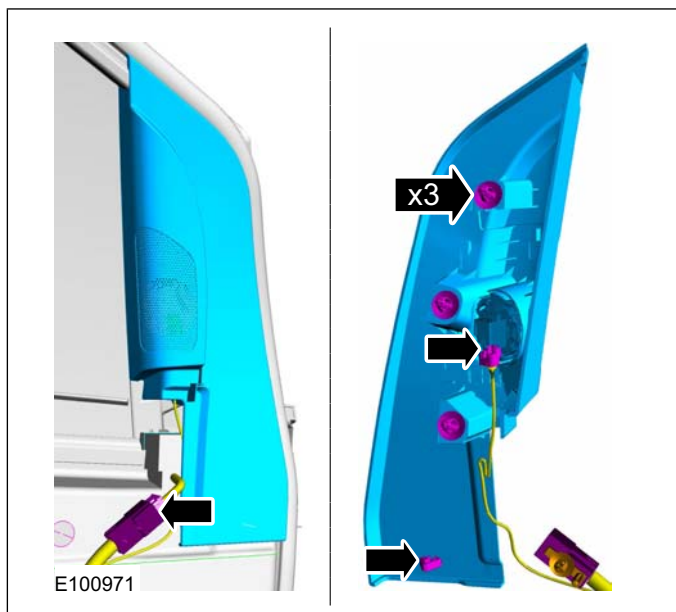
Front Door Window Glass

Removal

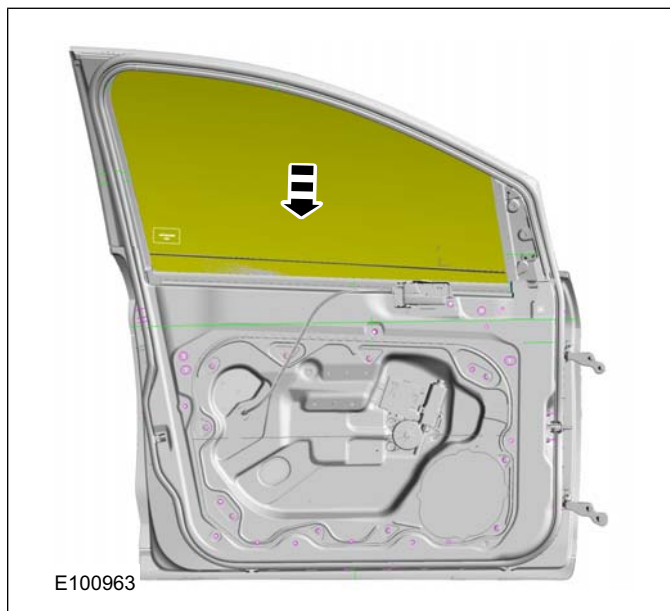
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Door Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

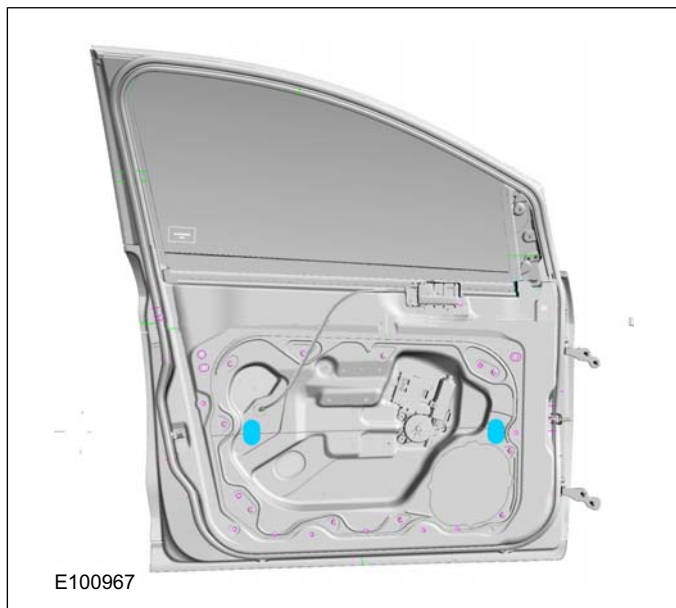
2.



4.



3.



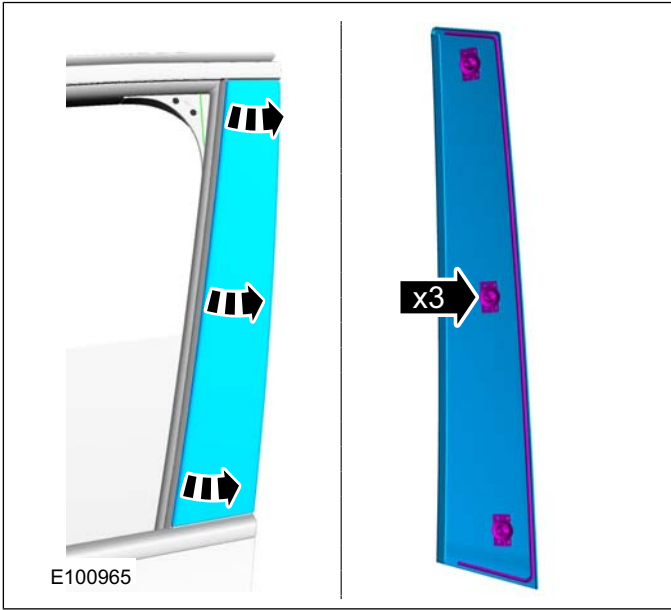
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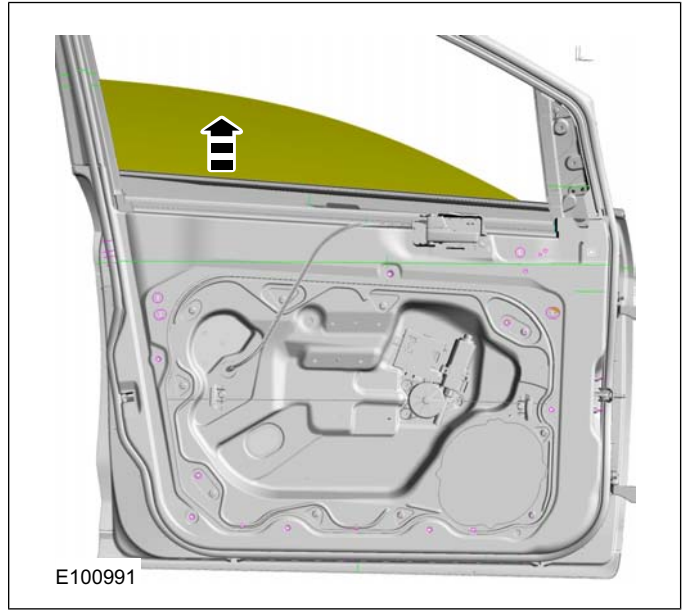


REMOVAL AND INSTALLATION

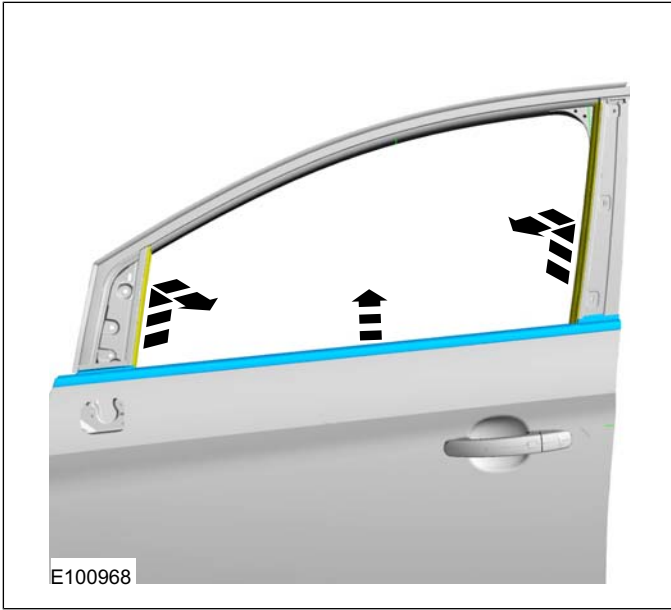
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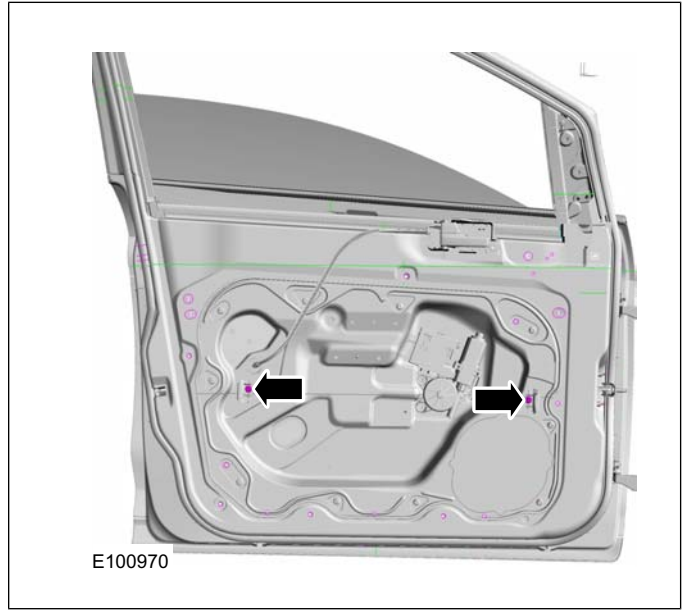
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7.

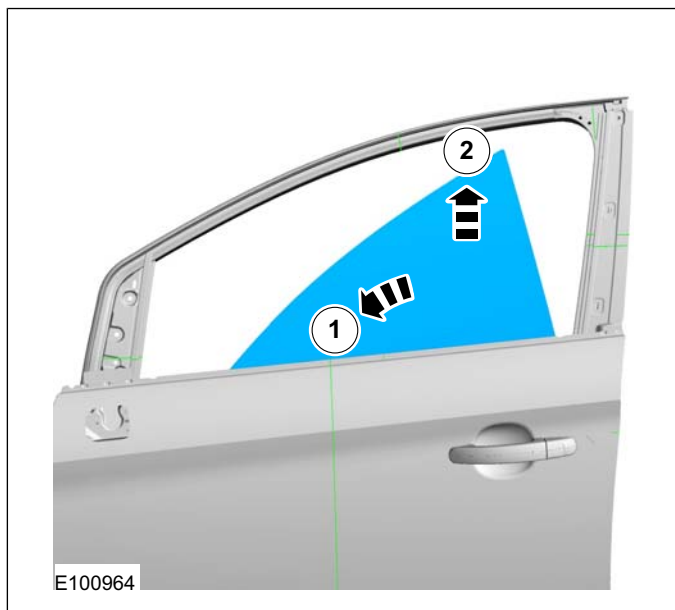


9. Torque: 7 Nm



## REMOVAL AND INSTALLATION

10.



## Installation

1. To install, reverse the removal procedure.



REMOVAL AND INSTALLATION

Front Door Window Regulator

General Equipment

5 mm Drill Bit
Adhesive Tape

General Equipment

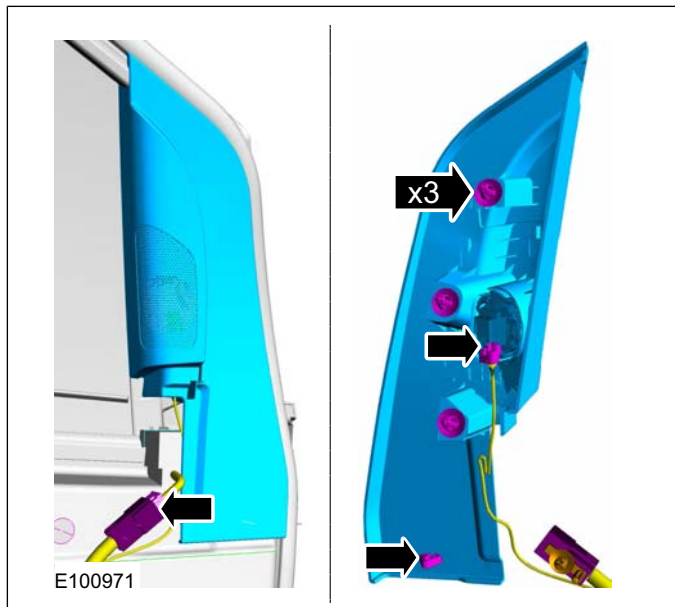
Blind Rivet Gun
Electric Drill

Removal

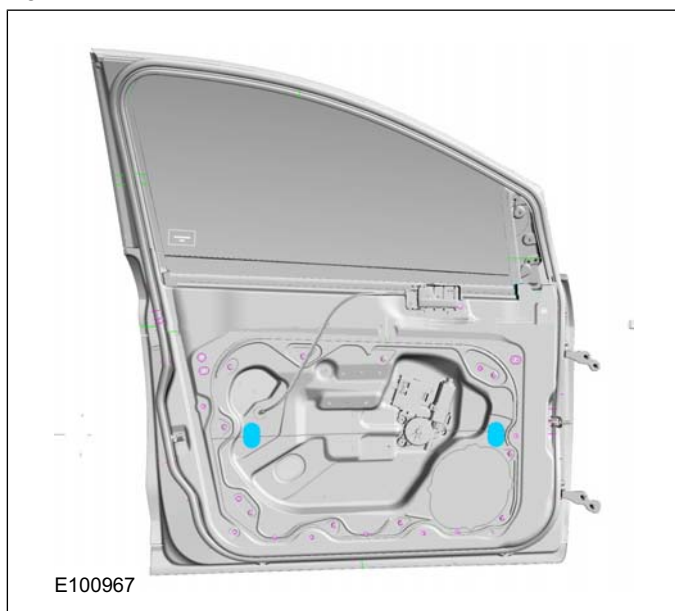
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Door Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

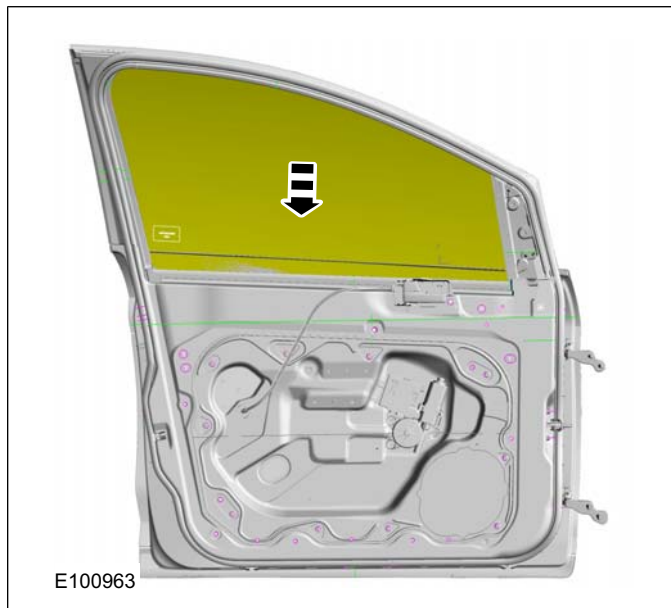
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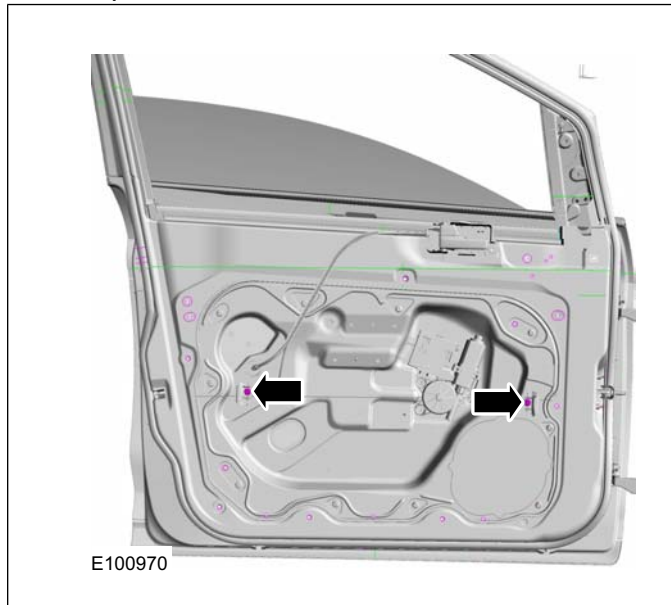
3.



4.



5. Torque: 7 Nm



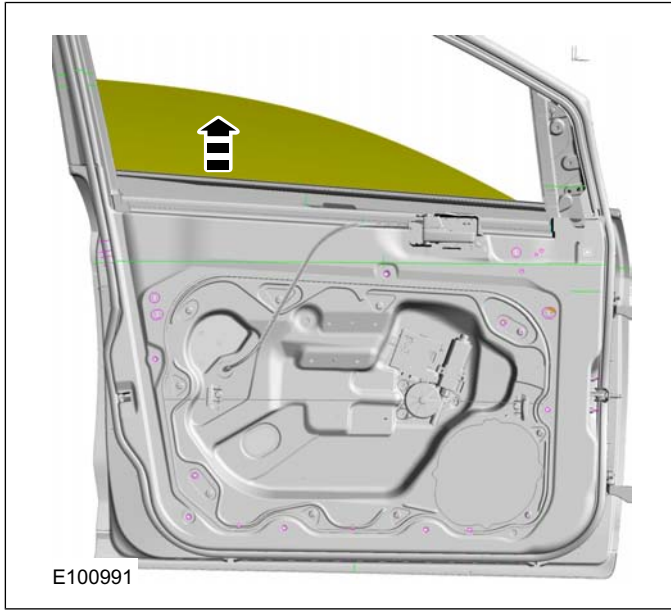
501-11-14

Glass, Frames and Mechanisms

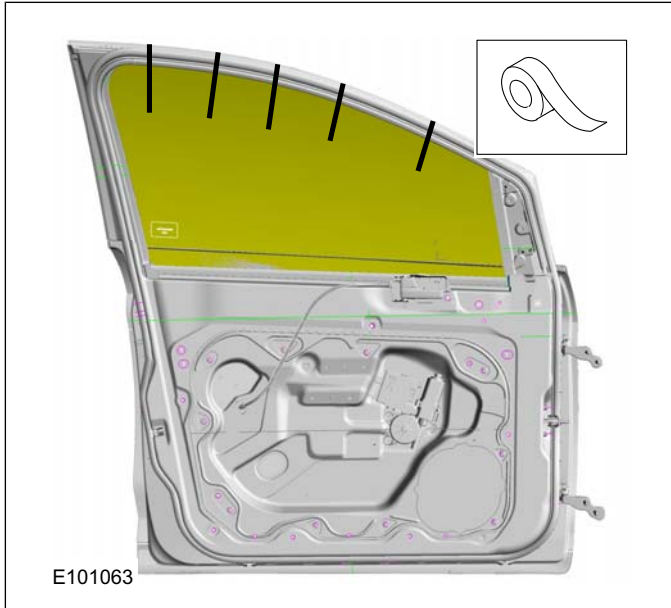
501-11-14

REMOVAL AND INSTALLATION

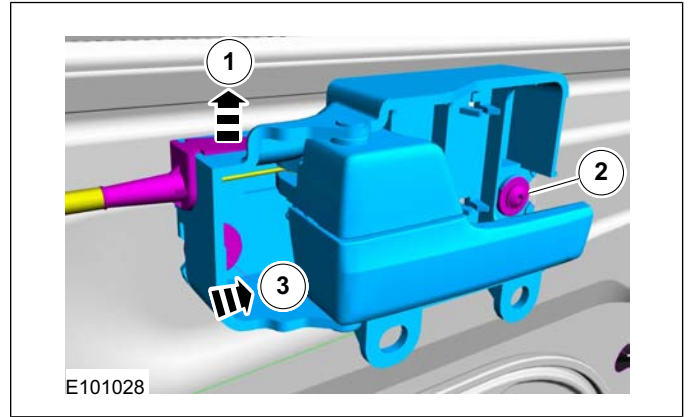
6.



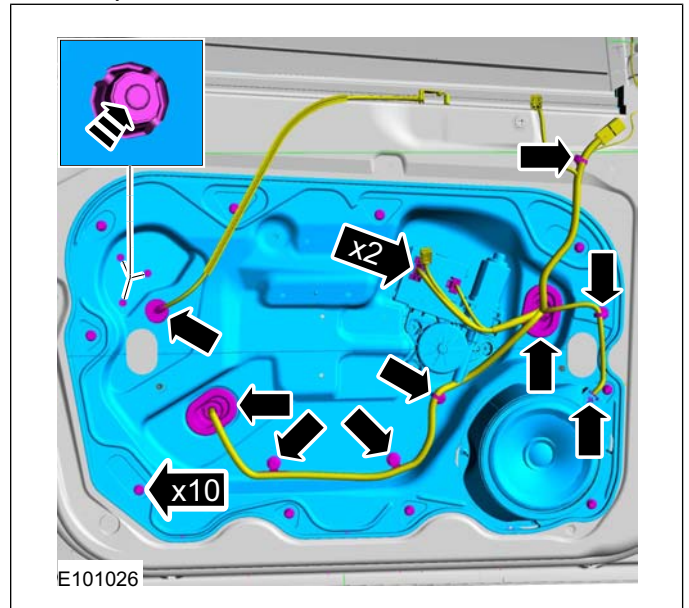
7. General Equipment: Adhesive Tape



8.



9. Torque: 8 Nm



**10. NOTE:** This step is only necessary when installing a new component.

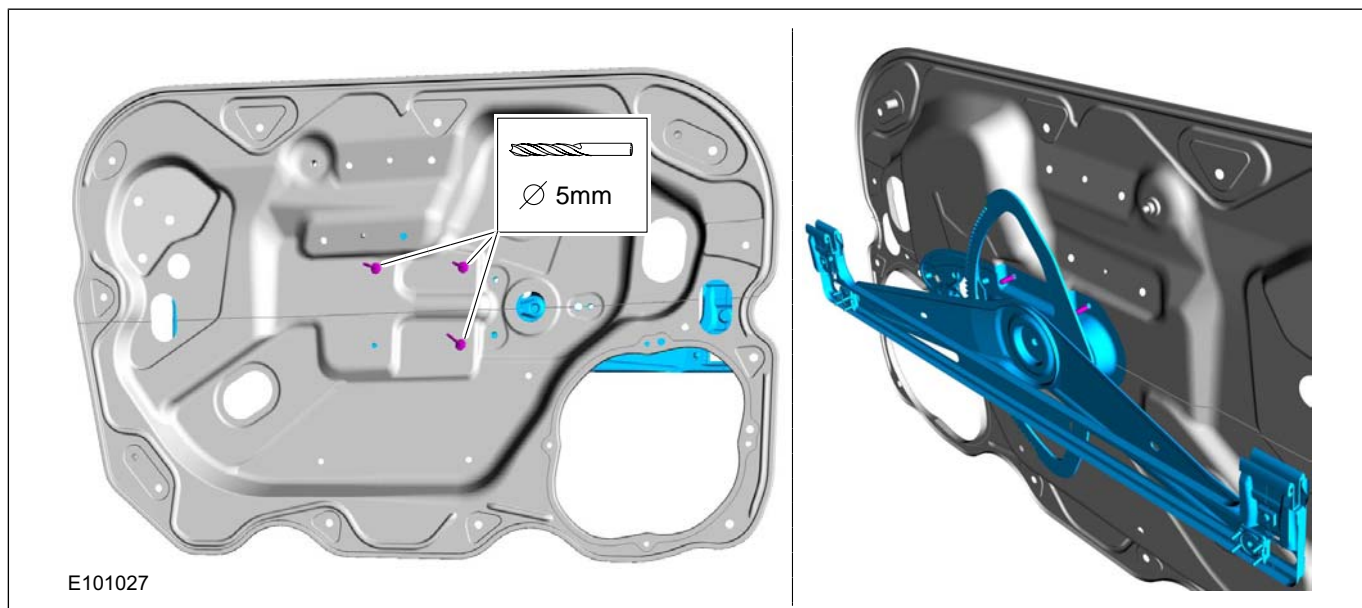
General Equipment: 5 mm Drill Bit  
General Equipment: Electric Drill

501-11-15

Glass, Frames and Mechanisms

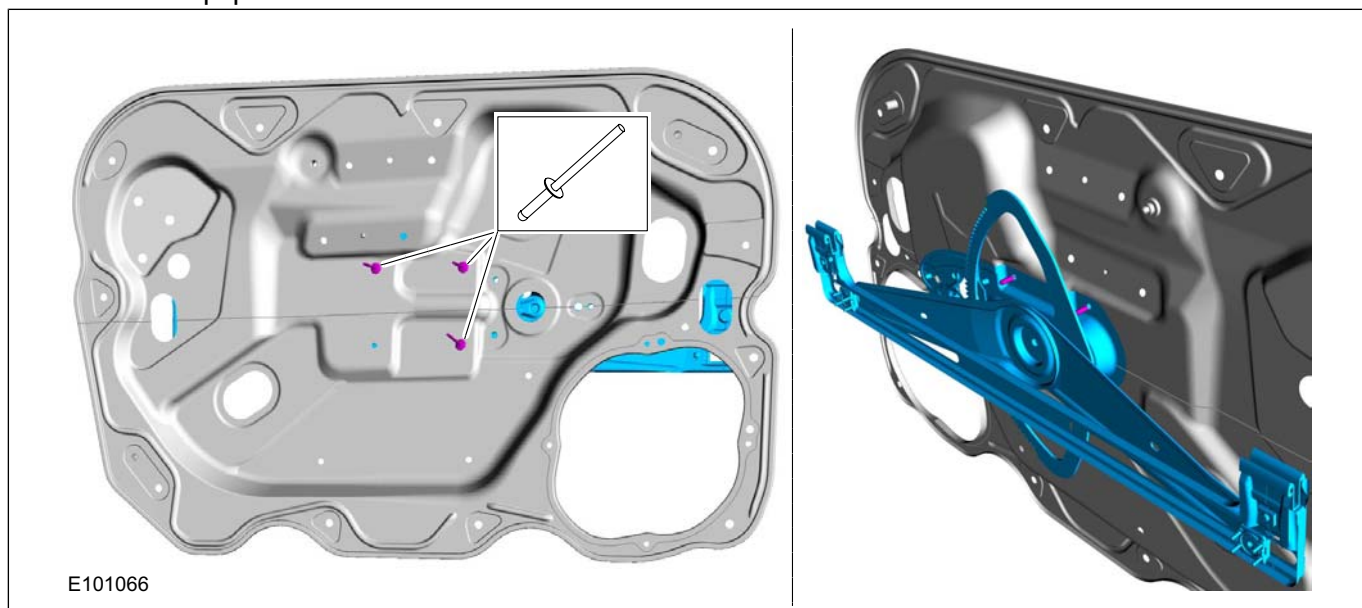
501-11-15

## REMOVAL AND INSTALLATION



## Installation

## 1. General Equipment: Blind Rivet Gun



## 2. To install, reverse the removal procedure.

Refer to: [Door Window Motor Initialization](#)  
(501-11 Glass, Frames and Mechanisms,  
General Procedures).

## REMOVAL AND INSTALLATION

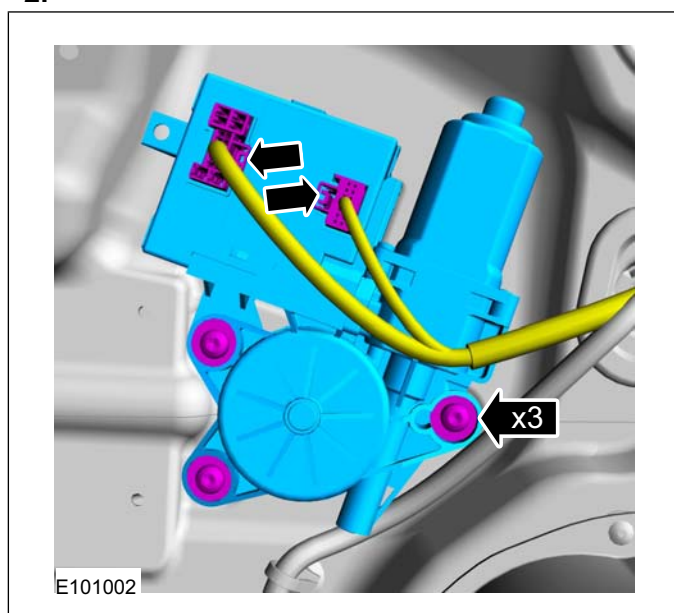
## Front Door Window Regulator Motor

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Door Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



## Installation

1. To install, reverse the removal procedure.

Refer to: **Door Window Motor Initialization** (501-11 Glass, Frames and Mechanisms, General Procedures).



## REMOVAL AND INSTALLATION

## Glass Roof Panel

## General Equipment

Adhesive Tape
Direct Glazing Removal/Replacement Equipment
Knife

## Materials

Name	Specification
Windscreen Adhesive Kit - 1 Component	WSK-M11P57-A3 / 7U7J-T03863-AA
Windshield Adhesive Kit	WSS-M11P57-A5

## Removal

1.  CAUTION:

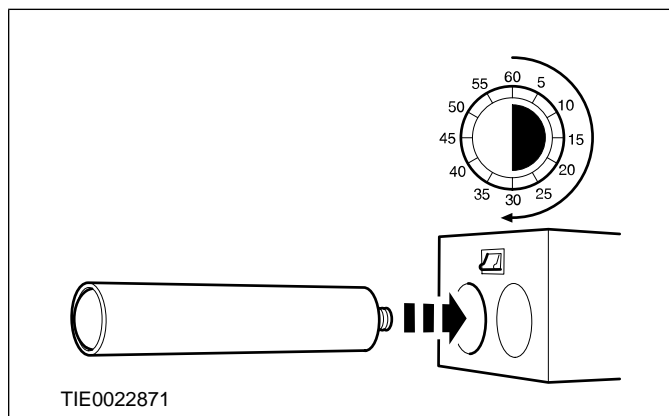
Refer to: **Window Glass Health and Safety Precautions** (100-00 General Information, Description and Operation).

1. Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive
2. Remove the polyurethane (PU) adhesive cap and heat the 2K-PU adhesive for a minimum of 30 minutes.

General Equipment: Direct Glazing Removal/Replacement Equipment

3. Repairs under warranty:

Material: Windscreen Adhesive Kit - 1 Component (WSK-M11P57-A3 / 7U7J-T03863-AA) adhesive



- 3.



REMOVAL AND INSTALLATION



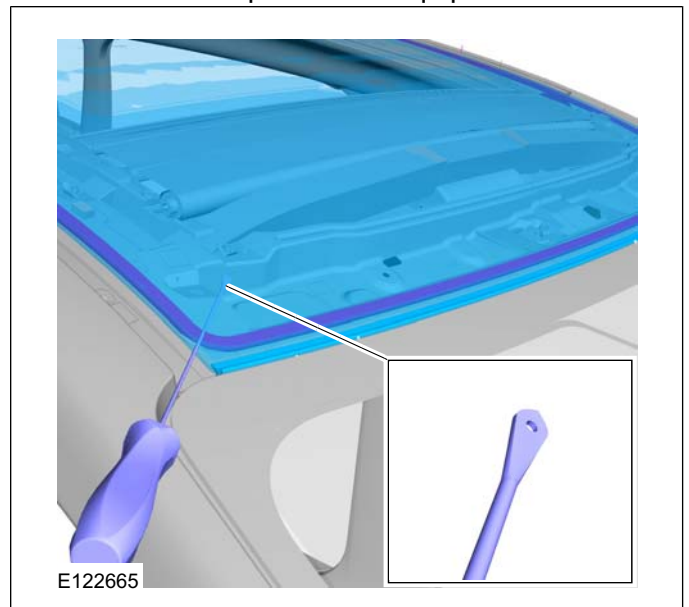
4. Refer to: **Roof Rail** (501-08 Exterior Trim and Ornamentation, Removal and Installation).



**WARNING:** Make sure that the component paintwork is not damaged.

Use a suitable awl to thread the cutting wire.

General Equipment: Direct Glazing Removal/Replacement Equipment



**WARNING:** Make sure that the component paintwork is not damaged.

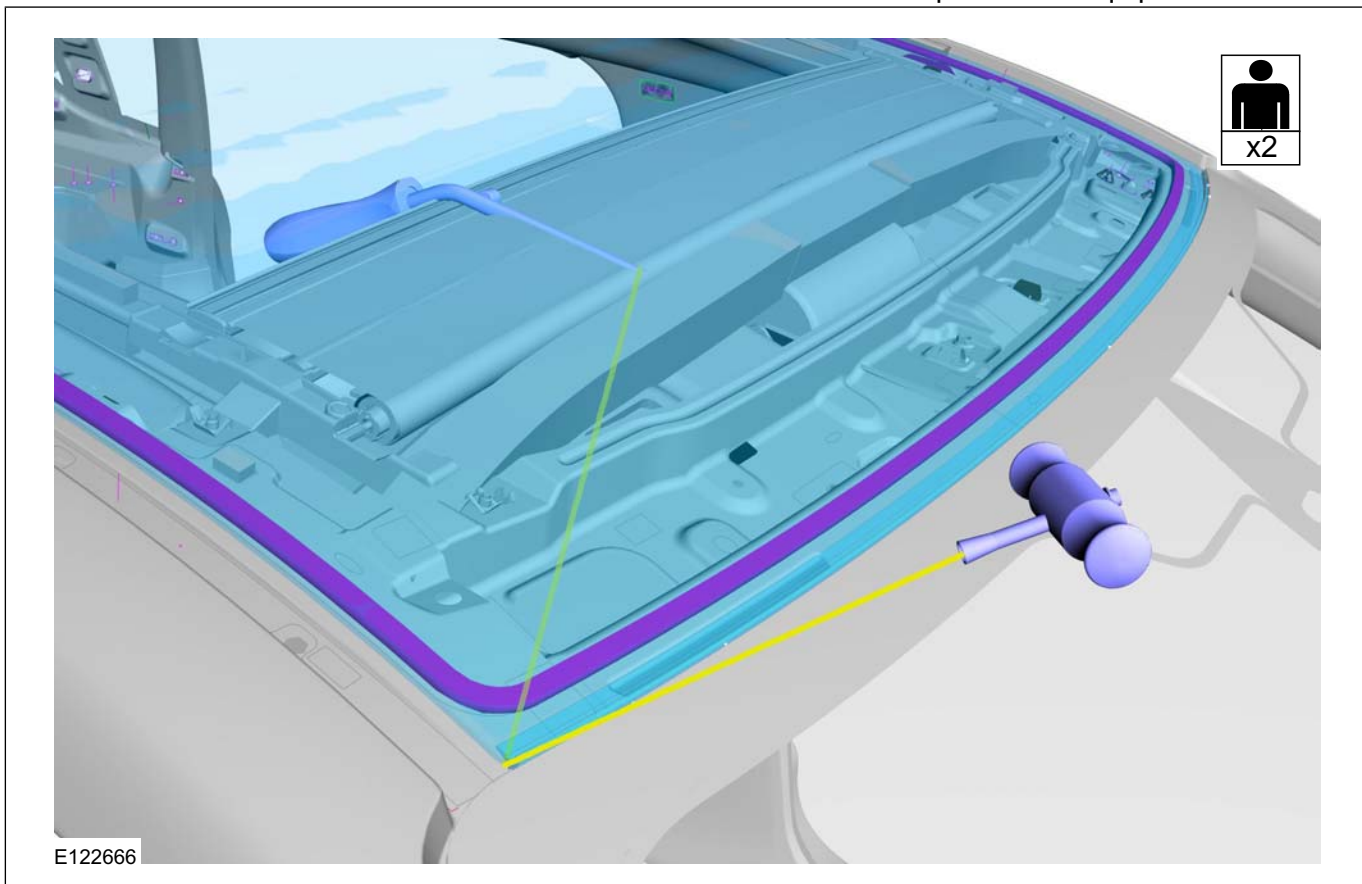




REMOVAL AND INSTALLATION

**NOTE:** Some resistance may be encountered when cutting through the glass locating spacers.

Use a suitable brace to prevent trim damages.  
General Equipment: Direct Glazing Removal/Replacement Equipment



501-11-20

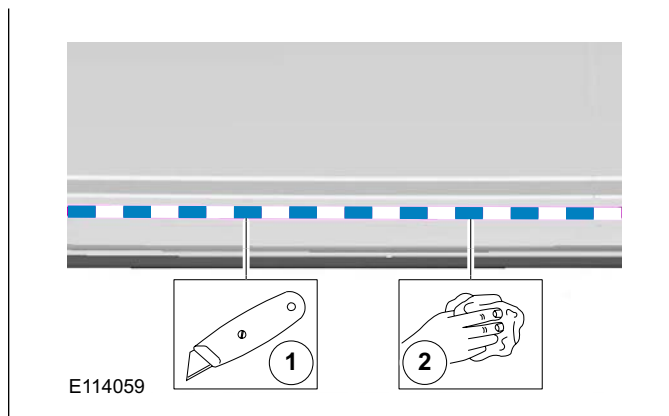
## Glass, Frames and Mechanisms

501-11-20

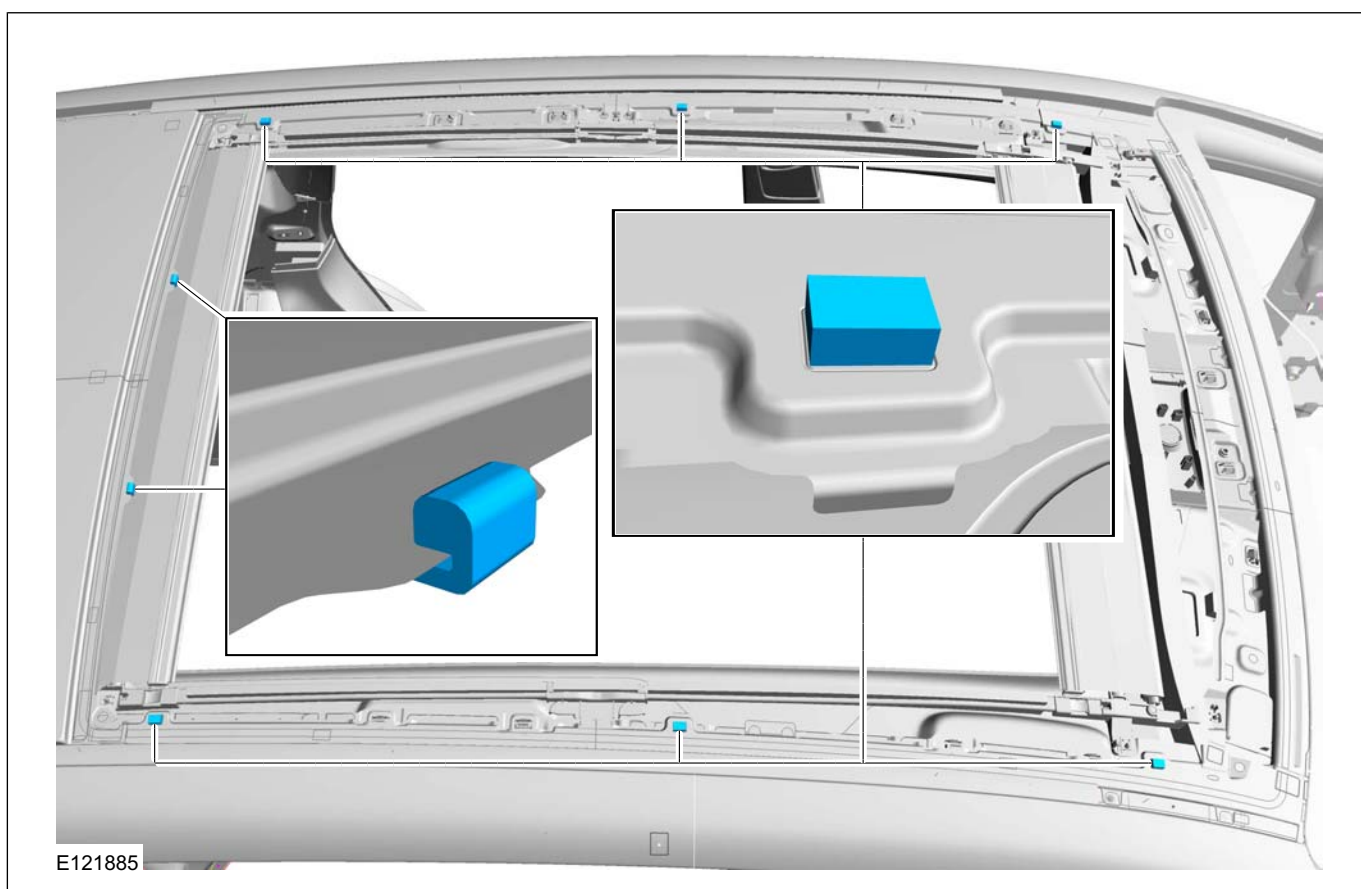
## REMOVAL AND INSTALLATION

## Installation

1. **NOTE:** Minimum 1 mm bead thickness.  
General Equipment: Knife
2. **NOTE:** Make sure that the mating faces are clean and free of foreign material.
3. **NOTE:** Touching the adhesive surface will impair rebonding.  
Prepare the glass roof panel, glass roof panel flange and trimmed PU adhesive in accordance with the instructions supplied with the glass adhesive kit.

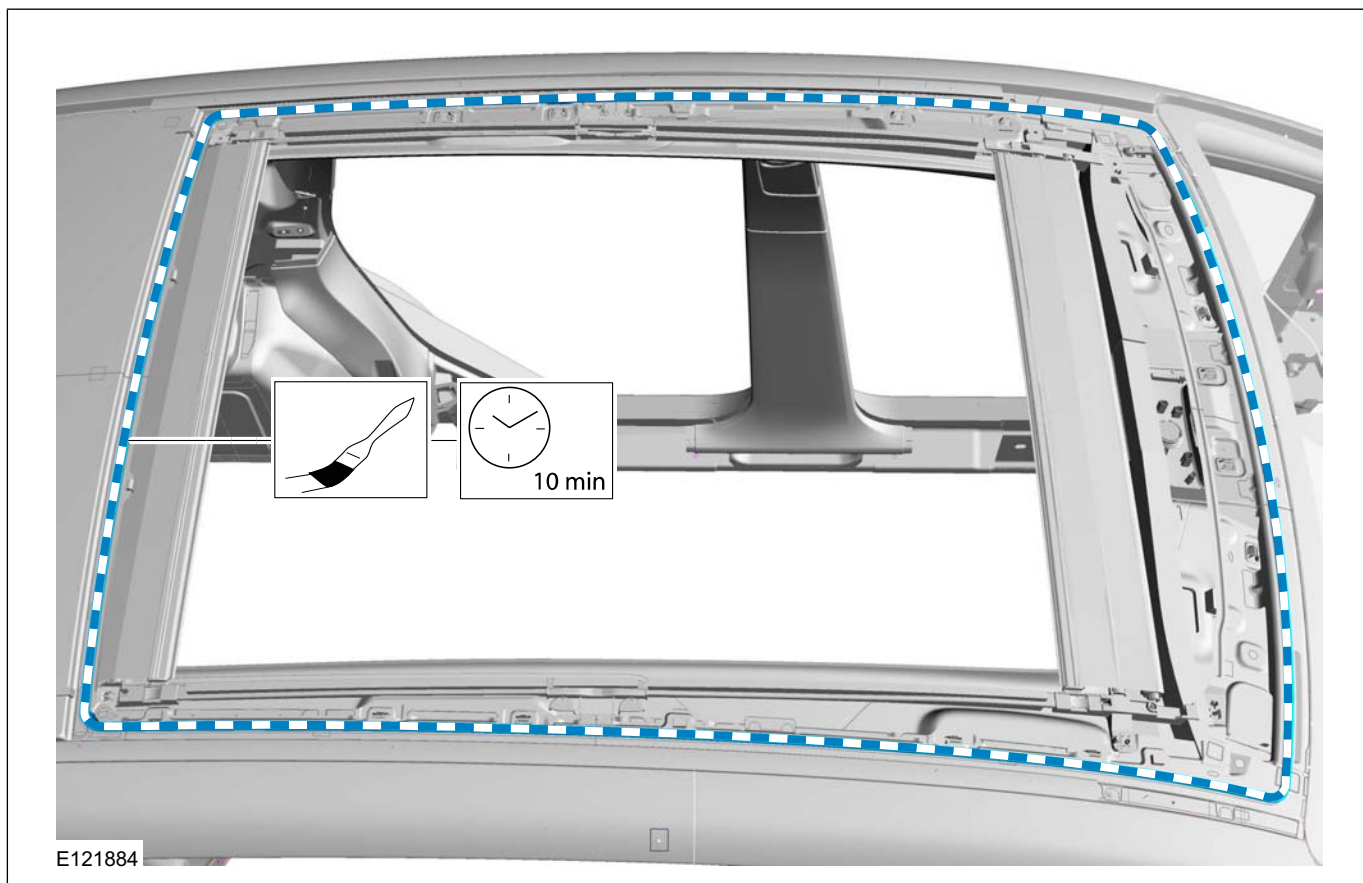


2.



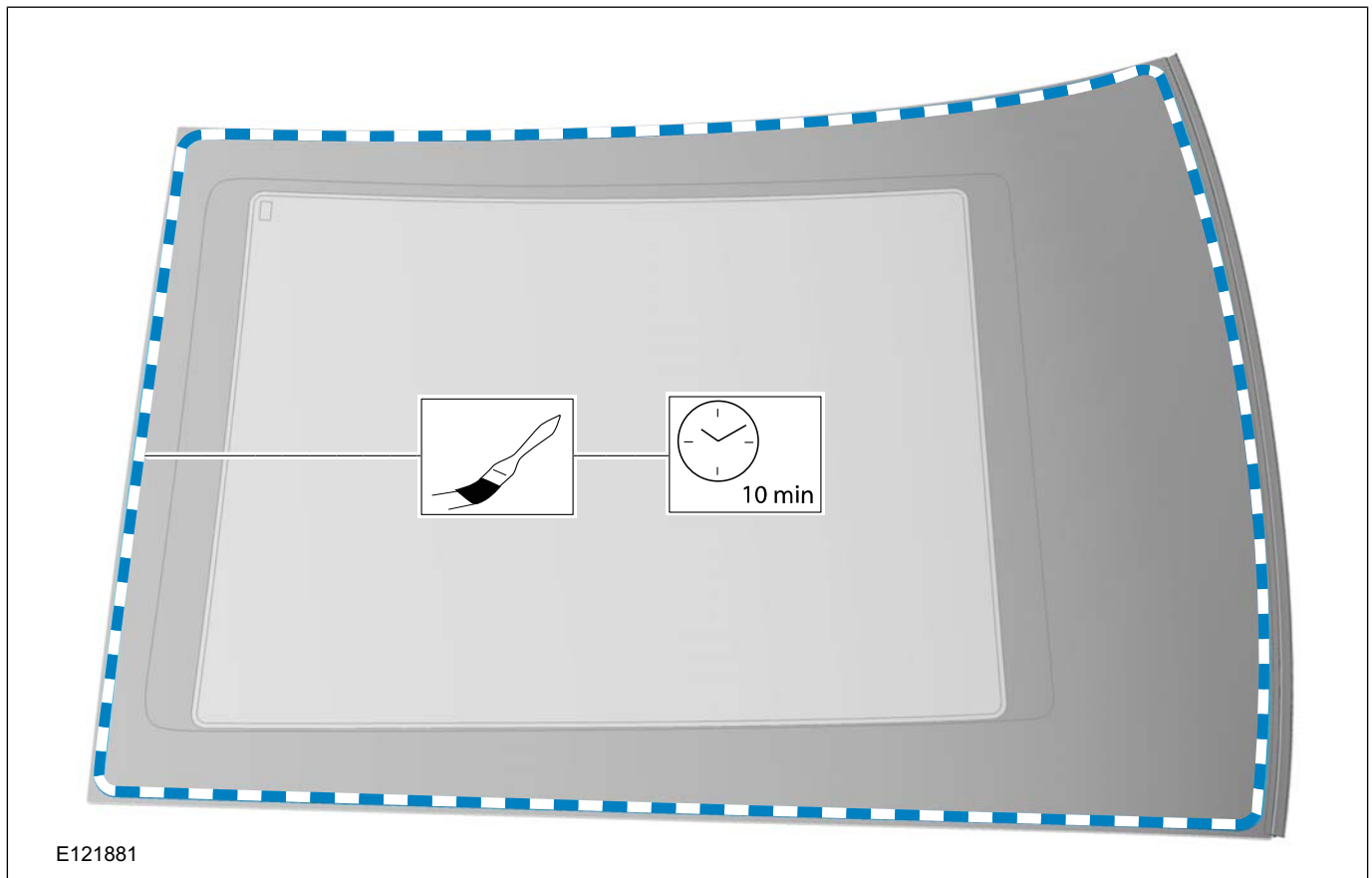
3. Apply the activator/ primer in accordance with the instructions supplied with the glass adhesive kit.

## REMOVAL AND INSTALLATION



4. Apply the activator/ primer in accordance with the instructions supplied with the glass adhesive kit.

## REMOVAL AND INSTALLATION



5. **NOTE:** Discard the first 100 mm of adhesive as this may have a reduced working time.

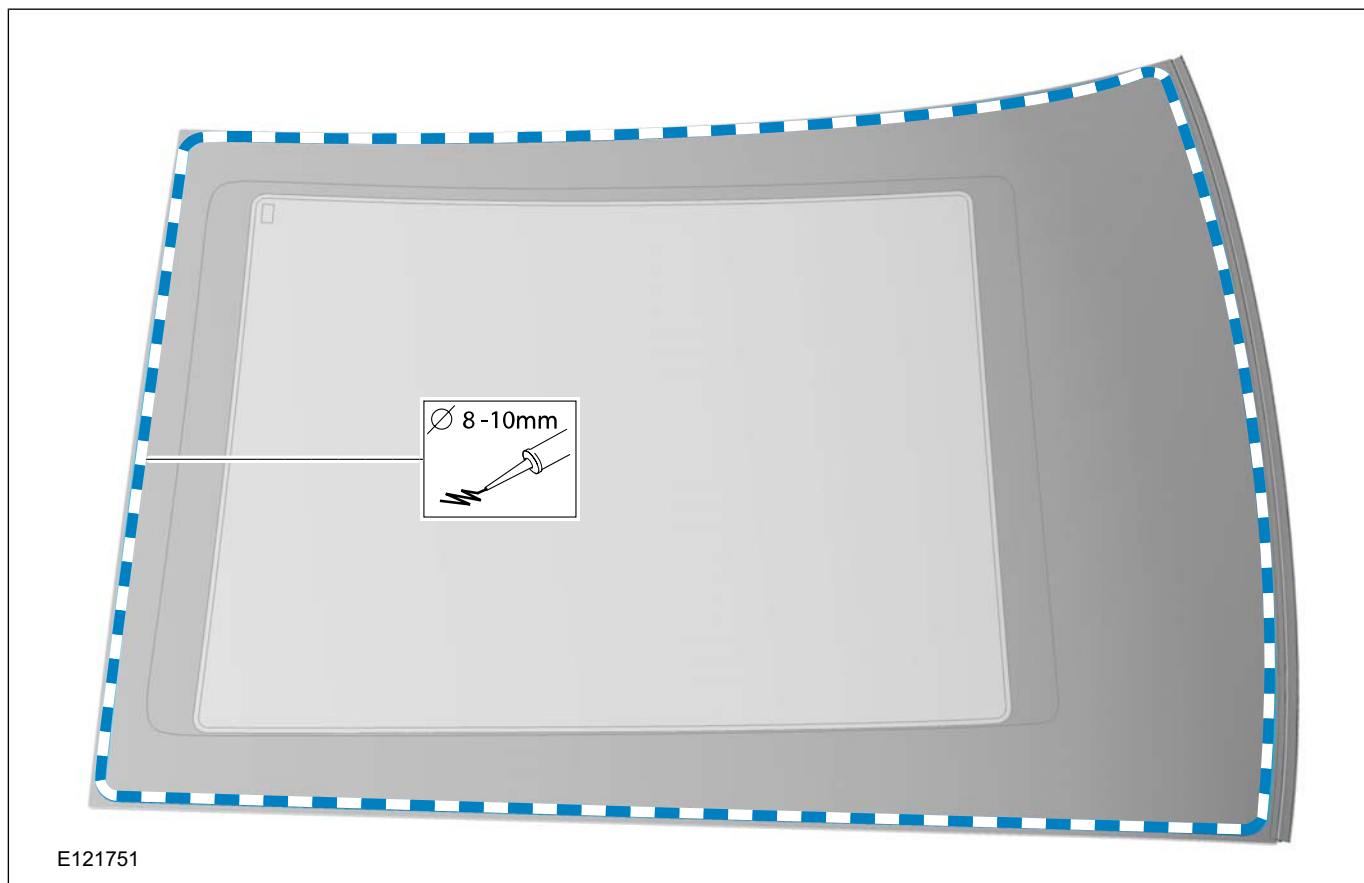
**NOTE:** Make sure that any breakage in the continuous bead of adhesive is overlapped by 20 mm.

General Equipment: Direct Glazing  
Removal/Replacement Equipment

Material: Windshield Adhesive Kit  
(WSS-M11P57-A5) adhesive

Material: Windscreen Adhesive Kit - 1  
Component (WSK-M11P57-A3 /  
7U7J-T03863-AA) adhesive

## REMOVAL AND INSTALLATION



6. • Press firmly and evenly into position.

General Equipment: Direct Glazing  
Removal/Replacement Equipment

- **⚠ CAUTION: During the curing time of the polyurethane (PU) adhesive, the door windows must be left open.**

Using tape, secure the glass roof panel in the correct position until the PU adhesive has cured.

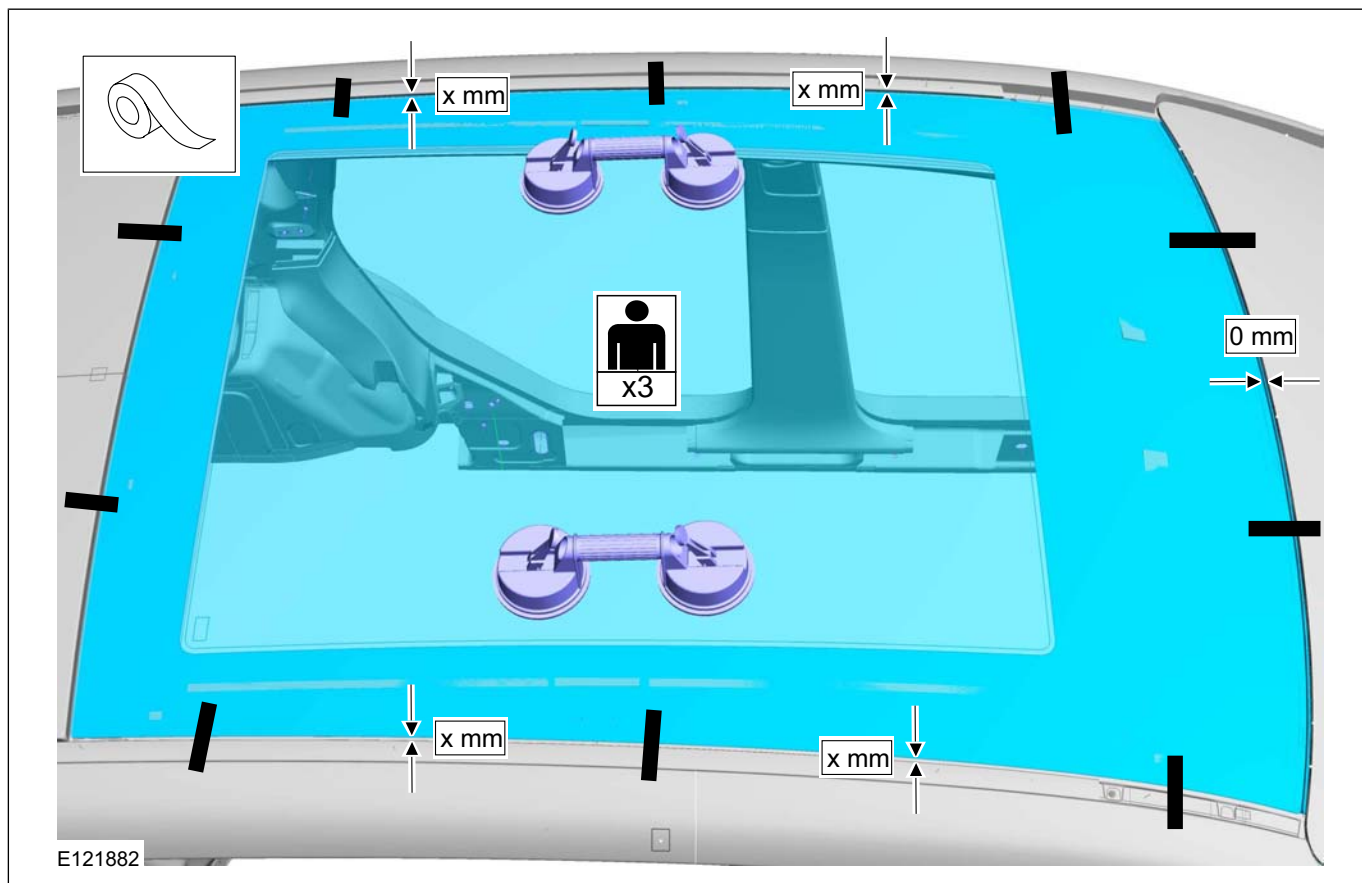
General Equipment: Adhesive Tape

501-11-24

Glass, Frames and Mechanisms

501-11-24

## REMOVAL AND INSTALLATION



7. Refer to: **Roof Rail** (501-08 Exterior Trim and Ornamentation, Removal and Installation).



REMOVAL AND INSTALLATION

Liftgate Window Glass

General Equipment

Adhesive Tape
Direct Glazing Removal/Replacement Equipment
Hot Air Gun
Knife

General Equipment

Laminated Card
----------------

Materials

Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

Removal

1.  CAUTION:

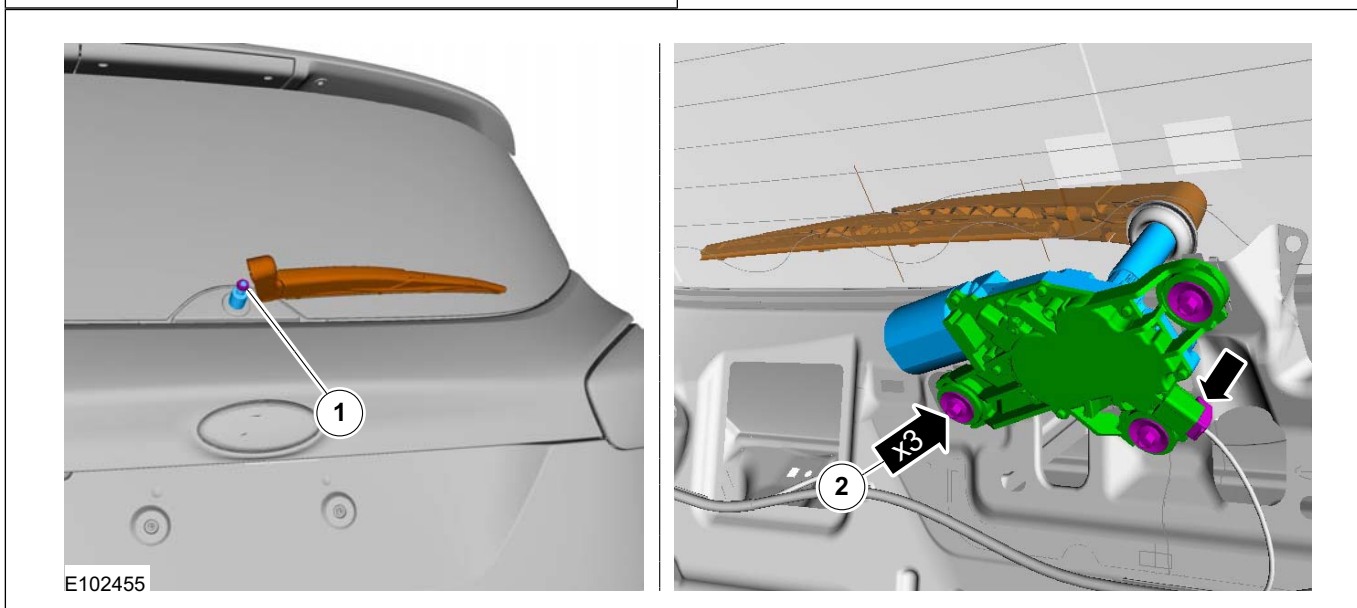
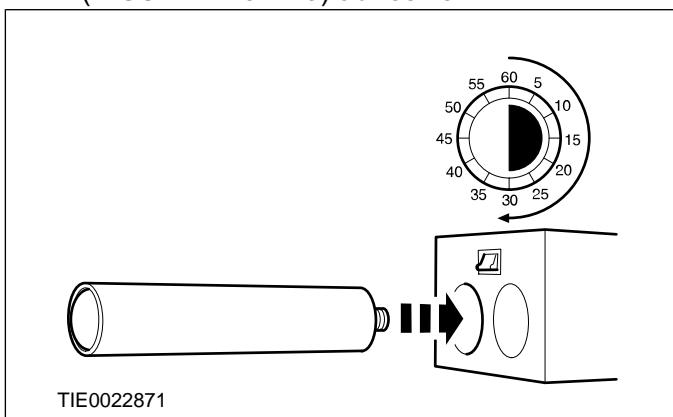
Refer to: **Window Glass Health and Safety Precautions** (100-00 General Information, Description and Operation).

- Remove the polyurethane (PU) adhesive cap and heat the PU adhesive for a minimum of 30 minutes.

Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive

- Refer to: **Liftgate Upper Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

4.



501-11-26

Glass, Frames and Mechanisms

501-11-26

## REMOVAL AND INSTALLATION

5. Refer to: **Rear Spoiler** (501-08 Exterior Trim and Ornamentation, Removal and Installation).



**CAUTION:** Make sure that the cutting blades are changed where the cutting depth changes.

Use laminated card to prevent paint damages.

General Equipment: Direct Glazing  
Removal/Replacement Equipment  
General Equipment: Laminated Card



## Installation

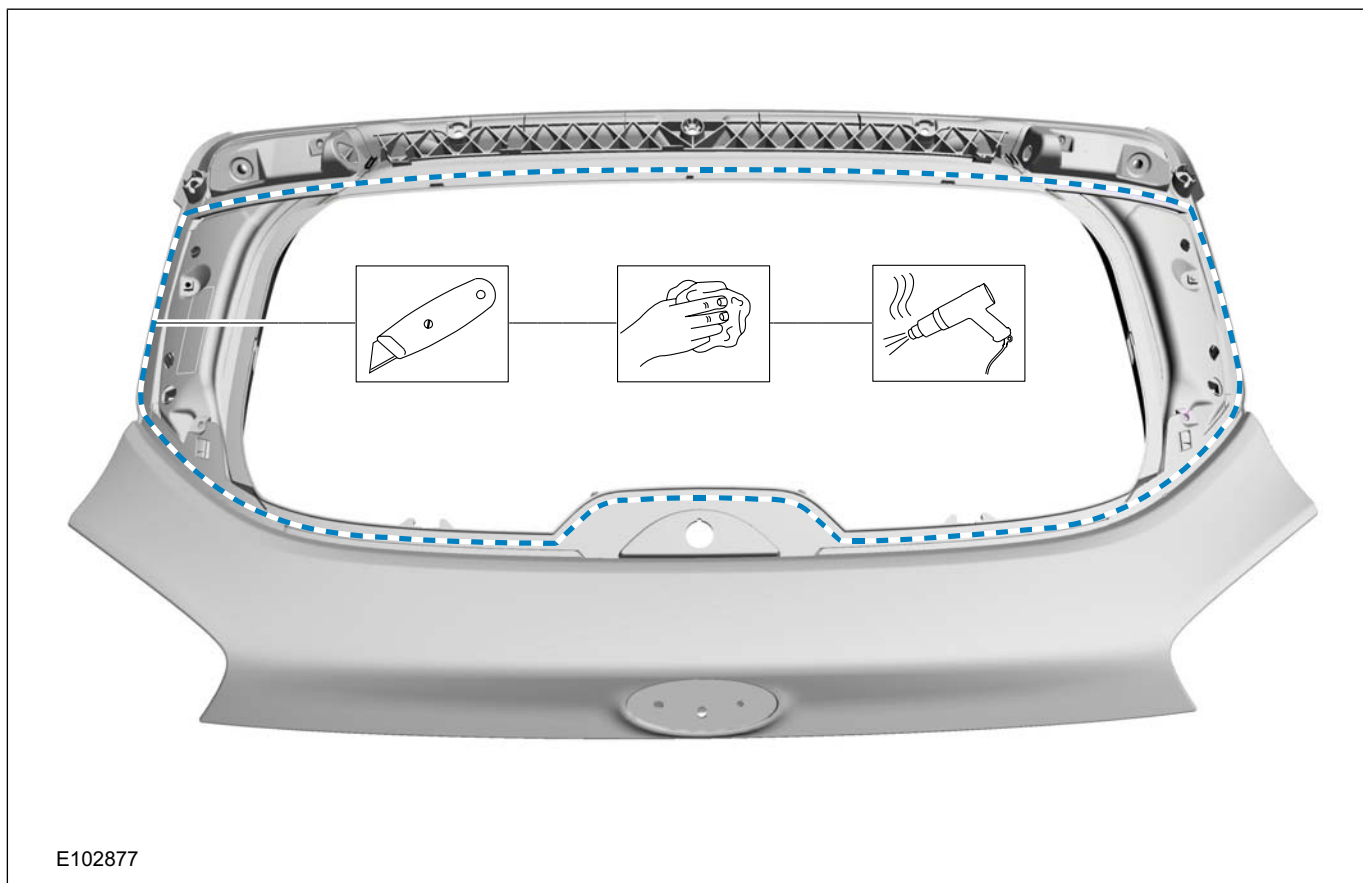
1. **NOTE:** Minimum 1 mm bead thickness.

**NOTE:** Make sure that the mating faces are clean and free of foreign material.

**NOTE:** Touching the adhesive surface will impair rebonding.

General Equipment: Knife  
General Equipment: Hot Air Gun

REMOVAL AND INSTALLATION



2. **NOTE:** This step is only necessary if the original component is to be reused.

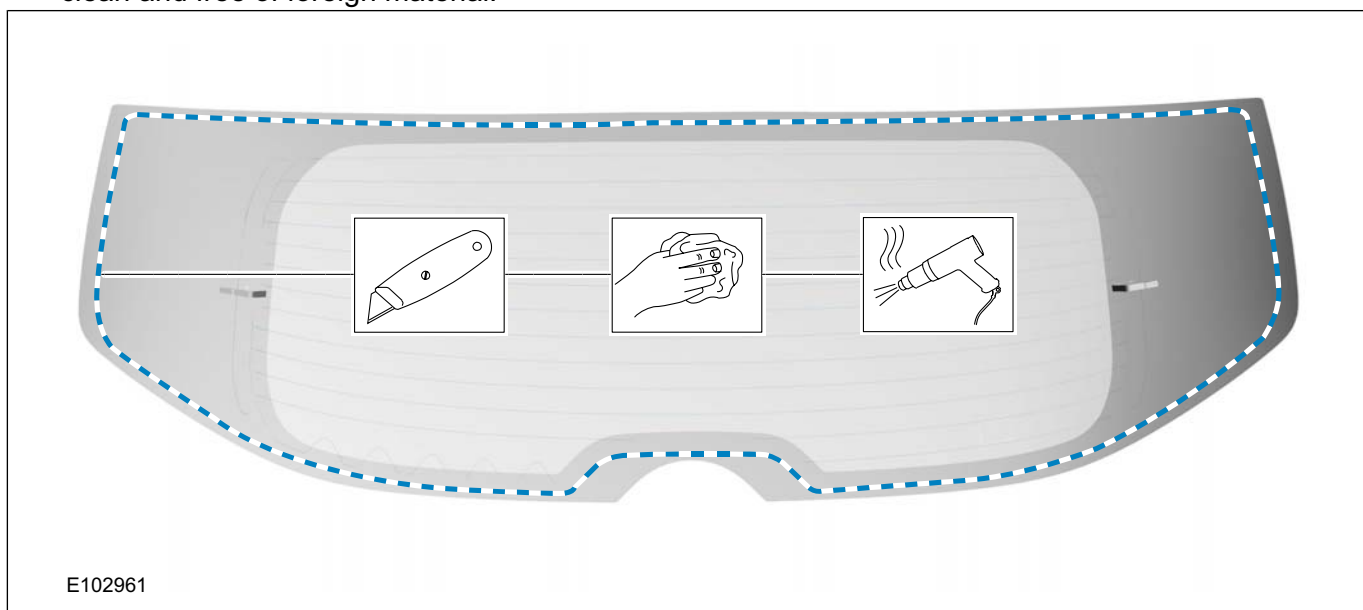
**NOTE:** Minimum 1 mm bead thickness.

**NOTE:** Make sure that the mating faces are clean and free of foreign material.

**NOTE:** Touching the adhesive surface will impair rebonding.

General Equipment: Knife

General Equipment: Hot Air Gun



3. **NOTE:** Discard the first 100 mm of adhesive as this may have a reduced working time.

501-11-28

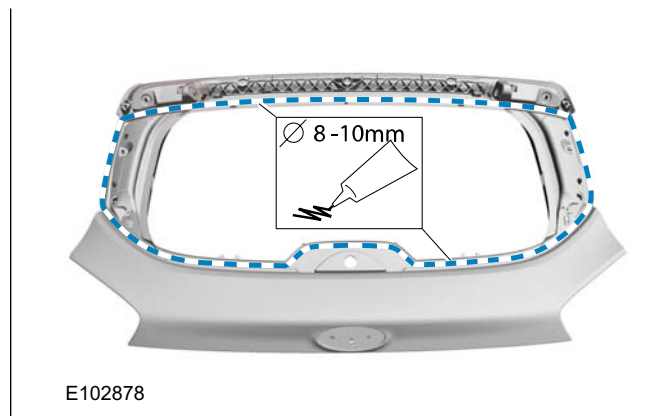
## Glass, Frames and Mechanisms

501-11-28

## REMOVAL AND INSTALLATION

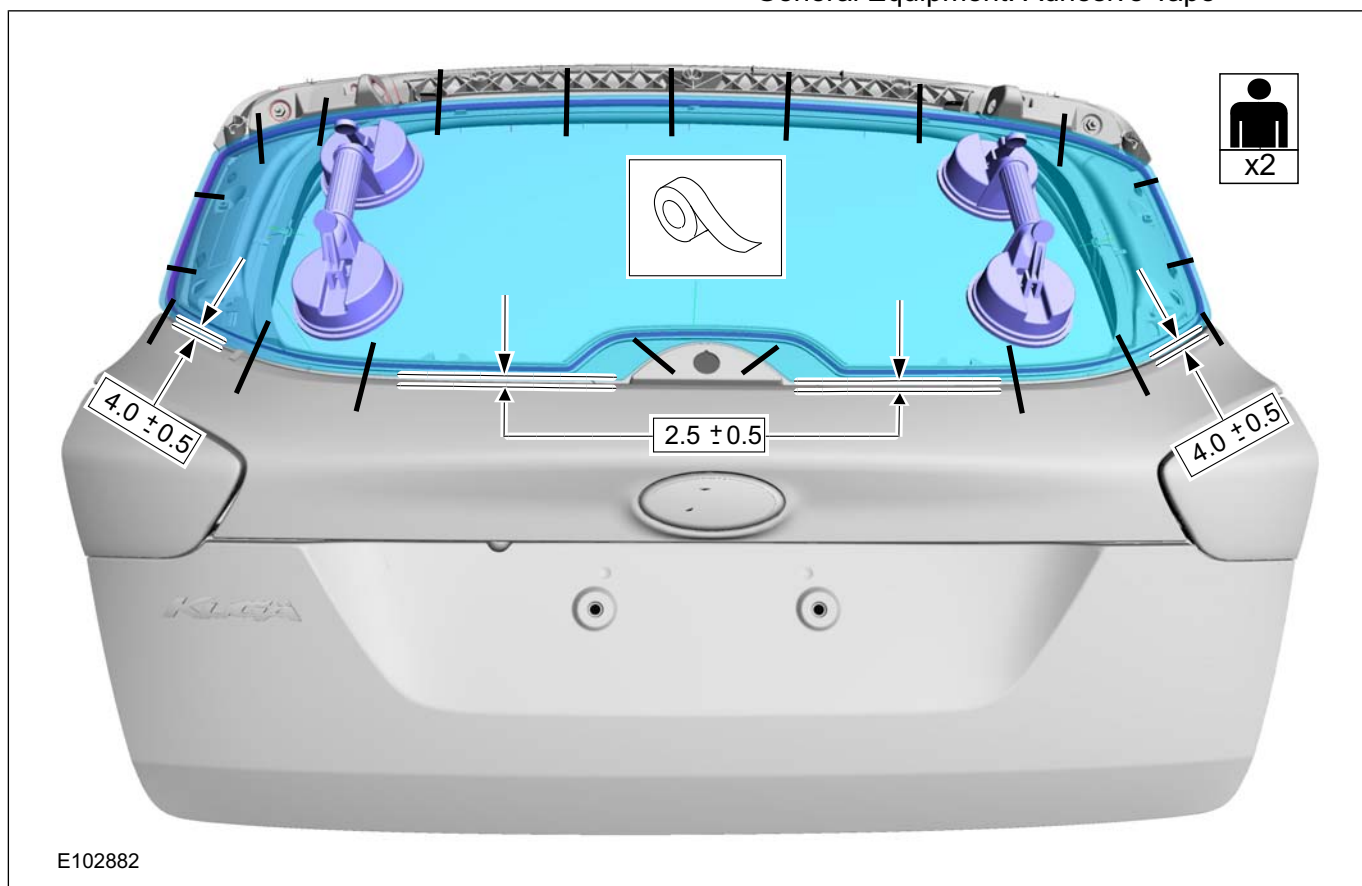
**NOTE:** Make sure that any breakage in the continuous bead of adhesive is overlapped by 20 mm.

General Equipment: Direct Glazing  
Removal/Replacement Equipment  
Material: Windshield Adhesive Kit  
(WSS-M11P57-A5) adhesive



4. **CAUTION:** During the curing time of the polyurethane (PU) adhesive, the door windows must be left open.

General Equipment: Adhesive Tape



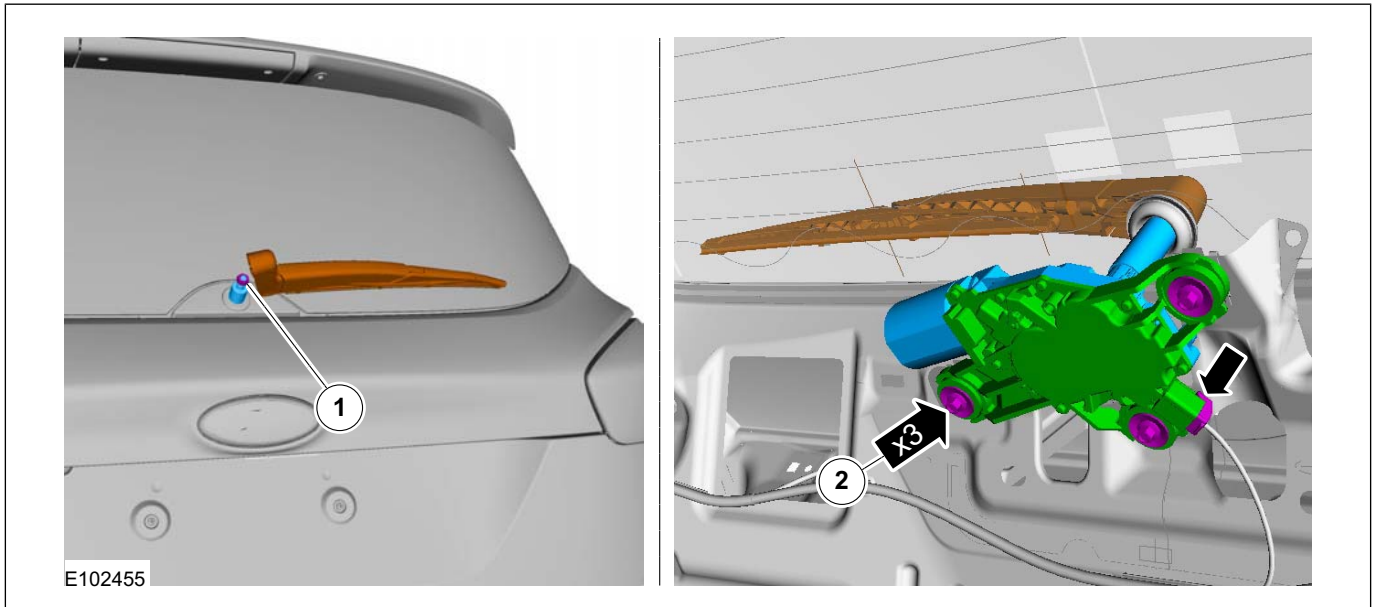
5. Refer to: **Rear Spoiler** (501-08 Exterior Trim and Ornamentation, Removal and Installation).
6. 1. Torque: 15 Nm  
2. Torque: 8 Nm

501-11-29

Glass, Frames and Mechanisms

501-11-29

## REMOVAL AND INSTALLATION



7. Refer to: [Liftgate Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

REMOVAL AND INSTALLATION

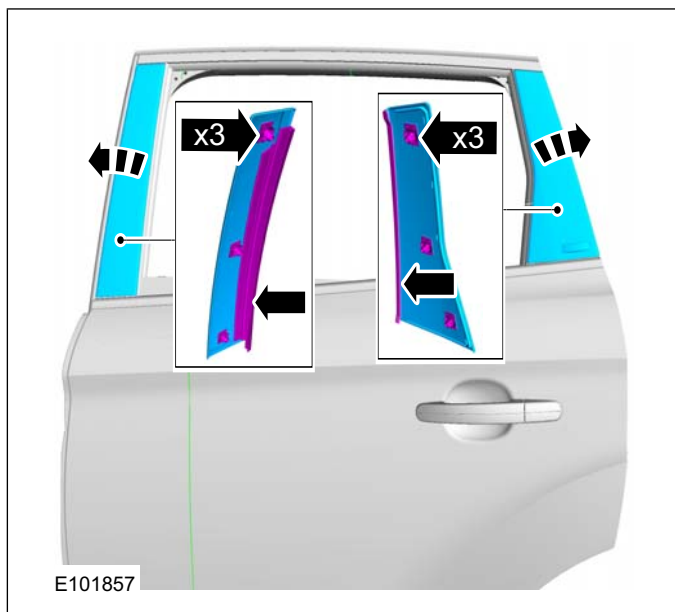
Rear Door Window Glass

Removal

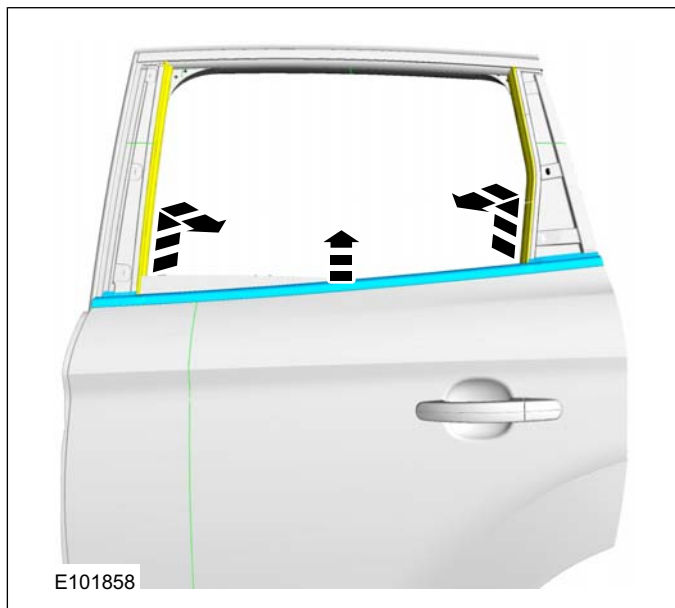
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Rear Door Window Regulator** (501-11 Glass, Frames and Mechanisms, Removal and Installation).

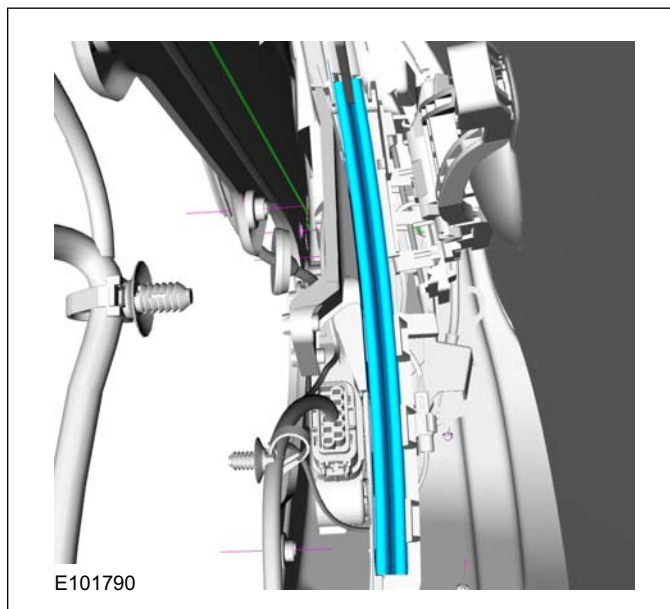
2.



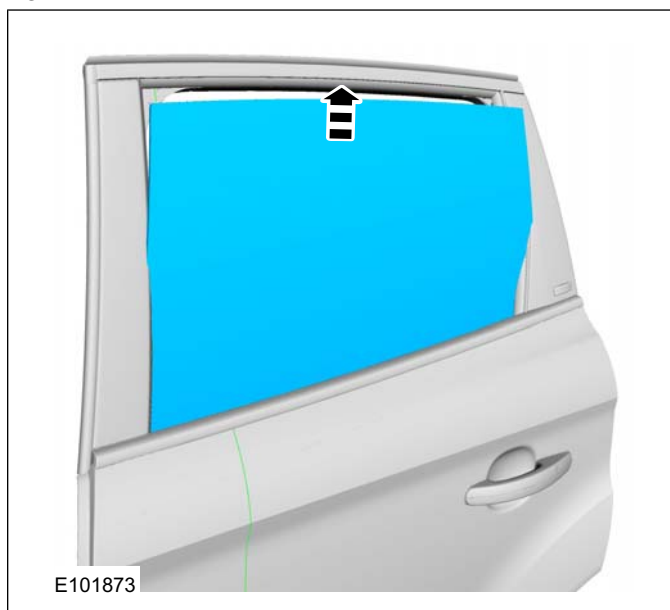
3.



4.



5.



Installation

1. To install, reverse the removal procedure.



REMOVAL AND INSTALLATION

Rear Door Window Regulator

General Equipment

5 mm Drill Bit
Adhesive Tape

General Equipment

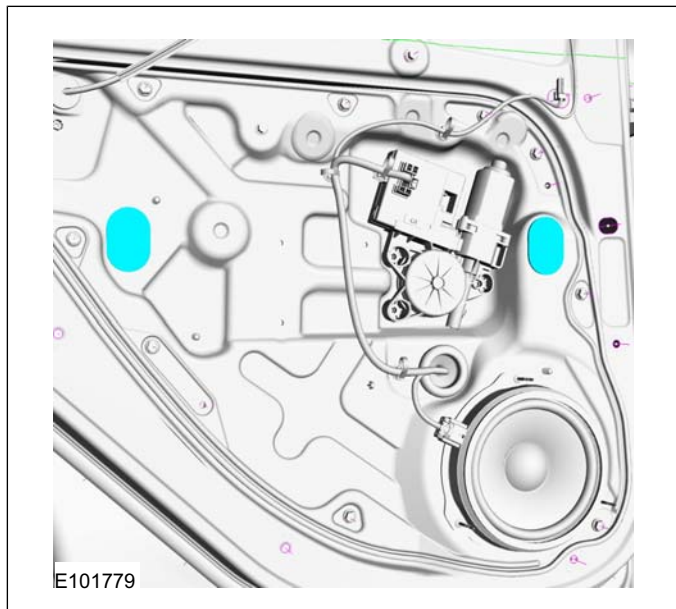
Blind Rivet Gun
Electric Drill

Removal

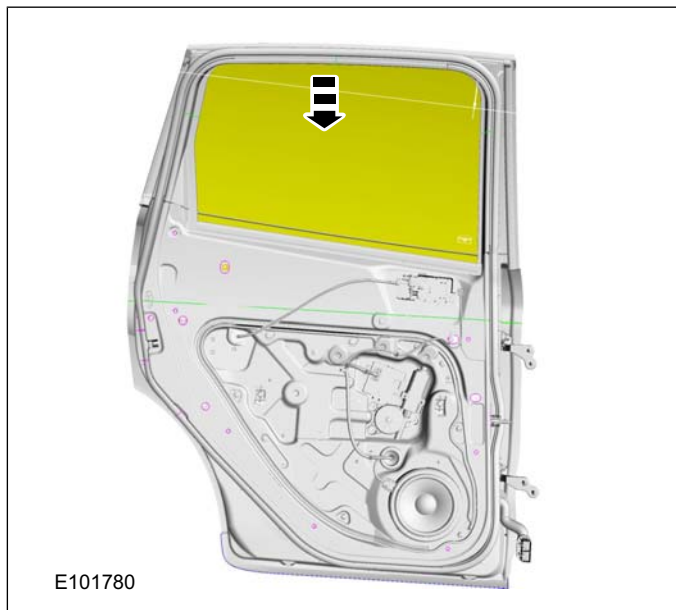
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Rear Door Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



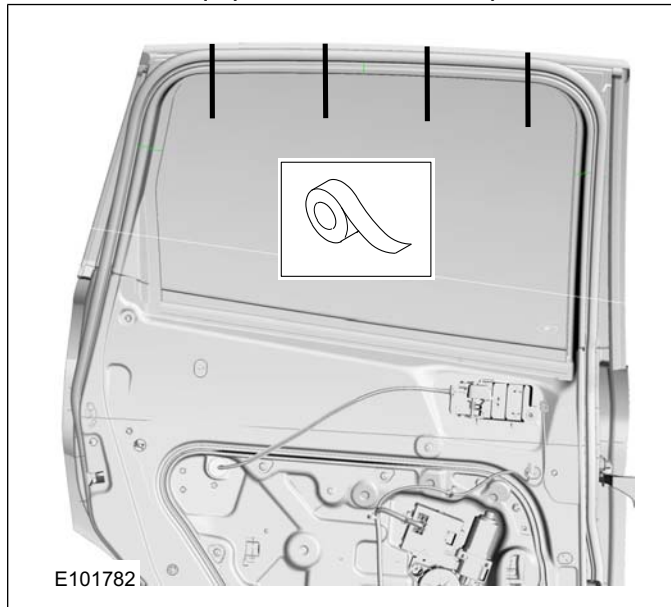
3.



4. Torque: 7 Nm

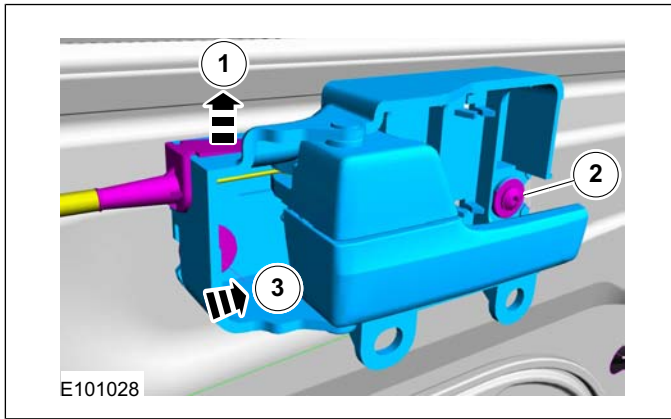


5. General Equipment: Adhesive Tape

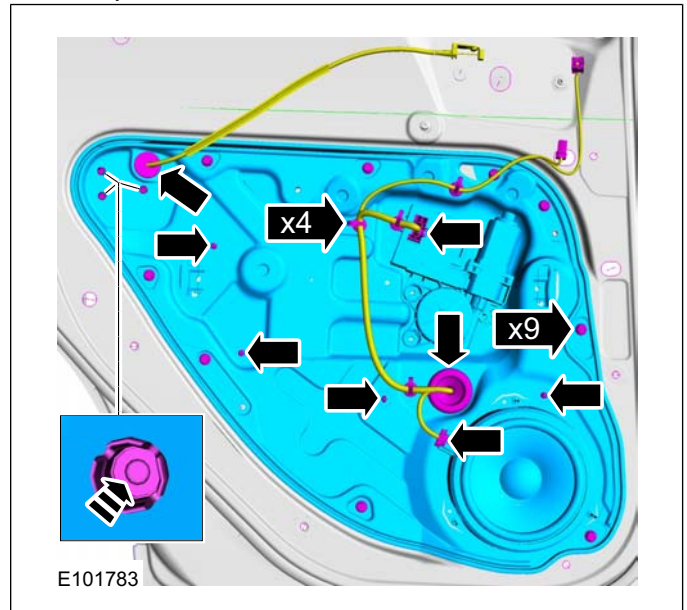


REMOVAL AND INSTALLATION

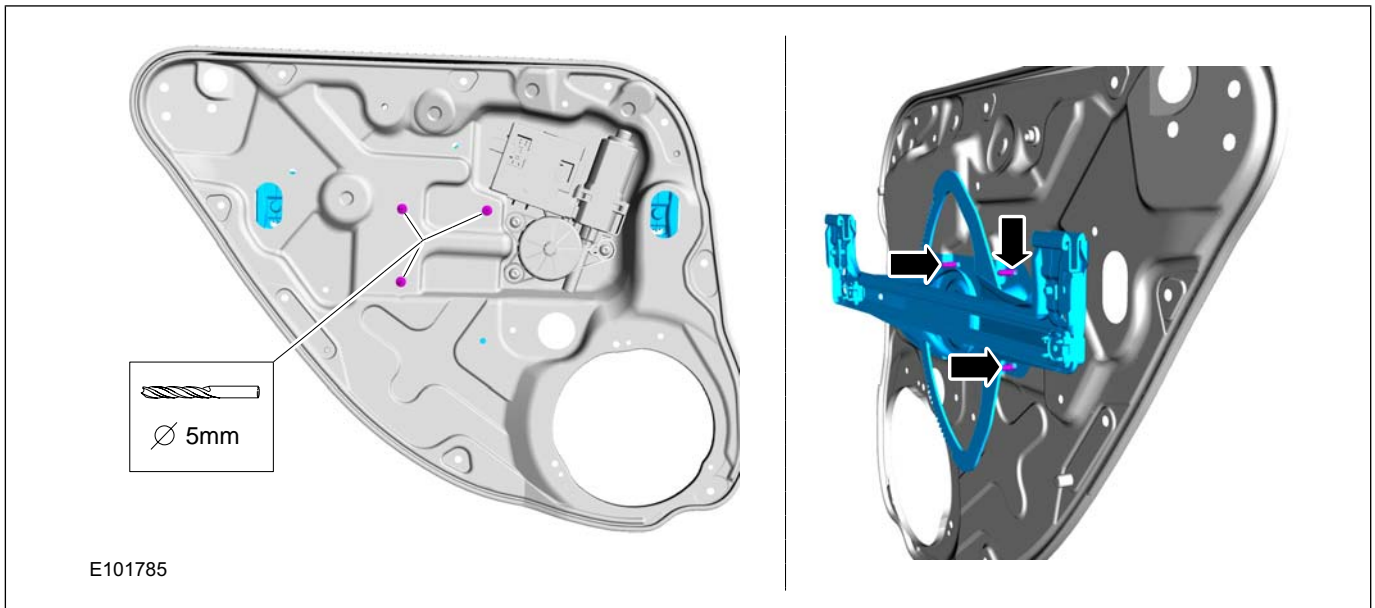
6.



7. Torque: 8 Nm



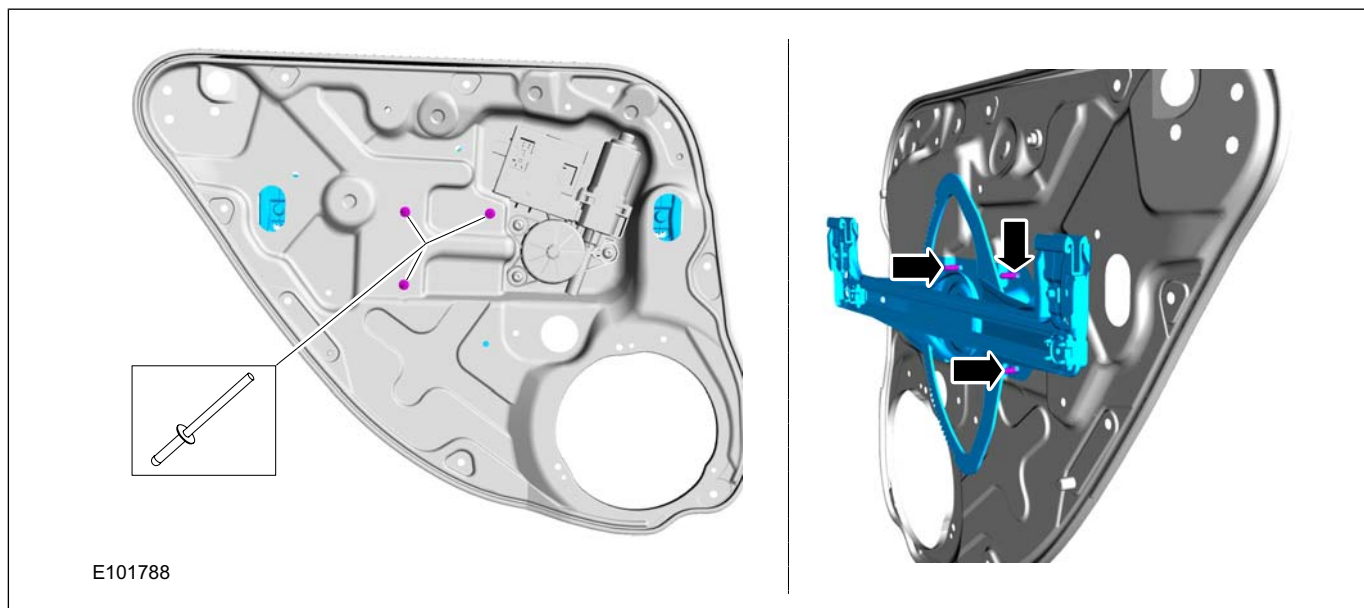
8. General Equipment: Electric Drill  
General Equipment: 5 mm Drill Bit



Installation

1. General Equipment: Blind Rivet Gun

## REMOVAL AND INSTALLATION



2. To install, reverse the removal procedure.

Refer to: **Door Window Motor Initialization**  
(501-11 Glass, Frames and Mechanisms,  
General Procedures).

## REMOVAL AND INSTALLATION

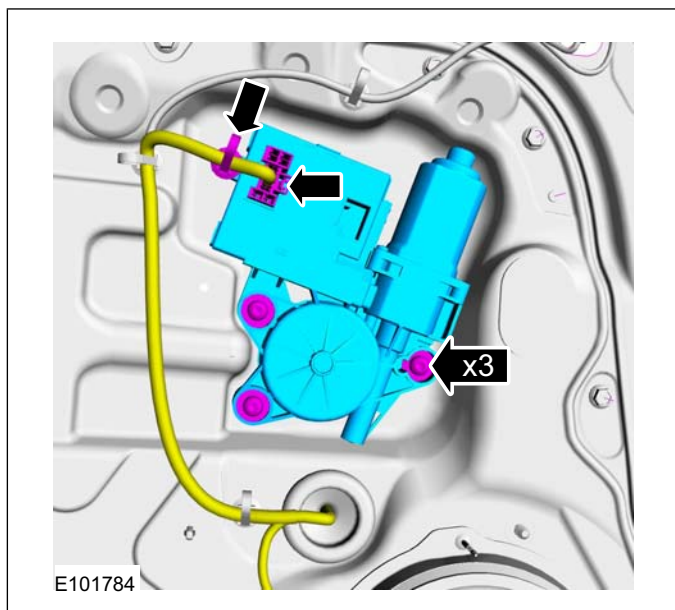
## Rear Door Window Regulator Motor

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Rear Door Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



## Installation

1. To install, reverse the removal procedure.

Refer to: **Door Window Motor Initialization** (501-11 Glass, Frames and Mechanisms, General Procedures).

501-11-35

Glass, Frames and Mechanisms

501-11-35

## REMOVAL AND INSTALLATION

## Rear Quarter Window Glass

## General Equipment

Adhesive Tape
Direct Glazing Removal/Replacement Equipment
Hot Air Gun
Knife

## Materials

Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

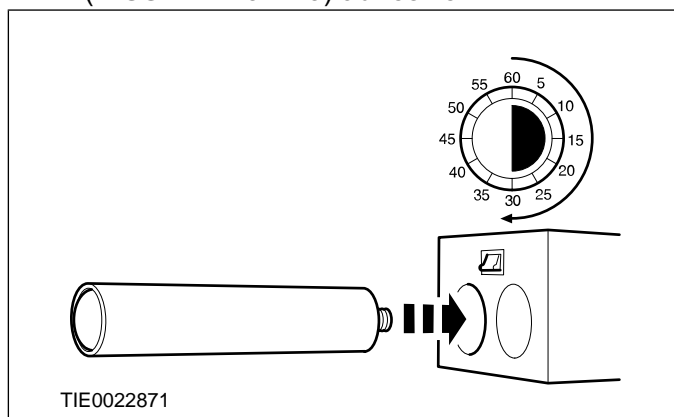
## Removal

1.  CAUTION:

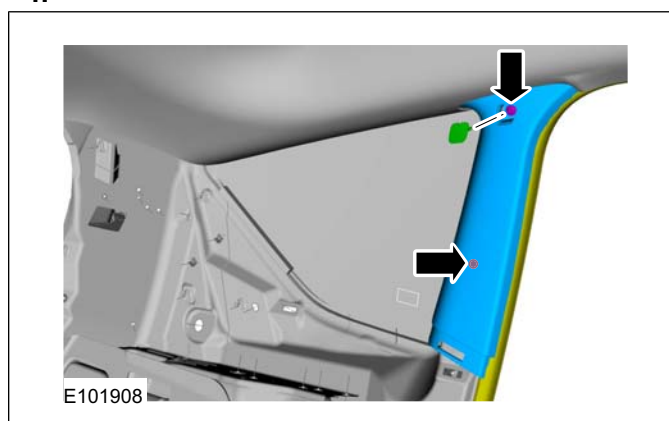
Refer to: **Window Glass Health and Safety Precautions** (100-00 General Information, Description and Operation).

## 2. Remove the polyurethane (PU) adhesive cap and heat the PU adhesive for a minimum of 30 minutes.

Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive


3. Refer to: **D-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

## 4.



## 5.



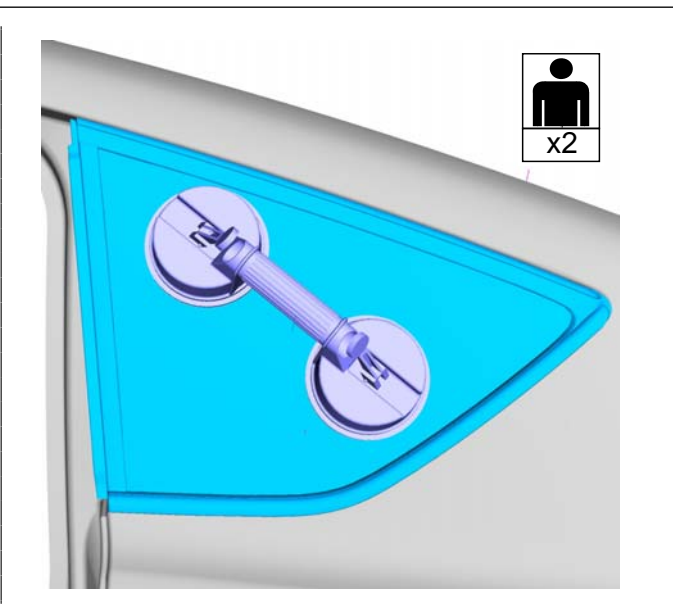
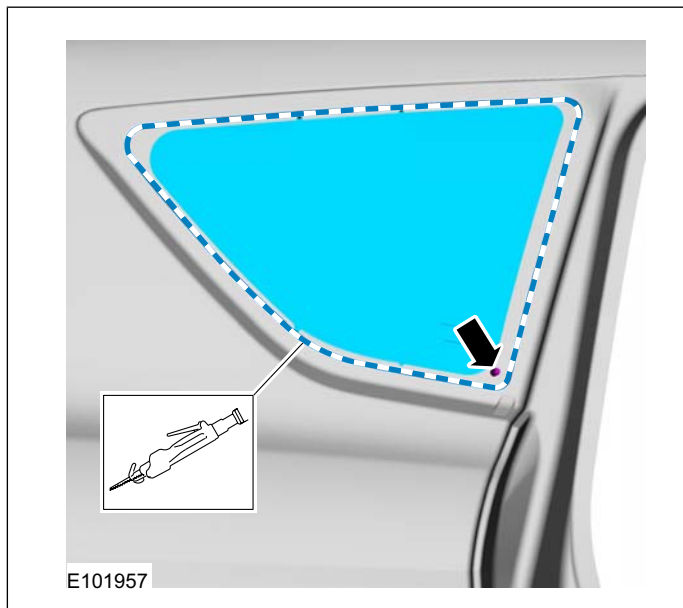
 **CAUTION:** Make sure that the cutting blades are changed where the cutting depth changes.

**NOTE:** Some resistance may be encountered when cutting through the glass locating spacers.

General Equipment: Direct Glazing Removal/Replacement Equipment



REMOVAL AND INSTALLATION



Installation

1. **NOTE:** Minimum 1 mm bead thickness.

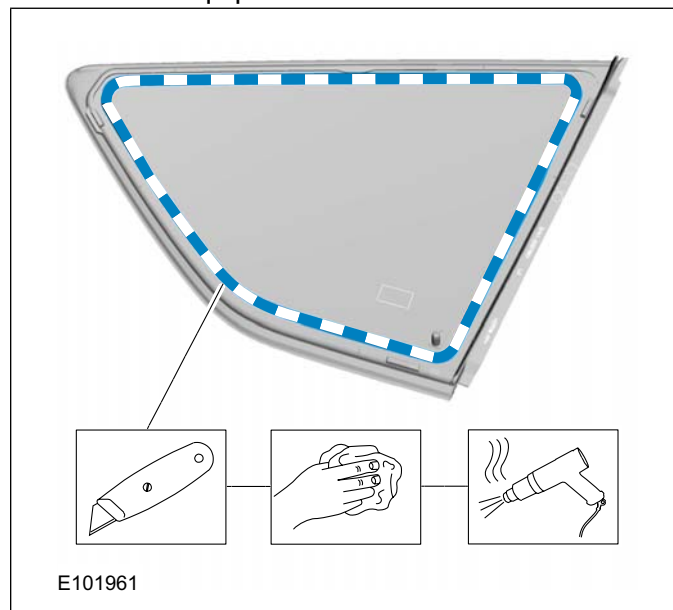
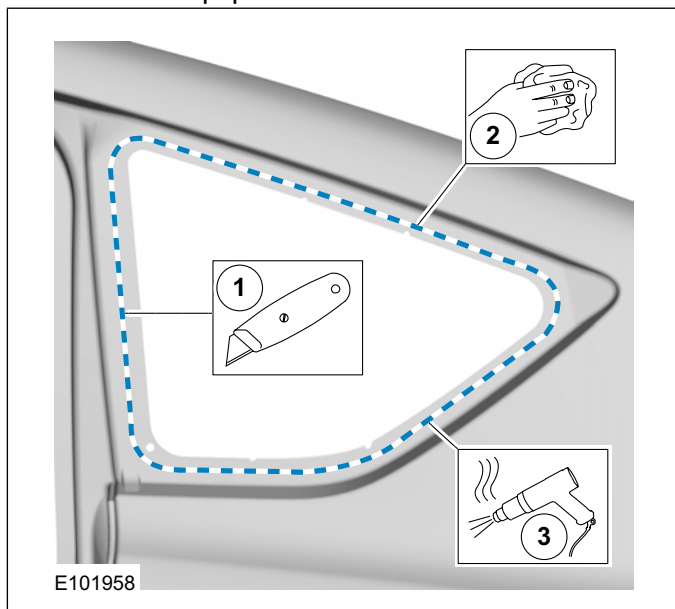
**NOTE:** Make sure that the mating faces are clean and free of foreign material.

**NOTE:** Touching the adhesive surface will impair rebonding.

General Equipment: Knife  
General Equipment: Hot Air Gun

**NOTE:** Touching the adhesive surface will impair rebonding.

General Equipment: Knife  
General Equipment: Hot Air Gun



2. **NOTE:** This step is only necessary if the original component is to be reused.

**NOTE:** Minimum 1 mm bead thickness.

**NOTE:** Make sure that the mating faces are clean and free of foreign material.

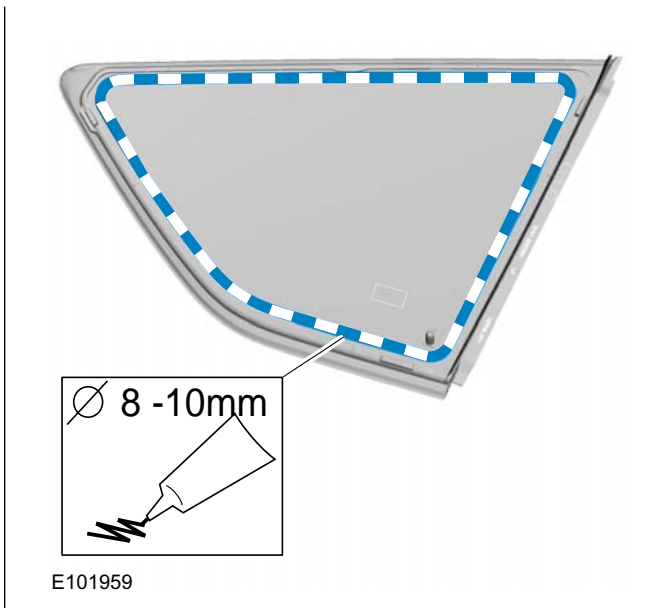
3. **NOTE:** Discard the first 100 mm of adhesive as this may have a reduced working time.



REMOVAL AND INSTALLATION

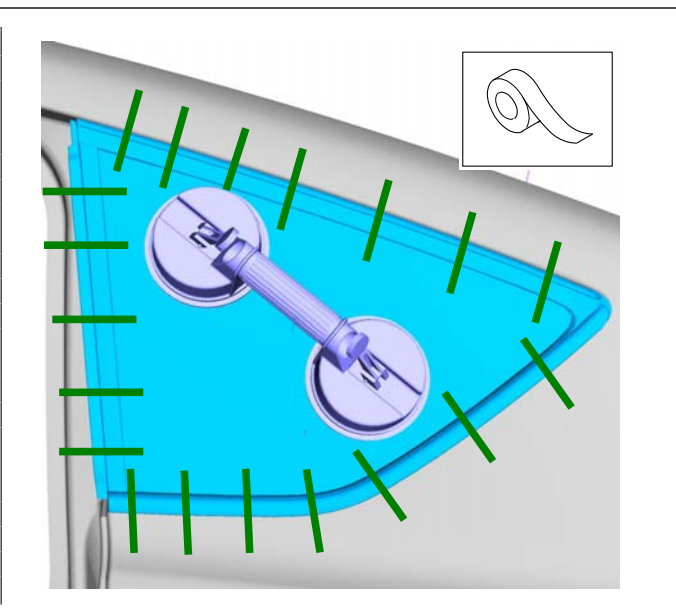
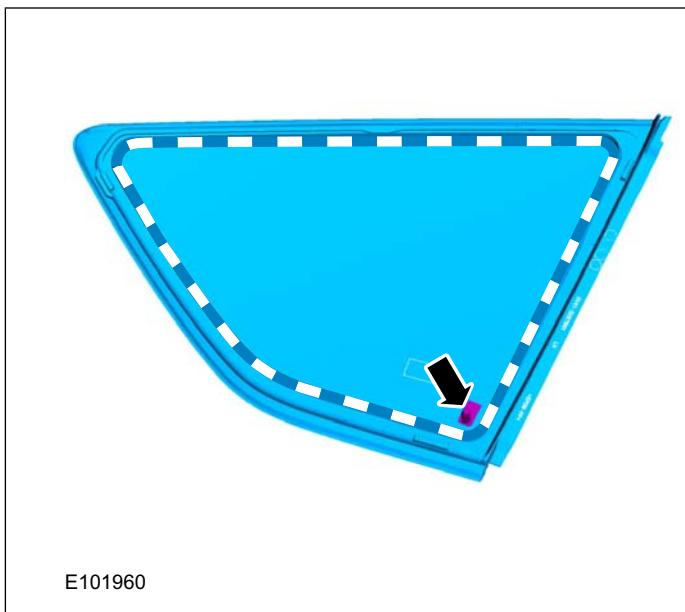
**NOTE:** Make sure that any breakage in the continuous bead of adhesive is overlapped by 20 mm.

General Equipment: Direct Glazing  
Removal/Replacement Equipment  
Material: Windshield Adhesive Kit  
(WSS-M11P57-A5) adhesive



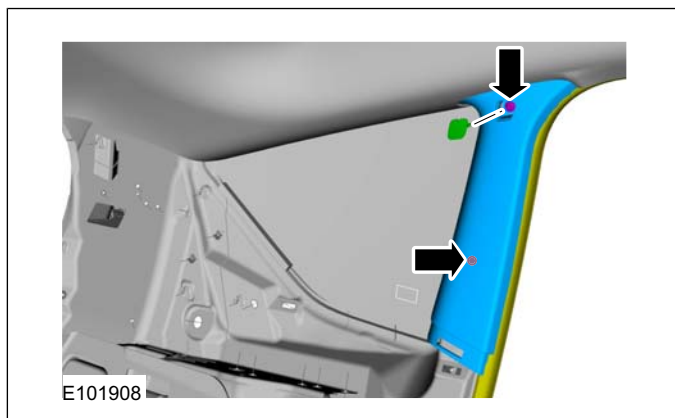
4. **CAUTION:** During the curing time of the polyurethane (PU) adhesive, the door windows must be left open.

General Equipment: Adhesive Tape



## REMOVAL AND INSTALLATION

5.



6. Refer to: **D-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

REMOVAL AND INSTALLATION

Windshield Glass

General Equipment

Adhesive Tape
Direct Glazing Removal/Replacement Equipment
Flat-bladed screwdriver
Knife

Materials

Name	Specification
Windscreen Adhesive Kit - 1 Component	WSK-M11P57-A3 / 7U7J-T03863-AA
Windshield Adhesive Kit	WSS-M11P57-A5

Removal

1.  CAUTION:

Refer to: **Window Glass Health and Safety Precautions** (100-00 General Information, Description and Operation).

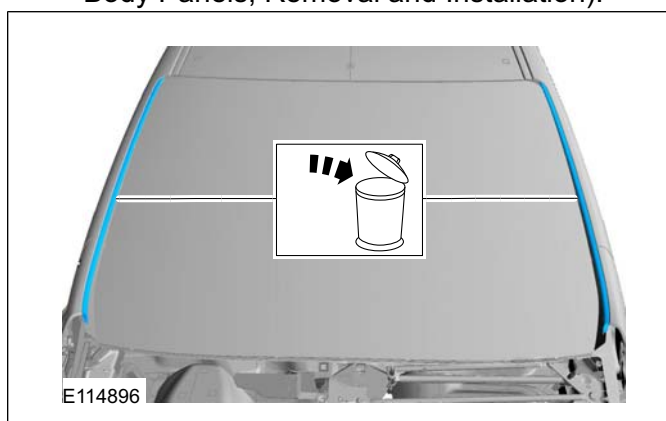
1. Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive
2. Remove the polyurethane (PU) adhesive cap and heat the 2K-PU adhesive for a minimum of 30 minutes.

General Equipment: Direct Glazing Removal/Replacement Equipment

3. Repairs under warranty:

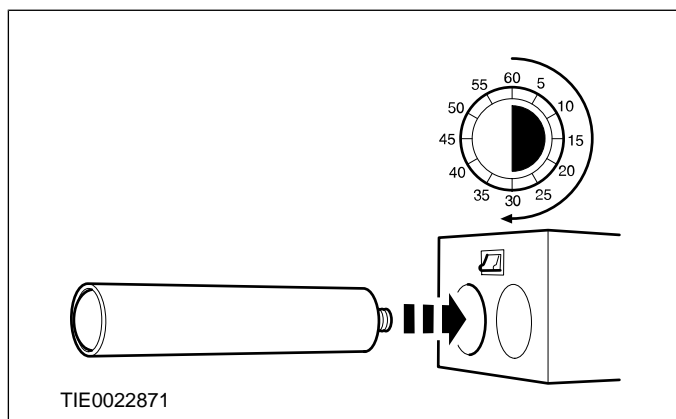
Material: Windscreen Adhesive Kit - 1 Component (WSK-M11P57-A3 / 7U7J-T03863-AA) adhesive

3. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).



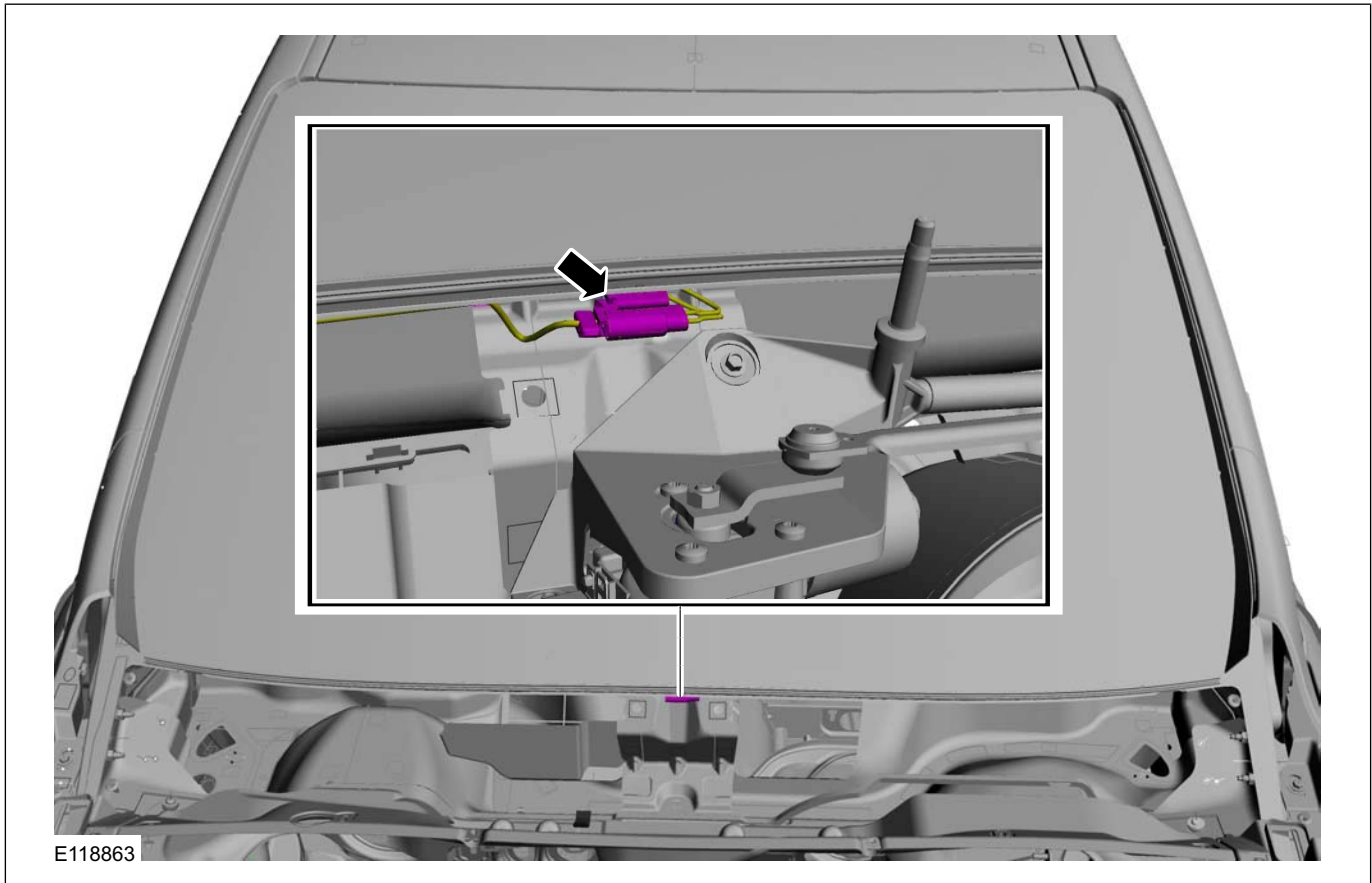
Vehicles with heated windshield

4.

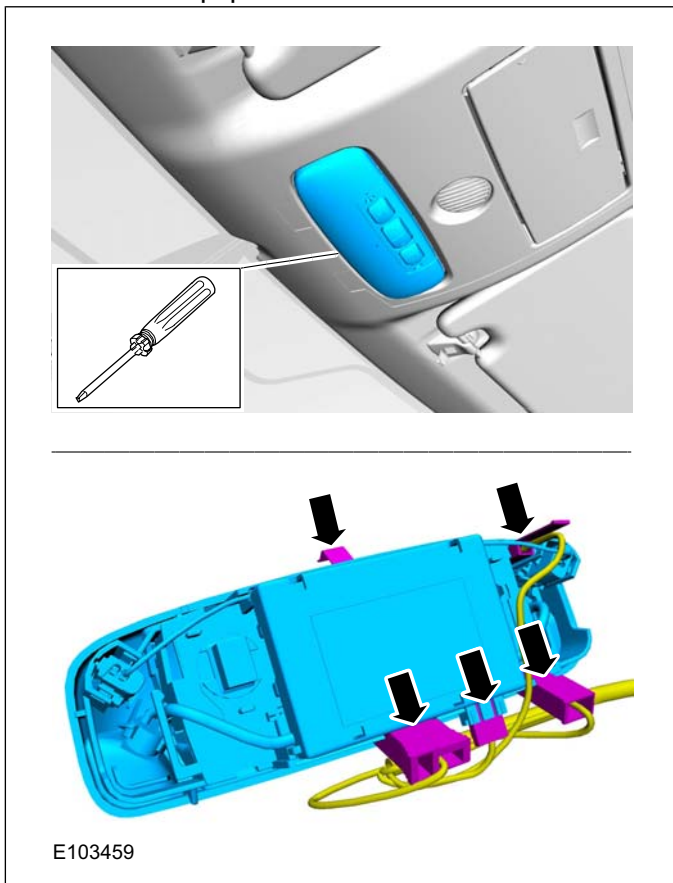




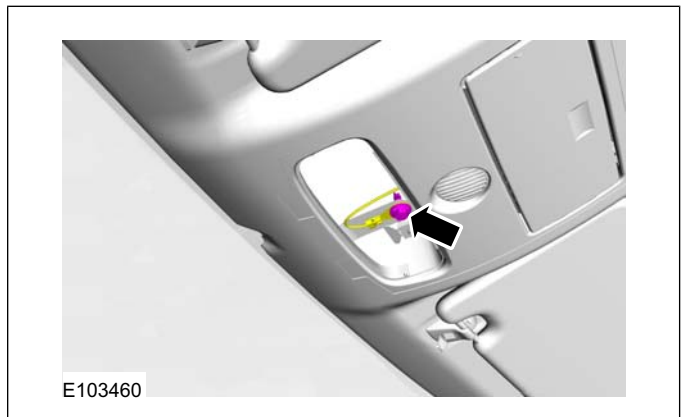
REMOVAL AND INSTALLATION



5. General Equipment: Flat-bladed screwdriver



6.

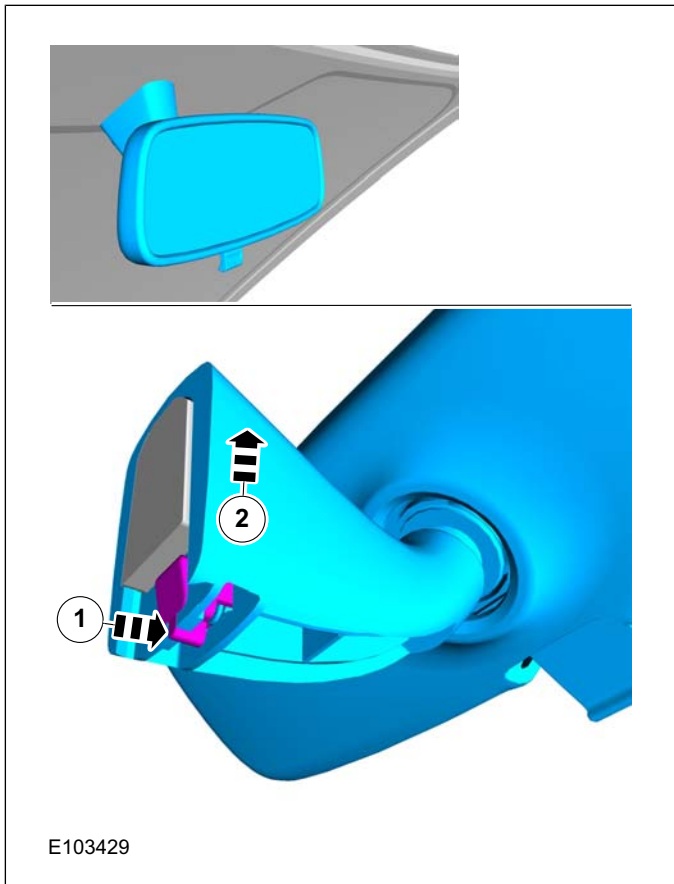




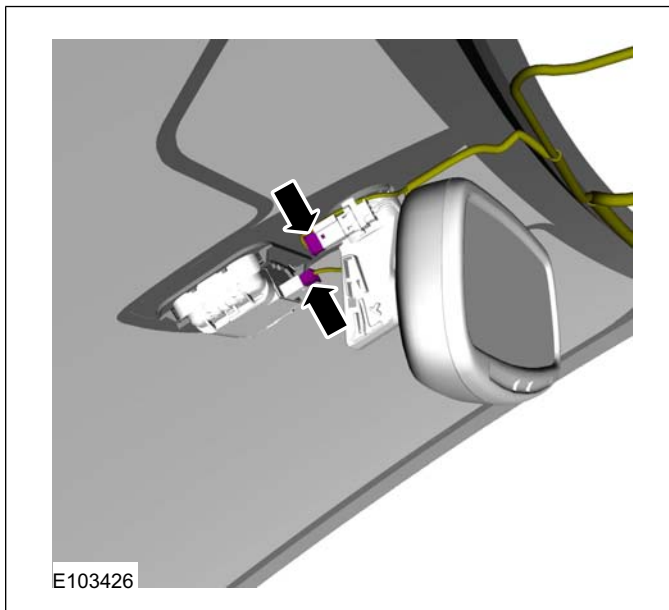
REMOVAL AND INSTALLATION

Vehicles with manual dimming interior mirror

7.

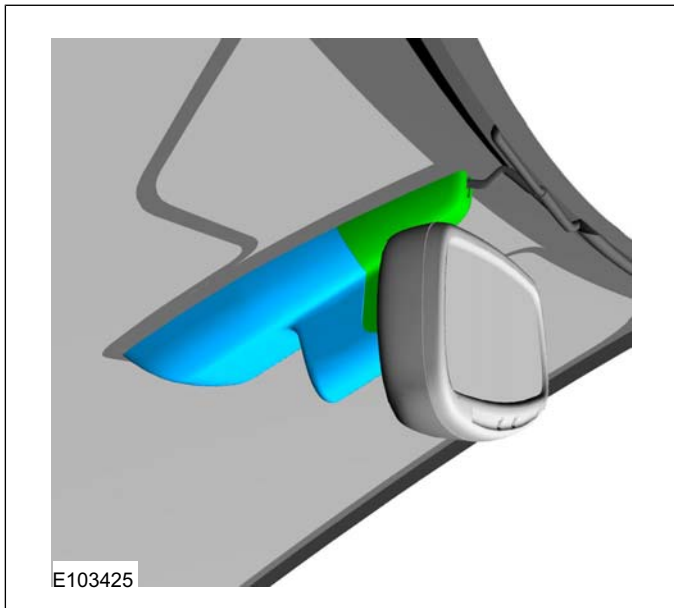


9.

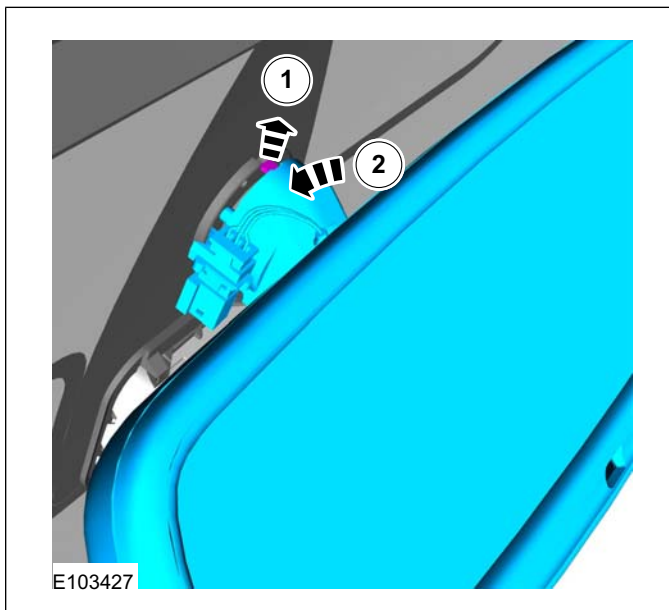


Vehicles with autolamps and rain sensor

8.



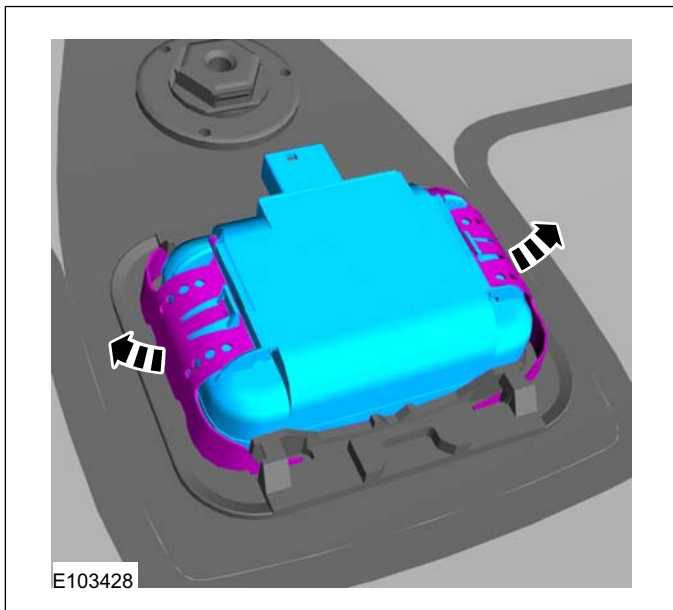
10.





REMOVAL AND INSTALLATION

11.



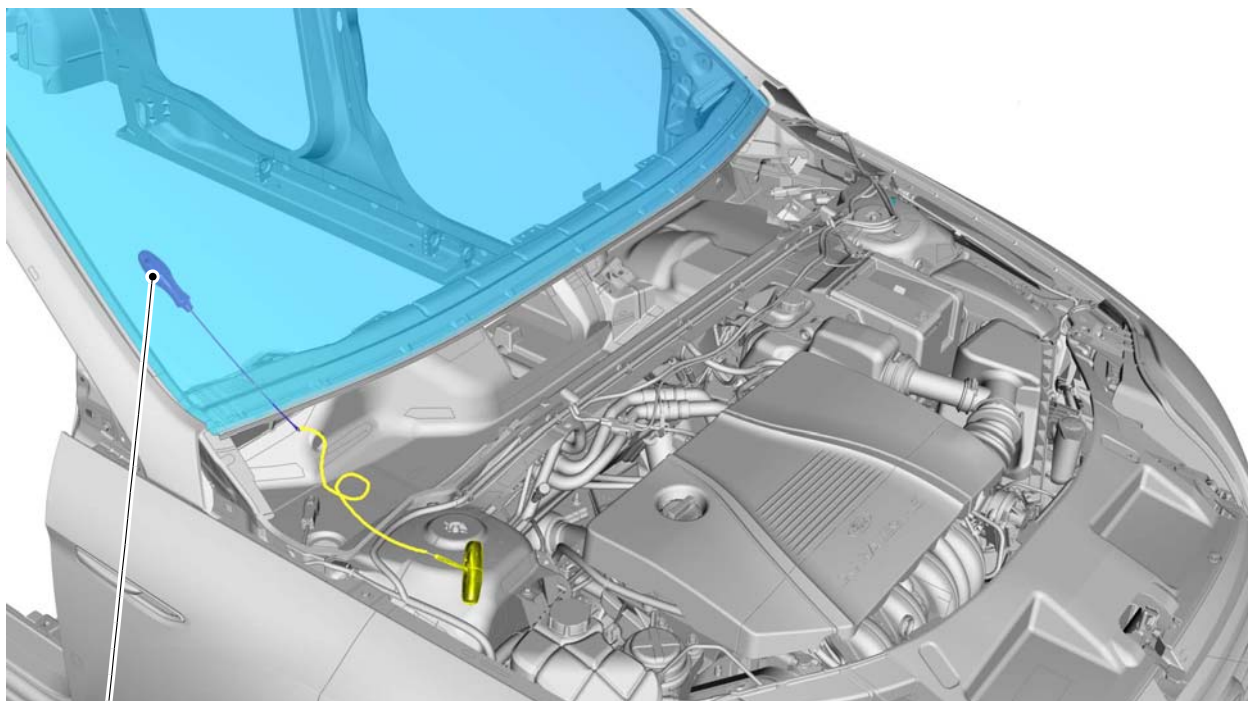
All vehicles

12.



Use a suitable awl to thread the cutting wire.

General Equipment: Direct Glazing  
Removal/Replacement Equipment



13.



**CAUTION:** If the original window glass is to be installed, take care not to

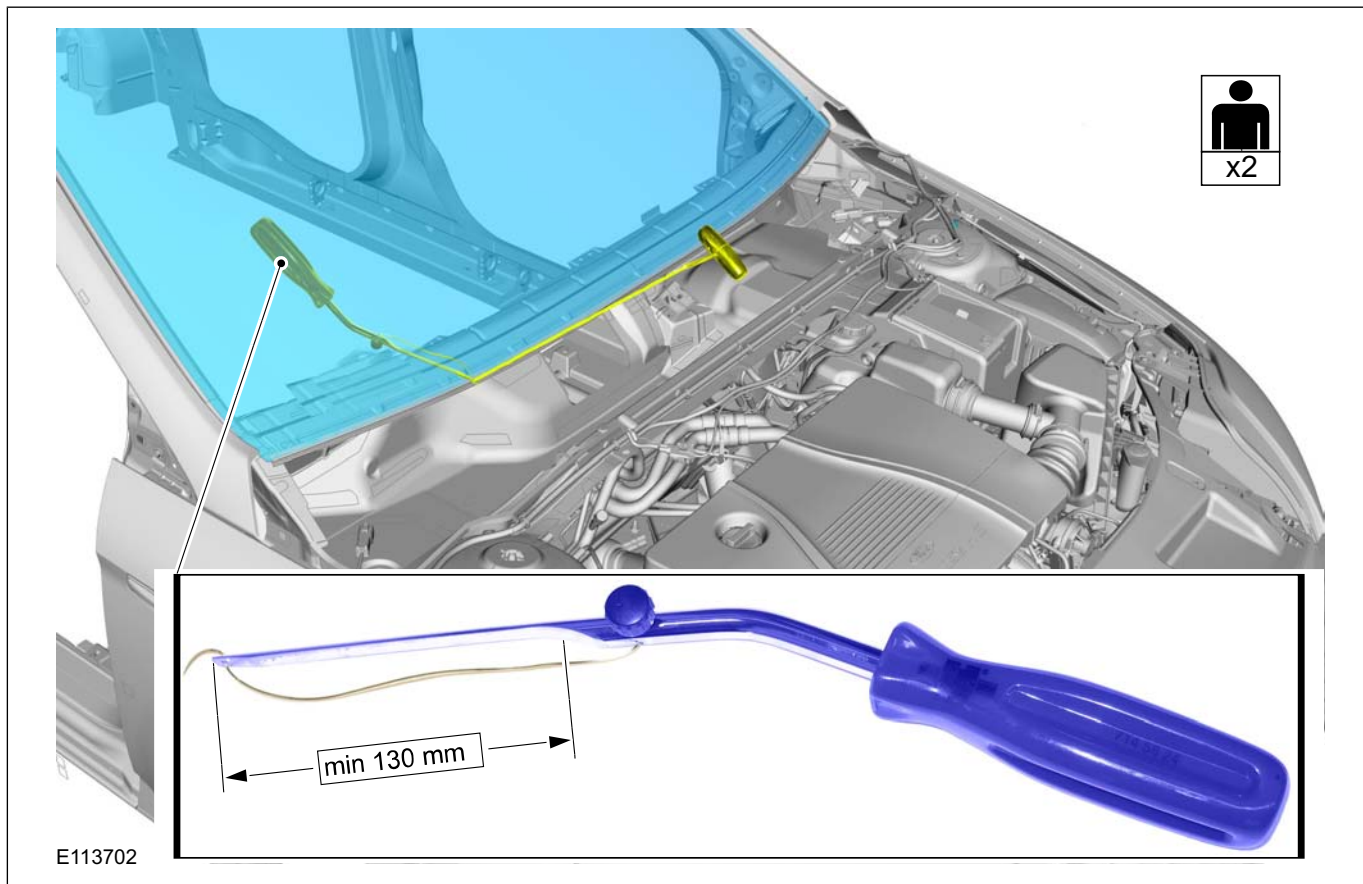
**damage the electrical connectors and the weatherstrip (if equipped).**

Use a suitable brace to prevent trim damages.

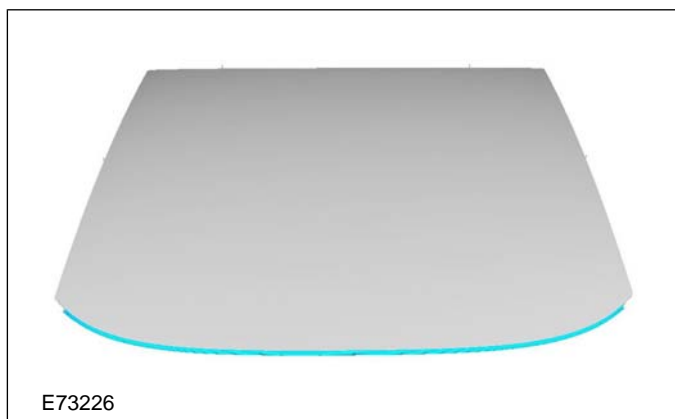
General Equipment: Direct Glazing  
Removal/Replacement Equipment



REMOVAL AND INSTALLATION



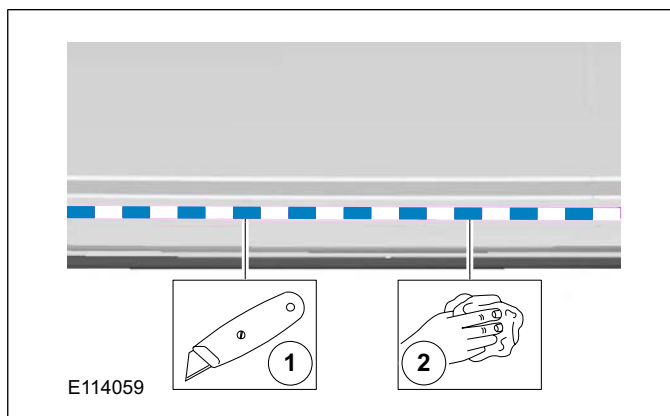
14.



Installation

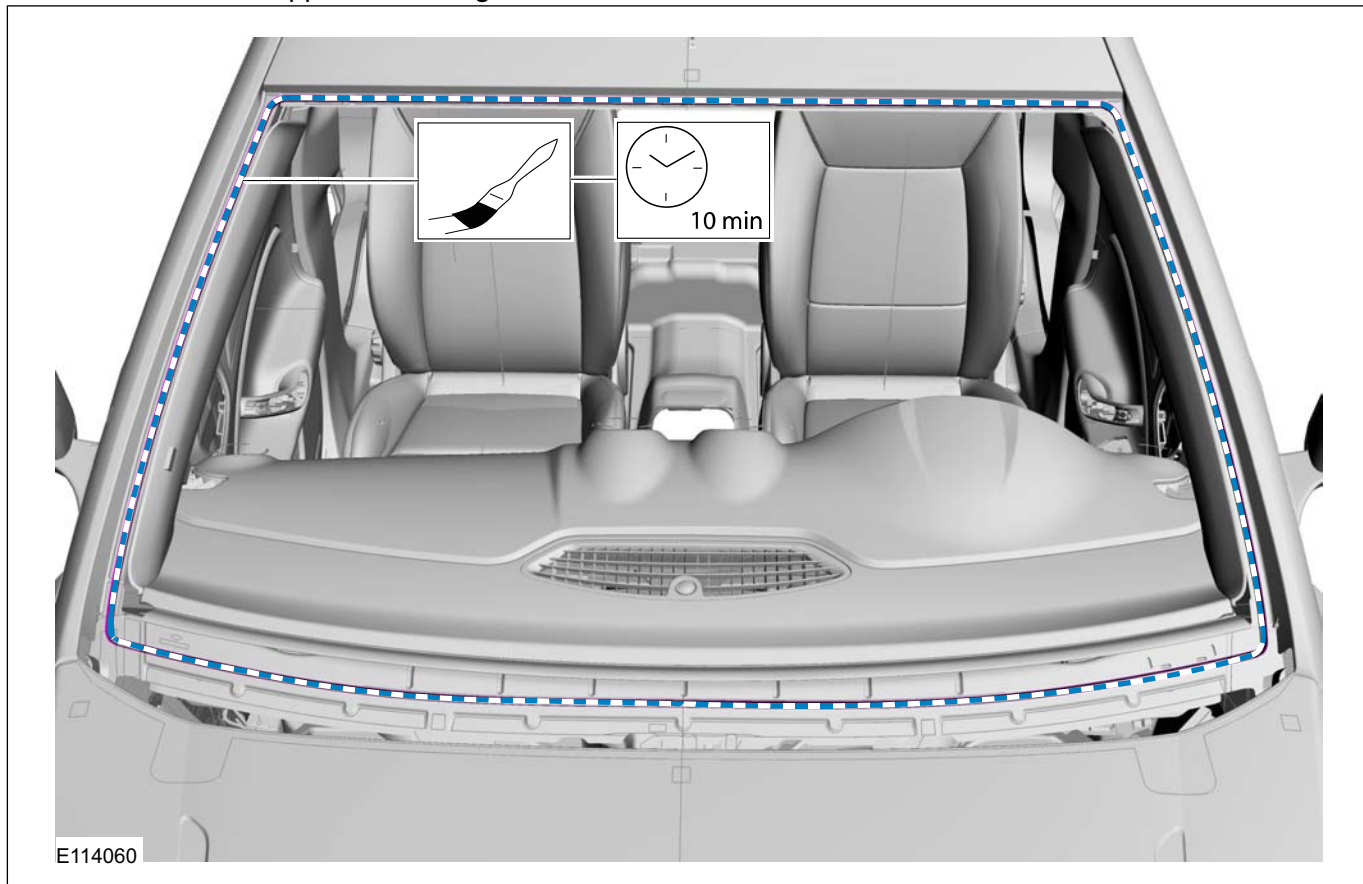
1. **NOTE:** Minimum 1 mm bead thickness.  
General Equipment: Knife
2. **NOTE:** Make sure that the mating faces are clean and free of foreign material.
3. **NOTE:** Touching the adhesive surface will impair rebonding.

Prepare the windshield glass, windshield glass flange and trimmed PU adhesive in accordance with the instructions supplied with the glass adhesive kit.



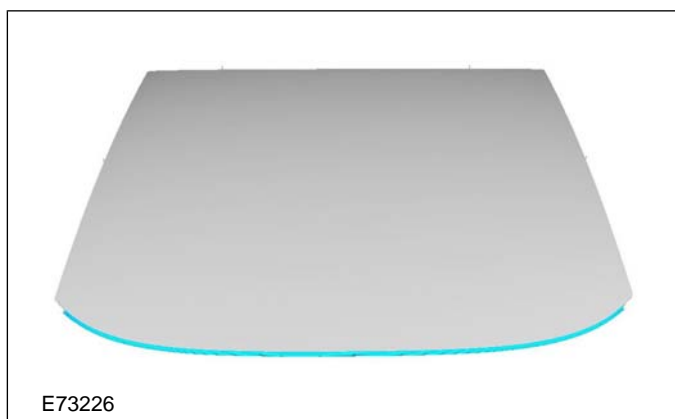
REMOVAL AND INSTALLATION

2. Apply the activator/ primer in accordance with the instructions supplied with the glass adhesive kit.

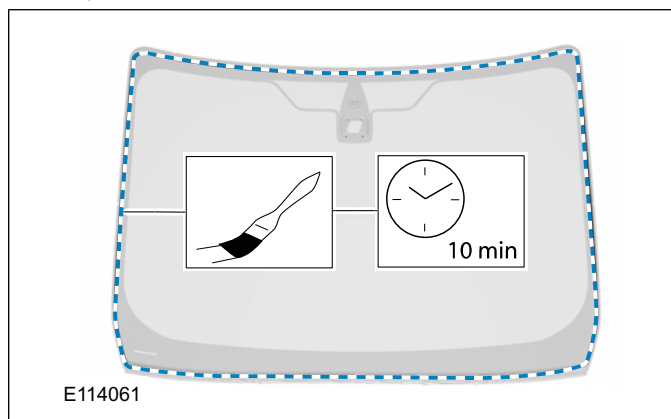


3. **NOTE:** Touching the adhesive surface will impair rebonding.

**NOTE:** Make sure that the mating faces are clean and free of foreign material.



4. Apply the activator/ primer in accordance with the instructions supplied with the glass adhesive kit.



5. **NOTE:** Discard the first 100 mm of adhesive as this may have a reduced working time.

REMOVAL AND INSTALLATION

**NOTE:** Make sure that any breakage in the continuous bead of adhesive is overlapped by 20 mm.


General Equipment: Direct Glazing Removal/Replacement Equipment

Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive

Material: Windscreen Adhesive Kit - 1 Component (WSK-M11P57-A3 / 7U7J-T03863-AA) adhesive

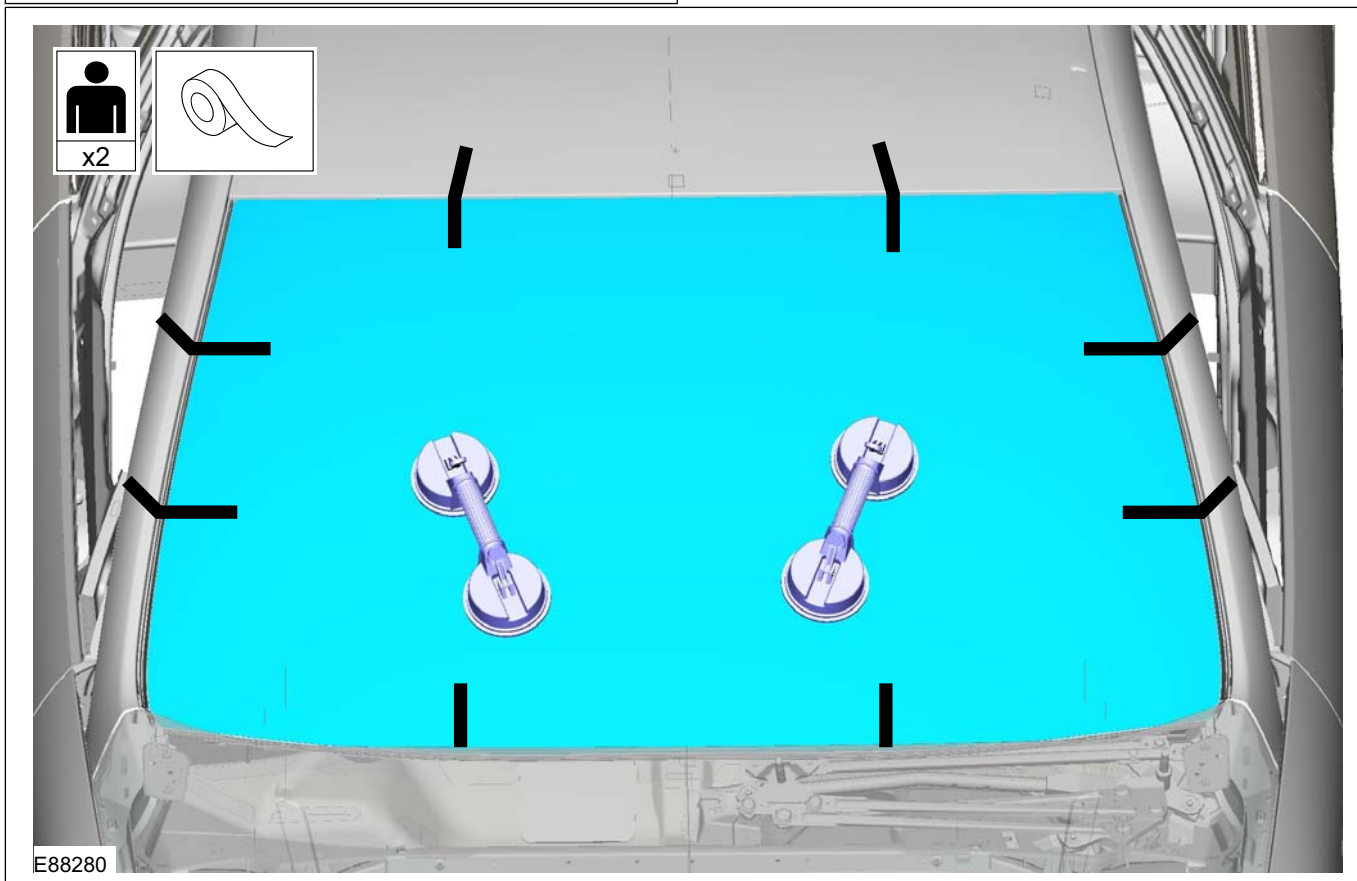
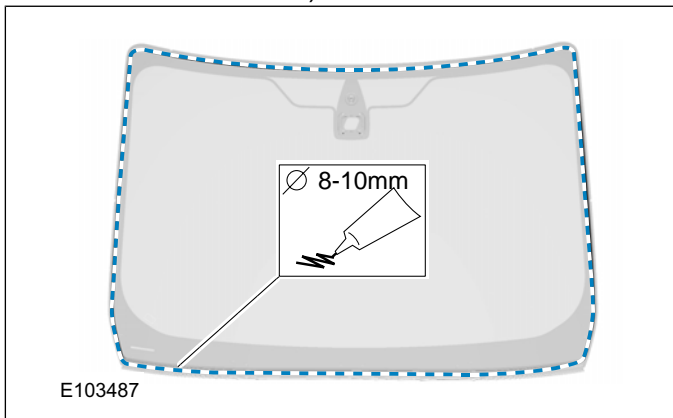
6. • Press firmly and evenly into position.

General Equipment: Direct Glazing Removal/Replacement Equipment

-  **CAUTION: During the curing time of the polyurethane (PU) adhesive, the door windows must be left open.**

Using tape, secure the windshield glass in the correct position until the PU adhesive has cured.

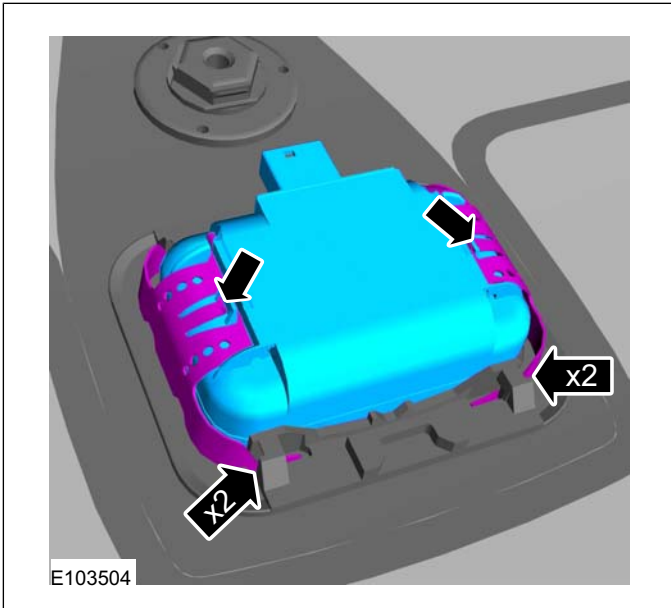
General Equipment: Adhesive Tape



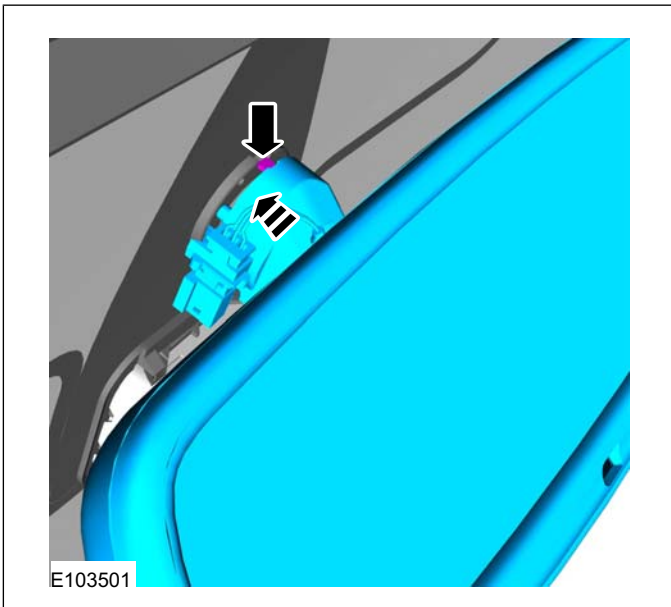
REMOVAL AND INSTALLATION

Vehicles with autolamps and rain sensor

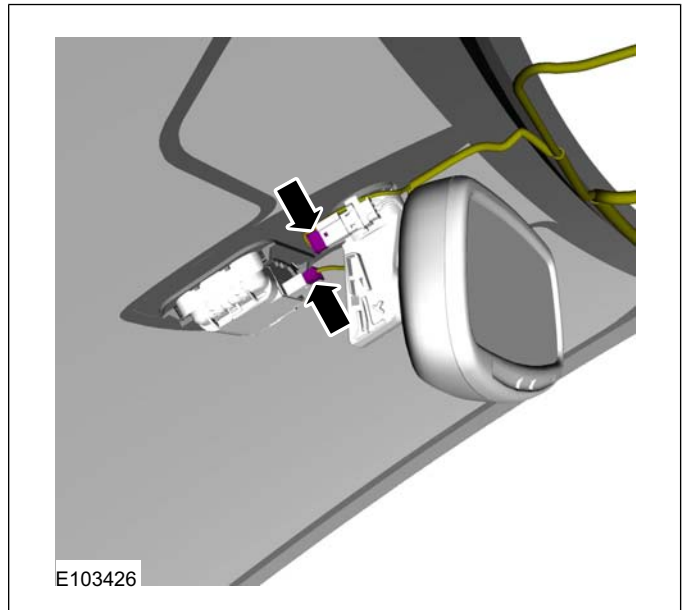
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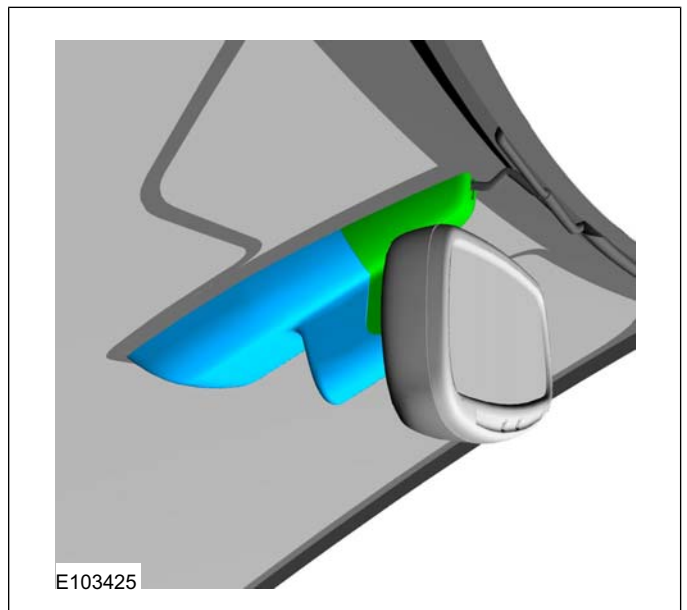
8.



9.



10.

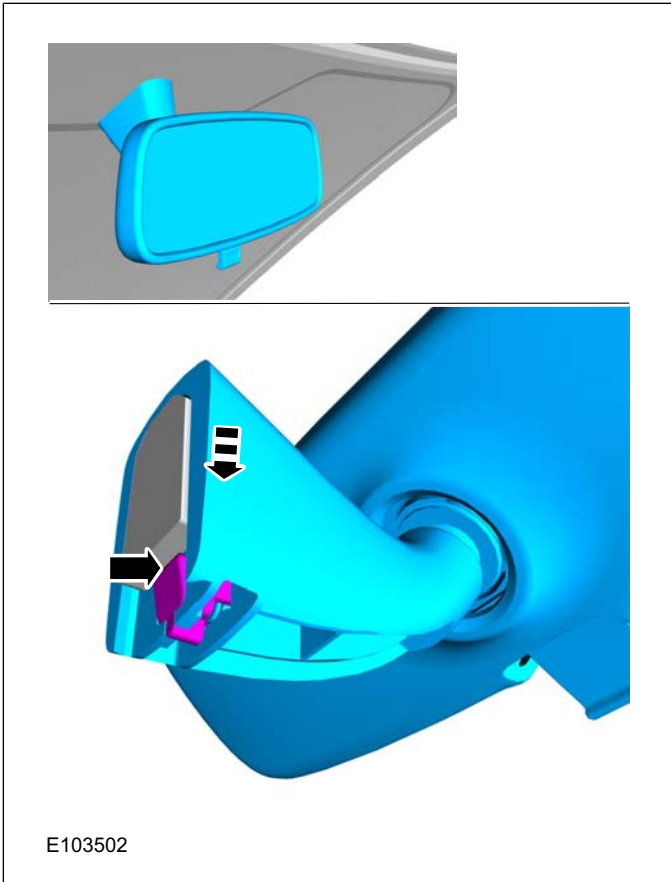




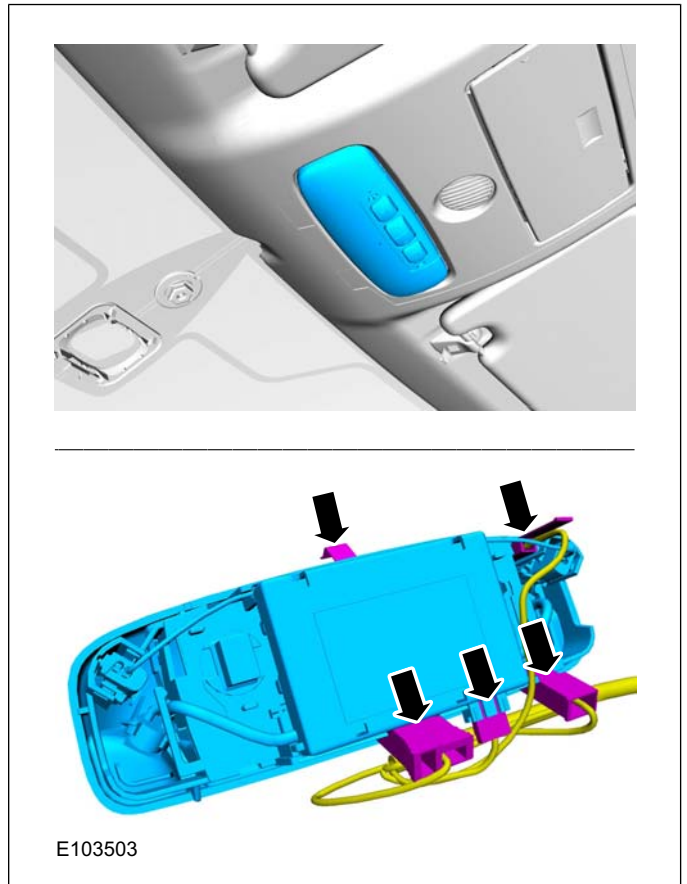
REMOVAL AND INSTALLATION

Vehicles with manual dimming interior mirror

11.

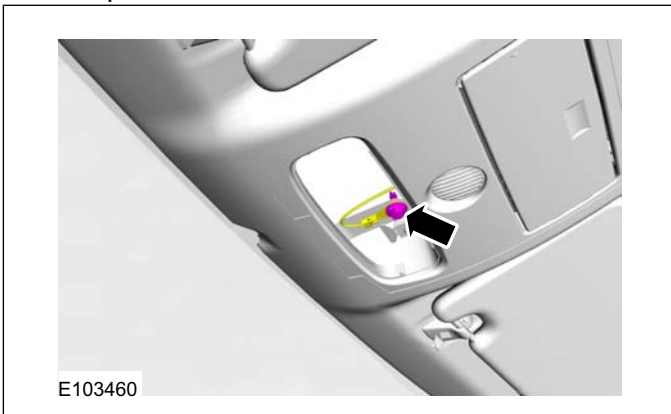


13.



Vehicles with heated windshield

12 Torque: 12 Nm



14.



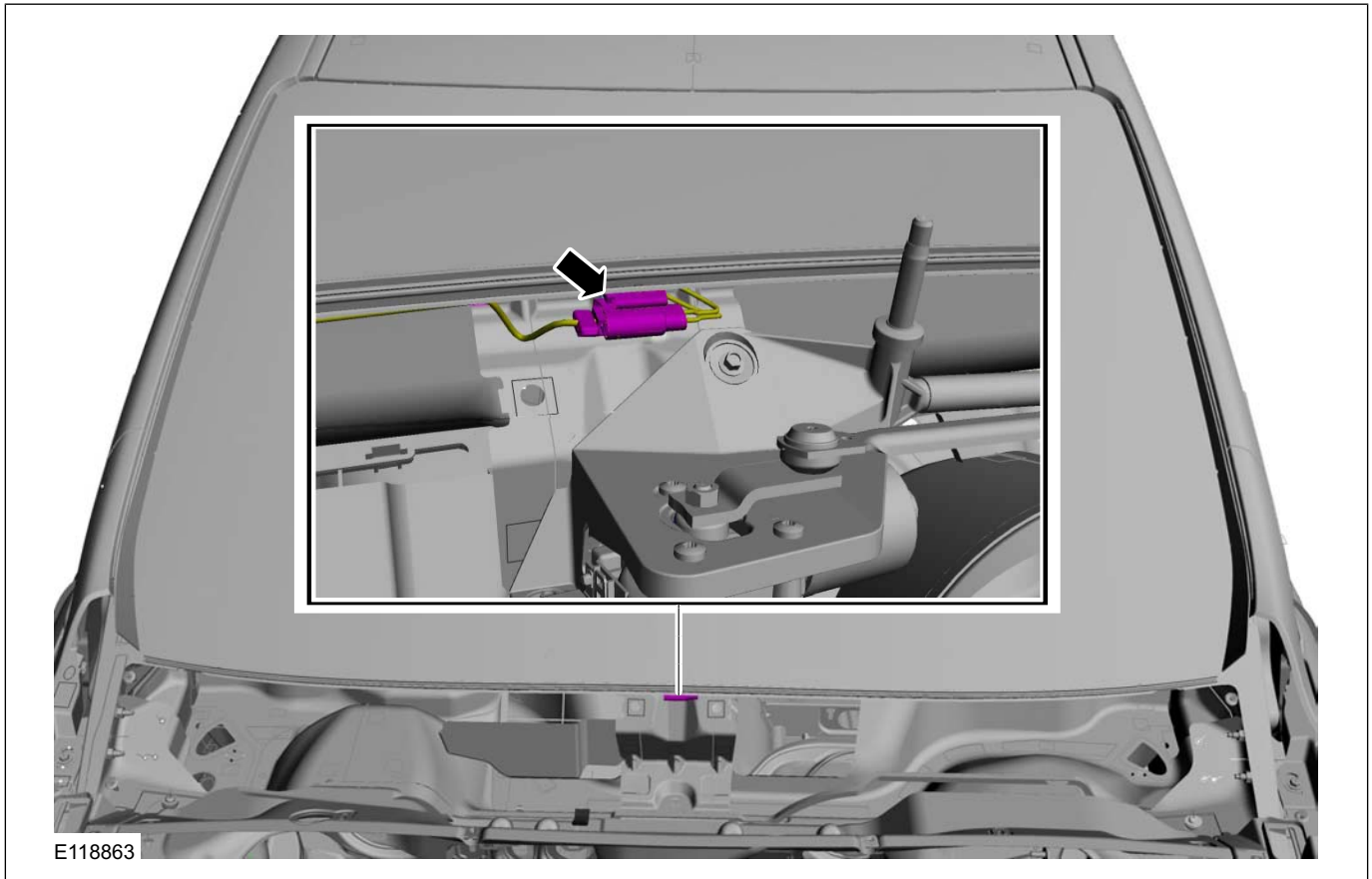


501-11-48

Glass, Frames and Mechanisms

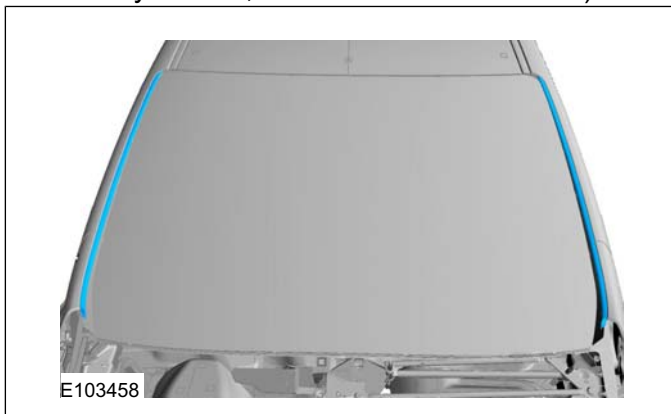
501-11-48

## REMOVAL AND INSTALLATION



All vehicles

15. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).







# SECTION 501-12 Instrument Panel and Console

VEHICLE APPLICATION: 2008.50 Kuga

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## REMOVAL AND INSTALLATION

## Instrument Panel

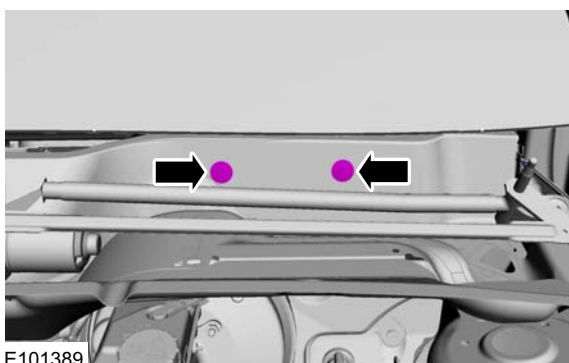
## Removal

## WARNINGS:

- ▲ The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.
- ▲ Make sure that the vehicle electrical system is fully depowered and no other power source is connected.
- ▲ Wear safety goggles.

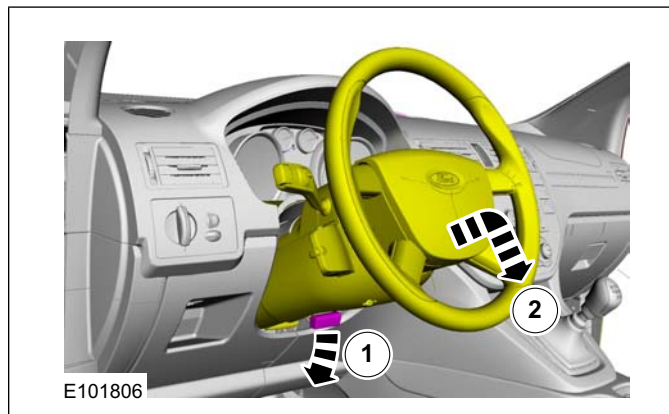
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Supplemental Restraint System (SRS) Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
4. Torque: 25 Nm



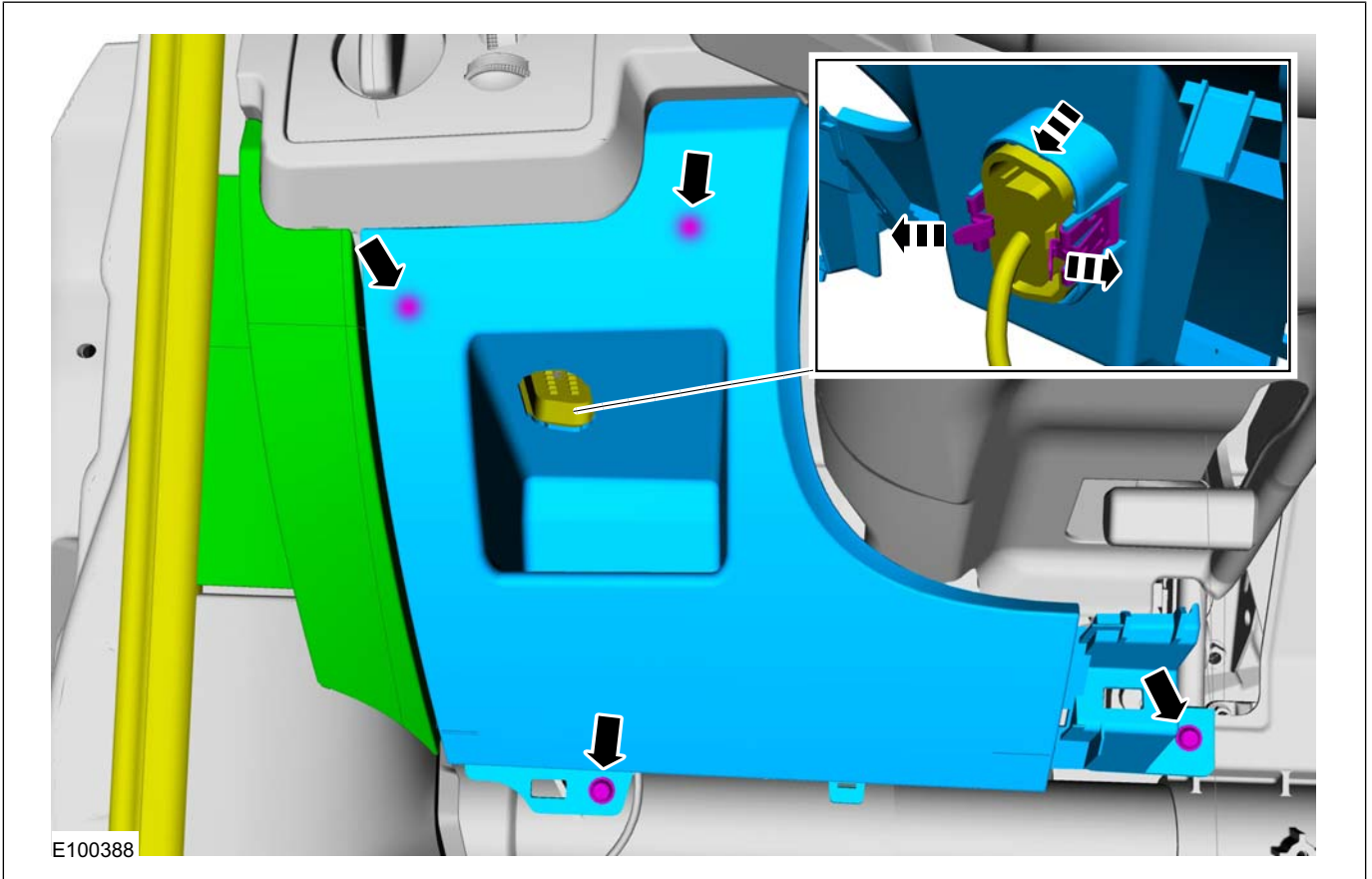
5. Remove the front doors.

6.

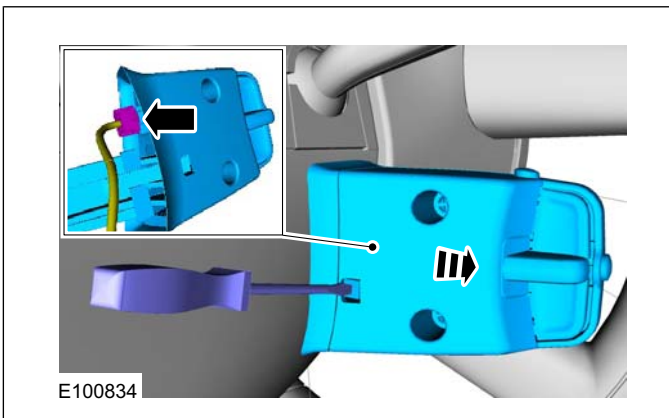


7. Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation).
8. Refer to: **Climate Control Assembly - Vehicles With: Manual Temperature Control** (412-01 Climate Control, Removal and Installation). Refer to: **Climate Control Assembly - Vehicles With: Automatic Temperature Control** (412-01 Climate Control, Removal and Installation).
- 9.

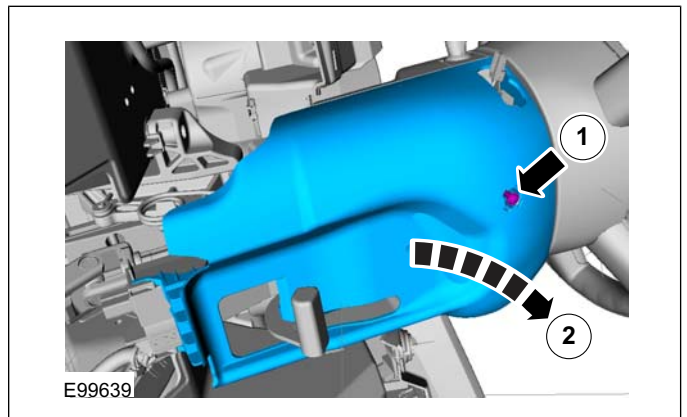
REMOVAL AND INSTALLATION



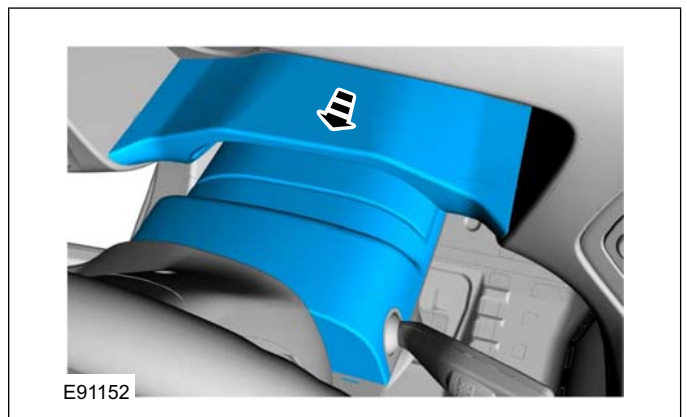
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11.

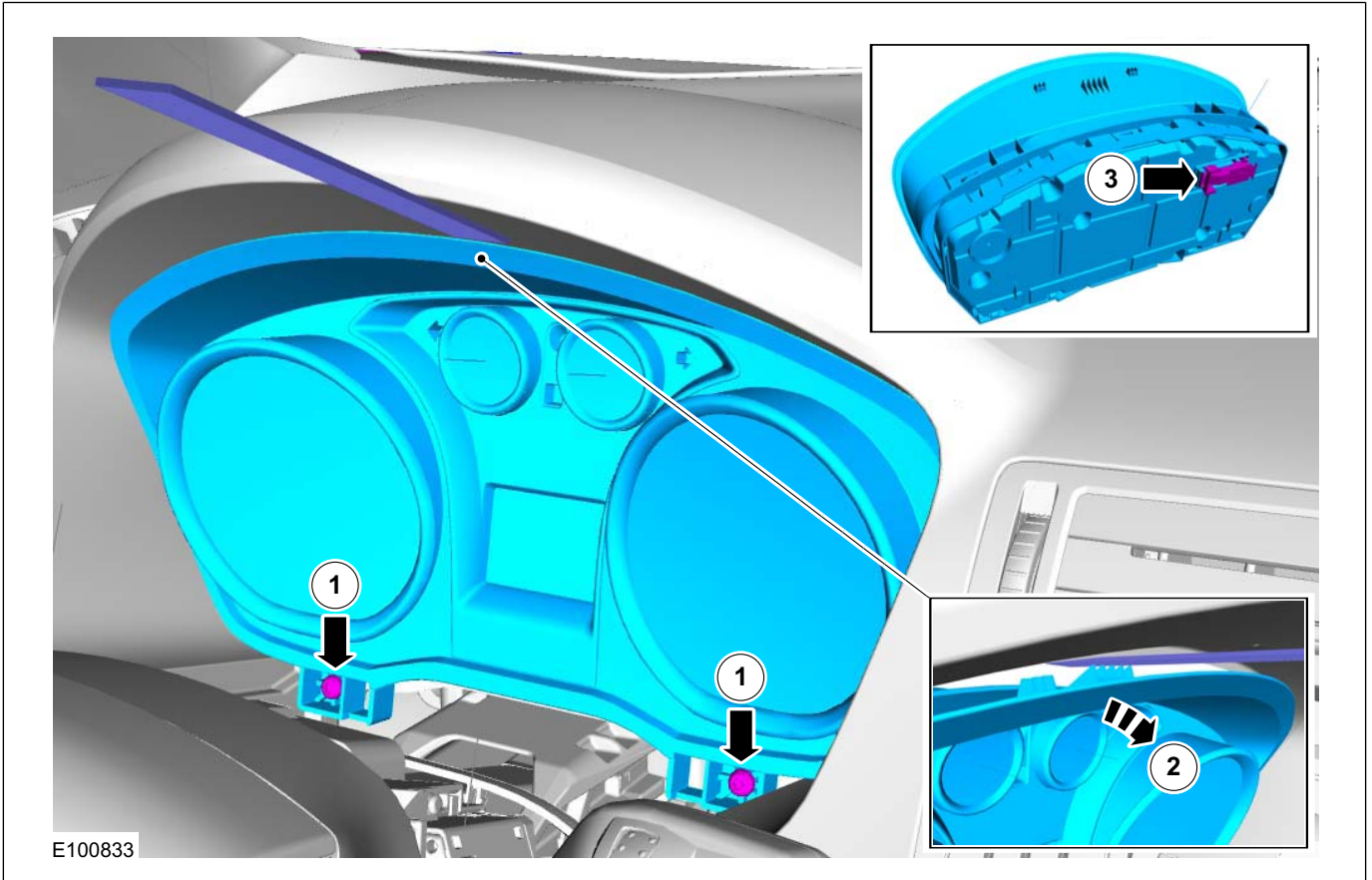


12.



REMOVAL AND INSTALLATION

13.





501-12-5

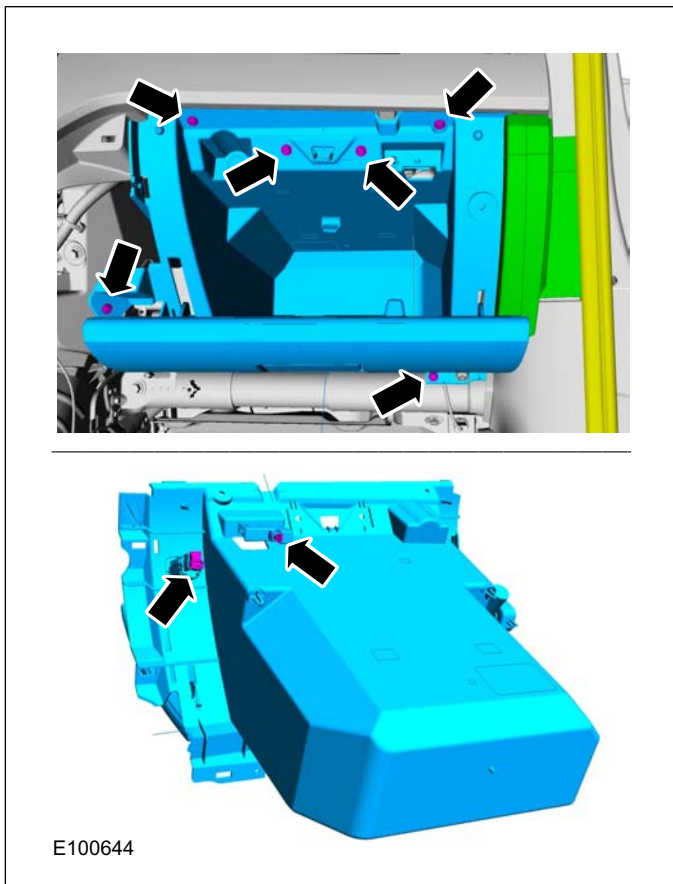
Instrument Panel and Console

501-12-5

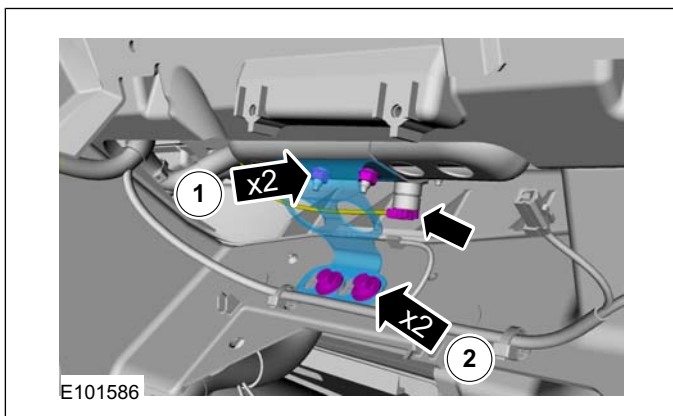
REMOVAL AND INSTALLATION

14. Refer to: **Headlamp Switch** (417-01 Exterior Lighting, Removal and Installation).

15.



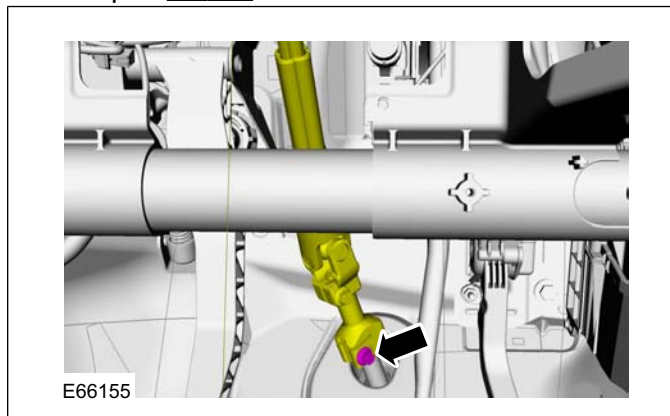
16. 1. Torque: 7 Nm  
2. Torque: 9 Nm



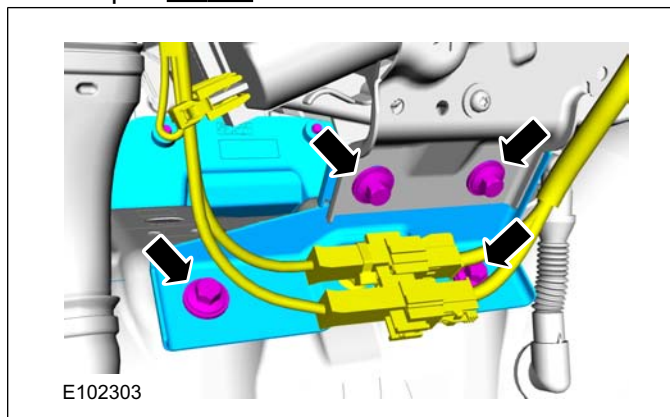
17. Remove both sides.

Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

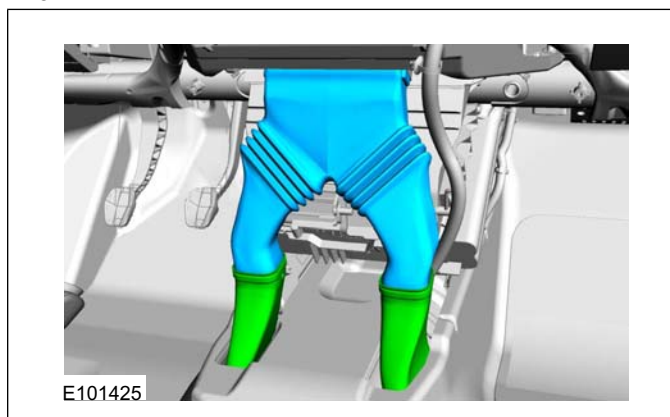
18. Torque: 28 Nm



19. On both sides  
Torque: 25 Nm



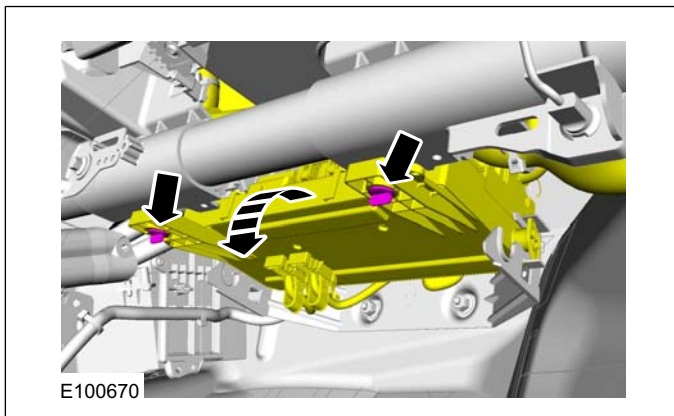
20.



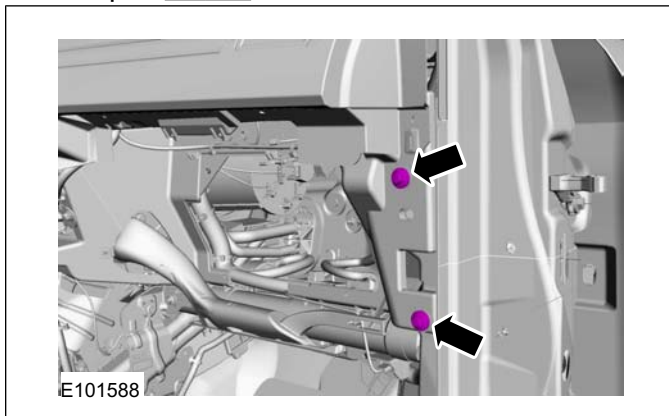


REMOVAL AND INSTALLATION

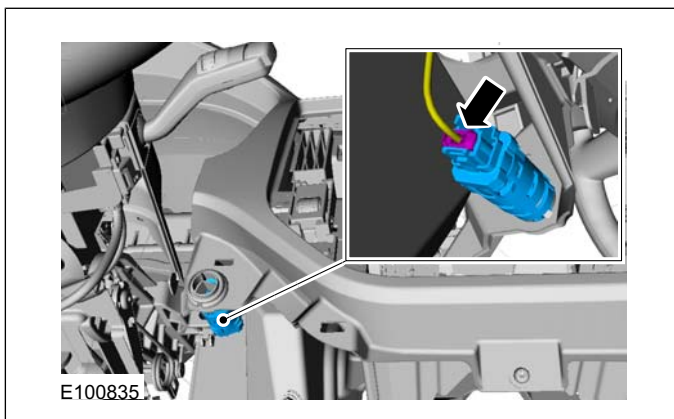
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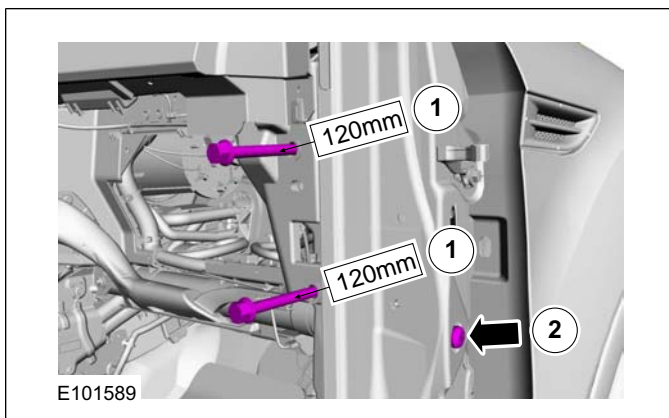
On both sides  
Torque: 25 Nm



22.

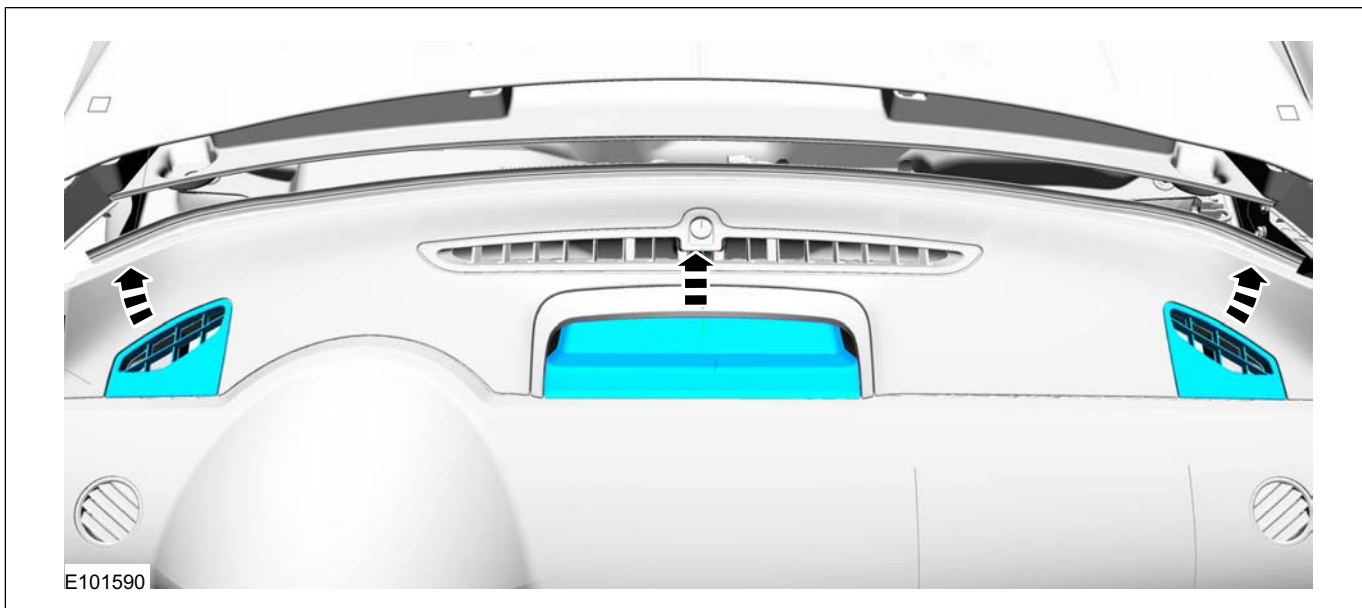


24. 1. Install M10 x 120 mm guide bolts in the right and left-hand A-pillar.  
2. Torque: 80 Nm



23. **NOTE:** Note the position of the component before removal.

25.



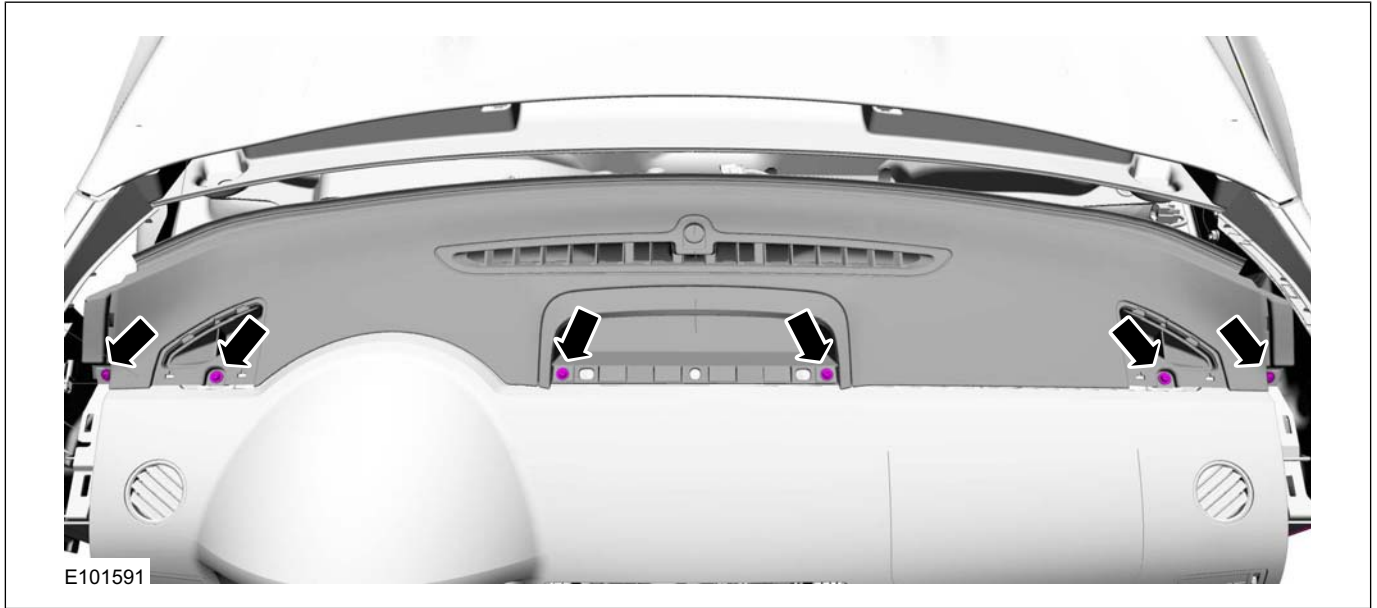
26.



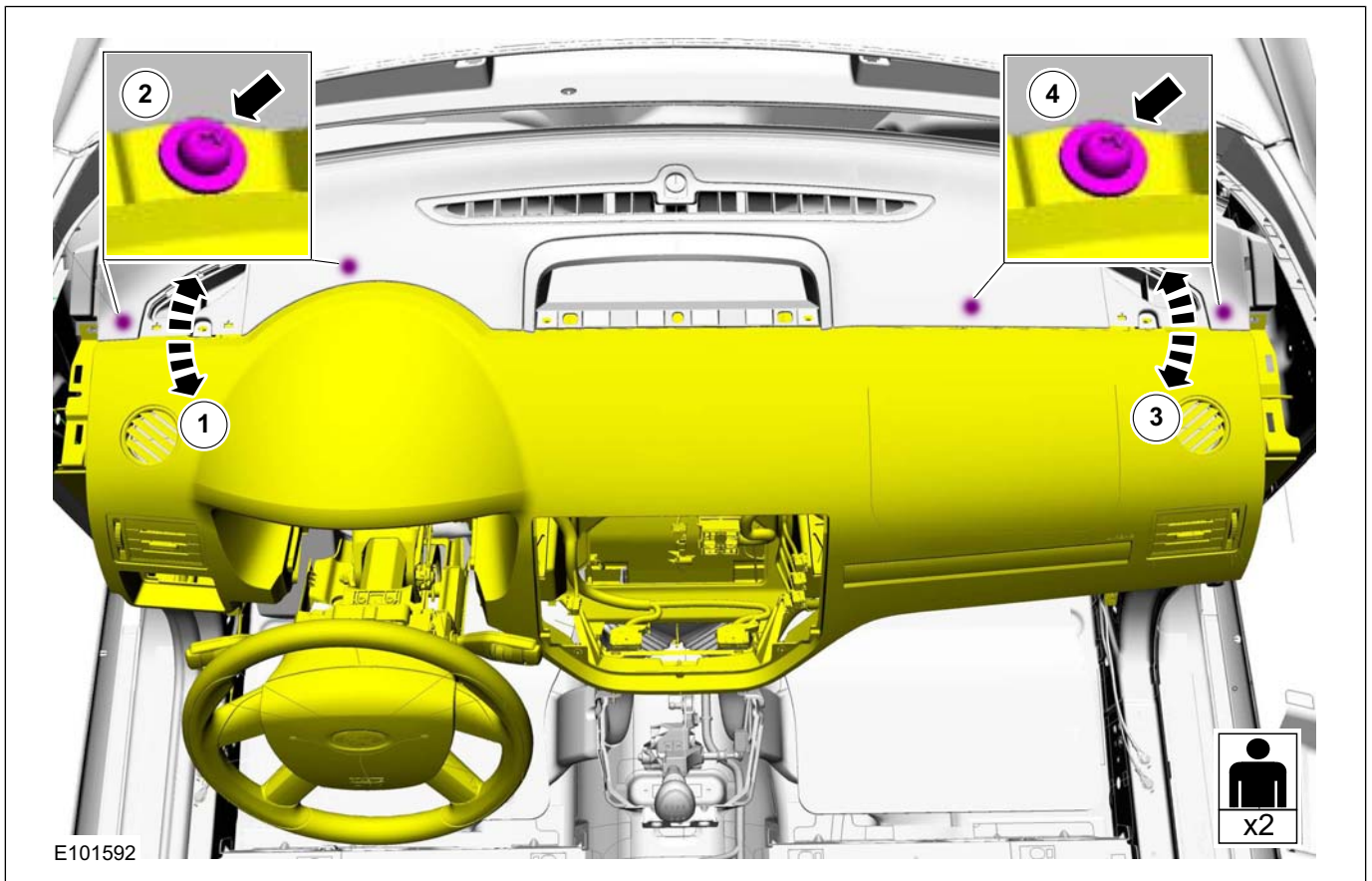




REMOVAL AND INSTALLATION



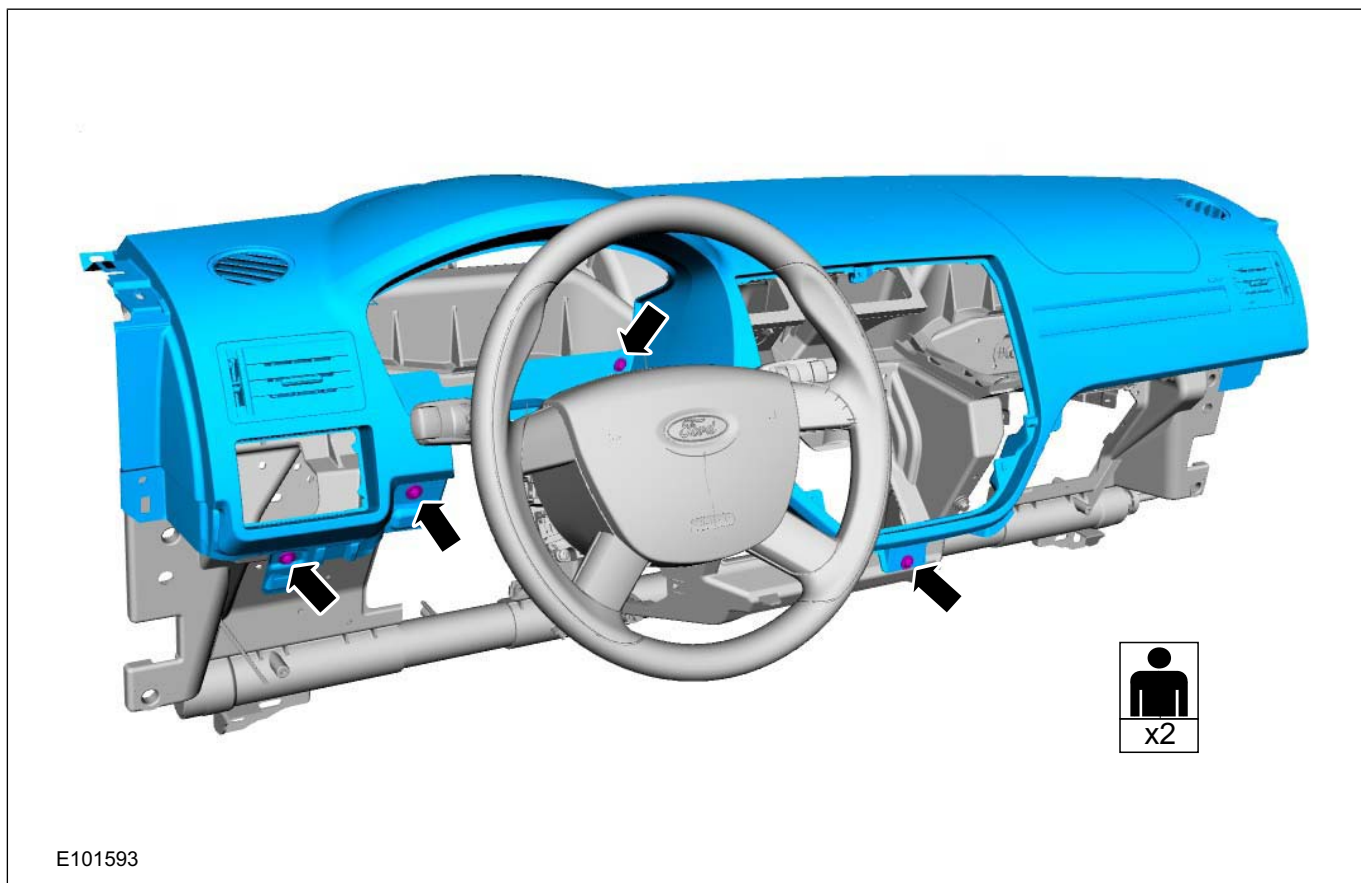
27.



28.



## REMOVAL AND INSTALLATION



## Installation

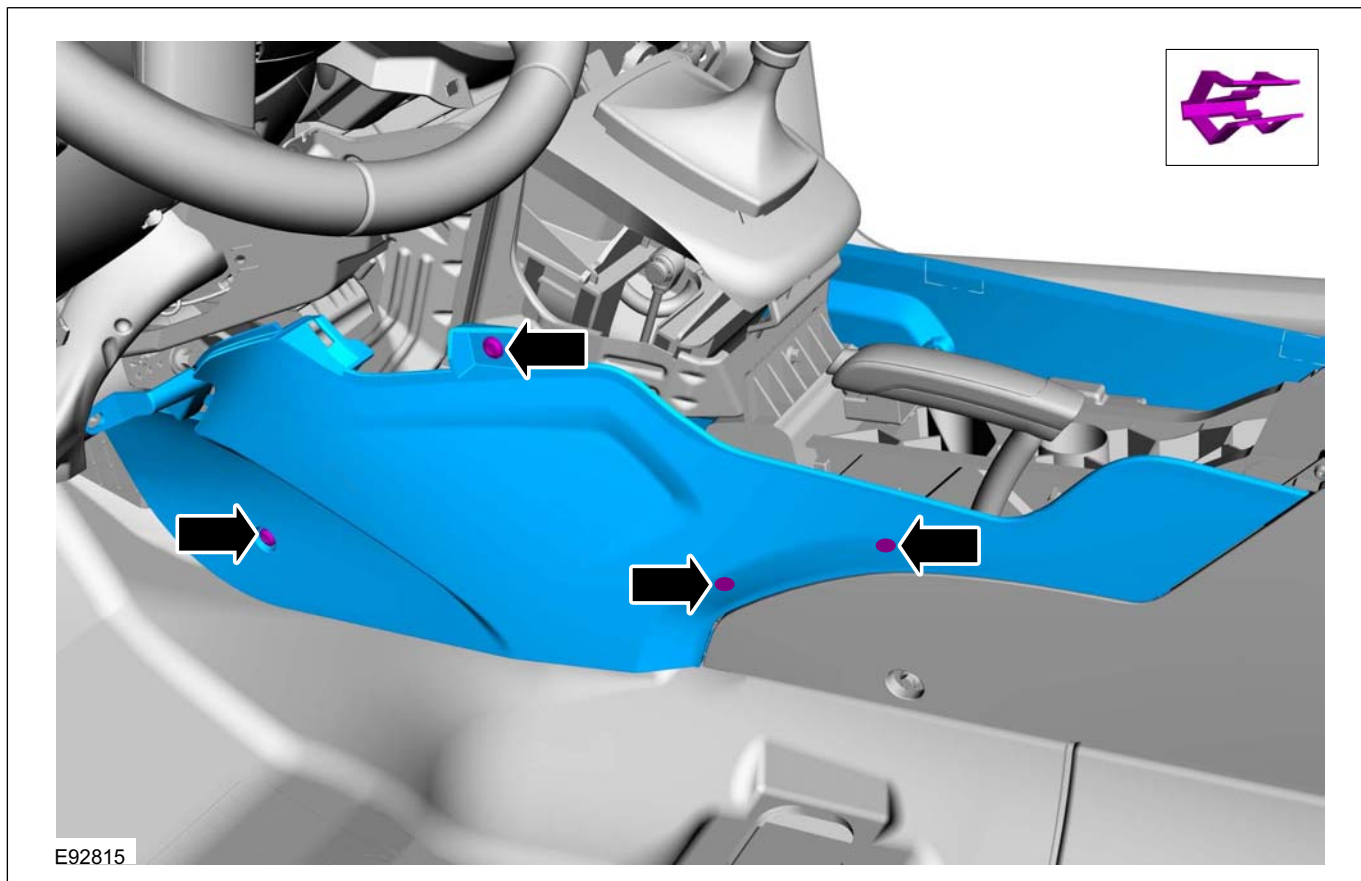
1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Floor Console

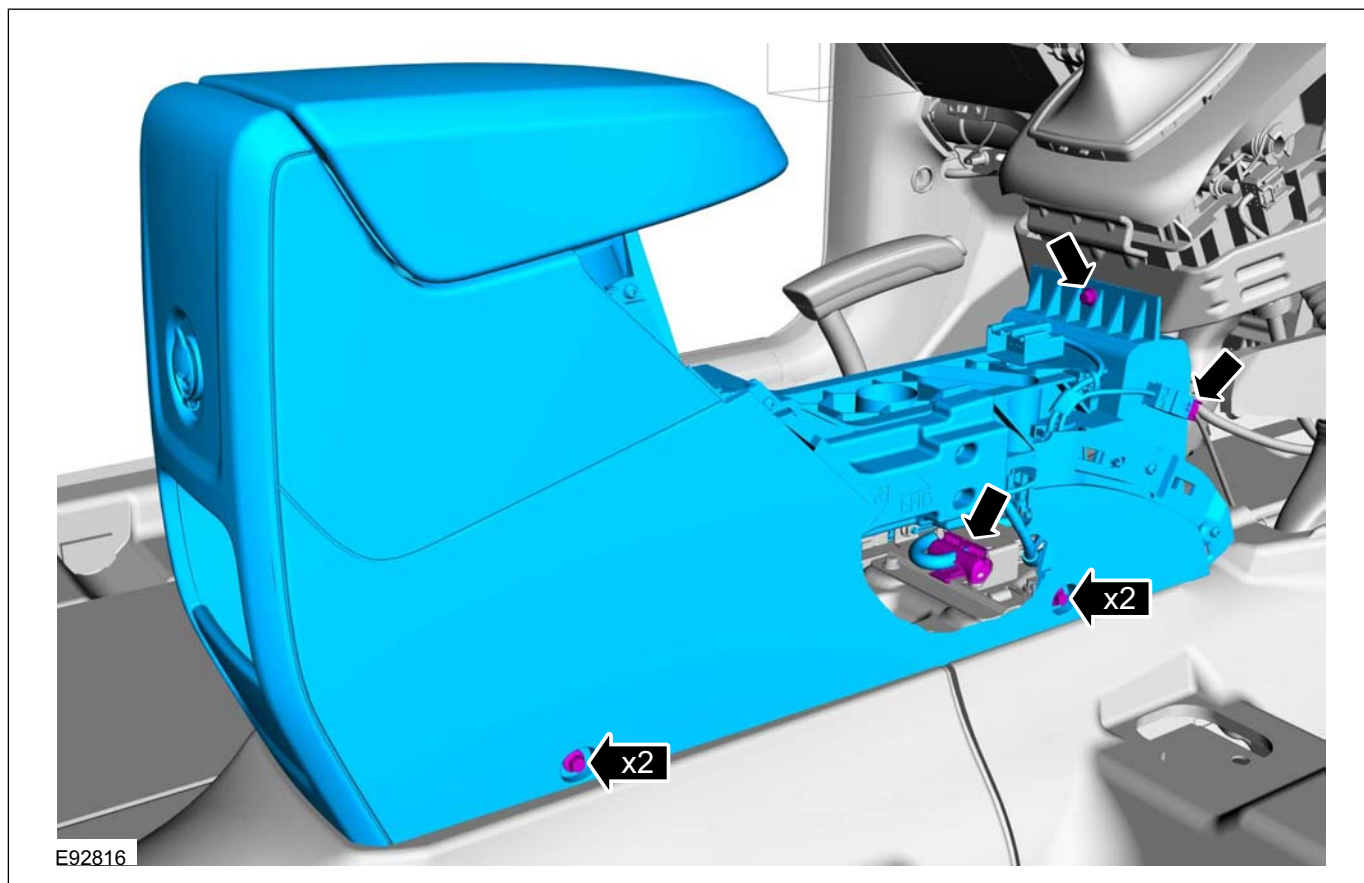
## Removal

1. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).
2. On both sides.



- 3.

## REMOVAL AND INSTALLATION



## Installation

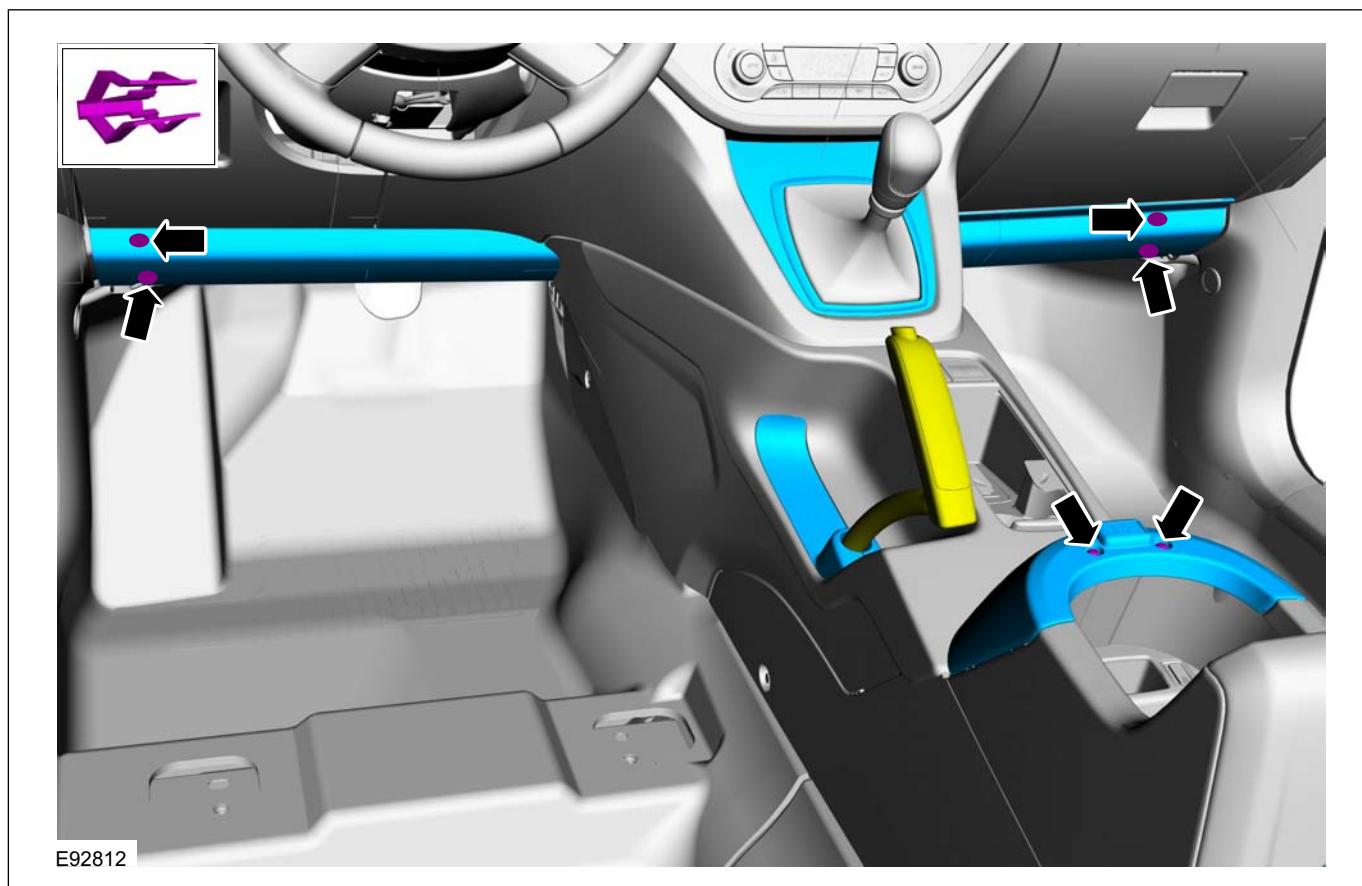
1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Floor Console Extension — Vehicles With: Center Armrest

## Removal

1.



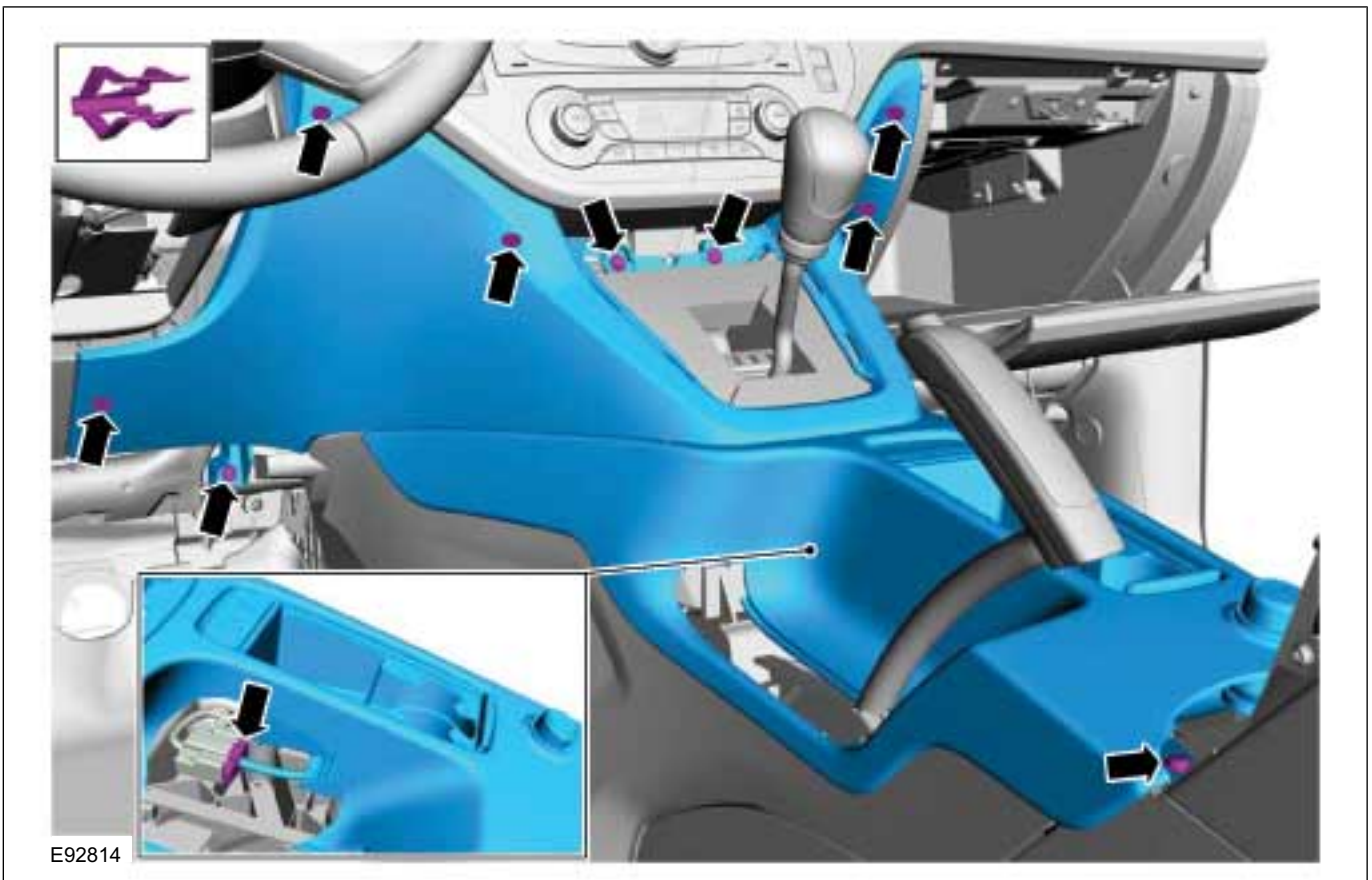
2.



REMOVAL AND INSTALLATION



3.





**501-12-13****Instrument Panel and Console****501-12-13****REMOVAL AND INSTALLATION**

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**Installation**

1. To install, reverse the removal procedure.



REMOVAL AND INSTALLATION

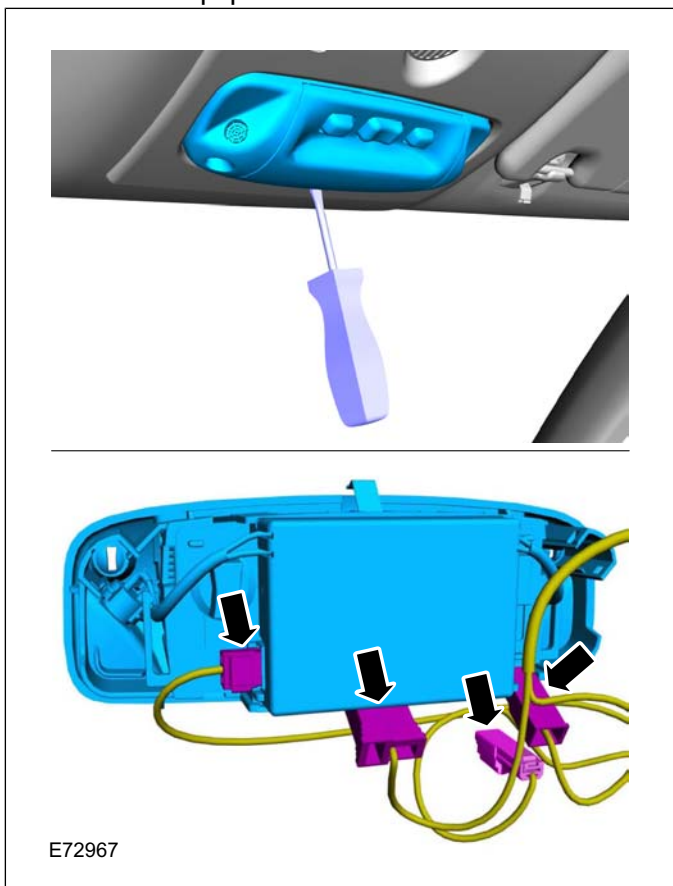
Overhead Console

General Equipment

Flat-bladed screwdriver

Removal

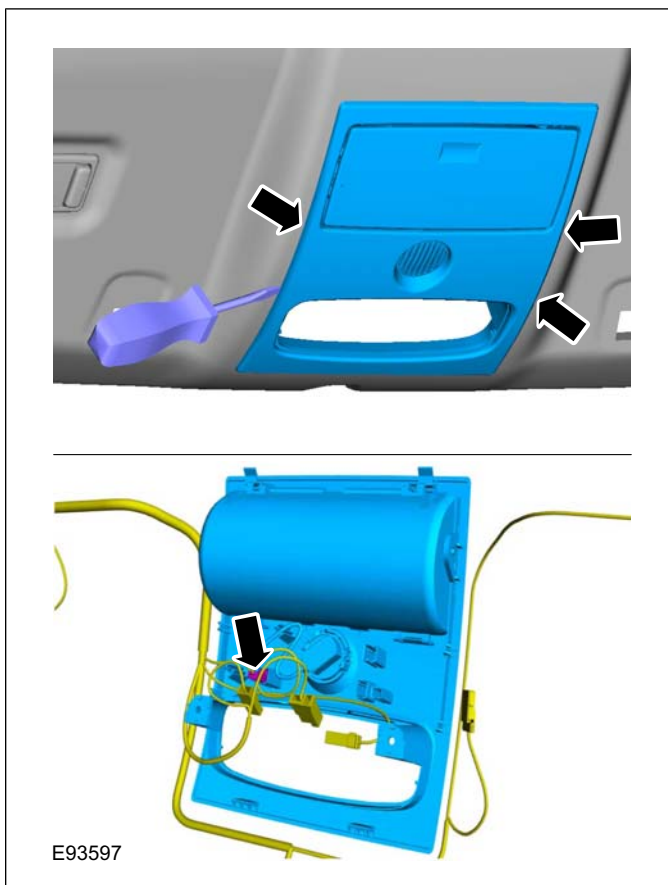
1. General Equipment: Flat-bladed screwdriver



2.



3.



Installation

1. To install, reverse the removal procedure.

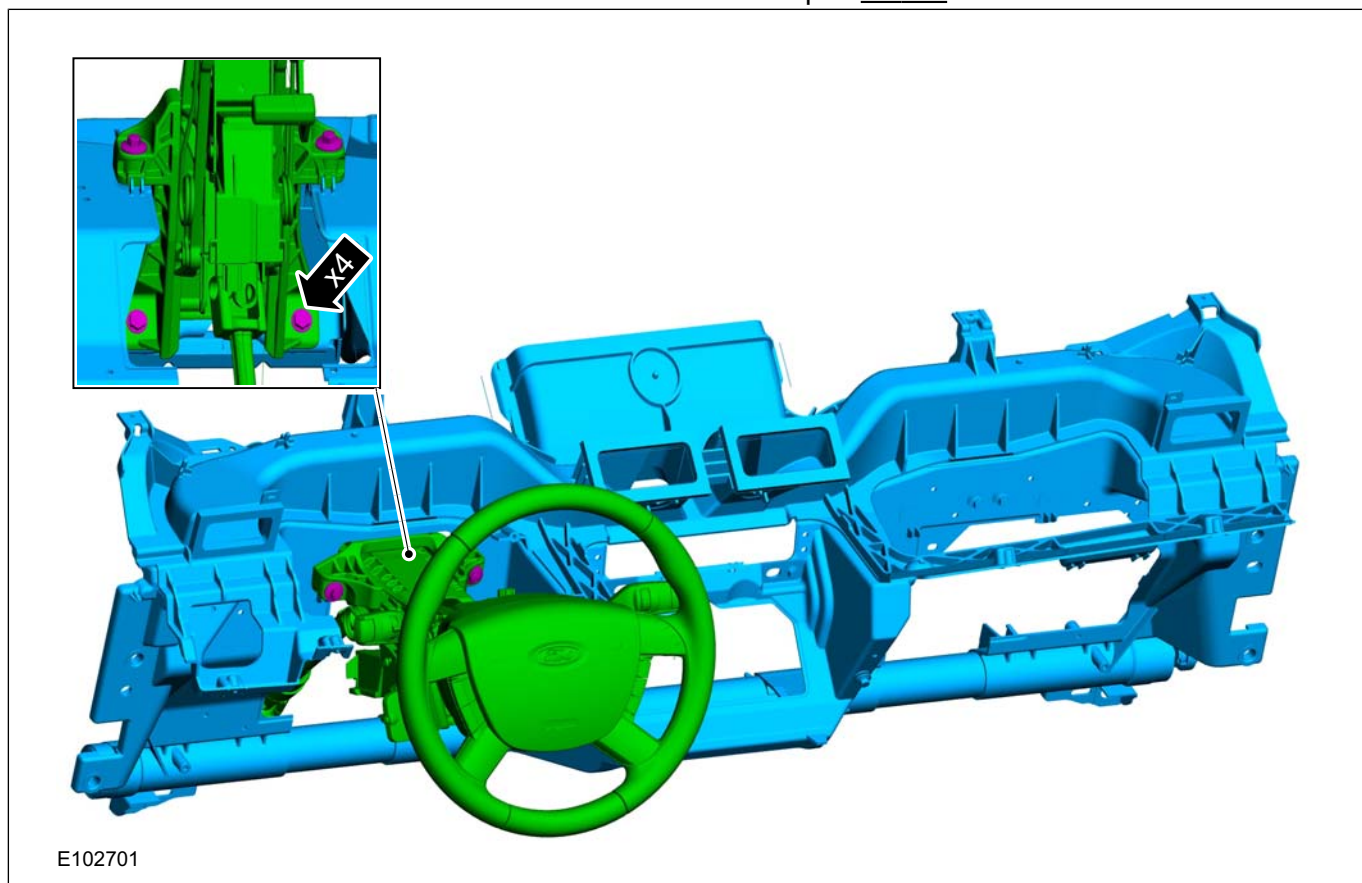
## REMOVAL AND INSTALLATION

## In-Vehicle Crossbeam

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Instrument Panel Wiring Harness** (418-02 Wiring Harnesses, Removal and Installation).
2. Torque: 24 Nm



## Installation

1. To install, reverse the removal procedure.

## SECTION 501-14 Handles, Locks, Latches and Entry Systems

### VEHICLE APPLICATION: 2008.50 Kuga

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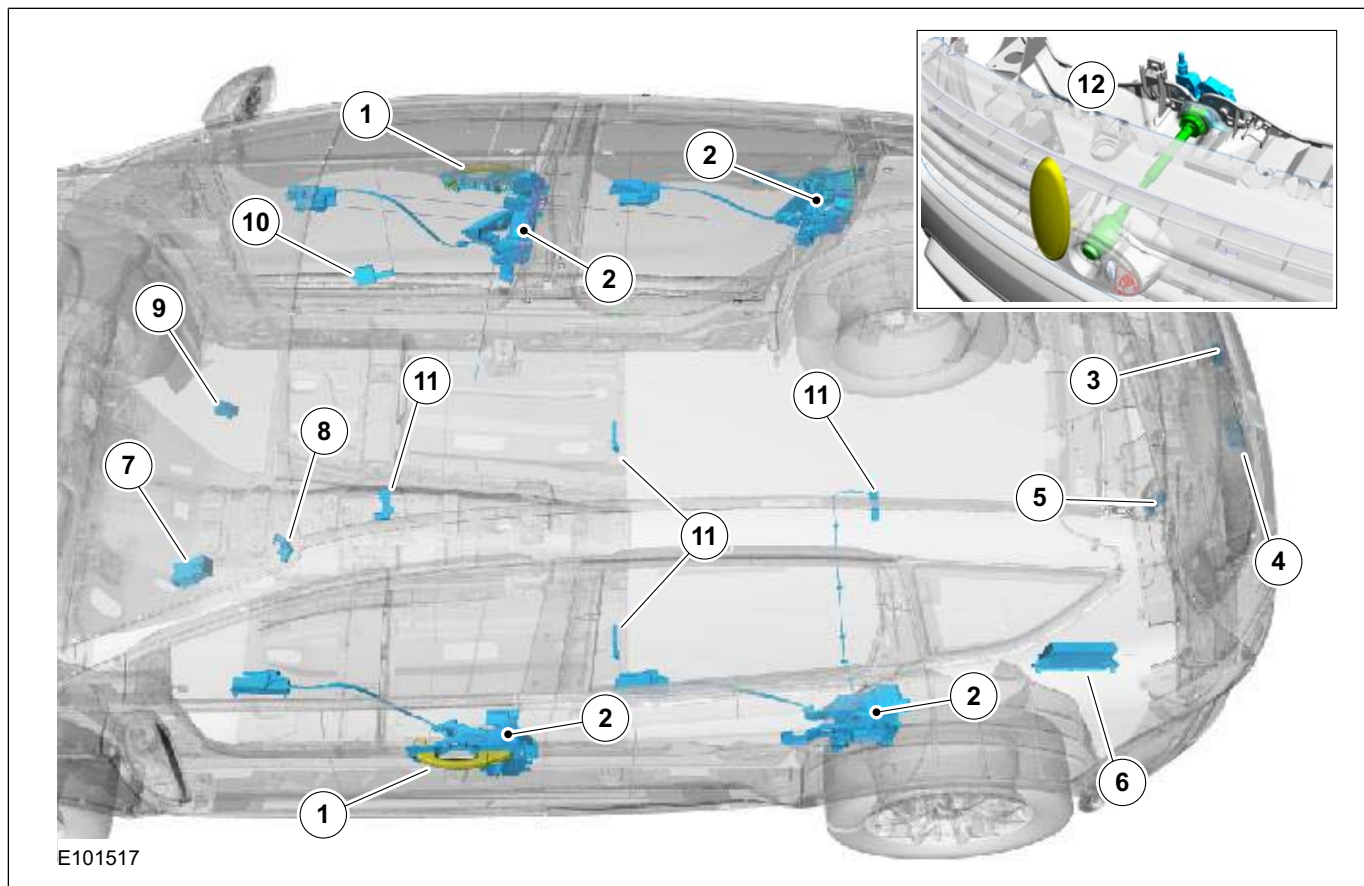
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DESCRIPTION AND OPERATION

Handles, Locks, Latches and Entry Systems – Component Location



E101517

Item	Description
1	Door handle with switch and integrated external aerial (vehicles with keyless vehicle module)
2	Door latch actuator
3	Folding rear window switch
4	Liftgate switch
5	External aerial (behind the bumper, vehicles with keyless vehicle module)

Item	Description
6	Keyless Vehicle Module
7	Electronic steering lock unit
8	PATS (passive anti-theft system) – Transceiver
9	Start/Stop button
10	RF remote receiver
11	Interior antenna
12	Hood catch



## DESCRIPTION AND OPERATION

## Handles, Locks, Latches and Entry Systems – Overview

## Vehicles with keyless start system

The keyless start system is installed as standard. With this system, the usual ignition lock is replaced by a start/stop button.

The system includes the following components:

- Keyless Vehicle Module
- Passive key (radio remote control with integrated emergency key)
- RF remote receiver
- Four interior antennas
- Electronic steering lock unit (replaces the mechanical steering lock)
- Start/stop button for starting/switching off the engine (the conventional ignition lock is dispensed with)

## Locking and unlocking the vehicle

The vehicle can be unlocked by pressing the unlock button on the remote control or by unlocking the door lock on the driver's side with the emergency key.

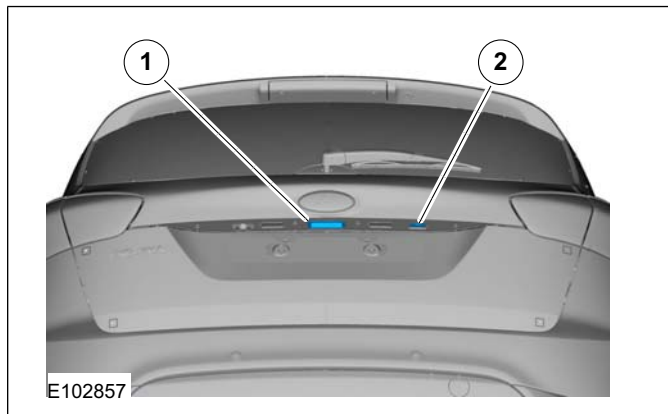
The vehicle can be locked by pressing the lock button on the remote control or by locking the door lock on the driver's side with the emergency key.

The anti-theft alarm system is switched off when the vehicle is unlocked. Provided the ignition is switched off, the anti-theft alarm system is switched on when the vehicle is locked.

Refer to: **Anti-Theft - Active** (419-01 Anti-Theft - Active, Description and Operation)  
/ **Anti-Theft - Active** (419-01 Anti-Theft - Active, Description and Operation)  
/ **Anti-Theft - Active** (419-01 Anti-Theft - Active, Description and Operation).

## Liftgate and folding rear window

A special feature is the two-part liftgate. Integrated in this liftgate is a folding rear window. This can be opened separately from the liftgate for fast and convenient loading and unloading of small items. Hydraulic dampers hold the rear window in the open position.



Item	Description
1	Tailgate release switch
2	Rear window release switch

To open the folding rear window, the luggage compartment release button on the remote control must be pressed for more than 1.6 seconds or the rear window release switch in the lower area of the rear window must be pressed. The folding rear window is then unlocked and can be opened by hand.

To open the whole liftgate, the luggage compartment release button on the remote control must be briefly pressed twice within 3 seconds or the rear window release switch in the lower area of the rear window must be pressed. The liftgate is then unlocked and can be opened by hand.

If one entryway is open, the other remains locked and cannot be opened. Both entryways are locked while the vehicle is in motion and can only be unlocked after the vehicle comes to a stop and a door is opened.

## engine compartment lid.

The hood is released by unlocking it at the lock behind the Ford badge on the radiator grille.

## Start the engine

**NOTE:** In order for engine starting to be enabled it is necessary for a valid passive key to be present inside the vehicle.

The passive vehicle key is detected by the interior antennas.

Pressing the start/stop button

**DESCRIPTION AND OPERATION**

- switches on the ignition
- starts the engine with the ignition in the ON position or directly from ignition OFF
  - if the clutch pedal is pressed at the same time.

Switching on the ignition will automatically

- deactivate the passive anti-theft system (PATS).

Refer to: **Anti-Theft - Passive** (419-01 Anti-Theft - Passive, Description and Operation).

- release the electronic steering lock unit.

Refer to: **Steering Column** (211-04 Steering Column, Description and Operation).

There are two switches for the clutch pedal position; a first one for approx. 25% and a second one for approx. 90% of the clutch pedal travel. If the function of the 90 % switch is impaired then the engine can be started if at the same time

- the clutch pedal is pressed,
- the brake pedal is depressed and
- the start/stop button is pressed.

This function is only intended for emergency situations and is not for use in continuous operation.

**Switching off the engine**

The engine is switched off by actuating the start/stop button, provided the vehicle is stationary (vehicle = 0 km/h).

In an emergency, the engine can be switched off at any speed as follows:

- By pressing the start/stop button three times within three seconds.
- By pressing and holding the start/stop button for two seconds.

In this case the engine can be restarted if the start/stop button is pressed.

Switching off the ignition will automatically

- activate the passive anti-theft system (PATS).

Refer to: **Anti-Theft - Passive** (419-01 Anti-Theft - Passive, Description and Operation).

- lock the electronic steering lock unit after 45 seconds if the vehicle is stationary.

Refer to: **Steering Column** (211-04 Steering Column, Description and Operation).

**Emergency starting function**

Refer to: **Handles, Locks, Latches and Entry Systems** (501-14 Handles, Locks, Latches and Entry Systems, Description and Operation).

**Vehicles with Keyless Vehicle System**

The keyless vehicle system allows the vehicle to be operated without conventional keys or without active actuation of the radio remote control. With this system, the user only needs to carry a valid radio remote control (a passive key).

The vehicle is supplied with a double latching function.

The system includes the following components:

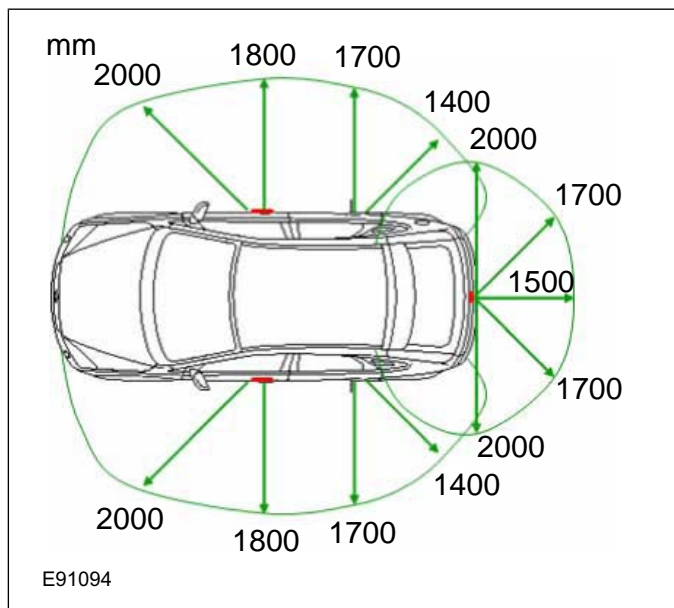
- Keyless Vehicle Module
- Passive key (radio remote control with integrated emergency key)
- RF remote receiver
- Additional latching and release buttons
- Electric door locks with fast-reaction motors
- Exterior antennas in both front doors and in the rear bumper
- Four interior antennas
- Electronic steering lock unit (replaces the mechanical steering lock)
- Start/stop button for starting/switching off the engine; the conventional ignition lock is dispensed with.

**Unlocking the vehicle**

In order to gain access to the vehicle, there must be a passive vehicle key in the vicinity of the vehicle. A passive vehicle key is identified by the exterior antennas.

**Exterior antennas: approximate range (in mm)**

## DESCRIPTION AND OPERATION



If a valid vehicle key is identified then the vehicle can be unlocked directly by operating a handle on one of the doors or by pressing the unlocking button on the liftgate. If the **global unlocking** function is activated then all of the doors are unlocked.

The anti-theft alarm system is switched off when the vehicle is unlocked.

Refer to: **Anti-Theft - Active** (419-01 Anti-Theft - Active, Description and Operation)  
/ **Anti-Theft - Active** (419-01 Anti-Theft - Active, Description and Operation)  
/ **Anti-Theft - Active** (419-01 Anti-Theft - Active, Description and Operation).

### Locking the vehicle

There are two ways of **centrally locking** the vehicle:

- actuating the door latch button once,
- actuating the relevant button on the radio remote control of the passive key once.

When the central locking system has been activated, the vehicle remains locked for 3 seconds. During this time, the vehicle **cannot** be unlocked with the passive key or with the remote control.

This allows the driver to check whether the vehicle is locked. This delay time can be changed or switched off via IDS (Integrated Diagnostic System).

The **global locking function** can only be activated via the driver's door. To this end, the exterior door

lock button on the driver's door must be pressed for at least 2 seconds.

Provided the ignition is switched off, the anti-theft alarm system is switched on when the vehicle is locked.

Refer to: **Anti-Theft - Active** (419-01 Anti-Theft - Active, Description and Operation)  
/ **Anti-Theft - Active** (419-01 Anti-Theft - Active, Description and Operation)  
/ **Anti-Theft - Active** (419-01 Anti-Theft - Active, Description and Operation).

### Emergency unlocking/locking

If the keyless vehicle module does not detect the passive key, then the vehicle can be unlocked and locked as described in **Vehicles with keyless vehicle module**.

### Liftgate and folding rear window

The liftgate and the folding rear window can be released in the way described in **Vehicles with keyless vehicle module**.

### engine compartment lid.

The hood is released by unlocking it at the lock behind the Ford badge on the radiator grille.

### Starting/switching off the engine

The routine for starting and switching off the engine is the same as for the keyless start system.

### Service Instructions

It is not possible to **replace the lock cylinder** in the driver's door or on the hood or **reorder a key/emergency key** without the key number. It is **not** possible to read off the code from the key itself in service.

If a **new passive key** (radio remote control with integrated emergency key) is to be **added**, it just needs to be reprogrammed with the IDS.

If a **passive key** (radio remote control with integrated emergency key) is to be **erased**, all keys first have to be erased. The remaining keys must then be reprogrammed. Up to 8 keys can be programmed.

---

**DESCRIPTION AND OPERATION**

Between the emergency key holder and the passive anti-theft system transceiver there is a copper ring which ensures the resonant frequency of the transceiver. This copper ring must be in position to ensure the function of the emergency key.

After **replacement of the new keyless vehicle module**, all the available passive vehicle keys as well as the emergency keys must be reprogrammed using the IDS. The new keyless vehicle module must also be initialized with the following modules using IDS:

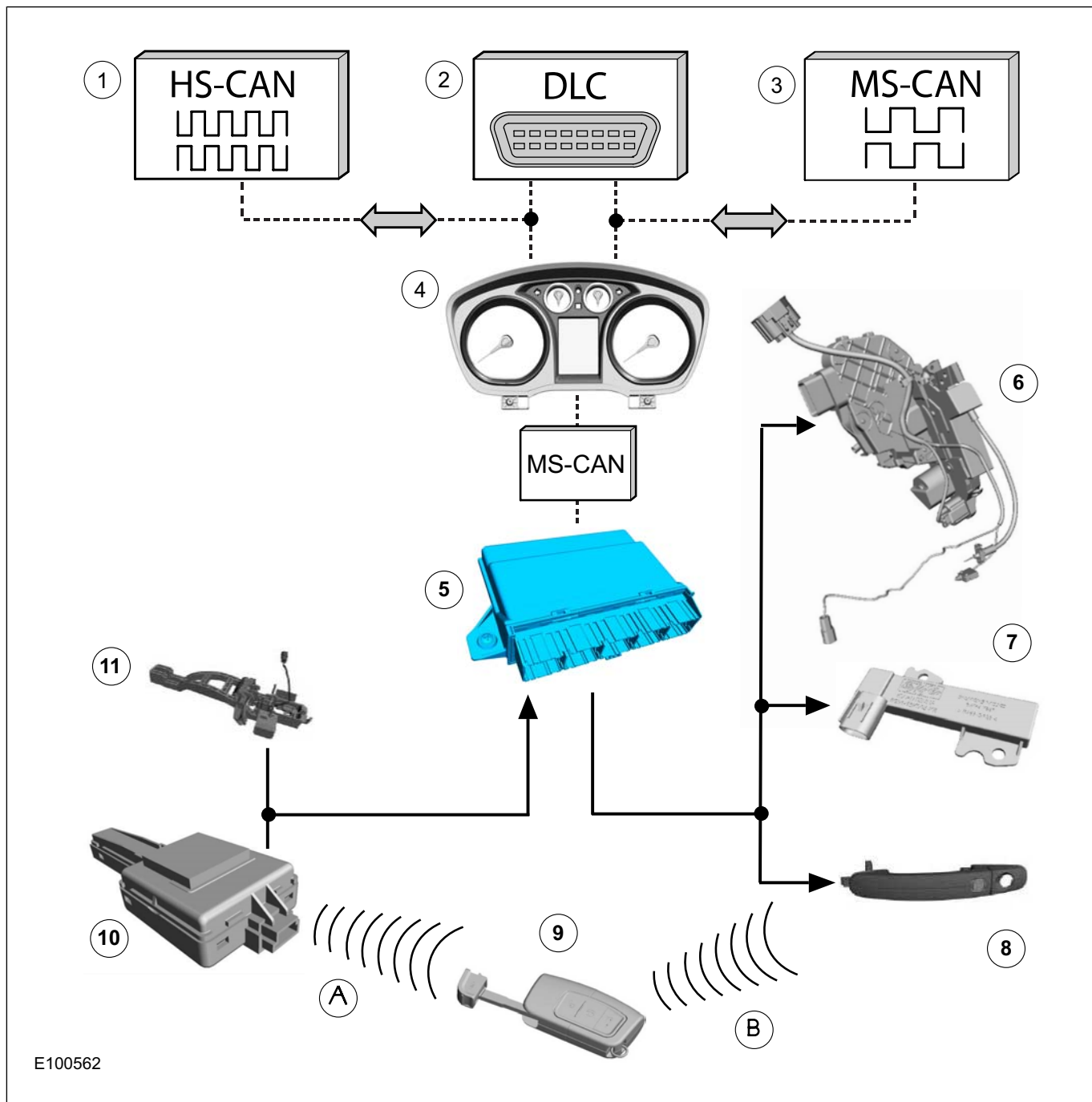
- PCM (powertrain control module)
- Steering Column Lock Control Unit

DESCRIPTION AND OPERATION

Handles, Locks, Latches and Entry Systems – System Operation and Component Description

System Diagram

Passive Entry



E100562

## DESCRIPTION AND OPERATION

Item	Description
A	Radio frequency signal (from the passive vehicle key to the radio frequency receiver)
B	Radio frequency signal (from an exterior antenna to the passive vehicle key)
1	HS-CAN (controller area network) databus
2	DLC (data link connector)
3	MS-CAN databus
4	Gateway (instrument cluster)
5	keyless vehicle module
6	Door lock actuator

Item	Description
7	Exterior antenna (beneath the rear bumper)
8	Exterior antenna (integrated in the exterior door handle)
9	Passive key (radio remote control with integrated emergency key) Refer to Component Description: (page ?)
10	RF remote receiver
11	Side door grip handle with exterior door release switch

## System Operation

## Passive Entry

**NOTE:** With the keyless vehicle system, the doors can be unlocked either individually or 'globally'. The programming process is the same as on vehicles without a keyless vehicle system.

## Unlocking the vehicle

When a door handle or the release button on the liftgate is actuated, the relevant exterior antenna emits a low frequency signal.

Three exterior antennas are installed on the vehicle:

- one in the driver door handle,
- one in the passenger door handle,
- one behind the bumper.

The passive vehicle key is then activated and it transmits a coded radio frequency signal.

The coded radio frequency signal from the passive key is received by the radio frequency receiver.

The radio frequency receiver transfers the signal to the keyless vehicle module.

If the module recognises a valid key signal, the actuated door or liftgate is unlocked. **Unlocking** of this door or liftgate is performed **directly** by the module.

If **global unlocking** is activated, the module transmits the unlocking request over the MS-CAN to the GEM (generic electronic module). The GEM then activates the individual door modules.

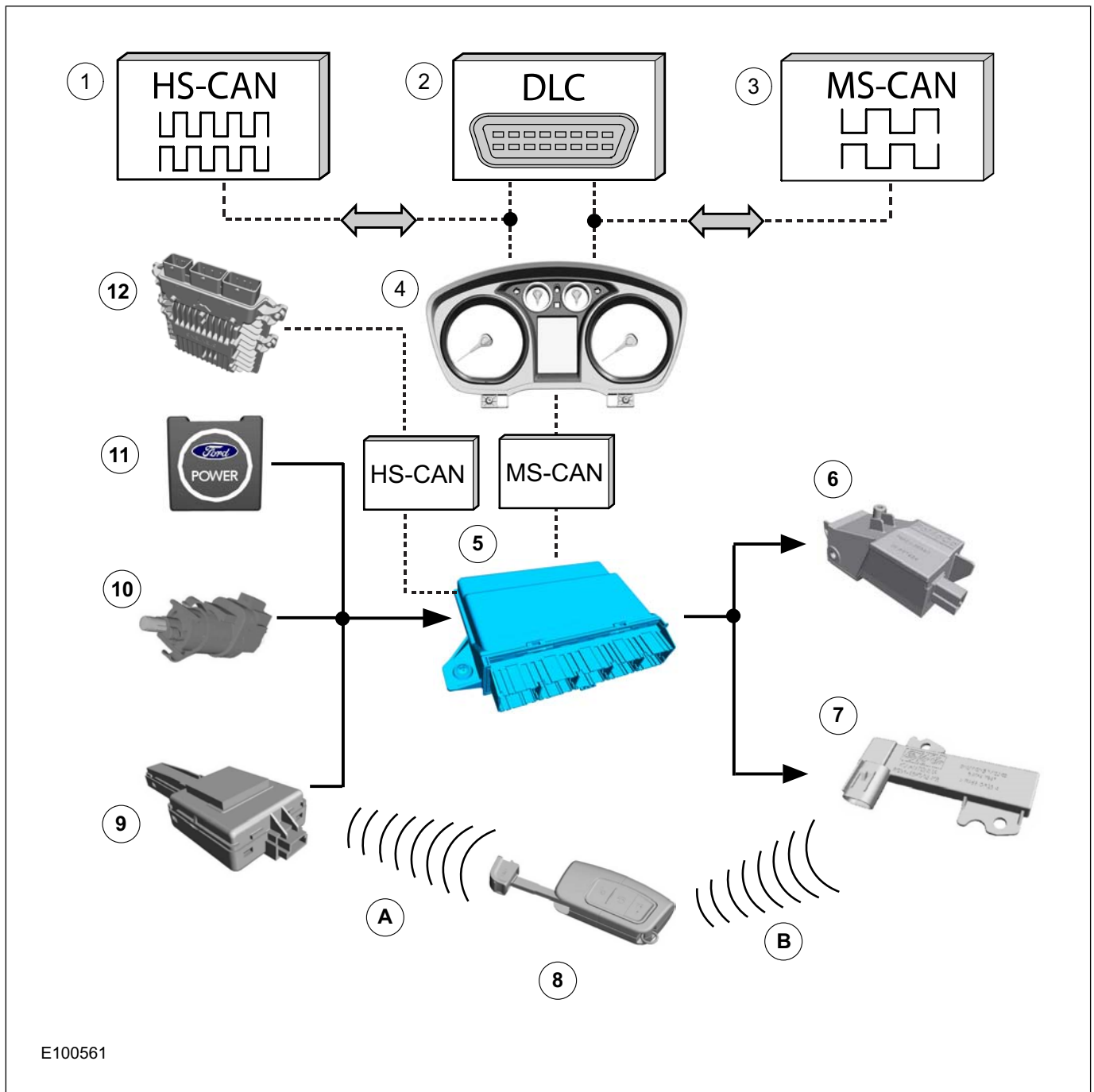
**NOTE:** .

- If the vehicle goes over 5 days without being unlocked, the system enters energy saving mode. This mode prevents excessive load on the vehicle battery
- In this mode, the response time of the keyless vehicle system during unlocking is slightly longer. Energy saving mode is deactivated again when the vehicle is unlocked again once after more than 5 days.



DESCRIPTION AND OPERATION

Passive Start



E100561

Item	Description
A	Radio frequency signal (from the passive vehicle key to the radio frequency receiver)
B	Radio frequency signal (from an interior antenna to the passive vehicle key)
1	HS-CAN databus
2	DLC
3	MS-CAN databus

Item	Description
4	Gateway (instrument cluster)
5	keyless vehicle module
6	Electronic steering lock unit
7	Interior antenna
8	Passive key (radio remote control with integrated emergency key) Refer to Component Description: (page ?)

**DESCRIPTION AND OPERATION**

Item	Description
9	RF remote receiver
10	BPP (brake pedal position)

Item	Description
11	Start/stop button
12	PCM

**Passive Start**

**NOTE:** In order for engine starting to be enabled it is necessary for a valid passive key to be present inside the vehicle.

A total of four internal antennas are installed, for identification of the passive vehicle key:

- one behind each of the front seats,
- one under the floor console,
- one behind the rear seat bench.

Three states can be switched to via the start/stop button:

- Switch on the ignition
- directly start the engine,
- Switch off the engine.

**Start the engine.**

The following options are available:

- Ignition ON:
  - actuate the start/stop button.
- Starting the engine from ignition ON or directly from ignition OFF:
  - actuate the clutch pedal and the start/stop button.

When the start/stop button is pressed, the interior antennas of the keyless vehicle module are activated.

The passive vehicle key is then activated and it transmits a coded radio frequency signal.

The coded radio frequency signal from the passive key is received by the radio frequency receiver.

The radio frequency receiver transfers the signal to the keyless vehicle module.

For security reasons, a code enquiry is made to the PCM before the vehicle can be started.

The coding enquiry is made over the HS-CAN. Starting is only enabled once confirmation has been received from the module.

**Switching off the engine**

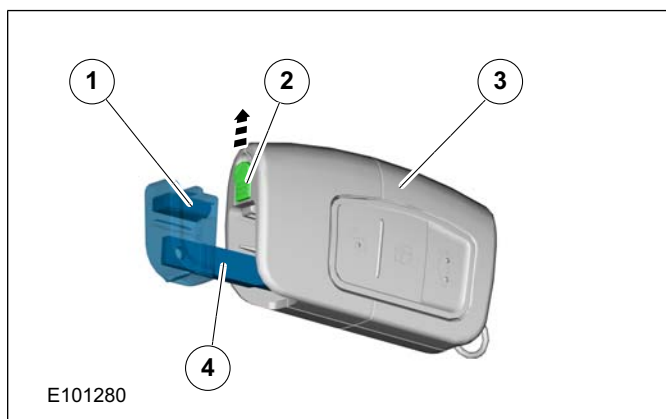
The engine is switched off by actuating the start/stop button, provided the vehicle is stationary (vehicle speed = 0 km/h).

In an emergency, the engine can be switched off at any speed as follows:

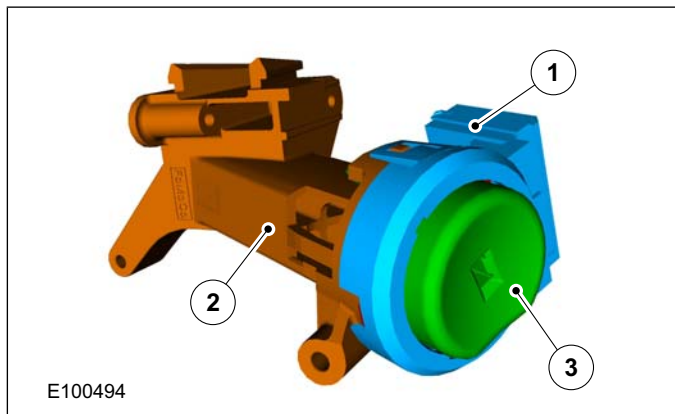
- By pressing the start/stop button three times within three seconds.
- By keeping the start/stop button pressed for two seconds.

**Component Description**

**Passive key (radio remote control with integrated emergency key)**



Item	Description
1	PATS transponder (emergency start function)
2	Latch
3	Passive Key
4	Emergency key blade

**DESCRIPTION AND OPERATION****Passive anti-theft system transceiver  
(emergency starting function)**

Item	Description
1	PATS transceiver
2	Transceiver holder
3	Emergency key holder

If the keyless vehicle system is unable to recognise the passive key, the vehicle can be started via the emergency starting function.

To this end, there is a holder for the transceiver of the passive anti-theft system on the steering column beneath a cover.

To start the engine, the emergency key must be held against the cover of the transceiver and the start/stop button pressed.

Alternatively, the emergency key can be inserted in the holder after removal of the cover and the start/stop button pressed. In both cases, the information is read out from the PATS transponder of the emergency key.

**DIAGNOSIS AND TESTING****Locks, Latches and Entry Systems****General Equipment**

The Ford approved diagnostic tool
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**Principles of Operation (Vehicles with Remote Keyless Entry (RKE))****RKE locking system overview**

This system consists of mechanical/electrical operated door latches driven by inputs from electronic door control modules. The system uses a radio frequency (RF) transmitter and receiver to operate the remote lock/unlock functions and normal key or remote door handle inputs for standard central and double locking functions.

When the remote handle is operated, switching contacts within the door latch supply a command signal to the door control module. The door control module communicates with the GEM using the central area network (CAN) bus circuit. Dependant upon the current state of the locking system, commands are then sent to all of the door control modules, which in turn allow battery voltage to be applied to the door latch motors.

The fuel filler door lock function is controlled by the GEM. The GEM receives the lock command from the door control module. The GEM operates the lock relay which supplies a voltage to the fuel filler door lock motor. To unlock the fuel filler door, the supplied voltage is reversed using the driver door/fuel filler door unlock relay.

The liftgate or luggage compartment lid is opened when the vehicle is in the unlocked mode by a ground signal from the liftgate/mimi-liftgate compartment lid release switch to the GEM. The GEM will supply a voltage to the liftgate or mimi-liftgate compartment lid latch motor.

If the vehicle is locked, the input from the liftgate/mini-liftgate compartment lid release switch will be ignored.

The RKE functions are operated by sending a radio frequency (RF) signal from the key transmitter. The signal is received by the vehicle remote RF receiver. For vehicles fitted with the Keyless system the RF signal is transferred to the keyless vehicle module and a signal is transmitted to the corresponding lock sent via CAN to the GEM module.

**Keyless Vehicle System Overview**

**NOTE:** Vehicles fitted with Keyless system the remote codes are programmed to the keyless vehicle module

The keyless vehicle system also incorporates RKE functions, however the main purpose of the system is to allow the operator of the vehicle to gain access to and operate the vehicle without carrying out any actions with a key or remote buttons.

The keyless vehicle system can be turned off to give basic key operation if required.

To isolate the keyless vehicle system, the emergency key must be inserted into the ignition switch turning knob and the ignition switch turning knob rotated to position II. It is now possible to select the KEY FREE ON or KEY FREE OFF from the instrument cluster liquid crystal display (LCD) using the remote steering column stalk control. In the OFF mode, the RKE functions still work.

Vehicles equipped with keyless vehicle systems, will be delivered from production in shipping mode. Shipping mode reduces the vehicle battery drain to a minimum to extend the period of time the vehicle can remain dormant without discharging the vehicle battery.

To exit the shipping mode, the emergency key must be inserted into the ignition switch turning knob and rotated to position II. The shipping mode can now be deselected from the instrument cluster LCD display using the steering column stalk control.

**Inspection and Verification (Vehicles with Remote Keyless Entry (RKE))**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**DIAGNOSIS AND TESTING****Visual Inspection Chart**

<b>Mechanical</b>	<b>Electrical</b>
– Misaligned door(s), hood, mini-liftgate, tailgate, luggage compartment and hood	– Fuse(s)
– Door latch(es)	– Relay(s)
– Liftgate latch	– Wiring harness
– Luggage compartment lid latch	– Electrical connector(s)
– Hood latch	– Door latch(s)
– Actuating Cable(s)	– Remote transmitter batteries
– Exterior door handle(s)	– Vehicle battery
– Door latch remote control(s)	– Remote transmitter
– Door lock cylinder	– RF receiver
	– Liftgate exterior release switch
	– Luggage compartment lid release switch
	– Door control module(s)
	– GEM

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

REMOVAL AND INSTALLATION

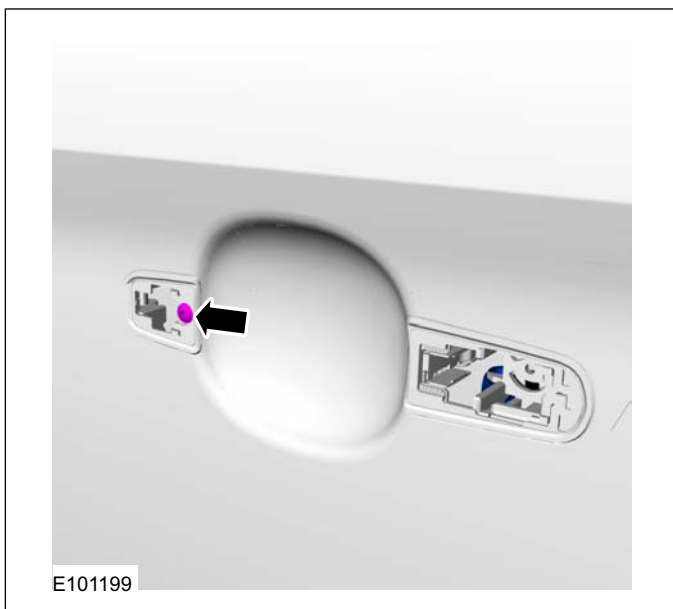
Front Door Latch

Removal

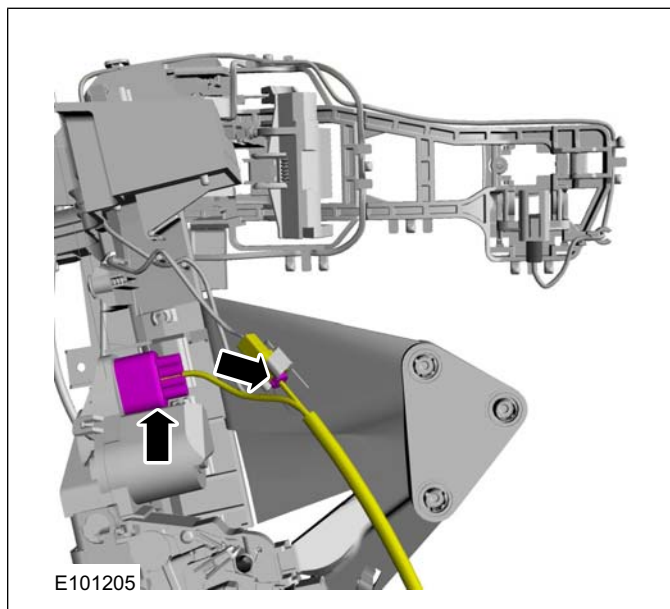
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Door Window Regulator** (501-11 Glass, Frames and Mechanisms, Removal and Installation).  
Refer to: **Exterior Front Door Handle** (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).  
Refer to: **Front Door Lock Cylinder** (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).

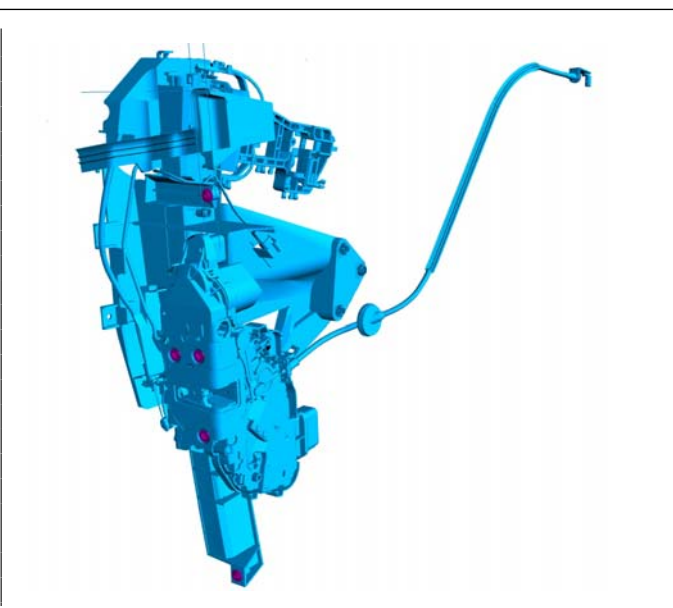
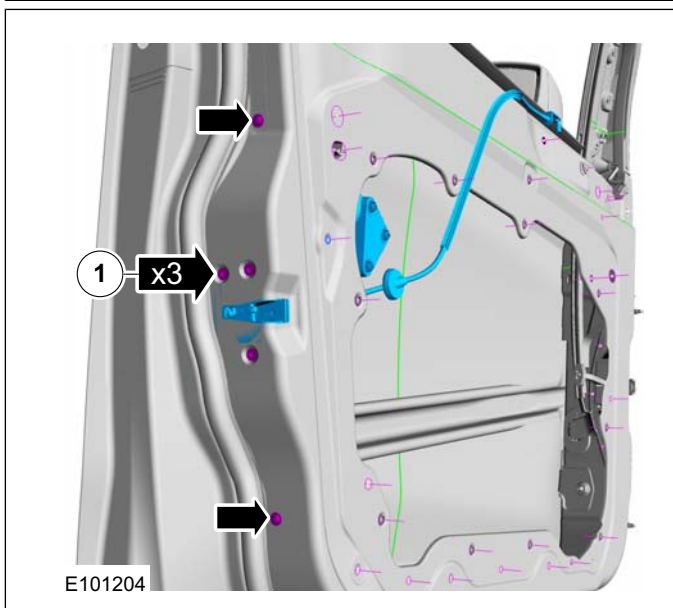
2.



3.



4. 1. Torque: 8 Nm





**501-14-16****Handles, Locks, Latches and Entry Systems****501-14-16**

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**REMOVAL AND INSTALLATION**

## Installation

1. To install, reverse the removal procedure.



REMOVAL AND INSTALLATION

Rear Door Latch

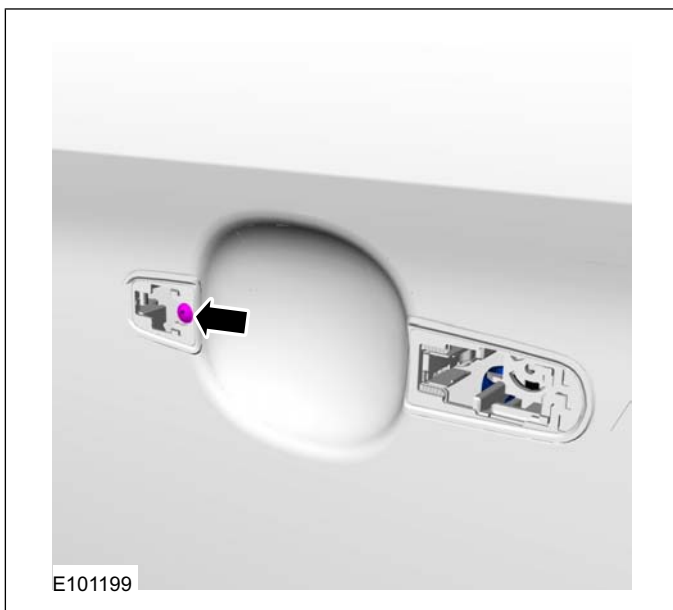
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

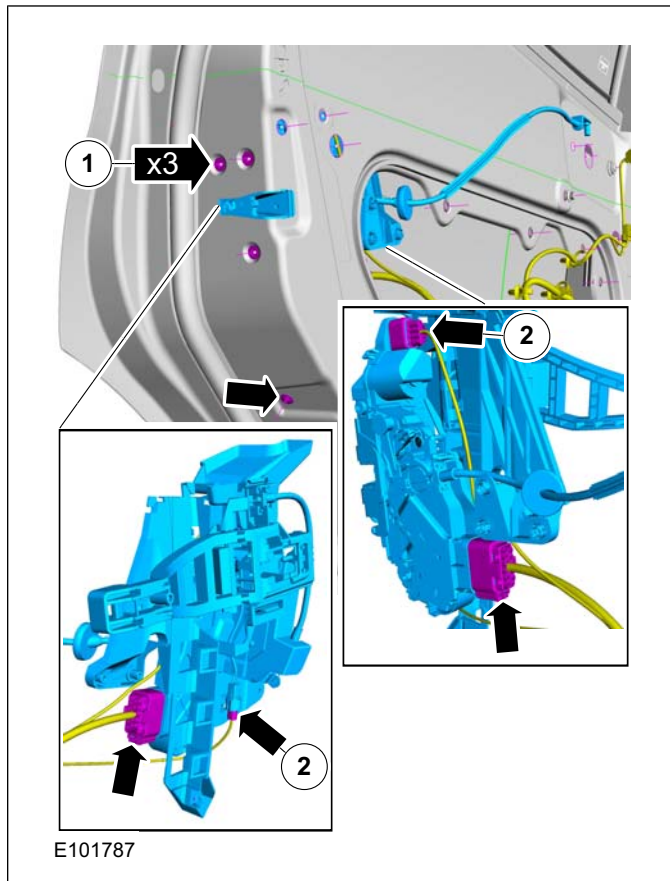
1. Refer to: **Rear Door Window Regulator** (501-11 Glass, Frames and Mechanisms, Removal and Installation).

Refer to: **Exterior Rear Door Handle** (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).

2.



3. 1. Torque: 8 Nm
2. if equipped



Installation

1. To install, reverse the removal procedure.



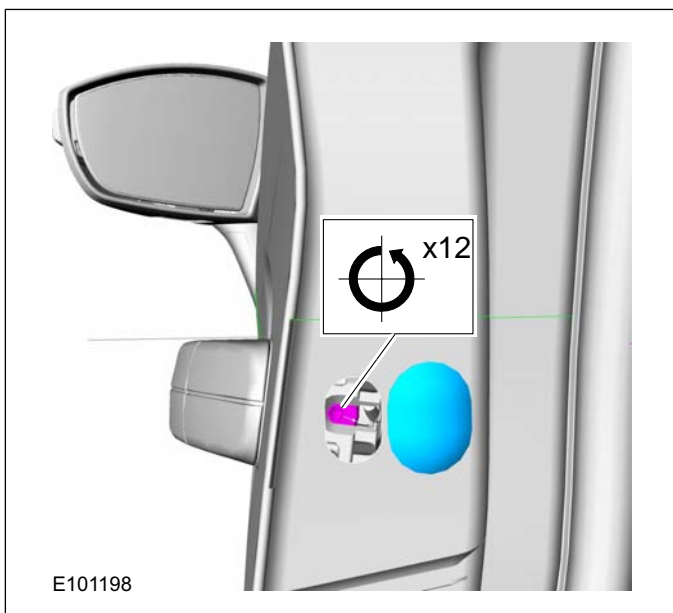
REMOVAL AND INSTALLATION

Exterior Front Door Handle

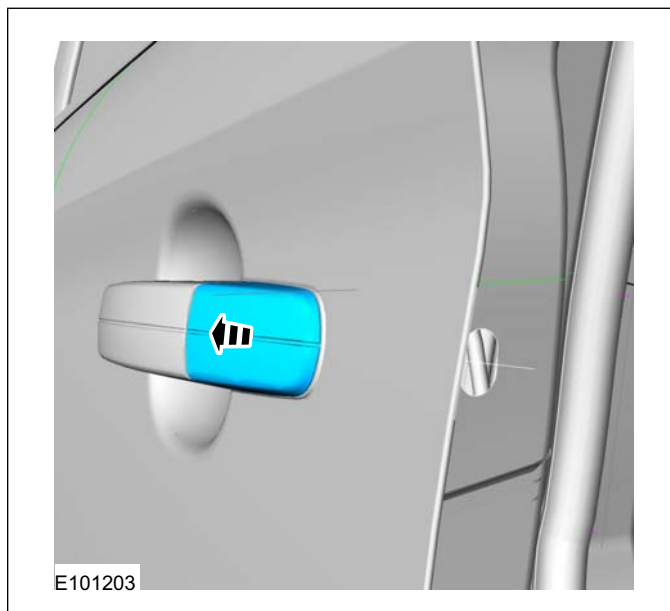
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1.



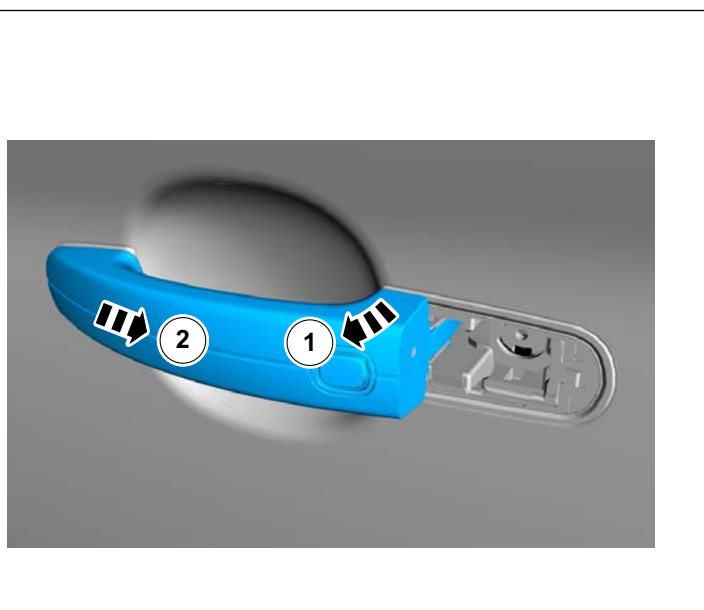
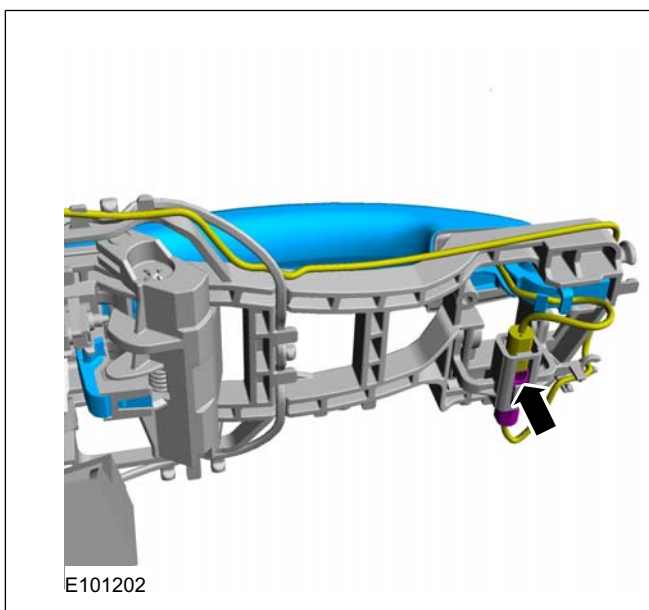
2.



Vehicles with keyless entry

3. Refer to: **Front Door Window Regulator** (501-11 Glass, Frames and Mechanisms, Removal and Installation).

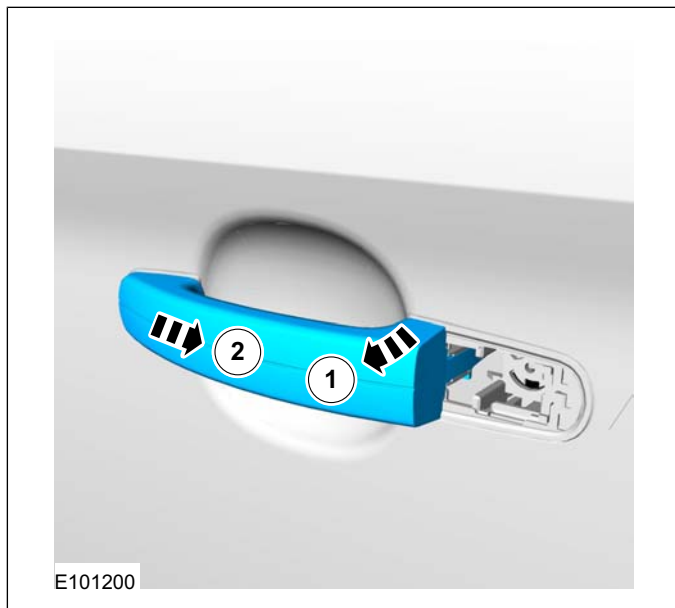
4.



**REMOVAL AND INSTALLATION**

Vehicles without keyless entry

5.

**Installation**

1. To install, reverse the removal procedure.

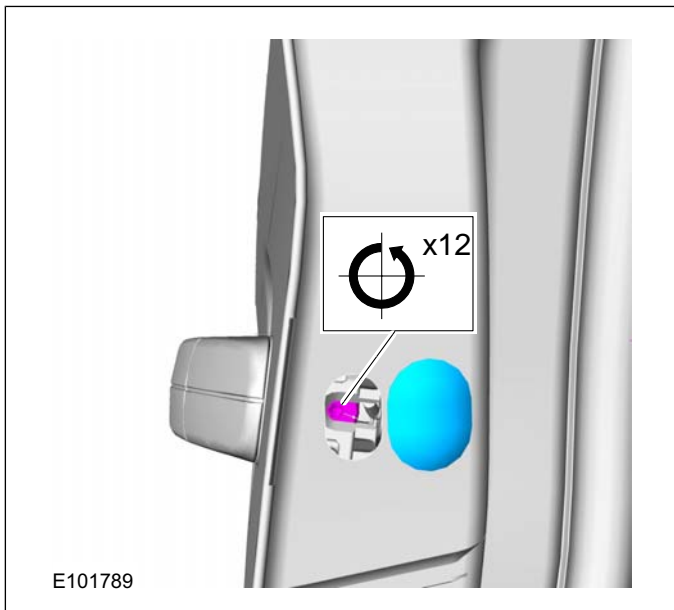
REMOVAL AND INSTALLATION

Exterior Rear Door Handle

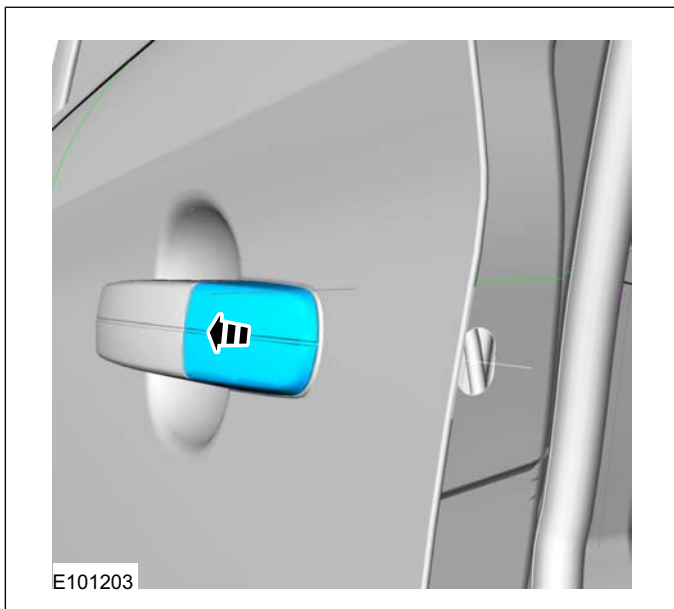
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

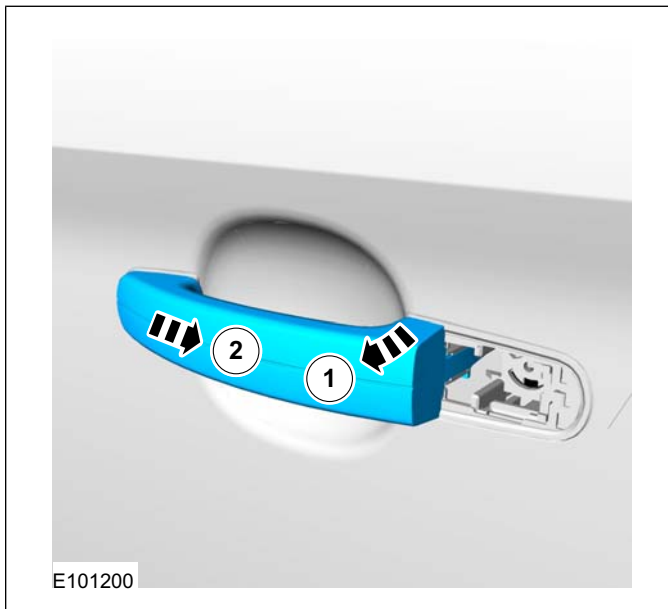
1.



2.



3.



Installation

1. To install, reverse the removal procedure.

501-14-21

Handles, Locks, Latches and Entry Systems

501-14-21

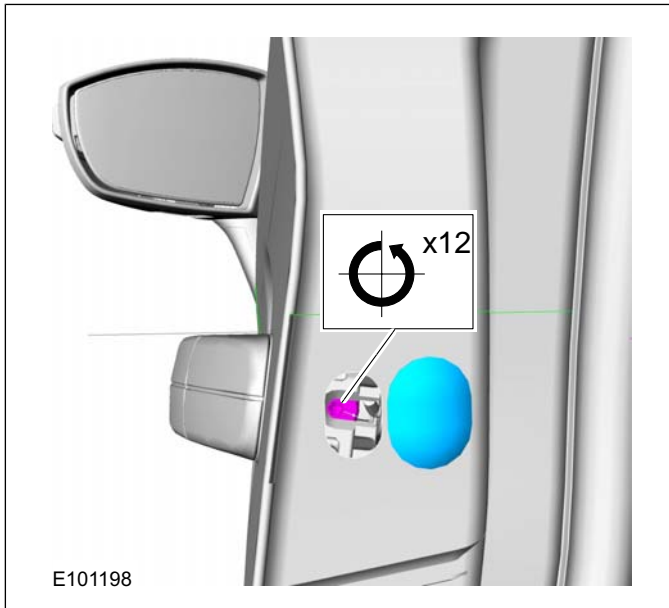
## REMOVAL AND INSTALLATION

## Front Door Lock Cylinder

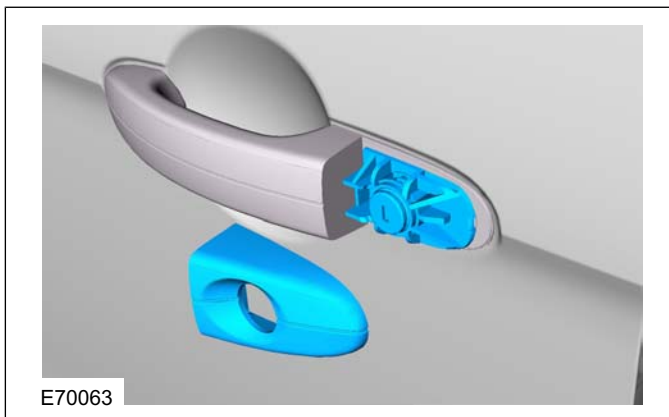
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1.



2.



## Installation

1. To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

## Keyless Vehicle Module (KVM)

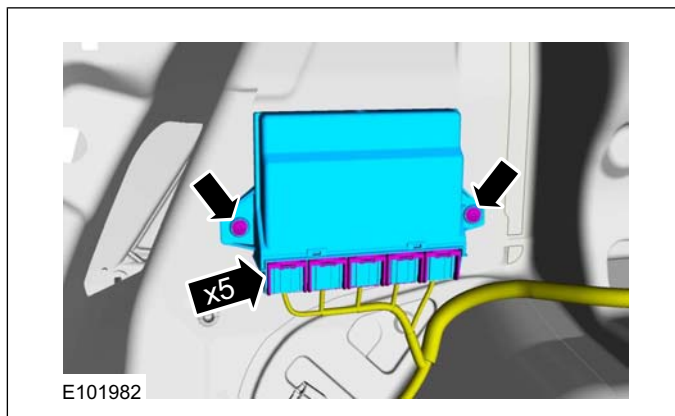
## General Equipment

Ford Diagnostic Equipment
---------------------------

## Removal

1. Refer to: **Loadspace Trim Panel LH** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- 2.



## Installation

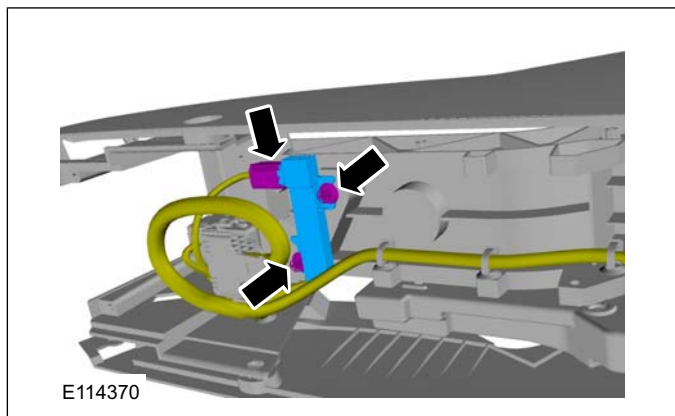
1. To install, reverse the removal procedure.
2. **NOTE:** This step is only necessary when installing a new component.  
Initialize the keyless vehicle module using the Programmable Modules Installation Routine.  
General Equipment: Ford Diagnostic Equipment
3. **NOTE:** This step is only necessary when installing a new component.  
Program all keys using the Key Programming Routine.  
General Equipment: Ford Diagnostic Equipment

## REMOVAL AND INSTALLATION

## Keyless Vehicle Front Antenna

## Removal

1. Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation).
- 2.



## Installation

1. To install, reverse the removal procedure.

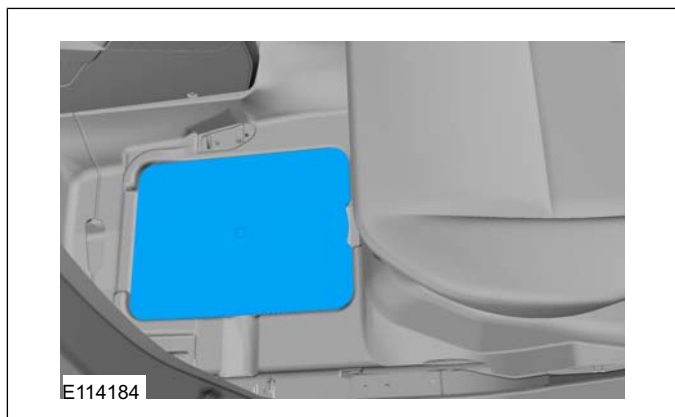
## REMOVAL AND INSTALLATION

## Keyless Vehicle Center Antenna

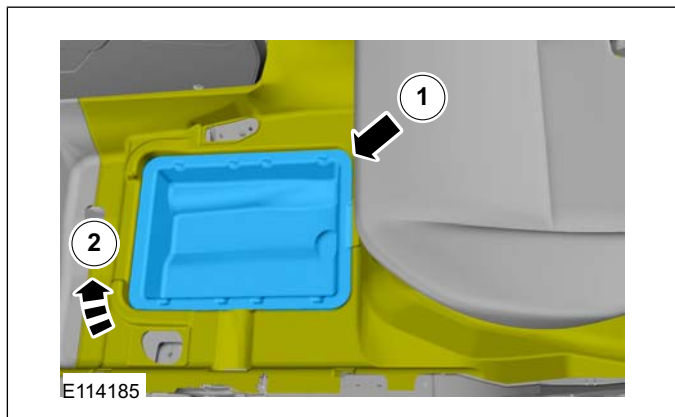
## Removal

1. Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
2. Refer to: **B-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

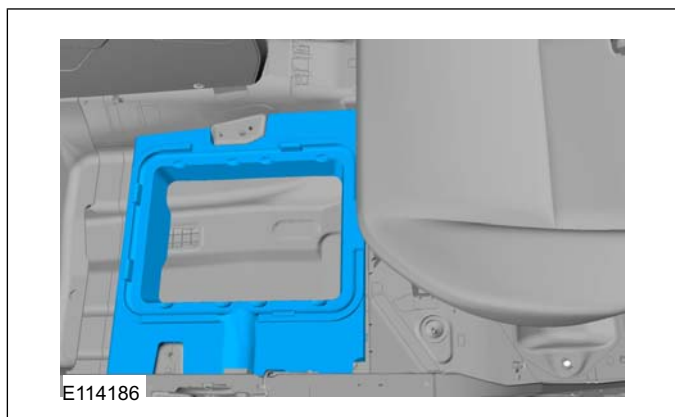
3.



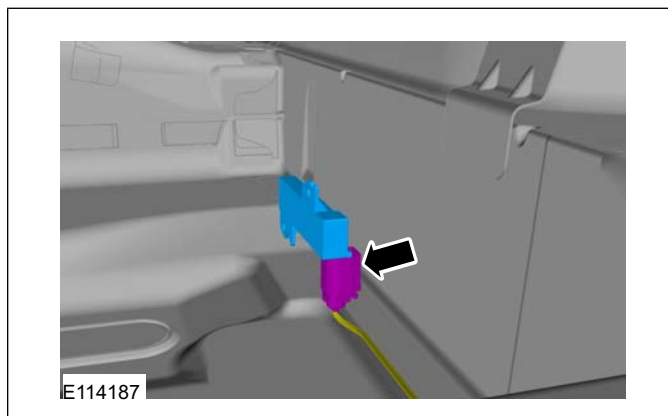
4.



5.



6.



## Installation

1. To install, reverse the removal procedure.

501-14-25

Handles, Locks, Latches and Entry Systems

501-14-25

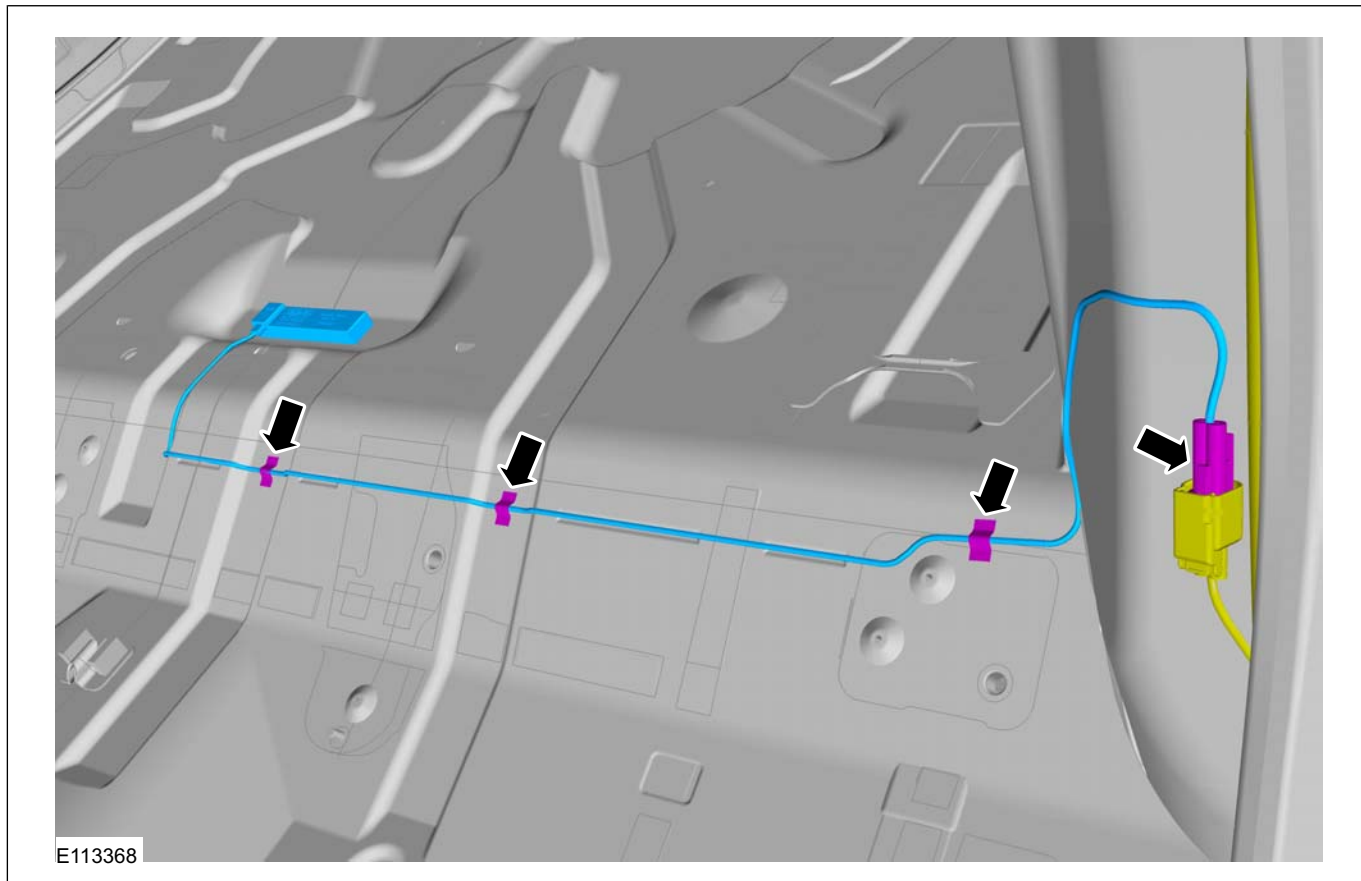
## REMOVAL AND INSTALLATION

## Keyless Vehicle Rear Antenna

## Removal

1. Refer to: **Loadspace Trim Panel LH** (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



## Installation

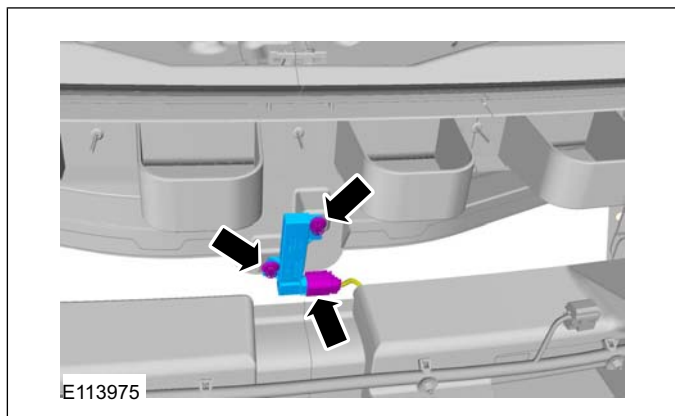
1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Keyless Vehicle Rear Bumper Antenna

## Removal

1. Refer to: **Rear Bumper Cover** (501-19 Bumpers, Removal and Installation).
- 2.



## Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

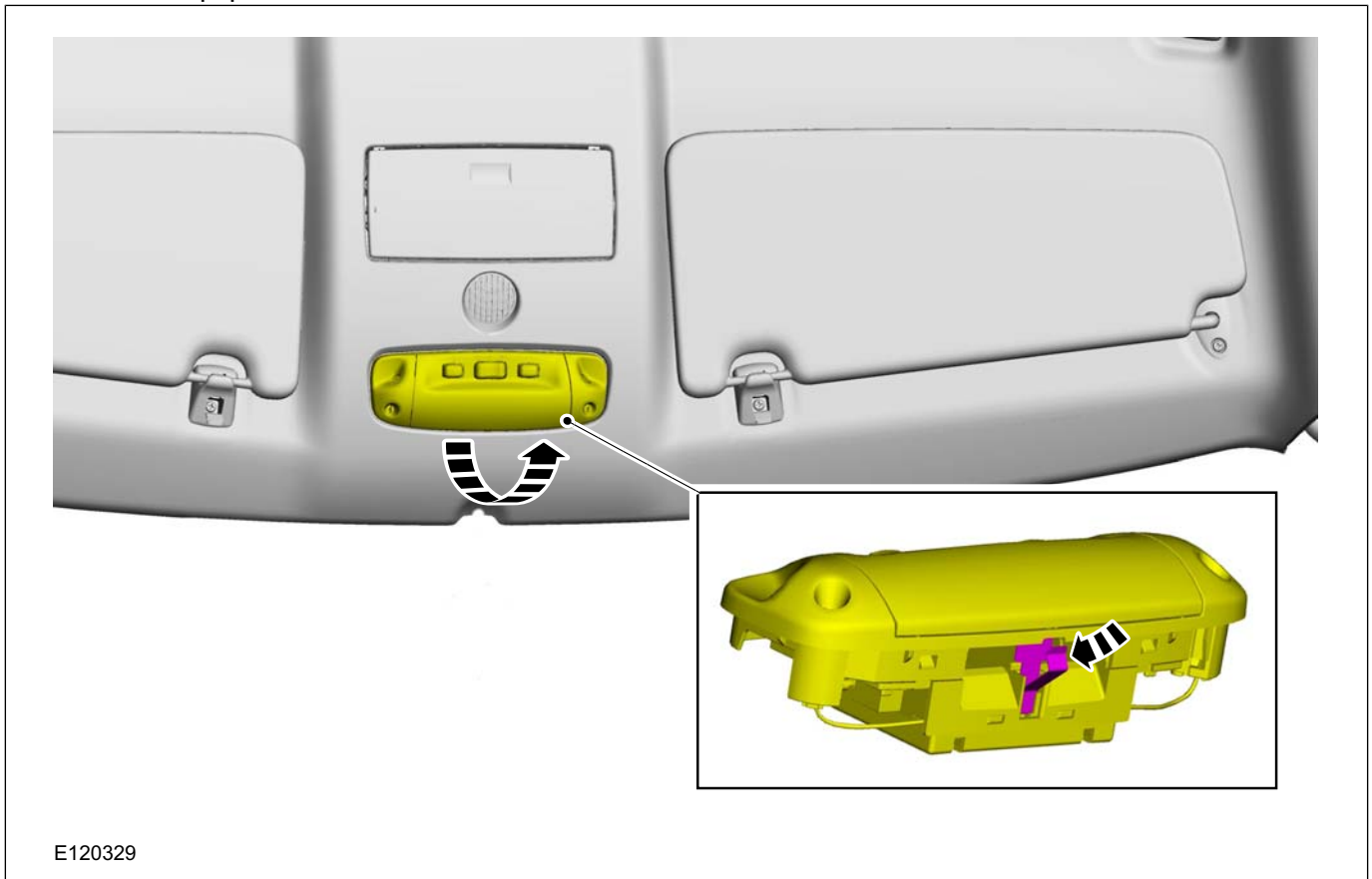
## Radio Frequency (RF) Receiver

## General Equipment

Flat-bladed screwdriver

## Removal

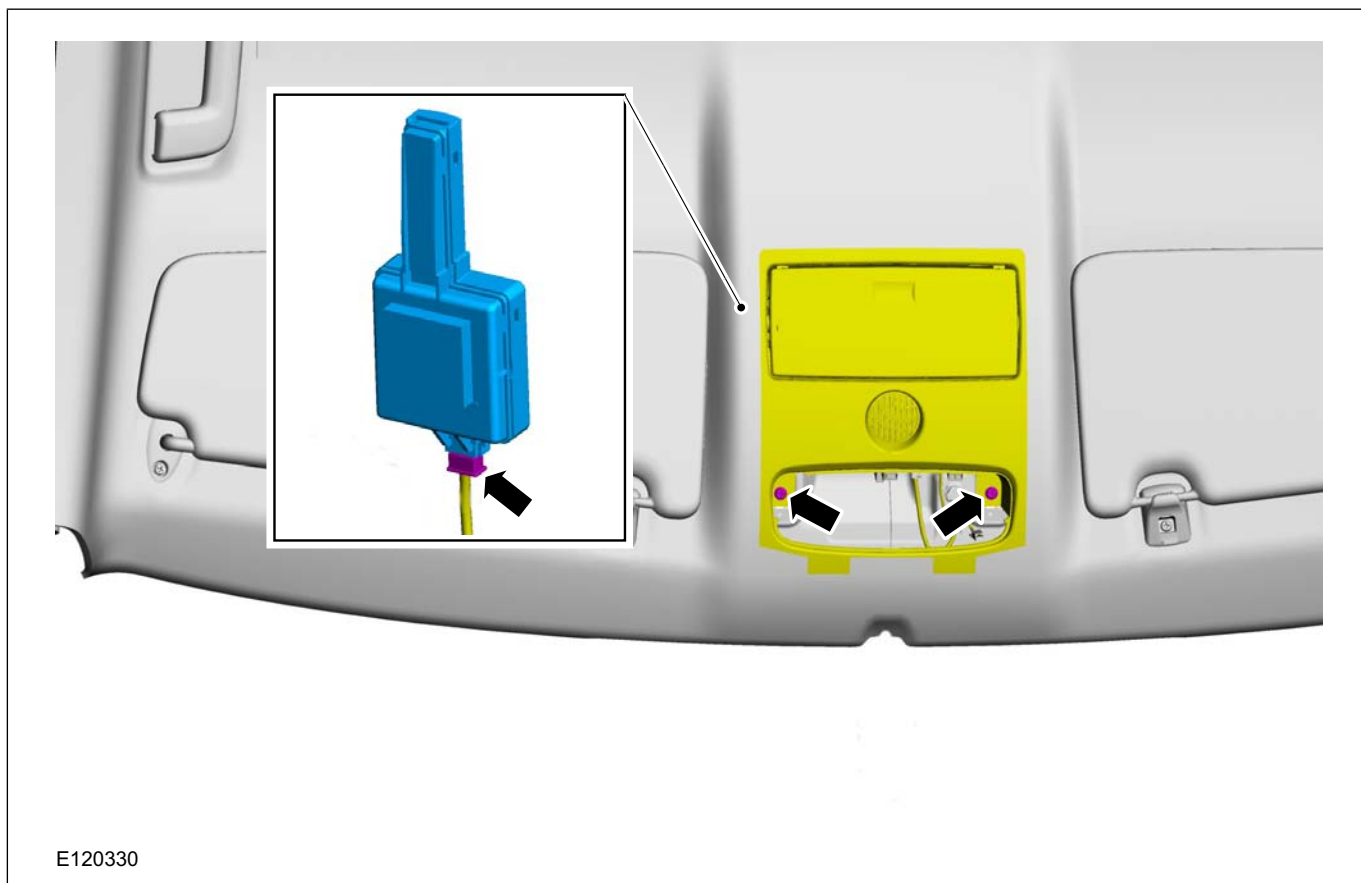
## 1. General Equipment: Flat-bladed screwdriver



## 2.



## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.

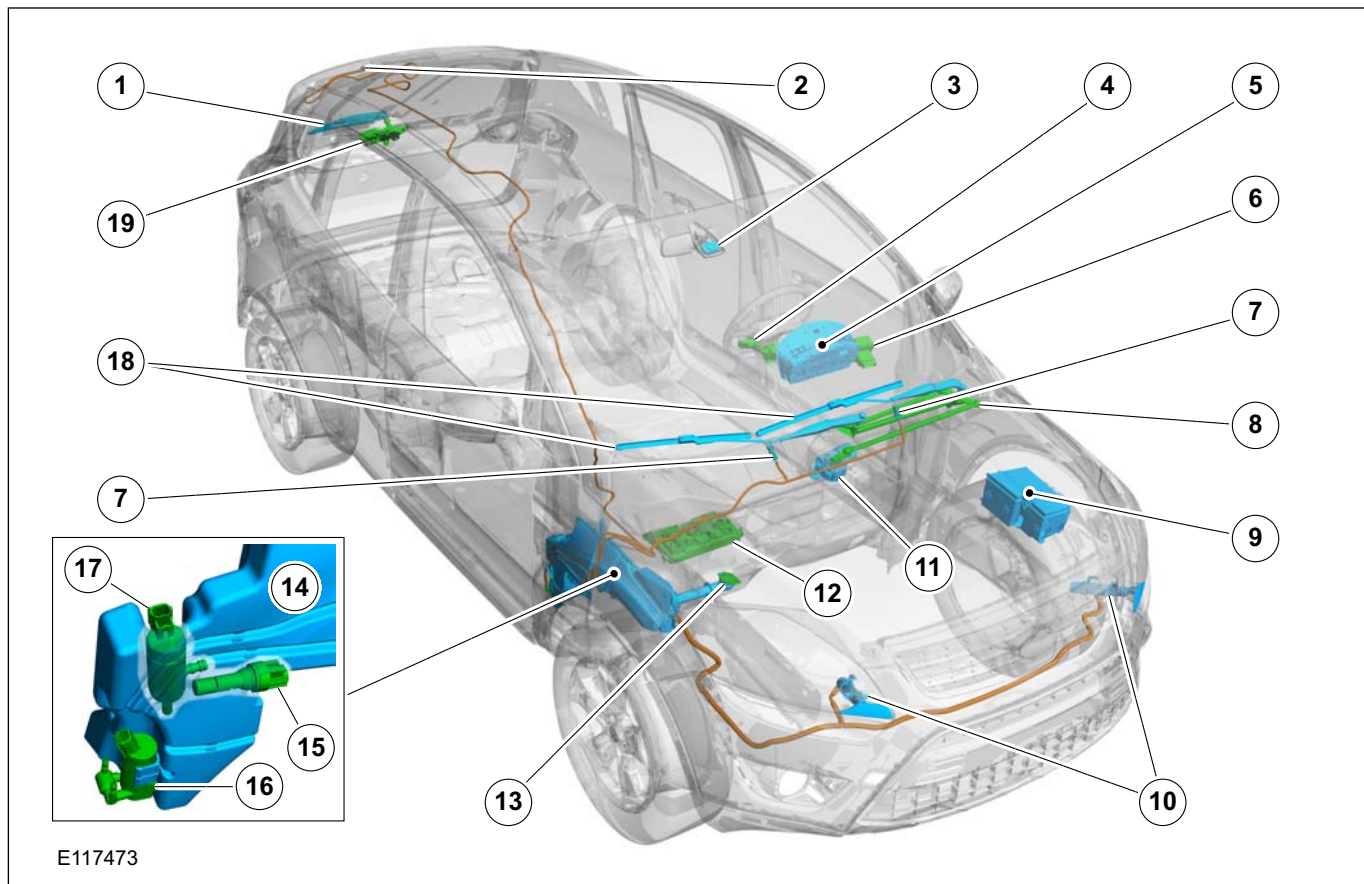
## SECTION 501-16 Wipers and Washers

**VEHICLE APPLICATION: 2008.50 Kuga**

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DESCRIPTION AND OPERATION

Wipers and Washers – Component Location



Item	Description
1	Rear windshield wiper
2	Rear window washer nozzle
3	Combined rain sensor/light sensor
4	Window wash/wipe switch, front and rear
5	Instrument Cluster
6	Light switch
7	Front window washer nozzle
8	Wiper linkage assembly
9	Fuse box - engine compartment

Item	Description
10	Headlamp washer nozzle
11	Front wiper motor
12	GEM (generic electronic module)
13	Windshield washer reservoir cap
14	Windshield washer reservoir
15	Sensor – window washer system fluid level
16	Window washer pump
17	Headlamp washer pump
18	Front wiper
19	Rear wiper motor

DESCRIPTION AND OPERATION

Wipers and Washers – Overview

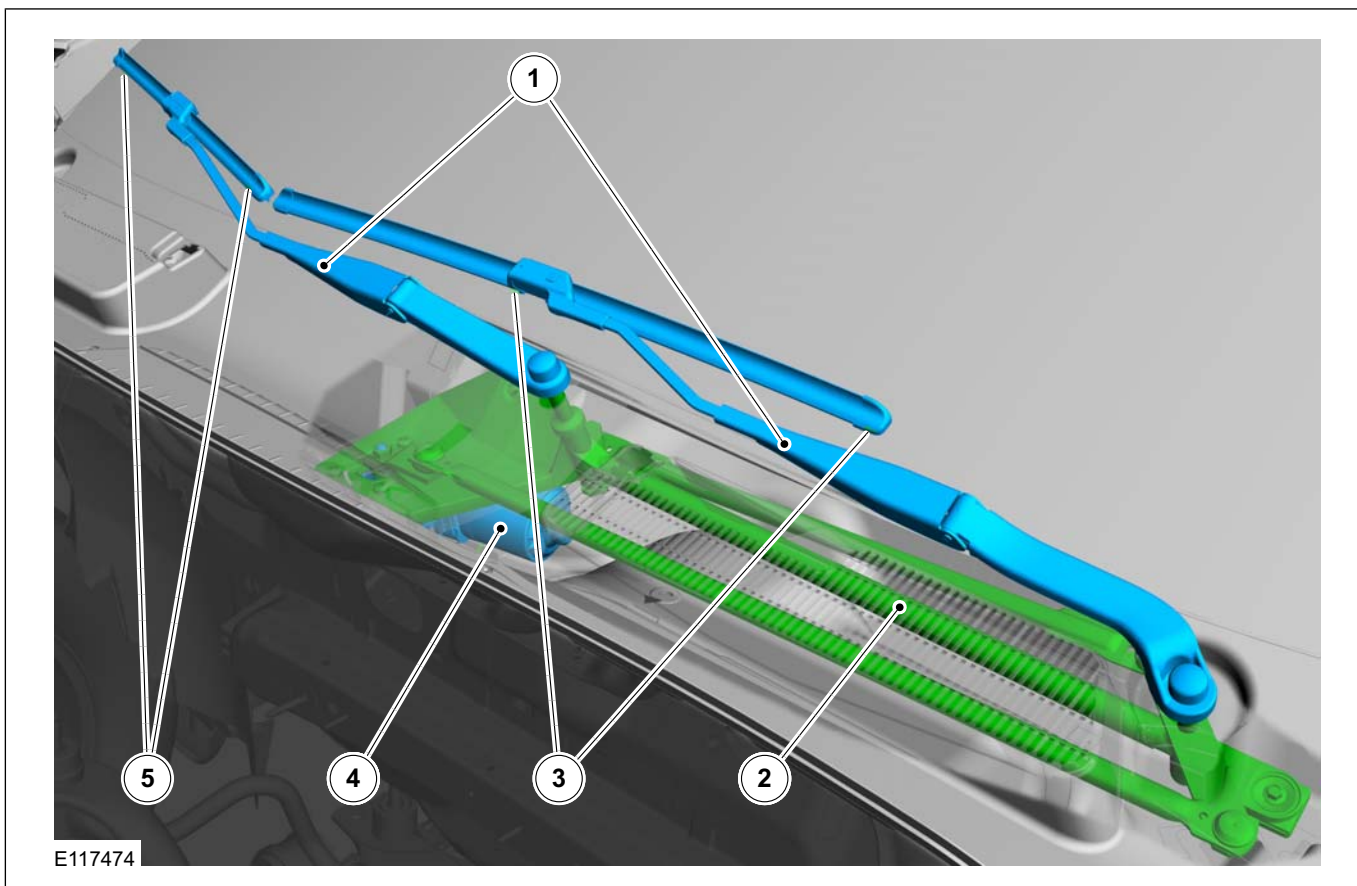
The windshield wash/wipe system is controlled by the GEM.

- reduced noise when operating
- improved wiping because of the reduced tendency to lift up at high vehicle speeds
- lower installed height

WINDSHIELD WIPERS

The front wiper blades are flat blades. These offer the following advantages over conventional wiper blades:

Front wiper



Item	Description
1	Wiper arms
2	Wiper linkage assembly

Item	Description
3	Home position markings, upper wiper arm
4	Front wiper motor
5	Home position markings, lower wiper arm

The home position markings show the correct position for assembly and removal of the **wiper arms**.

In order to remove and install the **wiper blades**, the windshield wiper arms must be run to their maintenance position (upper reversal point). To do this:

- Switch on the ignition
- Move the windshield wiper lever to position I.
- Switch off the ignition when the windshield wiper arms have reached the upper reversal point.

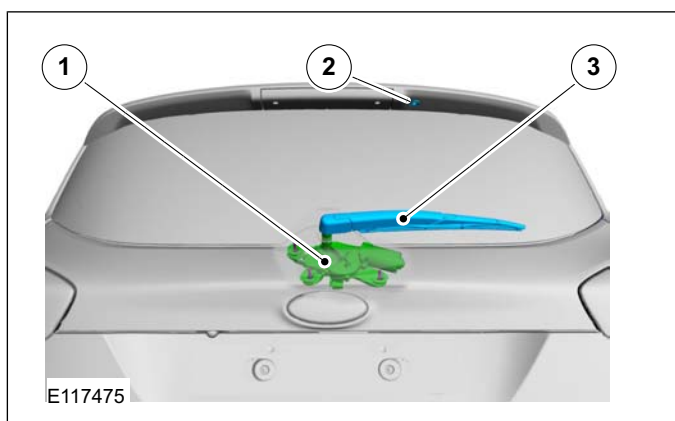
**DESCRIPTION AND OPERATION**

**Automatic wiper system**

Some models without a combined rain sensor/light sensor are equipped with a speed-dependent wiper interval for the front wipers.

If the vehicle is decelerated to walking speed or a standstill, then the system automatically changes to the next slower interval setting. If the speed is increased, the wiper speed returns to the manually selected setting. If the window wash/wipe switch is moved while the system is switched on then the system is switched off. If the vehicle is decelerated to walking speed or a standstill again, then the system is switched back on again.

**Rear windshield wiper**

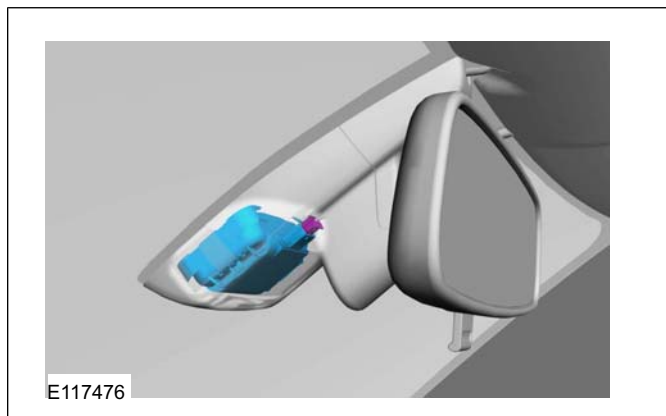


Item	Description
1	Rear wiper motor
2	Rear window washer nozzle
3	Rear windshield wiper

When reverse gear is engaged the rear wiper is automatically switched on if

- the rear wiper is switched off and
- the front wipers are switched on or
- if automatic wipe mode is selected and the front windshield wipers have been switched on by the rain sensor.

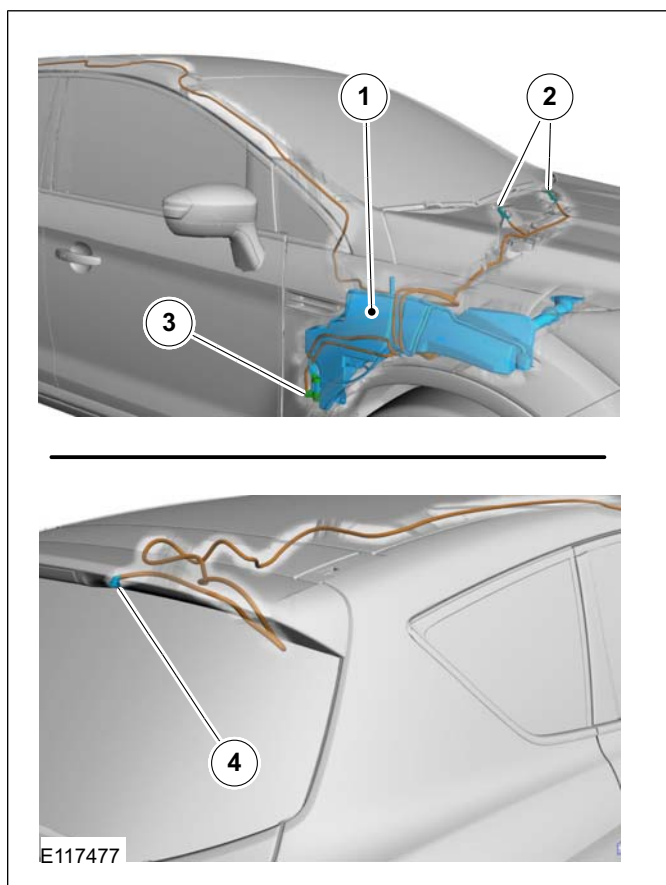
**Combined rain sensor/light sensor**



The rain sensor is built into a housing which is mounted behind the rear view mirror on the windshield.

The rain sensor evaluates optical conditions. Contamination such as oil, grease or dust will prevent correct operation. Before switching on the automatic wipe mode, the windshield must be clean in the area of the rain sensor.

**Windshield washer control**

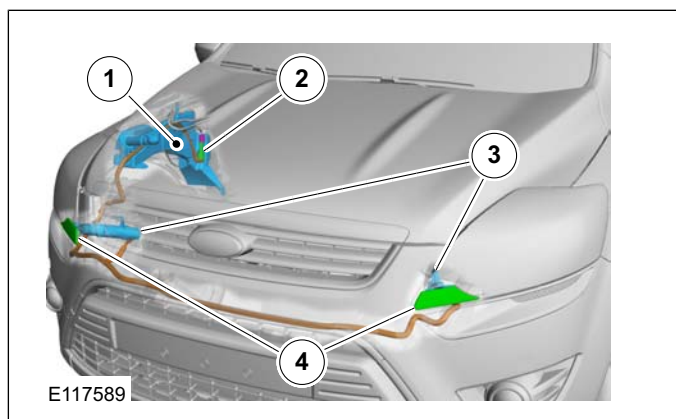




**DESCRIPTION AND OPERATION**

Item	Description
1	Windshield washer reservoir
2	Front washer jets
3	Window washer pump
4	Rear window washer nozzle

The front and rear window washer systems and the headlamp washer system are supplied from a shared washer reservoir. The window washer pump supplies both of the window washer systems at the front and rear.

**Headlamp Washers**

Item	Description
1	Windshield washer reservoir
2	Headlamp washer pump
3	Headlamp washer jets
4	Cover, headlamp washer nozzles

The headlamp washer system and the window washer systems are supplied from a shared washer reservoir.

If the headlamps are switched on then the headlamp washer system is switched on together with the front windshield washer system.

In order to prevent excessive water consumption, the headlamp washer system is only activated again

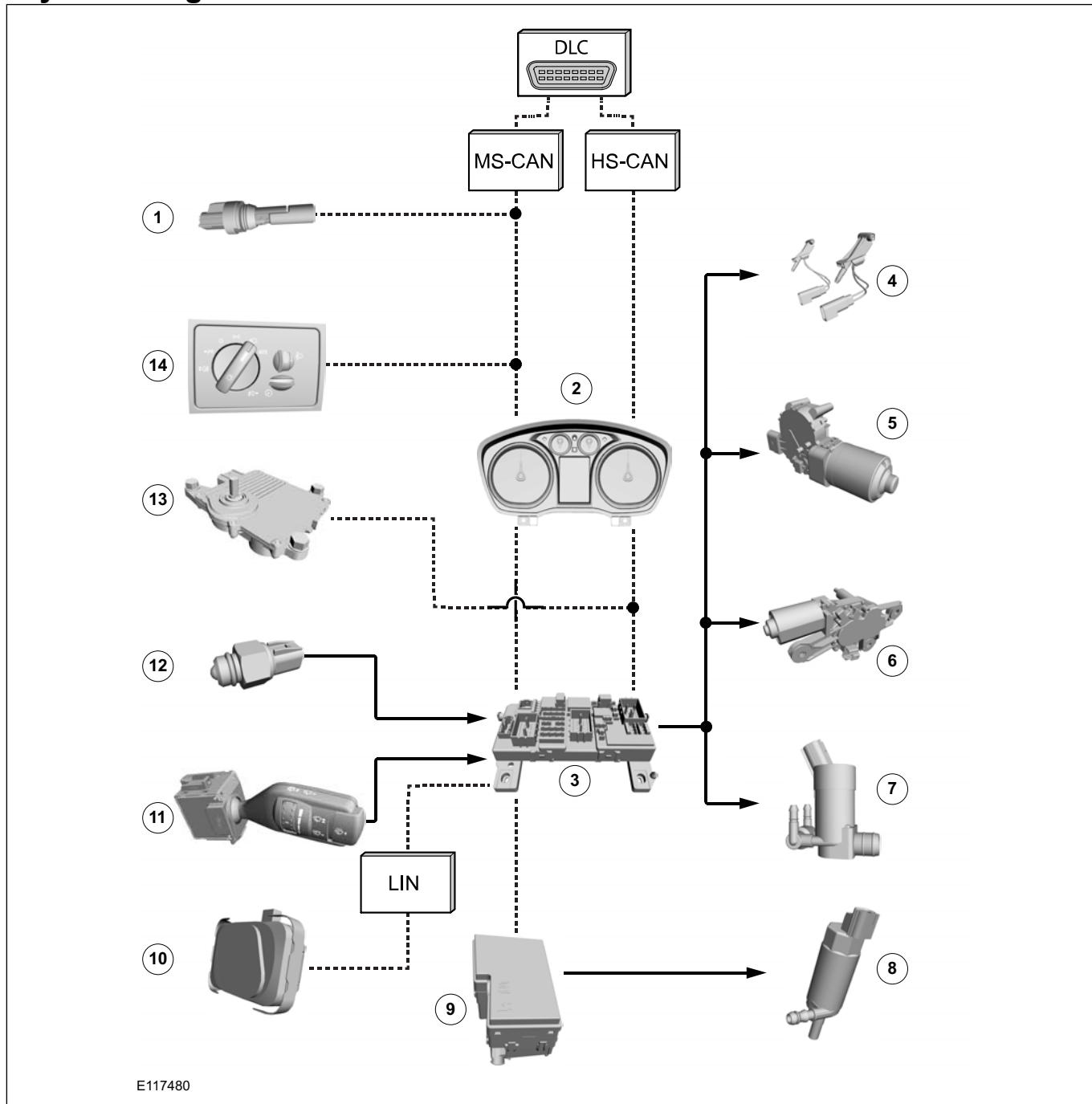
- every fourth time the window wash/wipe switch is operated within 10 minutes of it first being activated, or
- if 10 minutes have passed since the first activation and the window wash/wipe switch is operated. The timer is then restarted.



DESCRIPTION AND OPERATION

Wipers and Washers – System Operation and Component Description

System Diagram



E117480

Item	Description
1	Sensor – window washer system fluid level
2	Instrument Cluster
3	GEM
4	Heated window washer nozzles, front

Item	Description
5	Front wiper motor
6	Rear wiper motor
7	Window washer pump
8	Headlamp washer pump

**DESCRIPTION AND OPERATION**

Item	Description
9	EJB (engine junction box)
10	Combined rain sensor/light sensor
11	Window wash/wipe switch, front and rear

Item	Description
12	Reverse switch
13	TCM (transmission control module)
14	Light switch

**System Operation**

The windshield wash/wipe system is controlled by the GEM. To do this, the GEM primarily uses the signal from the window wash/wipe switch.

Secondary signals include the signals from the combined rain sensor/light sensor and the reverse gear switch (vehicles with manual transmission) or the TCM (vehicles with automatic transmission).

**Front wiper / washer system**

The front windshield wash/wipe system will only run if the ignition is switched on.

Four wipe functions are available:

- single wipe
- intermittent wipe or automatic wipe (depending on the vehicle specification)
- normal wipe
- fast wipe speed

The position of the window wash/wipe switch is transmitted to the GEM. The GEM then controls the wiper motor via relays and sets the wiper speed.

Normal wipe speed remains available in the event of failure of the GEM.

The wiping functions work as follows:

- Flick wipe
  - If short wipe is requested, the GEM activates a relay until the request is cancelled. The front windshield wiper wipes at normal speed. See wiping function - "Normal speed".
- Normal speed
  - If normal speed wiping is requested, the GEM activates a relay. This applies a voltage to the switching contacts of a second relay. This second relay controls normal and high-speed wiping. For normal speed the second relay remains switched off. The voltage is fed through the second relay to the window wiper motor brush contacts for normal speed.
- High speed
  - If high speed wiping is requested, the GEM activates both relays. The activated first relay

conducts the current to the switching contacts of the second relay. The activated second relay conducts the voltage to the window wiper motor brush contacts for high speed.

- Wiper off position
  - If intermittent wiping is requested, the GEM activates and deactivates the first relay at the required interval according to the rotary switch position. The second relay stays switched off.
  - Time interval at level 1 = 1 second
  - Time interval at level 2 = 3.5 seconds
  - Time interval at level 3 = 6 seconds
  - Time interval at level 4 = 9.5 seconds
  - Time interval at level 5 = 15.5 seconds
  - Time interval at level 6 = 22 seconds
- Auto
  - With this wiping function, the GEM uses the LIN (local interconnect network) signals from the rain sensor. The rain sensor supplies LIN signals with values of between 0 and 7. Refer to the rain sensor component description for details.

If the GEM fails, normal speed and a wiping interval of 3.5 seconds are available.

When the front windshield washer system is operated, the GEM activates the front windshield washer system relay. The windshield washer pump is supplied with power. The ground connection for the washer pump is provided by the deactivated rear window washer system relay. Both relays are integrated into the GEM. The GEM delays wiper operation for 100 ms after operation of the window wash/wipe switch. If the window wash/wipe switch is not held in the "on" position for at least 100 ms, then the GEM does not switch on the wiper. The GEM activates the windshield wiper for as long as the windshield washer system switch is operated. The windshield washer pump is switched off after 10 seconds. When the switch is released, the GEM allows the windshield wiper to wipe a further 2 or 3 times.

This additional wiping function allows the front wiper blades to wipe once for 4 seconds after the

**DESCRIPTION AND OPERATION**

last wiping movement to remove any remaining water from the windshield.

The additional wiping function is activated if:

- the windshield wipers are off when the front windshield washer system is operated
- the windshield wipers are set to intermittent mode and have not wiped in the last 4 seconds

The controller for returning the windshield wipers to their home position is integrated into the front windshield wiper motor. This ensures that the windshield wiper motor is returned to its home position if the windshield wiper is switched off before completing a wiping movement.

**Rear windshield wash/wipe system**

The rear windshield wash/wipe system will only run if the ignition is switched on.

The front and rear windshield wash/wipe systems use a shared window washer pump and cannot be used simultaneously.

Depending on the wiper speed of the front wipers, the rear wipers run with a delay interval of 6 seconds, 10 seconds or continuously. The time interval is controlled by the GEM.

The rear windshield wiper is switched on if:

- the window wash/wipe switch is in the 'rear wiper' position
  - The GEM actuates the rear window wiper motor. The windshield wiper runs in intermittent mode.
- the rear windshield washer system is operated
  - The GEM switches on the rear window washer system. The windshield washer pump is supplied with power. Reversing the polarity of the pump enables the washing fluid to flow to the rear washer jets instead of the front washer jets. The GEM activates the windshield wiper for as long as the windshield washer system switch is operated. The window washer pump is switched off after a maximum of 10 seconds. When the switch is released, the GEM allows the windshield wiper to wipe a further 2 or 3 times.
- the signal "Reverse gear engaged" is received from the reverse gear switch or from the TCM and the front window wash/wipe switch is in the position for normal or fast wipe speed, or it is

set to automatic wipe or intermittent wipe at high speed.

- The GEM actuates the rear wiper motor until the gear lever is moved to neutral.

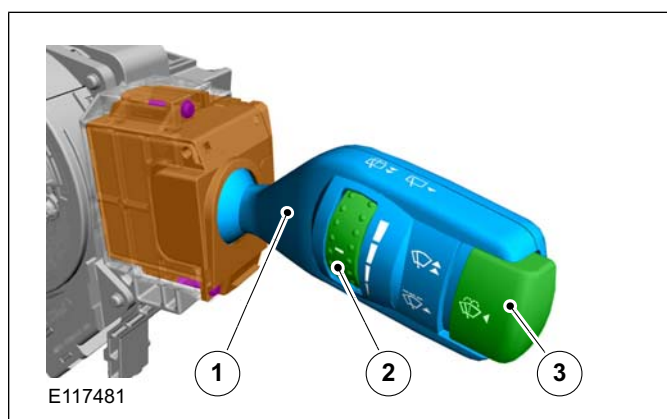
**Headlamp washer system**

The headlamp washer system is only active when the windshield washer system is operated, if the headlamps are on at the same time (dipped beam). The dipped beam can be selected using the light switch or the "automatic driving light" function. Electrical control is performed by the R9 relay. The relay is controlled by the GEM.

If the sensor for the window washer system fluid level reports that the fill level in the window washer reservoir is low, then the headlamp washer pump can no longer be activated until the washer reservoir has been topped up again. At the same time, "window washer fluid level low" is displayed on the instrument cluster.

**Component Description****Switch, wash/wipe system**

The window wash/wipe switch is a simple electrical switch which is inserted into the steering wheel module.



Item	Description
1	Switch, wash/wipe system
2	Window wiper rotary switch
3	Windshield washer switch

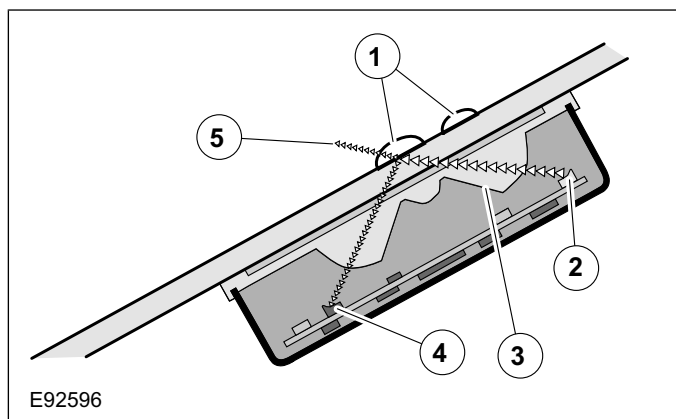
Switches and switch positions:

**DESCRIPTION AND OPERATION**

- Switch, wash/wipe system
  - One-touch function downwards for single front wipe
  - 3 fixed positions upwards for front intermittent wipe/automatic wipe, normal wipe, fast wipe
  - Fixed position towards the steering wheel for rear intermittent wipe
  - One-touch function beyond the fixed position towards the steering wheel for the rear washer system
- Window wiper rotary switch
  - 6 fixed switch positions for wiper interval delays/rain sensor sensitivity. The switch positions start from 1 (wide symbol) at the upper end point and end with 6 (narrow symbol) at the lower end point
- Windshield washer switch
  - One-touch function for front washer system

**Rain Sensor**

The sensor contains a number of transmitter and receiver diodes which emit and receive infrared light. By comparing the received signal with the known transmitted signal, the rain sensor can determine the moisture on the outside of the windshield and request that the windshield wipers are switched on.



Item	Description
1	Raindrop
2	LED <b>Comments:</b> (transmitter diode)
3	Lens

Item	Description
4	Photodiode <b>Comments:</b> (receiver diode)
5	Light loss due to deflection

The LED emits a beam of light with a known intensity. The emitted beam emerges through the lens and is then reflected by the windshield.

The reflected light beam enters back through the lens and then reaches the photodiode. The corresponding value taken without moisture on the windshield is used as the reference value for automatic calibration.

Subsequent deviations from this value cause the windshield wipers to be switched on.

If precipitation falls on the windshield, part of the light beam is deflected. This reduces the intensity of the light reflected by the windshield. This loss of intensity is detected by the photodiode and is reported by a LIN signal to the GEM.

When the automatic wipe function is switched on (wiper lever to intermittent wipe position), the wipers are only activated automatically if the rain sensor registers water on the windshield.

The sensitivity of the rain sensor can be changed by adjusting the window wiper rotary switch.

- Rotary switch at upper end point: High sensitivity
  - The wipers wipe even if only a small amount of water has been measured on the windshield.
- Rotary switch at lower end point: Low sensitivity
  - The wipers only wipe if a large amount of water has been measured on the windshield.

The rain sensor is self-calibrating.

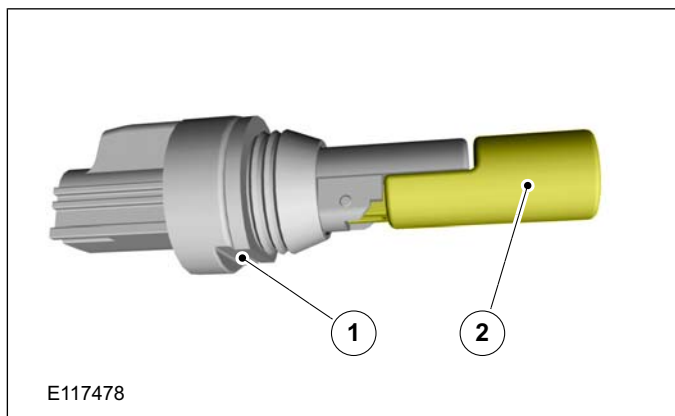
The rain sensor supplies LIN signals with values of between 0 and 7 to the GEM.

Meaning of signals from rain sensor:

- Signal "0": Windshield is dry
- Signal "1-5": Windshield is damp. The GEM activates normal wiping.
- Signal "6-7": Windshield is receiving severe precipitation. The GEM activates high speed wiping for as long as the signal value is greater than 4.

**DESCRIPTION AND OPERATION****Sensor, window washer system fluid level**

The window washer system fluid level sensor is connected directly to the instrument cluster. The instrument cluster sends the signal via CAN (controller area network) to the GEM.



Item	Description
1	Flat
2	Float

The window washer system fluid level sensor consists of the sensor housing and an articulated float. The float contains a permanent magnet. If the float moves down, the circuit in the sensor housing is closed to ground.

A flat on the switch housing helps to correctly locate the switch.

**Front wiper motor**

The front windshield wiper motor is a DC motor with 3 brush type contacts. One brush type contact is for ground and one is for normal wiping speed. The third brush type contact is activated for high wiping speed.

The integrated home switch is connected directly to the GEM. The home switch contacts are open in all wiper motor positions except the home position. When the home switch contacts are open, the wiper motor remains switched on even if a LIN signal from the steering wheel module requests that the wipers stop. In home position, the home switch contacts create a ground connection. The GEM recognizes this ground connection and switches the wiper motor off.

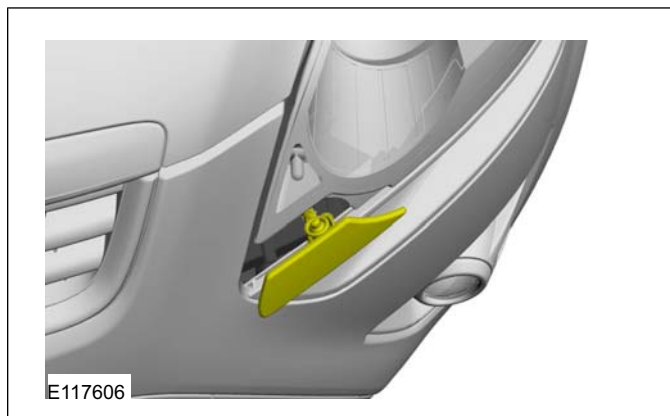
**Rear wiper motor**

The rear windshield wiper motor is a DC motor with 2 brush type contacts. It is controlled by a voltage supply.

The integrated home switch is connected directly to the GEM. The home switch contacts are closed in all wiper motor positions except the home position. When the home switch contacts are closed, the wiper motor is supplied with voltage by the GEM. When the wiper motor reaches the home position, the home switch contacts are opened and the voltage supply is interrupted by the GEM. While the window wash/wipe switch remains in the "rear washer" position, the wiper motor is again supplied with a voltage by the GEM and continues to run. This process is repeated at each revolution of the motor.

**Heated window washer nozzles, front**

The GEM activates the heated window washer nozzles as soon as the ignition is switched on.

**Headlamp washer jets**

The washer jets are operated hydraulically. The headlamp washer pump creates a positive pressure when operated. This positive pressure enables the headlamp washer jets to extend and spray.

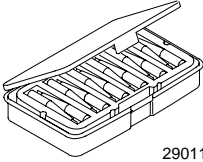


## DIAGNOSIS AND TESTING

## Wipers and Washers

Refer to Wiring Diagrams Section 501-16, for schematic and connector information.

**Special Tool(s) / General Equipment**

 <p>29011A</p>	<p>Terminal Probe Kit 29-011A</p>
<p>Digital multimeter</p>	
<p>The Ford approved diagnostic tool</p>	

**Description of operation**

A diagnosis of the generic electronic module (GEM) can be performed with the Ford approved diagnostic tool. Furthermore, an integrated service mode enables testing of the input and output signals without the need for further tools. To enable activation of service mode:

- switch off the ignition,
- switch off all other electrical consumers,
- apply the handbrake,
- shift to neutral
- and close the doors.

**Activating the service mode**

Proceed as follows to activate the service mode:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- Turn on the ignition.
- RELEASE the switch of the heated rear window

A signal sounds and the turn signal lamps come on to indicate that service mode has been successfully activated.

**NOTE:** If the alarm is activated (in vehicles fitted with an anti-theft alarm system), service mode cannot be activated.

**Inputs**

SWITCH the windshield wiper switch to the "Off" position to test the input signals. The following is a list of the switch signals to be tested, in no particular order:

- Turn signals (right, left, hazard warning lights)
- Windshield wiper stage I
- Windshield wiper stage II
- Windshield washer system
- Rear window wiper
- Rear window washer system
- Doors open/closed
- Remote control for central locking with double locking
- Hood open/closed (in vehicles equipped with an anti-theft alarm system)
- Tailgate open/closed
- A/C request signal
- Heated windscreen (if fitted)
- Parking Brake
- Brake reservoir fluid level
- Speed control system
- Autolamps
- Low beam
- High beam
- Headlamp flasher
- Marker Lamps
- Reversing lamp
- Liftgate release
- Ignition switch, terminal 15 (turn key to 0 position, then turn key to II position.)

An acoustic signal sounds and the turn signal lamps flash to indicate receipt of each input signal by the generic electronic module.

**Test the windshield wiper "intermittent mode" stage input signal (only vehicles with adjustable intermittent mode)**

The windshield wiper switch must be switched to "intermittent mode" in order to test the input signal. The delay times of the input signals can then be tested by operating the rotary switch. Each change of the rotary switch position is indicated by an acoustic signal and illumination of the turn signals.

**Output signals**

SWITCH the wiper switch to the "intermittent" position to test the output signals. PRESSING the heated rear window switch activates the output signals in the following order:

- a. Turn Indicator Left Hand
- b. Turn Indicator Right Hand



**DIAGNOSIS AND TESTING**

- c. High beam
- d. Low beam
- e. Windshield wiper stage I
- f. Windshield wiper stage II
- g. Heated rear window
- h. Heater blower motor
- i. Headlamp washer system (vehicles with gas discharge headlamps)
- j. Electric booster heater (if fitted)
- k. Autolamps (if fitted)
- l. Alarm horn (vehicles with alarm system)
- m. Rear window wiper
- n. Rear heated window relay

When the heated rear window switch is pressed again, the test of the relevant signal is terminated. When the heated rear window switch is pressed once more, the test for the next signal in the list is started.

**Ending the service mode**

The GEM automatically ends service mode 20 seconds after the last input or at a driving speed of over 7km/h. However, service mode can be manually ended at any time by proceeding as follows:

- OPERATE the switch of the heated rear window and HOLD IT THERE
- SWITCH OFF the ignition
- RELEASE the switch of the heated rear window

3 signals sound and the turn signal lamps illuminate to indicate that service mode has ended.

**Reset service mode**

If, after completion of service mode, some functions do not operate or do not operate properly, check the following functions:

- Instrument cluster illumination, side lamps and license plate lamp in autolamps mode
- Rear wiper
- Headlamp Washers
- Electric booster heater
- Active anti-theft sounder
- Heated windshield

If one or more of the listed functions is not OK, it's possible that the cause of the fault is due to not exiting service mode properly. To reactivate the functions correctly, perform the following steps:

1. SWITCH OFF the ignition

2. SWITCH OFF the switch for the windscreen wash/wipe system
3. OPERATE the switch of the heated rear window and HOLD IT THERE
4. Turn on the ignition.
5. RELEASE the heated rear window switch (an acoustic signal will sound if activation has been performed correctly)
6. SWITCH the windscreen wash/wipe switch to the "Intermittent wipe" position
7. OPERATE the heated rear window switch 6 times (the main beam headlamps switch on and off automatically)
8. SWITCH OFF the switch for the windscreen wash/wipe system
9. OPERATE the switch of the heated rear window and HOLD IT THERE
10. SWITCH OFF the ignition
11. RELEASE the heated rear window switch (three acoustic signals will sound if activation has been performed correctly)

After completion of the work, check all the functions.

**Inspection and Checking**

**NOTE:** The generic electronic module (GEM) forms part of the central junction box (CJB).

**NOTE:** If the generic electronic module (GEM) is changed, the new one must be reinitialized. For this purpose, the vehicle-specific data is read out of the module to be replaced using the Ford approved diagnostic tool and is transferred to the new module.

REFER to: **Communications Network** (418-00 Module Communications Network, Diagnosis and Testing).

**NOTE:** Before reading out the vehicle-specific data, remake all the electrical connections to the module to be removed, so that communication between the module and the Ford approved diagnostic tool is ensured.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical and electrical damage:

**NOTE:** Ensure correct engagement of the wiring harness connectors.

**DIAGNOSIS AND TESTING****Visual Inspection Chart**

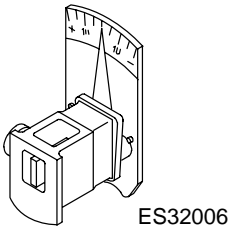
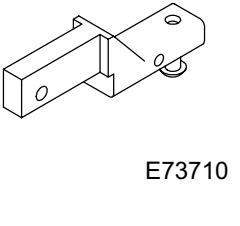
<b>Mechanical</b>	<b>Electrical</b>
<ul style="list-style-type: none"> <li>• Wiper blade(s)</li> <li>• Wiper arm shaft</li> <li>• Washer reservoir</li> <li>• Hose(s)</li> <li>• Nozzles</li> <li>• Check the passenger-side wiper blade for residue-free wiping in the vicinity of the rain sensor.</li> <li>• Check the adhesive pad between the rain sensor and the windshield for trapped air.</li> <li>• Clean wax residues from the windshield in the vicinity of the rain sensor.</li> <li>• Check the windshield for damage/cracks in the vicinity of the rain sensor.</li> <li>• Check that the rain sensor retaining frame is correctly attached to the windshield.</li> </ul>	<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Connectors</li> <li>• Wiring harness</li> <li>• Washer pump motor</li> <li>• Headlamp cleaning system pump</li> <li>• Headlamp cleaning system relay</li> <li>• Front/rear window wiper motor</li> <li>• Wash/wipe system switch</li> <li>• Central junction box (CJB):</li> <li>• Battery junction box (BJB)</li> </ul>

3. Resolve any obvious causes or concerns found during the visual inspection before carrying out any further tests.
4. If the concern persists after the visual inspection, **PERFORM** a fault diagnosis on the generic electronic module (GEM) using the Ford approved diagnostic tool and **RESOLVE** the fault(s) displayed according to the fault description. **CHECK** the operation of the system.
5. On a vehicle without stored fault(s), continue according to the Symptom Chart and the corresponding symptom.
6. After checking or rectifying the fault(s) and finishing the work, **READ OUT** the fault memory in the generic electronic module (GEM) and **DELETE** any saved faults. After performing a road test and **CHECKING** the system, **READ OUT** the fault memories again.

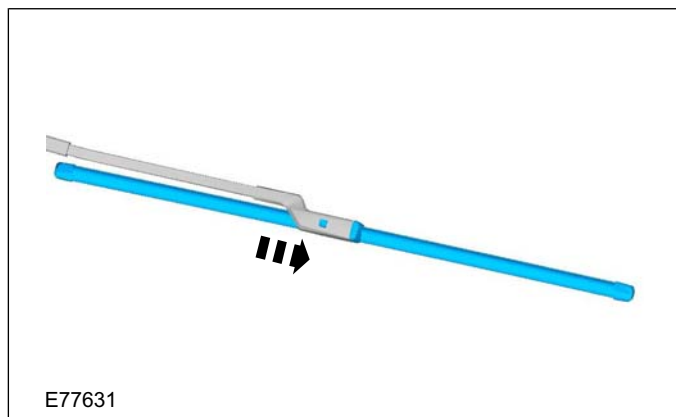
GENERAL PROCEDURES

Wiper Blade Angle Adjustment

Special Tool(s)

 <p>ES32006</p>	<p>501-027 Aligner, Wiper Arm</p>
 <p>E73710</p>	<p>501-027-01 Adapter for 501-027</p>

1. **CAUTION:** Make sure that the motor is in the park position.

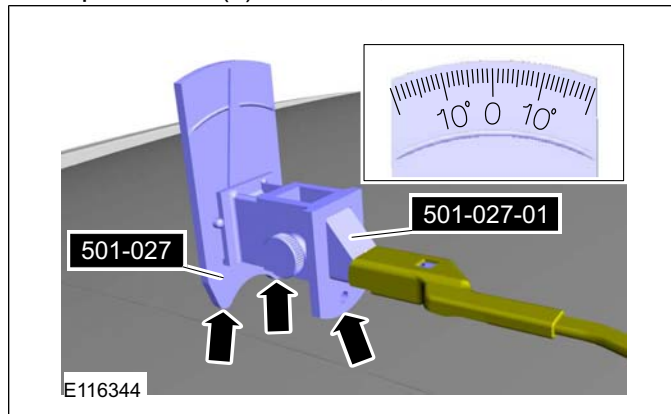


2. **NOTE:** The angle of the wiper on the scale must point from the zero center line to the center of the windshield/rear window. Ignore the sign (+/-) on the alignment tool.

**NOTE:** Make sure that the 3 marked points of the special tool are in contact with the glass.

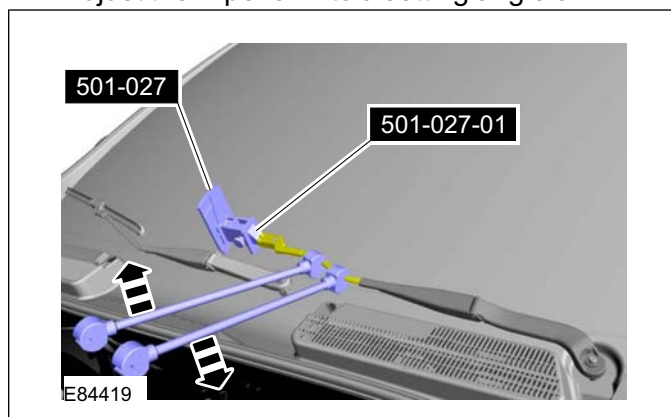
Using the special tool, read off the angle between the wiper arm and the glass.

Special Tool(s): 501-027, 501-027-01

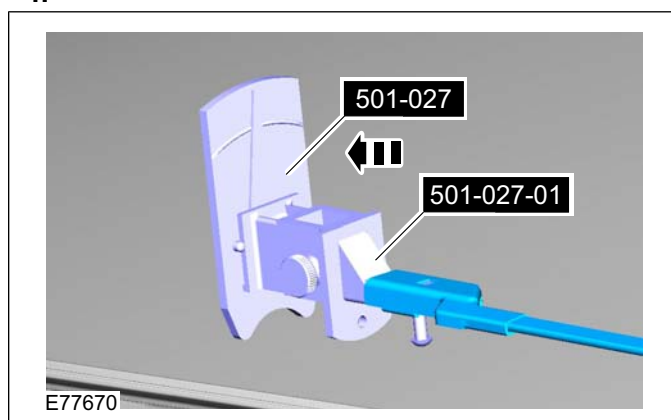


3. **CAUTION:** Make sure that the special tool is lifted off the glass when adjusting the angle.

Adjust the wiper arm to a setting angle of  $4^{\circ} \pm 2^{\circ}$ .



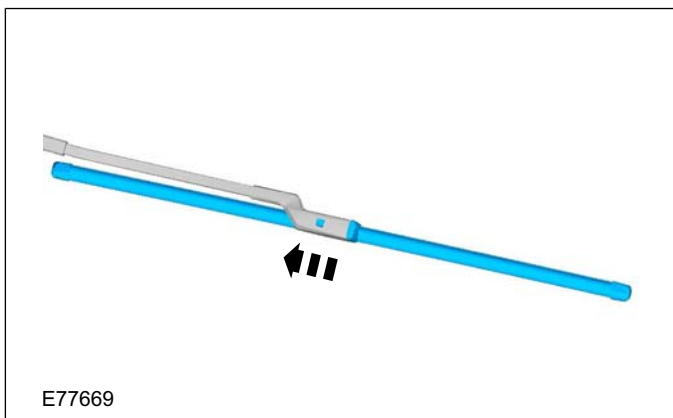
- 4.





GENERAL PROCEDURES

5.



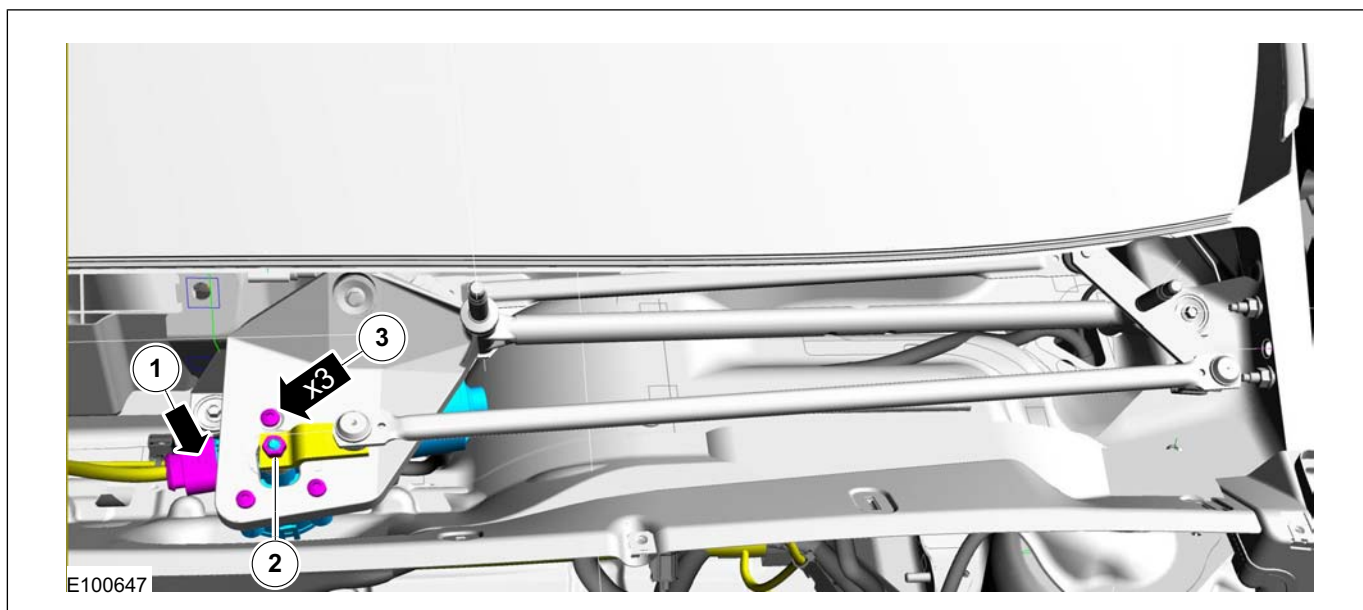
## REMOVAL AND INSTALLATION

## Windshield Wiper Motor

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.



1. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
- 2.



## Installation

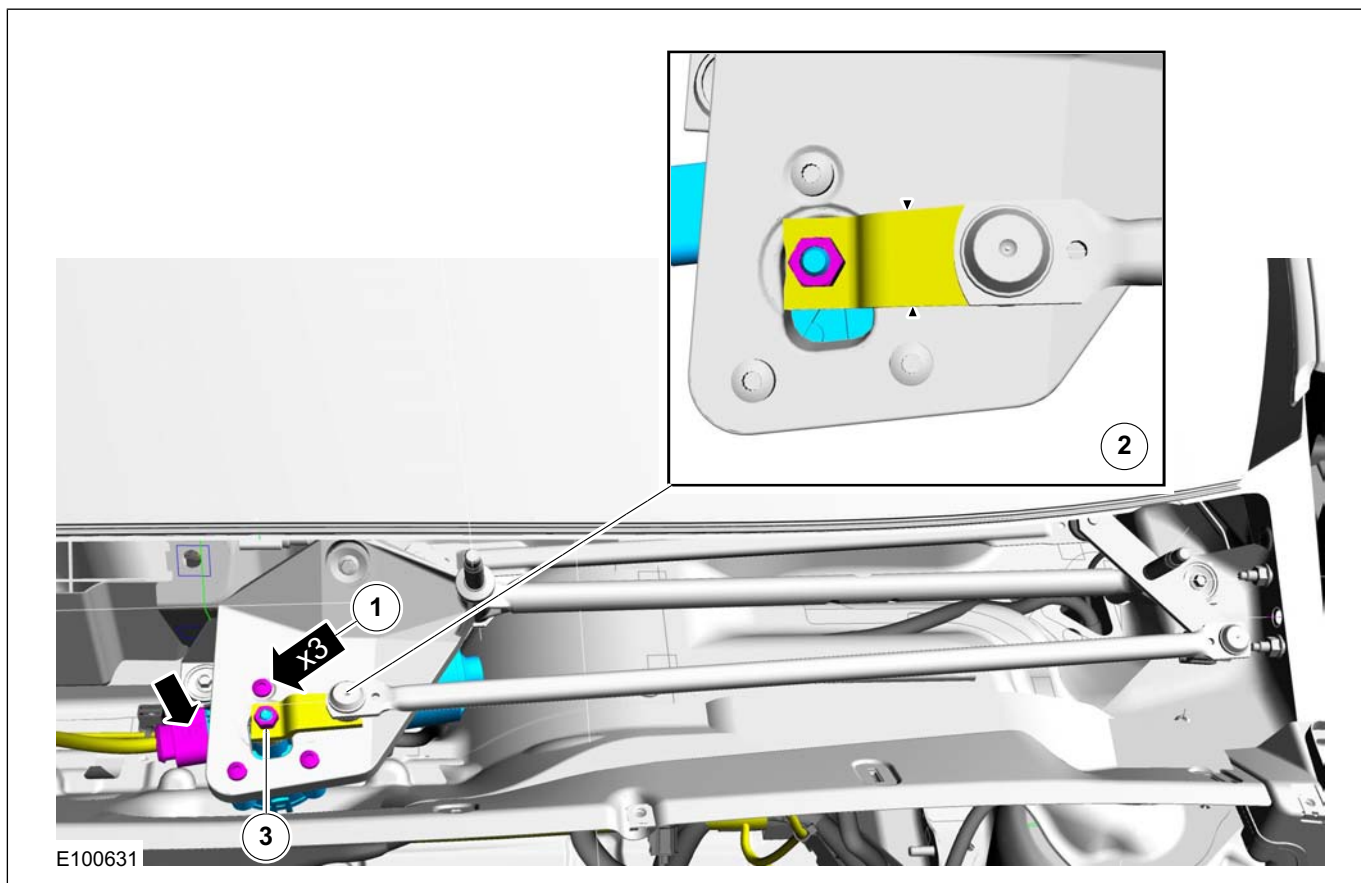
1. Torque: 9 Nm

2. **CAUTIONS:**

-  **Make sure that the motor is in the park position.**
-  **Make sure that the installation marks are aligned.**

3. Torque: 18 Nm

## REMOVAL AND INSTALLATION



2. To install, reverse the removal procedure.



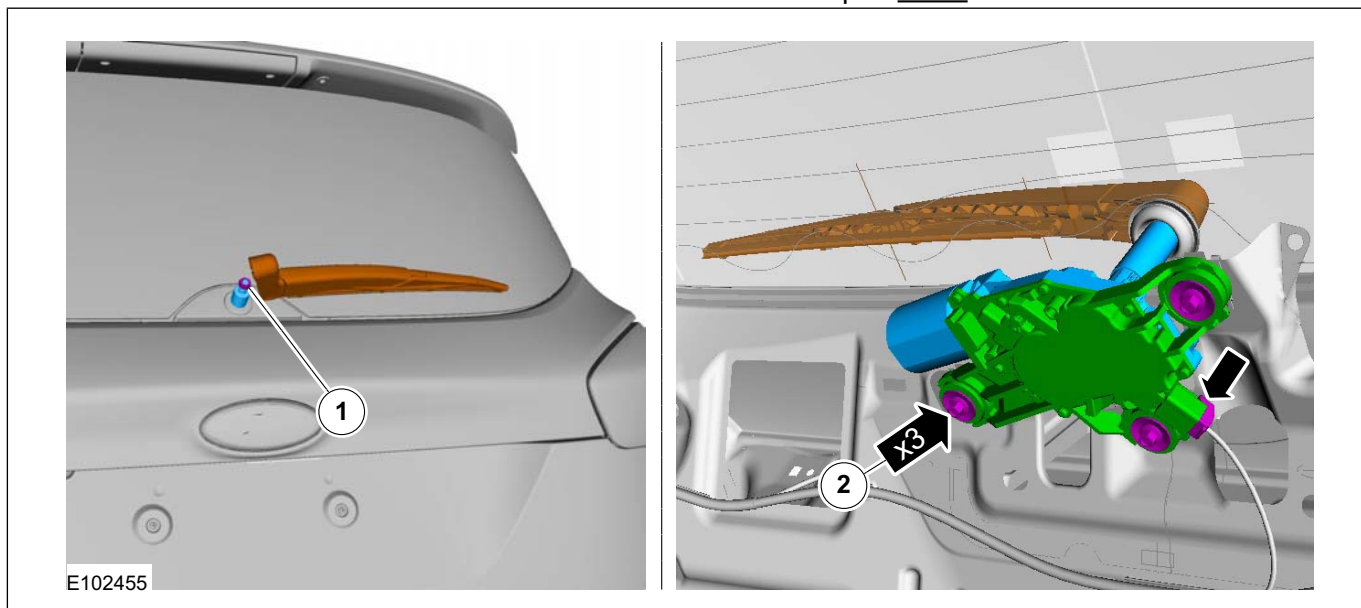
## REMOVAL AND INSTALLATION

## Rear Window Wiper Motor

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Liftgate Upper Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. 1. Torque: **15 Nm**  
2. Torque: **8 Nm**



## Installation

1. To assemble, reverse the disassembly procedure.

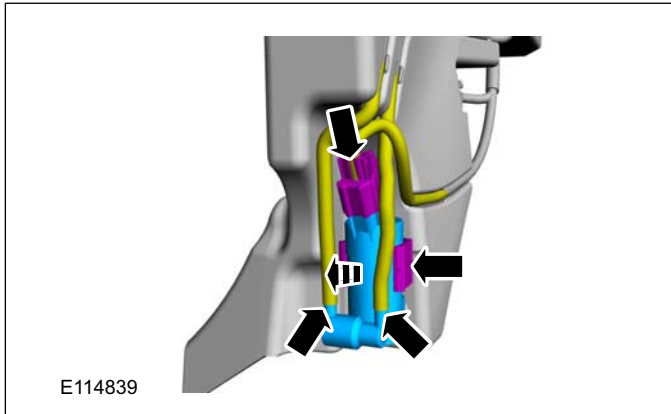
## REMOVAL AND INSTALLATION

## Windshield Washer Pump

## Removal

1. Refer to: **Windshield Washer Reservoir** (501-16 Wipers and Washers, Removal and Installation).

- 2.



## Installation

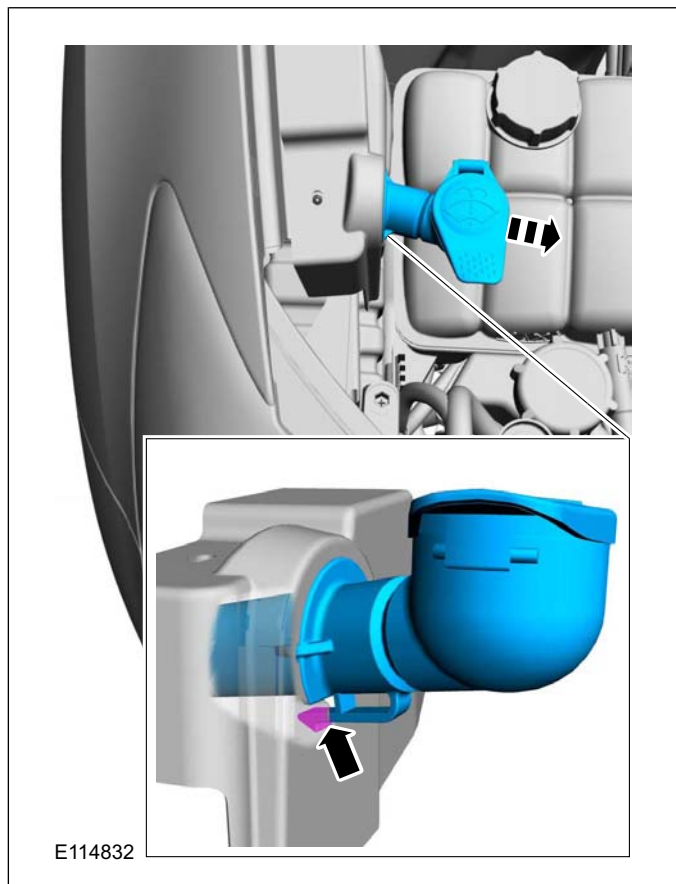
1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Windshield Washer Reservoir

## Removal

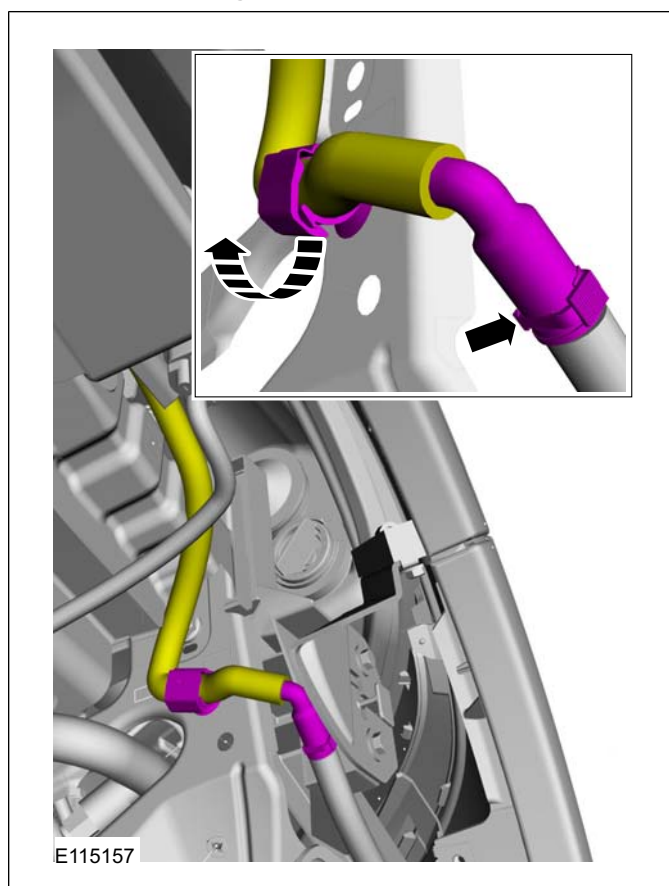
1.



2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
3. Refer to: **Fender Splash Shield** (501-02 Front End Body Panels, Removal and Installation).

## Vehicles with headlamp washers

4. **▲ WARNING:** Be prepared to collect escaping fluid.

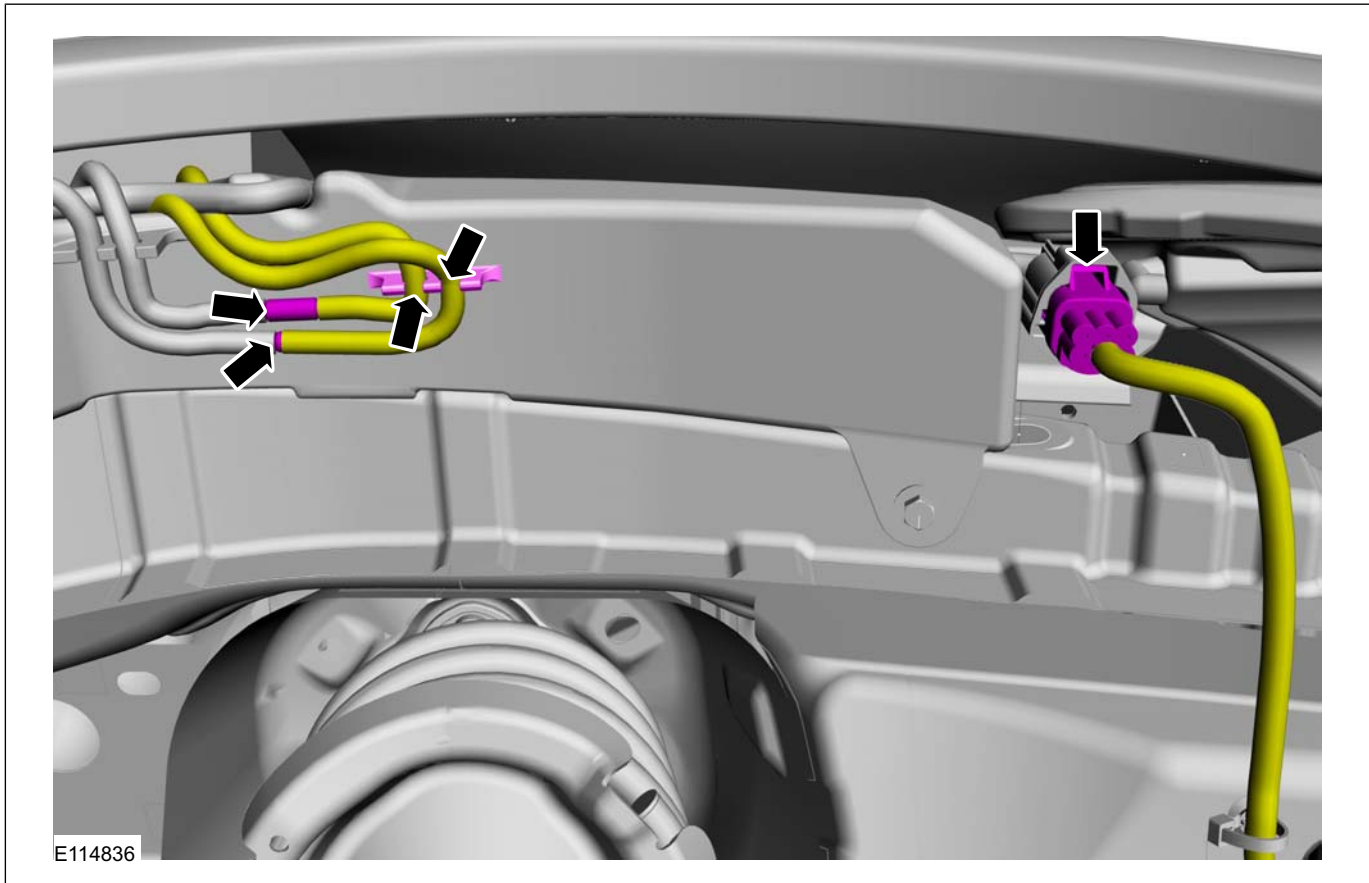


## All vehicles

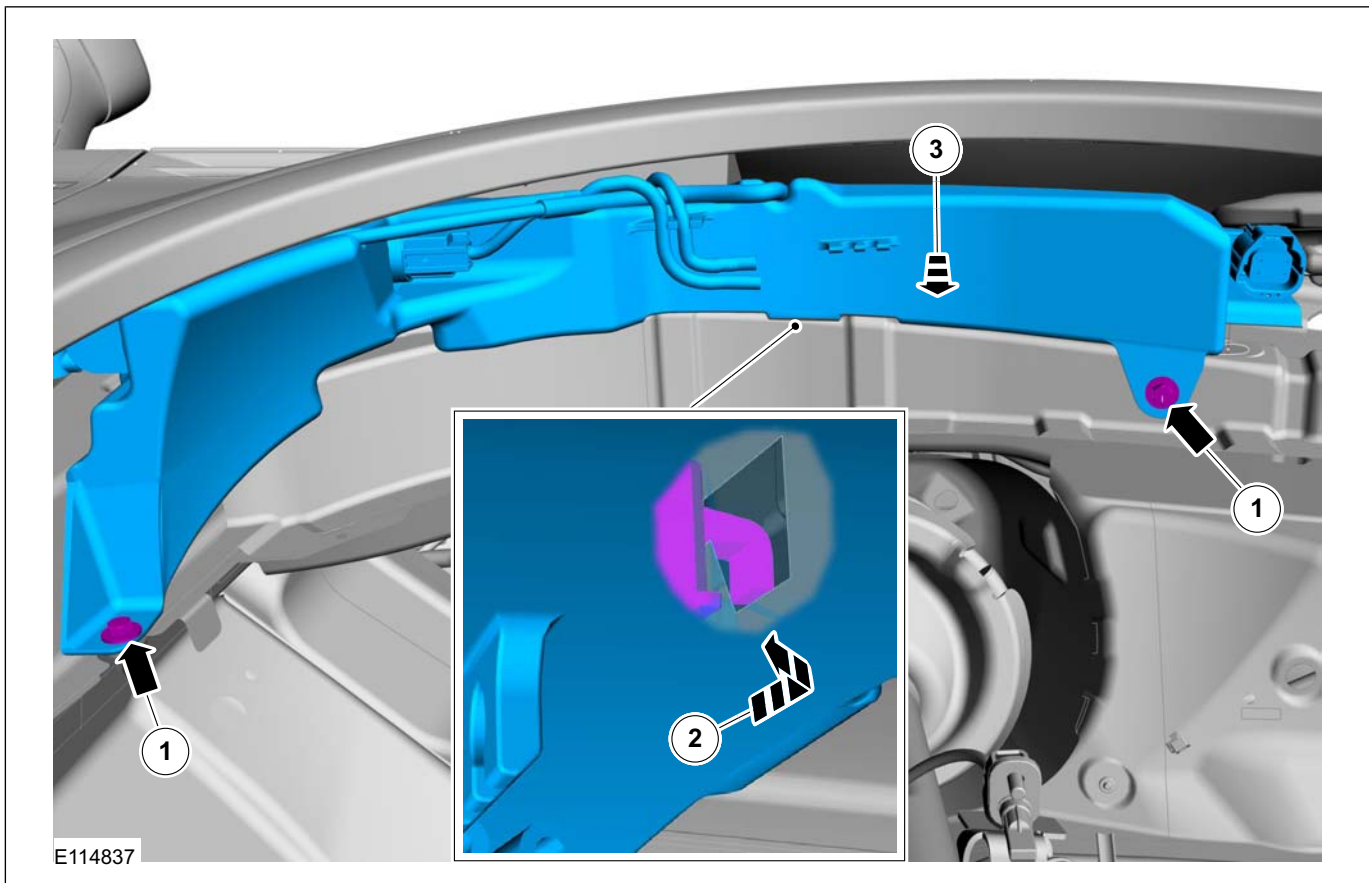
5. **▲ WARNING:** Be prepared to collect escaping fluid.



REMOVAL AND INSTALLATION



6.



501-16-22

Wipers and Washers

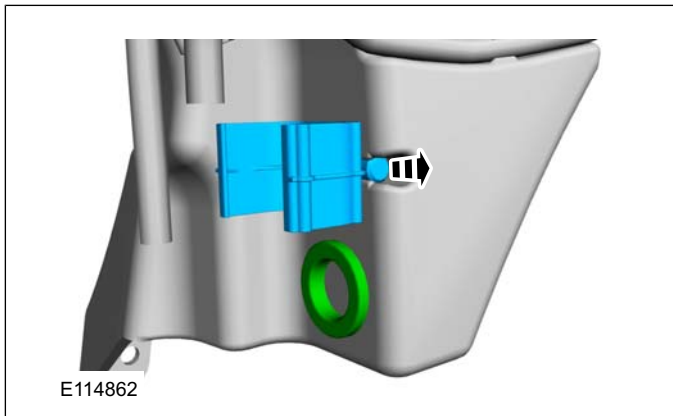
501-16-22

REMOVAL AND INSTALLATION

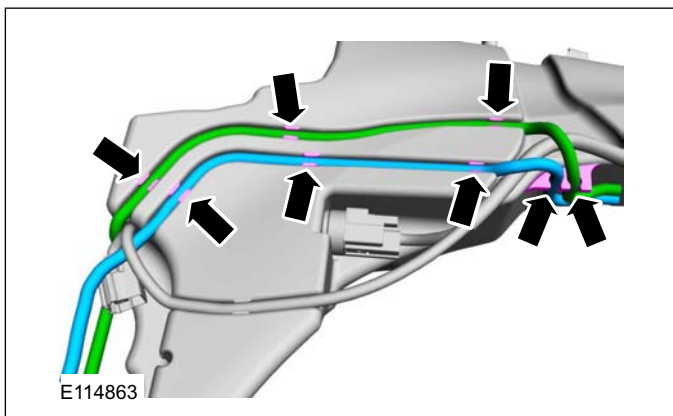
7. **NOTE:** This step is only necessary when installing a new component.

Refer to: **Windshield Washer Pump** (501-16 Wipers and Washers, Removal and Installation).

8. **NOTE:** This step is only necessary when installing a new component.



9. **NOTE:** This step is only necessary when installing a new component.

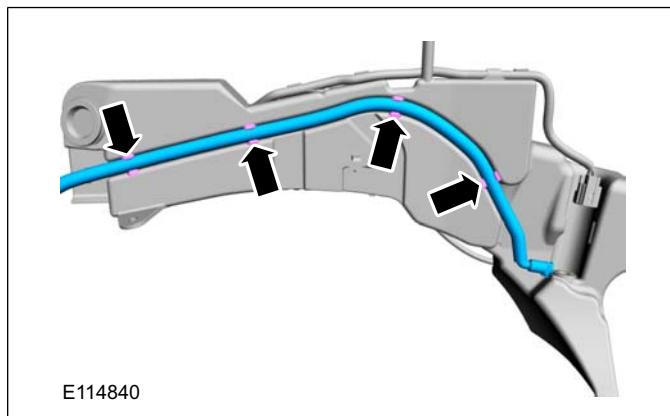


Vehicles with headlamp washers

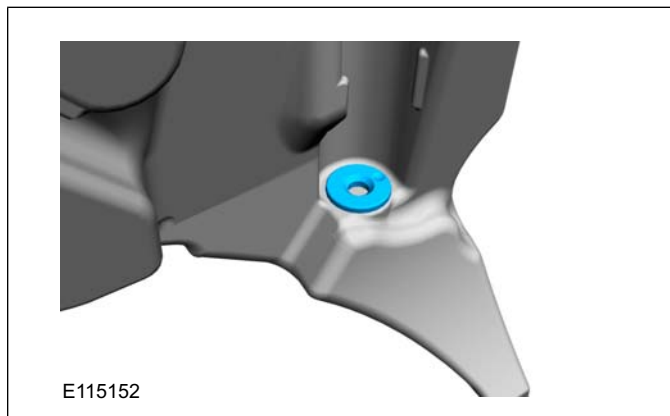
10. **NOTE:** This step is only necessary when installing a new component.

Refer to: **Headlamp Washer Pump** (501-16 Wipers and Washers, Removal and Installation).

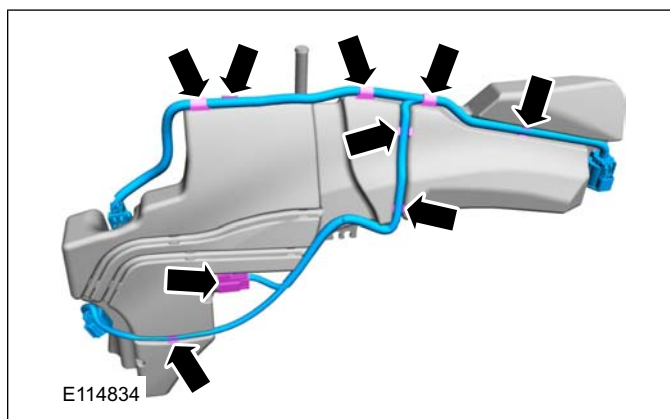
11. **NOTE:** This step is only necessary when installing a new component.



12. **NOTE:** This step is only necessary when installing a new component.



13. **NOTE:** This step is only necessary when installing a new component.



## 501-16-23

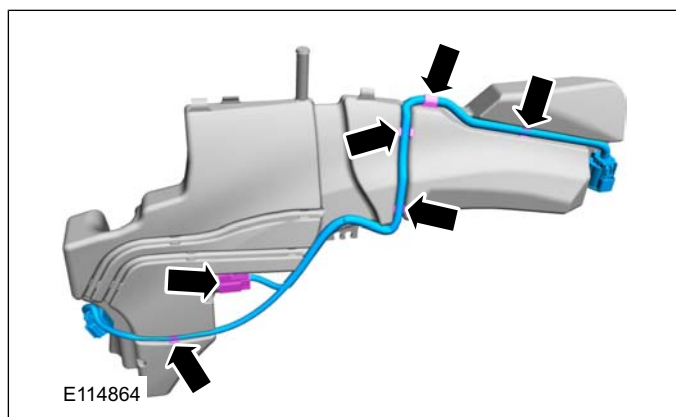
## Wipers and Washers

## 501-16-23

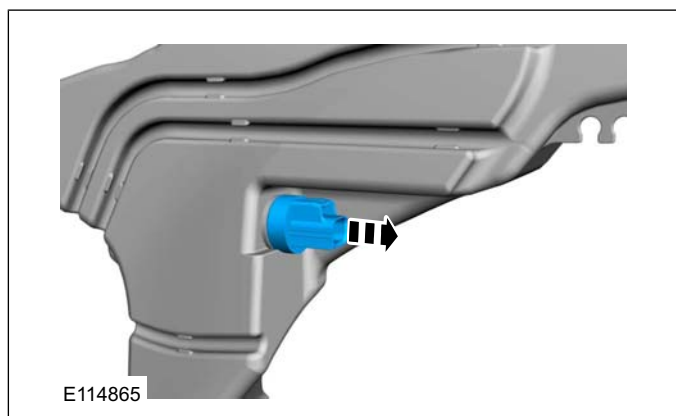
## REMOVAL AND INSTALLATION

All vehicles

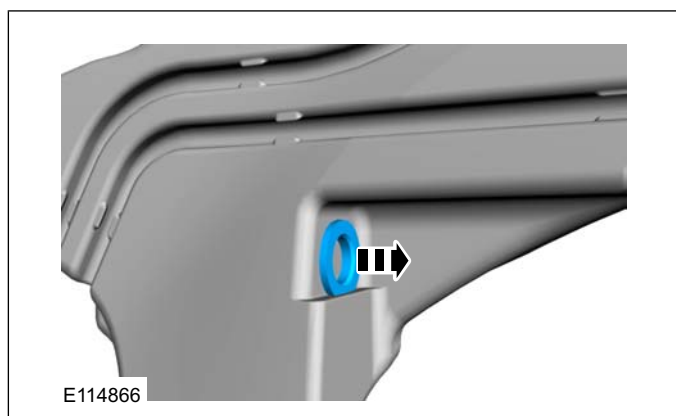
**14. NOTE:** This step is only necessary when installing a new component.



**15. NOTE:** This step is only necessary when installing a new component.



**16. NOTE:** This step is only necessary when installing a new component.



## Installation

1. To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

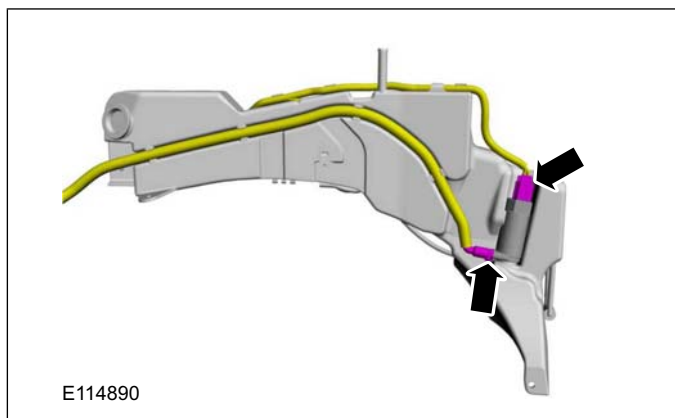
## Headlamp Washer Pump

## Removal

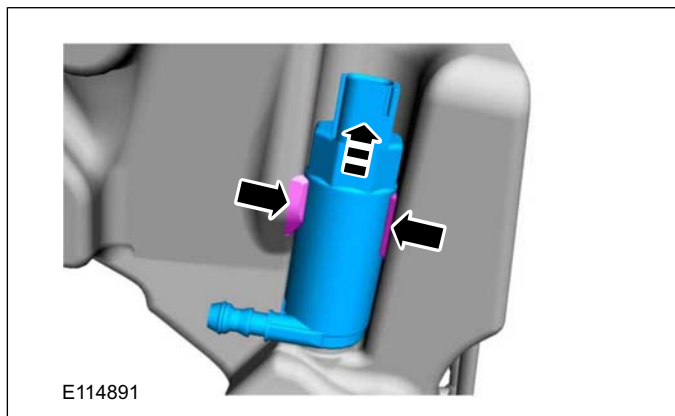
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Windshield Washer Reservoir** (501-16 Wipers and Washers, Removal and Installation).

2.



3.



## Installation

1. To install, reverse the removal procedure.



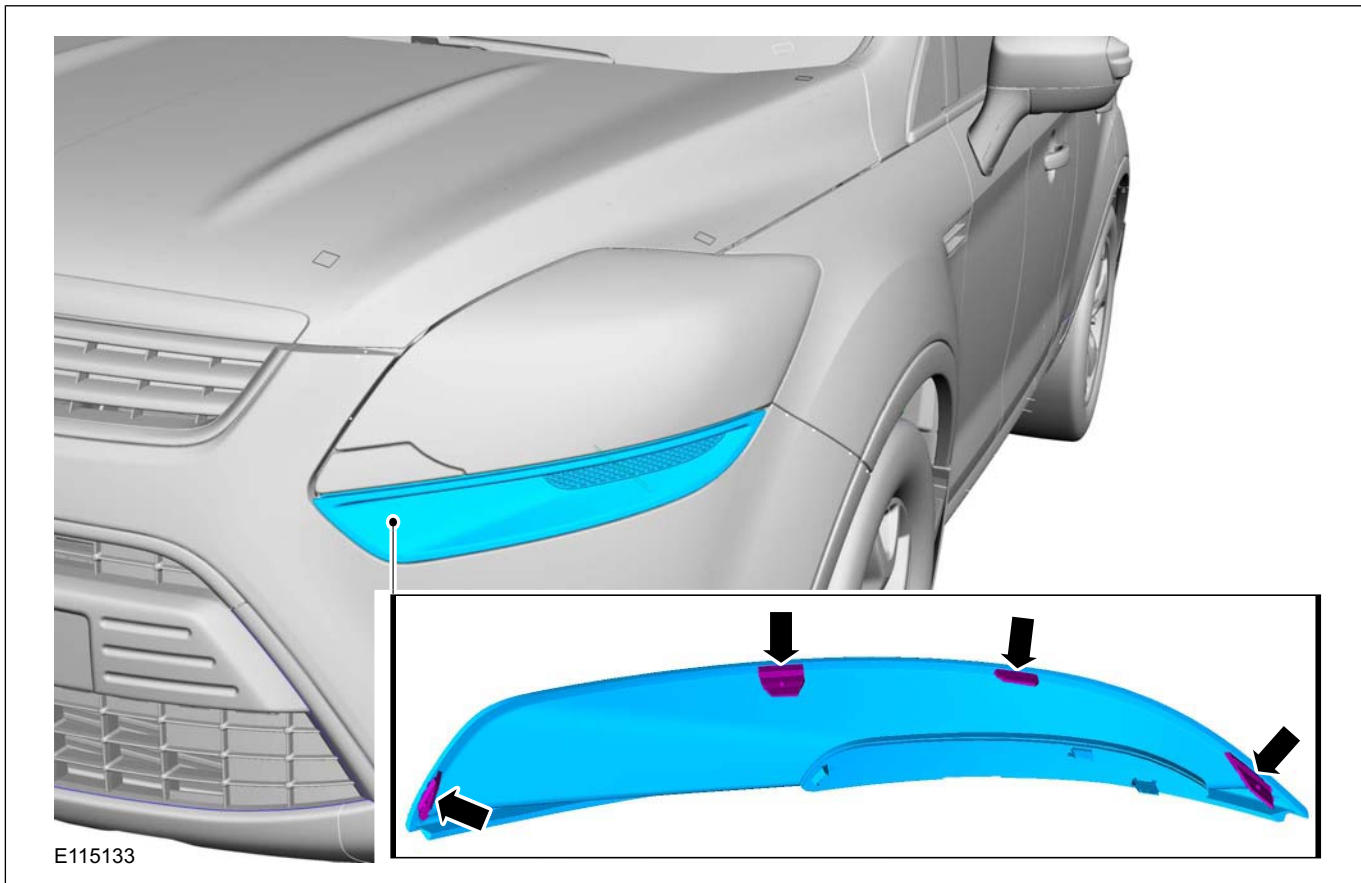
REMOVAL AND INSTALLATION

Headlamp Washer Jet

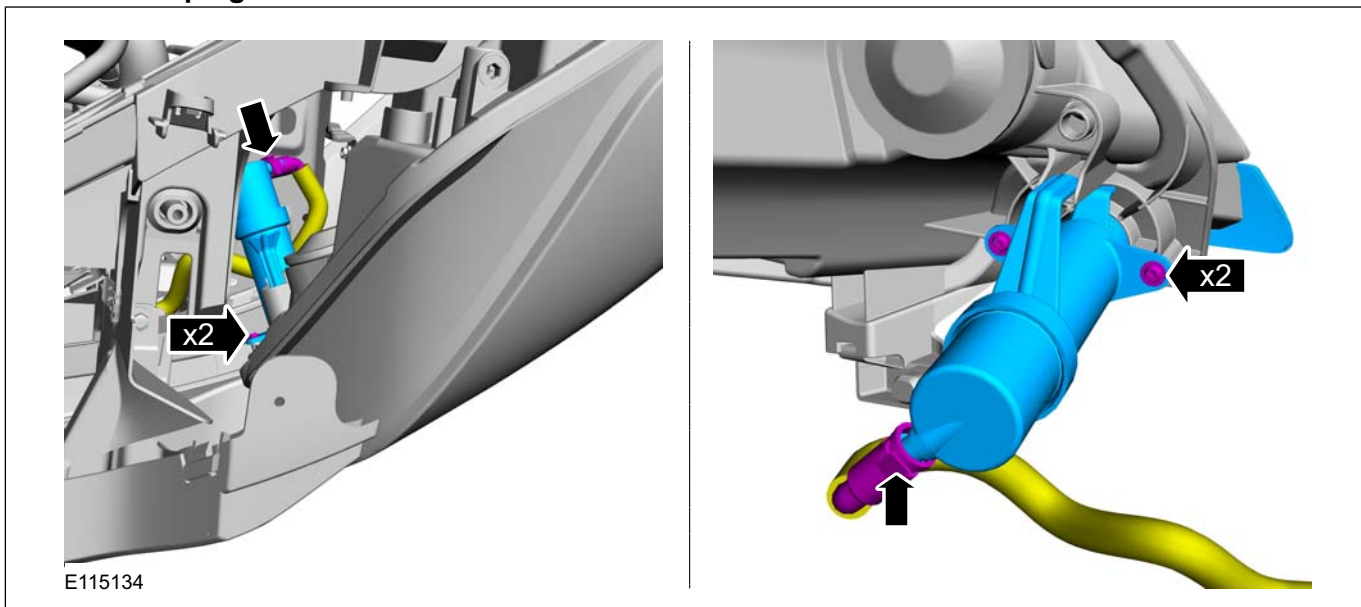
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1.



2. **WARNING:** Be prepared to collect escaping fluid.



501-16-26

Wipers and Washers

501-16-26

**REMOVAL AND INSTALLATION**

- 3. NOTE:** This step is only necessary when installing a new component.

**Installation**

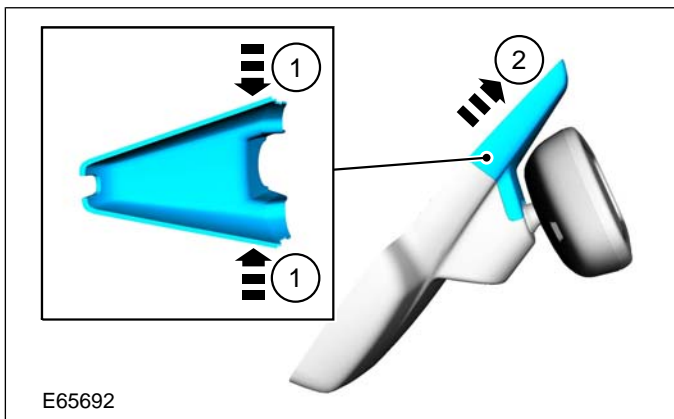
1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

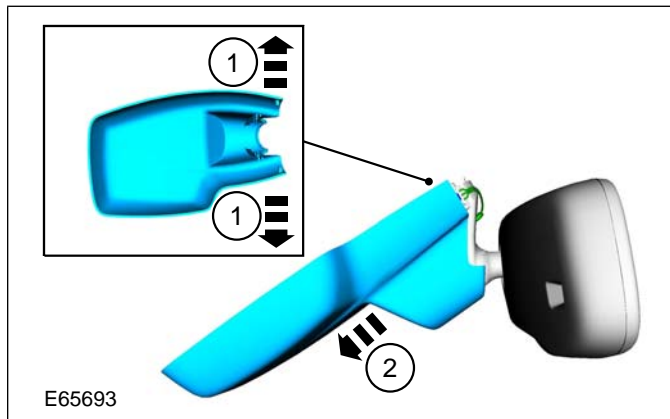
Rain Sensor

Removal

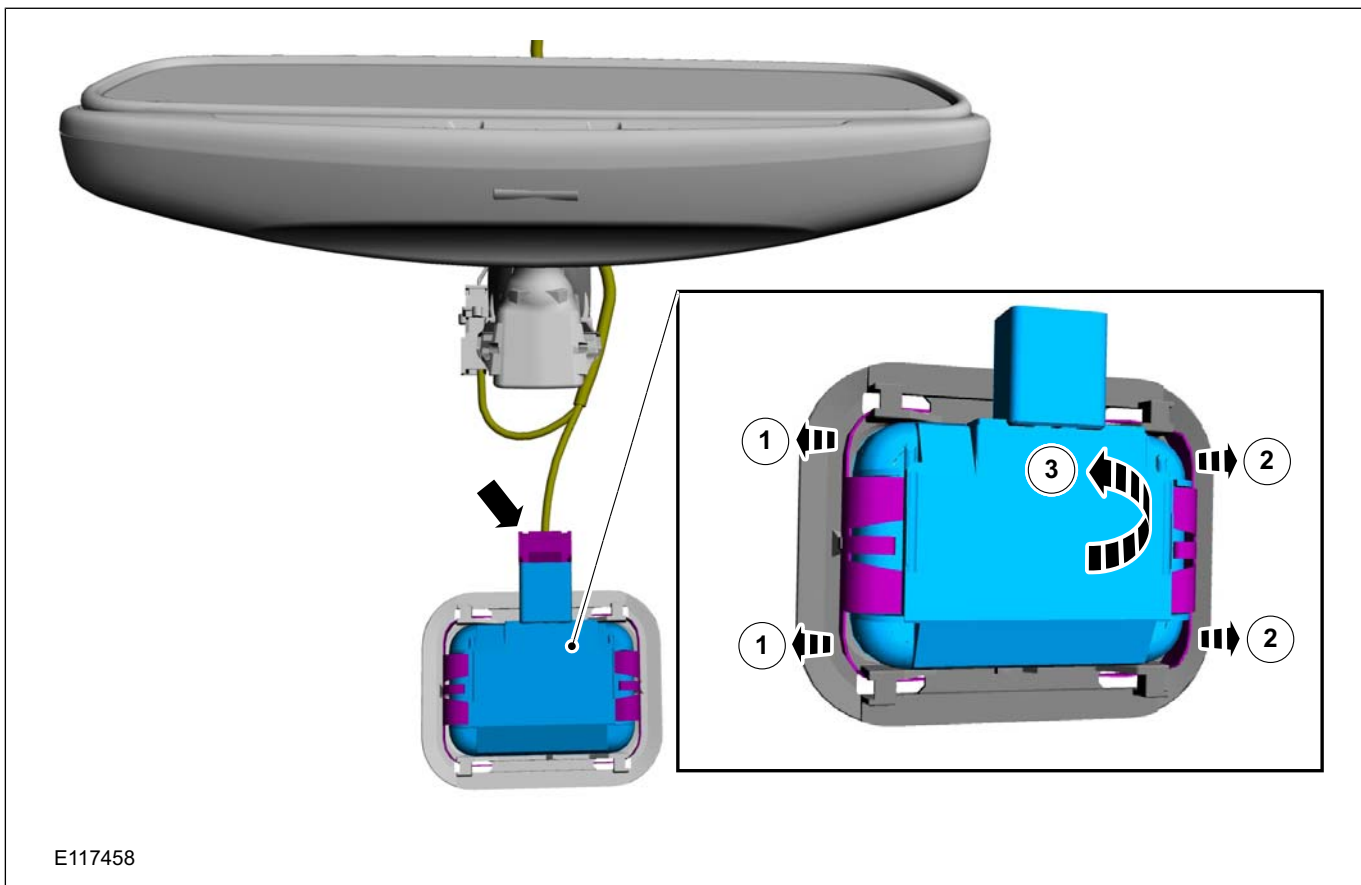
1.



2.



3.



Installation

1. **⚠ CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Install the components in reverse order.



# SECTION 501-19 Bumpers

VEHICLE APPLICATION: 2008.50 Kuga

CONTENTS	PAGE
<b>REMOVAL AND INSTALLATION</b>	
Front Bumper Cover.....	501-19-2
Rear Bumper Cover.....	501-19-8
<b>DISASSEMBLY AND ASSEMBLY</b>	
Front Bumper Cover.....	501-19-11
Rear Bumper Cover.....	501-19-14



## REMOVAL AND INSTALLATION

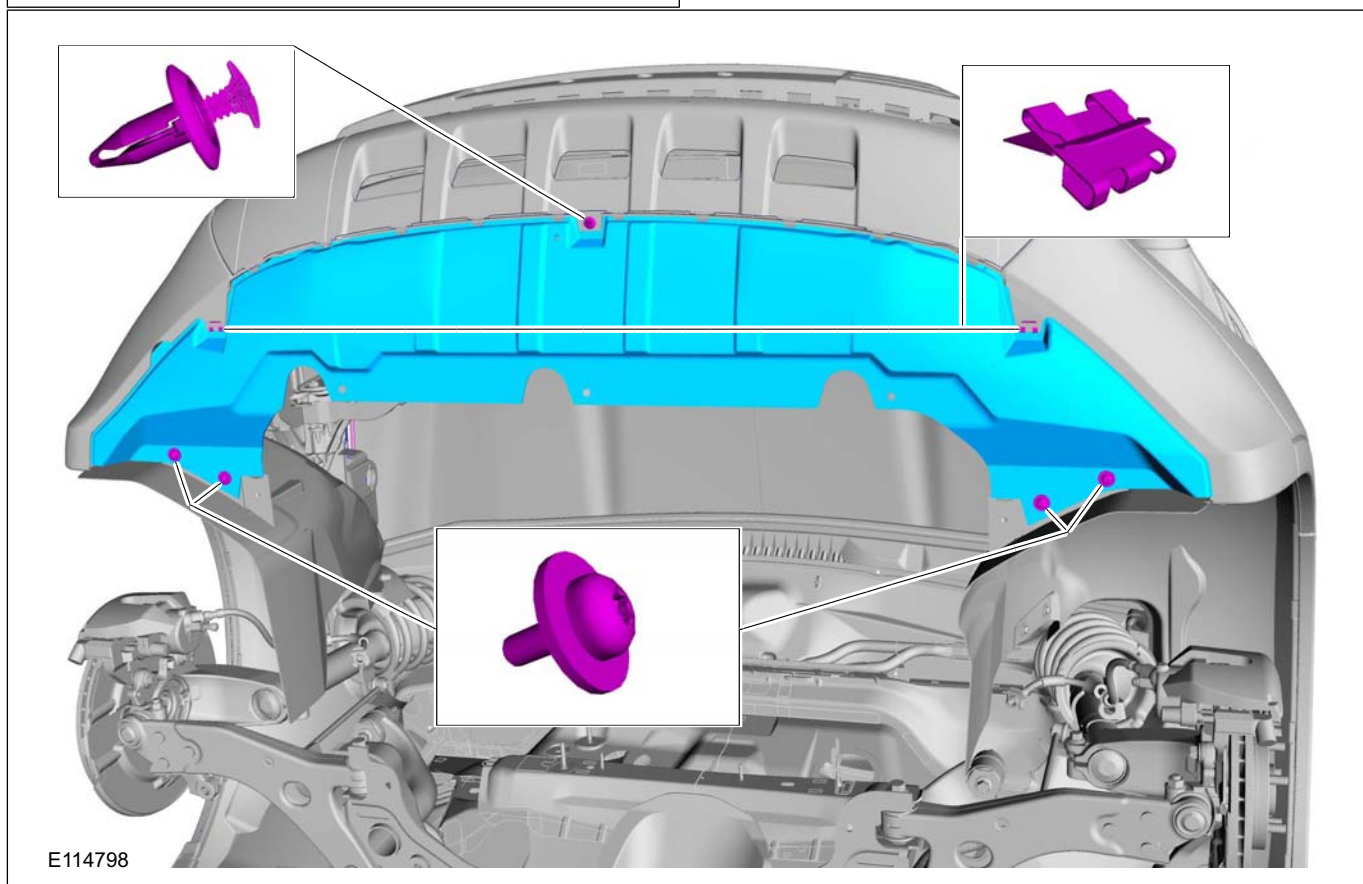
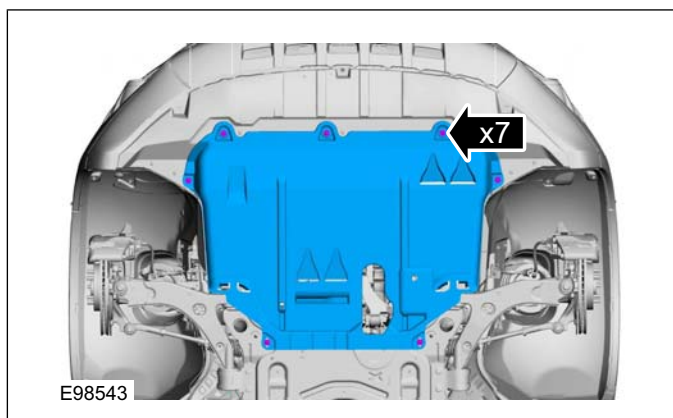
## Front Bumper Cover

## Removal

1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

3.

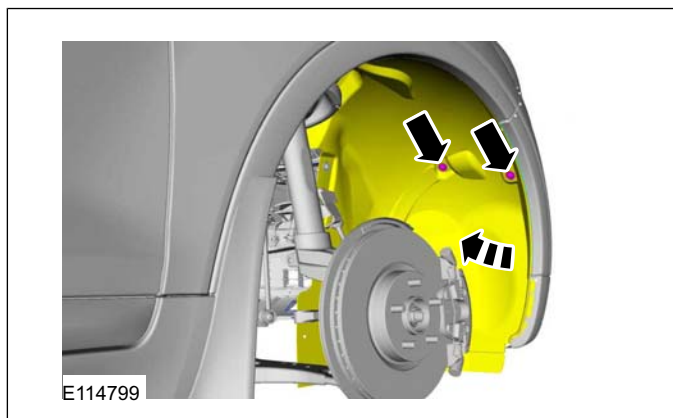
2.



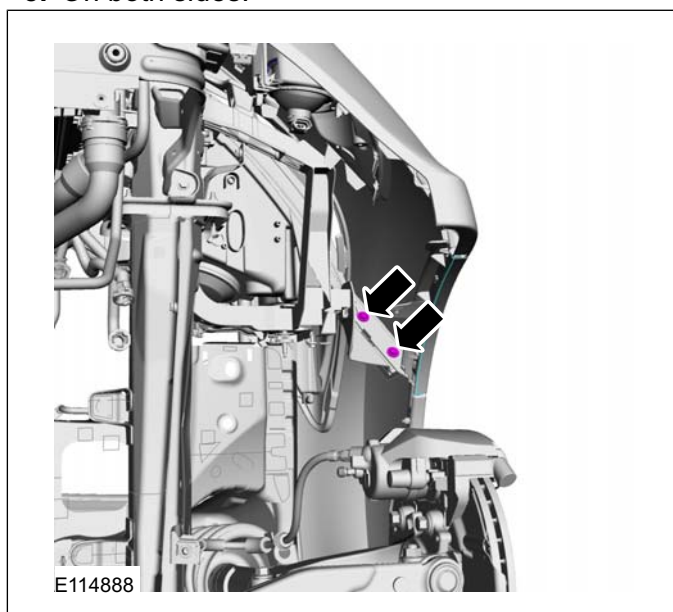


REMOVAL AND INSTALLATION

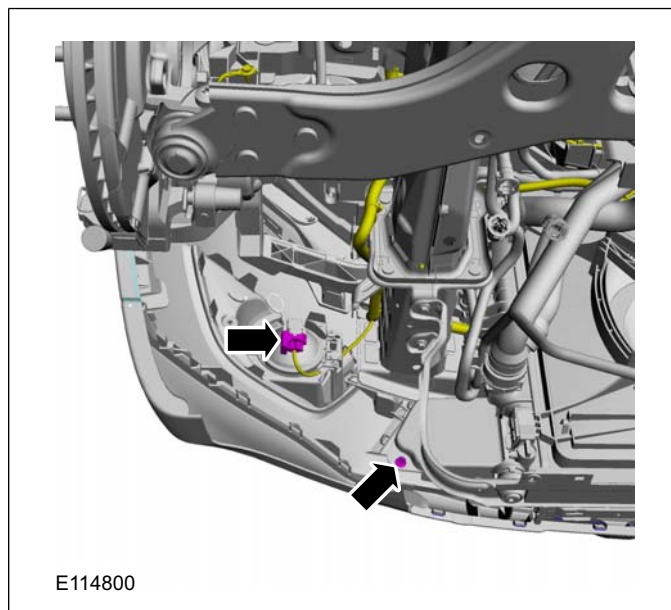
4. On both sides.



5. On both sides.



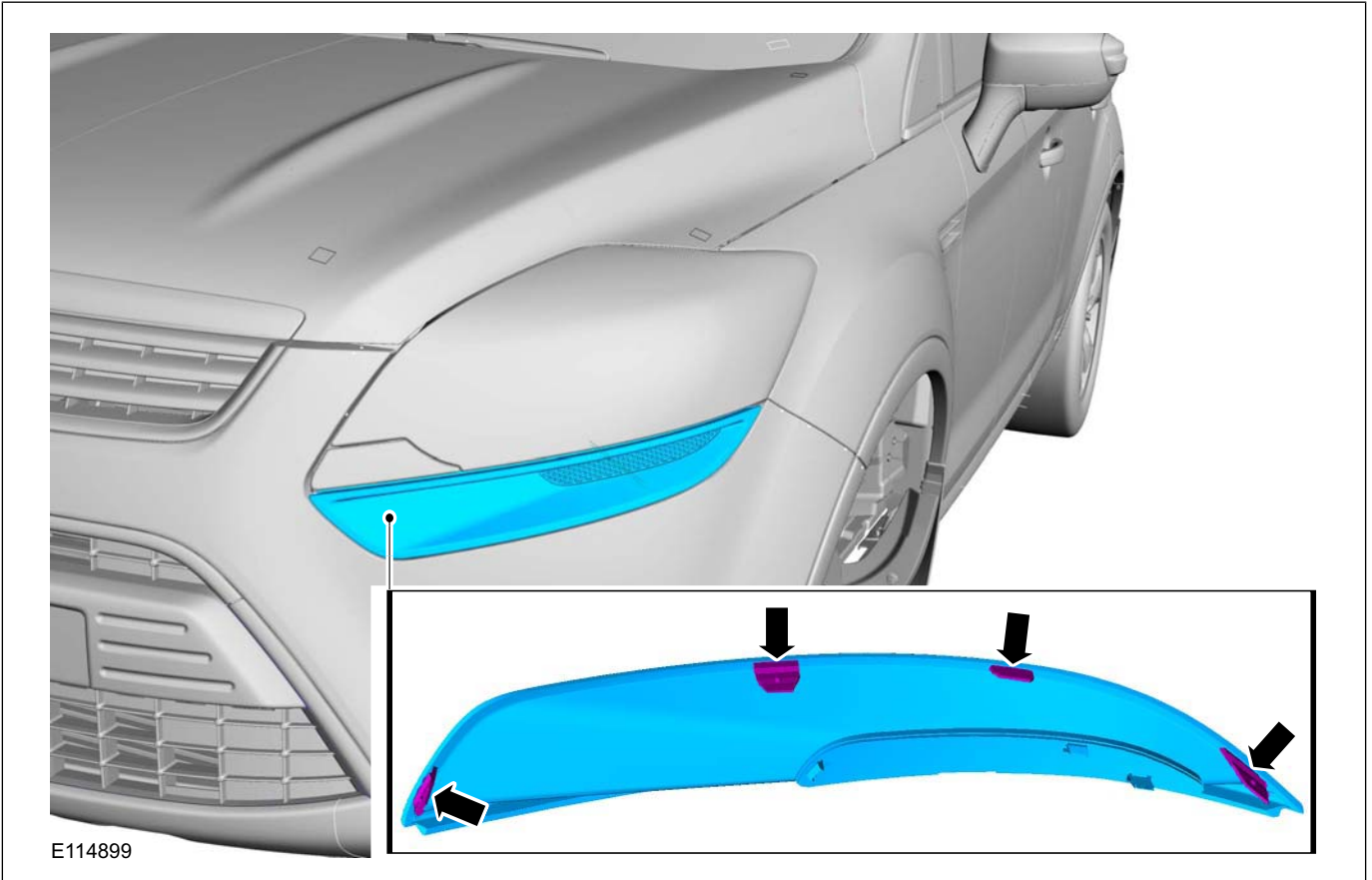
6. On both sides.



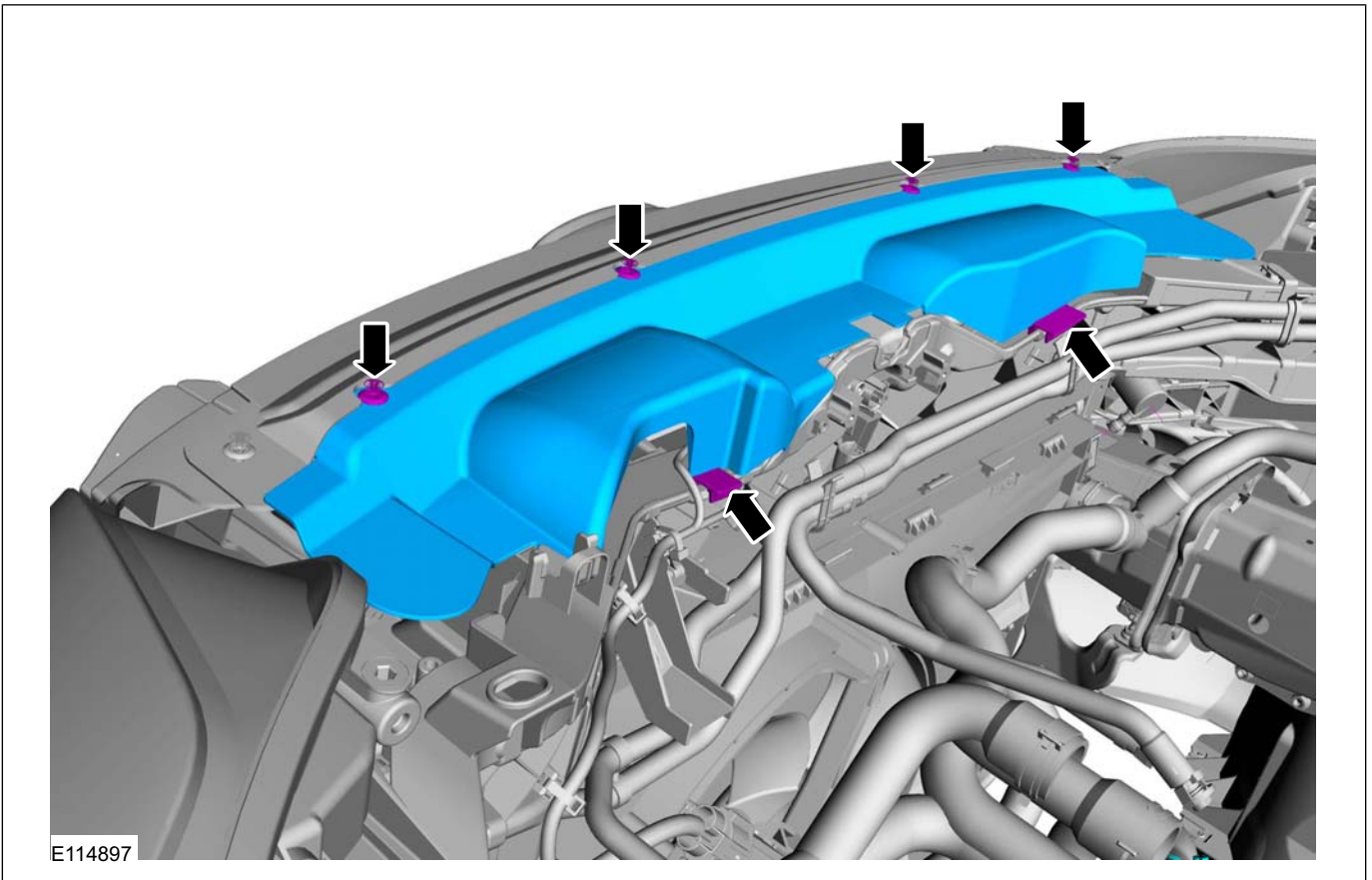
7. On both sides.



REMOVAL AND INSTALLATION



8.



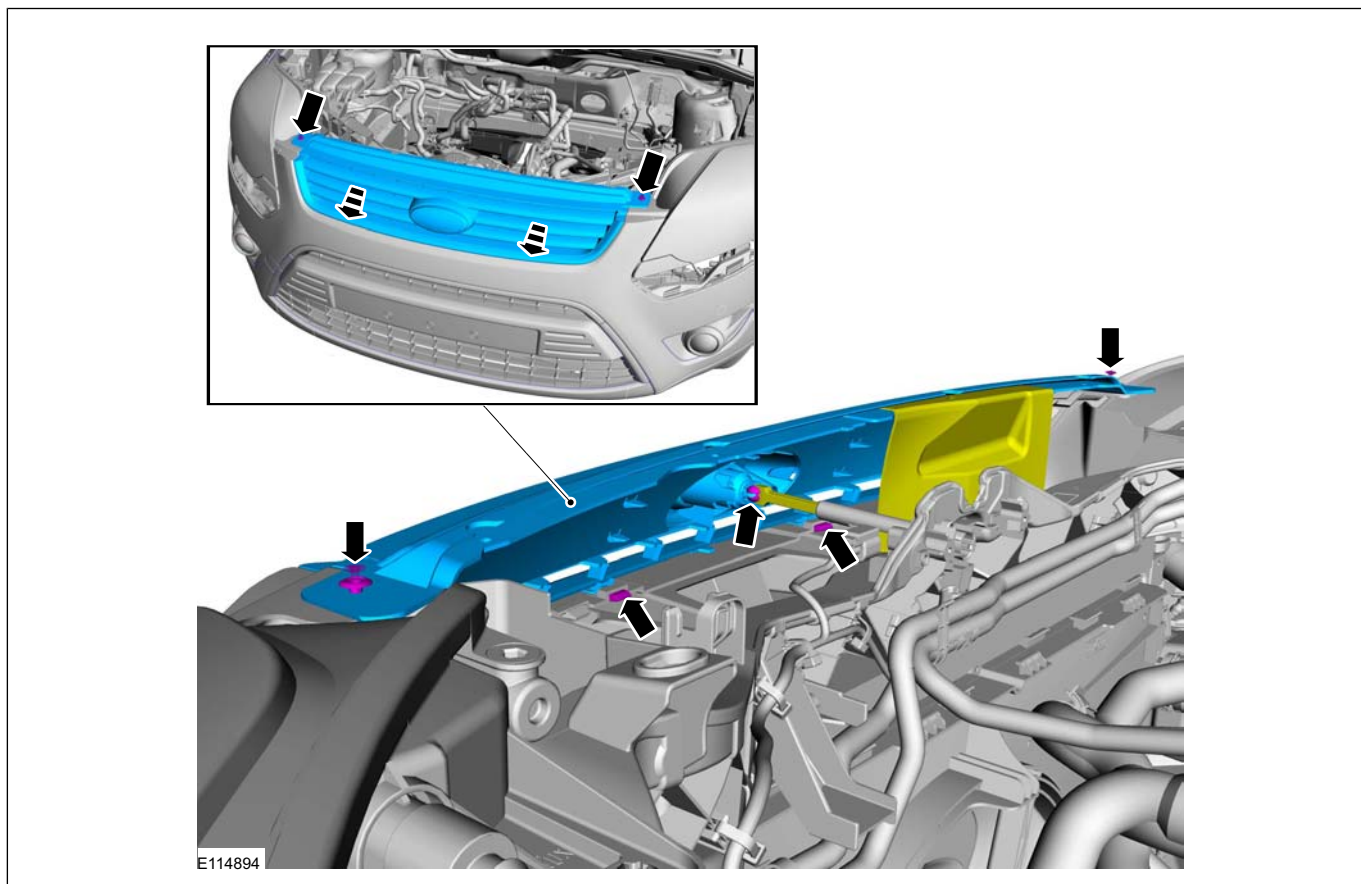
501-19-5

Bumpers

501-19-5

## REMOVAL AND INSTALLATION

9.



Vehicles with parking aid

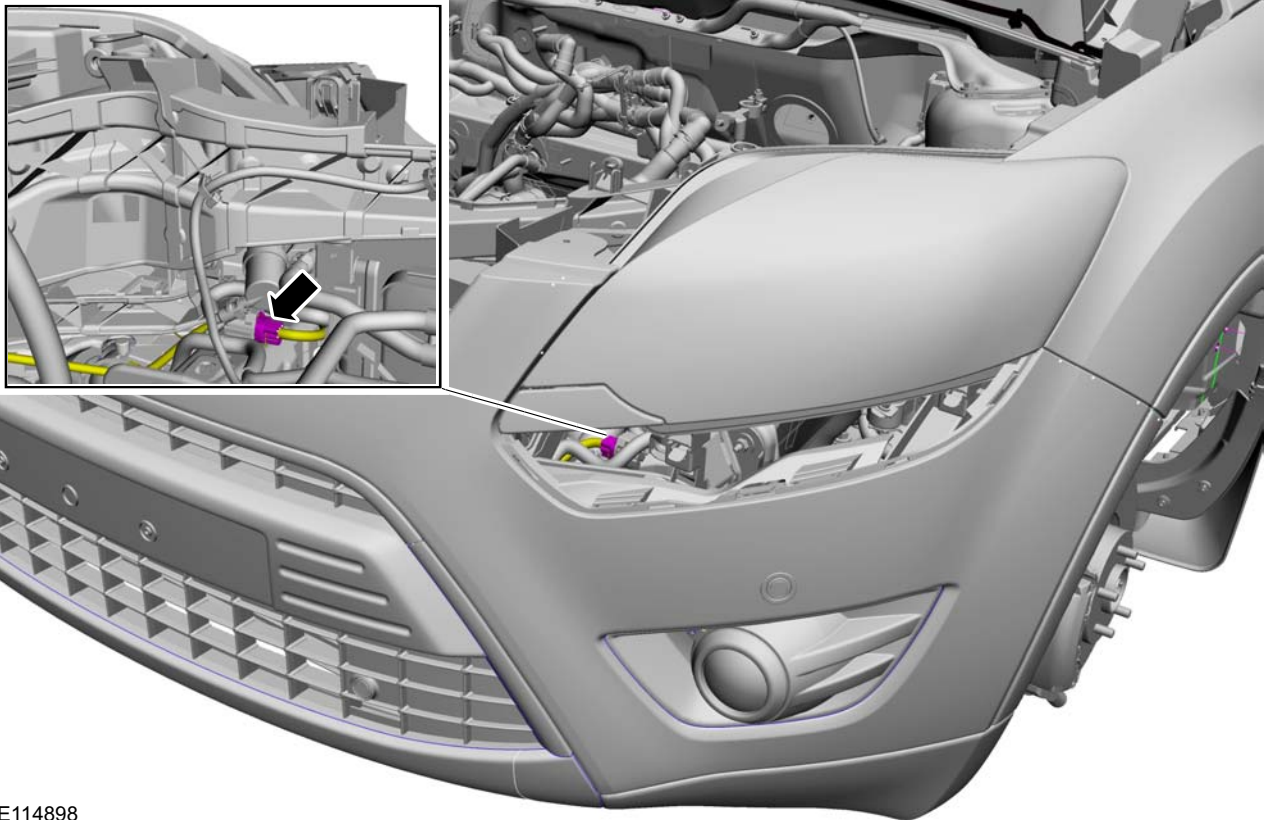
10.

501-19-6

Bumpers

501-19-6

## REMOVAL AND INSTALLATION

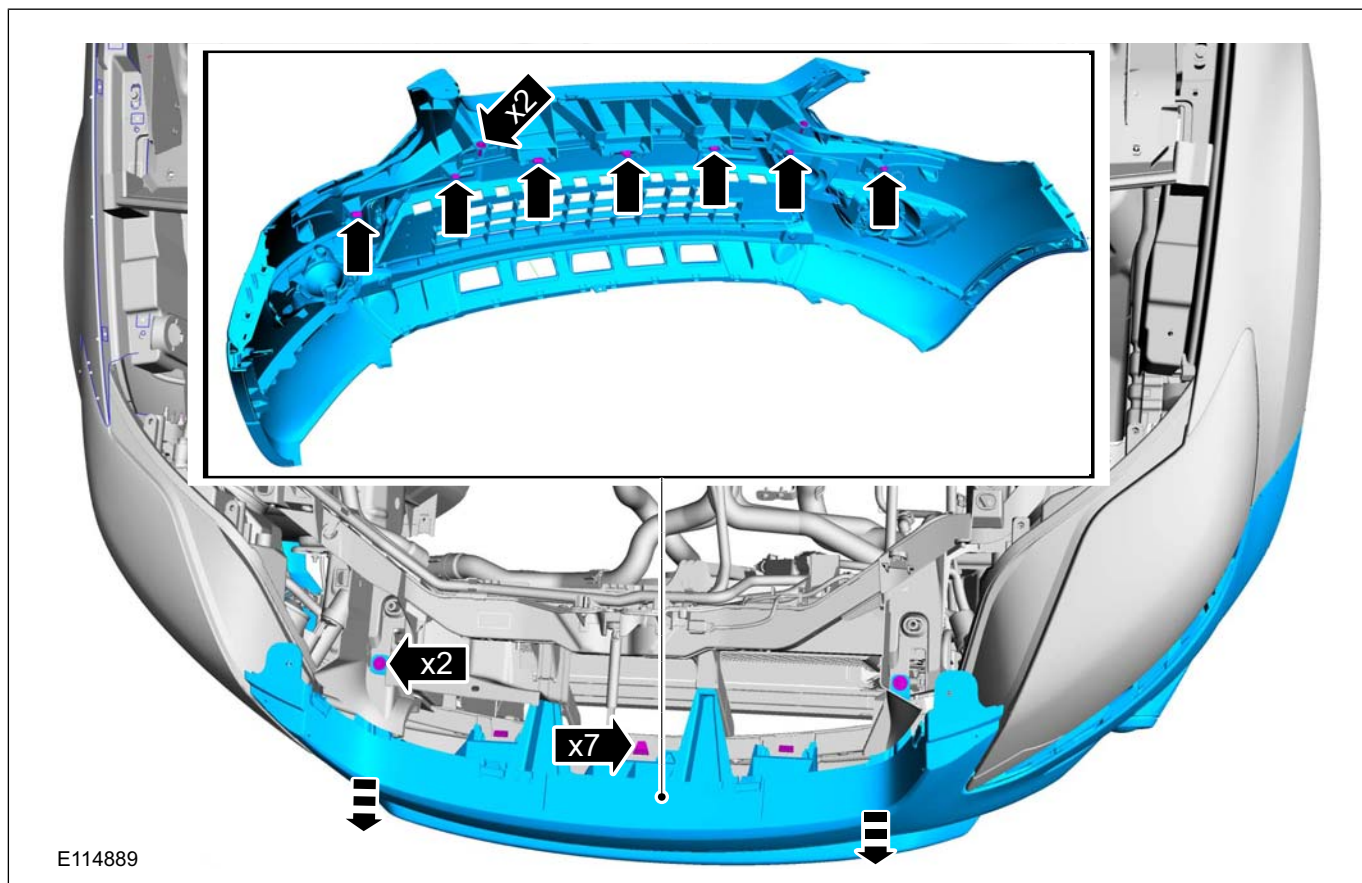


All vehicles

11.



## REMOVAL AND INSTALLATION



## Installation

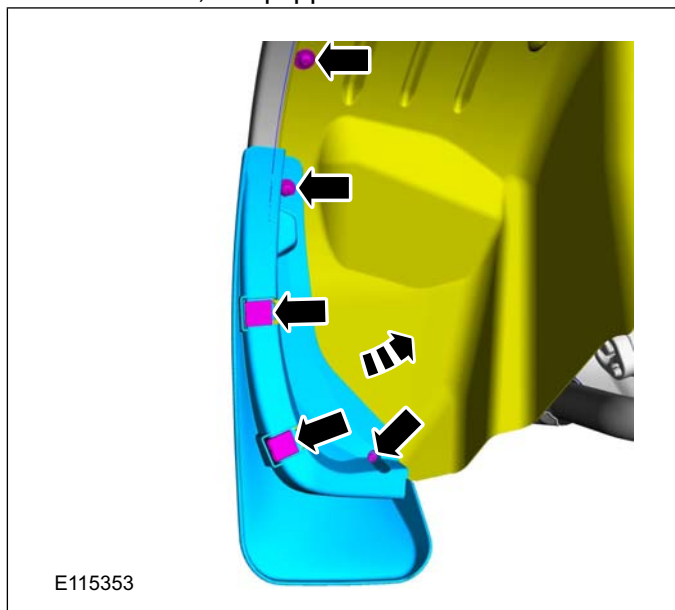
1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Rear Bumper Cover

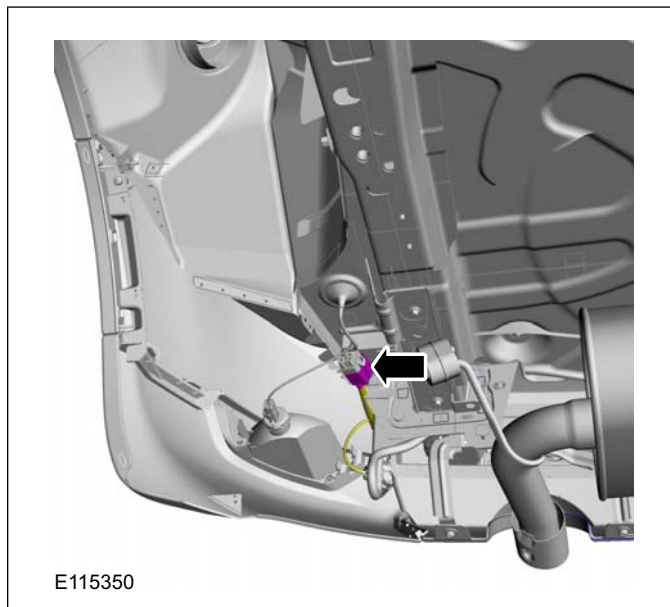
Removal

1. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
2. Both sides, If equipped.



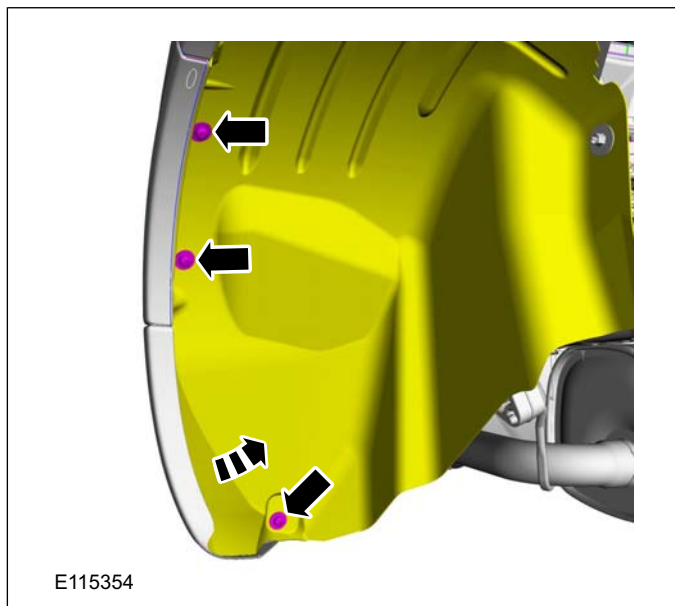
Vehicles with parking aid

4.

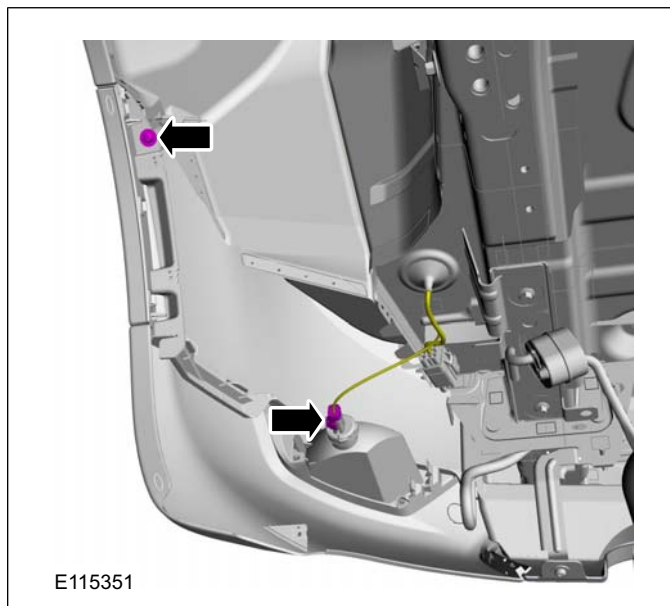


All vehicles

3. On both sides.



5. On both sides.

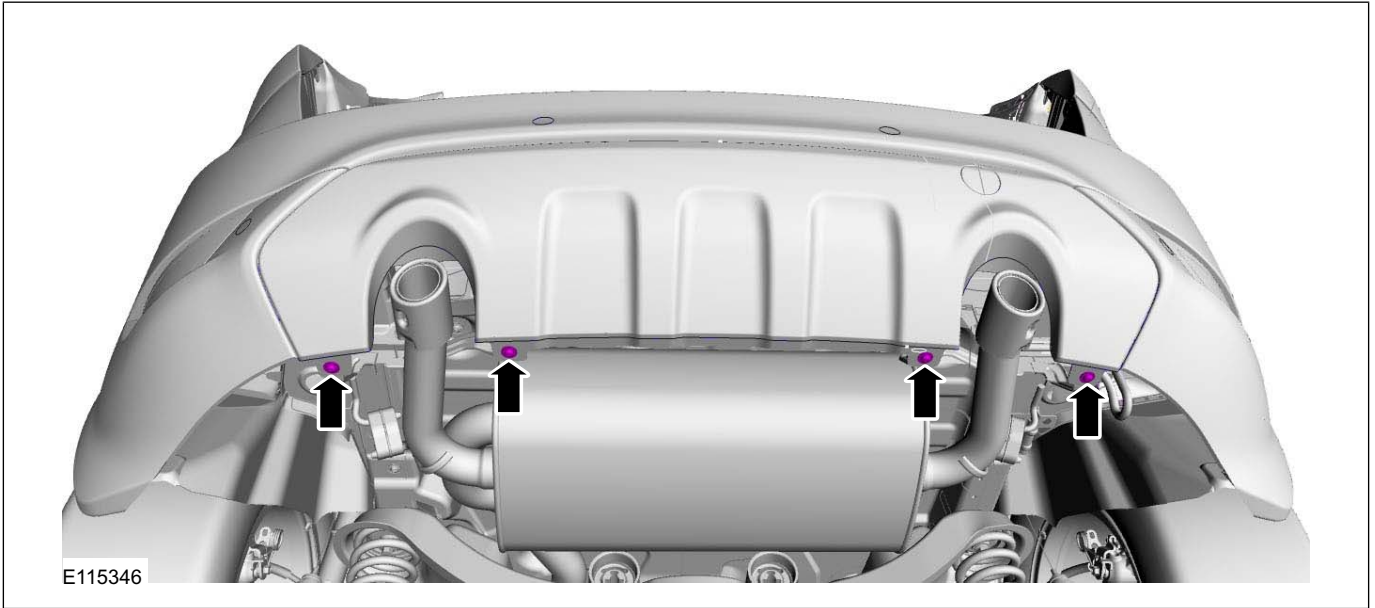


6.

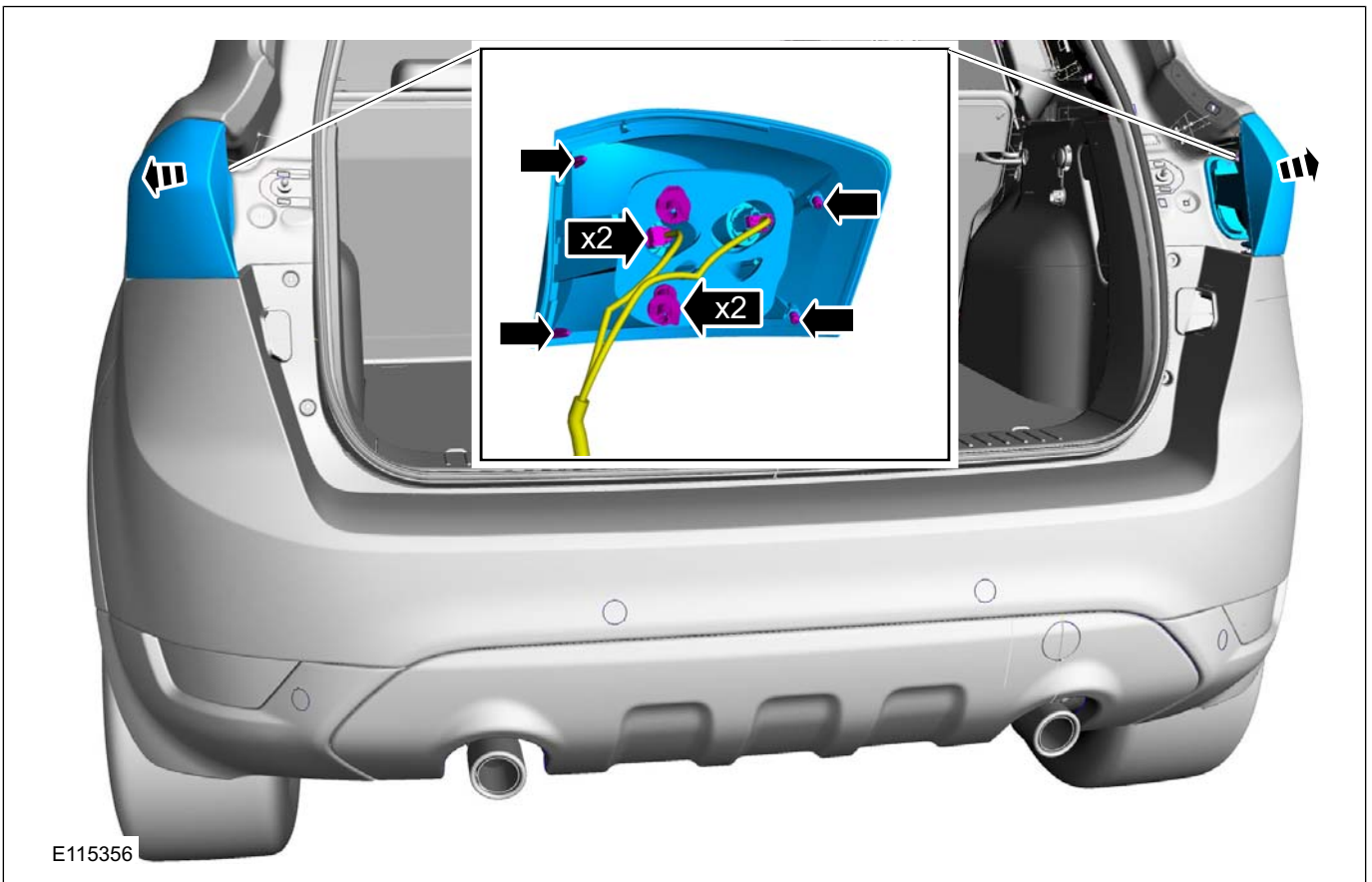




REMOVAL AND INSTALLATION



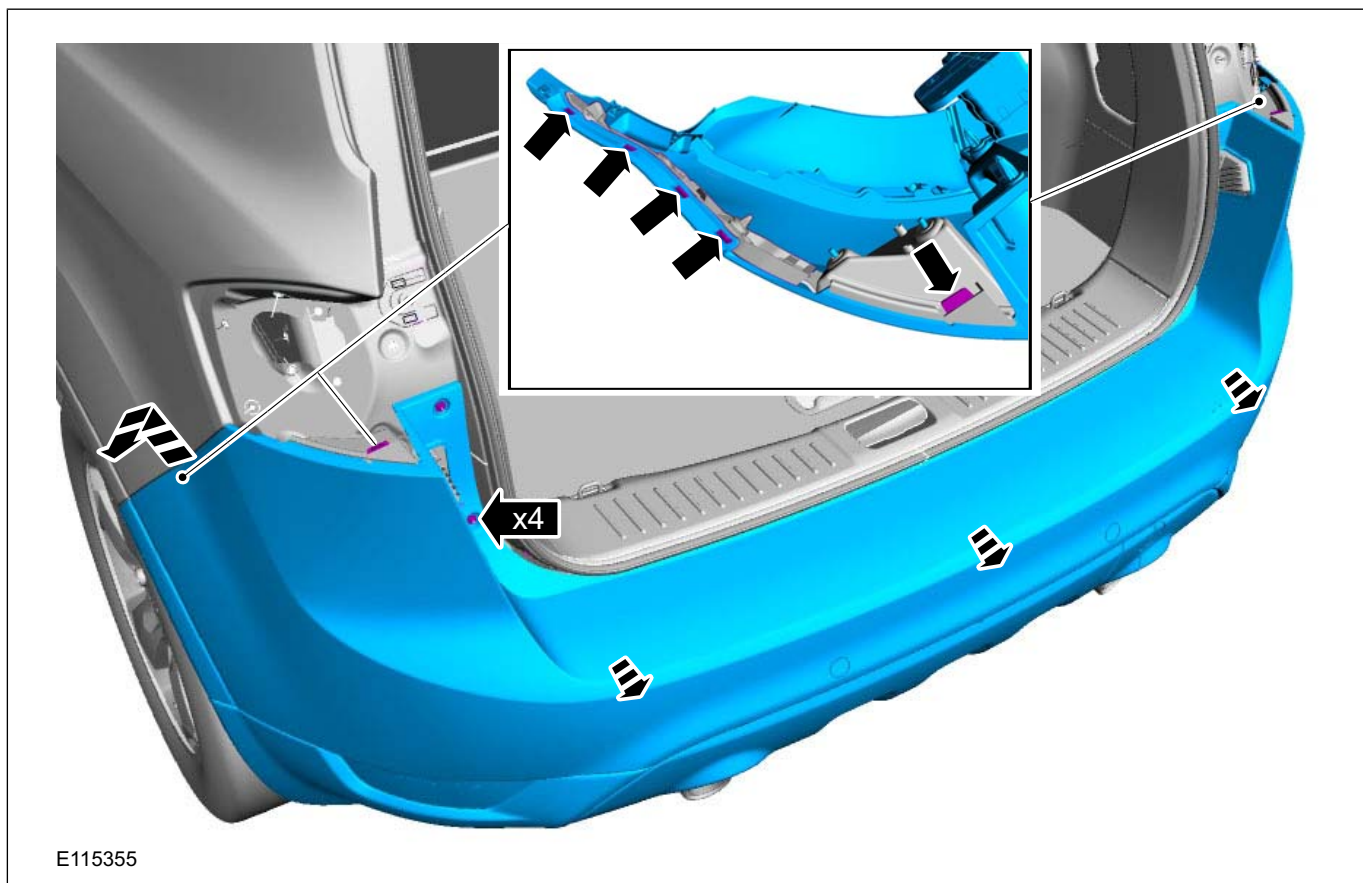
7.



8.



## REMOVAL AND INSTALLATION



## Installation

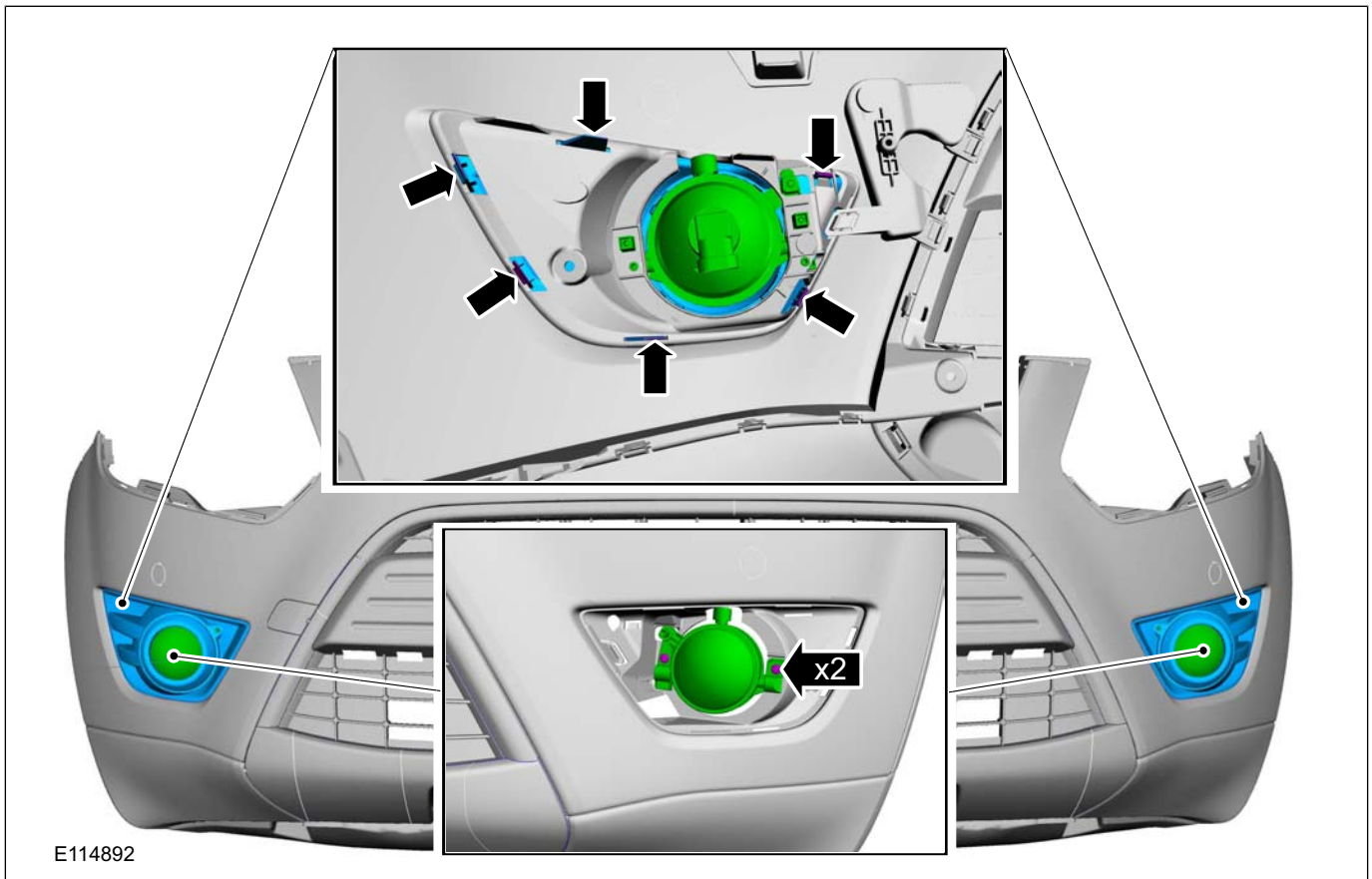
1. To install, reverse the removal procedure.

## DISASSEMBLY AND ASSEMBLY

## Front Bumper Cover

## Disassembly

1. Refer to: **Front Bumper Cover** (501-19 Bumpers, Removal and Installation).
- 2.



## Vehicles with parking aid

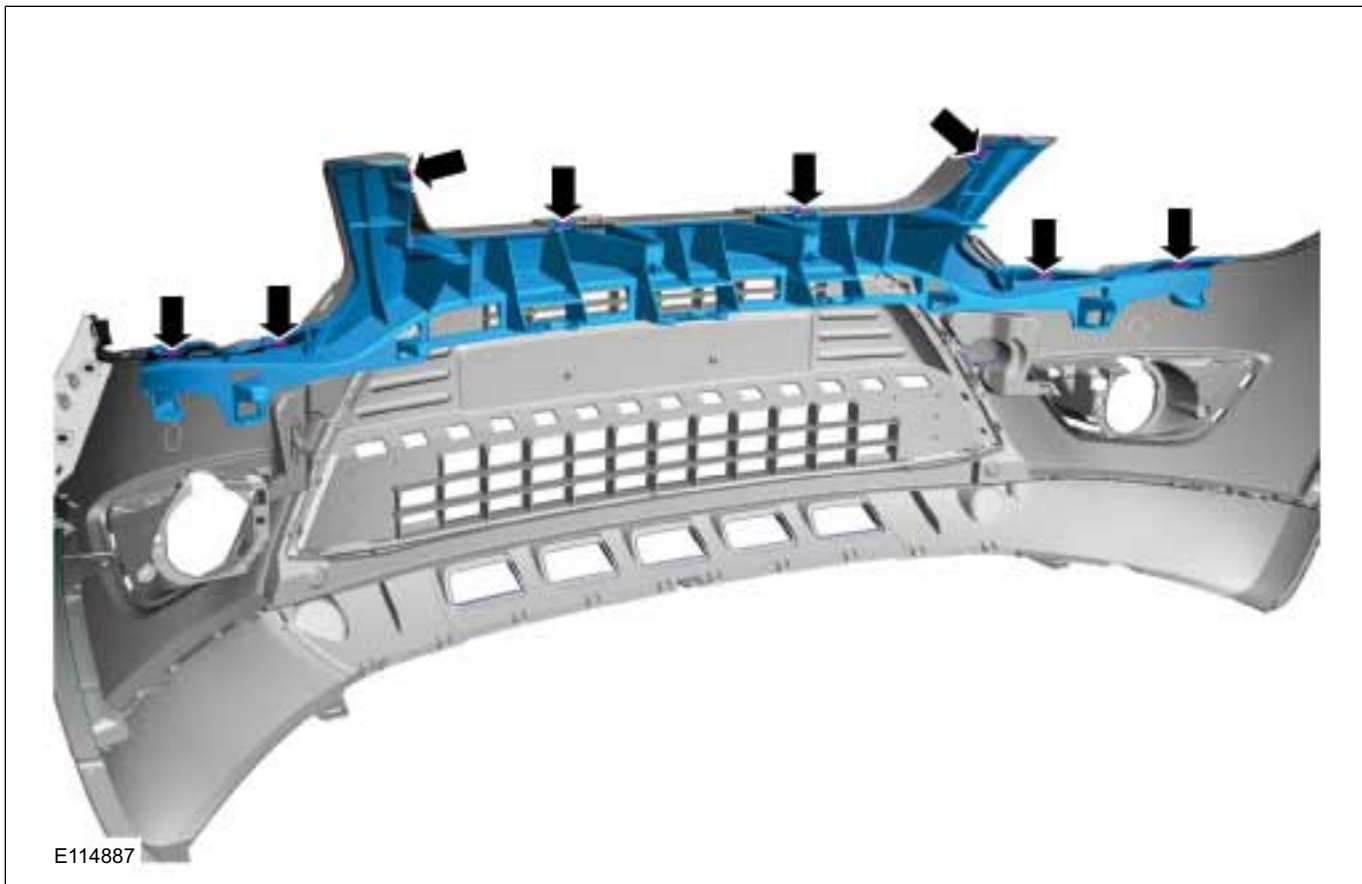
3. Refer to: **Front Parking Aid Sensor** (413-13 Parking Aid, Removal and Installation).

## All vehicles

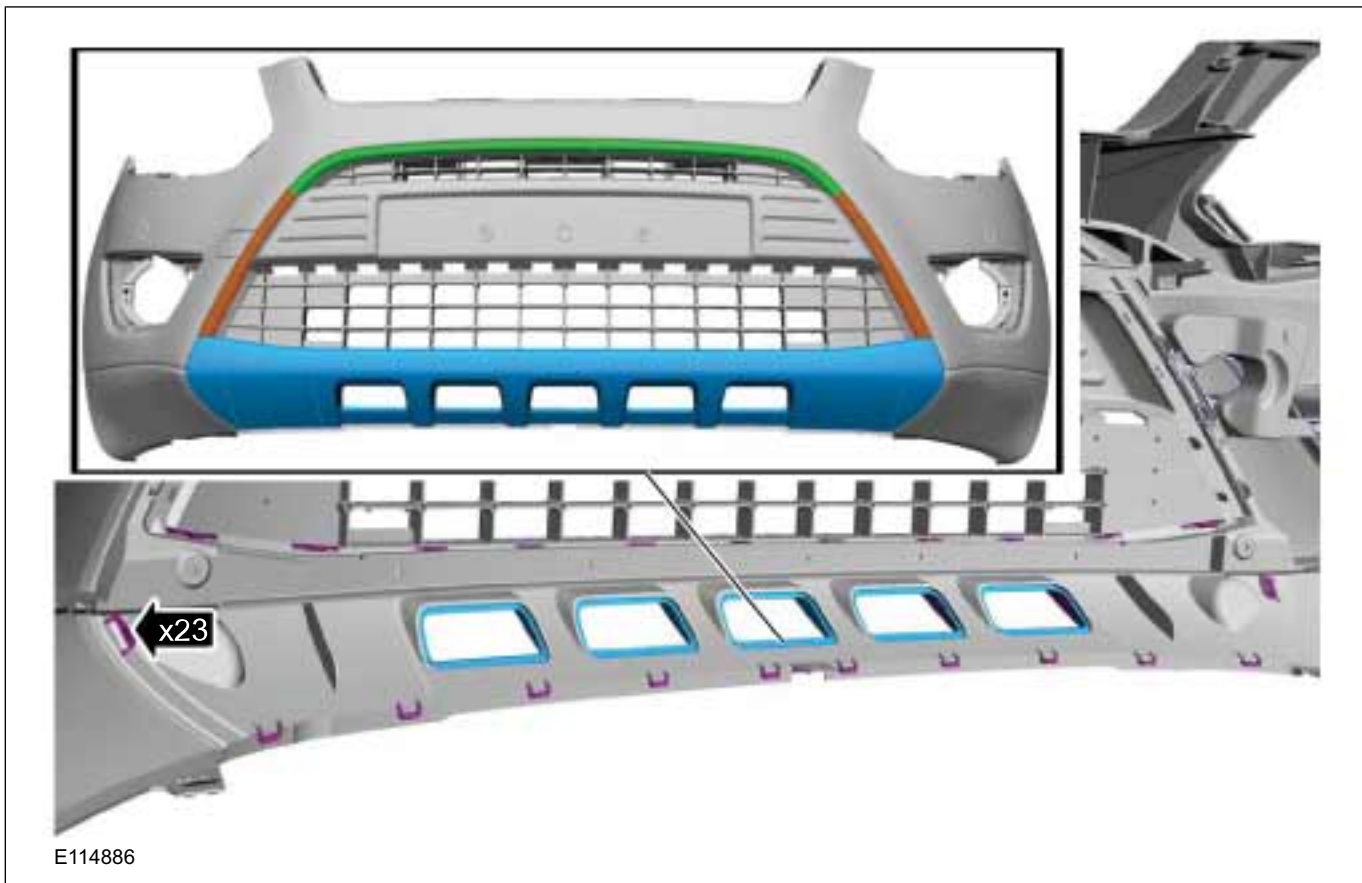
- 4.



DISASSEMBLY AND ASSEMBLY



5.





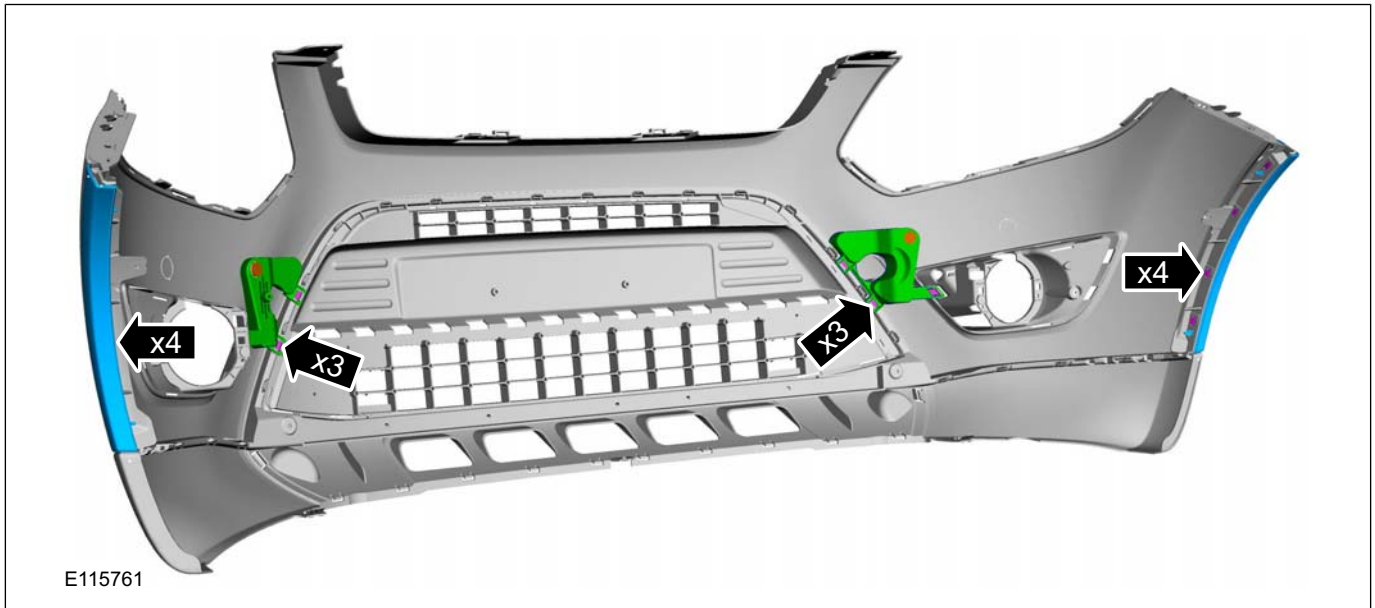
501-19-13

Bumpers

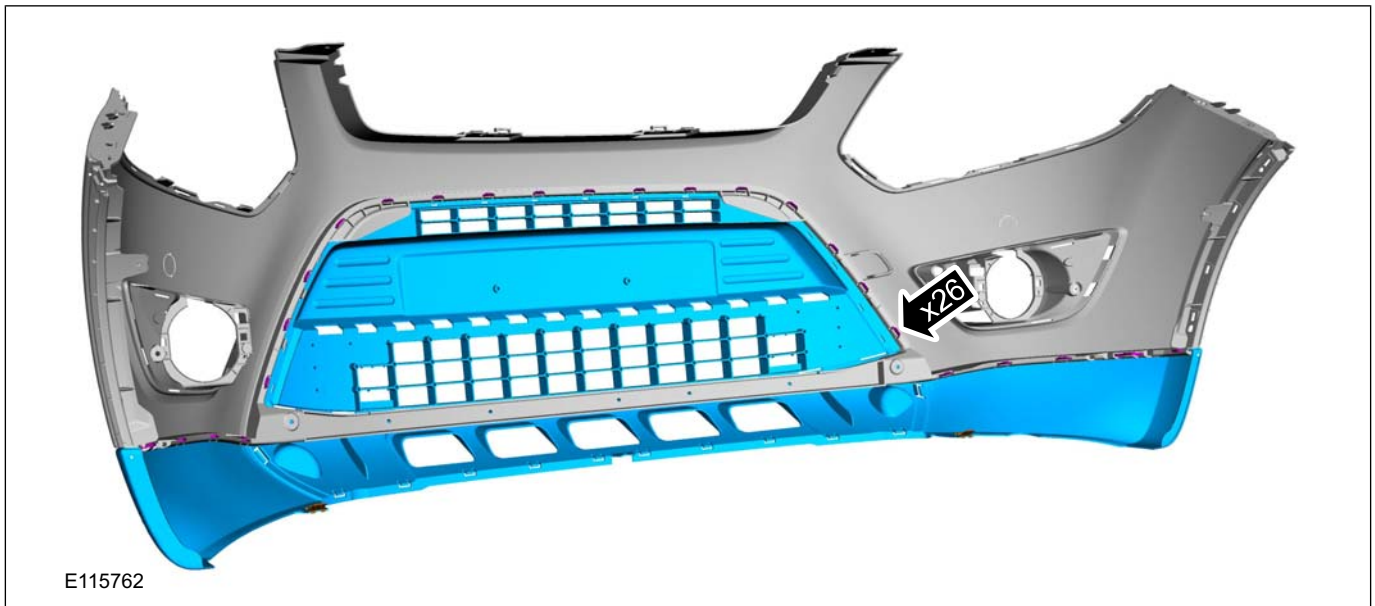
501-19-13

## DISASSEMBLY AND ASSEMBLY

6.



7.



## Assembly

8. To assemble, reverse the disassembly procedure.
9. Refer to: **Front Fog Lamp Adjustment** (417-01 Exterior Lighting, General Procedures).

## DISASSEMBLY AND ASSEMBLY

## Rear Bumper Cover

## Disassembly

Vehicles with parking aid

1. Refer to: **Rear Parking Aid Sensor** (413-13 Parking Aid, Removal and Installation).

All vehicles

2.



3.

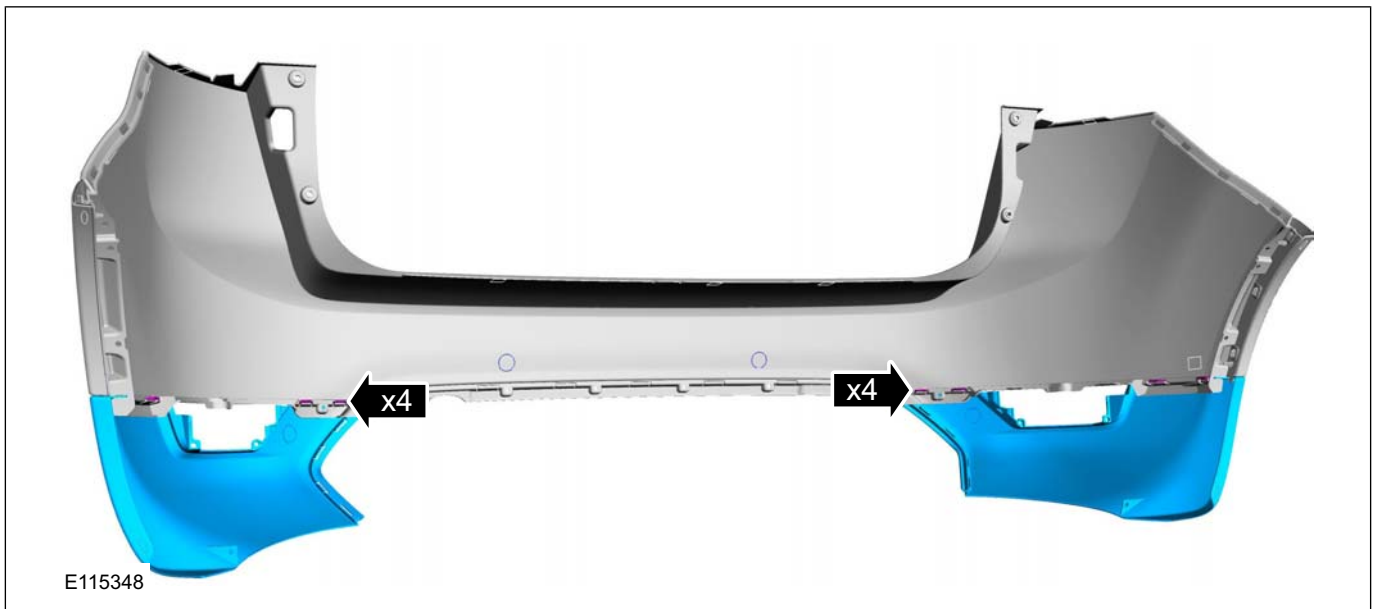




DISASSEMBLY AND ASSEMBLY



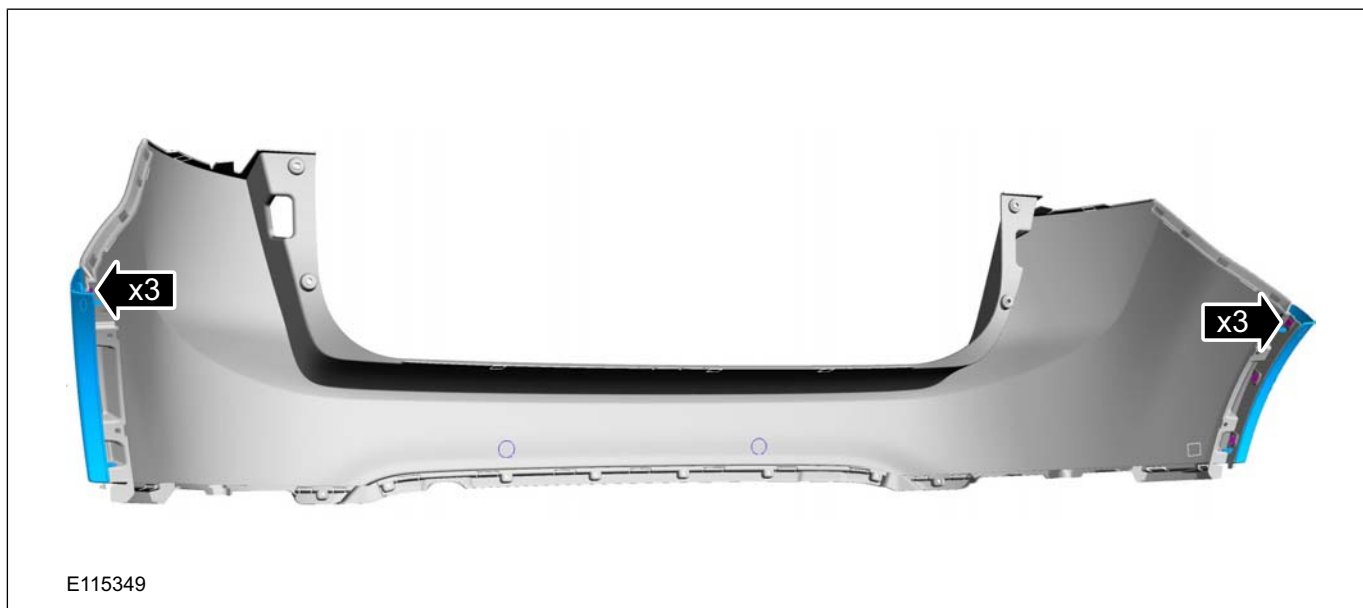
4.



5.



## DISASSEMBLY AND ASSEMBLY



## Assembly

6. To assemble, reverse the disassembly procedure.

## SECTION 501-20A Safety Belt System

VEHICLE APPLICATION: 2008.50 Kuga

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<b>DIAGNOSIS AND TESTING</b>	
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Principles of Operation.....	501-20A-2
Inspection and Verification.....	501-20A-2
Symptom Chart.....	501-20A-3
Component Test.....	501-20A-3
Vehicle Motion Sensor Test.....	501-20A-3
Test Method 1 (braking).....	501-20A-3
Test Method 2 (turning circle).....	501-20A-3
Static Test .....	501-20A-4
<b>REMOVAL AND INSTALLATION</b>	
Front Safety Belt Retractor.....	501-20A-5
Rear Safety Belt Retractor.....	501-20A-6
Rear Center Safety Belt Retractor.....	501-20A-7
Safety Belt Shoulder Height Adjuster.....	501-20A-10
Front Safety Belt Buckle.....	501-20A-11

## DIAGNOSIS AND TESTING

## Safety Belt System

## Principles of Operation

**▲ WARNING: All safety belt components including retractors, buckles, child safety seat tether brackets and attaching hardware in use during a collision must be removed and new components installed. New safety belt components should also be installed where safety belts not in use during a collision, are inspected and found to be damaged or operate incorrectly. Failure to follow these instructions may result in personal injury.**

The occupant restraint system utilizes three-point lap and diagonal safety belts in all seat positions.

Front seats are equipped with safety belt buckle pretensioners, which are controlled as part of the supplemental restraint system (SRS). For additional information,

REFER to: **Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)** (501-20 Supplemental Restraint System, Description and Operation).

The rear seat safety belt buckles are mounted directly to the floor panel.

The safety belt retractor, mounted within the base of the B-pillar, incorporates a torsion bar load limiting device. The device consists of a retractor reel which is mounted onto a spindle (torsion bar) which, once the sensor has locked the retractor reel and predetermined load is applied, twists and pays out additional webbing into the system. The deceleration force required to initiate this sequence is approximately the same as that required to initiate air bag deployment. The torsion bar load limiting device will only react if the safety belt is in use at the time of impact.

Rear seat safety belt retractors do not use this type of retractor, they are equipped with a conventional retractor.

**Emergency Locking Retractor (ELR)**

The retractors in all seat positions feature ELR. The ELR is part of the safety belt system that in

normal operation allows free movement of the belted occupant. In an emergency the ELR will lock, preventing webbing payout and hence forward movement of the occupant. Locking may be achieved by one of two mechanisms:

**Vehicle Motion Sensor (VMS)**

VMS is operated by sudden deceleration of the vehicle or excessive tilt. Once operated the VMS causes a locking pawl to be engaged, thus locking the retractor, preventing webbing payout. When the vehicle is stationary, the VMS stabilizes, causing the pawl to disengage and unlock the retractor, allowing webbing payout.

**Webbing Motion Sensor (WMS)**

The ELR WMS is operated by rapid acceleration of the webbing. Once operated, it causes a locking pawl to be engaged thus locking the retractor. Webbing payout is prevented in the same manner as VMS.

**Inspection and Verification**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical and electrical damage.

**Visual Inspection Chart**

Mechanical
<ul style="list-style-type: none"> <li>• Safety belt retractor</li> <li>• Safety belt buckle and pretensioner</li> <li>• Safety belt buckle</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

## DIAGNOSIS AND TESTING

## Symptom Chart

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>Normal mode - occupant restraint system inoperative</li> </ul>	<ul style="list-style-type: none"> <li>Safety belt retractor.</li> </ul>	<ul style="list-style-type: none"> <li>CARRY OUT the Safety Belt Component Test in this section.</li> </ul>

## Component Test

## Poor Retraction

If a safety belt does not retract correctly, check that the anchor covers and trim bezels are correctly installed and not rubbing against the safety belt webbing. Where necessary, check that the safety belt webbing is not rubbing at one end of the retractor cover slot and, if so, correct by loosening the retaining bolt, aligning the retractor to centralize the safety belt webbing and retighten the bolt.

The safety belts are "dual sensitive" which means that they have:

- a vehicle motion sensor, which locks the safety belt webbing under braking, cornering, on steep hills and in adverse camber conditions.
- a webbing motion sensor, which locks when the safety belt webbing is quickly extracted.

Both systems should be fully operational and can be checked by the tests below:

## Vehicle Motion Sensor Test

Either of the following two procedures may be used to check correct operation of the vehicle motion sensor. Both methods require two technicians but note that technicians of larger than normal build should not be asked to conduct these tests. This is to avoid the possibility of a fully unrolled safety belt webbing being mistaken for a correctly locked safety belt retractor.

## Test Method 1 (braking)

**▲ WARNING:** It is important that during this test, the driver and passenger allow the safety belts to provide the restraint and do not attempt to anticipate the sudden deceleration. The steering wheel should not be used as a brace. However, both driver and passenger should prepare themselves for the possibility that the safety belt will not lock. The passenger should hold their hands in front of them,

just clear of the instrument panel or front seat backrest, depending on which safety belt is being tested. Failure to follow these instructions may result in personal injury.

- Select for this test a quiet or private stretch of road. Make sure that the road is clear and that full visibility is maintained at all times.
- Both driver and passenger should adopt a normal, comfortable seating position. Both occupants should wear the safety belts and the safety belt webbing must be correctly adjusted, with no slack.
- Proceed at a speed of 10 km/h (6 mph). Do not exceed 10 km/h (6 mph) for this test.
- Apply the foot brake sharply to stop the vehicle. If the vehicle motion sensitive lock mechanism is operating correctly, the safety belt webbing will lock and restrain the wearer.
- Conduct the test twice in each front and rear passenger seat position.
- Any safety belt retractor which does not restrain the wearer during this test must not be reused. A new safety belt must be installed.

## Test Method 2 (turning circle)

This method requires a flat open area of private road, sufficient for the vehicle to be driven in a continuous circle on full steering lock.

- The driver should wear the safety belt provided and the belt webbing must be correctly adjusted, with no slack.
- The passenger should occupy a rear seat with the safety belt correctly adjusted, with no slack.
- Start the engine and, with the steering on full right-hand lock, drive the vehicle in a continuous circle at 16 km/h (10 mph). Do not exceed 16 km/h (10 mph) for this test.

## DIAGNOSIS AND TESTING

- When the speed is stable, the passenger should attempt to slowly extract the safety belt webbing from each safety belt retractor in turn. If the vehicle motion sensitive lock mechanism is operating correctly, it will not be possible to extract the webbing.
- Any safety belt retractor from which it is possible to extract the webbing during this test must not be used. A new safety belt must be installed.

### Static Test

With the vehicle stationary and on level ground take firm hold of the safety belt webbing (on the tongue side of the upper safety belt anchor) and pull out quickly. The retractor should lock within 0.25 meter (10 inches), preventing further webbing payout. Any safety belt retractor from which it is possible to extract further webbing must not be used. A new safety belt must be installed.



## REMOVAL AND INSTALLATION

## Front Safety Belt Retractor

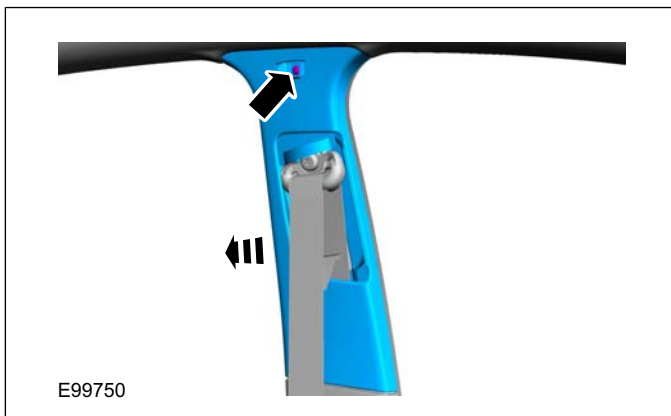
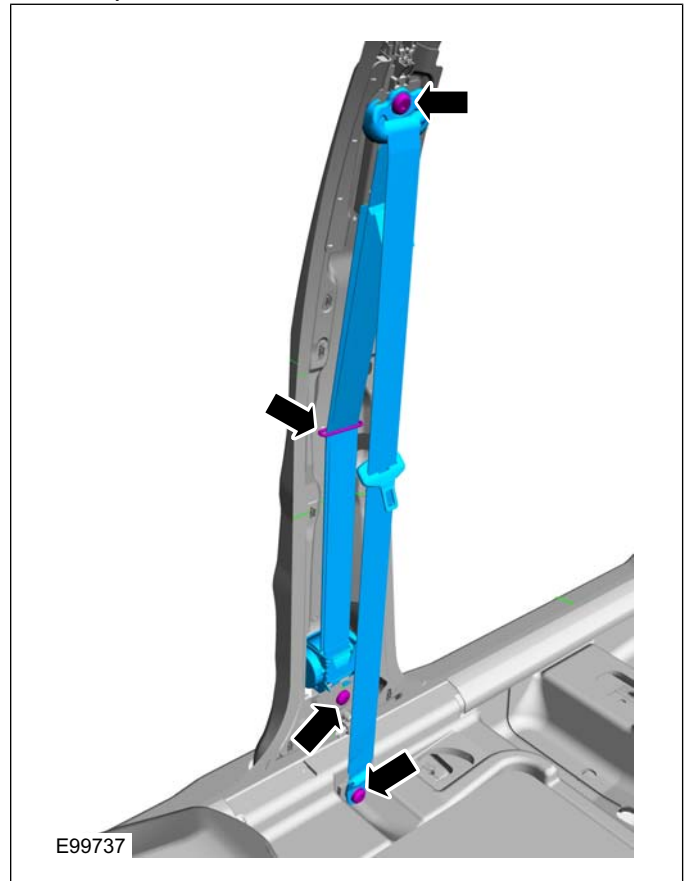
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Supplemental Restraint System (SRS) Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **B-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
- 3.



4.

5. Torque: 35 Nm

## Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Rear Safety Belt Retractor

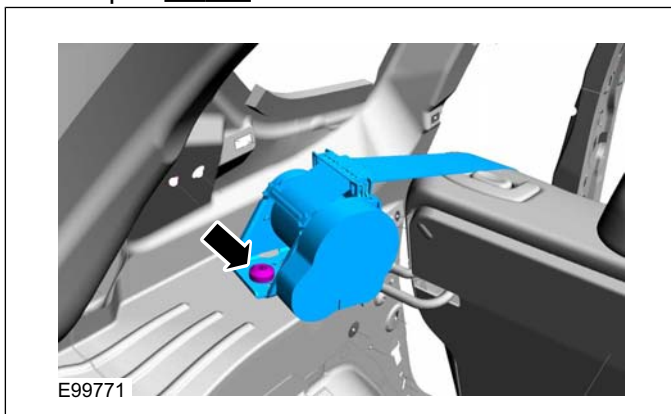
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Supplemental Restraint System (SRS) Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Loadspace Trim Panel LH** (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. **NOTE:** Note the position of the component before removal.

**NOTE:** Make sure that this component is installed to the noted removal position.

Torque: 35 Nm



## Installation

1. To install, reverse the removal procedure.



REMOVAL AND INSTALLATION

Rear Center Safety Belt Retractor

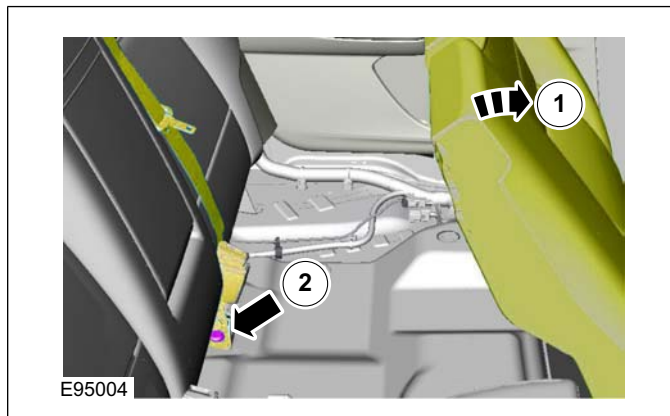
General Equipment

Flat-bladed screwdriver

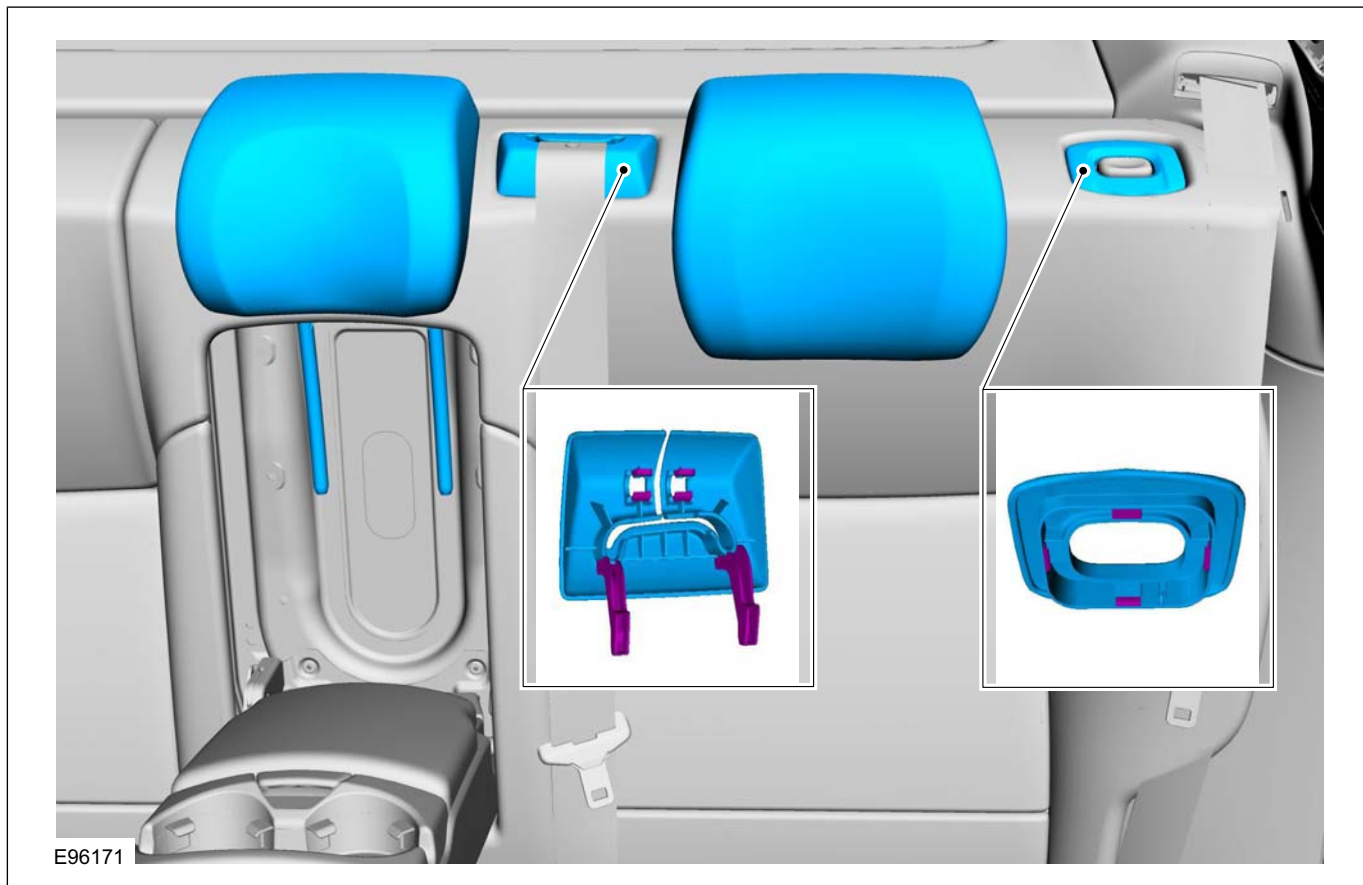
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. 1. On both sides.
2. Torque: 55 Nm



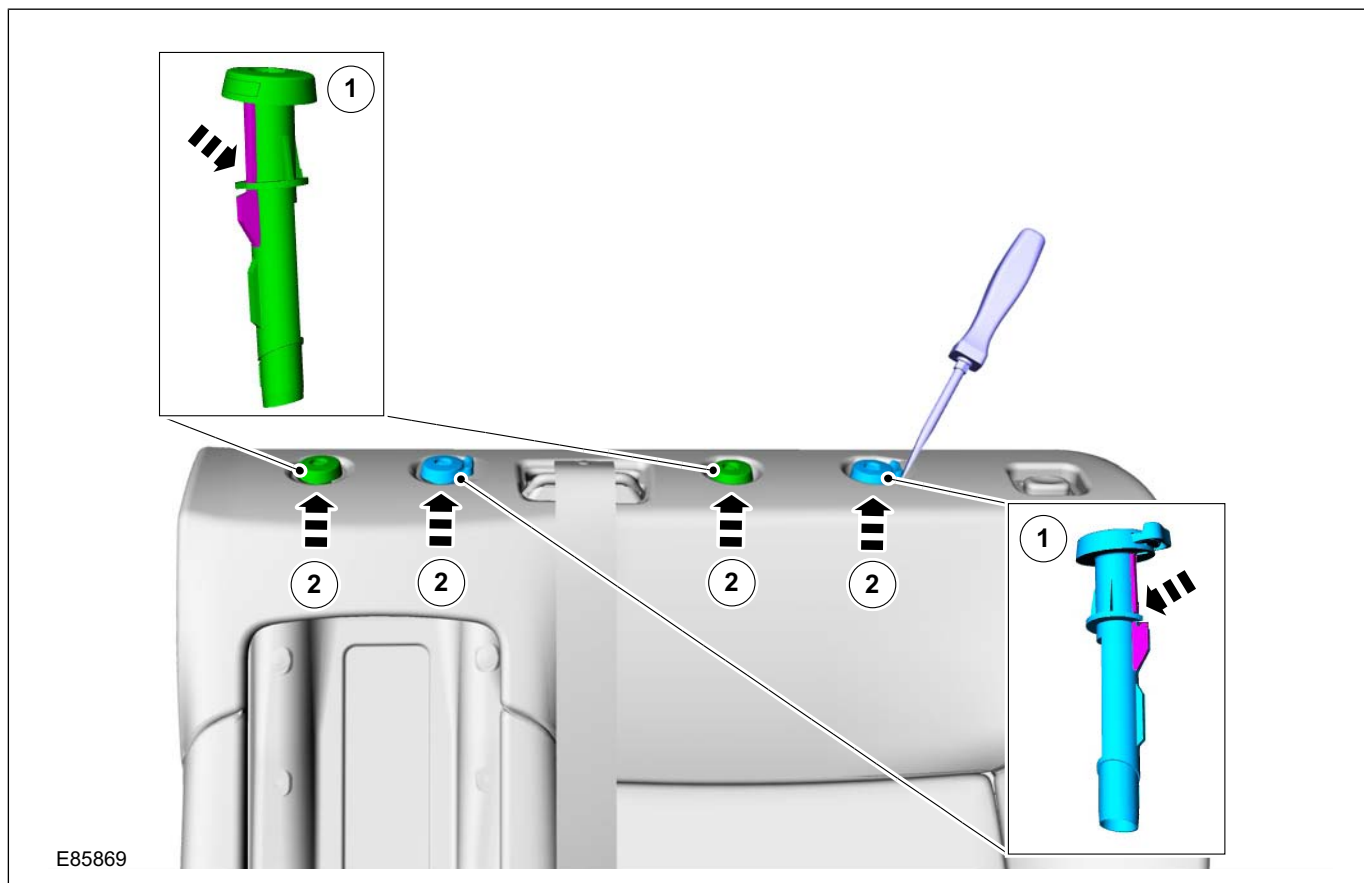
- 2.



3. General Equipment: Flat-bladed screwdriver



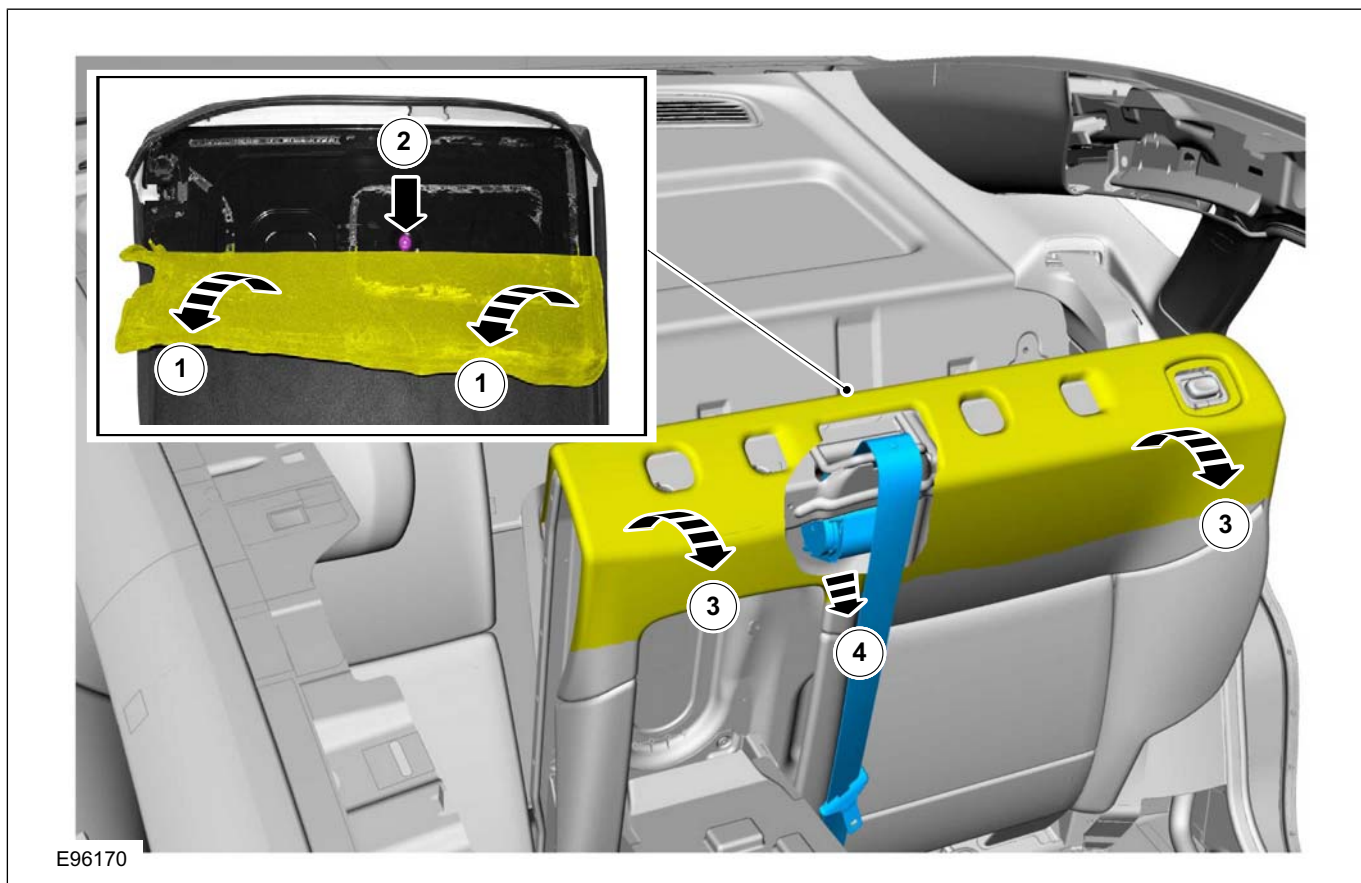
## REMOVAL AND INSTALLATION



4.  **CAUTION:** Touching the adhesive surface will impair rebonding.

Torque: 38 Nm

## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.

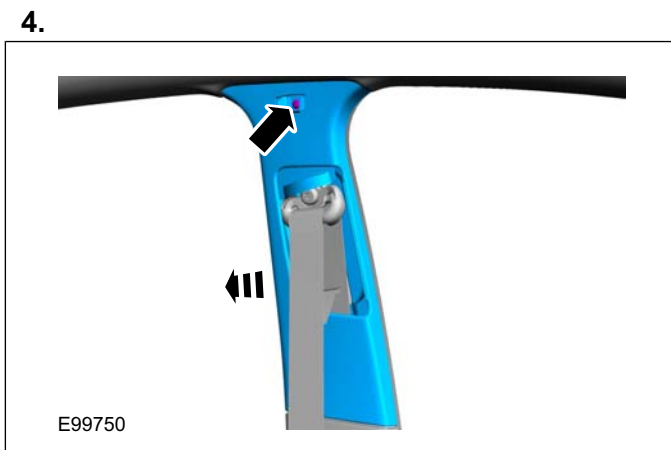
## REMOVAL AND INSTALLATION

## Safety Belt Shoulder Height Adjuster

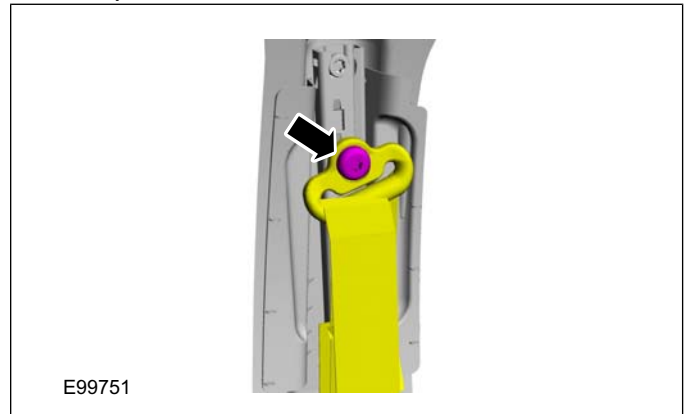
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

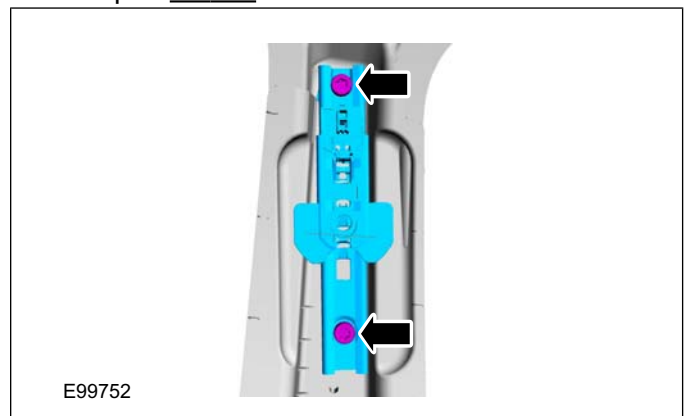
1. Refer to: **Supplemental Restraint System (SRS) Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **B-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
- 3.



5. Torque: 35 Nm



6. Torque: 35 Nm



## Installation

1. To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

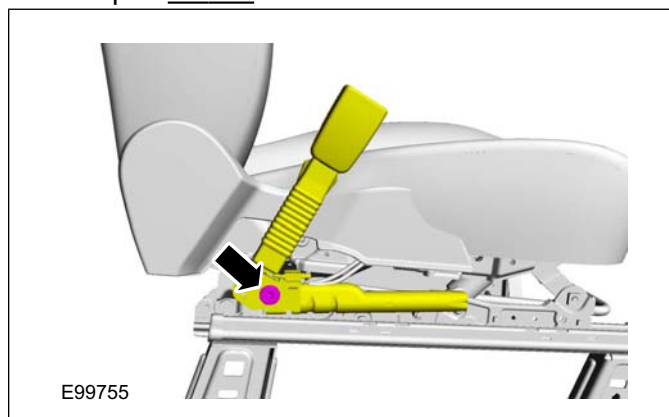
## Front Safety Belt Buckle

## Removal

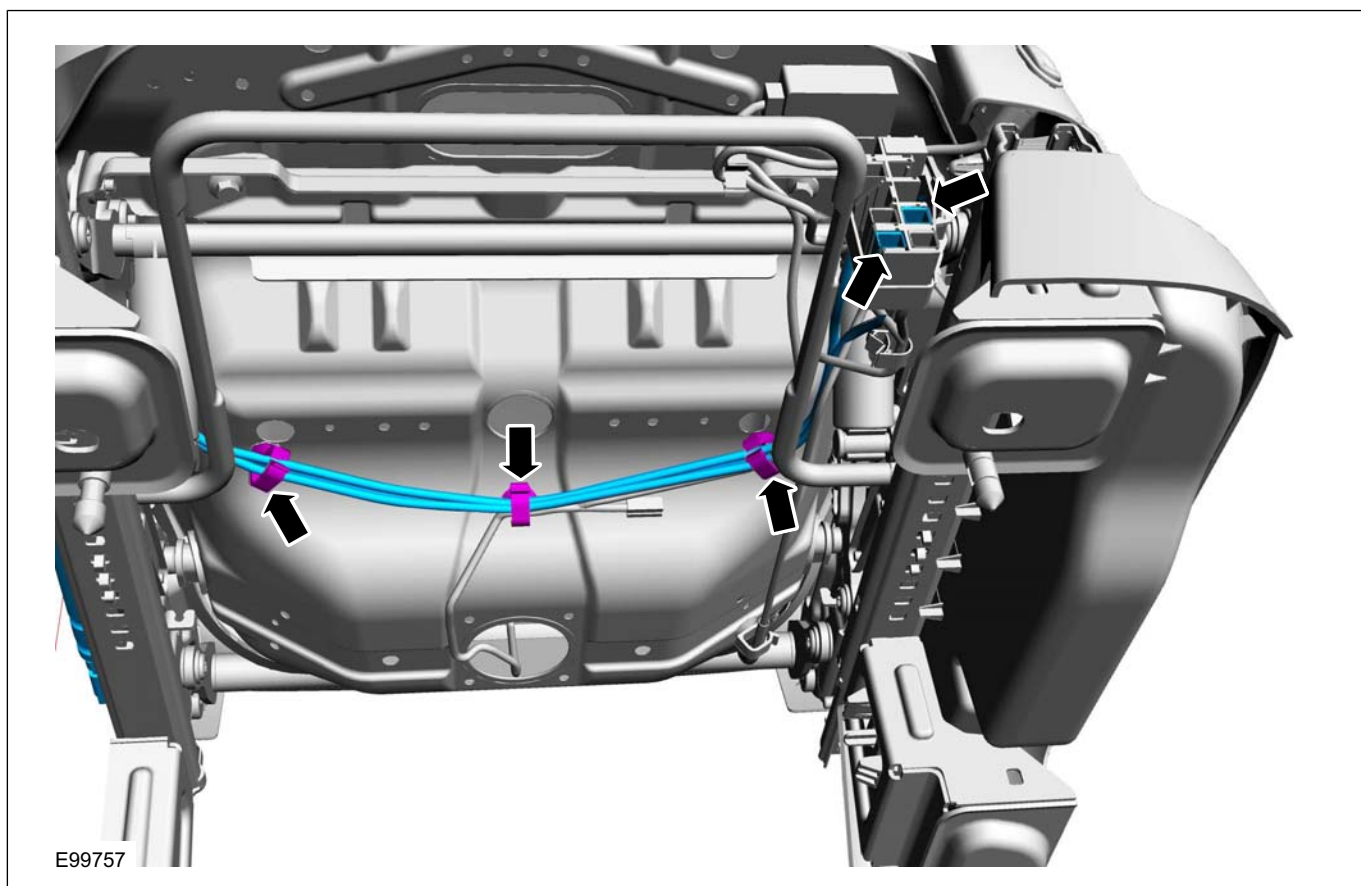
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Seat** (501-10 Seating, Removal and Installation).

2. Torque: 47 Nm



3.



## Installation

1. To install, reverse the removal procedure.

## SECTION 501-20B Supplemental Restraint System

**VEHICLE APPLICATION: 2008.50 Kuga**

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**REMOVAL AND INSTALLATION**

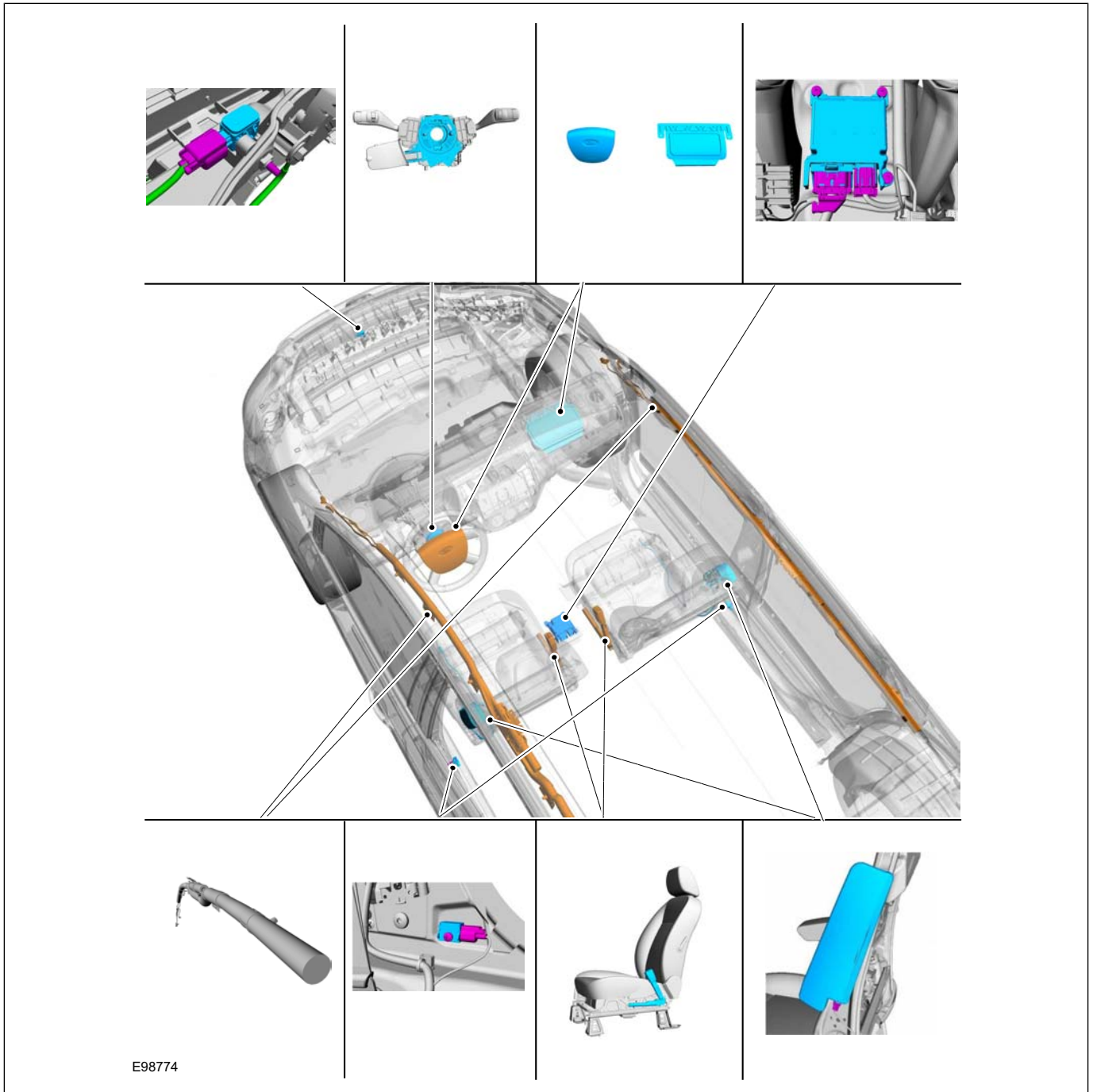
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DESCRIPTION AND OPERATION

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) – Component Location



**DESCRIPTION AND OPERATION**

## Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) – Overview

### Overview

The following instructions must be followed when working on the supplemental restraint system (SRS):

- The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a

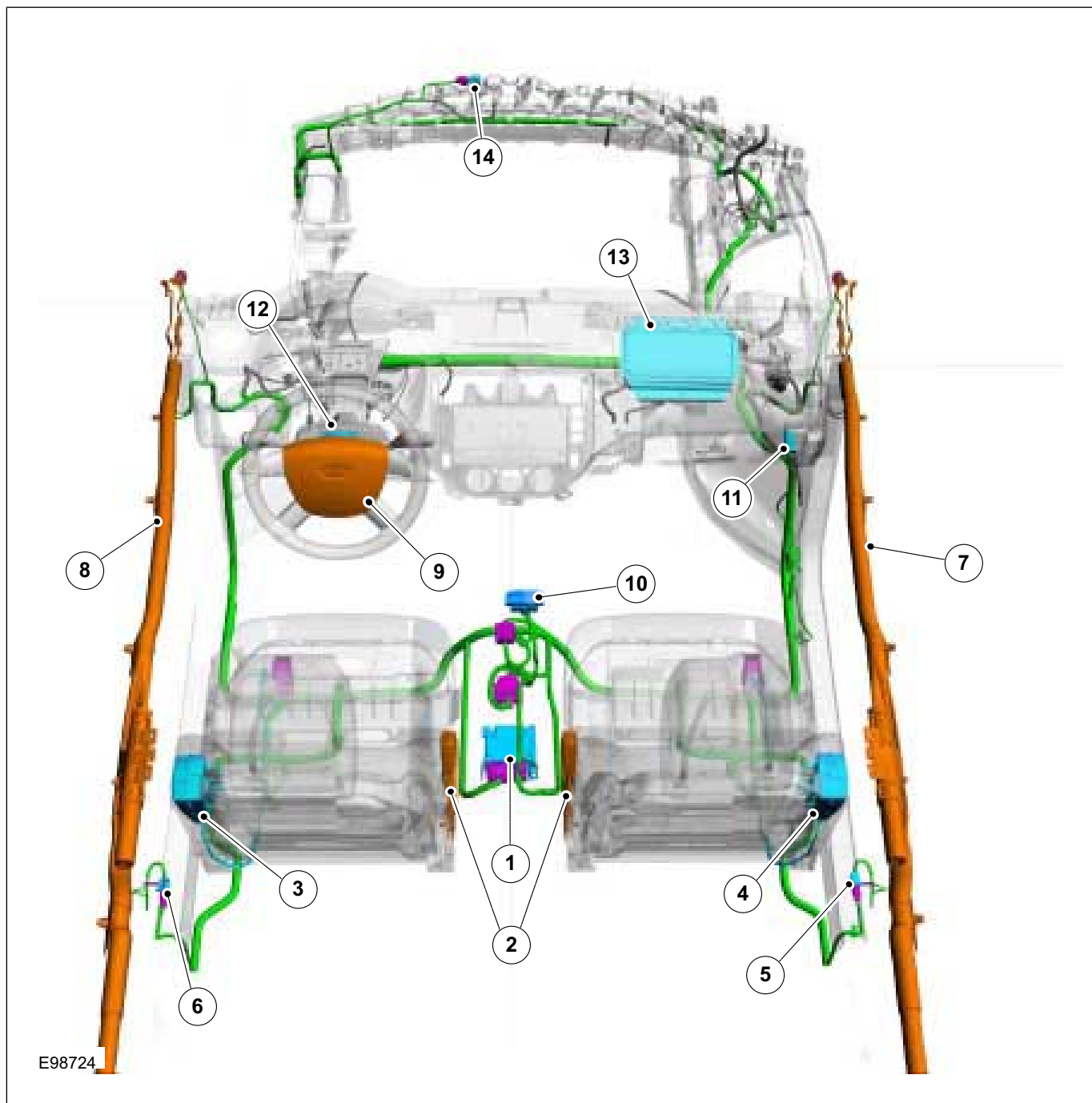
minimum of 3 minutes before disconnecting or removing any SRS components.

- Never use terminal probes to test any connectors of the supplemental restraint system.

Refer to: [Air Bag and Safety Belt Pretensioner Supplemental Restraint System \(SRS\) - Vehicles Built From: 06/2004](#) (501-20 Supplemental Restraint System, Diagnosis and Testing).

- Refer to: [Supplemental Restraint System \(SRS\) Health and Safety Precautions](#) (100-00 General Information, Description and Operation).

DESCRIPTION AND OPERATION



E98724

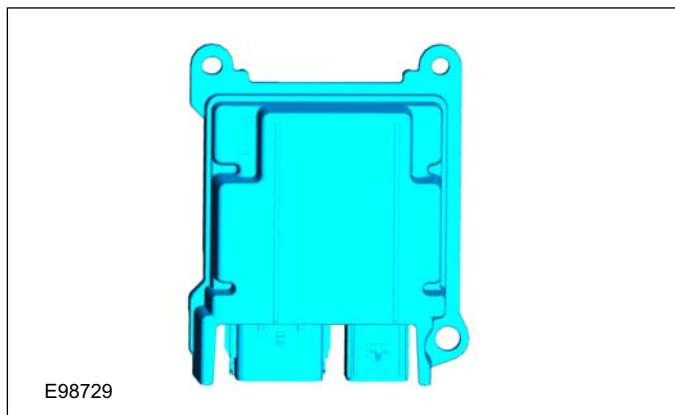
Item	Description
1	Restraints control module (RCM)
2	Pyrotechnic belt pretensioner
3	Side air bag module - Driver side
4	Side air bag module - Passenger side
5	Crash sensor – right-hand
6	Crash sensor – left-hand
7	Curtain air bag – right-hand
8	Curtain air bag – left-hand

Item	Description
9	Driver air bag
10	Warning lamp, passenger airbag deactivation (PAD) switch
11	Passenger air bag module deactivation (PAD) switch
12	Coil spring Refer to: <b>Steering Column Switches</b> (211-05 Steering Column Switches, Description and Operation).



## DESCRIPTION AND OPERATION

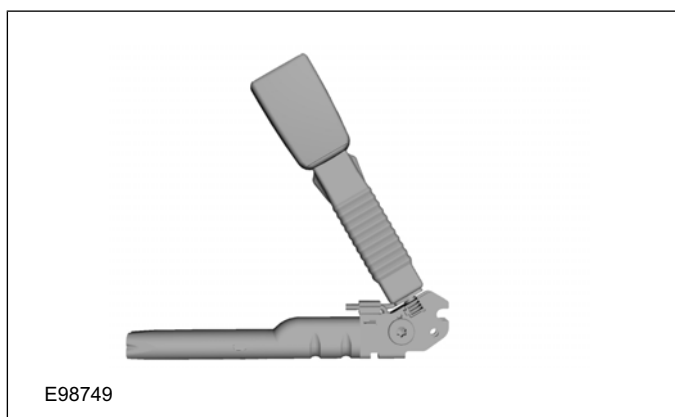
Item	Description
13	Front passenger airbag

**Restraints control module (RCM)**

The RCM is located underneath the center console near the gearshift lever.

The following instructions must be followed when removing, installing or replacing the RCM:

- After an accident, the RCM can only be used again if it is not physically damaged and if it passes a self-test without any faults. For further information refer to TECHNICAL SERVICE BULLETIN 35/2006.
- A new RCM needs to be programmed with the diagnostic unit.

**Pyrotechnic belt pretensioner**

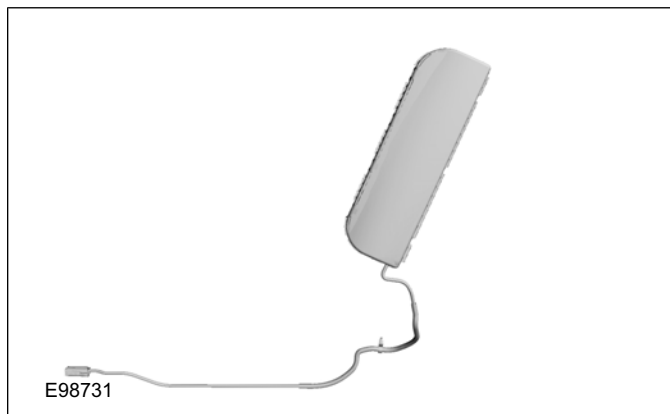
The pyrotechnic pretensioners for the driver and front passenger safety belts are incorporated into the safety belt buckle stalks.

The following instructions must be followed when removing, installing or replacing the safety belt tensioner:

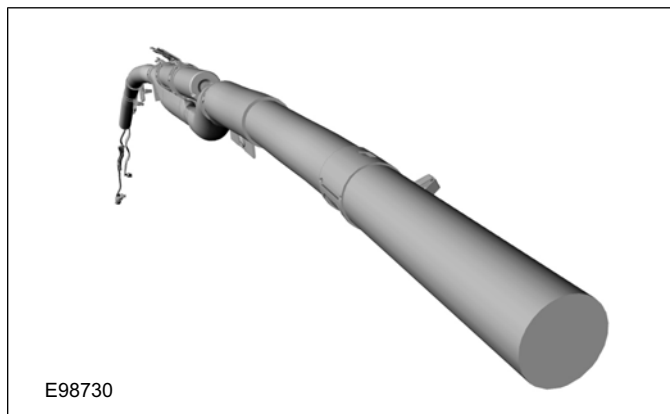
- Note the position and routing of the safety belt buckle pretensioner wiring harnesses to aid

Item	Description
14	Front impact sensor

installation. An incorrectly routed wiring harness may lead to the wiring harness becoming damaged on the seat mechanism.

**Side airbag**

The side airbag modules are integrated in the backrests of the front seats. A label is sewn onto seats with side airbag modules to indicate that a side airbag module is fitted to the seat.

**Side air curtain module**

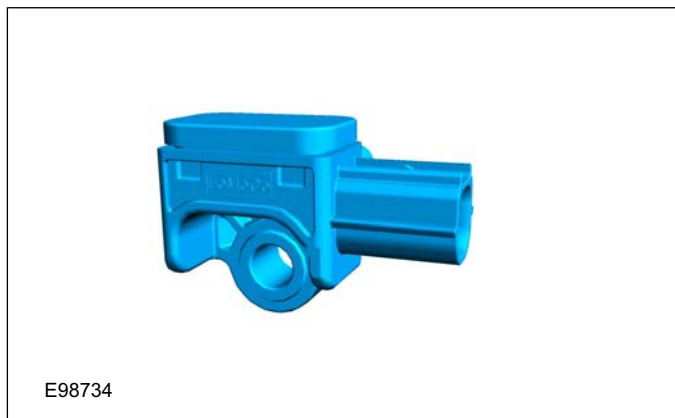
The side air curtain modules are located in the roof rail between the A-pillar and C-pillar.

The following instructions must be followed when removing, installing or replacing the side air curtain module:

- Note the position of each component before removal.
- If the side air curtain was deployed, check the vehicle body side air curtain mountings and ramps for deformation.

DESCRIPTION AND OPERATION

Crash sensor, left/right

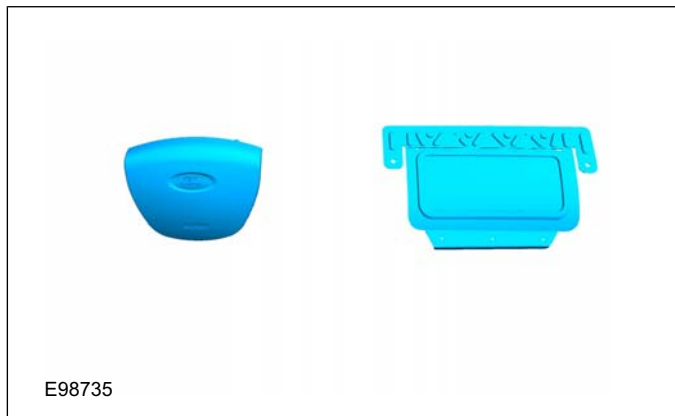


The left/right-hand crash sensors are located at the bottom of the B-pillars. They transmit acceleration data in digital form to the RCM.

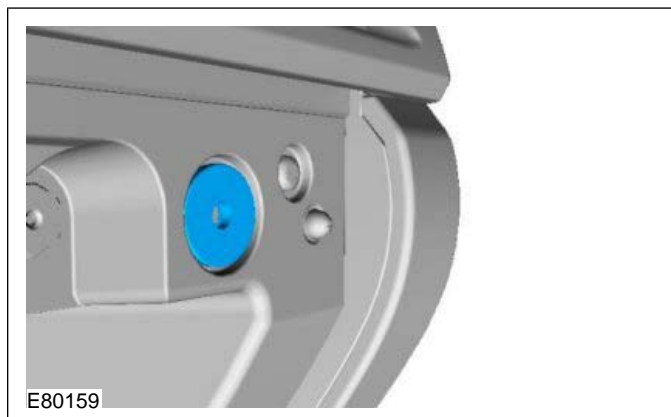
The following instructions must be followed when removing, installing or replacing the left/right-hand crash sensors:

- Continued use of the left/right-hand crash sensors after an accident is permissible provided they have not been physically damaged and they pass a self-test without faults.

Driver airbag module, passenger airbag module

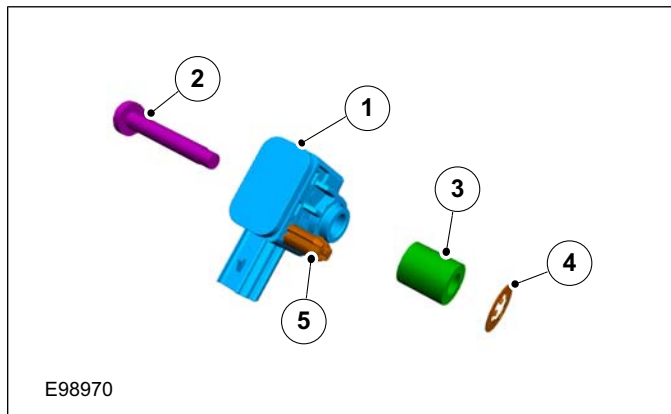


Passenger air bag module deactivation (PAD) switch



A PAD can be fitted by dealers as an option. The switch is integrated in the glove box. The driver can operate the PAD with a vehicle key to deactivate the passenger airbag. For further information refer to the TECHNICAL SERVICE BULLETIN.

Front impact sensor



Item	Description
1	Front impact sensor
2	Bolt, front crash sensor
3	Female connector
4	Serrated washer
5	Locating dowel

The crash sensor is installed at the front of the vehicle next to the hood lock.

**DESCRIPTION AND OPERATION**

The following instructions must be followed when removing, installing or replacing the front crash sensor:

- Continued use of the crash sensor is permissible provided it has not been physically damaged and it passes a self-test.
- Make sure that the front crash sensor is installed in the correct position.

**501-20B-9****Supplemental Restraint System****501-20B-9****DESCRIPTION AND OPERATION**

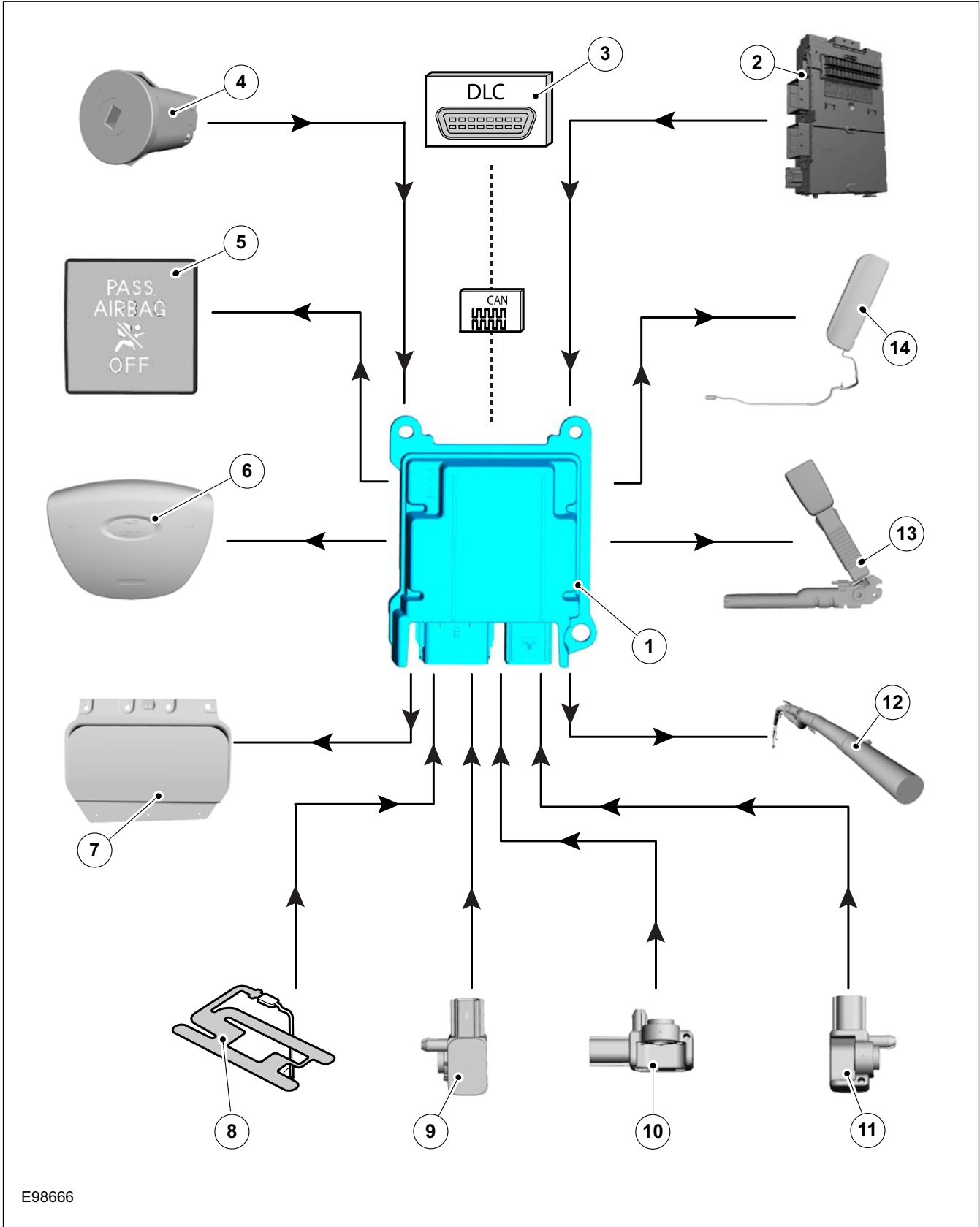
Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) – System Operation and Component Description

**System Diagram**

**VIEW DIAGRAM ON THE NEXT PAGE**



DESCRIPTION AND OPERATION



E98666

Item	Description
1	Restraints control module (RCM)
2	Generic Electronic Module (GEM)

Item	Description
3	Data link connector (DLC)

## DESCRIPTION AND OPERATION

Item	Description
4	Passenger air bag module deactivation (PAD) switch
5	Warning lamp, passenger air bag deactivation (PAD) switch
6	Driver air bag
7	Front passenger airbag
8	Seat occupancy sensor, passenger side

Item	Description
9	Crash sensor, left
10	Front impact sensor
11	Crash sensor, right
12	Side air curtain module
13	Pre-tensioner seat belt
14	Side airbag

## System Operation

When the ignition is switched on the restraints control module (RCM) supplies power to the crash sensors, which perform a self-diagnosis.

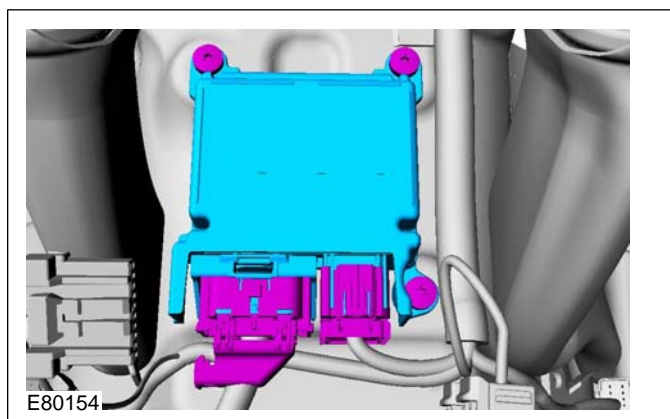
The crash sensors are located at the front of the vehicle and on both sides. Once the self-diagnosis has been successfully completed, the crash sensors continuously send acceleration data to the RCM. The use of multiple crash sensors optimizes airbag deployment times through faster detection of lateral and longitudinal acceleration and improves detection accuracy. Each crash sensor has an accelerometer which receives a current supply from the RCM. The acceleration is transmitted to the RCM, which then makes the decision on whether or not to activate the airbags and pretensioners. In the event of a fault, the affected crash sensor sends an error message to the RCM instead of the acceleration data. The RCM then stores a related fault code and illuminates the air bag warning indicator.

**Triggering process** The front airbags are designed so that they are not triggered in a side or rear impact if they do not offer additional protection to the occupant(s). In exceptional cases, the front air bags can be deployed even by a side impact if the forward motion of the vehicle suddenly comes to a complete stop. Airbags and safety belt pretensioners are triggered according to the severity of the impact in an accident. The exact triggering threshold is determined with the aid of a triggering algorithm which is specially calibrated for the vehicle. This algorithm contains triggering thresholds, which - when exceeded - cause the necessary restraint systems to be deployed according to the severity of the accident. When an impact occurs the airbag is inflated within approx. 30 milliseconds. The occupant reaches maximum immersion in the air bag after 80 ms. Emptying of the fully-inflated bag takes approx. 100 ms. The entire impact and energy absorption process is

completed after approx. 150 ms. The system triggers the safety belt pretensioners first. In a more severe accident the front airbags are also deployed. In a side impact, the relevant side air bag and side air curtain are deployed by the RCM, provided the severity of the side impact is such that the side air bag/side air curtain offers the occupant additional protection. Deployment is triggered on the basis of a signal input from the left or right crash sensor.

## Component Description

## central junction box



Electronic sensors are incorporated into the RCM; these measure the vehicle acceleration/deceleration in the event of a collision. The calculated value is evaluated by the RCM to determine the severity of the impact.

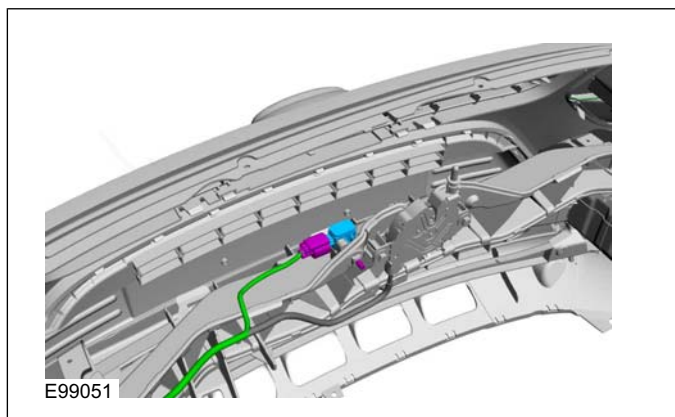
The RCM compares the values it receives from the crash sensor, side impact sensors and the internal electronic sensors. If the deceleration due to a frontal or side impact exceeds a stored threshold value then the RCM triggers the airbags and safety belt pretensioners as required.

**Deployment control:** Depending on the severity of the collision, the RCM decides which of the



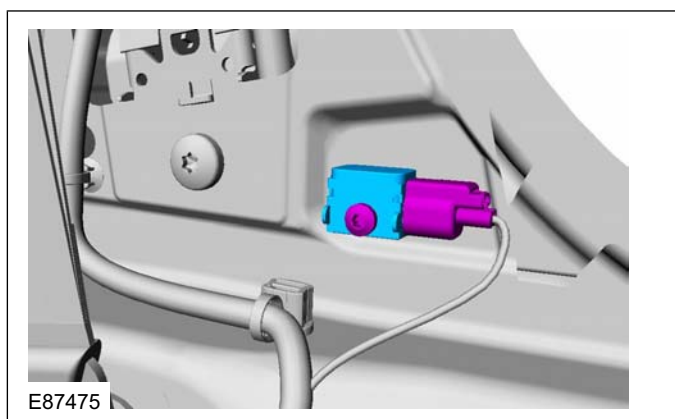
**DESCRIPTION AND OPERATION**

elements of the restraint system should be deployed. An energy reserve in the RCM ensures there is always a minimum of 150 milliseconds of stored energy available if the power supply from the ignition switch is disrupted during a crash. The stored energy is sufficient to produce firing signals for the driver air bag, the passenger air bag and the safety belt pretensioners. When the ignition is switched on the RCM performs cyclical monitoring of the system. If a fault is detected the RCM stores a related fault code and sends the signal to illuminate the air bag warning indicator. Faults can be read out via the diagnostic unit.

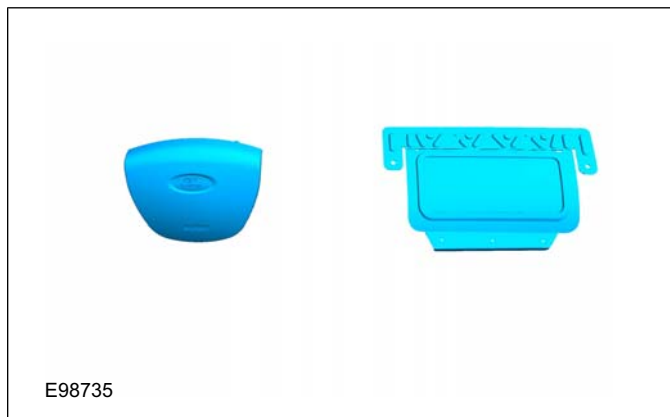
**Front impact sensor**

Data from the crash sensor are evaluated by the RCM to assess the severity of a frontal impact. The crash sensor transmits digitally encoded acceleration information to the RCM.

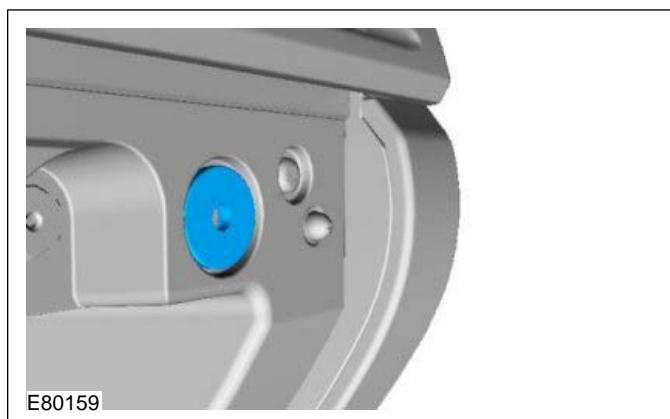
The RCM will store a trouble code (DTC) if one of the crash sensors fails.

**Crash sensor, left/right**

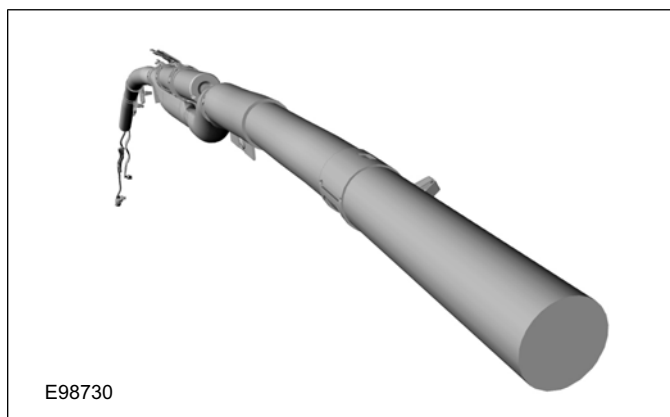
The left/right crash sensors transmit digitally encoded acceleration information to the RCM.

**Driver and passenger front air bag system.**

The driver and passenger air bags are single-stage air bags.

**Passenger Air Bag Deactivation**

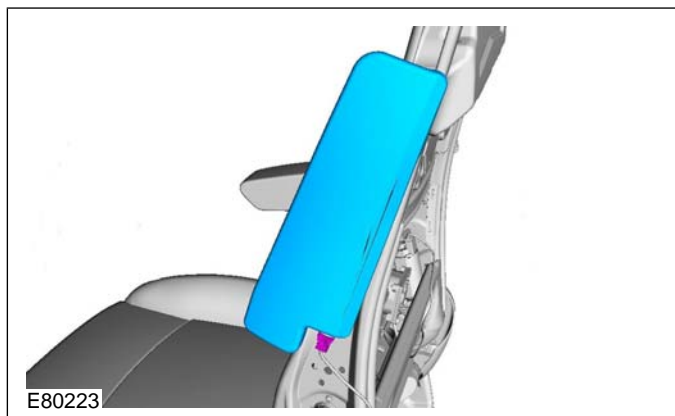
When the ignition is switched on, a warning lamp in the instrument panel indicates to the driver and passenger that the passenger air bag module has been deactivated.

**Side air curtain module**

**DESCRIPTION AND OPERATION**

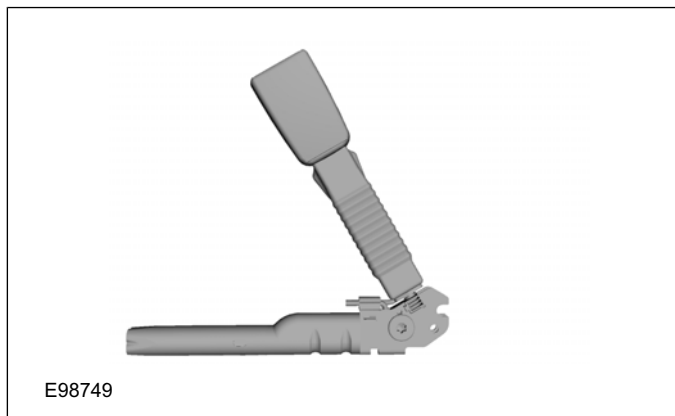
In the event of a side impact the relevant side air curtain is deployed and forms a protective cushion between the corresponding side window and the head of the person(s) sat on the front and rear seat.

The side air curtains are deployed simultaneously with the side air bags.

**Side airbag**

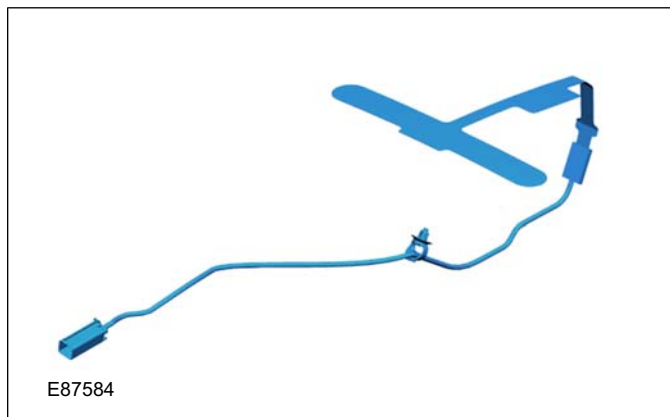
E80223

When a side air bag is deployed, the seam of the seat cover tears open enabling the side air bag to inflate unhindered from the front seat backrest.

**Pre-tensioner seat belt**

E98749

In the event of a collision, the safety belt pretensioners are either triggered alone or together with the front airbags depending on the severity of the impact.

**Seat occupancy sensor, passenger side**

E87584

The seat occupancy sensor is located in the cushion of the passenger seat between the foam lining and the cover. The sensor consists of a foil contact circuit, embedded in a plastic sheet. Weight on the sensor reduces the resistance of the circuit.

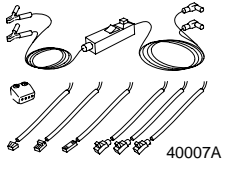

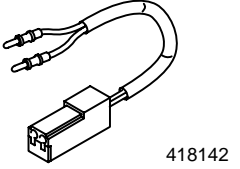
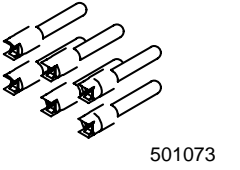
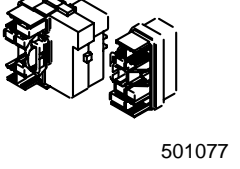
The safety belt buckle switch provides an output signal in response to the insertion of the safety belt tongue into the buckle. The output signal from the switch is used by the RCM to determine whether the front seat occupants are correctly restrained.

DIAGNOSIS AND TESTING

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) — Vehicles Built From: 06/2004

Refer to Wiring Diagrams Section 501-20B, for schematic and connector information.

Special Tool(s) / General Equipment

 <p>40007A</p>	<p>Test and Deployment Lead, Air Bag/Pyrotechnic Safety Belt 418-S055</p>
 <p>418525</p>	<p>Test and Deployment Lead; Driver, Passenger and Side Air Curtain Module 418-525</p>
 <p>418142</p>	<p>Test and Deployment Lead, Side Air Bag Module 418-555</p>
 <p>501073</p>	<p>Simulator, Driver and Passenger Air Bags and Side Air Curtains 501-073A</p>
 <p>501077</p>	<p>Simulator, Occupant Restraint Systems 501-077</p>
<p>Ford diagnostic equipment</p>	

Inspection and Verification

1. Verify the customer concern by operating the system.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Electrical
<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Loose or corroded electrical connector(s)</li> <li>• Circuit(s)</li> <li>• Safety belt buckle switch</li> <li>• Passenger seat mat minder</li> <li>• Safety belt pretensioners</li> <li>• Driver frontal air bag</li> <li>• Passenger frontal air bag</li> <li>• Driver and passenger side air bags (if equipped)</li> <li>• Driver and passenger side air curtains (if equipped)</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

Diagnosing Customer Concerns Without Hard DTCs

**WARNING:** To avoid accidental deployment, the restraints control module (RCM) backup power supply must be depleted. Wait at least one minute after disconnecting the battery ground cable(s) before commencing any repair or adjustment to the supplemental restraint system (SRS), or any component(s) adjacent to the SRS sensors. Failure to follow these instructions may result in personal injury.

**NOTE:** Following the pinpoint tests when a diagnostic trouble code (DTC) is not present, or the air bag warning lamp is not permanently illuminated, will result in needless replacement of air bag system components and repeat repairs.

Speak with the customer to determine if a particular set of conditions must be met in order for a fault to occur. If an illuminated air bag warning lamp is

**DIAGNOSIS AND TESTING**

reported by the customer but is not present when the vehicle comes in for repair, pinpoint test diagnostics cannot be used.

**Diagnosing Customer Concerns with Hard DTCs**

**▲ WARNING: Do not use substitute air bag simulators when working on the SRS. Use only the appropriate tool. Failure to follow these instructions may result in personal injury.**

Most air bag system diagnostic procedures require the use of system deactivation and system reactivation procedures. These procedures require the air bag module(s) and safety belt buckle pretensioners to be disconnected from the SRS, thereby removing the risk of air bag deployment while diagnostics are carried out.

Air bag simulators are required to carry out diagnosis and testing of the air bag system. The simulator contains a resistor, used to simulate an air bag module connection to the system. It is not acceptable to short-circuit the air bag module connections with a 0 ohm jumper wire. If a 0 ohm jumper wire is used to short-circuit the air bag module connections, an illuminated air bag warning lamp will be displayed and a DTC logged by the RCM.

**Deactivation**

**▲ WARNING: To avoid accidental deployment, the RCM backup power supply must be depleted. Wait at least one minute after disconnecting the battery ground cable(s) before commencing any repair or adjustment to the SRS, or any component(s) adjacent to the SRS sensors. Failure to follow these instructions may result in personal injury.**

1. Disconnect the battery ground cable.

REFER to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).

2. Wait at least one minute for the backup power supply in the RCM to deplete its stored energy.

**▲ WARNING: To minimize the possibility of premature deployment, live air bag modules must only be placed on work benches which have been ground bonded and with the trim cover facing up. Failure**

**to follow these instructions may result in personal injury.**

- Remove the driver air bag module from the vehicle.
- REFER to: **Driver Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation).

- Disconnect the driver air bag module electrical connector from the clockspring wiring harness.
- Connect the driver air bag simulator to the clockspring wiring harness in place of the driver air bag module at the top of the steering column.
- Remove the passenger air bag module from the vehicle.

REFER to: **Passenger Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation).

- Disconnect the passenger air bag module electrical connector.
- Connect the passenger air bag simulator to the wiring harness in place of the passenger air bag module.
- Remove the side air curtain modules from the vehicle.

REFER to: **Side Air Curtain Module** (501-20 Supplemental Restraint System, Removal and Installation).

- Disconnect the side air curtain module electrical connectors on both sides.
- Connect the side air curtain simulators to the wiring harnesses in place of the side air curtain modules.
- Remove the side air bag modules from the vehicle.

REFER to: **Side Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation).

- Disconnect the side air bag module electrical connectors on both sides.
  - Connect the side air bag simulators to the wiring harnesses in place of the side air bag modules.
3. Disconnect the driver side underseat occupant restraint systems electrical connector.
  4. Connect the occupant restraint systems simulator to the driver side underseat occupant restraint systems electrical connector in place of the safety belt pretensioner and side air bag module.

**DIAGNOSIS AND TESTING**

5. Disconnect the passenger side underseat occupant restraint systems electrical connector.
6. Connect the occupant restraint systems simulator to the passenger side underseat occupant restraint systems electrical connector in place of the safety belt pretensioner and side air bag module.
7. Connect the battery ground cable.

REFER to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).

**Reactivation**

**▲ WARNING: The air bag simulators must be removed and the air bag modules reconnected when reactivated to avoid non-deployment in a collision. Failure to follow this instruction may result in personal injury.**

1. Disconnect the battery ground cable.

REFER to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).

- Wait at least one minute for the backup power supply in the RCM to deplete its stored energy.
- Remove the driver air bag simulator from the sub-harness at the top of the steering column.
- Connect and install the driver air bag module.

REFER to: **Driver Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation).

- Remove the passenger air bag simulator from the passenger air bag module wiring harness.
- Connect and install the passenger air bag module.

REFER to: **Passenger Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation).

- Remove the side air curtain simulators from the side air curtain module wiring harnesses.
- Connect and install the side air curtain modules.

REFER to: **Side Air Curtain Module** (501-20 Supplemental Restraint System, Removal and Installation).

- Remove the side air bag simulators from the side air bag module wiring harnesses.

- Connect and install the side air bag modules.  
REFER to: **Side Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation).
- Remove the driver side underseat occupant restraint systems simulator.
- Connect the driver side underseat occupant restraint systems electrical connector.
- Remove the passenger side underseat occupant restraint systems simulator.
- Connect the passenger side underseat occupant restraint systems electrical connector.
- Connect the battery ground cable.  
REFER to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
- Prove out the system.

**Glossary****Air Bag Simulator**

Air bag simulators are used to simulate air bag module connections to the system.

**Deactivate the System**

Deactivate the system means to carry out the deactivation procedure. REFER to Deactivation in this procedure.

**Prove Out the System**

The air bag warning indicator will illuminate for three seconds. If there is a fault condition, the air bag warning indicator will stay illuminated or illuminate after a five second delay.

**Reactivate the System**

Reactivate the system means to carry out the reactivation procedure. REFER to Reactivation in this procedure.

**Principles of Operation****SRS Operation**

The vehicle is equipped with a DC fired sensing system.

In the event of a severe frontal or three-quarter frontal impact, in excess of a predetermined limit,



**DIAGNOSIS AND TESTING**

the driver and passenger front air bags and safety belt retractor pretensioners will deploy.

In the event of a severe full side impact, in excess of a predetermined limit, either the driver or passenger side air bag, side air curtain (if equipped) and both safety belt buckle pretensioners will deploy.

Air bag deployment will only occur, in the event of a severe collision, when the ignition key is in the RUN position. The passenger air bag deactivation (PAD) switch (if equipped) will deactivate the passenger frontal air bag in the event of a severe frontal impact; it will not deactivate any other deployable device.

**RCM**

The RCM retains full control of the whole system, providing continual system checks and full diagnostic capabilities. The non-volatile memory stores the diagnostic trouble codes, which can then be downloaded through the data link connector (DLC) to the Ford diagnostic equipment.

In the event of a failure in the vehicle supply during an accident, the RCM provides a backup power supply, sufficient to deploy the air bag(s) for a minimum of 150 ms. The backup power supply is discharged by the RCM within 60 seconds of the battery ground cable being disconnected.

The RCM contains electronic acceleration sensors which measure the longitudinal acceleration and the lateral acceleration and provide both signals to the micro-controller proportional to the amount of acceleration measured. The RCM also contains a safing sensor, which prevents unintentional deployment of the front air bags and safety belt buckle pretensioners and knee air bag (if equipped) in the event of a fault within the electronic acceleration sensor(s). The RCM compares the values it receives from the crash sensor, side impact sensors, safing sensor and the internal electronic sensors. If the deceleration due to a frontal or side impact exceeds a stored threshold value then the RCM triggers the air bags and safety belt pretensioners as required.

**Front Crash Sensor**

The front crash sensor contains an acceleration sensor, filter, amplifier and an application specific integrated circuit for signal transmitting and is mounted on the radiator grille opening panel

reinforcement. The front crash sensor sends a signal at a level determined by the crash severity to the RCM. The RCM will evaluate the signal against stored data and deploy the frontal air bags and safety belt buckle pretensioners if required. Both the front crash sensor and the internal RCM longitudinal acceleration sensor must exceed a preset limit to initiate the air bag.

**Side Impact Sensor**

The side impact sensors are mounted at the base of the B-pillar on either side of the vehicle, to facilitate remote lateral impact sensing. Each side impact sensor contains an acceleration sensor, filter, amplifier and an application specific integrated circuit for signal transmitting. In the event of an impact, in excess of a predetermined limit, the side impact sensor sends a signal at a level determined by the crash severity to the RCM. The RCM will evaluate the signal against stored data and deploy the side air bag on the side the deployment request was initiated. Both the side impact sensor and the internal RCM lateral acceleration sensor must exceed a preset limit to initiate the air bag. The RCM retains control of the side air bags, side air curtains.

**Air Bag Warning Indicator**

The air bag warning indicator is incorporated into the instrument cluster, together with the automatic detach detect circuit. The air bag warning indicator illuminates for 3.2 seconds at key ON and goes OFF for 4.8 seconds. If the system self-tests OK the indicator will stay OFF, but if there is a fault condition, the air bag warning indicator will come ON again and stay illuminated.

The system is designed to illuminate the air bag warning indicator continuously if the RCM circuit is broken, either by loss of power, ground supply, module disconnect or CAN BUS failure.




Diagnostic evaluation of the SRS should be made through the DLC using the Ford diagnostic equipment to establish the nature of the concern.



## GENERAL PROCEDURES

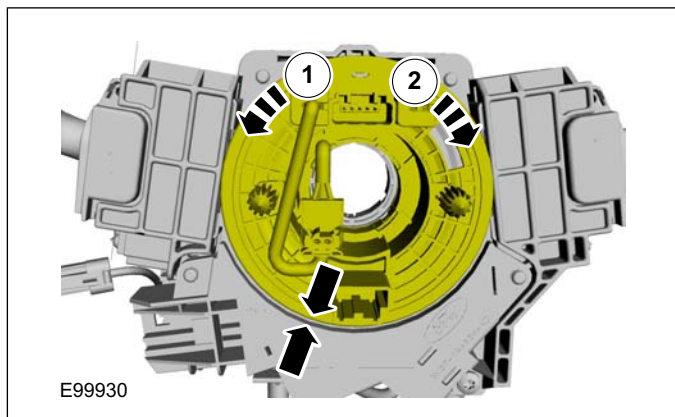
## Clockspring Adjustment

## WARNINGS:

-  If there is a break between installing the clockspring and steering wheel rotation sensor assembly and installing the steering wheel, the centralizing of the clockspring must be repeated.
-  If the centralization of the clockspring is in doubt, the centralizing of the clockspring must be repeated.
-  **CAUTION:** The clockspring and steering wheel rotation sensor assembly must not be rotated in a clockwise direction more than 3 revolutions.

**NOTE:** Make sure that the road wheels are in the straight ahead position.

1. 1. Turn the clockspring in a counterclockwise direction until a resistance is felt.
2. Turn the clockspring in a clockwise direction 3 revolutions, until the arrow marked on the rotor of the clockspring aligns with the raised 'V' section on the outer cover of the clockspring



2. Using a suitable piece of tape, secure the clockspring rotor to the clockspring body.

**GENERAL PROCEDURES****Deployed Air Bag Disposal**

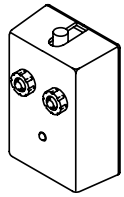
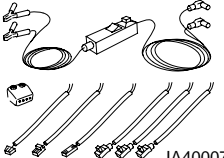
**▲ WARNING:** After deployment, the air bag module surface may contain deposits of sodium hydroxide, a product of the gas generate combustion, that is irritating to the skin. Use protective gloves when handling any deployed air bag module. Failure to follow this instruction may result in personal injury.

1. Remove the deployed air bag module(s). For additional information, refer to the relevant procedure in this section.
2. Seal the deployed air bag module(s) in the packaging from the new air bag module(s) or a suitable polythene bag, and then dispose of in accordance with local contaminated waste regulations.

## GENERAL PROCEDURES

Scrapped Vehicle Air Bag and Safety Belt Pretensioner Disposal  
- In-Vehicle Disposal

## Special Tool(s)

 <p>418143</p>	<p>418-143 Adapter Box (AC)</p>
 <p>IA40007</p>	<p>418-S055C Test and Deployment Lead, Air Bag/Pyrotechnic Safety Belt</p>

## Disposal

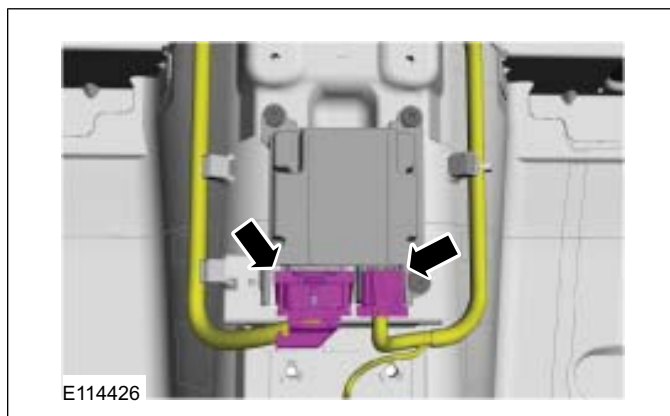
## WARNINGS:

- ▲ To avoid accidental deployment, the restraints control module (RCM) backup power supply must be depleted. Wait at least one minute after disconnecting the battery ground cable(s) before commencing any repair or adjustment to the supplemental restraint system (SRS), or any component(s) adjacent to the SRS sensors. Failure to follow these instructions may result in personal injury.
- ▲ To minimize the possibility of premature deployment, do not use radio key code savers when working on the SRS. Failure to follow this instruction may result in personal injury.
- ▲ Before deploying the air bag module or safety belt pretensioner pyrotechnic make sure that all personnel in the vicinity are aware that a loud noise (bang) is about to occur. Do not let anybody approach closer than 6 meters. Failure to follow this instruction may result in personal injury.
- ▲ The air bag module or the safety belt pretensioner should not be handled immediately following deployment as the air bag module will be very hot. Failure to

follow this instruction may result in personal injury.

- ▲ After deployment, the inflator(s) becomes inert, direct contact to the skin or eyes of any free pyrotechnic residues should be avoided. Failure to follow this instruction may result in personal injury.
- ▲ Always wear gloves and safety glasses when handling deployed air bag modules and safety belt pretensioners, Failure to follow this instruction may result in personal injury.
- ▲ If the air bag module or safety belt pretensioner pyrotechnic residue should contact the eyes, wash the eyes with clean water and seek medical assistance. Failure to follow this instruction may result in personal injury.
- ▲ If a large amount of air bag or safety belt pretensioner pyrotechnic residue is inhaled, seek medical assistance. Failure to follow this instruction may result in personal injury.

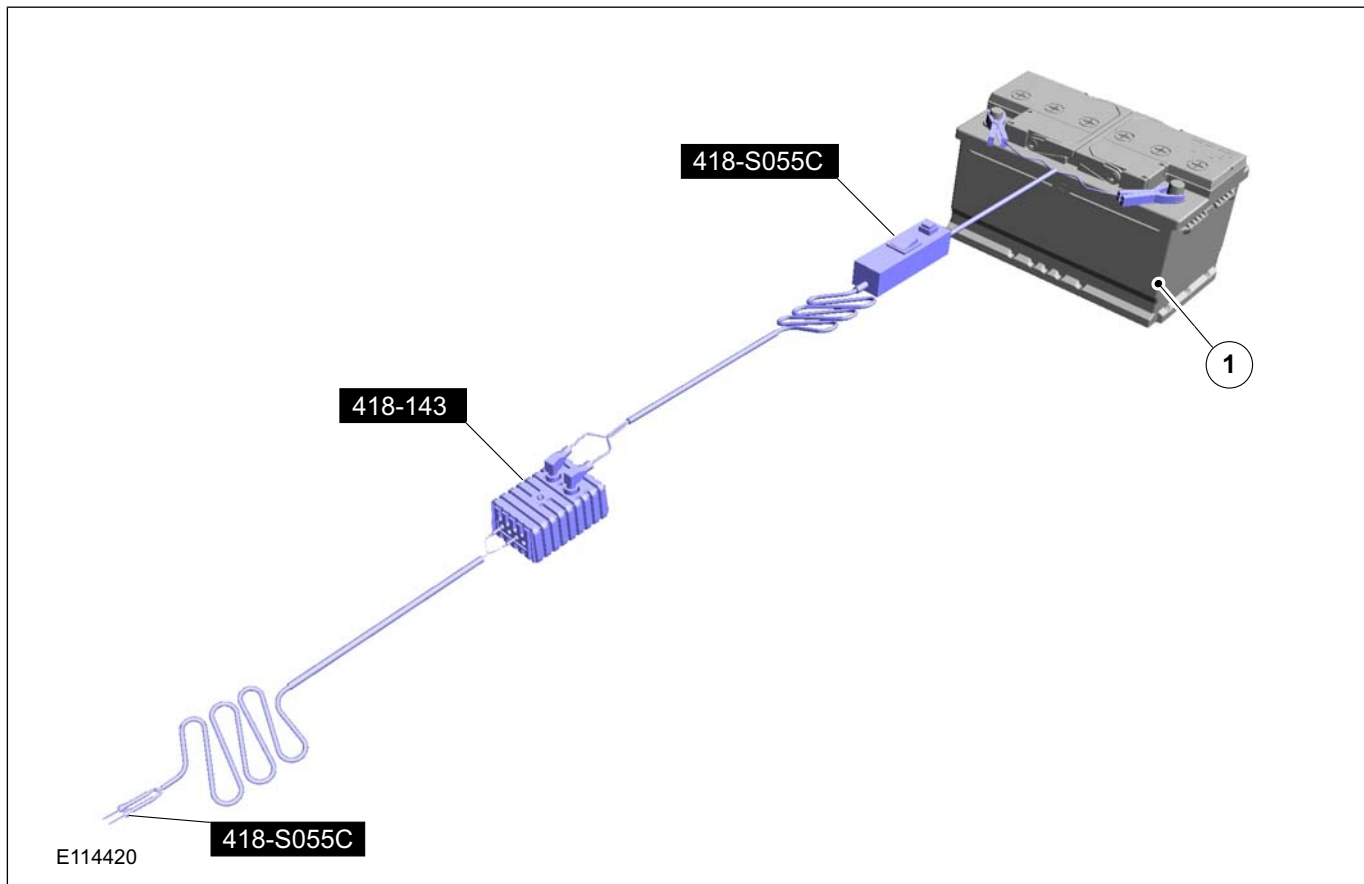
3. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
4. Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation). Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation).
- 5.



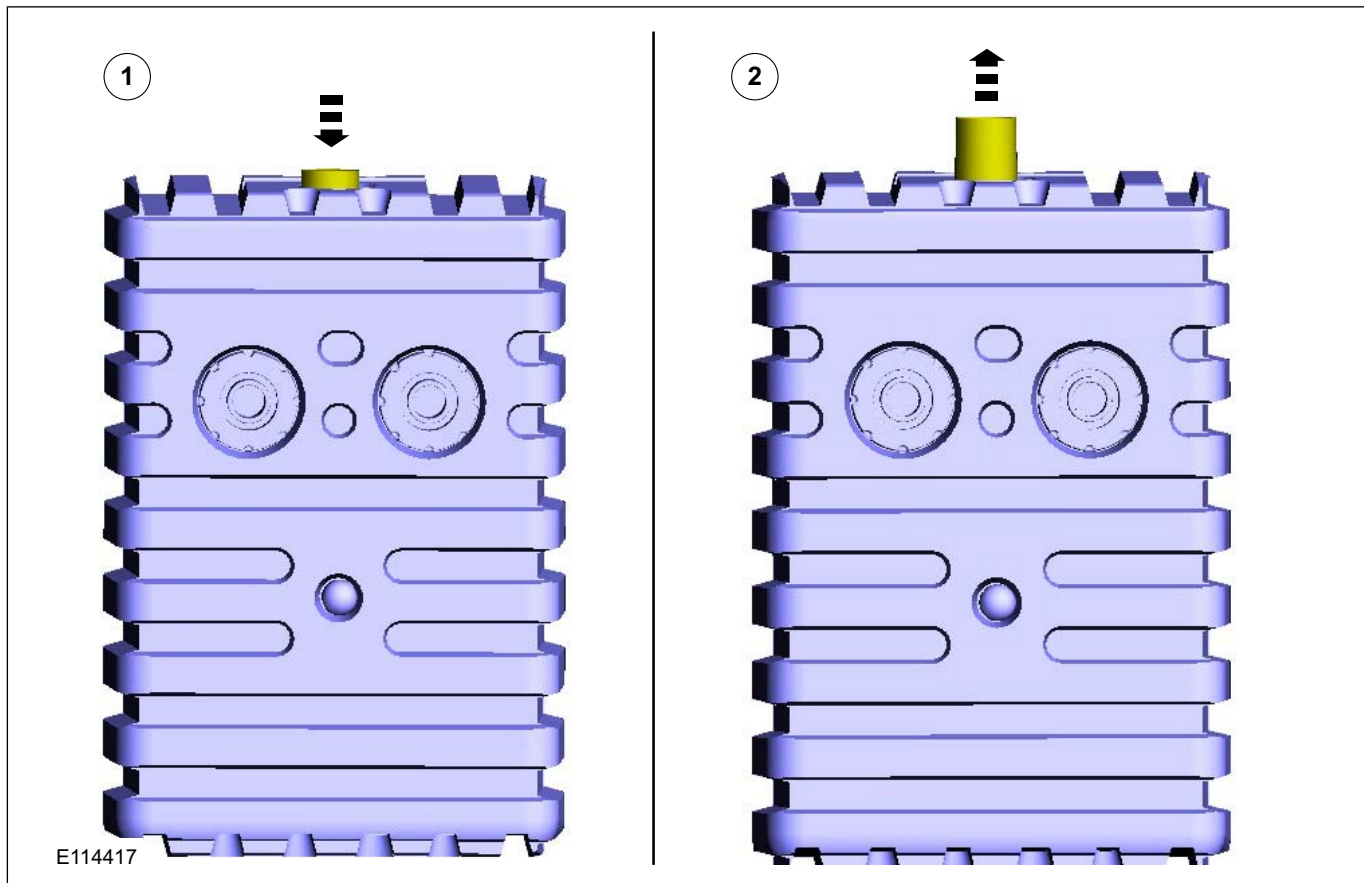
6. 1. 12 volt battery.

Special Tool(s): 418-143, 418-S055C

GENERAL PROCEDURES

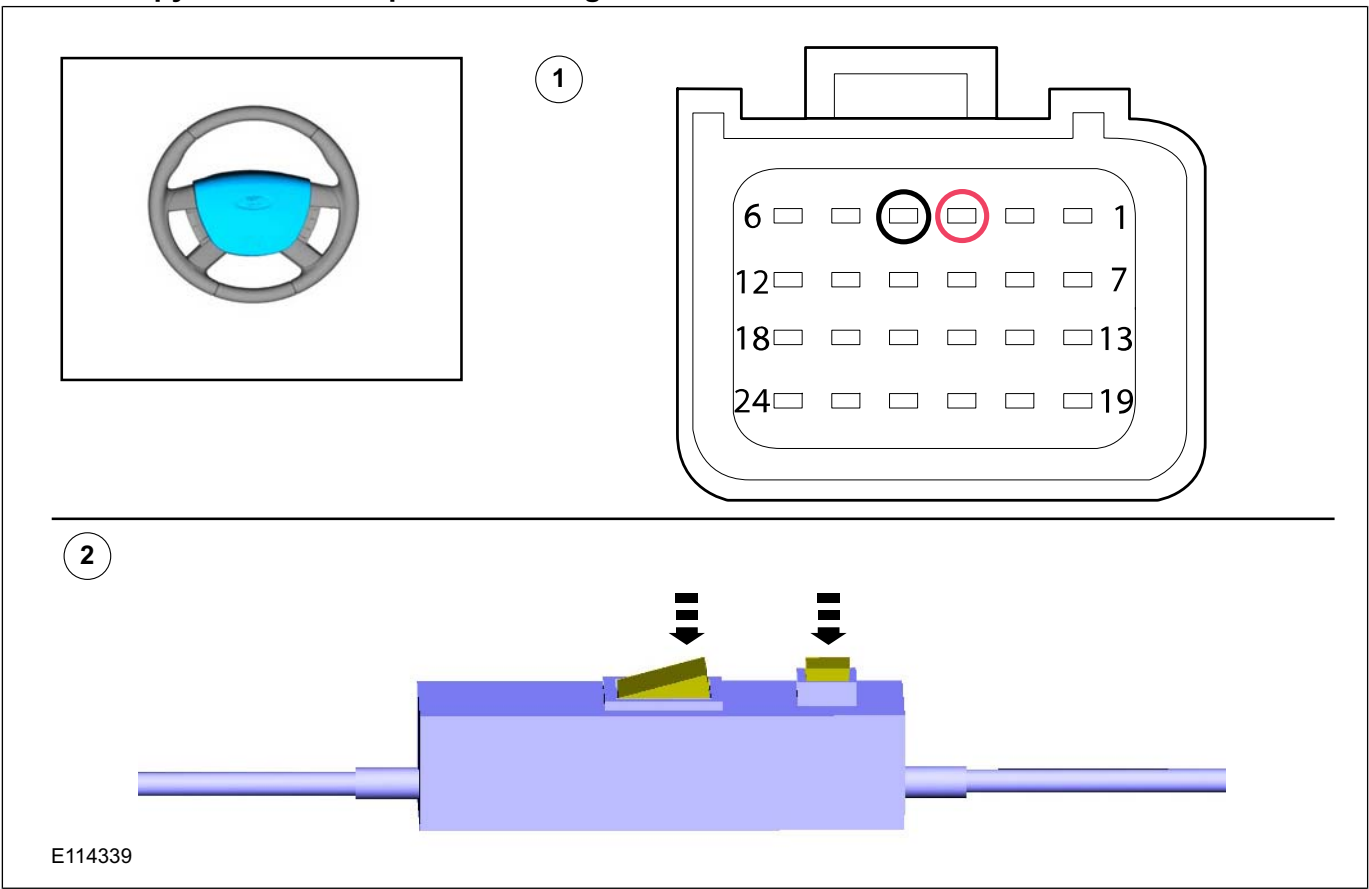


7.



GENERAL PROCEDURES

- 8. 2. **WARNING:** Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.



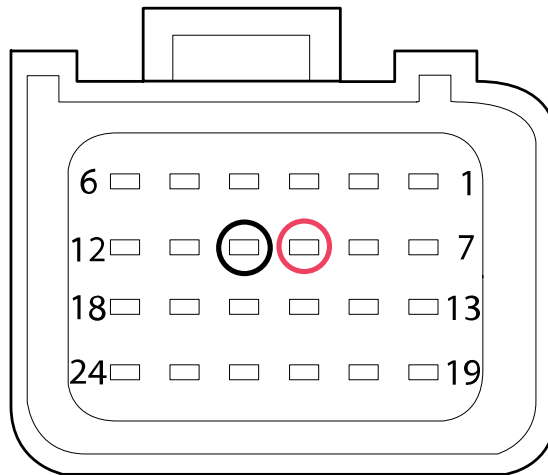
- 9. 2. **WARNING:** Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.



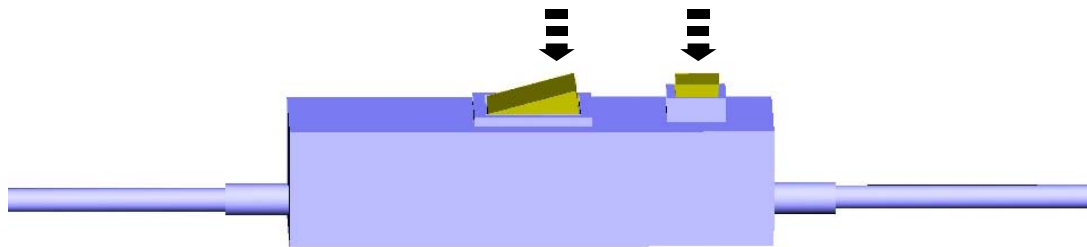
GENERAL PROCEDURES




1



2



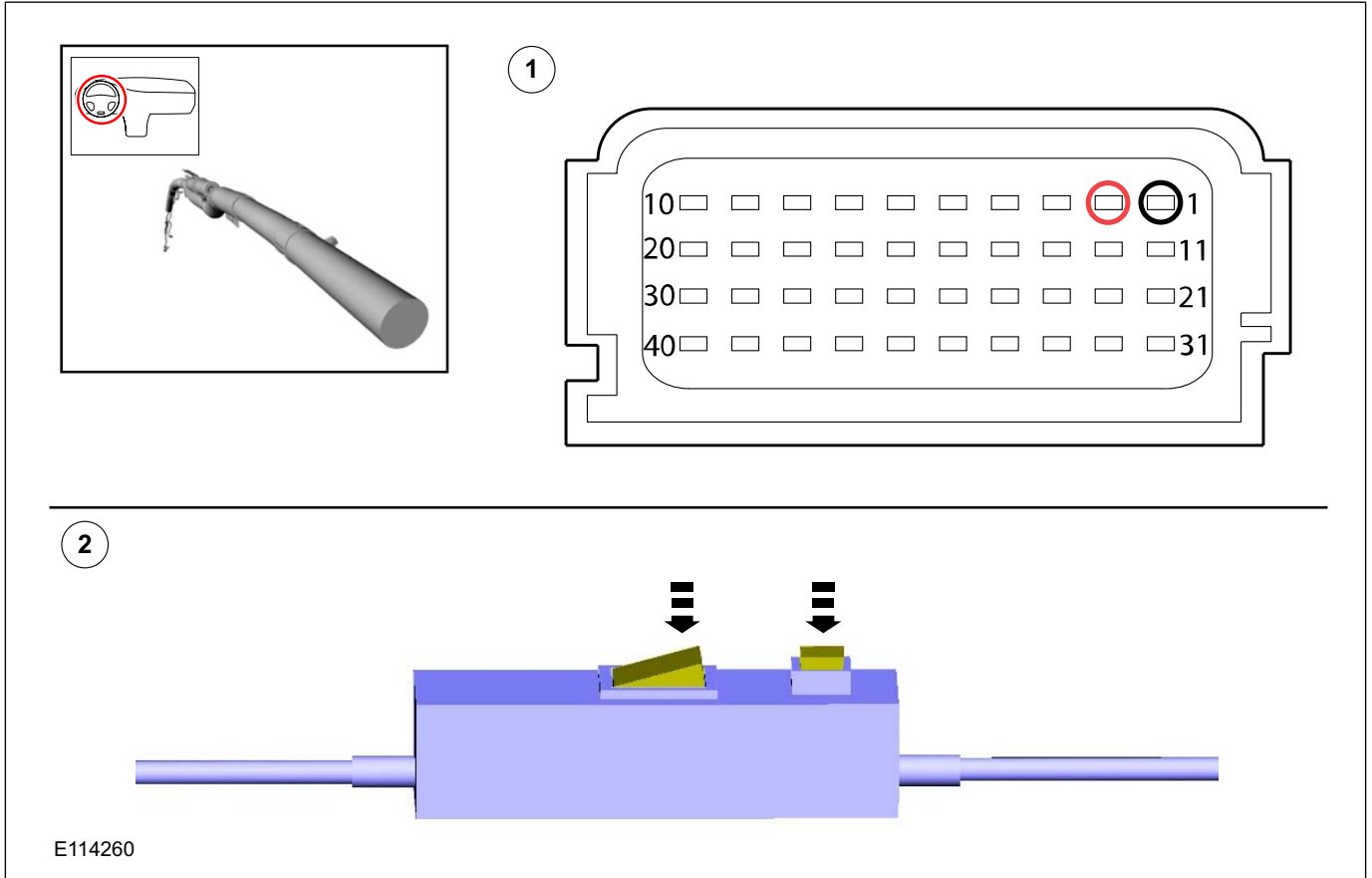
E114340

- 10.2.  **WARNING:** Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.





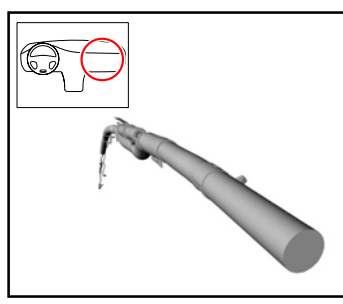
GENERAL PROCEDURES



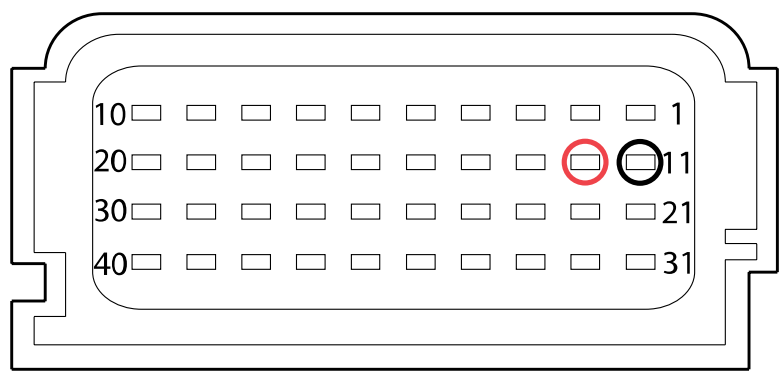
- 11.2. **WARNING:** Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.



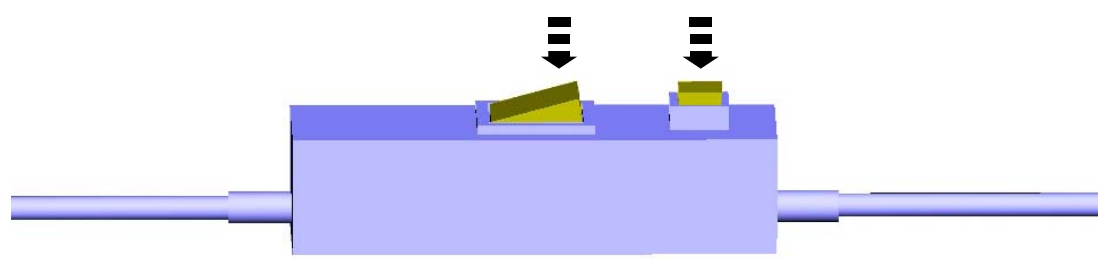
GENERAL PROCEDURES




1



2



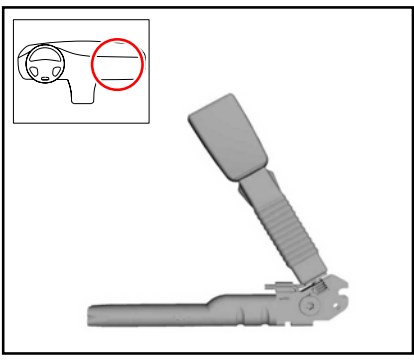
E114259

12.2.  **WARNING:** Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.

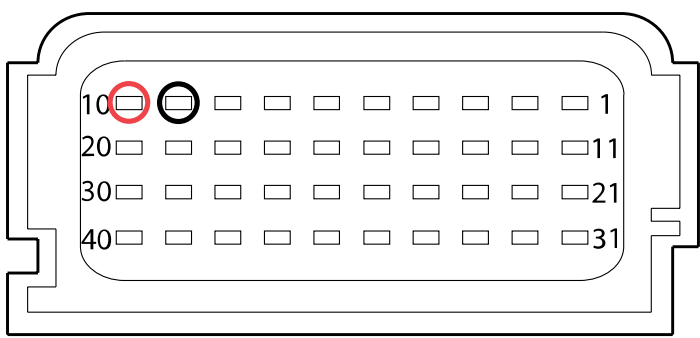




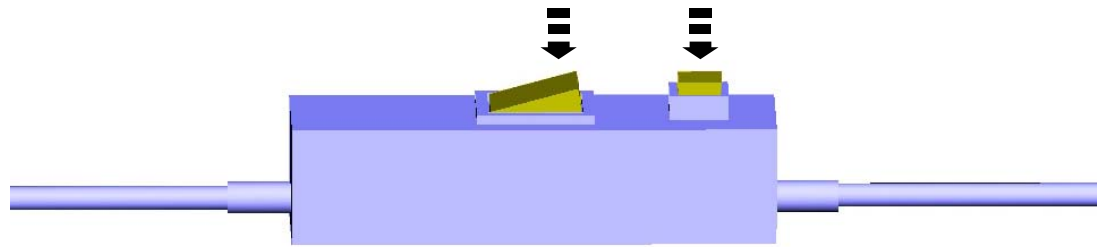
GENERAL PROCEDURES




1



2

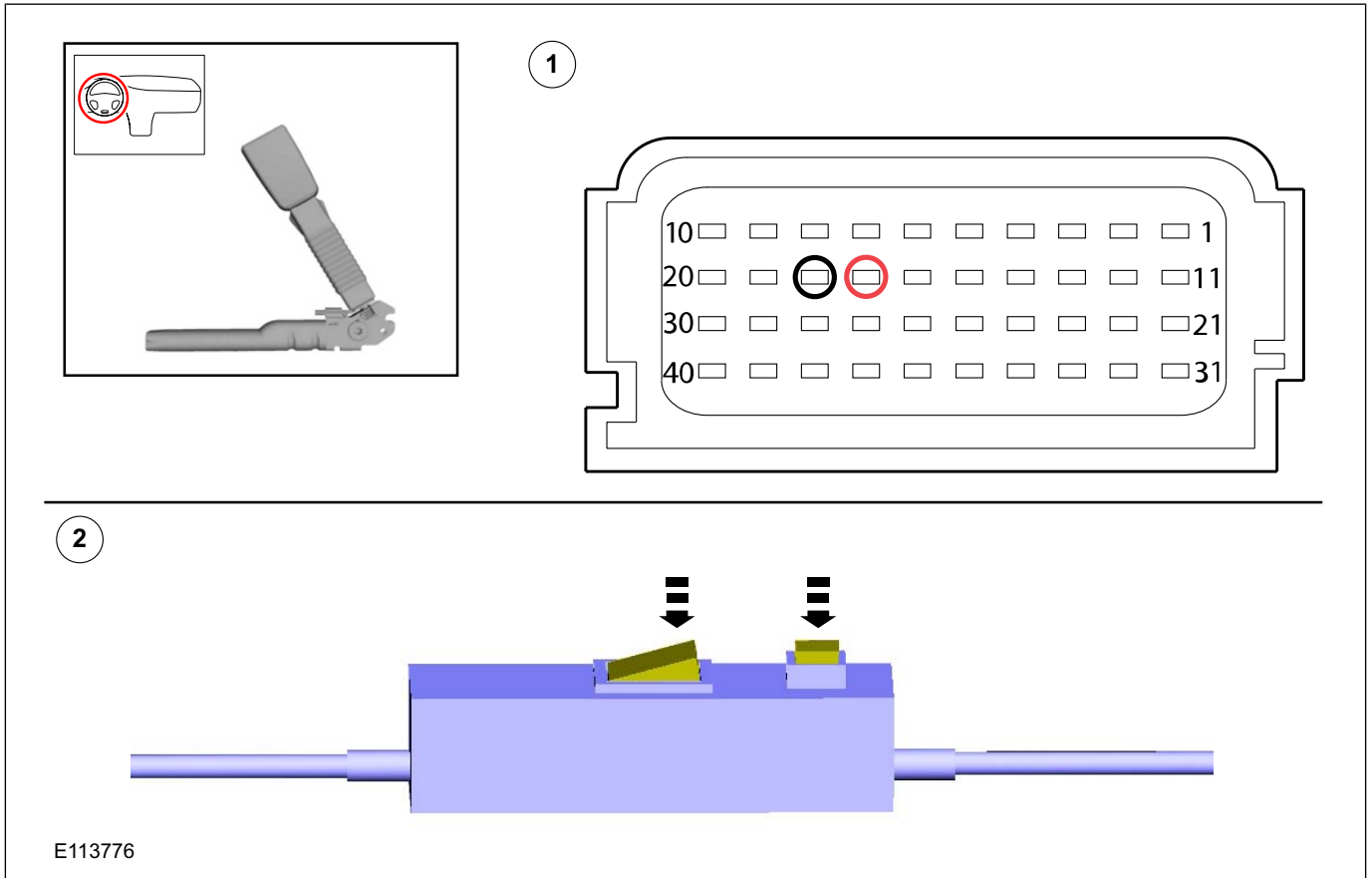


E114258

13.2.  **WARNING:** Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.



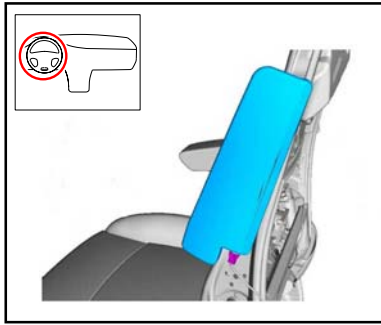
GENERAL PROCEDURES



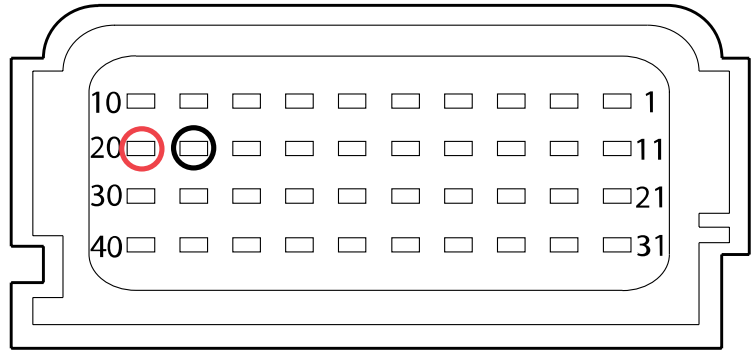
- 14.2. **WARNING:** Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.



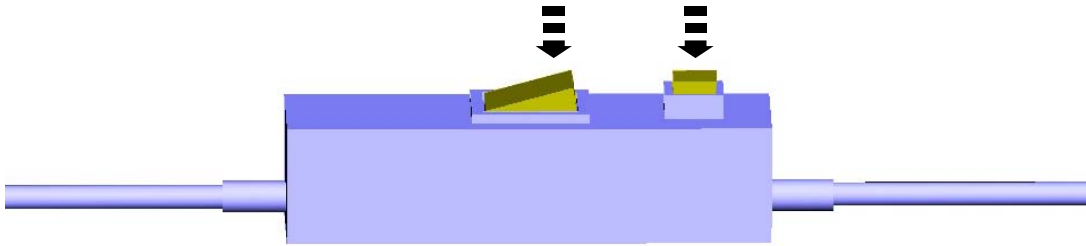
GENERAL PROCEDURES




1



2

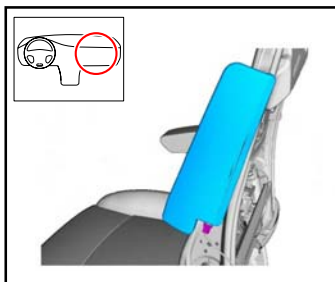


E113778

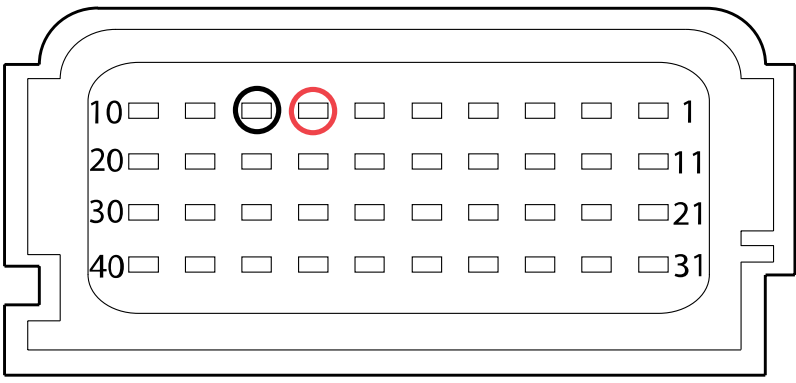
- 15.2.  **WARNING:** Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.



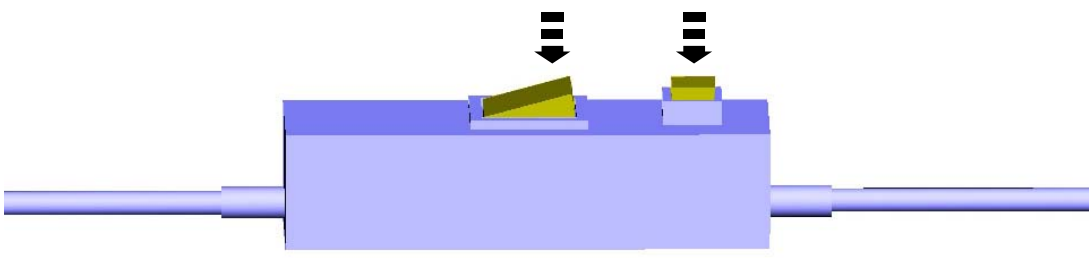
GENERAL PROCEDURES



1



2



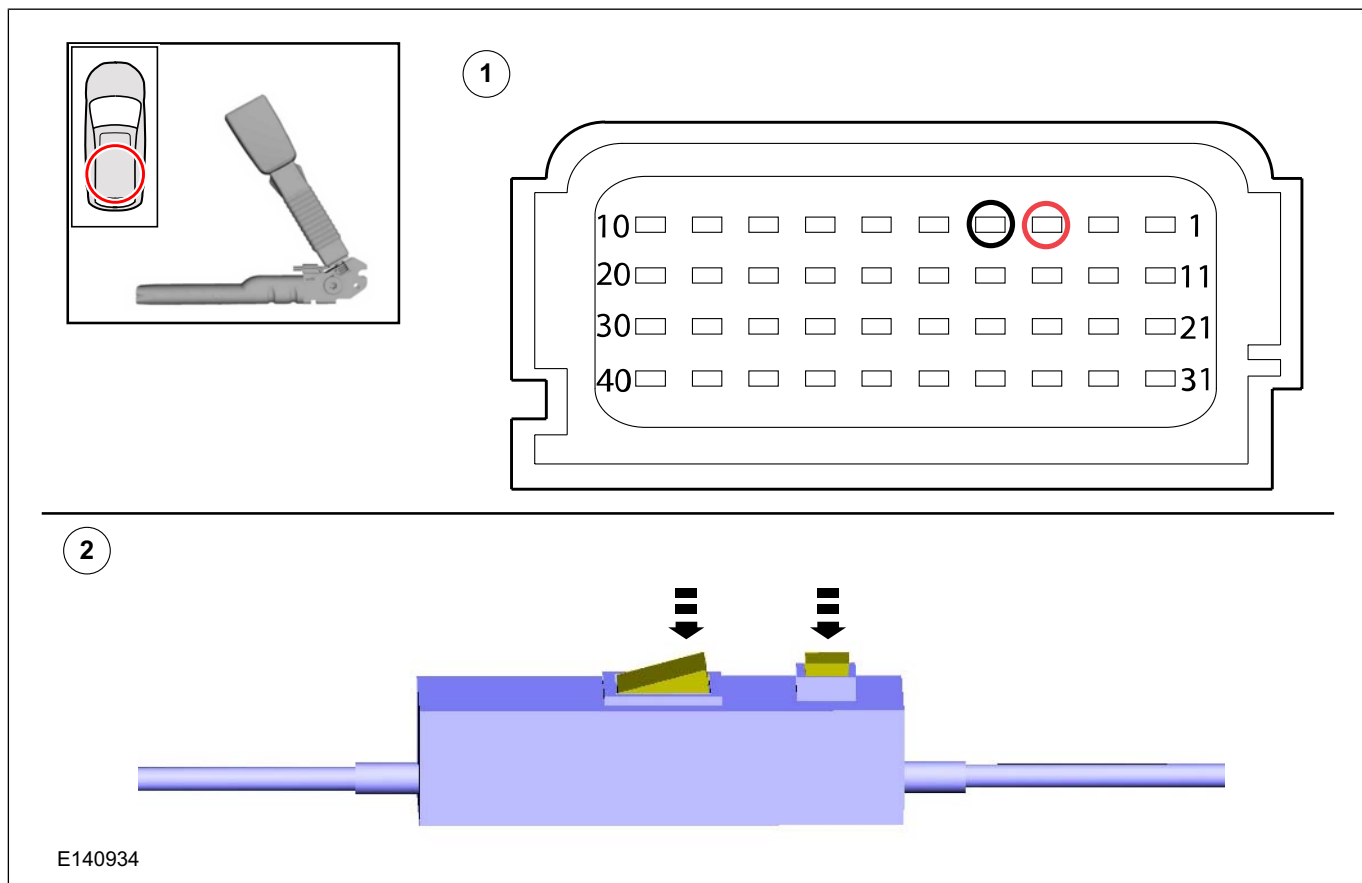
E113777

Grand MAV (5+2 seater)

- 16.2. **WARNING:** Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.



GENERAL PROCEDURES



All vehicles

17. Deployed air bag module(s) and safety belt pretensioners should be sealed in suitable bags and then disposed of in accordance with local contaminated waste regulations.

18. **NOTE:** All unserviceable air bag modules have been placed on the Mandatory Return List. All discolored or damaged air bag modules should be treated the same as any unserviceable live air bag module being returned.

Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation).

Refer to: **Driver Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation).

Refer to: **Passenger Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation).

Refer to: **Side Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation).

Refer to: **Side Air Curtain Module** (501-20 Supplemental Restraint System, Removal and Installation).

19. **WARNING:** Under no circumstances is an unserviceable air bag module or

**safety belt pretensioner to be returned through the local mailing system. Failure to follow this instruction may result in personal injury.**

If an air bag module or safety belt pretensioner fails to deploy, seal the unserviceable air bag module or safety belt pretensioner in suitable packaging and return to the Exchange Plan Center, as appointed through the local National Sales Company

**GENERAL PROCEDURES****Unserviceable Air Bag Disposal****1. WARNINGS:**

**▲** To minimize the possibility of injury in the event of premature deployment, always carry a live air bag module with the bag and trim cover pointed away from the body. Failure to follow this instruction may result in personal injury.

**▲** To prevent premature deployment, live air bag modules must only be placed on work benches which have been ground bonded. Failure to follow this instruction may result in personal injury.

**NOTE:** All unserviceable air bag modules have been placed on the Mandatory Return List. All discolored or damaged air bag modules should be treated the same as any unserviceable live air bag module being returned.

**Remove the unserviceable air bag module. For additional information, refer to the relevant procedure in this section.**

**2. ▲WARNING:** Under no circumstances is an unserviceable air bag module(s) to be returned through the local mailing system. Failure to follow this instruction may result in personal injury.

Seal the unserviceable air bag module(s) in the packaging from the new air bag module(s) and address to the appropriate manufacturer. The package should then be forwarded to the Exchange Plan Center (as appointed through the national sales company) who will arrange forwarding to the manufacturer.

**3. NOTE:** Autoliv air bag modules and seat belt pretensioners.

Autoliv GmbH, Theodor Heuss Strasse 2,  
85221, Dachau, Germany.

**4. NOTE:** TRW air bag modules.

TRW Occupant Restraint Systems, FAO Rene Getto, Industriestr 20, 73551, Aldorf, Germany.

**5. NOTE:** TRW seat belt pretensioners.

TRW Occupant Restraint Systems, FAO Helmut Goss, Industriestr 20, 73551, Aldorf, Germany.

**6. NOTE:** Takata Petri air bag modules.

Takata Petri AG, Grossostheimer Strasse  
223, D-63741 Aschaffenburg, (Supplier Code  
P790M) Germany.

## REMOVAL AND INSTALLATION

## Front Impact Severity Sensor

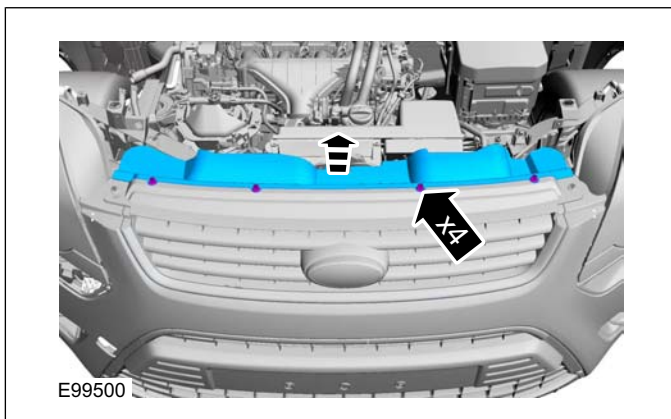
## Removal

## WARNINGS:

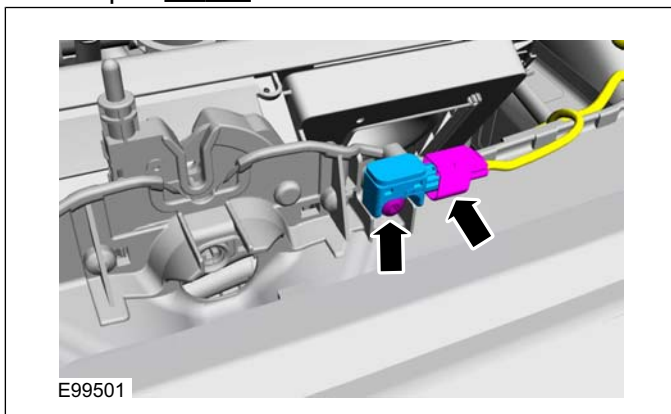
- ▲ The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.
- ▲ Make sure that the vehicle electrical system is fully depowered and no other power source is connected.
- ▲ Refer to: **Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation)**.

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures)**.
- 2.

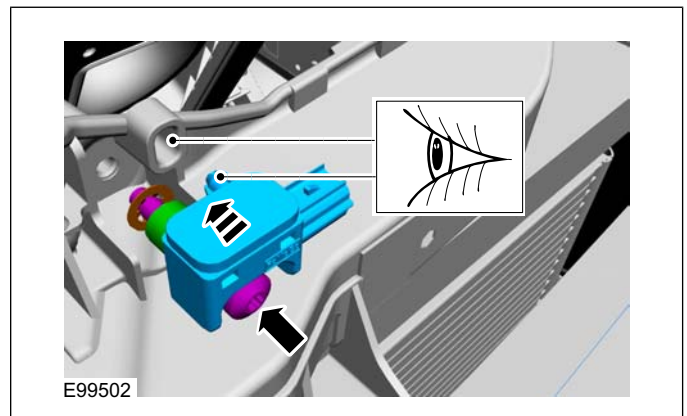


3. Torque: 10 Nm



## Installation

1. To install, reverse the removal procedure.
2. **NOTE:** Make sure that the sensor is installed in the same location as when removed.



## REMOVAL AND INSTALLATION

## Crash Sensor

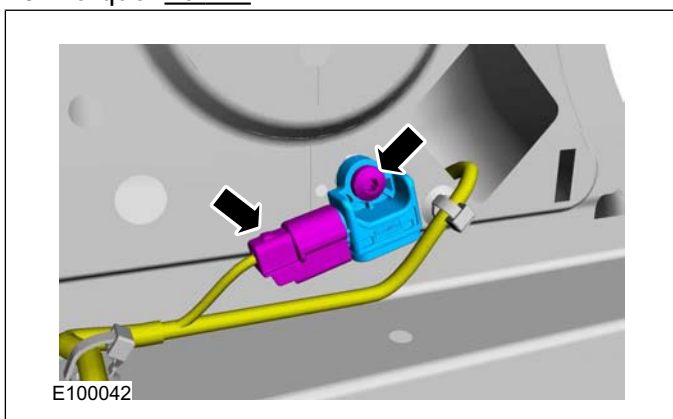
## Removal

## WARNINGS:

- ▲ The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.
- ▲ Make sure that the vehicle electrical system is fully depowered and no other power source is connected.
- ▲ Refer to: **Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation)**.

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: **B-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Torque: 10 Nm



## Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Driver Air Bag Module

## General Equipment

Flat-bladed screwdriver
-------------------------

## Removal

## WARNINGS:

**▲ The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.**

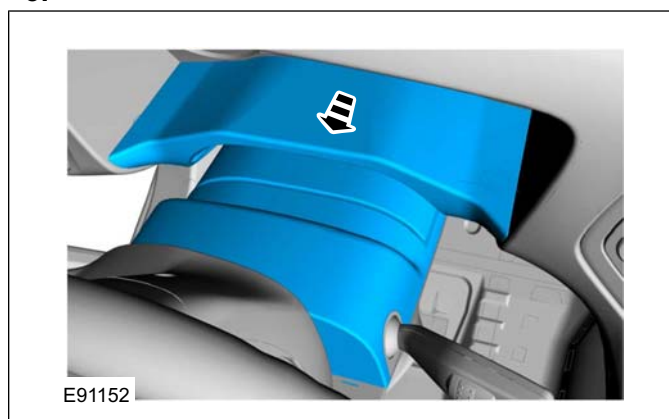
**▲ Make sure that the vehicle electrical system is fully depowered and no other power source is connected.**

**▲ Wear safety goggles.**

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Supplemental Restraint System (SRS) Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).

3.

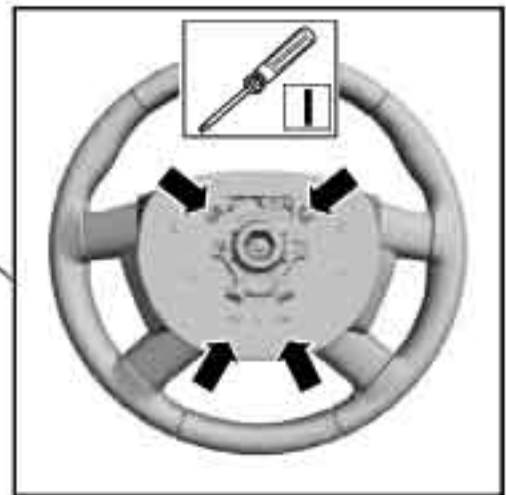
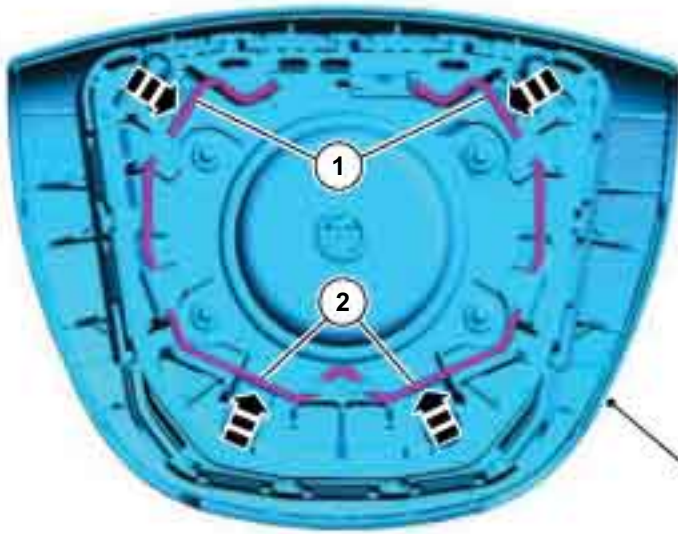


4. General Equipment: Flat-bladed screwdriver



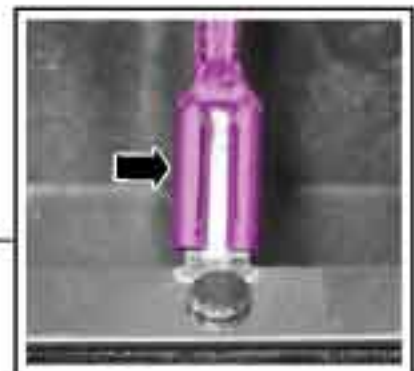
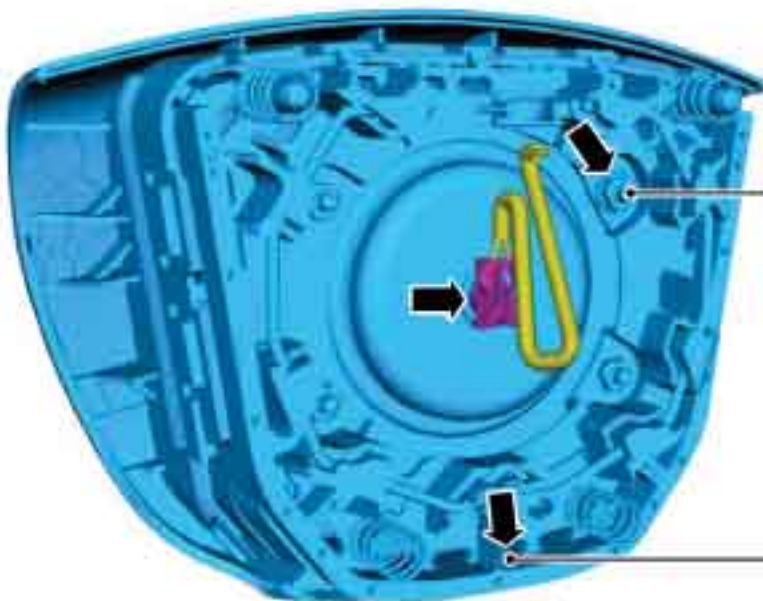


REMOVAL AND INSTALLATION



E99651

5.



E99652





**501-20B-36****Supplemental Restraint System****501-20B-36****REMOVAL AND INSTALLATION**

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## Installation

1. To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

## Passenger Air Bag Module

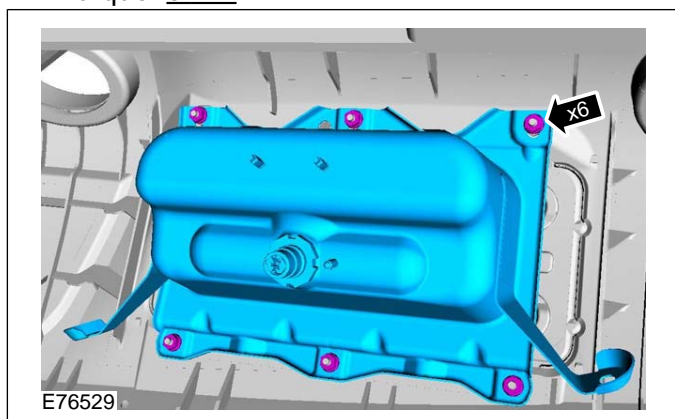
## Removal

## WARNINGS:

- ▲ The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.
- ▲ Make sure that the vehicle electrical system is fully depowered and no other power source is connected.
- ▲ Wear safety goggles.
- ▲ Refer to: **Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation)**.

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Instrument Panel** (501-12 Instrument Panel and Console, Removal and Installation).
2. Torque: 8 Nm



## Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION





## Restraints Control Module (RCM)

## General Equipment

Ford approved diagnostic tool
-------------------------------

## Removal

## WARNINGS:

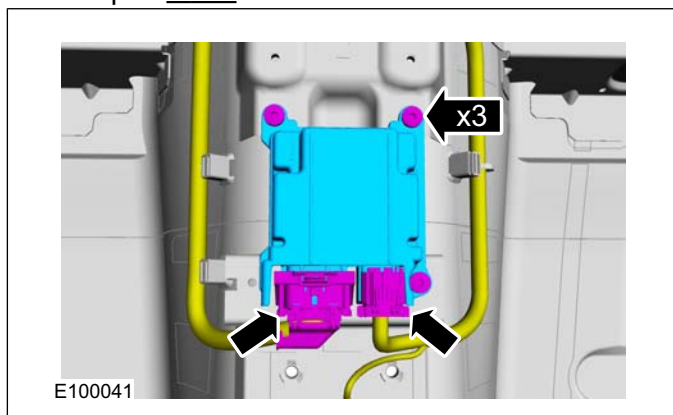
-  **The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.**
-  **Make sure that the vehicle electrical system is fully depowered and no other power source is connected.**
-  **Wear safety goggles.**
-  **Refer to: [Supplemental Restraint System \(SRS\) Health and Safety Precautions \(100-00 General Information, Description and Operation\)](#).**

2. When a new RCM is installed, configure the RCM using the diagnostic tool.

General Equipment: Ford approved diagnostic tool

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: [Battery Disconnect and Connect \(414-01 Battery, Mounting and Cables, General Procedures\)](#).
2. Refer to: [Floor Console \(501-12 Instrument Panel and Console, Removal and Installation\)](#).
3. Torque: 8 Nm



## Installation

1. To install, reverse the removal procedure.



REMOVAL AND INSTALLATION

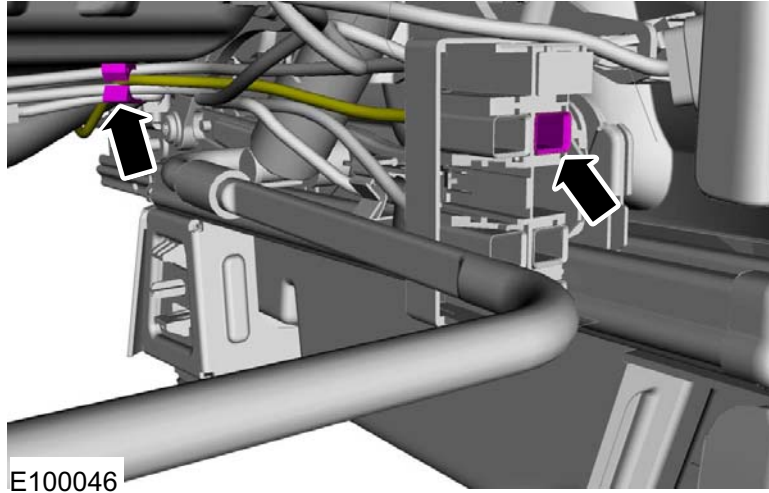
Side Air Bag Module

Removal

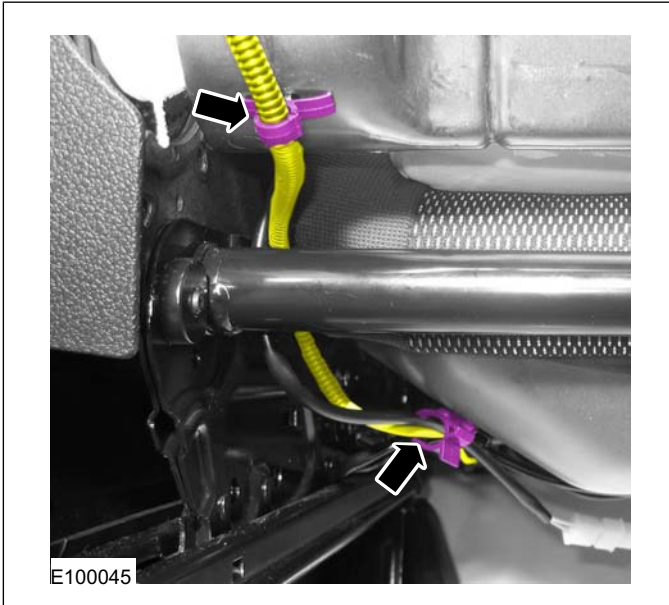
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Front Seat** (501-10 Seating, Removal and Installation).

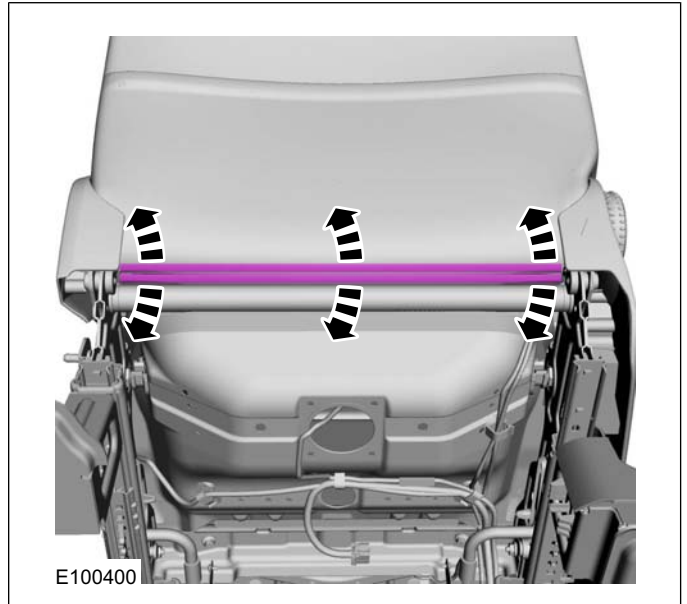
2.



3.



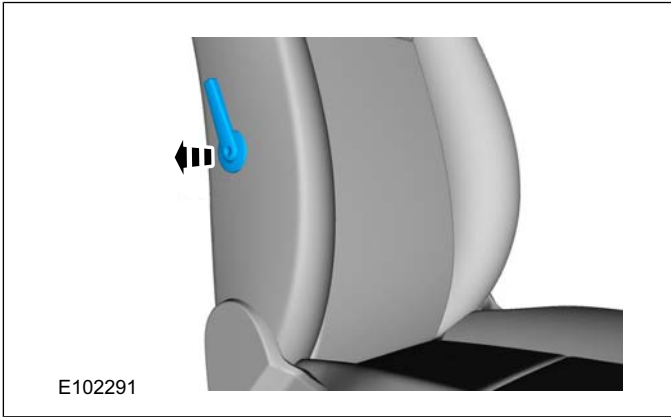
4.



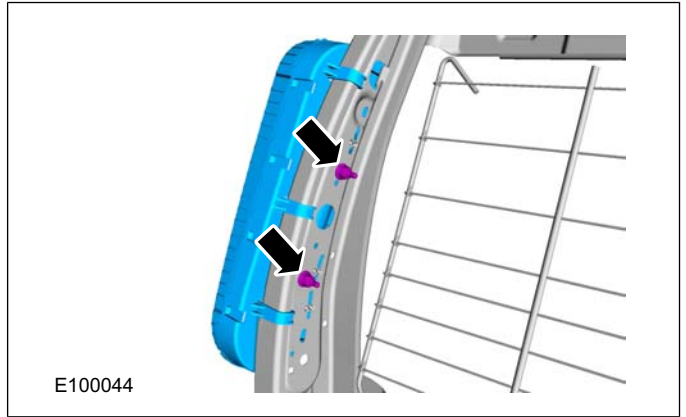


REMOVAL AND INSTALLATION

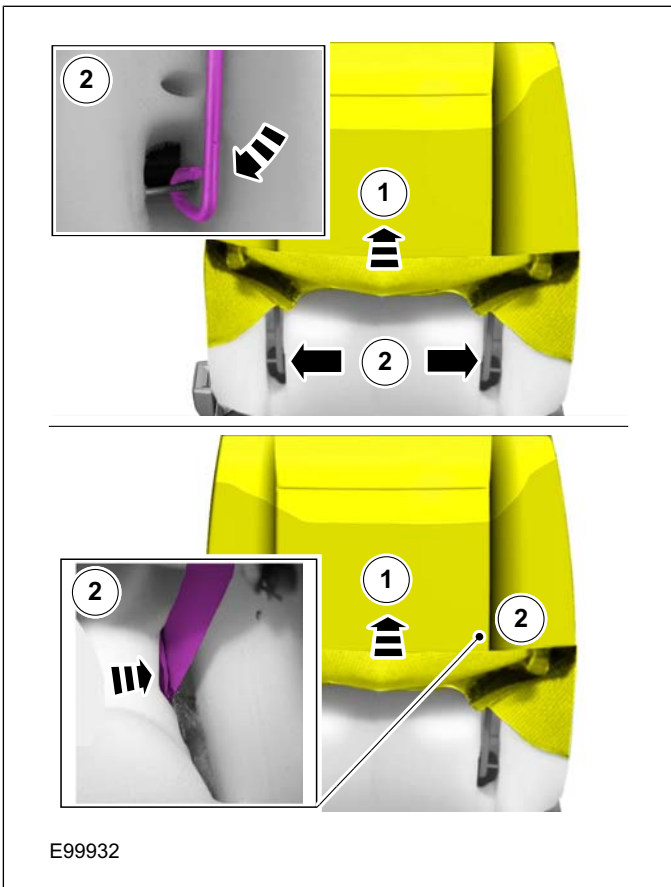
5. If equipped.



7. Torque: 5 Nm



6.



Installation

1. To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

## Side Air Curtain Module

## General Equipment

Long Nose Pliers
------------------

## Removal

## WARNINGS:

**▲** The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

**▲** Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

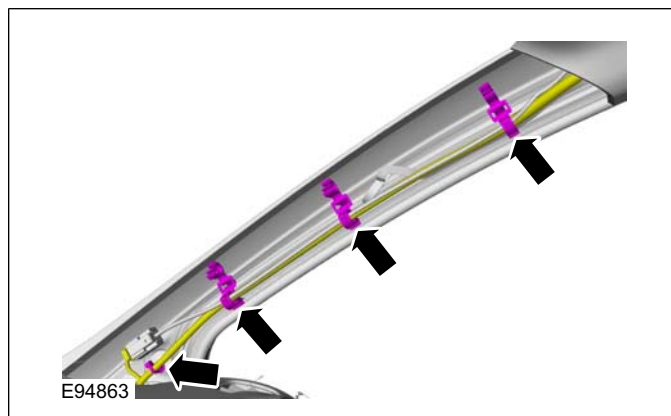
**▲** Wear safety goggles.

**▲** Refer to: **Supplemental Restraint System (SRS) Health and Safety Precautions** (100-00 General Information, Description and Operation).

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: **Headliner - Lowering** (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.

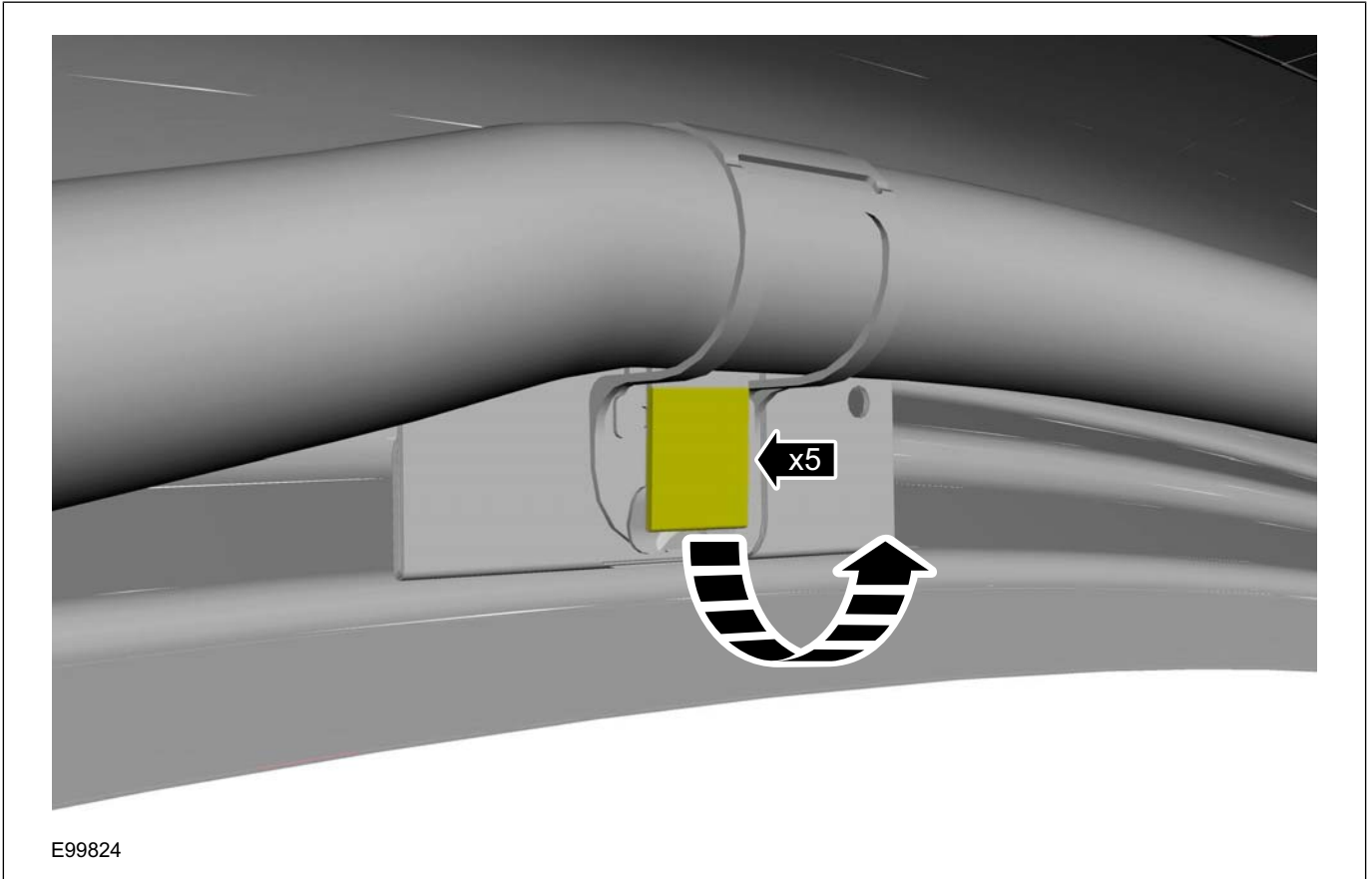


4.

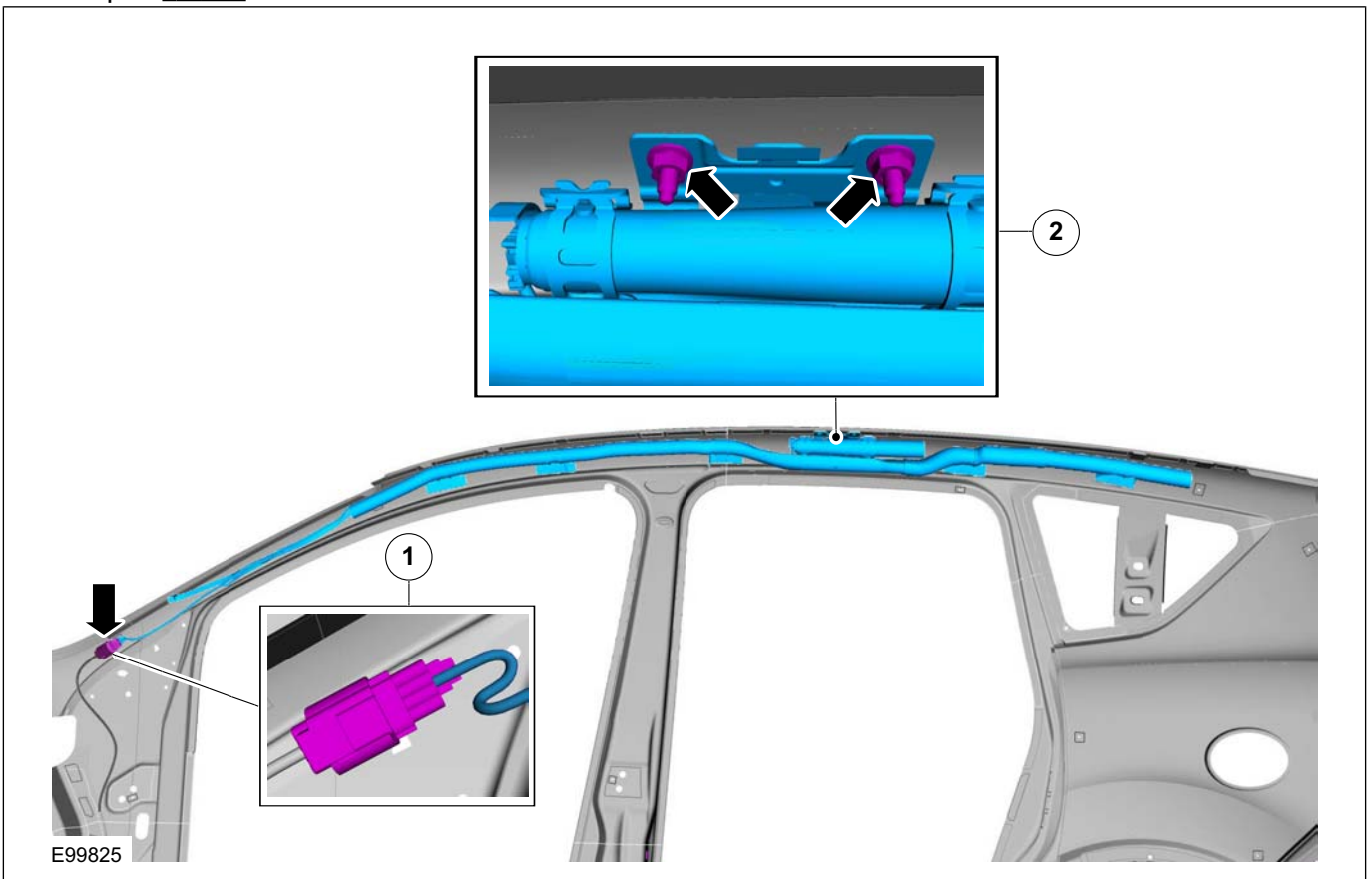




REMOVAL AND INSTALLATION



5. Torque: 11 Nm



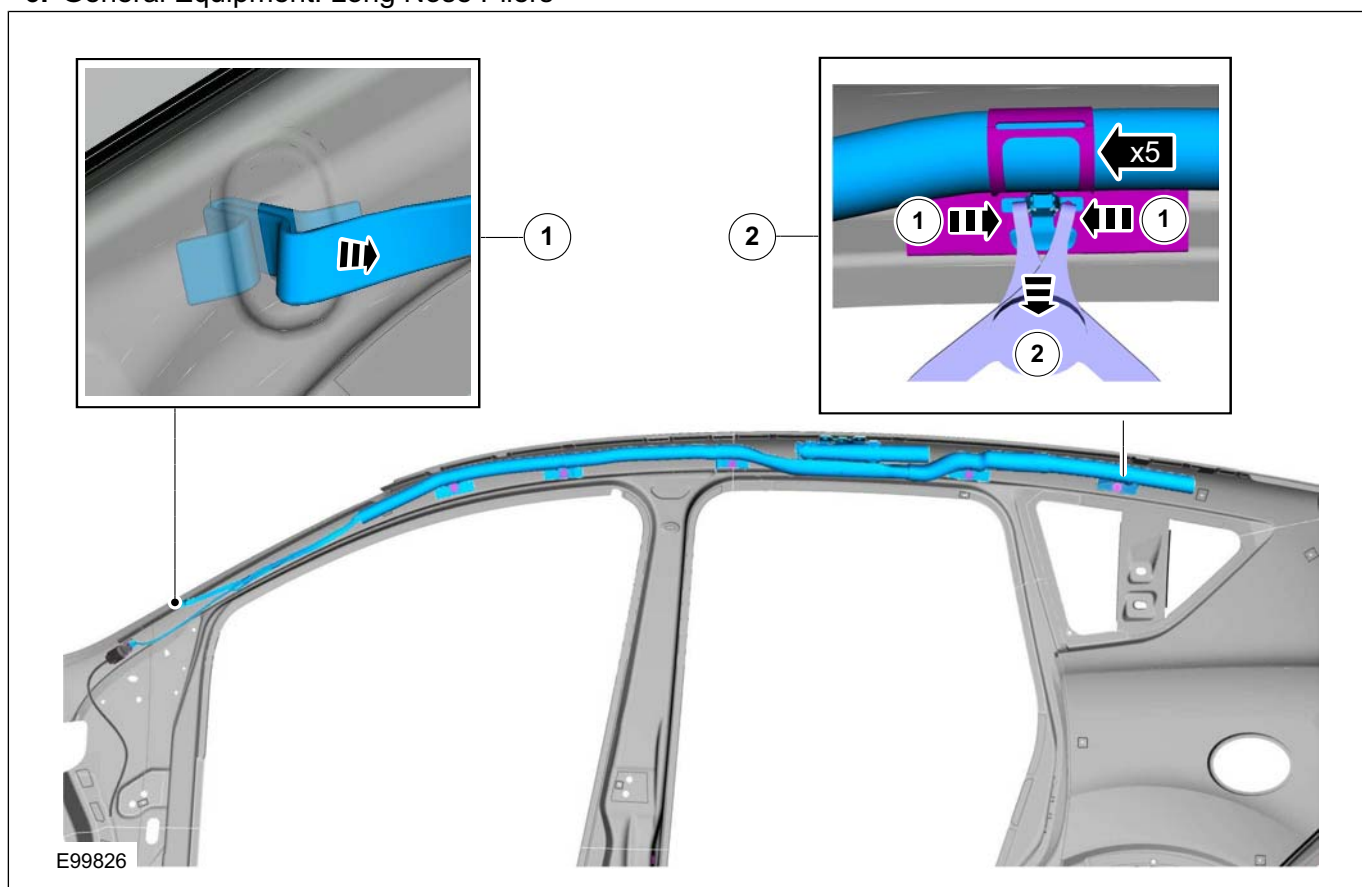
501-20B-43

Supplemental Restraint System

501-20B-43

## REMOVAL AND INSTALLATION

## 6. General Equipment: Long Nose Pliers



## Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

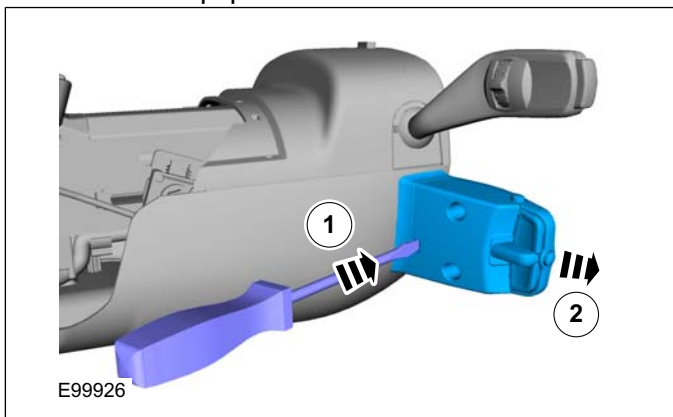
Clockspring

General Equipment

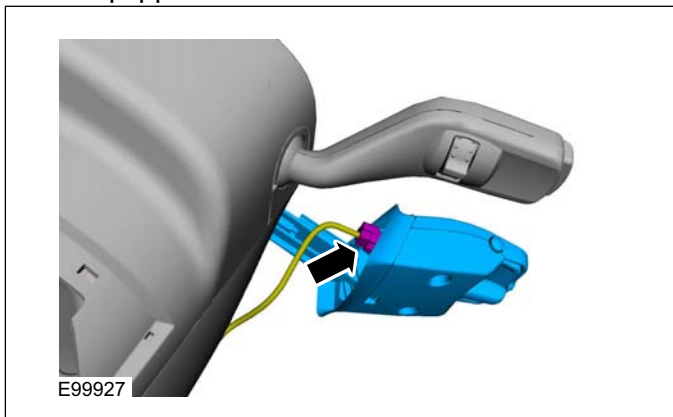
Flat-bladed screwdriver

Removal

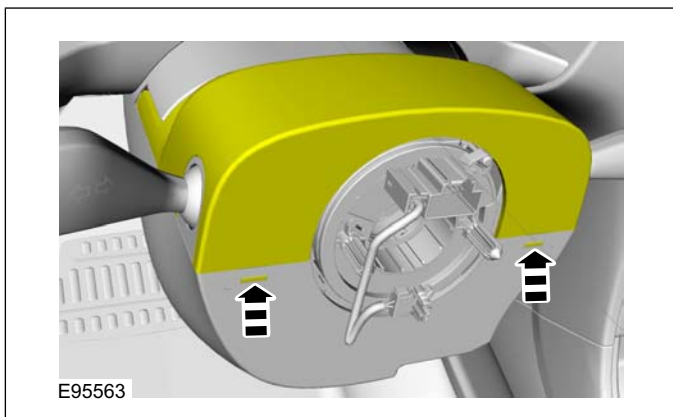
1. Refer to: **Steering Wheel** (211-04 Steering Column, Removal and Installation).
2. If equipped.  
General Equipment: Flat-bladed screwdriver



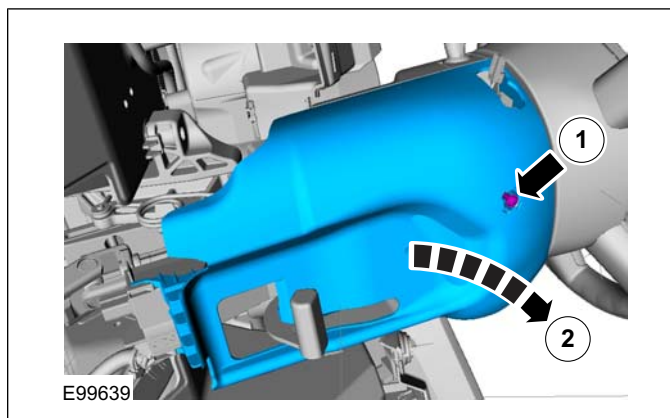
3. If equipped.



- 4.



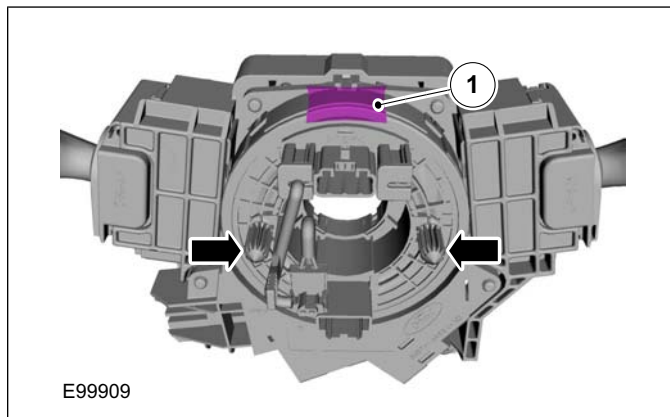
- 5.



6. CAUTIONS:

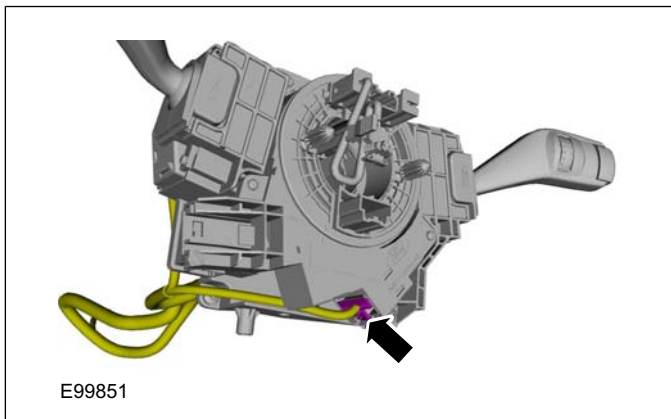
- ⚠ Make sure that the clockspring rotor does not rotate.
- ⚠ Make sure that the clockspring pins are not bent or damaged.

1. Using a suitable piece of tape, secure the clockspring rotor to the clockspring body.

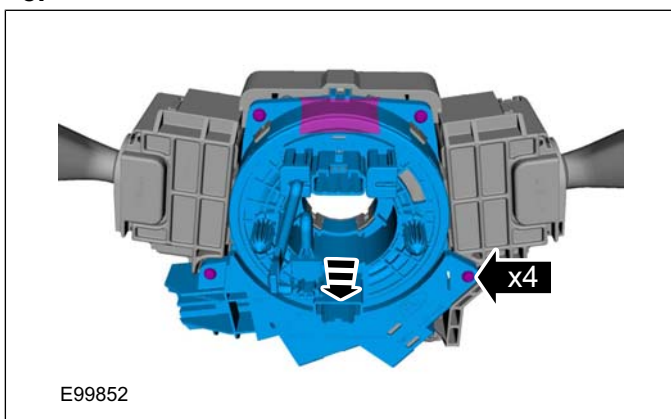


## REMOVAL AND INSTALLATION

7.



8.



## Installation

1. To install, reverse the removal procedure.
2. Refer to: **Clockspring Adjustment** (501-20 Supplemental Restraint System, General Procedures).

# SECTION 501-25 Body Repairs - General Information

**VEHICLE APPLICATION: 2008.50 Kuga**

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## 501-25-3

## Body Repairs - General Information

## 501-25-3

## SPECIFICATIONS

Description	Item number	FINIS	Specification
Stone chip under-body protection	AU7J-M5G39-AA	1720930	WSK-M5G39-B
Corrosion protection wax HP	2U7J-M7C89-AA	1219834	WSK-M7C89-A
Cavity wax T-HV4	BU7J-M7C80-AA	1742584	N/A
Profiled butyl seal	YS5J-M3G4620-AA	1128983	S-M3G4620-A
Clinched flange protection	1S5J-M4G245-AA	1136479	WSK-M4G245-B
Seam sealer T Anthracite	2U7J-M4G364-AA	1205817	WSS-M4G364-A
Metal adhesive kit, 2-component	2U7J-M2G400-AA	1203241	Set
Sealant DH-BR	3U7J-M4G4631-AA	1233502	S-M4G4631-A
Spoiler adhesive kit - 2-component	2U7J-M2G376-AA	1219837	Set
Body sealant T-SMP	AU7J-M4G245-AA	1726412	N/A
Glass adhesive H-PU (2K)	9U7J-M2G322-DA	1726389	WSK-M2G322-B1 (WSK-M11P57-A3)
Glass adhesive set - 2K	9U7J-T03863-AA	1633780	WSK-M11P57-A3
Glass adhesive D2 (1K)	BU7J-M2G316-AA	1749325	WSS-M2G316-B5 (WSS-M11P57-A5)
Glass adhesive set - 1K IM	BU7J-T03863-AA	1749324	WSS-M11P57-A5
Multi-purpose sealing compound	1S5J-M4G329-AA	1140216	WSK-M4G329-A

**DESCRIPTION AND OPERATION**

## Description and Usage of Body Repair Literature

The purpose of this document is to give the vehicle body specialist a general overview of possible repair techniques for body repair on Ford vehicles. Likewise, information about materials and tools to be used is given.

No model-specific information is given. Such information is saved in the respective Ford Etis workshop manual. Supplementary or updated information can be found in the Technical Service Information.

Information on repair techniques, materials or tools, which are not necessary for body repair on Ford vehicles or which are not considered as conventionally in use, are not listed in this document.

**Layout:**

The general section is divided into the following subject areas:

- How to use the document, with information on the symbols used
- Health and safety information on using materials and tools
- Information on bodywork construction and materials used
- Workshop equipment and use of tools
- Damage Assessment and determining the extent of the repair area
- Explanation of possible repair techniques for body repair
- Possibilities of the repair or remedying leaks, noises

**Training:**

The Ford Service Organization offers basic and more in-depth training on much of the content of this document. You can obtain an overview of the entire training offering from the Ford Service Organisation or on the Internet at [www.ford-training.de](http://www.ford-training.de).

## DESCRIPTION AND OPERATION

## Symbols

## Warnings and hazard notices

Warnings and hazard notices are shown in this literature by WARNING, CAUTION and NOTE indicators. These notices are always shown before a job step which can be associated with an immediate personal or material danger.

**▲ WARNING:** This notice is used when failure to exactly follow the instructions given in this literature or failure to follow them at all may result in a hazard to persons and/or in persons being injured.

**▲ CAUTION:** This notice is used when failure to exactly follow the instructions or test procedures given in this literature or failure to follow them at all may result in damage to the vehicle or to components.

**NOTE:** This notice is used when the operator should be made aware of special or extra information.

## Symbols used

Symbols are used to graphically represent additional information about the operation, tool or materials. This information will not be shown separately again as text.

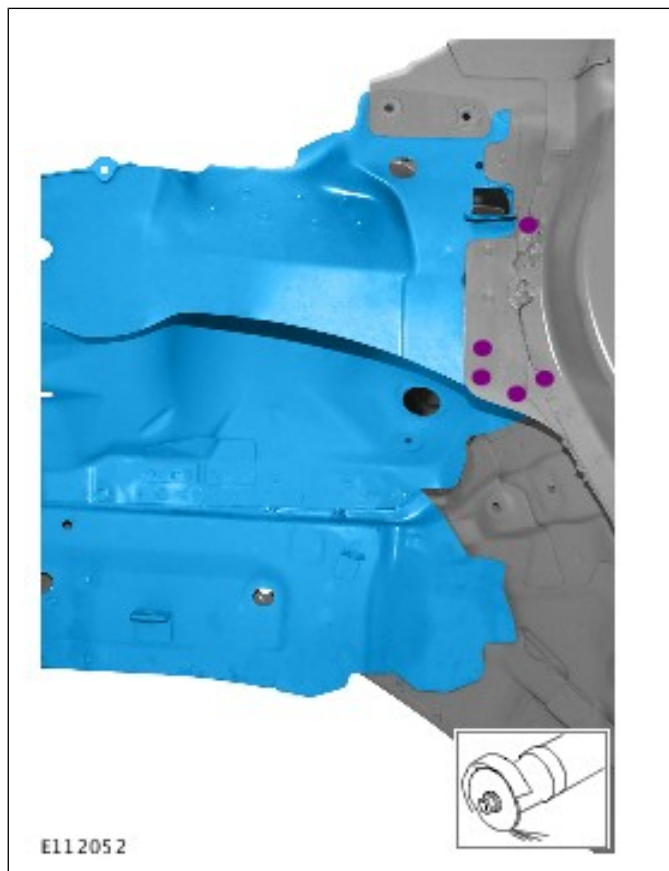
The symbols used in this and other body repair manuals may be used alone as well as in combination in a diagram.

All the symbols used in these documents can be found in the General Information section.

For additional information, refer to: **Symbols Glossary** (100-00 General Information, Description and Operation).

## Color coding

Different colors or shading can be used to depict special areas and components.



- Blue: Main component which will be removed or installed. Only actual movements will be shown in blue in the diagram.
- Magenta: Materials or fixings, e.g. bolts, clips, spot welds or adhesives.
- Yellow: Component which is being cleaned or loosened, moved or fastened, but remains in the vehicle.
- Light blue: Color for special tools and color for equipment.

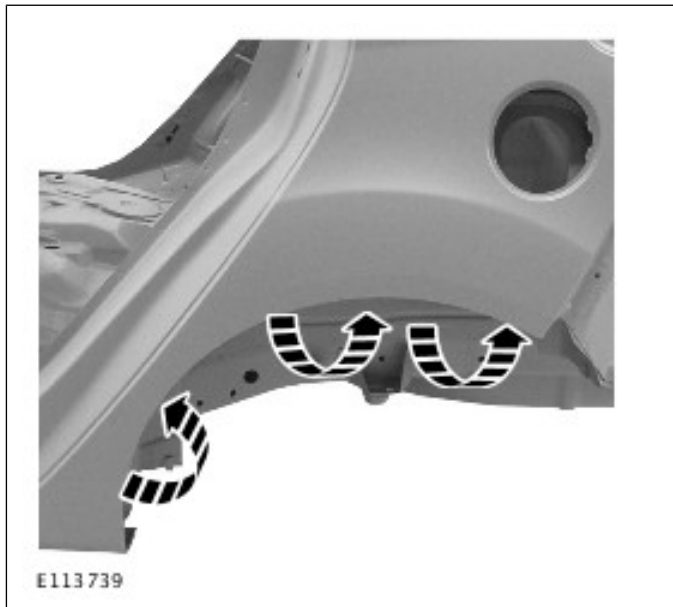
In an assembly operation, the colors show the sequence of removal steps.

- Blue: Main component which is being installed, removed, taken away or added.
- Green: Component which, in addition to the main component (blue) is being installed, removed, taken away or added.
- Brown: Component which, in addition to the main component (blue) and the additional component (green) is being installed, removed, taken away or added.

**DESCRIPTION AND OPERATION**

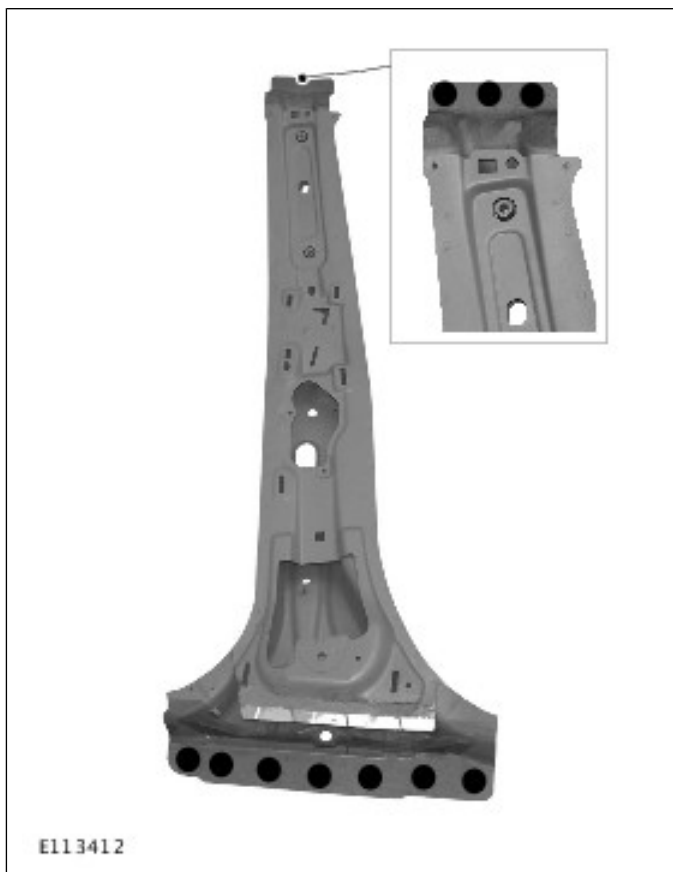
**Movement arrows**

Necessary work such as clinching flanges or moving lugs etc. will be represented by broken arrows.



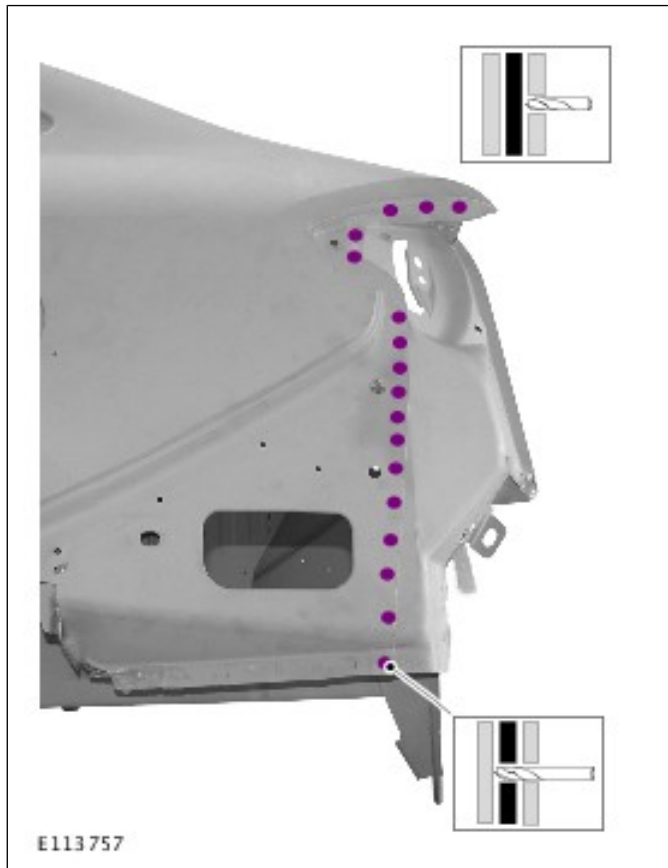
**Magnified and detailed views**

If a detail cannot be clearly seen in the illustration because of its size or location, it is shown enlarged in a separate window.



**Position lines within a diagram**

A position line is used to indicate a special position or a component. A spot weld which must be drilled out through two panel thicknesses is indicated here, different to all the others.



**DESCRIPTION AND OPERATION****Health and Safety Precautions****General**

Appropriate repair methods and their correct implementation are very important for both vehicle operating safety and personal safety.

**▲ WARNING: There is danger of injury through:**

- High voltage when electrical welding.
  - Do not perform welding work in a damp environment or on a wet substrate. Use suitable insulation underneath.
- Flammable substances in the welding area.
  - Remove flammable substances from the danger area. Remove the fuel tank and, where required, those components which supply fuel.
  - Completely remove the battery before carrying out any welding in that area.
- Welding fumes, which are harmful to health.
  - Always ventilate the workplace well and use an extraction system.
- Welding spatter and UV radiation.
  - Wear protective clothing, gloves and welding mask or welding goggles.
- Pyrotechnic components.
  - Disconnect the battery negative clamp and cover the battery terminal. Remove any airbag components.

All the regulations governing Health and Safety at Work must be complied with during body repairs.

**Personal protection**

Welding gases and grinding dusts can be harmful to the health. For this reason, make sure that rooms are well ventilated and work using the welding fumes extraction system. Sealants, underbody protection and paint residues must not be burnt down with an unshielded flame, as this will produce gases which are damaging to health. A dedicated extraction system must always be used when welding or brazing.

When working with substances containing solvents, good ventilation must be provided, respiratory protection must be worn and an extraction system must be used.

Do not weld in damp areas, if necessary use an insulation mat. Welding and grinding work near the battery presents the danger of explosion. For this reason, it must be removed before the work is started.

Cutting, grinding and alignment work on metal panels can cause a noise level of 85 to 90 dB (A) or even more. For this reason, you must always wear ear defenders.

The various body areas are subject to very high forces during realignment work. Should any component suddenly become detached during this process, there is a very great danger of injury. For this reason, pulling chains and pulling shackles must be secured with arrester cables.

**NOTE:** Work on airbag systems may only be performed by persons who have a relevant certificate of competence.

Some special instructions must be followed when working on airbag systems:

- Always stand to the side of it when removing or installing an airbag.
- Always store an airbag or an airbag/steering wheel with the airbag side pointing upwards and in a safe place.
- Only install the airbag again when the vehicle is fully repaired and the complete electrical systems has been tested.
- Take into account the location of air curtains and shoulder airbags.

**Protection of the vehicle**

Protect affected areas from weld spatter and dust during all welding and grinding work on the vehicle. If metallic dust stays on the vehicle for some time, there is the likelihood of film rust formation. Grinding or sanding work produce tiny spots of damage to the paint surface, which may cause corrosion.

For this reason, make sure to:

- Use carbon fibre blankets to protect the vehicle body.
- Use covering film to protect the vehicle body from sanding dust and metal dust.
- Take appropriate measures to protect the interior equipment of the vehicle during any repair work.



## DESCRIPTION AND OPERATION

In addition, take into account:

- Remove fuel supply components as necessary.
- Protect working areas which are in danger of catching fire with a fireproof blanket.
- The welding must not cause components of the air conditioning system to become heated.
- Removal of any attached components in the space adjoining the repair area.
- Use covering paper to protect the interior from grinding dust.
- Create a definite barrier between the work area and the interior by using a carbon fibre blanket.

### Protective equipment

The following protective equipment must always be used:

- Protective helmet or welding mask.
- Ear defenders and breathing protection.
- Protective gloves and safety boots.
- Welding fume extraction.

### Electronic components

Increased use of comfort and safety electronics in modern motor vehicles also requires the greatest attention to be paid during body work. Overvoltages produced during welding and in alignment work during bodyshell rectification may cause electronic systems to be damaged. In particular, the safety instructions for performing welding work on vehicles with airbag systems must be adhered to.

**NOTE:** After disconnecting the power supply and before performing further work, a wait time of up to 15 minutes must be maintained, depending on the vehicle. Work on airbag systems may only be performed by persons who have a relevant certificate of competence.

Pay attention to the following points:

- Disconnect the battery negative clamp and cover the battery terminal.
- Disconnect the electrical connector at the airbag control module.
- If welding is to be performed directly near a control module, it must be removed beforehand.
- Never connect the negative cable of the welder near an airbag or a control module.
- Connect the negative cable of the welder close to the location of the weld.

For additional information, refer to:

**Side Air Curtain Module** (501-20 Supplemental Restraint System, Removal and Installation),  
**Side Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation),  
**Driver Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation),  
**Passenger Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation),  
**Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) - Vehicles Built From: 06/2004** (501-20 Supplemental Restraint System, Diagnosis and Testing).

### Liquefied gas vehicles

Alternative fuel vehicles often require special handling in the workshop area. Above all, assembly operations to some extent require particular knowledge when dealing with the special technology and the safety regulations.

**NOTE:** Only fully trained personnel are permitted to work on alternative fuel vehicles.

These special requirements must be understood and taken into account in the body shop as well.

**⚠ CAUTION: Danger of fire and explosion. The safety instructions must always be followed when performing service work on fuel/gas systems. Failure to observe this instruction can lead to injury.**

If the smell of liquefied petroleum gas (LPG) or compressed natural gas (CNG) is noticed in the workshop, instruct everyone present as follows:

- No smoking and extinguish all naked flames.
- Shut off all electrical and air powered equipment.
- Evacuate the area.
- Ventilate the area.
- Contact the fire control authorities.
- Move the vehicle to a dedicated, well ventilated area.

Alternative fuels require special handling:

- Handle them in a specially dedicated, well ventilated area, which is only accessible to authorized persons.
- Identify the designated area with new warning notices.



**DESCRIPTION AND OPERATION**

- If possible close the main shut-off valve and run the vehicle on alternative fuel until it switches automatically to petrol operation. Only then is it allowed to drive the vehicle into the workshop or service area.
- If possible do not allow any liquefied gas (LPG) to escape.
- The ambient temperatures must not exceed 40°C. For this reason the LPG and CNG fuel tanks must be removed on vehicles with LPG or CNG operation before using a drying oven to dry the paint where the temperature exceeds 40°C.

Avoid situations in which fuel from an LPG or CNG fuel tank can escape. These situations include:

- Extremely hot ambient temperatures.
- Parking near a heating device.
- Raising the vehicle near a ceiling heater.

**Refrigerated conversion vehicles**

Apart from the special materials used in building the structure of the refrigerated compartment, such vehicles have special energy and refrigeration systems which require special handling during repair.

**CAUTIONS:**

**⚠ Danger of injury. Work on the 230<SP>volt system of the refrigeration equipment must only be carried out by trained specialist personnel.**

**⚠ The refrigeration system is filled with refrigerant R134a. This can cause frostbite if it contacts the skin. Pay attention to the corresponding warning notices and instructions in the chapter Air Conditioning Systems.**

**NOTE:** Work on the refrigerant circuit may only be performed by persons who have a relevant certificate of competence.

Vehicles with a refrigerated compartment are often used to transport foodstuffs. For this reason, additional hygiene regulations must be complied with during repair work.

Aluminum and plastic are used to construct the two different types of compartment found on refrigerated vehicles.

The aluminum conversion is a very stable and technically perfect variant. However, against this the relatively high production costs and a lower

payload must be taken into account, because of the weight of the aluminum conversion itself.

**NOTE:** Basic and in-depth training is offered on the following topics. You will find an overview of the complete range listed in the Training brochure published by the Ford Service Organization.

The plastic conversion has developed into a light, clean and economical alternative because of constant further development of materials and working techniques.

**NOTE:** The material combinations, the workmanship and the working methods must comply with the current food hygiene regulations. For this reason, service and repair work on the refrigerated conversion may only be performed by authorized and specially trained technicians.

Refrigerated compartment constructions are often made using both materials. The floor pan is made of structured, slip-proof aluminum panels and the wall and ceiling cladding is made of smooth surfaced plastic elements.

**⚠ CAUTION: PUR hard foam is flammable. If PUR hard foam is overheated, it will burn on its own with a brilliant yellowish flame. It produces unpleasant choking and toxic fumes. Special measures must be taken when welding the vehicle body.**

Polyurethane wall and ceiling elements are manufactured using a sandwich principle. An insulating polyurethane core is coated with food grade ABS plastic on one side.

PUR hard foam does not decompose, is rot resistant and is odorless. These properties make it suitable for use as insulation.

Because of its closed cell structure, water uptake by PUR hard foam is for the most part only a problem at edges. Cut edges or other mechanically worked surfaces must however be sealed with the greatest care.

The conversion to a refrigerated vehicle is performed as made-to-order production. The large surfaces of the wall and ceiling cladding can be changed and are particularly easy to repair.

If access to the back of a body panel section is needed because of body straightening work, in some circumstances it is cheaper to perform a cut-out repair instead of removing an element.

The repair process is fully described in the Student Information booklet Refrigeration System Technology, Transit 2000.5 Freshline.

## DESCRIPTION AND OPERATION

### Environmental Regulations

Orderly and responsible waste management is not only very important for the protection of health and the environment, but it also has great importance where saving natural resources is concerned.

In body repair shops, since the introduction of the EU directives on the avoidance of vehicle waste and the promotion of return, re-use and recycling of vehicles and their components (2000/53/EU), more rigorous attention than before is also paid to avoidance and recycling of waste materials.

**NOTE:** The organization of disposal in the operation must comply with the country specific waste regulations:

In this respect, body repair shops must take into account and comply with the following requirements:

- Separate waste according to its recycling and disposal methods.
- Produce evidence for the correct transport and disposal of waste.

**NOTE:** The organization of disposal in the plant must comply with the requirements of the Waste Avoidance and Management Act.

The avoidance and recycling of waste must always take priority. However, despite all measures which may be taken, waste cannot be completely avoided.

**NOTE:** Useable waste which is not allowed in household rubbish, must be disposed of as special waste

All remaining waste must be treated as commercial waste and disposed of according to the local requirements.

#### Only applies to the EU:

The vehicle manufacturer is also under a legal obligation since the older vehicle legislation came into force throughout Europe in 2002.

This law covers the surrender, withdrawal and environmentally friendly disposal of older vehicles through the manufacturer.

The older vehicle legislation contains all the necessary information for the environmentally compatible disposal of older vehicles, starting with preliminary handling involving the removal of all operating fluids, deactivation of pyrotechnic components, elimination of pollutants and then further handling by dismantling components for re-use and recycling.

## DESCRIPTION AND OPERATION

## Body Construction

## General

Under bodywork construction, a general distinction is made between monocoque and non-monocoque bodywork. The safety of the occupants is the main consideration for all types of bodywork construction. The front and rear sections are designed so that they absorb the energy of the impact via crumple zones. The use of modern design and manufacturing methods and the use of newly developed body panels (relating to their deformation and strength properties) mean that, despite the continuous weight-savings, all safety-related requirements made of the construction can be met.

## Integral body-frame

In this method of construction, coverings, reinforcements, retaining panels and profiles are permanently joined together using a variety of joining techniques (gluing, spot welding, laser welding, soft soldering or brazing). The load-bearing function of the structure must always be achieved in each case.

There is no distinction made between components which are purely subject to bending/torsion or thrust loads and parts which perform sealing/covering functions (as in non-monocoque bodywork for example). In modern passenger vehicles, monocoque bodywork is very widespread and offers the advantages of a lightweight and low-cost construction.



E59084

The rigidity of the bodywork is achieved by a panel skin and panel cross-section with the largest possible profile and therefore the largest resisting torque (such as for instance the rocker panel). Swage lines in the outer area of the bodywork increase the stiffness and the natural vibration frequency, to prevent possible drumming noises.

The mounting points for ancillary components such as doors and wings are permanently built into the monocoque bodywork.

High rigidity of the bodywork is vitally important to keep the elastic deformations low at the joints to the ancillary components and to prevent noise when driving. Small gap dimensions are therefore



**DESCRIPTION AND OPERATION**

only possible on vehicles with very stiff bodywork. With high bodywork stiffness, the construction can exert an influence on the handling of the vehicle (e.g. on poor road surfaces).

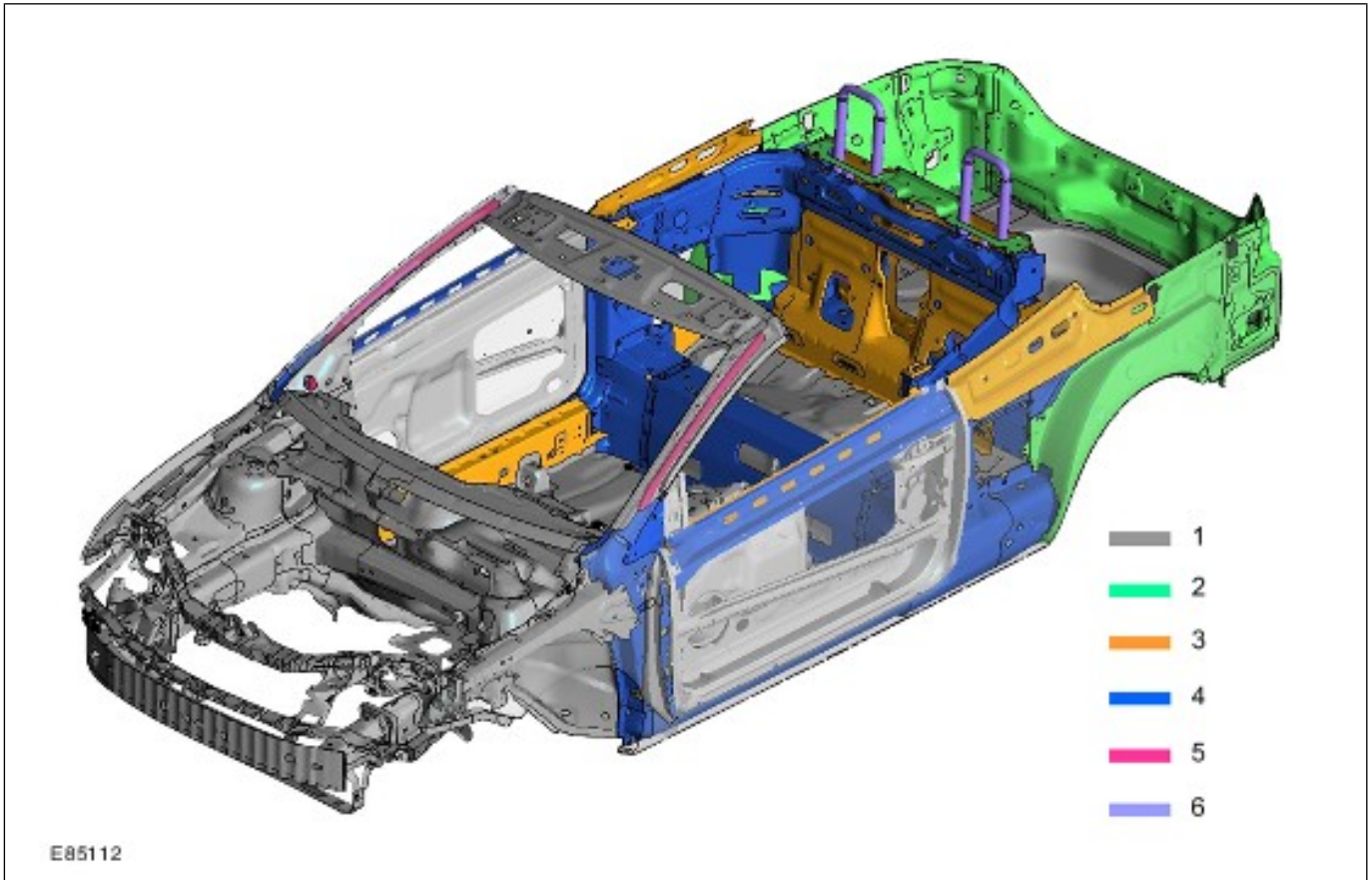
Advantages of monocoque bodywork:

- Weight reduction.
- Economical manufacturing technology.
- High torsional rigidity and high flexural strength.
- Defined deformation behavior at the front and rear.
- Maximum passive safety due to the strong passenger compartment

The protected passenger compartment with strong pillars, rocker panels and doors with integral side impact protection increase occupant protection. Opening of the doors is ensured, even if there is extreme deformation.

**NOTE:** Repair work must always be performed according to the established workshop literature. All the safety requirements must be guaranteed after any repair work has been performed !

**Convertible**



Descript ion	Description
1	Body components adopted from the Focus 2004.75 (07/2004-)
2	Conventional bodywork construction steel
3	High-strength sheet steel
4	Super-high strength sheet steel

Descript ion	Description
5	Maximum-strength sheet steel
6	Aluminium, can be subjected to high stresses

The body of a convertible differs from the principle of the integral body-frame of a saloon due to the lack of a roof construction. The body has a high





**DESCRIPTION AND OPERATION**

degree of torsional stiffness. This is achieved by using high, super-high and maximum-strength sheet steel and body reinforcements in specifically-targeted areas.

These reinforcements can be installed in the area of the doors (diagonal braces etc.) or on the underfloor. In contrast to the saloon (or other non-convertibles) with square-section side members (closed profile), these reinforcements have a profile which is open on the underside (U-section).

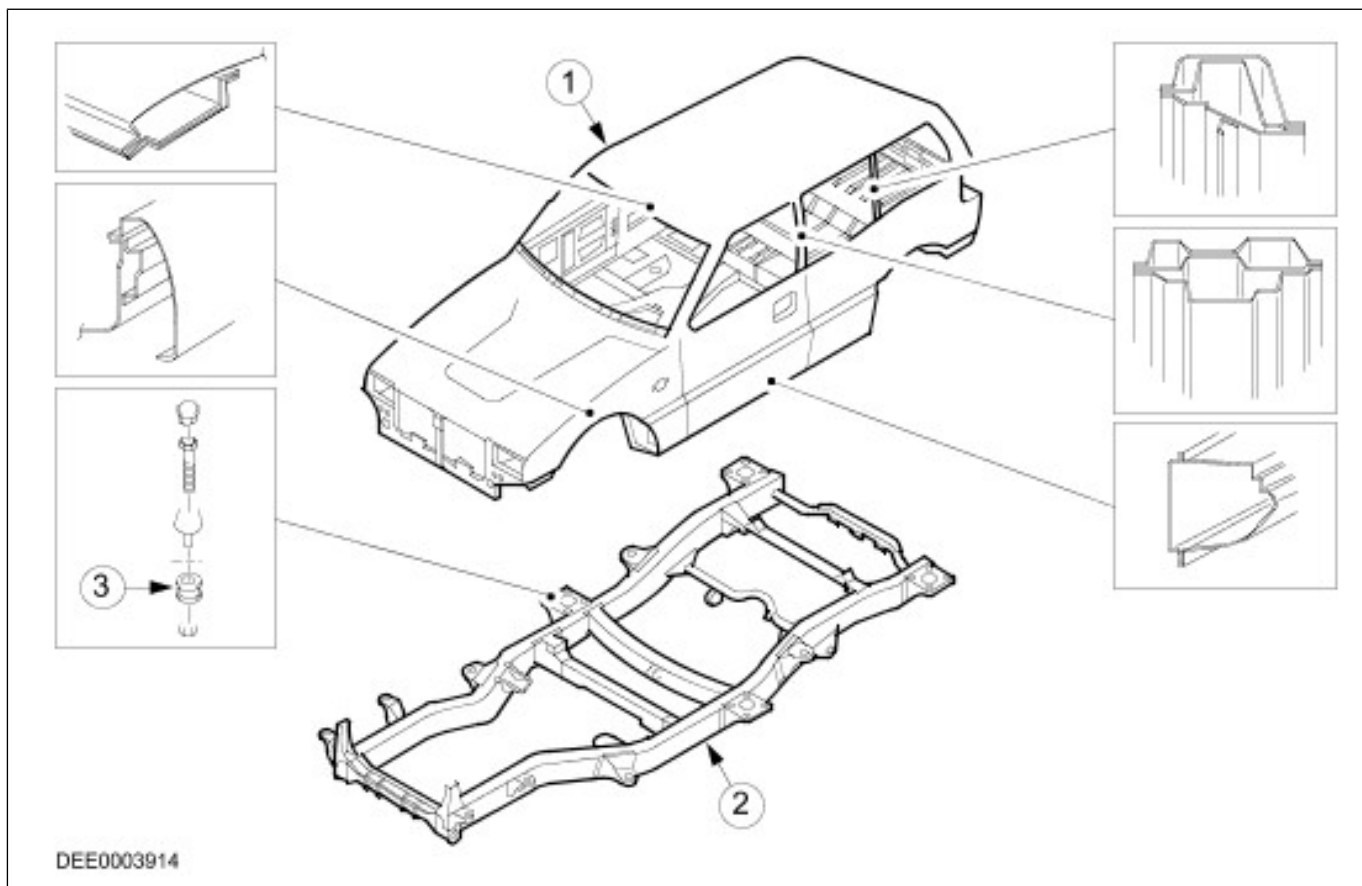
Special constructional changes within the bodywork structure:

- Reinforcing or increase in the thickness of the sheet steel in the pillar area.
- Reinforcing or increase in the thickness of the sheet steel in the floor pan structure (rocker panel area).

- Use of heavily structured reinforcing panels in the rocker panel and pillar area.
- In the area of the windshield frame and A-pillars, thick-walled reinforcing tubes are used (roll-over protection).
- Because there is no roof, the bridge construction principle cannot be used as it is on the saloon for example. Flexural and torsional rigidity must be ensured by other components.

**Non-monocoque bodywork**

Non-monocoque bodywork is built onto a frame or a chassis. Frames used for this have various construction forms, e.g. the ladder frame or tube frame. Non-monocoque bodywork is the original way of constructing vehicles.



Des cript ion	Description
1	Vehicle body.
2	Frame Assembly
3	Bolted connection

The ladder frame is still commonly used today for truck and off-road vehicles. The bodywork is placed on the frame or chassis. The total load which occurs while driving is transferred to the chassis.

More sporting vehicles can be built with non-monocoque bodywork, mostly using a lattice tube frame. Limitations in the design are accepted for the benefit of low weight. The outer skin here

**DESCRIPTION AND OPERATION**

is usually made of plastic or alloy. This type of construction is also common in touring car racing for instance.

**Special features of non-monocoque bodywork construction:**

- Partly large surface panels and high volume shaped parts.
- Thicker materials and greater reinforcements in the frame area.
- Floor pan as frame structure with high torsional rigidity and flexural strength.
- Side panels only make a small contribution to the overall stability of the body.

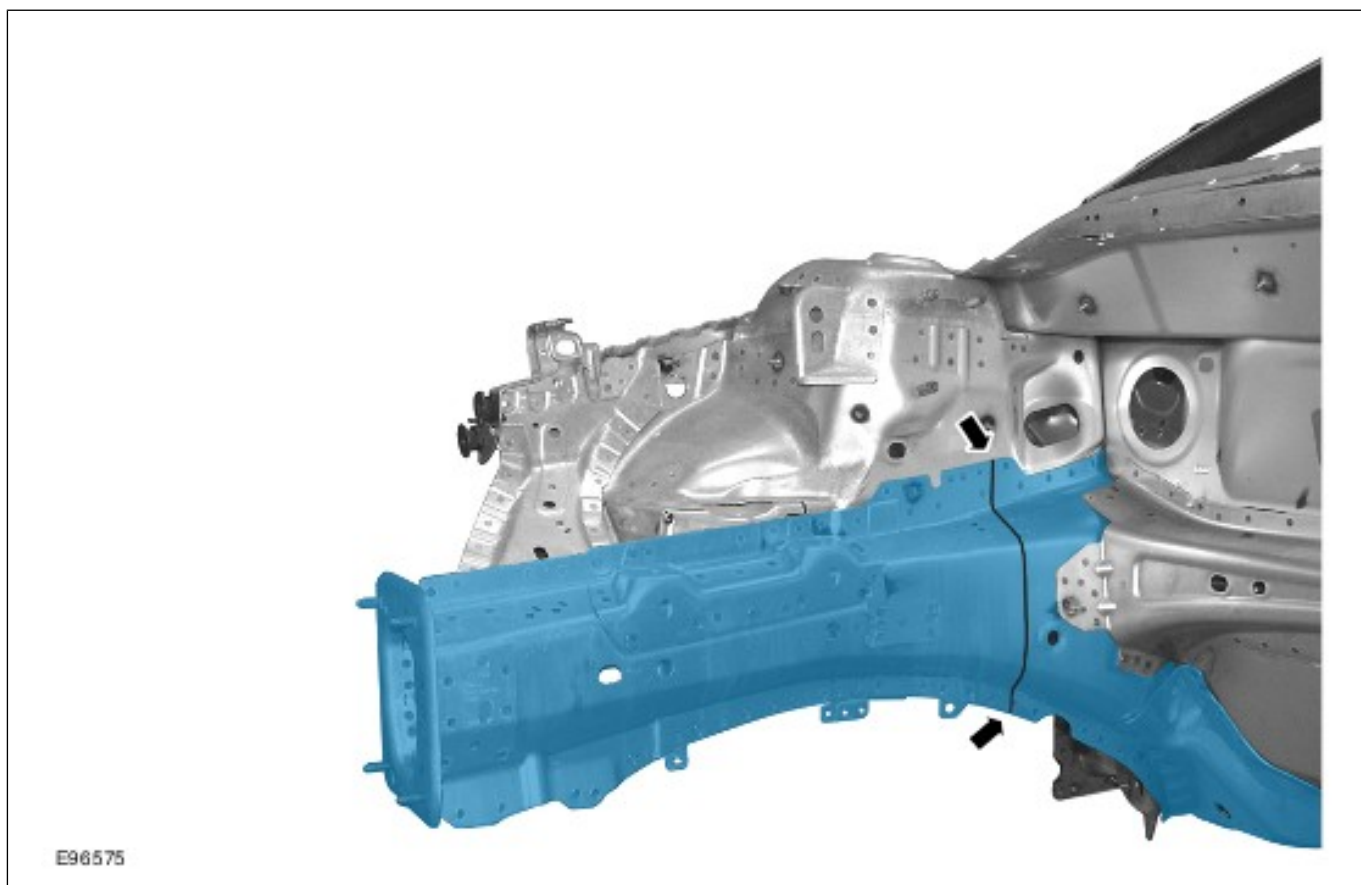
**Instructions for repair:**

A different repair technique is necessary during repairs. A deformed frame structure requires high

suction power during straightening repairs. Frequently, the body also has to be detached from the frame structure in order to carry out separate repair.

Due to the very stable frame structure, please note that the straightening behavior is completely different to that of a passenger vehicle. The frame and the attached body must be repaired independently of each other.

Further information can be found in the respective body repair manual.

**Special points:****Tailored blanks**

Blue: Tailored blank

Arrows: Laser weld seam

The term "tailored blanks" describes the connection of two different panel thicknesses and/or strengths in the bodywork carcass. This connection is done using laser weld seams. Cut locations exactly on the laser weld seams are not permitted, as at present no joining techniques are approved for use

in repair procedures that would re-create joins of the same quality.

**NOTE:** No cutting, no welding and therefore no sectional repairs are permitted in the immediate area of the laser weld seams. The model specific requirements are documented in the respective Body Repair Manuals.

Typical application areas are:

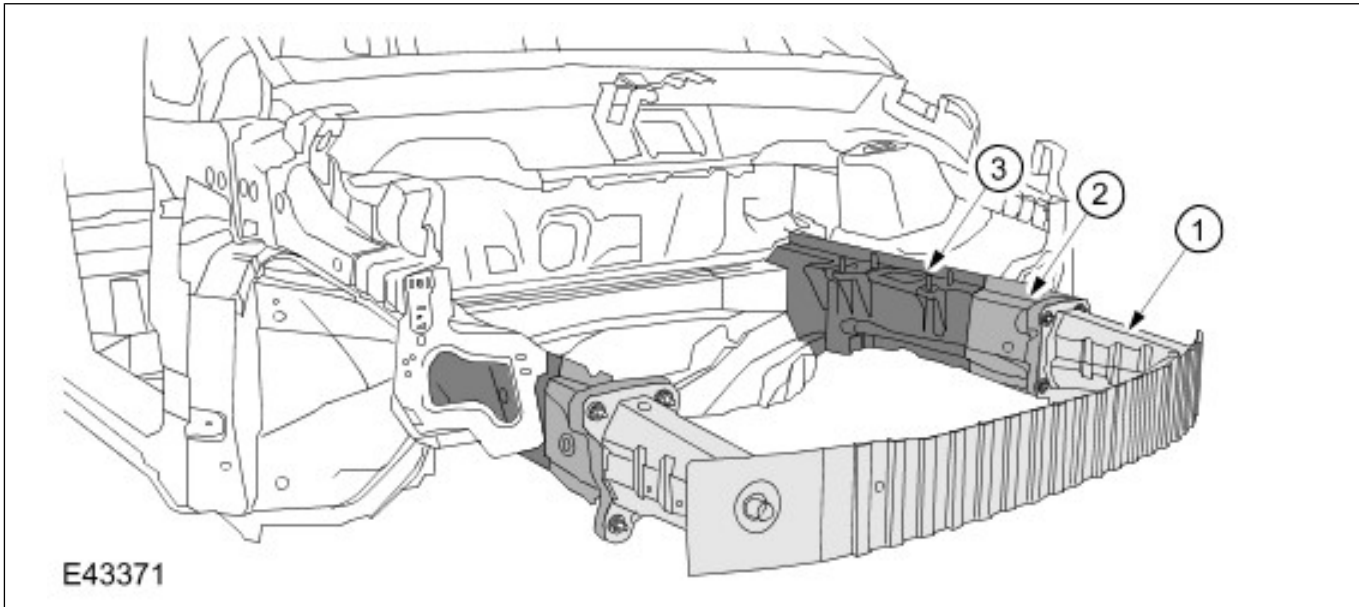




**DESCRIPTION AND OPERATION**

- Side member
- Door inner reinforcement/door frames
- Wheelhouses
- Rocker panel inner reinforcement
- Roof rail inner reinforcement

**Deformation behavior**



Des cript ion	Description
1	Bolted crash element
2	Front side member
3	Rear side member

The rear of the vehicle, like the front of the vehicle, has structures which protect the passenger cell through staged deformation in the event of an accident. The design layouts, however, are adapted to the requirements of the rear area.

Different materials and design features lead to staged deformation of the front and rear of the vehicle in an accident.

**Crash element:**

At the front of the vehicle there is a crash element which is connected to the side member by threaded connections. This crash element can absorb light impacts of up to about 15 km/hr. Because of the threaded connections, the crash element can be changed very quickly.

**NOTE:** Deformed crash elements must not be straightened or repaired.

Heavier impacts which can no longer be absorbed by the crash element must be absorbed by the side members or the floor pan structure. Depending on the extent of the damage, a part or complete replacement can be performed on the side member.



**DESCRIPTION AND OPERATION**

## Diagnosis and Damage Evaluation

Assessment of the extent of the damage includes visual inspection and dimensional inspection of the vehicle. In order to correctly determine the extent of the damage caused by an accident, in-depth technical knowledge, practical experience with the technical equipment and the testing and measuring devices is required.

### Noticeable damage to the bodywork structure

Positive accidental damage assessment can only be achieved if the service technician is able to reconstruct the effect of an impact on the body structure.

For example:

If the impact occurs on the front left-hand side member, the right-hand side member will usually also have been damaged. Often the length of this side member will not have changed, but because of the rigid body design, it may have become deformed. This damage can be detected through the size of the gap between the door and fender or by measuring the vehicle.

In the case of more severe impacts, in which the front part of the vehicle cannot absorb all of the impact energy, the passenger cell is also used to absorb the energy. Here, the energy is transferred via the A pillar and distributed there. This results in deformations in the roof and the door sill.

**NOTE:** Because of existing damage to the bodywork structure, damage diagnosis on a vehicle lift may give extra incorrect diagnosis results.

**NOTE:** Training courses are offered on this subject. For an overview, please refer to the Ford Service Organisation's training course brochure.

If for instance the Ford Focus Coupé/Cabriolet is raised on a vehicle lift, the dead weight of the vehicle will cause the front end to drop by approx. 2 to 3 mm.

The altered door position is clearly recognizable by stiffness of the lock; the door moves upwards. This causes the lock pin to contact the guide element of the door lock.

It is possible to draw conclusions about the extent of the damage through a visual inspection of the external damage. In general, the following areas are to be checked during the visual inspection:

- Outer panel including seam seals for cracks or flakes in the paint caused by the accident.
- Size of the gap on doors and hoods for evenness.
- Freedom of movement of door and hood/tailgate locks.
- The vehicle roof for folds (gap measurement on vehicles with sunroof)
- Dotted flange in door section for deformation and cracked weld spots.
- The side members and crash components for crumpling and folding.
- Trunk floor and floor pan from above and below for crumpling.

### No noticeable damage to the bodywork structure

In addition to external indicators such as flaking paintwork or cracks in the underbody protection, it is vital to check for damage to the body structure that is not visible from the outside (hidden body damage) during a damage assessment. Unless ancillary components are removed, it is often impossible to achieve accurate diagnosis of the underlying body parts.

**NOTE:** In order to determine the damage as accurately as possible, it may be necessary to remove ancillary components in the area of the damage.

Particular attention must be paid to the following components:

- The A, B and C pillars in the roof area.
- Floor pan.
- Rear ancillary components, such as bumper, lights, etc.
- Trunk floor, spare wheel cavity.
- Rear coverings, such as interior trim, carpet, etc.
- Lower rubber seals, e.g. in door area (welded flange).
- Area under the rear seat.
- Attachment points of transmission system, steering, engine, drive shafts, front and rear axles.
- Electrical components, e.g. the radio (damage through shaking or through voltage peaks).

**DESCRIPTION AND OPERATION****Non-monocoque bodywork**

The chassis and bodywork must always be checked during damage diagnosis on vehicles with non-monocoque bodywork.

It is also important here to inspect closely for damage the impact area and the areas absorbing forces.

With these vehicles, simple inspections can already give an indication of possible deformations.

In addition, you must check for the following for vehicles with frame structures:

- Cracks in the paint on the frame welds.
- Traces of deformation on frame components.
- Check attachment points (silent blocks) for position changes and damage.
- Changed position of rubber seals.
- Fit and function of the ancillary components.

DESCRIPTION AND OPERATION

Body Sheet Metal

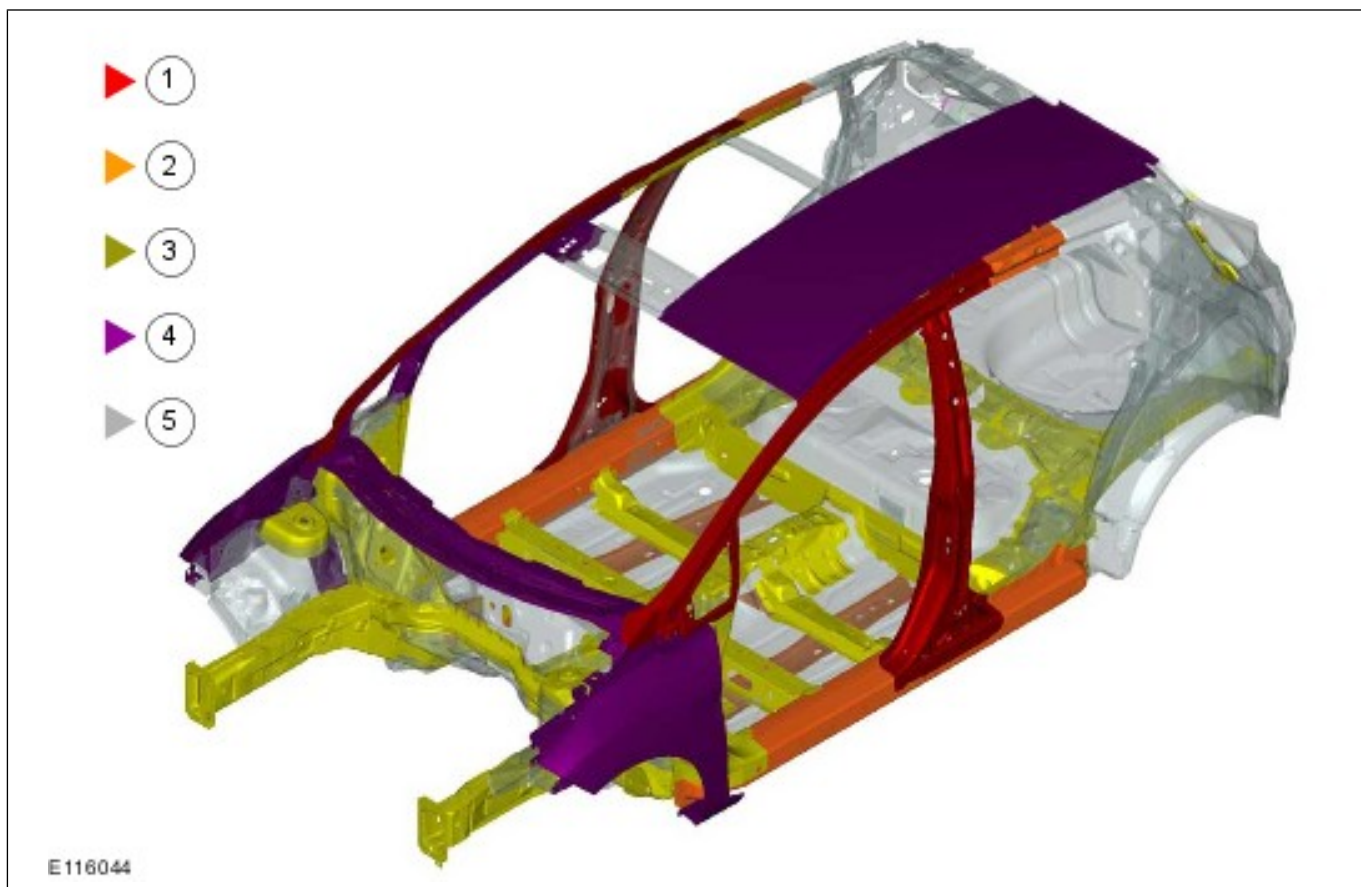
Types of steel

Steel body panels are still the most important materials used in the fabrication of stressed skin vehicle bodies. In addition to the familiar types of steel, reinforced high-strength and also ultra-high-strength special steels are used in vehicle body construction.

Types of steels are classified by their properties of strength and elasticity.

- Normal strength steel has a minimum yield strength of up to about 210 N/mm<sup>2</sup>.
- High strength steels have a minimum yield strength of about 150 to 600 N/mm<sup>2</sup>.
- Ultra-high-strength steels have a minimum yield strength of about 400 to 1200 N/mm<sup>2</sup>.

High-strength and ultra-high-strength steels are mostly installed in safety relevant locations (structural components). Among others, these are side members, pillars, roof frames.



Pos.	Used type of steel	Application range (Examples)
1	Ultra High Strength Steel (UHSS)	Impact Carriers, Bumper Carriers, A-B-Pillar Reinforcements
2	Extra High Strength Steel (EHSS)	Frame Side Member; Rocker Reinforcements
3	Very High Strength Steel (VHSS)	Wheel House; Structural Members

Pos.	Used type of steel	Application range (Examples)
4	High Strength Steel (HSS)	Roof Sticks, Fenders
5	Normal strength steels	Outer Panel

Normal strength steels

Normal strength steels are most often used in body construction. They are relatively soft and are therefore particularly suitable for the deep drawing

## DESCRIPTION AND OPERATION

processes used in body manufacturing. As well as very good reshaping properties, the panels also have a relatively high rigidity.

### High strength steels

The strength of the material and the nature of the surface can be changed as required by different engineering processes. In order to achieve suitable configuration and a good match between construction specifications and what is possible in production, a large range of high strength panels is available.

The range of the minimum yield strength is from 180 N/mm<sup>2</sup> to 460 N/mm<sup>2</sup>. High strength thin steel panels usually have a surface finish. Electrolytic surface sealing is preferred. Within the group of high strength steels, various types of steel are used in body construction:

- **Micro-alloyed high strength steels** for very difficult drawn components such as fenders, the internal components of doors, hoods and luggage compartment lids or load bearing components such as sidemembers, crossmembers etc.
- **Bake-hardening steels and phosphorus alloyed steels** for external panel components with higher draw depth and subject to higher operational demands.
- **Isotropic materials** for flat shaped outer steel panels on doors, hoods, luggage compartment lids, roofs.

### Ultra-high-strength steels


These steels are predominately used for body structural components which are relevant to safety. Despite the reduced thicknesses of the panels used, weight reduction is often achieved together with greater strength. As with high-strength steels, special types of steel are used in the ultra-high-strength steels group:

- **Complex phase steels** are used for door side impact carriers, bumper carriers and body components relevant to crashes. Besides high strength, they have good cold reshaping properties and are easily welded.
- **Dual phase steels** have the same properties as complex phase steels. Because of their high strengthening properties they are suitable for body reinforcements.

- **Residual austenite steels and martensite phase steels** have very high strength levels of up to 1200 N/mm<sup>2</sup> and are mostly used in body structures relevant to crashes.
- **Manganese-boron steels** have ultra high strength levels of up to 1600 N/mm<sup>2</sup> and are mostly used in body structures relevant to crashes.

Due to the use of Ultra-high-strength steels, some special points must be taken into account during body repair:

- Increased force required during straightening.
- Strong springback tendency during alignment work.
- Cutting tools have a shorter useful life.

 **CAUTION: High-strength and ultra-high-strength steel panels must not be heated during straightening work.**

Work without applying heat when carrying out straightening work. Losses of strength will occur at temperatures as low as 250 °C. The basic working methods and the tools to be used are the same however.

### Coated steel panels

In a similar way to high-strength steel panels, coated steel panels are finding more applications because of the better corrosion protection which they offer. There are basically two different processes which are used to apply a zinc layer:

- Hot dip zinc coating.
- Electrolytic zinc plating.

The following points must be noted when welding:

**NOTE:** Welding fumes are harmful to health. Make certain that the workspace is well ventilated and use welding fume extraction.

- Zinc starts to melt at about 420 °C.
- The zinc vaporizes at a temperature of about 900 °C.
- The amount of heating determines the damage to the zinc coating, and therefore to the corrosion protection.



**DESCRIPTION AND OPERATION**

- **NOTE:** Coated panels have a higher electrical resistance, but this can be compensated for by increasing the welding current by 10 - 20% .

Resistance spot welding is particularly suitable for welding zinc-coated panels, because no widespread warming occurs.

- With electrolytically zinc-plated panels there is no need for any special preparation because the zinc coating does not need to be removed.



## DESCRIPTION AND OPERATION

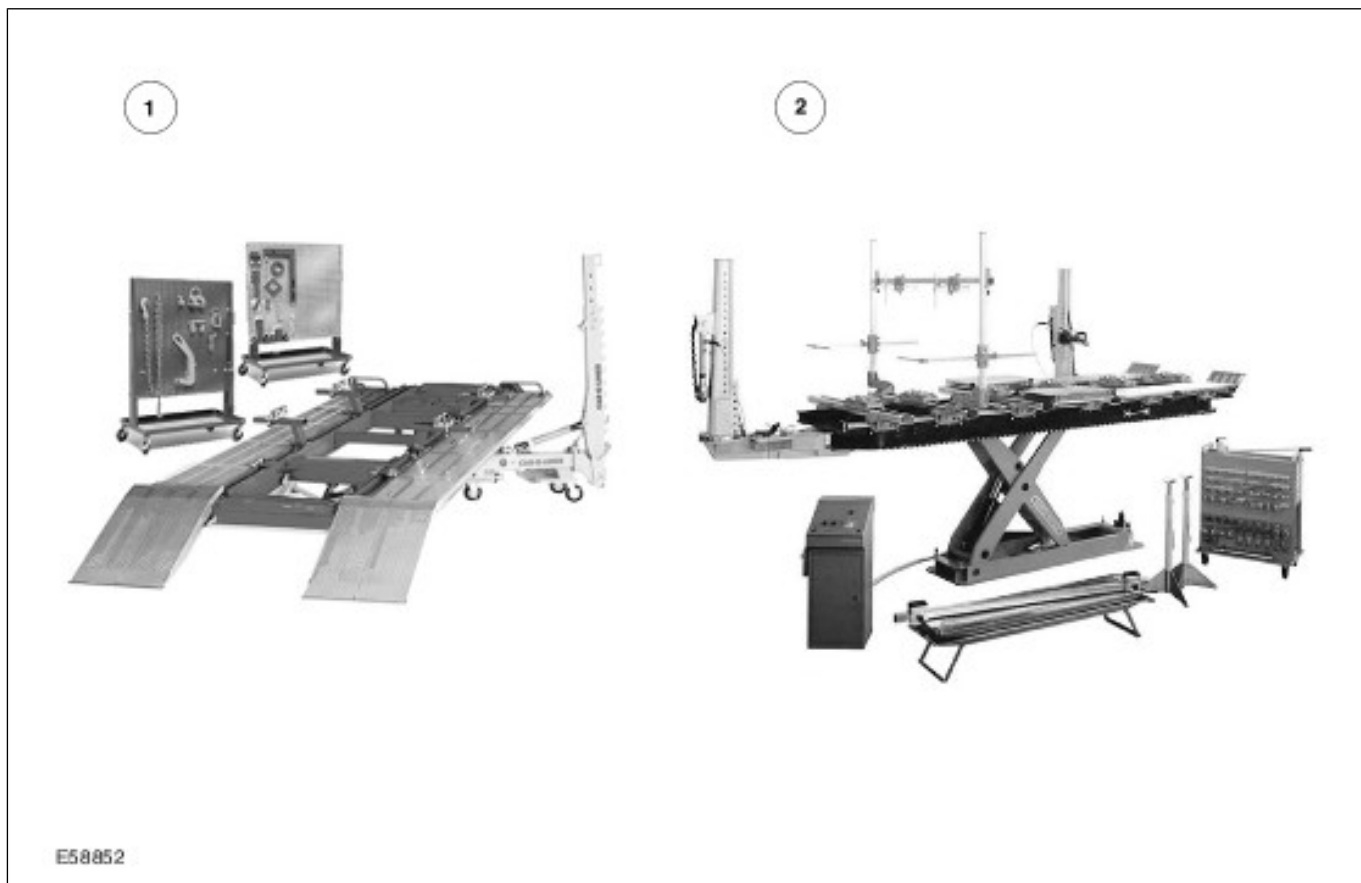
## Tools and Equipment for Body Repairs

**Alignment systems**

**NOTE:** All the equipment for body work and painting work can be ordered online via the Wielander & Schill service portal <http://fo.oem.wielanderschill.com>.

Straightening and alignment repairs are often required to restore a vehicle body to its original shape after accident damage.

Universal aligning and measuring systems and universal alignment angle systems are suitable for this work.



Descript ion	Description
1	Universal aligning and measuring system
2	Universal alignment angle system

Basically, the aligning and measuring system must satisfy the following requirements:

- Universally applicable to all types of passenger car. Can also be used on light commercial and off-road vehicles.
- Accepts the forces involved during straightening.
- High stability and mobility.
- Can accept all or part of the weight of the vehicle.
- Quick to set up.

- Simple to use.
  - Stationary design with drive-on ramp.
  - Height-adjustable aligning platform.
  - Universal gauge extensions with fast anchoring ability around the whole circumference of the aligning platform.
- Facility to test individual body measurement points, with or without aggregates being removed.

**Alignment angle devices** survey the vehicle at several points on the body. These are usually points which are also used in production. In addition, a recording over the rocker panels is possible. A measuring system is not needed, because the necessary body points are specified with gauges. For this purpose, vehicle specific or universal gauges are available.

## DESCRIPTION AND OPERATION

**Universal alignment systems** consist of a vehicle mounting (universal clamps at the rocker panels) and a pulling device. In addition, a measuring system is required.

**NOTE:** Because universal clamps are used, the rocker panel area must be reworked for optical and corrosion protection reasons after the repair is completed.

Pay attention to the following points:

- Clean the attachment areas.
- Anchor the vehicle free of stress on the relevant system.
- Support the aggregates to take strain off the body.

### Measuring systems

In order to exactly diagnose a damaged vehicle body, measuring systems are required. Depending on the measuring method, the systems vary in having mechanical, optical, acoustic and electronic measuring devices. In some cases, hybrid versions of particular systems are found.

**NOTE:** When working with each measuring system, the manufacturer's instructions provided in the description of the measuring equipment must be followed.

Basically, the measuring systems must meet the following requirements:

- Universally applicable to all types of passenger car. Also can be used on light commercial and off-road vehicles.
- Suitable for all accident damage.
- Fast capture of body measurement points in the underfloor and external areas.
- Data catalog to record all measurement points (length, width and height) both with and without the aggregates being installed.

**NOTE:** Basic and in-depth training is offered on the following topics. You will find an overview of the complete range of training offered in the Ford Service Organization training brochure.

#### Beam compass

The beam compass is a very practical and straightforward aid for measuring bodywork and especially floor assemblies. The beam compass can be used to detect dimensional variations across the length and the width by means of comparison measurements and diagonal measurements.

As a basic principal, body reference points should be chosen which are shown in the body frame measurement data sheet.

**NOTE:** To be able to determine difference in measurements, the same reference points must always be chosen on both sides. For this purpose the beam compass must be positioned symmetrically.

Comparison measurements can also be made on the outside of the body. Depending on the damage, left/right measurements (symmetry measurements) and diagonal measurements can be made using the beam compass, telescopic rod or a measuring tape.

#### Laser measuring systems

These systems use laser beams which are projected in one or more planes.



By the use of two parallel laser heads which can be turned, symmetrical points of a vehicle body can be tested and compared. Using the linear scales which are attached to the measuring points, the measurement data is read off with the aid of the projected laser beams.

The integral inclination gauge also allows differences in height to be quickly checked.

#### Mechanical measuring system

The use of mechanical measuring equipment is an easy and effective way to check a vehicle frame and chassis assembly quickly, exactly and reliably.

In many cases an assessment of the damage can be made with the help of this system, without the need for elaborate setting up.

DESCRIPTION AND OPERATION



Because of its self-centering mount, measurement can be carried out by one person.

Further advantages:

- Fast deployment.
- Simple to use.
- Can be extended using adapters, measuring probes and measuring tubes.

Measuring systems which are firmly mounted on an aligning platform require more work in setting them up. They are used to constantly check measurements during alignment work.

This type of mechanical measuring system has measuring scales and measuring slides in three measuring axes. So that the body can be measured, the vehicle is secured on the aligning platform base frame using four universal chassis clamps. The exact fixing points are given in each respective data sheet.

**Ultrasonic and mechanical-electronic measuring systems**

These measuring systems can be combined with all current aligning platforms. In addition these measuring systems can be used independently of an aligning platform by using a vehicle lift or suitable support stands.



Des cript ion	Description
1	Ultrasound measuring instrument
2	Mechanical-electronic measuring system

Acoustic or ultrasonic measuring systems use ultrasonic emitters and sensors to survey a body.

To do this, ultrasonic emitters are mounted on the vehicle using special attachments. During the measuring process the ultrasonic emitters constantly send out signals which are received by sensors (microphones) and then passed to a

**DESCRIPTION AND OPERATION**

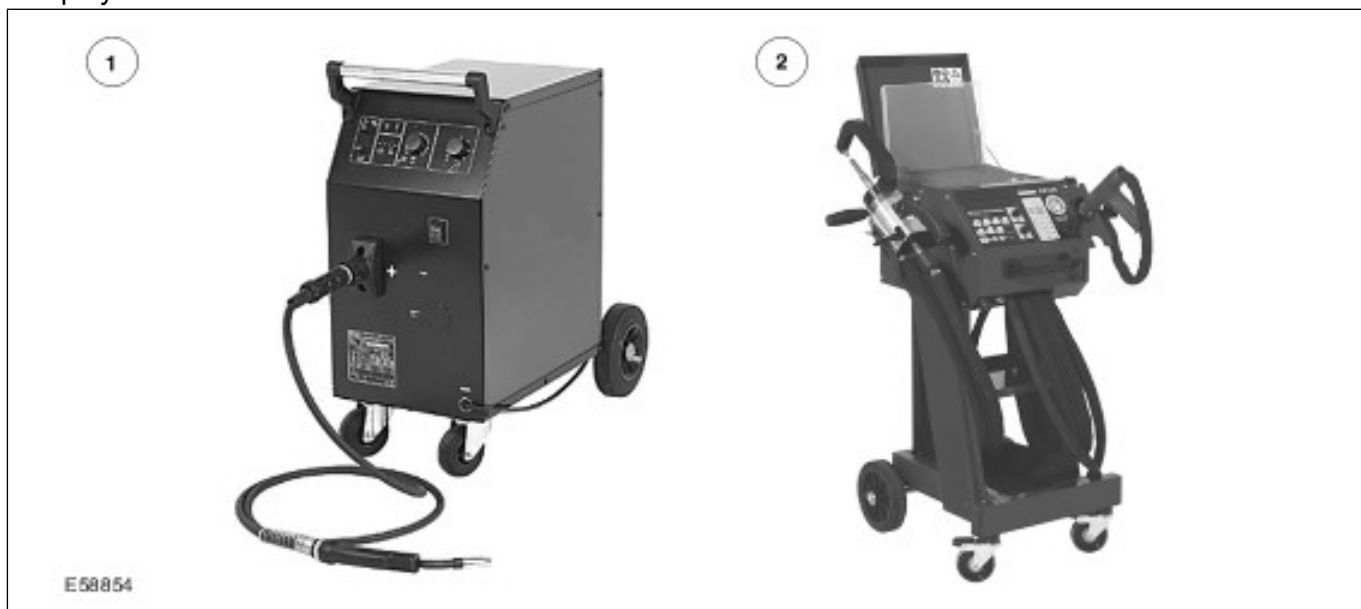
computer. The measurements are displayed on the computer screen and are compared with the required values supplied by the vehicle manufacturer.

The ways in which mechanical-electronic measuring systems can be used are similar to those of the acoustic measuring systems. They can also be set up on a suitable understructure, without an alignment jig. After this system has been arranged under the vehicle floor and adjusted to three undamaged vehicle measuring points, the measuring arm is brought up to the required measuring points and the readings compared with the reference values. The data is transmitted to a computer where it is evaluated and the results displayed on a screen.

**Welding gear**

As in the past, the dominant process in body construction is **resistance welding**, in particular spot welding. Depending on body type, up to 5000 spot welds are applied, either by welding robots or in the multi-point welding machine.

Resistance spot welding permits very high energy to be concentrated on a relatively small area of the workpiece in the shortest possible time and when high pressure is applied, a permanent joint is formed. During repairs the resistance spot welds used in production must be re-created accordingly.



Des cript ion	Description
1	MIG welding machine
2	Resistance spot welding machine

**NOTE:** If a suitably powerful welding machine is not available and multi-layer panel joints with a total thickness of over 3 mm need to be made, puddle welding must be used.

Although in principle, high and ultra-high-strength panels are adequately or well suited to resistance spot welding, considerable problems may arise because of low welding power, especially where thicker panels or triple or multi-layer panels have to be welded together in the workshop. In particular, older welding equipment does not have the latest welding technology nor welding power

and therefore cannot reliably join panel thicknesses greater than 3 mm.

**NOTE:** When installing body components made of ultra-high strength steel (e.g. boron), only **inverter welding equipment** certified by Ford may be used.

Equipment with inverter technology allows better spot weld quality because of a constant high welding current. In addition the high welding current makes shorter welding times possible and the electrodes therefore have a longer working life. Inverter welding is a further development of electrode welding. In addition, a much higher electrode force (contact pressure of welding tongs) can be achieved with modern equipment.

Further advantages of the new inverter welding equipment are:

## DESCRIPTION AND OPERATION

- good welding performance with constant quality, even with high switch-on times
- recognition of and compensation for disruptive factors: e.g. primer, adhesive, rust-prevention paint
- own and pre-set welding programs which can be saved and called up
- quality confirmation through logging of all important welding data
- fast changing of spot welding clamps or spot welding guns as required

The following functions can be controlled and monitored by programming the welding equipment:

- Control of the start conditions by resistance measurement (dirt, paint, bodywork adhesive, shunt circuit through the next spot weld).
- Ensuring the optimum welded connection.
- Checking the energy balance, resistance and quality.

In the case of resistance spot welded connections, faults in the weld are difficult to see from the outside. It is therefore absolutely vital to know the particular properties of the welding machine being used. A test weld with subsequent peeling test will provide information on the quality of the weld. The spot weld itself must not separate, it must tear away leaving a hole.

In the production of vehicle bodies, **MIG welding** plays a minor role as a joining technique. It is used for components subject to high demands, such as threaded plates for axle mountings, or at locations which cannot be spot welded for access reasons.



**DESCRIPTION AND OPERATION****Establish Repair Method****General**

Before starting accident repair work, make sure that the necessary spare parts and repair material are available.

**Planning**

**NOTE:** The body interconnection is to be maintained if possible. Repair is preferred to renewal of body components. Furthermore, check if it is possible to perform a partial repair.

During planning the following job steps must be observed and adhered to:

- Determine the repair method taking into account the information made available in ETIS.
- Work out which repair components will be needed and obtain them.
- Establish what disassembly work is needed.
- Check for specific features such as airbags, route of water drain hoses, electric cables and the location of NVH elements.
- Cut out the old parts (only when the new parts are waiting ready).
- Prepare the joint locations.
- Attach the new parts.
- Prepare the area of the repair for painting (grinding welded beads).
- Perform any solder work which is required at the repair location.

- Separate and remove the old part.
  - Take into account the special features particular to the vehicle.
- Prepare the joint locations.
  - Sand and align the weld flanges.
  - Apply corrosion protection measures.
  - Offer up the new part.
- Attach the new component.
- Rework the welded joints (grind welded seams).

**Chronological sequence of repair**

**NOTE:** Refer to each vehicle specific chapter in the workshop literature for details on the individual points.

The actual sequence of repair can be divided into the following steps:

Job steps for the coachbuilder:

- Straightening
- Establish separating cuts and mark them.
  - Take into account the requirements given in the repair instructions.
  - Place the new part ready for use and include it in the repair plan.



**DESCRIPTION AND OPERATION**

## Alignment Check

**General**

If there is concern that the body has been deformed, the body must be measured. Several measuring procedures and tools can be used for this purpose.

With simple measuring systems, it is possible in most cases to draw a conclusion about the extent of the damage through a quick measurement without time-consuming assembly work (straightening jig).

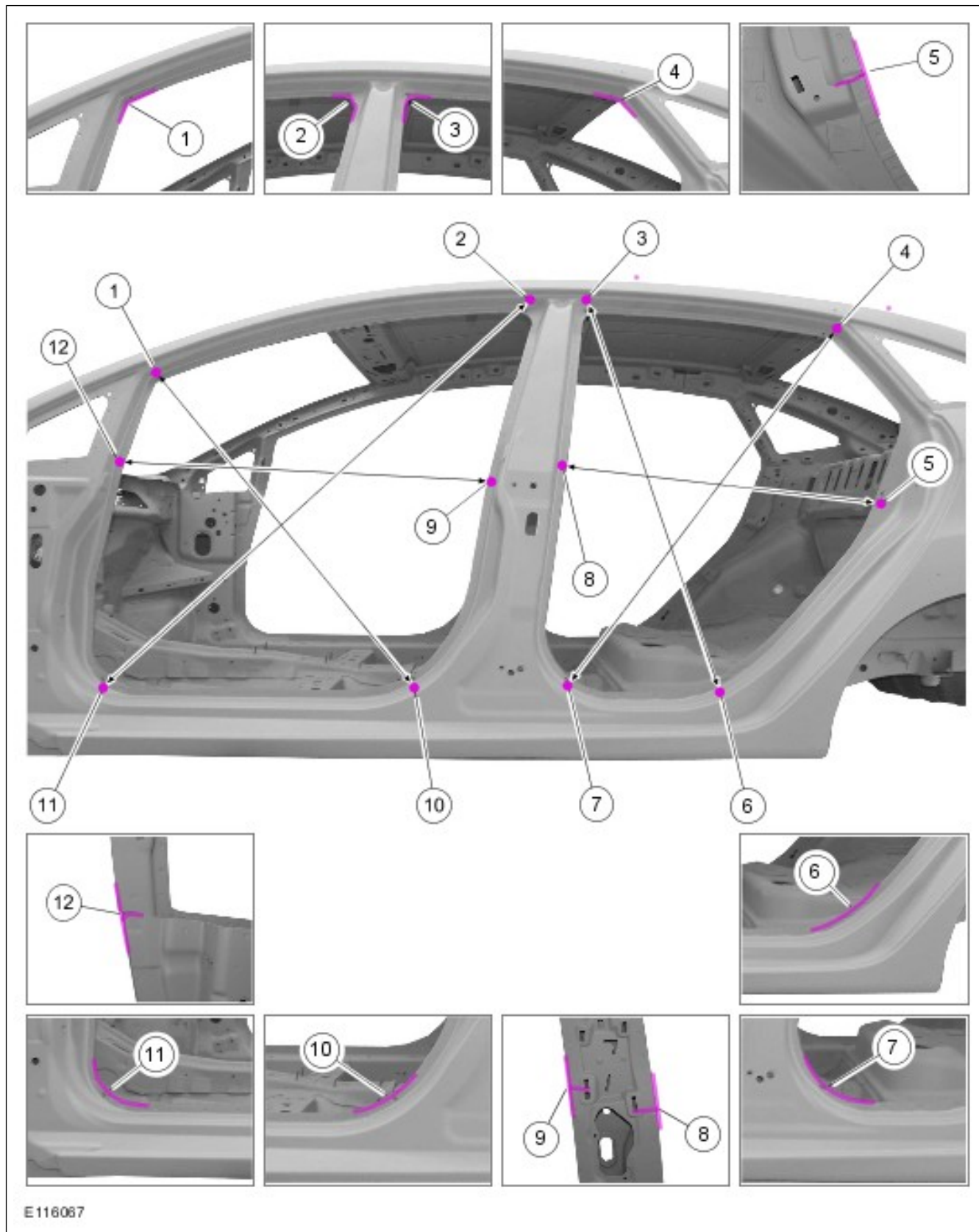
**NOTE:** For the floor pan and the exterior of the vehicle, measuring data is contained in the vehicle-specific repair instructions for each vehicle. Manufacturers of measuring and straightening jigs create data sheets for this purpose for each vehicle.

Data sheets with the body frame dimensions for body measurement are specified in the model-specific repair instructions in each case. Pay attention to the position of the measuring probes for each of the measurements given. A tolerance of  $\pm 3$  mm applies to all specified dimensions.

Measuring points that are specified in a curve are to be measured so that the greatest distance from the opposite measuring point is reflected. For exact determination of the measuring points, enlarged sections are shown.

**Example of measuring the vehicle superstructure**

DESCRIPTION AND OPERATION

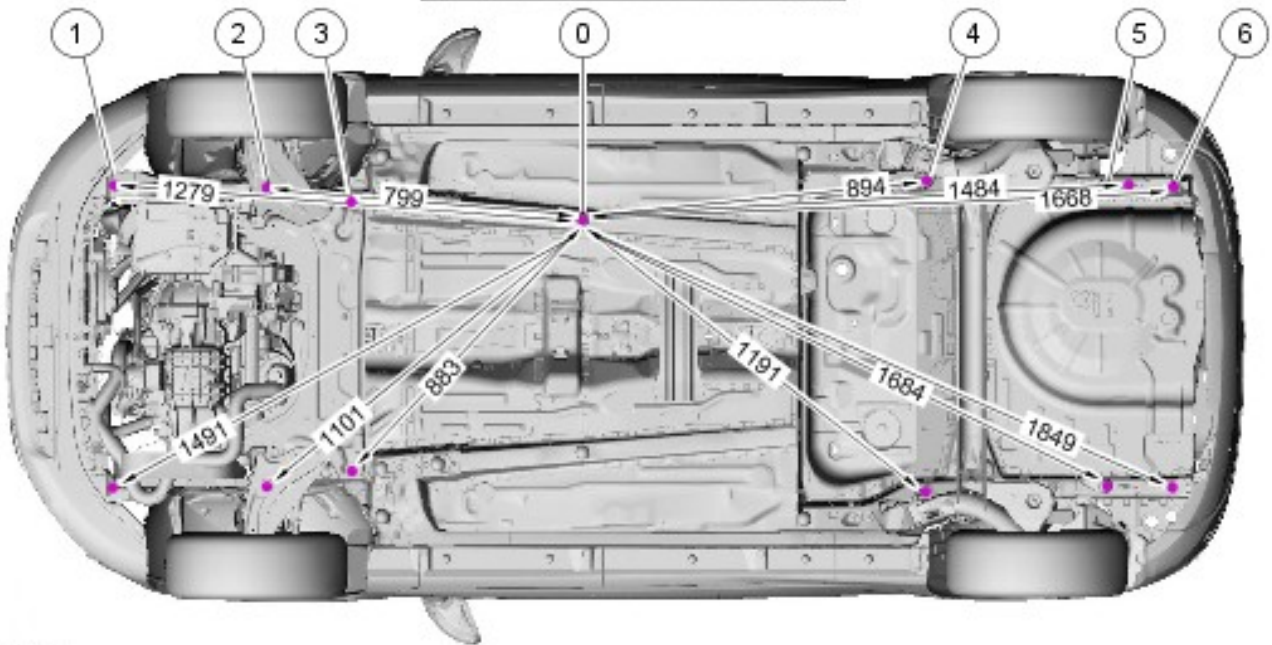
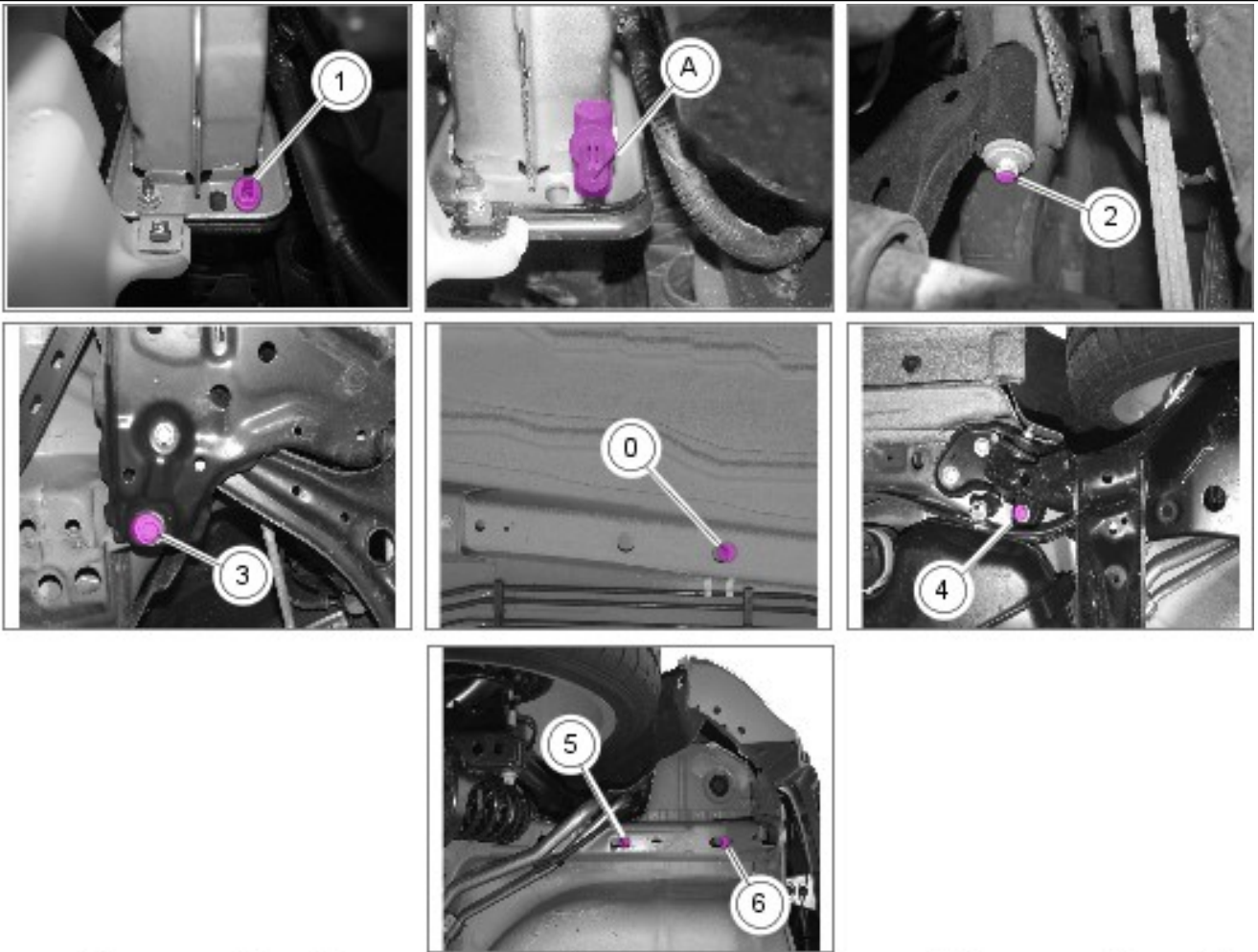


E116067

Example of measuring the floor pan



DESCRIPTION AND OPERATION



E116084



## DESCRIPTION AND OPERATION

## Straightening

## General

Straightening repairs are often required to restore the original body shape. To do this, the vehicle must be placed on a straightening jig so that a pulling device can be used.

**NOTE:** Basic and advanced training courses are offered for the following contents. For an overview of all training courses offered, please refer to the Ford Service Organisation training course brochure.

Straightening is considered as the process of pulling out the deformed body parts, up to cutting out the parts that need replacing. If distorted components remain on the vehicle, then the term alignment work is used.

Body straightening requires practice and experience. Before starting body straightening, the exact direction of impact must be determined. The straightening force must be applied in the opposite direction to that of the impact. Only in this way can it be guaranteed that the original shape will be achieved again.

Note the following points during the process of body straightening:

- Secure the pulling unit with a safety cable.
- Do not remove bonded glass prior to straightening.
- Never apply heat during straightening.
- If necessary, open doors or hoods/lids/liftgates during straightening.
- Check dimensions and gaps continuously during straightening.
- High-strength steel panels have a stronger tendency to retain their deformed shape.
- During the straightening repairs, monitor the attachment of the pulling unit to the vehicle.
- Carry out the straightening work in several stages, never in one pulling process. This prevents the risk of overstretching and of joints tearing out.
- During individual straightening steps (under a pulling load), relieve tension by striking the deformed areas with an aluminum hammer while they are still under tension.

## Special features of non-monocoque bodywork

Straightening is different to monocoque body construction because of separate straightening for bodywork and chassis.

If only the body is damaged in an accident, light straightening repairs can be carried out while still mounted on the chassis.

**NOTE:** With strong straightening forces, these bolted connections may be damaged (bodywork to chassis frame). Monitor the bolted connections continuously during the straightening work. Holding clamps or alignment angles must be attached directly to the chassis frame.

## Straightening of chassis frames

**NOTE:** High-strength steels must not be heated.

If the body and chassis frame have to be straightened, they must first be separated from each other.

The following conditions must be met:

- The repair must be economically justified.
- The production quality and stability of a frame must be achieved again after carrying out the repair.
- In principle, the driving and operating safety of the vehicle is paramount.
- Cold straightening of deformed areas with sharp edged folds cannot be carried out.
- Straightening with the application of heat (welding torch) requires much experience and accurate knowledge of the behavior of steel panels when heated.
- The temperature and duration of application of the heat are to be considered in particular.
- Individual components of the frame, such as cross members, brackets, etc. can be replaced.



## DESCRIPTION AND OPERATION

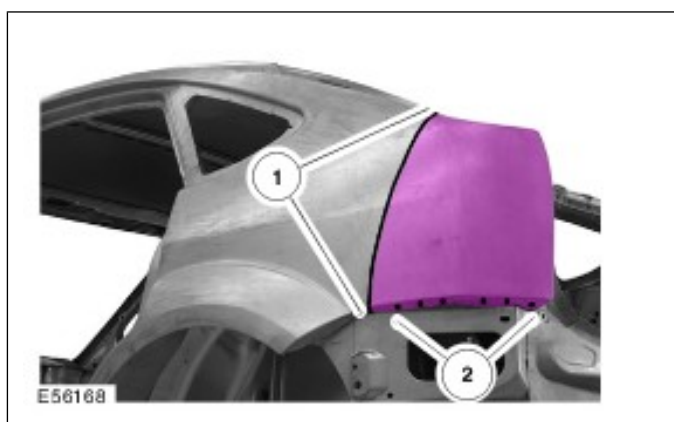
## Complete Panel Replacement/Partial Replacement

**NOTE:** Basic and advanced training is offered for the following contents. For an overview of all training courses offered, please refer to the Ford Service Organisation's training course brochure.

Repairs always mean intervention in the body shell structure and thus also intervention in the vehicle's passive security system.

**NOTE:** From an economic perspective, the possibility of a partial replacement (sectional repair) must be considered when assessing an accident-damaged vehicle.

## Partial Replacement



Item	Description
1	Join area
2	Original welding

## Decision criteria

The following are always crucial for the decision:

- How economical the repair is.
- Retention of the original join.

In addition, Ford must have given its approval for a sectional replacement solution in the damaged area. For those partial replacements approved by the factory and described in the model-specific body workshop literature/technician's information, some spare parts (service parts) specially prepared for partial replacements are offered through the spare parts sales department.

Sectional replacement (sectional repair) means the replacement of a section of the body shell structure. Sectional repairs fulfill their purpose above all if the replacement of a complete part is too time-consuming and thus not economical. Approved sectional repairs are clearly defined in

the model-specific body literature. These requirements must be complied with.

Depending on the damaged areas, further facts are to be taken into account when deciding for or against partial replacement:

- Severance cuts should be as short as possible.
- The effort for follow-on work on the connections must not be too great.
- It must be possible to reproduce the optical path of visible edges on door openings.
- Inner reinforcement panels must not limit the straightening work.
- Inner reinforcement profiles in the pillar areas must allow for separation.
- The Ford regulations for partial replacements on structural frame sections must be taken into account.
- The large surface welding seams at the connections must be restored.

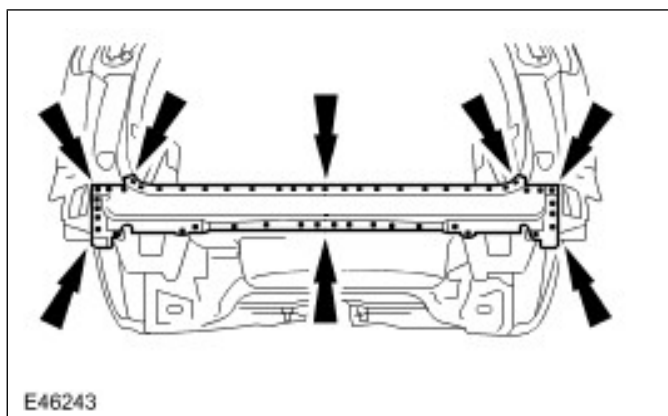
## Advantages of a partial replacement

A partial replacement repair offers many advantages for a professional repair of accident damage:

- Repairs can be made both in the outer panel area (e.g. side frame) and in the inner areas (e.g. structural member, trunk floor).
- The repair can be limited to the actual damaged area.
- Reduction of repair costs, as aggregates and other components can usually remain in the vehicle.

## Complete replacement

In a complete replacement, the original connections are largely reused.



**DESCRIPTION AND OPERATION**

A complete replacement is advantageous if the damaged body part can be detached from its original connections and a completely new part can be fitted without creating additional joints (e.g. liftgate).

A complete replacement is necessary if there is no sectional replacement solution.



**DESCRIPTION AND OPERATION**

## Corrosion Prevention

The corrosion protection provided in production must be carefully maintained and reproduced during body repair work, in order to ensure the long-term warranty for Ford vehicles.

**NOTE:** Please take the notes in the model-specific repair descriptions into account. Please also note the manufacturer's instructions when handling the different anti-corrosion agents.

Only Ford original bodywork components and Ford approved repair materials are to be used for body repairs. The Ford logo is stamped onto every Ford original spare part.

### Panel coatings and corrosion protection

Body steel panels are provided with a coating for corrosion protection purposes. The coating material is predominantly zinc in a variety of composition forms. Aluminum is also used to some extent. Basically, all types of steel sheet can be coated.

A variety of coating processes are used:

- Hot dip zinc coating.
- Electrolytic zinc plating.
- Organic coating.
- Hot dip aluminum coating.

**NOTE:** Welding fumes are harmful to health. Make certain that the workspace is well ventilated and use welding fume extraction.

The following points must be noted when welding:

- Zinc starts to melt at about 420°C.
- The zinc vaporizes at a temperature of about 900°C.
- The amount of heating determines the damage to the zinc coating, and therefore to the corrosion protection.
- Resistance spot welding is particularly suitable for welding zinc-coated panels, because no widespread warming occurs.
- With electrolytically zinc-plated panels there is no need for any special preparation because the zinc coating does not need to be removed.

**NOTE:** Coated panels have a higher electrical resistance, but this can be compensated for by increasing the welding current by 10 - 20% .

### Corrosion protection measures during repair work

**⚠ CAUTION:** Always be extremely careful when handling solvents, sealants and adhesives. Some products contain substances harmful to health or give off harmful or poisonous vapors. Always follow the manufacturer's instructions. If there is any doubt as to whether a particular solvent is suitable, it must NOT be used.

All Ford bodywork components have a cathodic primer. Moreover, most parts are zinc-plated on one or both sides. If possible, these protective layers must not be damaged.

#### Before welding

Interior surfaces of new bodywork components which will no longer be accessible after installation must be painted beforehand. The welding flanges are treated with a special welding primer. The joint areas are not always accessible from inside later. Therefore, prepare these areas so that no soot is produced by burning paint during welding.

**NOTE:** In order to ensure that the corrosion protection produced in production is not destroyed, the working area must be kept as small as possible.

**NOTE:** Do not touch cleaned bare metal any more with the bare hands. The dampness of your hands will corrode the metal.

Procedure:

- Remove the primer or paint/zinc layer in the welding area using a tress wire brush to prevent the formation of soot from the paint.
- Thoroughly clean the welding area with a metal cleaning agent and rub dry.
- Coat the welding flange with welding primer on all sides and allow to dry.

**NOTE:** The welding primer must only be applied thinly to the spot welding area, to minimize spattering when welding.

#### After welding

During repair work, body panels are often heated at very high temperatures, which results in the destruction of the corrosion protection.

**DESCRIPTION AND OPERATION**

Reworking of the affected areas is therefore vital:

- Grind the welded seams flat and clean thoroughly with silicone remover. Dry with a lint-free cloth.
- If the join area is accessible from the inside, the transition area to the paint must be abraded for all types of join so that good adhesion of the primer is achieved later.
- If the join area is not accessible from the inside, the cleaning and sanding work is not done. For this reason, ensure that there is as little contamination as possible in the area of the repair. This allows the cavity wax applied later to penetrate the join area without hindrance.

**NOTE:** Only apply a small amount of panel cleaner to the cleaning cloth when cleaning the repair area. Make sure that no cleaner reaches the connecting flange, so that the welding primer is not washed away again.

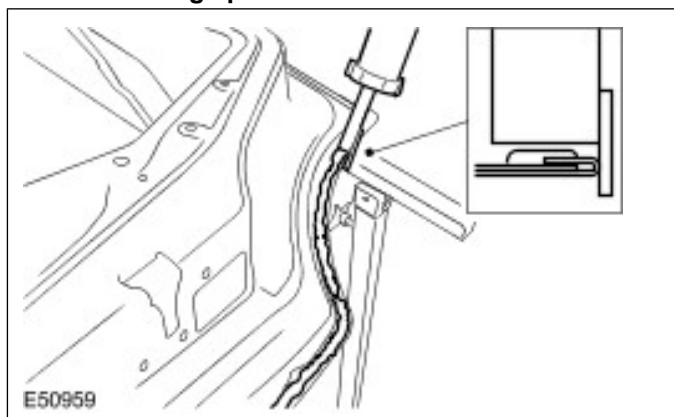
**Priming after welding**

Primer is applied to the welded flanges after cleaning. A check must also be made that the production corrosion protection is present in the area of the flanges. Any damage must also be re-primed.

**Sealing work**

- If MIG welding is carried out during a sectional repair on a connecting flange with sealant or adhesive material, the material must be applied at a distance of approx. 10 mm from the weld spot.
- These areas must be sealed very carefully after the work has been completed.

Depending on the type of repair, the clinched flanges on the hood, doors, tailgate and trunk lid must be sealed with clinched flange sealer.

**Clinched flange protection with flat nozzle**

Clean the clinched flange area of the new component with silicone remover and dry with a lint-free cloth.

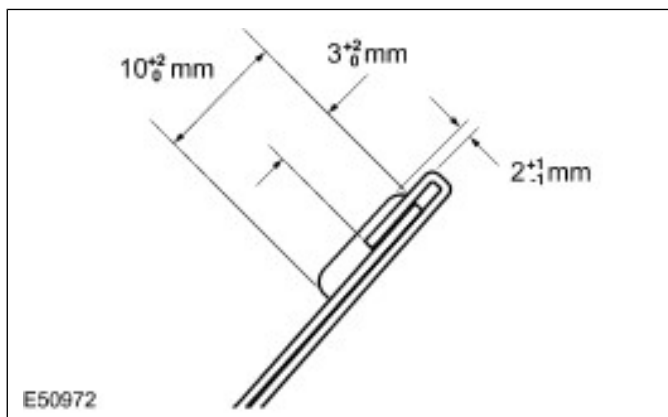
The sealant must be applied to the dry primed surface (i.e. dip priming as for delivery).

Apply clinched flange protection to the clinched flange using one of the flat nozzles supplied. The nozzle must be cut to the necessary width beforehand and the guide stop cut as required.

During application the clinched edge must be covered with an overlap of at least 3 mm. The beginnings, ends and edges or interruptions in the sealer bead need to be reworked by forming with a brush or a spatula, to ensure a 100% tight sealing of the flange.

The speed and angle of application are decisive for a good appearance and a bubble-free bead. Always apply the sealer with as few as possible interruptions to avoid sealer rework. Never use solvents or thinners as this will considerably slow down the hardening process of the sealer.

For an application thickness of 3 mm of the clinched flange sealer it is recommended to allow to dry over night at room temperature. A minimum hardening time of 5 hours is required anyhow before a 2-component primer can be applied.

**Clinched flange protection applied to the correct width and thickness.****Underbody protection/stone chip protection**

The underbody protection is used as corrosion protection and must also be applied such that it matches the original condition, from a visual perspective.

Two main application methods are used in production:

**DESCRIPTION AND OPERATION**

- The underbody protection is applied as a sprayable sealing compound.
- In the area around the structural members, the underbody protection is sprayed on and spread across a wide area.

Because of the coarse surface structure of the stone chip protection material, it is recommended to only perform a repair over the whole surface, if there is damage over visible areas. Otherwise there is the danger of serious irregularities on the surface.

The thickness and appearance of the underbody protection and stone chip protection must be matched to the original. Special spray guns are used to work the materials for this reason. A test spray must always be performed beforehand however, to determine the correct appearance and layer thickness.

**Cavity protection**

After painting work has been completed, a general check is made of the work that has been done. Before final reassembly of the vehicle, the cavity wax protection in the area of the repair must be renewed. Cavity wax protection must be performed carefully so that the quality of the repair conforms with Ford standards:

- Guide the cavity wax probe carefully in the area of the repair so that targeted corrosion protection is achieved.
- Pay special attention to edges and swage line on stepped joints, the wax must cover the inner edge areas.
- The cavity wax must flow along the stepped sheets so that the wax is drawn between them by capillary action.

A hole may be drilled in a suitable place for areas which are not accessible for the application of cavity wax. The diameter depends on the size of plugs available. When this is done it is vital to make sure that no drilling swarf remains in the cavity (rust will form if any remains). The edge of the hole must be treated with cavity wax. Finally close with a plug and seal with underseal.

Only on components with clinched flange edges:

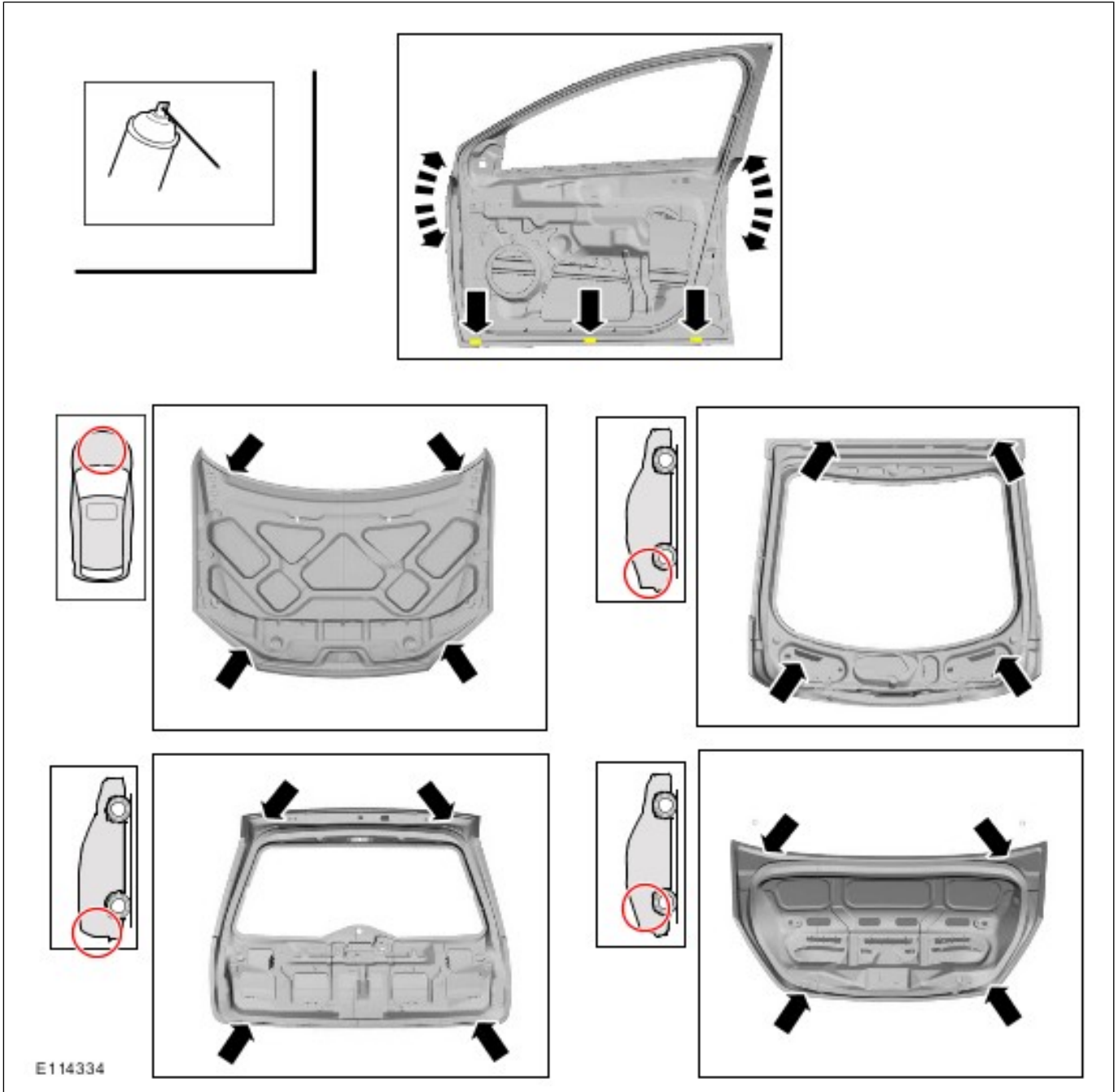
After painting, the inner clinched flange edge must be sealed as far as is possible with cavity wax. For this, the repaired component should be positioned upright and corrosion protection wax sprayed into the water drainage holes and/or the thread holes for the hinges in both directions (50 ml corresponds to about 20 seconds spraying time).

For doors, tilt and turn the component to spread the corrosion protection wax over the whole edge of the flange.

**Wax application**



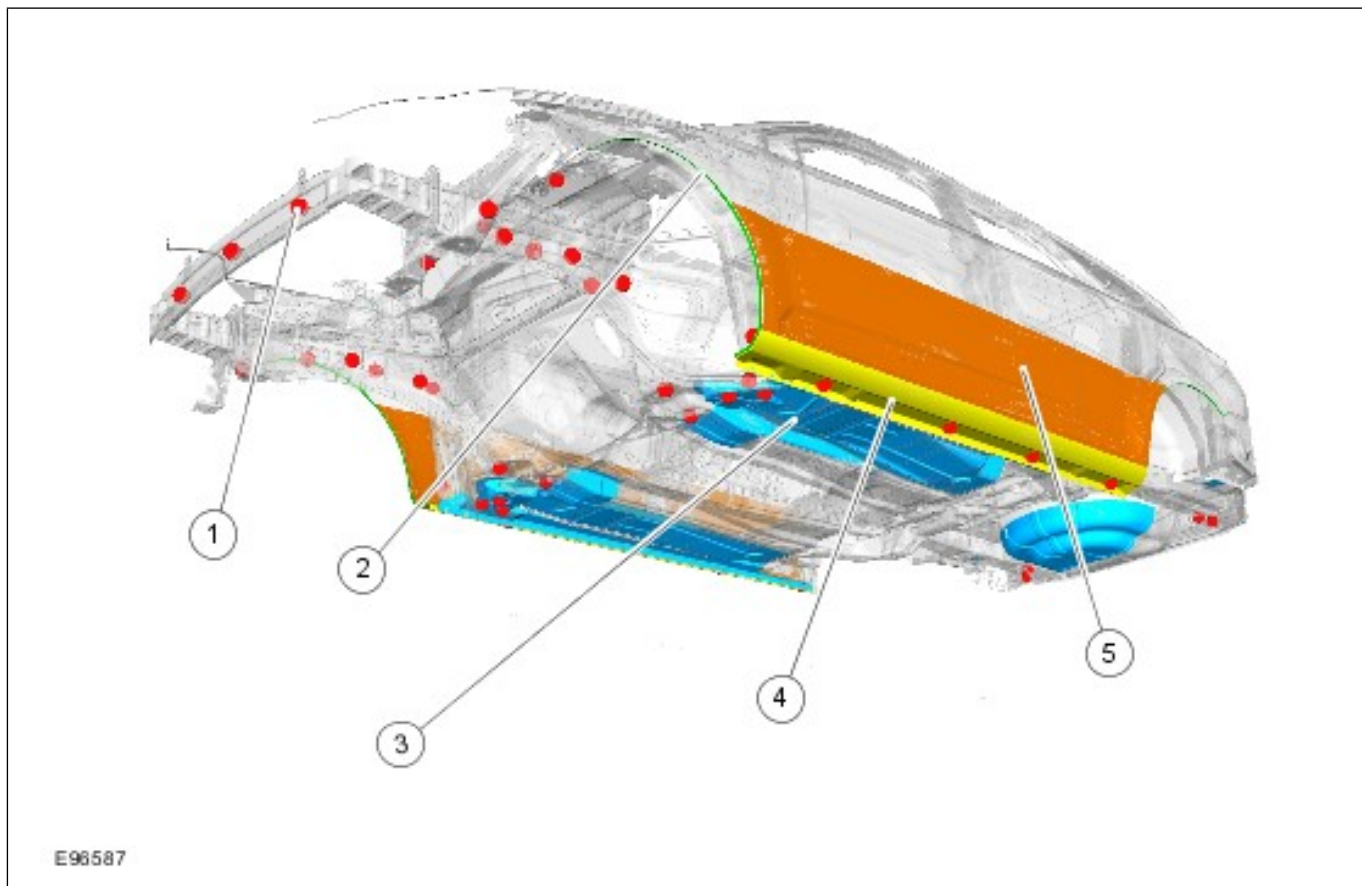
DESCRIPTION AND OPERATION





**DESCRIPTION AND OPERATION**

**Corrosion protection for the floor pan (example)**



Item	Description
1	Injection points for cavity wax protection
2	PVC stone chip protection at the wheel arches
3	PVC underbody protection
4	PVC stone chip protection
5	PU primer





## DESCRIPTION AND OPERATION

## Corrosion Damage/Corrosion Repair

Modern vehicle bodies are protected from corrosion by elaborate measures. Multilayer coatings on the panel surface prevent direct contact between the metal and oxygen, and so protect it from corrosion.

In the long-term however, corrosion on a vehicle cannot be completely prevented.

**NOTE:** Basic and in-depth training is offered on the following topics. You will find an overview of the complete range of training in the Training Brochure issued by the Ford Service Organization.

**What is corrosion?**

Corrosion is destruction of a subsurface caused by chemical or electrochemical effects which operate from the outer surface.

If the protective layers become damaged, electrochemical conversion processes are initiated, which allow the metal to oxidize. This leads to the formation of corrosion.

The following factors lead to corrosion:

- Mechanical damage such as stone chips and scratches which penetrate through to the steel panel.
- Damp interiors.
- Unfavorable weather or environmental conditions, as may occur in areas with high humidity, high salt content in the air or serious air pollution due to aggressive gases and dusts.
- Insufficient corrosion protection after repairs.
- Lack of care by the vehicle owner of the painted and corrosion proofed surfaces or areas on the vehicle.

In order to maintain long-term corrosion protection, the vehicle must be checked at regular intervals.

In doing so, the follow areas must be inspected and any damage rectified:

- Damage to the paint surface cause by scratches or stone impact must be suitably rectified according to the specifications.
- Damage to the PVC underbody protection or the PU stone chip protection must be refinished.
- Damage to the PVC underbody protection or the PU stone chip protection must be refinished.
- Incomplete or damaged sealing at clinched flanges must be renewed.
- Check the cavity protection and renew it if incomplete.

- Poorly installed or damaged covers and stone chip protection fixtures must always be renewed.
- Check seals and seal carriers for wear and correct mounting. Any damaged seals must be renewed.
- All rubber grommets and blanking plugs must be present and correctly installed.
- A damp or wet floor inside the vehicle indicates that there are leaks in the bodywork. The interior must be dried out and the leaks must be completely rectified.

The corrosion formation can vary in extent.

With rust film or edge rust formation, the surface of the paint has small traces of corrosion present. The traces of corrosion can possibly be removed in such cases by polishing the paint surfaces. If this is not possible however, the traces of corrosion must be rectified by using a touch-up technique.

If the corrosion is just starting, with up to 1 mm rusting below (in the form of a dot or a line) the damage is rectified as follows:

- Clean the defective location.
- Mechanically remove the rusting which is starting below the surface.
- If the area is small, apply primer and allow it to dry, then use the paint pencil to touch up the area - if not, respray the damaged area.

If rust is already under the paint finish to the steel panel, then the whole paint finish in the affected area must be sanded away.

Furthermore, the existing traces of corrosion in the body panel must be carefully and completely removed.

Finally a new paint finish must be applied in this area. In the case of rusting through, the affected body panel is already completely destroyed. Such damage requires complete or at least partial replacement.

**NOTE:** : In the general section there are several chapters which present the techniques necessary for a professional corrosion repair.

The outcome of this is the following repair sequence:

- Remove the rusted-through part.
- Remove the remaining traces of corrosion.
- Offer up the new part.
- Prepare the joint areas.



**501-25-39****Body Repairs - General Information****501-25-39****DESCRIPTION AND OPERATION**

- Weld the new part into place.
- Produce the corrosion protection.

For a professional repair it is essential to reproduce the corrosion protection during and after the repair.



**DESCRIPTION AND OPERATION****Sealer, Underbody Protection Material and Adhesives**

Sealants, adhesives, cavity wax and underbody protection materials are used during the various body repairs. In this area Ford offers a range of products which have been tested and matched to each other.

**⚠ CAUTION: Always be extremely careful when handling solvents, sealants and adhesives. Some products contain substances harmful to health or give off harmful or poisonous vapors. Always follow the manufacturer's instructions. If there is any doubt as to whether a particular solvent is suitable, it must NOT be used.**

**Clinched flange protection**

One-component adhesive/sealer which can be applied by brush or spraying, based on MS polymer, with a flat nozzle for application and with the following properties:

- Can be sanded
- Permanently elastic
- Non-corrosive
- Very good adhesion
- Rapid hardening and resistant to ageing
- Can be over-painted with almost all proprietary paints

**Seam sealant T Anthracite**

One-component sealer based on MS polymer, for sealing joints and seams, with the following properties:

- Silicon-free
- Solvent-free and low-odor
- suitable for gluing HVH elements into position in their respective body areas

**Body sealant T beige**

Sealer with the following properties:

- Stable
- Contains solvent
- Especially suitable for visible seams
- After hardening can be overpainted with two-pack paint

**Underbody Coating**

Underbody protection is necessary for permanently elastic corrosion protection of vehicle underbodies.

It is very durable and has good resistance to abrasion,

**Cavity wax**

This touch-proof, transparent corrosion protection wax is used for the preservation of cavities and flange joints.

**Anti-corrosion wax**

Anti-corrosion wax is a coating material which can be applied in fine spray, forming a very thin and grease-like protective film, therefore offering very good corrosion protection.

**2-component metal adhesive**

For joining metal to metal and plastic to metal. The adhesive reduces droning noises and improves corrosion protection.

**Windshield sealant**

Solvent-containing, stable sealing material. The sealer is permanently elastic and does not form a skin on the surface.

**1-component window glass adhesive kit**

For direct glazing. The vehicle is ready to drive after 6 hours (passenger airbag). Prevents contact corrosion.

**2-component window glass adhesive kit**

For direct glazing. The vehicle is ready to drive after 1 hour (passenger airbag). The adhesive is not an electrical conductor and permits interference-free radio reception. Prevents contact corrosion. Using a 150ml additional cartridge, the adhesive can also be used for large windows or to produce a double seam of adhesive.

**PU glass adhesive**

150ml additional/replacement cartridge for direct glazing using 2-component window adhesive kit. Suitable for double beads or larger windows. Also suitable for sealing NVH elements.

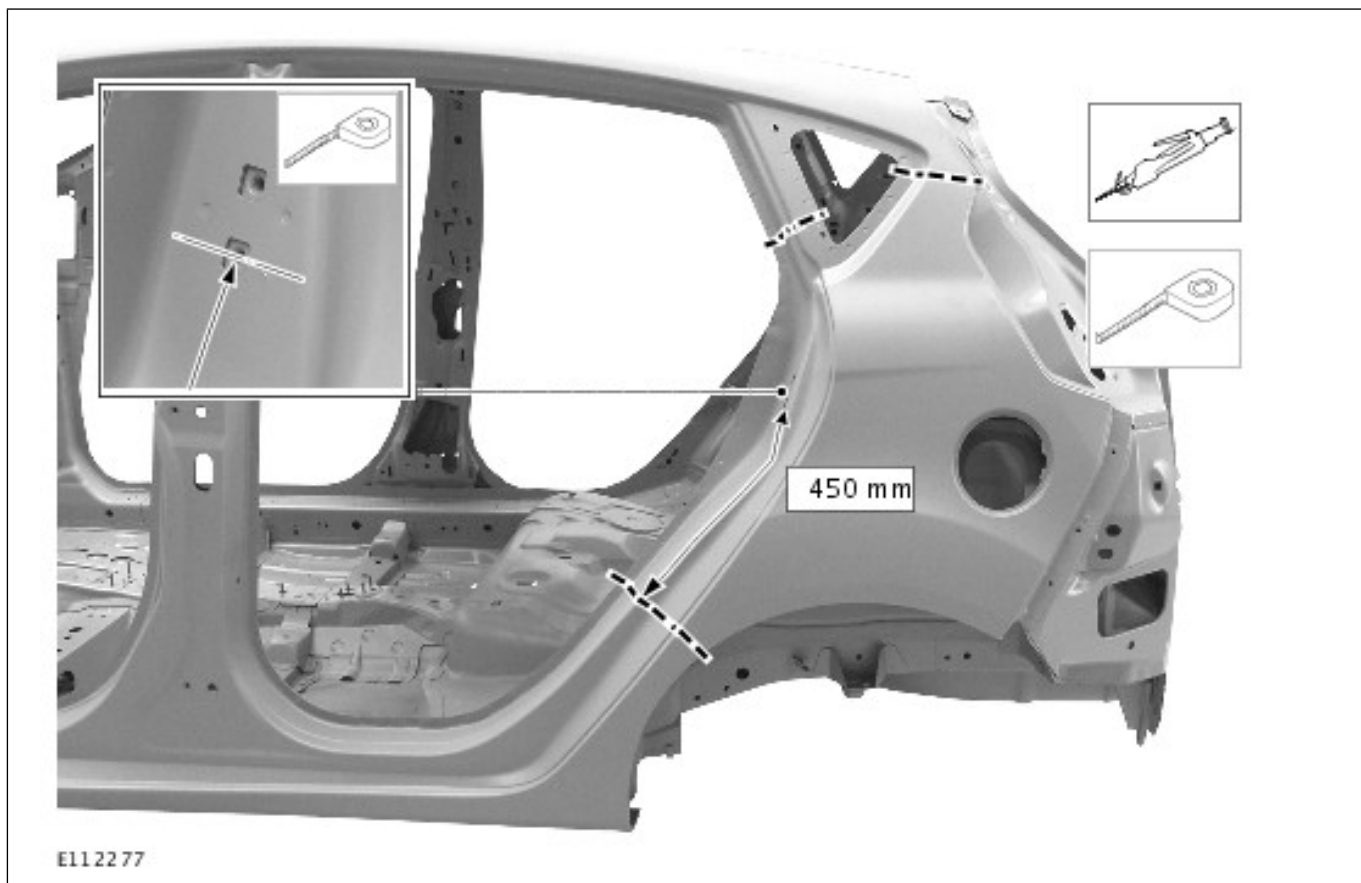
## DESCRIPTION AND OPERATION

## Cutting Technique

**NOTE:** Without exception, before starting work you must read the safety and warning instructions in the chapter "Safety Instructions". In addition, pay attention to the warning instructions of the particular equipment manufacturer.

**Possible cut lines (example)**

**NOTE:** After all separation work, make certain that the metal swarf is completely removed from the vehicle body.

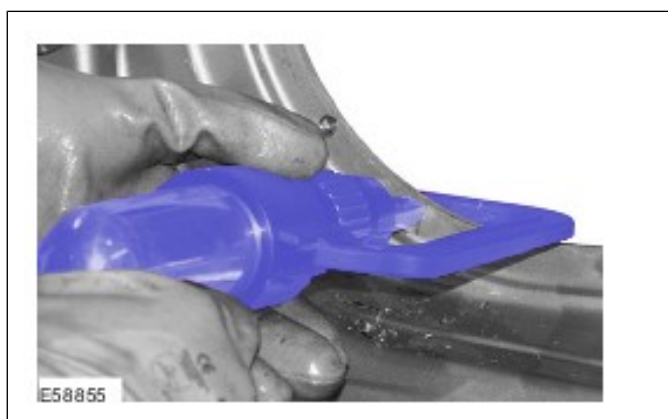


Depending on the separating tools used, there are some fundamental points to bear in mind:

- Only start the cutting work once the new part is to hand.
- Compare the new part with the old part for shape and size.
- The straightening work must be completed before any body components to be replaced are cut out.
- Before separation work is started, all welded connections which cannot be seen must be freed of underbody protection, sealant etc.

## Spot weld milling tool

Resistance spot welds are separated using a spot weld drilling machine or a spot weld milling tool.



**NOTE:** Steplessly variable machines increase the working life of the cutting tool. Use of a suitable lubricant can increase this even further.

A spot weld milling tool usually has an adjustable depth stop and a safety fixing system. These prevent the machine from drilling too deep and the cutter from slipping while working.

**DESCRIPTION AND OPERATION****Rod sander**

Another option for separating resistance spot welds is to use the rod sander.



If spot welds and MIG welds are difficult to reach, a rod sander may offer an alternative.

**Short stroke saw**

The short stroke saw is suitable for separating vehicle body components and for making a separating cut for partial repairs.

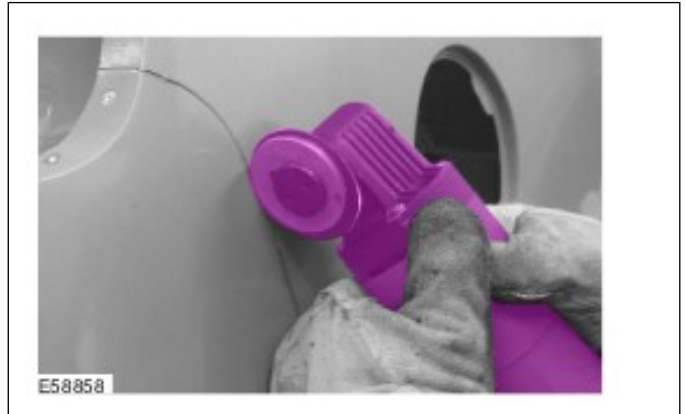


**NOTE:** In order not to damage panels, wiring harnesses, hoses or similar components which lie behind, remove them beforehand as necessary.

The narrow design of the saw blade permits cutting in tight curves. Straight cuts require a relatively great deal of practice.

**Orbital saw**

Where use of the short stroke saw is difficult because of the body construction, the orbital saw can be used.



The cutting depth of the orbital saw can be set. This allows separating cuts to be made, despite panels or other components lying in danger behind. Straight cut lines can be more easily made using the orbital saw.

DESCRIPTION AND OPERATION

Panel Beating Technique and Smart Repairs

General

Smaller scale body repairs, where damaged panels do not need to be replaced, can often be carried out by realignment work. Whether the repair is economical however, often depends on the accessibility of the affected body area.

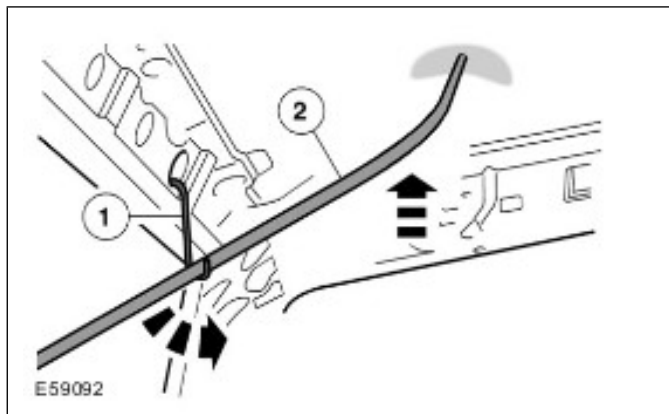
**NOTE:** Basic and in-depth training courses are offered on the topics which follow. An overview of the complete range of training offered is provided by the Ford Service Organization Training brochure.

During damage assessment, the following technical points must be taken into account:

- Small mild dents (without damage to the paint), which are in areas that make access from the inside possible, can be rectified using undamaged paint panel beating.
- If the inner side of the damaged area (with paint damage) can be accessed, then conventional panel beating techniques can be used.
- If the damaged area has no access from inside, then it can only be rectified using outside panel beating techniques.

**Dent removal using special panel beating levers**

**NOTE:** In the Undamaged Paint Dent Removal section, you will find more information on pressure techniques.



Des cript ion	Description
1	Deflection by a hook arrangement
2	Pressure tool

This panel beating technique with pressure is mainly used to rectify smaller dents as a result of hail impact, transportation or parking, without the paint being damaged.

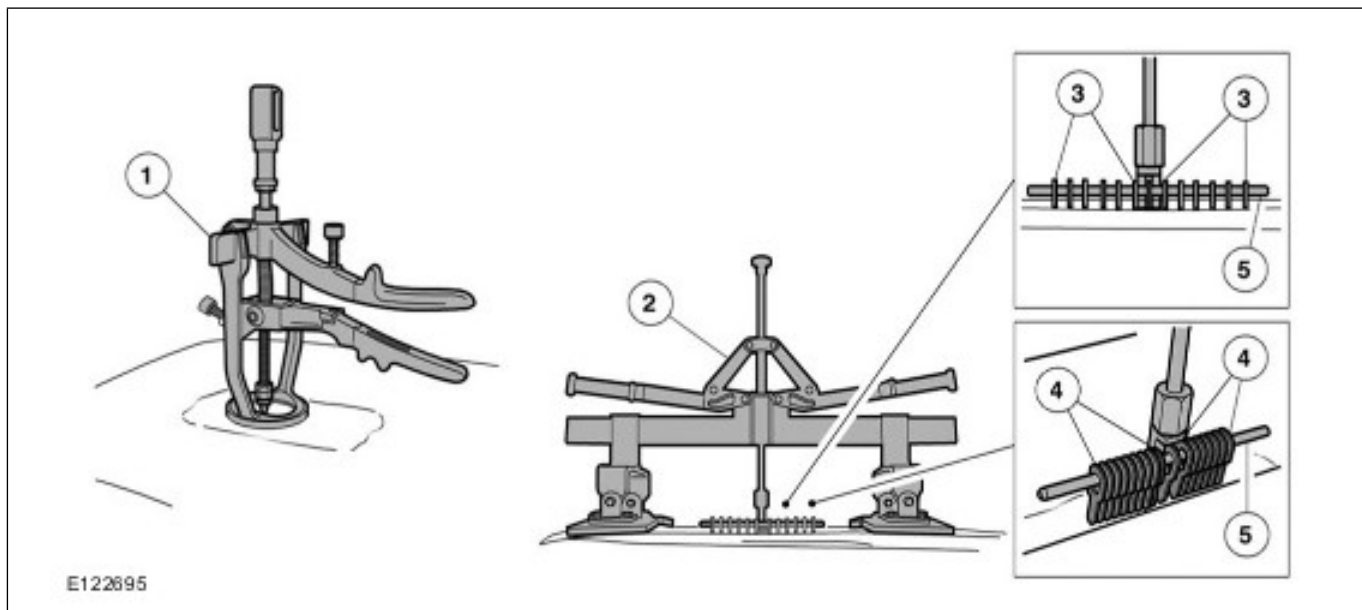
Small dents are removed from the inside of the body panel by pushing them outwards in a mechanical process using panel beating levers.

Because of the great variety of shapes of these levers, it is possible to use this panel beating technique on almost all areas of the vehicle body.



DESCRIPTION AND OPERATION

Dynamic puller with counter bearing



Descript ion	Description
1	Puller device for minor damage, with integral copper electrode
2	Puller device for more extensive damage
3	U-washers spot-welded in place
4	Puller bits spot-welded in place
5	Attachment for U-washers or puller bits

Hollow leveling (removing dent without a dolly)

Hollow leveling can only be used on areas which are accessible from the rear.

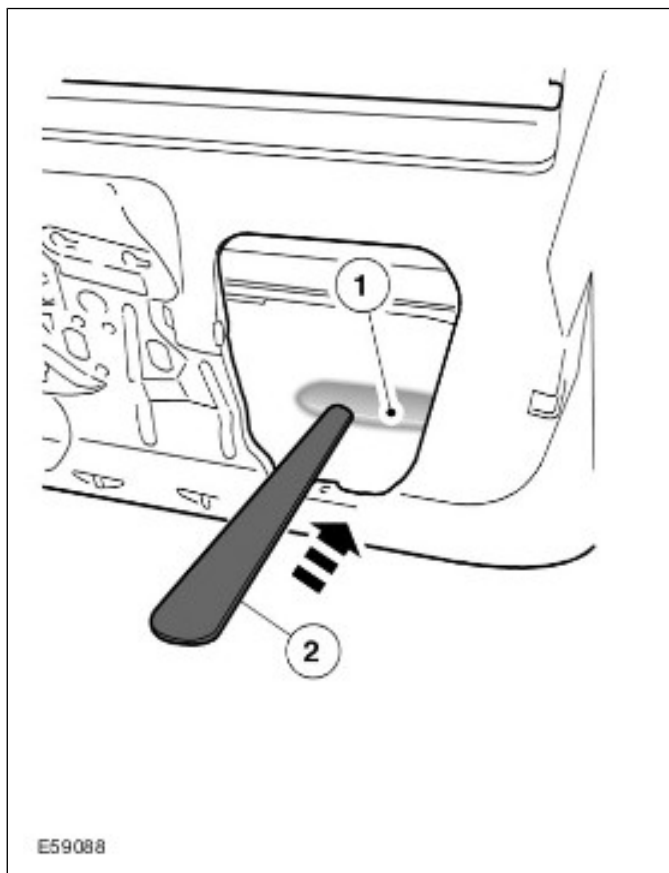
This method can be used to reshape dents or more extensive damage from the outside.

For minor damage, the copper electrode in the tool is secured onto the panel surface by spot-welding and the puller device is used to pull out the damage without jolting.

For more extensive damage, puller bits or U-washers (depending on the application area) are spot-welded to the panel surface and the area pulled out using the puller device.

Because of the versatile puller and the variable counter bearing, a wide variety of damage can be worked and rectified using this repair method.

Because of the mechanical lever operation, the variable counter bearing and the optimum controlled application of power, this external dent removal system allows dents in almost all vehicle body areas to be pulled out.





**DESCRIPTION AND OPERATION**

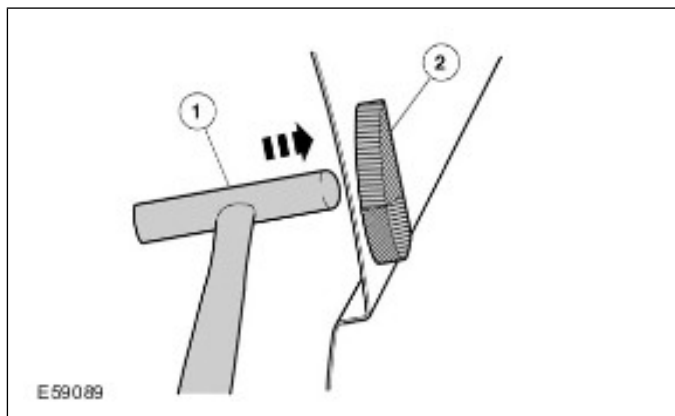
Descript ion	Description
1	Center of dent
2	Spoon

During hollow leveling, the dent is removed from the inside a using suitable panel beating tool and applying knocking or pressing movements. High spots around the edge of the dent area are flattened with blows from the aluminum or wooden headed hammer.

The usual tools are for instance hammers of various designs, dollies, levering irons and various spoon irons. The correct choice of tool is made depending on the shape of the dent and the access which is possible.

**Dent removal using hammer and dolly**

Panel beating can only be performed using a hammer and dolly if access can be gained from the rear side.



Descript ion	Description
1	Aluminum hammer
2	Box file

The purpose of the dolly in this case is to transfer the force of the impacts from the hammer to the steel panel which is in between. As this is done, the deformed body panel is smoothed (dressed) and the tension fields in the body panel are removed.

The favored tool for this repair process is the aluminum hammer and as opposite support the universal hand dolly. To rectify minor panel

damage, the box file should be used as opposite support. Because of its serrated surface, the box file prevents normal stretching of the body panel which would otherwise occur.

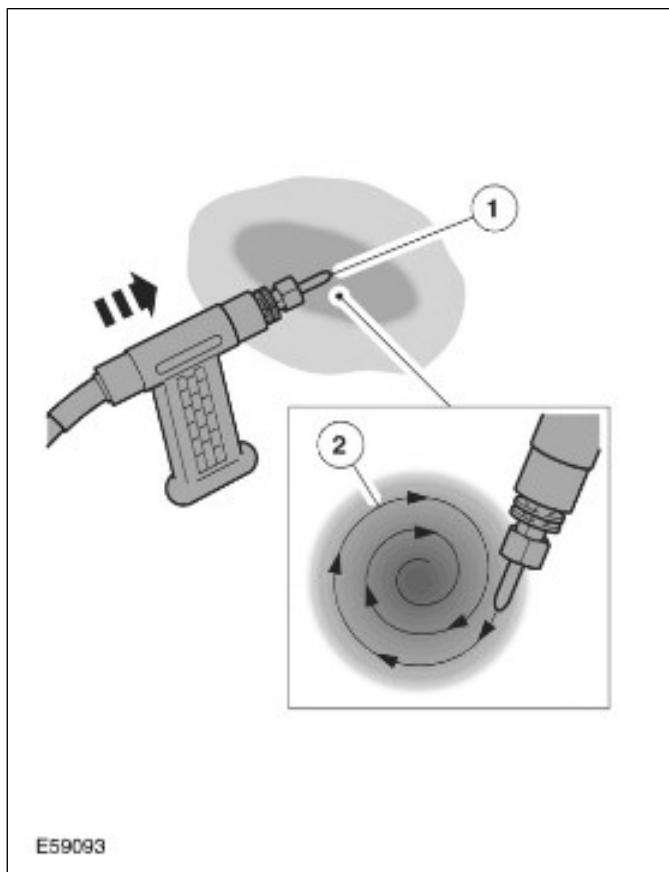
**Heat-induced material shrinking**

Material shrinking, also called settling in, can be performed in a variety of ways depending on the extent of the damage and the access to the repair area.

These repair processes differ depending on the type of heating and subsequent working of the heated surface. They sub-divide into two basic processes:

- Heating using a carbon electrode.
- Heating using the oxy-acetylene torch.

In the carbon electrode process the working is done exclusively by warming. In this case the access to the repair position is only from the outside.

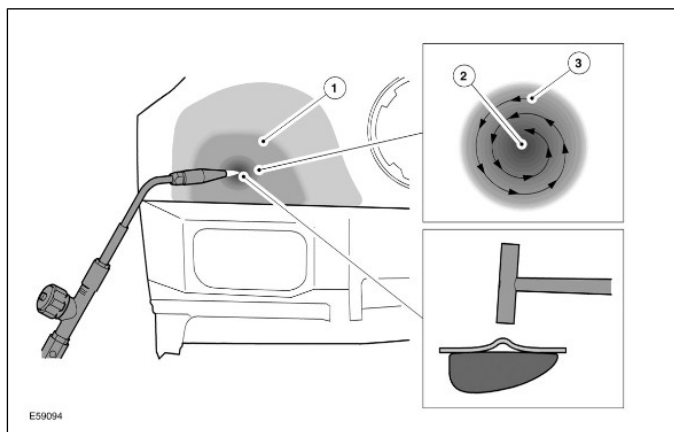


Descript ion	Description
1	Carbon electrode
2	Spiral shaped heating pattern

## DESCRIPTION AND OPERATION

If the damage is concentrated in a spot and is in the form of a more rigid raised area, then the carbon electrode must be replaced by a copper electrode. As heat is applied, slightly more pressure is applied to the raised area.

In the method using heating by the oxy-acetylene torch, material shrinking is achieved by a combination of heat and mechanical working of the damaged area.



Des cript ion	Description
1	Overstretched area
2	Point heating using the oxy-acetylene torch
3	Spiral shaped knocking back with dolly

The repair area must always be accessible from both sides, so that the heated area can be properly worked mechanically.

The combination of heating and mechanical working is very effective.

As soon as the warm point is established, hammering is immediately started using the aluminum hammer together with a suitable dolly on the inside of the repair surface, working in spiral movements towards the warm point. This causes material to build up in the center of the warmed area.

### Lead loading

Despite good external panel beating techniques, it is not always possible to rectify every surface unevenness. For this reason, application of lead loading is an important part of panel beating.

**CAUTION:** Poisonous gases and dust can be produced when working solder. Use an

extraction unit and, if required, a protective mask.

**NOTE:** Since 07/2003, lead compounds have been ruled out for production. Appropriate lead-free tin solders and pastes must also be used in the workshop.

Typical application areas:

- Body components with limited or no access from the rear.
- Body components with very narrow cross-section.
- Body components which are particularly exposed or which can move.
- Weld seams of partial repairs.
- Rocker panel areas, wheel arch edges, side panel areas.
- Doors, hood, luggage compartment lid.
- Swage lines and joint areas.

Tin has the following advantages:

- Excellent bonding on bare metal surfaces.
- Good moulding properties.
- Good properties for the production of shapes and contours.
- Permanent shape.
- Heat expansion is the same as steel.

To create a basis for the actual lead loading process, a lead loading paste is first applied to the panel. The paste is then heated and wiped away with a cloth. Now the tin can be applied and moulded with a brazing block.

After the repair site has cooled down, it is worked using for example the body plane until the surface is smooth and has no transitions.

**DESCRIPTION AND OPERATION**

**Paintless Dent Removal**

**NOTE:** Basic and in-depth training is offered on the following topics. You will find an overview of the complete range listed in the Training brochure published by the Ford Service Organization.

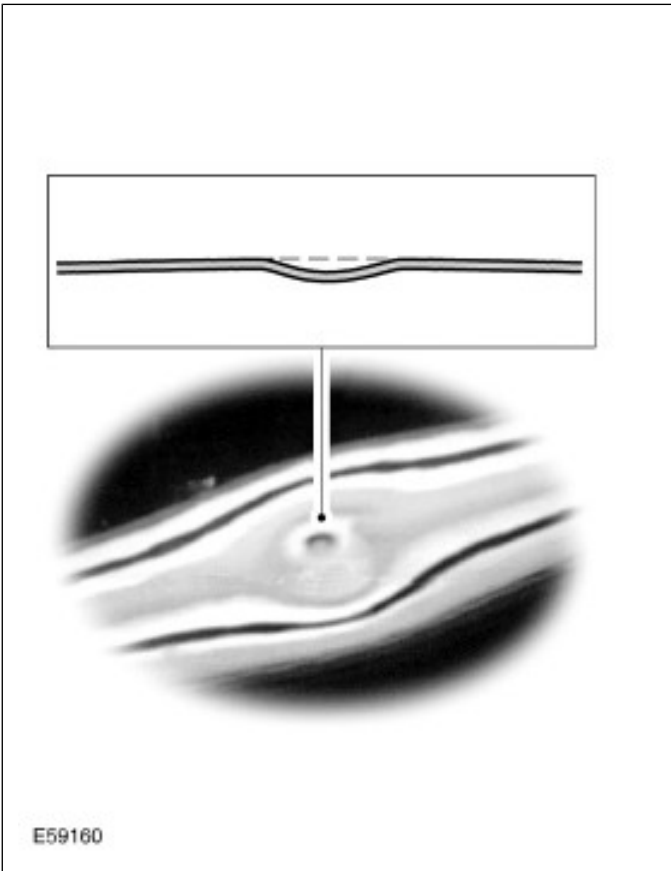
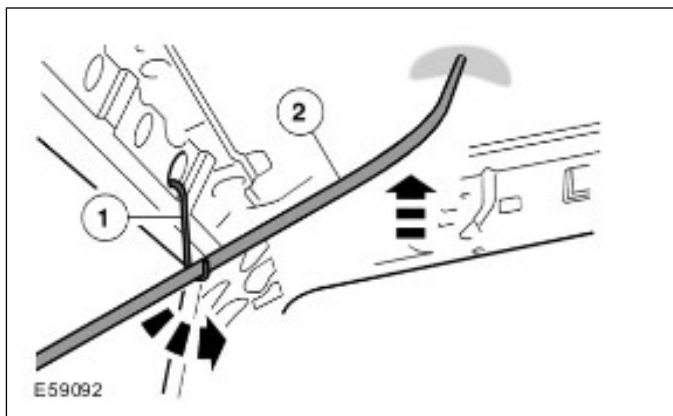
**General**

Application is restricted to body surfaces which are accessible from both sides. This repair technique is seldom feasible on double-skinned body components or closed body profiles. The same applies to edge areas, swage lines and seams on body components, which are very dimensionally stable.

The following characteristics must be present for a dent to be removed:

- The diameter must be no more than 50 mm.
- No material stretching in the centre of the dent.
- Repair area must be accessible

Furthermore, sufficient experience in the use of special tools and knowledge of materials are also requirements for a successful repair.



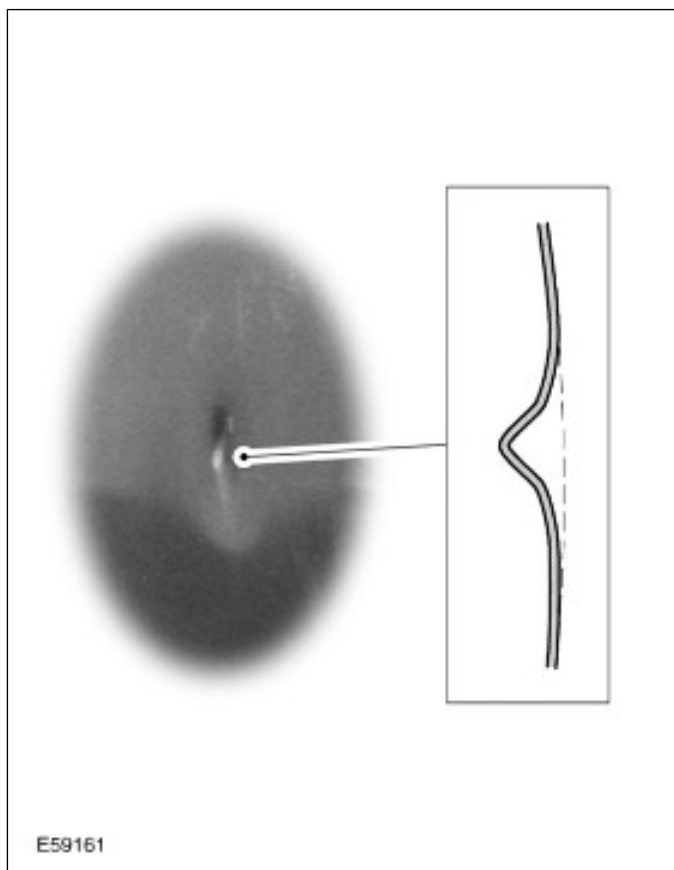
Satisfactory repair results are only possible on mild dents with little depth and small deformation radii. Therefore this repair method is particularly suitable for hail, parking and transportation damage.

**Dent with material stretching**

Item	Description
1	Deflection by a hook arrangement
2	Pressure tool

**Mild dent**

## DESCRIPTION AND OPERATION



If strong and direct force during the damage process causes the material to stretch in the middle of a dent, then the result is a small and sharp edged dent. Such damage cannot be rectified without visible deformation.

Advantages of a planishing technique:

- Economical in time and materials
- The original paint is retained
- Environmentally friendly (no sanding or painting work)

While carrying out the repair, the following itemized repair route and process flow must be complied with:

1. Damage diagnosis
2. Repair preparations
3. Perform repair
4. Paint finishing, corrosion protection and quality control

In order to ensure corrosion protection, all inner areas of the repair must be treated afterwards. Where it is possible, the paint is repaired. In every case the inner area of the repair must be treated with cavity wax.

**DESCRIPTION AND OPERATION**

**Plastic Repairs**

**General**

The proportion of plastics used in vehicle construction continues to rise. Up to now damaged plastic components often had to be replaced. These days, plastic repairs are becoming more and more widely accepted because of the increasing cost of spare parts.

**NOTE:** Plastic adhesives are chemical products and are subject to the safety instructions of the manufacturer.

In repair work, the material properties of plastics are highly significant. There are two main groups:

- Thermoplastics.
- Thermosets.

**NOTE:** Elastomers make up a third group of plastics. These are not mentioned below because they have no plastics repair applications.

**Thermoplastics**

Heat causes thermoplastics (also called TP polymers) to transform from the solid state into the thermoelastic state and then into the thermoplastic state. When thermoplastics are cooled, they return to solid state.

Brief description	Plastic
ABS	Acrylonitrile butadiene styrene copolymer
PA	Polyamide
PC	Polycarbonate
PP	Polypropylene
PP/EPDM	Polypropylene/ethylene propylene diene copolymer
PC/PBT	Polycarbonate/polybutylene terephthalate
Hard PVC / soft PVC	Polyvinylchloride

**Thermosets**

Thermosets (also called TS polymers) are much harder and more brittle than thermoplastics. Their strength remains largely unchanged when they are heated. Thermosets are destroyed when heated

above the critical temperature. Also, the original state will no longer be restored on cooling.

Brief description	Plastic
GRP	Glass reinforced plastic
PUR	Close-meshed cross-linked polyurethane
PUR	Wide-meshed cross-linked polyurethane

**Plastic identification**

Normally the appropriate identifier is marked on the plastic components used in vehicle construction.

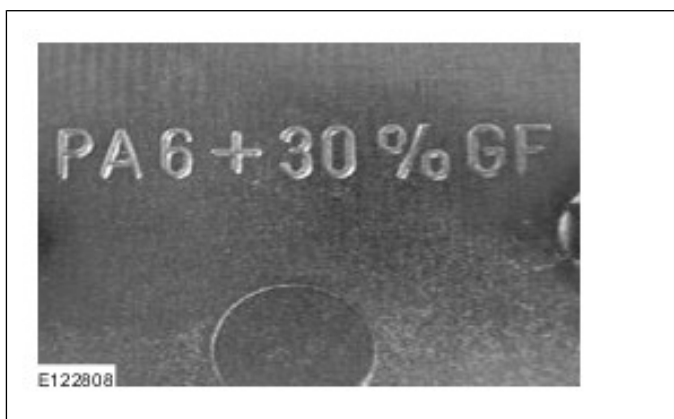
The capital letter sequences used for this are standardized in DIN EN ISO 1043-1 and DIN ISO 1629 (for rubber) and can be looked up in the tables which they contain. In addition the string of characters provides information about the exact mixture ratio and the proportion of certain fillers.

**Examples of the identification of plastics**





DESCRIPTION AND OPERATION



**NOTE:** The identification of the type of plastic is necessary for the plastic welding process in order to determine the correct welding rod (welding material) to use.

If an identifier is missing or cannot be made out, the following easy to perform tests will help:

**Visual Inspection**

Visual inspections mainly serve to identify PUR and GRP materials. Thermoplastic components are often painted and are therefore difficult to identify.

Identification characteristics:

- When PUR cracks or similar damage occurs, pores of foam can be seen.
- GRP can be recognized by the glass fiber structure on the inside.

**Mechanical test:**

The plastic group can be determined by a sound test:

- Degree of hardness - the higher-pitched the sound, the harder the plastic.
- Elasticity - the more muffled the sound, the higher the elasticity of the plastic.

**Sanding test**

In this a place is chosen which will not be visible later, and the finger belt sander is used to sand the plastic.

The plastic group can be determined using the pattern of the dust:

- Thermosets produce a white dust.
- Thermoplastics smear and do not produce dust.

**Float test in water:**

Take a small piece of plastic from the component to be repaired and test whether it floats on water (PP-EPDM, HD-PE, PP) or sinks (PVC/U, PVC/P, ABC, PC).

**Nature of the surface**

The surface of plastics can be categorized as rigid (PVC-U, PVC-P) and waxy (PP/EPDM, HD/PE, PP).

**Adherence test using welding rod**

Heat a welding rod that is identified with the type of material and the plastic component using the hot air gun. Press the welding rod onto the plastic component to be welded. When the welding rod cools down, if it remains stuck to the component or can only be removed with great difficulty, then it can be assumed that the two are made of the same plastic. When pulling away from PP/EPDM, HD/PE and PP, this can lead to strings.

**⚠ CAUTION: Danger of poisoning! When burned, most plastics release vapors harmful to health. Ventilate the room well and use respiratory protection. Where possible work using an extraction system.**

**Burning test**

Every plastic has a characteristic behavior and smell when burned. Using a knife, cut off a small piece from the component to be repaired, remove any dirt and paint residues and set light to the small chip. Now observe the burning behavior. Compare the color, type and smell of the smoke with the results from the following table.

Short description	Plastic recognition using a burning test
ABS	Blackish smoke, the material drips like a candle when burning and smells like wax.
PA	No smoke, draws filaments, smells like burnt horn.



**DESCRIPTION AND OPERATION**

Short description	Plastic recognition using a burning test
PC	Yellowish, sooty smoke. Smells sweetish.
PP	No smoke, the material drips like a candle when burning and smells like burnt oil.
PP/EDM	No smoke, the material drips like a candle when burning and smells like burnt oil.
PC/PBT	Hard and shiny, burns yellow, fluffy soot.
Hard PVC / soft PVC	Blackish smoke and acrid smell.

**Safety instructions**

In addition to the general safety instructions, the relevant regulations and accident prevention legislation must be observed.

**NOTE:** Without exception, before starting work you must read the safety and warning instructions in the chapter "Safety Instructions". In addition, pay attention to the warning instructions of the particular equipment manufacturer.

Information sheets, safety notices and guidelines for the processing of adhesives containing isocyanate, polyester resin, adhesives, solvent and thinners provide more details on their use.

The following instructions must always be followed:

- Polyester resin, adhesive, solvents and thinners are inflammable and must not be used near naked fire or flames.
- Sawing and grinding operations must only be carried out in rooms equipped with extraction systems.
- If no rooms with extraction systems are available, only use tools with extraction equipment.
- Protective equipment such as gloves, protective goggles, aprons and breathing masks are essential.

Because of the various compositions of plastics, repair work to plastic parts involves a variety of repair methods.

The following methods are used:

- Thermoplastic straightening.
- Plastic welding.
- Plastic adhesive bonding.
- Plastic lamination techniques.

**Thermoplastic straightening**

Damage to thermoplastics can be rectified by heating using the hot air gun (temperature about 100°C) while the deformation is pressed out until the shape is regained.

**Plastic welding**

Splits formed in plastic bumpers are typical possible plastic repairs.

**NOTE:** Do not carry out plastic welding in the area of fixed foam backing. The foam backing will usually be destroyed and the function of the component is then no longer guaranteed.

If repair using adhesive methods is not possible because of unfavorable conditions at the rear of the repair location, plastic welding is a possible repair process.

There are two methods of welding: hot air draw welding and hot air fanning welding.

**Plastic welding set**



Item	Description
1	Various welding rods
2	Scraper (heart-shaped)
3	Hot air blower (approx. 1500 W)
4	Clamps
5	Welding nozzles

In addition to the components listed, plastic welding requires tools already found in the workshop such as scrapers, sanders, face cutters etc.

**DESCRIPTION AND OPERATION**

As with all other welding processes, only certain material combinations can be joined together using plastic welding.

**NOTE:** Basic and in-depth training is offered on the following topics. You will find an overview of the complete range listed in the Training brochure published by the Ford Service Organization.

**NOTE:** The manufacturer's data must be taken into account when choosing welding materials and the correct temperature setting of the hot air gun.

Repair sequence during plastic welding:

- To prepare the location for welding, remove paint residues and sand the weld area.
- If parts of the material have been pushed in by an impact, the damaged area can be brought back to shape by heating.
- Drill out the ends of the split to stop it spreading further. Machine the location of the weld into a 90° V-shaped groove, to accept the welding rod.
- Lay the welding rod in the groove.
- Perform the welding. Hot air draw welding or hot air fanning welding.
- Rework the weld seam. After cooling, sand the raised weld seam.
- Clean the sanded repair surface using plastic cleaner. Apply plastic primer thinly to the repair surface and paint it.

Despite good preparation and the correct choice of welding materials, weld faults may occur.

The following points must be noted when welding plastic:

- Weld together like with like:
  - With very few exceptions, only the same materials can be welded together, e.g. PP with PP.
- Correct temperature:
  - The correct choice of temperature is important for the success of the repair. The plastic must be warmed until it plasticizes (dough-like, soft).

Guideline values for welding temperature:

Brief description	Plastic	Temperature
ABS	Acrylonitrile butadiene styrene copolymer	360°
PA	Polyamide	400°

Brief description	Plastic	Temperature
PC	Polycarbonate	370°
PP	Polypropylene	280°
PP/EPDM	Polypropylene/ethylene propylene diene copolymer	280°
PUR	Polyurethane	300°
Hard PVC	Polyvinylchloride	340°
Soft PVC	Polyvinylchloride	370°

- Even pressure:
  - When rod welding, the pressure is applied by pressing on the welding rod.
- Steady speed:
  - To achieve a good weld, care must be taken that the working speed is steady.

Possible causes of weld faults:

- Deformation caused by overheating of the repair area or tensions in the material while welding the component.
- Plastic material too thin.
- Poor weld joint because the weld temperature was too low or the welding speed was too fast.
- Welding different materials together.
- Weld seam dropped because the split gap was too wide or the welding temperature was too high.

A good weld is recognized by a slightly raised, smooth and even weld bead on the surface of the component.

The weld bead must only be worked once it has fully cooled down.

**Plastic adhesive bonding**

Adhesive bonding of plastics has some advantages over welding methods:

- Within the group of thermoelastic plastics, all semi-rigid ancillary components (such as bumpers, front grilles, etc.) can be repaired without identification.
- A two-component polyurethane based adhesive is used for all thermoplastic parts.
- Reinforcement strips can be attached behind splits (split length up to max. 100mm) and

**DESCRIPTION AND OPERATION**

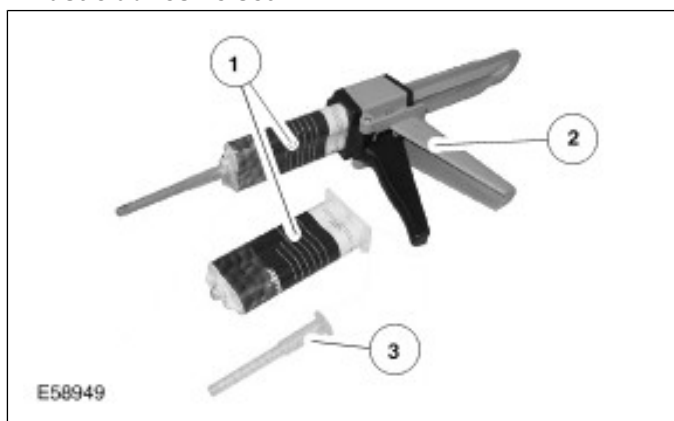
openings to ensure the original strength properties.

Tools and equipment also familiar from paint repairs can be used in making adhesive repairs to thermoplastic components.

Angle grinders and belt sanders can be used to grind out scratches and splits. Orbital sanders with extractors are used for fine sanding.

The infrared heater is used to provide fast and certain drying throughout.

**Plastic adhesive set**



Item	Description
1	2-component adhesive
2	Cartridge gun
3	Mixing tube

Apart from the components shown, other materials may be needed to bond plastics, depending on the repair position.

For large scale repairs, it may be necessary to insert reinforcement panel strips and reinforcement matting as fixing aids.

Repair sequence during plastic adhesive bonding:

**NOTE:** Follow the manufacturer's guidelines when using adhesives.

- Prepare the location of the bond. Remove paint residues and sand the area to be bonded. Drill out the ends of the split to stop it spreading further. Prepare the bond location into a V-shape and clean it with plastic cleaner.
- Apply the adhesive. The two-component adhesive is applied to the cleaned and primed repair location using a hand gun. Spread and smooth the adhesive using a flexible plastic spatula.
- Rework the bond location. After cooling, sand the raised adhesive. Clean the sanded repair

surface using plastic cleaner. Apply plastic primer thinly to the repair surface. Apply paint.

**GRP repairs**

GRP material is hard and brittle in its strength properties. Because of these material properties, splits and openings often result in cases of serious damage.

The stability of GRP parts is impaired if the glass fiber reinforcement is cracked. The component must be replaced in cases of serious damage that affect the structure.

Minor damage (such as abrasion, splits up to 80mm, holes up to approx. 60mm diameter, etc.) can be repaired to a technically and visually perfect standard, provided that the damage does not occur in heavily used or hard-to-reach areas.

To ensure perfect repair results, observe the following points:

- The room temperature should be at least 15°C and the air should be as dry as possible.
- The repair location must be thoroughly dry and clean.
- Before the repair, the GRP part being repaired must be dried using an infrared heater or in a drying oven.
- In cases of large splits and fractures, the strength of the outer skin can be re-established by backing with a reinforcement material.

Tools and equipment from the paint shop can be used to carry out repairs to GRP parts. Angle grinders and belt sanders can be used to grind out scratches and splits. Orbital sanders with extractors are used for fine sanding.

**GRP repair set**



**DESCRIPTION AND OPERATION**

Item	Description
1	Polyester resin
2	Glass fiber mats
3	Hardener

Scissors, paintbrush and cleaning materials are other materials which will be needed to perform a GRP repair.

**NOTE:** Follow the manufacturer's instructions when using the repair materials.

The repair process for a GRP repair is as follows:

- Prepare the repair location. Remove paint residues and sand the repair area.
- Drill out the ends of the split to stop it spreading further.
- The repair location must be sanded by hand. If machine working is attempted, the resin will be heated so much that the surface structure will be changed. The result is inadequate adhesion.
- Perform the GRP repair. Apply polyester resin thinly to the repair location. Lay the glass fiber mat in place and apply polyester resin over it again.
- Rework the location of the repair. Sand away any polyester resin which stands proud after it has hardened.
- Clean the sanded repair surface using plastic cleaner. Apply plastic primer thinly to the repair surface and after it has dried apply the paint finish.

## DESCRIPTION AND OPERATION

## Joining Techniques

## Welding

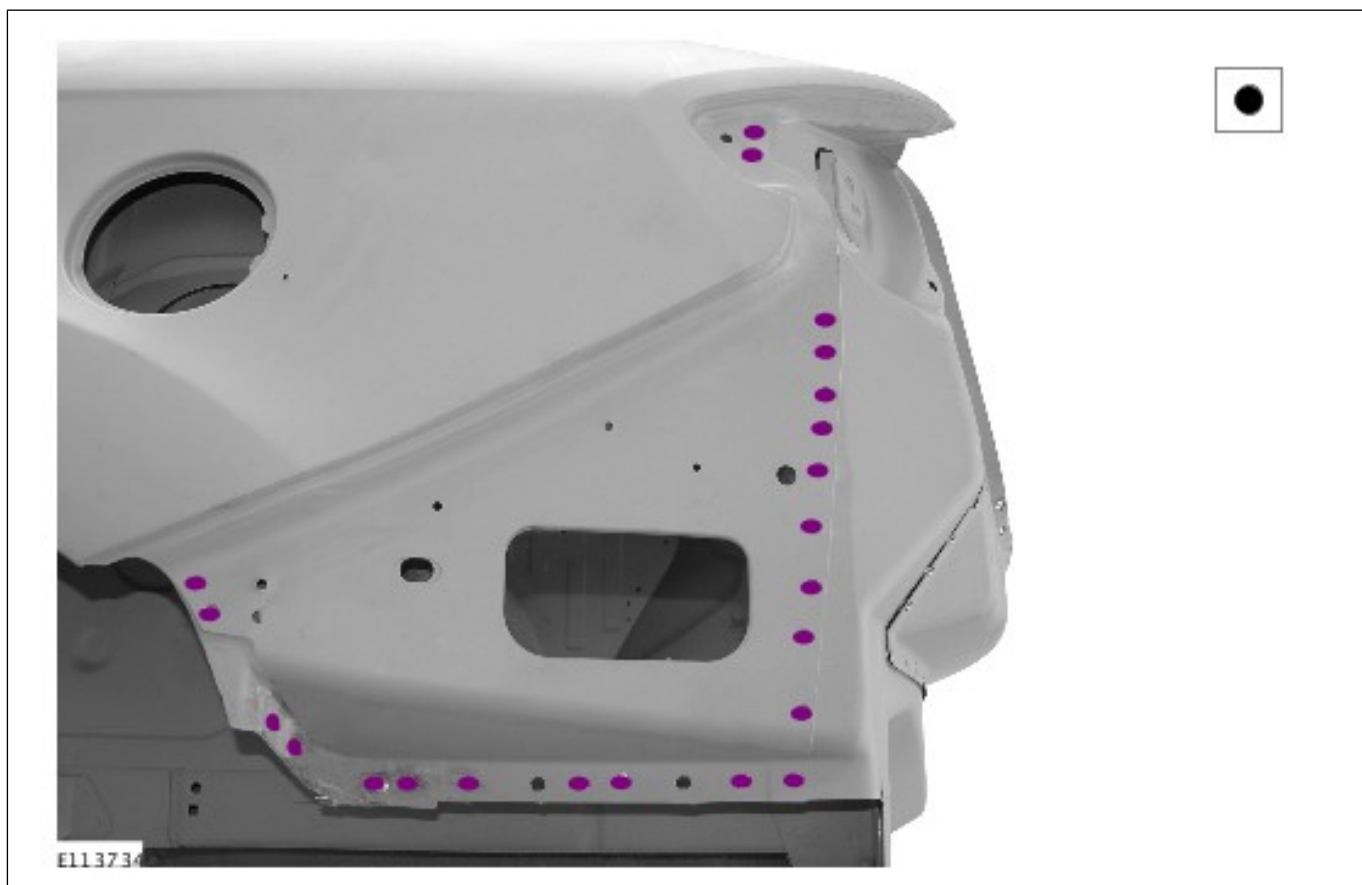
Before welding work is performed on a vehicle body, all safety measures for the protection of people, modules and electrical components must be observed.

**NOTE:** Before beginning the work, please refer to the safety instructions and warnings in the chapter Safety Instructions. Please also note the warnings of the respective equipment manufacturer.

Resistance spot welding and MIG welding are the most common techniques used in body construction. During repair work, the welded connection must be restored to be equivalent to the original.

## Resistance spot welding.

**NOTE:** Before starting the work, please refer to the chapter on safety instructions.



In doing so, the repair welds must match the standard of those produced in production in number and diameter.

Preconditions for resistance spot welding:

- The panels to be welded overlap.
- The weld spot is accessible on both sides for the electrodes.
- The shape and alignment of the weld electrodes is correct.
- The resistance welding equipment is powerful enough to be able to reproduce the production spot weld diameter.

**NOTE:** The welding equipment settings and the adjustment of the individual parameters are to be made in accordance with the device manufacturer's specifications.

Well-prepared welding flanges are a prerequisite for a problem-free welded joint. This means:

- The welding flanges must lie perfectly flat to one another.
- The welding flanges must be clean and free of oil or grease on both sides.
- Welding primer (zinc-coated and conductive) must be applied as corrosion prevention.



**DESCRIPTION AND OPERATION**

Only in limited cases can welding errors in resistance spot weld joints be detected from the outside. Therefore, a test weld should be carried out before each repair weld. The peel test carried out after the welding gives information on the quality of the welding. The spot weld itself must never separate, it must tear away leaving a hole.

**MIG welding**

Basically, three methods of MIG welding are used:

- Puddle weld.
- Continuous bead welding
- Intermittent bead welding

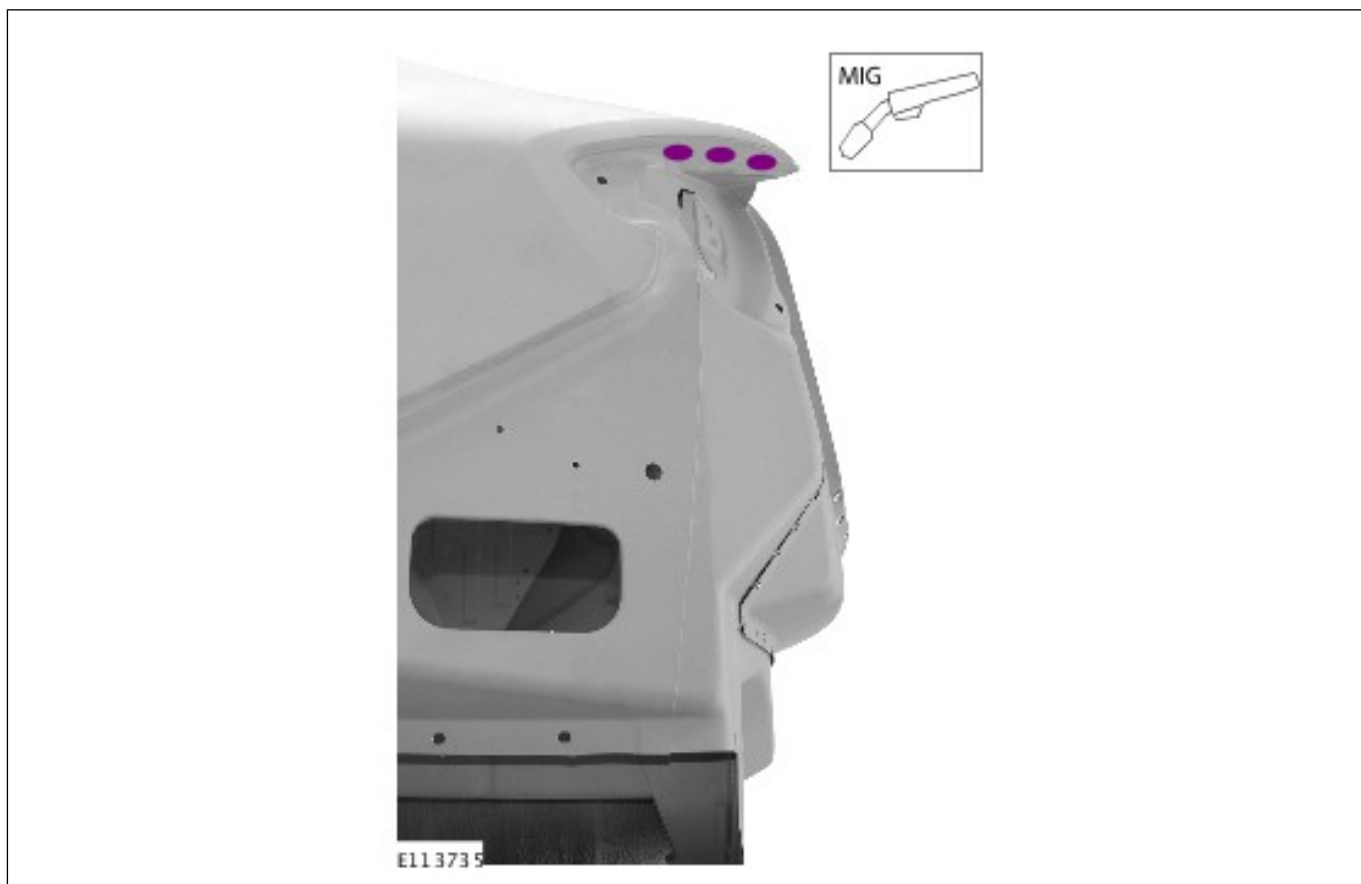
Fields of application

- Any joints that are MIG welded in production must also be replaced by MIG welds.
- Puddle welding may be used in certain cases, if there is insufficient access.
- If the overall panel thickness is greater than 3 mm, without correspondingly powerful spot welding equipment, puddle welding should be used.
- When dealing with any MIG brazed joints which are present, follow the vehicle-specific repair instructions.

**NOTE:** The increased application of heat during MIG welding destroys the corrosion protection layers over a much larger area than during resistance spot welding. For this reason, greater care must be taken when applying the corrosion protection afterwards.

Welding repairs can only be carried out properly if the equipment is set up correctly and all welding-related preparations are complied with accurately.

- Please note the instructions of the respective welding equipment manufacturer.
- The hose assembly must be untwisted.
- The core must be free from particles of wire debris.
- The gas and current nozzles must be free of slag and scale residue.
- Pay attention to the quality of the welding wire and the gas flow rate.
- Ensure that the joint surface is perfect.
- Prepare a bare metal joint surface.
- Maintain the correct gaps (root formation).
- Produce a test weld.

**Plug Weld**



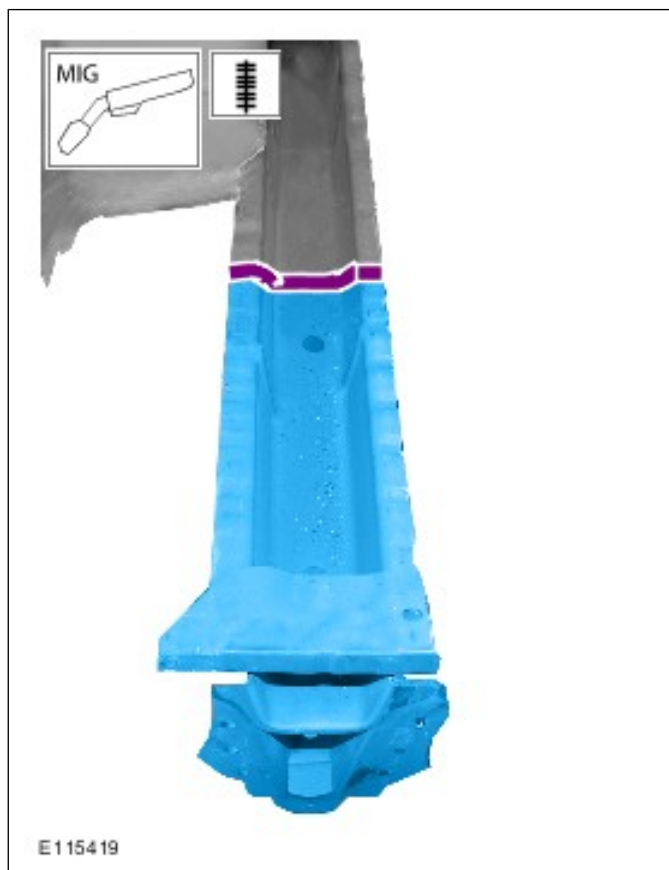
**DESCRIPTION AND OPERATION**

Special features to note when puddle welding:

- The panels to be joined must lie perfectly flat to one another.
- The panel flanges must be treated with corrosion protection. The position of the weld must be bare.
- Prepare the holes depending on the thickness and number of the panels. The hole size should be 6-10 mm, or match the original weld spot.
- Start the welding procedure on the panel at the bottom so that the hole is filled completely.

**Continuous bead welding**

A welded joint with a full seam is suitable for joining highly profiled body parts. Pillar and sill areas are typical application areas.



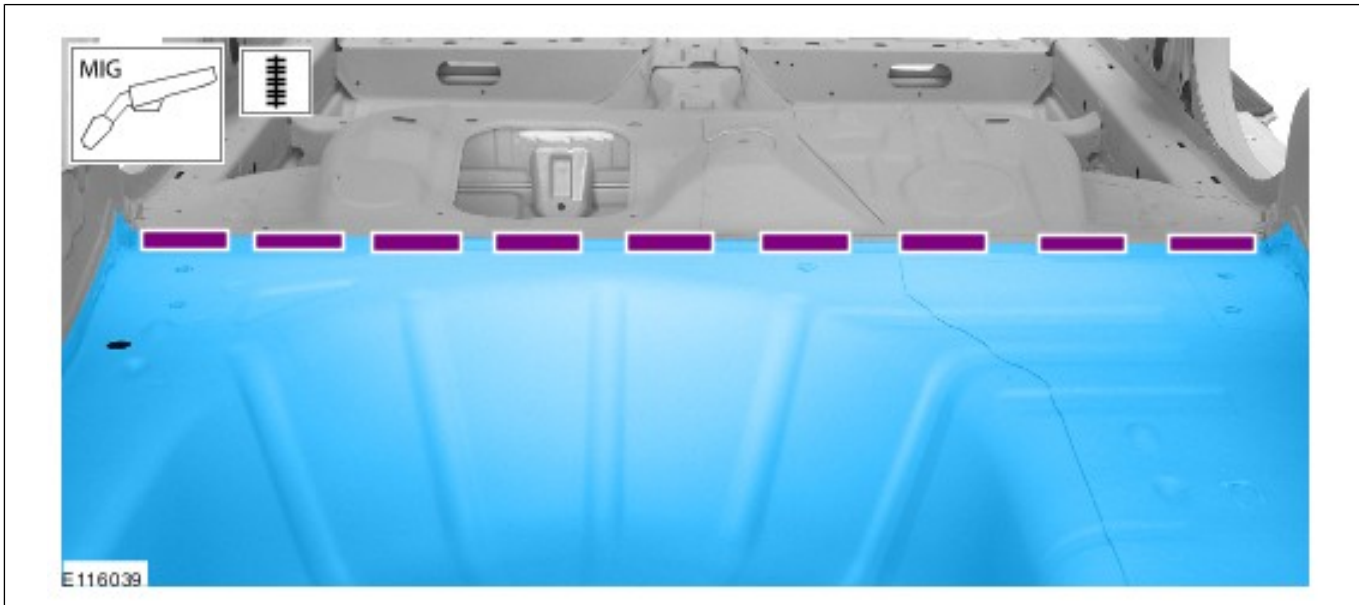
Special features to note during bead welding:

- Both parts of the panel must be bare on both sides over a width of 5 mm.
- Align the parts precisely with clamps.
- To prevent the panel from warping, tack longer joints before welding them.

**Intermittent bead welding**

Intermittent bead welding is used when the connecting flanges are stepped. This form of seam is mainly used on the external panel area for sectional repairs.

DESCRIPTION AND OPERATION

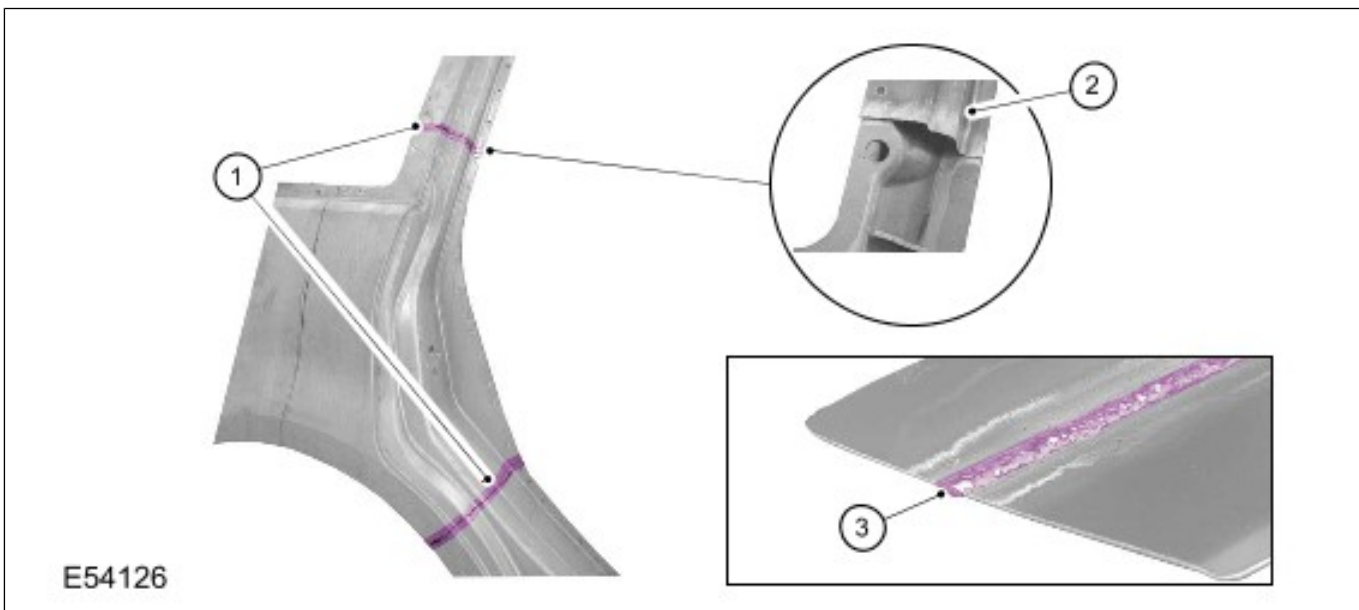


Special features to note when intermittent bead welding:

- Weld gap.
- Spot weld interval.
- Apply alternate tack welding across the entire length of the seam. This keeps warping to a minimum.

Joining techniques

Butt joints



Descript ion	Description
1	Join areas
2	Profile
3	Full seam

The butt joint is a joining technique frequently used in body repairs. The butt joint is typically used for repairs in the pillar and rocker panel area.

Areas that are suitable for the use of the butt joint:

- short seam lengths.
- highly profiled structures.

The edges of the panels to be joined are placed against each other and are joined with a full seam

**DESCRIPTION AND OPERATION**

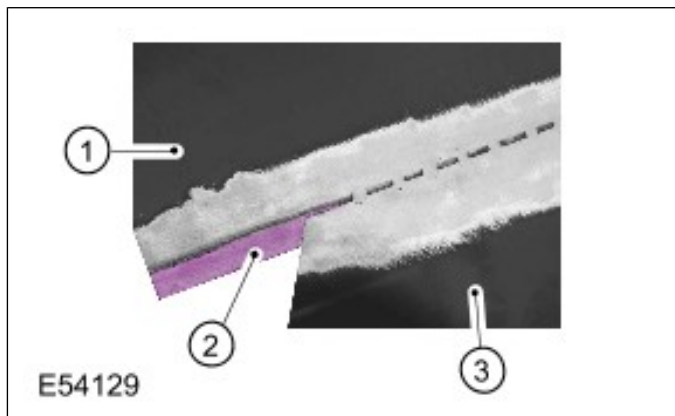
in whilst maintaining a required welding gap (welding gap same as panel thickness).

**NOTE:** The butt joint requires a high degree of accuracy and care when trimming and cutting. For correct execution of the welding, an exact, even welding gap must be maintained.

Preparation of the joint areas includes:

- Sanding the connection areas bare on both sides.
- Removal of the zinc layer in the welding area.
- Carrying out welding tests on an equivalent sample panel before the actual welding, if necessary.
- Tack welding in the join area: From the edges to the centre, then check the shape.
- Joining new and old parts with a full seam weld.

**Joggled joint**



Descript ion	Description
1	Body part
2	Joggled area
3	New panel

The joggled joint variant is restricted to body areas with a good surface condition without beads/swage lines or profiles. A sectional replacement with a joggled joint is welded using a continuous seam. This procedure is used, for example, at the transition from the side panel to the rocker panel (3-door vehicles).

When cutting the new part, slight measuring tolerances are permitted, as these are covered by the joggled area.

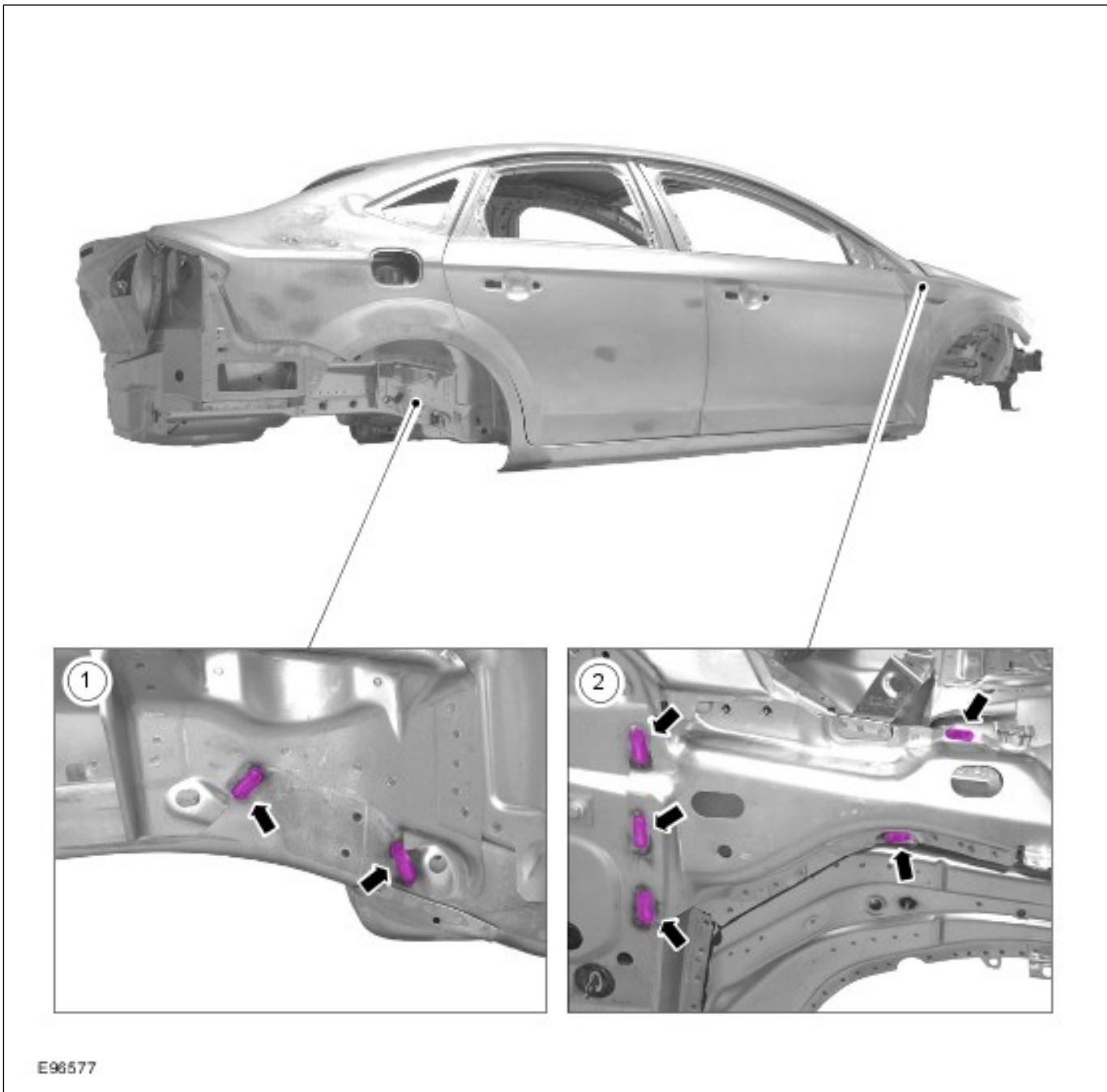
Preparation of the joint areas includes:

- Sanding the connection areas bare on both sides.
- Removal of the zinc layer in the welding area.
- Preparation of a joggled strip.
- Carrying out welding tests on an equivalent sample panel before the actual welding, if necessary.
- Joining the new and old panel with continuous seam welding.
- Lead loading the weld seam.



DESCRIPTION AND OPERATION

MIG brazes



E96577

Description	Description
1	Rear side member / wheelhouse reinforcement
2	Apron panel reinforcement / A-pillar

Metal Inert Gas (MIG) brazing is increasingly used in production for certain body areas.

In areas where resistance spot welding is not possible due to limited space or higher strength requirements, MIG welding was previously used.

Increasingly, these MIG welded seams are being replaced by MIG brazes. The temperature range used during MIG brazing is significantly lower. This keeps the damage to the anti-corrosion zinc layer on zinc-coated panels to a minimum.

This results in the following advantages of the MIG brazed seam:



**DESCRIPTION AND OPERATION**

- No corrosion of the brazed seam.
- Low erosion of the zinc coating in the joining area.
- Low level of heating and thus little warping.
- Easy finishing of the brazed seam.
- Good for bridging gaps.

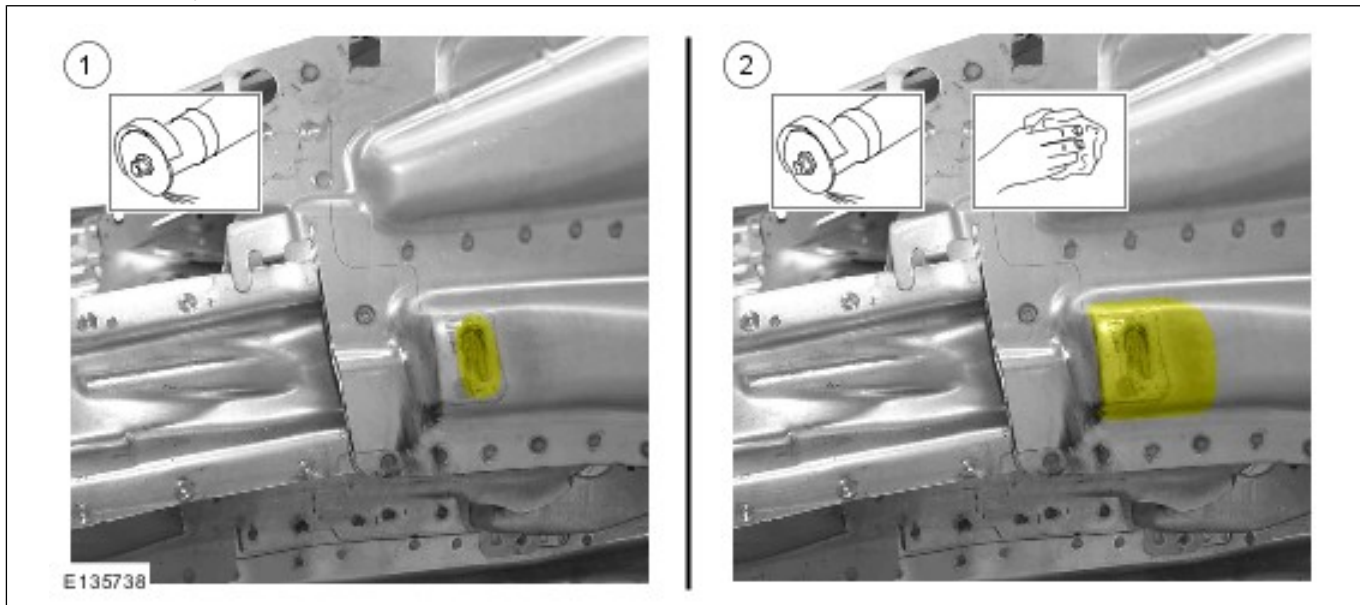
Technicians performing MIG brazing must use a **Ford-certified MIG brazing device** and must have been given appropriate **training** on the brazing techniques which are used.

Only use the Ford-approved brazing solder SG-CuSi3 (SG-CuSi3Mn1).

Unless specified otherwise, a minimum gap of 30 mm must be maintained between the MIG brazed seam and any adhesive bonds.

**⚠ CAUTION: MIG welds must not be carried out on or near existing MIG brazed seams as even the smallest amount of brazing solder can result in a reduction in the strength of the weld seam.**

If MIG brazing cannot be used then the factory-installed MIG brazed joints should be replaced with MIG welds in a different place during service repairs. These MIG welds must not be carried out on or in the immediate vicinity of existing MIG brazed seams as even the smallest amount of brazing solder can result in a reduction in the strength of the weld seam. Consequently, the corresponding graphics offer two alternative repair techniques (1: MIG brazing; 2: MIG welding).



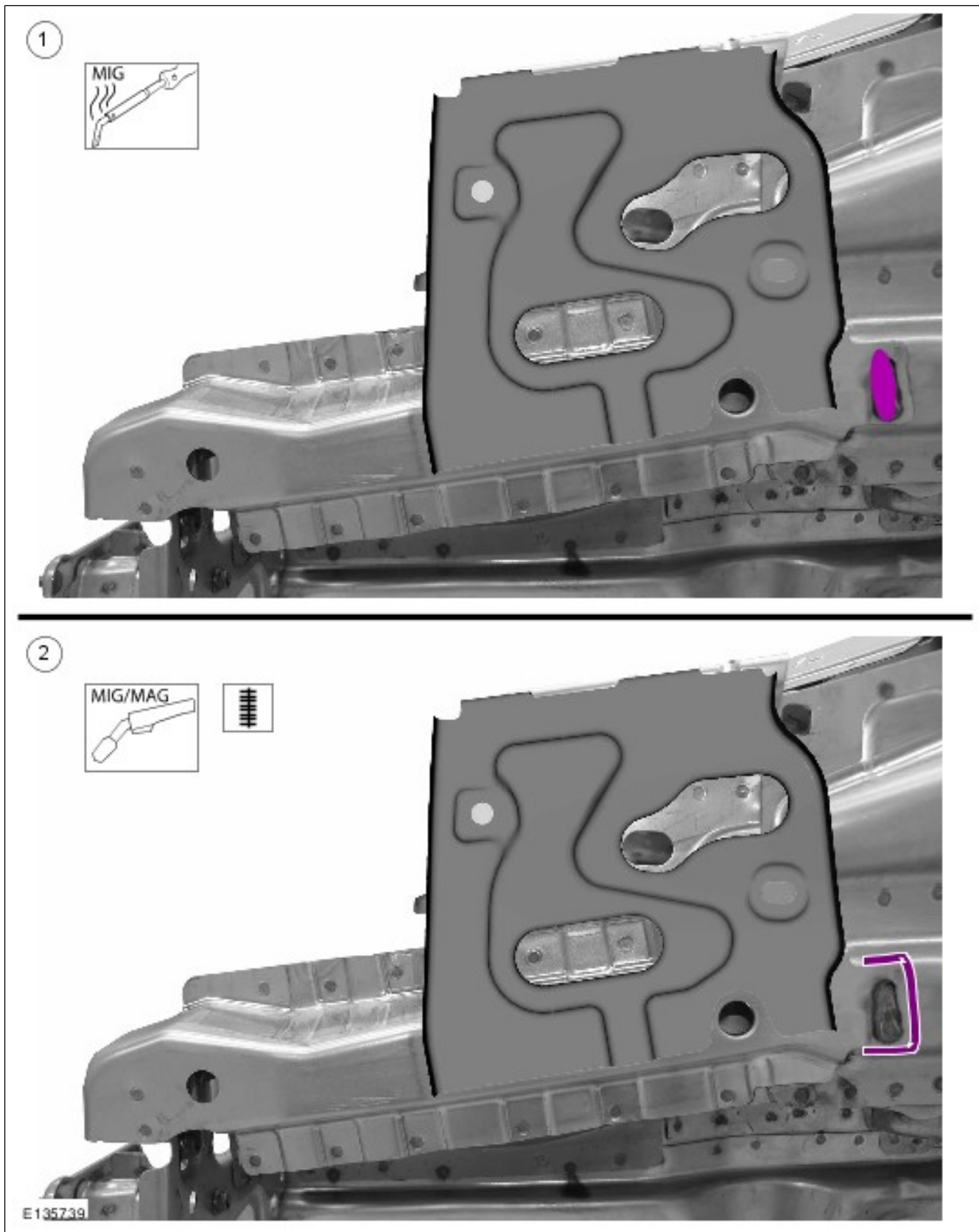
Des cript ion	Description
1	Preparation of the MIG brazing: Flatten the old brazed seam with a grinder.

Des cript ion	Description
2	Preparation of the MIG welding: Grind the old brazed seam and the surrounding area until they are clean, and remove any residue of the brazed seam.





DESCRIPTION AND OPERATION





DESCRIPTION AND OPERATION

Descript ion	Description
1	MIG brazing: Braze a new seam in the same place as the factory location for the seam.
2	MIG welding: Weld the seam <b>away</b> from the location of the factory-installed MIG brazed seam.

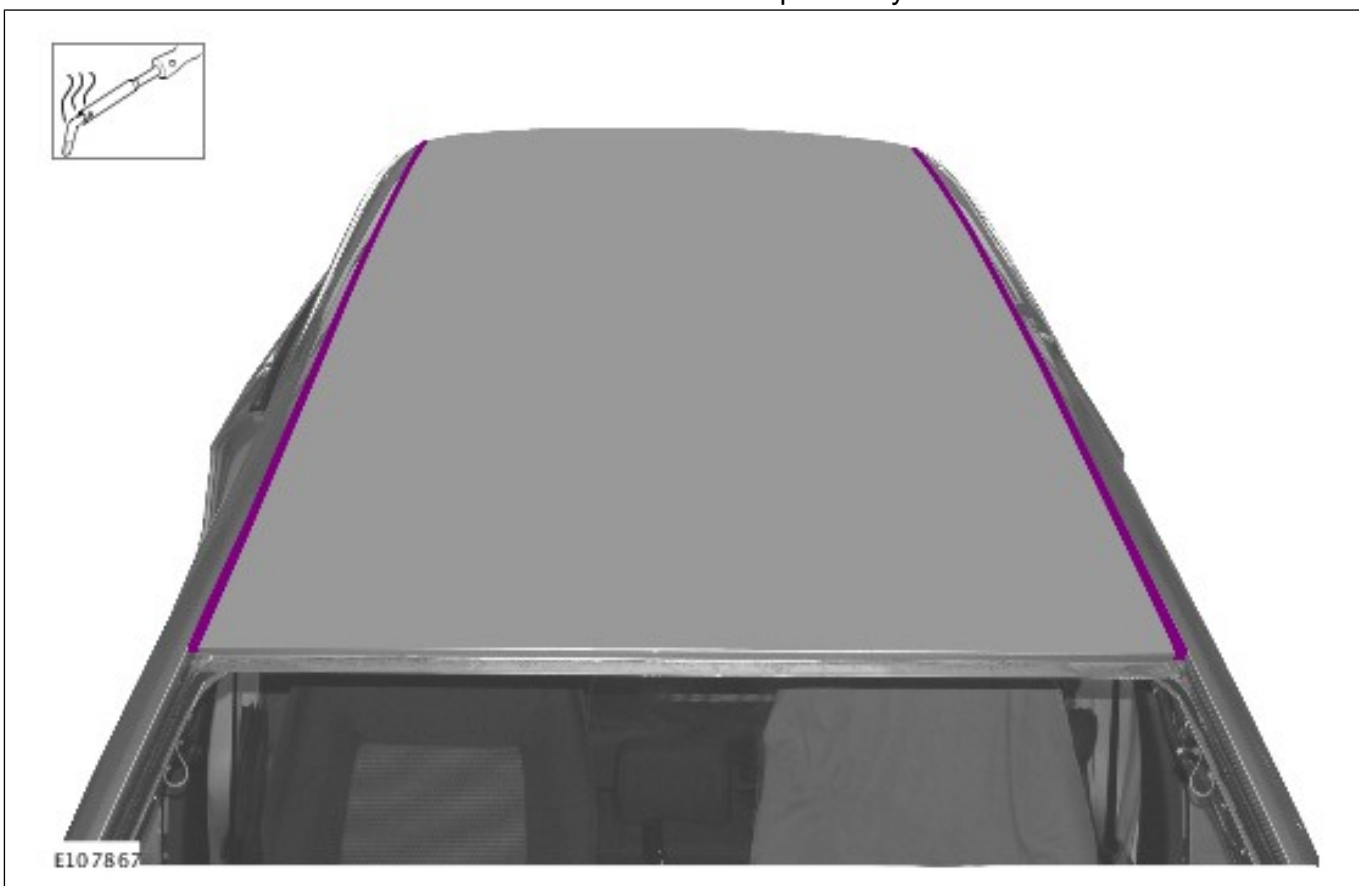
Apart from in the locations used in production, MIG brazing can also be performed on non load-bearing outer body skin panels and floor panels.

**CAUTION:** Without prior approval from Ford, MIG brazing must not be performed on structural parts of the chassis or body.

**Soft soldering**

**WARNING:** The roof repair may only be carried out in Ford-approved special workshops and only by specially trained personnel.

**NOTE:** The roof is secured to the side walls with laser soldered seams in production. When repairs are carried out, these laser-soldered seams must be replaced by soft-soldered seams.



**WARNING:** Poisonous gases and dust can be produced when working solder. Use an extraction unit and, if required, a protective mask.

**NOTE:** Ford offers basic and in-depth training on the following topics.

**NOTE:** Areas for soft soldered joints require careful preparation. It is extremely important that the joint surfaces are exactly aligned and that a bare metal joint surface is prepared.

This means:

- Thorough cleaning of the surfaces to be brazed.
- Close contact of the panels at the brazing position.
- Use the soldering iron to warm the location of the seam to be joined.
- The liquid brazing material is drawn between the panels through capillary action.

**Rivets**

With riveting, two or more panels are joined together using a joining element (rivet). In body

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construction, pop rivets and punched rivets are used.

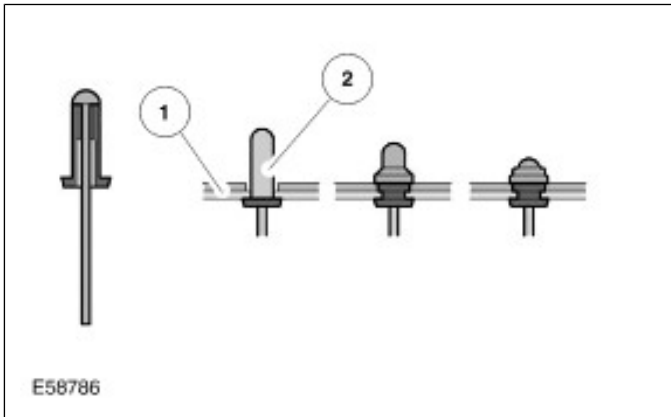
Advantages of riveted connections:

- Metallic and non-metallic materials can be joined together.
- Different thicknesses of materials can be used.
- The material does not have to be heated, and therefore does not warp.
- Low level of preparation required.

**NOTE:** For detailed instructions on the procedure, please refer to the equipment manufacturer's operating manual.

Disadvantage:

- During dismantling procedures, swarf/rivet remains can fall into inaccessible cavities, which can lead to rattling and rusting.



Descript ion	Description
1	Panels
2	Pop rivet

Pop rivets are used if only one side of the panel is accessible. In this process, overlapping panels are drilled and connected with a pop rivet.

Pop rivets can be inserted pneumatically, hydraulically or manually with rivet guns.

**Bonding**



Descript ion	Description
1	Butt joints
2	Bonded connection

Bonded connections are used more and more in modern body designs. Here, a distinction is made between bonds for stabilization purposes and bonds for adhesive strength. Bonds for stabilization purposes are found on clinched flanges and on cross beams in doors or on the roof.

**▲ WARNING: Risk of poisoning! Adhesive can be harmful to health. Ventilate rooms well and use breathing protection. Where possible, work with an extraction unit.**

**NOTE:** Adhesives are chemical products and are subject to the safety regulations of the manufacturer.

Please refer to the specifications in the general part of the particular manual for information on the repair adhesive which is to be used.

Advantages of glued joints:

## DESCRIPTION AND OPERATION

- They are air and watertight.
- High corrosion protection
- Different materials can be connected.
- Bonding can be combined with resistance spot welding.

**NOTE:** The quality of the bonded connection is largely dependent on the care taken during preparatory work. When gluing bodywork parts, follow the work instructions from the adhesive manufacturer.

### Bonding and welding

On some vehicle models, (such as the Ford Ka), bonding is combined with resistance spot welding. This connection technique has the following advantages:

- Tight, anti-corrosion connection seam.
- High strength due to additional resistance weld spots.

Please note the following points during the repair work:

- Only use adhesive suitable for welding (conductive).
- Carry out resistance spot welding on the connection flanges before the adhesive hardening process.
- Carry out test welding with the adhesive applied.
- If MIG welding is carried out during a sectional repair on a connecting flange with sealant or adhesive material, the material must be applied at a distance of approx. 10 mm from the weld spot.
- These areas must be sealed very carefully after the work has been completed.

### Bonding and riveting

As with welding, bonding can also be combined with riveting. This connection technique has additional advantages. These are:

- Metallic and non-metallic materials can be joined together.
- Different thicknesses of materials can be used.
- The material does not have to be heated, and therefore does not warp.
- The rivet connection stabilizes the connected components during the adhesive hardening phase.

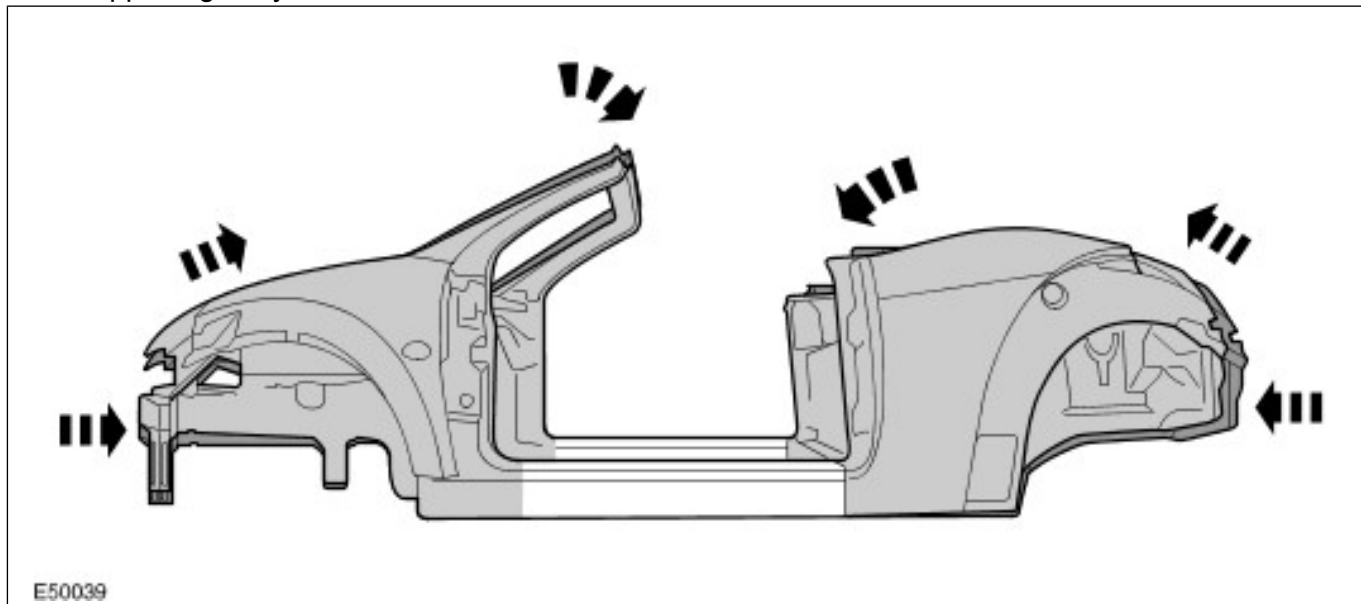
## DESCRIPTION AND OPERATION

## Special Repair Techniques

## Cabriolet vehicles

The body of a cabriolet vehicle is different to the self-supporting body of a saloon car because of

the special roof construction (folding top). The stability requirements must therefore be ensured by construction changes within the body structure.



These are for instance:

- Longitudinal and torsional reinforcing components which compensate for the lack of the roof.
- Reinforcements to the floor assembly, particularly in the rocker panel area.
- Reinforcements in the pillar areas.
- High-strength and ultra-high-strength steel panels with single panel thicknesses of up to 2.5 mm, which in combination can become up to 6mm thick (e.g. reinforcements in the floor area, rocker panels).

If deformation to load carrying components occurs, the stability of the whole body shell can be adversely affected.

On a cabriolet, accident damage repair to the components mentioned above is considerably different in certain aspects compared with the usual repairs (closed body construction):

- A model specific alignment angle system must always be used during straightening and repair

work, securing using clamps at the rocker panel area is not always adequate for the cabriolet.

- To avoid damage to the doors, they must always be open during straightening work. In the case of more severe damage, additional tension and compression spindles must be used to stabilize the door cut-outs (between the A- and B-pillars).
- In load bearing areas such as the rocker panels, side members and floor pan, increased straightening forces are necessary due to the additional reinforcements.
- **NOTE:** Additional information on welding can be found in the section Welding Equipment and Joining Techniques.

High-power welding equipment for panel thicknesses in overall combination of up to 6 mm total material thickness.

- The fitting accuracy and longitudinal rigidity of the affected component is especially important to ensure that the doors, door windows and the roof fit and close correctly.

## Liquefied gas vehicles

Alternative fuel vehicles often require special handling in the workshop area. Above all, assembly operations to some extent require particular

**DESCRIPTION AND OPERATION**

knowledge when dealing with the special technology and the safety regulations.

**NOTE:** Only fully trained personnel are permitted to work on alternative fuel vehicles.

These special requirements must be understood and taken into account in the body shop as well.

**⚠ CAUTION: Danger of fire and explosion. The safety instructions must always be followed when performing service work on fuel/gas systems. Failure to follow these instructions may result in personal injury.**

**NOTE:** You will find further information about working on liquefied gas vehicles in the section Health and Safety Information.

**Refrigerated conversion vehicles**

Apart from the special materials used in building the structure of the refrigerated compartment, such vehicles have special energy and refrigeration systems which require special handling during repair.

**⚠ CAUTION: Danger of injury. Work on the 230<SP>volt system of the refrigeration equipment must only be carried out by trained specialist personnel.**

**NOTE:** Work on the refrigerant circuit may only be performed by persons who have a relevant certificate of competence.

Vehicles with a refrigerated compartment are often used to transport foodstuffs. For this reason, additional hygiene regulations must be complied with during repair work.

Aluminum and plastic are used to construct the two different types of compartment found on refrigerated vehicles.

The aluminum conversion is a very stable and technically perfect variant. However, against this the relatively high production costs and a lower payload must be taken into account, because of the weight of the aluminum conversion itself.

**NOTE:** Basic and in-depth training is offered on the following topics. You will find an overview of the complete range listed in the Training brochure published by the Ford Service Organization.

The plastic conversion has developed into a light, clean and economical alternative because of constant further development of materials and working techniques.

**NOTE:** The material combinations, the workmanship and the working methods must comply with the current food hygiene regulations. For this reason, service and repair work on the refrigerated conversion may only be performed by authorized and specially trained technicians.

Refrigerated compartment constructions are often made using both materials. The floor pan is made of structured, slip-proof aluminum panels and the wall and ceiling cladding is made of smooth surfaced plastic elements.

**⚠ CAUTION: PUR hard foam is flammable. If PUR hard foam is overheated, it will burn on its own with a brilliant yellowish flame. It produces unpleasant choking and toxic fumes. Special measures must be taken when welding the vehicle body.**

Polyurethane wall and ceiling elements are manufactured using a sandwich principle. An insulating polyurethane core is coated with food grade ABS plastic on one side.

PUR hard foam does not decompose, is rot resistant and is odorless. These properties make it suitable for use as insulation.

Because of its closed cell structure, water uptake by PUR hard foam is for the most part only a problem at edges. Cut edges or other mechanically worked surfaces must however be sealed with the greatest care.

The conversion to a refrigerated vehicle is performed as made-to-order production. The large surfaces of the wall and ceiling cladding can be changed and are particularly easy to repair.

If access to the back of a body panel section is needed because of body straightening work, in some circumstances it is cheaper to perform a cut-out repair instead of removing an element.

The repair process is fully described in the Student Information booklet Refrigeration System Technology, Transit 2000.5 Freshline.

**NOTE:** You will find further information about working on vehicles with a refrigerated compartment in the section Health and Safety Information.



**DESCRIPTION AND OPERATION**

## Impact of Insufficient Repair Quality

Body repairs usually require a significant level of intervention in the existing body shell structure.

The corrosion protection, seals and NVH components are destroyed and must be replaced.

To prevent the vehicle quality from being reduced due to a poor quality repair, all repairs carried out in all repair sections must be inspected during and after the accident repair.

Simply checking the vehicle at the time of delivery is not sufficient to guarantee the repair quality. Rather, continuous checking of the work carried out is recommended.

**NOTE:** Logs of the acceptance of individual operations are a useful tool for quality assurance. A comprehensive final inspection can be carried out based on a final acceptance log.

In the process, the entire repair sequence must be split into meaningful sections, with the creation of check points to which particular attention must be paid.

The following are some possible sections:

- During and after body work.
- Final assembly, ancillary components, functional tests.
- Vehicle delivery.

**NOTE:** The following points offer an indication of possible test logs. They can be combined and supplemented differently, depending on the individual operating procedures.

**During and after body work the following areas should be checked:**

After completion of the body repairs, the following areas should be checked:

- Manufacturing inspection for functionality and originality in the accident area.
- Check snug fitting of metal panel parts (welding and screw connections).
- Check snug fitting of ancillary components (doors, hoods, glazing).
- Check surface condition of the welded seams.
- Check seals, blanking plugs, NVH components.
- Check corrosion prevention measures
- Check that the repair work is in the correct condition for painting.

**Final assembly, ancillary components, functional tests**

After final assembly, not only a visual inspection is required, but also the functionality of many components must be checked:

- Check repair area for originality.
- Check ancillary components for correct installation.
- Check precision fitting of all parts.
- Check that the doors and flaps are working correctly.
- Check that all mechanical parts, such as the window winder are working correctly.
- Check for leaks in the repair area.

**Vehicle delivery**

Vehicle delivery again offers the opportunity of checking the repair quality. In the process, the following points are to be checked again:

- Corrosion protection, sound damping matting and rubber seals.
- Check for traces of leftover paint.
- Check the cleanliness of the vehicle.
- Functional check of the mechanical and electrical components.
- Road test the vehicle.
- Check for noise, vibration and harshness (NVH).
- Check for wind noises.

After repair work on the body and vehicle, not only the visual restoration of the damaged vehicle, but also the functional restoration must be guaranteed.

Customers are making increasingly high demands of vehicles, particularly in terms of driving comfort. Customers find noise, vibrations and harshness (NVH) as well as squeaking and rattling annoying, particularly after repair work. It is therefore important that the condition of the vehicle at the time of production be restored after an accident repair.

After body repairs, the entire repair area must be checked for any water leaks. It is crucial that a leak test be carried out as part of the final inspection so that water leaks can be detected and eliminated even before delivery of the vehicle to the customer.

The requirements of the vehicle manufacturer are to be taken into consideration during all inspections. Only in this way can it be guaranteed



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that the vehicle quality is not reduced through insufficient repair quality.



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### Water Leaks

Water leaks can occur after body repair work, but can also occur on new vehicles. The test methods described below allow the various causes to be identified. In all cases, a systematic and logical procedure is required to locate water leaks.

#### General

When searching for faults, it must be taken into account that water can enter the vehicle passenger compartment in various ways and circumstances. Therefore, it is sometimes not sufficient to perform a water test on a stationary vehicle.

Before beginning extensive checks, a thorough visual inspection must be carried out. The following points are to be taken into account in the process:

- Check the clearance and accurate fit of ancillary components such as the trunk lid and doors.
- Check for correct installation and possible damage to sealing elements such as blanking plugs, seals and rubber door seals.
- Check that the water runoff openings and pipes are free of obstructions

#### Test method

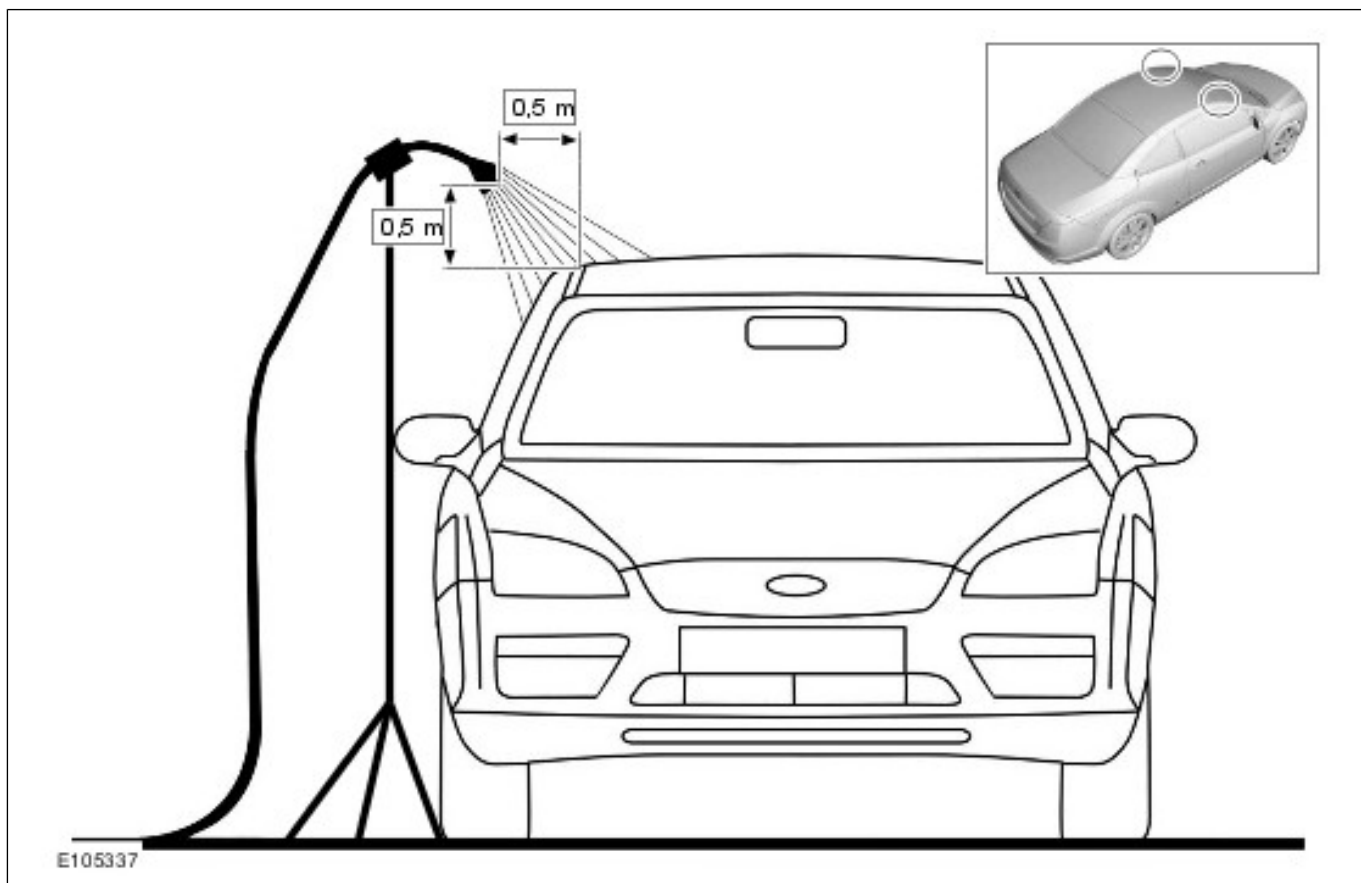
##### Water test

**NOTE:** Do not use a power washer. Use a normal garden hose with a spray nozzle or sprinkler head. Make certain that all windows and doors are completely closed.

Water leaks into the vehicle passenger compartment cannot usually be located immediately, as the water often spreads across a large area. For this reason, the passenger compartment must be dried before the leak tests. Any ancillary components that block the view must be removed. During the water test, the vehicle is sprayed or sprinkled with water at the suspected location of the leak. At the same time, a second person checks the passenger compartment for places where water enters the vehicle. Depending on the test and the vehicle, it may take some time before there is any sign of water entering the vehicle. We recommend laying blotting paper under the location being tested so that the water entry can be localized.

**Example: Water test with sprinkler head (rain test)**

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**Car wash test**

Certain leak problems only appear in a car wash or can only be simulated there. The concerned area of the passenger compartment should be inspected with a torch during the wash procedure.

**Road Test**

Some leaks only appear when the vehicle is moving. If no leaks are detected during the above-mentioned tests, road tests should be carried out on wet roads:

- At various speeds.
- On various road surfaces (asphalt to cobbles).
- With loaded or unloaded vehicle.
- Driving through puddles (splash water).

**Test with UV lamp**

A leak test can also be performed using a UV lamp and a special contrasting agent. The advantages of using contrast agent are:

- No need to dry out wet areas beforehand.
- The water entry and its subsequent path can be seen more clearly.
- No need to remove most ancillary components from the vehicle.

**NOTE:** The equipment manufacturer's instructions must be followed when using a UV lamp and contrast agent.

Procedure for using a UV lamp.

- Wet the test area with clear water from the outside.
- Prepare test liquid and apply it from the outside using a suitable water sprayer.
- Illuminate the relevant area from the inside using the UV lamp. The test liquid which enters will make the leak visible.

**Chalk/powder test**

This test checks the contact surfaces of seals on doors, hatches and lids.

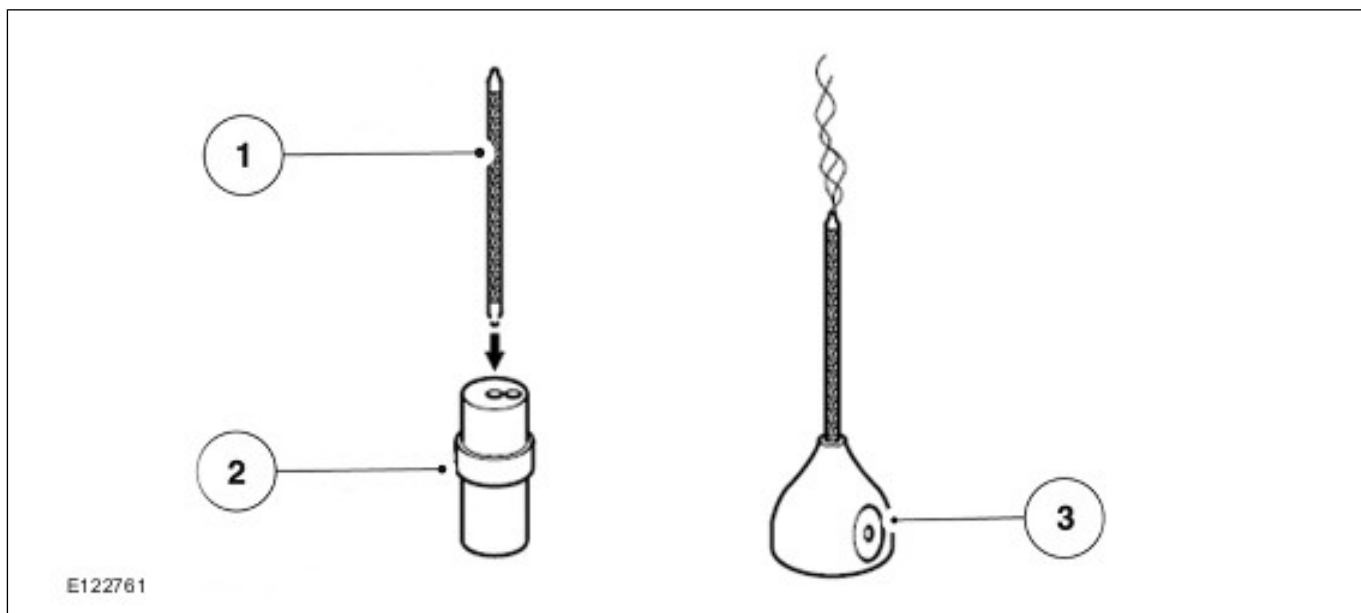
Process using a door seal as an example:

To do this, the door seal is coated with powder or brushed with chalk. A thin layer of grease is applied to the contact area of the seal. The door must then be slowly closed and reopened. The width and continuity of the imprint can now be checked on the seal.

DESCRIPTION AND OPERATION

Smoke test

Flow checking device



Descript ion	Description
1	Test pipe
2	Test pipe opener
3	Puffer ball

- Close all doors so that a slight overpressure can build up in the passenger compartment.
- Move the smoke pipe along the outside of the body to the areas to be checked.
- Leaks can be detected through the irregular movement of the smoke.

Operating principle

The flow checking device is a set made up of a flow-testing pipe, a test pipe opener, puffer ball and closing-off caps for the pipe.

The test pipe contains a filling layer which is impregnated with fuming sulfuric acid. When air is blown through the pipe by the puffer ball, sulfuric acid is emitted as an aerosol in the form of a white smoke.

**NOTE:** Pay attention to the instructions for use and the safety directions issued by the manufacturer. The smoke test can only be performed in a draft-free environment.

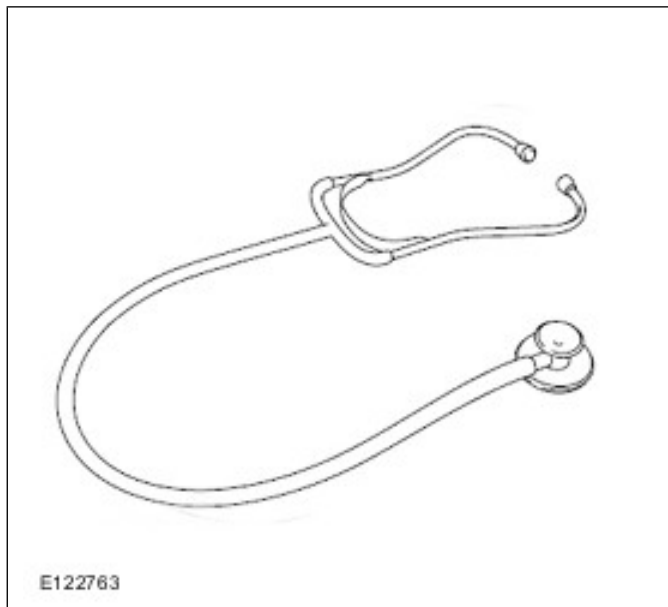
This test can be used to detect leaks visually. Procedure:

- Break off both tips of the pipe in the pipe opener, in exceptional cases in the top of the packaging.
- Insert the pipe into the puffer ball so there are no leaks.
- Close the hole in the puffer ball with your thumb and press the air contained in the ball through the pipe.
- Set the ventilation blower in the passenger compartment to the highest setting.

Stethoscope test

This procedure is very similar to the smoke test. Instead of the smoke pipe, move a stethoscope past the areas of the body that are at risk. Leaks can now be detected acoustically.

Stethoscope



**DESCRIPTION AND OPERATION**

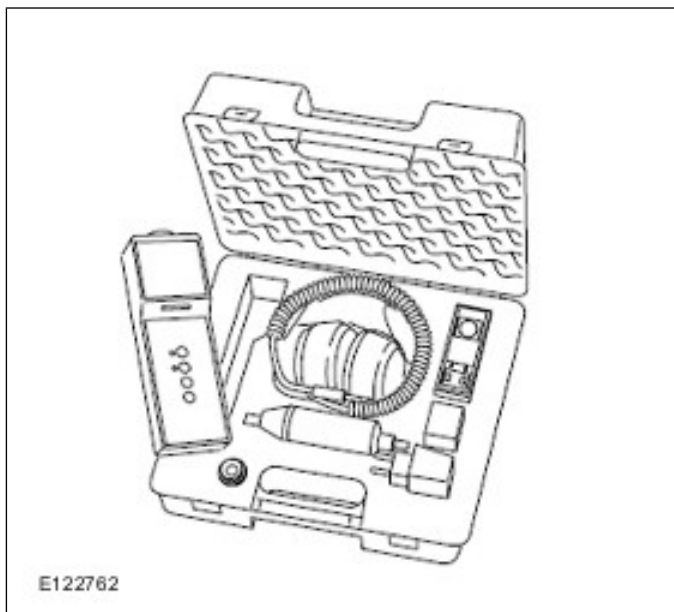
**Ultrasonic detection**

This test uses ultrasonic waves to locate the positions of leaks. When an ultrasonic transmitter is placed inside the vehicle, it sends out ultrasonic waves. A leak is located by running a detector along the suspected area. The position with the loudest reception of the escaping ultrasonic waves is the location of the leak.

Procedure:

- Place the ultrasonic transmitter in the vehicle.
- Completely close the vehicle.
- Search the exterior of the vehicle using the detector.
- The detector provides a simple indication of a leak.

**Ultrasonic test device**



**Workflow for tracing water entry**

Stage	Testing	Result	Action
1st	Ask customer for a detailed list of possible reasons for the water entry. Does this information allow the cause of the leak to be identified?	Yes	Dry out the vehicle and repair the damage. Perform a water test as a check (see test method).

Stage	Testing	Result	Action
		No	Step 2.
2nd	Perform an initial visual inspection on the vehicle. Look for signs of water entry. Can the cause of the leak be identified immediately?	Yes	Dry out vehicle. Repair damage. Perform a water test as a check (see test method).
		No	Step 3.
3rd	Is it possible that water is getting into the vehicle through a seal (door seal, trunk lid seal)?		Check the seal for damage. Check the creation of the seal using the chalk test (see test methods). Step 4.
		No	Step 5.
4th	Is the contact area for the seal adequate?	Yes	Step 5.
		No	Perform work as described under Areas with possible water leaks - Door seals. Dry out vehicle. Repair damage. Perform a water test as a check (see test method).
5th	Before starting any further work, use the VIN to look for model-specific information in eTIS. Perform Oasis query and check TSIs. Does this information allow the cause of the leak to be identified?	Yes	Dry out vehicle. Repair the damage using the information found. Perform a water test as a check (see test method).
		No	Step 6.

DESCRIPTION AND OPERATION

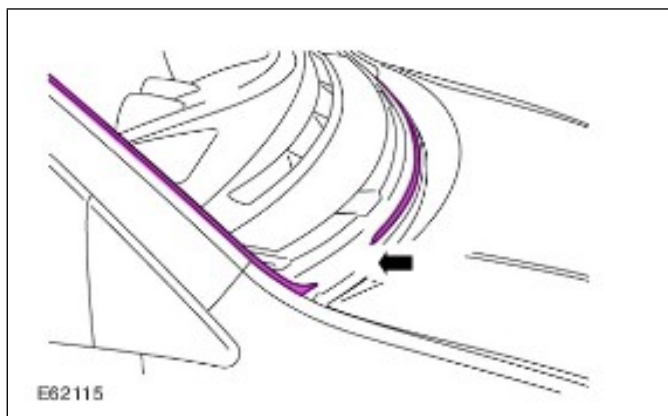
Stage	Testing	Result	Action
6th	Establish the extent of the damage. To do this, expose wet areas. Remove parts. Investigate the suspected area for signs of water. Does an investigation of the suspected area allow the cause of the leak to be identified?	Yes	Dry out vehicle. Repair leak. Perform a water test as a check (see test method).
		No	Step 7.
7th	Check exterior areas (seals, seal welds). Check interior areas: Signs of water, plugs, seal welds. Can the cause of the leak be identified?	Yes	Dry out vehicle. Repair leak. Perform a water test as a check (see test method).
		No	Step 8.
8th	Perform water test or ultra-sound test. Can the cause of the leak be found?	Yes	Dry out vehicle. Repair leak. Perform a water test as a check (see test method).
		No	The water entry may only occur under dynamic driving conditions. This requires intensive tests to be repeated with the corresponding climatic influences (rain).

vibrations, roughness chapters may be useful in identifying the fault.

An outline of the possible complaints due to water leaks is provided below. The causes of water leaks and the possible remedies are presented using selected examples. They are intended to provide troubleshooting tips and suggestions for the user but do not represent an exhaustive faults list.

**Glued windows**

A broken pasted seam can cause water to enter around the window. A broken pasted seam can be located using a water test or by carefully blowing compressed air onto the inside of the window seal.



**Corrective action**

Broken adhesive seams **-Arrow-** can be sealed from inside using PU glass adhesive.

If this seal does not resolve the problem or the broken pasted seam is too extensive, it is necessary to remove the window and glue it back into place.

**Door seals**

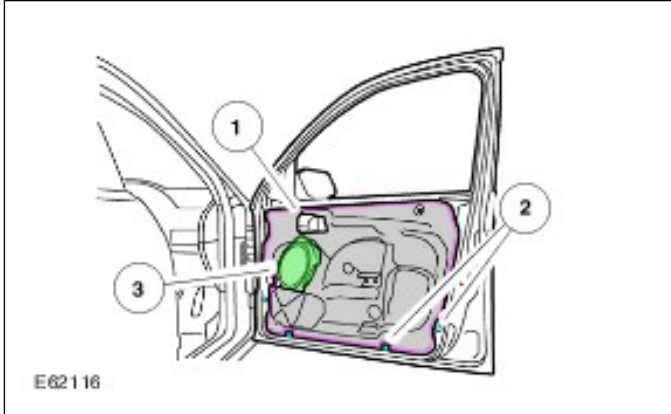
If water appears at the bottom of the door, it is possible that the door seal behind the door trim is damaged. If the door is intact, water can enter through the window weatherstrip and flow out through gaps on the underside of the door. If the door seal adhesion is faulty or the door seal is damaged, water can get into the interior.

**Possible complaints and corrective actions**

**NOTE:** Water leaks and changed vehicle acoustics can have similar causes. For this reason, information from the Wind noise or Noise,



DESCRIPTION AND OPERATION



Des cript ion	Description
1	Seal/adhesion
2	Clips
3	Door speaker

Fastening bolts could be loose or clips incorrectly positioned on door modules.

**Corrective action**

Depending on the door seals used, different sealing methods can be used.

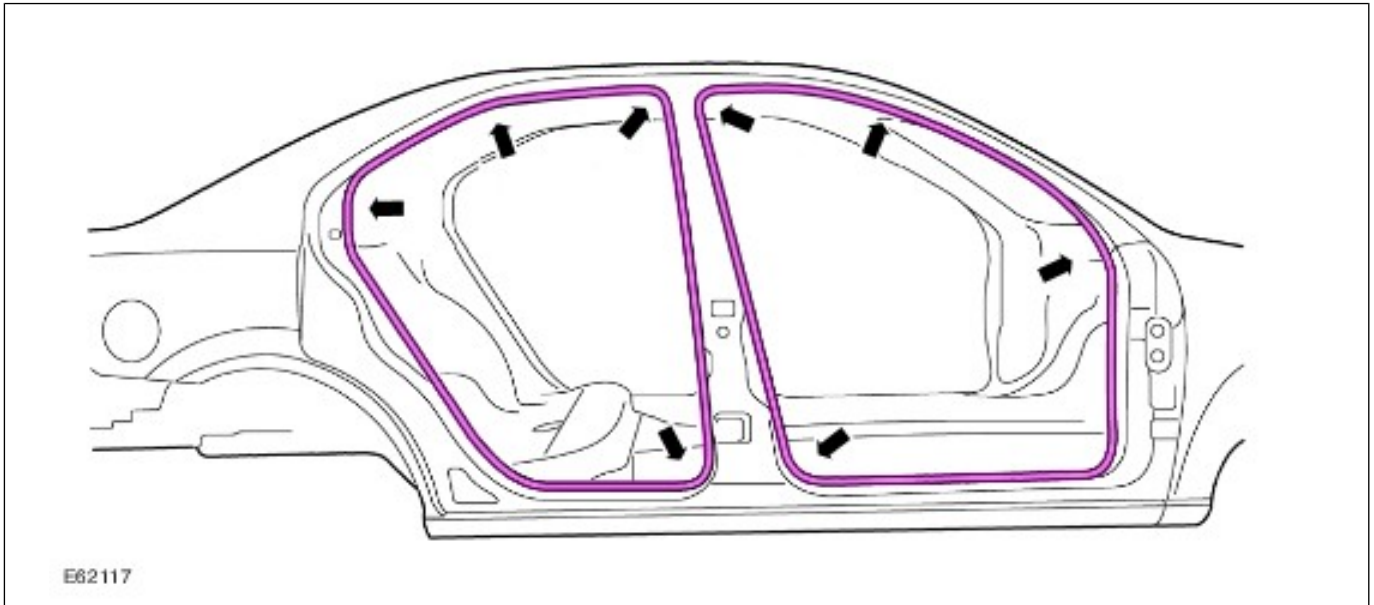
**NOTE:** The drainage holes on the underside of the door may not be blocked - if they are, clean them. Defective films and foam seals must be replaced.

Once the adhesive surfaces have been cleaned, plastic films must be stuck with double-sided adhesive tape or replaced.

Leaky foam seals are sealed with Butyl tape or replaced.

Plastic door modules are fitted with a weatherstrip, which cannot be replaced. Seal the leaky point with Butyl tape or replace the part.

**Door weatherstrip**



Leaks can be caused by badly fitted seals. In particular, areas with radii **-Arrow-** must be thoroughly checked.

Door seals can develop leaks due to:

- Damaged or expanded seals.
- Ageing.
- Insufficient contact pressure.
- Inadequate contact area for seal on body part.

- Uneven welded flange thickness because of several layers of body panels or production tolerances.
- Kinks.

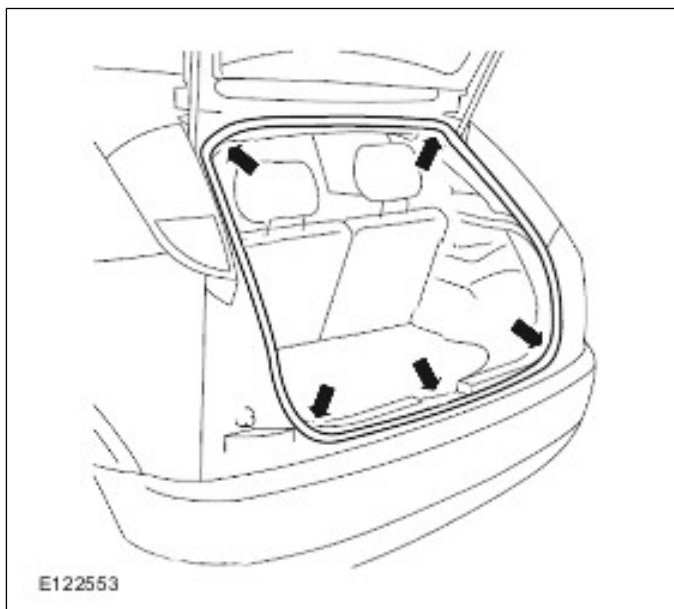
The contact pressure of a seal can be determined using a strip of paper. If a strip of paper trapped in the closed door can be pulled out easily, the contact pressure is too low.

**To resolve**

**DESCRIPTION AND OPERATION**

- Replace damaged or aged seals. Prevent kinks.
- The contact pressure can be changed by adjusting the catch bolt or correcting the panel flange.
- Even out the uneven welded flange thicknesses. Properly repair any paint damage that occurs. If the bodywork flanges are very uneven, appropriate alignment work must be performed. Pay particular attention here to the new corrosion protection which needs to be applied afterwards.
- If water entry is caused by a spot weld (burr on the surface), this must be rectified and appropriate corrosion protection applied.

**Tailgate sealing rubber**

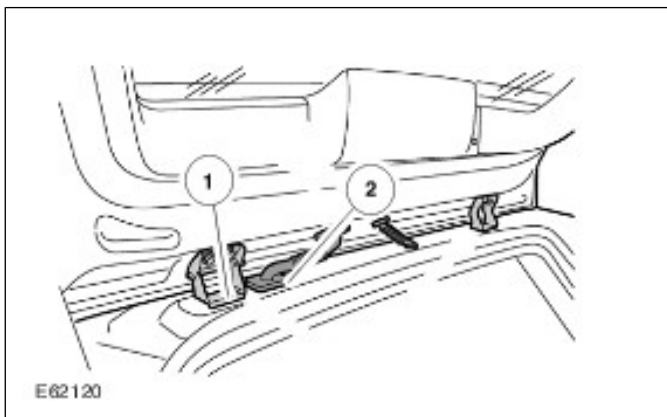


Leaks at the tailgate rubber seal have the same causes and remedial measures as for door rubber seals. Especially vulnerable areas -arrows- must be thoroughly checked.

**Rubber grommets / plugs**

Rubber grommets or plugs are fitted at numerous points on the body. They are frequently used as seals for cables, hoses or actuating links. Rubber plugs are frequently used for gaps caused during production.

**Example: Possible problem locations in the tailgate area**



Des cript ion	Description
1	Hinge seal
2	Cable duct

Leaks can be caused by badly fitted or damaged rubber grommets and plugs.

Damaged cable insulation can also cause leaks.

Where components are bolted on, water can enter if there are inadequate seals at the connection point.

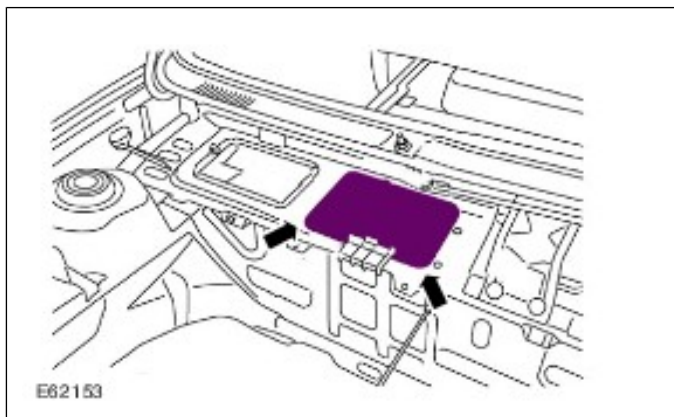
**To resolve**

- Correctly fit rubber grommets / plugs. During fitting, ensure that the sealing lips are not trapped and are applied properly.
- The contact area of the rubber grommets / plugs can also be sealed with PU sealing compound.
- Replace the damaged rubber grommets and repair the damaged cable insulation.
- Smooth the panel deformations in the contact area of the plugs.

**Heater housing/ventilation**

Loose butyl sealing strips, damaged sealing surfaces or a trapped carpet can cause leaks around the heater housing / ventilation **Arrow**. Badly positioned or badly fitted hoses can also be responsible for water entry. Water drains must not be blocked

DESCRIPTION AND OPERATION



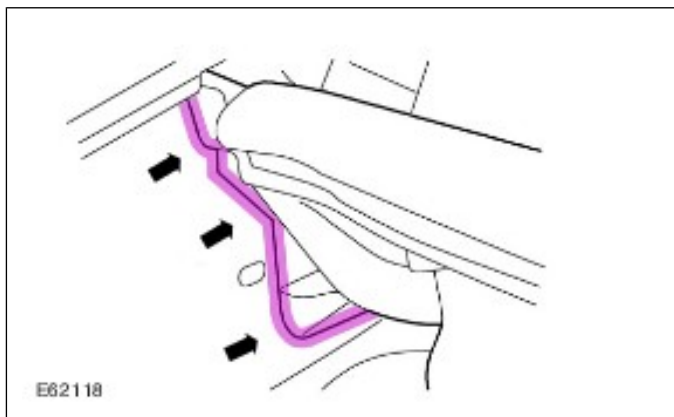
**NOTE:** A large quantity of water flows through the water tank. If there are leaks in this area, it is essential to ensure that the water drainage mechanisms function correctly. Drainage openings may not be blocked or stuck. Leaves and other dirt must be removed before troubleshooting.

**Corrective action**

Before the actual repair, make sure that the water drains are not blocked or stuck.

Remove the heater housing / ventilation and fit a new Butyl sealing strip. Damaged sealing surfaces must first be adjusted. A trapped carpet must be removed.

**Seal welds**



PU sealing beads are applied to welded or riveted connections **Arrows** to seal the interior of the vehicle. Incorrectly applied or damaged seal welds can allow moisture to penetrate into the interior of the vehicle. It is also possible that sealing beads whose shape and size appear to be intact actually have poor adhesion.

**Corrective action**

Incomplete seal welds must be supplemented with PU sealing compound. Damaged seal welds must

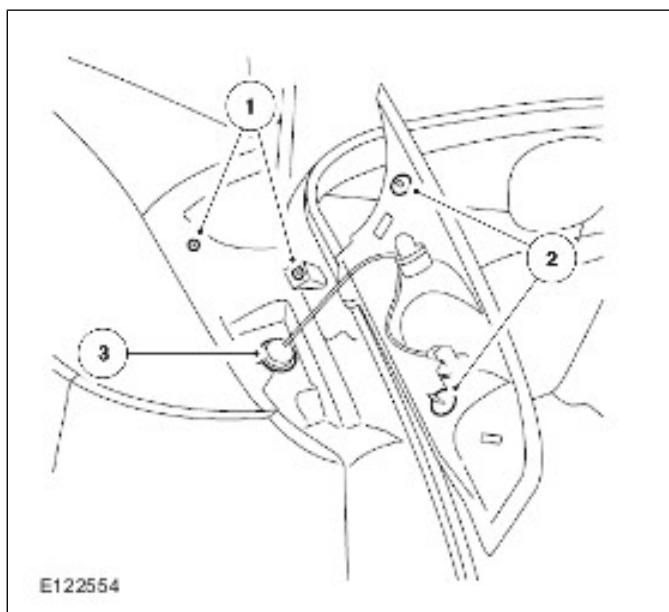
be removed and re-applied properly. Make sure that any residual moisture is effectively removed before a new seal is applied.

**Attached parts**

The add-on parts include:

- Exterior mirrors, handles, controls.
- Mouldings, roof mouldings, lettering.
- Roof aerial, roof rack or connections for roof rack systems.
- Bumper mountings.
- Injection nozzles, door contact switches, bump stop rubber.
- Control unit seals.
- Tail lamps.
- All kind of screwed connections (pedal block, door and tailgate hinges)

**Example: Possible water entry points at the rear lamp**



Des cript ion	Description
1	Clips
2	Gaskets.
3	Rubber grommet

Add-on body parts must be fitted with seals, grommets or sealing compound to prevent water entry. However, even when a sealing system is fitted, the screw thread may still cause leaks.



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**DESCRIPTION AND OPERATION****Corrective action**

Seals must be tested and, if necessary, replaced. Check contact surface and adjust if necessary. Points sealed with sealing compound must be thoroughly cleaned and the seal replaced. Check grommets and replace if necessary. At all screwed connections, seal the thread with an appropriate sealing material.



DESCRIPTION AND OPERATION

Wind Noise

Wind noises as well as other general noises are dealt with under Noise, Vibration and Harshness (NVH).

**NOTE:** Basic and in-depth training is offered on the following topics. You will find an overview of the complete range of courses in the Training Brochure issued by the Ford Service Organization.

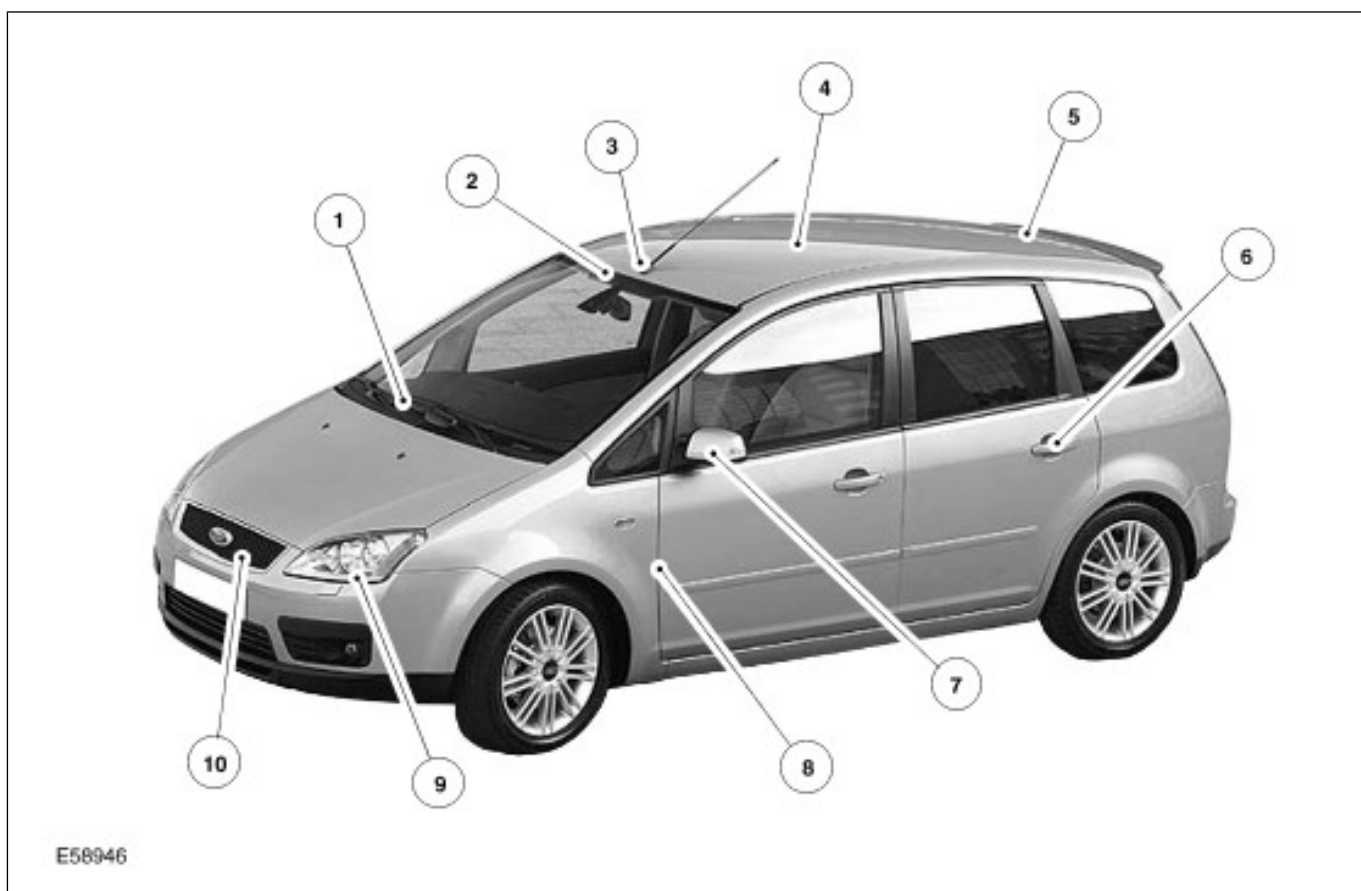
Due to the continuous reduction in drivetrain noises, wind noises have come to the fore in the vehicle and are perceived to a greater extent by the customer.

Potential areas of wind noises

There are various causes of wind noises. They can be due to the design of the vehicle, or they can occur after a repair. They are mostly caused by poorly mounted components, which must be located and installed in the correct position.

General information

In order to carry out targeted diagnosis, it is important to know the basics of noise formation and sound transmission.



Item	Description
1	Wiper arms
2	Windscreen seal
3	Antenna/antenna base
4	Sun roof/roof rail
5	Tailgate
6	Door handles
7	Exterior Rear View Mirror

Item	Description
8	Door seals
9	Headlamps
10	Radiator grille.

Noises are categorized according to their type and formation as follows:

**"Normal" air flow noises:**

Normal air flow noises are caused by air blowing against even, flat vehicle surfaces, such as the



**DESCRIPTION AND OPERATION**

roof, doors and side windows. When the vehicle is moving fast, air layers (turbulence) form, which cause variations in air pressure. These variations in air pressure spread in the form of sound waves and are transferred to the vehicle interior via the side windows and seals.

**Noises caused by deviations in air flow and circulation around separate components:**

If air flows over an edge on a vehicle, the air flow cannot follow the shape of the surface, but separates at the edge. Eddies are formed, which collapse again after a certain time or distance. The associated fluctuations in air pressure create a corresponding sound wave which is noticeable by for instance a rushing noise at the A-pillar or the outside mirror.

Turbulence and the associated radiation of noise can also occur at the vehicle underbody. Air circulation around small components and also flow through small gaps (e.g. the radiator grille) cause the rushing noise to change to a whistling, which rises and becomes louder as the vehicle speed increases.

**Noises caused by vibrating seals:**

Seals which do not make firm contact at the door or window area can be made to vibrate by pressure variations outside the vehicle, which in turn mean noise radiating into the interior of the vehicle.

**Noises caused by air flowing out:**

Noises caused by air flowing out are created by leaks at the vehicle interior sealing system, when stationary air mixes with flowing air. As a result, the noise increases as the speed of the air flowing out increases. Example: Letting air out of a tire.

**Cavity noises:**

Cavity noises are those created when the air volumes found in bodywork cavities are caused to vibrate by an opening located in the airflow. The frequency of the tone does not vary with the vehicle speed but depends on the volume of the cavity and the size of the opening. Example: Blowing across the top of a bottle.

**Wind noises overview:****Workshop diagnosis**

Assessment	Type of wind noises	Place of origin
Normal	"Normal" wind noises	Roof, side windows
Normal	Noises caused partly by changes in the direction of air flow and by air flow around separate components	A-pillars, outside mirrors, antennas
Serious	Noises caused by vibrating seals	Door gaps too large, door/window seals not making firm contact
Serious	Air escape and air passage noises	Leaks in the bodywork/sealing system
Serious	Cavity noises	Unsealed bodywork cavities

Those noises listed under "Serious" indicate a possible source of the fault.

**Workshop diagnosis**

There are two ways that the level of noise in the vehicle interior can be reduced and the character of the noise can be improved through assessment and diagnosis in the service department:

- Reducing the intensity of the noise sources.
- Reducing the noise transfer routes.

Before carrying out repair work, a visual inspection of the vehicle must be carried out. The gaps in the doors, the sunroof and at all other body parts must be checked in particular.

When the doors are adjusted to fit exactly, development of wind noises at high speeds can often be eliminated (lifting of doors off the seals). Furthermore, the following points should be noted:

- The windows and doors must be fully closed.
- The air guides and air grilles must be correctly seated.
- All of the trim strips and plastic components must be firmly fixed down without gaps.
- All blanking plugs present.



**DESCRIPTION AND OPERATION**

**Test method**

The test procedures given in the chapter Noise, Vibration and Harshness can also be used to diagnose wind noises.

**Road tests**

Wind noises can usually only be localized by road tests

**NOTE:** There should always be two people present during road tests to find noises. A driver who reconstructs the situation causing the noise, and a person to carry out the checks.

The following points should be taken into account for such road tests:

- Check that the tire pressure is correct.
- Remove non-standard ancillary components from the vehicle.
- Choose a dry, flat road with as little traffic as possible.

- Carry out the road test in all speed ranges. Use a high gear so that the engine noise is low.
- Do not perform a road test near any sound reflecting objects.

If it is difficult to detect the noise sources, the search can be made easier by masking potential areas.

**Chalk/powder test**

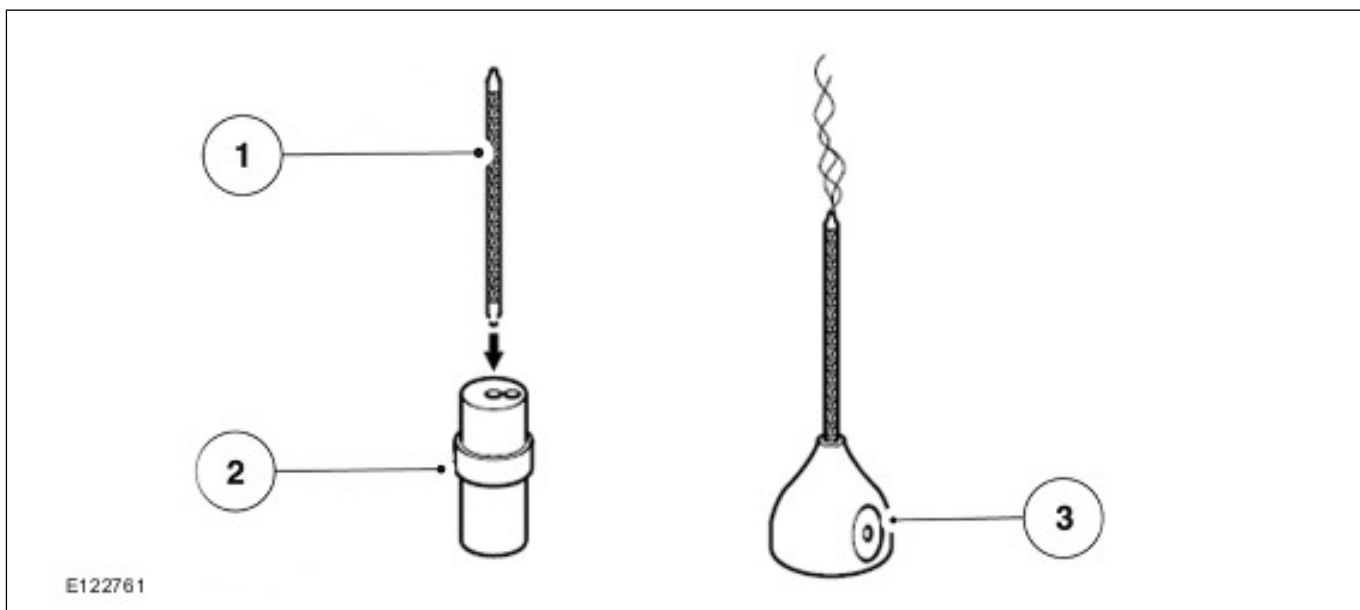
This test checks the contact surfaces of seals on doors, hatches and lids.

Process using a door seal as an example:

To do this, the door seal is coated with powder or brushed with chalk. A thin layer of grease is applied to the surface against which the seal makes contact. The door must then be slowly closed and reopened. The width and continuity of the imprint can now be checked on the seal.

**Smoke test**

Flow checking device



Item	Description
1	Test pipe
2	Test pipe opener
3	Puffer ball

acid aerosol is emitted in the form of a white smoke.

**NOTE:** Pay attention to the instructions for use and the safety directions issued by the manufacturer. The smoke test can only be performed in a draft-free environment.

Mode of operation:

The flow checking device is a set made up of a flow-testing pipe, a test pipe opener, puffer ball and closing-off caps for the pipe.

The test pipe contains a filling layer which is impregnated with fuming sulfuric acid. When air is blown through the pipe by the puffer ball, sulfuric

This test can be used to detect leaks visually.

Procedure:

- Break off both tips of the pipe in the pipe opener, in exceptional cases in the top of the packaging.
- Insert the pipe into the puffer ball so there are no leaks.

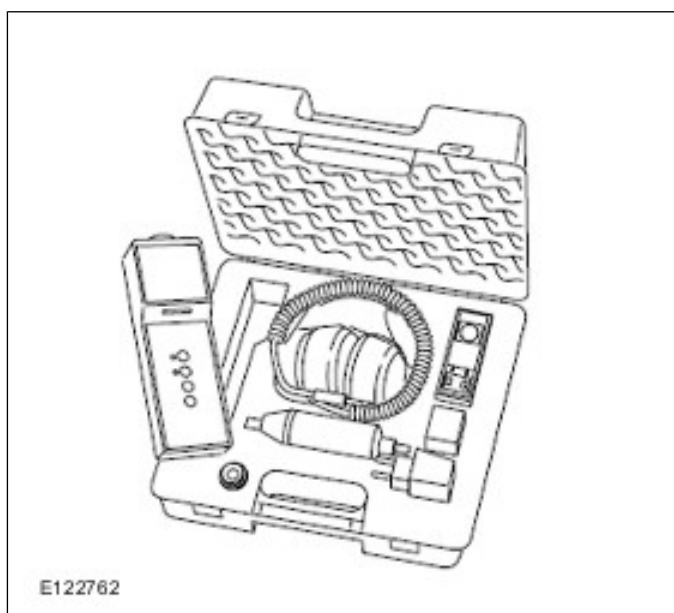
**DESCRIPTION AND OPERATION**

- Close the hole in the puffer ball with your thumb and press the air contained in the ball through the pipe.
- Set the ventilation blower in the passenger compartment to the highest setting.
- Close all doors so that a slight overpressure can build up in the passenger compartment.
- Move the smoke pipe along the outside of the body to the areas to be checked. Leaks can be detected through the irregular movement of the smoke.

**Ultrasonic test**

This test searches for leaks in the system of seals or rather acoustic bridges. When an ultrasonic transmitter is placed inside the vehicle, it sends out ultrasonic waves. A leak is located by running a detector along the suspected area. The position with the loudest reception of the escaping ultrasonic waves indicates places where noises occur.

Ultrasonic test device

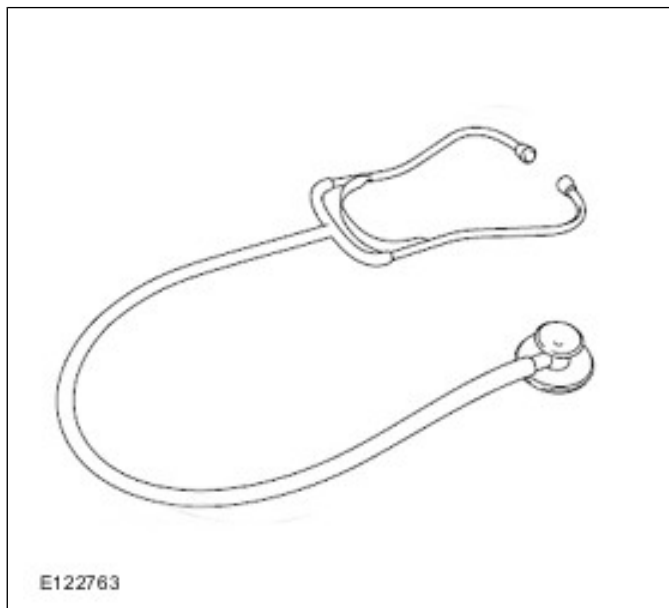


Procedure:

- Place the ultrasonic transmitter in the vehicle.
- Completely close the vehicle.
- Search the exterior of the vehicle using the detector.
- The detector provides a simple indication of a leak.

**Stethoscope test**

Stethoscope

**Diagnosis**

Wind noises often have similar causes as the general NVH noises. For instance, a windshield which is incorrectly bonded in position can cause normal driving noises to become more noticeable.

Asking the customer detailed questions and a road test together with the customer are the requirements for a targeted diagnosis.

**NOTE:** Take the customer concern seriously. But do not confirm that a noise is a problem until you are sure that it is something which is not normal for the vehicle series.

Possible questions:

- How long has the noise been there?
- Has any work been done on the vehicle?
- Where does the noise come from?
- In which driving situation does the noise appear?
- Is there any special situation in which the noise appears?

Remember that a noise is often more or less noticeable depending on where you are sitting in the vehicle.

**DESCRIPTION AND OPERATION**

Sta ge	to test	Res ult	Reference or Action
1st	Road test the vehicle with the customer. First let the customer drive to demonstrate the noise, before you drive the vehicle yourself. Check that the concern is justified. Is this a noise which gives cause for concern?	Yes	Step 2.
		No	Explain the noise and tell the customer what is causing it. Possibly offer a comparable vehicle for a road test.
2nd	Visually inspect the vehicle. Look for loose, damaged or missing components. Check that the vehicle is to standard production series specification. In particular, check for any after-market components which may have been installed. Depending on the type of noise, check the suspected area. Could a cause of the noise be found?	Yes	Eliminate the noise or carry out a repair as the case may be. Check whether the measures have been successful.
		No	Step 3.

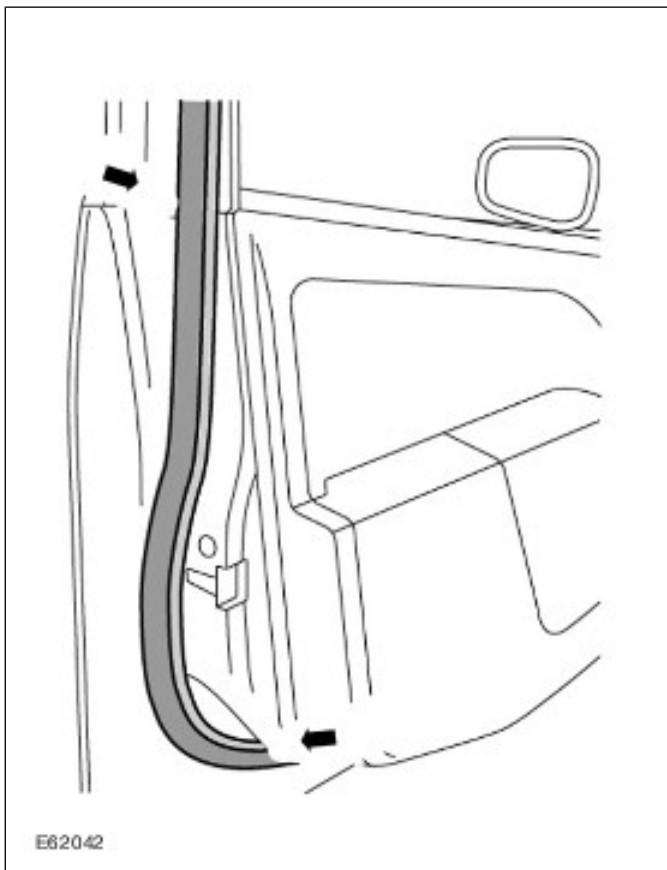
Sta ge	to test	Res ult	Reference or Action
3rd	Before starting any further work, use the VIN to look for model-specific information in eTIS. Perform Oasis query and check TSBs. Can a cause for the noise be determined based on the information available?	Yes	Take the action specified in the Oasis or TSB information. Check whether the measures have been successful.
		No	Step 4.
4th	Localize the noise. In doing so, check whether it is an unusual noise or if it is a usual driving noise that is more noticeable because of inadequate sealing. Is it an unusual noise?	Yes	Step 5.
		No	Step 7.
5th	Determine the source of the noise. Can the cause be determined?	Yes	Eliminate the noise or carry out a repair as the case may be. Check whether the measures have been successful.
		No	Step 6.
6th	Determine the path of the noise using the stethoscope. By way of a trial, mask the suspected area or components or remove them. Can the cause be determined?	Yes	Eliminate the noise or carry out a repair as the case may be. Check whether the measures have been successful.
		No	Step 7.

**DESCRIPTION AND OPERATION**

Sta ge	to test	Res ult	Reference or Action
7th	Check the vehicle for inadequate or damaged seals. The sealing of a vehicle can be checked using the stethoscope, the powder test, the smoke test and the ultra-sonic detector. (See under test method.) Could a leak be detected?	Yes	Renew the seal or perform the appropriate repair as necessary. Check whether the measures have been successful.
		No	Step 8.
8th	Under certain circumstances there may be a constructional problem which is not yet known about. Record the problem in an Express Service Report and send it on by the usual method.		

**Seals**

In general, seals are very important when eliminating wind noises. Special attention should always be paid here to the possible causes of wind noises.



Take the following points into account:

- Seals age, i.e. they become porous and with time they lose their original elasticity. If the vehicle is relatively old and there are already visible signs of distortion or damage to a seal, then it should be replaced.
- At high speeds the doors or hatches may lift slightly from the seal surfaces because of variations in air pressure. Wind noises are caused when the preload on the sealing surface is not sufficient. The preload depends on the installation position of the components, the elasticity of the seal and the location of the sealing flange.
- The contact surface of the seal must be sufficient. This can be checked using the chalk test. If the specified width of the contact surface is not known, you must determine it on another component of identical construction.
- A bulging seal carrier indicates that the sheet metal of the retaining flange is uneven.

**Possible concerns with corrective measures**

**NOTE:** Instructions on general noise are summarized separately in the Noise, Vibration and Harshness section. These can be useful when searching for the causes of wind noises.

There follows an outline of the possible concerns relating to wind noises. Selected examples are given showing the causes of wind noises and the ways in which they can be eliminated. They are intended to provide troubleshooting tips and suggestions for the user but do not represent an exhaustive faults list. The topics are subdivided by the different groups of components.

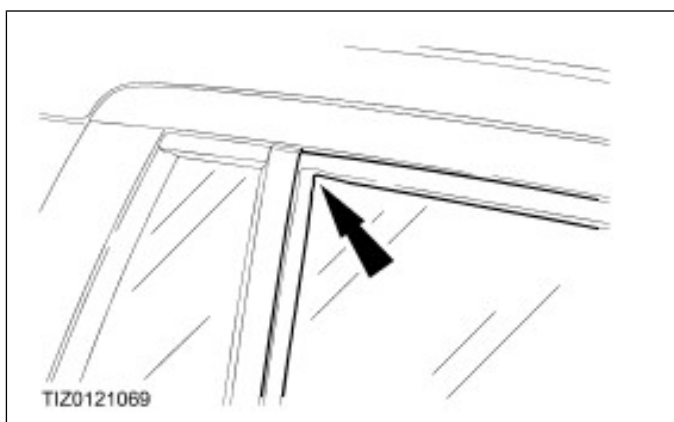
The test procedures described in the Noise, Vibration and Harshness section can be used when troubleshooting.

## DESCRIPTION AND OPERATION

- Seals must be correctly installed. Special attention must be paid at corners **-arrow-** that the installation follows the contours.
- The seal must not show any kinks or folds or any other damage.
- Seals must seal all around their circumference. Gaps in seals result in openings which lead to an increased incidence of noise. In this respect, it is especially important to pay attention to the seals in the area of the windows.

## Remedial Action

Renew older seals which no longer have adequate preload. Deformed or widened retaining flanges must be reworked and provided with a new seal.

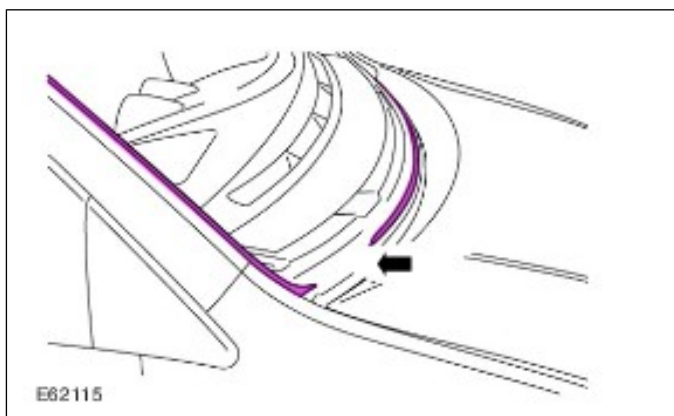


The corner areas **-arrow-** of a seal must be properly seated. In some circumstances, a butyl sealing strip must be affixed to support the sealing at a corner.

## Bonded joints

Glass is usually installed today using a bonded joint. Gaps in the bonded joint can lead to noises in the vehicle interior. If there are noises which are believed to be associated with window glass, the following points should be checked:

Gap in window bonding



- The window must be bonded without any gaps **-arrow-**. Leaks can be found using the ultrasonic tester or compressed air carefully blown from inside onto the window glass bonding.
- The installed position of the window glass must be correct. It must not have been bonded into a position which is too low or offset to one side.
- The sealing or trim strips must fit tightly and the glass must be mounted so that it is fully enclosed. If a sealing or trim strip has not been applied with enough pressure, high air speeds can cause it to lift up. This can lead to wind noises at higher speeds. Apply masking tape to these areas for test purposes.

## Corrective measures

Leaking areas of the window glass bonding material can be sealed using PU sealing compound. Pay special attention at the front windshield, that any breaks in the bonding are not too large. Otherwise the glass must be removed and bonded in place again.

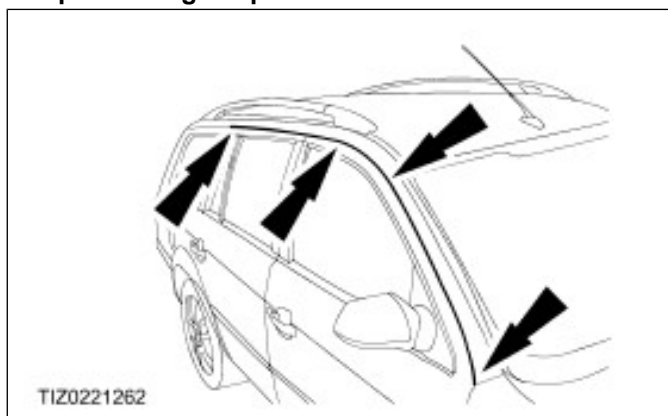
The installed location of a window glass cannot be corrected. It must be removed and bonded into place again.

Replace the trim strips or secure the lip seal using PU adhesive.

## Gaps, edges

Door gaps and edges are places where air turbulence can form. This causes noises which can be perceived as troublesome.

## Gaps and edges - problem areas



Doors, hood and tailgate can cause wind noises because of gaps **-arrow-** which are too large. If the components are not installed flush to the bodywork or the neighboring component, air break edges can arise, which in turn can create a wind noise.



**DESCRIPTION AND OPERATION**

The sun roof may be the cause of whistling noises in the roof area. The sun roof may be incorrectly adjusted or the seal on the sun roof may be damaged.

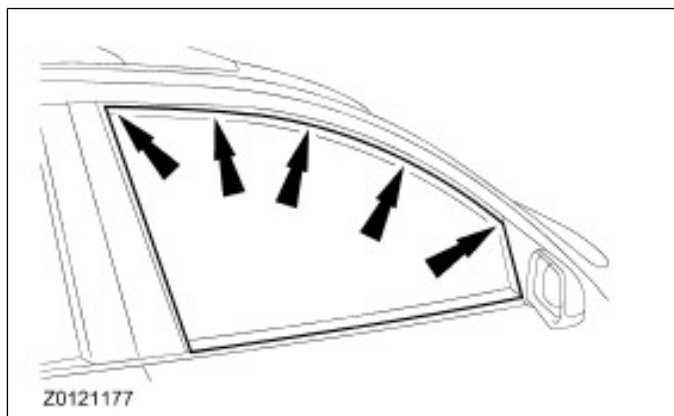
Noises from the door area could come from a window which does not fully close. Side guides (seals) can also be the cause of wind noises.

The covers of window frames can be incorrectly mounted or aligned. The quarter-lights in doors must also be be checked for correct installation.

**Corrective measures**

Check the gaps and adjust them according to the specifications. If there are problems at the sun roof, correct the adjustment and if necessary replace the seals.

Problem area at side windows



Side windows which do not fully shut **-arrows-** must be adjusted. If the vehicle is equipped with electric window regulators, the remedy may be to perform the window regulator learning process again. In all cases, make certain that the glass enters far enough into the seal.

**Ancillary Components**

Components installed on the bodywork may cause noises when they are not correctly mounted.

When troubleshooting it may be helpful to remove the suspected component or, when this is not possible, to mask it off with suitable covering tape.

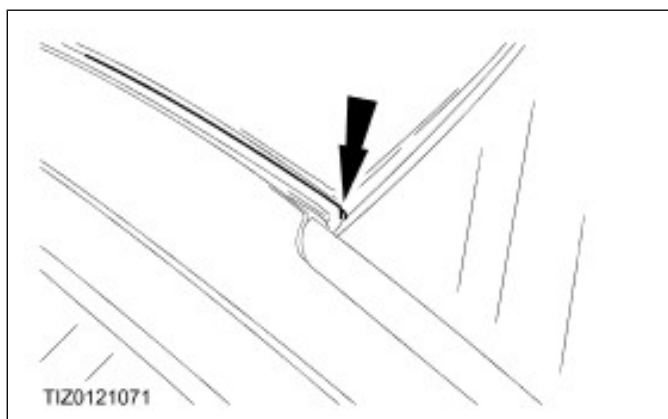
**Roof moldings, roof rail, roof antennas**

Moldings and roof moldings must touch the bodywork along their whole length without any gap. Check the end sections in particular. These must neither have any splits nor stand away from the bodywork.

Noises may come from the roof rail if the seal between it and the roof is not correctly installed or is cracked. Gaps at the mounting grooves of the carrier can also create wind noises.

The roof antenna and antenna foot seal must be correctly secured. The seal must lie completely on the roof and must not be damaged.

Roof moldings mounting



If the original mounting points of the roof moldings are in good condition, the fixing can be improved using silicone sealant **-arrow-** if necessary. Align or renew the seals of the roof rail. Reduce the clearances of the mounting grooves.

**Corrective measures**

If the original mounting points of the roof moldings are in good condition, the fixing can be improved if necessary using silicone sealant **-arrow-**.

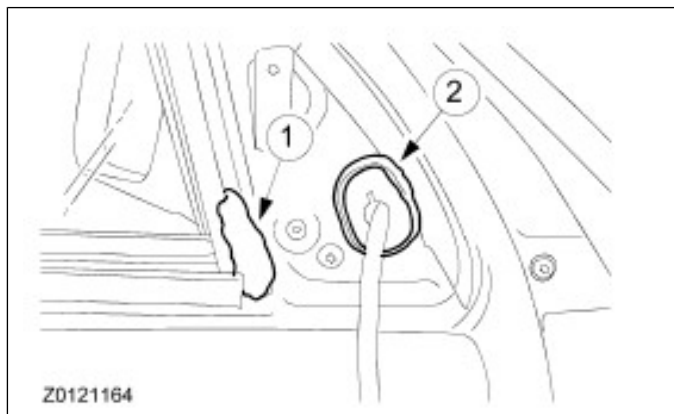
**Exterior mirrors**

Exterior mirrors or covers of exterior mirrors which are not correctly mounted cause noises. The cover must lie evenly on the component and must not lift during driving. There are ducts present on the doors for the electrical or mechanical adjusters for the exterior mirrors. If there are leaks, wind noises will be caused. Holes can also be present at the transition to other components.

Exterior mirror seals



## DESCRIPTION AND OPERATION



There are ducts present on the doors for the electrical or mechanical adjusters for the exterior mirrors. If there are leaks, wind noises will be caused. Holes can also be present at the transition to other components.

**Remedial Action**

If there is inadequate sealing of the foam seals **-2-** they must be replaced or supplemented with suitable material. Transitions to other components can be sealed with butyl sealing compound **-1-**.

**Moldings, covers, door handles, windshield wiper arms**

Moldings and covers especially tend to cause wind noises because of their location. These components interrupt smooth bodywork surfaces and air turbulence therefore arises at the edges. If there are noise concerns in the area of the doors, check especially for gaps and projections. Moldings must not stand away from the bodywork or the door. There must not be any gaps or discontinuities at the location of joints.

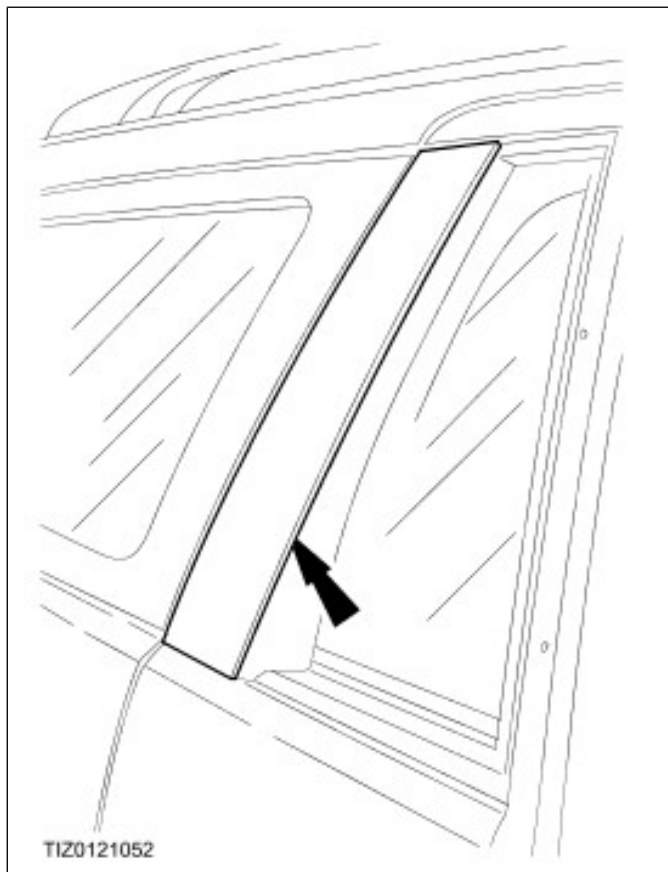
Incorrectly adjusted windshield wiper arms can cause wind noises. Especially if they are too far over the glass surface when in the rest position.

Wind noises in the transition area between the air cowl cover and the wing or the windshield can be caused by an incorrectly installed air cowl cover. At high air speeds the air cowl cover may lift and noises will then occur.

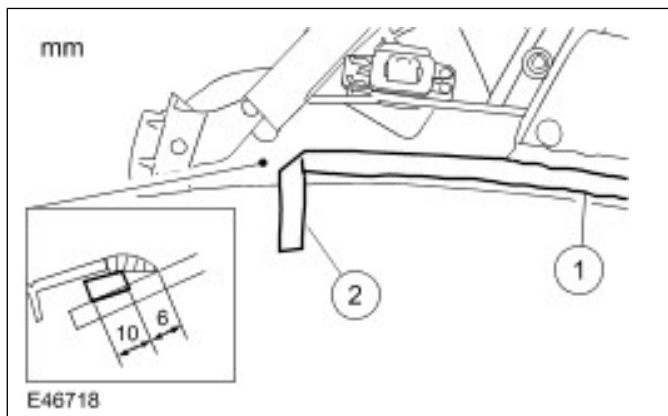
Because of their necessary mechanical features, door handles have a range of openings and edges which allow noise to be generated. The door handle can be masked off for testing purposes. If a reduction in wind noises is noticed, inadequate sealing may be the reason for the noises.

**Remedial Action**

Openings which are used to secure trim panels must be checked for leaks. Any leaks found can be rectified using butyl strips.



Loose or damaged outer trim on the pillars **-arrow-** must be secured or replaced.



A butyl sealing strip **-1-** can be laid underneath the cover in the transition area between the air cowl cover and the wing or windshield.

The sealing of the door handles must be renewed when required. In addition, noise absorbing material can be applied to the back of the door handles.

**DESCRIPTION AND OPERATION**

## Noise, Vibration and Harshness

**Noise**, coming from the vehicle and which can be heard inside and outside the vehicle.

**Vibrations**, oscillations that are felt and noticeable inside the vehicle.

**Harshness**, noises which come from the vehicle and which can be heard, felt and noticed inside and outside the vehicle.

These terms are grouped together under the title Noise, Vibration, Harshness, or NVH for short.

The task of vehicle development and production is to ensure that noises caused by the vehicle do not disturb the driver and passengers. Moreover, the the external noises emitted by the vehicle must not exceed the thresholds set by law.

**NOTE:** Basic and advanced training courses are offered for the following contents. For an overview of all courses offered, please refer to the Ford Service Organisation's training course brochure.

### Noise types and causes

Noises in and around the vehicle are assigned specific descriptions:

- Humming and droning are perceived as low tones.
- Buzzing and whirring are middle tones.
- Howling, whistling, squeaking are assigned to the high tones.

Low to middle tones are considered to be unpleasant. They are palpable and noticeable as oscillations and vibrations throughout the body. Loud howling and whistling is painful to the ears.

A noise usually consists of a superimposition of different tones which spread as oscillations.

Each of these oscillations has a specific oscillating time and can be measured in frequencies. The frequency describes the number of oscillations per second. The frequency unit is specified in Hertz (Hz).

The human ear can perceive frequencies between 20 and 20000 Hz.

### Where the different notes come from in a vehicle:

- Low notes are mostly produced by the engine.
- Low tones can also be produced by the roadbed, particularly on rough surfaces. This is a form of droning which can be felt by the vehicle occupants as vibration or roughness.

- High tones however, which are experienced as howling or whistling noises, are often air currents (wind noises) or come from ancillary components such as the generator, power steering pump or drivebelt.
- There are also clattering noises which can occur when driving over an uneven road. These jerking noises are produced by, for example, the shock absorbers, chassis components or loose articles inside the vehicle.

Noises can already be contained where they occur or, if this is not possible, can be confined with suitable measures.

The basic procedures here are the damping of oscillating parts, the insulation of components or the absorption of the noises through appropriate materials.

### Damping

If a damper is installed next to an oscillating mass, the characteristic of the damper will reduce the movement of this mass accordingly (e.g. bumper on chassis).

Damping affects the resonance of an object or system.

### Isolation

In oscillation technology, the term isolation means decoupling (separation) of components and systems. An engine is mounted in sprung elements, so that as little oscillation as possible is passed to the vehicle.

In automotive technology, the isolation technique used is nearly always rubber mounting. Rubber has a large internal damping capacity. The elasticity of the rubber acts like a spring.

### Absorption

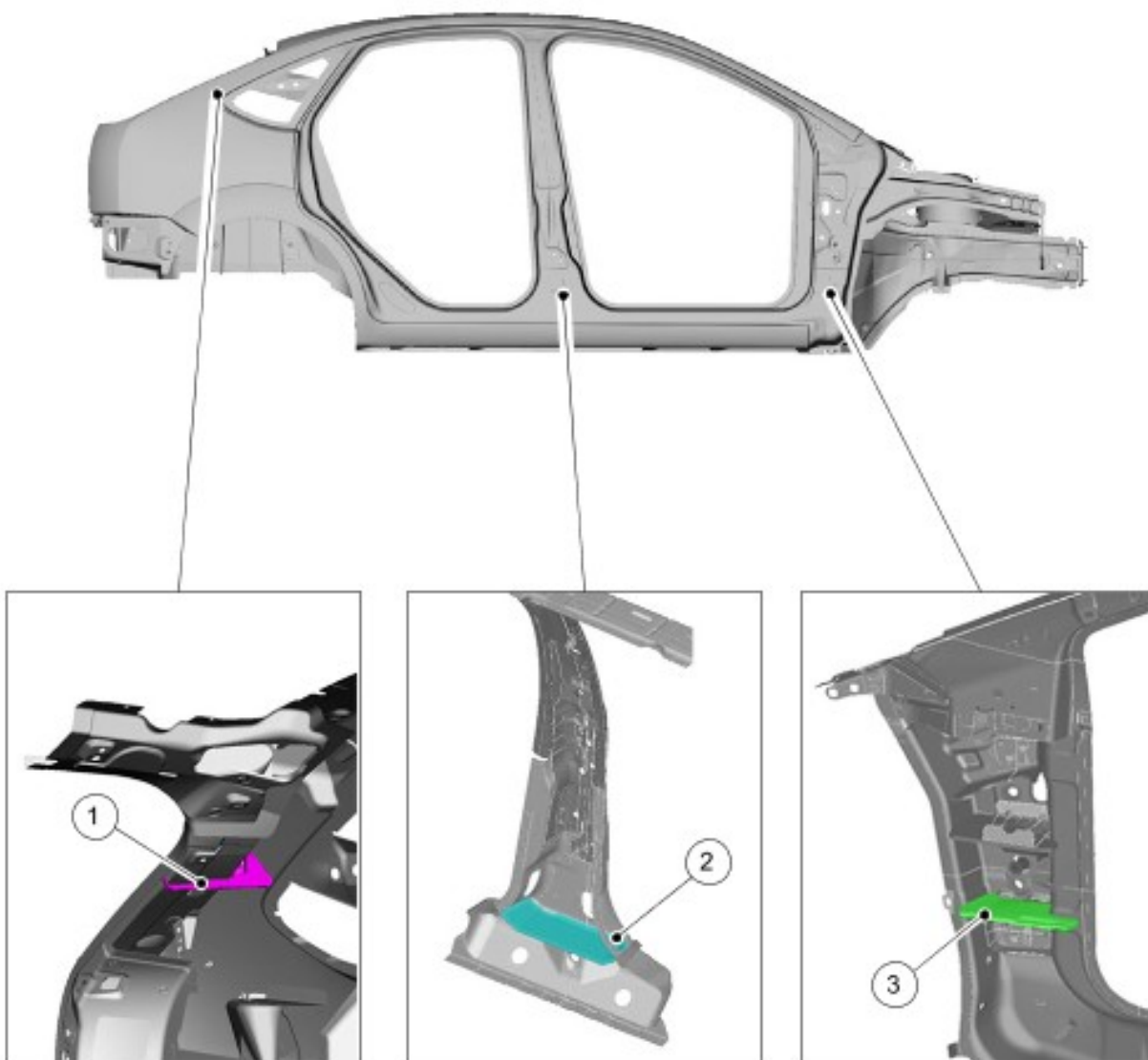
Sound waves are reflected from hard surfaces. Through the use of absorption material, sound waves hit soft surfaces and are absorbed by them.

The composition and thickness of the material used plays an important role here. A soft surface, depending on its composition, absorbs the sound waves and reduces their energy.

### NVH elements

NVH elements are installed to prevent airborne sound transfers to the passenger compartment in different body cavities.

DESCRIPTION AND OPERATION



E54912

Item	Description
1	C-pillar area
2	B-pillar area
3	A-pillar area

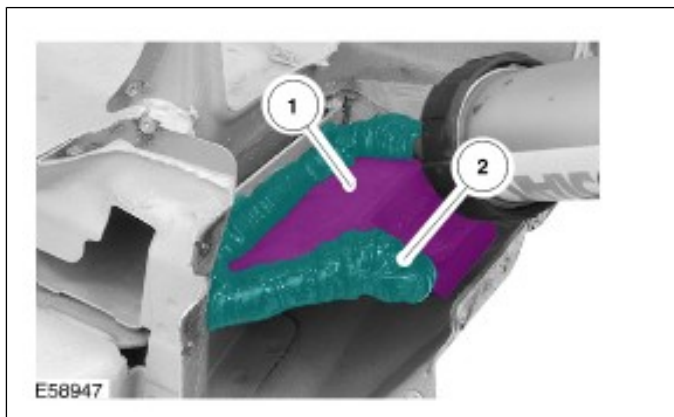
On the Focus 2004.75 (07/2004-) these elements are located in the cavities of the A, B and C pillars. On the estate version, they are also located in the D pillars.

The NVH material consists of a carrier plate which has compressed isolation material at the edges. In the drying system of the painting equipment used in production, the body is heated to approx. 170°

C. At this temperature the isolation material expands to seal the gap between the carrier plate and the bodywork.

**NOTE:** NVH elements must not be damaged during work on the vehicle body. NVH elements deformed through impact must always be replaced. PU adhesive must always be applied to the edges of new and reused NVH elements during repair work.

**DESCRIPTION AND OPERATION**



Item	Description
1	NVH element
2	PU adhesive

For the exact installation position of an NVH element, please refer to the vehicle-specific repair instructions.

If an NVH element is to be reused, the bonding on the body panel must be detached. To do this, the body panel must be heated in the area around the NVH element. The bonding can be detached at approx. 170° C. The damaged panel part can now be carefully dismantled.

Before installing the new panel part, a PU adhesive must be applied to the contact areas between the panel and the NVH element.

**Test techniques, measuring devices**

The shortest route to an accurate diagnosis results from:

- general information on the problem vehicle and a comparison test with a vehicle of the same construction, without NVH problems.
- vehicle history, including repair history and usage patterns.
- condition history, especially any relationship to repairs or sudden change.
- knowledge of probable causes.
- application of diagnosis procedures in which the vehicle is split into corresponding areas.

The diagnosis and correction of noise, vibration and harshness concerns requires:

- general information on the problem vehicle and a comparison test with a vehicle of the same construction, without NVH problems.
- vehicle history, including repair history and usage patterns.

- condition history, especially any relationship to repairs or sudden change.
- knowledge of probable causes.
- application of diagnosis procedures in which the vehicle is split into corresponding areas.

**NOTE:** The diagnosis of droning problems is one of the most difficult tasks in the NVH area. With the exception of installed components under stress, a certain diagnosis of droning problems (or boom) on customer vehicles makes great demands on the automotive technician. The performance of measuring equipment and their practice-orientated application can only be obtained through suitable instruction (NVH training). The successful use of these devices requires a great deal of experience on the part of the user.

The diagnosis and correction of noise, vibration and harshness concerns requires:

- a road or system test to determine the exact nature of the concern.

Analysis of possible causes:

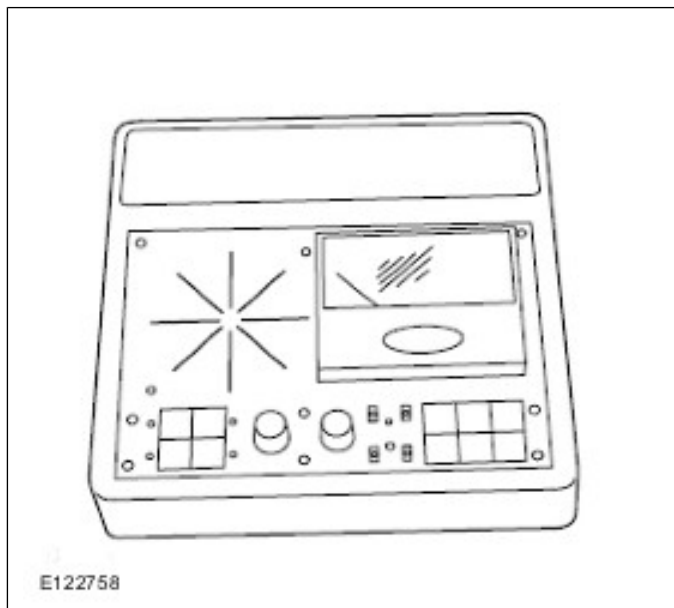
- checking of the cause and elimination of the faults found.
- a road test or system test to make sure the concern has been corrected or brought back to within an acceptable range.
- It is often very difficult to locate noises that are audible in the passenger compartment based on the problem description provided by the customer and the road tests performed. The direction of the noise can be detected subjectively, but the source of the noise cannot be found.

**NOTE:** For a selection of simple test tools, see the wind noises section.

**Electronic NVH tester**



## DESCRIPTION AND OPERATION



**NOTE:** Before using the NVH tester in the service, the service technician should take part in an NVH training course to ensure effective use of this device during the road test. A description of the function and application of the NVH tester is enclosed with the device.

The measuring device described below is used for diagnosis of the solid-borne sound and solid-borne sound transmission paths. The device is particularly suitable for medium and high frequency noise analyses. It principally enables noise diagnosis in the area of solid-borne sound and helps to identify solid-borne sound transmission routes.

In order to obtain a positive diagnosis of droning problems (low frequency noises) and their sources, you must have sufficient experience of how to use this measuring device.

The device works according to the following operating principle: Accelerometers (transmitters) are fitted on various vehicle components or body areas. The signals recorded here can be listened to one after the other on headphones or speakers via the different channels. Simultaneous illustration of several or all measuring channels (for comparison) is only possible visually on the display of the measuring device.

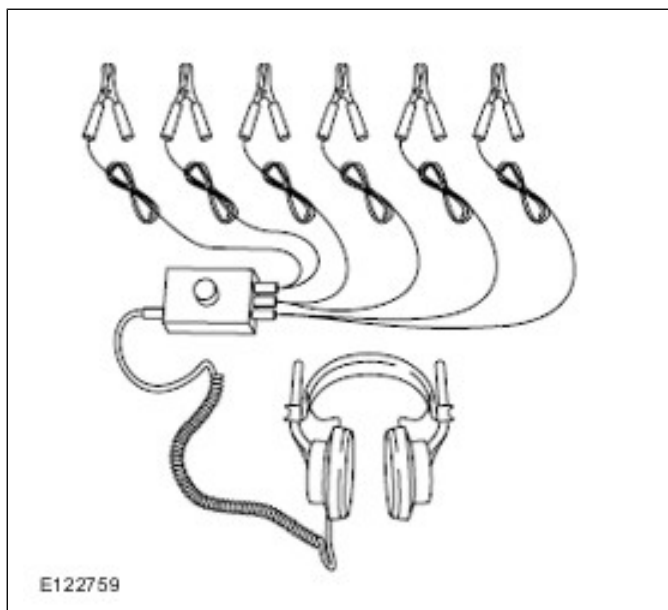
Layout and operation:

- The test device has six different channels for noise diagnosis.
- Each channel is marked in color on the terminal, cable and test device.
- The solid-borne sound recorded is transmitted to the test device or the headphones by the magnetic accelerometers (transmitters).

- There is an amplifier on the test device with which the signal strength and the corresponding channel can be set.
- Only the noises from a transmitter are transferred to the headphones.
- All connected cables can be visually illustrated individually or simultaneously on the display.
- The test device saves the recorded data.
- The recorded data can be imported to a PC and evaluated.

The NVH tester is equipped in addition with mobile magnetic sensors which are particularly suitable for the following noise tests:

- Internal noises at the dashboard
- Engine noise
- Electrical noises (sparking/voltage transmissions)
- Wind noises
- Vacuum - leaks

**Chassis noise tester (chassis ear)**

Used to diagnose solid-borne sound and its transmission routes. The device is particularly suitable for medium and high frequency noise analysis and principally enables noise diagnosis in the area of solid-borne sound and helps to identify solid-borne sound transmission routes.

In order to obtain a positive diagnosis of droning problems (low frequency noises) and their sources, you must have sufficient experience of how to use this measuring device.

Layout and operation:

**DESCRIPTION AND OPERATION**

The test device has six different channels for noise diagnosis. This means that six microphones equipped with clamps can be attached to different components on the vehicle. The emitted or transmitted solid-borne sound will be transferred from microphone to the headphones. There is an amplifier between the microphone and the headphones at which the signal strengths and the corresponding channel can be set.

Only the noises from one microphone are transferred to the headphones. Each channel is color-coded on the clamp, cable and amplifier.

**NOTE:** In order to be able to relate the positions of the different microphones during the test process, they are entered in a special test sheet according to their colors. Microphones, clamps and cables must be carefully routed and attached.

**Test process (example for transmission noise):**

- Attach microphones to various positions on the transmission or mountings. This first allows the source of the noise to be determined, and then the possible transfer routes.
- A road test can be performed after all the clamps have been attached to the vehicle and all the cables connected to the amplifier.
- Firstly, all the channels are switched through one after the other in neutral, to check the operation of the different channels as well as the noise level in neutral.
- During the road test, all channels are listened to in the different gears, engine speeds, vehicle speeds and loads. This procedural method permits unambiguous diagnosis of the cause of the noise and the route of the noise until it enters the bodywork structure.
- The characteristics of the noise which is the cause of the concern should match those of the noise which is heard. This means compare the sound.
- Depending on the input signal level, there may be a great deal of difference in the noise level in the individual channels.
- Always set the amplifier volume to zero before switching to another channel.
- In order to be able to make any comparisons, the volume settings of the different channels must be recorded on the test sheet.



## SECTION 501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks

VEHICLE APPLICATION: **2008.50 Kuga**

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MIG brazed joints.....	501-26-12
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<b>GENERAL PROCEDURES</b>	
Underbody Tolerance Check.....	501-26-18
Frame Tolerance Check.....	501-26-20

## DESCRIPTION AND OPERATION

## Body and Frame – Component Location

Body variants: Steel roof - panorama roof



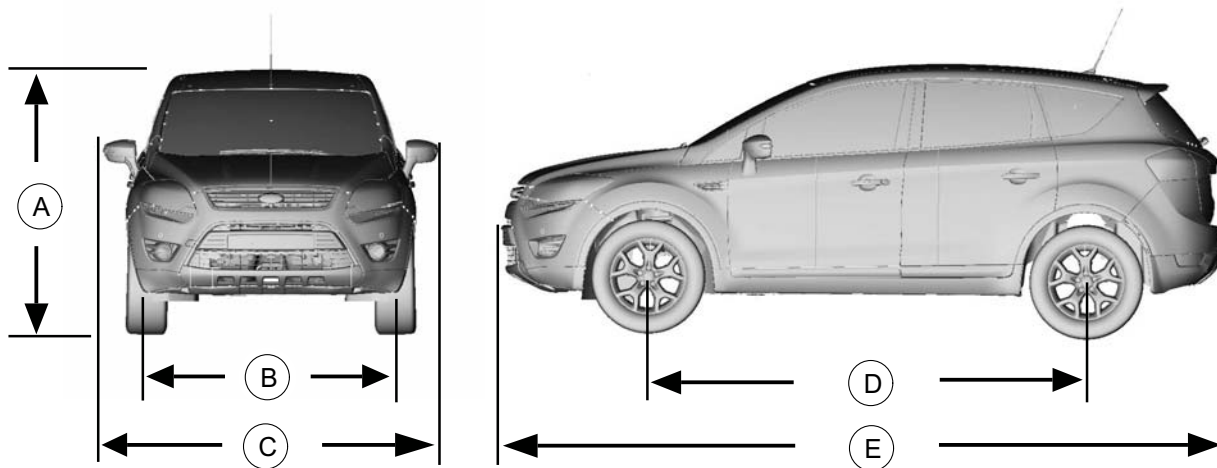
E118104

DESCRIPTION AND OPERATION



E118107

Dimension



E100572

Item	Description
A	Height (without roof rail) 1655 - 1677 mm
A	Height (with roof rail) 1687 - 1710 mm
B	Track width, front: 1574 - 1580 mm

Item	Description
B	Track width, rear: 1584 - 1590 mm
C	Overall width: 2128 mm
Drive	Wheel base: 2690 mm
E	Overall length: 4443 mm

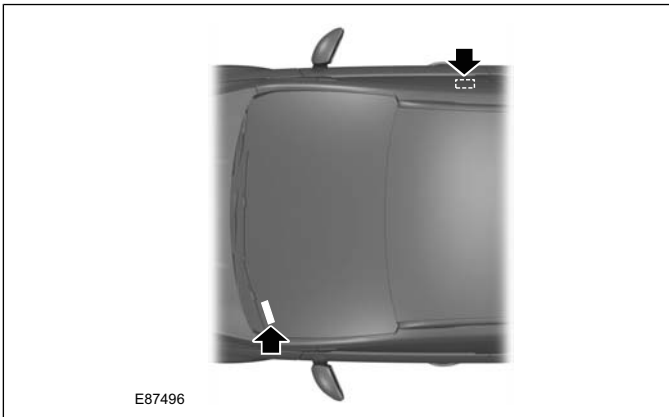
Body Repairs - Vehicle Specific Information  
and Tolerance Checks

501-26-4

501-26-4

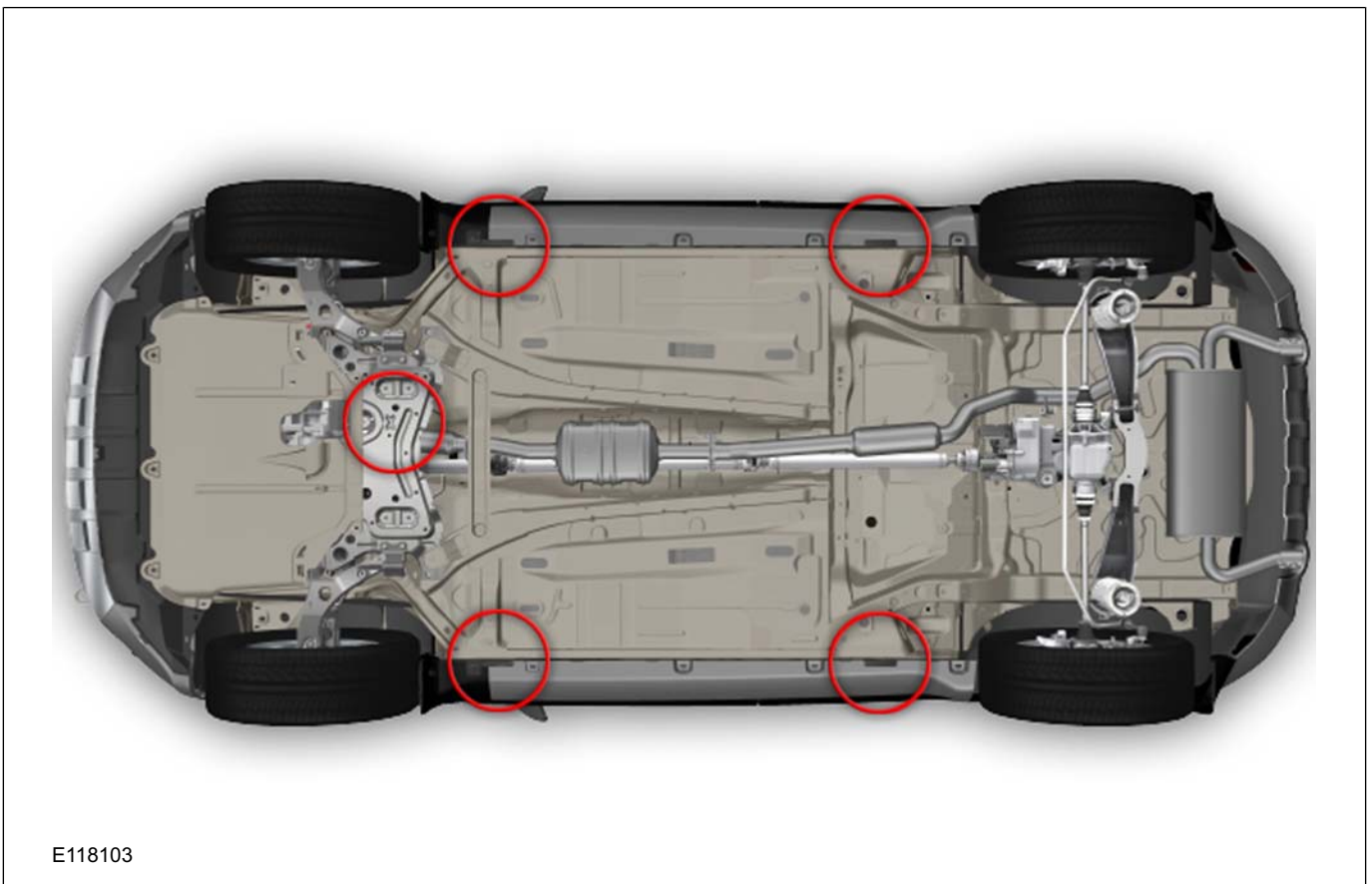
DESCRIPTION AND OPERATION

Location of the VIN plate



E87496

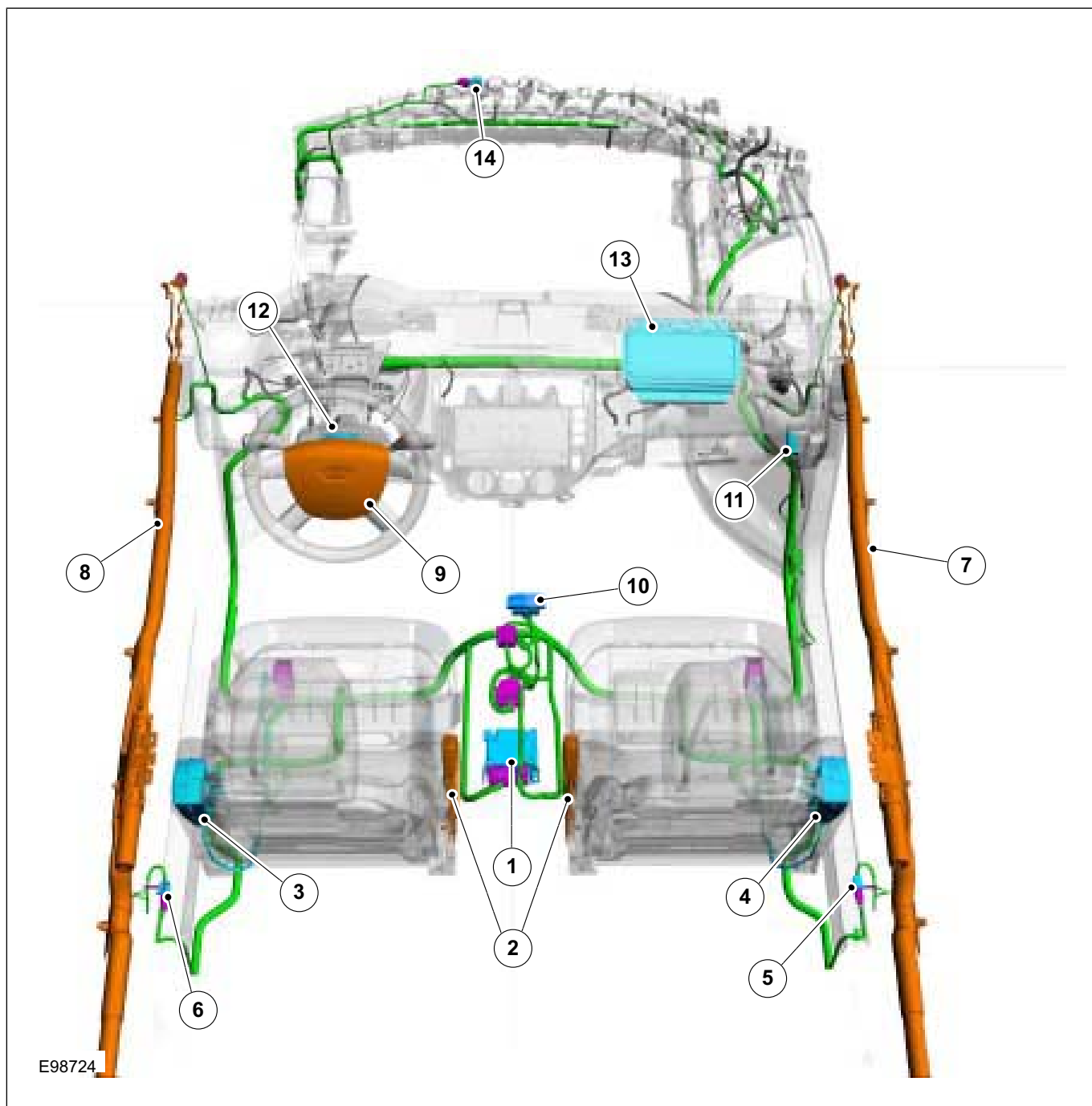
Lifting Points



E118103

DESCRIPTION AND OPERATION

Supplemental Restraint System (SRS) Operation



E98724

Item	Description
1	RCM module (supplemental restraint control module)
2	Pyrotechnic belt pretensioner
3	Driver side air bag module.
4	Passenger side air bag module.
5	Crash sensor – right-hand
6	Crash sensor – left-hand

Item	Description
7	Right-hand side air curtain <b>Comments:</b> Optional
8	Left-hand side air curtain <b>Comments:</b> Optional
9	Driver Air bag
10	Passenger air bag deactivation switch indicator

**Body Repairs - Vehicle Specific Information  
and Tolerance Checks**

501-26-6

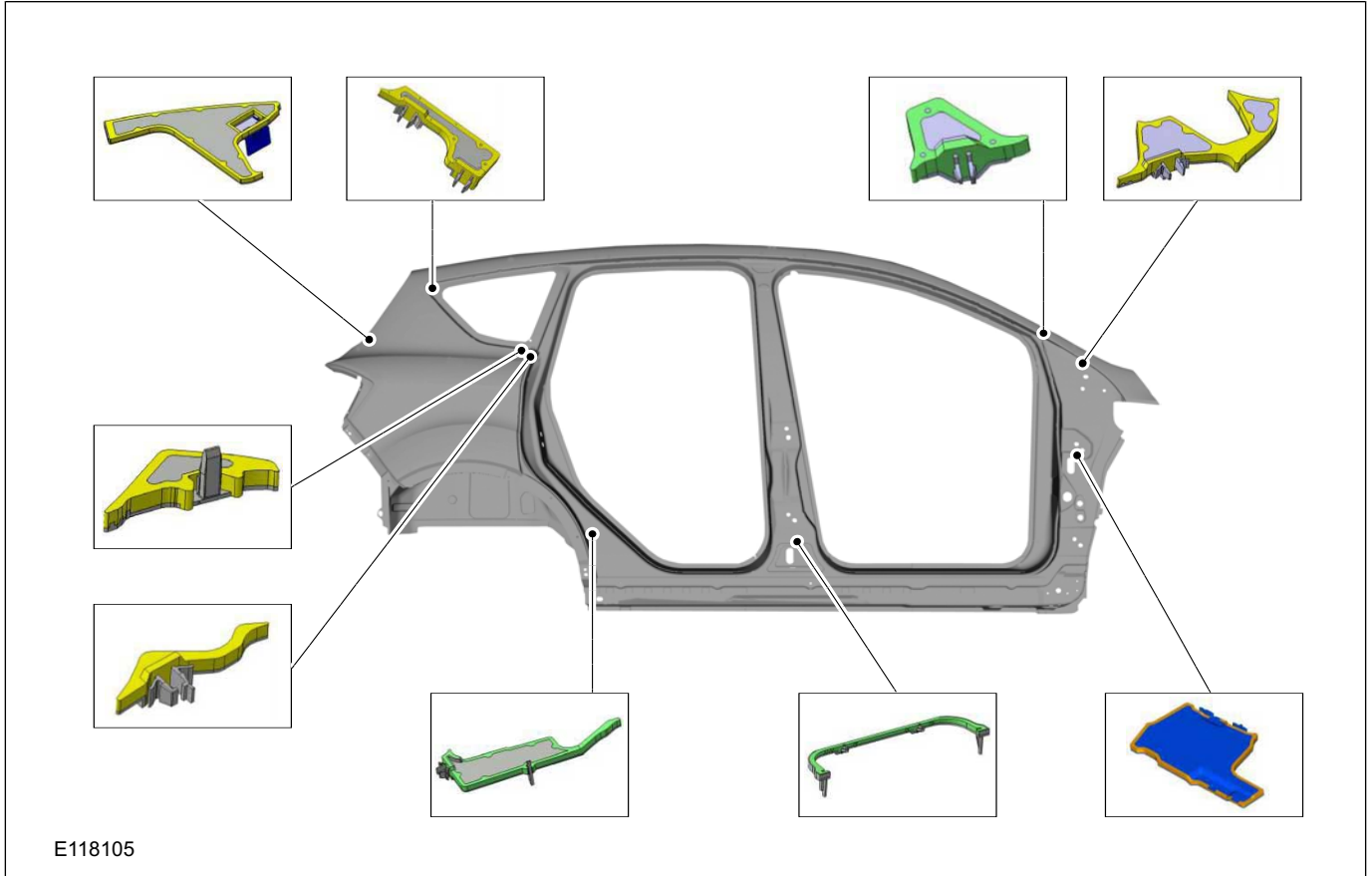
501-26-6

**DESCRIPTION AND OPERATION**

Item	Description
11	Passenger air bag module deactivation (PAD) switch
12	Rotary coupler

Item	Description
13	Front passenger airbag
14	Front Crash Sensor

**NVH expandables**



E118105



## DESCRIPTION AND OPERATION

## Body and Frame – Overview

## Introduction

The new Kuga was developed on the basis of the platform of the C-MAX. The innovative design of the Kuga offers a high vehicle ride height as well as an elevated seat position. Like many of the new Ford models already, the new crossover concept is characterised by the extremely dynamic styling of the Ford kinetic design.

The Kuga is supplied with five seats.

A panoramic roof over the first and second seat row is available as an option. The panoramic roof consists of laminated glass, which is vapour-coated with a heat-reflecting "Solar Reflect" coating.

Some systems already used on the C-MAX 2007.5 are also used on the new Kuga. In addition, a number of new systems and functions are available for the new Kuga. Components have also been carried over from the S-MAX/Galaxy and the new Mondeo.

A significant modification has been made to the powertrain. The Kuga is optionally available with all-wheel drive. This is realised by means of a Haldex clutch.

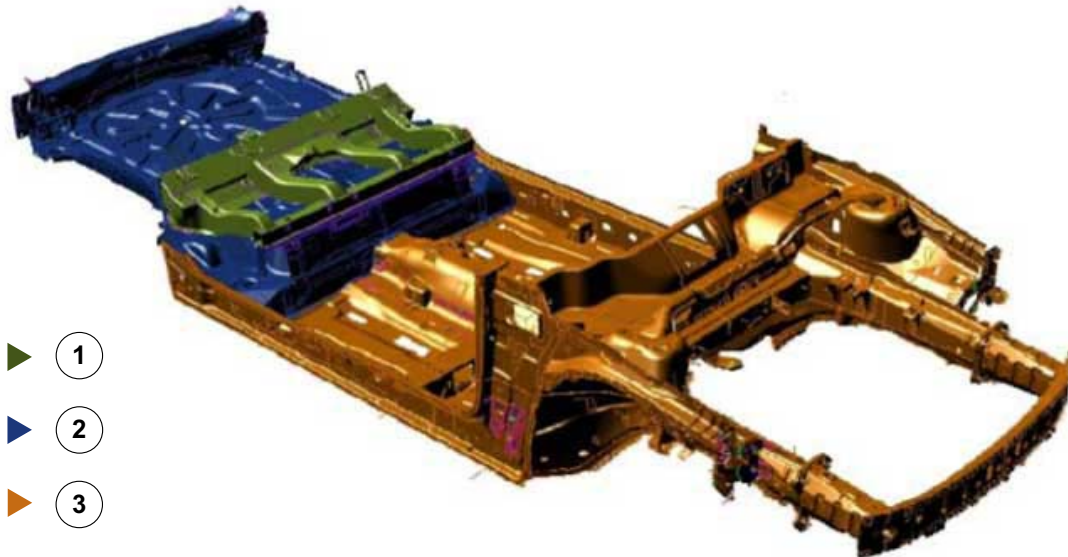
A reversing camera is available in combination with the navigation systems. The high-end hands-free phone kit with Bluetooth® and voice control features a USB jack with iPod® control function.



E118104

## DESCRIPTION AND OPERATION

## Body - floor pan

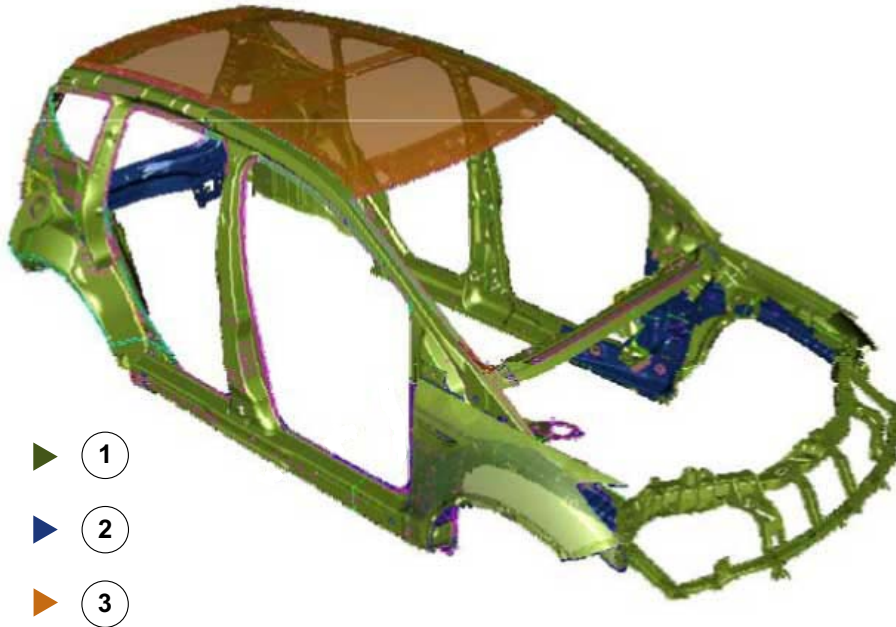


E118139

Item	Description
1	Specific to Kuga
2	Based on Focus ST (C307)
3	Based on C-Max (C214)

## DESCRIPTION AND OPERATION

## Body - passenger compartment

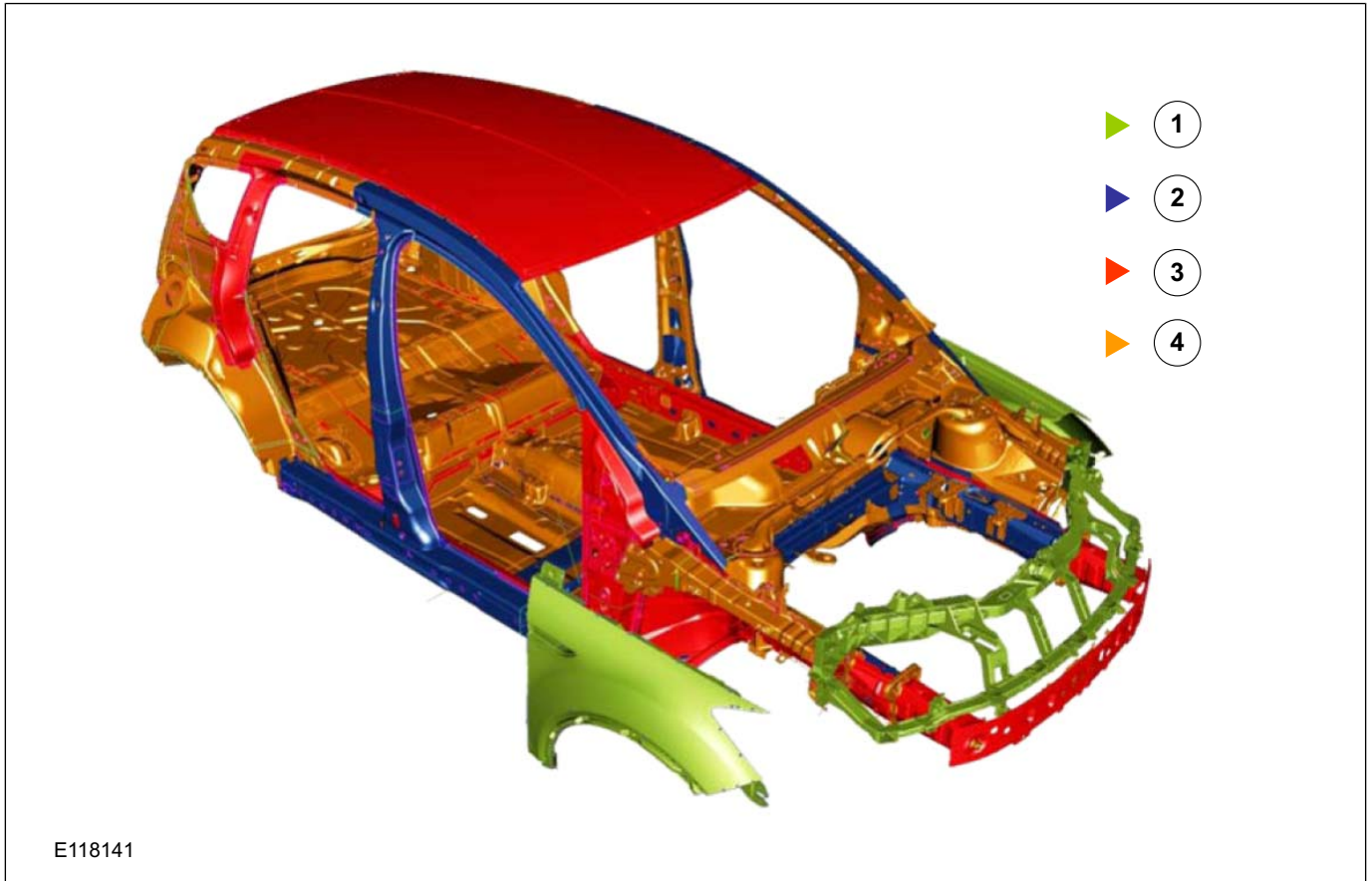


E118140

Item	Description
1	Specific to Kuga
2	Based on Focus (C307)
3	Based on C-Max (C214)

DESCRIPTION AND OPERATION

Body - materials

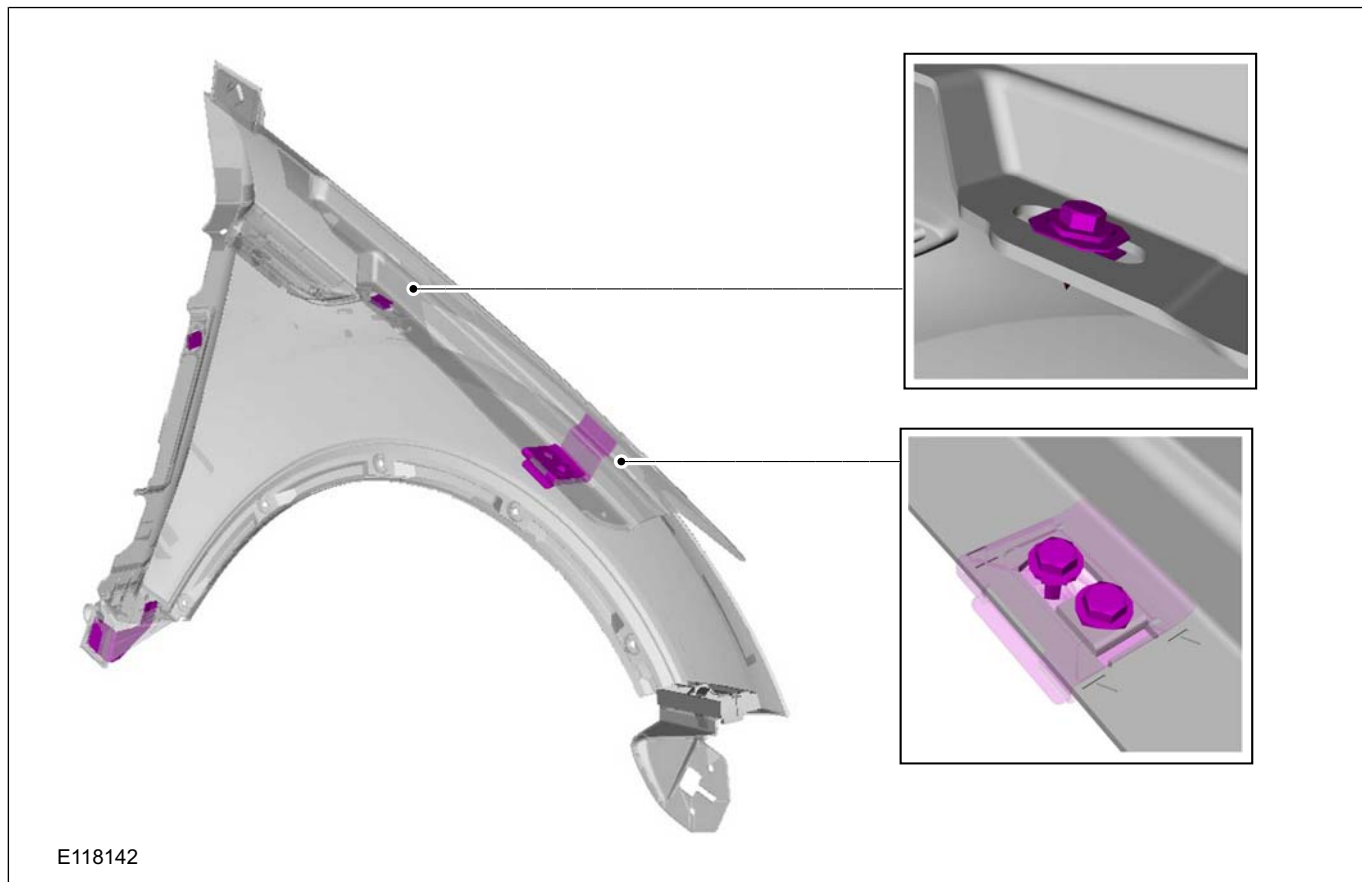


Item	Description
1	Plastic
2	Dual phase steels

Item	Description
3	Microalloyed steels
4	Normal strength steels

## DESCRIPTION AND OPERATION

## Plastic fenders



The front fenders are made from plastic. This offers a weight advantage in comparison with fenders made from metal and allows minor parking "nudges" to be withstood without damage.

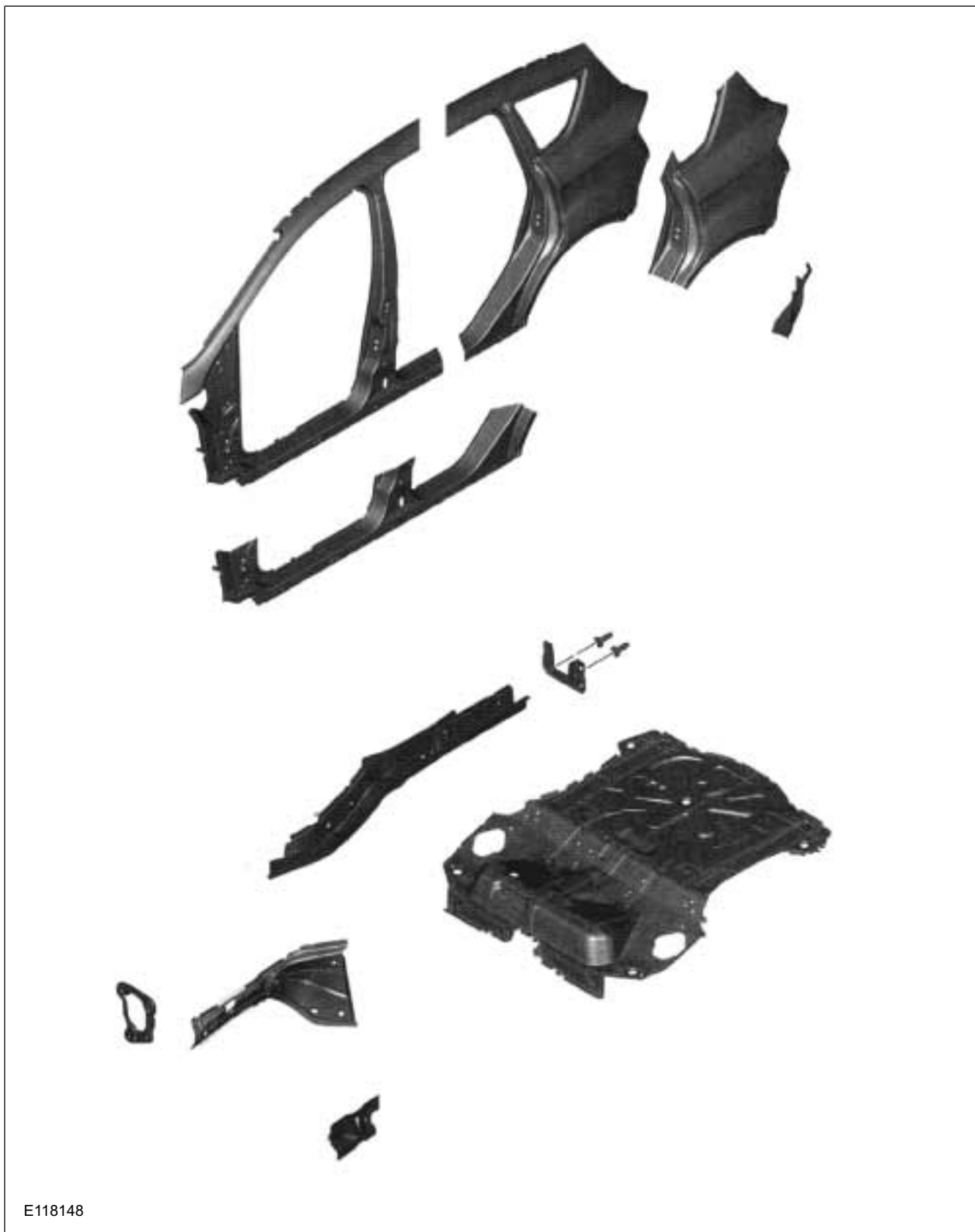
Since plastic moulded parts expand more under the influence of heat than steel, special sliding mounts are used to secure the fenders. If they are permanently fixed in place, the fenders lose their shape. It must therefore be ensured that a flexible

connection is used. Paint jobs are performed as on conventional fenders.

### Sheet metal parts for partial replacement

Various service sheet metal parts are available for sectional replacement.

## DESCRIPTION AND OPERATION



E118148

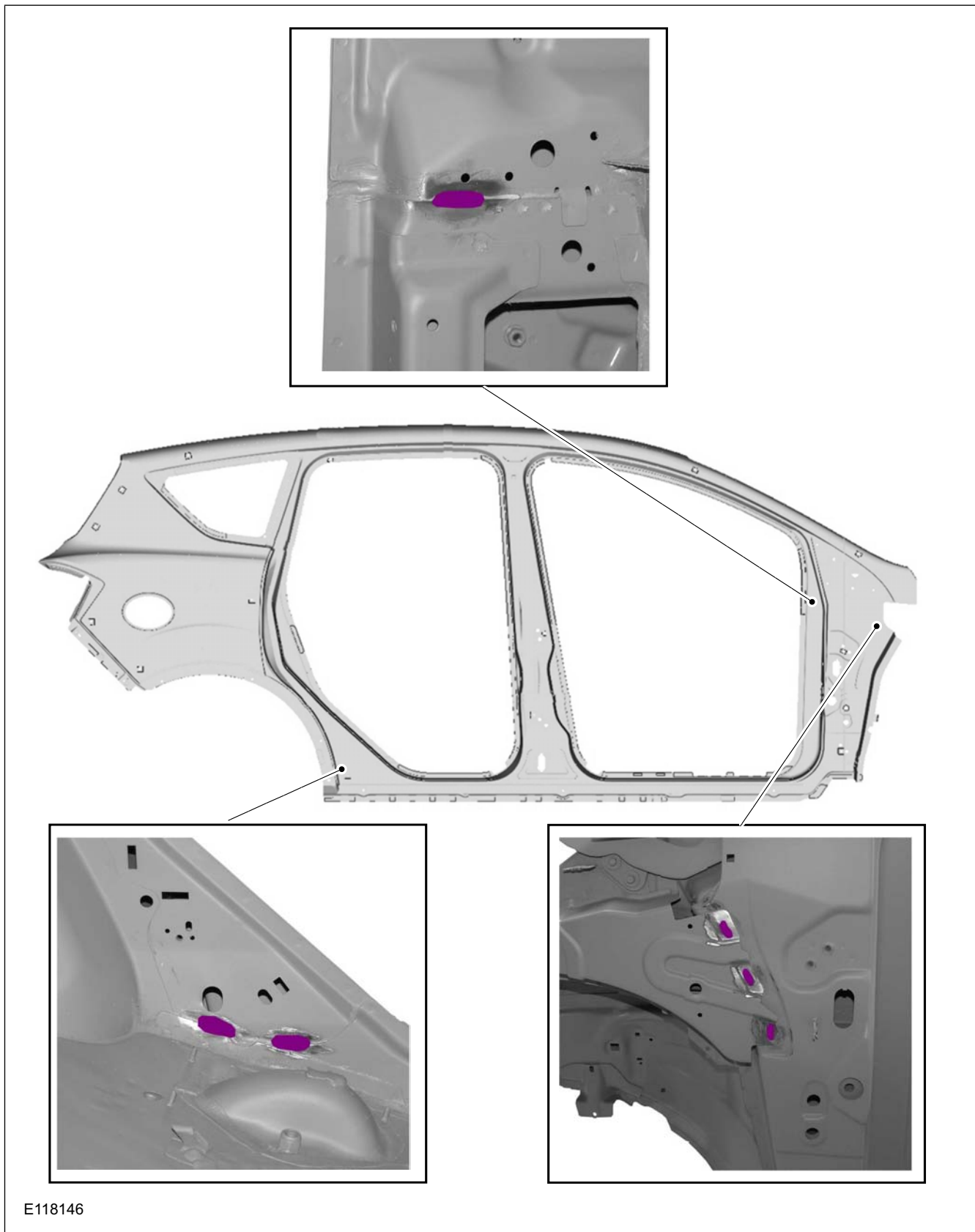
**MIG brazed joints**

MIG brazed joints are used in production in the areas of the bulkhead reinforcement to A-pillar,

A-pillar reinforcement to A-pillar inner panel and outer wheelhouse to door sill reinforcement.



DESCRIPTION AND OPERATION



E118146

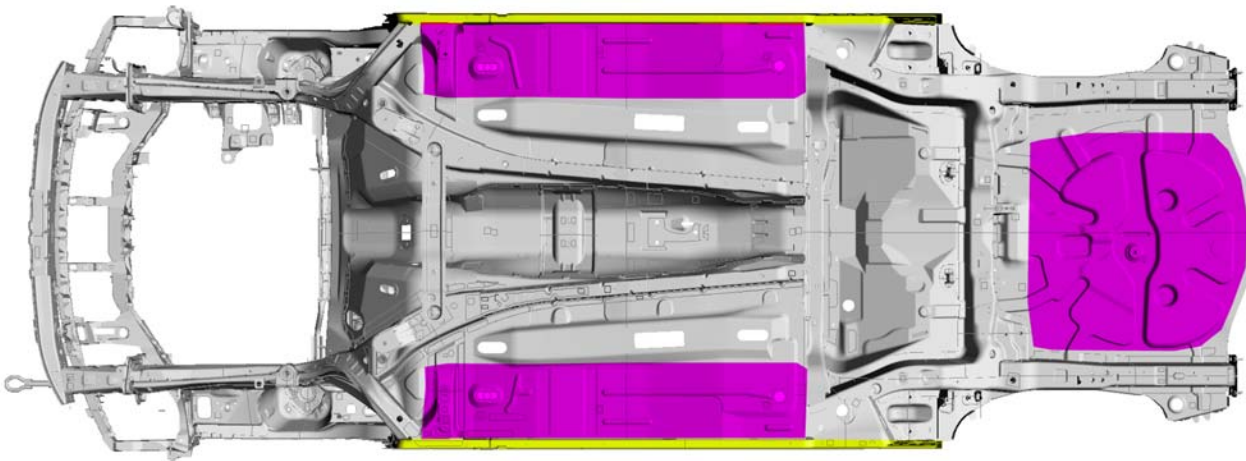
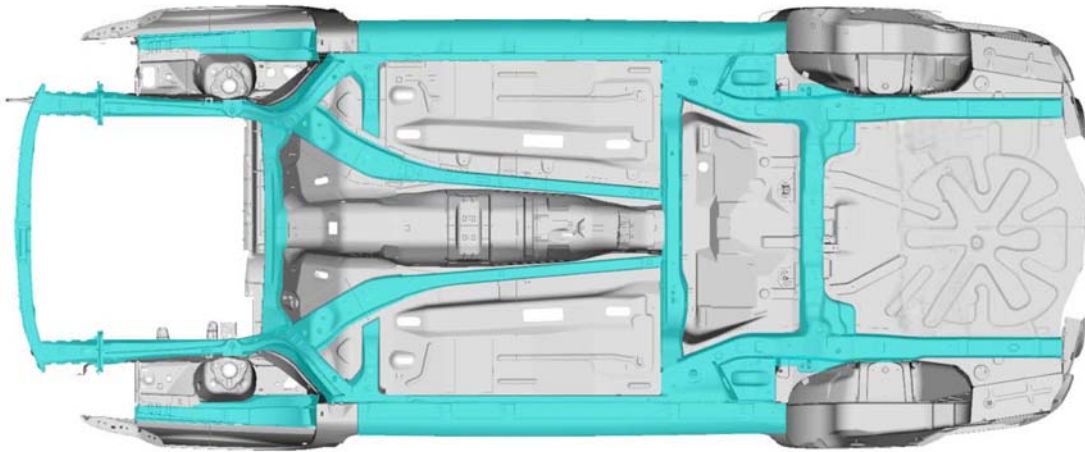
These MIG brazed joints must be replaced by MIG welds at another place if a repair is performed.

**NOTE:** These MIG welds must not be carried out on or near existing MIG brazed seams as even the smallest amount of brazing material can result in a reduction in the strength of the weld seams.

DESCRIPTION AND OPERATION

Anti-corrosion protection

Underbody



- ▶ ①
- ▶ ②
- ▶ ③

E118145

**Body Repairs - Vehicle Specific Information  
and Tolerance Checks**

501-26-15

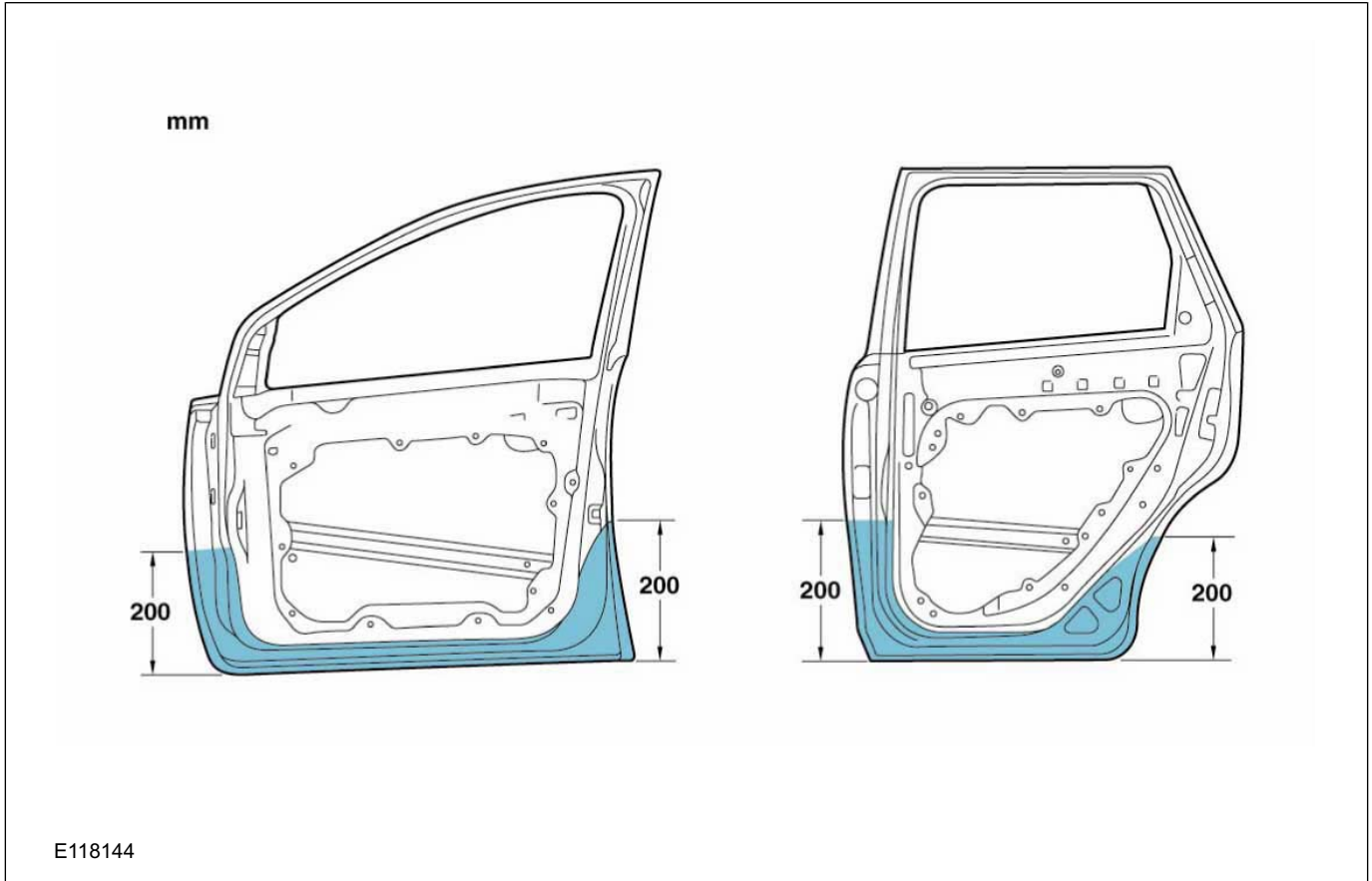
501-26-15

**DESCRIPTION AND OPERATION**

Item	Description
1	Cavity Wax
2	PVC stone chip protection

Item	Description
3	PVC underbody protection

**Door cavity wax protection**



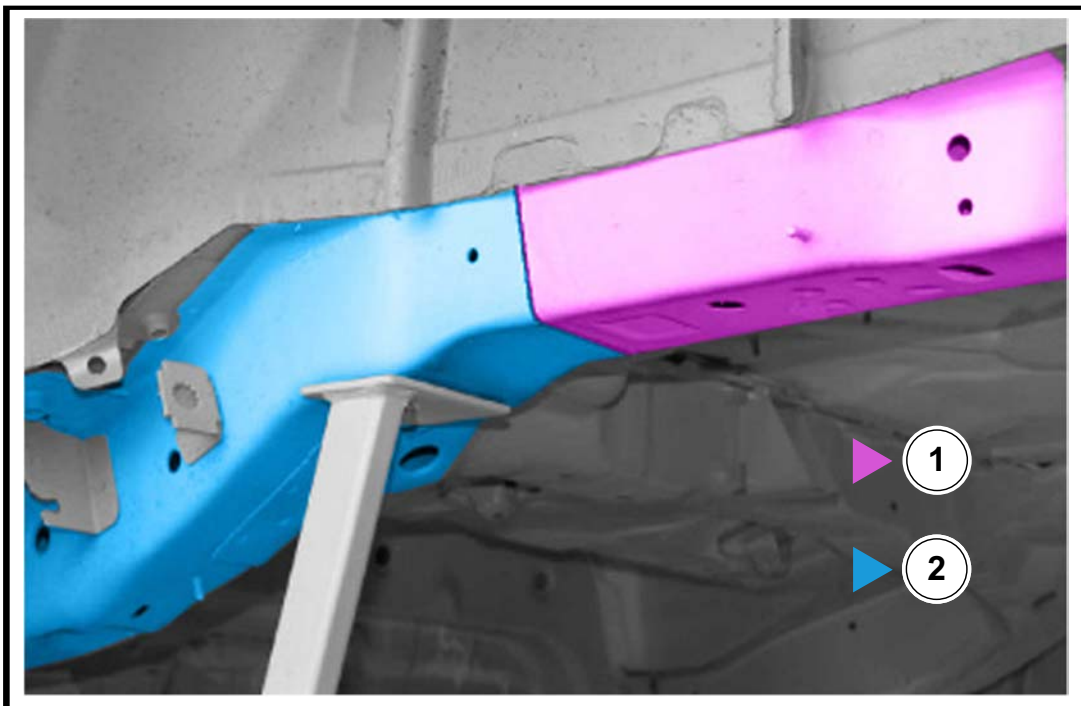
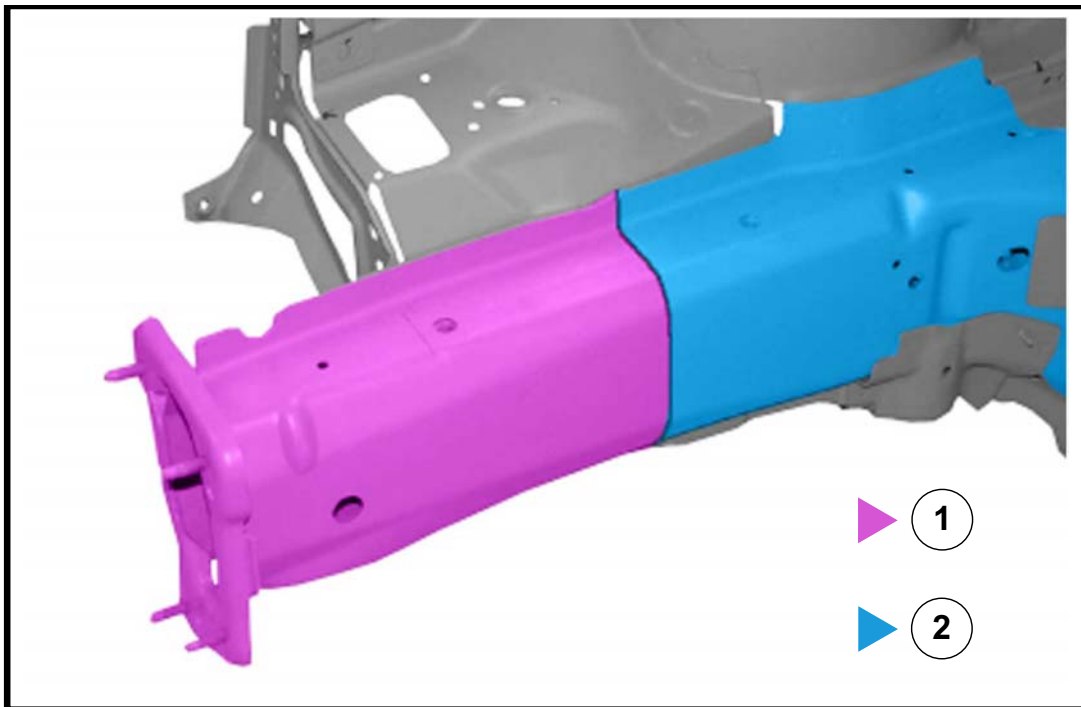
**Tailored blanks**

Body Repairs - Vehicle Specific Information  
and Tolerance Checks

501-26-16

501-26-16

DESCRIPTION AND OPERATION



E118147

Item	Description
1	ZStE 340
2	DP 600

**Body Repairs - Vehicle Specific Information  
and Tolerance Checks** 501-26-17501-26-17 **DESCRIPTION AND OPERATION**

There are laser weld seams on the side members. These laser weld seams are used to join body components of different quality and/or different material thickness (tailored blanks).

Cut locations exactly on the laser weld seams are not permitted, as at present no joining techniques are approved for use in repair procedures that would re-create joins of the same quality.

## GENERAL PROCEDURES

## Underbody Tolerance Check

## 1. Body dimensions (quick measurements using the Allvis system)

- All dimensions are measured from the middle of the hole or bolt head or from the edge of

the panel, using the Allvis system, with component assemblies installed.

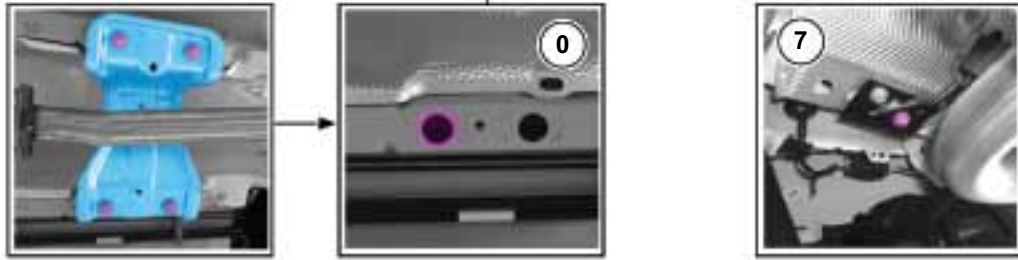
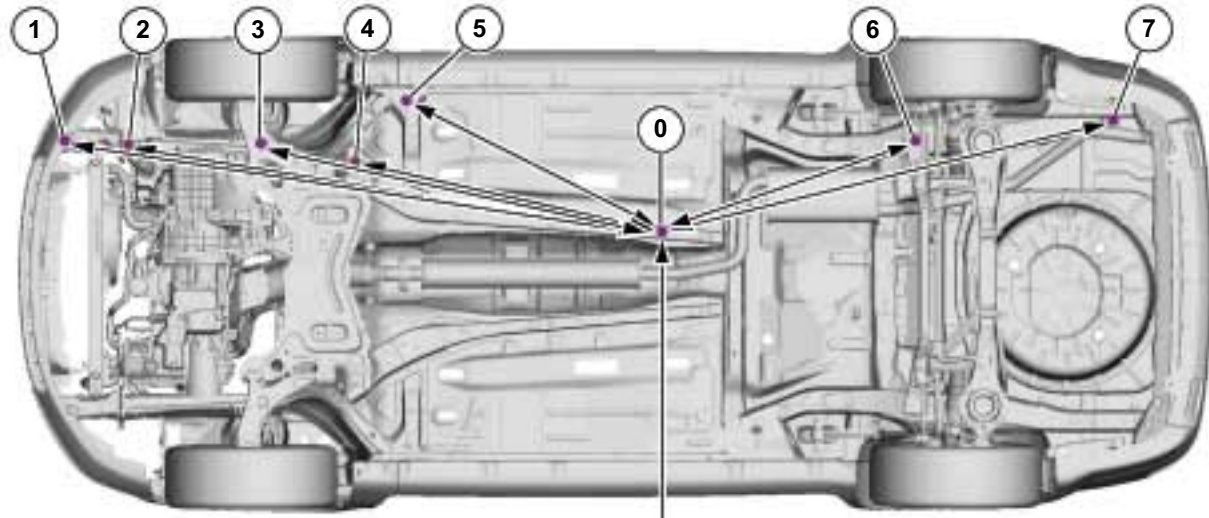
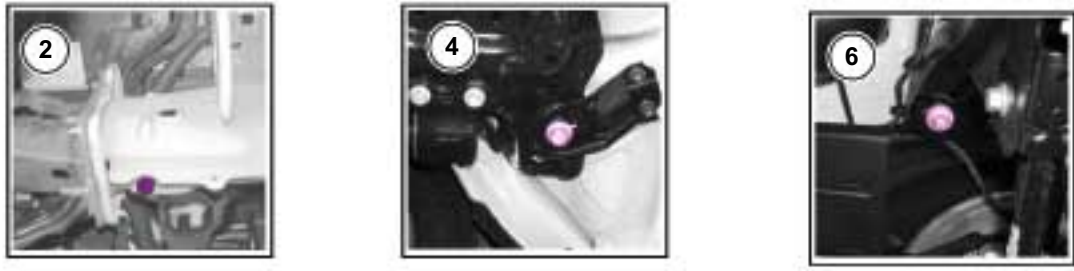
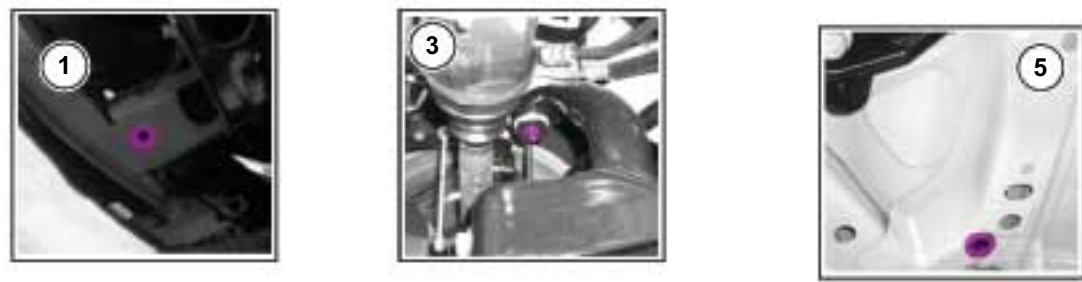
- A tolerance of  $\pm 3$  mm applies to all measurements given. All detailed illustrations correspond to the left-hand side of the vehicle.

## Allvis specifications

Point of measurement	Measurement to Point 0	Adapter	Height setting of the test probes
1	2198 mm	25 mm (Probe)	280 mm
2	1928 mm	25 mm (Probe)	350 mm
3	1458 mm	25 mm (Probe)	240 mm
4	1074 mm	25 mm (Probe)	30 mm
5	997 mm	25 mm (Probe)	110 mm
6	1057 mm	25 mm (Probe)	250 mm
7	1685 mm	25 mm (Probe)	340 mm



GENERAL PROCEDURES



E118002

## GENERAL PROCEDURES

## Frame Tolerance Check

## 1. Front End Body Dimensions

**NOTE:** Details only shown for LH side!

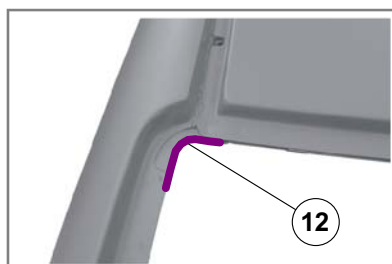
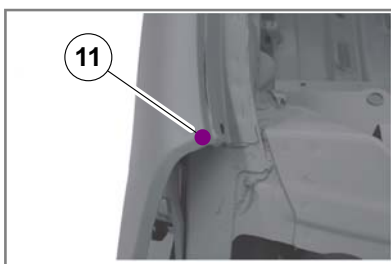
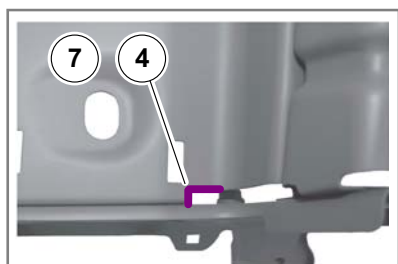
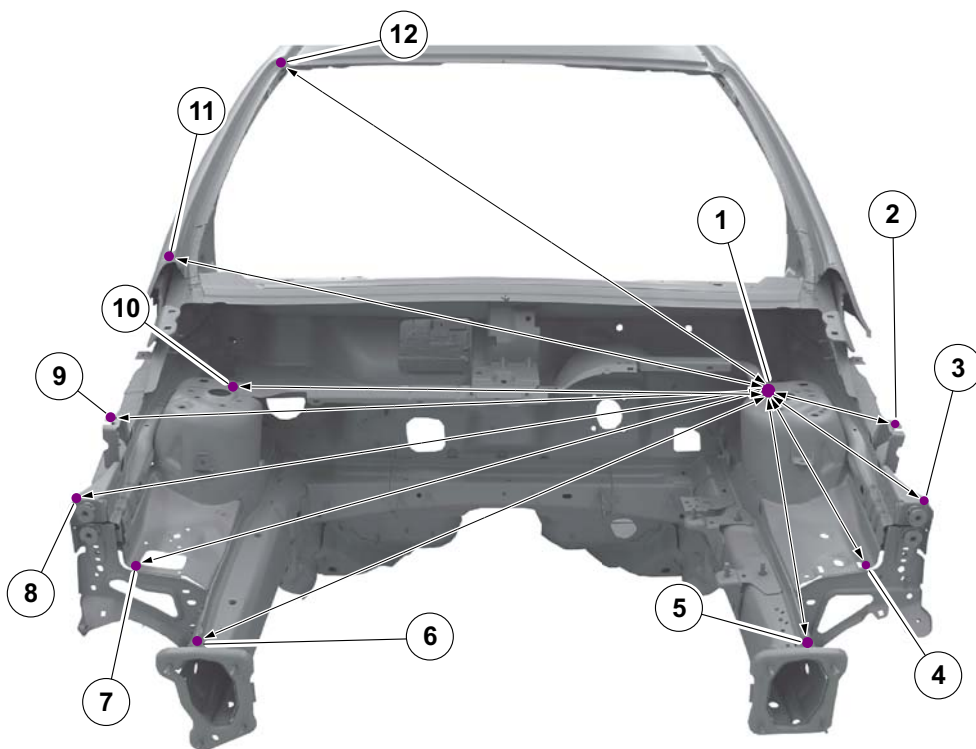
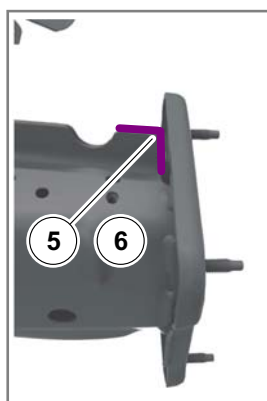
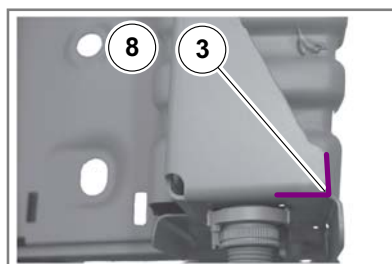
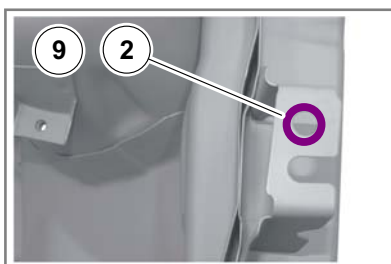
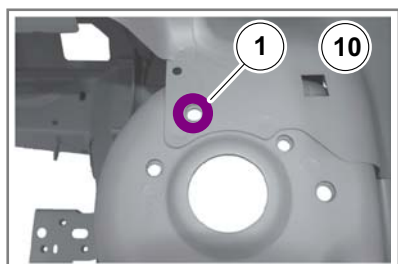
- All dimensions with tolerance  $\pm 3$  mm. All dimensions were determined starting from the centre of each hole or panel edge using a symmetrically adjusted measuring gauge.

**Measuring Points and Dimensions**

1 - 2 = 296 mm	1 - 8 = 1359 mm
----------------	-----------------

1 - 3 = 463 mm	1 - 9 = 1304 mm
1 - 4 = 460 mm	1 - 10 = 1104 mm
1 - 5 = 602 mm	1 - 11 = 1290 mm
1 - 6 = 1220 mm	1 - 12 = 1574 mm
1 - 7 = 1283 mm	

GENERAL PROCEDURES



E102748

2. Body Dimensions - Side View

- All dimensions with tolerance  $\pm 3$  mm. All dimensions were determined starting from

- the edge of the steel panel using a symmetrically adjusted measuring gauge.
- Measuring points 1, 2, 3, 4, 6, 7, 10 and 11 are measured in the curve and represent the

**Body Repairs - Vehicle Specific Information  
and Tolerance Checks****501-26-22****501-26-22****GENERAL PROCEDURES**

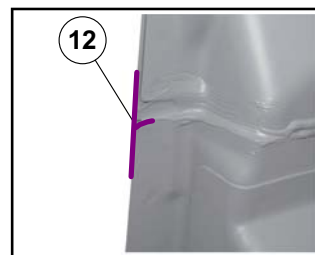
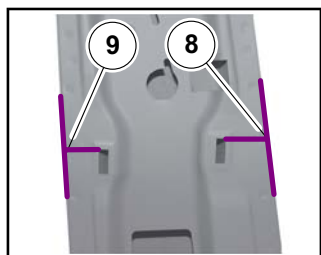
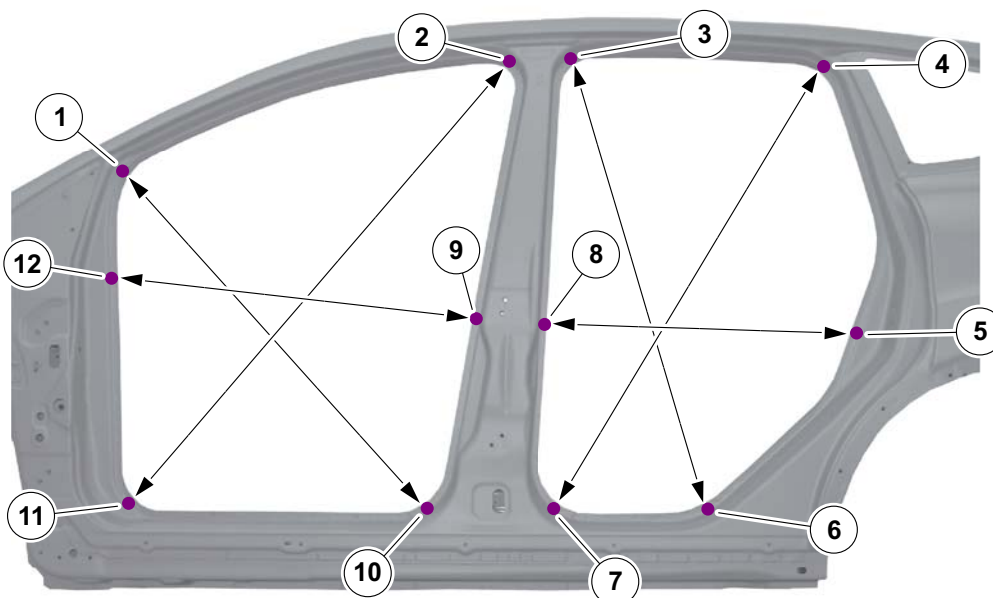
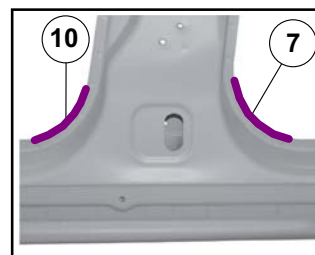
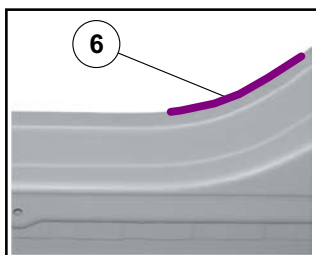
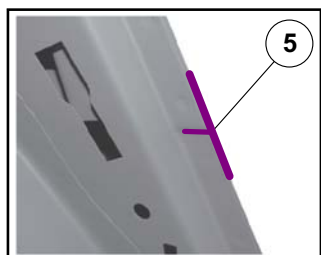
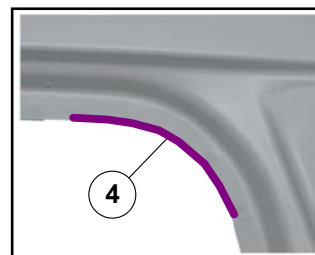
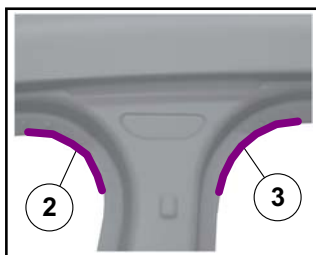
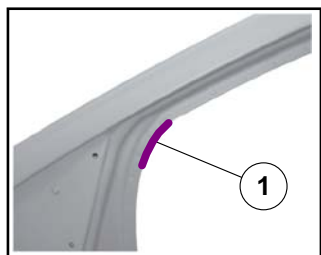
greatest distance to the measuring point opposite.

- The detailed views of measuring points 5, 8, 9 and 12 are shown looking from the vehicle interior outwards.

**Measuring Points and Dimensions**

1 - 10 = 1054 mm	4 - 7 = 1225 mm
2 - 11 = 1357 mm	5 - 8 = 706 mm
3 - 6 = 1113 mm	9 - 12 = 840 mm

GENERAL PROCEDURES



E102749

3. Body Dimensions - Rear

NOTE: Details only shown for LH side!

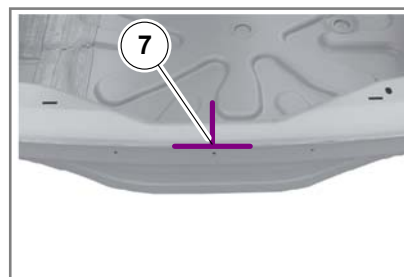
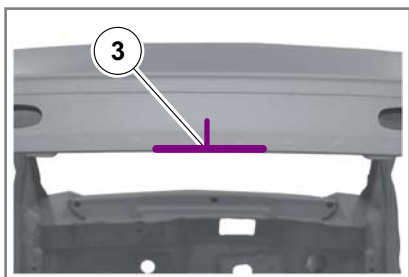
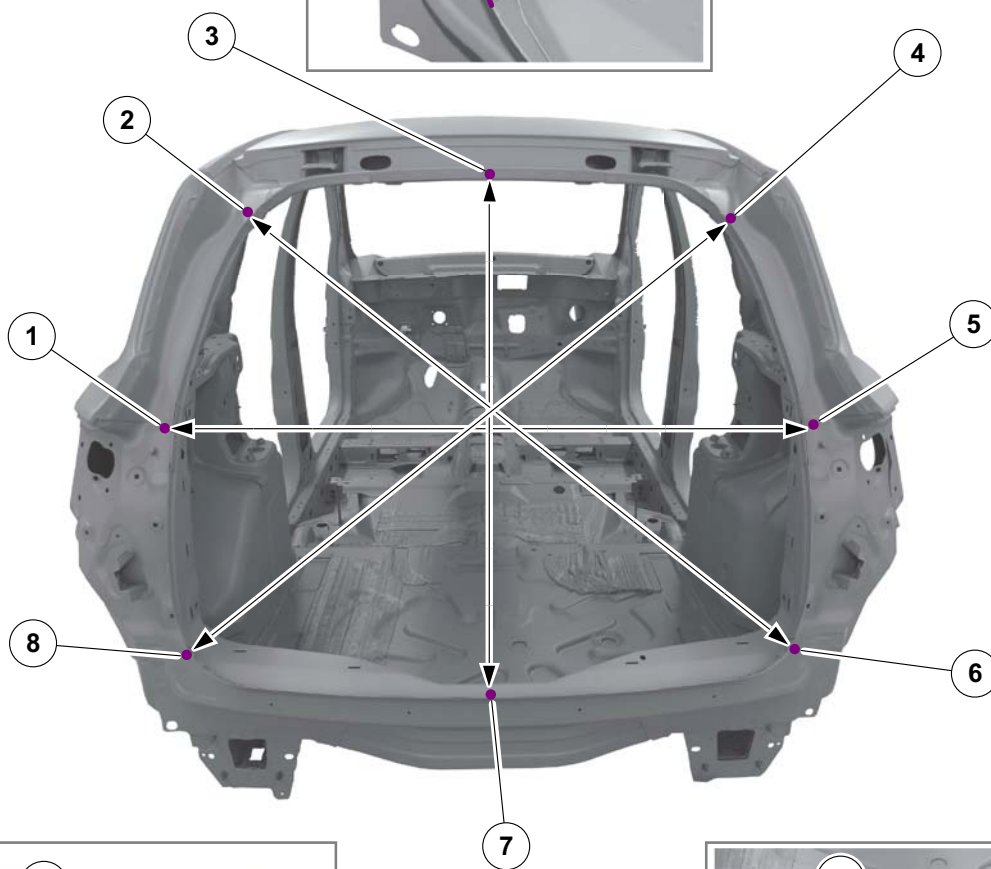
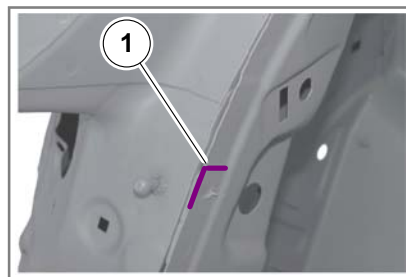
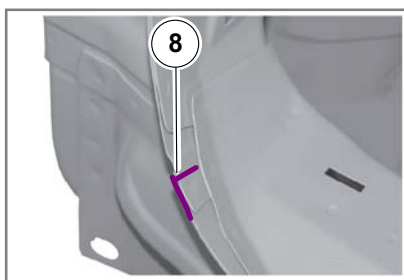
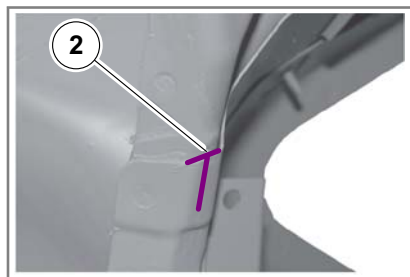
- All dimensions with tolerance  $\pm 3$  mm. All dimensions were determined starting from the center of the welded flange using a symmetrically adjusted measuring gauge.

GENERAL PROCEDURES

Measuring points and dimensions

1 - 5 = 1122 mm	3 - 7 = 888 mm
-----------------	----------------

2 - 6 = 1235 mm	4 - 8 = 1235 mm
-----------------	-----------------



E102750

4. Body Dimensions - Interior

NOTE: Details only shown for LH side!



### Body Repairs - Vehicle Specific Information and Tolerance Checks

501-26-25

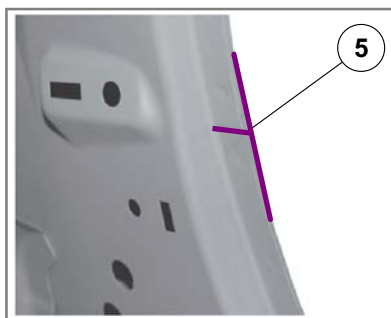
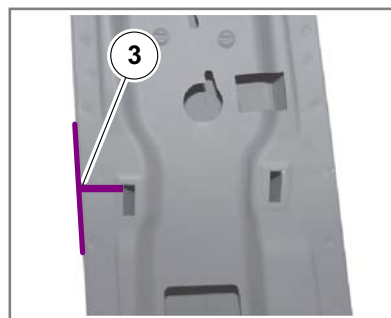
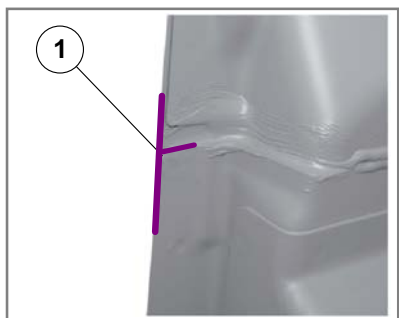
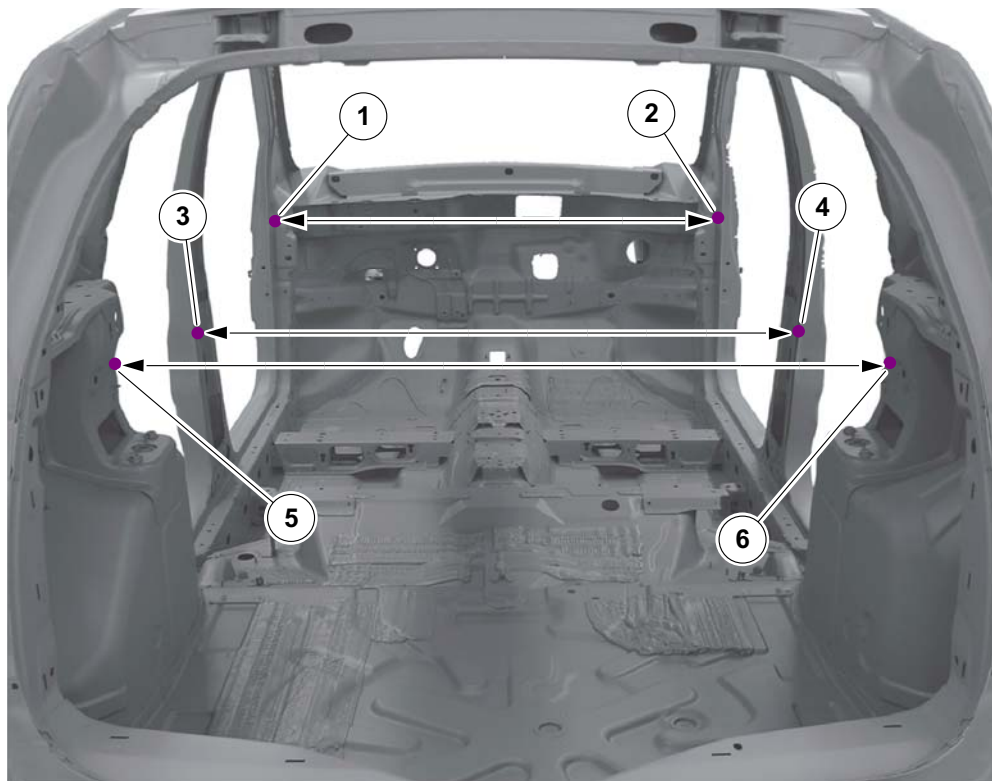
501-26-25

#### GENERAL PROCEDURES

- All dimensions with tolerance  $\pm 3$  mm. All dimensions were determined starting from the center of the welded flange using a symmetrically adjusted measuring gauge.

#### Measuring points and dimensions

1 - 2 = 1434 mm	5 - 6 = 1427 mm
3 - 4 = 1455 mm	



E102751



# SECTION 501-27 Front End Sheet Metal Repairs

VEHICLE APPLICATION: 2008.50 Kuga

CONTENTS PAGE

## REMOVAL AND INSTALLATION

Fender Apron Panel Reinforcement.....	501-27-2
Front Side Member Section.....	501-27-5
Front Side Member and Fender Apron Panel LH.....	501-27-9
Front Fender.....	501-27-20
Fender Apron Panel Section.....	501-27-23

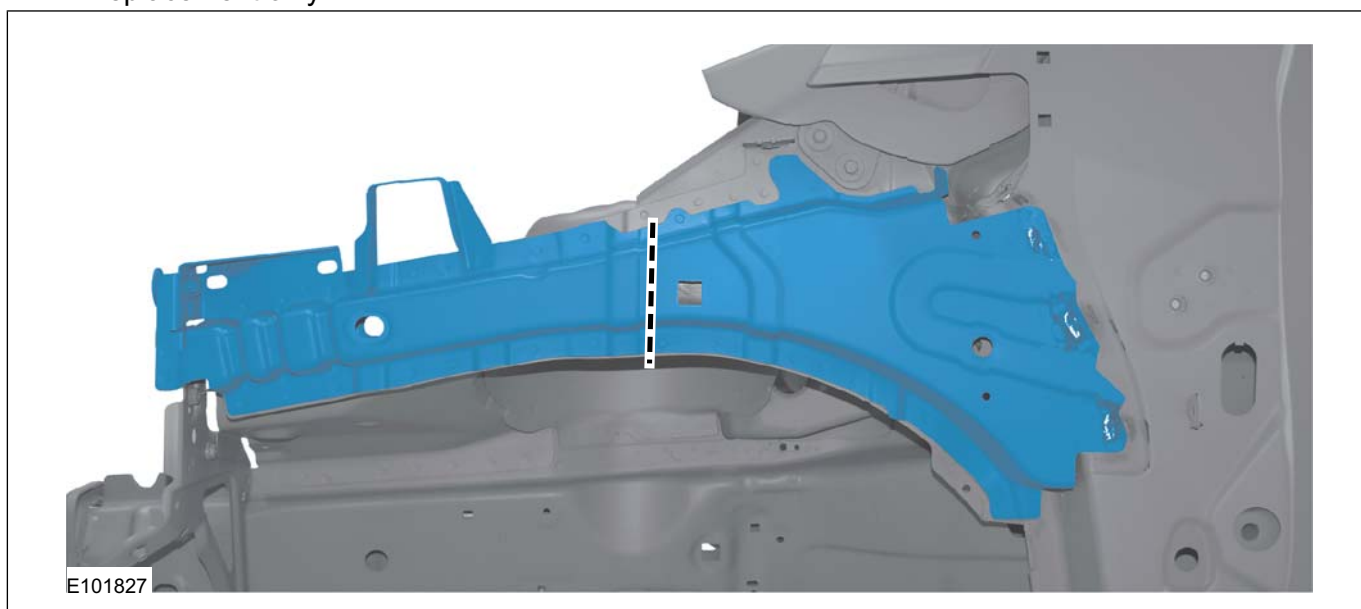


## REMOVAL AND INSTALLATION

## Fender Apron Panel Reinforcement

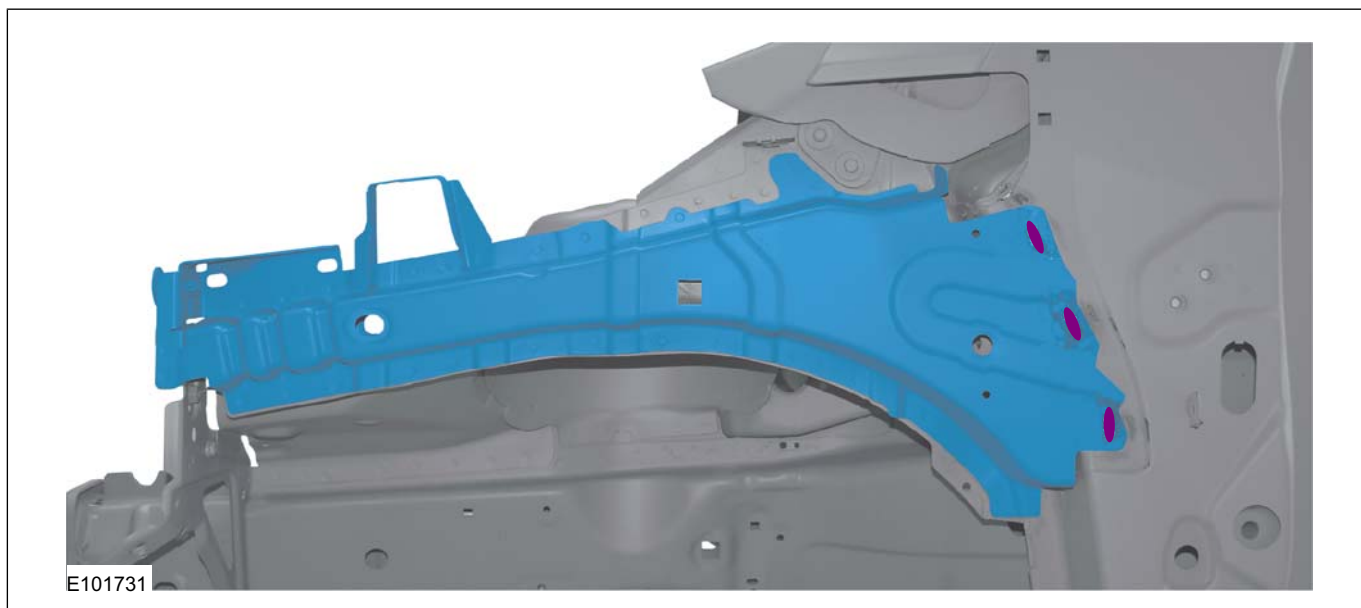
## Removal

1. • **Replacement Parts:**
  - Fender Apron Panel Reinforcement
2. • **NOTE:** Partial Replacement
  - Partial Replacement is possible for the fender apron panel reinforcement.
  - Potential cut line is shown in illustration E101827.
  - The repair shown describes a complete replacement only.
3. • **Necessary Removal Work:**
  - Door
  - Hood
  - Bumper Cover and Bumper
  - Fender
  - Headlamp
  - Hood Closing Panel
4. • **Partial Replacement**
  - Possible cut line.



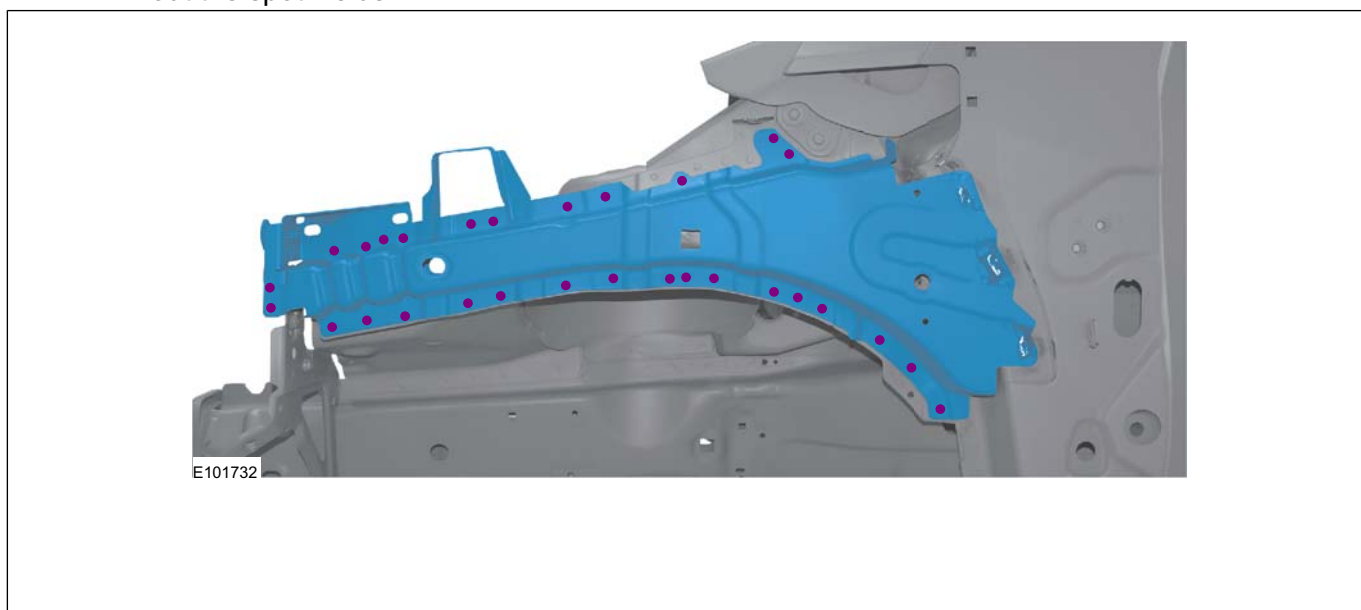
5. • **Fender Apron Panel Reinforcement**
  - Grind out the MIG brazed joints.

## REMOVAL AND INSTALLATION



## 6. • Fender Apron Panel Reinforcement

- Mill out the spot welds.



## Installation

**NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

**NOTE:** Replacement of MIG brazed joints by MIG welds.

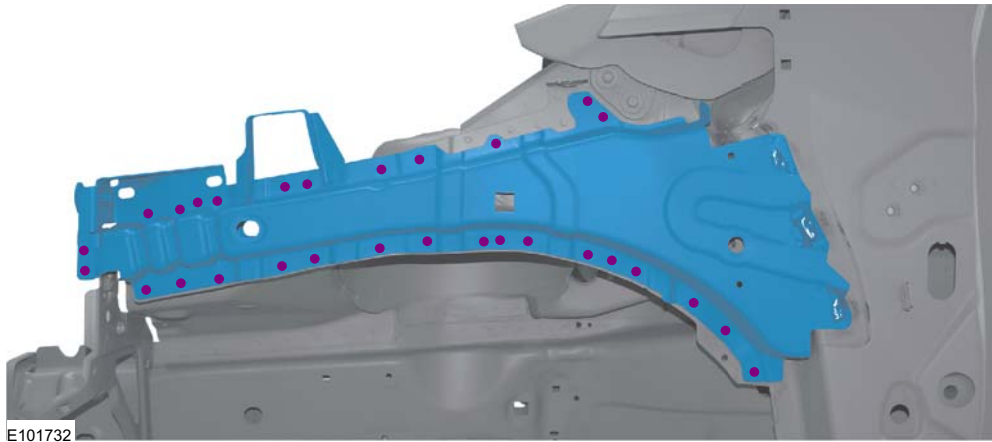
Refer to: **Joining Techniques** (501-25 Body Repairs - General Information, Description and Operation).

- The factory-installed MIG brazed joints must be replaced by MIG welds in a different position.
- These MIG welds must not be carried out on or in the immediate vicinity of existing MIG brazed seams as even the smallest amount of brazing solder can result in a reduction in the strength of the weld seam.

## REMOVAL AND INSTALLATION

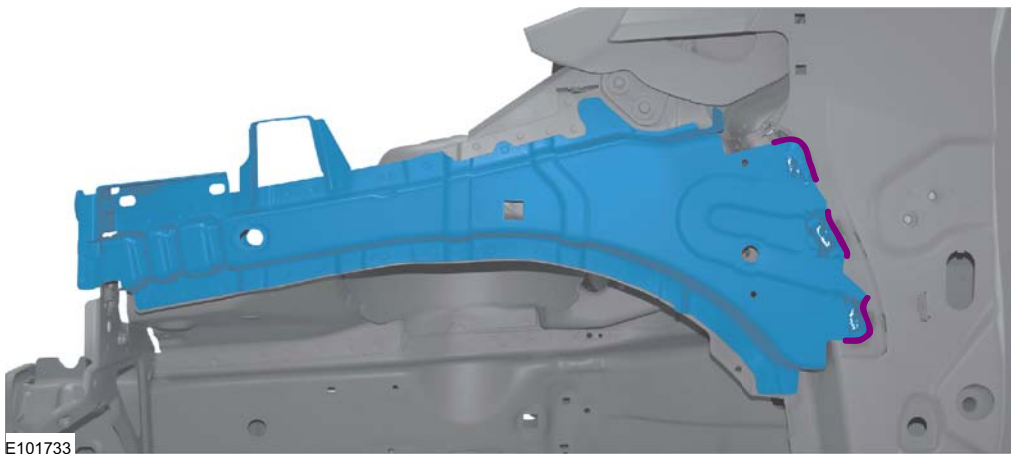
## 1. • Fender Apron Panel Reinforcement

- Resistance spot weld - Panel thickness 3 mm and greater!



## 2. • Fender Apron Panel Reinforcement

- MIG weld.



## REMOVAL AND INSTALLATION

## Front Side Member Section

## Removal

**NOTE:** Equipment:

**Measurement and alignment angle system**

1. **NOTE:** The required partial replacement sections need to be cut out from the outer and inner side member .

- **Replacement Parts:**
- Inner side member
- Outer side member
- Longitudinal Member Flange Plate

2. • **Necessary Removal and Installation Work:**

- Cross Member Assy
- Reposition the carpeting and the wiring harness away from the working area.

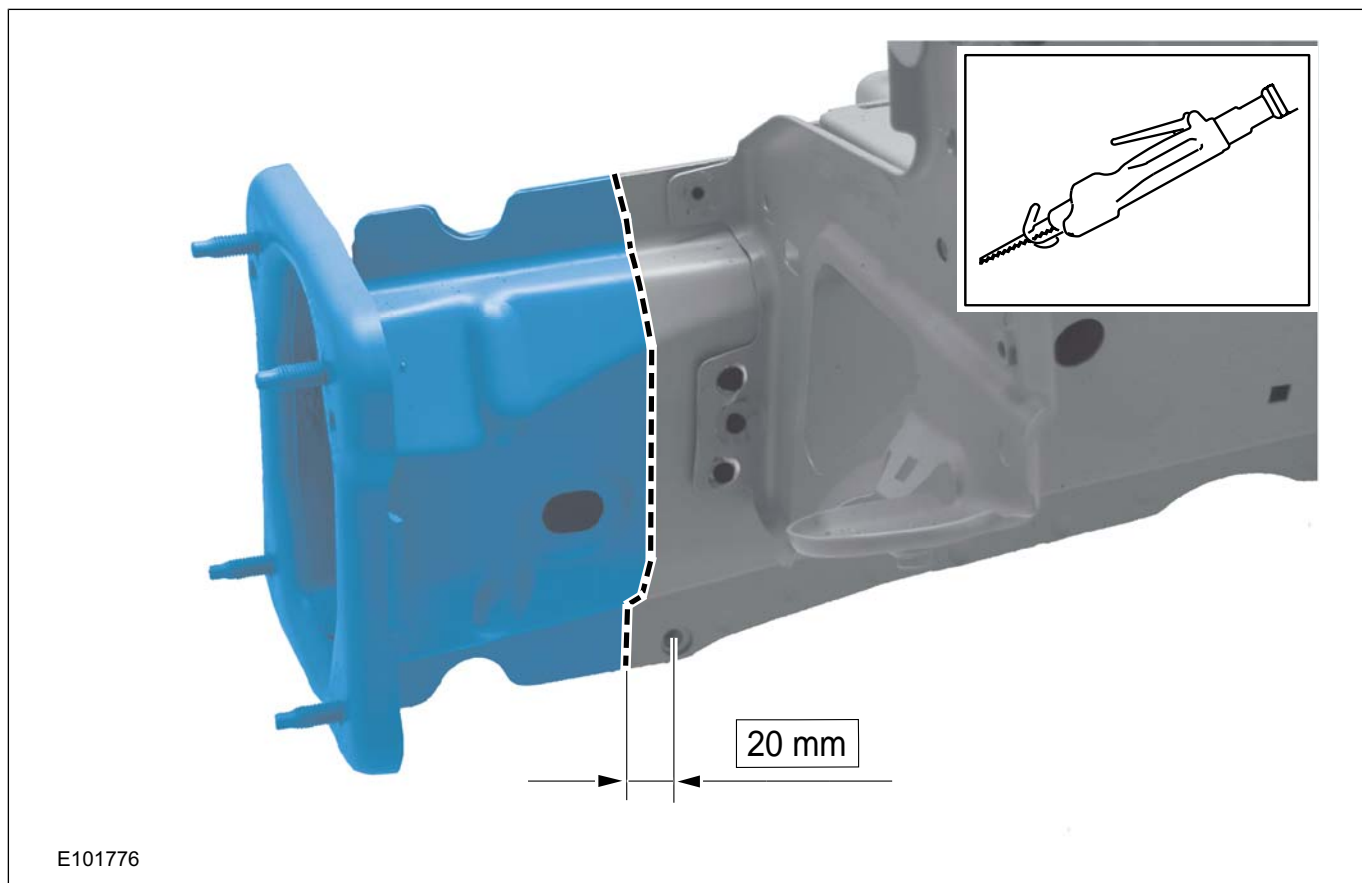
3. • **▲ WARNING: Cut line positions**

- Due to the positions of inner reinforcements, it is very important that the dimension quoted for the separating cut on the inner side member is accurately met.

4. • **Front Side Member**

- **NOTE:** The cut shown is the final cut for the outer part.

Separating cut through outer and inner part of the front side member.





## 501-27-6

## Front End Sheet Metal Repairs

## 501-27-6

## REMOVAL AND INSTALLATION

## 5. • Front Side Member

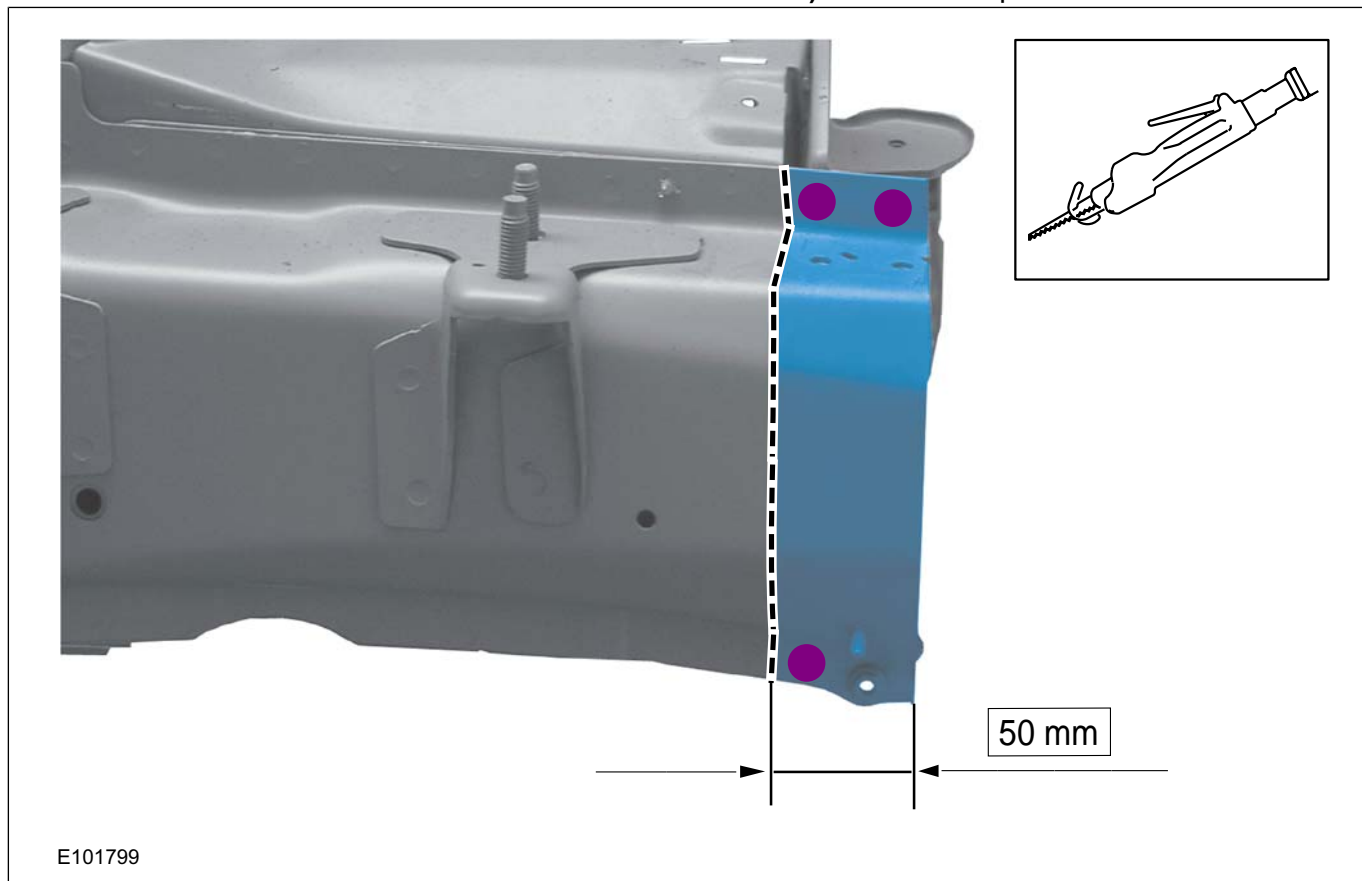
## • CAUTIONS:

 Do not cut into outer part of the side member!

 Right Hand Side Member - Do not cut in inner reinforcement!

Separating cut through inner part of the front side member.

- 1) Mill out the spot welds.



## Installation

**NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

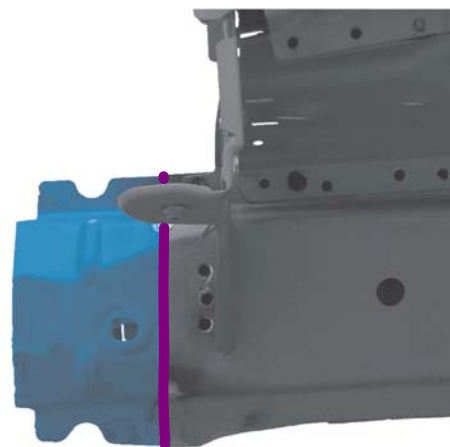
501-27-7

## Front End Sheet Metal Repairs

501-27-7

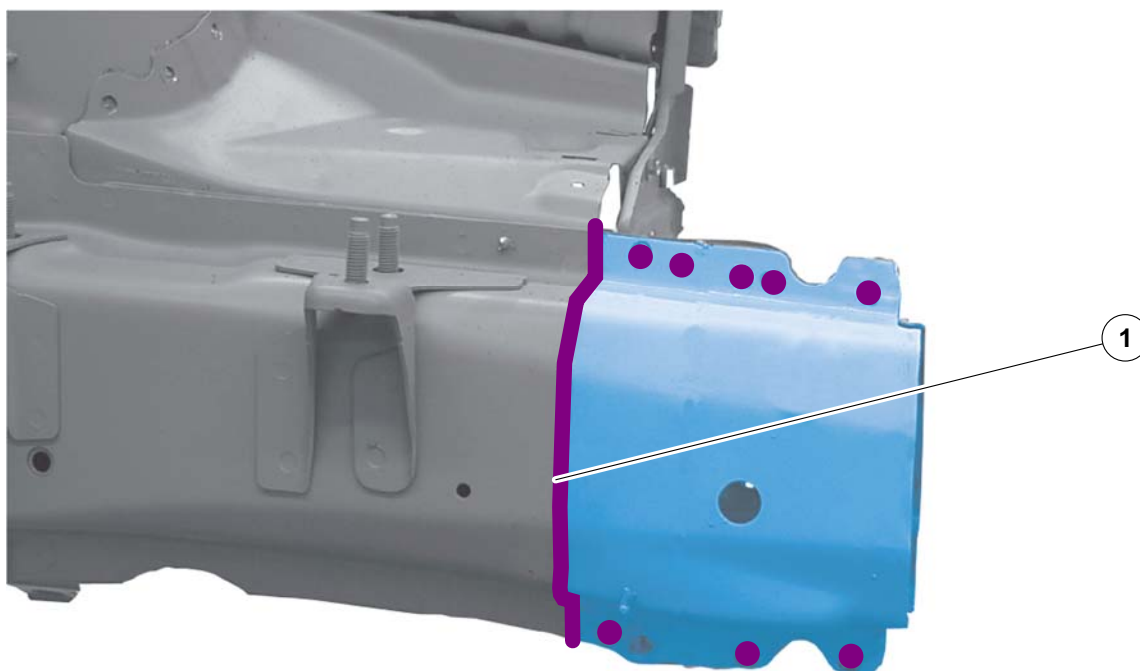
## REMOVAL AND INSTALLATION

1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).
2. • **Outer Front Side Member**
  - Continuous MIG weld seam.



E101803

3. • **Inner Front Side Member**
  - 1) Continuous MIG weld seam.
  - Resistance spot weld - Panel thickness 3 mm and greater!



E101809

## 501-27-8

## Front End Sheet Metal Repairs

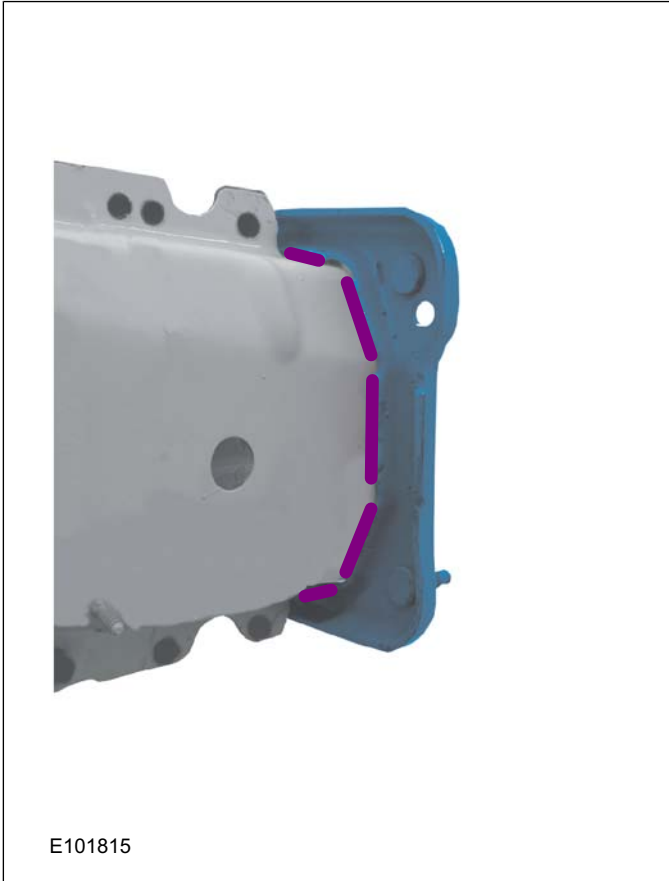
## 501-27-8

## REMOVAL AND INSTALLATION

4. • **NOTE:** Fit the longitudinal member flange plate using the straightening angle.

**Longitudinal Member Flange Plate Inside**

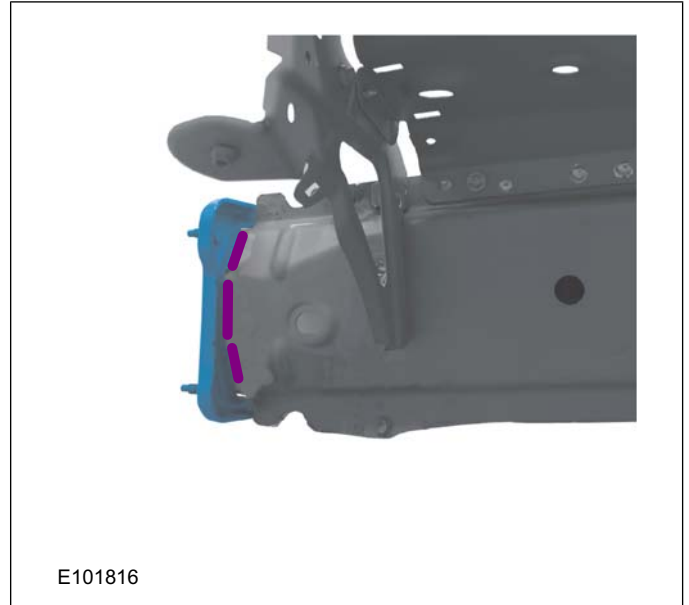
- Continuous MIG weld seams.



5. • **NOTE:** Fit the longitudinal member flange plate using the straightening angle.

**Longitudinal Member Flange Plate Outside**

- Continuous MIG weld seams.



## REMOVAL AND INSTALLATION

## Front Side Member and Fender Apron Panel LH

## Removal

**NOTE:** Equipment:**Measurement and alignment angle system.****1. • Replacement Parts:**

- Inner Side Member
- Outer Side Member
- Apron Panel
- Strut Tower
- Grill Opening Support
- Longitudinal Member Flange Plate

**2. • Necessary Removal and Installation Work:**

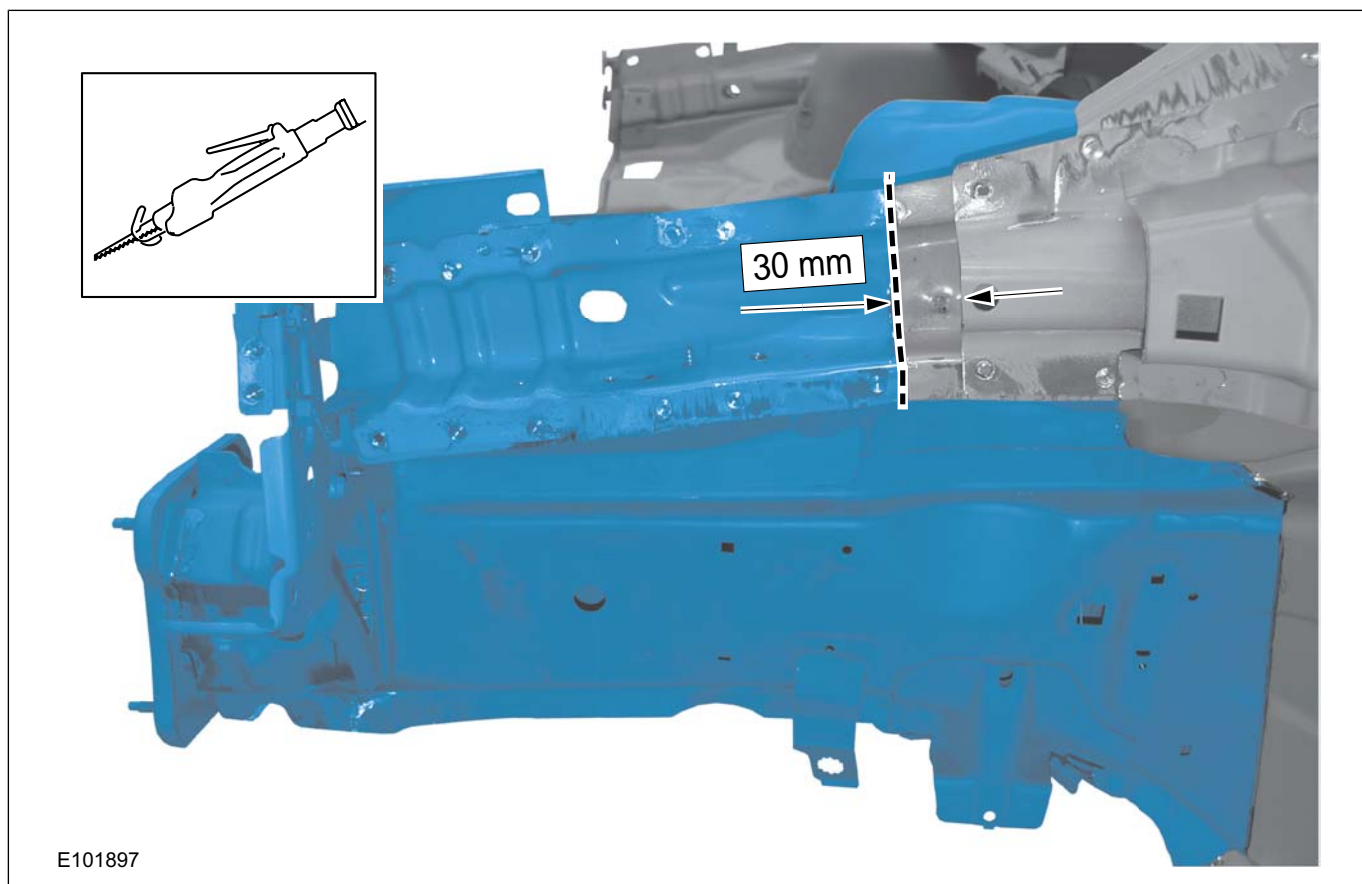
- Fender Apron Panel Reinforcement

Refer to: **Fender Apron Panel Reinforcement**  
(501-27 Front End Sheet Metal Repairs,  
Removal and Installation).

- Reposition the carpeting and the wiring harness away from the working area.

**3. • Inner Panel - Fender Apron Panel Reinforcement**

- Mark the cutline and cut.



## 501-27-10

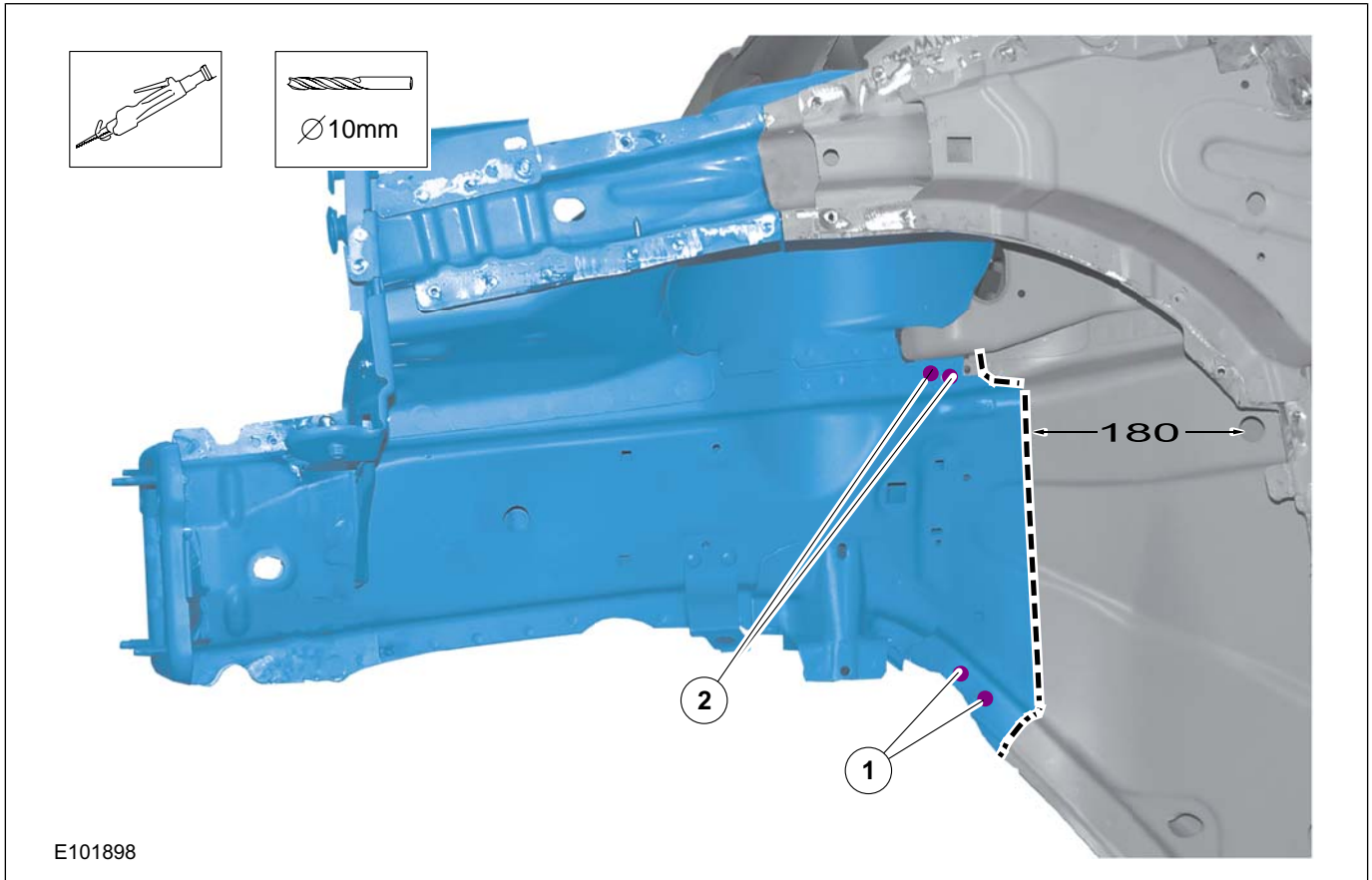
## Front End Sheet Metal Repairs

## 501-27-10

## REMOVAL AND INSTALLATION

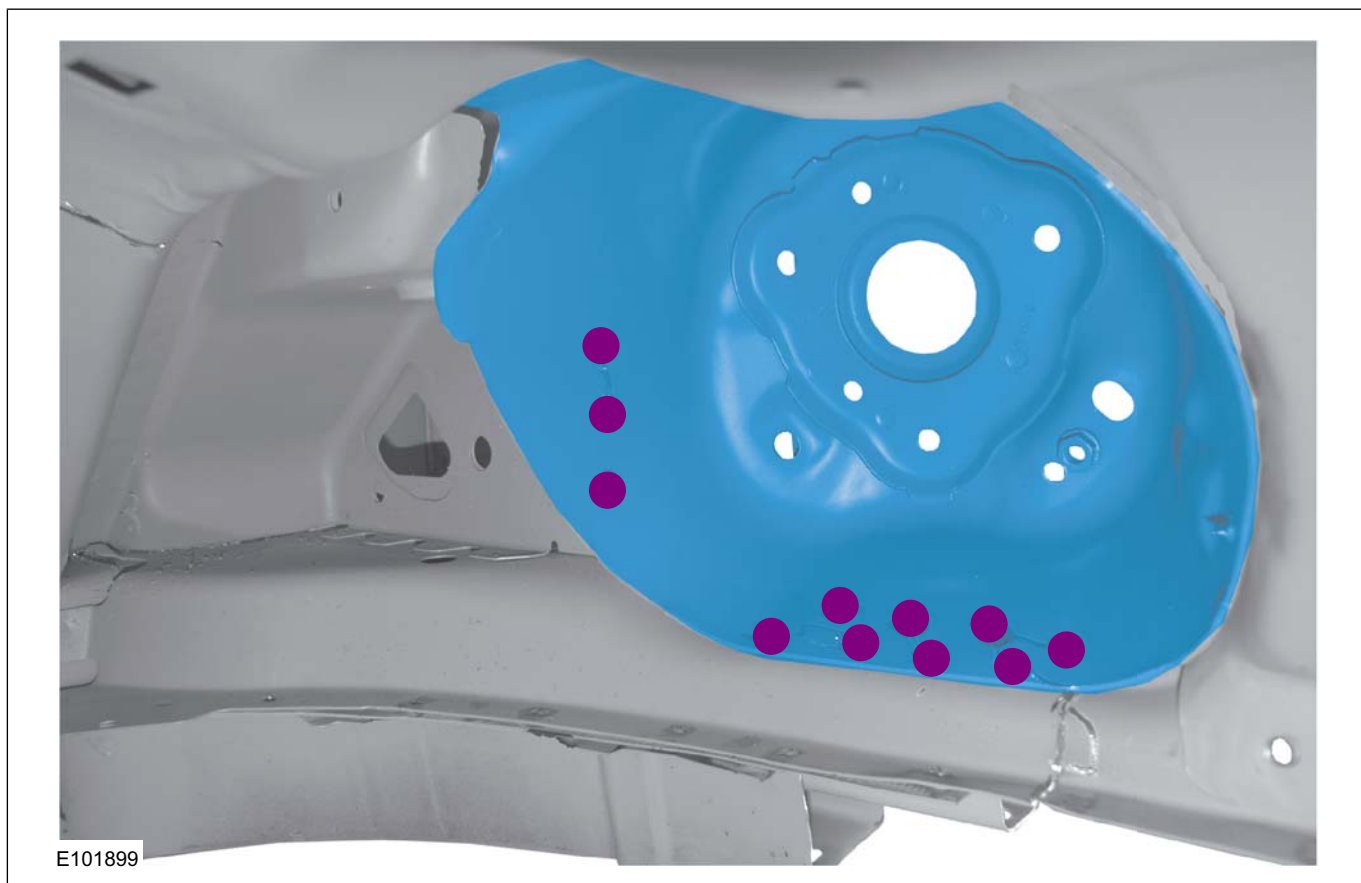
4. • **Front Side Member Outside**
- Mark the cutline and cut.

- 1) Mill out the spot welds ( $\varnothing$  10 mm).
- 2) Mill out the spot welds - Two panel thickness ( $\varnothing$  10 mm).



5. • **Strut Tower**
- Grind out the spot welds from inside.

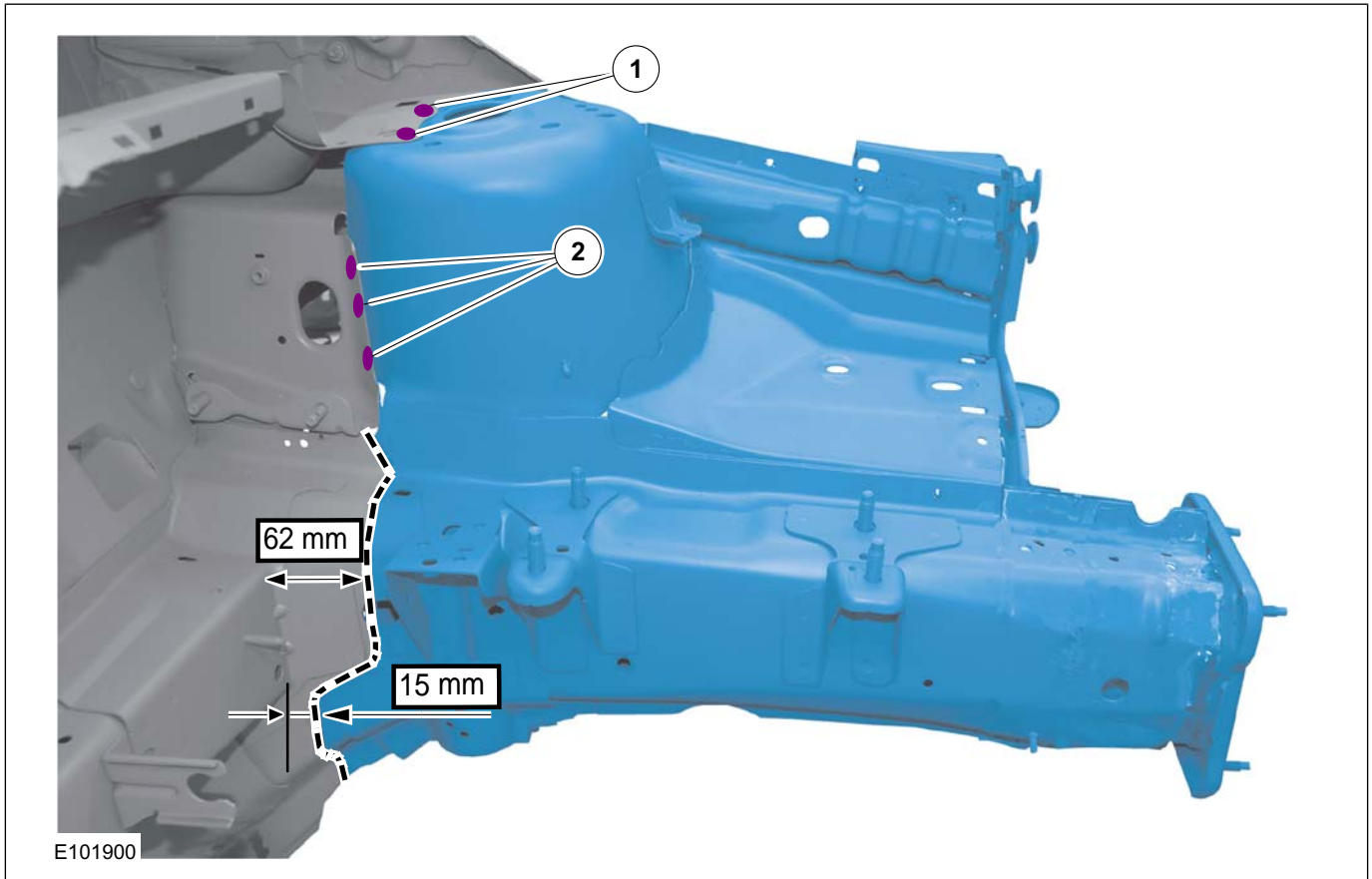
## REMOVAL AND INSTALLATION



6. • **Front Side Member Inside**
  - Mark the cutline and cut.
  - **1)** Mill out the spot welds.
  - **2)** Mill out the spot welds with a spherical cutter.



REMOVAL AND INSTALLATION



Installation

**NOTE:** Preparation of the replacement parts:

- The required replacement parts needs to be cut out from outer and inner side member replacement part.
- Fit the outer side member, the inner side member and the longitudinal member flange plate and secure them with the alignment angle.

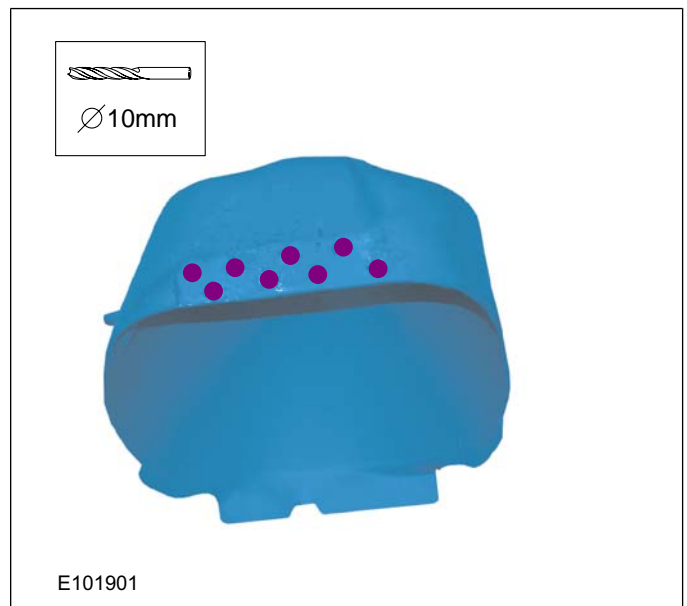
**NOTE:** Welding

- Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

1. • **Preparation of the Strut Tower**

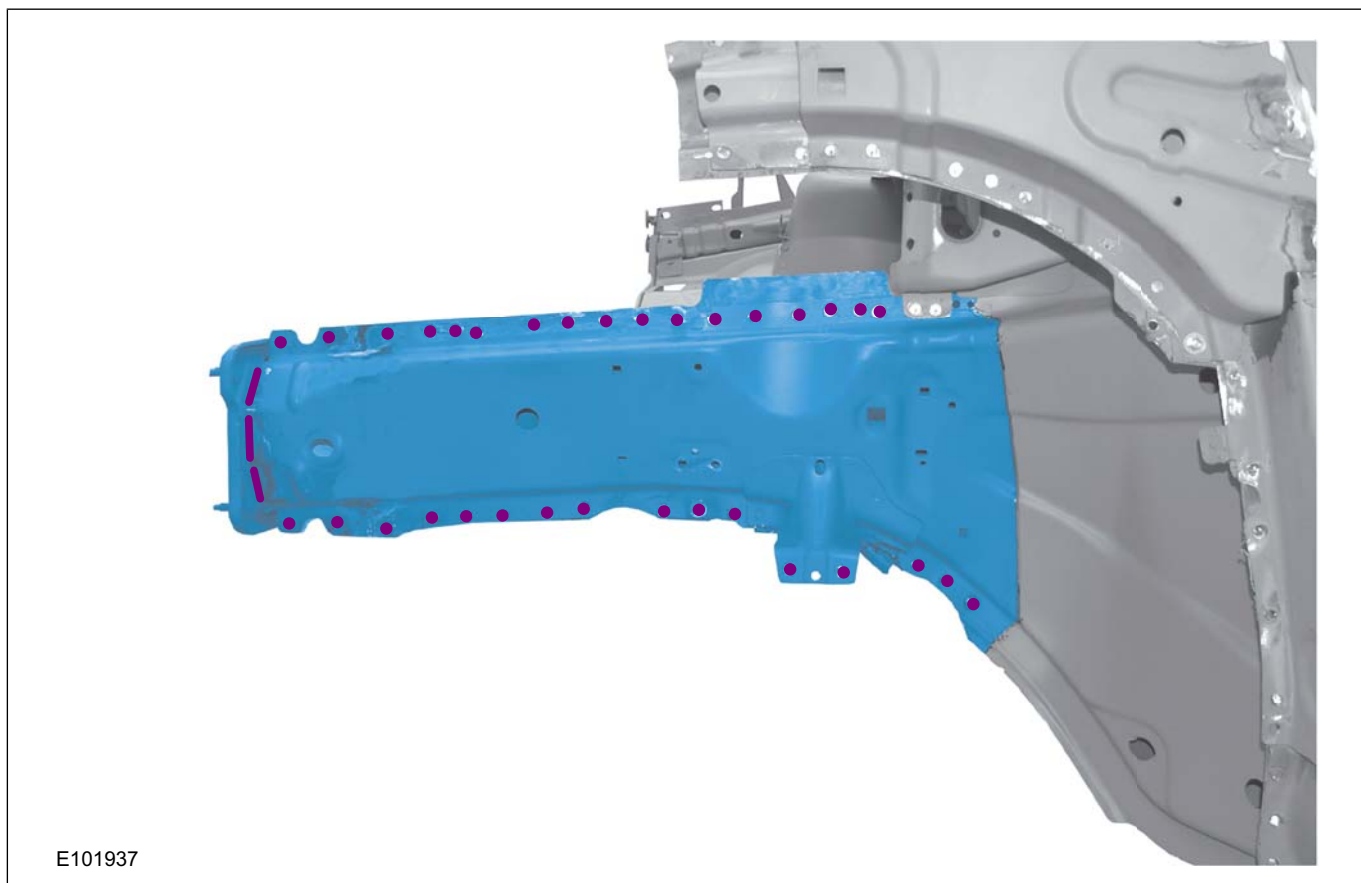
- Drill holes for puddle welding (Ø 10 mm).



2. • **Front Side Member Outside**

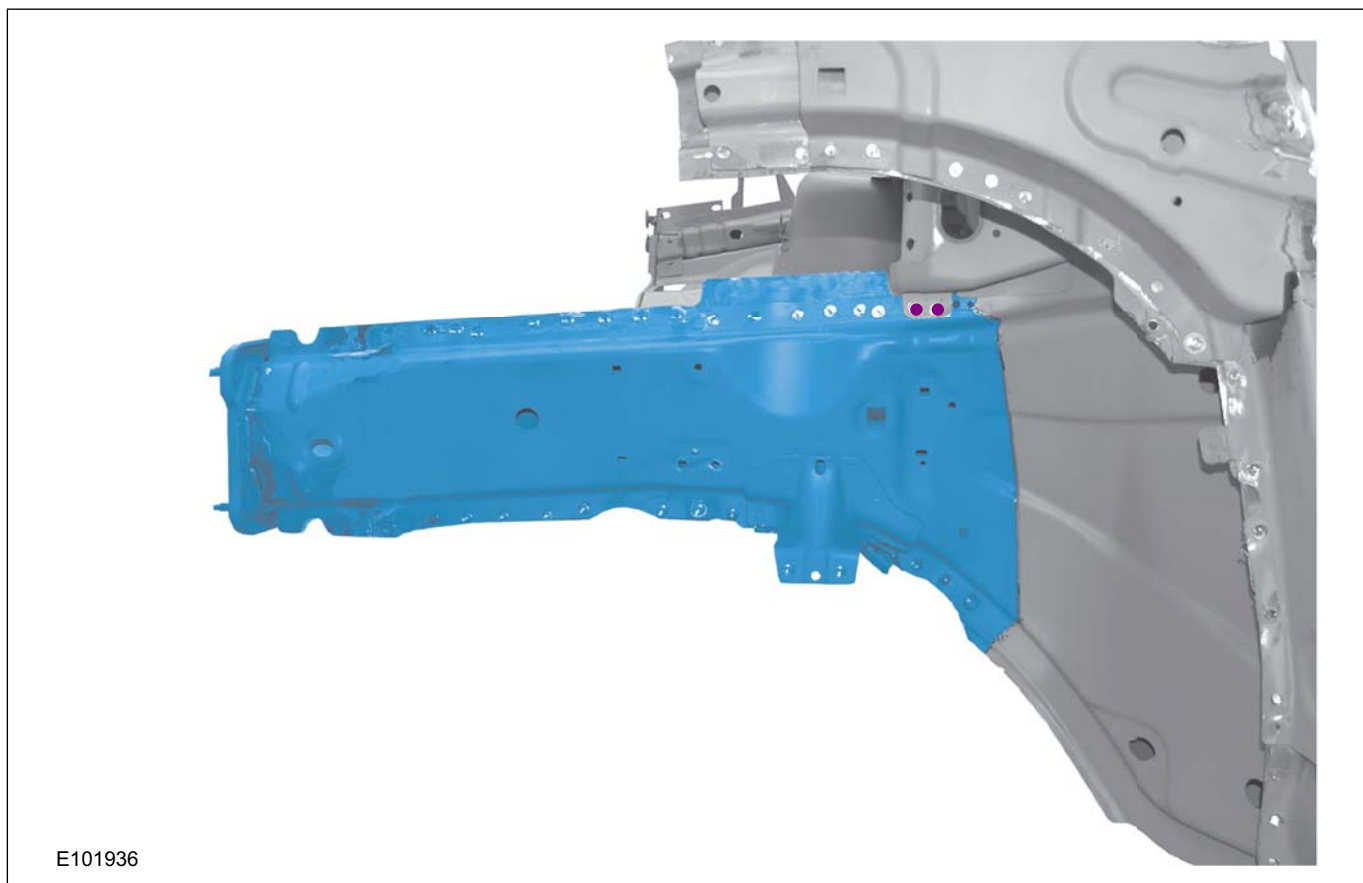
- Resistance spot weld - Panel thickness 3 mm and greater!
- Continuous MIG weld seams.

## REMOVAL AND INSTALLATION



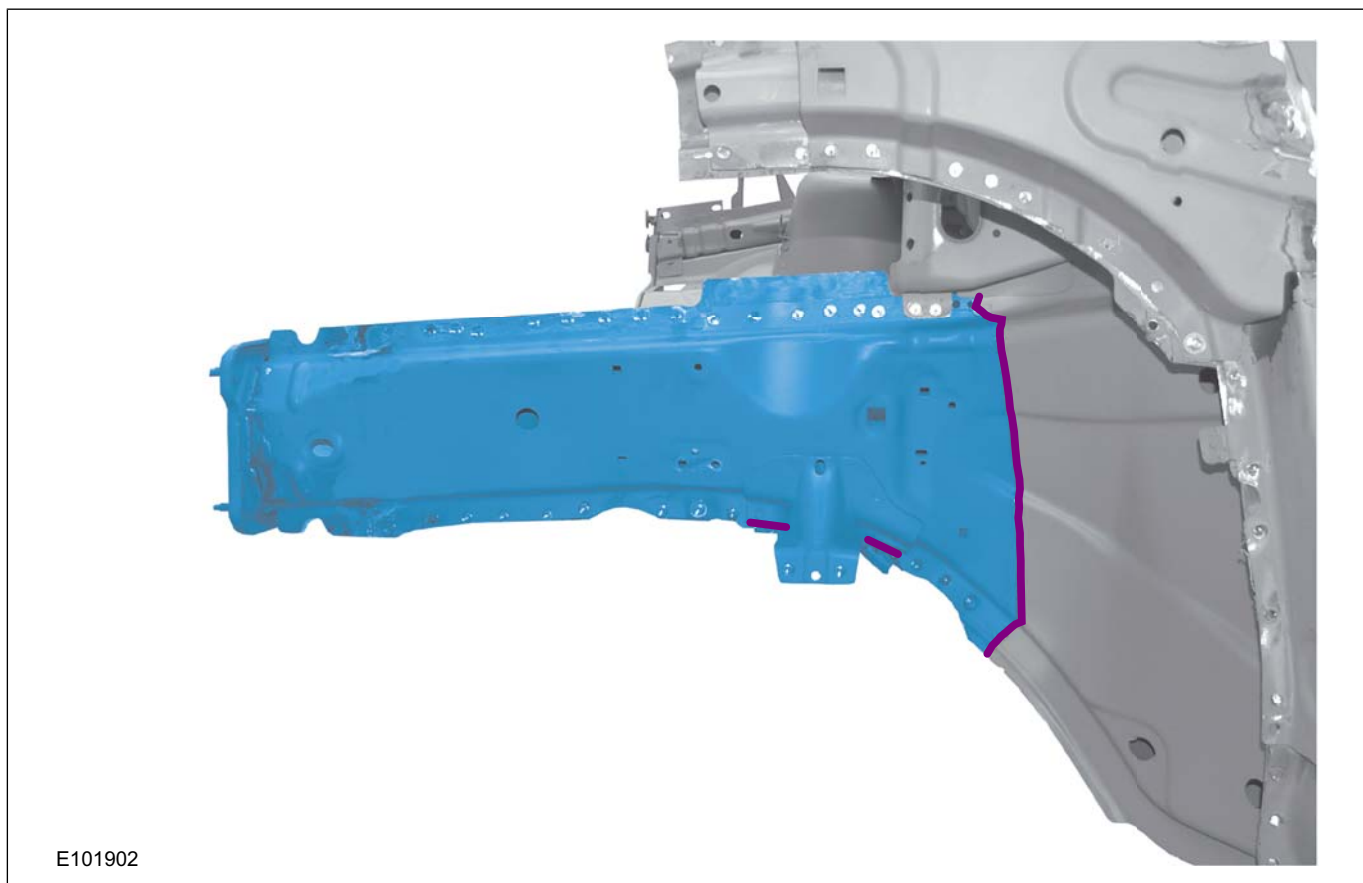
3. • **Front Side Member Outside**
  - Drill out by one panel thickness for puddle welding - puddle weld 3 panel layers.

## REMOVAL AND INSTALLATION



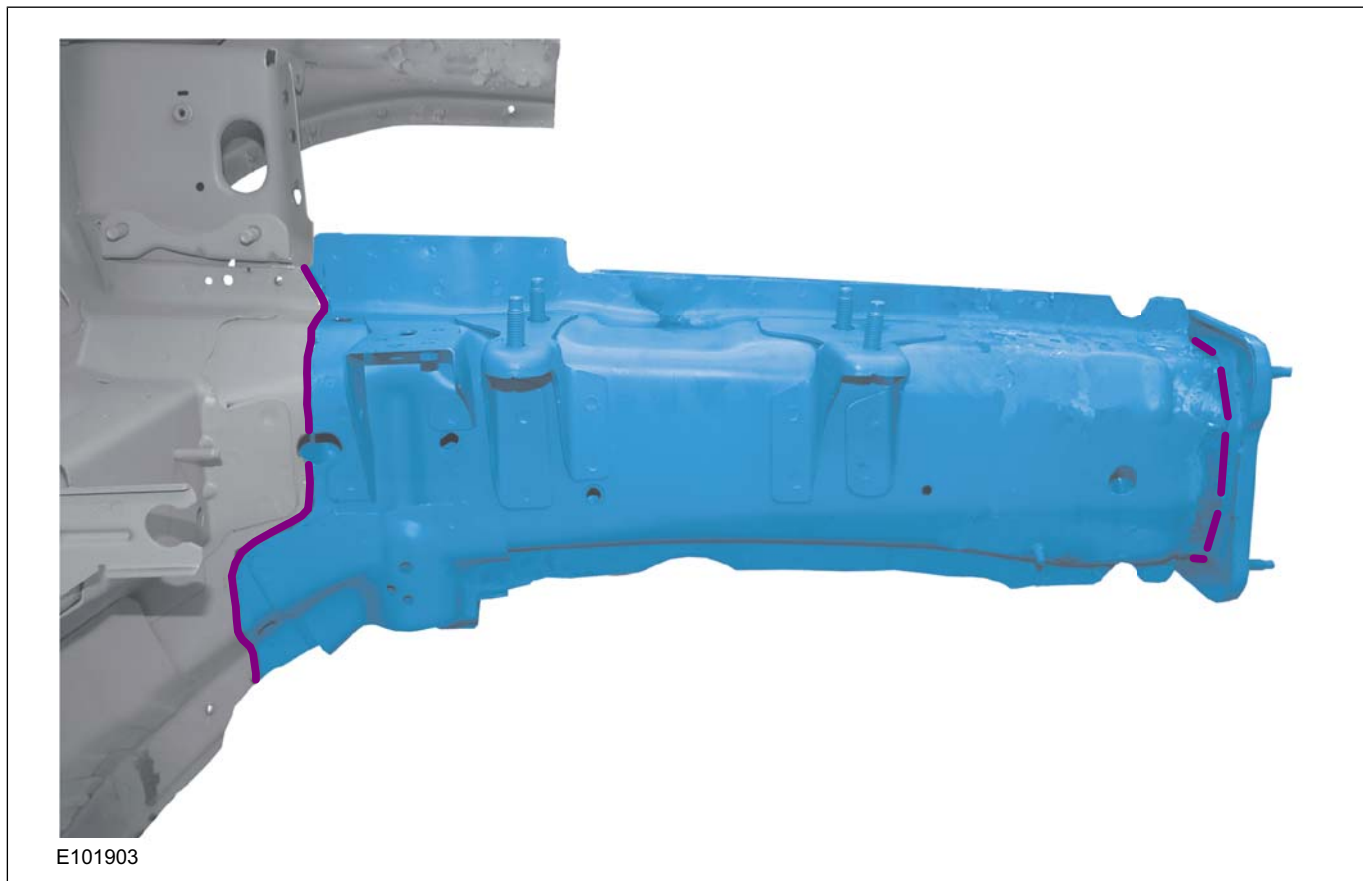
4. • **Front Side Member Outside**
  - Continuous MIG weld seams.

## REMOVAL AND INSTALLATION



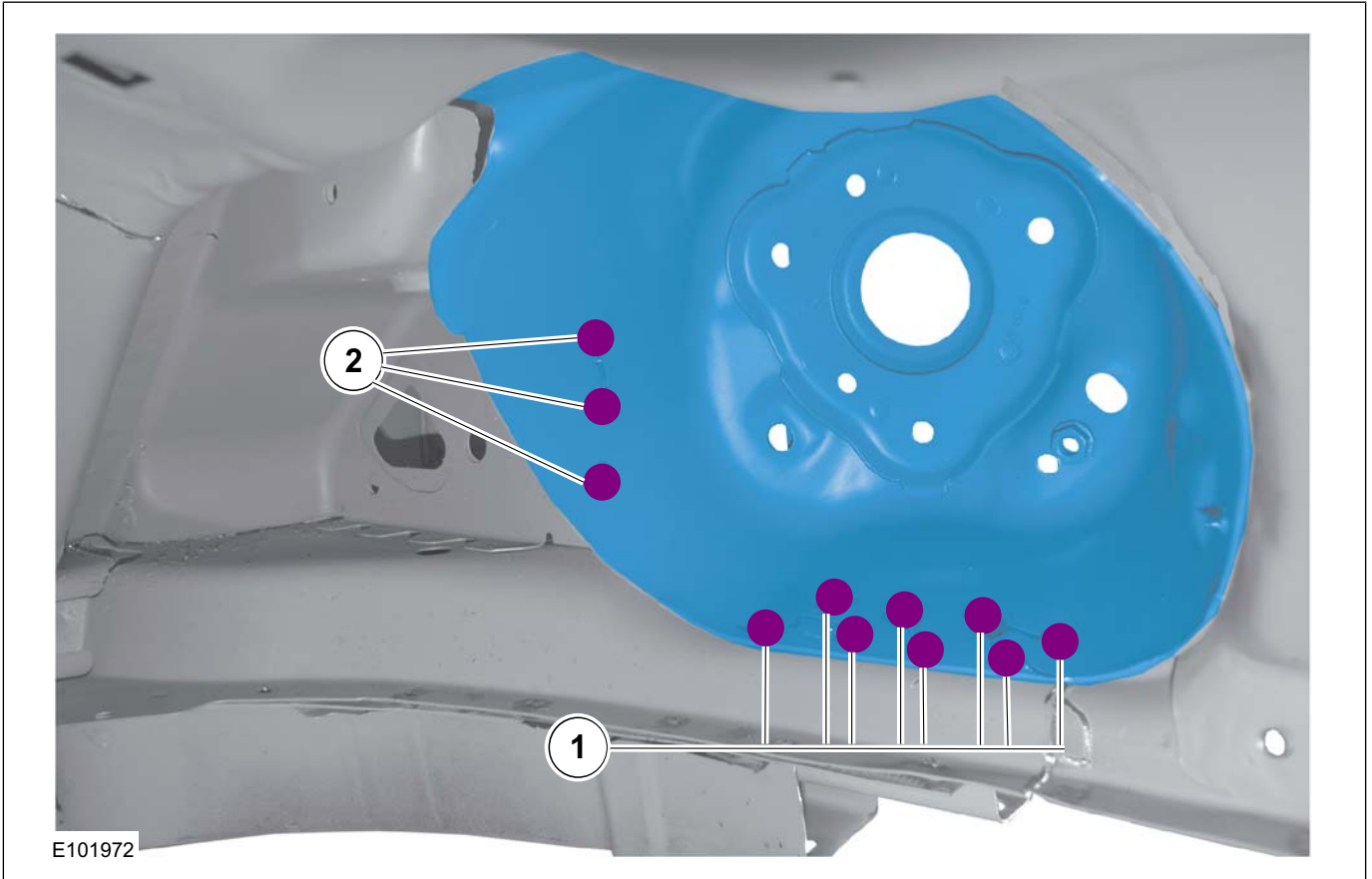
5. • **Front Side Member Inside**
  - Continuous MIG weld seams.

## REMOVAL AND INSTALLATION



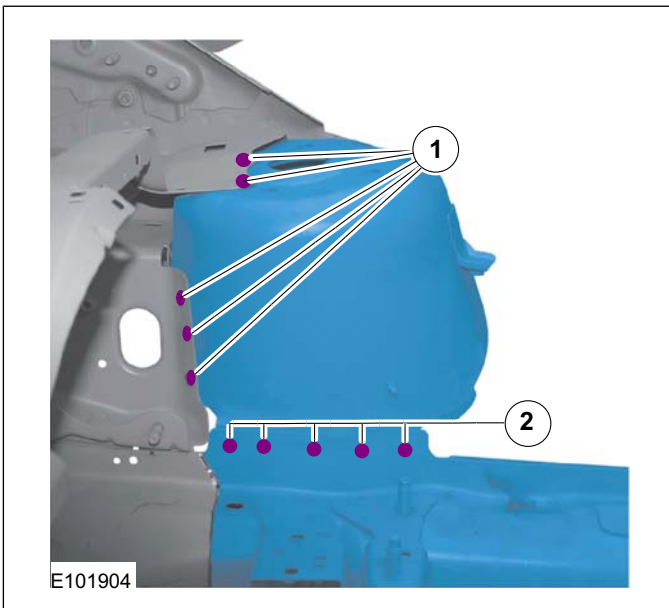
6. • **Strut Tower**
  - 1) Puddle weld.
  - 2) Resistance spot weld - Panel thickness 3 mm and greater!

REMOVAL AND INSTALLATION



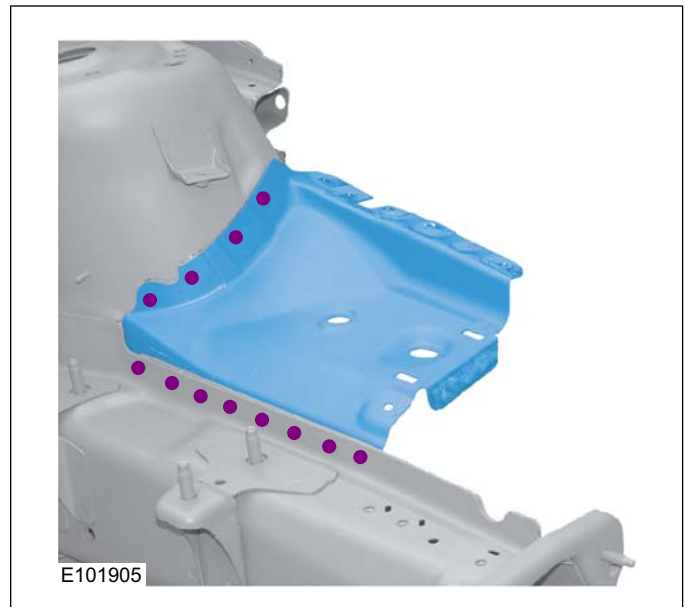
7. • **Strut Tower**

- 1) Puddle weld.
- 2) Resistance spot weld - Panel thickness 3 mm and greater!



8. • **Apron Panel**

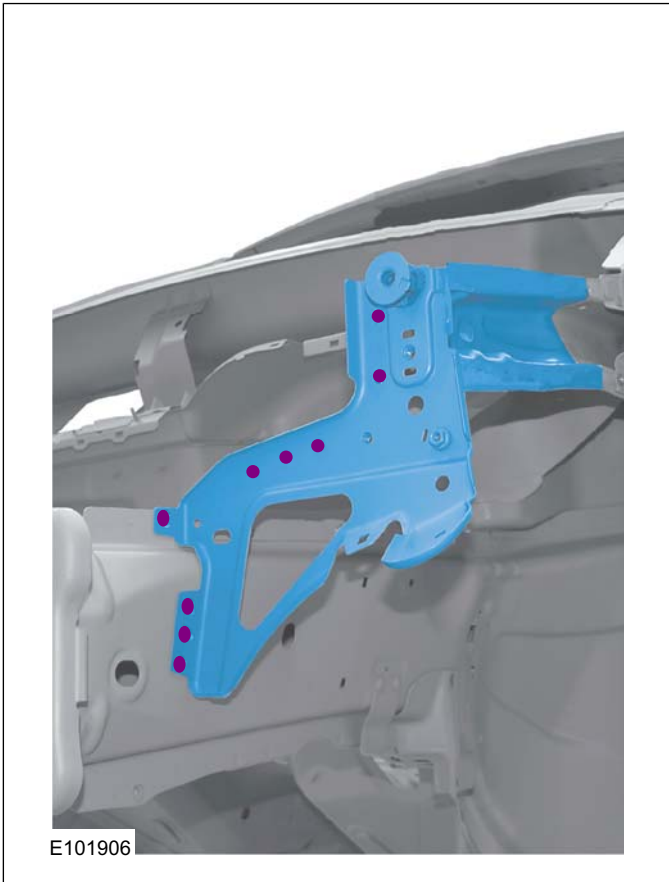
- Resistance spot weld.





**REMOVAL AND INSTALLATION****9. • Grill Opening Support**

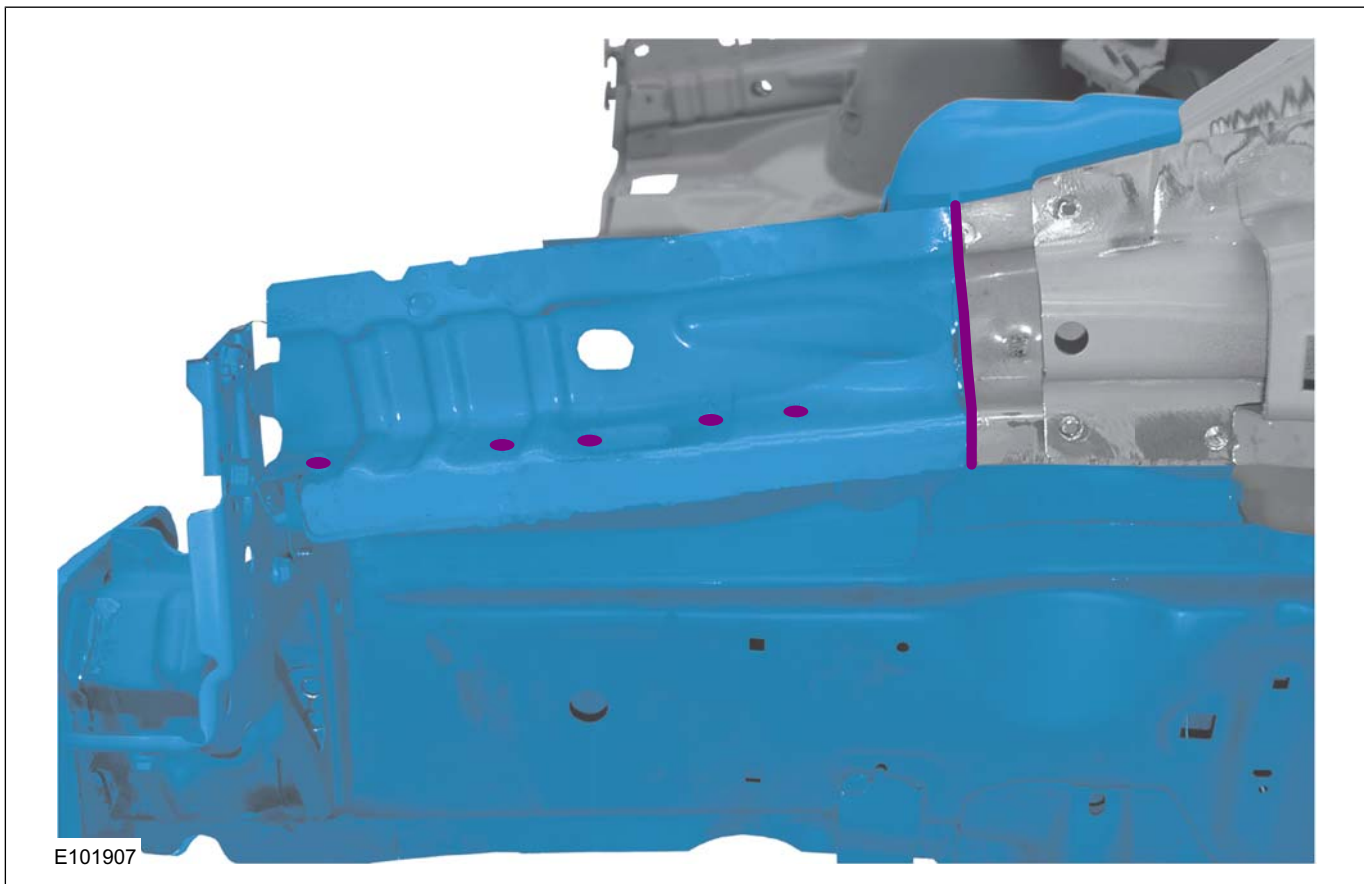
- Resistance spot weld - Panel thickness 3 mm and greater!

**10. • Inner Panel - Fender Apron Panel Reinforcement**

- Continuous MIG weld seam.
- Resistance spot weld.



REMOVAL AND INSTALLATION



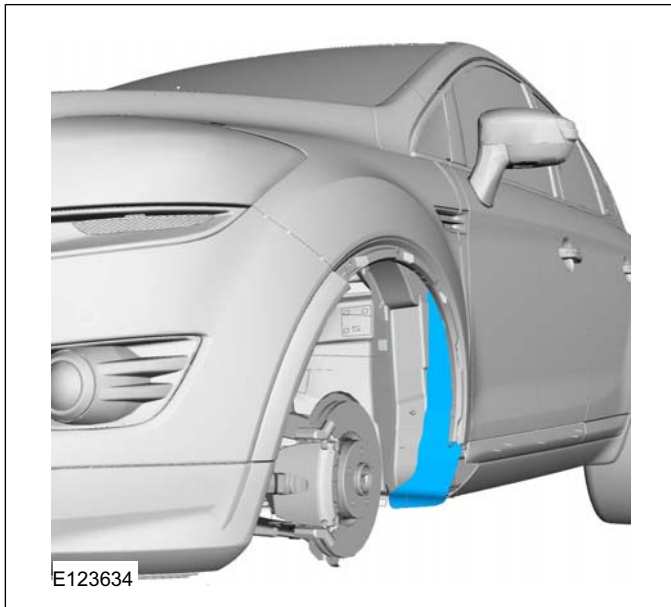
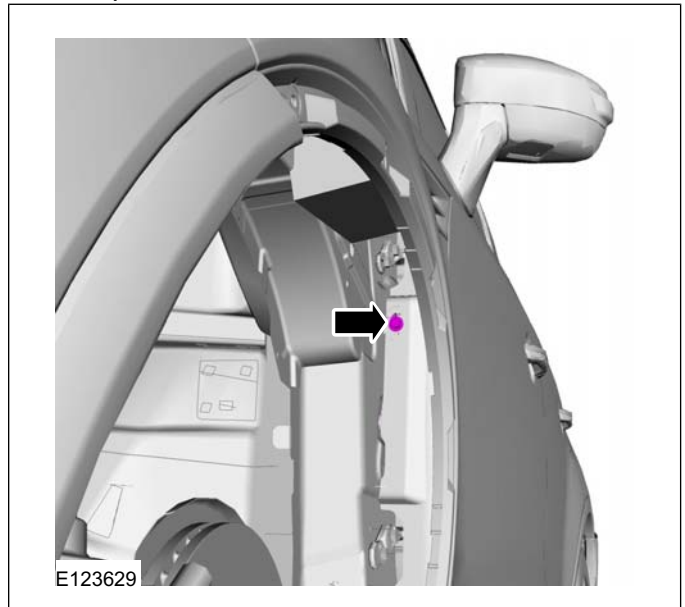
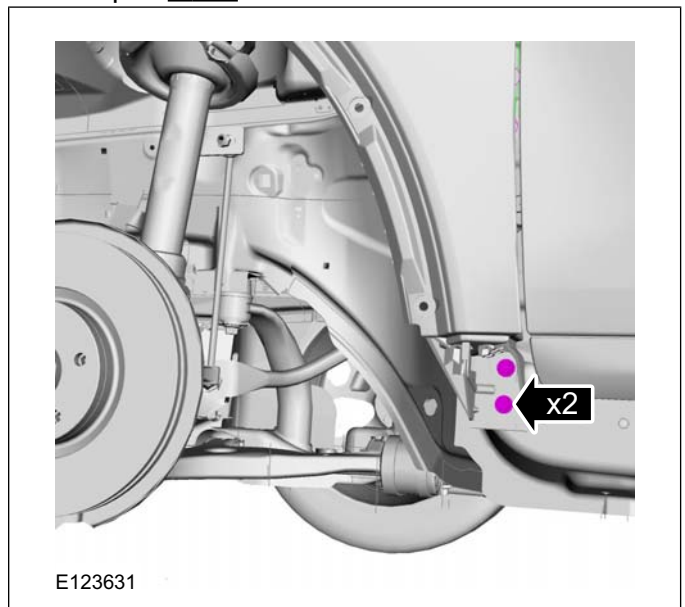
## REMOVAL AND INSTALLATION

## Front Fender

## Removal

1. Refer to: **Fender Splash Shield** (501-02 Front End Body Panels, Removal and Installation).  
Refer to: **Front Fender Moulding** (501-08 Exterior Trim and Ornamentation, Removal and Installation).  
Refer to: **Headlamp Assembly** (417-01 Exterior Lighting, Removal and Installation).  
Refer to: **Windshield Washer Reservoir** (501-16 Wipers and Washers, Removal and Installation).

2.

3. Torque: 7 Nm4. Torque: 7 Nm

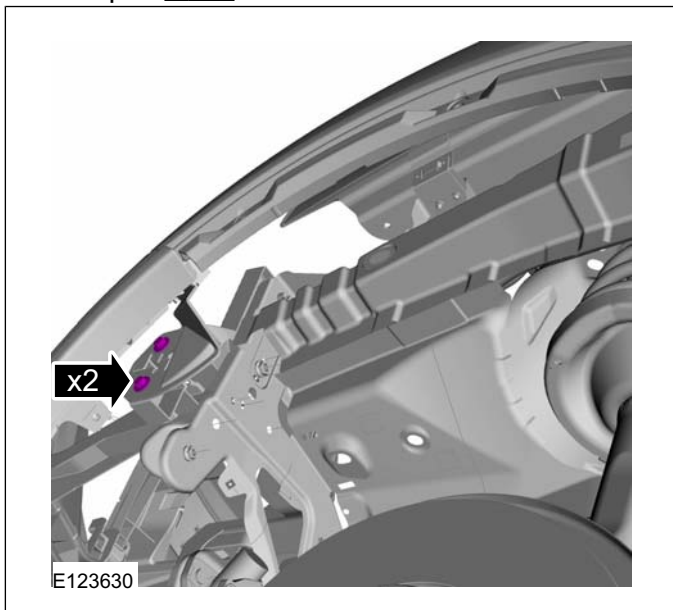
501-27-21

Front End Sheet Metal Repairs

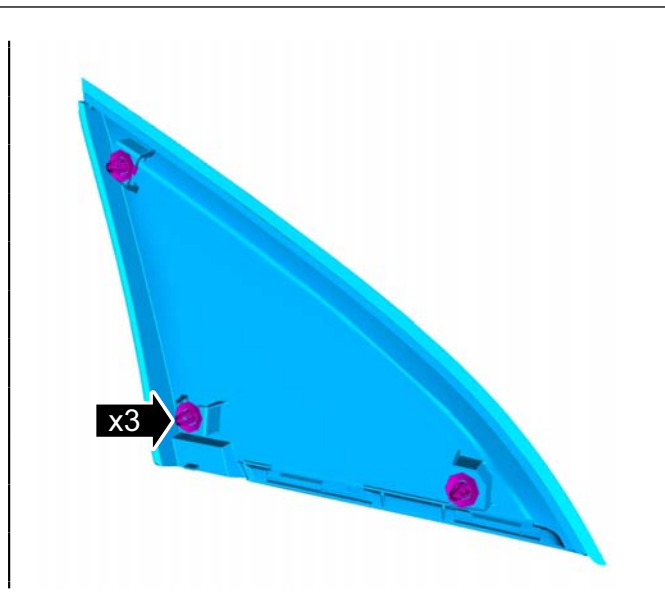
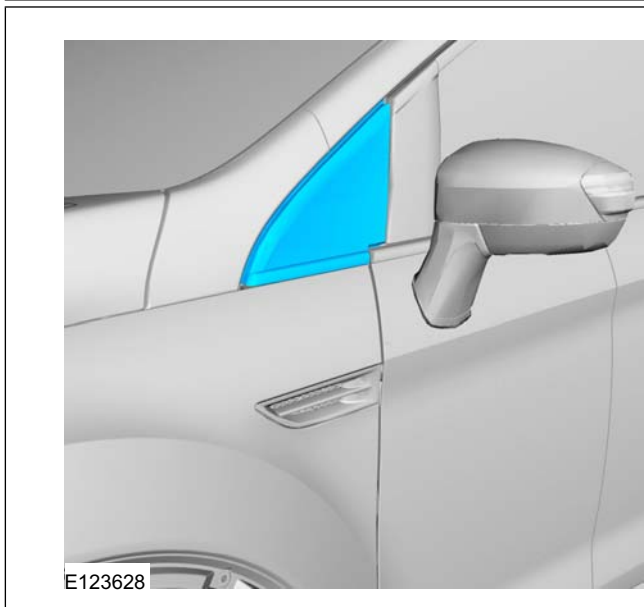
501-27-21

REMOVAL AND INSTALLATION

5. Torque: 7 Nm



6.



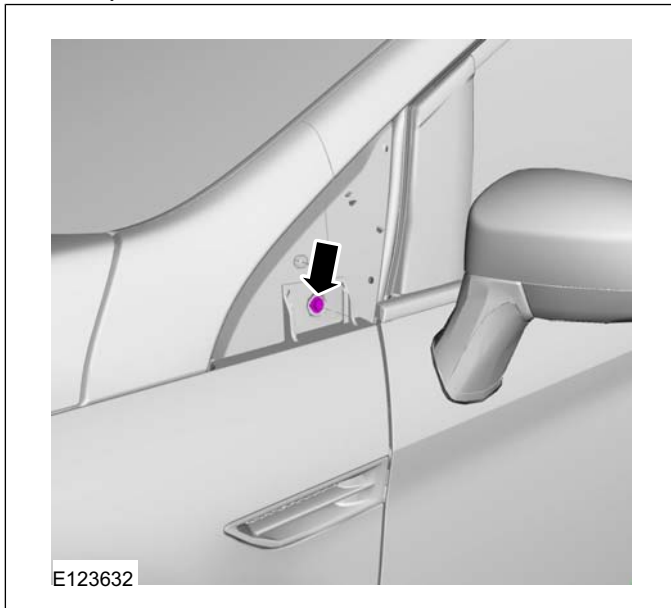
501-27-22

Front End Sheet Metal Repairs

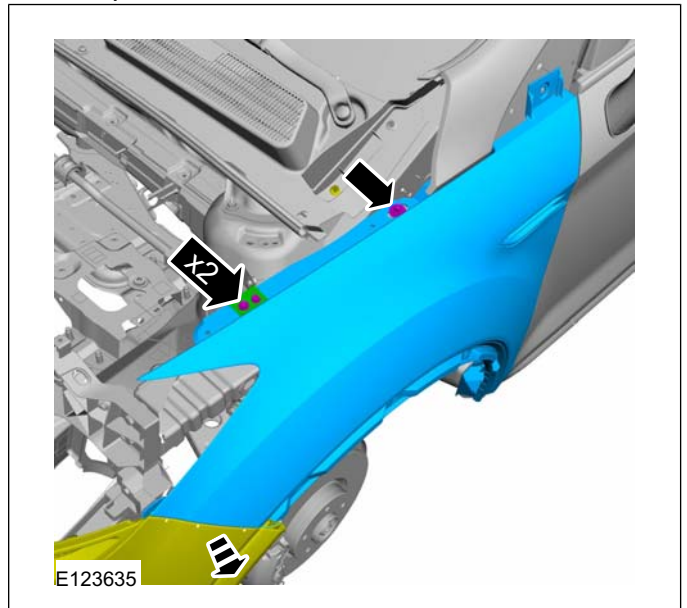
501-27-22

REMOVAL AND INSTALLATION

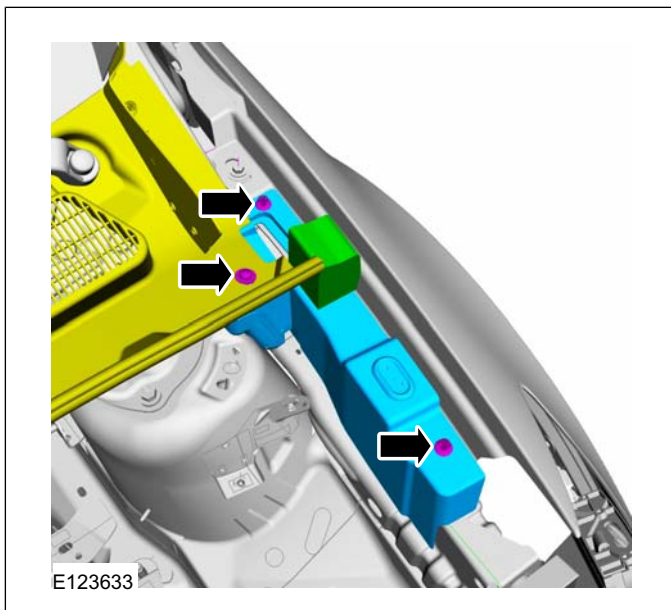
7. Torque: 7 Nm



9. Torque: 7 Nm



8.



Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Fender Apron Panel Section

## General Equipment

Air Body Saw

## General Equipment

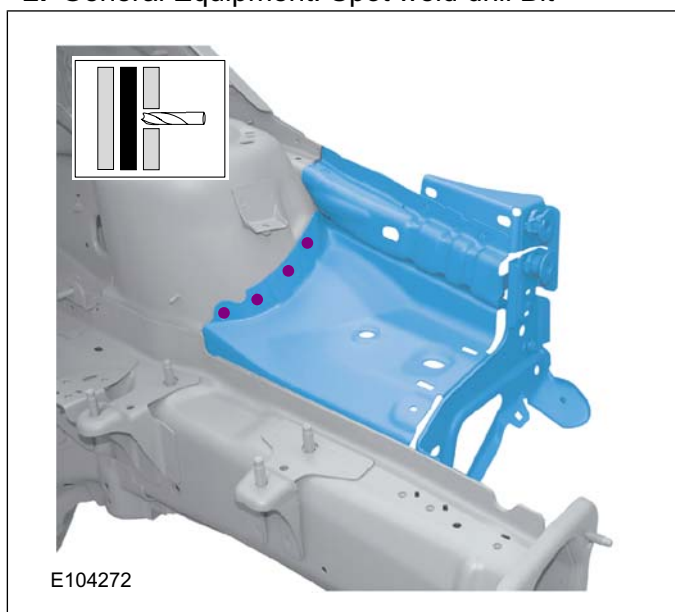
MIG/MAG Welding Equipment

Spot weld drill Bit

## Removal

1. Refer to: **Fender Apron Panel Reinforcement** (501-27 Front End Sheet Metal Repairs, Removal and Installation).
2. General Equipment: Spot weld drill Bit

3. 1. General Equipment: Air Body Saw
2. General Equipment: Spot weld drill Bit



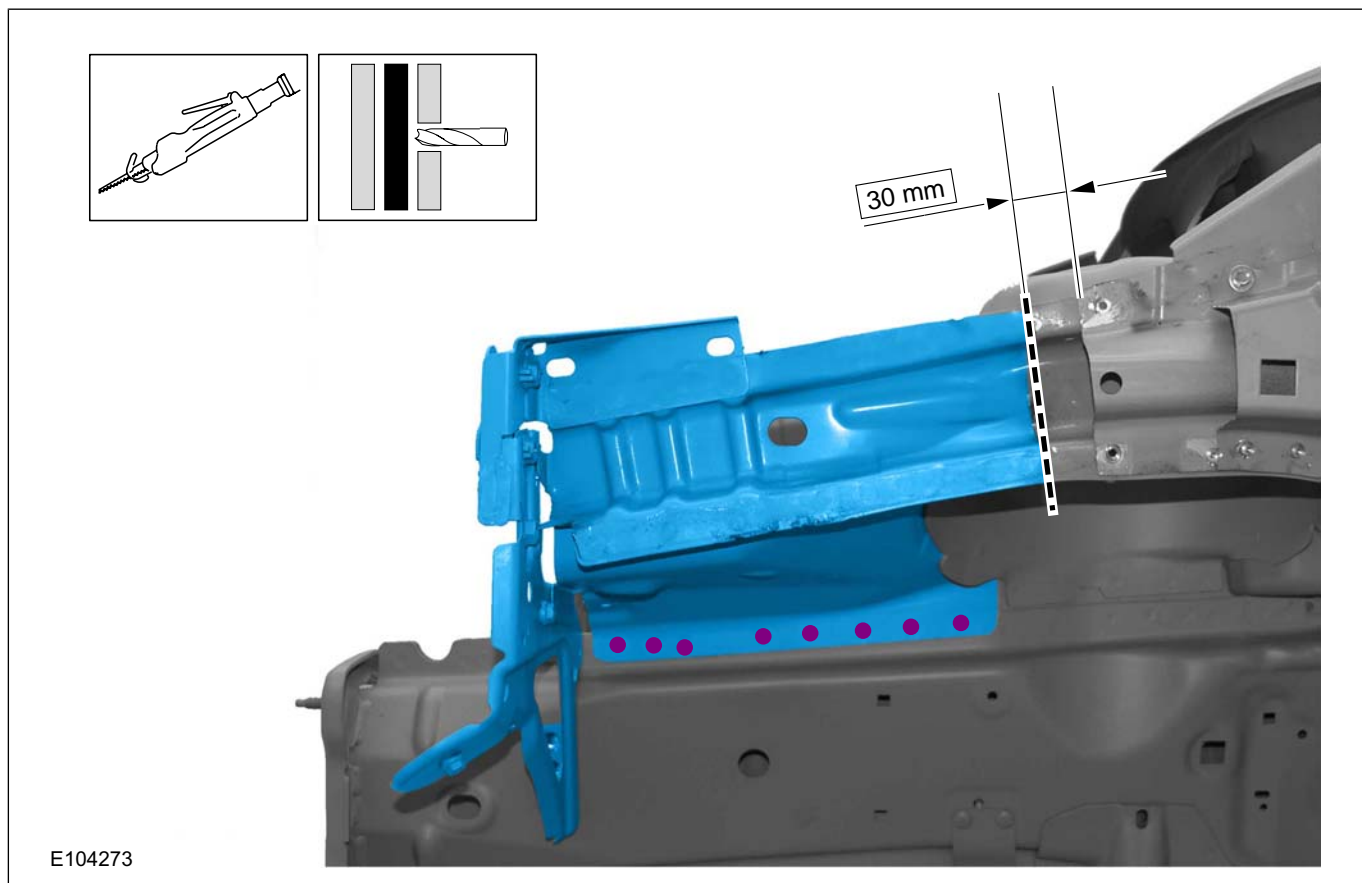


501-27-24

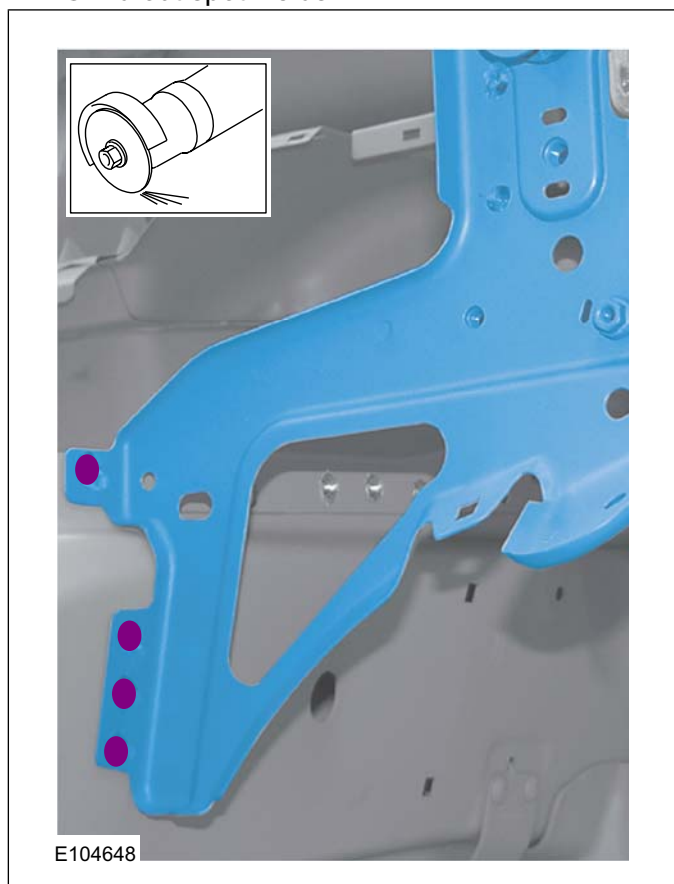
Front End Sheet Metal Repairs

501-27-24

## REMOVAL AND INSTALLATION



## 4. Grind out spot welds.



## Installation

**NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

**NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

501-27-25

Front End Sheet Metal Repairs

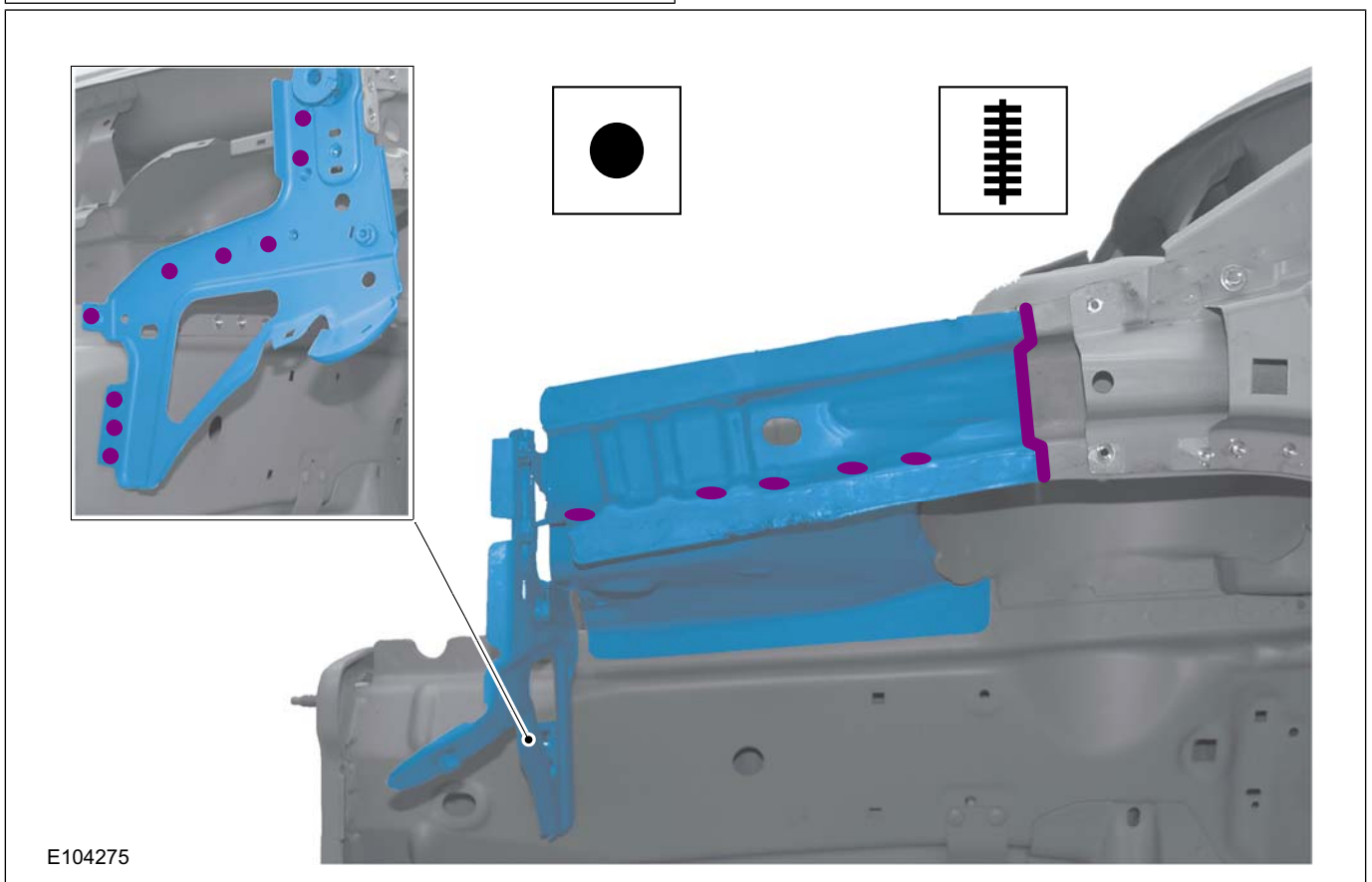
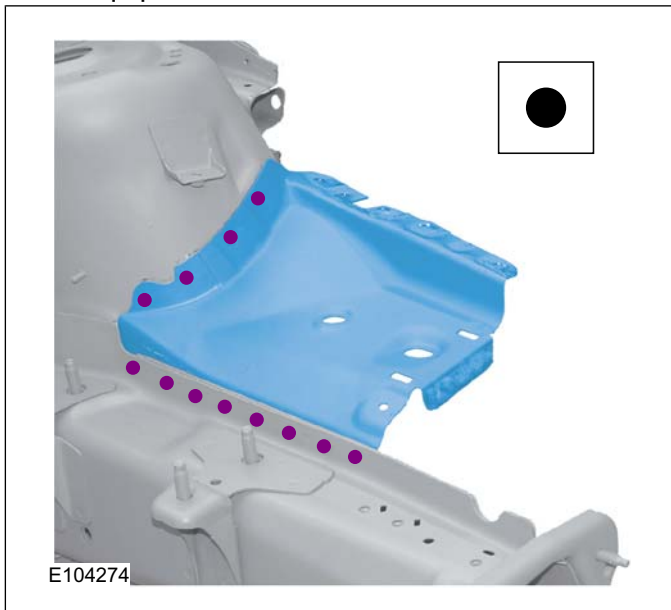
501-27-25

REMOVAL AND INSTALLATION

2. General Equipment: MIG/MAG Welding Equipment

3. Panel thickness 3 mm and greater!

General Equipment: MIG/MAG Welding Equipment



4. Refer to: **Fender Apron Panel Reinforcement** (501-27 Front End Sheet Metal Repairs, Removal and Installation).



# SECTION 501-28 Roof Sheet Metal Repairs

VEHICLE APPLICATION: 2008.50 Kuga

CONTENTS	PAGE
<b>REMOVAL AND INSTALLATION</b>	
Roof Panel.....	501-28-2
Roof Front Frame.....	501-28-9
Roof Rear Frame.....	501-28-11



## REMOVAL AND INSTALLATION

## Roof Panel

## General Equipment

6 mm Drill Bit
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

## General Equipment

Spot weld drill Bit
---------------------

## Materials

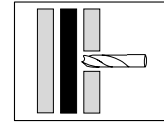
Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

## Removal

- Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **B-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **C-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **D-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **Headliner** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **Windshield Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).
  - Refer to: **Liftgate** (501-03 Body Closures, Removal and Installation).
  - Reposition the carpeting and the wiring harness away from the working area.
- General Equipment: Spot weld drill Bit

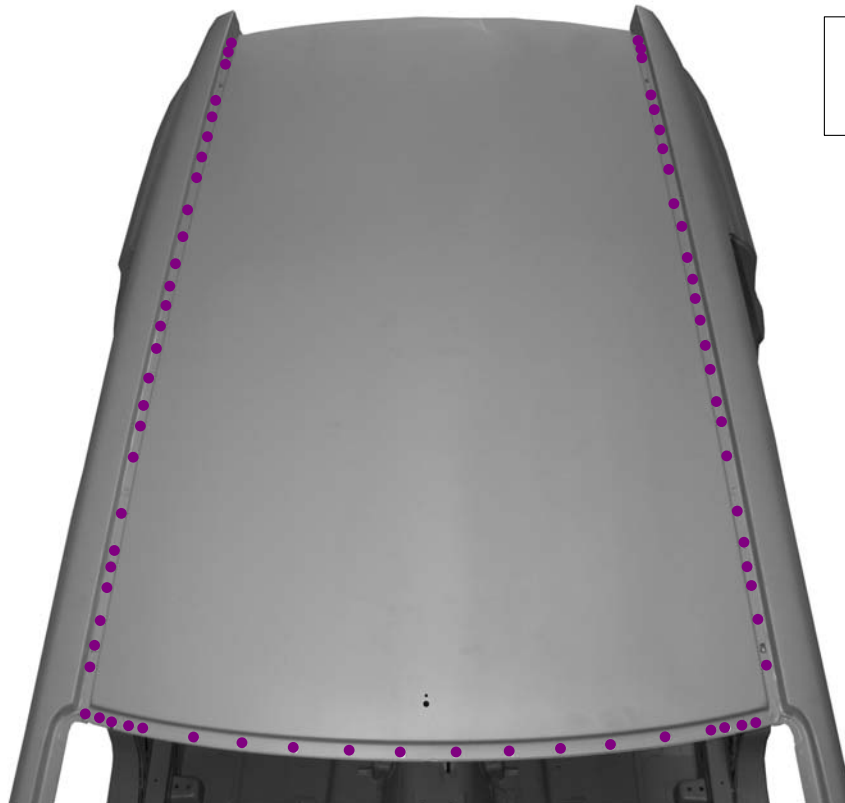
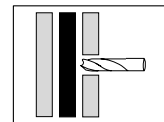


REMOVAL AND INSTALLATION



E119464

3. General Equipment: Spot weld drill Bit

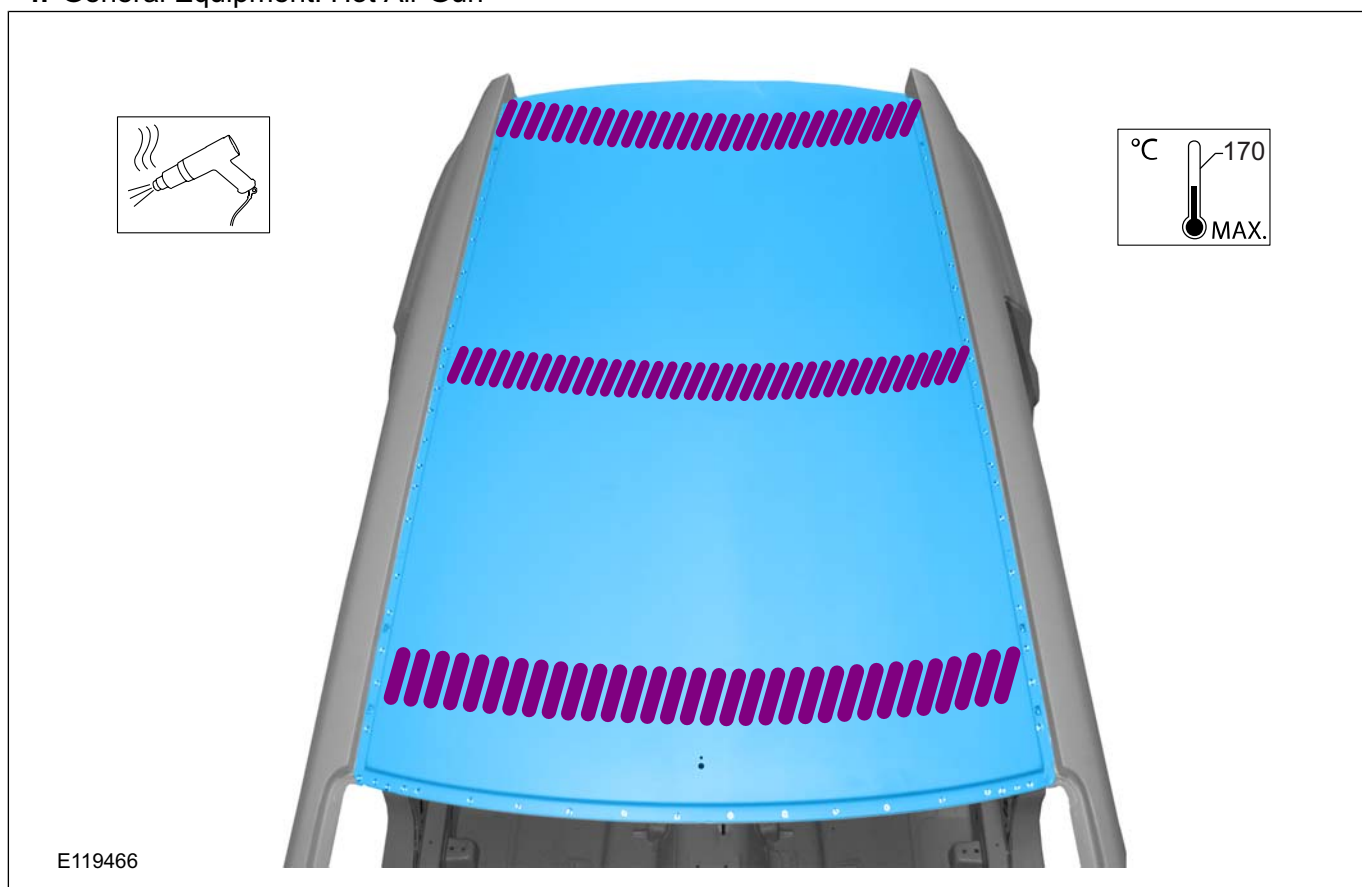


E119465



## REMOVAL AND INSTALLATION

## 4. General Equipment: Hot Air Gun



## Installation

- NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

- NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

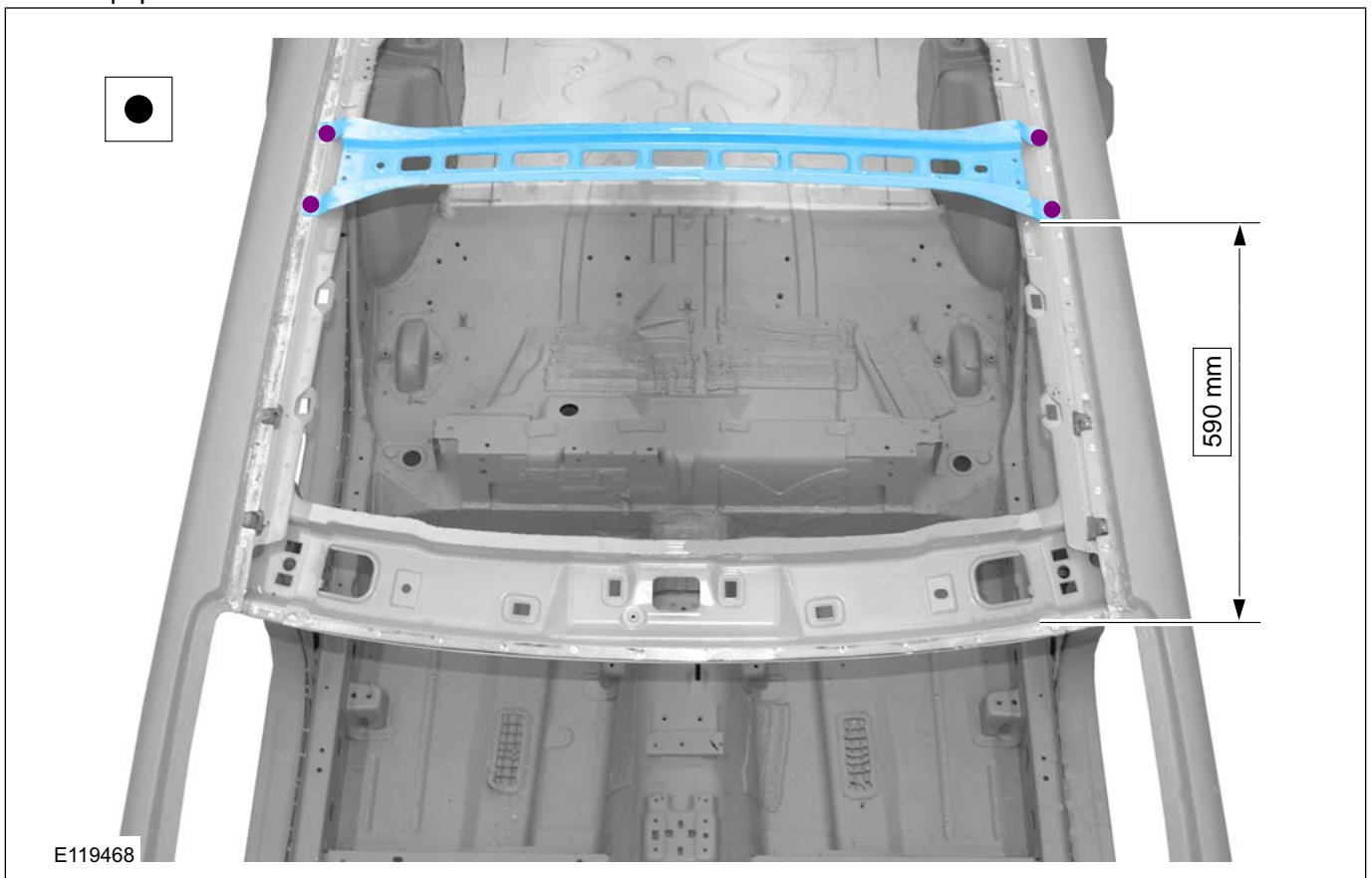
- General Equipment: 6 mm Drill Bit



REMOVAL AND INSTALLATION



4. General Equipment: Resistance Spotwelding  
Equipment



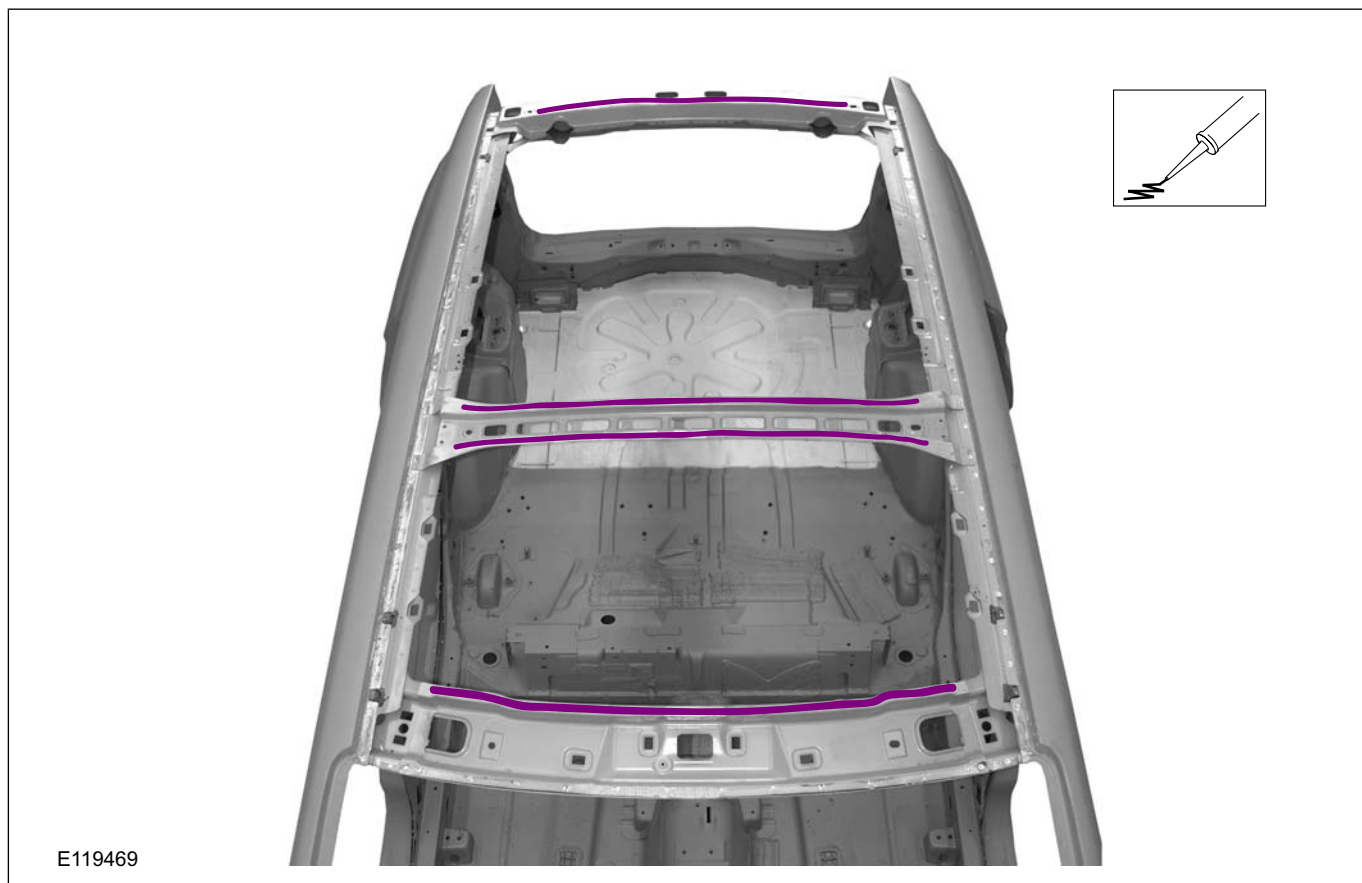
5. Material: Windshield Adhesive Kit  
(WSS-M11P57-A5) adhesive

501-28-6

## Roof Sheet Metal Repairs

501-28-6

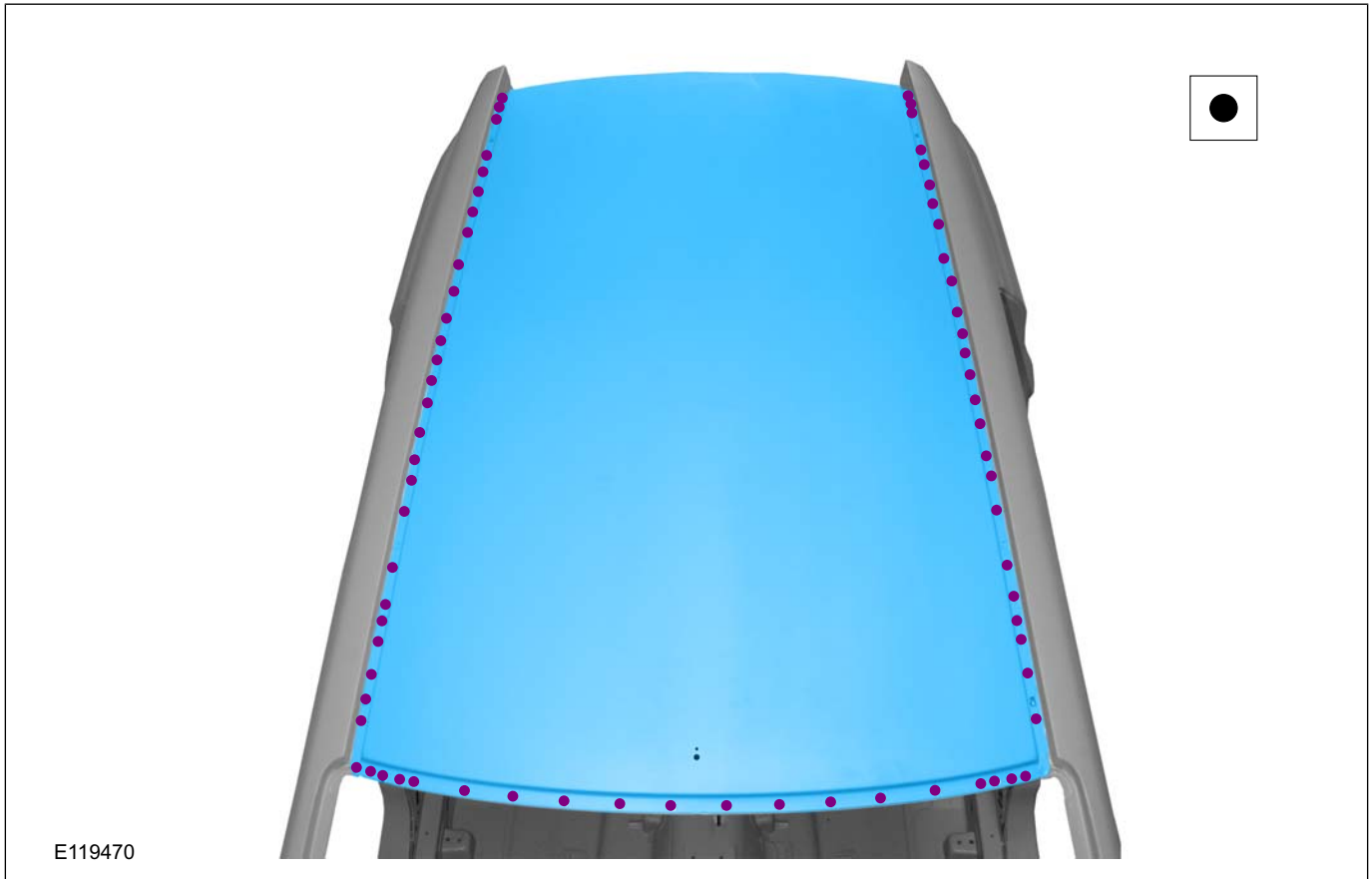
## REMOVAL AND INSTALLATION



6. Resistance spot weld - Panel thickness 3 mm and greater!

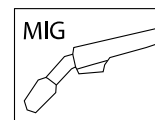
General Equipment: Resistance Spotwelding Equipment

## REMOVAL AND INSTALLATION



7. General Equipment: MIG/MAG Welding Equipment

## REMOVAL AND INSTALLATION



8. • Refer to: **Windshield Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).  
Refer to: **Liftgate** (501-03 Body Closures, Removal and Installation).  
Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).  
Refer to: **B-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).  
Refer to: **C-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).  
Refer to: **D-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).  
Refer to: **Headliner** (501-05 Interior Trim and Ornamentation, Removal and Installation).

## REMOVAL AND INSTALLATION

## Roof Front Frame

## General Equipment

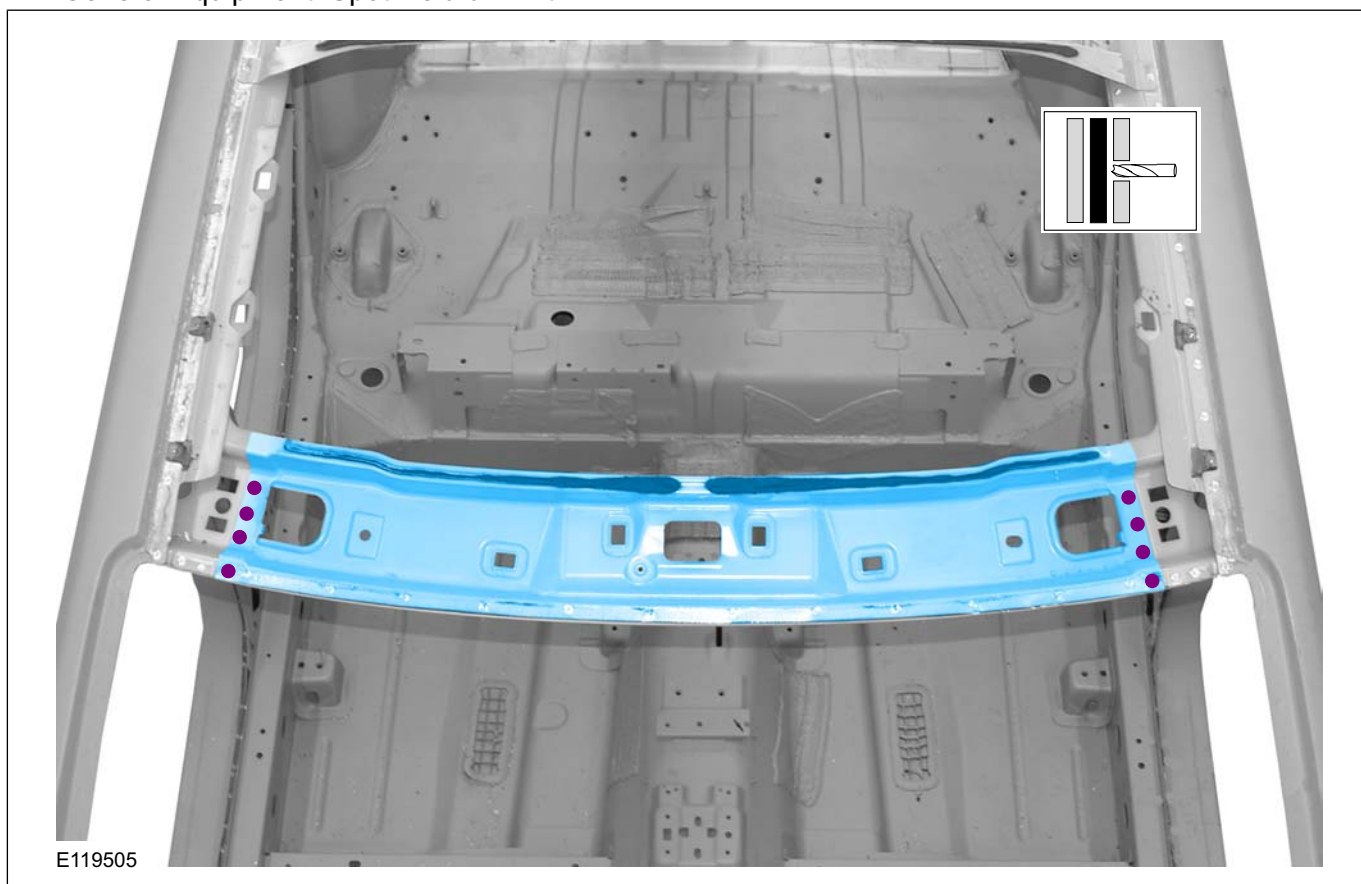
Resistance Spotwelding Equipment

## General Equipment

Spot weld drill Bit

## Removal

1. Refer to: **Roof Panel** (501-28 Roof Sheet Metal Repairs, Removal and Installation).
2. General Equipment: Spot weld drill Bit



## Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

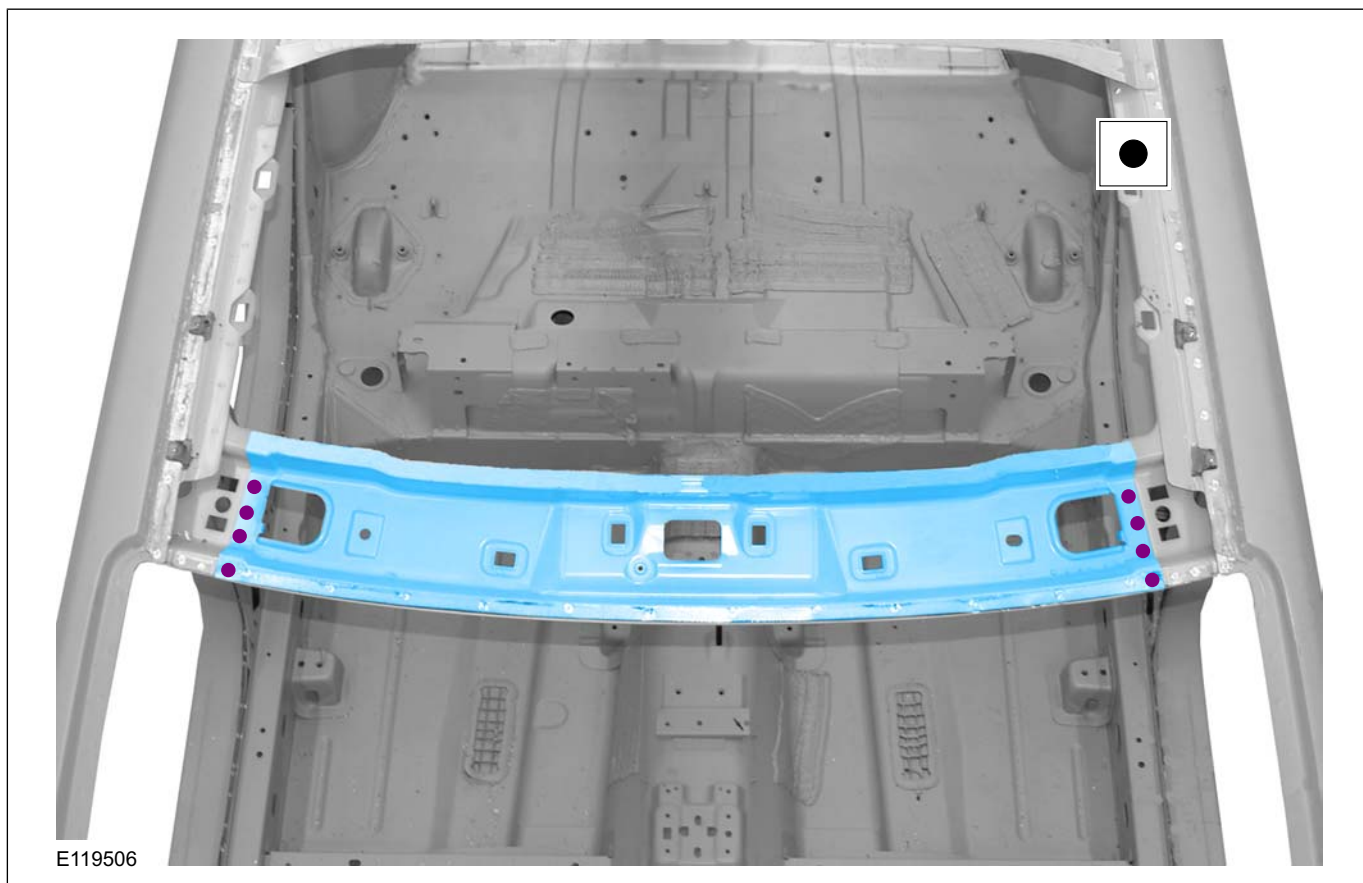
Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

3. General Equipment: Resistance Spotwelding Equipment

## REMOVAL AND INSTALLATION



4. Refer to: **Roof Panel** (501-28 Roof Sheet Metal Repairs, Removal and Installation).



## REMOVAL AND INSTALLATION

## Roof Rear Frame

## General Equipment

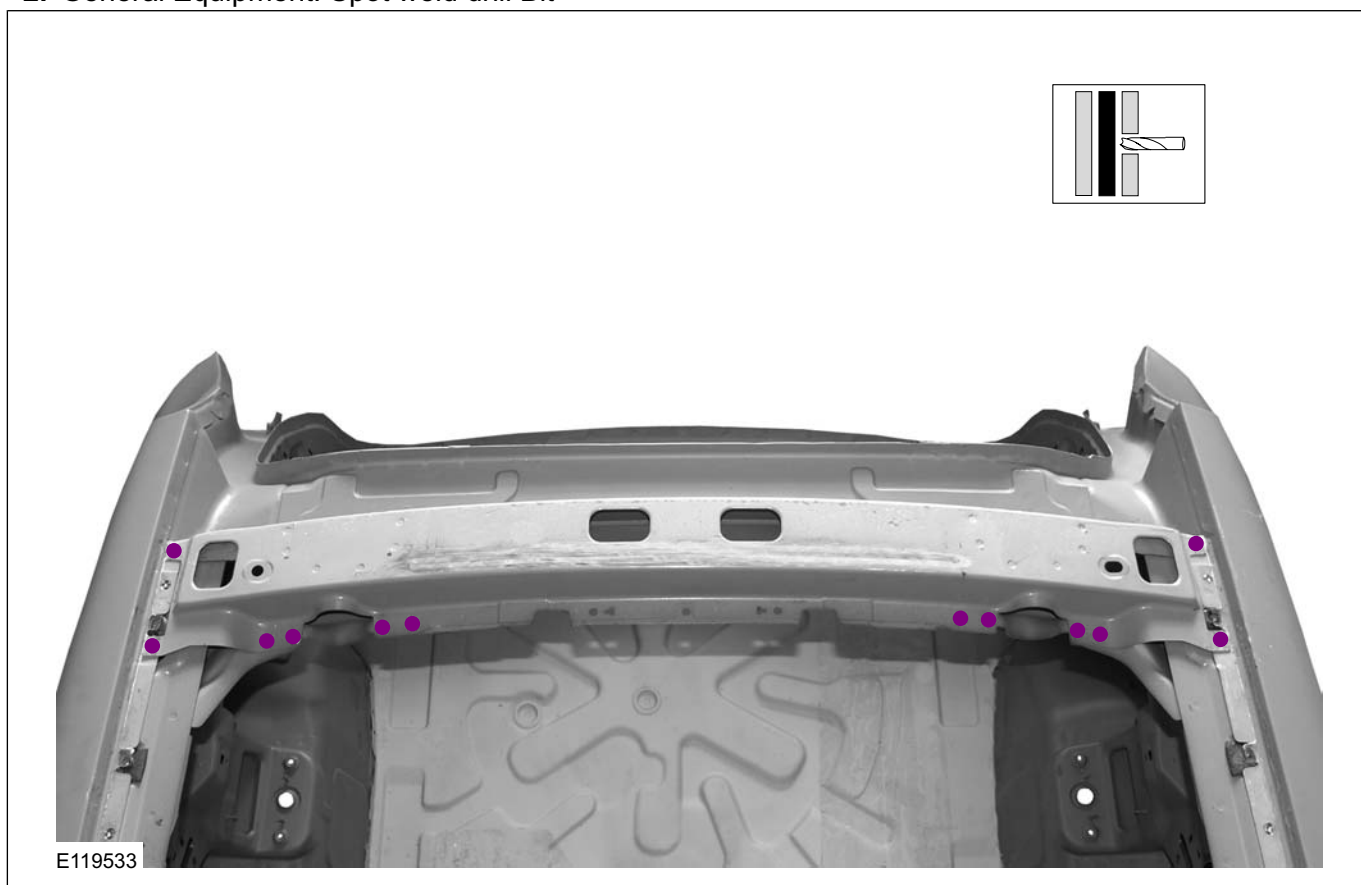
8 mm Drill Bit
MIG/MAG Welding Equipment

## General Equipment

Resistance Spotwelding Equipment
Spot weld drill Bit

## Removal

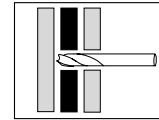
1. Refer to: **Roof Panel** (501-28 Roof Sheet Metal Repairs, Removal and Installation).
2. General Equipment: Spot weld drill Bit



3. General Equipment: Spot weld drill Bit

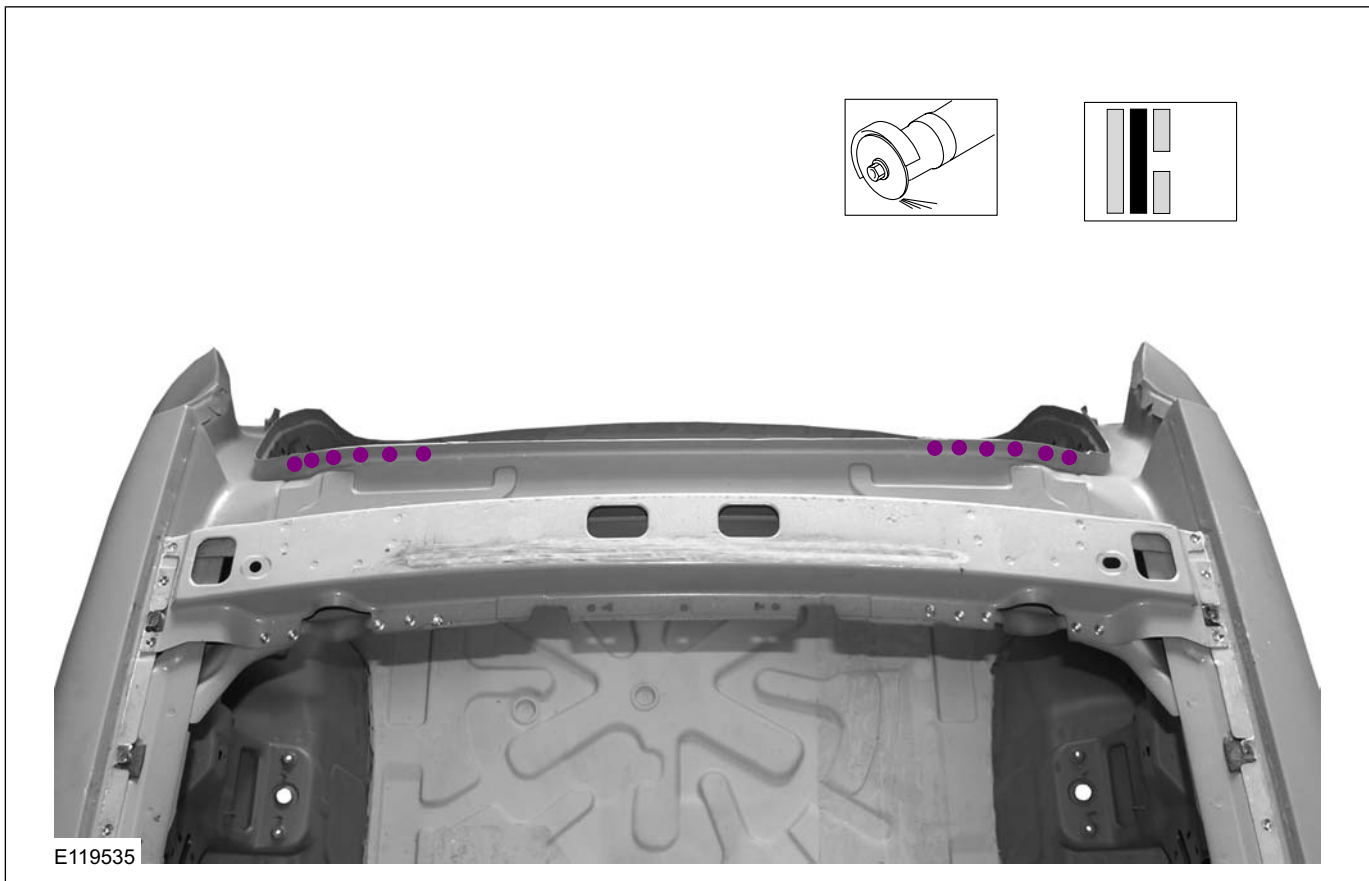
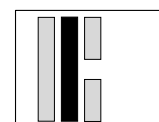
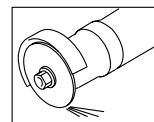


REMOVAL AND INSTALLATION



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4.



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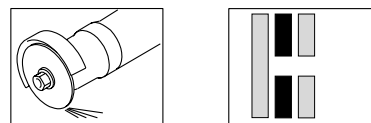
501-28-13

## Roof Sheet Metal Repairs

501-28-13

## REMOVAL AND INSTALLATION

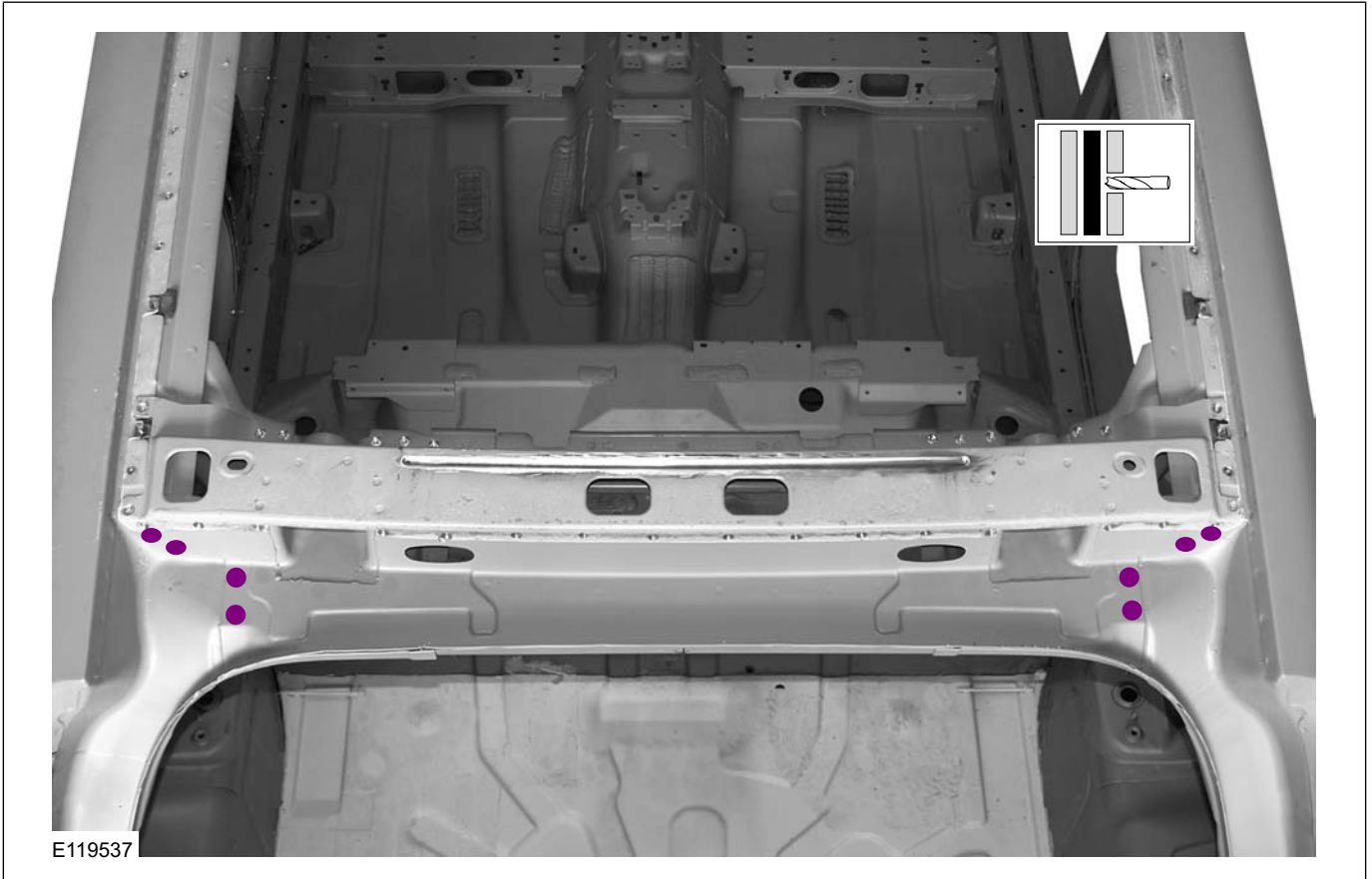
5.



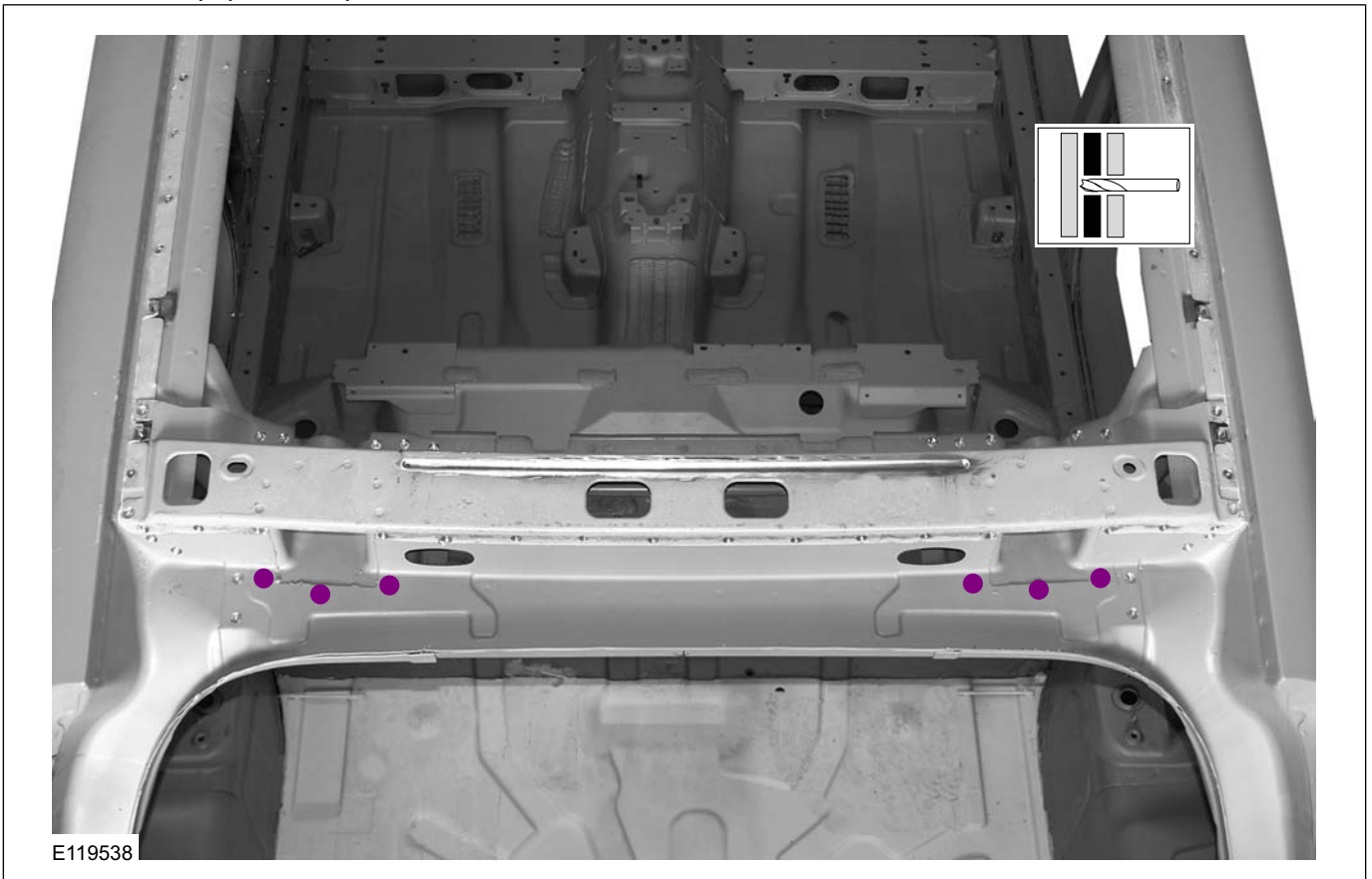
6. General Equipment: Spot weld drill Bit



REMOVAL AND INSTALLATION

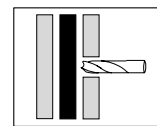


7. General Equipment: Spot weld drill Bit



## REMOVAL AND INSTALLATION

## 8. General Equipment: Spot weld drill Bit



## Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

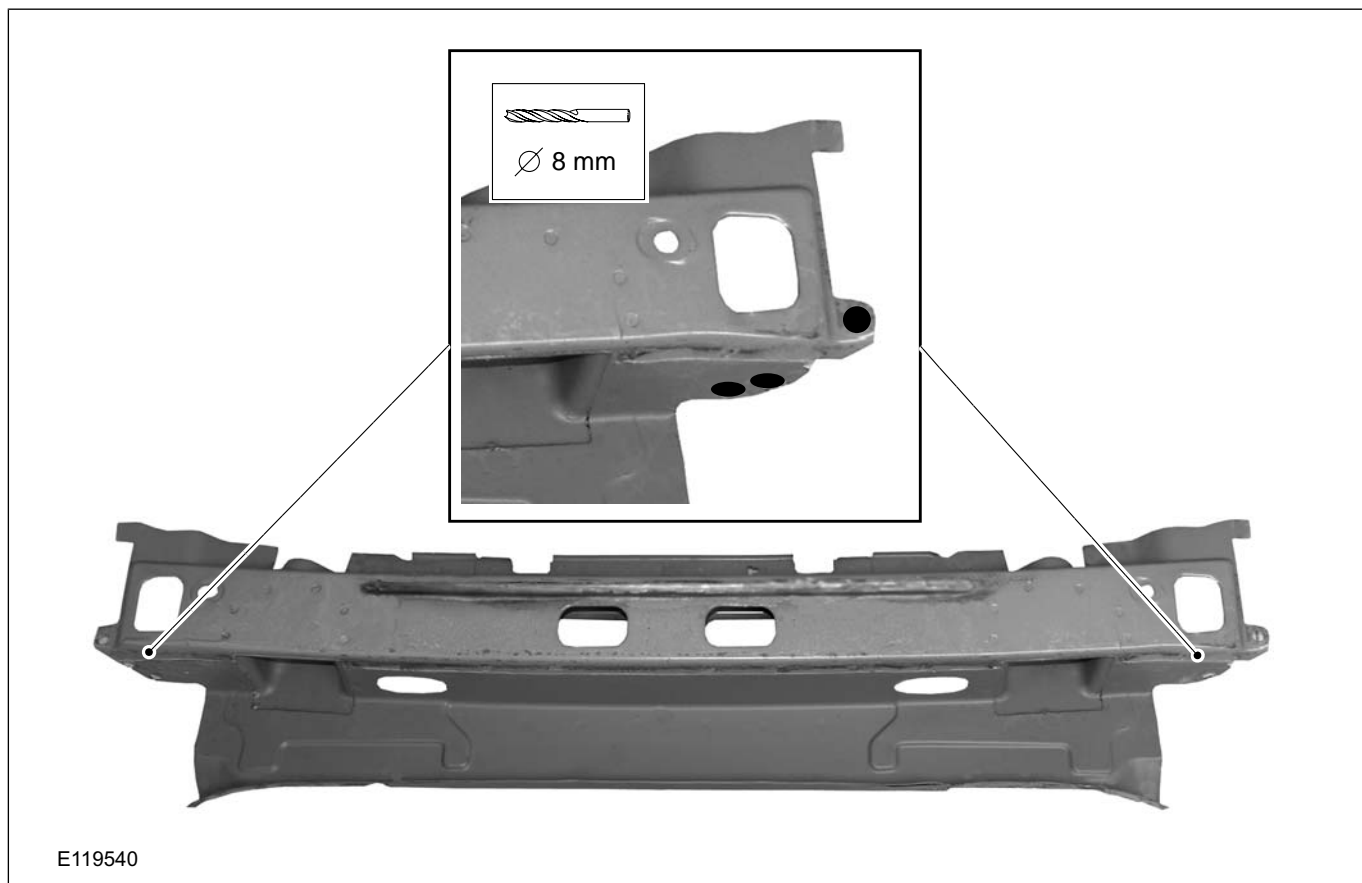
3. General Equipment: 8 mm Drill Bit

501-28-16

## Roof Sheet Metal Repairs

501-28-16

## REMOVAL AND INSTALLATION

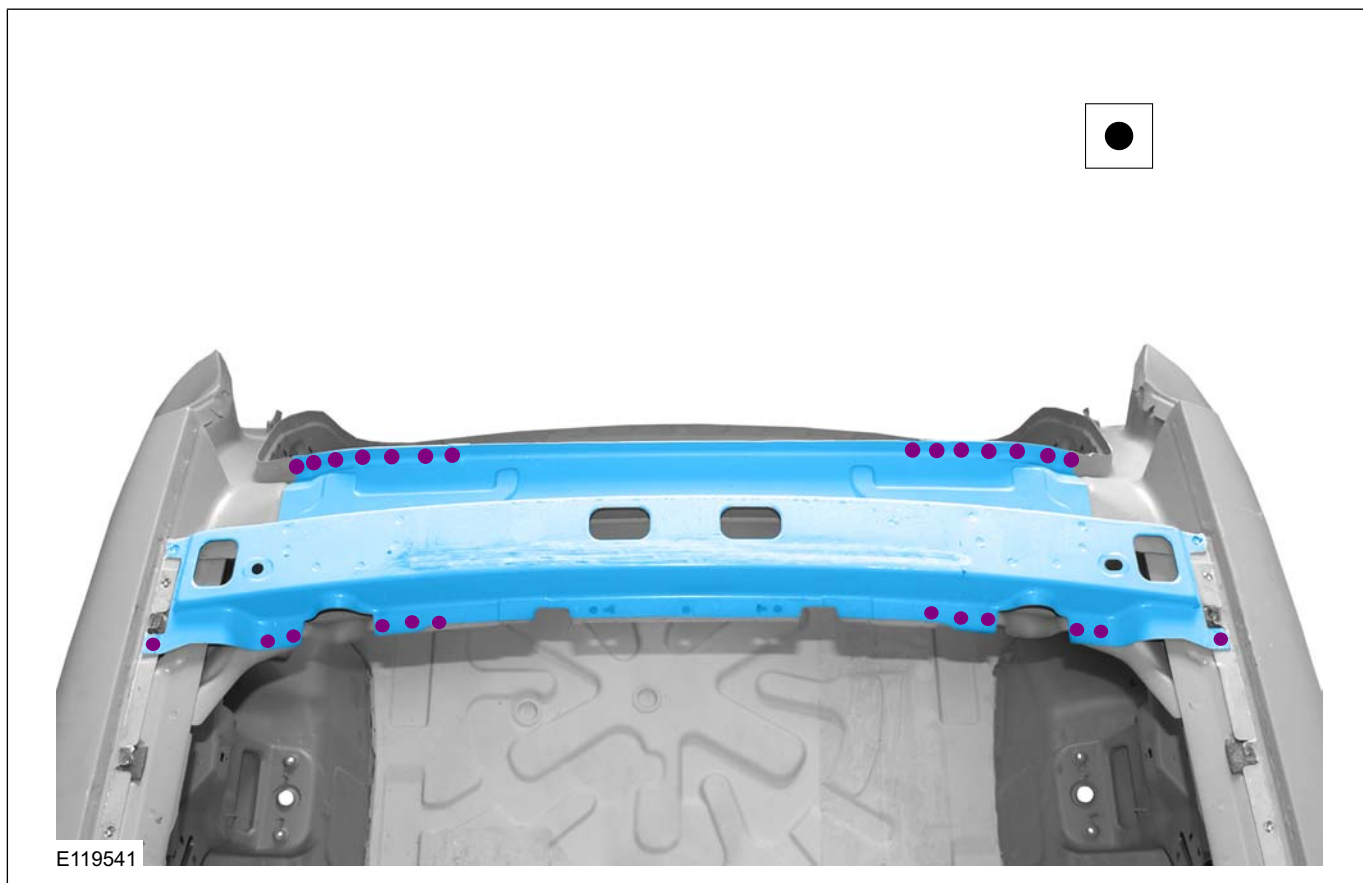


4. Resistance spot weld - Panel thickness 3 mm and greater!

General Equipment: Resistance Spotwelding Equipment

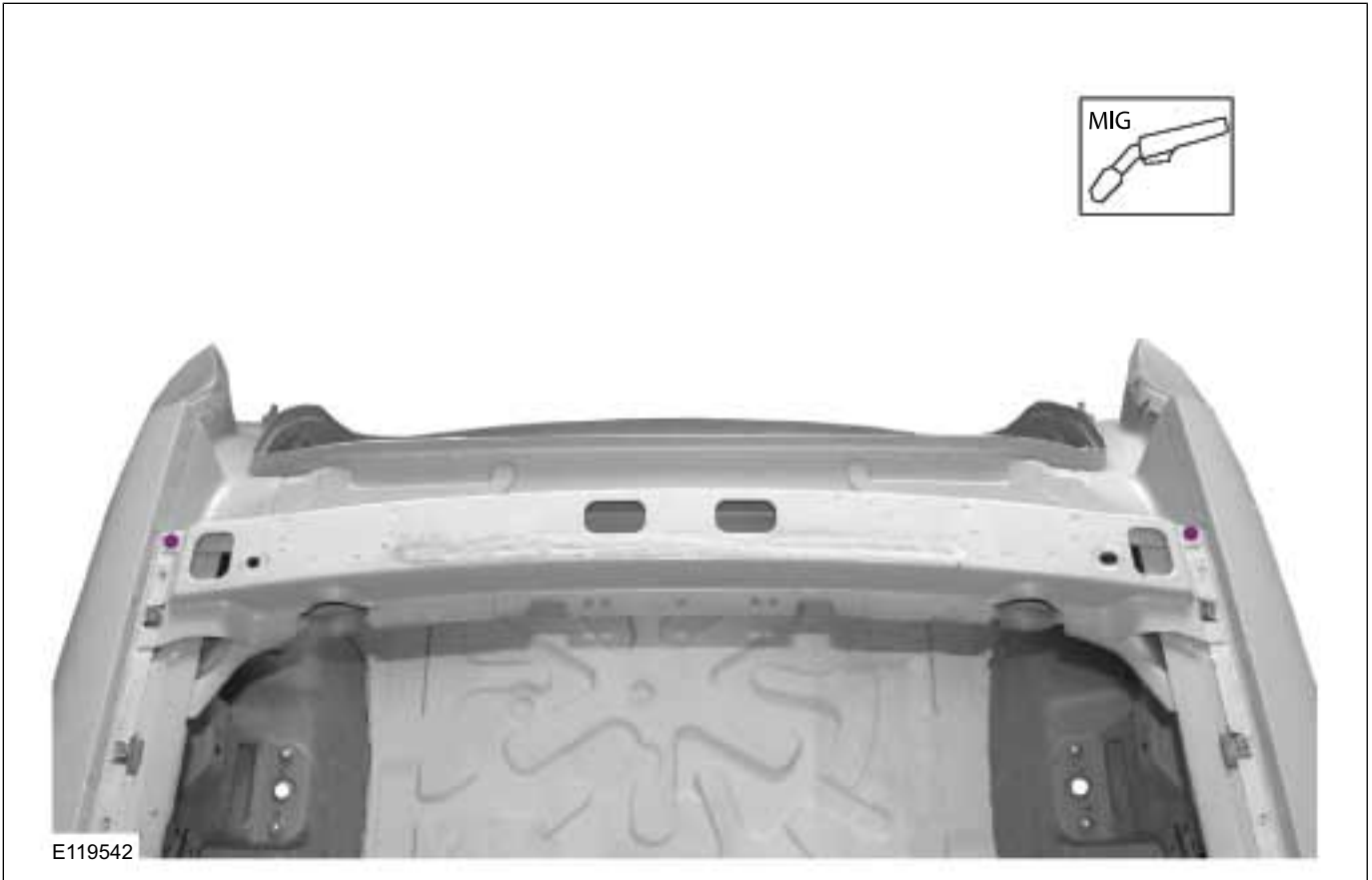
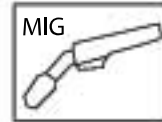


## REMOVAL AND INSTALLATION



5. General Equipment: MIG/MAG Welding Equipment

## REMOVAL AND INSTALLATION



6. Resistance spot weld - Panel thickness 3 mm and greater!

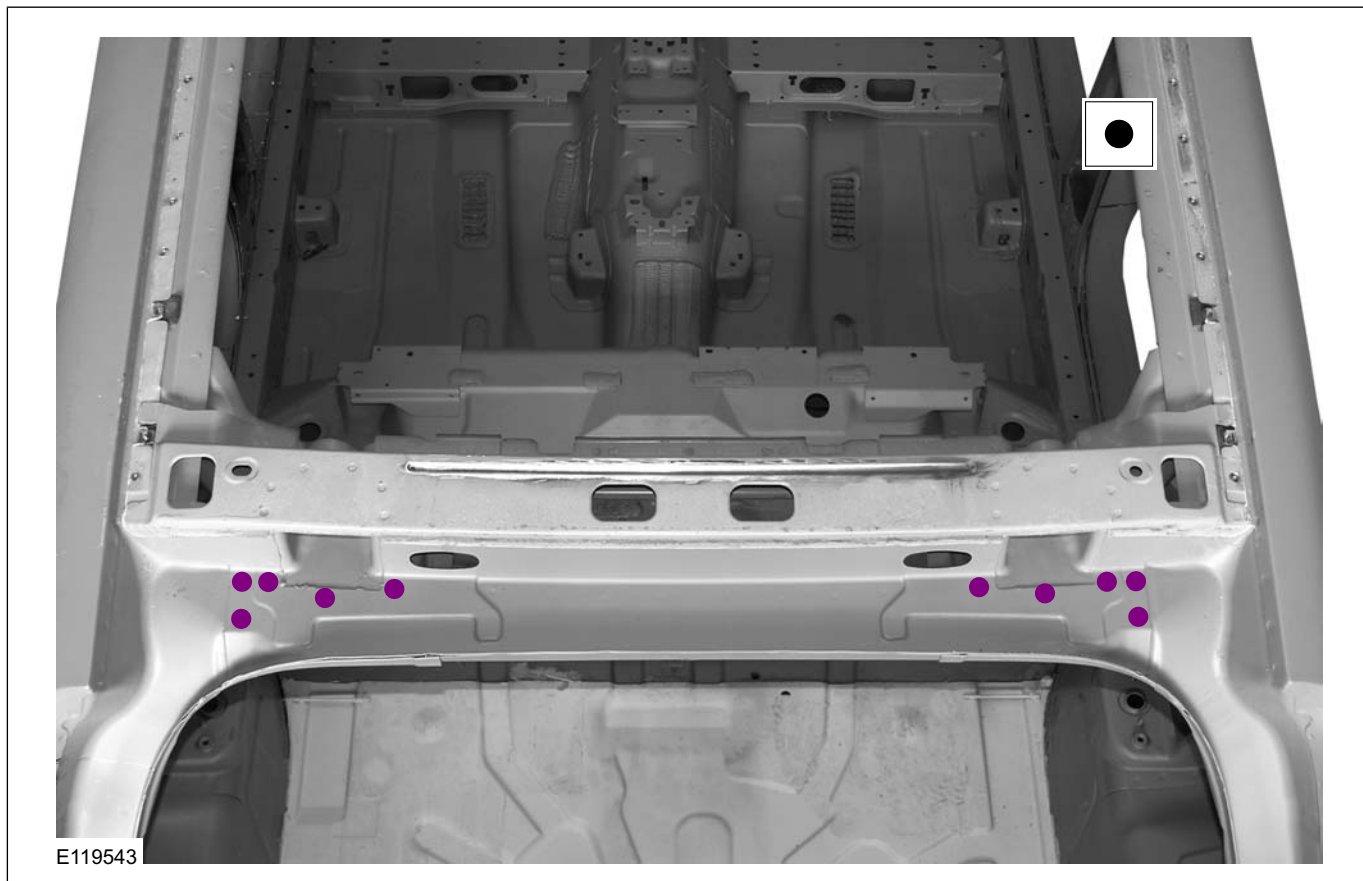
General Equipment: Resistance Spotwelding Equipment

501-28-19

## Roof Sheet Metal Repairs

501-28-19

## REMOVAL AND INSTALLATION



7. General Equipment: MIG/MAG Welding Equipment

501-28-20

## Roof Sheet Metal Repairs

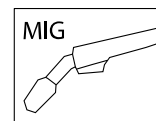
501-28-20

## REMOVAL AND INSTALLATION



8. General Equipment: MIG/MAG Welding Equipment

## REMOVAL AND INSTALLATION



9. Refer to: **Roof Panel** (501-28 Roof Sheet Metal Repairs, Removal and Installation).



# SECTION 501-29 Side Panel Sheet Metal Repairs

VEHICLE APPLICATION: 2008.50 Kuga

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<b>REMOVAL AND INSTALLATION</b>	
Rocker Panel.....	501-29-2
B-Pillar and Reinforcement.....	501-29-9
B-Pillar Outer Panel.....	501-29-26
Rocker Panel Inner Reinforcement.....	501-29-30
A-Pillar Outer Panel Section and Reinforcement.....	501-29-33





**REMOVAL AND INSTALLATION****Rocker Panel****Removal**

1. • **Replacement Parts:**
  - Rocker Panel
2. • **Necessary Removal and Installation Work:**
  - Front and Rear Door
  - Door Hinges
  - Rocker Panel Cladding
  - Front Wheel Arch Trim
  - Rear Wheel Arch Trim
  - A- B- and C-Pillar Trim

Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

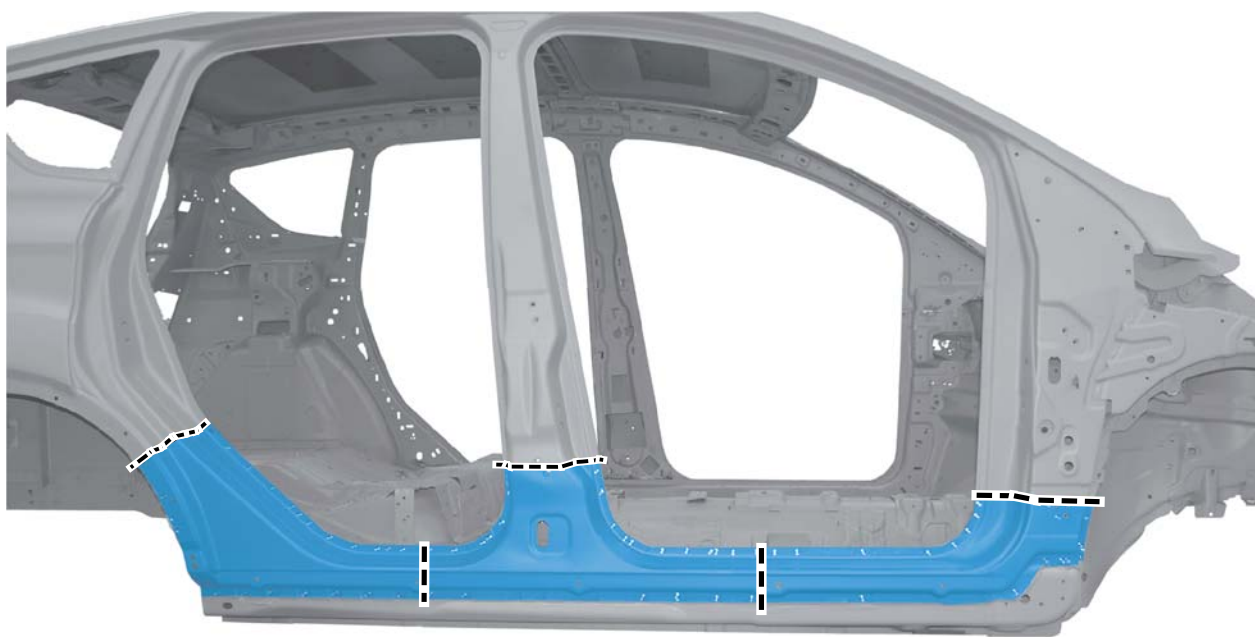
Refer to: **B-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

Refer to: **C-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- Rocker Panel Trim
  - Driver or Passenger Seat
- Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
- Rear Seat
- Refer to: **Rear Seat Cushion** (501-10 Seating, Removal and Installation).
- Refer to: **Rear Seat Backrest** (501-10 Seating, Removal and Installation).
- Reposition the carpeting and the wiring harness away from the working area.
3. **NOTE:** The cut locations may vary depending upon the extent of the damage. The repair shown describes a full replacement.
    - **Rocker Panel**
    - Rocker panel cut lines options.



REMOVAL AND INSTALLATION



E102036



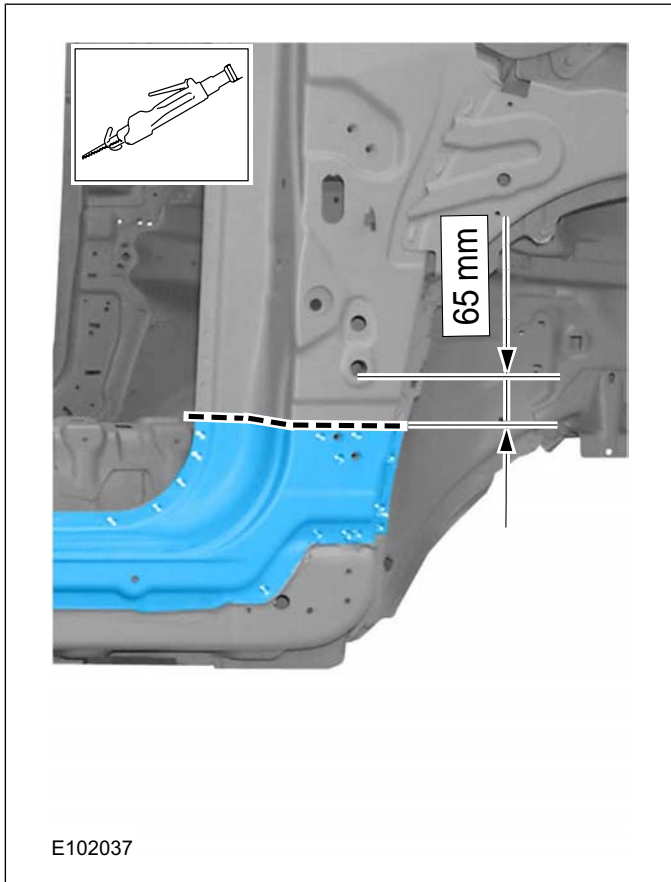
501-29-4

Side Panel Sheet Metal Repairs

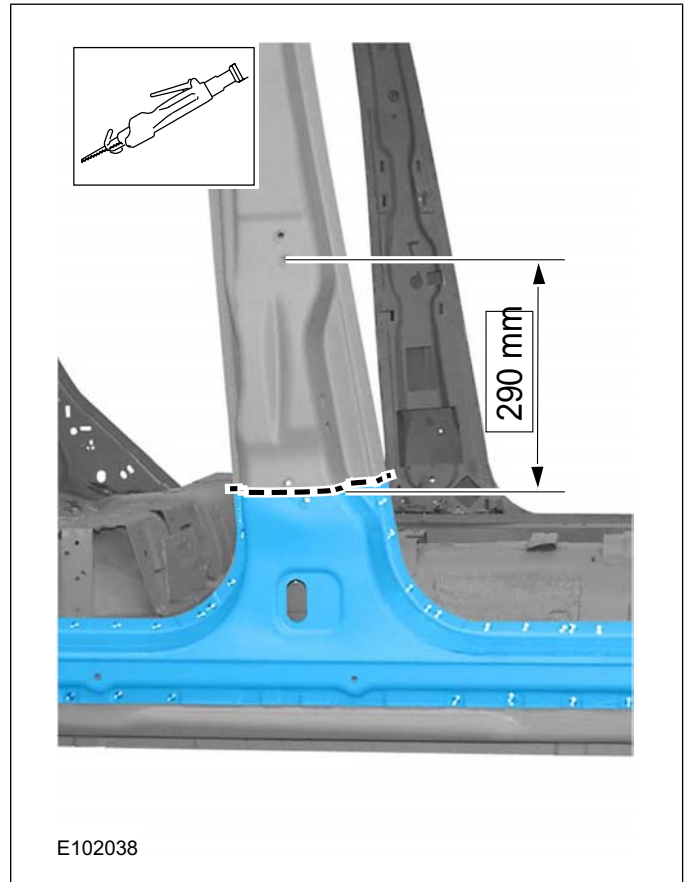
501-29-4

REMOVAL AND INSTALLATION

4. • **Rocker Panel - A-Pillar**  
• Cut line.



5. • **Rocker Panel - B-Pillar**  
• Cut line.



## 501-29-5

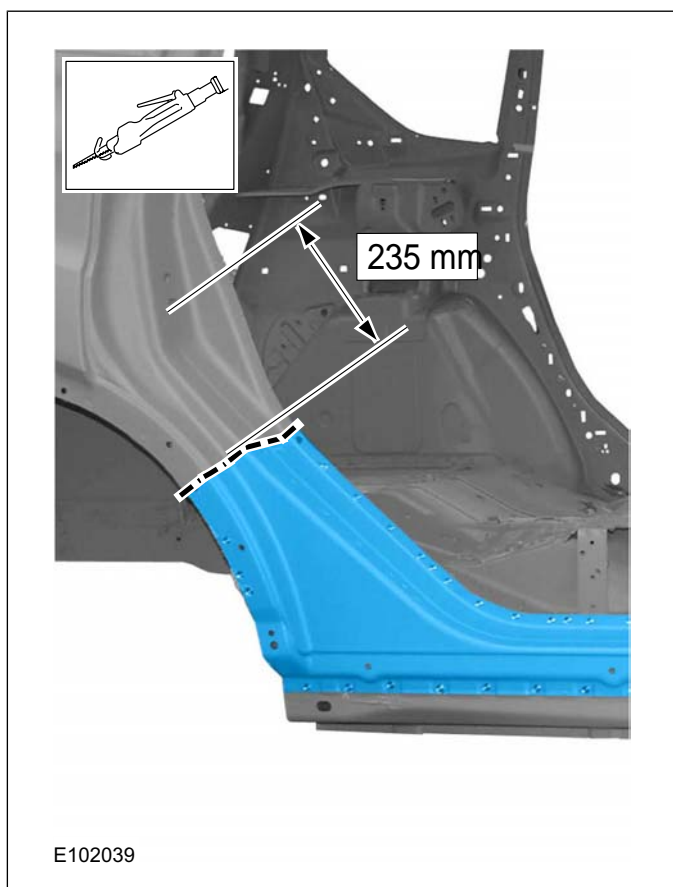
## Side Panel Sheet Metal Repairs

## 501-29-5

## REMOVAL AND INSTALLATION

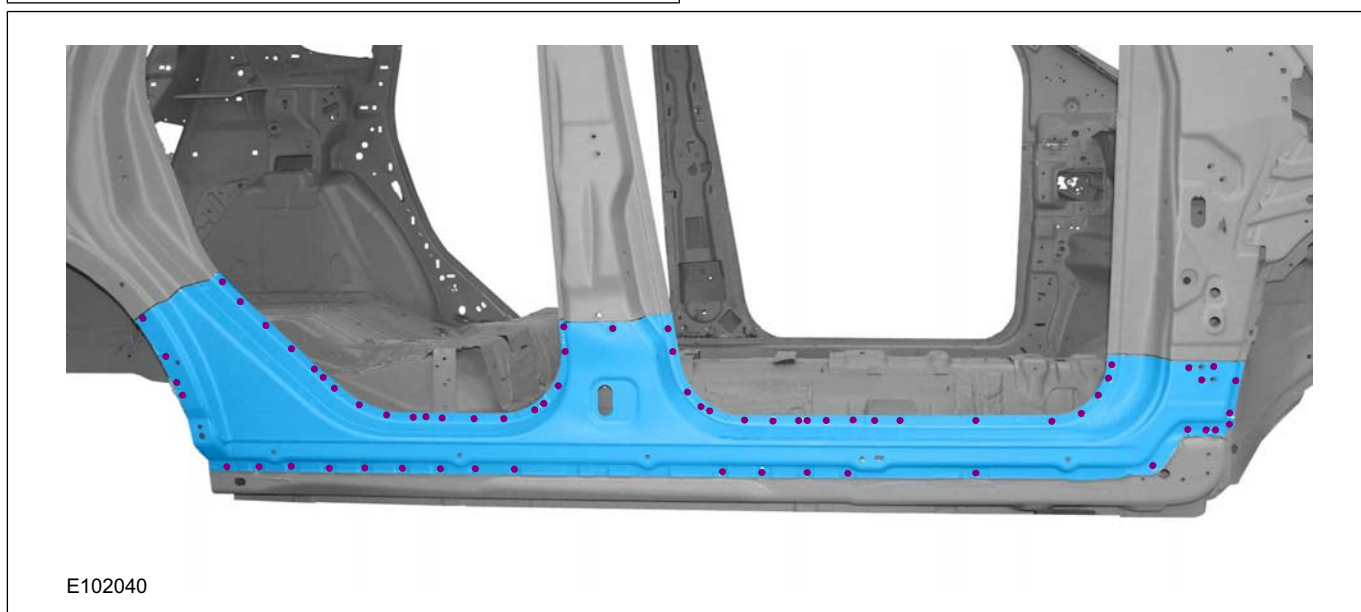
## 6. • Rocker Panel - C-Pillar

- Cut line.



## 7. • Rocker Panel

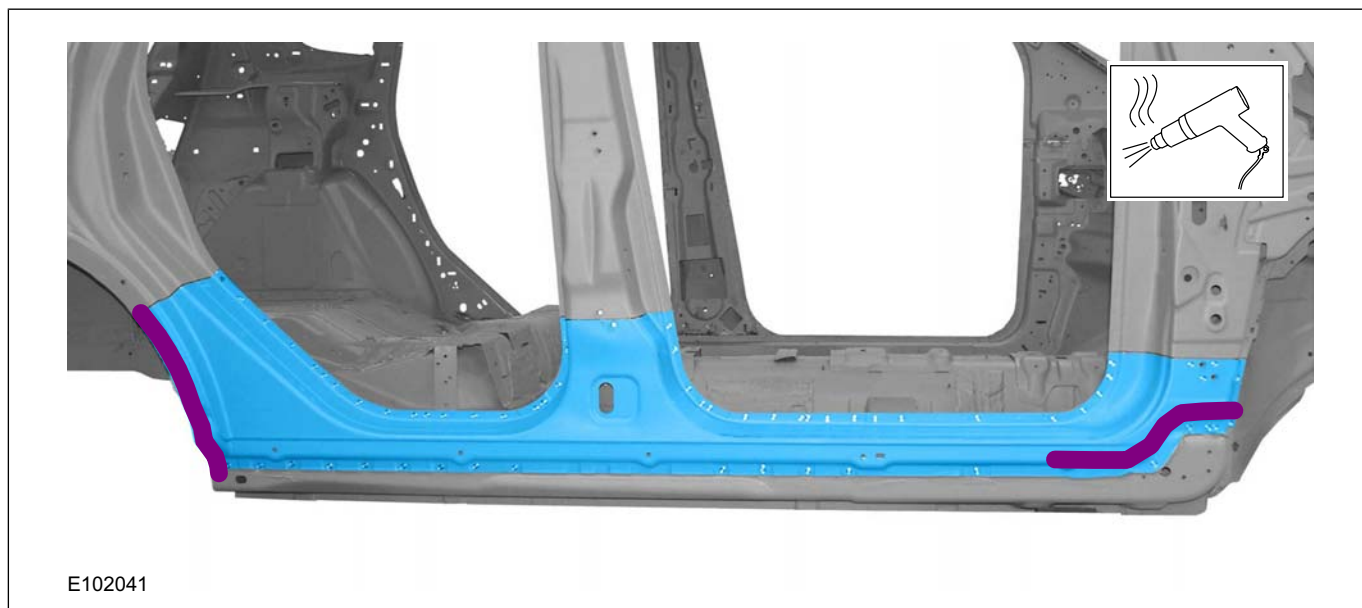
- Mill out the spot welds.



## 8. • Rocker Panel

- Heat the area (approx. 170 °C) and detach bonded/sealed areas.

## REMOVAL AND INSTALLATION



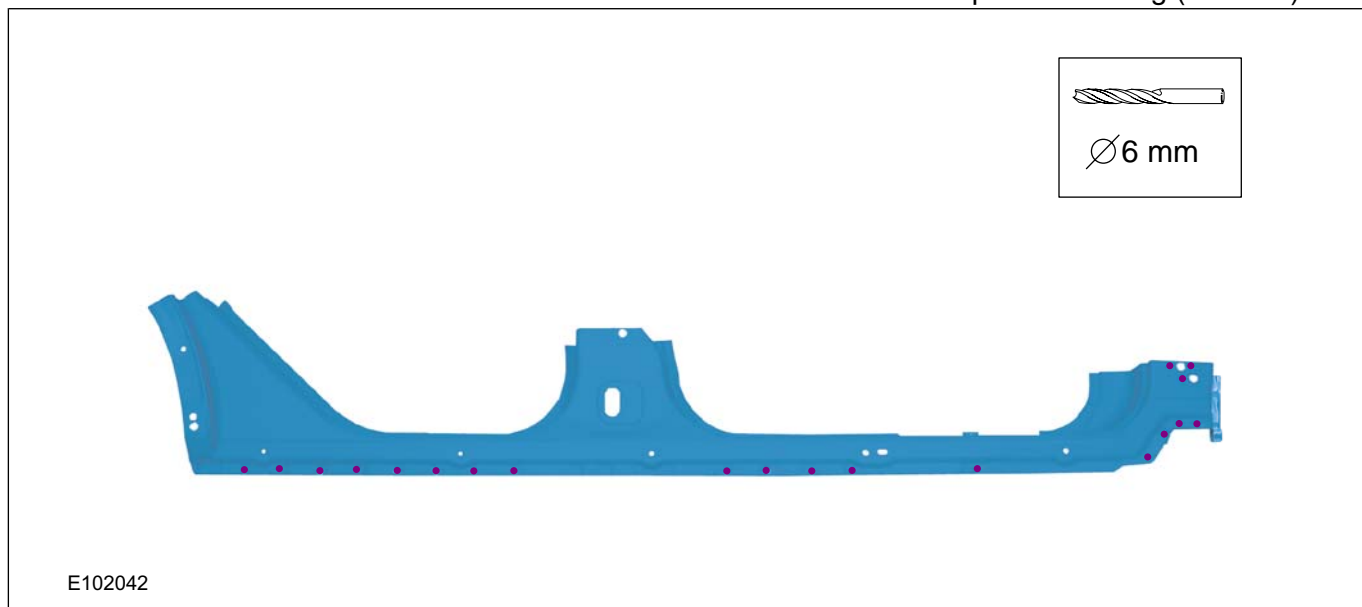
## Installation

**NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

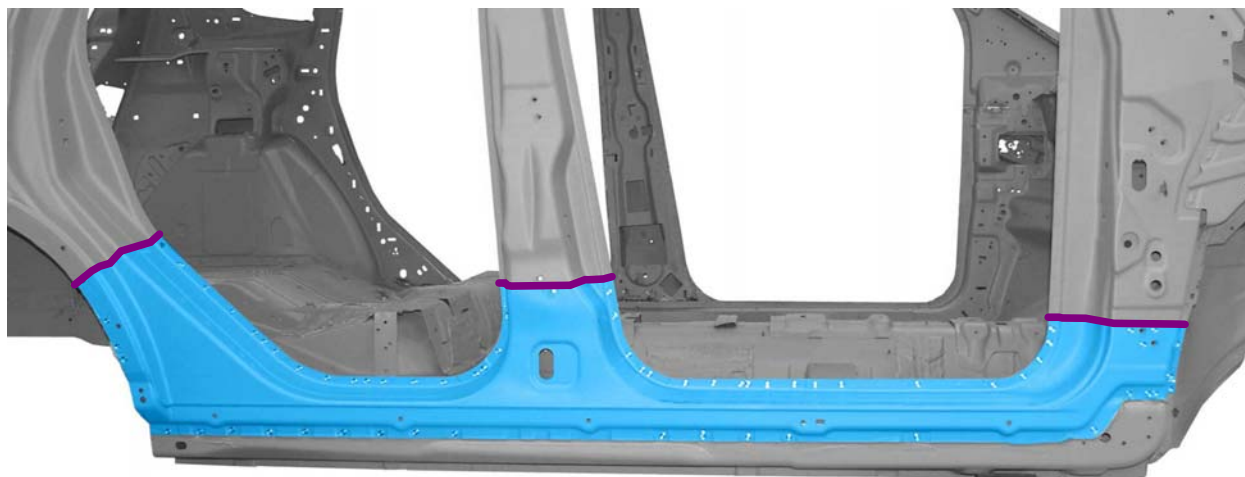
**NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

2. • **Preparation of the Rocker Panel.**
  - Drill holes for puddle welding (Ø 6 mm).



3. • **Rocker Panel**
  - Continuous MIG weld seam.

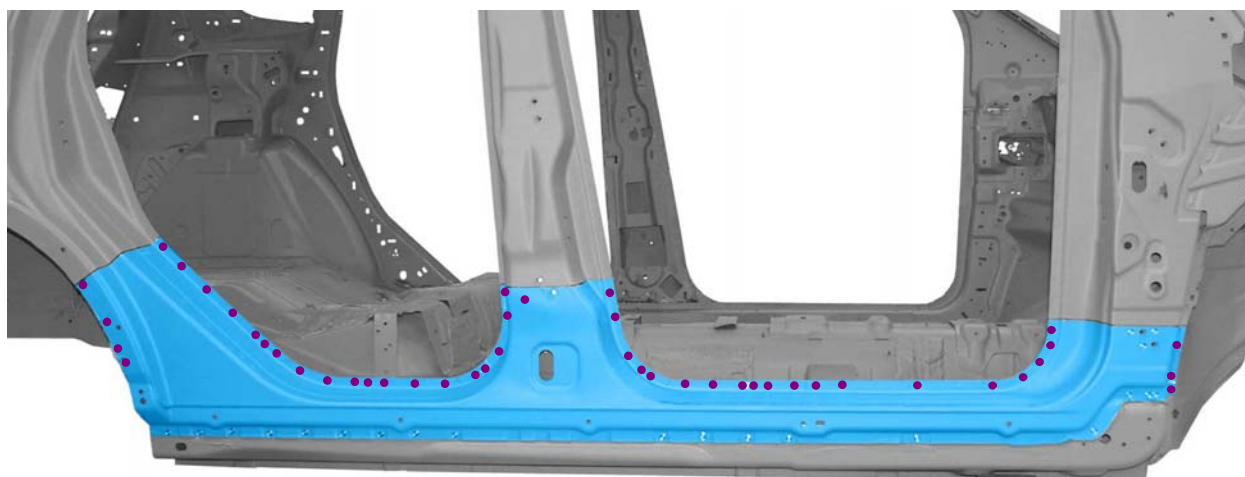
## REMOVAL AND INSTALLATION



E102043

**4. • Rocker Panel**

- Resistance spot weld - Panel thickness 3 mm and greater!



E102044

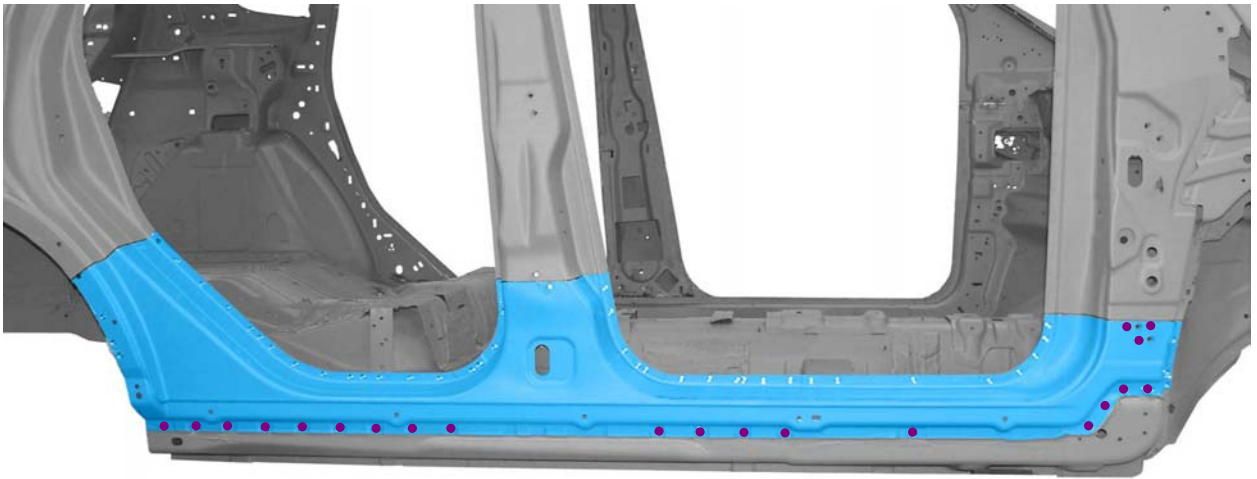
**5. • Rocker Panel**

- Puddle weld.





REMOVAL AND INSTALLATION



E102045



## REMOVAL AND INSTALLATION

## B-Pillar and Reinforcement

## General Equipment

10 mm Drill Bit
6 mm Drill Bit
8 mm Drill Bit
Air Body Saw
Hot Air Gun
Locking Pliers
Measurement and Alignment Angle System

## General Equipment

MIG/MAG Welding Equipment
Resistance Spotwelding Equipment
Spot weld drill Bit

## Materials

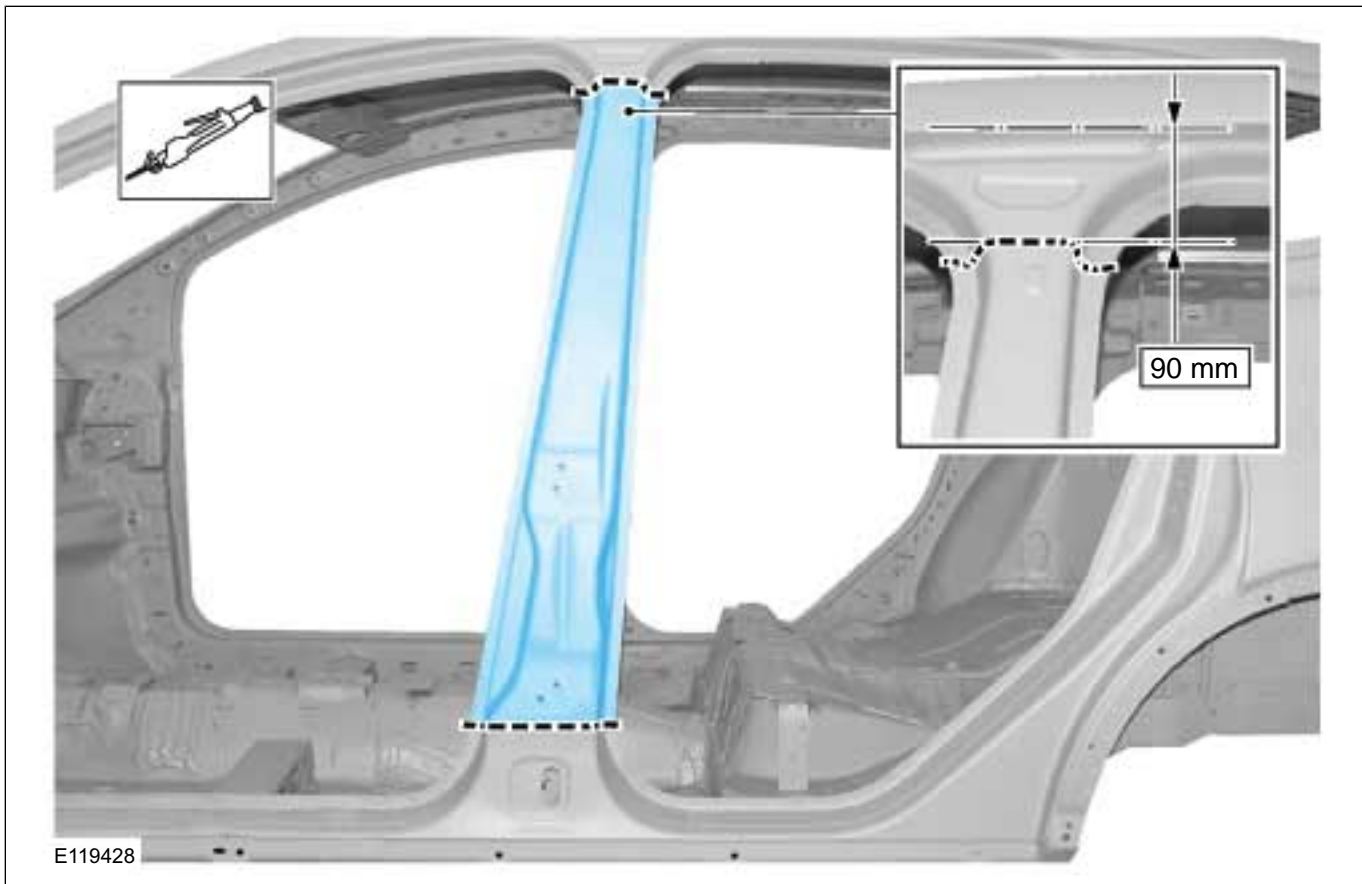
Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

## Removal

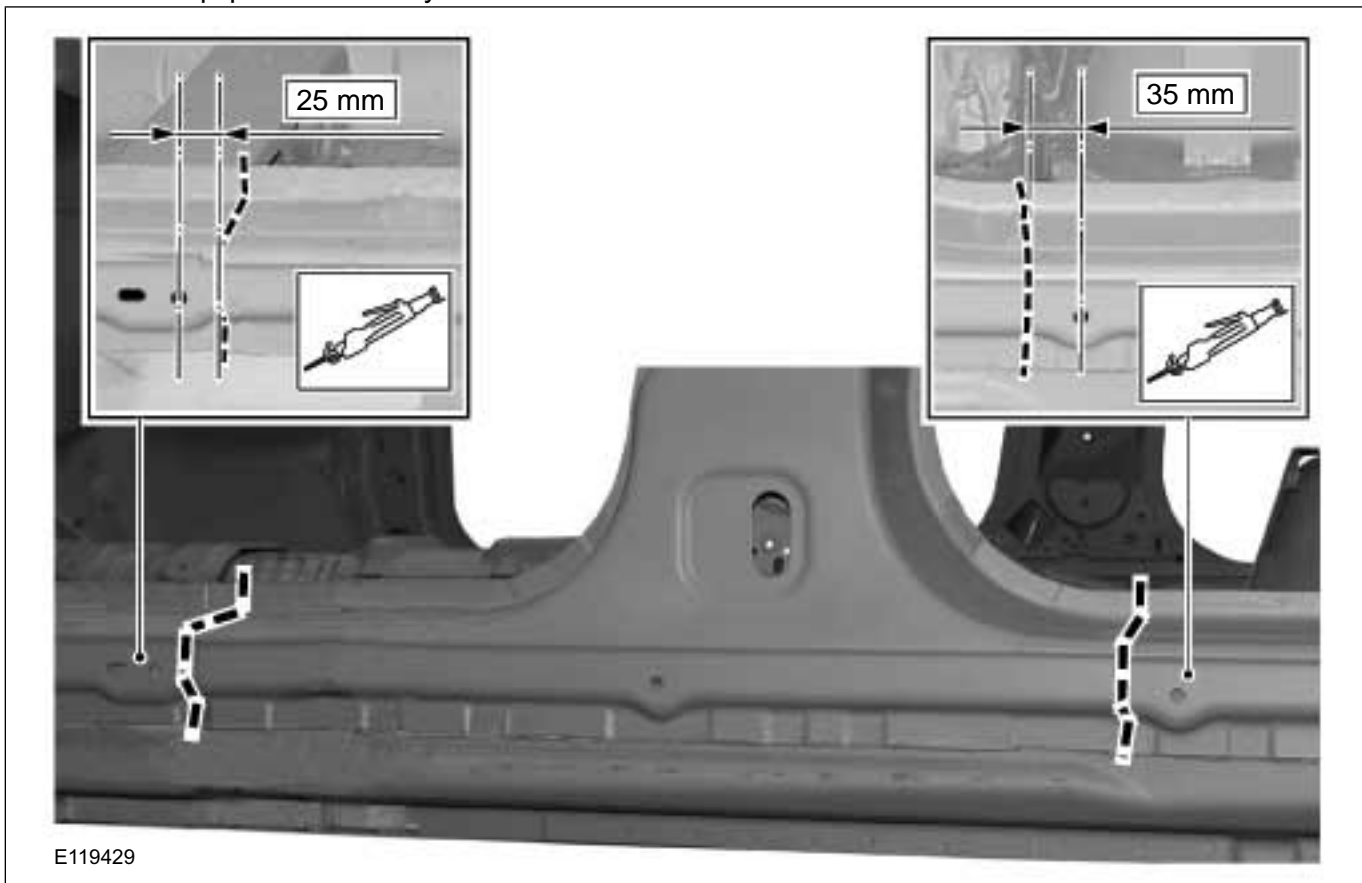
1. General Equipment: Measurement and Alignment Angle System
2. • Front and Rear Door
  - Refer to: **Front Seat** (501-10 Seating, Removal and Installation).  
Refer to: **Rear Seat Cushion** (501-10 Seating, Removal and Installation).  
Refer to: **Rear Seat Backrest** (501-10 Seating, Removal and Installation).  
Refer to: **B-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).  
Refer to: **Front Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).  
Refer to: **Rear Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Reposition the carpeting and the wiring harness away from the working area.
3. Rough cut through **all** body panels.  
General Equipment: Air Body Saw



REMOVAL AND INSTALLATION

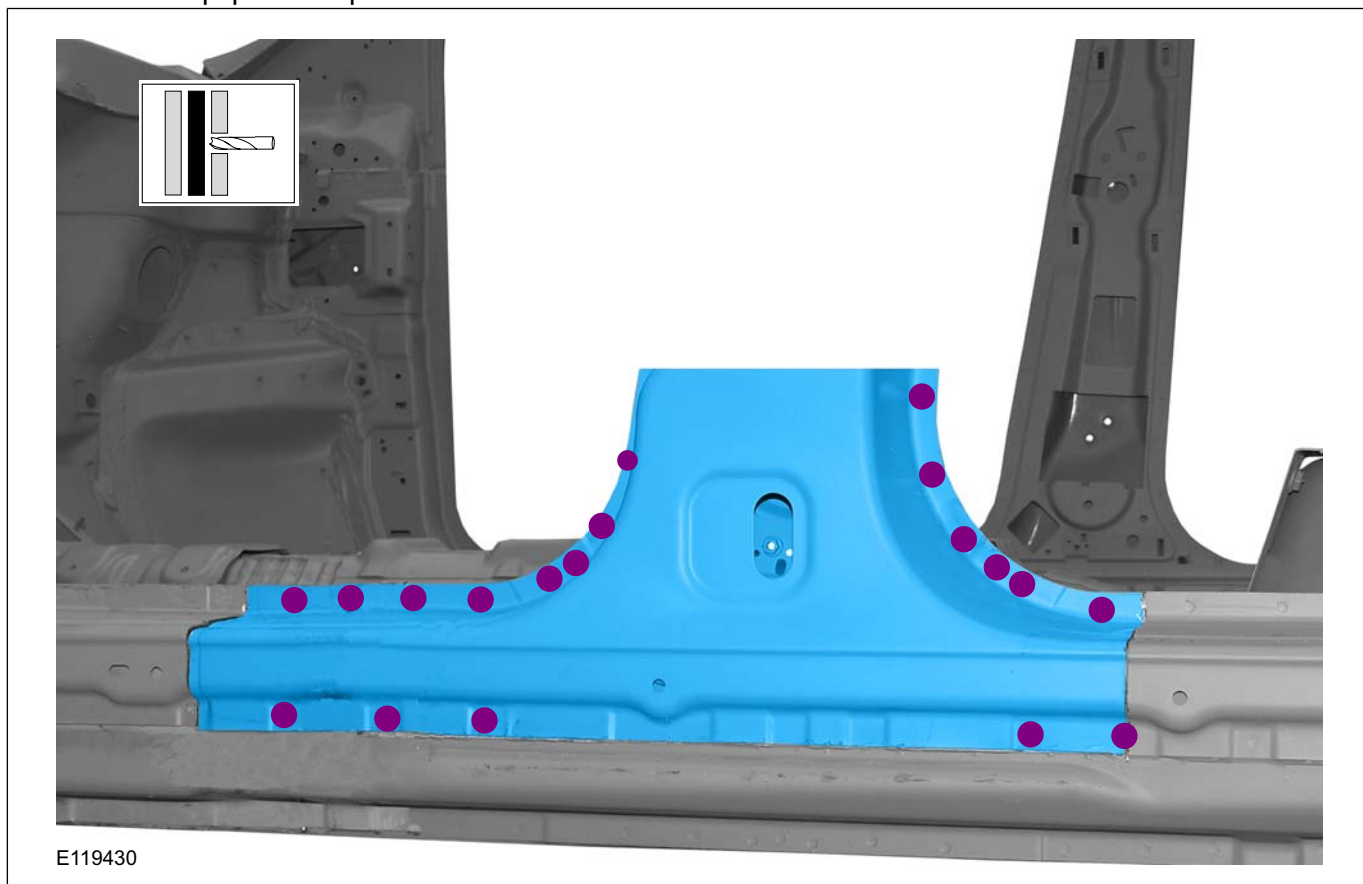


4. General Equipment: Air Body Saw



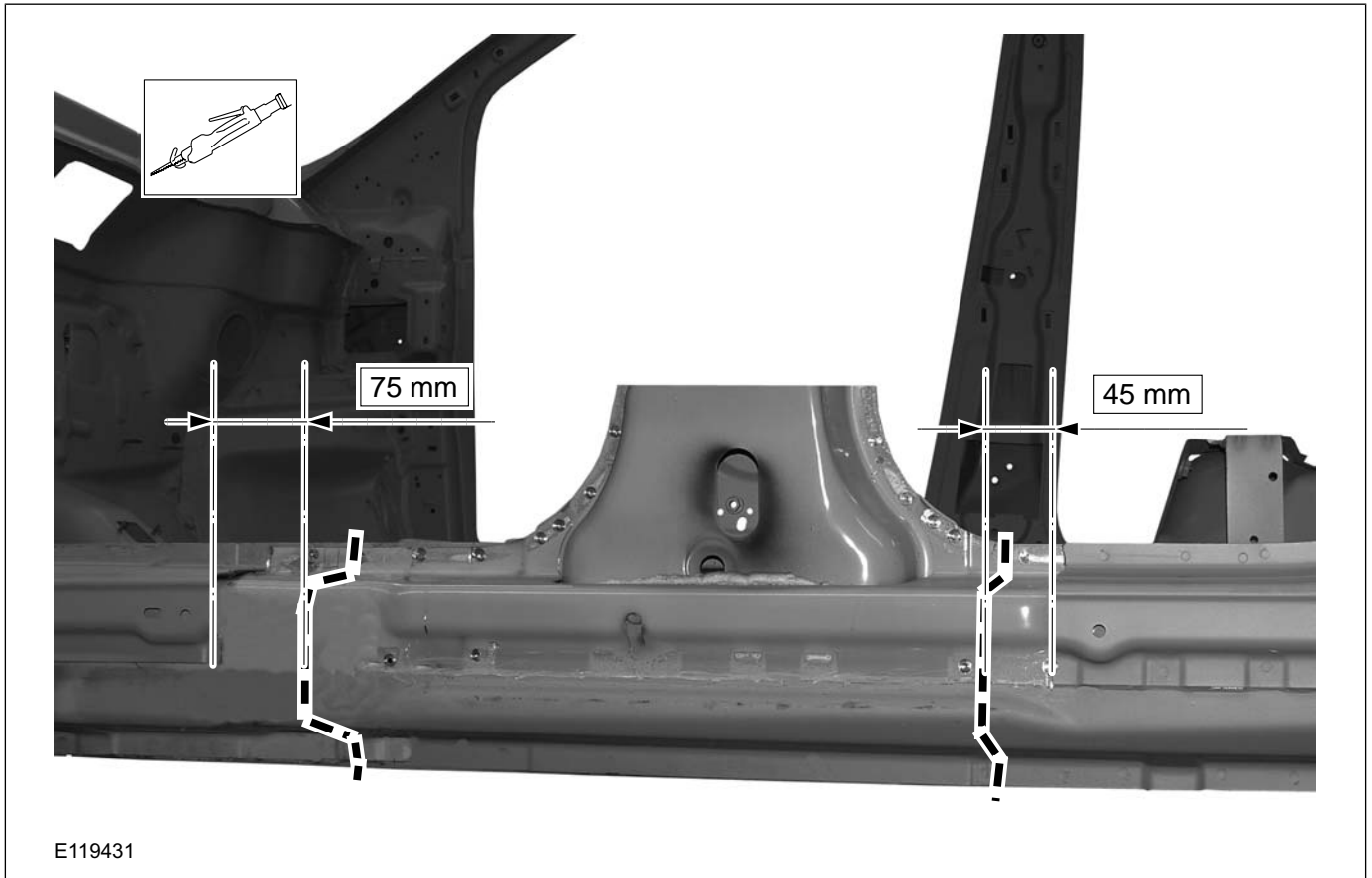
## REMOVAL AND INSTALLATION

## 5. General Equipment: Spot weld drill Bit

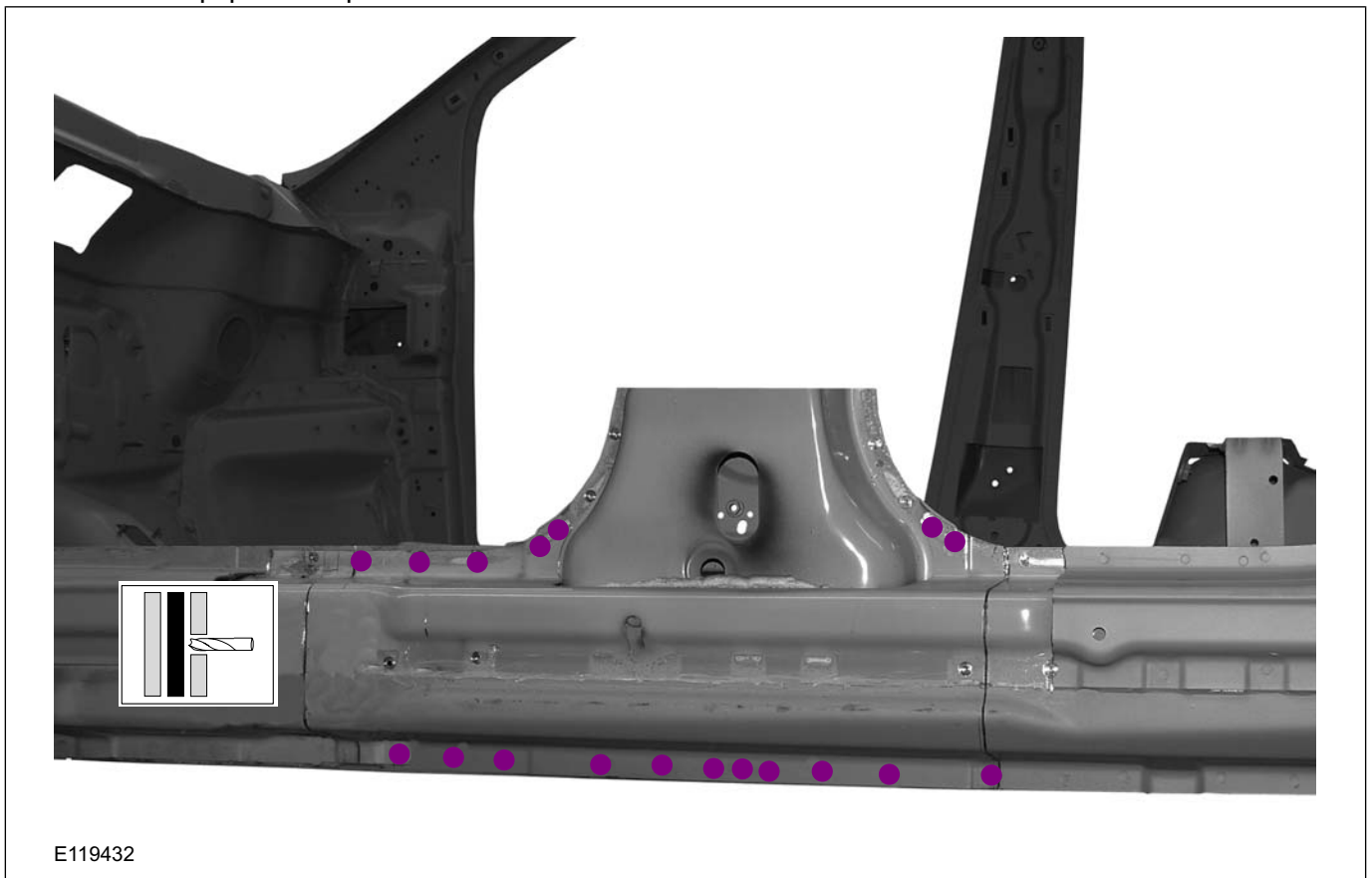


## 6. General Equipment: Air Body Saw

REMOVAL AND INSTALLATION



7. General Equipment: Spot weld drill Bit



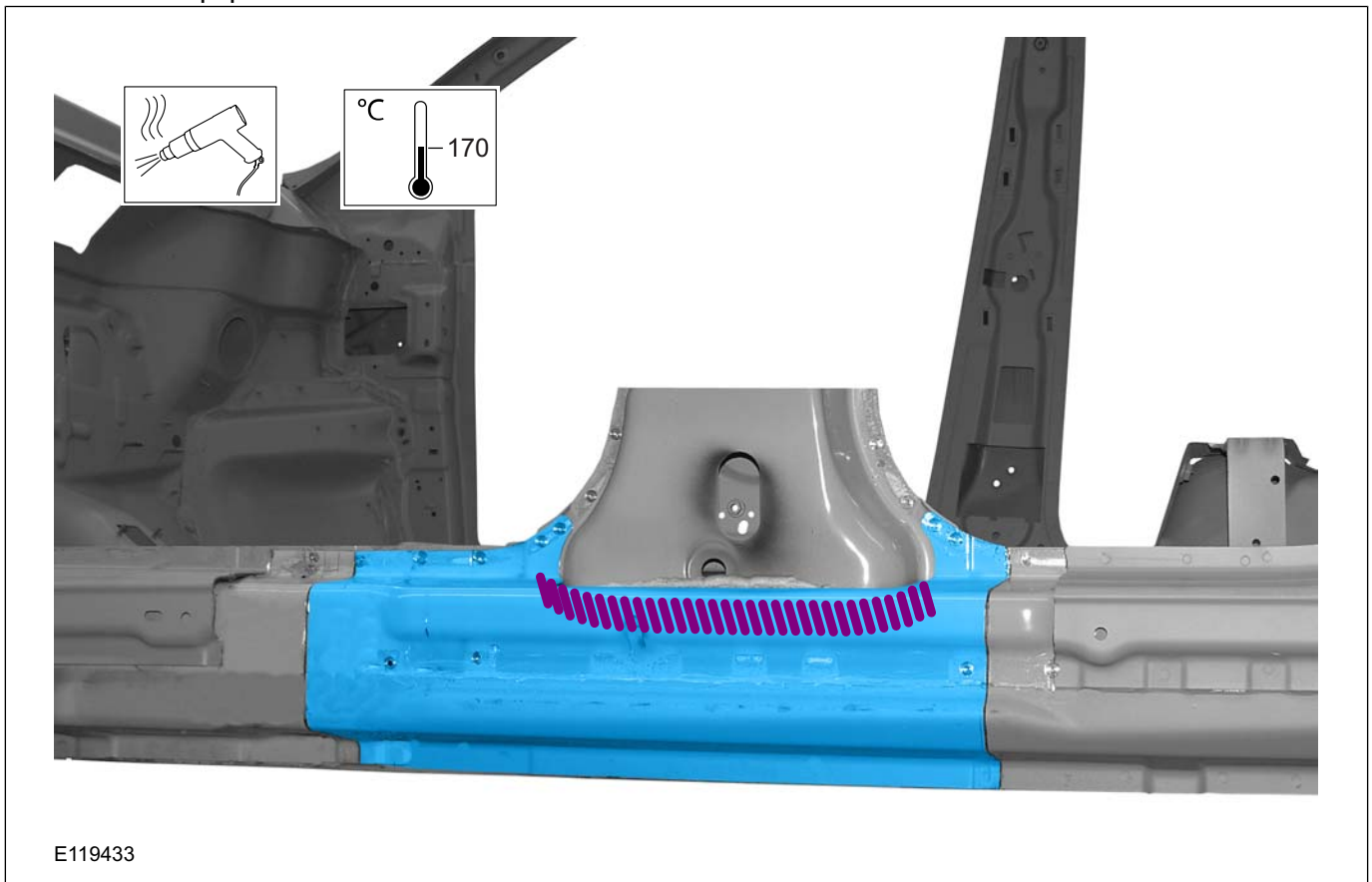
501-29-13

## Side Panel Sheet Metal Repairs

501-29-13

## REMOVAL AND INSTALLATION

## 8. General Equipment: Hot Air Gun

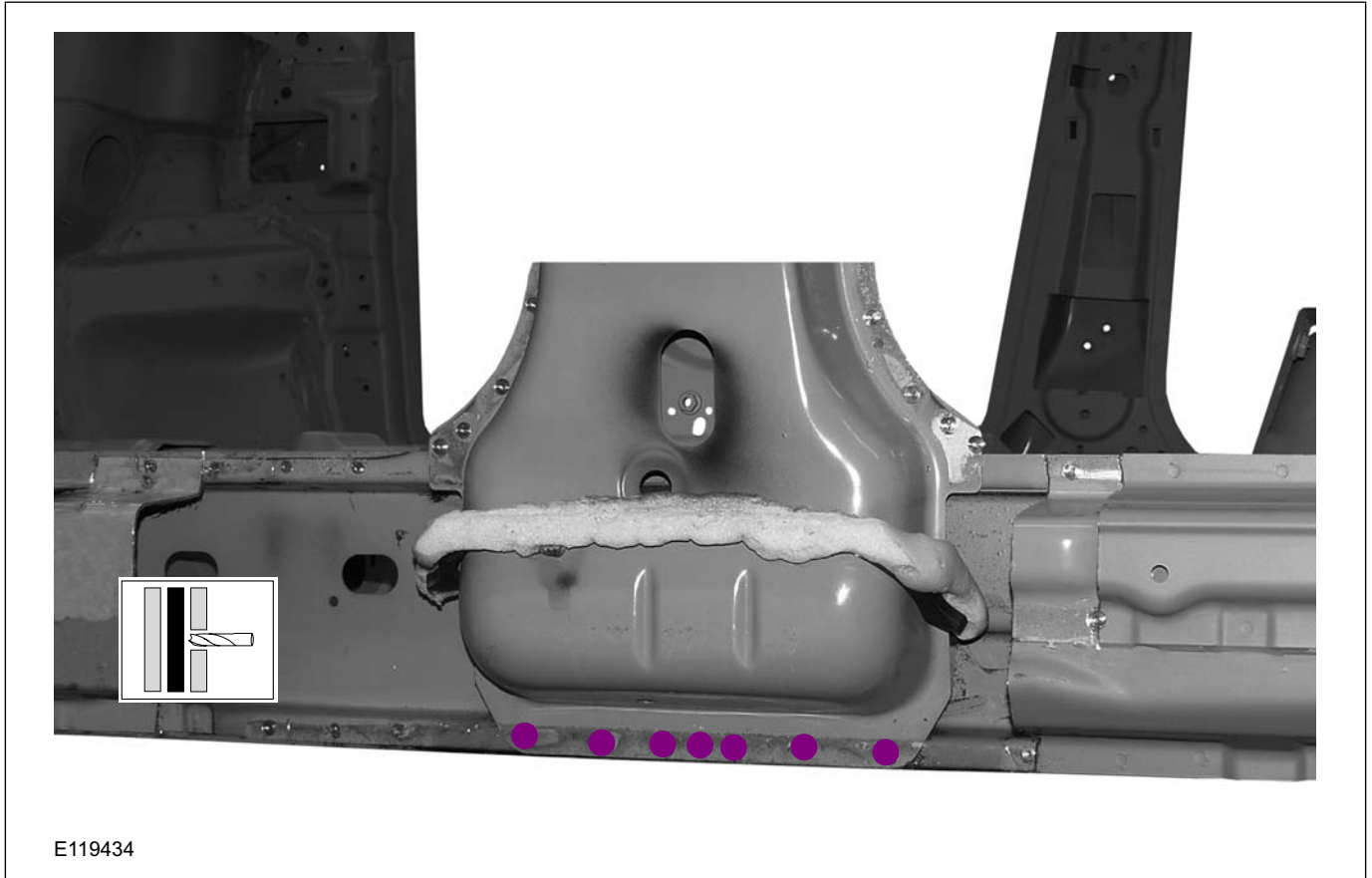


## 9. General Equipment: Spot weld drill Bit

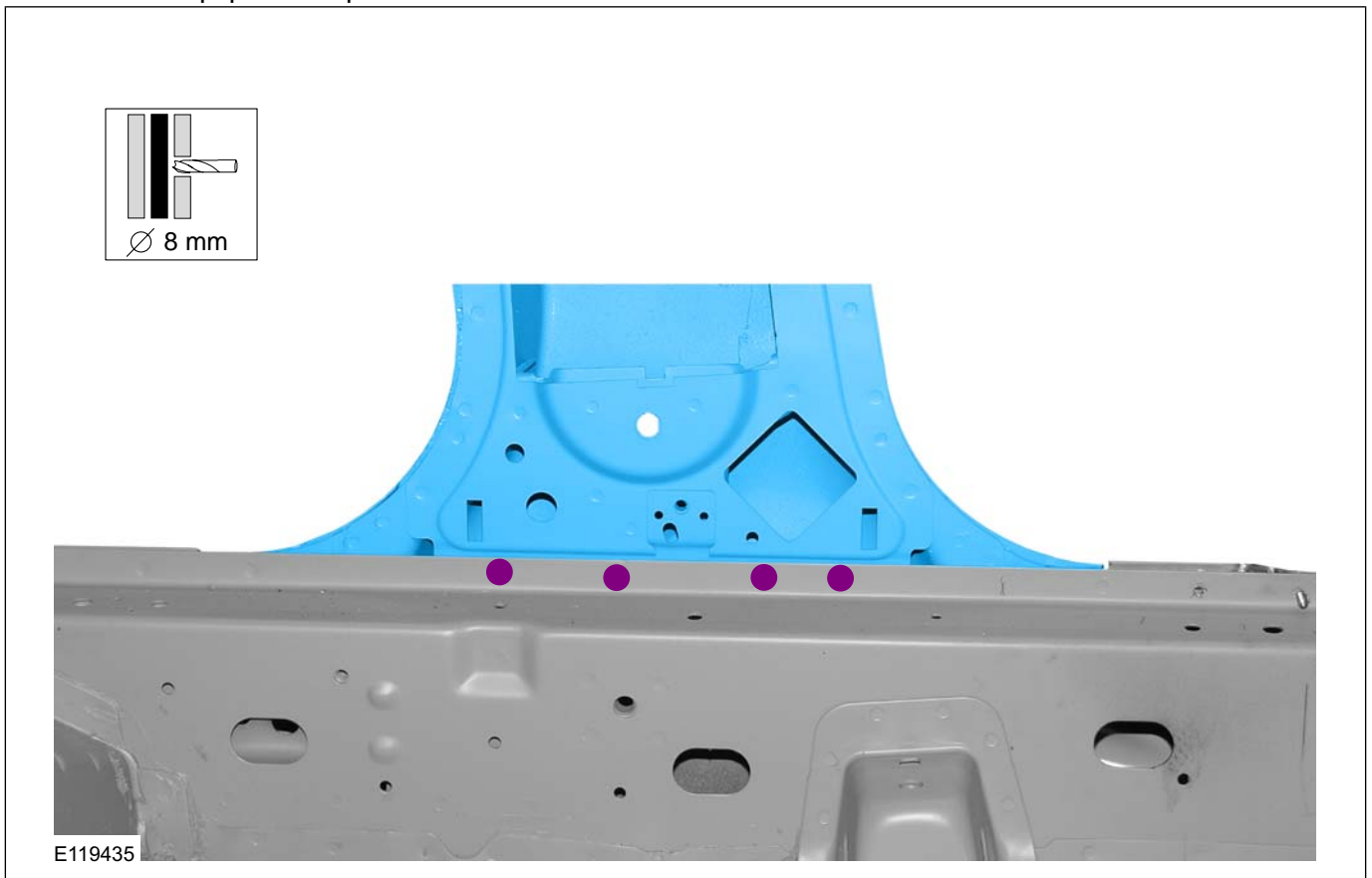




REMOVAL AND INSTALLATION

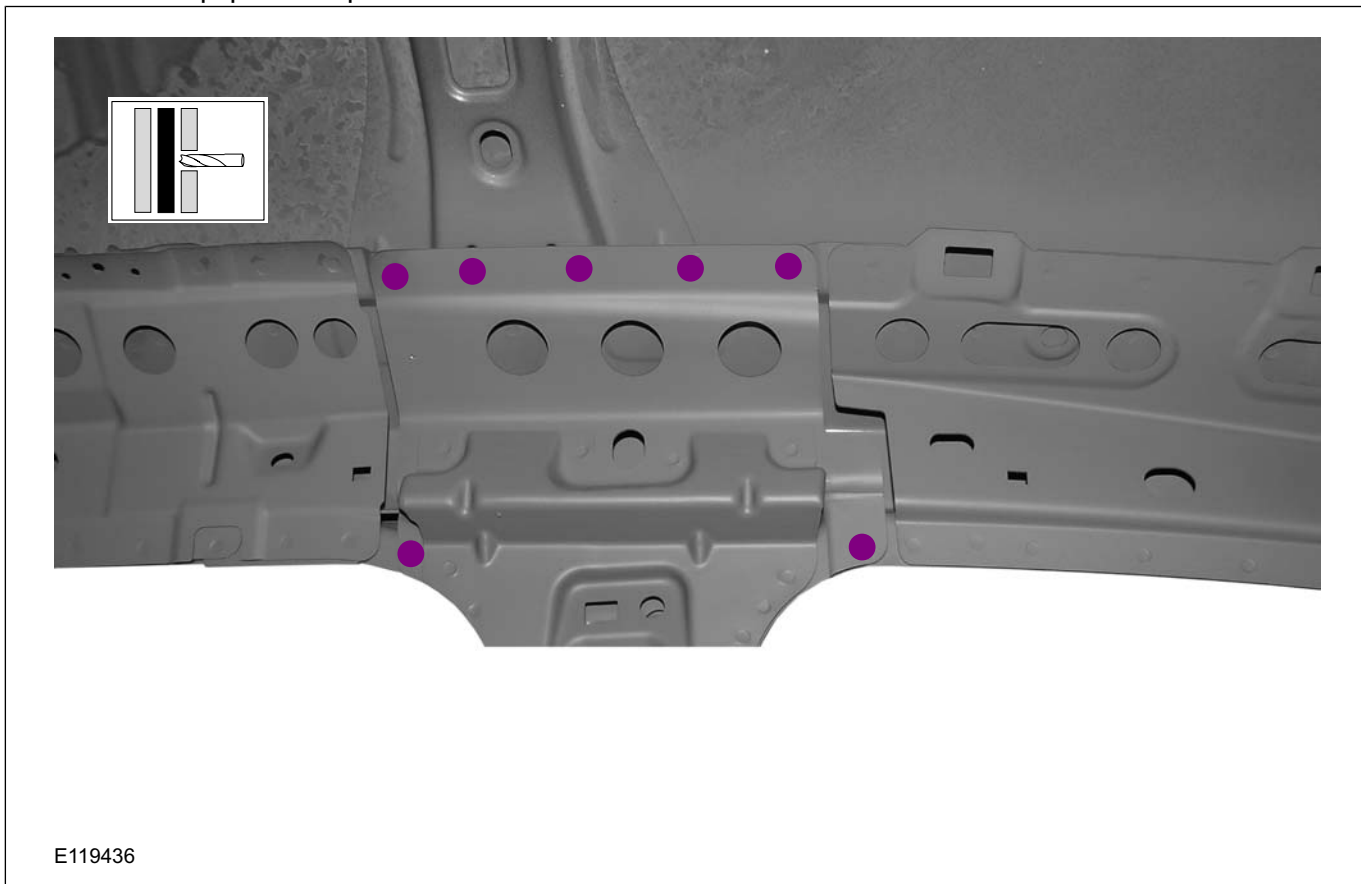


10. General Equipment: Spot weld drill Bit



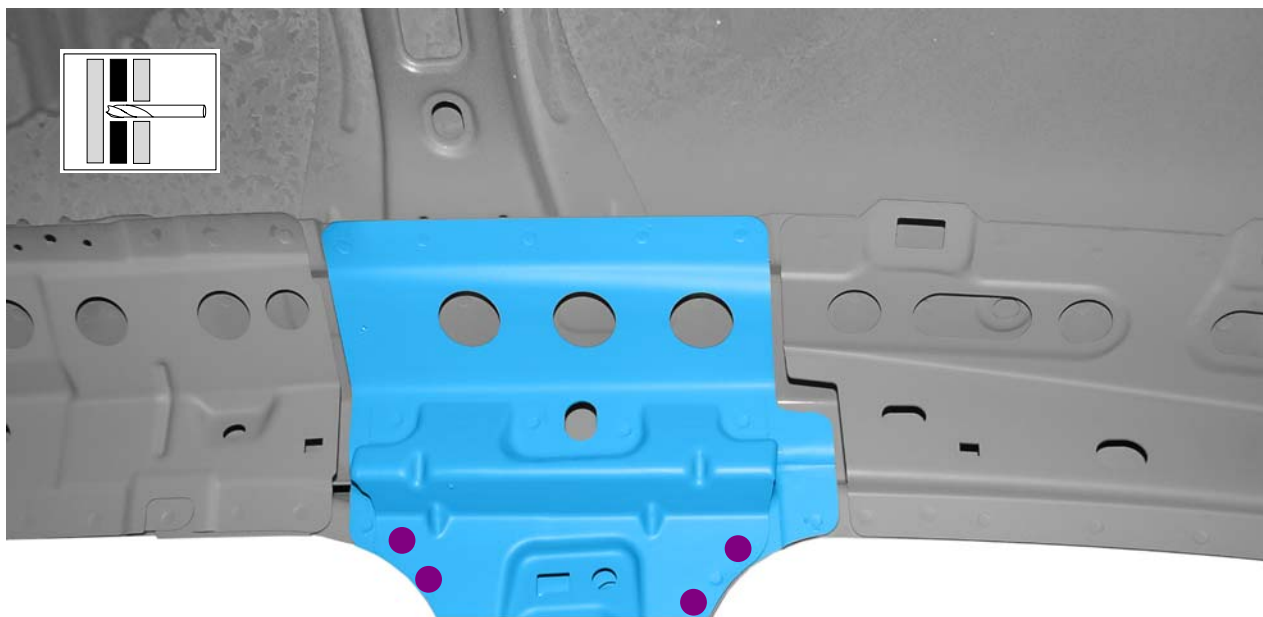
## REMOVAL AND INSTALLATION

## 11. General Equipment: Spot weld drill Bit



## 12. General Equipment: Spot weld drill Bit

## REMOVAL AND INSTALLATION



E119437

## Installation

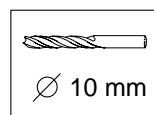
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

## 3. General Equipment: 10 mm Drill Bit



E119438

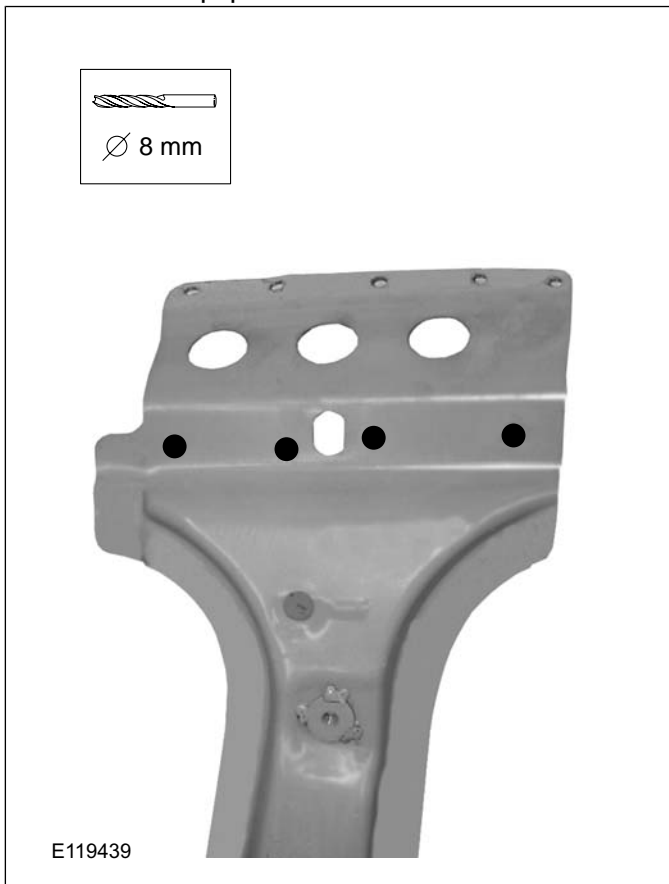
501-29-17

## Side Panel Sheet Metal Repairs

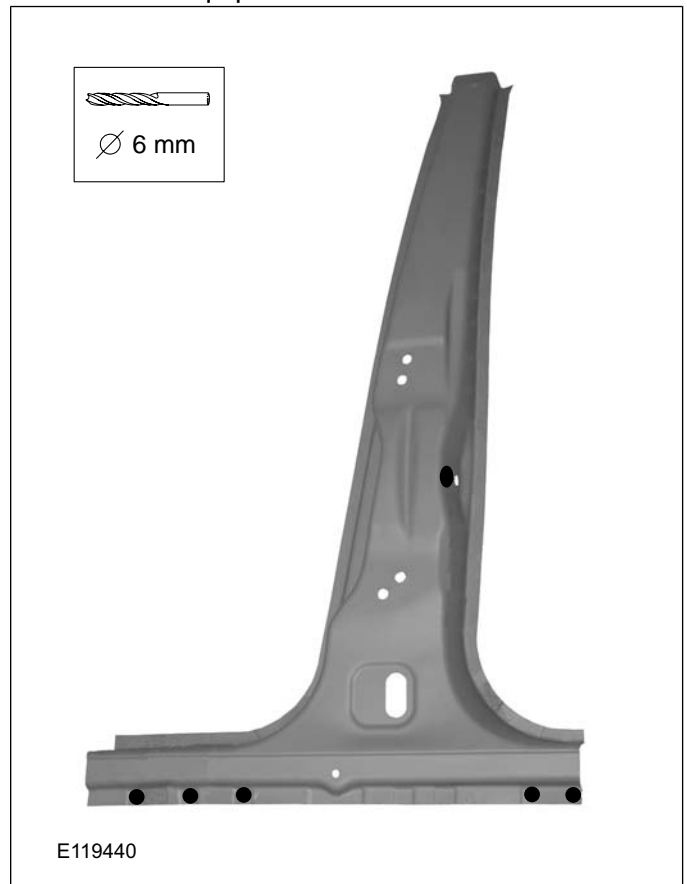
501-29-17

## REMOVAL AND INSTALLATION

## 4. General Equipment: 8 mm Drill Bit



## 5. General Equipment: 6 mm Drill Bit



## 6. Resistance spot weld - Panel thickness 3 mm and greater!

General Equipment: Locking Pliers

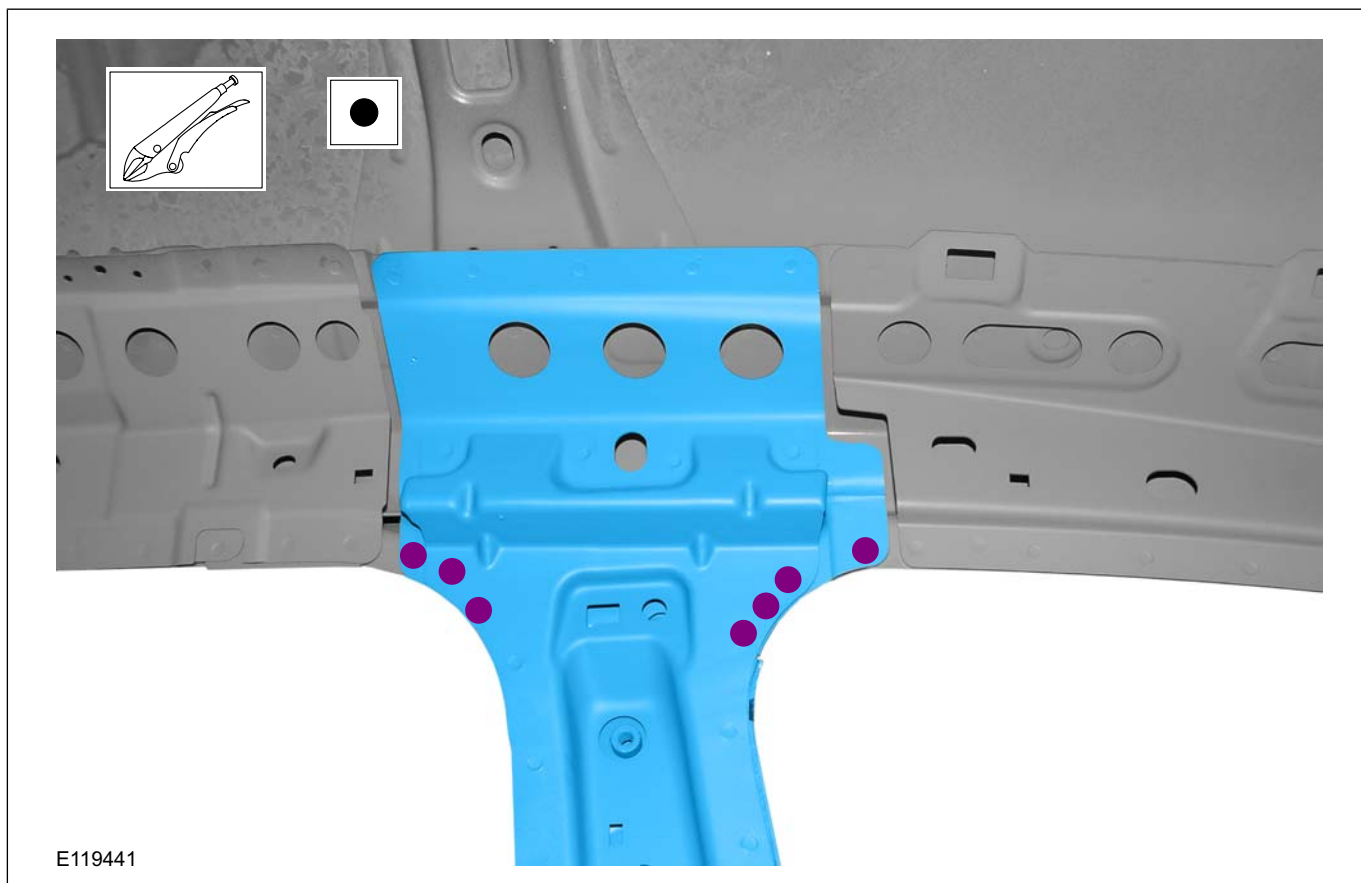
General Equipment: Resistance Spotwelding Equipment

501-29-18

Side Panel Sheet Metal Repairs

501-29-18

## REMOVAL AND INSTALLATION



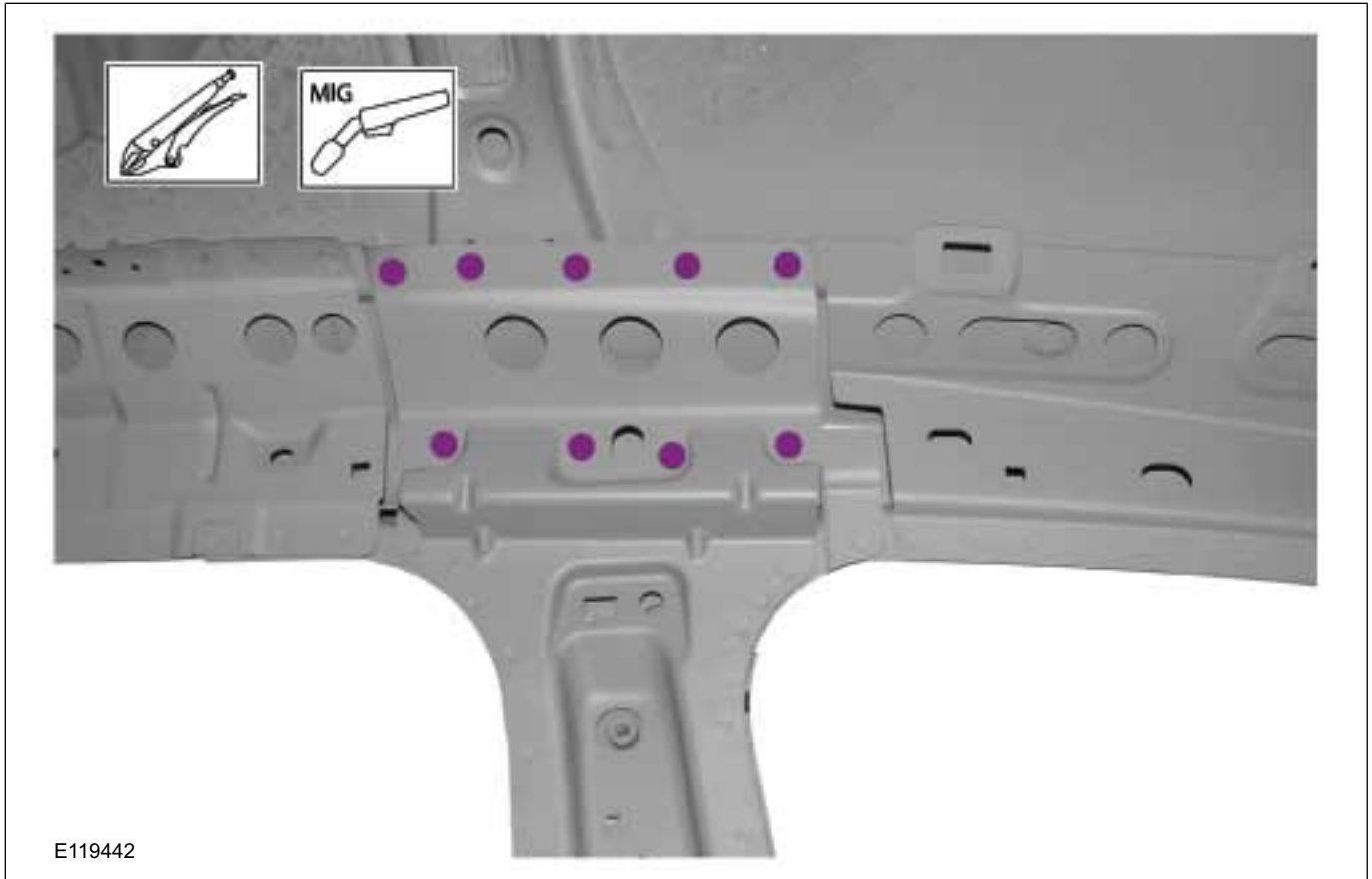
7. General Equipment: Locking Pliers  
General Equipment: MIG/MAG Welding  
Equipment

501-29-19

Side Panel Sheet Metal Repairs

501-29-19

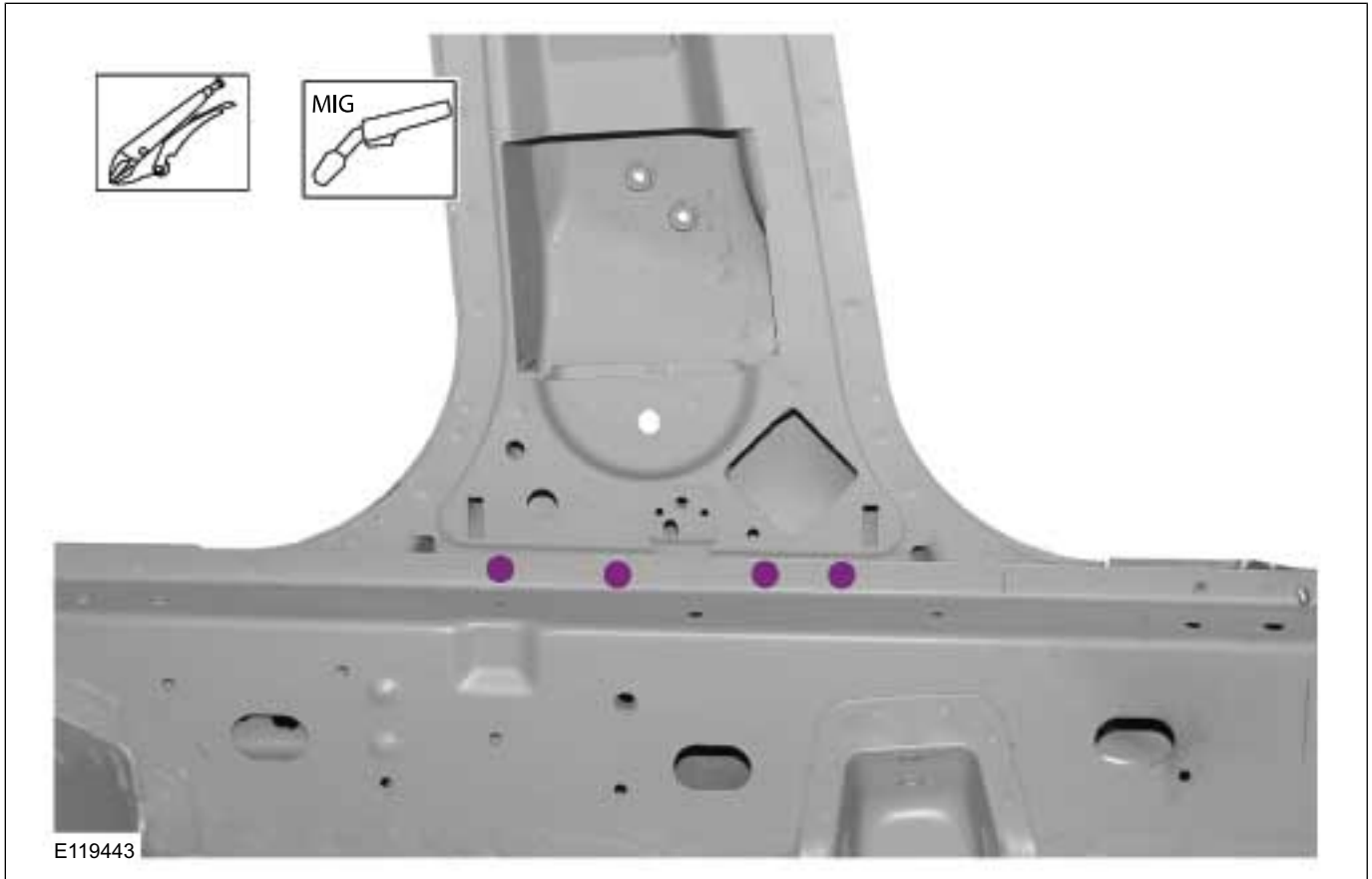
## REMOVAL AND INSTALLATION



8. General Equipment: Locking Pliers  
General Equipment: MIG/MAG Welding  
Equipment



## REMOVAL AND INSTALLATION



9. Resistance spot weld - Panel thickness 3 mm and greater!

General Equipment: Locking Pliers

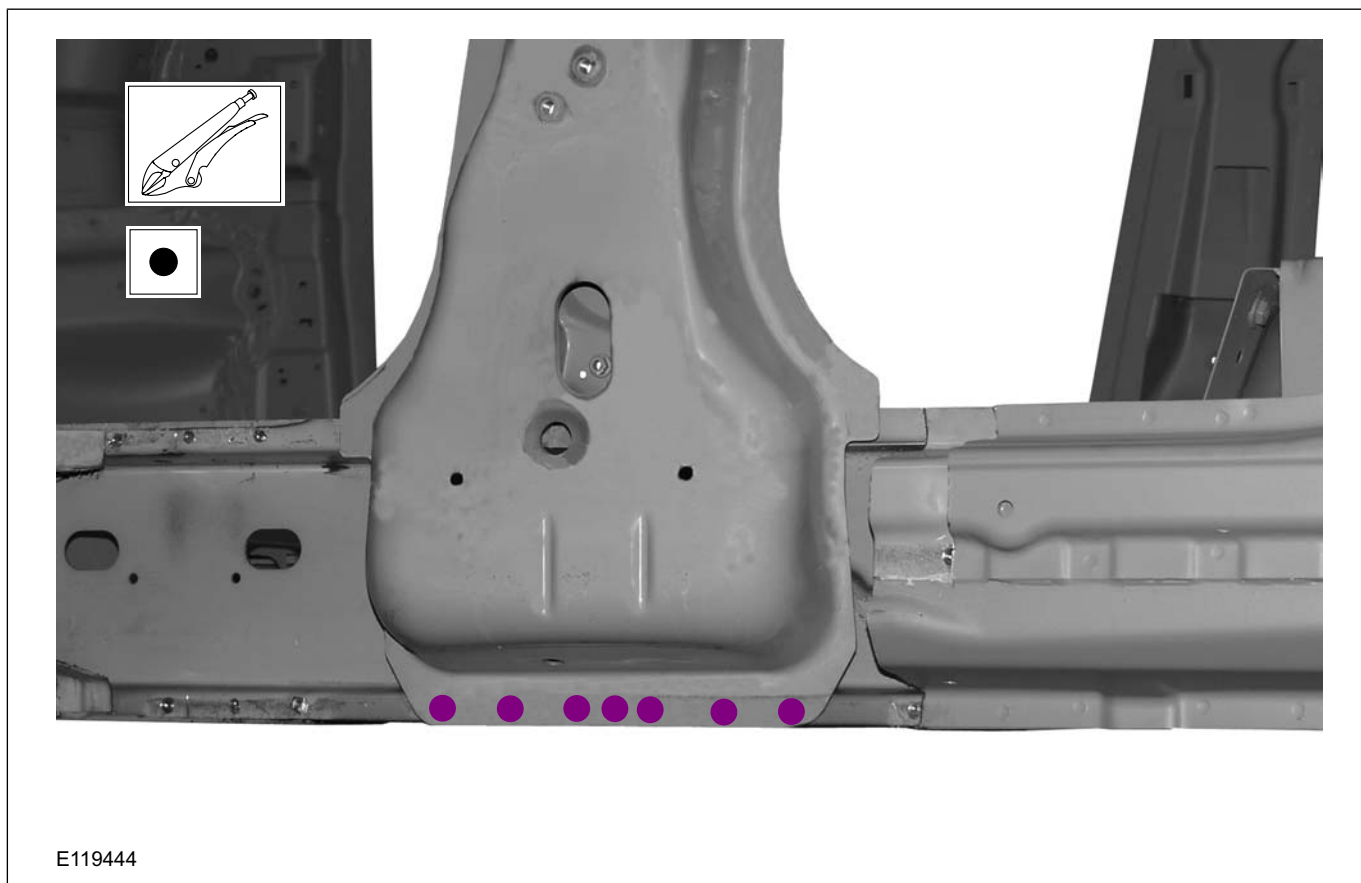
General Equipment: Resistance Spotwelding Equipment

501-29-21

Side Panel Sheet Metal Repairs

501-29-21

## REMOVAL AND INSTALLATION



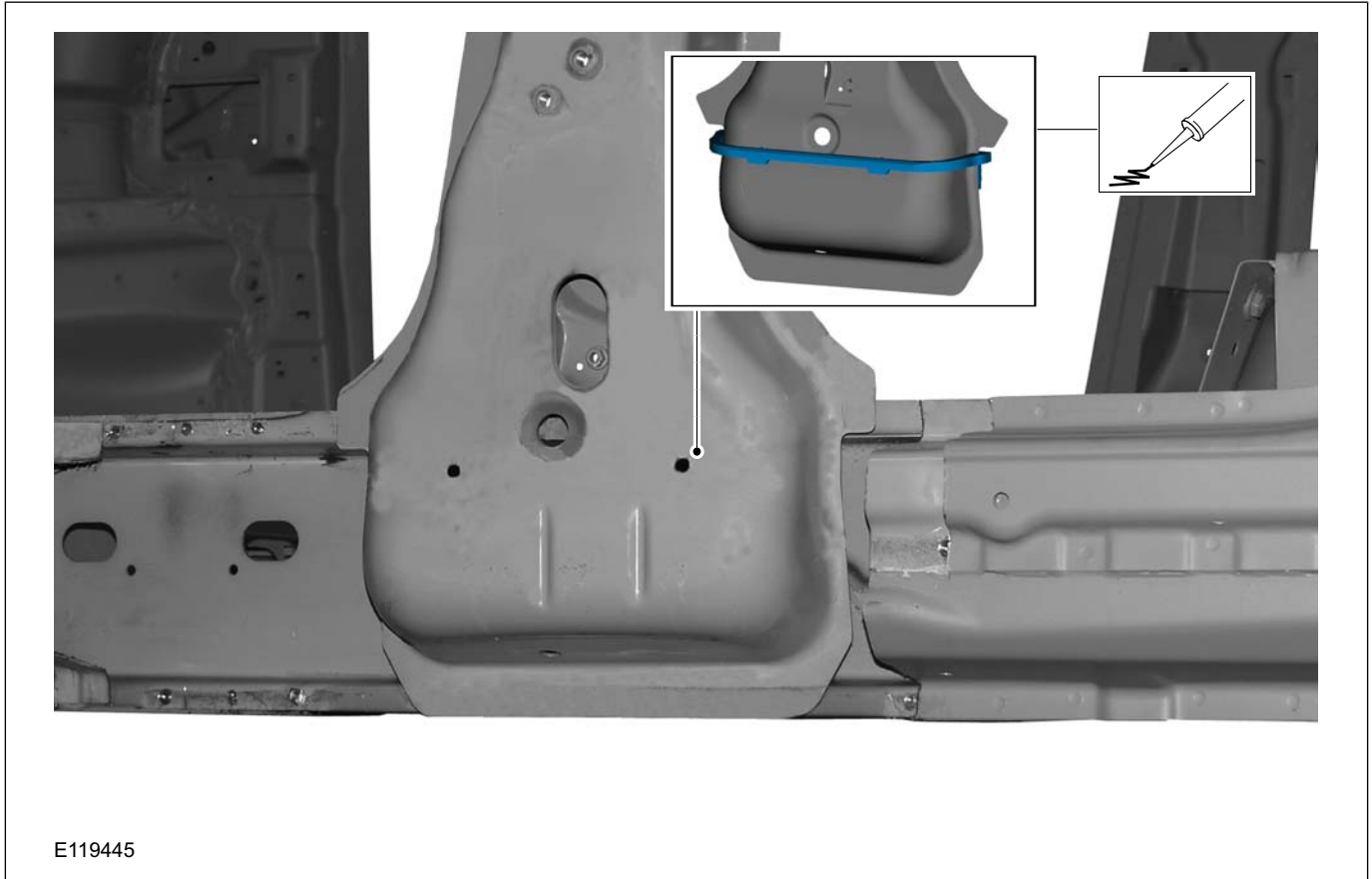
10. Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive

501-29-22

Side Panel Sheet Metal Repairs

501-29-22

## REMOVAL AND INSTALLATION



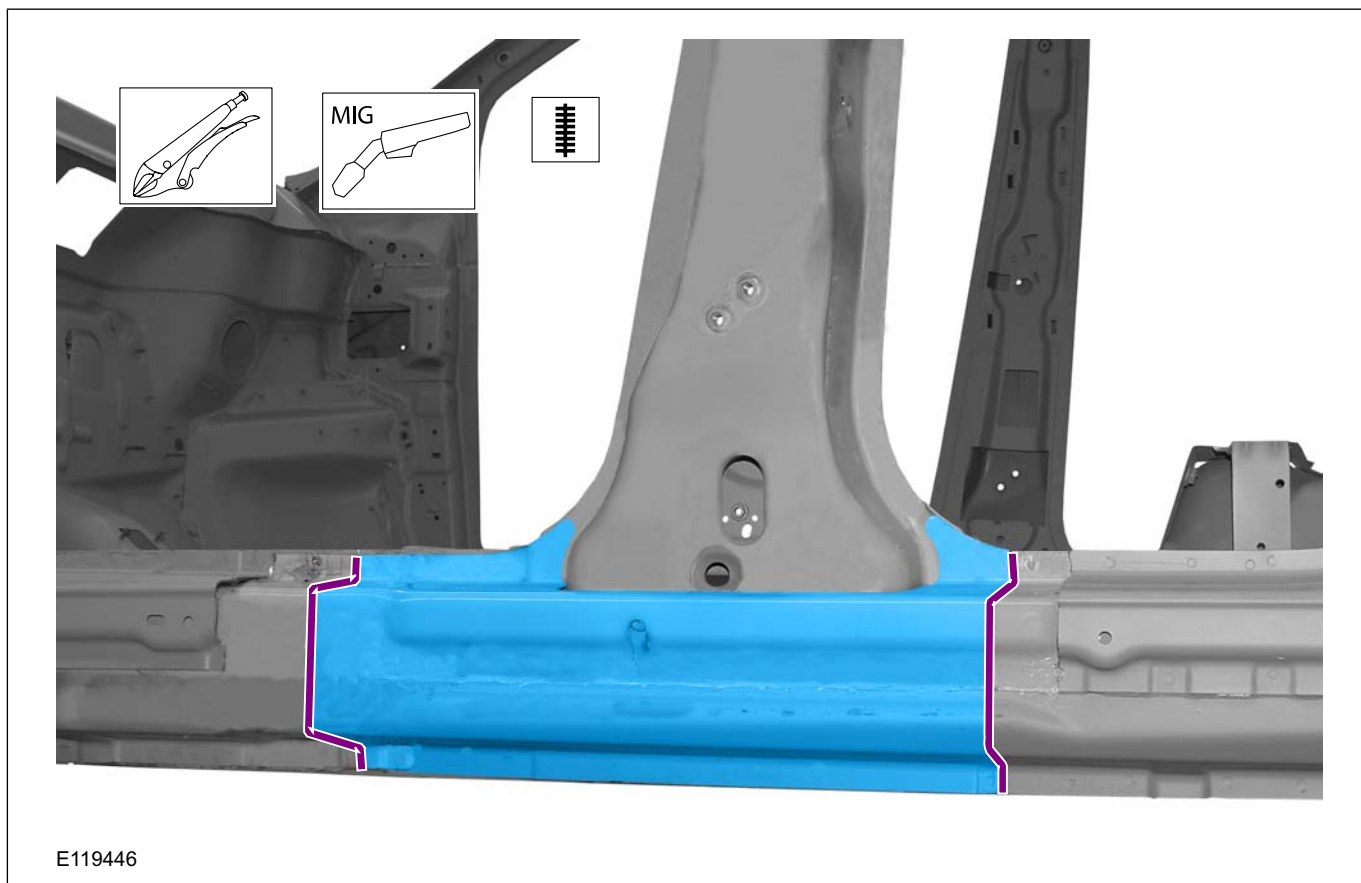
11. General Equipment: Locking Pliers  
General Equipment: MIG/MAG Welding  
Equipment

501-29-23

Side Panel Sheet Metal Repairs

501-29-23

## REMOVAL AND INSTALLATION

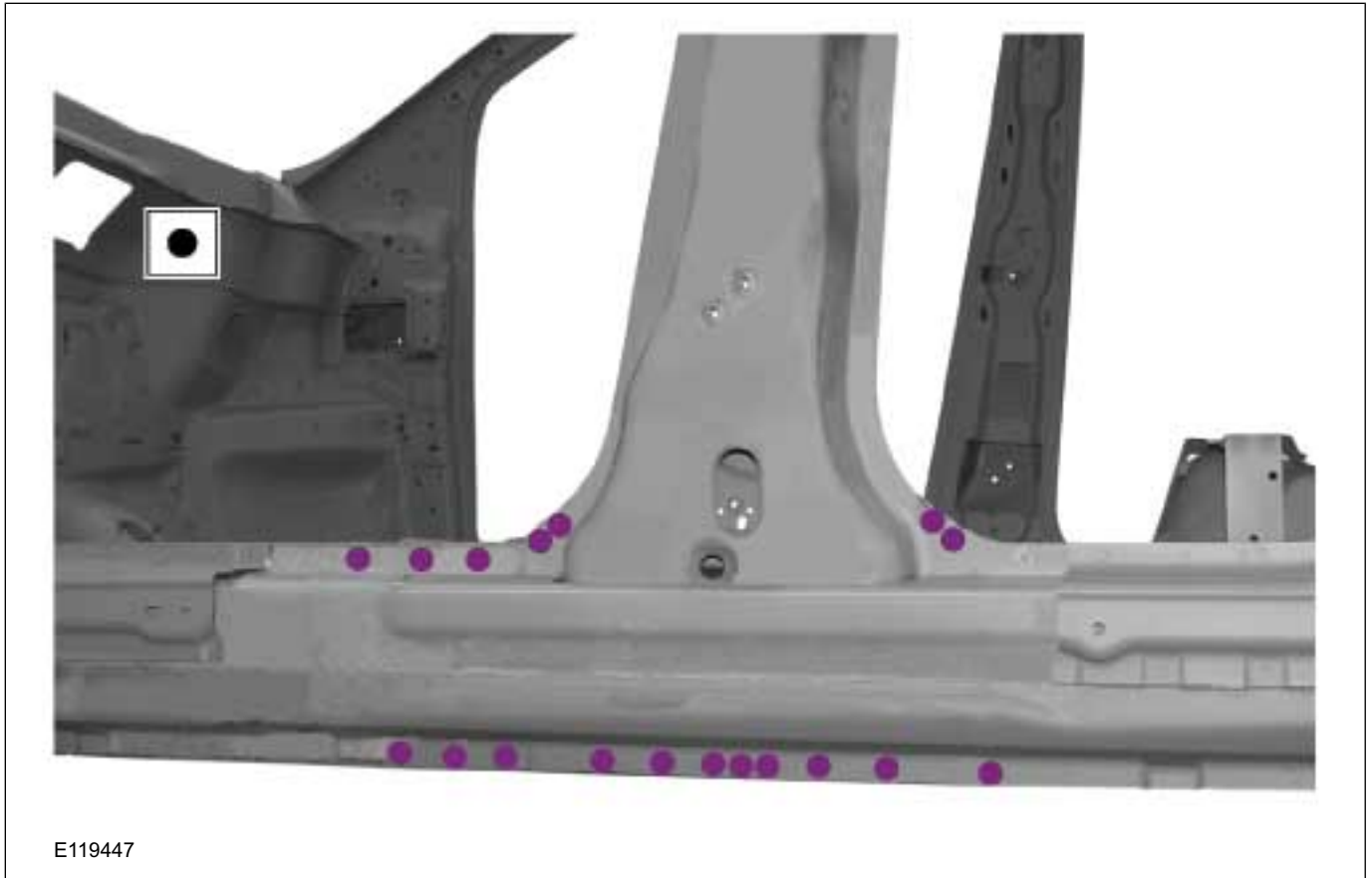


**12** Resistance spot weld - Panel thickness 3 mm and greater!

General Equipment: Resistance Spotwelding Equipment



REMOVAL AND INSTALLATION



## 501-29-25

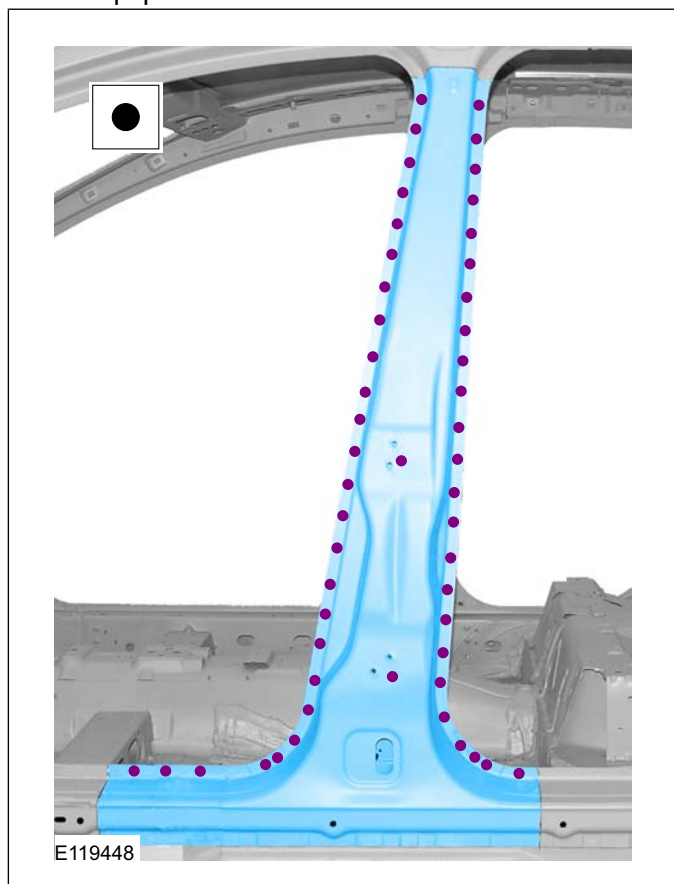
## Side Panel Sheet Metal Repairs

## 501-29-25

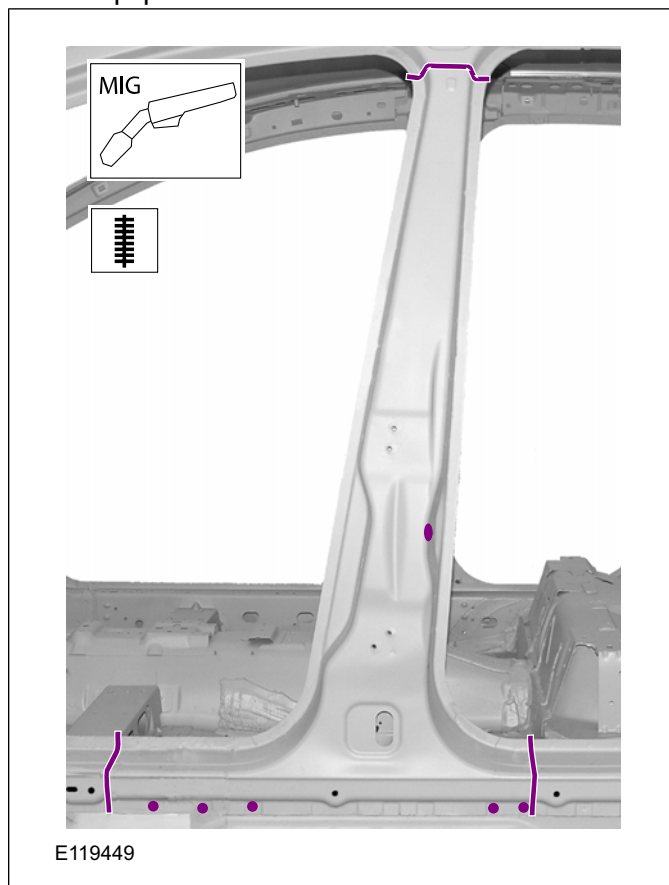
## REMOVAL AND INSTALLATION

13. Resistance spot weld - Panel thickness 3 mm and greater!

General Equipment: Resistance Spotwelding Equipment



14. General Equipment: MIG/MAG Welding Equipment



15. • Front and Rear Door
- Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
  - Refer to: **Rear Seat Cushion** (501-10 Seating, Removal and Installation).
  - Refer to: **Rear Seat Backrest** (501-10 Seating, Removal and Installation).
  - Refer to: **B-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **Front Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **Rear Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).



## REMOVAL AND INSTALLATION

## B-Pillar Outer Panel

## General Equipment

6 mm Drill Bit

Air Body Saw

## General Equipment

MIG/MAG Welding Equipment

Resistance Spotwelding Equipment

Spot weld drill Bit

## Removal

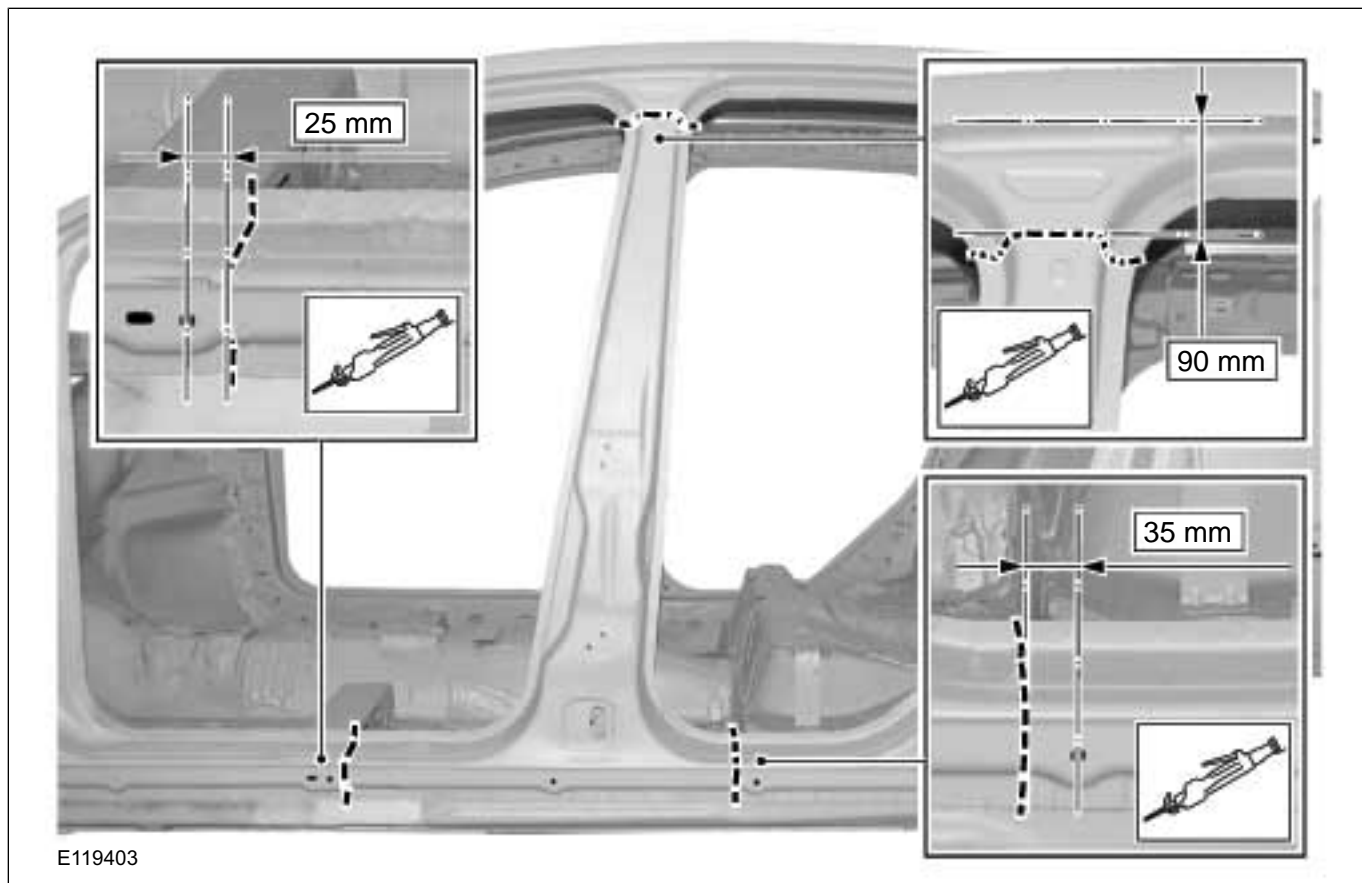
1. • Front and Rear Door
  - Refer to: **Front Seat** (501-10 Seating, Removal and Installation).  
Refer to: **Rear Seat Cushion** (501-10 Seating, Removal and Installation).  
Refer to: **Rear Seat Backrest** (501-10 Seating, Removal and Installation).  
Refer to: **B-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).  
Refer to: **Front Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).  
Refer to: **Rear Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Reposition the carpeting and the wiring harness away from the working area.
2. General Equipment: Air Body Saw

501-29-27

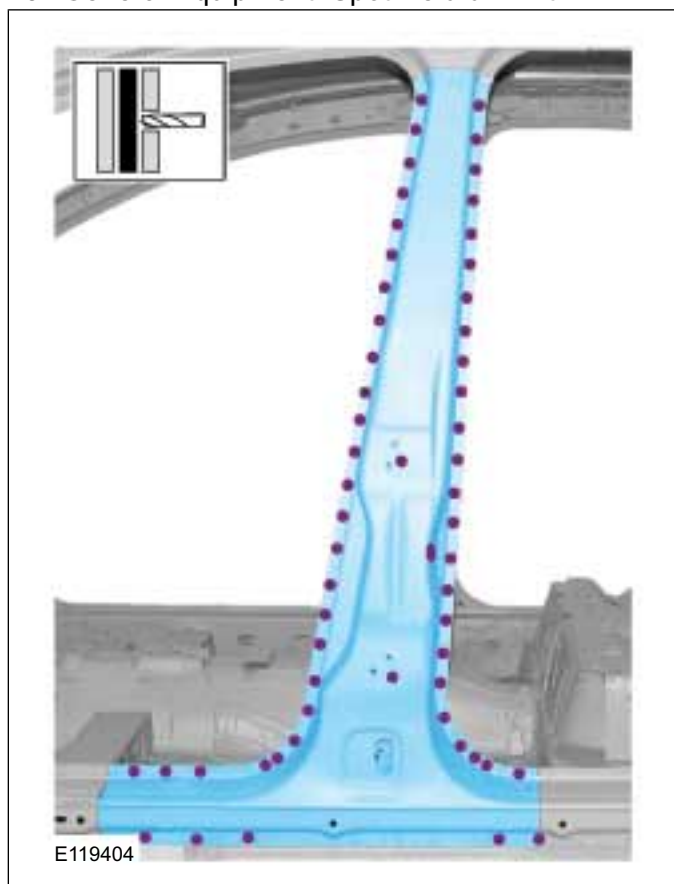
Side Panel Sheet Metal Repairs

501-29-27

## REMOVAL AND INSTALLATION



## 3. General Equipment: Spot weld drill Bit



## Installation

- NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

- NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

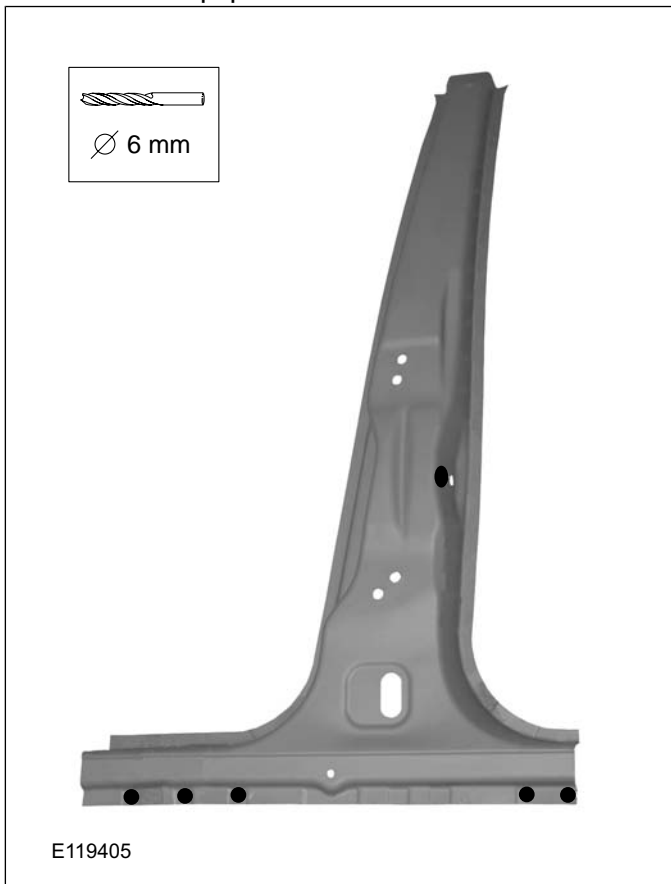
501-29-28

Side Panel Sheet Metal Repairs

501-29-28

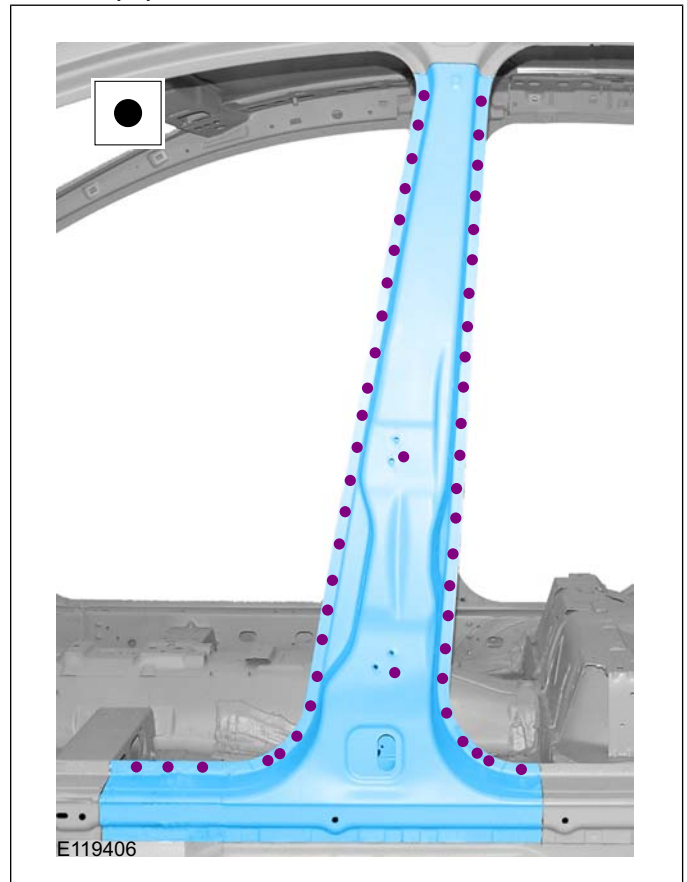
REMOVAL AND INSTALLATION

3. General Equipment: 6 mm Drill Bit



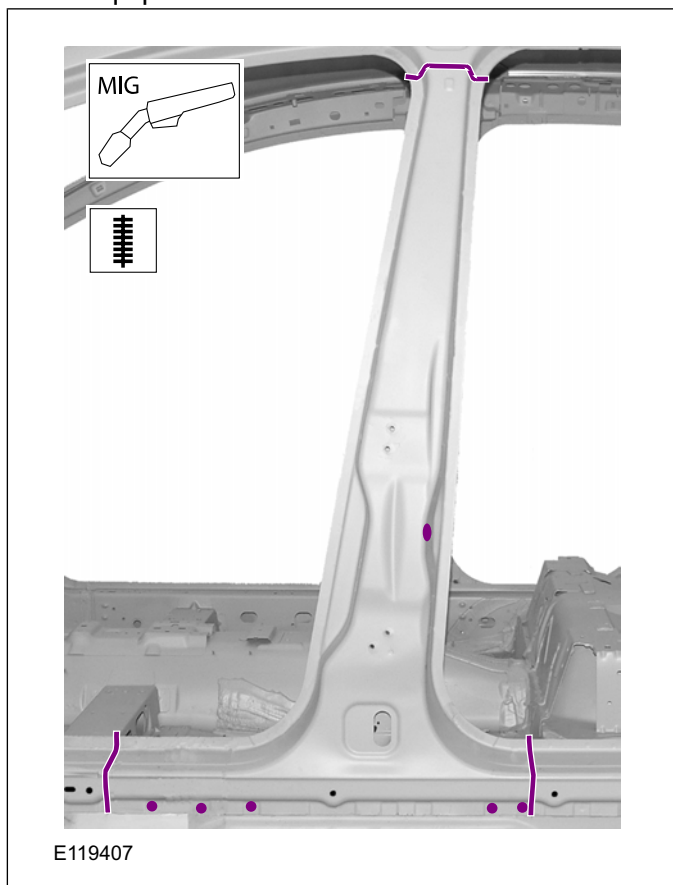
4. Resistance spot weld - Panel thickness 3 mm and greater!

General Equipment: Resistance Spotwelding Equipment



## REMOVAL AND INSTALLATION

## 5. General Equipment: MIG/MAG Welding Equipment



6. • Front and Rear Door
- Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
  - Refer to: **Rear Seat Cushion** (501-10 Seating, Removal and Installation).
  - Refer to: **Rear Seat Backrest** (501-10 Seating, Removal and Installation).
  - Refer to: **B-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **Front Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **Rear Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

## REMOVAL AND INSTALLATION

## Rocker Panel Inner Reinforcement

## General Equipment

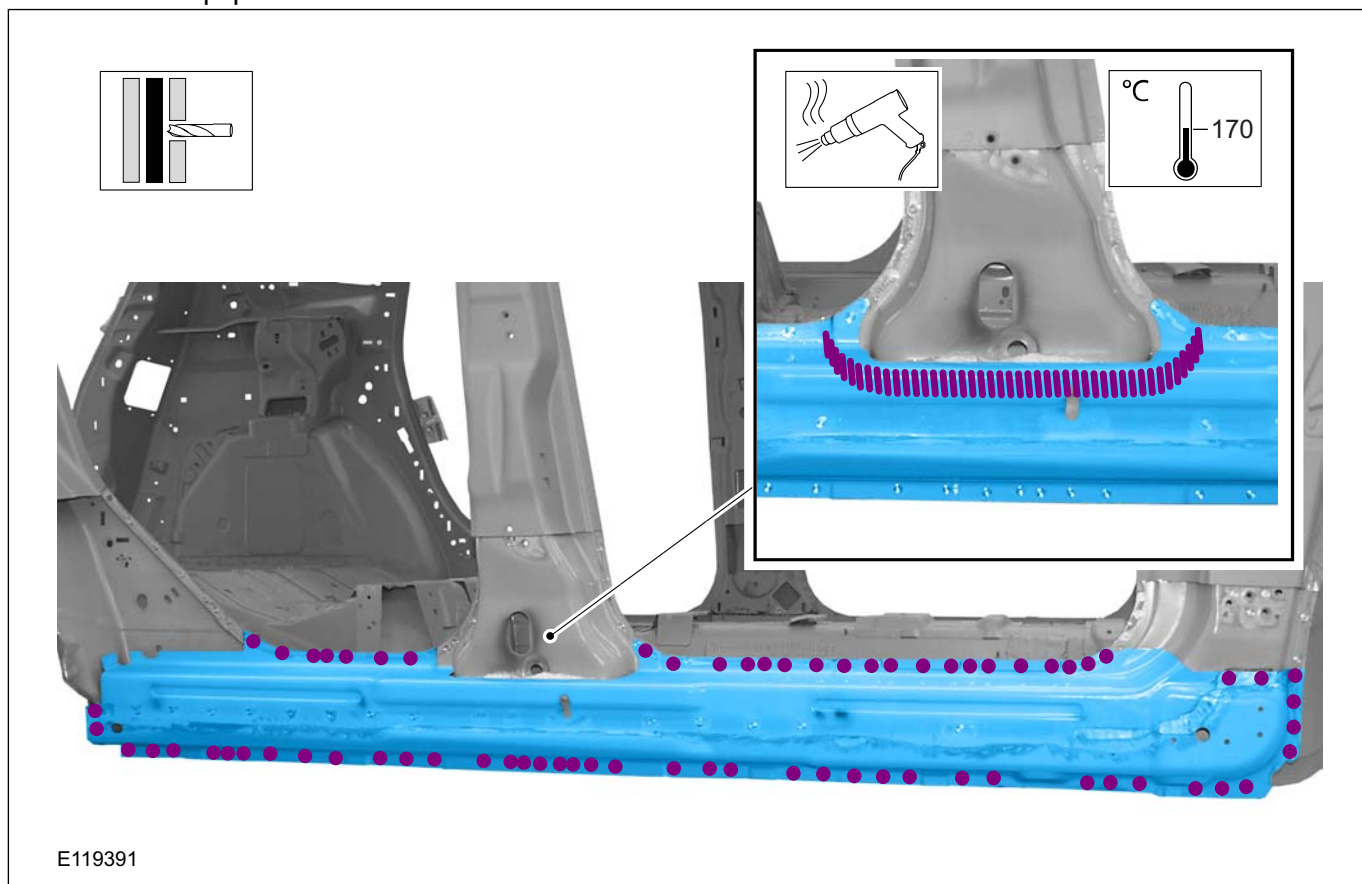
10 mm Drill Bit
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

## General Equipment

Spot weld drill Bit	
<b>Materials</b>	
Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

## Removal

- Refer to: **Rocker Panel** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
  - Reposition the carpeting and the wiring harness away from the working area.
- General Equipment: Spot weld drill Bit
  - General Equipment: Hot Air Gun



## Installation

- NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment

instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

501-29-31

## Side Panel Sheet Metal Repairs

501-29-31

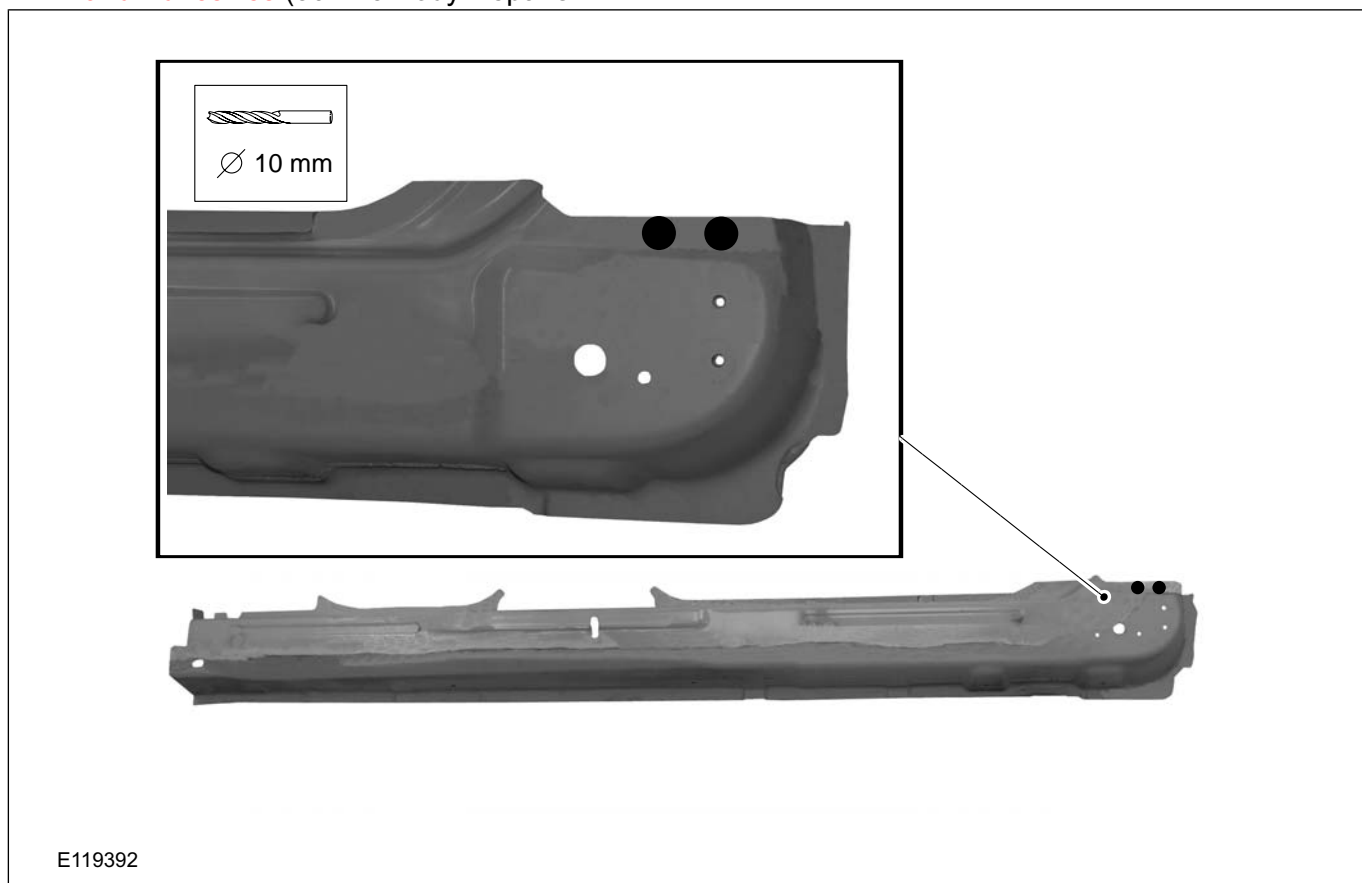
## REMOVAL AND INSTALLATION

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

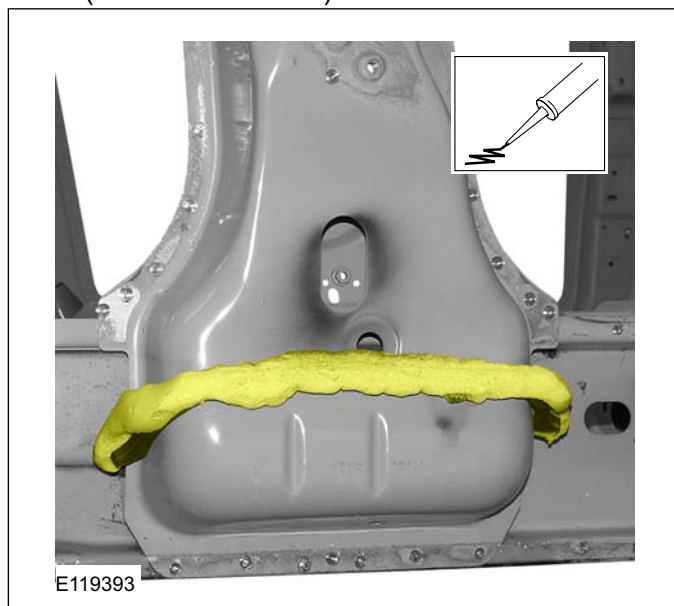
Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs -

General Information, Description and Operation).

3. General Equipment: 10 mm Drill Bit



4. Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive



5. Resistance spot weld - Panel thickness 3 mm and greater!

General Equipment: Resistance Spotwelding Equipment

General Equipment: MIG/MAG Welding Equipment

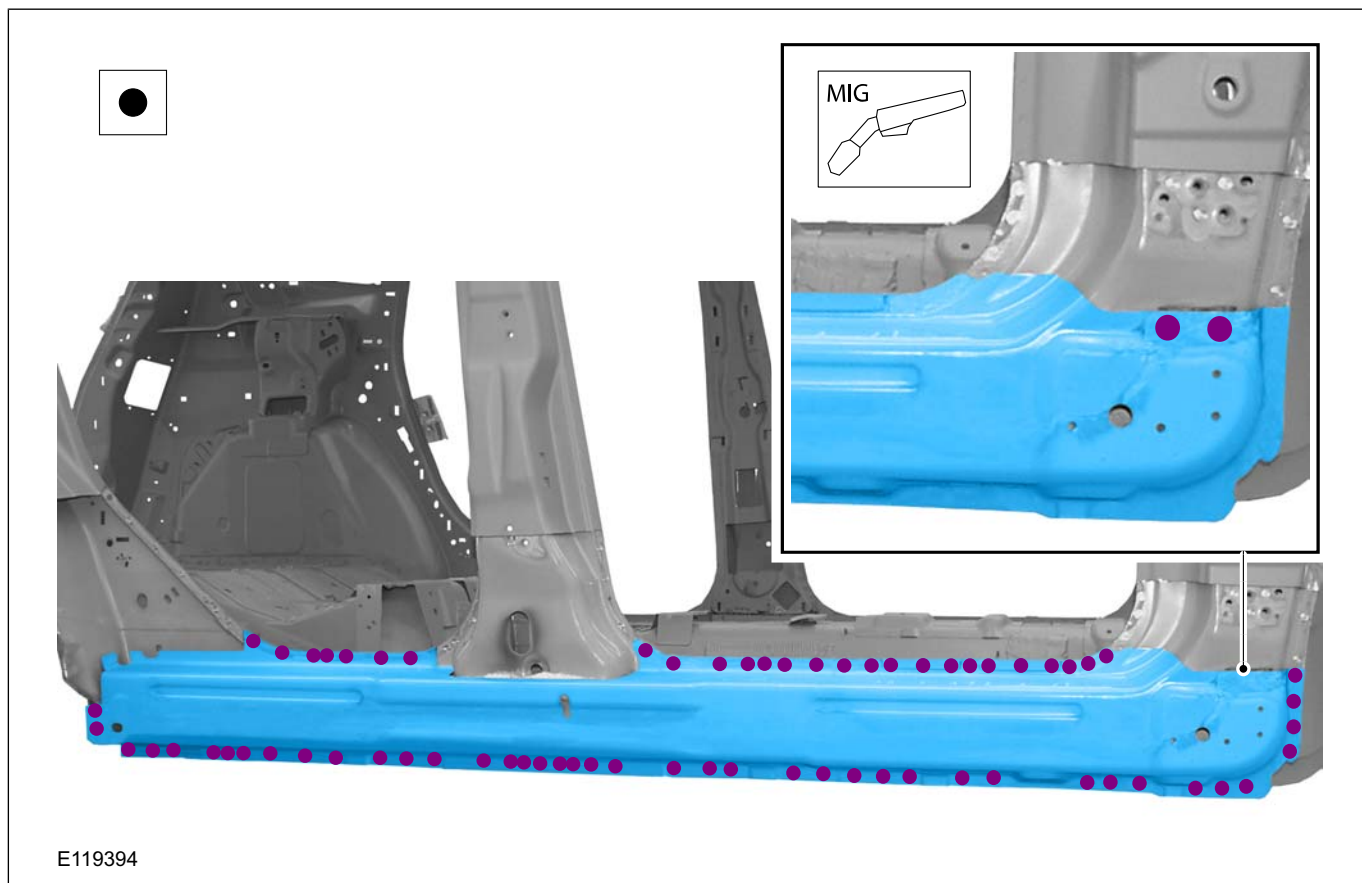


501-29-32

Side Panel Sheet Metal Repairs

501-29-32

## REMOVAL AND INSTALLATION



- Refer to: **Rocker Panel** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).

## REMOVAL AND INSTALLATION

## A-Pillar Outer Panel Section and Reinforcement

## General Equipment

10 mm Drill Bit
6 mm Drill Bit
Air Body Saw
Hot Air Gun
Locking Pliers
Measurement and Alignment Angle System

## General Equipment

MIG/MAG Welding Equipment
Resistance Spotwelding Equipment
Spot weld drill Bit

## Materials

Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

## Removal

- General Equipment: Measurement and Alignment Angle System
- Front Door
  - Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
  - Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **Front Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **Windshield Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).
  - Refer to: **Fender Apron Panel Reinforcement** (501-27 Front End Sheet Metal Repairs, Removal and Installation).
  - Reposition the carpeting and the wiring harness away from the working area.
- General Equipment: Spot weld drill Bit



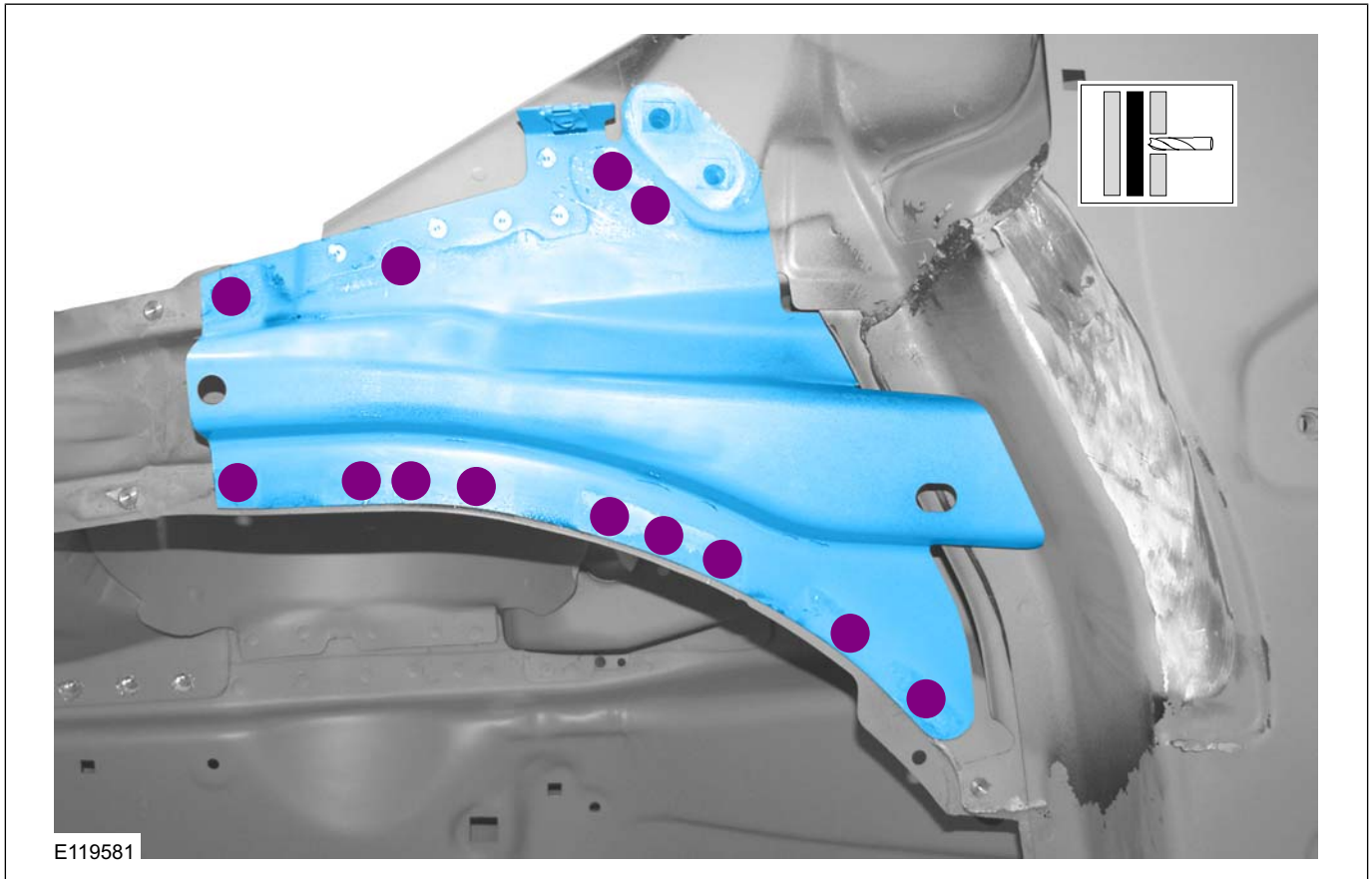
501-29-34

### Side Panel Sheet Metal Repairs

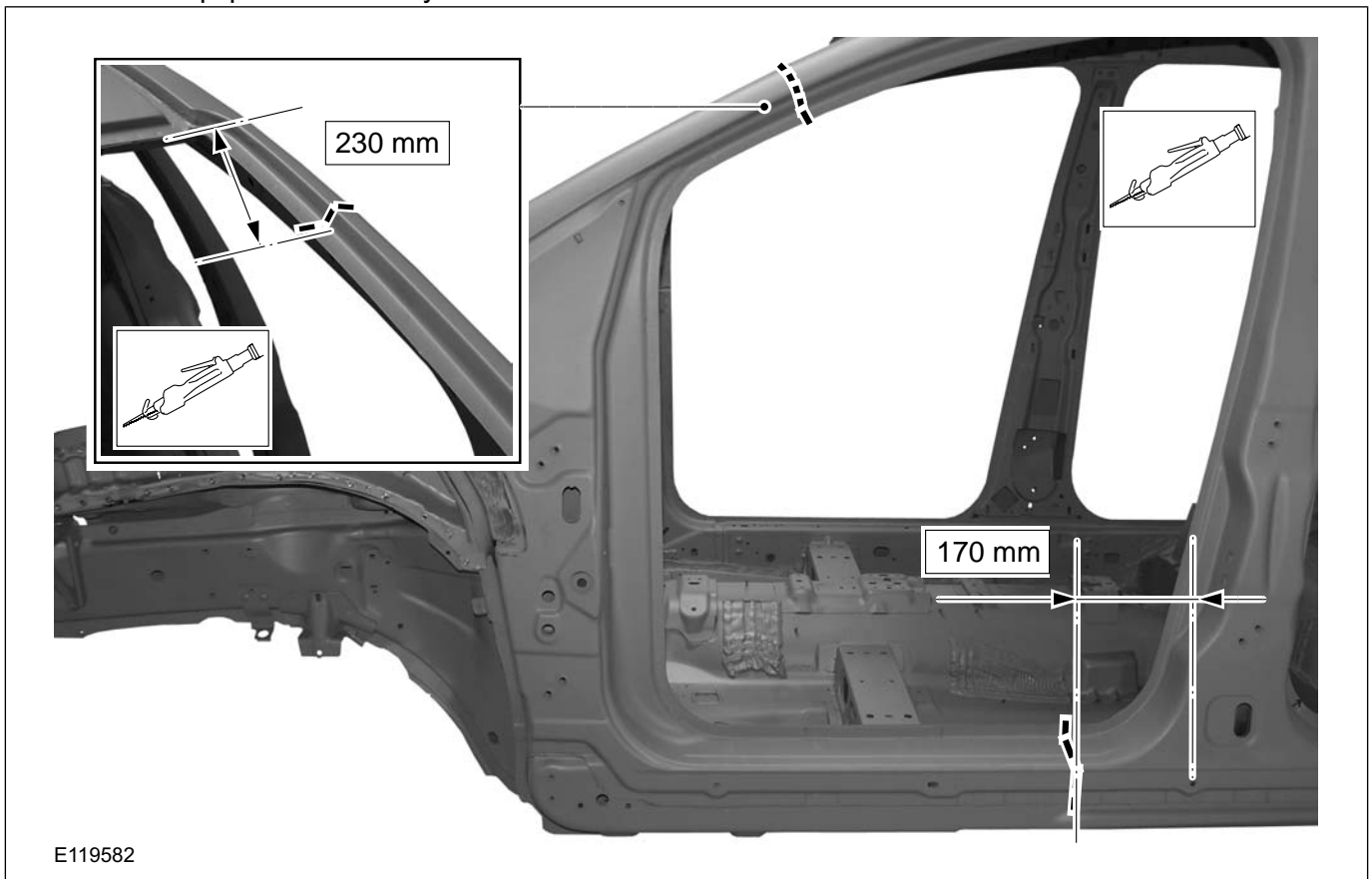
501-29-34



## REMOVAL AND INSTALLATION



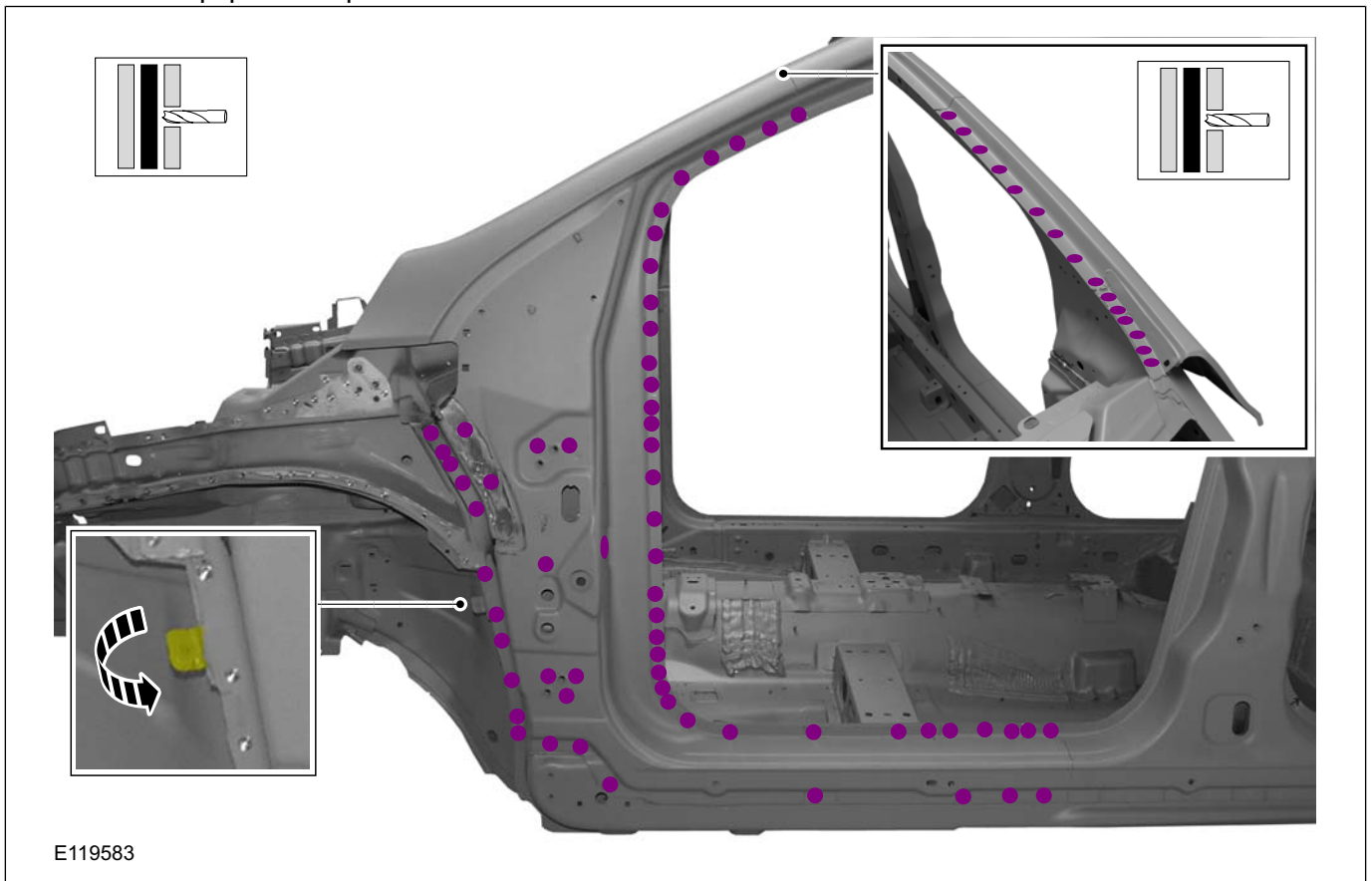
#### 4. General Equipment: Air Body Saw





REMOVAL AND INSTALLATION

5. General Equipment: Spot weld drill Bit



E119583

6. General Equipment: Hot Air Gun

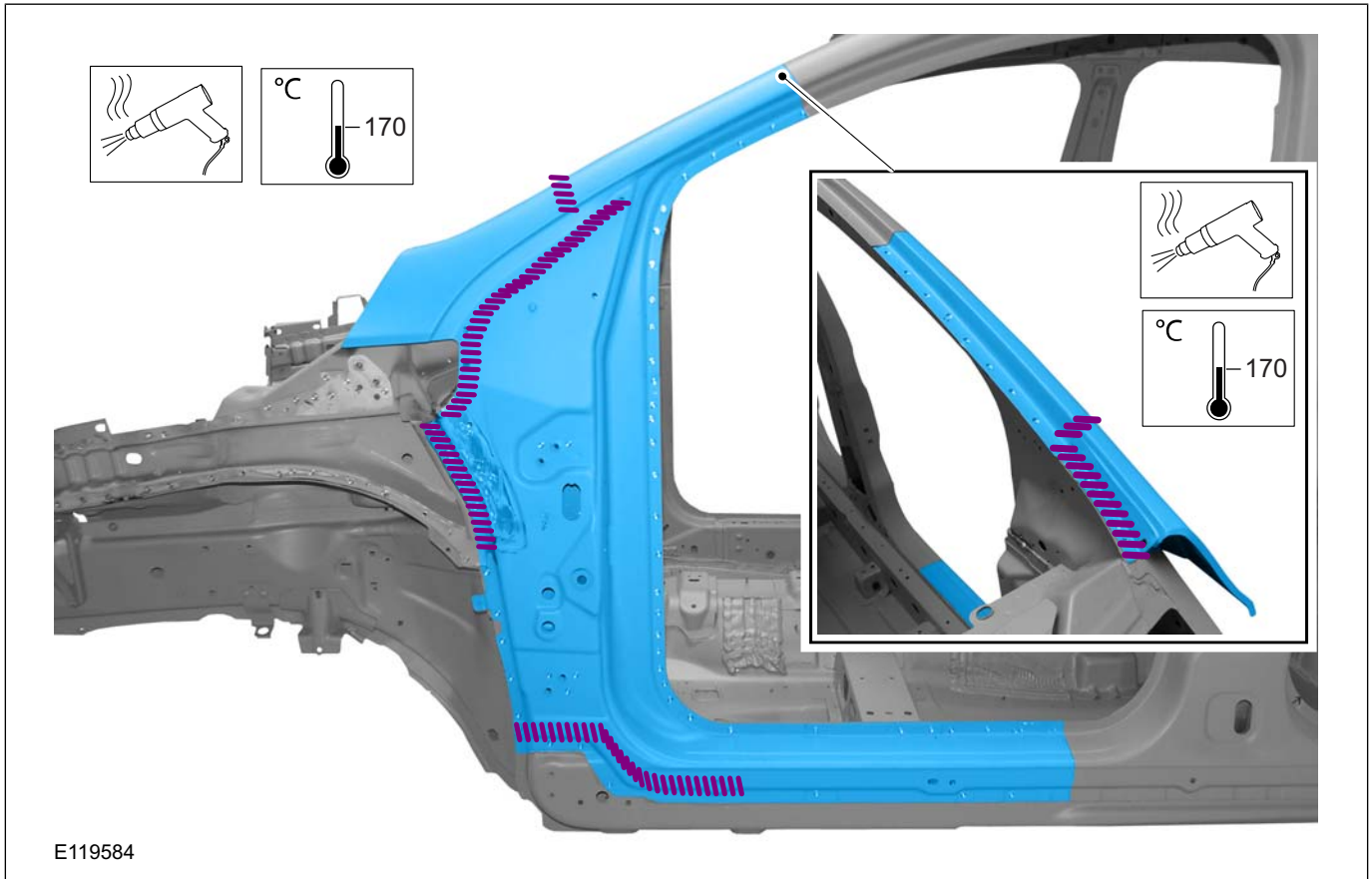


501-29-36

Side Panel Sheet Metal Repairs

501-29-36

## REMOVAL AND INSTALLATION

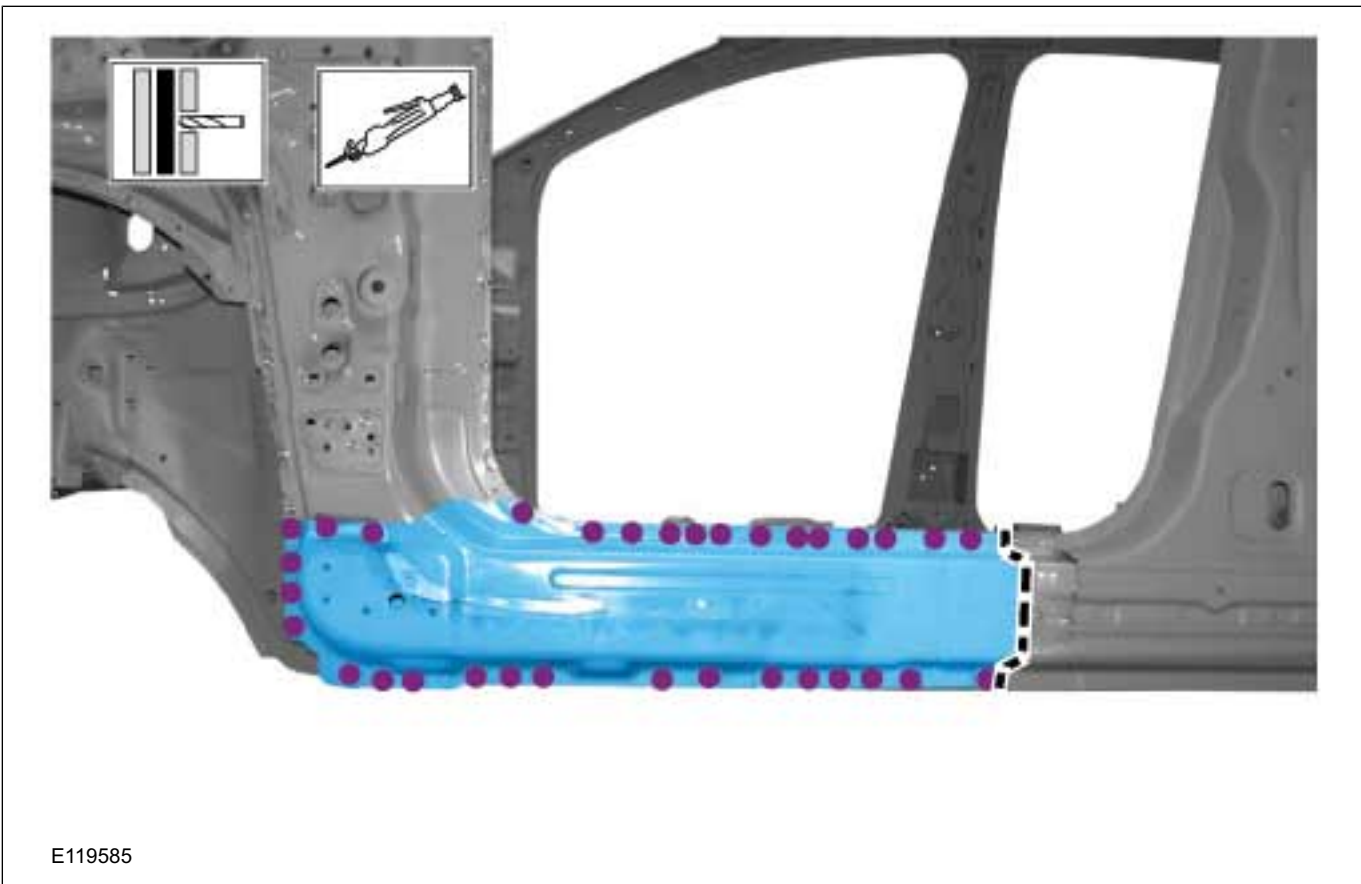


7. General Equipment: Spot weld drill Bit  
General Equipment: Air Body Saw

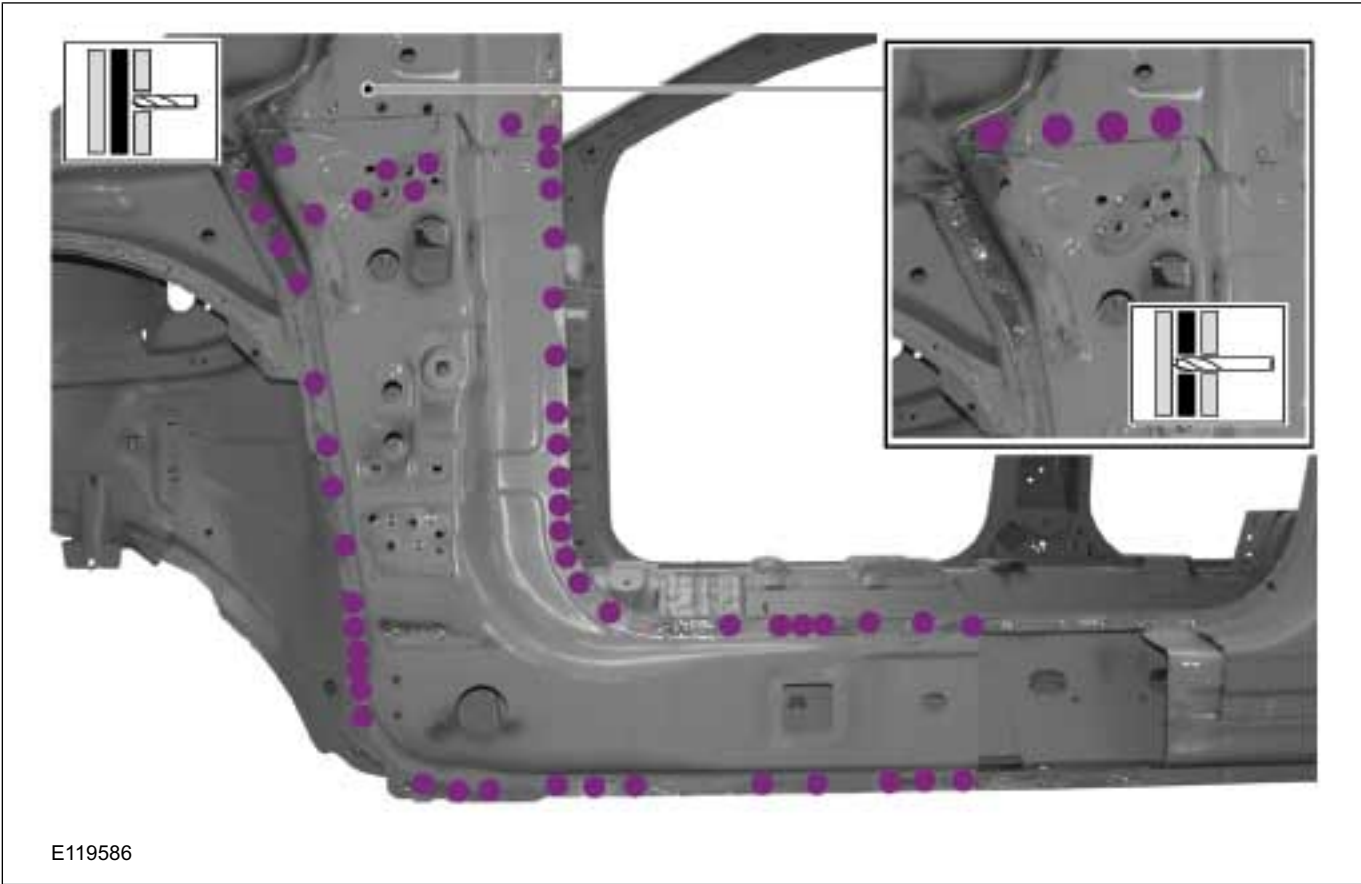




REMOVAL AND INSTALLATION



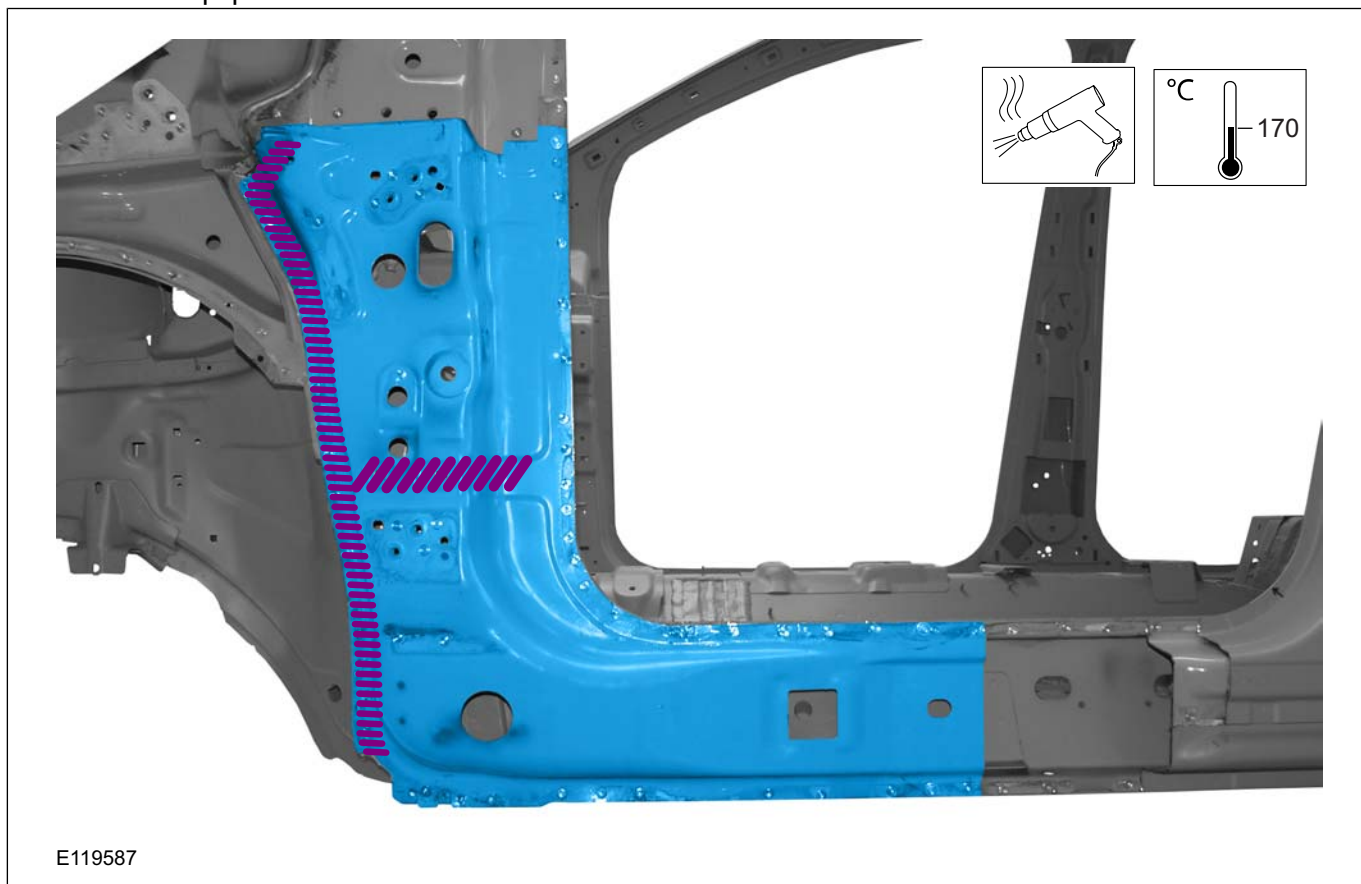
8. General Equipment: Spot weld drill Bit





## REMOVAL AND INSTALLATION

## 9. General Equipment: Hot Air Gun



## Installation

- NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

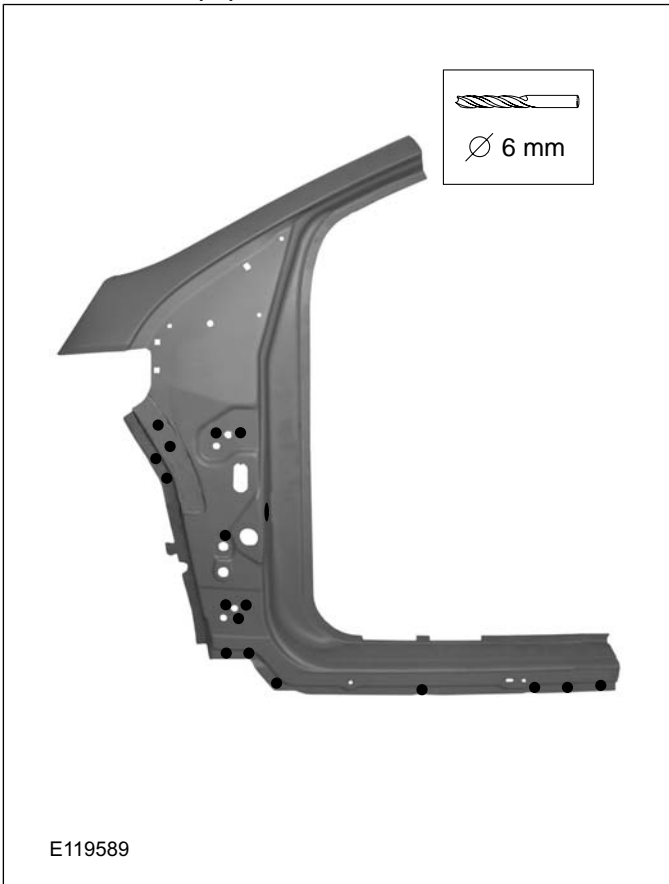
- NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

REMOVAL AND INSTALLATION

3. General Equipment: 6 mm Drill Bit

4. General Equipment: 10 mm Drill Bit



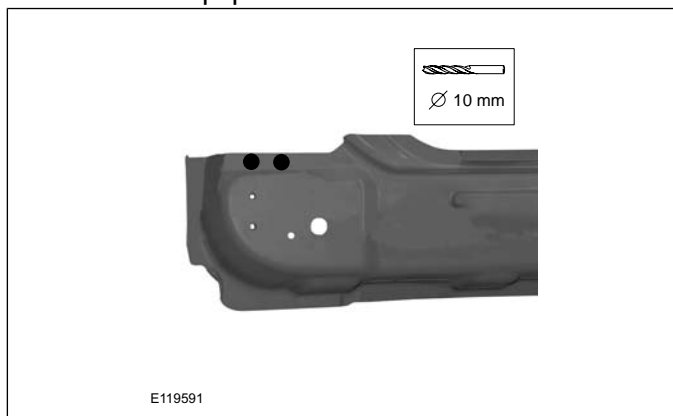
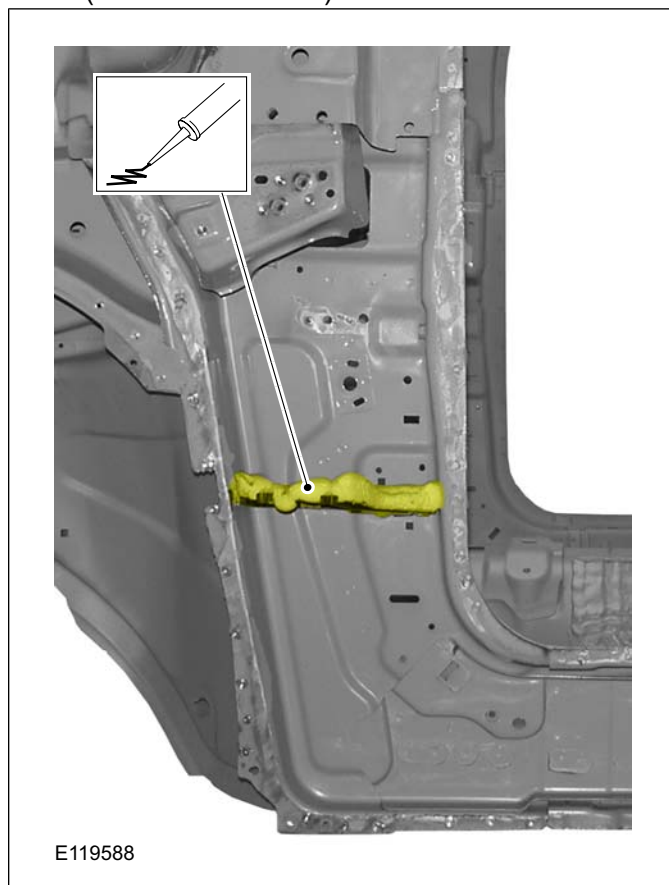
501-29-40

## Side Panel Sheet Metal Repairs

501-29-40

## REMOVAL AND INSTALLATION

5. General Equipment: 10 mm Drill Bit

6. Material: Windshield Adhesive Kit  
(WSS-M11P57-A5) adhesive

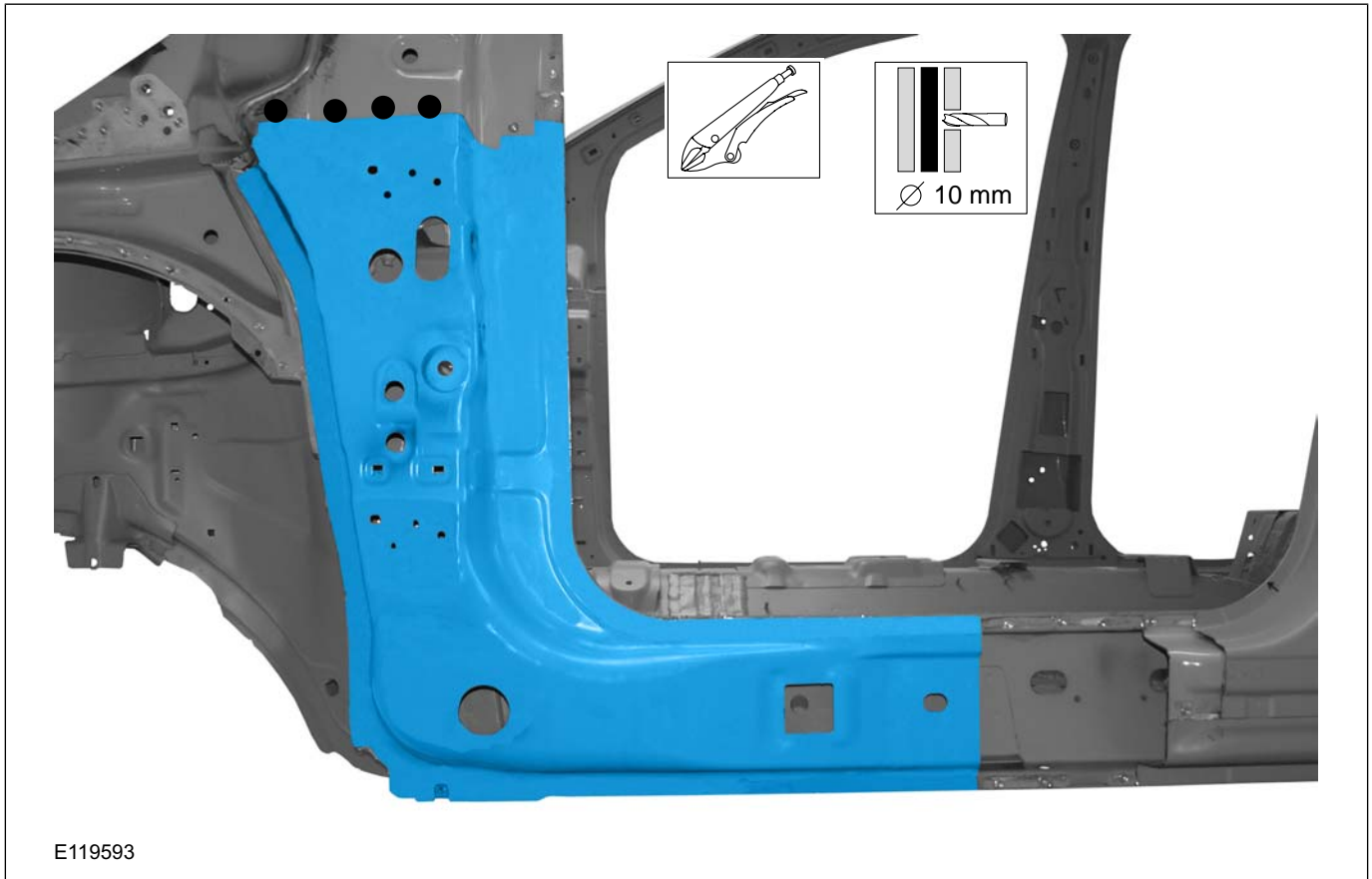
7. General Equipment: 10 mm Drill Bit

501-29-41

Side Panel Sheet Metal Repairs

501-29-41

## REMOVAL AND INSTALLATION



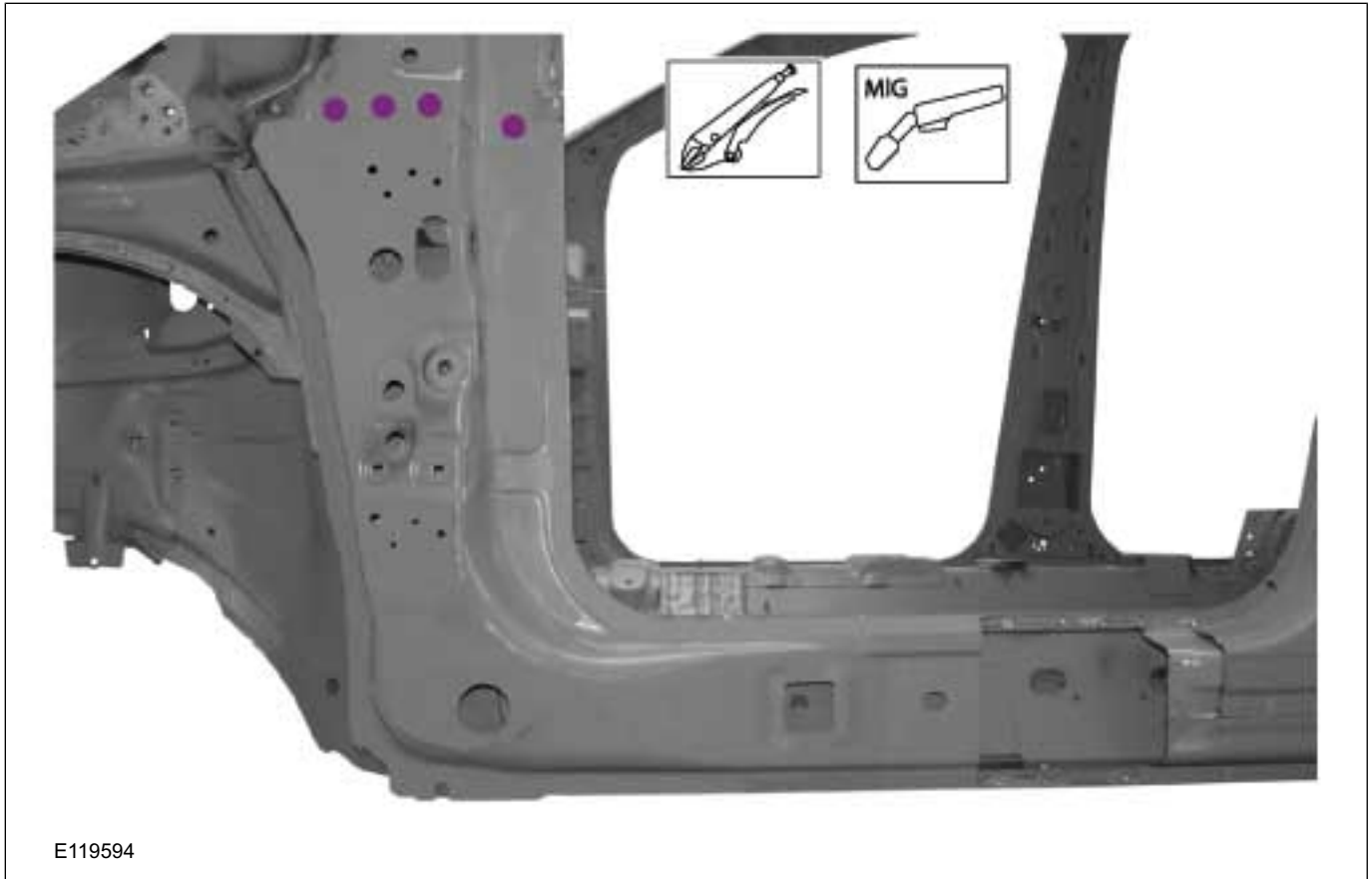
8. General Equipment: Locking Pliers  
General Equipment: MIG/MAG Welding  
Equipment

501-29-42

Side Panel Sheet Metal Repairs

501-29-42

## REMOVAL AND INSTALLATION

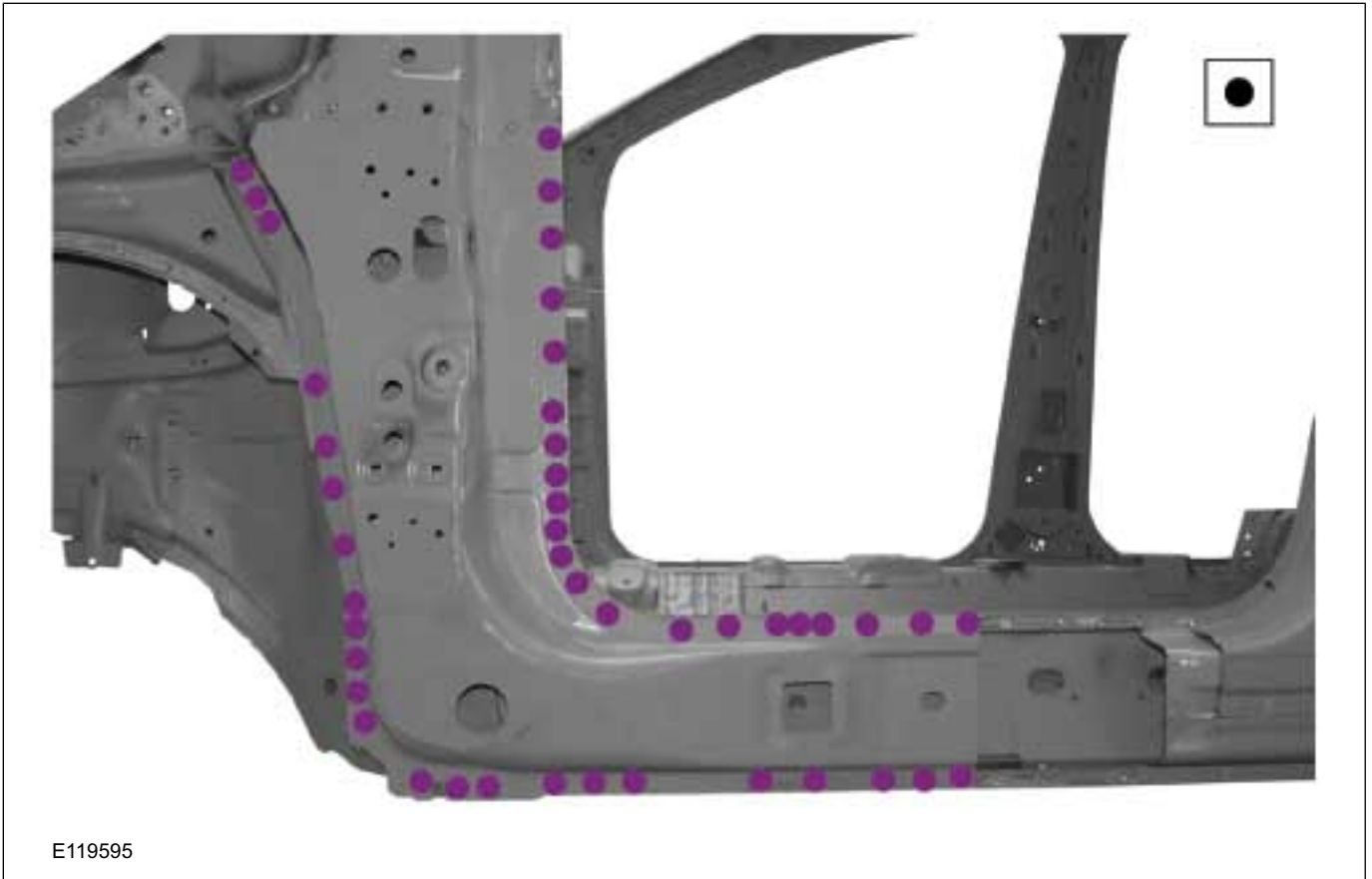


9. Resistance spot weld - Panel thickness 3 mm and greater!

General Equipment: Resistance Spotwelding Equipment



REMOVAL AND INSTALLATION



10. General Equipment: MIG/MAG Welding Equipment



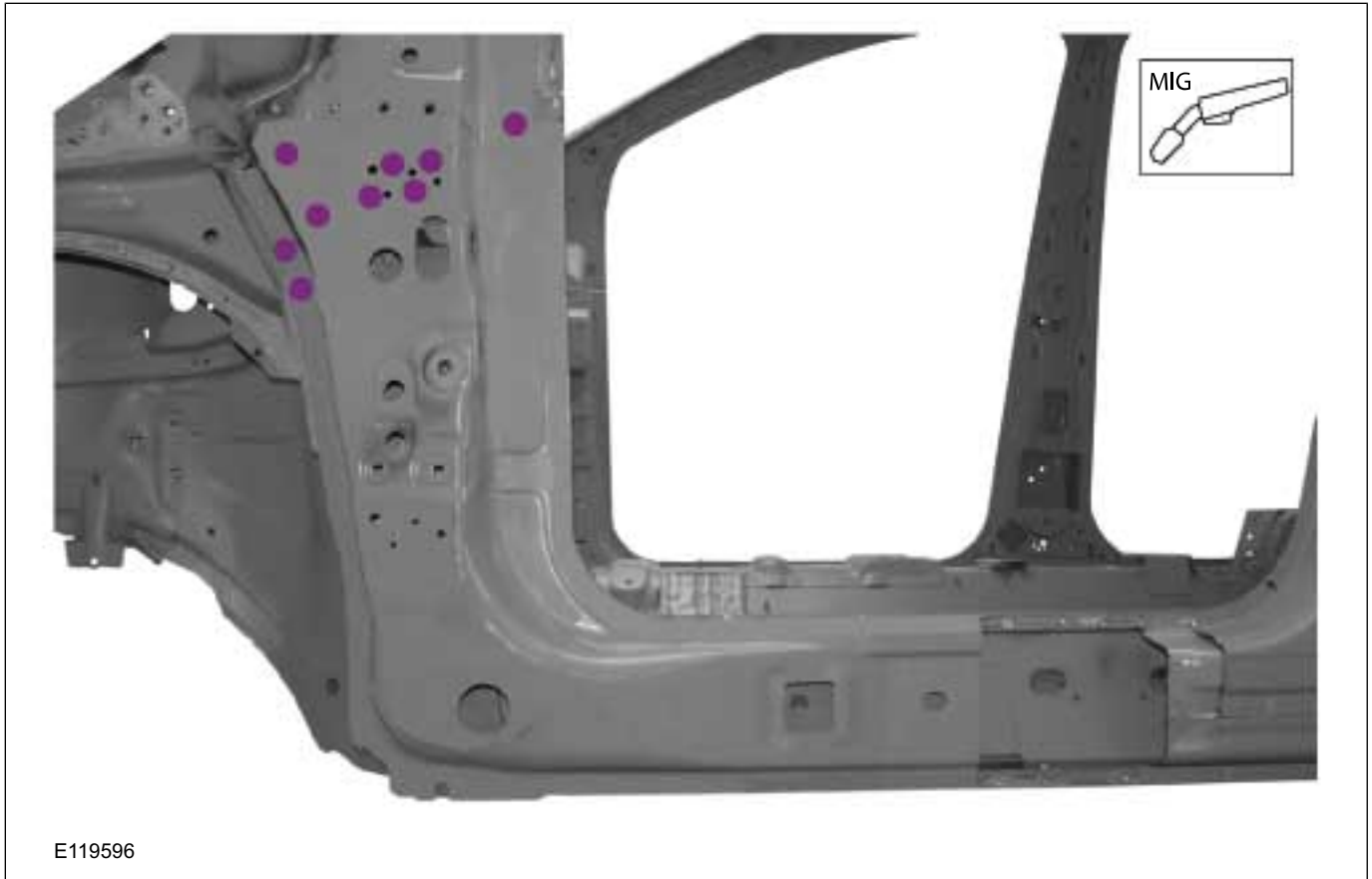


501-29-44

Side Panel Sheet Metal Repairs

501-29-44

## REMOVAL AND INSTALLATION



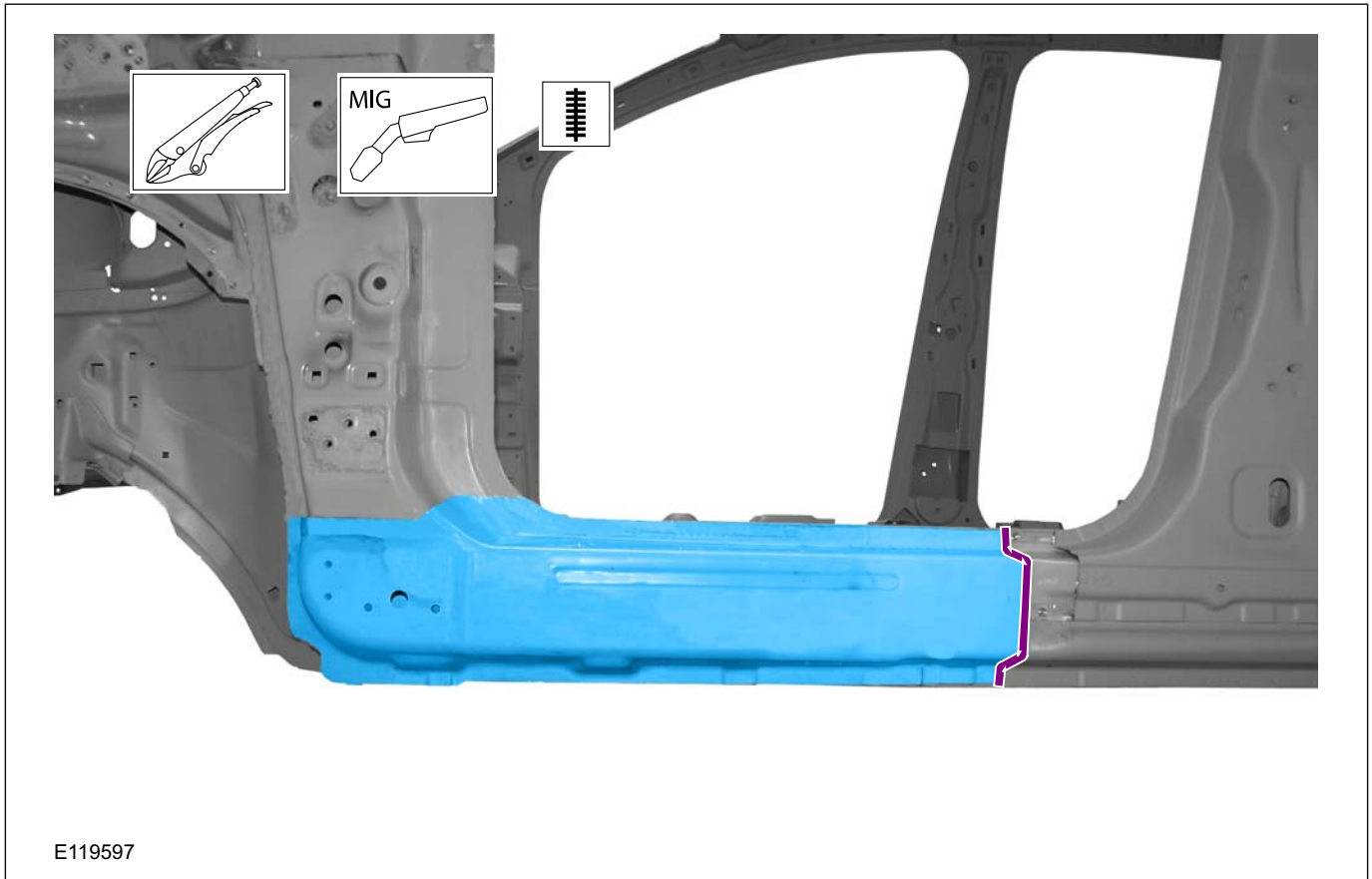
11. General Equipment: Locking Pliers  
General Equipment: MIG/MAG Welding  
Equipment

501-29-45

Side Panel Sheet Metal Repairs

501-29-45

## REMOVAL AND INSTALLATION



**12** Resistance spot weld - Panel thickness 3 mm and greater!

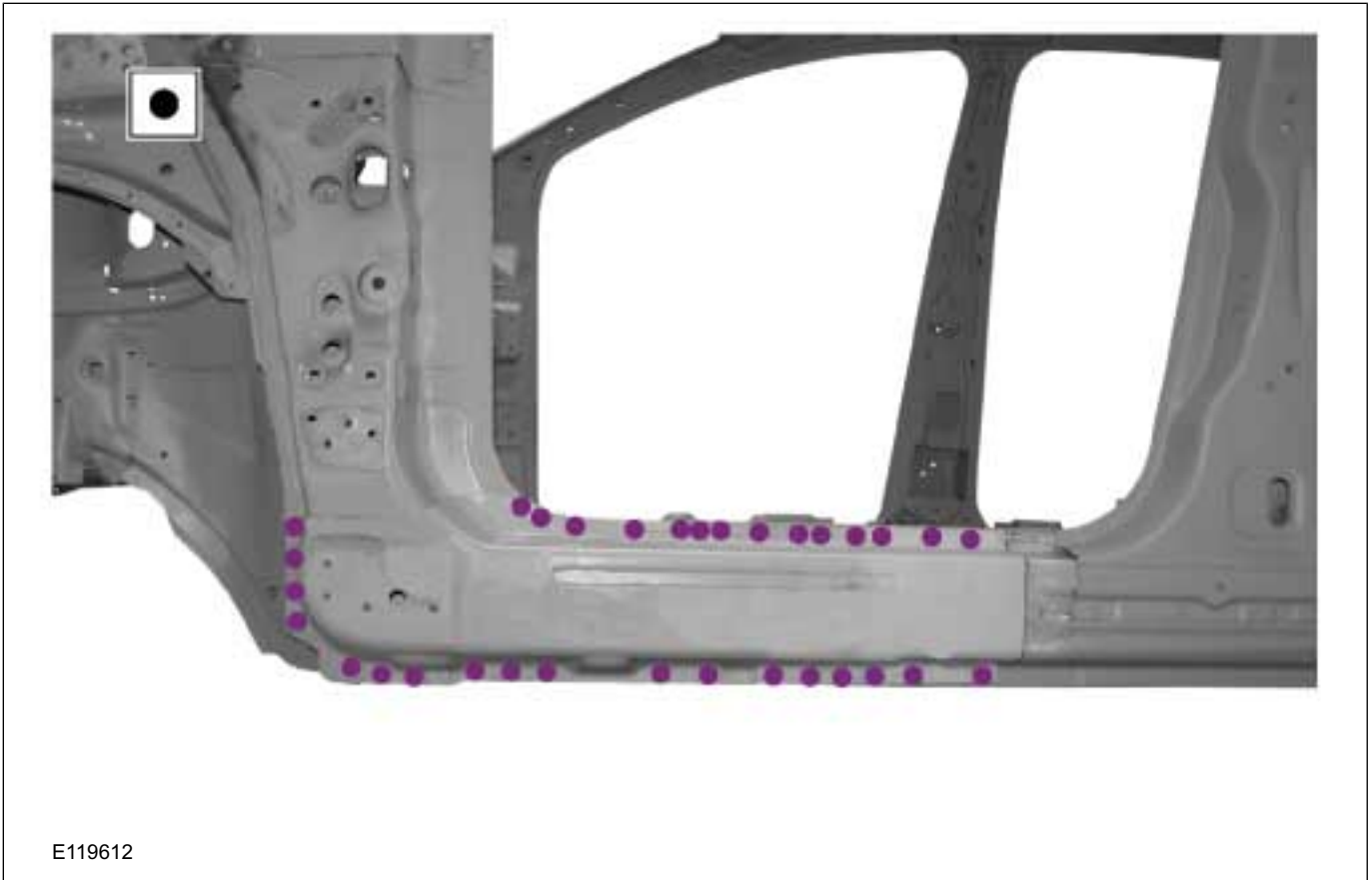
General Equipment: Resistance Spotwelding Equipment

501-29-46

Side Panel Sheet Metal Repairs

501-29-46

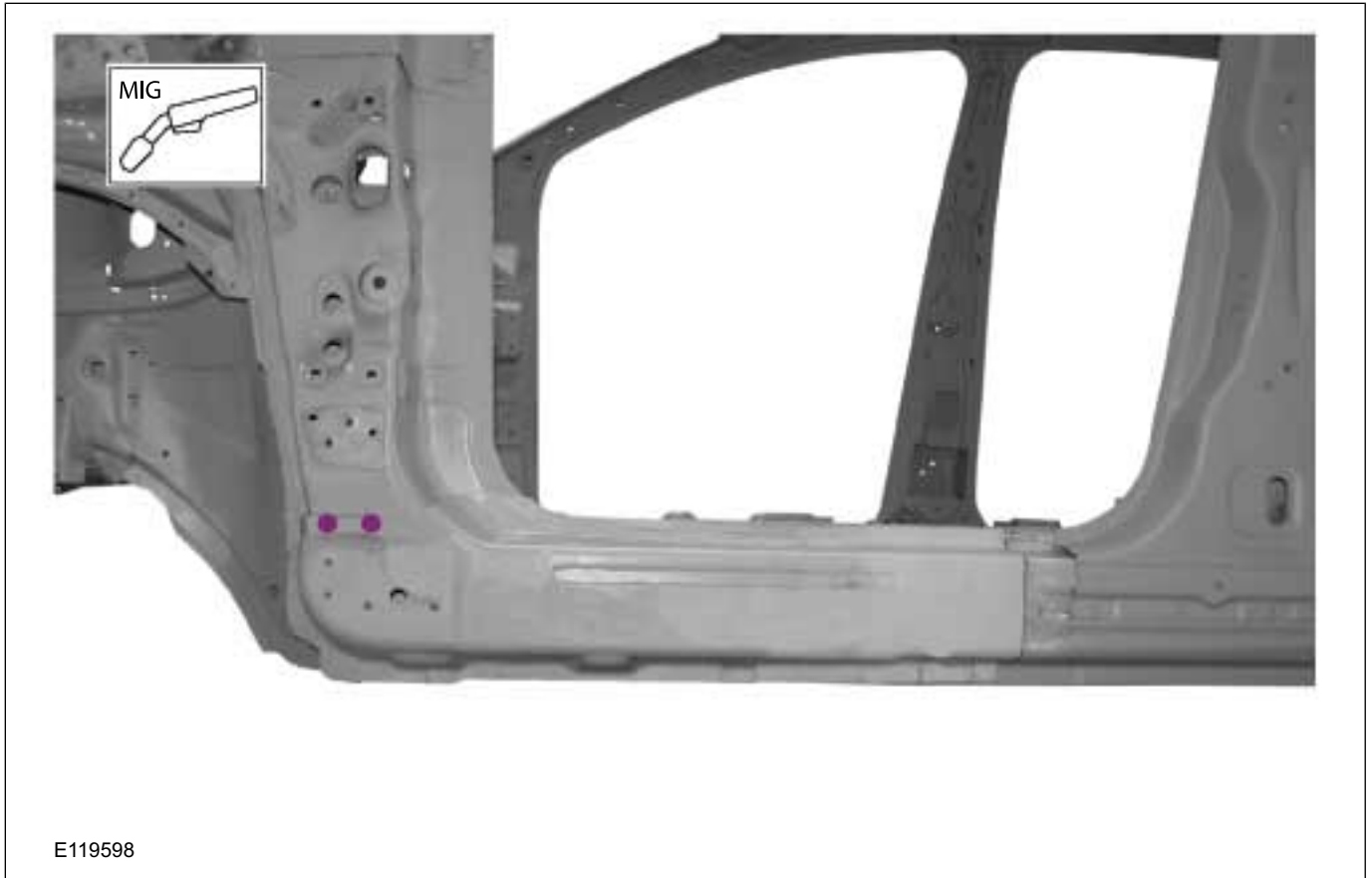
## REMOVAL AND INSTALLATION



13. General Equipment: MIG/MAG Welding  
Equipment

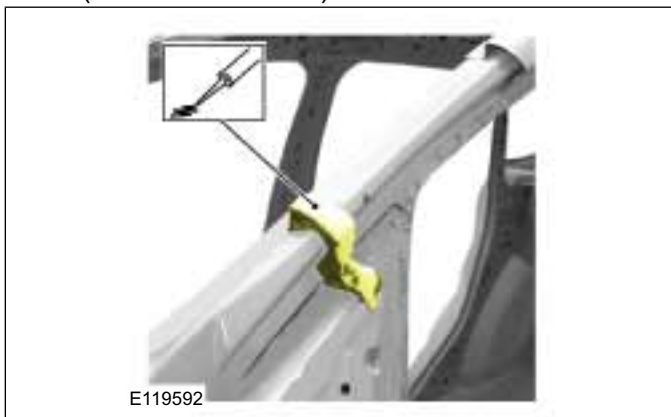


REMOVAL AND INSTALLATION



14. Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive

15. General Equipment: MIG/MAG Welding Equipment

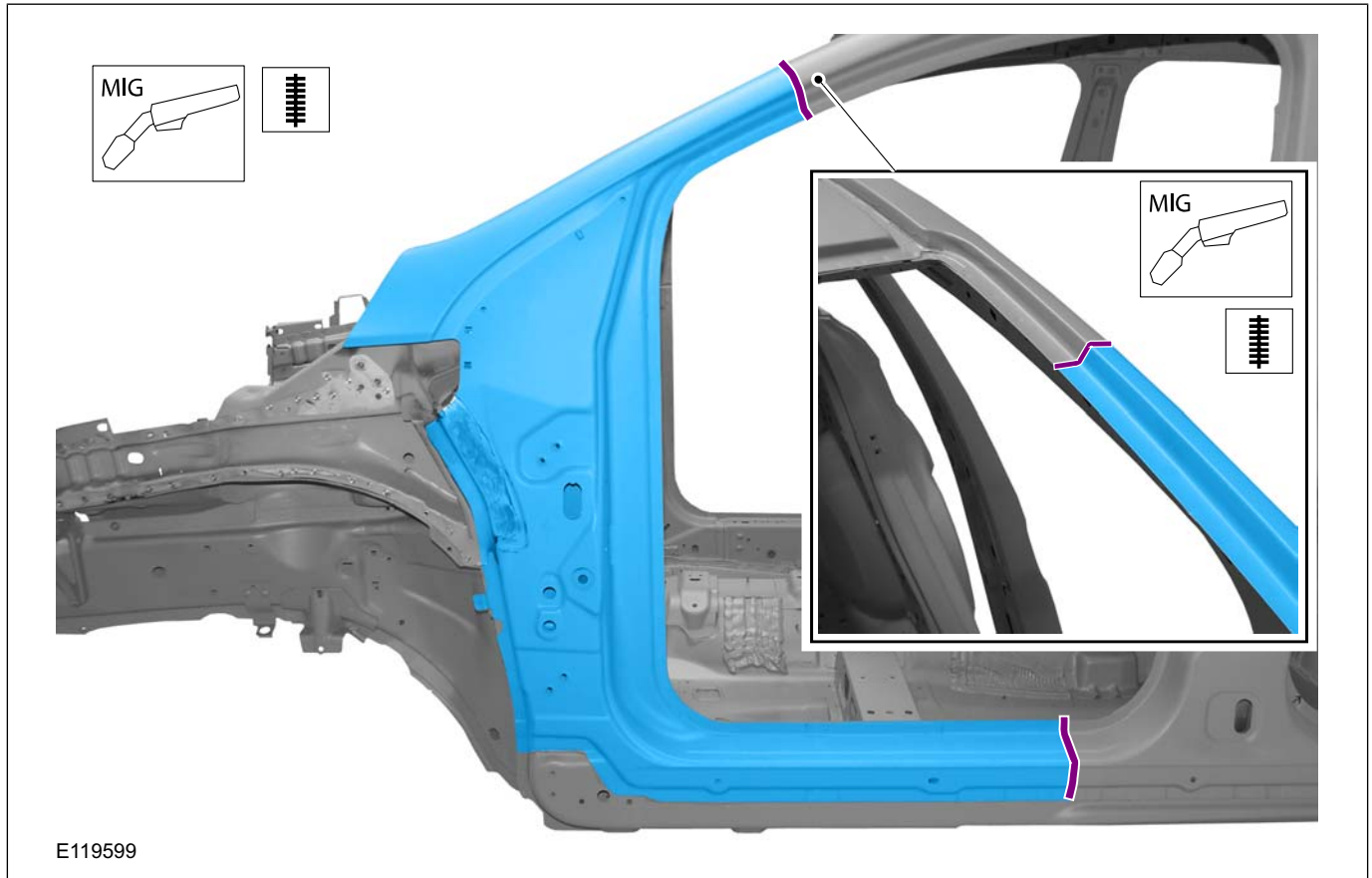


501-29-48

Side Panel Sheet Metal Repairs

501-29-48

## REMOVAL AND INSTALLATION

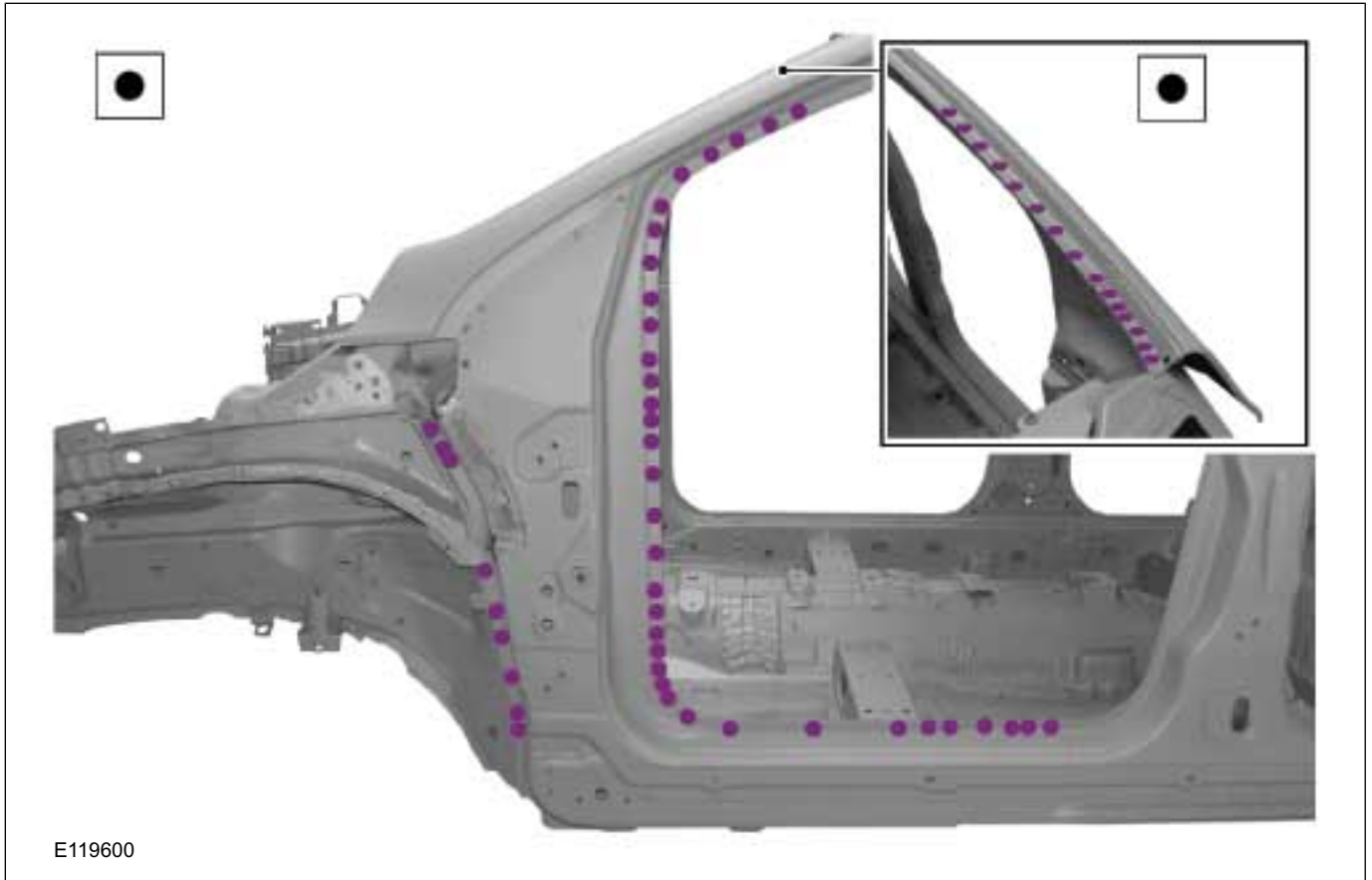


**16.** Resistance spot weld - Panel thickness 3 mm and greater!

General Equipment: Resistance Spotwelding Equipment



REMOVAL AND INSTALLATION



17. General Equipment: MIG/MAG Welding Equipment







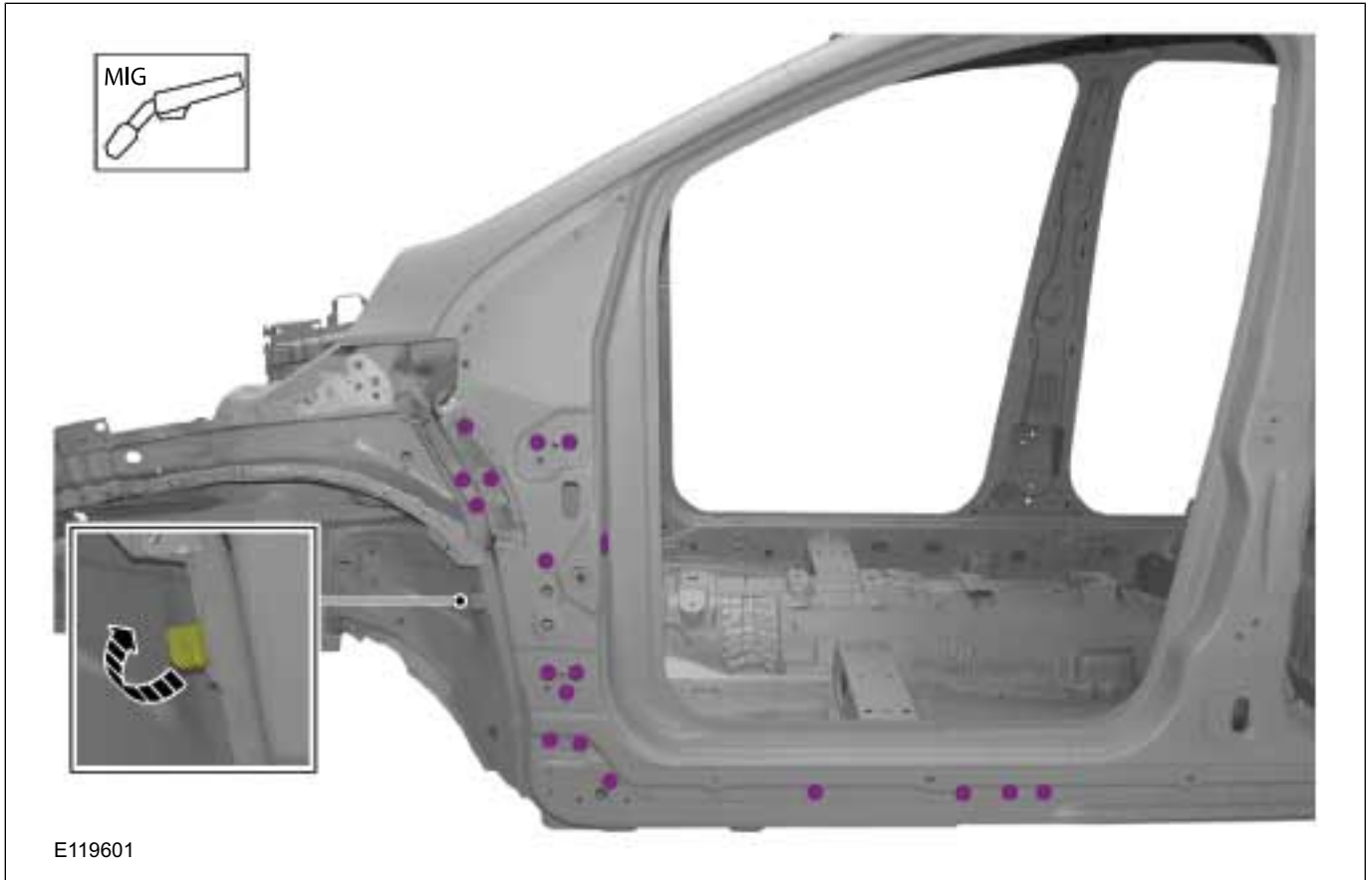
501-29-50

Side Panel Sheet Metal Repairs

501-29-50



REMOVAL AND INSTALLATION

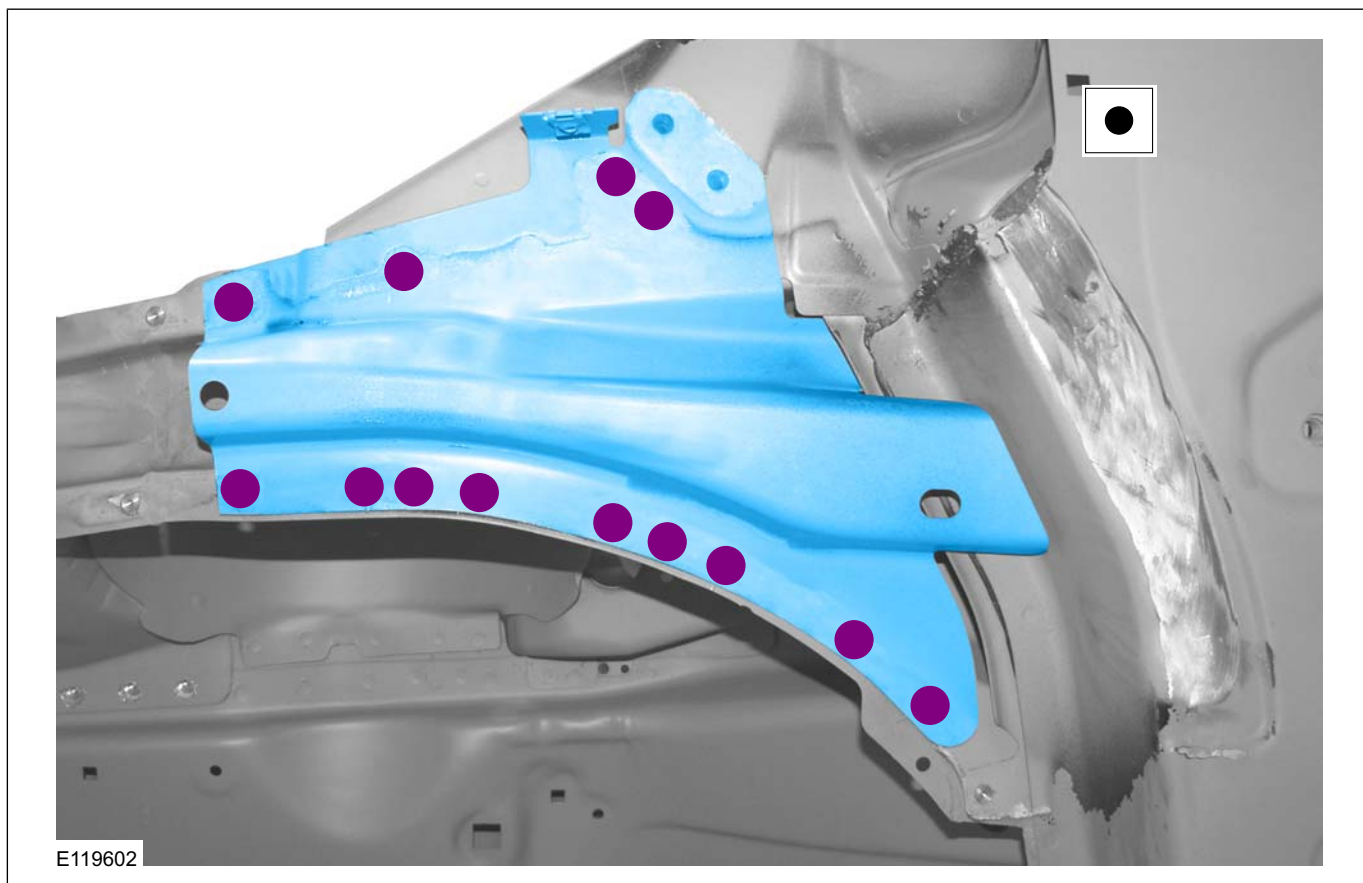


E119601

18. General Equipment: Resistance Spotwelding Equipment



## REMOVAL AND INSTALLATION



19. • Front Door
- Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
  - Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **Front Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
  - Refer to: **Windshield Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).
  - Refer to: **Fender Apron Panel Reinforcement** (501-27 Front End Sheet Metal Repairs, Removal and Installation).

## SECTION 501-30 Rear End Sheet Metal Repairs

VEHICLE APPLICATION: 2008.50 Kuga

### CONTENTS

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**REMOVAL AND INSTALLATION**

Quarter Panel LH

Removal



## REMOVAL AND INSTALLATION

1. • **Replacement parts:**
  - Quarter Panel
2. • **Necessary Removal and Installation Work:**
  - Rear Door
  - Rear Quarter Window Glass

Refer to: **Rear Quarter Window Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).

- Rear Seat

Refer to: **Rear Seat Cushion** (501-10 Seating, Removal and Installation).

Refer to: **Rear Seat Backrest** (501-10 Seating, Removal and Installation).

Refer to: **Rear Seat Backrest Latch** (501-10 Seating, Removal and Installation).

- Loadspace Trim Panel

Refer to: **Loadspace Trim Panel LH** (501-05 Interior Trim and Ornamentation, Removal and Installation).

Refer to: **Loadspace Trim Panel RH** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- C-Pillar Trim Panel

Refer to: **C-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

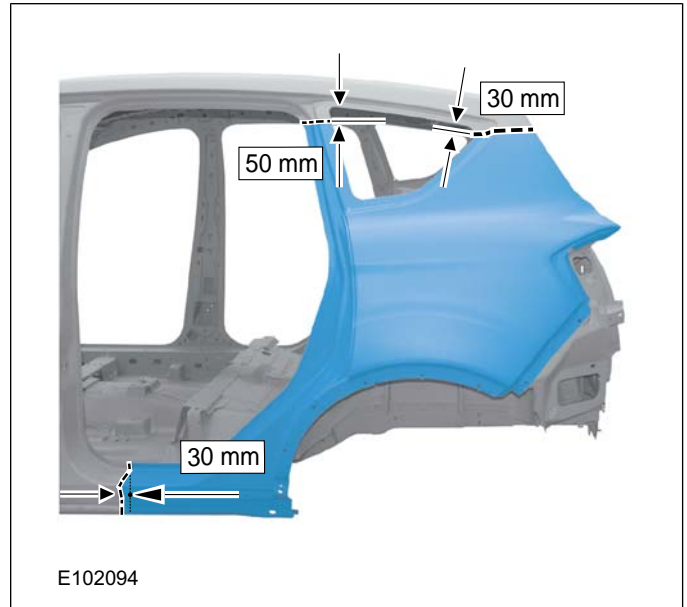
- D-Pillar Trim Panel

Refer to: **D-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- Headliner

Refer to: **Headliner** (501-05 Interior Trim and

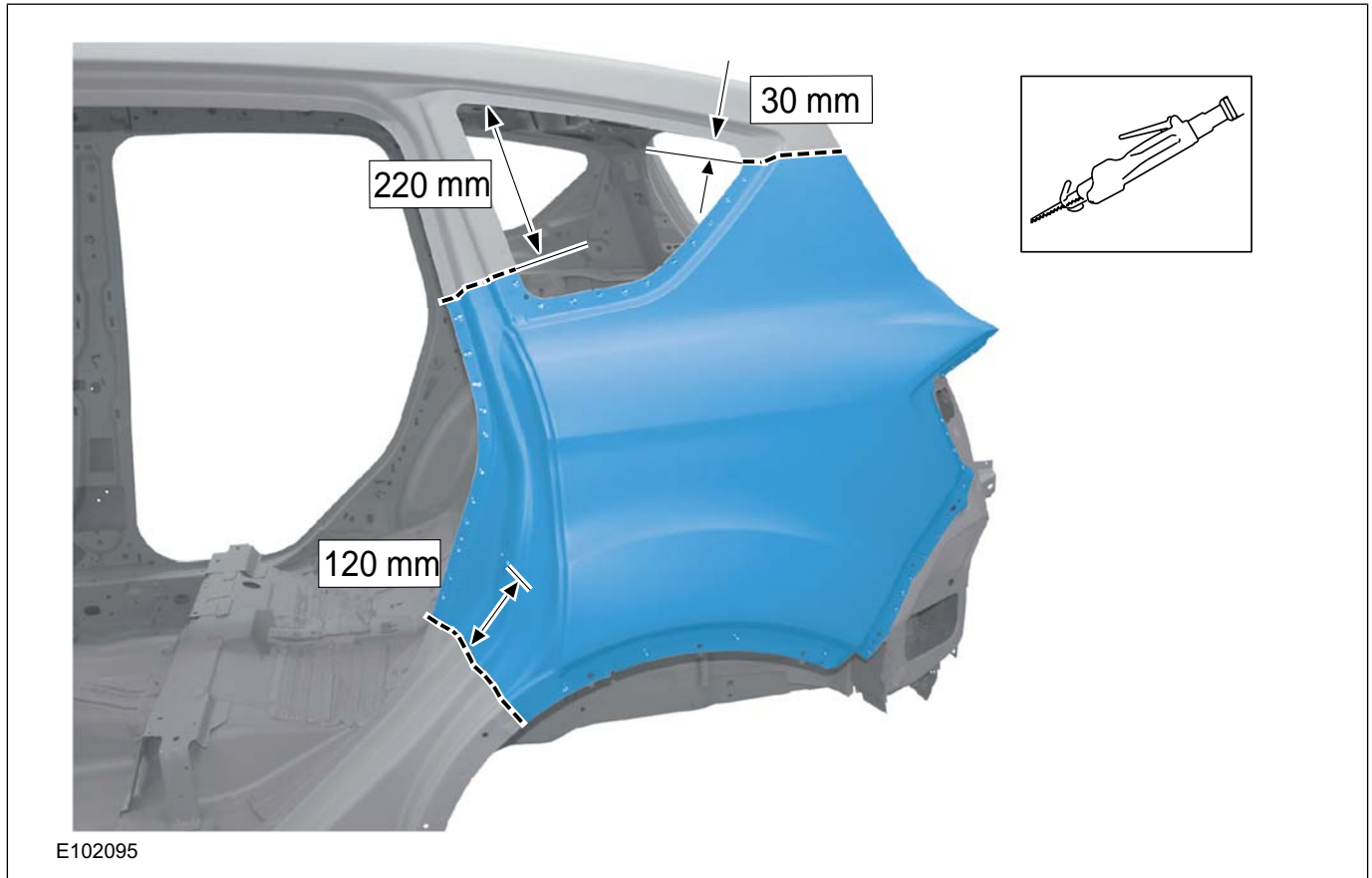
- Ornamentation, Removal and Installation).
- Rear Bumper Cover and Bumper
- Rear Lamp
- Reposition the carpeting and the wiring harness away from the working area.

3. • **Quarter Panel Cut Lines Options**

4. **NOTE:** The specified dimensions must be met when making the separating cuts.

- **Quarter Panel Cut Lines**
- **C-Pillar Upper** reference point: Sheet metal edge of window opening.
- **C-Pillar Lower** reference point: Center of striker reinforcement mounting (Spot welds).
- **D-Pillar** reference point: Sheet metal edge of window opening.

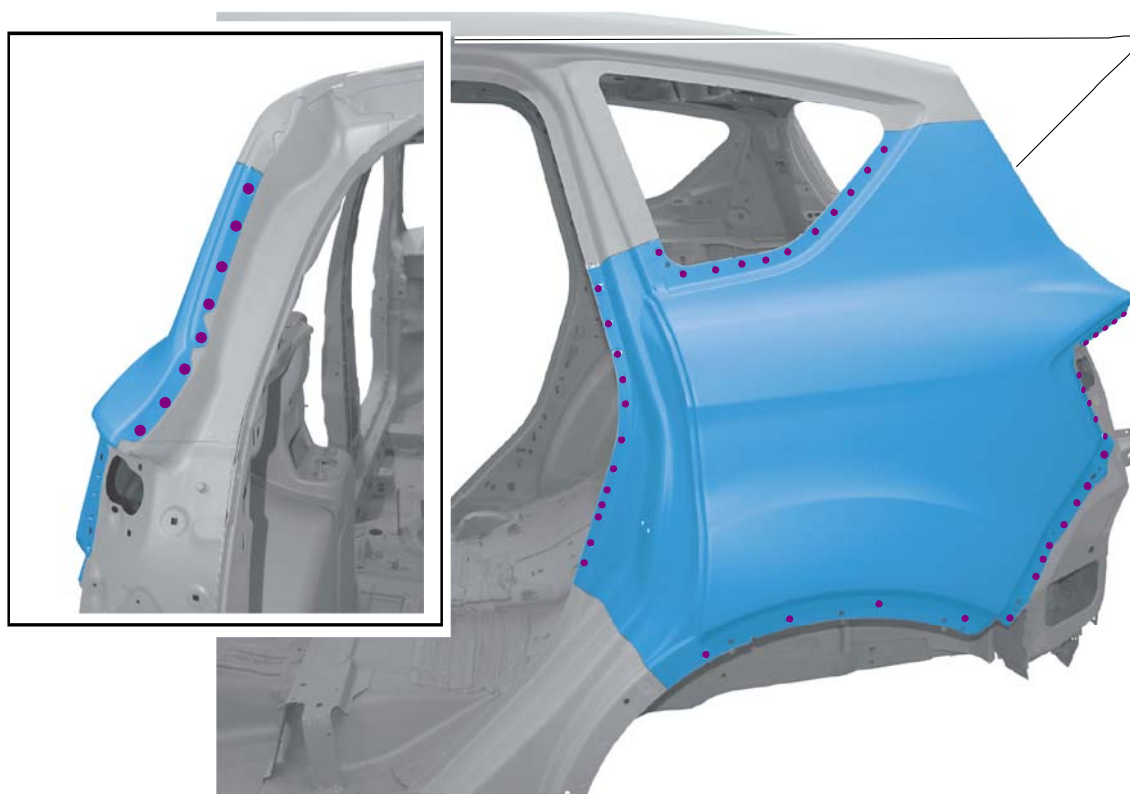
## REMOVAL AND INSTALLATION



5. • **Quarter Panel**
  - Mill out the spot welds.



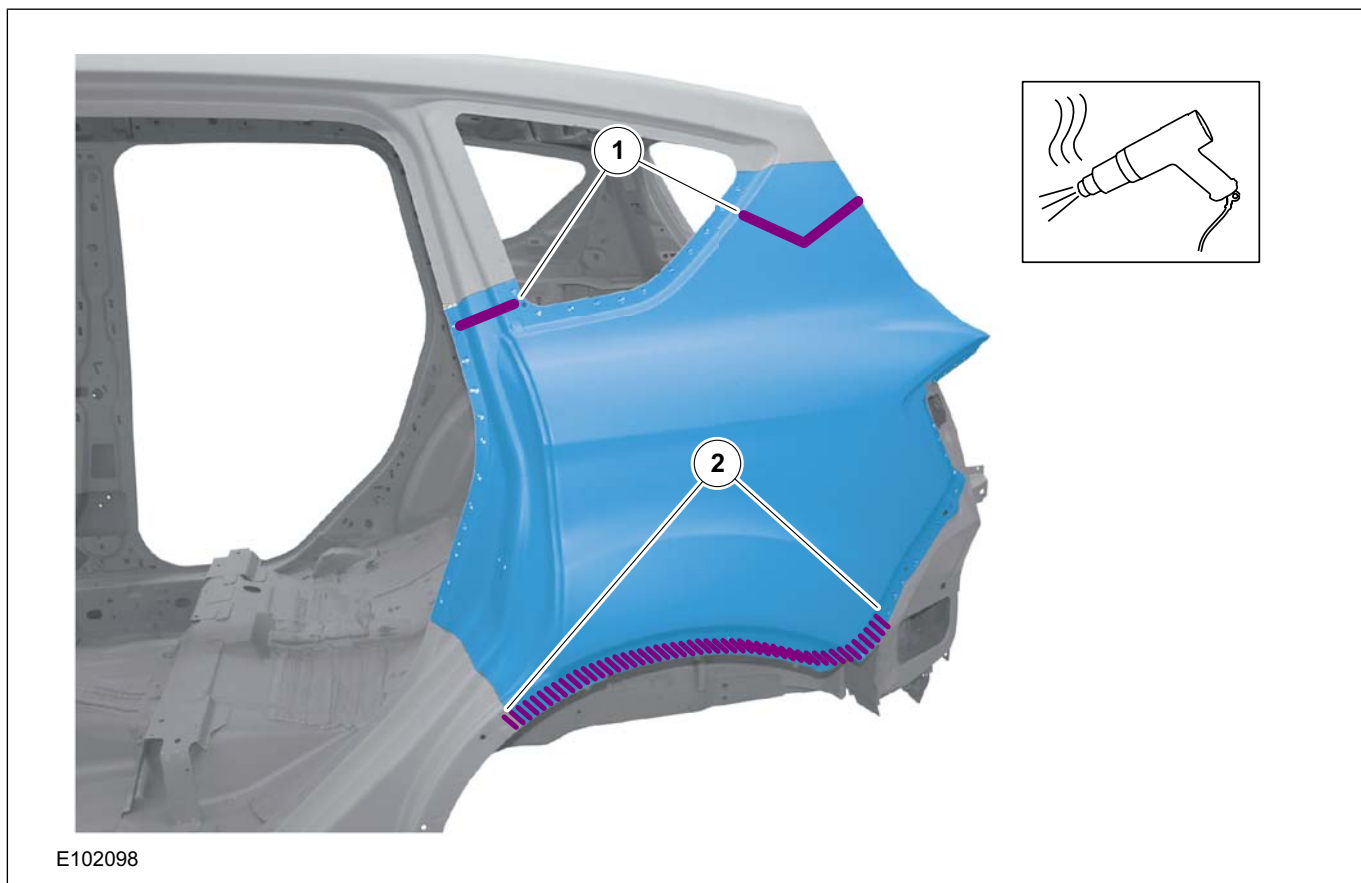
## REMOVAL AND INSTALLATION



E102096

6. • **Quarter Panel**
  - Heat the areas (approx. 170 °C) and detach:
    - 1) NVH elements.
    - 2) Bonded / Sealed area at the edge of the wheel arch.

## REMOVAL AND INSTALLATION



## Installation

**NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

**NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

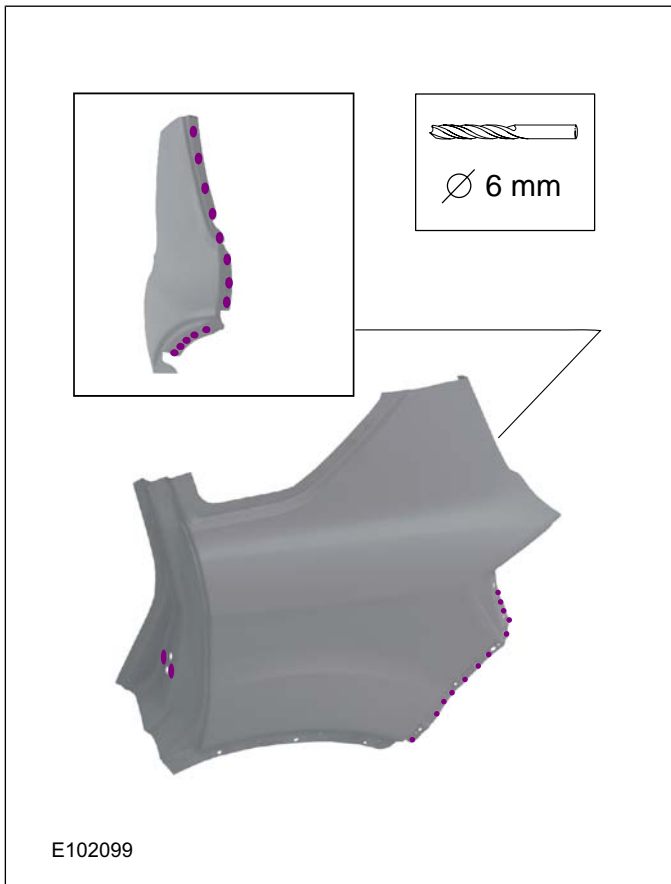
501-30-7

## Rear End Sheet Metal Repairs

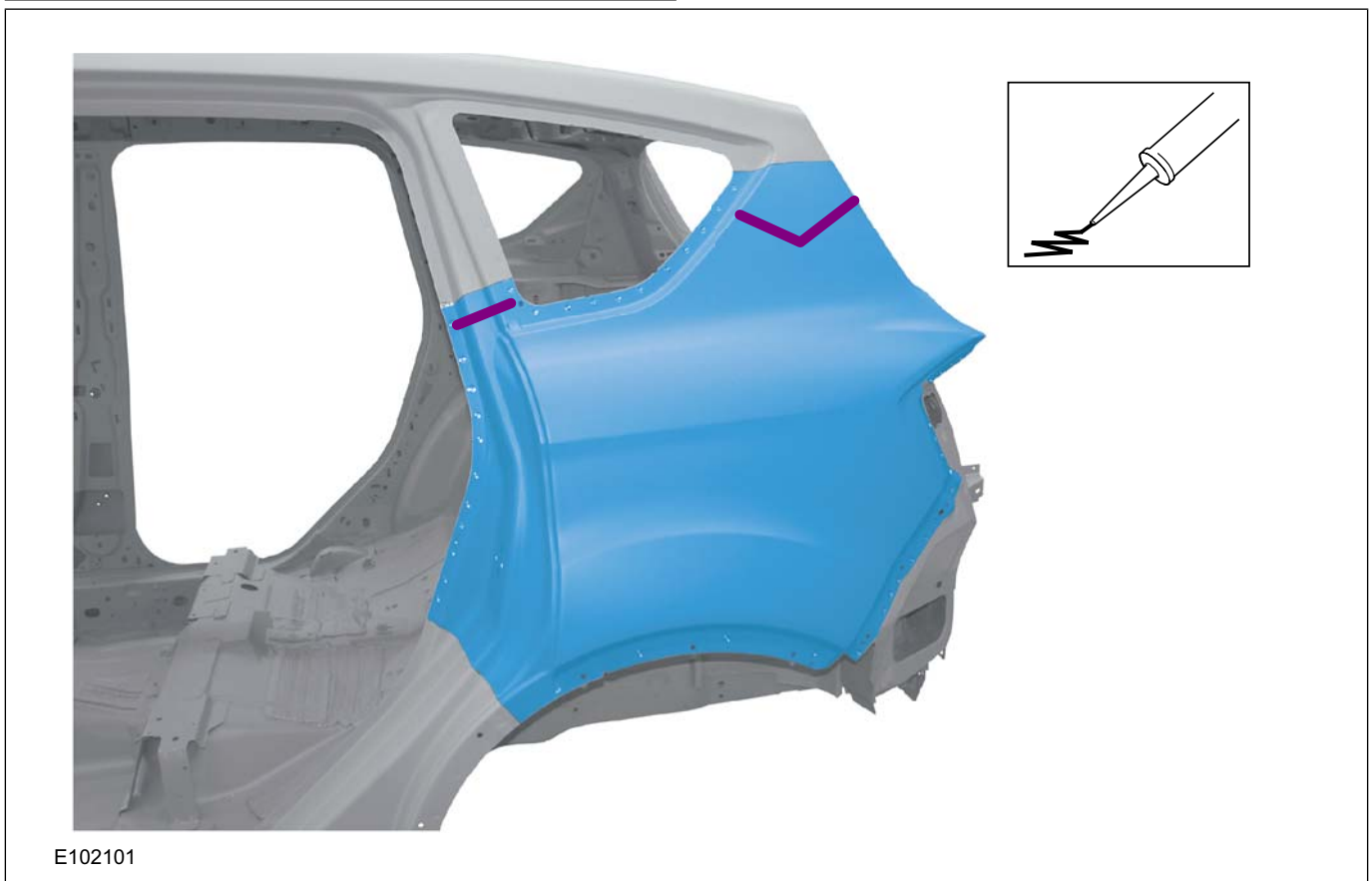
501-30-7

## REMOVAL AND INSTALLATION

2. • **Preparation of the Quarter Panel**
  - Drill holes for puddle welding ( $\varnothing$  6 mm).



3. • **Quarter Panel**
  - Apply PU glass adhesive to the NVH element.



501-30-8

## Rear End Sheet Metal Repairs

501-30-8

## REMOVAL AND INSTALLATION

## 4. • Quarter Panel

- Resistance spot weld - Panel thickness 3 mm and greater!



E102102

## 5. • Quarter Panel

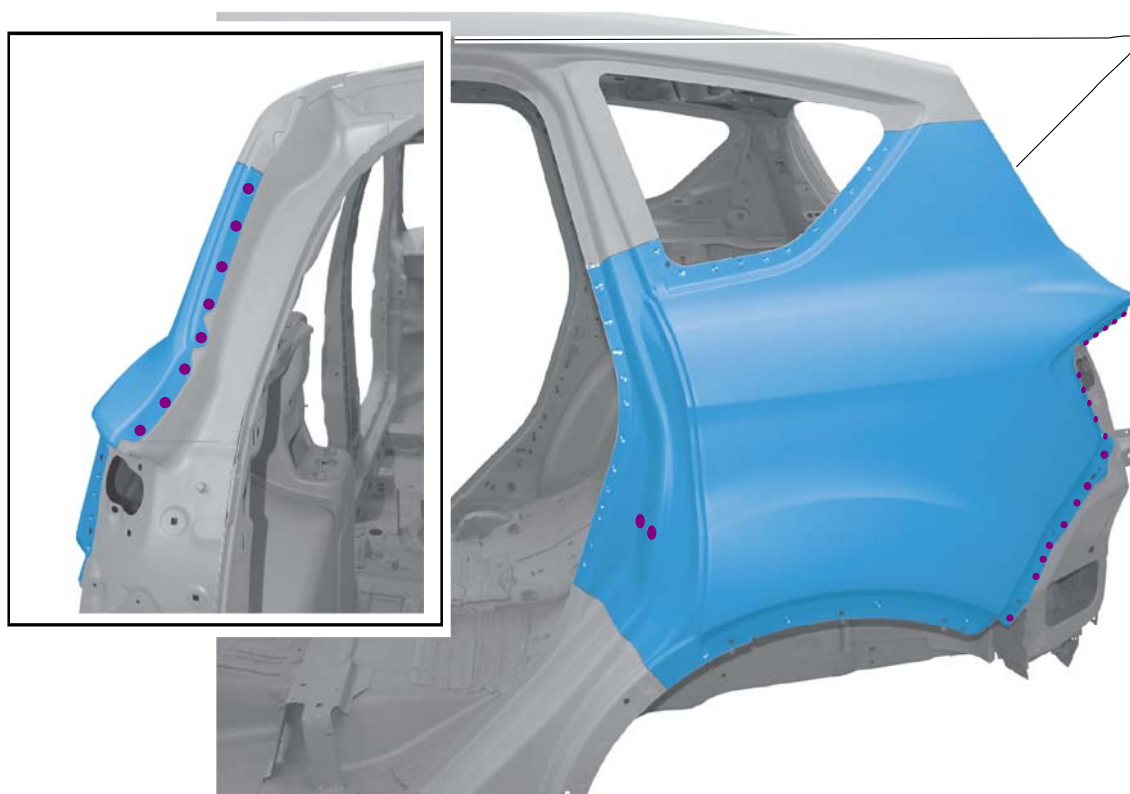
- Puddle weld.

501-30-9

Rear End Sheet Metal Repairs

501-30-9

## REMOVAL AND INSTALLATION



E102103

6. • **Quarter Panel**
  - Continuous MIG weld seam.



REMOVAL AND INSTALLATION



E102104



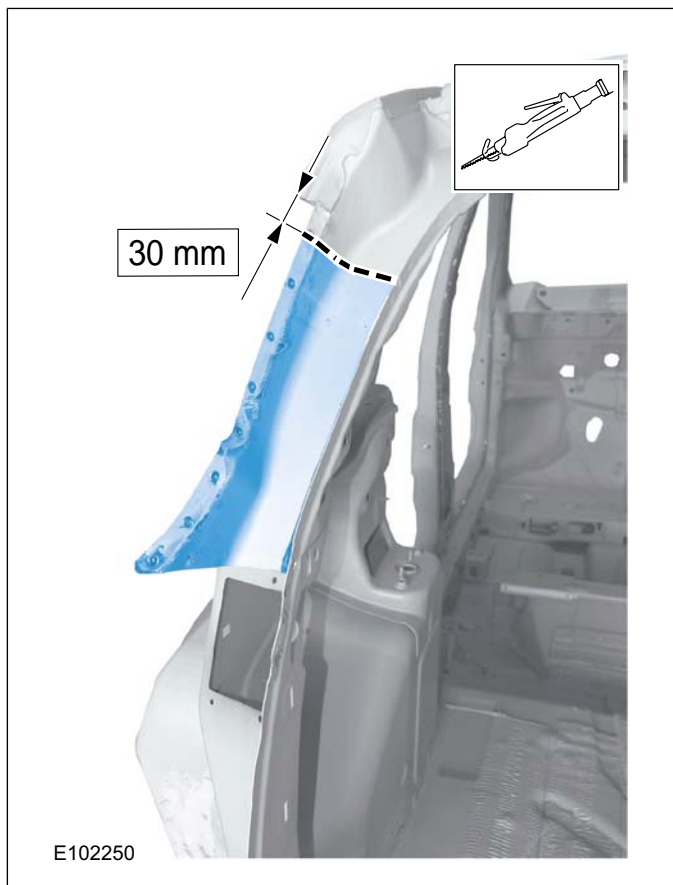


## REMOVAL AND INSTALLATION

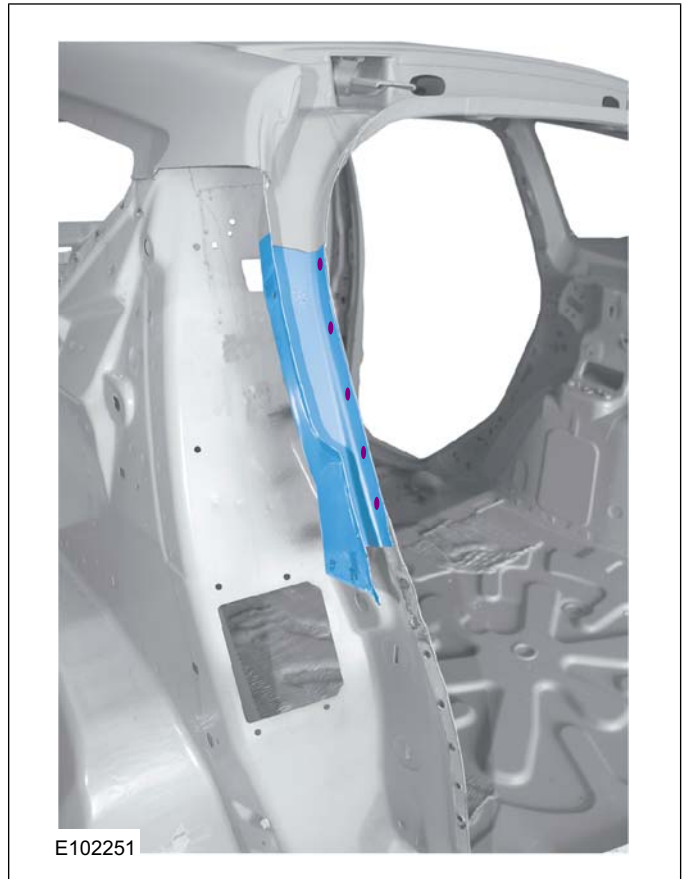
## Water Drain Panel

## Removal

1. • **Replacement Parts:**
  - Water Drain Panel
2. • **Necessary Removal and Installation Work:**
  - Liftgate
  - Refer to: **Liftgate Alignment** (501-03 Body Closures, General Procedures).
  - Quarter Panel
  - Refer to: **Quarter Panel LH** (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
  - Reposition the carpeting and the wiring harness away from the working area.
3. • **Water Drain Panel**
  - Do not cut in the panel below.
  - Mark cutline and cut.



4. • **Water Drain Panel**
  - Mill out the spot welds.



## 501-30-12

## Rear End Sheet Metal Repairs

## 501-30-12

## REMOVAL AND INSTALLATION

## Installation

1. • **Water Drain Panel**
  - Resistance spot weld.



2. • **Water Drain Panel**
  - Continuous MIG weld seam.



## REMOVAL AND INSTALLATION

## Water Drain Panel Reinforcement

## Removal

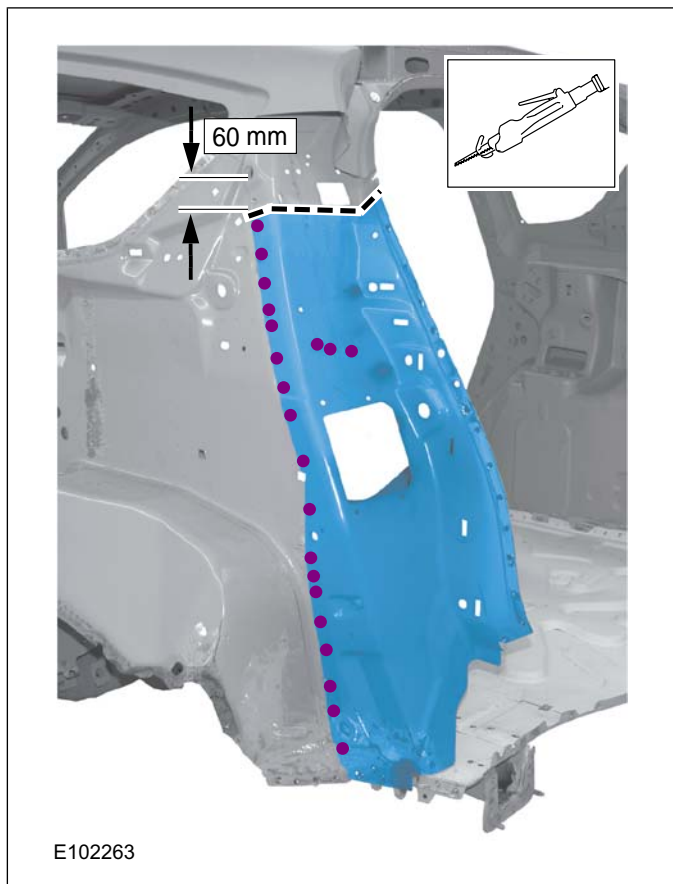
1. • **Replacement Parts:**
  - Water Drain Panel Reinforcement
2. • **Necessary Removal and Installation Work:**
  - Water Drain Panel

Refer to: **Water Drain Panel** (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

- Back Panel Panel and Reinforcement

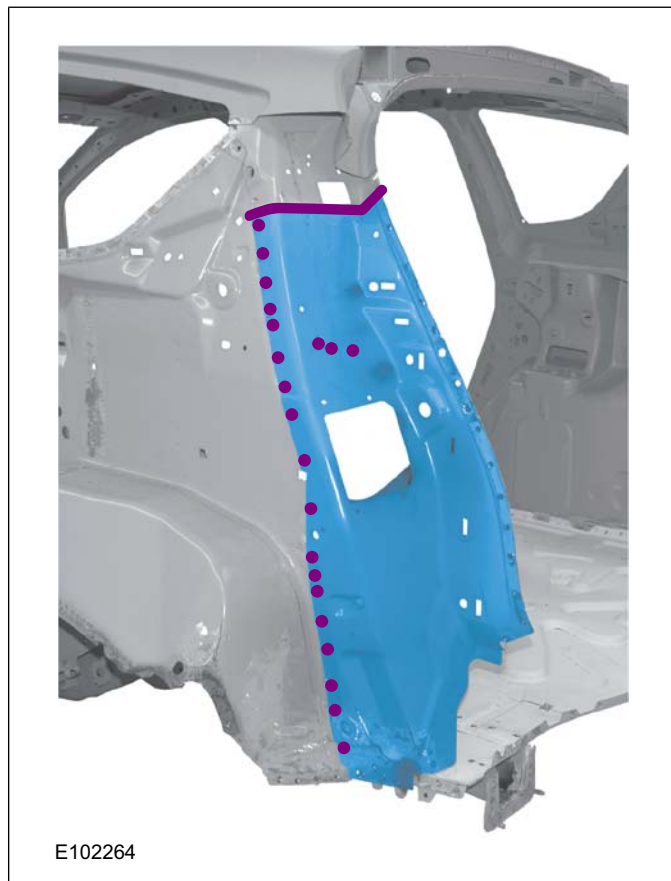
Refer to: **Back Panel and Reinforcement** (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

- Reposition the carpeting and the wiring harness away from the working area.
3. • **Water Drain Panel Reinforcement**
  - Mark cutline and cut.
  - Mill out the spot welds.



## Installation

1. • **Water Drain Panel Reinforcement**
  - Resistance spot weld.
  - Continuous MIG weld seam.





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**REMOVAL AND INSTALLATION**

Rear Wheelhouse Outer

Removal



## 501-30-15

## Rear End Sheet Metal Repairs

## 501-30-15

## REMOVAL AND INSTALLATION

## 1. • Replacement Parts:

- **NOTE:** For a partial replacement the required replacement part needs to be cut out from the complete inner quarter panel with wheelhouse.

Rear Outer Wheelhouse (Repair Panel)

- C-Pillar Reinforcement
- NVH Element

## 2. • Necessary Removal and Installation Work:

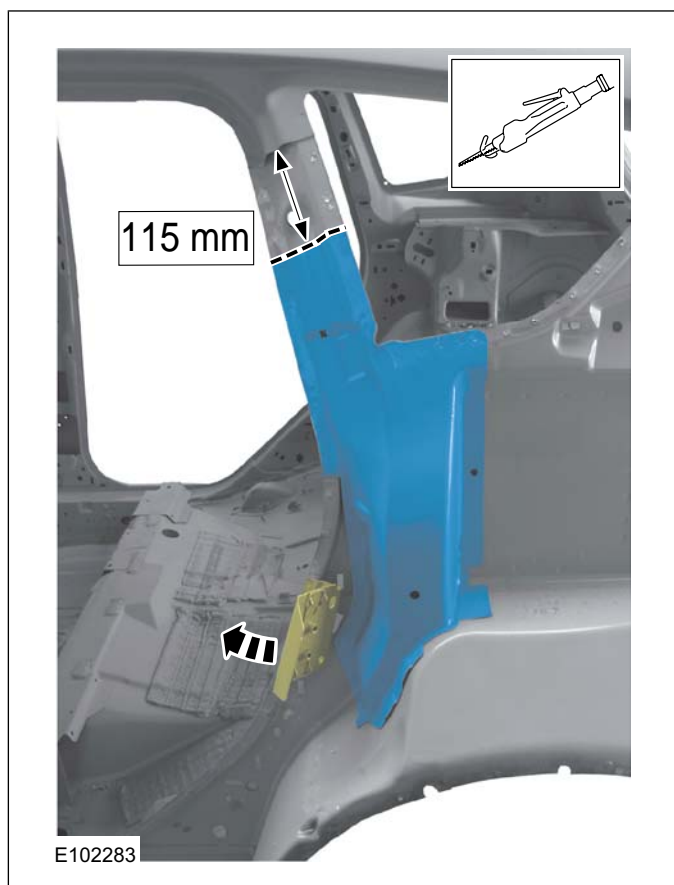
- Quarter Panel

Refer to: **Quarter Panel LH** (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

- Reposition the carpeting and the wiring harness away from the working area.

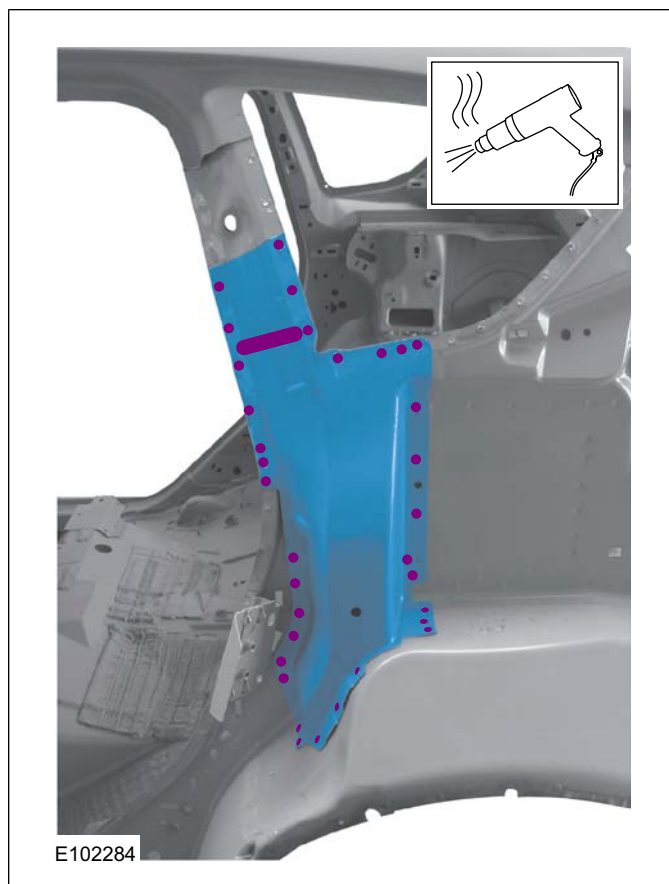
3. **NOTE:** The specified dimensions must be met when making the separating cuts.

- **C-Pillar Reinforcement Cut Line.**
- **Reference point:** Quarter panel separating cut.
- Mark cut line and cut C-Pillar reinforcement.
- Bend striker reinforcement to front until spot weld is accessible.



## 4. • C-Pillar Reinforcement

- Mill out the spot welds.
- Heat the area (approx. 170 °C) and detach NVH element.



## 5. • Rear Outer Wheelhouse

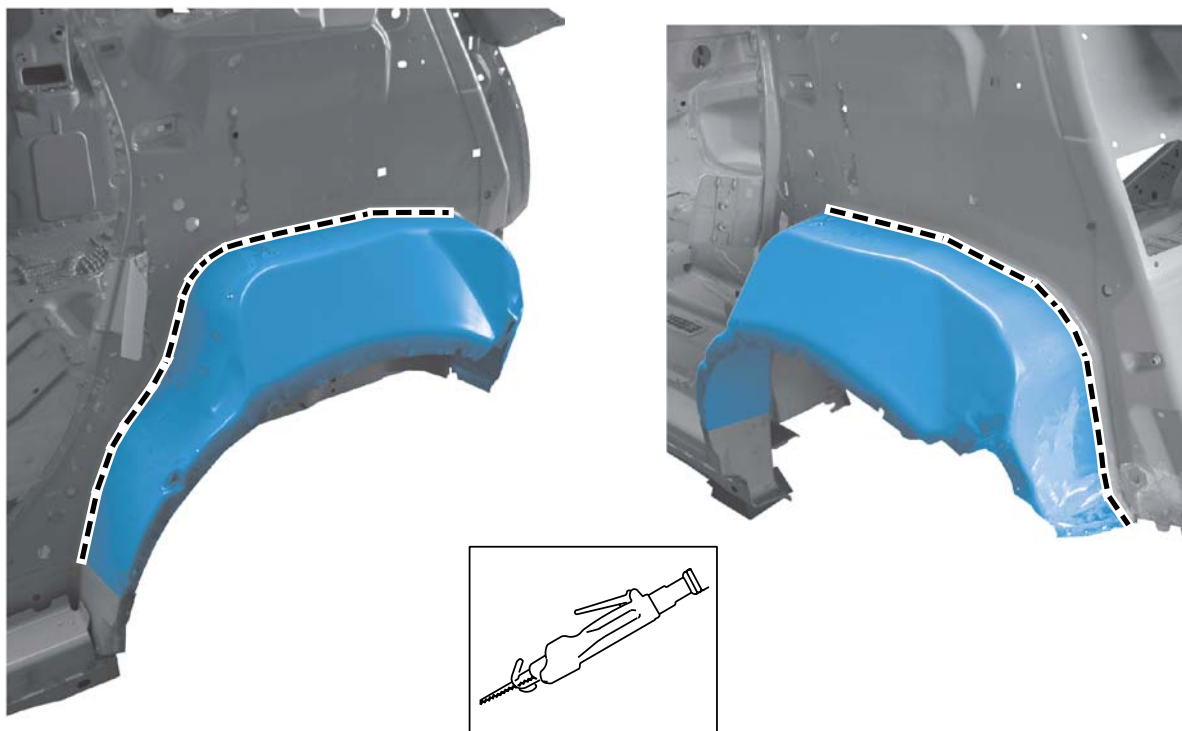
- **NOTE:** A residual flange in the joining area of approx. 12 mm is needed for welding in the components with an overlap.

**NOTE:** Do not cut into the lower panel in the front area.

Mark cut line and cut.



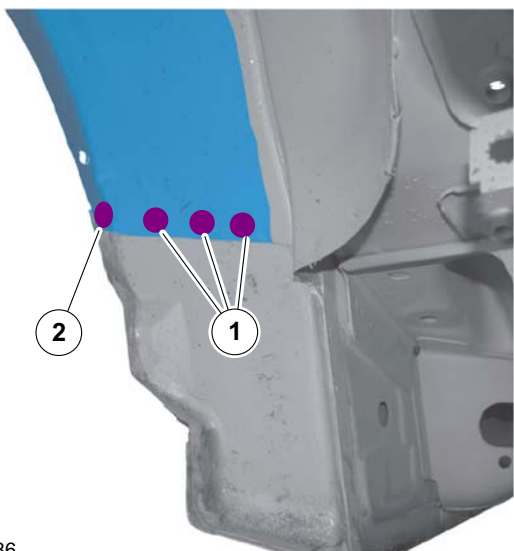
REMOVAL AND INSTALLATION



E102285

6. • **Rear Outer Wheelhouse**

- 1) Mill out the spot weld.
- 2) Grind out the spot weld.



E102286

Installation

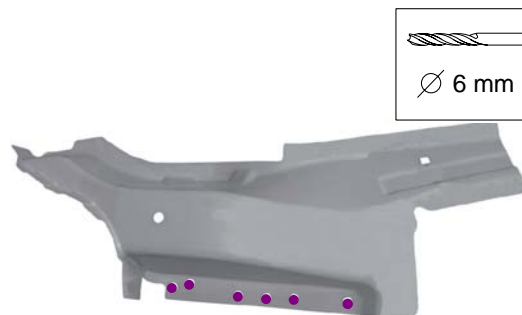
**NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment

instructions and sub-section 501-25 must be followed.

1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

**NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

2. • **Preparation of the C-Pillar Reinforcement.**
  - Drill holes for puddle welding (Ø 6 mm).



E102287

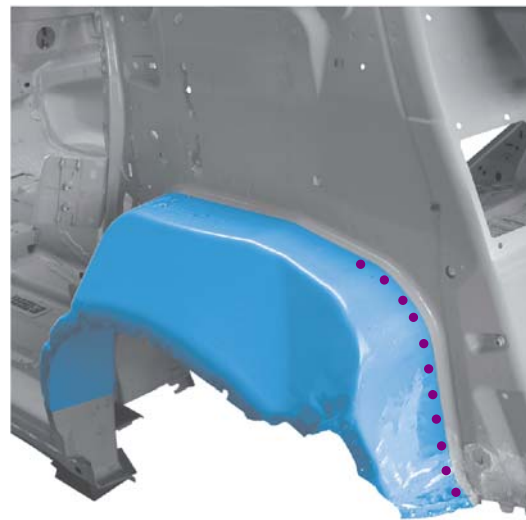
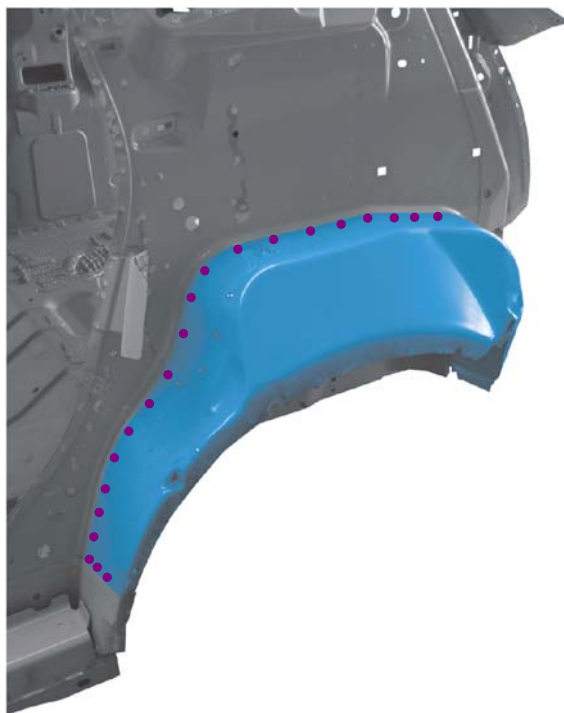


## REMOVAL AND INSTALLATION

## 3. • Rear Outer Wheelhouse

- **NOTE:** Cut repair panel so that it will overlap

by approx. 12 mm in the joining area.  
Resistance spot weld.



E102288

## 501-30-18

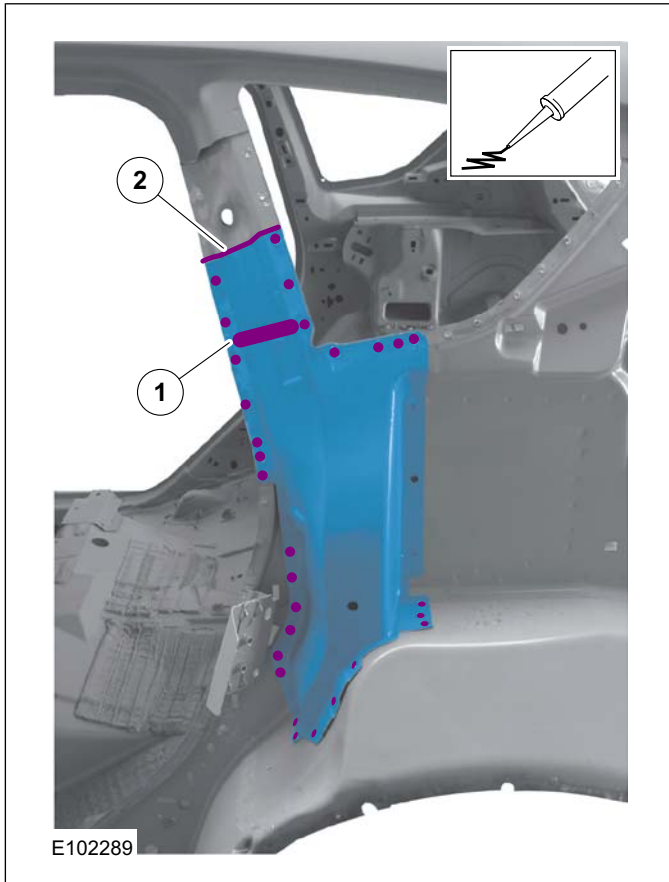
## Rear End Sheet Metal Repairs

## 501-30-18

## REMOVAL AND INSTALLATION

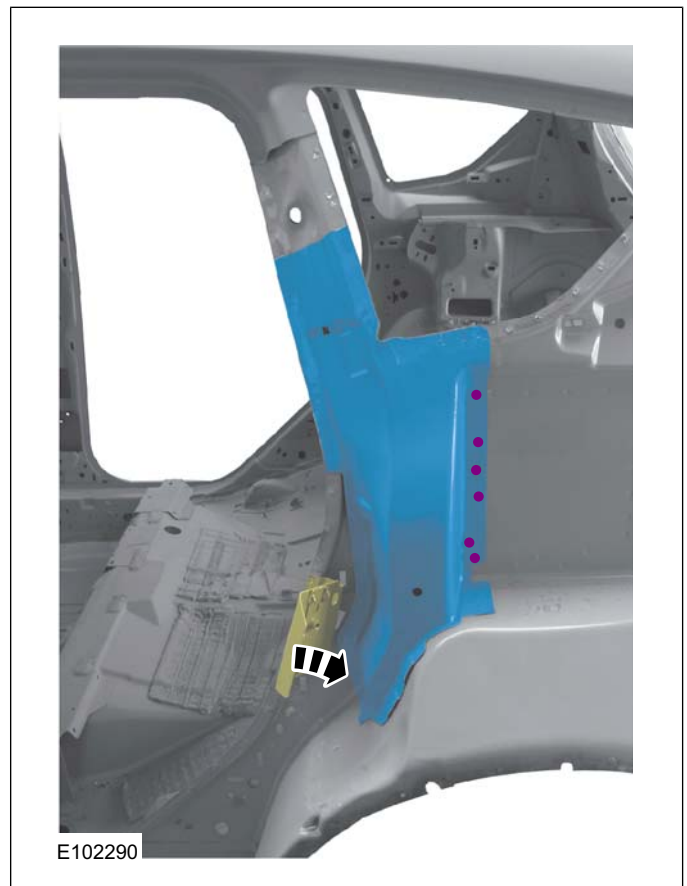
## 4. • C-Pillar Reinforcement

- 1) Apply PU glass adhesive to the NVH element and fit in NVH element.
- 2) Continuous MIG weld seam.
- Resistance spot weld.



## 5. • C-Pillar Reinforcement

- Puddle weld.
- Bend in striker reinforcement.



## REMOVAL AND INSTALLATION

## Back Panel and Reinforcement

## Removal

1. • **Replacement Parts:**

- Back Panel
- Back Panel Reinforcement
- Reinforcement Bumper Mounting
- Striker Reinforcement
- Inner Bumper Mounting

2. • **Necessary Removal and Installation Work:**

- Liftgate

Refer to: **Liftgate** (501-03 Body Closures, Removal and Installation).

- Bumper Cover and Bumper
- Loadspace Trim Panel

Refer to: **Loadspace Trim Panel LH** (501-05 Interior Trim and Ornamentation, Removal and Installation).

Refer to: **Loadspace Trim Panel RH** (501-05 Interior Trim and Ornamentation, Removal and Installation).

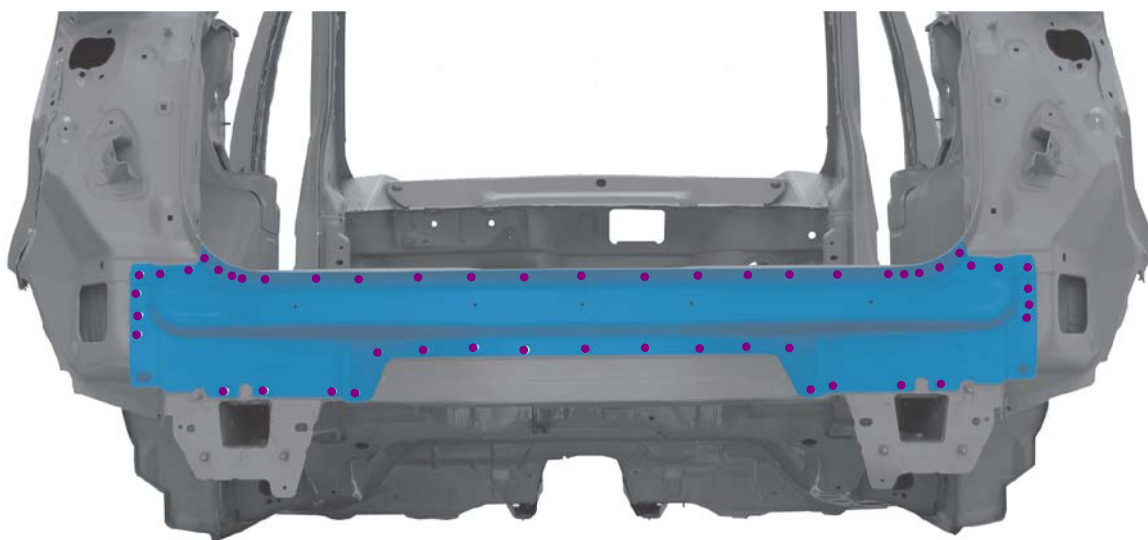
- D-Pillar Trim Panel

Refer to: **D-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- Reposition the carpeting and the wiring harness away from the working area.

3. • **Back Panel**

- Mill out the spot welds.



E102312

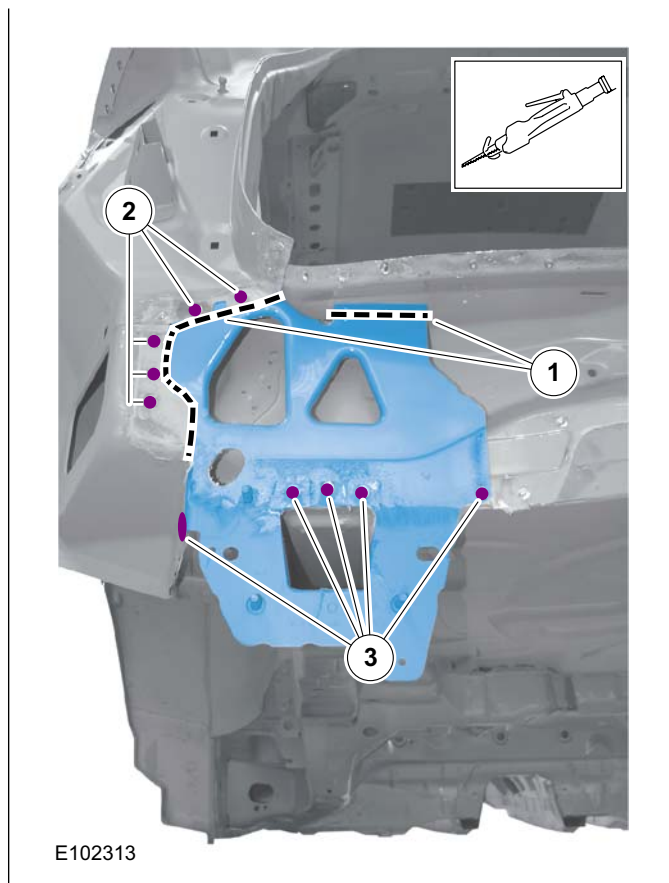
501-30-20

Rear End Sheet Metal Repairs

501-30-20

## REMOVAL AND INSTALLATION

4. • **Reinforcement Bumper Mounting - Both sides**
- 1) Rough Cut
  - 2) Grind out the spot welds from inside.
  - 3) Mill out the spot welds - Two panel thickness.



5. • **Back Panel Reinforcement Outer**
- Mill out the spot welds.



## 501-30-21

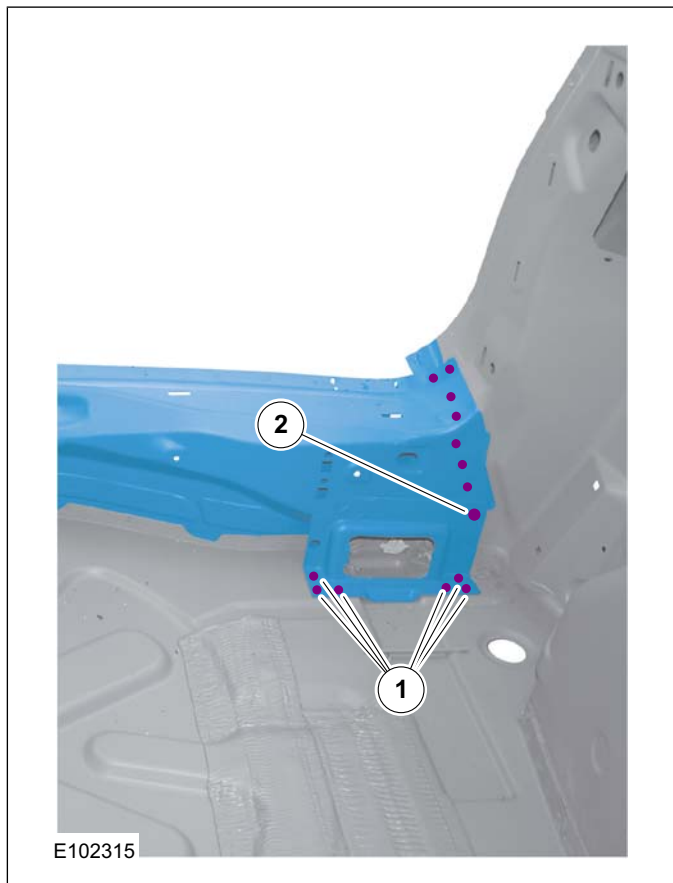
## Rear End Sheet Metal Repairs

## 501-30-21

## REMOVAL AND INSTALLATION

## 6. • Back Panel Reinforcement Inner - Both sides

- 1) Grind out the spot welds.
- 2) Grind out the spot welds - Two panel thickness.
- Mill out the spot welds.



## Installation

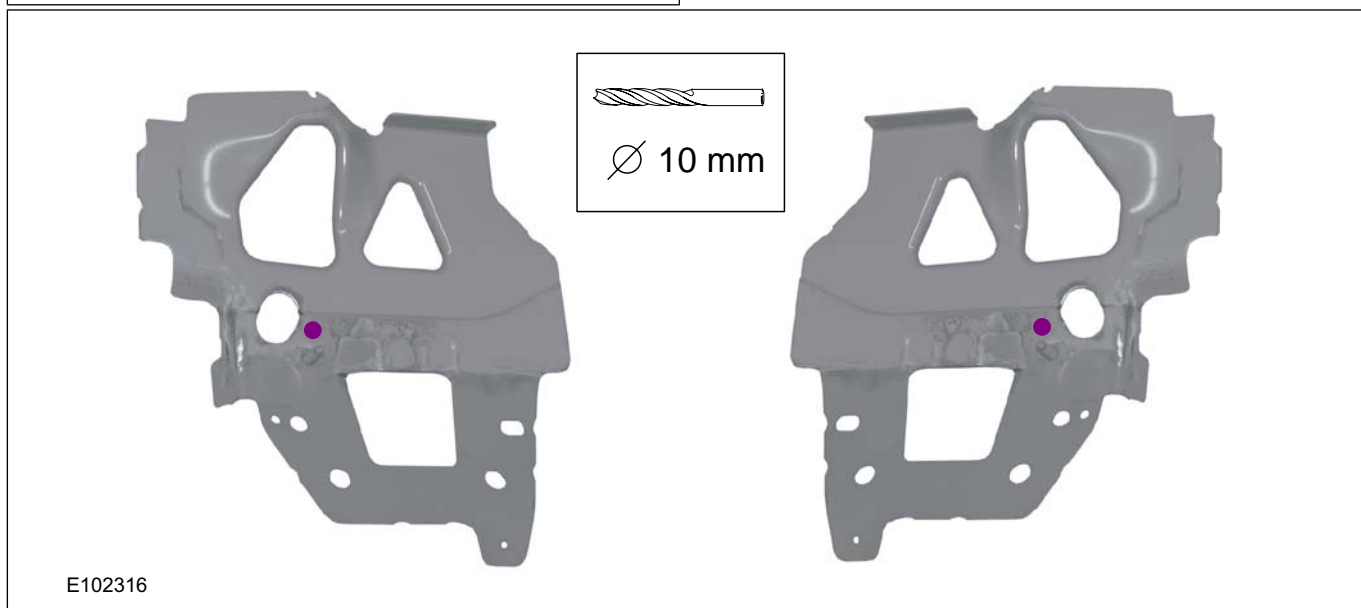
**NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

**NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

## 2. • Preperation - Reinforcement Bumper Mounting

- Drill holes for puddle welding (Ø 10 mm).



## 3. • Inner Bumper Mounting

- Resistance spot weld - Panel thickness 3 mm and greater!

501-30-22

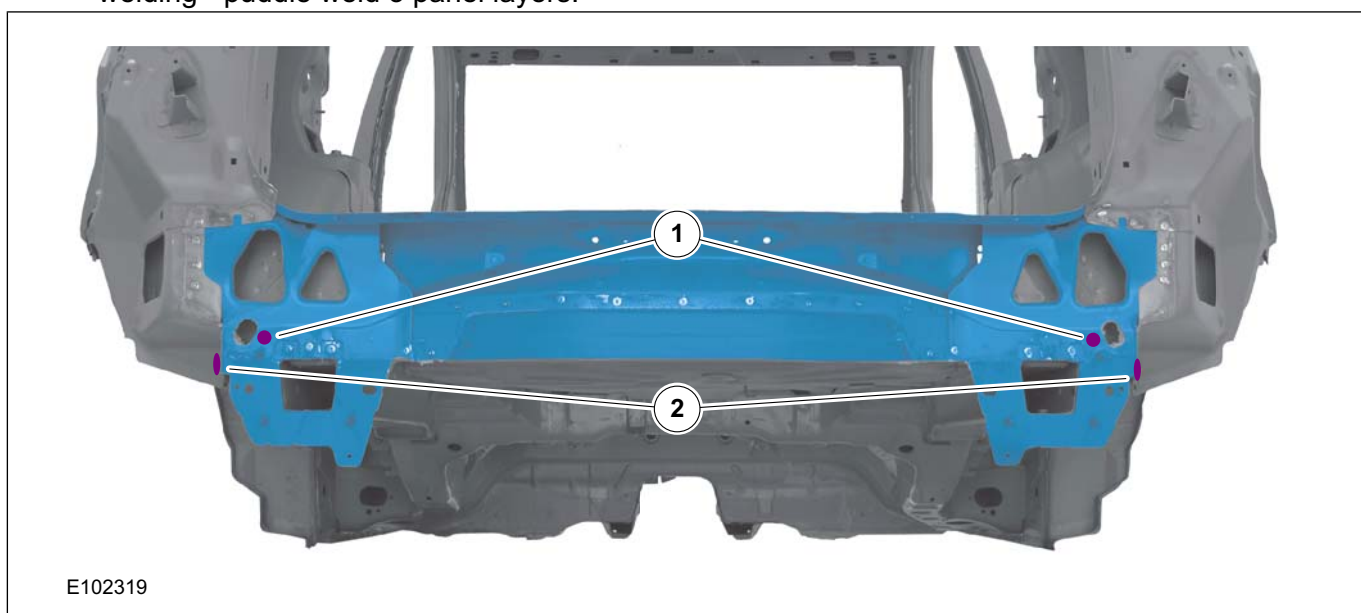
Rear End Sheet Metal Repairs

501-30-22

## REMOVAL AND INSTALLATION

4. • **Back Panel Reinforcement Outer**

- 1) Puddle weld.
- 2) Drill out by one panel thickness for puddle welding - puddle weld 3 panel layers.

5. • **Back Panel Reinforcement Inner**

- Resistance spot weld - Panel thickness 3 mm and greater!



501-30-23

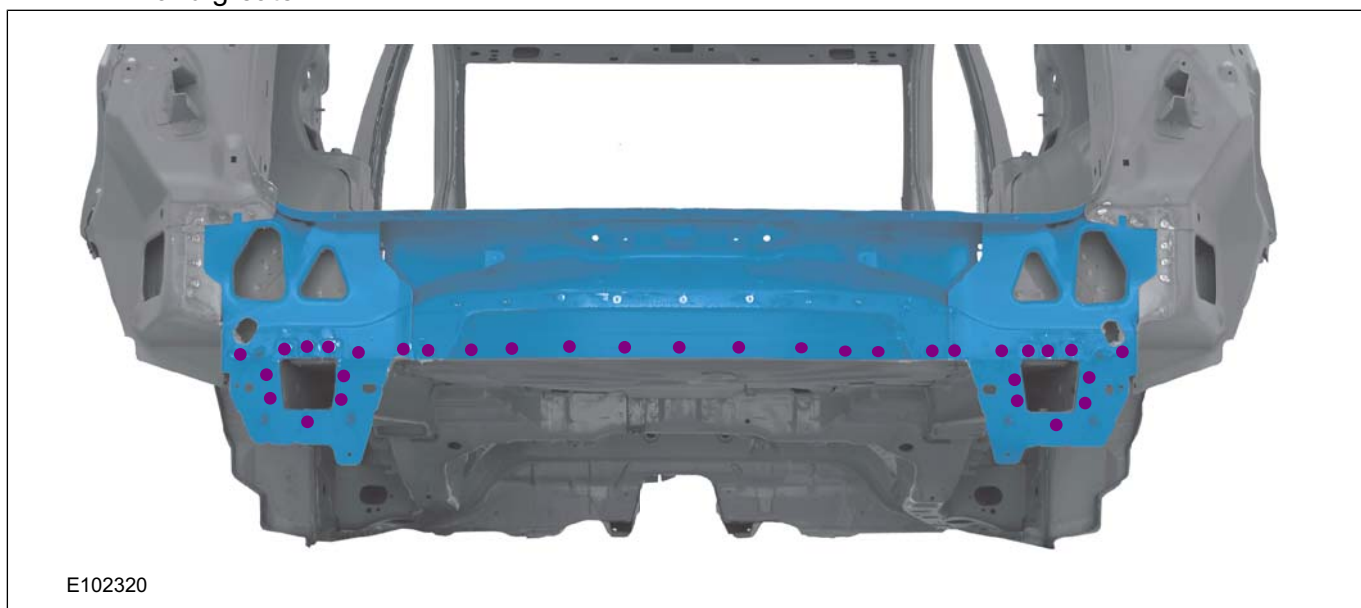
Rear End Sheet Metal Repairs

501-30-23

## REMOVAL AND INSTALLATION

**6. • Back Panel Reinforcement Outer**

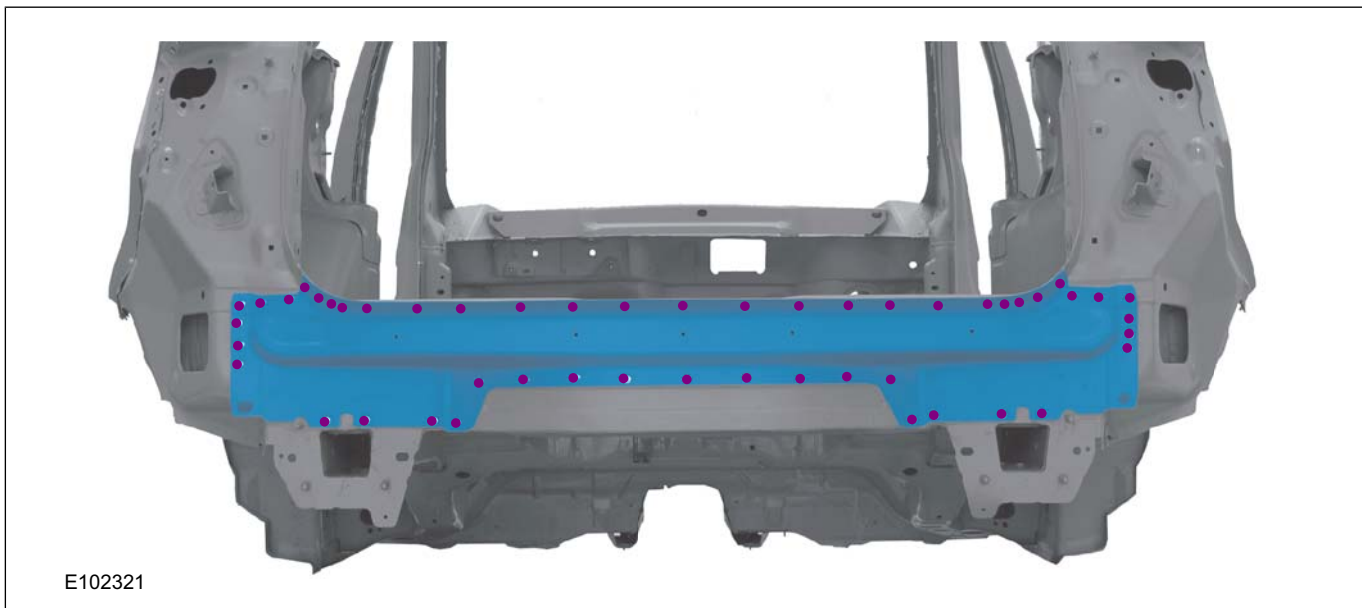
- Resistance spot weld - Panel thickness 3 mm and greater!

**7. • Back Panel**

- Resistance spot weld - Panel thickness 3 mm and greater!




REMOVAL AND INSTALLATION



## REMOVAL AND INSTALLATION

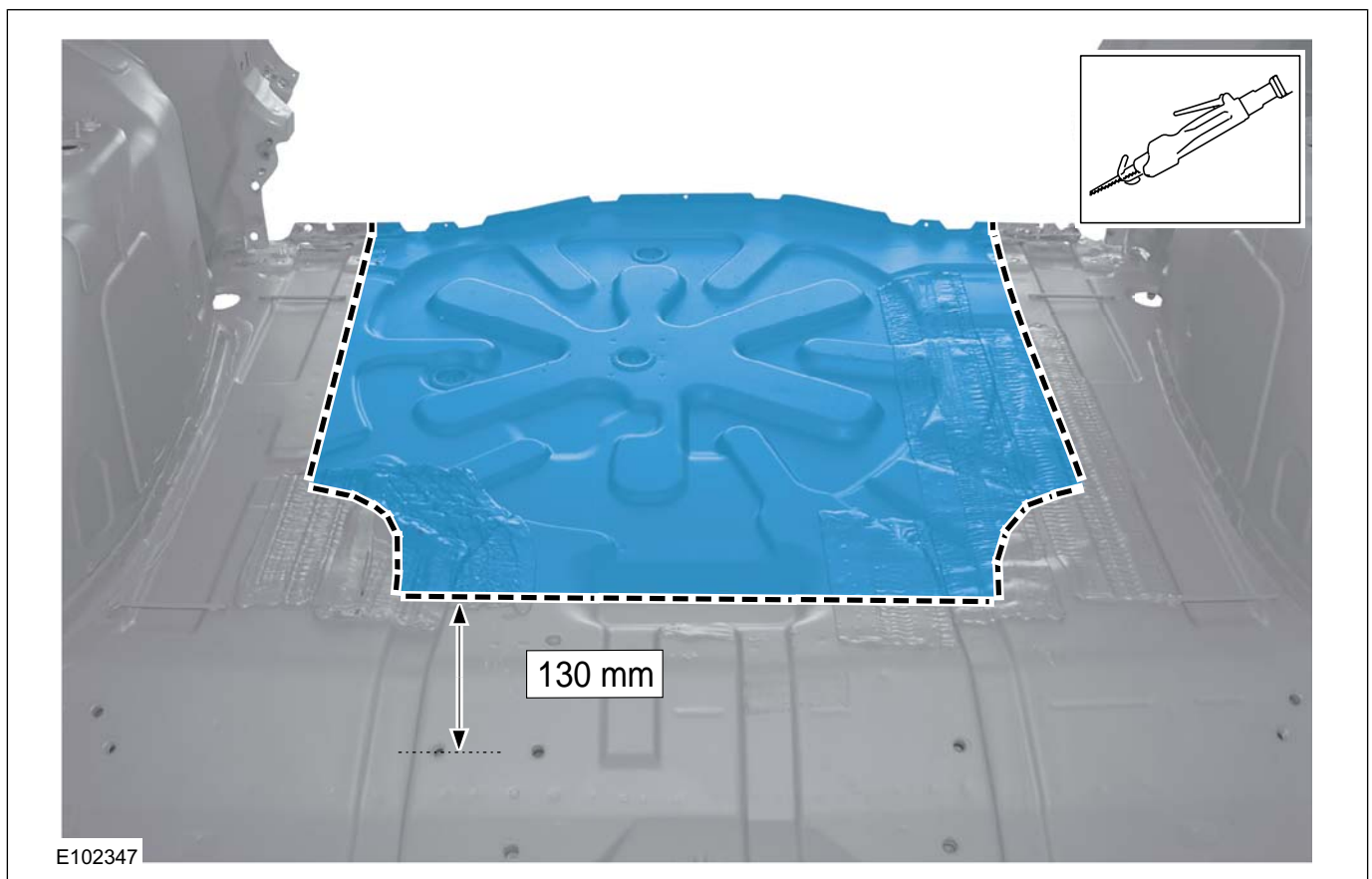
## Rear Floor Panel

## Removal

1. • **Replacement parts:**
  - Rear Floor Panel (Repair Panel)
2. • **Necessary Removal and Installation Work:**
  - Back Panel and ReinforcementRefer to: **Back Panel and Reinforcement**  
(501-30 Rear End Sheet Metal Repairs, Removal and Installation).
  - Reposition the carpeting and the wiring harness away from the working area.
3. • **Rear Floor Panel - Rough Cut**
  -  **CAUTION: Do not cut into members and reinforcements beneath!**Mark the cutline and cut out the rear floor panel with a rough separating cut.
  - **NOTE:** The specified dimensions must be met when making the separating cuts.

**Reference Points:**

- Lateral direction: min. 130 mm from center of thread.
- Longitudinal direction: parallel to the rear side member.



## 501-30-26

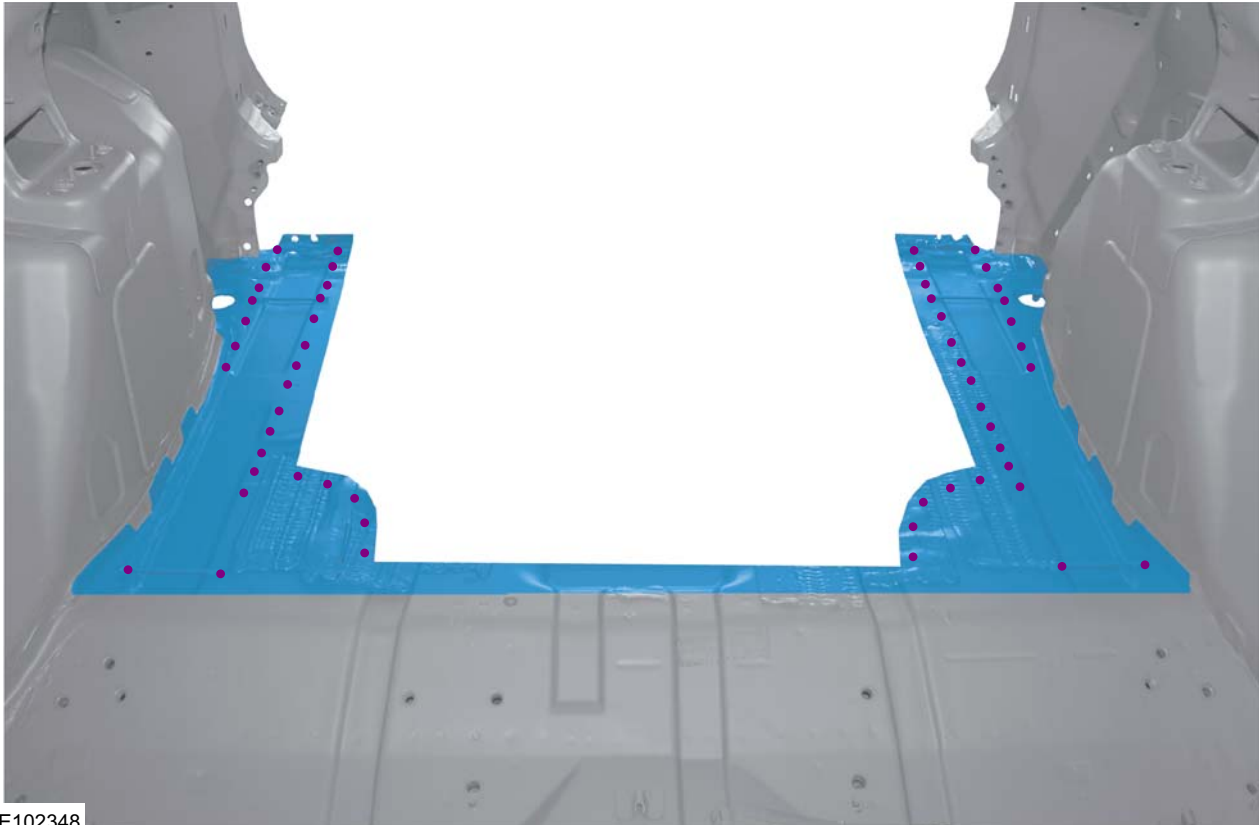
## Rear End Sheet Metal Repairs

## 501-30-26

## REMOVAL AND INSTALLATION

## 4. • Rear Floor Panel - Residual Parts

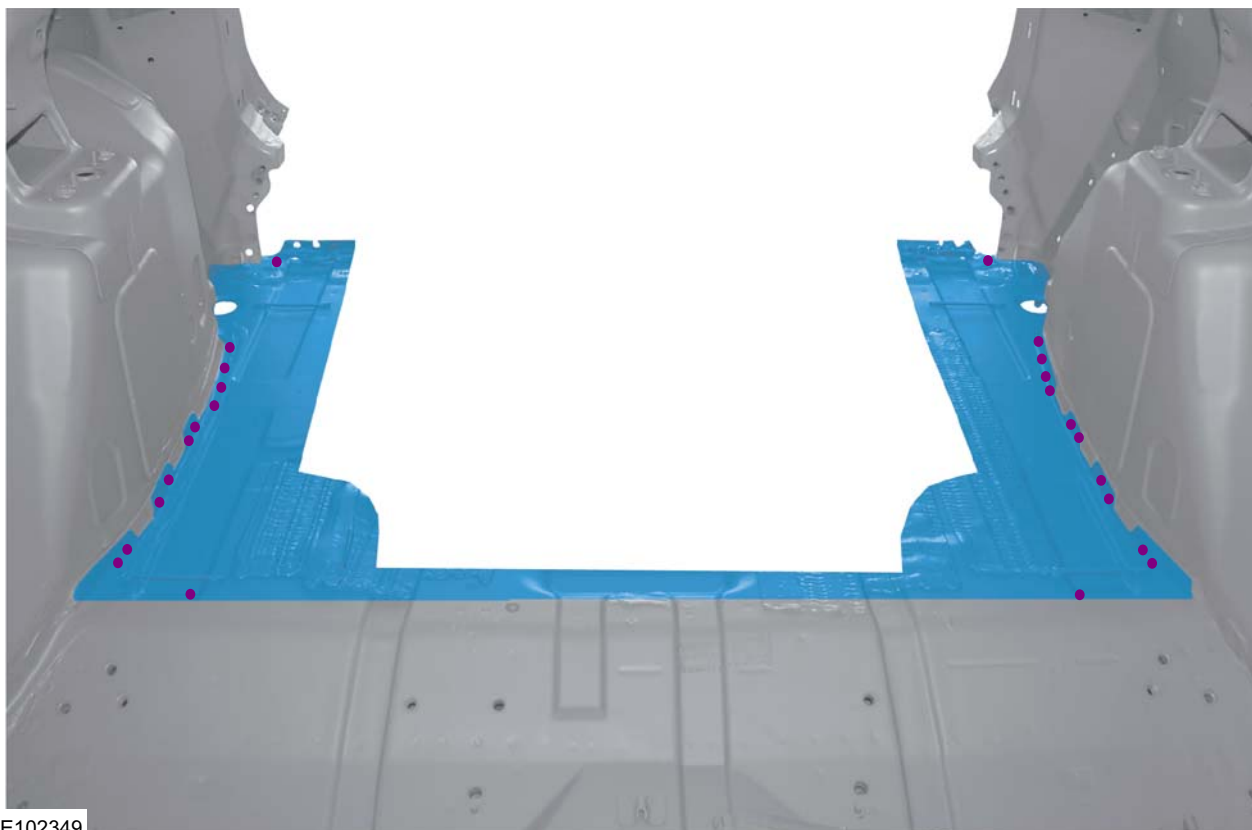
- Mill out the spot welds.



## 5. • Rear Floor Panel - Residual Parts

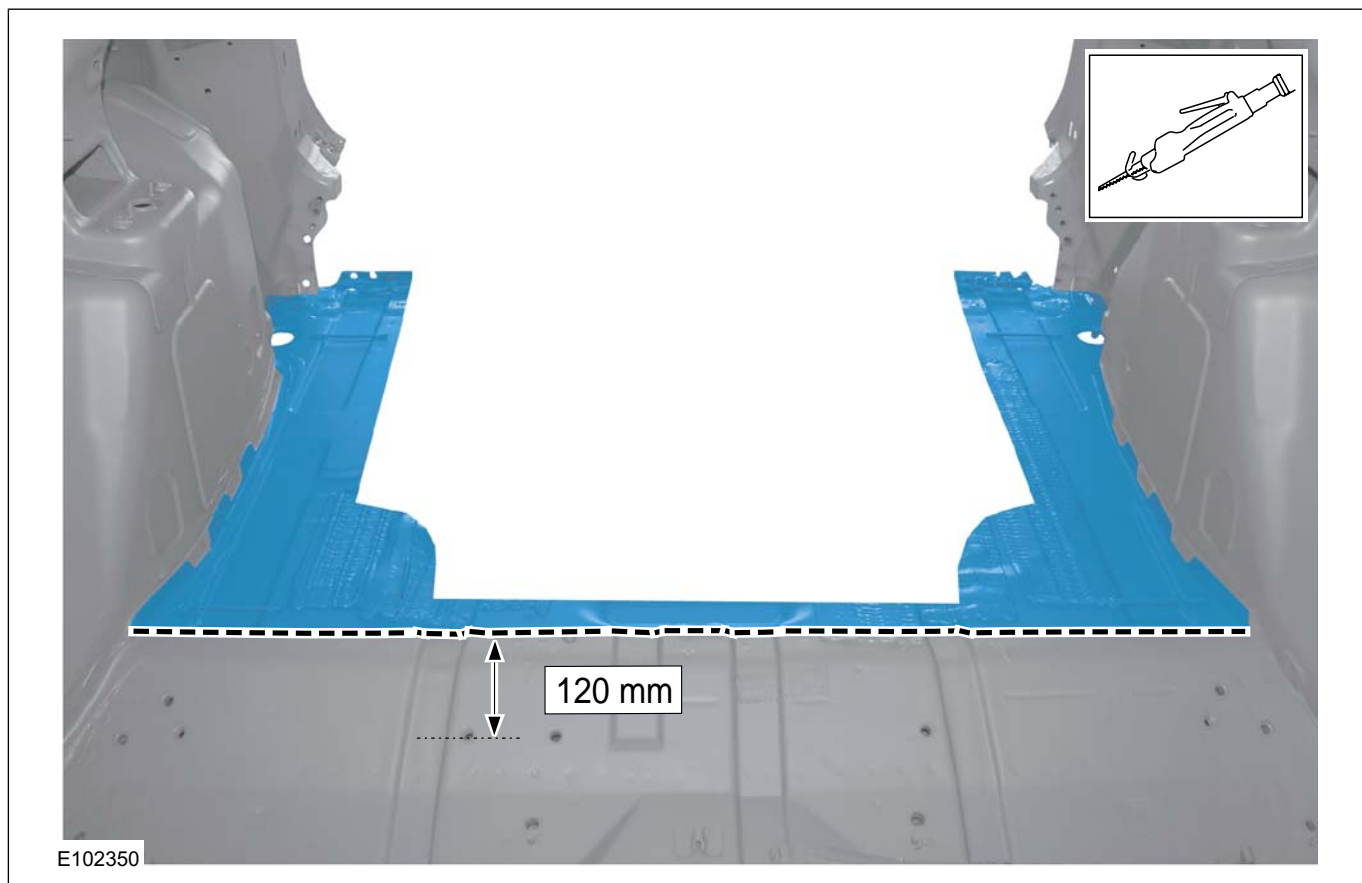
- Grind out the spot welds.

## REMOVAL AND INSTALLATION



6. • **Rear Floor Panel - Final Cut**
  - **⚠ CAUTION: Do not cut into members and reinforcements beneath!**  
Mark the cutline and cut out the rear floor panel.
  - **NOTE:** The specified dimensions must be met when making the final cut.  
**Reference Points:**
    - Lateral direction: 120 mm from center of thread.

## REMOVAL AND INSTALLATION



7. • **Rear Floor Panel (below)**
  - **Below Inner Side:** Grind out the spot welds
    - On both sides.

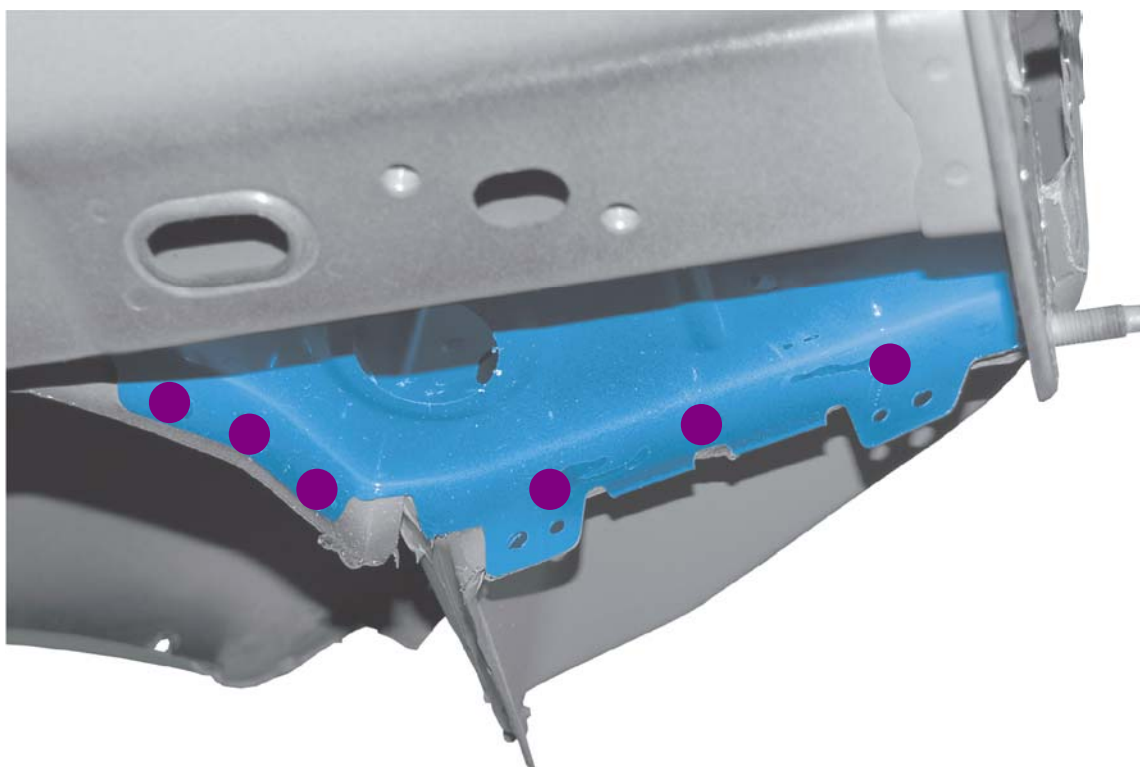


501-30-29

Rear End Sheet Metal Repairs

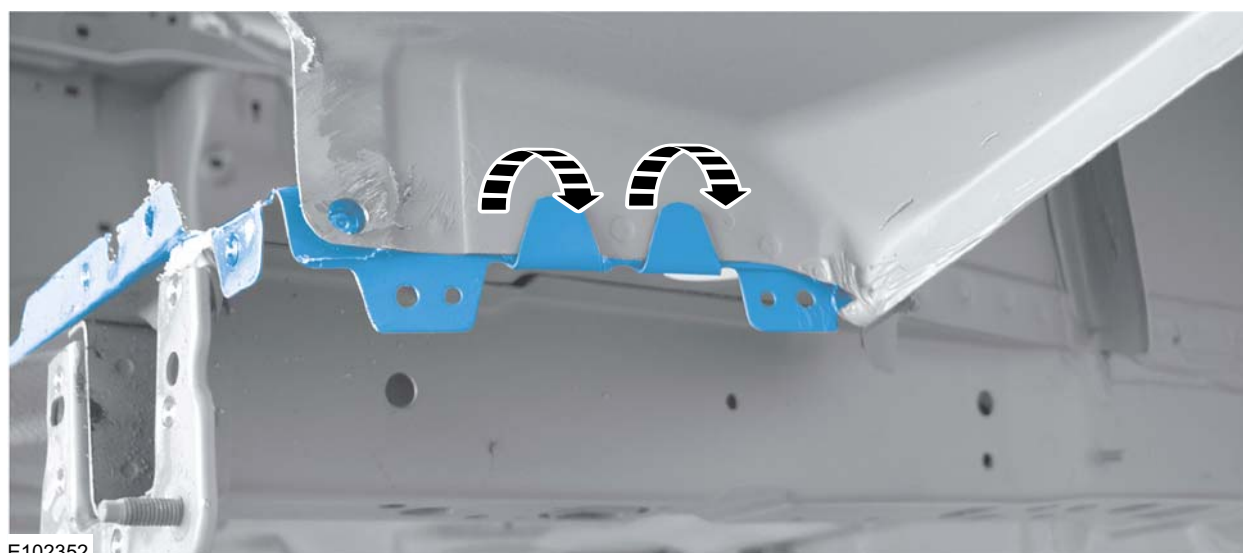
501-30-29

## REMOVAL AND INSTALLATION



E102351

8. • **Rear Floor Panel (below)**
  - **Below Outer Side:** Bend open metal tabs -  
On both sides.



E102352

## Installation

**NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment

instructions and sub-section 501-25 must be followed.

## 501-30-30

## Rear End Sheet Metal Repairs

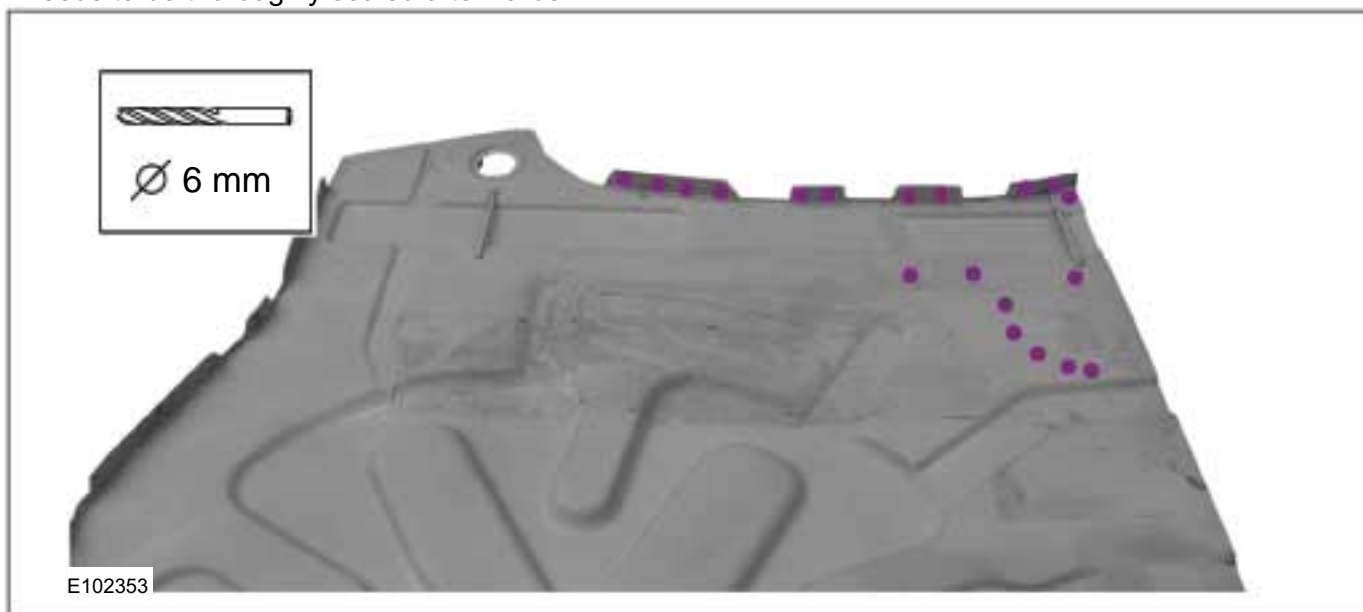
## 501-30-30

## REMOVAL AND INSTALLATION

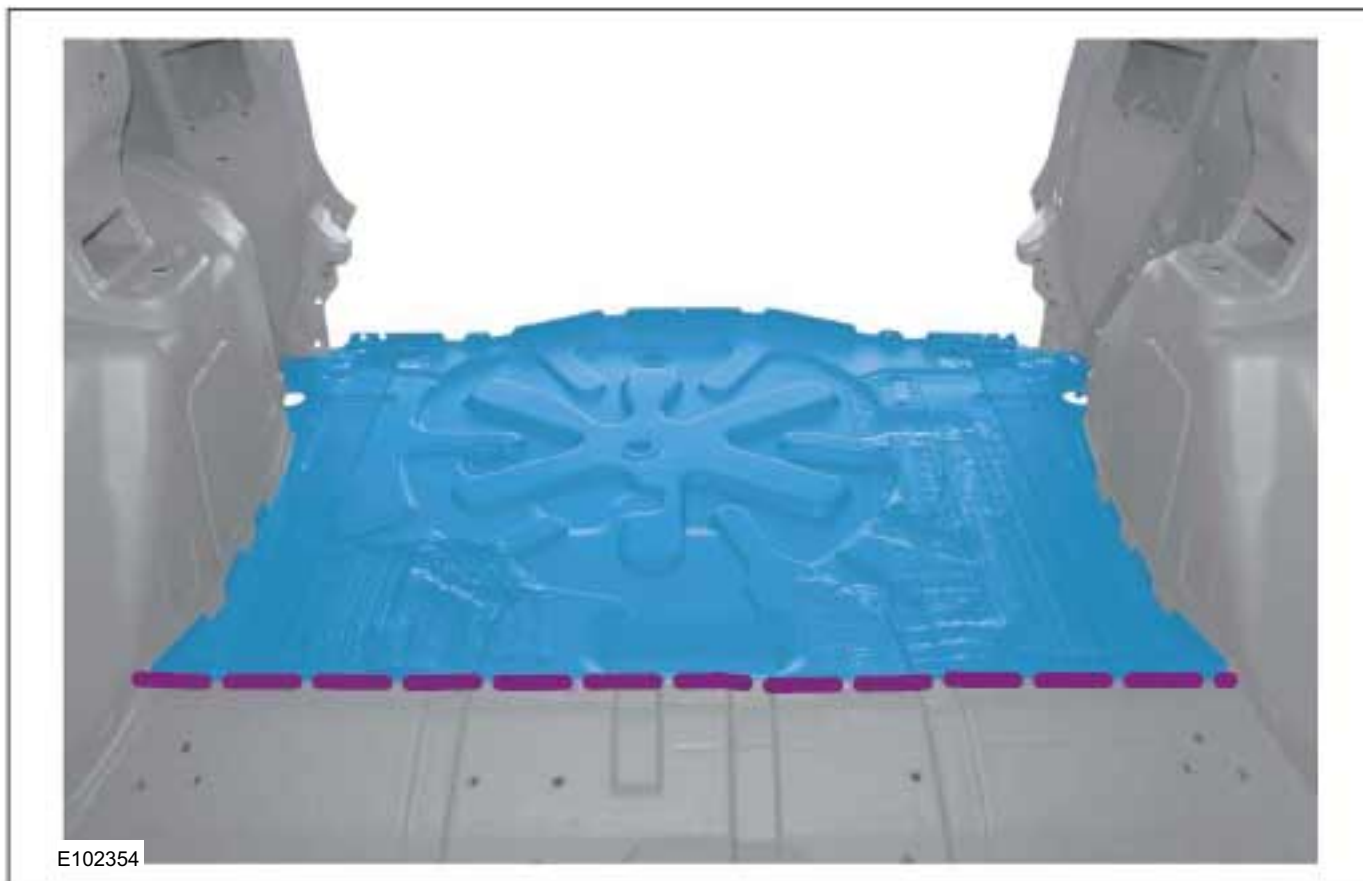
1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

**NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

2. • **Preparation of the Rear Floor Panel:**
  - Cut repair panel so that it will overlap by approx. 12 mm in the joining area.
  - Drill holes for puddle welding ( $\varnothing$  6 mm) - On both sides.



3. • **Rear Floor Panel**
  - Intermittant MIG weld seam.



501-30-31

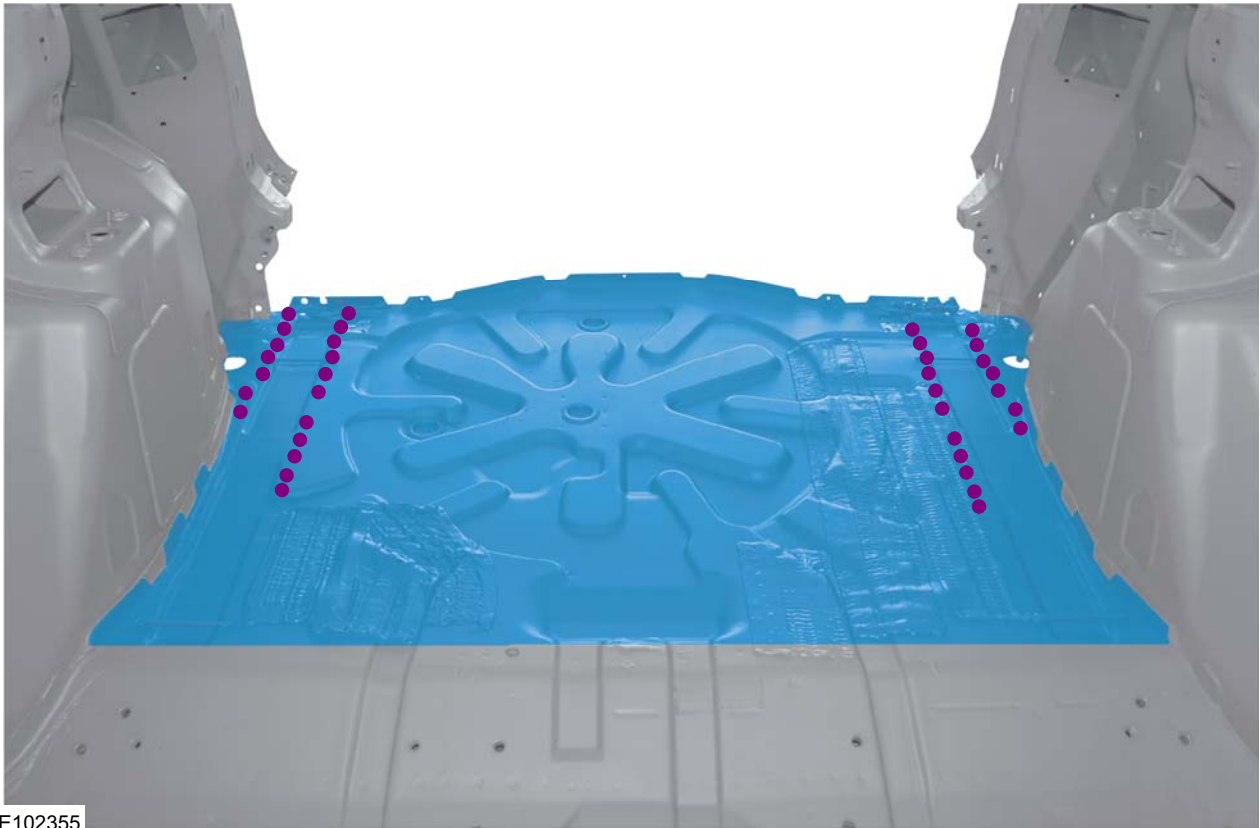
## Rear End Sheet Metal Repairs

501-30-31

## REMOVAL AND INSTALLATION

## 4. • Rear Floor Panel

- Resistance spot weld - Panel thickness partially 3 mm and greater!



E102355

## 5. • Rear Floor Panel

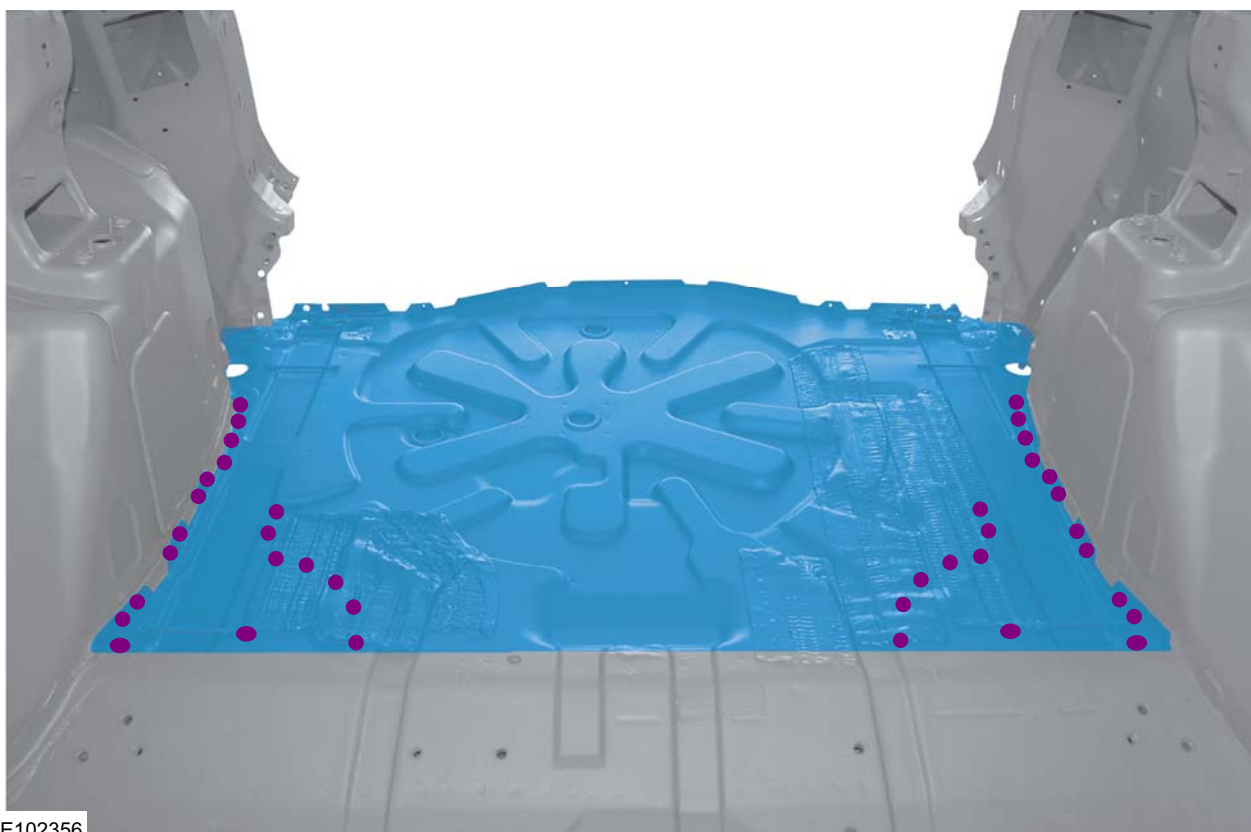
- Puddle weld.

501-30-32

Rear End Sheet Metal Repairs

501-30-32

## REMOVAL AND INSTALLATION



E102356

6. • **Rear Floor Panel (below)**
  - **Below Outer Side:** Bend in metal tabs - On both sides.

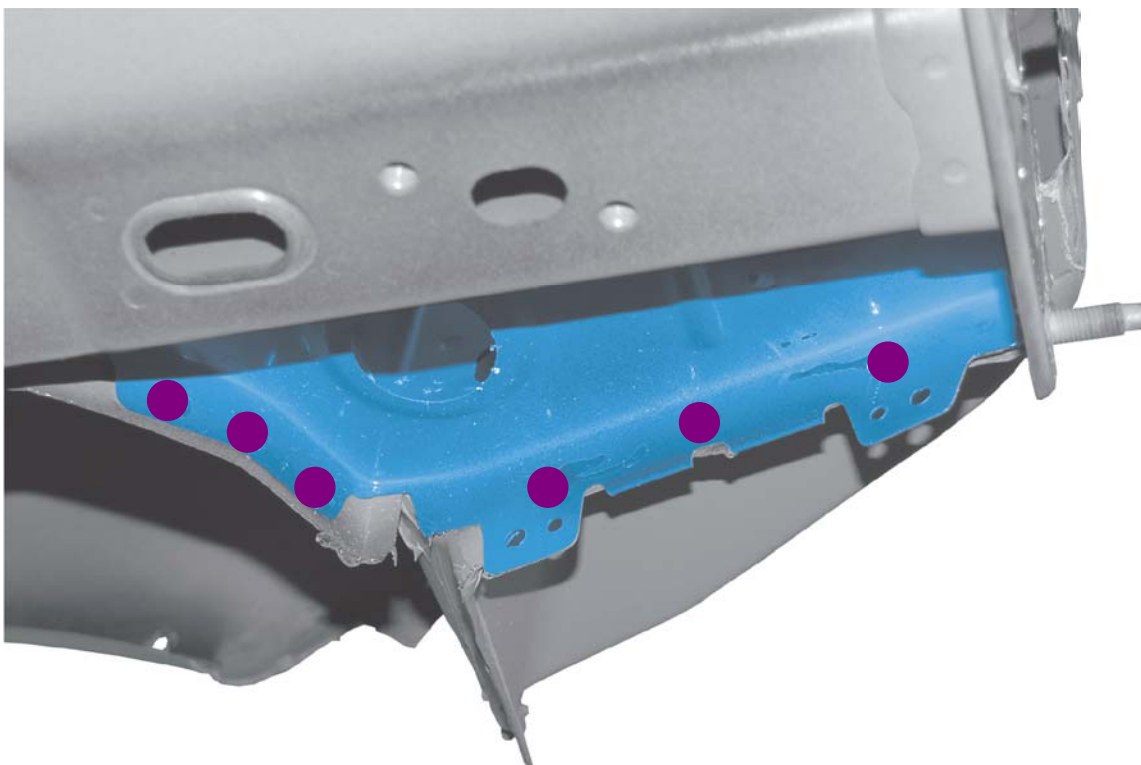


E102357

7. • **Rear Floor Panel (below)**
  - **Below Inner Side:** Resistance spot weld - On both sides - Panel thickness partially 3 mm and greater!



REMOVAL AND INSTALLATION



E102358





## REMOVAL AND INSTALLATION

## Inner Quarter Panel and Wheelhouse

## Removal

**NOTE:** Equipment:**Measurement and alignment angle system**

1. • **Replacement Parts:**
  - **NOTE:** For a partial replacement the required replacement parts needs to be cut out from the complete panels.
  - Inner Quarter Panel and Wheelhouse
  - Wheelhouse Inner
  - Striker Reinforcement
  - Rocker Panel Inner Reinforcement
2. • **Necessary Removal and Installation Work:**
  - Quarter Panel  
Refer to: **Quarter Panel LH** (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
  - Reinforcement C-Pillar  
Refer to: **Rear Wheelhouse Outer** (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
  - Back Panel and Reinforcement  
Refer to: **Back Panel and Reinforcement** (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
  - Rear Lamp Mounting Panel
  - Rocker Panel (partial)  
Refer to: **Rocker Panel** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
  - Water Drain Panel  
Refer to: **Water Drain Panel** (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
  - Reposition the carpeting and the wiring harness away from the working area.
3. • **Rocker Panel Inner Reinforcement**
  - Mark the cutline and cut out the rocker panel inner reinforcement partial.
  - Mill out the spotwelds.
  - Heat the area (approx. 170 °C) and detach bonded / sealed area at the edge of the wheel arch.

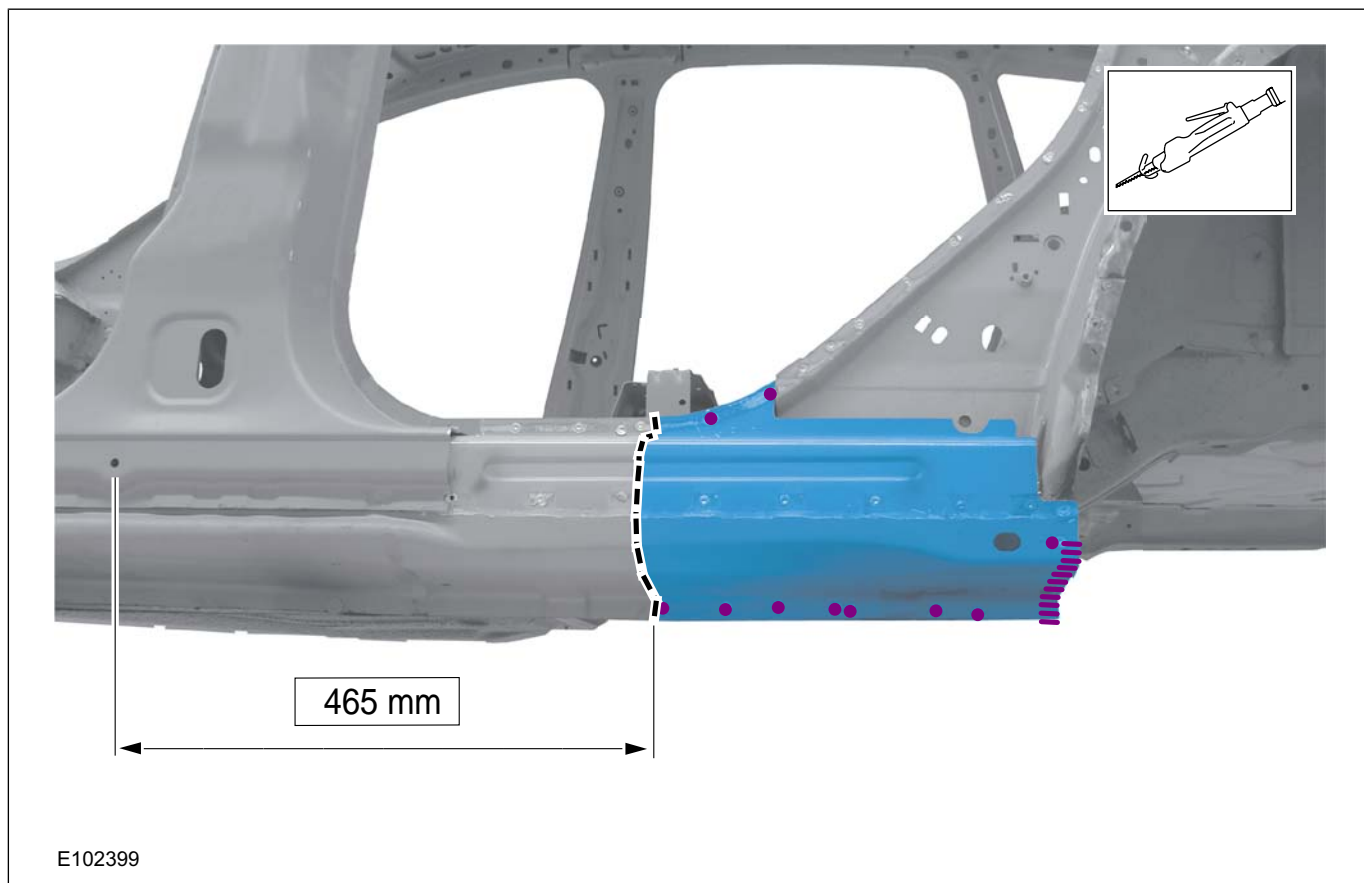


501-30-35

Rear End Sheet Metal Repairs

501-30-35

## REMOVAL AND INSTALLATION



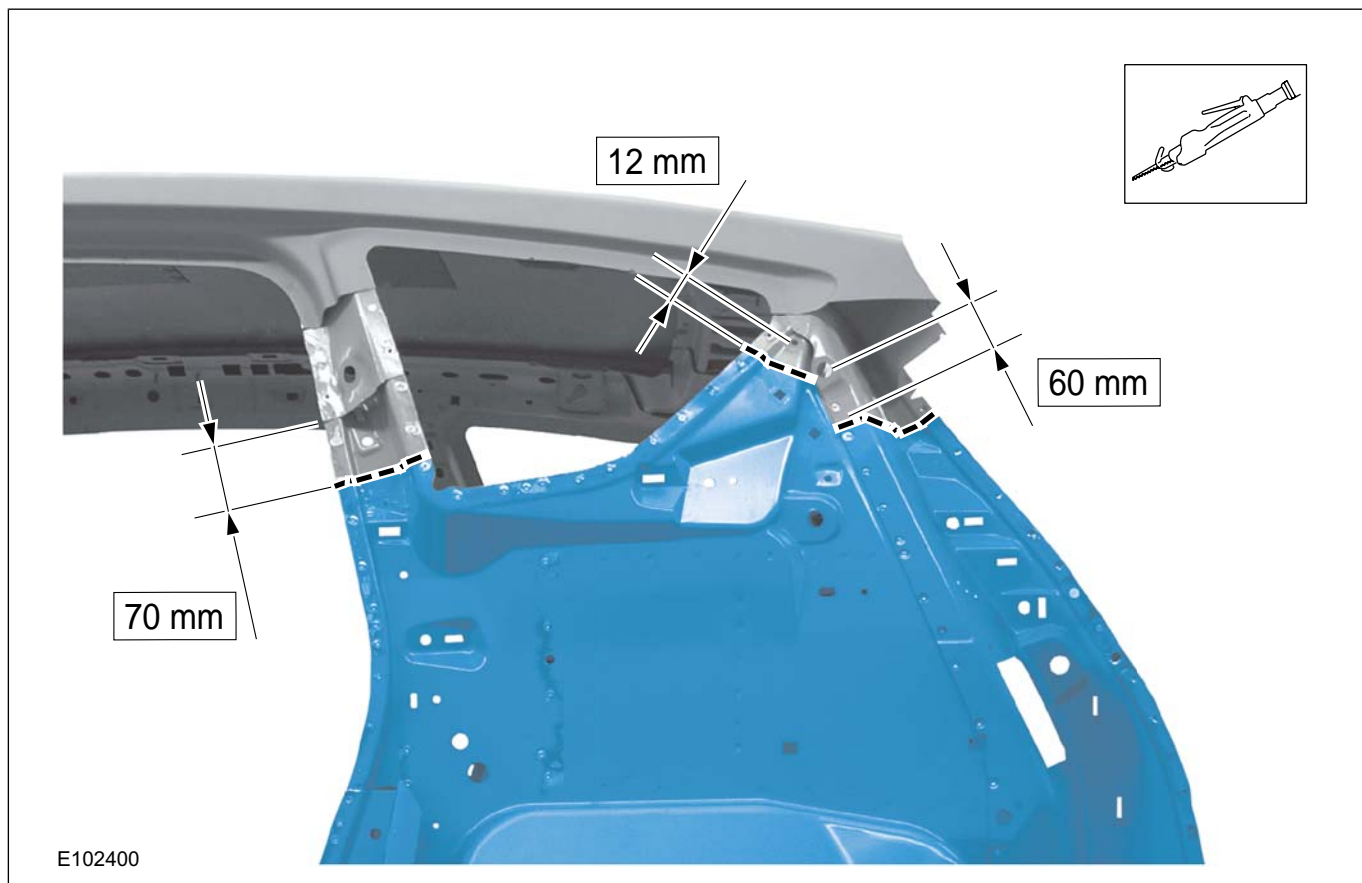
4. • **C-Pillar - D-Pillar**
  - Mark the cutline and cut C- and D-Pillar.

501-30-36

Rear End Sheet Metal Repairs

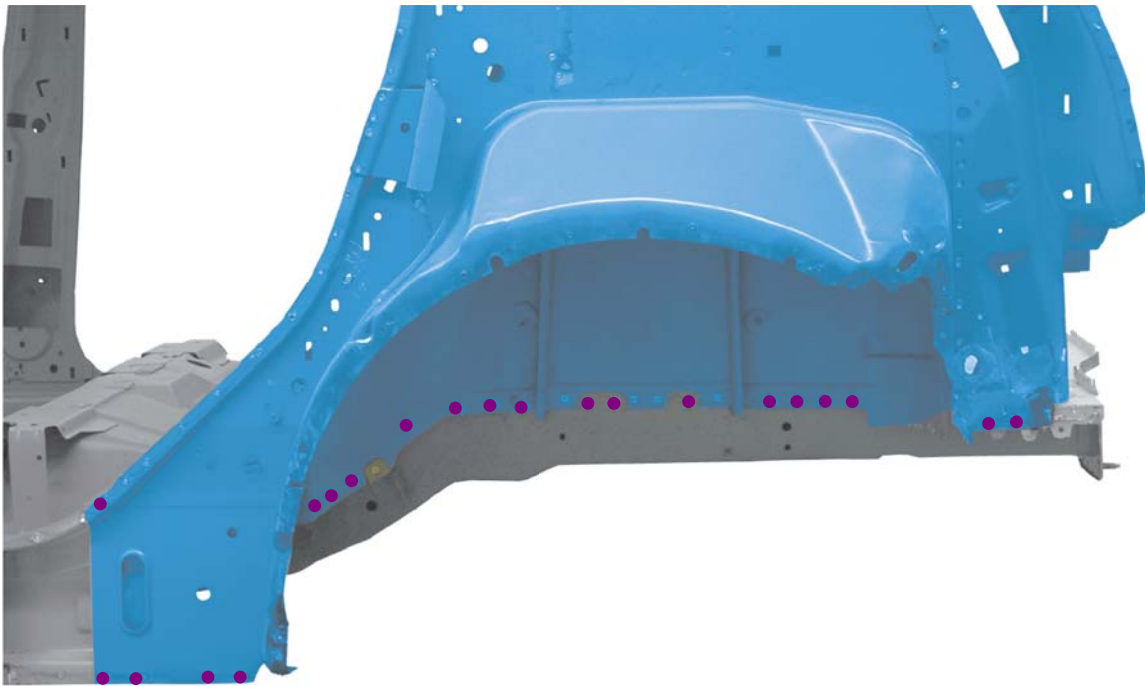
501-30-36

## REMOVAL AND INSTALLATION



5. • **Wheelhouse**
  - Mill out spotwelds.

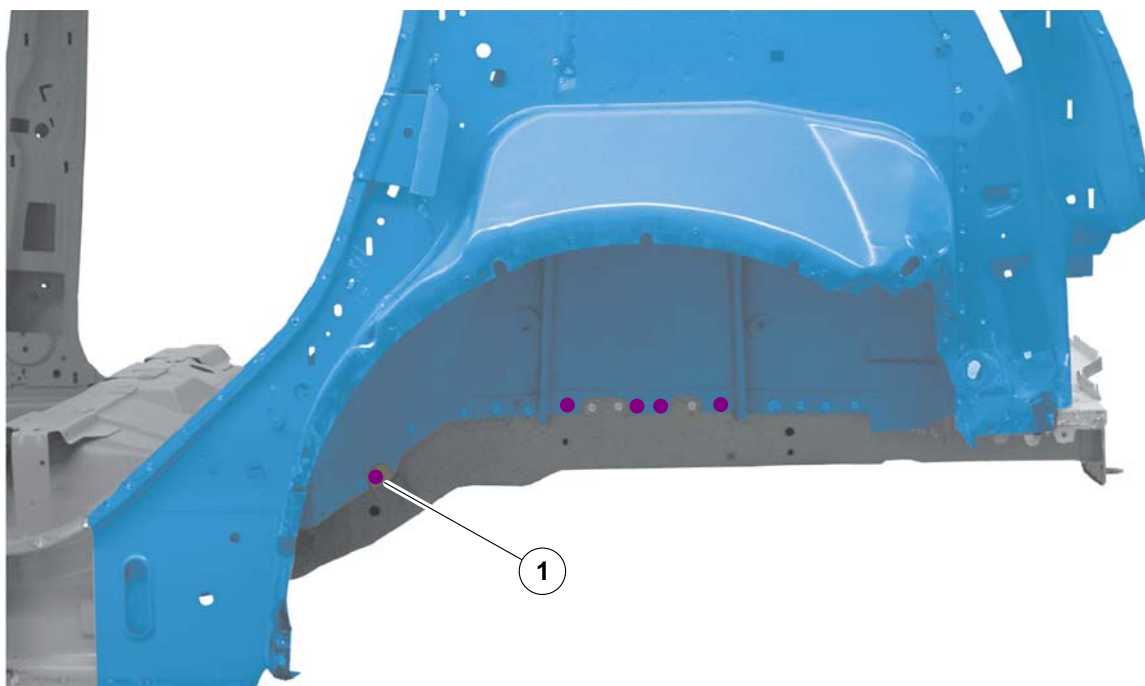
## REMOVAL AND INSTALLATION



E102401

6. • **Wheelhouse**
  - Mill out the spot welds - Two panel thickness.
  - **1)** Mill out the spot weld - Bend open metal tab.

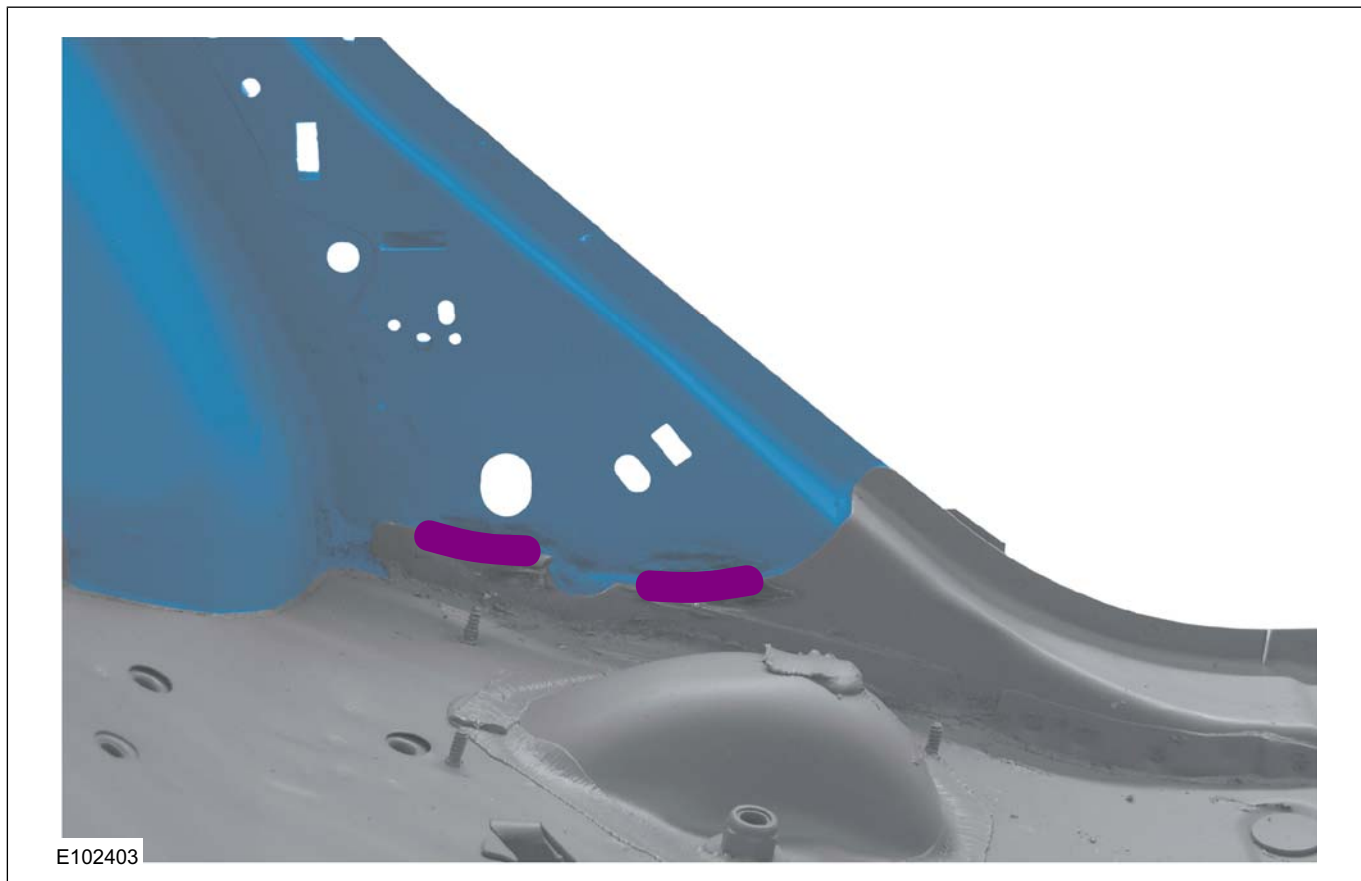
## REMOVAL AND INSTALLATION



E102402

7. • **Wheelhouse - Doorframe**
  - Grind out the MIG brazed joints.

## REMOVAL AND INSTALLATION



## Installation

**NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

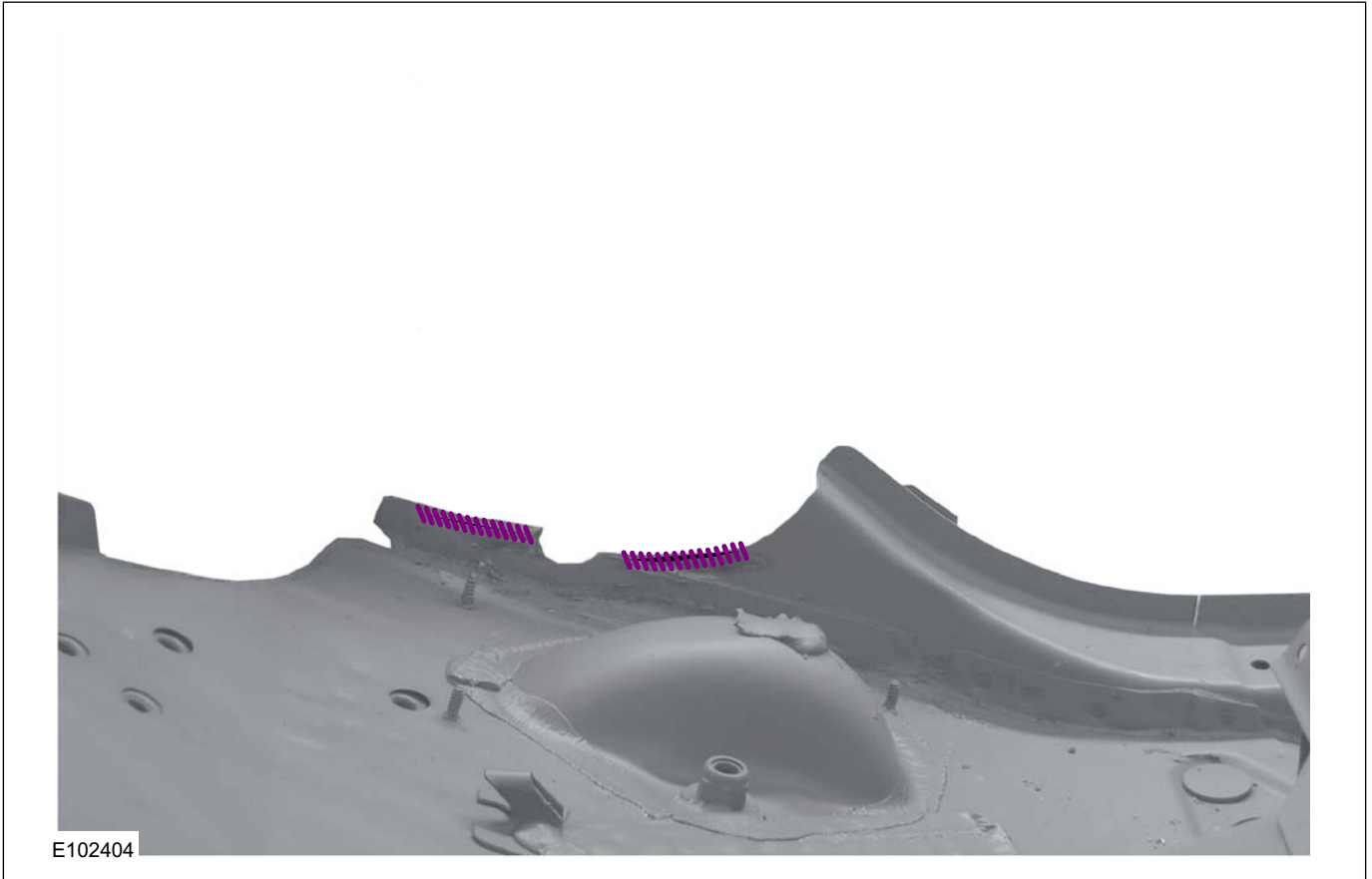
**NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

**NOTE:** Replacement of MIG brazed joints by MIG welds.

2. Refer to: **Joining Techniques** (501-25 Body Repairs - General Information, Description and Operation).
  - The factory-installed MIG brazed joints must be replaced by MIG welds in a different position.
  - These MIG welds must not be carried out on or in the immediate vicinity of existing MIG brazed seams as even the smallest amount of brazing solder can result in a reduction in the strength of the weld seam.
3. • **Preparation of the body**
  - Grind down MIG braze residues.



REMOVAL AND INSTALLATION



4. • **Preparation of the Inner Wheelhouse**
- Drill holes for puddle welding (Ø 8 mm).

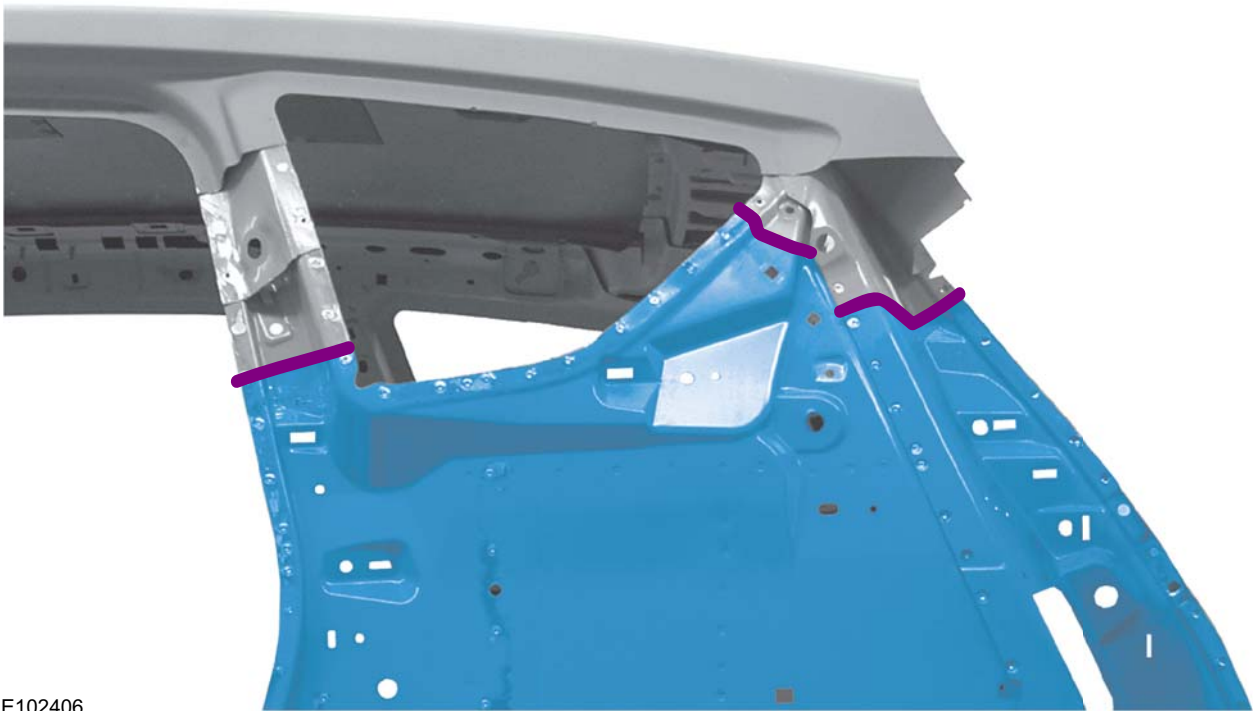


5. • **Inner Quarter Panel and Wheelhouse**
- Continuous MIG weld seam on C-Pillar and D-Pillar.
  - **NOTE:** Level weld flanges.





## REMOVAL AND INSTALLATION



E102406

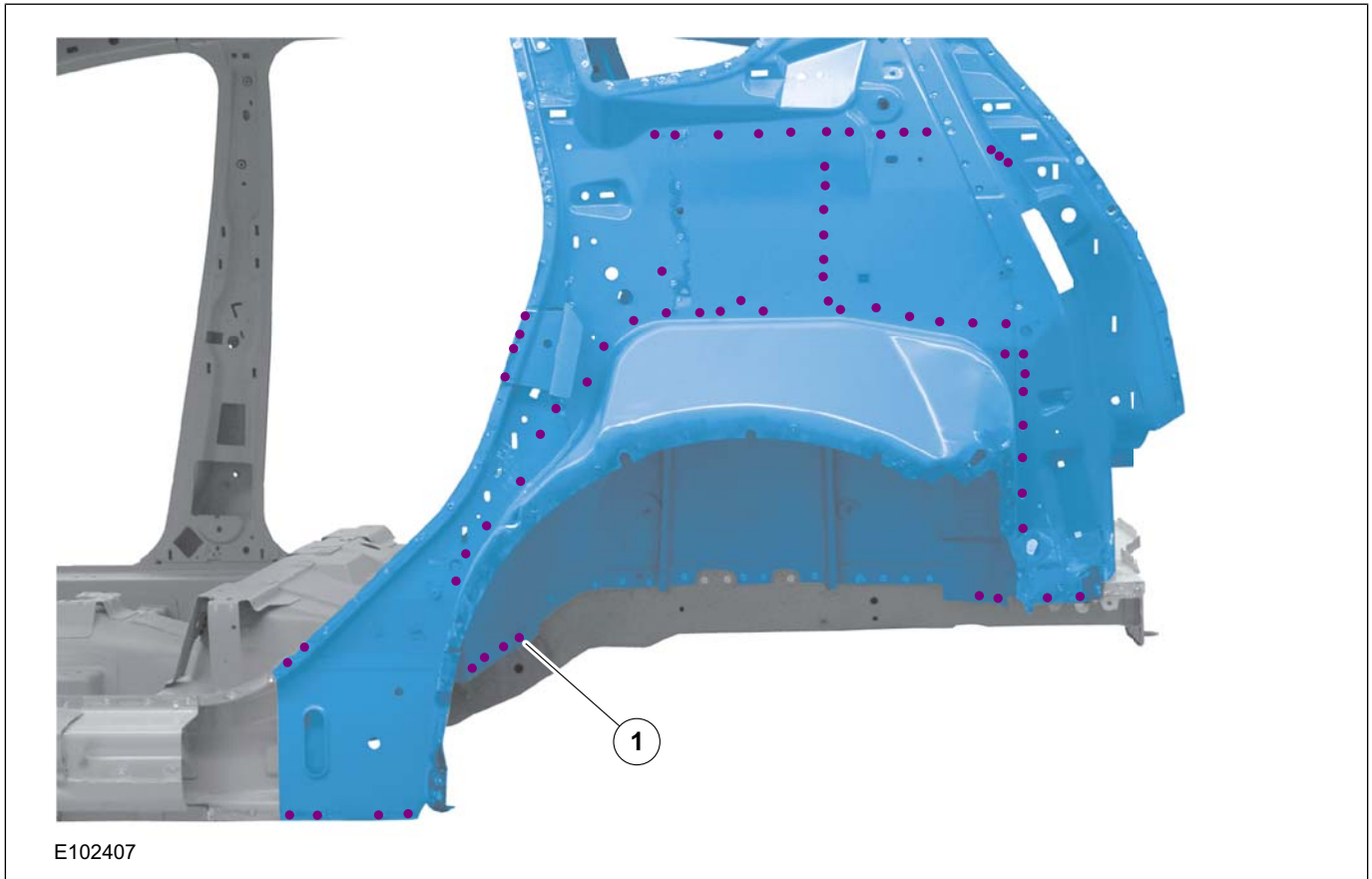
6. • **Inner Quarter Panel and Wheelhouse**
  - Resistance spot weld - Panel thickness 3 mm and greater!
  - **1)** Bend in metal tab - Resistance spot weld - Panel thickness 3 mm and greater.

501-30-42

Rear End Sheet Metal Repairs

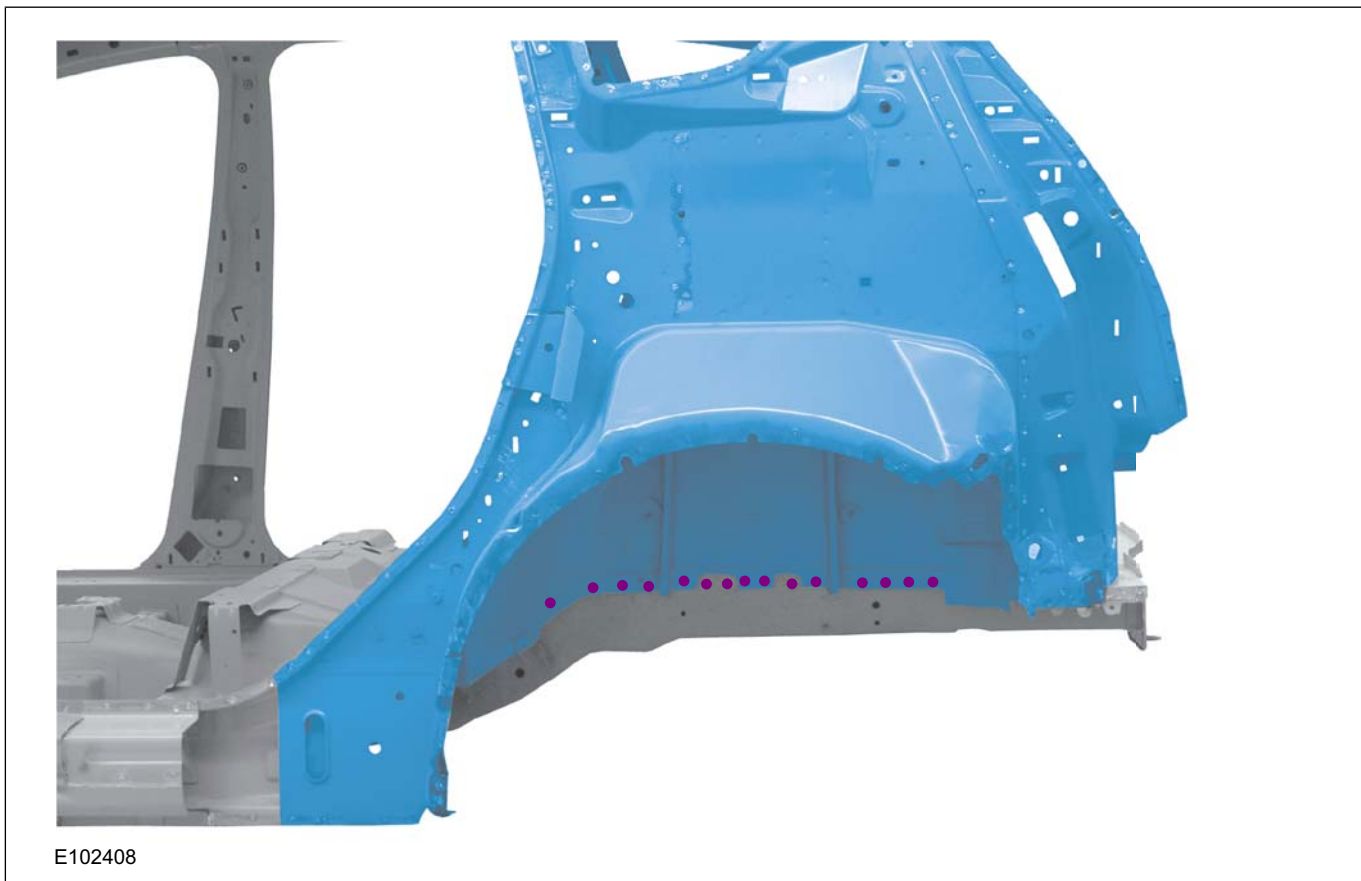
501-30-42

## REMOVAL AND INSTALLATION



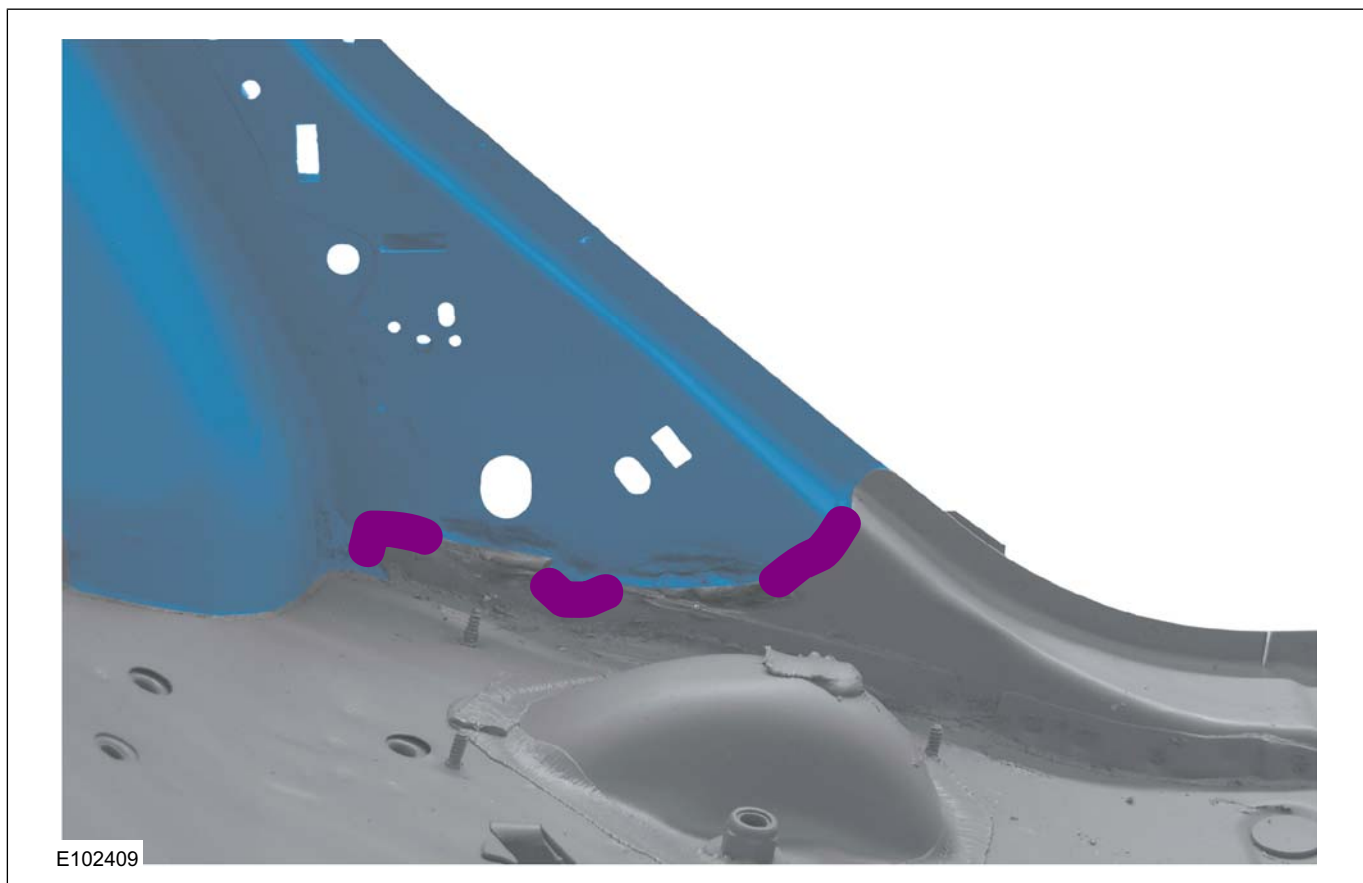
7. • **Wheelhouse**
  - Puddle weld.

## REMOVAL AND INSTALLATION



8. • **Wheelhouse - Doorframe**
  - MIG weld.

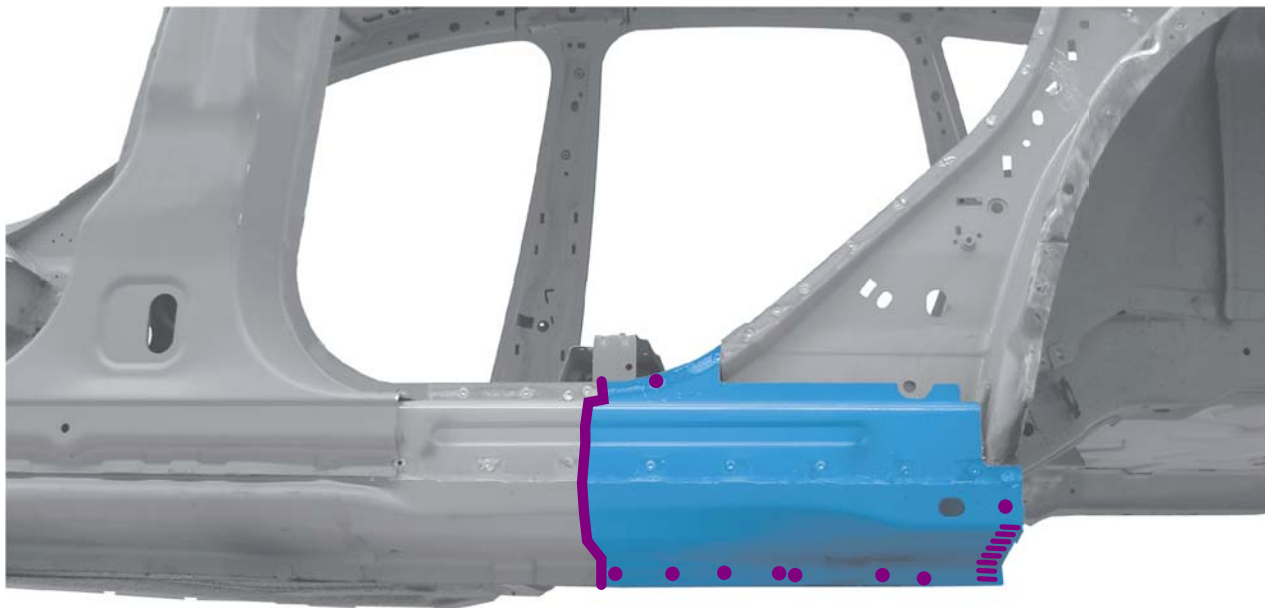
## REMOVAL AND INSTALLATION

**9. • Rocker Panel Inner Reinforcement**

- Apply PU glass adhesive.
- Continuous MIG weld seam.
- Resistance spot weld - Panel thickness 3 mm and greater!



REMOVAL AND INSTALLATION



E102410



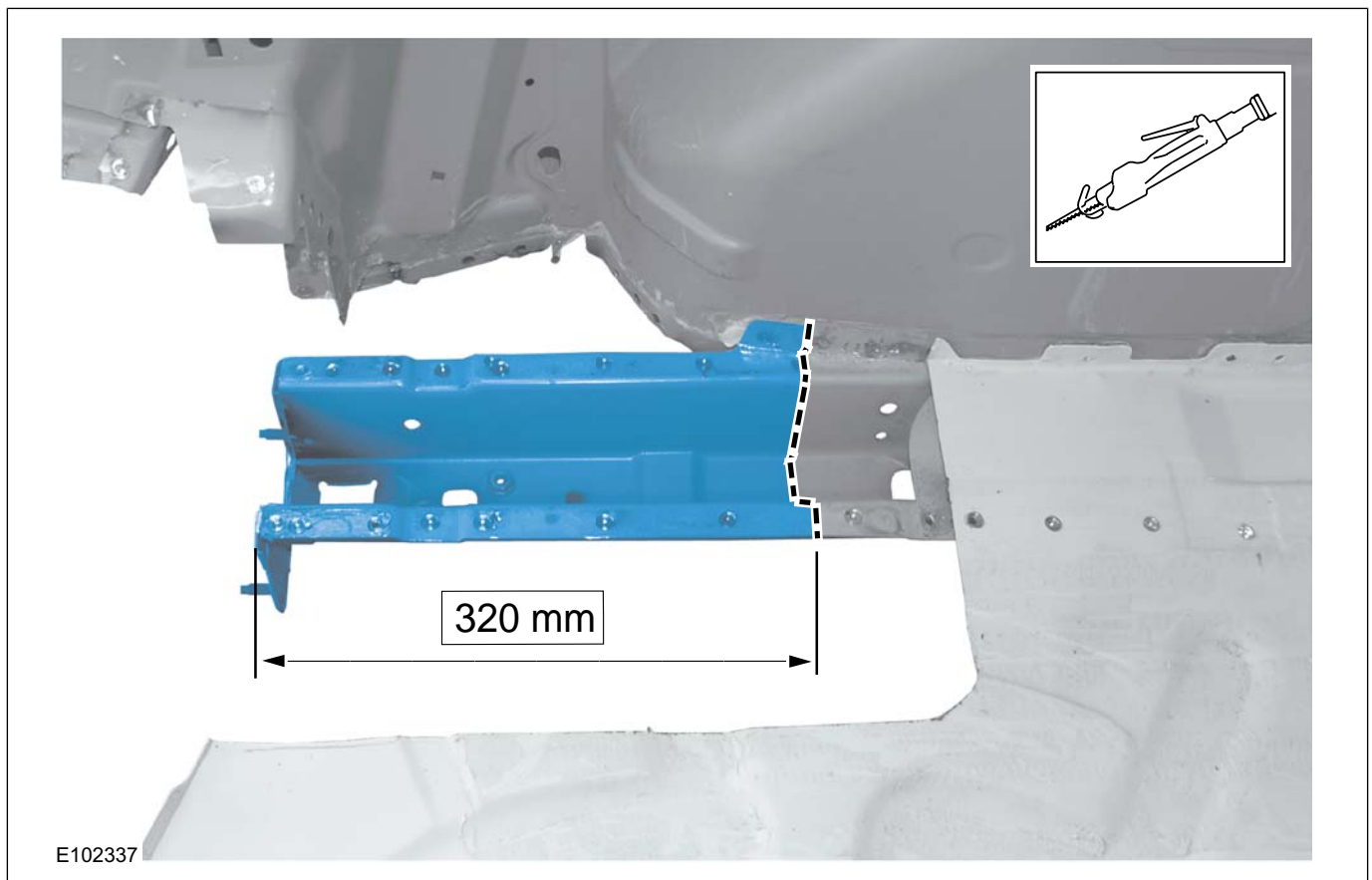
## REMOVAL AND INSTALLATION

## Rear Side Member Section

## Removal

**NOTE:** Equipment:**Measurement and alignment angle system**

1. • **Replacement Parts:**
  - Rear Side Member Sectional Part
2. • **Necessary Removal and Installation Work:**
  - Back Panel and Reinforcement
    - Refer to: **Back Panel and Reinforcement** (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
  - Rear Floor Panel Section
  - Reposition the carpeting and the wiring harness away from the working area.
3. **NOTE:** The cut location may vary depending upon the extent of the damage.
  - **Rear Side Member**
  - Cut location.



## Installation

**NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment

instructions and sub-section 501-25 must be followed.



## REMOVAL AND INSTALLATION

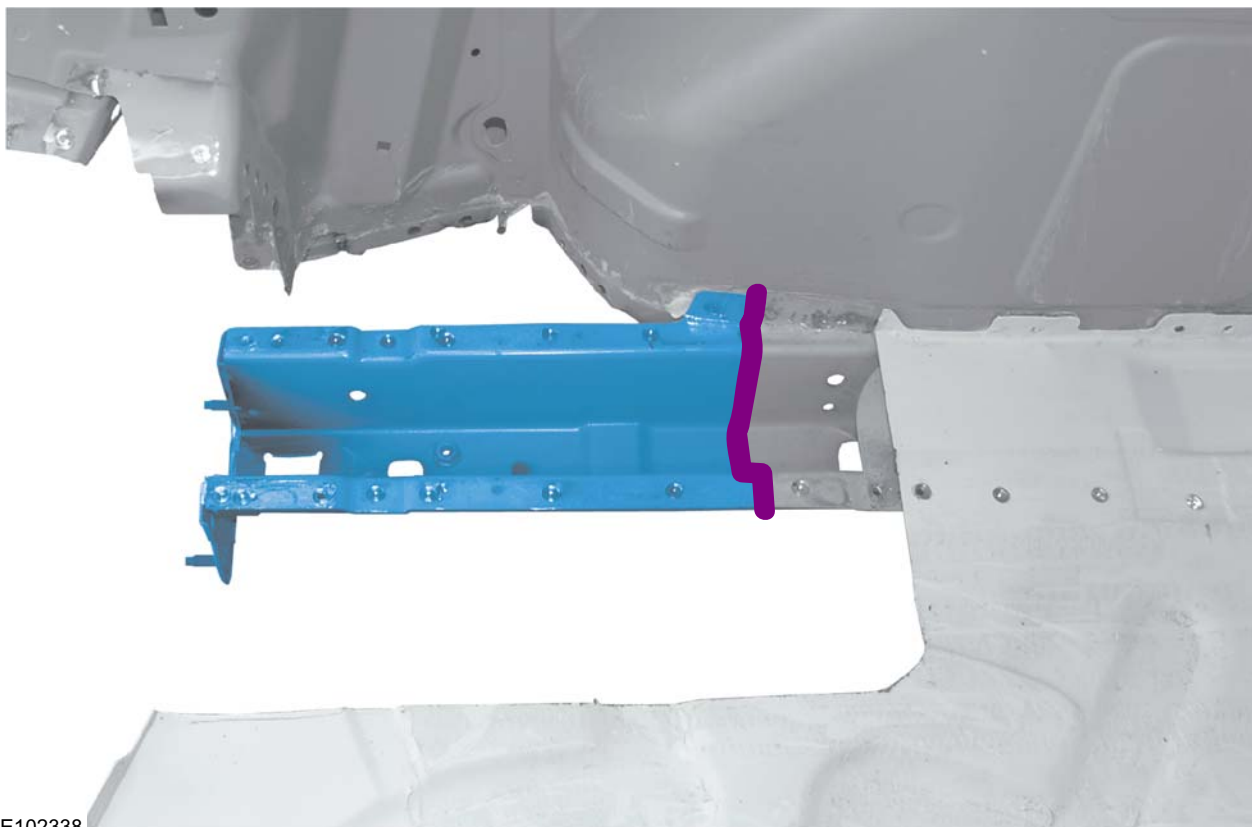
1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

**NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed

needs to be thoroughly sealed afterwards.

2. **NOTE:** Insert and fit the side member using the straightening angle.

- **Rear Side Member**
- Continuous MIG weld seam.



E102338

## SECTION 501-36 Paint - General Information

### VEHICLE APPLICATION: 2008.50 Kuga

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**DESCRIPTION AND OPERATION**

## Description and Usage of Paint Literature

Vehicle paints are subject to severe demands caused by external influences. Moisture, air-borne deposits in the form of various chemicals and UV light constantly affect a paint surface. Furthermore, mechanical damage occurs through grit, stones and sand. Bird droppings, insect residues, pollen and tree sap also attack the paint surface.

The present literature not only informs the specialist about current repair painting techniques, but also provides tips and instructions on modern and economical repair processes.

High quality bodywork paints require the use of the most modern technologies and regular updating of the technician's knowledge of painting techniques, because of the constantly new developments in paint technology.

Information about different materials is listed under Specification.

Furthermore, information on the fundamental principles of repair painting and paint materials is provided in several chapters. The safety instructions indicate the possible health hazards and other sources of danger. There are also notes about tools and materials as well as on basic painting methods.

In the model specific repair instructions, only the most important repair steps or special features are referred to. Detailed information on the generally applicable painting procedures is given in this paint manual.

Direct supply of repair paints by Ford has been discontinued. There is however an agreement with many paint manufacturers, which ensures fast and problem-free supply to the dealer undertakings.

Paint suppliers:

- DuPont
- Glasurit
- PPG
- Sikkens
- Spies Hecker
- Standox

When using painting materials, it should be taken into account that the manufacturers have exactly matched their products between each other. In order to avoid quality defects, difficulties in working and losses in corrosion protection, these may not be substituted with other products.

**NOTE:** The Ford Service Organization organizes basic and more in-depth training on much of the content of this paint manual. As well as the practical part of the training, a further component is the Student Information document, which offers supplementary information in the form of a brochure.

During all work it must always be ensured that personal safety and the operational capability of the vehicle are not threatened by the choice of methods, tools and components.


The information given in the diagrams in the chapter "Paint Damage" is provided by the repair paint manufacturer.


**DESCRIPTION AND OPERATION**

## Symbols

### General

Various symbols, signs, instructions and illustrations are used in this literature. Warnings and cautions have different meanings and require different ways of proceeding. Diagrammatic representations are provided with instructional signs for improved clarity. These are briefly explained below:

 **WARNING:** This caption is used when failure to follow instructions exactly or failure to follow them at all may result in a hazard to persons or in persons being injured.

 **CAUTION:** This caption is used when incorrectly following the test procedures or instructions or failure to follow them at all could lead to damage to the vehicle or components.

**NOTE:** This caption is used when attention needs to be drawn to special or extra information.

When reading this handbook, you will come across the points WARNING, CAUTION AND NOTE. These instructions are always given immediately before the corresponding job steps.

### Hazardous materials designations

Many accidents occur because of ignorance. In the area of personal health protection, it is particularly important to clearly emphasize sources of danger and their effects on human organs.

Only with knowledge of hazardous material designations can it be certain that the necessary precautions are taken when handling substances which are harmful to health.

**NOTE:** Pay attention to the manufacturer's data on the containers and given in the Safety Data Sheet.

DESCRIPTION AND OPERATION

Hazardous material symbols



Item	Description
1	Very poisonous, T+ (extremely toxic), small quantities can be fatal.
2	Poisonous, T (toxic), causes serious damage to health
3	Corrosive, C (corrosive), destroys living tissue.
4	Harmful to health, Xn (noxious).
5	Irritant, Xi (irritant), can cause inflammation.

Item	Description
6	Explosive
7	Highly flammable, F+ (extremely flammable), already flammable at temperatures below 0° C.
8	Flammable, F (flammable), forms a flammable mixture with air.
9	Oxidizing, O (oxidizing), reacts with combustible substances.

As well as the danger symbols, there is more comprehensive manufacturer's information to be



**DESCRIPTION AND OPERATION**

found on the containers and in the Safety Data Sheets, and you must pay attention to this information.

**Instructions on measures to be taken for personal protection.**

As well as the information about sources of danger, there are mandatory instructions which draw your attention to the personal protection measures to be taken.

**Mandatory symbol**



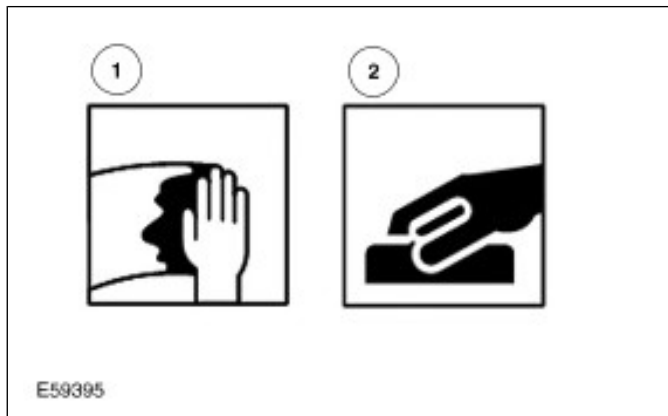
Item	Description
1	Breathing protection must be worn
2	Eye protection must be worn
3	Ear protection must be worn
4	Protective gloves must be worn
5	Protective footwear must be worn

**Icons**

So that the necessary information for optimal handling is clear, unambiguous and can be quickly understood, the leading paint manufacturers have

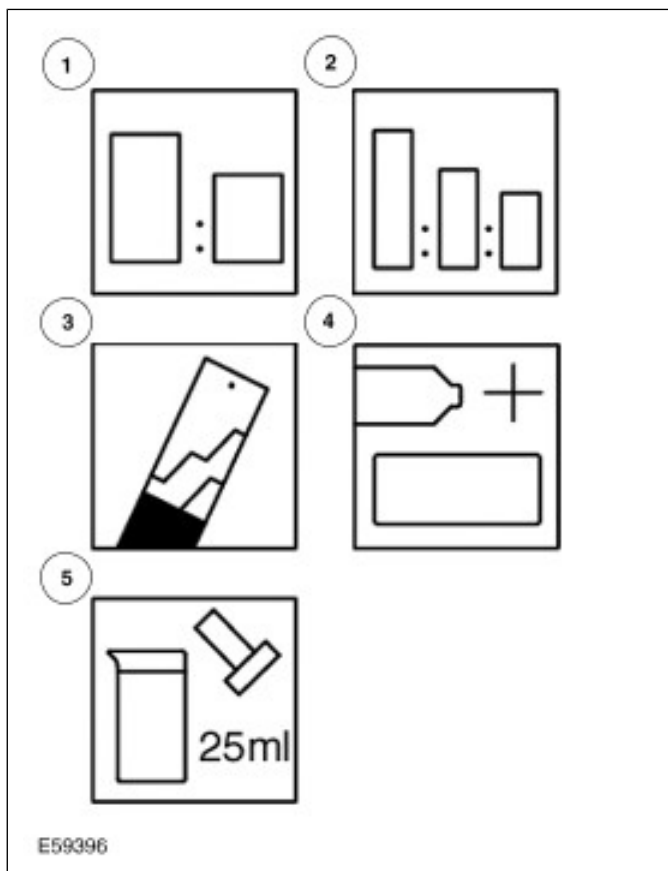
agreed a standard symbolic language. Language independent representations in the form of icons provide handling instructions which are supplemented with quantity or time information.

**Pretreatment**



Item	Description
1	Clean
2	Sand

**Mix**



Item	Description
1	2 component mixture
2	3 component mixture

**DESCRIPTION AND OPERATION**

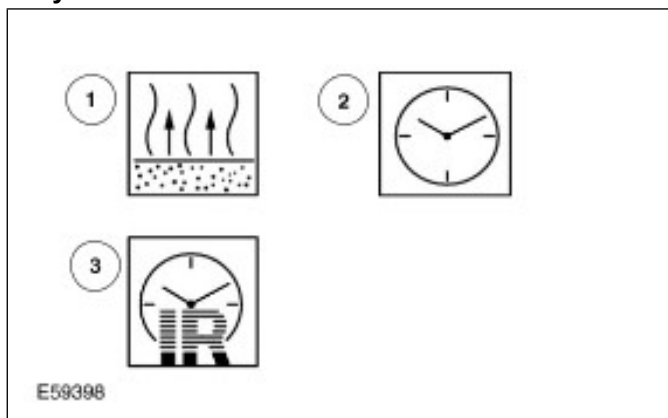
Item	Description
3	Use a measuring rod
4	Addition of hardener
5	Addition of additives

**Process**



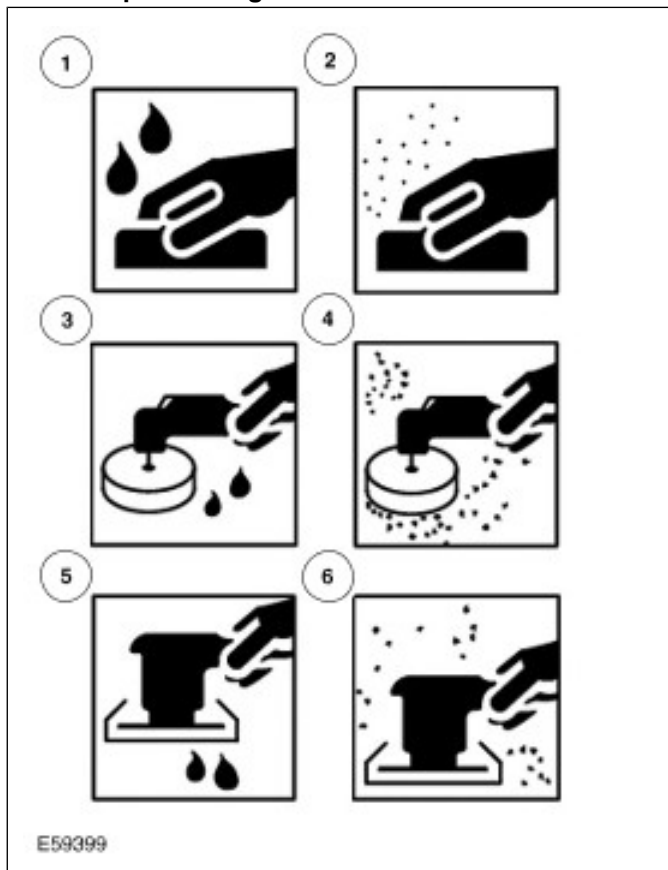
Item	Description
1	Flow-beaker spray gun
2	Suction-beaker spray gun
3	Spray passes
4	Filler
5	Coat
6	Underbody protection spray gun

**Dry**



Item	Description
1	Ventilate
2	Drying time
3	Drying time with infra-red dryer

**Further processing**

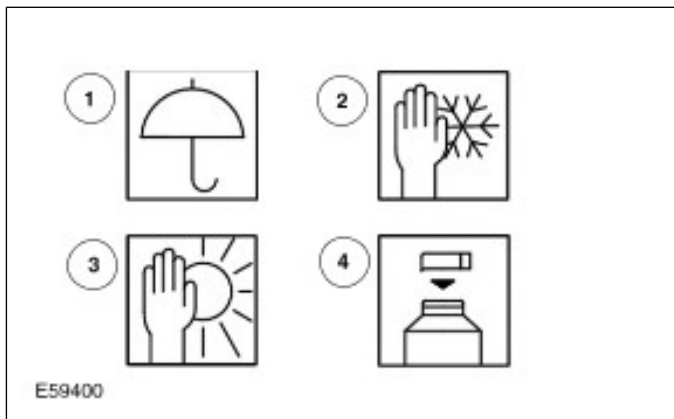


Item	Description
1	Hand abrade (wet)
2	Hand abrade (dry)
3	Eccentric sander (wet)
4	Eccentric sander (dry)

**DESCRIPTION AND OPERATION**

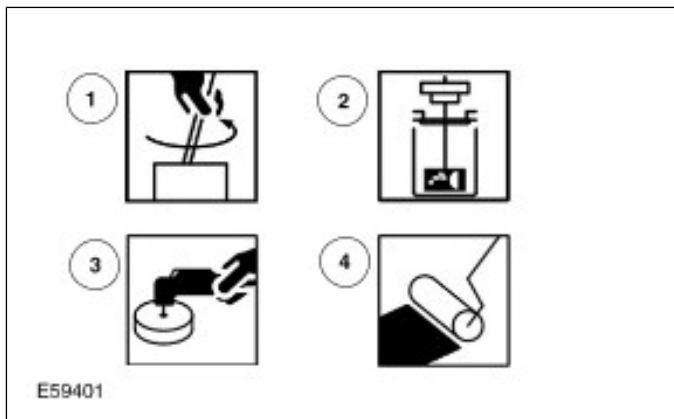
Item	Description
5	Oscillating sander (wet)
6	Oscillating sander (dry)

**Store**



Item	Description
1	Protect from moisture
2	Store in a frost-free environment
3	Store in a cool place
4	Close the container

**Other**



Item	Description
1	Stir by hand
2	Stir using a mixing machine
3	Polish
4	Roll

**DESCRIPTION AND OPERATION**

**Health and Safety Precautions**

**General instructions for the paint shop and handling paint materials**

Hazardous areas in repair paint shops:

- Danger from fires, explosions and hot surfaces.
- Dangers to health and safety from the effects of harmful substances because of their absorption through the skin and/or inhalation.
- Dangers caused by electricity, compressed air, power tools and noise.

**▲ WARNING: During painting work there is an increased danger of fire or explosion. Prevent any sparks being created. Fire, naked lights and smoking are forbidden.**

Measures:

- Wear protective footwear made from anti-static material.
- Only use tools made of wood, brass or copper to clean stands and extraction ducts. Do not use tools made of steel.

Only fill or decant paint materials in a specially marked area.

As well as these general instructions on the dangers in repair paint shops, all national and international regulations must be observed:

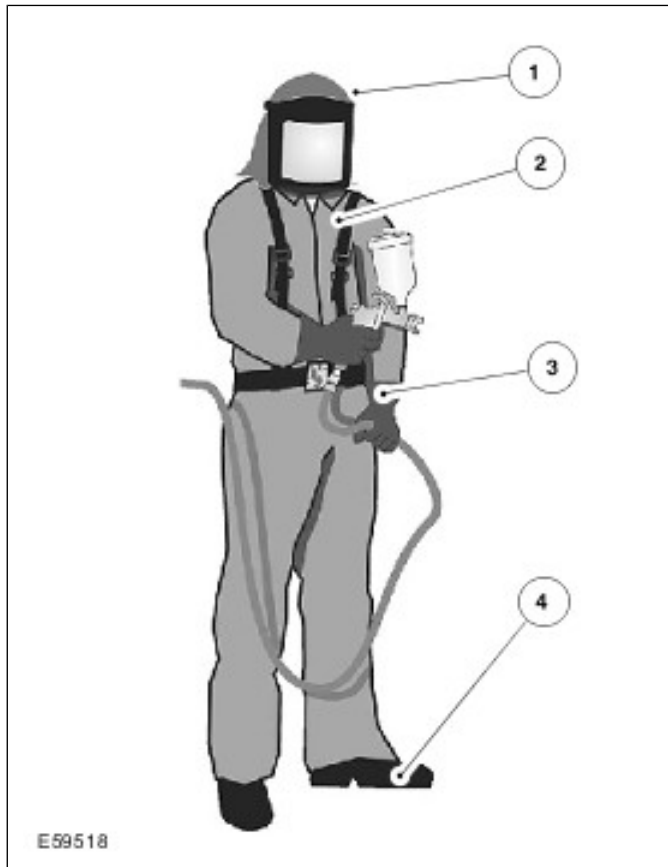
- Health and Safety at Work Act
- Ordinance on Hazardous Substances
- Technical Rules for Hazardous Substances
- Regulations for the Prevention of Industrial Accidents
- EU Directive on Hazardous Substances, 98/24/EU
- EU Directive on Noise, 2003/10/EU
- EU Directive on Volatile Organic Compounds (VOC), 1999/13/EU, 2001/81/EU, 2004/42/EU
- Safety instructions of equipment and tool manufacturers

**Personal protection**

Besides the body and limbs, several organs vital to life are in very particular danger. Because damage is mostly irreparable, special attention and comprehensive protection are necessary.

**▲ WARNING: Solvents cause damage to the health through inhalation. Splashes in the**

**eyes or on the skin can cause bodily harm. When working with solvents, always use suitable means of protection.**



Item	Description
1	Protective hood with fresh air supply
2	Protective clothing
3	Protective gloves
4	Protective footwear

**Breathing protection**

During painting work and in the preparations for painting, gases, vapors, mists or dusts can appear in dangerous concentrations in the areas where fellow employees breath.

For short periods of work or minimal concentrations of hazardous substances, breathing protection devices with a combination filter are suitable as breathing protection equipment.

## DESCRIPTION AND OPERATION



Item	Description
1	Activated charcoal filter
2	Coarse filter

For higher concentrations of harmful substances, breathing protection devices which are independent of the local atmosphere are suitable.

In these types of isolation systems, a compressed air hose carries natural air from the compressor line into the protective mask. During supply, the air undergoes pressure reduction, water removal, fine filtration and usually warming to natural breath temperature.

**▲ WARNING: Vapor or spray mist containing isocyanate as a paint base or hardener can cause toxic respiratory disease (conditions similar to asthma) leading to permanent damage, even when inhaled in the lowest concentrations.**

Filter masks with wadding, sponge or colloid filters and also paper masks are all unsuitable for working with coating materials because they do not stop solvent vapors.

The instructions for use provided by the manufacturer must be observed when working with breathing protection equipment.

### Skin protection

Spray painters who are subject to considerable exposure to coating materials must wear suitable protective work clothing (flame-proof and anti-static).

**NOTE:** Also, when working with water based materials, comprehensive skin protection must be worn, because these materials are very easily absorbed through the skin.

The protective clothing must be changed at the proper intervals. Items of clothing which are contaminated with coating materials can easily catch fire.

When selecting protective clothing, it must be taken into account that cloth containing a high proportion of easily melted plastic thread considerably increases the degree of burns injury (melted plastic on the skin!). This must also be taken into account in the choice of underwear.

For areas of skin which are not covered by protective clothing, suitable skin protection, skin cleaning and skin care agents must be used.

### Eye protection

Working with portable hand sanding machines on which the tools move unguarded, at speed and with power is fundamentally dangerous.

Goggles must be worn not only when sanding, but also when working with paints and their additives. These contain substances which are harmful to the eyes. Damage ranging from irritation of the cornea to incurable illnesses are possible.

The protective goggles must be inert toward splashes of solvent, and fully enclose the areas at the side of the eyes on both sides. The best protection during spray painting is offered by full mask respirators or helmet respirators with a built-in visor.

### Ear protection

Noise disturbance in repair paint shops caused by various sources is particularly high. Sanding and compressed air machines, paint cabin extractor fans (compressors) and extractor ducts in the work rooms are the causes of the high levels of noise.

**▲ WARNING: Avoid damage to your hearing! Wear ear protection.**

Suitable ear protection is offered by ear plugs or ear defenders.



**DESCRIPTION AND OPERATION**

## Environmental Regulations

### Waste disposal in the repair paint shop

More than ever before, since the introduction of EU directives, rigorous attention is paid to the avoidance of waste materials and to recycling in repair paint shops. In this respect, repair paint shops must take into account and comply with the following requirements:

- Separate waste according to its recycling and disposal methods.
- Produce evidence for the correct transport and disposal of waste.

**NOTE:** The organization of disposal in the plant must comply with the requirements of the Waste Avoidance and Management Act: The avoidance and recycling of waste must always take priority.

However, despite all measures which may be taken, waste cannot be completely avoided.

**NOTE:** Waste which is not allowed in household rubbish, and which can no longer be utilized, must be disposed of as special waste.

Paint residues containing solvent, application residues, sanding dust, waste containing peroxides, solvents, soiled cleaning cloths and paint slurry all count as special waste. Each of these must be collected in a separate, sealed and suitably labeled metal container and properly disposed of using a specialist company.

Careful separation allows some waste to be usefully re-used.

- Empty metal containers can be sent for scrap instead of being disposed of as waste.
- Contaminated cleaning thinners can be separated by distillation.
- Packing material and masking paper can be added to the recycled paper collection.

Residues which cannot be used must be correctly disposed of.

All remaining waste must be treated as commercial waste and disposed of according to the local regulations.

### The new VOC (Volatile Organic Compounds) solvent regulation

Keeping the air clean protects the environment and the population from the health-damaging effects of air pollutants.

In certain atmospheric conditions, volatile organic compounds contribute to summer smog.

**NOTE:** For comprehensive information, please refer to the European VOC Directive, 1999/13/EU. Furthermore, the effective national regulations must be complied with.

The European VOC (Volatile Organic Compounds) Directive has controlled the limits for such compounds since August 2001. It applies to production coating companies and those which undertake repair painting of private and commercial vehicles.

Not least because of the VOC legislation, modern, low solvent and solvent-free lacquers and paints are finding greatly increased distribution across industry and the trade. Up to the year 2007, emissions from painting work will drop by at least 40%.

At the same time, the paint manufacturers guarantee for example that they will produce a ready-to-spray product consisting of base paint + hardener + thinners, with a permitted VOC level.

A company in business today can conform with the stipulated requirements by introducing water-based paints and using the other necessary products from the relevant paint manufacturers.

For more detailed information, please refer to the EU VOC Directive.



**DESCRIPTION AND OPERATION****Factory Paint Application****General fundamentals of paint technology**

Paint is a pigment-containing liquid which undergoes chemical and/or physical processes after it has been applied to a surface, so changing into a solid film covering.

Repair paint consists of binder, pigments, filler and solvent.

**NOTE:** Organic solvent is being replaced by solvent based on water.

**Constituents of paint**

- Binder
  - Mostly semi-fluid resins which bind together the other components of the paint when it dries.
  - Makes the paint durable.
  - Ensures good surface coverage.
- Pigments
  - Fine, colored powders, which give color to the paint.
  - Cover the components below (covering power).
- Additives
  - Additives give the paint special properties.
  - e.g. flow improver, softener, drying accelerator, thickener.
- Solvent
  - Thins the paint and allows it to flow more freely.
  - Evaporates during drying.

**Painting process and corrosion protection.**

In production, painting consists of individual steps which are optimally matched to each other.

Bodywork consists almost entirely of steel panels which have been pre-coated with zinc. The zinc layer is between 5-10 µm thick and acts as the first corrosion protection layer of the steel panel.

Production sequence:

- Clean and de-grease
  - In the first step, the bare bodywork is initially dipped in a cleaning bath and cleaned with a degreasing solution.
- Phosphatising
  - The cleaned bodywork is dipped in a bath containing various phosphate salt solutions. This creates a crystalline metal-phosphate layer which offers the optimal prepared surface and also corrosion protection.
- CDP base
  - The cathophoretic dip paint (CDP) base acts as a further corrosion protection layer.
  - In this process the bodywork is completely immersed in a bath consisting of a paint and electrolyte solution.
  - By application of an electric voltage, an electric field is created.
  - Positively charged paint particles settle on the negatively charged bodywork and form a protective layer up to 20 µm thick.
  - Next the bodywork is placed in a dryer, where the CDP base is hardened at 180°C.
- Sealing, stone-chip protection
  - Edges, seams and but joints are sealed with a sealing compound.
  - Vulnerable areas are coated with stone-chip protection.
- Filler
  - Filler protects the body panels from stone impacts. Furthermore, any unevenness of the metal surface is flattened out, in order to create the most homogenous and fault-free undersurface possible.
  - Once the filler is dry, it serves as the base on which paint is applied.
- Top coat
  - The top coat is applied as a single layer or two layers of paint.
  - When working with two layer paint, in the first job step the initial colored base paint is applied. In the second job step, a clear lacquer is applied, giving the base paint shine and hardness.

**DESCRIPTION AND OPERATION**

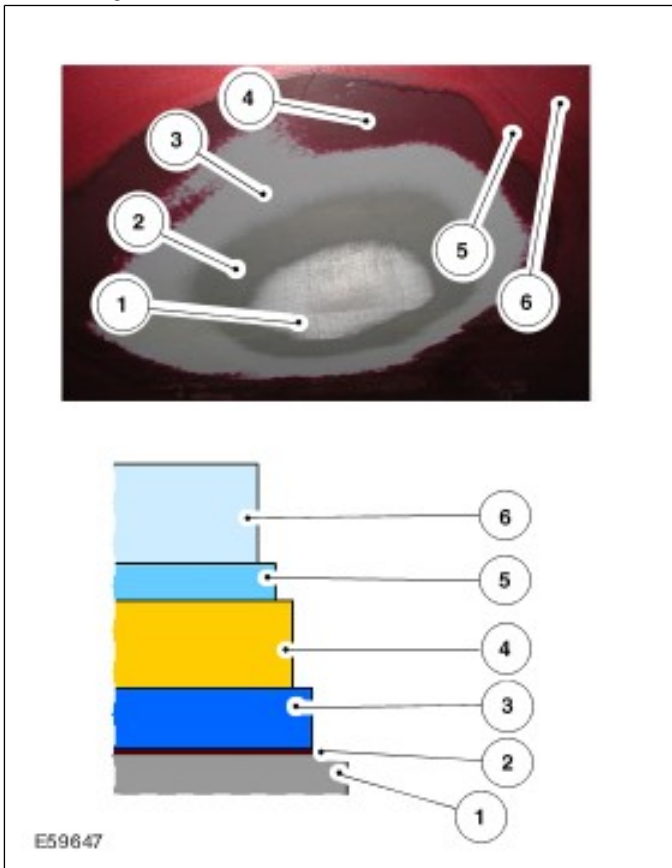
**The structure of an original paint finish**

During construction of the original paint, a total surface thickness of between 120 and 130 µm is achieved. The thicknesses of the layers may vary however, because they are greater for horizontal surfaces than vertical ones.

Not every exterior paint has its own matching filler. It is more that the tones of the filler are color compatible, i.e. they have similar intensity to the top coat.

During repair painting the filler color tones must be used according to the manufacturer's instructions.

**Paint layers**



Item	Description
1	Steel panel
2	Phosphate layer 2.9 g/m <sup>2</sup> , corresponding to 2 µm.
3	Cathodic dip paint 30-35 µm
4	Filler 30-35 µm
5	Base paint 15-20 µm
6	Clear varnish 55 µm

**Colored fillers applied in production**

Filler which gives color is used in production. Its use makes the base paint and clear varnish unnecessary on certain vehicle interior surfaces (engine, doors).

**DESCRIPTION AND OPERATION****Paintwork Defects and Damage****Diagnosis and Damage Assessment**

Paint concerns, regardless of their causes, are part of the everyday work in the paint shop. Correct damage assessment and determination of the cause are preconditions for a professional resolution of a paint concern.

Paint concerns can still occur through a variety of causes, despite improved paint materials and new spray methods.

**NOTE:** A first appraisal of the paint damage should be done before cleaning. External factors such as rust, droppings, incorrect or insufficient paint care can then be more easily detected.

Diagnosis is best done in daylight but not in direct sunlight. Exact evaluation can also be done under artificial light from special luminescent lamps.

**Paint damage guide**

The most important paint damage concerns which make a paint repair necessary are:

- Damage from biological paint contamination such as bird or insect droppings, tree resin and aphids.
- Chemical paint damage caused by industrial contaminants such as smoke, fuel, acids, oils.
- Mechanical damage caused by stone impact during operation, scratches in the car wash and parking.
- Damage caused by faults in treatment. Application defects such as paint runs or orange peel.
- Dirt inclusions in the paint layer, e.g. caused by dust in top coat or textile lint.
- Damage due to corrosion.

Before repair of such paint concerns, exact diagnosis must be performed to determine the cause exactly. On the spot diagnoses using simple aids and processes are often enough.

Diagnosis without disturbing the paint is done by:

- Optical inspection without visual aids, under suitable light conditions from a suitable angle and correct distance.
- Optical inspection with the help of a magnifying glass.

- pH paper.
- Measurement of the thickness using FE / NFE coating thickness meters for ferrous (FE) and non-ferrous metals and non-magnetic steel (NFE) - magnetic process on steel panels, eddy current process on non-metals.

A test method where the traces of testing can be easily removed again is the finger nail test. With suitable experience the existing hardness of the paint can be determined.

Test methods where the paint is partially destroyed are:

- Pencil hardness test.
- Adhesion test using adhesive tape.
- Lattice cut test process to check the strength of adhesion.

Under certain circumstances these test methods are not enough for a certain diagnosis. In this case, paint diagnosis under laboratory conditions must be performed.

**Measuring and testing equipment for painted surfaces**

Coating thickness measuring devices

Magnifying glass

pH paper (together with water)

Suitable photographic equipment with macro lens

Shine measuring equipment

**Paint damage caused by environmental factors**

- Bee droppings
- Bird droppings
- Insects
- Tree resin and sap
- Aphid secretions
- Tar spots
- Cement, plaster and slaked lime
- Rust film/deposits from industrial fallout
- Battery acid
- Brake fluid

**DESCRIPTION AND OPERATION**

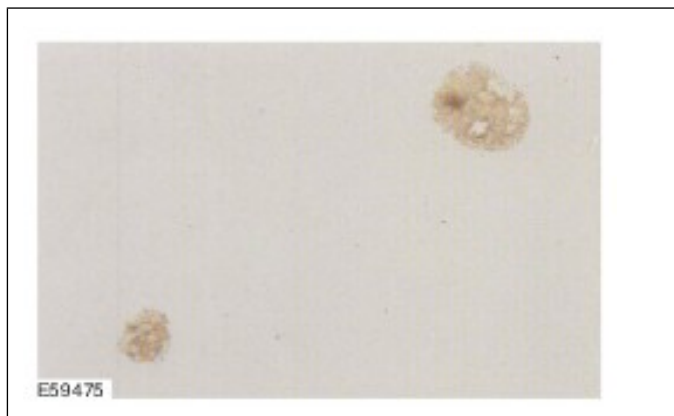
In all the cases of paint damage described below, if the damage is irreversible a new paint finish must be applied.

**Paint damage cause by bee droppings**

Bee droppings can be recognized on a paint surface through its yellow or brown color and sausage or drop-like shape with a diameter of 3-4 mm.

Cause/damage pattern:

- In combination with heat and high air humidity, bee droppings leave discolorations and cause paint decomposition.
- The paint can be destroyed down to the filler.



Repair of damage:

- If the damage is light, perform a polishing repair.

**Paint damage caused by bird droppings**

Bird dropping damage appears most often as matt, etched topcoat areas of various sizes. If left on the vehicle for a long time, crack formation and etching down to the filler will occur.

Cause/damage pattern:

- Bird droppings are particularly harmful in combination with heat and moisture. The urea (white part) has a very high salt content and is very aggressive.
- The intensity of the damage varies depending on the type, quantity, contact time and extent.
- Cracks, etching, marks up to dissolution of the top coat are the results.



Repair of damage:

- If the damage is light, perform a polishing repair.

**Paint damage caused by insects**

At insect impact locations on the hood, roof and bumper, small etched or etched through paint marks with partially visible spots of filler.

Cause/damage pattern:

- The top coat layer is destroyed in a short time by surface swelling and etching.
- Colliding insects stick to the paint surface. In combination with moisture and heat, because of the resulting acids the insect bodies sink into the paint top coat.
- The corrosion is G, C, U or O shaped and is only a few millimeters thick.



Repair of damage:

- Wash the vehicle, treat the affected area with insect remover. Clean the paint surface several times.
- Protect with hard wax.



**DESCRIPTION AND OPERATION****Paint damage caused by tree resin or sap**

Small yellow-brown marks or drops on the horizontal parts of the vehicle. The drops melt in sunlight. Resin damage only occurs in the warm summer months.

Cause/damage pattern:

- Because of their chemical composition, tree resins combine with or adhere very well to paint top coats and cause them to swell. The higher the temperature, the more intensive is the chemical bonding between the resin and the paint topcoat surface.



Repair of damage:

- Soak several times using a cloth saturated with a petrol & paraffin mixture.

**NOTE:** After successful cleaning the top coat must be preserved.

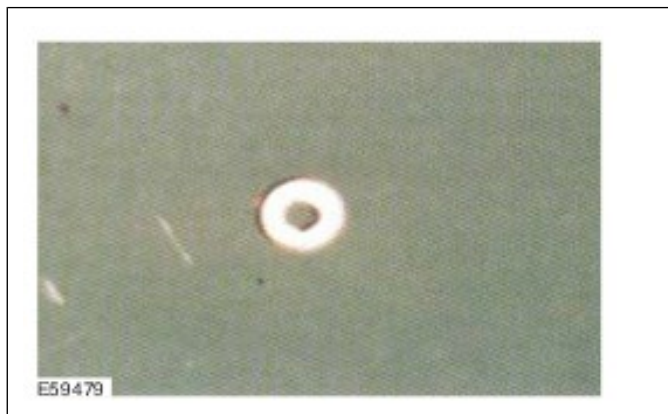
- Swellings can be removed by warming.

**Paint damage from aphid secretions**

Small, round, matt marks about 1 mm diameter and etching with small islands down to the filler. Fresh aphid excrement looks like small drops of honey.

Cause/damage pattern:

- Aphids produce a mixture of starch, leaf acid and sugar from sap in leaves. Under the effects of warming and moisture this can turn into alcohol.
- The round shape of the damage and the island of intact paint are typical.



Repair of damage:

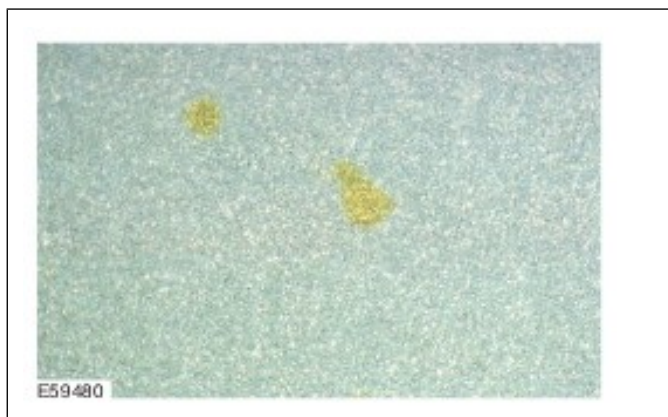
- Remove the excrement as soon as possible.
- Small single matt locations without etching can be repaired using a polishing repair.

**Paint damage caused by tar spots**

Yellow or dark marks.

Cause/damage pattern:

- Firmly stuck spots of tar which lead to discoloration of the surface. In some cases penetration through the clear lacquer into the top coat.



Repair of damage:

- Clean the paint surface with tar remover and polish.

**Paint damage caused by cement, plaster and slaked lime**

Damage appears as whitish matt marks on the top coat.

Cause/damage pattern:

- Corrosive alkaline compounds interacting with moisture.

## DESCRIPTION AND OPERATION



Repair of damage:

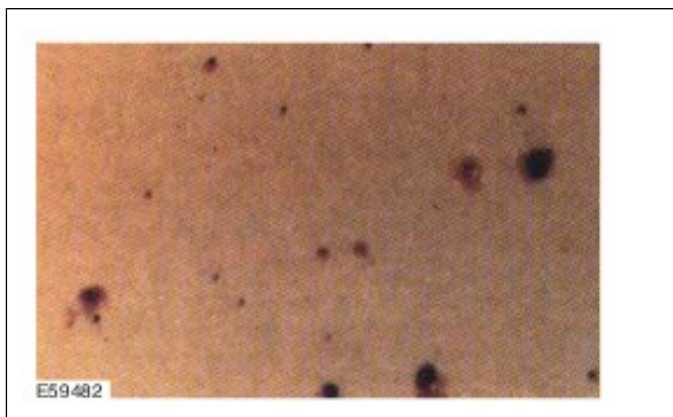
- Wash immediately if the contamination is fresh.
- If the contamination has dried on, dissolve and neutralise it with vinegar, then thoroughly wash off with water and rinse.
- Rectify mild damage using a polishing repair.

**Rust film/deposits from industrial fallout**

Small round marks, about 1 mm in size, in all shades from black, grey, blue to reddish, on the horizontal surfaces of the vehicle.

Cause/damage pattern:

- Deposits from oil fired systems and industrial plant, especially at high humidities and inversion weather conditions, cause damage to the paint top coat.
- As the activity time increases so called rust halos form. They spread as long as the deposits corrode.
- Industrial fallout containing iron will no longer be removable after a few days!



Repair of damage:

- Remove the dust using an industrial fallout remover and thoroughly wash.
- Polish the paint surface.

**NOTE:** Never try to remove the particles of industrial fallout by polishing or rubbing!

- Use cleaning dough.

**Damage caused by battery acid.**

Splashes of battery acid caused by carelessly topping up the battery.

**▲ WARNING: Batteries contain sulphuric acid. When working near the battery, or where there is battery acid on the vehicle body, protect the skin and eyes from contact with the acid. If battery acid contacts the skin or enters the eyes, flush the affected area immediately with water (flush for at least 15 minutes) and call a doctor without delay. If acid is swallowed, call a doctor immediately. Failure to follow these instructions may result in personal injury.**

**NOTE:** High temperatures accelerate the attack on the top coat. At 50°C the top coat layer breaks down after about 15 minutes!

Cause/damage pattern:

- Etching of the paint layer to decomposition of the paint finish.



Repair of damage:

- Flush the acid splashes with plenty of water and neutralize with car washing liquid.
- If the contact time of the acid was short, perform a polishing repair.

**Paint damage caused by brake fluid.**

Careless handling of brake fluid. The glycols contained in the fluid cause swellings.



**DESCRIPTION AND OPERATION**

Cause/damage pattern:

- The temperature and contact time are critical. Splashes lead to loss of shine and lightening of color.



Repair of damage:

- Flush immediately with plenty of water.
- The swellings can often be made to recede completely by treatment with the radiant heater or in the paint drying oven at max. 60°C for about 1 hour.

**Mechanical damage****Stone impact damage or mechanical damage**

Mechanical damage caused by impact of stones or other hard objects and extending down to the metal panel lead very quickly to corrosion and rusting under the paint on the adjoining surface.

Cause/damage pattern:

- Paint damage caused from the outside, down to filler, primer or metal panel.



Repair of damage:

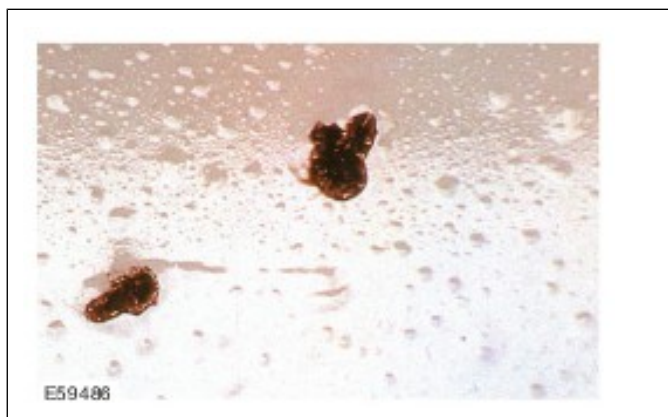
- Sand or blast out.
- Use anti-corrosion primer.
- Apply top coat.

**Damage due to corrosion****Blistering/rusting below**

Air or water filled blister-shaped raised areas in the paint film.

Cause/damage pattern:

- Overpainting corroded steel panel.
- Condensation in the spray air.
- Sanding water not dried out or salt crystal residues.
- Road chippings and road winter grit containing salt.



Repair of damage:

- Sand the affected area of damage or the body component and re-create the paint finish.
- More severe and larger areas of rusting below must be repaired using the corresponding repair painting, Repair Level III or IV.

**Damage caused by faults in treatment**

- Craters
- Paint boils
- Adhesion defects
- Adhesion defects - clear lacquer
- Sanding scores
- Formation of stripes
- Peeling/blistering on plastic parts
- Blistering on polyester material
- Peroxide marks in metallic paints

**DESCRIPTION AND OPERATION**

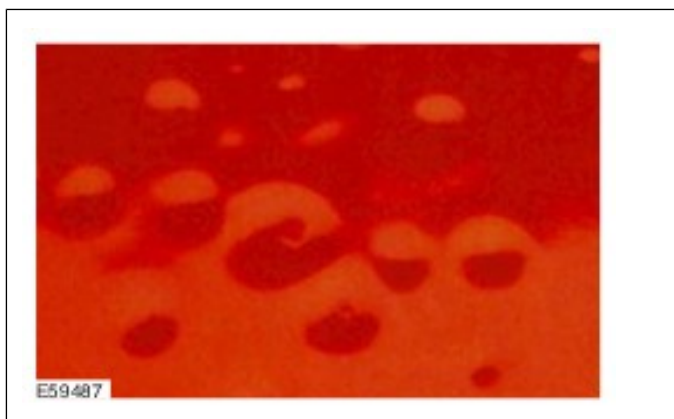
- Crack formation
- Shrinking back/zone edge marks
- Blistering
- Etching
- Paint wrinkles/puckering
- Cloud formation
- Spots/metallics
- Metamerism/color deviations
- Washing out
- Loss of gloss
- Covering ability/areas of thin paint
- Flow problems/orange peel
- Dirt embedded in metallic base paint
- Dirt embedded in top coat
- Water marks
- Paint runs
- Swirl marks

**Craters**

Crater-like single or extensively occurring depressions with raised edges, in top coat or the intermediate layers.

Cause/damage pattern:

- Substrate not adequately cleaned with silicone remover.
- Spray air contaminated by oil residues and water accumulations.
- Filter ceiling not adequate for requirements.
- Use of polishes, cleaning agents or sprays (e.g. interior sprays) containing silicone.
- Oil, wax, grease, silicone containing residues.
- Working clothes contaminated by materials containing silicone.



Repair of damage:

- Sand paint surface, clean with silicone remover and apply one thin spray pass. Let it begin to dry well, then apply several thin and dry sprayed passes.

**Paint boils**

Small, hard, closed or burst blisters in the paint top coat. They appear locally in groups or spread individually across the whole surface. Sanding opens up a larger cavity, under which the primer can often be seen.

Cause/damage pattern:

- Paint applied in layers which were too thick.
- Specified flash-off and drying times between coats were not adhered to.
- Specified working viscosity and spray pressure were not adhered to.
- Use of unsuitable hardener and thinner materials. (Solvent combinations in paint system not optimally matched).
- Poor booth conditions.



Repair of damage:

- Single boil blisters can be removed using polishing.
- After thorough drying, sand the top coat at the affected areas, clean with silicone remover and re-paint. Fill any fine pores still present with 2-component acrylic filler.
- On larger areas of damaged topcoat, sand completely away and apply new paint finish.

**Adhesion defects**

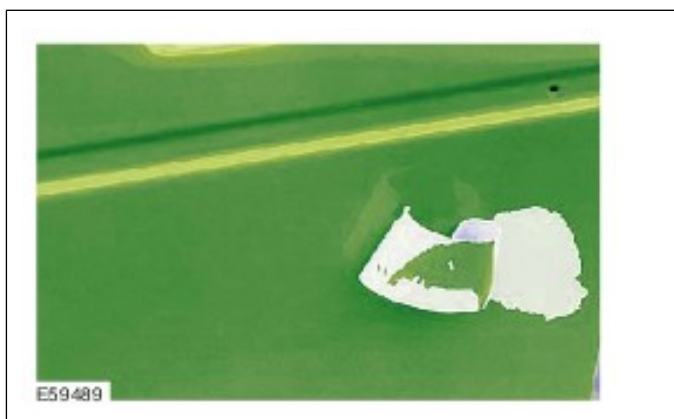
Whole coating detached from substrate or individual layers one from another. Sometimes

**DESCRIPTION AND OPERATION**

adhesion defects can only be noticed after an external influence such as stone impact.

Cause/damage pattern:

- Substrate not adequately prepared (rust, grease, moisture, sanding, cleaning).
- Unsuitable material used.
- Drying times, flash-off times too short.
- Base paint not sprayed wet-in-wet, instead the intermediate drying times were too long.
- Failure to intermediate sand.
- Condensation formed because of temperature fluctuations.
- Unprofessional preparation (especially on plastics).
- Overheated CDP/intermediate filler.



Repair of damage:

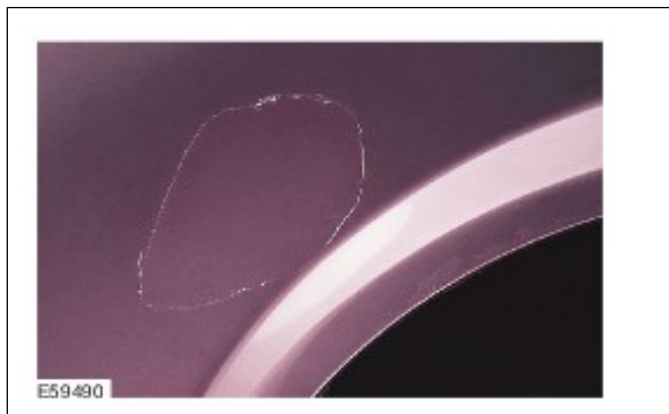
- Sand out the damage and recreate the paint finish. Create the paint finish strictly in accordance with the general technical information.

**Adhesion defects in clear lacquer.**

Clear lacquer detached from base paint.

Cause/damage pattern:

- Base paint layer too thick.
- Intermediate and final flash-off times of base paint too long.
- Incorrect mixture ratio clear lacquer/hardner.



Repair of damage:

- Refinish sanding and recreate the paint finish.

**Sanding scores**

Single or wide area clusters of scoring or sanding marks, often with raised edges. Noticeable on metallic paints as light-dark stripes.

Cause/damage pattern:

- Stopper sanded too coarsely.
- Filler sanded too coarsely.
- Filler not thoroughly dried before sanding.
- Old paint sanded too coarsely.
- Soft elastic substrates, e.g. TPA base, treated with thinners which was too aggressive and therefore etched.
- Top coat applied too thinly.



Repair of damage:

- If the damage pattern is minimal, after the top coat has dried fine sand the paint surface and refurbish by polishing.
- If the damage is great or on metallic paints, sand the paint surface or substrates and if necessary remove them, then cover the bare metal and re-paint.

**DESCRIPTION AND OPERATION****Formation of stripes**

Differing, stripe shaped color/effect formations in dark/light areas of a metallic paint finish.

Cause/damage pattern:

- Spray gun (nozzle) not perfect.
- Incorrect spray pressure.
- Thinners not suitable.
- Incorrect spray viscosity.
- Flash-off time too short.
- Unsuitable working temperature.



Repair of damage:

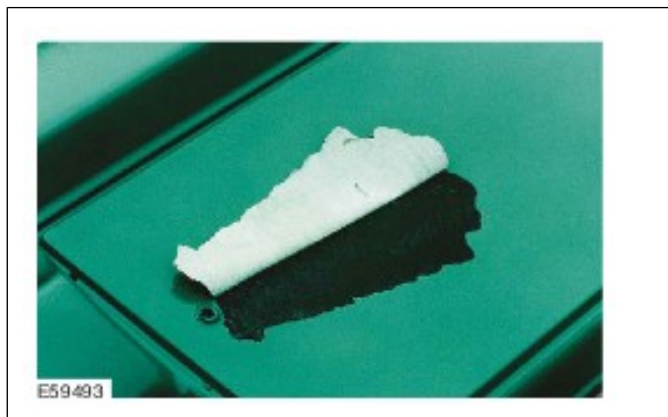
- Apply base paint evenly.
- Repair spray gun.
- After clear lacquer has thoroughly dried, sand surface and paint again.

**Peeling/blistering on plastic parts**

Paint adhesion insufficient between top coat and filler and/or primer layer. It often happens that the whole of the paint finish detaches from the plastic.

Cause/damage pattern:

- Plastic item not cleaned sufficiently, not or inadequately tempered.
- Unsuitable cleaning agent used.
- Unsuitable materials used.
- Moisture.
- Paint finish underbaked or overbaked.
- Poor or lack of intermediate sanding.



Repair of damage:

- Sand away faulty paint coats and re-apply paint finish.
- In extreme cases use a new part.

**Blistering on polyester material**

Color shade differences or marks in paintwork subsequently applied to previously unpainted plastic material.

Cause/damage pattern:

- Plastic material is not suitable for painting.
- Incorrect bonding agent.
- Paint used not solvent resistant.

Repair of damage:

- Repaint using suitable materials.
- Install unpainted new part (after consulting customer).

**Peroxide marks in metallic paints**

After longer period of drying, abnormal marks where the color shade varies.

Cause/damage pattern:

- Too much hardener added to polyester stopper (over 3% can cause this damage pattern).
- Polyester stopper not well enough mixed.



## DESCRIPTION AND OPERATION



Repair of damage:

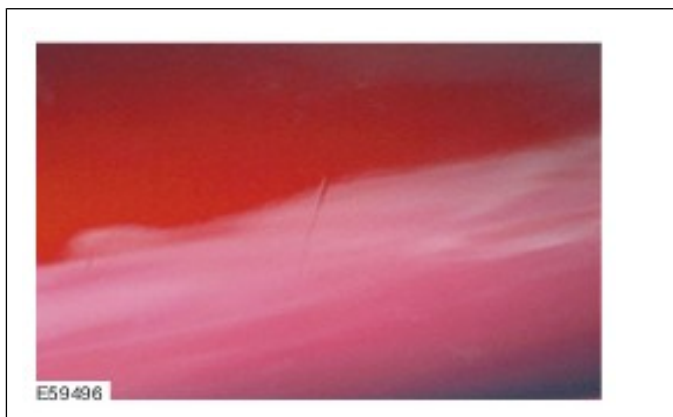
- Sand, fill with polyester or epoxide filler and re-paint.

### Crack formation

Cracks of different lengths and depths running in all directions.

Cause/damage pattern:

- Layers too thick.
- Painted several times.
- Temperature fluctuations.
- Mechanical effects e.g. distortions.
- Substrate not thoroughly hardened.
- Old paint not completely dried out.
- No or insufficient hardener added.
- 2-component materials used on nitro or TPA.



Repair of damage:

- Sand away layers until sound substrate is reached and create new paint finish (prime, fill, apply topcoat).

### Shrinking back/zone edge marks

Lifting or dropping in of edge zones (edges which accentuate themselves in the top coat), flow problems and loss of shine in top coat.

Cause/damage pattern:

- Old paintwork not rubbed down to a seamless transition.
- Stopper and filler on a viscoplastic base primer.
- Filler sanded and overpainted when not thoroughly hard.
- Previous materials overworked too early, substrate not sufficiently hardened.
- Primer applied in layers which were too thick, and not dried for long enough.
- Sanding paper too coarse.
- Top coat thinned too much.



Repair of damage:

- After hardening off the top coat, fine sand the surface and polish up, apply filler if necessary and paint once more.

### Blistering

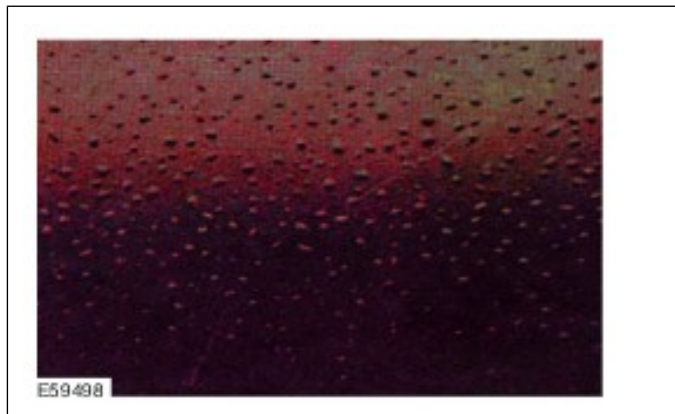
Small, spot-like, air-filled or water-filled blister shaped high-spots in the paint construction. Their dimensions can range from pin-head to pin-point size in a closed paint film. Arrangement and accumulation very variable. In the advanced stages, circular flaking of the paint from the substrate. These are neither boils nor corrosion.

Cause/damage pattern:

- Moisture absorption by substrate.
- Insufficient drying of the substrate after wet sanding (especially on polyester material).
- Humidity too high before painting; condensation formation because of temperature fluctuations.
- Pores/sink holes in substrate not sanded out.

**DESCRIPTION AND OPERATION**

- Polyester material not covered.
- Sweat from hands.
- Salts and minerals in sanding water.
- Spray air contaminated.



Repair of damage:

- Sand away damage, matt sand remainder of surface, clean with silicone remover, fill and re-paint.

**Etching**

The base paint is etched by the clear lacquer. This causes the aluminum pigments to change their alignments. The color of the etched base paint seems more grey than that of normal base paint. Result is that the surface structure of the clear lacquer becomes increasingly more matt.

Cause/damage pattern:

- Base painted too wet.
- No intermediate flash-off time.
- Layers too thick.



Repair of damage:

- Sand and re-paint.

**Paint wrinkles/puckering**

Lifting/puckering of the paint surface.

Cause/damage pattern:

- First paint not hardened through or can be etched.
- Areas of clear lacquer which were sanded through to base paint have not been not isolated with filler, or with unsuitable filler.
- Unsuitable substrate (e.g. spray can painting with TPA or nitro).
- Use of unsuitable primer, paint and thinner materials.
- Paint systems not matched to each other.
- In wet-in-wet process, specified flash-off times not adhered to.
- Synthetic resin top coat (alkyd resin) worked over too soon.



Repair of damage:

- After thorough drying, completely remove the top coat together with the attacked substrate at the affected areas and re-create a new paint finish.
- Before applying top coat, rub down the complete surface.

**Cloud formation**

Differing, blotchy color/effect formations in dark/light areas of a metallic paint finish.

Cause/damage pattern:

- Spray gun, spray nozzle, spray pressure not perfect.
- Varying spray viscosity, spraying method, flash-off times, spray booth temperature.
- Thinners not suitable.



**DESCRIPTION AND OPERATION**

Repair of damage:

- Droplet method before clear lacquer application.
- After clear lacquer has thoroughly dried, sand surface and re-paint.

**Spots**

Points rising up from the paint film.

Cause/damage pattern:

- Metallic base paint sprayed too dry, so that the metal particles could not incorporate into the paint. The clear lacquer could not cover these vertical standing particles because the spray air was too hot or the booth temperature was too high.



Repair of damage:

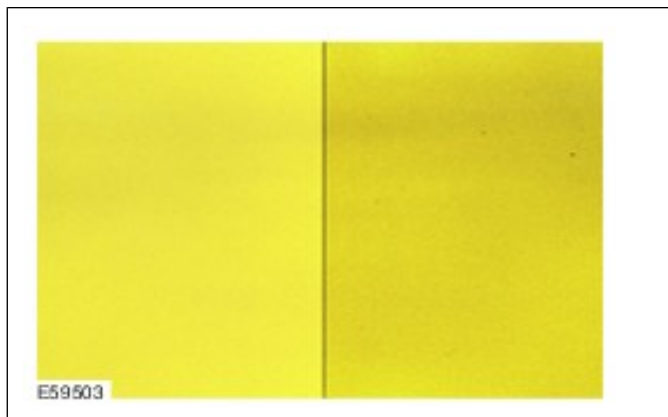
- After the paint surface has dried, lightly sand it with grade P800 sanding paper, clean with silicone remover and re-apply clear lacquer.

**Metamerism/color deviations**

Noticeable when identical color shades undergo a change of hue as the light source changes (daylight/artificial light). Different pigment composition between original and repair paint.

Cause/damage pattern:

- Use of paints with pigmentation which was not compatible with the standard, e.g. a green can be formulated from yellow and blue, or directly from green.
- Use of an unsuitable mixed or ready made paint to re-tone.



Repair of damage:

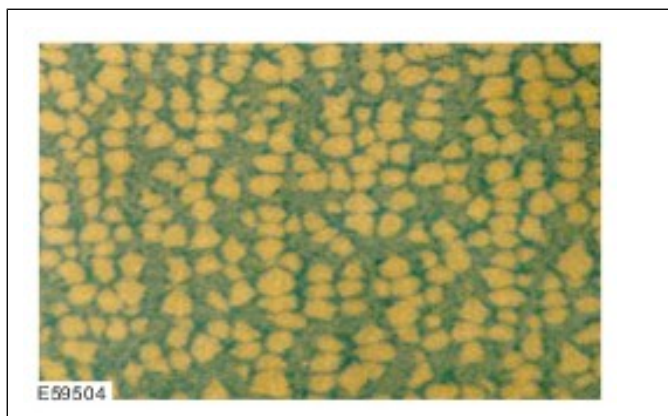
- Repaint using the correct paint.

**Washing out**

On paint which has been newly applied but not yet dried, the interaction of surface tension and very different specific gravities of the different pigments can lead to swirl-like turbulence which results in separation of the pigments.

Cause/damage pattern:

- Layer too thick, paint not stirred enough.



Repair of damage:

- Sand and re-paint.

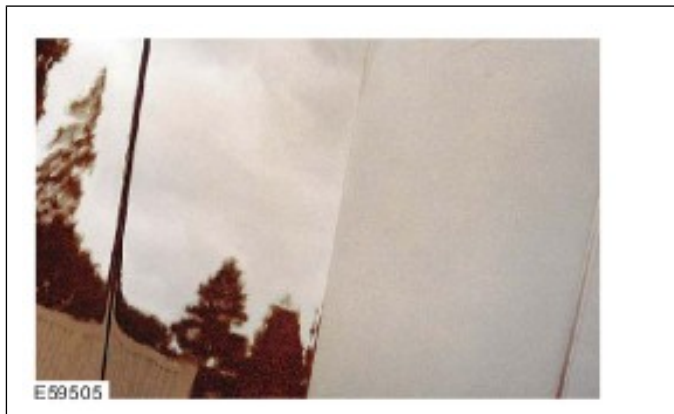
**Loss of gloss**

Milky, dreary tarnishing of the paint with more or less even loss of gloss.

**DESCRIPTION AND OPERATION**

Cause/damage pattern:

- Cold with low air humidity.
- Heat with high air humidity.
- Substrate can be etched.
- Hardener fault or wrong hardener used.
- Paint thinned too much.
- Proportion of pigment too high because of poor stirring.
- Not optimum drying.



Repair of damage:

- After drying, remove the matt effect by polishing. If unsuccessful, rub down complete area and paint again.

**Covering ability/areas of thin paint**

Different color shades in the surface. The minimum layer thickness is not achieved here. The effects range from local minor shade variations through mottled spray zones to completely missing top coat.

Cause/damage pattern:

- No correct, uniform substrate (effect paint).
- On three-layer systems, wrong filler.
- Insufficient top coat application.



Repair of damage:

- Sand surface and recreate the paint finish.

**Flow problems/orange peel**

Surface structure bumpy, grained. The surface is similar to the peel of an orange.

Cause/damage pattern:

- Paint viscosity too high.
- Use of fast evaporating, highly volatile thinners.
- Booth temperature too high.
- Spray gun distance too great, too little material applied.
- Nozzle too large.
- Incorrect spray pressure.



Repair of damage:

- Small surfaces: fine sand and polish.
- Sand out the surface and recreate the paint finish.

**Dirt embedded in metallic base paint.**

Inclusions of contamination in metallic base paint, of different sizes and shapes (grains or lint).

Cause/damage pattern:

- Dust was not properly removed from the surface to be painted.
- Paint material not sieved.
- Function of the painting facilities not optimum.
- Filter contaminated.
- Wearing unsuitable clothing.

Repair of damage:

- Sand and repaint.

**DESCRIPTION AND OPERATION****Dirt embedded in top coat**

Inclusions of contamination in top coat or under paint layers, of different sizes and shapes (grains or lint). Optical adverse effect.

Cause/damage pattern:

- Dust was not properly removed from the surface to be painted.
- Paint material not sieved.
- Function of the painting facilities not optimum.
- Filter contaminated.
- Wearing unsuitable clothing.



Repair of damage:

- Single inclusions: after thorough hardening, sand out using 1200 - 1500 grade paper and repolish using a suitable silicone-free sanding or painting paste.
- Large area contamination: sand and repaint.

**Water marks**

Ring shaped marks appearing on the paint surface.

Cause/damage pattern:

- Evaporation of water droplets on freshly painted and not yet fully hardened paint finishes (mostly only found on horizontal surfaces).
- Layer too thick.
- Drying time too short.
- Hardening faults or hardener no longer useable.
- Use of unsuitable thinners.



Repair of damage:

- Rub down only slight marks with sanding paper grade P1000 - P1200 and then polish.
- For heavy marking, sand the surface matt, clean with silicone remover and repaint.

**Paint runs**

Wave-like paint run tracks in top coat or in an intermediate layer on vertical surfaces. Mostly in the area of swage lines, seams or openings (there they are paint runs, otherwise curtains).

Cause/damage pattern:

- Uneven paint application.
- The specified viscosity was not complied with.
- Use of unsuitable thinner materials.
- Air, material or room temperature too low.
- Layers too thick.
- Spray gun (nozzle) not perfect.



Repair of damage:

- After thorough drying, sand unevenness flat, if necessary leave to dry afterwards.
- Small areas of damage can be equalised using the paint plane, then sand, polish or repaint.

**DESCRIPTION AND OPERATION****Swirl marks**

Three dimensional appearance in the paint surface in the form of smears or blotches. This effect is intensified in direct sunlight.

Cause/damage pattern:

- Polishing using polishing machine on paint which has not yet hardened throughout.
- Polishing intervals too long or none at all.
- Pressure too high while polishing.
- Incorrect polishing material or polishing tool.



Repair of damage:

- Allow the paint to harden completely and then polish.
- If the damage is irreversible, rub down and apply new clear lacquer.



## DESCRIPTION AND OPERATION

## Tools and Equipment for Paint Repairs

## General work equipment

In the repair paint shop there is a range of painting tools which make the work of the painter easier and improve the quality of the repair paintwork.

Among these are small tools which are used for the following work:

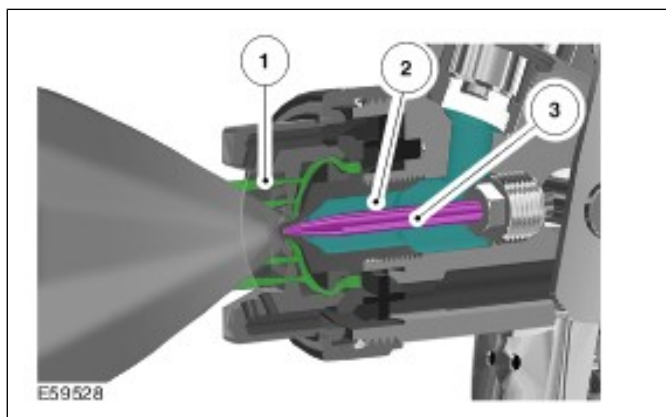
- **Measuring beakers** to measure and mix various paint materials.
- **Measuring rods** with which the required combination amounts of paint and primer filler are gauged and mixed.
- **Viscosity measuring beaker** with a calibrated opening of 4mm, used to set the correct paint viscosity.
- **Paint filter/paint sieve** for filtering foreign bodies out of mixed paint or primer. Care must be taken that the correct filter is used for each paint.
- **Color sample plates** onto which the mixed paint is applied, and the shade is then compared to that of the vehicle. Other aids which should help the painter to find the correct shade are **color sample cards** and **color panels**, which are offered by many paint manufacturers.
- **Dust bonding cloths** which are impregnated with a tacky resin and which pick up dust particles particularly well. A surface to be painted must be cleaned with a dust binding cloth immediately before paint is applied.
- **Compressed air guns** are used to remove sanding residues and to dry sanded surfaces.

## Filler and spray guns

**NOTE:** Regular maintenance, cleaning after use and careful handling of all individual parts of the spray gun are essential for a high-quality paint finish.

The spray gun is the most important implement in the paint shop. Application of paint using the spray gun can produce a layer with absolutely constant thickness and a smooth paint surface.

## Principle of operation



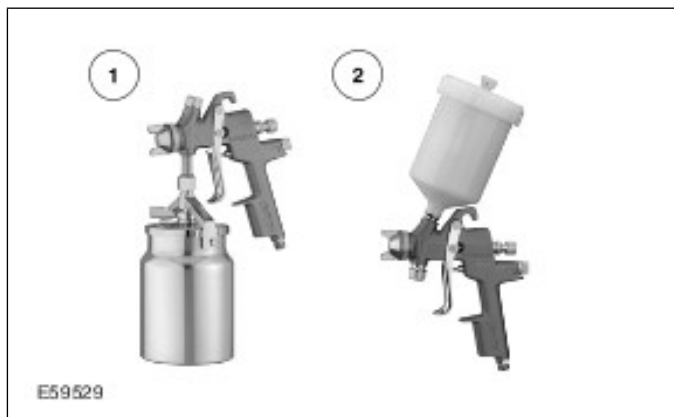
Item	Description
1	Air supply
2	Paint supply
3	Nozzle needle

Because of the construction design and with the aid of compressed air, a spray-ready paint mixture is dragged out of the container to the nozzle by the venturi effect, and is applied to the surface being worked.

When the trigger of the spray gun is pressed to the first pressure point, only the compressed air passage opens. If the trigger is pressed further, the nozzle needle displaces and the air stream drags paint with it at high speed. This produces a spray mist consisting of micro-droplets of paint.

**DESCRIPTION AND OPERATION**

**Types of spray gun**



Item	Description
1	Suction-beaker spray gun
2	Flow-beaker spray gun

In the flow-beaker spray gun, the paint container is mounted above the spray gun. On the suction-beaker spray gun, it is below.

Furthermore, spray guns are categorized by their air pressure requirement into high and low pressure guns.

High pressure guns have the disadvantage that they exhibit high consumption of energy and materials. The spray pressure they require is between 1 - 6 bar.

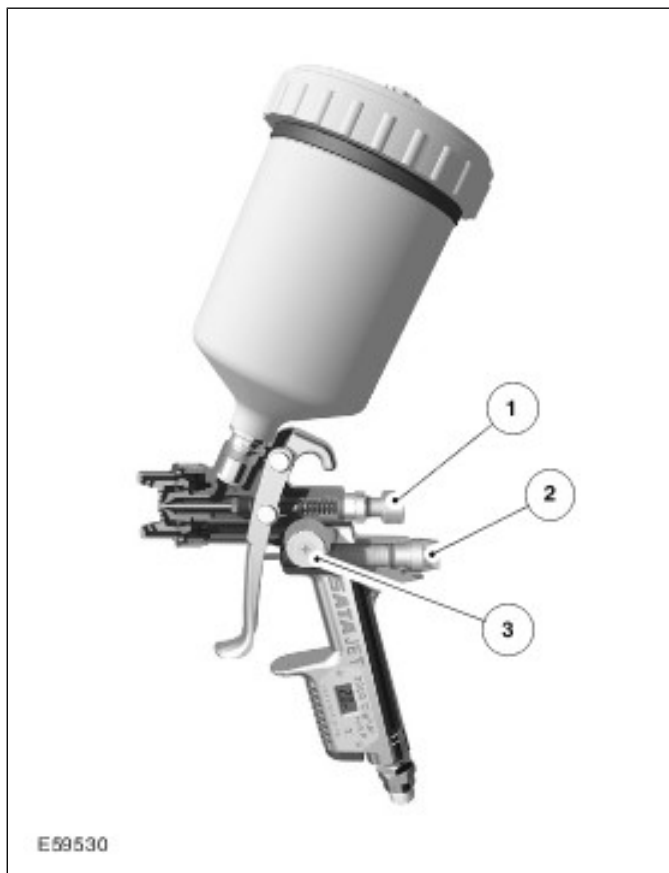
Because of the high air pressure and the large amount of air needed, the result is a powerful paint mist formation (paint transfer rate approx. 35%).

Current practice is mainly to work with reduced mist spray systems (RP and HVLP systems).

Reduced pressure (RP) guns are optimized high pressure guns which have an input pressure at the gun of approx. 2.5 bar and an atomization pressure at the air cap of 1 - 2 bar. In practice this spray technology is preferred for spraying clear lacquer because of the finer atomization.

Low pressure guns have the advantage that they exhibit minimal paint mist formation and because of this the paint transfer rate rises to approx. 65%. The spray pressure required in this case is between 1 - 5 bar. Nozzle sizes from 1 - 2.2 mm can be used.

**HVLP spray guns**



Item	Description
1	Quantity control
2	Working pressure control
3	Spray pattern control

The high volume low pressure (HVLP) spray gun is a high performance spray gun which forms a soft, fine and homogenous spray pattern. The atomization pressure at the air cap is 0.7 bar when the input pressure at the gun is 2.0 bar.

The low atomization pressure of 0.7 bar together with greatly reduced spray mist provide high material ejection. The low nozzle internal pressure minimizes rebound of the paint droplets from the object and thus the proportion of overspray.

This spray technology has a very high application efficiency. By matching the size of the nozzle, the HVLP spray gun can be used for all repair painting materials.

HVLP spray guns are often used in practice for the application of water based paints.

Mini spray guns are often used for small, localized touching-up work. Use of HVLP spray technology and nozzle sizes of 0.3 - 1.2 mm permits very fine



**DESCRIPTION AND OPERATION**

work, so that the area of the repair can be kept as small as possible.

In order to ensure that a spray gun operates efficiently for a long time, careful cleaning is absolutely vital after use.

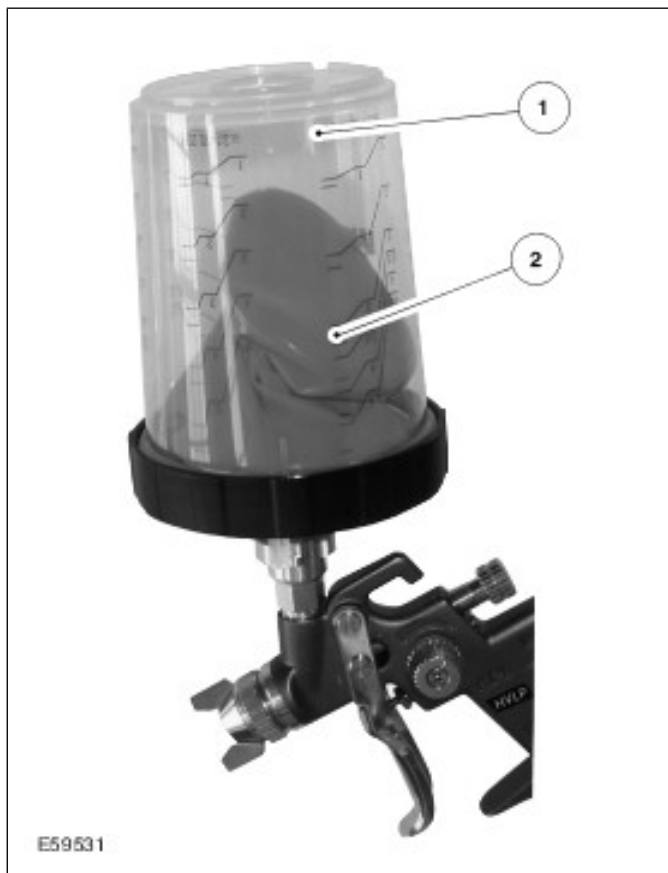
**NOTE:** During cleaning you must distinguish between water based and solvent based materials.

Cleaning by hand:

- Empty the paint beaker immediately after use.
- Flush the gun with cleaner.
- Clean it inside and outside with a brush.
- Dismantle the gun to clean it thoroughly.
- Clean the air cap using a suitable brush.
- Use nozzle cleaning needles to clean bores and nozzles.

A spray gun washing machine is recommended if the painting work is highly intensive.

New types of paint processing systems are replacing the conventional mixing beaker, filter and spray gun flow beaker. This reduces the amount of solvent required for cleaning and the amount of routine waste which remains.

**Paint preparation system (PPS)**

Item	Description
1	Beaker
2	Color bag

With this system, which is suitable for both suction and flow beaker spray guns, only one beaker is required for mixing and painting.

A bag is inserted in the beaker, in which paint can be mixed, processed and stored after use or completely disposed of.

The small quantity of paint remaining in the gun is removed using a minimum quantity of solvent from the pipette bottle.

The amount of cleaner used is reduced because only the spray gun needs to be cleaned.

**Hand and machine sanding tools**

Sanding is used to prepare a surface for application of a paint layer, enabling it to adhere well. Sanding materials have a great influence on the quality of a repair paint finish. The correct sanding medium must therefore be chosen for every material.

**DESCRIPTION AND OPERATION**

During sanding, material is mechanically removed from a surface.

In the paint shop, carborundum or silicon carbide abrasive on a substrate of paper or cloth are the most common sanding materials used.

Carborundum is a very hard mineral consisting mostly of aluminum oxide. During use carborundum becomes blunt and wears away.

Silicon carbide has a very high degree of hardness, but is more brittle than carborundum. When silicon carbide is used, the mineral grains break. New long and pointed profiles are formed.

Use of the correct sanding paper depends on the application, the substrates and the tools used. The following table can be used as a guideline, but the recommendations of the supplier of the auxiliary materials and additive materials must be followed.

Application	Working area	Grade	Sanding system
Body work, corrosion damage	Equalizing paint system transition	to P150	Orbital sander, dry
			Hand sanding, dry
Stopper	Rough sand	P80 - P150	Orbital sander, dry
	Fine sand	P240 - P320	Orbital sander, dry
Spray stopper	Rough sand	P120 - P180	Orbital sander, dry
			Orbital sander, dry
			Hand sanding, dry
Filler sanding work	Filler fine sand	P400 - P500	Orbital sander, dry
			Hand sand, wet
Top coat	Old paint	P400 - P500	Orbital sand, dry
			Hand sand, wet
Paint damage	Sanding out faults	P1000 - P2000	Hand sand, wet
			Hand sand, wet

Soft Pads are recommended for manual refinishing of contours, curves and difficult to reach areas. On a Soft Pad the abrasive is found on a coarse structured fleece. Because of this, it is very flexible, does not kink and does not slip in the hand. This enables a fine and even finish to be achieved.



Item	Description
1	Extraction bores
2	Connection for extraction equipment

Notes on working with sanding tools:

**DESCRIPTION AND OPERATION**

- Tools with a rigid backing pad do not adjust to fit the surface. They are used for flat surfaces.
- Tools with a flexible backing pad are used for fine sanding of a surface because they adjust to the shape of the surface.
- Build up an even working pressure over the sanding surface.
- Keep the sanding paper tight on the tool (use self-gripping systems).
- Align the extraction holes in the sanding paper with the holes in the tool.
- Guide the tool flat over the surface to be worked. Do not tilt it.

Hand sanding can be carried out dry but also wet. Wet and dry paper with particle size P 80 to P 1200 is used for this in the paint field.

**Ways of sanding**

Sanding tools are driven either by electricity or compressed air.



Item	Description
1	Sanding machine
2	Polishing machine
3	Orbital sander

The disadvantage of electrically driven machines is that their own weight is high compared with pneumatic systems. They also become warm during work. They do not however need any special operating equipment for their energy supply.

Sanding machines are categorized by their type of sanding movement.

**Rotational sanders**

On these machines the sanding paper turns.

- Advantage:
  - Ideal for heavy sanding work.
  - Fast and aggressive sanding possible.
- Disadvantage:
  - Large amount of heat developed.
  - Difficulty sanding flat surfaces.
- Application:
  - Removal of old paint layers.
  - Preparation of panel for stopper.
  - Removal of rust.

**Oscillating sander**

On these machines the sanding paper oscillates. The backing pad is rectangular.

- Advantage:
  - Large sanding surface.
  - Ideal for large and flat surfaces.
- Disadvantage:
  - Hardly useable on rounded surfaces.
  - Flexible backing pad not possible.
  - Vibrations because of the poor support of the backing pad.
- Application:
  - Sanding of polyester stopper.
  - Sanding processes on flat surfaces.

**Orbital sander**

On these machines the sanding paper turns and oscillates.

- Advantage:
  - Easy to handle and good sanding power.
  - Minimal heat development.
- Disadvantage:
  - Not suitable for sanding stopper on flat surfaces.
  - Smooth guidance important, otherwise sanding marks will occur.
- Application:
  - Sanding of paint layers.
  - Well suited for final preparation of a primer.

**NOTE:** Comply with the manufacturer's recommendations when setting the orbital sander.

**DESCRIPTION AND OPERATION**

On the orbital sander, stroke settings of approx. 3 mm for fine sanding work and approx. 5 - 7 mm for coarse sanding work have been established.

**Polishing and finishing tools**

The term polishing in the context of paint repairs means the elimination of paint flaws and high shine polishing of neighboring parts.

During polishing the fine sanded surface is returned to a high shine using a special abrasive polish.

Before the actual polishing, all flaws in the paint surface must be removed and the following working procedures must be adhered to:

- Thoroughly clean the vehicle.
- Remove spray mist from all surfaces.
- Sand out and polish particle inclusions.
- Sand down paint runs and polish them out.
- Examine the exactness of the color match in daylight.
- Remove masking edges.
- Remove sanding water, sanding dust and polish residues.

After the polishing process the results must be tested using a special test spray.

**Infrared drying technology**

The drying process in a painting/drying cabin occurs through heat conductance (convection). When an infrared dryer is used, the drying process is through heat radiation.



The infrared rays penetrate the air and the paint layer without warming them. Because the infrared rays are reflected from the steel panel, the paint coat is warmed from the inside outwards.

Advantages of infrared drying:

- The drying process occurs from the inside to the outside.
- The drying time is shorter than for warm air systems.
- Because the infrared dryer consists of several cassettes which can be switched on independently, the drying area can be optimally controlled.

Independent of the manufacturer's instructions, pay attention to the following:

- Flash-off time of the paint before switching on the infrared dryer.
- Distance between the infrared dryer and the surface.
- Duration of the irradiation.

The most common use of the infrared dryer is to dry stopper and primers. The wait time between the job steps is shortened without having to use the painting/drying cabin.

The painting/drying cabin can then be used exclusively for application and drying of topcoat.

There are two types of infrared dryer:

- Infrared dryer with short wavelength radiation.
- Infrared dryer with medium wavelength radiation.

As an indication, the following drying times are listed for some materials (at 80 cm distance):

**NOTE:** Observe the material manufacturer's and supplier's specifications.

- Polyester stopper 2 minutes.
- Spray stopper 2 to 7 minutes.
- Water based primer-filler 7 to 9 minutes.
- Primer 3 to 8 minutes.
- Top coat 7 to 10 minutes.

**Air dryers**

The air dryer is suitable in places where drying needs to be done, but without great outlay (painting/drying cabin or infrared dryer).

## DESCRIPTION AND OPERATION



**NOTE:** Air from the compressor is often too cold for effective drying.

Air dryers use the venturi effect to blow the warm ambient air over the paint surface in a gentle air flow.

### Paint mixing system

Because of the many different color variants, it is now seldom possible to store all color shades as ready-made mixtures.

For this reason, vehicle manufacturers make the mixture proportions of their paints available as color codes. The required color shade can be obtained from the paint mixing system using this color code.

All the color components are combined according to their proportions by weight using a precise computer scales to produce a finished color shade.

### Painting cabin

The air requirement in a painting cabin is large. The outside air which is drawn in must be passed through filtering and warming equipment. This particularly applies during colder times of the year and especially for combined types of building where the painting cabin is also used as a drying cabin.

It is primarily used to keep the air free of dust. At the same time, explosive solvent-air mixture concentrations are prevented

**NOTE:** Vacuum will lead to contamination of the newly applied paint. The outside air flows through door gaps, wall joints and other openings and as it does so, brings dust deposits with it.

The air supply quantity depends on the size of the painting space and the quantity of extracted air. Enough air must be supplied to cause positive pressure in the painting space. An air extraction : air supply ratio of about 1 : 1.05 is sufficient.

The filters should have a dust-removal grade of not less than 99.8% and must always be kept clean.

It is especially important that the air supply does not cause strong air currents in the painting cabin. If not, the following problems could occur:

- Paint contamination cause by paint mist, which persists in air eddies and gradually falls on the fresh paintwork.
- Flow problems in the paint because of the high speed of the air, causing the paint to thicken very quickly on the surface.
- Loss of gloss and wrinkle formation because the surface dries too fast.
- Painter disturbance while working.

In modern paint cabins the air supply is provided from the complete surface of the ceiling. The air speed should be 0.3 m/sec (measured in the unrestricted cross-section of the spray cabin). At the same time, the air in the cabin should change about 350 times per hour.

Air extraction is best achieved through extraction channels in the floor of the painting cabin.

**NOTE:** Refer to the manufacturer's specifications for the operating instructions, safety instructions and notes on the maintenance of a paint cabin.

Smooth walls in the paint cabin should prevent dust deposits. Regular cleaning is necessary however.

Special easily washed adhesive-bonding paint can be applied to the walls to protect the cabin from paint mist.



## DESCRIPTION AND OPERATION

## Refinishing Materials

**The manufacturer's instructions must always be followed when dealing with all materials!**

The information given in the following text is data which is independent of the manufacturer, and it should only be used as an indication.

## Stopper materials

- 1-component nitro-combination stopper
- 2-component polyester stopper
- 2-component plastic stopper

Use suitable primer to protect from corrosion areas which have been sanded bare before applying stopper.

## 1-component nitro-combination stopper

**Nitro-combination stopper has mostly been superseded by 2-component polyester stopper.**

Fast drying fine stopper for the smoothing of irregularities.


The working properties of 1-component nitro-combination stopper can be improved by the addition of nitro thinners.

Drying time increases with thickness of the layer.

Application	1-component nitro-combination stopper
Layer thickness	Max. 80 µm
Drying time	up to 2 hours at 20°C
Sand	P240 - P400

## 2-component polyester general stopper

## CAUTIONS:

 **Do not exceed the quantity of hardener specified by the manufacturer, excess peroxide can cause staining of the paint top coat.**

 **Mix the stopper base and the hardener well to avoid a marble-like effect.**

Check that the manufacturer permits use on the substrate to which it will be applied.

2-component polyester stopper is available in coarse and fine grades. The coarse stopper can

be used for very uneven areas and surfaces and fine stopper or spray stopper should be applied afterwards.

Application	2-component polyester coarse stopper
Use	Rough equalization of unevenness
Hardener quantity	approx. 3 - 5%
Working time	approx. 4 - 6 minutes
Drying	20°C approx. 12 minutes
	Short wavelength infrared approx. 4 minutes
	Medium wavelength infrared approx. 5 - 10 minutes
Sanding tool	Eccentric, sanding disk by hand
Grade	P80 - P150

Application	2-component polyester fine stopper
Use	Equalization of unevenness
Hardener quantity	approx. 3 - 5%
Working time	approx. 4 - 6 minutes
Drying	20°C approx. 12 minutes
	Short wavelength infrared approx. 4 minutes
	Medium wavelength infrared approx. 5 - 10 minutes
Sanding tool	Eccentric, sanding disk by hand
Grade	P80 - P240

Application	2-component polyester glass fiber stopper
Use	Equalization of unevenness; blending in of vehicle extensions; repair of GRP components
Hardener quantity	approx. 3 - 5%



**DESCRIPTION AND OPERATION**

Application	2-component polyester glass fiber stopper
Working time	approx. 4 - 6 minutes
Drying	20°C approx. 12 minutes
	Short wavelength infrared approx. 4 minutes
	Medium wavelength infrared approx. 5 - 10 minutes
Sanding tool	Eccentric, sanding disk by hand
Grade	P80 - P150

2-component polyester fine stopper should always be applied after 2-component polyester glass fiber stopper.

Application	2-component polyester spray stopper
Use	Equalization of unevenness
Hardener quantity	approx. 3 - 5%
Working time	approx. 25 - 30 minutes
Layer thickness	200 µm or 4 - 8 spray passes
Drying	20°C approx. 3 hours
	Short wavelength infrared approx. 10 minutes
	Medium wavelength infrared approx. 15 - 20 minutes
Sanding tool	Eccentric, sanding disk by hand
Grade	P80 - P150; fine sand - P280

Application	2-component plastic stopper for flexible thermoplastic
Use	Equalization of scratches or unevenness
Hardener quantity	approx. 3 - 5%
Working time	approx. 25 - 30 minutes
Drying	20°C approx. 15 - 30 minutes

Application	2-component plastic stopper for flexible thermoplastic
	60°C approx. 15 min
	(Short wavelength infrared approx. 8 minutes)*
	(Medium wavelength infrared approx. 8-10 minutes)*
Sanding tool	Eccentric, sanding disk by hand
Grade	P80 - P150; fine sand - P280

**\*Infrared drying may adversely affect adhesion, therefore check the manufacturer's instructions.**

Plastic stopper has a very great tendency to shrink back, so that the edge of the stopper repair becomes visible.

Plastic stoppers are flexible and universally applicable on all types of plastic (except for pure PE and PP, these are plastics which cannot be painted). The manufacturer's instructions must be very exactly followed in order that no adhesion problems occur. A special plastic etch primer is specified for some materials.

**Primers**

Application	1-component primer
Use	Isolation of bare sanded areas.
Spray gun	HVLP 1.3 mm
Spray pressure	2.0 bar
Drying	20°C approx. 15 - 20 minutes
	60°C approx. 10 min
Coat application	Wet on wet, no intermediate sanding

Application	2-component primer
Use	Corrosion protection and bonding agent (steel sheet, zinc coated steel sheet, aluminum)

**DESCRIPTION AND OPERATION**

Application	2-component primer
Spray gun	HVLP 1.3 mm
Spray pressure	2.0 bar
Drying	20°C approx. 15 - 20 minutes
	60°C approx. 10 min
Coat application	Wet on wet, no intermediate sanding

Application	HS primer filler and HS tinted filler
	(Medium wavelength infrared approx. 10-15 minutes)*
Coat application	Wet on wet, no intermediate sanding

**\*In order to avoid boiling out, drying should be performed slowly.**

**HS primer filler and HS tinted filler**

Note:

- Primer filler is available as 1-component and 2-component water based and solvent based forms.
- 1-component products are only suitable for isolation of sanded through bare areas and new painting.
- Water based products are also used for the skinning of thermoplastics and substrates which are sensitive to solvents.
- Tinted fillers can be individually matched to the top coat color and therefore find uses in effect paints and paints with poor covering power.
- Use dry sand or wet sand filler according to application in order to avoid unnecessary sanding work.
- On critical substrates the use of epoxy resin base filler is recommended in order to avoid adhesion problems.

Application	HS primer filler and HS tinted filler
Use	Equalization of unevenness, edge zones, sanding scores
Spray gun	HVLP 1.6 - 1.9 mm
Spray pressure	2.0 bar
Layer thickness	50 - 70 µm to 150 µm possible
Drying	20°C approx. 2.5 hours
	(60°C approx. 25 min)*
	(Short wavelength infrared approx. 8 minutes)*

**Paint**

The base and the clear lacquer must be matched to one another.

Application	Water based paint
Use	Two layer metallic effect paint and Uni-paint finishes
Spray viscosity	At 20°C 18 - 20 s
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 bar
Layer thickness	15 - 20 µm
Drying	20°C approx. 2.5 hours
	60°C approx. 25 min
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes
Coat application	Wet on wet
Ventilation time	approx. 5 minutes

The base paint must be dried matt before the clear lacquer is applied.

Application	2-component HS clear lacquer
Use	Gloss providing protective coat for base coat substrate
Spray viscosity	At 20°C 18 - 20 s
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 bar
Layer thickness	50 - 70 µm

501-36-38

## Paint - General Information

501-36-38

## DESCRIPTION AND OPERATION

Application	2-component HS clear lacquer
Drying	20°C approx. 10 hours
	60°C approx. 30 min
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Application	2K HS Uni top coat
Use	Color and gloss providing paint layer
Spray viscosity	At 20°C 20 - 22 s
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 bar - 3.0 bar
Layer thickness	50 - 70 µm
Drying	20°C approx. 8 hours
	60°C approx. 30 min
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 -15 minutes

**DESCRIPTION AND OPERATION**

**Additional Materials**

**The manufacturer's instructions must always be followed when dealing with any materials!**

The information given in the following text is data which is independent of the manufacturer, and it should only used as an indication.

**Adhesive sealants**

Adhesive sealants are permanently elastic, long-lived, can be painted and accept filler.

Application: Sealing of visible and normal seams.

Can be over-painted with 2-component paint, primer and fillers after having dried throughout.

Contamination can be removed using cleaner and thinner.

**1-component PUR adhesive sealant**

Note:

- Hardens using oxygen from the air. For that reason, it must only be stripped after it has completely dried through.

**2-component MS polymer adhesive sealant**

2-component MS polymer adhesive sealant is free of isocyanate, solvent and silicones and can be spot-welded.

**MS polymer adhesive sealant**

Can be over painted with water-based paints.

Suitable for spraying and brushing to obtain a composition true to the original.

MS polymer adhesive sealant is free of isocyanate, solvent and silicones and can be spot-welded.

**Underbody protection**

Underbody protection products are immune to abrasion, permanently elastic, adhere well and are suitable for a true to original texture.

**Underbody protection based on solvent**

Application:

- Underbody protection for visible areas.

Properties:

- Can be over-painted, also with 2-component paint.
- Can be colored with a proportion of up to 40% paint.

Note:

- Contamination can be removed using cleaner and thinner.

**Water based underbody protection**

Can be over-painted with water based paint.

Can be colored with water based paint.

Contamination can be removed using water.

Application	Water based underbody protection
Use	<b>Underbody protection</b> for visible areas
Spray viscosity	ready to use
Spray gun	Suction beaker HVLP gun 3 - 4 mm
Spray pressure	4 - 6 bar
Layer thickness	500 - 1000 µm
Drying	approx. 6 hours at 20°C
	approx. 45 - 60 minutes at 60°C
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Application	Water based underbody protection
Use	<b>Isolation primer</b> for peroxide marks, bloomed old paintwork and thermo-plastics.

501-36-40

Paint - General Information

501-36-40

## DESCRIPTION AND OPERATION

Application	Water based underbody protection
Spray viscosity	Thin as necessary with distilled water
Spray gun	HVLP gun 1.9 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	40 - 50 µm
Drying	approx. 2 hours at 20°C
	approx. 30 minutes at 60°C
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Application	Drying accelerator
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 bar
Layer thickness	50 - 70 µm
Drying	approx. 6 hours at 20°C
	approx. 25 minutes at 60°C
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Cannot be used in all paints, read the manufacturer's instructions.

Particularly suitable for partial painting.

## Paint additives

Application	Sanding test color
Use	To test sanding results
Spray gun	HVLP 1.7 - 1.9 mm
Spray pressure	2.0 bar
Layer thickness	Spray drifted

Application	Fixer additive
Use	Converts solid top coat into two layer solid; multi-color painting
Spray viscosity	18 - 20 secs at 20°C
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	max. 30 µm
Coat application	Wet on wet
Ventilation time	approx. 15 - 30 minutes

Maintain maximum layer thickness without fail.  
Must always next be overpainted with clear lacquer.

Application	Drying accelerator
Use	Accelerates drying with only minimal reduction in working life
Working life	approx. 5 hours at 20°C

Application	Elastifier additive in primer material
Use	Elastifies the complete paint structure on plastics.
Addition	Up to 25%
Spray gun	HVLP 1.7 - 1.9 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	50 µm
Drying	approx. 4 hours at 20°C
	approx. 40 minutes at 60°C
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Application	Elastifier additive in top coat
Use	Elastifies the complete paint structure on plastics.
Addition	Up to 25%
Spray gun	HVLP 1.7 - 1.9 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	50 - 60 µm

## DESCRIPTION AND OPERATION

Application	Elastifier additive in top coat
Drying	approx. 16 hours at 20°C
	approx. 45 minutes at 60°C
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Application	Matting additive in solid paint
Use	Elastifies the complete paint structure on plastics.
Semi-gloss addition	Up to 25% in the paint without hardener and thinner
Silk gloss addition	Up to 35% in the paint without hardener and thinner
Silk matt addition	Up to 45% in the paint without hardener and thinner
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	50 - 70 µm
Drying	approx. 8 hours at 20°C
	approx. 30 minutes at 60°C
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

 **CAUTION: Do not dry using infrared.**

Application	Matting additive in clear lacquer
Use	Elastifies the complete paint structure on plastics.

Application	Matting additive in clear lacquer
Semi-gloss addition	Up to 25% in the paint without hardener and thinner
Silk gloss addition	Up to 35% in the paint without hardener and thinner
Silk matt addition	Up to 45% in the paint without hardener and thinner
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	50 - 70 µm
Drying	approx. 8 hours at 20°C
	approx. 30 minutes at 60°C

Note:

- When mixing, first put in the matting additive, then the hardener and thinners.
- Stir immediately after adding the matting additive.
- Do not store after addition of the matting additive, storage will change the degree of gloss.
- Also suitable for use on plastics without addition of elastifier additive.

Application	Matting paste
Use	Matts, elasticizes and gives structure to solid paint and clear lacquer during painting of bumpers or hard plastic.
Addition	1:1 or 2:1 depending on manufacturer in solid paint without hardener or thinners.
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	50 - 70 µm
Drying	approx. 6 - 10 hours at 20°C
	approx. 30 minutes at 60°C



**DESCRIPTION AND OPERATION**

Application	Matting paste
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Note:

- **The paint must not be filtered.**

Application	Anti-silicone additive
Use	Prevents silicone craters
Addition	2% to maximum 5%

Note:

- Only add away from the paint cabin and immediately remove contaminated cloths.
- If anti-silicone additive is used in the first coat, then it must be used in the following coats, and in at least the same proportions.

**Additive materials****Variety of adhesive tapes**

For profile, fine and large area masking work.

Properties:

- Withstands heat.
- Withstands water-based paint.
- Accepts paint.
- Easily removed without leaving adhesive residues.

**Masking film.**

For masking of large areas on vehicles.

Properties:

- Accepts 2-component and water-based paints.
- Withstands heat.
- Withstands water spray and condensation.
- Withstands solvent.
- Easily cut.
- Environmentally friendly and can be recycled.

**Polishing materials.**

Polishing means microfine sanding. For this reason, polishes must only contain abrasives, and no silicones.

During polishing repair, a good shine is achieved through the step-by-step use of polishes, starting with a highly abrasive polish and ending with a polish having very slight abrasive action.

Polishes are available in graduations from coarse to fine.

**Abrasives**

Please refer to the "Tools" chapter for information on abrasives.

## DESCRIPTION AND OPERATION

## Paint Repairs

## General information

There is a great difference between painting in production and repair painting.

In production, only the bodyshell is painted, it has no trim, upholstery or assemblies. Because of this, other paints, tools and processing techniques can be used.

In contrast to that used in production, paint used in the workshop must dry at low temperatures. Plastics and the vehicle electronics must not be subjected to temperatures greater than 70°C.

The painting process in the case of repair work consists of two phases:

- Pre-treatment of the surface for corrosion protection and the smoothing of irregularities.
- Top coat application.

The precondition for a professional paint finish on a vehicle is the permanently maintained cleanliness of work spaces, tools and equipment,

Original materials must be worked according to the manufacturer's instructions, so that no problems arise in the processing nor during drying.

The room temperature must be 20 - 25°C and the humidity must be low. Temperatures which are too low or too high can lead to porosity, poor flow and boiling. High humidity leads to paint damage such as tarnishing of the paint film (matt film), adhesion problems and craters.

## Pre-treatment of the surface

Perfect preparation of the subsurface is the precondition for a brilliant paintwork result. Faults in the preliminary stages delay completion and cause unnecessary extra work. The working steps described here demonstrate how important it is to follow these instructions step by step.

**NOTE:** Thorough cleaning of the vehicle and especially of the area being repaired is particularly important because of the danger of contamination of the paint.

## Clean the area of the damage



Clean the damaged surface thoroughly, to allow the extent of the damage to be seen. Use silicone remover to produce a grease-free surface.

**NOTE:** The treated surface must be rubbed with a clean dry cloth before the solvent evaporates, otherwise there will be no cleaning effect.

Effective de-greasing is important not only before the application of paint, but also before all sanding stages, for two reasons:

- During sanding of grease contaminated surfaces, globules may form with the sanding dust. Sanding marks will occur and the sanding medium quickly becomes unuseable.
- Oil and grease are embedded by the action of the abrasive particles, and are then very difficult to remove.

Establish the area of damage and the repair stages. In doing so, establish how much disassembly work must be undertaken. Perform a color test at this stage.

Mask off the area of the repair ready for preparatory work.

## Sand out the damage location



**DESCRIPTION AND OPERATION**

When sanding, produce smooth transitions from the painted area to the bare metal.

Use an eccentric sander and P80 or P120 abrasive sheets. Finish off sanding with P150 or P180. The remaining adhering sanding dust must be completely removed.

**Cleaning, de-greasing**

Use silicone remover to thoroughly clean the surface in order to remove grease residues, sweat from the hands and other contamination.

**NOTE:** Use a solvent test to establish whether the old paint can be etched. Apply 2-component thinners to the damaged area using a clean cloth and rub lightly for about 1 minute. If the subsurfaces can be etched away, special pre-treatment is necessary. See "Tips and Tricks"

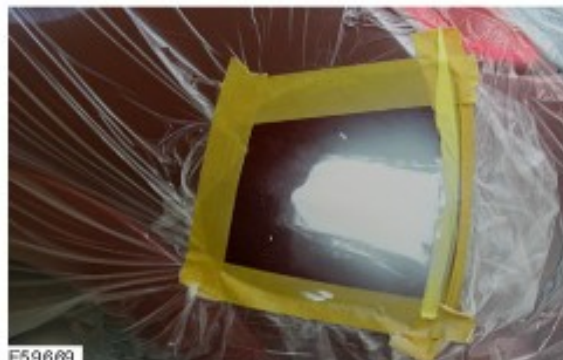
**Apply primer filler**

Before applying stopper, apply primer to the sanded and bare surface.

Allow the primer to dry and then lightly sand by hand using P220 - P400 dry.

**NOTE:** Most stopper can be applied directly to bare metal. But application of a primer filler provides better corrosion protection.

**NOTE:** Avoid sanding through to the bare metal. Points which are sanded through must be retreated with primer filler.

**Stopper application**

Pre-sand the hardened stopper using an eccentric sander and P80 dry, then final-sand using P120 - P140 dry. Clean the sanded surface using silicone remover.

Apply 2-component stopper to the filled surface. The stopper compound must only be applied thinly.

**NOTE:** Use of a testing powder is recommended so that the sanding process can be more easily checked.

**Apply filler**

Filler can now be applied to the dried repair area. Choose the correctly toned filler according to the manufacturer's instructions.

**NOTE:** Alternatively, filler with the correct tone can be mixed with the aid of colour matching cards.



**DESCRIPTION AND OPERATION****Sand the filler.**

The working area is expanded by applying new masking. This makes it possible to even out the transition from the damage area to the vehicle paintwork.

**NOTE:** The primer filler must be carefully sanded. Faults in the primer filler layer will be visible in the top coat.

The sanding process consists of two stages. Coarse sanding levels out the surface of the filler primer. Fine sanding ensures the necessary surface structure which allows the top coat to adhere well and cover sanding marks.

Sand the filler using the eccentric sander and P400 - P500 used dry. Clean the sanded filler finished surface using silicone remover.

The painted area is matted using a fine matting sponge, and then thoroughly cleaned.

**Surface ready for paint**

The surface which has been repaired and then prepared according to the manufacturer's instructions is now ready for basic paint application.

**Top coat application**

It is important for a good paint result that the recommended process data is adhered to, i.e.

mixture proportions, layer thickness, viscosity, drying time etc.

First of all the work area is carefully masked ready for paint application. The correct adhesive materials and techniques must be used so that no hard transitions and edges are created during painting.

**NOTE:** The chapter "Tips and Tricks" gives in-depth information on masking work.

Thoroughly check the surface once more and rub-off with a dust-bonding cloth.

**NOTE:** Once more check the paint material and that the spray gun is correctly adjusted before applying the paint.

**Paint application**

The base paint is applied in two or three steps. First of all only the repair area is painted with the first paint application.

**Flash off**

Allow the paint application to flash off until the surface has a matt appearance. So that the transition to the original paint is optimally created, the next paint application is applied to a wider area.

After the base paint has dried for the specified time, the clear lacquer is applied. Next the transitions to the original paintwork are treated with fade-out

**DESCRIPTION AND OPERATION**

remover. This removes the spray mist and forms an ideal paint surface.

**Repair stages for repair painting**

The required time and material data is divided into four painting levels for calculations concerning repair painting. Proceed according to these divisions for every calculation.

**Level 1 - Painting of new components**

On new components, all inner surfaces, seams and edges which will no longer be seen after assembly must be primed and pre-painted.

**NOTE:** The cathodic dip primer must not be sanded away. Cleaning with silicone remover or light sanding of the primer is all that is required.

Job steps:

- Wash off, prime and pre-paint inner surfaces, seams and edges which cannot be reached at all or only partly after the component is installed.
- Sand new component with P280 - P320 or a fine sanding pad.
- Clean subsurface with silicone remover.
- Carry out masking work (when painting an installed component).
- Apply one spray run of filler, dry.
- Sand the filler. P1200 wet or P500 dry.
- Clean filler application with silicone remover.

Then the prepared surface can be painted with solid or 2-component paint.

If the new part has mild transport damage, this must be rectified beforehand.

To do so, add the following steps:

- Grind out the scratch.
- Finely sand the surrounding surfaces.
- Use a steel cleaning agent to thoroughly clean and then rub dry.
- Apply corrosion protection primer to the bare areas.

**Level II - Top surface painting (color tone matching)**

Complete bodywork surfaces which are to be painted without the need to apply stopper belong to this group. In addition, surfaces with faults in the top coat surface which cannot be removed by polishing.

The following faults are included:

- Loss of gloss.
- Sanding scores.
- Heavy paint runs.
- Large dust and dirt inclusions.

The scope of the work is as follows:

- Sand the surface.
- Sand out paint damage and faults.
- Treatment of small areas which have been sanded through.
- Masking work (when painting an installed component).
- Apply top coat according to the painting process (one or several coat process).
- Dry the top coat and perform finishing work.

**Level III - Repair painting with stopper applied to up to 50% of the surface.**

If in addition to painting, work with stopper application must be performed, then the repair levels III or IV must be used.

In repair level III, apart from painting the complete bodywork surface, partial stopper work is carried out on up to 50% of the surface to be painted. The necessary primer and filler work are also included.

The following damage must be rectified in this level:

- Slight panel unevenness.
- Damage due to corrosion.
- Dented body surfaces.
- Weld locations.
- Deep scores or scratches.

The scope of the work is as follows:

- Fine sand pre-treated bodywork surfaces (e.g. lead-loaded areas).
- Sand out existing damage.
- Perform all necessary masking operations on the vehicle.
- Apply primer.
- Partial stopper application on up to 50% of the surface to be painted (two to a maximum of three stopper applications).
- Fill the repair area.
- Apply stone chip protection (when present in production).
- Apply top coat according to the painting process (one or several coat process).
- Dry the top coat and perform finishing work.

**DESCRIPTION AND OPERATION**

**Level IV - Repair painting with stopper applied to more than 50% of the surface.**

In repair level IV, apart from painting the complete bodywork surface, partial stopper work is carried out on more than 50% of the surface to be painted. The necessary primer and filler work are also included.

The following damage must be rectified in this level:

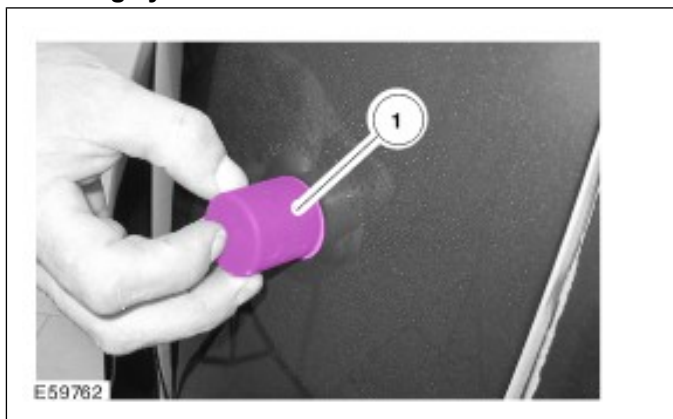
- Damage due to hail.
- More extensive stone chip damage.
- Extensively dented body panels.
- Sectional repairs with large weld seams.
- Surfaces with severe corrosion damage.

The scope of the work is different to level III because of the partial application of stopper to more than 50% of the area to be painted. In addition, more extensive sanding work is usually required.

**Polish**

In order to achieve faultless quality, it is sometimes necessary afterwards to polish a newly painted surface.

Even after the most careful painting, it sometimes happens that dirt inclusions and paint runs occur in work with top coat or clear lacquer. Before polishing, such paint faults must be removed with the sanding cylinder ("Finiball") and hand sanding or eccentric sander in a wet sanding process.

**Sanding cylinder**

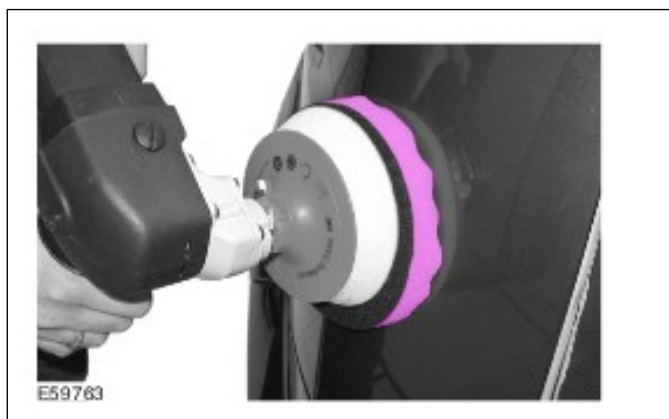
The special sanding compound **-1-** (sanding bloom) for the sanding cylinder is self-adhering and available in grades from P1000 to P2500.

- P1000 - P1500 for pre-sanding of runs and large imperfections in the paint.
- P1500 - P3000 for subsequent sanding of runs and sanding out of dust inclusions.

A small eccentric sander can be used for more extensive working areas. When doing so, first of all put the eccentric sander in place and then switch it on, so that the danger of sanding through on edge is reduced.

Finally polish the sanded area to a high gloss with suitable polish. To this end the various manufacturers recommend materials and process techniques which are specially suited to their products.

**NOTE:** The polishing is to be done in the same way as that used to remove swirl marks.

**Polish**

**NOTE:** Before using the nap sponge for the first time and after any long pauses in working, dampen the nap sponge with polish.

Job steps:

- Clean and degrease the area to be polished using silicone remover.
- Apply the polish to the polishing disc and spread it.
- Place the polishing machine down flat on the area to be polished and before switching it on, gently distribute the polish over the underlying surface.
- Polish out the location for 10 - 15 seconds with the edge, working with a criss-cross motion.
- Subsequently polish the location for about 10 seconds with the machine laid down flat.
- Wash off and clean the polished location using the professional polishing cloth and then clean the polished surface.
- It is absolutely vital to carry out a visual check after finishing the polishing procedure. If any swirl marks are not completely removed by the first polishing procedure, then process must be repeated.



**DESCRIPTION AND OPERATION****Aids****Cleaning putty**

Cleaning putty allows deposits on the paint surface to be removed easily and gently. The following paint faults can be removed using cleaning putty:

- Metal deposits and iron dust.
- Paint or color mist.
- Tree resin and tar.
- Insect residues.

The surface to be worked must be thoroughly cleaned before the cleaning putty can be applied. Then the surface is sprayed with soapy water. Now the cleaning putty can be slid over the surface until all unevenness is removed.

**DESCRIPTION AND OPERATION**

## Painting Plastic Parts

### General

Although these days plastics can be produced in all colors and with a matt or gloss surface, painting is often necessary.

**NOTE:** Manufacturer's limitations concerning the feasibility of painting certain components must always be observed.

Reasons in favor of applying paint to plastic are:

- Individual coloring, matching the body paint.
- More gloss and color brilliance through painting.
- Removal of production imperfections.
- Protection from atmospheric exposure.

Nowadays painting plastic presents no problems because the materials are known and matched to the paint. In order that the painter can use the correct painting materials, the type of plastic must first be correctly determined.

To allow this, plastics are marked on the rear in accordance with the recommendations of the Association of Vehicle Manufacturers.

Once the type of plastic is determined it is an easy matter to assign special paint recommendations, matched to that particular plastic. Unmarked plastics require knowledge of materials so that a correct choice of paint materials can be made and the component can be reliably painted.

### Plastic groups

#### Thermoplastics

When warmed these undergo a reversible transformation into a plastic deformable state and once cooled they maintain their shape. They consist of string-like (linear) or only slightly branched molecular chains.

#### Thermosets

Thermosets are hard and have the form of a close-meshed network in all directions. They do not undergo plastic deformation, are especially resistant to chemicals, are difficult to swell and are insoluble. At normal temperatures they are hard to brittle. At first the material does not undergo any change when heated, but when it reaches a critical point, the thermoset is totally destroyed.

### Elastomers

Elastomers are characterized by high elasticity over a wide temperature range. They have properties like rubber or a sponge and after compression or distension they return to their original state.

### Types of plastic

The plastics used in the automotive area:

- ABS - Acrylonitrile butadiene styrene (polymer)
- PA - Polyamide
- PC - Polycarbonate
- PE - Polyethylene
- PP - Polypropylene
- PP/EPDM - Polypropylene/ethylene propylene diene copolymer
- PC/PBT - Polycarbonate/Polybutylene terephthalate
- PBT/PC - Polybutylene terephthalate/Polycarbonate
- PUR - Polyurethane
- GRP - Glass reinforced plastic

**NOTE:** PE and PP are plastics which cannot be painted, or can only be painted using special techniques.

As well as the pure plastics, so-called 'blends' are also used. This means combinations of different plastics. If we were dealing with metals they would be called alloys.

### Plastic identification

Normally the identifier is marked on the plastic components used in vehicle construction.

One method to determine the plastic group is the sanding test. In this a place is chosen which will not be visible later, and the finger belt sander is used to sand the plastic.

The plastic group can be determined using the pattern left by the sanding and the dust:

- Thermosets produce a white dust.
- Thermoplastics smear and do not produce dust.

The plastic group can be determined by a sound test:

**DESCRIPTION AND OPERATION**

- Degree of hardness - the higher-pitched the sound, the harder the plastic.
- Elasticity - the more muffled the sound, the higher the elasticity of the plastic.

**Cleaning plastic**

Plastic components are manufactured using complicated moulds and presses or other highly engineered tools, mostly using an injection moulding process or reactive injection moulding process.

In order to be able to remove the component from a particular tool, a separating agent is used, which in some cases adheres very strongly to the plastic.

This separating agent on the plastic components must be completely removed before any surface coating is applied.

Warm storage (tempering) before actual cleaning brings the following advantages:

- The separating agent sweats out of the plastic.
- Tensions in the plastic are released.
- Air inclusions can be recognized and removed.

Intensively clean the item several times using a pad and fresh cleaning agent.

**NOTE:** A single wipe, even with cleaning agent, is not usually sufficient in most cases. Clean textured components with the aid of a soft brush.

After cleaning, it is absolutely vital that cleaning agent absorbed by the plastic should be expelled by tempering again. If the ventilation is good and the room temperature is about 20°C the solvent can be evaporated away by overnight storage.

**Painting new components**

It is absolutely vital that the substrate of an unpainted new component is free of separating agent. Paint can only be applied directly to very few plastics. The plastic must first be identified exactly and then worked with a repair system which is matched to the type of plastic. In most cases a plastic etch primer must be applied as adhesion base to all plastics which can be painted.

**NOTE:** Plastics have a tendency to become electrostatically charged. This can easily cause contamination during painting. Special antistatic cleaning cloths prevent electrostatic charging.

Work process for thermoplastics:

- Thoroughly clean the surface.
- Temper the plastic.

- Afterwards clean with antistatic cleaner or antistatic cloths.
- Apply the bonding agent.
- Apply elastic filler. After it has dried, sand and clean.
- Apply one coat Uni-paint with elasticizer additive. For two layer painting the elasticizer additive is in the clear lacquer.

**NOTE:** Follow the paint manufacturer's guidelines during all work.

Work process for thermosets:

- As a rule, thermosets can be handled in the same way as normal body components.

Work process for PUR soft foam:

- The work process is the same as for thermoplastic.
- Instead of using bonding agent, a filler wash is applied to close the pores of the PUR soft foam.

The primer which has been applied to a primed new component can vary greatly. If no manufacturer's data is available, the composition and suitability for further working must be tested.

Painted components with an already ascertained and intact paint coat present no problems for possible repainting. After sanding and careful cleaning with plastic cleaner or thinners, painting can be done directly.

**Unknown primer**

When dealing with unknown substrates it is important to carry out an adhesion test on the existing paint before any repainting is attempted. First of all a mechanical test must be carried out, for instance using a lattice cut and tear-off band. If the adhesion of the old paint is not acceptable, it must be mechanically removed and new paint finish applied.

If the adhesion is acceptable, then an etch test is performed using 2-component thinners. If no etching can be detected in this test, application of the the paint finish can be started directly. Otherwise the old paint must be removed and a new paint finish created.

With the help of universal or special plastic primers and with only a few materials complementary to those previously present anyway, the painter can now apply a long-lasting paint finish to all popular vehicle attachments made of plastic.

**DESCRIPTION AND OPERATION****Paint faults on plastic substrates**

**NOTE:** Paint faults are fully described in the chapter Paint Defects and Damage.

The most common paint faults which can occur when painting plastic components and the methods of repair are briefly described.

**Discoloration**

Cause/damage pattern:

- Plastic material is not suitable for painting.
- Incorrect bonding agent.
- Paint used not solvent resistant.

Repair of damage:

- Repaint using suitable materials.
- Install a new unpainted component.

**Softening**

Cause/damage pattern:

- Substrate not carefully cleaned.
- Air humidity too high or working temperature too low.
- Drying time incorrect (too short).
- Materials for substrate not correctly matched to each other or not mixed correctly.

Repair of damage:

- Dry out, sand, re-isolate and paint.
- Sand away faulty paint coats and re-apply paint finish.

**Paint damage caused by detachment, poor adhesion**

Cause/damage pattern:

- Insufficient paint adhesion between top coat and filler. The whole of the paint finish detaches from the plastic.
- Plastic not cleaned sufficiently, not or inadequately tempered.
- Unsuitable cleaning agent or materials used.
- Poor or lack of intermediate sanding.
- Paint finish underbaked or overbaked.

Repair of damage:

- Sand away faulty paint coats and re-apply paint finish.

**Paint damage caused by blisters, craters, sink holes**

Cause/damage pattern:

- Painting on PUR plastic which was not painted in production.
- Surface of the plastic material too porous.
- Flash-off time not adhered to.
- Drying temperature too high.
- Moisture in plastic material.
- Layers too thick.

Repair of damage:

- Clean the damaged area, sand, re-isolate and paint.
- Remove the paint layers and re-paint.

**Crack formation**

Cause/damage pattern:

- Overexpansion of painted PUR plastic components.
- Use of unsuitable paint materials.
- Paint materials not suited to each other or incorrect mixture ratio.

Repair of damage:

- It is not possible to repair overexpanded PUR plastic components.
- On other plastics, sand away damaged layers, isolate and repaint.

## DESCRIPTION AND OPERATION

## Spot Repairs

## General

In general, partial surface painting at a point is called a spot repair. Using this technique, minor paint damage can be resolved economically and to time.

## Advantage of this method

Because this application remains confined to the area of the damage, it is often unnecessary to remove components or color match against neighboring components. The material used is very much reduced because only a part of the repair area is coated.

## Practical application areas

Only occasionally can satisfactory results be achieved in the centre of larger surfaces and/or on difficult colors. In addition, unprofessional

application may cause tear-off edges to appear in clear lacquer. Only certain application areas are recommended.

**NOTE:** The final decision on whether to spot repair or paint the component must be made by an expert.

Application areas:

- 2-layer paint.
- Depending on the damage zone, paint damage up to a diameter of 3.5 cm or a length of 10 cm.
- Scratches.
- Clear lacquer application up to an area of DIN A4 max.
- Smaller areas which are optically broken up by other components such as trim strip, tail lights, swage lines and edges.
- Boundary zones and edge areas of larger components.

The best application areas have proven to be optical break lines such as corners, narrow surfaces, fenders and wheel arches.



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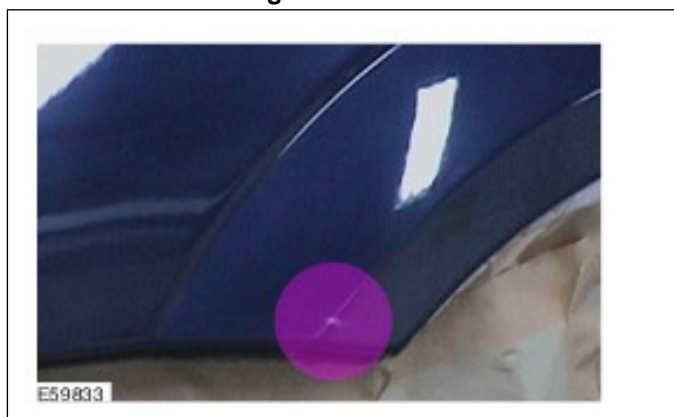
Because of their locations, the violet colored areas are the most suitable for spot repair painting. The turquoise areas are only marginally suitable and

the rest of the areas are not suitable for spot repairs.



**DESCRIPTION AND OPERATION****Repair process**

Perfect preparation of the subsurface is the precondition for a brilliant paintwork result. Faults in the preliminary stages delay completion and cause unnecessary extra work. The working steps described here demonstrate how important it is to follow these instructions step by step.

**Illustration of damage**

A typical case for spot repair is a small stone chip on the fender.

**Cleaning**

First of all the component is thoroughly cleaned using silicone remover and refurbished using abrading and polishing paste. This re-creates the original degree of shine and ensures exact color matching on the touch-up surface.

**Sand out**

Sand out the damaged location using P180 - P320. Only small sanding blocks and small sanding machines must be used, so that the area of the repair remains as small as possible.

Sanding is completed by rubbing down the surrounding surface with a fine sanding pad or P1000 paper. Remove sanding residues and clean the repair area with silicone remover. The peripheral zone must then be masked for application of the filler.

**NOTE:** The size of the repair area must be kept as small as possible (maximum size DIN A4).

**Filling**

The filler layer is applied in stages. First of all, filler is only applied to the location which has been sanded away. After a wait time for flashing off, the second coat is applied so that it spreads over onto the existing paintwork.

The filler must be dried according to the instructions of the material supplier.



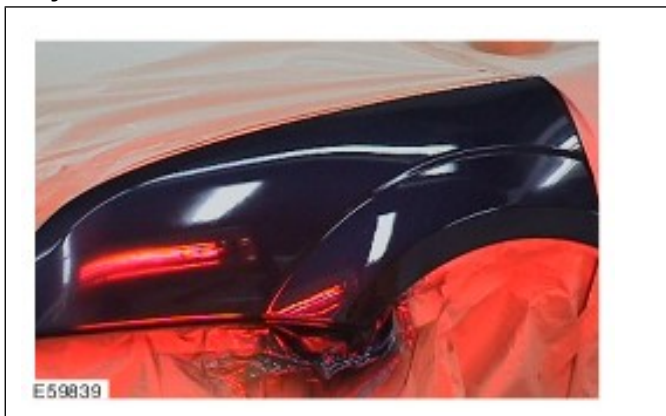
**DESCRIPTION AND OPERATION****Rubbing down**

The repair location is now rubbed down with P400 - P500 and the bordering surface with P2000 - P4000. Remove sanding residues and clean the repair area with silicone remover.

**Paint**

Before painting, clean the area for the final time using a dust-bonding cloth. Then apply the basic paint in thin layers using a spray gun until enough coverage is achieved.

After drying, apply clear lacquer in 1 or 2 coats (depending on product). In doing so, spray so that only the newly applied basic paint is completely covered. Finally a touch-up thinners is sprayed over the edge of the clear lacquer to dissolve the clear lacquer spray mist.

**Dry**

Now dry the clear lacquer according to the manufacturer's instructions using an infrared gun.

**Polish**

Polish the component using a polisher and polish and check the polished area for any swirl marks which may be present. Polish away any swirl marks which are present.

**Dirt inclusions****Sand out**

Minor damage can be removed with a small sanding machine or preferably with an eccentric sander with P1500 - P2000. Very fine spray mist



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**DESCRIPTION AND OPERATION**

can be removed using P2000 - P4000 paper and a larger eccentric sander.



**DESCRIPTION AND OPERATION****Corrosion Prevention****General**

Although corrosion protection measures and painting processes in production have reached a very high technical standard and will be continuously developed further, in the long term corrosion on a vehicle cannot be totally avoided. Further demands are therefore made of the paint specialist besides his knowledge of normal repainting of vehicles which have been repaired after an accident, in addition specialist knowledge is required for assessing and rectifying damage due to corrosion.

During repair painting, take care over the maintenance and re-creation of the corrosion protection applied in production, in view of the long-term warranty on Ford vehicles. Only those repair materials which are approved by Ford may be used for body repair work and repair painting.

For detailed information on corrosion protection measures during body repairs, please refer to chapter 501-25.

Furthermore, information on corrosion protection measures is repeated in individual chapters of the paint manual.

In particular, pay attention that the layer thicknesses specified in production are maintained. The complete system of solid one-layer on galvanized steel panels must equal at least 90 µm and the total system of two-layer on galvanized steel panels must equal at least 105 µm.

It is important that sealing operations, as far as they are necessary, should be undertaken after the application of the paint to specification, in order to ensure the best corrosion protection. All components which form hollow cavities such as pillars, rails, side components etc. must be provided with a coating of cavity protection wax.

**Causes of corrosion**

Corrosion of steel is an electrochemical process during which the steel combines with oxygen. The following factors lead to corrosion:

- Acidic compounds contained in the air, such as carbonic acid and sulphur dioxide, combined with oxygen from the air and/or water. Salts

such as sodium chloride used as road salt accelerate the corrosion process.

- Mechanical damage such as stone chips and scratches which penetrate through to the steel panel.
- Lack of care by the vehicle owner of the painted and corrosion proofed surfaces or areas on the vehicle.
- Unfavorable weather or environmental conditions, as may occur in areas with high humidity, high salt content in the air or serious air pollution due to aggressive gases and dusts.

In the case of mechanical damage, formation of rust can often be seen, beginning to spread into the painted surface from a point (stone chip) or from a line (scratch). If these faults are not professionally rectified in good time, the result is rusting through from the outside to the inside. Rusting penetration from the inside to the outside occurs when for instance the cavity protection was inadequate.

**Operations after painting**

**NOTE:** The manufacturer's instructions must be followed when working with the various corrosion protection materials.

- After painting, treat all cavities in the repair area with cavity protection wax. In doing so, pay particular attention to the weld seams. In dead-end applications with a panel insert, the cavity protection wax must be applied so that it also reaches the area of the panel insert.
- Seals which were applied in production and not over painted must be reapplied. Seals protect vulnerable parts of the bodywork, keep moisture away, reduce wind and road noise and dampen vibrations.
- Apply transparent wax.

**Definition of the degree of rust**

In workshop practice, in order to be able to carry out a consistent and objective evaluation of the scope of the damage, a degree of rust on the scale of 1 to 5 is determined by the DIN 53 210 standard. The main criterion here is the extent to which rust exists under the paint structure. It is determined in millimeters (mm).

**DESCRIPTION AND OPERATION****Underlying rust grade: R1 < 1 mm**

Corrosion starting with up to 1 mm of rust underlying (in the form of a spot or a line).

The damage can be rectified by cleaning the defective location and mechanically removing the underlying rust. For a small extent, apply a primer using a brush and allow it to dry. Touch-up the location with a paint pen or provide a new paint coating.

**Underlying rust grade R2 < 1 - 2 mm**

Advanced corrosion with up to 2 mm underlying rust.

Rectifying the damage:

- Clean the defective location.
- Remove the underlying rust mechanically down to the paintwork carrier.
- Apply 1-component filler and then 2-component "Vario" filler.
- Provide the damage location with new paint coat on visible outer surfaces. Only locally touch-up areas which are not optically conspicuous.

**Underlying rust grade R3 < 2 - 4 mm**

More advanced corrosion with up to 4 mm underlying rust. The damage must be rectified in the same way as for R2. A permanent cure of this type of damage pattern is still just possible

**Underlying rust grade R4 < 4 - 5 mm**

Notably advanced corrosion with up to 5 mm underlying rust. The damage must be rectified in the same way as for R2. If it is found that for whole areas this is only possible with a great deal of work, or is not possible at all, then a new component must be used.

**Underlying rust grade R5 > 5 mm**

Extreme corrosion, with more than 5mm underlying rust (panels, flanges or load-bearing components partially rusted or rusted through).

Such damage can no longer be repaired because in many cases the constructional strength of the component can no longer be produced. The risk in making a repair is too great. Install a new component and paint it.

## DESCRIPTION AND OPERATION

## Color Identification and Chromatics

## Basic color theory

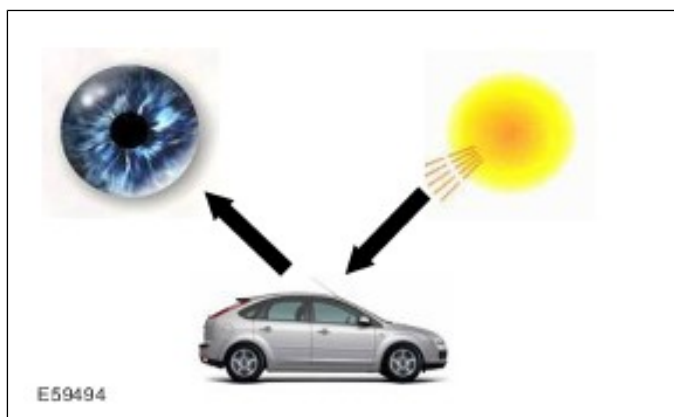
In order to achieve optically perfect painting results it is vital to understand the physical principles of the origin of color impression.

## Color

Color itself is a sensory perception.

This perception arises through the combined effect of the following components:

- Light (sunlight or artificial light irradiates the object).
- Surface of the object (reflection from the object of certain constituent parts of the light).
- Eye (perception of the reflections from the object).

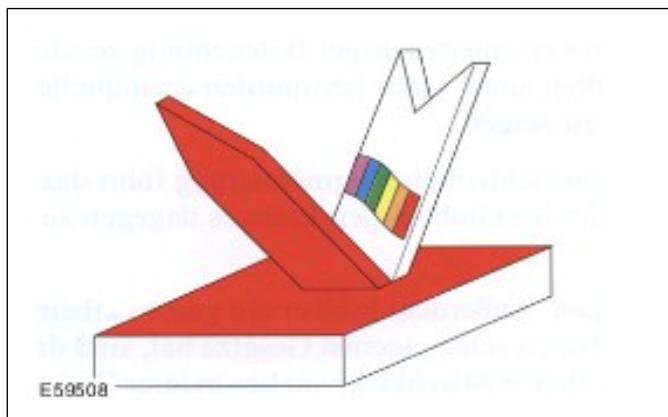


Because the sensory impression of color is produced by all three of these components, it is dependent on the type, quality and function of the individual components. Practical examples make this clear:

- If a particular article is subjected to artificial light, then it gives a different impression of color to that which it gives in sunlight.
- An object with uniform color but different surface textures appears to have different colors (grained or ungrained dashboard).
- A person with perception disorder (colorblindness) cannot recognize certain colors or distinguish between them e.g. red-green weakness).

In turn the type of color is determined by the light absorption ability of an object. Light shines with all color components (spectral colors) onto an object, certain components of the light are absorbed (taken

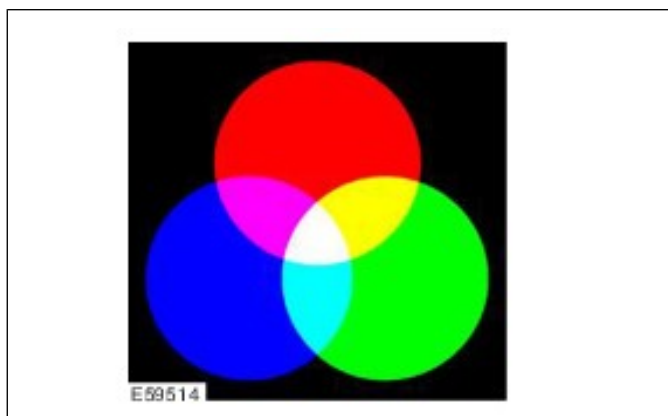
in) and other components are reflected (sent on). The components which are reflected produce the specific color impression.



The colors as we see them are the result of a combination of reflected colors from the spectrum. Physically speaking, these are electromagnetic waves with different wavelengths (and frequencies). The healthy human eye can recognize wavelengths between 0.36  $\mu\text{m}$  (violet) and 0.78  $\mu\text{m}$  (red).

If all the perceptible wavelengths of the spectrum impinge on the human eye at the same time, the impression of white light is produced.

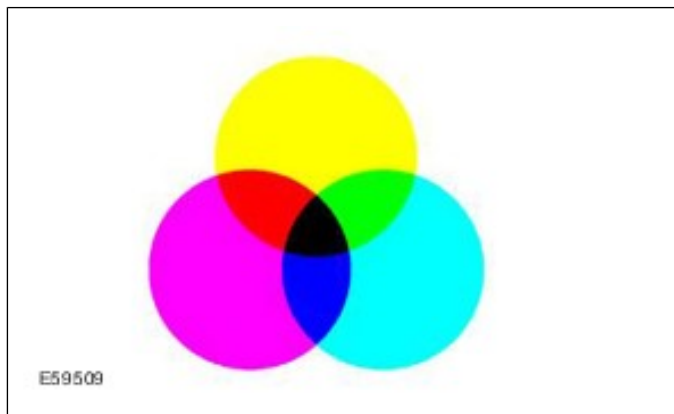
## Additive and subtractive color mixing



Additive color mixing is the combination of light from different sources to give white. Different intensities of the additive primary colors red, green and blue allow millions of different colors to be represented (RGB colors).

Additive color mixing is always therefore used when light should enter the eye directly (without reflection off an object). Such as in the case of computer monitors or overhead beamers.



**DESCRIPTION AND OPERATION**

Subtractive color mixing means mixing the primary colors cyan, magenta and yellow to form a desired color (CMY colors).

Subtractive color mixing is used when light should enter the eye of an observer after reflection from an object. Such as happens with painting or in printing.

**Oswald color circle**

The Oswald color circle is based on subtractive color mixing, and enables the behavior of paints when they are mixed together to be represented.

Colors lying opposite each other are complementary colors and should not be mixed together as this will produce a dull (i.e. grey) shade. If green is added to red, the red becomes greyer, not greener.

Color shades which are side by side are partner colors and produce a mixed color shade. For instance, mixing red and blue produces a pure violet.

In addition, black and/or white may be necessary to produce a particular color shade.

- White makes the color shade lighter.
- Black makes the color shade darker.
- With black and white the color shade becomes more dreary or greyer.

**Metamerism**

Metamerism is the name of the effect which occurs when two colors appear identical in a particular light (e.g. artificial light), but the colors appear different under another light source (e.g. daylight).

The cause is the fact that the human brain, aided by the eyes, does not evaluate the wavelength, instead it evaluates the spectral intensity of the reflected light.

It is for this reason that color matching in practice must only ever be performed in daylight, or under special artificial light which is based on daylight.

**Metallic and pearl pigments**

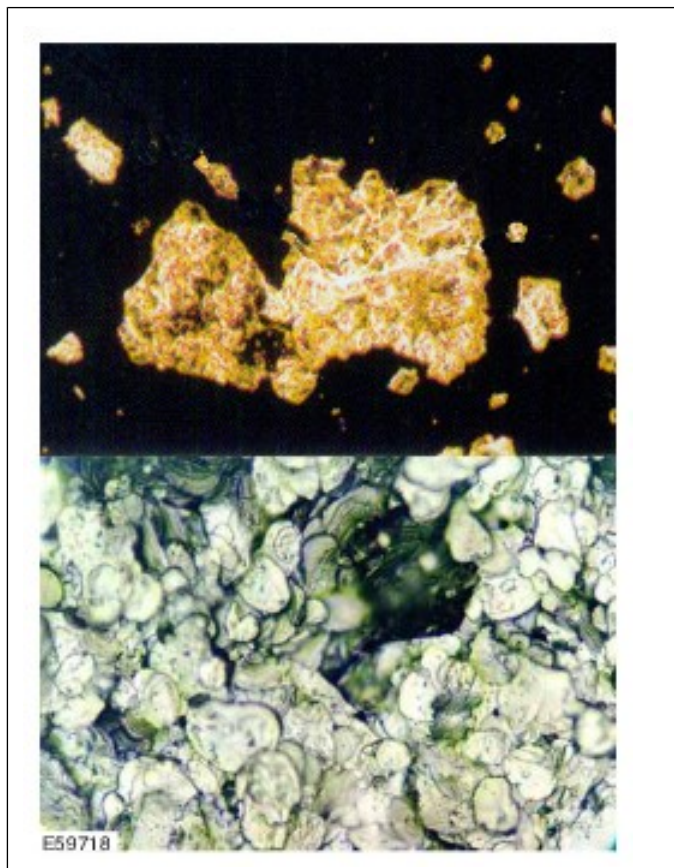
Colored paints achieve their color effect by the addition of pigments. Pigments are colored, solid, very fine organic and inorganic particles which are insoluble in the binding material.

**Metallic pigments**

Aluminum platelets are added as pigment to form metallic paint.



## DESCRIPTION AND OPERATION



Depending on the size and shape of the aluminum platelets, different metallic effects can be achieved:

- Cornflake aluminum (1) causes very strong dispersion because of rough edges, low brilliance, very low flop and produces grey-silver shades.
- Dollar aluminum (2) causes hardly any dispersion because of the smooth surface, high brilliance, produces very light, almost white silver shades.

With metallic paints however, only a light-dark light reflection effect occurs.

Colored metallic paints are produced by the extra addition of color pigments to the metallic paint.

## Pearl pigments



The basis of pearl pigments is formed by mica, which is metallized with a silver or gold layer.

Depending on the angles of light and observation, the mica platelets reflect different proportions of light. Because of this, the color of the paint appears to the observer to change.

Pearl pigments produce a colored and light-dark reflected light effect.

## Color codes and their determination on Ford vehicles

It is necessary to determine the correct color shade of the original paintwork in order to perform a professional and perfect paint repair.

The original paint color shade can be found by:

- Inspection of the vehicle type plate with the color code stamped on it.
  - Later design
  - Earlier design
- Color shade catalog or color shade system of the manufacturer.
- The bare bodyshell plate with color designation.

## Type plate

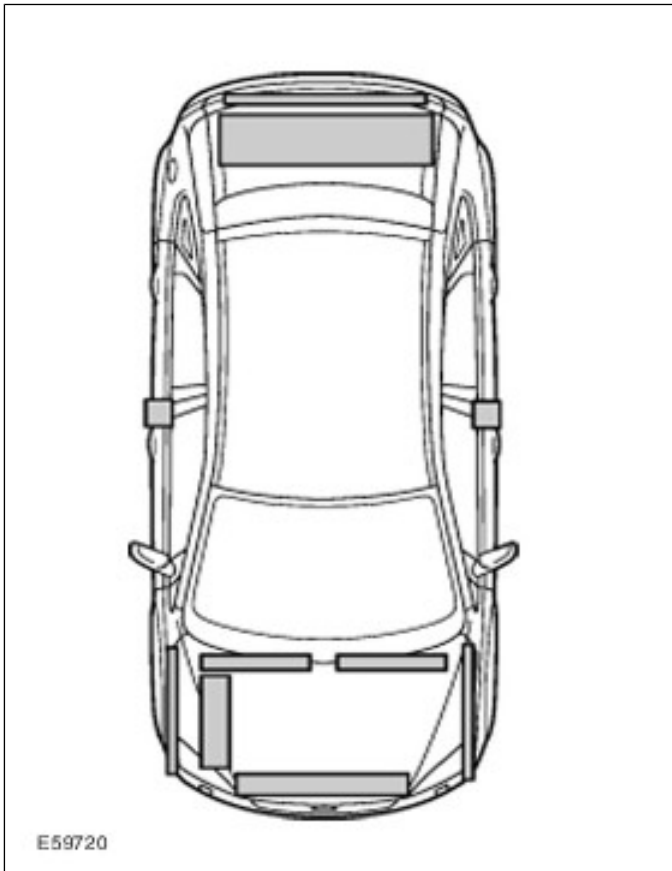
Type plate - location on Ford vehicles:

- Right-hand B-pillar - door rebate
- Left-hand B-pillar - door rebate
- Hood lock panel
- Left-hand vertical edge of inner front wing
- Right-hand vertical edge of inner front wing
- Right-hand engine compartment side member
- Left-hand bulkhead
- Right-hand bulkhead

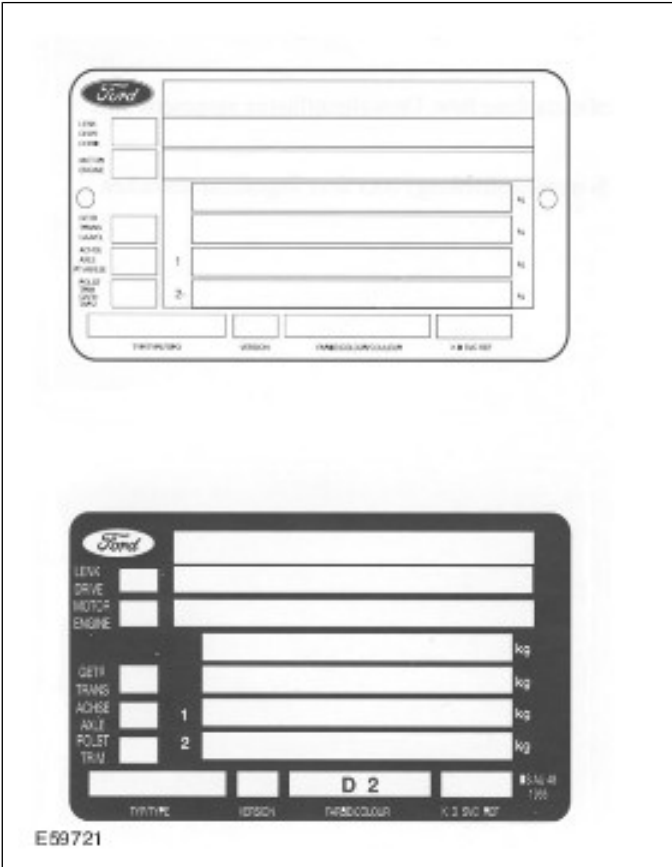


**DESCRIPTION AND OPERATION**

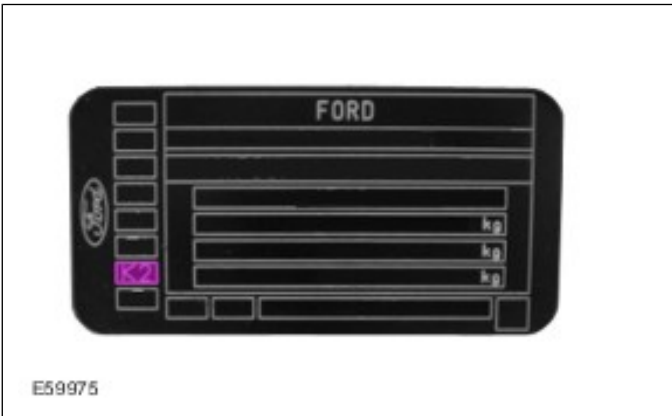
- Luggage compartment interior
- Inner rear panel - luggage compartment



The type plate gives the color code in the last row.



On the newer type plates, the color code is given in the left-hand column, at the penultimate position.



**Color shade catalog or color shade system of the repair paint manufacturer.**

The repair paint manufacturers offer a variety of possible systems for the determining the production color shade of motor vehicles. There are electronic systems, color card systems and manuals for the determination of color shades.



**DESCRIPTION AND OPERATION**

Most repair paint manufacturers use the following systems:

- A tabular system based on the following parameters:
  - Color code
  - Make
  - Model
  - Build year
  - Color or color name
  - Ancillary codes
- A system with color cards based on the following parameters:
  - Make
  - Color shade
  - Build year

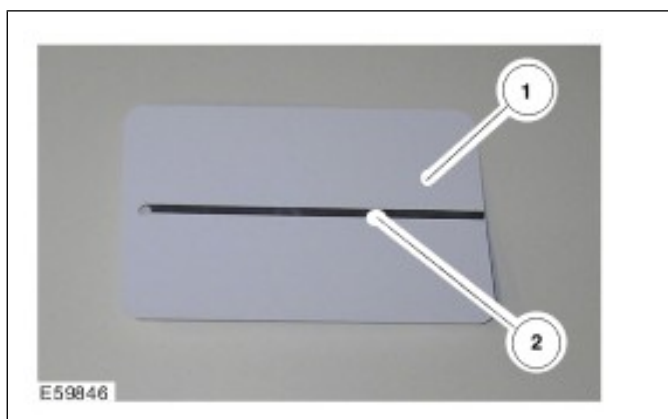


Because of the many parameters used, in a tabular system the color shade can also be determined by the lack of a parameter.

When using the color cards, emphasis is placed on matching of the original color shade with the color shade samples. For this reason this method is very helpful when the other parameters are not available.

Comparison of the results of both methods increases the certainty of using the correct original color shade and its formulation.

Additional certainty can be achieved during color shade determination by making a color sample plate. Here it is however important to apply the complete paint structure with base paint and clear lacquer onto a sample plate (1) in order to carry out a color shade and color coverage test.



The color shade comparison is done by comparing the vehicle paintwork with the sample plate (1). The color coverage test is possible by using the black test stripe (2): If the test stripe (2) is still visible after test painting of the sample plate (1), the coverage is not good enough.

By using this determination of the original color shade, the formulation and information on any very slight fine adjustments which may be necessary can be established.

**Bare bodyshell plate**

The bare bodyshell plate is located:

- On the hood lock panel.
- Near the type plate.

The color name is stamped on in the last row.



**DESCRIPTION AND OPERATION****Matching tinted filler to the color code**

**NOTE:** Color samples must always be made from the same materials as the subsequent repair painting. Perform color shade matching in the fully hardened state, in natural light or under suitable artificial light.

Various tinted fillers are used during factory painting. In order to achieve the exact color shade of the factory applied paint, attention should be paid that the correctly matched fillers are used.



The repair paint manufacturers offer suitable precolored primers. The use of filler color cards allows the matching color shade to be determined.



**DESCRIPTION AND OPERATION****Tips and Tricks****Comparing paint structures**

It may happen that an area remains visible, especially when the area of the repair is small. The reason for this is the structural variation in the paint surface at the repair location compared with the original paint finish. The original paint finish has a slight orange peel effect while the repair areas is extremely smooth.

This effect can be reduced by fine sanding using P3000 of the area around the repair location and then polishing.

**Etching substrate**

If the substrate can be etched during the solvent test, suitable preparation must be done.

Job steps:

**NOTE:** Follow the manufacturer specific instructions.

- Sand the damaged area extensively using an eccentric sander and P80 or P120 abrasive sheets. Finish off sanding with P150 or P180.
- Remove the sanding dust and clean the area of the damage using silicone remover.
- Apply polyester stopper to the bare panel and to the damaged area.
- Sand the dried polyester stopper to an even surface using P80 - P150. Finish sanding using P180 - P240. If required apply more stopper, again only on the bare panel.
- Wet sand the residual old paint finish using P600 - P800. Transitions with P400 - P600. Clean with silicone remover.
- Prime bare metal areas with acid primer.
- After the acid primer has been left exposed to the air for the correct evaporation time, apply 2-component primer filler in thin layers over the complete repair area, leaving enough air exposure time in between coats.
- After the filler has dried, sand wet with P800 or sand dry with P400. Sanded through areas must be covered again with 2-component Nonstop filler primer.

Another possible method of preventing etching of the substrate is to use waterbased primer and filler materials.

**Masking the vehicle**

Masking and covering work are among the most important preparations required to achieve a high quality paint finish. Paint application onto neighboring components, paint mist and sharp paint transitions are quality faults. For this reason it is extremely important to take special care and to use suitable masking materials.

**NOTE:** When water based paints are used, all materials must be stable towards water.

Plan the masking work:

- Determine the sequence of masking work. Sometimes after masking film has been applied, it is difficult or impossible to reach certain areas.
- Prepare the masking material.
- Start with small difficult areas.

Pay special attention to the areas of profiled seals, edges, openings and paint transitions.

**Masking tape**

Masking tape is available in various widths for special application areas. In practice however, a wide tape has proved best for almost all areas, also taking into account the time required for masking work.

**NOTE:** Use of differing masking materials is often much more time-consuming.

Advantages

- Good coverage. Narrower tapes must often be applied in several layers.
- More resistant to tearing.
- Wide tapes can be applied deep into joints and therefore protect from paint mist and contamination.
- Removal is often easier.

**Masking film**

Transparent plastic film has become accepted as a practical method to mask large areas of a whole vehicle. It can quickly and easily be applied to the vehicle from the roll.

**DESCRIPTION AND OPERATION**

**NOTE:** Only mask the vehicle when it is dry. Moisture under the film can lead to matt paint in the drying process.

Using masking film

- Clean the vehicle before masking it.
- Pull the film over the vehicle. Because of the static charge, the film lies on the vehicle like a second skin.
- Cut out the repair area using the film knife and then mask it.

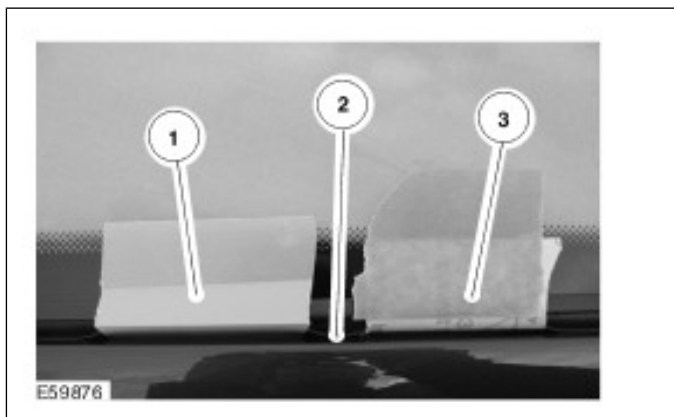
Other ways of masking a vehicle are:

- Masking using masking paper.
- Painting cloth (mostly used during filling work).

**Profiled seals**

If it is not possible to remove a profiled seal, then it must be masked in such a way that no edges can form due to paint accumulation.

To do this, the seal is lifted slightly and masked. The following techniques are possible:



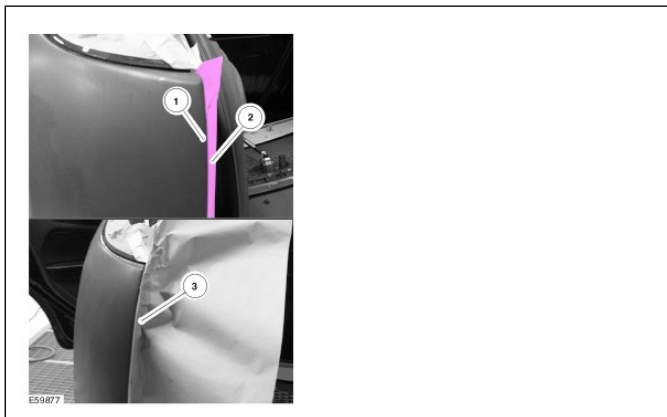
Item	Description
1	Masking tape with plastic strips
2	Sealing lip
3	Sandpaper with masking tape

- Laying a string or cord under the seal. Suitable for soft and elastic seal lips.
- Special masking tape with plastic strips for hard seal lips.
- Instead of using plastic strips, fine sandpaper cut into strips can be inserted and secured using normal masking tape.
- If the seal can be easily displaced, normal masking tape can also be used.

**Edges/openings**

Smooth paint transitions can be produced by positioning adhesive tapes.

**NOTE:** Pull the adhesive tapes away immediately after the paint has been applied and check the paint transitions.



Item	Description
1	Vehicle edge
2	Adhesive surface
3	Masking paper

**Possible variations**

- At edges apply one strip of masking tape half on the area not to be painted and mask using a second strip.
- On surfaces, two masking strips can be attached, each affixed by half their adhesive surface. The adhesive strip which arises is then applied with one half on the edge of the area to be painted. The other half is aligned and fixed in addition in the curves.
- Affix masking paper on one side over the area to be painted. Double back the masking paper and secure it.
- Affix round profiled foam at the edge of the area to be painted using masking tape.

Foam strips are suitable for affixing to openings such as door gaps.



## DESCRIPTION AND OPERATION



**NOTE:** Choose a suitable profile diameter. A profile which is too thick will protrude from the opening, one which is too thin will leave a gap.

Clean the door opening well and affix the matching shape.

### Color shade problems

If a vehicle color shade is taken from a vehicle on a hot summer day and the mixed color applied, this may cause color shade problems. Some colors change so much at higher temperatures that it can lead to an incorrect result. Red color shades are particularly prone to this shade behavior.

This means that color determination should always be done on the bodywork when it is at about the same temperature as the later working temperature will be. The best temperature of the item is between 15° and 25° C.

### Isopropanol and water

Painted surfaces are very easily cleaned using a mixture of 70% water and 30% isopropanol (can be obtained through a laboratory supplies specialist or a pharmacist).

### Temperature reduction spray

If finishing work must be performed on touched-up surfaces and newly painted plastic parts, problems may arise. The paint and the transitions are not yet fully hardened.

**NOTE:** When working with the polishing machine, make certain that each operating run lasts no longer than about 5 - 10 seconds, in order to prevent the paint becoming warm.

Even so, in order to be able to polish over transitions, temperature reduction spray must be

applied to the surface. The transition area is then alternately sprayed and polished until a perfect transition surface is achieved.

Paint faults on soft plastic components where elasticizer additive has been used in painting must be wet sanded using grade P2000 - P2500 paper.

In doing this the sanding location and the surroundings are sprayed with temperature reduction spray and the paint faults sanded out by hand. Afterwards the location is polished as described above.

### Paint plane

Dirt inclusions and paint runs can be removed with the sanding cylinder ("Finiball") and hand sanding or eccentric sander in a wet sanding process.

Another practical tool for removal of paint faults which lie proud of the surface is the paint plane.

**NOTE:** Guide the tool carefully with the minimum of force. It must not tilt, otherwise more serious damage may easily be caused.



This tool allows paint faults to be carefully removed in shavings. Afterwards the surface must be polished using suitable materials.

### Shading

Even when all the rules, steps and corresponding instructions have been followed concerning possible shades, it may happen that the mixed color shade does not exactly match the vehicle color.

In these cases, shading must be done. Because there is no fixed formula for this, experience and a trained eye are important. Some rules must be followed for shading.

**NOTE:** Self-made color sample plates of the current colors are very helpful for determining the

## DESCRIPTION AND OPERATION

color shade. Refer to the chapter Color Determination and Color Theory.

- When shading, if possible only use the paint mixture that is also allotted in the color shade formula.
- Observe the rules concerning contrary colors (complementary colors) and partner colors according to the Oswald color circle.
- Complementary colors are not recommended during shading because they mutually inhibit and lead to muddy mixtures.

### Sanding marks

In certain circumstances, the recommended sanding methods up to now are no longer suitable for light metallic color shades. Wet sanding with grade P1200 paper or a grey sanding pad can cause sanding scratches which can become very visible under certain lights.

In order to achieve an excellent paint result on difficult color shades, follow these working rules:

- Sand filler as before, rub down area to be painted with 3M ultra fine matting sponge and 3M matting gel.
- Sand filler as before, rub down area to be painted with soaked 3M wet sand paper P1500 - P2000.
- Sand filler as before, rub down area to be painted with 3M 260 L P1000 eccentric (Interface Pad).

### Improving touch-up work

During application of special effect base paints, the effect particles align themselves exactly parallel to the surface in the paint layer while it is still liquid. This means a particular thickness of the paint layer is required.

Because during painting the layer thickness in the transition zones reduces from normal to zero, the effect particles can no longer align themselves. This leads to lighter, darker or cloudy zones.

If 1-component clear lacquer is sprayed before the base coat, this effect is prevented. An optically perfect transition will result.



# SECTION 502-00 Uni-Body, Subframe and Mounting System

VEHICLE APPLICATION: **2008.50 Kuga**

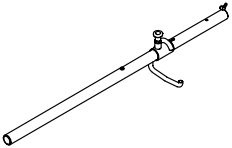
CONTENTS	PAGE
<b>REMOVAL AND INSTALLATION</b>	
Front Subframe.....	502-00-2
Front Subframe Front Bushing.....	502-00-8
Front Subframe Rear Bushing.....	502-00-12
Rear Subframe.....	502-00-16
Rear Subframe Bushing.....	502-00-20



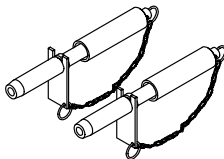
REMOVAL AND INSTALLATION

Front Subframe

Special Tool(s) / General Equipment

 <p>E63772</p>	<p>204-605 Separator, Lower Arm Ball Joint</p>
---	--

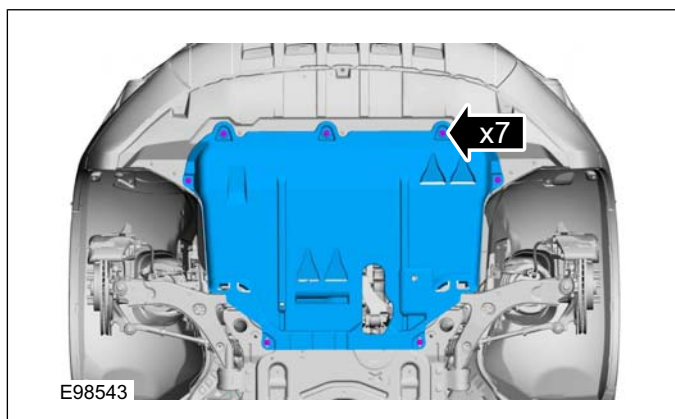
Special Tool(s) / General Equipment

 <p>E93105</p>	<p>205-880 Alignment Pins, Subframe</p>
<p>Transmission Jack</p>	

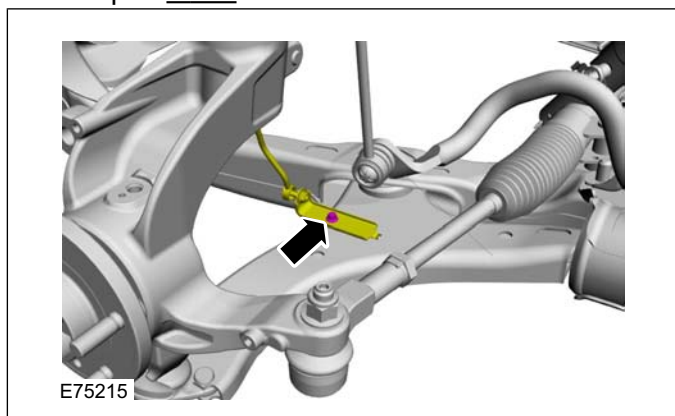
Removal

1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

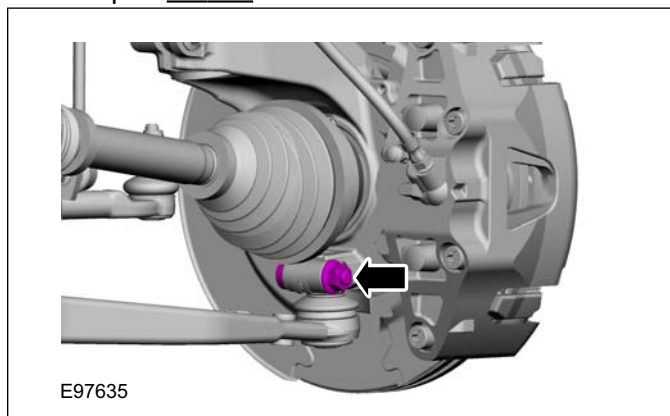
2.



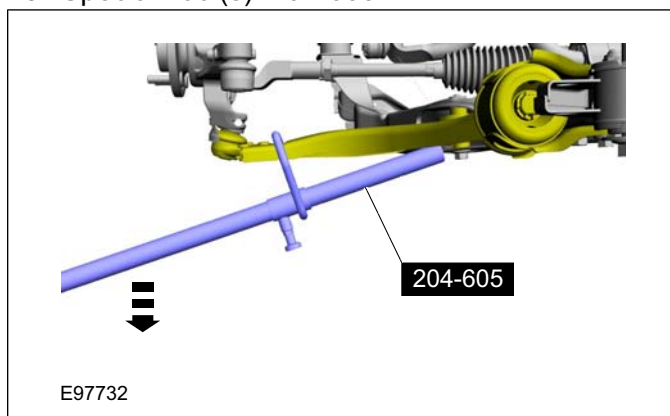
3. If equipped.  
Torque: **8 Nm**



4. Torque: **83 Nm**

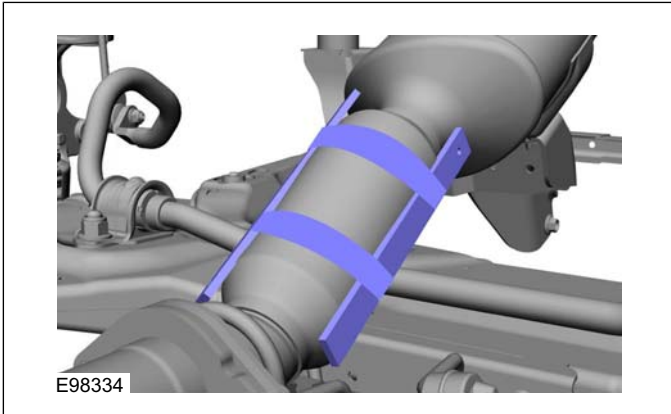


5. Special Tool(s): 204-605

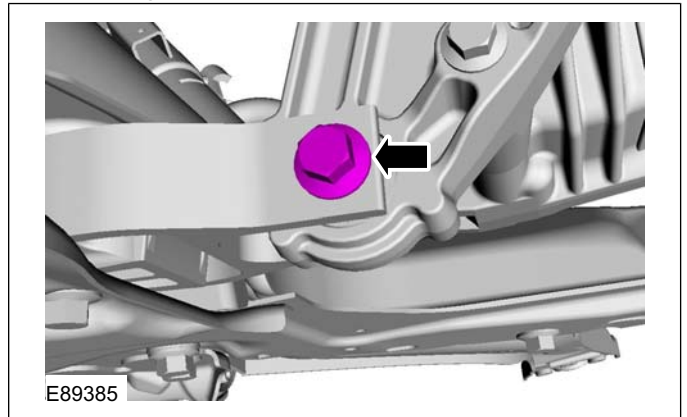


REMOVAL AND INSTALLATION

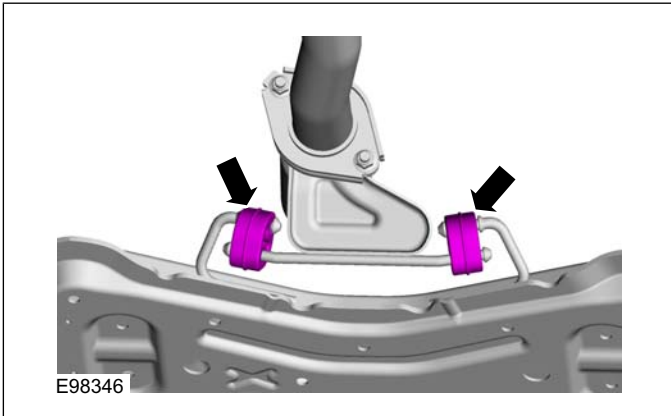
6.  **CAUTION:** Make sure that the exhaust flexible pipe is not forcibly bent.



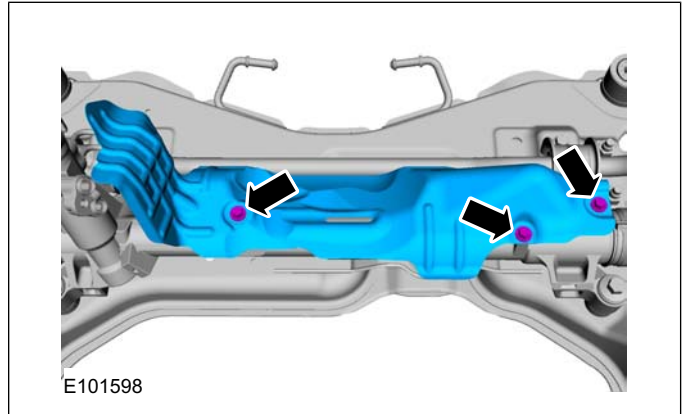
8. Torque:
- Stage 1: 35 Nm
  - Stage 2: Loosen 360°
  - Stage 3: 85 Nm



7.



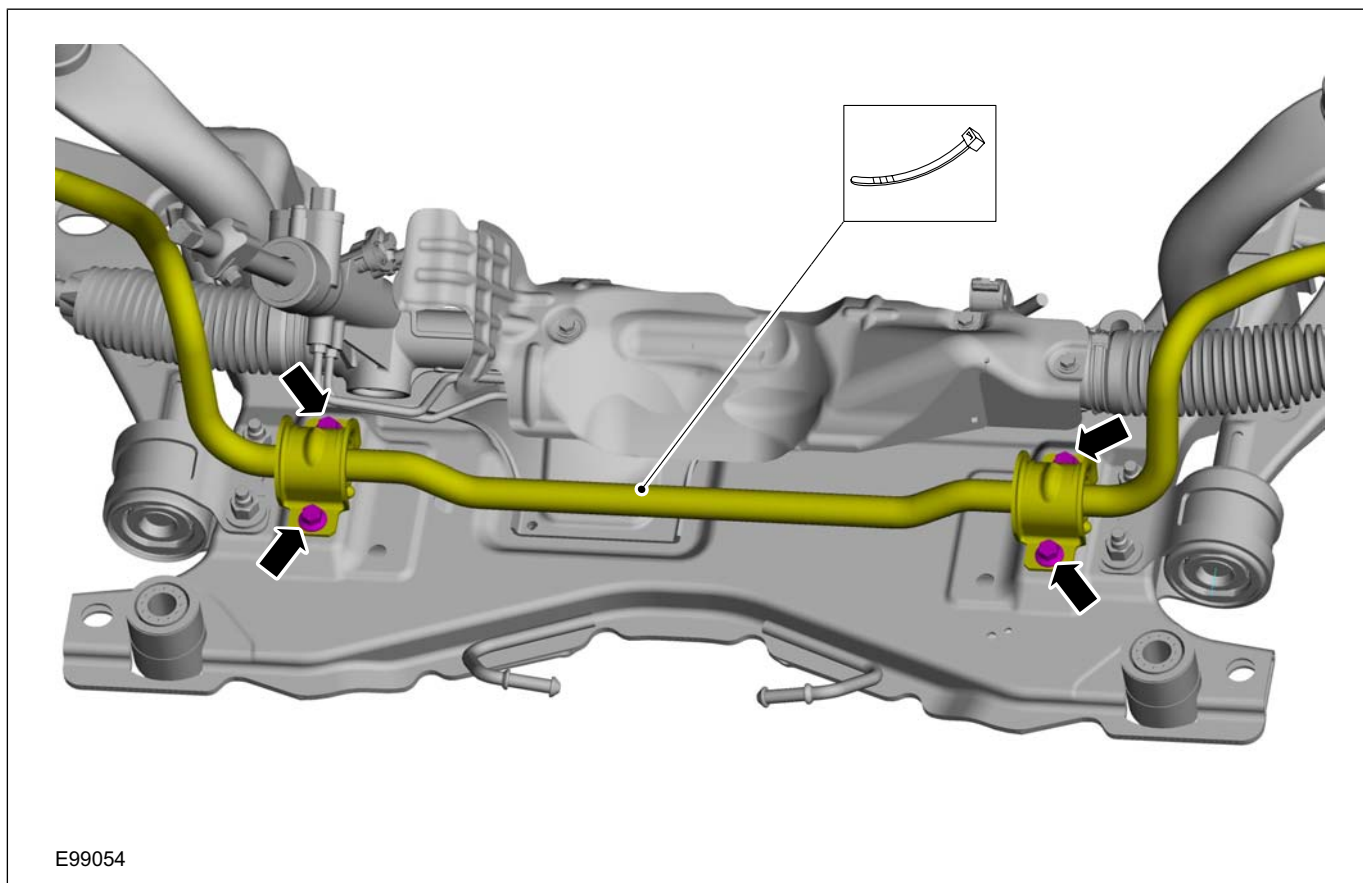
9. Torque: 7 Nm



10. Torque: 47.5 Nm

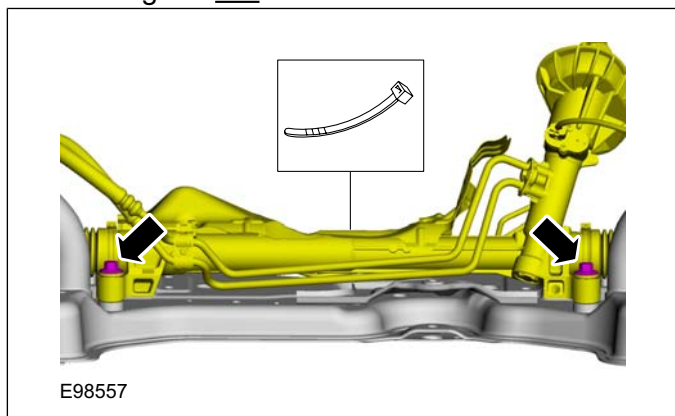


REMOVAL AND INSTALLATION

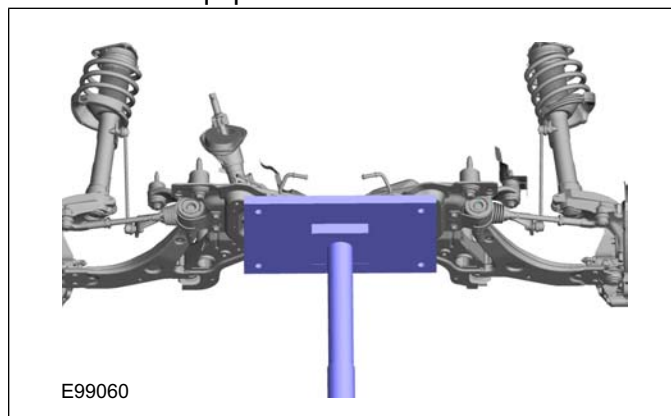


11. Torque:

- Stage 1: 40 Nm
- Stage 2: 60°



12 General Equipment: Transmission Jack



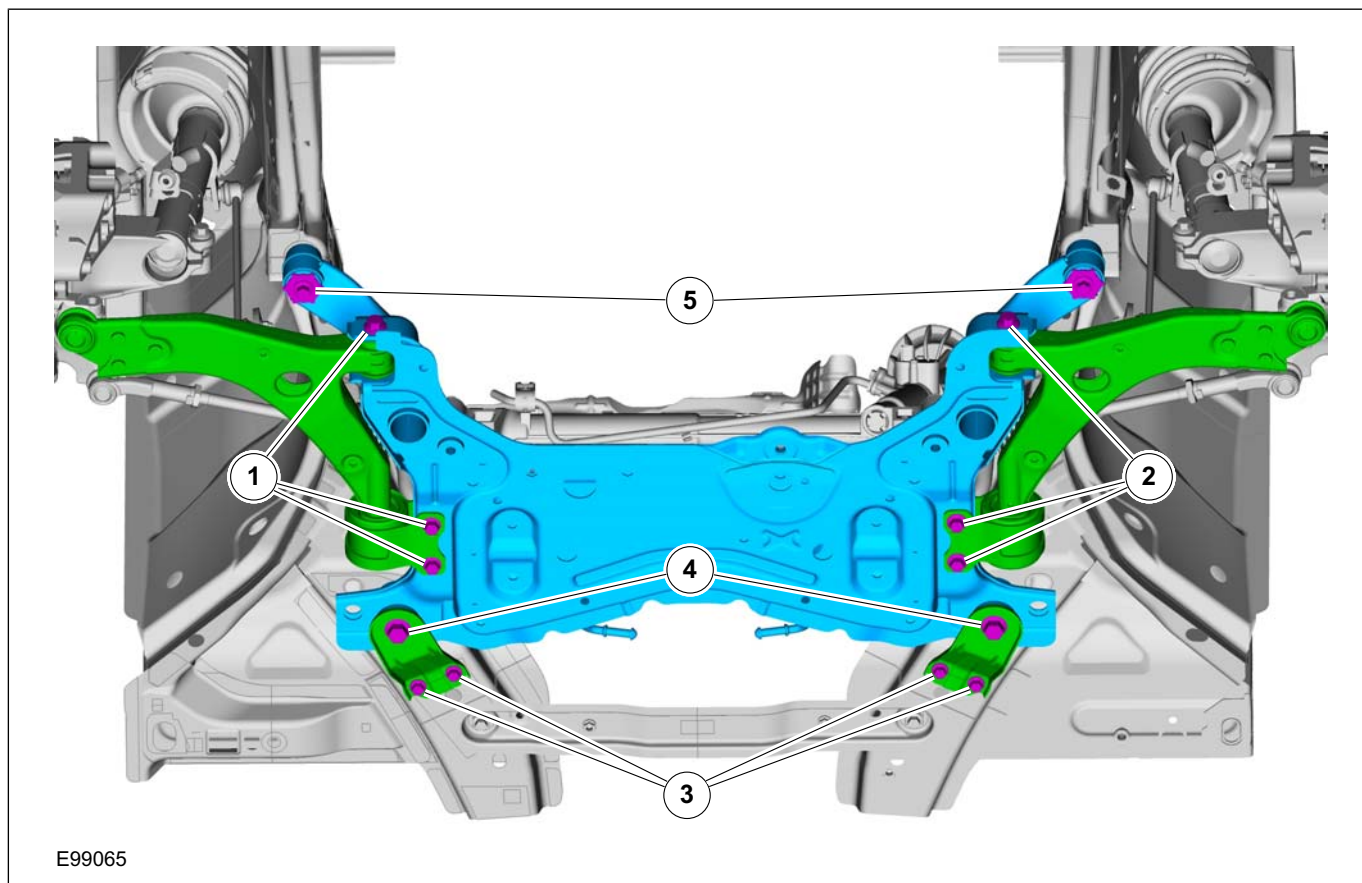
13. **⚠ WARNING:** This step requires the aid of another technician.

**⚠ CAUTION:** Make sure that the wiring harness does not catch.

**NOTE:** This step is only necessary when installing a new component.



## REMOVAL AND INSTALLATION



14. **WARNING:** This step requires the aid of another technician.

**CAUTION:** Make sure that the wiring harness does not catch.

Remove the following items:

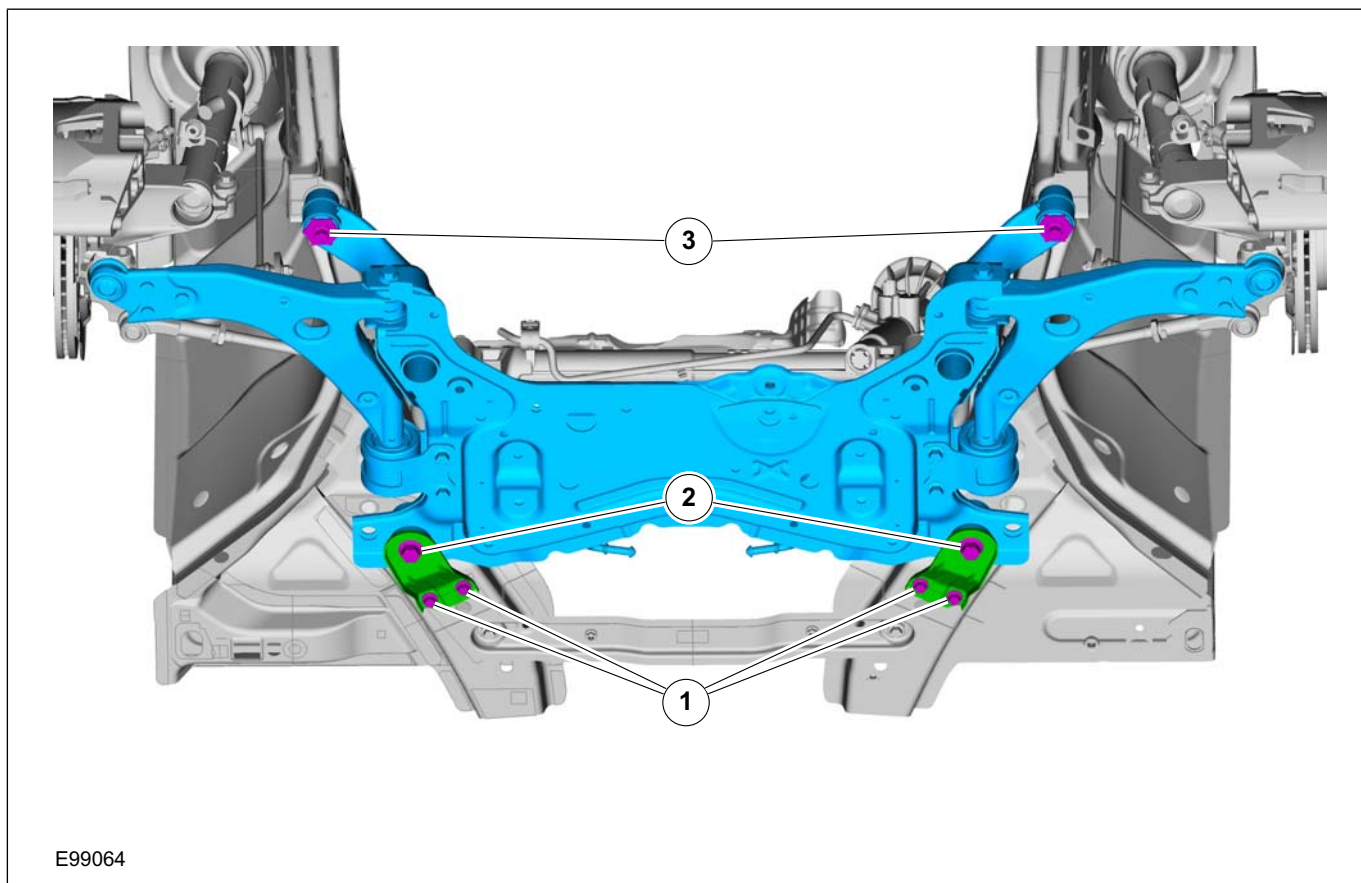
1. Torque: 70 Nm
2. Torque:
  - Stage 1: 140 Nm
  - Stage 2: 180°
3. Torque: 125 Nm

502-00-6

## Uni-Body, Subframe and Mounting System

502-00-6

## REMOVAL AND INSTALLATION



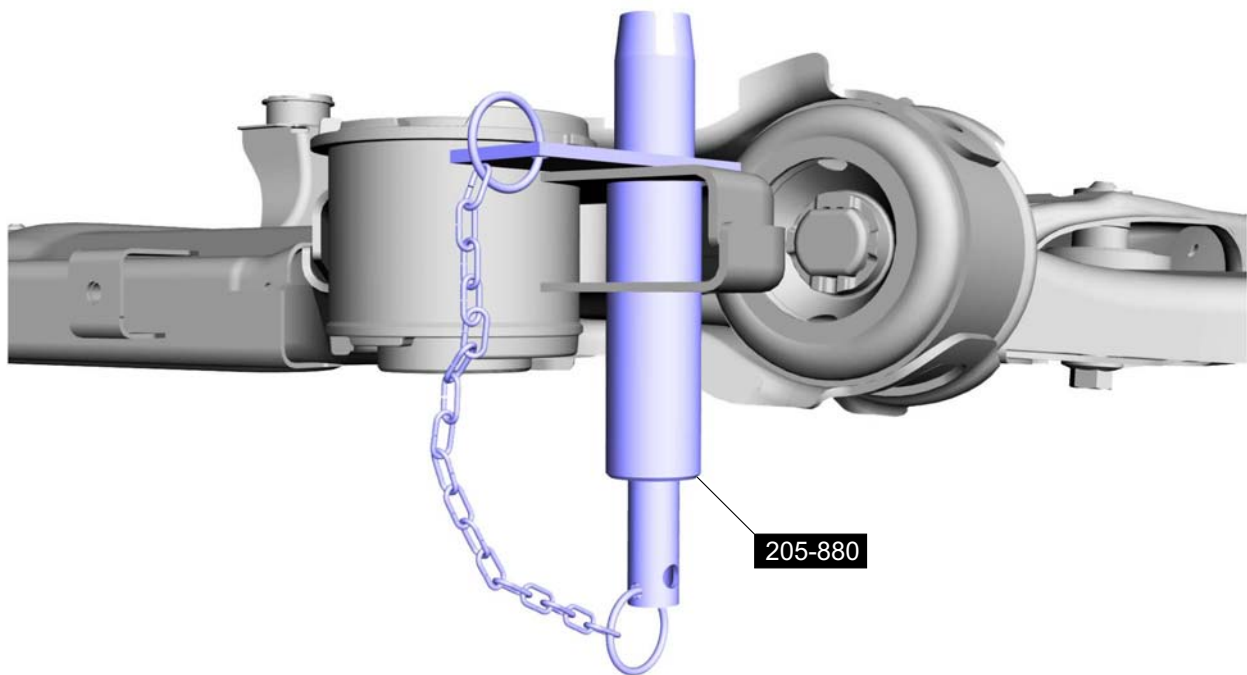
## Installation

1. To install, reverse the removal procedure.

2. Special Tool(s): 205-880



REMOVAL AND INSTALLATION



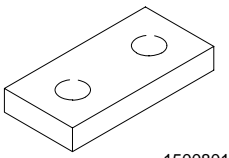
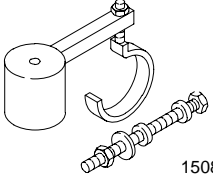
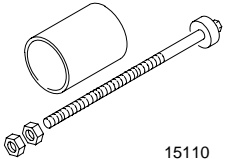
E99249



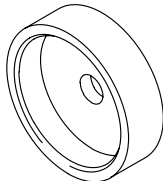
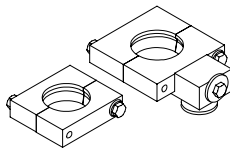
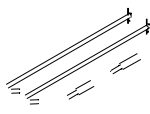
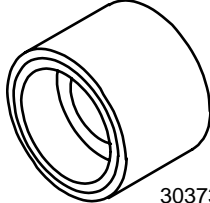
REMOVAL AND INSTALLATION

Front Subframe Front Bushing

Special Tool(s)

 <p>1500801</p>	<p>205-044-01 Adapter for 205-044</p>
 <p>15086</p>	<p>205-297 Remover/Installer, Pivot Bushing</p>
 <p>15110</p>	<p>205-342 Remover/Installer, Pivot Bushing</p>

Special Tool(s)

 <p>1511002</p>	<p>205-342-02 Adapter for 205-342</p>
 <p>E51254</p>	<p>205-810 Installer, Subframe Bushing Guide</p>
 <p>30329013</p>	<p>303-290-13 Adapter for 303-290A</p>
 <p>303733</p>	<p>303-733 Installer, Crankshaft Front Seal</p>

Removal

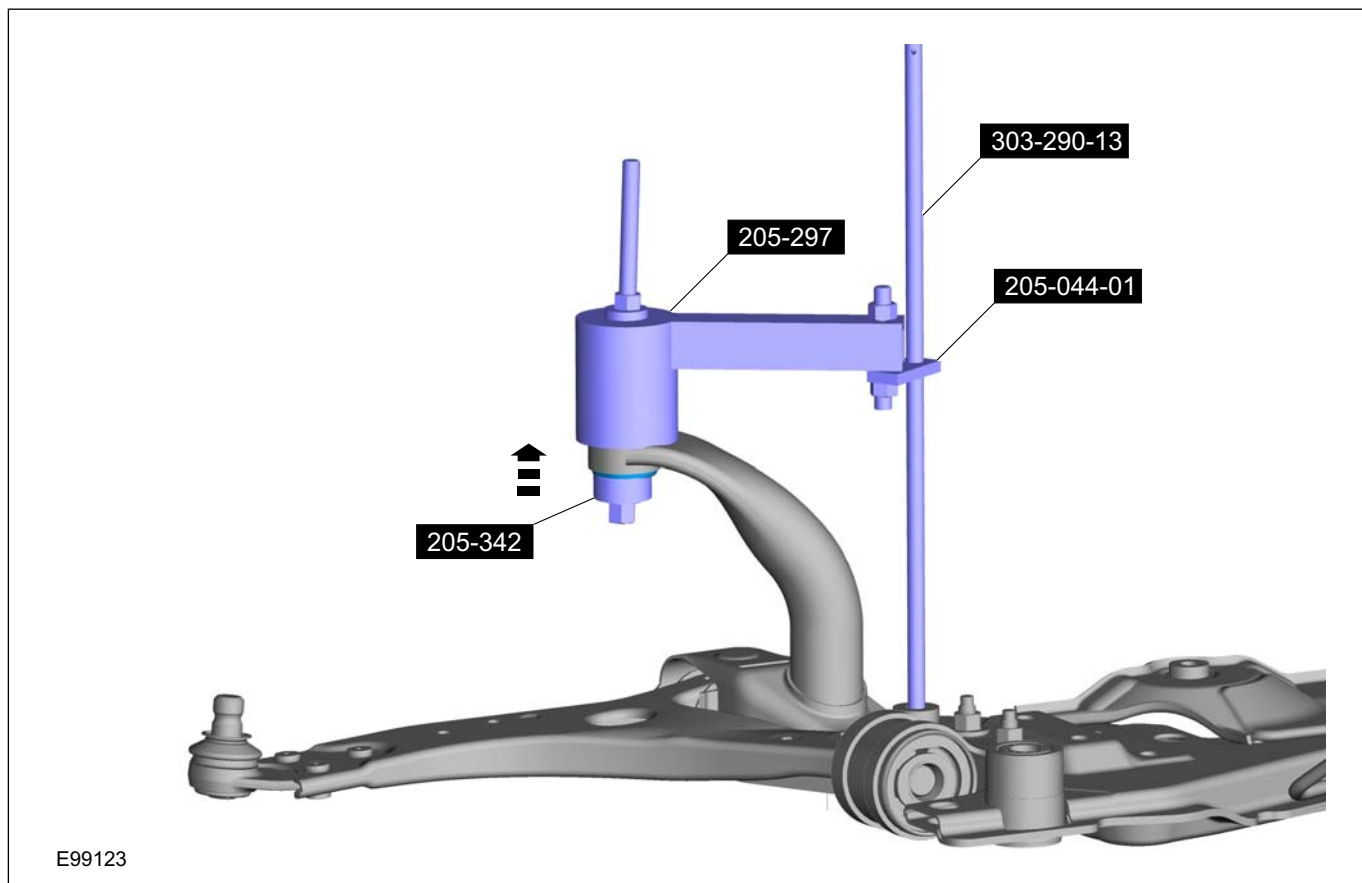
1. Refer to: **Front Subframe** (502-00 Uni-Body, Subframe and Mounting System, Removal and Installation).
2. Special Tool(s): 205-342, 205-297, 303-290-13, 205-044-01

502-00-9

Uni-Body, Subframe and Mounting System

502-00-9

## REMOVAL AND INSTALLATION



## Installation

1. Special Tool(s): 205-342-02, 205-342, 205-810, 303-733



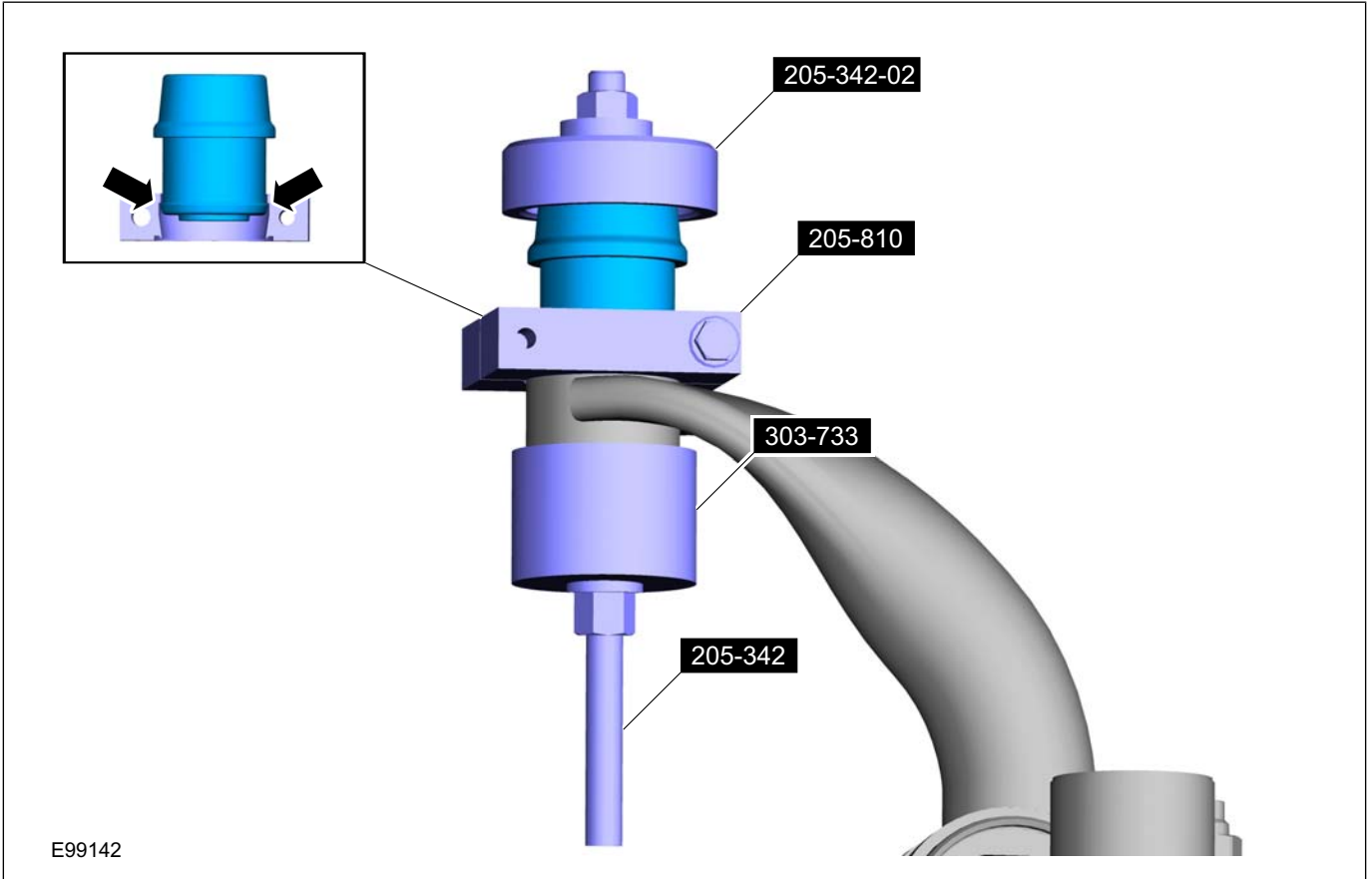
502-00-10

# Uni-Body, Subframe and Mounting System

502-00-10

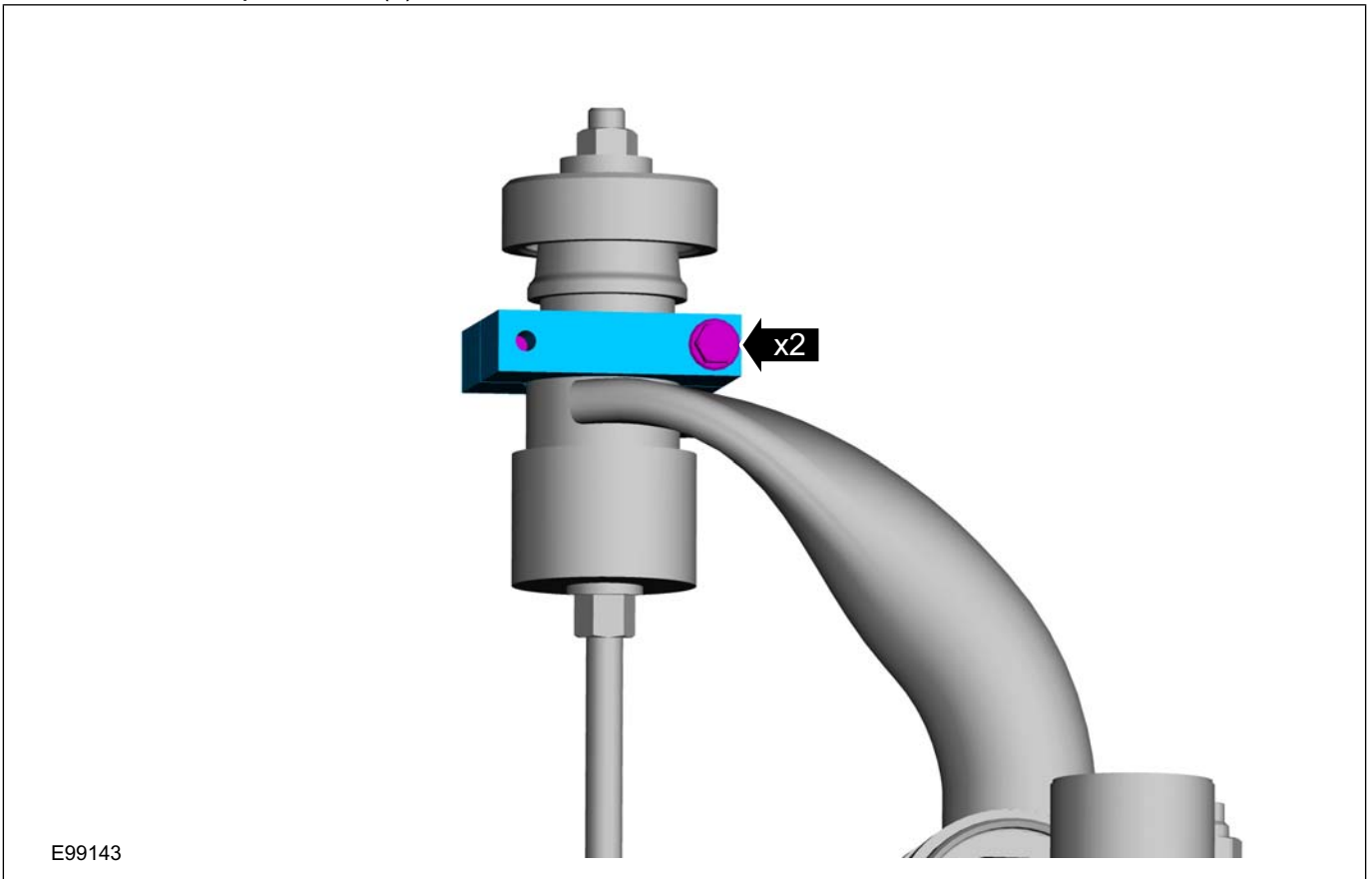


## REMOVAL AND INSTALLATION



E99142

2. Remove the Special Tool(s): 205-810



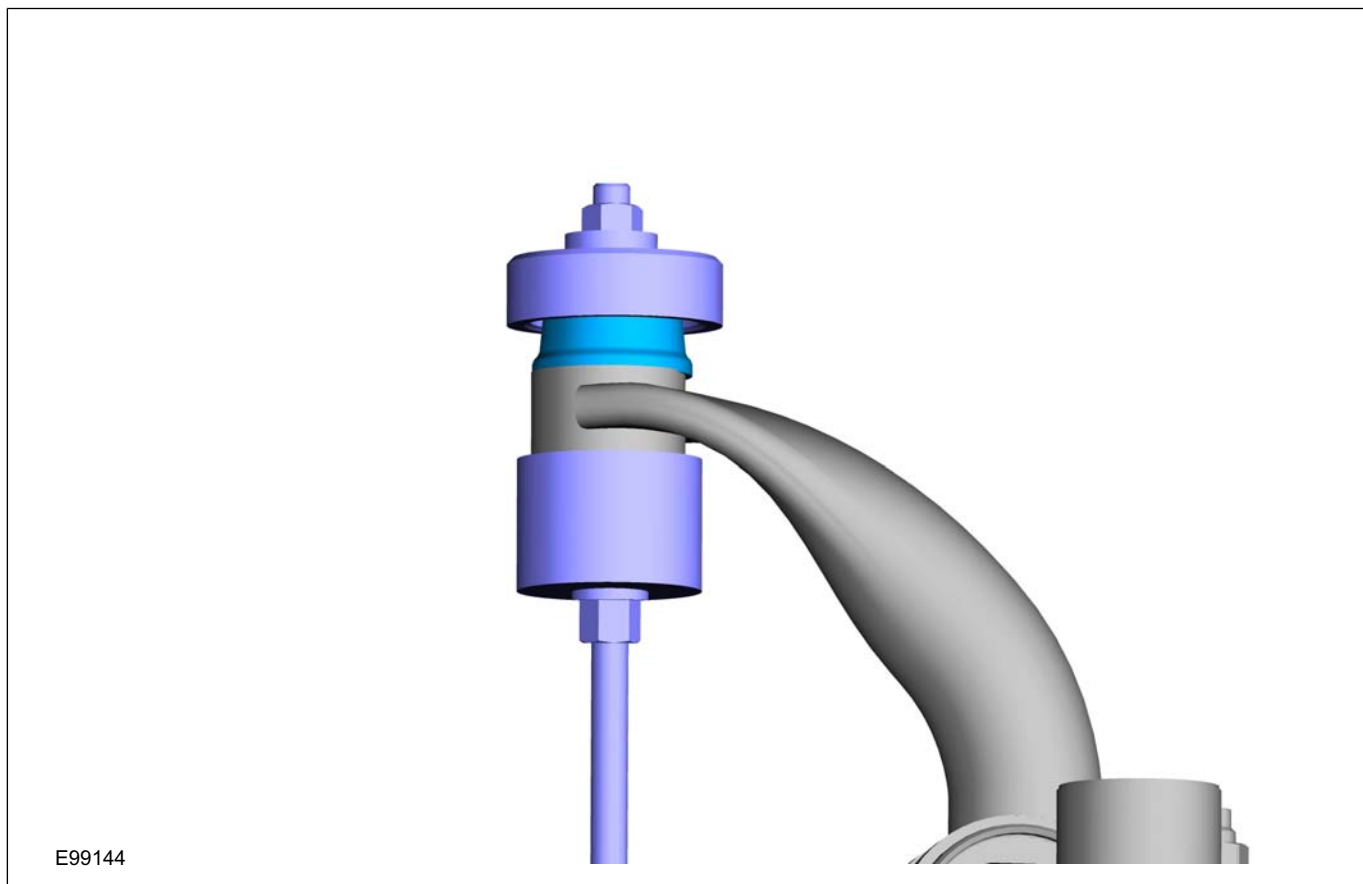
E99143





## REMOVAL AND INSTALLATION

3.

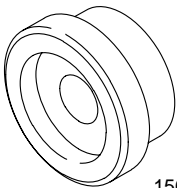
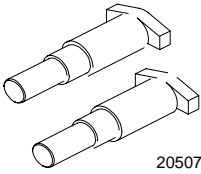


4. Remove the Special Tool(s): 205-342, 205-342-02, 303-733
5. Refer to: **Front Subframe** (502-00 Uni-Body, Subframe and Mounting System, Removal and Installation).

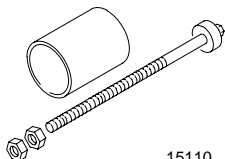
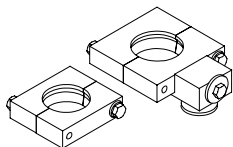
REMOVAL AND INSTALLATION

Front Subframe Rear Bushing

Special Tool(s)

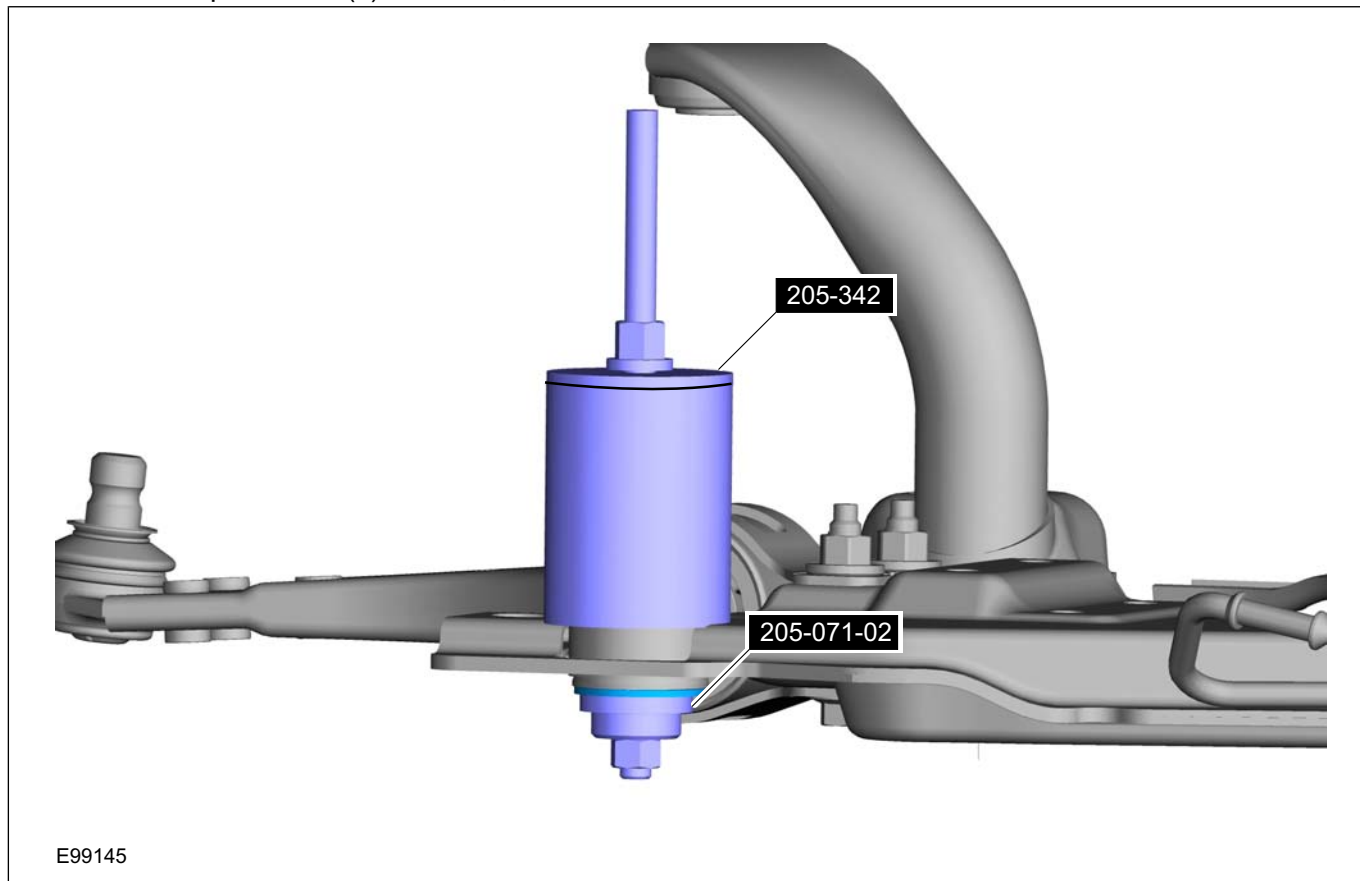
 <p>1502651</p>	<p>205-071-02 Adapter for 205-071 (Thrust Pad)</p>
 <p>20507202</p>	<p>205-072-02 Adapter for 205-072</p>

Special Tool(s)

 <p>15110</p>	<p>205-342 Remover/Installer, Pivot Bushing</p>
 <p>E51254</p>	<p>205-810 Installer, Subframe Bushing Guide</p>

Removal

1. Refer to: **Front Subframe** (502-00 Uni-Body, Subframe and Mounting System, Removal and Installation).
2. Install the Special Tool(s): 205-342, 205-071-02



502-00-13

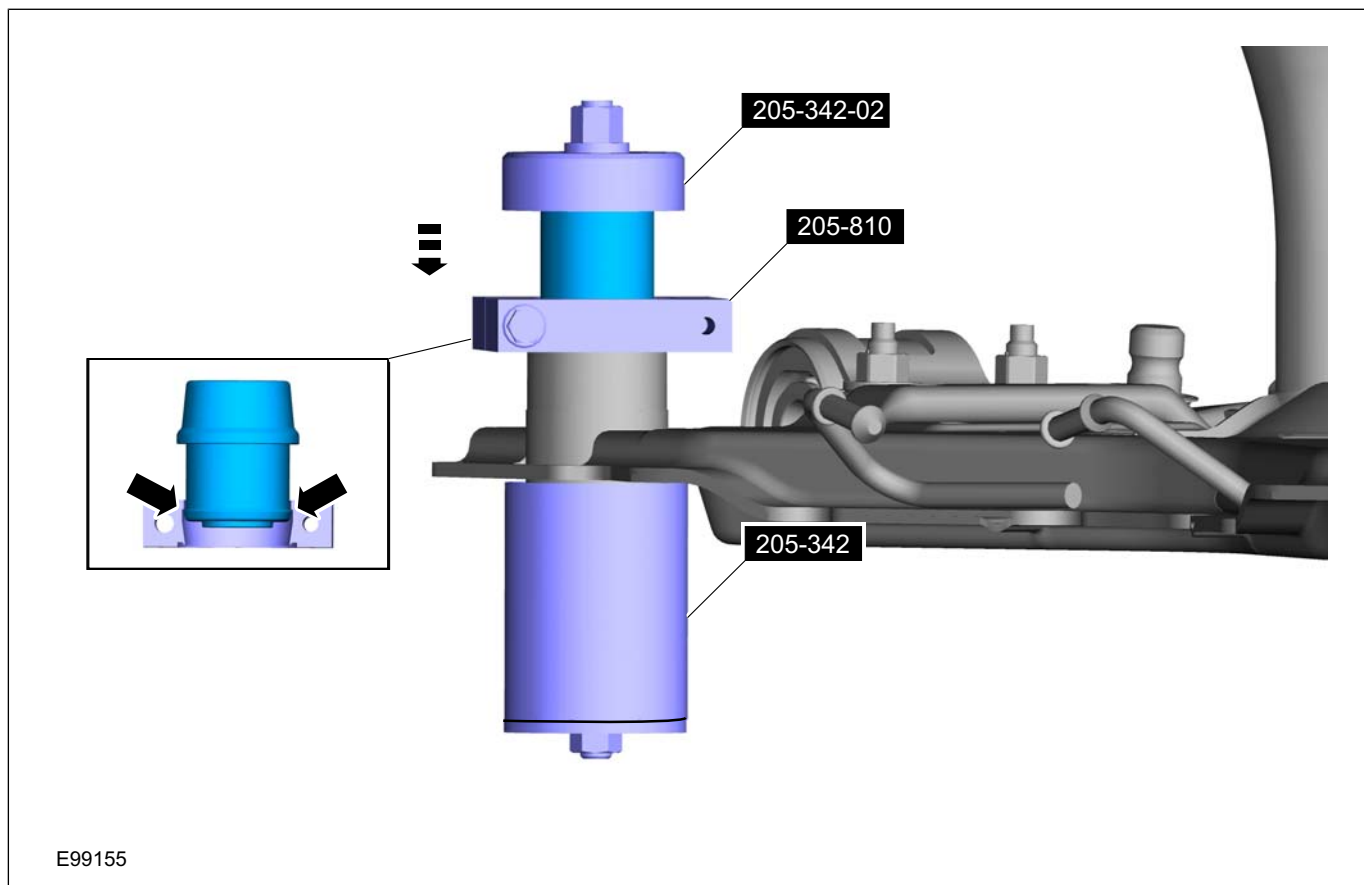
## Uni-Body, Subframe and Mounting System

502-00-13

## REMOVAL AND INSTALLATION

## Installation

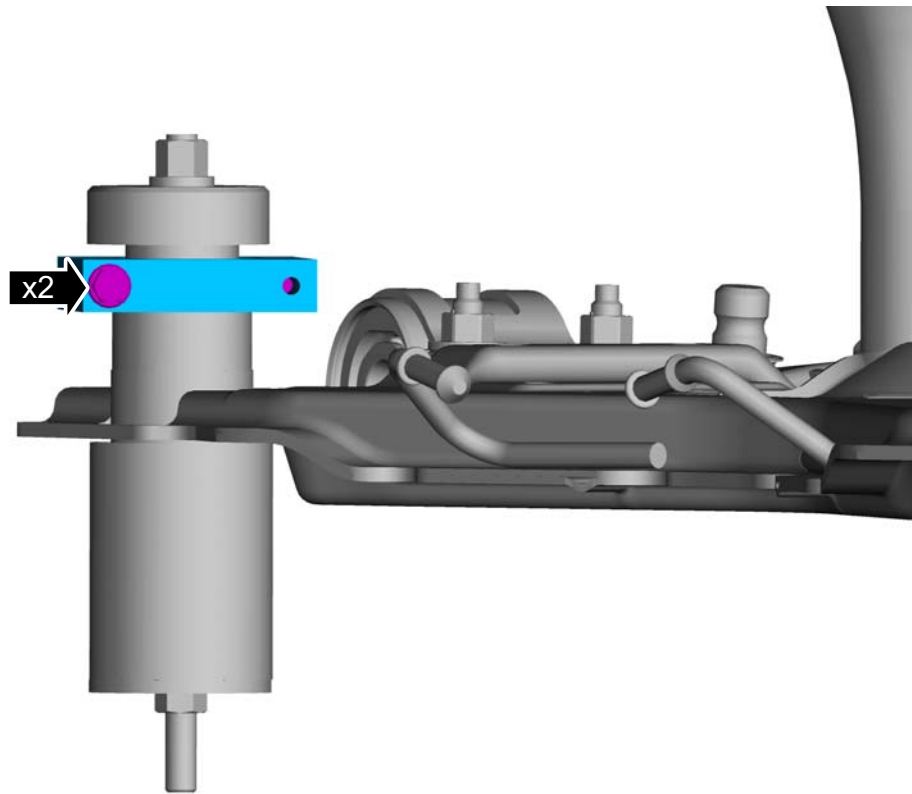
1. Install the Special Tool(s): 205-342, 205-810, 205-071-02



2. Remove the Special Tool(s): 205-810

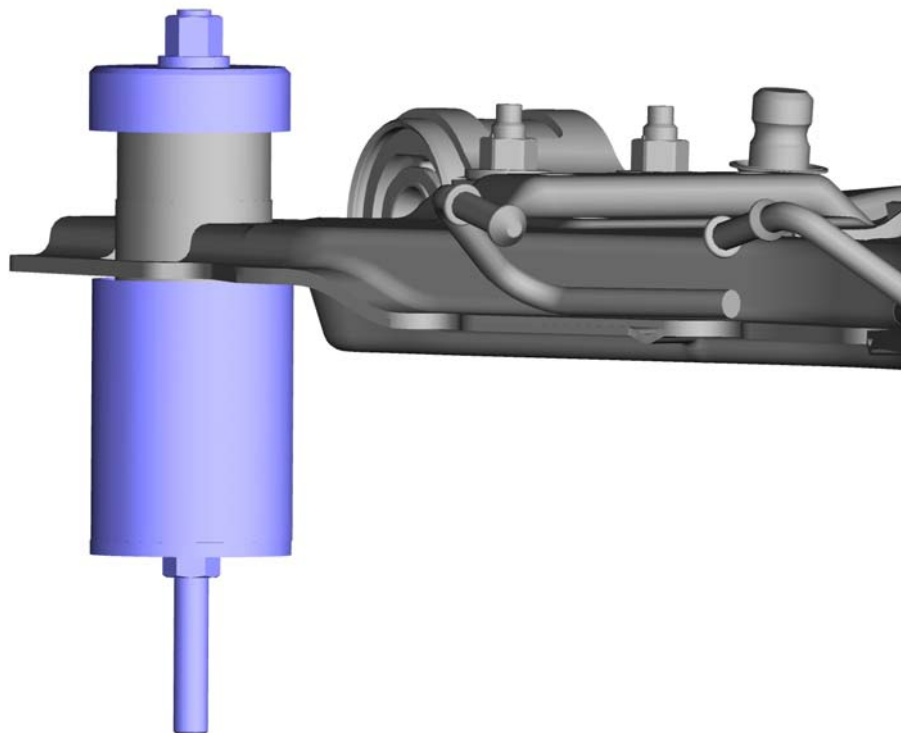


REMOVAL AND INSTALLATION



E99156

3.



E99157



502-00-15

## Uni-Body, Subframe and Mounting System

502-00-15

**REMOVAL AND INSTALLATION**

4. Remove the Special Tool(s): 205-342,  
205-072-02
5. Refer to: **Front Subframe** (502-00 Uni-Body,  
Subframe and Mounting System, Removal  
and Installation).

REMOVAL AND INSTALLATION

Rear Subframe

General Equipment

Transmission Jack

Removal

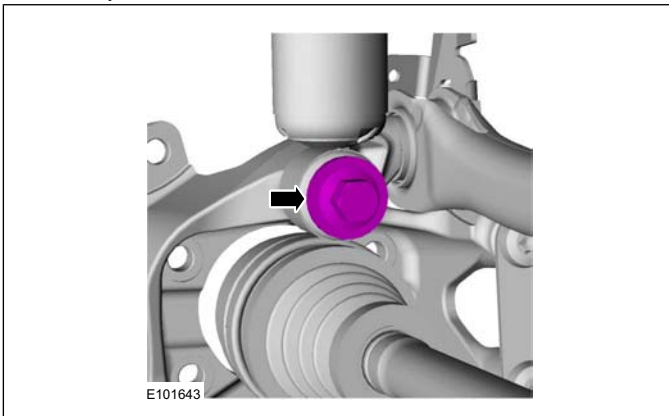
4x4

1. Refer to: **Differential Case** (205-02 Rear Drive Axle/Differential, Removal and Installation).

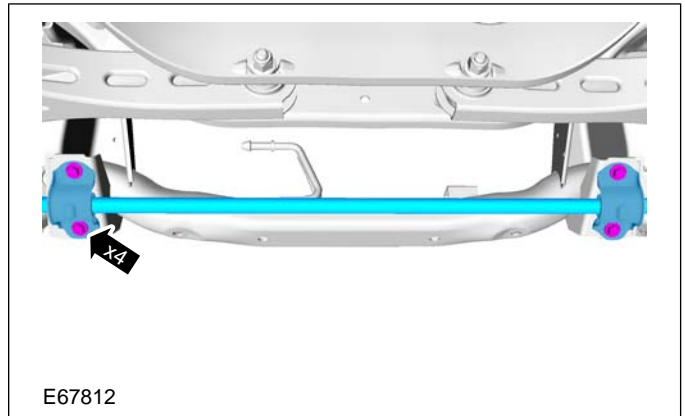
4x2

2. On both sides.  
Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

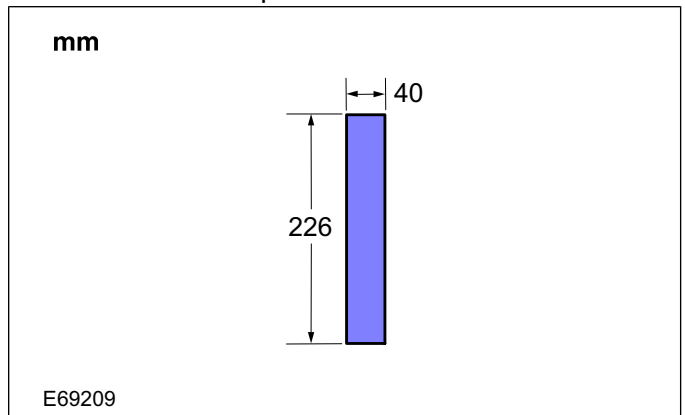
3. Torque: 115 Nm



6.



7. Fabricate two spacers.

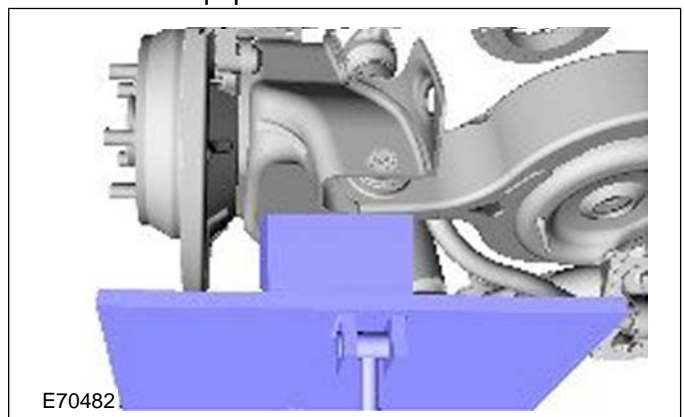


All vehicles

4. On both sides.  
Refer to: **Spring** (204-02 Rear Suspension, Removal and Installation).
5. On both sides.  
Refer to: **Rear Stabilizer Bar Link** (204-02 Rear Suspension, Removal and Installation).

8. On both sides.

General Equipment: Transmission Jack







502-00-17

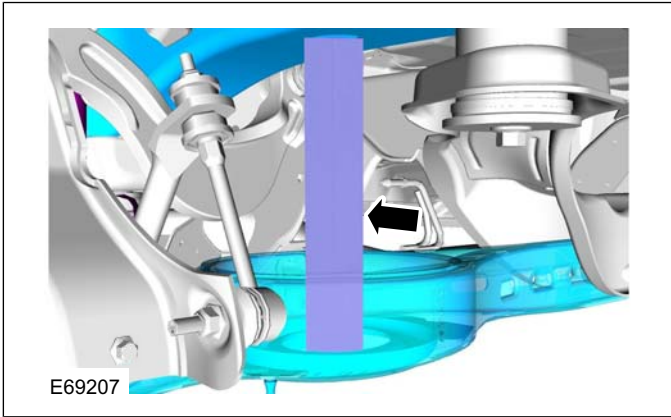
Uni-Body, Subframe and Mounting System

502-00-17

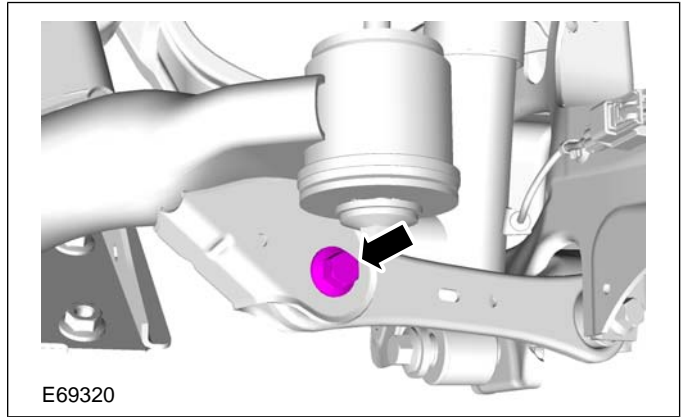


REMOVAL AND INSTALLATION

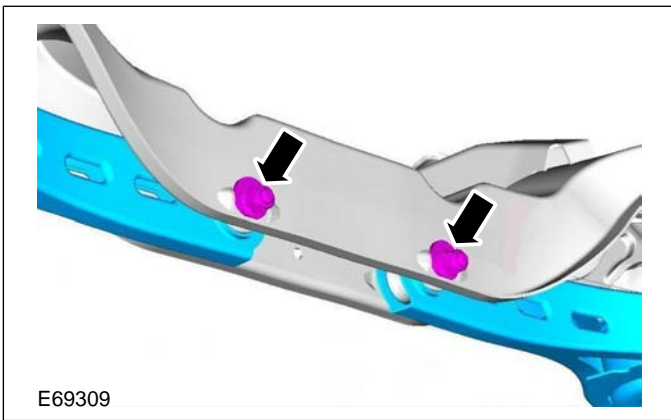
9.



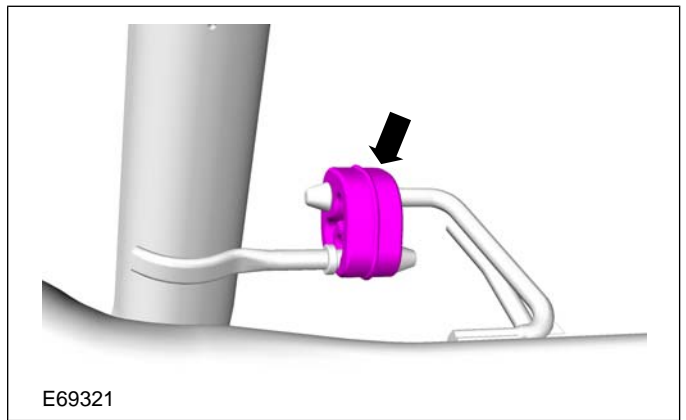
12. On both sides.



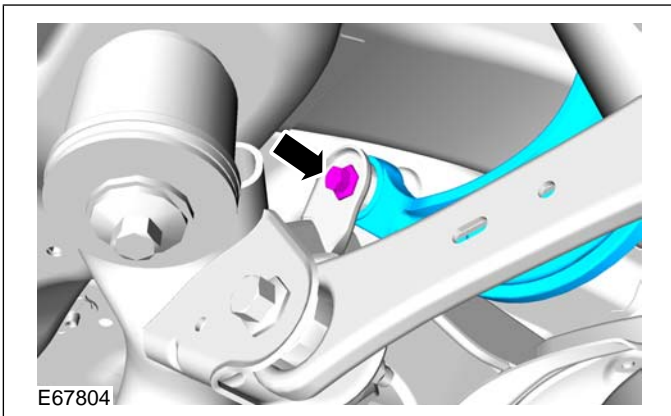
10.



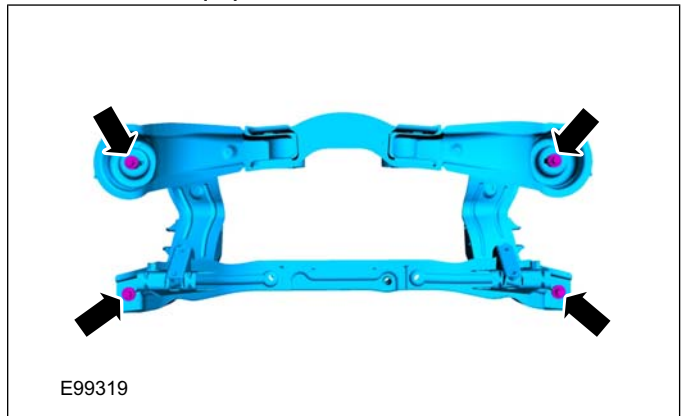
13.



11. On both sides.



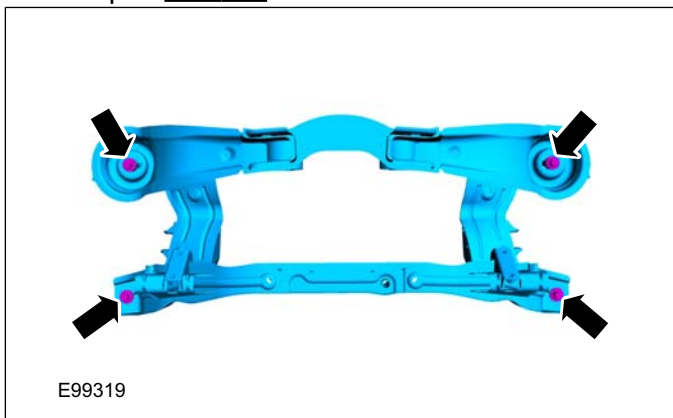
14. General Equipment: Transmission Jack



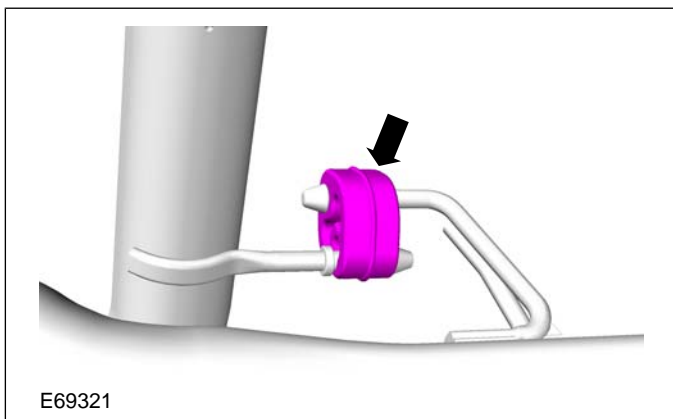
REMOVAL AND INSTALLATION

Installation

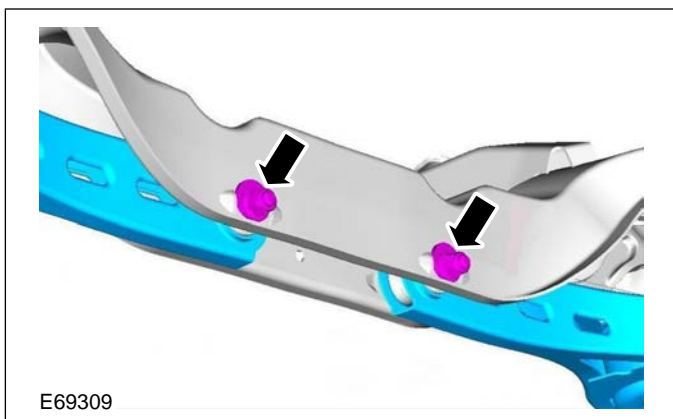
1. General Equipment: Transmission Jack  
Torque: 120 Nm



- 2.

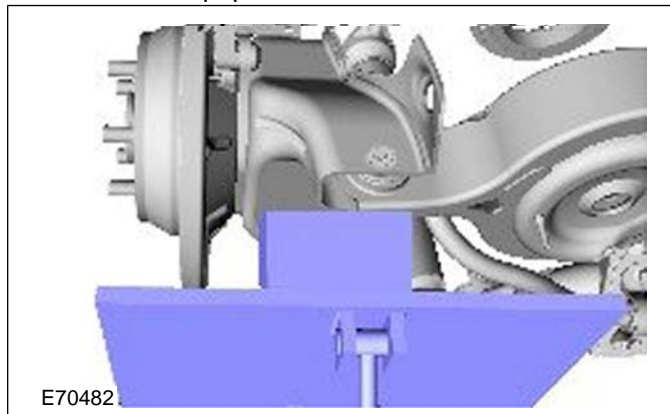


3. **NOTE:** Only tighten the nuts and bolts finger tight at this stage.

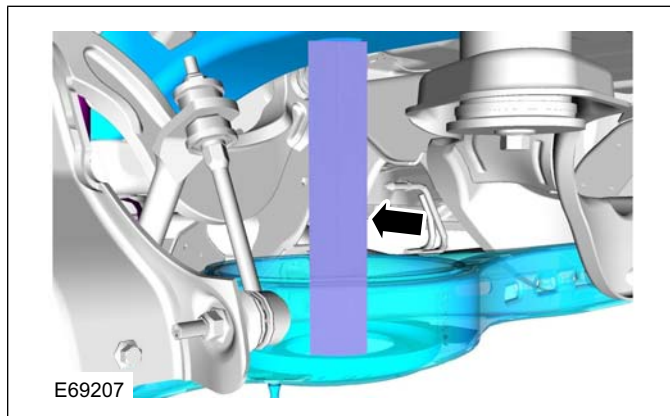


4. On both sides.

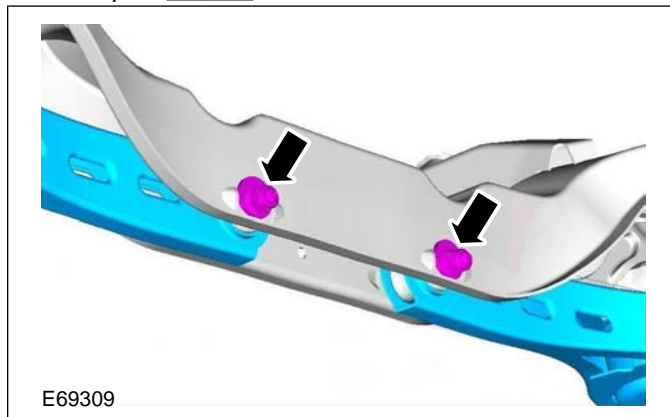
General Equipment: Transmission Jack



- 5.



6. Torque: 18 Nm

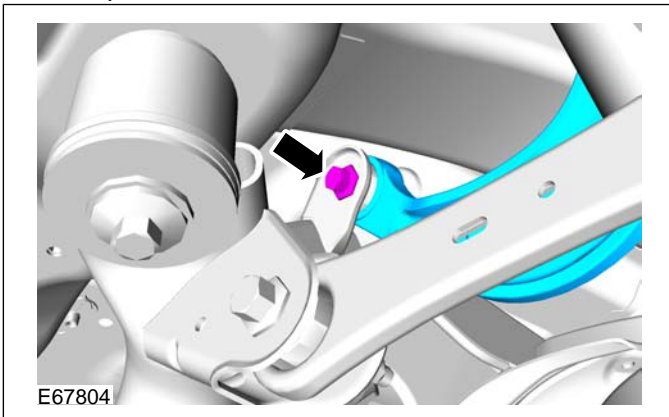
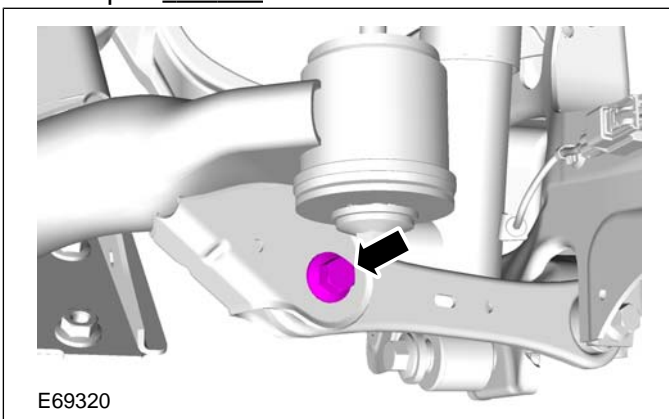
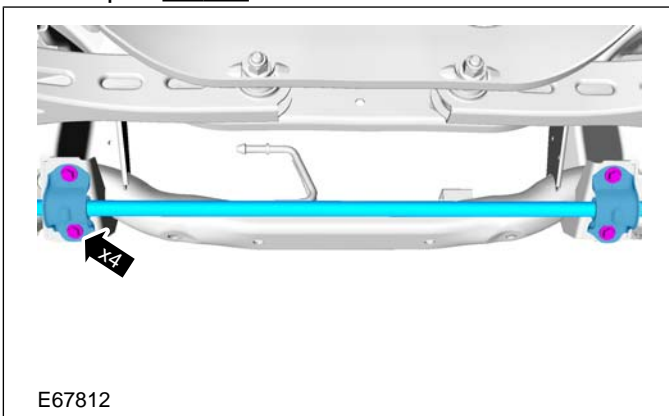


502-00-19

## Uni-Body, Subframe and Mounting System

502-00-19

## REMOVAL AND INSTALLATION

7. Torque: 115 Nm8. Torque: 115 Nm9. Torque: 48 Nm

10. On both sides.

Refer to: **Spring** (204-02 Rear Suspension, Removal and Installation).

11. On both sides.

Refer to: **Rear Stabilizer Bar Link** (204-02 Rear Suspension, Removal and Installation).

4x4

12. Refer to: **Differential Case** (205-02 Rear Drive Axle/Differential, Removal and Installation).

4x2

13. On both sides.

Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

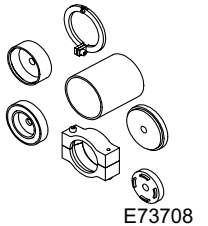
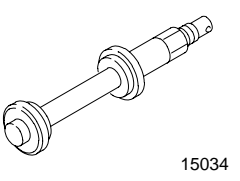
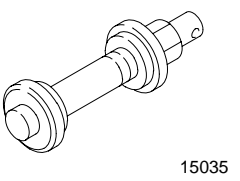
All vehicles

14. Refer to: **Rear Toe Adjustment** (204-00 Suspension System - General Information, General Procedures).

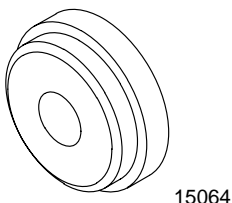
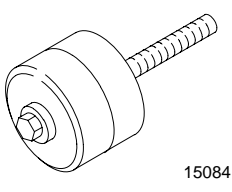
REMOVAL AND INSTALLATION

Rear Subframe Bushing

Special Tool(s)

 <p>E73708</p>	<p>204-598-01 Remover/Installer, Subframe Bushing Guide</p>
 <p>15034</p>	<p>205-073 Installer, Differential Bearing Cone</p>
 <p>15035</p>	<p>205-074 Installer, Differential Bearing Cone</p>

Special Tool(s)

 <p>15064</p>	<p>205-074-01 Adapter for 205-074</p>
 <p>15084</p>	<p>205-271 Installer, Pivot Bushing</p>

Removal

**NOTE:** Removal steps in this procedure may contain installation details.

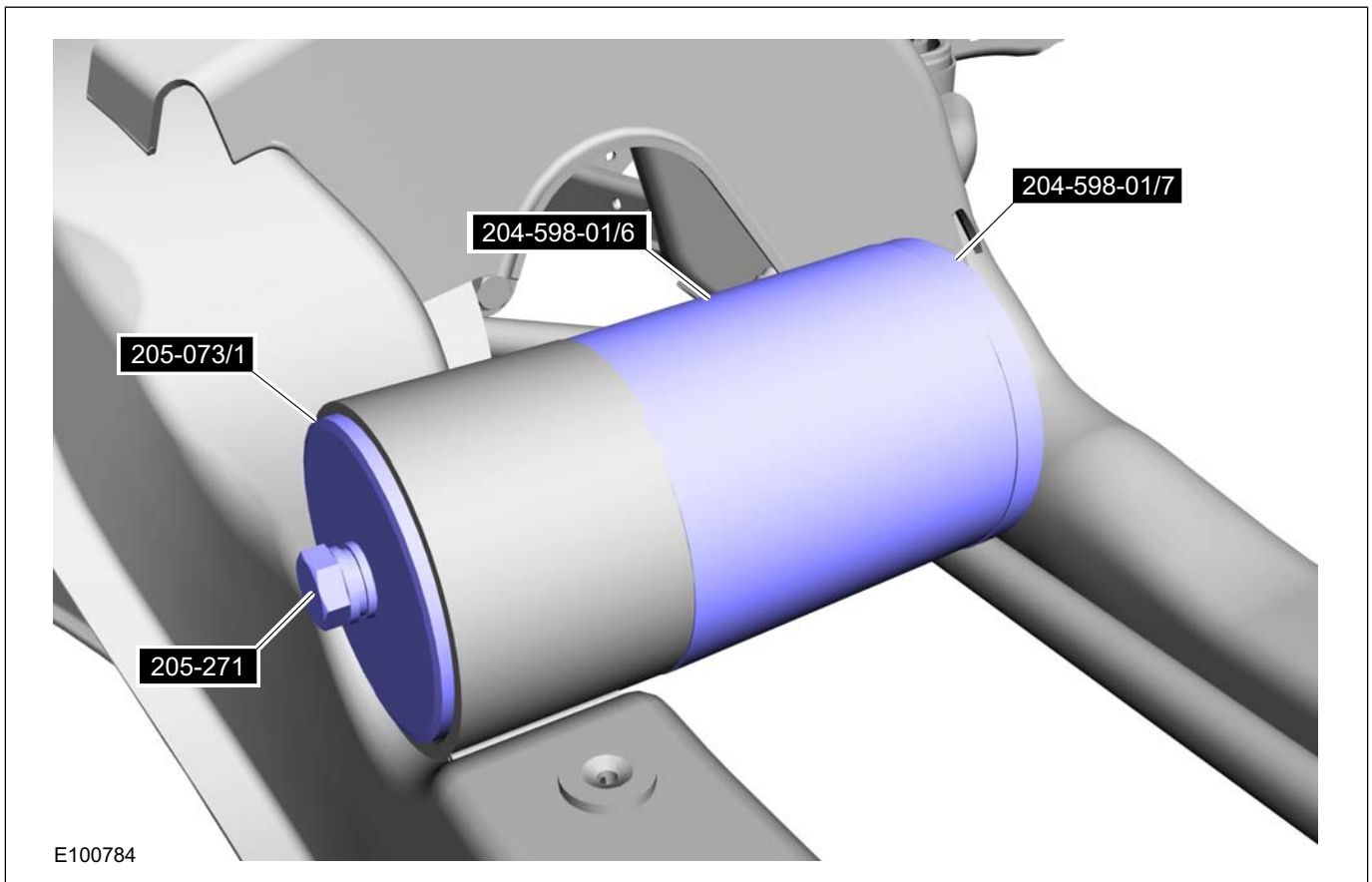
1. Refer to: **Differential Case** (205-02 Rear Drive Axle/Differential, Removal and Installation).
2. Special Tool(s): 204-598-01, 205-073, 205-271

502-00-21

Uni-Body, Subframe and Mounting System

502-00-21

## REMOVAL AND INSTALLATION



## Installation

1. Special Tool(s): 205-271, 205-074, 205-074-01

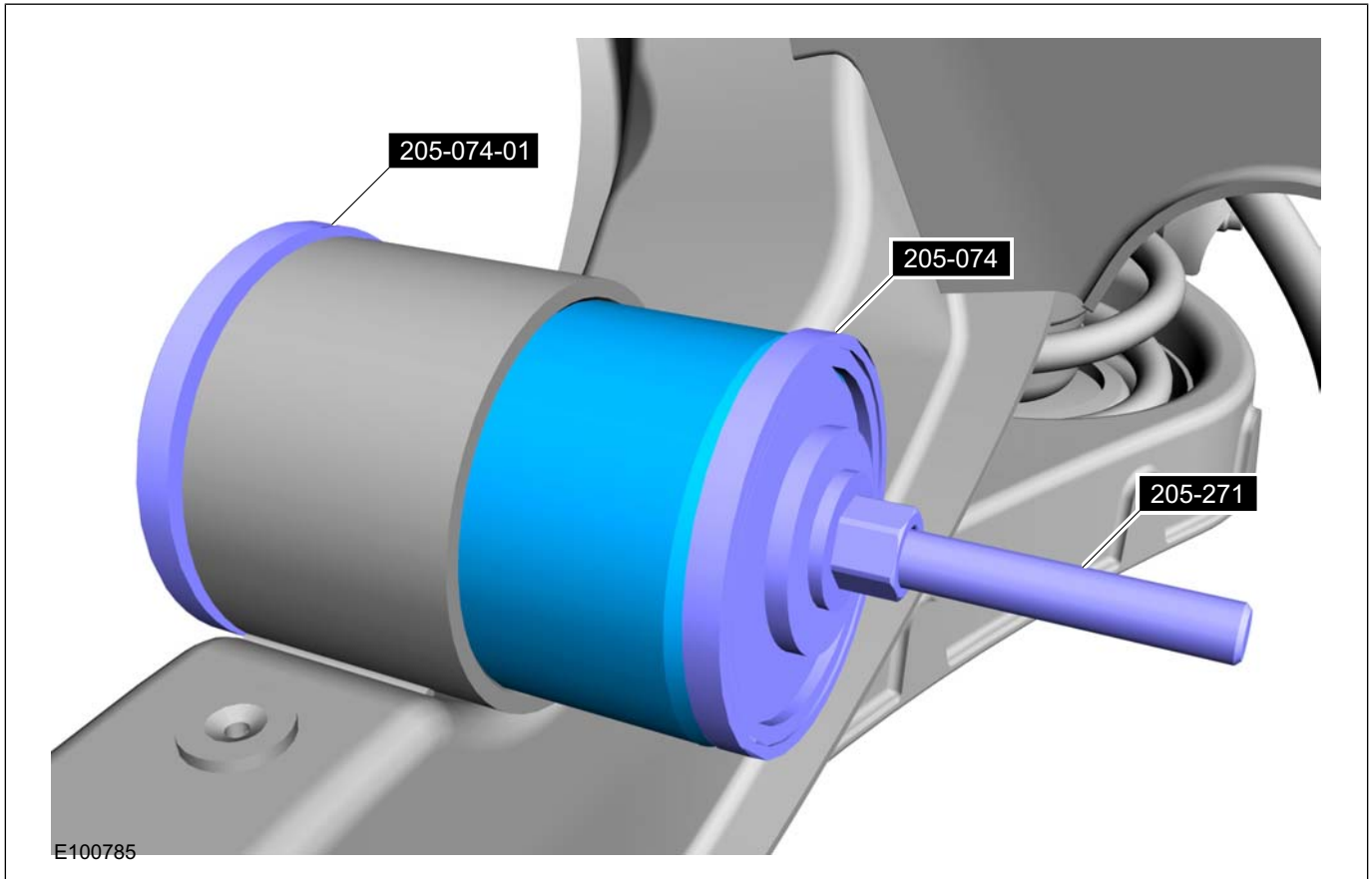


502-00-22

Uni-Body, Subframe and Mounting System

502-00-22

## REMOVAL AND INSTALLATION



2. To install, reverse the removal procedure.





## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>Steering wheel off center</li> </ul>	<ul style="list-style-type: none"> <li>Vehicle attitude incorrect (front or rear is high or low).</li> </ul>	<ul style="list-style-type: none"> <li>Vehicles without load levelling shock absorbers, CHECK for abnormal loading, spring sag or non-standard springs.</li> <li>Vehicles with load levelling shock absorbers, GO to <b>Pinpoint Test C</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Steering gear or linkage worn or damaged.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the steering system. REFER to: <b>Steering System</b> (211-00 Steering System - General Information, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Suspension lower arm ball joint.</li> </ul>	<ul style="list-style-type: none"> <li>CARRY OUT the Ball Joint Inspection Component Test in this procedure.</li> </ul>
	<ul style="list-style-type: none"> <li>Incorrect wheel alignment.</li> </ul>	<ul style="list-style-type: none"> <li>ADJUST the wheel alignment. REFER to: <b>Front Toe Adjustment</b> (204-00 Suspension System - General Information, General Procedures) / <b>Rear Toe Adjustment</b> (204-00 Suspension System - General Information, General Procedures).</li> </ul>
<ul style="list-style-type: none"> <li>Rough ride</li> </ul>	<ul style="list-style-type: none"> <li>Front strut and spring assemblies.</li> </ul>	<ul style="list-style-type: none"> <li>CARRY OUT the Strut or Shock Absorber Testing component test in this procedure.</li> <li>CHECK and INSTALL new suspension components as necessary. REFER to: <b>Front Strut and Spring Assembly</b> (204-01 Front Suspension, Disassembly and Assembly).</li> </ul>
	<ul style="list-style-type: none"> <li>Front or rear stabilizer bar connecting links or bushings.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK and INSTALL new suspension components as necessary. REFER to: <b>Front Strut and Spring Assembly</b> (204-01 Front Suspension, Disassembly and Assembly), <b>Rear Stabilizer Bar</b> (204-02 Rear Suspension, Removal and Installation).</li> </ul>

## DIAGNOSIS AND TESTING


Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Front suspension lower arm bushings.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new lower arm. REFER to: <b>Lower Arm</b> (204-01 Front Suspension, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Rear suspension arm bushings.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK and INSTALL new components as necessary. REFER to: <b>Rear Stabilizer Bar Bushing</b> (204-02 Rear Suspension, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Rear shock absorbers.</li> </ul>	<ul style="list-style-type: none"> <li>CARRY OUT the Strut or Shock Absorber Testing component test in this procedure.</li> <li>CHECK and INSTALL new suspension components as necessary.</li> </ul>
<ul style="list-style-type: none"> <li>Excessive noise</li> </ul>	<ul style="list-style-type: none"> <li>Front strut and spring assembly or rear shock absorber and spring upper mounting bolts or nuts loose or broken.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Shock absorbers leaking.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Shock absorbers performance incorrect.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Stabilizer bar components.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Strut and spring assembly and springs.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Springs moving on springs upper or lower seats.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Suspension bushings.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Lower arm ball joint.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Worn front wheel bearings</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Wheels and tires.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B</b>.</li> </ul>
<ul style="list-style-type: none"> <li>Incorrect tire wear</li> </ul>	<ul style="list-style-type: none"> <li>Front or rear suspension damage.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK and INSTALL new suspension components as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Incorrect wheel alignment.</li> </ul>	<ul style="list-style-type: none"> <li>ADJUST the wheel alignment. REFER to: <b>Front Toe Adjustment</b> (204-00 Suspension System - General Information, General Procedures) / <b>Rear Toe Adjustment</b> (204-00 Suspension System - General Information, General Procedures).</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
• Vibration	• Damaged or worn front wheel bearings.	• CHECK the front wheel bearings.
	• Wheels and tires.	• CHECK the tires. BALANCE or INSTALL new tires as necessary.
	• Steering gear or linkage worn or damaged.	• CHECK the steering system. REFER to: <b>Steering System</b> (211-00 Steering System - General Information, Diagnosis and Testing).
	• Front strut and spring assemblies.	• CARRY OUT the Strut or Shock Absorber Testing component test in this procedure. • CHECK and INSTALL new suspension components as necessary. REFER to: <b>Front Strut and Spring Assembly</b> (204-01 Front Suspension, Removal and Installation).
	• Damaged front suspension lower arm(s).	• CHECK and INSTALL new suspension components as necessary. REFER to: <b>Lower Arm</b> (204-01 Front Suspension, Removal and Installation).
• Vehicle lean	• Load-levelling shock absorbers.	• GO to <b>Pinpoint Test C</b> .

## Pinpoint Tests

## PINPOINT TEST A : DRIFT LEFT OR RIGHT

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
 <b>WARNING:</b> To avoid personal injury due to the loss of vehicle control, the inspection should be carried out by two people to maintain safe driving conditions. Adequate grip should	

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<p><b>always be maintained on the steering wheel. Failure to follow these instructions may result in personal injury.</b></p>	
<p><b>NOTE:</b> The following conditions must be met when evaluating the vehicle.</p>	
<p><b>NOTE:</b> The tire swapping procedures are for bi-directional rotating tires only.</p>	
<p><b>A1: SWAP THE FRONT WHEEL AND TIRE ASSEMBLIES</b></p>	
	<p>1 Raise and support the vehicle. REFER to: (100-02 Jacking and Lifting)</p> <p><b>Jacking</b> (Description and Operation), <b>Lifting</b> (Description and Operation).</p> <ul style="list-style-type: none"> <li>- Swap the front left-hand wheel and tire assembly with the front right-hand wheel and tire assembly.</li> <li>- Road test the vehicle.</li> </ul> <ul style="list-style-type: none"> <li>• Does the vehicle drift? <ul style="list-style-type: none"> <li>→ <b>Yes</b> GO to A2.</li> <li>→ <b>No</b> The concern has been corrected.</li> </ul> </li> </ul>
<p><b>A2: SWAP THE REAR WHEEL AND TIRE ASSEMBLIES</b></p>	
	<p>1 Raise and support the vehicle. REFER to: (100-02 Jacking and Lifting)</p> <p><b>Jacking</b> (Description and Operation), <b>Lifting</b> (Description and Operation).</p> <ul style="list-style-type: none"> <li>- Swap the rear left-hand wheel and tire assembly with the rear right-hand wheel and tire assembly.</li> <li>- Road test the vehicle.</li> </ul> <ul style="list-style-type: none"> <li>• Does the vehicle drift? <ul style="list-style-type: none"> <li>→ <b>Yes</b> GO to A3.</li> <li>→ <b>No</b> The concern has been corrected.</li> </ul> </li> </ul>

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A3: SWAP THE LEFT-HAND WHEEL AND TIRE ASSEMBLIES</b>	
	<p>1 Raise and support the vehicle. REFER to: (100-02 Jacking and Lifting)</p> <p><b>Jacking</b> (Description and Operation), <b>Lifting</b> (Description and Operation).</p> <ul style="list-style-type: none"> <li>- Swap the front left-hand wheel and tire assembly with the rear left-hand wheel and tire assembly.</li> <li>- Road test the vehicle.</li> </ul> <p>• Does the vehicle drift?</p> <p>→ <b>Yes</b> GO to A4.</p> <p>→ <b>No</b> The concern has been corrected.</p>
<b>A4: SWAP THE RIGHT-HAND WHEEL AND TIRE ASSEMBLIES</b>	
	<p>1 Raise and support the vehicle. REFER to: (100-02 Jacking and Lifting)</p> <p><b>Jacking</b> (Description and Operation), <b>Lifting</b> (Description and Operation).</p> <ul style="list-style-type: none"> <li>- Swap the front right-hand wheel and tire assembly with the rear right-hand wheel and tire assembly.</li> <li>- Road test the vehicle.</li> </ul> <p>• Does the vehicle drift?</p> <p>→ <b>Yes</b> GO to A5.</p> <p>→ <b>No</b> The concern has been corrected.</p>
<b>A5: SWAP THE FRONT LEFT-HAND WHEEL AND TIRE ASSEMBLY</b>	
	<p>1 Raise and support the vehicle. REFER to: (100-02 Jacking and Lifting)</p> <p><b>Jacking</b> (Description and Operation), <b>Lifting</b> (Description and Operation).</p> <ul style="list-style-type: none"> <li>- Swap the front left-hand wheel and tire assembly with the rear right-hand wheel and tire assembly.</li> <li>- Road test the vehicle.</li> </ul> <p>• Does the vehicle drift?</p> <p>→ <b>Yes</b> <b>GO to A6.</b></p> <p>→ <b>No</b> The concern has been corrected.</p>

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A6: SWAP THE FRONT RIGHT-HAND WHEEL AND TIRE ASSEMBLY</b>	
	<p>1 Raise and support the vehicle. REFER to: (100-02 Jacking and Lifting)</p> <p><b>Jacking</b> (Description and Operation), <b>Lifting</b> (Description and Operation).</p> <ul style="list-style-type: none"> <li>– Swap the front right-hand wheel and tire assembly with the rear left-hand wheel and tire assembly.</li> <li>– Road test the vehicle.</li> </ul> <ul style="list-style-type: none"> <li>• Does the vehicle drift?           <ul style="list-style-type: none"> <li>→ <b>Yes</b> GO to A7.</li> <li>→ <b>No</b> The concern has been corrected.</li> </ul> </li> </ul>
<b>A7: INSTALL NEW TIRES</b>	
<b>NOTE:</b> Install new tires only once.	
	<p>1 Install new tires to the four road wheels. TEST the system for normal operation.</p> <ul style="list-style-type: none"> <li>• Does the vehicle drift?           <ul style="list-style-type: none"> <li>→ <b>Yes</b> Verify possible sources, refer to the Symptom Chart.</li> <li>→ <b>No</b> The concern has been corrected.</li> </ul> </li> </ul>

## PINPOINT TEST B : EXCESSIVE NOISE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B1: INSPECT ALL STRUT AND SPRING ASSEMBLY AND SHOCK ABSORBER MOUNTING BOLTS AND NUTS</b>	
	<p>1 Inspect the strut and spring assembly and shock absorber mounting bolts and nuts.</p> <ul style="list-style-type: none"> <li>• Are the mounting bolts or nuts loose or broken?           <ul style="list-style-type: none"> <li>→ <b>Yes</b> TIGHTEN or INSTALL new suspension mounting bolts. REFER to: <b>Specifications</b> (204-01 Front Suspension, Specifications).</li> <li>→ <b>No</b> GO to B2.</li> </ul> </li> </ul>



## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B2: INSPECT THE STRUT AND SPRING ASSEMBLIES AND SHOCK ABSORBERS FOR LEAKS</b>	
	<p><b>NOTE:</b> Make sure that the oil is not from another source.</p> <p>1 Inspect the strut and spring assemblies and shock absorbers for signs of oil weepage or leaks. Refer to weepage and leakage conditions in the Strut or Shock Absorber Testing component test in this procedure.</p> <ul style="list-style-type: none"> <li>• Are the struts or shock absorbers leaking?</li> </ul> <p>→ <b>Yes</b> INSTALL new struts or shock absorbers as necessary.</p> <p>REFER to: <b>Front Strut and Spring Assembly</b> (204-01 Front Suspension, Removal and Installation).</p> <p>→ <b>No</b> GO to B3.</p>
<b>B3: INSPECT THE SPRINGS AND STABILIZER BAR(S)</b>	
	<p>1 Inspect the springs and stabilizer bar(s) for damage.</p> <ul style="list-style-type: none"> <li>• Are the springs or stabilizer bar(s) damaged?</li> </ul> <p>→ <b>Yes</b> INSTALL new springs or stabilizer bar(s). REFER to:</p> <p><b>Front Strut and Spring Assembly</b> (204-01 Front Suspension, Removal and Installation), <b>Front Stabilizer Bar</b> (204-01 Front Suspension, Removal and Installation), <b>Rear Stabilizer Bar Link</b> (204-02 Rear Suspension, Removal and Installation).</p> <p>→ <b>No</b> GO to B4.</p>

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B4: INSPECT THE SUSPENSION BUSHINGS</b>	
	<p>1 Inspect the suspension bushings for excessive wear or damage.</p> <ul style="list-style-type: none"> <li>• Are the bushings worn or damaged?</li> </ul> <p>→ <b>Yes</b> INSTALL new components as necessary. REFER to:</p> <p><b>Lower Arm</b> (204-01 Front Suspension, Removal and Installation), <b>Front Strut and Spring Assembly</b> (204-01 Front Suspension, Removal and Installation), <b>Front Stabilizer Bar</b> (204-01 Front Suspension, Removal and Installation), <b>Rear Stabilizer Bar Link</b> (204-02 Rear Suspension, Removal and Installation).</p> <p>→ <b>No</b> GO to B5.</p>
<b>B5: INSPECT THE SUSPENSIONS LOWER ARM BALL JOINTS</b>	
	<p>1 Carry out the Ball Joint Inspection component test in this procedure.</p> <ul style="list-style-type: none"> <li>• Is the lower arm ball joint or gaiter damaged?</li> </ul> <p>→ <b>Yes</b> INSTALL new lower arm. REFER to: <b>Lower Arm</b> (204-01 Front Suspension, Removal and Installation). TEST the system for normal operation.</p> <p>→ <b>No</b> GO to B6.</p>
<b>B6: INSPECT THE WHEEL BEARINGS</b>	
	<p>1 Check the wheel bearings.</p> <ul style="list-style-type: none"> <li>• Are the wheel bearings damaged?</li> </ul> <p>→ <b>Yes</b> INSTALL a new wheel hub(s). REFER to: <b>Wheel Hub</b> (204-01 Front Suspension, Removal and Installation).</p> <p>→ <b>No</b> <b>GO to B7.</b></p>

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B7: INSPECT THE WHEEL AND TIRES</b>	
	<p>1 Inspect the tires for uneven wear.</p> <ul style="list-style-type: none"> <li>• Is there uneven wear?</li> </ul> <p>→ <b>Yes</b> REFER to the symptom chart.</p> <p>→ <b>No</b> GO to B8.</p>
<b>B8: INSPECT THE STRUT AND SPRING ASSEMBLY AND REAR SUSPENSION SPRING INTERFACE</b>	
	<p>1 Loosen the strut and spring assemblies and shock absorbers top and bottom mounting bolts and nuts. Tighten the mounting bolts and nuts. REFER to:</p> <p><b>Specifications</b> (204-01 Front Suspension, Specifications), <b>Specifications</b> (204-02 Rear Suspension, Specifications).</p> <ul style="list-style-type: none"> <li>• Is the concern still evident?</li> </ul> <p>→ <b>Yes</b> GO to B9.</p> <p>→ <b>No</b> Vehicle condition corrected.</p>
<b>B9: INSPECT THE STRUT AND SPRING ASSEMBLIES AND SHOCK ABSORBER COMPONENTS</b>	
	<p>1 Check that the spring is correctly located on the spring seat and has not moved.</p> <p>2 Disassemble the strut and spring and assembly and inspect the individual components. REFER to: <b>Front Strut and Spring Assembly</b> (204-01 Front Suspension, Removal and Installation).</p> <p>3 Inspect the shock absorber top mount for wear or damage.</p>

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
	<p>4 Carry out the Strut or Shock Absorber Testing component test in this procedure.</p> <ul style="list-style-type: none"> <li>Are any of the strut and spring assemblies or shock absorber components damaged?</li> </ul> <p>→ <b>Yes</b> INSTALL new components as necessary. REFER to:</p> <p><b>Front Strut and Spring Assembly</b> (204-01 Front Suspension, Removal and Installation), <b>Spring</b> (204-02 Rear Suspension, Removal and Installation).</p> <p>→ <b>No</b> REINSTALL the strut and spring assemblies or shock absorbers. GO to C1.</p>

## PINPOINT TEST C : VEHICLE LEAN

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>C1: VEHICLE LEAN</b>	
	<p>1 Detach the load levelling shock absorbers from the wheel knuckles.</p> <ul style="list-style-type: none"> <li>Does the vehicle lean?</li> </ul> <p>→ <b>Yes</b> Install new rear springs. REFER to: <b>Spring</b> (204-02 Rear Suspension, Removal and Installation). TEST the system for normal operation.</p> <p>→ <b>No</b> CARRY OUT the Load-Levelling Shock Absorber Component Test in this section.</p>

## Component Tests

Raise and support the vehicle. REFER to: (100-02 Jacking and Lifting)

**Jacking** (Description and Operation),  
**Lifting** (Description and Operation).

2. If there is any free movement install a new lower arm.

REFER to: **Lower Arm** (204-01 Front Suspension, Removal and Installation).

## Ball Joint Inspection

1. Firmly grasp the outer end of the suspension lower arm and try to move it up and down, watching and feeling for any movement. Free movement will usually be accompanied by an audible "click". There should be no free movement.

**DIAGNOSIS AND TESTING**

3. If a new lower arm is installed it will be necessary to check and adjust the front wheel alignment.

REFER to: **Front Toe Adjustment** (204-00 Suspension System - General Information, General Procedures)

/ **Rear Toe Adjustment** (204-00 Suspension System - General Information, General Procedures).

4. Compress and pull the piston rod in the vertical position. Feel if the resistance force at the point of direction change-over is perceptible without a lag. If a lag is perceptible it is an indication of damper valve damage and new struts or shock absorbers must be installed. REFER to:

**Front Strut and Spring Assembly** (204-01 Front Suspension, Removal and Installation),  
**Spring** (204-02 Rear Suspension, Removal and Installation).

**Strut or Shock Absorber Inspection**

**NOTE:** Inspect the struts or shock absorber for signs of oil weepage or leaks. Make sure that the oil is not from another source.

Weepage:

- deposits a thin film of oil on the strut and spring assembly or shock absorber.
- is normally noticed due to a collection of dust on the strut and spring assembly or shock absorber.
- occurs during the normal running-in period of 4800 - 8050 km. After this period no new signs of oil should be visible.
- does not require new struts or shock absorbers to be installed.

Leakage:

- covers the entire strut and spring assembly or shock absorber with oil.
- will drip oil onto the surrounding suspension components.
- requires new struts or shock absorbers to be installed.

**Strut or Shock Absorber Testing**

**NOTE:** Struts or shock absorbers must be tested in the vertical position.

1. Remove both strut and spring assemblies or shock absorbers. The piston rods should extend.
- Disassemble the strut and spring assemblies.

REFER to: **Front Strut and Spring Assembly** (204-01 Front Suspension, Removal and Installation).

2. Compress the piston rods. Both piston rods should offer the same resistance when compressing.
3. Compress and release the piston rods. The piston rods should extent equally.

**Load-Levelling Shock Absorber**

1. With the vehicle unladen, measure and note the dimensions between the base of the wheel rim and the top of the rear fender on both sides.
- The measurements on both sides should be approximately equal.
2. With a load of 4 average size adults and a 100 kg weight, measure and note the dimensions between the base of the wheel rim and the top of the rear fender on both sides.

- 3. NOTE: Due to the internal ratchet mechanism of the suspension components, the height of the rear of the vehicle should rise during the road test.**

With a load of 4 average size adults and a 100 kg weight, drive the vehicle for 3 km on a road of normal condition.

4. With a load of 4 average size adults and a 100 kg weight, measure and note the dimensions between the base of the wheel rim and the top of the rear fender on both sides.
5. If the dimensions on both sides are no longer approximately equal, install new load levelling shock absorbers.

REFER to: **Spring** (204-02 Rear Suspension, Removal and Installation).

- 6. NOTE: Due to the internal ratchet mechanism of the suspension components, the height of the rear of the vehicle should rise during the road test.**

If the dimensions are approximately equal, unload the vehicle and drive the vehicle for 3 km on a road of normal condition.

7. With the vehicle unladen, measure and note the dimensions between the base of the wheel rim and the top of the rear fender on both sides. Check the final dimensions with the original dimensions taken in the unladen condition.

**DIAGNOSIS AND TESTING**

8. If the final dimensions do not approximately equal the original dimensions, install new load levelling shock absorbers.

REFER to: **Spring** (204-02 Rear Suspension, Removal and Installation).

9. If the final dimensions approximately equal the original dimensions, verify the customer concern.



## GENERAL PROCEDURES

## Front Toe Adjustment(14 117 3)

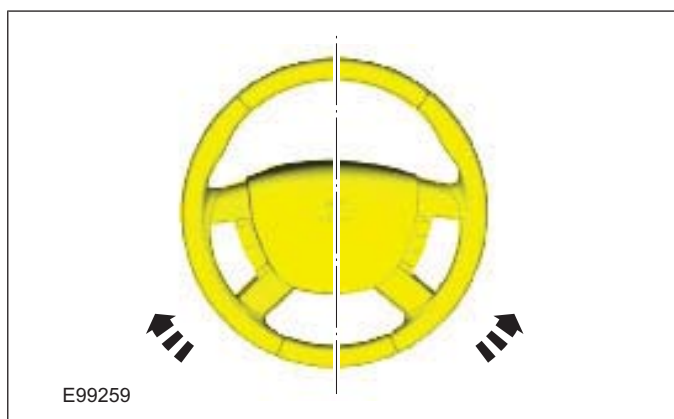
## General Equipment

Wheel Alignment System
------------------------

**NOTE:** Make sure that the vehicle is standing on a level surface.

1.  **CAUTION:** Make sure that the steering wheel lock is engaged.

**NOTE:** Make sure that the road wheels are in the straight ahead position.

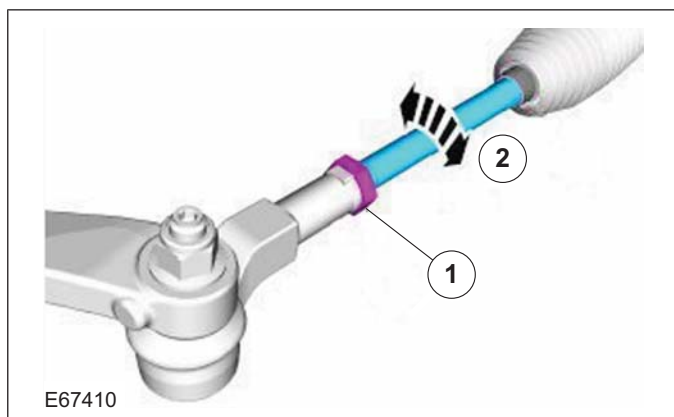


2. Check the toe setting on both sides.

General Equipment: Wheel Alignment System

3. 1. Loosen on both sides.  
Torque: 69 Nm
2. **NOTE:** Make sure that the boot is correctly located.

Rotate the tie-rods an equal amount in either a clockwise or a counterclockwise direction to adjust the toe setting on both sides.



## GENERAL PROCEDURES

## Rear Toe Adjustment(15 211 3)

## General Equipment

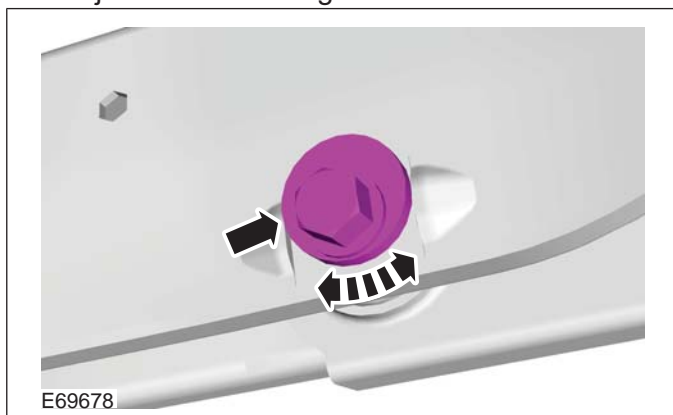
Wheel Alignment System

**NOTE:** Make sure that the vehicle is standing on a level surface.

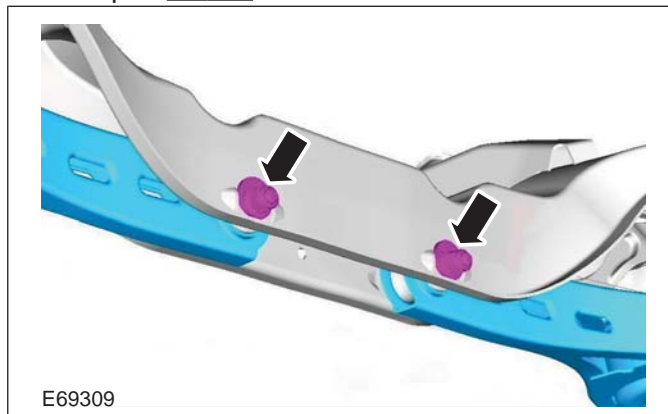
1. Check the toe setting.  
Refer to: **Specifications** (204-02 Rear Suspension, Specifications).  
General Equipment: Wheel Alignment System
2. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
3. Loosen the rear lower arm adjustment cam nut on both sides.  
Torque: **18 Nm**



4. Lower the vehicle.
5. Bounce the vehicle to make sure that the suspension is in its normal resting position.
6. Adjust the toe setting.



7. **NOTE:** Only tighten the nuts and bolts when the suspension is in the normal drive position.

Torque: **90 Nm**

## SECTION 204-01 Front Suspension

**VEHICLE APPLICATION: 2008.50 Kuga**

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<b>SPECIFICATIONS</b>		
Specifications.....		204-01-2
<b>DESCRIPTION AND OPERATION</b>		
Front Suspension (Component Location).....		204-01-3
Front Suspension (Overview).....		204-01-4
Overview.....		204-01-4
Spring and damper assembly.....		204-01-5
Subframe.....		204-01-6
Stabilizer bar.....		204-01-7
<b>REMOVAL AND INSTALLATION</b>		
Wheel Hub.....	(14 371 0)	204-01-8
Front Wheel Bearing.....	(14 411 0; 14 411 4; 14 412 0; 14 414 4; 14 416 4)	204-01-9
Lower Arm.....	(14 706 0; 14 707 0; 14 709 0)	204-01-13
Front Stabilizer Bar.....	(14 752 0)	204-01-15
Front Stabilizer Bar Bushing.....	(14 754 0; 14 754 4)	204-01-20
Wheel Knuckle.....	(14 343 0)	204-01-21
Front Strut and Spring Assembly.....	(14 781 0; 14 782 0)	204-01-26
<b>DISASSEMBLY AND ASSEMBLY</b>		
Front Strut and Spring Assembly.....	(14 783 4)	204-01-29

## SPECIFICATIONS

## Front Wheel Alignment 2WD (at curb weight)

Description	Measurements	Tolerance Range	Setting or Nominal	Maximum Variance Left or Right
Caster angle	Degrees and minutes	3°26' to 5°26'	4°26'	1°00'
	Decimal degrees	3.44° to 5.44°	4.44°	1.00°
Camber angle	Degrees and minutes	-2°03' to +0°27'	-0°48'	1°15'
	Decimal degrees	-2.05° to -0.45°	-0.80°	1.25°
Total toe	mm	1.5 Toe-in ± 2.6	1.5 Toe-in ± 1.1	-
	Degrees and minutes	0°12' Toe-in ± 0°21'	0°12' Toe-in ± 0°09'	-
	Decimal degrees	0.20° Toe-in ± 0.35°	0.20° Toe-in ± 0.15°	-

## Front Wheel Alignment 4WD (at curb weight)

Description	Measurements	Tolerance Range	Setting or Nominal	Maximum Variance Left or Right
Caster angle	Degrees and minutes	3°22' to 5°22'	4°22'	1°00'
	Decimal degrees	3.37° to 5.37°	4.37°	1.00°
Camber angle	Degrees and minutes	-2°02' to +0°28'	-0°47'	1°15'
	Decimal degrees	-2.03° to -0.47°	-0.78°	1.25°
Total toe	mm	1.5 Toe-in ± 2.6	1.5 Toe-in ± 1.1	-
	Degrees and minutes	0°12' Toe-in ± 0°21'	0°12' Toe-in ± 0°09'	-
	Decimal degrees	0.20° Toe-in ± 0.35°	0.20° Toe-in ± 0.15°	-

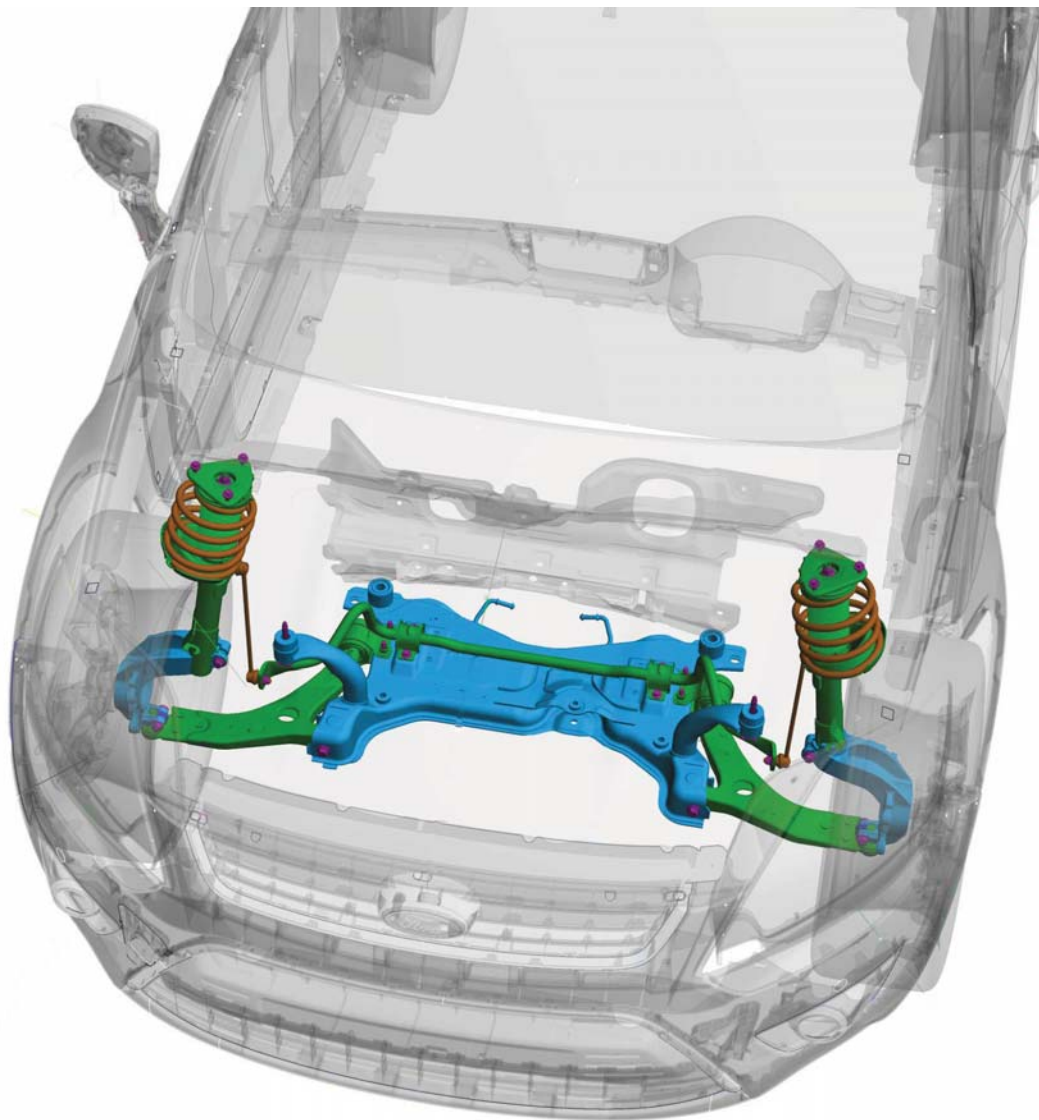
204-01-3

Front Suspension

204-01-3

## DESCRIPTION AND OPERATION

## Front Suspension – Component Location

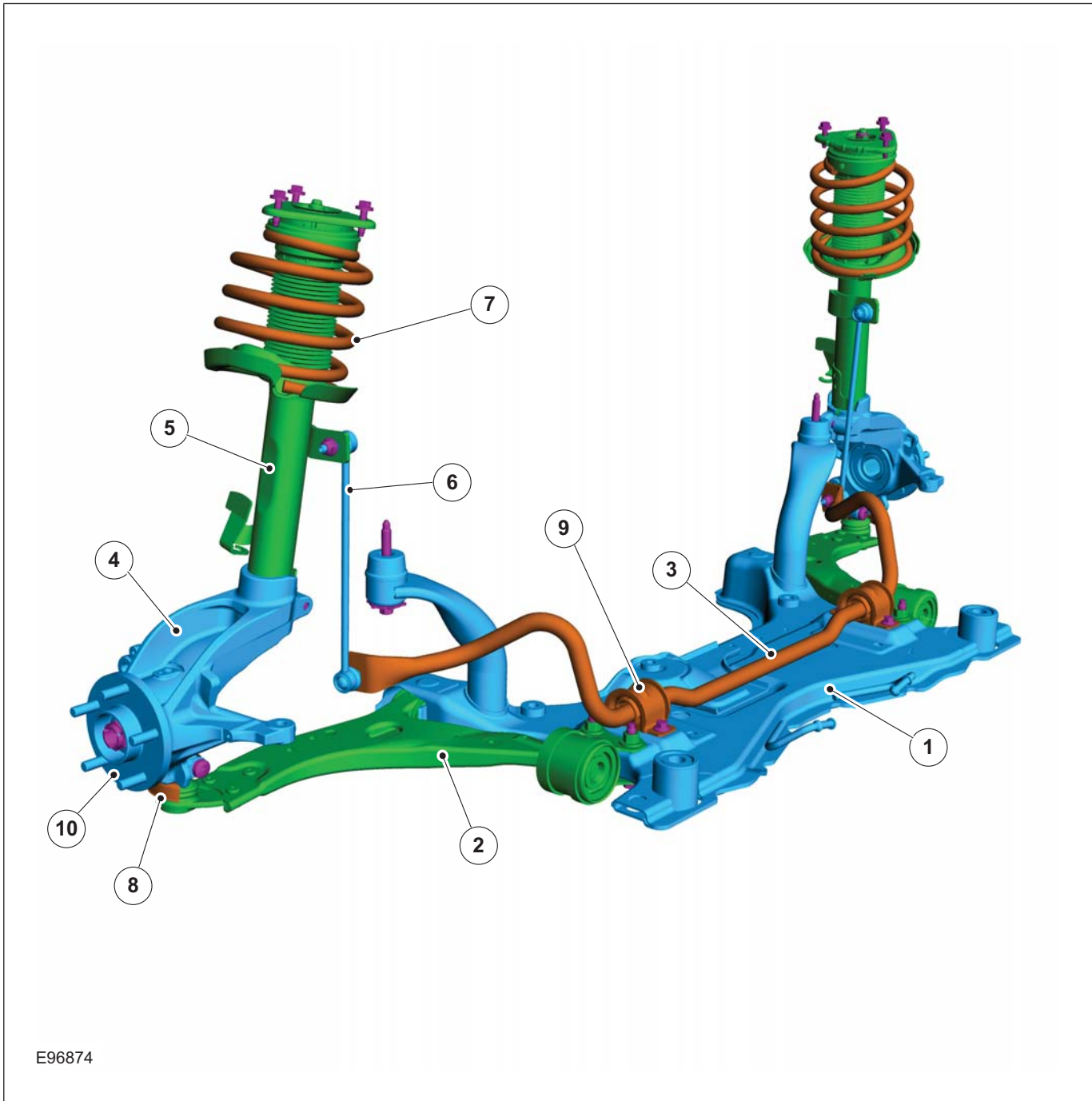


E98521

DESCRIPTION AND OPERATION

Front Suspension – Overview

Overview



Item	Description
1	Subframe
2	Lower arm
3	Stabilizer bar
4	Wheel knuckle

Item	Description
5	Shock absorber
6	Stabilizer bar link
7	Spring
8	Heat shield

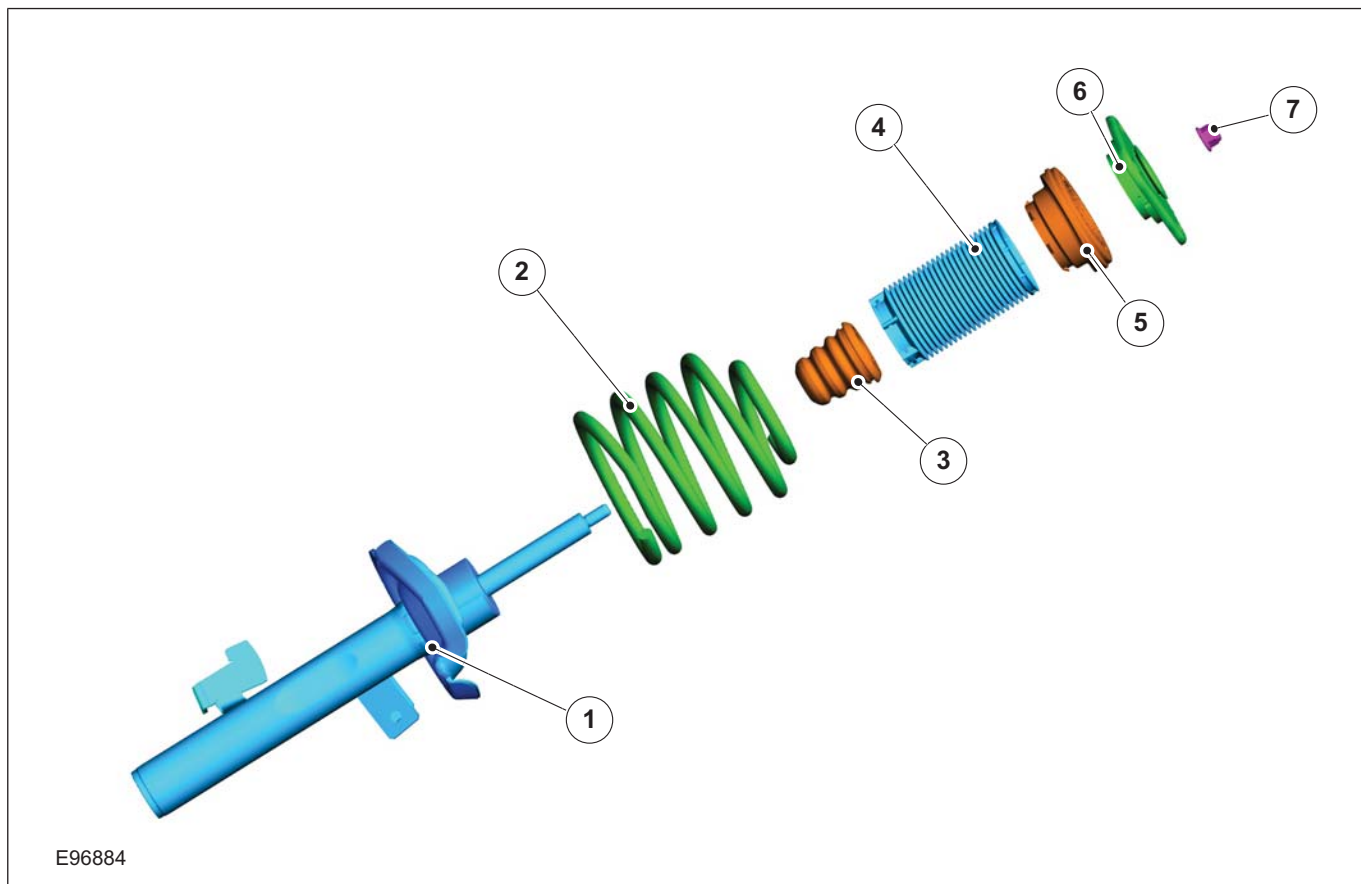


DESCRIPTION AND OPERATION

Item	Description
9	Stabilizer bar bushes and bracket

Item	Description
10	Wheel hub

Spring and damper assembly



Item	Description
1	Shock absorber
2	Spring
3	Spring aid

Item	Description
4	Gaitor
5	Bearing
6	Top mount assembly
7	Retaining nut

The following components may be renewed:

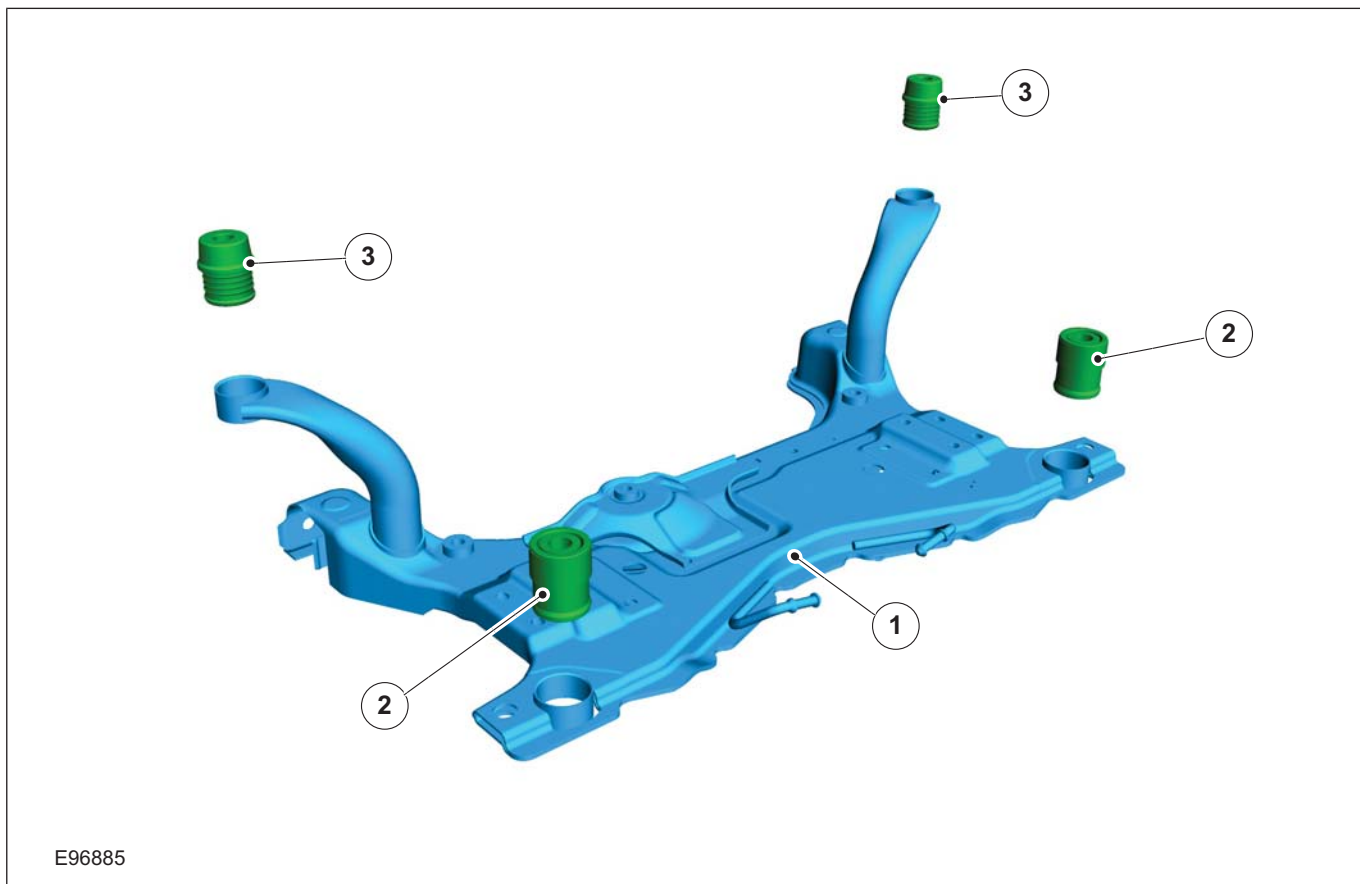
- Shock absorber
- Spring
- Spring aid
- Gaitor
- Bearing
- Top mount assembly
- Retaining nut

During removal and installation or renewal of components of the spring and damper assembly, pay attention to the following:

- Prior to installation of the spring and damper assembly, the bearing and support bearing must be aligned according to the installation instructions.
- Take extra care when handling the compressed spring.
- After completing the work, the suspension geometry of the vehicle must be checked and corrected as necessary.

## DESCRIPTION AND OPERATION

## Subframe



Item	Description
1	Subframe
2	Rear bushes, subframe
3	Front bushes, subframe

The following components may be renewed:

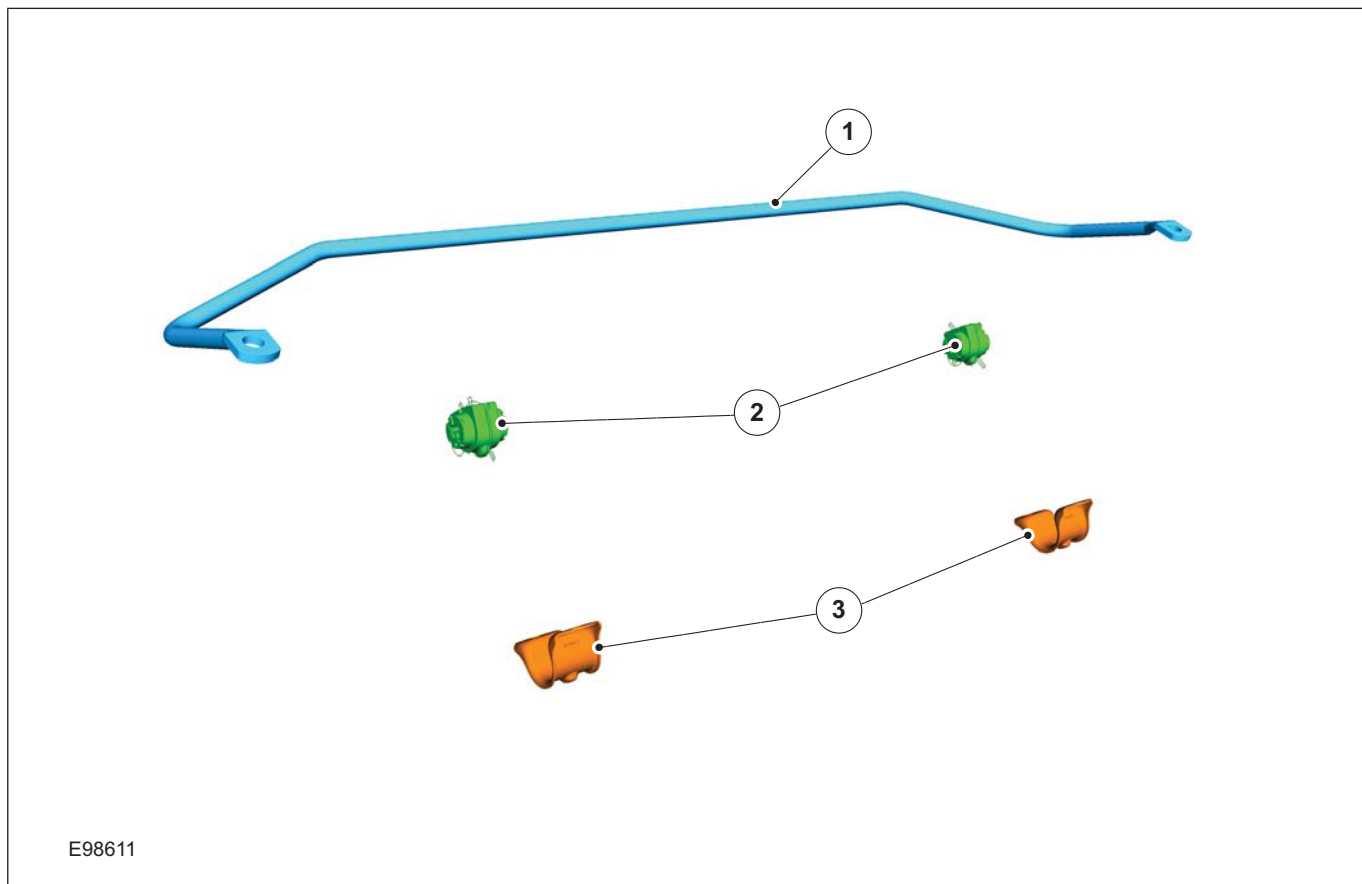
- Subframe
- Subframe bushes

During removal and installation or renewal of components of the subframe, pay attention to the following:

- Before installing the subframe bushes, they must be aligned according to the installation instructions.
- When the subframe is installed or removed, it must be aligned with the vehicle body using the appropriate special tools.
- After completing the work, the suspension geometry of the vehicle must be checked and corrected as necessary.

## DESCRIPTION AND OPERATION

## Stabilizer bar



Item	Description
1	Stabilizer bar
2	Bushes, stabilizer bar
3	Bracket, stabilizer bar bushes

The following components may be renewed:

- Stabilizer bar
- Bushes, stabilizer bar
- Bracket, stabilizer bar bushes

During removal and installation or renewal of components of the stabilizer bar, pay attention to the following:

- Before installing the stabilizer bar bushes, they must be aligned according to the installation instructions.
- After completing the work, the suspension geometry of the vehicle must be checked and corrected as necessary.



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**REMOVAL AND INSTALLATION****Wheel Hub(14 371 0)****Removal**

1. Refer to: **Front Wheel Bearing** (204-01 Front Suspension, Removal and Installation).

**Installation**

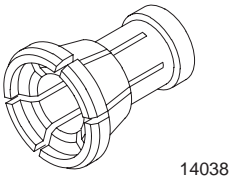
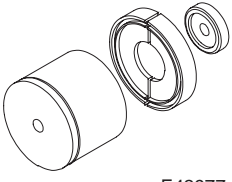
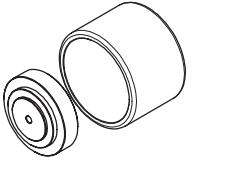
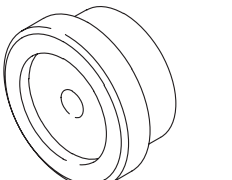
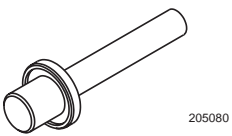
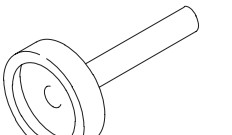
1. To install, reverse the removal procedure.



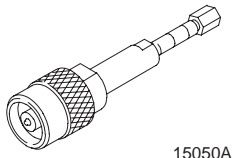
REMOVAL AND INSTALLATION

Front Wheel Bearing(14 411 0; 14 411 4; 14 412 0; 14 414 4; 14 416 4)

Special Tool(s) / General Equipment

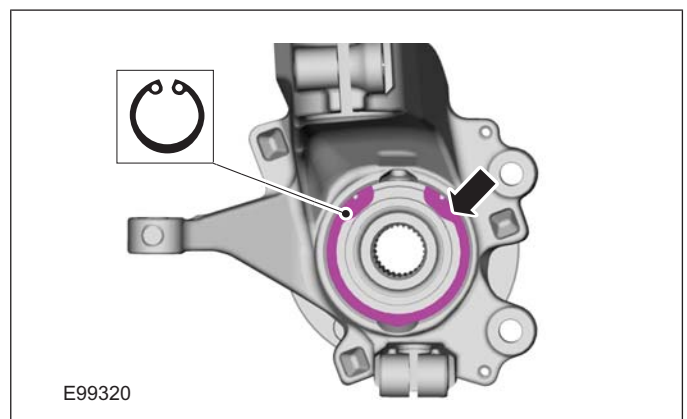
 <p>14038</p>	<p>204-158 Collet for 205-295</p>
 <p>E42977</p>	<p>204-348 Remover/Installer, Wheel Hub/Wheel Bearing</p>
 <p>E10014</p>	<p>204-740 Remover/Installer, Wheel Hub/Bearing</p>
 <p>15026A01</p>	<p>205-071-01 Adapter for 205-071 (Thrust Pad)</p>
 <p>205080</p>	<p>205-080 Installer, Differential Bearing</p>
 <p>14045</p>	<p>205-255 Installer, Front Wheel Hub Seal</p>

Special Tool(s) / General Equipment

 <p>15050A</p>	<p>205-295 Remover, Bearing (Main Tool)</p>
<p>Hydraulic Press</p>	

Removal

1. Refer to: **Wheel Knuckle** (204-01 Front Suspension, Removal and Installation).
2. **NOTE:** Note the position of the component before removal.

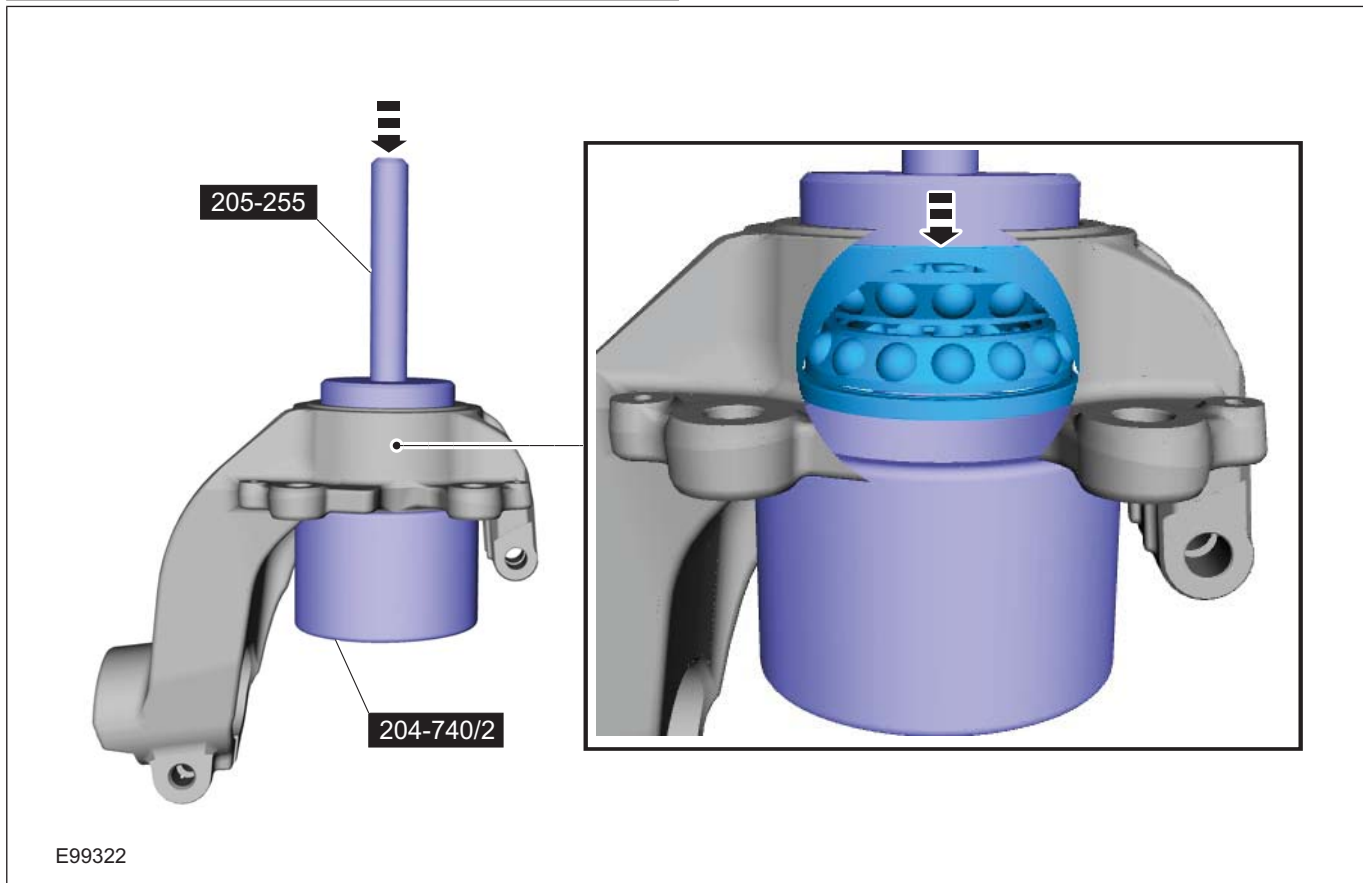
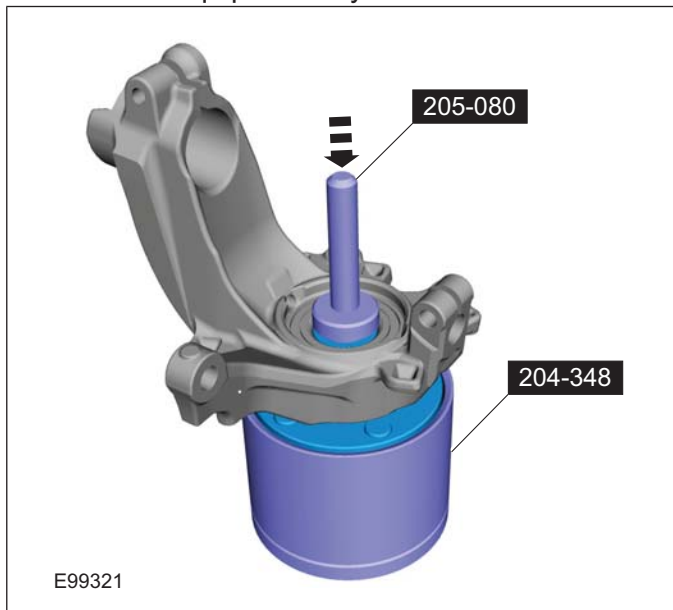




**REMOVAL AND INSTALLATION**

3. Special Tool(s): 205-080, 204-348  
General Equipment: Hydraulic Press

4. Special Tool(s): 205-255, 204-740  
General Equipment: Hydraulic Press



5. Special Tool(s): 205-071-01, 205-295, 204-158



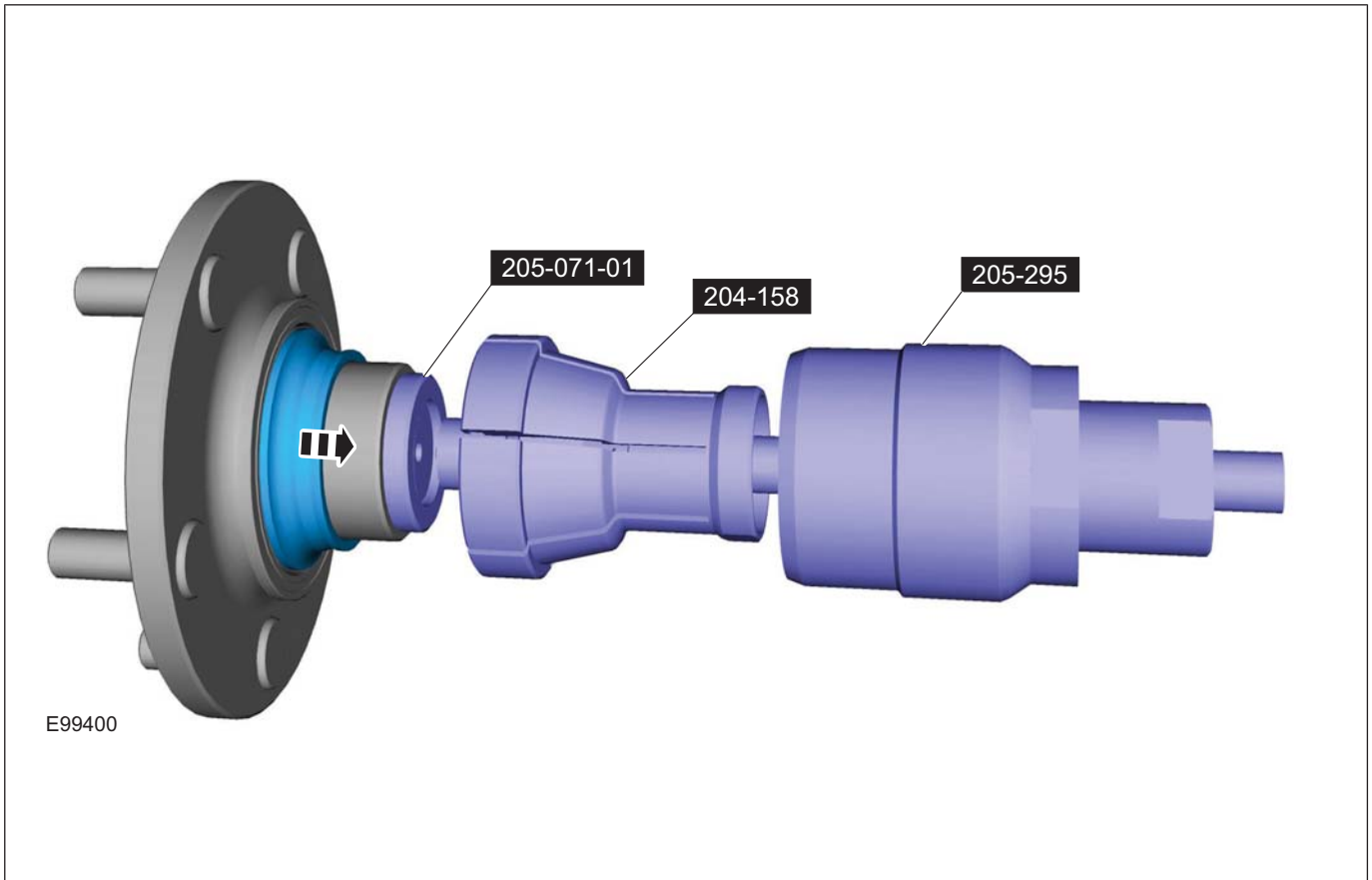


204-01-11

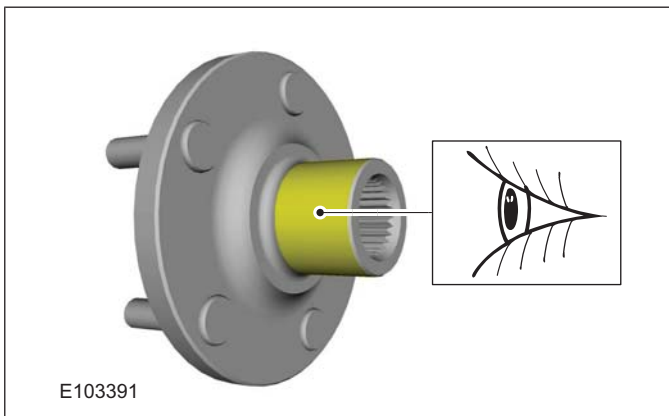
Front Suspension

204-01-11

## REMOVAL AND INSTALLATION



6.



## Installation

- NOTE:** Make sure that the sensor ring is correctly located.

## 204-01-12

## Front Suspension

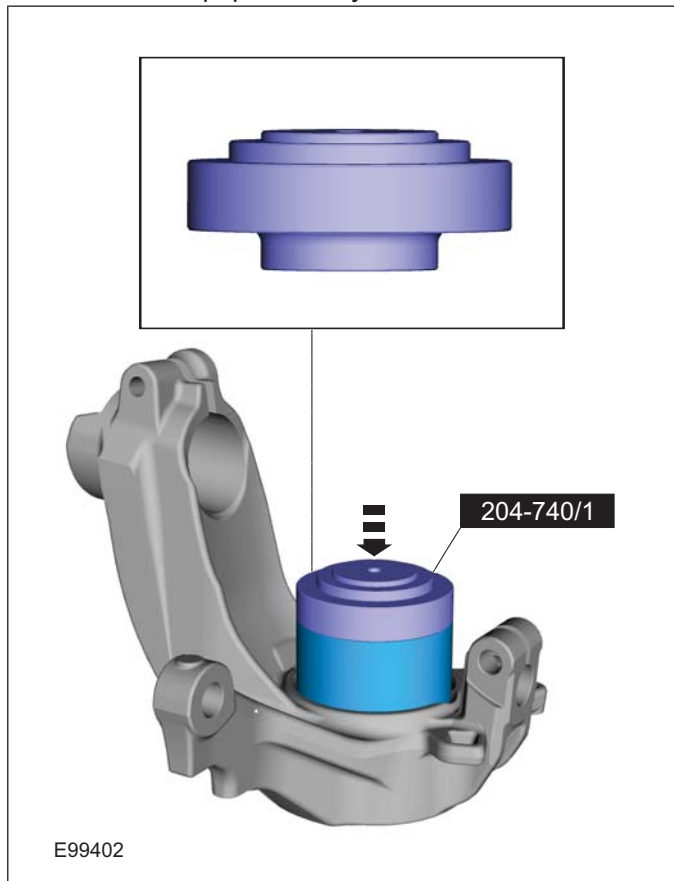
## 204-01-12

## REMOVAL AND INSTALLATION

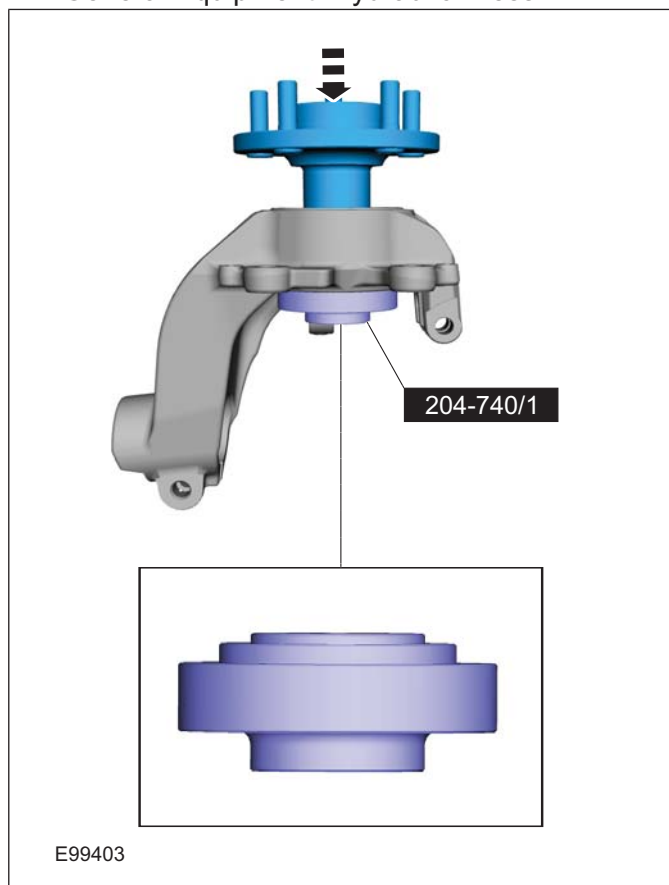
Install the wheel bearing with the black colored wheel speed sensor ring facing towards the transmission side.

Special Tool(s): 204-740

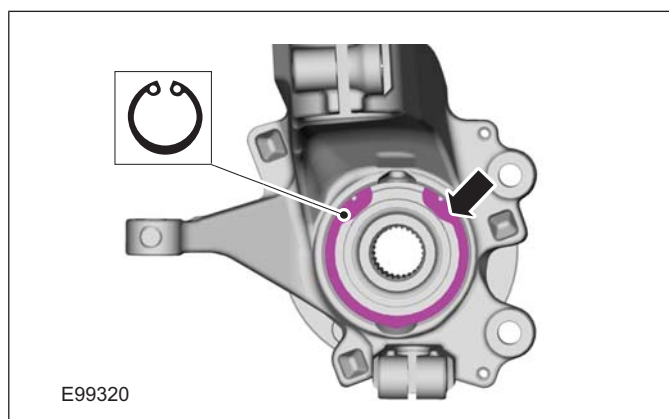
General Equipment: Hydraulic Press



2. Special Tool(s): 204-740  
General Equipment: Hydraulic Press



3. **NOTE:** Make sure that this component is installed to the noted removal position.



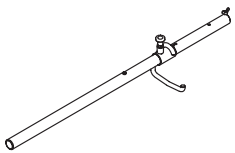
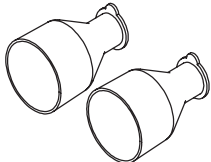
4. Refer to: **Wheel Knuckle** (204-01 Front Suspension, Removal and Installation).



REMOVAL AND INSTALLATION

Lower Arm(14 706 0; 14 707 0; 14 709 0)

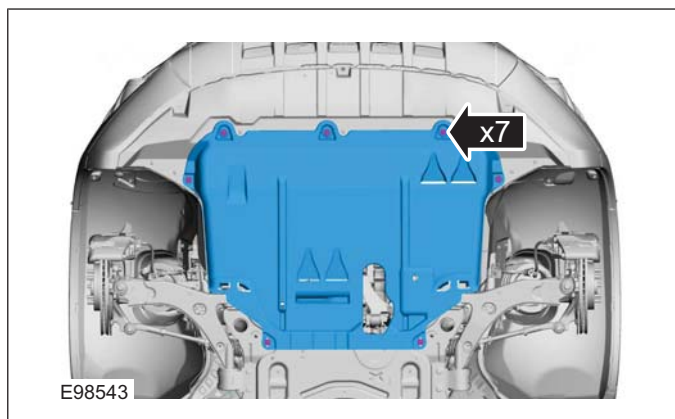
Special Tool(s)

 <p>E63772</p>	<p>204-605 Separator, Lower Arm Ball Joint</p>
 <p>E75372</p>	<p>204-609 Protection Cap, Ball Joint Gaiter</p>

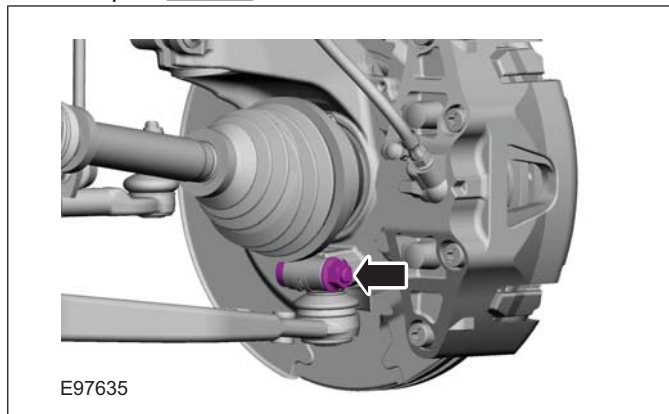
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

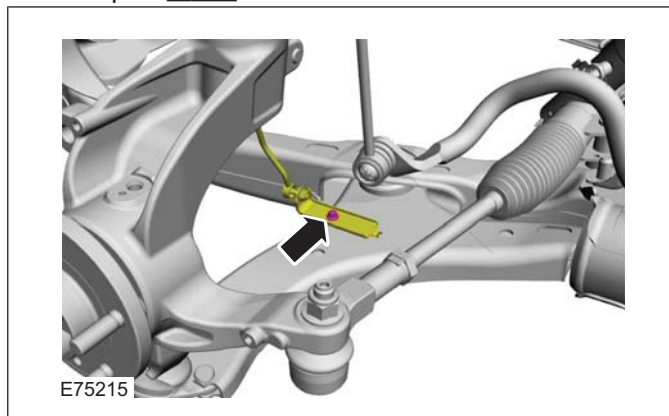
1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
- 2.



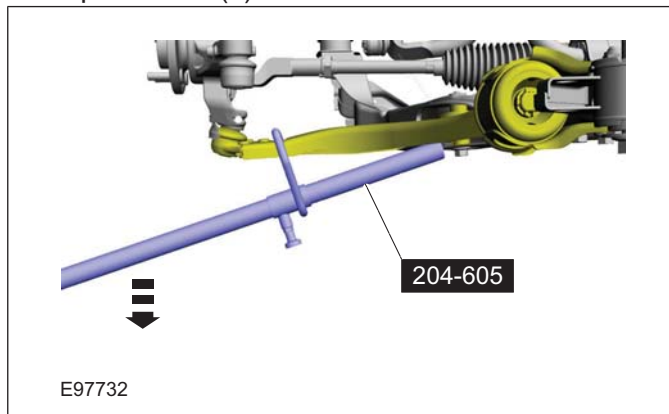
3. Torque: 83 Nm



4. If equipped.  
Torque: 8 Nm

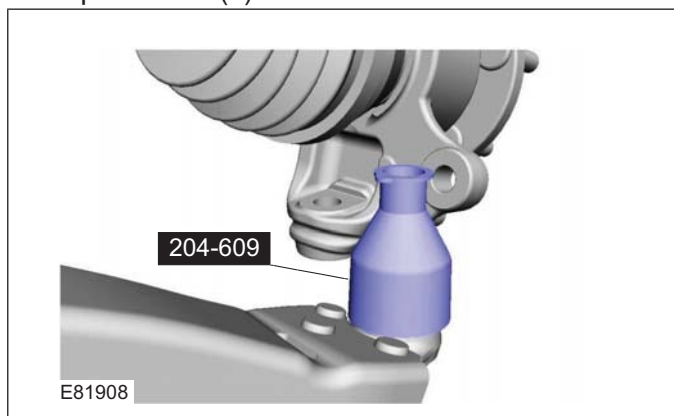


5. Special Tool(s): 204-605



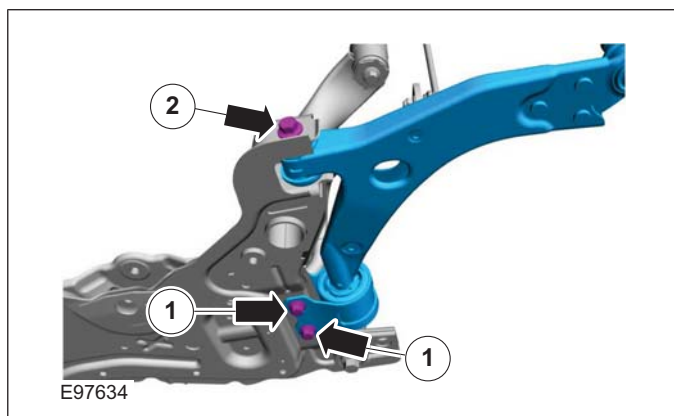
## REMOVAL AND INSTALLATION

## 6. Special Tool(s): 204-609

7.  **CAUTION:** Make sure that new bolts are installed.

## 1. Torque:

- Stage 1: 100 Nm
- Stage 2: Loosen 90°
- Stage 3: 125 Nm

2. Torque: 175 Nm

## Installation

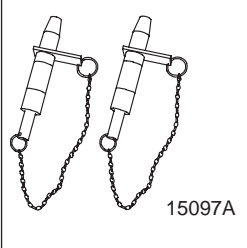
1. To install, reverse the removal procedure.
2. Check the toe setting and adjust as necessary.

Refer to: **Front Toe Adjustment** (204-00 Suspension System - General Information, General Procedures).

REMOVAL AND INSTALLATION

Front Stabilizer Bar(14 752 0)

Special Tool(s) / General Equipment

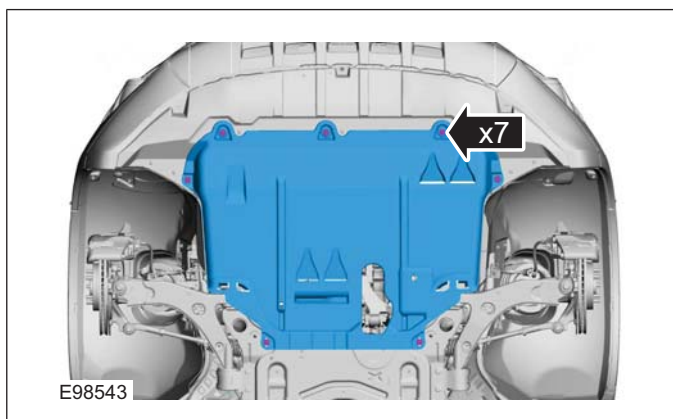
 <p>15097A</p>	<p>205-316A Alignment Pins, Subframe</p>
<p>Hydraulic Press</p>	
<p>Transmission Jack</p>	

Removal

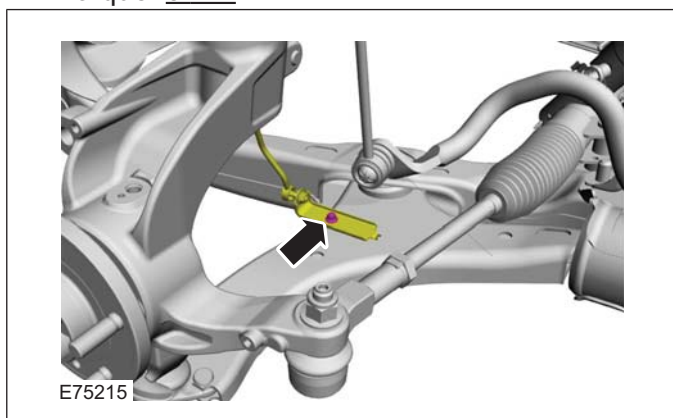
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

2.

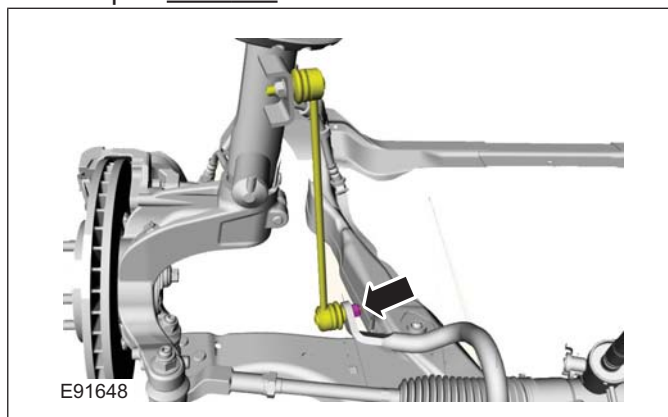


3. If equipped.  
Torque: 8 Nm

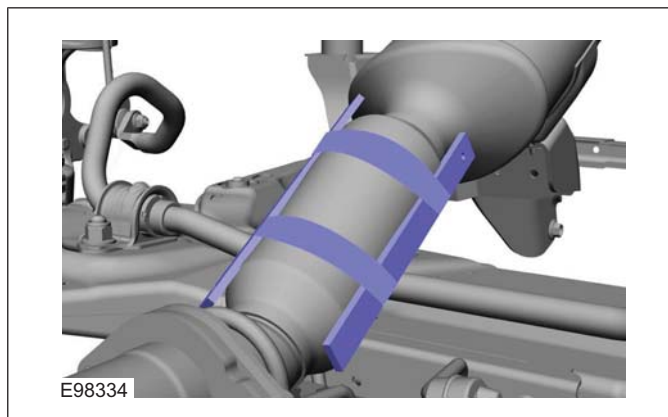


4. **CAUTION:** Make sure that the ball joint ball does not rotate.

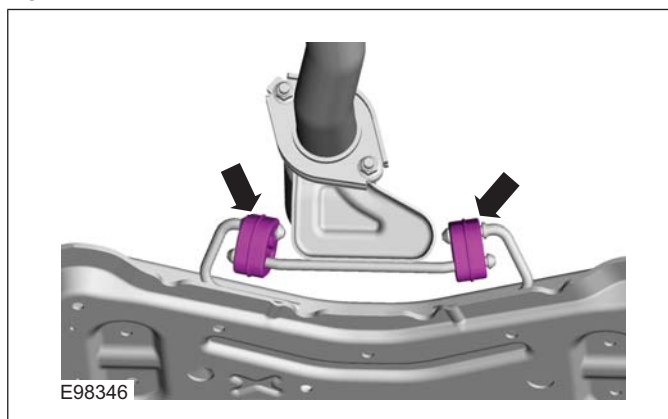
On both sides.  
Torque: 47.5 Nm



5. **CAUTION:** Make sure that the exhaust flexible pipe is not forcibly bent.



6.



204-01-16

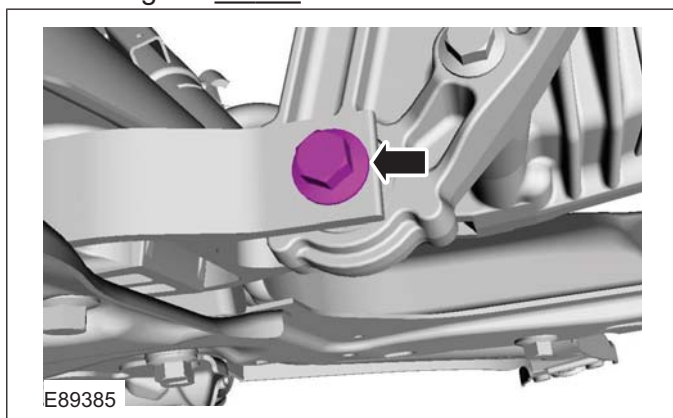
Front Suspension

204-01-16

## REMOVAL AND INSTALLATION

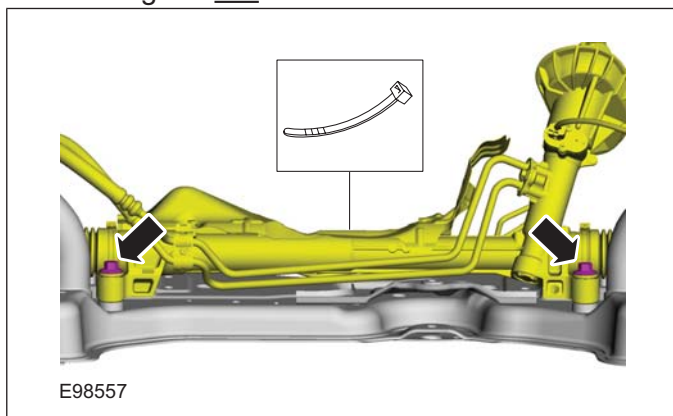
## 7. Torque:

- Stage 1: 35 Nm
- Stage 2: Loosen 360°
- Stage 3: 85 Nm

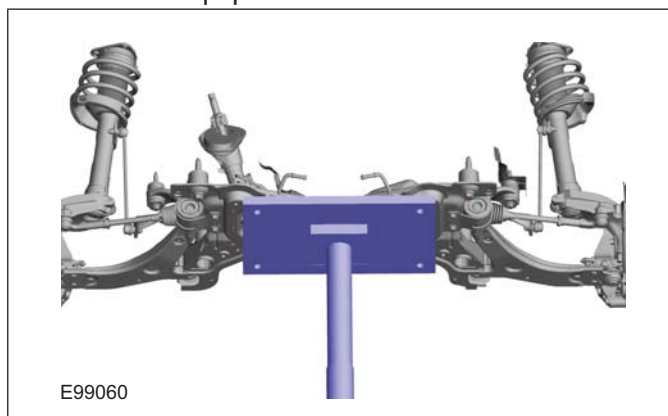


## 8. Torque:

- Stage 1: 40 Nm
- Stage 2: 60°



## 9. General Equipment: Transmission Jack



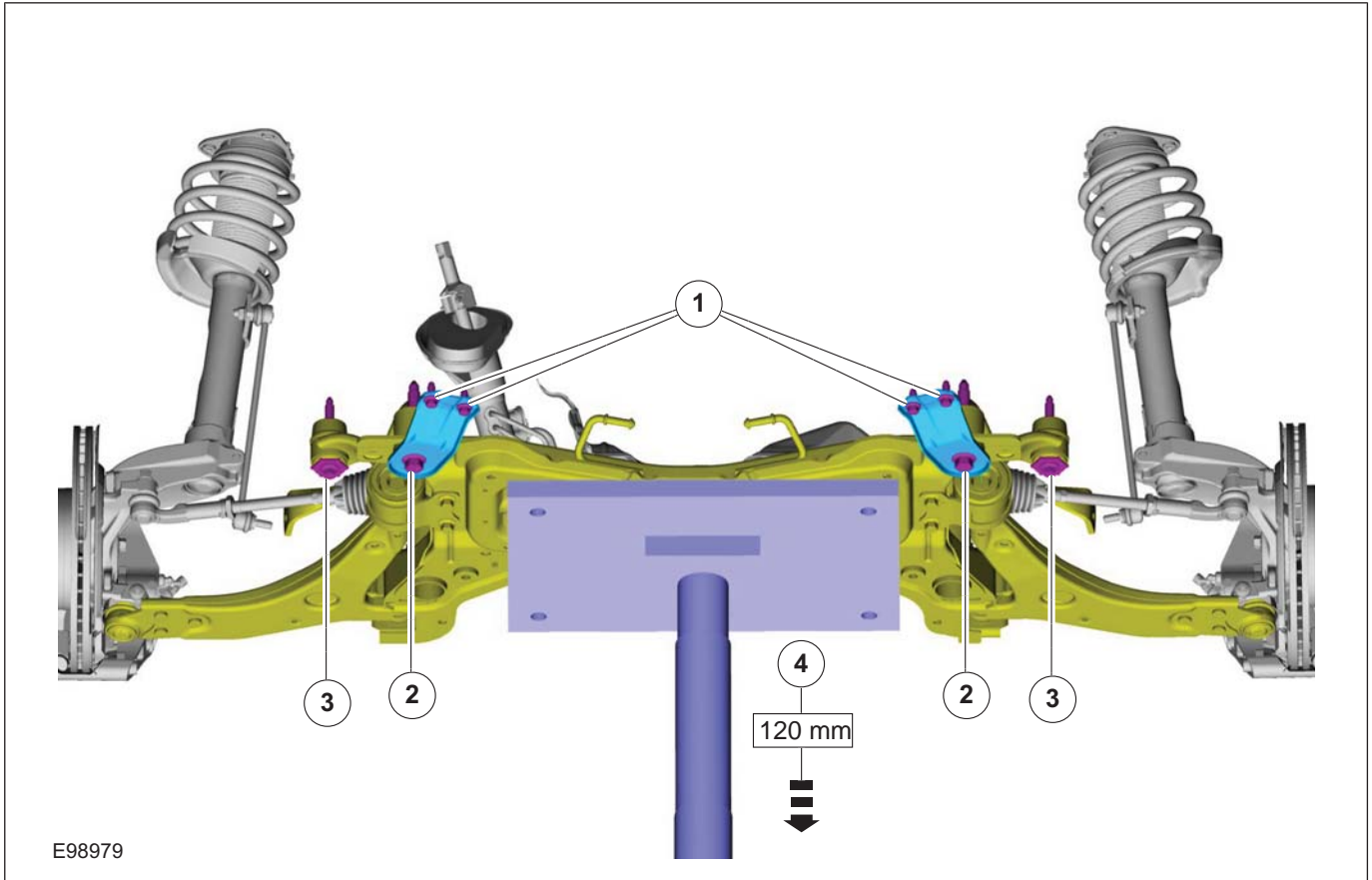
## 10. Remove the following items:

1. Torque: 70 Nm
2. Torque:
  - Stage 1: 140 Nm
  - Stage 2: 180°
3. Torque: 125 Nm

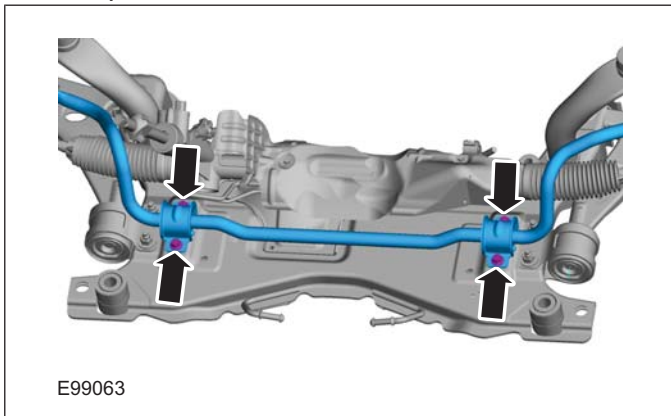




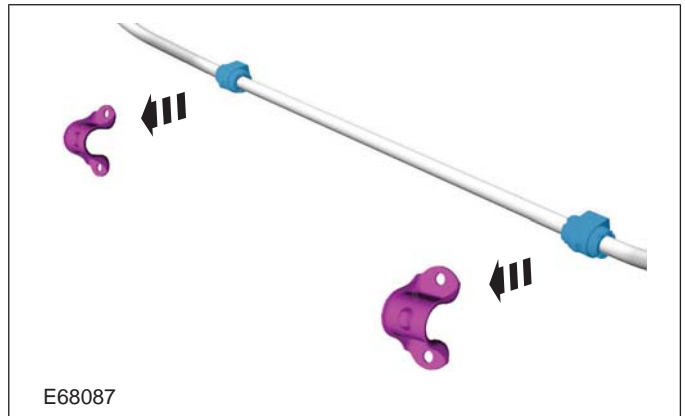
REMOVAL AND INSTALLATION



11. Torque: 47.5 Nm



12 **NOTE:** Note the position of each component before removal.



Installation

1. **NOTE:** Make sure that the component is clean, free of foreign material and lubricant.

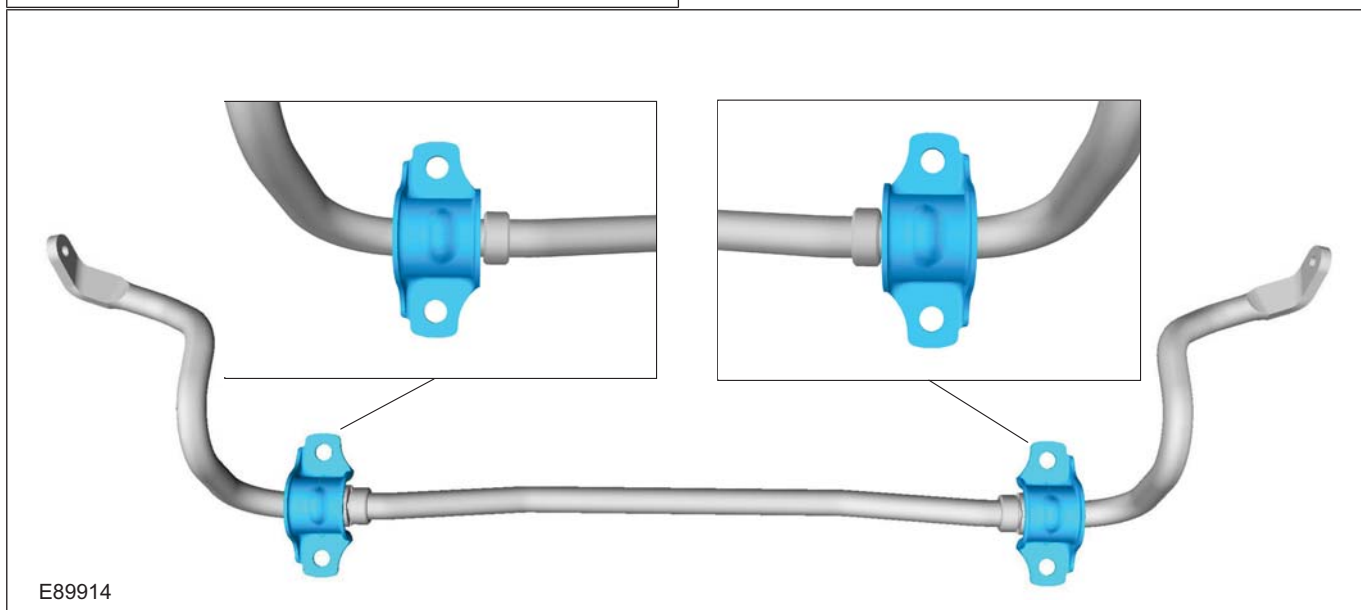




REMOVAL AND INSTALLATION

**NOTE:** Make sure that these components are installed to the noted removal position.

**2. NOTE:** Make sure that the clamp is installed to the same orientation as when removed.  
On both sides.

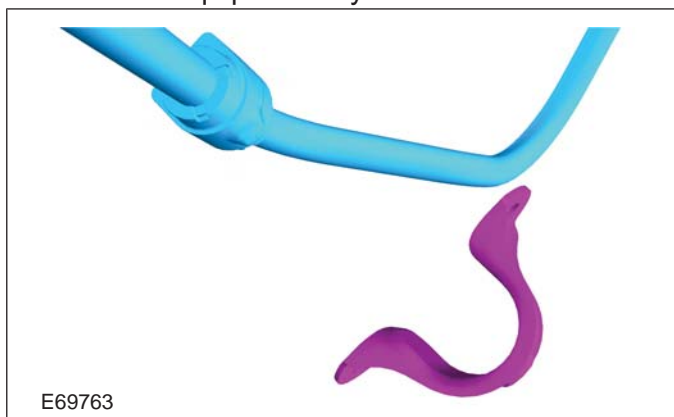


**3.** On both sides.

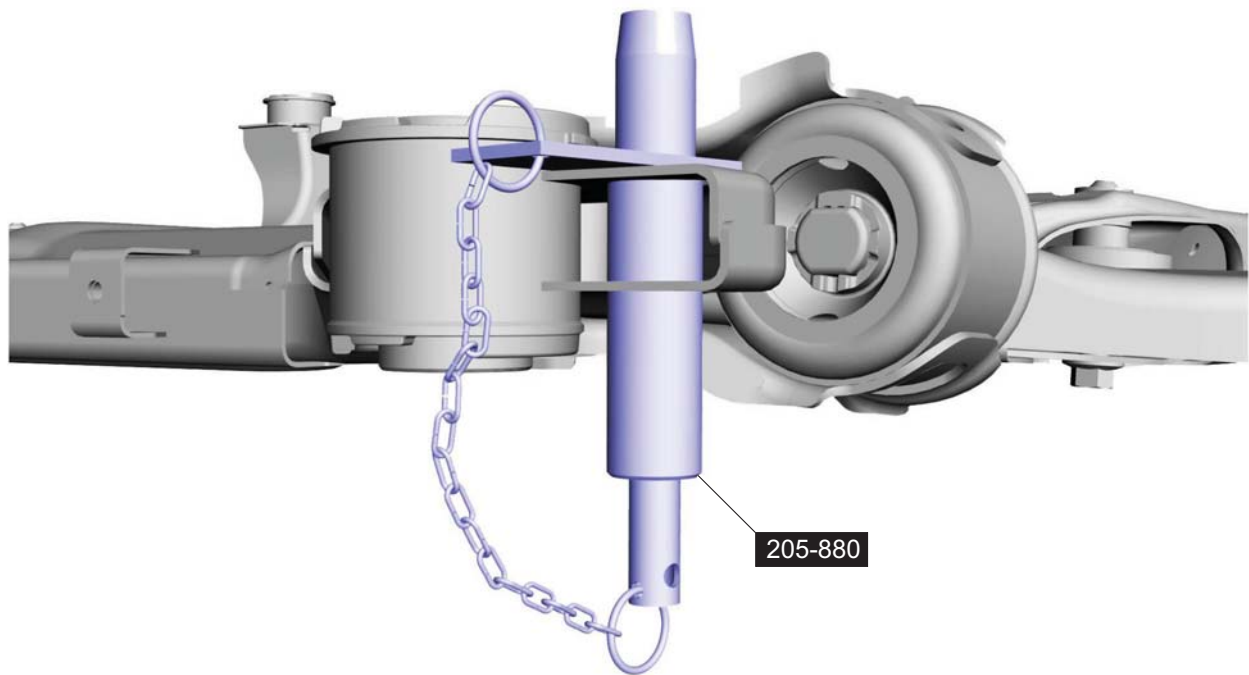
General Equipment: Hydraulic Press

**4.** To install, reverse the removal procedure.

**5.** Install the Special Tool(s): 205-316A



## REMOVAL AND INSTALLATION



E99249

6. Refer to: **Front Toe Adjustment** (204-00 Suspension System - General Information, General Procedures).

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**REMOVAL AND INSTALLATION****Front Stabilizer Bar Bushing(14 754 0; 14 754 4)****Removal**

1. Refer to: **Front Stabilizer Bar** (204-01 Front Suspension, Removal and Installation).

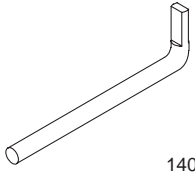
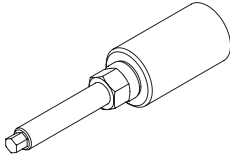
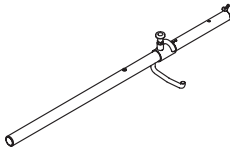
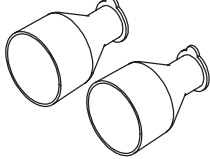
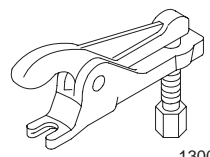
**Installation**

- 1.

REMOVAL AND INSTALLATION

Wheel Knuckle(14 343 0)

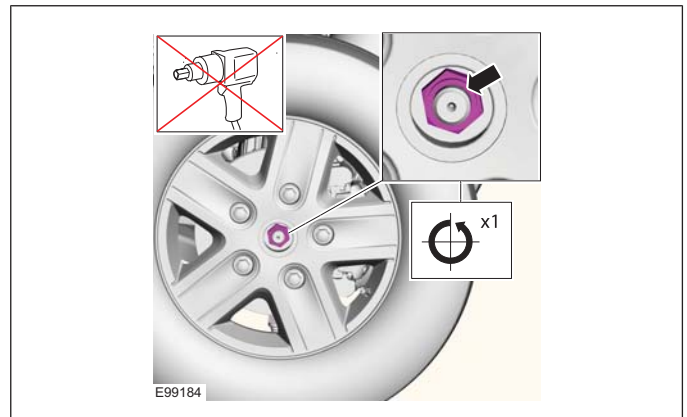
Special Tool(s)

 <p>14026A</p>	<p>204-052 Lever, Wheel Knuckle</p>
 <p>E62067</p>	<p>204-602 Installer, Halfshaft</p>
 <p>E63772</p>	<p>204-605 Separator, Lower Arm Ball Joint</p>
 <p>E75372</p>	<p>204-609 Protection Cap, Ball Joint Gaiter</p>
 <p>13006</p>	<p>211-020 Separator, Ball Joint</p>

Removal

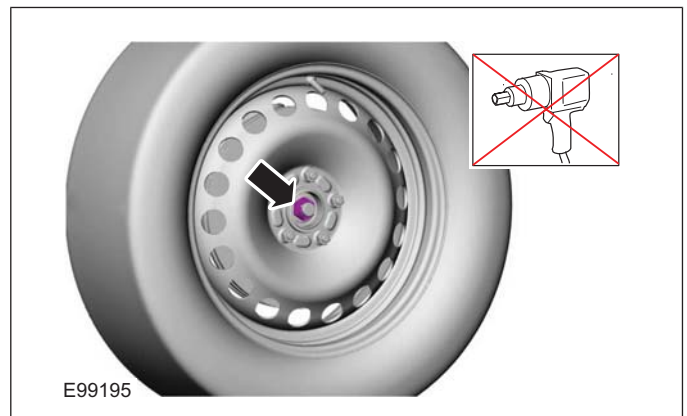
**NOTE:** Removal steps in this procedure may contain installation details.

1.

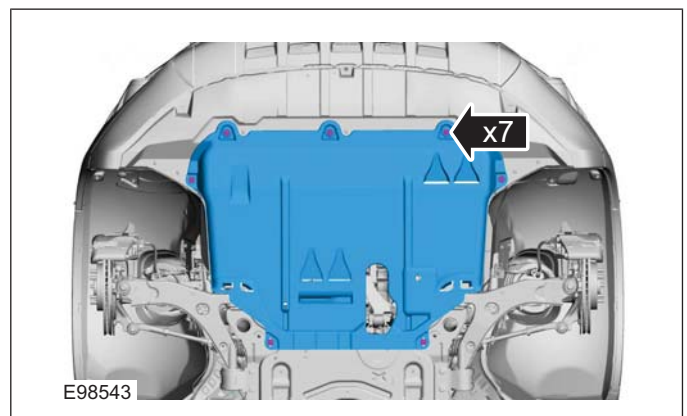


2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

3.



4.

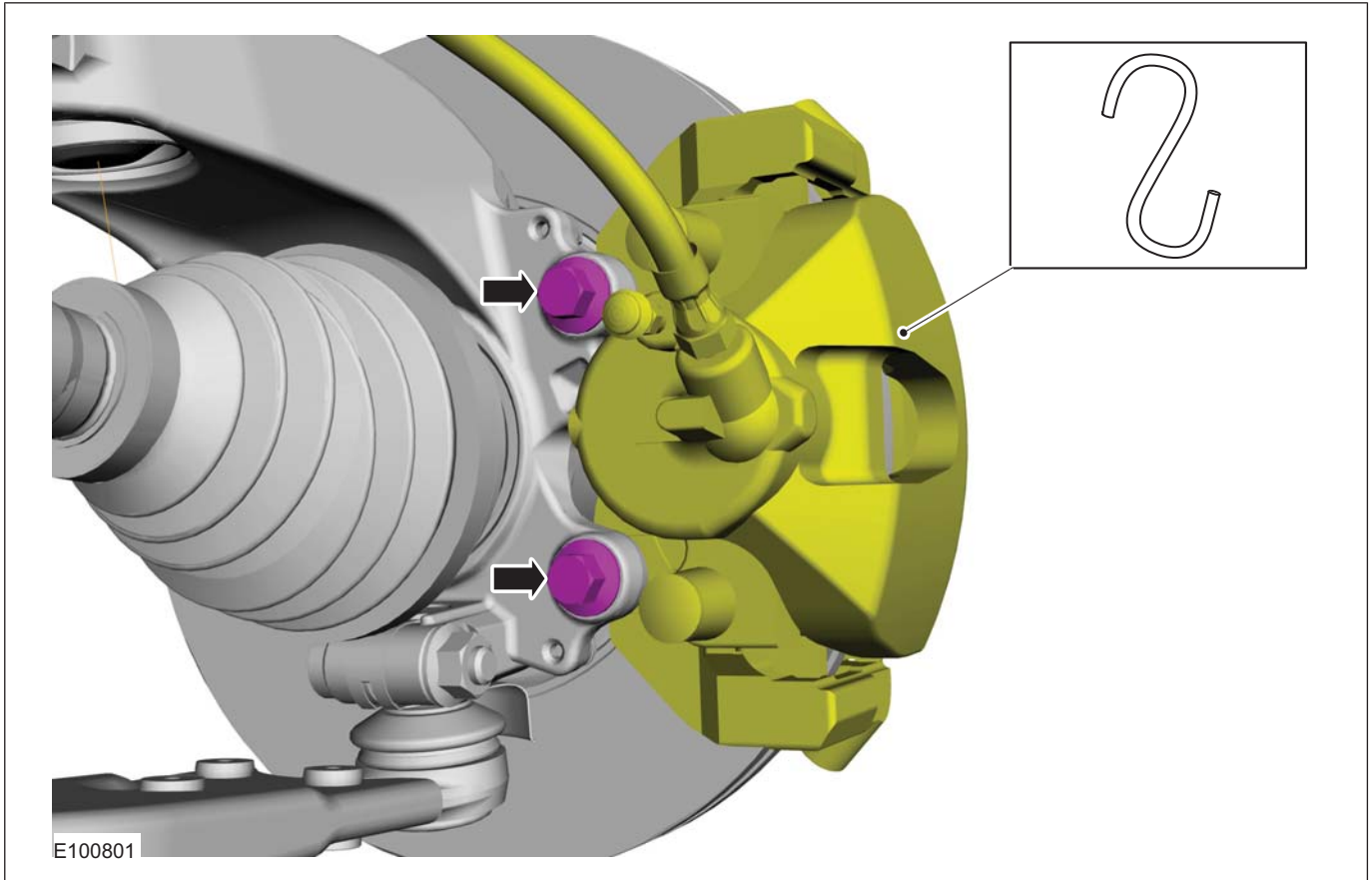


5. **WARNING:** Make sure that no load is placed on the brake hose.

Torque: 120 Nm

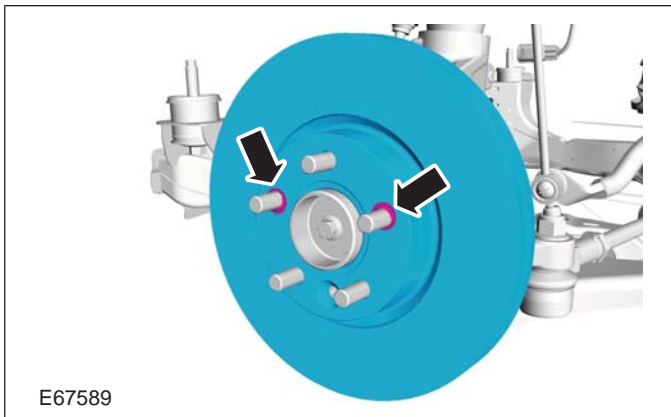


REMOVAL AND INSTALLATION

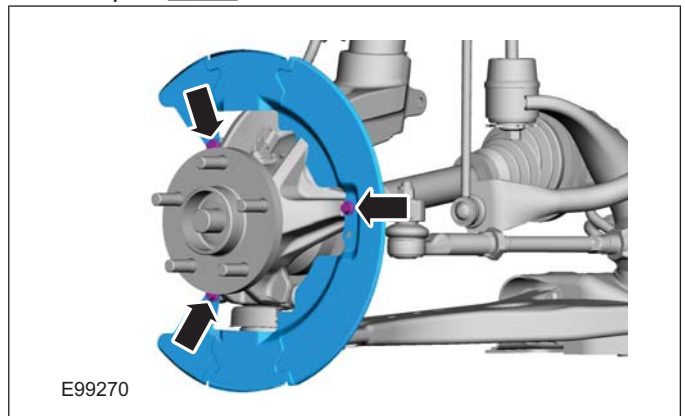


6. Refer to: **Front Wheel Speed Sensor** (206-09 Anti-Lock Control - Stability Assist, Removal and Installation).

7.



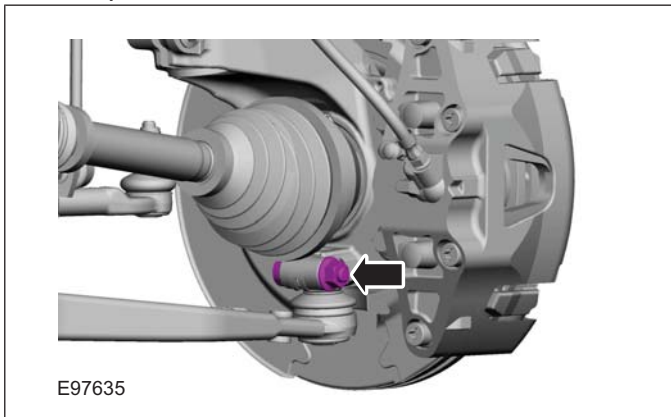
8. If equipped.  
Torque: 9 Nm



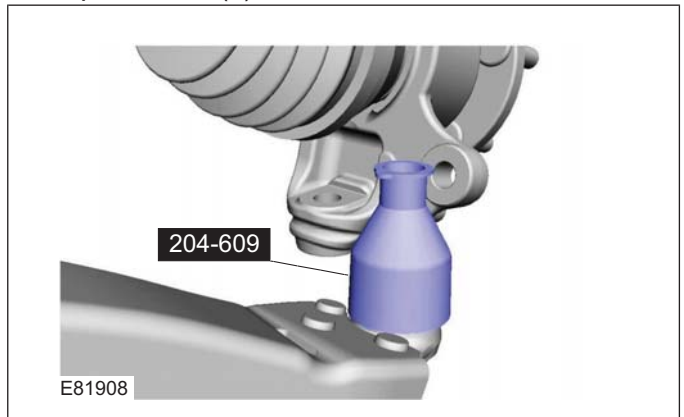


REMOVAL AND INSTALLATION

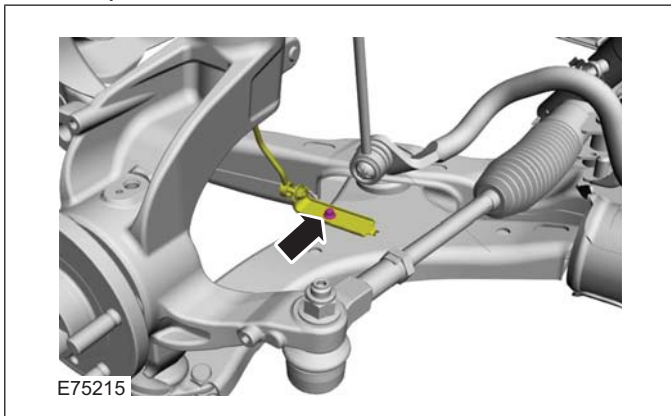
9. Torque: 83 Nm



12. Special Tool(s): 204-609

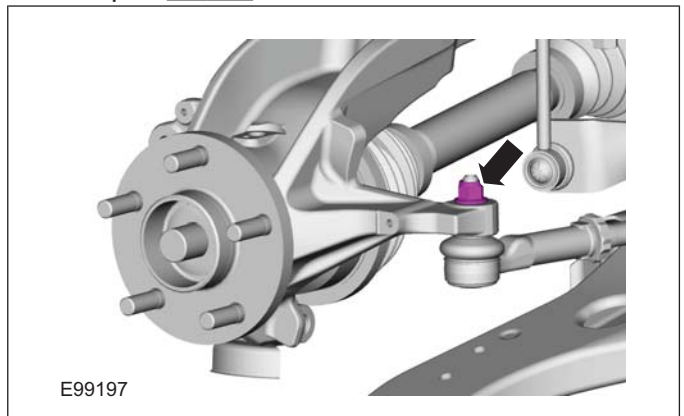


10. If equipped.  
Torque: 8 Nm

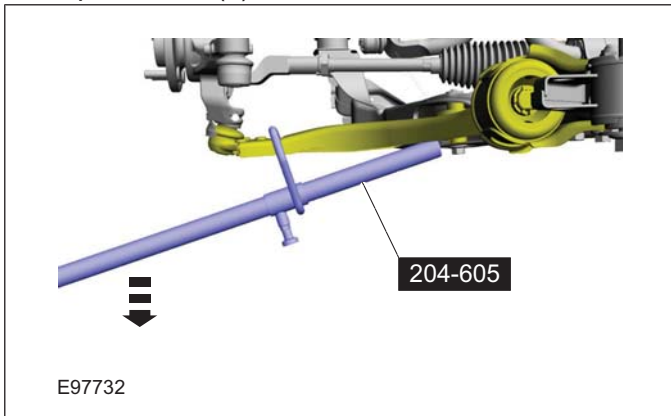


13. **⚠ CAUTION: Make sure that the ball joint ball does not rotate.**

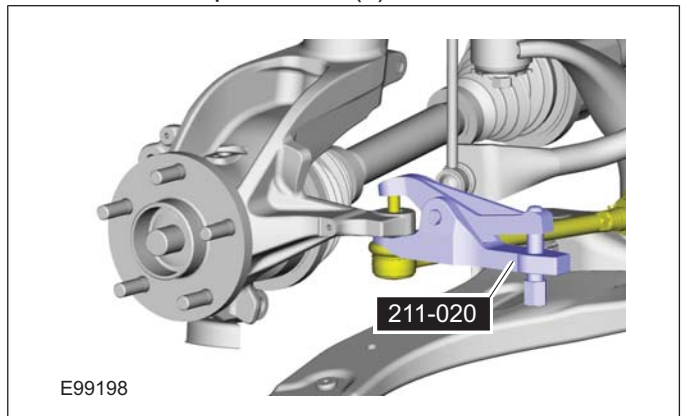
Torque: 48 Nm



11. Special Tool(s): 204-605



14. Install the Special Tool(s): 211-020

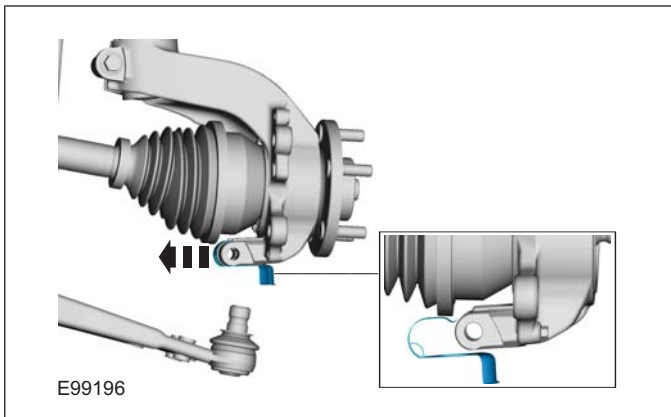




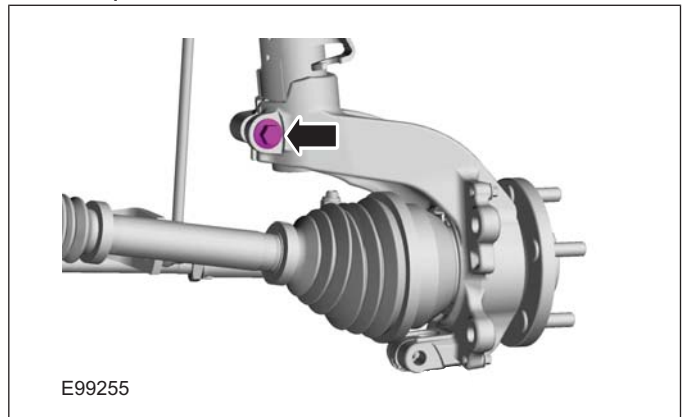
REMOVAL AND INSTALLATION

15. Remove the Special Tool(s): 211-020

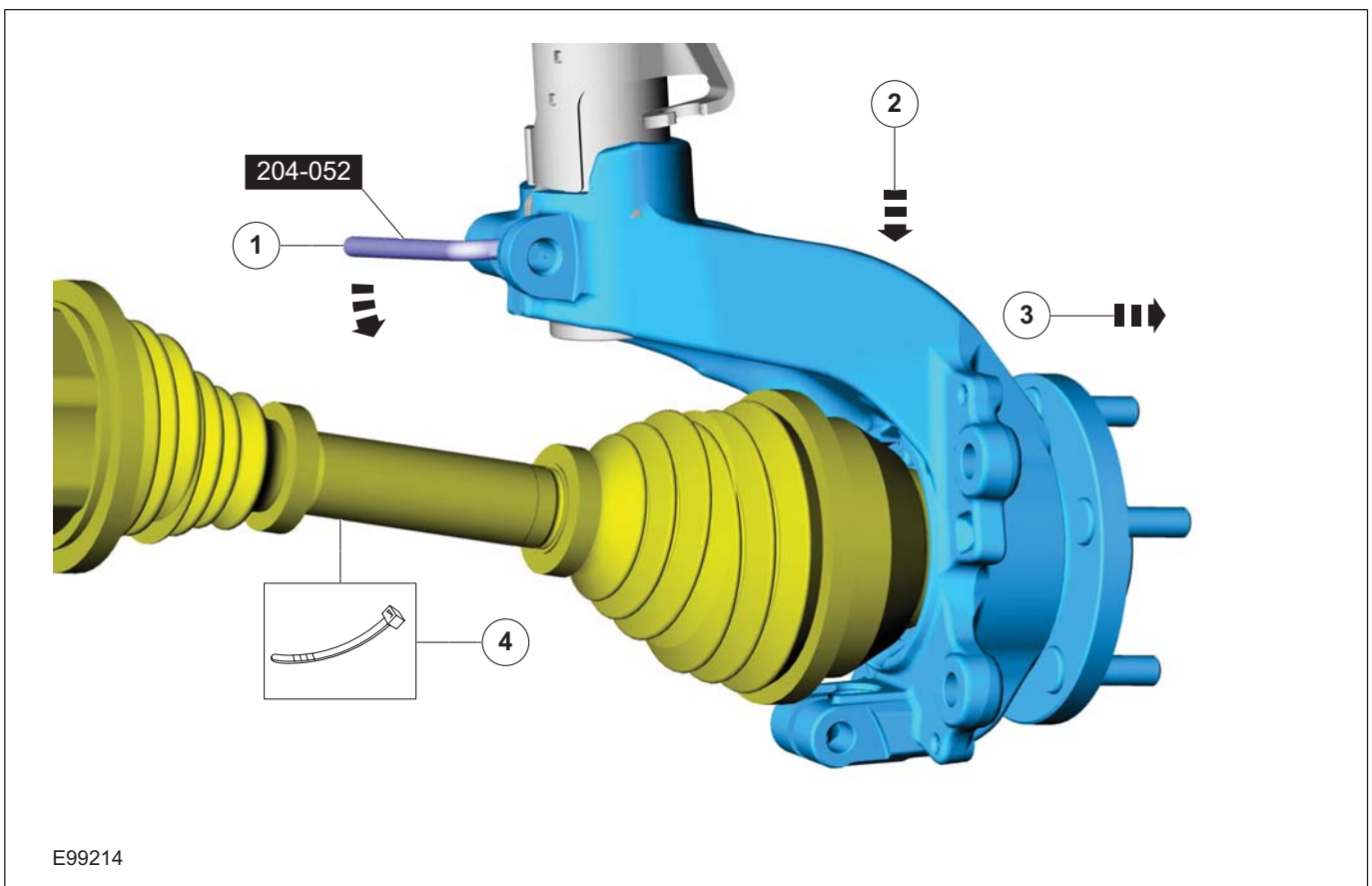
16.



17. Torque: 90 Nm



18. Special Tool(s): 204-052



19. Refer to: **Wheel Hub** (204-01 Front Suspension, Removal and Installation).

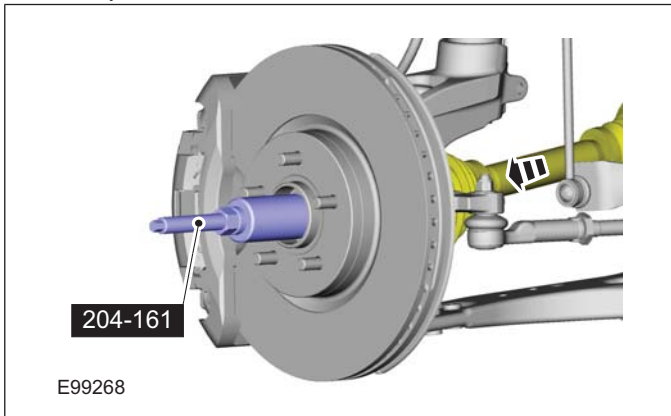
Installation

1. To install, reverse the removal procedure.



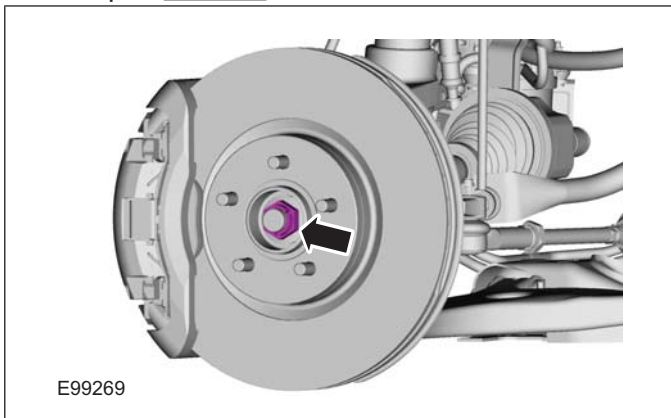
REMOVAL AND INSTALLATION

2. Install the Special Tool(s): 204-602  
Torque: 45 Nm



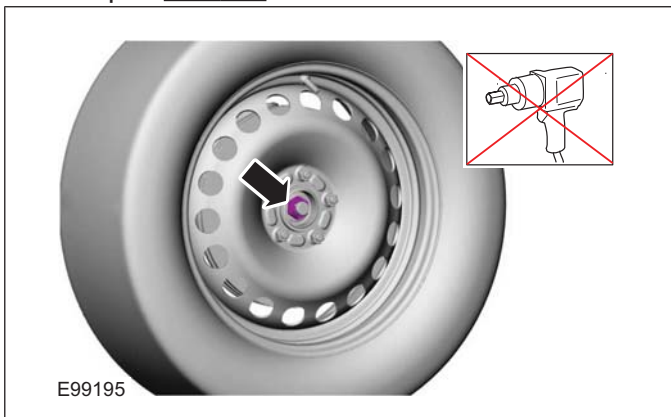
3. Remove the Special Tool(s): 204-602

4. Torque: 100 Nm



5. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

6. Torque: 270 Nm

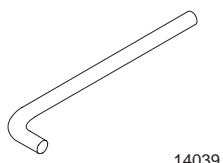
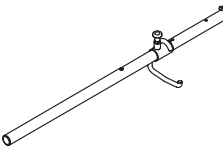




REMOVAL AND INSTALLATION

Front Strut and Spring Assembly(14 781 0; 14 782 0)

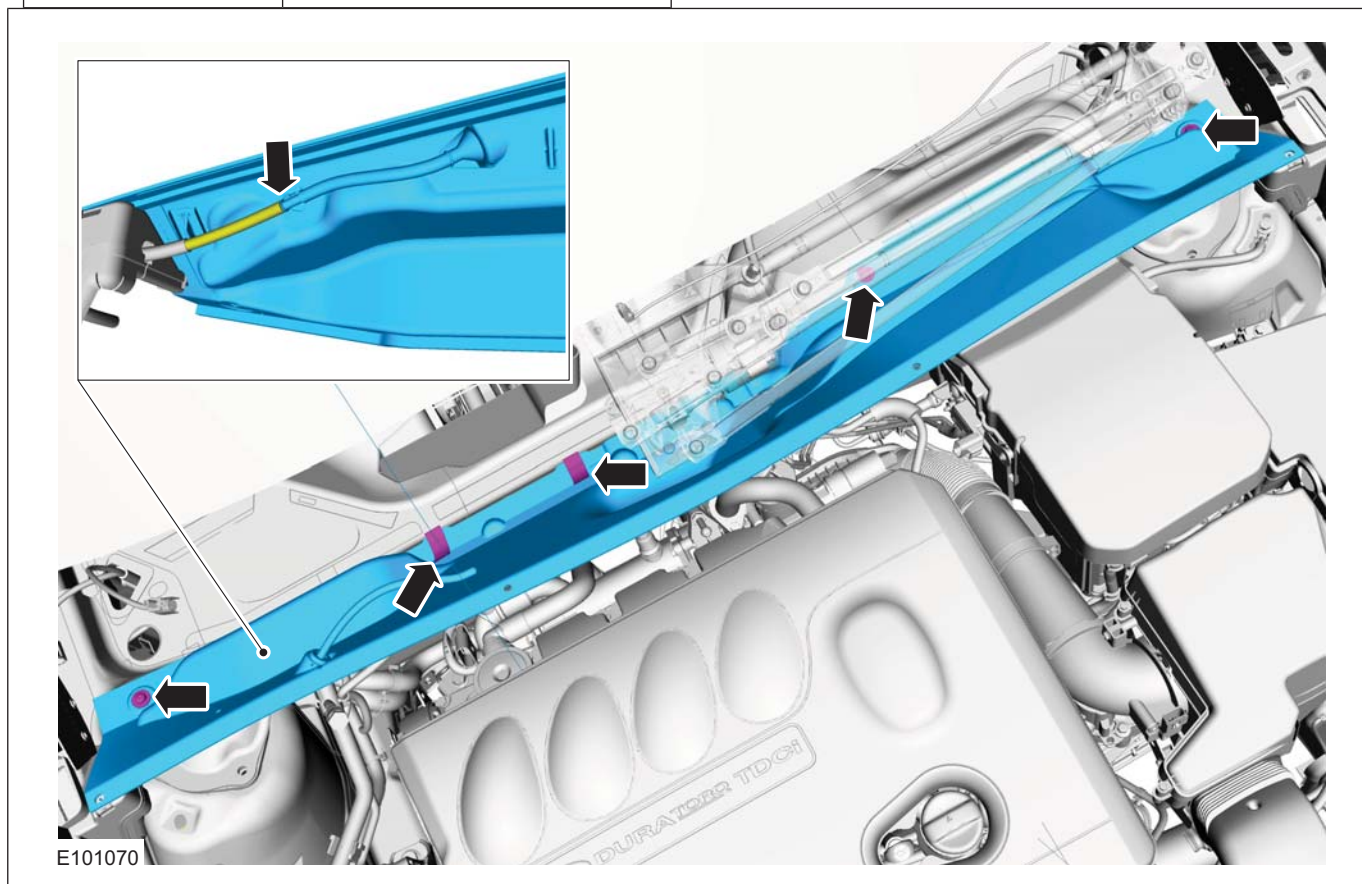
Special Tool(s)

 <p>14039</p>	<p>204-159 Lever, Wheel Knuckle</p>
 <p>E63772</p>	<p>204-605 Separator, Lower Arm Ball Joint</p>

Removal

**NOTE:** Removal steps in this procedure may contain installation details.

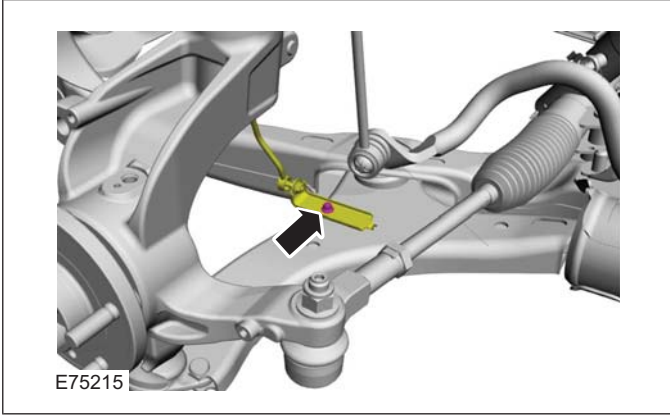
1. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
- 2.



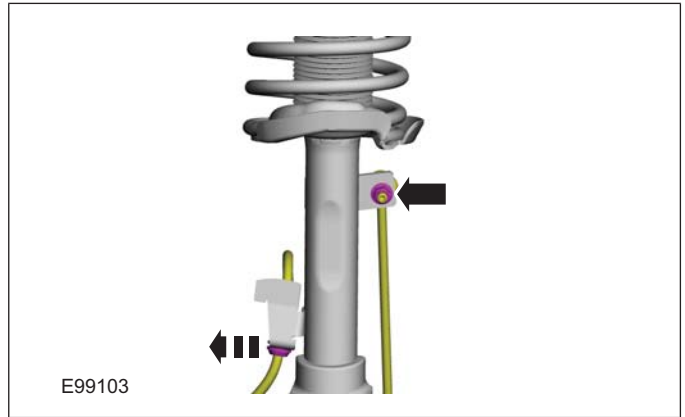


**REMOVAL AND INSTALLATION**

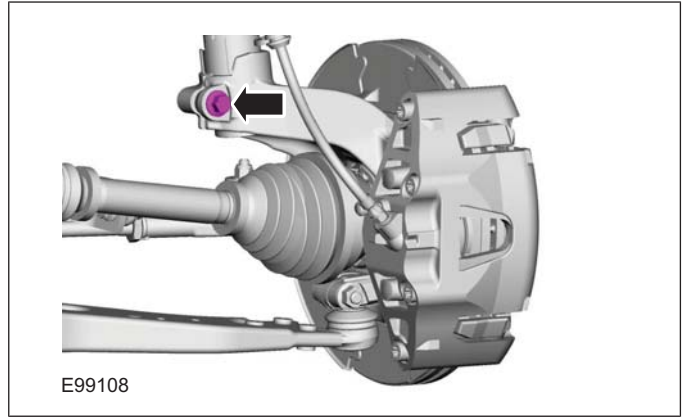
- 3. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
- 4. If equipped.  
Torque: 8 Nm



- 5. **CAUTION:** Make sure that the ball joint ball does not rotate.  
Torque: 47 Nm



- 6. Torque: 90 Nm



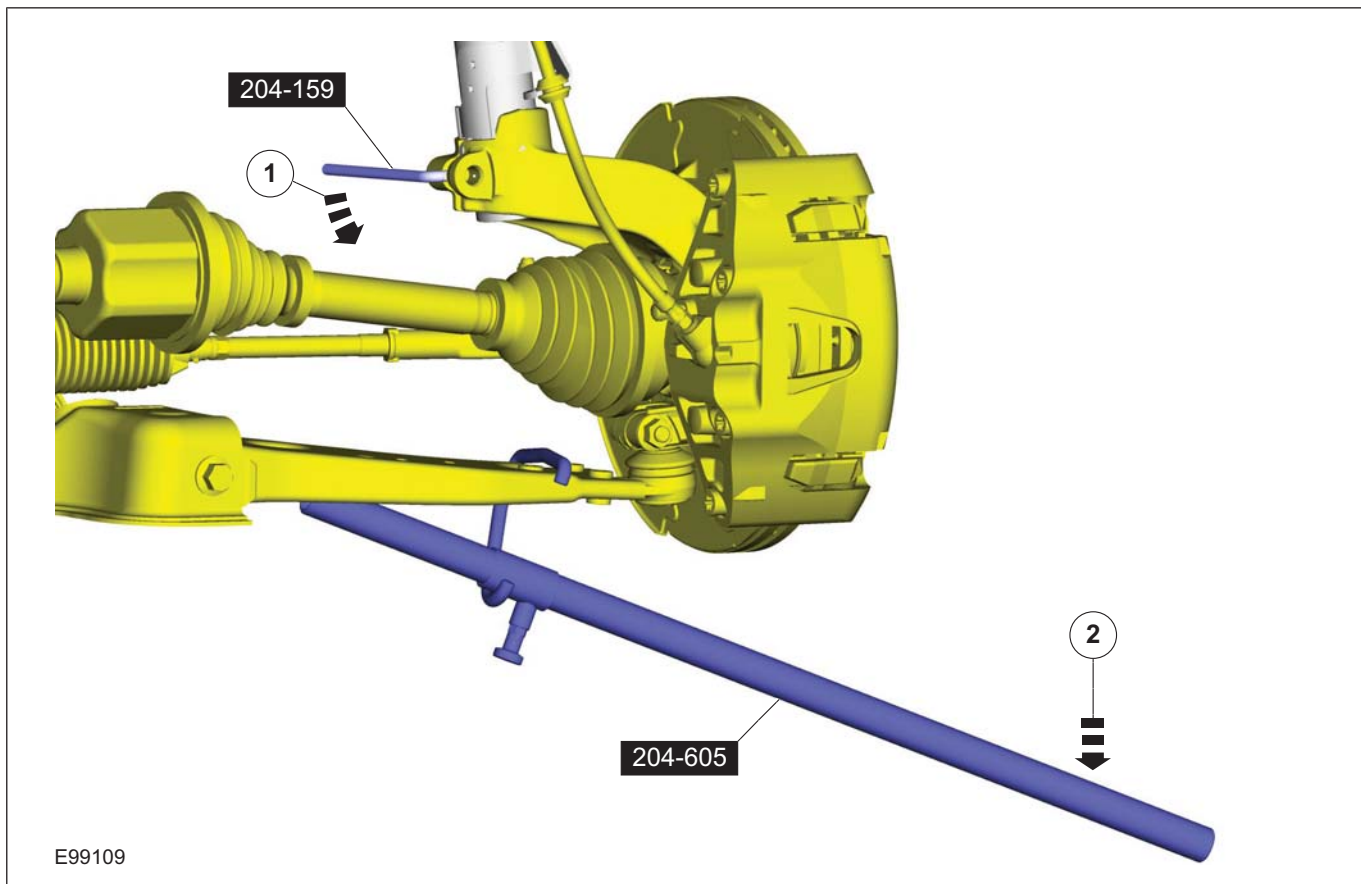
- 7. Special Tool(s): 204-159, 204-605







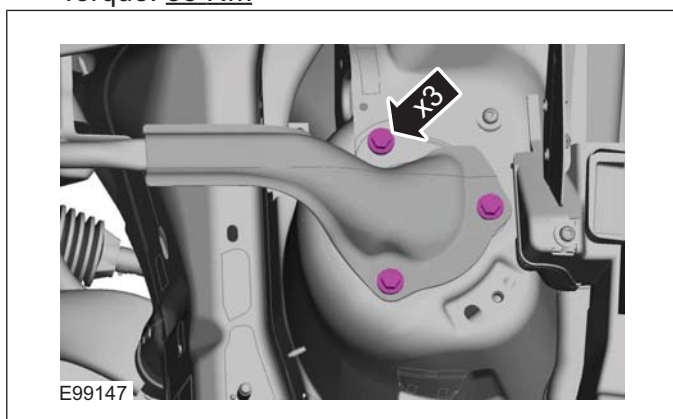
REMOVAL AND INSTALLATION



E99109

- 8. **WARNING:** This step requires the aid of another technician.

Torque: 35 Nm



E99147

Installation

- 1. To install, reverse the removal procedure.



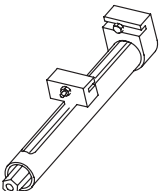
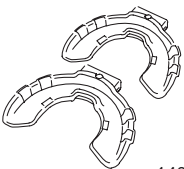




DISASSEMBLY AND ASSEMBLY

Front Strut and Spring Assembly(14 783 4)

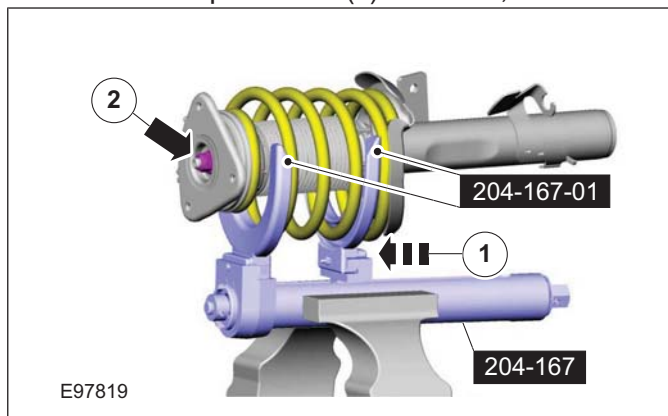
Special Tool(s)

 <p>14042</p>	<p>204-167 Compressor, Coil Spring</p>
 <p>1404201</p>	<p>204-167-01 Adapter for 204-167</p>

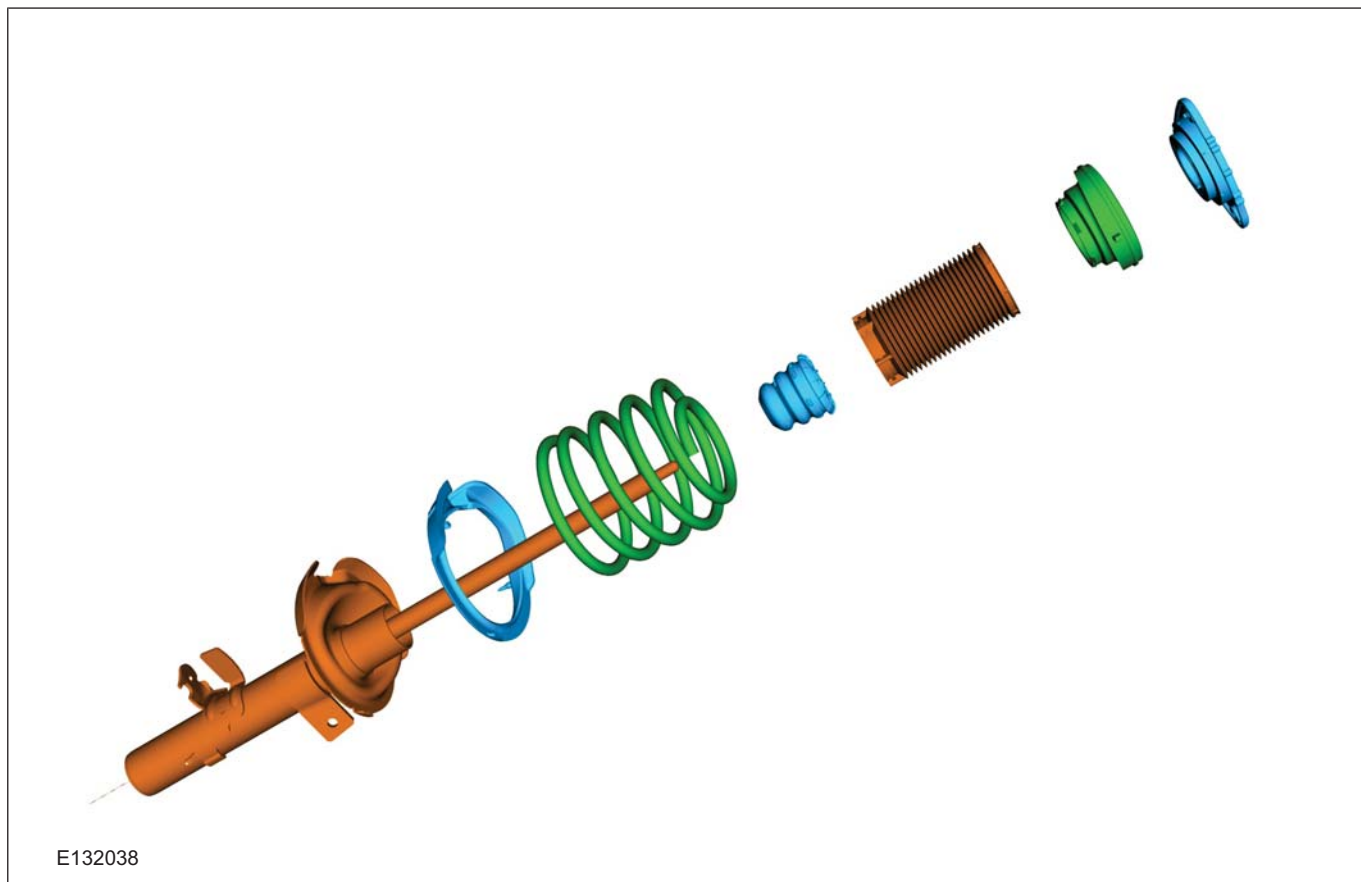
Disassembly

**⚠ WARNING:** Take extra care when handling the compressed spring.

1. Install the Special Tool(s): 204-167, 204-167-01



2. **NOTE:** Note the position of each component before removal.



204-01-30

Front Suspension

204-01-30

## DISASSEMBLY AND ASSEMBLY

## Assembly

**▲ WARNING:** Take extra care when handling the compressed spring.

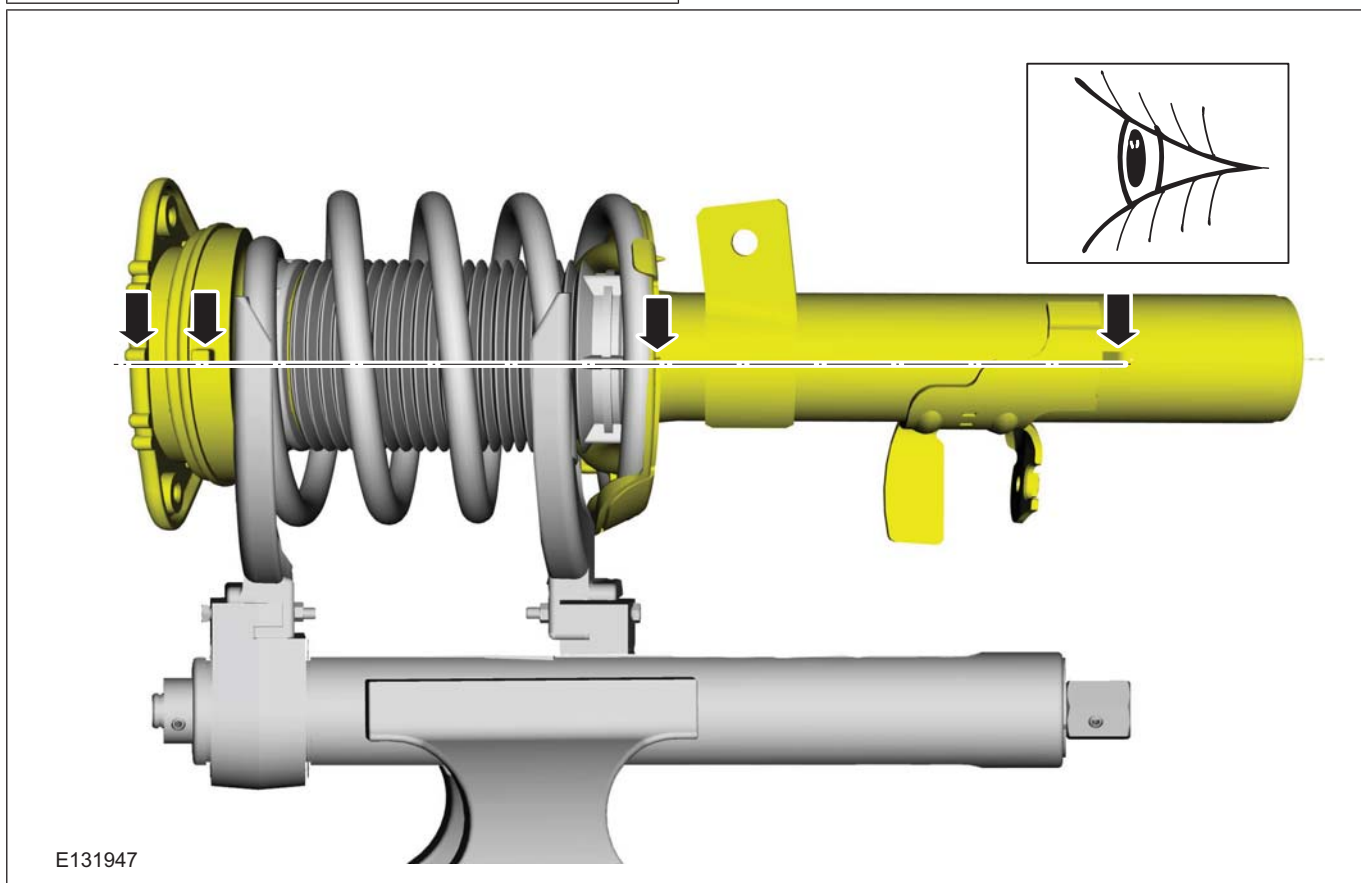
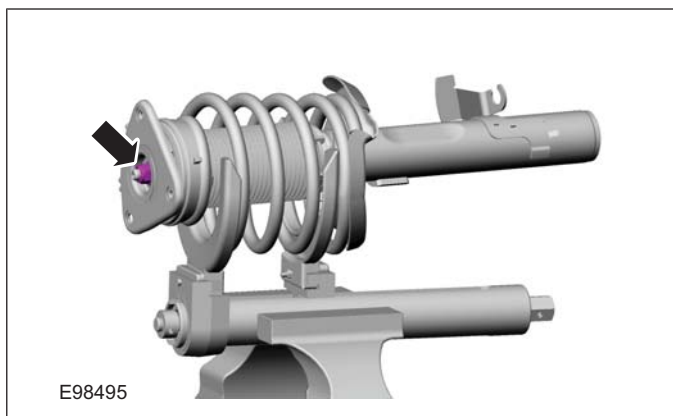
3. To assemble, reverse the disassembly procedure.

4. **NOTE:** Only tighten the nut finger tight at this stage.

5. **NOTE:** Make sure that these components are installed to the noted removal position.

**NOTE:** Make sure that the spring is correctly located in the lower spring seat.

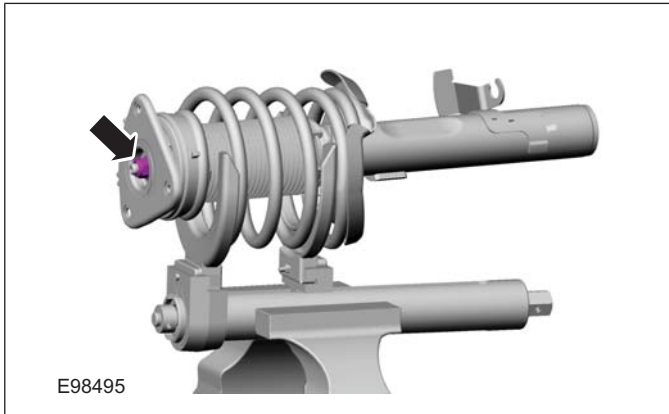
**NOTE:** Make sure that the installation marks are aligned.



**DISASSEMBLY AND ASSEMBLY**

6.  **CAUTION:** Use an Allen key to prevent the piston rod from rotating.

Torque: 55 Nm



7. Remove the Special Tool(s): 204-167,  
204-167-01

## SECTION 204-02 Rear Suspension

**VEHICLE APPLICATION: 2008.50 Kuga**

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<b>DESCRIPTION AND OPERATION</b>	
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Overview.....	204-02-3
Upper control arm.....	204-02-4
Rear lower arm and spring lower pad.....	204-02-4
Front lower arm.....	204-02-4
Stabilizer bar.....	204-02-5
<b>REMOVAL AND INSTALLATION</b>	
Wheel Bearing and Wheel Hub.....	204-02-6
Upper Arm..... (15 701 0)	204-02-9
Front Lower Arm..... (15 690 0)	204-02-11
Rear Lower Arm..... (15 705 0)	204-02-13
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Rear Stabilizer Bar Bushing.....	204-02-18
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Spring..... (15 621 0)	204-02-25

## SPECIFICATIONS

## Rear Wheel Alignment 2WD

Description	Measurements	Tolerance Range	Setting or Nominal	Maximum Variance Left or Right
Camber angle	Degrees and minutes	-2°47' to -0°17'	-1°32'	1°15'
	Decimal degrees	-2.79° to -0.29°	-1.54°	1.25°
Single wheel toe	mm	1.4 ± 1.3	1.4 Toe-in ± 0.6	-
	Degrees and minutes	0°11' ± 0°10'	0°11' Toe-in ± 0°05'	-
	Decimal degrees	0.19° ± 0.18°	0.19° Toe-in ± 0.08°	-
Total toe	mm	2.8 ± 2.6	2.8 Toe-in ± 1.1	-
	Degrees and minutes	0°23' ± 0°21'	0°23' Toe-in ± 0°09'	-
	Decimal degrees	0.38° ± 0.35°	0.38° Toe-in ± 0.15°	-

## Rear Wheel Alignment 4WD

Description	Measurements	Tolerance Range	Setting or Nominal	Maximum Variance Left or Right
Camber angle	Degrees and minutes	-2°.47' to -0°17'	-1°32'	1°15'
	Decimal degrees	-2.79° to -0.29°	-1.54°	1.25°
Single wheel toe	mm	1.4 ± 1.3	1.4 Toe-in ± 0.6	-
	Degrees and minutes	0°11' ± 0°10'	0°11' Toe-in ± 0°05'	-
	Decimal degrees	0.19° ± 0.18°	0.19° Toe-in ± 0.08°	-
Total toe	mm	2.8 ± 2.6	2.8 Toe-in ± 1.1	-
	Degrees and minutes	0°23' ± 0°21'	0°23' Toe-in ± 0°09'	-
	Decimal degrees	0.38° ± 0.35°	0.38° Toe-in ± 0.15°	-

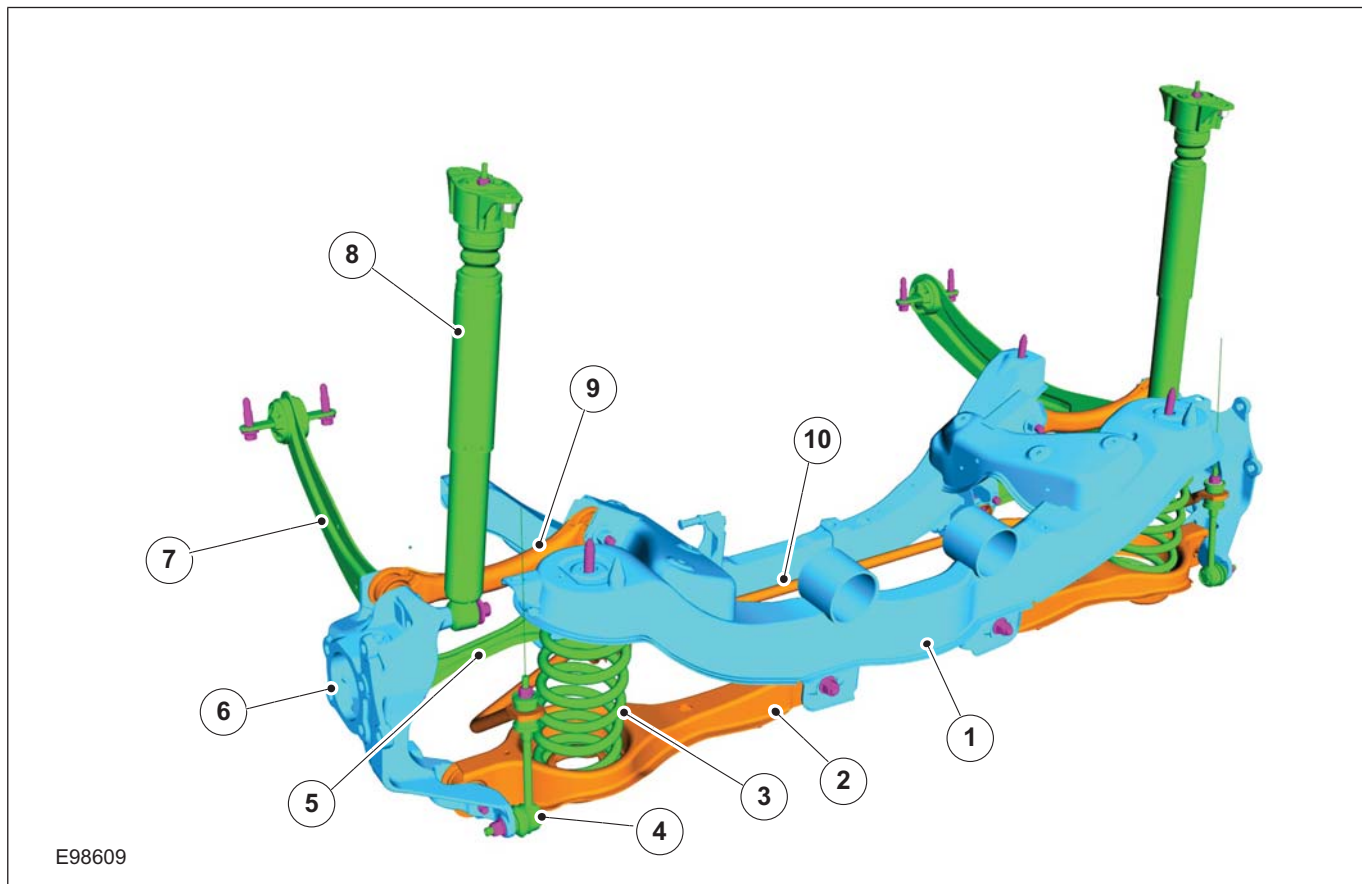
## Torque Specifications

Item	Nm	lb-ft	lb-in
Rear Shock Absorber - Upper Fixing	18	14	160
Rear Shock Absorber - Lower Fixing	115	85	1018

DESCRIPTION AND OPERATION

Rear Suspension – Overview

Overview



E98609

Item	Description
1	Subframe
2	Rear lower arm and spring lower pad
3	Spring
4	Stabilizer bar link
5	Front lower arm

Item	Description
6	Wheel knuckle
7	Tie-bar
8	Shock absorber
9	Upper control arm
10	Stabilizer bar, bushings and clamps



**DESCRIPTION AND OPERATION****Upper control arm**

The following components may be renewed:

- Lower arms

During removal and installation or renewal of the lower arm, pay attention to the following:

- After completing the work, the suspension geometry of the vehicle must be checked and corrected as necessary.

**Rear lower arm and spring lower pad**

The following components may be renewed:

- Lower arms

During removal and installation or renewal of the lower arm, pay attention to the following:

- After completing the work, the suspension geometry of the vehicle must be checked and corrected as necessary.

**Front lower arm**

The following components may be renewed:

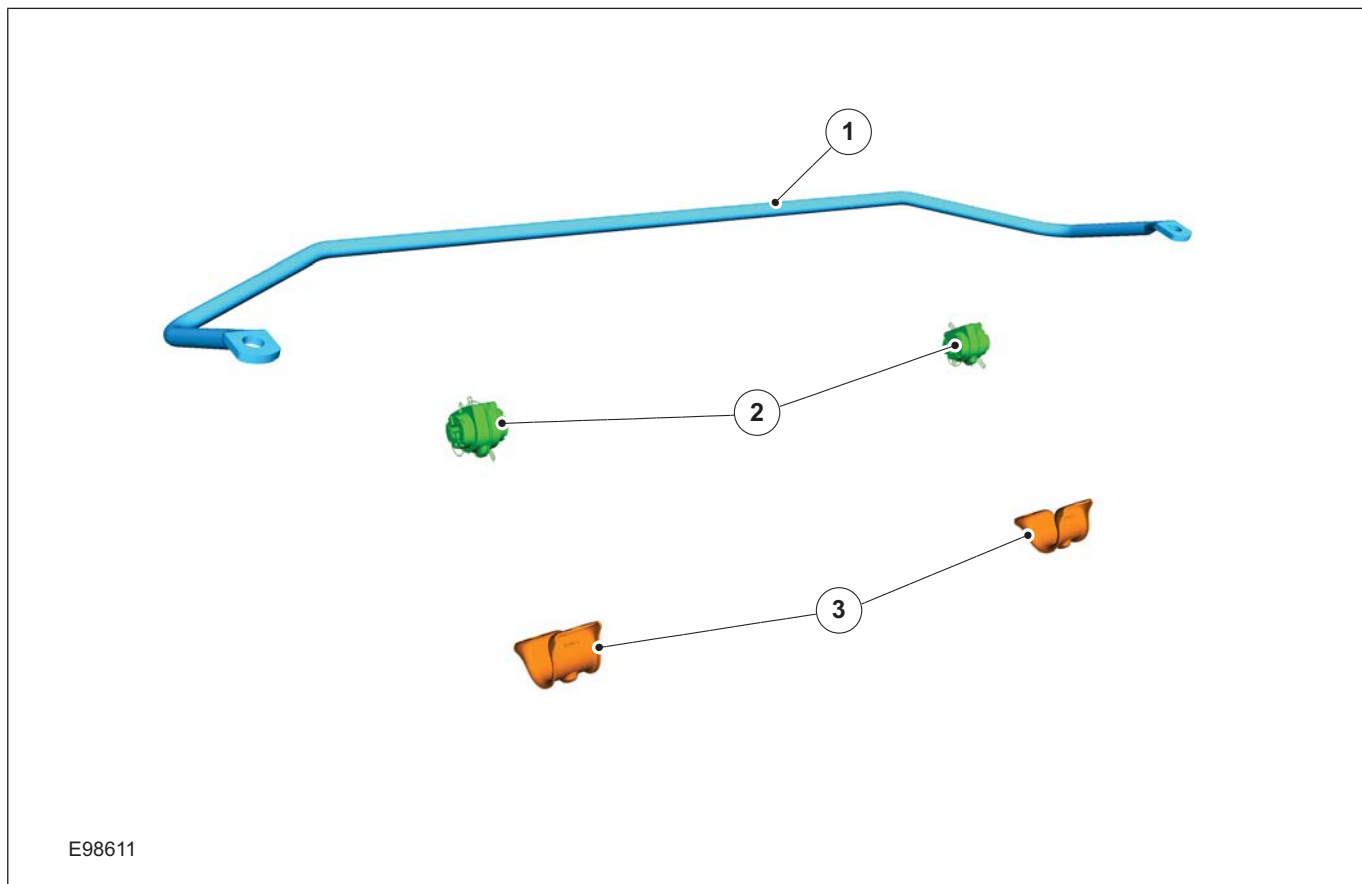
- Lower arms

During removal and installation or renewal of the lower arm, pay attention to the following:

- After completing the work, the suspension geometry of the vehicle must be checked and corrected as necessary.

## DESCRIPTION AND OPERATION

## Stabilizer bar



Item	Description
1	Stabilizer bar
2	Bushes, stabilizer bar
3	Bracket, stabilizer bar bushes

The following components may be renewed:

- Stabilizer bar
- Bushes, stabilizer bar
- Bracket, stabilizer bar bushes

During removal and installation or renewal of components of the stabilizer bar, pay attention to the following:

- Before installing the stabilizer bar bushes, they must be aligned according to the installation instructions.

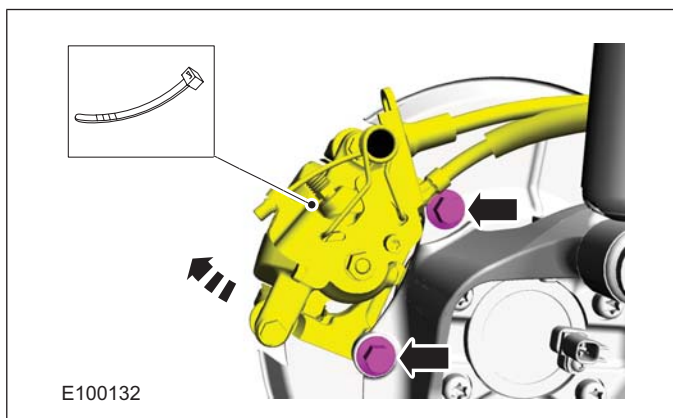
## REMOVAL AND INSTALLATION

## Wheel Bearing and Wheel Hub

## Removal

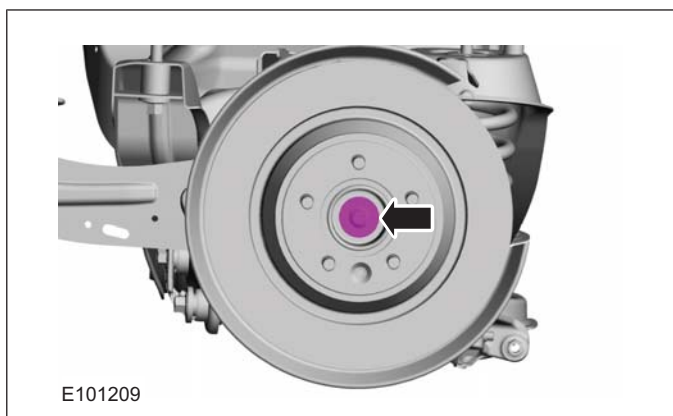
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
2. Refer to: **Rear Wheel Speed Sensor** (206-09 Anti-Lock Control - Stability Assist, Removal and Installation).
3. **WARNING:** Make sure that no load is placed on the brake hose.

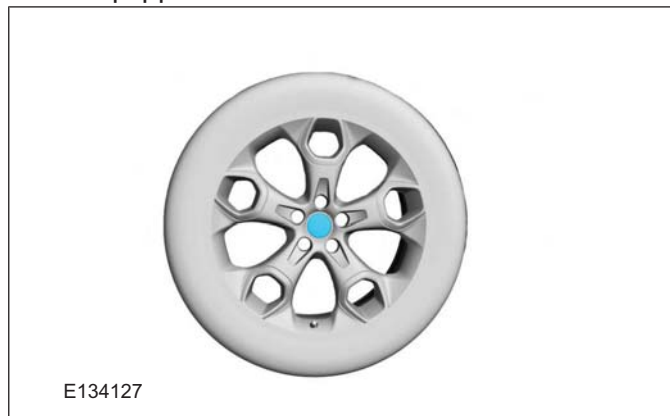


4x4

4.

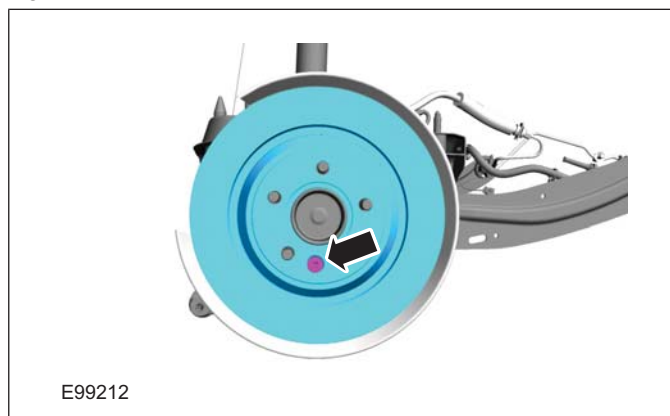


5. If equipped.



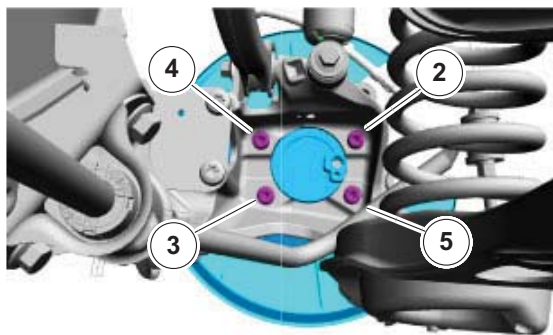
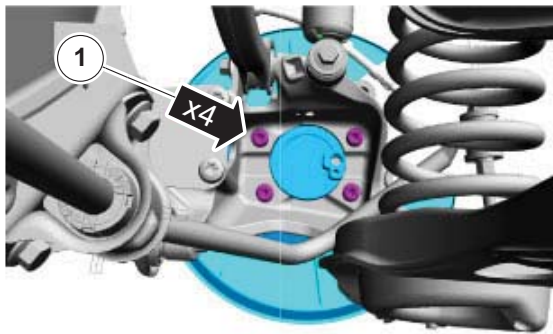
All vehicles

6.



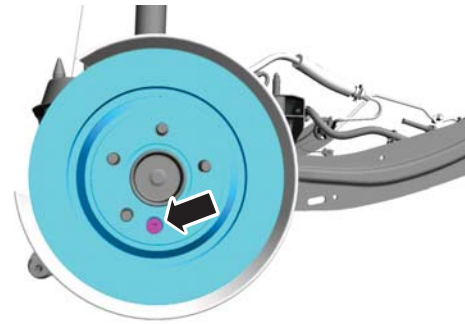
REMOVAL AND INSTALLATION

7.



E99213

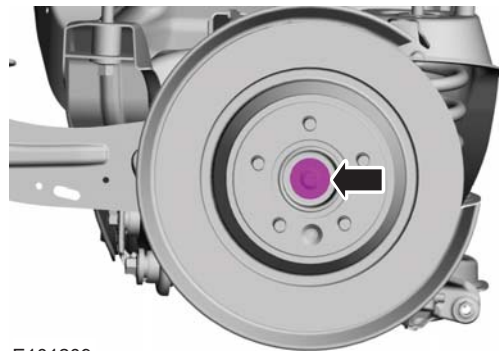
2.



E99212

4x4

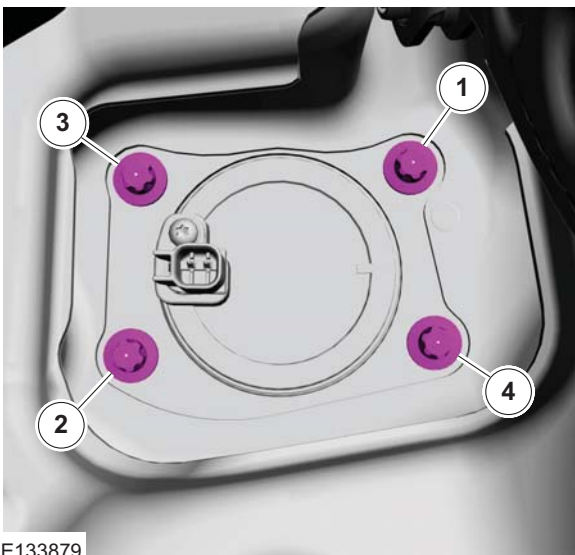
3. **NOTE:** Only tighten the bolt finger tight at this stage.



E101209

Installation

1. Torque: 110 Nm

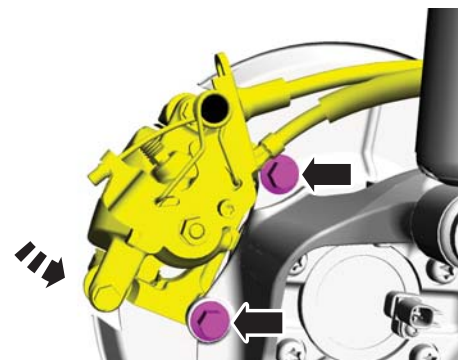


E133879

All vehicles

4. **WARNING:** Make sure that no load is placed on the brake hose.

Torque: 110 Nm



E134113

**REMOVAL AND INSTALLATION**

5. Refer to: **Rear Wheel Speed Sensor** (206-09 Anti-Lock Control - Stability Assist, Removal and Installation).
6. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

4x4

7. Torque: 50 Nm



E134128

8. If equipped.



E134126

REMOVAL AND INSTALLATION

Upper Arm(15 701 0)

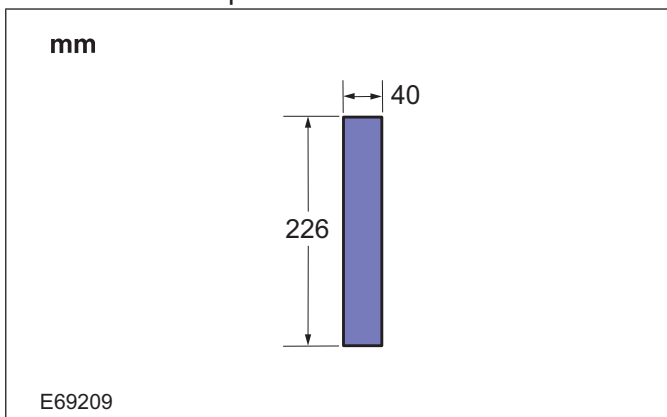
General Equipment

Transmission Jack

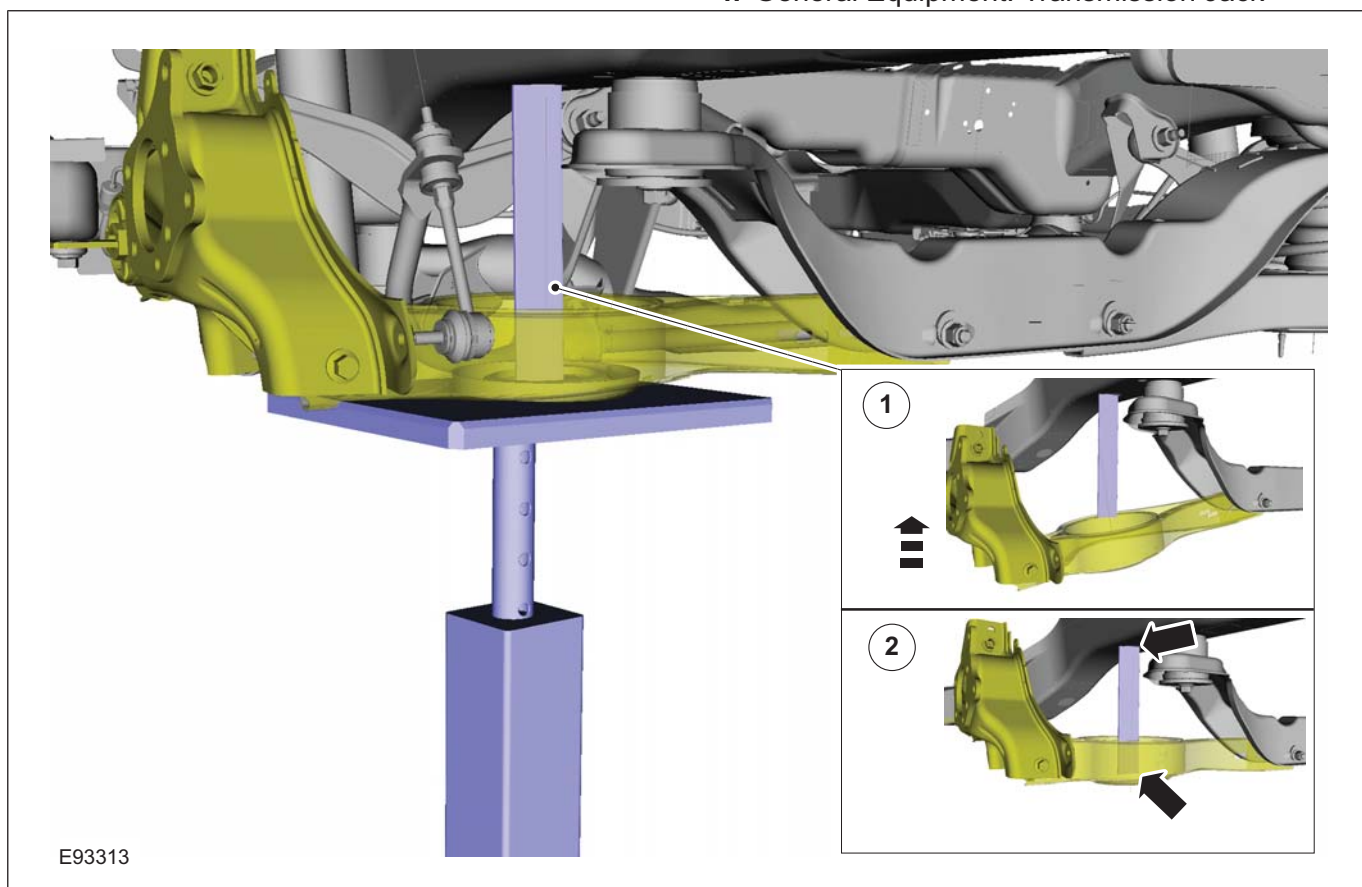
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
2. Refer to: **Spring** (204-02 Rear Suspension, Removal and Installation).
3. Fabricate a spacer.



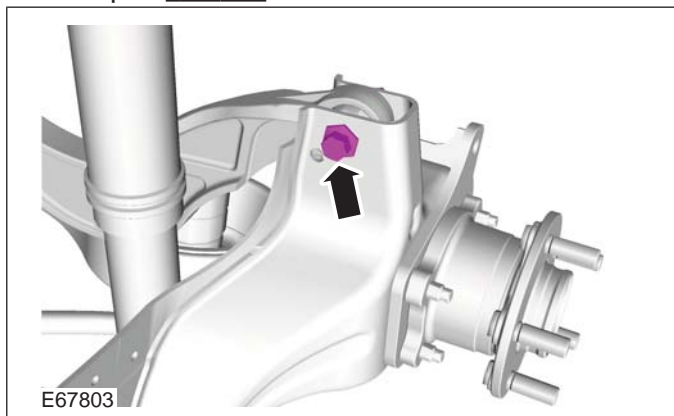
4. General Equipment: Transmission Jack



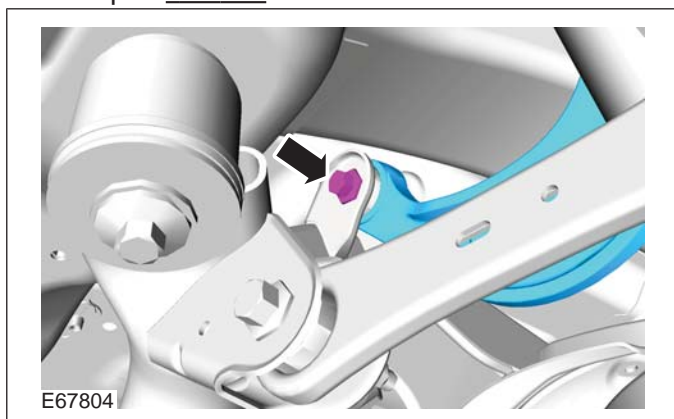


## REMOVAL AND INSTALLATION

5. Torque: 115 Nm



6. Torque: 115 Nm



## Installation

1. To install, reverse the removal procedure.
2. Refer to: **Rear Toe Adjustment** (204-00 Suspension System - General Information, General Procedures).

REMOVAL AND INSTALLATION

Front Lower Arm(15 690 0)

General Equipment

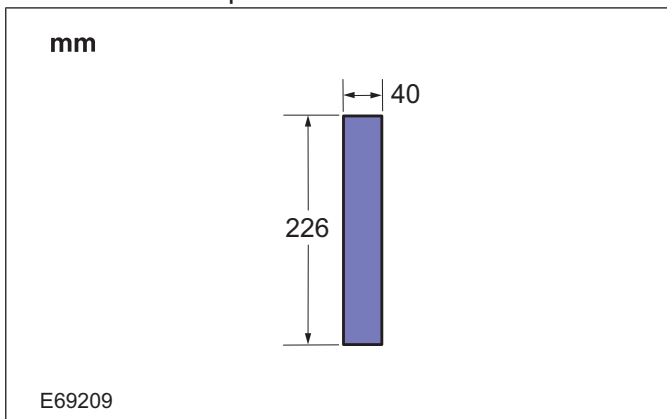
Transmission Jack

Removal

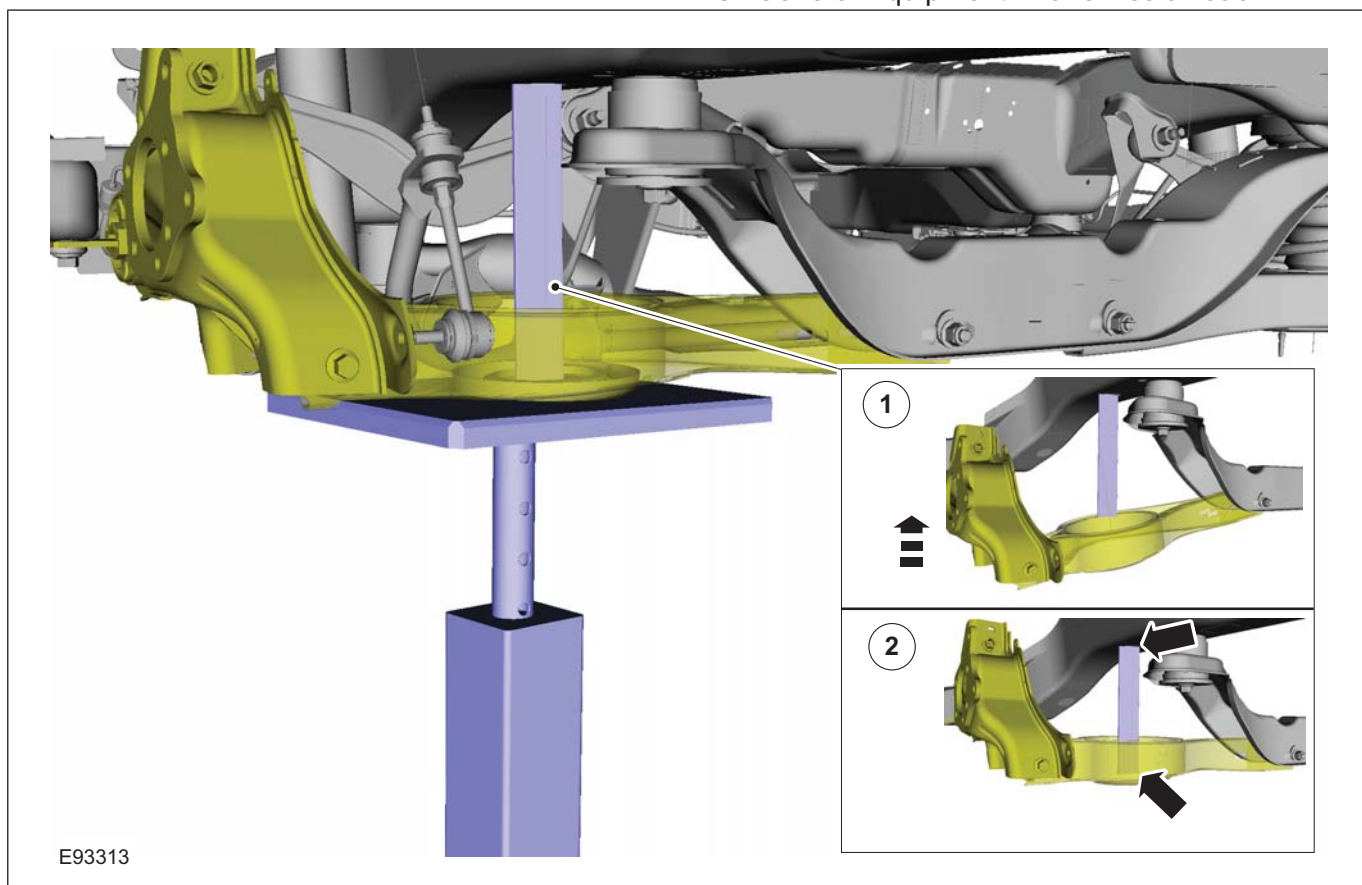
**NOTE:** Removal steps in this procedure may contain installation details.

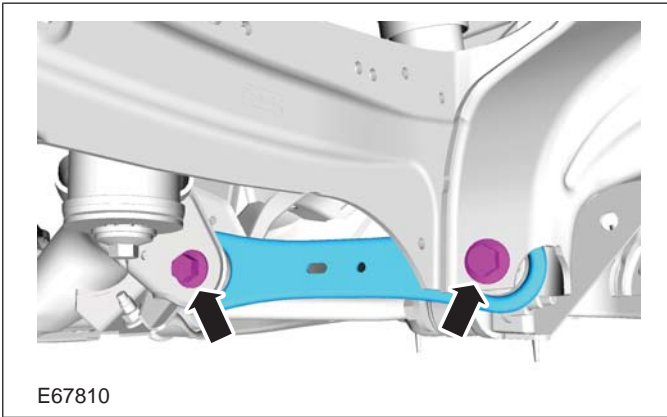
1. Refer to: **Spring** (204-02 Rear Suspension, Removal and Installation).

2. Fabricate a spacer.



3. General Equipment: Transmission Jack



**REMOVAL AND INSTALLATION****4. Torque: 115 Nm****Installation**

1. To install, reverse the removal procedure.
2. Refer to: **Rear Toe Adjustment** (204-00 Suspension System - General Information, General Procedures).

REMOVAL AND INSTALLATION

Rear Lower Arm(15 705 0)

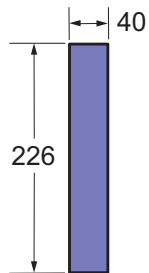
General Equipment

Transmission Jack

Removal

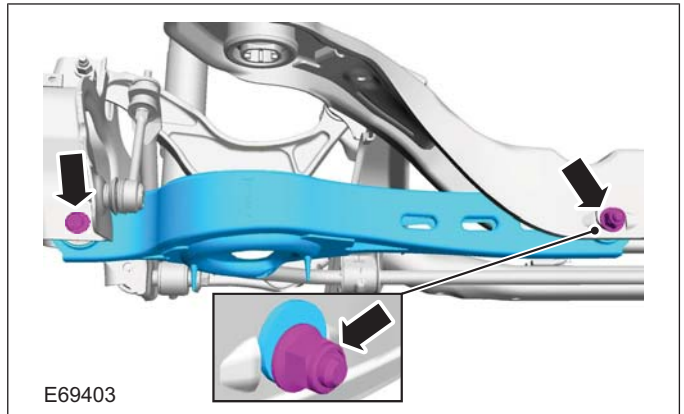
1. Refer to: **Spring** (204-02 Rear Suspension, Removal and Installation).
2. Fabricate a spacer.

mm



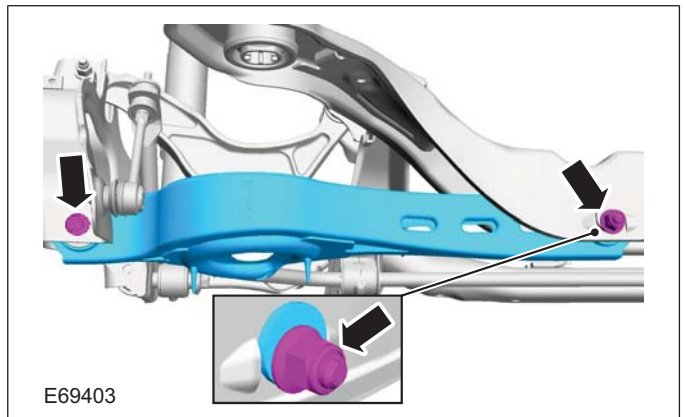
E69209

3.



Installation

1. **NOTE:** Only tighten the nuts finger tight at this stage.



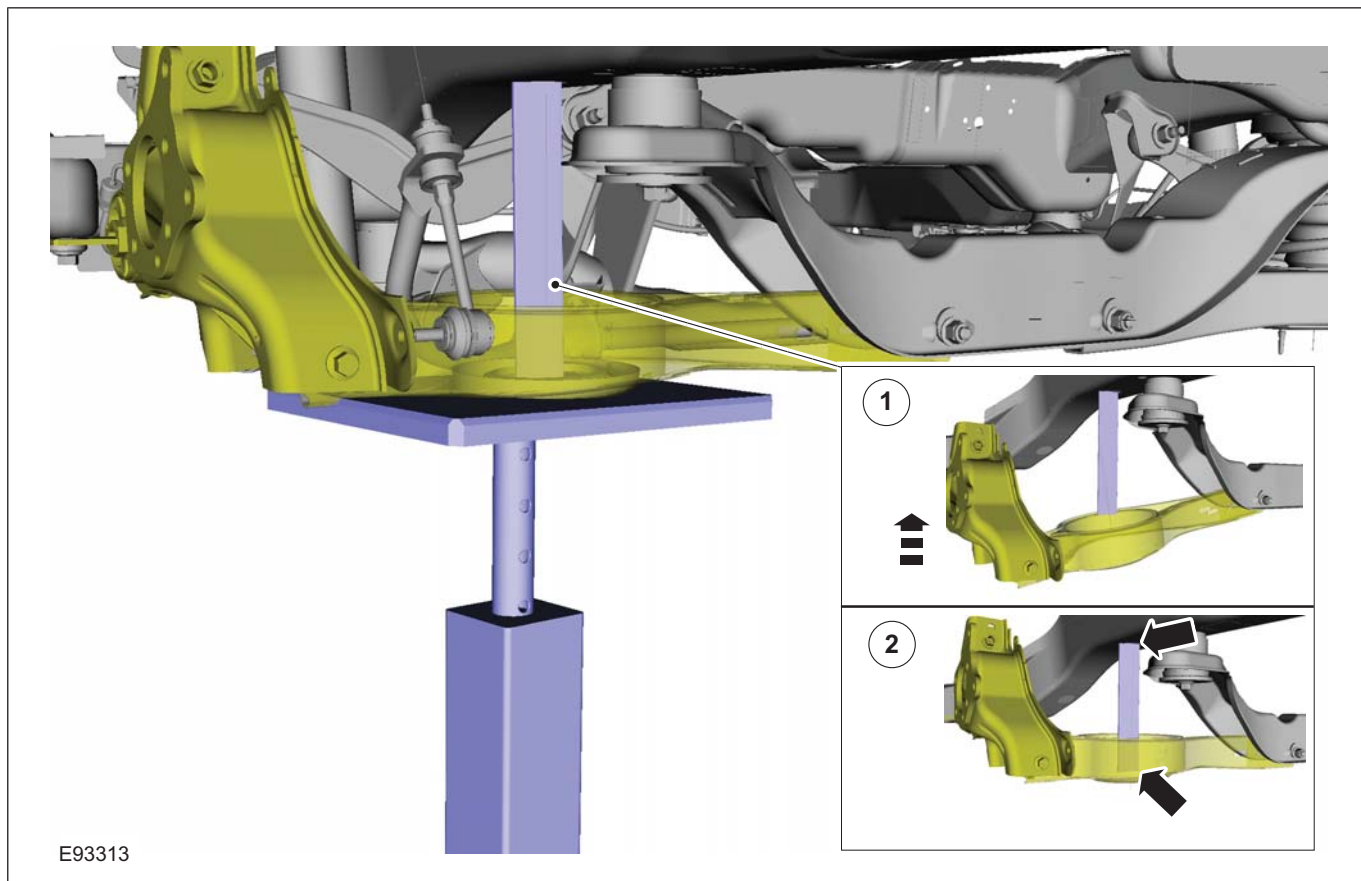
2. General Equipment: Transmission Jack

204-02-14

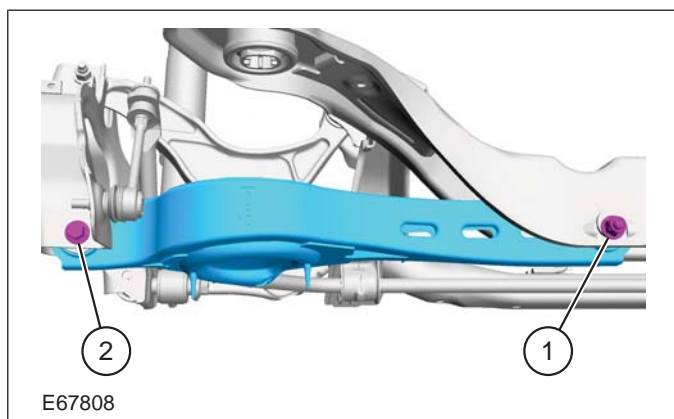
Rear Suspension

204-02-14

## REMOVAL AND INSTALLATION



3. 1. Torque: 18 Nm
2. Torque: 115 Nm



4. Remove the spacer.
5. Install the spring.  
Refer to: **Spring** (204-02 Rear Suspension, Removal and Installation).
6. Refer to: **Rear Toe Adjustment** (204-00 Suspension System - General Information, General Procedures).

204-02-15

Rear Suspension

204-02-15

## REMOVAL AND INSTALLATION

## Rear Stabilizer Bar(15 752 0)

## General Equipment

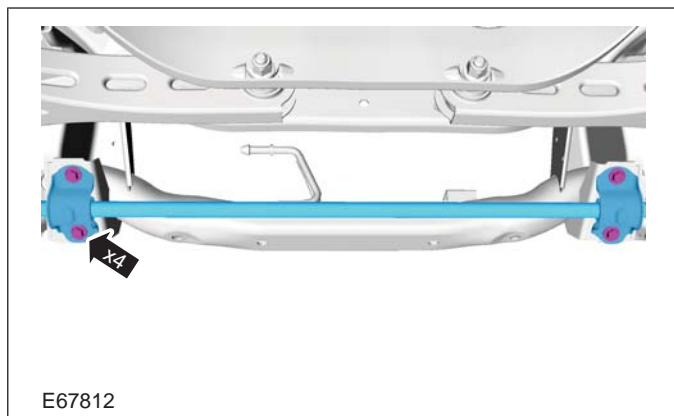
Hydraulic Press

## Removal

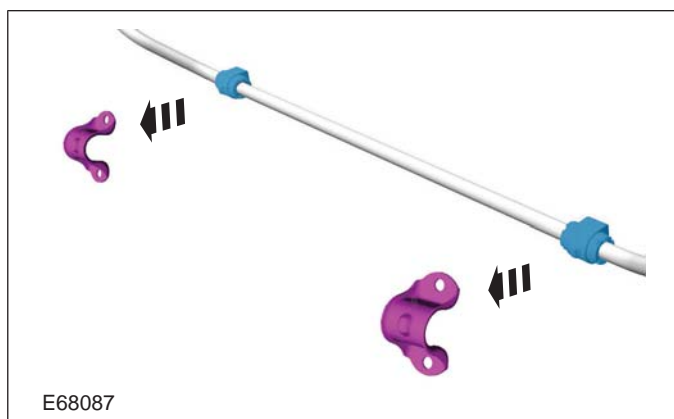
1. On both sides.

Refer to: **Rear Stabilizer Bar Link** (204-02 Rear Suspension, Removal and Installation).

- 2.



3. **NOTE:** Note the position of each component before removal.



## Installation

1. **NOTE:** Make sure that the component is clean, free of foreign material and lubricant.

**NOTE:** Make sure that these components are installed to the noted removal position.



2. **NOTE:** Make sure that the clamp is installed to the same orientation as when removed.  
On both sides.

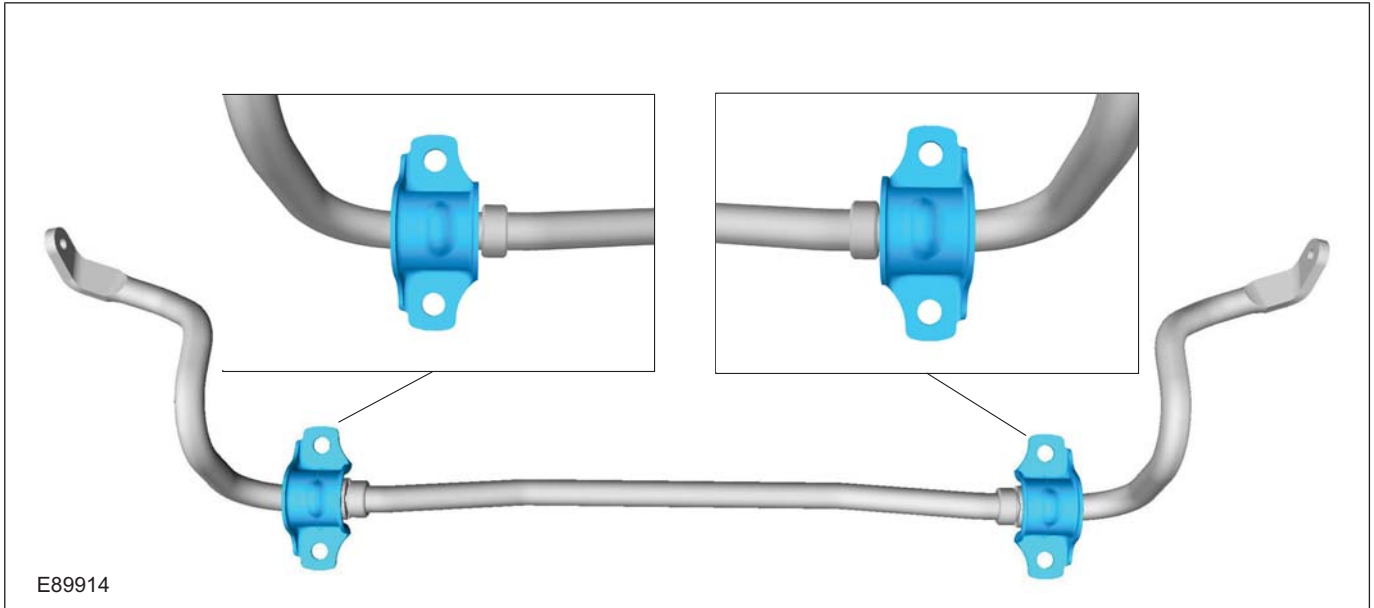


204-02-16

Rear Suspension

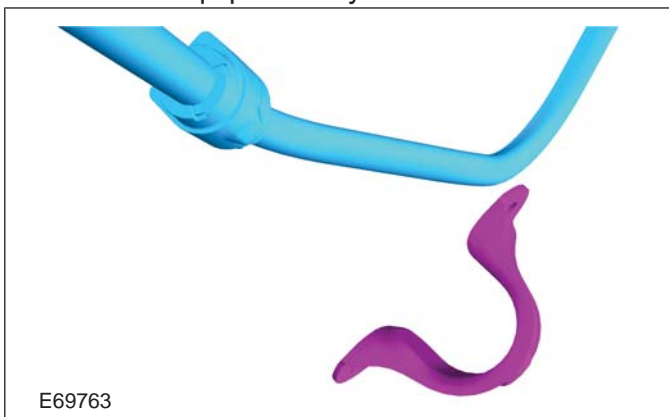
204-02-16

## REMOVAL AND INSTALLATION

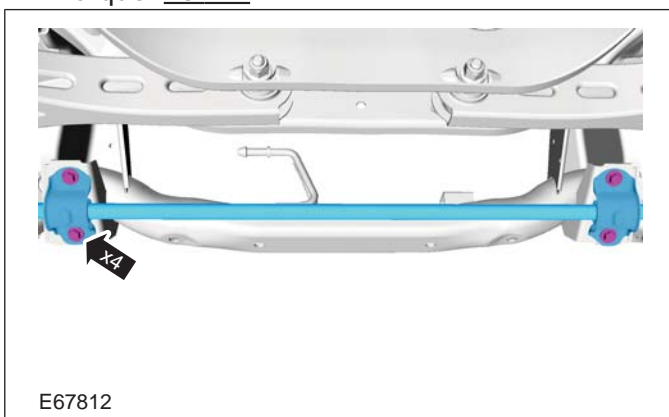


3. On both sides.

General Equipment: Hydraulic Press



4. Torque: 48 Nm



5. On both sides.


Refer to: **Rear Stabilizer Bar Link** (204-02 Rear Suspension, Removal and Installation).

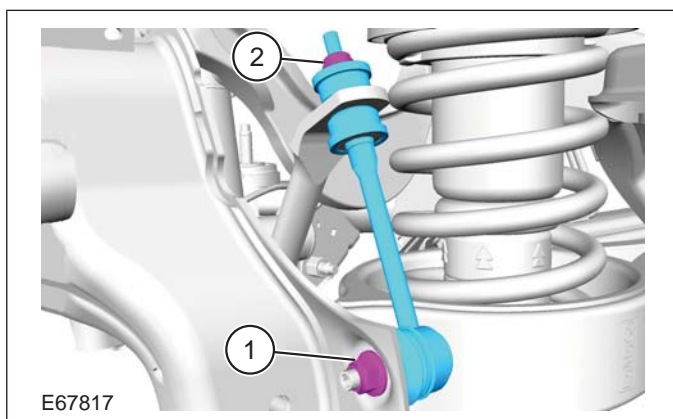
## REMOVAL AND INSTALLATION

## Rear Stabilizer Bar Link

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
2.  **CAUTION: Make sure that the ball joint ball does not rotate.**
  1. Torque: 70 Nm
  2. Torque: 15 Nm



## Installation

1. To install, reverse the removal procedure.



---

## REMOVAL AND INSTALLATION

### Rear Stabilizer Bar Bushing

#### Removal

1. Refer to: **Rear Stabilizer Bar** (204-02 Rear Suspension, Removal and Installation).

#### Installation

- 1.



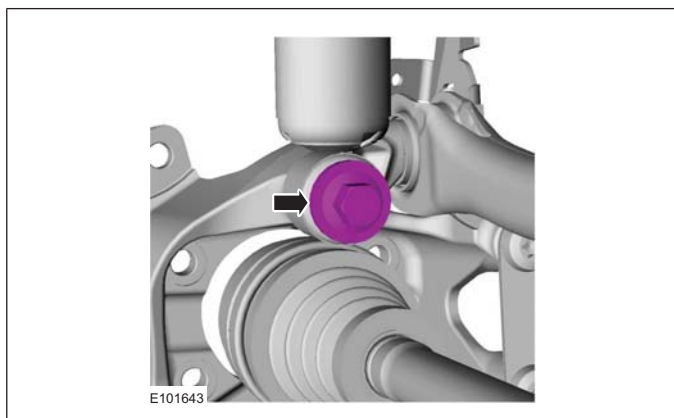


REMOVAL AND INSTALLATION

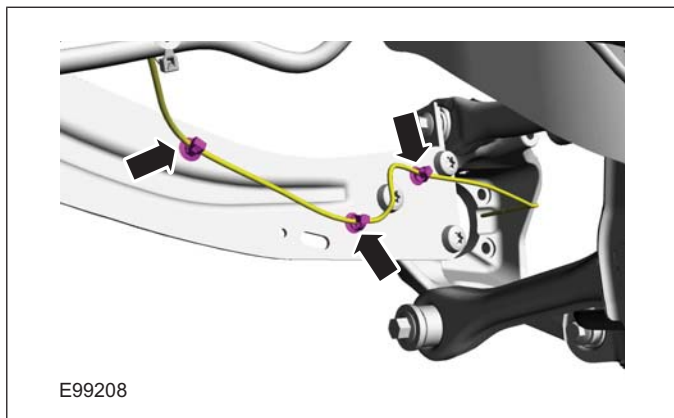
Wheel Knuckle — LHD FWD/RHD FWD

Removal

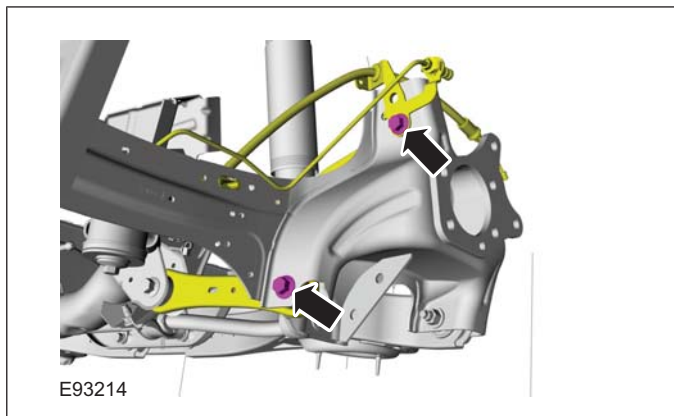
1. Refer to: **Spring** (204-02 Rear Suspension, Removal and Installation).
2. Refer to: **Wheel Bearing and Wheel Hub** (204-02 Rear Suspension, Removal and Installation).
- 3.



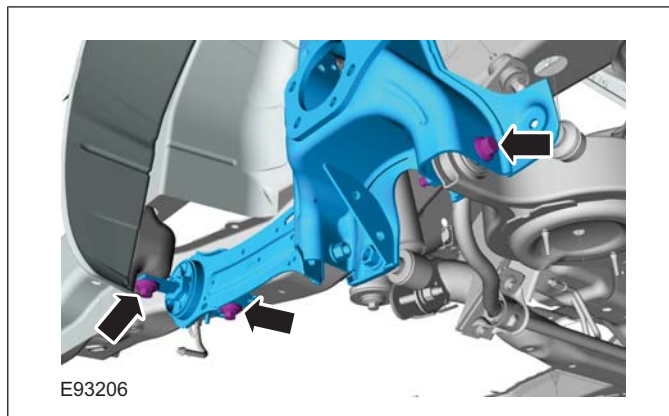
4.



5.

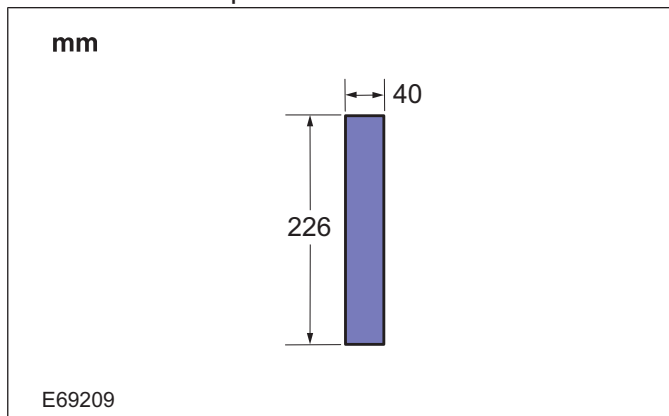


6.

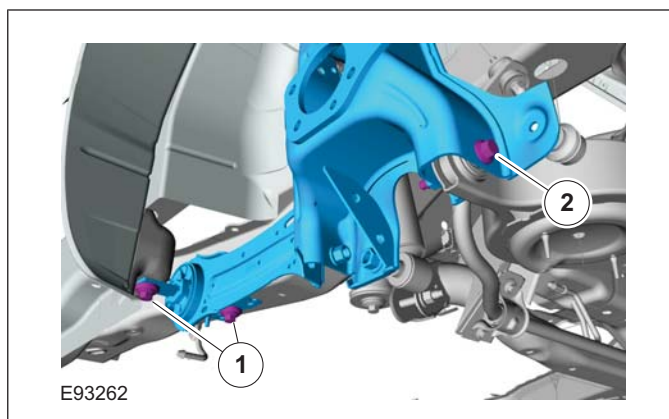


Installation

1. Fabricate a spacer.



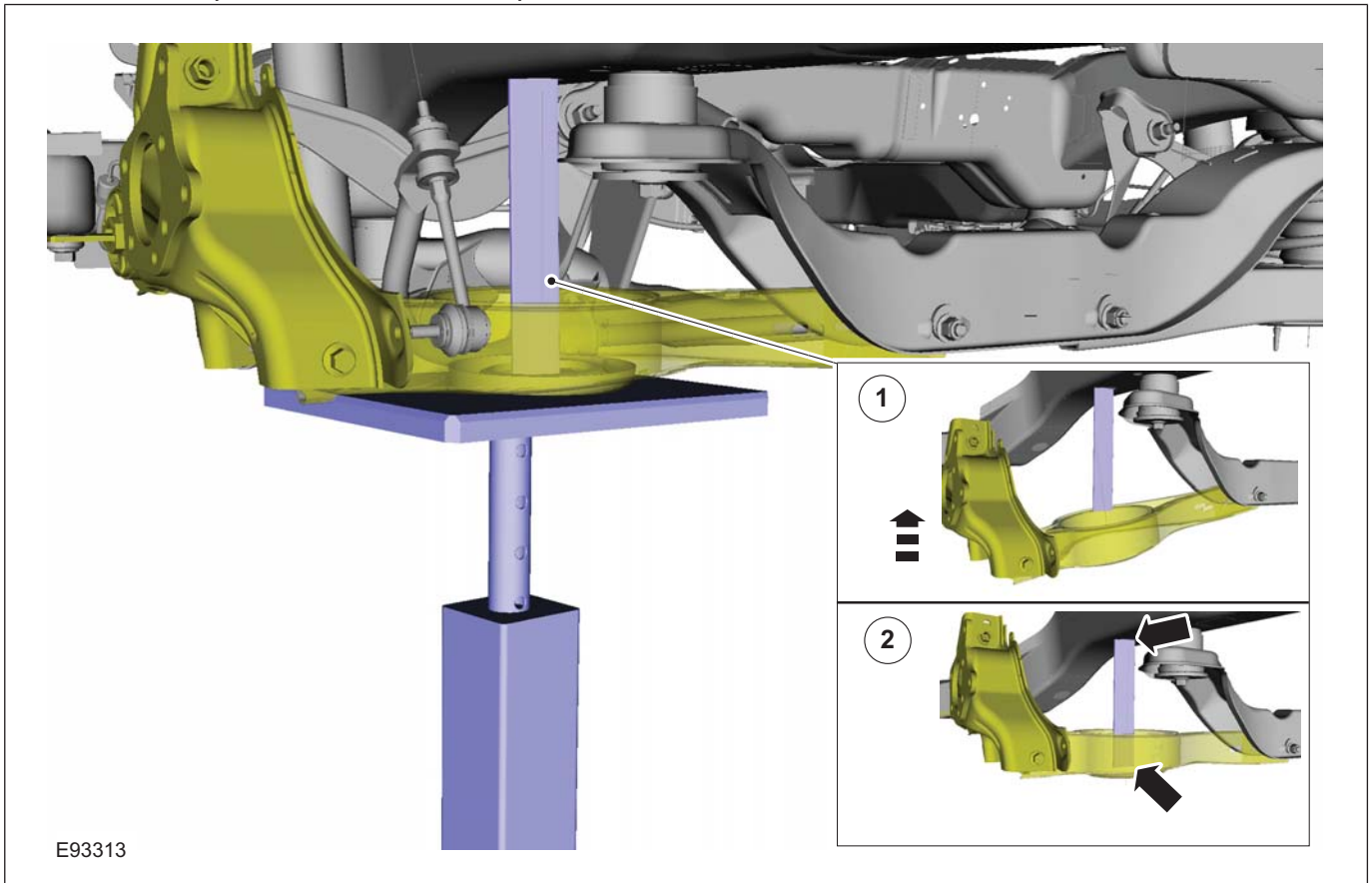
2. 1. Torque: 120 Nm
2. **NOTE:** Only tighten the bolt finger tight at this stage.



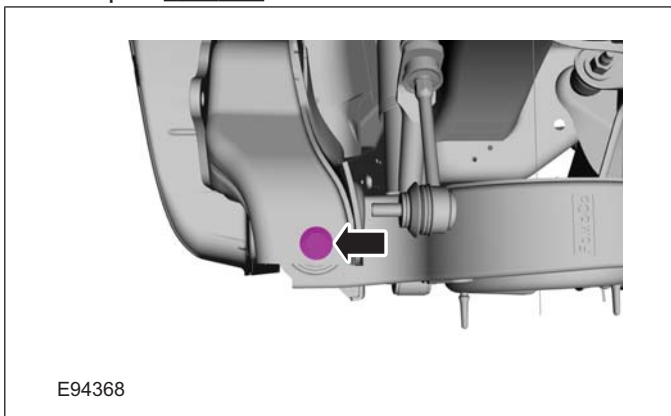


REMOVAL AND INSTALLATION

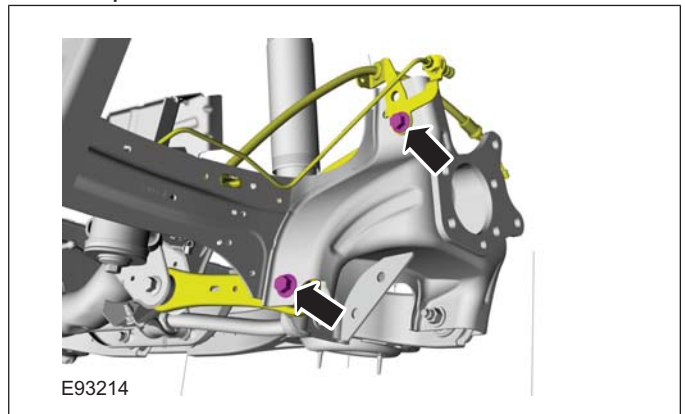
3. Install the spacer. Make sure that the spacer is in a vertical plane and raise the suspension to the design height setting.



4. Torque: 115 Nm



5. Torque: 115 Nm



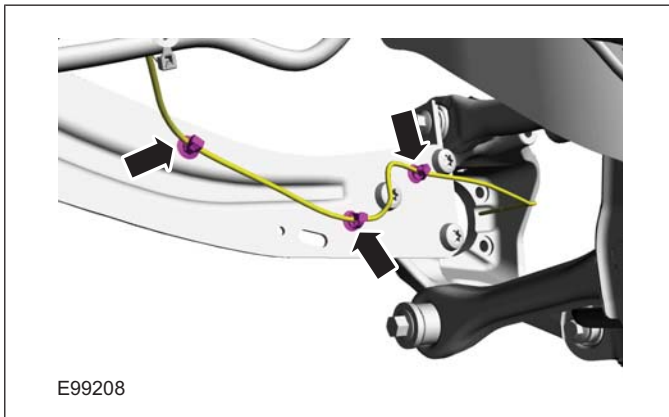
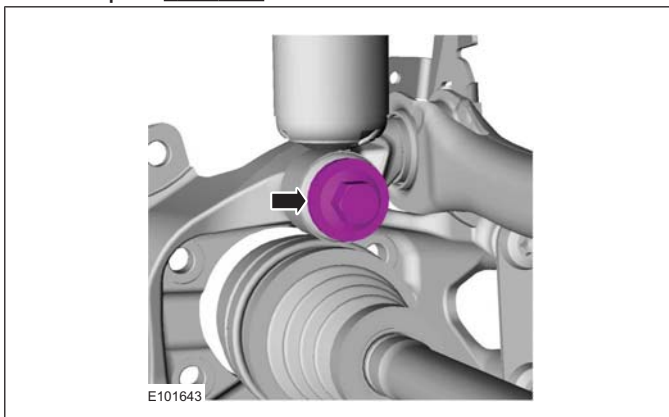
204-02-21

Rear Suspension

204-02-21

## REMOVAL AND INSTALLATION

6.

7. Torque: 115 Nm

8. Refer to: **Wheel Bearing and Wheel Hub** (204-02 Rear Suspension, Removal and Installation).
9. Refer to: **Spring** (204-02 Rear Suspension, Removal and Installation).



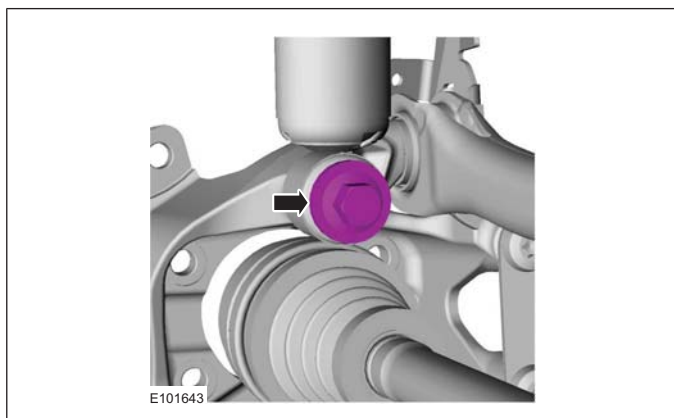


REMOVAL AND INSTALLATION

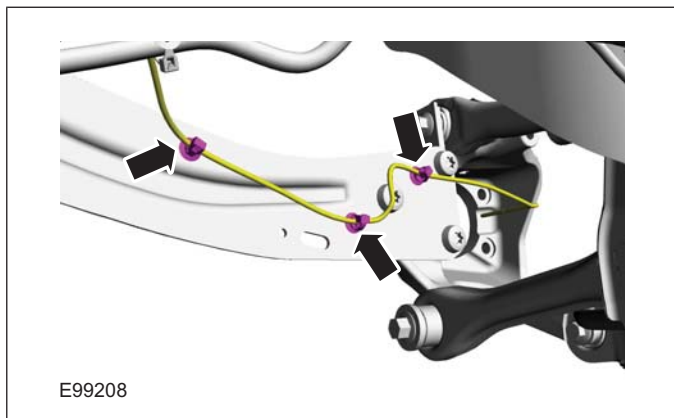
Wheel Knuckle — LHD 4WD/RHD 4WD

Removal

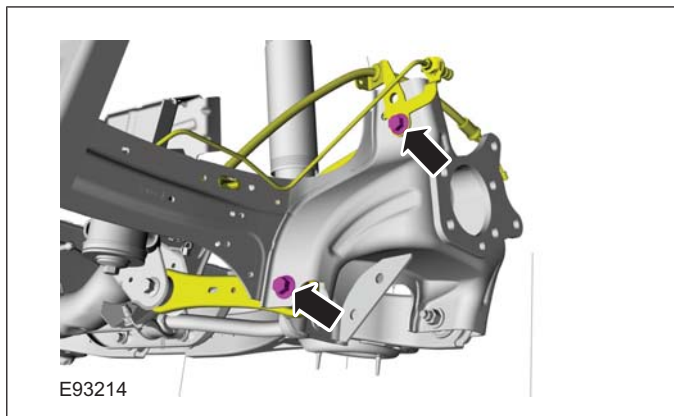
1. Refer to: **Spring** (204-02 Rear Suspension, Removal and Installation).
2. Refer to: **Wheel Bearing and Wheel Hub** (204-02 Rear Suspension, Removal and Installation).
- 3.



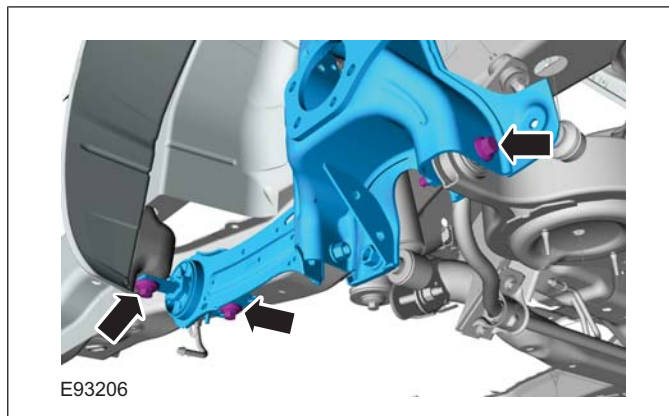
4.



5.

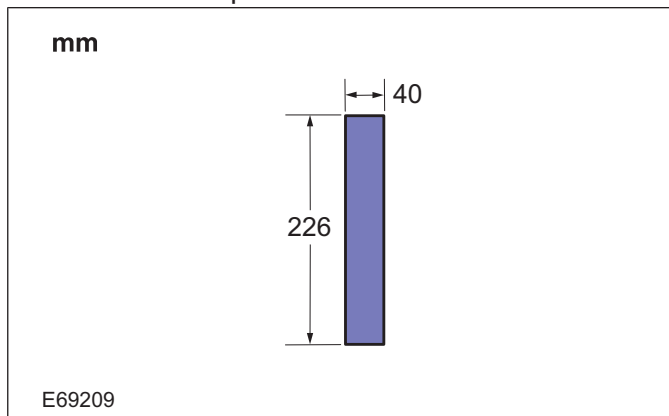


6.

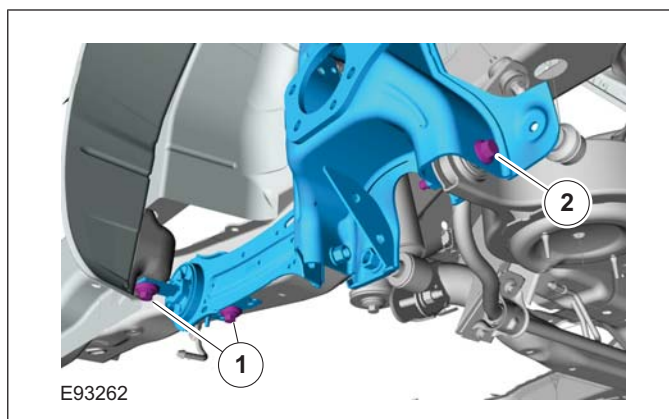


Installation

1. Fabricate a spacer.



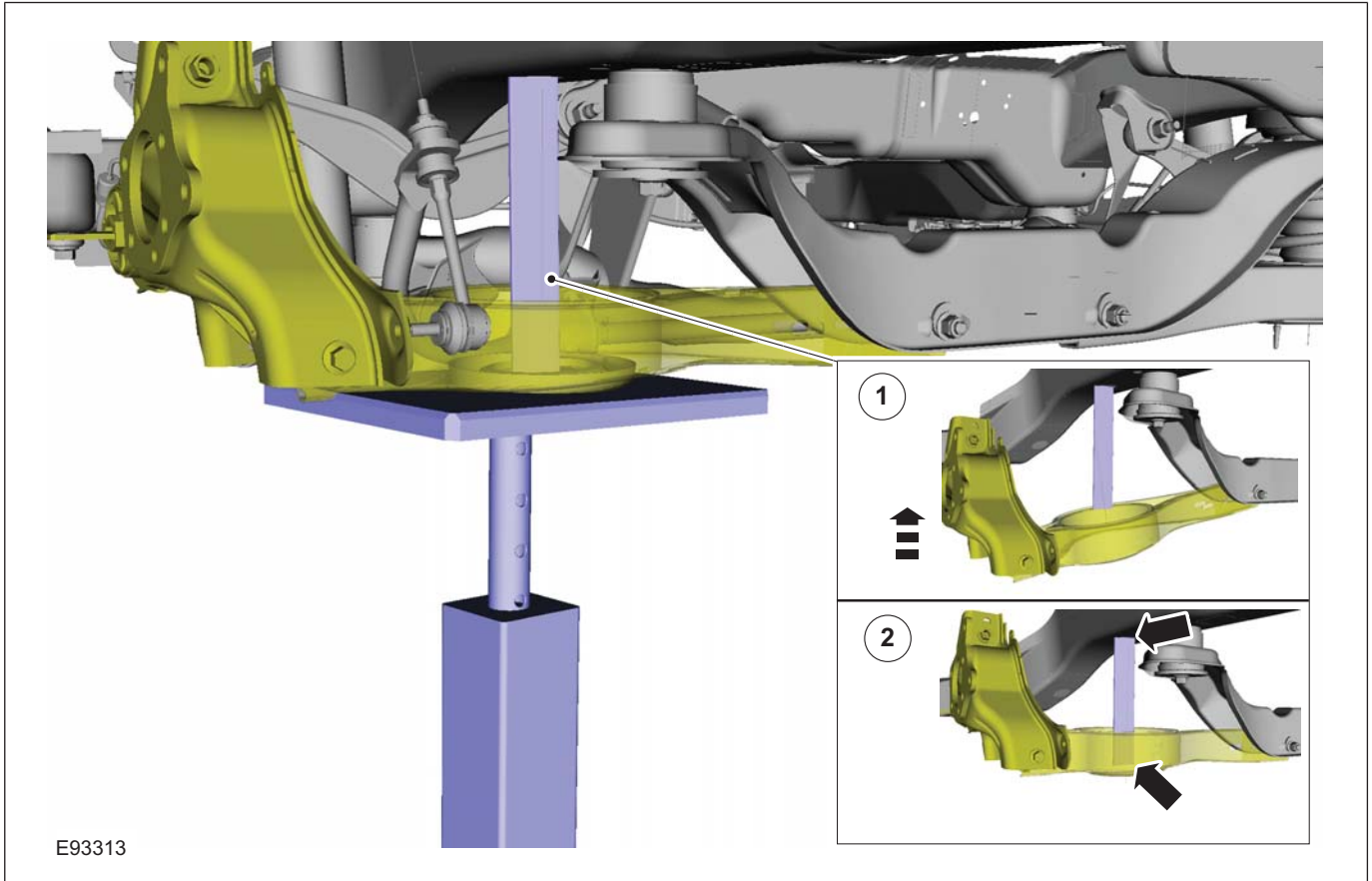
2. 1. Torque: 120 Nm
2. **NOTE:** Only tighten the bolt finger tight at this stage.



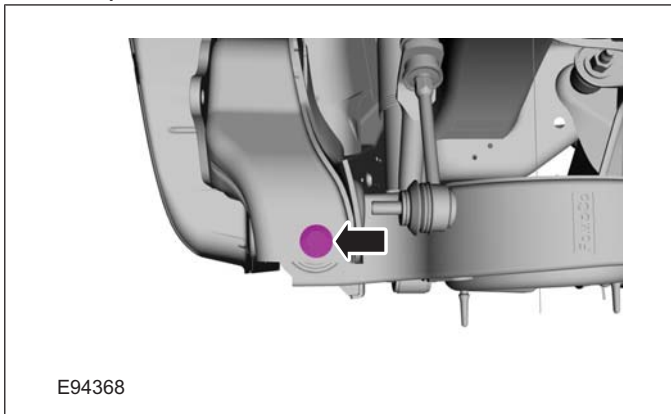


REMOVAL AND INSTALLATION

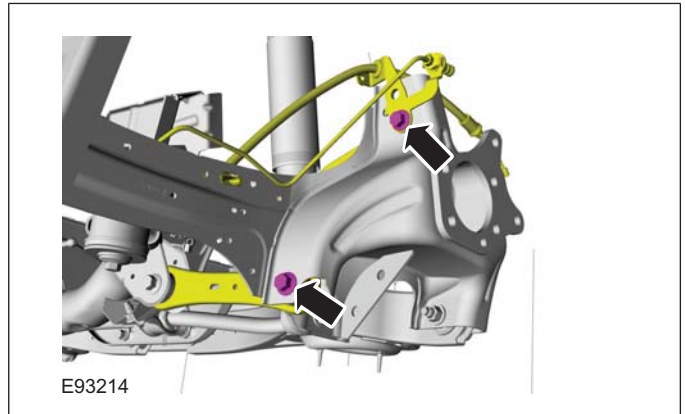
3. Install the spacer. Make sure that the spacer is in a vertical plane and raise the suspension to the design height setting.



4. Torque: 115 Nm



5. Torque: 115 Nm



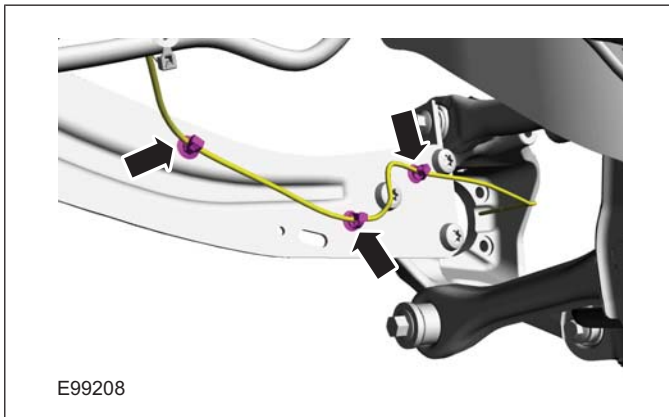
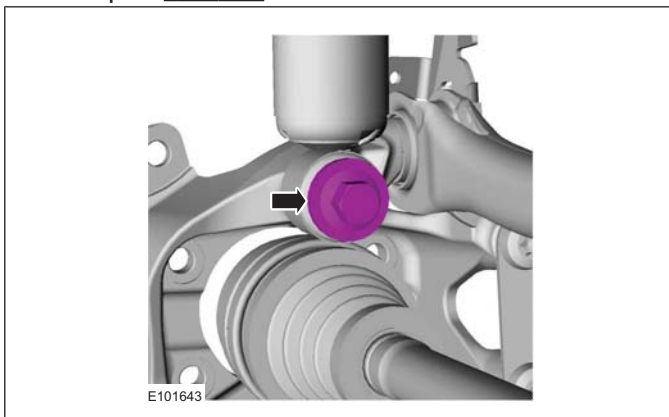
204-02-24

Rear Suspension

204-02-24

## REMOVAL AND INSTALLATION

6.

7. Torque: 115 Nm

8. Refer to: **Wheel Bearing and Wheel Hub** (204-02 Rear Suspension, Removal and Installation).
9. Refer to: **Spring** (204-02 Rear Suspension, Removal and Installation).

204-02-25

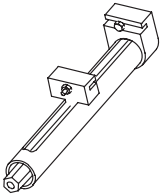

Rear Suspension

204-02-25

## REMOVAL AND INSTALLATION

## Spring(15 621 0)

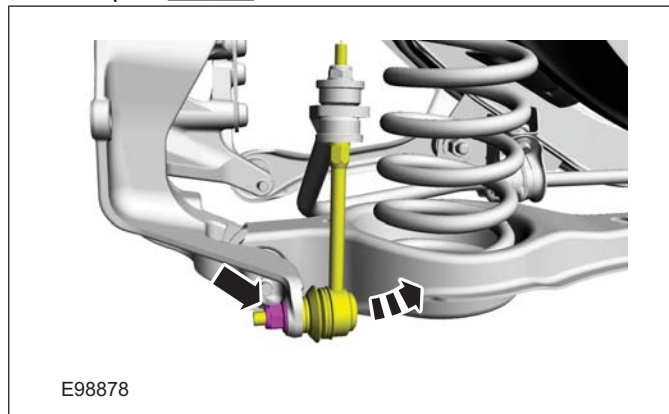
## Special Tool(s)

 <p>14042</p>	<p>204-167 Compressor, Coil Spring</p>
 <p>15111</p>	<p>204-215 Adapter for 204-167</p>

1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

2.  **CAUTION:** Make sure that the ball joint ball does not rotate.

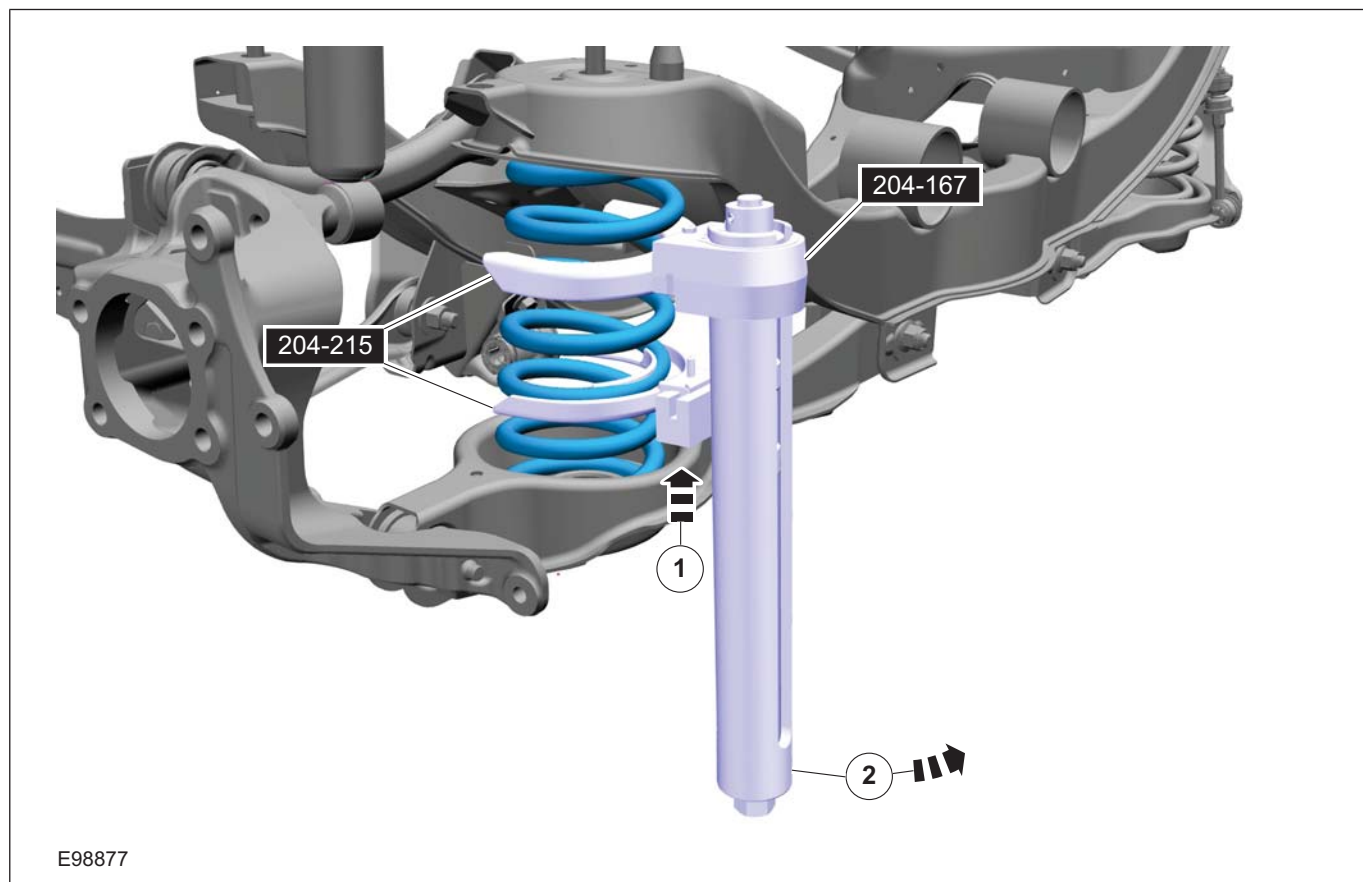
Torque: 70 Nm



## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

3. Install the Special Tool(s): 204-167, 204-215



## Installation

1. To install, reverse the removal procedure.

## SECTION 204-04 Wheels and Tires

### VEHICLE APPLICATION: 2008.50 Kuga

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Wheel and Tire.....	204-04-11

## SPECIFICATIONS

## Tyre pressures (cold tyres) - Up to 80 km/h (50 mph)

Variant	Tyre size	Normal load		Full load	
		Front	Rear	Front	Rear
		bar (psi)	bar (psi)	bar (psi)	bar (psi)
All	T135/90 R17	4.2 (61)	4.2 (61)	4.2 (61)	4.2 (61)

## Tyre pressures (cold tyres) - Up to 160 km/h (100 mph)

Variant	Tyre size	Normal load		Full load	
		Front	Rear	Front	Rear
		bar (psi)	bar (psi)	bar (psi)	bar (psi)
All	215/65 R16	2.2 (32)	2.3 (33)	2.4 (35)	2.8 (41)
All	215/70 R16	2.2 (32)	2.3 (33)	2.4 (35)	2.8 (41)
All	235/60 R16	2.2 (32)	2.3 (33)	2.4 (35)	2.8 (41)
All	235/55 R17	2.2 (32)	2.3 (33)	2.4 (35)	2.8 (41)
All	235/55 RF17	2.2 (32)	2.3 (33)	2.4 (35)	2.8 (41)
All	235/50 R18	2.1 (31)	2.2 (32)	2.4 (35)	2.8 (41)
All	235/45 R19	2.1 (31)	2.2 (32)	2.4 (35)	2.8 (41)

## Tyre pressures (cold tyres) - Continuous speed in excess of 160 km/h (100 mph)

Variant	Tyre size	Normal load		Full load	
		Front	Rear	Front	Rear
		bar (psi)	bar (psi)	bar (psi)	bar (psi)
All	215/65 R16	2.3 (33)	2.3 (33)	2.4 (35)	2.8 (41)
All	215/70 R16	2.3 (33)	2.3 (33)	2.4 (35)	2.8 (41)
All	235/60 R16	2.3 (33)	2.3 (33)	2.4 (35)	2.8 (41)
All	235/55 R17	2.3 (33)	2.3 (33)	2.4 (35)	2.8 (41)
All	235/55 RF17	2.3 (33)	2.3 (33)	2.4 (35)	2.8 (41)
All	235/50 R18	2.3 (33)	2.3 (33)	2.4 (35)	2.8 (41)
All	235/45 R19	2.3 (33)	2.3 (33)	2.4 (35)	2.8 (41)



## DESCRIPTION AND OPERATION

### Wheels and Tires – Overview

#### Tire/wheel rim combinations

The following tire/wheel rim combinations are available:

- 235/60 R16 V – 6.5X16 (\*)
- 235/55 R17 V – 7.0X17 (\*)
- 235/55 R17 V – 7.5X17 (\*)
- 235/50 R18 V – 7.5X18
- 235/45 R19 V – 8.0X19

(\*) Also available as tires with run-flat capabilities.

#### Use of snow chains

Snow chains are only approved for use with size 235/60R16 tires.

Fine chains with a link thickness of 10mm may be used at speeds of up to 50 km/h (please refer to the manufacturer's instructions).

Coarser chains with a link thickness of 11 to 14 mm may be used at speeds of up to 40 km/h (please refer to the manufacturer's instructions).

#### Tire repair kit

If the tires used do not have run-flat properties then the vehicle will be equipped with a tire repair kit.

A tire repair kit is located in the spare wheel well in the luggage compartment.

The tire repair kit consists of:

- a compressor with a pressure gauge,
- a lead for voltage supply via the cigar lighter,
- an air hose,
- tire sealant.

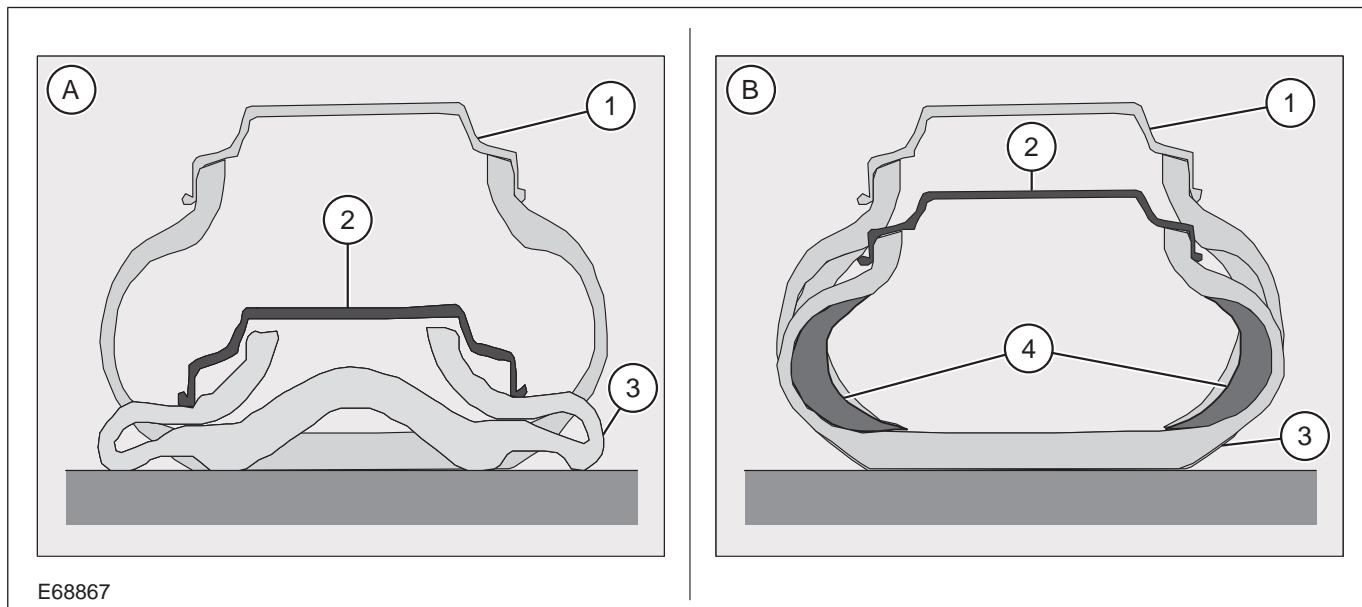
A tire filled with tire sealant must be replaced with a new tire after 200 km at the latest. Read and observe the instructions regarding the tire low pressure sensors (see lesson 4 – Tire pressure monitoring system).

Instructions on handling and using the tire repair kit can be found in a separate operating manual that is enclosed with the tire repair kit.

DESCRIPTION AND OPERATION

Run-Flat Tires – Overview

Tires with Run-flat Properties



E68867

Item	Description
A	Standard tire after pressure loss
B	Tire with run-flat properties after pressure loss
1	Wheel position with correct tire pressure

Item	Description
2	Wheel position with insufficient tire pressure
3	Tires
4	Reinforced sidewall

In addition to the standard tires, **run-flat** tires are also optionally available. These tires have a reinforced sidewall and provide the advantage that the tire maintains its shape to a large extent even in the event of insufficient tire pressure. This ensures that the vehicle handling remains stable.

Advantage:

- These tires maintain their shape to a large extent, even in the event of insufficient tire pressure. This ensures that the vehicle handling remains stable.

Special wheel rims (EH2) and a tire pressure monitoring system are needed for run-flat tires.

Standard tires can also be installed on the EH2 (EH = **E**xtended **H**ump) wheel rims. Tires with run-flat properties have the same size code and the same appearance as standard tires.

With some tires, the code **RF** for run-flat is included in the tire designation, e.g. 205/55 **RF** 16.

Tires with run-flat properties have various different codes on the sidewall, depending on the manufacturer.

- The RFT logo
- "RUNFLAT" as an additional designation
- The additional designation "RSC" (RSC = **R**unflat **S**ystem **C**omponent)
- The additional designation "SSR" (SSR = **S**elf **S**upporting **R**un-Flat-Tire)
- The additional designation "SST" (SST = **S**elf **S**upporting **R**un-Flat-Tire)

**WARNING:** If a tire with run-flat properties is used without air then the vehicle speed must not exceed 80 km/h and the vehicle must not be driven for distances in excess of 80 km.

**Note:** Vehicles equipped at the factory with run-flat tires do not feature a tire repair kit or a spare wheel.

**DESCRIPTION AND OPERATION****Tire Pressure Monitoring System (TPMS) – Overview****Description of operation**

The tire pressure monitoring system is able to detect loss of air in a tire at an early stage and warn the driver. Because it can only compare the behavior of the tires with each other, it is not possible to draw conclusions about the absolute tire pressure. It is also not possible to monitor the spare tire pressure. In order for the system to operate correctly, the tire pressures must be regularly checked and corrected and the system subsequently initialized (see below).

The tire pressure monitoring system used here, depending on the equipment level, is built into the anti-lock braking system (ABS) as an extra function and therefore does not have its own sensors.

The ABS module determines the loss of pressure in the tires by calculation using the wheel speed sensors of the ABS system. If a tire loses pressure, its diameter decreases and the speed of the wheel therefore increases. If the ABS module detects such a loss in pressure, it sends a signal to the instrument cluster via the CAN bus and a warning message is displayed in the driver information system. The warning threshold depends among other things on the dimension of the tires being used, the vehicle operating conditions and the status at the last initialization. Since neither the absolute tire pressure nor the position of the tire is known, after a tire pressure warning the pressure of all the tires must be checked and the system re-initialized. If necessary, the cause of the loss of pressure must be investigated.

Furthermore, regular pressure checks are necessary. The system must be initialized after a tire is changed, winter or summer tires fitted, the pressures corrected or adjusted to suit the vehicle load. This can be done by the driver using the driver information system. For further information, see: Owner's Manual.

**DIAGNOSIS AND TESTING****Wheels and Tires****Inspection and Verification****Visual Inspection Chart**

<b>Mechanical</b>
Wheel(s)
Tire(s)
Tire pressure(s) *
Wheel nuts
Wheel studs
* Vehicles equipped with a tire deflation detection system (DDS) must be inspected for correct operation using the Ford approved diagnostic tool.

To maximize tire performance, inspect the tires for signs of incorrect inflation and uneven wear which may indicate a need for balancing, rotation or suspension alignment. Tires should also be checked frequently for cuts, stone bruises, abrasions, blisters and for objects that may have become embedded in the tread. More frequent inspections are recommended when rapid or extreme temperature changes occur or when road surfaces are rough or occasionally littered with foreign material.

As a further visible check of tire condition, tread wear indicators are molded into the bottom of the tread grooves. When these indicator bands become visible, new tires must be installed.

**Tire Wear Diagnosis**

Uneven wear is usually caused by either excessive camber or excessive toe on tires.

Sometimes incorrect toe settings or worn struts will cause severe 'cupping' or 'scalloped' tire wear on non-driven wheels.

Severely incorrect toe settings will also cause other unusual wear patterns.

**Tire Vibration Diagnosis**

A tire vibration diagnostic procedure always begins with a road test. The road test and customer interview (if available) will provide much of the information needed to find the source of a vibration.

During the road test, drive the vehicle on a road that is smooth and free of undulations. If vibration is apparent, note and record the following:

- the speed at which the vibration occurs.
- what type of vibration occurs in each speed range.
  - mechanical or audible
- how the vibration is affected by changes in the following:
  - engine torque
  - vehicle speed
  - engine speed
- type of vibration - sensitivity:
  - torque sensitive
  - vehicle speed sensitive
  - engine speed sensitive

The following explanations help isolate the source of the vibration.

**Torque Sensitive**

This means that the condition can be improved or made worse by accelerating, decelerating, coasting, maintaining a steady vehicle speed or applying engine torque.

**Vehicle Speed Sensitive**

This means that the vibration always occurs at the same vehicle speed and is not affected by engine torque, engine speed or the transmission gear selected.

## DIAGNOSIS AND TESTING

## Engine Speed Sensitive

This means that the vibration occurs at varying vehicle speeds when a different transmission gear is selected. It can sometimes be isolated by increasing or decreasing engine speed with the transmission in NEUTRAL or by stall testing with the transmission in gear. If the condition is engine speed sensitive, the cause is probably not related to the tires.

If the road test indicates that there is tire whine, but no shake or vibration, the noise originates with the contact between the tire and the road surface.

A thumping noise usually means that the tire is flat or has soft spots making a noise as they slap the roadway. Tire whine can be distinguished from axle noise. Tire whine remains the same over a range of speeds.

A complete road test procedure is described in Section 100-04.

REFER to: **Noise, Vibration and Harshness (NVH)** (100-04 Noise, Vibration and Harshness, Diagnosis and Testing).

## Symptom Chart

Symptom	Possible Sources	Action
• DDS warning lamp illuminated	• Loss of tire pressure.	• ADJUST the tire pressure and reset the DDS. For additional information REFER to the owners guide.
• DDS warning lamp illuminated with the correct tire pressure	• The DDS reset procedure was not carried out after adjustment of the tire pressure.	• REFER to the DDS reset procedure. For additional information REFER to the owners guide.
• DDS warning lamp not illuminated when one or more tire(s) have the incorrect tire pressure	• The DDS reset procedure was carried out under incorrect tire conditions.	• ADJUST the tire pressure and reset the DDS. For additional information REFER to the owners guide.
• DDS reset command was not confirmed	• The DDS reset procedure was not completed.	• REFER to the DDS reset procedure. For additional information REFER to the owners guide.
• DDS failure warning display	• Anti-lock brake system (ABS) module.	• REFER to the Ford approved diagnostic tool.
• Tire(s) show excess wear on edge of tread	• Tire(s) under-inflated.	• ADJUST the tire pressure(s).
	• Vehicle overloaded.	• CORRECT as necessary.
	• Incorrect wheel alignment.	• ADJUST the wheel alignment. REFER to: <b>Suspension System</b> (204-00 Suspension System - General Information, Diagnosis and Testing).
• Tire(s) show excess wear in center of tread	• Tire(s) over-inflated.	• ADJUST the tire pressure(s).
• Other excessive tire wear concerns	• Incorrect tire pressure(s).	• ADJUST the tire pressure(s).

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Wheel and tire assemblies need rotating.</li> </ul>	<ul style="list-style-type: none"> <li>ROTATE the wheel and tire assemblies.</li> </ul>
	<ul style="list-style-type: none"> <li>Incorrect wheel alignment.</li> </ul>	<ul style="list-style-type: none"> <li>ADJUST the wheel alignment. REFER to: <b>Suspension System</b> (204-00 Suspension System - General Information, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Vehicle overloaded.</li> </ul>	<ul style="list-style-type: none"> <li>CORRECT as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Loose or leaking front strut and spring assembly.</li> </ul>	<ul style="list-style-type: none"> <li>TIGHTEN or INSTALL new suspension components as necessary. REFER to: <b>Front Strut and Spring Assembly</b> (204-01 Front Suspension, Disassembly and Assembly).</li> </ul>
	<ul style="list-style-type: none"> <li>Wheel bearings worn.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL new wheel bearings as necessary. REFER to: <b>Front Wheel Bearing</b> (204-01 Front Suspension, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Suspension components, bushings and ball joints.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK or INSTALL new suspension components as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Excessive lateral or radial runout of wheel or tire.</li> </ul>	<ul style="list-style-type: none"> <li>BALANCE the wheel and tire assemblies. Using a suitable dial indicator gauge and holding fixture, CHECK lateral and radial runout of the wheel and tire assemblies. INSTALL new wheel and tire assemblies as necessary. REFER to: <b>Wheel and Tire</b> (204-04 Wheels and Tires, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Wobble or shimmy affecting wheel runout</li> </ul>	<ul style="list-style-type: none"> <li>Damaged wheel.</li> </ul> <ul style="list-style-type: none"> <li>INSPECT the wheel rims for damage. BALANCE the wheel and tire assemblies. Using a suitable dial indicator gauge and holding fixture, CHECK lateral and radial runout of the wheel and tire assemblies. INSTALL new wheel and tire assemblies as necessary. REFER to: <b>Wheel and Tire</b> (204-04 Wheels and Tires, Removal and Installation).</li> </ul>



## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Front wheel bearing.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK or INSTALL new wheel bearings as necessary. REFER to: <b>Front Wheel Bearing</b> (204-01 Front Suspension, Removal and Installation).</li> </ul>
<ul style="list-style-type: none"> <li>Excessive vehicle vibration, rough steering</li> </ul>	<ul style="list-style-type: none"> <li>Suspension components.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK or INSTALL new suspension components as necessary.</li> </ul>
<ul style="list-style-type: none"> <li>Vehicle vibrations from wheels and tires</li> </ul>	<ul style="list-style-type: none"> <li>Incorrect tire pressure(s).</li> </ul>	<ul style="list-style-type: none"> <li>ADJUST the tire pressure(s).</li> </ul>
	<ul style="list-style-type: none"> <li>Wheel or tire imbalance.</li> </ul>	<ul style="list-style-type: none"> <li>BALANCE the wheel and tire assemblies.</li> </ul>
	<ul style="list-style-type: none"> <li>Uneven tire wear.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new tire(s) as necessary. REFER to: <b>Wheel and Tire</b> (204-04 Wheels and Tires, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Brake disc imbalance.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the brake disc for foreign material.</li> </ul>
	<ul style="list-style-type: none"> <li>Water in tire(s).</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE the water.</li> </ul>
	<ul style="list-style-type: none"> <li>Bent wheel.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new wheel and tire assembly. REFER to: <b>Wheel and Tire</b> (204-04 Wheels and Tires, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Incorrectly seated tire bead.</li> </ul>	<ul style="list-style-type: none"> <li>SPIN the wheel on the vehicle. EXAMINE the area where the tire and the wheel meet. If that section of the tire appears to waver while being rotated, the tire bead may not be correctly seated on the wheel. REMOVE the tire and CLEAN the bead seat areas on both wheel and tire.</li> </ul>
	<ul style="list-style-type: none"> <li>Excessive lateral or radial runout of wheel or tire.</li> </ul>	<ul style="list-style-type: none"> <li>BALANCE the wheel and tire assemblies. Using a suitable dial indicator gauge and holding fixture, CHECK the lateral and radial runout of the wheel and tire assemblies. INSTALL new wheel and tire assemblies as necessary. REFER to: <b>Wheel and Tire</b> (204-04 Wheels and Tires, Removal and Installation).</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Foreign material between wheel mounting face and hub mounting surface.</li> </ul>	<ul style="list-style-type: none"> <li>CLEAN mounting surfaces.</li> </ul>
	<ul style="list-style-type: none"> <li>Front wheel bearing.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK or INSTALL new wheel bearings as necessary. REFER to: <b>Front Wheel Bearing</b> (204-01 Front Suspension, Removal and Installation).</li> </ul>
<ul style="list-style-type: none"> <li>Seized wheel nuts</li> </ul>	<ul style="list-style-type: none"> <li>Corrosion.</li> </ul>	<ul style="list-style-type: none"> <li>CAUTION: Do not permit lubricant to get on cone sets of stud holes or on cone angle of wheel nuts. If corrosion is slight, wire brush away. If corrosion is excessive, INSTALL new wheel studs and nuts. REFER to: <b>Wheel and Tire</b> (204-04 Wheels and Tires, Removal and Installation). If the condition persists, LUBRICATE the first three threads of each wheel stud with a graphite-based lubricant.</li> </ul>
	<ul style="list-style-type: none"> <li>Vehicle overloaded</li> </ul>	<ul style="list-style-type: none"> <li>CORRECT as necessary.</li> </ul>

## REMOVAL AND INSTALLATION

## Wheel and Tire

## Removal

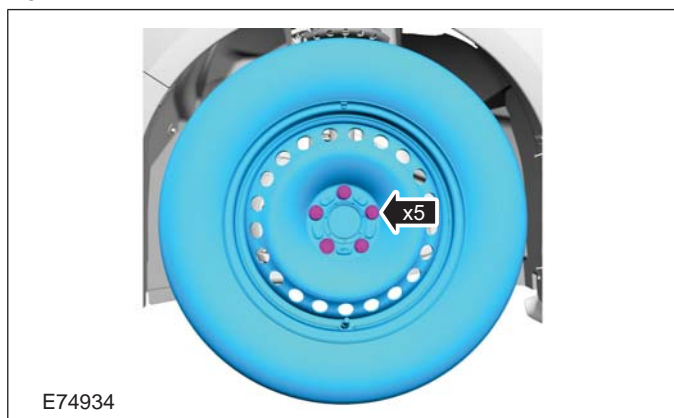
**⚠ CAUTION:** Do not use heat to loosen a seized wheel nut.

1. Loosen: 360°

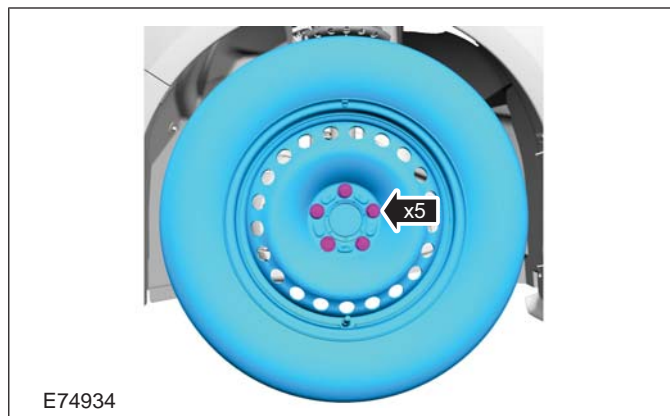


2. Refer to: **Jacking** (100-02 Jacking and Lifting, Description and Operation).  
Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

3.

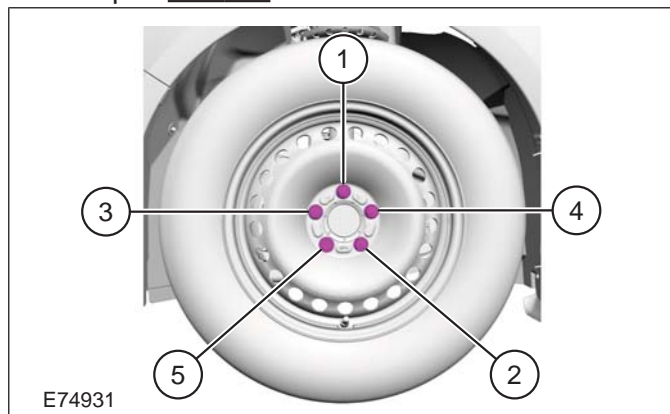


**NOTE:** Only tighten the nuts finger tight at this stage.



2. Lower the vehicle.

3. Tighten the wheel nuts in the sequence shown.  
Torque: 130 Nm



## Installation

1. **⚠ WARNING:** Make sure that the mating faces are clean and free of corrosion and foreign material



# SECTION 205-01 Driveshaft

VEHICLE APPLICATION: 2008.50 Kuga

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<b>REMOVAL AND INSTALLATION</b>	
Driveshaft.....	(15 514 0) 205-01-2



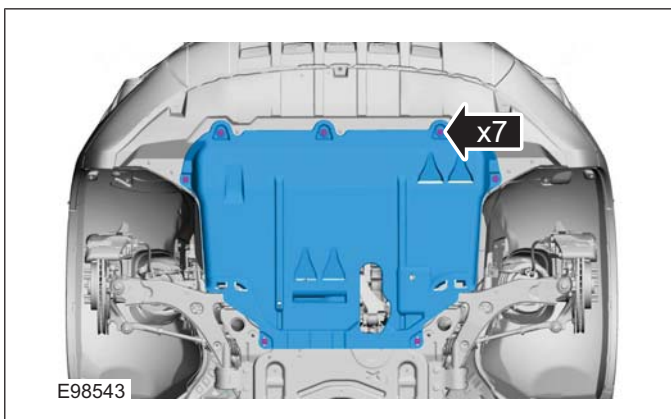
REMOVAL AND INSTALLATION

Driveshaft(15 514 0)

Removal

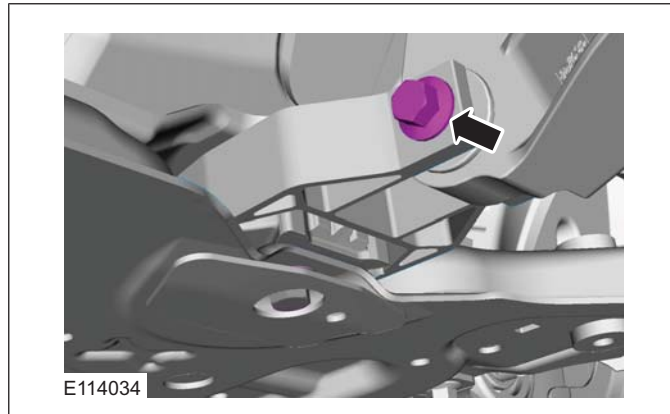
All vehicles

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
- 3.



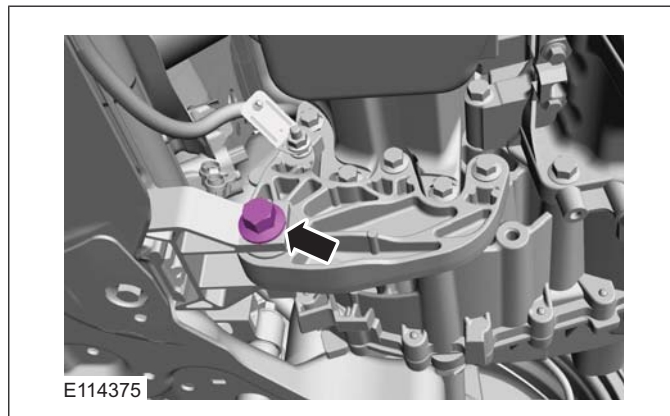
Vehicles with 2.0L diesel engine

4.



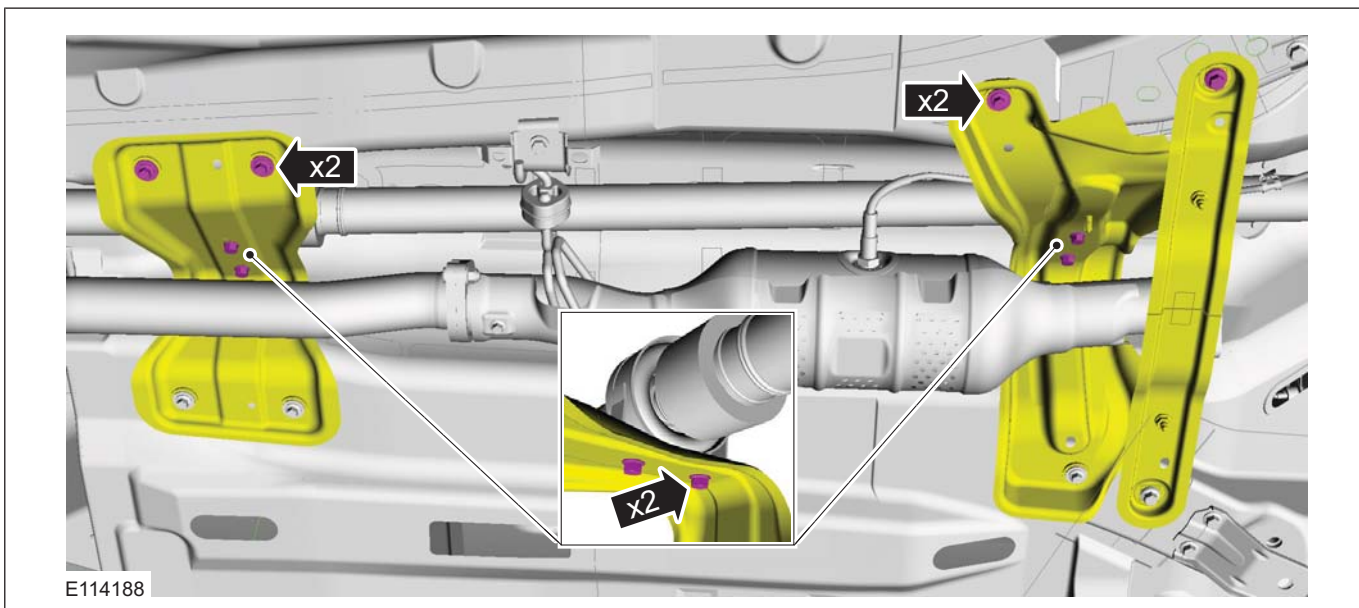
Vehicles with 2.5L engine

5.



All vehicles

6.

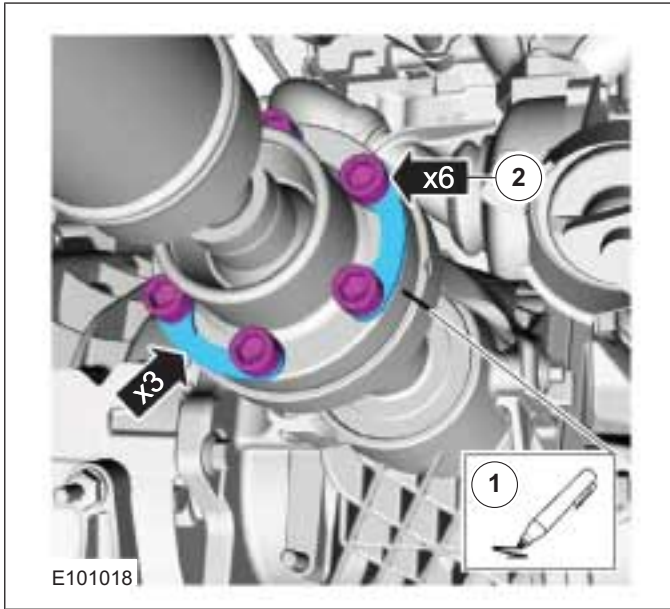






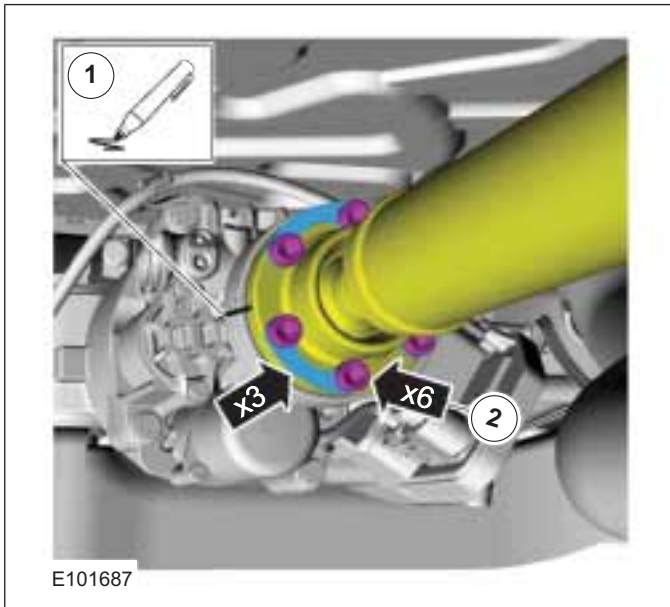
REMOVAL AND INSTALLATION

7.

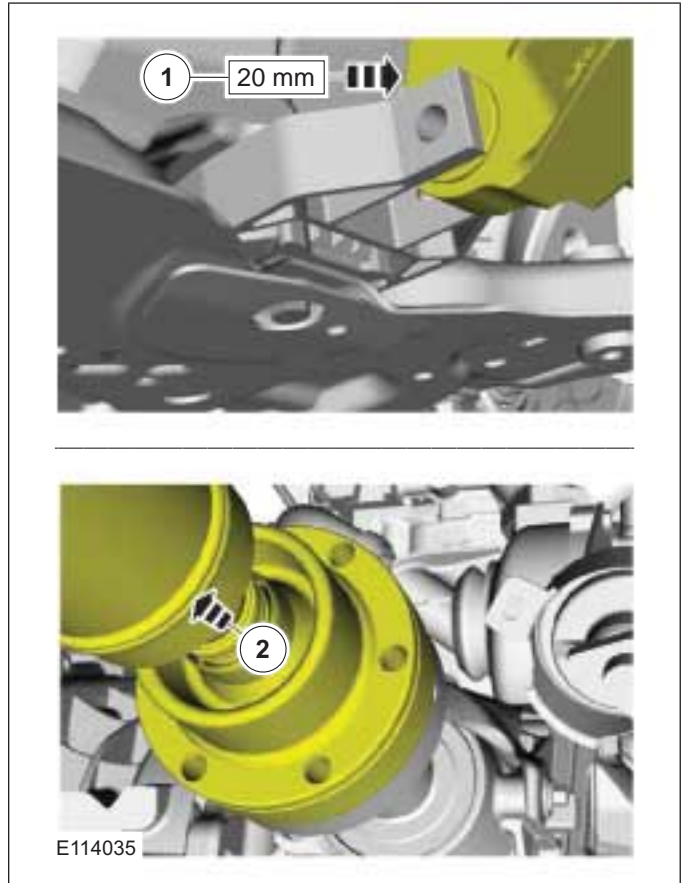


Vehicles with 2.0L diesel engine

8.

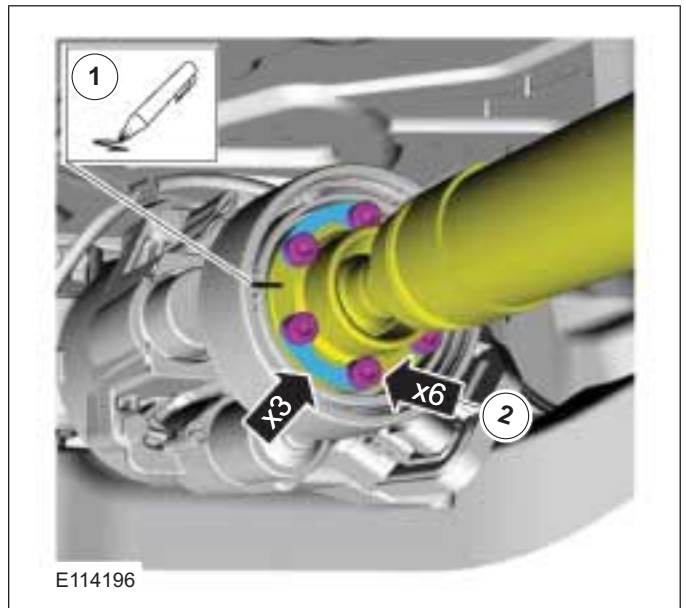


9.



Vehicles with 2.5L engine

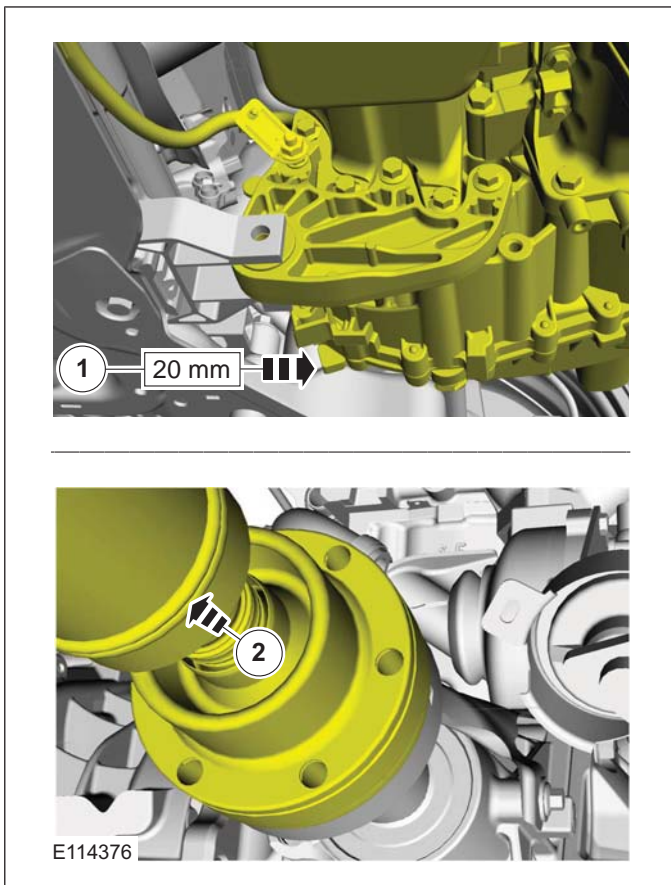
10.





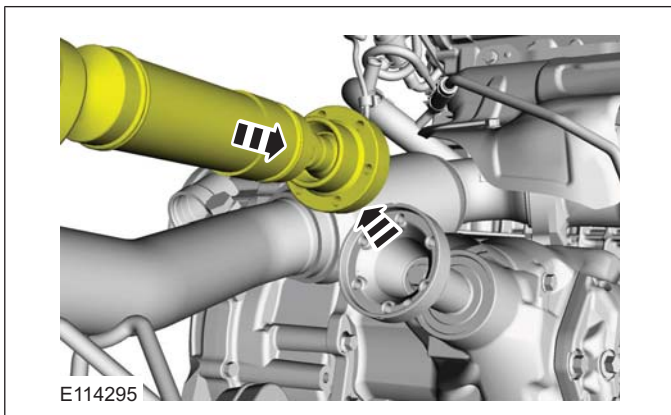
REMOVAL AND INSTALLATION

11.

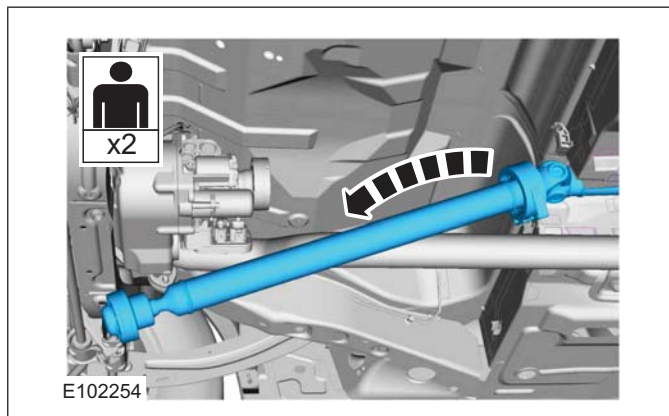


All vehicles

12



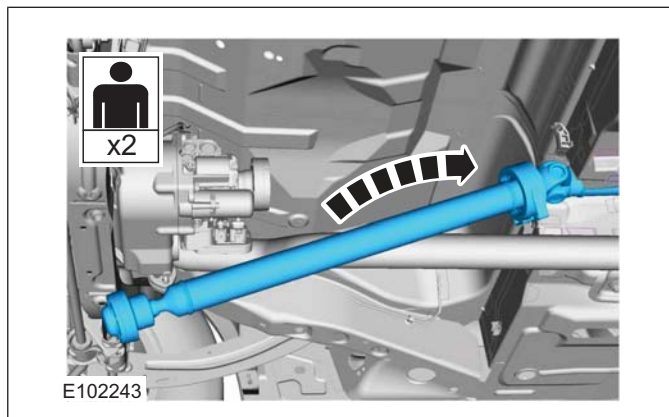
13.



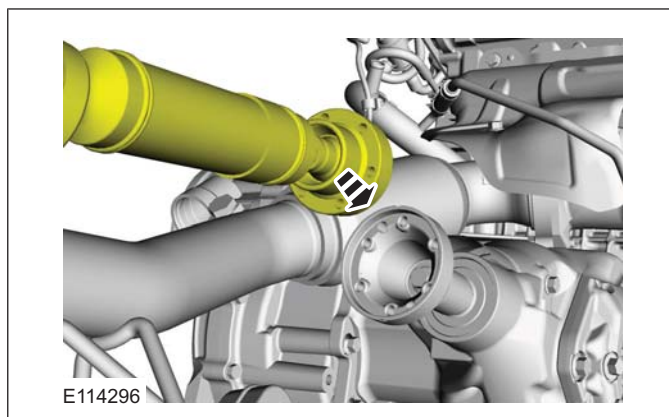
Installation

All vehicles

1.



2.





REMOVAL AND INSTALLATION

Vehicles with 2.0L diesel engine

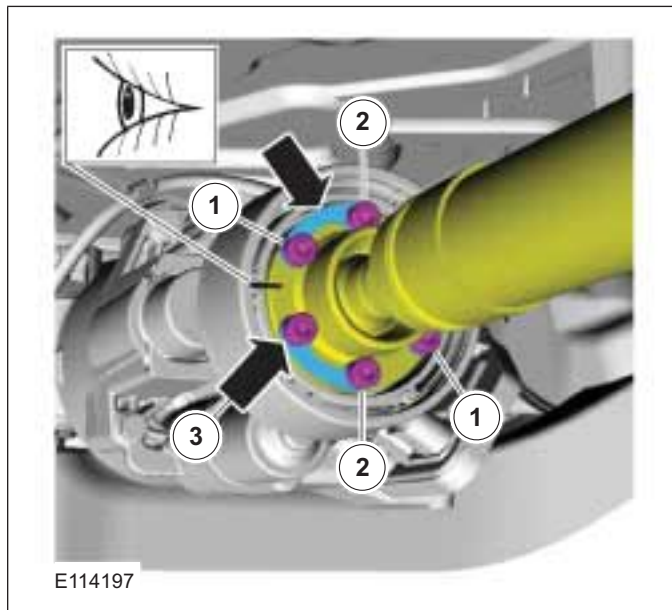
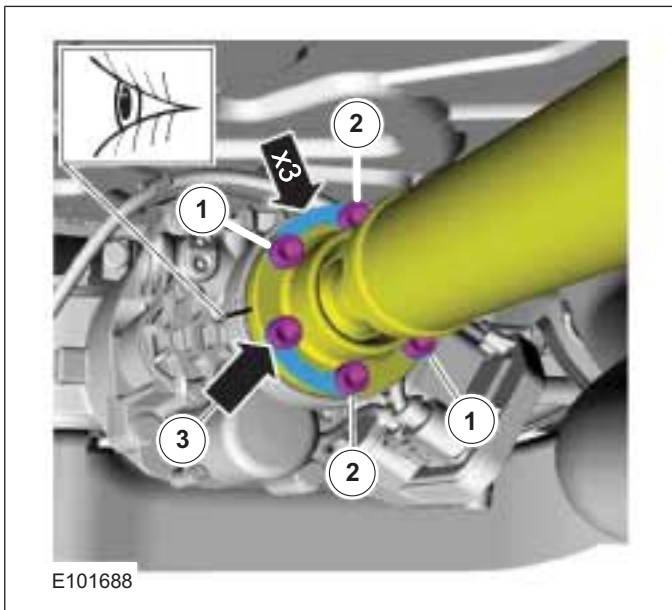
3. **CAUTION:** Make sure that the installation marks are aligned.

1. Torque: 35 Nm
2. Torque: 35 Nm
3. Torque: 35 Nm

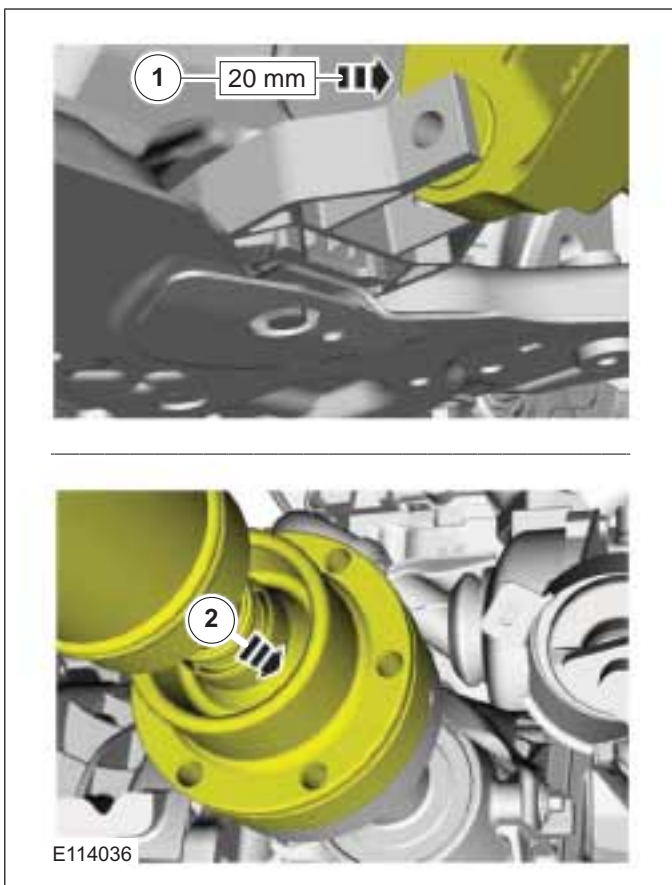
Vehicles with 2.5L engine

5. **CAUTION:** Make sure that the installation marks are aligned.

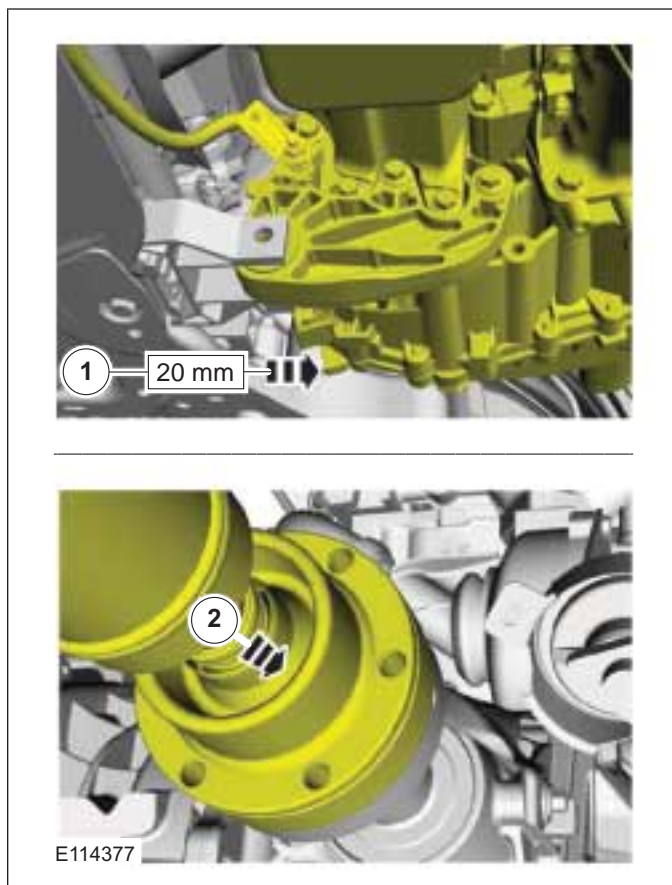
1. Torque: 35 Nm
2. Torque: 35 Nm
3. Torque: 35 Nm



4.



6.



205-01-6

Driveshaft

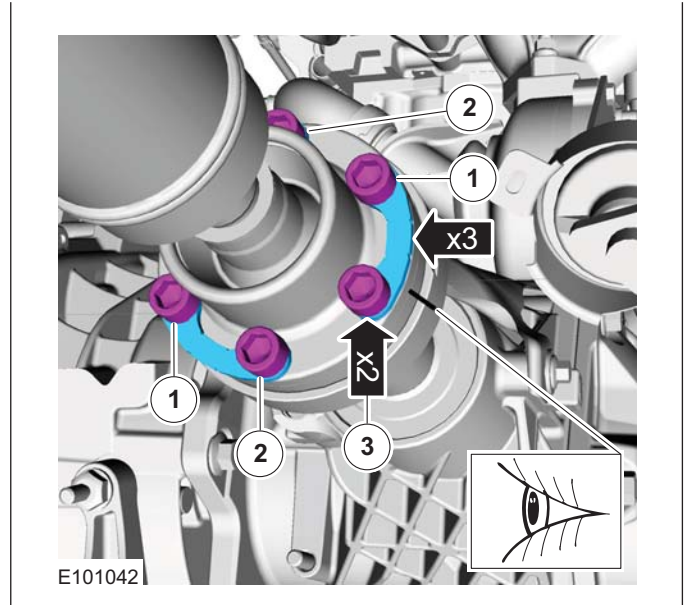
205-01-6

## REMOVAL AND INSTALLATION

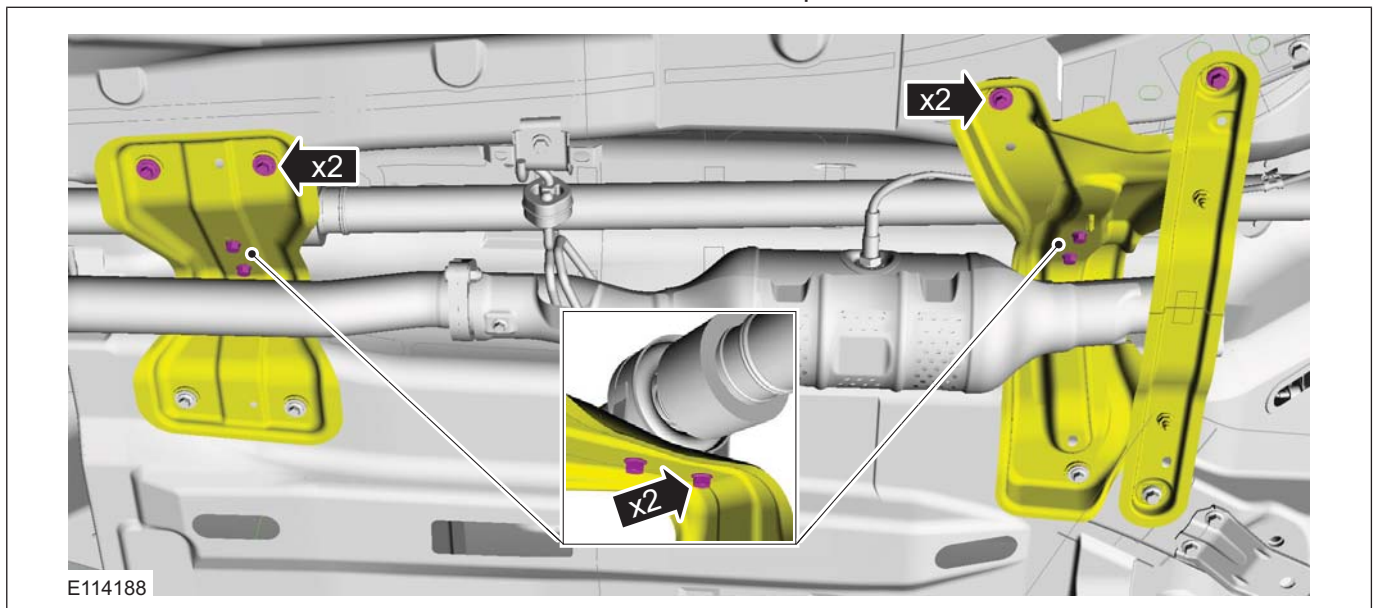
All vehicles

7. **⚠ CAUTION:** Make sure that the installation marks are aligned.

1. Torque: 35 Nm
2. Torque: 35 Nm
3. Torque: 35 Nm



8. Torque: 25 Nm





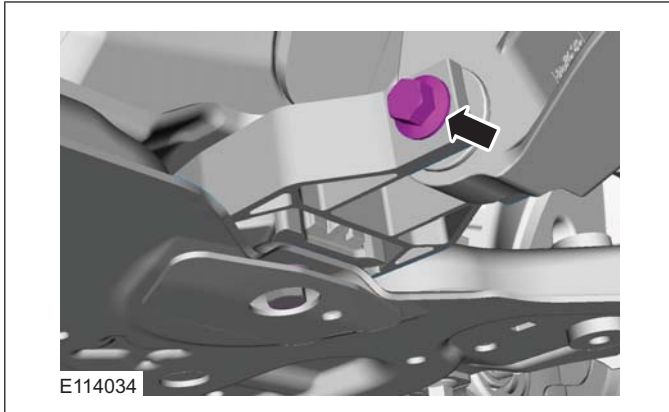
## REMOVAL AND INSTALLATION

Vehicles with 2.0L diesel engine

13. Lower the vehicle.

## 9. Torque:

- Stage 1: 35 Nm
- Stage 2: Loosen 360°
- Stage 3: 85 Nm

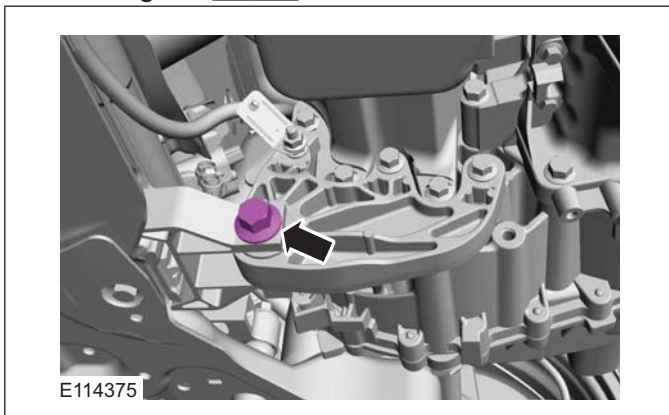


Vehicles with 2.5L engine

## 10.

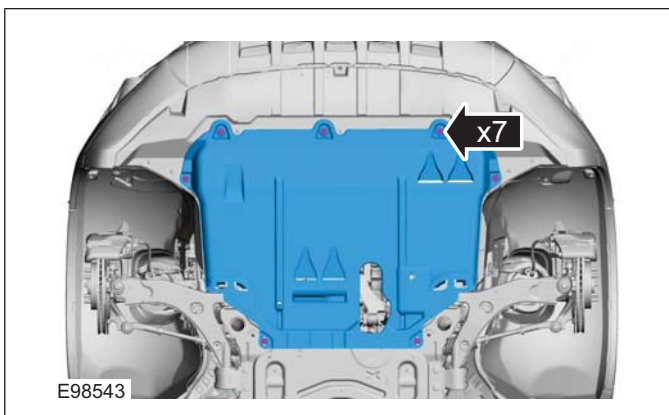
## 11. Torque:

- Stage 1: 35 Nm
- Stage 2: Loosen 360°
- Stage 3: 85 Nm



All vehicles

## 12



## SECTION 205-02 Rear Drive Axle/Differential

**VEHICLE APPLICATION: 2008.50 Kuga**

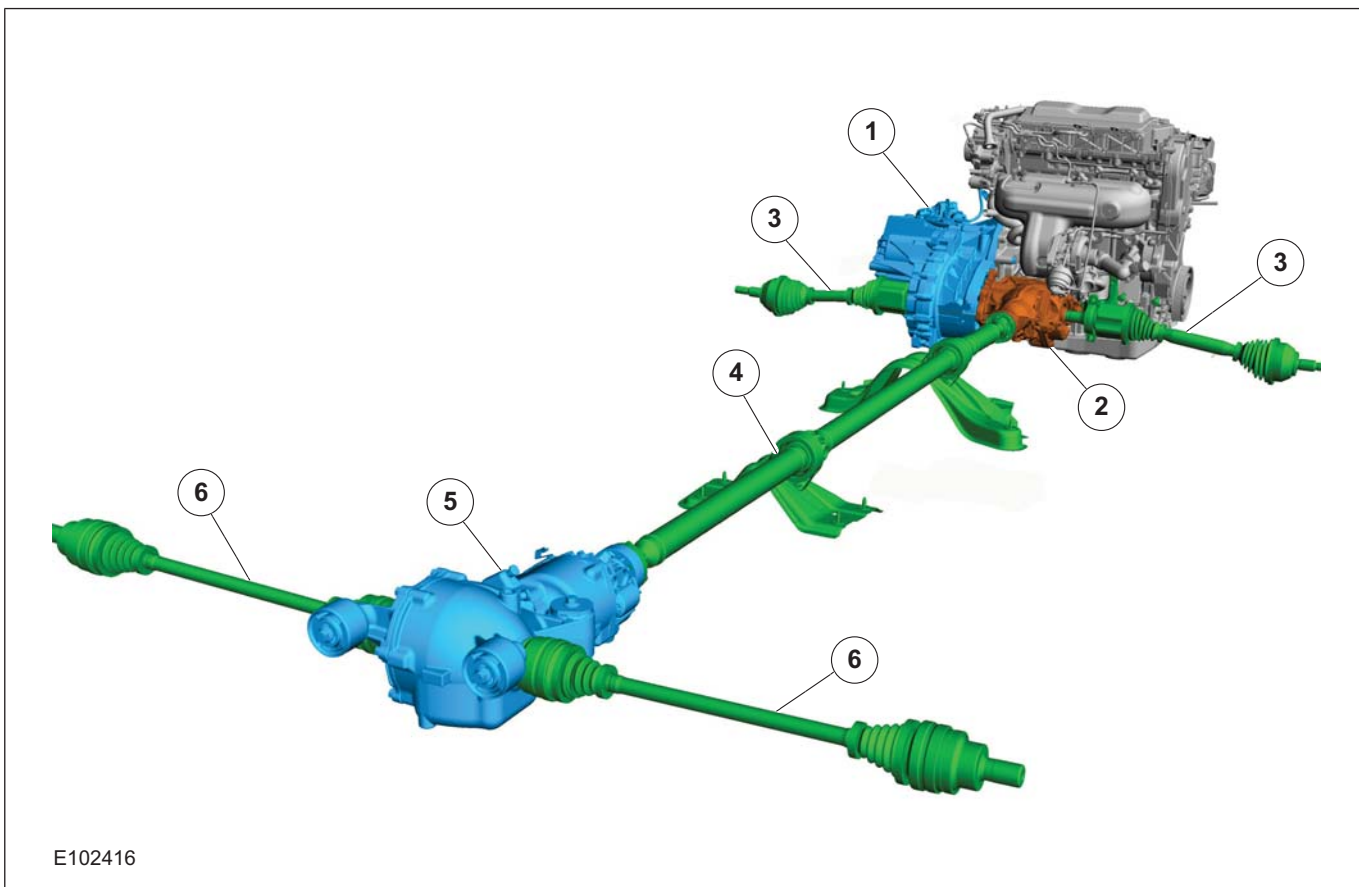
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DESCRIPTION AND OPERATION

Rear Drive Axle and Differential – Component Location

Powertrain



Item	Description
1	Transmission assembly
2	Transfer box,
3	Halfshaft - front axle

Item	Description
4	Drive shaft
5	Rear axle
6	Halfshaft - rear axle

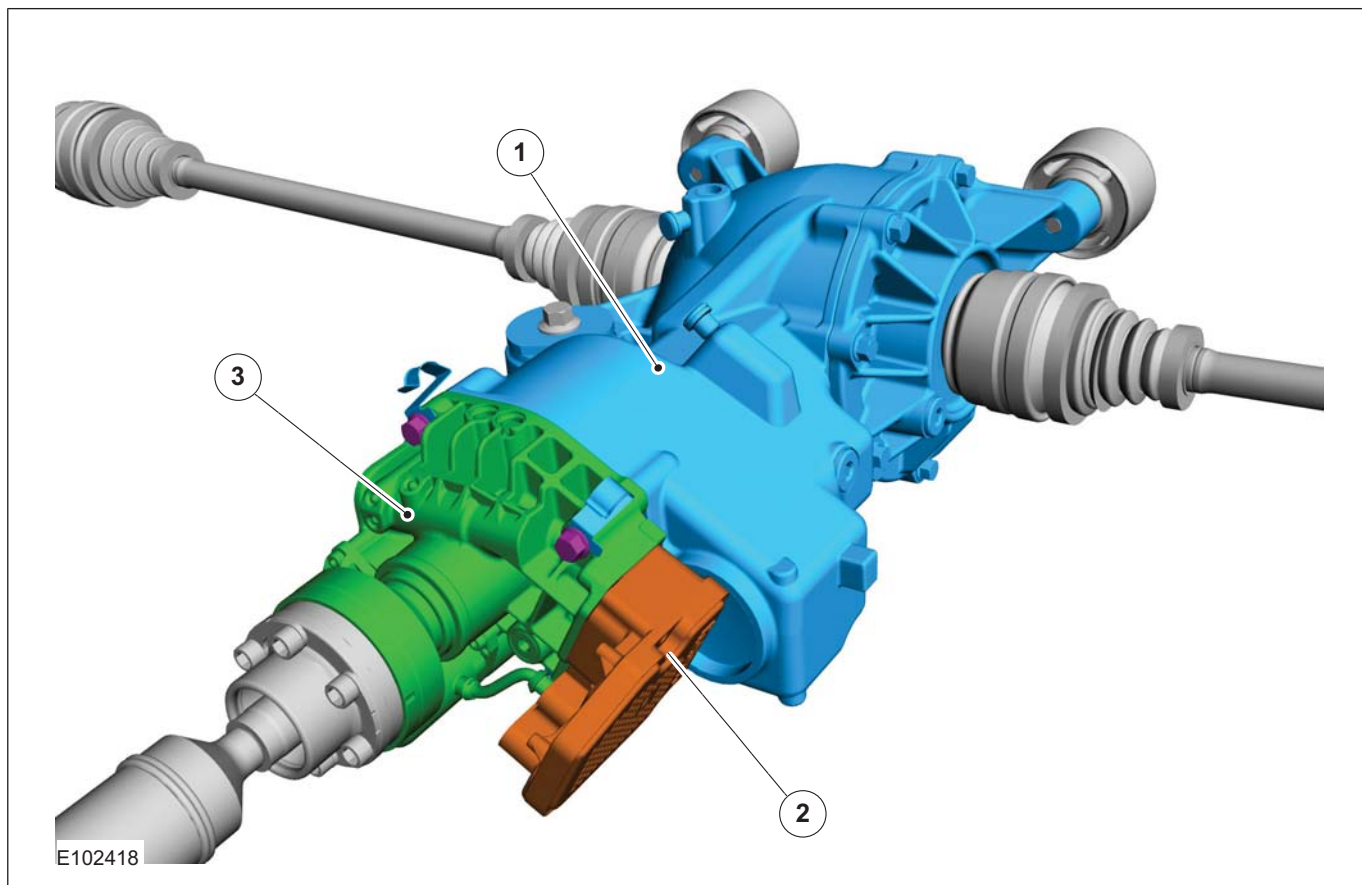






DESCRIPTION AND OPERATION

Rear axle



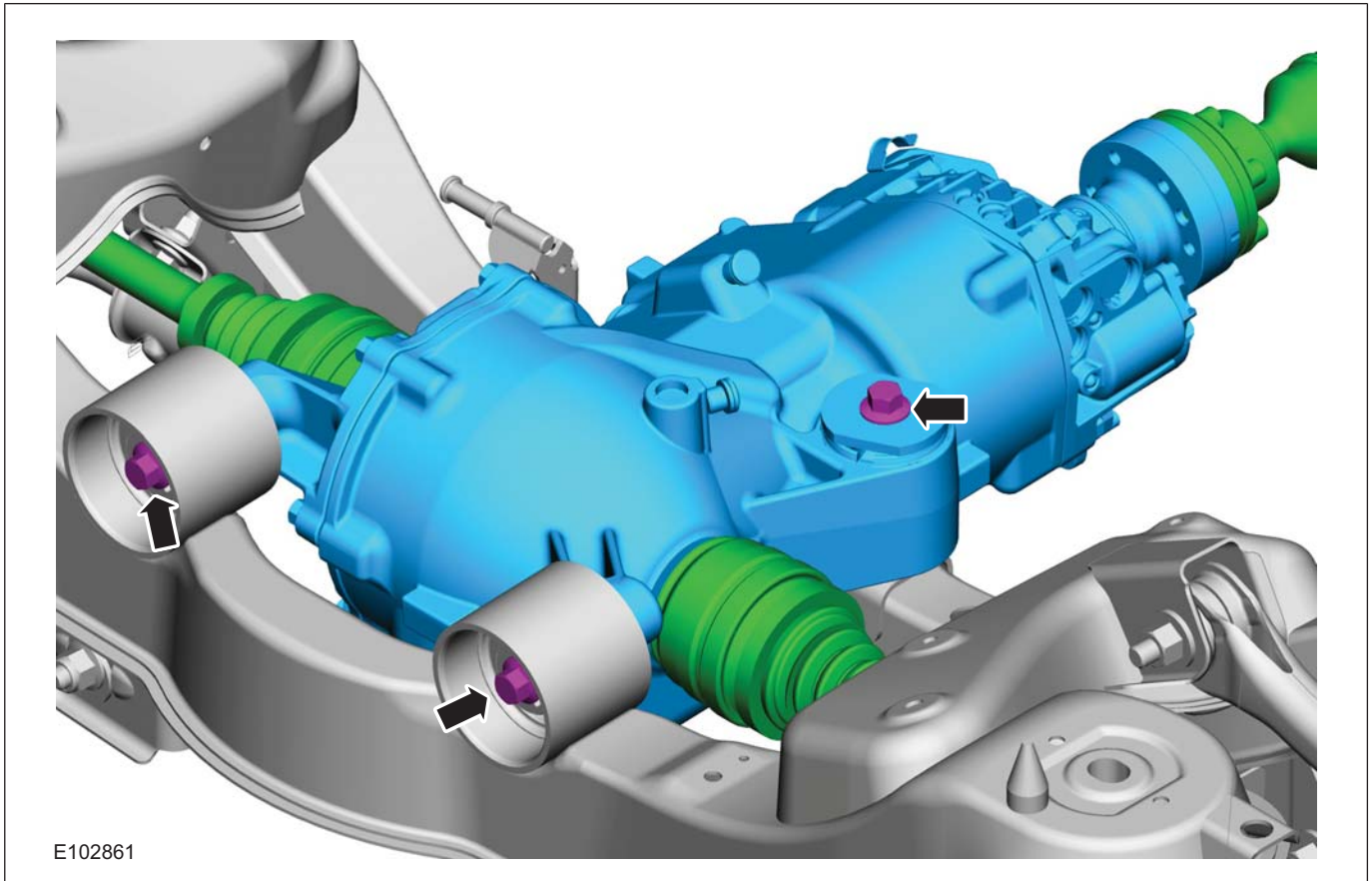
Item	Description
1	Rear axle differential.
2	All-wheel drive control unit
3	Haldex controlled coupling



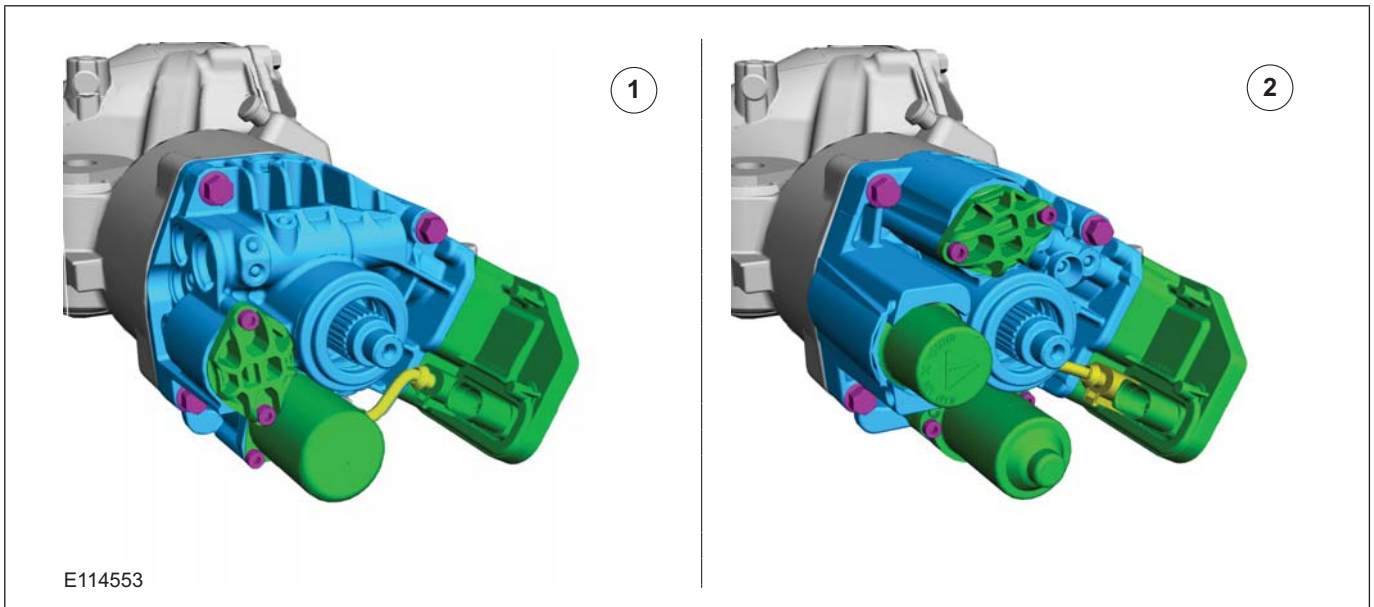


DESCRIPTION AND OPERATION

Mounting points - rear differential



Haldex coupling generation III/IV



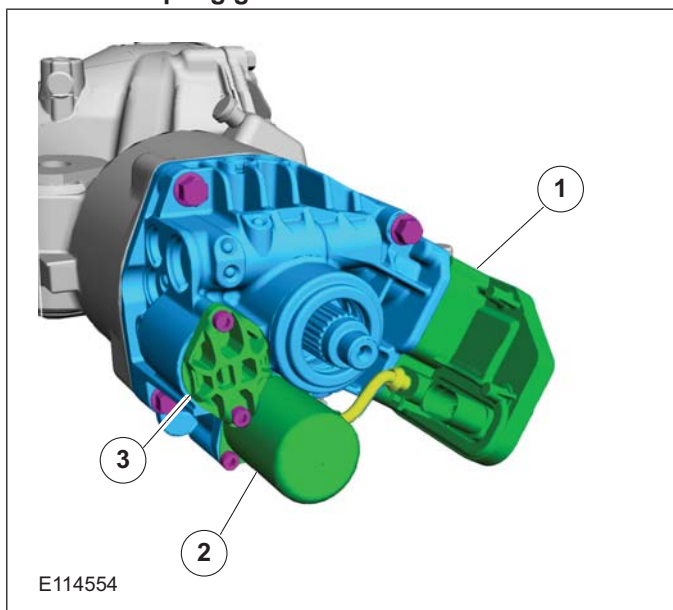
Item	Description
1	Haldex coupling generation III
2	Haldex coupling generation IV





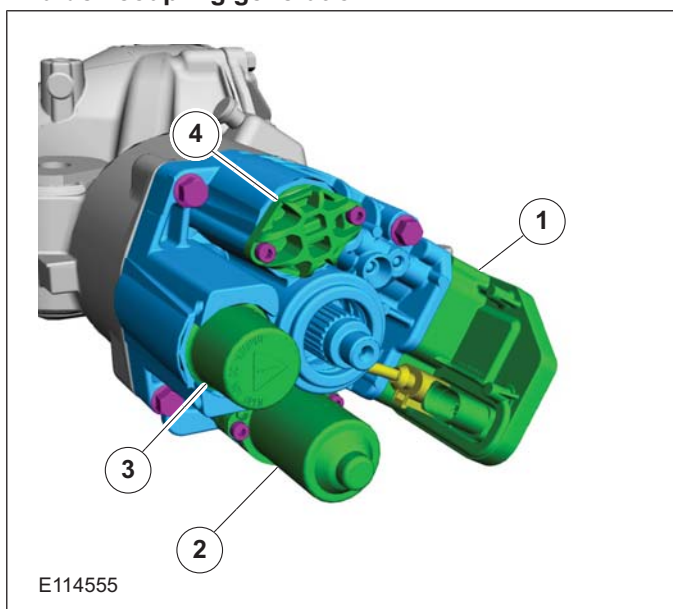
**DESCRIPTION AND OPERATION**

**Haldex coupling generation III**



Item	Description
1	All-wheel drive control unit
2	Electric feed pump
3	Oil filter

**Haldex coupling generation IV**



Item	Description
1	All-wheel drive control unit
2	Electric feed pump
3	Reservoir
4	Oil filter



**DESCRIPTION AND OPERATION****Rear Drive Axle and Differential – System Operation and Component Description****System Operation****General Information**

The powertrain with all-wheel drive consists of the following main components:

- engine
- transaxle with front axle differential
- transfer box
- halfshafts and driveshafts
- Haldex clutch
- rear axle differential

The Haldex clutch guarantees continuous variable torque transmission to the rear axle under all driving conditions. The Haldex clutch reacts immediately and equally quickly with slow or fast wheel slip.

A difference in angle of rotation of 90° between the input and output shafts is required to build up maximum pressure at the multi-plate clutch or to transmit maximum torque.

The advantage of vehicles with all-wheel drive is that they distribute the drive between all four wheels. They therefore have a higher tractive power. They feature improved cornering behaviour, as the grip at all four wheels can be better utilised. Thus, the wheels contribute to a greater degree towards cornering stability.

The engine torque is transmitted from the transfer box to the rear axle via a driveshaft. The driveshaft is flange-mounted to the input side of the Haldex clutch.

**Driving situations****Pulling away and accelerating**

- When pulling away and accelerating, as much all-wheel drive as necessary must be available immediately in the short-term. During acceleration, the electronic system detects slip at the front axle. This slip is counter-controlled and thus the propulsive force optimally distributed to the two axes.

**Cornering**

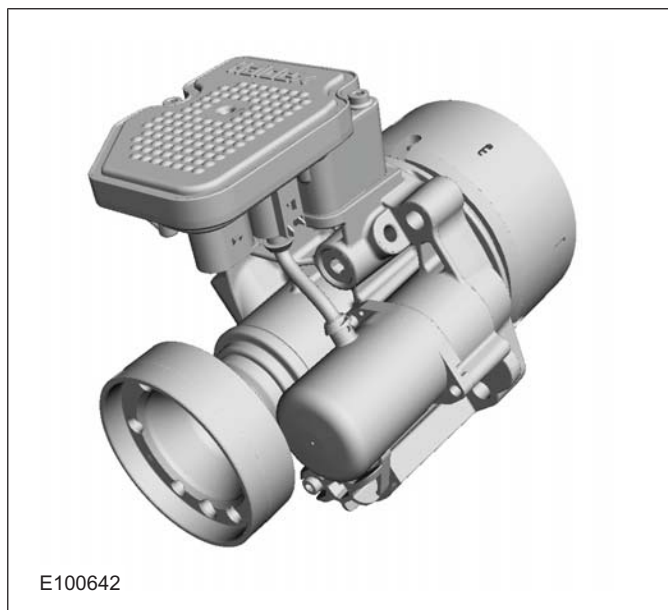
- A sporty driving style, in particular dynamic cornering, demands stable cornering behaviour. The all-wheel system distributes the propulsive force to all four wheels and by so doing boosts the high cornering forces so that the vehicle makes optimum contact with the road surface.

**Snow and black ice**

- Snow and black ice require particularly high grip. Under these conditions, the Haldex clutch always distributes the propulsive force to the axle with the better traction. The all-wheel system reacts intelligently and quickly to all driving situations.

**Trailer operation**

- When driving with a trailer, the trailer weight (support load) is transmitted to the rear axle via the towbar. This reduces the load on the front wheels, which means they can slip. The electronic system detects this difference and distributes most of the propulsive force to the rear axle.

**Haldex clutch**



## DESCRIPTION AND OPERATION

## General overview

Haldex clutches of the 3rd and 4th generations are used in the Ford Kuga.

The development of the third generation Haldex clutch represents a big step forward in modern all-wheel technology. The Haldex clutch is electro-hydraulically controlled. Additional information is taken into consideration during control tasks via the all-wheel drive control unit. Slip alone is no longer decisive for the distribution of the propulsive forces; the vehicle's driving dynamics are also taken into consideration. The control unit accesses the driving-related data via the data bus. With this data, the control unit has all the essential information about speed, cornering, coasting or traction operation, and can optimally react to every driving situation.

Compared with the previous generation, the 4th generation Haldex clutches operate with higher pressure and achieve shorter response times when distributing the drive forces.

Advantages of the Haldex clutch:

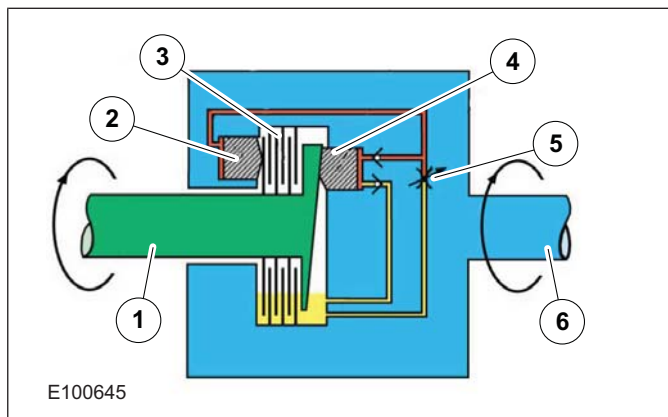
- Permanent all-wheel drive with electronically-controlled multi-plate clutch
- Fast response
- No straining when parking and manoeuvring
- Compatible with different tyres (e.g. emergency spare wheel)
- Fully combinable with driving dynamic control systems

The driveshaft is connected to the input shaft of the Haldex clutch. Within the Haldex clutch, the input shaft is separated from the output shaft to the rear axle differential by means of a multi-plate clutch. Torque is only transmitted to the rear axle differential when the plate assembly of the Haldex clutch is closed.

The multi-plate clutch is electro-hydraulically controlled via the all-wheel drive control unit. For ecological driving, the torque to the rear axle is

reduced to a minimum up to a throttle position of approx. 50%. A prerequisite for this is that there is no difference in speed in the Haldex clutch between the input and output shafts.

## Operation



Item	Description
1	Output shaft
2	Working piston
3	Plates
4	Ring piston pump
5	Control Valve
6	Input shaft

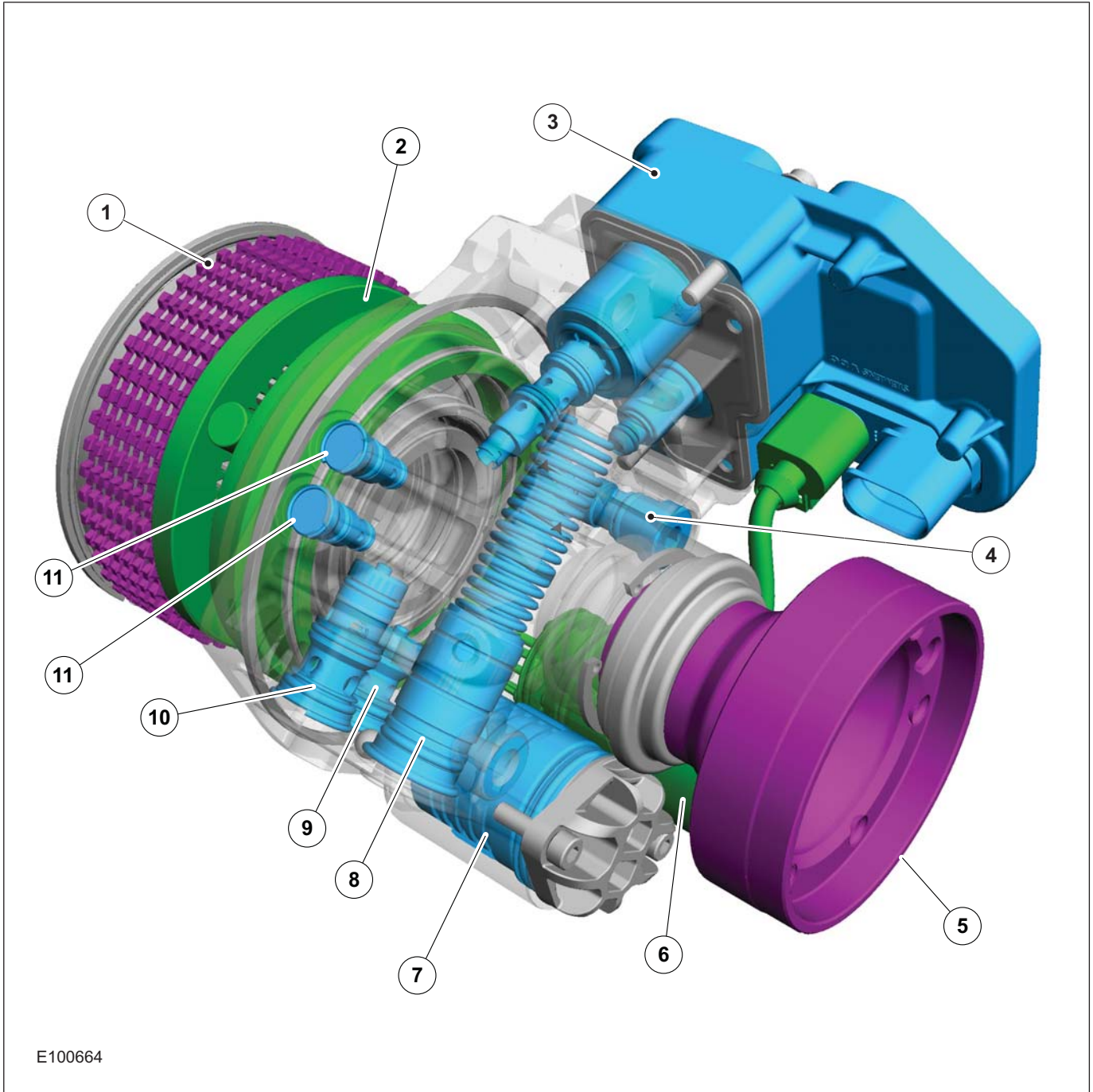
Within the Haldex clutch is a plate assembly and a so-called ring piston pump with a pump plunger and a working piston.

Fluid supply is started if there is a speed difference between the input and output shafts.

This fluid pressure is transmitted to the working piston and in this way the plate assembly is compressed.

## Design of the 3rd generation Haldex clutch

DESCRIPTION AND OPERATION



E100664

Item	Description
1	Multiplate clutch
2	Ring piston pump
3	All-wheel drive control unit
4	Pressure relief valve (high pressure)
5	Input shaft

Item	Description
6	Electric feed pump
7	Fluid filter
8	Pressure accumulator
9	Pressure relief valve (low pressure)
10	Preload valve
11	High-pressure valves



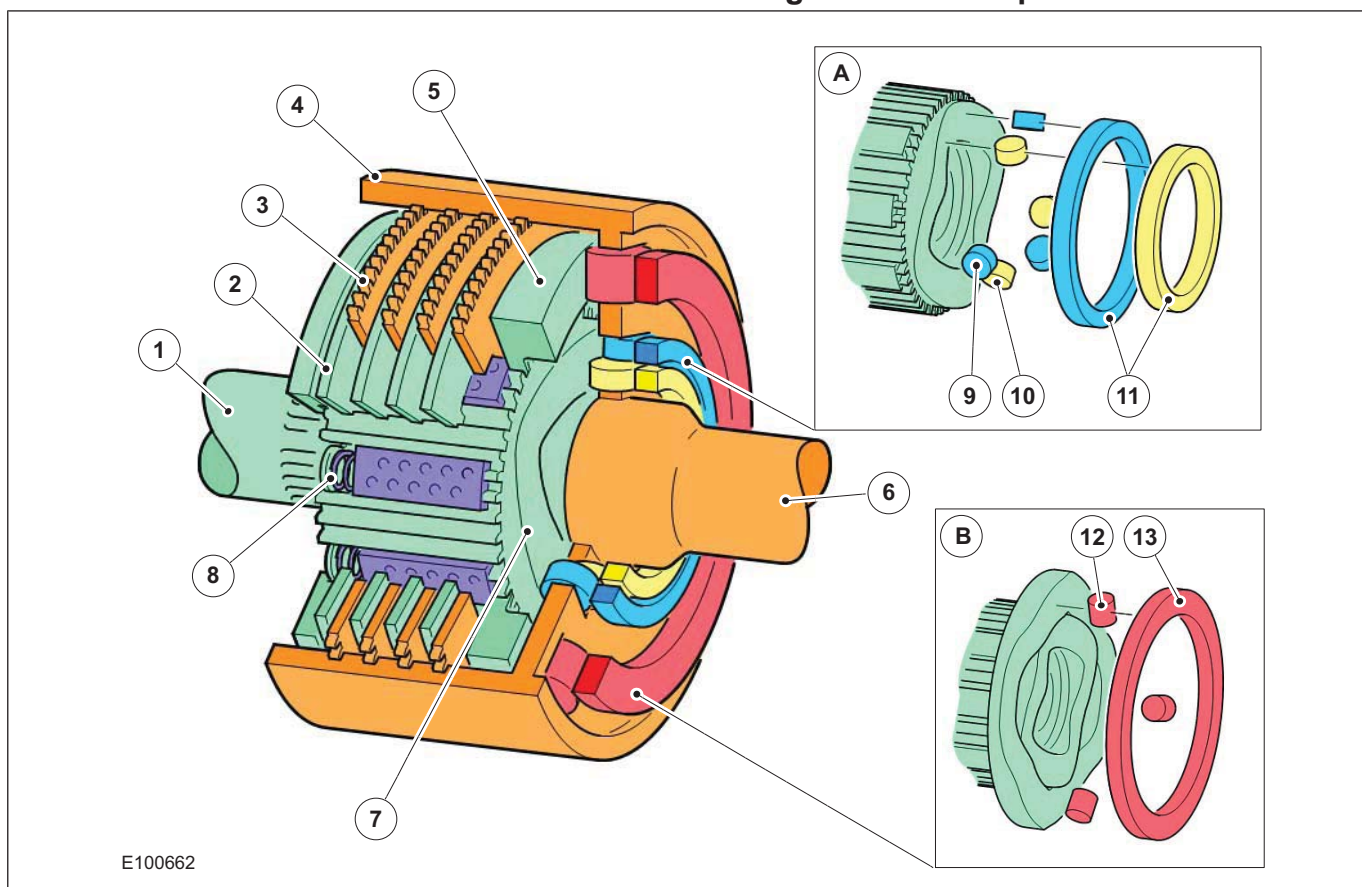
**DESCRIPTION AND OPERATION**

The Haldex clutch is based on the principle of a simple wet clutch that distributes the torque variably between the front and rear axles.

Three components are linked within the Haldex clutch:

- A mechanical component, comprising input and output shafts, the plate assembly (clutch) as well as the cam plate and the roller bearing.
- A hydraulic component, essentially comprising pressure valves, a pressure accumulator, the control valve, the ring pistons and a fluid filter.
- The electronic control comprises the electric fluid pump and the all-wheel drive control unit with integrated pressure/temperature sensor and an actuator motor for the control valve.

**Design of the multi-plate clutch**

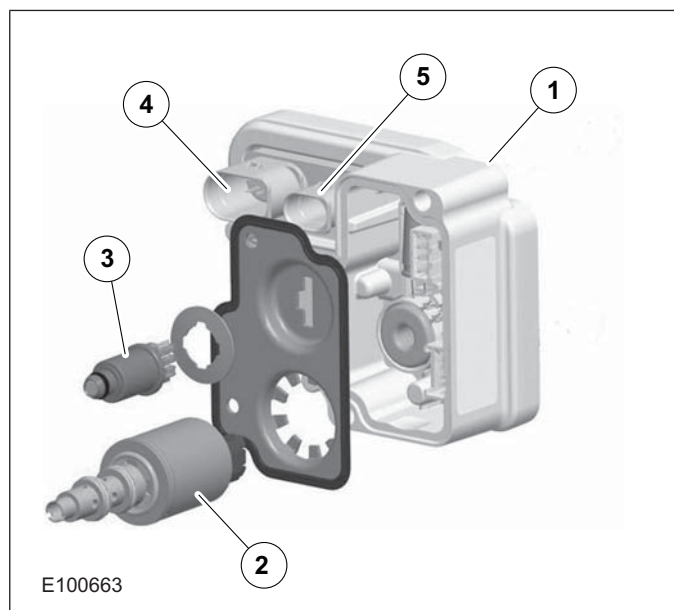


Item	Description
A	Pump plunger assembly
B	Working piston assembly
1	Output shaft
2	Inner plates
3	Outer plates
4	Disc drum
5	Contact plate

Item	Description
6	Input shaft
7	Cam disc
8	Springs
9	Pump plunger roller
10	Pump plunger roller
11	Pump plunger
12	Working piston roller
13	Working piston

## DESCRIPTION AND OPERATION

## All-wheel drive control unit



Item	Description
1	Electronic Control Unit
2	Control valve
3	Pressure/temperature sensor
4	Electrical connection CAN (controller area network) databus
5	Electric feed pump connection

The all-wheel drive control unit is bolted directly to the housing of the Haldex clutch.

It forms one unit made up of the control valve, a pressure/temperature sensor, and a control module. It receives signals from the PCM and from the ABS control module via the CAN data bus. The control module in the control unit uses these signals to determine the fluid pressure that is needed to actuate the clutch plates depending on the requirement. This determines how much torque should be transmitted to the rear wheels. All-wheel drive is deactivated if a fault occurs in the all-wheel drive control unit.

A preload of approx. 80 Nm is always present at the Haldex clutch.

The temperature sensor of the Haldex clutch is installed near the control valve in the control unit and is surrounded by the hydraulic fluid. The temperature is transmitted to the control module and is used for adaptation to the changing viscosity of the hydraulic fluid. If the hydraulic fluid is cold, the control valve has to be opened slightly more than requested. This allowance has to be reduced as the temperature increases. The normal working temperature of the hydraulic fluid is between +40 °C and +60 °C. If the temperature rises above 100 °C, the clutch is depressurised; if the temperature falls below 95 °C, the clutch is pressurised again. All-wheel drive is deactivated and a diagnostic trouble code set if a fault occurs in the temperature sensor.

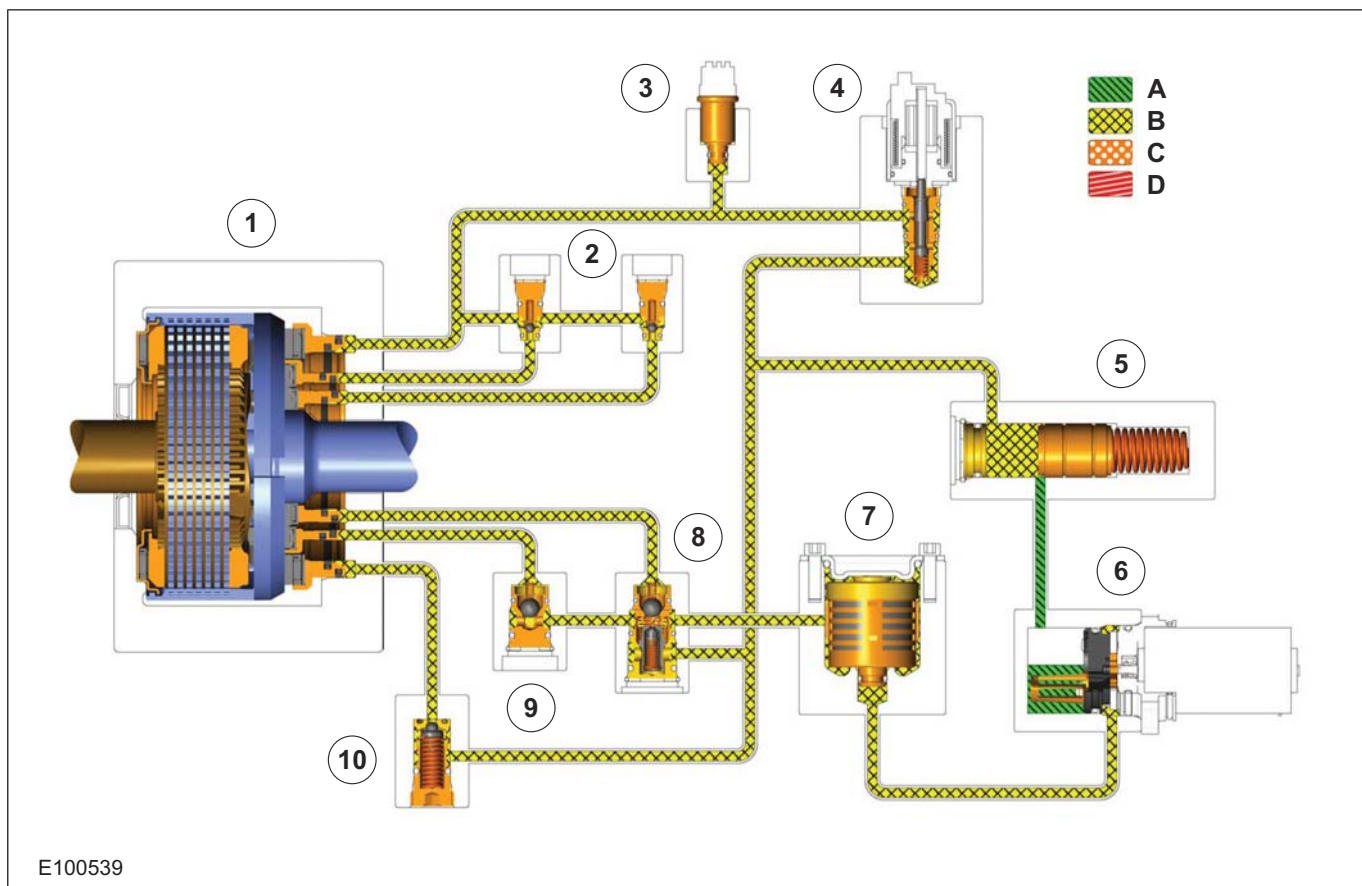
With Haldex Generations I and II, the control valve was actuated via a stepper motor. With Haldex Generation III, the stepper motor has been omitted. The control valve is now actuated via a solenoid valve. The solenoid valve is actuated by the control module in the all-wheel drive control unit by means of pulse width modulation. The pulse width modulation determines the position of the adjustment spindle and thus the opening cross section of the return hole. This is how the pressure at the working piston of the plates is determined. If the return hole is fully closed, maximum pressure is applied to the plates. If the return hole is fully open, the plates are unpressurized.

### Electric feed pump

The electric feed pump is installed in the clutch unit. It works according to the gerotor principle. The main purpose of the feed pump is to fill the pressure accumulator and the space behind the pump plunger with hydraulic fluid, thereby ensuring a fast response time of the Haldex clutch. The feed pump used in the third generation is designed to achieve an even higher pressure than the base pressure of 4 bar. It is supplied with current by the control module in the all-wheel drive control unit when the engine is running above approx. 400 rpm.

### Pressure control - 3rd generation Haldex clutch

DESCRIPTION AND OPERATION



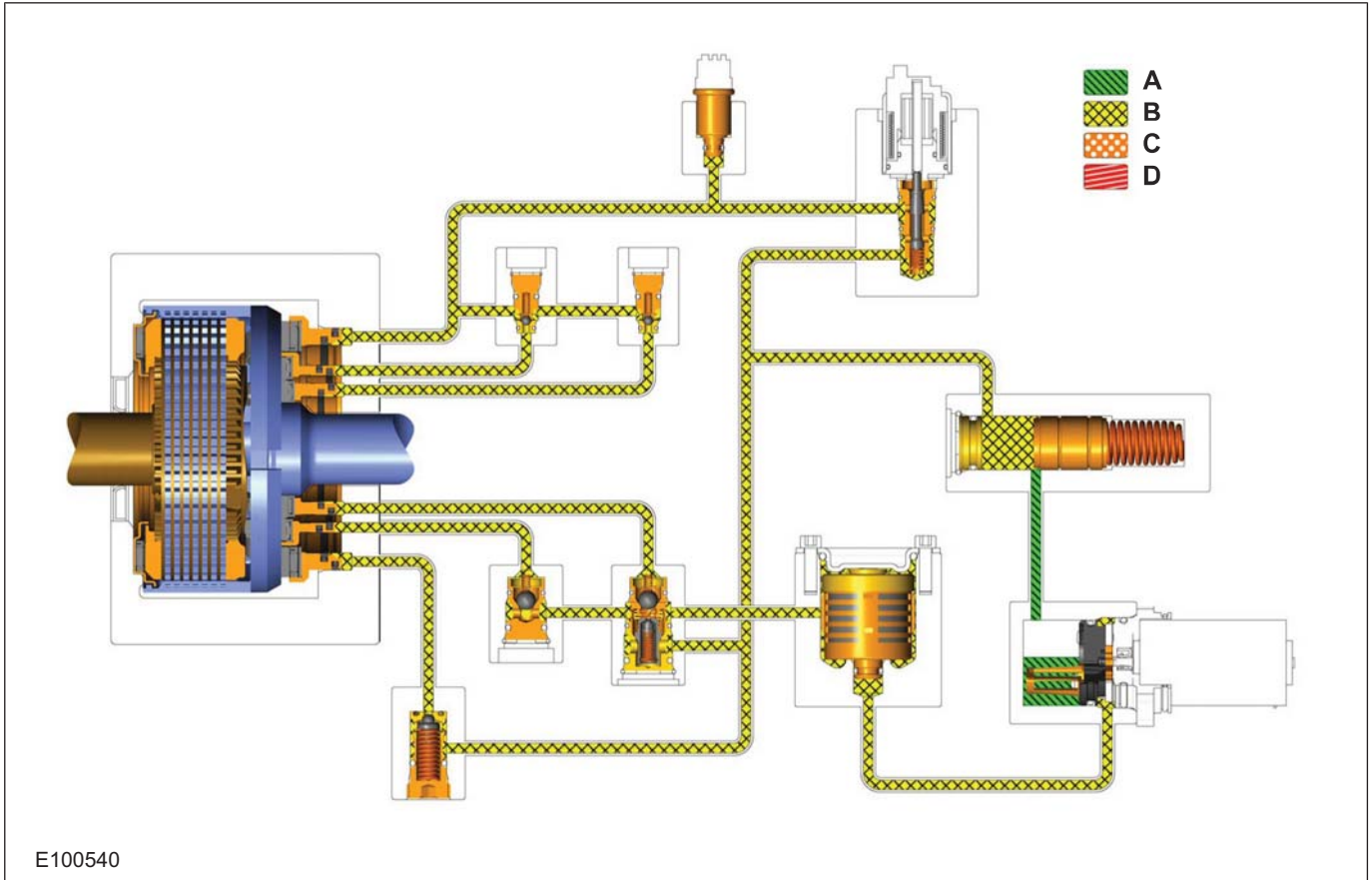
E100539

Item	Description
A	Barometric Pressure
B	Base pressure
C	Increased base pressure (preload)
Drive	Operating pressure
1	Plate assembly and ring piston pump
2	High-pressure valves
3	Pressure Sensor

Item	Description
4	Control valve
5	Pressure accumulator
6	Electric feed pump
7	Filters
8	Preload valve
9	Pressure relief valve (low pressure)
10	Pressure relief valve (high pressure)

Base pressure

DESCRIPTION AND OPERATION



E100540

Item	Description
A	Barometric Pressure
B	Base pressure

Item	Description
C	Increased base pressure (preload)
Drive	Operating pressure

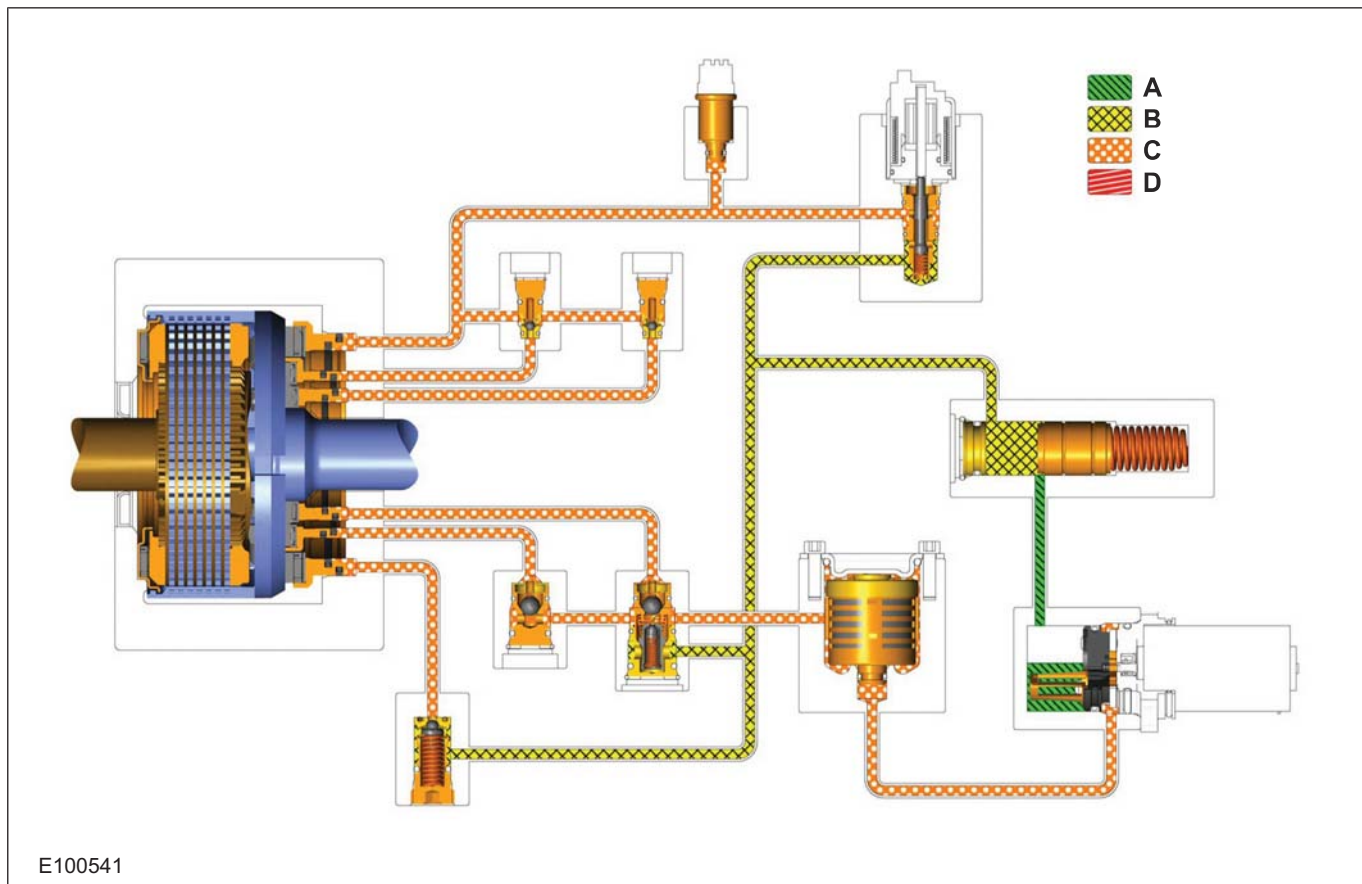
The hydraulic fluid is drawn from the sump of the hydraulic system and directed through a filter. The feed pump pressurises the system and pumps hydraulic fluid into the pump plungers. This base pressure of 4 bar presses the rollers for the pump plungers against the cam disc. At the same time, hydraulic fluid flows into the working piston. This eliminates the play in the clutch plates. The Haldex clutch can respond quickly and distribute the torque within fractions of a second. The spring force in the pressure accumulator determines the base

pressure of 4 bar and compensates pressure fluctuations. A compensating spring works in the opposite direction and prevents the plate discs becoming blocked by the force of the working piston. This restricts the transferable torque to approx. 7 Nm. This value can, however, deviate slightly due to temperature and/or the difference in speed between the input and output shafts.

**Increased base pressure (preload)**



DESCRIPTION AND OPERATION



E100541

Item	Description
A	Barometric Pressure
B	Base pressure

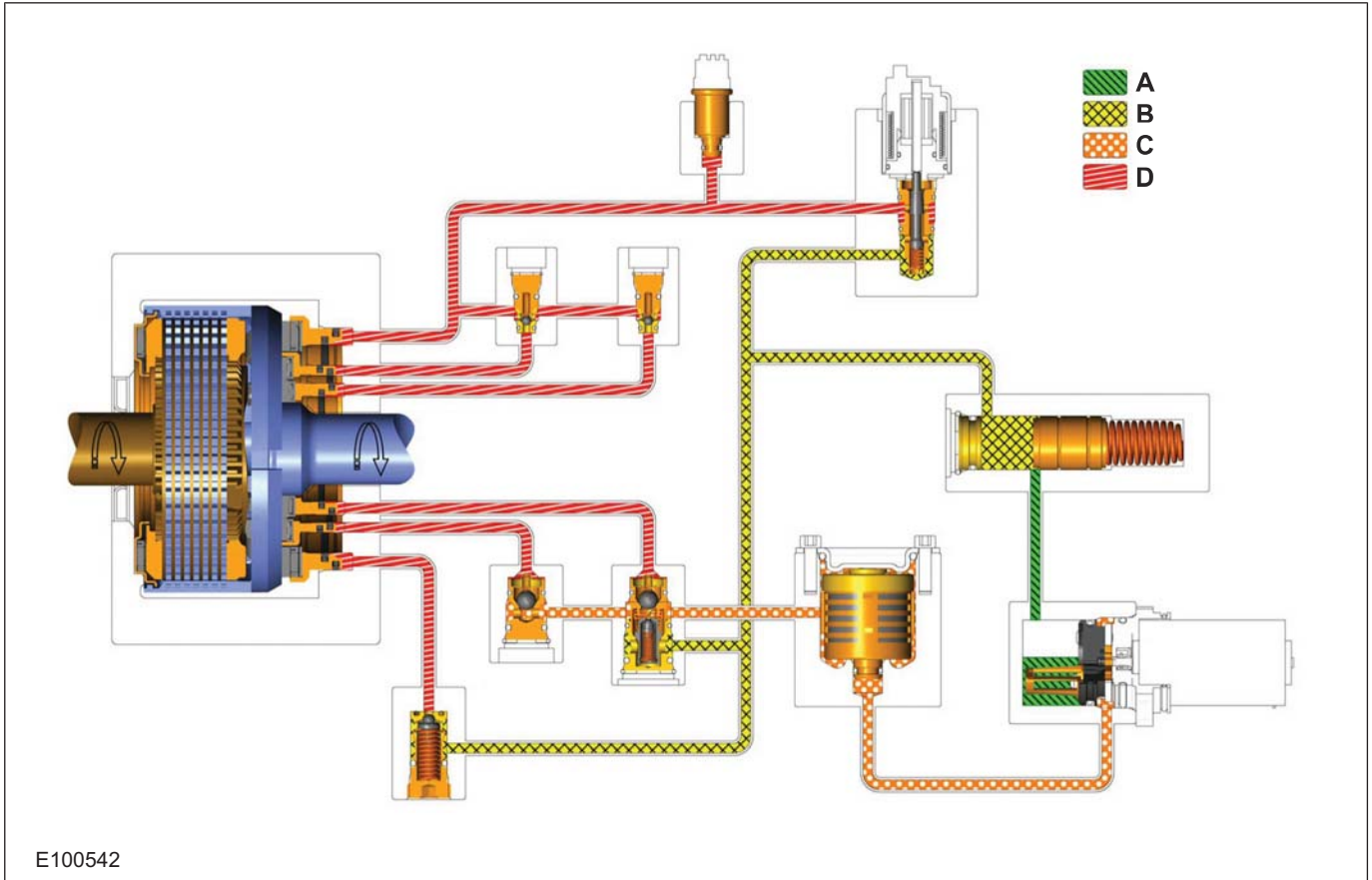
Item	Description
C	Increased base pressure (preload)
Drive	Operating pressure

To ensure very fast torque transmission, a higher voltage is applied to the electric feed pump and the control valve fully closed before the shaft-driven pump is brought into operation. As a result, the maximum pressure is raised above the base pressure, and a torque of up to 80 Nm applied to the multi-plate clutch. This achieves significantly faster pressure build-up than with older systems

(second generation). To protect the pump from overloading, the pressure is restricted to approx. 10 bar by the pressure relief valve. The hydraulic fluid flows back into the sump via the pressure accumulator.

**Pressure build-up**

DESCRIPTION AND OPERATION



Item	Description
A	Barometric Pressure
B	Base pressure

Item	Description
C	Increased base pressure (preload)
Drive	Operating pressure

The pump plungers generate the operating pressure that is controlled by the control valve as a function of the difference in speed between the input and output shafts. The control valve works progressively from fully open to fully closed. The fluid pressure can be approx. 67 bar when the control valve is fully open. The maximum pressure

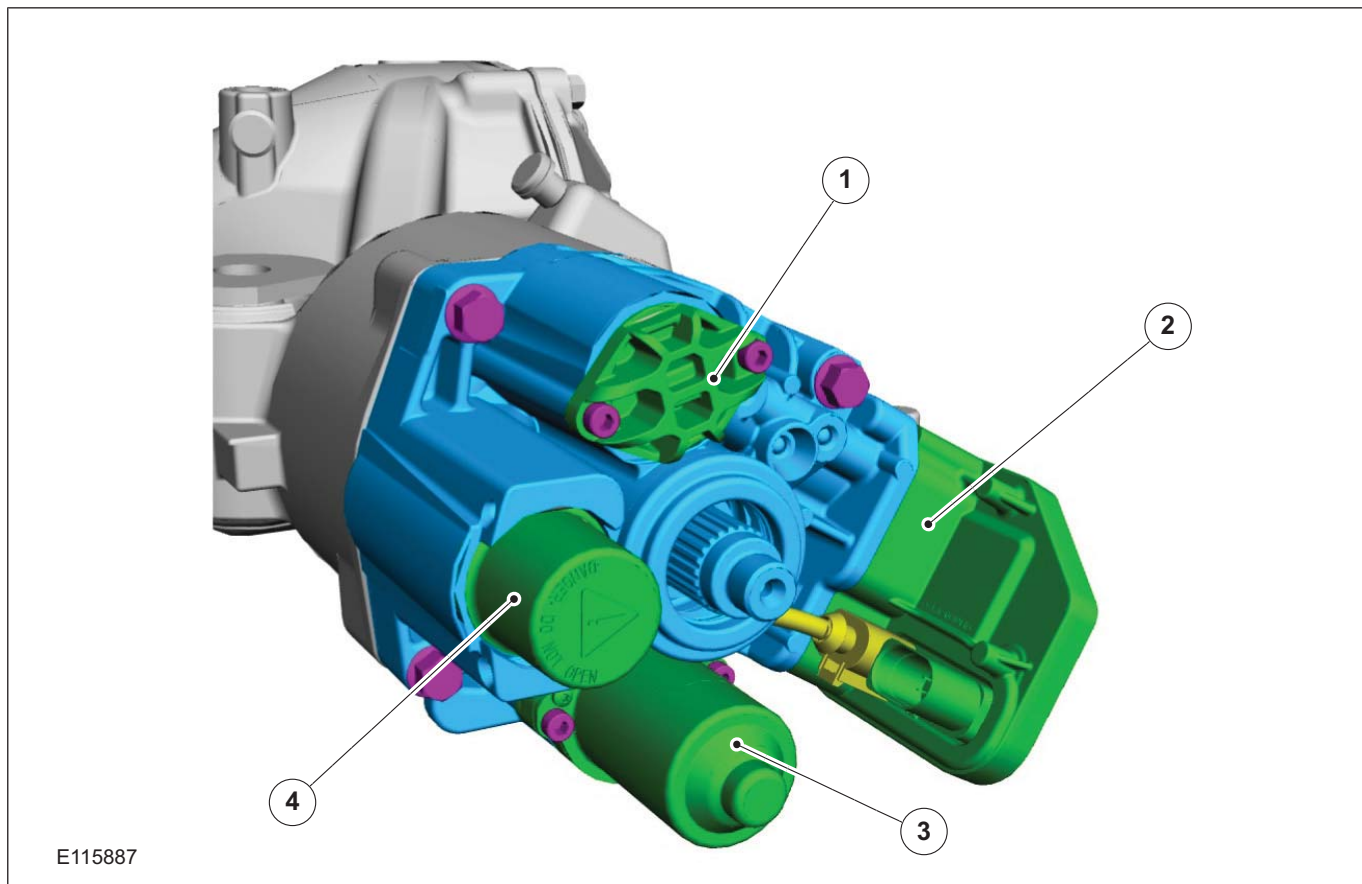
is mechanically controlled by means of the pressure relief valve.

**Design of the 4th generation Haldex clutch**

**General overview**



DESCRIPTION AND OPERATION



Item	Description
1	Fluid filter
2	All-wheel drive control unit

Item	Description
3	Electric feed pump
4	Pressure accumulator

The electric feed pump is an axial piston pump which is more robustly designed than the gerotor pump in the 3rd generation Haldex. The higher feed pressure means that the ring piston pump at the clutch plate assembly, the pressure relief valves, preload valve and the high pressure valves are no longer necessary.

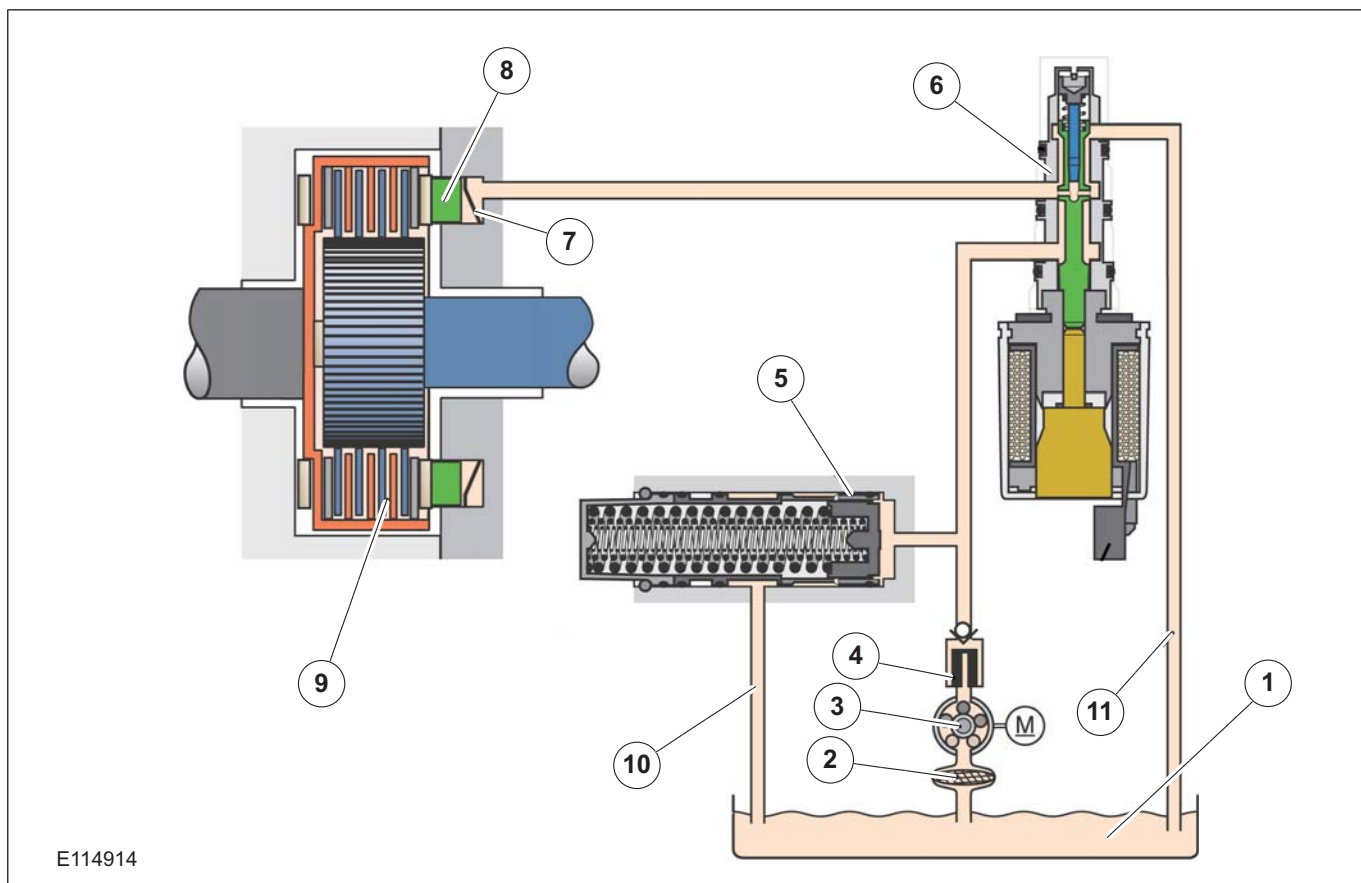
The pressure accumulator on the 4th generation Haldex is larger and is designed for the higher pressure.

The 4th generation Haldex has a larger fluid filter which contains a non-return valve.

The all-wheel drive control unit no longer contains a pressure sensor in the 4th generation Haldex.

**Pressure control - 4th generation Haldex clutch**

## DESCRIPTION AND OPERATION



E114914

Item	Description
1	Haldex clutch fluid
2	Inlet filter
3	Electric feed pump
4	Filters
5	Pressure accumulator

Item	Description
6	Control valve
7	Dished washer
8	Ring piston
9	Clutch plate pack
10	Return pressure accumulator
11	Return control valve

Full torque is available at any time on the 4th generation Haldex clutch because the pressure is not dependent on the difference in the speeds of rotation. This is used for instance to activate the Haldex clutch for better traction when moving off.

On the 4th generation Haldex clutch, the preload function which applied 80 Nm to the plates in the 3rd generation is no longer required.

On request from the control unit and at engine speeds above 400 rpm, the electric feed pump runs and maintains the storage pressure at about 30 bar.

A pressure reducing valve acts as a control valve, allowing the all-wheel drive control unit to control the pressure with much greater precision. The all-wheel drive control unit monitors the position

and function of the control valve. The control valve distributes the pressure, depending on the requirements, across its three outlet openings (storage pressure, working pressure, return).

From the storage pressure (30 bar) and depending on the requirements, the control valve regulates a working pressure of 0 - 17 bar, which is applied to the ring piston. At 17 bar working pressure, the maximum torque of 1000 Nm is transferred to the rear wheels. The all-wheel drive control unit ensures the best possible performance under all driving conditions, for all road conditions and independent of the speed.

GENERAL PROCEDURES

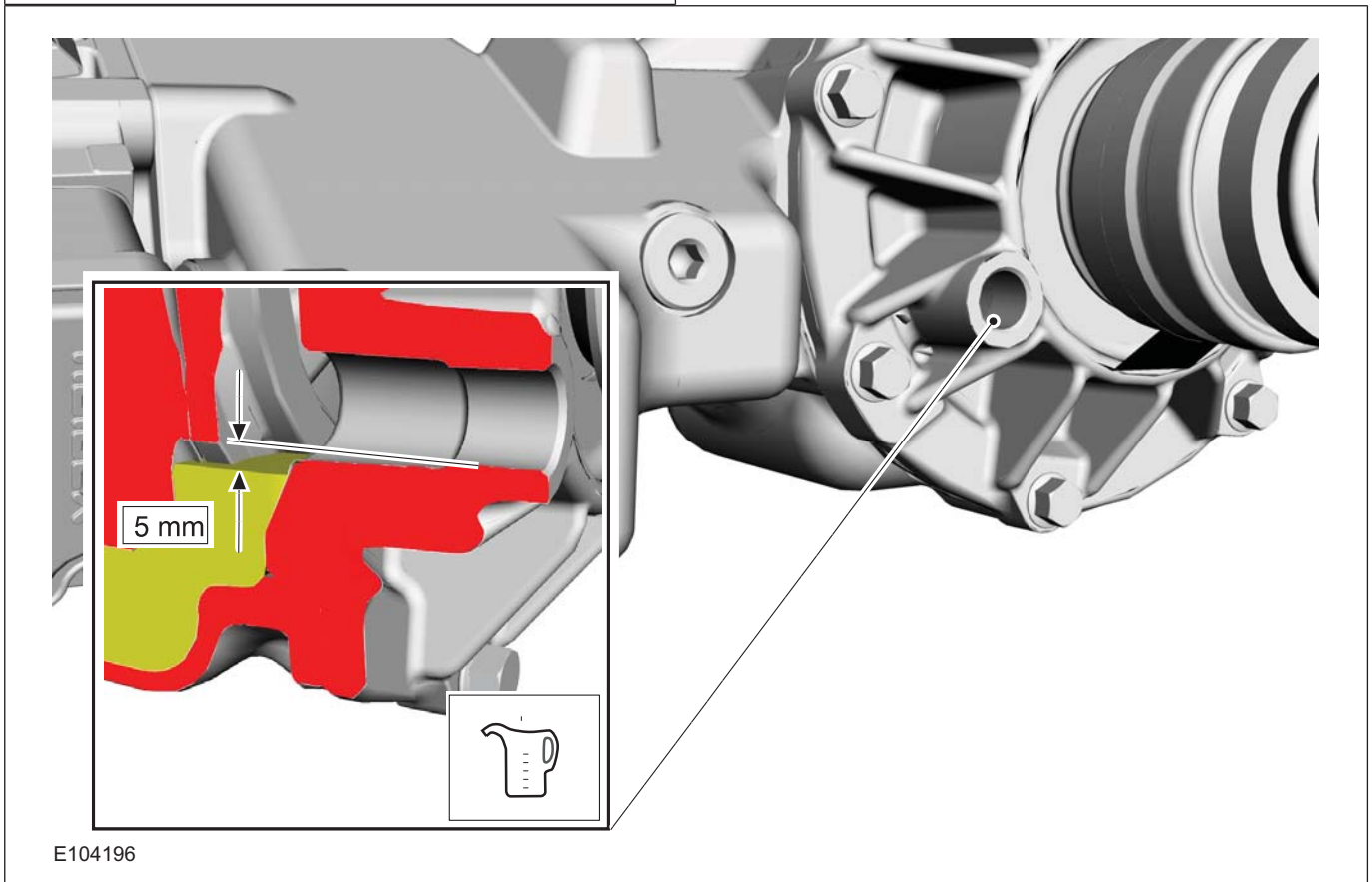
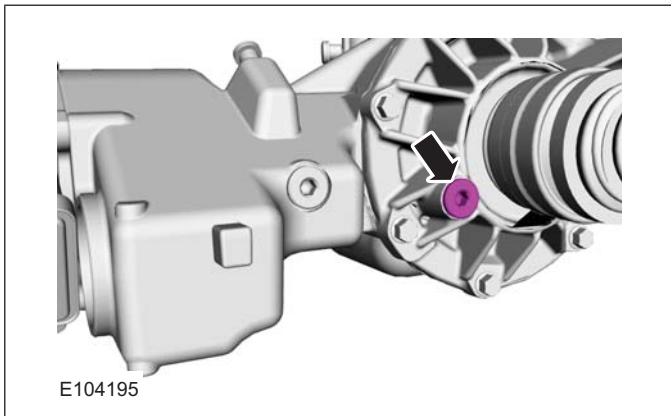
Differential Fluid Level Check

Materials	
Name	Specification
Rear Axle Oil SAE 80W-90 F	WSP-M2C197-A / 4U7J-M2C197-AA

- Material: Rear Axle Oil SAE 80W-90 F (WSP-M2C197-A / 4U7J-M2C197-AA) transmission fluid
- Correct the rear axle oil level if necessary.
- 24 ml ~ 1 mm

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).

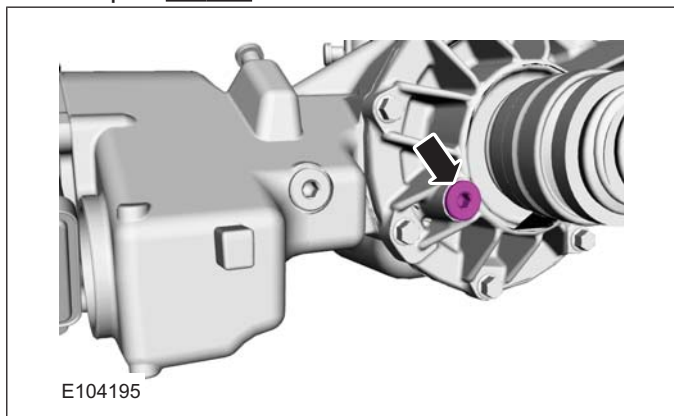
2.



205-02-18

Rear Drive Axle/Differential

205-02-18

**GENERAL PROCEDURES**4. Torque: 43 Nm

## GENERAL PROCEDURES

## Active On-Demand Coupling Fluid Level Check

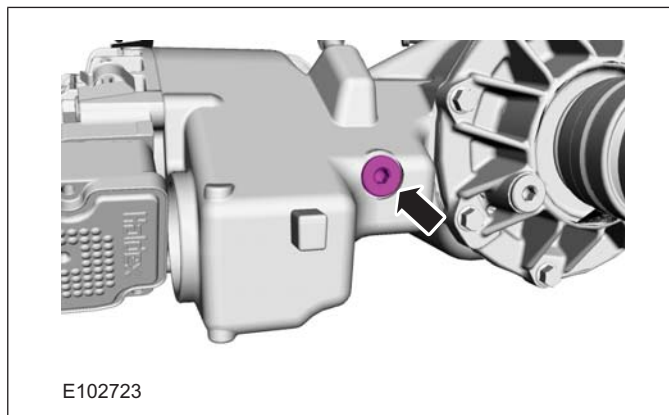
## Materials

Name	Specification
Transmission Oil AWD	8U7J-8708687-AA

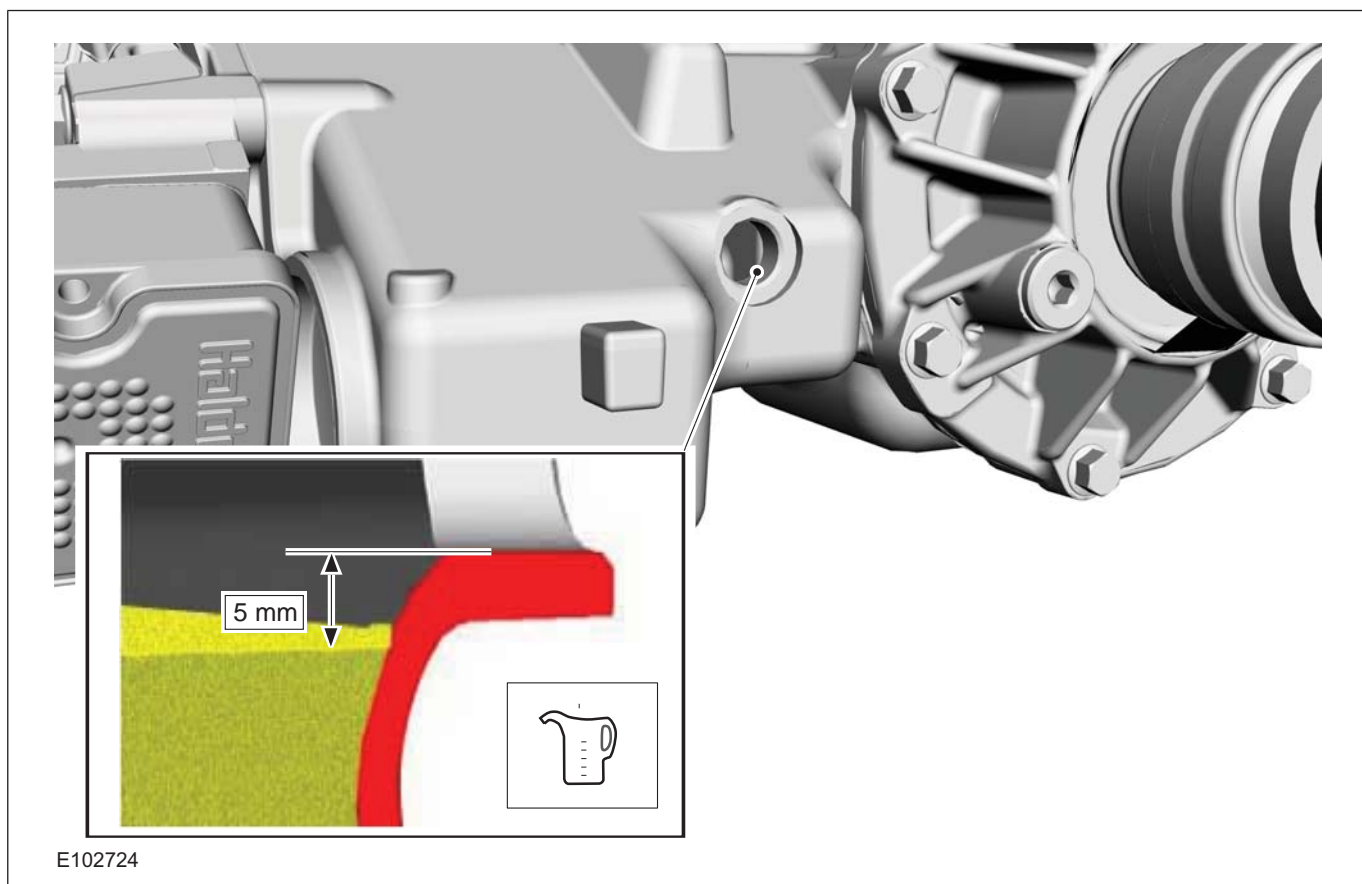
## Activation

- Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
- NOTE:** This component does not have a drain plug because the fluid does not need to be drained or changed.

7.



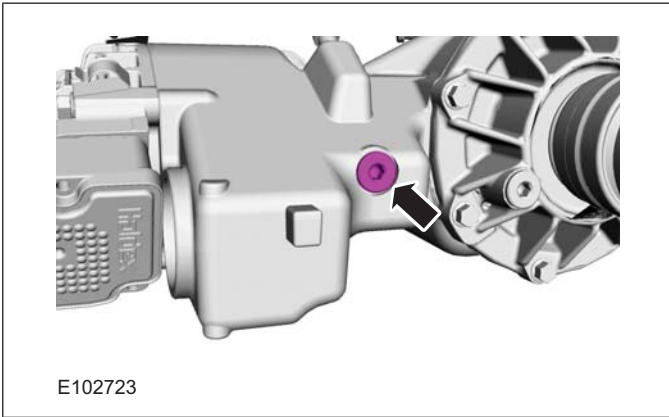
- Material: Transmission Oil AWD (8U7J-8708687-AA) transmission fluid
  - Correct the oil level if necessary.
  - 24 ml ~ 1 mm





**GENERAL PROCEDURES**

9. Torque: 43 Nm







REMOVAL AND INSTALLATION

Differential Case

General Equipment

Cable Ties

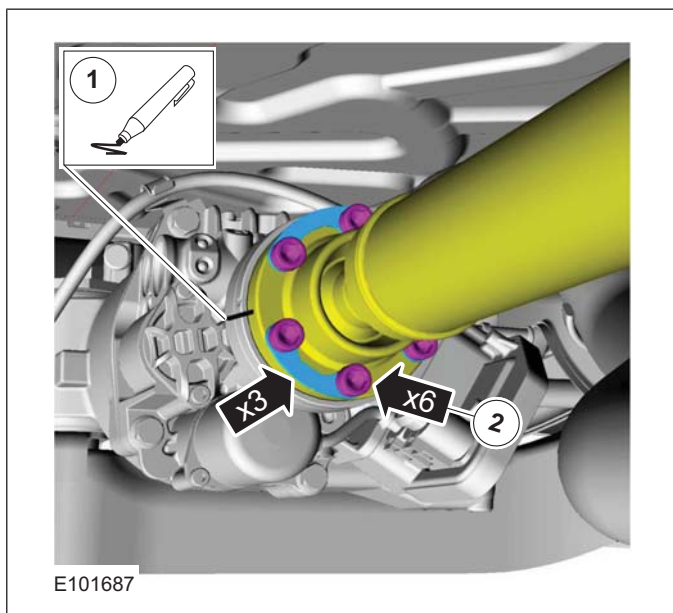
Removal

All vehicles

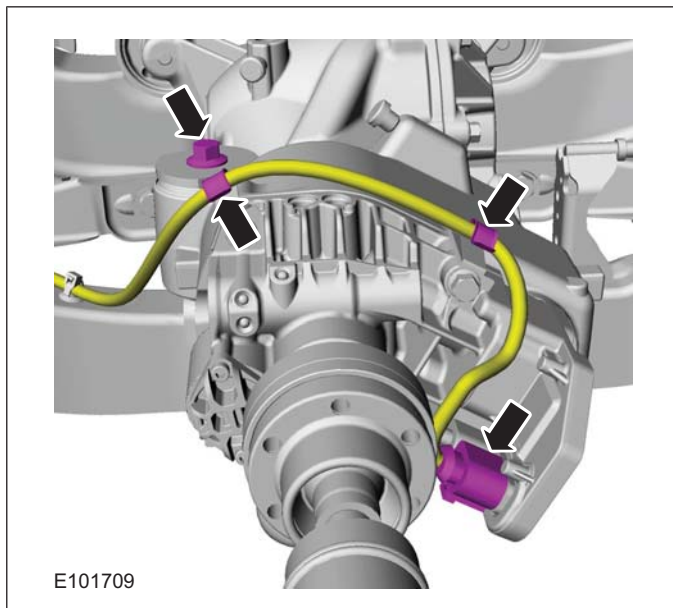
1. Refer to: **Rear Halfshaft** (205-05 Rear Drive Halfshafts, Removal and Installation).

Vehicles with 2.0L diesel engine

2.



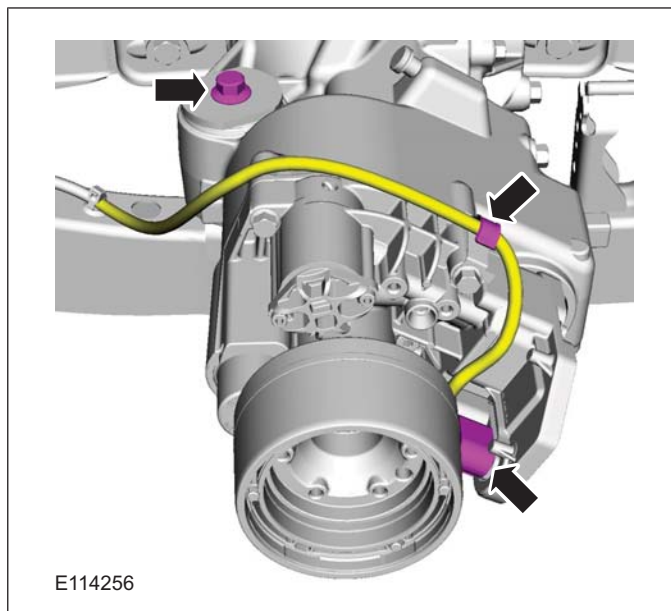
3.



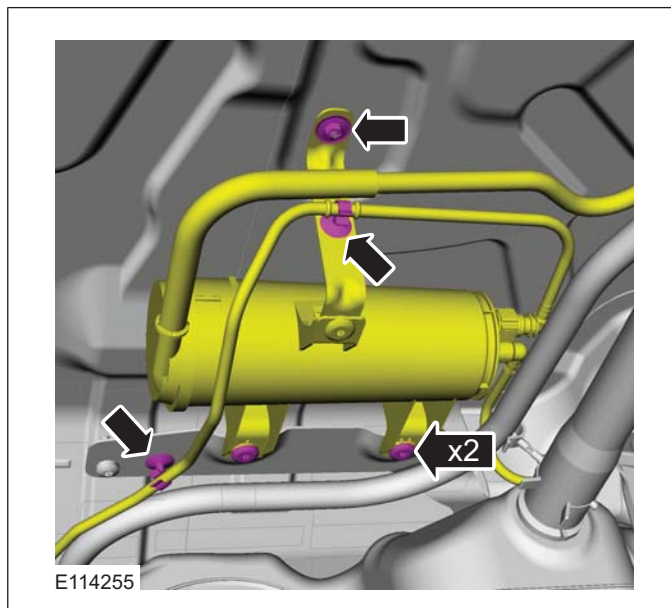
Vehicles with 2.5L engine

4. Refer to: **Driveshaft** (205-01 Driveshaft, Removal and Installation).

5.



6.





205-02-22

Rear Drive Axle/Differential

205-02-22



REMOVAL AND INSTALLATION

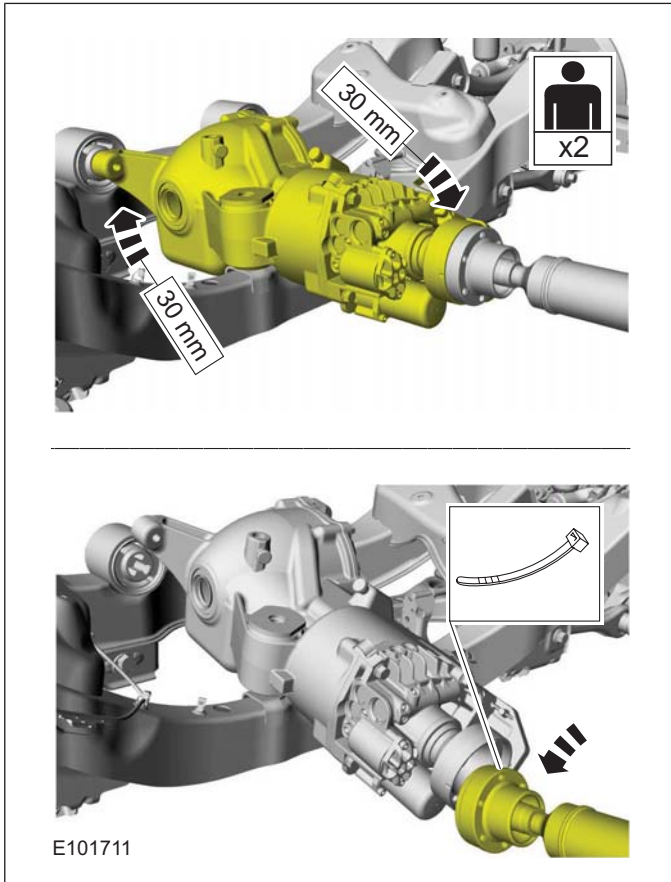
All vehicles

7.



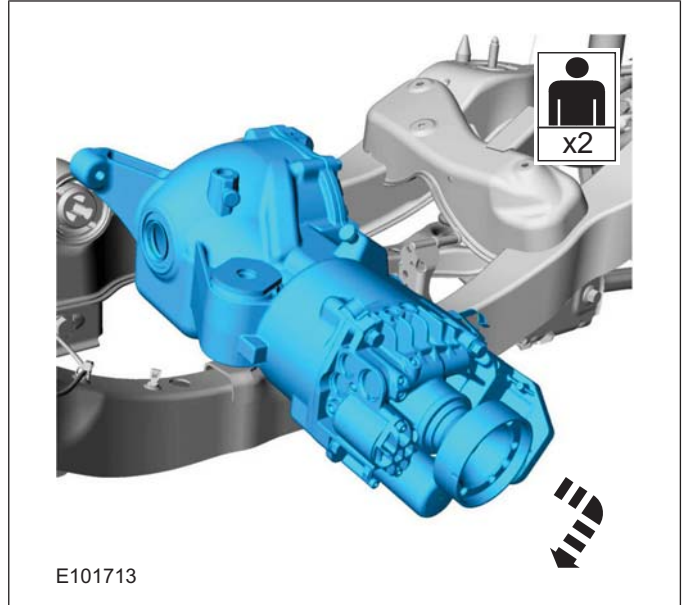
Vehicles with 2.0L diesel engine

8. General Equipment: Cable Ties



All vehicles

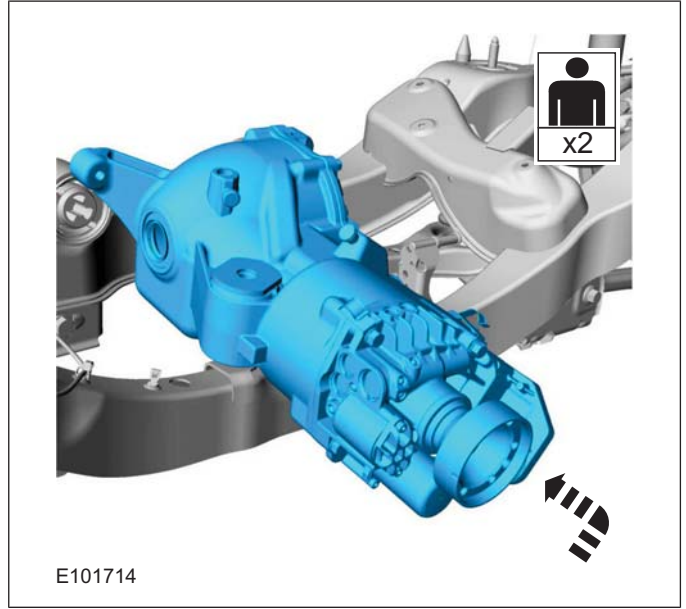
9.



Installation

All vehicles

1.





205-02-23

Rear Drive Axle/Differential

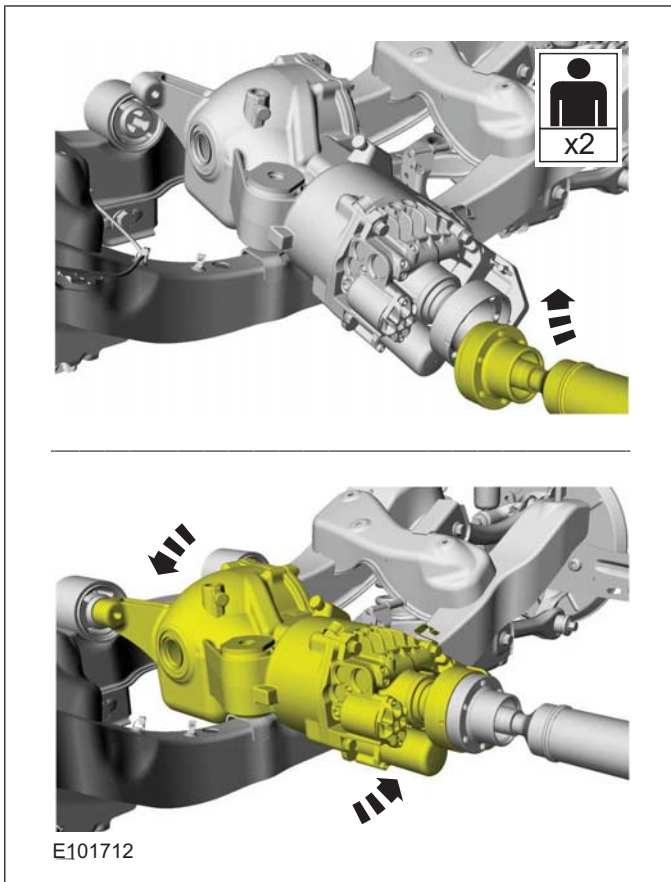
205-02-23



REMOVAL AND INSTALLATION

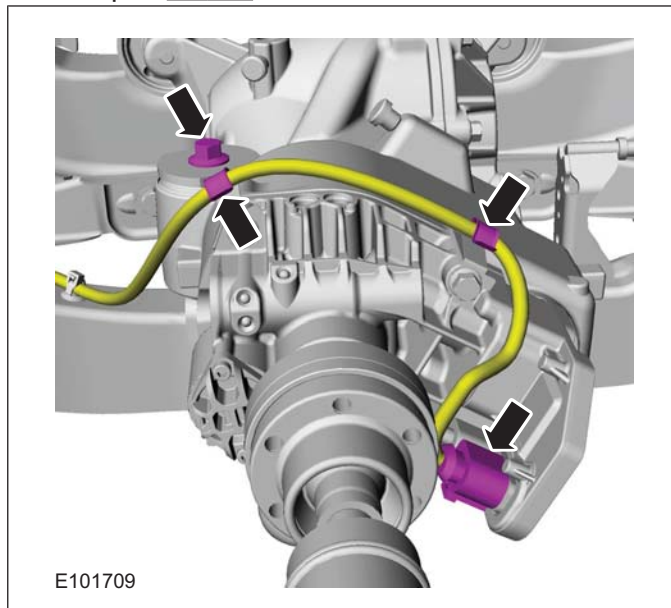
Vehicles with 2.0L diesel engine

2.



Vehicles with 2.0L diesel engine

4. Torque: 80 Nm

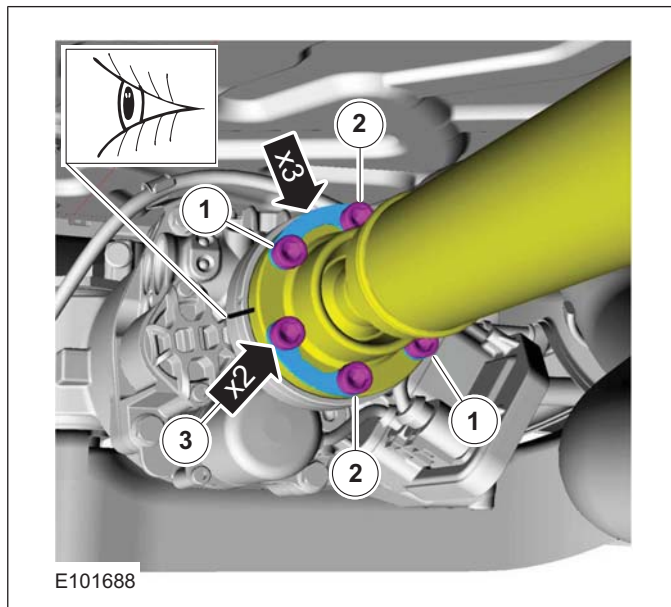
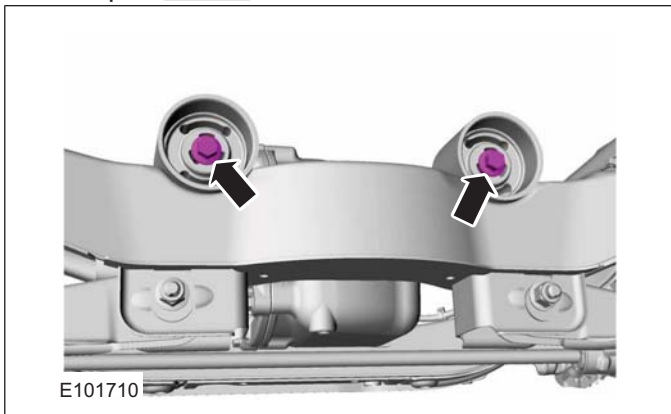


5. **⚠ CAUTION:** Make sure that the installation marks are aligned.

1. Torque: 35 Nm
2. Torque: 35 Nm
3. Torque: 35 Nm

All vehicles

3. Torque: 80 Nm

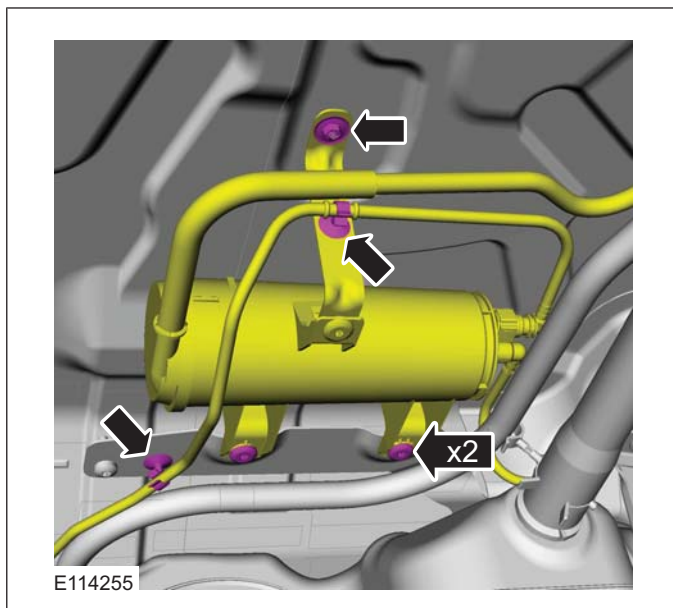




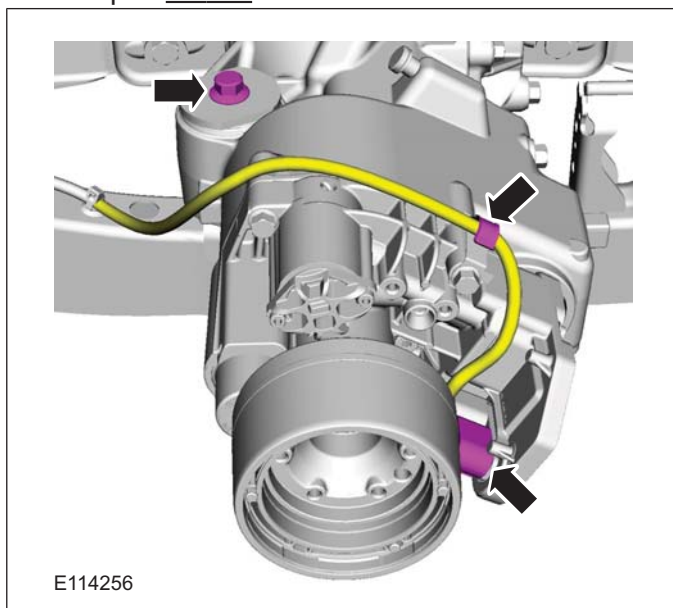
## REMOVAL AND INSTALLATION

Vehicles with 2.5L engine

6.



7. Torque: 80 Nm



8. Refer to: **Driveshaft** (205-01 Driveshaft, Removal and Installation).

All vehicles

9. Refer to: **Rear Halfshaft** (205-05 Rear Drive Halfshafts, Removal and Installation).

10. Refer to: **Differential Fluid Level Check** (205-02 Rear Drive Axle/Differential, General Procedures).

REMOVAL AND INSTALLATION

Active On-Demand Coupling Module

Materials	
Name	Specification
Transmission Oil AWD	8U7J-8708687-AA

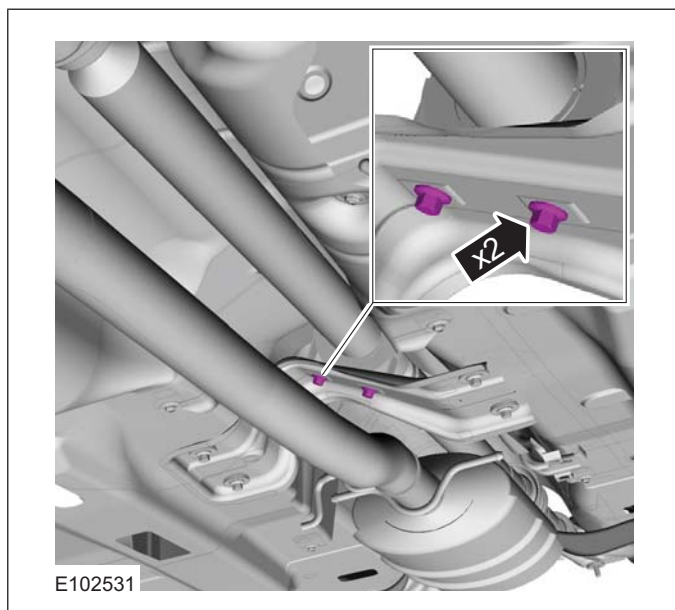
Removal

All vehicles

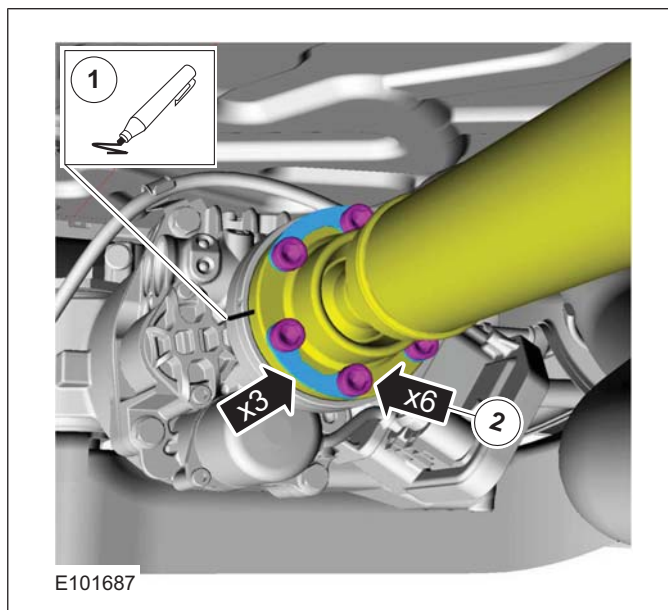
1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

Vehicles with 2.0L diesel engine

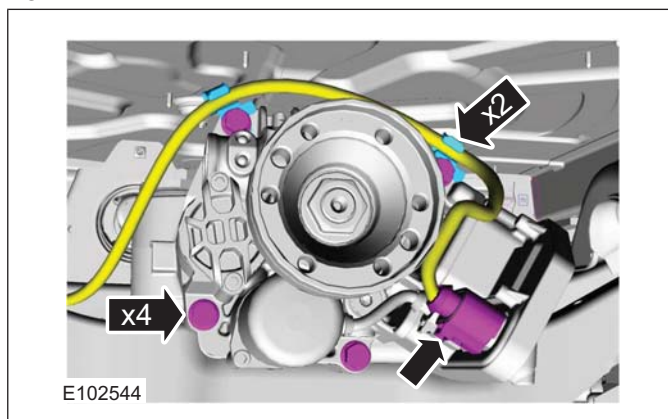
3.



4.



5.





205-02-26

Rear Drive Axle/Differential

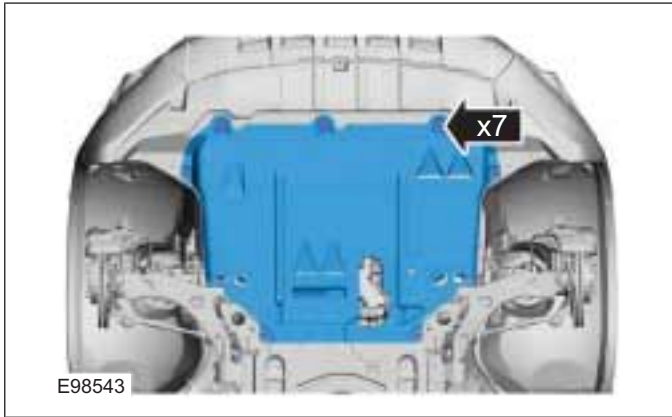
205-02-26



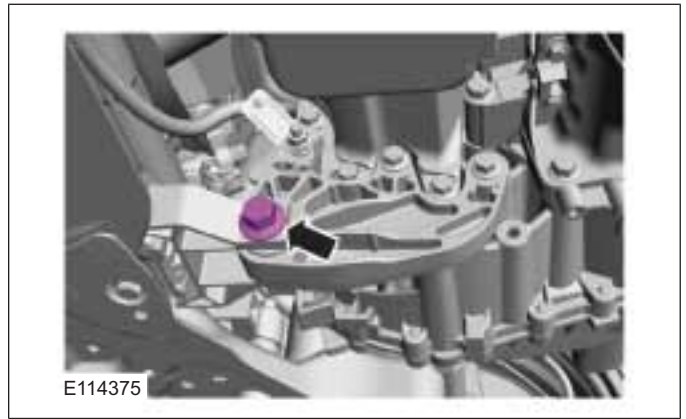
### REMOVAL AND INSTALLATION

Vehicles with 2.5L engine

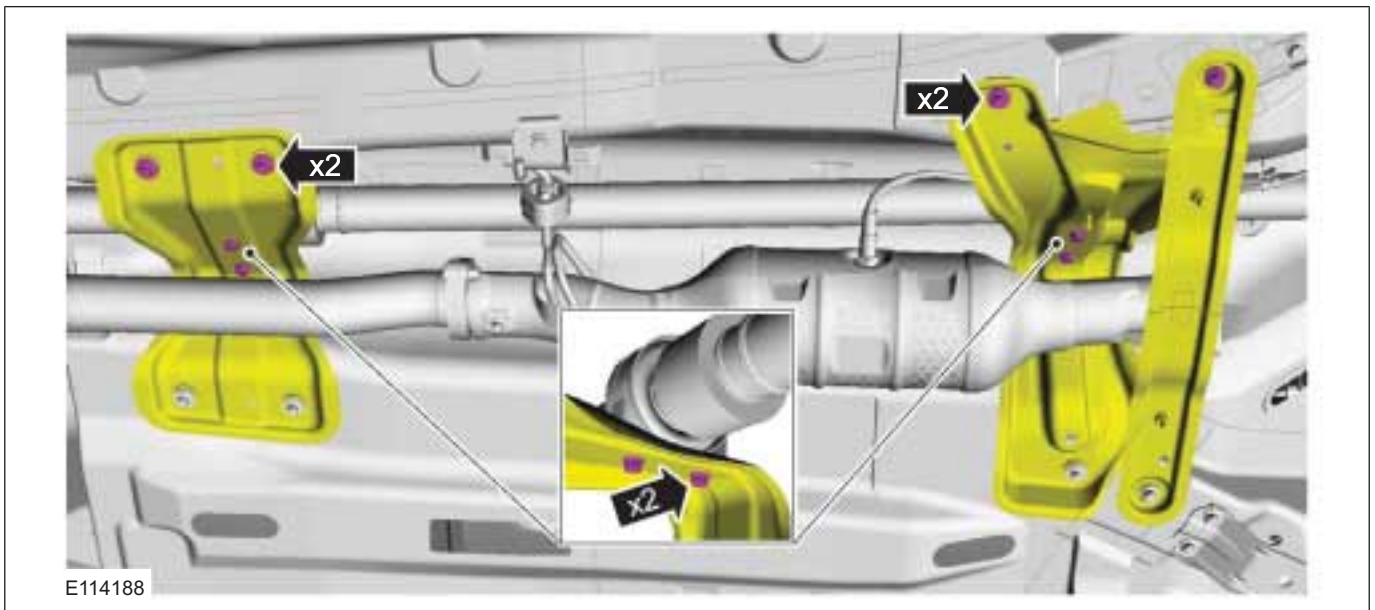
6.



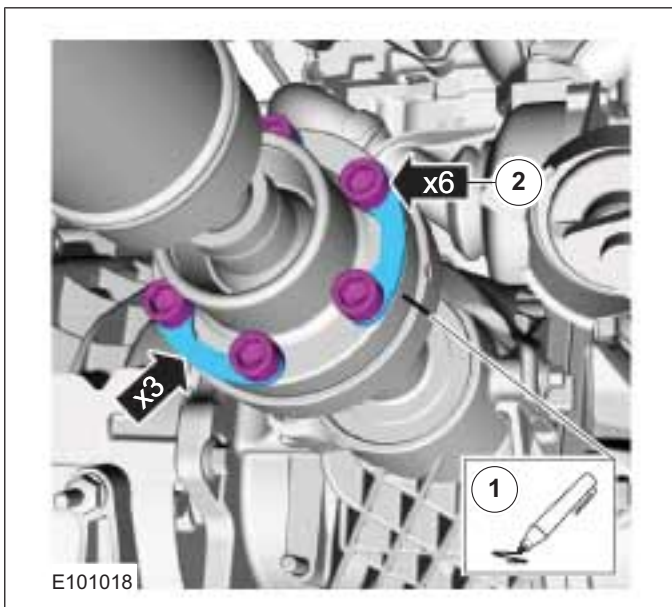
7.



8.



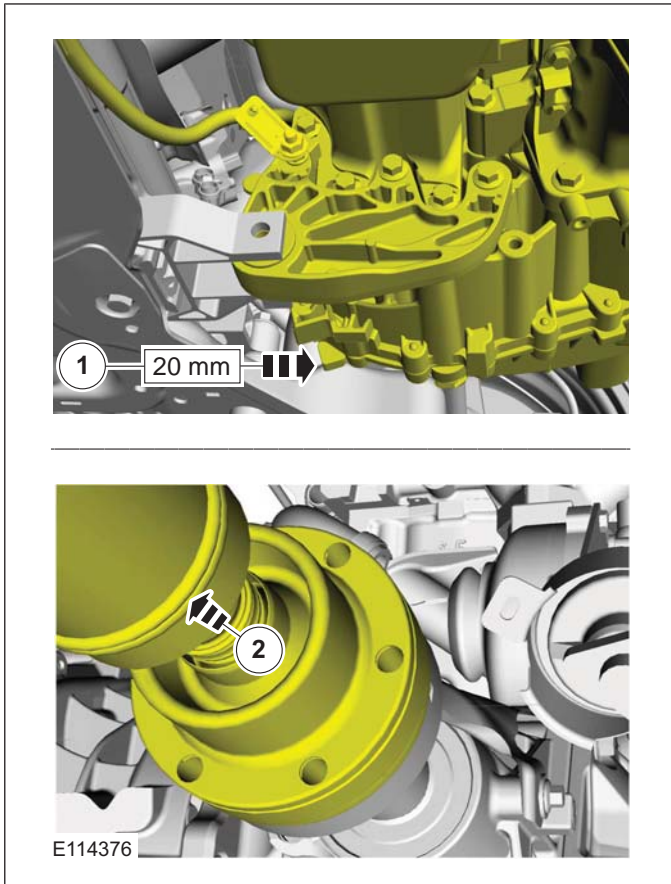
9.



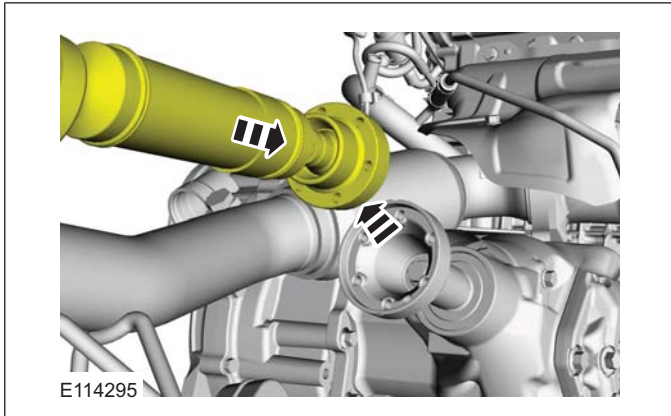


REMOVAL AND INSTALLATION

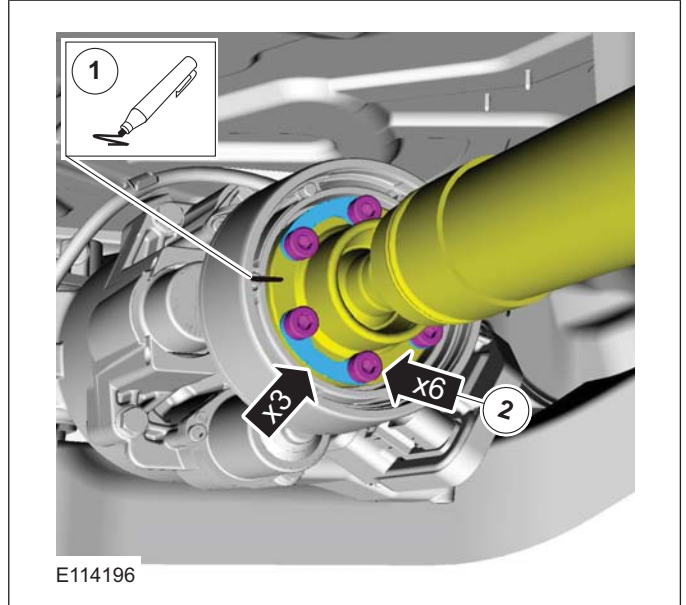
10.



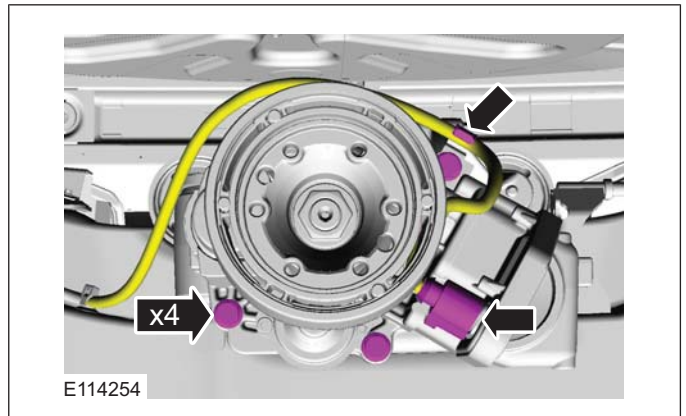
11.



12.



13.

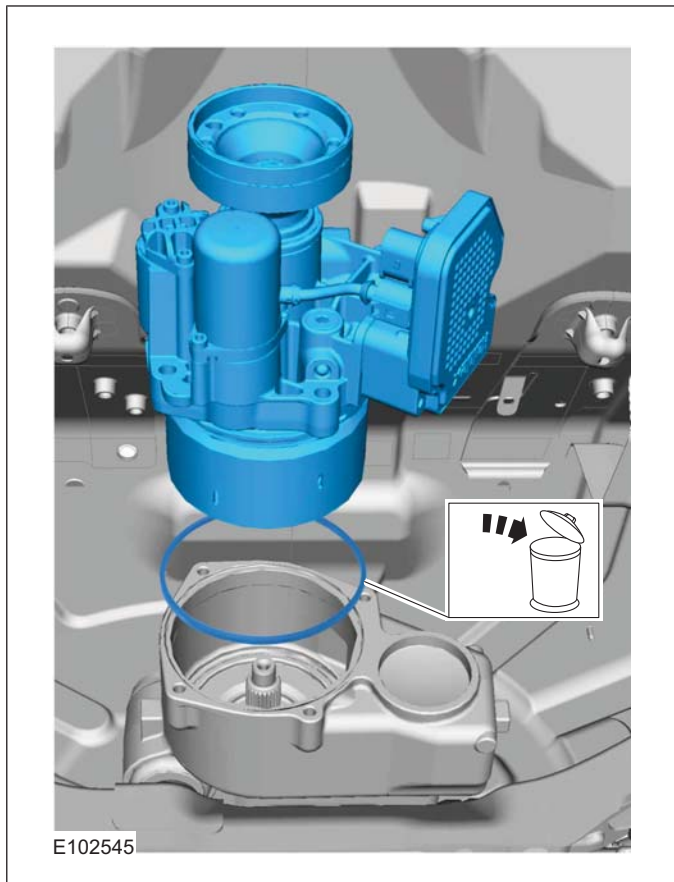




REMOVAL AND INSTALLATION

All vehicles

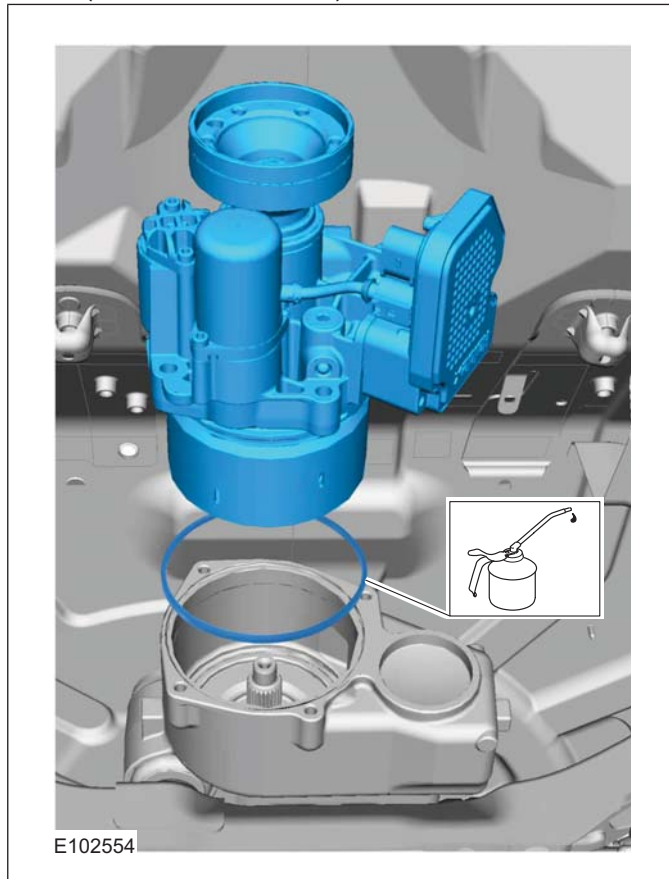
14.



Installation

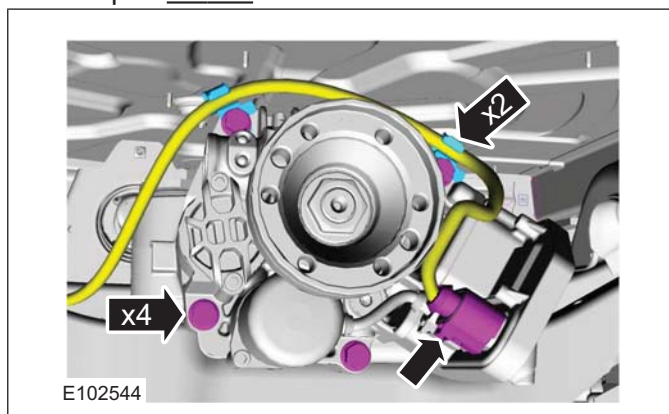
All vehicles

1. Material: Transmission Oil AWD (8U7J-8708687-AA) transmission fluid



Vehicles with 2.0L diesel engine

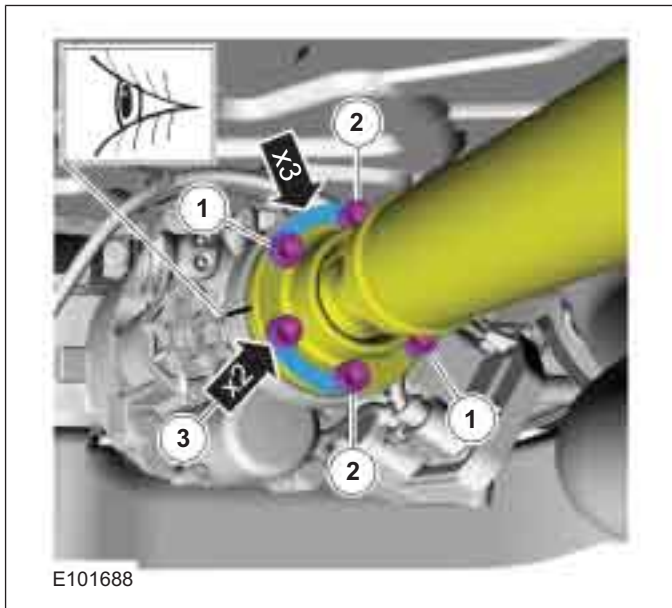
2. Torque: 25 Nm



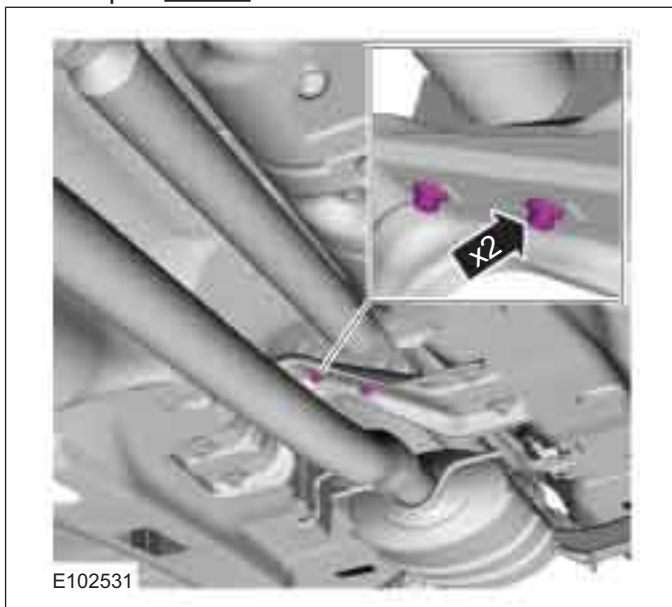
REMOVAL AND INSTALLATION

3. **⚠ CAUTION:** Make sure that the installation marks are aligned.

- 1. Torque: 35 Nm
- 2. Torque: 35 Nm
- 3. Torque: 35 Nm

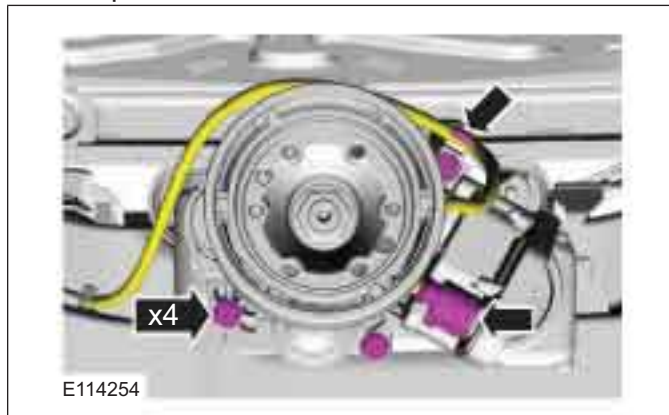


4. Torque: 25 Nm



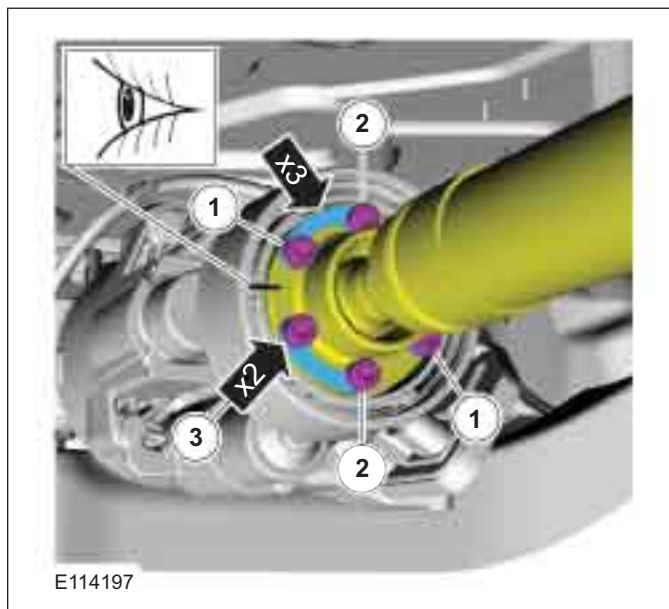
Vehicles with 2.5L engine

5. Torque: 25 Nm

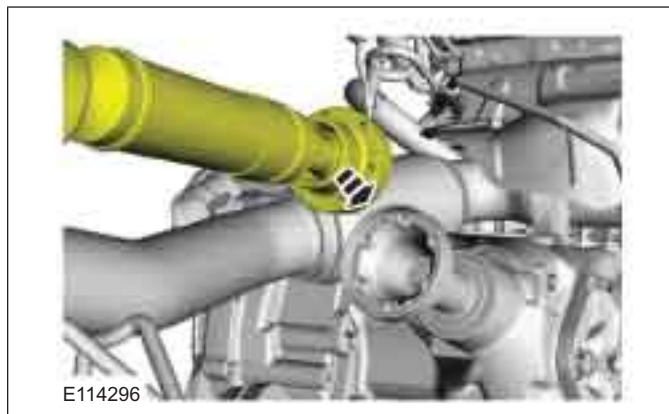


6. **⚠ CAUTION:** Make sure that the installation marks are aligned.

- 1. Torque: 35 Nm
- 2. Torque: 35 Nm
- 3. Torque: 35 Nm



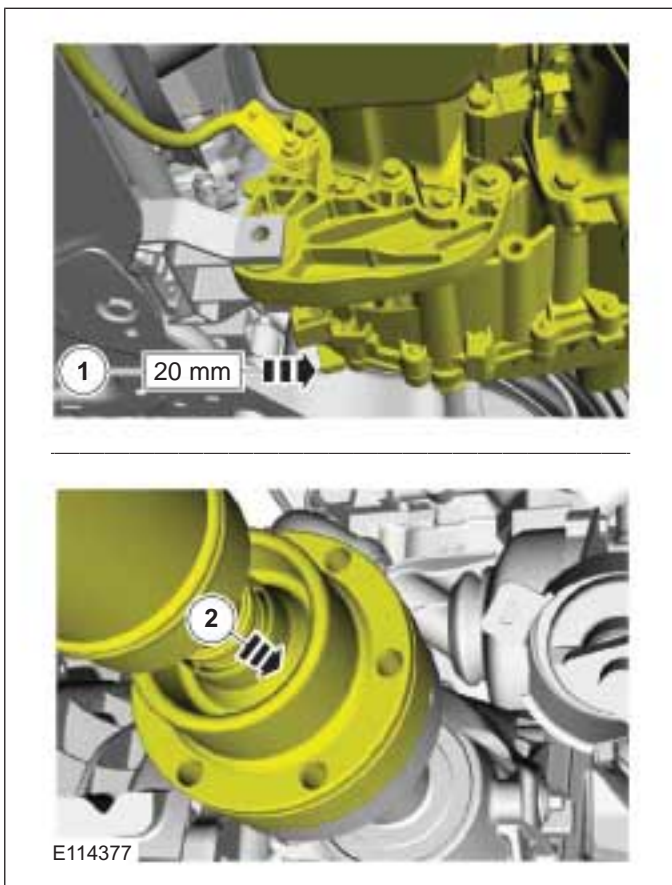
7.





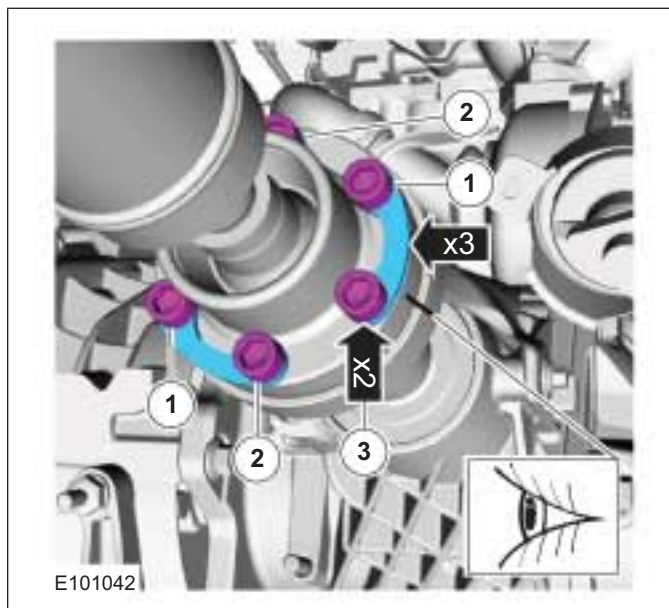
REMOVAL AND INSTALLATION

8.

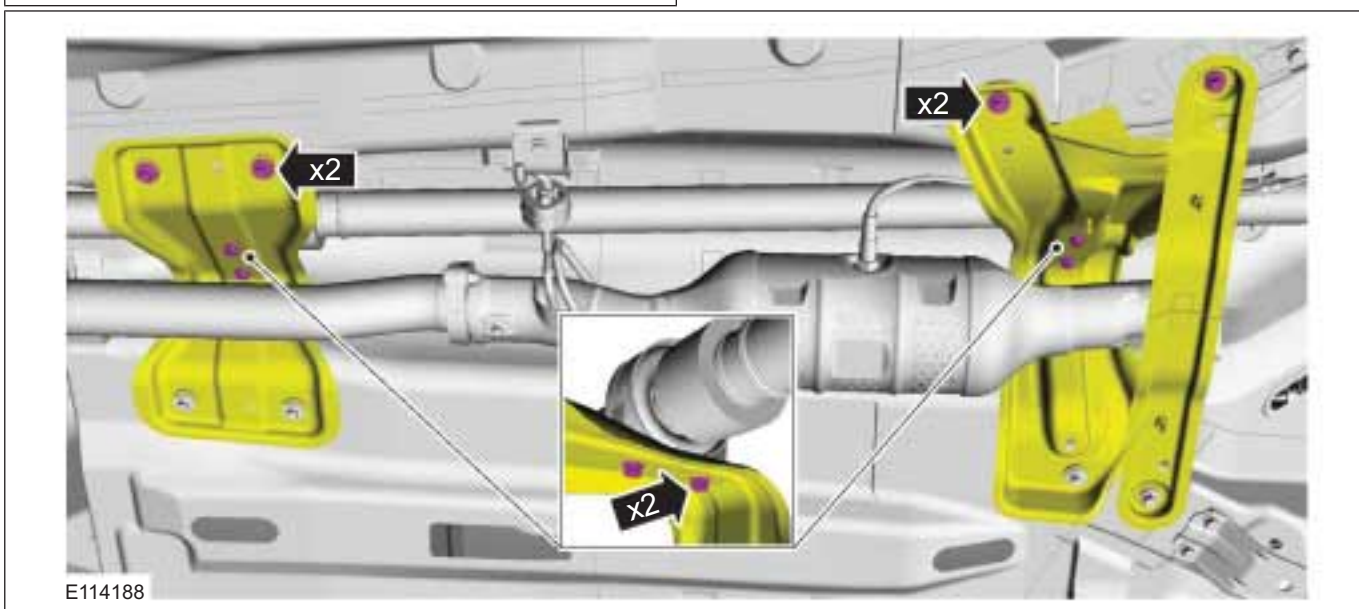


9. **⚠ CAUTION:** Make sure that the installation marks are aligned.

1. Torque: 35 Nm
2. Torque: 35 Nm
3. Torque: 35 Nm



10. Torque: 25 Nm



205-02-31

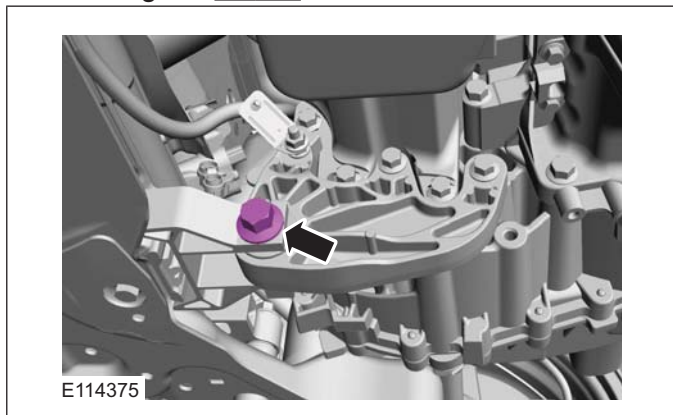
Rear Drive Axle/Differential

205-02-31

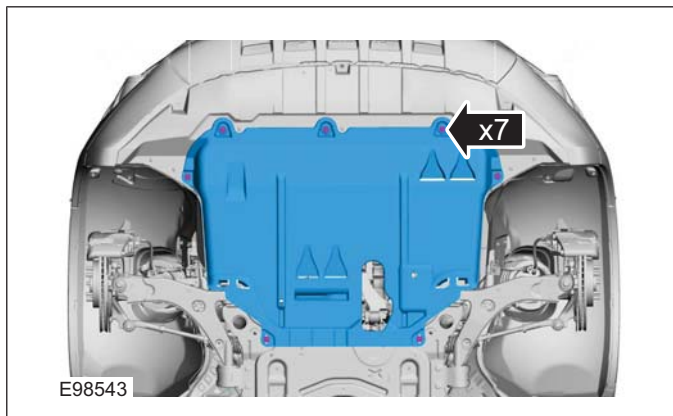
## REMOVAL AND INSTALLATION

## 11. Torque:

- Stage 1: 35 Nm
- Stage 2: Loosen 360°
- Stage 3: 85 Nm



## 12



All vehicles

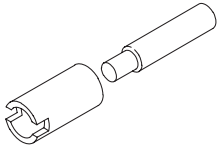
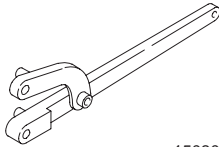
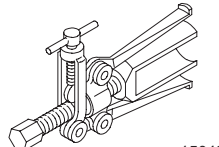
13. Refer to: **Active On-Demand Coupling Fluid Level Check** (205-02 Rear Drive Axle/Differential, General Procedures).  
Refer to: **Differential Fluid Level Check** (205-02 Rear Drive Axle/Differential, General Procedures).

14. Lower the vehicle.

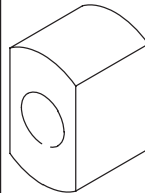
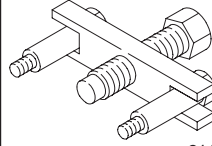
REMOVAL AND INSTALLATION

Differential Input Shaft Seal

Special Tool(s) / General Equipment

 <p>14032</p>	<p>204-093 Remover/Installer, Lower Arm Bushing</p>
 <p>15030A</p>	<p>205-072 Universal Flange Holding Wrench</p>
 <p>15048</p>	<p>205-078 Remover, Drive Pinion Seal</p>

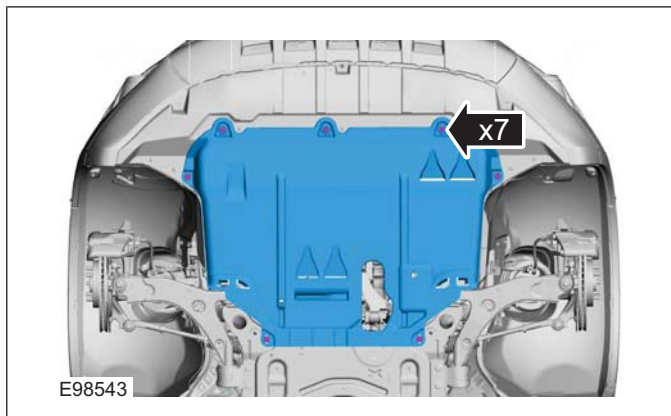
Special Tool(s) / General Equipment

 <p>1504801</p>	<p>205-078-01 Adapter for 205-078 (Thrust Pad)</p>
 <p>21132</p>	<p>303-249 Remover, Crankshaft Timing Pulley</p>
<p>Puller</p>	

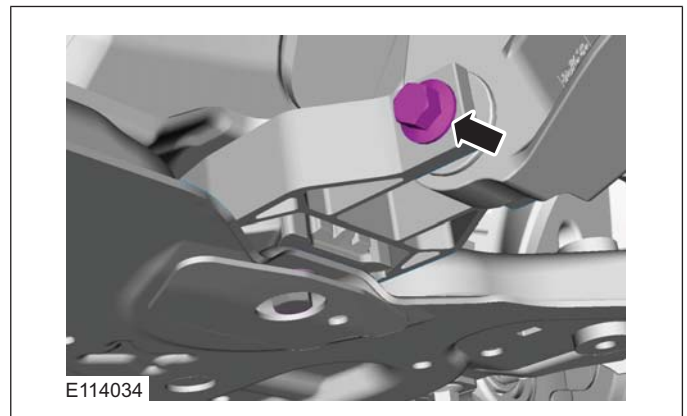
Removal

All vehicles

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
- 3.



4.

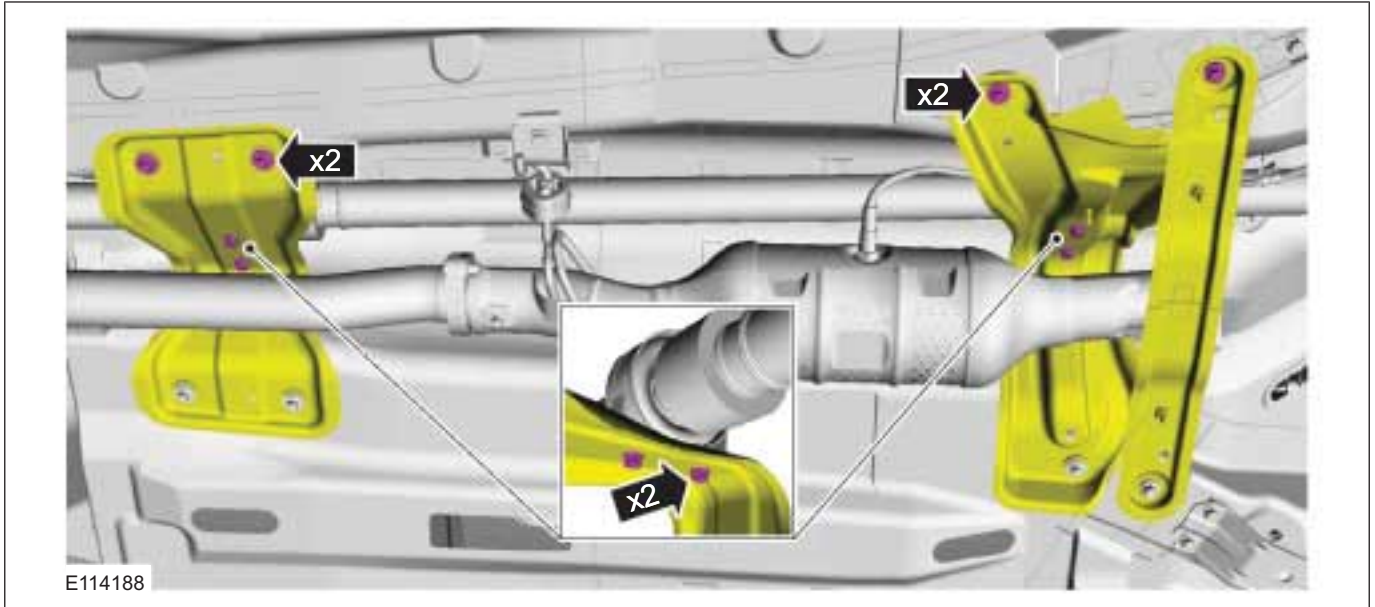


5.

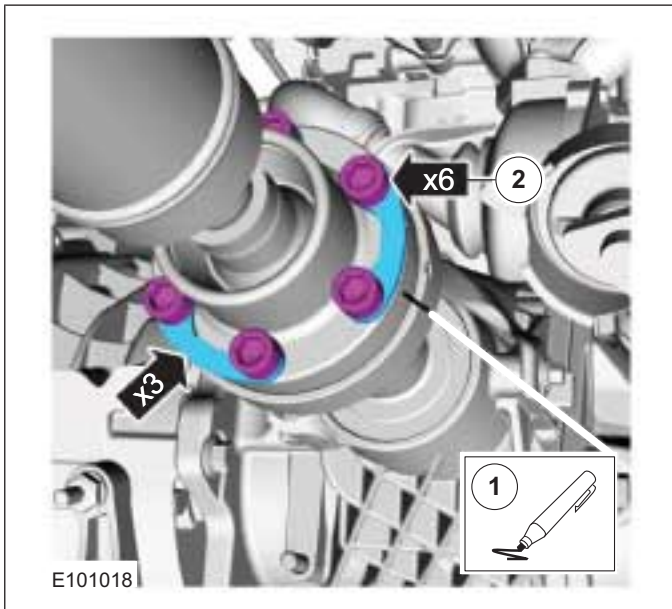




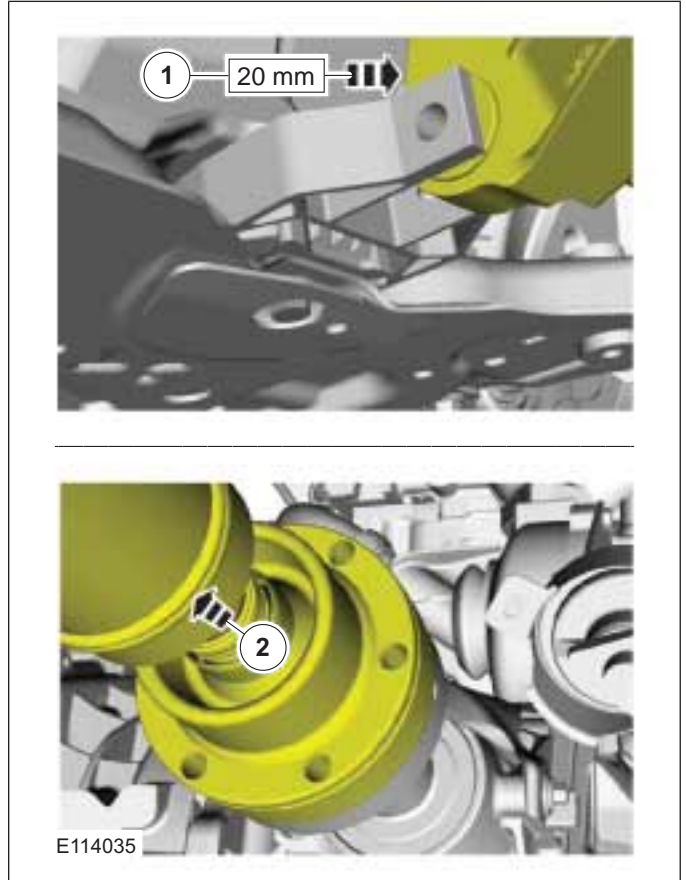
REMOVAL AND INSTALLATION



6.



7.





205-02-34

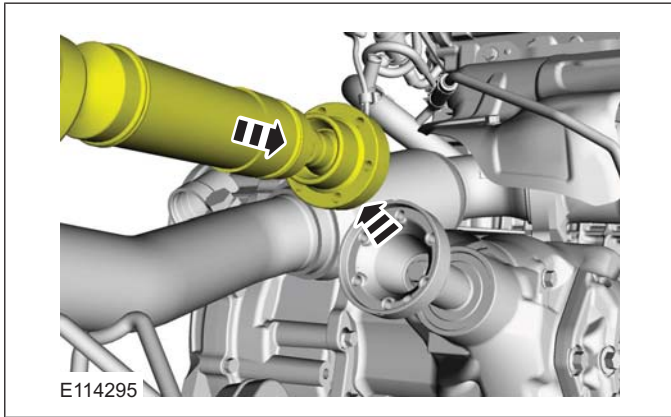
Rear Drive Axle/Differential

205-02-34

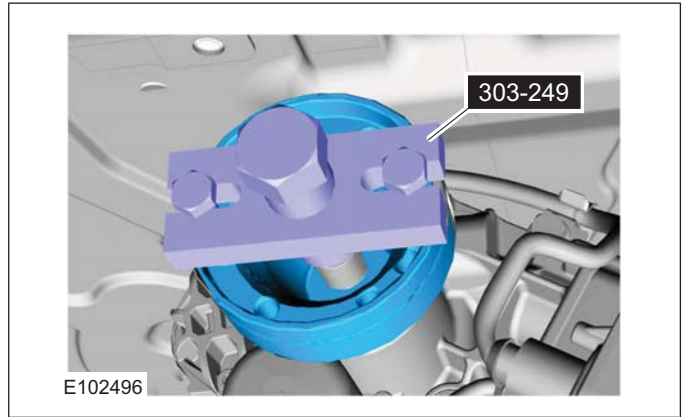


REMOVAL AND INSTALLATION

8.

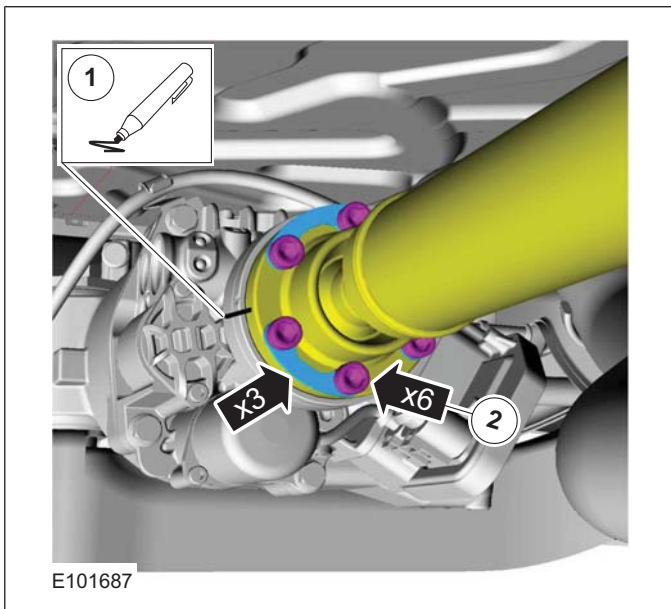


11. Special Tool(s): 303-249



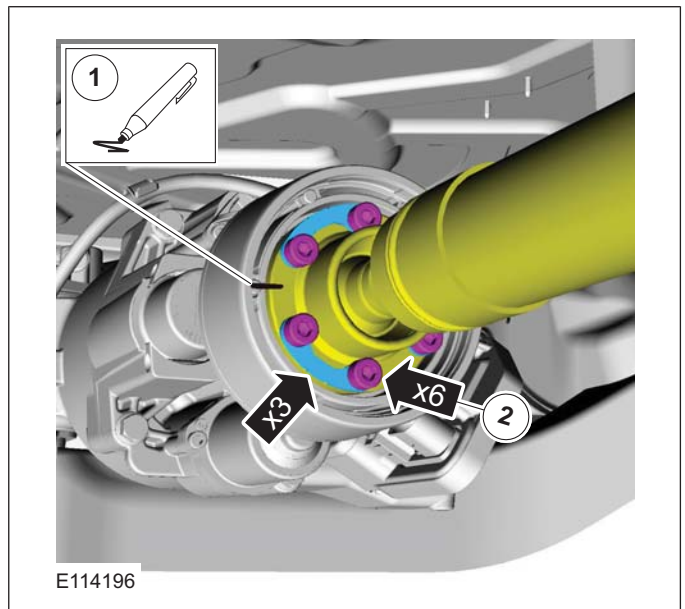
Vehicles with manual transmission

9.

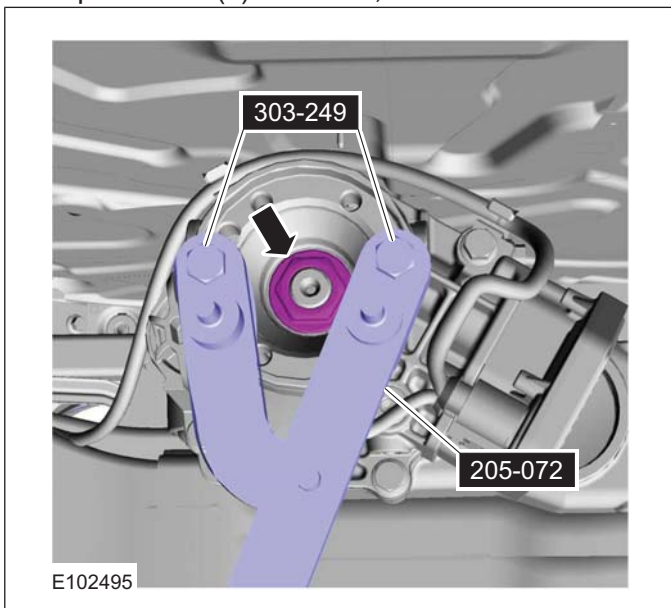


Vehicles with automatic transmission

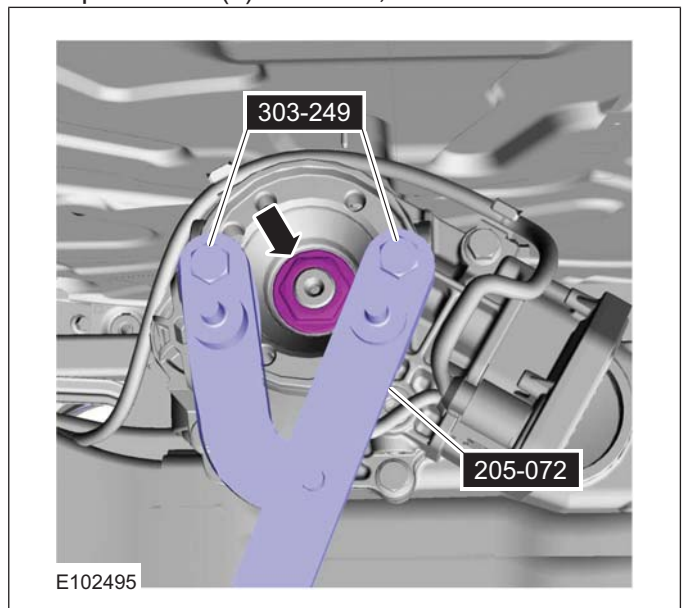
12



10. Special Tool(s): 205-072, 303-249



13. Special Tool(s): 205-072, 303-249





205-02-35

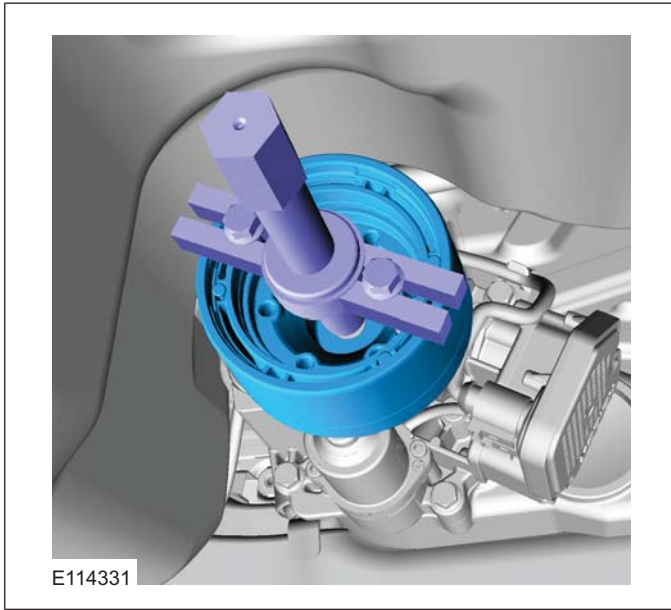
Rear Drive Axle/Differential

205-02-35



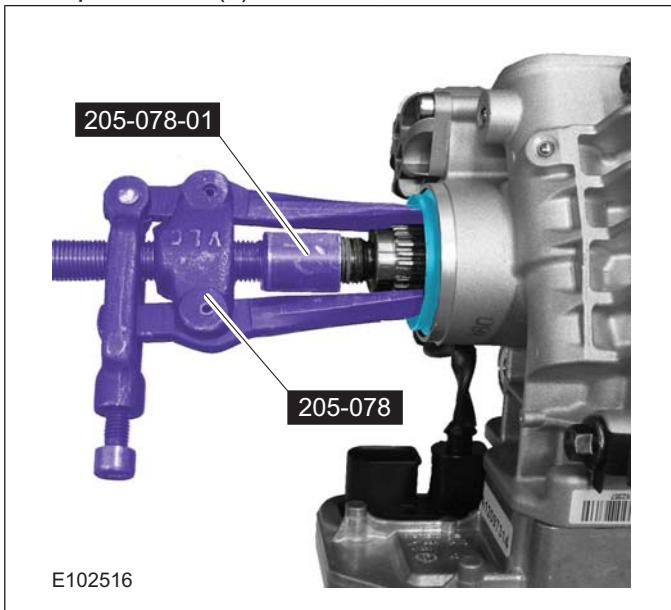
REMOVAL AND INSTALLATION

14. General Equipment: Puller



All vehicles

15. Special Tool(s): 205-078, 205-078-01



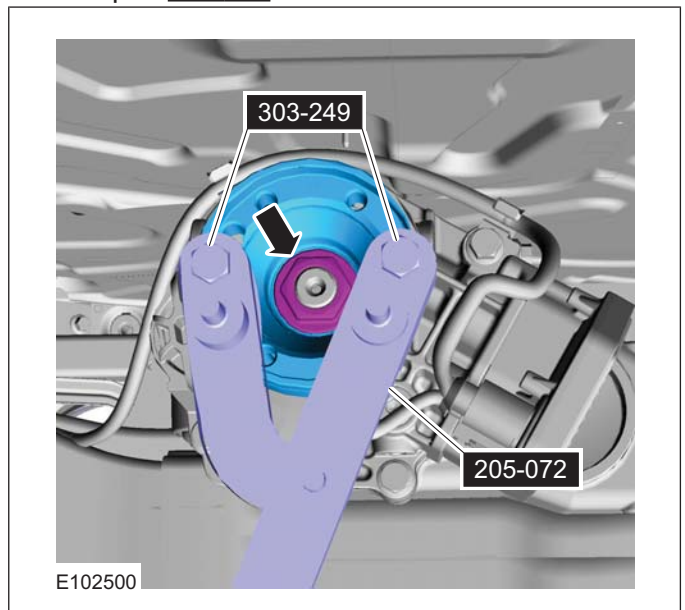
Installation

All vehicles

1. Special Tool(s): 204-093



2. Special Tool(s): 205-072, 303-249  
Torque: 150 Nm





205-02-36

Rear Drive Axle/Differential

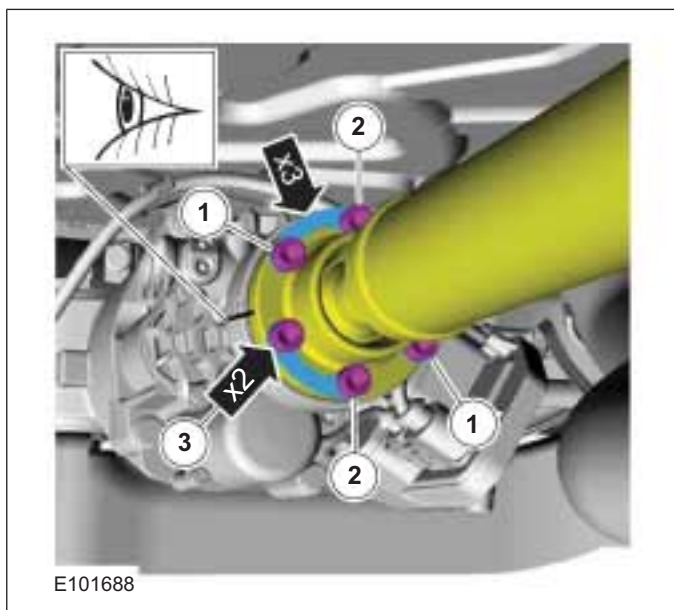
205-02-36

REMOVAL AND INSTALLATION

Vehicles with manual transmission

3. **CAUTION:** Make sure that the installation marks are aligned.

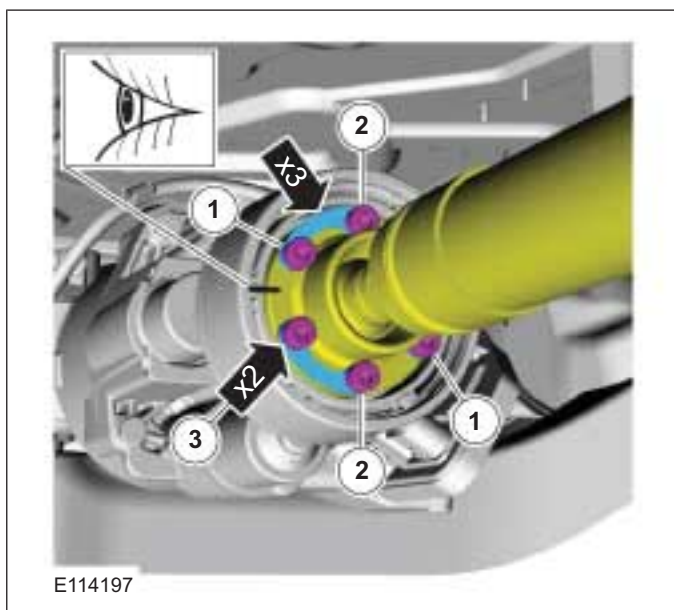
- 1. Torque: 35 Nm
- 2. Torque: 35 Nm
- 3. Torque: 35 Nm



Vehicles with automatic transmission

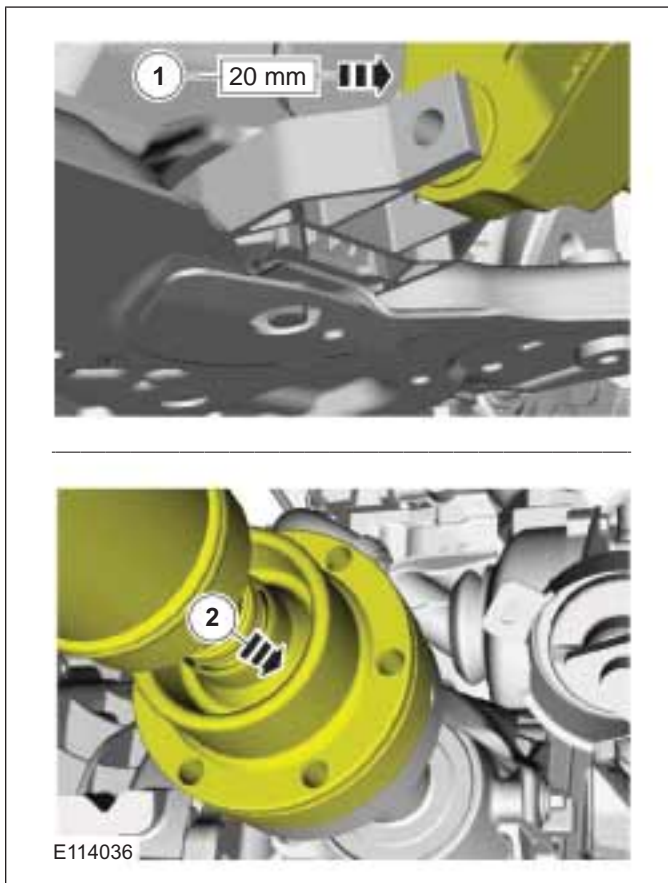
4. **CAUTION:** Make sure that the installation marks are aligned.

- 1. Torque: 35 Nm
- 2. Torque: 35 Nm
- 3. Torque: 35 Nm



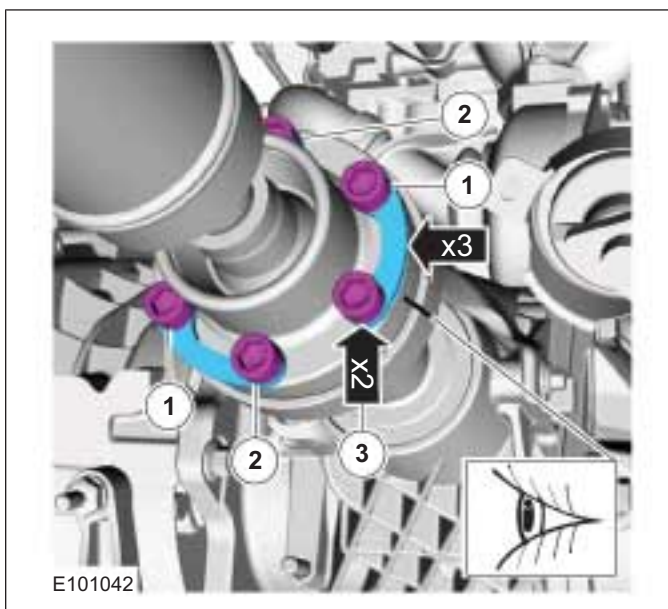
All vehicles

5.



6. **CAUTION:** Make sure that the installation marks are aligned.

- 1. Torque: 35 Nm
- 2. Torque: 35 Nm
- 3. Torque: 35 Nm

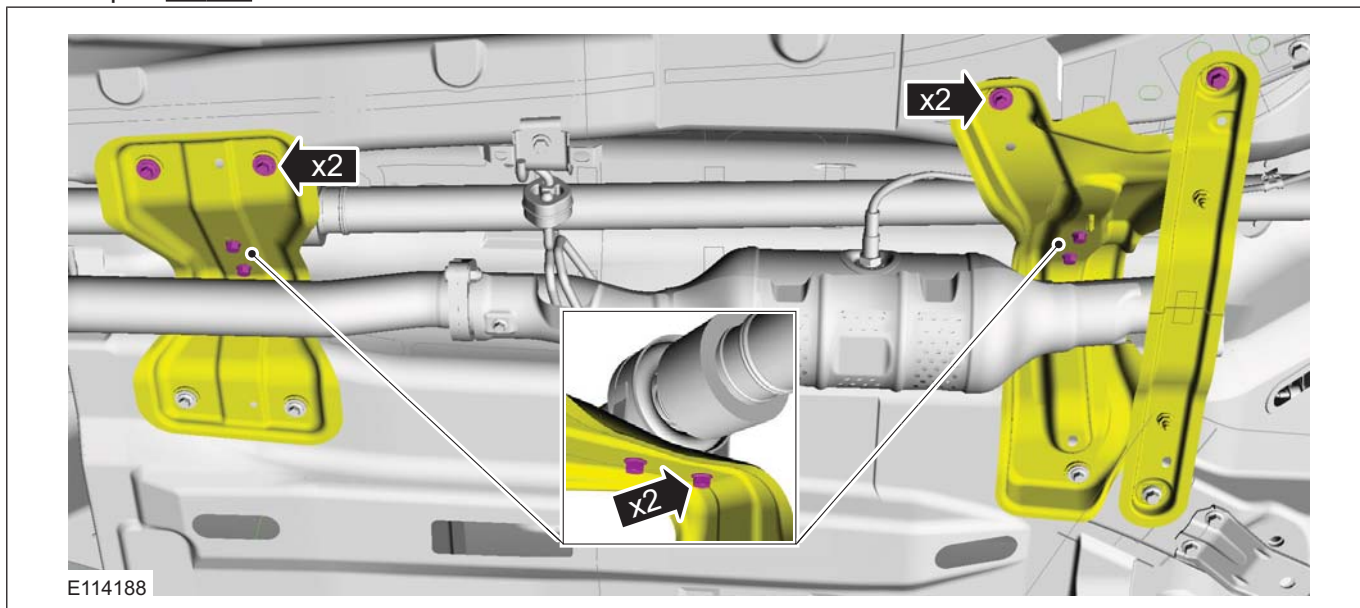


205-02-37

Rear Drive Axle/Differential

205-02-37

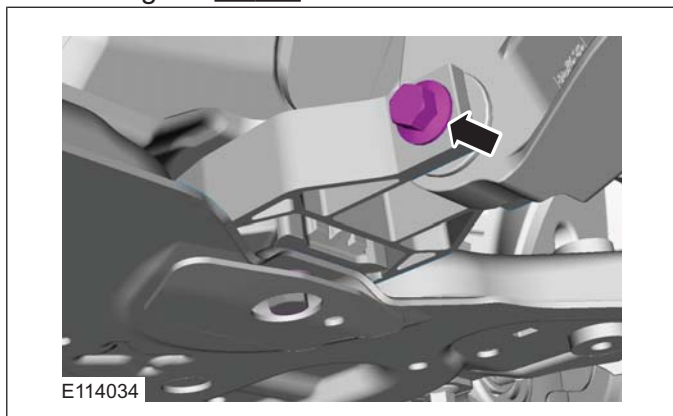
## REMOVAL AND INSTALLATION

7. Torque: 25 Nm

8. Torque:

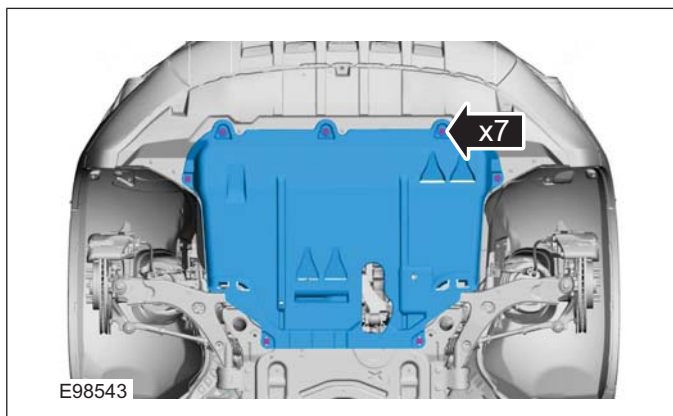
- Stage 1: 35 Nm
- Stage 2: Loosen 360°
- Stage 3: 85 Nm

11. Lower the vehicle.



9. Refer to: **Differential Fluid Level Check** (205-02 Rear Drive Axle/Differential, General Procedures).

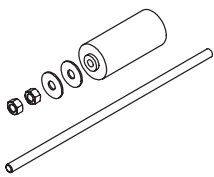
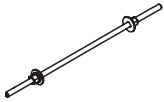
10.



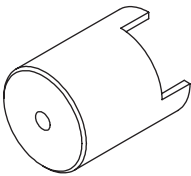
REMOVAL AND INSTALLATION

Differential Support Insulator

Special Tool(s)

 <p>E75373</p>	<p>204-598 Hydraulic Cylinder 10t</p>
 <p>E103784</p>	<p>204-598-03 Adapter for 204-598</p>

Special Tool(s)

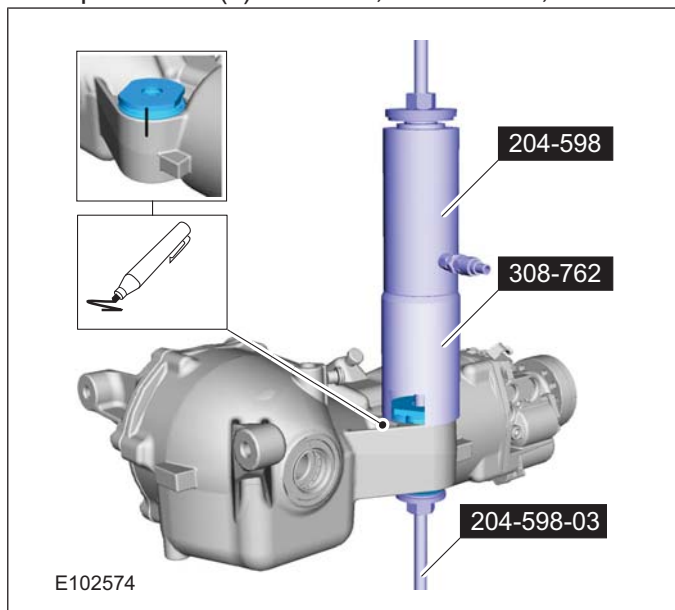
 <p>E102678</p>	<p>308-762 Remover/Installer, Bush RDU</p>
---	--

Materials

Name	Specification
Transmission Oil 75W FE	WSS-M2C200-D2 / 7U7J-M2C200-BA

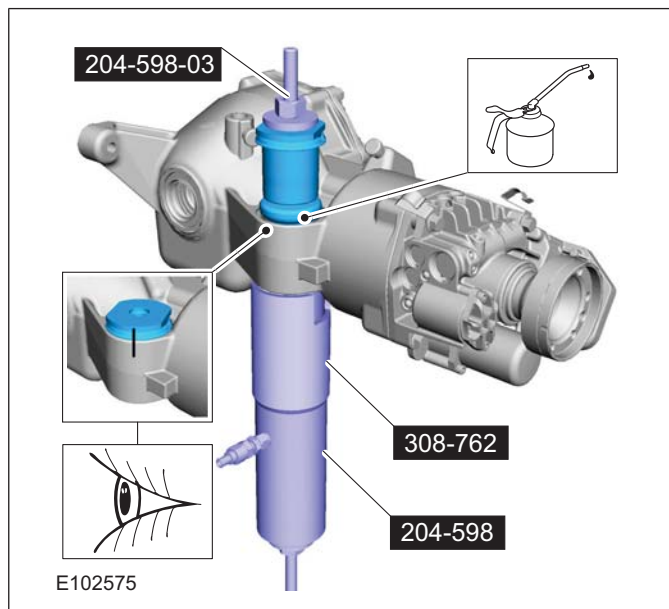
Removal

1. Refer to: **Differential Case** (205-02 Rear Drive Axle/Differential, Removal and Installation).
2. Special Tool(s): 204-598, 204-598-03, 308-762



Installation

1. Special Tool(s): 204-598, 204-598-03, 308-762  
Material: Transmission Oil 75W FE (WSS-M2C200-D2 / 7U7J-M2C200-BA) transmission fluid



2. Refer to: **Differential Case** (205-02 Rear Drive Axle/Differential, Removal and Installation).





REMOVAL AND INSTALLATION

Rear Halfshaft Seal

Special Tool(s) / General Equipment

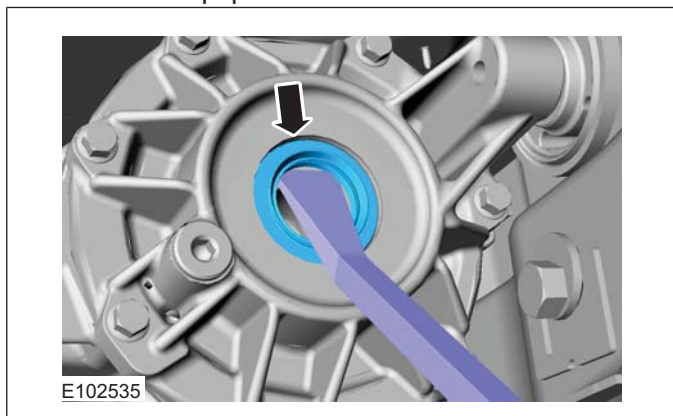
 <p>21171</p>	<p>303-395 Installer, Crankshaft Seal</p>
--	---

Special Tool(s) / General Equipment

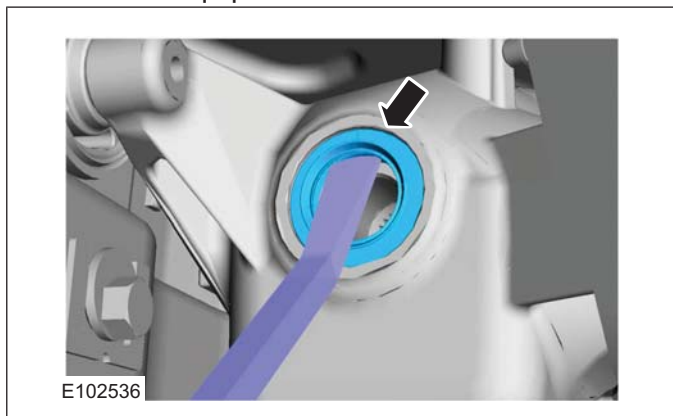
<p>Tire Lever</p>
-------------------

Removal

1. Refer to: **Rear Halfshaft** (205-05 Rear Drive Halfshafts, Removal and Installation).
2. General Equipment: Tire Lever

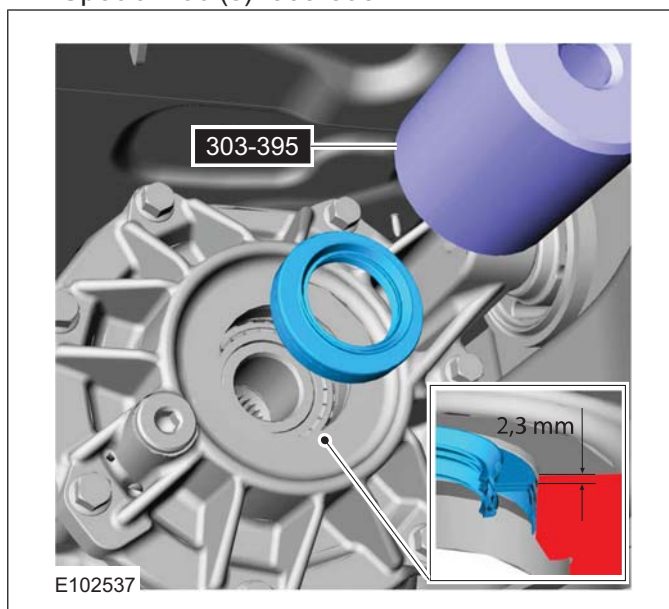


3. General Equipment: Tire Lever



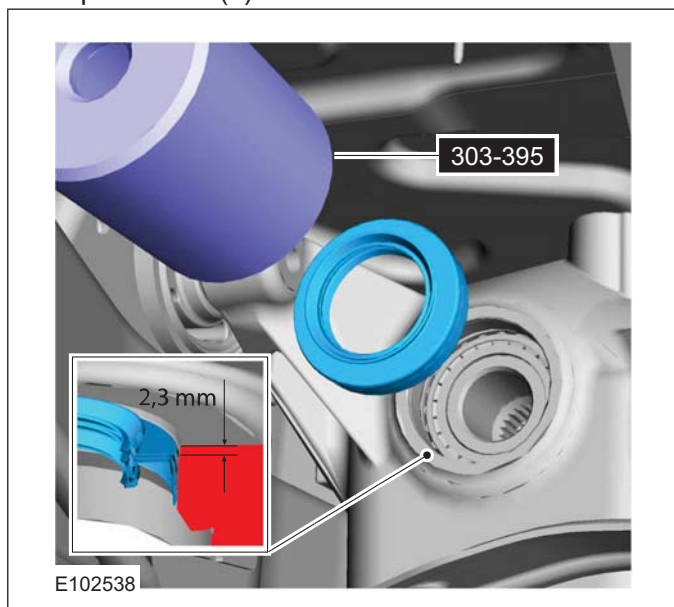
Installation

1. Special Tool(s): 303-395



## REMOVAL AND INSTALLATION

## 2. Special Tool(s): 303-395



3. Refer to: **Rear Halfshaft** (205-05 Rear Drive Halfshafts, Removal and Installation).
4. Refer to: **Differential Fluid Level Check** (205-02 Rear Drive Axle/Differential, General Procedures).

205-02-41

Rear Drive Axle/Differential

205-02-41

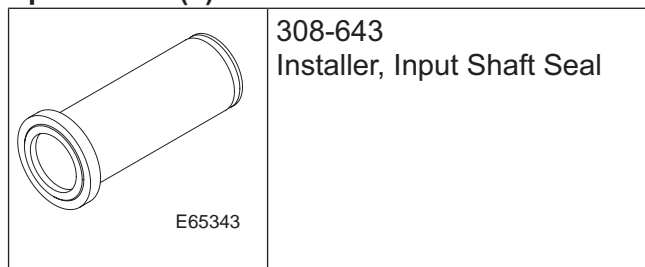
## REMOVAL AND INSTALLATION

## Drive Pinion Seal

## Special Tool(s)

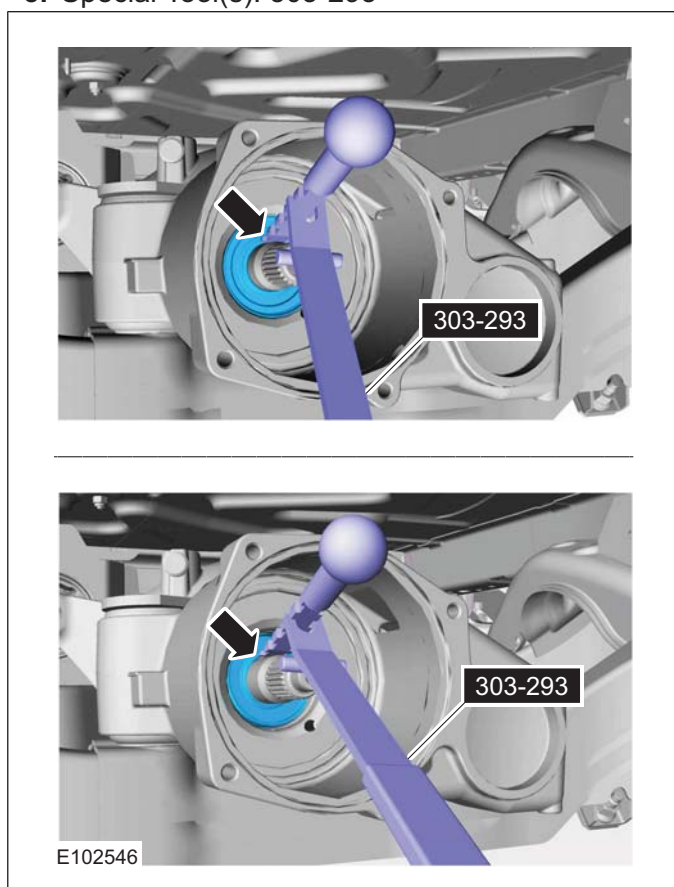


## Special Tool(s)



## Removal

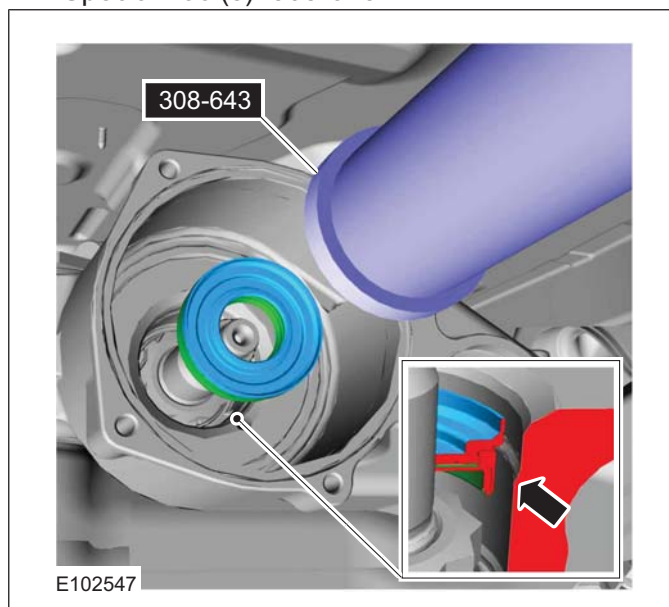
1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Active On-Demand Coupling Module** (205-02 Rear Drive Axle/Differential, Removal and Installation).
3. Special Tool(s): 303-293



## Installation

1. **CAUTION:** Take extra care not to damage the seal.

Special Tool(s): 308-643

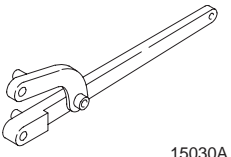


2. Refer to: **Active On-Demand Coupling Module** (205-02 Rear Drive Axle/Differential, Removal and Installation).

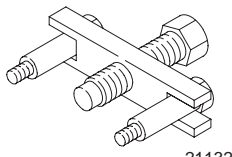
**DISASSEMBLY AND ASSEMBLY**

**Active On-Demand Coupling — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450**

**Special Tool(s) / General Equipment**

 <p>15030A</p>	<p>205-072 Universal Flange Holding Wrench</p>
---	--

**Special Tool(s) / General Equipment**

 <p>21132</p>	<p>303-249 Remover, Crankshaft Timing Pulley</p>
---	--

Puller

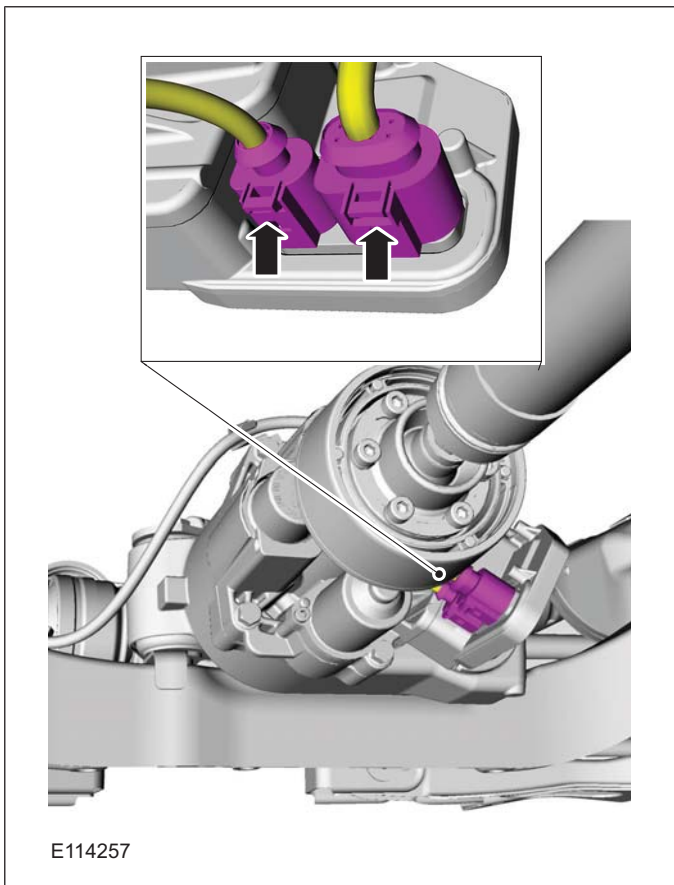
Materials	
Name	Specification
Transmission Oil AWD	8U7J-8708687-AA

Disassembly

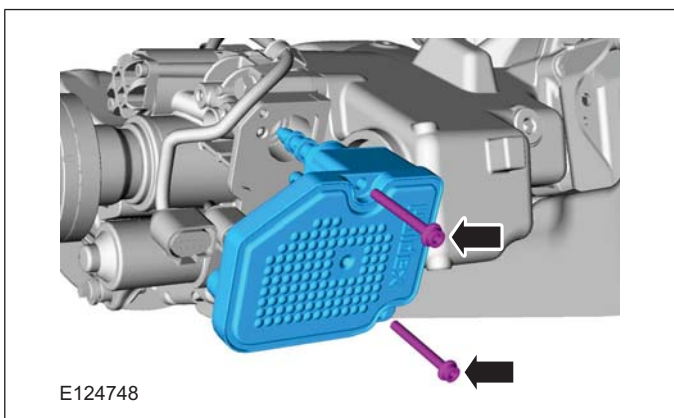


**DISASSEMBLY AND ASSEMBLY**

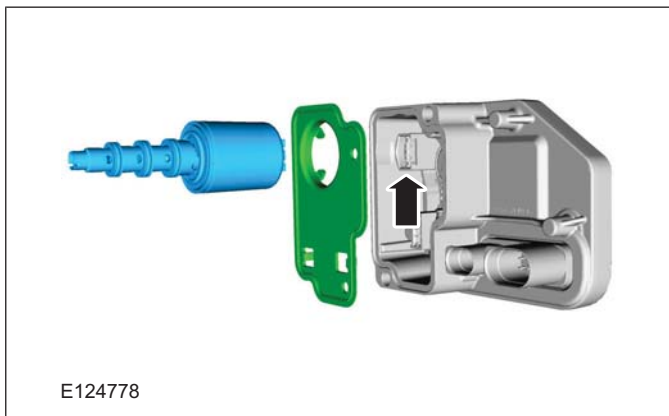
1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
- 3.



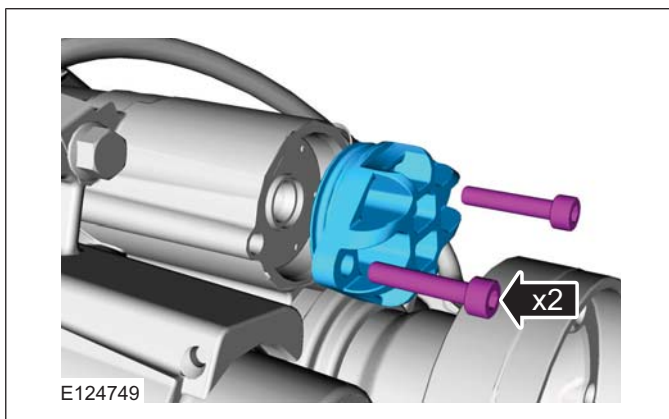
4. **⚠ WARNING: Be prepared to collect escaping fluid.**



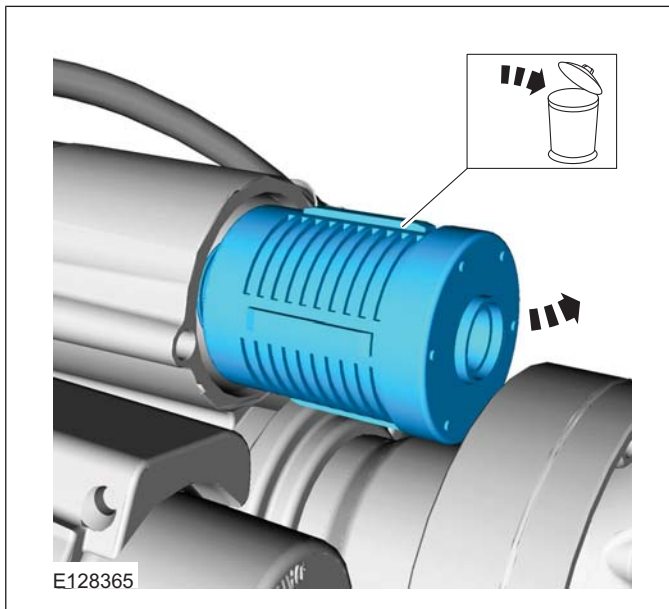
- 5.



6. **⚠ WARNING: Be prepared to collect escaping fluid.**



- 7.







205-02-44

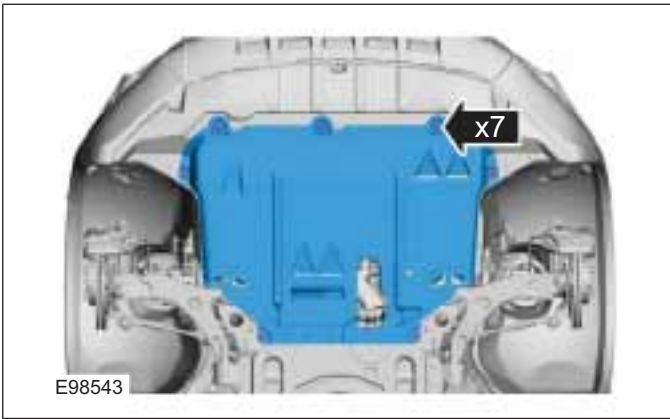
Rear Drive Axle/Differential

205-02-44

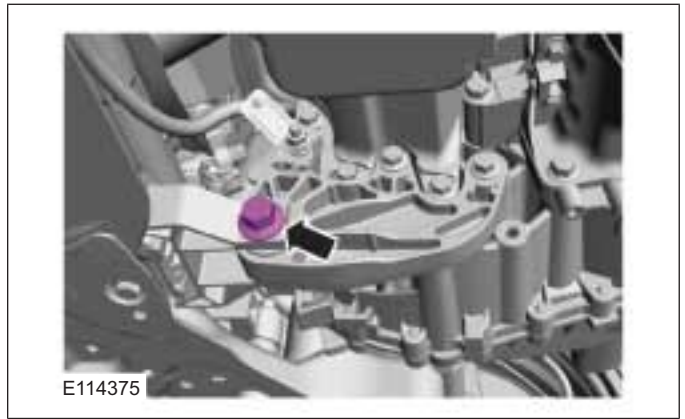


DISASSEMBLY AND ASSEMBLY

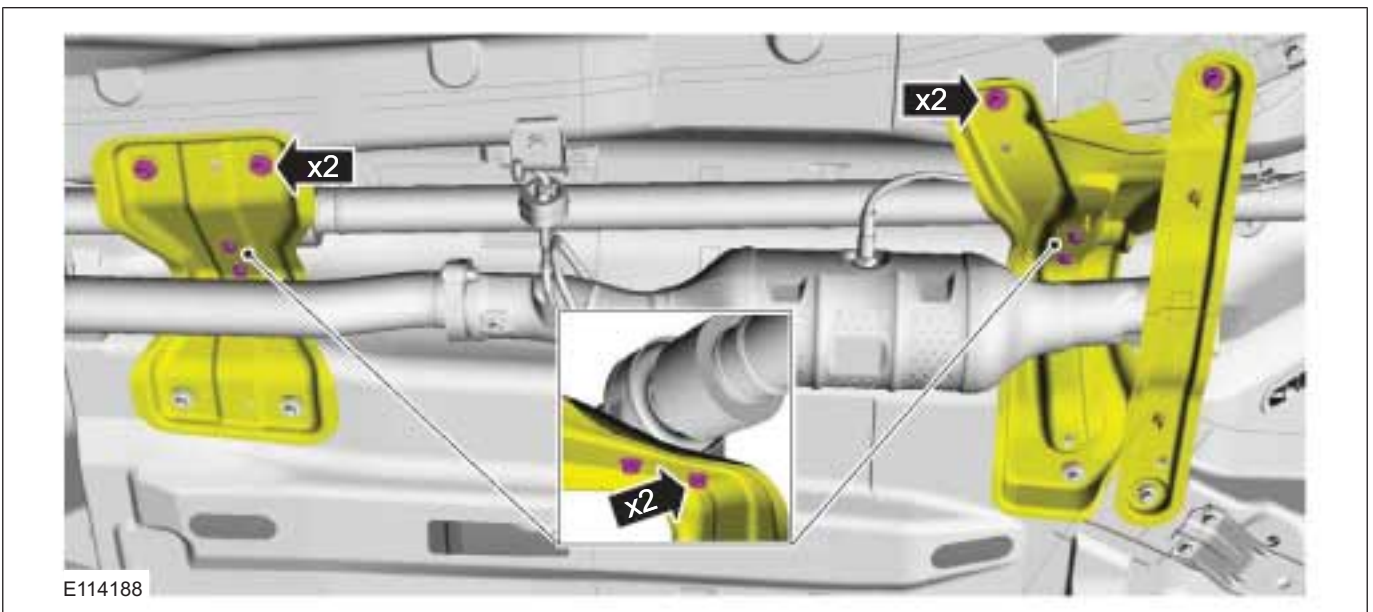
8.



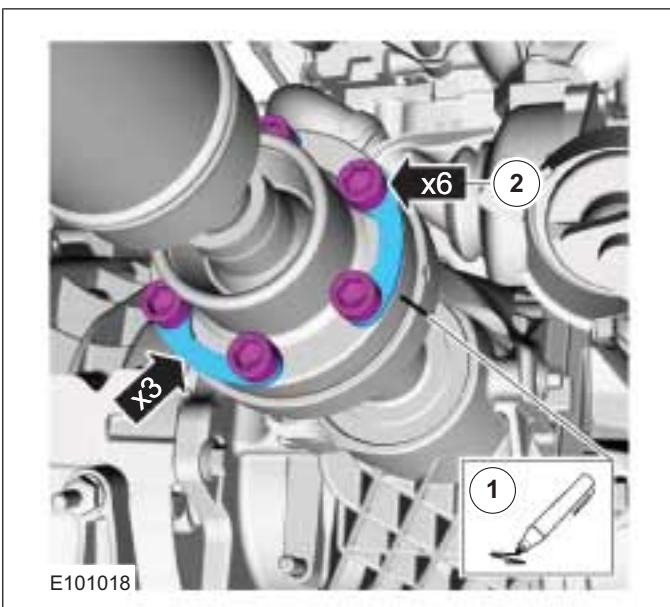
9.



10.



11.

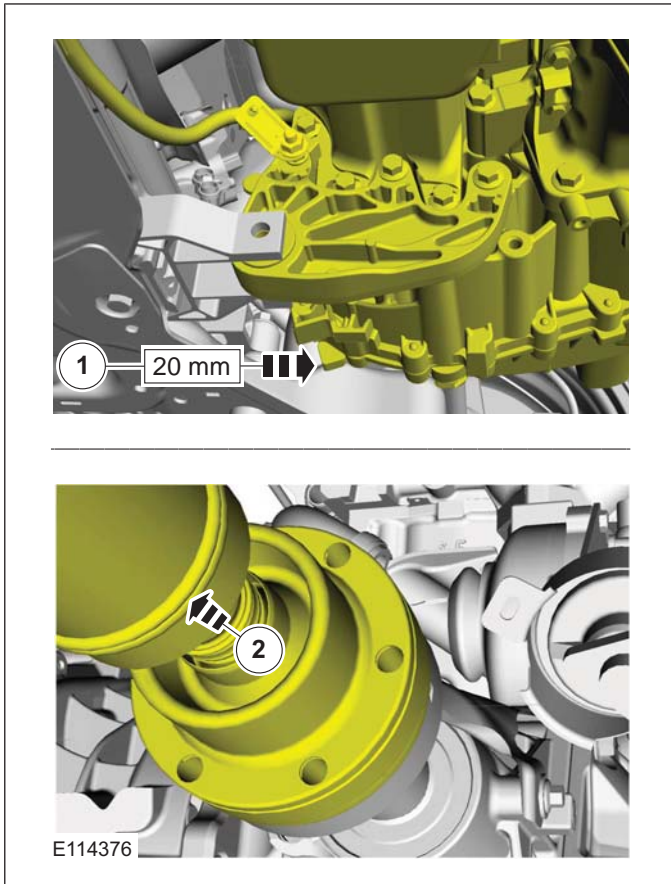




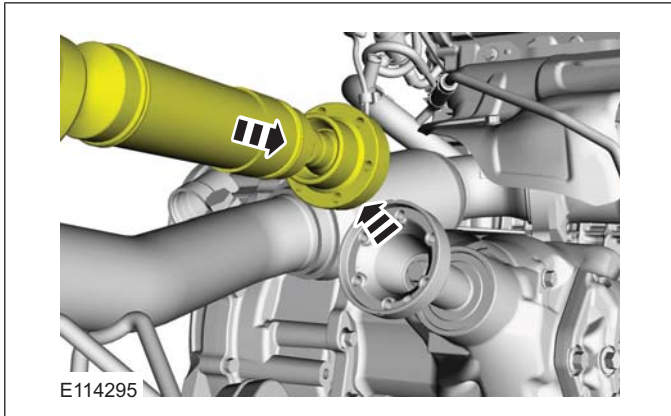


DISASSEMBLY AND ASSEMBLY

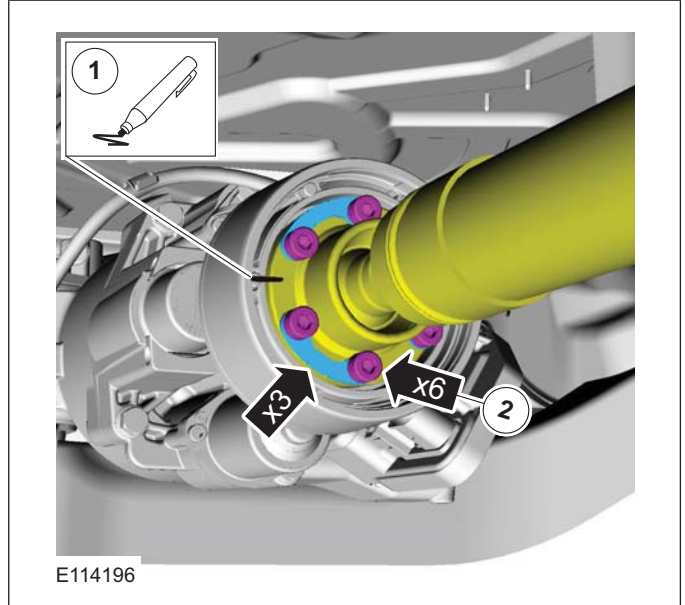
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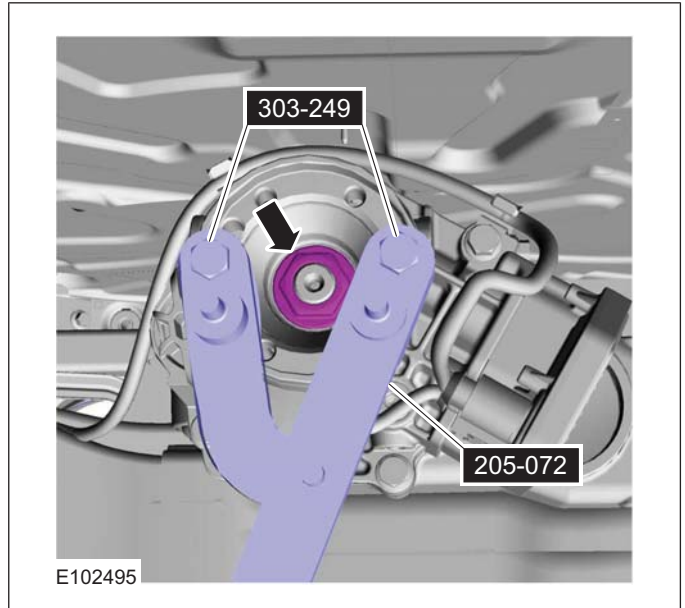
13.



14.



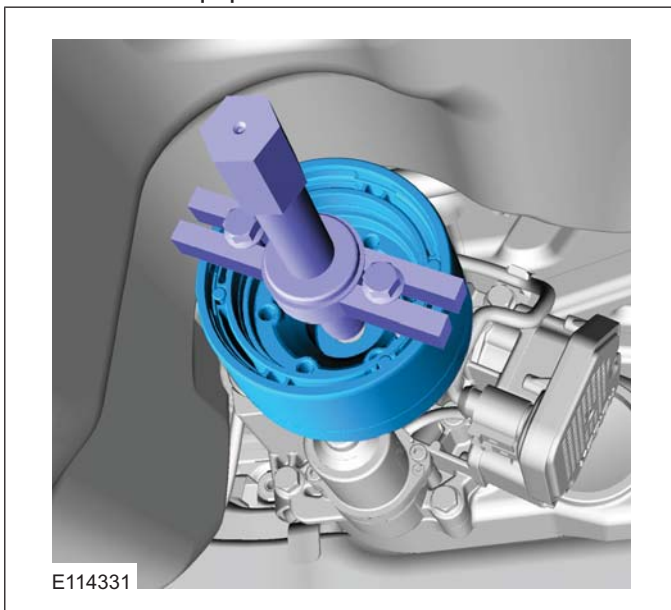
15. Special Tool(s): 205-072, 303-249



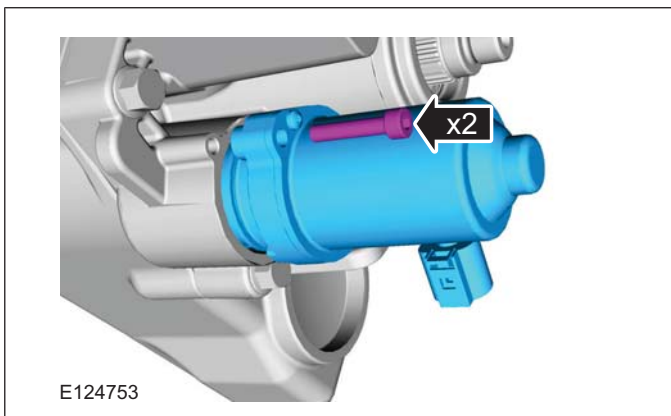


**DISASSEMBLY AND ASSEMBLY**

16. General Equipment: Puller

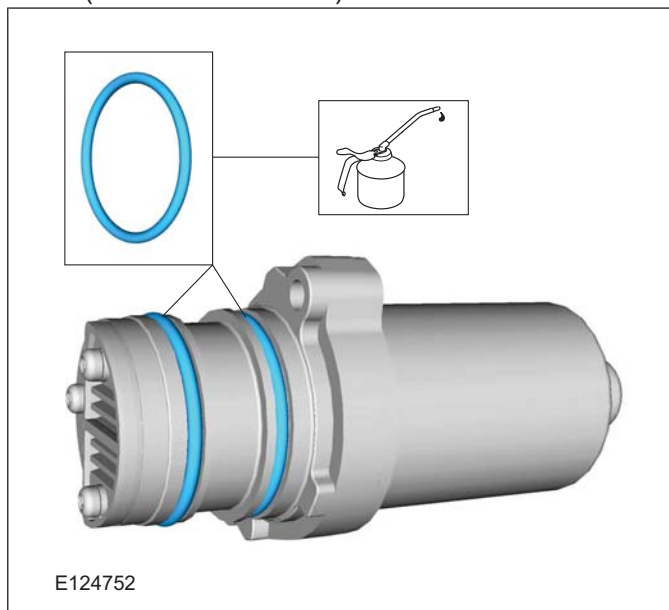


17. **⚠ WARNING:** Be prepared to collect escaping fluid.

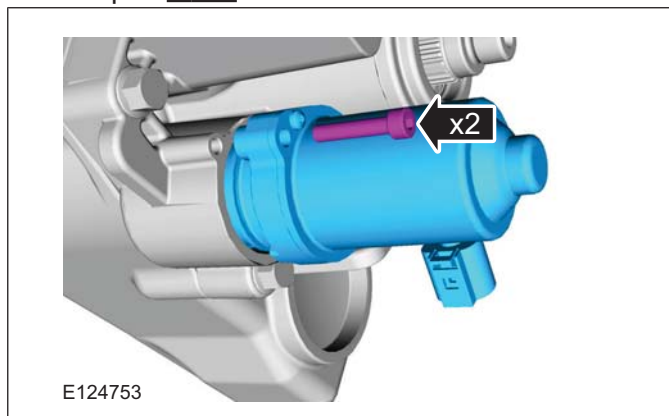


Assembly

18. Material: Transmission Oil AWD  
(8U7J-8708687-AA) transmission fluid



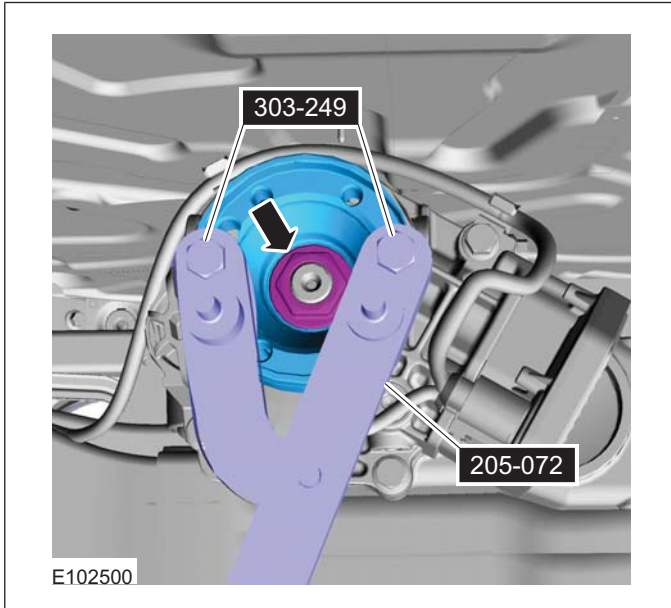
19. Torque: 6 Nm





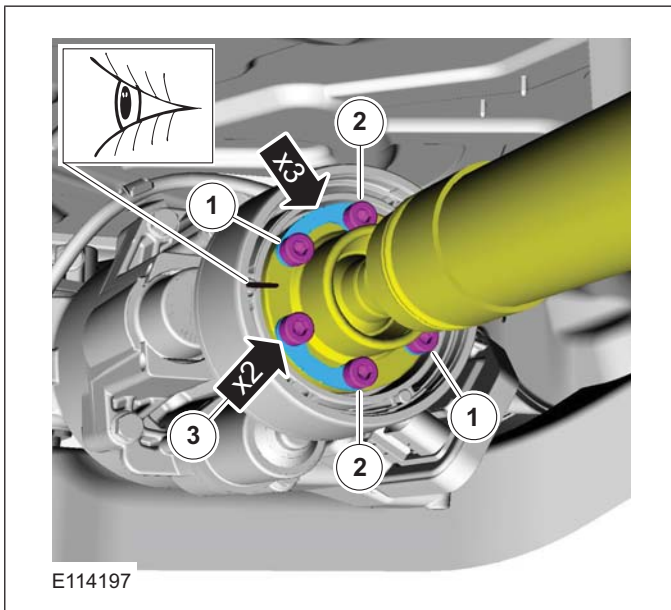
**DISASSEMBLY AND ASSEMBLY**

20. Special Tool(s): 205-072, 303-249  
Torque: 150 Nm

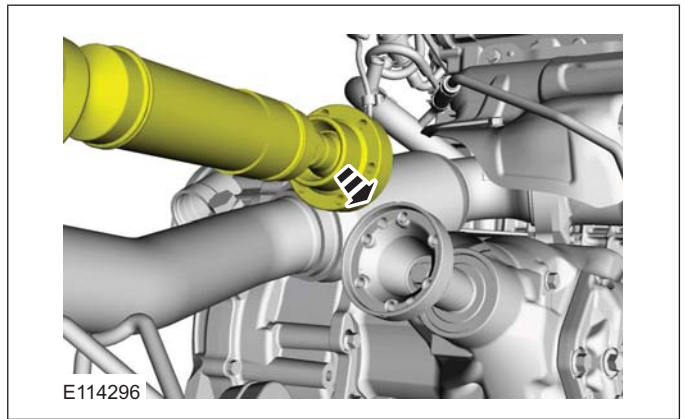


21. **CAUTION:** Make sure that the installation marks are aligned.

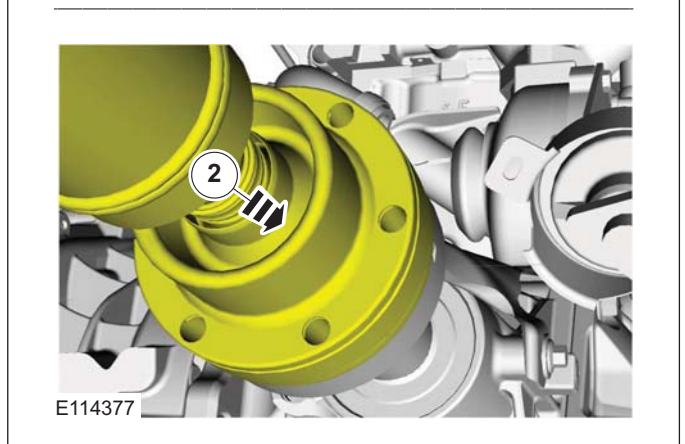
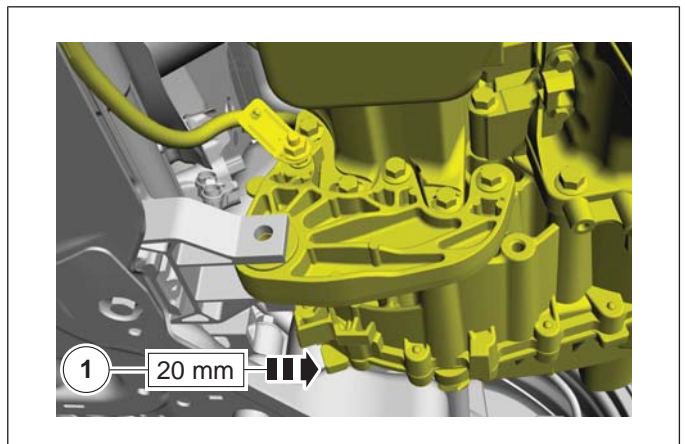
1. Torque: 35 Nm
2. Torque: 35 Nm
3. Torque: 35 Nm



22.



23.

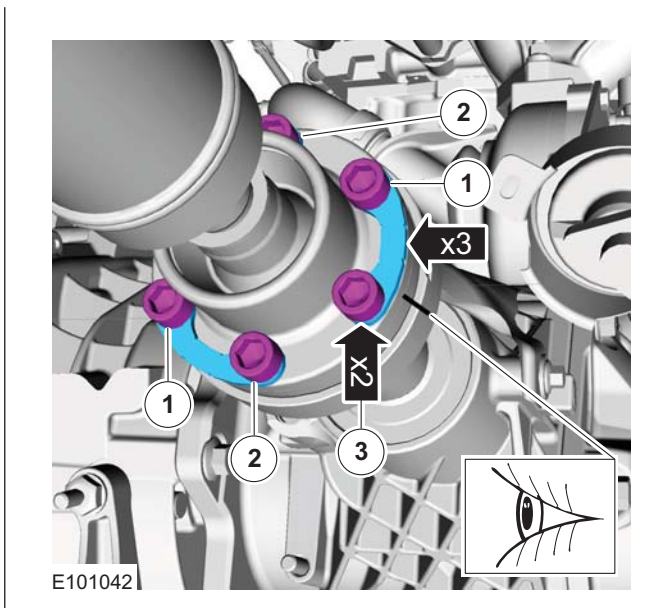




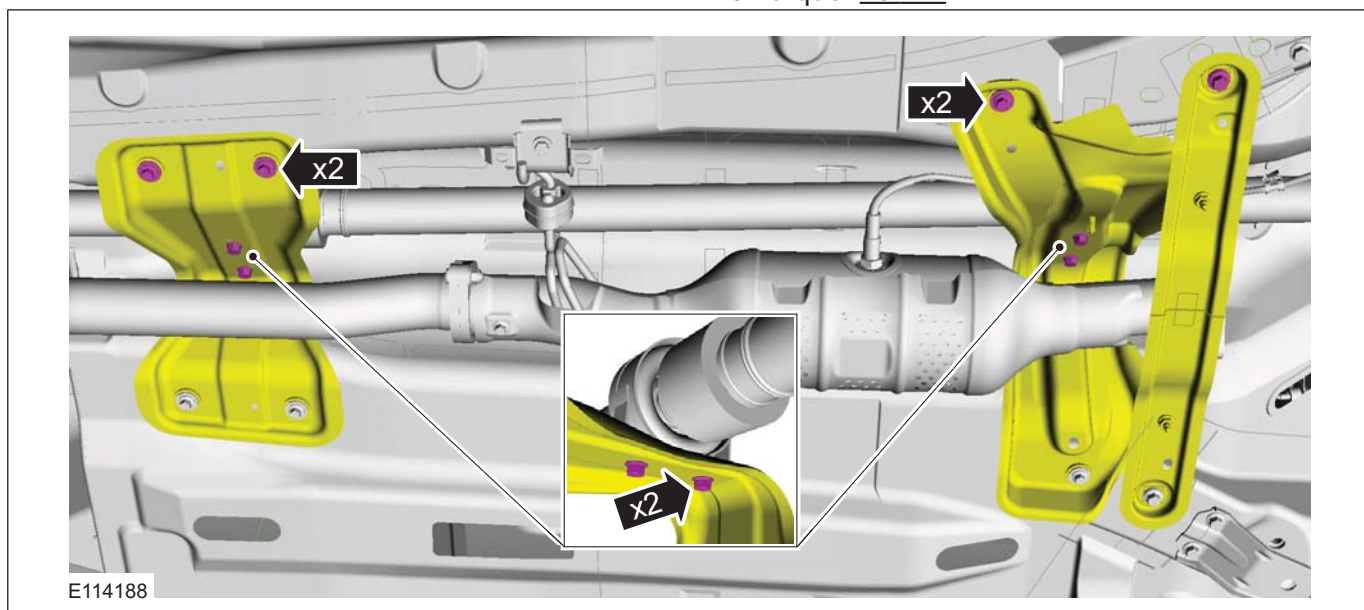
DISASSEMBLY AND ASSEMBLY

24.  **CAUTION:** Make sure that the installation marks are aligned.

- 1. Torque: 35 Nm
- 2. Torque: 35 Nm
- 3. Torque: 35 Nm



25. Torque: 25 Nm

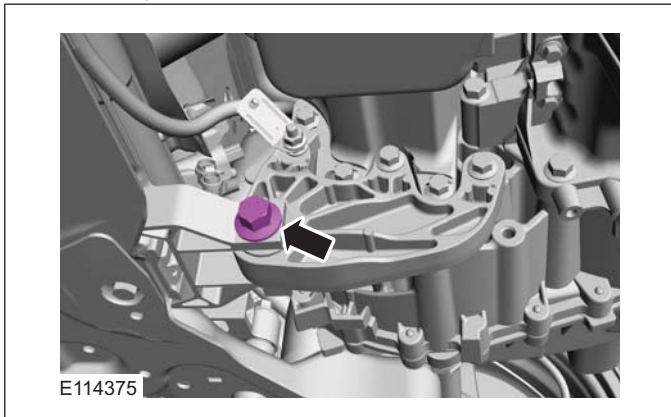




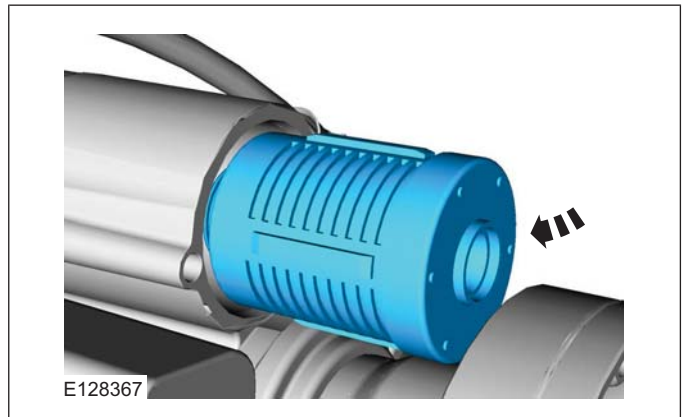
**DISASSEMBLY AND ASSEMBLY**

**26. Torque:**

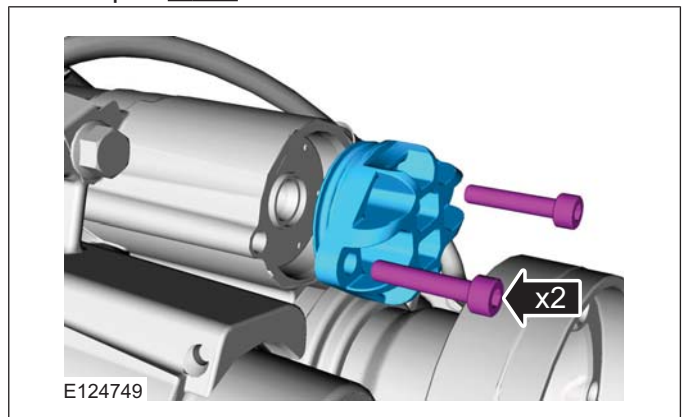
- Stage 1: 35 Nm
- Stage 2: Loosen 360°
- Stage 3: 85 Nm



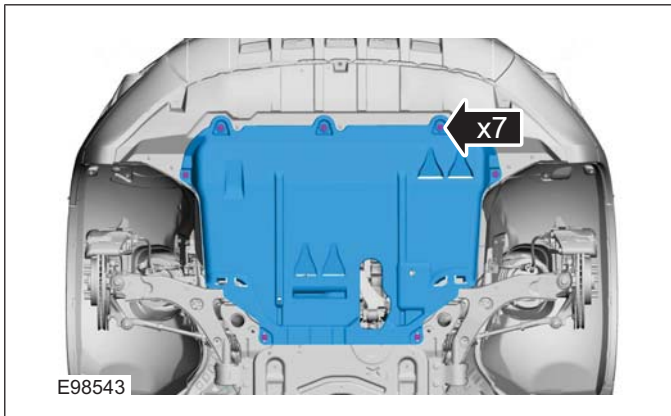
**29.**



**30. Torque: 6 Nm**



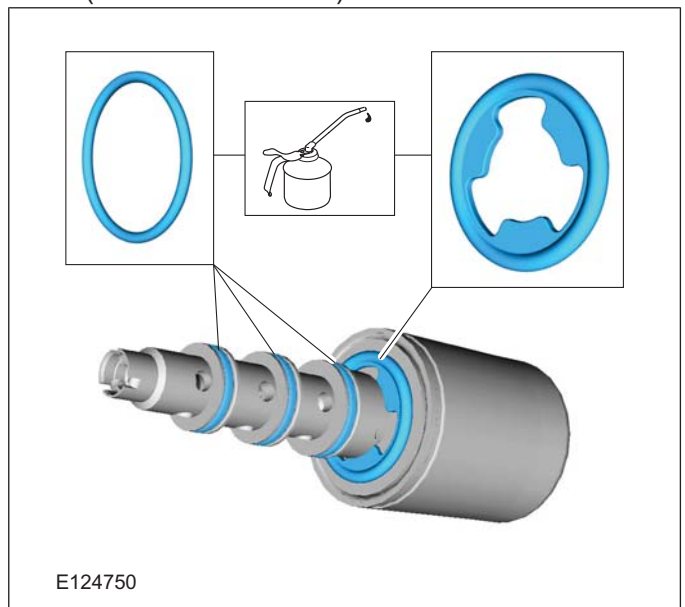
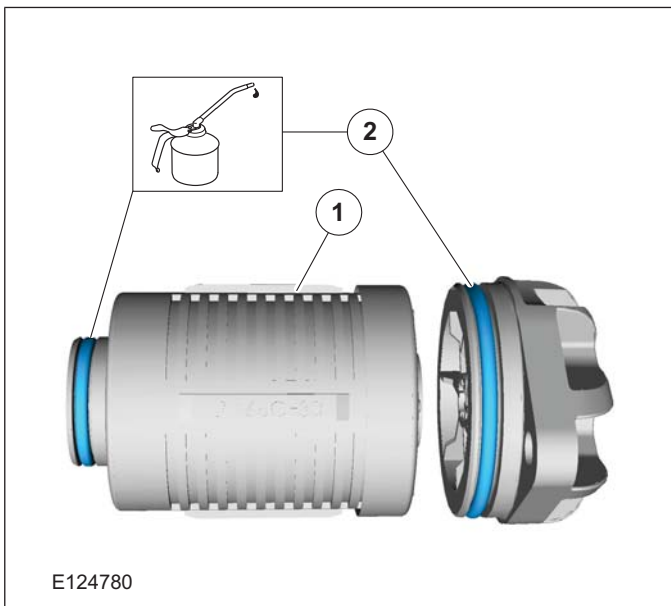
**27.**



**31. Material: Transmission Oil AWD (8U7J-8708687-AA) transmission fluid**

**28. 1. NOTE:** Make sure that a new component is installed.

2. Material: Transmission Oil AWD (8U7J-8708687-AA) transmission fluid

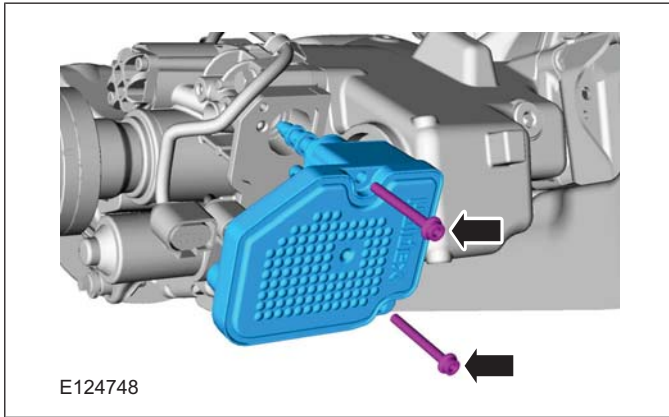


205-02-50

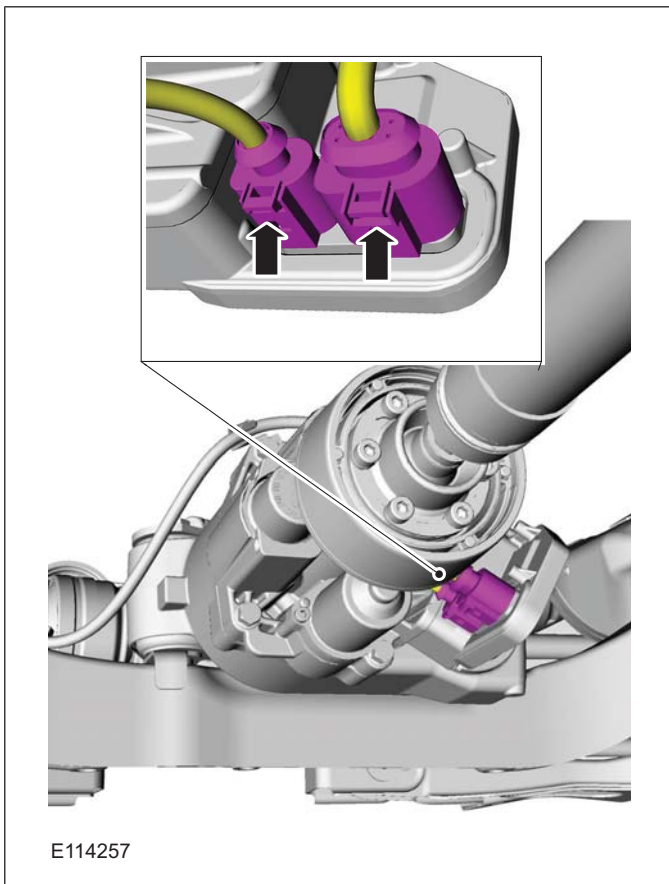
Rear Drive Axle/Differential

205-02-50

## DISASSEMBLY AND ASSEMBLY

32. Torque: 6 Nm

33.



34. Refer to: **Active On-Demand Coupling Fluid Level Check** (205-02 Rear Drive Axle/Differential, General Procedures).

35. Lower the vehicle.



## SECTION 205-04 Front Drive Halfshafts

**VEHICLE APPLICATION: 2008.50 Kuga**

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<b>DIAGNOSIS AND TESTING</b>		
Front Drive Halfshafts.....		205-04-3
Inspection and Verification.....		205-04-3
<b>REMOVAL AND INSTALLATION</b>		
Front Halfshaft LH.....	(14 320 0)	205-04-5
Front Halfshaft RH — LHD 4WD/RHD 4WD.....	(14 321 0)	205-04-16
Inner Constant Velocity (CV) Joint Boot.....	(14 336 0)	205-04-27
Outer Constant Velocity (CV) Joint Boot.....	(14 338 0)	205-04-30
Halfshaft Bearing.....		205-04-31

## SPECIFICATIONS

## Lubricants, Fluids, Sealers and Adhesives

	Specificat ions
Outer Constant Velocity Joint Grease	WSS-M1C 259-A1

	Specificat ions
Inner Constant Velocity Joint Grease	WSS-M1C 259-A1

## Capacity

Description	Driveshaft Joint Grease Fill Capacity	
	Inner (Grams)	Outer (Grams)
2.0 L Duratorq	160	180
2.5 L Duratec		

## Torque Specifications

Item	Nm	lb-ft	lb-in
2.0 L Duratorq - Intermediate shaft center bearing bracket to engine block bolts - 2WD (M10x 30)	48	35	-
2.0 L Duratorq - Intermediate shaft center bearing bracket to engine block bolts - 4WD (M10x 30)	48	35	
2.0 L Duratorq - Intermediate shaft center bearing bracket to engine block bolt - 4WD (M10x 40)	60	44	-
2.5 L Duratec - Intermediate shaft center bearing bracket to engine block bolts - 4WD (M10x 30)	48	35	-
2.5 L Duratec - Intermediate shaft center bearing bracket to engine block bolt - 4WD (M10x 40)	60	44	-

## DIAGNOSIS AND TESTING

## Front Drive Halfshafts

## Inspection and Verification

**NOTE:** New front wheel drive halfshafts should not be installed unless disassembly and inspection reveals unusual wear.

1. Inspect front wheel driveshaft joint boots for evidence of cracks, tears or splits.

**NOTE:** While inspecting the front wheel driveshaft CV joint boots, watch for indentations (dimples) in the boot convolutions. If an indentation is observed, it must be removed.

2. Inspect the underbody for any indication of grease splatter in the vicinity of the front wheel driveshaft CV joint boots outboard and inboard locations, which is an indication of front wheel driveshaft CV joint boot and/or front wheel driveshaft CV joint boot clamp damage.

3. Inspect for inboard CV joint stub shaft pilot bearing housing seal leakage at the front wheel driveshaft CV joint.
4. Make sure front axle wheel hub retainer is the correct prevailing torque type.
5. The silicone front wheel driveshaft CV joint boot will sweat during operation, causing a light film of grease to show on the outside of the front wheel driveshaft CV joint boot. This condition is normal.

**NOTE:** Halfshafts are not balanced and do not contribute to rotational vibration.

6. If the concerns remain after the inspection, determine the symptoms and go to the Symptom Chart. For additional Noise, Vibration and Harshness (NVH). REFER to Section **100-04 [Noise, Vibration and Harshness]**.

## Symptom Chart

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>Clicking, Popping or Grinding Noises While Turning</li> </ul>	<ul style="list-style-type: none"> <li>Inadequate or contaminated lube in outboard/inboard front wheel driveshaft CV joint.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT, CLEAN and LUBRICATE as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Another component contacting driveshaft assembly.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT and REPAIR as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Wheel bearings, brakes, suspension or steering components.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT and REPAIR as necessary. REFER to Section <b>204-00 [Suspension System - General Information]</b> / <b>206-00 [Brake System - General Information]</b> / <b>211-00 [Steering System - General Information]</b>.</li> </ul>
<ul style="list-style-type: none"> <li>Vibration at Highway Speeds</li> </ul>	<ul style="list-style-type: none"> <li>Out of balance front wheels or tires.</li> </ul>	<ul style="list-style-type: none"> <li>REPAIR or INSTALL new as necessary. REFER to Section <b>204-04 [Wheels and Tires]</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Out-of-round tires.</li> </ul>	<ul style="list-style-type: none"> <li>REPAIR or INSTALL new as necessary. REFER to Section <b>204-04 [Wheels and Tires]</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Incorrectly seated outboard front wheel driveshaft CV joint in front wheel hub.</li> </ul>	<ul style="list-style-type: none"> <li>REPAIR or INSTALL new as necessary.</li> <li>REFER to Halfshaft Disassembly and Assembly in this section.</li> </ul>

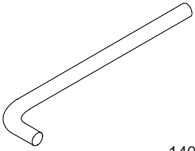
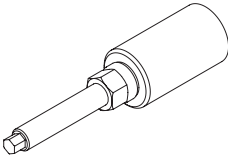
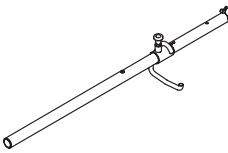
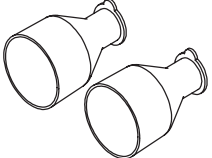
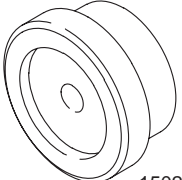
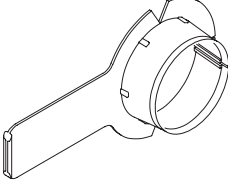
## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>Shudder Vibration During Acceleration.</li> </ul>	<ul style="list-style-type: none"> <li>Excessively high CV joint operating angles caused by incorrect ride height.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK ride height, VERIFY correct spring rate and CHECK items under Halfshaft Joint Pullout. REPAIR or INSTALL new as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Excessively worn or damaged inboard front wheel driveshaft joint or outboard front wheel driveshaft joint.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT and INSTALL new as necessary.</li> </ul>
<ul style="list-style-type: none"> <li>Halfshaft Joint Pullout</li> </ul>	<ul style="list-style-type: none"> <li>Inboard driveshaft bearing retainer circlip missing or not correctly seated in differential side gear.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT and REPAIR or INSTALL new as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Engine/transaxle assembly mispositioned.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK engine mounts for damage or wear. REPAIR or INSTALL new as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Frame rail or strut tower out of position or damaged.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK underbody dimensions. REFER to REFER to Section 501-00 [Body System - General Information].</li> </ul>
	<ul style="list-style-type: none"> <li>Front suspension components worn or damaged.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK for worn bushings or bent components (front stabilizer bar, front suspension lower arm). REPAIR or INSTALL new as necessary.</li> </ul>

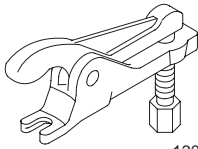
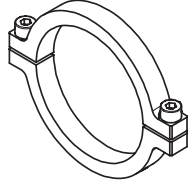
REMOVAL AND INSTALLATION

Front Halfshaft LH(14 320 0)

Special Tool(s) / General Equipment

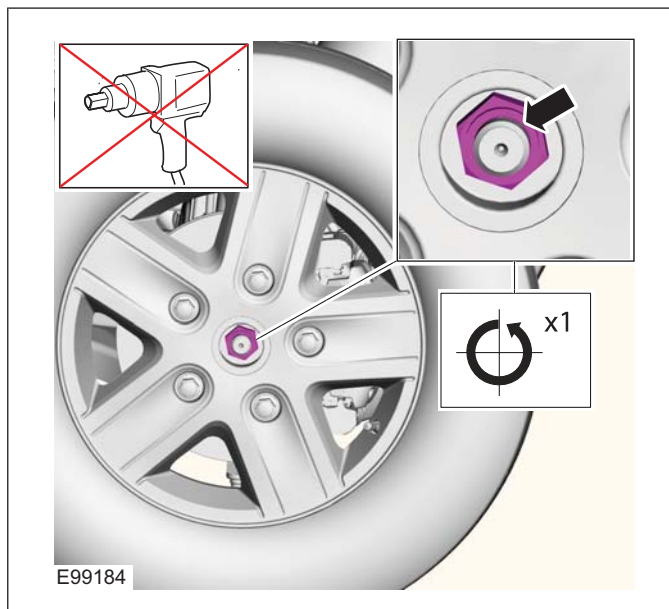
 <p>14039</p>	<p>204-159 Lever, Wheel Knuckle</p>
 <p>E62067</p>	<p>204-602 Installer, Halfshaft</p>
 <p>E63772</p>	<p>204-605 Separator, Lower Arm Ball Joint</p>
 <p>E75372</p>	<p>204-609 Protection Cap, Ball Joint Gaiter</p>
 <p>15026A01</p>	<p>205-071-01 Adapter for 205-071 (Thrust Pad)</p>
 <p>E47098</p>	<p>205-775 Protector, Halfshaft Seal</p>

Special Tool(s) / General Equipment

 <p>13006</p>	<p>211-020 Separator, Ball Joint</p>
 <p>E115823</p>	<p>308-782 Remover, Driveline</p>
<p>Puller Tire Lever</p>	

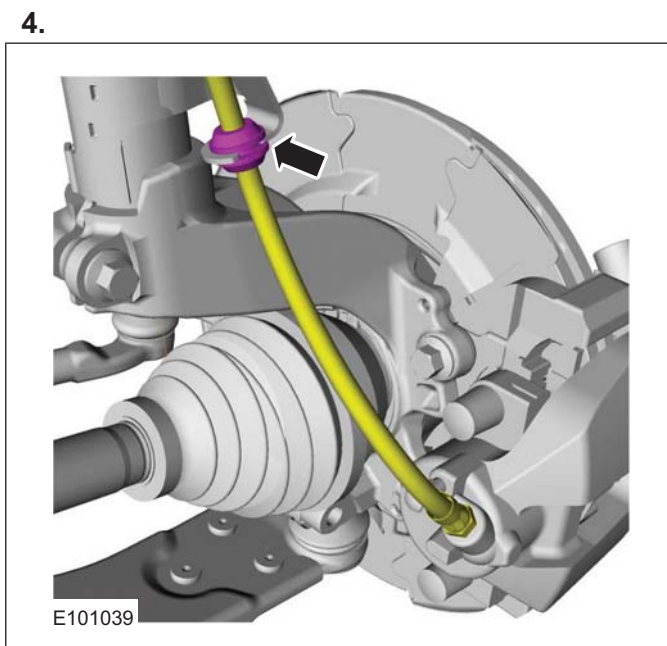
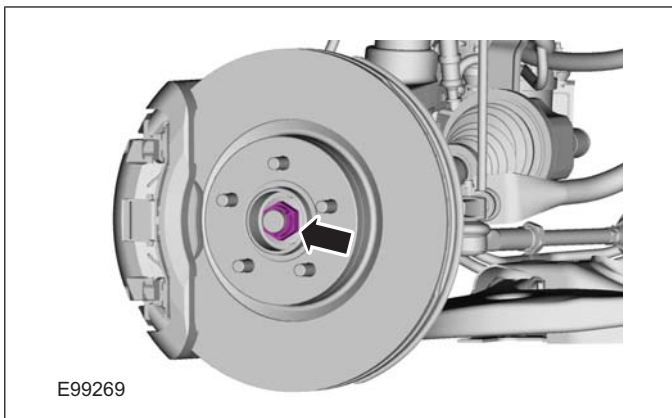
Removal

- NOTE:** This step is only necessary when installing a new component.

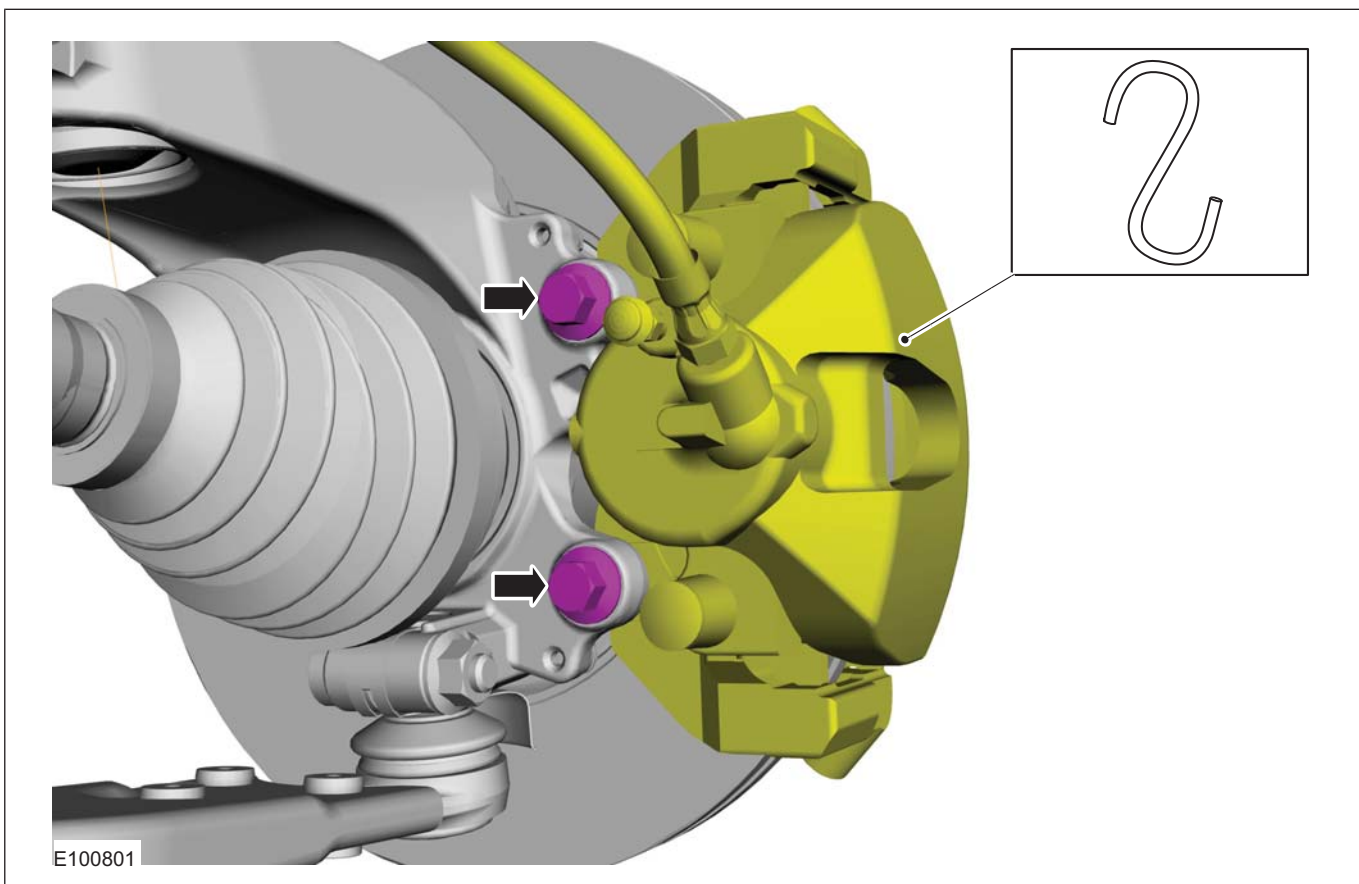


REMOVAL AND INSTALLATION

2. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).  
Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
3. **NOTE:** This step is only necessary when installing a new component.



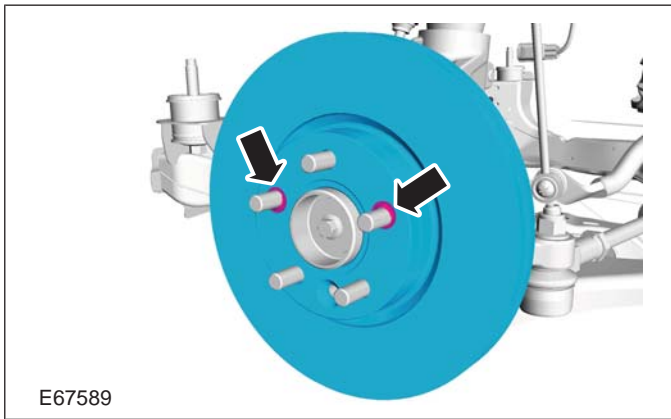
5. **WARNING:** Make sure that no load is placed on the brake hose.



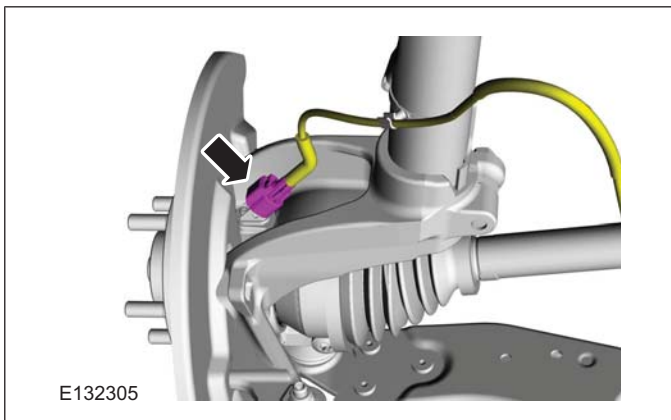


REMOVAL AND INSTALLATION

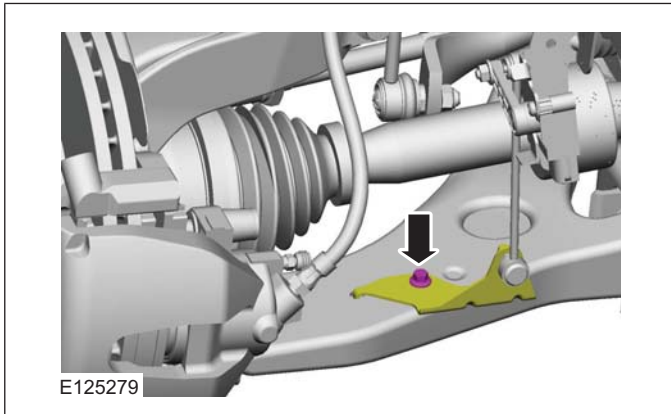
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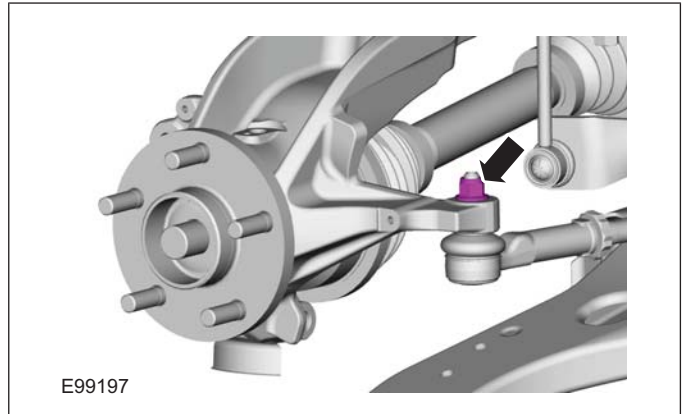
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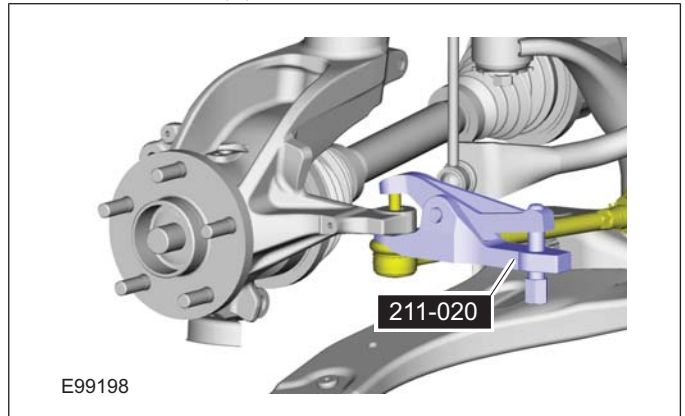
8. If equipped.



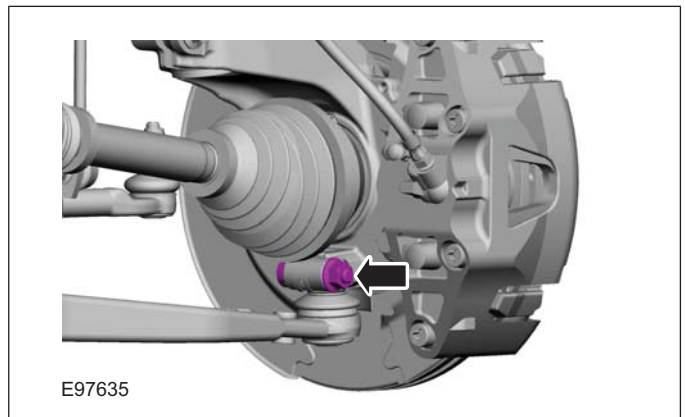
9.  **CAUTION:** Make sure that the ball joint ball does not rotate.



10. Special Tool(s): 211-020

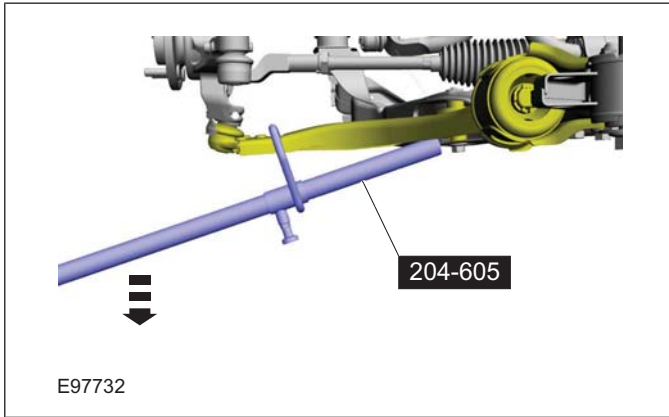


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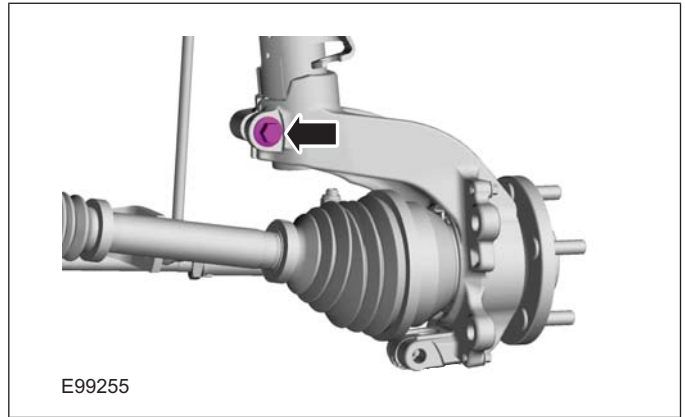


REMOVAL AND INSTALLATION

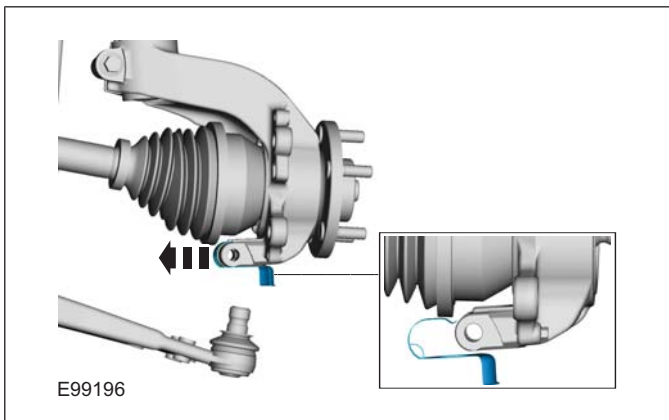
12. Special Tool(s): 204-605



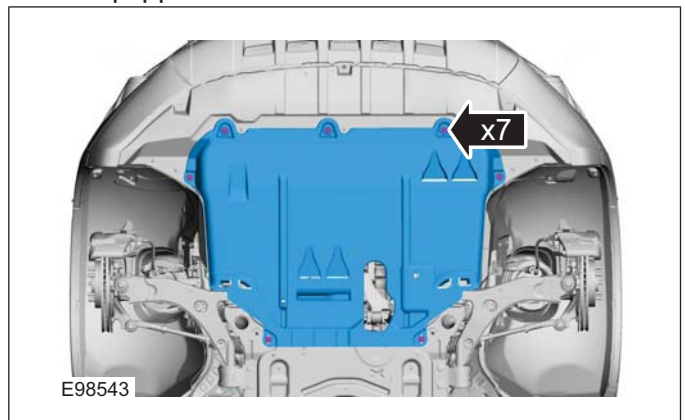
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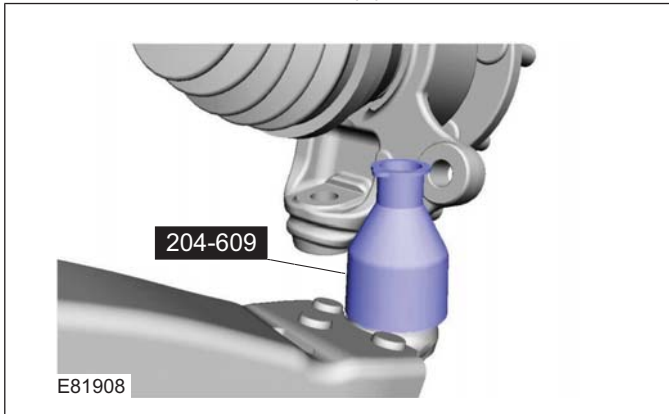
13.



16. If equipped.



14. Install the Special Tool(s): 204-609

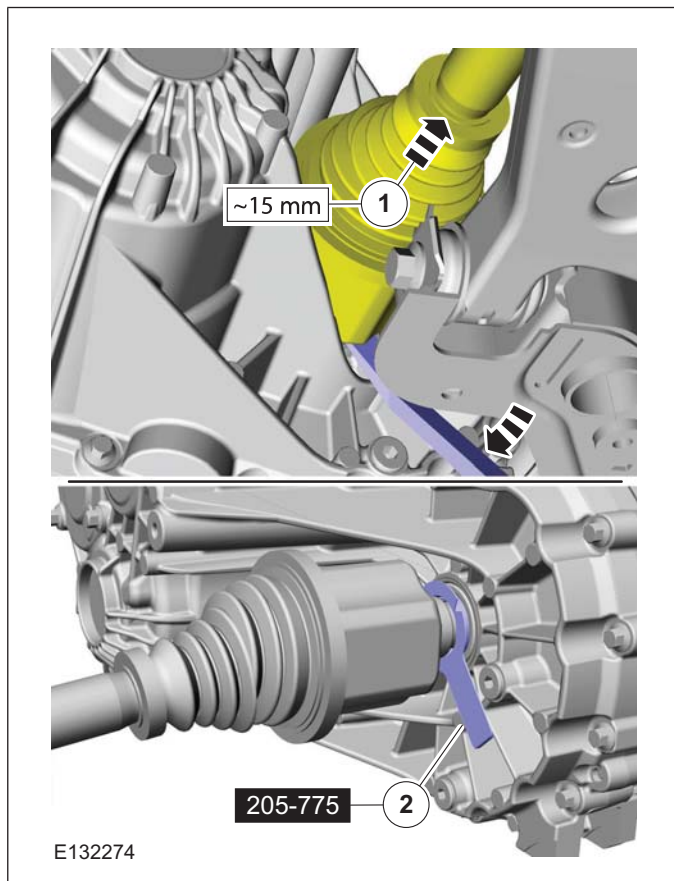


## REMOVAL AND INSTALLATION

Vehicles with 6-speed manual transaxle (MMT6)

17. **WARNING:** Be prepared to collect escaping fluid.

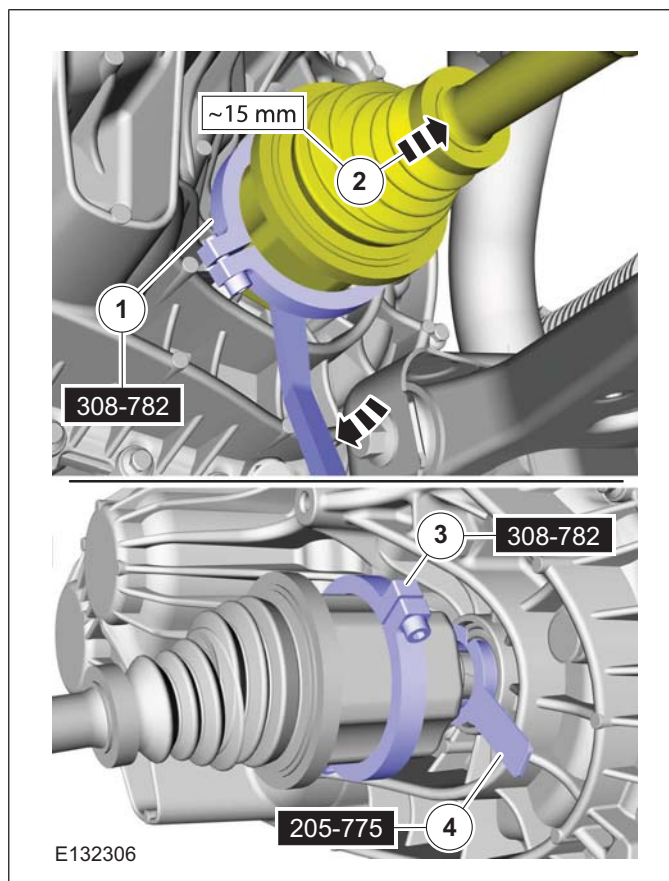
1. General Equipment: Tire Lever
2. Install the Special Tool(s): 205-775



Vehicles with 6-speed manual transmission (M66)

18. **WARNING:** Be prepared to collect escaping fluid.

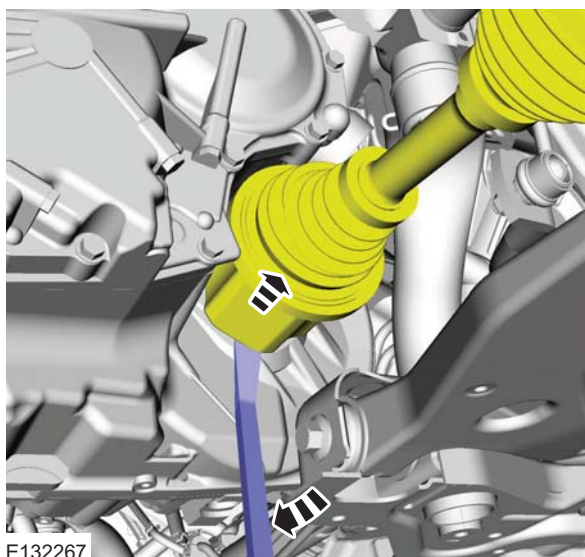
1. Install the Special Tool(s): 308-782
2. General Equipment: Tire Lever
3. Remove the Special Tool(s): 308-782
4. Install the Special Tool(s): 205-775



REMOVAL AND INSTALLATION

Vehicles with automatic transaxle

19. General Equipment: Tire Lever



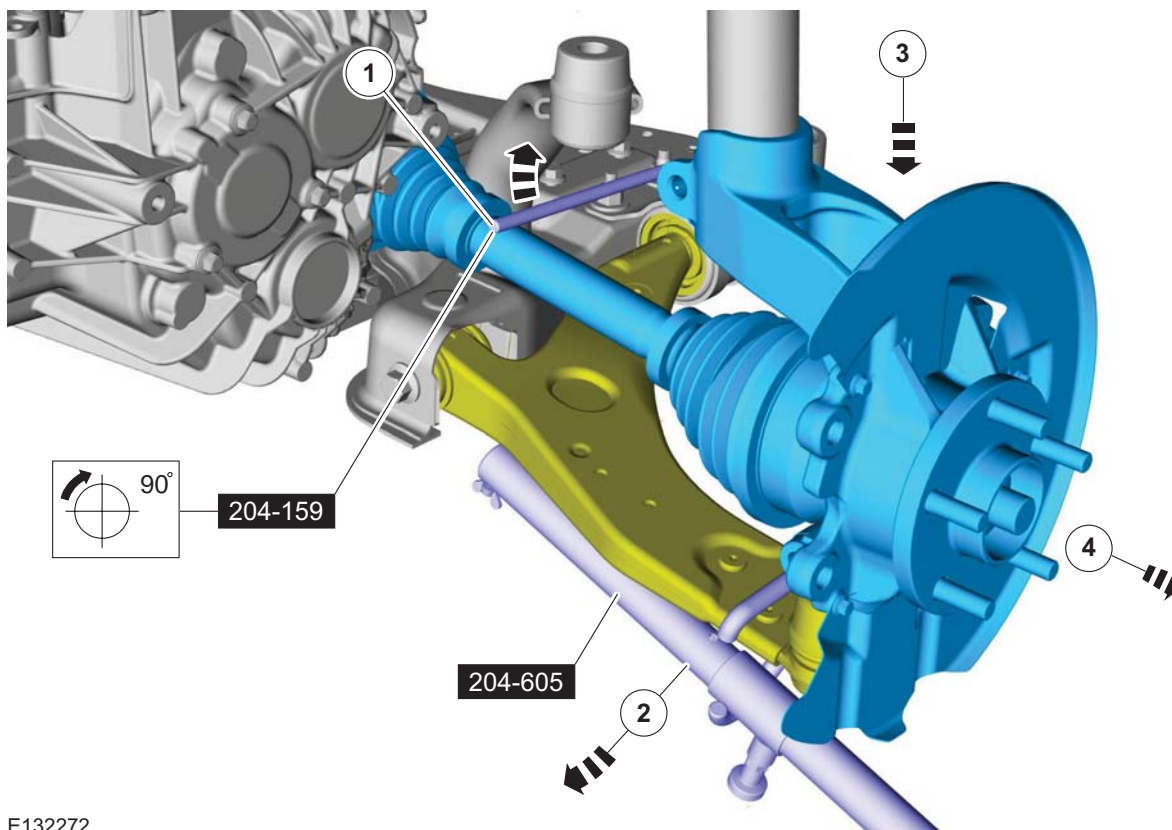
E132267

All vehicles

20. CAUTIONS:

- ⚠ The inner constant velocity (CV) joint must not be bent more than 18°.
- ⚠ The outer constant velocity (CV) joint must not be bent more than 45°.

Special Tool(s): 204-159, 204-605



E132272



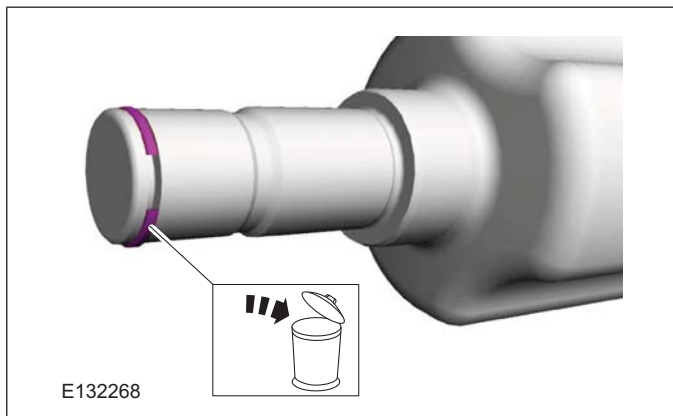
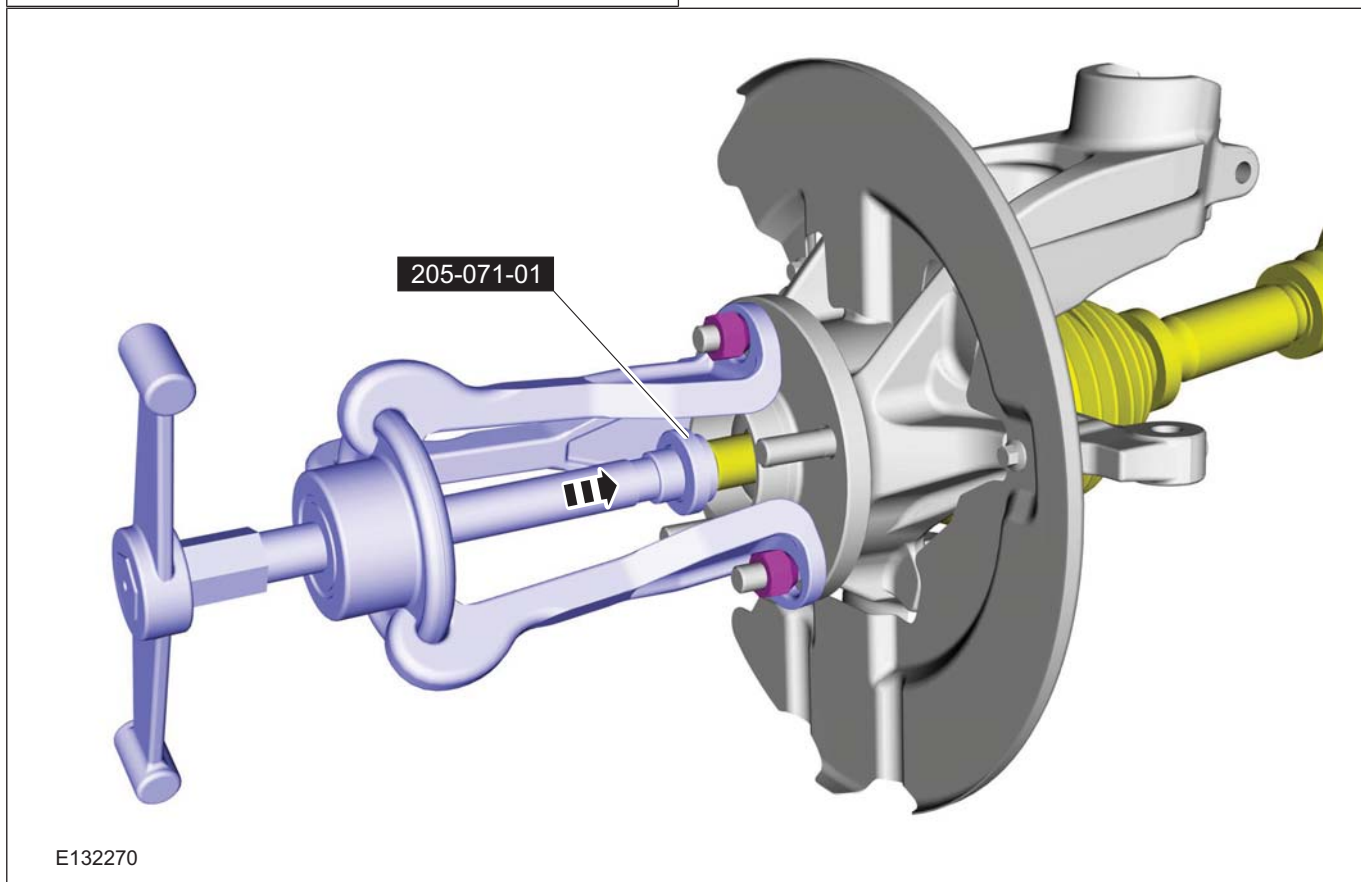
205-04-11

## Front Drive Halfshafts

205-04-11

## REMOVAL AND INSTALLATION

21.

**22 NOTE:** This step is only necessary when installing a new component.Special Tool(s): 205-071-01  
General Equipment: Puller

## Installation

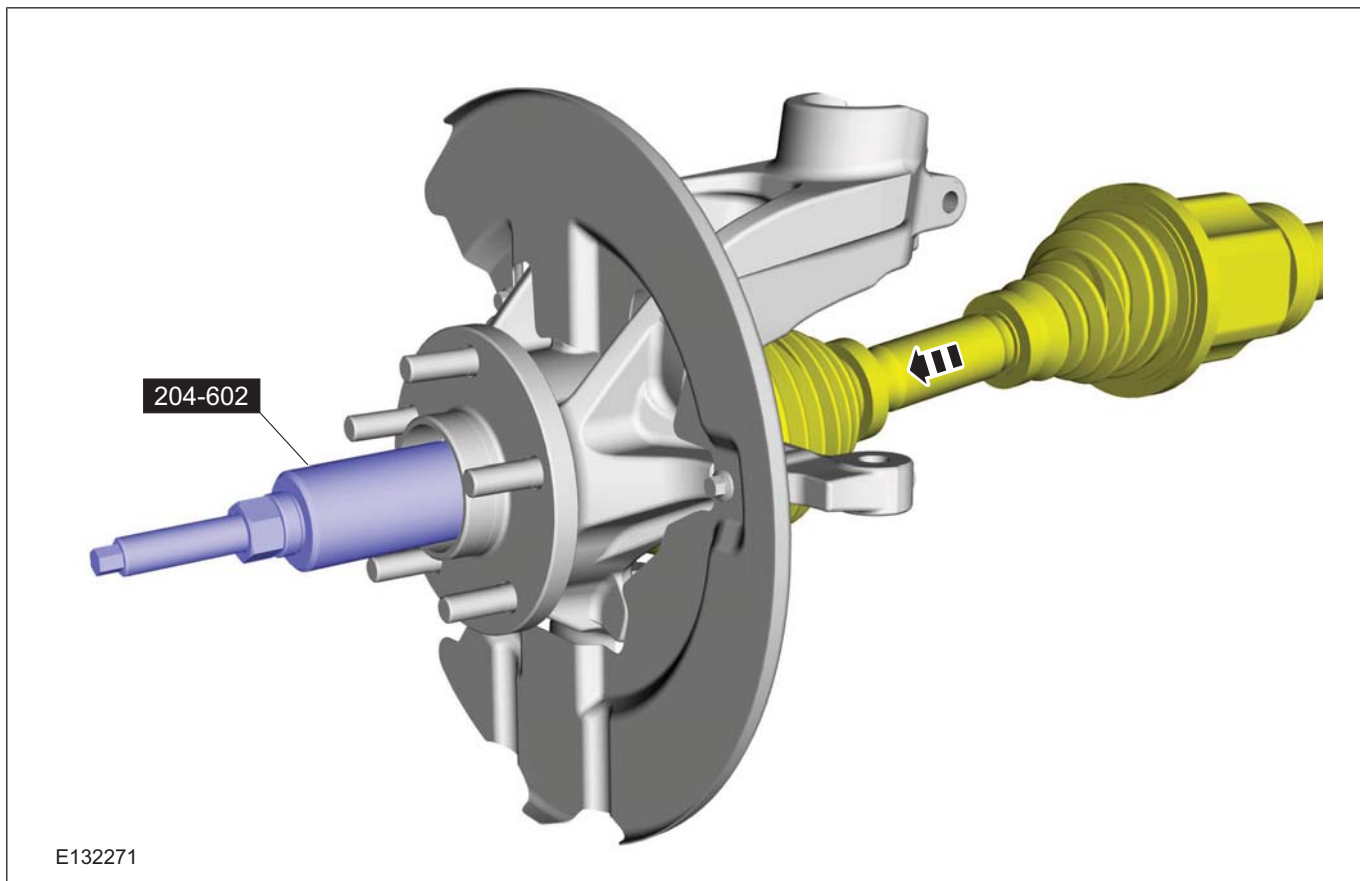
**1. NOTE:** This step is only necessary when installing a new component.Special Tool(s): 204-602  
Torque: 45 Nm

205-04-12

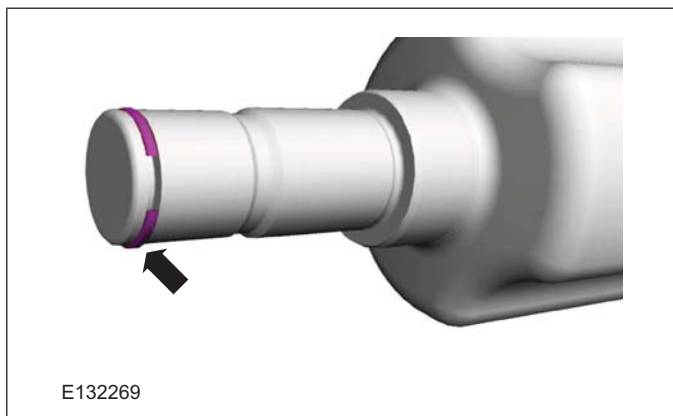
Front Drive Halfshafts

205-04-12

## REMOVAL AND INSTALLATION



2. **NOTE:** Make sure that a new component is installed.

3. **CAUTIONS:**

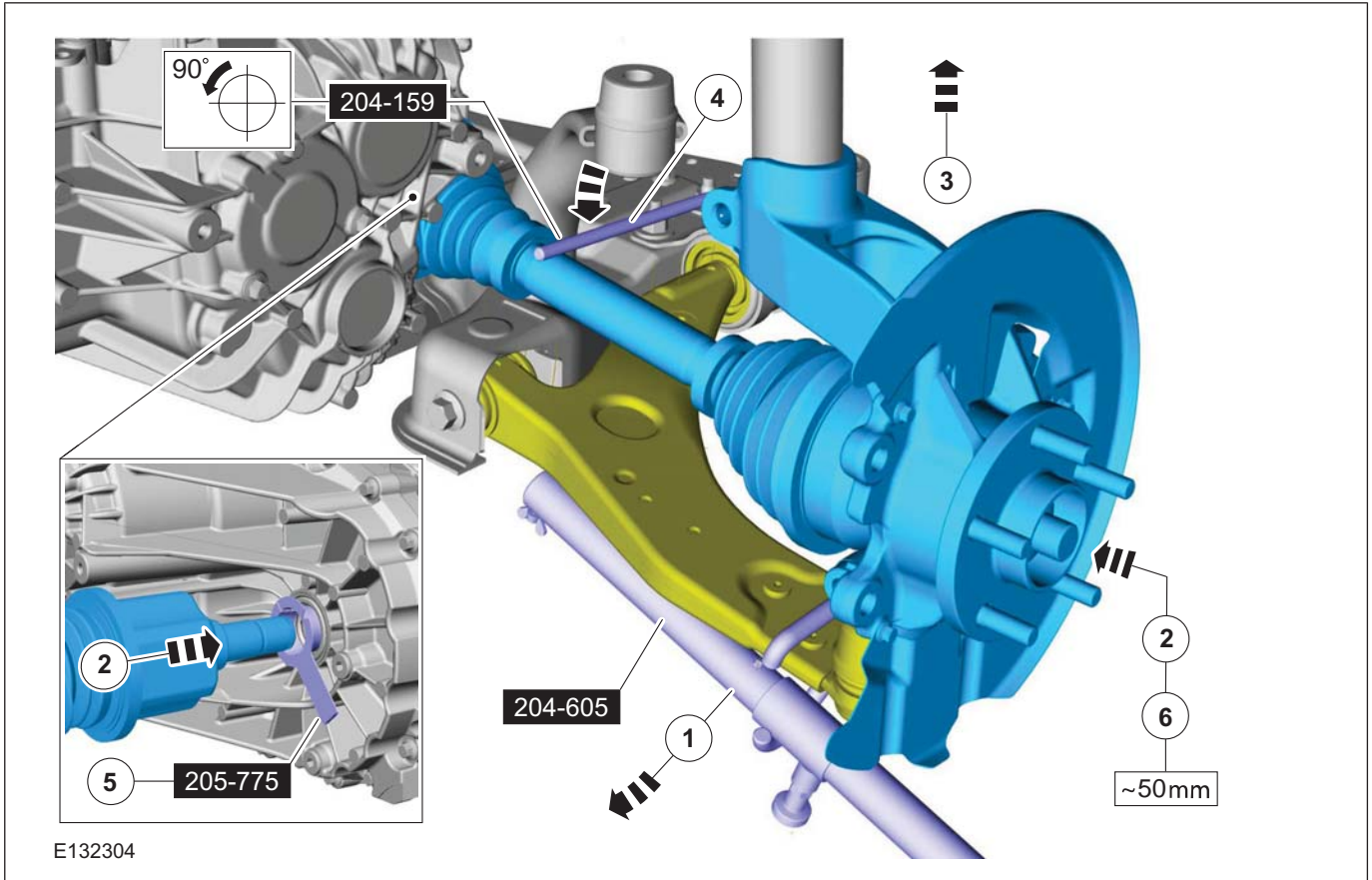
⚠ The inner constant velocity (CV) joint must not be bent more than 18°.

⚠ The outer constant velocity (CV) joint must not be bent more than 45°.

1. Special Tool(s): 204-605
4. Special Tool(s): 204-159
5. Remove the Special Tool(s): 205-775

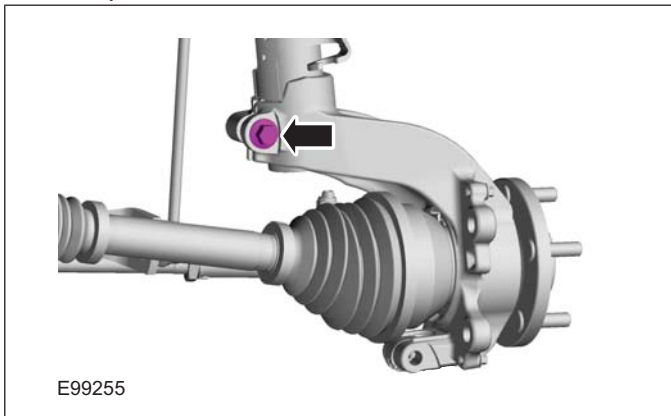


REMOVAL AND INSTALLATION



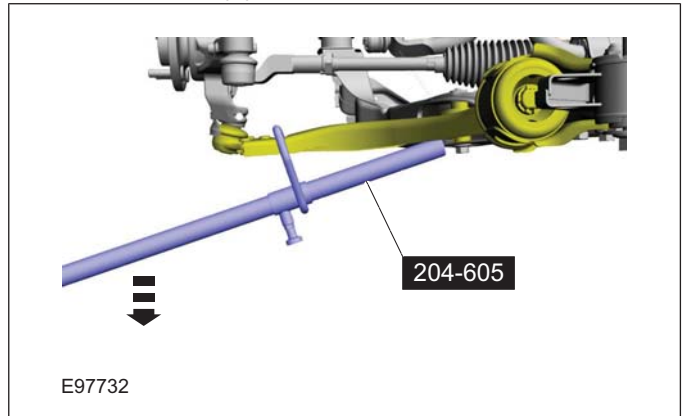
E132304

4. Torque: 90 Nm



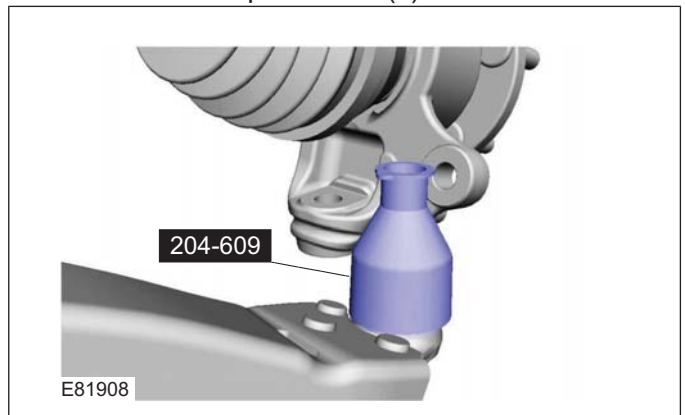
E99255

5. Special Tool(s): 204-605



E97732

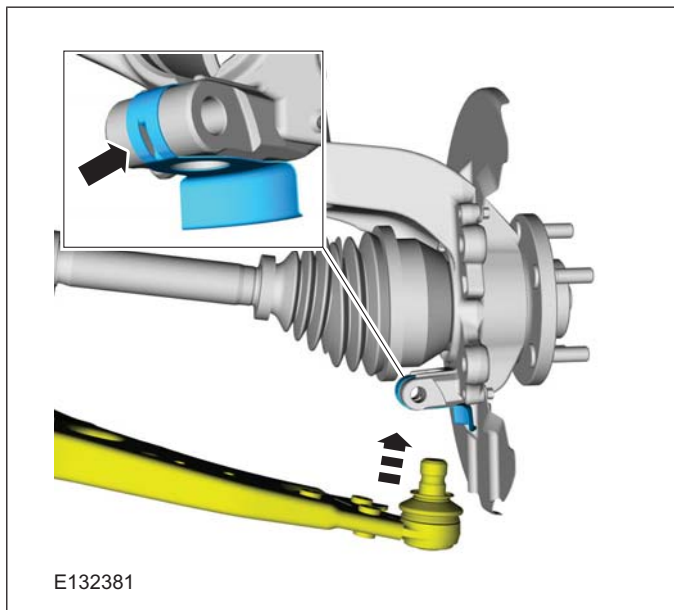
6. Remove the Special Tool(s): 204-609



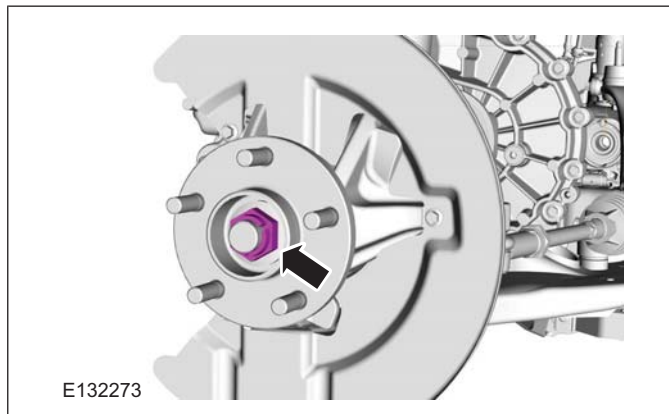
E81908

REMOVAL AND INSTALLATION

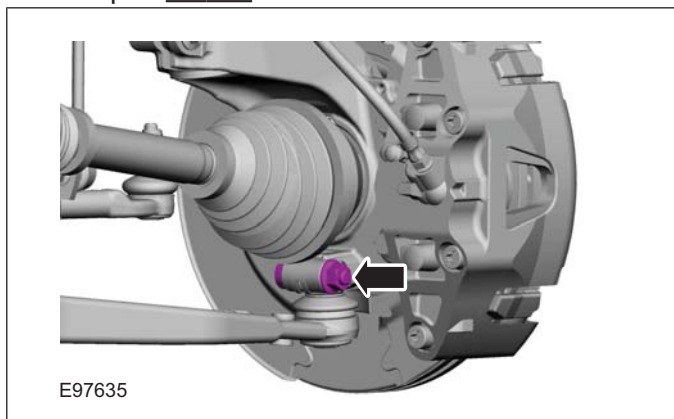
7.



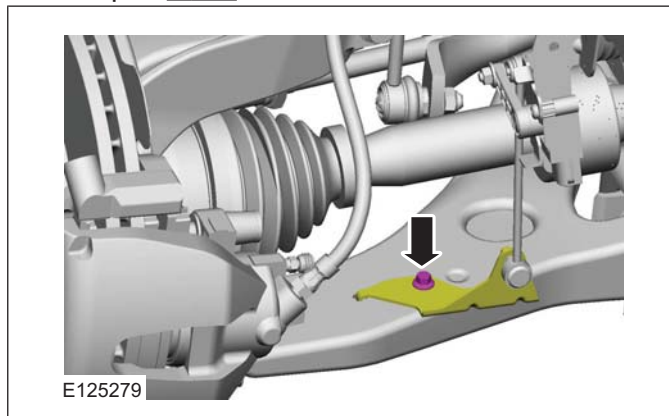
**NOTE:** Only tighten the nut finger tight at this stage.



8. Torque: 83 Nm



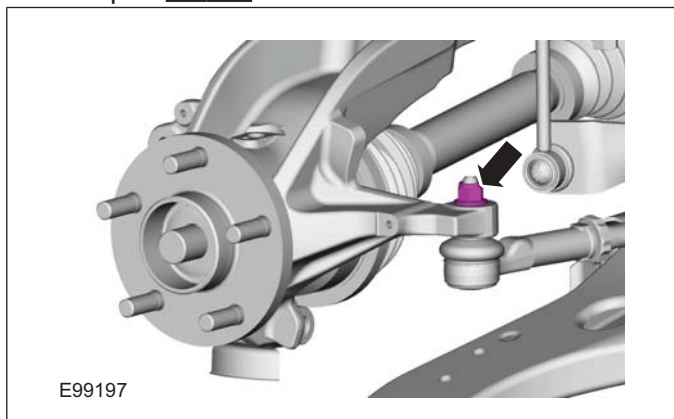
11. If equipped.  
Torque: 8 Nm



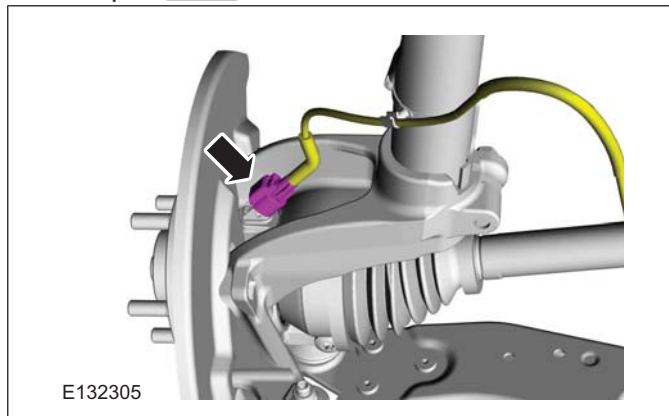
9. **WARNING:** Make sure that a new nut is installed.

**CAUTION:** Make sure that the ball joint ball does not rotate.

Torque: 80 Nm



12 Torque: 5 Nm

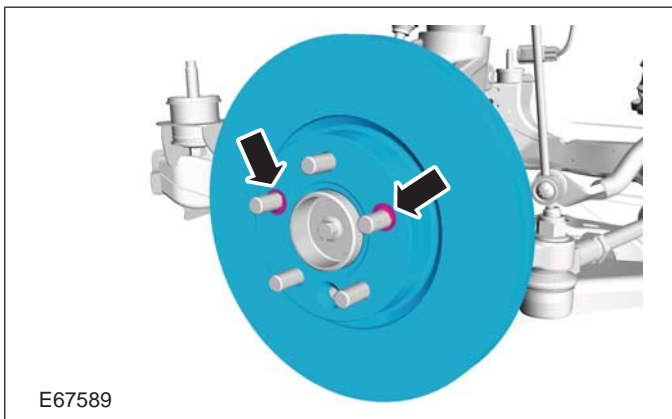


10. **NOTE:** This step is only necessary when installing a new component.

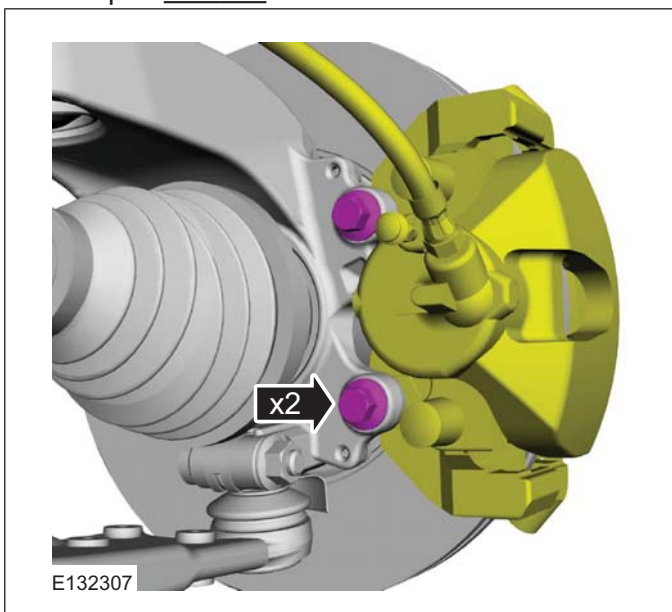


REMOVAL AND INSTALLATION

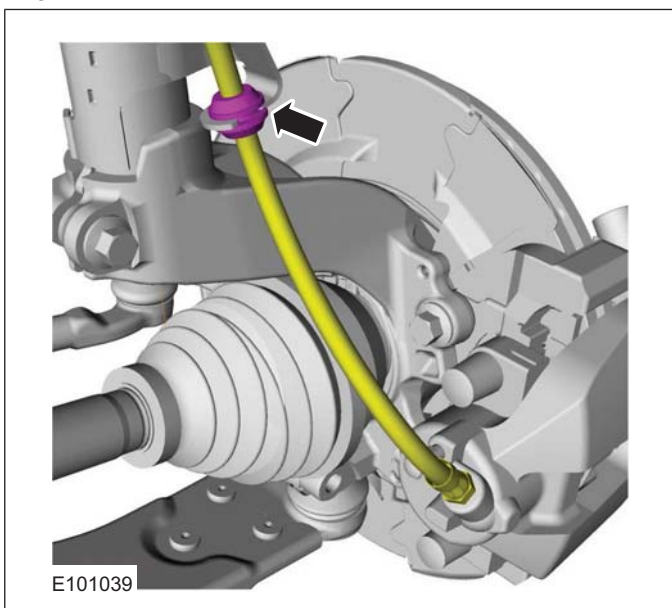
13.



14. Torque: 120 Nm

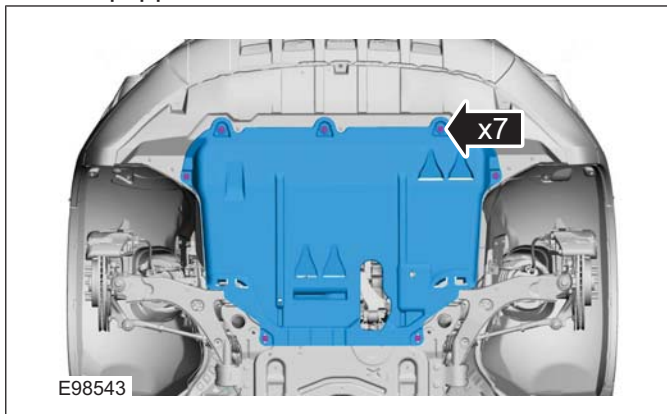


15.



16.

17. If equipped.

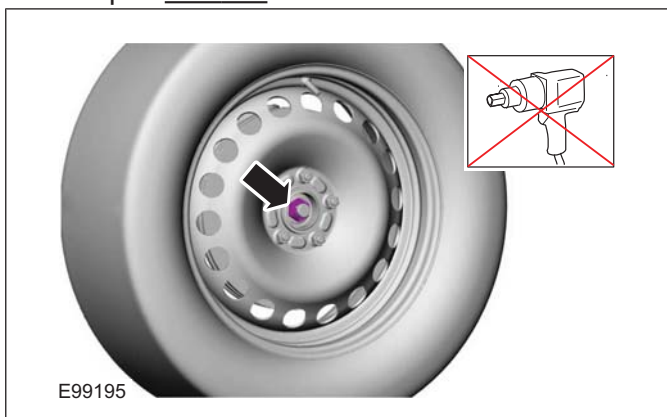


18. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

19. Lower the Vehicle.

20. **NOTE:** This step is only necessary when installing a new component.

Torque: 270 Nm

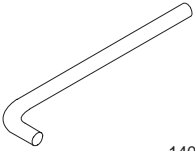
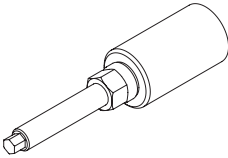
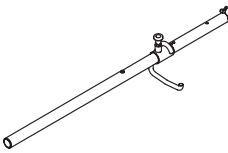
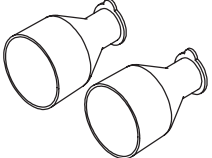
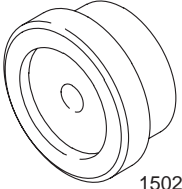
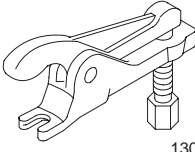




REMOVAL AND INSTALLATION

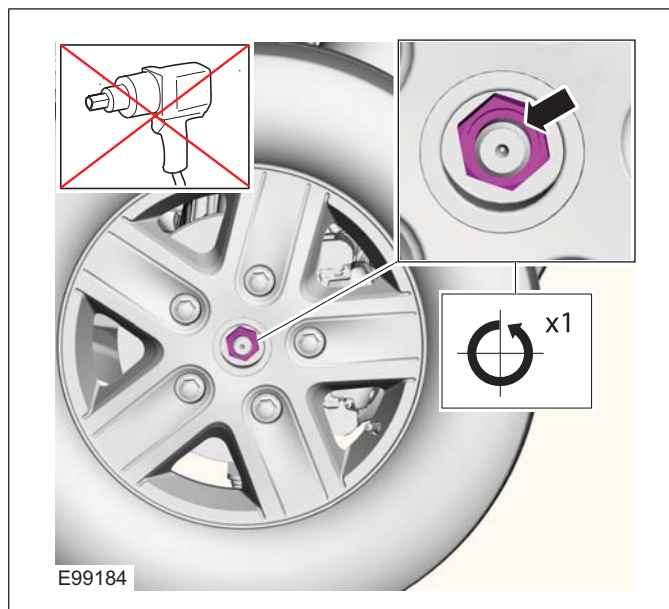
Front Halfshaft RH — LHD 4WD/RHD 4WD(14 321 0)

Special Tool(s) / General Equipment

 <p>14039</p>	<p>204-159 Lever, Wheel Knuckle</p>
 <p>E62067</p>	<p>204-602 Installer, Halfshaft</p>
 <p>E63772</p>	<p>204-605 Separator, Lower Arm Ball Joint</p>
 <p>E75372</p>	<p>204-609 Protection Cap, Ball Joint Gaiter</p>
 <p>15026A01</p>	<p>205-071-01 Adapter for 205-071 (Thrust Pad)</p>
 <p>13006</p>	<p>211-020 Separator, Ball Joint</p>
<p>Puller</p>	

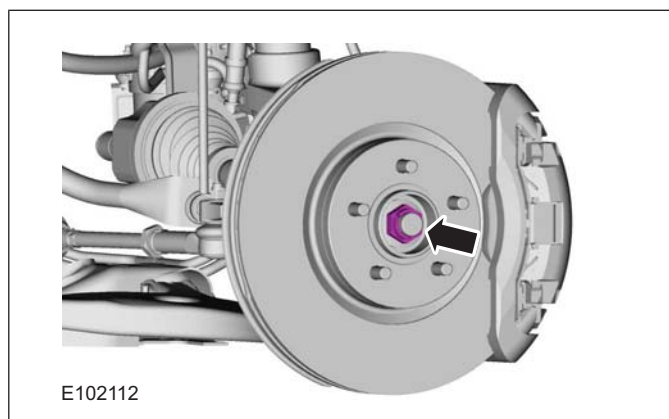
Removal

1. **NOTE:** This step is only necessary when installing a new component.



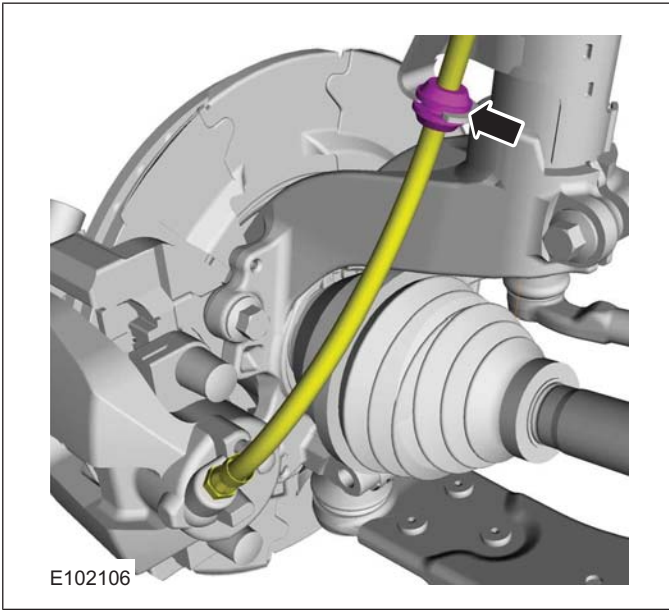
2. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).  
Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

3. **NOTE:** This step is only necessary when installing a new component.

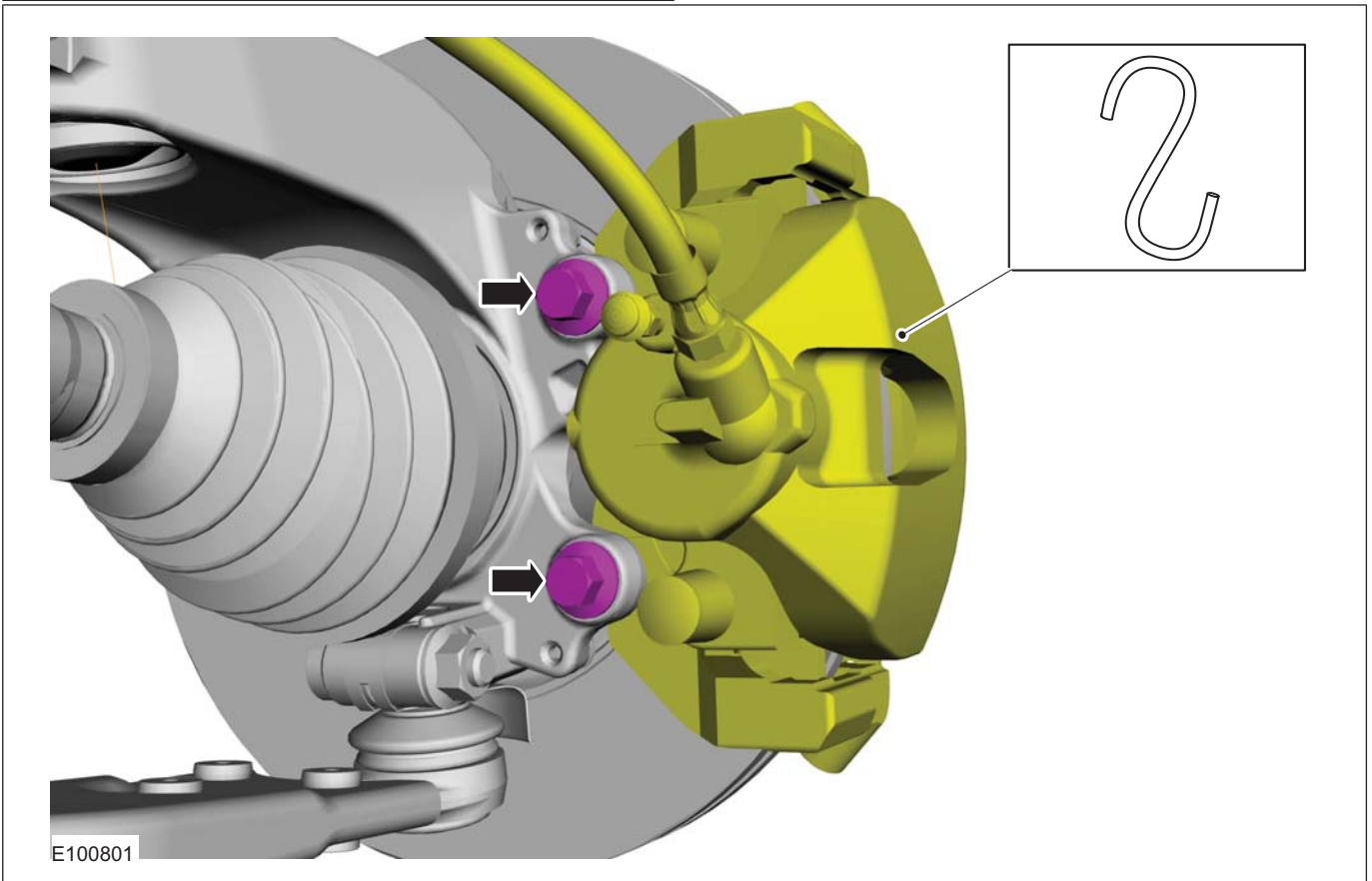


REMOVAL AND INSTALLATION

4.



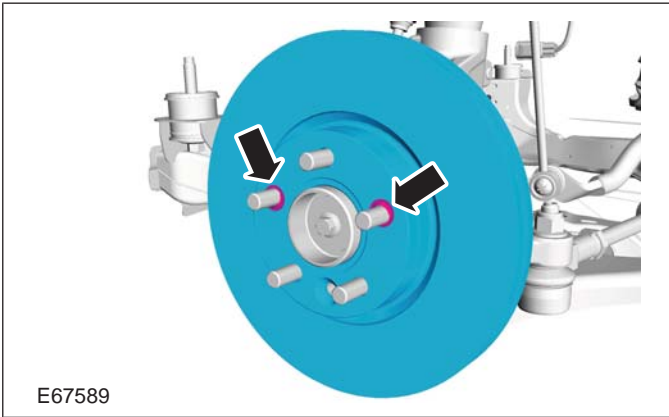
5. **⚠ WARNING:** Make sure that no load is placed on the brake hose.



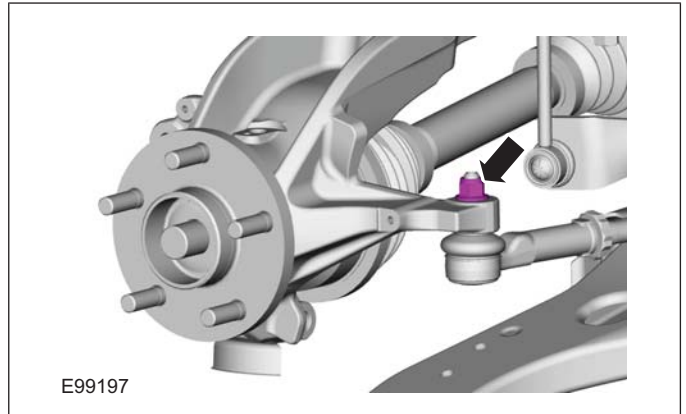


REMOVAL AND INSTALLATION

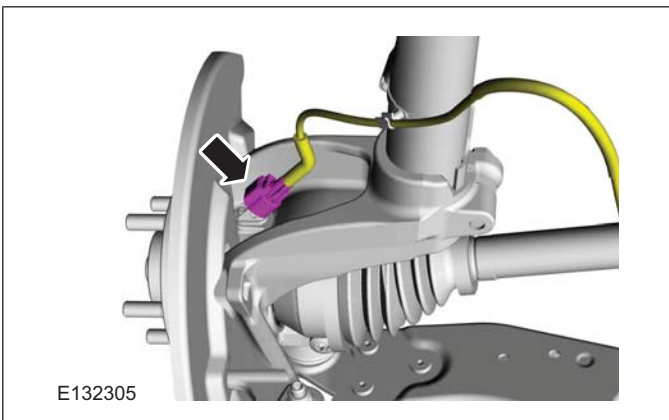
6.



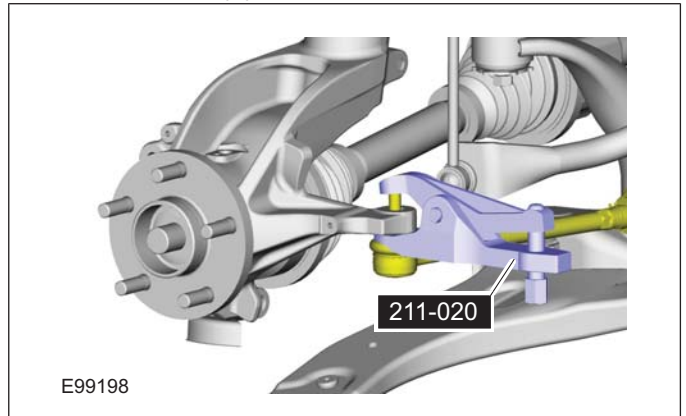
9. **CAUTION:** Make sure that the ball joint ball does not rotate.



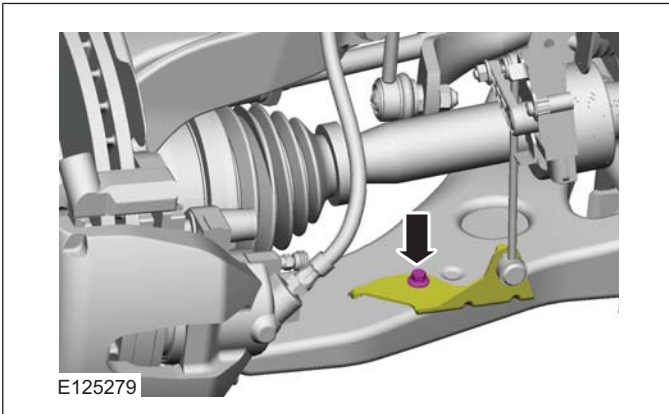
7.



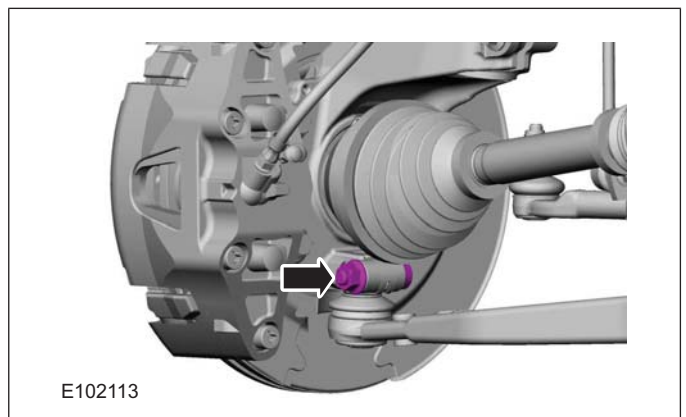
10. Special Tool(s): 211-020



8. If equipped.



11.

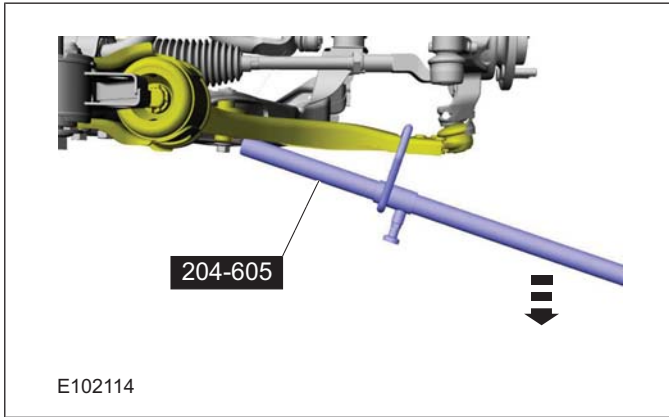




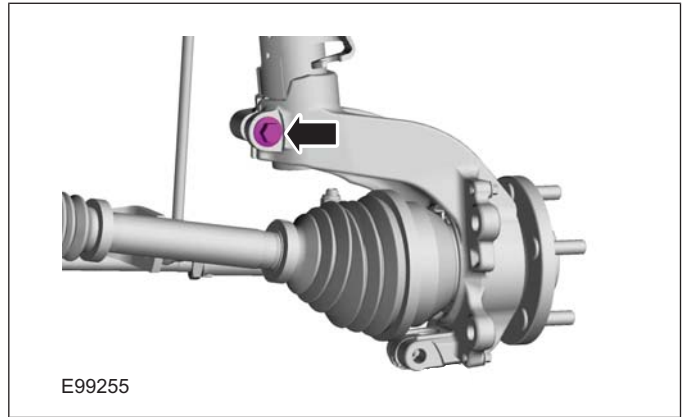


REMOVAL AND INSTALLATION

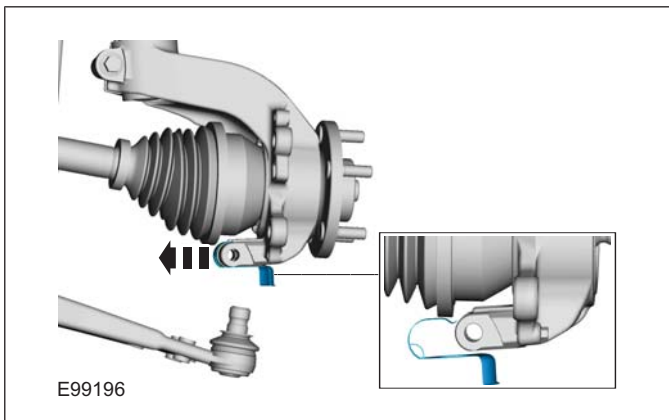
12 Special Tool(s): 204-605



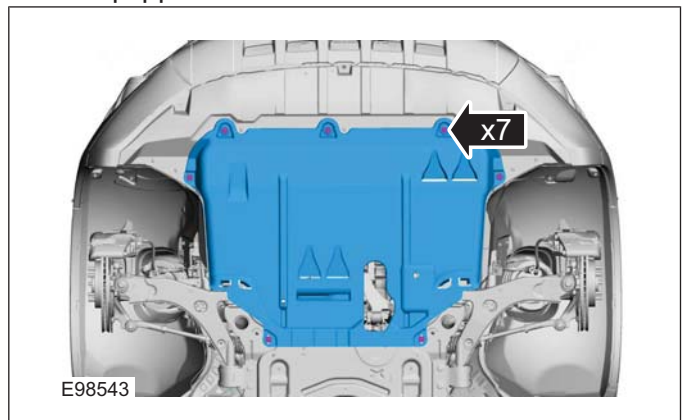
15.



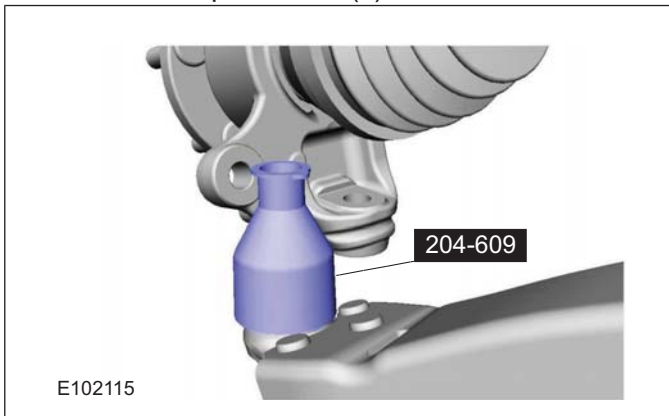
13.



16. If equipped.

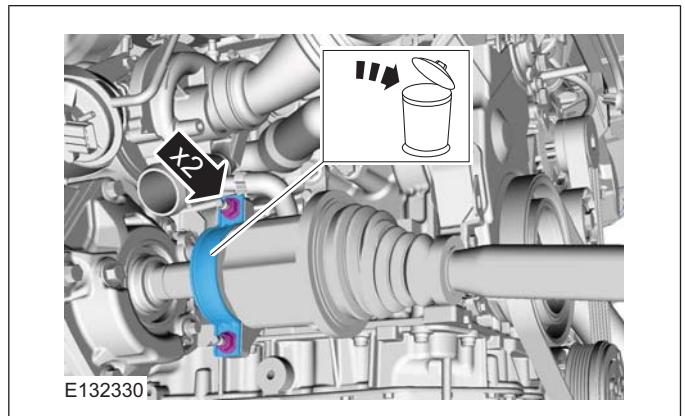


14. Install the Special Tool(s): 204-609



Vehicles with 6-speed manual transaxle (MMT6)

17.

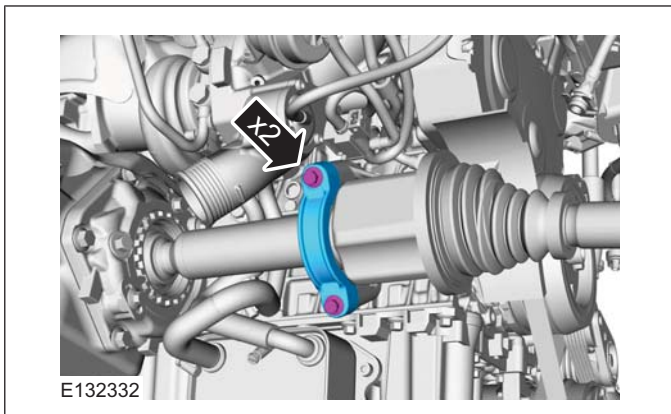




REMOVAL AND INSTALLATION

Vehicles with 2.5L engine

18.



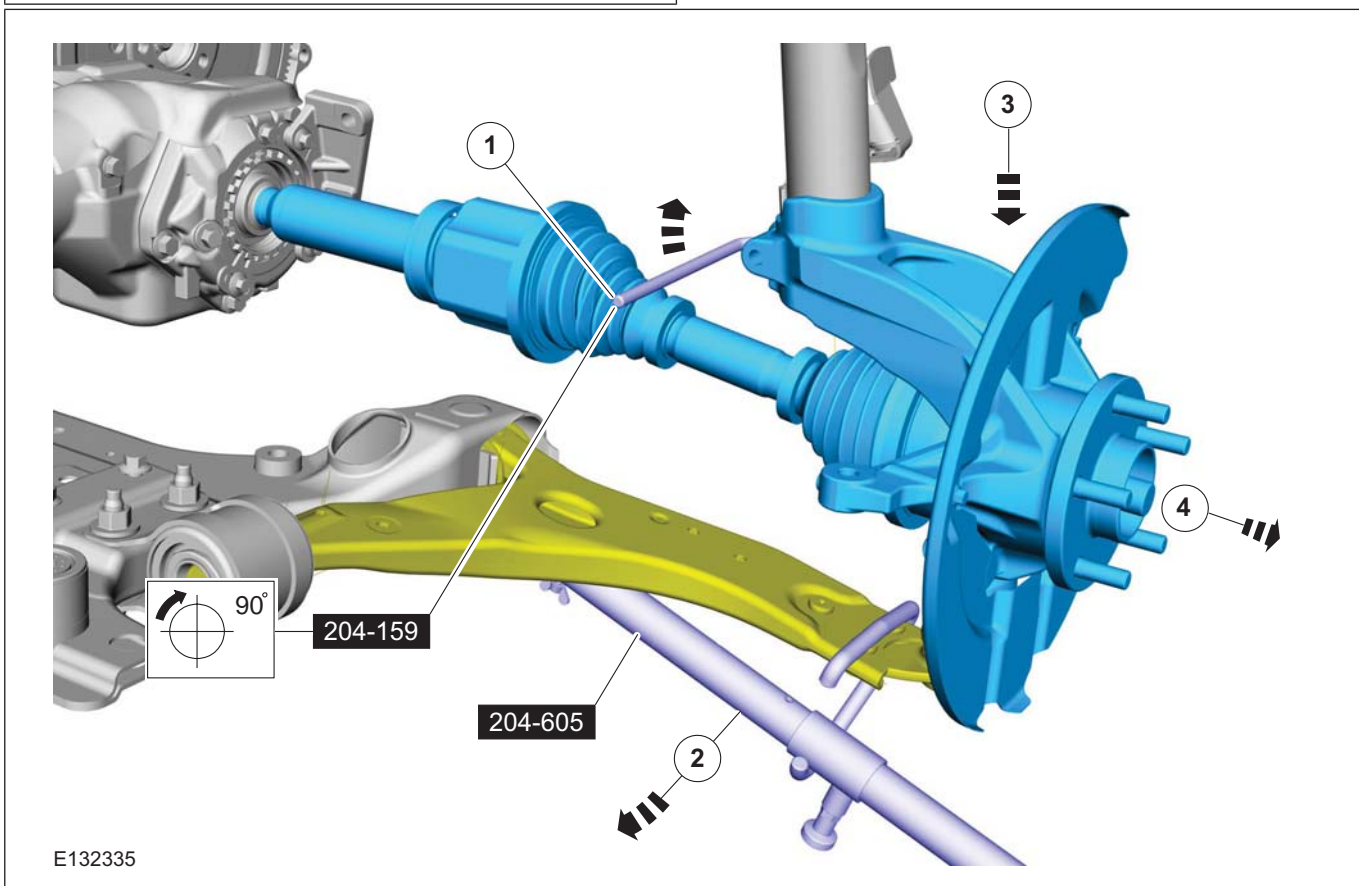
All vehicles

19. **WARNING:** Be prepared to collect escaping fluid.

CAUTIONS:

- ⚠** The inner constant velocity (CV) joint must not be bent more than 18°.
- ⚠** The outer constant velocity (CV) joint must not be bent more than 45°.

Special Tool(s): 204-159, 204-605

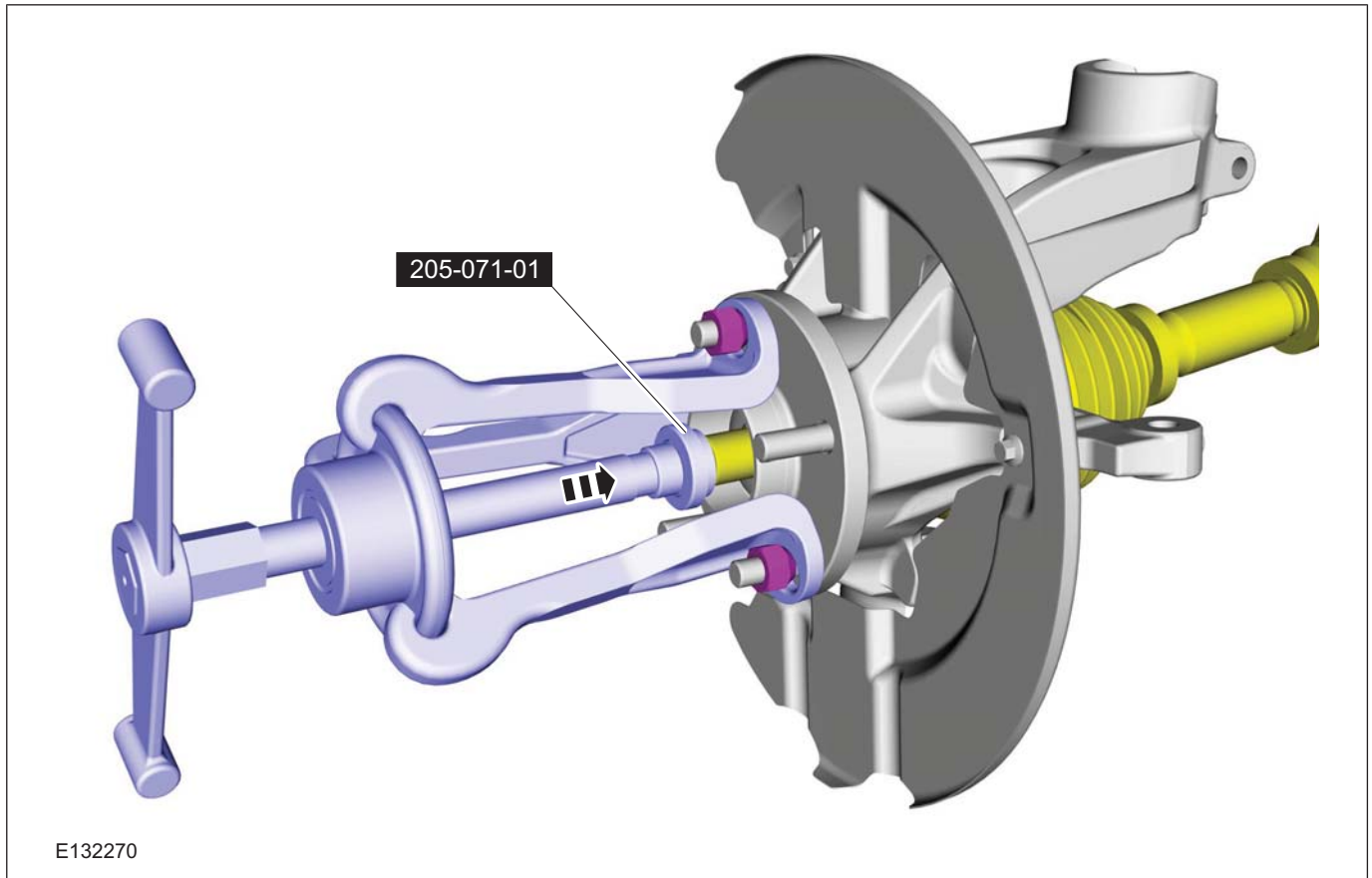


20. **NOTE:** This step is only necessary when installing a new component.

Special Tool(s): 205-071-01  
General Equipment: Puller



## REMOVAL AND INSTALLATION



## Installation

1. **NOTE:** This step is only necessary when installing a new component.

Special Tool(s): 204-602

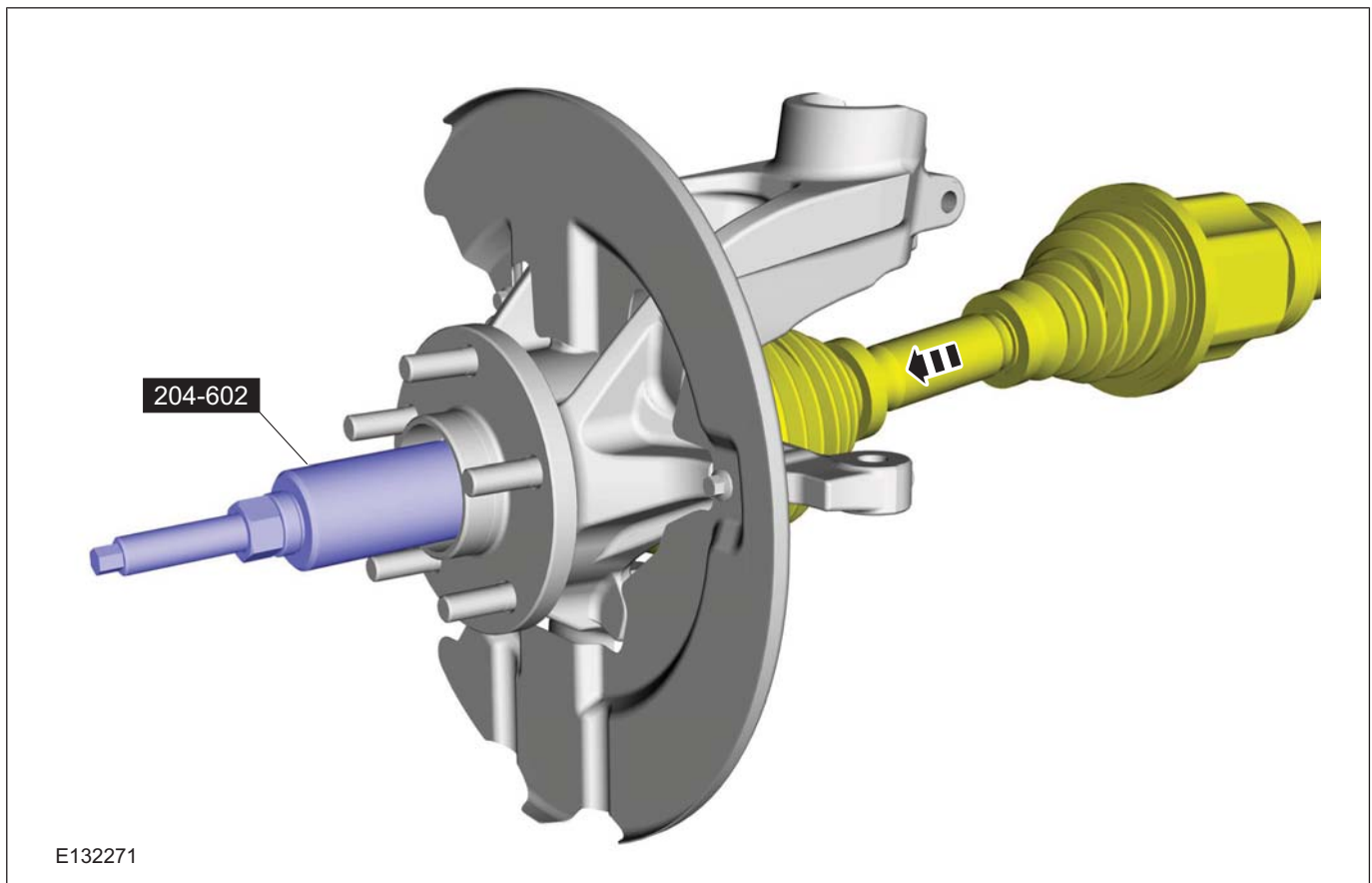
Torque: 45 Nm

205-04-22

Front Drive Halfshafts

205-04-22

## REMOVAL AND INSTALLATION



## 2. CAUTIONS:

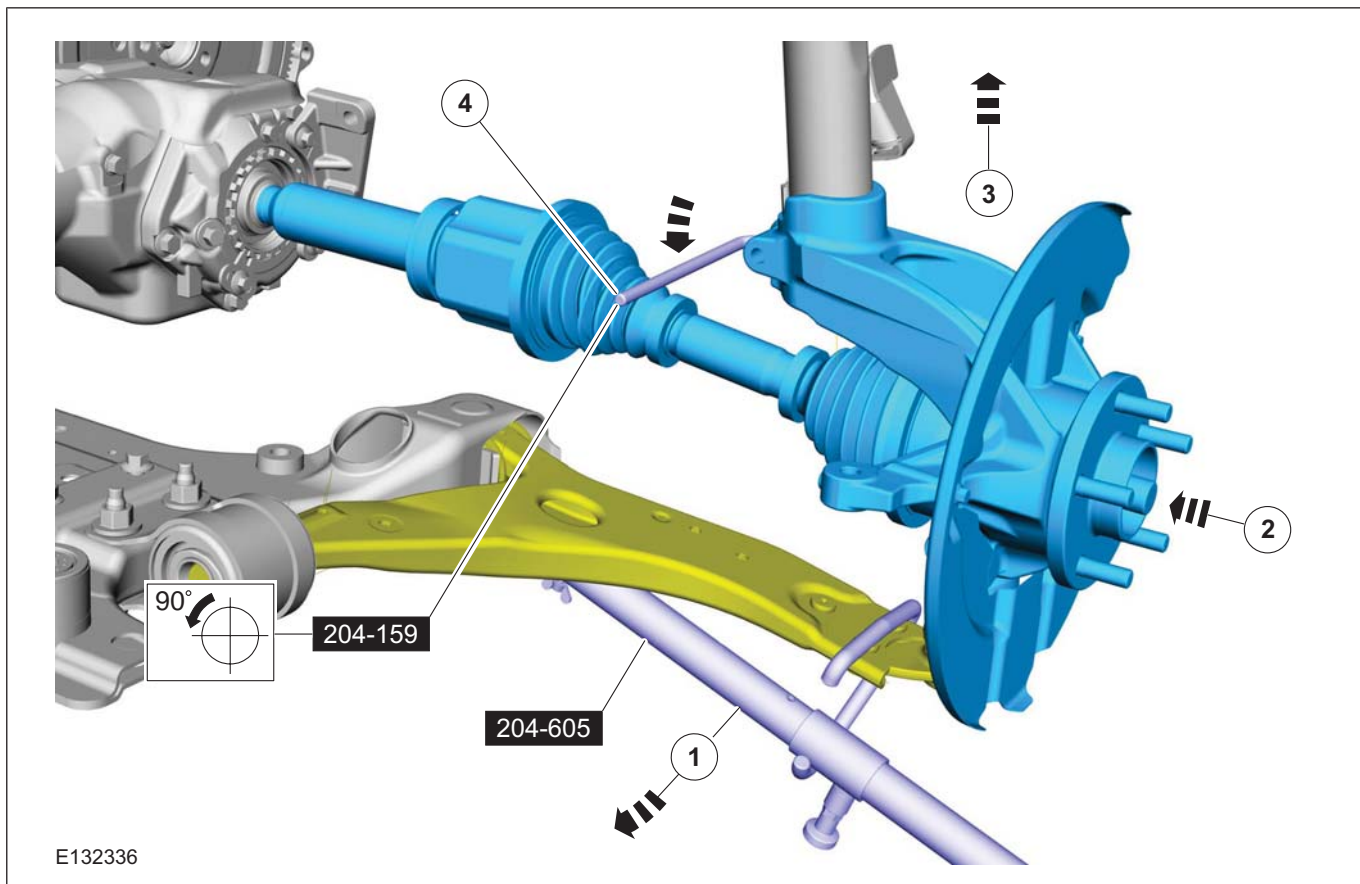
- ⚠ The inner constant velocity (CV) joint must not be bent more than 18°.

- ⚠ The outer constant velocity (CV) joint must not be bent more than 45°.

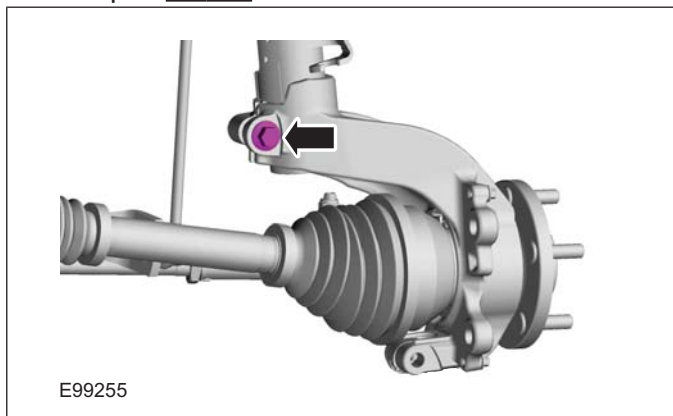
Special Tool(s): 204-159, 204-605



REMOVAL AND INSTALLATION

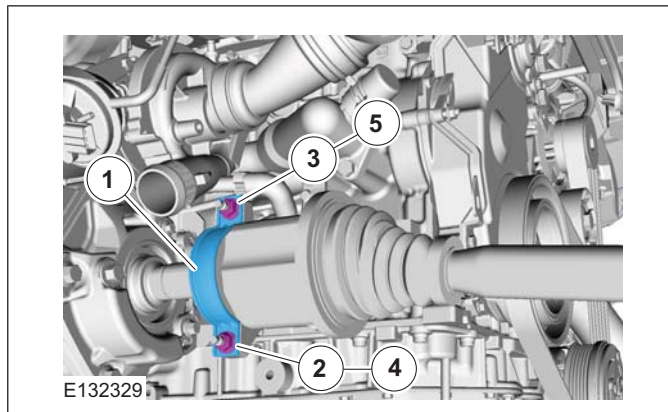


3. Torque: 90 Nm



Vehicles with 6-speed manual transaxle (MMT6)

4. 1. **NOTE:** Make sure that a new component is installed.
2. **NOTE:** Make sure that a new component is installed.  
Torque: 6 Nm
3. **NOTE:** Make sure that a new component is installed.  
Torque: 6 Nm
4. Torque: 25 Nm
5. Torque: 25 Nm



REMOVAL AND INSTALLATION

Vehicles with 2.5L engine

5. 1. **NOTE:** Make sure that a new component is installed.

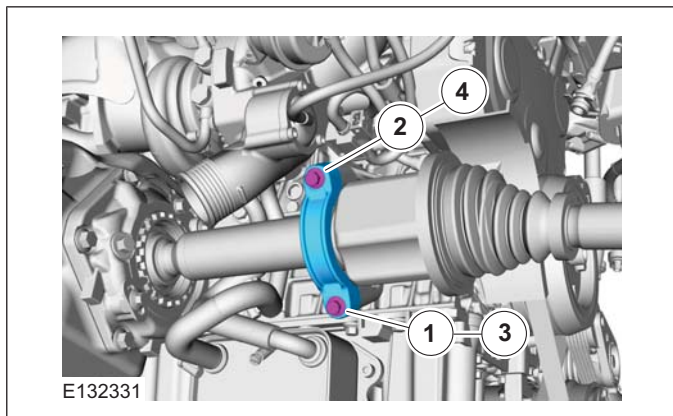
Torque: 10 Nm

2. **NOTE:** Make sure that a new component is installed.

Torque: 10 Nm

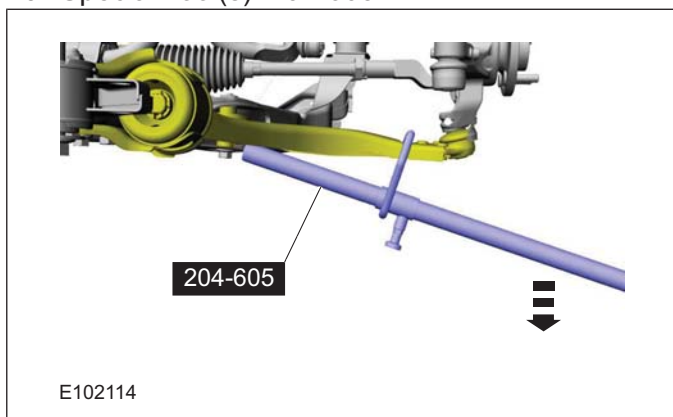
3. Torque: 25 Nm

4. Torque: 25 Nm

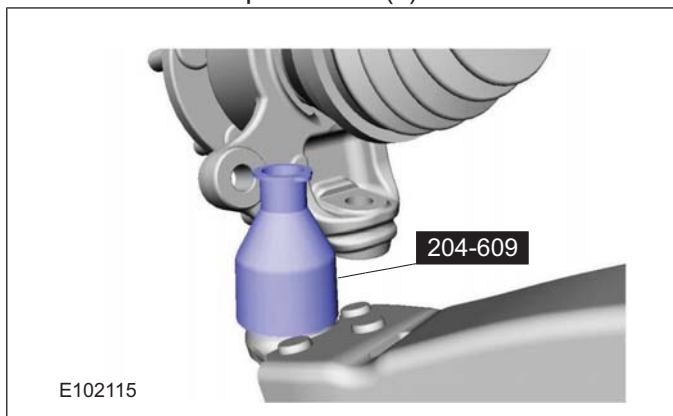


All vehicles

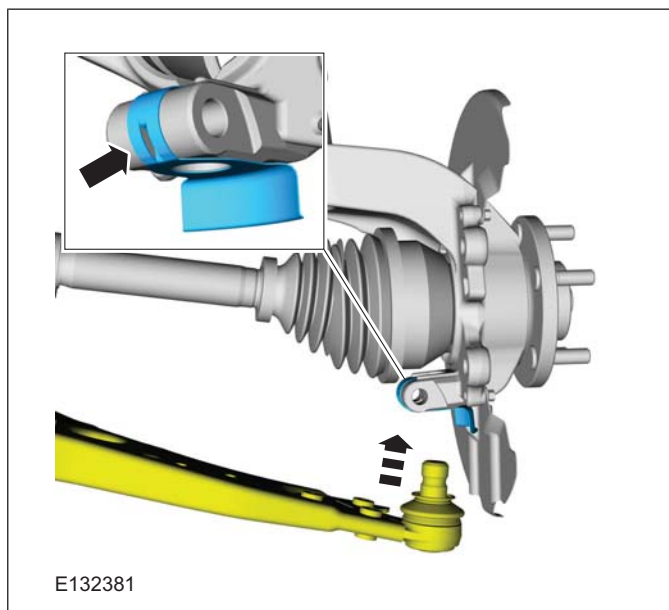
6. Special Tool(s): 204-605



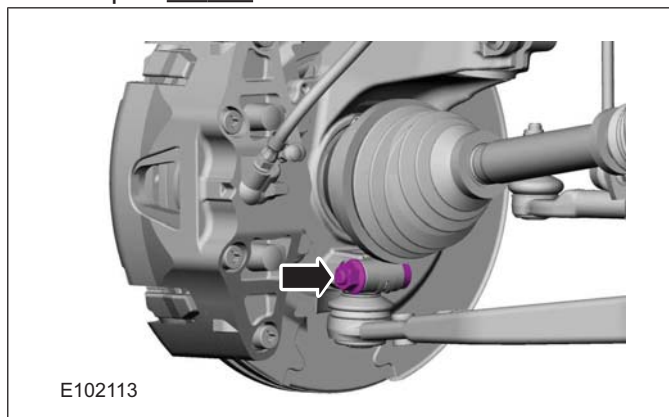
7. Remove the Special Tool(s): 204-609



- 8.



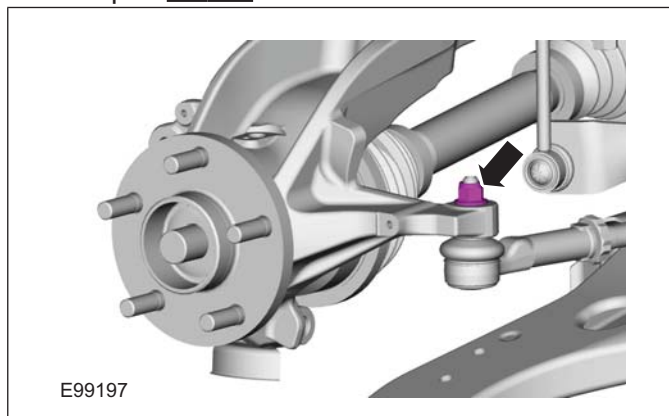
9. Torque: 83 Nm



10. **WARNING:** Make sure that a new nut is installed.

**CAUTION:** Make sure that the ball joint ball does not rotate.

Torque: 80 Nm

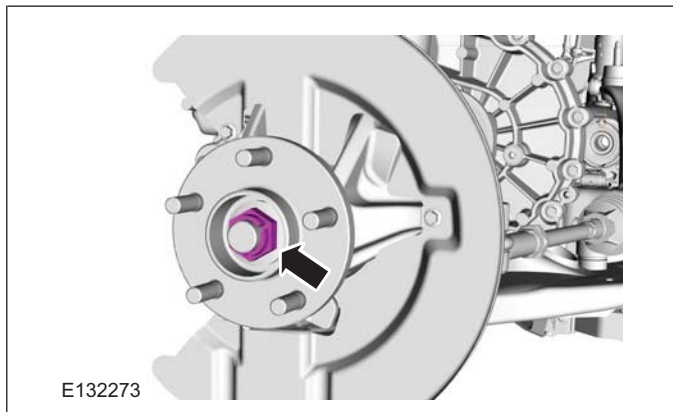


11. **NOTE:** This step is only necessary when installing a new component.

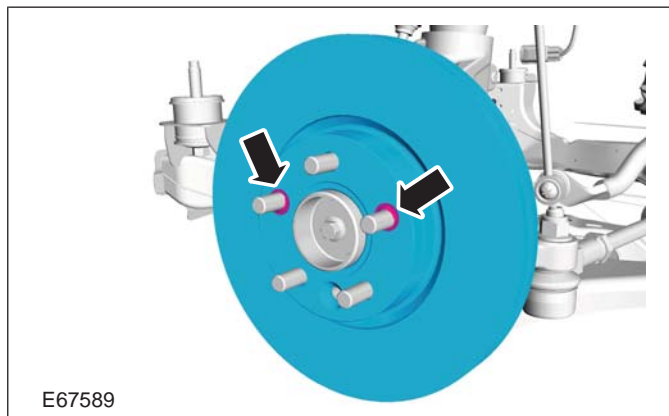


REMOVAL AND INSTALLATION

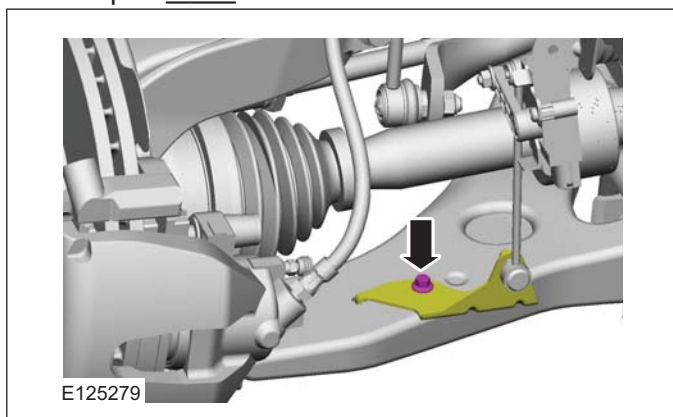
**NOTE:** Only tighten the nut finger tight at this stage.



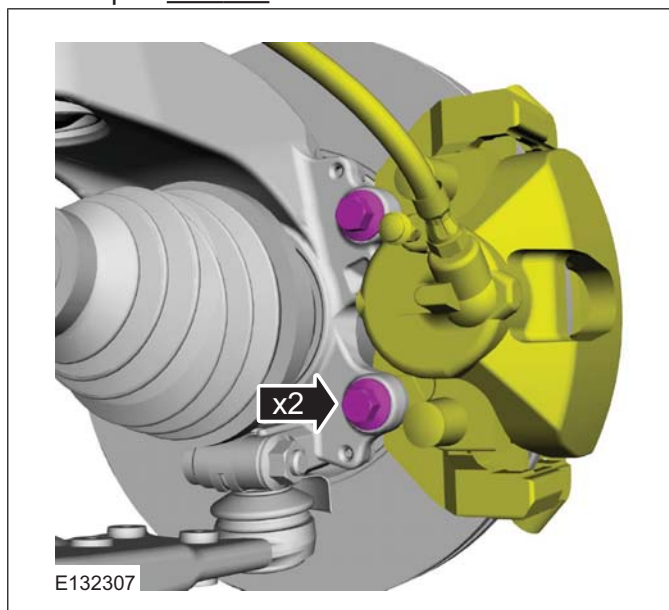
14.



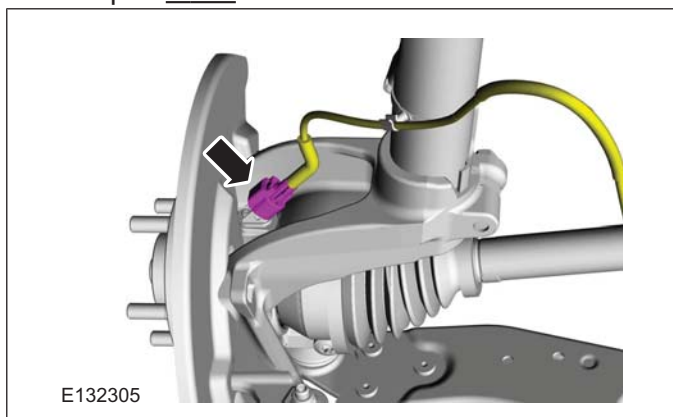
12. If equipped.  
Torque: 8 Nm



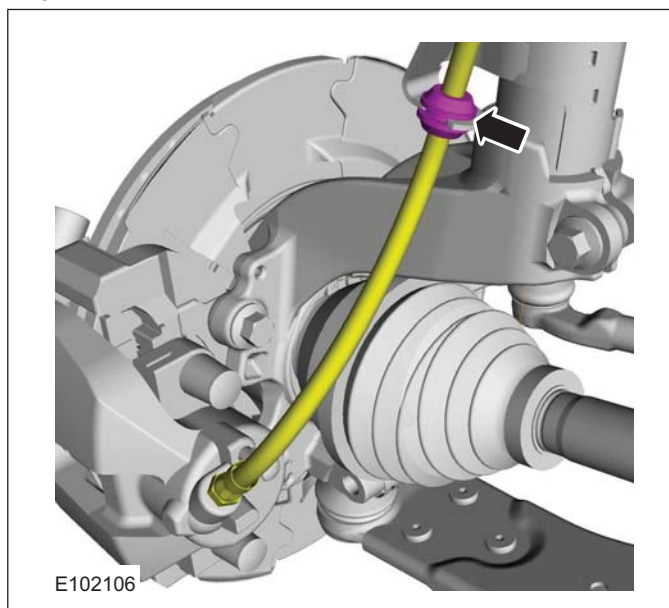
15. Torque: 120 Nm



13. Torque: 5 Nm



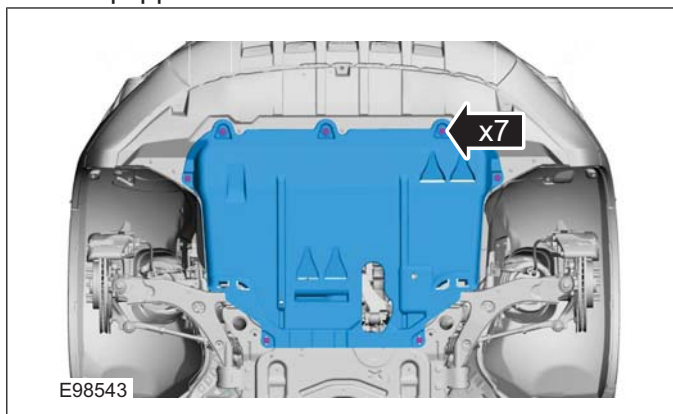
16.



## REMOVAL AND INSTALLATION

17.

18. If equipped.

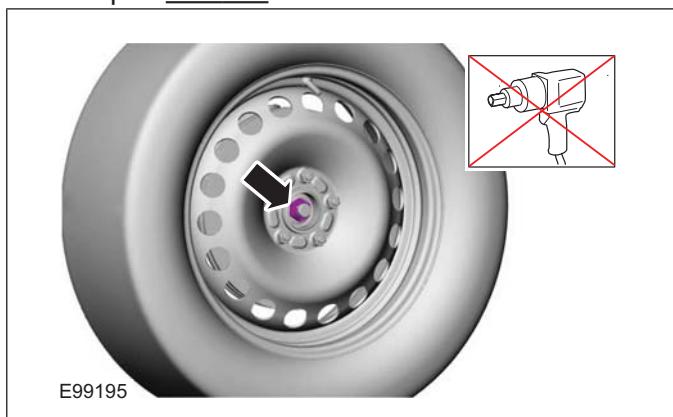


19. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

20. Lower the Vehicle.

21. **NOTE:** This step is only necessary when installing a new component.

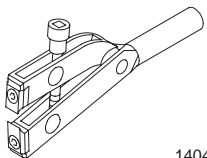
Torque: 270 Nm

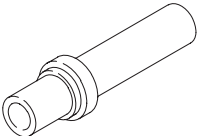


REMOVAL AND INSTALLATION

Inner Constant Velocity (CV) Joint Boot(14 336 0)

Special Tool(s) / General Equipment

 <p>14044</p>	<p>204-169 Clamping Tool, Boot Retaining Clamp</p>
--	--

 <p>16016</p>	<p>308-046 Installer, Transmission Extension Housing Bushing/Seal</p>
--	---

<p>Flat-bladed screwdriver</p>
<p>Puller</p>

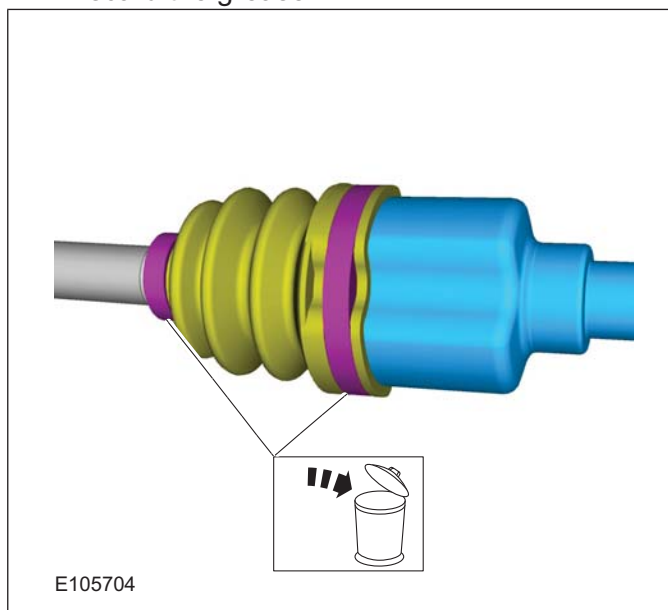
Materials	
Name	Specification
<p>Grease FD-R</p>	<p>WSS-M1C259-A1 / 3M5J-M1C259-AA</p>

Removal

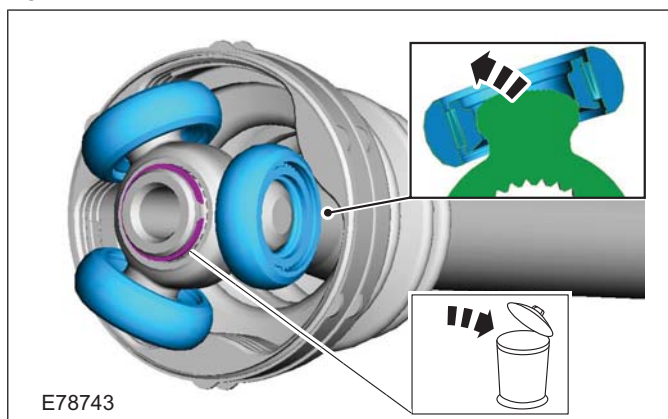
1. Remove the halfshaft.

Refer to: **Front Halfshaft LH** (205-04 Front Drive Halfshafts, Removal and Installation).  
Refer to: **Front Halfshaft RH - LHD 4WD/RHD 4WD** (205-04 Front Drive Halfshafts, Removal and Installation).

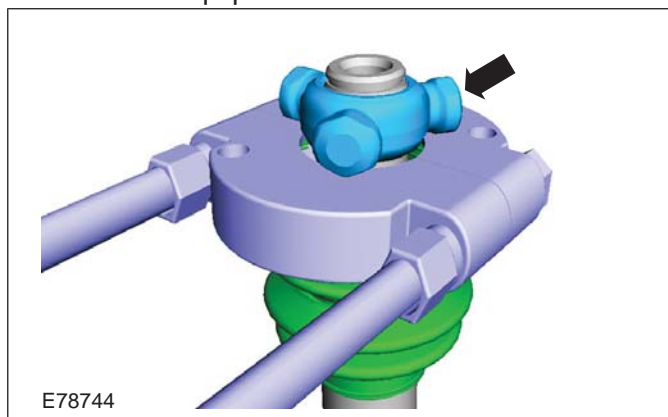
2. Discard the grease.



3.



4. General Equipment: Puller



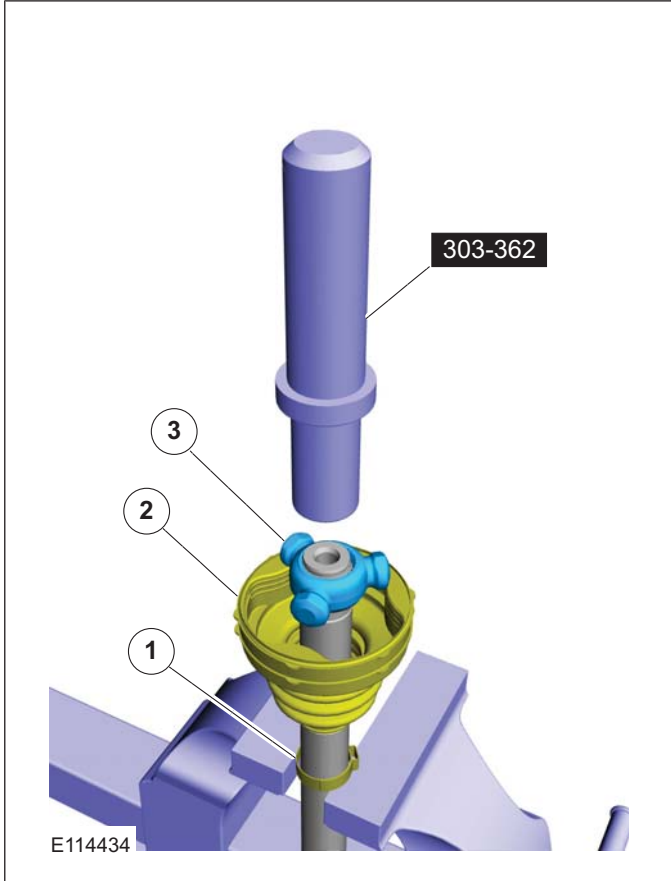


REMOVAL AND INSTALLATION

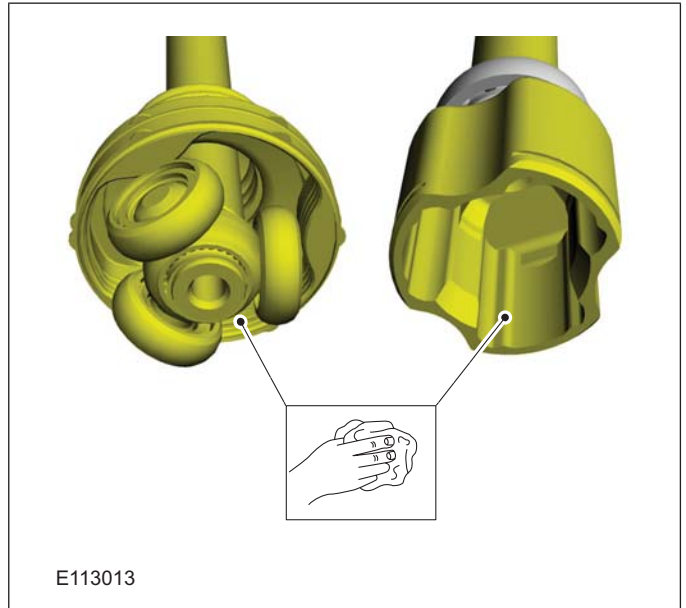
Installation

**NOTE:** Make sure that the component is clean, free of foreign material and lubricant.

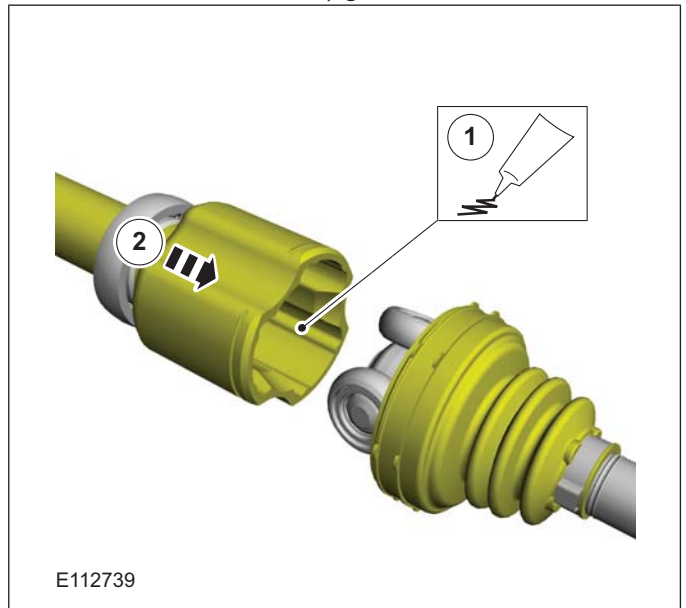
1. Special Tool(s): 308-046



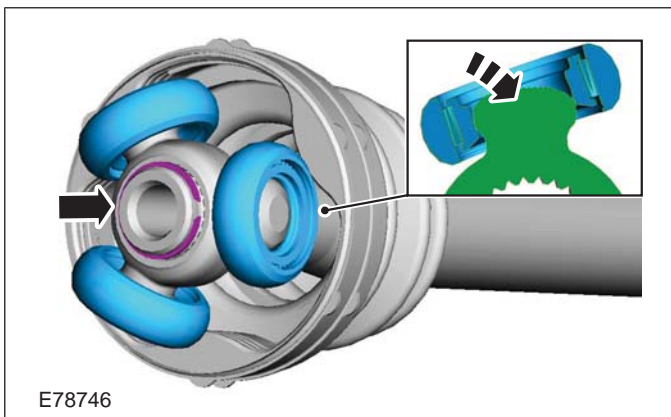
3.



4. Material: Grease FD-R (WSS-M1C259-A1 / 3M5J-M1C259-AA) grease



2.



REMOVAL AND INSTALLATION

5. 1. Release any trapped air.

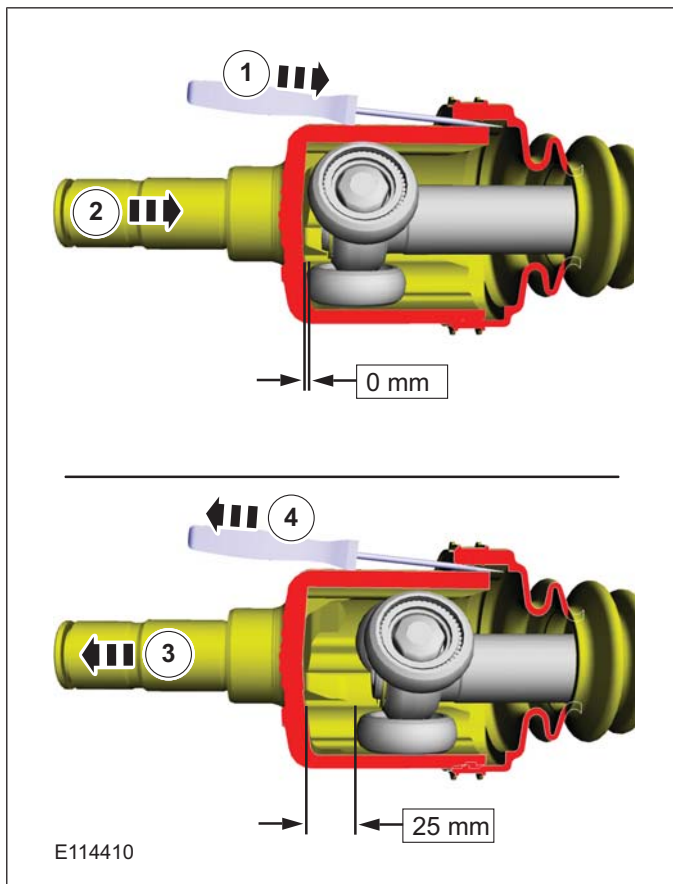
General Equipment: Flat-bladed screwdriver

4. General Equipment: Flat-bladed screwdriver

7. Install the halfshaft.

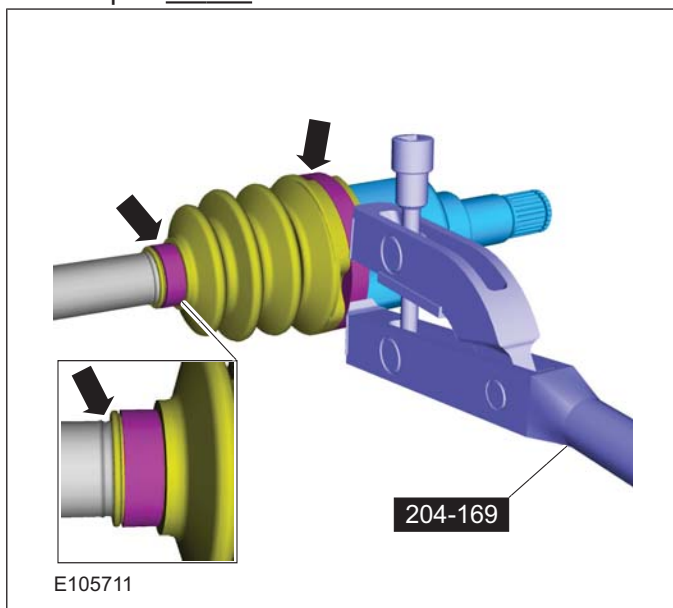
Refer to: **Front Halfshaft LH** (205-04 Front Drive Halfshafts, Removal and Installation).

Refer to: **Front Halfshaft RH - LHD 4WD/RHD 4WD** (205-04 Front Drive Halfshafts, Removal and Installation).



6. Special Tool(s): 204-169

Torque: 21 Nm





205-04-30

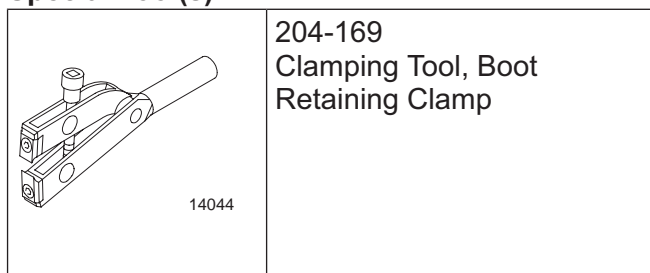
Front Drive Halfshafts

205-04-30

## REMOVAL AND INSTALLATION

## Outer Constant Velocity (CV) Joint Boot(14 338 0)

## Special Tool(s)

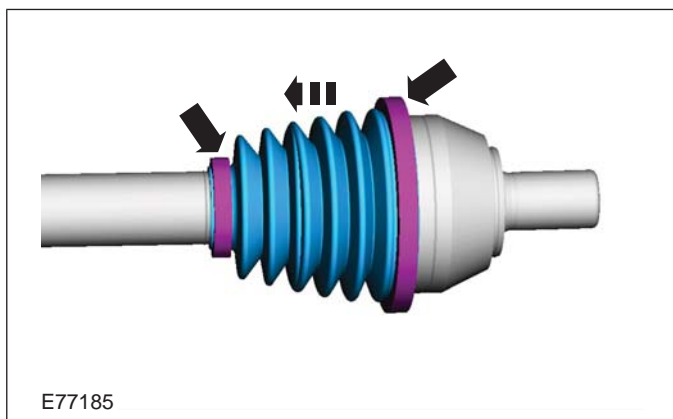


## Removal

1. Remove the inner CV joint boot.

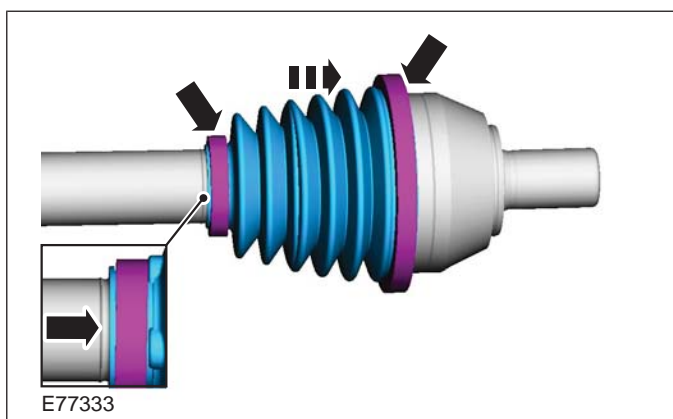
Refer to: **Inner Constant Velocity (CV) Joint Boot**  
(205-04 Front Drive Halfshafts, Removal and Installation).

2.

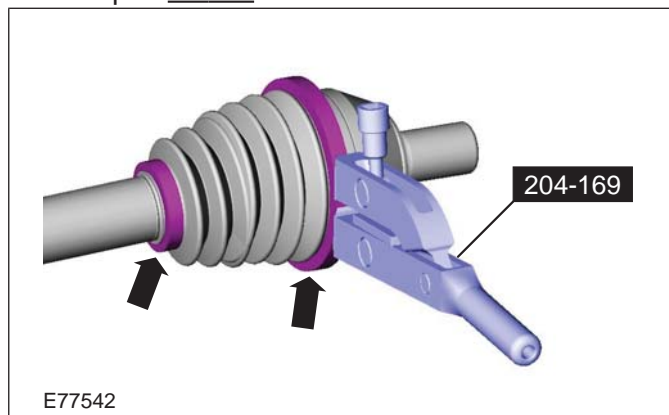


## Installation

1. • Fill the CV joint with grease.  
• Insert a small screwdriver under the boot seat to allow the air to escape.



2. Special Tool(s): 204-169  
Torque: 21 Nm



3. Install the inner CV joint boot.

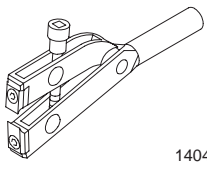
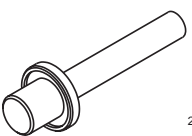
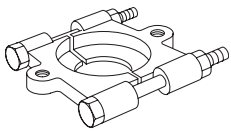
Refer to: **Inner Constant Velocity (CV) Joint Boot**  
(205-04 Front Drive Halfshafts, Removal and Installation).



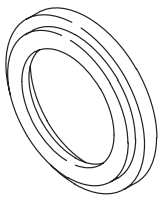
REMOVAL AND INSTALLATION

Halfshaft Bearing

Special Tool(s) / General Equipment

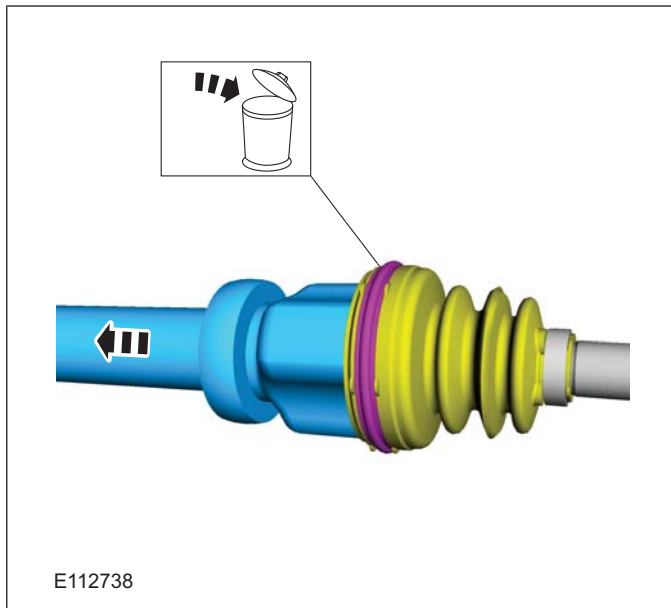
 <p>14044</p>	<p>204-169 Clamping Tool, Boot Retaining Clamp</p>
 <p>205080</p>	<p>205-080 Installer, Differential Bearing</p>
 <p>T115091</p>	<p>205-310 Remover, Bearing/Gear</p>

Special Tool(s) / General Equipment

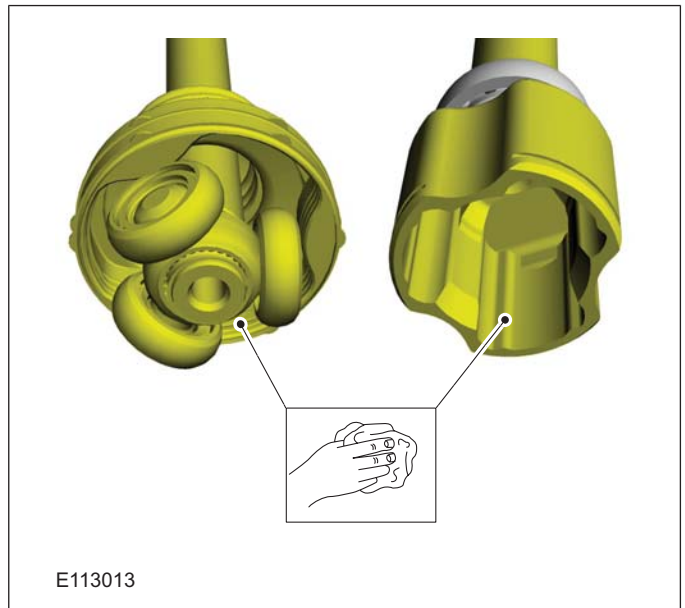
 <p>21136</p>	<p>303-255 Installer, Timing Cover Seal</p>
<p>Flat-bladed screwdriver</p>	
<p>Hydraulic Press</p>	
<p><b>Materials</b></p>	
<p><b>Name</b></p>	<p><b>Specification</b></p>
<p>Grease FD-R</p>	<p>WSS-M1C259-A1 / 3M5J-M1C259-AA</p>

Removal

1.



2.



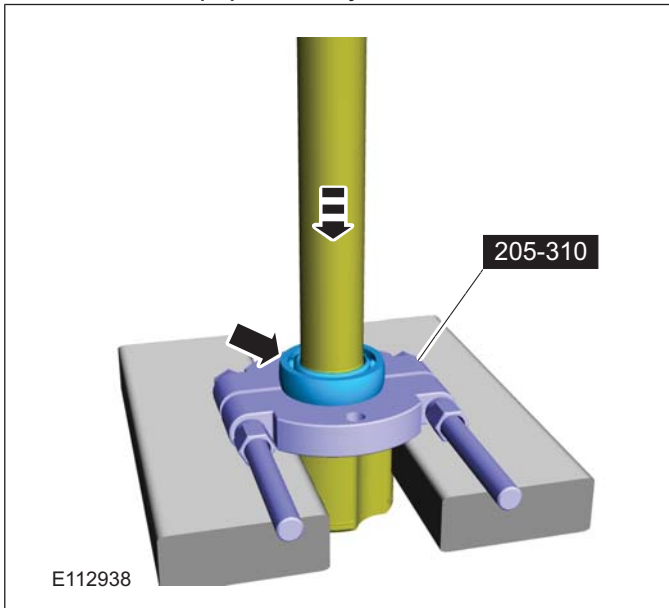
205-04-32

Front Drive Halfshafts

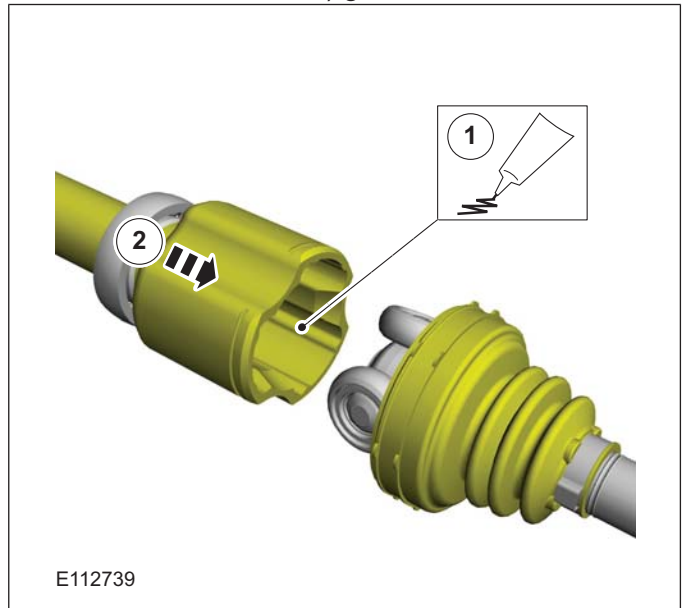
205-04-32

REMOVAL AND INSTALLATION

3. Special Tool(s): 205-310  
General Equipment: Hydraulic Press

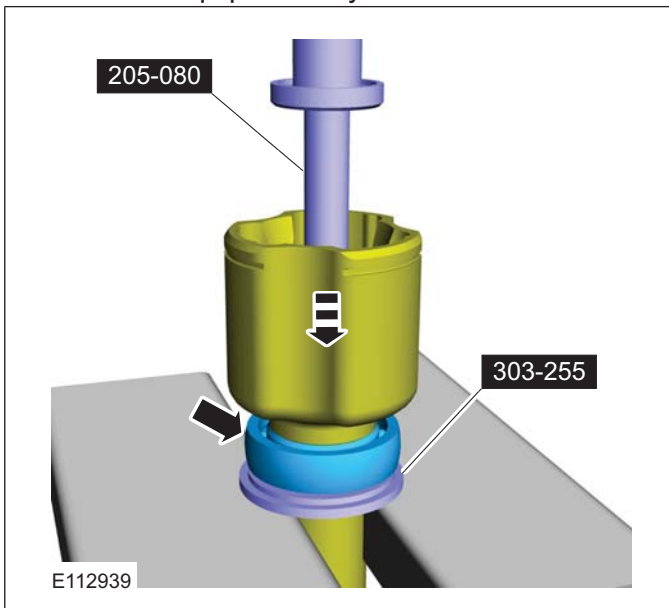


2. Material: Grease FD-R (WSS-M1C259-A1 / 3M5J-M1C259-AA) grease

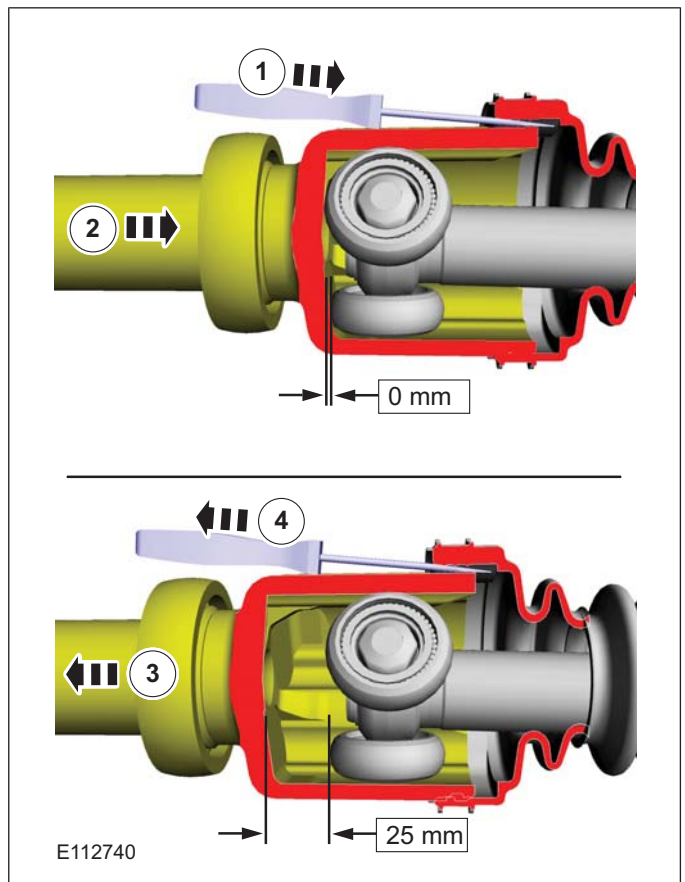


Installation

1. Special Tool(s): 205-080, 303-255  
General Equipment: Hydraulic Press



3. 1. Release any trapped air.  
General Equipment: Flat-bladed screwdriver  
4. General Equipment: Flat-bladed screwdriver



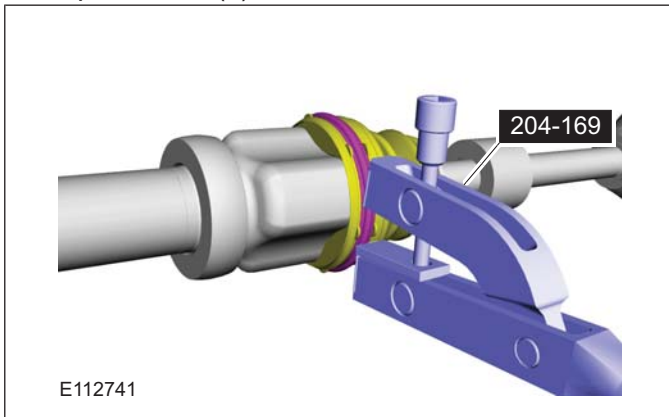
205-04-33

Front Drive Halfshafts

205-04-33

**REMOVAL AND INSTALLATION**

4. Special Tool(s): 204-169





# SECTION 205-05 Rear Drive Halfshafts

VEHICLE APPLICATION: 2008.50 Kuga

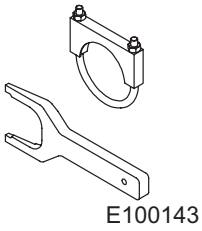
CONTENTS	PAGE
<b>REMOVAL AND INSTALLATION</b>	
Rear Halfshaft.....	205-05-2



REMOVAL AND INSTALLATION

Rear Halfshaft

Special Tool(s) / General Equipment

	<p>308-759 Remover, Rear Driveshaft</p>
<p>Cable Ties</p>	

Special Tool(s) / General Equipment

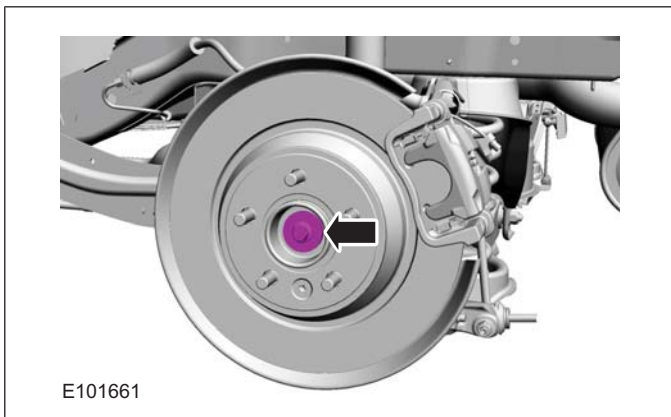
<p>Tire Lever</p>	
<p>Transmission Jack</p>	
<p><b>Materials</b></p>	
<p><b>Name</b></p>	<p><b>Specification</b></p>
<p>Sealant LGN</p>	<p>WSK-M2G349-A8 / 9U7J-M2G349-AA</p>

Removal

1. On both sides.

Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

2. On both sides.

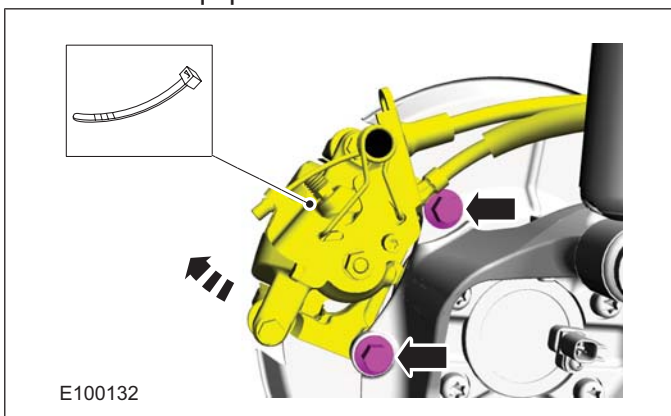


3. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

4. **WARNING:** Make sure that no load is placed on the brake hose.

On both sides.

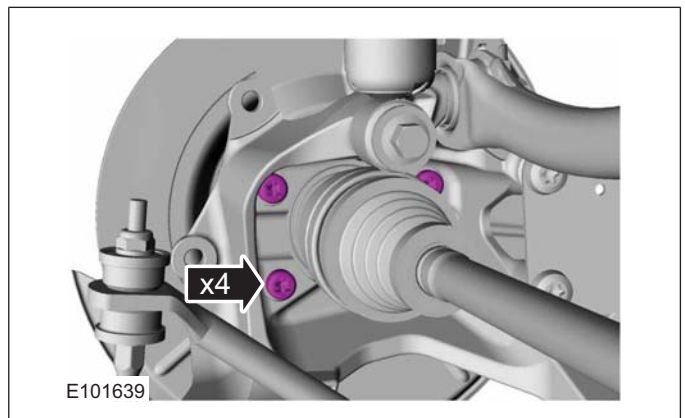
General Equipment: Cable Ties



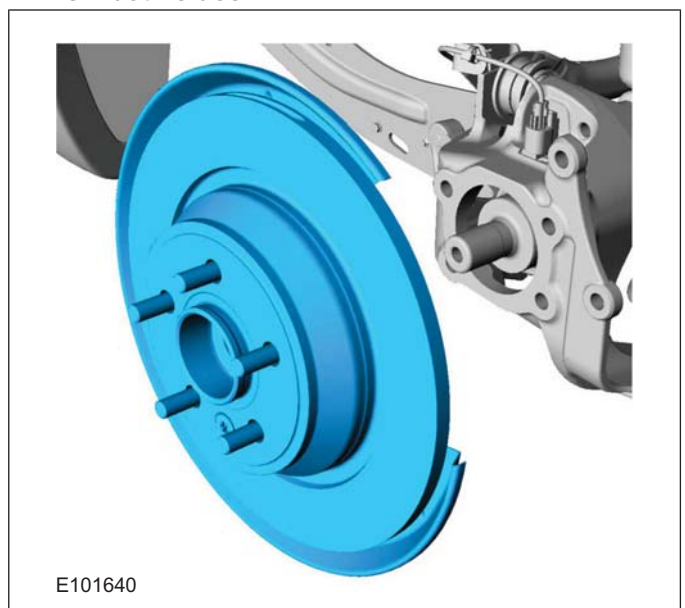
5. On both sides.

Refer to: **Spring** (204-02 Rear Suspension, Removal and Installation).

6. On both sides.

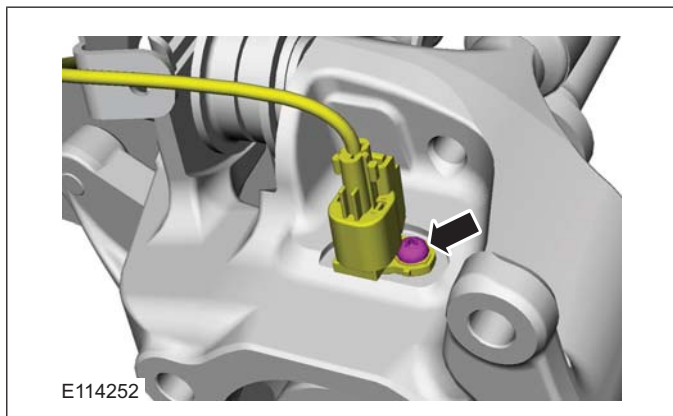


7. On both sides.

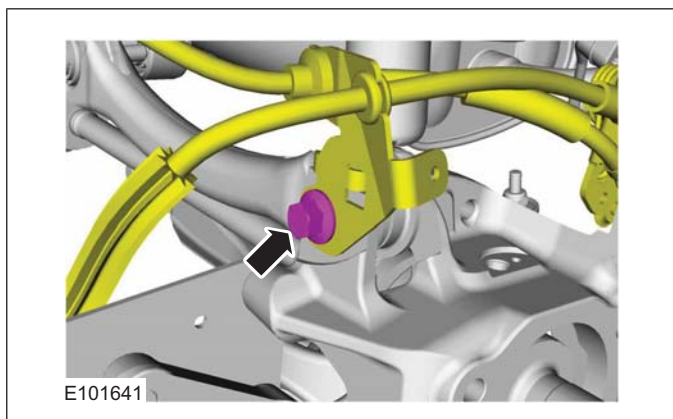


REMOVAL AND INSTALLATION

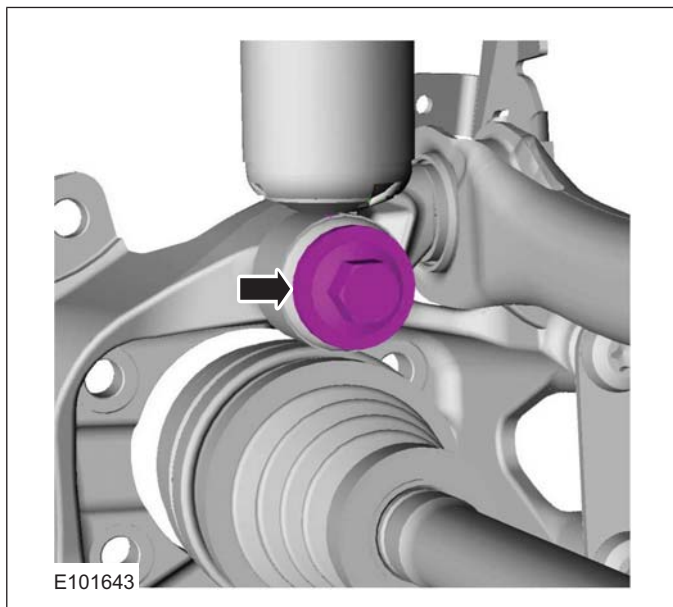
8. On both sides.



9. On both sides.

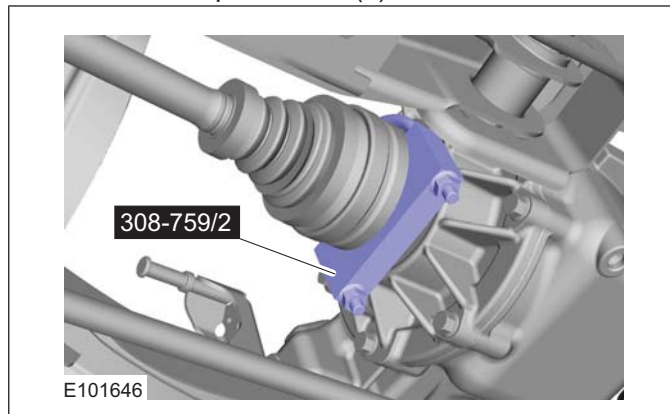


10. On both sides.

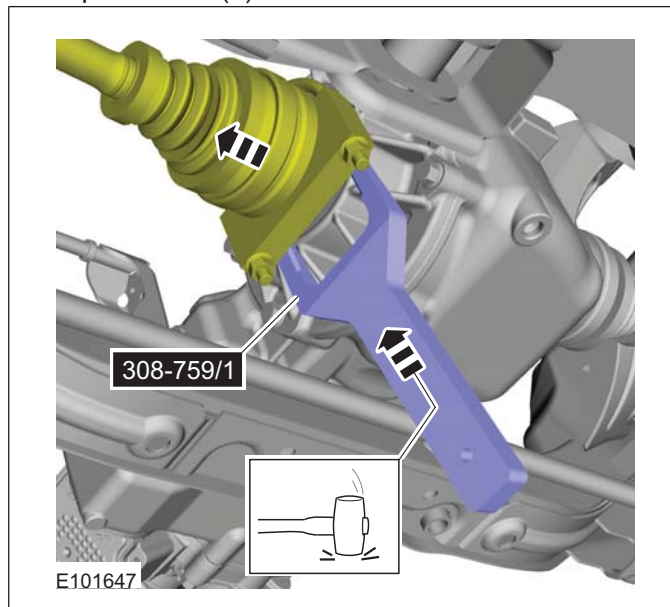


Vehicles built up to 06/2009

11. Install the Special Tool(s): 308-759



12 Special Tool(s): 308-759



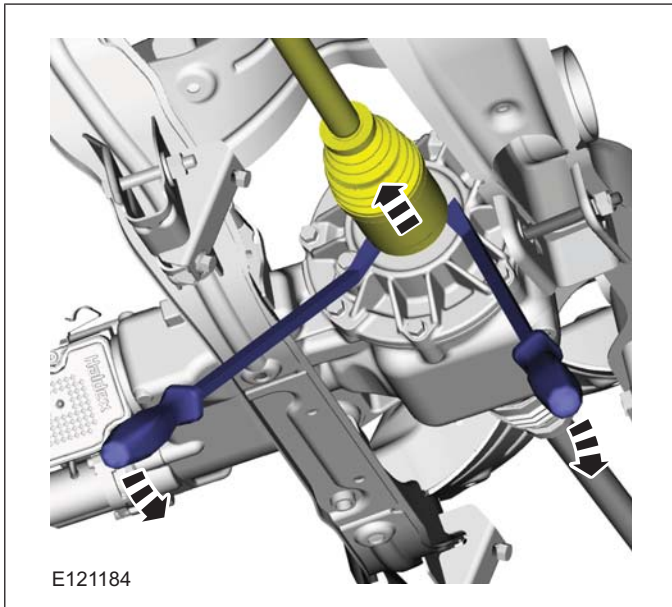


REMOVAL AND INSTALLATION

13. Remove the Special Tool(s): 308-759

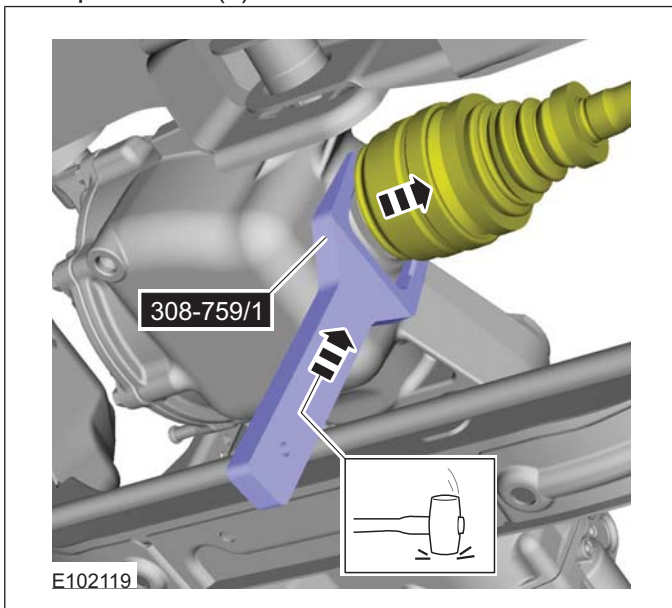
Vehicles built 07/2009 onwards

14. General Equipment: Tire Lever

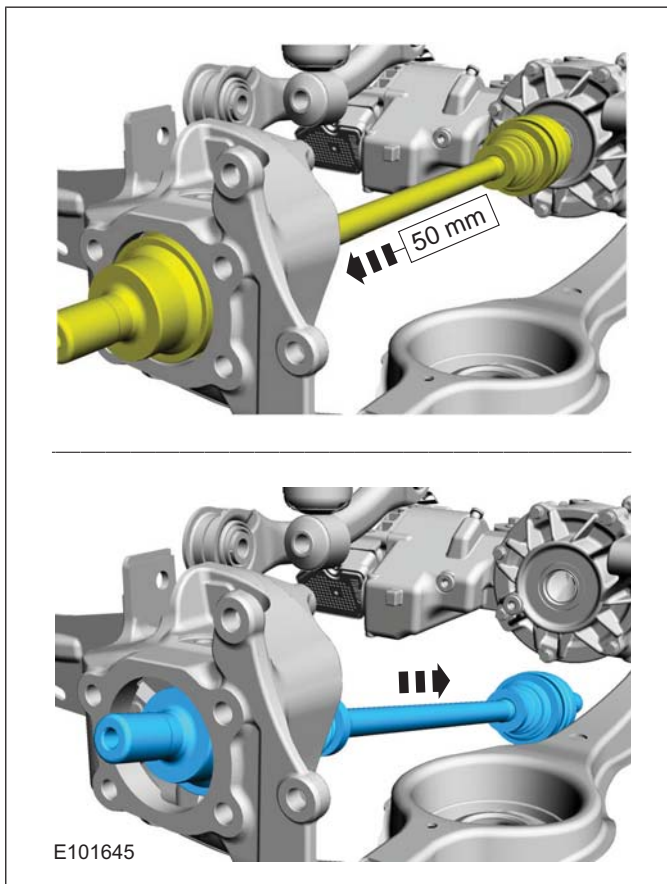


All vehicles

15. Special Tool(s): 308-759



16. On both sides.

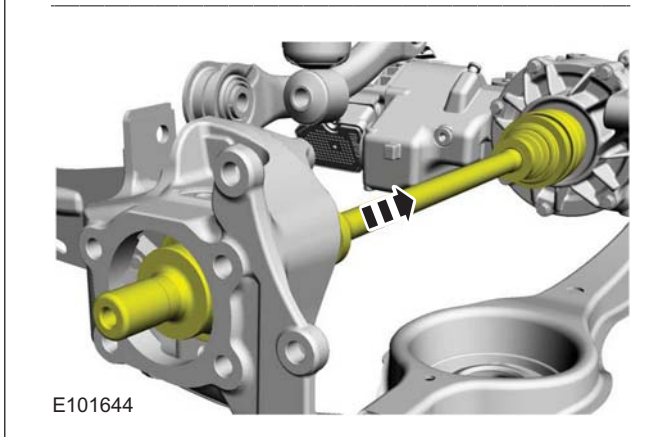
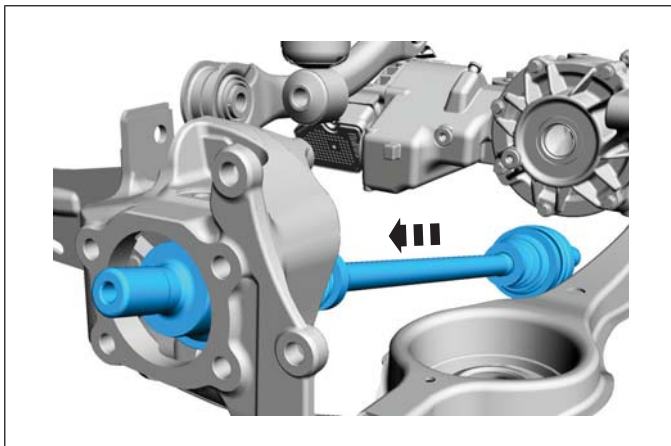




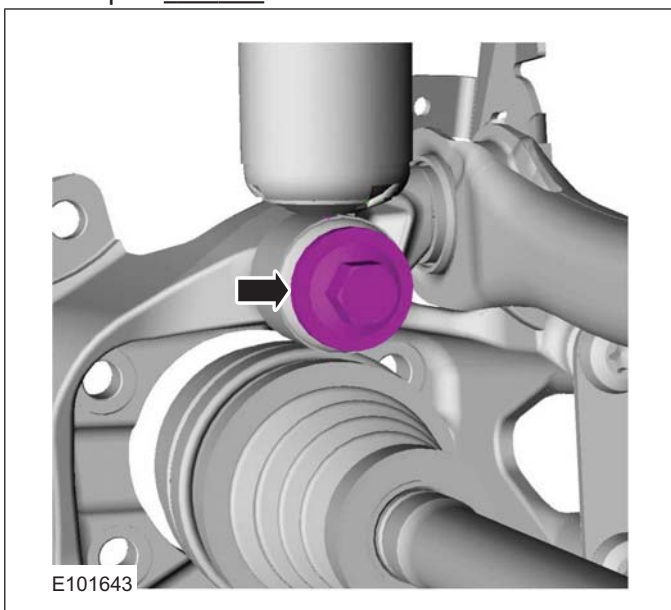
REMOVAL AND INSTALLATION

Installation

1. On both sides.

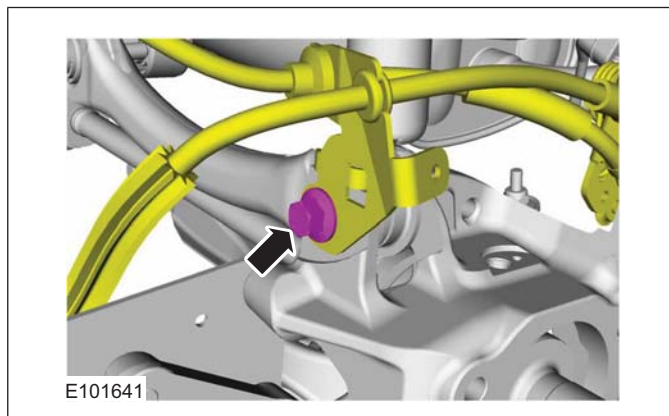


2. On both sides.  
Torque: 115 Nm

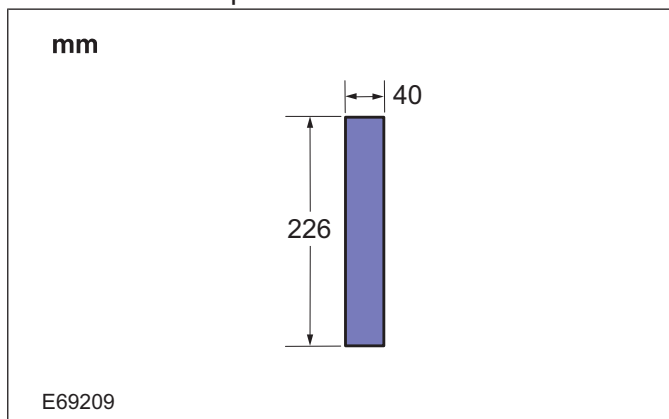


3. **NOTE:** Only tighten the bolt finger tight at this stage.

On both sides.



4. Fabricate a spacer.

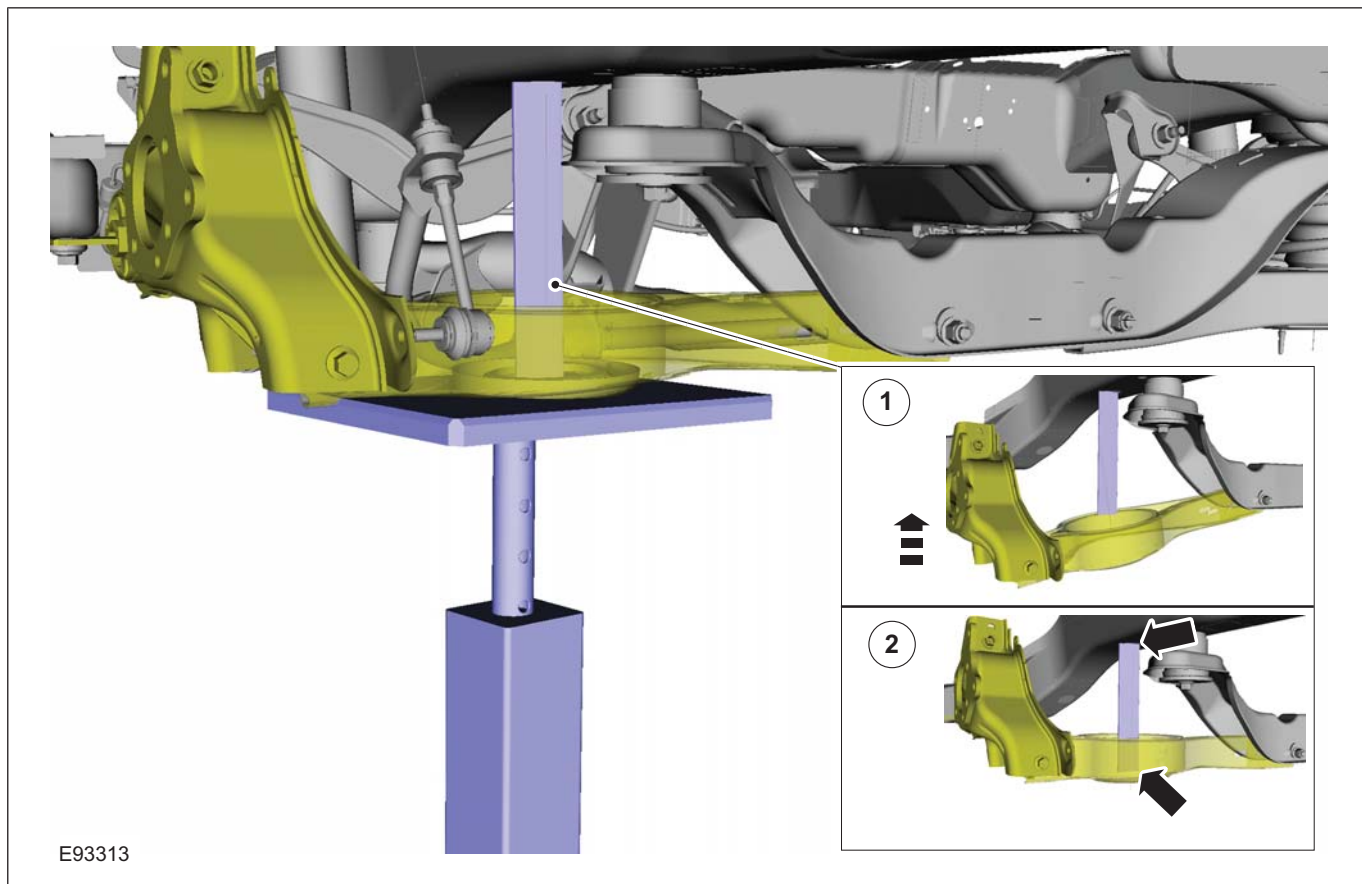


5. On both sides.

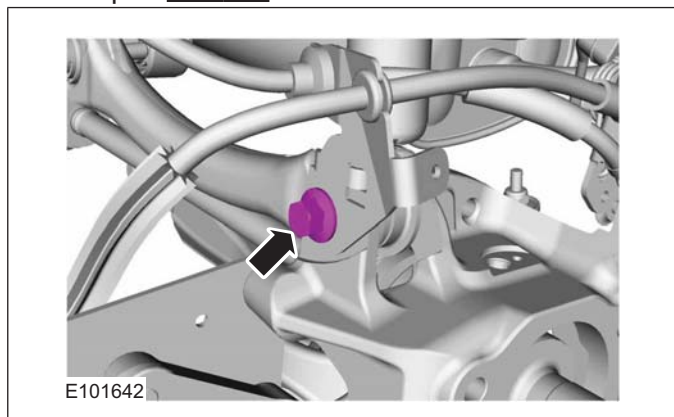
General Equipment: Transmission Jack



REMOVAL AND INSTALLATION

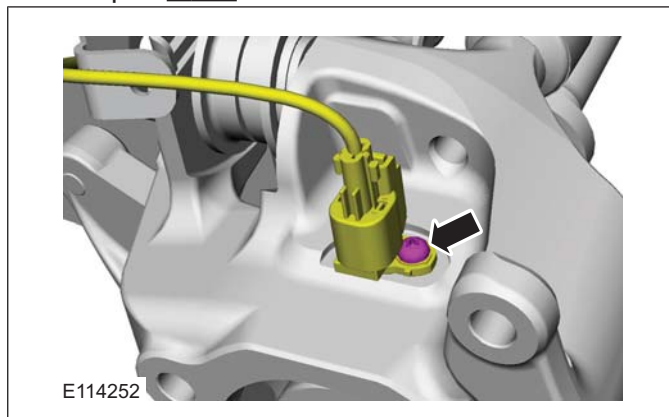


6. On both sides.  
Torque: 130 Nm



7. Remove the following items:  
1. Spacer  
2. General Equipment: Transmission Jack

8. On both sides.  
Torque: 5 Nm





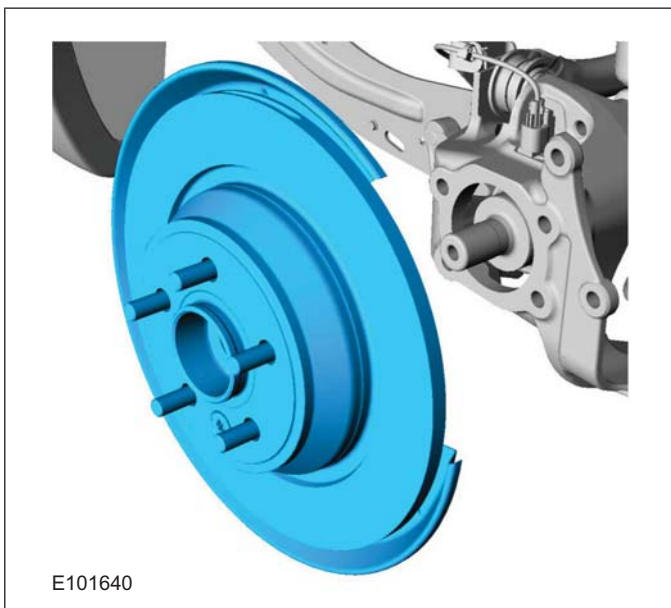
REMOVAL AND INSTALLATION

9. On both sides.

Material: Sealant LGN (WSK-M2G349-A8 / 9U7J-M2G349-AA) adhesive

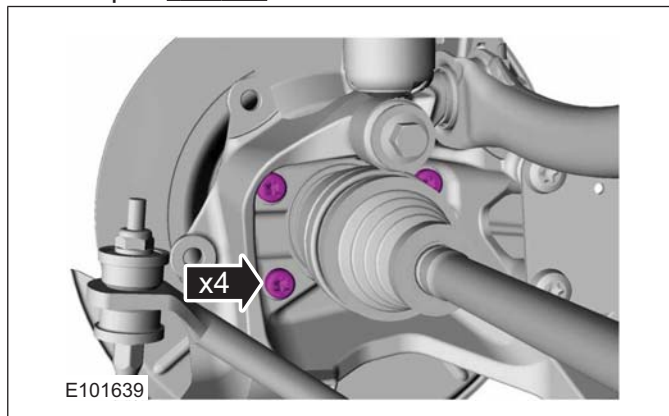


10. On both sides.



11. On both sides.

Torque: 110 Nm

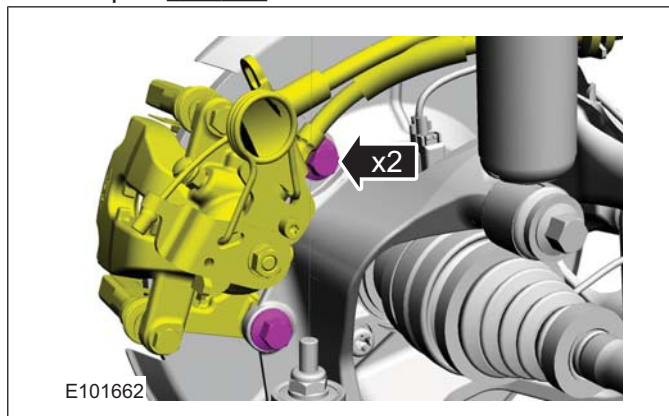


12. On both sides.

Refer to: **Spring** (204-02 Rear Suspension, Removal and Installation).

13. **WARNING:** Make sure that no load is placed on the brake hose.

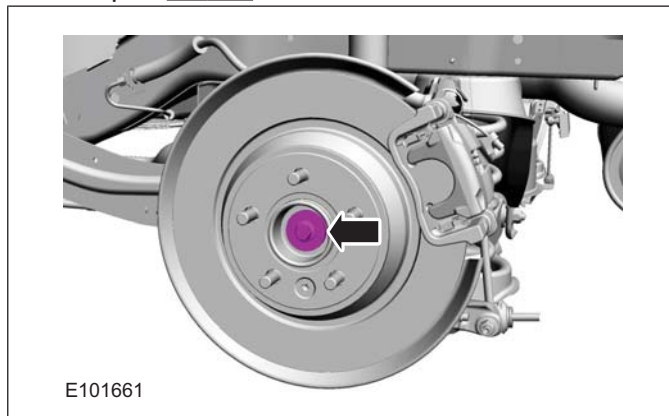
On both sides.  
Torque: 110 Nm



14. On both sides.

Material: Sealant LGN (WSK-M2G349-A8 / 9U7J-M2G349-AA) adhesive

Torque: 50 Nm



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**REMOVAL AND INSTALLATION**

15. On both sides.

Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

16. Refer to: **Differential Fluid Level Check** (205-02 Rear Drive Axle/Differential, General Procedures).

## SECTION 206-00 Brake System - General Information

### VEHICLE APPLICATION: 2008.50 Kuga

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**SPECIFICATIONS****Lubricants, Fluids, Sealers and Adhesives**

	Specification
Super DOT 4 brake fluid	ESD-M6C57-A / WSSM6C57- A2

**Front Brake Disc Specification**

	mm
Brake disc diameter	300
New brake disc nominal thickness	25
Worn brake disc discard thickness *	23
Maximum brake disc thickness variation	0.025
Worn brake pad discard thickness**	1.5
Maximum brake disc runout (installed)	0.015

\* When the discard thickness has been reached, install a new brake disc and brake pads.

\*\* When the discard thickness has been reached, install new brake pads.

**Rear Disc Brake Specification**

Description	mm
Brake disc diameter	302
New brake disc nominal thickness	11
Worn brake disc discard thickness *	9
Maximum brake disc thickness variation	0.025
Worn brake pad discard thickness **	1.5
Maximum brake disc runout (installed)	0.1

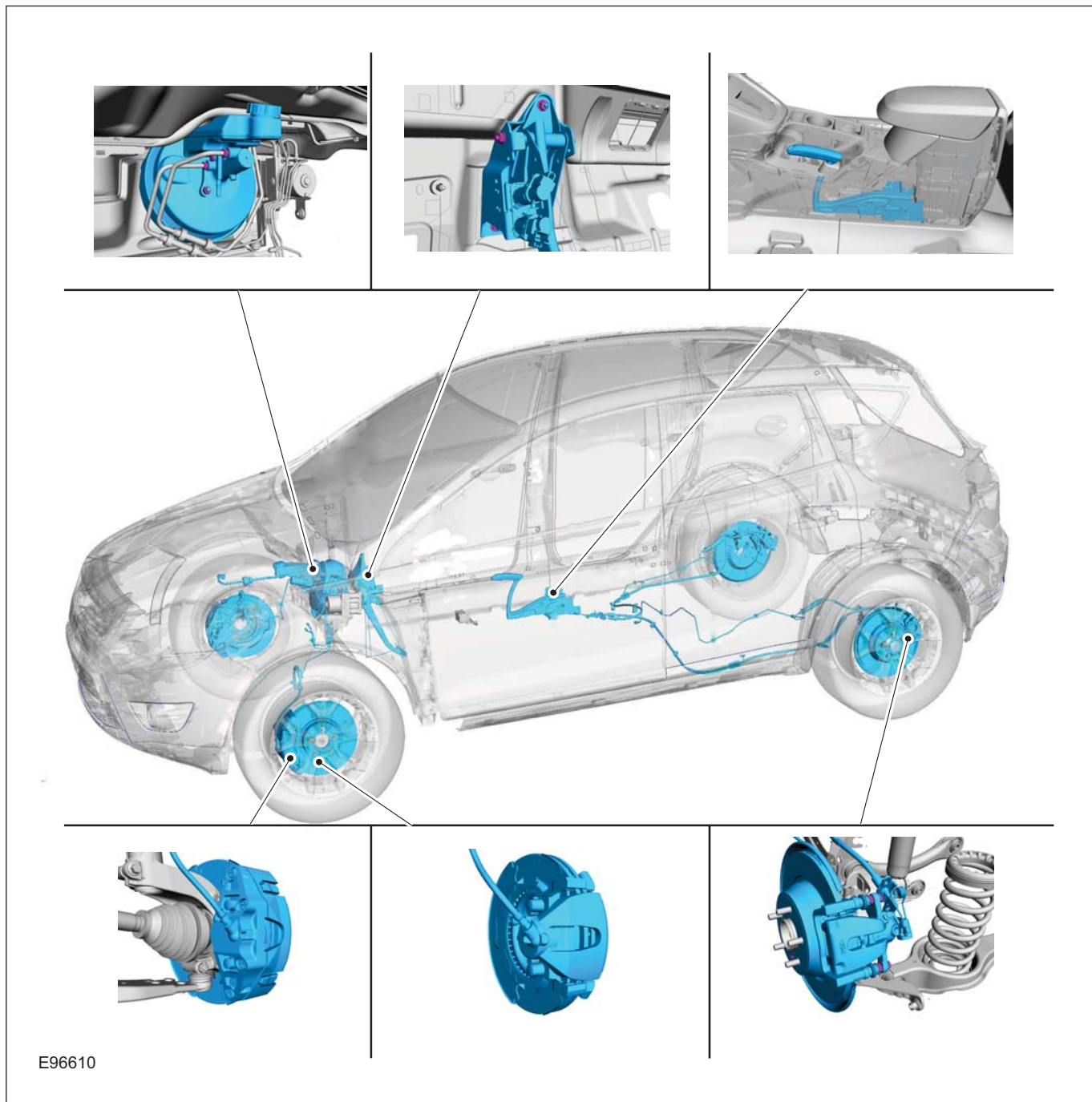
\* When the discard thickness has been reached, install a new brake disc and brake pads.

\*\* When the discard thickness has been reached, install new brake pads.

DESCRIPTION AND OPERATION

Brake System – Overview

Brake System



**DIAGNOSIS AND TESTING****Brake System****General Equipment**

Pressure/vacuum gauge set
The Ford approved diagnostic tool

The brake system operates by transferring effort applied to the brake pedal by the driver to the brakes at each wheel.

The braking effort is distributed to each wheel, using a hydraulic system. The system is assisted using a vacuum brake booster that reduces pedal effort and increases hydraulic pressure.

The parking brake operates on the rear wheels and is applied using a hand operated control.

**Inspection and Verification**

**NOTE:** Before carrying out any diagnosis, make sure that the brake system warning indicator is functional.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

Mechanical	Electrical
<ul style="list-style-type: none"> <li>• Tire pressure(s)</li> <li>• Wheels and tires</li> <li>• Fluid leak(s)</li> </ul>	<ul style="list-style-type: none"> <li>• Electrical connector(s)</li> <li>• Wiring harness(s)</li> <li>• Switch(es)</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the case (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

**Road Test**

Carry out a road test to compare actual vehicle braking performance with the performance standards expected by the driver. The ability of the test driver to make valid comparisons and detect performance deficiencies will depend on experience.

The driver should have a thorough knowledge of the brake system operation and accepted general

performance guidelines to make good comparisons and detect performance concerns.

An experienced technician will always establish a route that will be used for all brake diagnosis road tests. The road selected will be reasonably smooth and level. Gravel or bumpy roads are not suitable because the surface does not allow the tires to grip the road equally. Crowned roads should be avoided because of the large amount of weight shifted to the low set of wheels on this type of road. Once the route is established and consistently used, the road surface variable can be eliminated from the test results.

Before a road test, get a complete description of the customer concerns or suspected condition. From the description, the technician will be able to match possible causes with symptoms. Certain components will be identified as possible sources while others will be eliminated by the evidence. More importantly, the customer description can reveal unsafe conditions which should be checked or corrected before a road test. The description will also help form the basic approach to the road test by narrowing the concern to specific components, vehicle speed or conditions.

Begin the road test with a general brake performance check. Using the description of the concern, test the brakes at different vehicle speeds using both light and heavy pedal pressure. Determine if the concern is in the front or rear braking system. First use the foot brake and then the parking brake. If the condition (i.e. pull, vibration, pulsation) occurs only on operation of the parking brake, the concern is in the rear brake system. If the condition occurs when the foot brake is depressed, the concern is in the front brake system.

Avoid locking the brakes and sliding the tires. This condition will not indicate brake efficiency. A heavily braked but turning wheel will stop the vehicle in a shorter distance than locked wheels.

If the concern becomes evident during this check, make sure it fits the description given before the road test. If the concern is not evident, attempt to duplicate the condition using the information from the description.

If a concern exists, use the Brake System Symptom Chart in order to isolate it to a specific sub-system and condition description. From this description, a list of possible sources can be used to further

## DIAGNOSIS AND TESTING

narrow the cause to a specific component or condition.

## Symptom Chart

Symptom	Possible Sources	Action
• Brakes pull or drift	• Worn or damaged brake shoes or brake pads and linings.	• INSTALL new brake shoes or brake pads. REFER to: <b>Brake Pads</b> (206-03 Front Disc Brake, Removal and Installation).
	• Abnormal wear or distortion of front brake disc.	• INSTALL a new front brake disc. REFER to: <b>Brake Caliper</b> (206-03 Front Disc Brake, Removal and Installation).
	• Incorrect rear brake adjustment.	• ADJUST the parking brake cable. REFER to: <b>Parking Brake Cable Adjustment</b> (206-05 Parking Brake and Actuation, General Procedures).
	• Incorrect wheel alignment adjustment.	• ADJUST the wheel alignment. REFER to: (204-00 Suspension System - General Information) <b>Front Toe Adjustment</b> (General Procedures), <b>Rear Toe Adjustment</b> (General Procedures).
	• Incorrect wheel bearing preload adjustment.	• ADJUST or INSTALL a new wheel bearing. REFER to: <b>Front Wheel Bearing</b> (204-01 Front Suspension, Removal and Installation).
	• Grease or fluid on the brake shoes or brake pads; glazed linings.	• INSTALL new brake shoes or brake pads. REFER to: <b>Brake Pads</b> (206-03 Front Disc Brake, Removal and Installation).
	• Stuck or seized wheel cylinders or brake calipers.	• INSTALL a new wheel cylinder or brake caliper. REFER to: <b>Brake Caliper</b> (206-04 Rear Disc Brake, Removal and Installation).
• The red brake warning indicator is always on	• Low brake fluid level.	• FILL the reservoir. CHECK the brake and clutch system for leaks including brake fluid in the brake booster.

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Leaking brake master cylinder primary piston cup.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new brake master cylinder.</li> <li>REFER to: <b>Brake Master Cylinder - 2.5L Duratec (147kW/200PS) - VI5</b> (206-06 Hydraulic Brake Actuation, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Parking brake control not fully released.</li> </ul>	<ul style="list-style-type: none"> <li>FREE UP and ADJUST the parking brake cable.</li> <li>REFER to: <b>Parking Brake Cable Adjustment</b> (206-05 Parking Brake and Actuation, General Procedures).</li> <li>INSTALL new components as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Malfunctioning anti-lock braking system (ABS).</li> </ul>	<ul style="list-style-type: none"> <li>REFER to: <b>Anti-Lock Control</b> (206-09 Anti-Lock Control, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Shorted indicator circuit.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to: <b>Instrument Cluster</b> (413-01 Instrument Cluster, Diagnosis and Testing).</li> </ul>
<ul style="list-style-type: none"> <li>Vibration when the brakes are applied</li> </ul>	<ul style="list-style-type: none"> <li>Grease or fluid on the brake shoes or brake pads; glazed linings.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL new brake shoes or brake pads.</li> <li>REFER to: <b>Brake Pads</b> (206-03 Front Disc Brake, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Worn or damaged brake shoes or brake pads.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL new brake shoes or brake pads.</li> <li>REFER to: <b>Brake Pads</b> (206-03 Front Disc Brake, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Loose caliper mounting bolt(s).</li> </ul>	<ul style="list-style-type: none"> <li>TIGHTEN the caliper mounting bolt(s).</li> </ul>
	<ul style="list-style-type: none"> <li>Excessive brake disc thickness variation or brake disc runout.</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
	<ul style="list-style-type: none"> <li>Wheels and tires.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the tires. BALANCE or INSTALL new tires as necessary.</li> <li>REFER to: <b>Wheels and Tires</b> (204-04 Wheels and Tires, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Loose or missing wheel hub bolts.</li> </ul>	<ul style="list-style-type: none"> <li>TIGHTEN or INSTALL new wheel hub bolts as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Worn or damaged brake drums or brake discs.</li> </ul>	<ul style="list-style-type: none"> <li>CARRY OUT a brake disc runout check.</li> </ul>

206-00-7

## Brake System - General Information

206-00-7

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
• Pedal goes down fast	• Low brake fluid level.	• FILL the reservoir. CHECK the brake and clutch system for leaks including brake fluid in the brake booster.
	• Leak in the hydraulic system.	• REPAIR the leak. CHECK the entire hydraulic system. FILL and BLEED the brake system. REFER to: (206-00 Brake System - General Information) <b>Brake System Bleeding</b> (General Procedures), <b>Brake System Pressure Bleeding</b> (General Procedures), <b>Component Bleeding</b> (General Procedures).
	• Air in the system.	• CHECK for leaks. BLEED the brake system. REFER to: (206-00 Brake System - General Information) <b>Brake System Bleeding</b> (General Procedures), <b>Brake System Pressure Bleeding</b> (General Procedures), <b>Component Bleeding</b> (General Procedures).
	• Brake disc "brake knock back" (Brake pads push the brake caliper piston back into the brake caliper. Caused by excessive brake disc lateral runout or loose wheel bearings.)	• CARRY OUT a brake disc runout check.
	• Worn brake shoes or brake pads.	• INSTALL new brake shoes or brake pads. REFER to: <b>Brake Pads</b> (206-03 Front Disc Brake, Removal and Installation).
	• Worn brake master cylinder piston cups or scored cylinder bore.	• GO to <b>Pinpoint Test A</b> .



206-00-8

## Brake System - General Information

206-00-8

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>Pedal eases down slowly</li> </ul>	<ul style="list-style-type: none"> <li>Air in the system.</li> </ul>	<ul style="list-style-type: none"> <li>BLEED the brake system. REFER to: <b>Brake System Pressure Bleeding</b> (206-00 Brake System - General Information, General Procedures). REFER to: (206-00 Brake System - General Information) <b>Brake System Bleeding</b> (General Procedures), <b>Component Bleeding</b> (General Procedures).</li> </ul>
	<ul style="list-style-type: none"> <li>Malfunctioning brake master cylinder.</li> <li>Low engine vacuum (stationary).</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test B.</b></li> </ul>
<ul style="list-style-type: none"> <li>Pedal is low or feels spongy</li> </ul>	<ul style="list-style-type: none"> <li>Worn brake shoes or brake pads.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL new brake shoes or brake pads. REFER to: <b>Brake Pads</b> (206-03 Front Disc Brake, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Air in the system.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK for leaks. BLEED the brake system. REFER to: (206-00 Brake System - General Information) <b>Brake System Bleeding</b> (General Procedures), <b>Brake System Pressure Bleeding</b> (General Procedures), <b>Component Bleeding</b> (General Procedures).</li> </ul>
<ul style="list-style-type: none"> <li>Brake lockup during light brake pedal force</li> </ul>	<ul style="list-style-type: none"> <li>Glazed or worn brake shoes or brake pads.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL new brake shoes or brake pads. REFER to: <b>Brake Pads</b> (206-03 Front Disc Brake, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Brake booster.</li> <li>Low engine vacuum.</li> </ul>	<ul style="list-style-type: none"> <li>GO to <b>Pinpoint Test C.</b></li> </ul>
<ul style="list-style-type: none"> <li>Excessive or erratic pedal travel</li> </ul>	<ul style="list-style-type: none"> <li>Worn brake shoes or brake pads.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL new brake shoes or brake pads. REFER to: <b>Brake Pads</b> (206-03 Front Disc Brake, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Wheel bearings</li> </ul>	<ul style="list-style-type: none"> <li>CARRY OUT a brake disc runout check.</li> </ul>

206-00-9

## Brake System - General Information

206-00-9

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
• Brake drag	• Incorrectly adjusted parking brake or brake pedal switch	• ADJUST the parking brake cable or switch REFER to: <b>Parking Brake Cable Adjustment</b> (206-05 Parking Brake and Actuation, General Procedures).
	• Brake booster.	• REFER to brake booster operation check in this procedure.
	• Seized wheel cylinder or brake caliper.	• INSTALL a new wheel cylinder or brake caliper. REFER to: <b>Brake Caliper</b> (206-03 Front Disc Brake, Removal and Installation).
	• Seized brake caliper slide pins.	• INSTALL a new brake caliper. REFER to: <b>Brake Caliper</b> (206-03 Front Disc Brake, Removal and Installation).
	• Seized parking brake cables.	• INSTALL new parking brake cables. REFER to: <b>Parking Brake Cable Adjustment</b> (206-05 Parking Brake and Actuation, General Procedures).
	• Parking brake not fully released.	• Check the parking brake lever position and make sure there are no obstructions.
	• Brake hose incorrectly fitted.	• Check all brake hose(s) for correct fitment. REFER to: <b>Rear Brake Flexible Hose</b> (206-04 Rear Disc Brake, Removal and Installation) / <b>Front Brake Flexible Hose</b> (206-03 Front Disc Brake, Removal and Installation).
• Excessive brake pedal effort	• Worn or contaminated brake shoes or brake pads.	• INSTALL new brake shoes or brake pads. REFER to: <b>Brake Pads</b> (206-03 Front Disc Brake, Removal and Installation).
	• Malfunctioning vacuum pump (diesel).	• INSTALL a new brake vacuum pump.
	• Disconnected or damaged brake booster vacuum pipe.	• CONNECT or INSTALL a new brake booster vacuum pipe as necessary.
	• Brake booster.	• GO to <b>Pinpoint Test D</b> .

206-00-10

## Brake System - General Information

206-00-10

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
• Brake noise	• Worn or damaged brake shoes or brake pads.	• INSTALL new brake shoes or brake pads. REFER to: <b>Brake Pads</b> (206-03 Front Disc Brake, Removal and Installation).
	• Brake booster.	• GO to <b>Pinpoint Test E</b> .
• Slow or incomplete brake pedal return	• Brake booster. • Seized brake pedal pivot.	• GO to <b>Pinpoint Test F</b> .

## Pinpoint Tests

## PINPOINT TEST A : PEDAL GOES DOWN FAST

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A1: PRESSURIZE THE SYSTEM</b>	
	<p>1 Pump the foot brake rapidly five times.</p> <ul style="list-style-type: none"> <li>Does the brake pedal height build up and then hold?</li> </ul> <p>→ <b>Yes</b> CHECK parking brake adjustment and ADJUST as necessary. REFER to: <b>Parking Brake Cable Adjustment</b> (206-05 Parking Brake and Actuation, General Procedures). If the condition still exists. BLEED the brake system. REFER to: (206-00 Brake System - General Information) <b>Brake System Bleeding</b> (General Procedures), <b>Brake System Pressure Bleeding</b> (General Procedures), <b>Component Bleeding</b> (General Procedures). TEST the system for normal operation.</p> <p>→ <b>No</b> <b>GO to A2.</b></p>

206-00-11

## Brake System - General Information

206-00-11

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A2: CHECK FOR BRAKE SYSTEM LEAKS</b>	
	<p>1 Check for external brake and clutch system leaks. Refer to Brake Master Cylinder Component Test in this procedure.</p> <ul style="list-style-type: none"> <li>Are any leaks present?</li> </ul> <p>→ <b>Yes</b> REPAIR as necessary. ADD fluid and BLEED the brake system. REFER to: (206-00 Brake System - General Information)</p> <p><b>Brake System Bleeding</b> (General Procedures), <b>Brake System Pressure Bleeding</b> (General Procedures), <b>Component Bleeding</b> (General Procedures). TEST the system for normal operation.</p> <p>→ <b>No</b> GO to A3.</p>
<b>A3: PERFORM A BRAKE MASTER CYLINDER BYPASS CONDITION TEST</b>	
	<p>1 Carry out a brake master cylinder bypass Condition Test. Refer to the Brake Master Cylinder Component Test in this procedure.</p> <ul style="list-style-type: none"> <li>Was a concern found?</li> </ul> <p>→ <b>Yes</b> INSTALL a new brake master cylinder. REFER to: <b>Brake Master Cylinder - 2.5L Duratec (147kW/200PS) - VI5</b> (206-06 Hydraulic Brake Actuation, Removal and Installation). TEST the system for normal operation.</p> <p>→ <b>No</b> VERIFY the customer concern.</p>

## PINPOINT TEST B : PEDAL EASES DOWN SLOWLY

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B1: CHECK THE BRAKE PEDAL OPERATION</b>	
	<p>1 Depress the brake pedal.</p> <ul style="list-style-type: none"> <li>Does the pedal ease down slowly?</li> </ul> <p>→ <b>Yes</b> <b>GO to B2.</b></p> <p>→ <b>No</b> Refer to the Brake Master Cylinder Component Test in this procedure.</p>

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B2: CHECK FOR BRAKE SYSTEM LEAKS</b>	
	<p>1 Check for external brake system leaks.</p> <ul style="list-style-type: none"> <li>Are any leaks present?</li> </ul> <p>→ <b>Yes</b> REPAIR as necessary. ADD fluid and BLEED the brake system. REFER to: (206-00 Brake System - General Information)</p> <p><b>Brake System Bleeding</b> (General Procedures), <b>Brake System Pressure Bleeding</b> (General Procedures), Component Bleeding (General Procedures). TEST the system for normal operation.</p> <p>→ <b>No</b> GO to B3.</p>
<b>B3: PERFORM A BRAKE MASTER CYLINDER BYPASS CONDITION TEST</b>	
	<p>1 Carry out a brake master cylinder bypass Condition Test. Refer to the Brake Master Cylinder Component Test in this procedure.</p> <ul style="list-style-type: none"> <li>Was a concern found?</li> </ul> <p>→ <b>Yes</b> INSTALL a new brake master cylinder. REFER to: <b>Brake Master Cylinder - 2.5L Duratec (147kW/200PS) - VI5</b> (206-06 Hydraulic Brake Actuation, Removal and Installation). TEST the system for normal operation.</p> <p>→ <b>No</b> GO to B4.</p>
<b>B4: CHECK THE BRAKE BOOSTER CHECK VALVE</b>	
	<p>1 Disconnect the brake booster check valve vacuum hose at the manifold.</p> <p>2 Blow into the hose attached to the brake booster check valve.</p> <ul style="list-style-type: none"> <li>Does air pass through the valve?</li> </ul> <p>→ <b>Yes</b> INSTALL a new brake booster check valve.</p> <p>→ <b>No</b> GO to B5.</p>
<b>B5: CHECK THE BRAKE BOOSTER CHECK VALVE VACUUM</b>	
	<p>1 Run the engine at idle.</p>

206-00-13

## Brake System - General Information

206-00-13

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
	<p>2 Using a suitable vacuum gauge, check the vacuum pressure.</p> <ul style="list-style-type: none"> <li>Is the vacuum pressure above 40.5 kPa (0.4 bar) with the brake booster non-operational?</li> </ul> <p>→ <b>Yes</b> VERIFY the customer concern.</p> <p>→ <b>No</b> INSTALL a new brake booster check valve vacuum hose. TEST the system for normal operation.</p>

## PINPOINT TEST C : BRAKE LOCK UP DURING LIGHT BRAKE PEDAL FORCE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>C1: CHECK THE BRAKE BOOSTER</b>	
	<p>1 Check the brake booster push rod alignment and pedal travel.</p> <ul style="list-style-type: none"> <li>Is the push rod and pedal travel OK?</li> </ul> <p>→ <b>Yes</b> TEST the brake pedal application. GO to Pinpoint Test D.</p> <p>→ <b>No</b> INSTALL a new brake booster. TEST the system for normal operation.</p>

## PINPOINT TEST D : EXCESSIVE BRAKE PEDAL EFFORT

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>D1: CHECK BRAKE APPLICATION</b>	
	<p>1 With the engine off, apply and release the brake pedal five times to deplete all vacuum from the brake booster. Apply the brake pedal, hold with light pressure. Start the engine.</p> <ul style="list-style-type: none"> <li>Does the brake pedal hold?</li> </ul> <p>→ <b>Yes</b> GO to D2.</p> <p>→ <b>No</b> GO to D3.</p>



206-00-14

## Brake System - General Information

206-00-14

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>D2: CHECK THE BRAKE BOOSTER FOR LEAKS</b>	
	<p>1 Run the engine at approximately 1000 rpm, release the accelerator pedal and turn the engine off. Wait 90 seconds and apply the brakes. Two or more brake applications should be power assisted.</p> <ul style="list-style-type: none"> <li>• Does the brake booster work?</li> </ul> <p>→ <b>Yes</b> VERIFY the customer concern.</p> <p>→ <b>No</b> GO to D4.</p>
<b>D3: CHECK THE BRAKE PEDAL LINKAGE</b>	
	<p>1 Disconnect the actuator rod from the pedal pin and fully depress the brake pedal.</p> <ul style="list-style-type: none"> <li>• Did the pedal move freely?</li> </ul> <p>→ <b>Yes</b> VERIFY the customer concern.</p> <p>→ <b>No</b> INSTALL new brake pedal bushings. TEST the system for normal operation.</p>
<b>D4: CHECK THE BRAKE BOOSTER CHECK VALVE</b>	
	<p>1 Disconnect the brake booster check valve vacuum hose at the manifold.</p> <p>2 Blow into the hose attached to the brake booster check valve.</p> <ul style="list-style-type: none"> <li>• Does air pass through the valve?</li> </ul> <p>→ <b>Yes</b> INSTALL a new brake booster check valve. TEST the system for normal operation.</p> <p>→ <b>No</b> GO to D5.</p>
<b>D5: CHECK THE BRAKE BOOSTER CHECK VALVE VACUUM</b>	
	<p>1 Run the engine at idle.</p>

206-00-15

## Brake System - General Information

206-00-15

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
	<p>2 Using a suitable vacuum gauge, check the vacuum pressure.</p> <ul style="list-style-type: none"> <li>Is the vacuum pressure above 40.5 kPa (0.4 bar) with the brake booster non-operational?</li> </ul> <p>→ <b>Yes</b> GO to D6.</p> <p>→ <b>No</b> INSTALL a new vacuum hose and fittings. TEST the system for normal operation.</p>
<b>D6: CHECK THE BRAKE BOOSTER</b>	
	<p>1 Check the brake booster. REFER to the Brake Booster Operation Check in this procedure.</p> <ul style="list-style-type: none"> <li>Is the brake booster OK?</li> </ul> <p>→ <b>Yes</b> VERIFY the customer concern.</p> <p>→ <b>No</b> INSTALL a new brake booster. TEST the system for normal operation.</p>

## PINPOINT TEST E : BRAKE NOISE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>E1: CHECK FOR PEDAL NOISE</b>	
	<p>1 Run the engine at idle for 10 seconds or longer.</p>
	<p>2 Apply the brake pedal and listen for noise.</p>
	<p>3 Compare results with a known good system.</p> <ul style="list-style-type: none"> <li>Was a noise present?</li> </ul> <p>→ <b>Yes</b> <b>GO to E2.</b></p> <p>→ <b>No</b> VERIFY the customer concern.</p>

206-00-16

## Brake System - General Information

206-00-16

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>E2: CHECK THE BRAKE BOOSTER</b>	
	<ol style="list-style-type: none"> <li>1 Check the brake booster push rod alignment and travel. <ul style="list-style-type: none"> <li>• Is the push rod and pedal travel OK?</li> <li>→ <b>Yes</b> BLEED the brake system. REFER to: (206-00 Brake System - General Information) <b>Brake System Bleeding</b> (General Procedures), <b>Brake System Pressure Bleeding</b> (General Procedures), <b>Component Bleeding</b> (General Procedures). TEST the system for normal operation.</li> <li>→ <b>No</b> INSTALL a new brake booster. TEST the system for normal operation.</li> </ul> </li> </ol>

## PINPOINT TEST F : SLOW OR INCOMPLETE BRAKE PEDAL RETURN

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>F1: CHECK FOR BRAKE PEDAL RETURN</b>	
	<ol style="list-style-type: none"> <li>1 Run the engine at approximately 1200 rpm whilst making several brake applications.</li> <li>2 Pull the brake pedal upwards with approximately 44.5 N (10 lbs) force.</li> <li>3 Release the brake pedal and measure the distance to the floor panel and note the reading.</li> <li>4 Make a hard brake application.</li> <li>5 Release the brake pedal and measure the distance to the floor panel and note the reading.</li> <li>6 Compare the measurements. <ul style="list-style-type: none"> <li>• Did the brake pedal return to its original position?</li> <li>→ <b>Yes</b> VERIFY the customer concern.</li> <li>→ <b>No</b> <b>GO to F2.</b></li> </ul> </li> </ol>

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>F2: CHECK FOR BRAKE PEDAL BINDING</b>	
	<ol style="list-style-type: none"> <li>1 Check the brake pedal for free operation. <ul style="list-style-type: none"> <li>• Did the brake pedal operate freely? <ul style="list-style-type: none"> <li>→ <b>Yes</b> INSTALL a new brake booster. TEST the system for normal operation.</li> <li>→ <b>No</b> INSTALL new brake pedal bushings. TEST the system for normal operation.</li> </ul> </li> </ul> </li> </ol>

## Component Tests

## Hydraulic Leak Check

**NOTE:** There is a common clutch and brake fluid reservoir, therefore it is possible that a clutch leak can lead to reduction in the reservoir level.

It is possible that all evidence of fluid leakage may have washed off if the vehicle has been operated in rain or snow, as brake fluid is water-soluble. Refill the system, bleed then apply the brakes several times. Examine the system to verify that the reservoir fluid level is actually dropping. Locate and repair the external leak. If the fluid level drops and no external leak can be found, check for a brake master cylinder bore end seal leak.

## Brake System Check

## Brake Pedal Reserve Check

Where a low brake pedal or the feel of a bottomed-out condition exists, check for brake pedal reserve.

1. Operate the engine at idle with the transaxle in the NEUTRAL position.
2. Apply the brake pedal lightly three or four times.
3. Allow 15 seconds for the vacuum to replenish the brake booster.

**NOTE:** This increased resistance may feel like something has bottomed out.

4. Apply the brake pedal until it stops moving downward or an increased resistance to the pedal travel occurs.

5. Hold the brake pedal in the applied position and raise the engine speed to approximately 2000 rpm.

**NOTE:** The additional movement of the brake pedal is the result of the increased engine manifold vacuum which exerts more force on the brake booster during engine rundown. This means that additional stroke is available in the brake master cylinder and the brake system is not bottoming out.

6. Release the accelerator pedal and observe that the brake pedal moves downward as the engine returns to idle speed.

## Brake Booster Functional Test

Inspect all hoses and connections. All unused vacuum connectors should be capped. Hoses and their connections should be correctly secured and in good condition with no holes and no collapsed areas. Inspect the check valve on the brake booster for damage.

## Brake Booster Operation Check

1. Check the hydraulic brake system for leaks or low fluid.
2. With the transaxle in the NEUTRAL position, stop the engine and apply the parking brake. Apply the brake pedal several times to exhaust all the vacuum in the system.
3. With the engine turned off and the vacuum in the system exhausted, apply the brake pedal and hold it down. Start the engine. If the vacuum system is operating, the brake pedal will tend to move downward under constant foot pressure. If no motion is felt, the vacuum booster system is not functioning.

**DIAGNOSIS AND TESTING**

4. Remove the vacuum hose from the brake booster. Manifold vacuum should be available at the brake booster end of the hose with the engine at idle speed and the transaxle in the NEUTRAL position. Make sure that all unused vacuum outlets are correctly capped, hose connectors are correctly secured and vacuum hoses are in good condition. When it is established that manifold vacuum is available to the brake booster, connect the vacuum hose to the brake booster and repeat Step 3. If no downward movement of the brake pedal is felt, install a new brake booster.
5. Operate the engine a minimum of 10 seconds at approximately 1200 rpm. Stop the engine and let the vehicle stand for 10 minutes. Then, apply the brake pedal with approximately 89 N (20 lb) force. The pedal feel (brake application) should be the same as that noted with the engine operating. If the brake pedal feels hard (no power assist), install a new vacuum check valve and then repeat the test. If the brake pedal still feels hard, install a new brake booster. If the brake pedal movement feels spongy, bleed the brake system. REFER to: (206-00 Brake System - General Information)

**Brake System Bleeding** (General Procedures),  
**Brake System Pressure Bleeding** (General Procedures),  
**Component Bleeding** (General Procedures).

**Brake Master Cylinder**

Usually, the first and strongest indicator of anything wrong with the braking system is a feeling through the brake pedal. In diagnosing the condition of the brake master cylinder, check pedal feel as evidence of a brake concern. Check for the red brake warning indicator illumination and the fluid level in the master cylinder reservoir.

**Normal Conditions**

The following conditions are considered normal and are not indications that the brake master cylinder is in need of service.

- Modern brake systems are not designed to produce as hard a pedal effort as in the past. Complaints of light pedal efforts should be compared to pedal efforts of another vehicle, of the same model and year.
- During normal operation of the brake pedal, the fluid level in the reservoir will rise during brake pedal application and fall during release. The net fluid level (i.e., after brake pedal application and release) will remain unchanged.
- A trace of brake fluid will exist on the brake booster shell below the master cylinder mounting flange. This results from the normal lubricating action of the master cylinder bore end seal.
- The fluid level will fall with brake shoe and lining wear.

**Abnormal Conditions**

**NOTE:** Prior to performing any diagnosis, make sure the brake system warning indicator is functional.

Changes in brake pedal feel or travel are indicators that something could be wrong with the braking system. The diagnostic procedure and techniques use brake pedal feel, warning indicator illumination and low brake fluid level as indicators in diagnosing braking system concerns. The following conditions are considered abnormal and indicate that the brake master cylinder is in need of service.

- The brake pedal goes down fast. This could be caused by an external or internal leak.
- The brake pedal eases down slowly. This could be caused by an external or internal leak.
- The brake pedal is low and or feels spongy. This condition may be caused by no fluid in the brake master cylinder reservoir, reservoir cap vent holes clogged or air in the hydraulic system.
- The brake pedal effort is excessive. This may be caused by a bind or obstruction in the pedal or linkage, clogged fluid control valve or insufficient booster vacuum.
- The rear brakes lock up during light pedal force. This may be caused by incorrect tire pressures, grease or fluid on the brake shoes and linings, damaged brake shoes and linings, incorrectly adjusted parking brake, or damaged or contaminated brake pressure control valves.
- The brake pedal effort is erratic. This condition could be caused by a brake booster malfunction, extreme caliper piston knock back or incorrectly installed brake shoes and linings.
- The red brake warning indicator is ON. This may be caused by low fluid level, ignition wire routing

## DIAGNOSIS AND TESTING

too close to the fluid level indicator assembly,  
or float assembly damage.

### Bypass Condition Test

1. Check the fluid in the brake master cylinder reservoir. Fill the brake master cylinder reservoir if low or empty.
2. Observe the fluid level in the brake master cylinder reservoir. If after several brake applications, the fluid level remains the same, measure the wheel turning torque required to rotate the wheels with the brakes applied as follows:

Place the transaxle in the NEUTRAL position.  
Raise and support the vehicle. REFER to: (100-02  
Jacking and Lifting)

**Jacking** (Description and Operation),  
**Lifting** (Description and Operation).

Apply the brakes with a minimum of 445 N (100 lb) and hold for approximately 15 seconds. With the brakes still applied, exert a torque on the front wheels of 10.1 Nm (75 lb ft). If either wheel rotates, install a new brake master cylinder.

REFER to: **Brake Master Cylinder - 2.5L Duratec (147kW/200PS) - VI5** (206-06 Hydraulic Brake Actuation, Removal and Installation).

### Non-Pressure Leaks

Any empty brake master cylinder reservoir condition may be caused by two types of non-pressure external leaks.

Type 1: An external leak may occur at the brake master cylinder reservoir cap because of incorrect positioning of the gasket and cap. Reposition the cap and gasket.

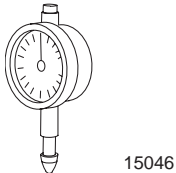
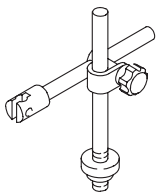
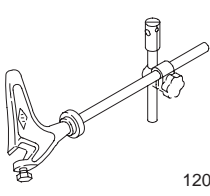
Type 2: An external leak may occur at the brake master cylinder reservoir mounting seals. Service such a leak by installing new seals.



GENERAL PROCEDURES

Brake Disc Runout Check(12 221 0)

Special Tool(s) / General Equipment

 <p>15046</p>	<p>Dial Indicator Gauge (Metric) 205-069 (15-046)</p>
 <p>15022A</p>	<p>Holding Fixture, Dial Indicator Gauge 205-070 (15-022A)</p>
 <p>12003</p>	<p>Holding Fixture, Dial Indicator Gauge (Disc Brake) 206-003 (12-003)</p>
<p>Micrometer 0-125 mm</p>	

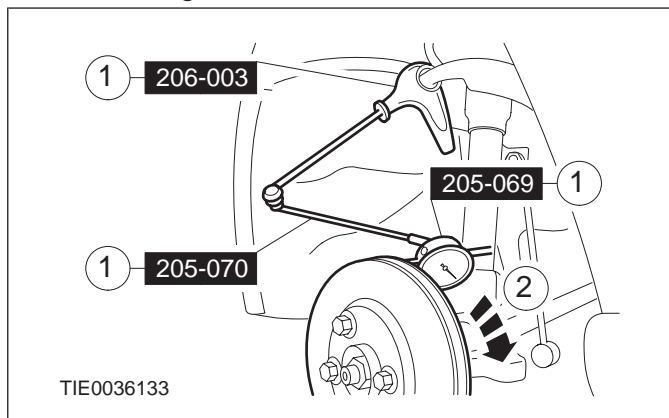
Check

1. **NOTE:** The total dial indicator gauge reading should not exceed 0.05 mm.

Using the special tools, measure the brake disc runout on the inner face of the brake disc (wheel and tire shown removed for clarity).

1. Position the dial indicator gauge so that it contacts the brake disc approximately 10 mm from the outer edge.

2. Slowly rotate the wheel and tire and note the readings.



2. **NOTE:** Using paint or typing correction fluid, mark the position of the wheel in relation to the wheel hub.

Remove the wheel and tire.

For additional information, refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

3. Remove the brake pads.

For additional information, refer to: **Brake Caliper** - Detach (206-03 Front Disc Brake, Removal and Installation) / **Brake Caliper** - Detach (206-04 Rear Disc Brake, Removal and Installation).

4. Install the wheel nuts and tighten the wheel nuts to 10 Nm, to hold the brake disc in place.

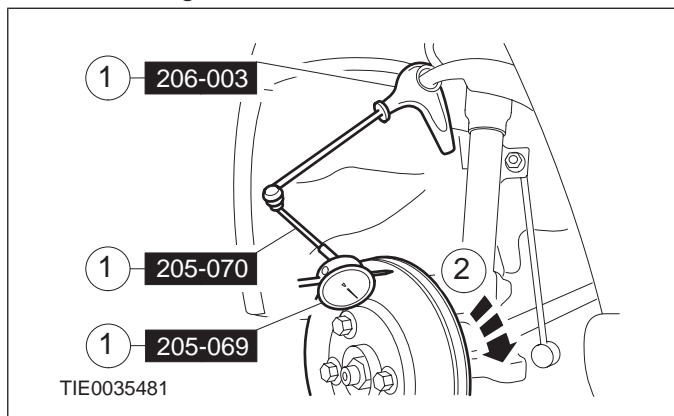
5. **NOTE:** The total dial indicator gauge reading should not exceed 0.05 mm.

Using the special tools, measure the brake disc runout on the inner and outer faces of the brake disc (outer face measurement shown).

1. Position the dial indicator gauge so that it contacts the brake disc approximately 10 mm from the outer edge.

## GENERAL PROCEDURES

2. Slowly rotate the brake disc and note the readings.



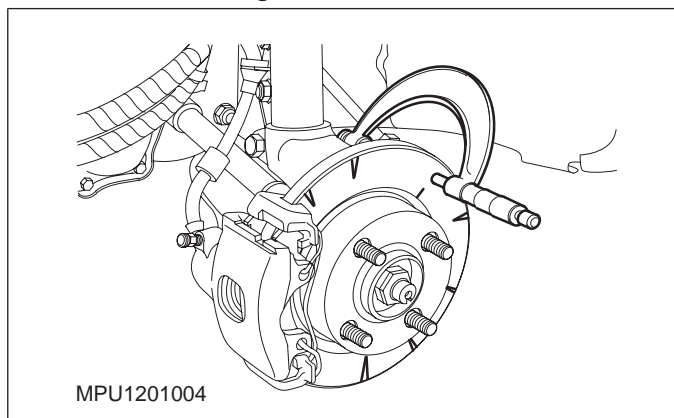
6. **NOTE:** If any of the readings vary by more than 0.015 mm or the brake disc thickness is less than the specified minimum, a new brake disc must be installed and the brake disc runout re-checked.

Check the brake disc thickness variation.

For additional information, refer to:

**Specifications** (206-00 Brake System - General Information, Specifications).

- Using a suitable micrometer, measure the brake disc thickness at eight positions, 45 degrees apart and approximately 15 mm from the outer edge of the brake disc.



7. If all the brake disc runout measurements and the thickness variation are within the specifications, check the wheel balance.
8. If just the brake disc runout measurement with the wheel and tire fitted exceeds the specification, the wheel and tire must be rotated through 90 degrees in relation to the brake disc and the brake disc runout re-checked.
- If the brake disc runout measurement still exceeds the specification, repeat the wheel

and tire rotation and checking process until the measurement is within specification.

9. If the brake disc runout measurement without the wheel and tire fitted is outside the specification, check the wheel hub face runout.

10. **NOTE:** Using paint or typing correction fluid, mark the position of the brake disc in relation to the wheel hub.

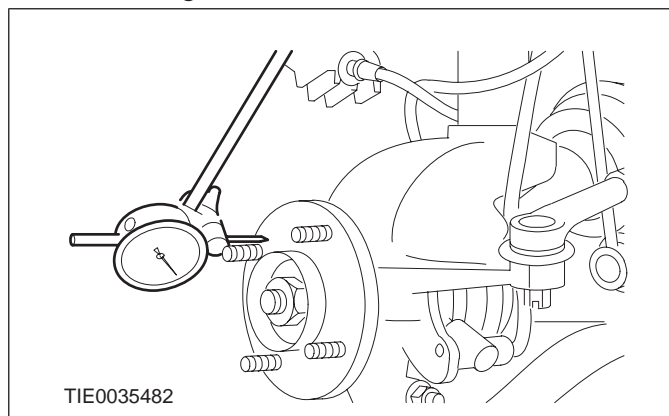
Remove the brake disc.

11. **NOTE:** Make sure that the wheel hub face is clean and free of rust and foreign material.

**NOTE:** Re-position the dial indicator gauge so that it contacts the wheel hub approximately 10 mm from the outer edge of the wheel hub.

Check the wheel hub face runout.

- Slowly rotate the wheel hub and note the readings.



12. If the wheel hub runout exceeds 0.03 mm, install a new wheel hub.

For additional information, refer to: **Wheel Hub** (204-01 Front Suspension, Removal and Installation)

/ **Wheel Bearing and Wheel Hub** (204-02 Rear Suspension, Removal and Installation).

13. If the wheel hub face runout is within specification, install a new brake disc.

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Brake System - General Information

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## GENERAL PROCEDURES

## Component Bleeding

## General Equipment

Fluid Container

## Bleeding

**NOTE:** Make sure that the vehicle is standing on a level surface.

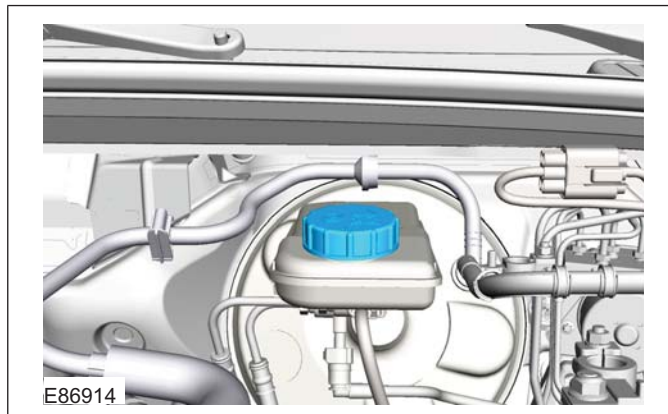
1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).

Vehicles with stability assist

2. Bleed the brake system using the BleedMASTER function in the diagnostic tool.

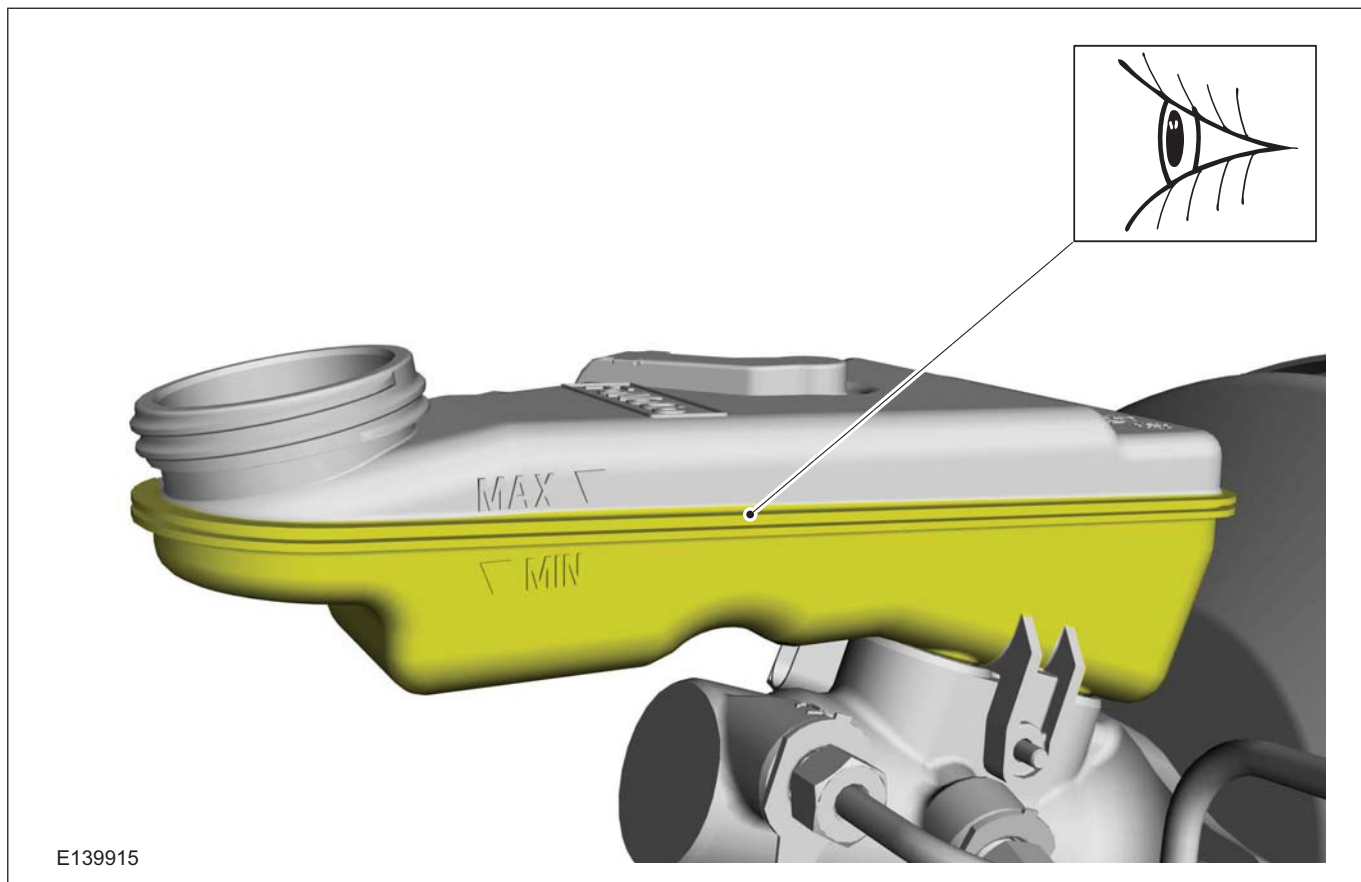
Vehicles without stability assist

3.



4. **CAUTION:** The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

Refer to: **Specifications** (206-00 Brake System - General Information, Specifications).



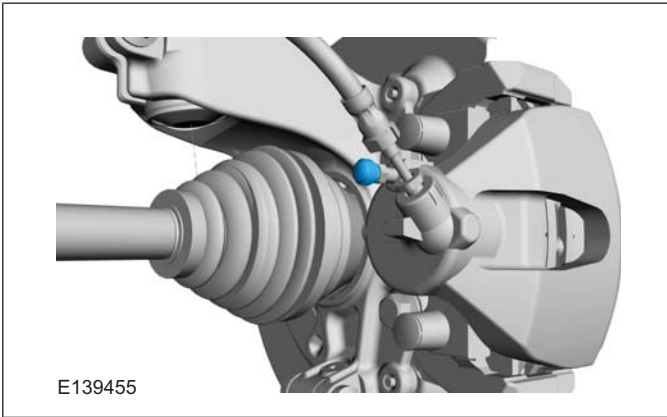
206-00-23

Brake System - General Information

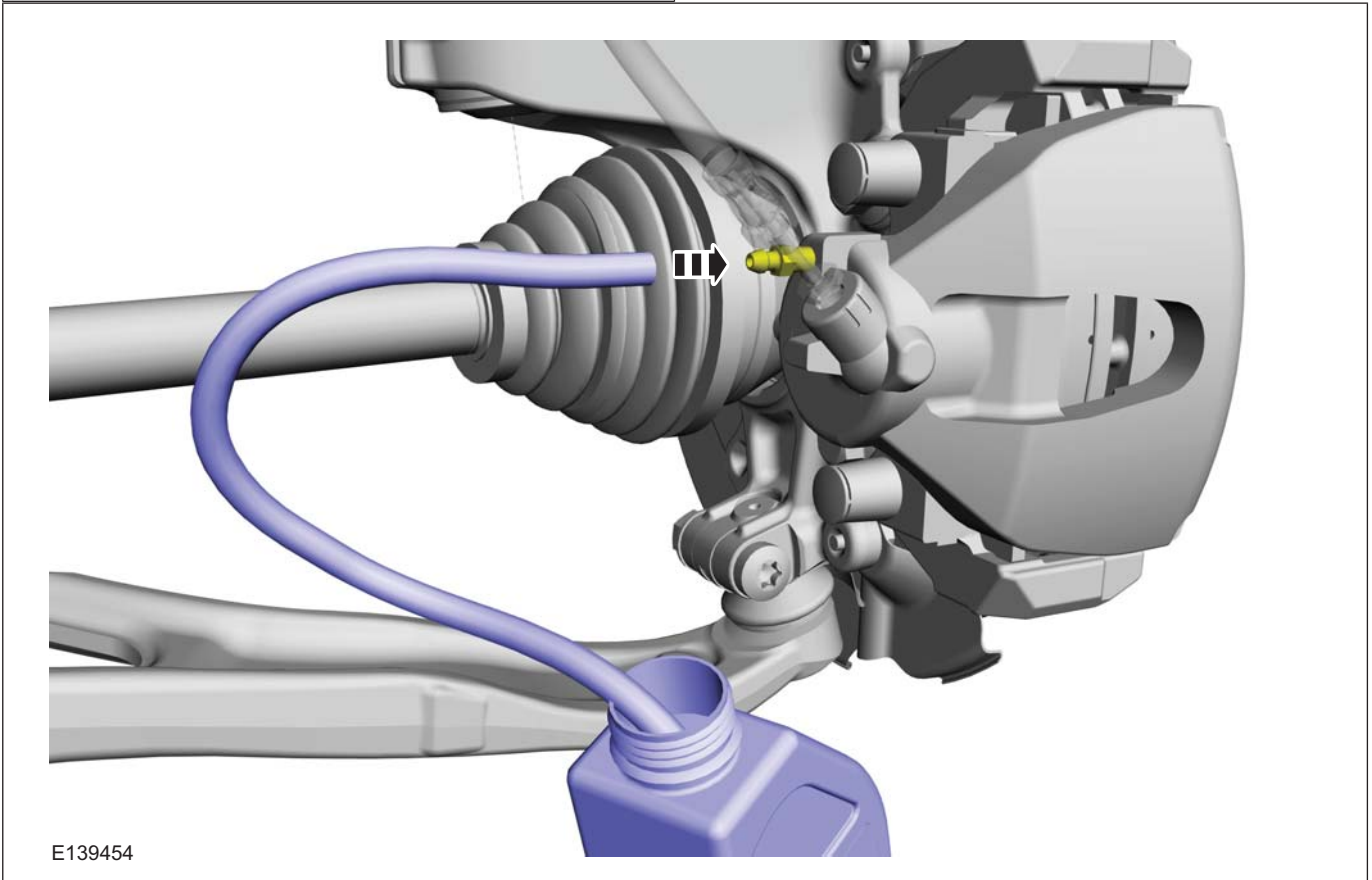
206-00-23

## GENERAL PROCEDURES

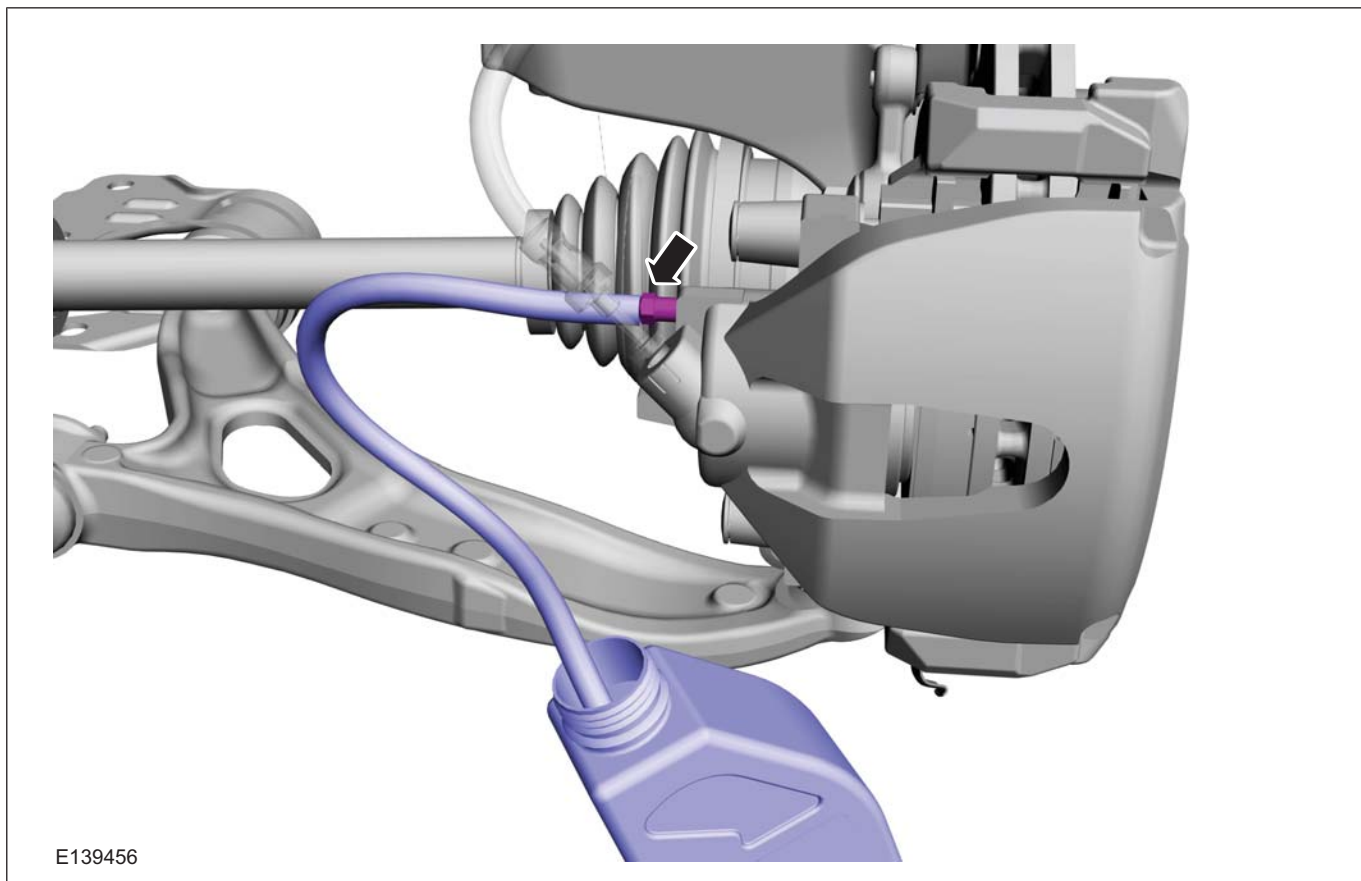
5.



6. General Equipment: Fluid Container

7. Loosen: 180°

## GENERAL PROCEDURES

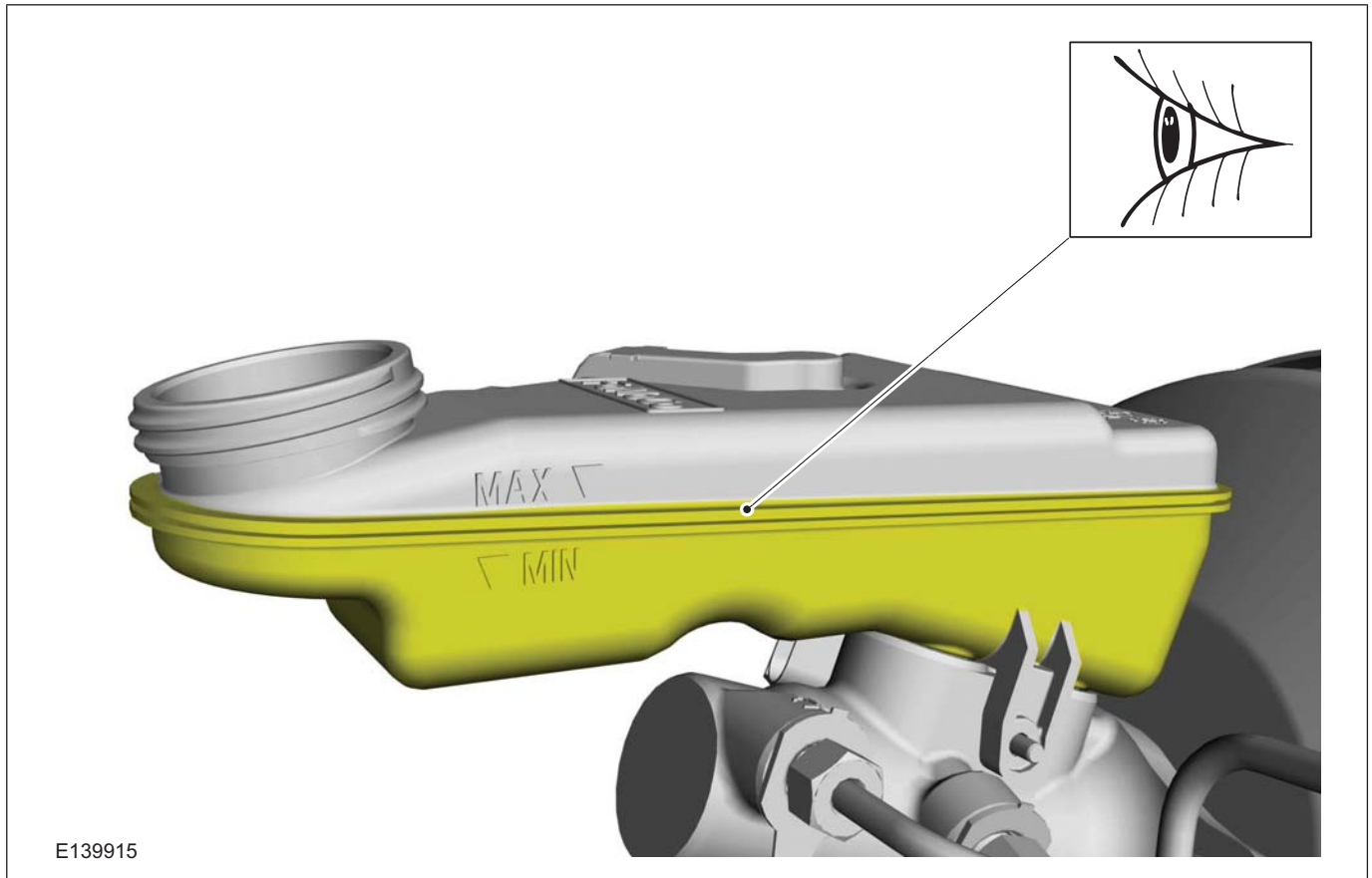


8. Operate the brake pedal fully (pumping brake fluid and air into the bleed jar) and allow the brake pedal to return to the rest position.

9. Continue operating the brake pedal until air-free fluid is being pumped into the bleed jar.

10. Refer to: **Specifications** (206-00 Brake System - General Information, Specifications).

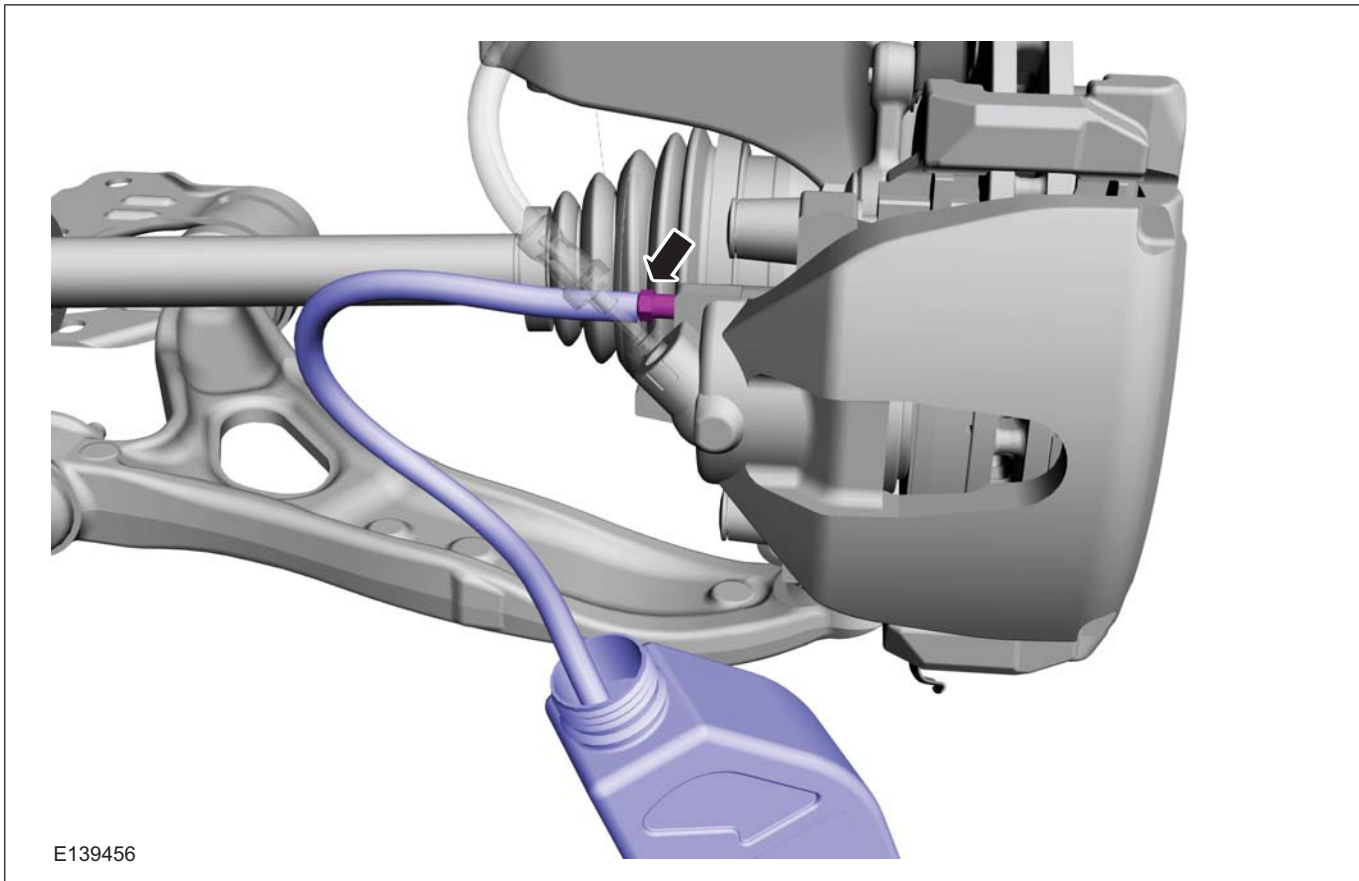
## GENERAL PROCEDURES



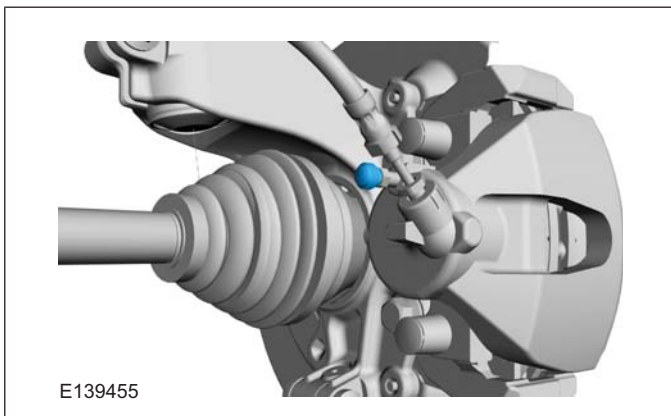
11. With the brake pedal fully depressed tighten the bleed nipple.  
Torque: 9 Nm



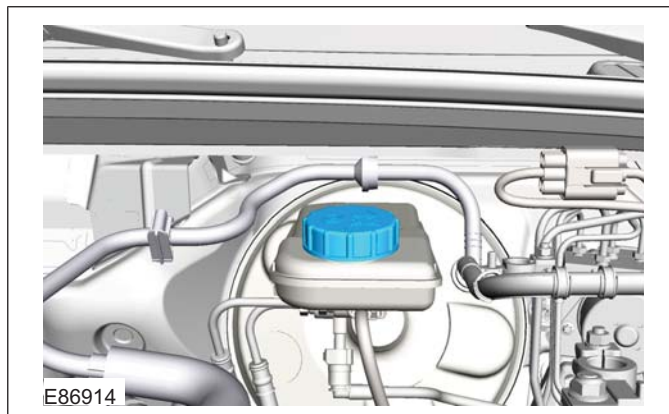
GENERAL PROCEDURES



12.



13.



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Brake System - General Information

206-00-27

## GENERAL PROCEDURES

## Brake System Bleeding

## General Equipment

Fluid Container

**NOTE:** Make sure that the vehicle is standing on a level surface.

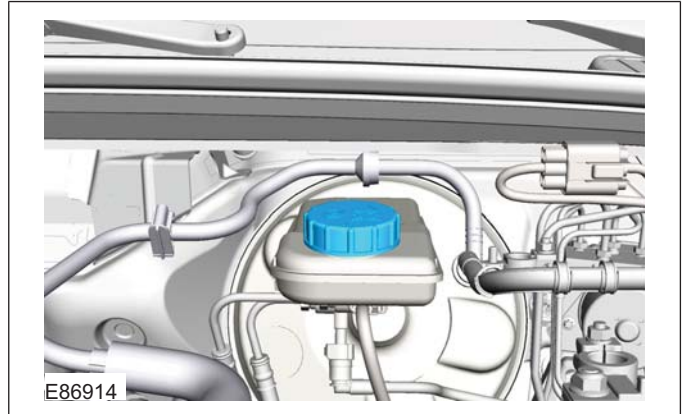
1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).

Vehicles with stability assist

2. Bleed the brake system using the BleedMASTER function in the diagnostic tool.

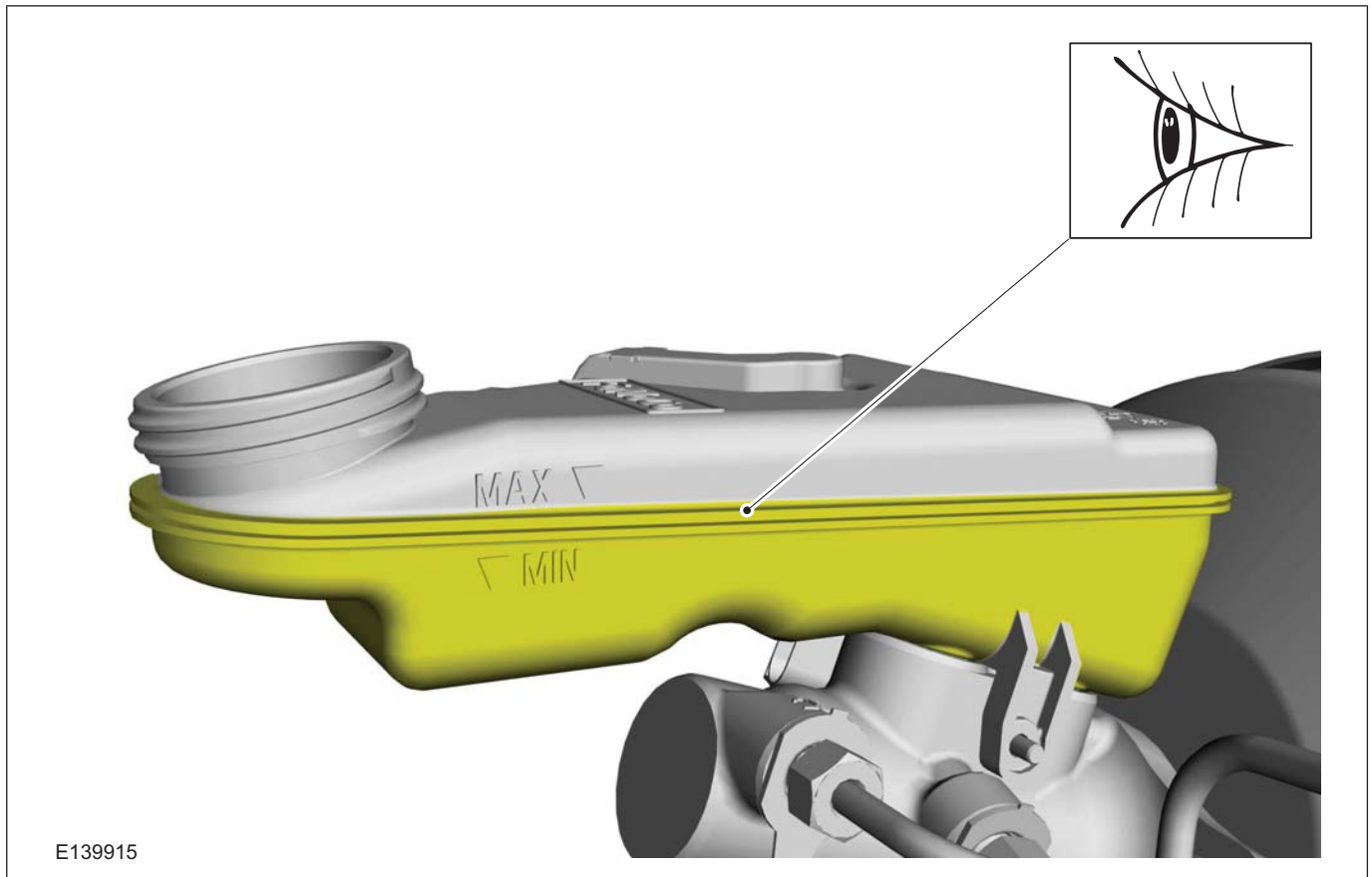
Vehicles without stability assist

3.



4. **CAUTION:** The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

Refer to: **Specifications** (206-00 Brake System - General Information, Specifications).



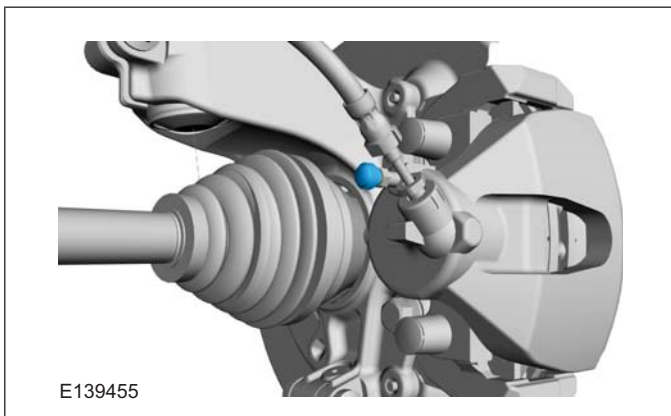
206-00-28


Brake System - General Information

206-00-28

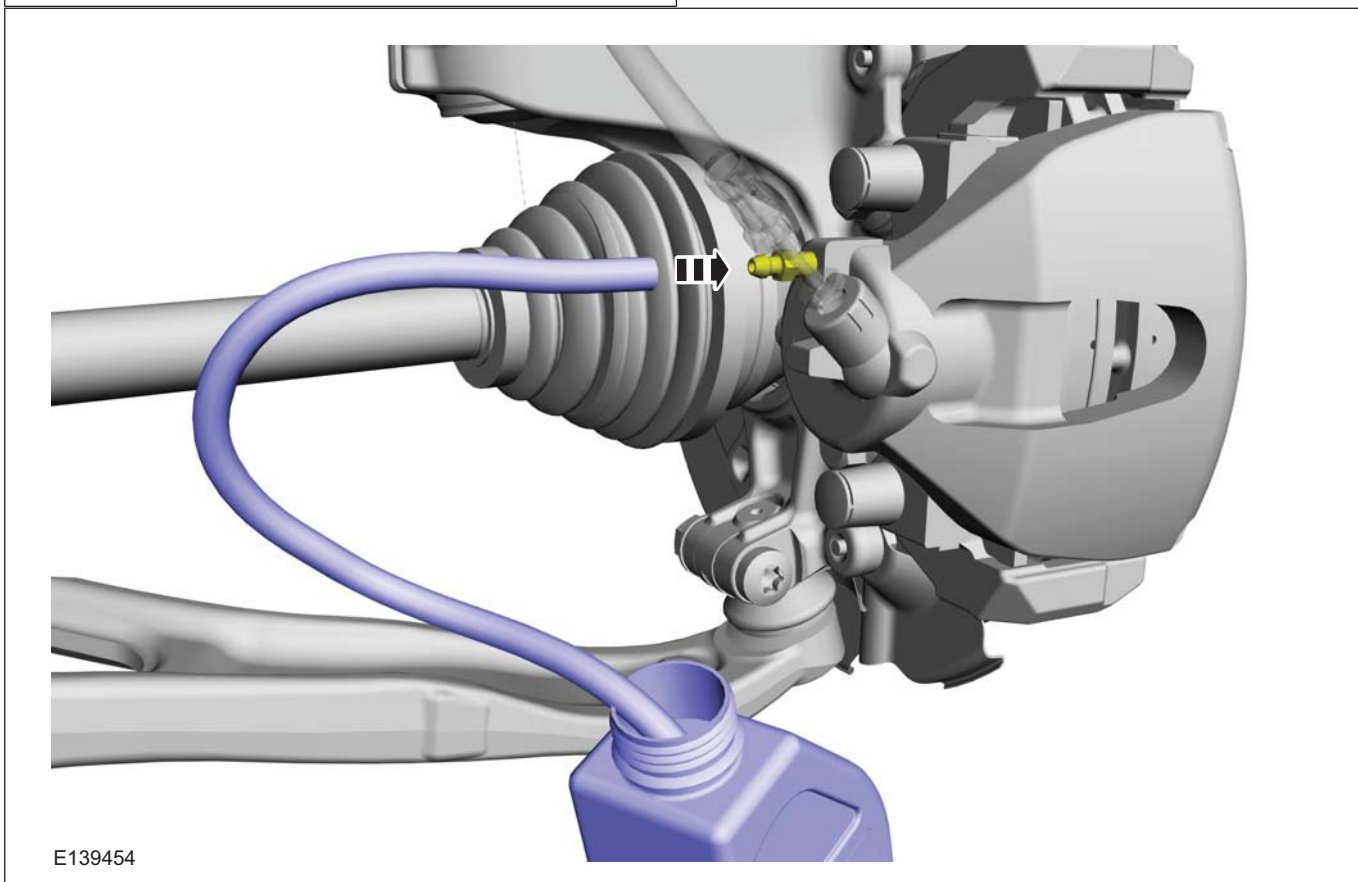
## GENERAL PROCEDURES

5.

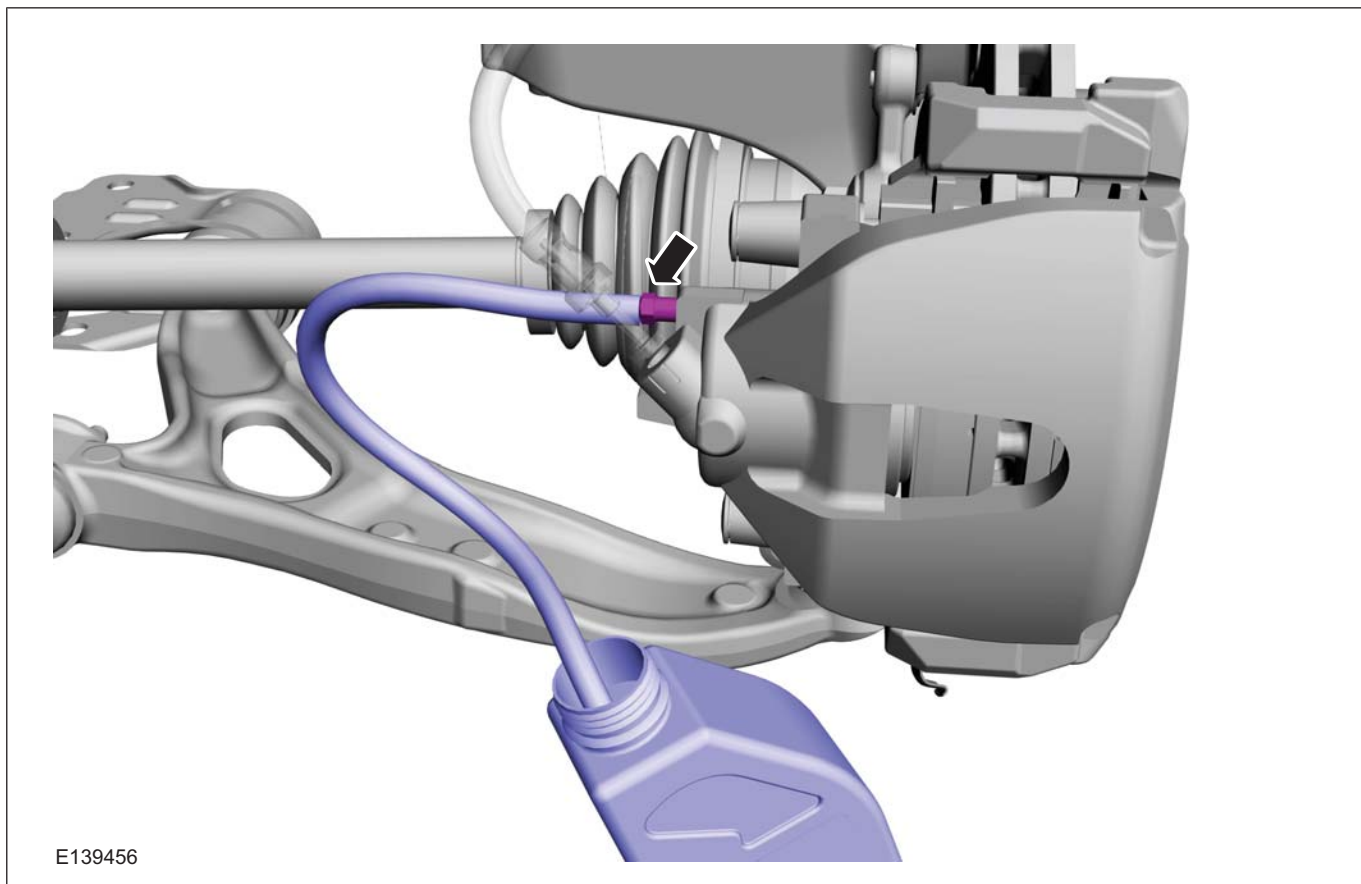


6.  **CAUTION:** Make sure that the pressure within the brake system does not exceed 1 bar.

General Equipment: Fluid Container

7. Loosen: 180°

## GENERAL PROCEDURES



8. Operate the brake pedal fully (pumping brake fluid and air into the bleed jar) and allow the brake pedal to return to the rest position.

9. Continue operating the brake pedal until air-free fluid is being pumped into the bleed jar.

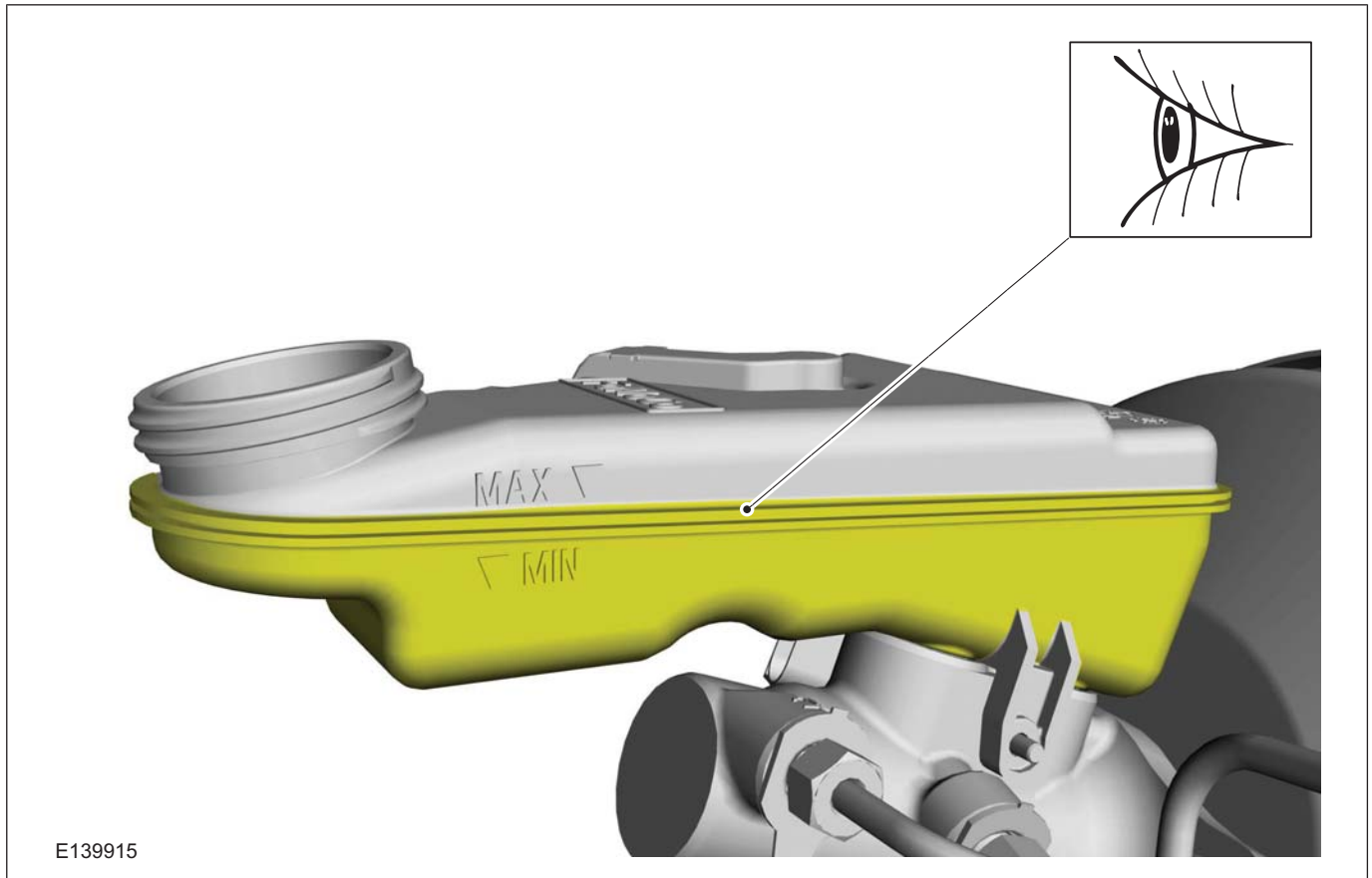
10. Refer to: **Specifications** (206-00 Brake System - General Information, Specifications).

206-00-30

Brake System - General Information

206-00-30

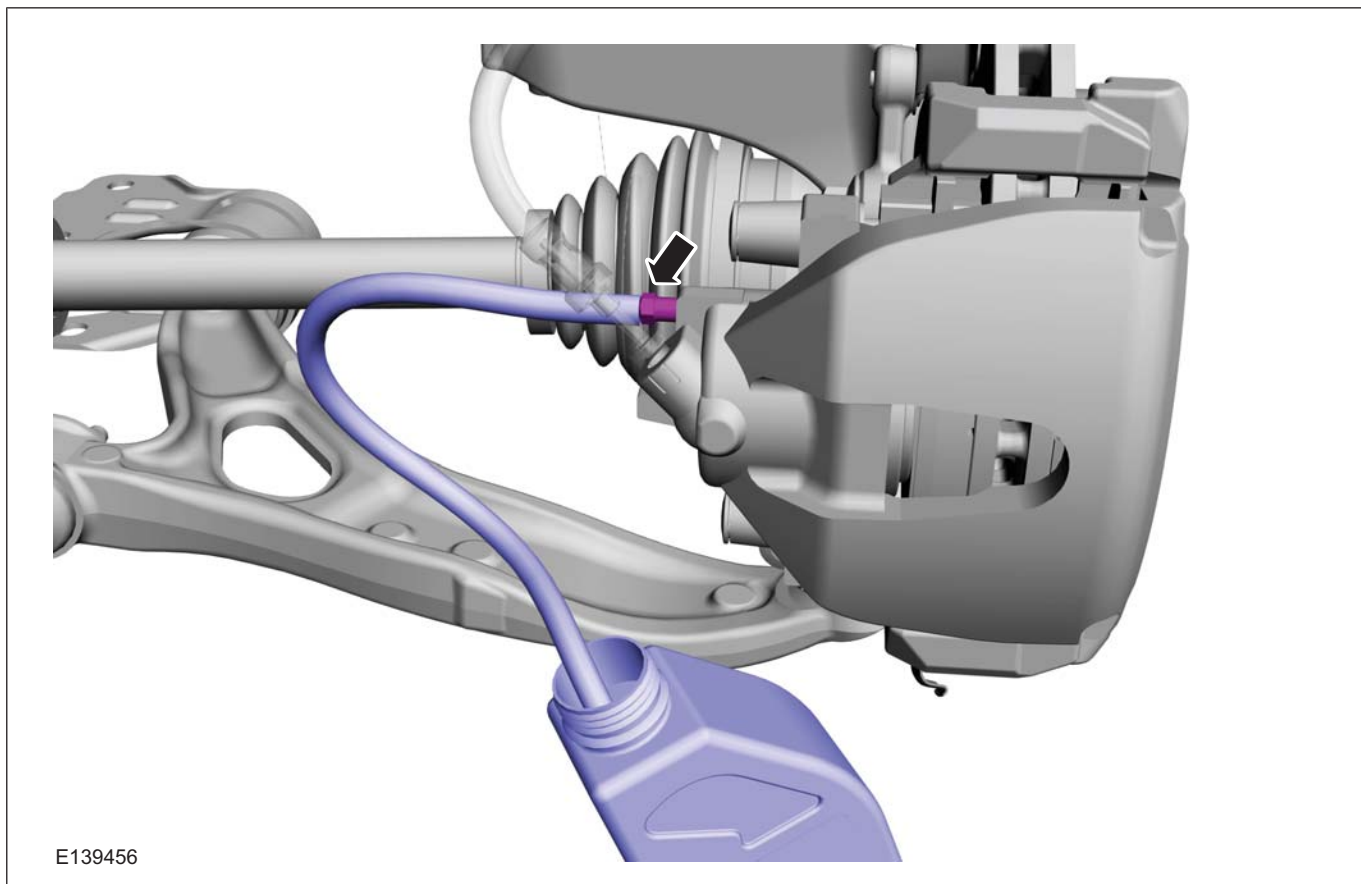
## GENERAL PROCEDURES



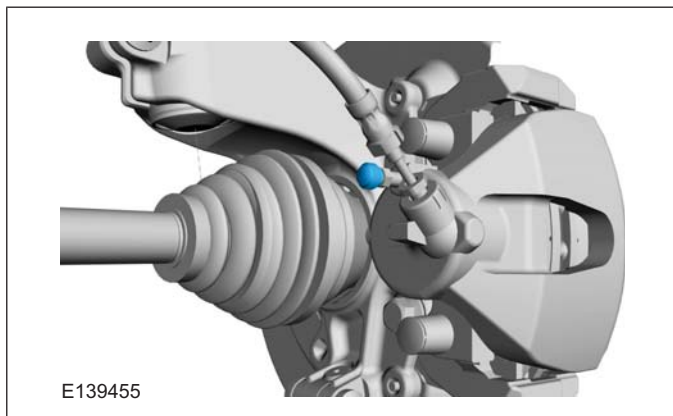
11. With the brake pedal fully depressed tighten the bleed nipple.  
Torque: 9 Nm



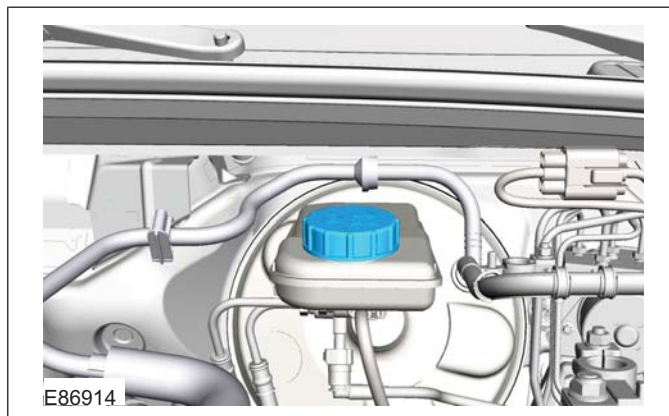
GENERAL PROCEDURES



12.



14.



13. Repeat the procedure for the remaining brake lines.



206-00-32

Brake System - General Information

206-00-32

## GENERAL PROCEDURES

## Brake System Draining and Filling(12 154 0; 12 154 4)

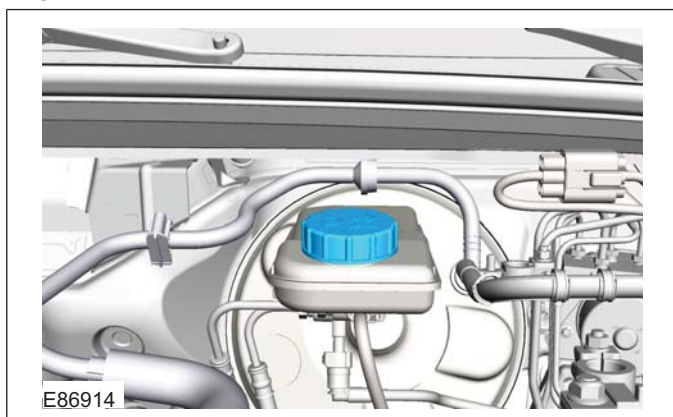
## General Equipment

Fluid Container

## Draining

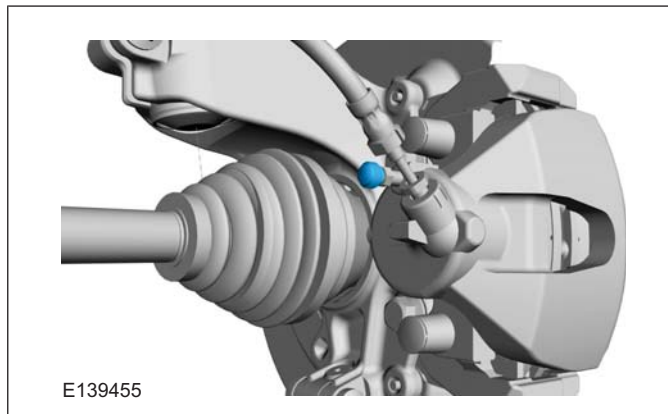
15. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).

16.



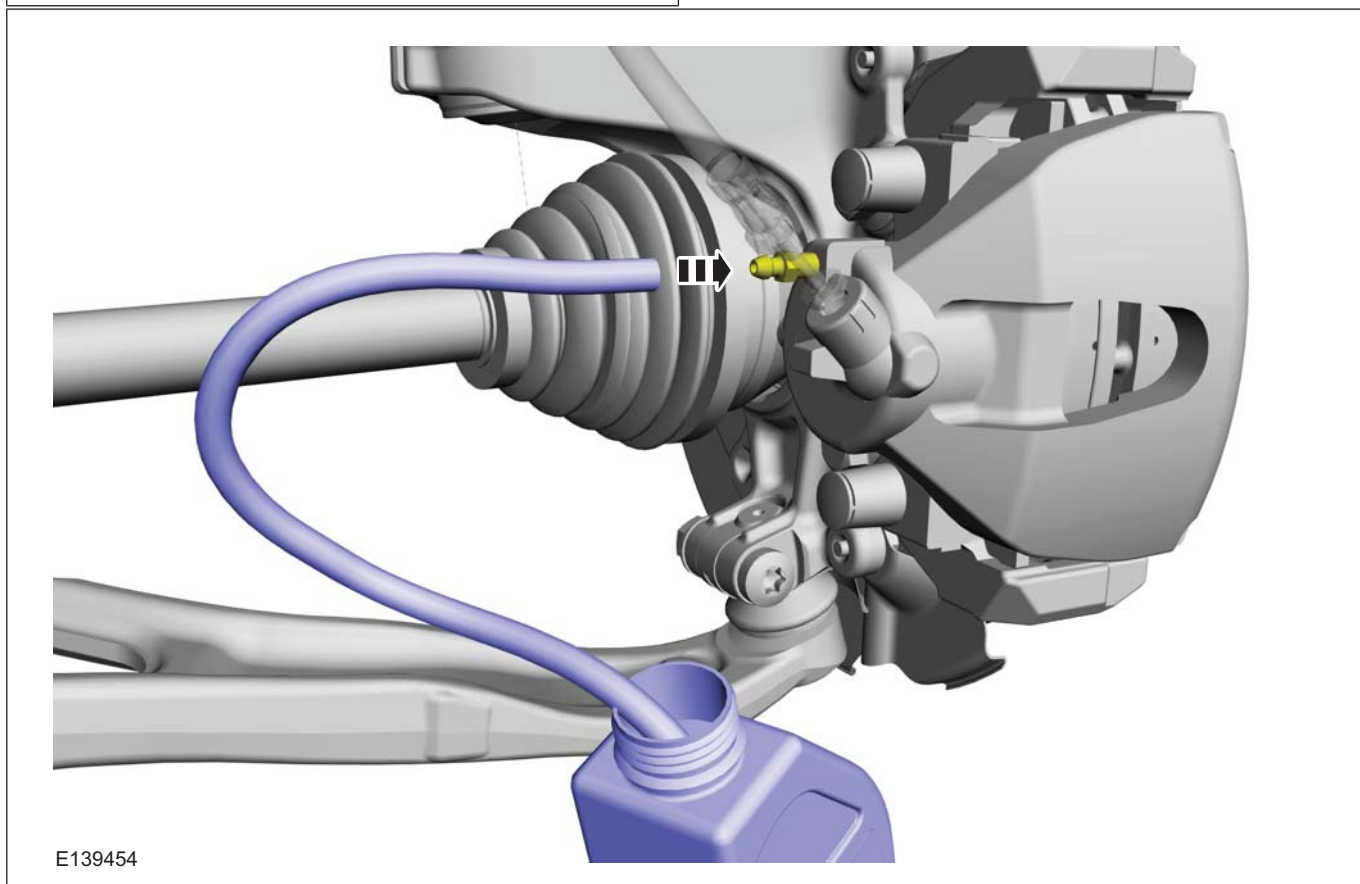
17. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

18. On both sides.



19. On both sides.

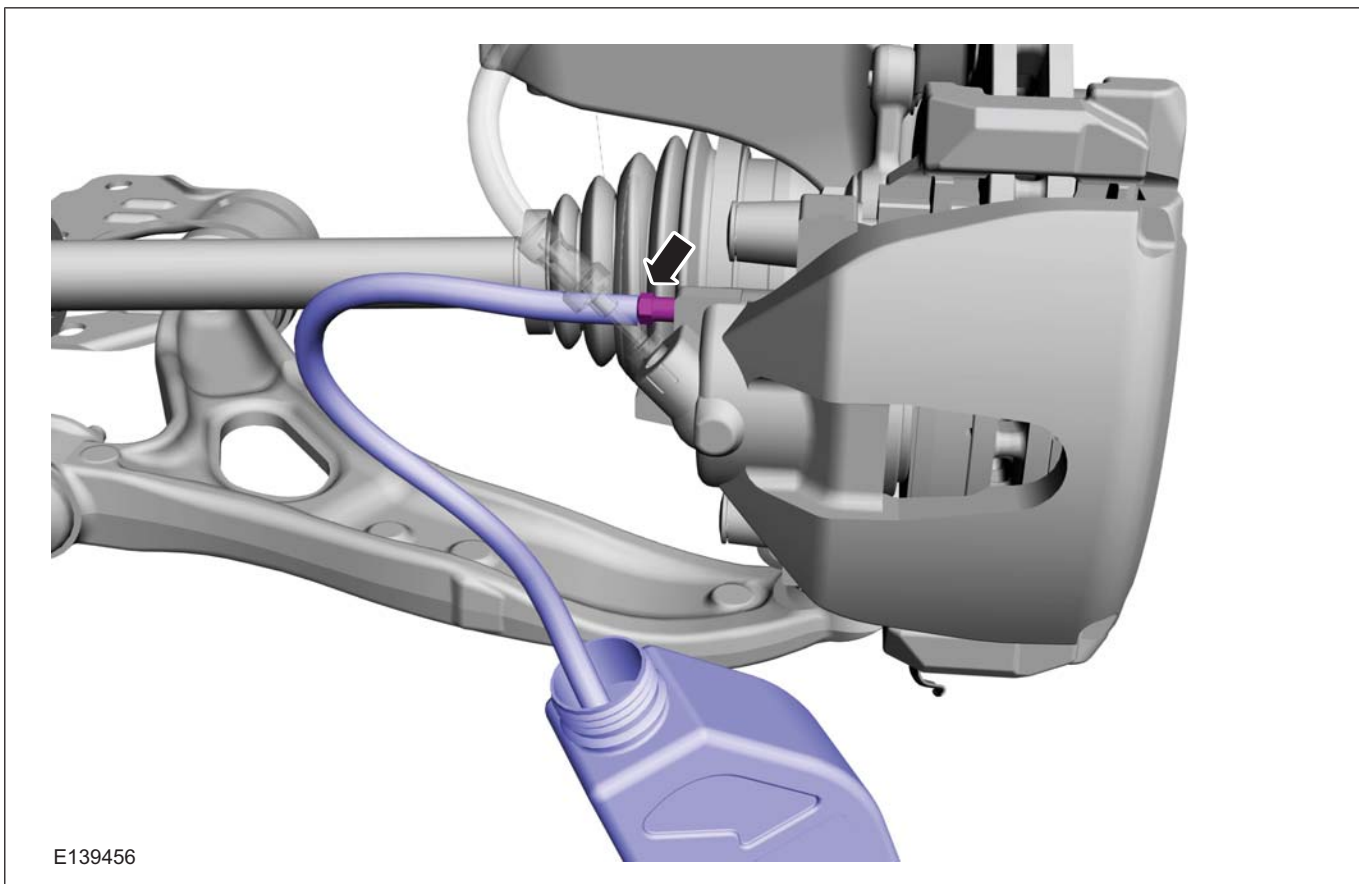
General Equipment: Fluid Container



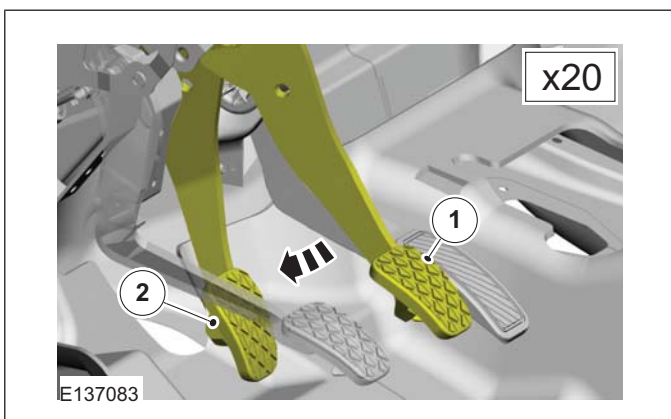
20. On both sides.  
Loosen: 180°



GENERAL PROCEDURES



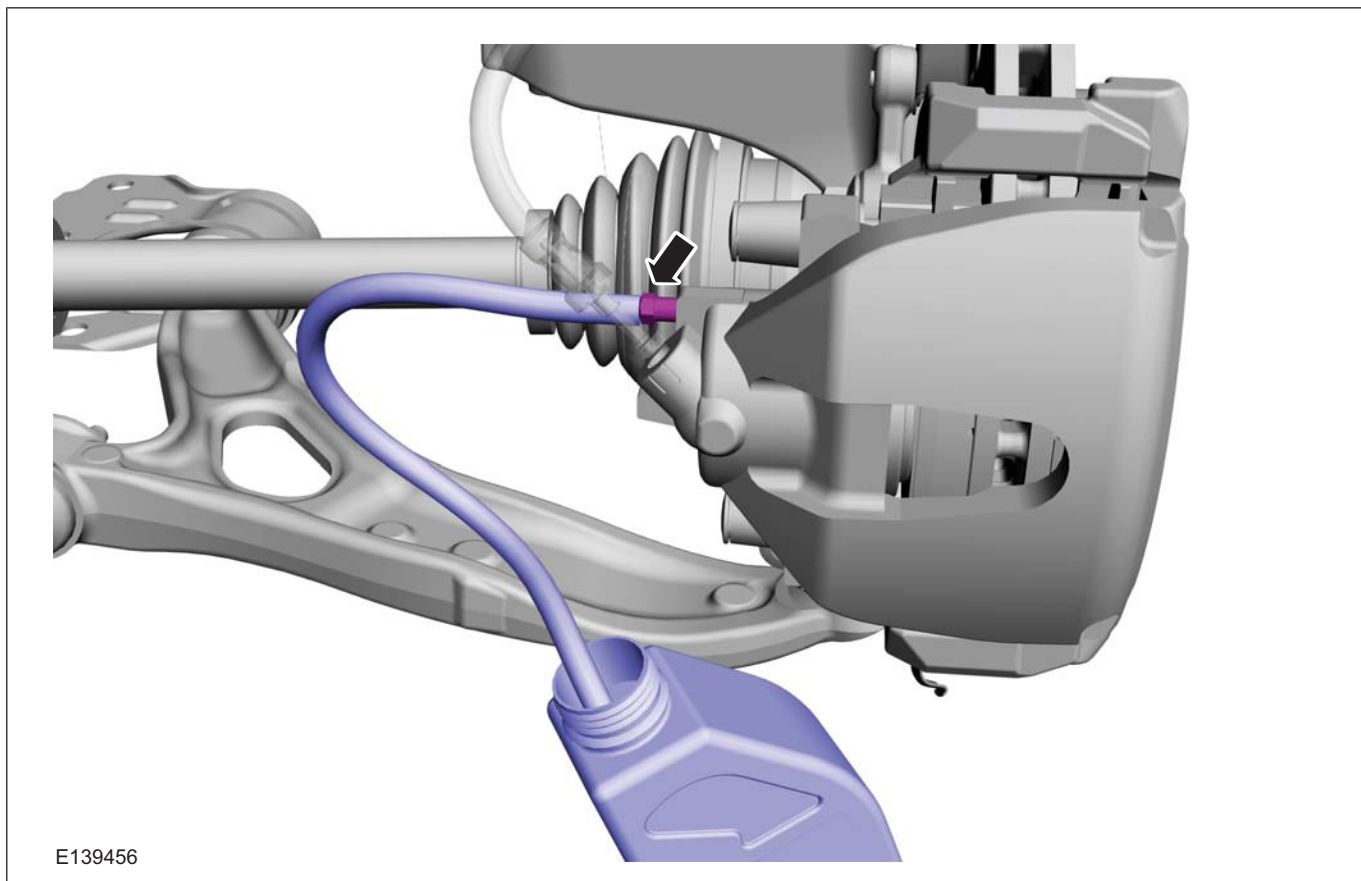
21.



22 On both sides.  
Torque: 9 Nm



## GENERAL PROCEDURES

**Filling**

23. Refer to: **Brake System Bleeding** (206-00 Brake System - General Information, General Procedures).

Refer to: **Brake System Pressure Bleeding** (206-00 Brake System - General Information, General Procedures).

Refer to: **Component Bleeding** (206-00 Brake System - General Information, General Procedures).

206-00-35

Brake System - General Information

206-00-35

## GENERAL PROCEDURES

## Brake System Pressure Bleeding

## General Equipment

Brake/Clutch System Pressure Bleeder/Filler

**NOTE:** Make sure that the vehicle is standing on a level surface.

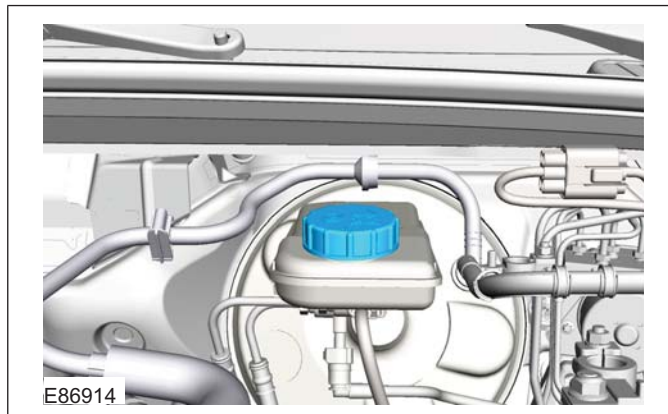
1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).

Vehicles with stability assist

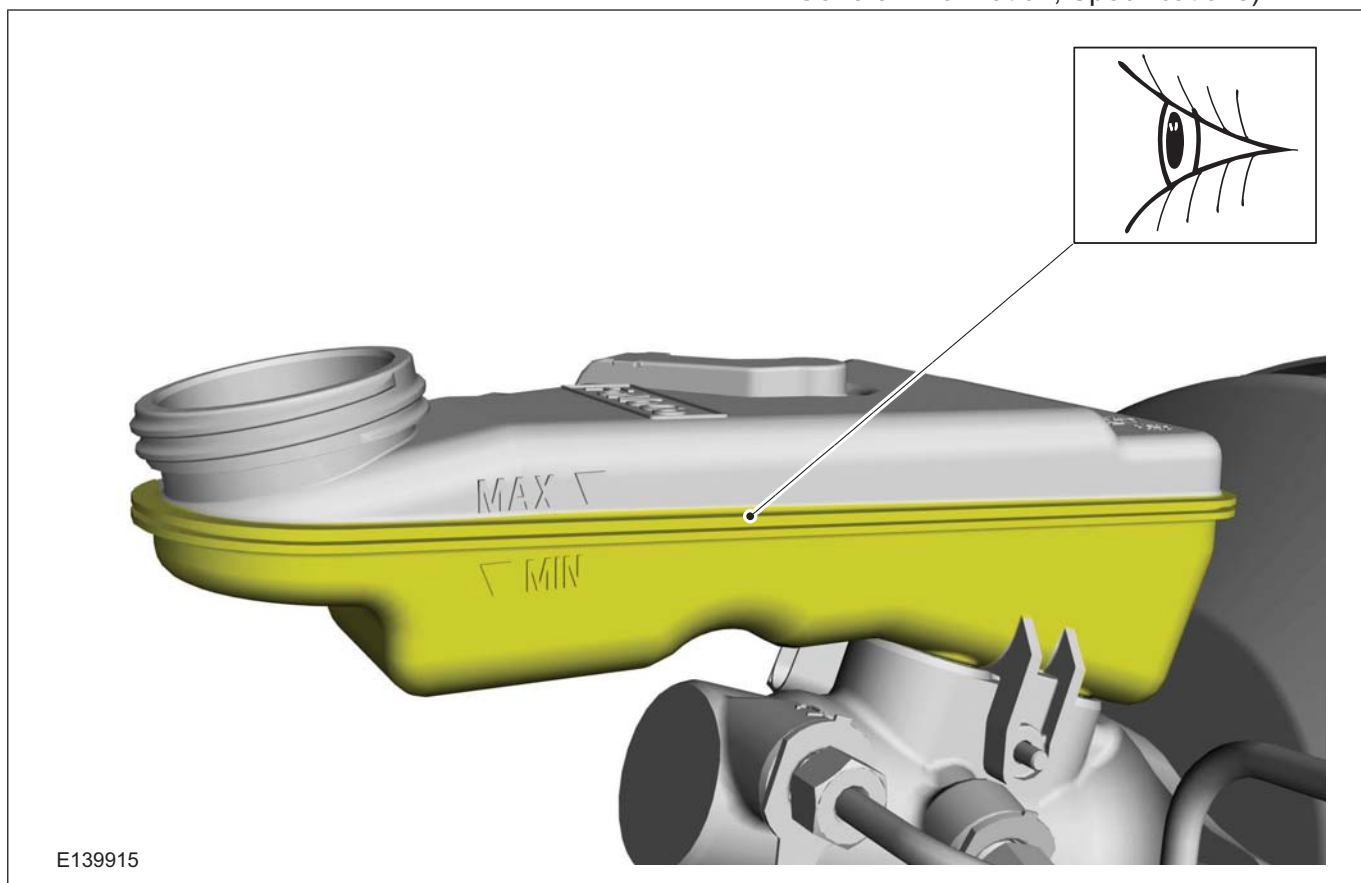
2. Bleed the brake system using the BleedMASTER function in the diagnostic tool.

Vehicles without stability assist

3.



4. Refer to: **Specifications** (206-00 Brake System - General Information, Specifications).



5. **CAUTION:** Make sure that the pressure within the brake system does not exceed 1 bar.

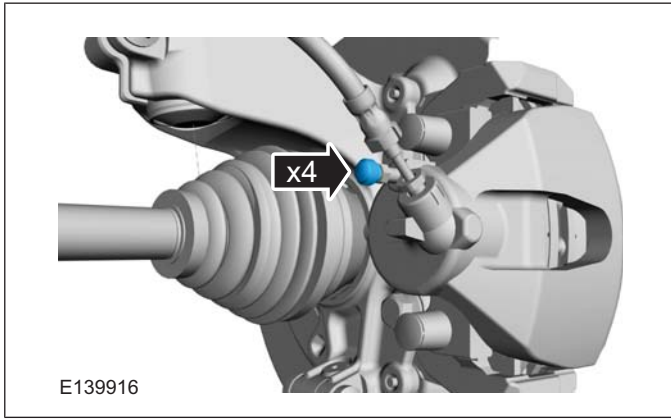
Using the brake/clutch system pressure bleeder/filler, pressure bleed the system in accordance with the manufacturer's instructions.

General Equipment: Brake/Clutch System Pressure Bleeder/Filler

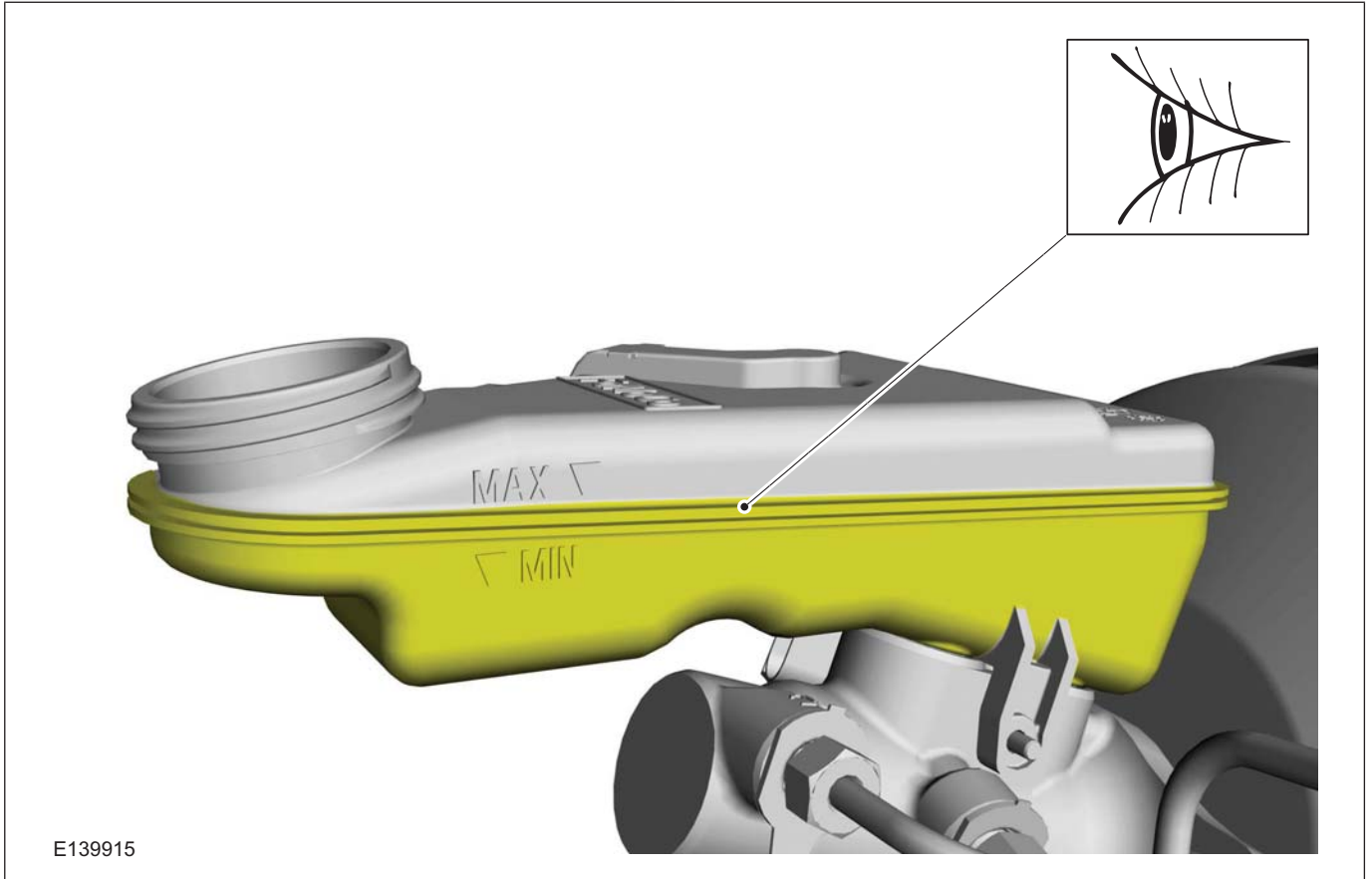
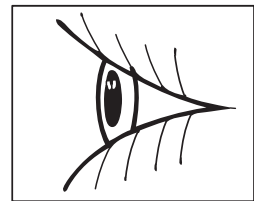


GENERAL PROCEDURES

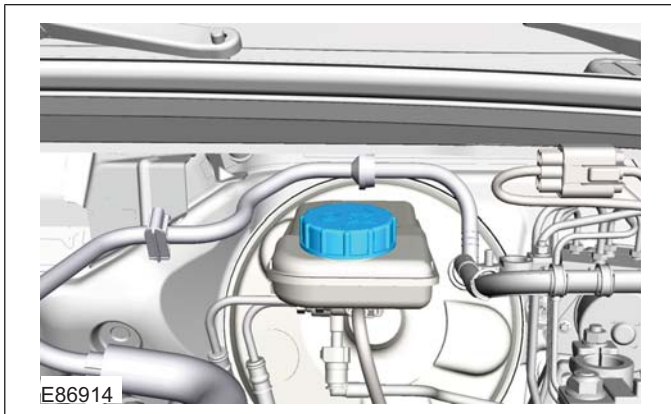
6.



7. Refer to: **Specifications** (206-00 Brake System - General Information, Specifications).



8.







# SECTION 206-03 Front Disc Brake

VEHICLE APPLICATION: 2008.50 Kuga

CONTENTS	PAGE
<b>REMOVAL AND INSTALLATION</b>	
Brake Pads..... (12 234 0)	206-03-2
Brake Caliper..... (12 243 0)	206-03-4
Front Brake Flexible Hose.....	206-03-5

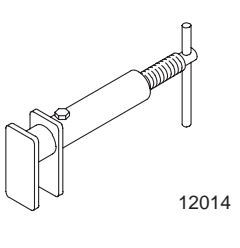




REMOVAL AND INSTALLATION

Brake Pads(12 234 0)

Special Tool(s)

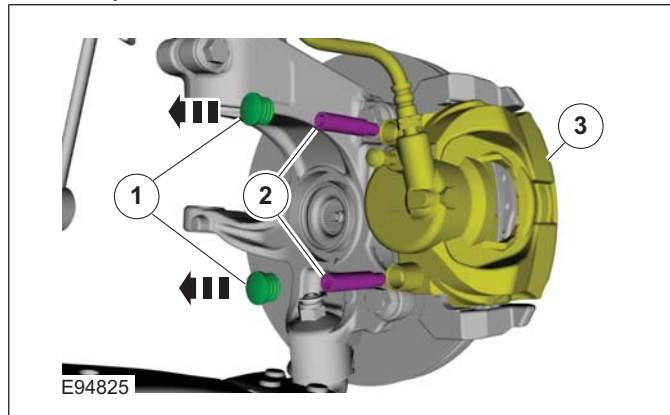
 <p>12014</p>	<p>206-005 Retractor, Brake Caliper Piston</p>
--	--

Materials

Name	Specification
Brake Fluid - Super DOT4	WSS-M6C57-A2
Lubricating Paste	WSS-M12A4-A2 / 1C1J-19584-BA

**CAUTION:** Make sure that no load is placed on the brake hose.

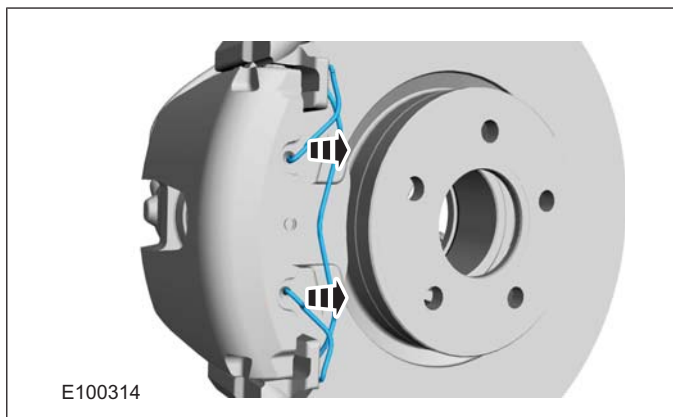
Torque: 28 Nm



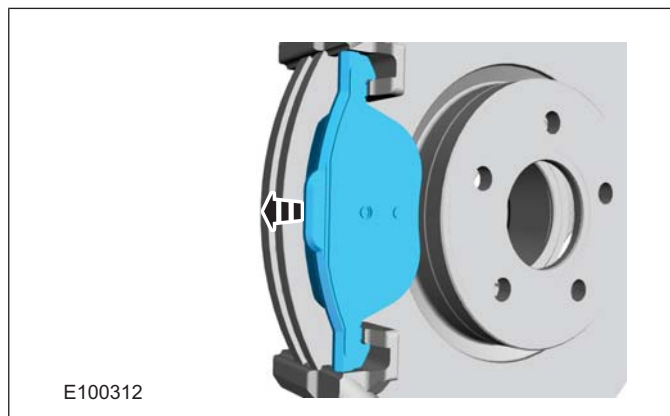
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

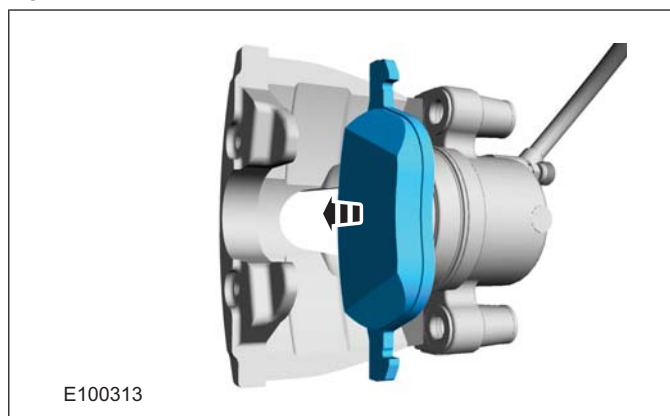
1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
- 3.



5.



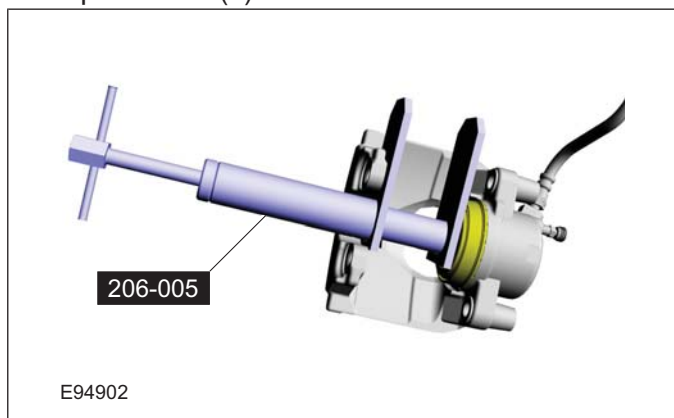
6.



4. **WARNING:** The brake caliper housing Torx bolts must not be removed.

REMOVAL AND INSTALLATION

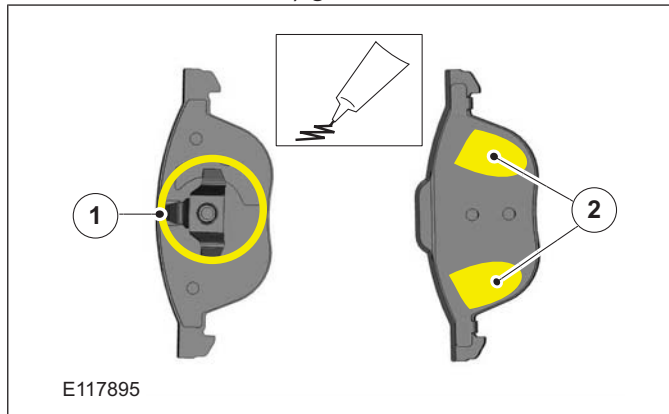
7. Special Tool(s): 206-005



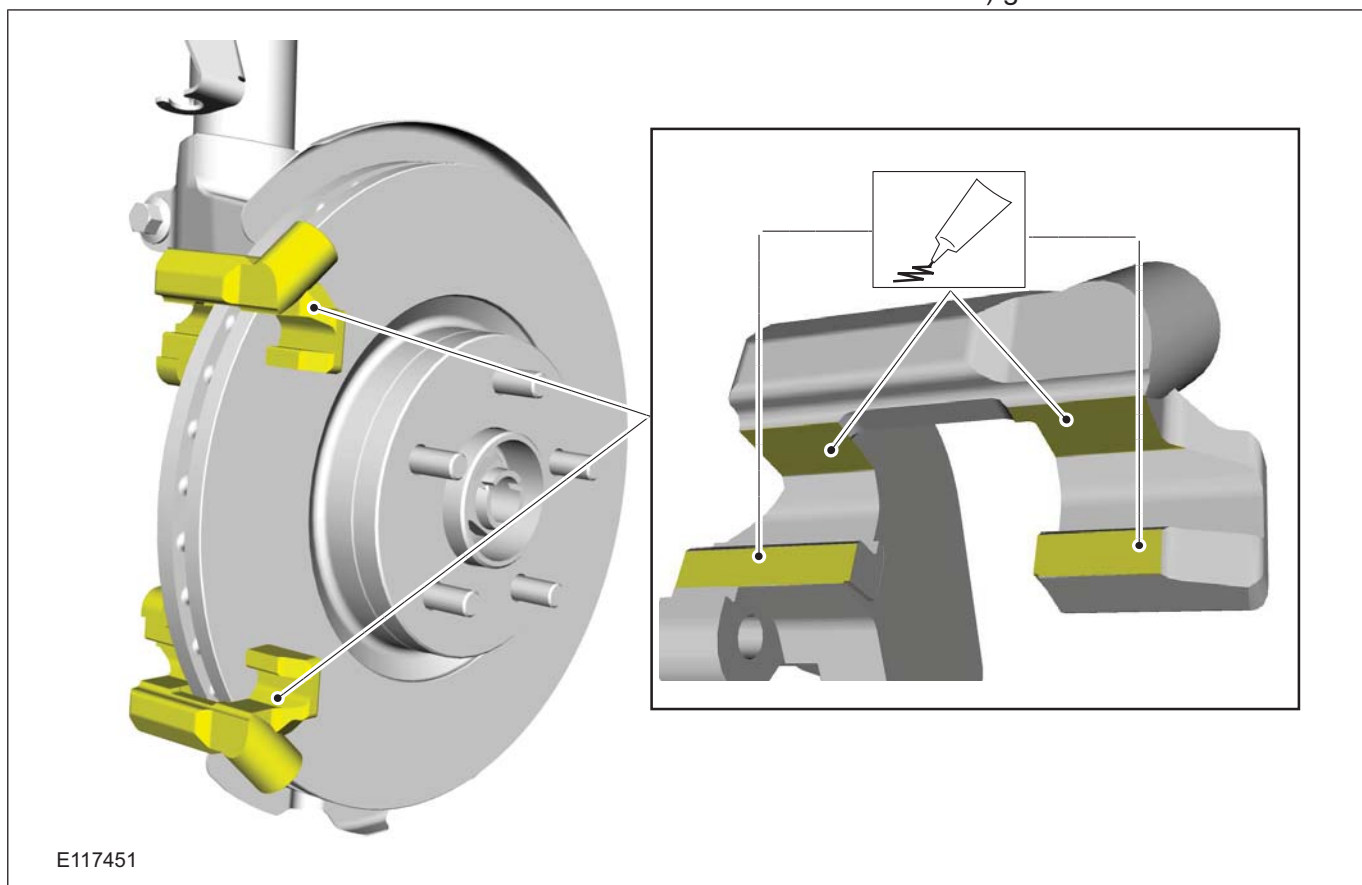
Installation

1. NOTE:

Material: Lubricating Paste (WSS-M12A4-A2 / 1C1J-19584-BA) grease



2. Material: Lubricating Paste (WSS-M12A4-A2 / 1C1J-19584-BA) grease



3. To install, reverse the removal procedure.

4. Depress the brake pedal, check the brake fluid level in the brake fluid reservoir and top up as necessary with brake fluid.

Material: Brake Fluid - Super DOT4 (WSS-M6C57-A2) brake fluid

## REMOVAL AND INSTALLATION

## Brake Caliper(12 243 0)

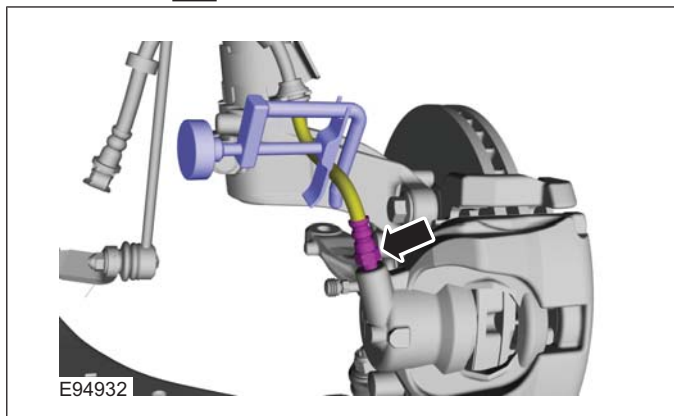
## General Equipment

Hose Clamp(s)

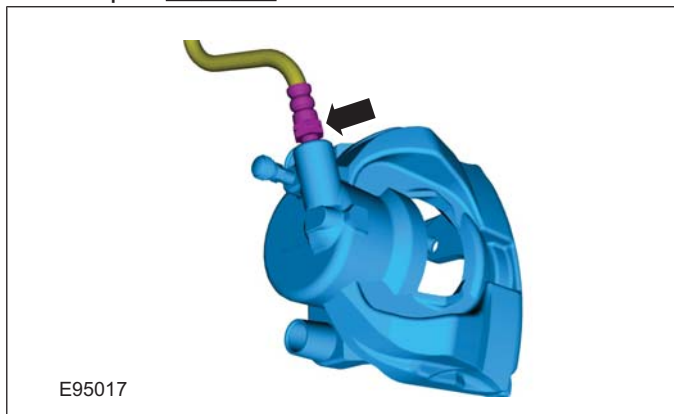
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
3. General Equipment: Hose Clamp(s)  
Loosen: 90°



4. Refer to: **Brake Pads** (206-03 Front Disc Brake, Removal and Installation).
5. Torque: 22,5 Nm



6. **WARNING:** Make sure that the brake hose is not twisted and is correctly located.

**NOTE:** This step is only necessary when installing a new component.

Refer to: **Front Brake Flexible Hose** (206-03 Front Disc Brake, Removal and Installation).

## Installation

1. To install, reverse the removal procedure.
2. Refer to: **Brake System Bleeding** (206-00 Brake System - General Information, General Procedures).  
Refer to: **Brake System Pressure Bleeding** (206-00 Brake System - General Information, General Procedures).

## REMOVAL AND INSTALLATION

## Front Brake Flexible Hose

## Removal

**CAUTION:**  
Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

2. **WARNINGS:**

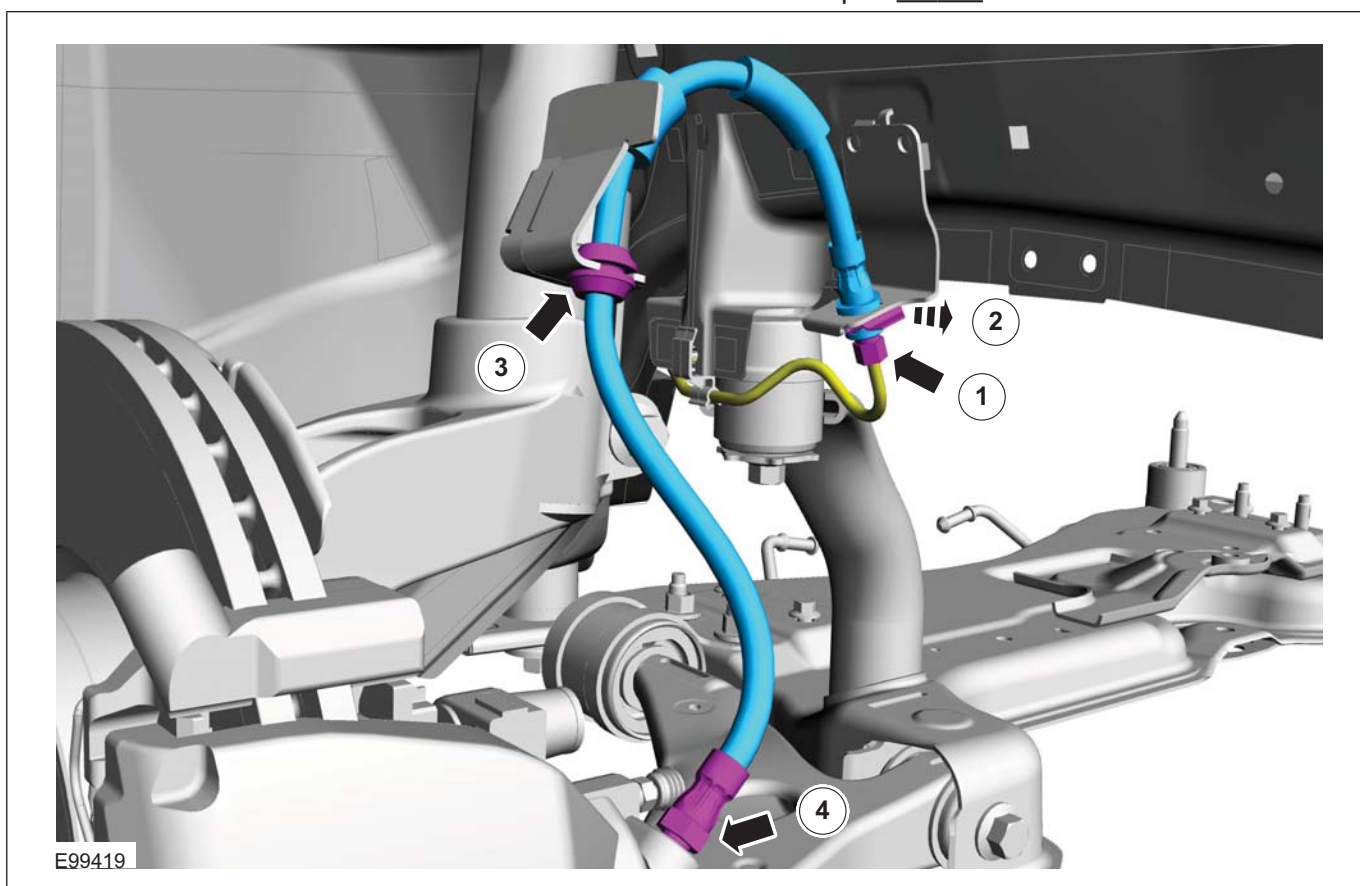
**▲** Make sure that no load is placed on the brake hose.

**▲** Be prepared to collect escaping fluid.

**▲** **CAUTION:** Make sure that all openings are sealed.

1. Torque: 15 Nm

4. Torque: 23 Nm



## Installation

1. To install, reverse the removal procedure.
2. Refer to: **Component Bleeding** (206-00 Brake System - General Information, General Procedures).



## SECTION 206-04 Rear Disc Brake

VEHICLE APPLICATION: 2008.50 Kuga

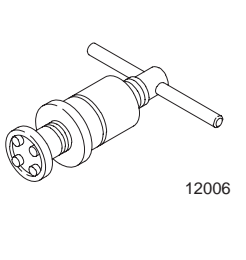
CONTENTS	PAGE
<b>REMOVAL AND INSTALLATION</b>	
Brake Pads..... (12 238 0)	206-04-2
Brake Caliper..... (12 253 0)	206-04-4
Rear Brake Flexible Hose.....	206-04-5



## REMOVAL AND INSTALLATION

## Brake Pads(12 238 0)

## Special Tool(s)

	206-012 Retractor, Rear Brake Caliper Piston
---	--

12006

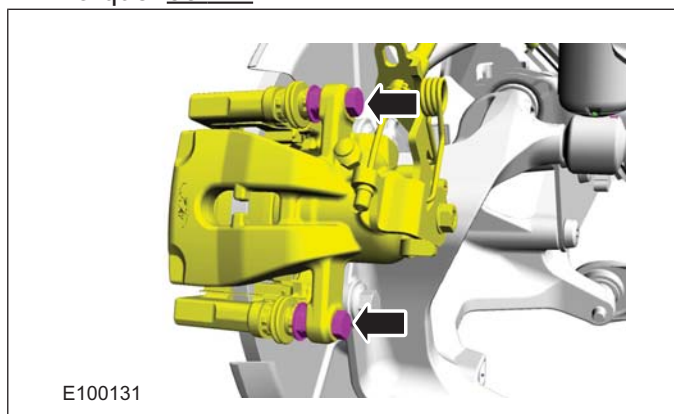
## Materials

Name	Specification
Brake Fluid - Super DOT4	WSS-M6C57-A2



## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

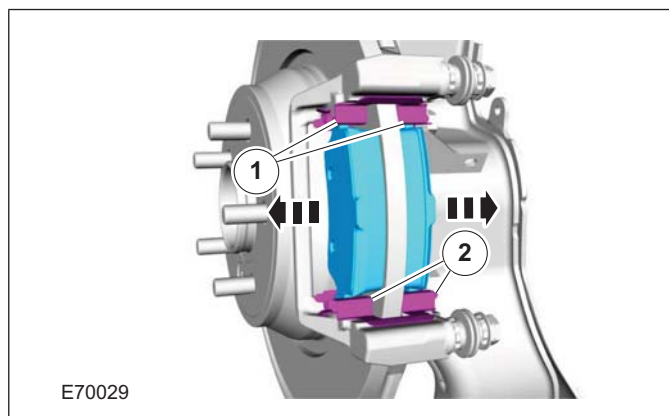
1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
3. **WARNING:** Make sure that no load is placed on the brake hose.

Torque: 35 Nm

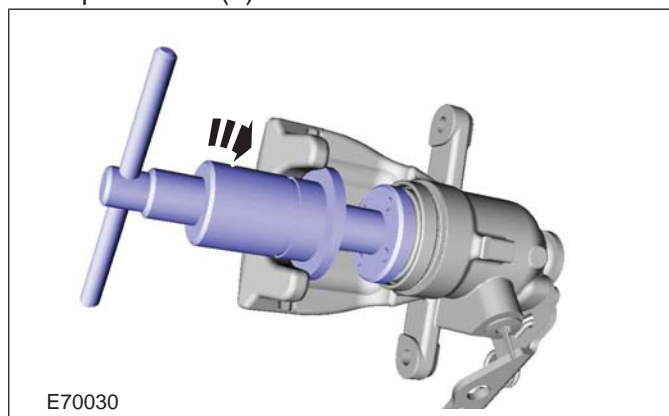
## 4. CAUTIONS:

-  **Make sure that the component is not bent.**
-  **Make sure that the clips are correctly located.**


**NOTE:** Note the position of each component before removal.



## 5. Special Tool(s): 206-012



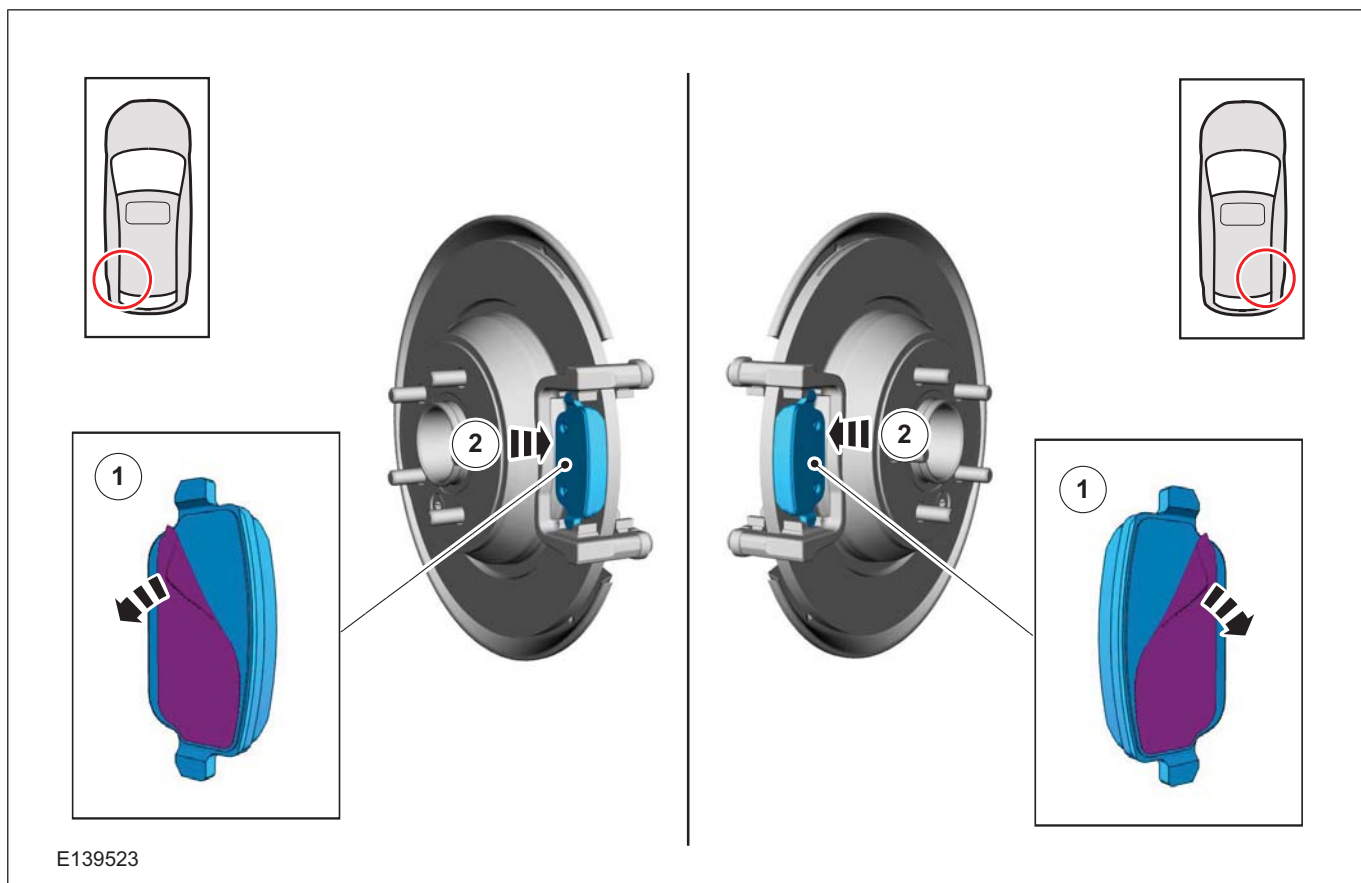
## Installation

1.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Remove the adhesive foil from the rear of the outer brake pad.



## REMOVAL AND INSTALLATION



2. To install, reverse the removal procedure.
3. Depress the brake pedal, check the brake fluid level in the brake fluid reservoir and top up as necessary with brake fluid.

Material: Brake Fluid - Super DOT4  
(WSS-M6C57-A2) brake fluid

## REMOVAL AND INSTALLATION

## Brake Caliper(12 253 0)

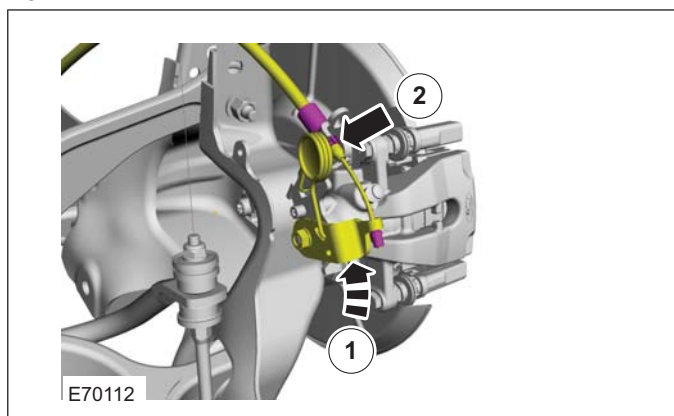
## General Equipment

Hose Clamp(s)	
<b>Materials</b>	
<b>Name</b>	<b>Specification</b>
Brake Fluid - Super DOT4	WSS-M6C57-A2

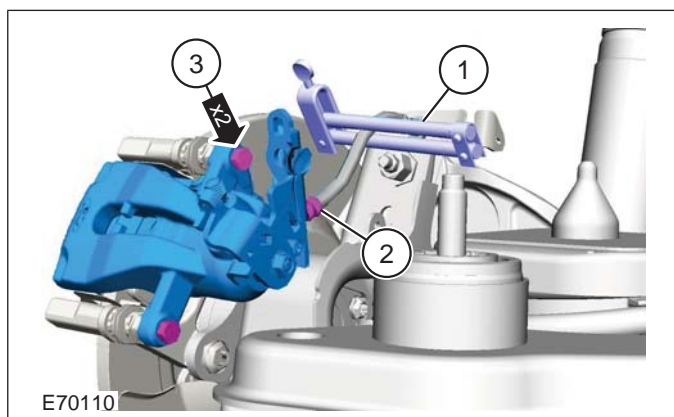
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
- 3.

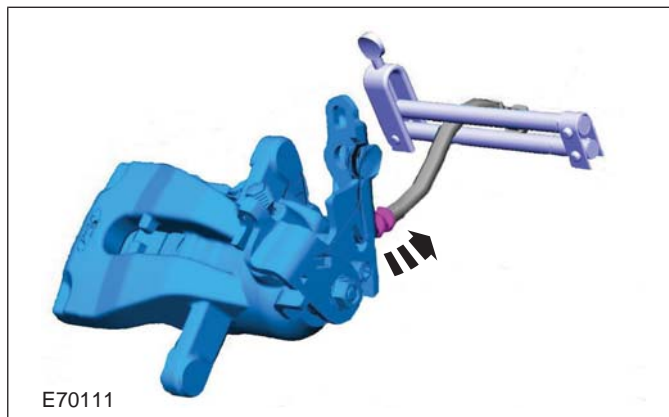


4. 1. General Equipment: Hose Clamp(s)
2. Torque: 28 Nm
3. Torque: 35 Nm



5. **CAUTION:** Make sure that all openings are sealed.

**NOTE:** Note the position of each component before removal.



6. **NOTE:** This step is only necessary when installing a new component.

Refer to: **Rear Brake Flexible Hose** (206-04 Rear Disc Brake, Removal and Installation).

## Installation

1. To install, reverse the removal procedure.
2. Refer to: **Brake System Bleeding** (206-00 Brake System - General Information, General Procedures).  
Refer to: **Brake System Pressure Bleeding** (206-00 Brake System - General Information, General Procedures).

3. **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Depress the brake pedal, check the brake fluid level in the brake fluid reservoir and top up as necessary with brake fluid.

Material: Brake Fluid - Super DOT4 (WSS-M6C57-A2) brake fluid

## REMOVAL AND INSTALLATION

## Rear Brake Flexible Hose

## Removal

**CAUTION:**  
Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

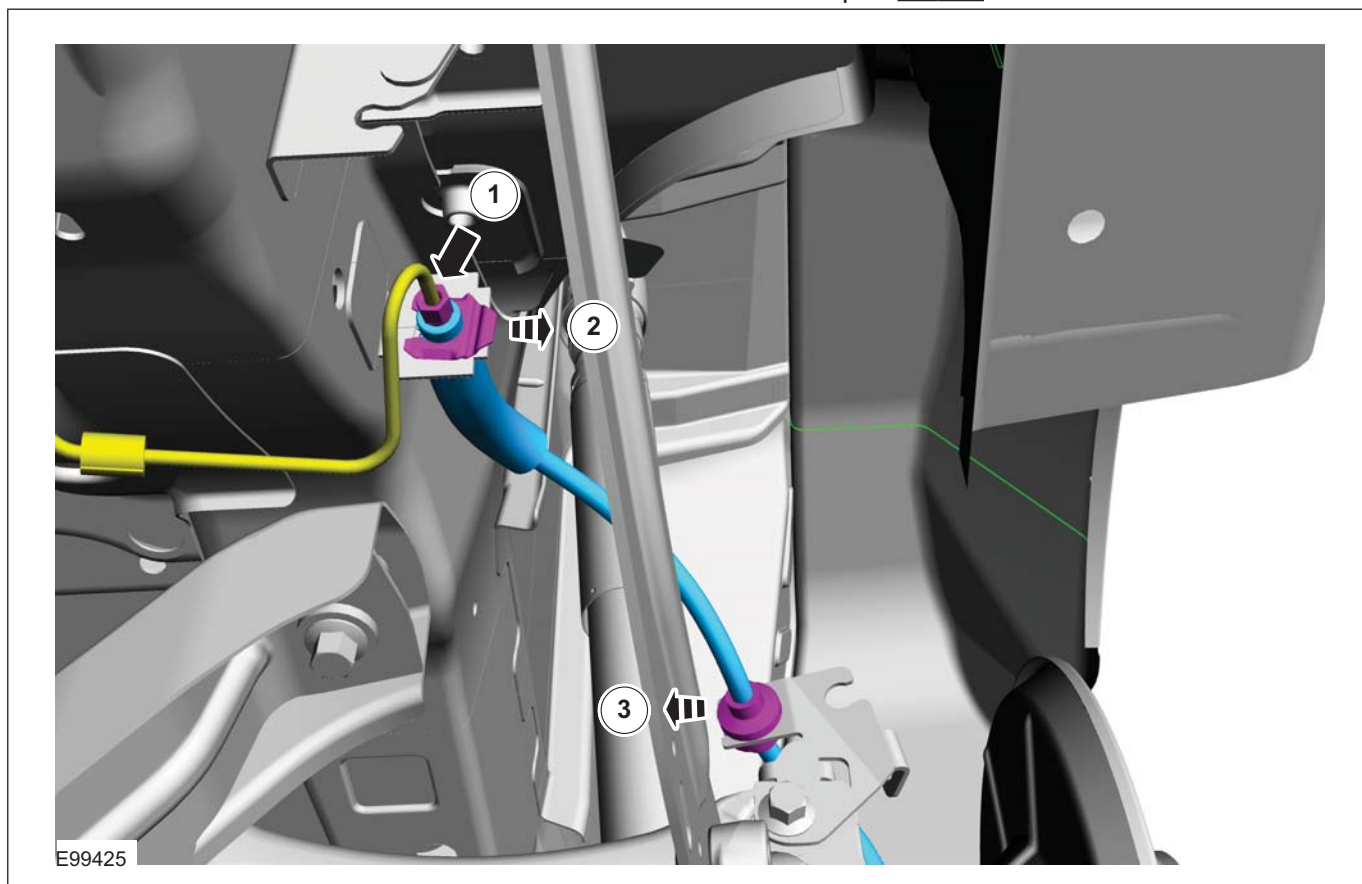
2. **WARNINGS:**

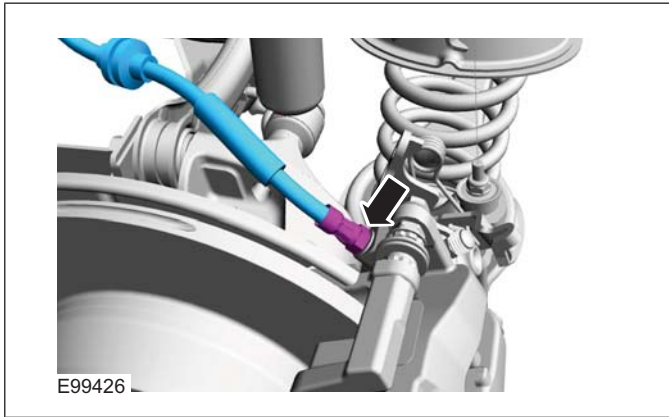
**▲** Make sure that no load is placed on the brake hose.

**▲** Be prepared to collect escaping fluid.

**▲** **CAUTION:** Make sure that all openings are sealed.

1. Torque: 15 Nm



**REMOVAL AND INSTALLATION****3. Torque: 28 Nm****Installation**

1. To install, reverse the removal procedure.
2. Refer to: **Component Bleeding** (206-00 Brake System - General Information, General Procedures).

## SECTION 206-05 Parking Brake and Actuation

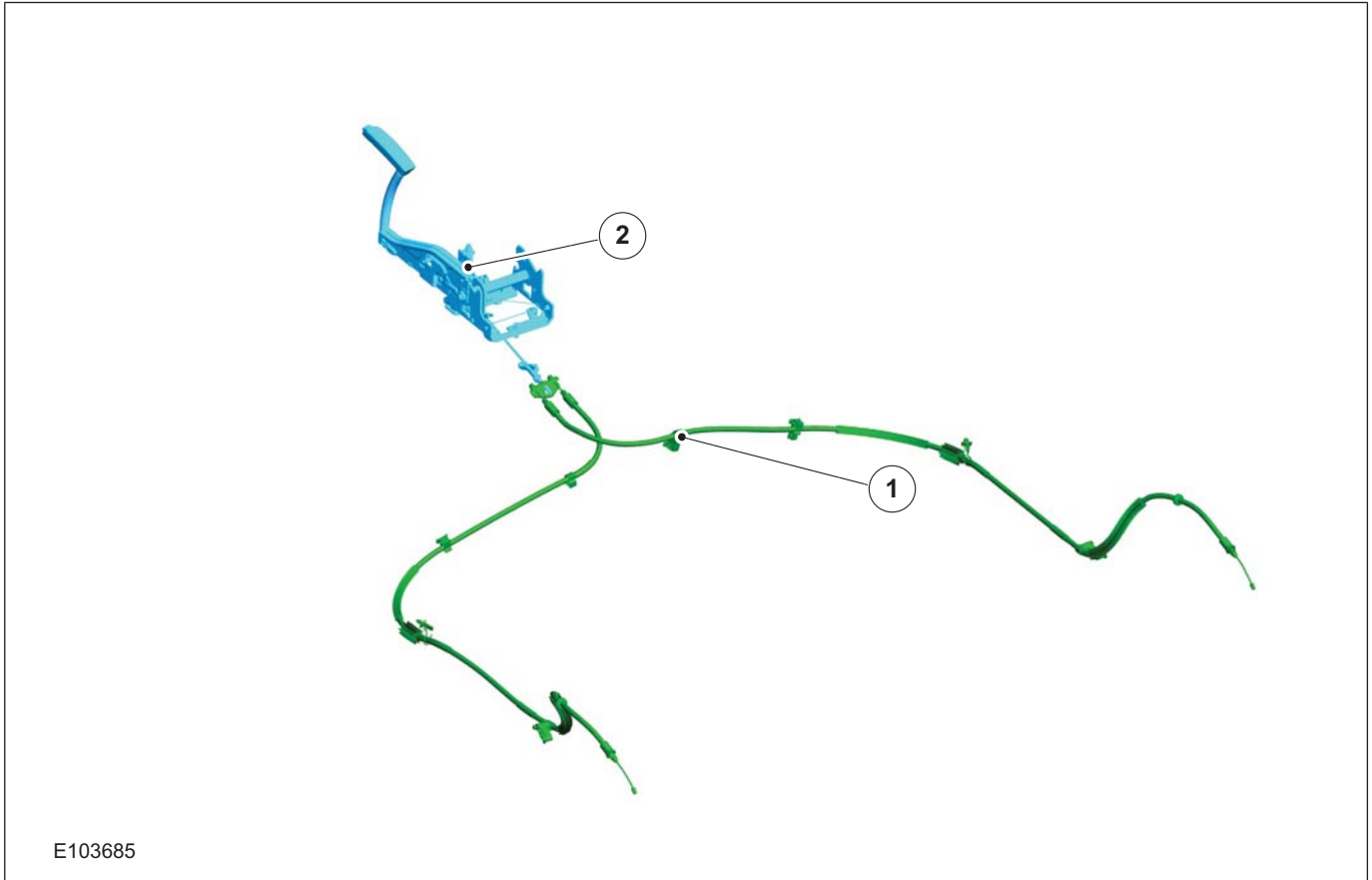
**VEHICLE APPLICATION: 2008.50 Kuga**

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<b>DESCRIPTION AND OPERATION</b>	
Parking Brake (Overview).....	206-05-2
Overview.....	206-05-2
Parking brake cable.....	206-05-2
Parking brake control.....	206-05-3
<b>DIAGNOSIS AND TESTING</b>	
Parking Brake.....	206-05-4
Inspection and Verification.....	206-05-4
Symptom Chart.....	206-05-4
Pinpoint Tests.....	206-05-5
<b>GENERAL PROCEDURES</b>	
Parking Brake Cable Adjustment.....	206-05-9
<b>REMOVAL AND INSTALLATION</b>	
Parking Brake Control..... (12 664 0)	206-05-11
Parking Brake Rear Cables.....	206-05-12

DESCRIPTION AND OPERATION

Parking Brake – Overview

Overview



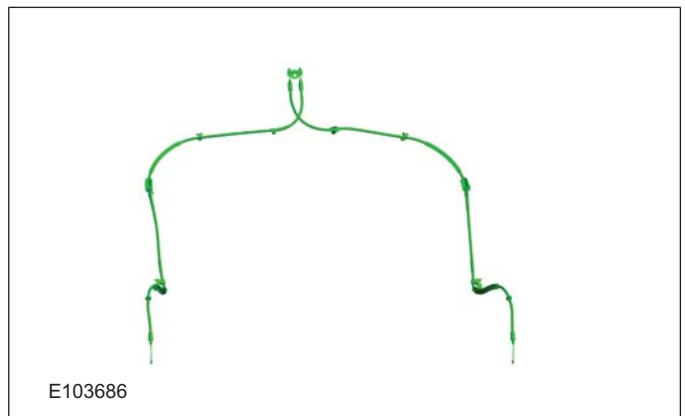
E103685

Item	Description
1	Parking brake cable
2	Parking brake control

The following components may be renewed separately:

- Parking brake cable
- Parking brake control

Parking brake cable



E103686



## DESCRIPTION AND OPERATION

The following instructions must be followed when removing, installing or renewing the parking brake cable:

- If the parking brake cable is removed, installed or renewed, the parking brake must be adjusted after the work is completed.

Refer to: **Parking Brake Cable Adjustment**  
(206-05 Parking Brake and Actuation, General Procedures).

### Parking brake control



The following instructions must be followed when removing, installing or renewing the parking brake lever:

- If the parking brake lever is removed, installed or renewed, the parking brake must be adjusted after the work is completed.

Refer to: **Parking Brake Cable Adjustment**  
(206-05 Parking Brake and Actuation, General Procedures).

## DIAGNOSIS AND TESTING

## Parking Brake

## Inspection and Verification

1. Verify the customer concern by operating the parking brake system.
2. Visually inspect for obvious signs of mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

## Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> <li>– Parking brake control</li> </ul> <p>REFER to: <b>Parking Brake Control</b> (206-05 Parking Brake and Actuation, Removal and Installation).</p> <ul style="list-style-type: none"> <li>– Cable and conduit</li> </ul> <p>REFER to: <b>Parking Brake Rear Cables</b> (206-05 Parking Brake and Actuation, Removal and Installation).</p>	<ul style="list-style-type: none"> <li>– Parking brake warning circuit.</li> </ul> <p>REFER to: <b>Instrument Cluster</b> (413-01 Instrument Cluster, Diagnosis and Testing).</p>

## Symptom Chart

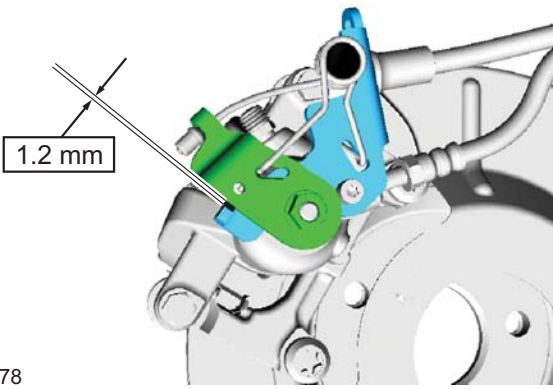
## Symptom Chart

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>• The parking brake will not apply</li> </ul>	<ul style="list-style-type: none"> <li>• Parking brake control.</li> <li>• Cable and conduit.</li> </ul>	<ul style="list-style-type: none"> <li>• GO to <b>Pinpoint Test A.</b></li> </ul>
<ul style="list-style-type: none"> <li>• The parking brake will not hold the vehicle</li> </ul>	<ul style="list-style-type: none"> <li>• Parking brake control.</li> </ul>	<ul style="list-style-type: none"> <li>• GO to <b>Pinpoint Test A.</b></li> </ul>
<ul style="list-style-type: none"> <li>• The parking brake will not release</li> </ul>	<ul style="list-style-type: none"> <li>• Parking brake control.</li> <li>• Cable and conduit.</li> </ul>	<ul style="list-style-type: none"> <li>• GO to <b>Pinpoint Test B.</b></li> </ul>

## DIAGNOSIS AND TESTING

## Pinpoint Tests

## PINPOINT TEST A : THE PARKING BRAKE WILL NOT APPLY

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A1: CHECK PARKING BRAKE CABLE ADJUSTMENT</b>	
 <p>E83778</p>	<p>1 Release the parking brake and measure the gap between the lever and the caliper.</p> <ul style="list-style-type: none"> <li>Is the gap 1.2mm?</li> </ul> <p>→ <b>Yes</b> Vehicle OK</p> <p>→ <b>No</b> REFER to: <b>Parking Brake Cable Adjustment</b> (206-05 Parking Brake and Actuation, General Procedures).</p>
<b>A2: CHECK FUNCTION OF PARKING BRAKE ON BRAKE CALIPER</b>	
	<p>1 Raise and support the vehicle on a lift with the parking brake fully applied.</p> <p>REFER to: <b>Lifting</b> (100-02 Jacking and Lifting, Description and Operation).</p> <ul style="list-style-type: none"> <li>With the aid of another technician, release the parking brake and check the operation of the brake cables and levers.</li> </ul> <ul style="list-style-type: none"> <li>Are the left-hand (LH) and right-hand (RH) parking brake levers moving a similar distance?</li> </ul> <p>→ <b>Yes</b> CHECK the other causes such as conventional brake system components. REPAIR or INSTALL new components as necessary.</p> <p>→ <b>No</b> REFER to: <b>Brake Caliper</b> (206-04 Rear Disc Brake, Removal and Installation). TEST the system for normal operation.</p>

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A3: CHECK FOR WORN BRAKE SHOES OR PADS</b>	
	<p>1 Inspect the brake shoes or pads for excessive wear.</p> <p>REFER to: <b>Specifications</b> (206-00 Brake System - General Information, Specifications).</p> <ul style="list-style-type: none"> <li>Are the brake shoe linings or brake pads OK?</li> </ul> <p>→ <b>Yes</b> GO to A4.</p> <p>→ <b>No</b> INSTALL new brake shoes or pads.</p> <p>REFER to: <b>Brake Pads</b> (206-04 Rear Disc Brake, Removal and Installation). TEST the system for normal operation.</p>
<b>A4: CHECK FOR DAMAGED PARKING BRAKE CABLES</b>	
	<p>1 Inspect the parking brake cables and conduits for damage, rust or fraying.</p> <ul style="list-style-type: none"> <li>Are the parking brake cables and conduits OK?</li> </ul> <p>→ <b>Yes</b> CHECK for other causes such as loose parking brake control or conventional brake system components.</p> <p>→ <b>No</b> REPAIR or INSTALL cables and conduit as necessary. TEST the system for normal operation.</p>

## PINPOINT TEST B : THE PARKING BRAKE WILL NOT RELEASE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B1: CHECK PARKING BRAKE CONTROL</b>	
	<p>1 Raise and support the vehicle on a lift with the parking brake fully applied.</p> <ul style="list-style-type: none"> <li>With the aid of another technician, release the parking brake and check the operation of the brake cables and levers.</li> </ul> <ul style="list-style-type: none"> <li>Did the parking brake release?</li> </ul> <p>→ <b>Yes</b> CHECK the other causes such as conventional brake system components. REPAIR or INSTALL new components as necessary.</p> <p>→ <b>No</b> <b>GO to B2.</b></p>

206-05-7

## Parking Brake and Actuation

206-05-7

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B2: CHECK PARKING BRAKE CABLES</b>	
	<p>1 Loosen the parking brake cable tension.</p> <ul style="list-style-type: none"> <li>– Rotate the rear wheels by hand.</li> </ul> <ul style="list-style-type: none"> <li>• Did the rear wheels turn freely?</li> </ul> <p>→ <b>Yes</b> INSTALL a new parking brake control. REFER to: <b>Parking Brake Control</b> (206-05 Parking Brake and Actuation, Removal and Installation). TEST the system for normal operation.</p> <p>→ <b>No</b> GO to B3.</p>
<b>B3: CHECK FRONT PARKING BRAKE CABLE</b>	
	<p>1 Disconnect the parking brake front cable and conduit from the rear brake cable and conduit at the equalizer.</p> <ul style="list-style-type: none"> <li>– Rotate the rear wheels by hand.</li> </ul> <ul style="list-style-type: none"> <li>• Did the rear wheels turn freely?</li> </ul> <p>→ <b>Yes</b> INSTALL a new front parking brake cable and conduit. REFER to: <b>Parking Brake Rear Cables</b> (206-05 Parking Brake and Actuation, Removal and Installation). TEST the system for normal operation.</p> <p>→ <b>No</b> GO to B4.</p>

206-05-8

## Parking Brake and Actuation

206-05-8

## DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B4: CHECK REAR PARKING BRAKE CABLES</b>	
	<p>1 Disconnect the parking brake at the rear brakes, one at a time.</p> <ul style="list-style-type: none"> <li>– Rotate the wheel affected by the disconnected parking brake.</li> <li>• Did the wheel turn freely?</li> </ul> <p>→ <b>Yes</b></p> <p>INSTALL a new parking brake control lever on the rear drum brakes or caliper assembly on rear disc brakes.</p> <p>REFER to: <b>Parking Brake Control</b> (206-05 Parking Brake and Actuation, Removal and Installation)</p> <p>/ <b>Brake Caliper</b> (206-04 Rear Disc Brake, Removal and Installation).</p> <p>TEST the system for normal operation.</p> <p>→ <b>No</b></p> <p>REFER to: <b>Brake System</b> (206-00 Brake System - General Information, Diagnosis and Testing).</p>



GENERAL PROCEDURES

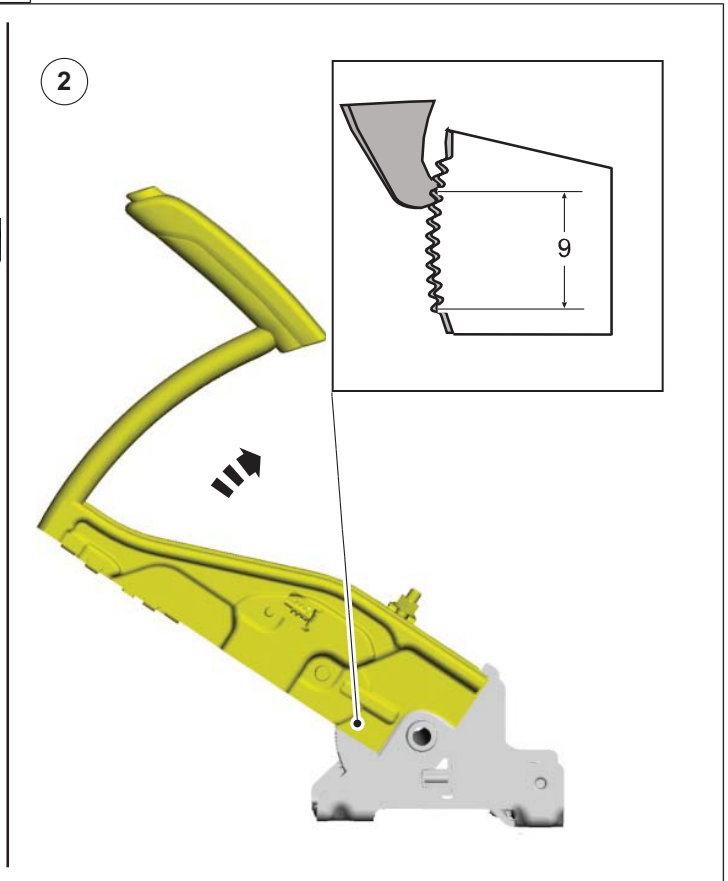
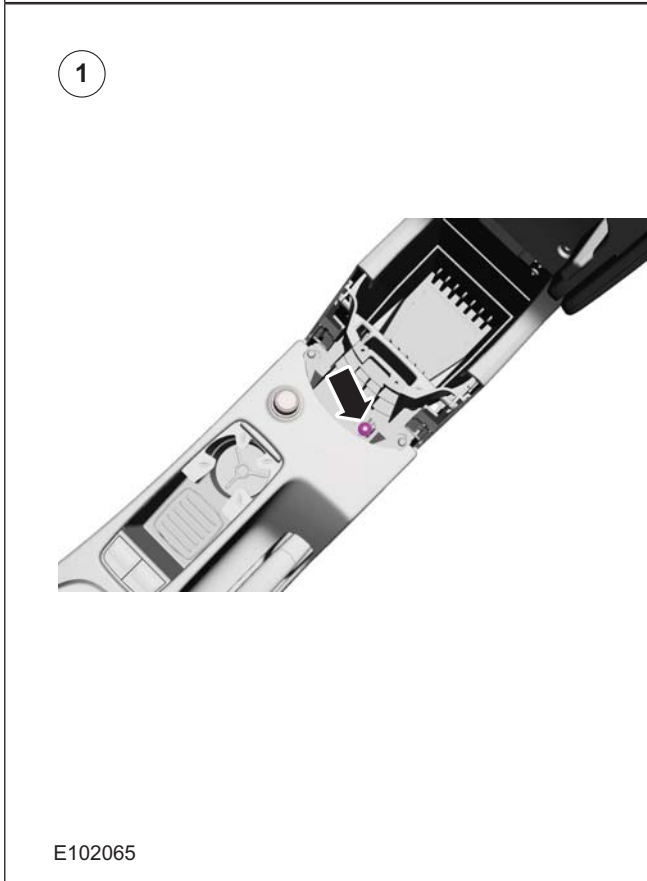
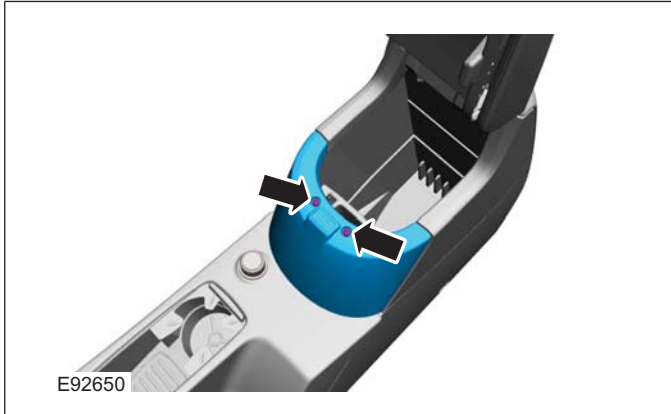
Parking Brake Cable Adjustment

1. 1. Fully apply the parking brake.
2. Fully release the parking brake control.

3. **NOTE:** This step is only necessary if the parking brake cable was removed.

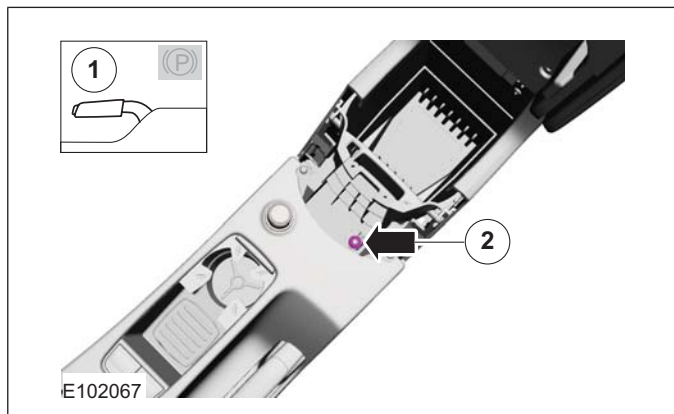
2.

1. Torque: 2 Nm

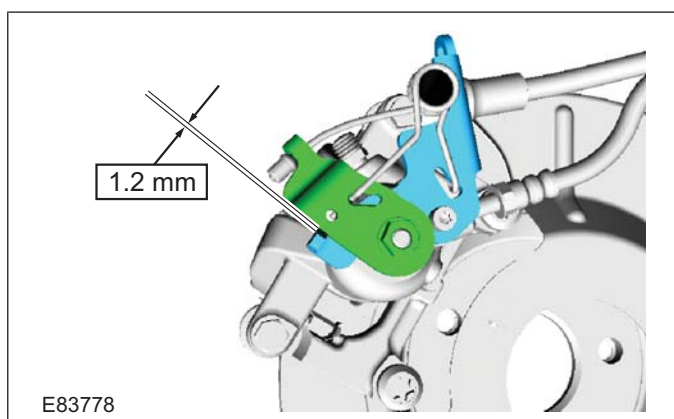


## GENERAL PROCEDURES

4. 2. Loosen the parking brake cable adjustment nut to the end of the parking brake cable thread.



5. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
6. **NOTE:** This step requires the aid of another technician.
  1. Insert a 1.2 mm feeler gauge between the parking brake lever and the brake caliper abutment, on both sides.
  2. Tighten the parking brake cable adjustment nut until movement is observed on one of the parking brake levers.
  3. Remove the feeler gauges.
  4. Rotate the rear wheels and tires and check for brake drag. If brake drag is felt, loosen the parking brake cable adjustment nut to the end of the parking brake cable thread, clean the parking brake cables and repeat the parking brake cable adjustment procedure.
  5. If brake drag is still felt after, repeat the adjustment using a 1.0 mm feeler gauge. If brake drag is still felt, loosen the parking brake adjustment nut and reduce the feeler gauge measurement by 0.2 mm each time, until no brake drag can be felt at the rear wheels and tires.



206-05-11

Parking Brake and Actuation

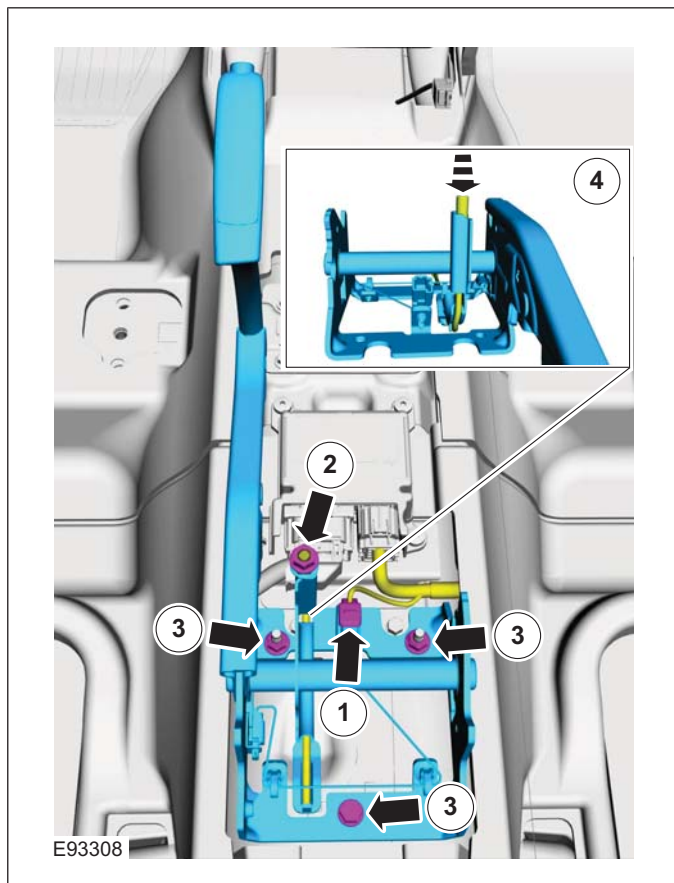
206-05-11

## REMOVAL AND INSTALLATION

## Parking Brake Control(12 664 0)

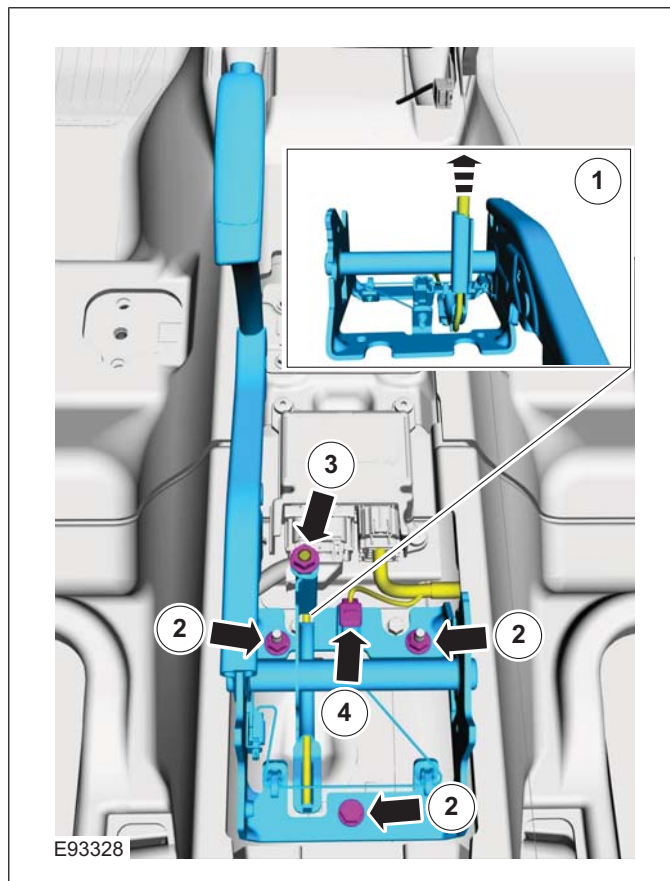
## Removal

1. Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation).
2. Release the parking brake.
- 3.



## Installation

1. 2. Torque: 35 Nm
3. **NOTE:** Only tighten the nut finger tight at this stage.



2. Refer to: **Parking Brake Cable Adjustment** (206-05 Parking Brake and Actuation, General Procedures).
3. Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation).

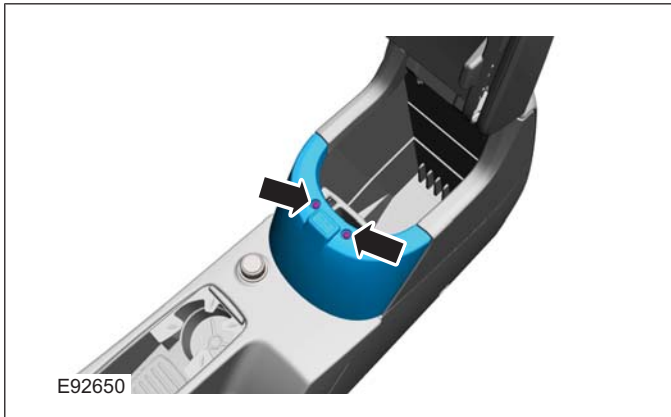
REMOVAL AND INSTALLATION

Parking Brake Rear Cables

Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Fully release the parking brake control.
- 2.



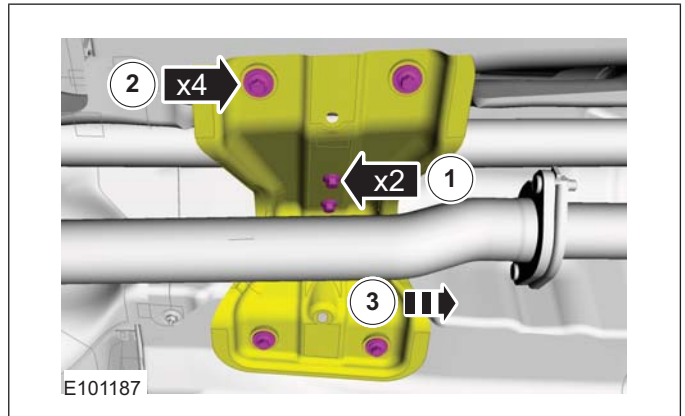
3. Loosen the parking brake cable adjustment nut to the end of the parking brake cable thread.



4. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

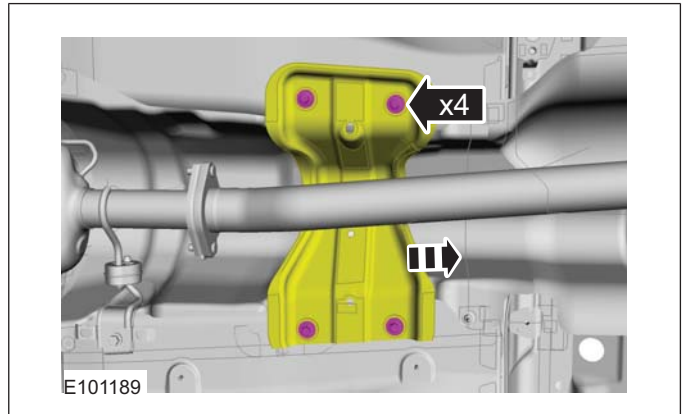
4x4

5. Torque: 25 Nm



4x2

6. Torque: 25 Nm

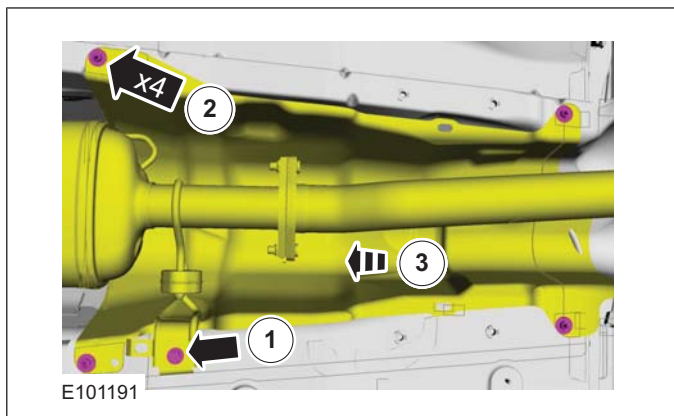




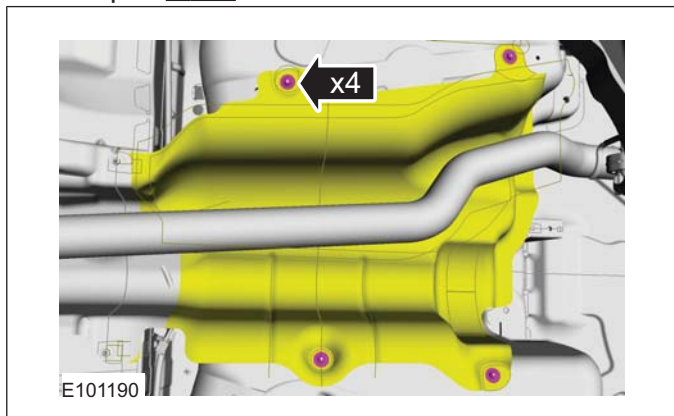
REMOVAL AND INSTALLATION

All vehicles

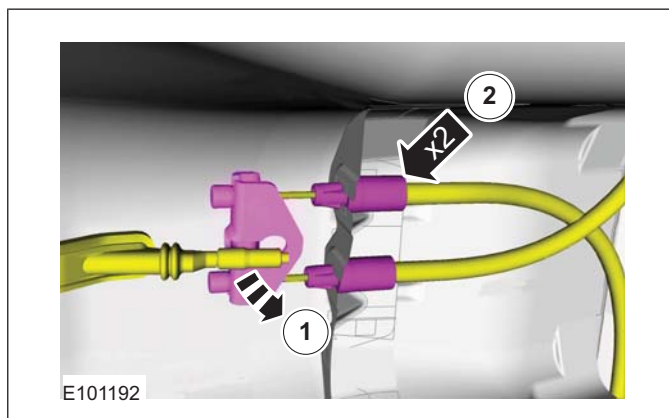
- 7. 1. Torque: 25 Nm
- 2. Torque: 5 Nm



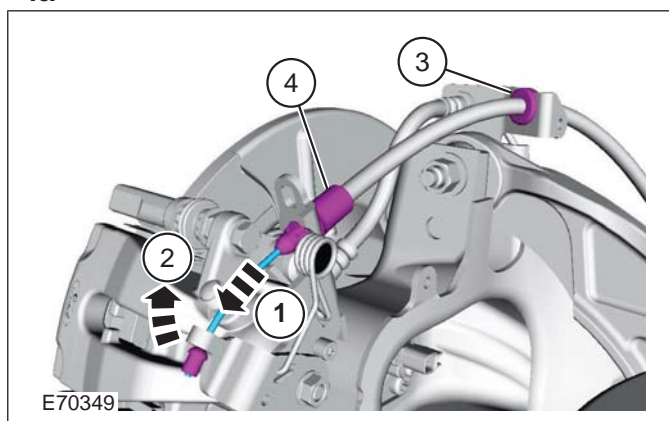
- 8. Torque: 5 Nm



9.



10.



- 11. Torque: 2 Nm



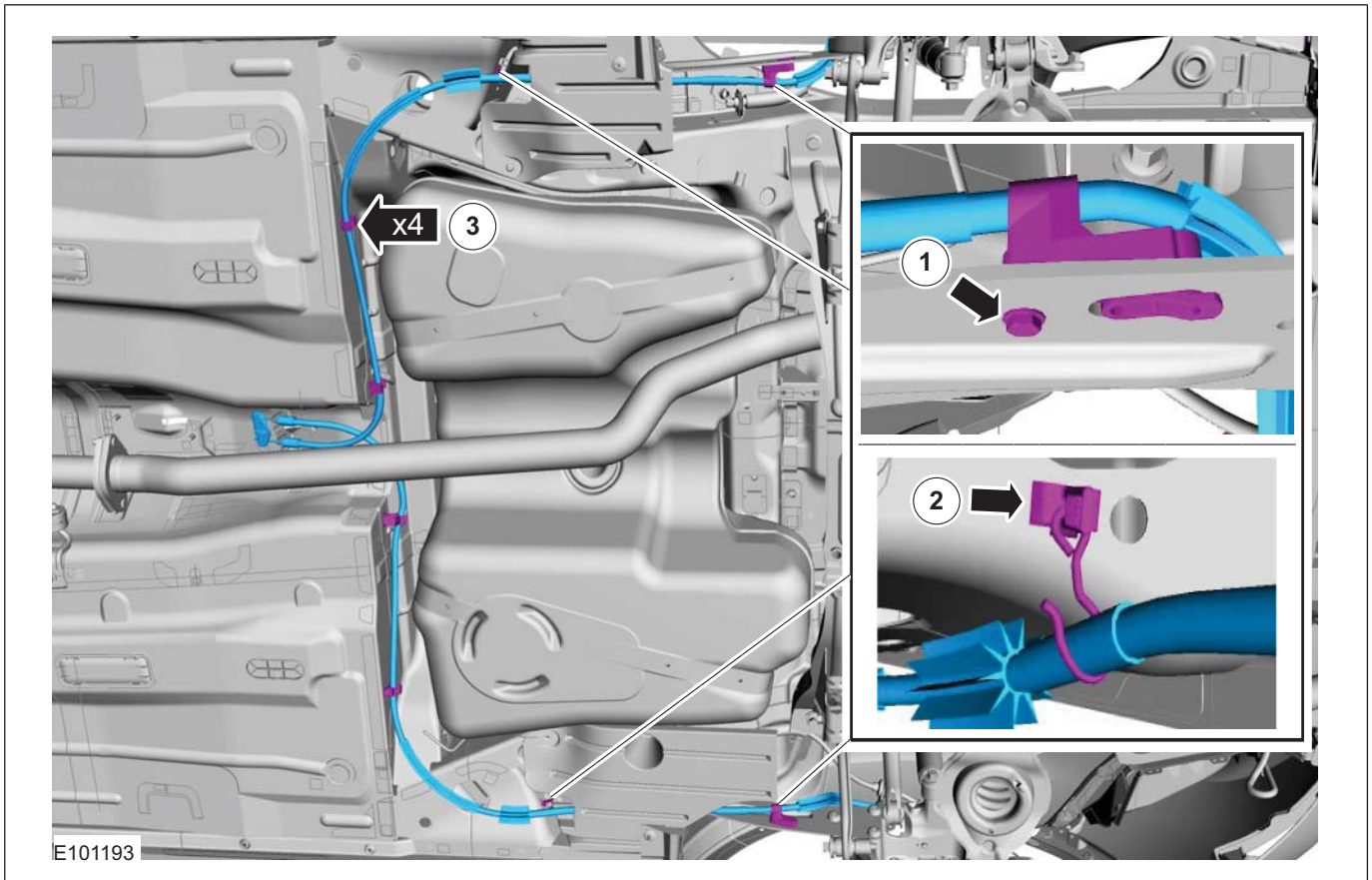


206-05-14

Parking Brake and Actuation

206-05-14

## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.
2. Refer to: **Parking Brake Cable Adjustment** (206-05 Parking Brake and Actuation, General Procedures).





## SECTION 206-06 Hydraulic Brake Actuation

VEHICLE APPLICATION: 2008.50 Kuga

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<b>REMOVAL AND INSTALLATION</b>	
Brake Pedal and Bracket — RHD 4WD/RHD FWD.....	206-06-2
Brake Master Cylinder — 2.5L Duratec (147kW/200PS) - VI5..... (12 343 0)	206-06-5



## REMOVAL AND INSTALLATION

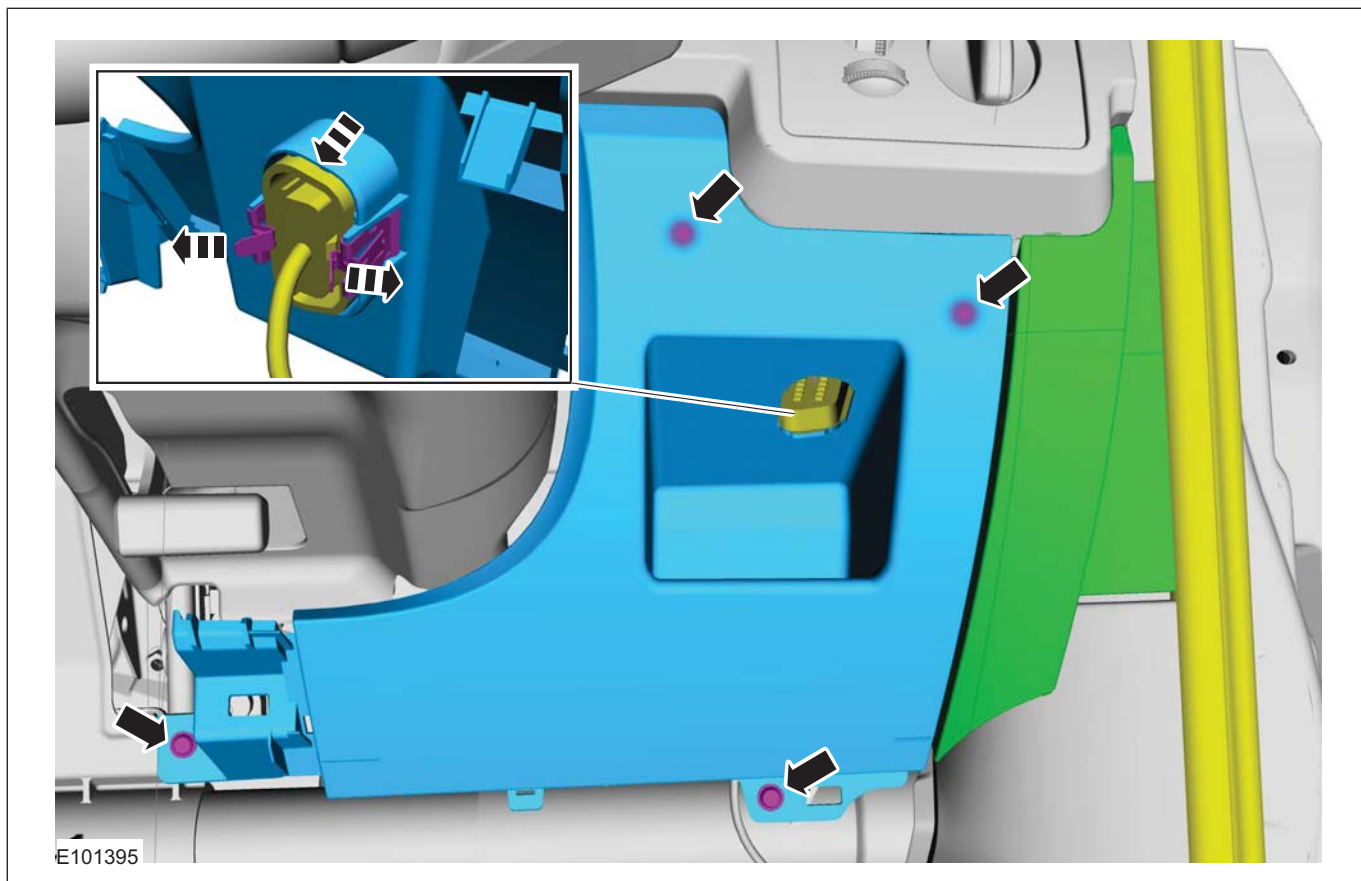
## Brake Pedal and Bracket — RHD 4WD/RHD FWD

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).

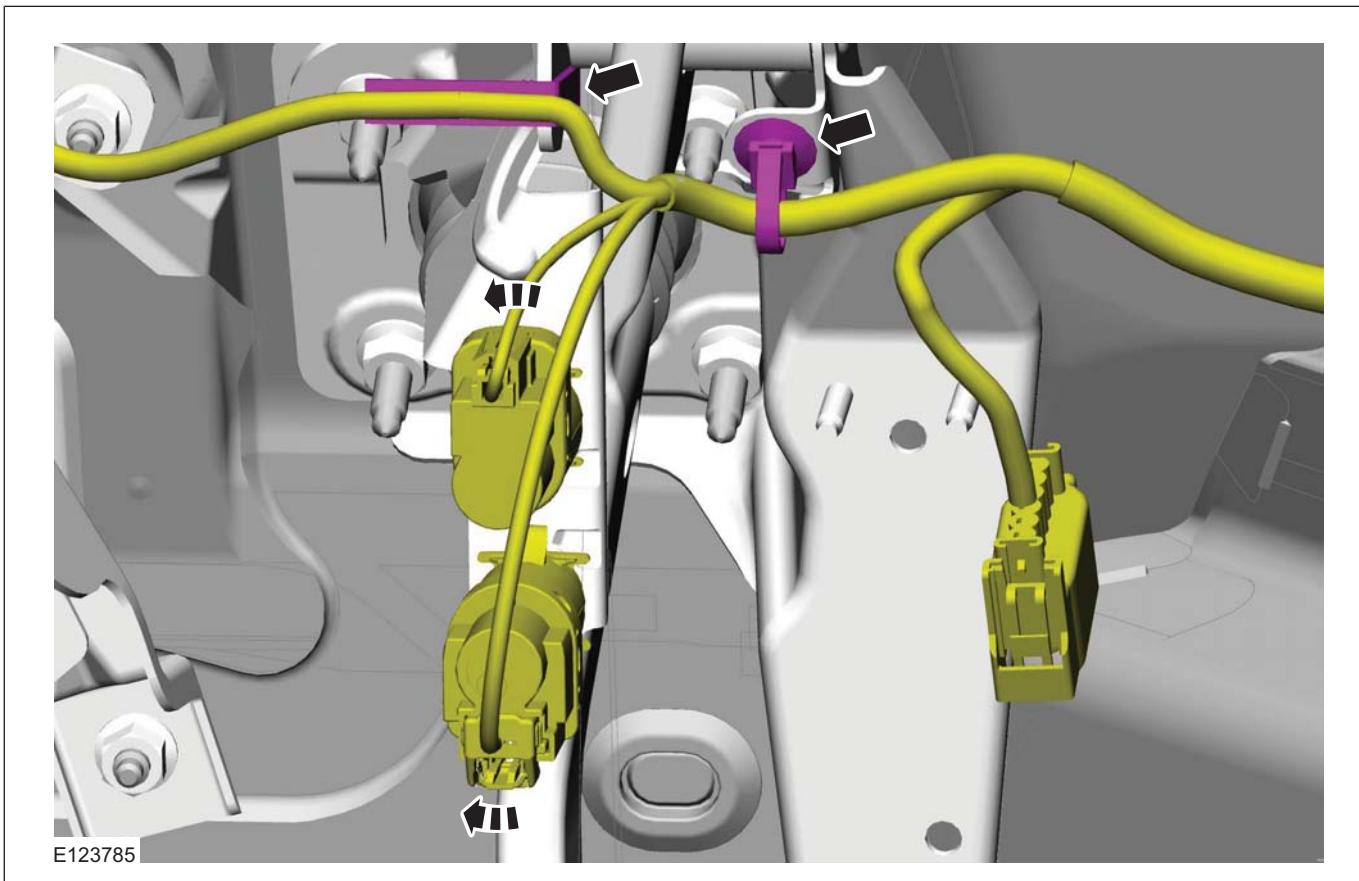
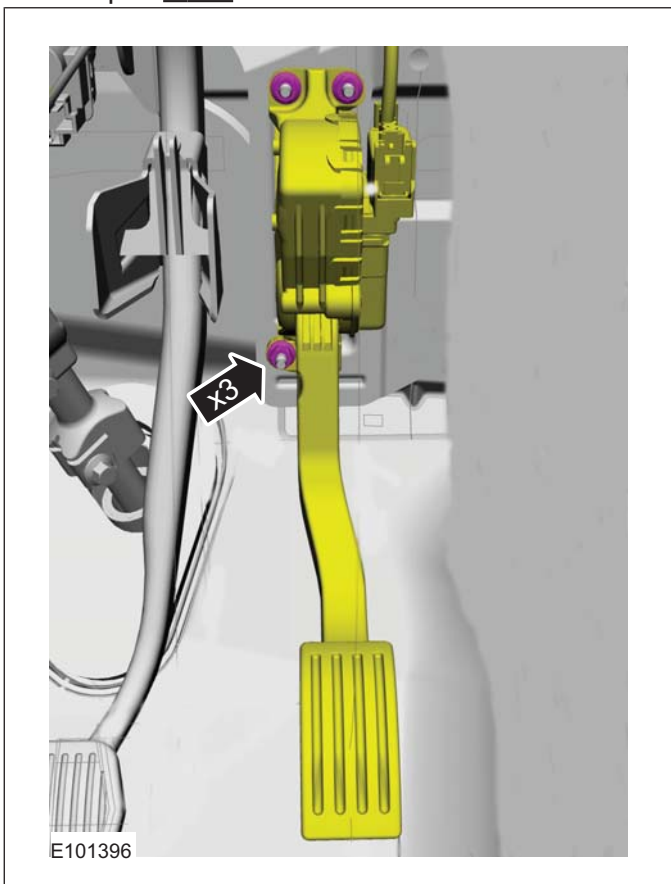
- 2.



REMOVAL AND INSTALLATION

3. Torque: 9 Nm

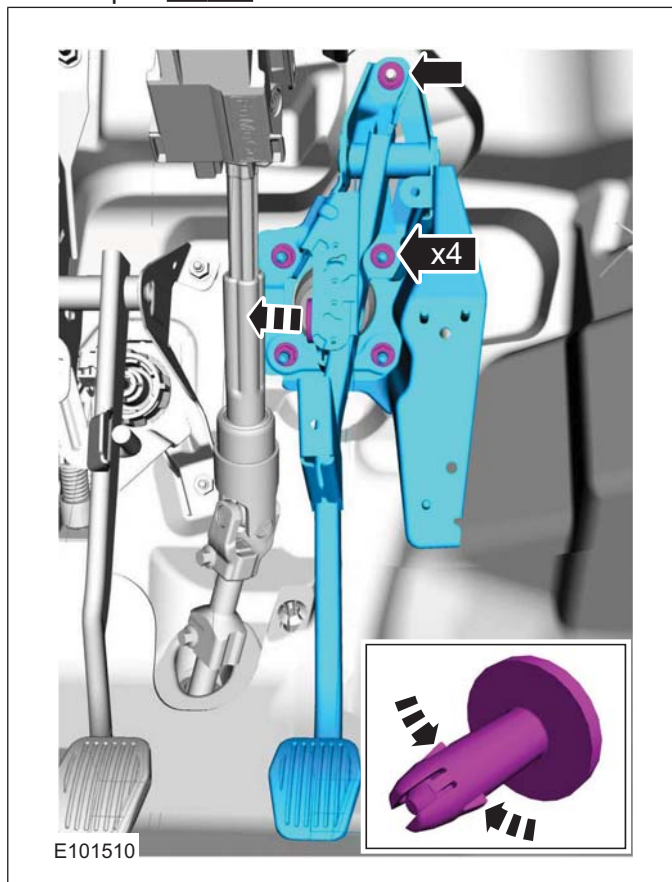
4.  **CAUTION:** Make sure that the brake pedal remains in the rest position.



## REMOVAL AND INSTALLATION



5.  **CAUTION:** Make sure that the brake pedal remains in the rest position.

Torque: 24 Nm



## Installation

## 1. CAUTIONS:

-  Make sure that the brake booster push rod is correctly located.
-  Make sure that the brake pedal remains in the rest position.

To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

Brake Master Cylinder — 2.5L Duratec (147kW/200PS) -  
VI5(12 343 0)

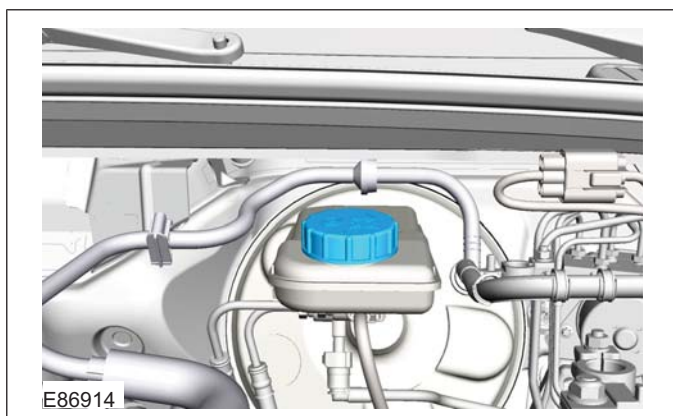
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

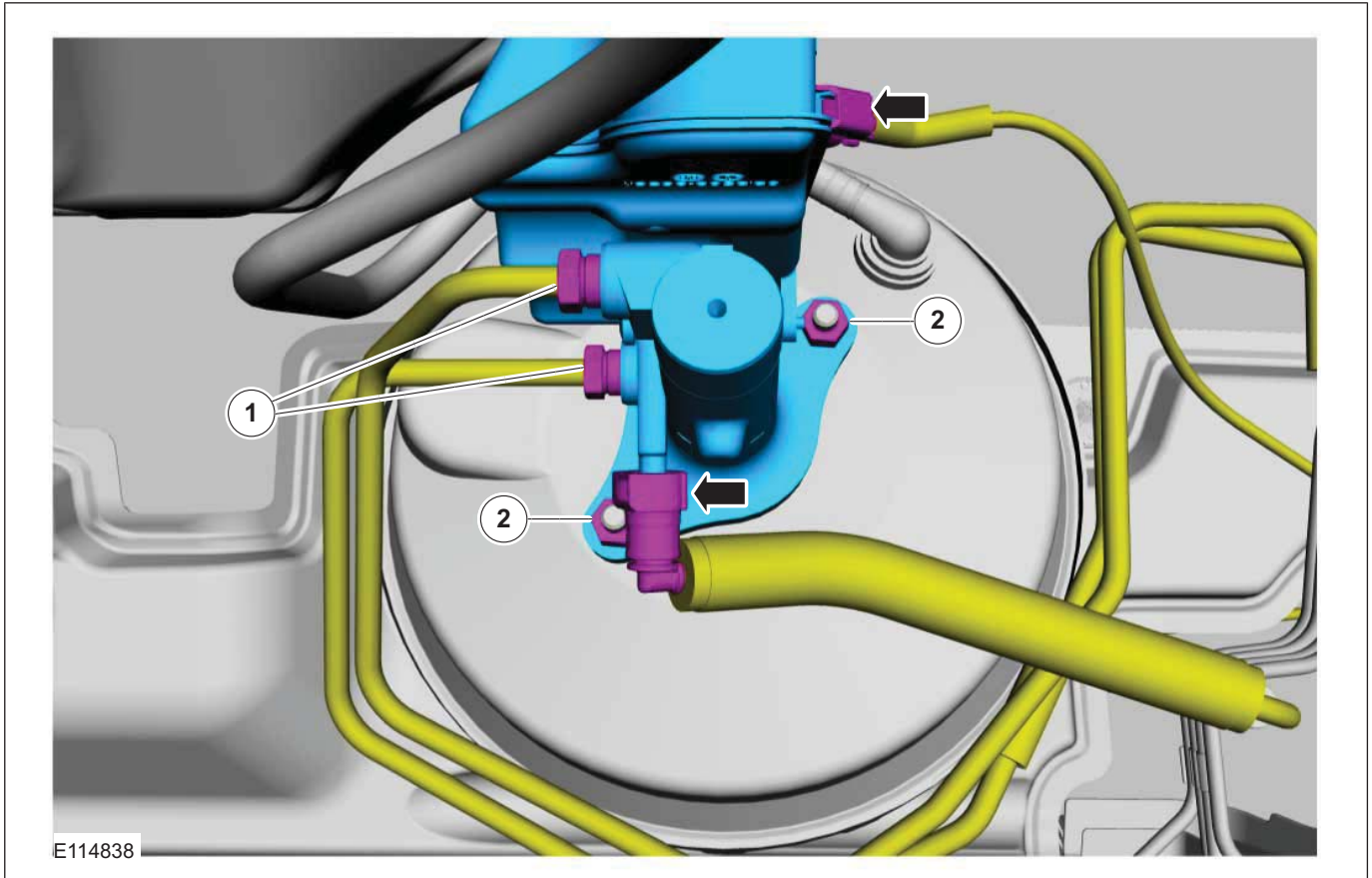
1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. 1. Connect one end of a suitable piece of clear plastic pipe to the brake caliper bleed nipple and place the other end into a suitable container.  
2. Loosen the bleed nipple.  
3. Depress the brake pedal until no more brake fluid comes through the bleed nipple.  
4. Tighten the bleed nipple.  
5. Repeat the draining procedure on the opposite side brake caliper.

Left-hand drive vehicles

3. **CAUTION:** Make sure that all openings are sealed.
  1. Torque: 18 Nm
  2. **NOTE:** Make sure that new components are installed.  
Torque: 25 Nm



## REMOVAL AND INSTALLATION



Right-hand drive vehicles

4. **⚠ CAUTION:** Make sure that all openings are sealed.

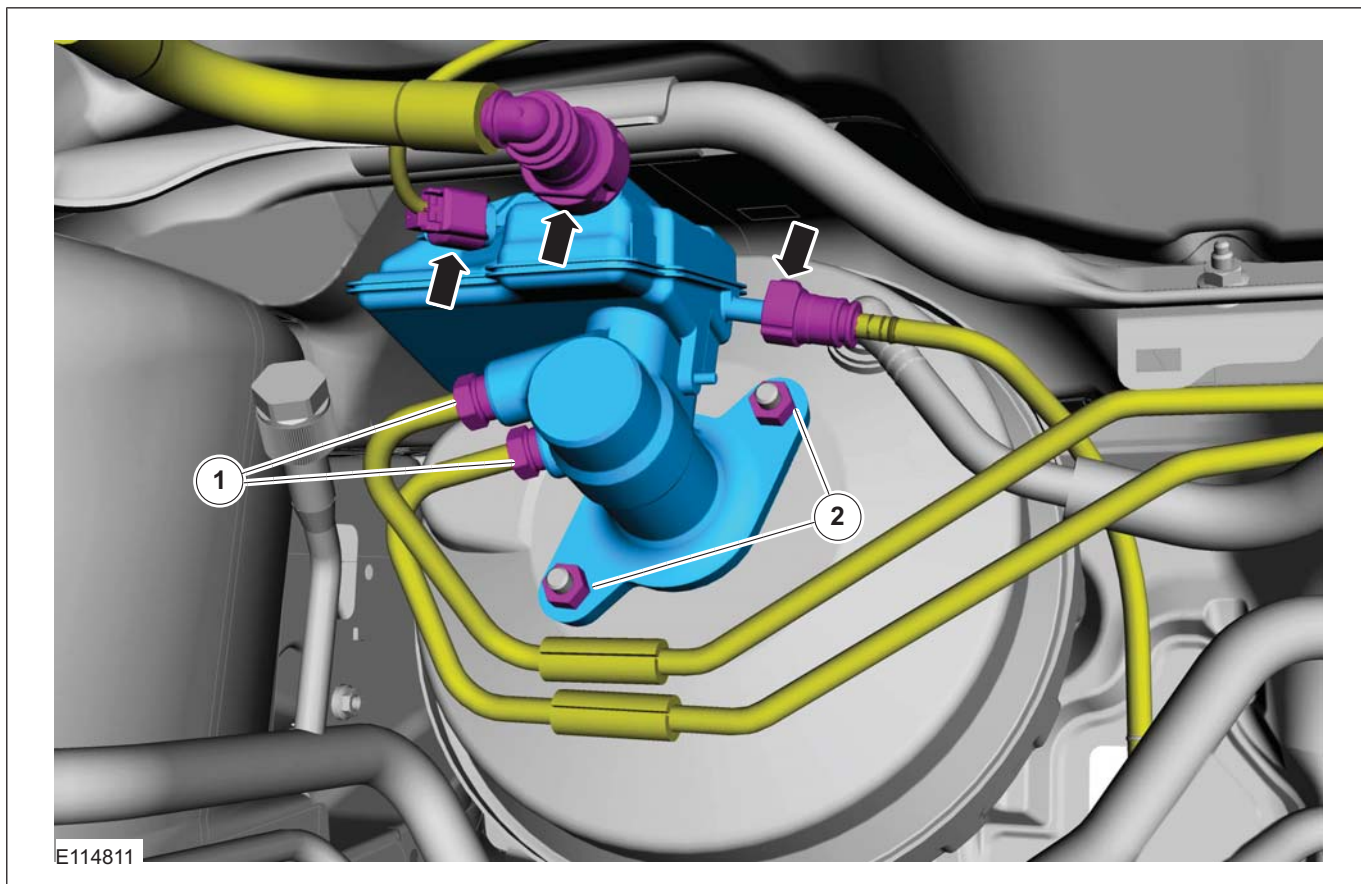
1. Torque: 18 Nm

2. **NOTE:** Make sure that new components are installed.

Torque: 25 Nm



## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.
2. Refer to: **Brake System Bleeding** (206-00 Brake System - General Information, General Procedures).  
Refer to: **Brake System Pressure Bleeding** (206-00 Brake System - General Information, General Procedures).

## SECTION 206-07 Power Brake Actuation

VEHICLE APPLICATION: 2008.50 Kuga

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Brake Vacuum Hose — 2.5L Duratec (147kW/200PS) - VI5.....	206-07-7
Brake Vacuum Pump — 2.5L Duratec (147kW/200PS) - VI5..... (12 414 0)	206-07-9

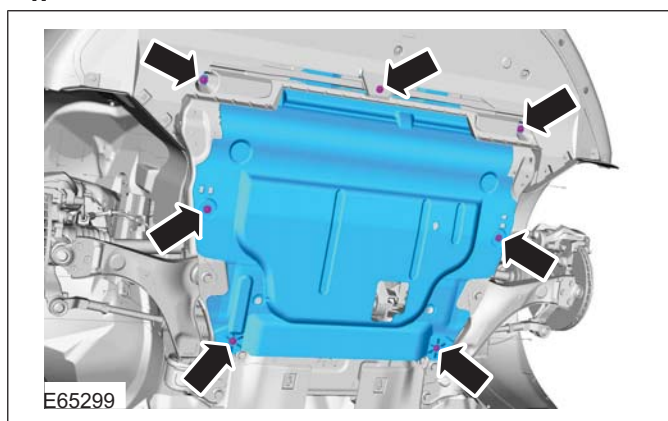
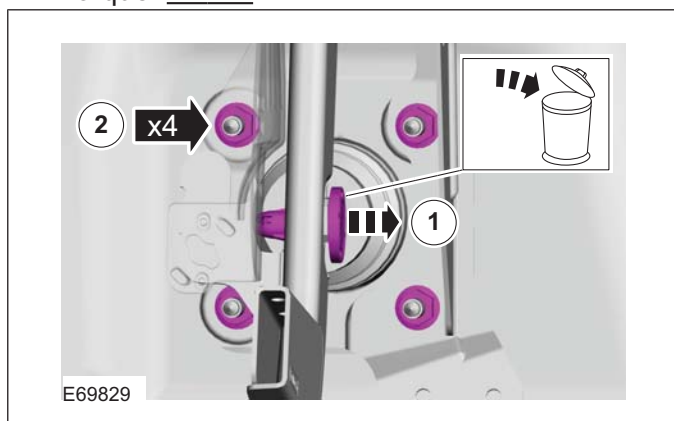
## REMOVAL AND INSTALLATION

Brake Booster — 2.5L Duratec (147kW/200PS) - VI5, RHD  
4WD/RHD FWD(12 451 0)

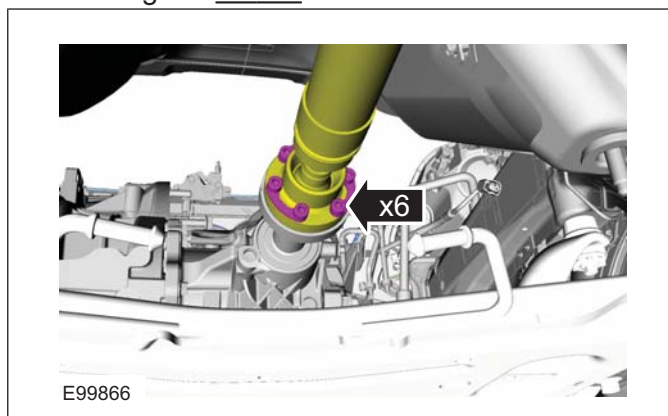
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Torque: 24 Nm
3. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).  
Refer to: **Brake Master Cylinder - 2.5L Duratec (147kW/200PS) - VI5** (206-06 Hydraulic Brake Actuation, Removal and Installation).  
Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

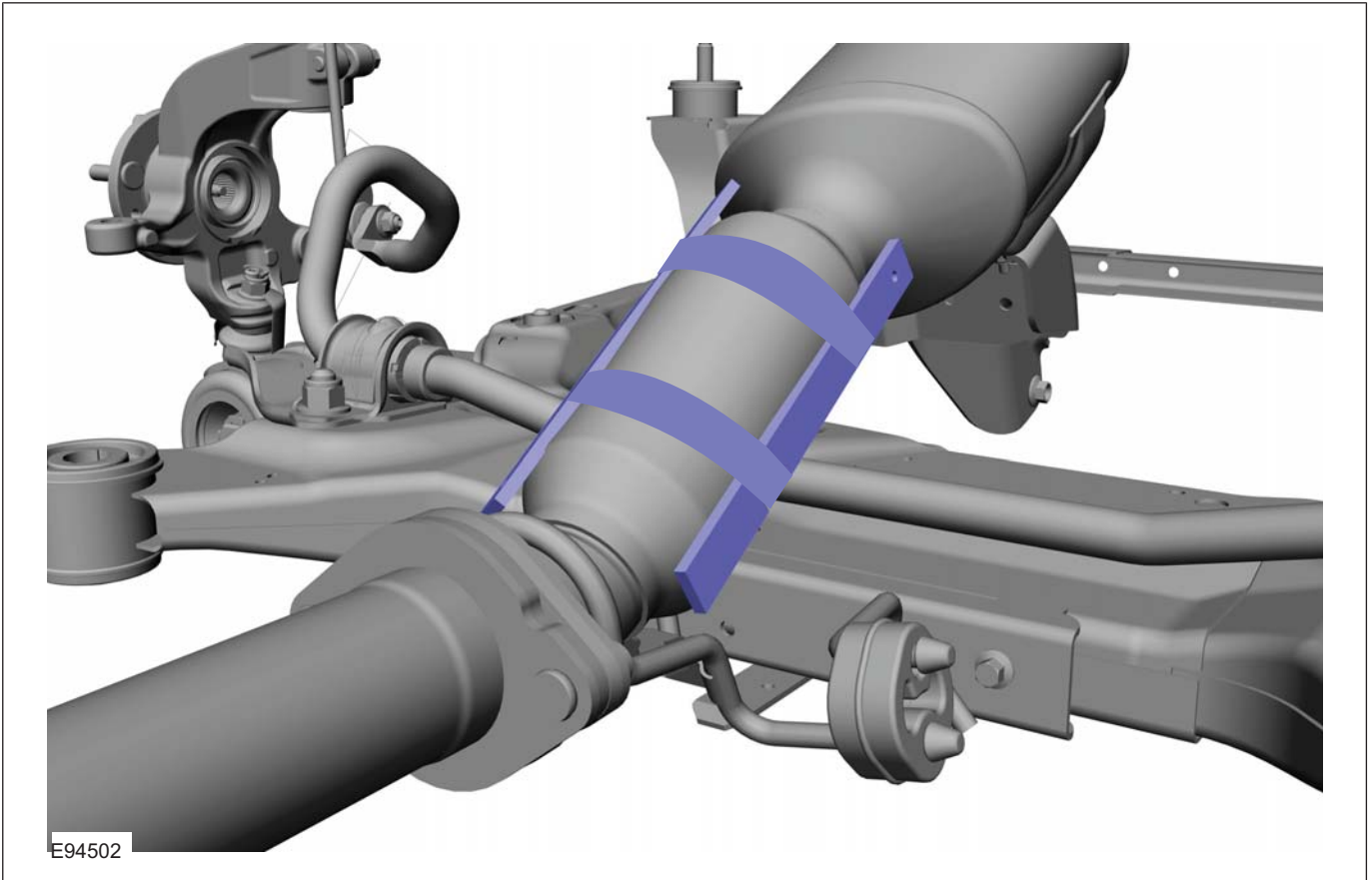


5. Torque:
  - Stage 1: 10 Nm
  - Stage 2: 25 Nm

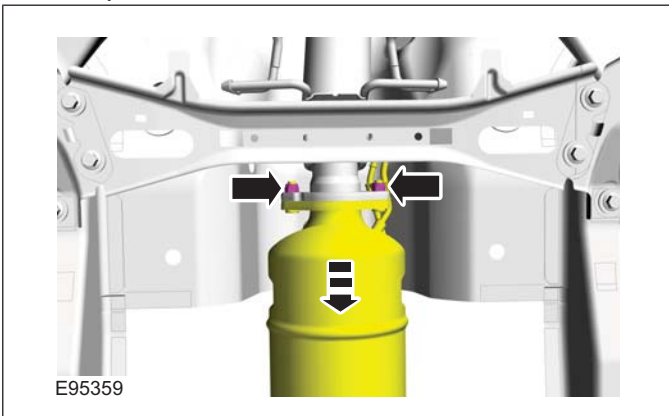


- 6.

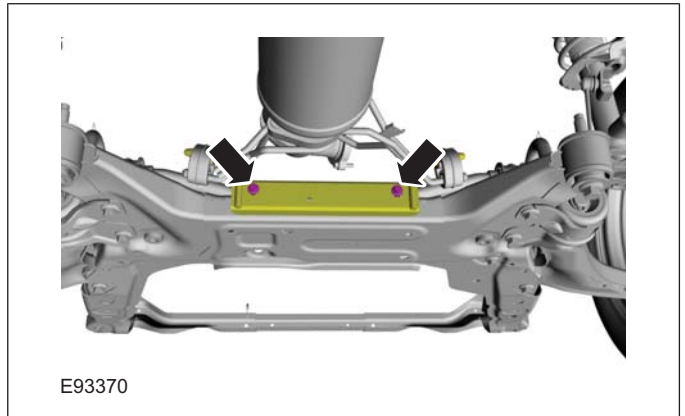
REMOVAL AND INSTALLATION



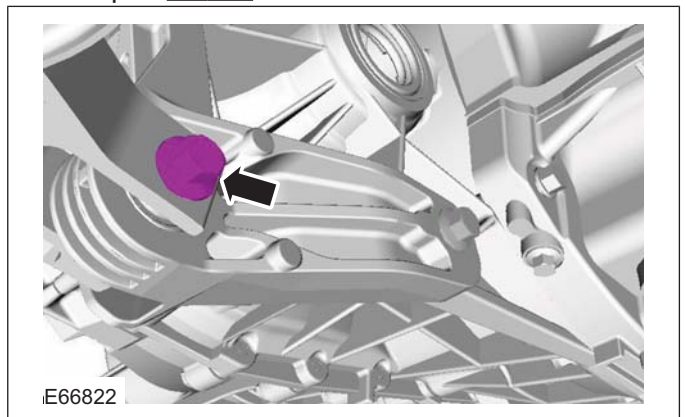
7. Torque: 48 Nm



8. Torque: 10 Nm



9. Torque: 80 Nm



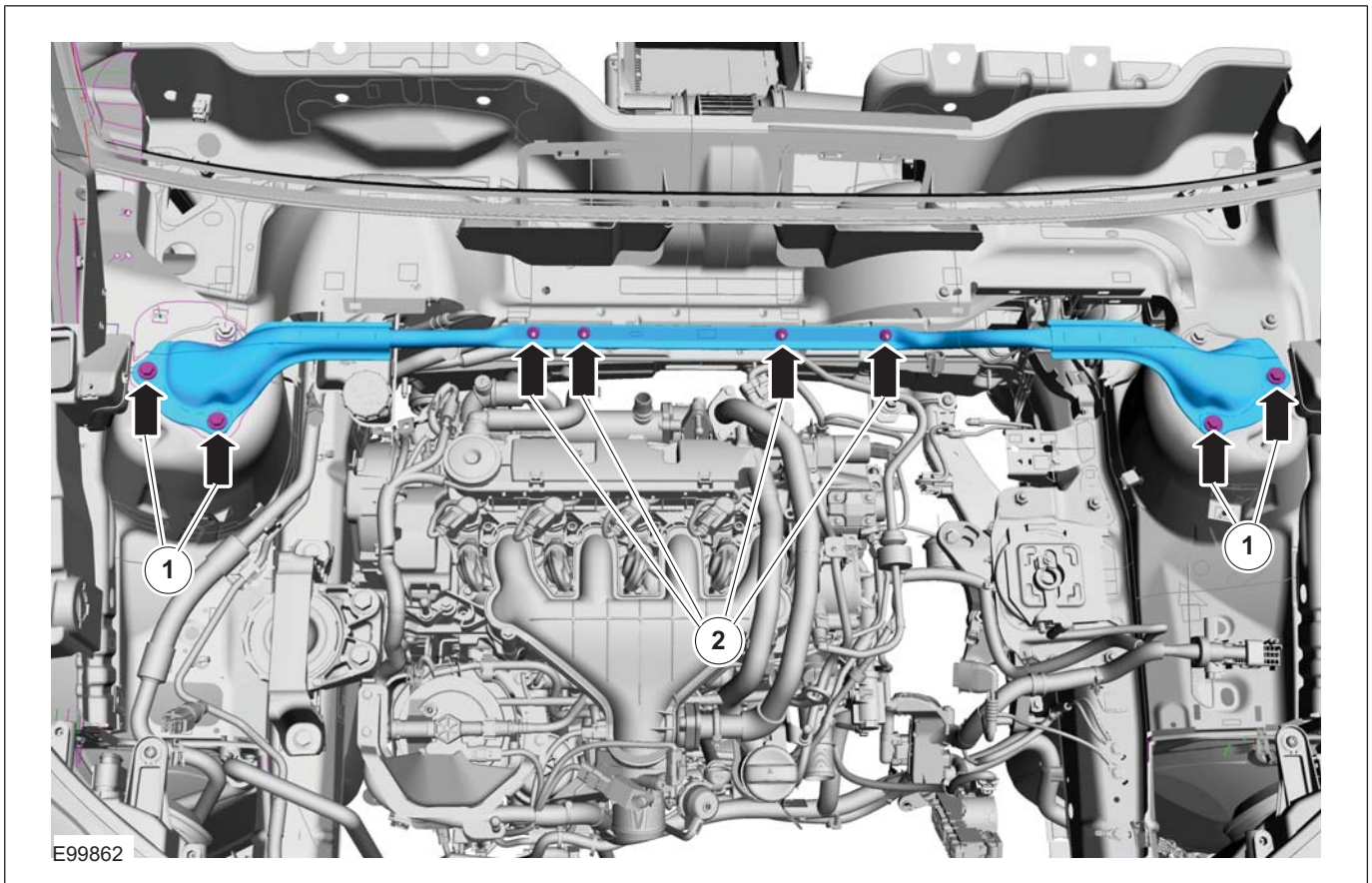


206-07-4

Power Brake Actuation

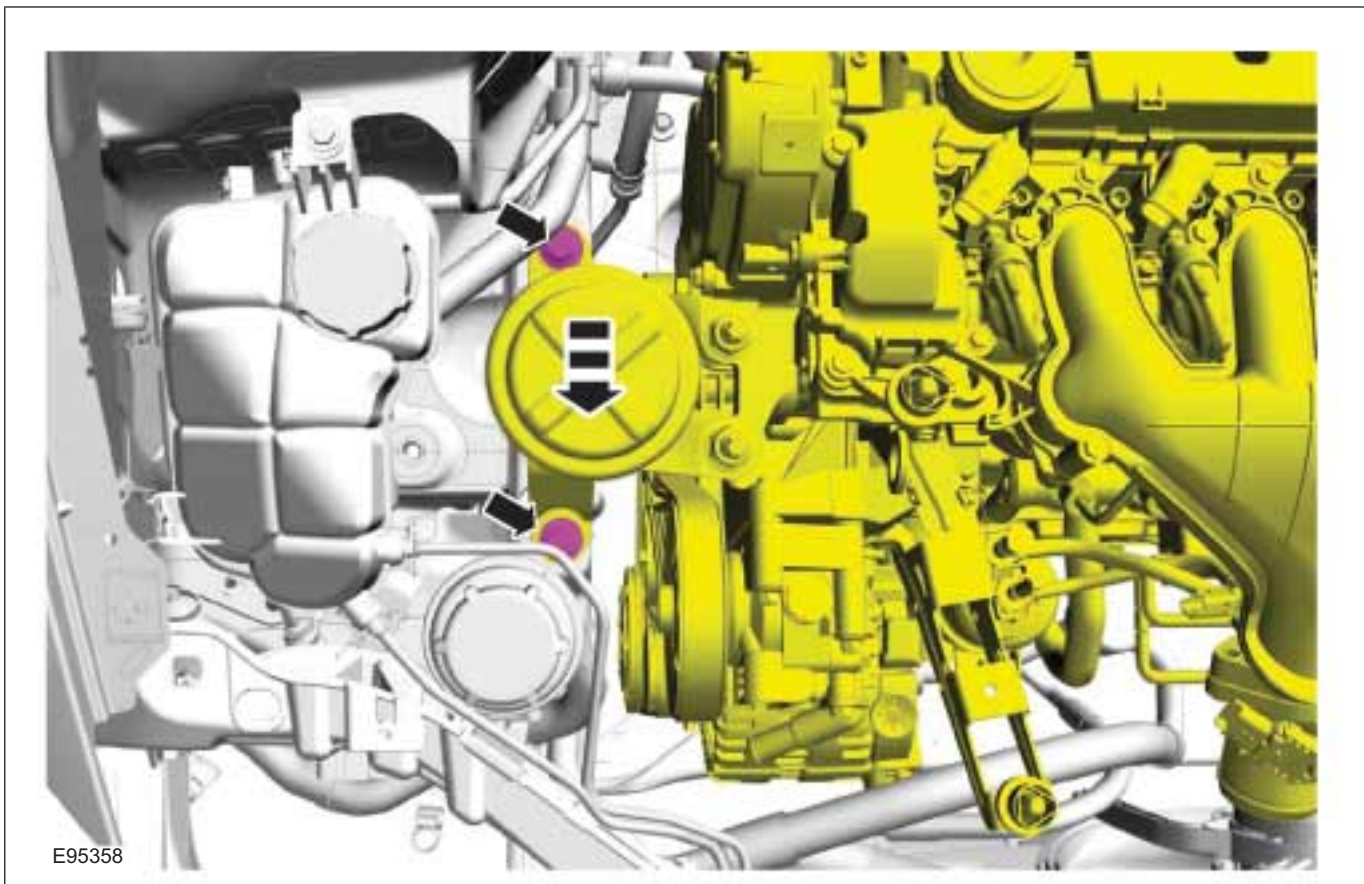
206-07-4

## REMOVAL AND INSTALLATION

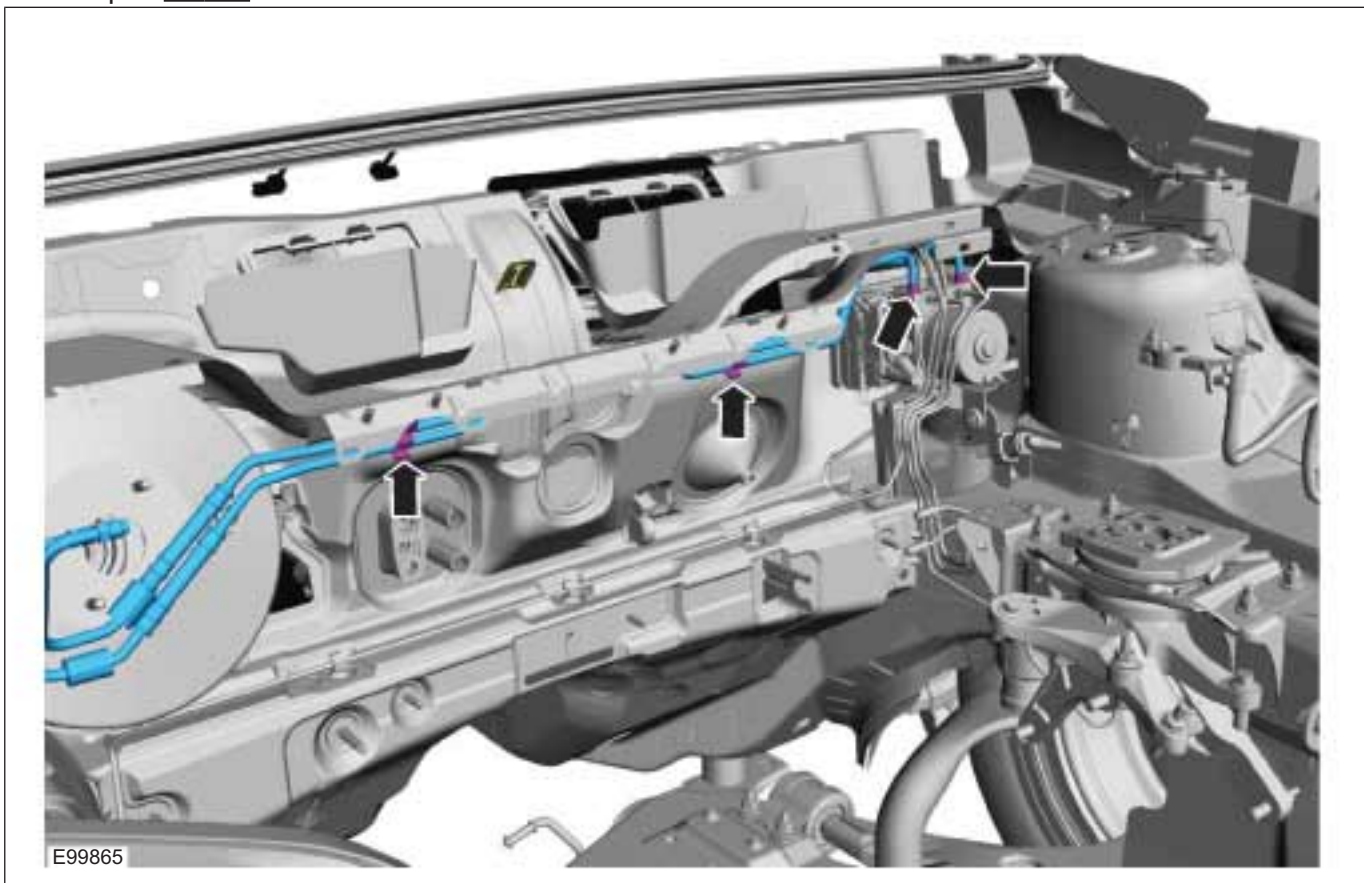
10. 1. Torque: 35 Nm2. Torque: 10 Nm11. Torque: 80 Nm



REMOVAL AND INSTALLATION



12 Torque: 18 Nm





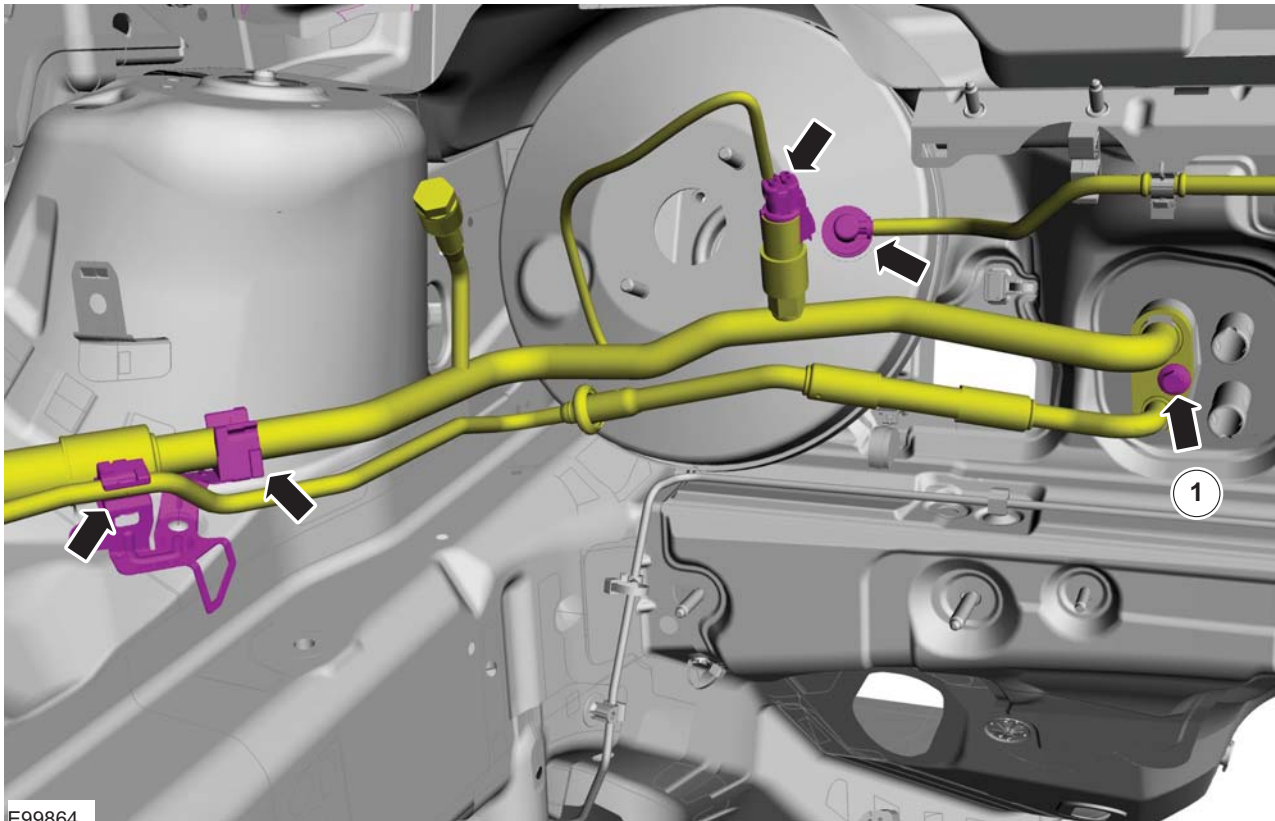
206-07-6

Power Brake Actuation

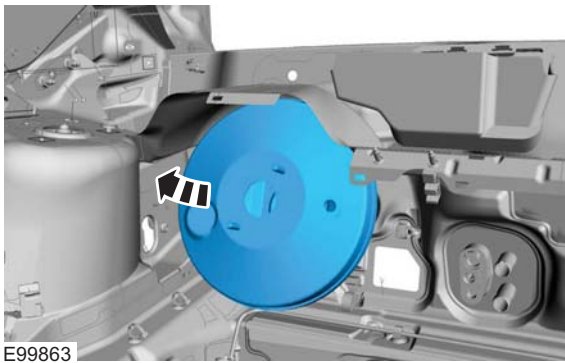
206-07-6

## REMOVAL AND INSTALLATION

13. Torque: 8 Nm



14.



## Installation

**⚠ CAUTION:** Make sure that the brake booster pushrod is correctly located.

1. To install, reverse the removal procedure.

206-07-7

Power Brake Actuation

206-07-7

## REMOVAL AND INSTALLATION

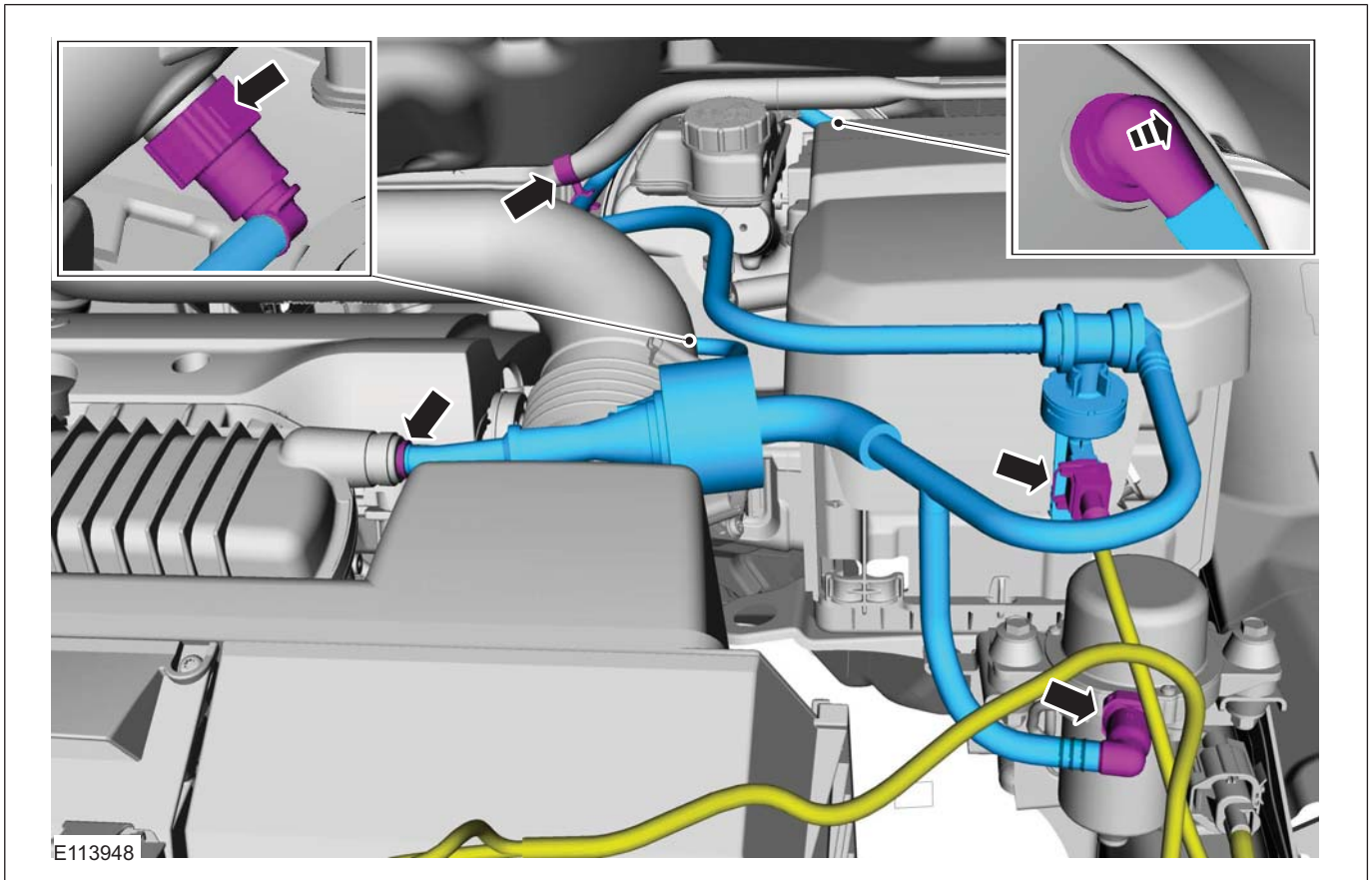
## Brake Vacuum Hose — 2.5L Duratec (147kW/200PS) - VI5

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

Left-hand drive vehicles

1.



Right-hand drive vehicles

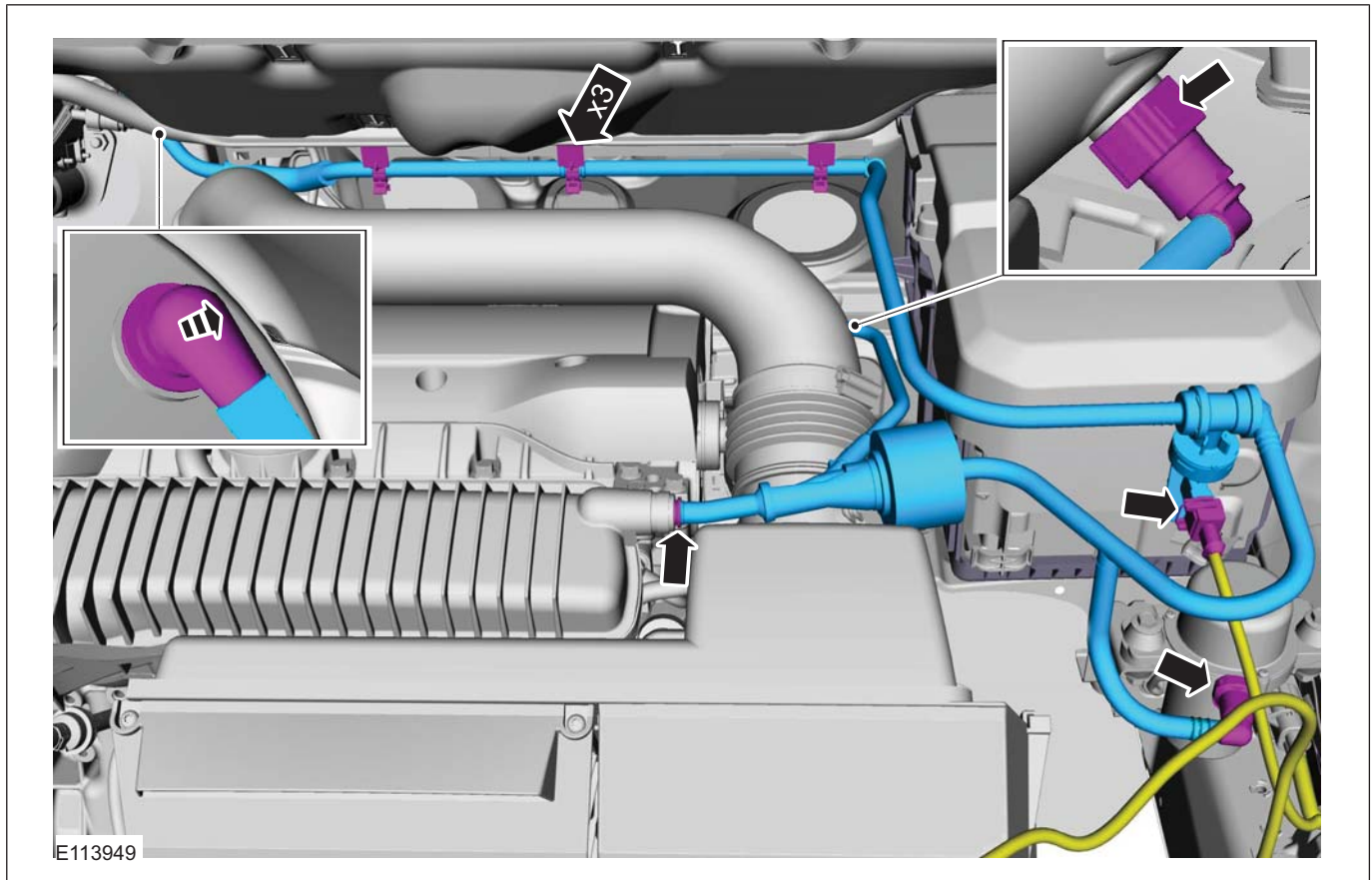
2.

206-07-8

Power Brake Actuation

206-07-8

## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.

206-07-9

Power Brake Actuation

206-07-9

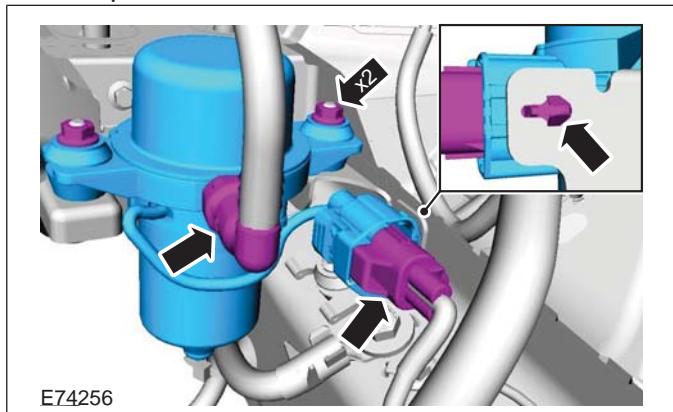
## REMOVAL AND INSTALLATION

Brake Vacuum Pump — 2.5L Duratec (147kW/200PS) -  
VI5(12 414 0)

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Torque: 10 Nm



## Installation

1. To install, reverse the removal procedure.

## SECTION 206-09A Anti-Lock Control

**VEHICLE APPLICATION: 2008.50 Kuga**

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Anti-Lock Control (System Operation and Component Description).....	206-09A-4
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<b>DIAGNOSIS AND TESTING</b>	
Anti-Lock Control.....	206-09A-5
Inspection and Verification.....	206-09A-5



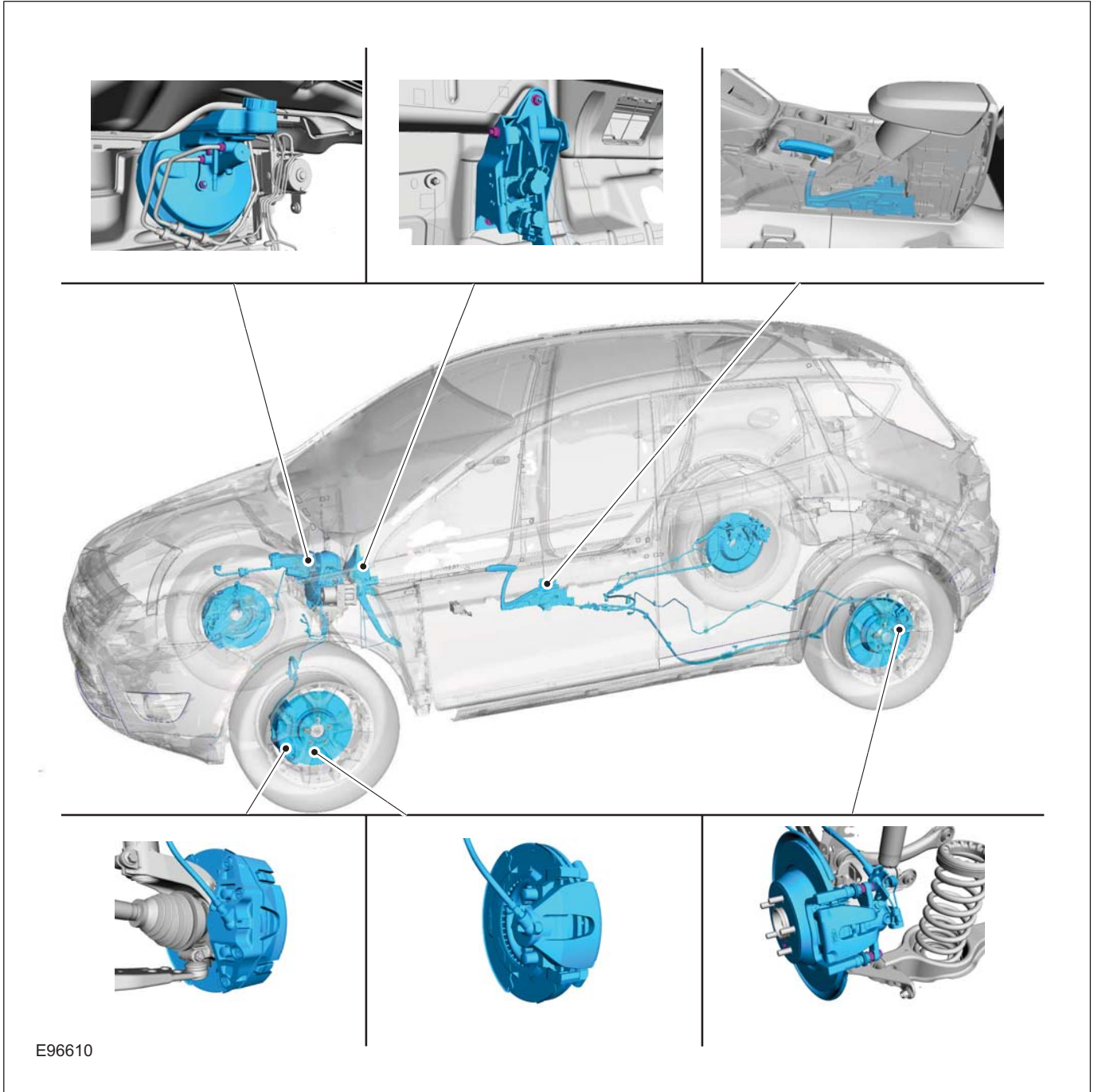


DESCRIPTION AND OPERATION

Anti-Lock Control – Component Location

NOTE:

Refer to: **Brake System** (206-00 Brake System - General Information, Description and Operation).





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**DESCRIPTION AND OPERATION****Anti-Lock Control – Overview****Anti-lock Brake System**

Refer to: **Anti-Lock Control - Stability Assist** (206-09 Anti-Lock Control - Stability Assist, Description and Operation).

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**DESCRIPTION AND OPERATION****Anti-Lock Control – System Operation and Component Description****System Operation**

Refer to: **Anti-Lock Control - Stability Assist** (206-09 Anti-Lock Control - Stability Assist, Description and Operation).

**DIAGNOSIS AND TESTING****Anti-Lock Control**

Refer to **Wiring Diagrams Section 206-09A**, for schematic and connector information.

**General Equipment**

The Ford approved diagnostic tool
-----------------------------------

**Inspection and Verification**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

Mechanical	Electrical
<ul style="list-style-type: none"> <li>• Wheel speed sensor(s)</li> <li>• Wheel speed sensor ring(s)</li> </ul>	<ul style="list-style-type: none"> <li>• Fuse(s)</li> <li>• Electrical connector(s)</li> <li>• Wiring harness(s).</li> <li>• Anti-lock brake system (ABS) module</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

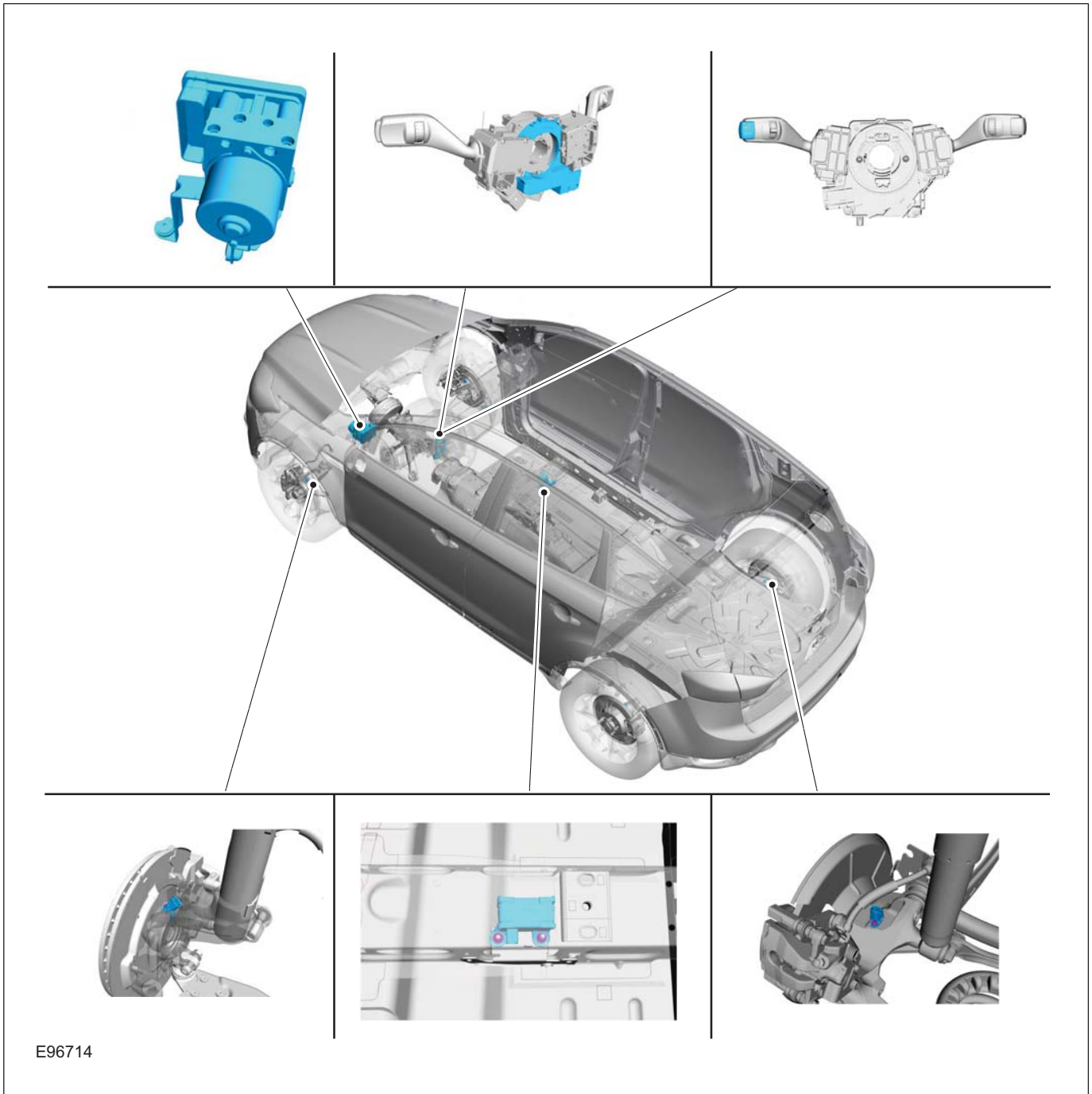
## SECTION 206-09B Anti-Lock Control - Stability Assist

**VEHICLE APPLICATION: 2008.50 Kuga**

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Front wheel sensor.....	206-09B-5
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Opto-electronic steering wheel rotation sensor.....	206-09B-5
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Opto-electronic steering wheel rotation sensor.....	206-09B-?
ABS/ESP module or hydraulic control unit (HCU).....	206-09B-?
ESP switch.....	206-09B-?
Combined yaw rate sensor and lateral acceleration sensor / longitudinal acceleration sensor.....	206-09B-?
Front wheel sensor.....	206-09B-?
Rear wheel sensor.....	206-09B-?
<b>REMOVAL AND INSTALLATION</b>	
Hydraulic Control Unit (HCU).....	206-09B-16
Stability Assist Module.....	206-09B-19
Front Wheel Speed Sensor.....	206-09B-21
Rear Wheel Speed Sensor.....	206-09B-22
Yaw Rate Sensor.....	206-09B-23

DESCRIPTION AND OPERATION

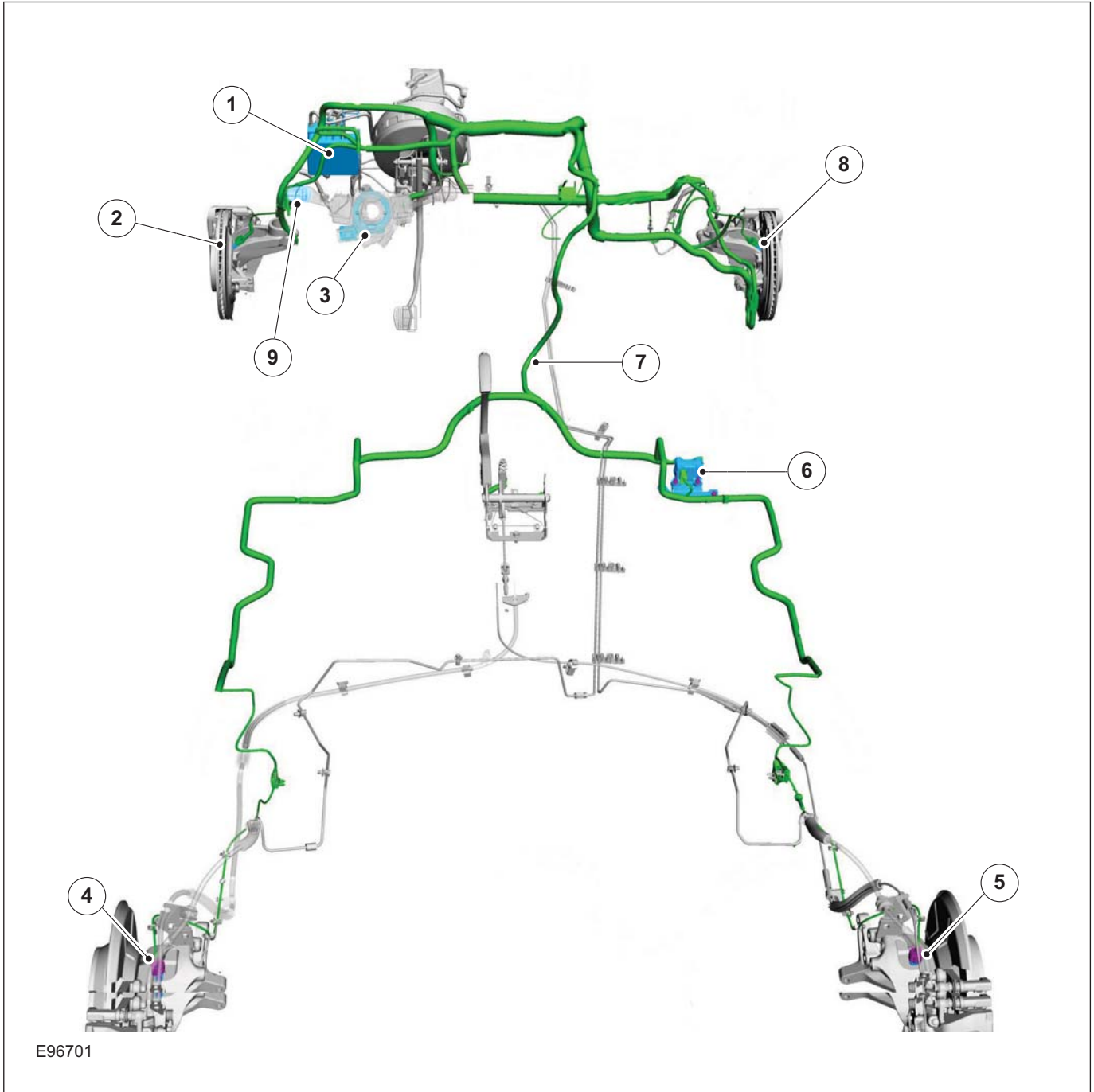
Anti-Lock Control - Stability Assist – Component Location



DESCRIPTION AND OPERATION

Anti-Lock Control - Stability Assist – Overview

Overview



E96701

Item	Description
1	ABS/ESP module or hydraulic control unit (HCU)
2	Front wheel sensor, left-hand side
3	Steering Wheel Rotation Sensor
4	Rear wheel sensor, left-hand side

Item	Description
5	Rear wheel sensor, right-hand side
6	Combined yaw rate sensor and lateral acceleration sensor / longitudinal acceleration sensor
7	Wiring harness



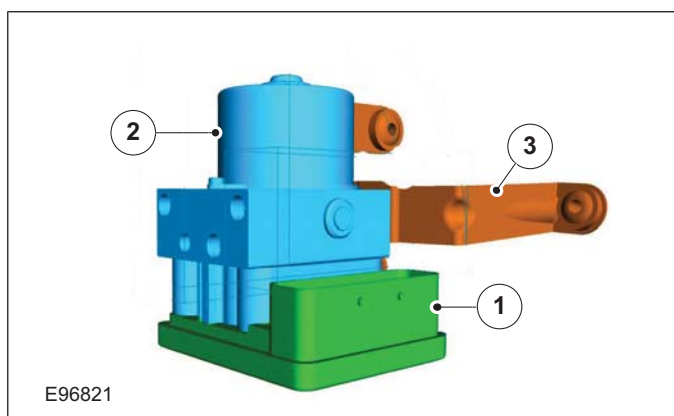
## DESCRIPTION AND OPERATION

Item	Description
8	Front wheel sensor, right-hand side

**Testing the brakes on a roller dynamometer - 4X4 vehicles only**

On 4X4 vehicles a brake test on a roller dynamometer must only be performed under the following conditions.

- The brake test must not exceed a duration of 1 minute.
- Ignition key in position 0.
- The roller speed must not exceed 5 km/h.

**ABS/ESP module or hydraulic control unit (HCU)**

The ABS/ESP module or the hydraulic control unit (HCU) is mounted on the left-hand side of the bulkhead. Diagnosis is performed with the aid of a diagnostic tester.

The following components can be replaced separately or as a unit:

- Hydraulic Control Unit (HCU)
- ABS/ESP module
- Mounting Bracket

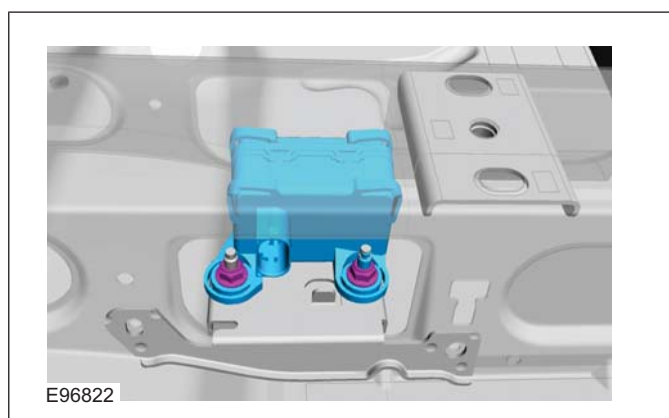
The following must be taken into account when removing/installing or renewing the ABS/ESP module or the hydraulic control unit (HCU):

- Only hydraulic control units (HCU) which are pre-filled with brake fluid are available for service operations.
- After replacing the HCU it is not necessary to bleed the system via the diagnostic tester.
- After replacing the brake fluid it is also only necessary to perform standard bleeding.
- The blanking caps/plugs must not be removed until the brake tubes are ready to be connected.

Item	Description
9	ESP switch

- If accidentally dropped or knocked install a new hydraulic control unit (HCU) and module assembly.
- When the ABS/ESP module is removed/installed or replaced, it is necessary to reconfigure the ABS/ESP module with the aid of the diagnostic tester once all of the installation work has been performed.

Refer to: **Module Configuration** (418-01 Module Configuration, General Procedures).

**Combined yaw rate sensor and lateral acceleration sensor / longitudinal acceleration sensor**

The sensor is attached to the floor crossmember at the front right. For vehicles with 4x4 drive, a longitudinal acceleration sensor is also integrated in the same housing.

The following must be taken into account when removing/installing or replacing the combined yaw rate sensor and lateral/longitudinal acceleration sensor:

- Ensure the correct installation position of the yaw rate sensor and lateral/longitudinal acceleration sensor.

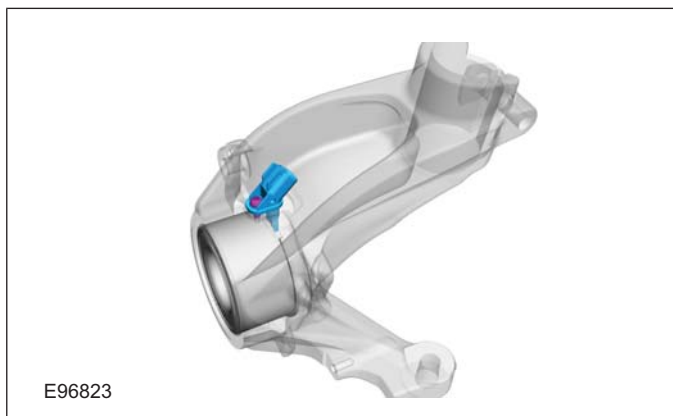
## 206-09B-5

## Anti-Lock Control - Stability Assist

## 206-09B-5

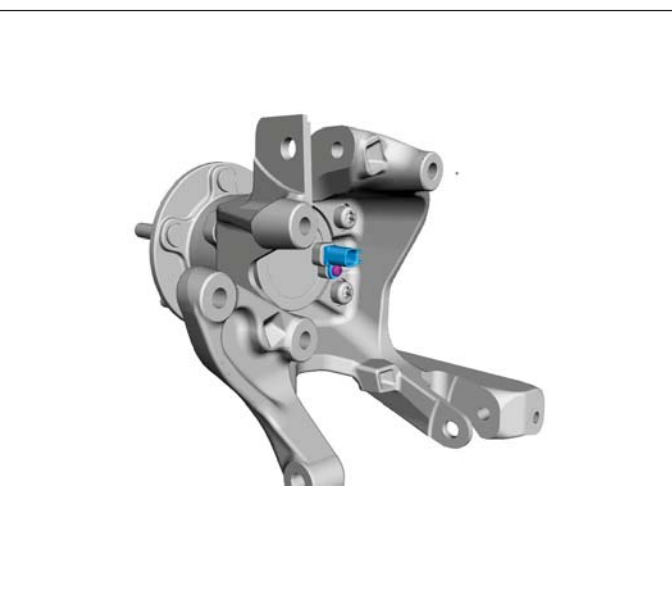
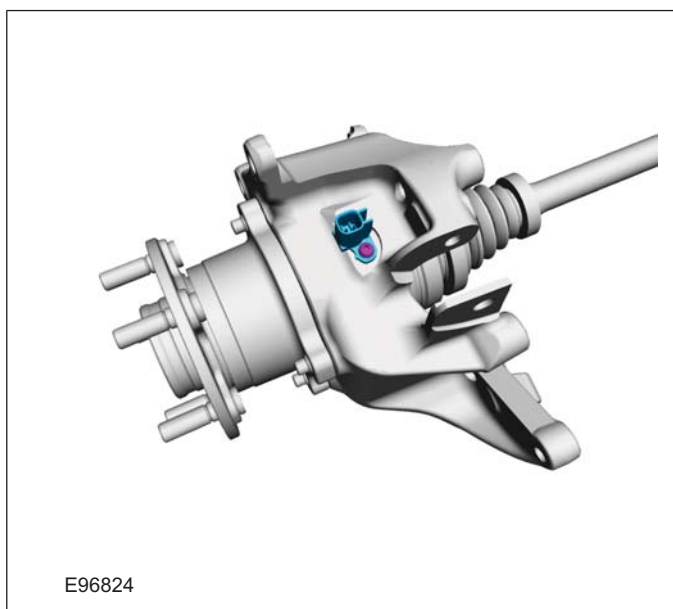
## DESCRIPTION AND OPERATION

## Front wheel sensor



The ABS sensor rings are built into the seals in the front wheel bearings. The wheel sensors are joined to the main wiring harness using a separate connecting cable.

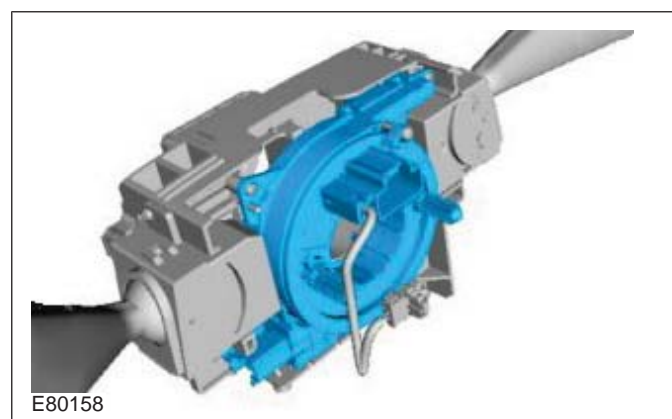
## Rear wheel sensor



**4X4:** The ABS sensor rings are pressed onto the rear drive shafts. The wheel sensors are joined to the main wiring harness using a separate connecting cable.

**4X2:** The ABS sensor rings are built into the hubs of the rear wheel bearings. When installing a replacement bearing, ensure that the new part is aligned correctly. The wheel sensors are joined to the main wiring harness using a separate connecting cable.

## Opto-electronic steering wheel rotation sensor



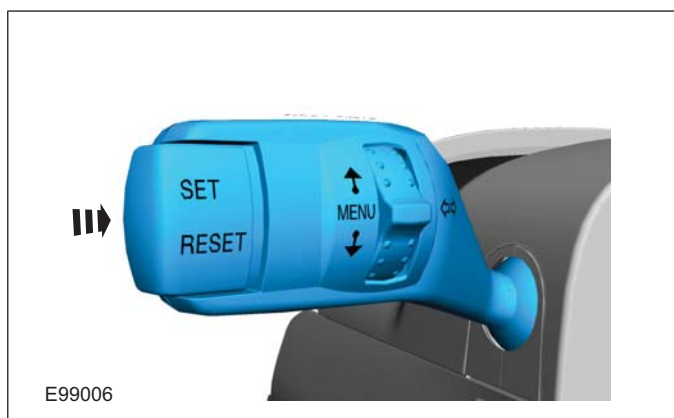
## DESCRIPTION AND OPERATION

Vehicles with ESP are equipped with an opto-electronic steering wheel rotation sensor as an integral part of the clockspring.

The following must be taken into account when removing/installing or replacing the opto-electronic steering wheel rotation sensor:

- If installing a new clockspring, remove the clockspring locking screw.

### ESP switch

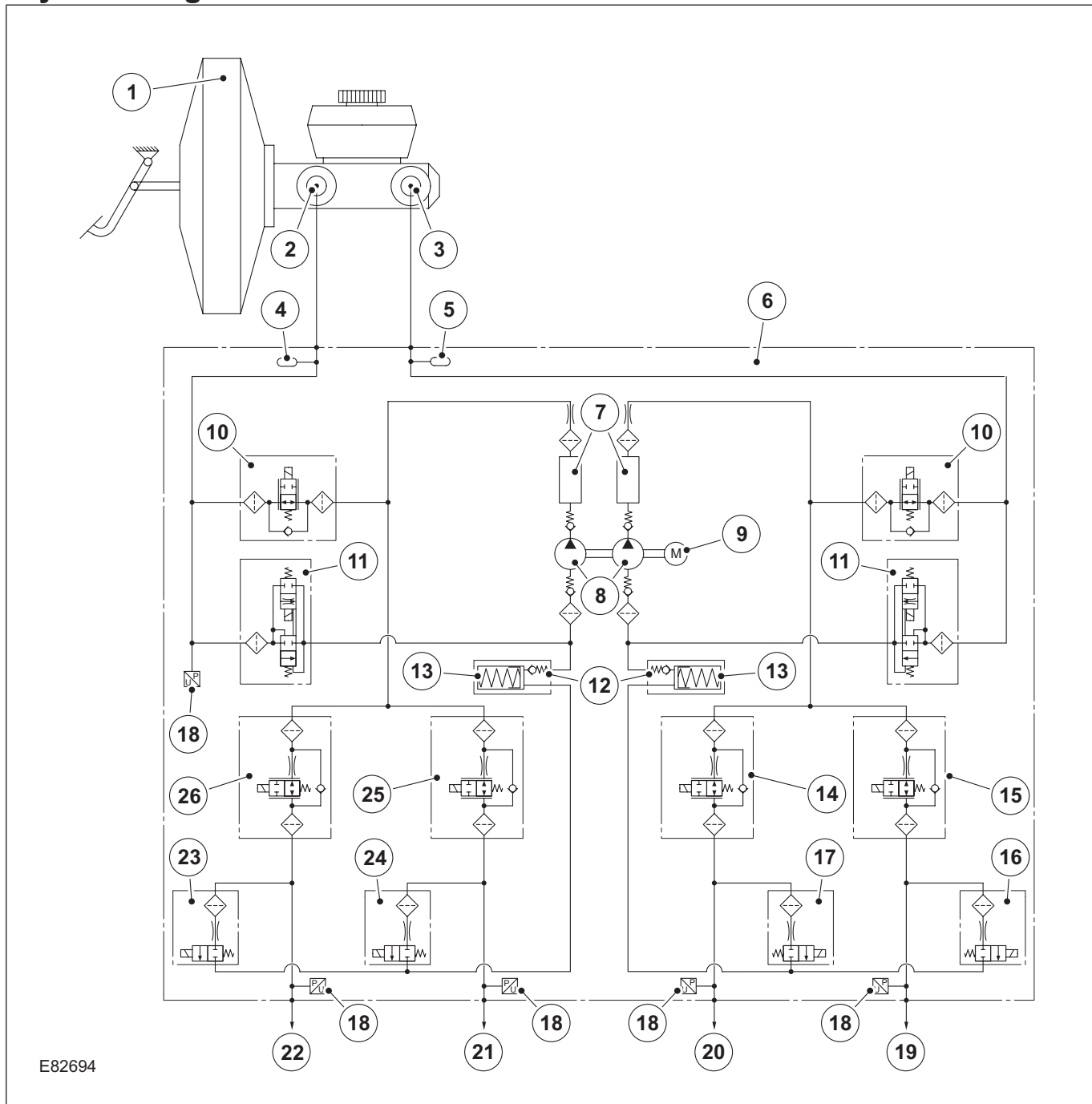


Stability assist can be deactivated via the menu in the instrument cluster.

DESCRIPTION AND OPERATION

Anti-Lock Control - Stability Assist – System Operation and Component Description

System Diagram



E82694

Item	Description
1	Brake booster
2	Primary hydraulic circuit
3	Secondary hydraulic circuit
4	Pulsation damper

Item	Description
5	Pulsation damper
6	engine control module
7	Damping chamber
8	Dual circuit hydraulic pump

## DESCRIPTION AND OPERATION

Item	Description
9	D.C. motor
10	Solenoid-operated pilot valve (2 off)
11	Solenoid-operated priming valve (2 off)
12	One way check valve
13	Low-pressure accumulator (2 off)
14	Solenoid-operated inlet valve (RH rear brake)
15	Solenoid-operated inlet valve (LH front brake)
16	Solenoid-operated outlet valve (LH front brake)
17	Solenoid-operated outlet valve (RH rear brake)

Item	Description
18	Pressure sensor (5 off)
19	LH front brake (secondary circuit)
20	RH rear brake (secondary circuit)
21	LH rear brake (primary circuit)
22	RH front brake (primary circuit)
23	Solenoid-operated outlet valve (RH front brake)
24	Solenoid-operated outlet valve (LH rear brake)
25	Solenoid-operated inlet valve (LH rear brake)
26	Solenoid-operated inlet valve (RH front brake)

## System Operation

The HCU features 3 operating modes:

**Normal braking:** Initially, no current is supplied to any of the solenoid-operated valves. Operating the brake pedal produces a corresponding increase or decrease of pressure in the brakes, through the open pilot valves and inlet valves. If the ABS module determines that EBD is necessary, it energizes the inlet valves for both the rear brakes, to isolate the brakes from any further increase in hydraulic pressure.

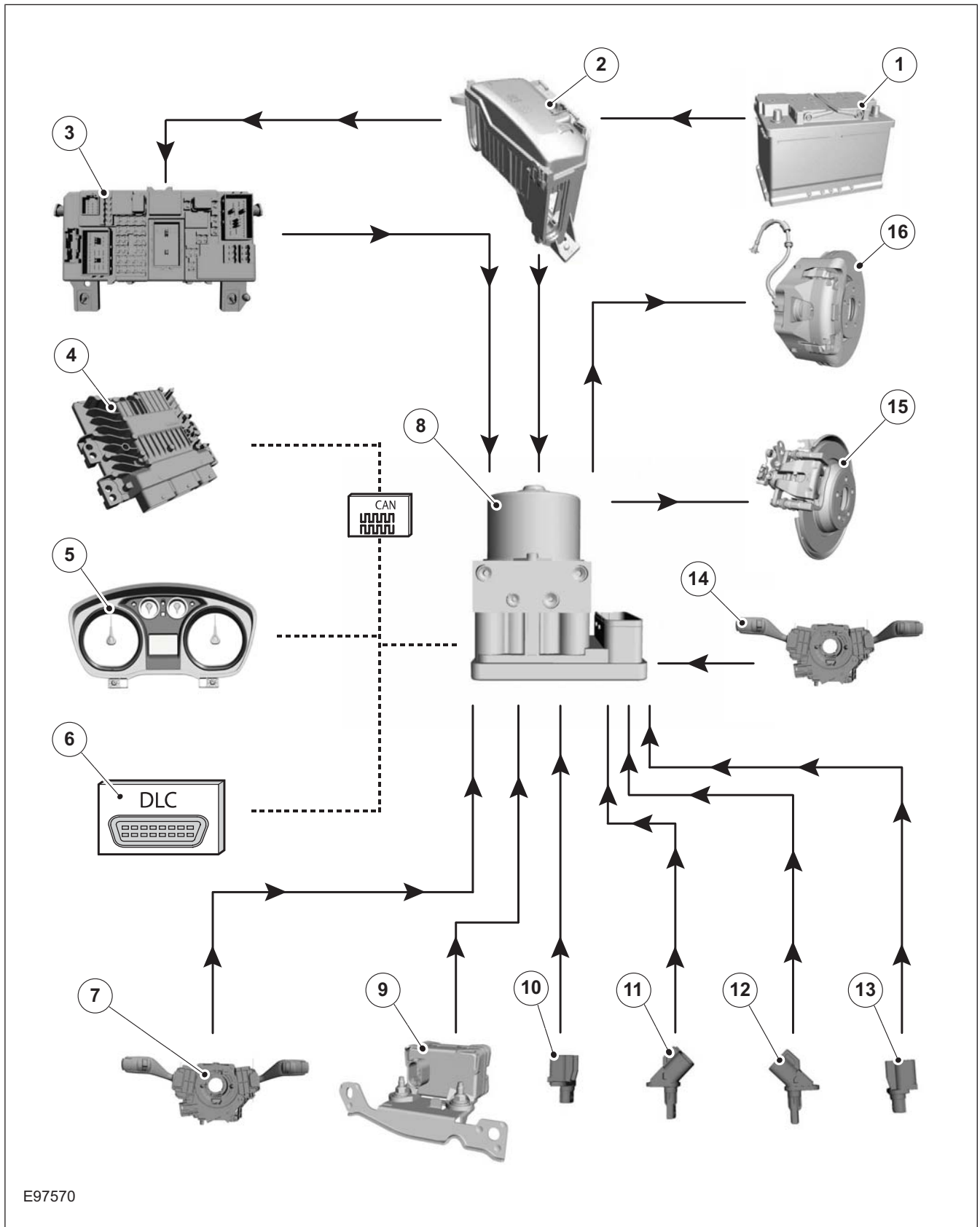
**ABS braking:** If the ABS module determines that ABS braking is necessary, it actuates the inlet and outlet valves of the relevant brake and starts the hydraulic return pump. The inlet valve closes to isolate the brake from pressurized fluid; the outlet valve opens to release pressure from the brake into the accumulator and the return pump circuit. The brake releases slightly and the wheel starts to

turn again. The ABS control unit then operates the inlet and outlet valves to regulate the hydraulic pressure acting on the brake in order to maximize braking effect without the wheel locking up. Control of the valves for each wheel takes place individually.

**Active braking:** With active braking, pressure is generated for other braking functions than the normal and ABS braking systems, e.g. for the ESP and TCS systems. For active braking, the ABS module energizes the pilot valves and priming valves, starts the return pump and energizes all of the inlet valves. Brake fluid, drawn from the reservoir through the master cylinder and priming valve, is pressurized by the return pump and supplied to the inlet valves. The ABS control unit then actuates the inlet and outlet valves in order to regulate the pressure for the individual brakes. Some noise may be generated during active braking.

DESCRIPTION AND OPERATION

PRINCIPLES OF OPERATION





## DESCRIPTION AND OPERATION

Item	Description
1	Battery
2	Battery junction box (BJB) in the engine compartment
3	Generic electronic module (GEM)
4	Powertrain Control Module (PCM)
5	Instrument cluster
6	Data link connector (DLC)
7	Steering Wheel Rotation Sensor
8	ABS/ESP module or hydraulic control unit (HCU)

The ABS monitors the different wheel speeds of the vehicle with the aid of wheel speed sensors. Using the data from all of the wheel speed sensors, the ABS module calculates the so-called reference speed, which is a measure of the actual road speed. The ABS module compares the individual circumferential wheel speeds with this reference speed when the driver initiates braking. If one or more of the circumferential wheel speeds deviates too far from the reference speed, this means that slip at the affected wheels is so great that steering stability of the vehicle is no longer ensured. The ABS module actuates electro-mechanical valves which influence the brake pressure at the relevant wheels.

Like the traction control system (TCS), the ESP system uses a large proportion of the ABS components. In addition, there are sensors which pick up the steering angle, the acceleration forces acting on the vehicle and the yaw rate or yaw moment. The sensors transmit these signals to the combined ABS/ESP module. Using the wheel speed and steering angle data, the ABS/ESP module calculates the direction of travel planned by the driver and determines the corresponding speed-dependent lateral acceleration and yaw moment. These values are compared with those actual measured. If the actual lateral acceleration and the yaw moment deviate excessively from the target values (unstable driving characteristics), the ABS/ESP module actuates individual brakes selectively via the HCU (hydraulic control unit). In addition, the engine speed is reduced by intervention in the engine management system.

**How the system works for understeer:** In the event of understeer, brake intervention occurs at the wheels on the inside of the curve. The rear wheel is braked heavily, so that a high amount of

Item	Description
9	Combined yaw rate sensor and lateral acceleration sensor / longitudinal acceleration sensor
10	Front wheel sensor
11	Rear wheel sensor
12	Rear wheel sensor
13	Front wheel sensor
14	ESP switch
15	Rear brakes
16	Front brake

slip is caused. In this way, the cornering force of the rear axle is heavily reduced and the centrifugal force that now becomes effective turns the rear of the vehicle back into the curve. The front wheel is not braked as hard. The braking force that is transmitted via the front wheel to the road surface generates a torque with the aid of the lever arm (vertical tire force to the vehicle's centre of gravity), which supports the yaw moment of the vehicle. Both measures together result in the vehicle reverting back to the curved path intended by the driver.

**How the system works for oversteer:** In the event of oversteer the wheels on the outside of the curve are braked. This time, the front wheel is subjected to a high level of slip so that the cornering force at the front axle is reduced. The rear wheel is not braked as heavily and, together with the effective lever arm, results in a reduction in the vehicle yaw moment. Both measures together result in the vehicle being stabilized and reverting back to the curved path intended by the driver.

If ESP control occurs, possible ABS interventions will be overridden as the ESP works at higher slip rates than the ABS.

**Emergency brake assist (EBA):** The emergency brake assist helps drivers in emergency braking situations by automatically applying the brakes with the maximum possible braking force.

If the brake pedal is pressed very suddenly, the ABS module increases the hydraulic pressure to all of the brakes until the threshold for ABS intervention is reached. This applies the maximum braking effort for the available traction. The ABS control unit monitors inputs from the brake pedal switch and from the pressure sensor within the

## DESCRIPTION AND OPERATION

HCU to check for sudden actuation of the brakes. With the brake pedal pressed, the ABS module triggers emergency braking if the rate of increase of hydraulic pressure exceeds the predetermined limit.

If the brake pedal is pressed so hard that the ABS becomes active on the front wheels then the ABS control unit increases the pressure to the rear wheel brakes up to the ABS intervention threshold.

EBA operation continues until the driver releases the brake pedal sufficiently for the hydraulic pressure in the HCU to drop below a threshold value stored in the ABS module.

**Trailer stability control:** If the vehicle is ordered with a trailer coupling then the Trailer Stability Control function is integrated in the ESP. The ESP detects snaking when driving with a trailer and reduces the speed of the vehicle and trailer through adapted braking and, if necessary, by also reducing the engine output until the snaking movement of the trailer is corrected.

**Roll-over protection:** The ESP dynamically determines the tipping tendency of the vehicle and works in conjunction with the EBA system to prevent the vehicle from tipping over during dynamic maneuvers like lane changing or while negotiating bends.

**Emergency brake light:** The emergency brake light automatically switches on the hazard flasher system to warn drivers of other vehicles that emergency braking is being initiated. Based on a defined delay value, the ABS/ESP module sends a signal to the generic electronic module (GEM) via the CAN data bus. The GEM activates the hazard flasher system, that then flashes 7 times.

Prerequisites for activation of the emergency brake light are:

- The speed is higher than 50 km/h.
- The brake pedal is being actuated.
- The deceleration is greater than 9 m/s<sup>2</sup>.

To prevent activation on snow or ice, for example, the following prerequisites must be met:

- The speed is higher than 50 km/h.
- The brake pedal is being actuated.
- ABS regulation takes place.
- The deceleration is greater than 6 m/s<sup>2</sup>.

**Tire pressure monitoring system:** The tire pressure monitoring system used in the Kuga is able to detect loss of air in a tire at an early stage and warn the driver. Because it can only compare the behaviour of the tyres with each other, it is not

possible to draw conclusions about the absolute tyre pressure. It is also not possible to monitor the spare tyre pressure. In order for the system to operate correctly, the tyre pressures must be regularly checked and corrected and the system subsequently initialised (see below).

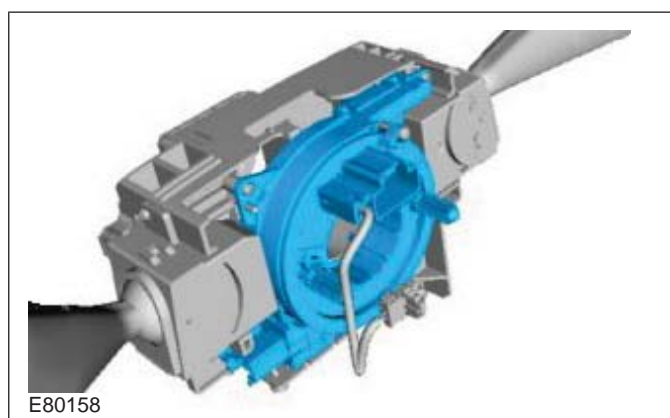
The tire pressure monitoring system used here, depending on the equipment level, is built into the anti-lock braking system (ABS) as an extra function and therefore does not have its own sensors.

The ABS module measures the loss of pressure in the tyres by calculation using the wheel speed sensors of the ABS system. If a tyre loses pressure, its diameter decreases and the speed of the wheel therefore increases. If the ABS module detects such a loss in pressure, it sends a signal to the instrument cluster via the CAN bus and a warning message is displayed in the message centre. The warning threshold depends among other things on the dimension of the tyres being used, the vehicle operating conditions and the status at the last initialisation. Since neither the absolute tyre pressure nor the position of the tyre is known, the pressure of all the tyres must be checked and the system re-initialised after a tyre pressure warning. If necessary, the cause of the loss of pressure must be investigated.

Regular tyre pressure checks are still necessary. The system must be initialised after a tyre is changed, winter or summer tyres fitted, the pressures corrected or adjusted to suit the vehicle load. This can be done by the driver using the driver information system. For further information, see: Owner's Manual.

## Component Description

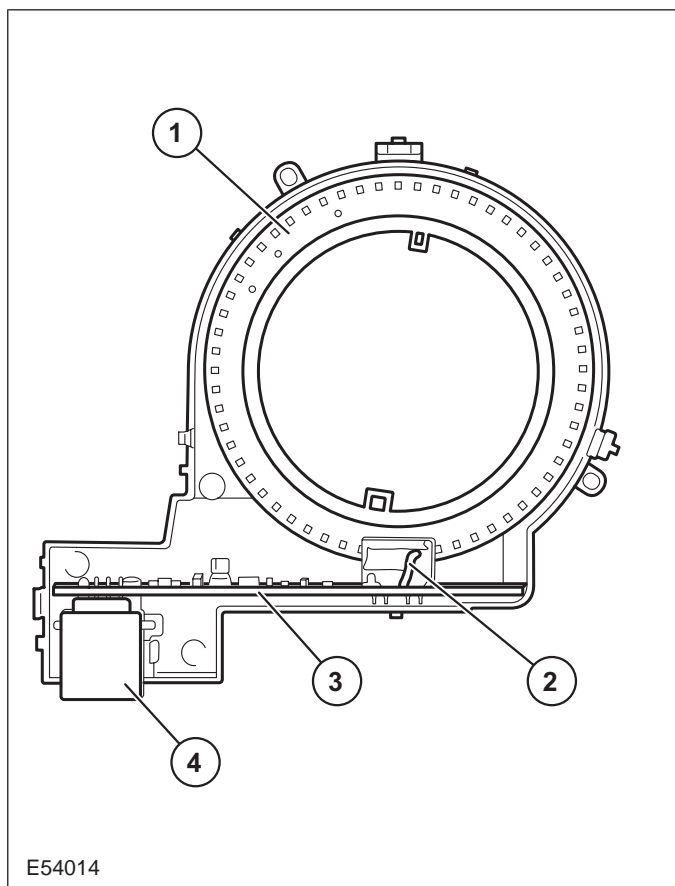
### Opto-electronic steering wheel rotation sensor



**DESCRIPTION AND OPERATION**

The opto-electronic steering wheel rotation sensors use light barriers for contactless scanning of a segment disk which is connected fixedly to the steering shaft.

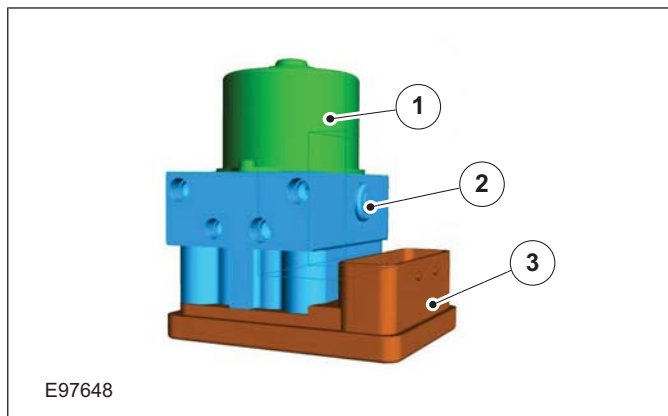
specific steering angle there is therefore a specific switch status of all photoelectric barriers.



Item	Description
1	Segment disk
2	Photoelectric barrier
3	Electronics
4	Electrical connection

Use is made of opto-electronic types of sensors with relative and absolute steering angle sensing. For relative steering angle sensing, changes in the steering angle are measured exclusively by the sensor and transmitted to the ABS/ESP module. With the aid of other vehicle status signals (e.g. wheel speed sensors) the module calculates the straight ahead position of the steering. For absolute steering angle sensing, the sensor transmits a specific signal to the module for each steering angle position (in relation to one turn of the steering wheel). The straight ahead position of the steering is therefore defined in the sensor. On an absolute steering angle sensor, several photoelectric barrier modules are distributed around the segment disk at varying distances. The gaps between segments of the segment disk are also unequal. For each

**ABS/ESP module or hydraulic control unit (HCU)**



Item	Description
1	ABS Pump Motor
2	Valve block (with low-pressure accumulators)
3	ABS module

The HCU comprises the ABS module, the valve block (with low-pressure accumulators) and the ABS pump.

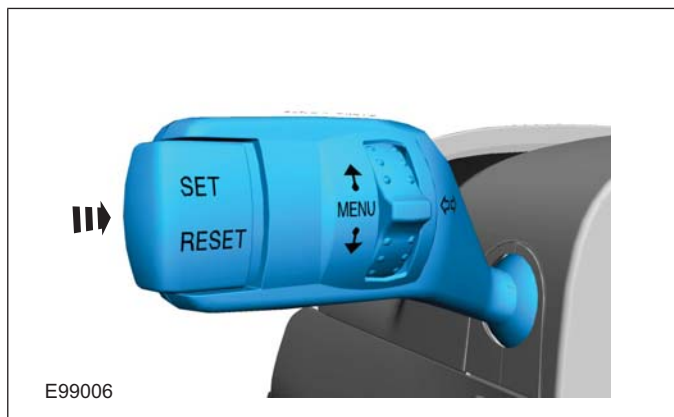
The valve block combines all of the brake pressure control valves in one unit. Depending on the system, either simple changeover valves or proportioning valves (e.g. on EBD (electronic brake force distribution) systems) are installed. The low-pressure accumulators store the brake fluid that is returned from the wheel brakes during the pressure reduction phase until it is drawn back into the system by the ABS pump.

The ABS pump is designed as a dual piston pump. This means that two separate pump elements assure an increase in brake pressure during control interventions. A direct current motor drives the pump pistons via an eccentric shaft.

The ABS/ESP module monitors the input signals of all sensors and actuates the electro-magnetic brake pressure valves and the ABS pump as required. For reasons of safety, the module is of the redundant type, whereby processing of the signals is carried out via two separate processors that also monitor each other.

## DESCRIPTION AND OPERATION

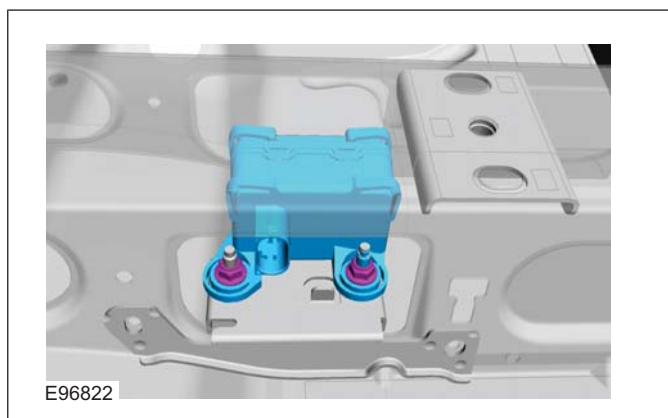
## ESP switch



Stability assist can be deactivated via the menu in the instrument cluster. The stability assist functions are deactivated when the Set switch is actuated. The ABS control module makes the stability assist functions available once more when the Set switch is actuated again. The stability assist function is automatically reactivated when the ignition is switched on.

The electronic EBA is a constant function and will remain active even if the ESP has been switched off.

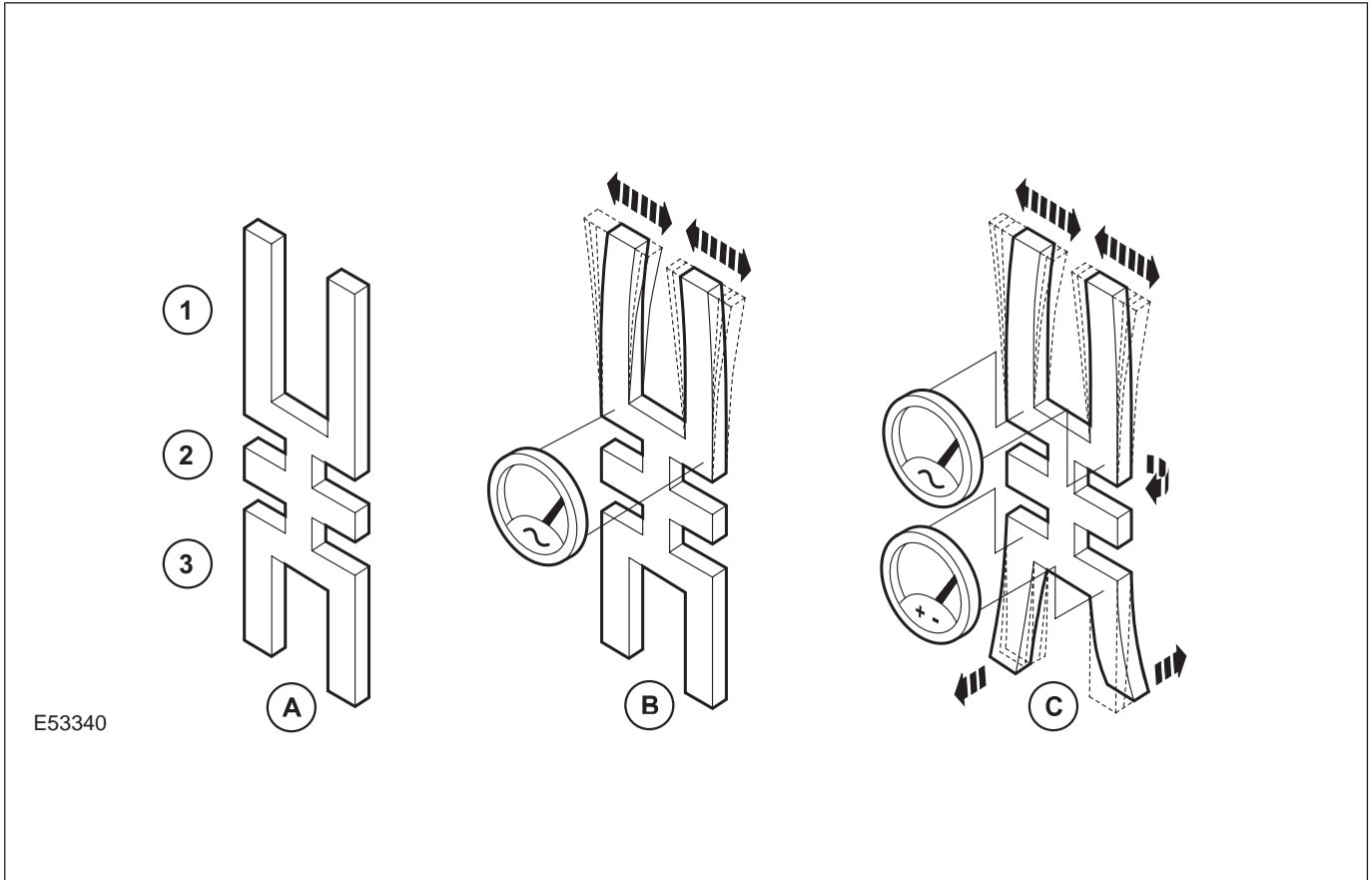
## Combined yaw rate sensor and lateral acceleration sensor / longitudinal acceleration sensor



The heart of the combined yaw rate sensor and lateral acceleration sensor/longitudinal acceleration sensor is a small, double-sided tuning fork made of a piezo crystal (A). The exciter side of this tuning fork is set to a resonance of 11 kHz with the aid of an alternating current. The measuring side of the tuning fork features a resonance frequency of 11.33 kHz and therefore does not vibrate (B). Since, under influence of an external accelerating force, a vibrating mass reacts slower than a comparable mass that is not vibrating, the tuning fork twists within itself with rotational movement being imparted on the sensor (C). This rotation results in a change in the charge distribution in the Piezo element, which is subsequently picked up and converted into an electronic signal by electronics integrated into the sensor. This electronic signal is then sent to the ESP module. The ESP module evaluates these data and takes into account the other input data (vehicle speed, wheel speed) before deciding whether the ESP function is required.



DESCRIPTION AND OPERATION

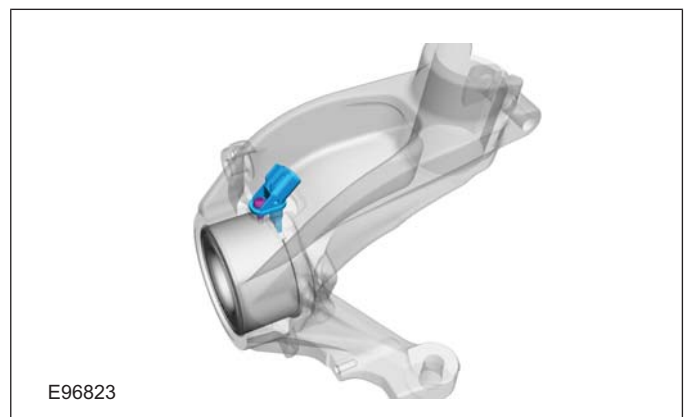


E53340

Item	Description
1	Tuning fork exciter
2	Suspension
3	Measuring side

Due to the special way in which it works, the combined yaw rate sensor and lateral acceleration sensor/longitudinal acceleration sensor must be installed the right way up in the designated location specified by the manufacturer. Any slight deviation in the installation position and/or installation location could lead to impaired functionality and thereby possible failure of the stability assist.

Front wheel sensor



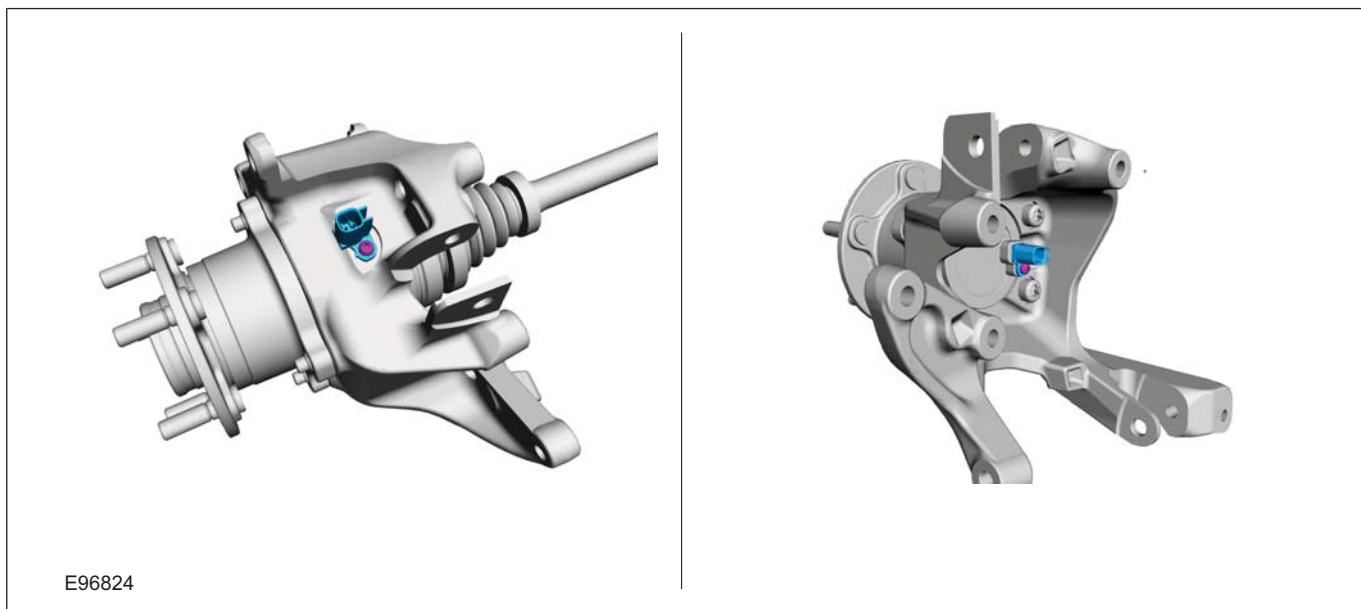
E96823

Active sensors are used to determine the rotational speeds of the wheels at the hub. After the ignition is switched on, the ABS module supplies the sensors with power. The sensors work in accordance with the Hall effect principle and

**DESCRIPTION AND OPERATION**

generate a square wave output signal. The signal acts in proportion to the rotational speed of the sensor ring. The ABS sensor rings are built into the seals in the front wheel bearings. The ABS module evaluates the signals from all four sensors to calculate a vehicle speed signal based on the rotational speeds of all wheels. The road speed is transmitted on the CAN bus. The powertrain control

module (PCM) uses this signal and the programmed tire size to calculate the vehicle speed. The calculated vehicle speed is forwarded on the CAN bus and is requested by other control units that need this input information.

**Rear wheel sensor**

The sensors are joined to the main wiring harness using a separate connecting cable.



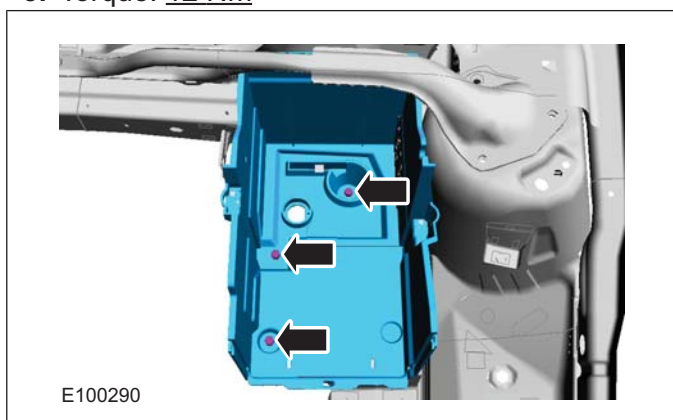
## REMOVAL AND INSTALLATION

## Hydraulic Control Unit (HCU)

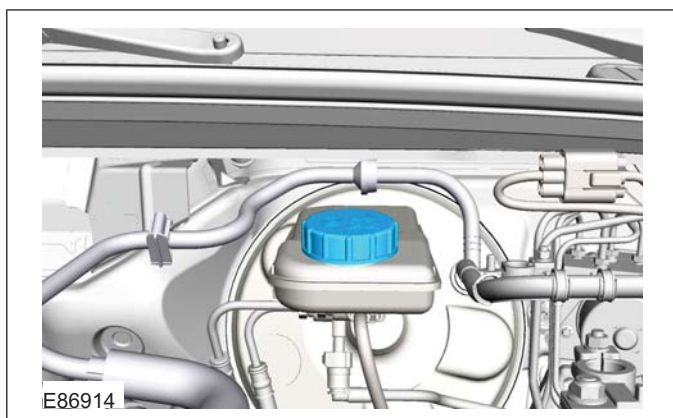
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Battery** (414-01 Battery, Mounting and Cables, Removal and Installation).
3. Torque: 12 Nm



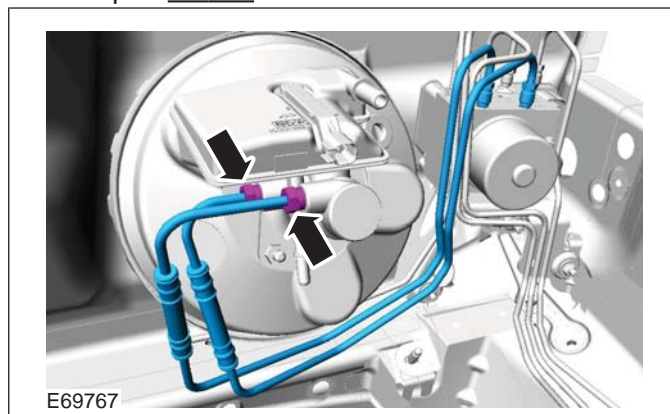
4. 1. Connect one end of a suitable piece of clear plastic pipe to the brake caliper bleed nipple and place the other end into a suitable container.
2. Loosen the bleed nipple.
3. Depress the brake pedal until all the brake fluid is drained from the brake fluid reservoir.
4. Tighten the bleed nipple.
5. Repeat the draining procedure on the opposite side brake caliper.



## Left-hand drive vehicles

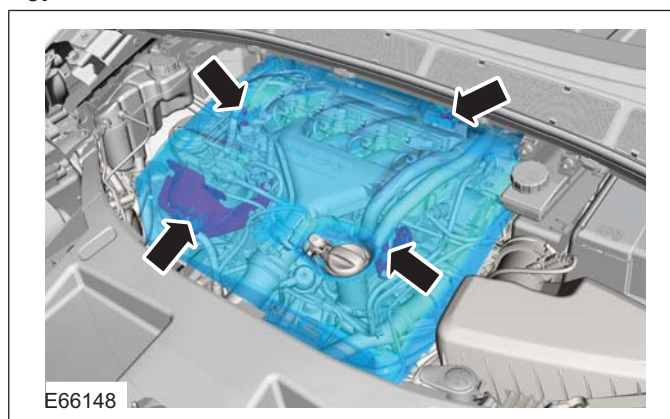
5. **NOTE:** Make sure that the seal is correctly located.

Torque: 18 Nm



## Right-hand drive vehicles

- 6.



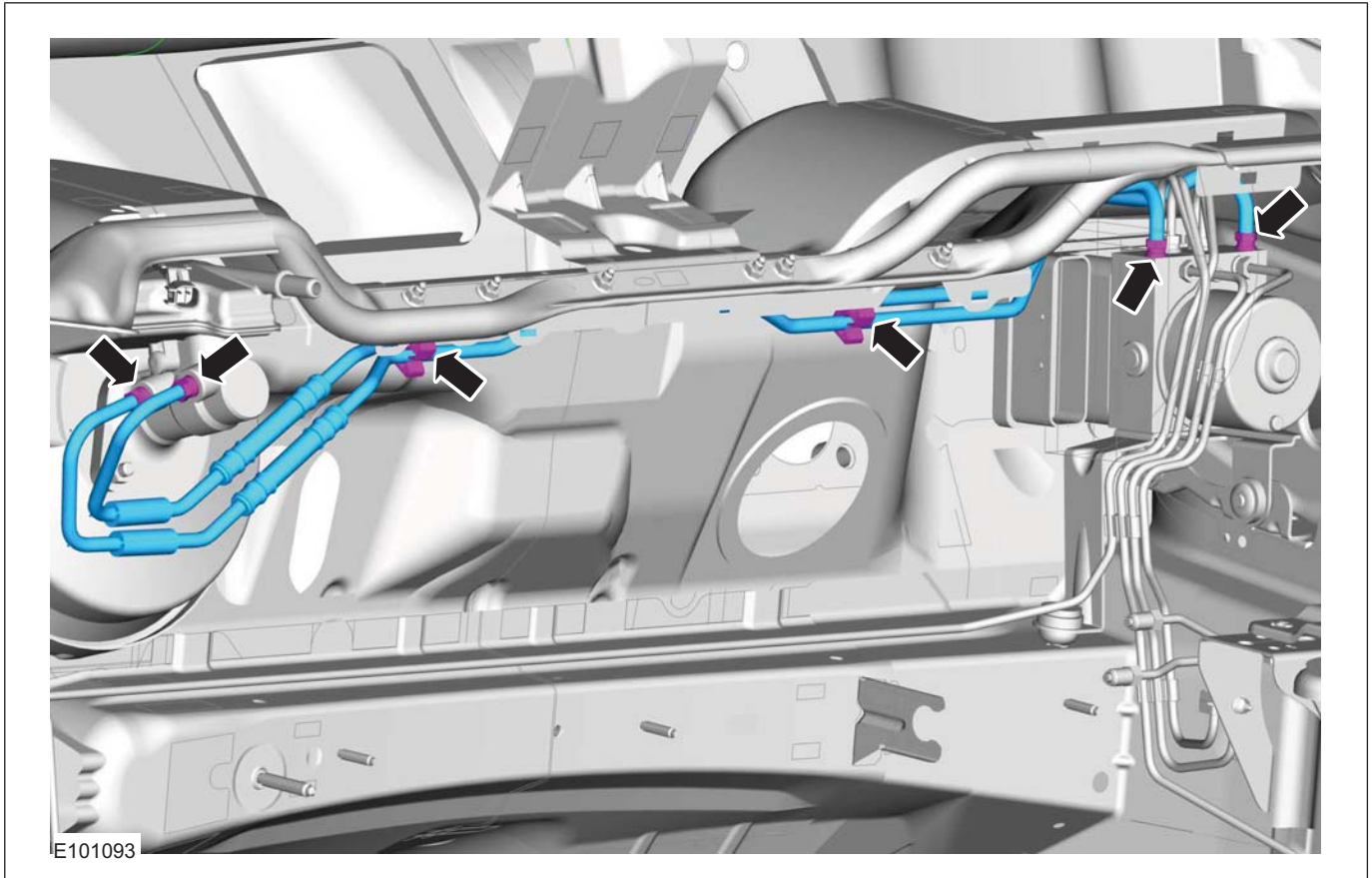
7. Torque: 18 Nm

206-09B-17

Anti-Lock Control - Stability Assist

206-09B-17

## REMOVAL AND INSTALLATION

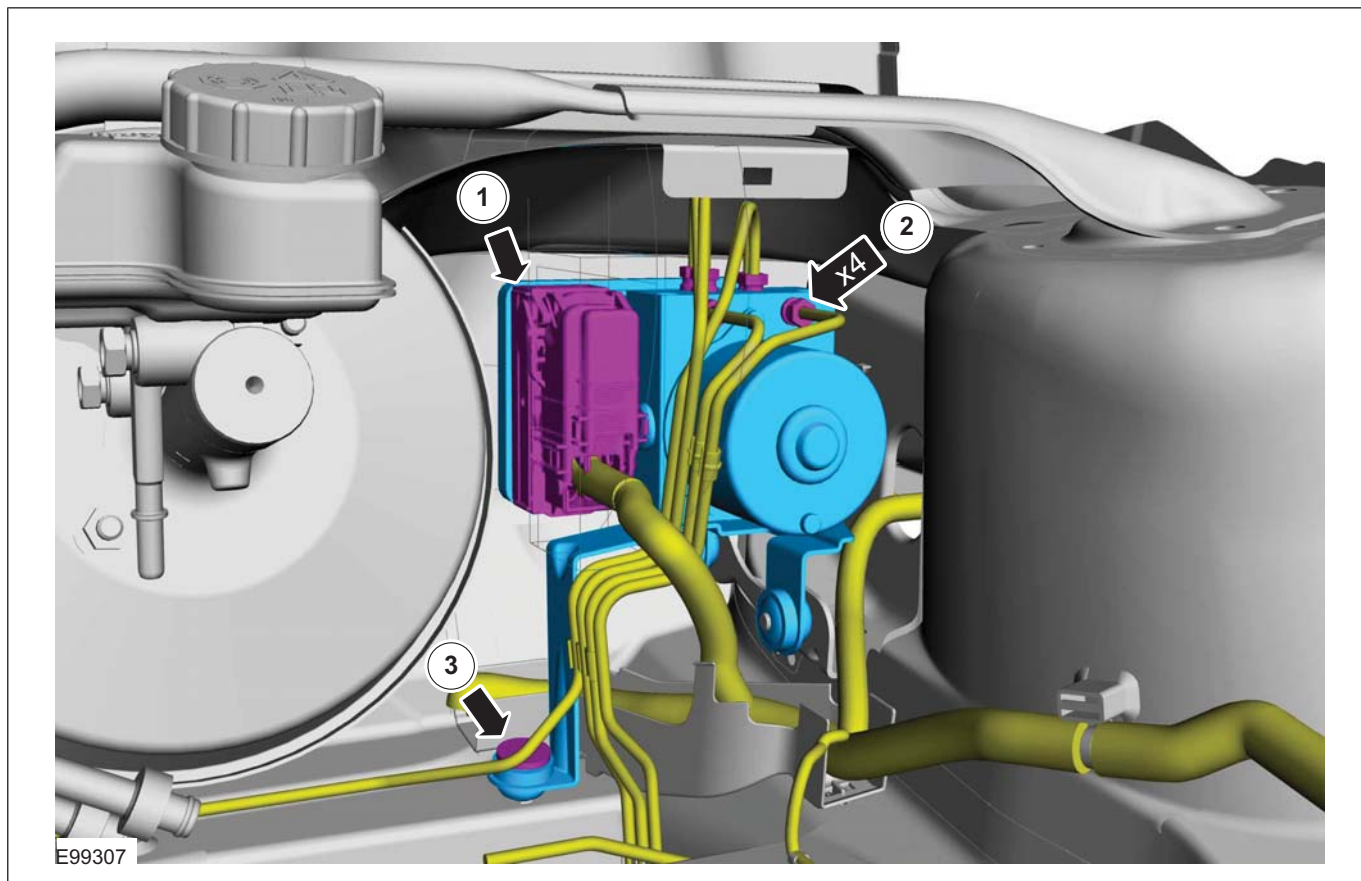
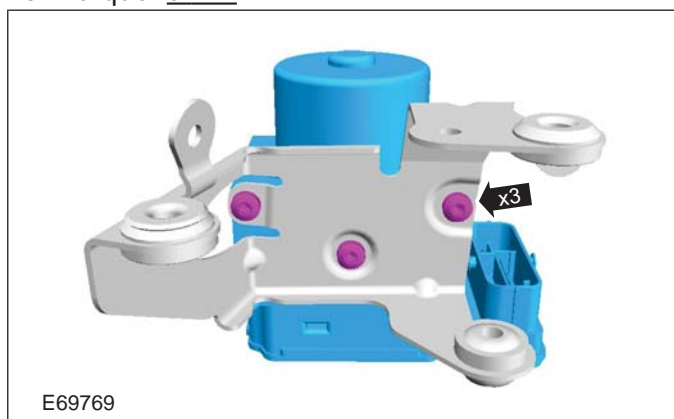


All vehicles

8. **NOTE:** Make sure that the seal is correctly located.

2. Torque: 18 Nm
3. Torque: 9 Nm

## REMOVAL AND INSTALLATION

9. Torque: 9 Nm

10. Refer to: **Stability Assist Module** (206-09 Anti-Lock Control - Stability Assist, Removal and Installation).

## Installation

1. **CAUTION:** If accidentally dropped or knocked install a new hydraulic control unit (HCU) and module.

The blanking caps/plugs must not be removed until the brake tubes are ready to be connected.

To install, reverse the removal procedure.

2. Refer to: **Brake System Bleeding** (206-00 Brake System - General Information, General Procedures).

Refer to: **Brake System Pressure Bleeding** (206-00 Brake System - General Information, General Procedures).

## REMOVAL AND INSTALLATION

## Stability Assist Module

## General Equipment

Ford approved diagnostic tool

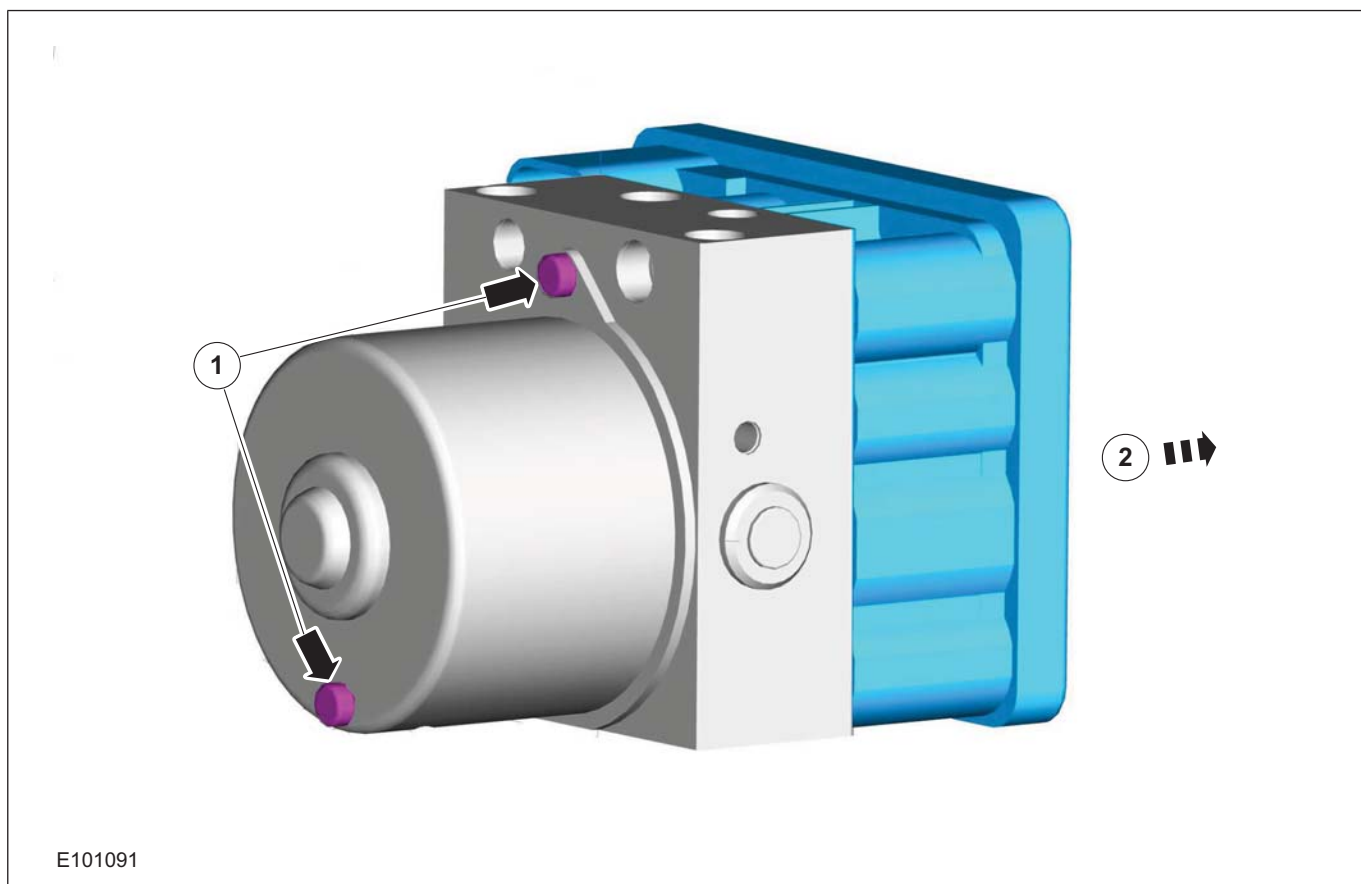
Pneumatic Vacuum Gun

## Materials

Name	Specification
Metal Adhesive Kit - 2 Component	WSK-M2G342-A / 2U7J-M2G400-AA

## Removal

1. Refer to: **Hydraulic Control Unit (HCU)** (206-09 Anti-Lock Control - Stability Assist, Removal and Installation).
- 2.



3. Clean the HCU contact surface.

Material: Metal Adhesive Kit - 2 Component (WSK-M2G342-A / 2U7J-M2G400-AA) cleaner

4. Remove all traces of the cleaner and foreign material.

General Equipment: Pneumatic Vacuum Gun

## Installation

1. **WARNING:** Make sure that the module is correctly located on the hydraulic control unit (HCU).
- CAUTION:** If accidentally dropped or knocked install a new hydraulic control unit (HCU) and module.

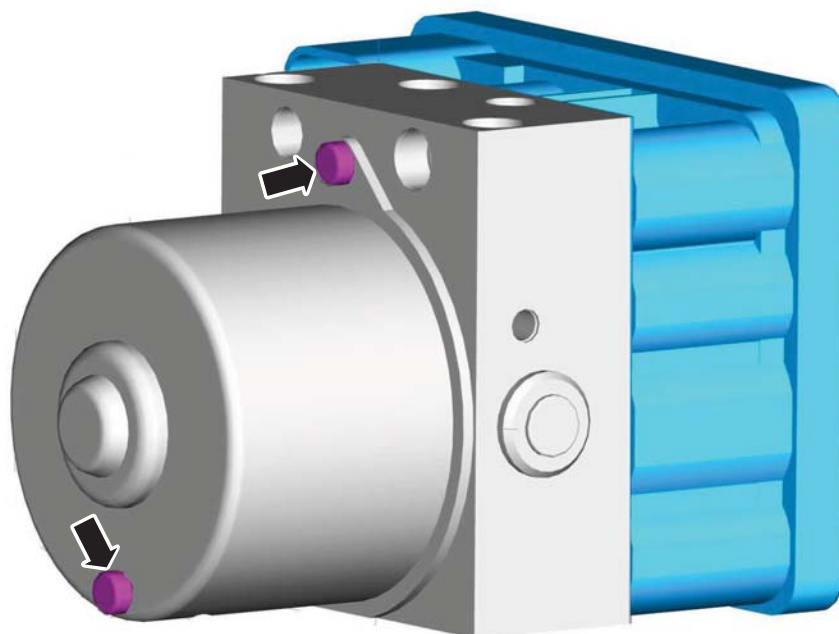
Take extra care not to damage the seal.



## REMOVAL AND INSTALLATION

**NOTE:** Make sure that the seal is correctly located.

Torque: 5,5 Nm



E101092

2. Refer to: **Hydraulic Control Unit (HCU)** (206-09 Anti-Lock Control - Stability Assist, Removal and Installation).
3. Configure the stability assist program.  
General Equipment: Ford approved diagnostic tool
4. Carry out the stability assist program Function Test.  
General Equipment: Ford approved diagnostic tool
5. Carry out a road test.  
Refer to: **Road/Roller Testing** (100-00 General Information, Description and Operation).

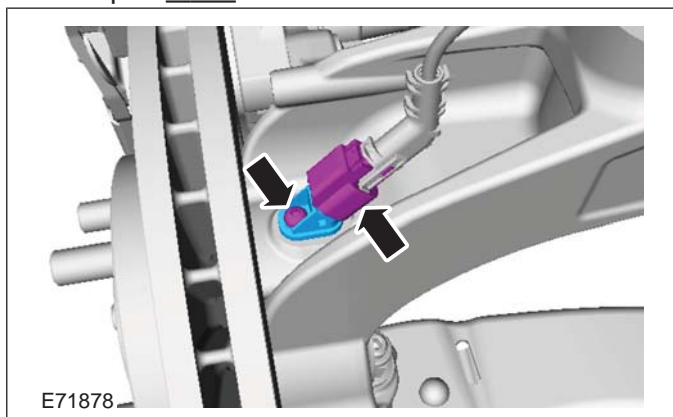
## REMOVAL AND INSTALLATION

## Front Wheel Speed Sensor

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
2. Torque: 5 Nm



## Installation

1. To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

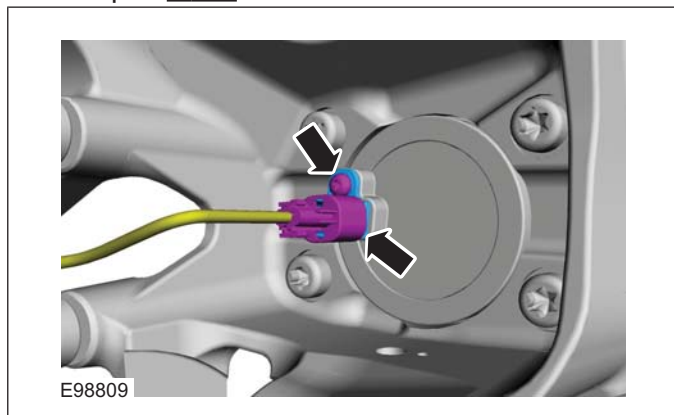
## Rear Wheel Speed Sensor

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

4x2

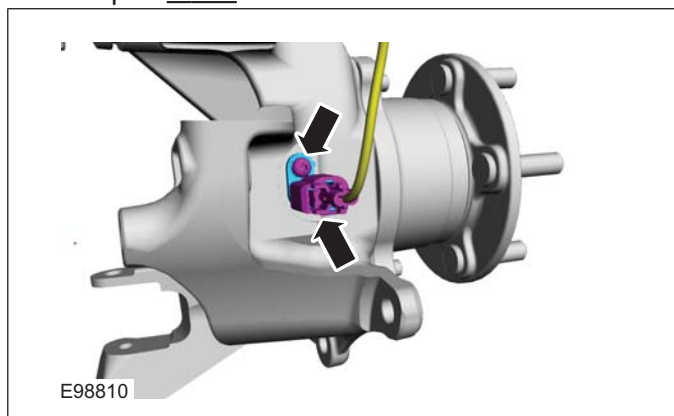
1. Torque: 5 Nm



4x4

2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

3. Torque: 5 Nm



All vehicles

4. **NOTE:** The O-ring seal is to be reused unless damaged.



## Installation

1. **NOTE:** Make sure that the sensor housing is clean and free of foreign material.

**NOTE:** Make sure that the sensor ring is correctly located.

To install, reverse the removal procedure.

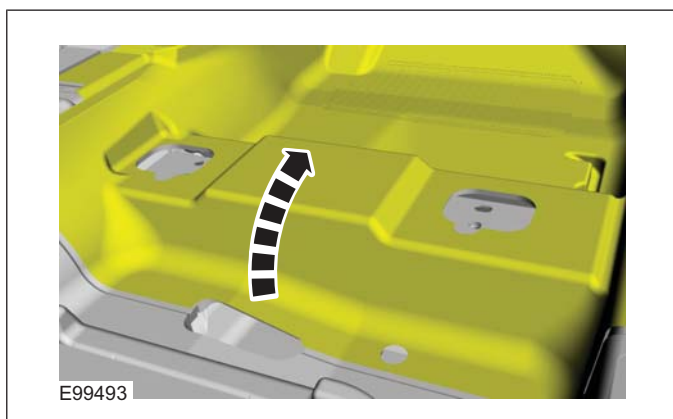
## REMOVAL AND INSTALLATION

## Yaw Rate Sensor

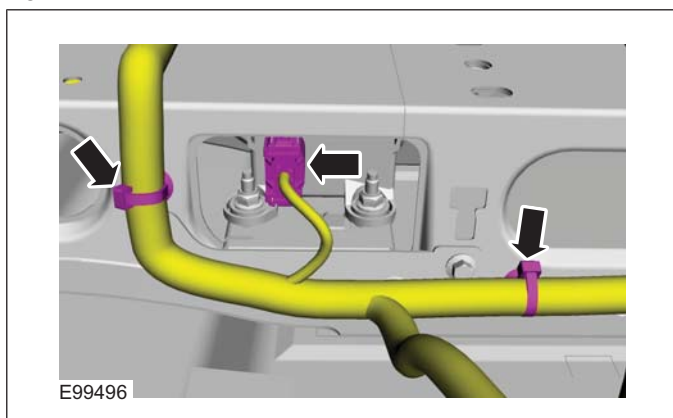
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

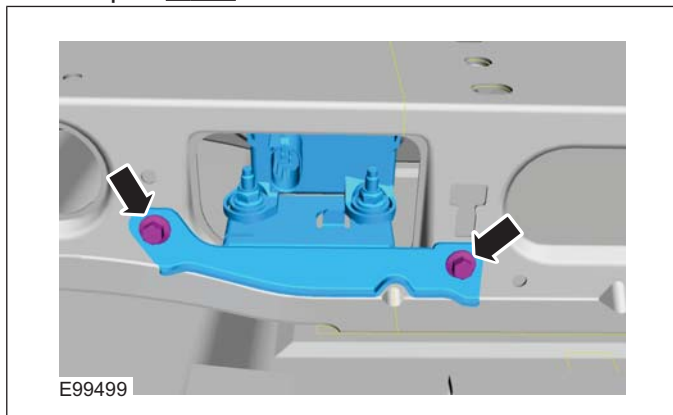
1. Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
- 2.



3.



4. Torque: 9 Nm



## Installation

1. To install, reverse the removal procedure.

## SECTION 211-00 Steering System - General Information

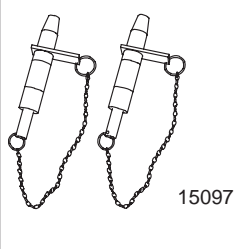
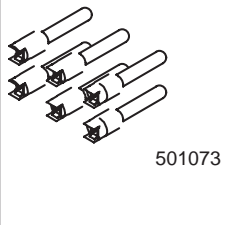
VEHICLE APPLICATION: 2008.50 Kuga

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## DIAGNOSIS AND TESTING

## Steering System

## Special Tool(s) / General Equipment

 <p>15097</p>	<p>Alignment Pins, Subframe 205-316 (15-097A)</p>
 <p>501073</p>	<p>Simulator, Driver and Passenger Air Bags and Side Air Curtains 501-073 (40-016)</p>
<p>The Ford approved diagnostic tool</p>	

## Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

## Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> <li>• Tire pressure(s)</li> <li>• Loose tie-rod end(s)</li> <li>• Loose strut and spring assemblies or ball joints</li> <li>• Loose pinch bolts on steering column shaft flexible coupling</li> <li>• Wheels and tires</li> <li>• Power steering line fluid leaks</li> <li>• Steering gear bellows</li> </ul>	<ul style="list-style-type: none"> <li>• Battery</li> <li>• Battery cables</li> <li>• Steering angle sensor electrical connector</li> <li>• Power steering pump control module electrical connectors</li> <li>• Power steering pump control module ground cable</li> <li>• Power steering pump control module ground cable retaining screw</li> <li>• Steering angle sensor warning indicator</li> <li>• Fuse(s)</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

## Components Tests

## Steering Linkage

1. Grasp the steering wheel firmly and move it up and down and to the left and right without turning the steering wheel to check the steering column bearing for wear, steering column shaft for wear, steering wheel for looseness and steering column for looseness. If the steering column bearing or the steering column shaft is worn install a new steering column. If the steering wheel or the steering column is loose, tighten the steering wheel or the steering column retaining bolts.
2. With the road wheels in the straight ahead position, gently turn the steering wheel to the left and the right to check for free play in the steering linkage.
3. There should be no excessive free play at the steering wheel rim. If there is excessive free play, CHECK the tie-rod inner and outer ball joints, REFER to Tie-Rod Component Test in this procedure. CHECK the steering column universal joint, REFER to Steering Column Universal Joint Component Test in this procedure. If there is no free play in the tie-rod and the steering column, install a new steering gear.

## Tie-Rod

**CAUTION:** Steering gear boots must be handled carefully to avoid damage. Use new steering boot clamps when installing the steering gear boots.

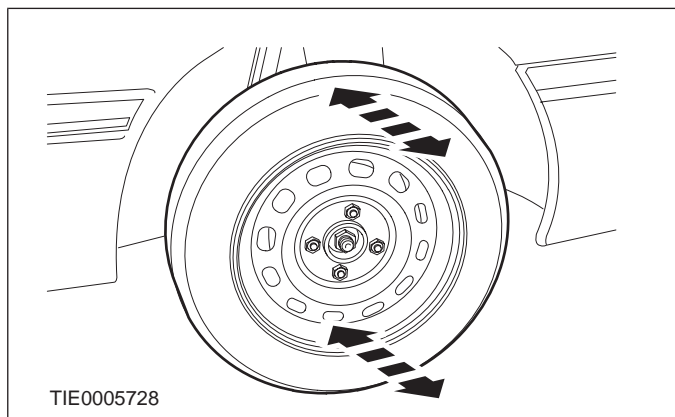
**NOTE:** Noises such as knocks, which may appear to originate from the steering linkage, may also be generated by front suspension components.

REFER to: **Noise, Vibration and Harshness (NVH)** (100-04 Noise, Vibration and Harshness, Diagnosis and Testing).

## DIAGNOSIS AND TESTING

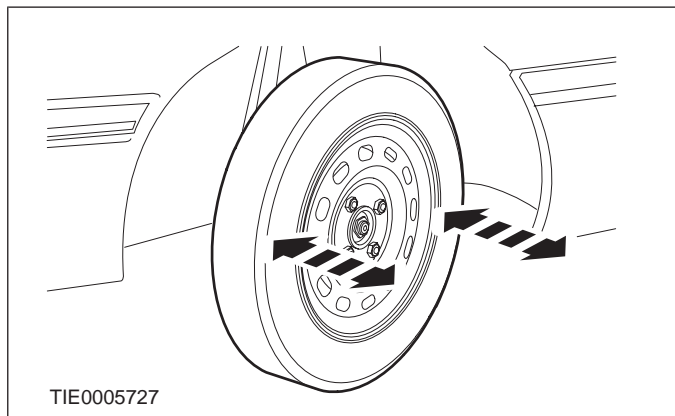
1. Raise and support the vehicle. REFER to:  
(100-02 Jacking and Lifting)

**Jacking** (Description and Operation),  
**Lifting** (Description and Operation).



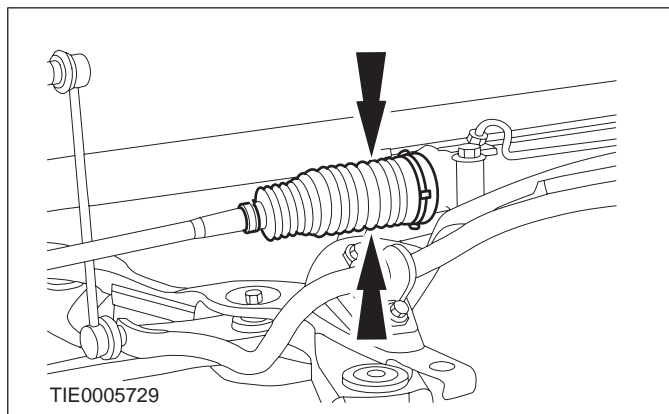
2. Firmly grasp the road wheel and apply a rocking motion checking for any free play in the wheel bearing or suspension components.
3. **CAUTION:** To prevent damage to the steering linkage, turn the steering wheel to move the steering linkage to the right-hand steering lock stop.

Turn the steering wheel to position the steering linkage against the right-hand steering lock stop.



4. **NOTE:** To isolate the steering gear design clearance, check the right-hand steering linkage with the steering held against the right-hand steering lock stop.

With the aid of another technician holding the steering linkage against the right-hand steering lock stop, firmly grasp the road wheel and apply a rocking motion checking for any free play in the steering linkage.



5. Detach the steering gear boot from the steering gear body and check for free play at the tie-rod inner ball joint.
6. If there is free play at the tie-rod inner ball joint, install a new tie-rod.

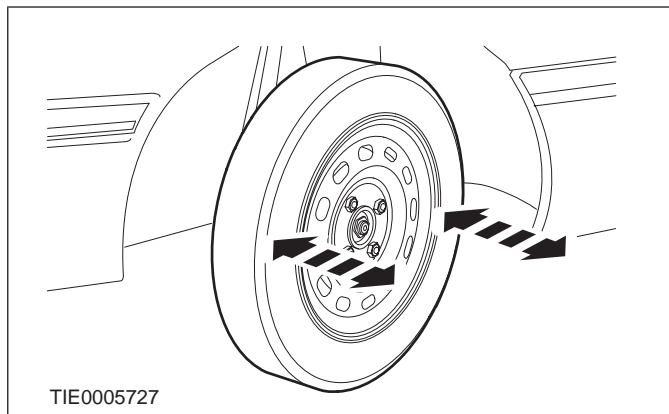
REFER to: **Tie Rod End** (211-03 Steering Linkage, Removal and Installation)  
/ **Tie Rod** (211-03 Steering Linkage, Removal and Installation).

7. Check the tie-rod end for free play. Install a new tie-rod end if necessary.

REFER to: **Tie Rod End** (211-03 Steering Linkage, Removal and Installation)  
/ **Tie Rod** (211-03 Steering Linkage, Removal and Installation).

8. **CAUTION:** To prevent damage to the steering linkage, turn the steering wheel to move the steering linkage to the left-hand steering lock stop.

Turn the steering wheel to position the steering linkage against the left-hand steering lock stop.

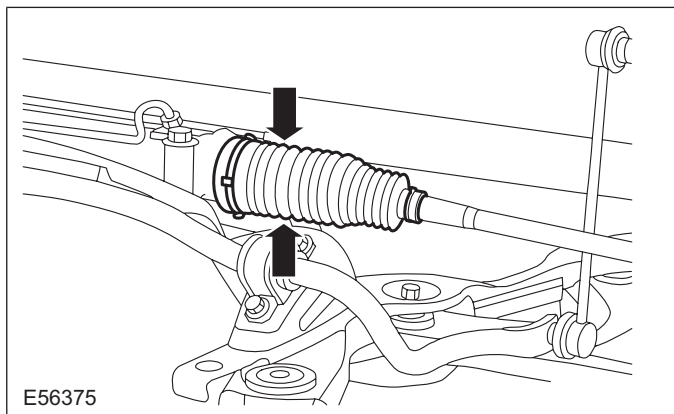


9. **NOTE:** To isolate the steering gear design clearance, check the left-hand steering linkage with the steering held against the left-hand steering lock stop.

With the aid of another technician holding the steering against the left-hand steering lock stop,

## DIAGNOSIS AND TESTING

firmly grasp the road wheel and apply a rocking motion checking for any free play in the steering linkage.



10. Detach the steering gear boot from the steering gear body and check for free play at the tie-rod inner ball joint.
11. If there is free play at the tie-rod inner ball joint, install a new tie-rod.

REFER to: **Tie Rod** (211-03 Steering Linkage, Removal and Installation).

12. Check the tie-rod end for free play. Install a new tie-rod end if necessary.

REFER to: **Tie Rod End** (211-03 Steering Linkage, Removal and Installation).

## Turning Effort Test

**NOTE:** Before carrying out this test, make sure that the suspension components are serviceable.

**NOTE:** Before carrying out this test, make sure that the steering column is serviceable.

**NOTE:** Before carrying out this test, make sure that the toe adjustment and tire pressures are correct.

1. Park the vehicle on a dry, even surface and apply the parking brake.
2. Remove the driver air bag module.  
REFER to: **Driver Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation).
3. Connect the air bag simulators to the sub-harnesses in place of the driver air bag module at the top of the steering column.
4. Start the engine and turn the steering wheel from lock to lock several times until the power steering fluid has reached normal operating temperature.

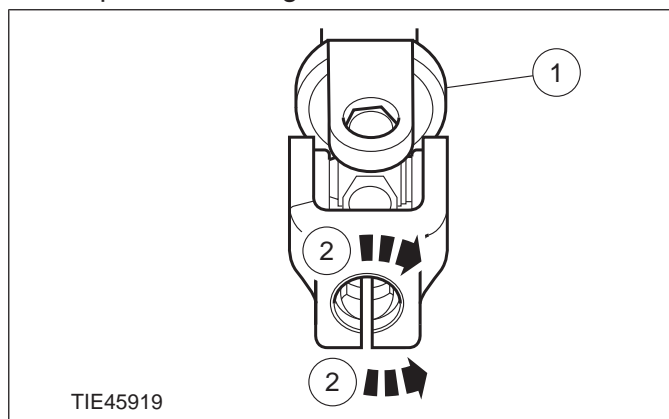
5. Using a suitable torque wrench and socket, check the steering wheel turning effort.
6. If the steering wheel turning effort is greater than the specification, install a new steering gear.

## Steering Column Universal Joint

1. **▲WARNING:** Install a new steering column to steering gear pinion retaining bolt. Failure to follow this instruction may result in personal injury.

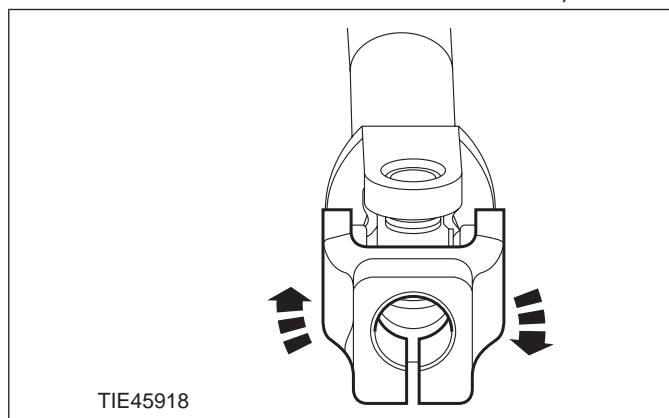
Detach the steering column from the steering gear pinion.

- Discard the steering column to steering gear pinion retaining bolt.



2. Check for smooth movement of the steering column universal joint.
  1. Hold the steering column universal joint yoke.
  2. Articulate the free yoke in a figure of eight movement.
  - If the movement is not smooth or resistance is felt, install a new steering column.

REFER to: **Steering Column** (211-04 Steering Column, Removal and Installation).



3. Hold both of the steering column universal joint yokes and twist them clockwise and counterclockwise.



**DIAGNOSIS AND TESTING**

- If movement is felt, install a new steering column.

REFER to: **Steering Column** (211-04 Steering Column, Removal and Installation).

## DIAGNOSIS AND TESTING

## Steering Gear Checks After a Collision

## General Equipment

Feeler gauge

Straight edge

## Items to be observed when checking the steering system

The following list of steering gear conditions and the methods of testing should be taken into account when carrying out checks to the steering system:

- If the steering gear has no faults after completing the following checks, do not install a new steering gear.
- Surface corrosion and marks on the tie-rod are acceptable.
- When checking for turning effort torque peaks in the steering gear, turn the steering wheel from steering lock stop to steering lock stop in approximately 15 seconds.
- A steady increase of turning effort torque from steering center to steering lock stop is acceptable.
- When checking for power steering fluid leaks, turn the steering wheel to the steering lock stop in approximately 10 seconds.
- Noises from the power steering, for example the power steering pump relief valve, are acceptable.

## STEERING GEAR HOUSING

1. Raise and support the vehicle.  
REFER to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
2. Visually inspect the steering gear housing for cracks and damage. If the steering gear housing is cracked or damaged, install a new steering gear.  
REFER to: **Steering Gear** (211-02 Power Steering, Removal and Installation).

## TIE-RODS

1. Using a straight edge and feeler gauge, check the tie-rods to see if they are straight. If the distance between the tie-rod and straight edge

is greater than 0.5 mm, install a new steering gear.

REFER to: **Steering Gear** (211-02 Power Steering, Removal and Installation).

2. Check the tightening torque of the tie-rod end to wheel knuckle nut.

REFER to: **Tie Rod End** (211-03 Steering Linkage, Removal and Installation).

3. Check the tightening torque of the tie-rod end locking nut.

REFER to: **Tie Rod End** (211-03 Steering Linkage, Removal and Installation).

## CHECK FOR TURNING EFFORT TORQUE PEAKS IN THE STEERING GEAR

1. Lower and support the vehicle making sure that the road wheels are just clear of the floor.
2. With the ignition switch in position I, slowly turn the steering wheel from steering lock stop to steering lock stop. If a turning effort torque peak or judder is felt while turning the steering wheel, detach the tie-rods from the wheel knuckles.
3. Slowly turn the steering wheel from steering lock stop to steering lock stop. If a turning effort torque peak or judder is felt while turning the steering wheel, install a new steering gear.

REFER to: **Steering Gear** (211-02 Power Steering, Removal and Installation).

## CHECK FOR POWER STEERING FLUID LEAKS

1. Lower the vehicle.
2. Run the engine at a fast idle and slowly turn the steering wheel to the left-hand steering lock stop. Hold the steering wheel in this position for 5 seconds with a turning effort torque of 15 Nm at the steering wheel rim.
3. Turn the steering wheel away from the left-hand steering lock stop for 30 seconds.
4. Run the engine at a fast idle and slowly turn the steering wheel to the right-hand steering lock stop. Hold the steering wheel in this position for 5 seconds with a turning effort torque of 15 Nm at the steering wheel rim.
5. Turn the steering wheel away from the right-hand steering lock stop.
6. Check for power steering fluid leaks at the steering gear housing and the power steering line connections to the steering gear. If there is

211-00-7

## Steering System - General Information

211-00-7

**DIAGNOSIS AND TESTING**

a power steering fluid leak at the steering gear,  
install a new steering gear.

REFER to: **Steering Gear** (211-02 Power  
Steering, Removal and Installation).

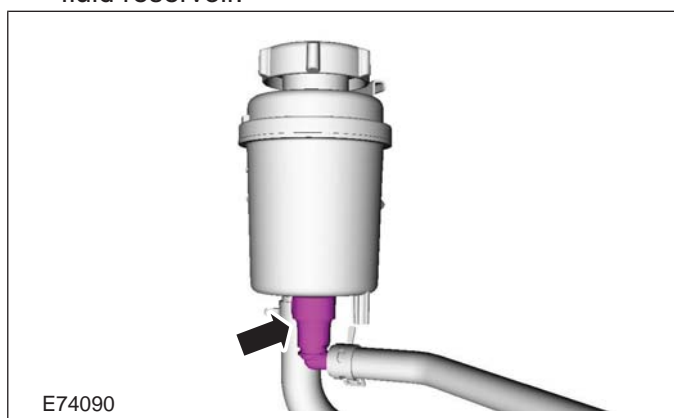
## GENERAL PROCEDURES

## Power Steering System Flushing

Materials	
Name	Specification
Hydraulic Fluid DP-PS	WSS-M2C204-A2 / 5U7J-M2C204-AA

- 1. ⚠ WARNING: Be prepared to collect escaping fluids.**

Using a blanking cap, cap the power steering fluid reservoir.

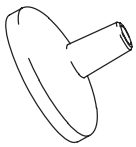
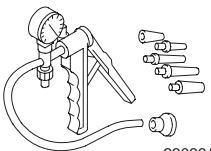


- 2.** Place the end of the steering gear return line into a container.
- 3.** Fill the power steering reservoir to the MAX mark.  
Material: Hydraulic Fluid DP-PS  
(WSS-M2C204-A2 / 5U7J-M2C204-AA)  
hydraulic fluid
- 4.** Raise the vehicle until the road wheels are clear of the floor. Support the vehicle.  
Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
- 5. NOTE:** This step requires the aid of another technician.
  1. Start the engine and slowly turn the steering from steering lock to steering lock until clean power steering fluid comes out of the return line.
  2. With the aid of another technician, add the power steering fluid until the system is free of contaminated power steering fluid.  
Material: Hydraulic Fluid DP-PS  
(WSS-M2C204-A2 / 5U7J-M2C204-AA)  
hydraulic fluid

## GENERAL PROCEDURES

## Power Steering System Filling

## Special Tool(s)

 <p>13016</p>	<p>211-189 Adapter, Power Steering Bleeding</p>
 <p>23036A</p>	<p>416-D001 Hand Vacuum Pump/Pressure Pump</p>

## Materials

Name	Specification
Hydraulic Fluid DP-PS	WSS-M2C204-A2 / 5U7J-M2C204-AA

1. Fill the power steering fluid reservoir to the MAX mark.

Material: Hydraulic Fluid DP-PS  
(WSS-M2C204-A2 / 5U7J-M2C204-AA)  
hydraulic fluid

2. Raise the vehicle until the road wheels are clear of the floor. Support the vehicle.

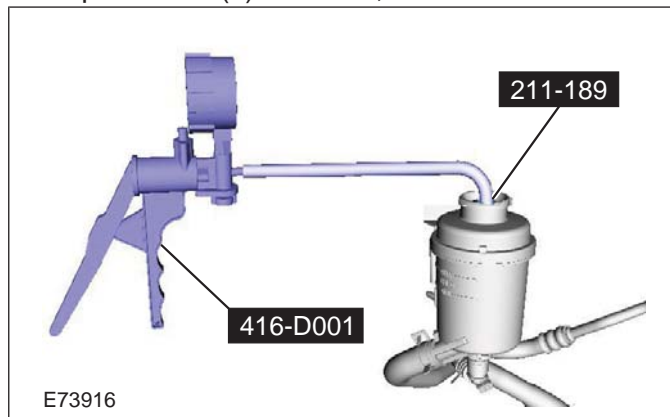
Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

3. Slowly turn the steering wheel from lock to lock and add power steering fluid until the power steering fluid in the power steering fluid reservoir stops dropping.

4. Start the engine and slowly turn the steering wheel from lock to lock and add power steering fluid until the power steering fluid in the power steering fluid reservoir stops dropping.

5. Switch the engine OFF and using the special tools, create a vacuum of 62cm-Hg - 75cm-Hg for 30 seconds.

Special Tool(s): 211-189, 416-D001



6. 1. Observe the vacuum gauge reading.  
2. If the vacuum decreases by more than 5cm-Hg in 5 minutes, the system should be checked for leaks.

7. Remove the special tools. Fill the power steering fluid reservoir to the MAX mark as necessary.

Material: Hydraulic Fluid DP-PS  
(WSS-M2C204-A2 / 5U7J-M2C204-AA)  
hydraulic fluid

8. Lower the vehicle.

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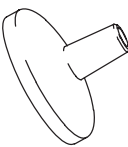
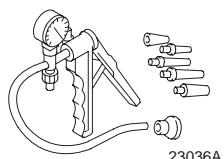
Steering System - General Information

211-00-10

## GENERAL PROCEDURES

## Power Steering System Vacuum Bleeding

## Special Tool(s)

 <p>13016</p>	<p>211-189 Adapter, Power Steering Bleeding</p>
 <p>23036A</p>	<p>416-D001 Hand Vacuum Pump/Pressure Pump</p>

## Materials

Name	Specification
Power Steering Fluid IW	WSA-M2C195-A / 9U7J-M2C195-AA

## Bleeding

9. Refer to: **Steering System Health and Safety Precautions** (100-00 General Information, Description and Operation).
- 10.



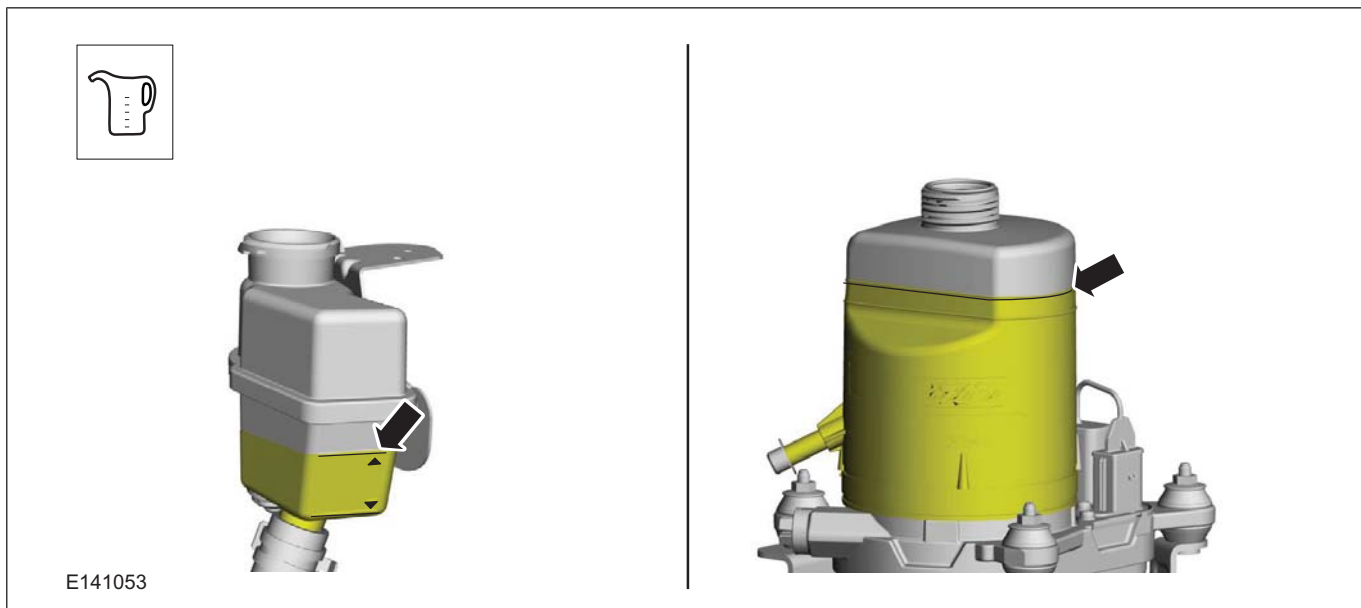
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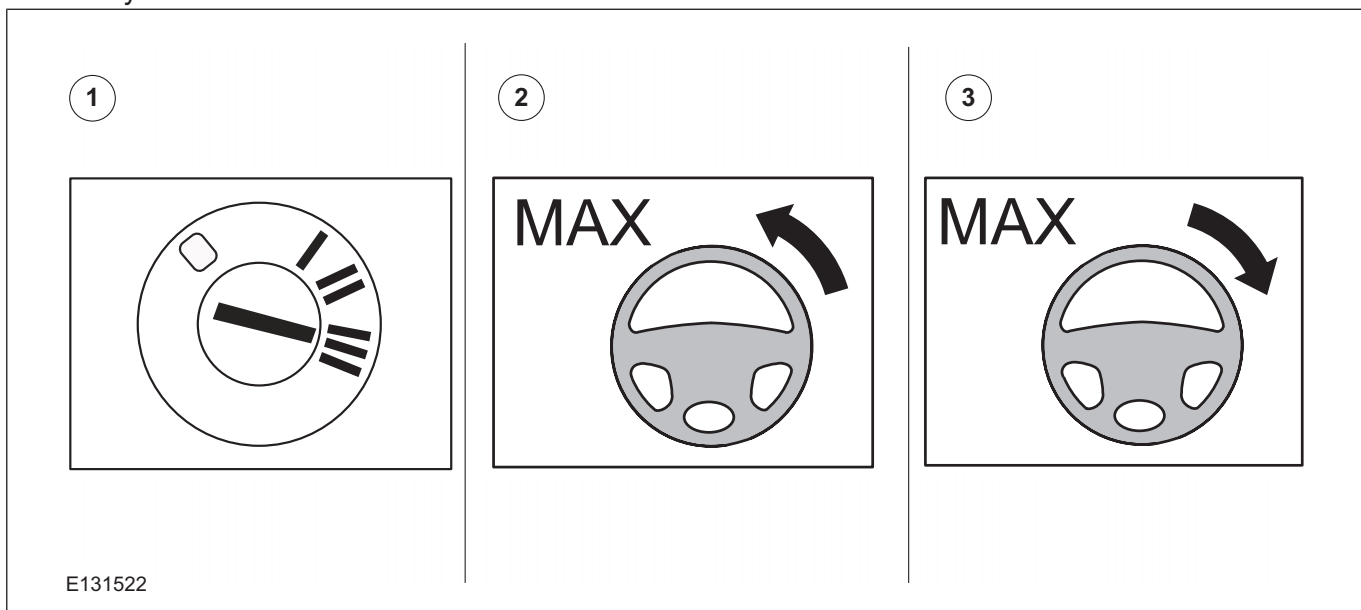
11. Material: Power Steering Fluid IW (WSA-M2C195-A / 9U7J-M2C195-AA) hydraulic fluid



GENERAL PROCEDURES

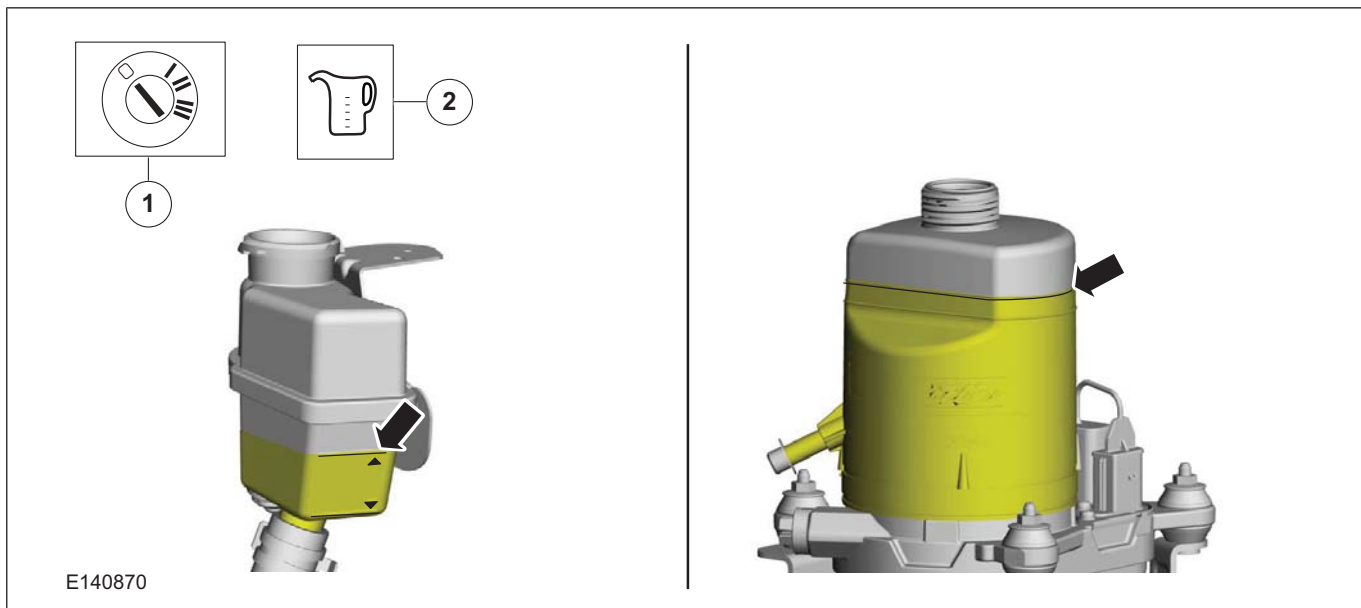


**12 NOTE:** Make sure the fluid in the reservoir does not fall below the MIN mark, as air could enter the system.



**13. Material:** Power Steering Fluid IW  
(WSA-M2C195-A / 9U7J-M2C195-AA)  
hydraulic fluid

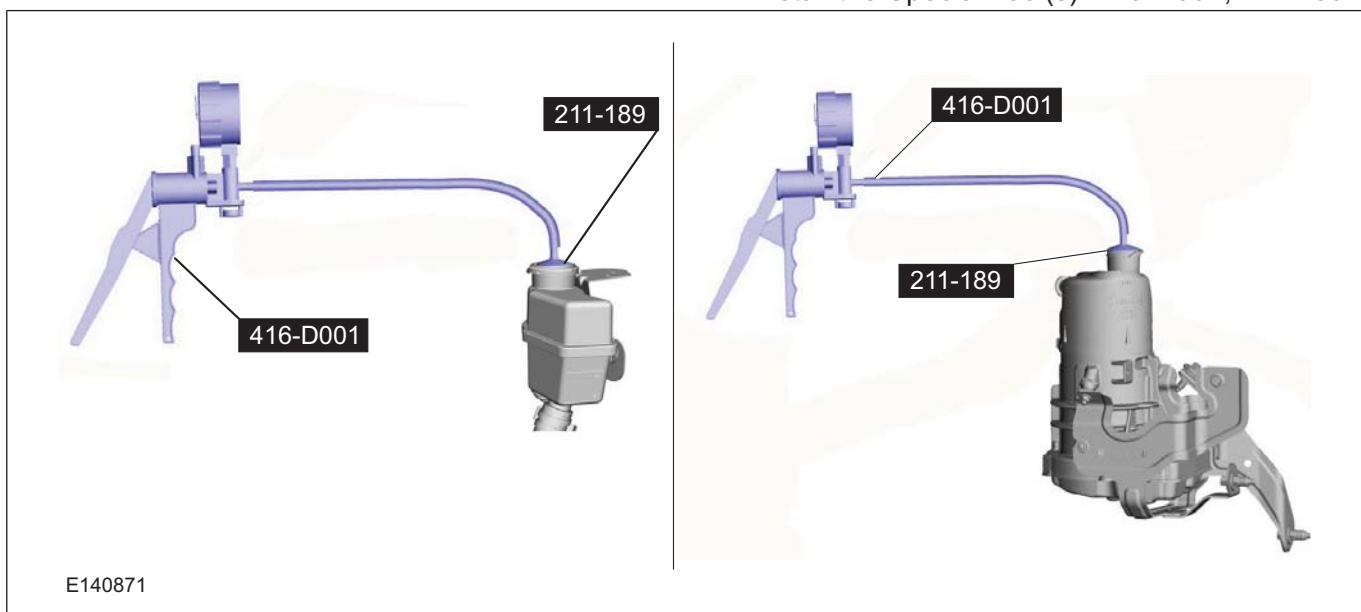
GENERAL PROCEDURES



14. When bleeding the power steering system the vacuum will decrease. Using the special tools, maintain a sufficient vacuum of 38cm-Hg. If the

vacuum decreases by more than 5cm-Hg in 5 minutes, the system should be checked for leaks.

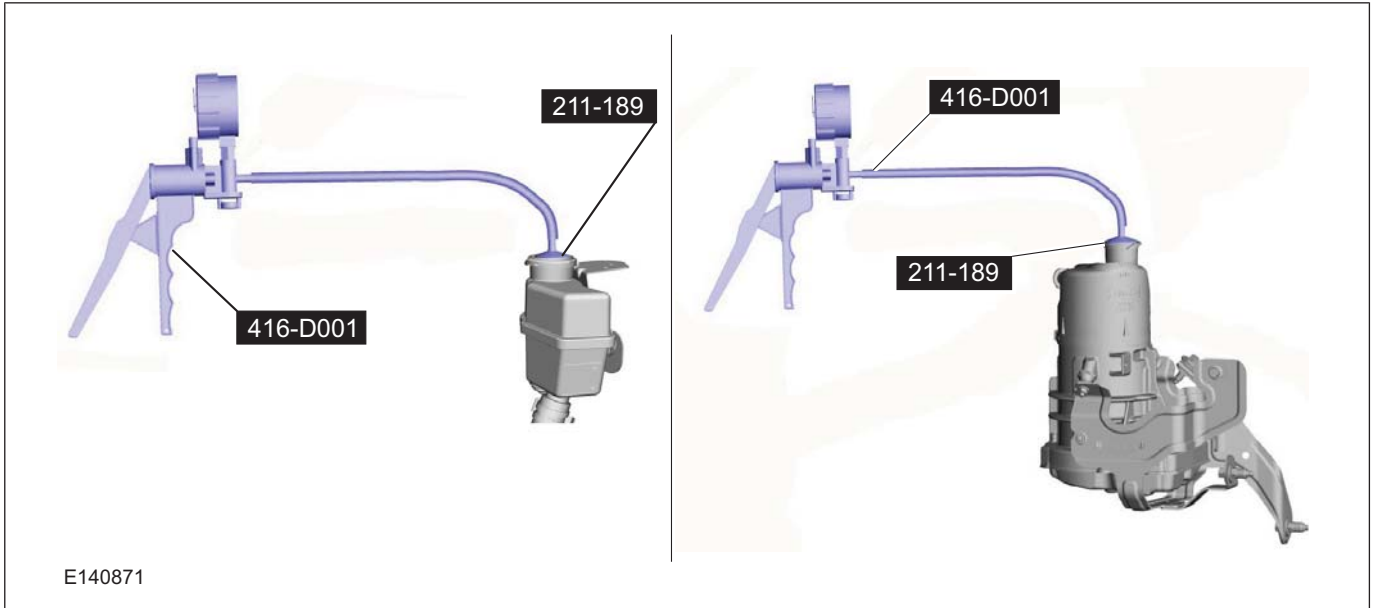
Install the Special Tool(s): 416-D001, 211-189



15. Remove the Special Tool(s): 211-189, 416-D001

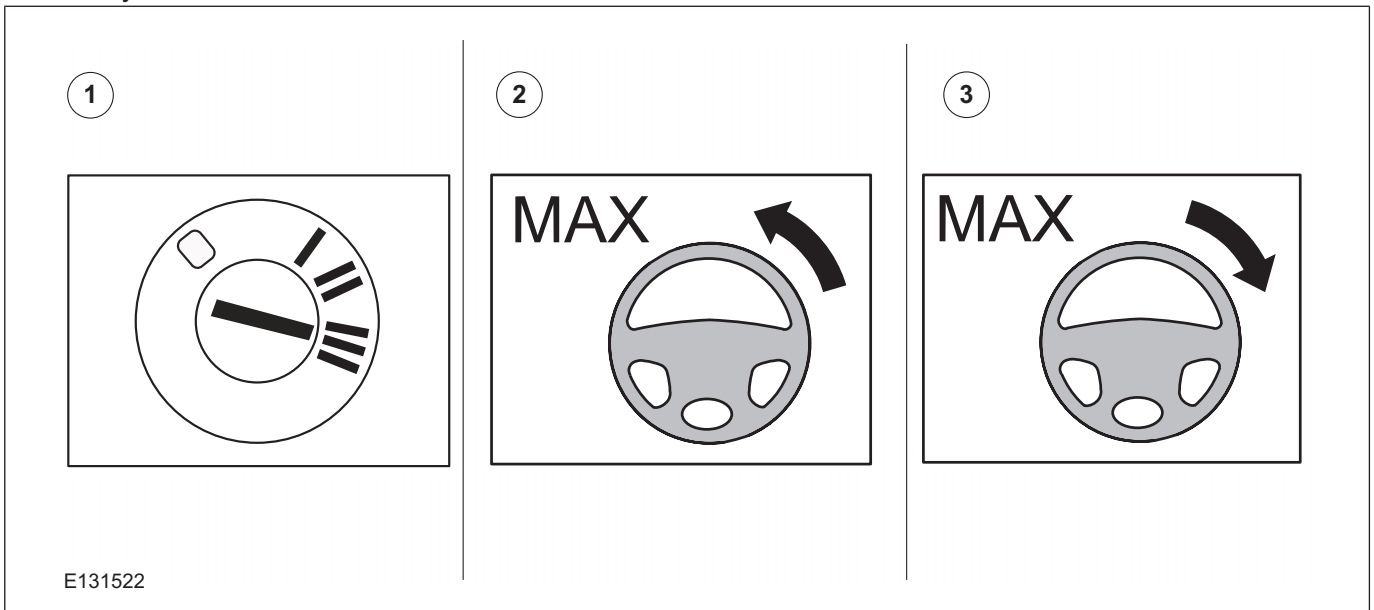


GENERAL PROCEDURES



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**16. NOTE:** Make sure the fluid in the reservoir does not fall below the MIN mark, as air could enter the system.

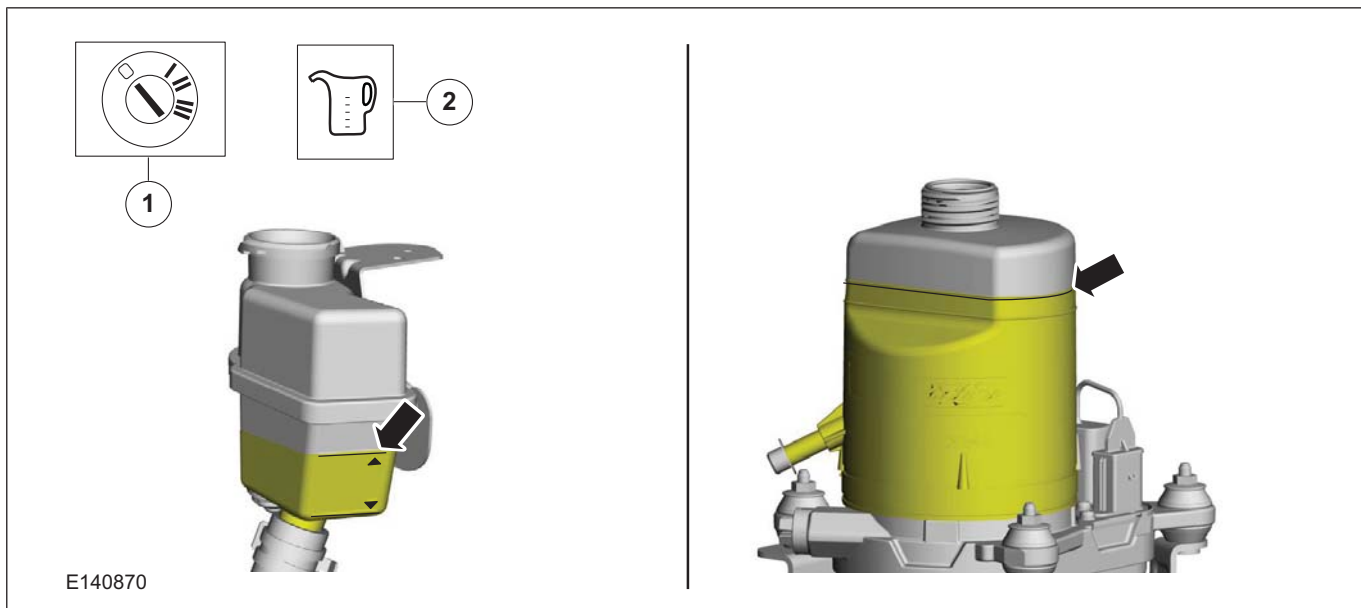


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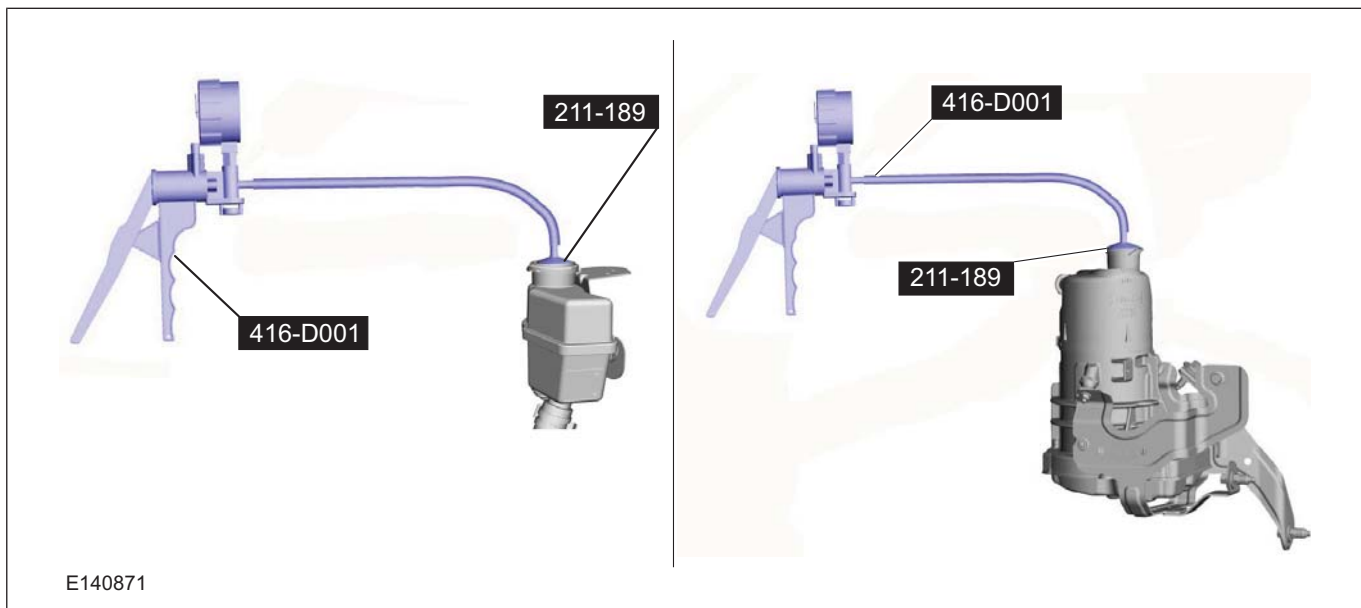
**17. Material:** Power Steering Fluid IW  
(WSA-M2C195-A / 9U7J-M2C195-AA)  
hydraulic fluid



GENERAL PROCEDURES



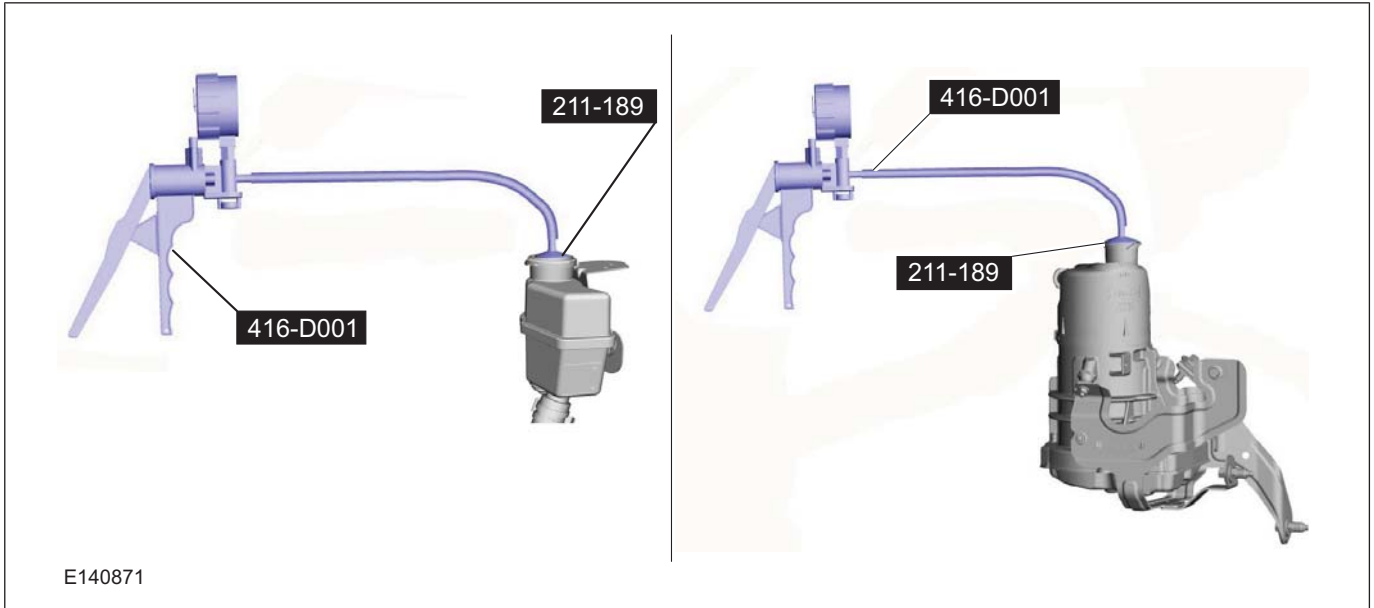
18. 1. Using the special tools, create a vacuum of 38cm-Hg. Maintain the vacuum until the air is evacuated from the system (minimum of five minutes).
2. Release the vacuum.



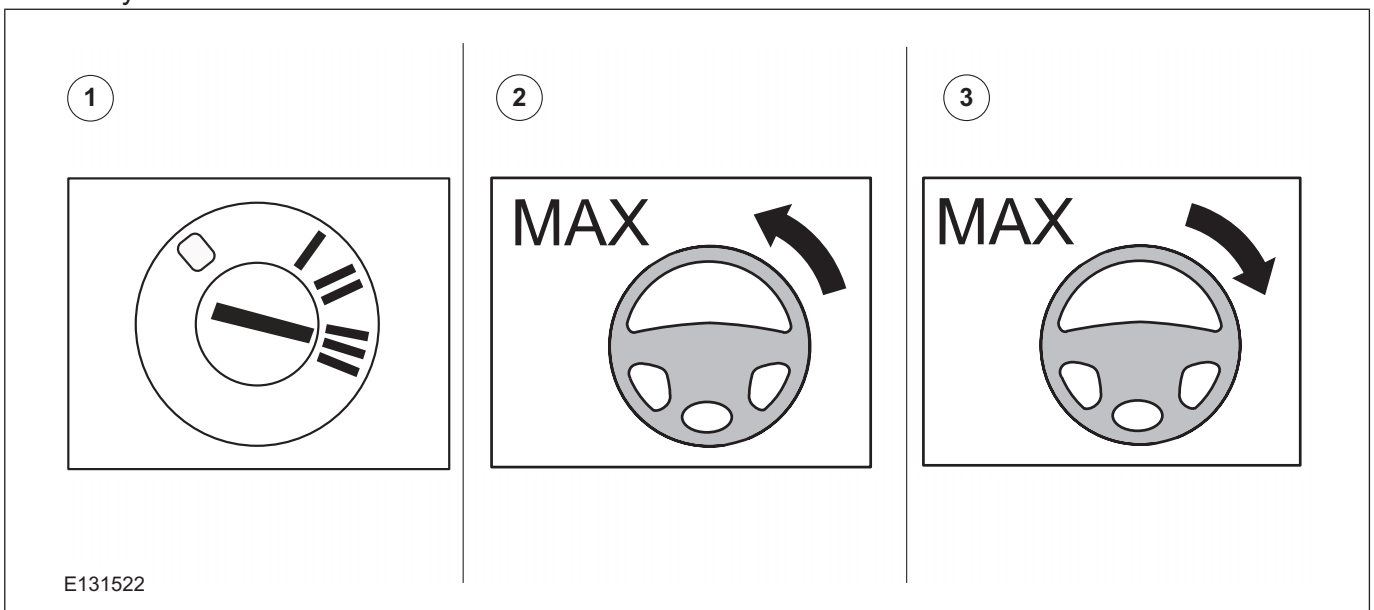
19. Remove the Special Tool(s): 211-189, 416-D001



GENERAL PROCEDURES



**20. NOTE:** Make sure the fluid in the reservoir does not fall below the MIN mark, as air could enter the system.

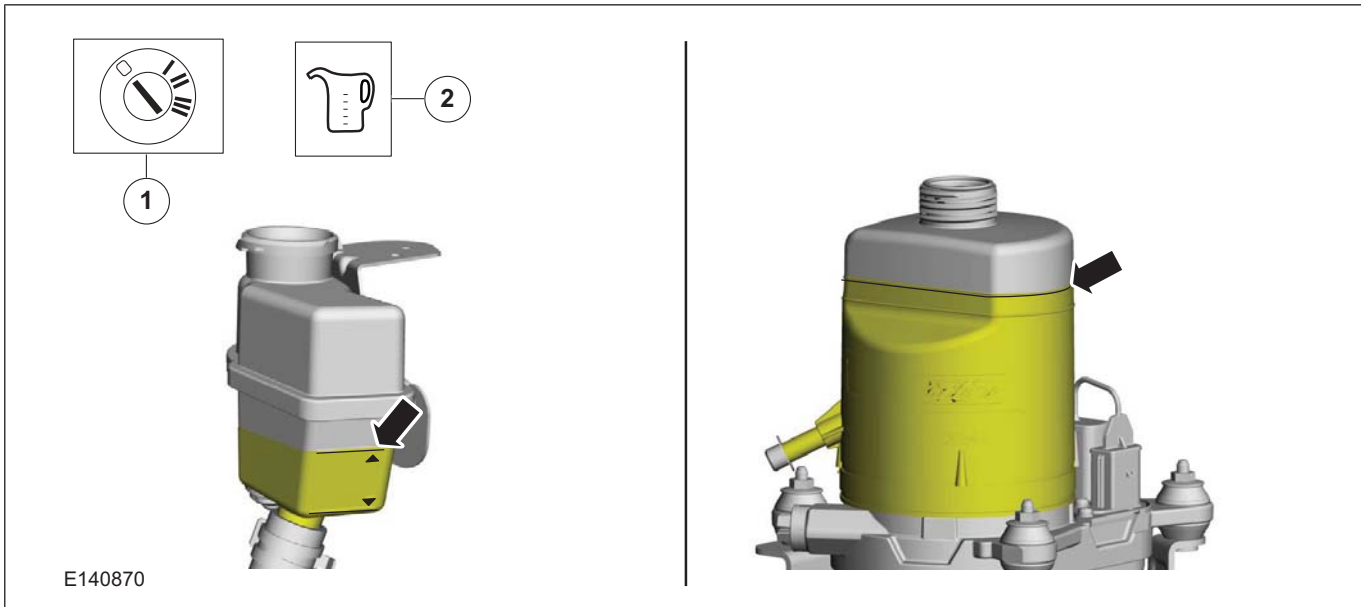


**21. Material:** Power Steering Fluid IW  
(WSA-M2C195-A / 9U7J-M2C195-AA)  
hydraulic fluid

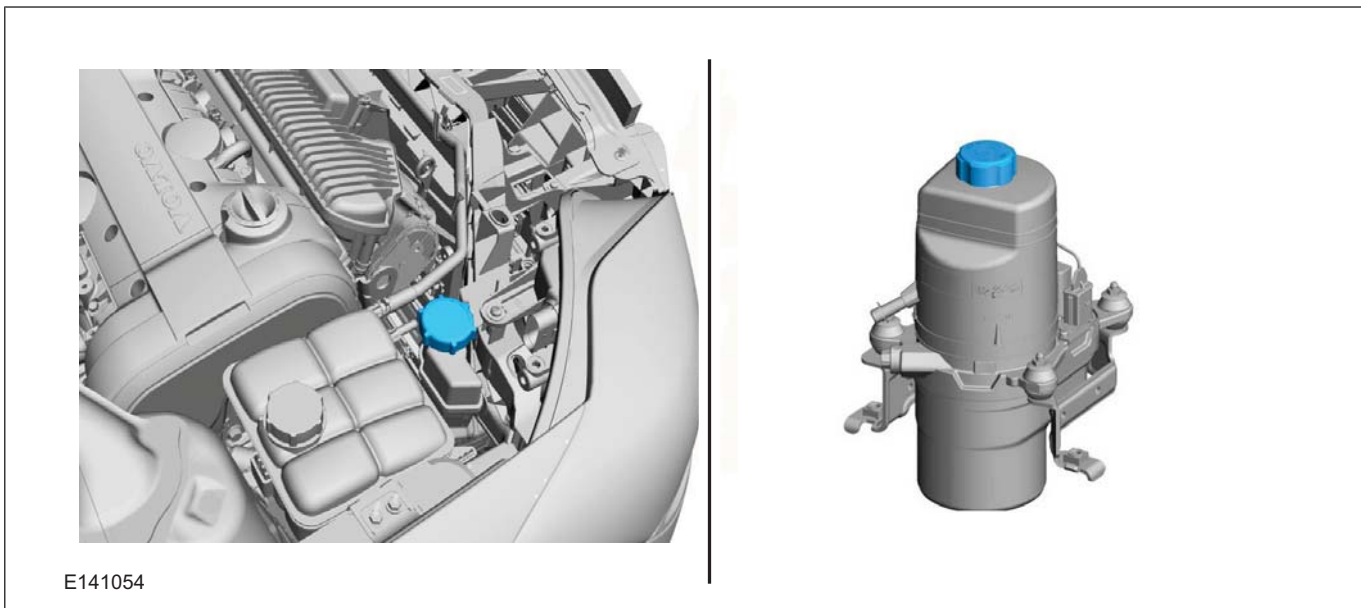




GENERAL PROCEDURES



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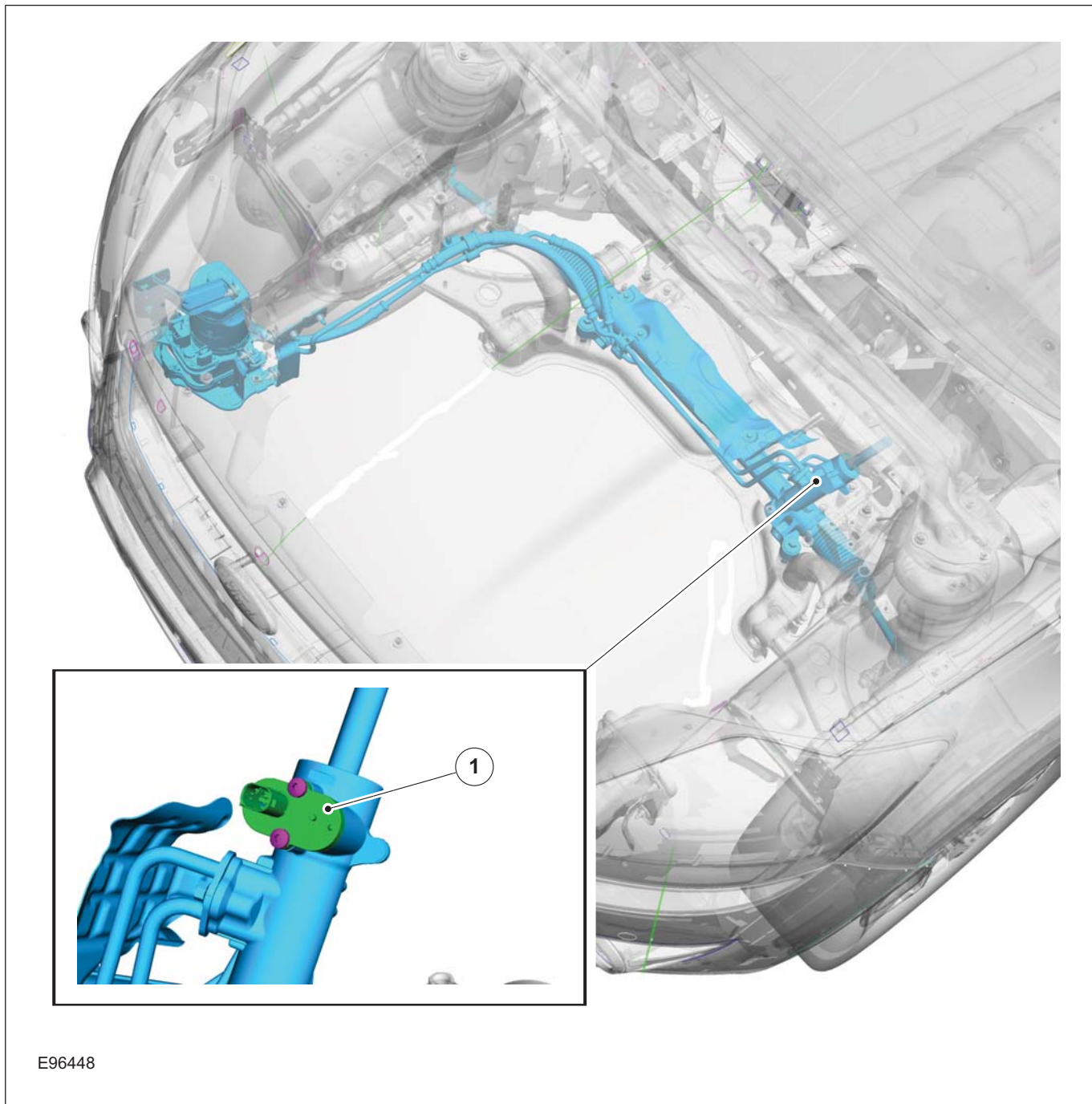
## SECTION 211-02 Power Steering

### VEHICLE APPLICATION: 2008.50 Kuga

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Steering Gear.....	(13 116 0) 211-02-25
Steering Gear to Power Steering Fluid Reservoir Return Line — 2.5L Duratec (147kW/200PS) - VI5.....	(13 439 0) 211-02-36

DESCRIPTION AND OPERATION

Power Steering – Component Location



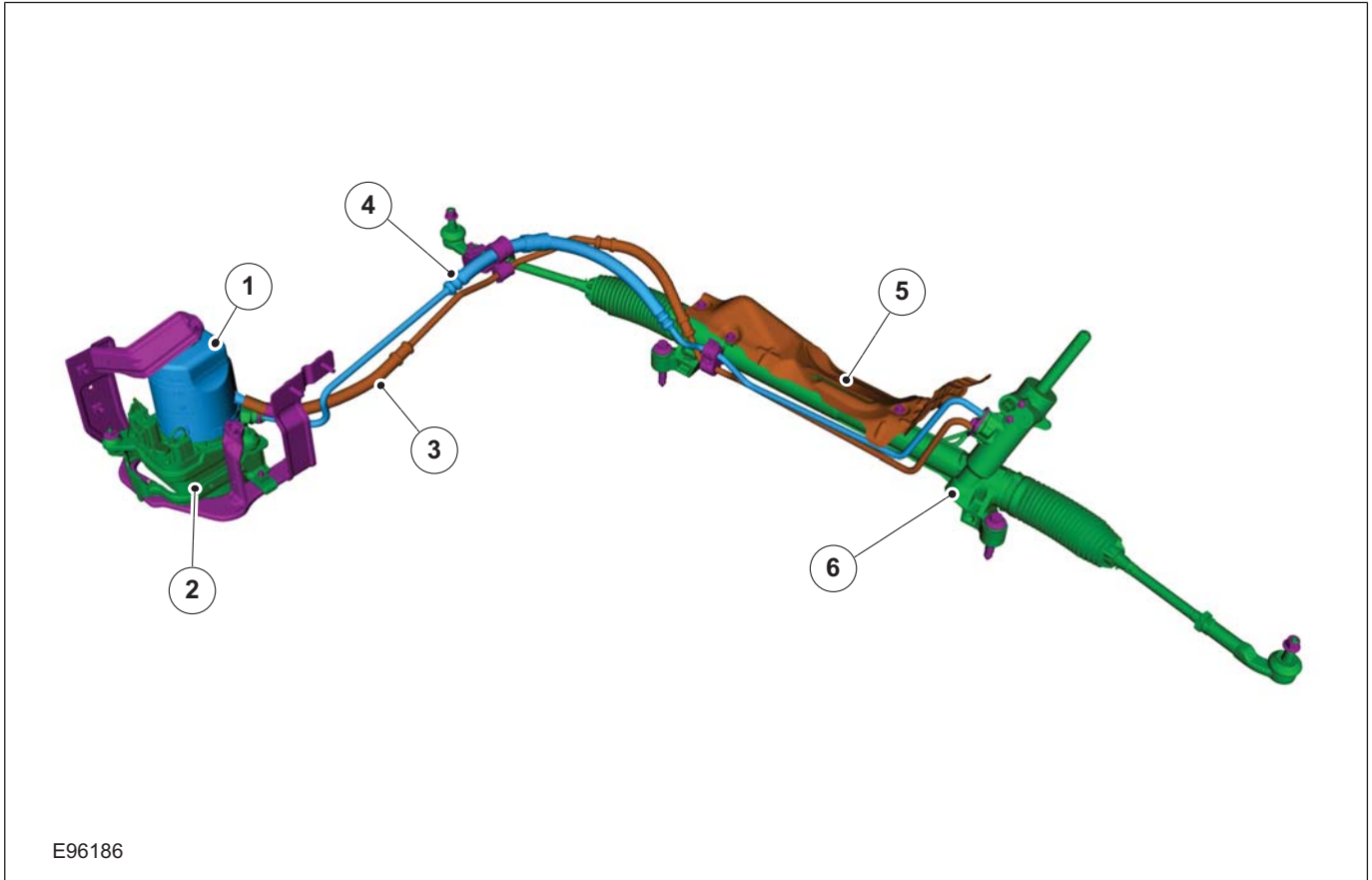
E96448

Item	Description
1	Integrated steering angle sensor - vehicles built up to 09/2009

DESCRIPTION AND OPERATION

Power Steering – Overview

Power Steering



E96186

Item	Description
1	Reservoir
2	Electro-hydraulic power steering pump
3	power steering return hose

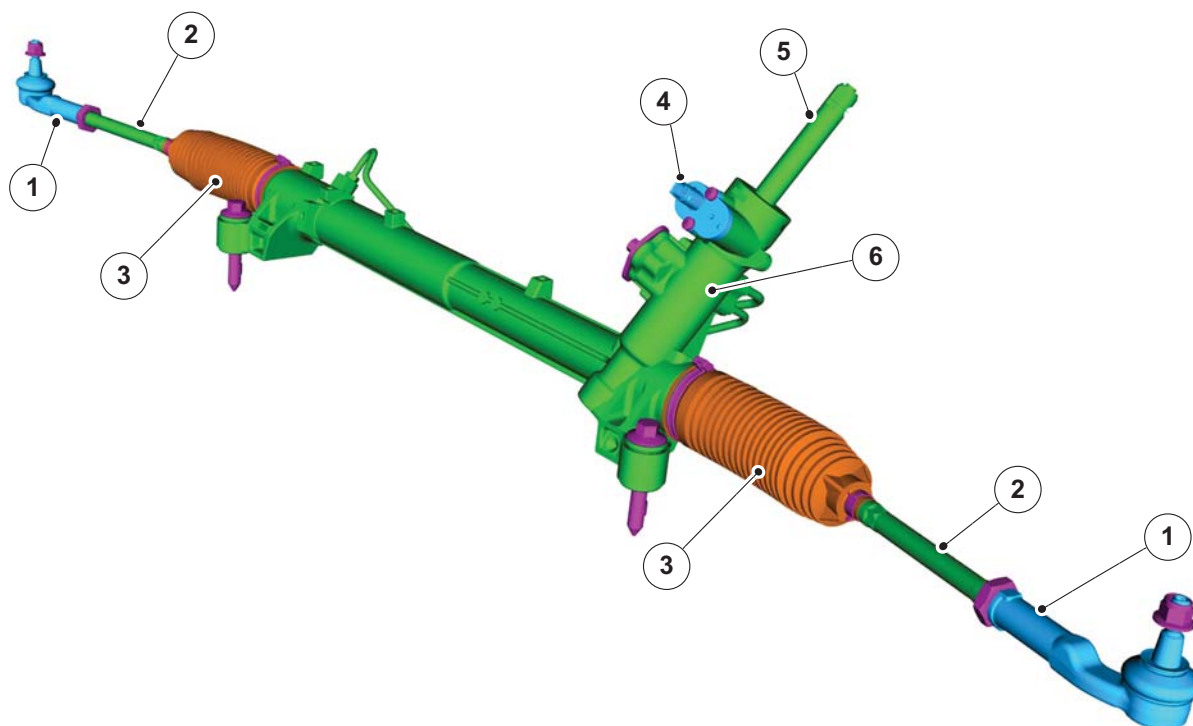
Item	Description
4	Power steering fluid pressure line
5	Heat shield
6	Steering gear

The EHPS system uses an electrically driven hydraulic pump and a conventional rack and pinion steering gear. This ensures precise steering

operation and steering assistance with minimum energy consumption.

## DESCRIPTION AND OPERATION

## Steering gear



E96209

Item	Description
1	Tie-rod end
2	Tie-rod
3	steering gear boot

Item	Description
4	Steering angle sensor - vehicles built up to 09/2009
5	Input shaft
6	Valve unit housing

The steering gear is mounted on the front axle crossmember and is secured with two bolts. The bolts are inserted in the steering gear from above and screwed into the threaded lugs on the front axle crossmember.

The following components can be renewed separately or as a unit:

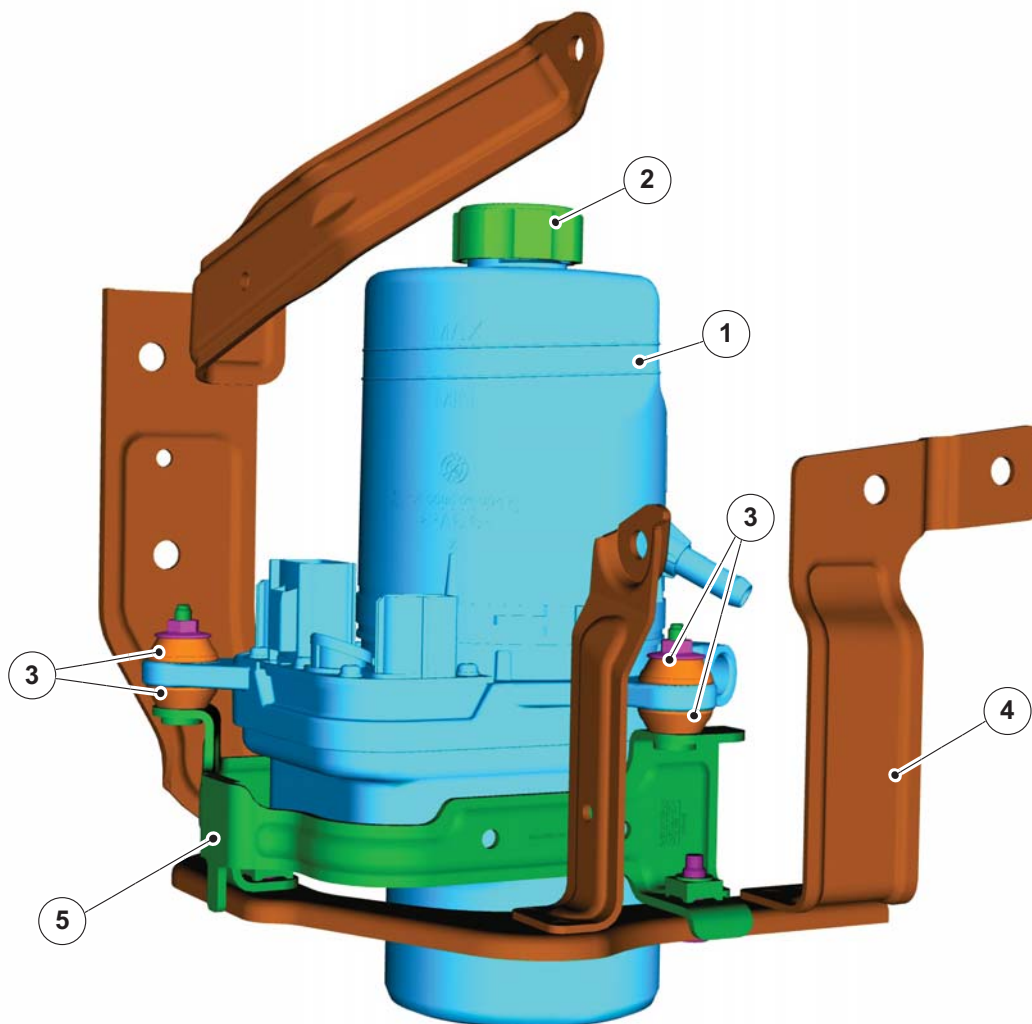
- Complete steering gear
- Steering gear rubber bushes
- Tie rods.
- Steering gear boot
- Tie-rod end
- Steering angle sensor - vehicles built up to 09/2009

During removal and installation or renewal of components of the steering gear, pay attention to the following: (excluding steering angle sensor)

- Before undertaking repair work on an accident damaged steering gear, the scope of the repair must be determined using the inspection instructions "Steering gear inspection after an accident". For additional information, refer to "Diagnosis and Testing" in this section.
- When the steering gear is removed and installed, the front axle crossmember must be aligned with the bodywork using the appropriate special tools.
- After completing the work, the suspension geometry of the vehicle must be checked and corrected as necessary.

DESCRIPTION AND OPERATION

Electro-hydraulic power steering pump



E96414

Item	Description
1	Electro-hydraulic power steering pump
2	Cap, reservoir

Item	Description
3	Rubber bushes, electro-hydraulic power steering pump
4	Bracket #1
5	Bracket #2

The electro-hydraulic power steering pump is mounted at the front right-hand side in the wheel housing.

The following components may be renewed:

- Electro-hydraulic power steering pump
- Cap, reservoir

**DESCRIPTION AND OPERATION**

- Rubber bushes, electro-hydraulic power steering pump
- Bracket #1
- Bracket #2

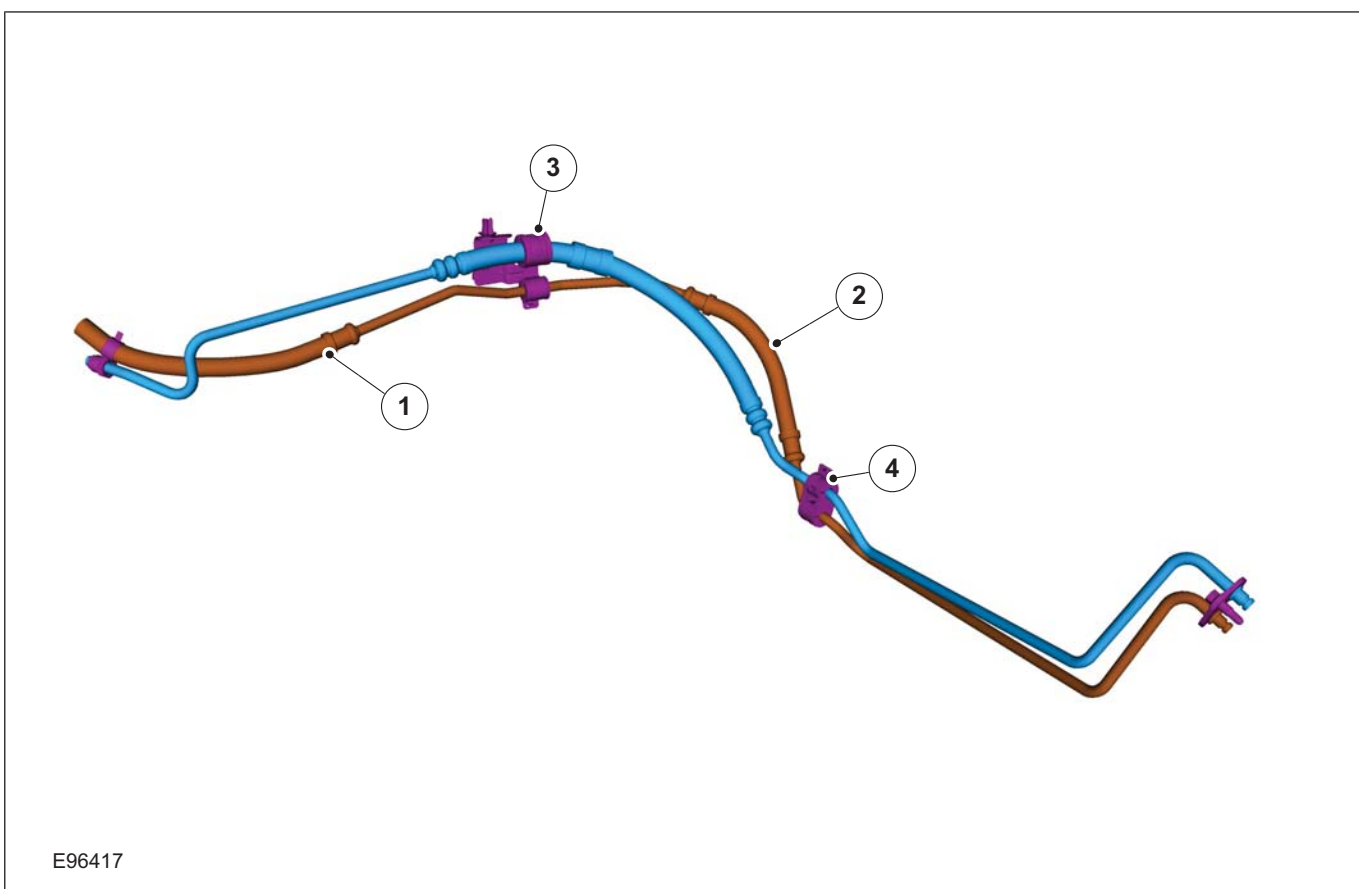
During removal and installation or renewal of components of the electro-hydraulic power steering pump, pay attention to the following:

- Before starting work to renew the electro-hydraulic power steering pump, the program code of the electro-hydraulic power

steering must be read out using the diagnostic unit and noted.

- After the work to renew the electro-hydraulic power steering pump is completed, the electro-hydraulic power steering must be reconfigured using the diagnostic unit. For further information, see: Module Configuration (418-01 Module Configuration, General Procedures).
- The electro-hydraulic power steering pump must be filled and vented as specified.

**Pressure and return lines**



E96417

Item	Description
1	power steering return hose
2	Power steering fluid pressure line

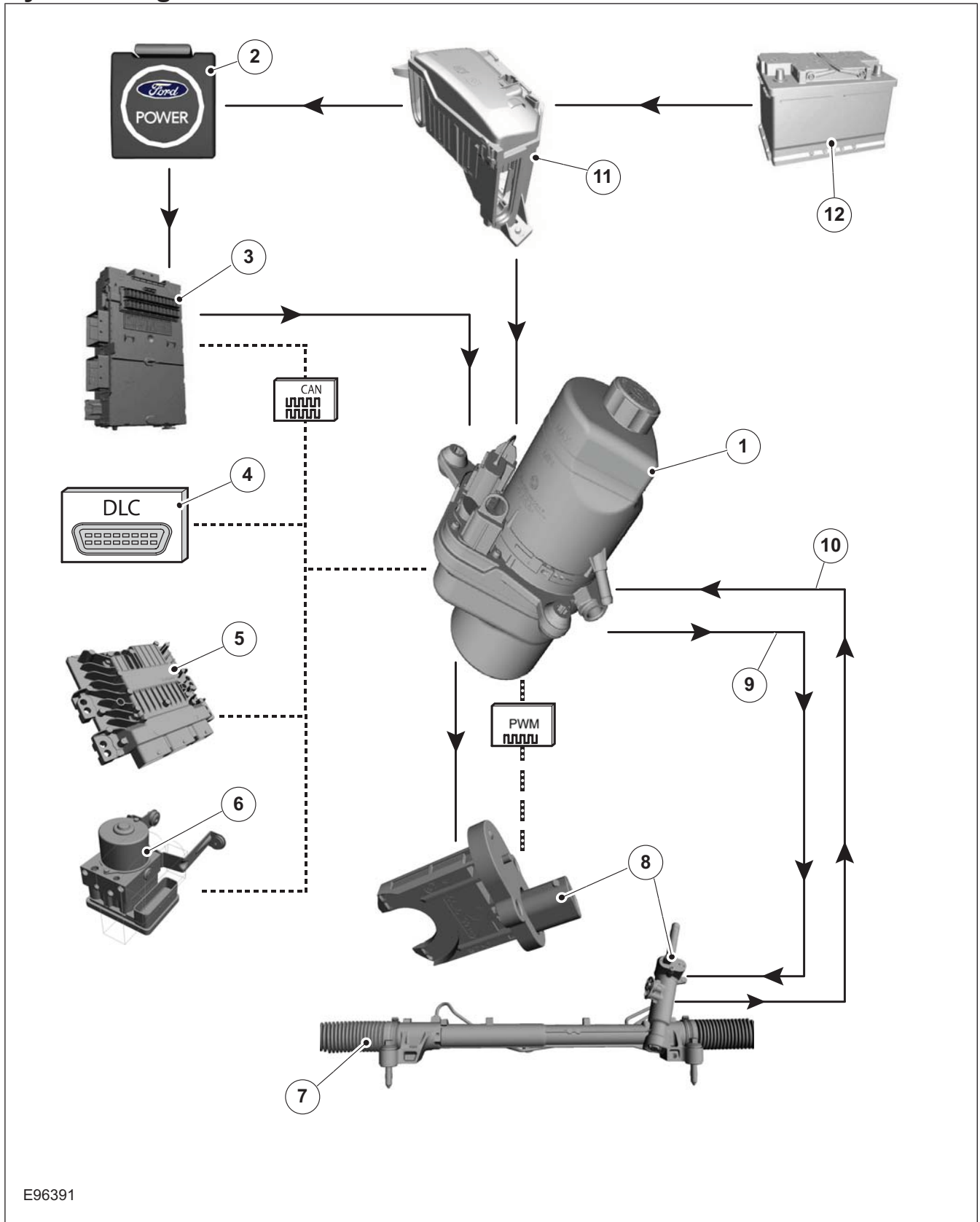
Item	Description
3	Bracket #1
4	Bracket #2



DESCRIPTION AND OPERATION

Power Steering – System Operation and Component Description

System Diagram



E96391

**DESCRIPTION AND OPERATION**

Item	Description
1	Electro-hydraulic power steering pump with integrated power steering module Refer to Component Description: Electro-hydraulic power steering pump (page 5)
2	Ignition switch
3	Generic electronic module (GEM)
4	Data link connector (DLC)
5	Powertrain Control Module (PCM)
6	ABS module or ESP module

Item	Description
7	Steering gear
8	Integrated steering angle sensor - vehicles built up to 09/2009 Refer to Component Description: (page 10)
9	High pressure pipe
10	Fluid Return Line
11	Battery junction box (BJB)
12	Battery

**System Operation****Electronic principle of operation**

The power steering module requires the following information in order to ensure precise steering behavior in all driving situations:

- Steering wheel position
- Rate of turn of the steering wheel
- Vehicle speed
- Information about the vehicle configuration
- Information about the ignition switch position
- Instantaneous engine operating status

The required information is made available to the power steering module via direct connections and via the CAN bus (refer to the flow chart).

The steering wheel position and the rate of turn of the steering wheel are transmitted to the power steering module as PWM signals from the steering angle sensor. The steering angle sensor receives its voltage and ground supply from the power steering module and operates inductively with an input voltage of 5 V.

The vehicle speed is made available to the power steering module as a CAN bus signal from the ABS module or ESP module.

The engine operating status is made available to the power steering module as a CAN bus signal from the PCM.

The power steering module obtains the vehicle configuration information via the CAN bus from the GEM. This information is required by the power steering module in order to define the internal characteristics of the power steering.

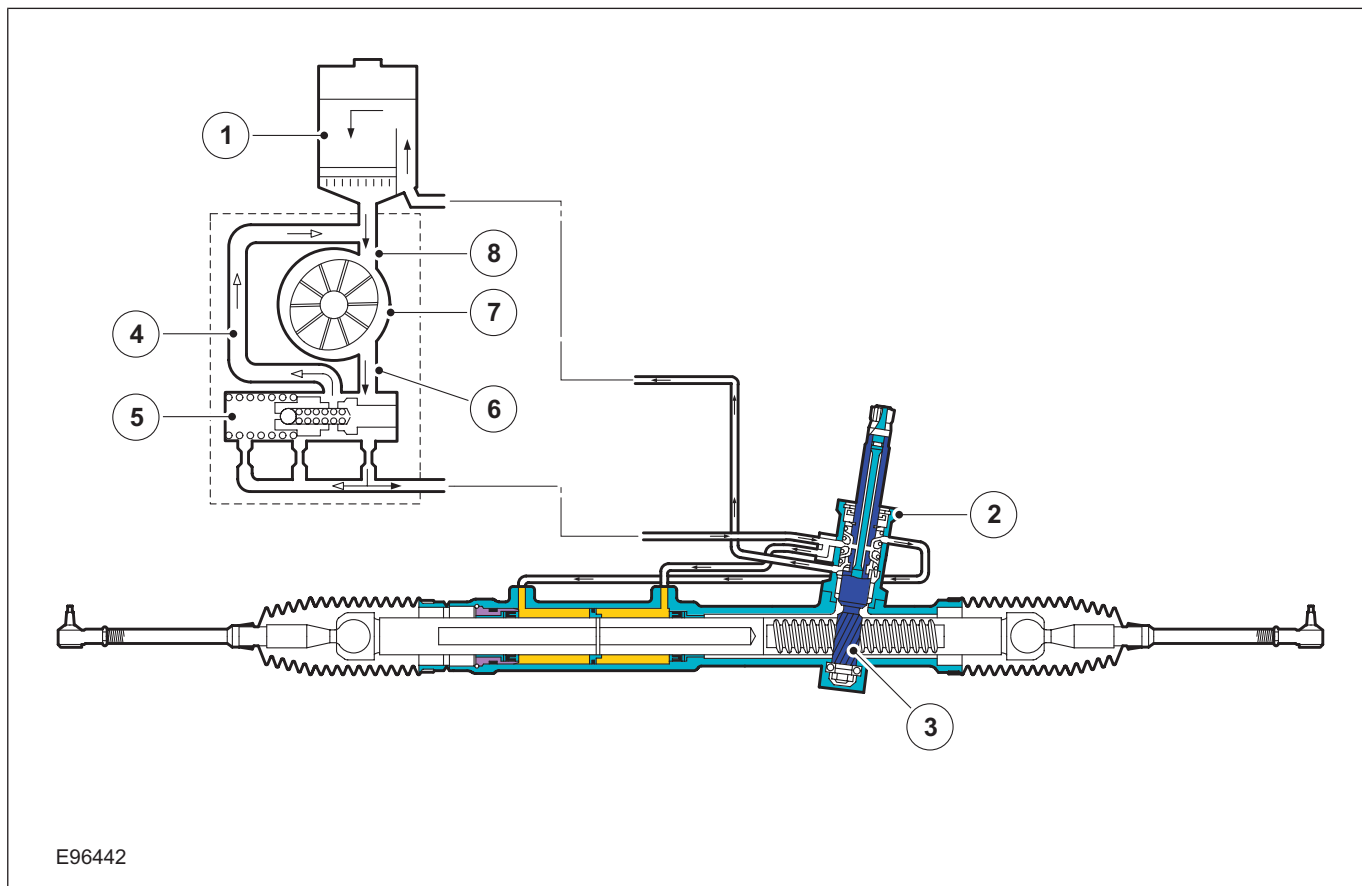
The power steering module obtains information about the current ignition switch position via the voltage input (terminal 15) of the ignition switch.

Whilst constantly monitoring the relevant input signals the power steering module accesses stored maps. With the aid of this information the pump speed is matched to the current driving situation.

An electronic diagnosis of the electro-hydraulic power steering can be performed with the aid of a diagnostic tester via the DLC of the vehicle. For additional information please refer to "Diagnosis and Testing" in this section.

## DESCRIPTION AND OPERATION

## Hydraulic principle of operation



Item	Description
1	Reservoir
2	Valve unit
3	Steering rack and pinion
4	Flow control/pressure relief - return
5	Flow control/pressure relief valve

Item	Description
6	Outlet of the power steering pump
7	Electro-hydraulic power steering pump Refer to Component Description: (page 5)
8	Low pressure suction line

When the engine is started, the electro-hydraulic power steering pump sucks in power steering fluid from the reservoir. The fluid flows through the pump and is discharged under high pressure from the outlet. The high-pressure line carries the power steering fluid to the servo valve.

If no steering effort is applied, there is no resistance to the circulation of power steering fluid and the supply pressure from the pump is very low. Only minimal pressure is applied by the servo valve to the two sides of the piston in the working cylinder.

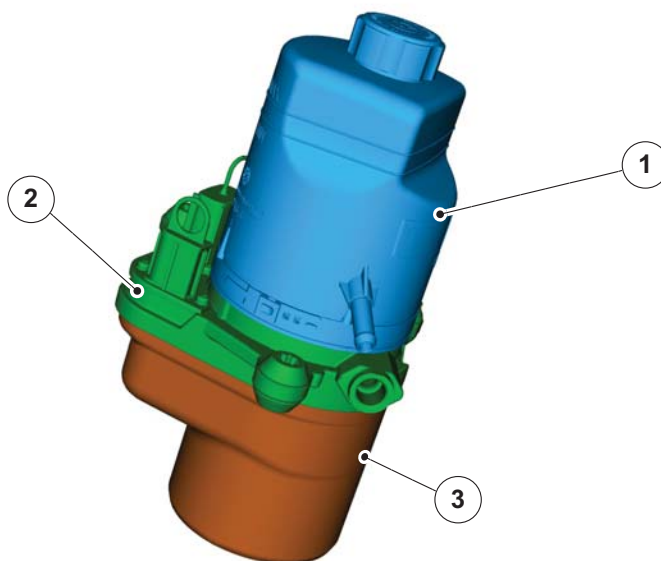
When the steering wheel is turned in either direction, the return flow of fluid to the reservoir is

restricted by the servo valve, causing the pressure to increase on the supply side. The power steering fluid is directed by the servo valve to the corresponding side of the piston in the working cylinder, providing the power assistance required to reduce the steering effort. The power steering fluid which is displaced towards the low-pressure side of the cylinder flows through the servo valve and the return line back to the reservoir.

## Component Description

## Electro-hydraulic power steering pump

## DESCRIPTION AND OPERATION



E96312

Item	Description
1	Reservoir
2	Hydraulic pump
3	Brushless DC motor with integral power steering module Refer to Component Description: (page 11)

**NOTE:** The power steering pump must be filled and vented as specified.

The electro-hydraulic power steering pump comprises a brushless DC motor, the hydraulic pump and the power steering fluid reservoir.

The hydraulic pump is a gear pump; a resonance chamber incorporated into the pump body reduces noise emissions.

The operating pressure is also regulated by means of a pressure limiting valve which is integrated in the pump housing. The pressure limiting valve stabilizes the throughput to the steering gear to a particular level independently of engine speed.

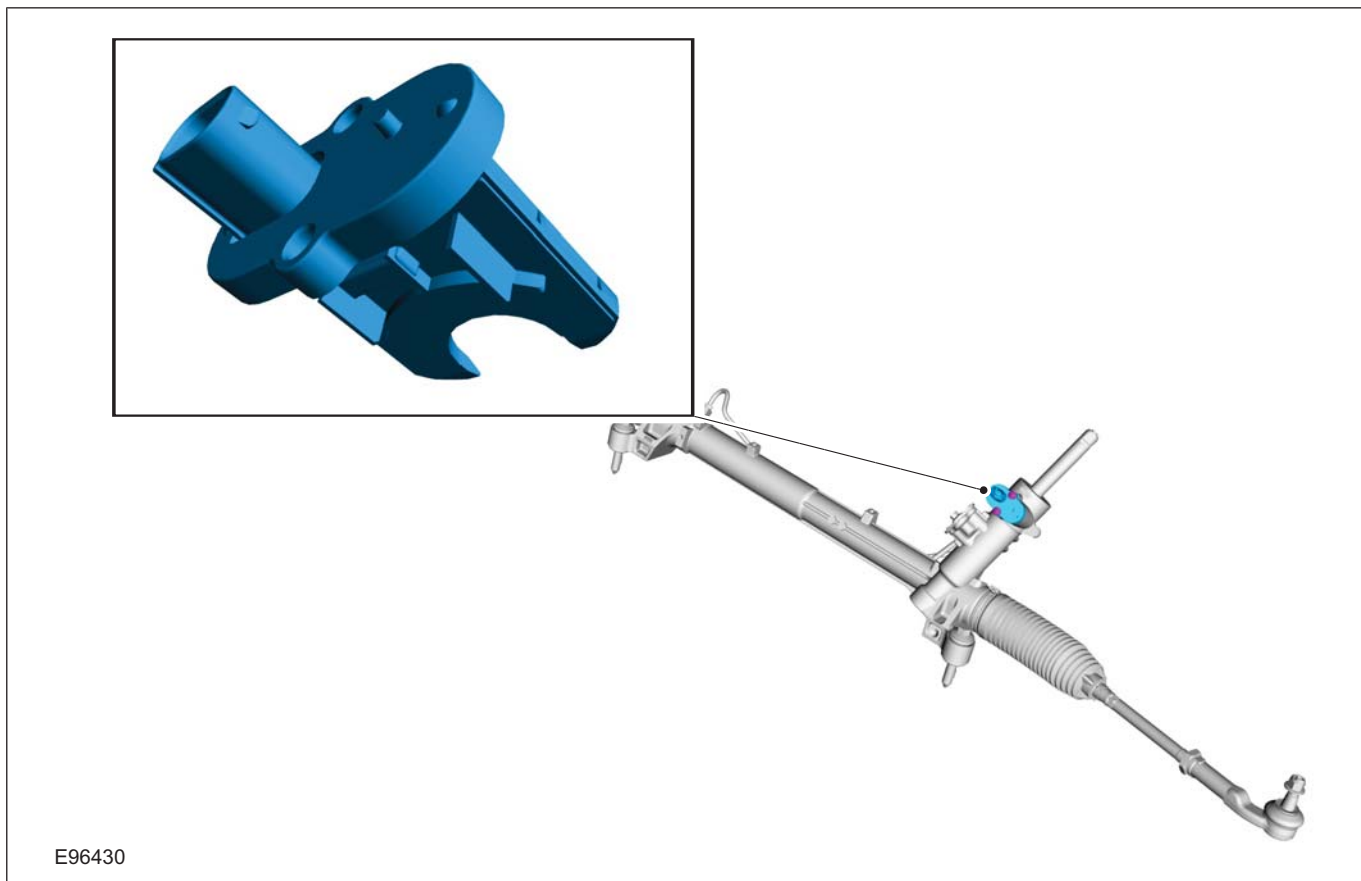
The pressure relief valve will operate if the discharge from the pump is restricted, for example,

steering held on full lock. If the output from the pump is blocked, all output is recirculated through the pump. As no fresh fluid from the reservoir is drawn into the pump in the process, the temperature of the power steering fluid in the pump quickly increases. Consequently, periods of holding the steering wheel at full lock should be kept to a minimum to prevent overheating of the pump and the power steering fluid within it.

The pressure limiting valve limits the pressure on the outlet side to 120 bar.

**Integrated steering angle sensor - vehicles built up to 09/2009**

## DESCRIPTION AND OPERATION



E96430

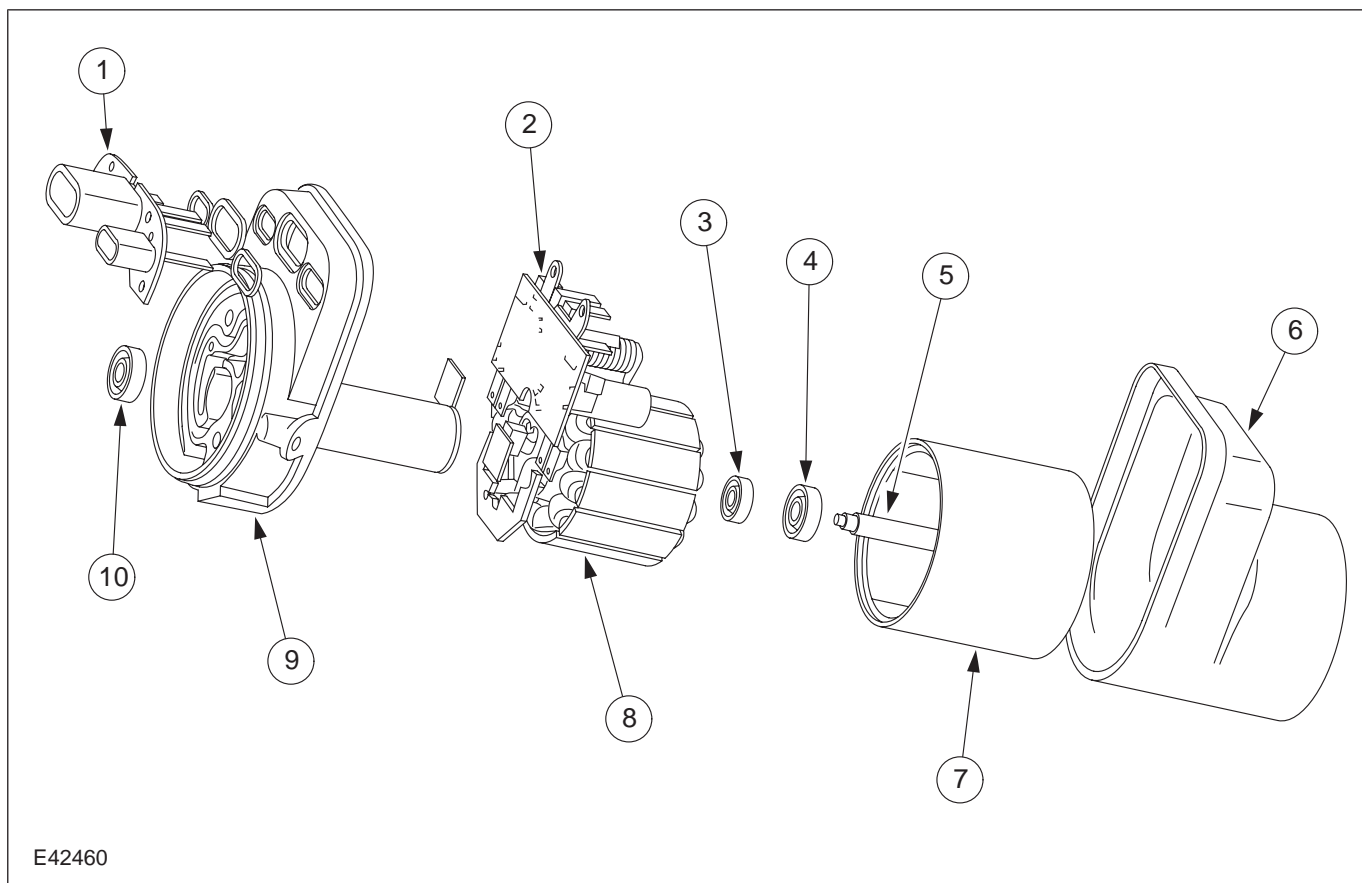
The steering angle sensor is an inductive sensor. The steering angle sensor monitors the steering wheel position and the rate of turn of the steering wheel. This information is sent to the power steering module.

**On vehicles built from 09/2009** the power steering module uses the information from the steering

angle sensor at the steering column. The required information is made available to the power steering module via the CAN bus.

**Brushless DC motor with integral power steering module**

## DESCRIPTION AND OPERATION



E42460

Item	Description
1	Connector
2	Power steering module
3	Seal
4	Bearing
5	Shaft

Item	Description
6	Cover
7	Rotor with magnets
8	Stator
9	Distributor
10	Bearing

In the electrohydraulic power steering system, a brushless 12 volt direct current motor drives the hydraulic pump. Higher pumping rates are only provided when they are required for steering manoeuvres. This avoids unnecessary energy consumption in the majority of phases in a drive cycle.

Commutation in the motor is done electronically. As a result, there are no brushes to wear away. The entire system is designed for maintenance-free operation.

In more than 85% of all driving situations, the power steering pump operates at standby speed and consumes less than 4A. However, pump speed can quickly increase to full rotational speed if emergency steering manoeuvres require it.

The system has a continuously variable pump rotational speed.



## REMOVAL AND INSTALLATION

## Power Steering Pressure Line and Return Line Assembly — 2.5L Duratec (147kW/200PS) - VI5(13 443 0)

## General Equipment

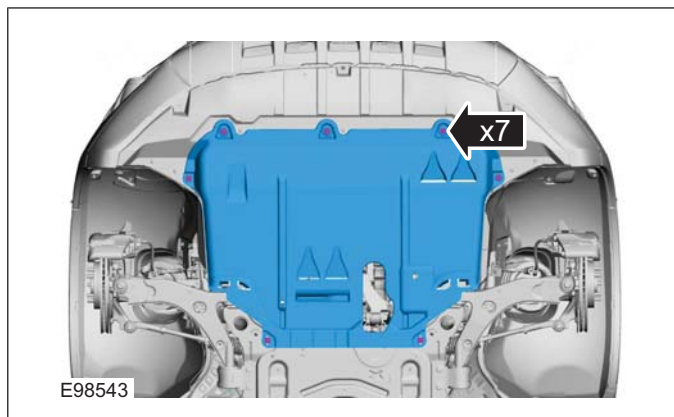
Hose Clamp Remover/Installer

## Removal

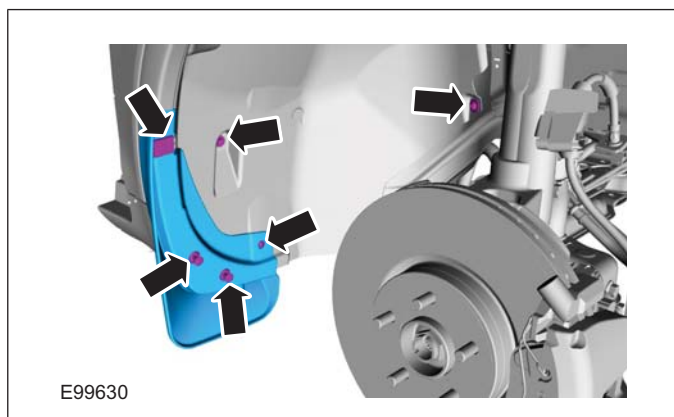
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Steering System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

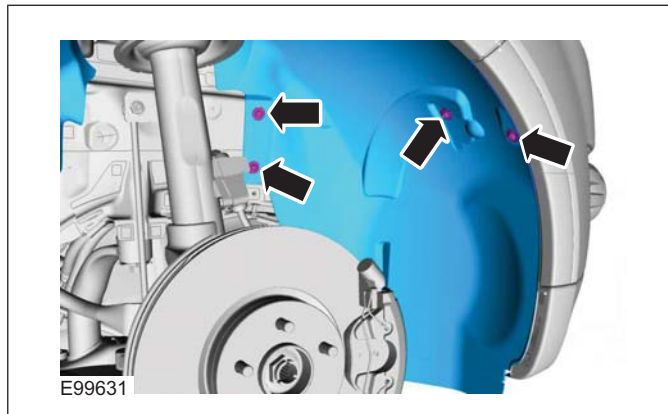
3.



4.

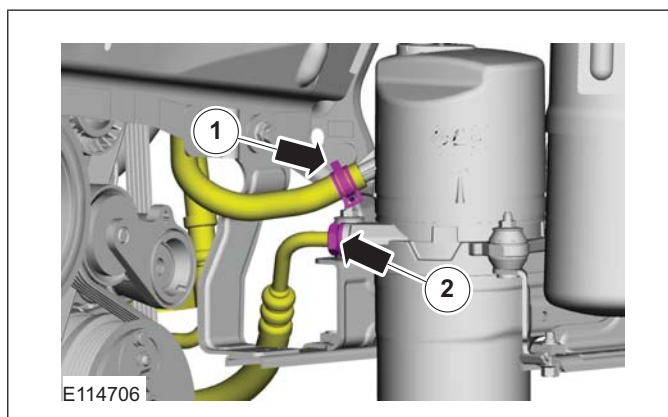


5.



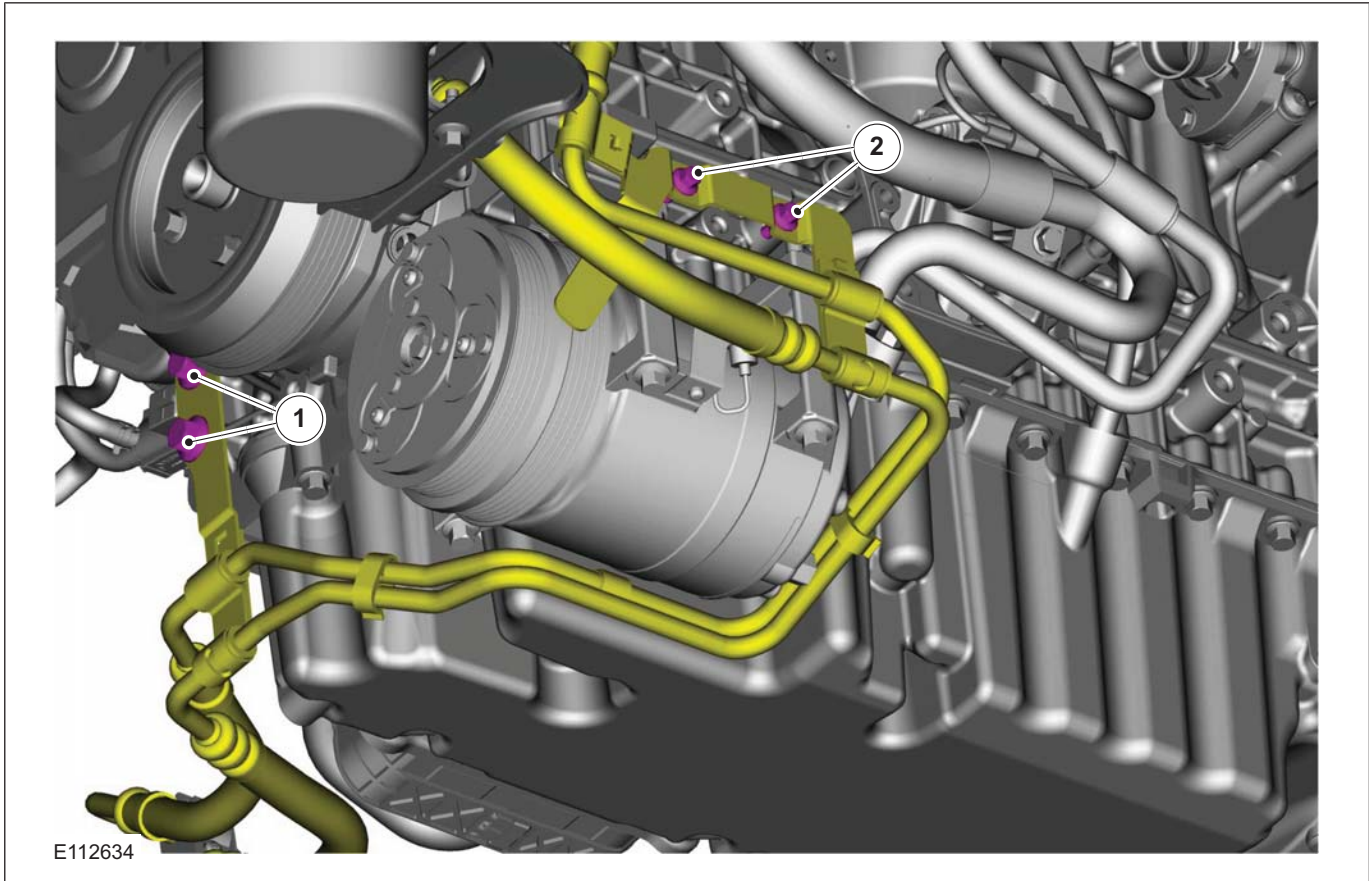
6. **WARNING:** Be prepared to collect escaping fluid.

1. General Equipment: Hose Clamp Remover/Installer
2. Torque: 30 Nm

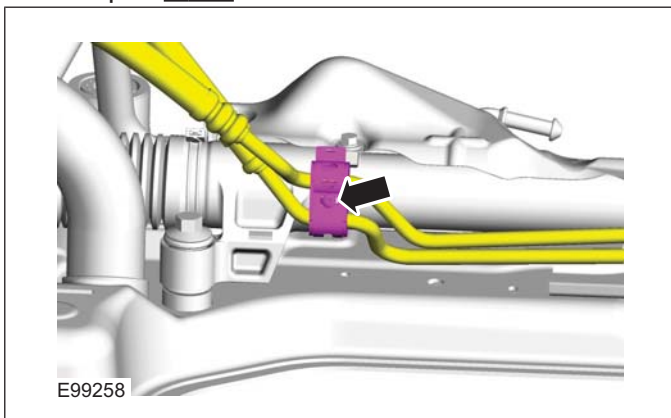


7. 1. Torque: 23 Nm
2. Torque: 7 Nm

REMOVAL AND INSTALLATION



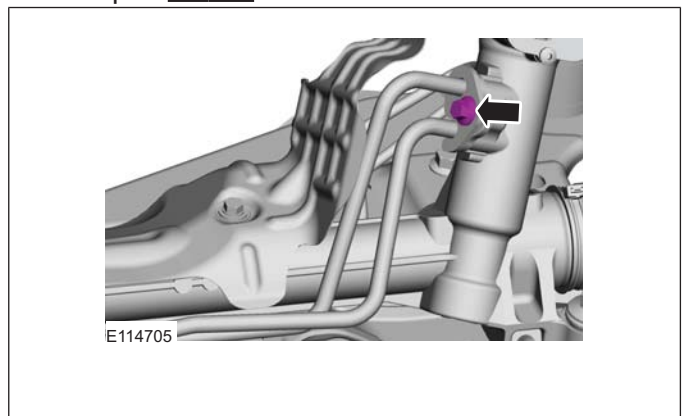
8. Torque: 4 Nm



9. **▲ WARNING:** Be prepared to collect escaping fluid.

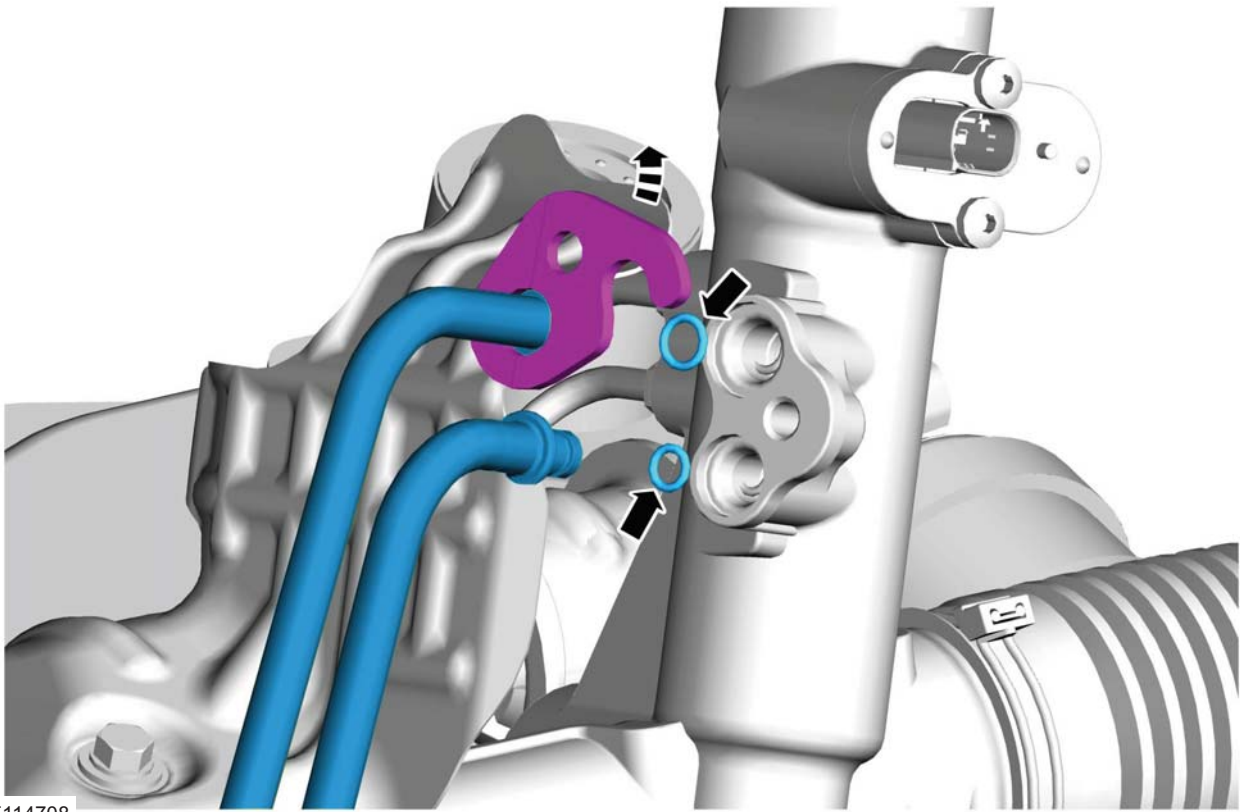
**▲ CAUTION:** Make sure that all openings are sealed.

Torque: 18 Nm



10.

## REMOVAL AND INSTALLATION

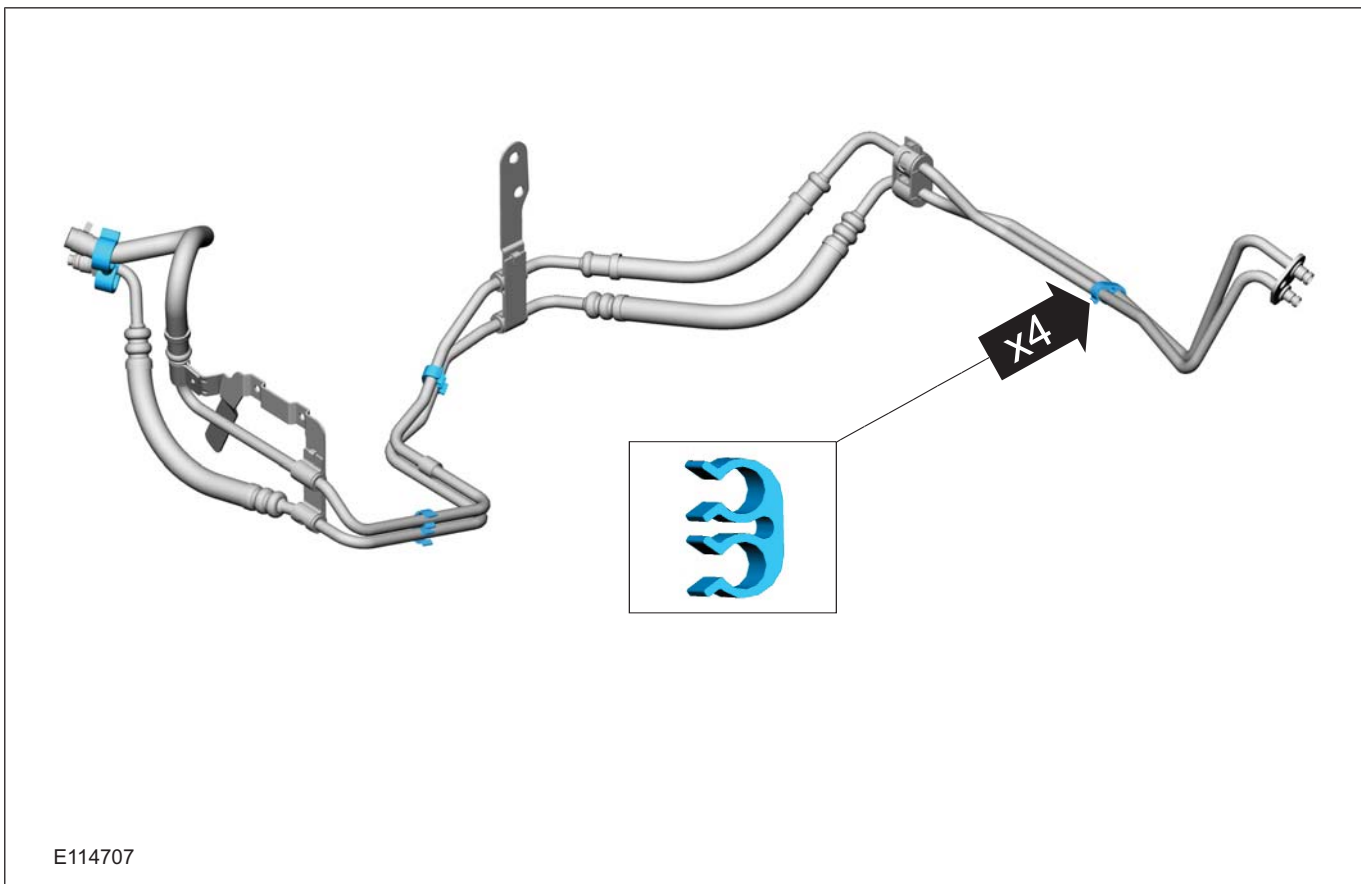


## Installation

1. **NOTE:** This step is only necessary when installing a new component.



REMOVAL AND INSTALLATION

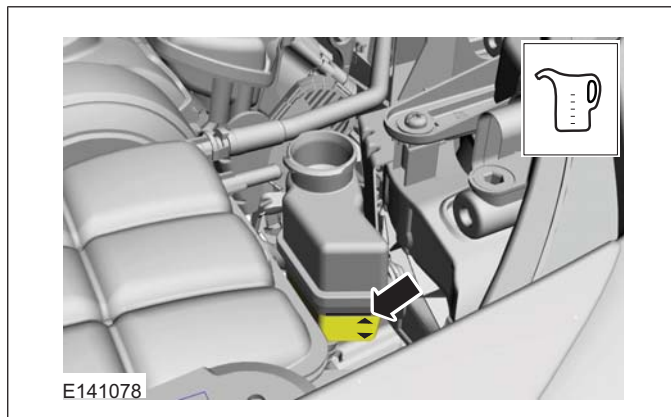


2. To install, reverse the removal procedure.

3.



4.



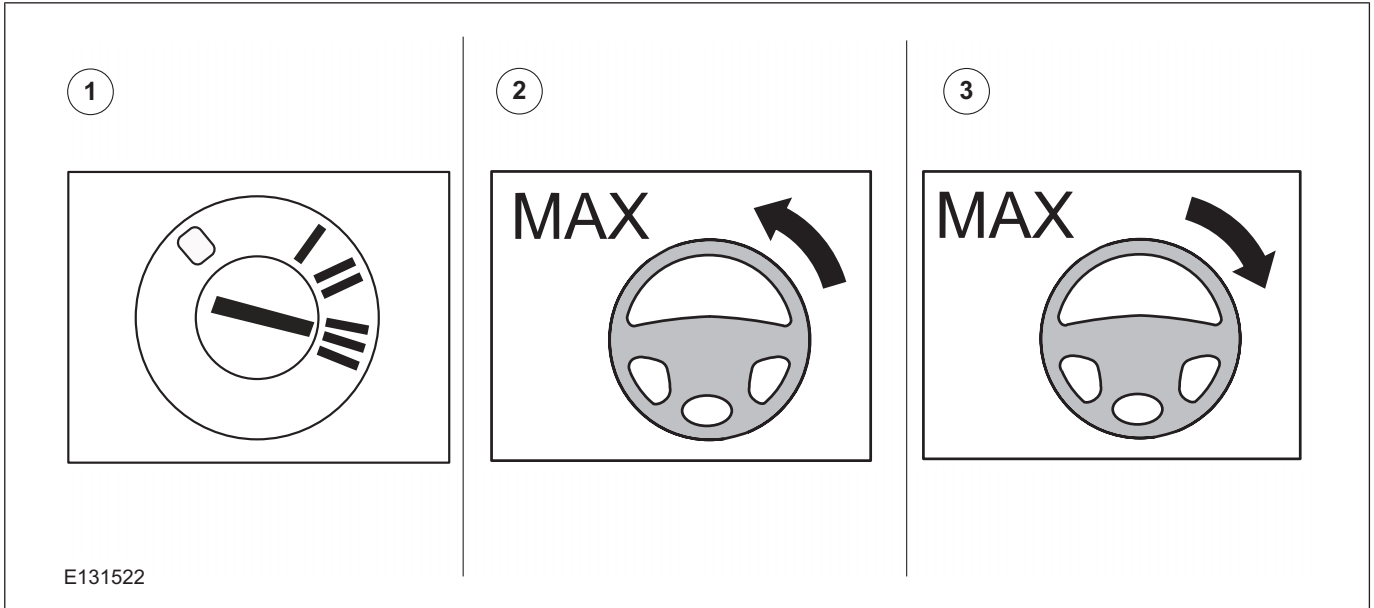
5. **NOTE:** Make sure the fluid in the reservoir does not fall below the MIN mark, as air could enter the system.

Slowly turn the steering wheel from lock to lock five times.

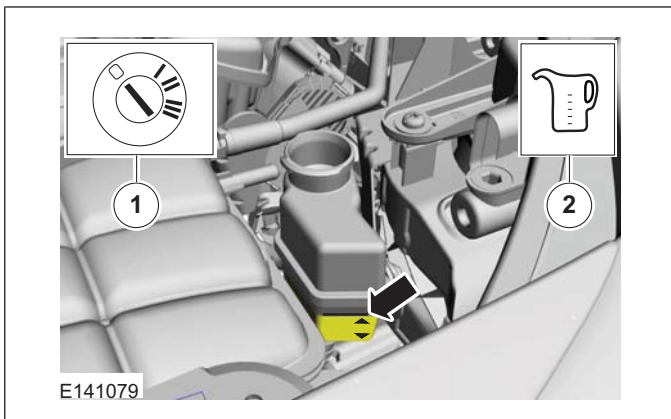




REMOVAL AND INSTALLATION



6.



7.



211-02-18

Power Steering

211-02-18

## REMOVAL AND INSTALLATION

Power Steering Pump — 2.5L Duratec (147kW/200PS) -  
VI5(13 434 0)

## General Equipment

Hose Clamp(s)

Hose Clamp Remover/Installer

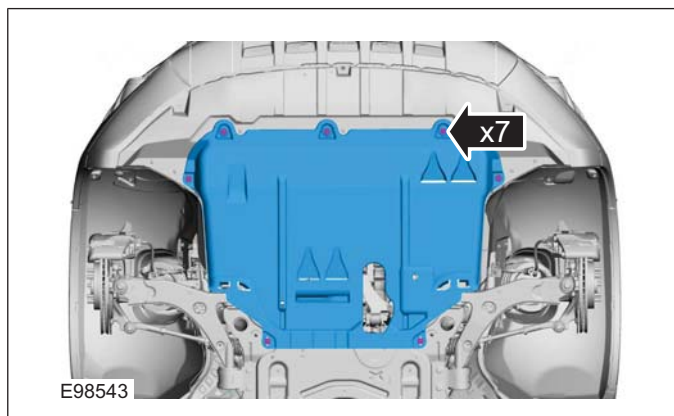
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

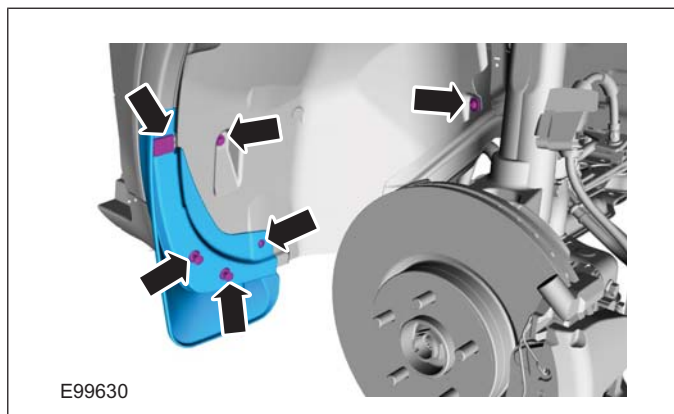
1. Refer to: **Steering System Health and Safety Precautions** (100-00 General Information, Description and Operation).

2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

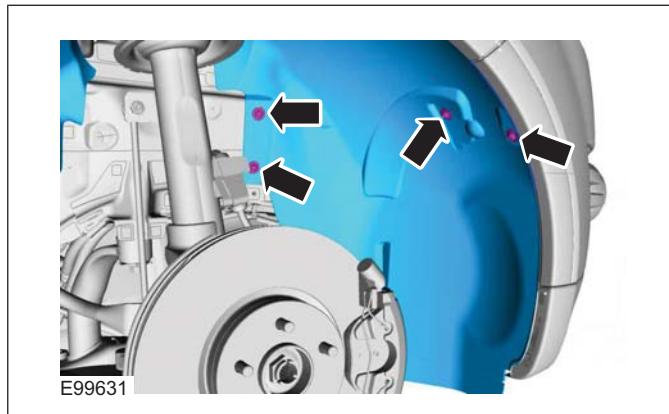
3.



4.



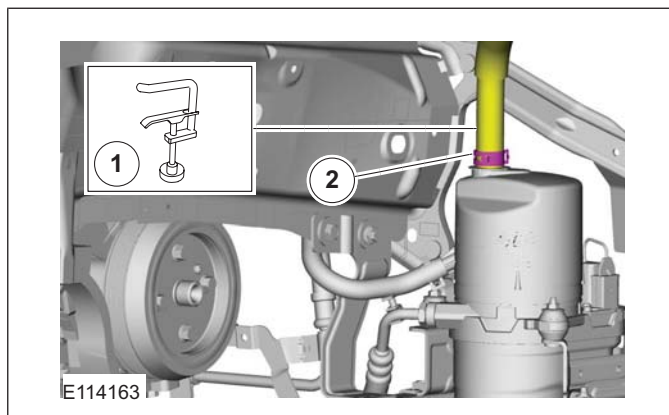
5.



6. 1. **WARNING: Be prepared to collect escaping fluid.**

General Equipment: Hose Clamp(s)

2. General Equipment: Hose Clamp Remover/Installer



7. 1. **WARNING: Be prepared to collect escaping fluid.**

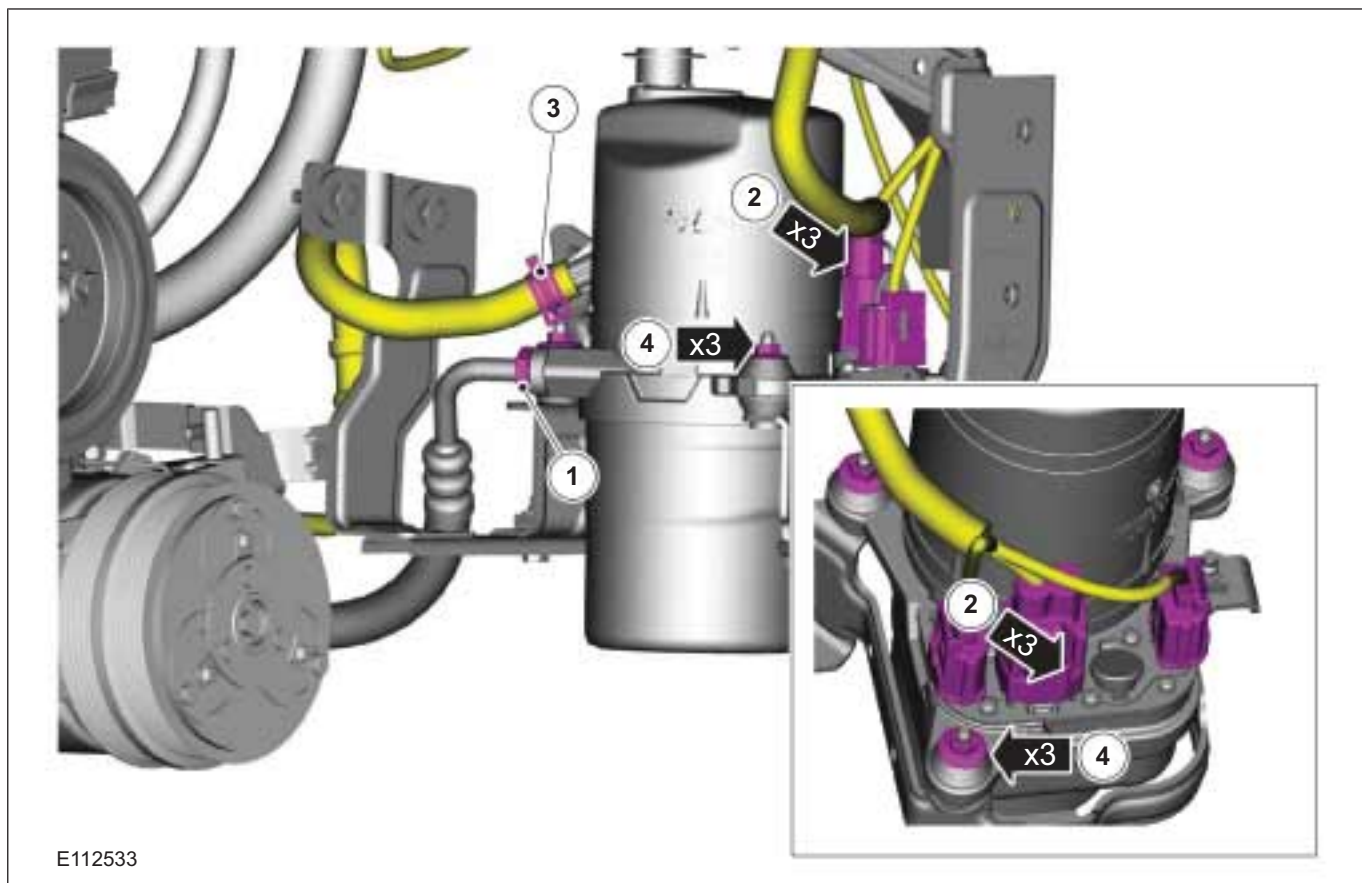
Torque: 30 Nm

3. General Equipment: Hose Clamp Remover/Installer

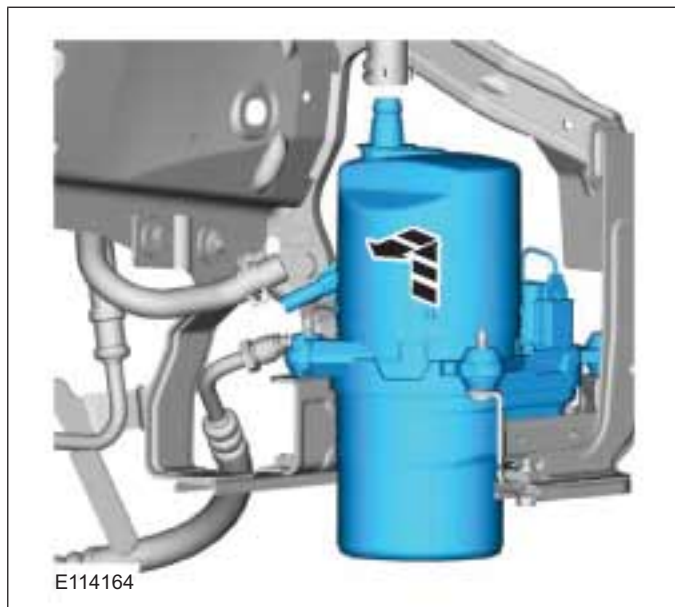
4. Torque: 10 Nm



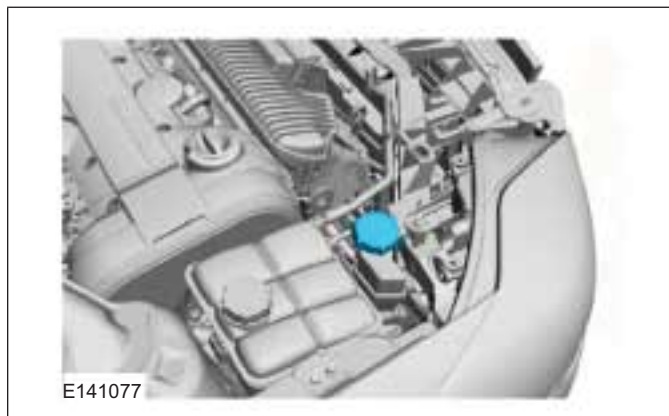
REMOVAL AND INSTALLATION



8.



2.



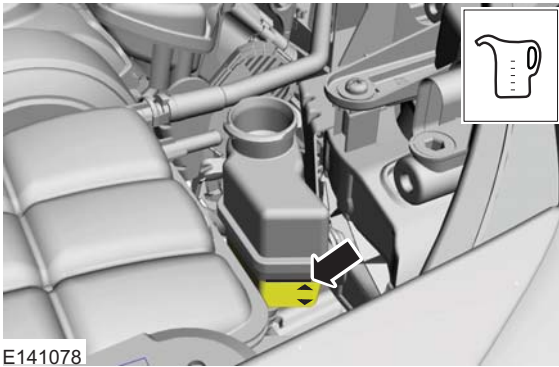
Installation

1. To install, reverse the removal procedure.



REMOVAL AND INSTALLATION

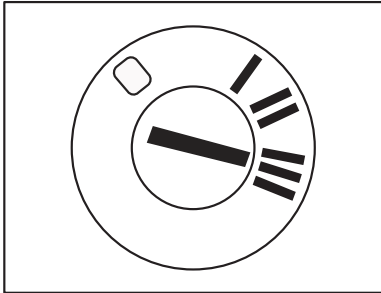
3.



4. **NOTE:** Make sure the fluid in the reservoir does not fall below the MIN mark, as air could enter the system.

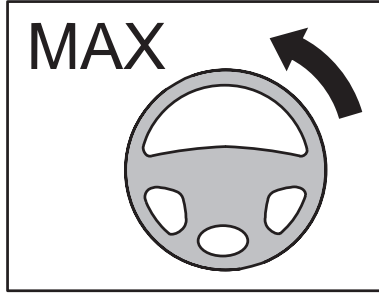
Slowly turn the steering wheel from lock to lock five times.

1

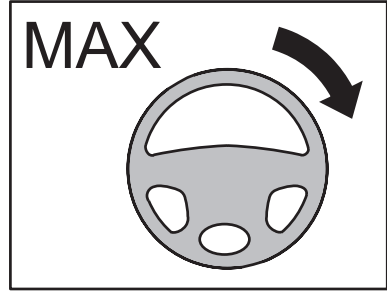


E131522

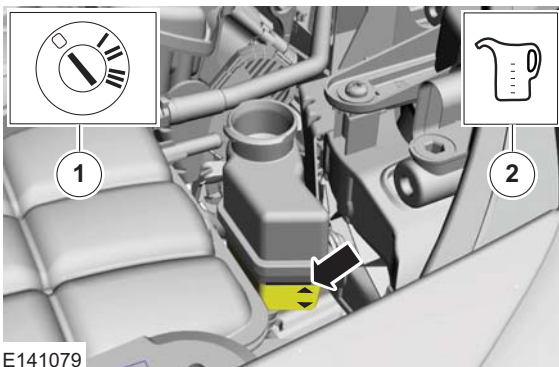
2



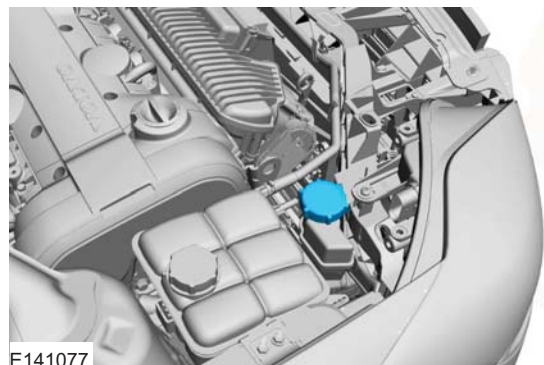
3



5.



6.



211-02-21

Power Steering

211-02-21

## REMOVAL AND INSTALLATION

## Power Steering Pump to Steering Gear Pressure Line — 2.5L Duratec (147kW/200PS) - VI5(13 440 0; 13 443 0)

## General Equipment

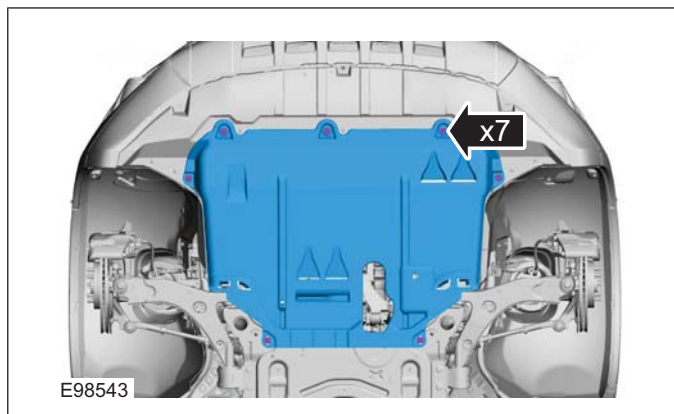
Hose Clamp Remover/Installer

## Removal

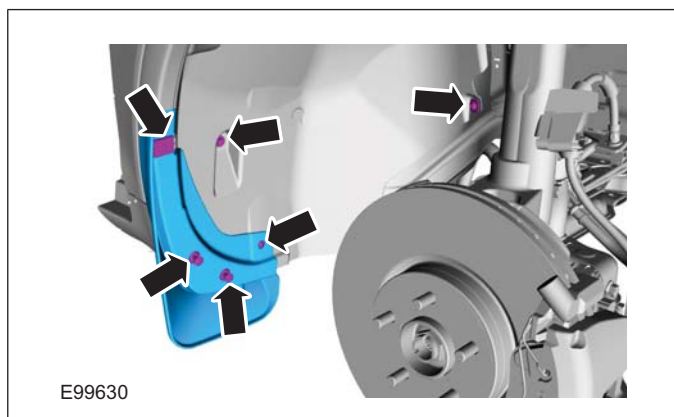
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Steering System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

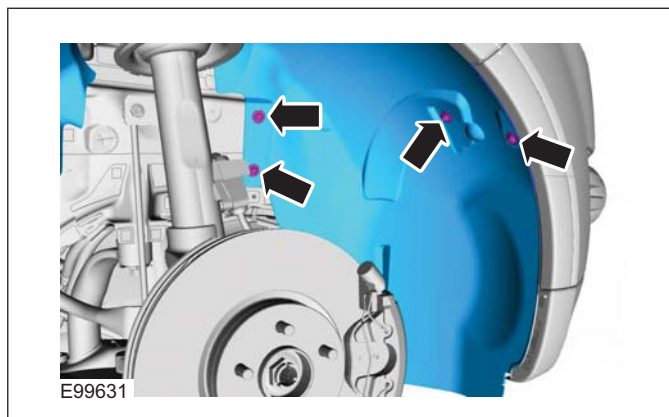
3.



4.

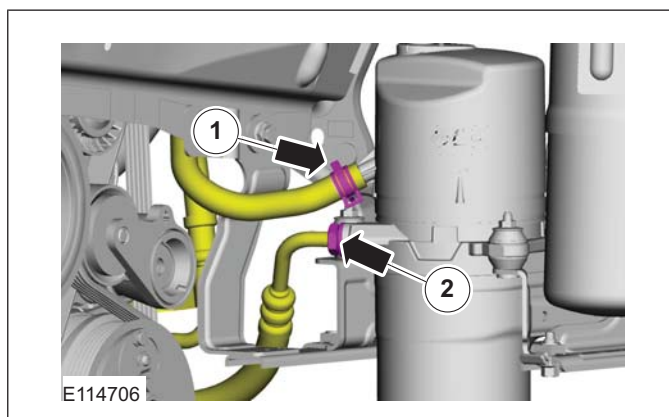


5.



6. **WARNING:** Be prepared to collect escaping fluid.

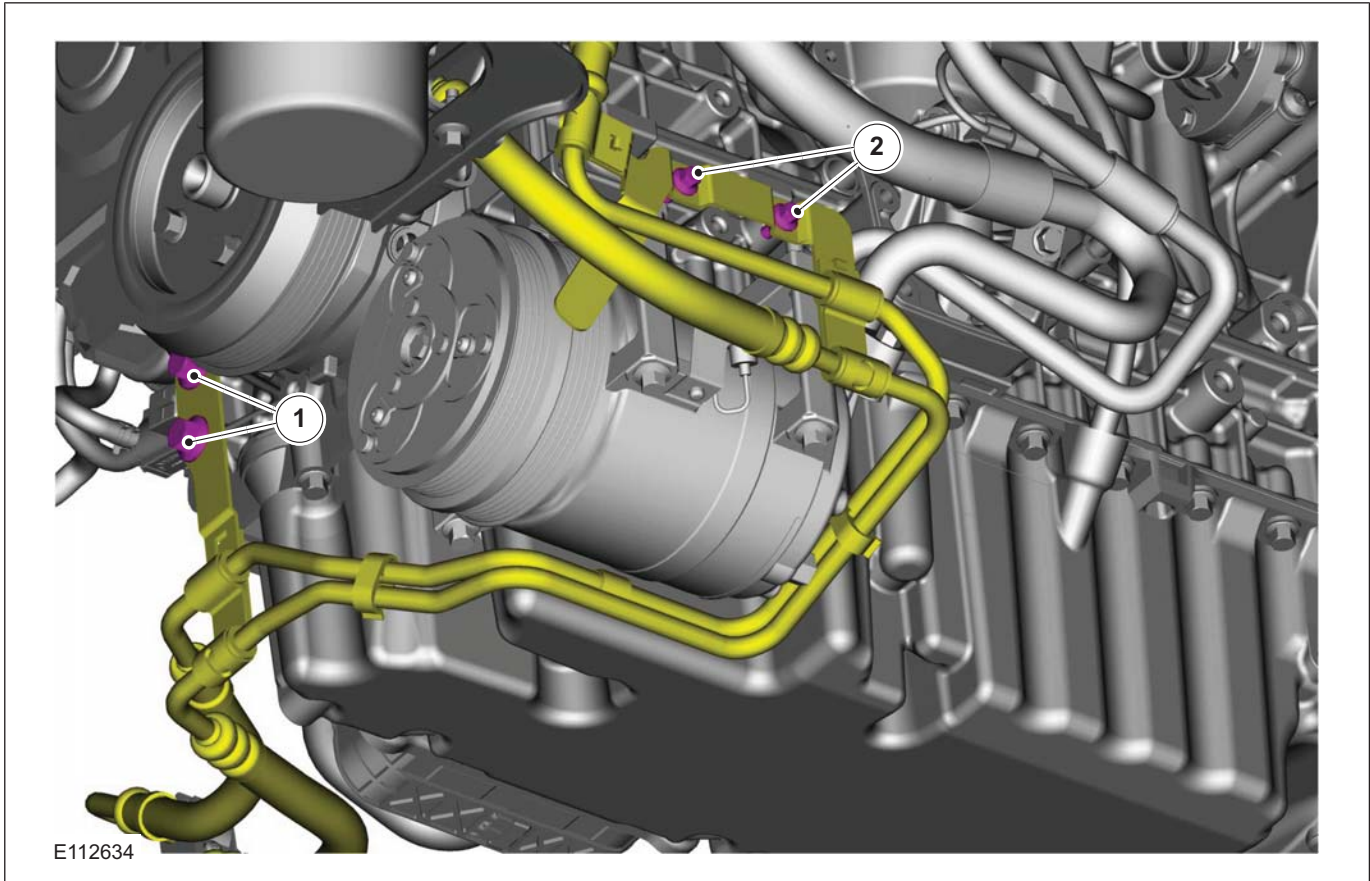
1. General Equipment: Hose Clamp Remover/Installer
2. Torque: 30 Nm



7. 1. Torque: 23 Nm
2. Torque: 7 Nm

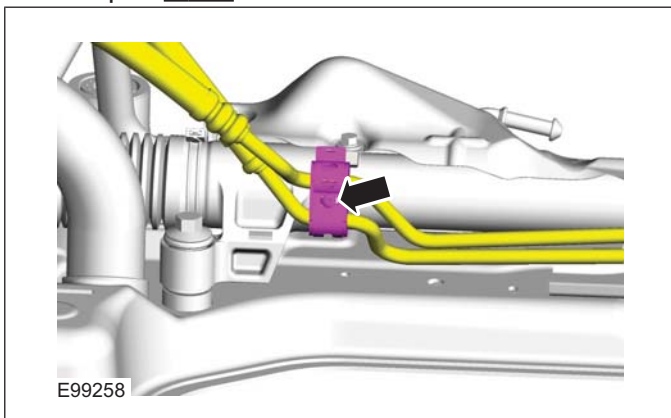


REMOVAL AND INSTALLATION



E112634

8. Torque: 4 Nm

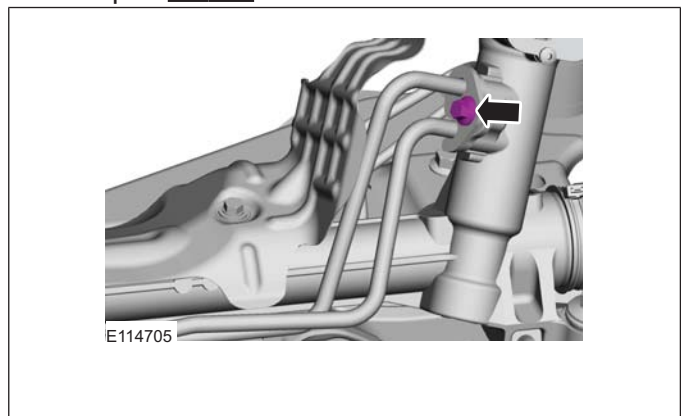


E99258

9. **⚠ WARNING:** Be prepared to collect escaping fluid.

**⚠ CAUTION:** Make sure that all openings are sealed.

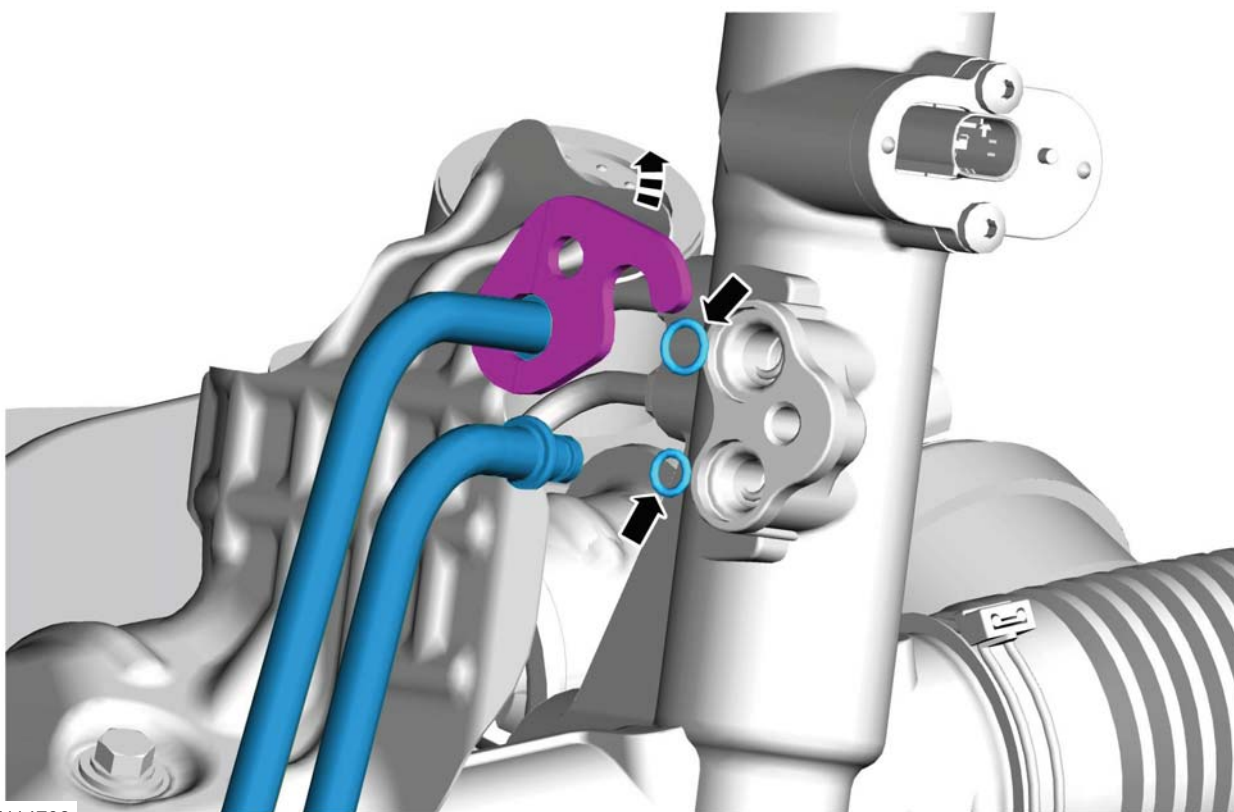
Torque: 18 Nm



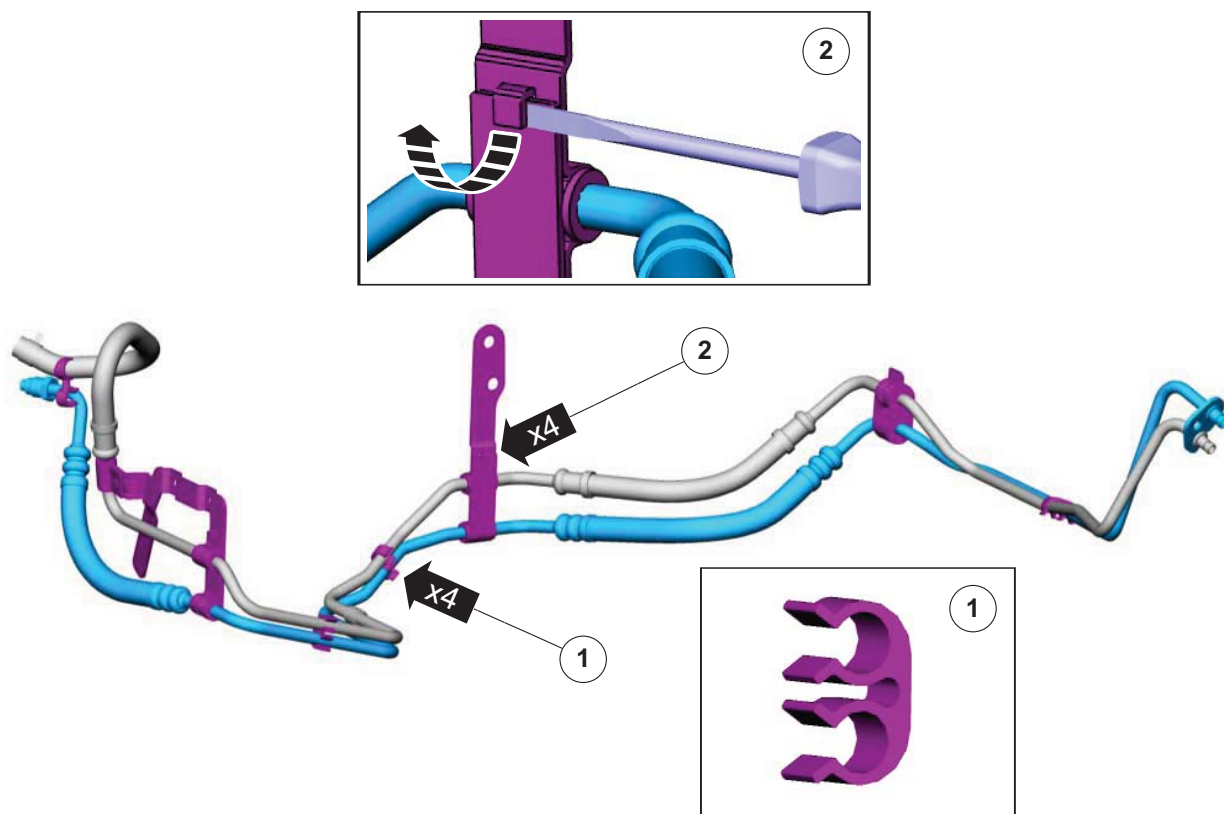
E114705

10.

REMOVAL AND INSTALLATION



11.



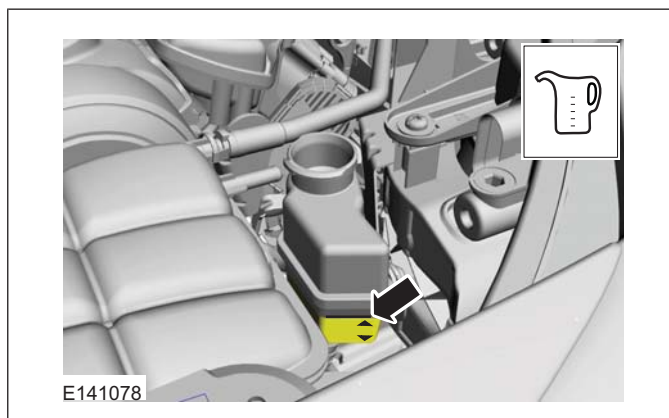
### REMOVAL AND INSTALLATION

#### Installation

1. To install, reverse the removal procedure.
- 2.

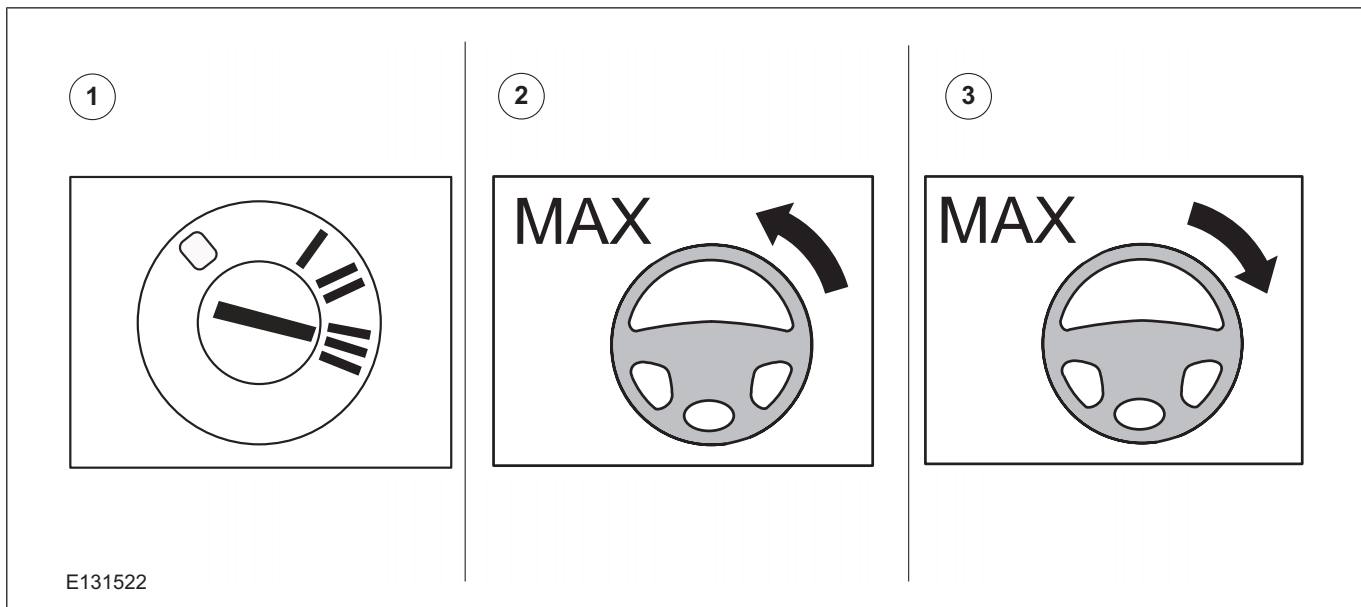


3.

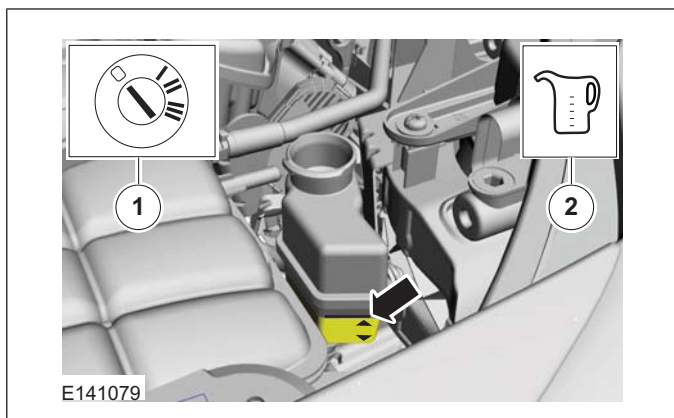


4. **NOTE:** Make sure the fluid in the reservoir does not fall below the MIN mark, as air could enter the system.

Slowly turn the steering wheel from lock to lock five times.



5.



6.

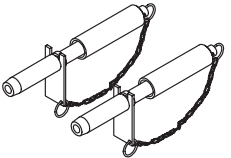
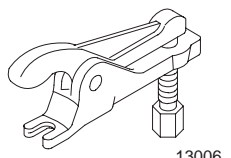




REMOVAL AND INSTALLATION

Steering Gear(13 116 0)

Special Tool(s) / General Equipment

 <p>E93105</p>	<p>205-880 Alignment Pins, Subframe</p>
 <p>13006</p>	<p>211-020 Separator, Ball Joint</p>
<p>Transmission Jack</p>	

Materials

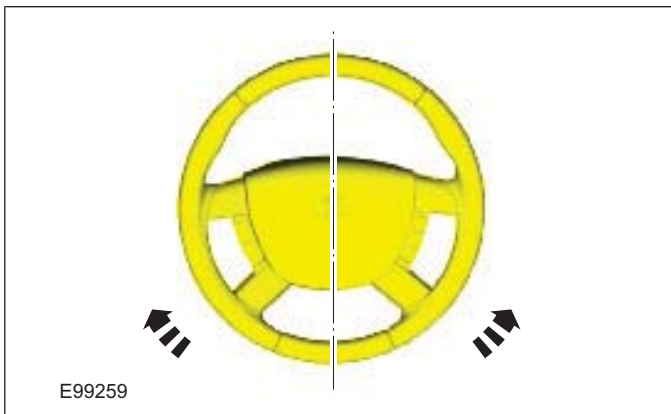
Name	Specification
Power Steering Fluid IW	WSA-M2C195-A / 9U7J-M2C195-AA

Removal

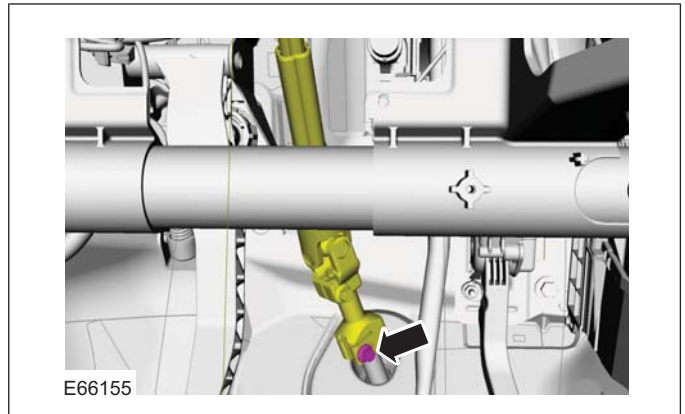
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Steering System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. **CAUTION:** Make sure that the steering wheel lock is engaged.

**NOTE:** Make sure that the road wheels are in the straight ahead position.



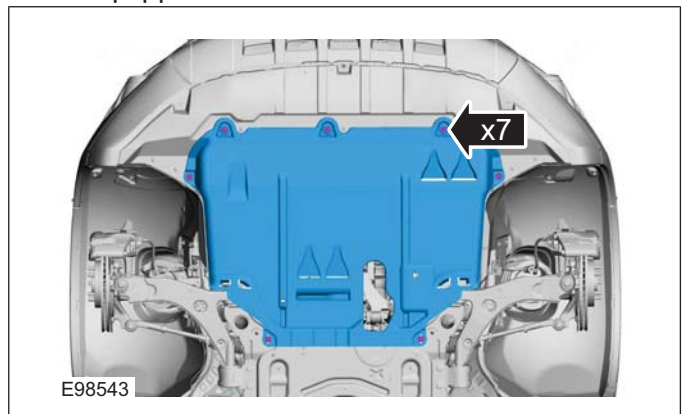
3. Torque: 30 Nm



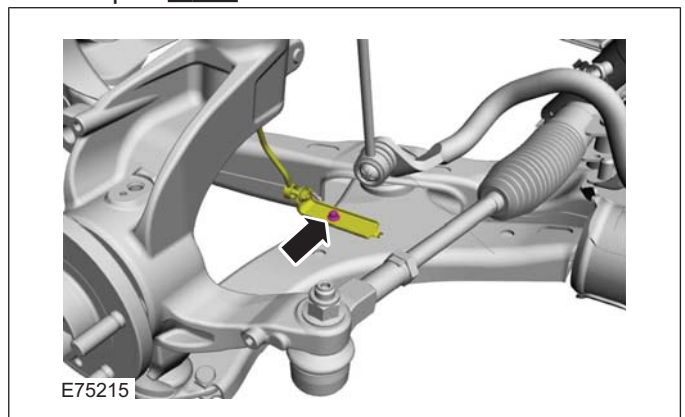
4. On both sides.

Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

5. If equipped.



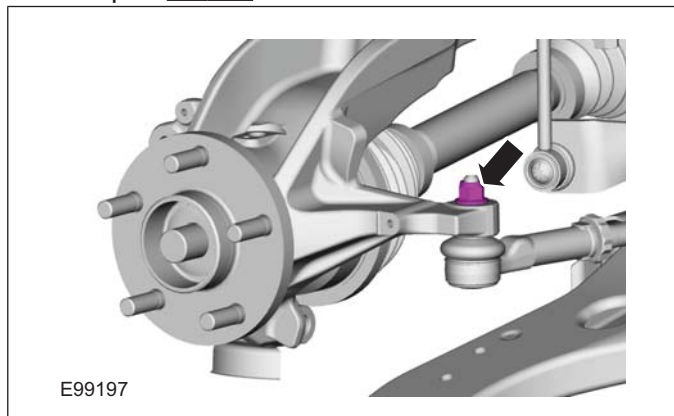
6. If equipped.  
Torque: 8 Nm



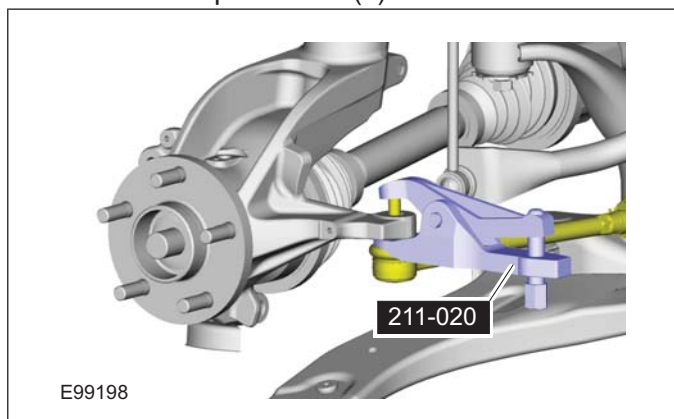
7. **CAUTION:** Make sure that the ball joint ball does not rotate.

REMOVAL AND INSTALLATION

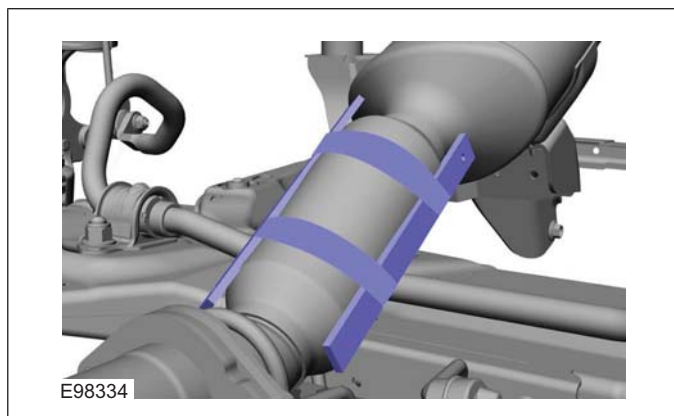
On both sides.  
Torque: 48 Nm



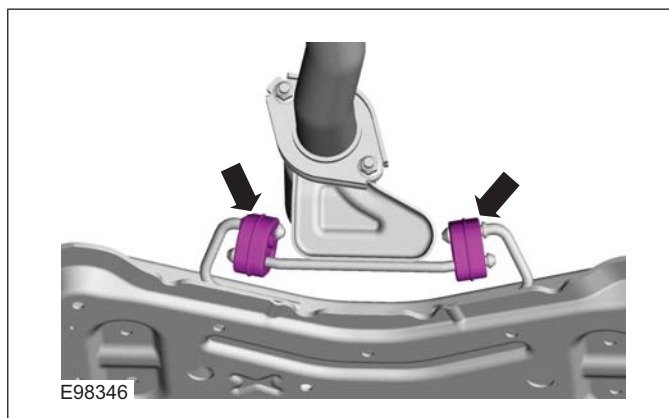
8. On both sides.  
Install the Special Tool(s): 211-020



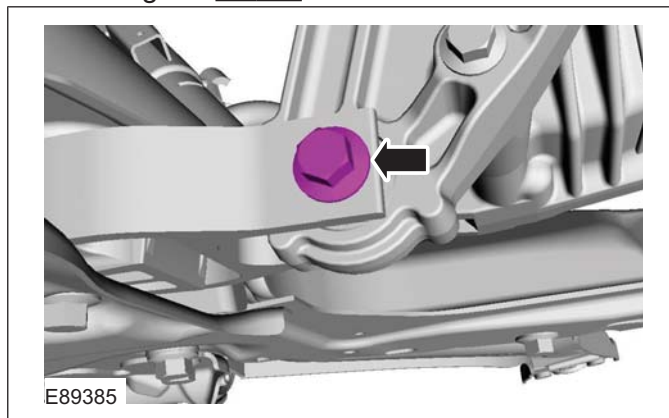
9. **CAUTION:** Make sure that the exhaust flexible pipe is not forcibly bent.



10.

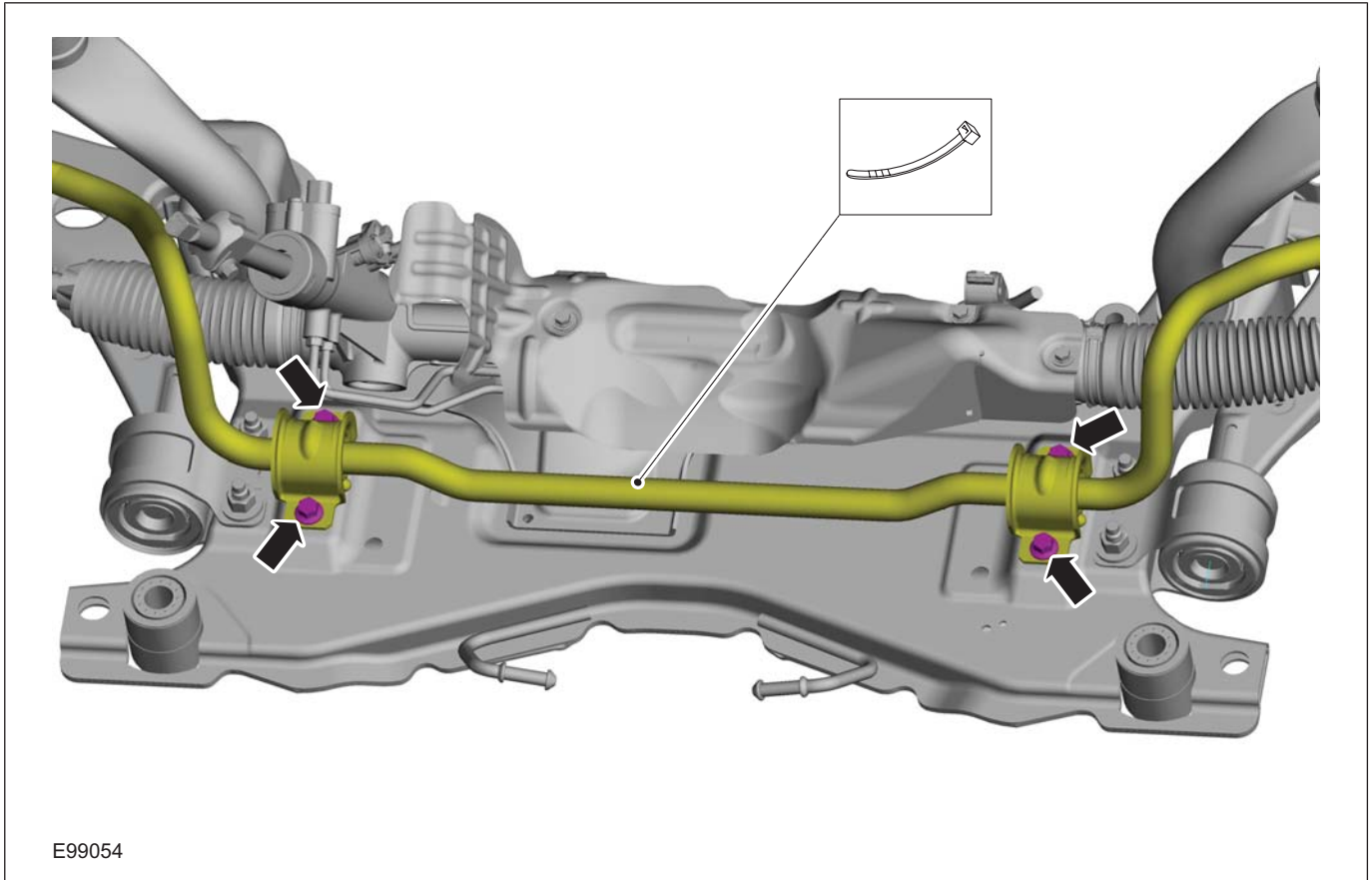


11. Torque:  
• Stage 1: 35 Nm  
• Stage 2: Loosen 360°  
• Stage 3: 85 Nm

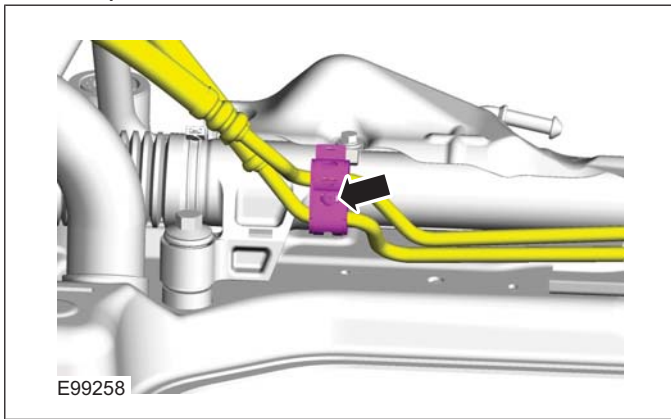


12 Torque: 48 Nm

REMOVAL AND INSTALLATION



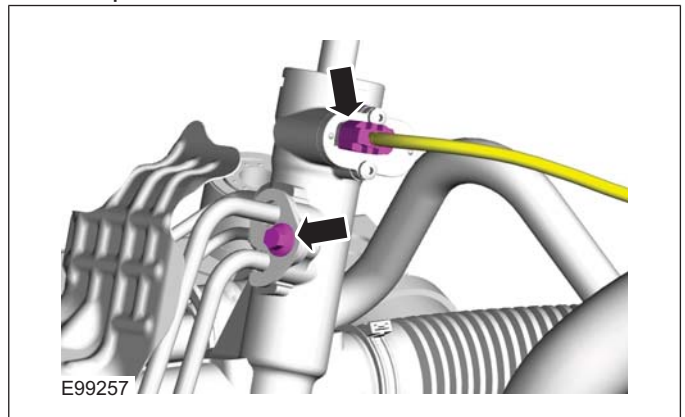
13. Torque: 4 Nm



14. **WARNING:** Be prepared to collect escaping fluid.

**CAUTION:** Make sure that all openings are sealed.

Torque: 20 Nm



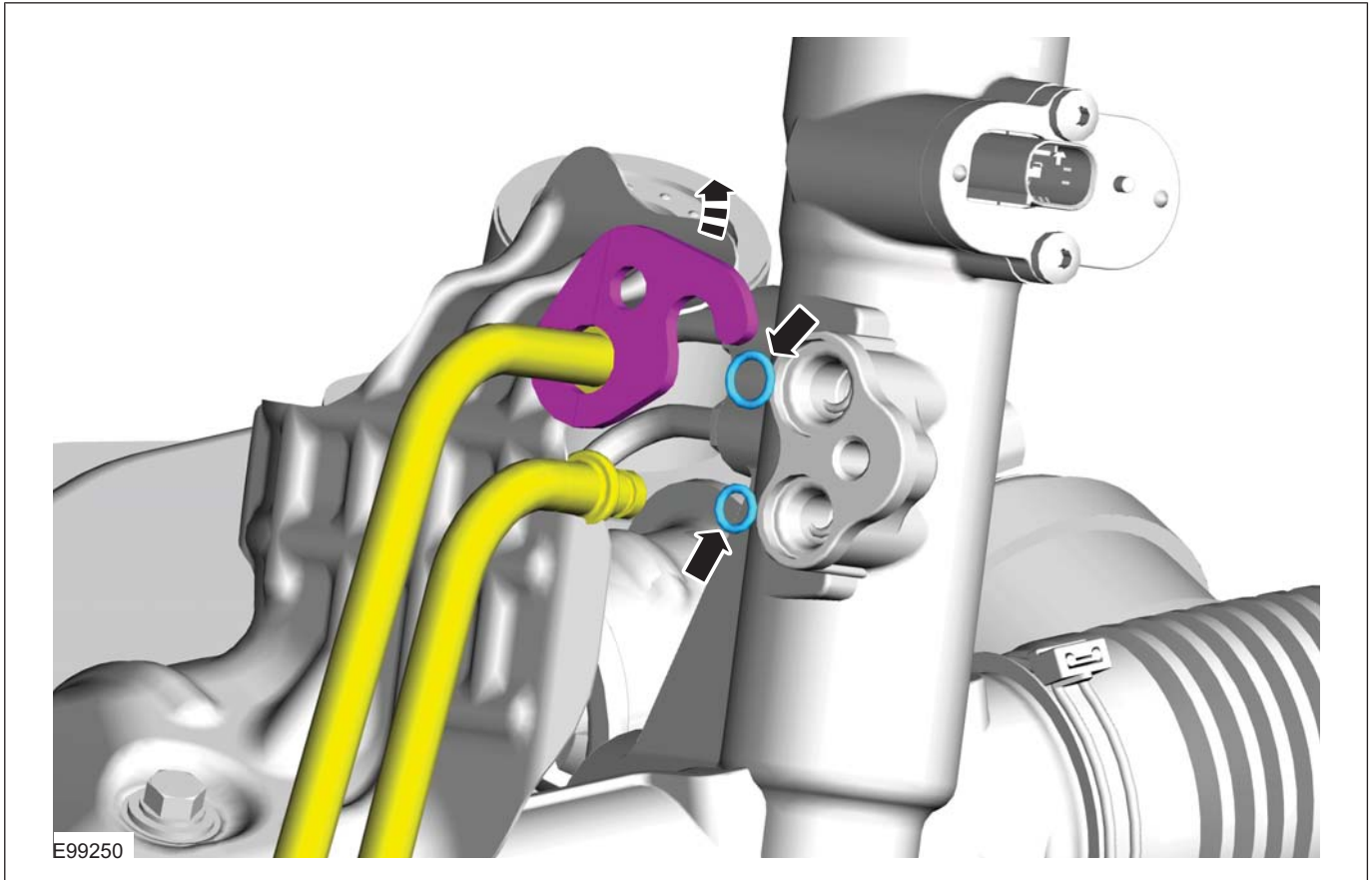
15.

211-02-28

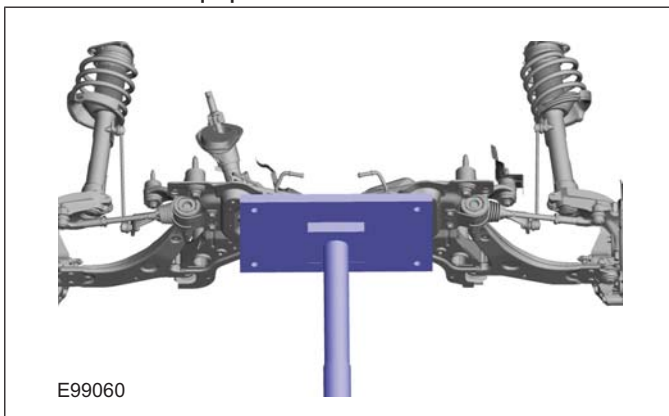
Power Steering

211-02-28

## REMOVAL AND INSTALLATION



## 16. General Equipment: Transmission Jack



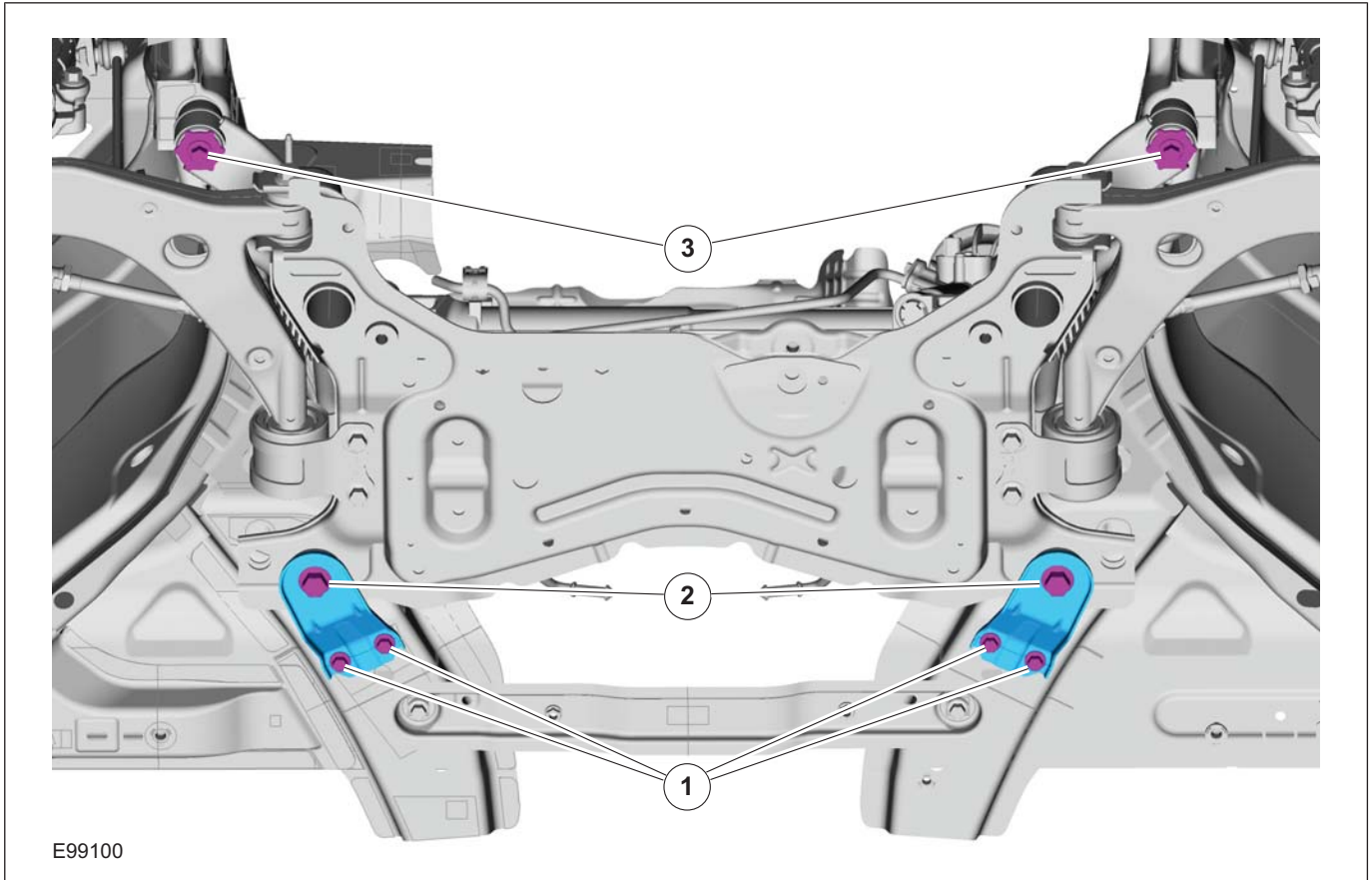
## 17. Remove the following items:

1. Torque: 70 Nm
2. Torque:
  - Stage 1: 140 Nm
  - Stage 2: 180°
3. Torque: 125 Nm



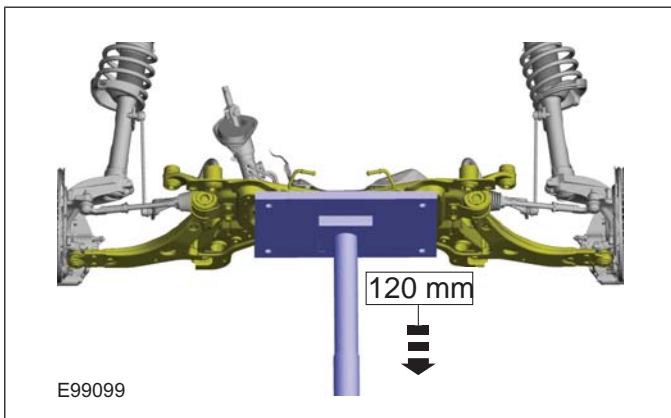


REMOVAL AND INSTALLATION



E99100

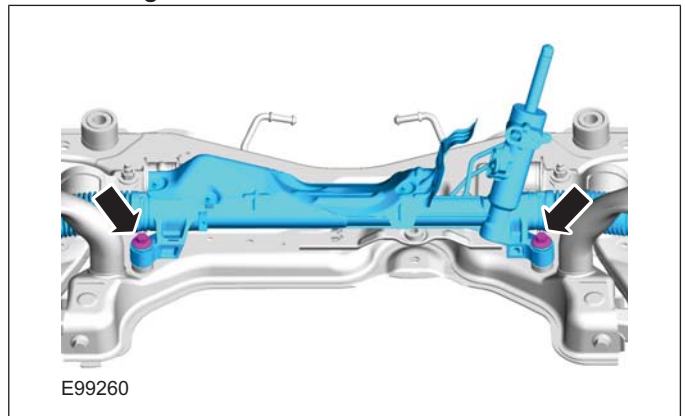
18.



E99099

19. Torque:

- Stage 1: 40 Nm
- Stage 2: 60°



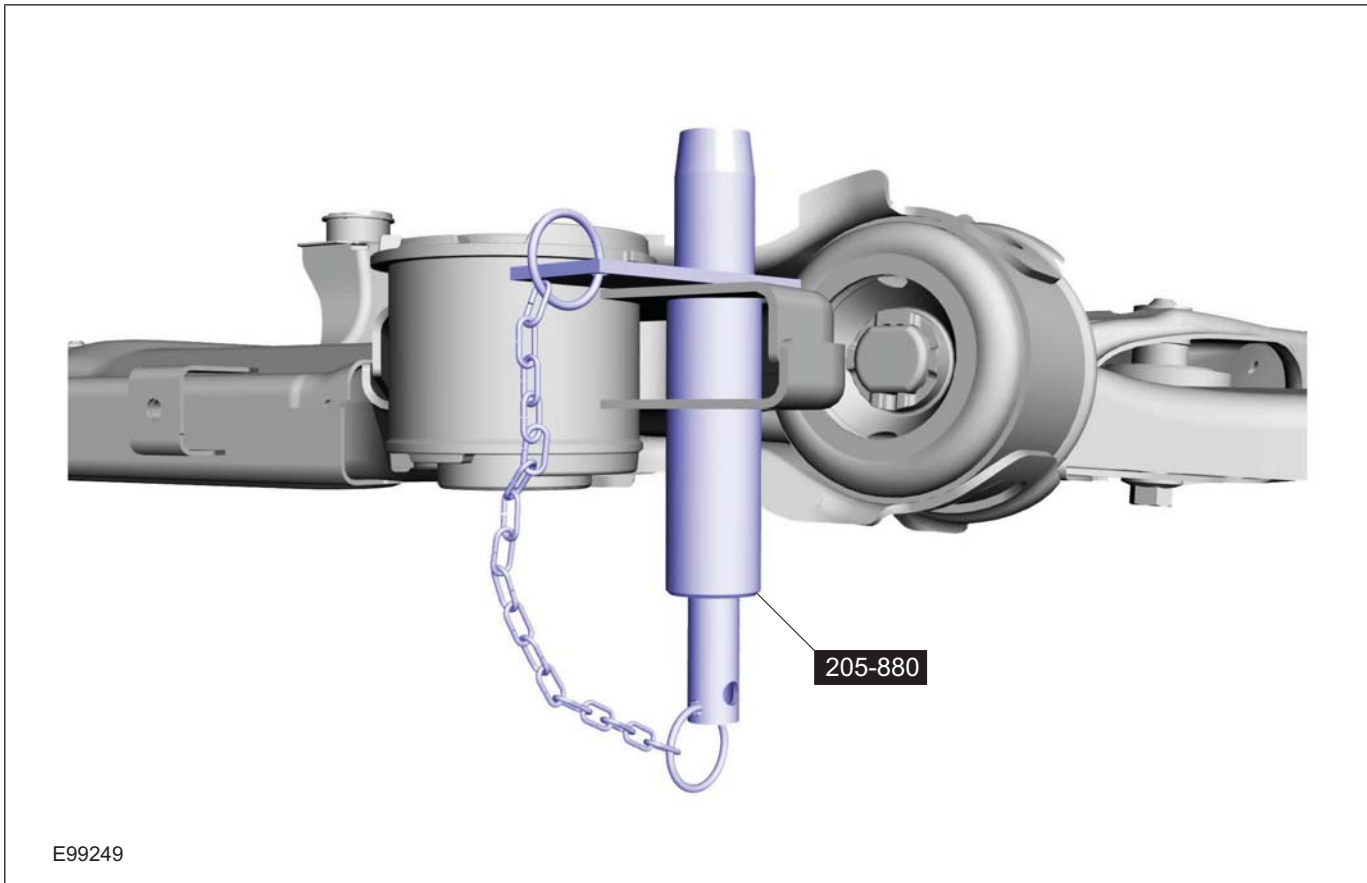
E99260

Installation

1. To install, reverse the removal procedure.
2. Special Tool(s): 205-880

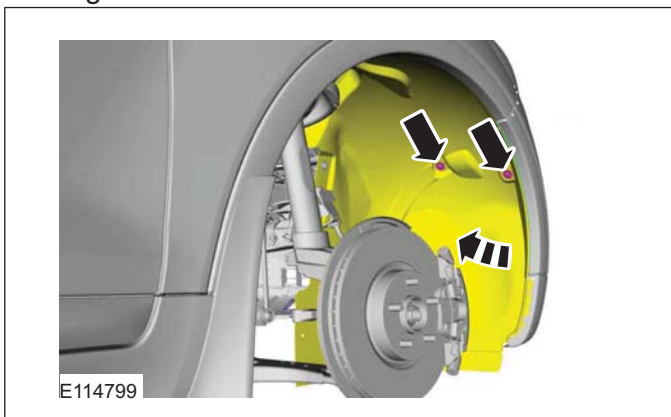


REMOVAL AND INSTALLATION

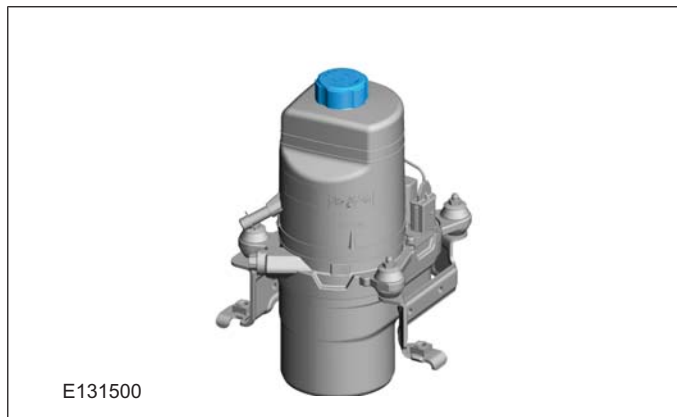


Vehicles with 2.0L engine

3. Right-hand side.



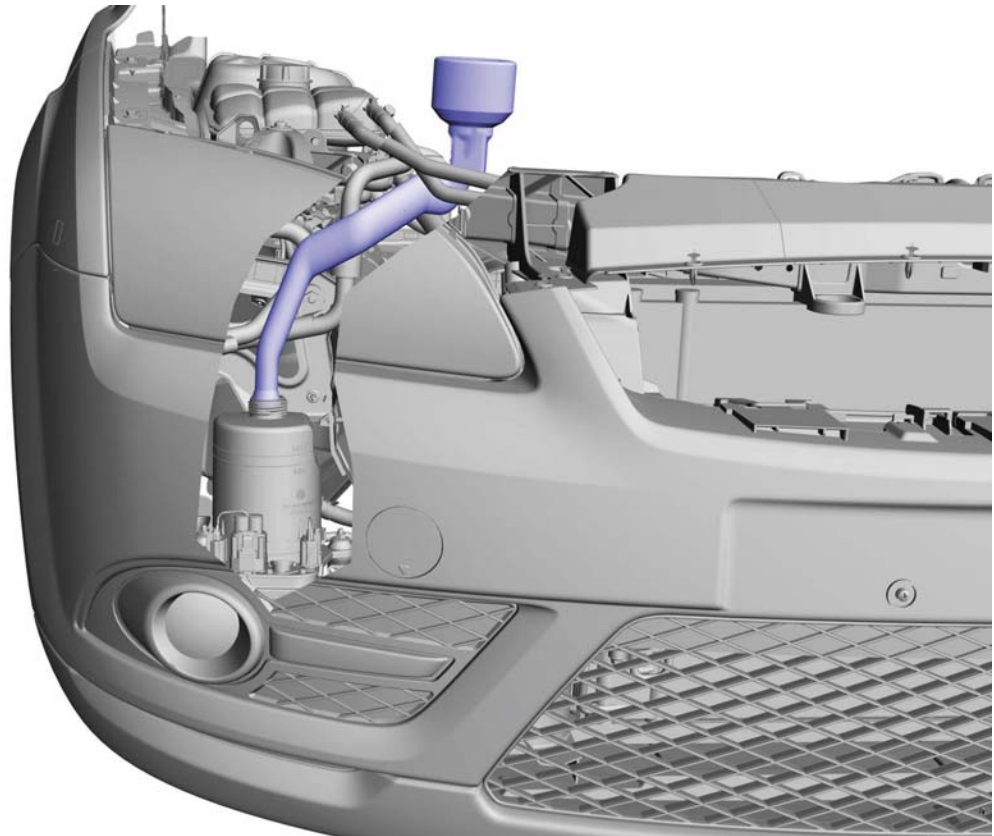
4.



5.



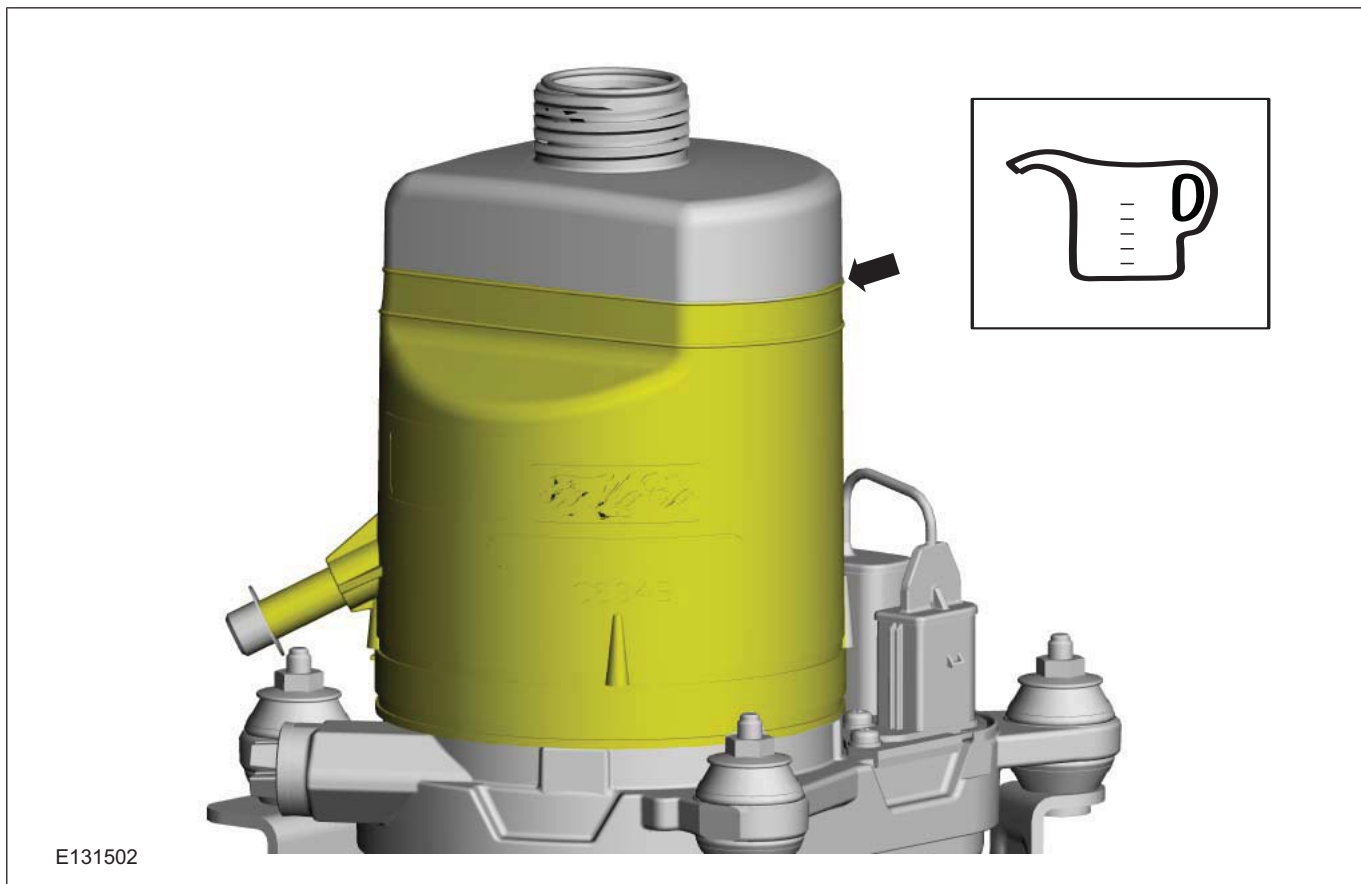
## REMOVAL AND INSTALLATION



E131518

6. Material: Power Steering Fluid IW  
(WSA-M2C195-A / 9U7J-M2C195-AA)  
hydraulic fluid

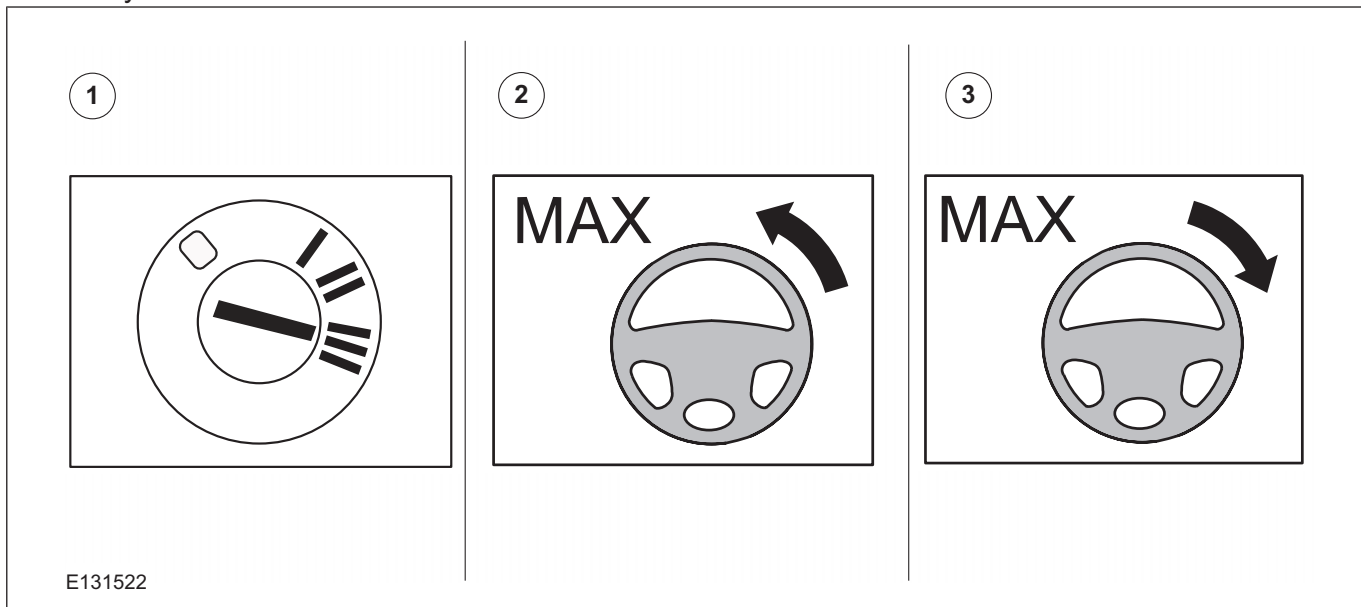
REMOVAL AND INSTALLATION



E131502

7. **NOTE:** Make sure the fluid in the reservoir does not fall below the MIN mark, as air could enter the system.

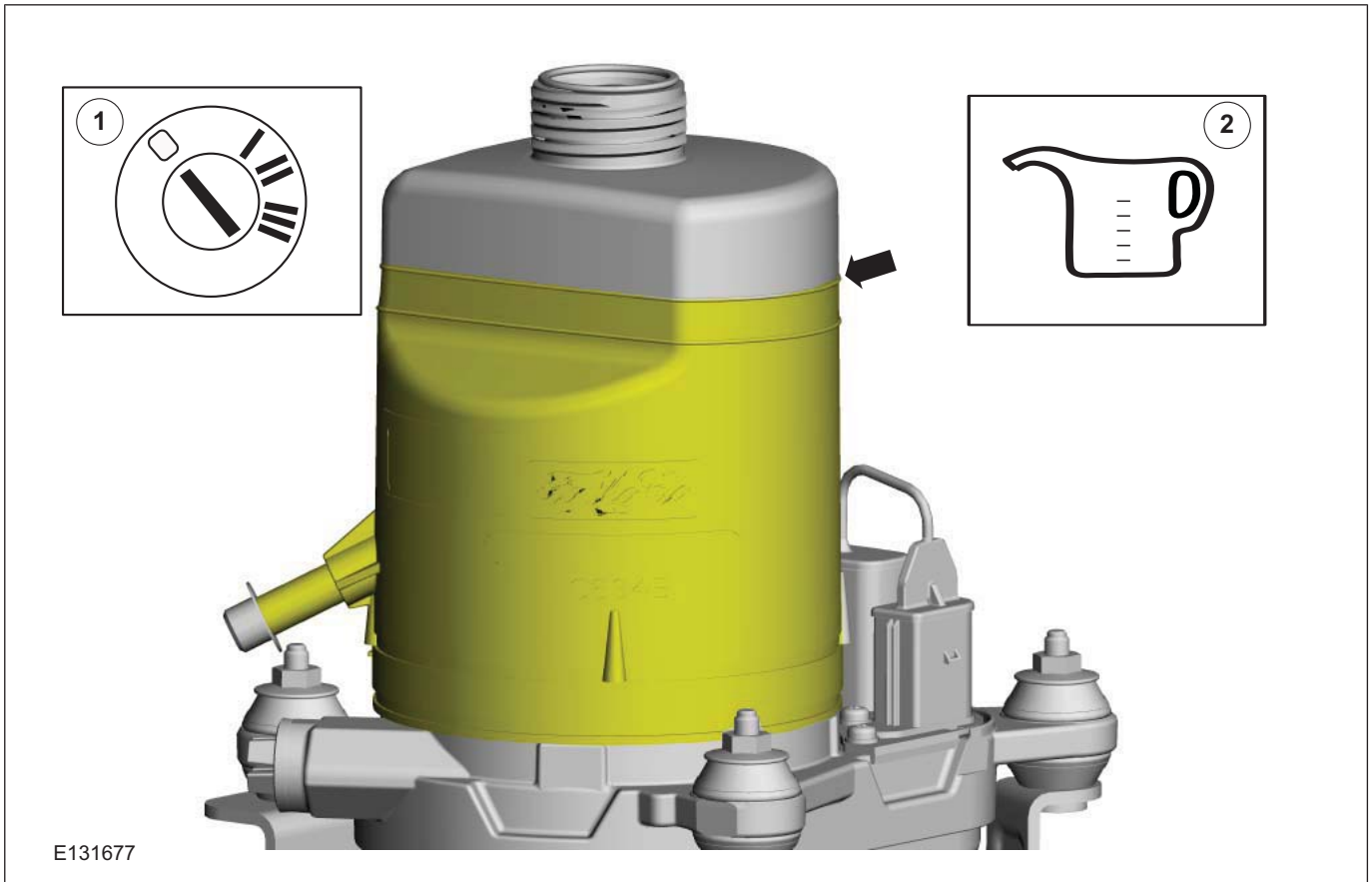
Slowly turn the steering wheel from lock to lock five times.



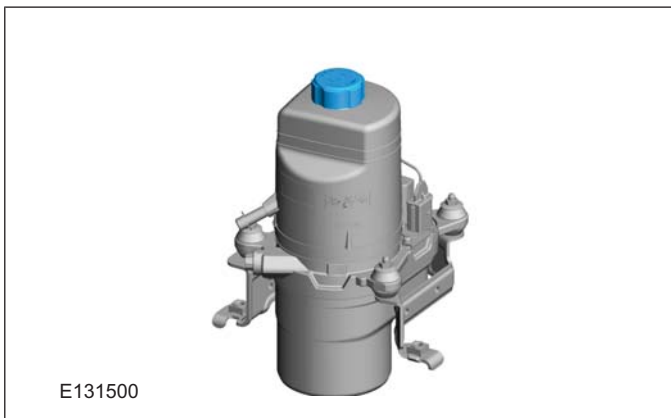
E131522

8. Material: Power Steering Fluid IW  
(WSA-M2C195-A / 9U7J-M2C195-AA)  
hydraulic fluid

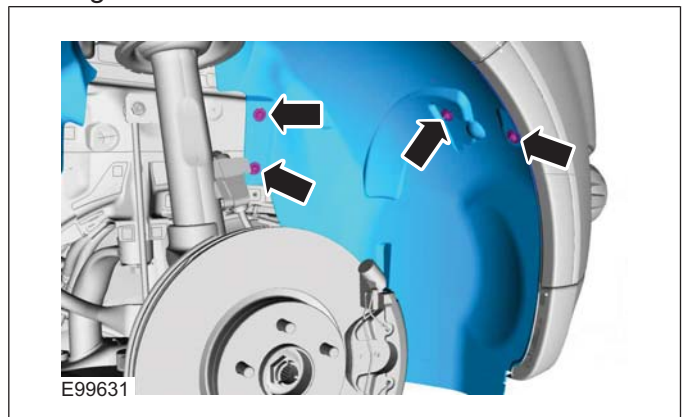
REMOVAL AND INSTALLATION



9.



10. Right-hand side.



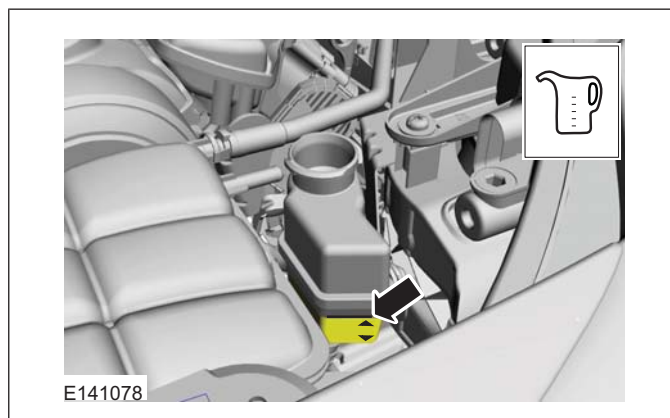
REMOVAL AND INSTALLATION

Vehicles with 2.5L engine

11.

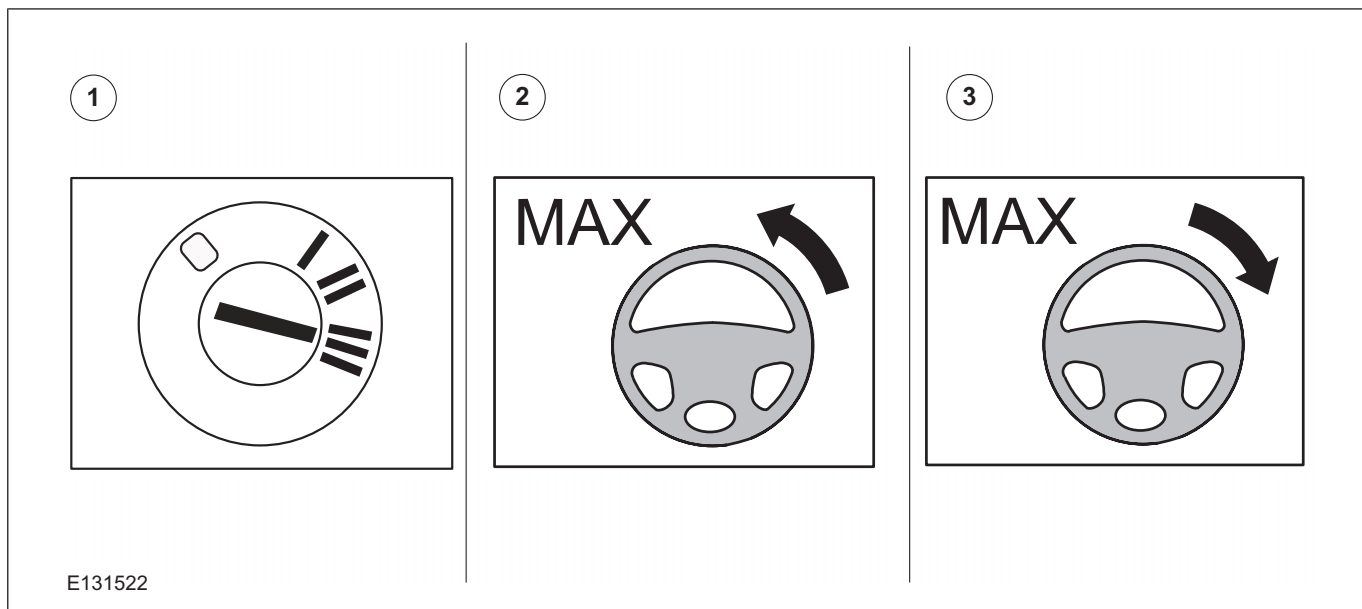


12.

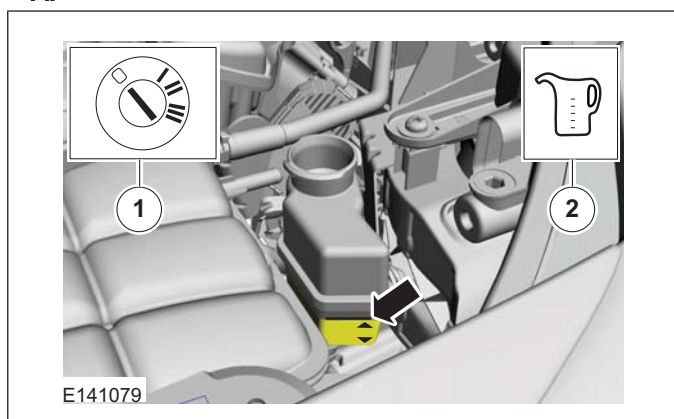


13. **NOTE:** Make sure the fluid in the reservoir does not fall below the MIN mark, as air could enter the system.

Slowly turn the steering wheel from lock to lock five times.



14.



15.



**211-02-35****Power Steering****211-02-35**

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**REMOVAL AND INSTALLATION**

All vehicles

16. Refer to: **Front Toe Adjustment** (204-00 Suspension System - General Information, General Procedures).



211-02-36

Power Steering

211-02-36

## REMOVAL AND INSTALLATION

Steering Gear to Power Steering Fluid Reservoir Return Line —  
2.5L Duratec (147kW/200PS) - VI5(13 439 0)

## General Equipment

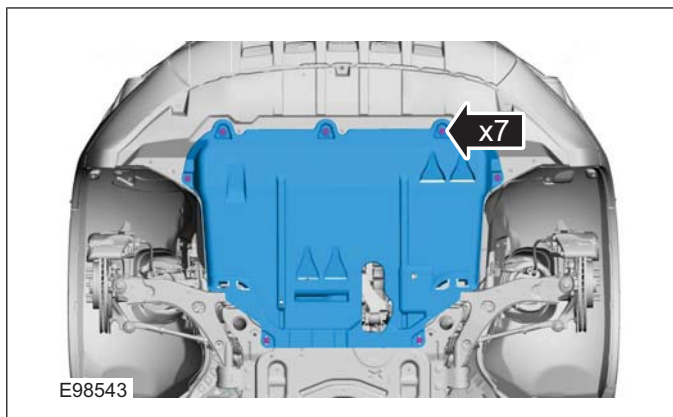
Hose Clamp Remover/Installer

## Removal

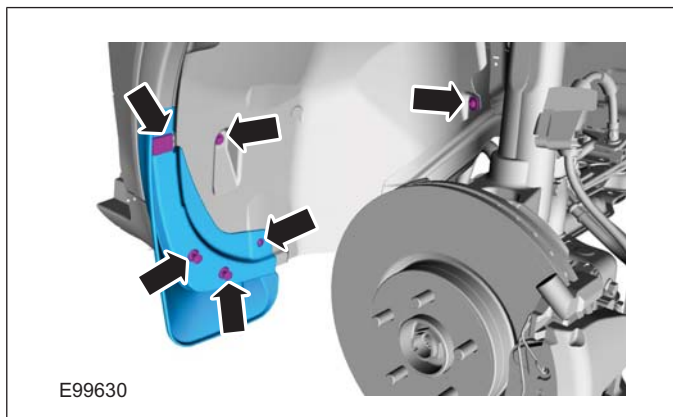
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Steering System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

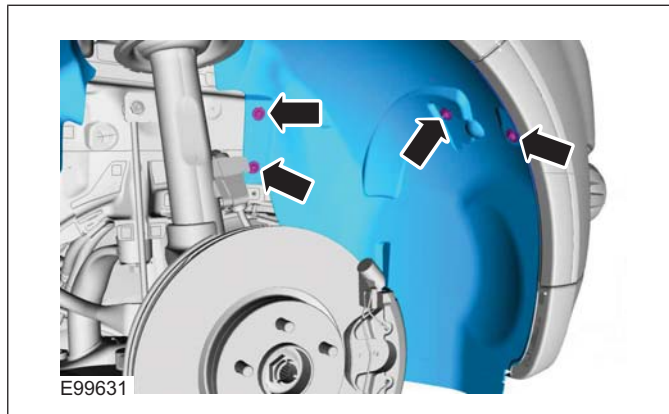
3.



4.

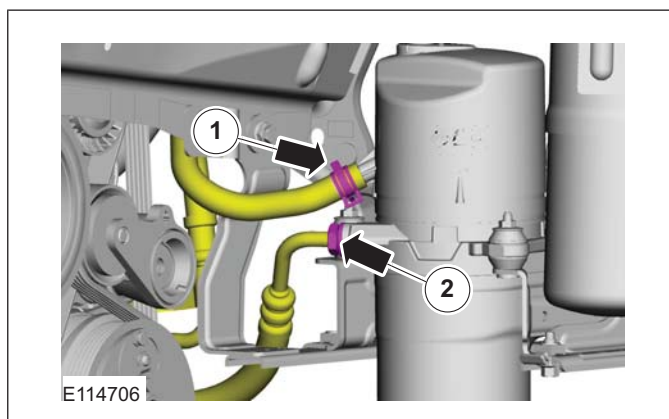


5.



6. **WARNING:** Be prepared to collect escaping fluid.

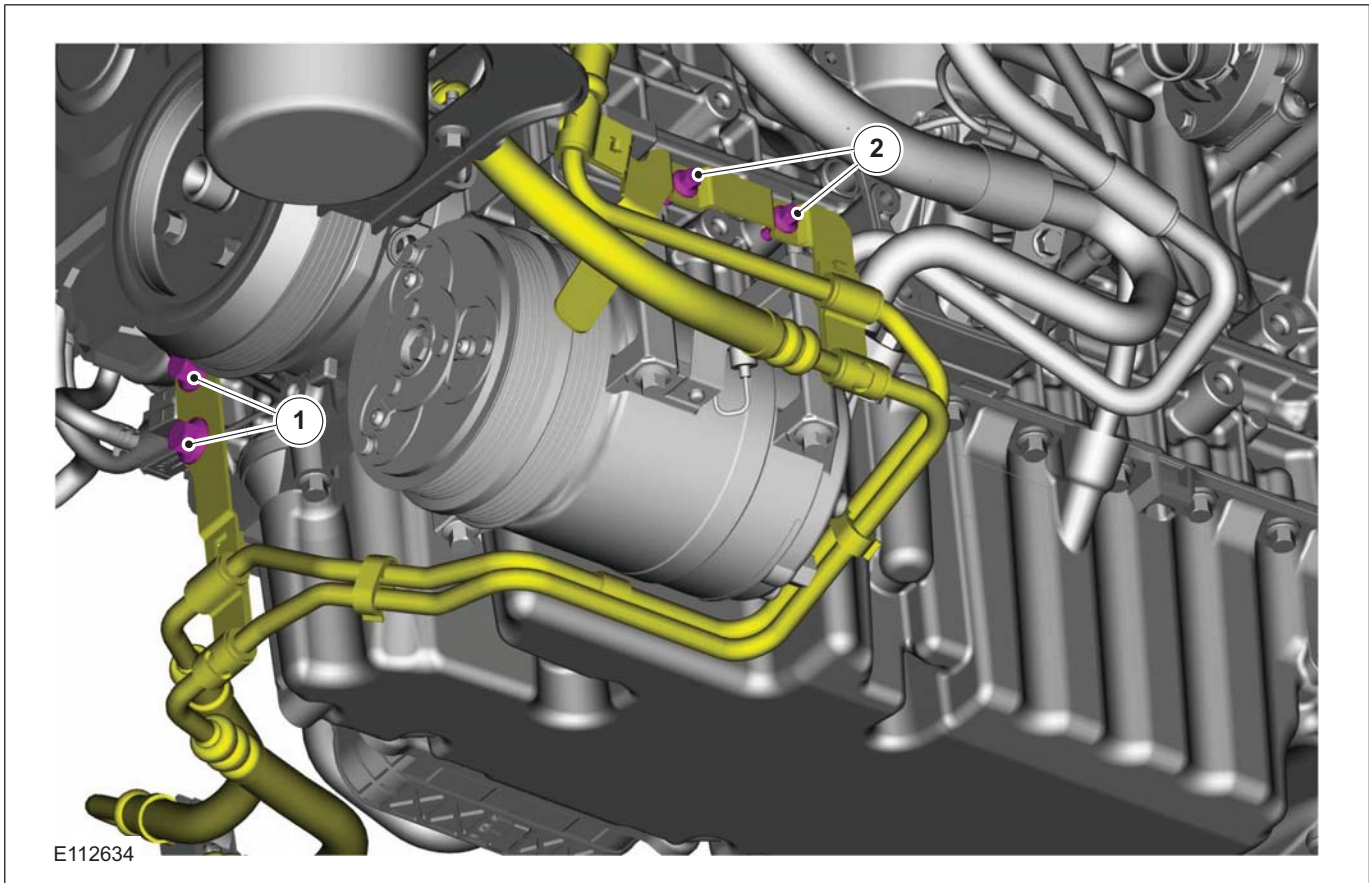
1. General Equipment: Hose Clamp Remover/Installer
2. Torque: 30 Nm



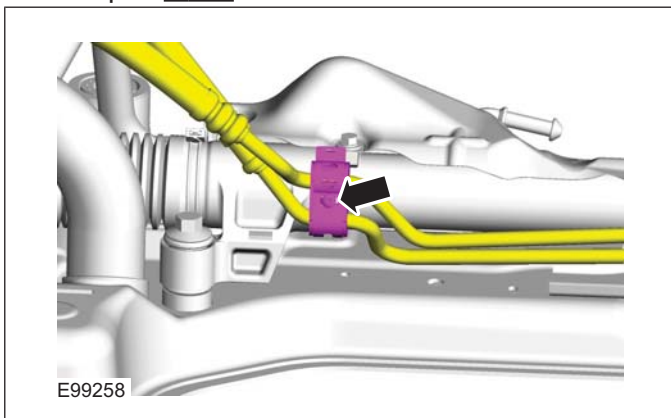
7. 1. Torque: 23 Nm
2. Torque: 7 Nm



REMOVAL AND INSTALLATION



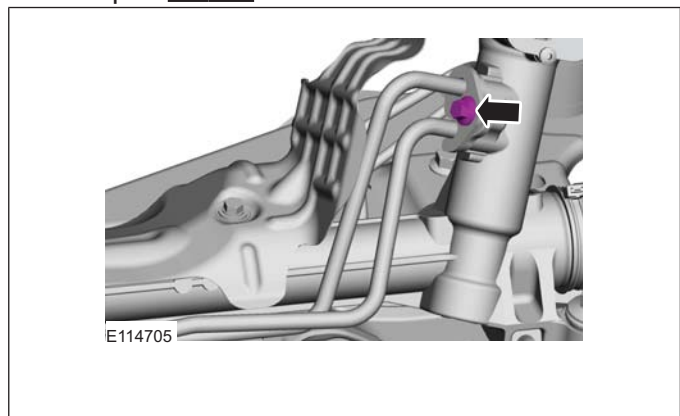
8. Torque: 4 Nm



9. **▲ WARNING:** Be prepared to collect escaping fluid.

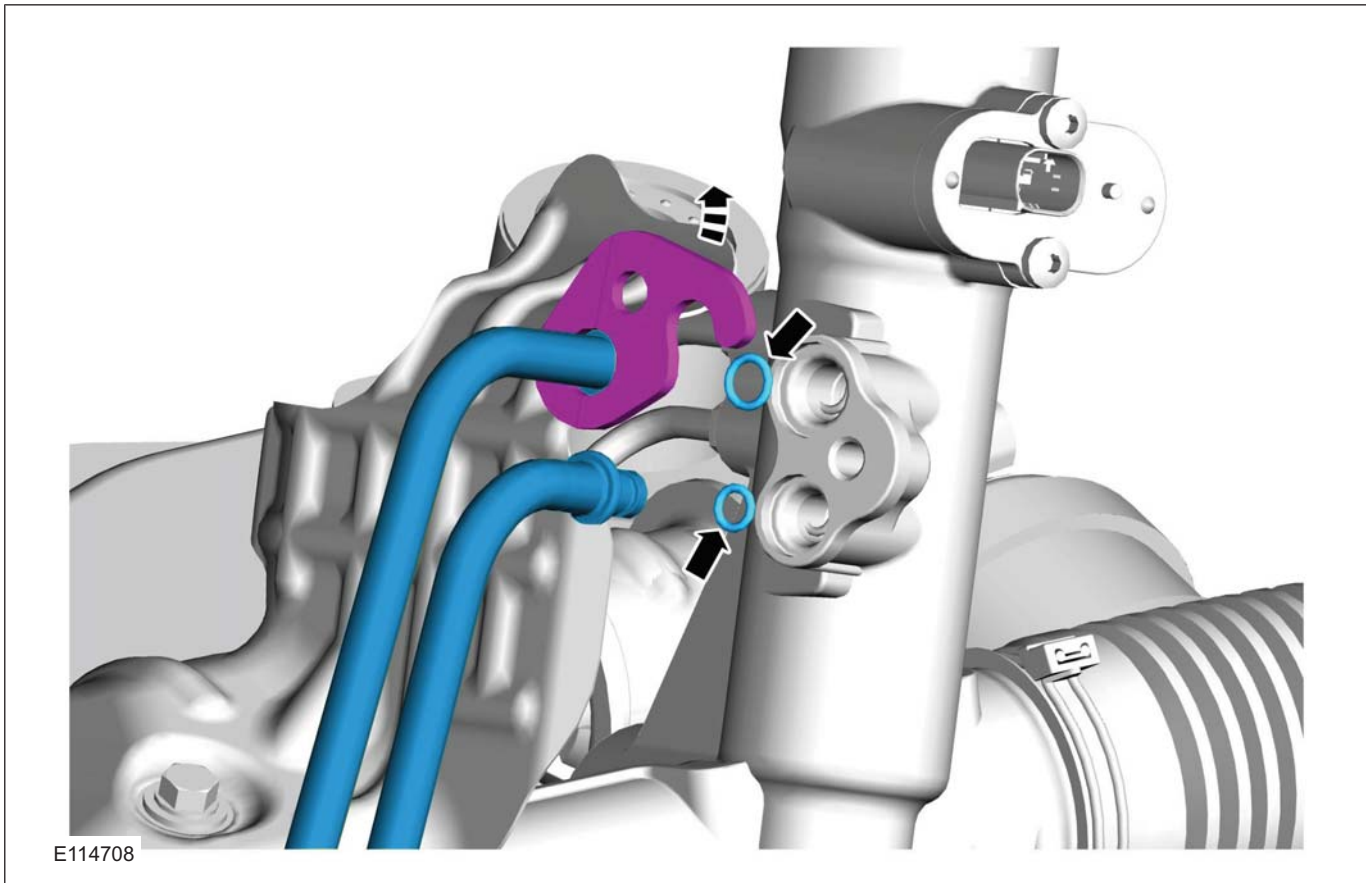
**▲ CAUTION:** Make sure that all openings are sealed.

Torque: 18 Nm

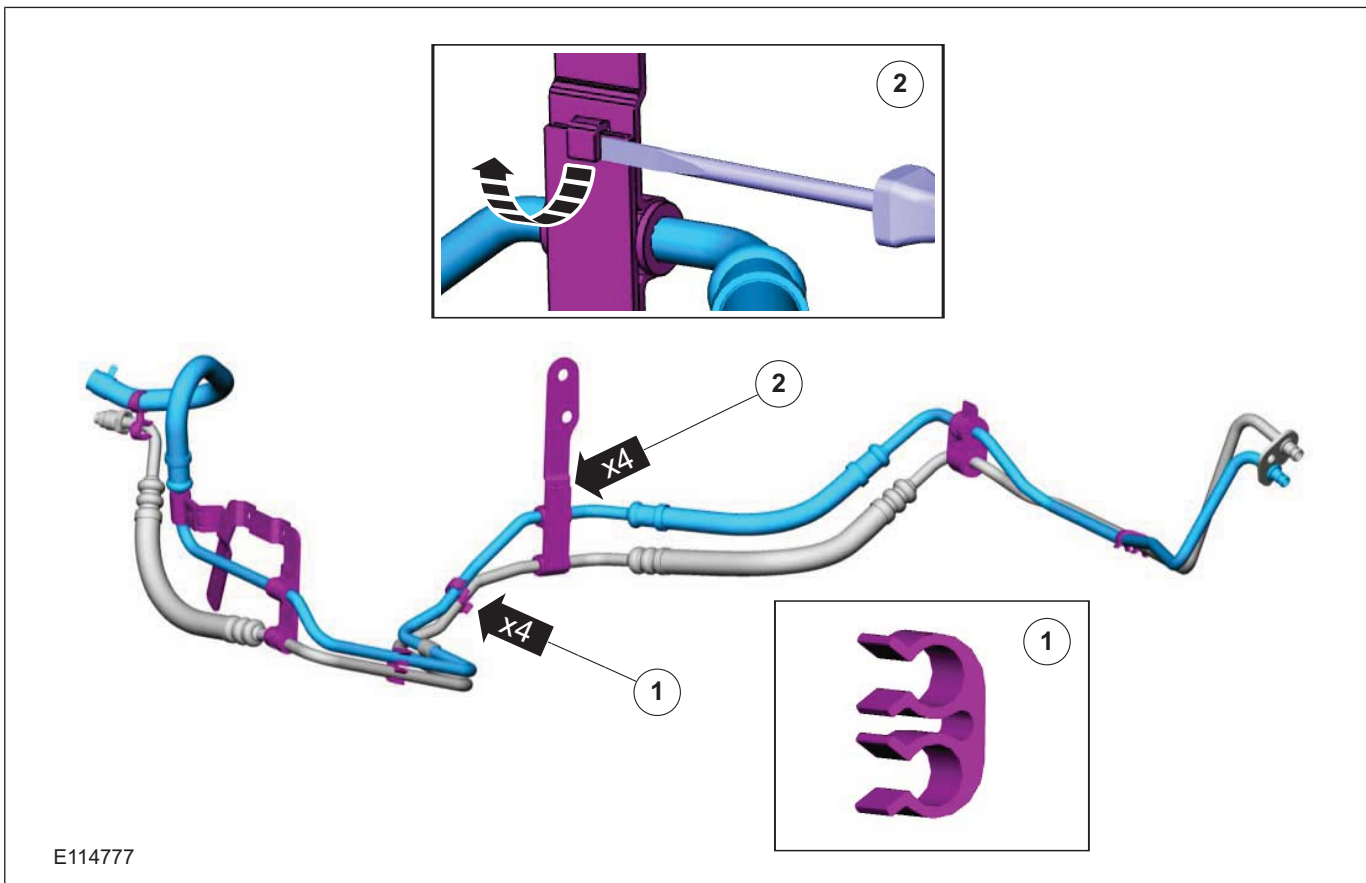


10.

REMOVAL AND INSTALLATION



11.





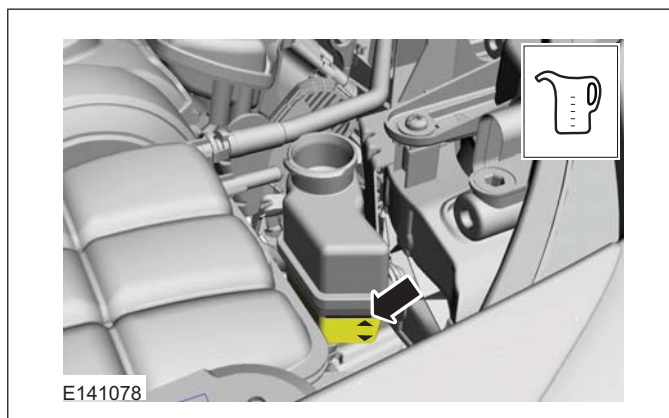
REMOVAL AND INSTALLATION

Installation

1. To install, reverse the removal procedure.
- 2.

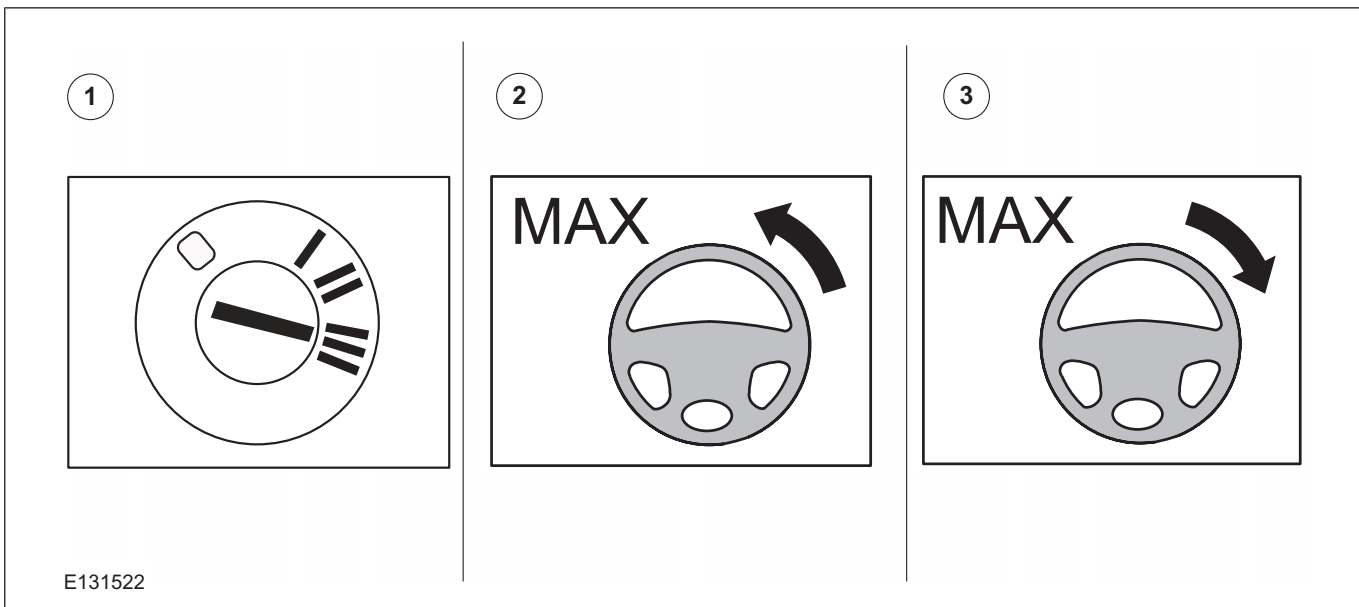


3.

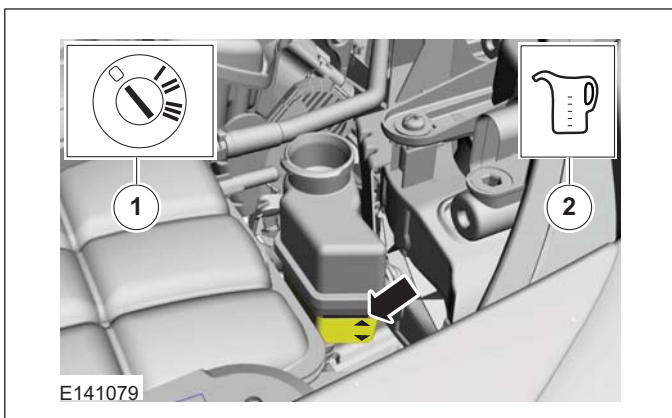


4. **NOTE:** Make sure the fluid in the reservoir does not fall below the MIN mark, as air could enter the system.

Slowly turn the steering wheel from lock to lock five times.



5.



6.





## SECTION 211-03 Steering Linkage

VEHICLE APPLICATION: 2008.50 Kuga

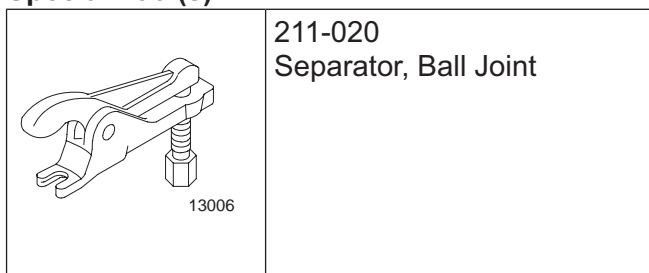
CONTENTS		PAGE
<b>REMOVAL AND INSTALLATION</b>		
Tie Rod End.....	(13 273 0)	211-03-2
Tie Rod.....	(13 263 0)	211-03-3
Steering Gear Boot.....	(13 134 0)	211-03-5



## REMOVAL AND INSTALLATION

## Tie Rod End(13 273 0)

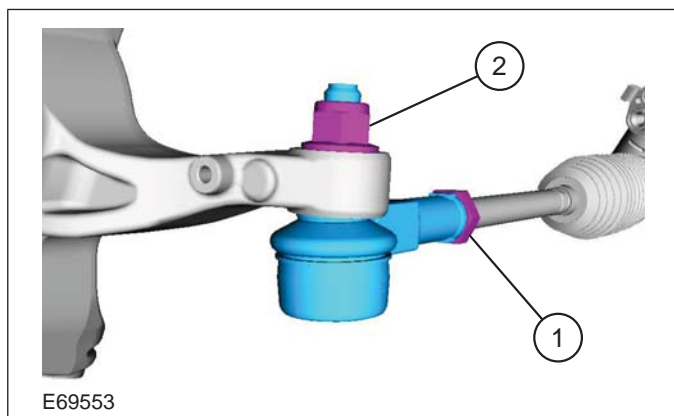
## Special Tool(s)



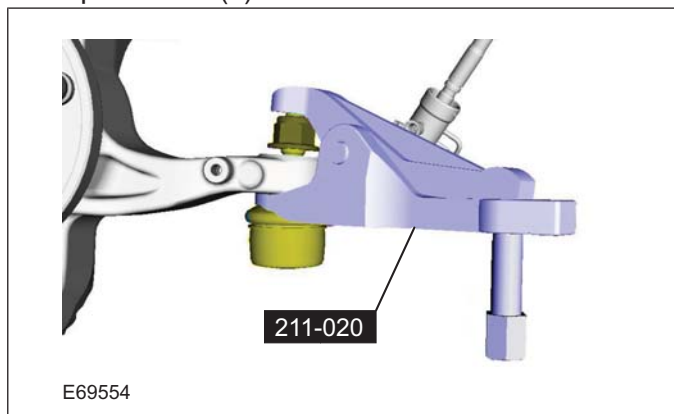
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

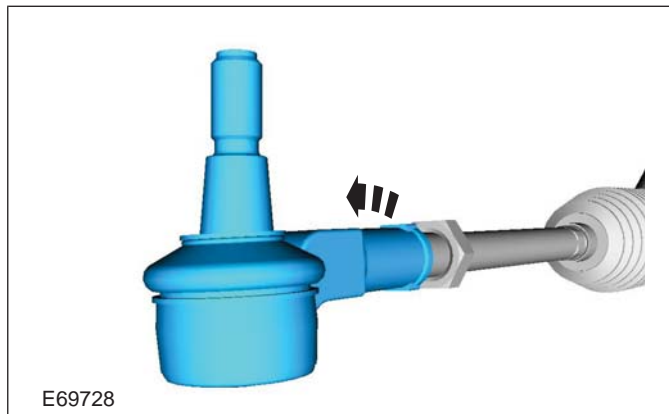
1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
2. **CAUTION:** Make sure that the ball joint ball does not rotate.
  1. Torque: 69 Nm
  2. Torque: 48 Nm



3. Special Tool(s): 211-020



4. **NOTE:** Make sure that the tie rod end is installed with the same number of turns as when removed.



## Installation

1. To install, reverse the removal procedure.
2. Refer to: **Front Toe Adjustment** (204-00 Suspension System - General Information, General Procedures).



REMOVAL AND INSTALLATION

Tie Rod(13 263 0)

Special Tool(s) / General Equipment

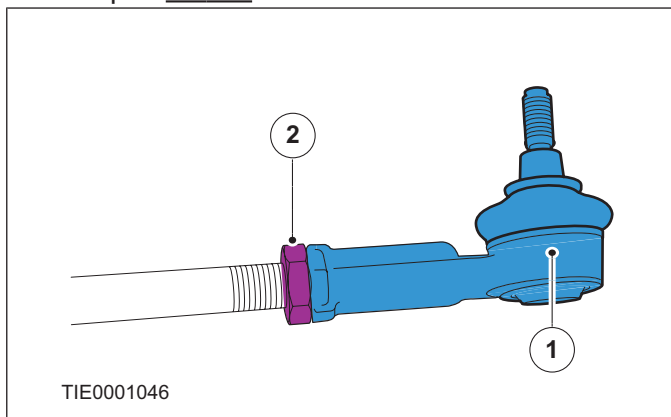
 <p>14044</p>	<p>204-169 Clamping Tool, Boot Retaining Clamp</p>
 <p>13025</p>	<p>211-245 Socket, Steering Gear Tie-Rod</p>
<p>Vise</p>	
<p>Vise Jaw Protectors</p>	

Removal

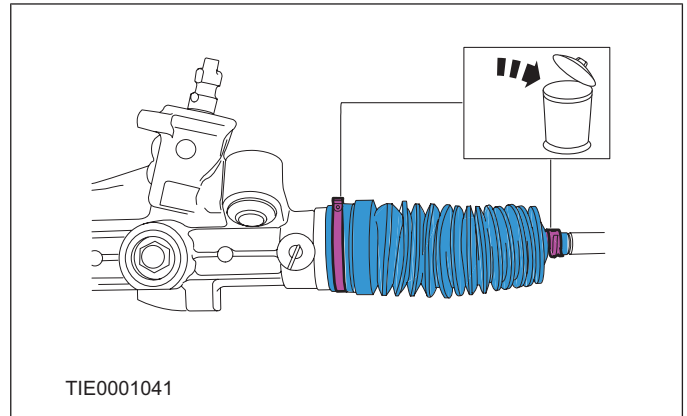
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Steering Gear** (211-02 Power Steering, Removal and Installation).
2. **NOTE:** Make sure that the tie rod end is installed with the same number of turns as when removed.

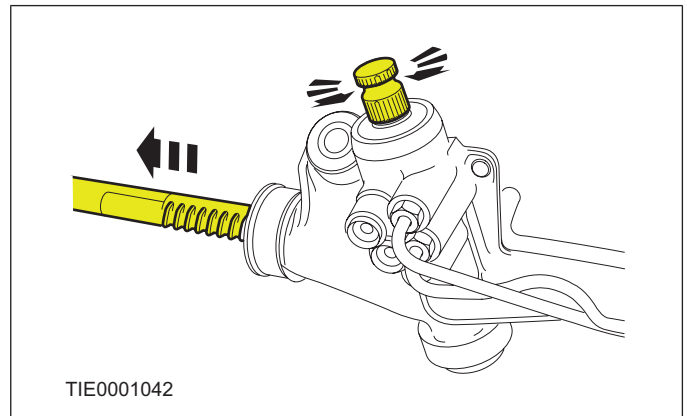
Torque: 69 Nm



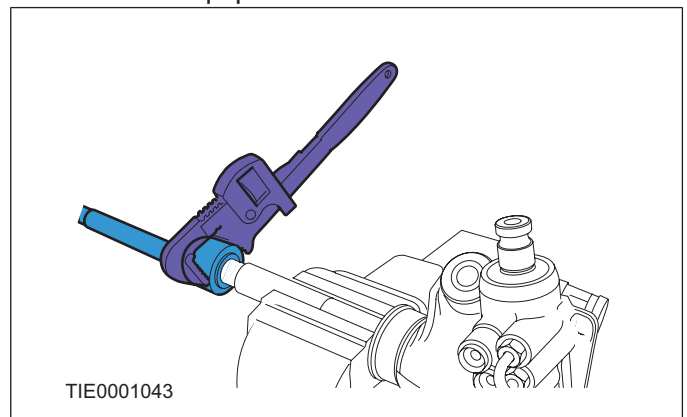
3. **NOTE:** Note the position of each component before removal.



- 4.



5. General Equipment: Vise  
General Equipment: Vise Jaw Protectors





## 211-03-4

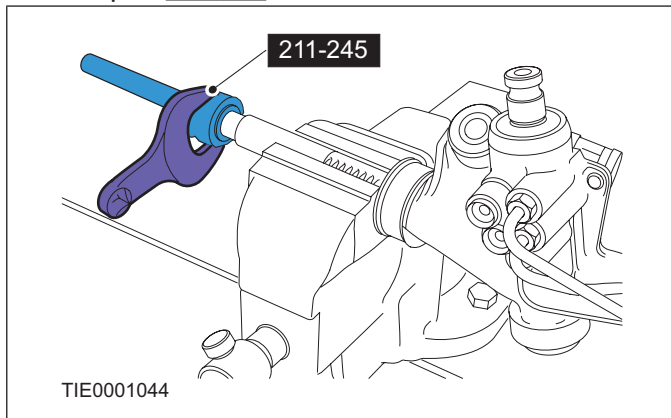
## Steering Linkage

## 211-03-4

## REMOVAL AND INSTALLATION

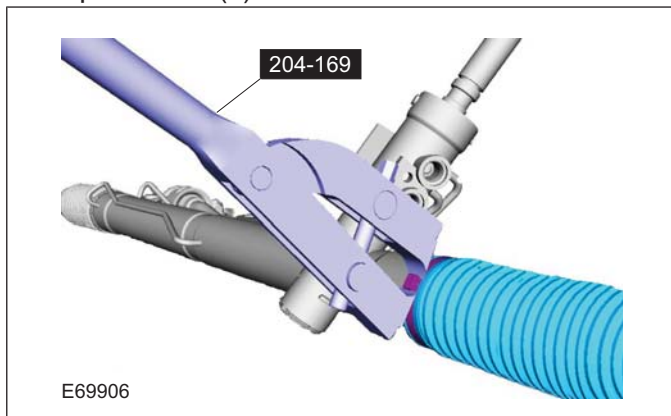
## Installation

1. Special Tool(s): 211-245  
Torque: 110 Nm



2. **NOTE:** Make sure that these components are installed to the noted removal position.

Special Tool(s): 204-169

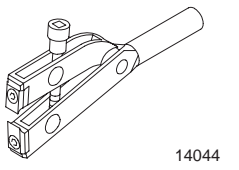


3. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Steering Gear Boot(13 134 0)

## Special Tool(s)

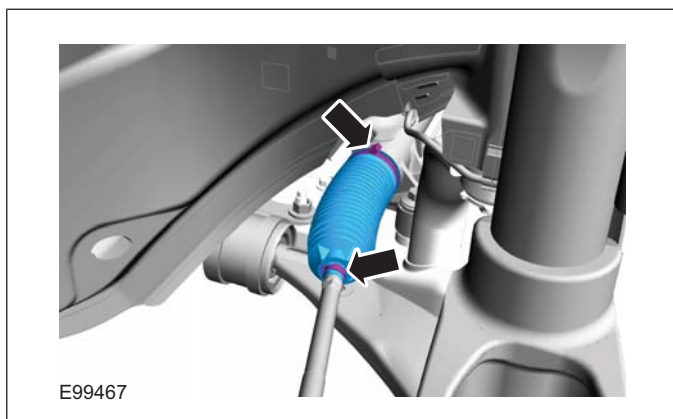
 <p>14044</p>	<p>204-169 Clamping Tool, Boot Retaining Clamp</p>
--	--

3. Refer to: **Front Toe Adjustment** (204-00 Suspension System - General Information, General Procedures).

## Removal

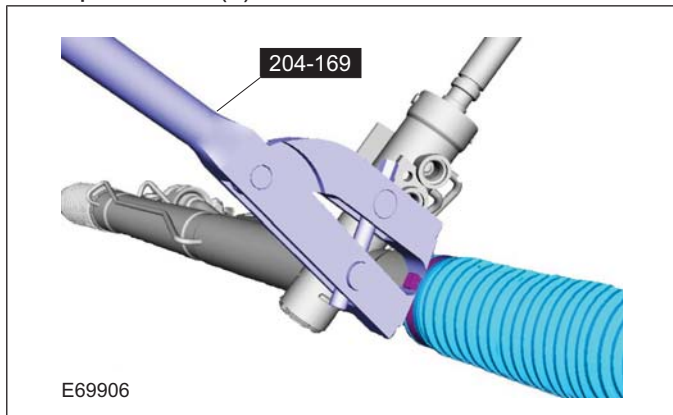
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Tie Rod End** (211-03 Steering Linkage, Removal and Installation).
- 2.



## Installation

1. To install, reverse the removal procedure.
2. Special Tool(s): 204-169



## SECTION 211-04 Steering Column

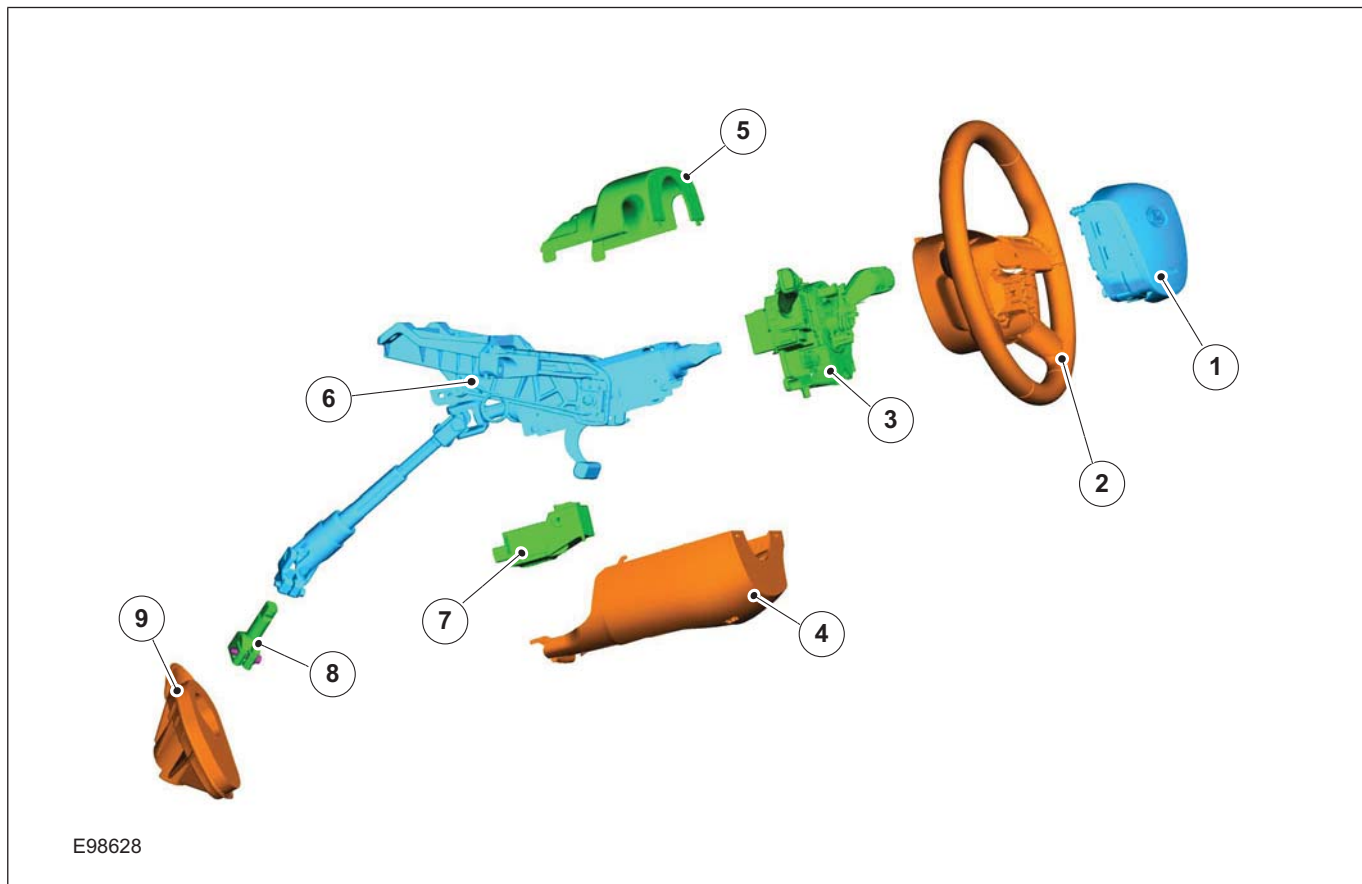
**VEHICLE APPLICATION: 2008.50 Kuga**

CONTENTS	PAGE
<b>DESCRIPTION AND OPERATION</b>	
Steering Column (Overview).....	211-04-2
General overview.....	211-04-2
Steering wheel.....	211-04-3
Extension, steering shaft.....	211-04-3
Steering Column.....	211-04-3
<b>REMOVAL AND INSTALLATION</b>	
Steering Wheel..... (13 524 0)	211-04-4
Steering Column..... (13 542 0)	211-04-5
Steering Column Shaft.....	211-04-7

DESCRIPTION AND OPERATION

Steering Column – Overview

General overview



Item	Description
1	Driver airbag Refer to: <b>Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)</b> (501-20 Supplemental Restraint System, Description and Operation).
2	Steering wheel
3	Switch unit, steering column Refer to: <b>Steering Column Switches</b> (211-05 Steering Column Switches, Description and Operation).

Item	Description
4	Steering column lower shroud
5	Steering column upper shroud
6	Steering Column
7	Steering lock
8	Extension, steering shaft
9	Steering gear to bulkhead seal

**DESCRIPTION AND OPERATION**

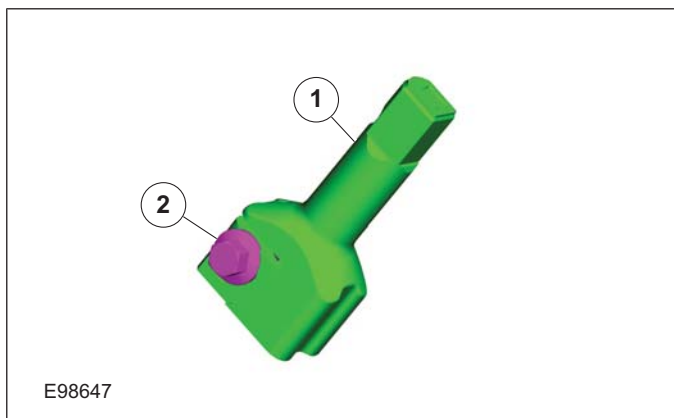
**Steering wheel**



During removal and installation or renewal of the steering wheel, pay attention to the following:

- Make sure that the vehicle electrical system is fully depowered and no other power source is connected.
- The clockspring rotor must not be turned during removal or installation of the steering wheel.
- Secure the clockspring rotor with adhesive tape to the clockspring outer.
- Make sure that the pins of the clockspring are not bent or damaged during installation.

**Extension, steering shaft**

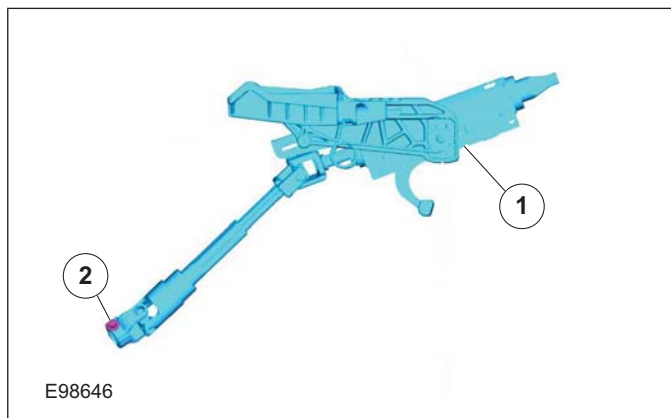


Item	Description
1	Extension, steering shaft
2	Bolt, steering shaft extension

During removal and installation or renewal of components of the steering shaft extension, pay attention to the following:

- Make certain that a new steering shaft extension bolt is installed.
- Make sure a new steering column flexible coupling bolt is installed.

**Steering Column**



Item	Description
1	Steering Column
2	Bolt, steering shaft flexible coupling

The following components may be renewed:

- Steering Column

During removal and installation or renewal of components of the steering column, pay attention to the following:

- Make sure that the vehicle electrical system is fully depowered and no other power source is connected.
- Make sure a new steering column flexible coupling bolt is installed.
- Secure the clockspring rotor with adhesive tape to the clockspring outer.
- The clockspring rotor must not be turned during removal or installation of the steering wheel or the steering column switch unit.

## REMOVAL AND INSTALLATION

## Steering Wheel(13 524 0)

## General Equipment

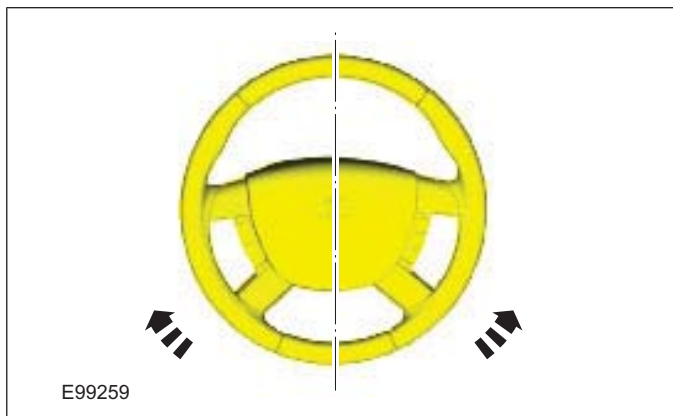
Adhesive Tape

## Removal

1. Refer to: **Driver Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation).

2. **CAUTION:** Make sure that the steering wheel lock is engaged.

**NOTE:** Make sure that the road wheels are in the straight ahead position.

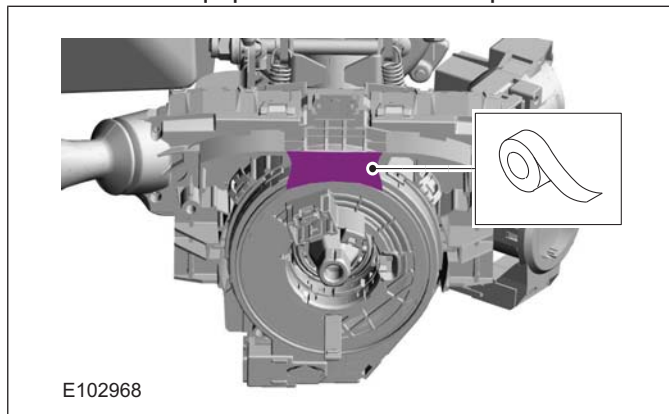


3. Torque: 48 Nm



4. **CAUTION:** Make sure that the clockspring rotor does not rotate.

General Equipment: Adhesive Tape



## Installation

1. To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

## Steering Column(13 542 0)

## Removal

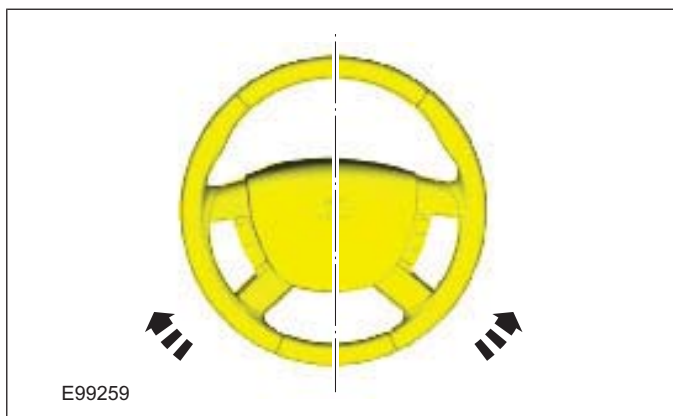
## WARNINGS:

**▲** The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

**▲** Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

**NOTE:** Removal steps in this procedure may contain installation details.

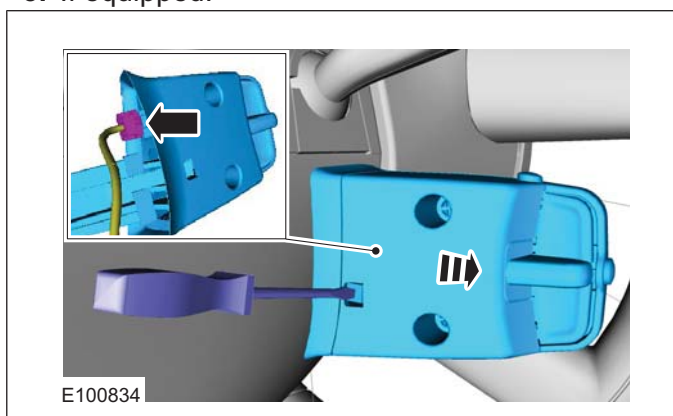
1. **NOTE:** Make sure that the road wheels are in the straight ahead position.



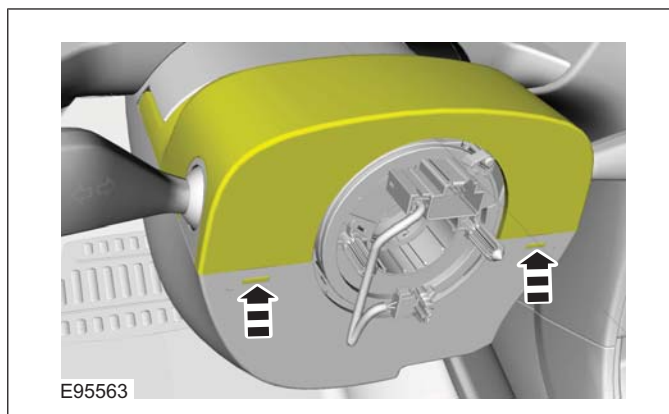
2. **▲ CAUTION:** Make sure that the steering wheel lock is engaged.

Refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

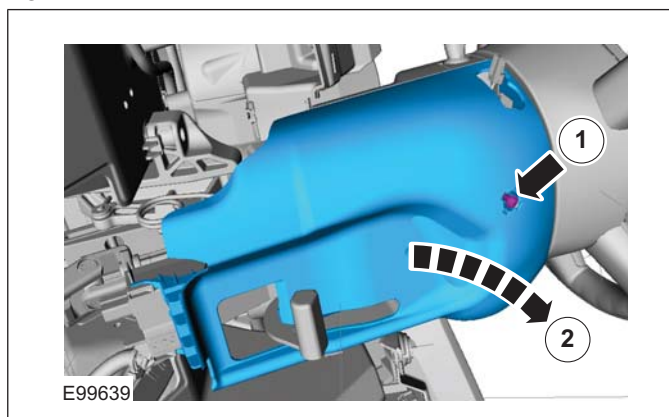
3. If equipped.



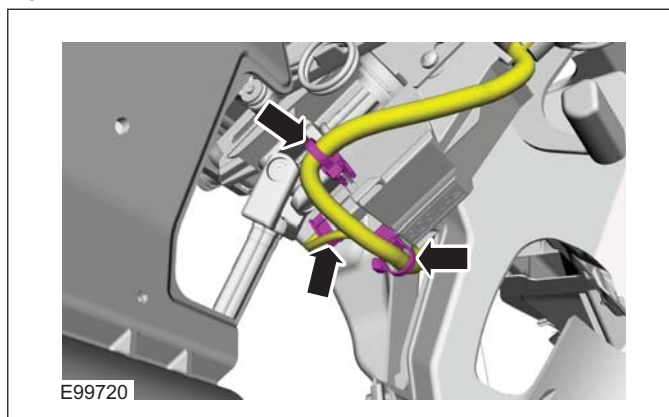
4.



5.

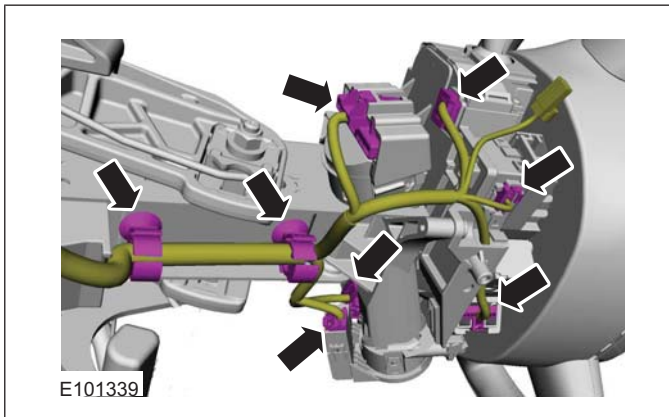
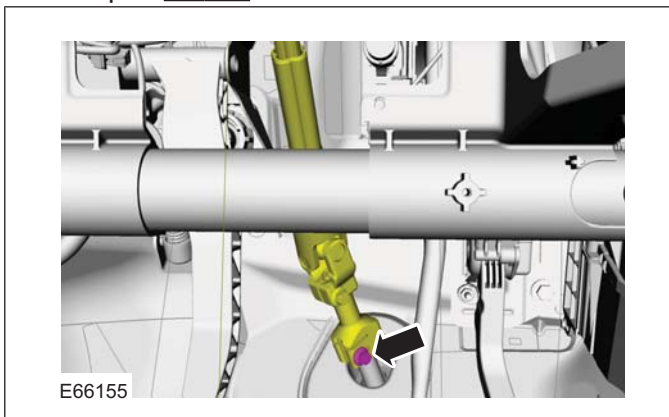
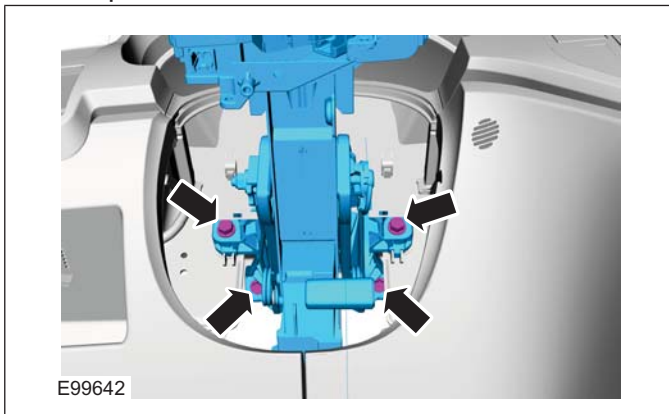


6.



## REMOVAL AND INSTALLATION

7.

8. Torque: 30 Nm9. Torque: 24 Nm

## Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Steering Column Shaft

## Removal

## WARNINGS:

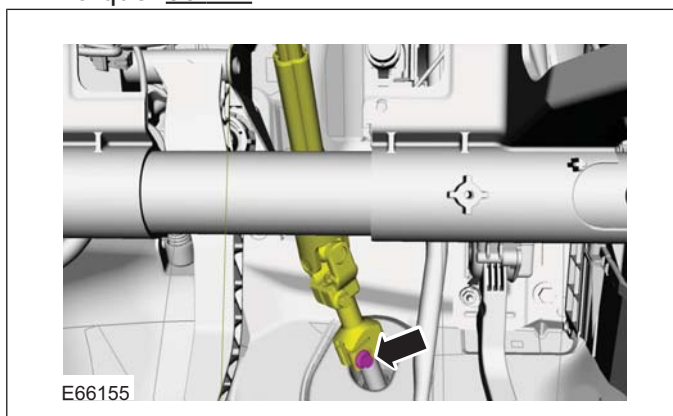
**▲** The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

**▲** Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

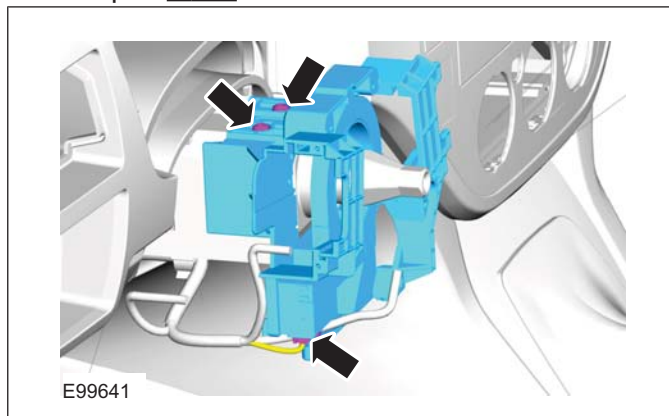
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Clockspring** (501-20 Supplemental Restraint System, Removal and Installation). Refer to: **Steering Column Multifunction Switch LH** (211-05 Steering Column Switches, Removal and Installation). Refer to: **Steering Column Multifunction Switch RH** (211-05 Steering Column Switches, Removal and Installation). Refer to: **Steering Column Lock Module** (211-05 Steering Column Switches, Removal and Installation).

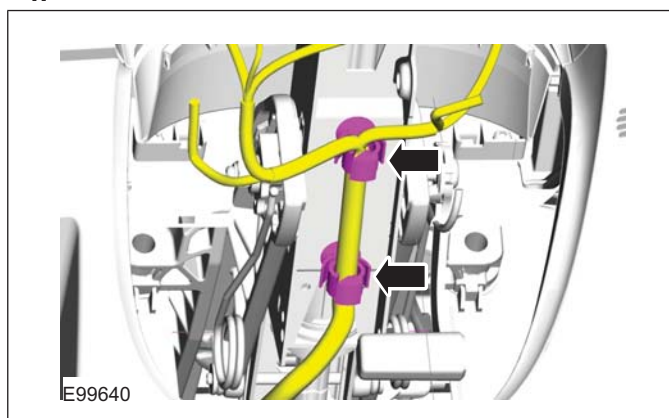
2. Torque: 30 Nm



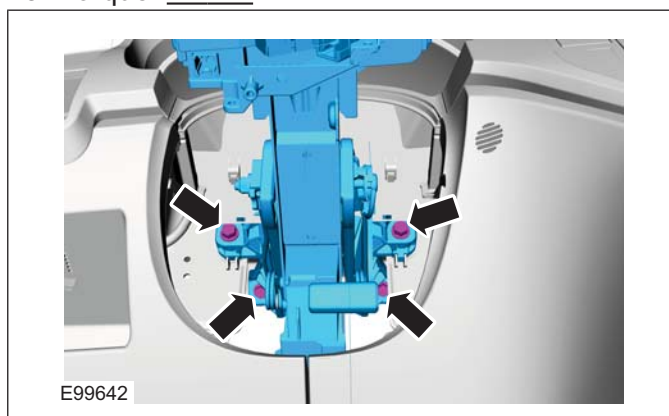
3. Torque: 5 Nm



- 4.



5. Torque: 24 Nm



## Installation

1. To install, reverse the removal procedure.

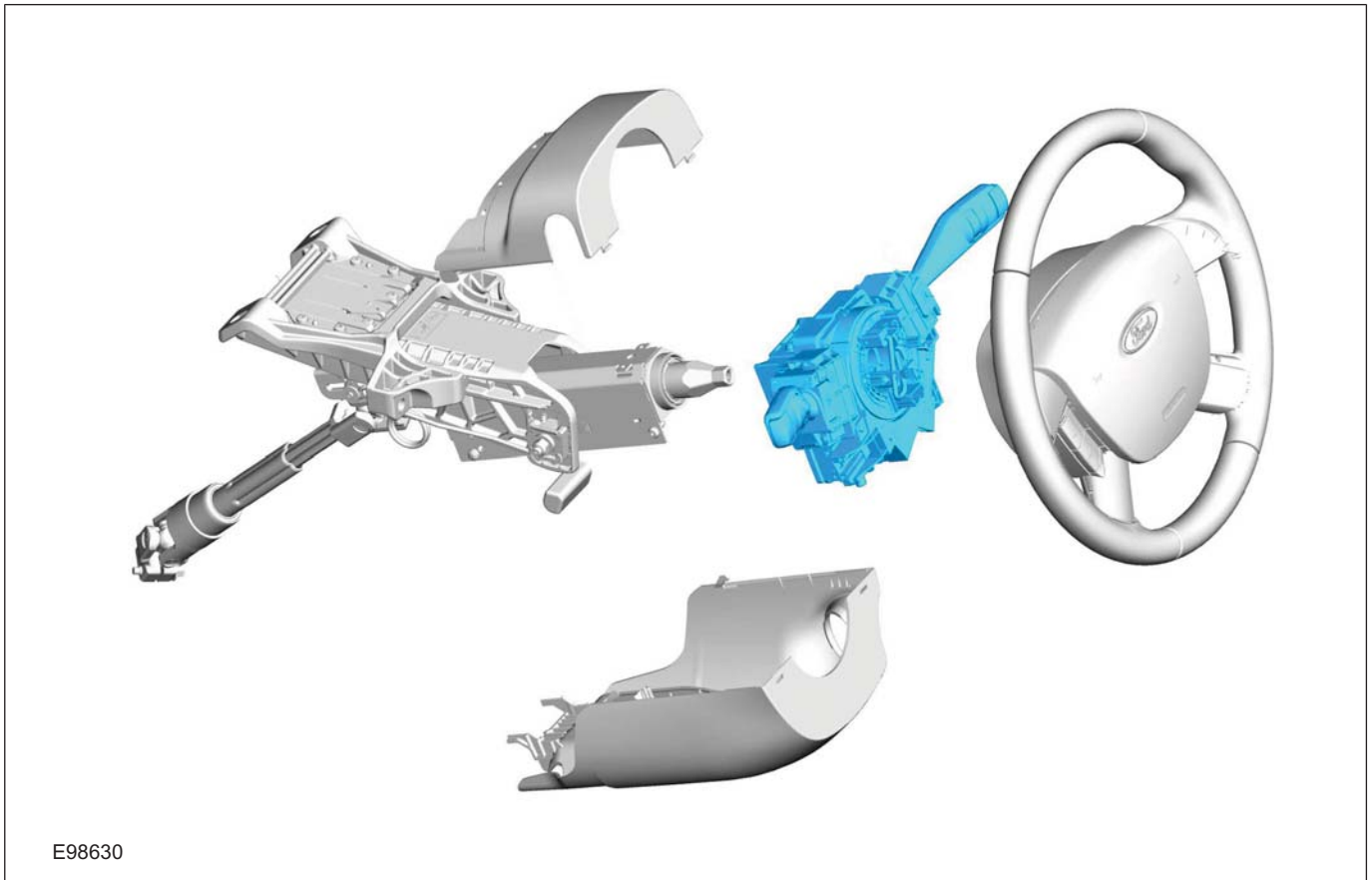
## SECTION 211-05 Steering Column Switches

**VEHICLE APPLICATION: 2008.50 Kuga**

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Switch unit, steering column.....	211-05-3
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<b>REMOVAL AND INSTALLATION</b>	
Steering Column Lock Module.....	211-05-4
Steering Column Multifunction Switch LH.....	211-05-6
Steering Column Multifunction Switch RH.....	211-05-7

## DESCRIPTION AND OPERATION

## Steering Column Switches – Component Location

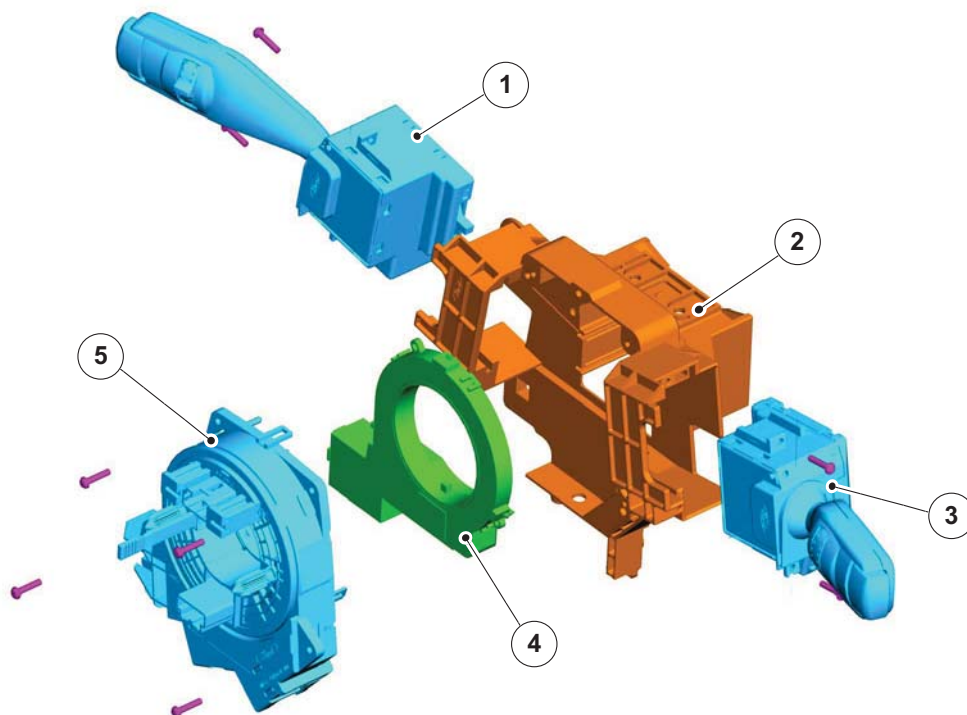




## DESCRIPTION AND OPERATION

## Steering Column Switches – Overview

## Switch unit, steering column



E98629

Item	Description
1	Left-hand switch, steering column
2	Switch unit carrier, steering column
3	Right-hand switch, steering column

Item	Description
4	Steering wheel rotation sensor Refer to: <b>Anti-Lock Control - Stability Assist</b> (206-09 Anti-Lock Control - Stability Assist, Description and Operation).
5	Clockspring

**Clockspring**

The clockspring is designed to carry signals between the RCM and the driver air bag module. The clockspring is installed on the steering column, and consists of fixed and moving parts connected by a coiled Mylar tape with internal conducting tracks. The Mylar tape is able to 'wind up' and 'unwind' as the steering wheel is rotated, maintaining electrical contact at all times between the RCM and the driver air bag module.

During removal and installation or renewal of the clockspring, pay attention to the following:

- Before installation of the clockspring, it must be aligned according to the installation instructions.
- Make sure that the vehicle electrical system is fully depowered and no other power source is connected.
- Secure the clockspring rotor with adhesive tape to the clockspring outer.
- The clockspring rotor must not be turned during removal or installation of the steering wheel or the steering column switch unit.



REMOVAL AND INSTALLATION

Steering Column Lock Module

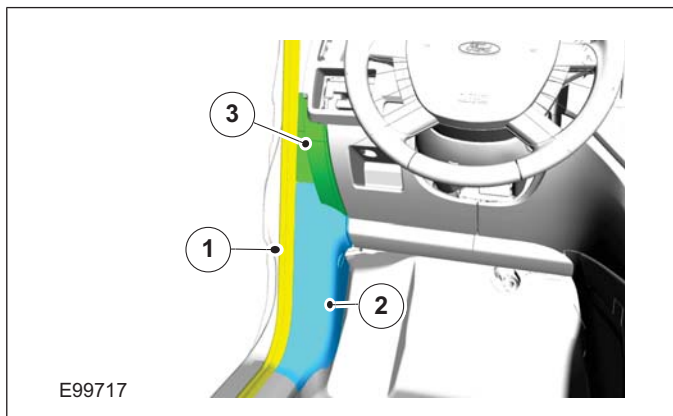
General Equipment

Ford approved diagnostic tool

Removal

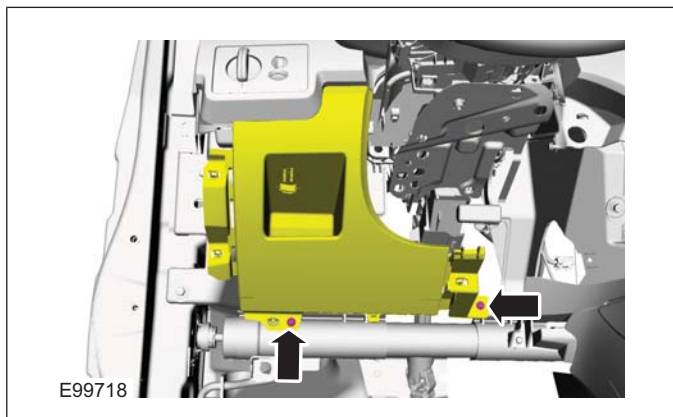
**NOTE:** Removal steps in this procedure may contain installation details.

1.

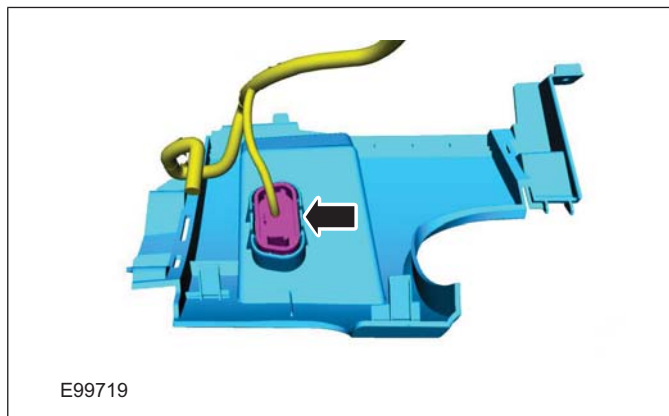


2. Refer to: **Floor Console** (501-12 Instrument Panel and Console, Removal and Installation).

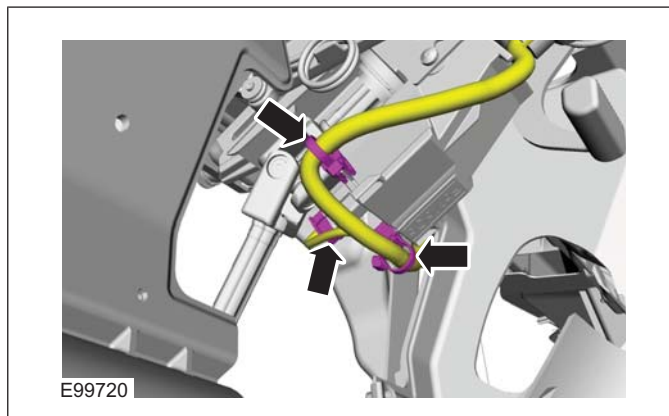
3.



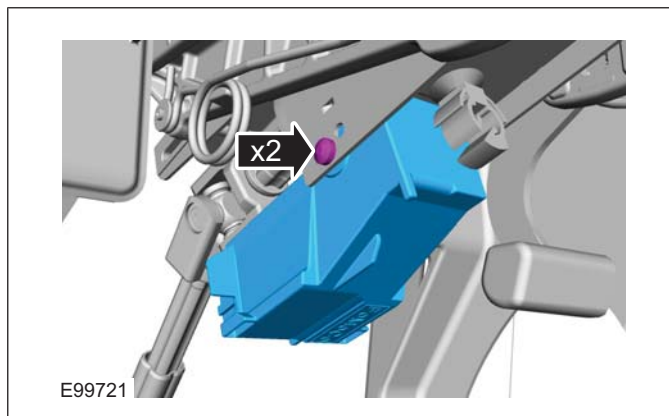
4.



5.



6.



Installation

1. To install, reverse the removal procedure.

**211-05-5****Steering Column Switches****211-05-5****REMOVAL AND INSTALLATION**

---

2. Initialize the Steering Column Lock Module.

General Equipment: Ford approved diagnostic tool



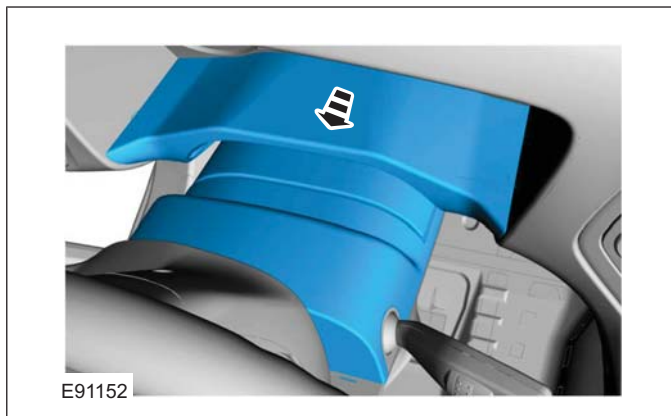
## REMOVAL AND INSTALLATION

## Steering Column Multifunction Switch LH

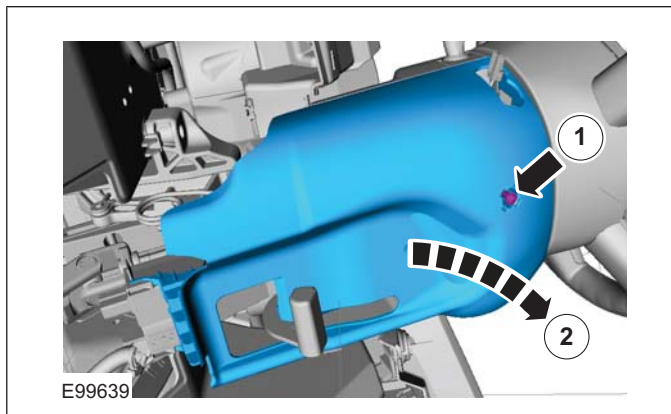
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

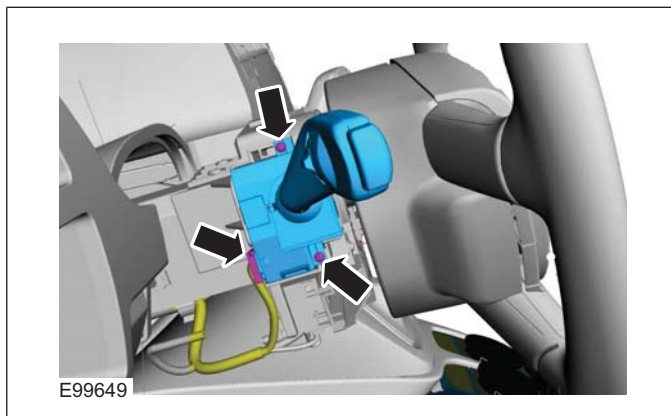
1.



2.



3.



## Installation

1. To install, reverse the removal procedure.

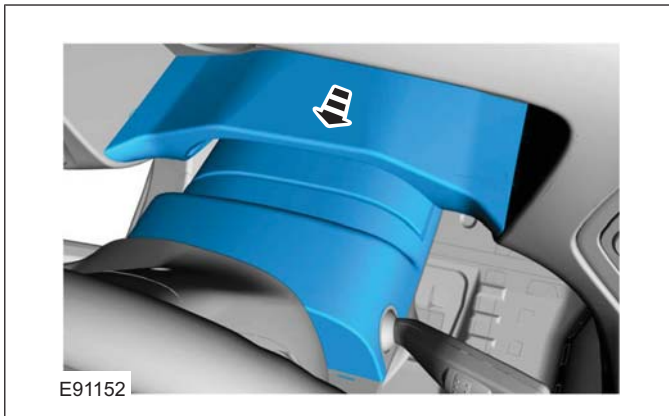
## REMOVAL AND INSTALLATION

## Steering Column Multifunction Switch RH

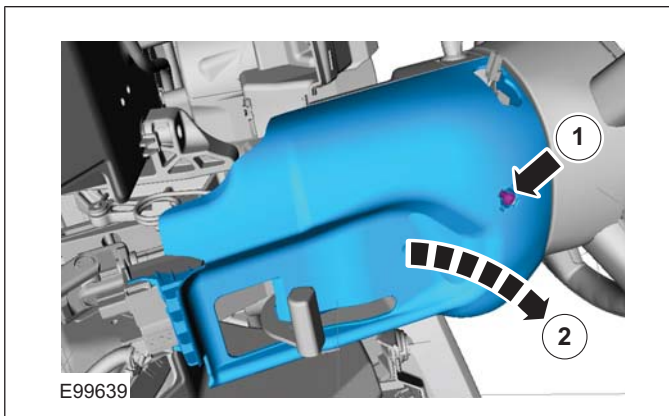
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

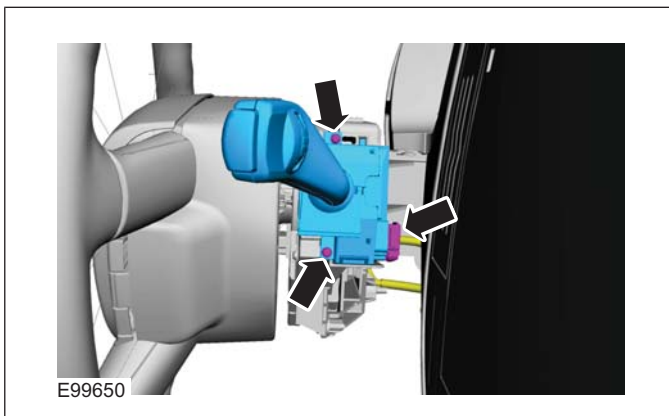
1.



2.



3.



## Installation

1. To install, reverse the removal procedure.

## GROUP

## 3

## Powertrain

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## SECTION 303-00 Engine System - General Information

**VEHICLE APPLICATION: 2008.50 Kuga**

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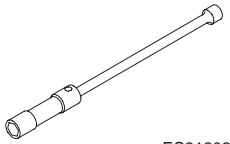
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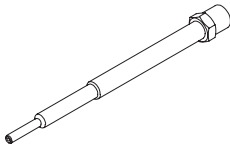


**DIAGNOSIS AND TESTING**

**Engine**

**Special Tool(s) / General Equipment**

 ES21202	Socket, Spark Plug 303-499
--	-------------------------------

 E42936	Compression Test Adapter 303-1056
---	--------------------------------------

Ford diagnostic equipment

Materials	
Name	Specification
Adhesive - Loctite 243	WSK-M2G349-A7

1. Verify the customer concern by operating the system
2. Visually inspect for obvious signs of mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

**Visual Inspection Chart**

Mechanical	Electrical
<ul style="list-style-type: none"> <li>- Coolant leaks</li> <li>- Oil leaks</li> <li>- Fuel system leaks</li> <li>- Visibly damaged or worn parts</li> <li>- Loose or missing nuts or bolts</li> </ul>	<ul style="list-style-type: none"> <li>- Fuse(s)</li> <li>- Loose or corroded connector(s)</li> <li>- Control module</li> <li>- Damaged or worn switch(es)</li> </ul>

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>• Loss of oil</li> </ul>	<ul style="list-style-type: none"> <li>• Oil leaks on components that are either coated in oil themselves or on components local to them.</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK for evidence of oil leaks on components. Use an ultraviolet (UV) leak tester if an oil leak is not evident. INSTALL new gaskets or components as required.</li> </ul>
	<ul style="list-style-type: none"> <li>• Internal or external leak at the oil cooler.</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK the coolant expansion tank for a film of oil on the coolant surface. INSTALL a new oil cooler or oil cooler gasket.</li> </ul>
	<ul style="list-style-type: none"> <li>• Leak at the crankshaft seal.</li> </ul>	<ul style="list-style-type: none"> <li>• INSTALL a new crankshaft seal.</li> </ul>
	<ul style="list-style-type: none"> <li>• Leaks from oil carrying components or basic engine.</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK for cracks in oil-carrying components of the basic engine by means of a UV leak test. INSTALL new components or seals as necessary.</li> </ul>
<ul style="list-style-type: none"> <li>• Oil consumption</li> </ul>	<ul style="list-style-type: none"> <li>• Use of the wrong type of engine oil.</li> </ul>	<ul style="list-style-type: none"> <li>• DETERMINE the last type of engine oil used and compare with the specification. Change the engine oil to the specification.</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Faulty positive crankcase ventilation (PCV) system. <ul style="list-style-type: none"> <li>Hoses or ventilation or breather valves are blocked. This causes excessive pressure in the crankcase which causes more oil to enter the combustion chamber.</li> <li>PCV oil separator is faulty and engine oil can enter the combustion chamber through the intake manifold.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>CHECK if the PCV system is operating correctly and repair as necessary. Engine - 2.5L Duratec-ST (VI5) - REFER to: <b>Engine Emission Control</b> (303-08 Engine Emission Control - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
	<ul style="list-style-type: none"> <li>Turbocharger seals.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new turbocharger. Engine - 2.5L Duratec-ST (VI5) - REFER to: <b>Turbocharger</b> (303-04 Fuel Charging and Controls - Turbocharger - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
	<ul style="list-style-type: none"> <li>Damaged gaskets or mating surfaces. <ul style="list-style-type: none"> <li>Cylinder head gasket is damaged or mating face are warped.</li> <li>Valve stem seals are worn and engine oil can enter the combustion chamber between the valve stem and the valve stem guide.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>CHECK the gaskets and mating surfaces for damage. Remove the cylinder head. CHECK the mating faces, cylinder head gasket and the evenness of the cylinder head and engine block mating faces. INSTALL new valve seals. Engine - 2.5L Duratec-ST (VI5) - REFER to: <b>Valve Stem Seals</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
	<ul style="list-style-type: none"> <li>Piston ring or cylinder liner wear.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL new components as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Damaged cylinder liners or excessive clearance of engine components. <ul style="list-style-type: none"> <li>Pistons.</li> <li>Piston rings (clearance in groove and end gap).</li> <li>Cylinder liners.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>CHECK the running surfaces and clearances of the individual engine components. INSTALL new components as necessary. INSTALL a new cylinder block if necessary.</li> <li>Check the pistons and piston rings.</li> </ul>

303-00-4

## Engine System - General Information

303-00-4

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
• Coolant consumption	• Cooling system components.	• Check the cooling system components. Engine - 2.5L Duratec-ST (VI5) - REFER to: <b>Engine Cooling</b> (303-03 Engine Cooling, Diagnosis and Testing). Engine - 2.0L Duratorq-TDCi (DW) Diesel - REFER to: <b>Engine Cooling</b> (303-03 Engine Cooling, Diagnosis and Testing).
	• Oil cooler.	• INSTALL a new oil cooler.
	• Damaged gaskets or warped mating faces.	• CHECK the cylinder head gasket for damage. CHECK the cylinder head for distortion.
	• Cracks or fractures in engine components surrounded by coolant, such as cylinder liners and cylinder head combustion chamber.	• DETERMINE the damaged engine component(s) and install new component(s) as necessary.
• Engine will not crank	• Battery or cables.	• CHECK the battery and cables. REFER to: <b>Charging System</b> (414-00 Charging System - General Information, Diagnosis and Testing).
	• Starter motor or cables.	• CHECK the starting system. Engine - 2.5L Duratec-ST (VI5) - - REFER to: <b>Starting System</b> (303-06 Starting System - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing). Engine - 2.0L Duratorq-TDCi (DW) Diesel -
• Engine cranks but will not start	• Fuel tank is empty.	• CHECK the fuel level.
	• Water in fuel (diesel engine only).	• Drain the water from the fuel system.
	• Fuel filter blocked.	• INSTALL a new fuel filter. Engine - 2.0L Duratorq-TDCi (DW) Diesel -

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Engine intake air system.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the intake air system. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Intake Air Distribution and Filtering</b> (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
	<ul style="list-style-type: none"> <li>Glow plug faulty (diesel engine only).</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the glow plugs. INSTALL new glow plugs as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Engine management system.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the engine management system. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Electronic Engine Controls</b> (303-14 Electronic Engine Controls - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
	<ul style="list-style-type: none"> <li>Ignition system (petrol engine only).</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the ignition system. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Engine Ignition</b> (303-07 Engine Ignition - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Incorrect valve timing.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK and adjust the valve timing. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Timing Belt</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>

303-00-6

Engine System - General Information

303-00-6

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Broken or damaged timing belt/timing chain or pulley/sprocket.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the timing belt/timing chain and sprockets/pulleys. INSTALL new components as necessary. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Timing Belt</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
<ul style="list-style-type: none"> <li>Very poor power output or fuel consumption too high or engine running rough.</li> </ul>	<ul style="list-style-type: none"> <li>Fuel system.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the fuel system. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Fuel Charging and Controls</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
	<ul style="list-style-type: none"> <li>Engine intake air system.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the intake air system. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Intake Air Distribution and Filtering</b> (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
	<ul style="list-style-type: none"> <li>Exhaust system blocked.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the exhaust system.</li> </ul>
	<ul style="list-style-type: none"> <li>Engine management system.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the engine management system. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Electronic Engine Controls</b> (303-14 Electronic Engine Controls - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Fault in ignition system (petrol engine only).</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the ignition system. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Engine Ignition</b> (303-07 Engine Ignition - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Turbocharger.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the turbocharger. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Turbocharger</b> (303-04 Fuel Charging and Controls - Turbocharger - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
	<ul style="list-style-type: none"> <li>Incorrect valve timing. Timing belt/timing sprocket or pulley/sprocket damaged.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK and adjust valve timing. INSTALL new components as necessary. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Timing Belt</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
	<ul style="list-style-type: none"> <li>Ignition timing incorrect (petrol engine only).</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the electronic engine controls. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Electronic Engine Controls</b> (303-14 Electronic Engine Controls - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing).</li> </ul>
<ul style="list-style-type: none"> <li>Noisy running</li> </ul>	<ul style="list-style-type: none"> <li>Engine auxiliary components loose or damaged.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK engine auxiliary components for damage or looseness. CHECK and adjust valve timing. INSTALL new components as necessary. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Timing Belt</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>



303-00-8

## Engine System - General Information

303-00-8

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>Noisy running, misfiring, back-firing or knocking</li> </ul>	<ul style="list-style-type: none"> <li>Incorrect fuel</li> </ul>	<ul style="list-style-type: none"> <li>DETERMINE which type of fuel was last put into the fuel tank (note the country specific fuel specifications).</li> </ul>
	<ul style="list-style-type: none"> <li>Water in fuel or fuel contaminated.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the fuel system for water or other contamination.</li> </ul>
	<ul style="list-style-type: none"> <li>Valve timing incorrect, timing belt/chain or pulley/sprocket damaged.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK and adjust valve timing. INSTALL new components as necessary. Engine - 2.5L Duratec-ST (VI5) - REFER to: <b>Timing Belt</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
<ul style="list-style-type: none"> <li>Noisy running or valve train noise</li> </ul>	<ul style="list-style-type: none"> <li>Valve clearance too large due to faulty valve tappets or worn valve train components.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL new hydraulic lash adjusters or adjust the valve clearance. Engine - 2.5L Duratec-ST (VI5) - REFER to: <b>Valve Clearance Adjustment</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, General Procedures). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
	<ul style="list-style-type: none"> <li>Timing belt or timing chain damaged.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new timing belt or timing chain. Engine - 2.5L Duratec-ST (VI5) - REFER to: <b>Timing Belt</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>
	<ul style="list-style-type: none"> <li>Timing belt or timing chain incorrectly tensioned.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the timing belt tension. INSTALL a new timing belt or timing chain as necessary. Engine - 2.5L Duratec-ST (VI5) - - REFER to: <b>Timing Belt</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>Noisy running or engine noise</li> </ul>	<ul style="list-style-type: none"> <li>Engine components <ul style="list-style-type: none"> <li>Pistons.</li> <li>Piston rings.</li> <li>Connecting rod big end, main bearing or thrust bearing journals.</li> <li>Connecting rods bent or damaged.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>CHECK the engine components for wear or damage. Make sure that all components are within specification. INSTALL new components as necessary. Engine - 2.5L Duratec-ST (VI5) -</li> <li>REFER to: <b>Specifications</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Specifications).</li> <li>Engine - 2.0L Duratorq-TDCi (DW) Diesel -</li> </ul>

**Engine - Oil Leaks**

**NOTE:** Before installing new gaskets or oil seals, make sure that the fault is clearly established.

If the oil leak cannot be identified clearly by a visual inspection, carry out an ultraviolet (UV) test:

**Ultraviolet (UV) Testing**

- Clean the engine and transmission with a suitable cleaning fluid.
- Pour the UV-test fluid in accordance with the quantity specified by the manufacturer through the oil filler neck into the engine and install the oil filler cap.

**▲ WARNING:** Vehicles with manual transaxle, shift the transaxle into Neutral. Failure to follow this instruction may result in personal injury.

- Start the engine and let it run for about five minutes.
- Switch off the engine.

**NOTE:** If no leak can be found, road test the vehicle under various loads and check the engine for leaks again.

- Check the engine for oil leaks using a suitable UV lamp.
- Rectify any leaks found and check the engine for oil leaks.

**Measure the compression pressure**

**NOTE:** The powertrain control module (PCM) receives an error message when the fuel pump relay is removed or electrical components are

disconnected. This error message must be deleted from the fault memory using the Ford diagnostic equipment after completing the compression test.

**NOTE:** Valve clearance must be set correctly before performing a compression test. Make sure the engine is at the normal operating temperature.

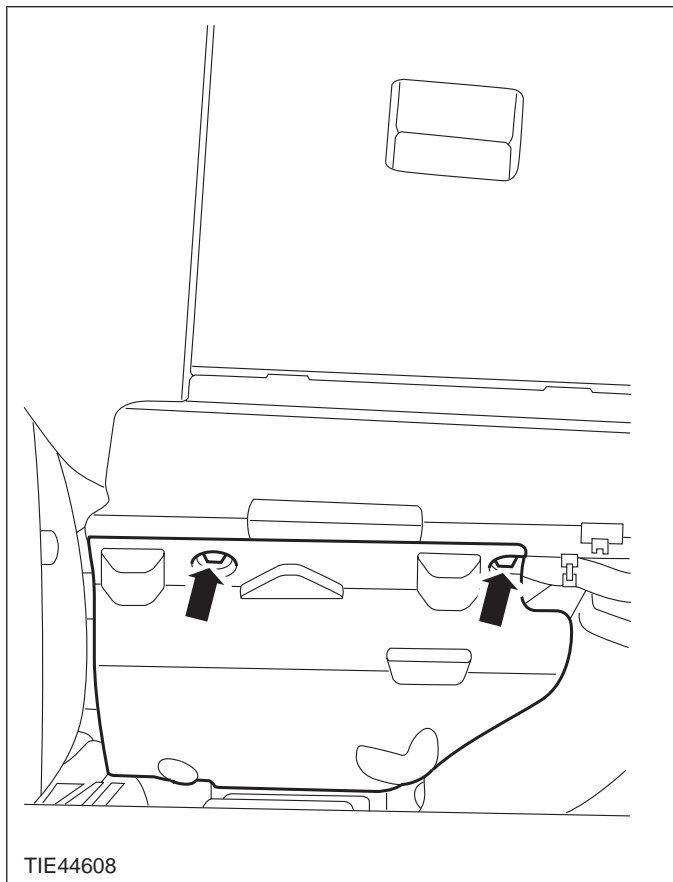
**NOTE:** The varying design of compression checking devices and fluctuating starter motor speeds normally only allows for a comparison to be made of the compression pressures in all cylinders.

303-00-10

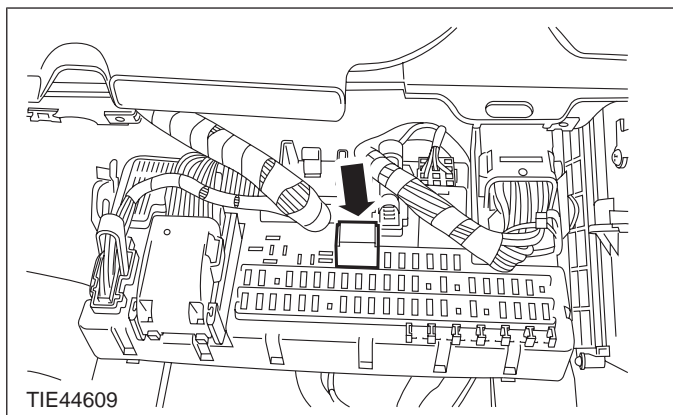
Engine System - General Information

303-00-10

## DIAGNOSIS AND TESTING

Measure the compression pressure  
(Engine - 2.5L Duratec-ST (VI5))

1. Remove the central junction box (CJB) cover.

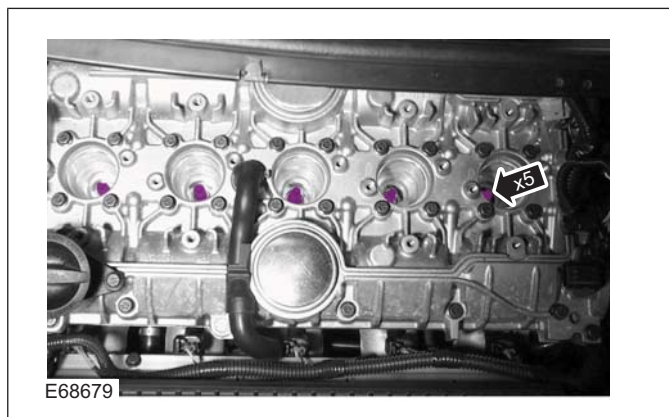


2. Open the CJB and remove the fuel pump relay.
3. **NOTE: The engine will start, run for a few seconds and then stop.**  
Start the engine.
4. Remove the ignition coil-on-plug.

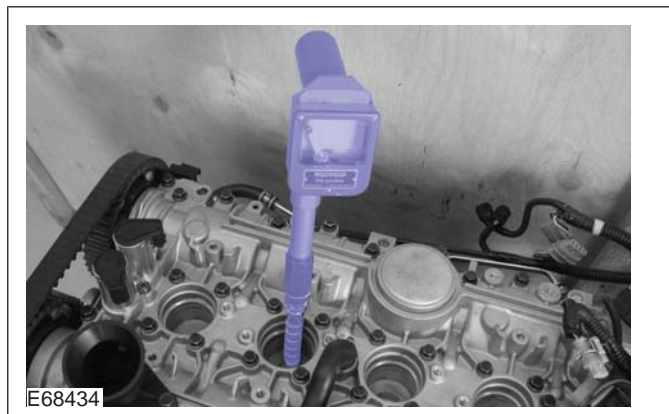
REFER to: **Ignition Coil-On-Plug** (303-07 Engine Ignition - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

5. Connect the battery ground cable.

REFER to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).

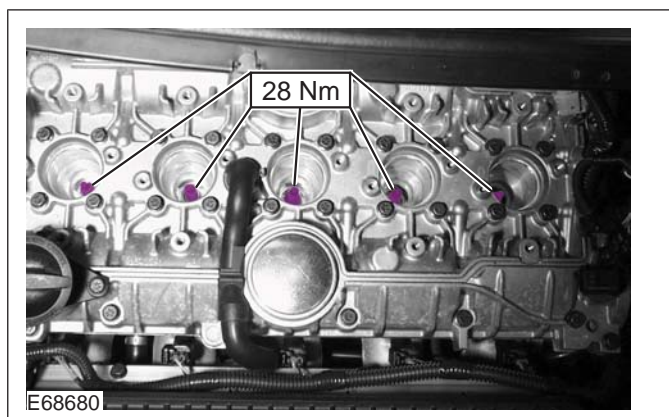


6. Using Special Tool 303-499, remove the spark plugs.



**NOTE:** Operate the starter motor with wide open throttle until the pointer on the measuring device stops rising.

7. Carry out the measurement in accordance with the instructions supplied with the measuring device on every cylinder using a suitable compression pressure recorder with a suitable adapter.

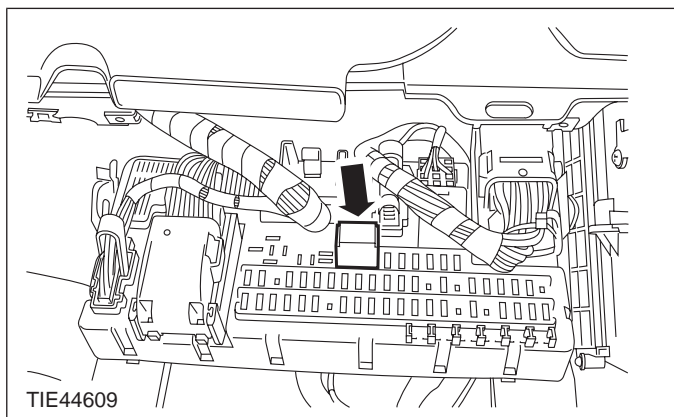


8. Using Special Tool 303-499, install the spark plugs.

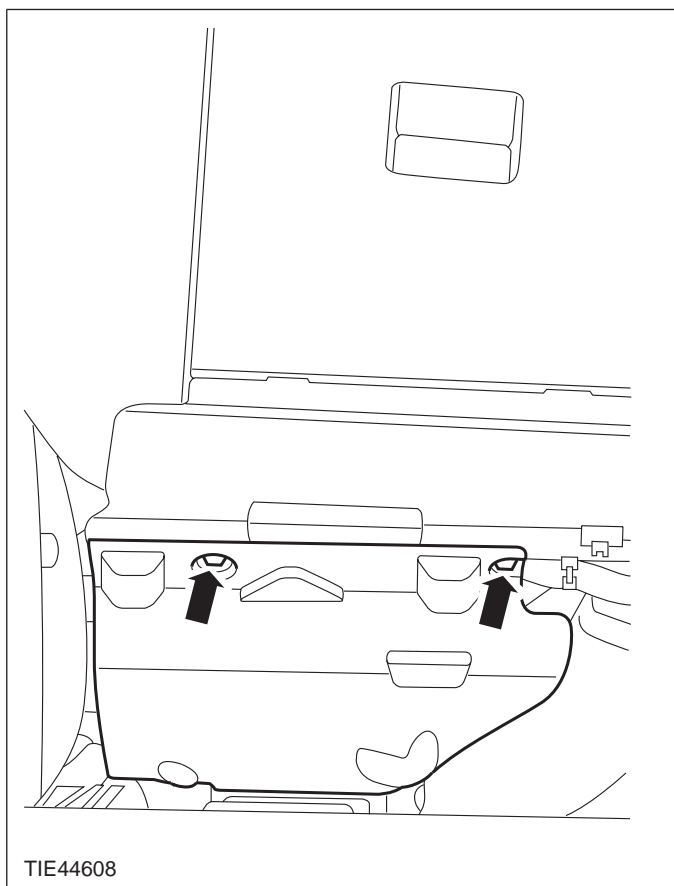
## DIAGNOSIS AND TESTING

9. Install the ignition coil-on-plug.

REFER to: **Ignition Coil-On-Plug** (303-07 Engine Ignition - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).



10. Install the fuel pump relay and close the CJB.



11. Install the CJB cover.

### Measure the compression pressure (Engine - 2.0L Duratorq-TDCi (DW) Diesel)

#### WARNINGS:

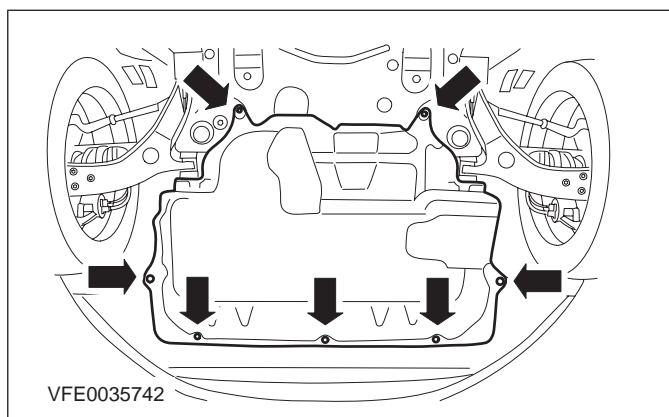
**▲ Do not smoke or carry lighted tobacco or open flame of any type when working on**

**or near any fuel related components. Highly flammable vapors are always present and can ignite. Failure to follow these instructions may result in personal injury.**

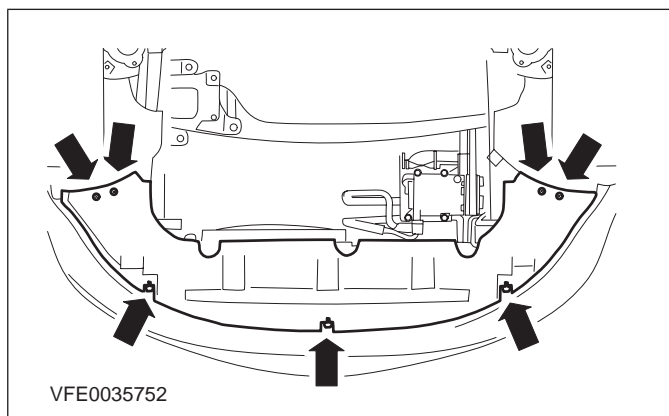
**▲ Do not carry out any repairs to the fuel injection system without checking that the fuel pressure has dropped to zero and that the fuel temperature has either reached ambient temperature or is below 30°C, whichever is the greater. Failure to follow these instructions may result in personal injury.**

1. Using datalogger in the Ford diagnostic equipment, check that the fuel pressure has dropped to zero and that the fuel temperature has either reached ambient temperature or is below 30°C, whichever is the greater.
2. Raise and support the vehicle.

REFER to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).



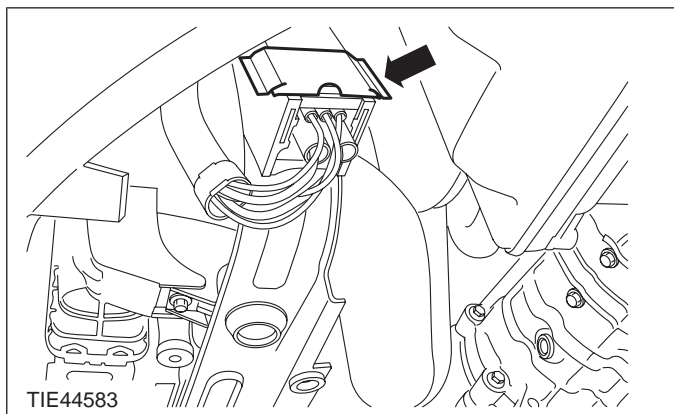
3. Remove the engine undershield.



4. Remove the radiator undershield.

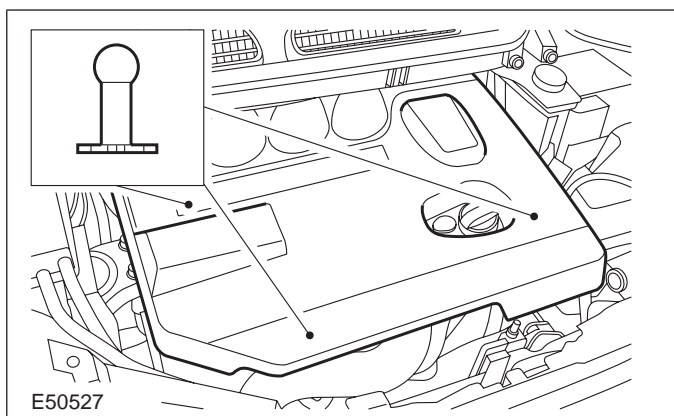


## DIAGNOSIS AND TESTING



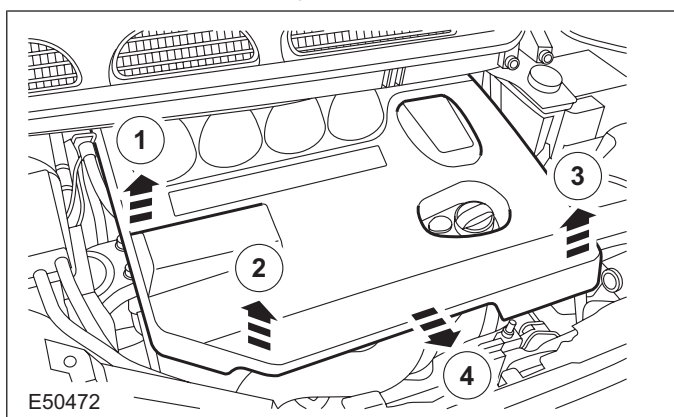
5. Remove the glow plug relay.
6. Lower the vehicle.
7. Remove the cowl panel grille.

REFER to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).



8. **NOTE:** The engine upper cover is held in place by 3 ball clips. The ball clips are not vertical, but are angled backwards by approximately 20 degrees.

Location of the engine upper cover ball clips.



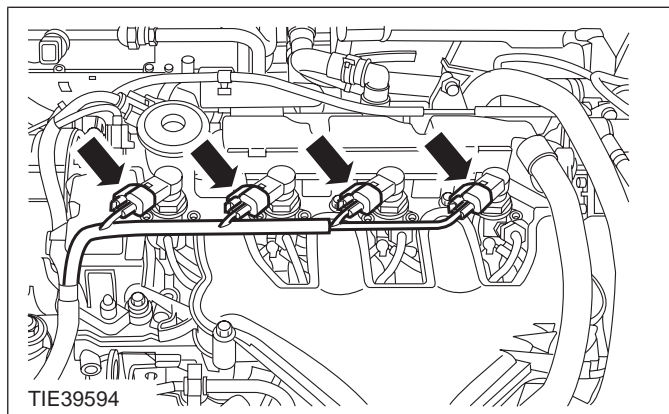
9. **CAUTION:** Contact of the engine upper cover with the cowl panel may cause damage (scratches) on the engine upper cover. If the ambient temperature is below 0°C, detach the engine upper cover with extreme caution.

Failure to follow this instruction may cause the engine upper cover to be damaged.

**NOTE:** Only remove and install the engine upper cover in the sequence shown.

Remove the engine upper cover.

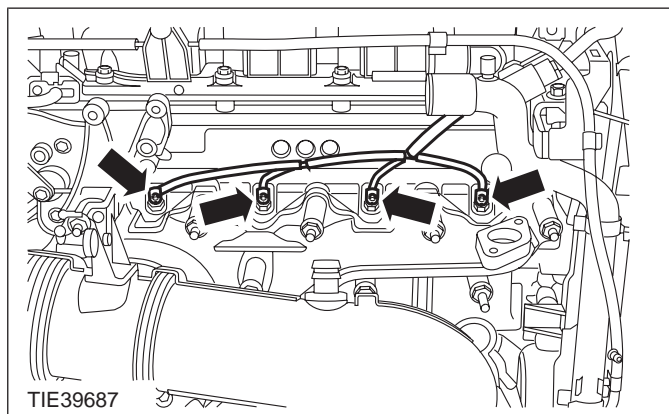
- Detach the engine upper cover ball clips in the sequence shown.



10. **CAUTION:** Do not disconnect the fuel injection pump electrical connectors and crank the engine.

Disconnect the fuel injector electrical connectors.

11. Remove the exhaust gas recirculation (EGR) cooler.
12. Remove the EGR valve.



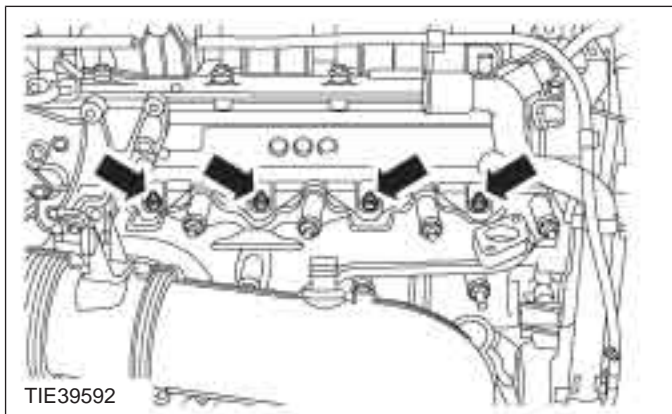
13. Remove the glow plug power supply.

303-00-13

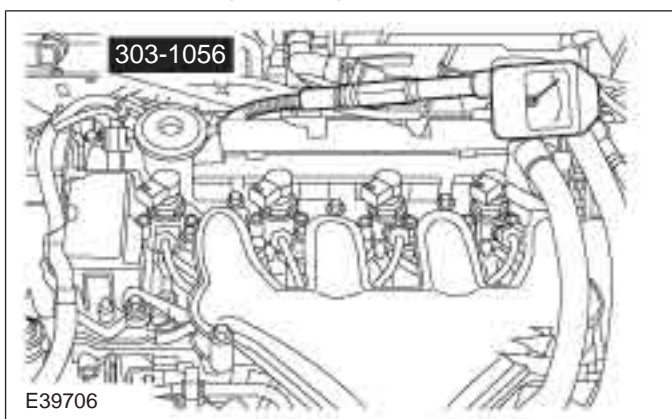
Engine System - General Information

303-00-13

## DIAGNOSIS AND TESTING



14. Remove the glow plugs.

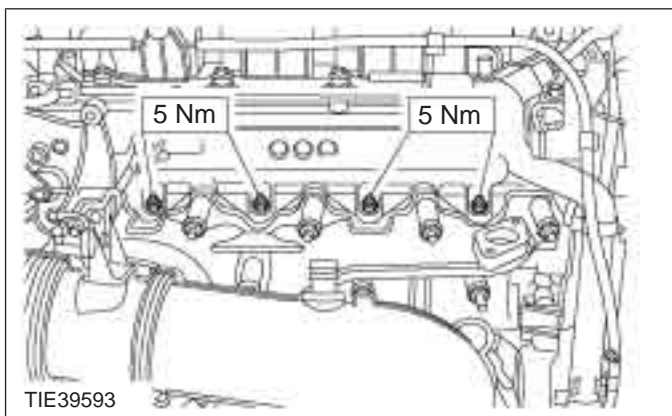


15. Install the special tool and a suitable compression tester into the glow plug bore.

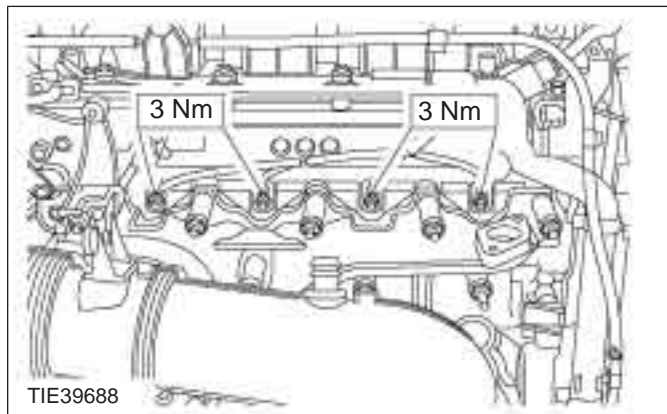
**NOTE:** Crank the engine with the starter motor until the pointer on the compression tester stops rising.

16. Carry out the measurement on all cylinders, following the measuring equipment manufacturer's instructions.

17. Detach the compression tester and the special tool.



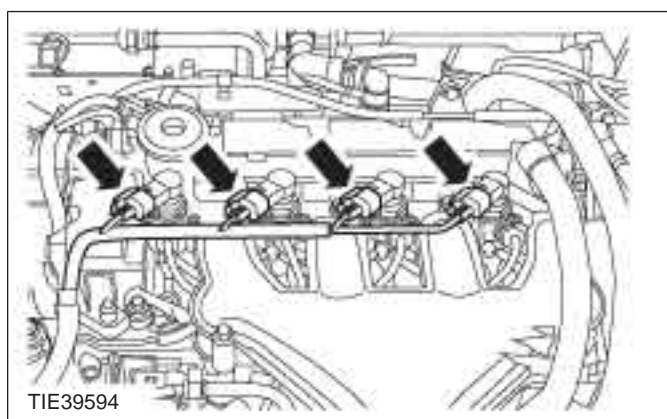
18. Install the glow plugs.



19. Install the glow plug power supply.

20. Install the EGR valve.

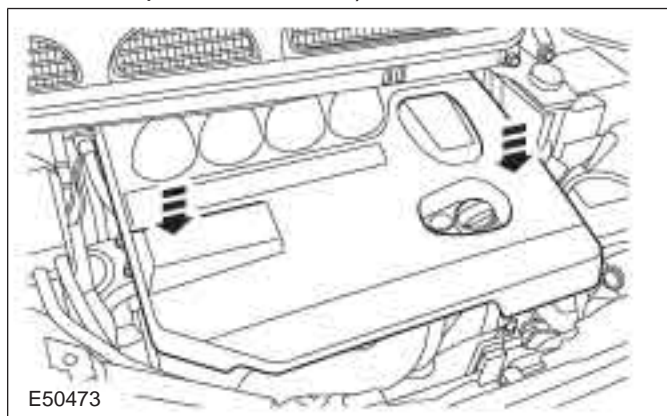
21. Install the EGR cooler.



22. Connect the fuel injector electrical connectors.

23. Apply soap solution to the ball clip mountings in the engine upper cover.

- Soap solution (maximum concentration of soap in water 1:200).



24. **⚠ CAUTION:** Contact of the engine upper cover with the cowl panel may cause damage (scratches) on the engine upper cover. Failure to follow this instruction may cause the engine upper cover to be damaged.



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## Engine System - General Information

303-00-14

## DIAGNOSIS AND TESTING

Put the engine cover into installation position and clip it in place by pressing at the places shown.

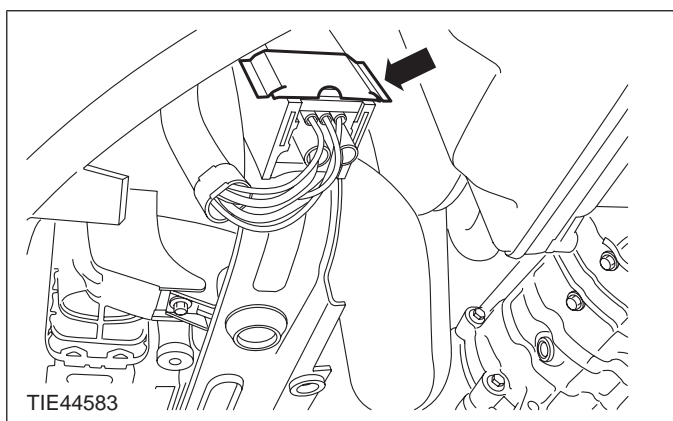
- Make sure that the engine upper cover is fully engaged in the area of the fuel filter, if necessary apply more pressure in the areas shown.

25. Install the cowl panel grille.

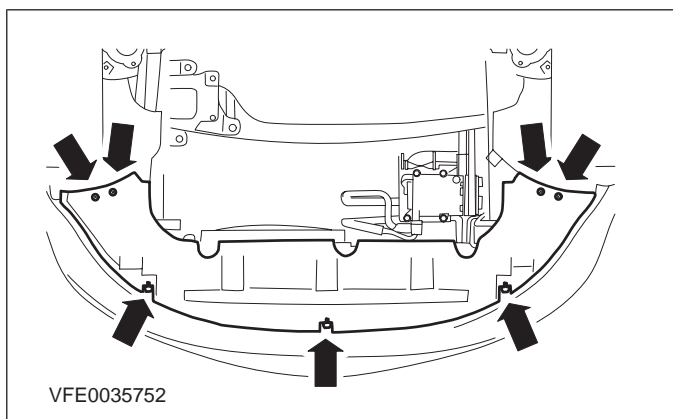
REFER to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).

26. Raise and support the vehicle.

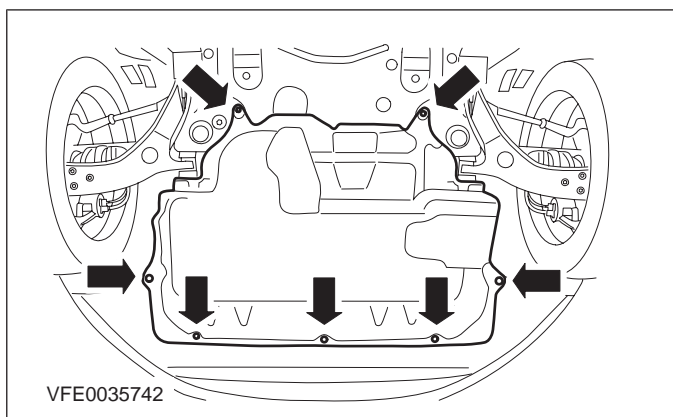
REFER to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).



27. Install the glow plug relay.



28. Install the radiator undershield.



29. Install the engine undershield.
30. Lower the vehicle.
31. Reset the PCM fault memory.

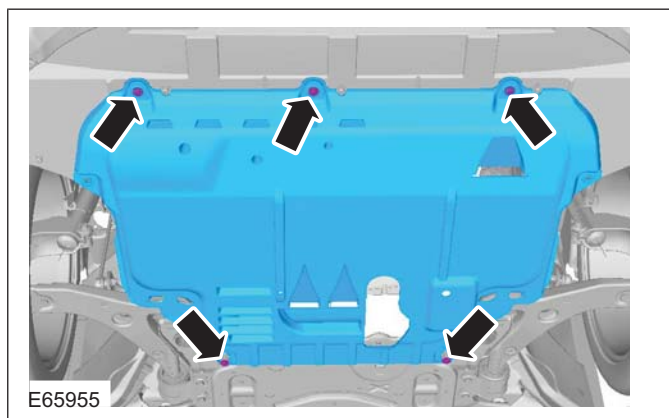
### Measure the oil pressure (21 113 0)

The oil pressure depends on various factors (engine speed, oil temperature, oil viscosity, amount of oil filter contamination etc.).

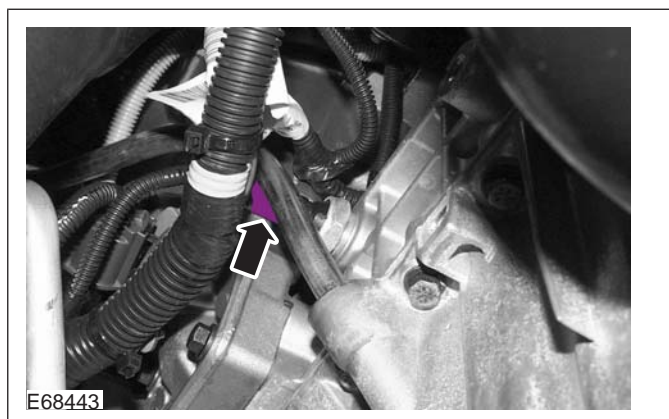
### Measure the oil pressure (Engine - 2.5L Duratec-ST (VI5))

1. Raise and support the vehicle.

REFER to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).



2. Remove the engine undershield.



3. Disconnect the oil pressure switch electrical connector.

## DIAGNOSIS AND TESTING



E68435

4. Remove the oil pressure switch.



E68436

5. Attach the oil pressure gauge with the oil pressure gauge connector to the oil pressure switch bore, and position it to allow reading from above.
6. Lower the vehicle.



E68436

7. **NOTE: Measure the oil pressure at an oil temperature of 100°C.**

**NOTE:** Measure the oil pressure at idle speed and at 4000 rpm.

**NOTE:** Minimum oil pressure at idle speed: 1.0 bar.

**NOTE:** Minimum oil pressure at 4000 rpm: 3.5 bar.

**NOTE:** Maximum oil pressure: 4.8 bar.

Measure the oil pressure.

8. Raise and support the vehicle.

REFER to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).



E68436

9. Detach the oil pressure gauge and connector from the oil pressure switch bore.
10. Coat the oil pressure switch with adhesive.



E68435

11. Install the oil pressure switch.



E68443

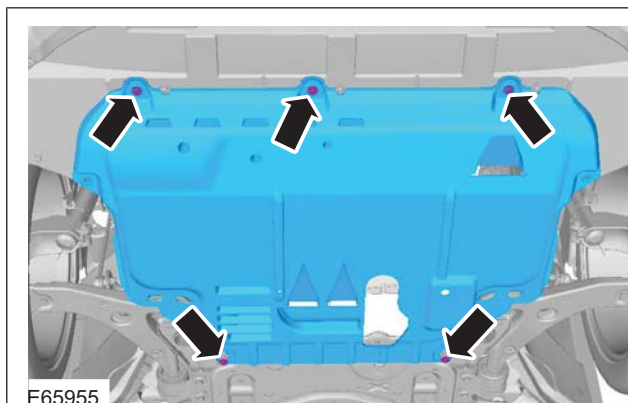
12. Connect the oil pressure switch electrical connector to the oil pressure switch.

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Engine System - General Information

303-00-16

## DIAGNOSIS AND TESTING

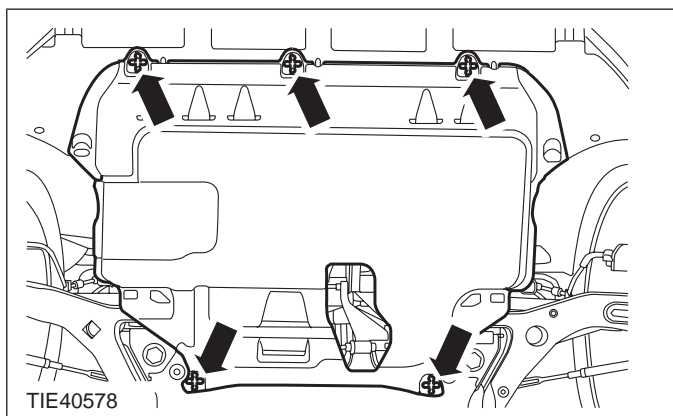


13. Install the engine undershield.
14. Lower the vehicle.

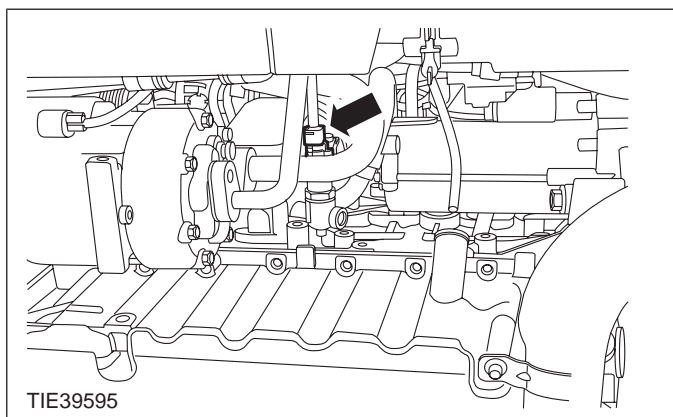
### Measure the oil pressure (Engine - 2.0L Duratorq-TDCi (DW) Diesel)

1. Raise and support the vehicle.

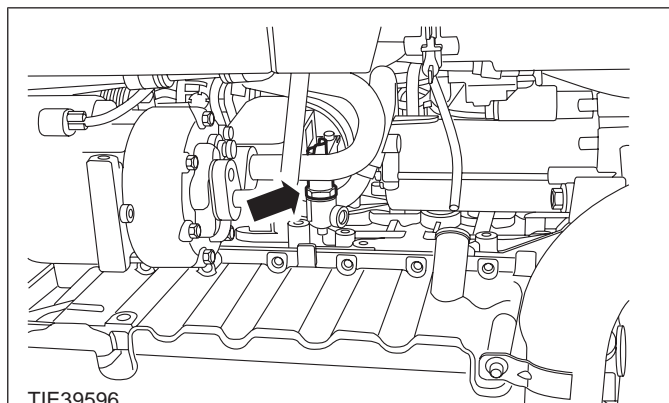
REFER to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).



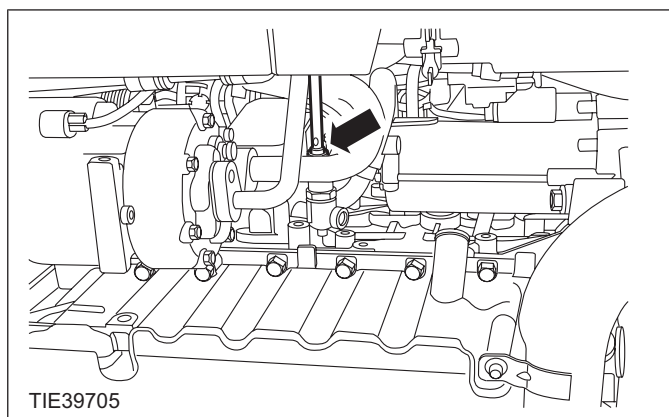
2. Remove the engine under shield.



3. Disconnect the oil pressure switch electrical connector.



4. Remove the oil pressure switch.



5. Attach the oil pressure gauge with the oil pressure gauge connector.

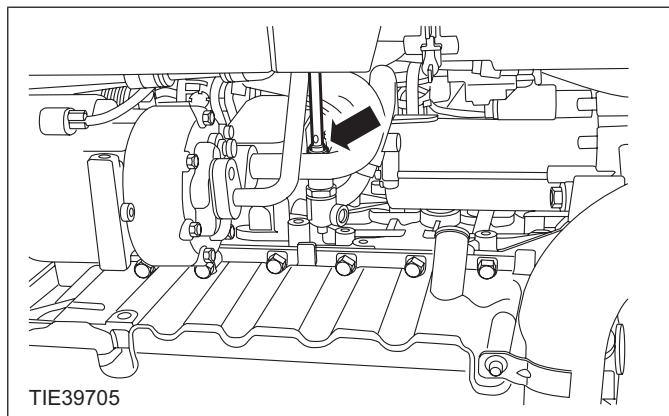
6. **NOTE: Measure the oil pressure at the specified engine speed. Measure the oil pressure at an oil temperature of 80° C.**

**NOTE:** Measure the oil pressure at 2000 rpm and at 4000 rpm.

**NOTE:** Oil pressure at 2000 rpm: 2.0 bar.

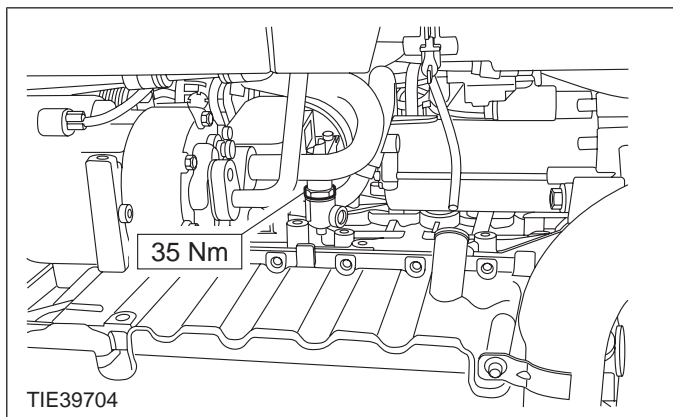
**NOTE:** Oil pressure at 4000 rpm: 4.0 bar.

Check the oil pressure.

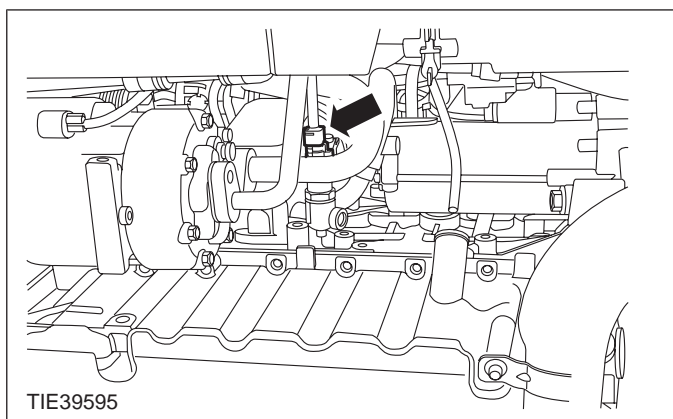


7. Detach the oil pressure gauge and the oil pressure gauge connector.
8. Coat the oil pressure switch with adhesive.

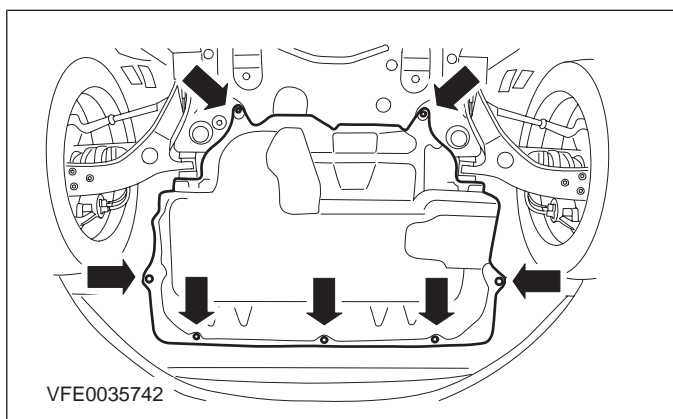


**DIAGNOSIS AND TESTING**

9. Install the oil pressure switch.



10. Connect the oil pressure switch electrical connector.



11. Install the engine under shield.

12. Lower the vehicle.

**Valve train analysis - static (engine off)**

Remove the valve cover.

Check all valve train components for damage and wear. Make sure that only original components are installed and that all bolts and nuts have been tightened to the correct tightening torque.

## SECTION 303-01 Engine — 2.5L Duratec (147kW/200PS) - VI5

### VEHICLE APPLICATION: 2008.50 Kuga

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21 132 6;  
21 132 7) 303-01-119



## SPECIFICATIONS

## Engine Data

Description		
Engine code	HYDB	HYDC
Firing order	1-2-4-5-3	
Emission level	Stage IV	Stage V
Bore	83 mm	
Stroke	93.2 mm	
Cubic capacity	2522 cm <sup>3</sup>	
Compression ratio	9 : 1	
Power output at 6000 rpm	147 kW (200 PS)	
Maximum torque at 1600 rpm	320 Nm	
Maximum engine speed (intermittent)	6850 rpm	
Maximum engine speed (continuous)	6500 rpm	
Idle speed	770 rpm	
Number of main bearings	6	
Camshaft drive	Belt	
Oil consumption	0.5 l/1000 Km	

## Engine Oil

Viscosity / ambient temperature	Type	Specification
<b>Recommended engine oil</b>		
SAE 5W-30 / below -20°C to over +40°C	Ford Formula E	WSS-M2C913-C
<b>Alternative engine oils (for top-up only)</b>		
SAE 10W-40 / -20°C to over +40°C	Ford Formula XR+	ACEA A3/B3
SAE 5W-40 / below -20°C to over +40°C	Ford Formula S	ACEA A3/B3

## Engine Oil Capacity

Description	Liters
Service fill including filter	5.8
Service fill excluding filter	5.5

## Oil Pressure

Description	Bar
Minimum oil pressure at 800 - 850 rpm (normal operating temperature)	1.0
Minimum oil pressure at 4000 rpm (normal operating temperature)	3.5

## SPECIFICATIONS

Description	Bar
Oil pressure relief valve opening pressure	4.8

## Valve Clearance

Description	mm
Valve clearance (engine cold), intake	0.17 - 0.23
Valve clearance (engine cold), exhaust	0.36 - 0.43

## Valves

Description	mm
Intake valve length	101.93 - 102.07
Intake valve shaft diameter	5.87 - 6.01
Intake valve guide clearance	0.05 - 0.07
Exhaust valve length	101.43 - 101.57
Exhaust valve shaft diameter	5.87 - 6.01
Exhaust valve guide clearance	0.05 - 0.07

## Valve Seats

Description	degree
Intake valve seat angle	45.33 - 45.67
Exhaust valve seat angle	45.33 - 45.67

## Cylinder Head

Description	mm
Cylinder head height	149.25 - 149.55
Maximum mating face distortion (lengthwise)	0.05
Maximum mating face distortion (crosswise)	0.02
Maximum face milling	0.30

## Camshafts

Description	mm
Intake camshaft lobe lift	8.68
Exhaust camshaft lobe lift	9.05

## Crankshaft

Description	mm
Crankshaft axial clearance	0.08 - 0.19

## Crankshaft Main Bearing Selection

	Code - Cylinder block		Code - Cylinder block		Code - Cylinder block	
	A		B		C	
Crankshaft main bearing for:	Cylinder block	Crankshaft main bearing carrier	Cylinder block	Crankshaft main bearing carrier	Cylinder block	Crankshaft main bearing carrier

303-01-5

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-5

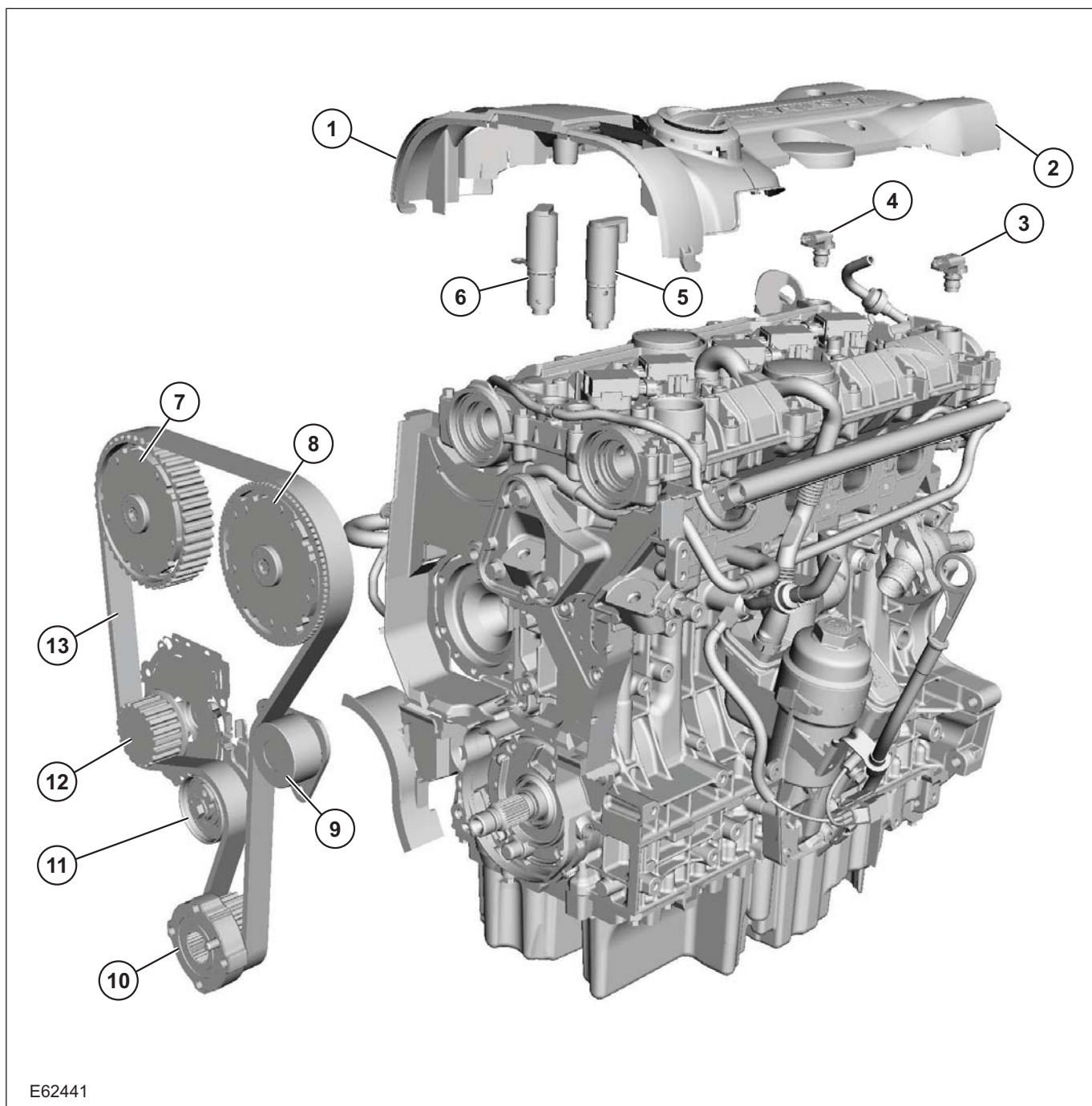
## SPECIFICATIONS

	Code - Cylinder block		Code - Cylinder block		Code - Cylinder block	
Code - Crankshaft						
<b>A</b>	yellow medium	yellow medium	yellow medium	blue thick	blue thick	blue thick
<b>B</b>	red thin	yellow medium	yellow medium	yellow medium	yellow medium	blue thick
<b>C</b>	red thin	red thin	red thin	yellow medium	yellow medium	yellow medium

DESCRIPTION AND OPERATION

Engine – Component Location

Engine



E62441

Item	Description
1	Front engine cover
2	Rear engine cover
3	CMP (camshaft position) Sensor - intake camshaft
4	CMP Sensor - exhaust camshaft

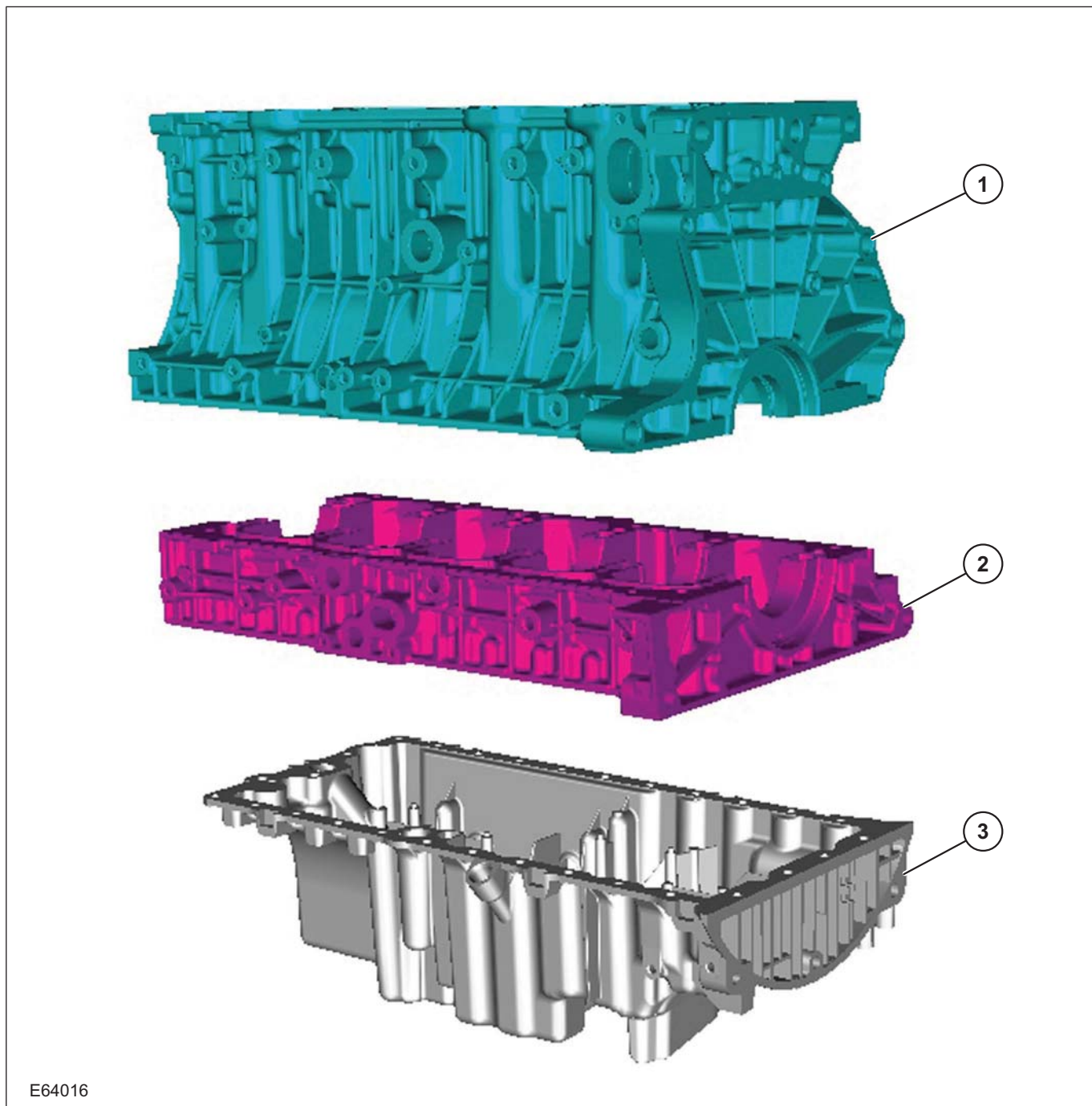
Item	Description
5	Intake variable camshaft timing oil control solenoid
6	Exhaust variable camshaft timing oil control solenoid
7	Exhaust VCT control unit
8	Intake VCT control unit

DESCRIPTION AND OPERATION

Item	Description
9	Timing belt idler pulley
10	Crankshaft timing belt pulley
11	Timing belt tensioner

Item	Description
12	Coolant pump pulley
13	Timing belt

Cylinder block



E64016

303-01-8

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-8

## DESCRIPTION AND OPERATION

Item	Description
1	Cylinder block
2	Bedplate

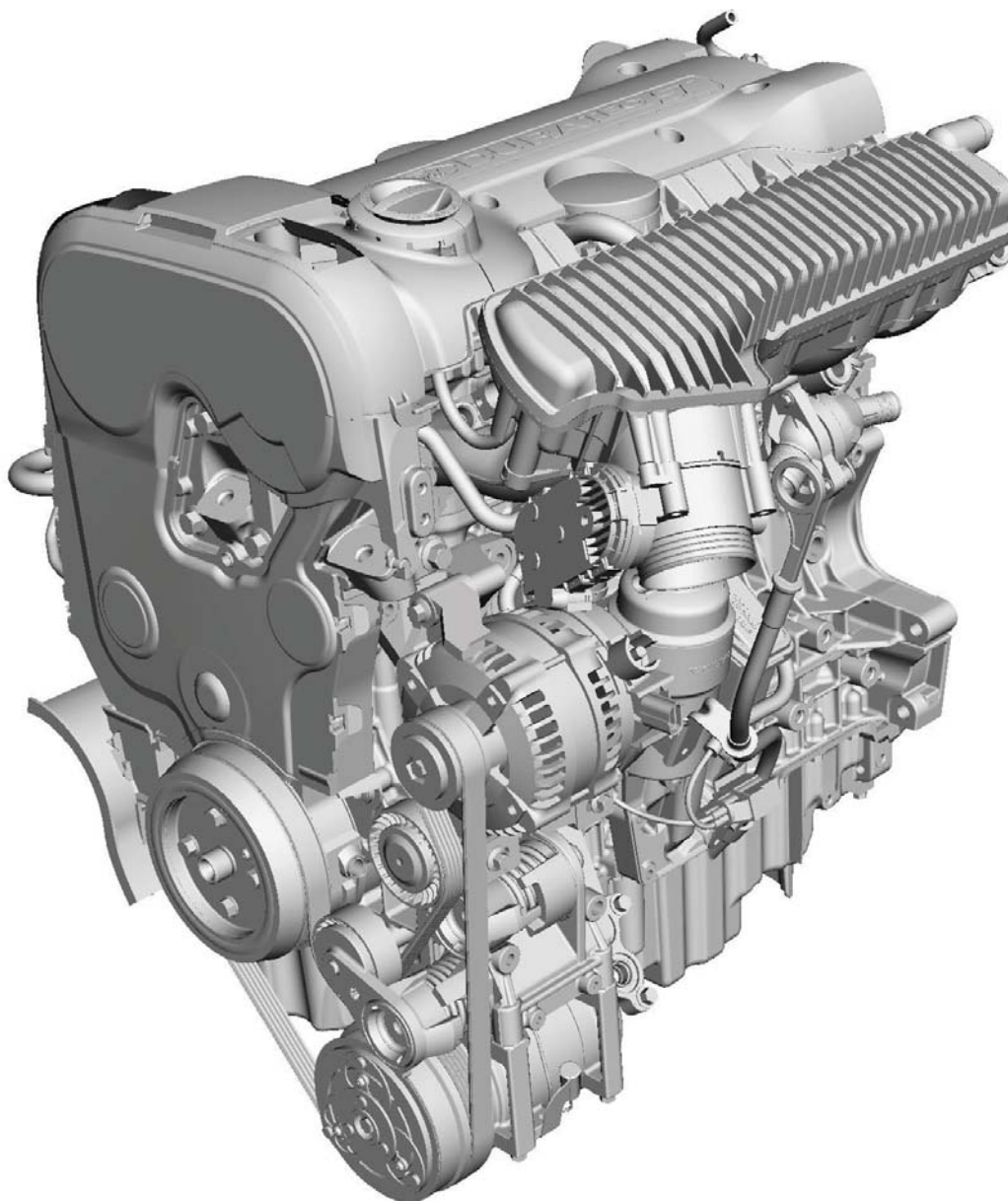
Item	Description
3	Oil sump



## DESCRIPTION AND OPERATION

## Engine – Overview

## General

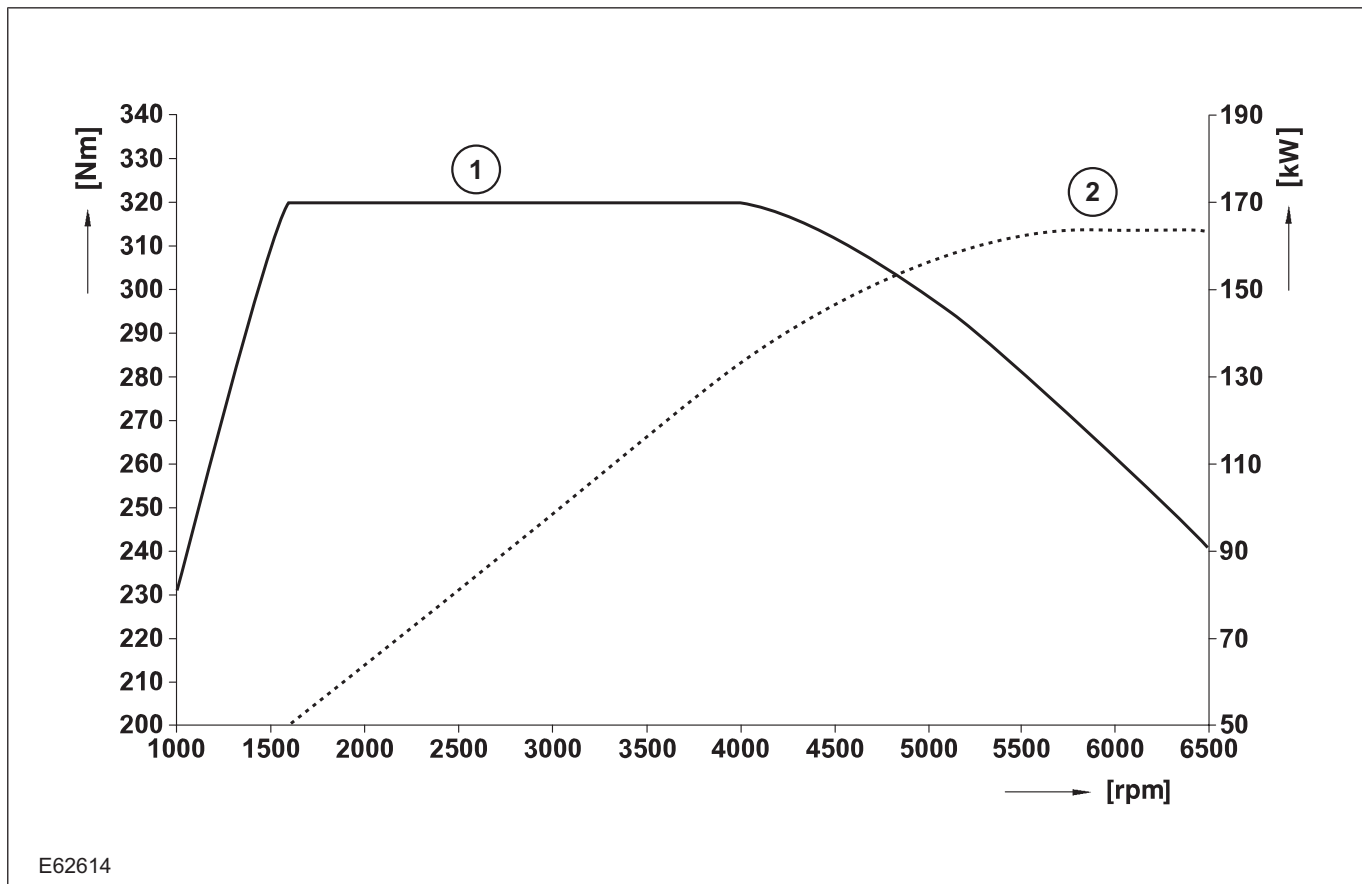


E62439

The 2.5L Duratec (V15) engine is a turbo engine with 5 cylinders and 20 valves, with electronically controlled camshaft adjustment for both camshafts.

The valve train is driven by a timing belt.

DESCRIPTION AND OPERATION



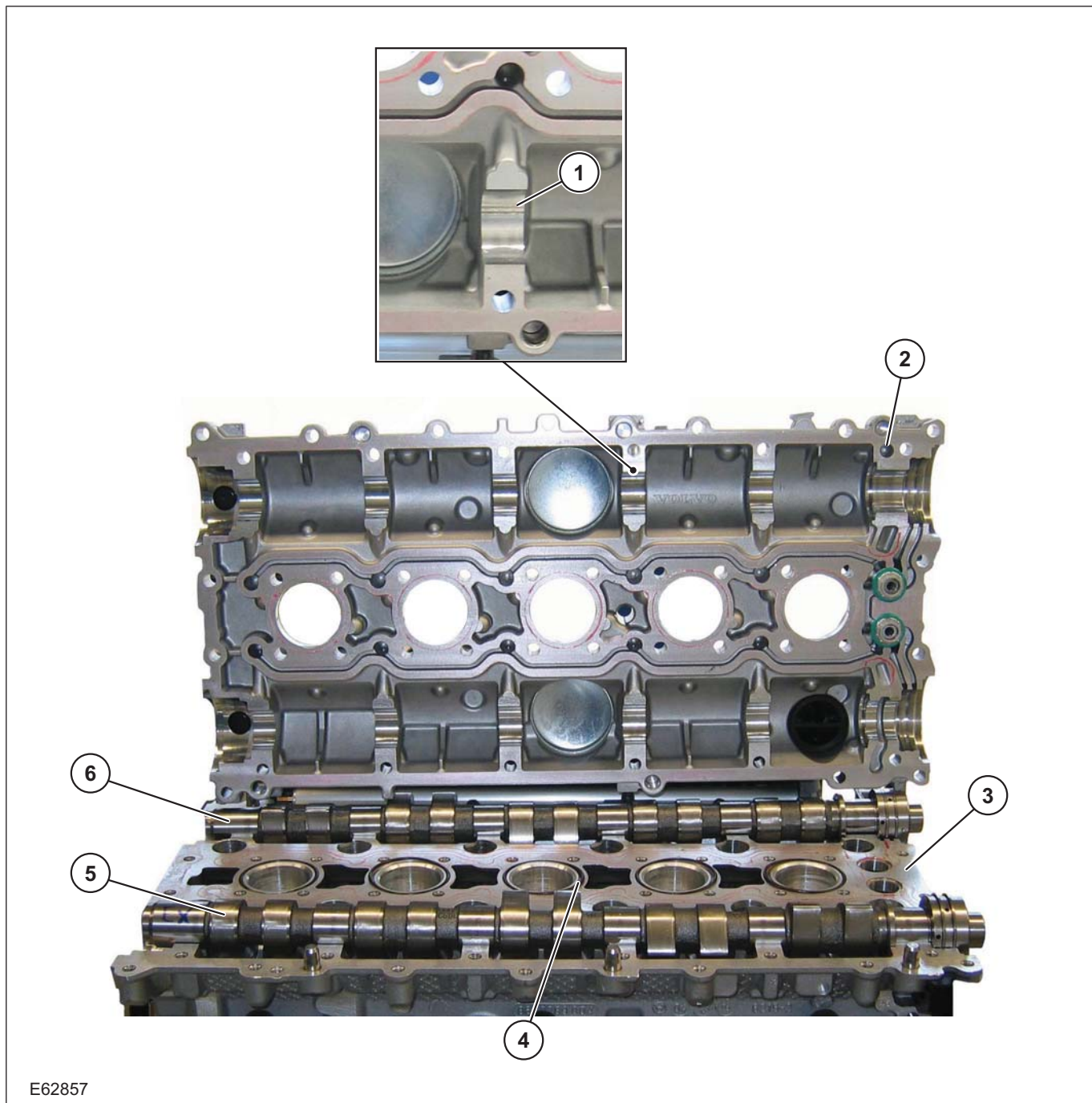
Item	Description
1	Engine speed curve
2	Power output curve

By the use of VCT for the intake and exhaust camshafts it is possible to attain maximum torque across a wide engine speed range.

**Cylinder head**

The cylinder head consists of two parts. The top half of the cylinder head consists of a valve cover with integral camshaft bearing caps.

DESCRIPTION AND OPERATION



E62857

Item	Description
1	Camshaft bearings
2	Valve cover
3	Cylinder head

Item	Description
4	Spark plug well sealing ring
5	Exhaust camshaft
6	intake camshaft

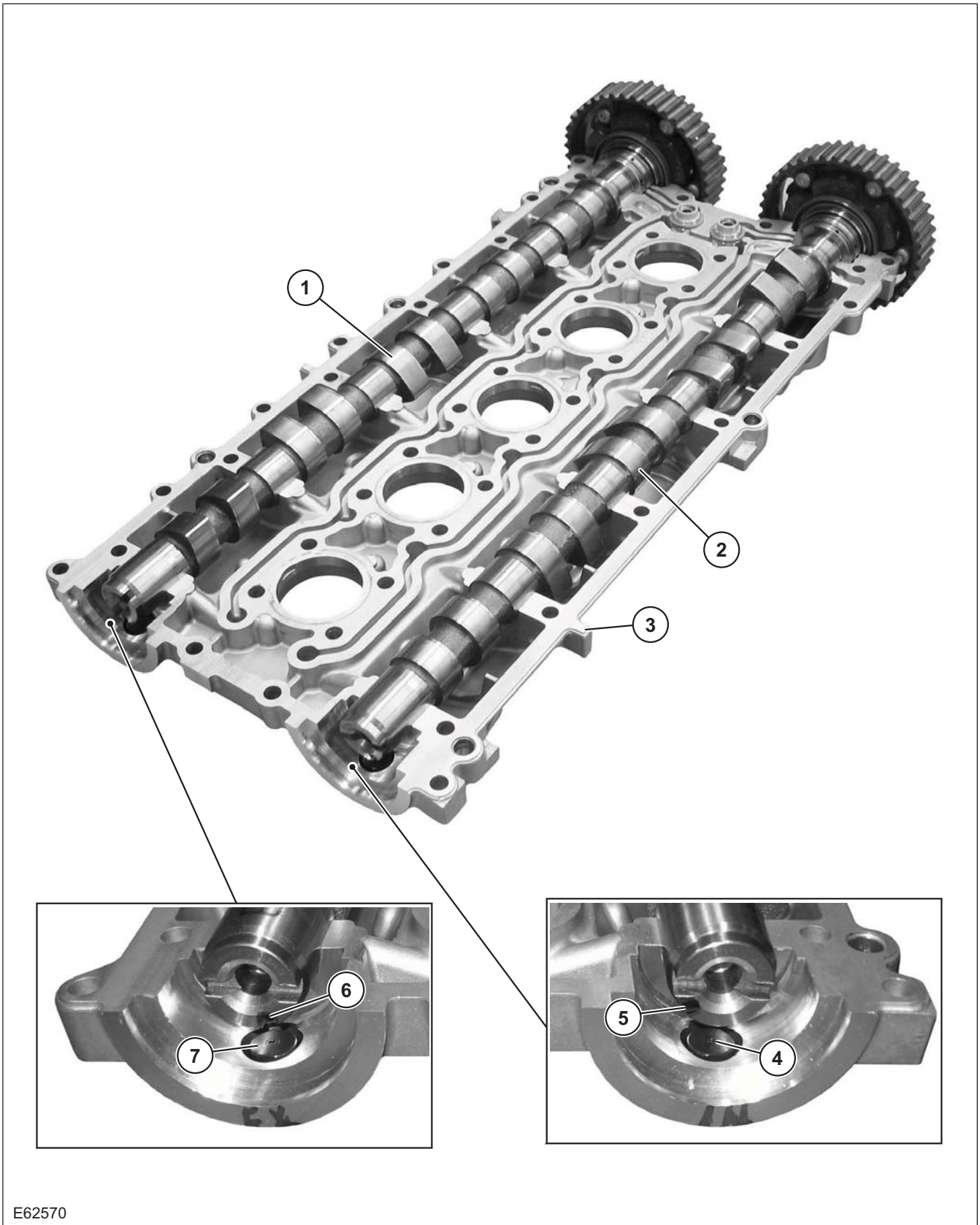
A conventional cylinder head gasket is installed between the cylinder head and the cylinder block.

The gaskets between the other mating faces are fluid gaskets.



DESCRIPTION AND OPERATION

Camshafts



E62570






## DESCRIPTION AND OPERATION

Item	Description
1	Exhaust camshaft
2	intake camshaft
3	Valve cover
4	CMP Sensor - intake camshaft

Item	Description
5	Intake camshaft reference mark
6	Exhaust camshaft reference mark
7	CMP Sensor - exhaust camshaft

 **CAUTION: Before removal, mark the camshafts as the intake and exhaust camshafts can be mixed up.**

A reference mark for the CMP sensor is machined into each camshaft. When the camshafts are set precisely to the timing marks, the machined mark on the exhaust camshaft is located roughly at the 5 o'clock position and the machined mark on the intake camshaft is located at 8 o'clock.

When changing the toothed belts it is not necessary to dismantle the camshaft adjustment units. A special tool prevents the VCT control units from turning during the adjustment process by locking the two VCT control units to one another.

A further special tool is needed to fix the camshafts in the adjustment position. The special tool engages in corresponding recesses for the reference marks on the CMP sensors.

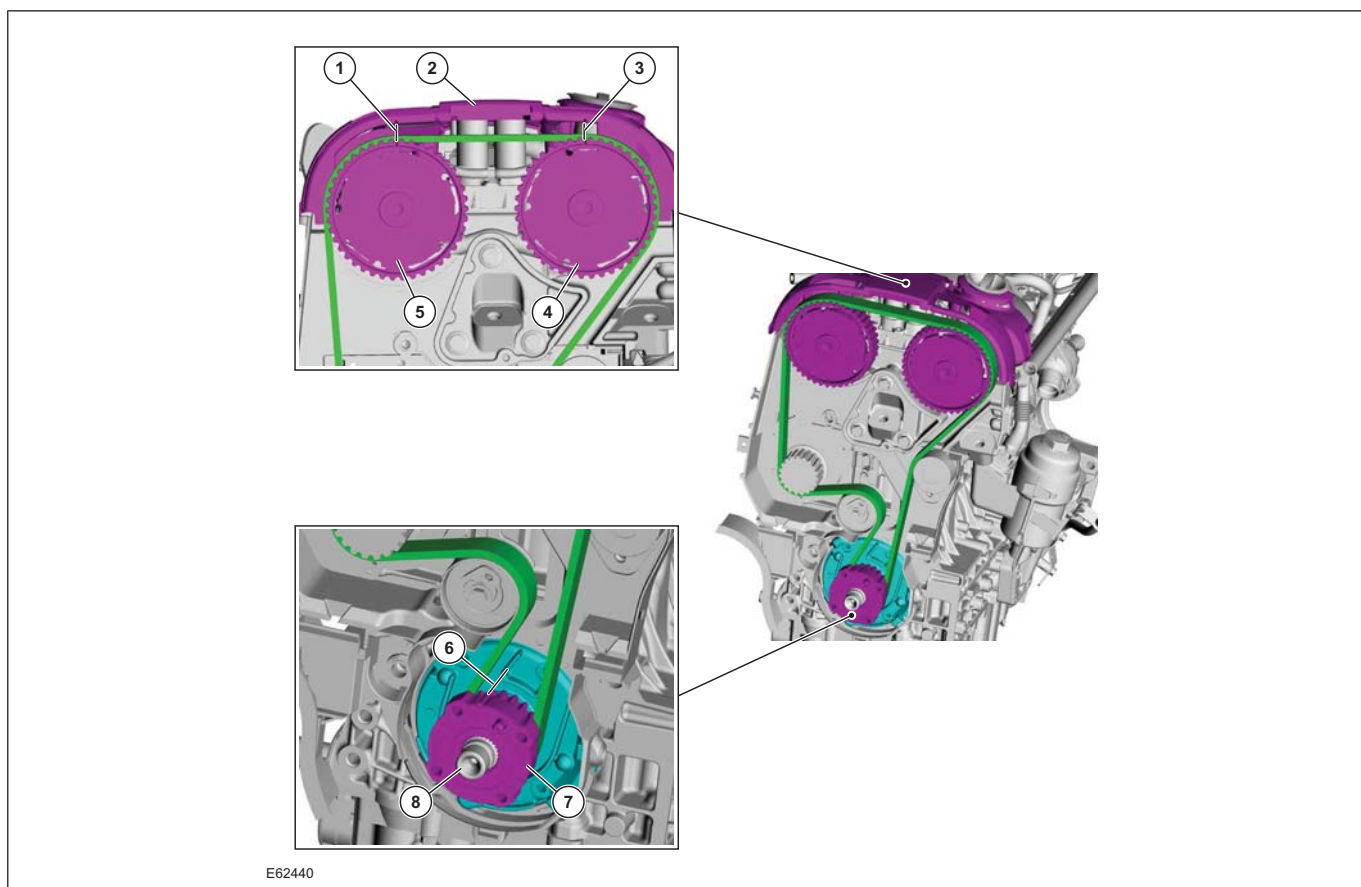
Each camshaft is fixed in place using four bearing caps and the bearing cap VVT. The bearing caps must not be changed around and must always be fitted in their original positions.

The VCT control units for the intake and exhaust camshafts are moved into the locked base position when the engine is stopped through the engagement of a spring-loaded locking pin. The movement to the locked base position is assisted by the tensile force of the timing belt for the intake VCT control unit. With the exhaust VCT control unit, a spring inside the control unit additionally assists in reaching the locked base position. The intake VCT control unit is in the "retarded timing" position and the exhaust VCT control unit is in the "advanced timing" position when in the locked base position. The lock is hydraulically released when the engine is started depending on the oil pressure.

The mechanical valve tappets are maintenance free.

## DESCRIPTION AND OPERATION

## Timing marks



E62440

Item	Description
1	Exhaust camshaft pulley timing mark
2	Engine front cover with timing marks
3	Intake camshaft pulley timing mark
4	Intake camshaft drive gear

Item	Description
5	Exhaust camshaft drive gear
6	Crankshaft timing belt pulley timing mark
7	Crankshaft timing belt pulley
8	Crankshaft

The front engine cover must always be fitted when checking and adjusting the valve timing or timing belt tension, as the timing marks for both camshaft pulleys are provided on its front end.

Correct timing belt tension is ensured by the automatic timing belt tensioner.

No direction of movement is specified when using a new timing belt. If, however, the old timing belt is reused, the direction of movement must be marked prior to removal.

Once the timing belt has been correctly tensioned, the engine must be rotated by hand two turns clockwise at the crankshaft in order to allow a

subsequent check of the timing belt tension and adjustment.

### Cylinder block

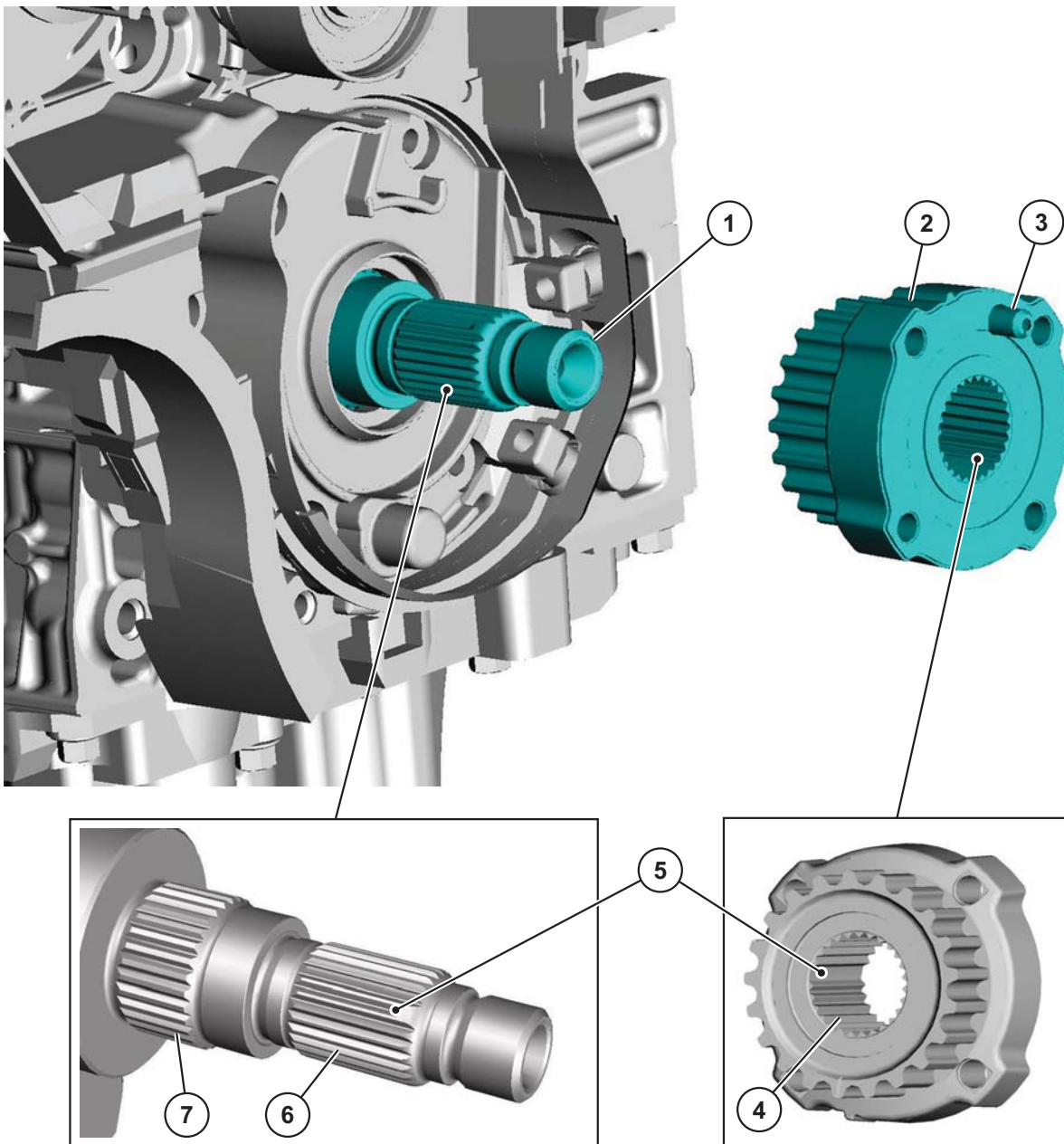
The cylinder block consists of three parts. These are the cylinder block, the lower crankcase and the sump pan. The cylinder block has five cylinder liners made of cast iron, which cannot be replaced.

The pistons are made of a homogeneous aluminum alloy with a graphite coating on the sides. This coating serves to reduce friction and dampen noise. The pistons are cooled from below via oil-spray nozzles screwed into the cylinder block.



DESCRIPTION AND OPERATION

Crankshaft



E62853

Item	Description
1	Crankshaft
2	Timing belt pulley
3	Dowel

Item	Description
4	Timing belt pulley splines
5	Wide spline
6	Crankshaft outer splines
7	Crankshaft inner splines

Located on the drive side of the crankshaft are two sets of splines. The inner splines drive the oil pump. The outer splines engage in the timing belt pulley. The timing belt pulley can only be fitted onto

the outer splines in a particular position. For this purpose, one spline on the timing belt pulley and one on the crankshaft have been made wider. The dowel fixes the vibration damper in place.

**DESCRIPTION AND OPERATION****Engine – System Operation and Component Description****System Operation**

The variable camshaft timing occurs electro-hydraulically and individually for both camshafts.

The camshaft adjusters work according to the vane cell principle and have an adjustment range of 52° crank angle on the intake side and 47° crank angle on the exhaust side. On starting the engine and during idling, both camshafts are mechanically locked in their starting positions. The exhaust camshaft is in the early position and the intake camshaft is in the late position. The camshaft

adjuster on the exhaust side has a torsion spring which compensates the camshaft drive torque. This ensures that the assembly can return to the starting position under all operating conditions and when the engine is turned off.

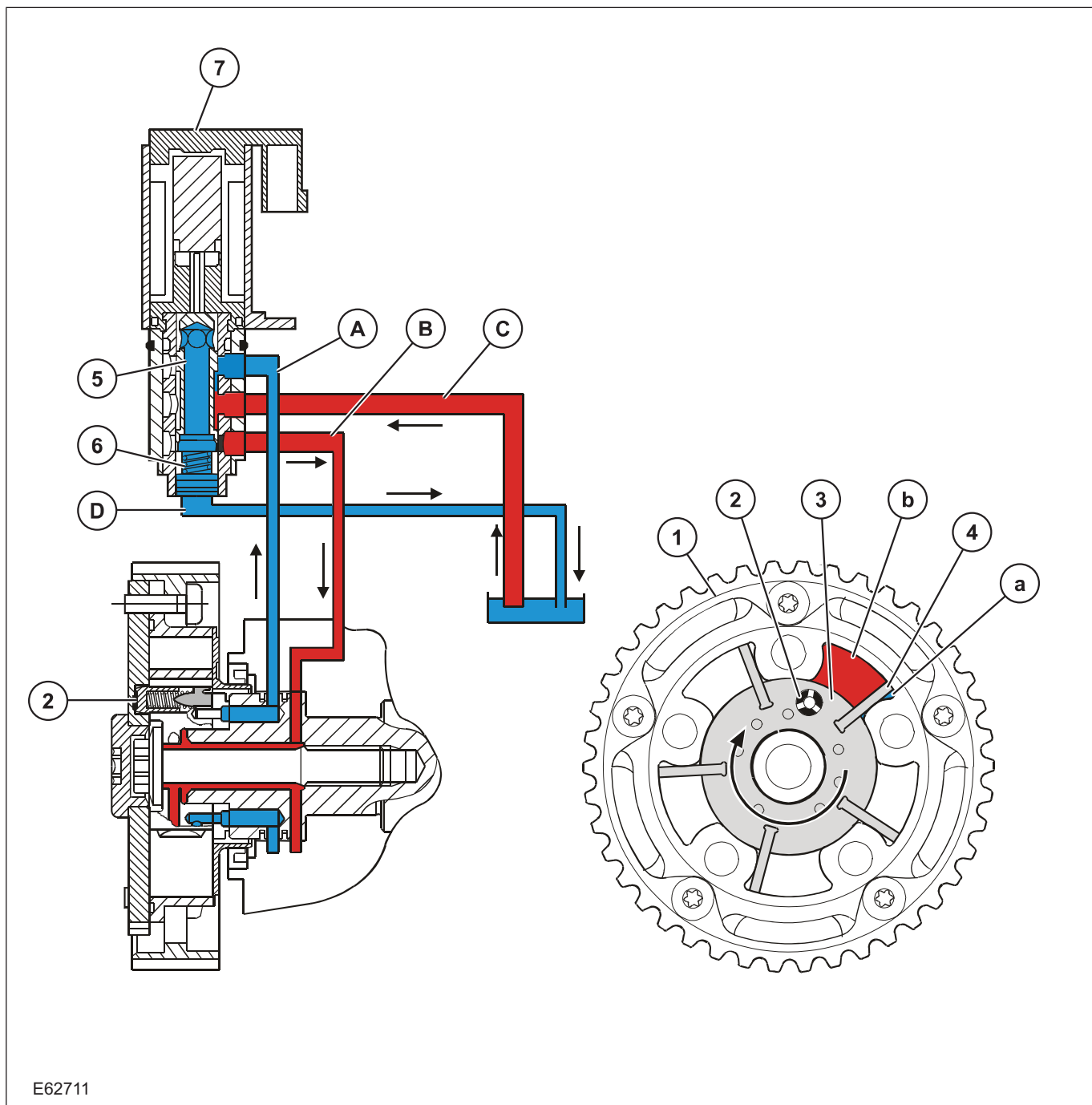
Internal exhaust gas recirculation can be realized through continuous adjustment of the timings. This results in better fuel consumption and more favorable combustion temperatures which produce less pollutants. This means that pollutant level IV can be adhered to with a 3-way catalytic converter.

The variable timings also make it possible to optimize performance with wide open throttle.

DESCRIPTION AND OPERATION

Variable camshaft timing

Timing retard



E62711

Item	Description
1	Camshaft pulley
2	Locking pin
3	Valve rotor
4	Rotor vane
5	Plunger

Item	Description
6	Return spring
7	Camshaft adjuster solenoid
A	Duct connected to chamber (a)
B	Duct connected to chamber (b)
C	Oil feed duct
Drive	Oil return duct

303-01-18

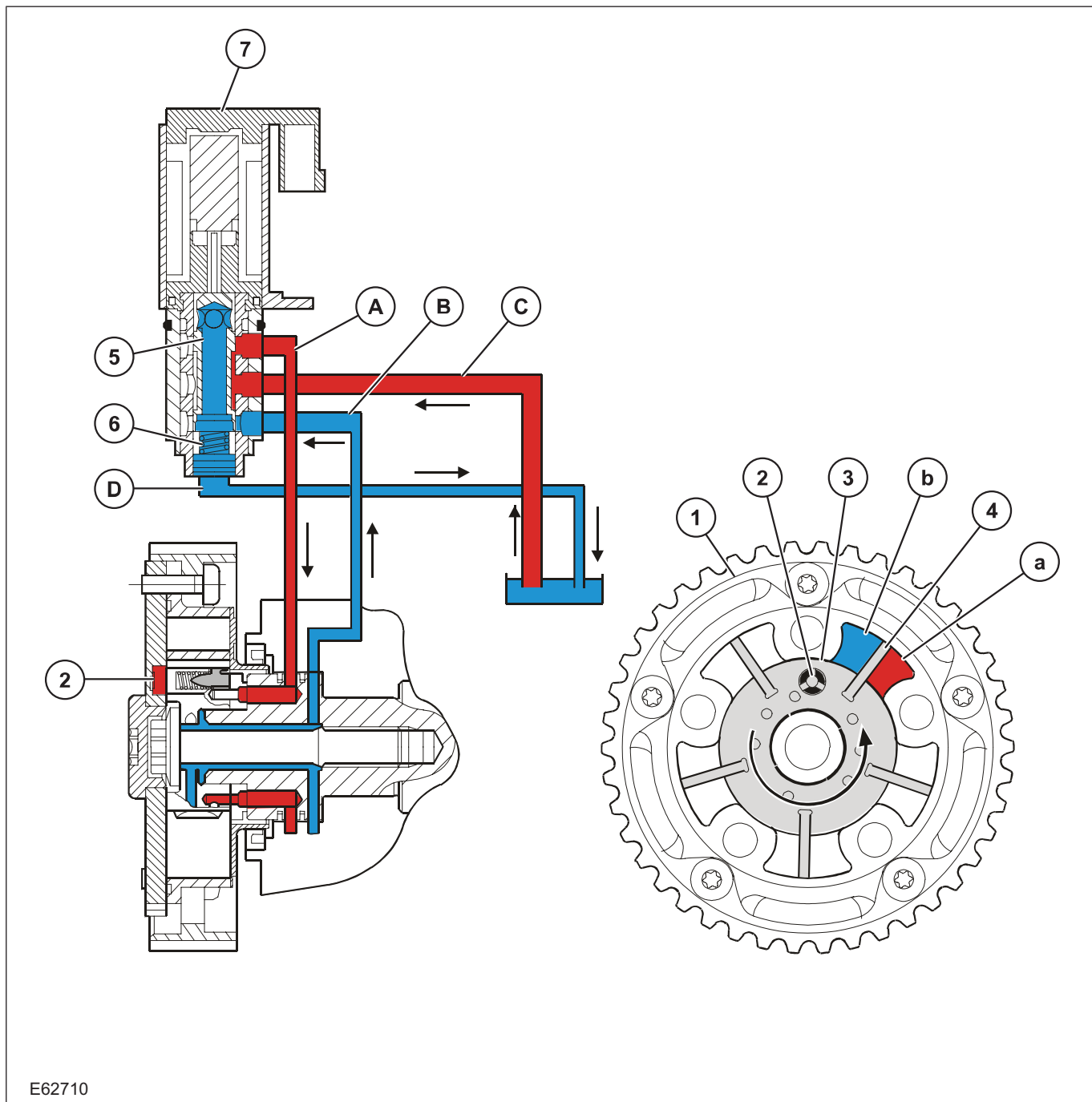
Engine — 2.5L Duratec (147kW/200PS) - V15

303-01-18

## DESCRIPTION AND OPERATION

The engine oil is drawn from the oil pan and routed to the camshaft oil ducts via the engine oil circuit before passing from there to the VCT oil control solenoid and to the locking pin. This releases the locking pin and separates the positive engagement between the camshaft pulley and the rotor. When

the control unit is being retarded, the chamber (b) fills with engine oil. The rotor turns clockwise because of the oil pressure in the chamber (b). The engine oil returning from the chamber (a) flows via the oil return duct (D) to the VCT oil control solenoid and from there back into the oil pan.



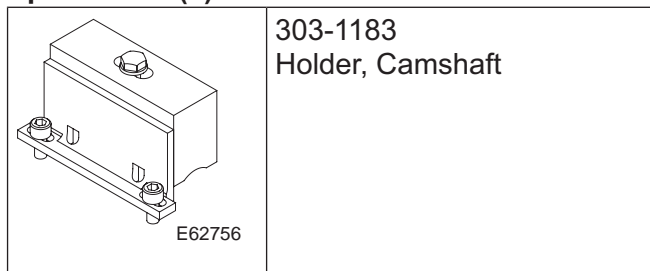
E62710

When the VCT control unit is being advanced, the chamber (a) fills with engine oil. The rotor turns counter-clockwise because of the oil pressure in the chamber (a). This completes the advance adjustment. The engine oil returning from the chamber (b) flows via the oil return duct (D) to the VCT oil control solenoid and from there back into the oil pan.

## GENERAL PROCEDURES

## Valve Clearance Adjustment

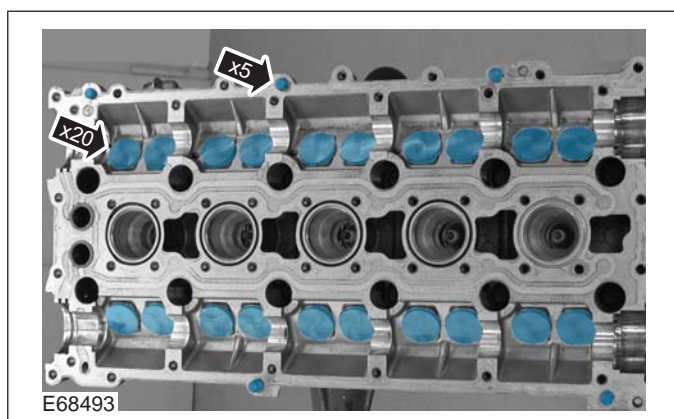
## Special Tool(s)



1. Remove the camshafts.

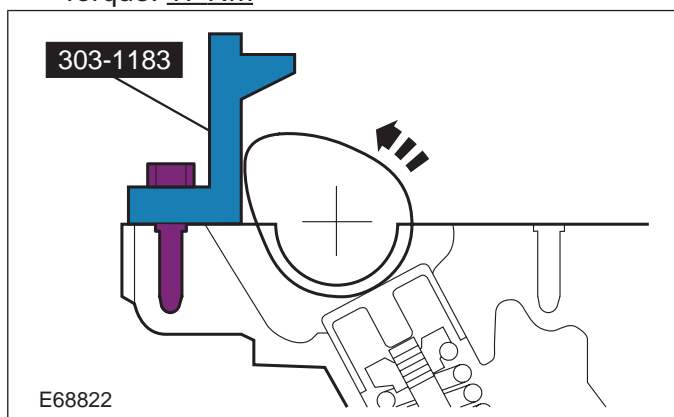
Refer to: **Camshafts** (303-01 Engine - 2.5L Duratec (147kW/200PS) - V15, Removal and Installation).

2.  **CAUTION: Make sure that the valve tappets are installed in their original locations.**



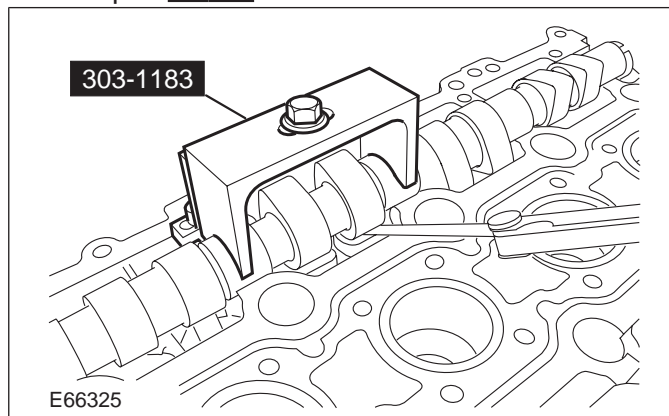
3. Install only one pair of tappets and the camshaft for the first measurement.

Special Tool(s): 303-1183  
Torque: 17 Nm



4. Measure the valve clearance and if necessary, adjust by installing new tappets.

Special Tool(s): 303-1183  
Torque: 12 Nm



5. Repeat the measuring procedures for all cylinders on the intake and on the exhaust side.



303-01-20

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-20

## REMOVAL AND INSTALLATION

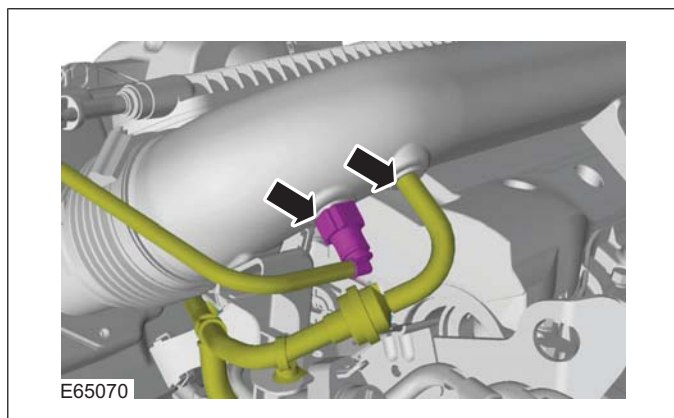
## Intake Manifold(21 183 0)

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

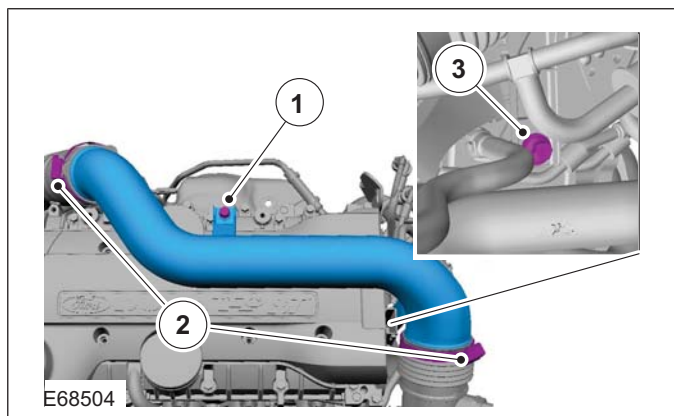
1. Refer to: **Fuel System Pressure Release** (310-00 Fuel System - General Information, General Procedures).
2. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: **Air Cleaner** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

4.

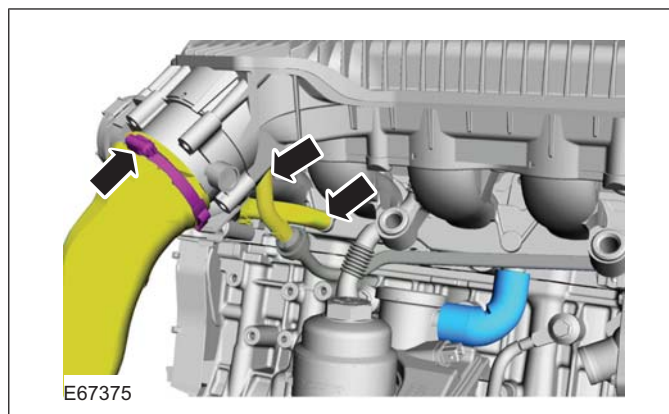


5. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

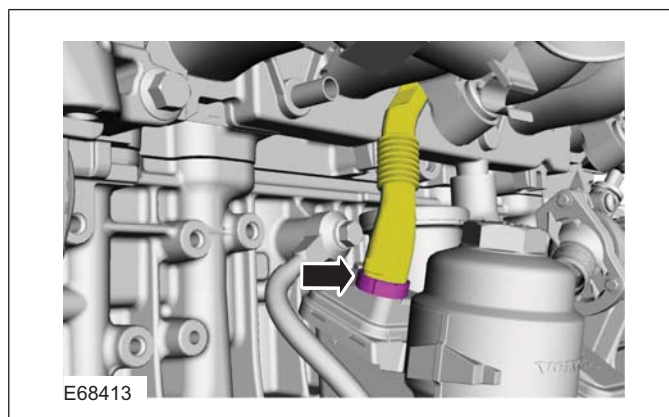
1. Torque: 10 Nm
2. Torque: 4 Nm
3. Torque: 10 Nm



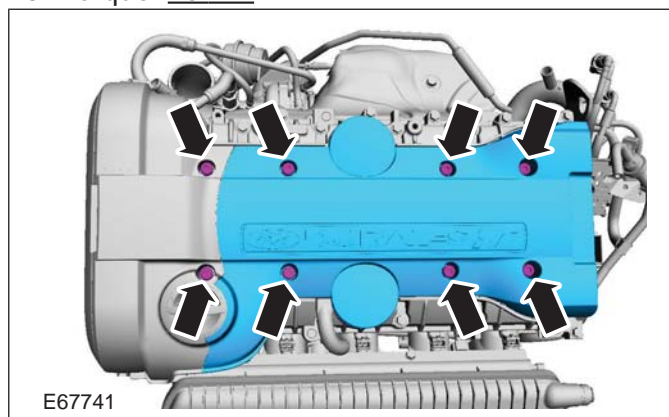
6.



7.



8. Torque: 10 Nm





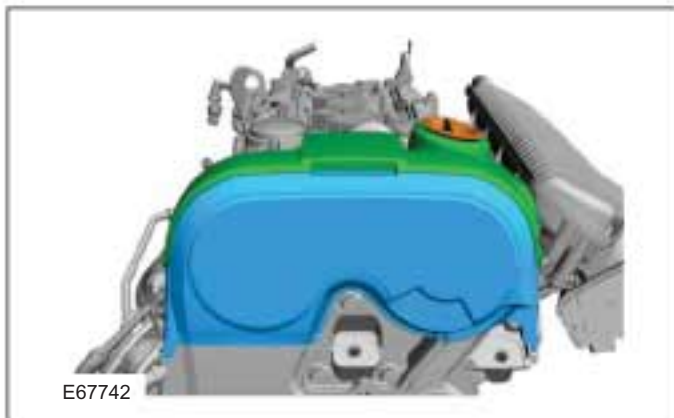
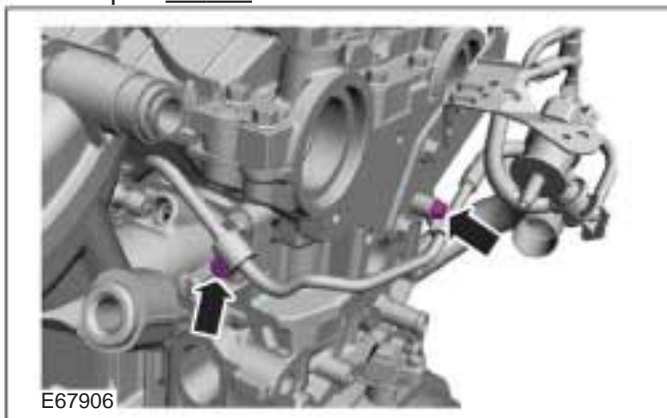
303-01-21

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-21

## REMOVAL AND INSTALLATION

9.

12 Torque: 10 Nm

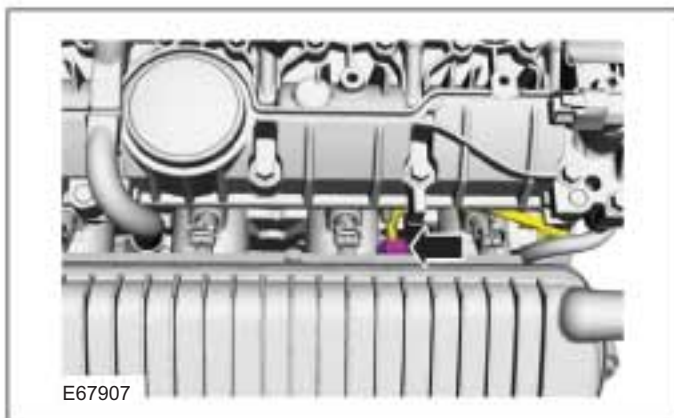
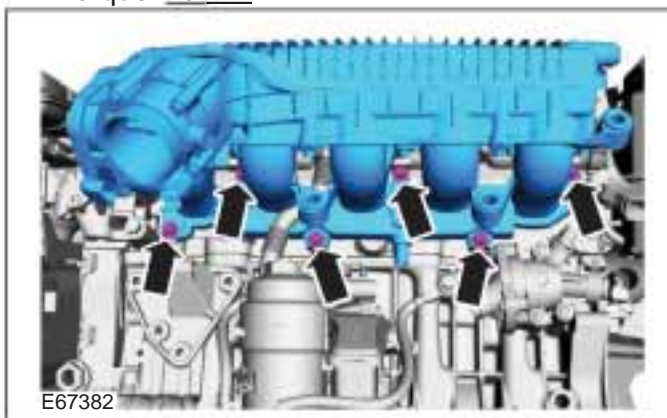
10.



13.



11.

14 Torque: 19 Nm

## Installation

1. To install, reverse the removal procedure.
2. Refer to: **Door Window Motor Initialization** (501-11 Glass, Frames and Mechanisms, General Procedures).

303-01-22

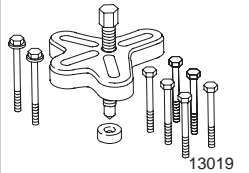
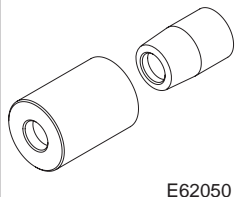
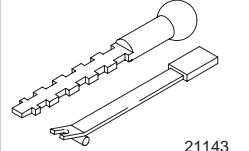
Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-22

## REMOVAL AND INSTALLATION

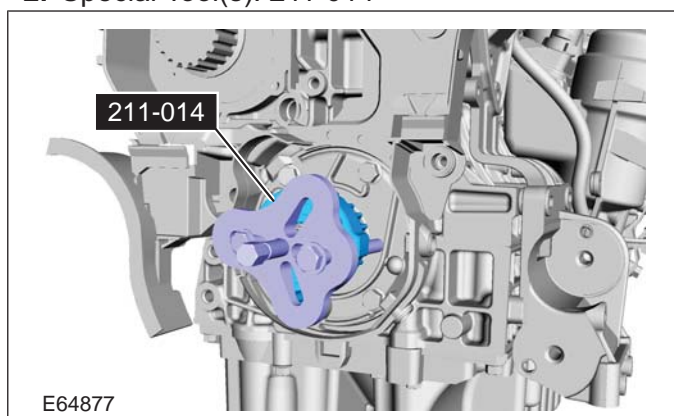
## Crankshaft Front Seal(21 467 0)

## Special Tool(s)

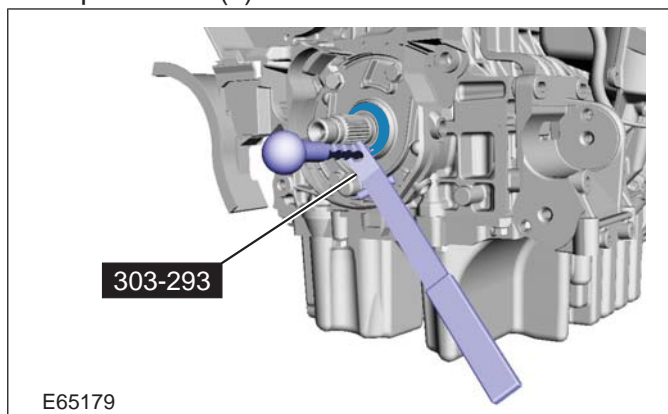
 <p>13019</p>	<p>211-014 Remover, Steering Wheel</p>
 <p>E62050</p>	<p>303-1180 Installer, Crankshaft Front Seal</p>
 <p>21143</p>	<p>303-293 Remover, Crankshaft Seal</p>

## Removal

1. Refer to: **Timing Belt** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
2. Special Tool(s): 211-014

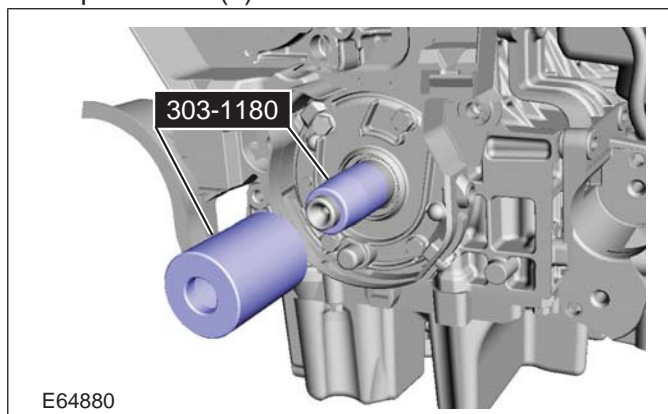


3. Special Tool(s): 303-293

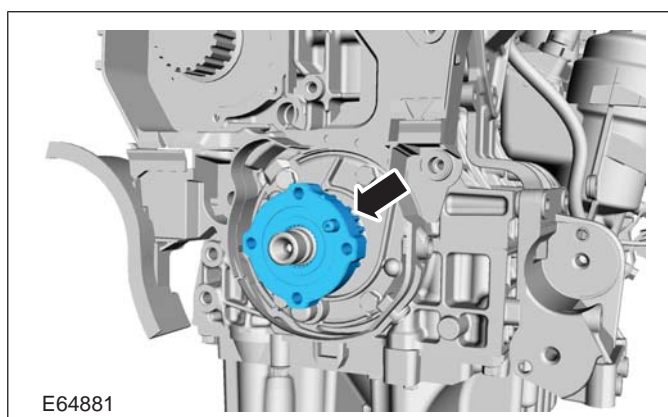


## Installation

1. Special Tool(s): 303-1180



2. **NOTE:** The crankshaft timing pulley can only be installed in 1 position on the crankshaft splines.

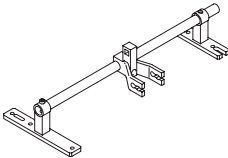
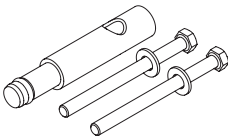
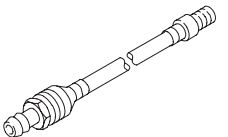
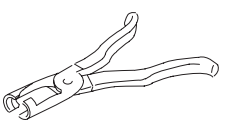


3. Refer to: **Timing Belt** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

REMOVAL AND INSTALLATION

Valve Stem Seals(21 238 0)

Special Tool(s)

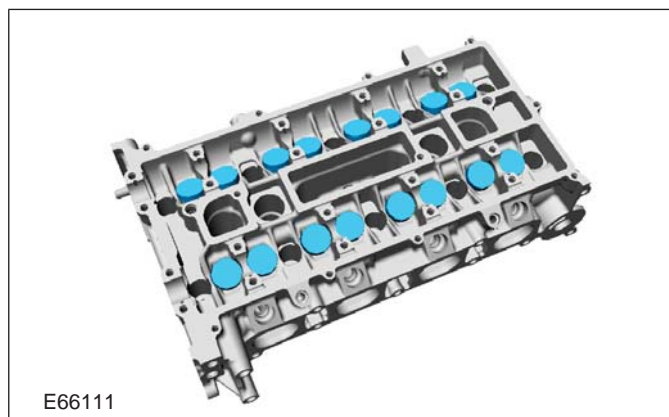
 <p>E62757</p>	<p>303-361B Compressor, Valve Spring</p>
 <p>E62041</p>	<p>303-361B-06 Adapter for 303-361B</p>
 <p>21157</p>	<p>303-363 Adapter, Air Supply (Cylinder Head)</p>
 <p>21211</p>	<p>303-508 Pliers, Valve Stem Seal</p>

Removal

1. Remove the camshafts.

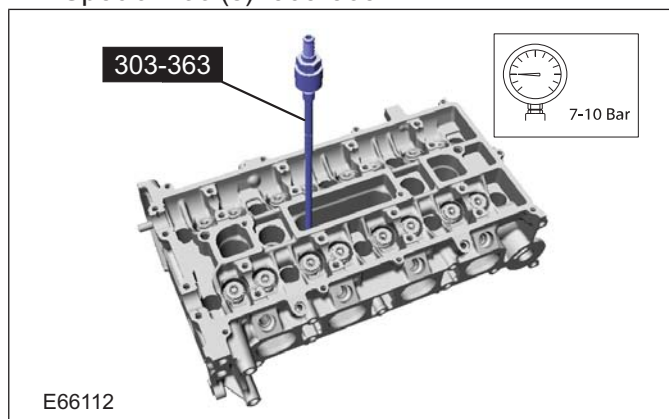
Refer to: **Camshafts** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

- 2.

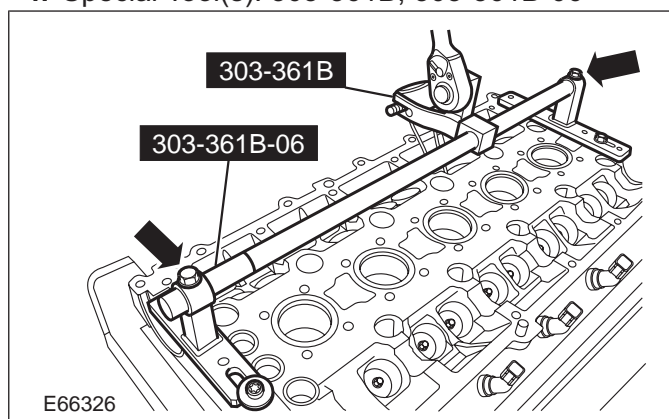


3. Using the special tool, apply 7 to 10 bar of compressed air into the cylinder.

Special Tool(s): 303-363



4. Special Tool(s): 303-361B, 303-361B-06



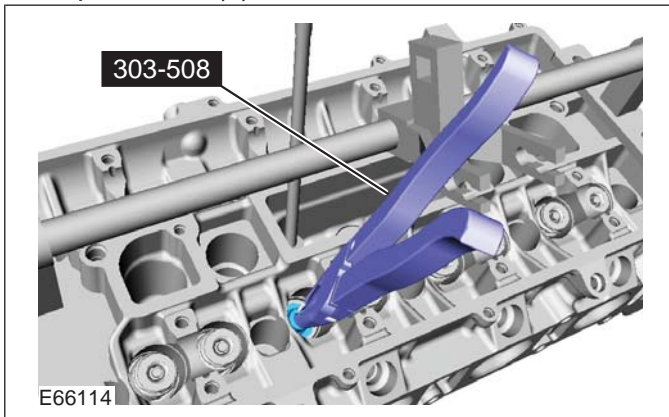
303-01-24

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-24

**REMOVAL AND INSTALLATION**

5. Special Tool(s): 303-508

**Installation**

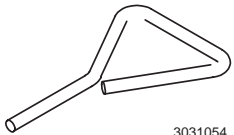
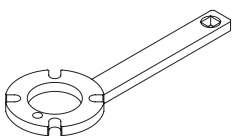
1. To install reverse the removal procedure.



REMOVAL AND INSTALLATION

Timing Belt(21 304 0)

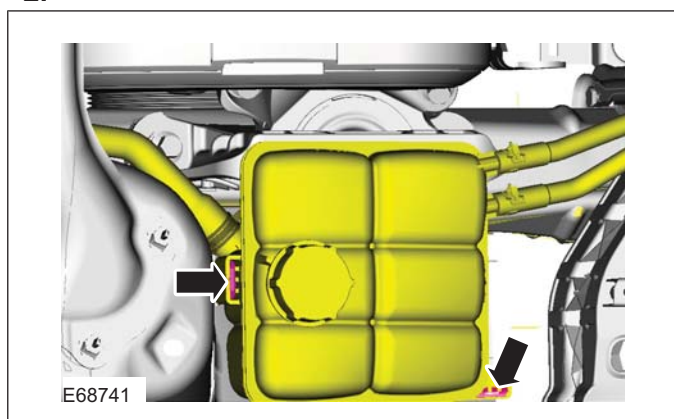
Special Tool(s) / General Equipment

 <p>3031054</p>	<p>303-1054 Locking Tool, Timing Belt Tensioner</p>
 <p>E62035</p>	<p>303-1179 Holding Wrench, Crankshaft</p>
<p>Trolley Jack</p>	
<p>Two Leg Puller</p>	

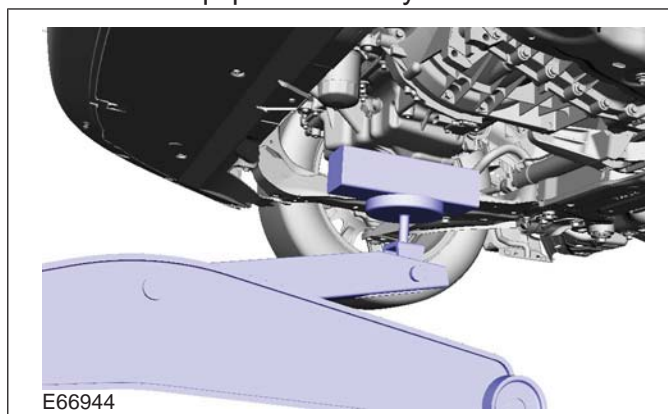
Removal

1. Refer to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

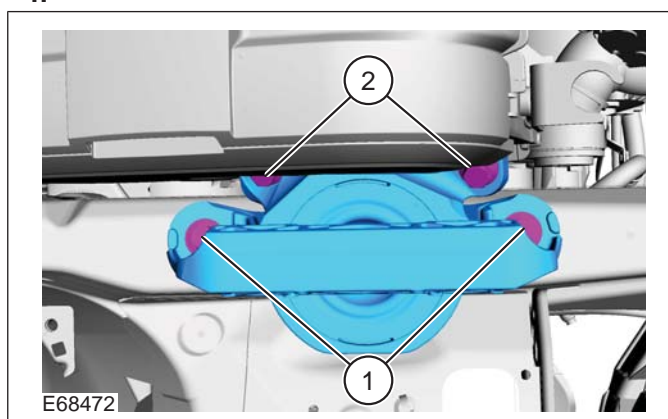
2.



3. General Equipment: Trolley Jack



4.

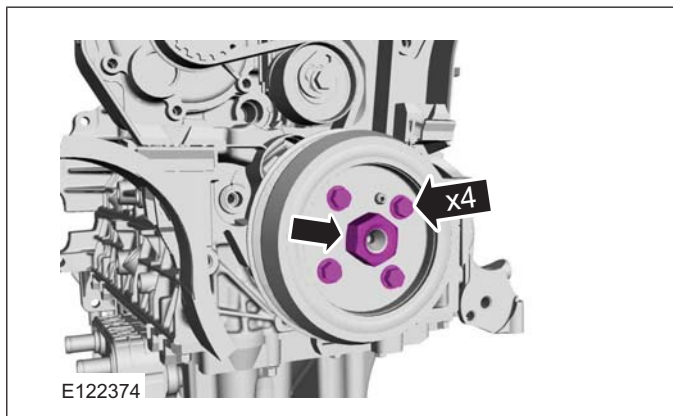


5.

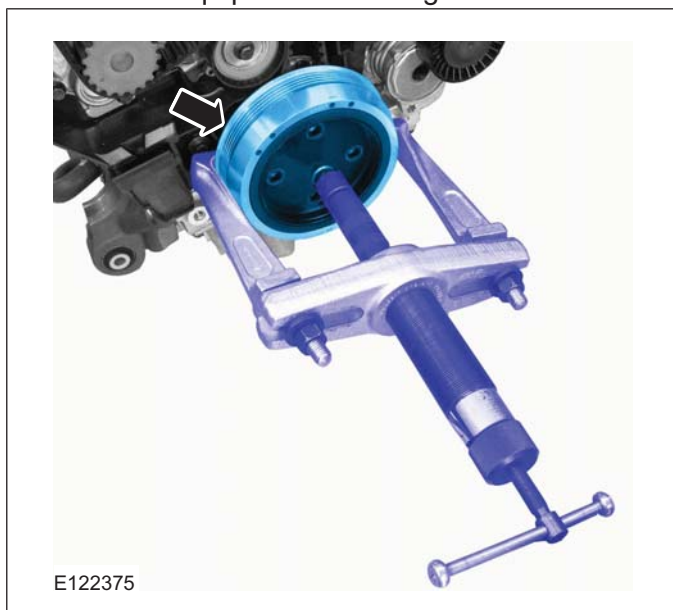


REMOVAL AND INSTALLATION

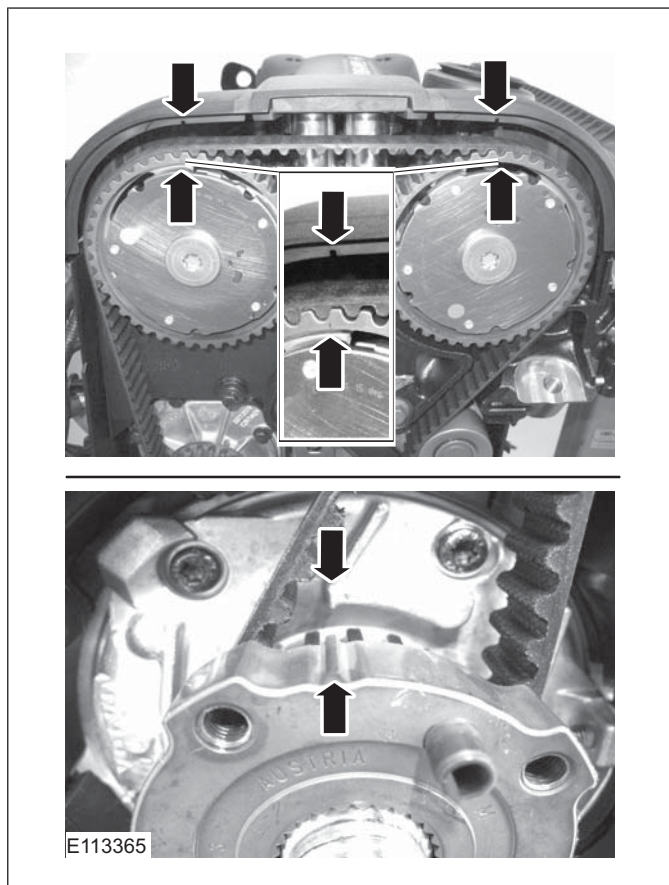
6.



7. General Equipment: Two Leg Puller



8.  **CAUTION:** Make sure that the installation marks are aligned.



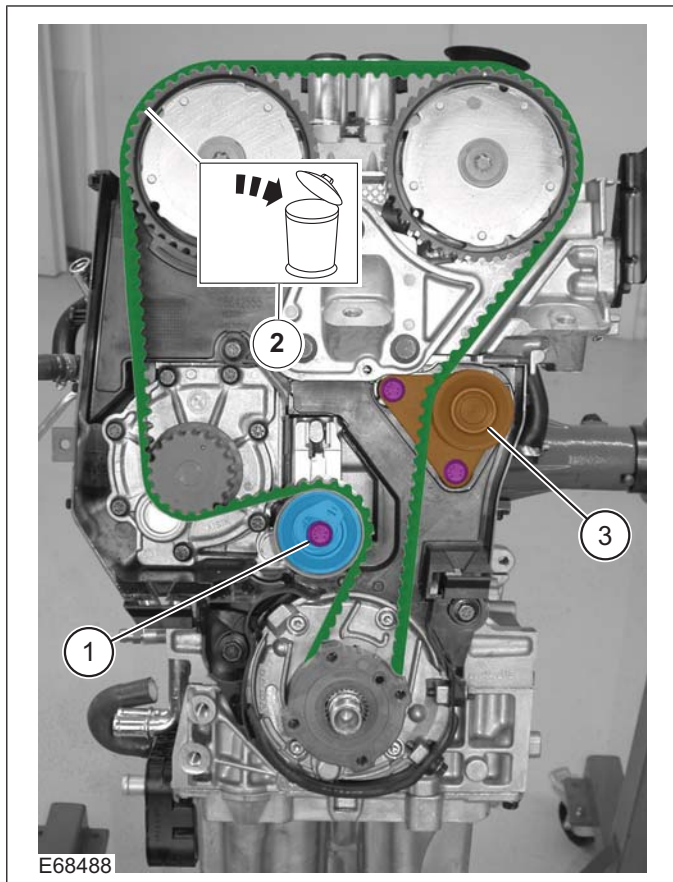




REMOVAL AND INSTALLATION

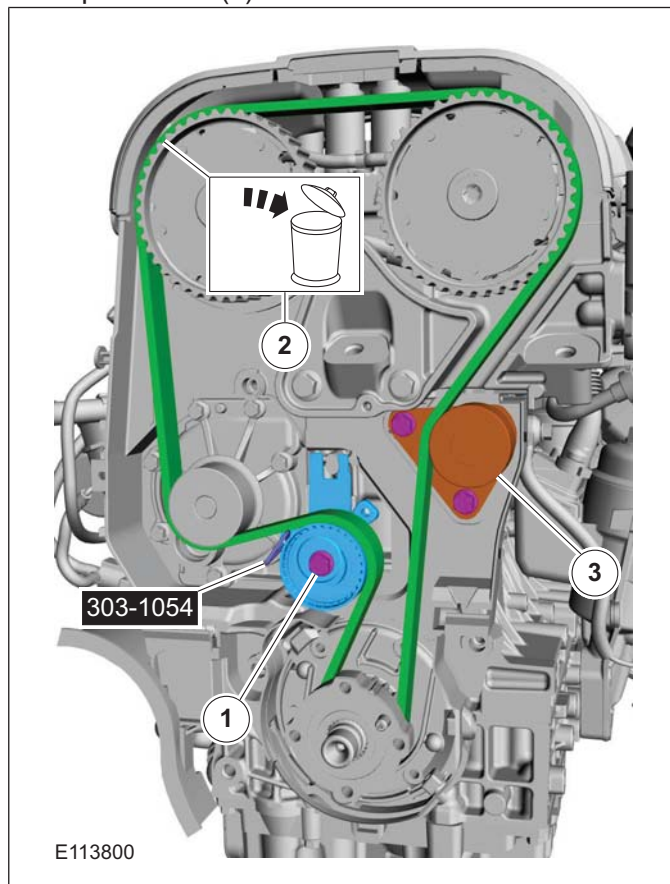
Vehicles with mechanical timing belt tensioner

9.



11. **⚠ WARNING:** Take extra care when handling the compressed spring.

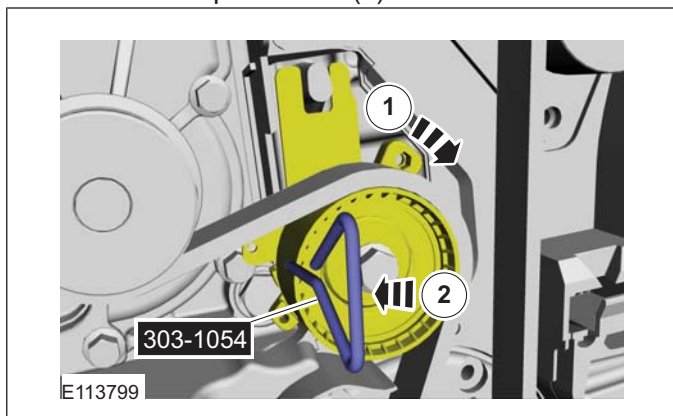
Special Tool(s): 303-1054



Vehicles with automatic timing belt tensioner

10. **⚠ WARNING:** Take extra care when handling the compressed spring.

Install the Special Tool(s): 303-1054



## REMOVAL AND INSTALLATION

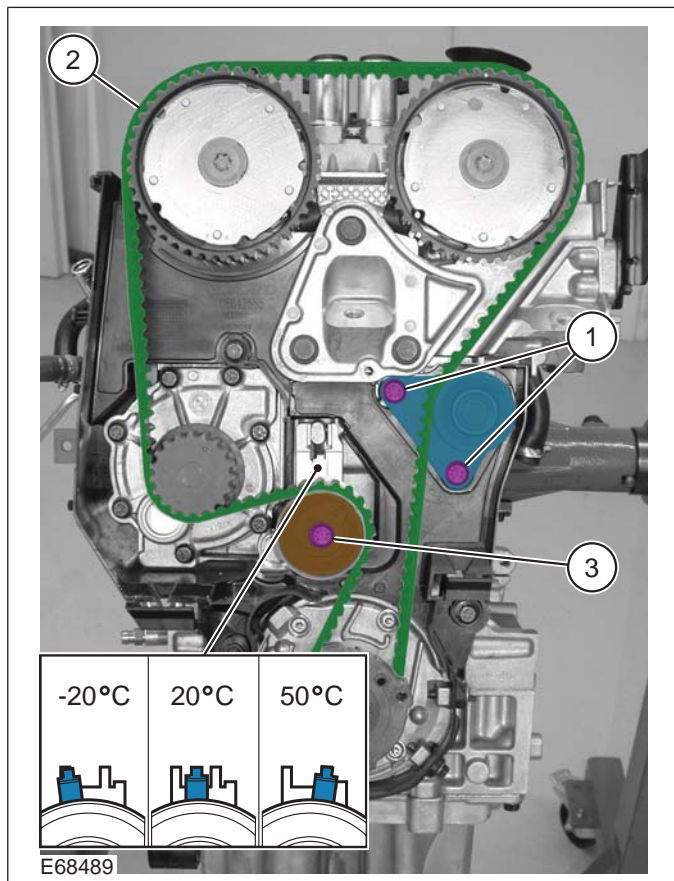
### Installation

Vehicles with mechanical timing belt tensioner

1. **NOTE:** Make sure that new components are installed.

1. Torque: 25 Nm

3. Torque: 25 Nm



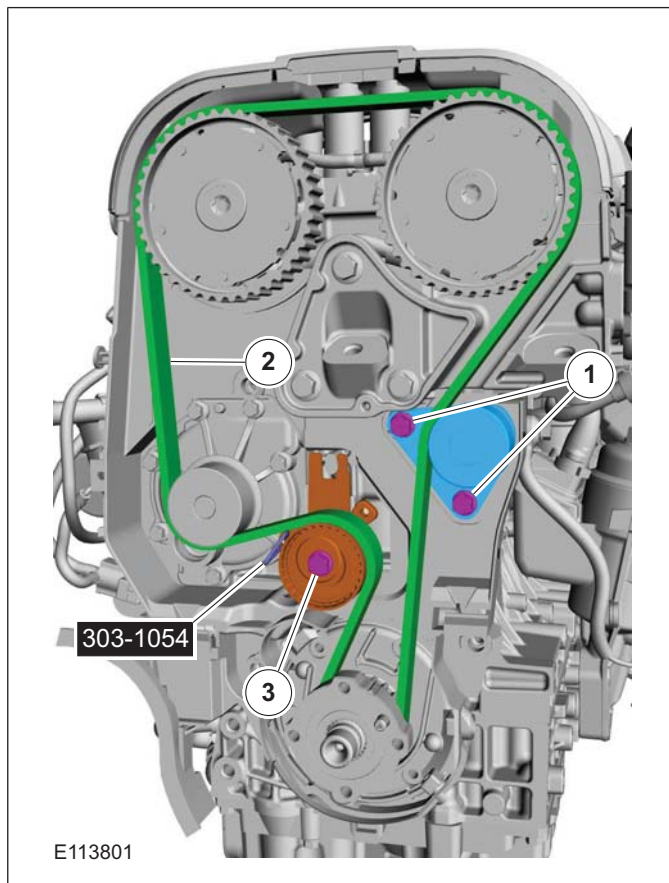
Vehicles with automatic timing belt tensioner

2. **NOTE:** Make sure that new components are installed.

1. Torque: 25 Nm

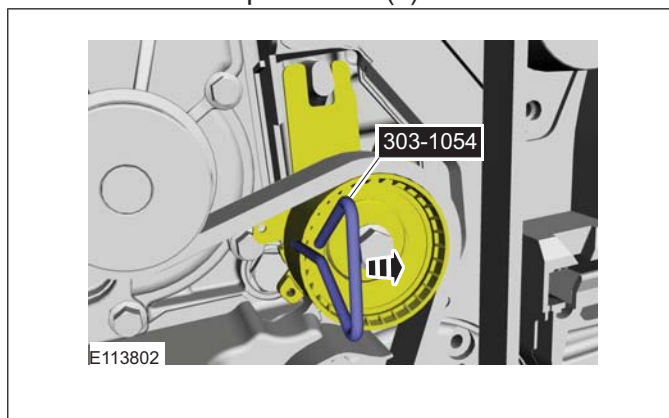
3. Special Tool(s): 303-1054

Torque: 25 Nm



3. **WARNING:** Take extra care when handling the compressed spring.

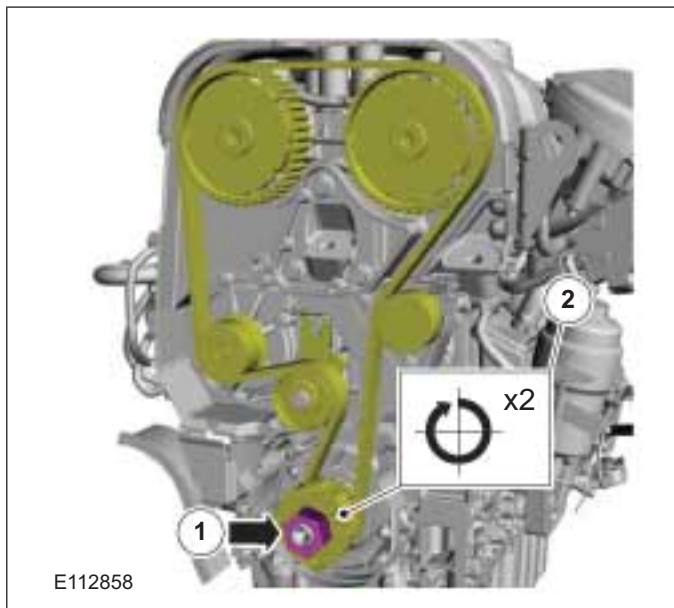
Remove the Special Tool(s): 303-1054



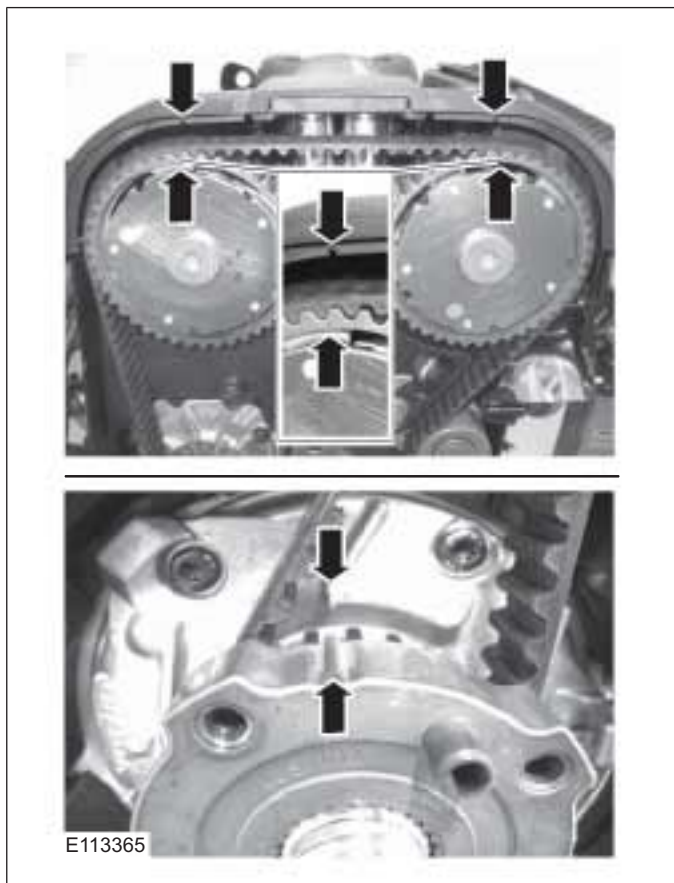
REMOVAL AND INSTALLATION

All vehicles

4.



5. **CAUTION:** Make sure that the installation marks are aligned.

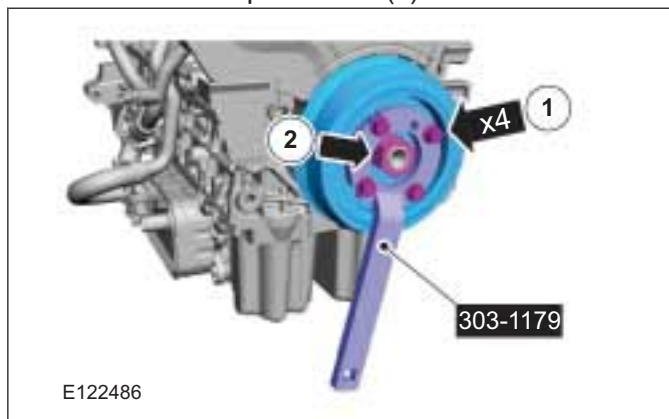


6. 1. **NOTE:** Only tighten the bolts finger tight at this stage.

Install the Special Tool(s): 303-1179

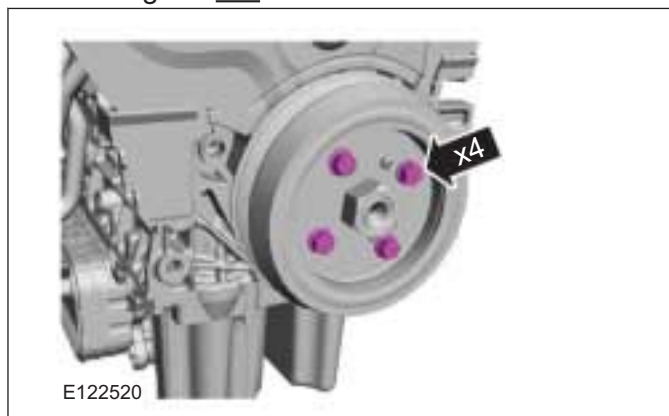
2. Torque: 180 Nm

7. Remove the Special Tool(s): 303-1179



8. Torque:

- Stage 1: 25 Nm
- Stage 2: 60°



9. Torque: 10 Nm





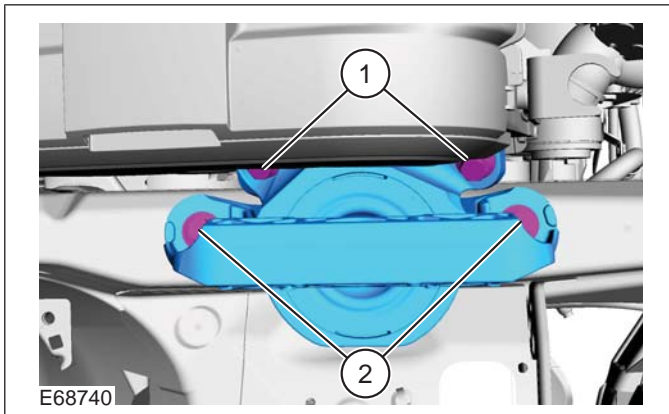
303-01-30

Engine — 2.5L Duratec (147kW/200PS) - VI5

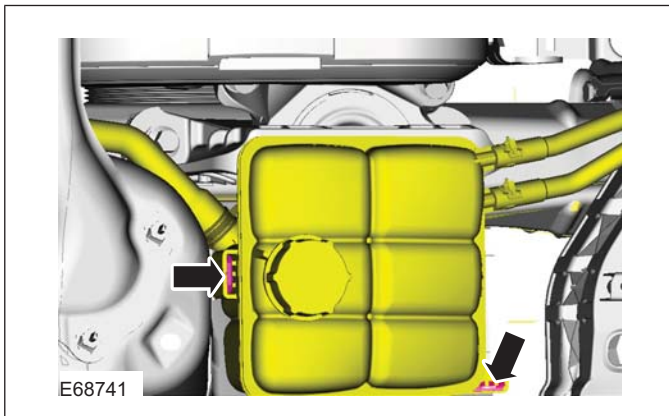
303-01-30

## REMOVAL AND INSTALLATION

10. 1. Torque: 115 Nm
2. Torque: 90 Nm



11.

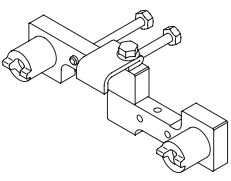


- 12 Refer to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

REMOVAL AND INSTALLATION

Camshafts(21 284 0)

Special Tool(s) / General Equipment

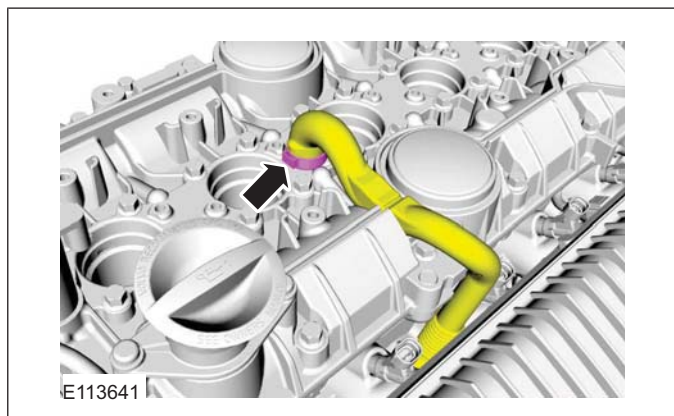
 <p>E62051</p>	<p>303-1178 Timing Tool Camshaft</p>
---	--

Punch

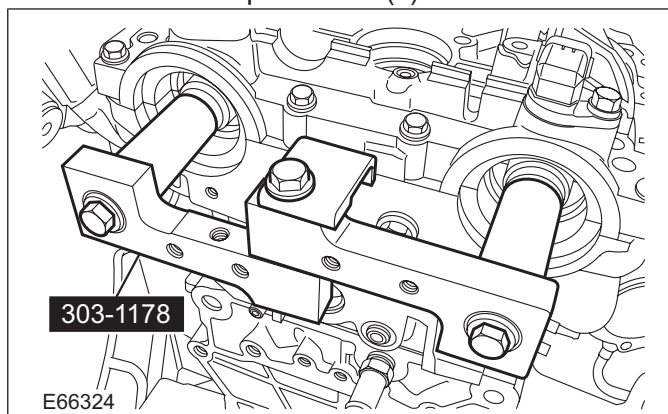
Materials	
Name	Specification
Engine Oil - 5W-30	WSS-M2C913-C
Flange Sealant - Anaerobic LP	WSK-M2G348-A7 / 5U7J-M2G348-BA

Removal

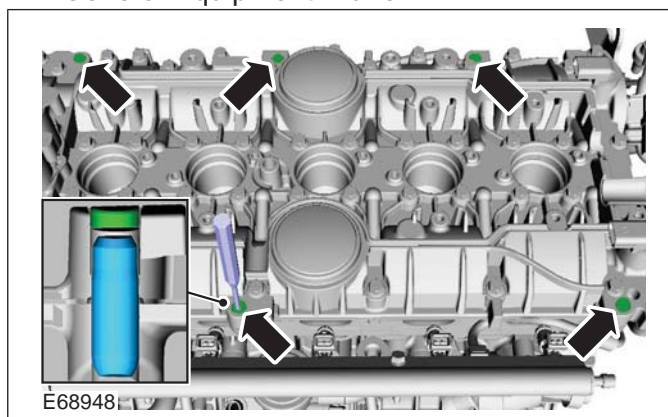
1. Refer to: **Camshaft Seal** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
- 2.



3. Remove the Special Tool(s): 303-1178



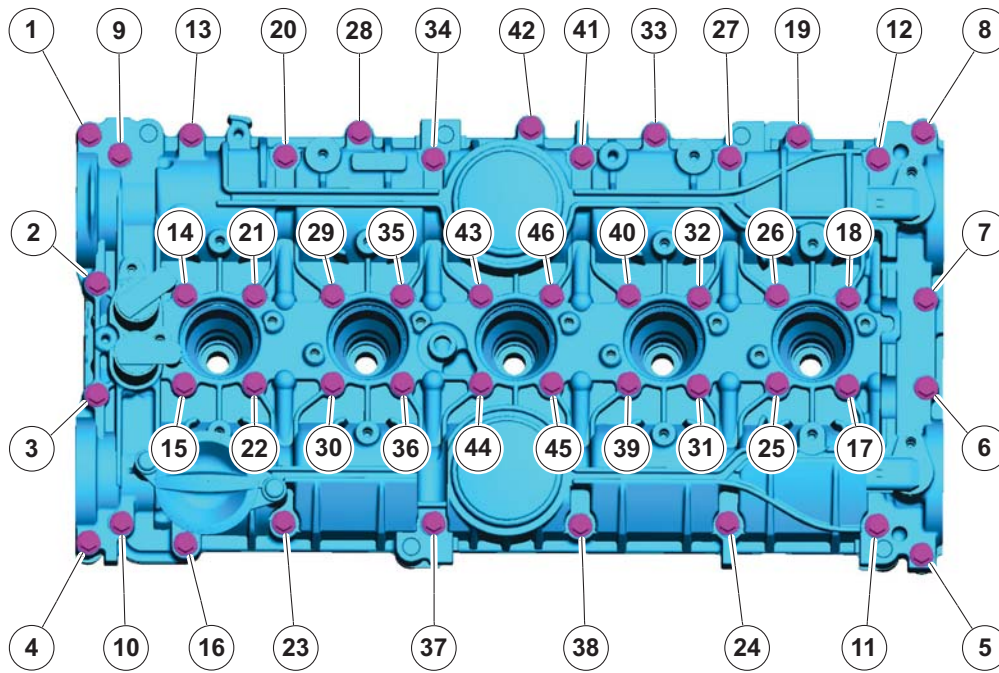
4. General Equipment: Punch



5. Loosen each bolt 2 turns at a time until all bolts are removed.



REMOVAL AND INSTALLATION



E68743

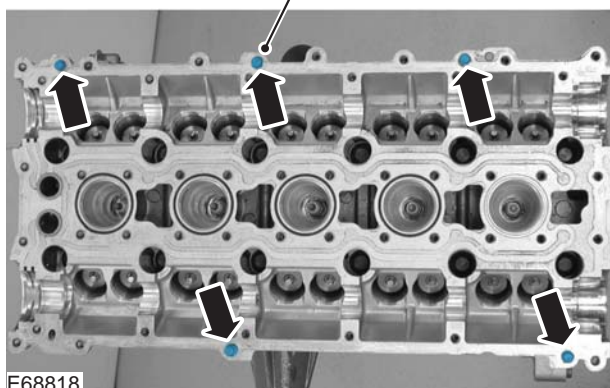
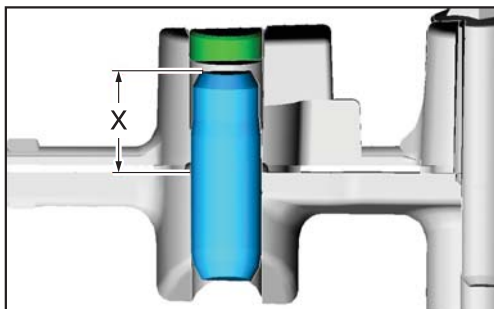




REMOVAL AND INSTALLATION

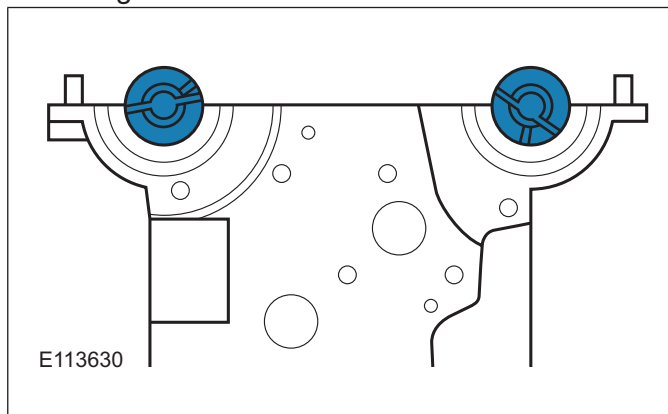
Installation

1. Refer to: **Valve Clearance Adjustment** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, General Procedures).
2. • X = 15 mm.

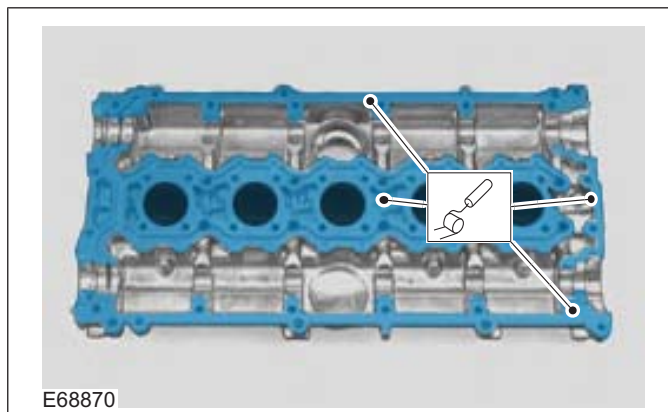


3. Apply a thin coating.

Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil

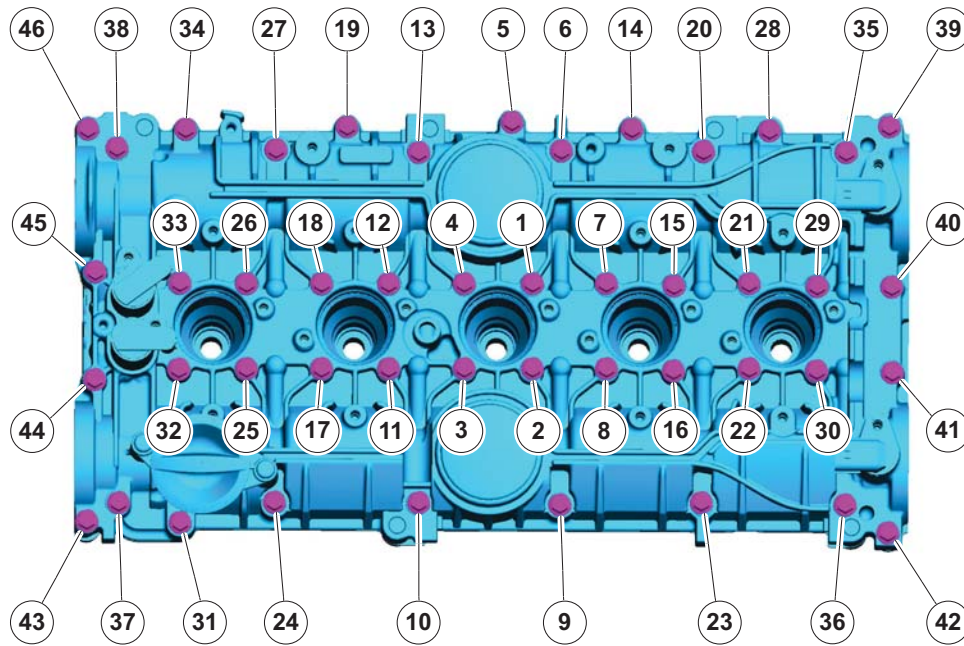


4. Material: Flange Sealant - Anaerobic LP (WSK-M2G348-A7 / 5U7J-M2G348-BA) sealant



5. Tighten each bolt 2 turns at a time.  
Torque: 17 Nm

REMOVAL AND INSTALLATION



E87508

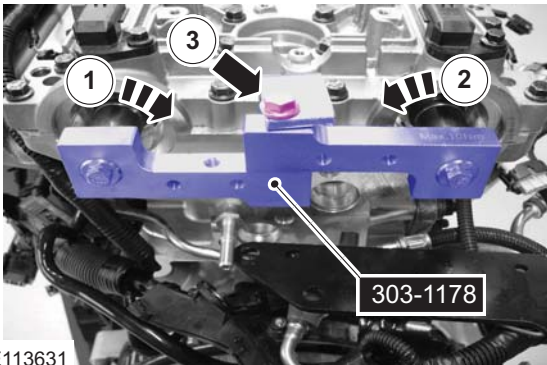
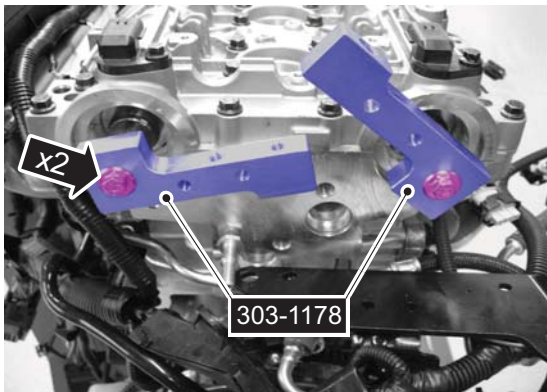
303-01-35

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-35

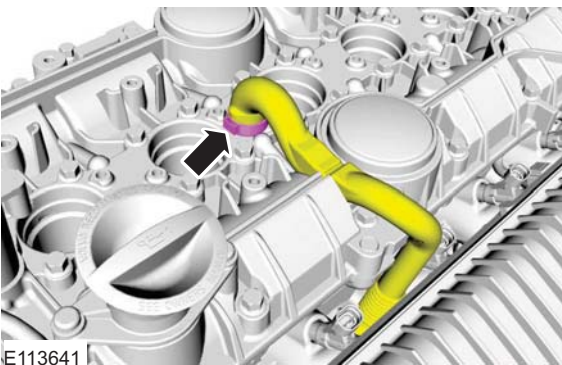
## REMOVAL AND INSTALLATION

6. Install the Special Tool(s): 303-1178  
Torque: 10 Nm



E113631

7.



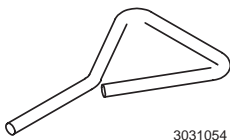
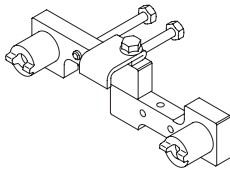
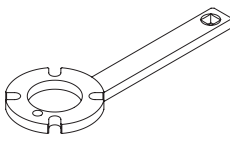
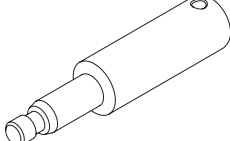
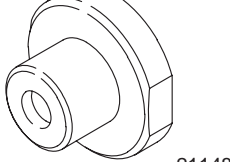
E113641

8. Refer to: **Camshaft Seal** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

REMOVAL AND INSTALLATION

Camshaft Seal(21 288 0)

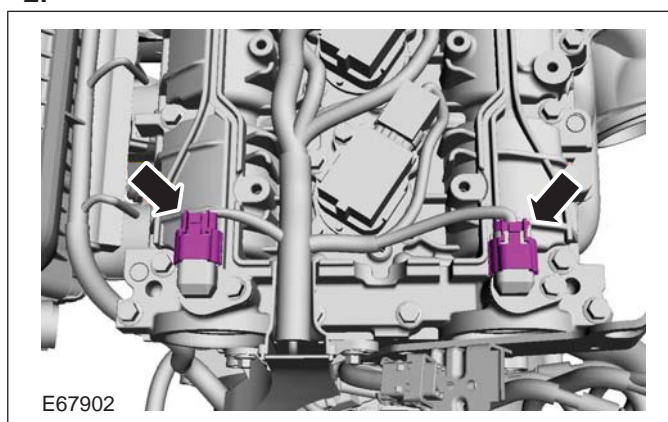
Special Tool(s)

 <p>3031054</p>	<p>303-1054 Locking Tool, Timing Belt Tensioner</p>
 <p>E62051</p>	<p>303-1178 Timing Tool Camshaft</p>
 <p>E62035</p>	<p>303-1179 Holding Wrench, Crankshaft</p>
 <p>E62027</p>	<p>303-1182 Timing Tool, Crankshaft</p>
 <p>21148</p>	<p>303-318 Aligner/Installer, Crankshaft Front Seal</p>

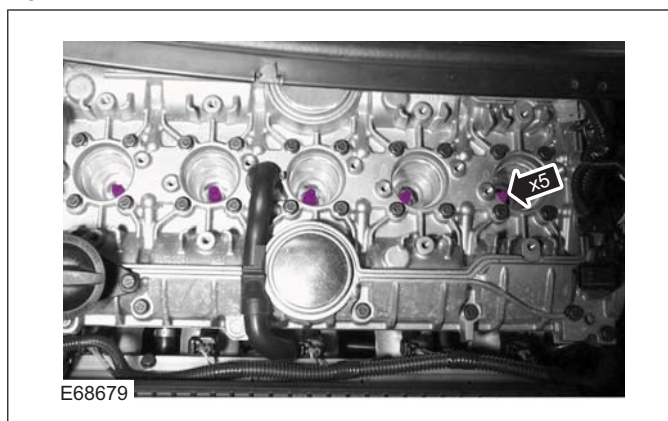
Removal

1. Remove the following items:
  1. Refer to: **Ignition Coil-On-Plug** (303-07 Engine Ignition - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
  2. Refer to: **Starter Motor** (303-06 Starting System - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

2.



3.





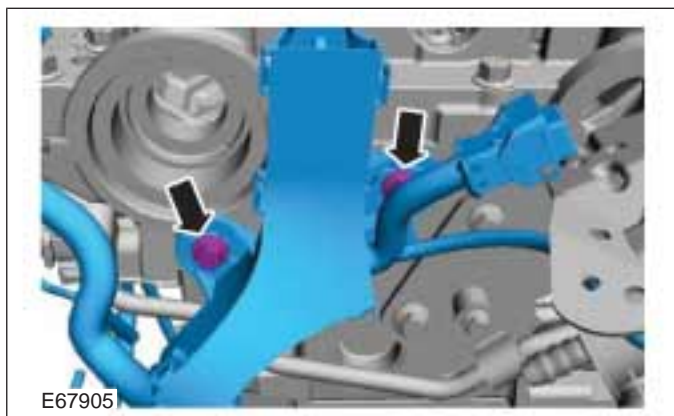
303-01-37

Engine — 2.5L Duratec (147kW/200PS) - VI5

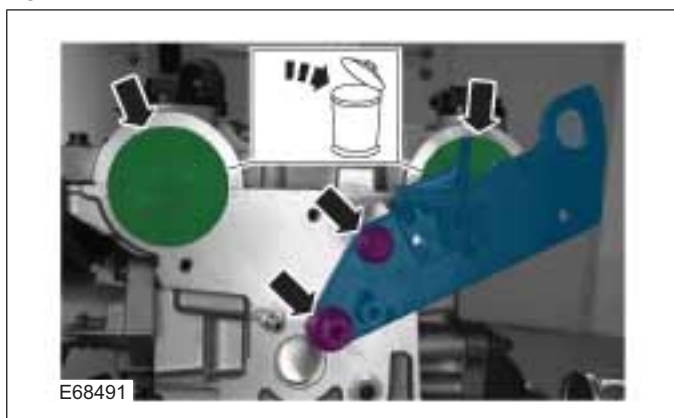
303-01-37

REMOVAL AND INSTALLATION

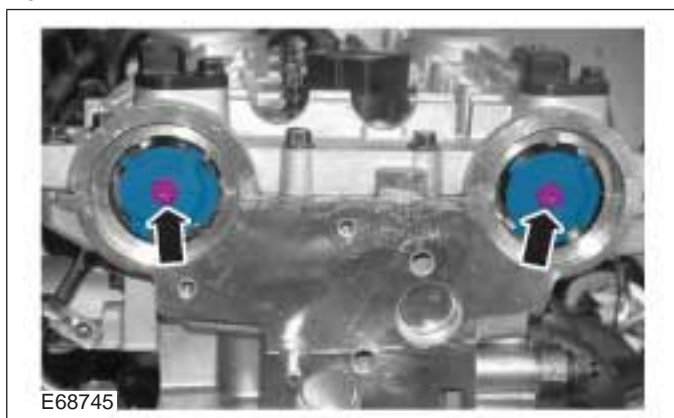
4.



5.

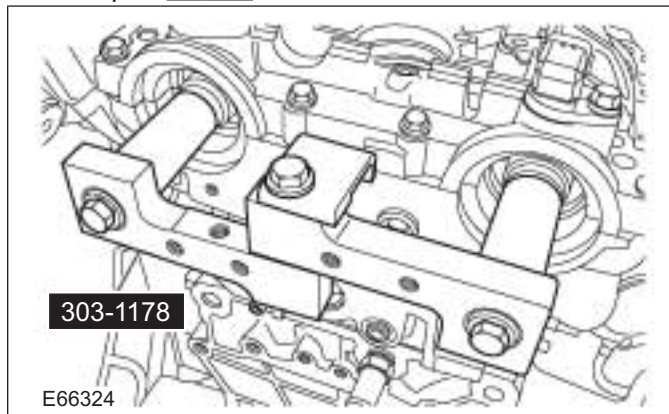


6.

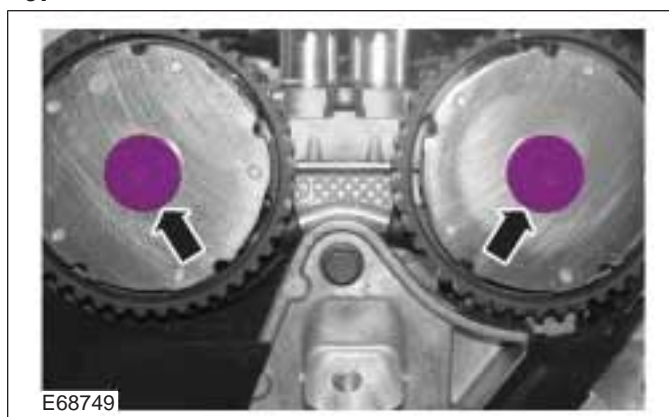


7. Refer to: **Timing Belt** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

8. Install the Special Tool(s): 303-1178  
Torque: 10 Nm



9.



10.





303-01-38

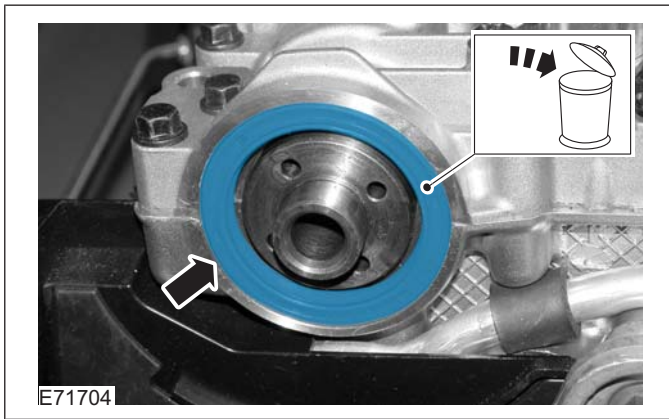
Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-38

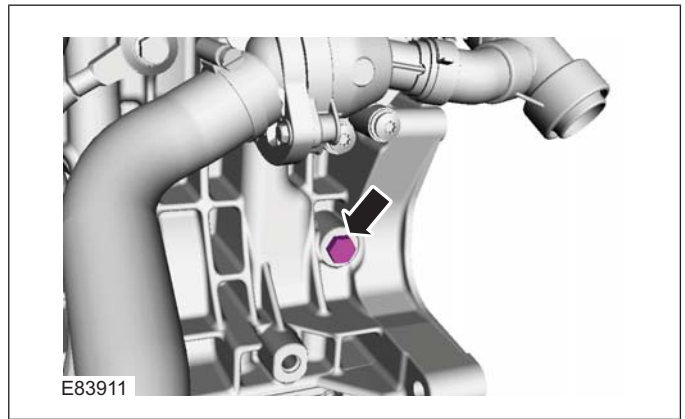


REMOVAL AND INSTALLATION

11.



3.

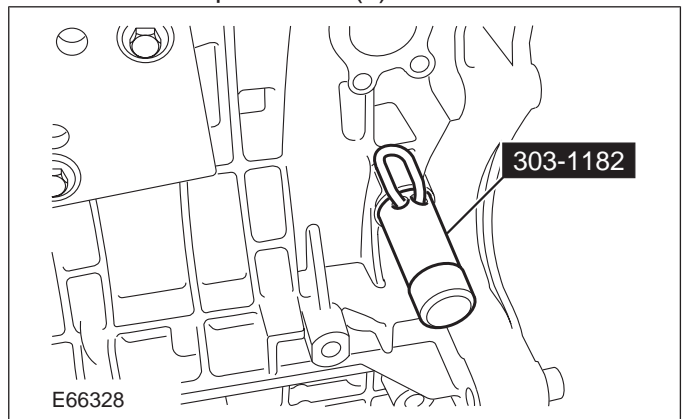


Installation

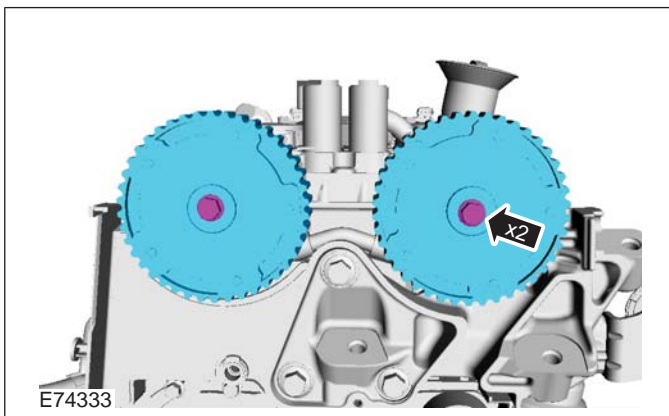
1. Special Tool(s): 303-318



4. Using the special tool, align the crankshaft.  
Install the Special Tool(s): 303-1182



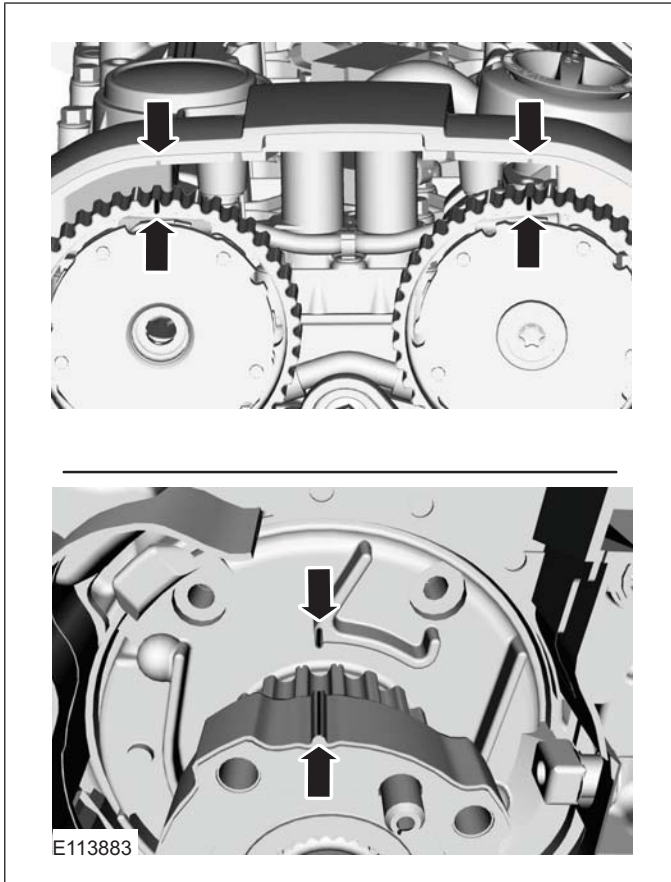
2. **NOTE:** Only tighten the bolts finger tight at this stage.





REMOVAL AND INSTALLATION

5.  **CAUTION:** Make sure that the installation marks are aligned.

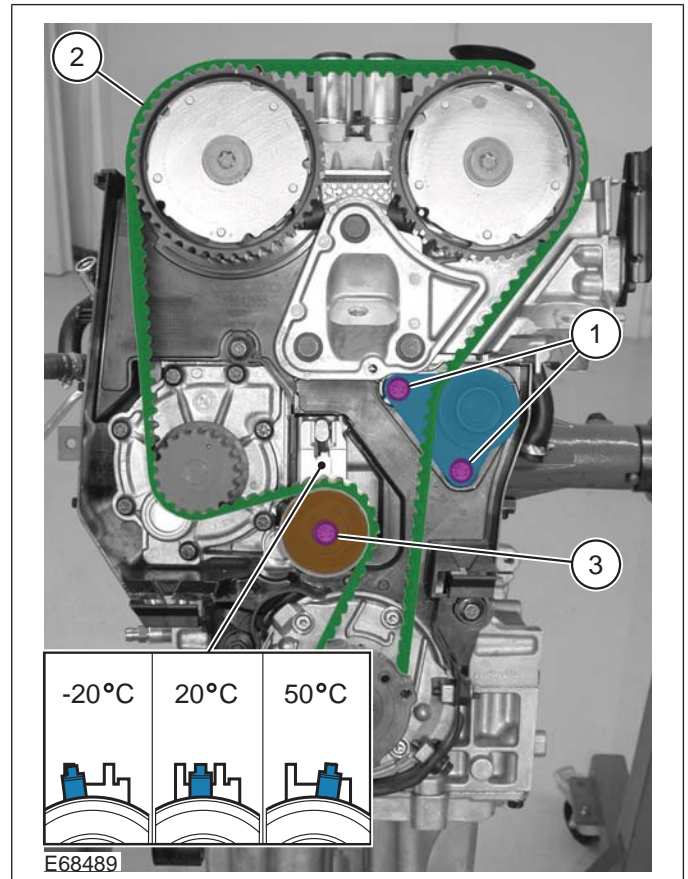


Vehicles with mechanical timing belt tensioner

6. **NOTE:** Make sure that new components are installed.

1. Torque: 25 Nm
3. **NOTE:** The timing belt tensioner setting is dependant on the engine temperature.

Torque: 25 Nm



303-01-40

Engine — 2.5L Duratec (147kW/200PS) - V15

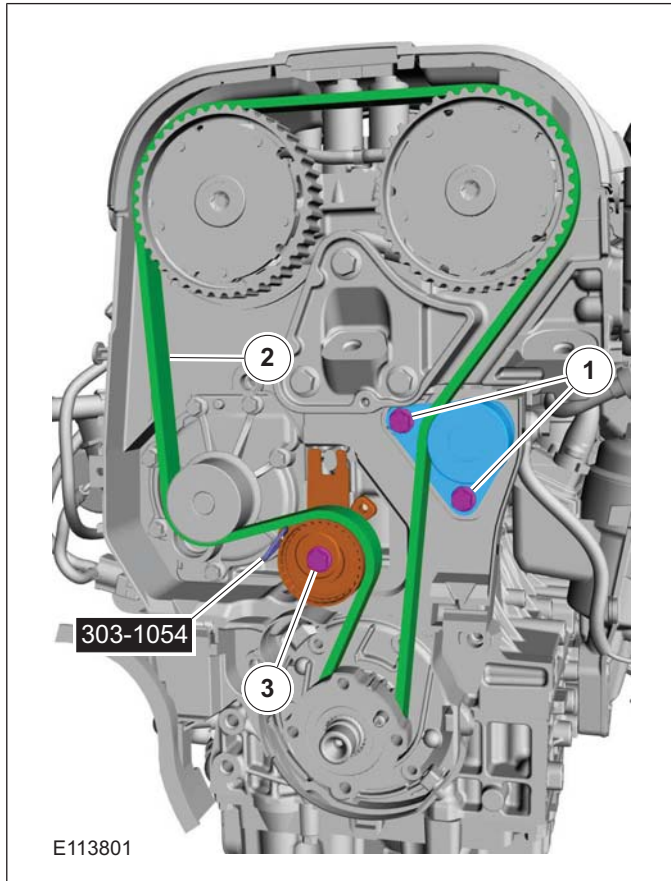
303-01-40

REMOVAL AND INSTALLATION

Vehicles with automatic timing belt tensioner

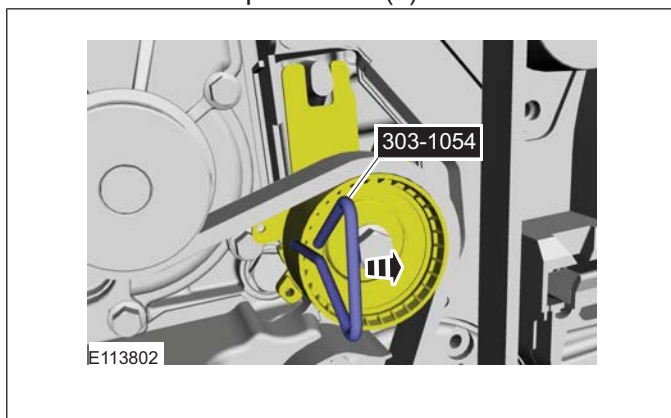
7. **NOTE:** Make sure that new components are installed.

- 1. Torque: 25 Nm
- 3. Special Tool(s): 303-1054  
Torque: 25 Nm



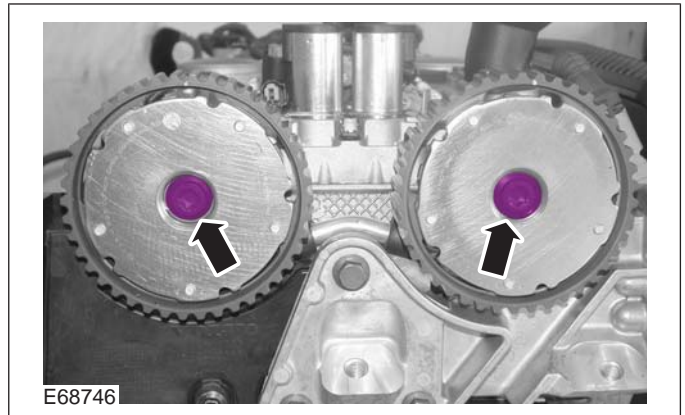
8. **WARNING:** Take extra care when handling the compressed spring.

Remove the Special Tool(s): 303-1054

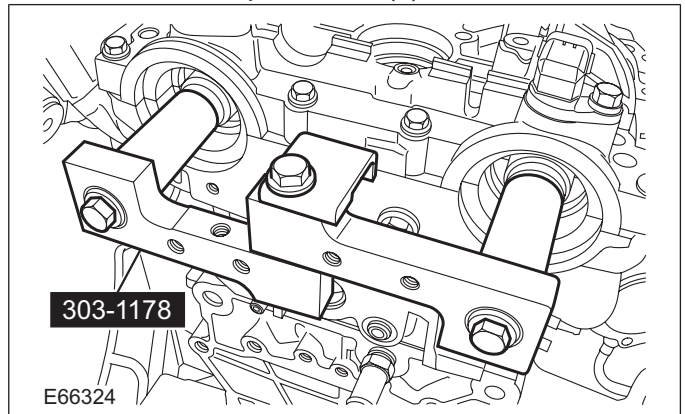


All vehicles

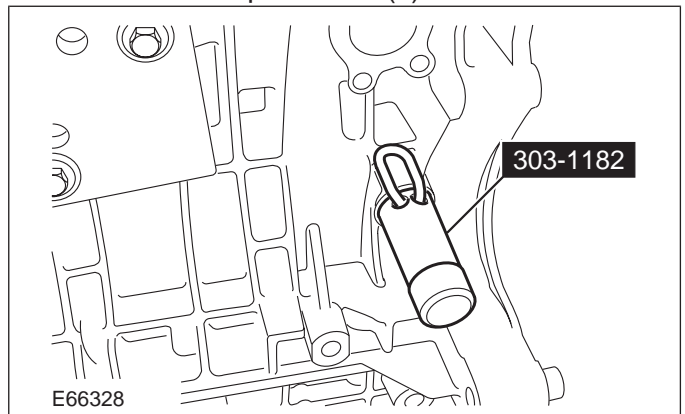
9. Torque: 120 Nm



10. Remove the Special Tool(s): 303-1178



11. Remove the Special Tool(s): 303-1182



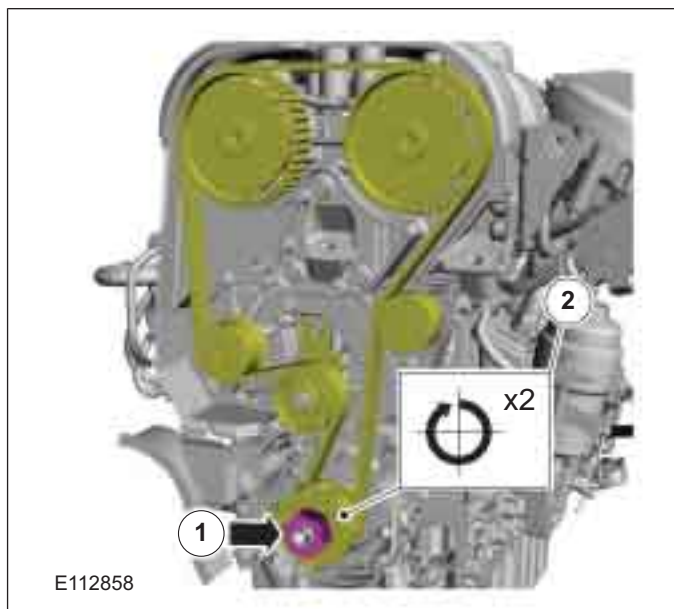
303-01-41

Engine — 2.5L Duratec (147kW/200PS) - V15

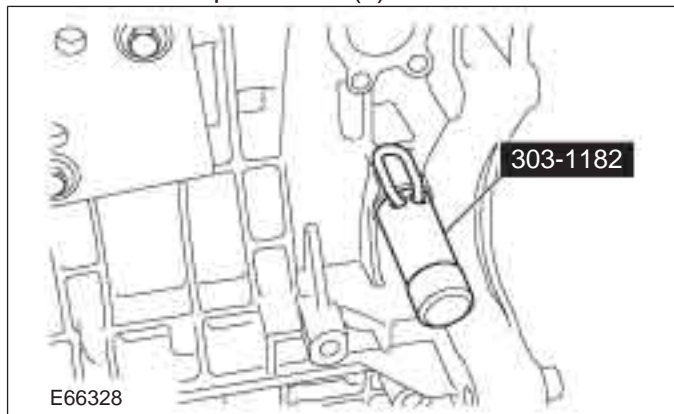
303-01-41

REMOVAL AND INSTALLATION

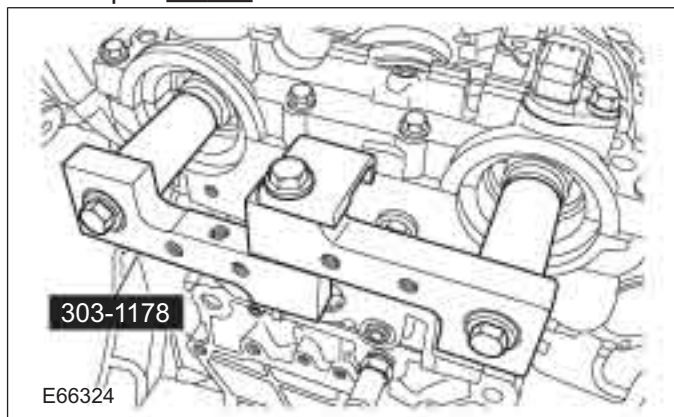
12



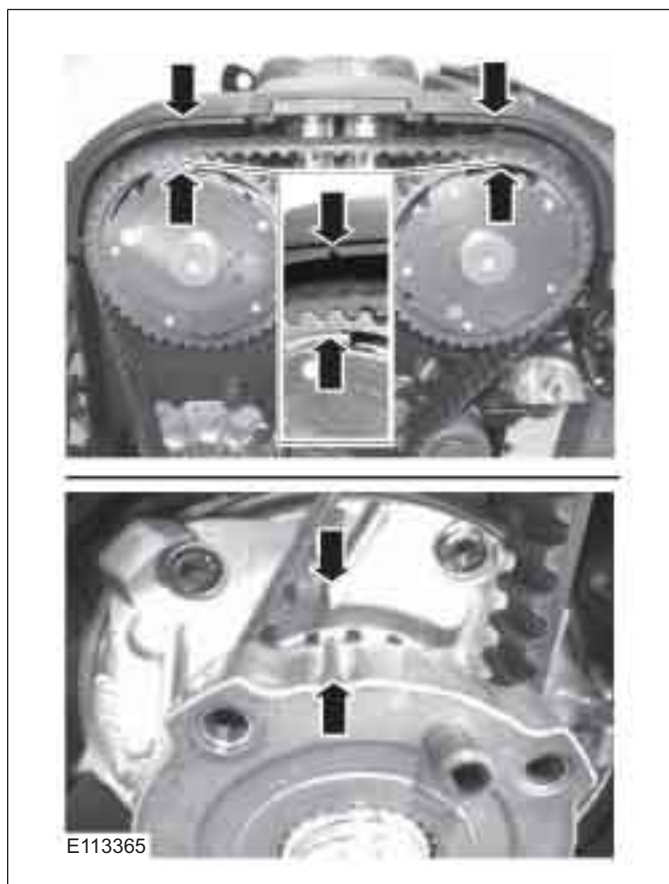
13. Using the special tool, align the crankshaft.  
Install the Special Tool(s): 303-1182



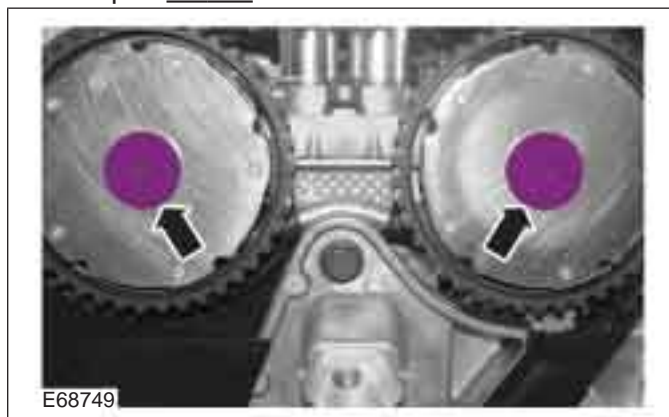
14. Install the Special Tool(s): 303-1178  
Torque: 10 Nm



15. **⚠ CAUTION:** Make sure that the installation marks are aligned.



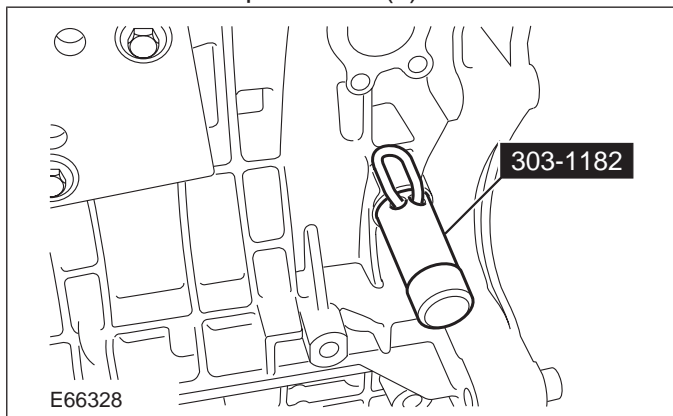
16. Torque: 35 Nm



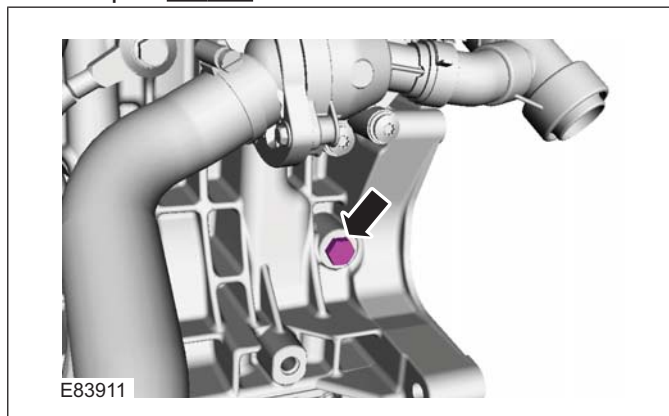


REMOVAL AND INSTALLATION

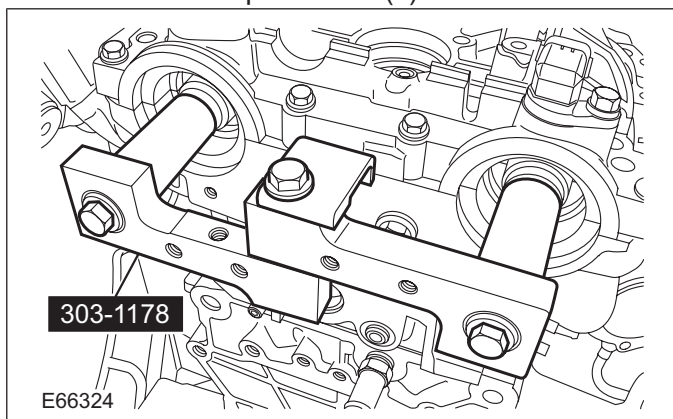
17. Remove the Special Tool(s): 303-1182



20. Torque: 40 Nm

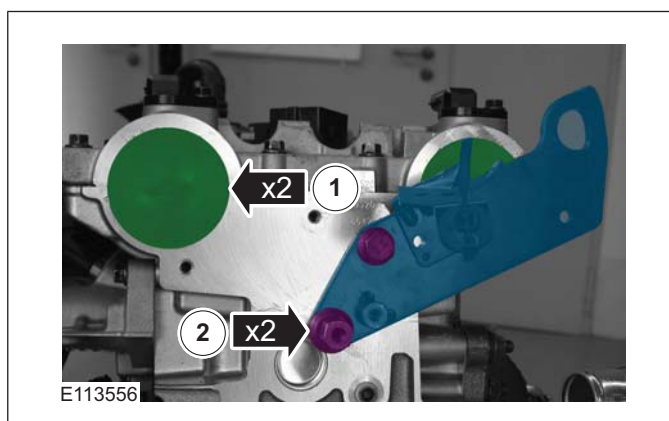


18. Remove the Special Tool(s): 303-1178

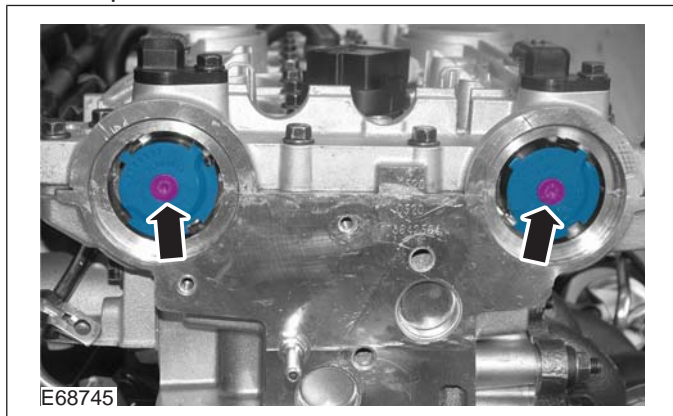


21. 1. **NOTE:** Make sure that new components are installed.

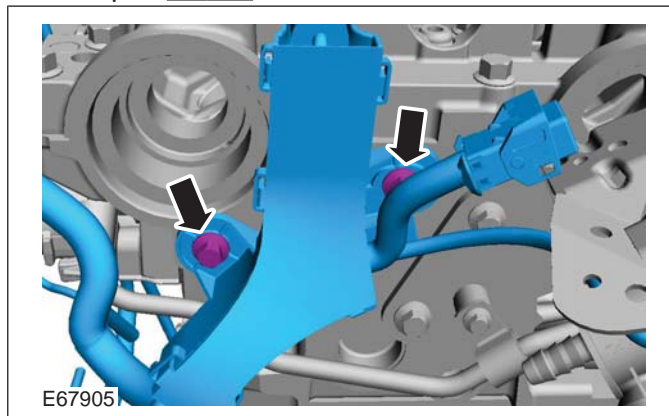
2. Torque: 40 Nm



19. Torque: 17 Nm



22 Torque: 10 Nm



303-01-43

Engine — 2.5L Duratec (147kW/200PS) - VI5

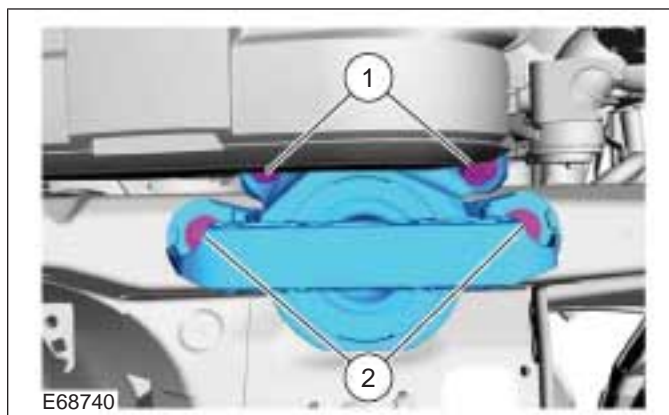
303-01-43

REMOVAL AND INSTALLATION

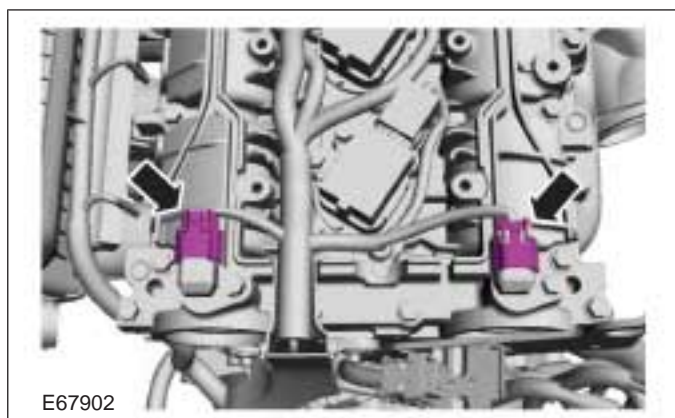
23. Torque: 28 Nm



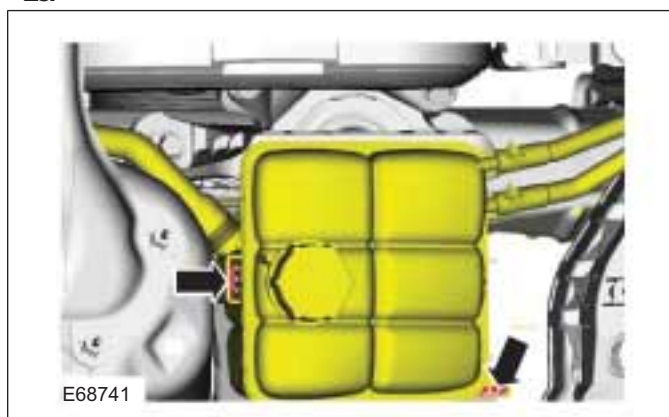
27. 1. Torque: 115 Nm  
2. Torque: 90 Nm



24.

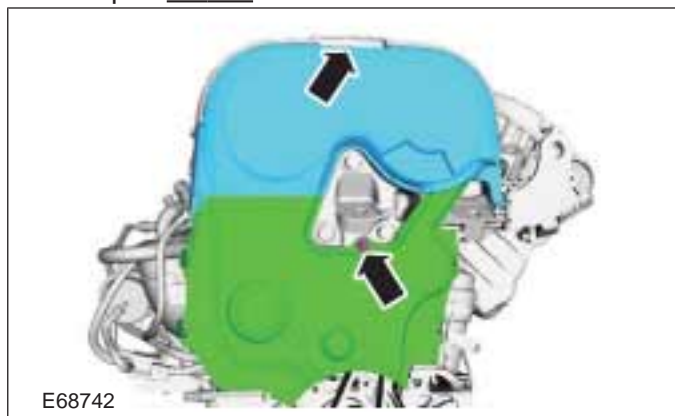


28.



25. Refer to: **Ignition Coil-On-Plug** (303-07 Engine Ignition - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

26. Torque: 10 Nm

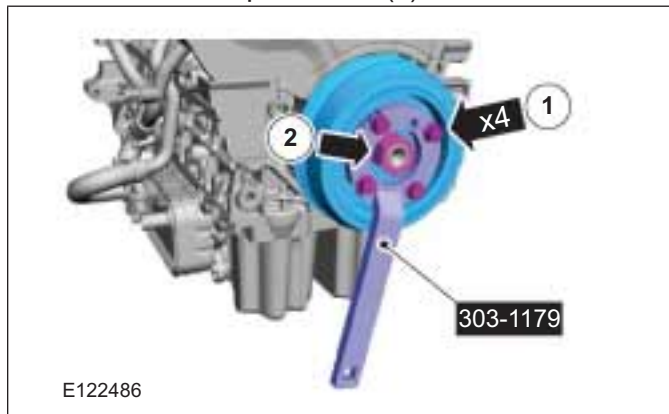


29. 1. **NOTE:** Only tighten the bolts finger tight at this stage.

Install the Special Tool(s): 303-1179

2. Torque: 180 Nm

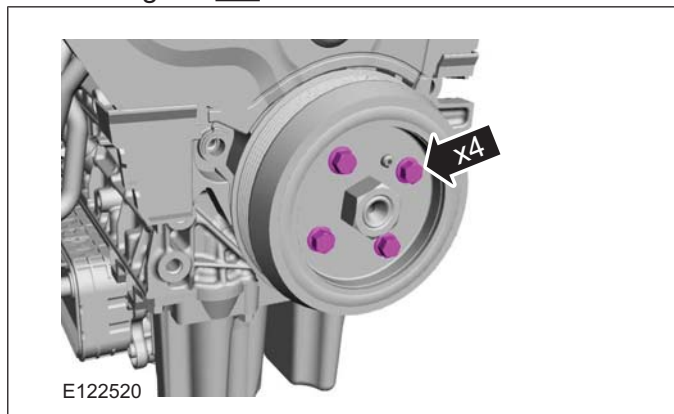
30. Remove the Special Tool(s): 303-1179



## REMOVAL AND INSTALLATION

## 31. Torque:

- Stage 1: 25 Nm
- Stage 2: 60°



## 32 Install the following items:

1. Refer to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
2. Refer to: **Starter Motor** (303-06 Starting System - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).



303-01-45

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-45

## REMOVAL AND INSTALLATION

## Oil Pan(21 154 0)

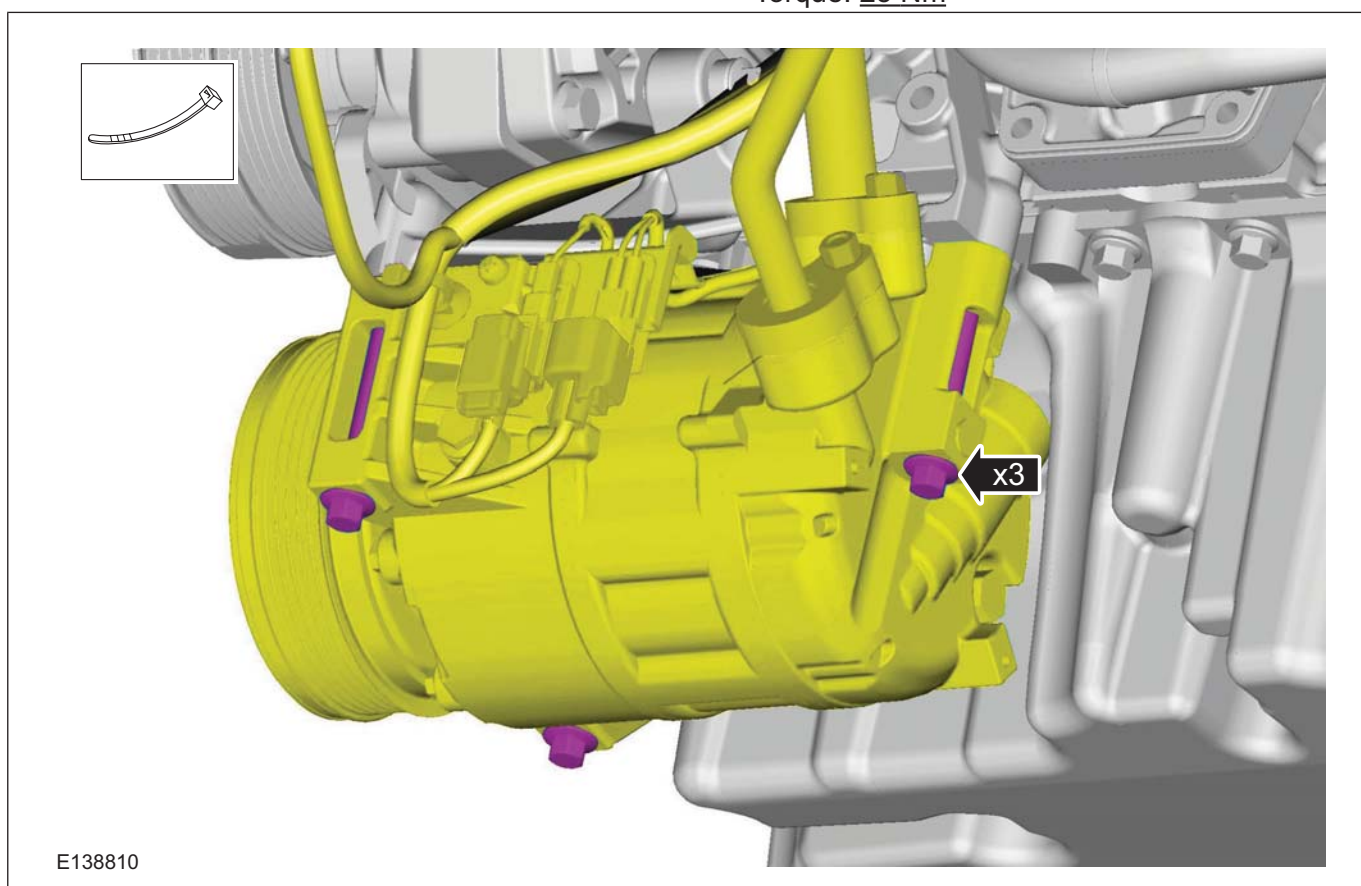
## General Equipment

Cable Ties	
<b>Materials</b>	
Name	Specification
Engine Oil - 5W-30	WSS-M2C913-C
Flange Sealant - Anaerobic LP	WSK-M2G348-A7 / 5U7J-M2G348-BA

## Removal

**NOTE:** Removal steps in the procedure may contain installation details.

1. Refer to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
2. General Equipment: Cable Ties  
Torque: 25 Nm



3.



303-01-46

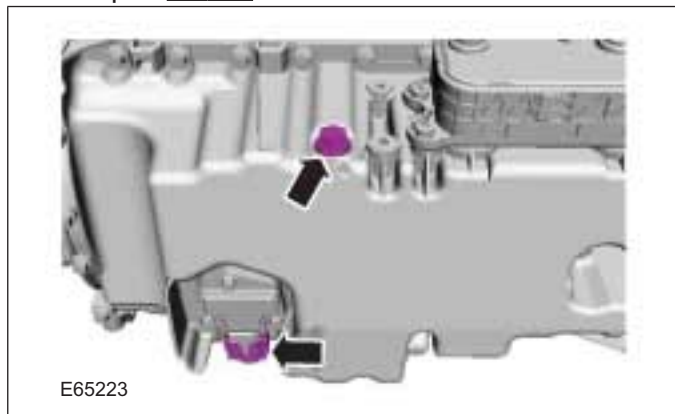
Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-46

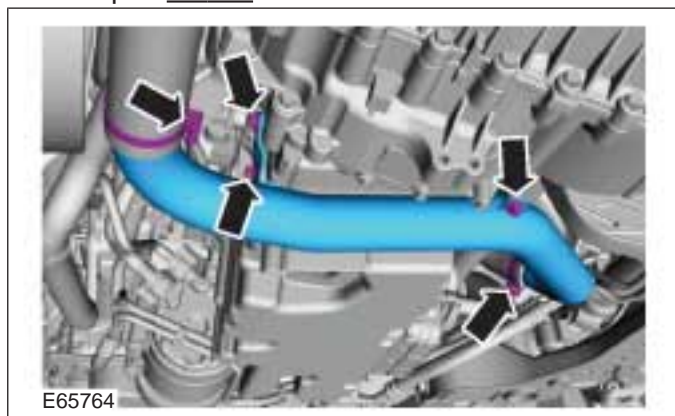
REMOVAL AND INSTALLATION

**⚠ WARNING:** Be prepared to collect escaping fluid.

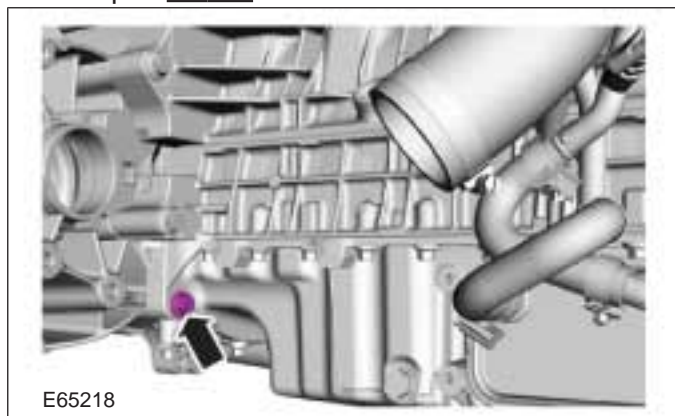
Torque: 38 Nm



4. Torque: 17 Nm



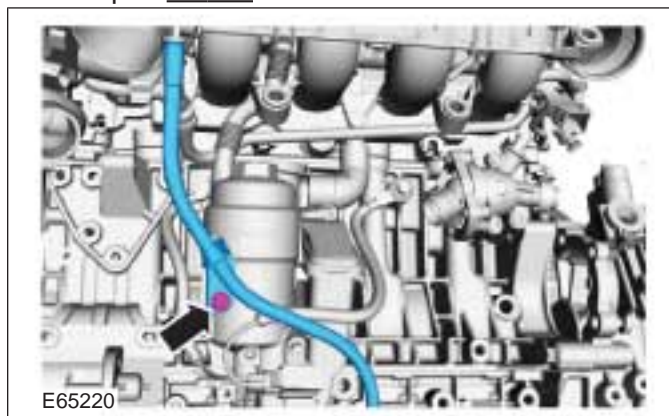
5. Torque: 48 Nm



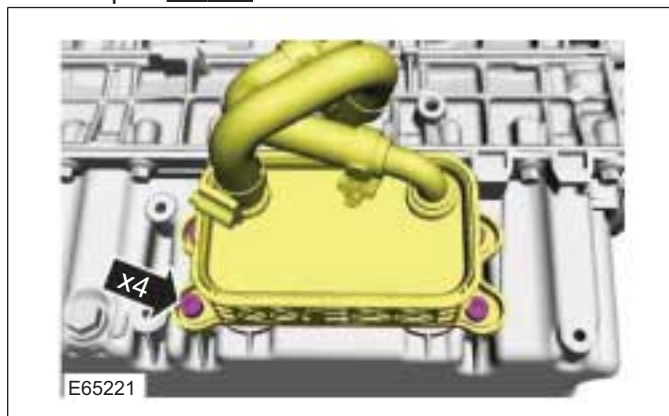
6. Torque: 48 Nm



7. Torque: 10 Nm



8. Torque: 17 Nm

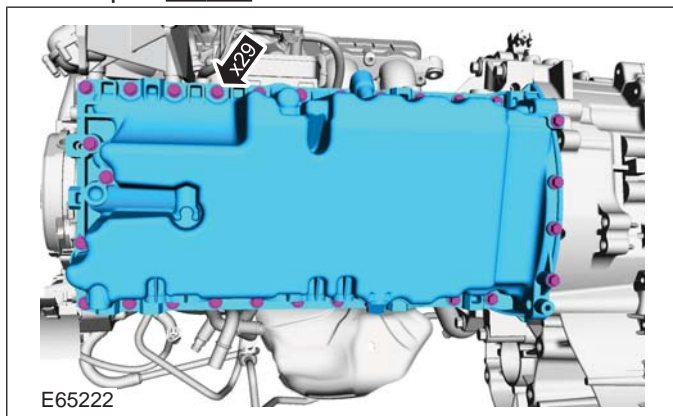


303-01-47

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-47

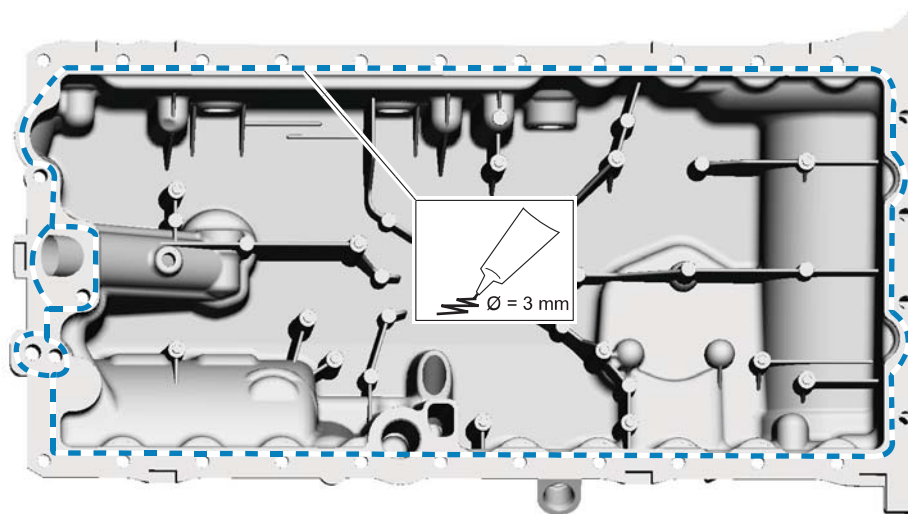
## REMOVAL AND INSTALLATION

9. Torque: 17 Nm

## Installation

- NOTE:** The component must be installed within 5 minutes of applying the sealant.

Material: Flange Sealant - Anaerobic LP  
(WSK-M2G348-A7 / 5U7J-M2G348-BA)  
sealant



- To install, reverse the removal procedure.

- CAUTION:** The fluid level must remain between the MAX and MIN marks.

Material: Engine Oil - 5W-30 (WSS-M2C913-C)  
engine oil

303-01-48

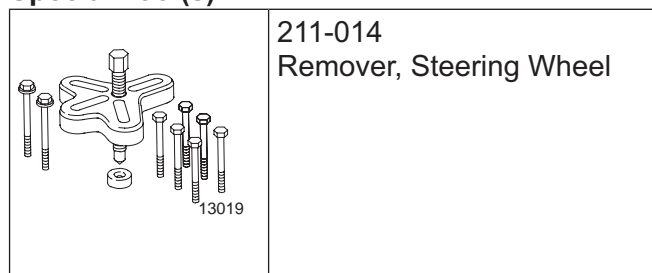
Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-48

## REMOVAL AND INSTALLATION

## Oil Pump(21 714 0)

## Special Tool(s)



4. Refer to: **Crankshaft Front Seal** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

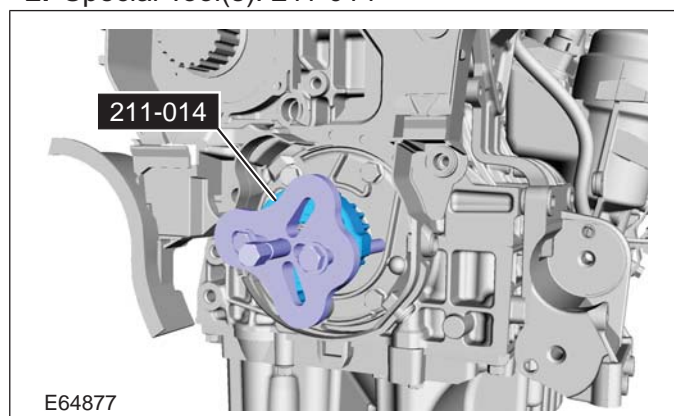
## Installation

1. To install, reverse the removal procedure.

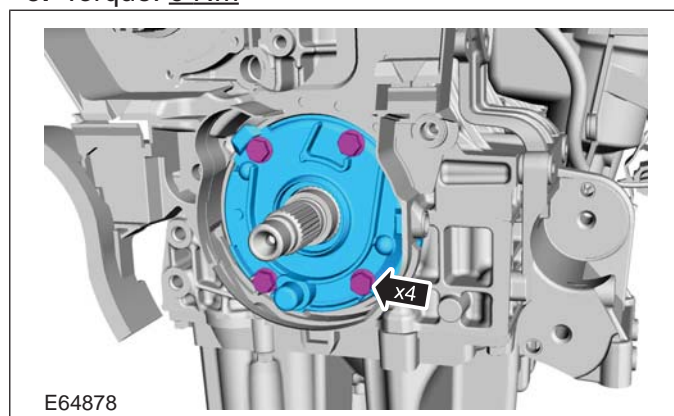
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Timing Belt** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
2. Special Tool(s): 211-014



3. Torque: 6 Nm



**REMOVAL AND INSTALLATION****Exhaust Manifold(21 187 0)****Removal**

1. Refer to: **Turbocharger** (303-04 Fuel Charging and Controls - Turbocharger - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

**Installation**

1. Refer to: **Turbocharger** (303-04 Fuel Charging and Controls - Turbocharger - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).



REMOVAL AND INSTALLATION

Cylinder Head(21 163 0)

General Equipment

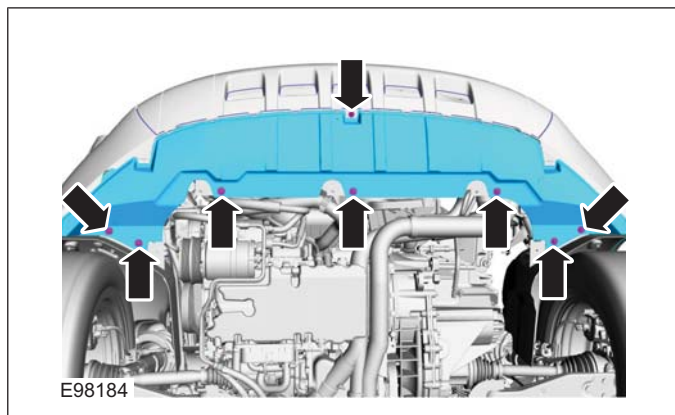
Fluid Container	
Tire Lever	
<b>Materials</b>	
<b>Name</b>	<b>Specification</b>
Engine Oil - 5W-30	WSS-M2C913-C
Grease KS-PS	SA-M1C9107-A / YS5J-M1C9107-AA

Removal

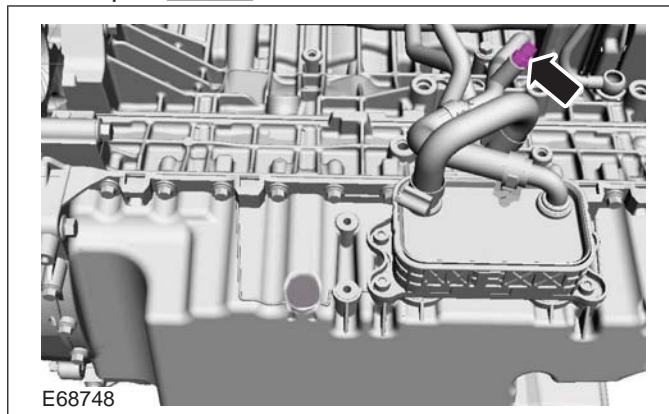
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Cooling System Draining and Vacuum Filling** (303-03 Engine Cooling, General Procedures).
2. Refer to: **Fuel System Pressure Release** (310-00 Fuel System - General Information, General Procedures).
3. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
4. Refer to: **Air Cleaner** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

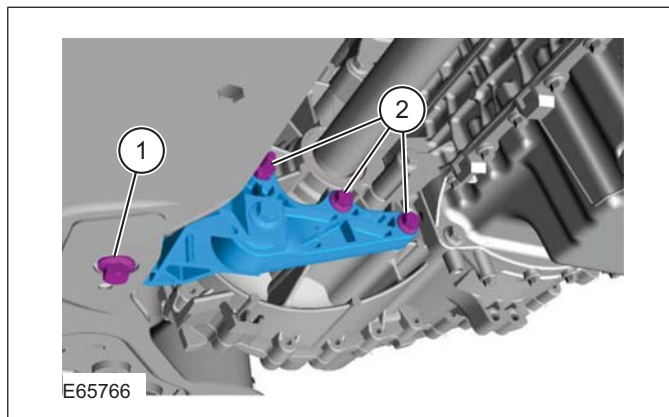
5.



6. Torque: 24 Nm

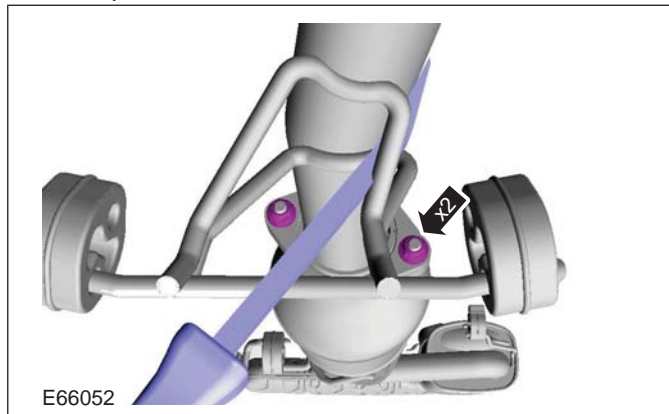


7. 1. Torque: 48 Nm
2. Torque: 80 Nm



8. **CAUTION:** Make sure that the exhaust flexible pipe is not forcibly bent.

General Equipment: Tire Lever  
Material: Grease KS-PS (SA-M1C9107-A / YS5J-M1C9107-AA) grease  
Torque: 50 Nm

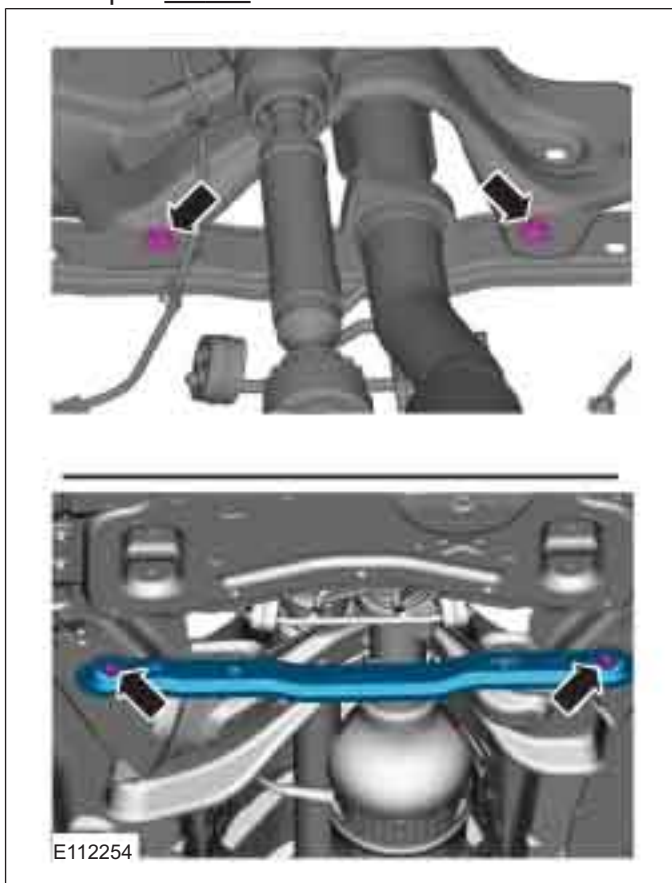




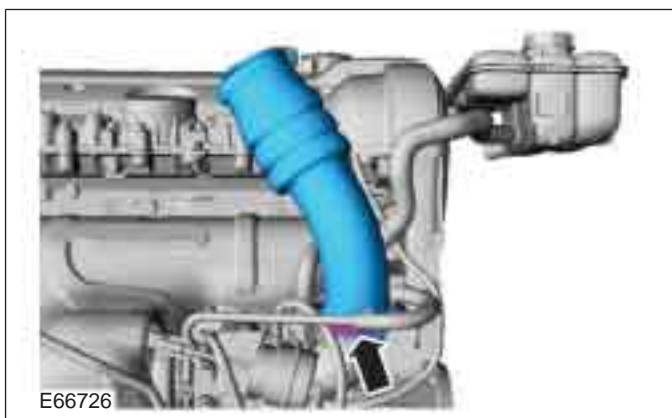


REMOVAL AND INSTALLATION

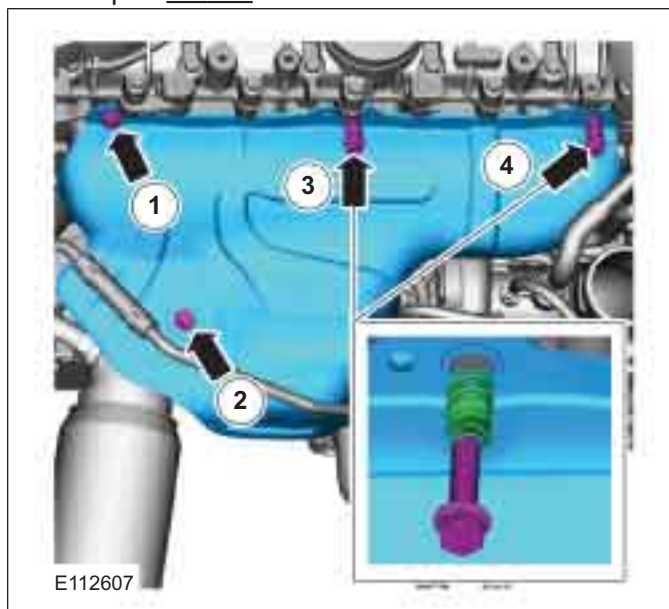
9. Torque: 24 Nm



10. CAUTION: Make sure that the inside of the pipe ends are clean and free of oil residue.

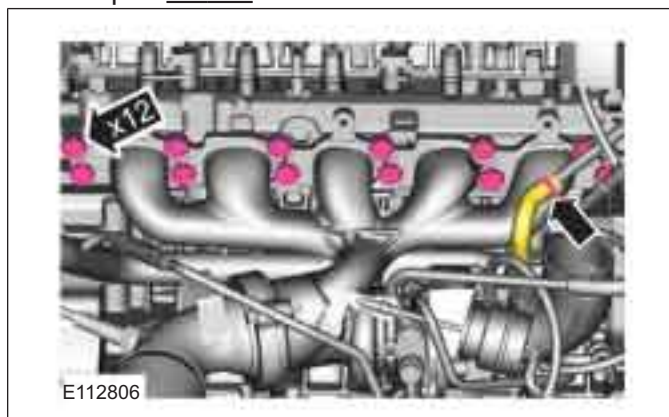


11. Torque: 24 Nm

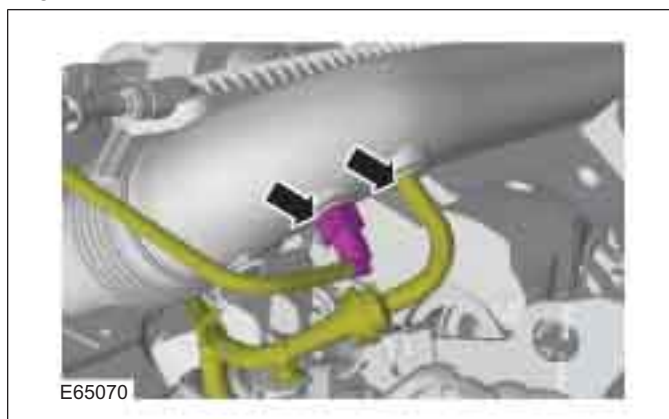


12. CAUTION: Make sure that the gaskets are correctly located.

Torque: 24 Nm

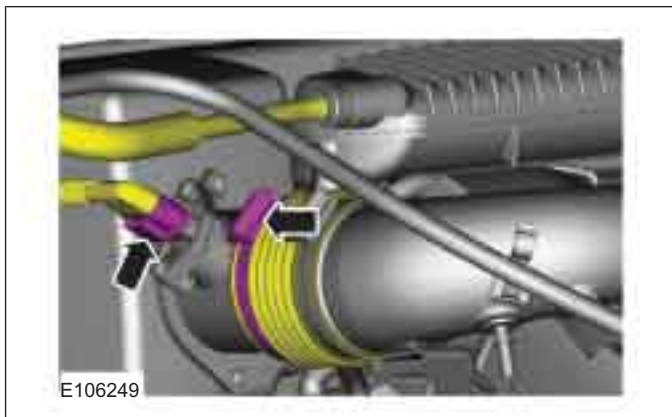


13.



REMOVAL AND INSTALLATION

14.

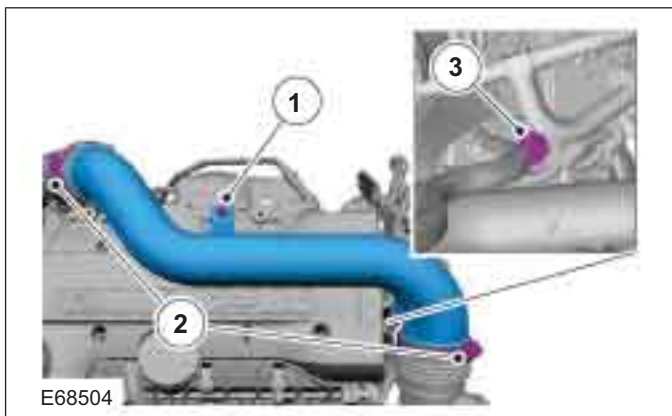


17.

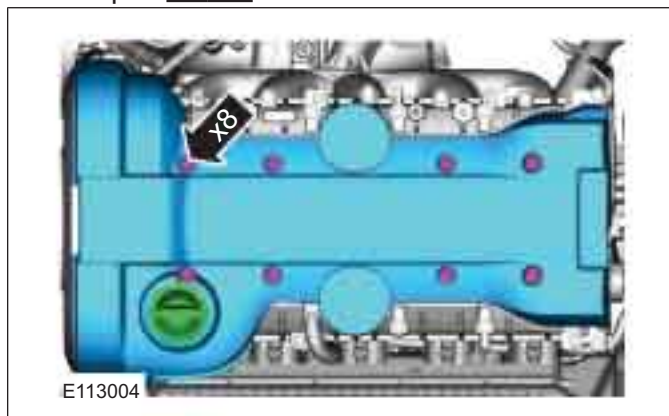


15. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

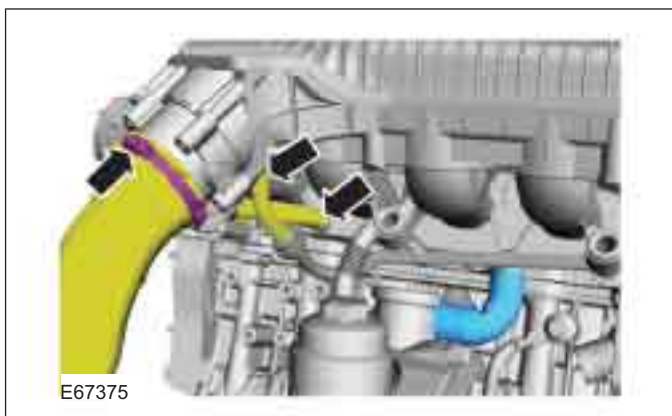
1. Torque: 10 Nm
2. Torque: 4 Nm
3. Torque: 10 Nm



18. Torque: 10 Nm



16. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.



19.



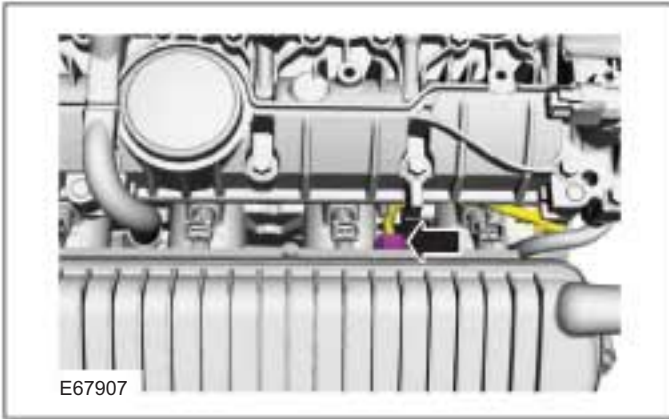
303-01-53

Engine — 2.5L Duratec (147kW/200PS) - VI5

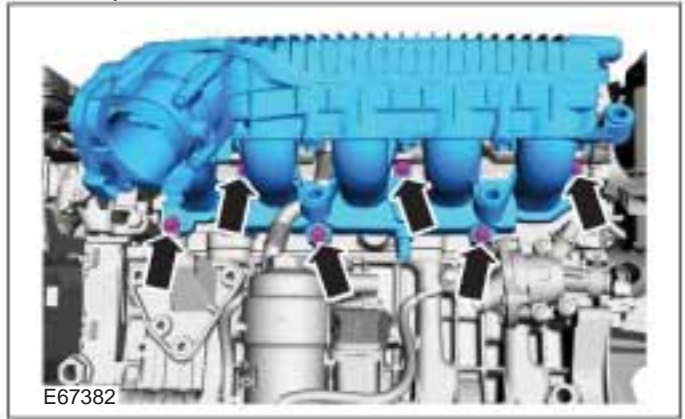
303-01-53

REMOVAL AND INSTALLATION

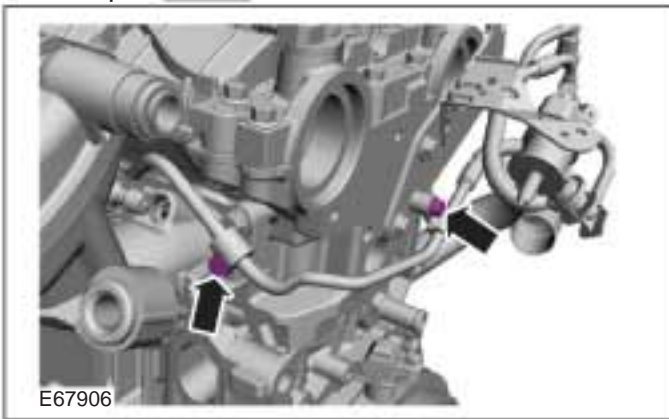
20.



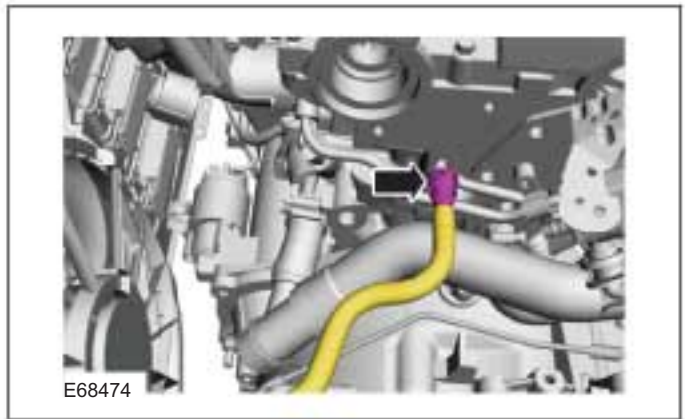
23. Torque: 19 Nm



21. Torque: 10 Nm



24.

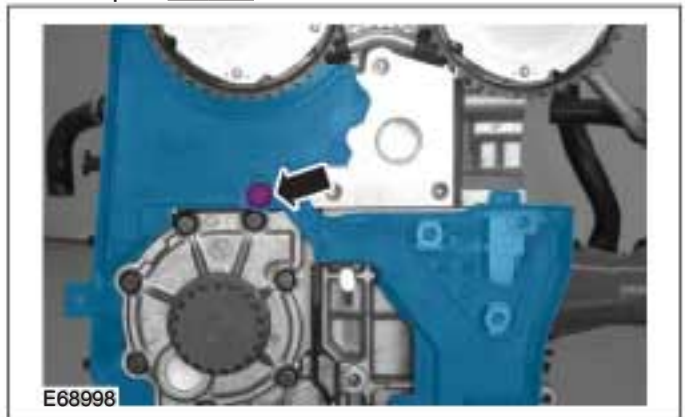


22.



25. Refer to: **Camshafts** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

26. Torque: 25 Nm

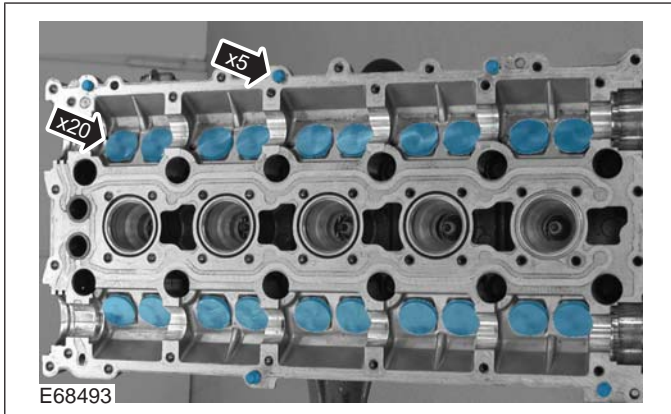






REMOVAL AND INSTALLATION

27. **CAUTION:** Note the position of the components before removal.



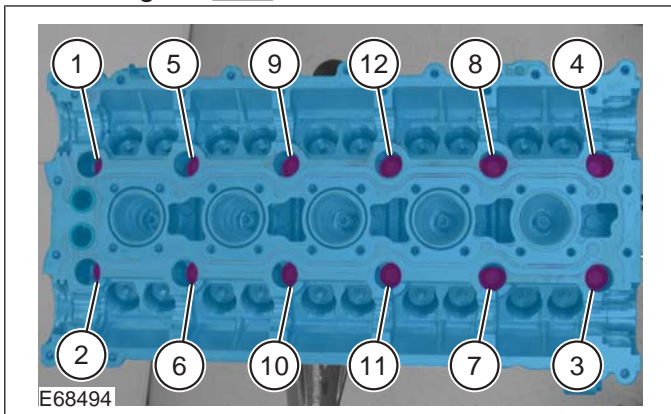
30. Torque: 25 Nm



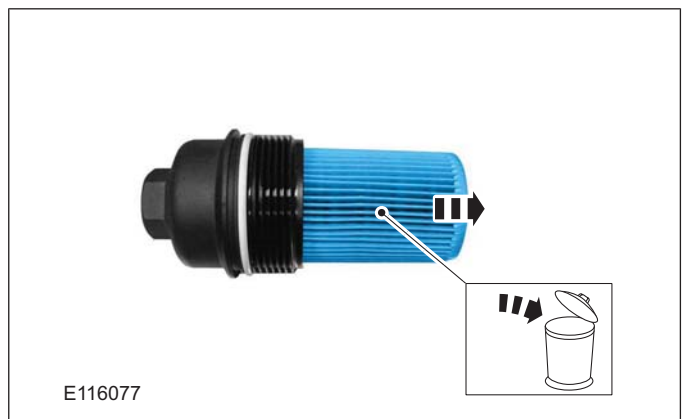
28. **CAUTION:** Make sure that no fluids are present in the threaded bores.

Torque:

- Stage 1: 20 Nm
- Stage 2: 60 Nm
- Stage 3: 130°



31.



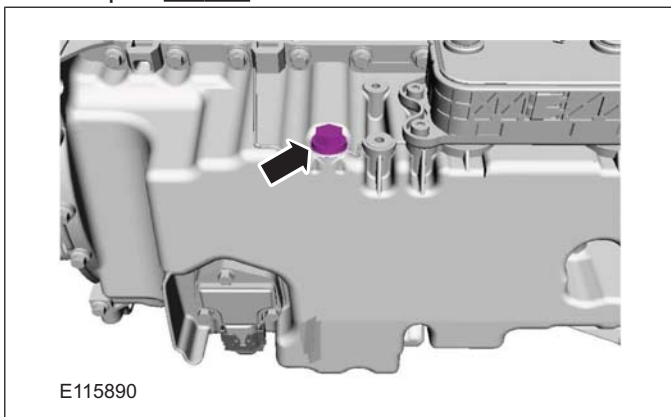
Installation

1. To install, reverse the removal procedure.

29. **WARNING:** Be prepared to collect escaping fluid.

General Equipment: Fluid Container

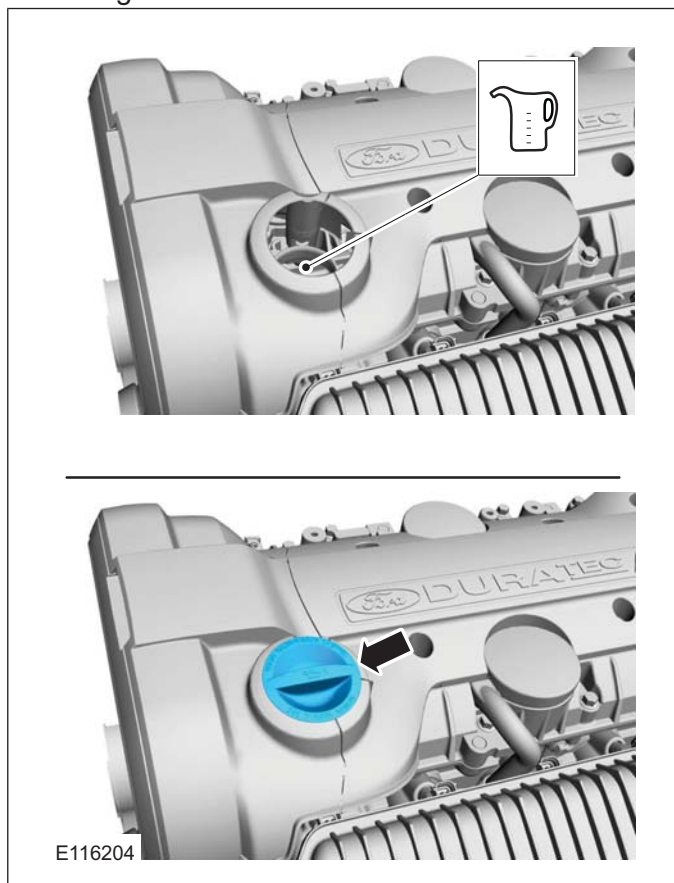
Torque: 38 Nm



## REMOVAL AND INSTALLATION

2.  **CAUTION:** Make sure that fluid level is to the MAX mark.

Refer to: **Specifications** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Specifications).  
Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil

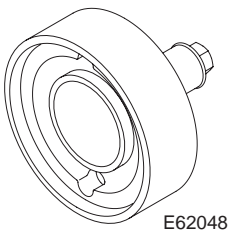
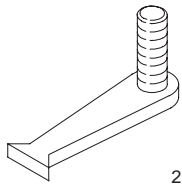
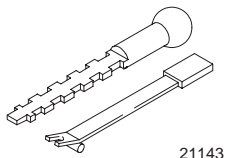


3. Refer to: **Door Window Motor Initialization** (501-11 Glass, Frames and Mechanisms, General Procedures).

REMOVAL AND INSTALLATION

Crankshaft Rear Seal(21 468 4)

Special Tool(s)

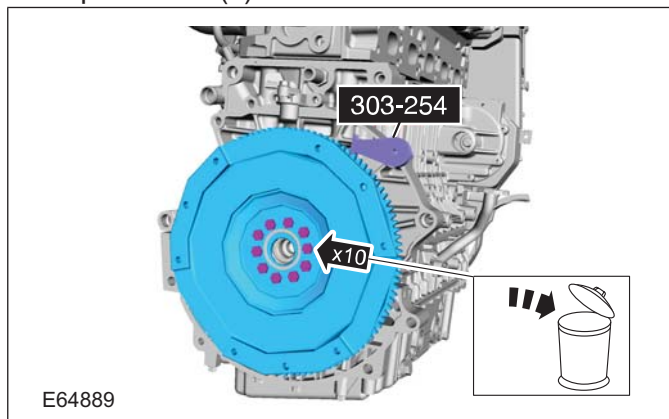
 <p>E62048</p>	<p>303-1181 Installer, Crankshaft Rear Seal</p>
 <p>21135</p>	<p>303-254 Locking Tool, Flywheel</p>
 <p>21143</p>	<p>303-293 Remover, Crankshaft Seal</p>

Vehicles with automatic transmission

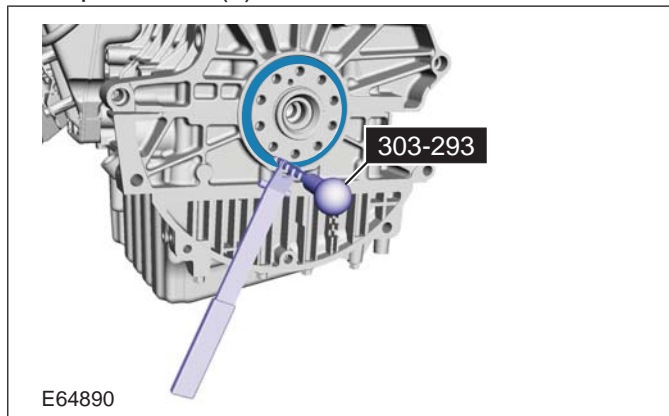
2. Refer to: **Transmission** (307-01 Automatic Transmission/Transaxle - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD, Removal).

All vehicles

3. Special Tool(s): 303-254



4. Special Tool(s): 303-293



Removal

Vehicles with manual transmission

- 1.



303-01-57

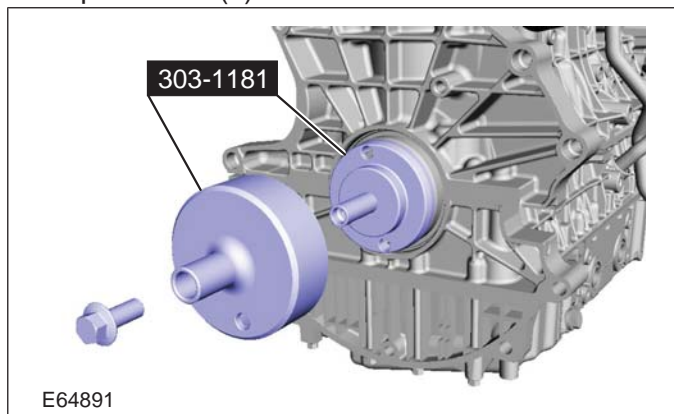
Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-57

## REMOVAL AND INSTALLATION

## Installation

1. Special Tool(s): 303-1181



Vehicles with manual transmission

## 2. CAUTIONS:

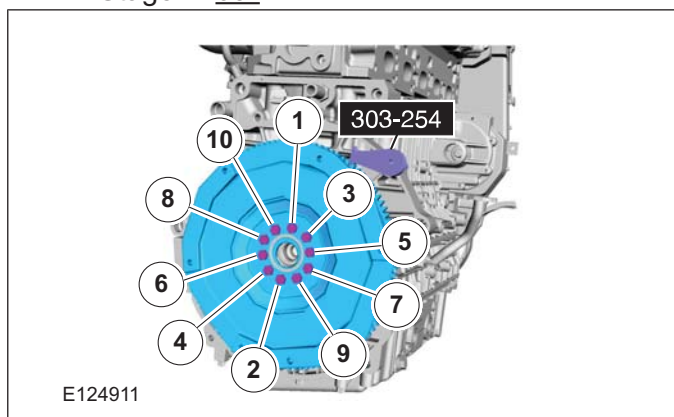
- ⚠ Make sure that new bolts are installed.
- ⚠ Make sure that no excess sealant residue is evident.

**NOTE:** Make sure that the locating pin on the crankshaft is aligned with the guide hole in the flywheel or flexplate.

Special Tool(s): 303-254

Torque:

- Stage 1: 45 Nm
- Stage 2: 65°



3.

Vehicles with automatic transmission

## 4. CAUTIONS:

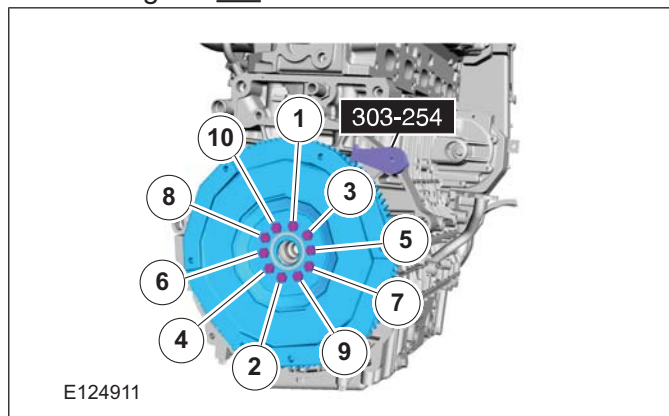
- ⚠ Make sure that new bolts are installed.
- ⚠ Make sure that no excess sealant residue is evident.

**NOTE:** Make sure that the locating pin on the crankshaft is aligned with the guide hole in the flywheel or flexplate.

Special Tool(s): 303-254

Torque:

- Stage 1: 45 Nm
- Stage 2: 50°



5. Refer to: **Transmission** (307-01 Automatic Transmission/Transaxle - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD, Removal).

REMOVAL AND INSTALLATION

Oil Cooler(21 764 0)

General Equipment

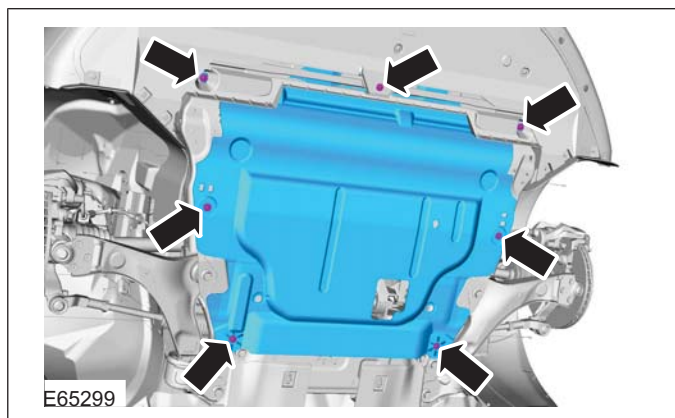
Fluid Container
Hose Clamp(s)

Materials	
Name	Specification
Engine Oil - 5W-30	WSS-M2C913-C

Removal

**NOTE:** Removal steps in the procedure may contain installation details.

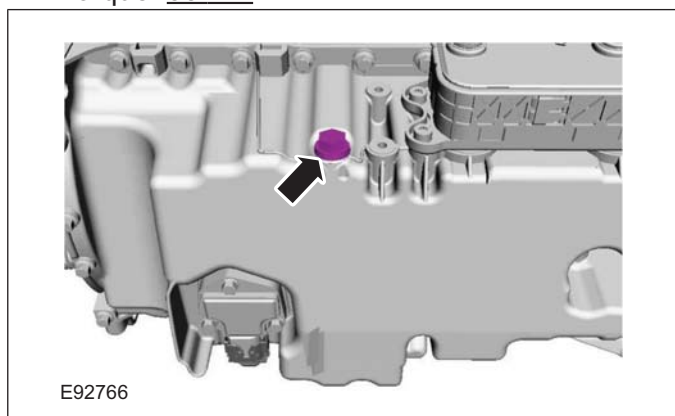
1.



2.

**WARNING:** Be prepared to collect escaping fluid.

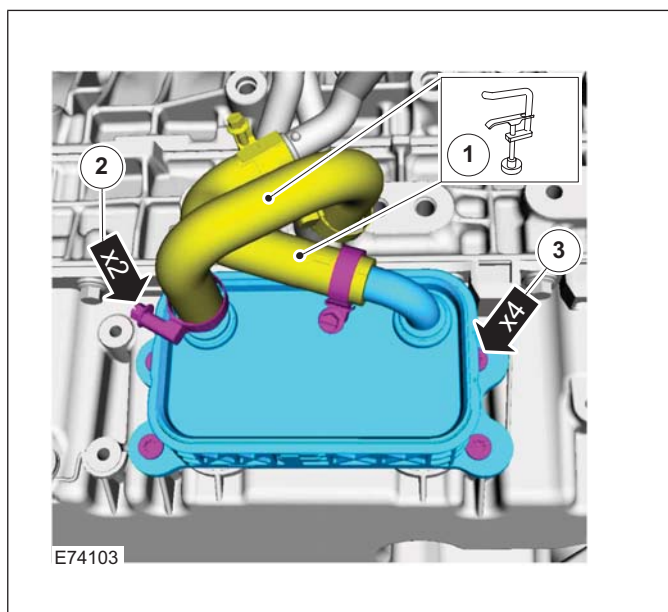
General Equipment: Fluid Container  
Torque: 38 Nm



3.

**WARNING:** Be prepared to collect escaping fluids.

1. General Equipment: Fluid Container  
General Equipment: Hose Clamp(s)
2. Torque: 3 Nm
3. Torque: 17 Nm



Installation

1. To install, reverse the removal procedure.
2. **CAUTION:** Make sure that fluid level is to the MAX mark.  
Refer to: **Specifications** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Specifications).  
Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil
3. Refer to: **Cooling System Draining and Vacuum Filling** (303-03 Engine Cooling, General Procedures).

303-01-59

Engine — 2.5L Duratec (147kW/200PS) - VI5

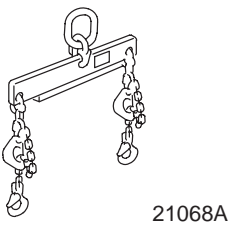
303-01-59

## REMOVAL

Engine — Vehicles With: 5-Speed Automatic Transaxle  
(AW55)(21 132 0; 21 132 6; 21 132 7)

## Removal

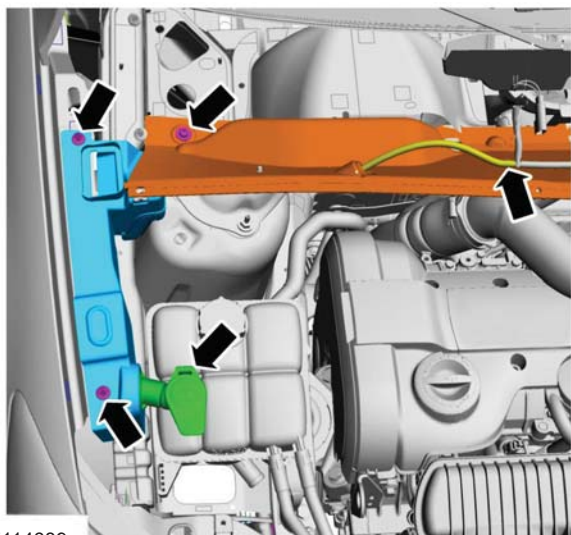
## Special Tool(s) / General Equipment

	303-122 Lifting Bracket, Engine
Cable Ties	
Hose Clamp Remover/Installer	
Hydraulic Jib Crane	
Mounting Table Set	

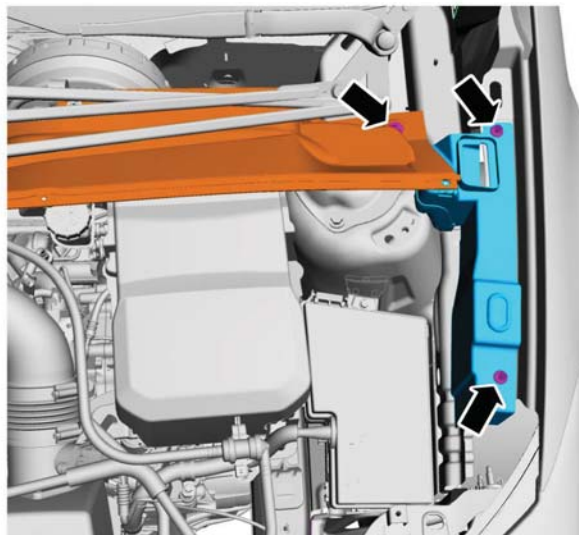
## Special Tool(s) / General Equipment

Retaining Strap
Trolley Jack
Wooden Block

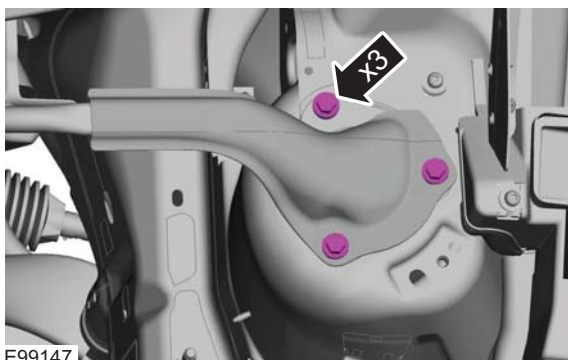
1. Refer to: **Fuel System Pressure Release** (310-00 Fuel System - General Information, General Procedures).
2. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
3. Refer to: **Battery** (414-01 Battery, Mounting and Cables, Removal and Installation).
- 4.



E114689



5. On both sides.  
Loosen: 3 turn(s)



E99147

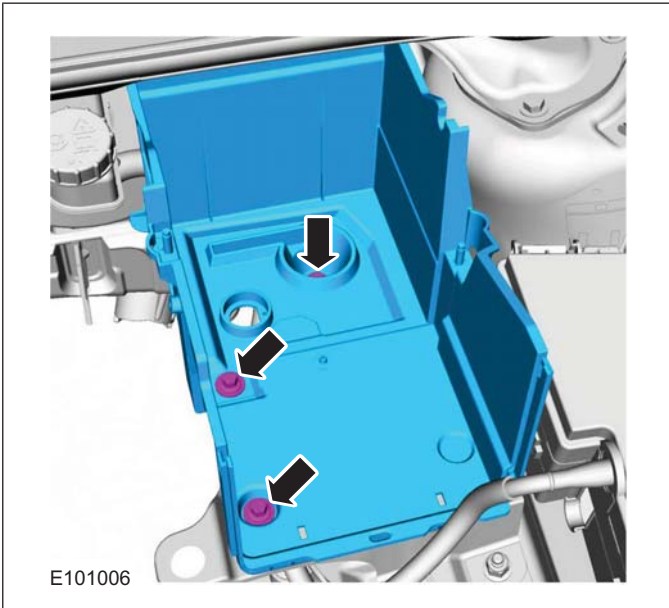
303-01-60

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-60

REMOVAL

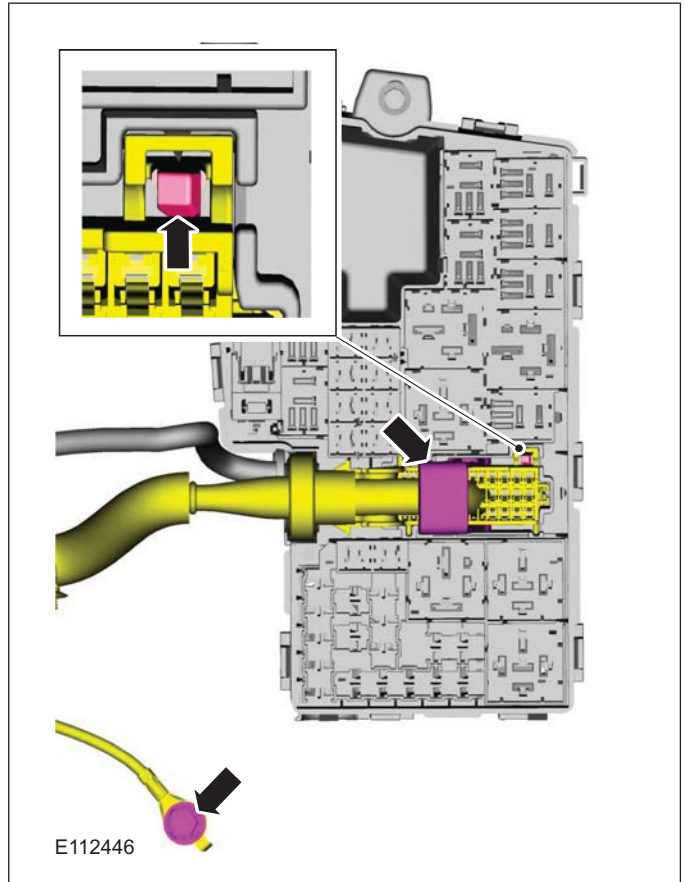
6.



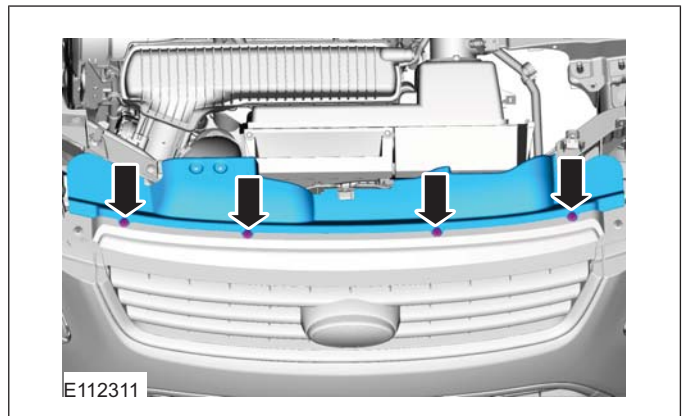
7.



8.



9.

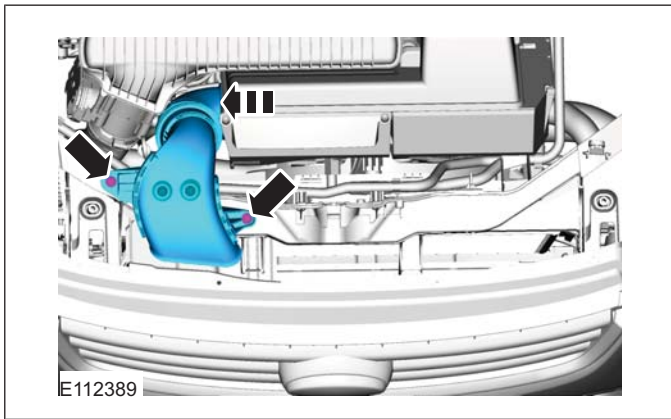




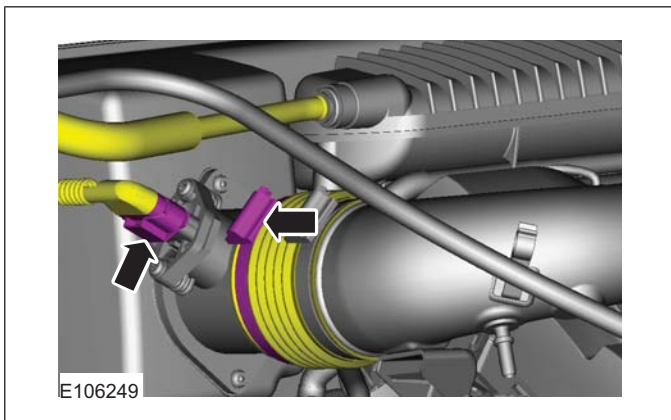


REMOVAL

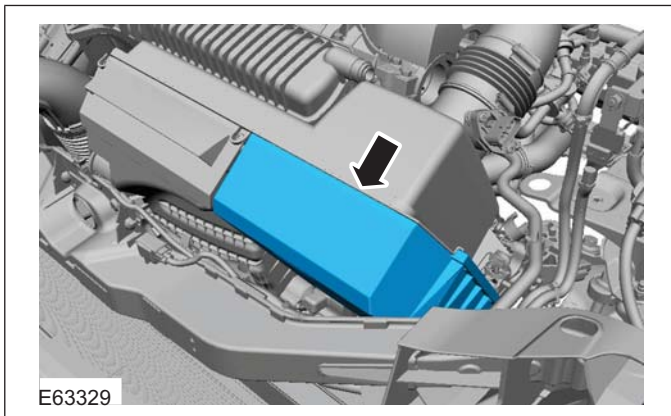
10.



11.

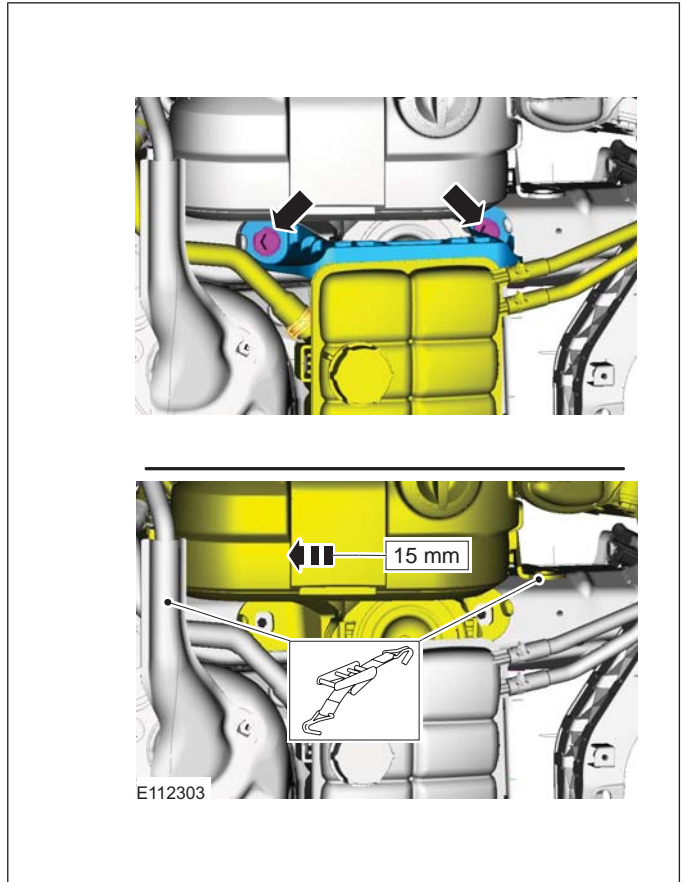


12.



13.  **CAUTION:** Make sure that no components catch.

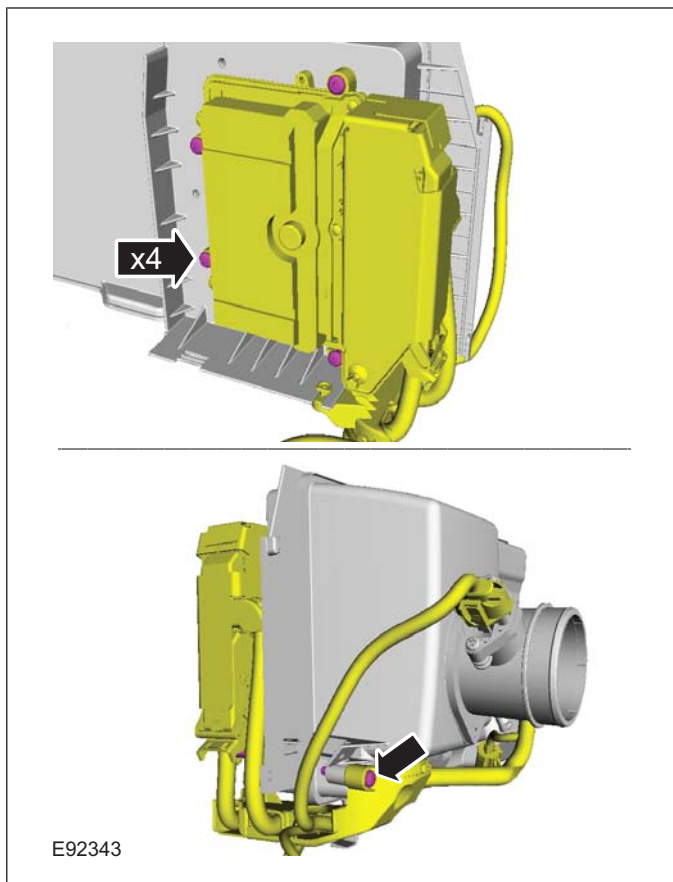
General Equipment: Retaining Strap  
General Equipment: Trolley Jack



REMOVAL

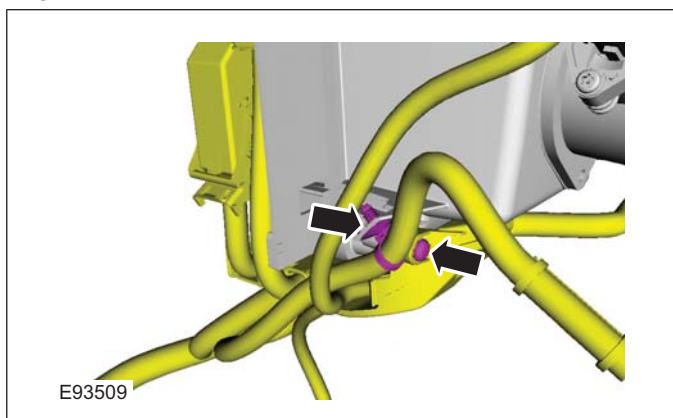
Vehicles with PCM security shield

14.

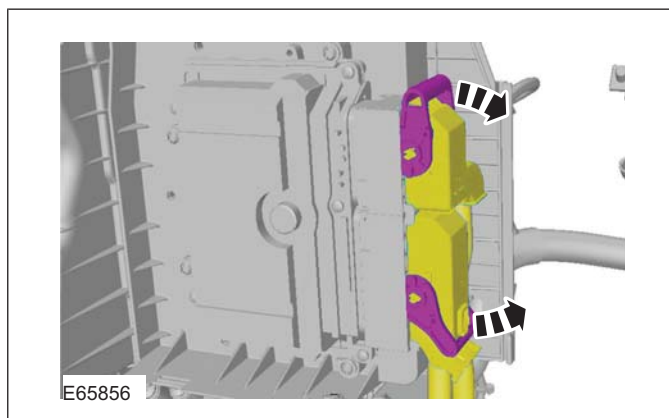


Vehicles without PCM security shield

15.

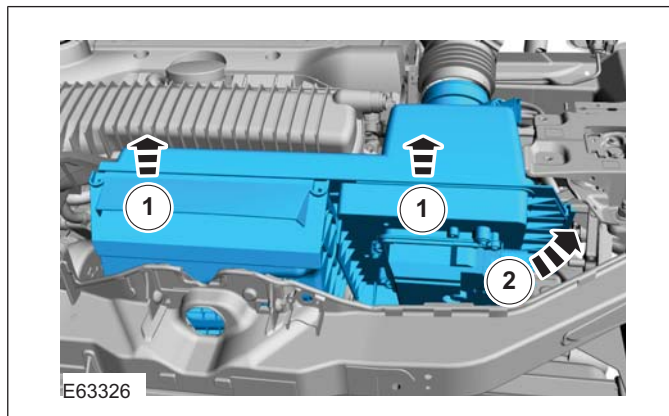


16.



All vehicles

17.



18. **CAUTION:** Make sure that no components catch.

Remove the following items:

- General Equipment: Retaining Strap

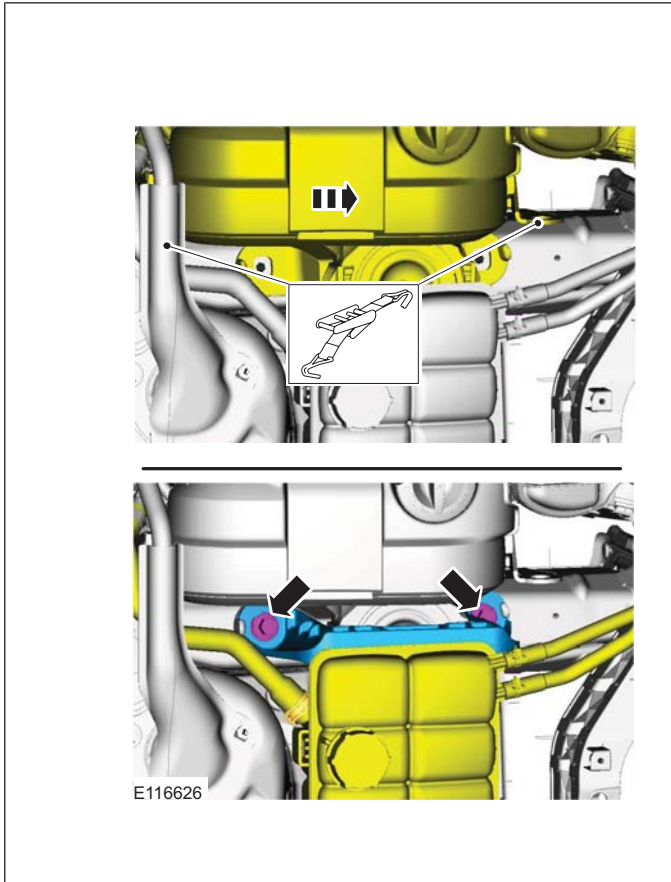
19. **NOTE:** Only tighten the bolts finger tight at this stage.



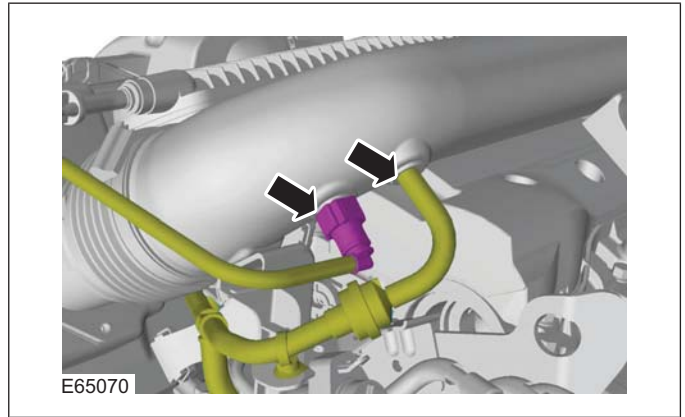
REMOVAL

Remove the following items:

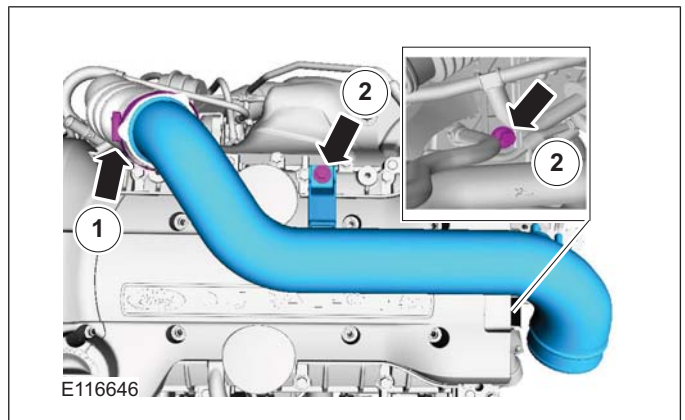
- General Equipment: Trolley Jack



20.



21.



22 General Equipment: Cable Ties



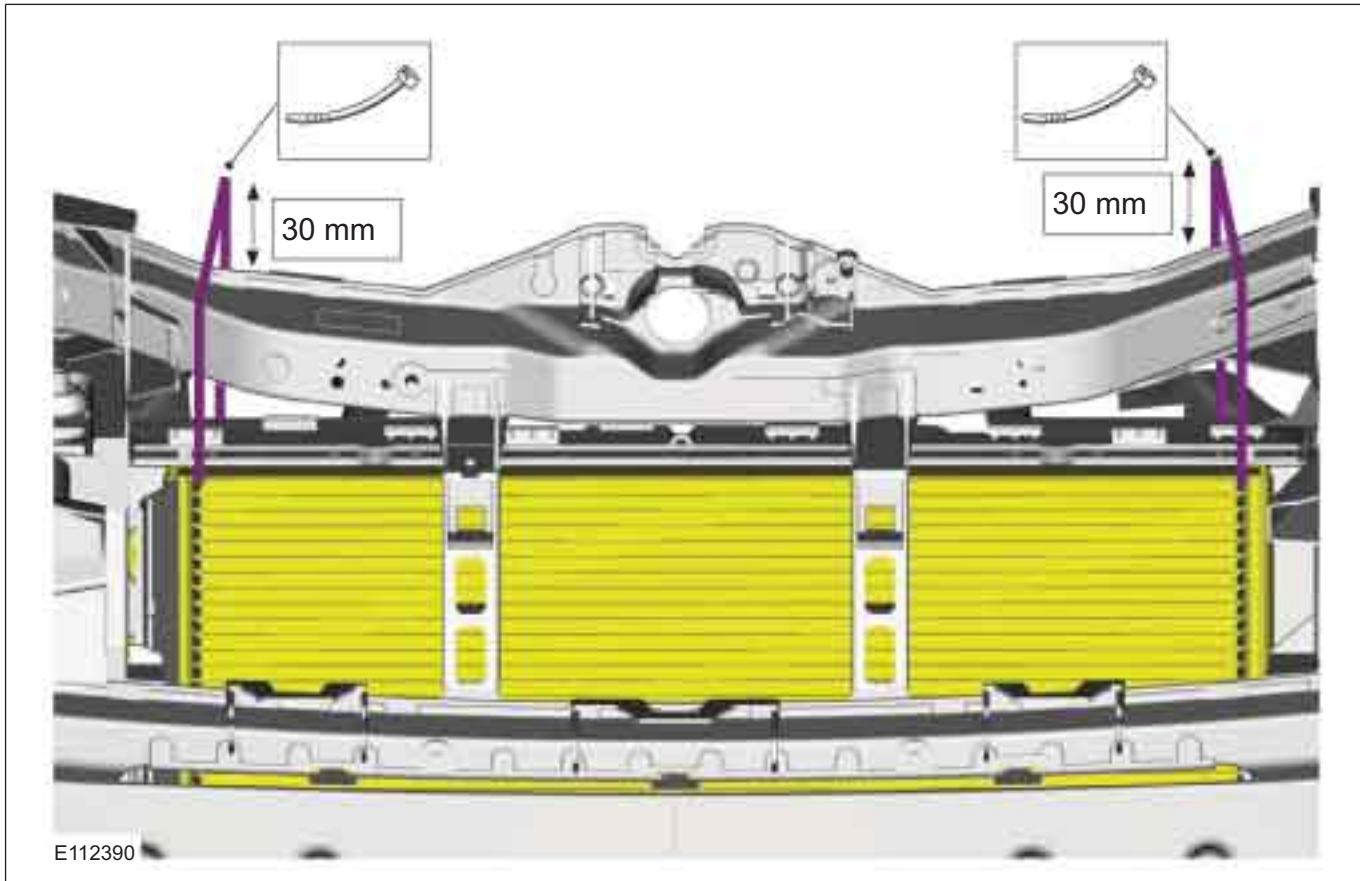
303-01-64

Engine — 2.5L Duratec (147kW/200PS) - VI5

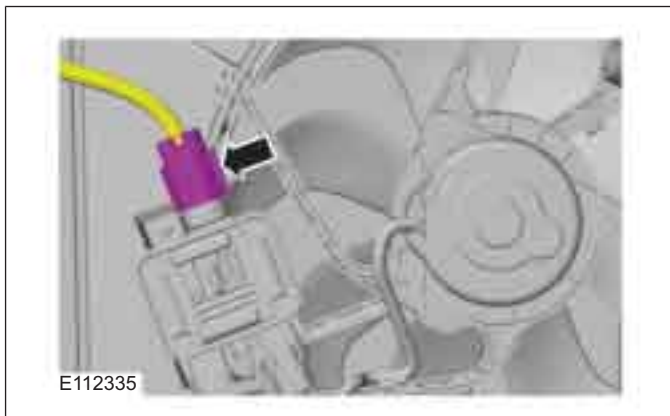
303-01-64



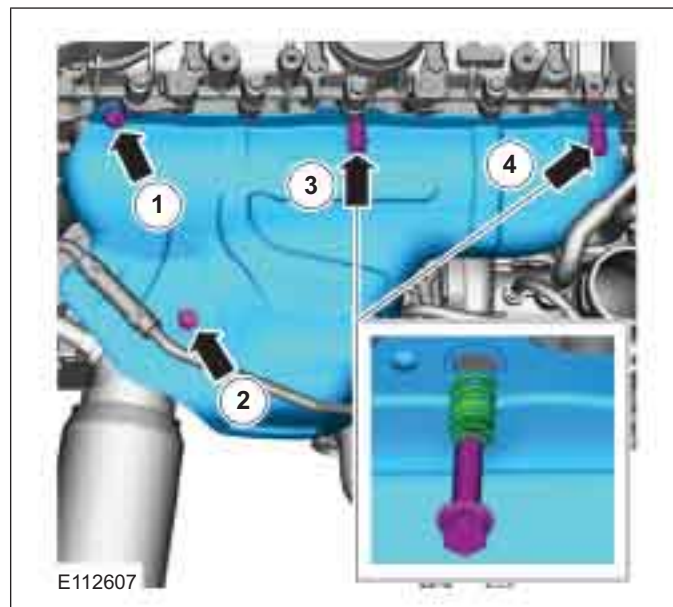
REMOVAL



23.



24.



303-01-65

Engine — 2.5L Duratec (147kW/200PS) - VI5

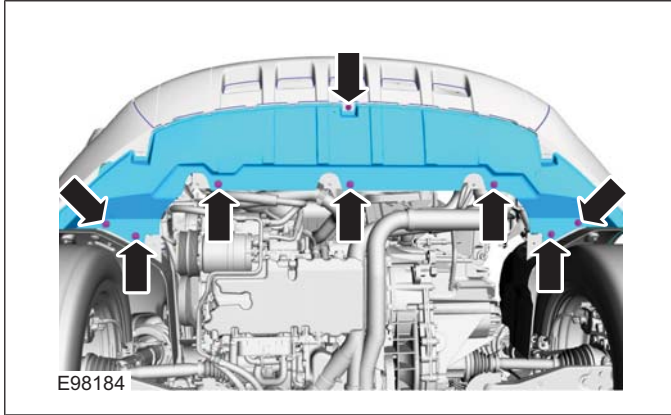
303-01-65

REMOVAL

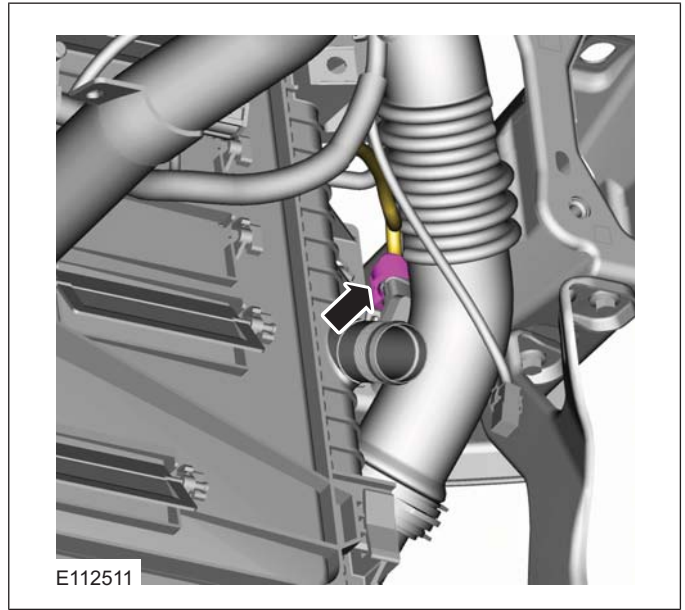
25. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

26. Refer to: **Cooling System Draining and Vacuum Filling** (303-03 Engine Cooling, General Procedures).

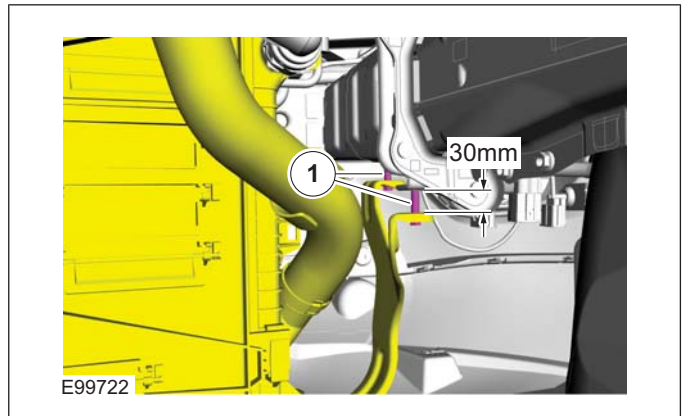
27.



28.



29. On both sides.



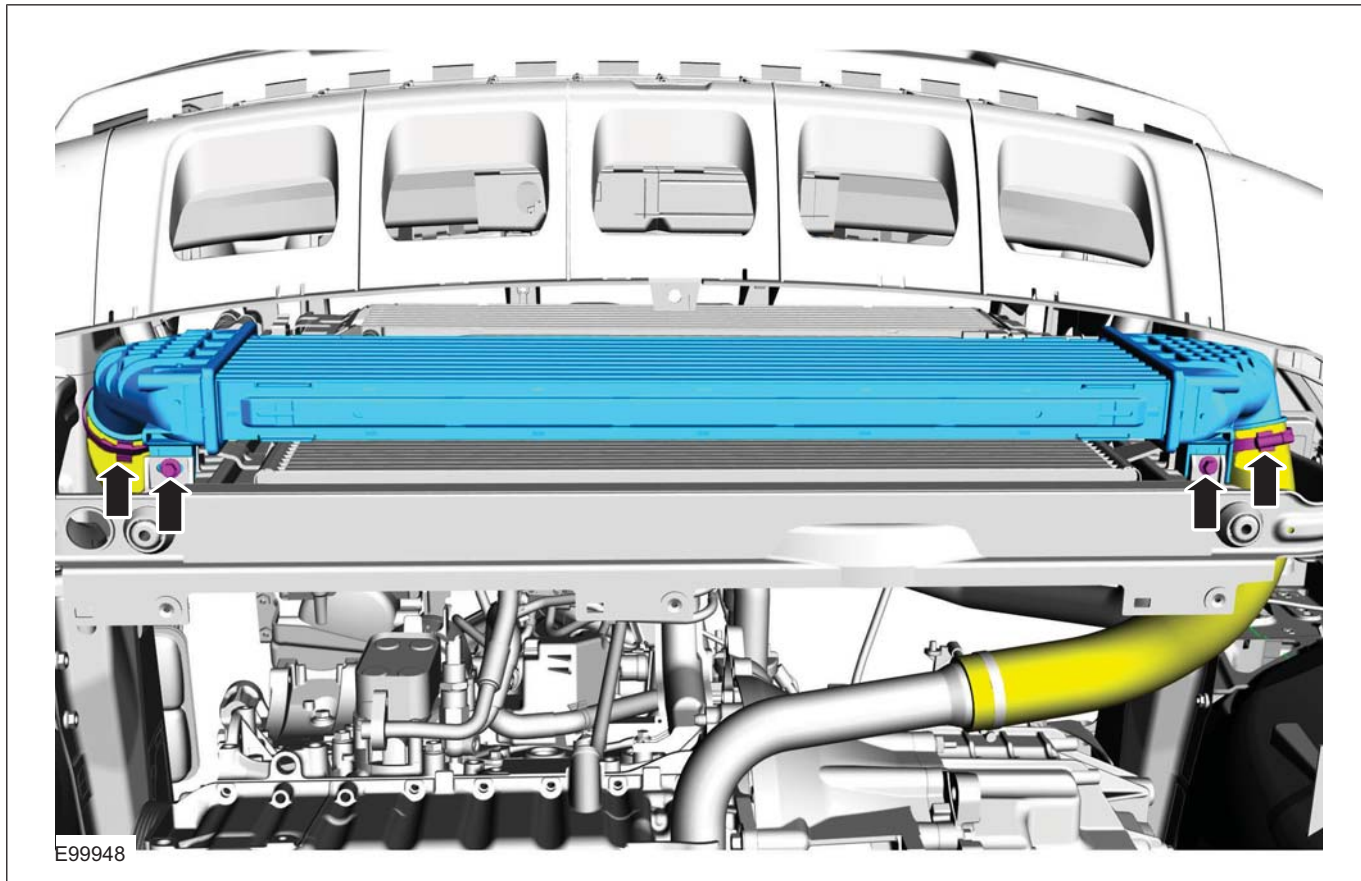
30.

303-01-66

Engine — 2.5L Duratec (147kW/200PS) - V15

303-01-66

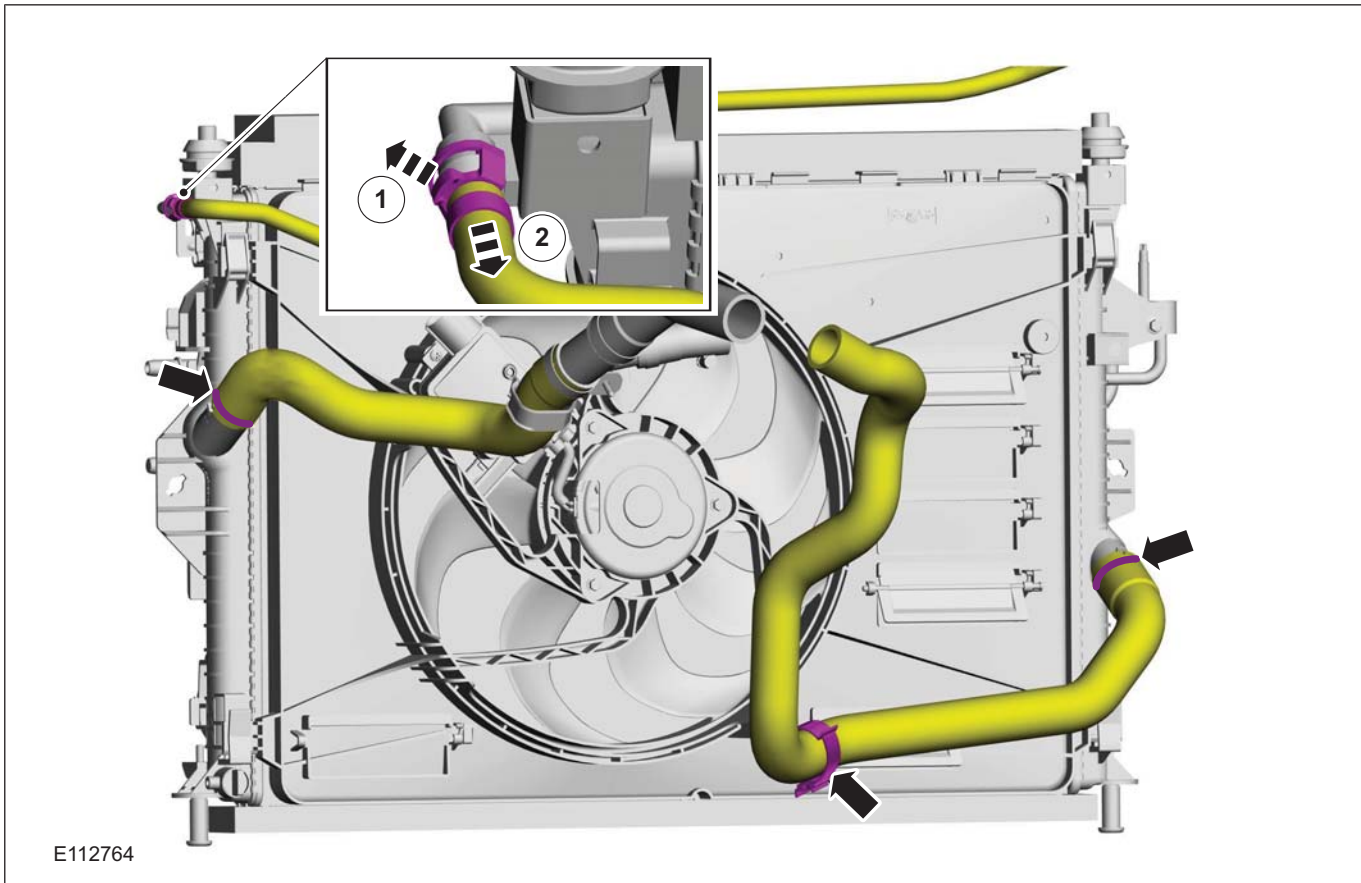
## REMOVAL

**31. General Equipment: Hose Clamp  
Remover/Installer**





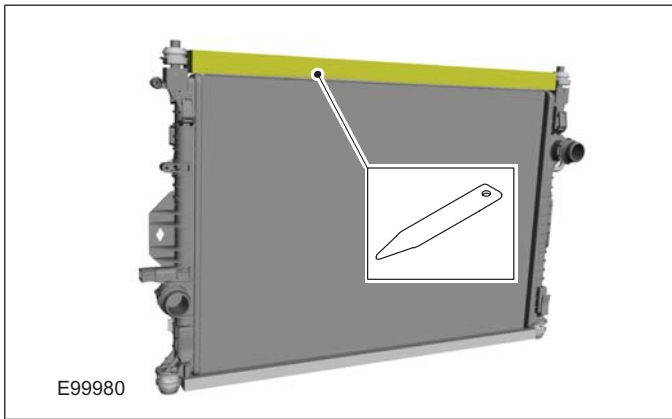
REMOVAL



E112764

32

33.



E99980

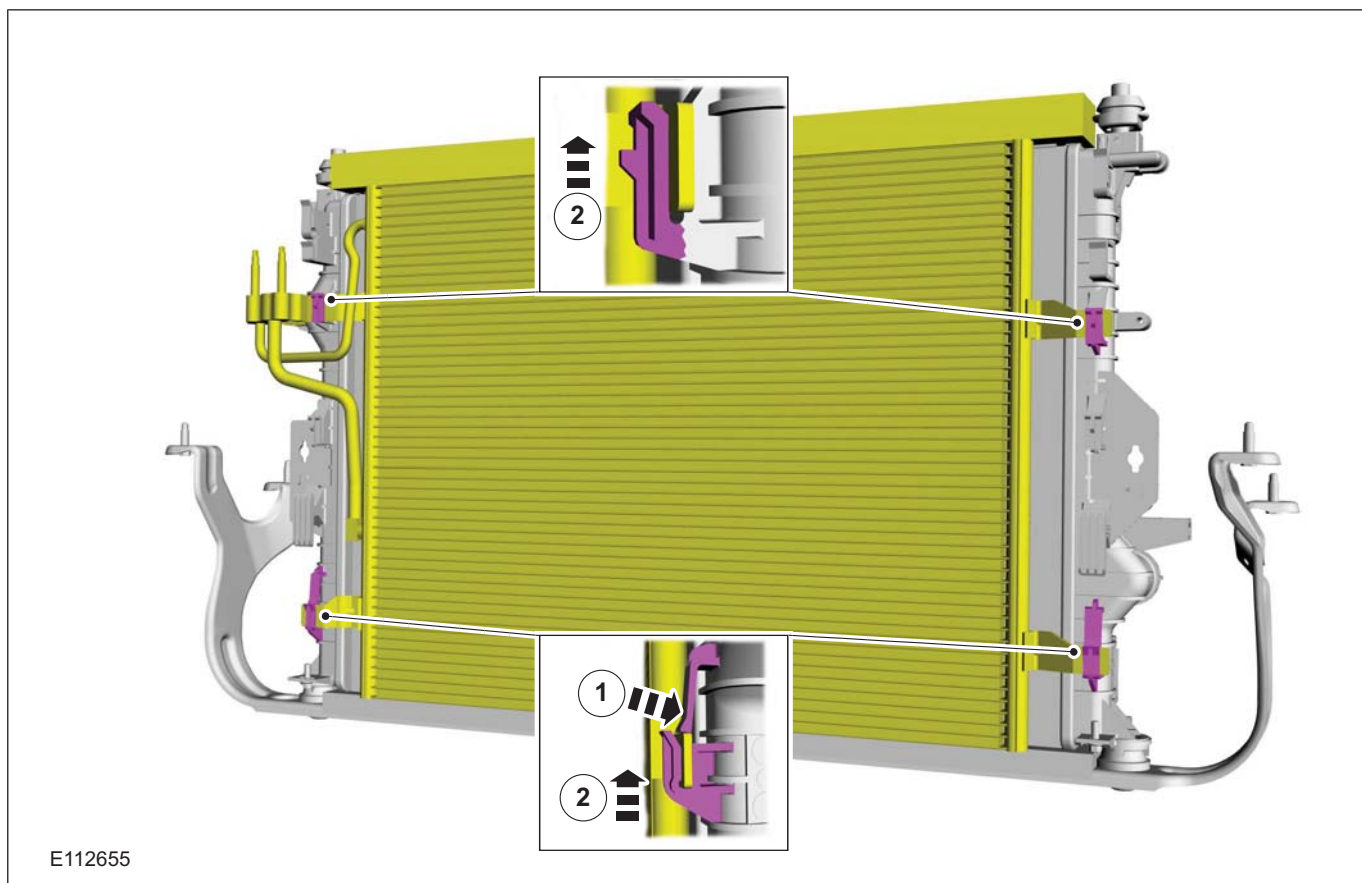


303-01-68

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-68

## REMOVAL



34.  **CAUTION:** Make sure that no components catch.



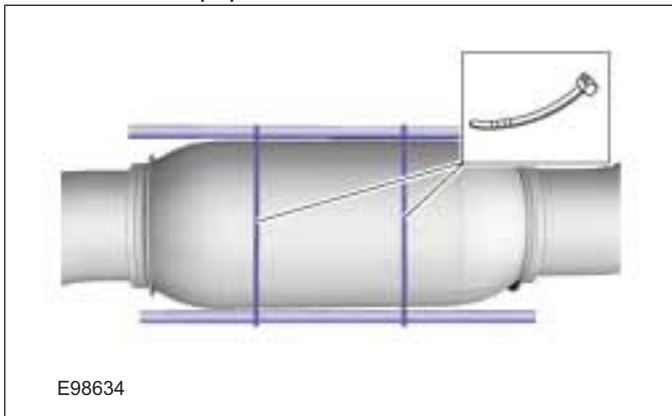


REMOVAL



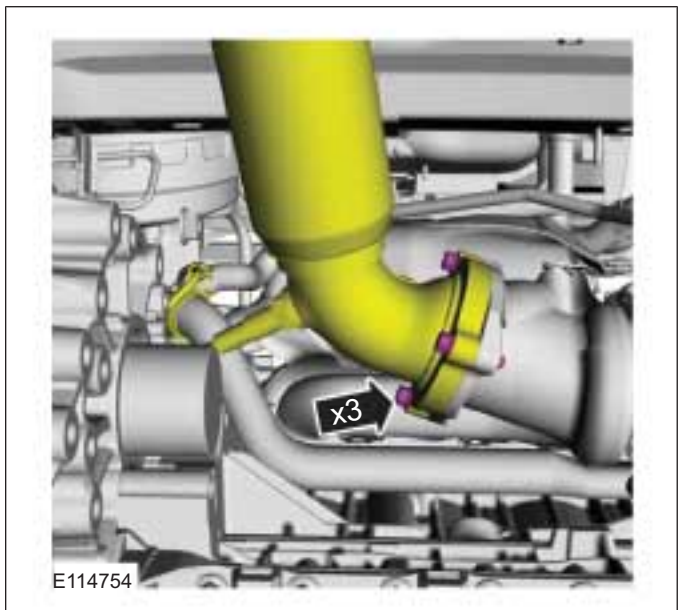
E112439

35. General Equipment: Cable Ties



E98634

36.  CAUTION: Make sure that the exhaust flexible pipe is not forcibly bent.



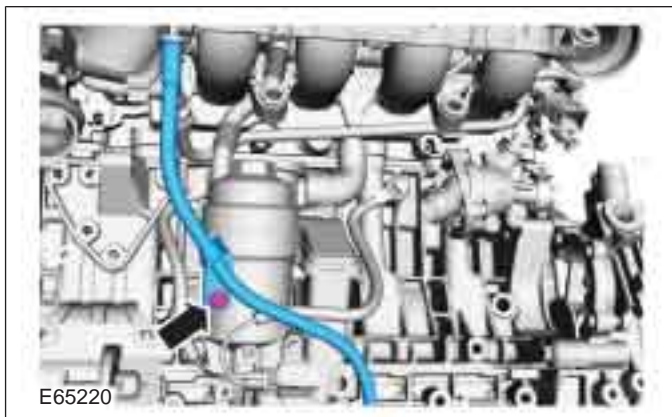
E114754





REMOVAL

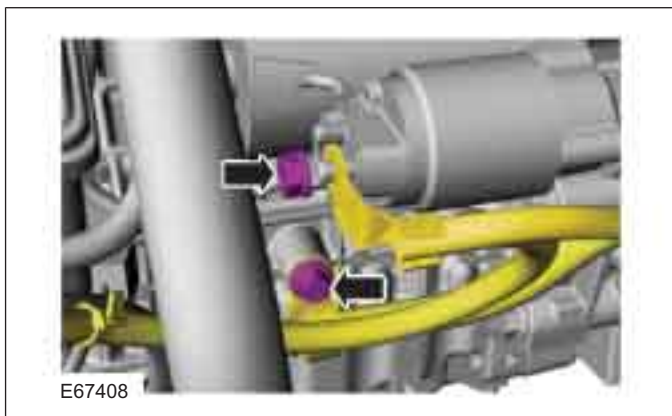
37.



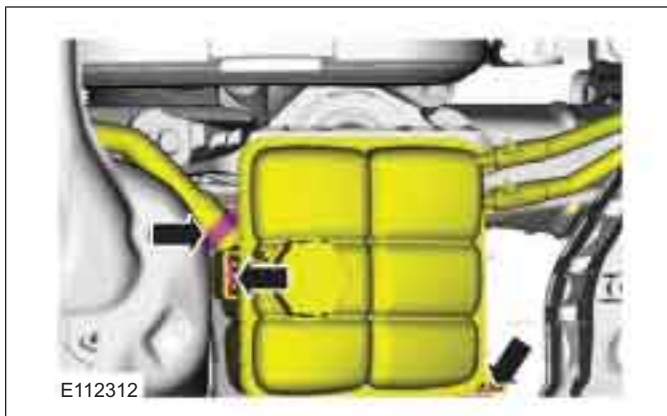
40.



38.

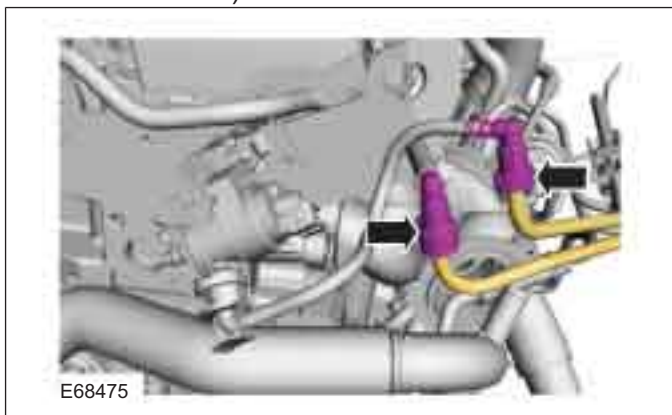


41. General Equipment: Hose Clamp Remover/Installer

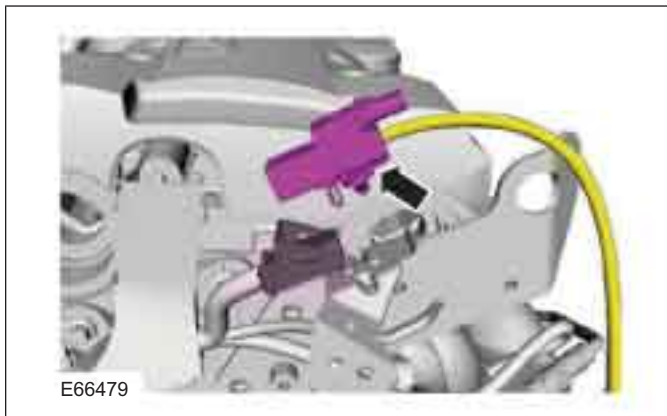


39.  **WARNING:** Be prepared to collect escaping fluid.

Refer to: **Quick Release Coupling** (310-00 Fuel System - General Information, General Procedures).

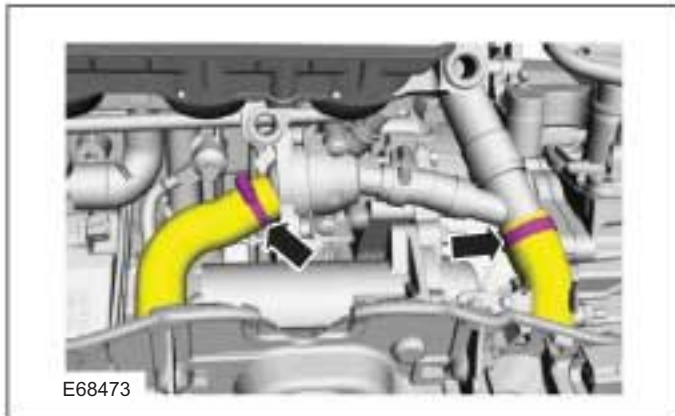


42.

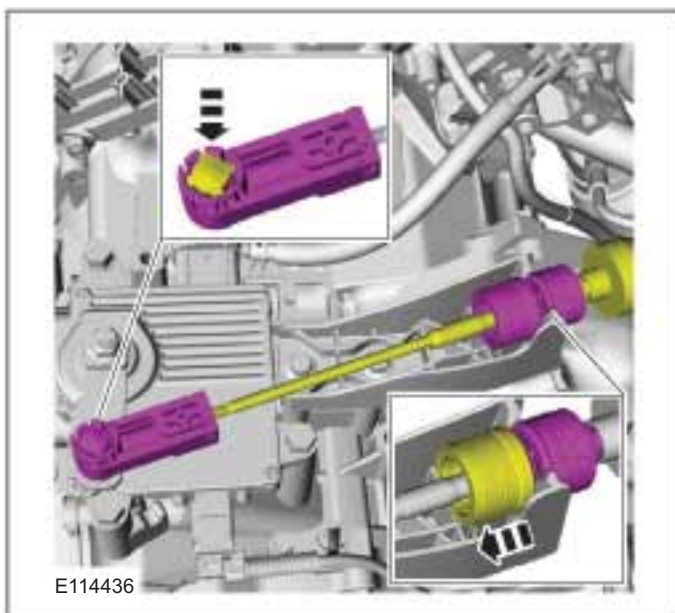


REMOVAL

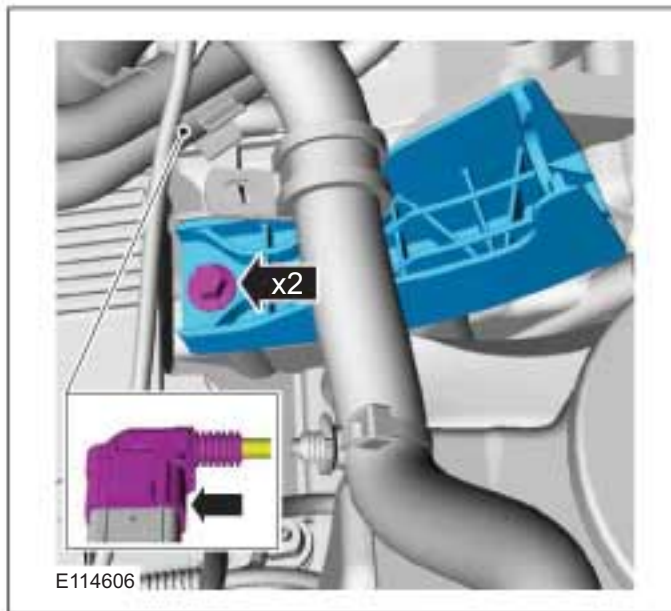
43. General Equipment: Hose Clamp Remover/Installer



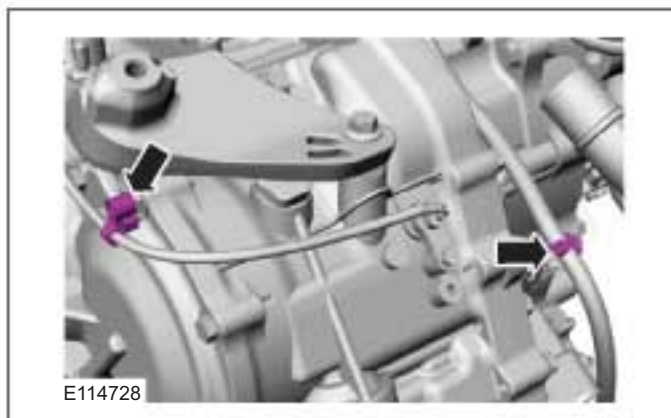
44. **CAUTION:** Gearshift cables must not be kinked or bent.



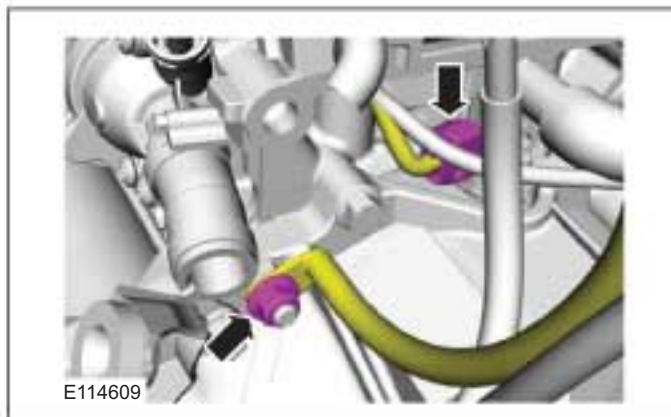
45.



46.



47.

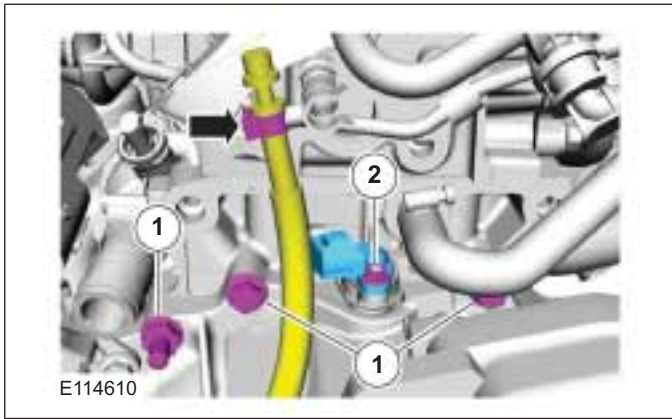




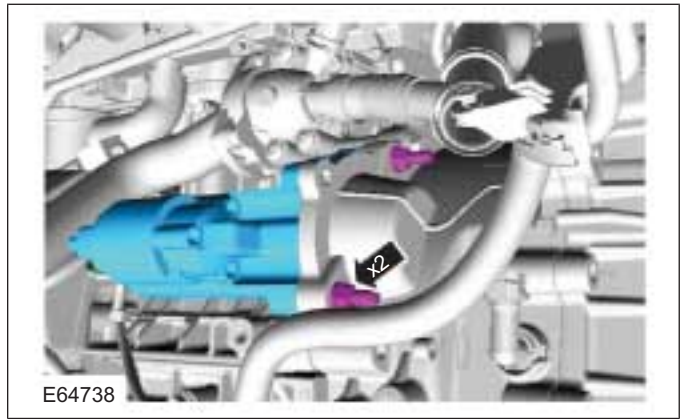


REMOVAL

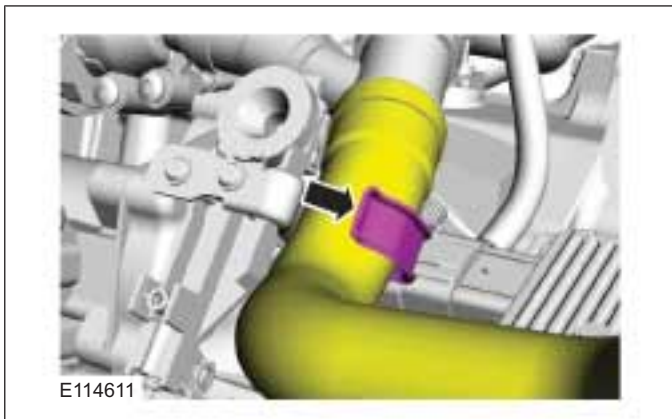
48.



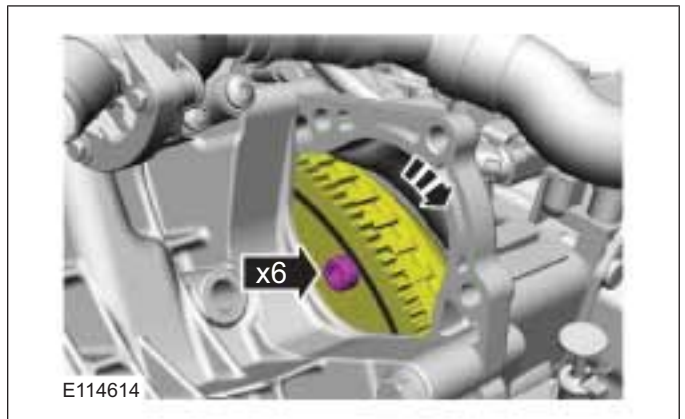
51.



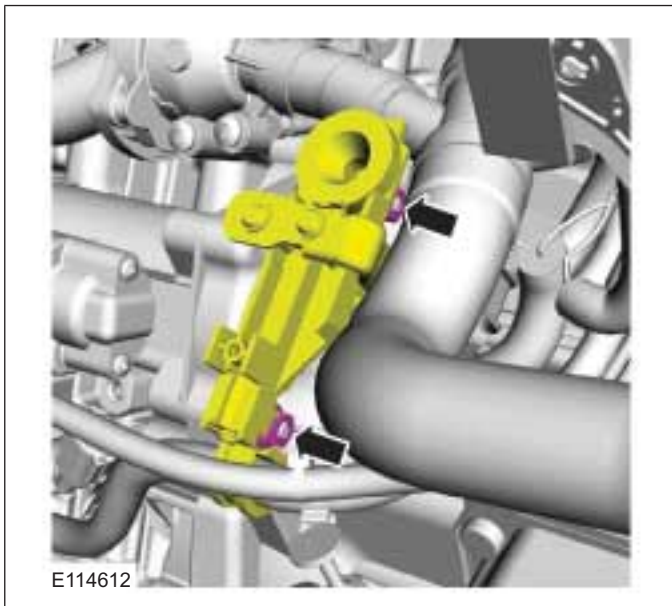
49.



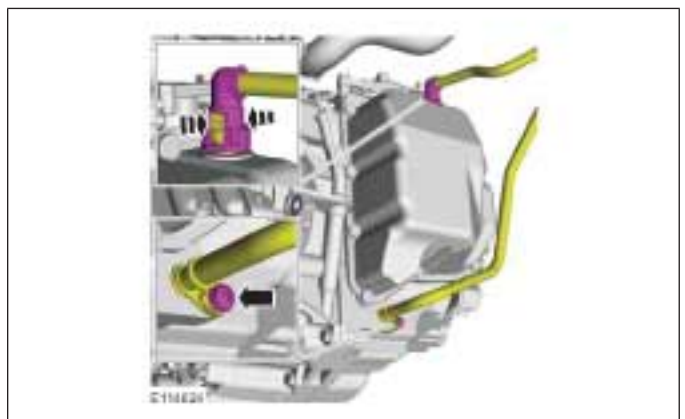
52.



50.



53. **CAUTION:** Make sure that all openings are sealed.



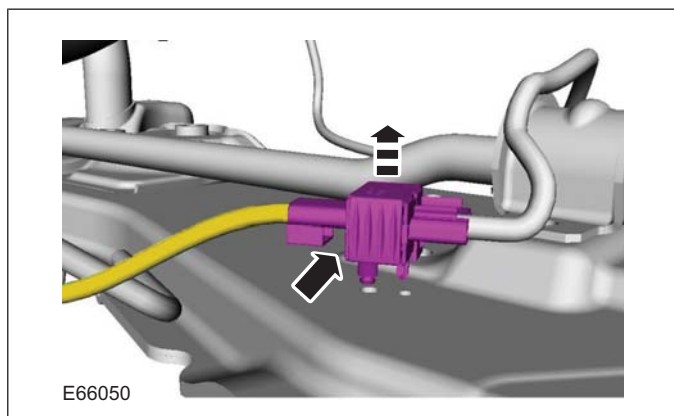
303-01-73

Engine — 2.5L Duratec (147kW/200PS) - VI5

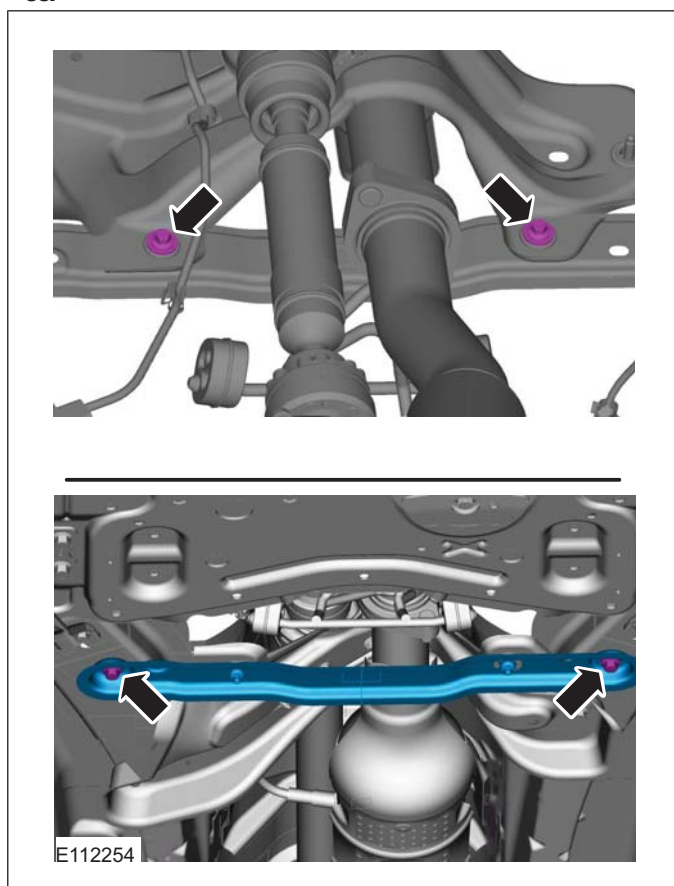
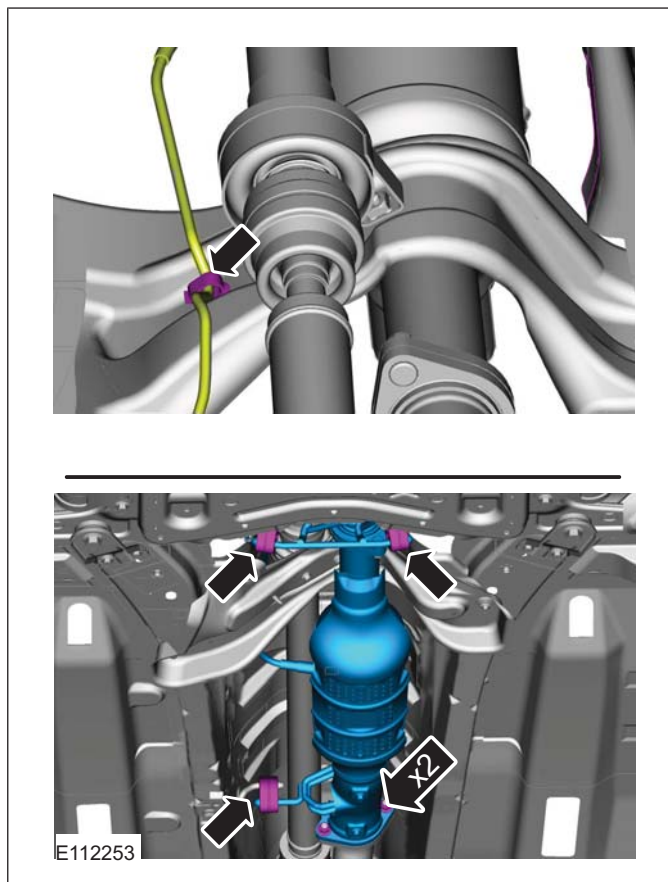
303-01-73

## REMOVAL

54.



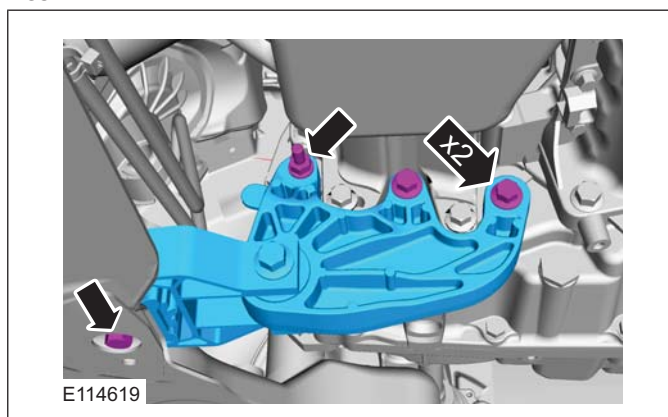
55.

56.  **CAUTION:** Make sure that the exhaust flexible pipe is not forcibly bent.

57. Remove the following items:

1. Refer to: **Transfer Case** (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Removal).
2. Refer to: **Front Halfshaft LH** (205-04 Front Drive Halfshafts, Removal and Installation).
3. Refer to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

58.





303-01-74

Engine — 2.5L Duratec (147kW/200PS) - V15

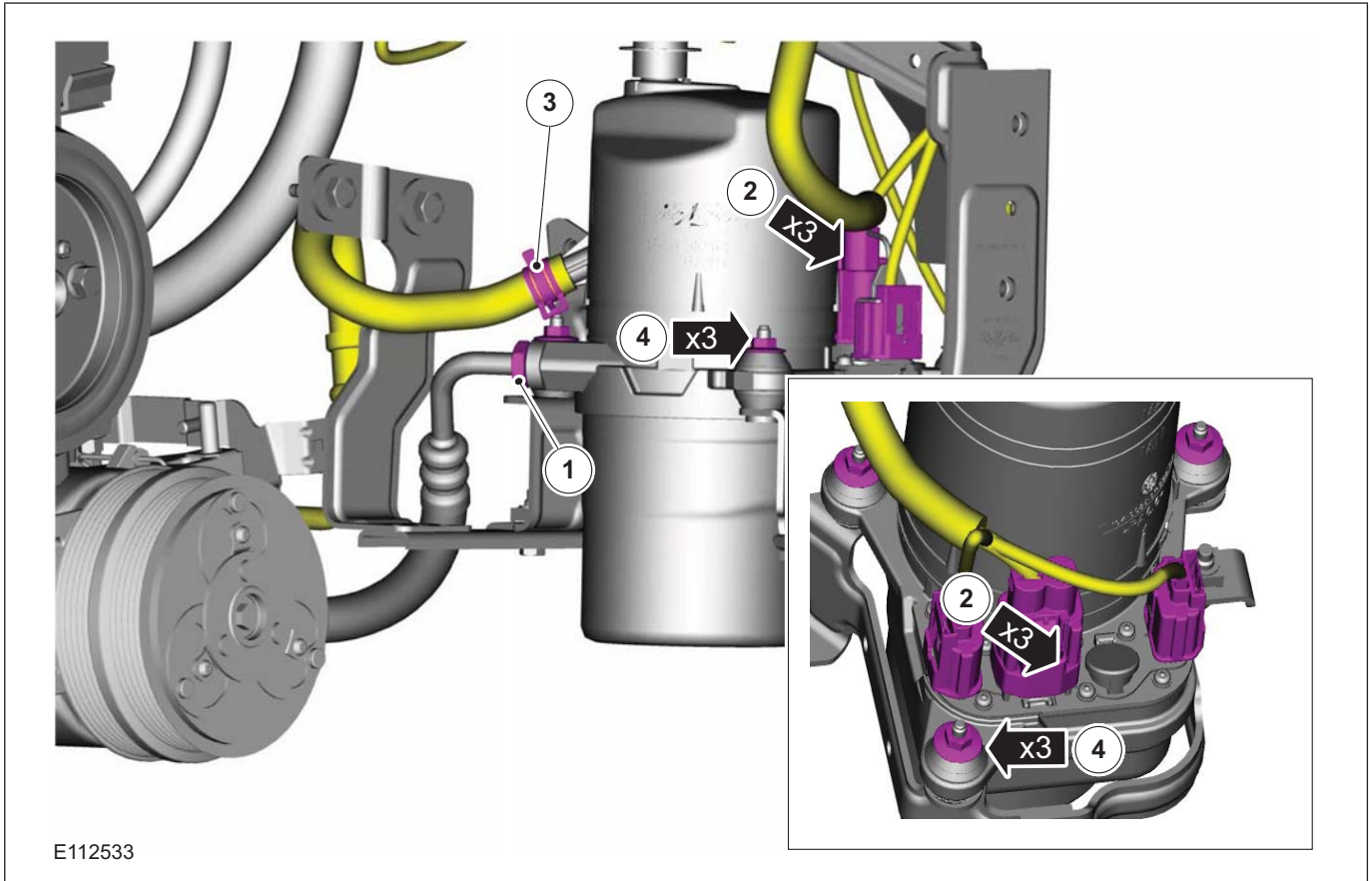
303-01-74



REMOVAL

59. **⚠ WARNING: Be prepared to collect escaping fluid.**

3. General Equipment: Hose Clamp Remover/Installer

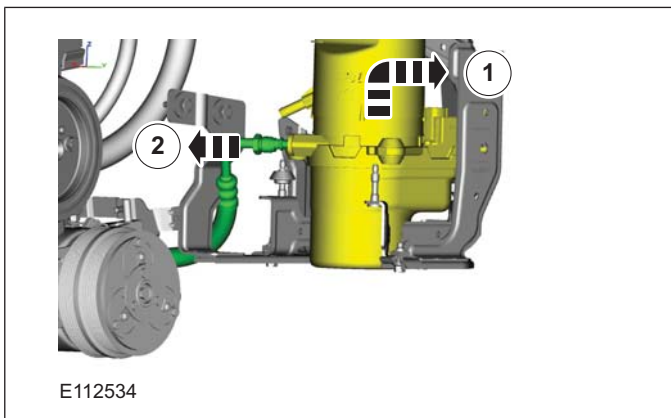


E112533

60.

61. **⚠ WARNING: Be prepared to collect escaping fluid.**

General Equipment: Cable Ties



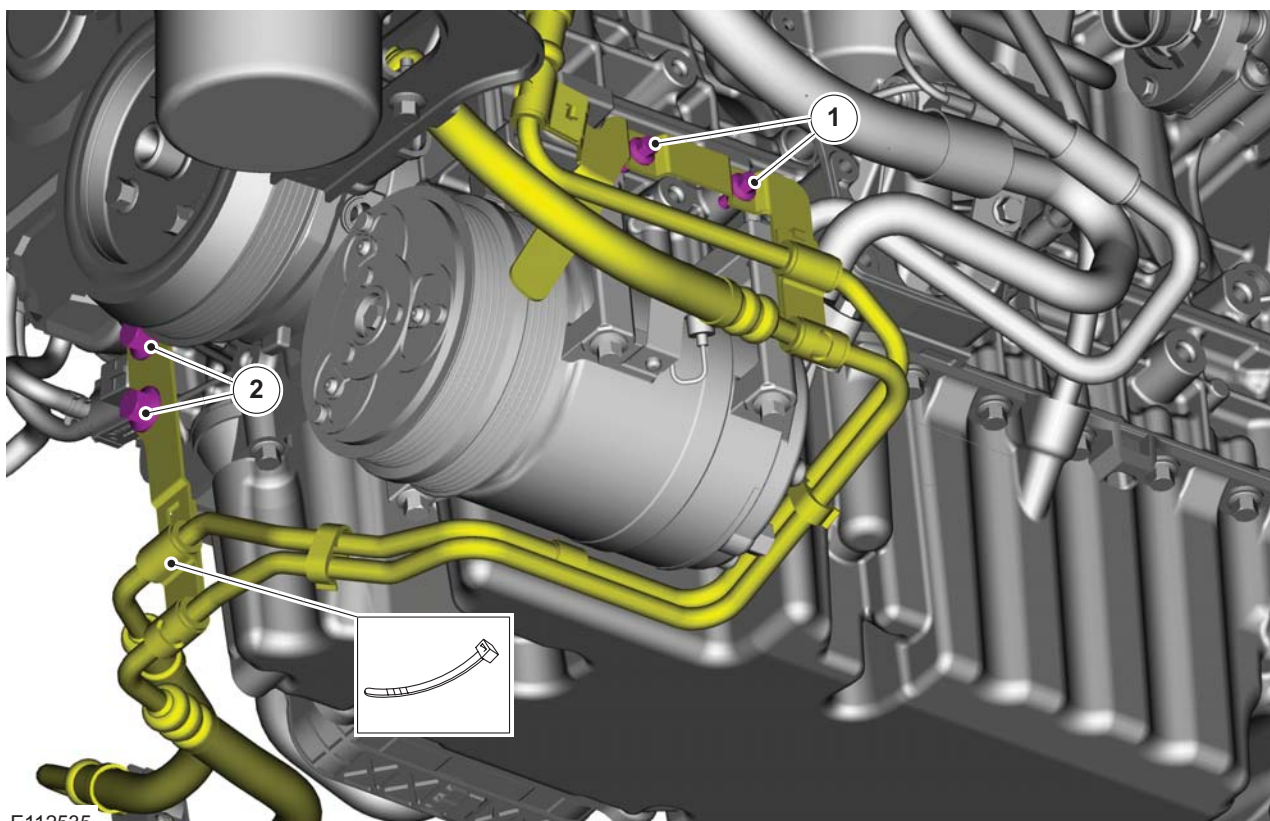
E112534



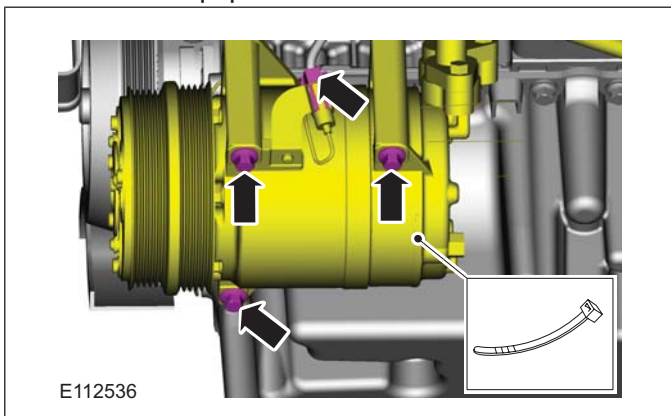




REMOVAL



62 General Equipment: Cable Ties



63. **⚠ WARNING:** Make sure that the engine and transmission assembly is on wooden blocks and secured with suitable retaining straps.

- General Equipment: Retaining Strap
- General Equipment: Mounting Table Set
- General Equipment: Wooden Block





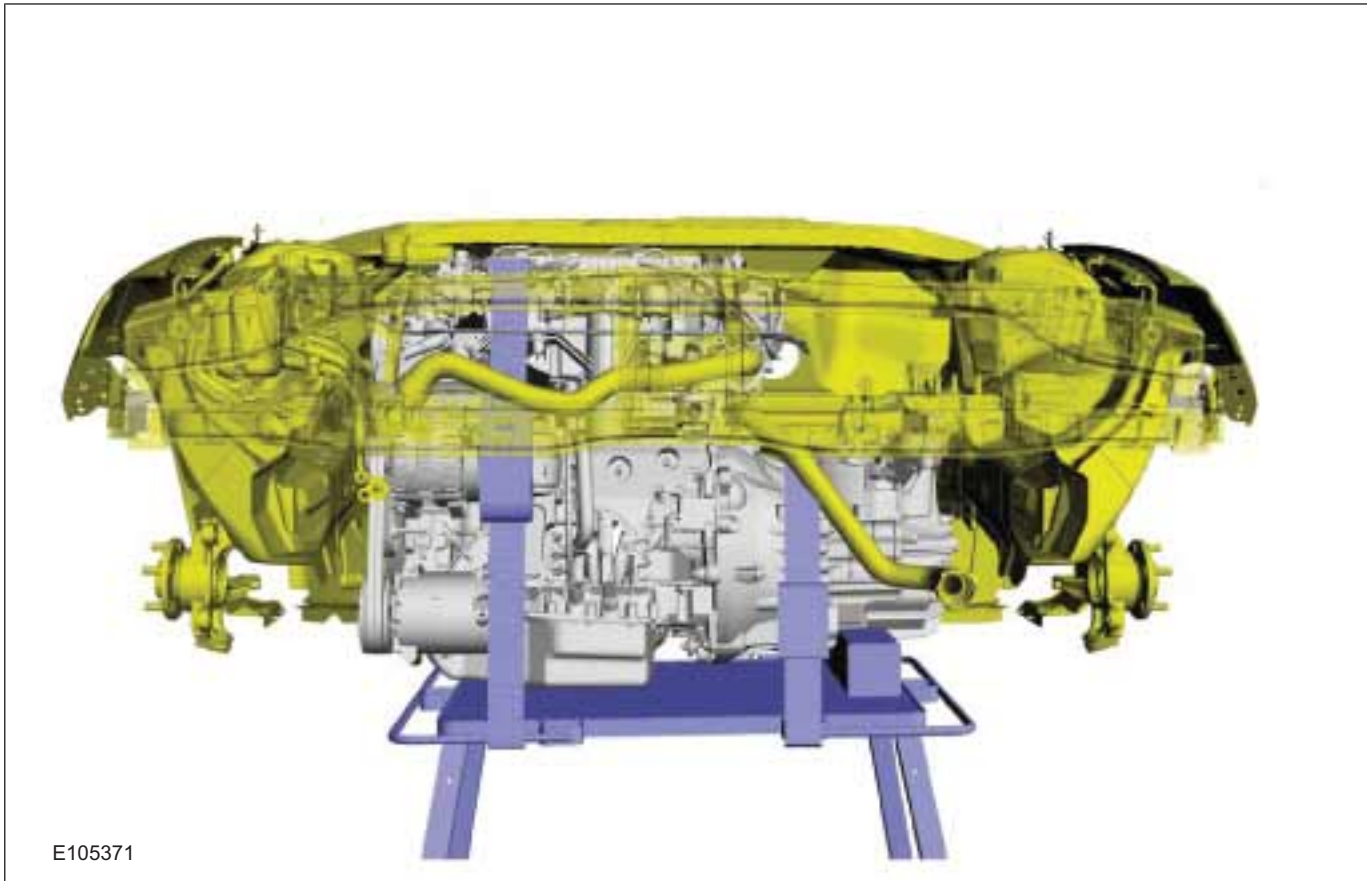
303-01-76

Engine — 2.5L Duratec (147kW/200PS) - VI5

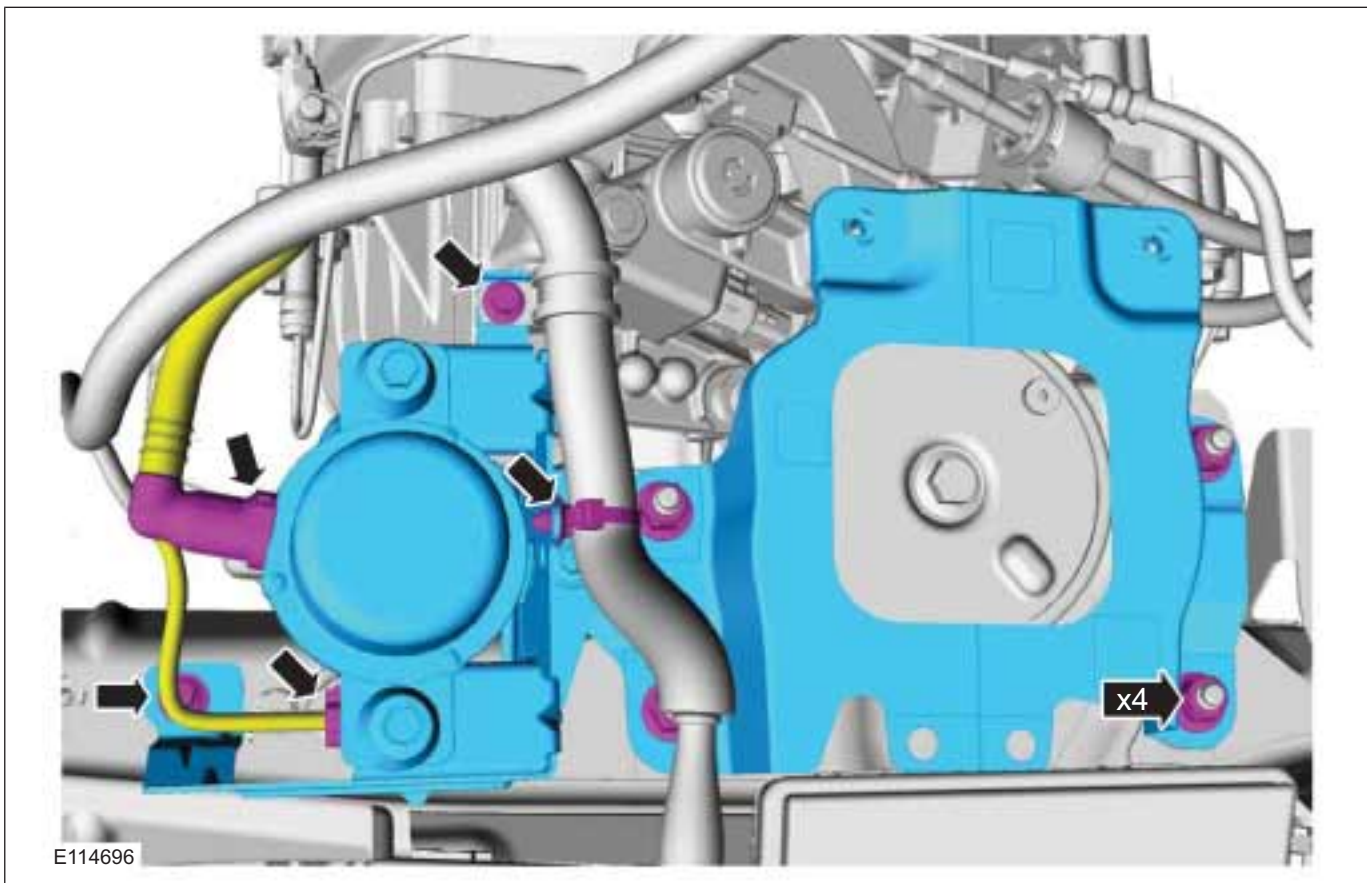
303-01-76



REMOVAL



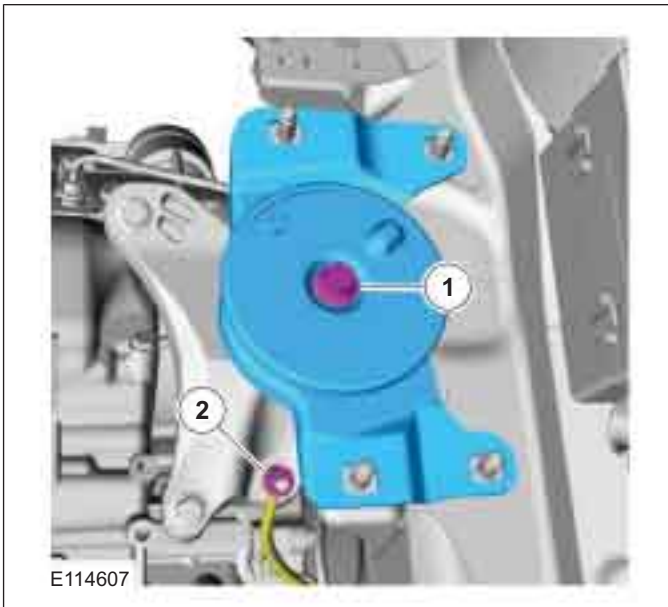
64.



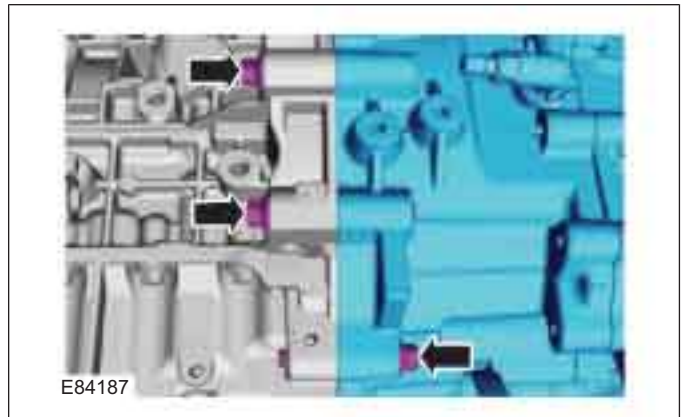


REMOVAL

65.



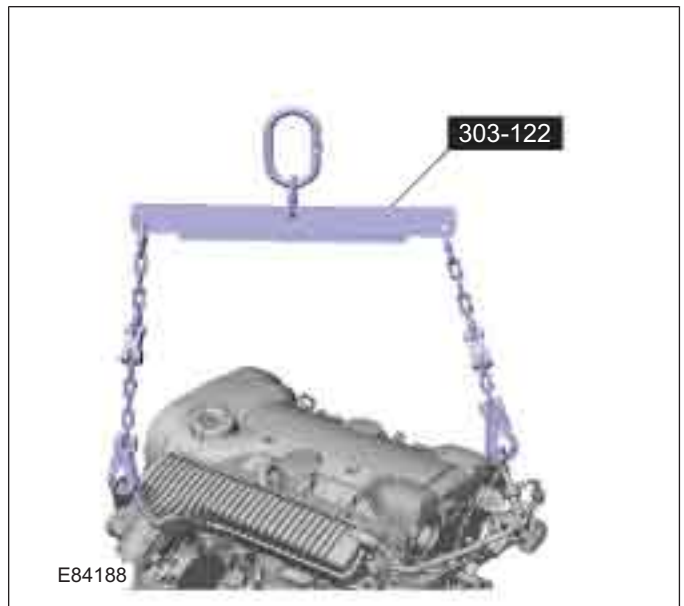
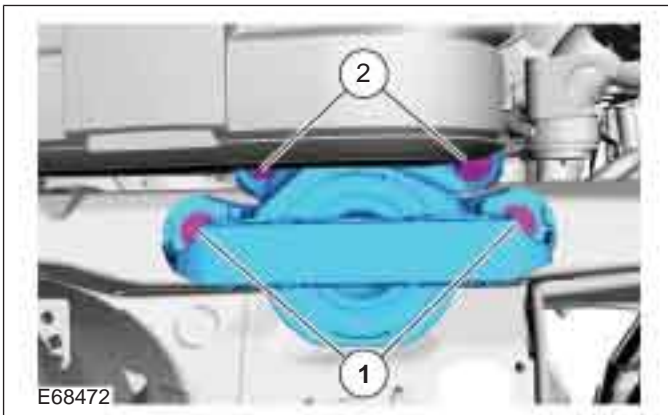
69.



70. Special Tool(s): 303-122  
General Equipment: Hydraulic Jib Crane

71. Remove the following items:  
• General Equipment: Retaining Strap

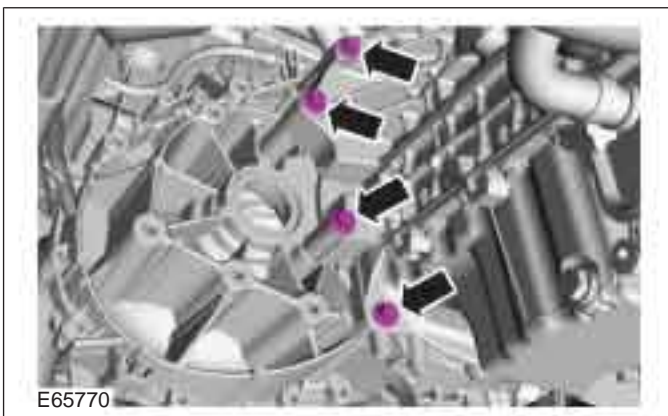
66.



67.  **CAUTION:** Make sure that no components catch.

Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

68.



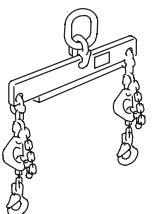
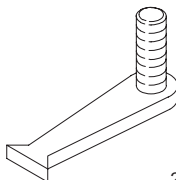
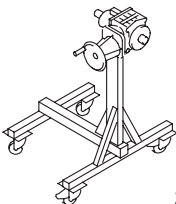
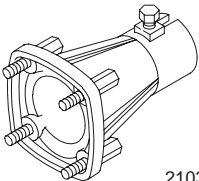
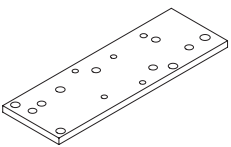


REMOVAL

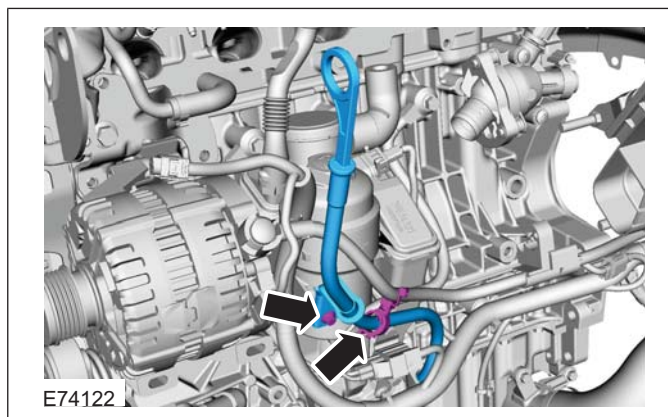
Engine Accessories(21 139 4)

Removal

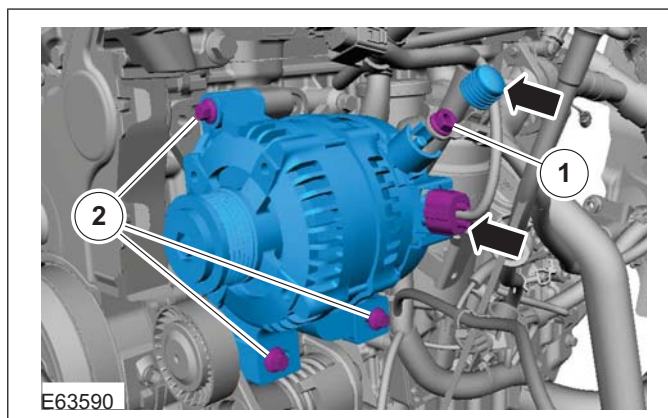
Special Tool(s)

 <p>21068A</p>	<p>303-122 Lifting Bracket, Engine</p>
 <p>21135</p>	<p>303-254 Locking Tool, Flywheel</p>
 <p>21187</p>	<p>303-435 Mounting Stand</p>
 <p>21031B</p>	<p>303-435-06 Mounting Bracket for 303-435</p>
 <p>E62805</p>	<p>303-435-14B Mounting Plate for 303-435-06</p>

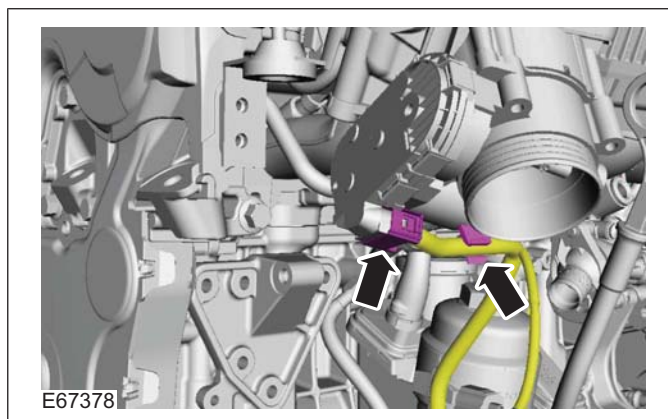
1.



2.



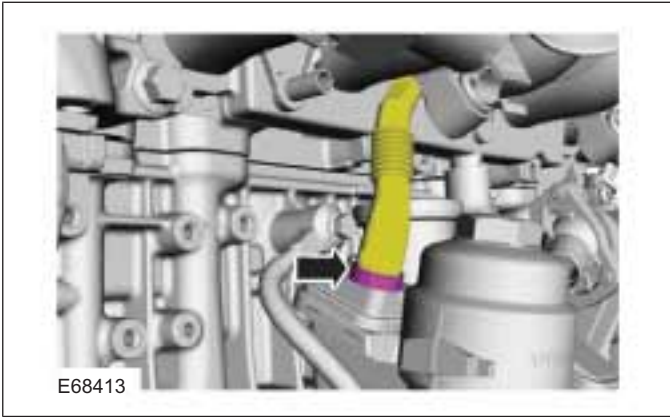
3.



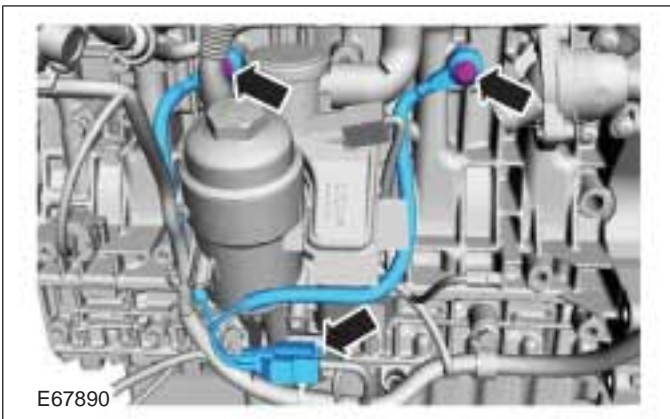


REMOVAL

4.



5.



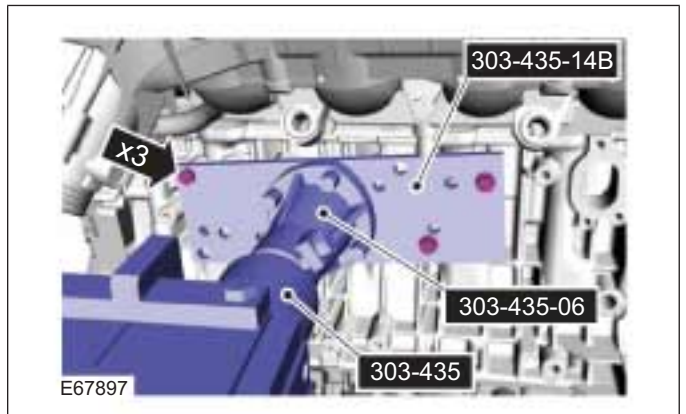
6.



7.



8. Install the Special Tool(s): 303-435, 303-435-06, 303-435-14B



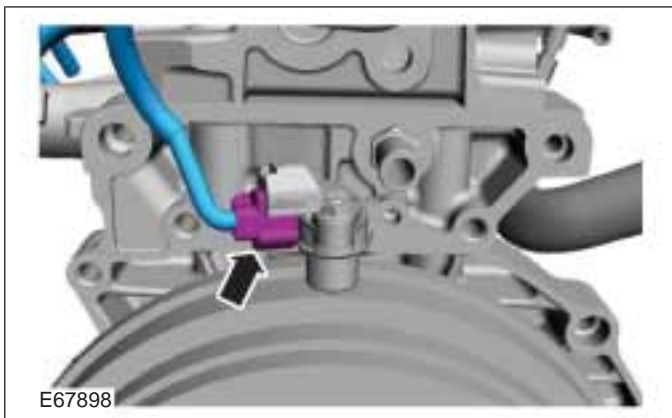


REMOVAL

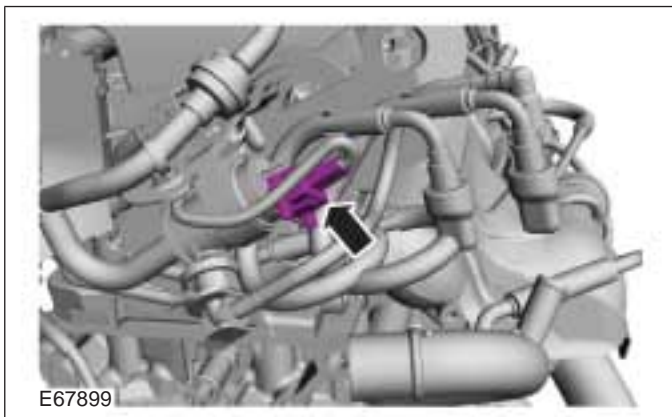
9. Remove the Special Tool(s): 303-122



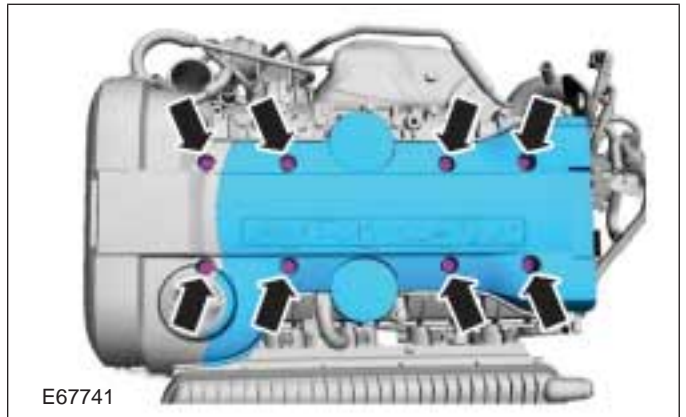
10.



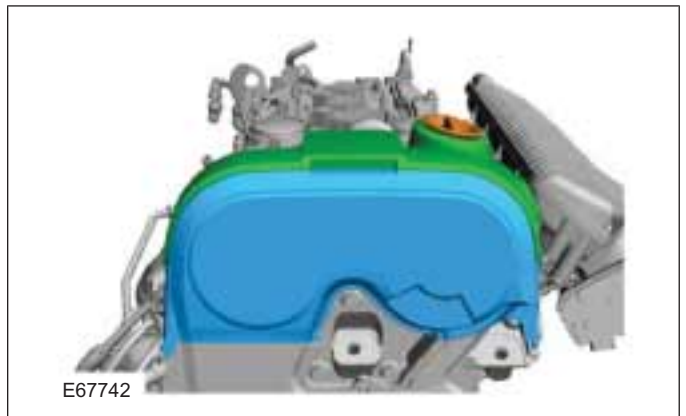
11.



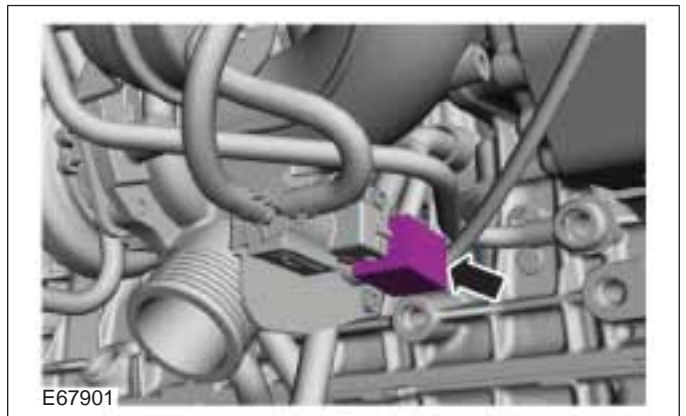
12.



13.



14.







303-01-81

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-81

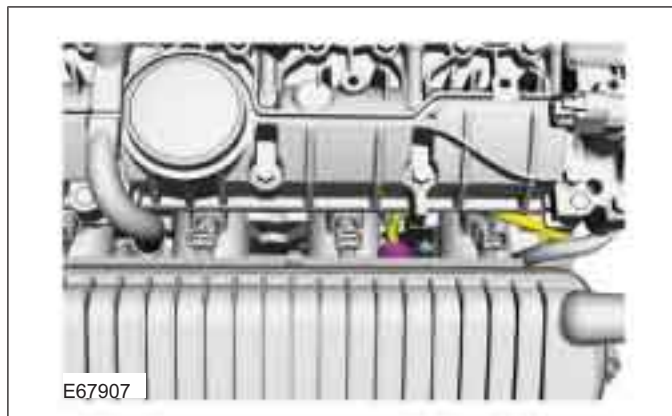


REMOVAL

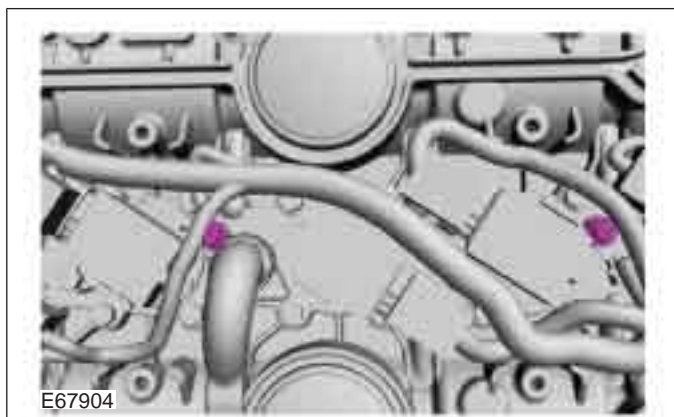
15.



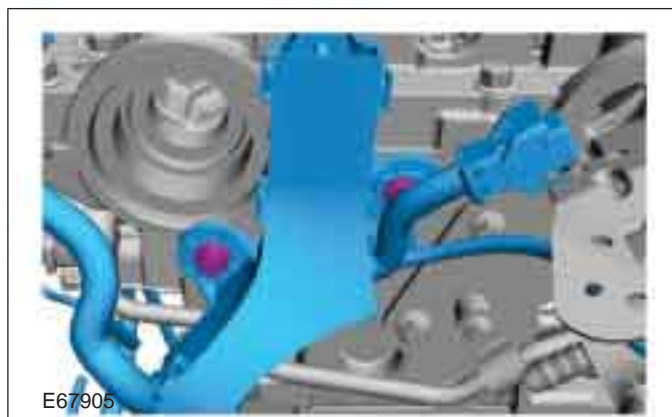
18.



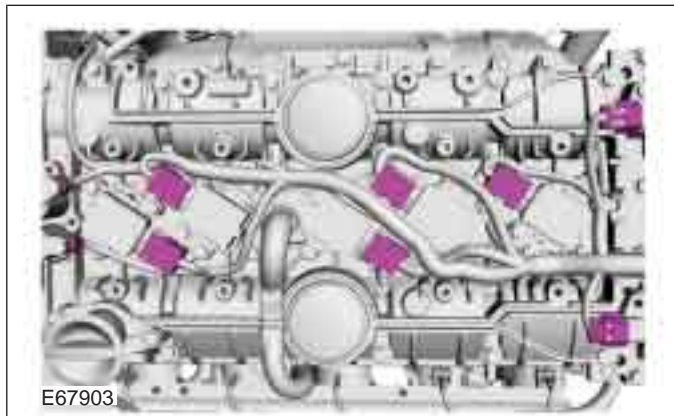
16.



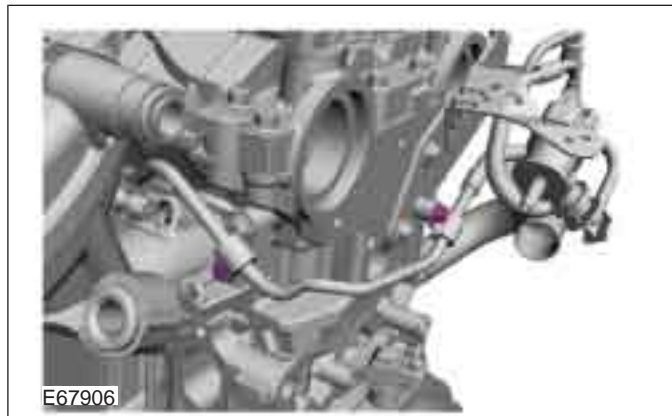
19.



17.



20.



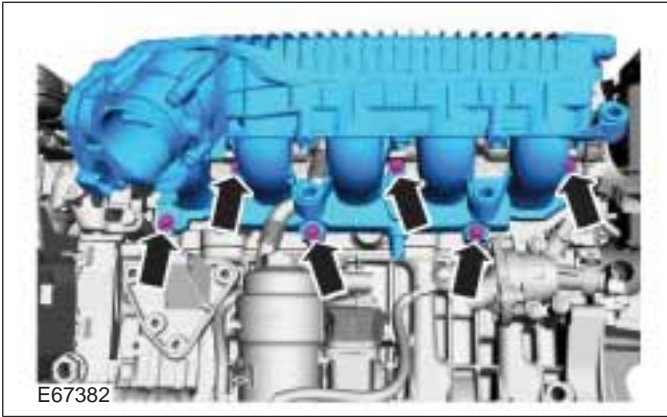
303-01-82

Engine — 2.5L Duratec (147kW/200PS) - VI5

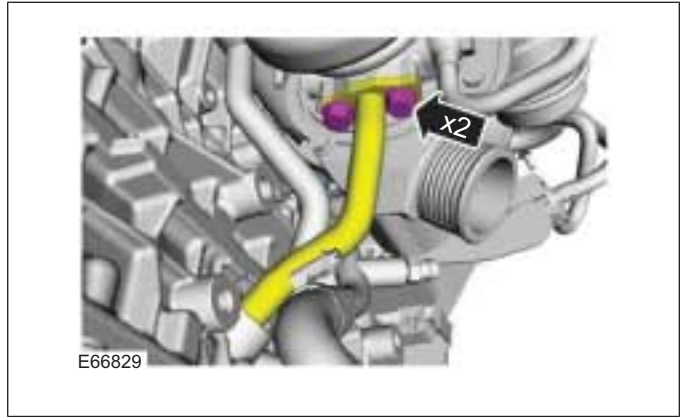
303-01-82

REMOVAL

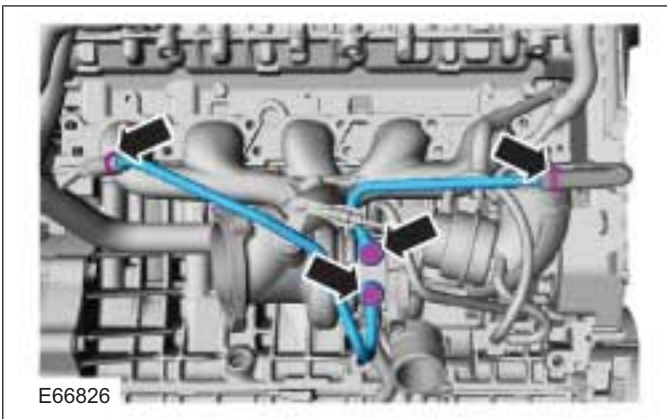
21.



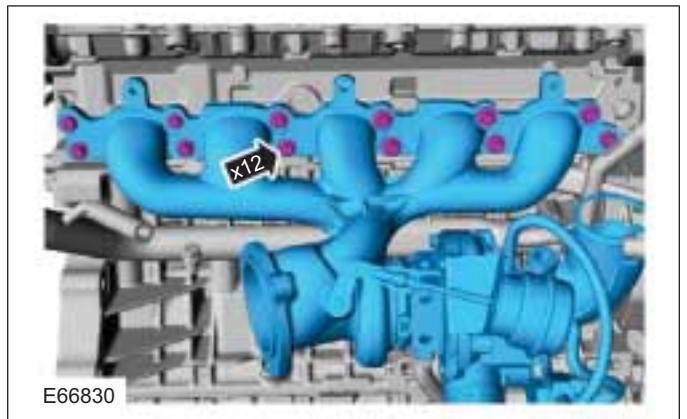
24.



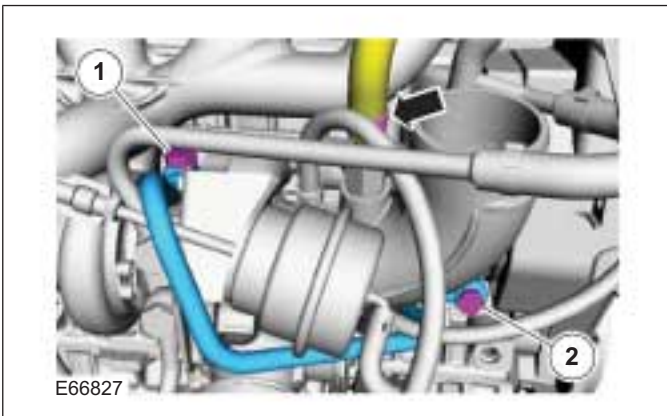
22.



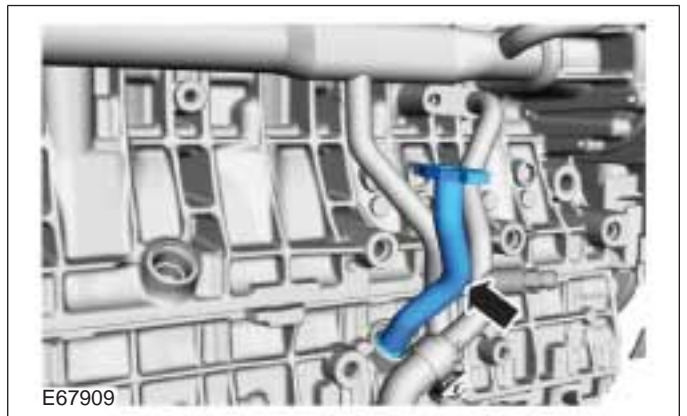
25.



23.



26.





303-01-83

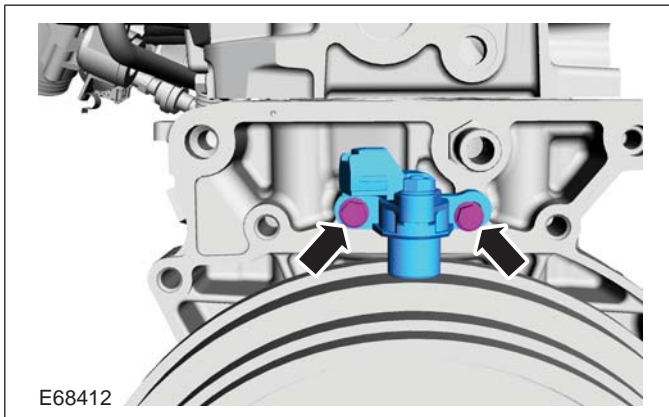
Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-83

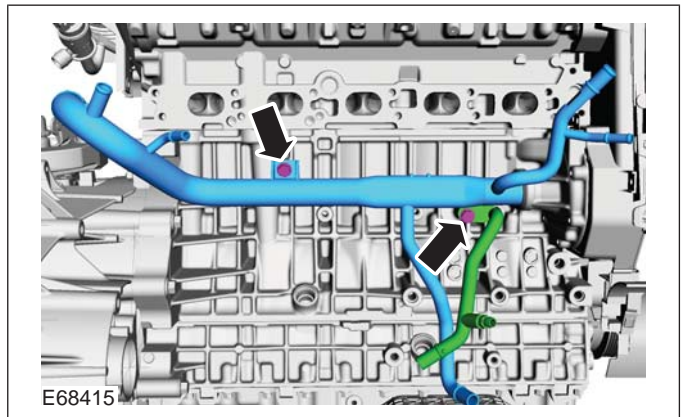


REMOVAL

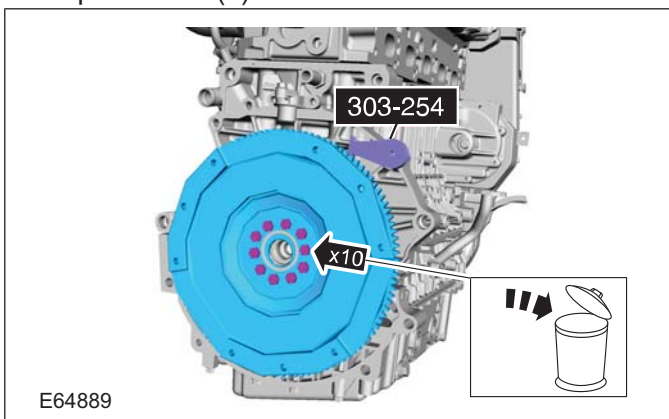
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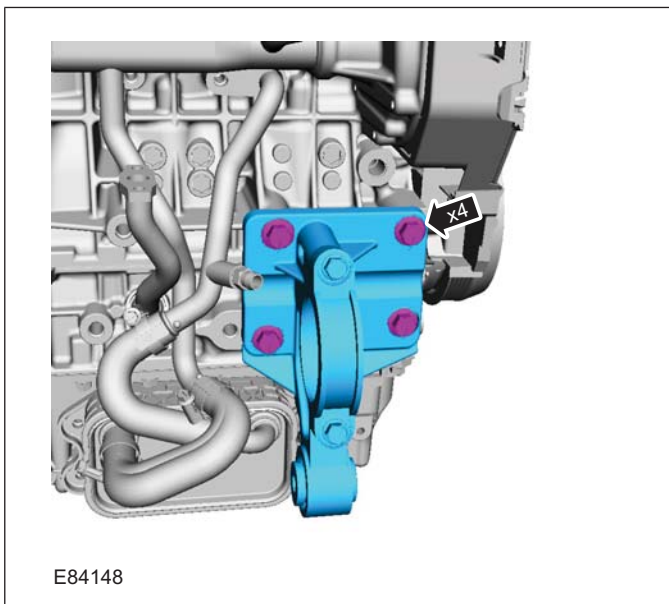
30.



28. Special Tool(s): 303-254



29.





303-01-84

Engine — 2.5L Duratec (147kW/200PS) - VI5

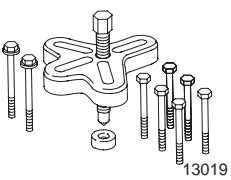
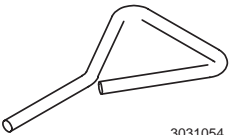
303-01-84

DISASSEMBLY

Engine(21 134 8)

Disassembly

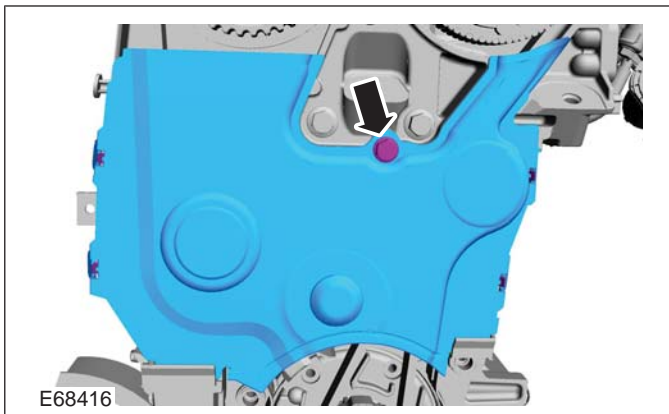
Special Tool(s) / General Equipment

 <p>13019</p>	<p>211-014 Remover, Steering Wheel</p>
 <p>3031054</p>	<p>303-1054 Locking Tool, Timing Belt Tensioner</p>
<p>Punch</p>	
<p>Two Leg Puller</p>	

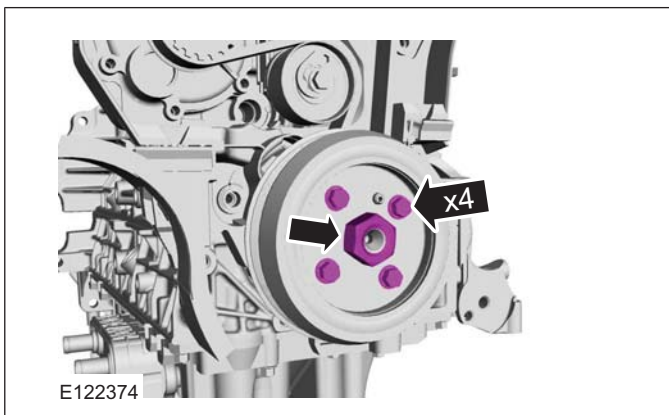
3. General Equipment: Two Leg Puller



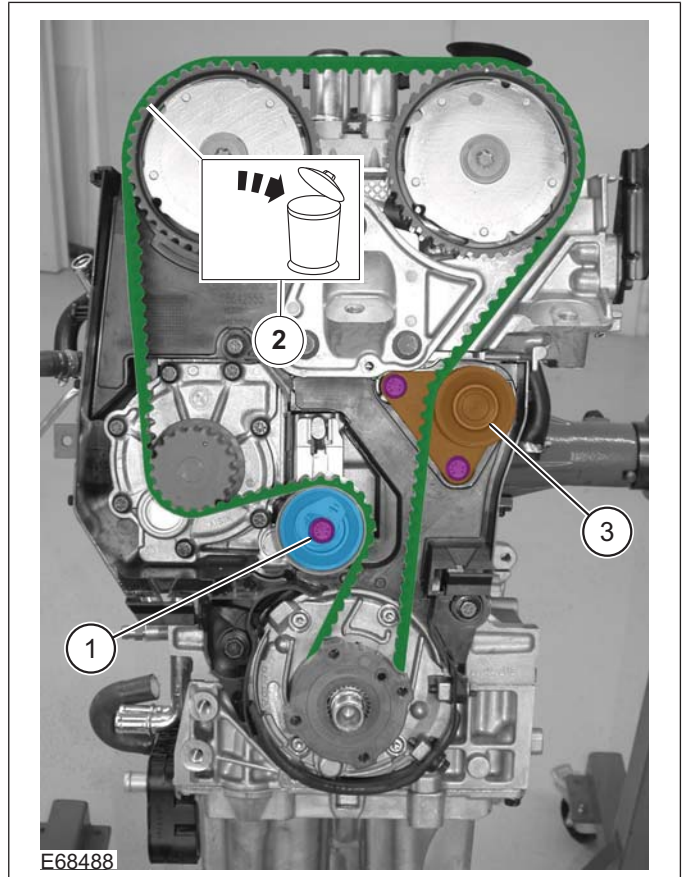
1.



2.



4.



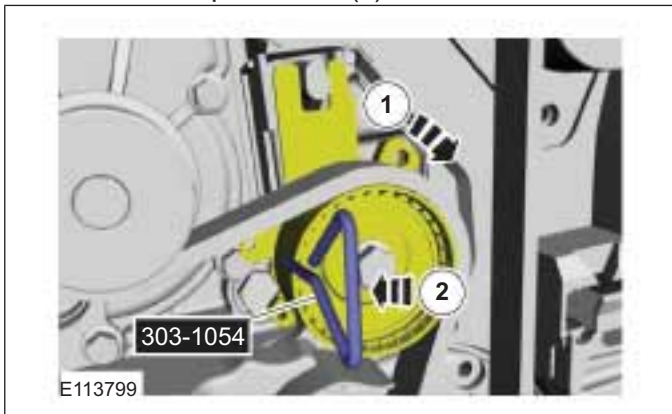


**DISASSEMBLY**

Vehicles with automatic timing belt tensioner

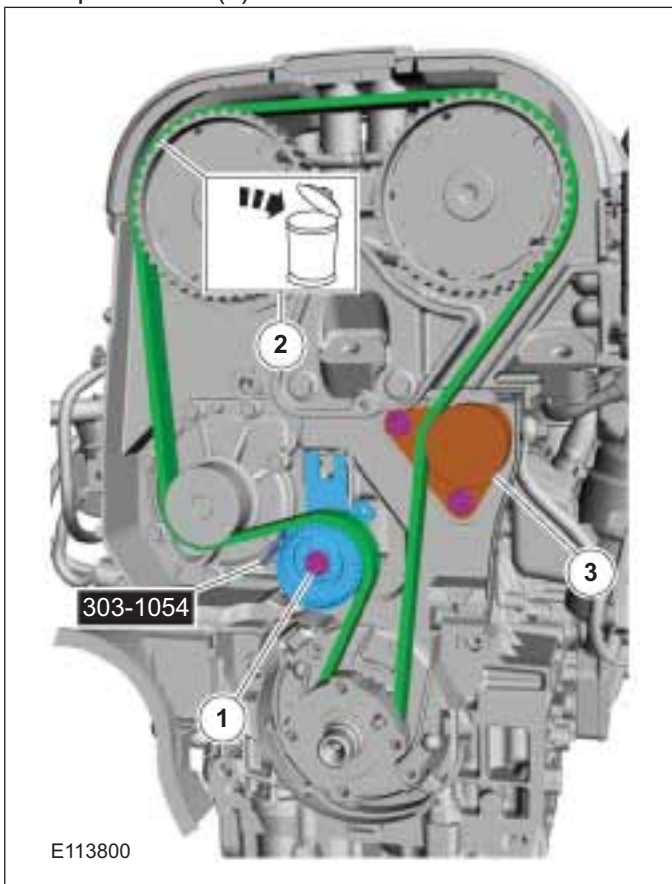
- 5. **⚠ WARNING: Take extra care when handling the compressed spring.**

Install the Special Tool(s): 303-1054



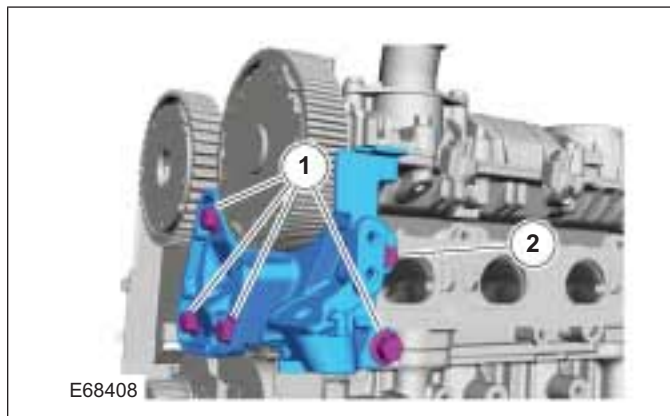
- 6. **⚠ WARNING: Take extra care when handling the compressed spring.**

Special Tool(s): 303-1054

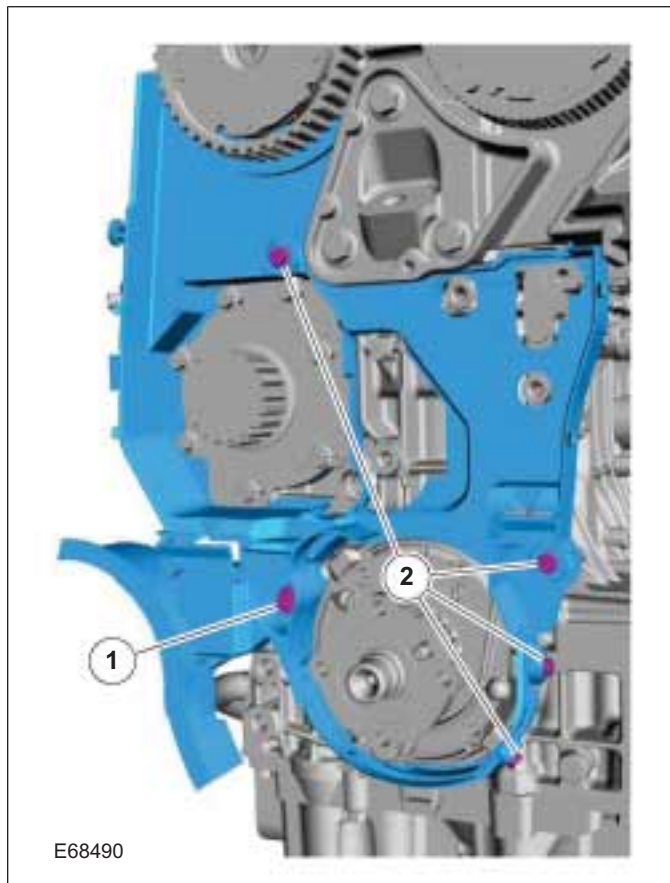


All vehicles

- 7.



- 8.





303-01-86

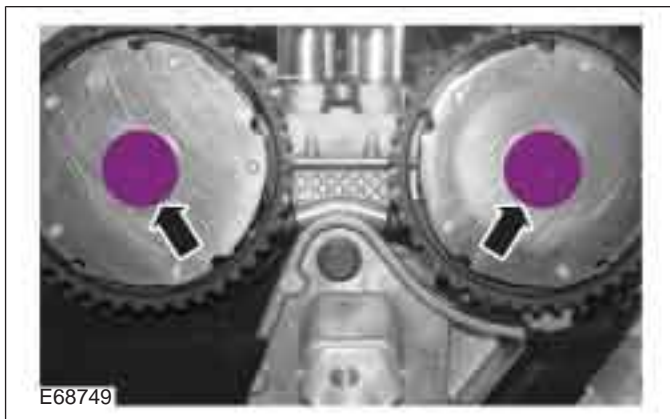
Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-86

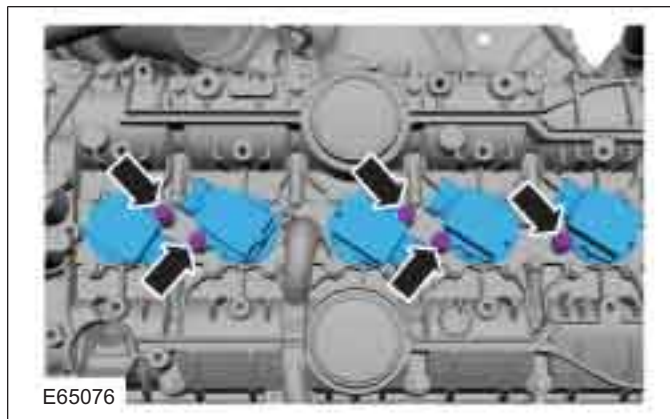


DISASSEMBLY

9.



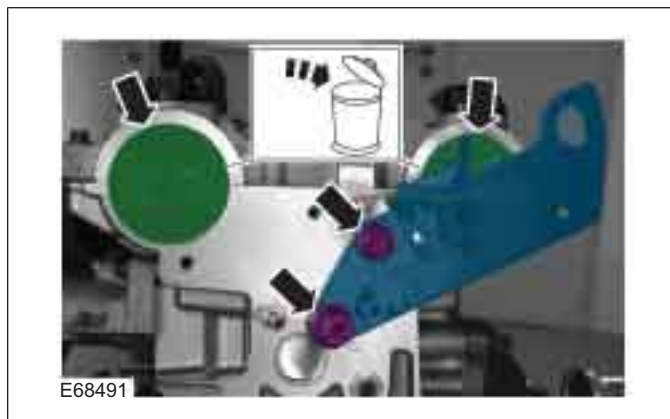
12.



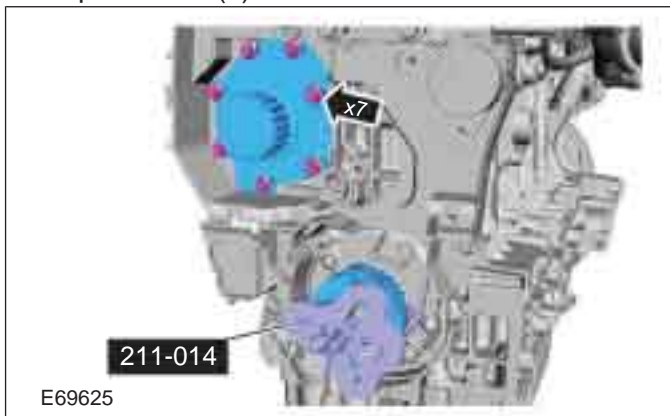
10.



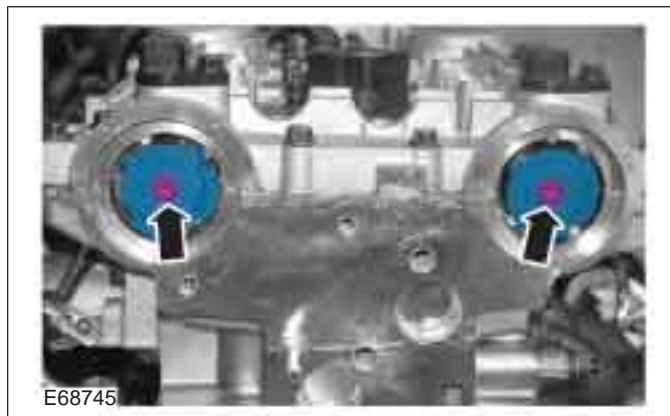
13.



11. Special Tool(s): 211-014



14.





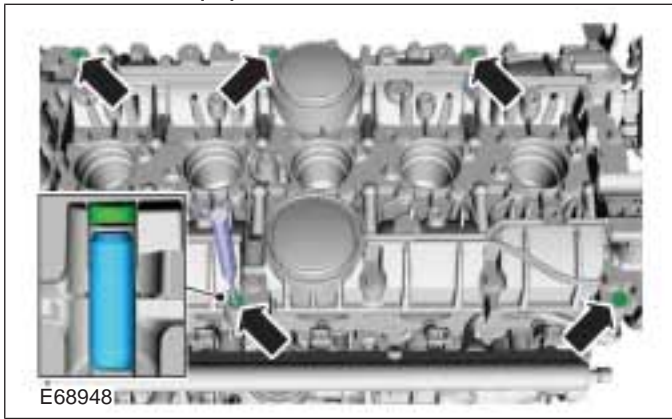
303-01-87

Engine — 2.5L Duratec (147kW/200PS) - VI5

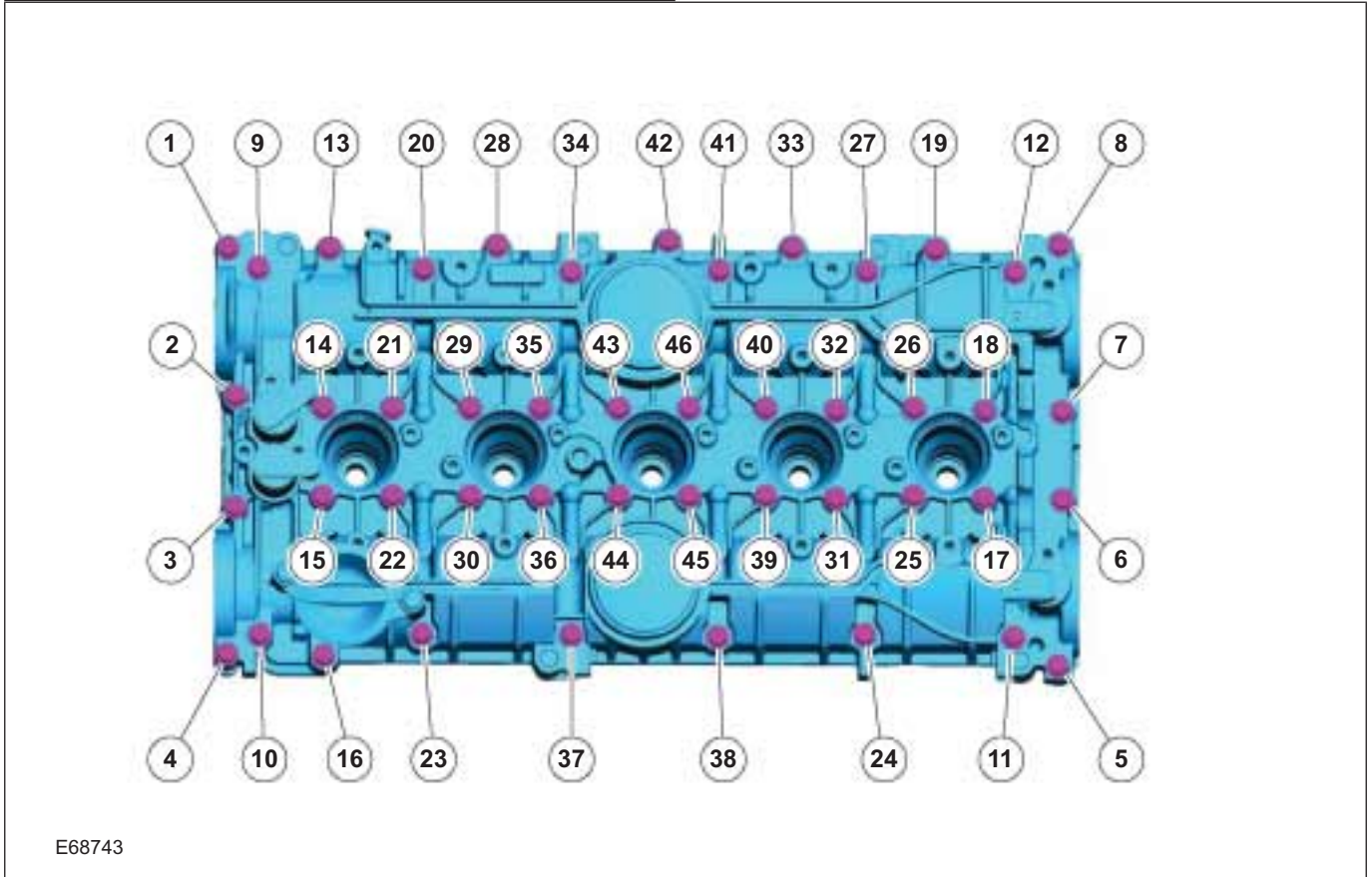
303-01-87

DISASSEMBLY

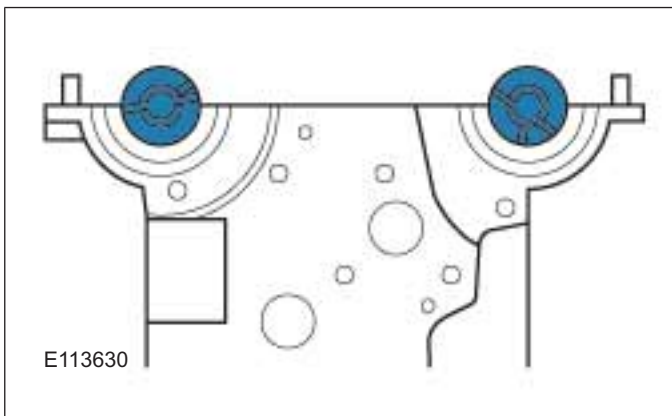
15. General Equipment: Punch



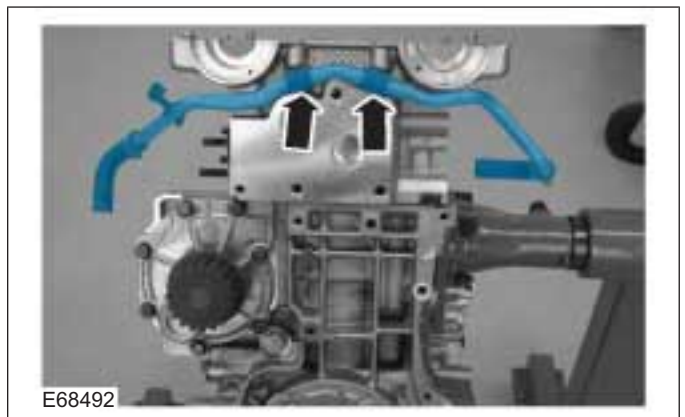
16.



17.



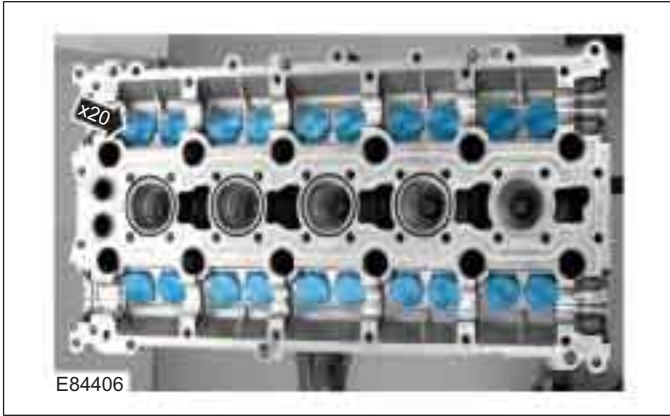
18.



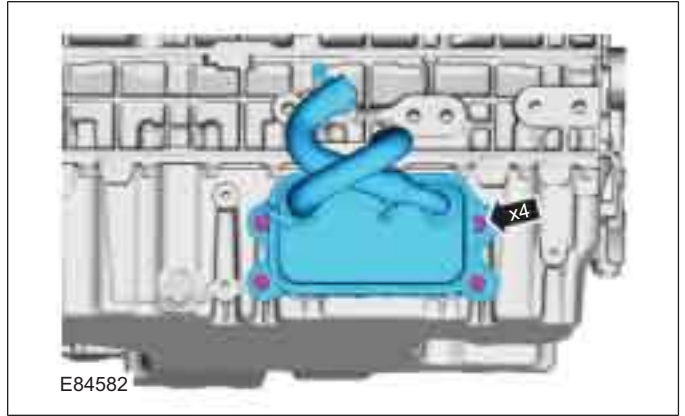


DISASSEMBLY

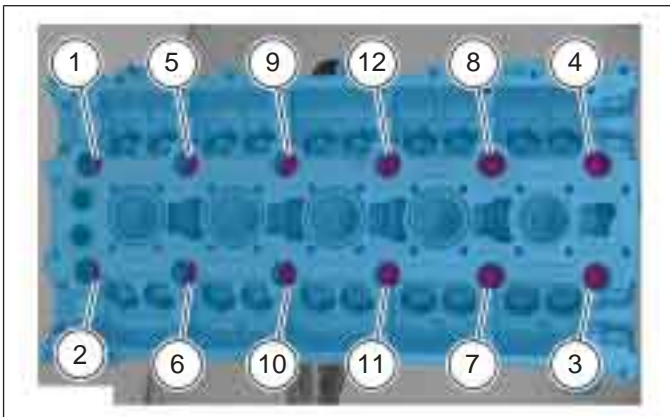
19.



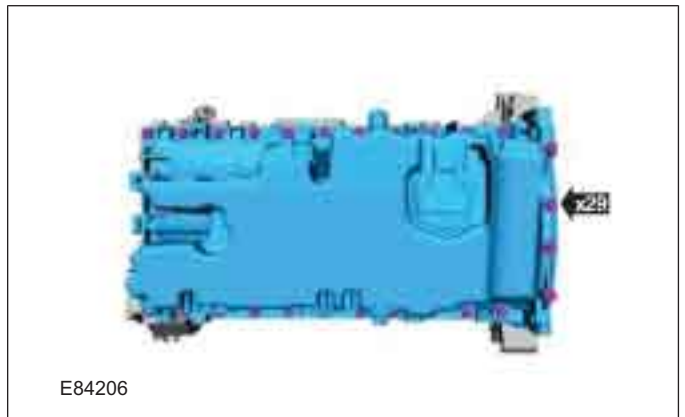
22.



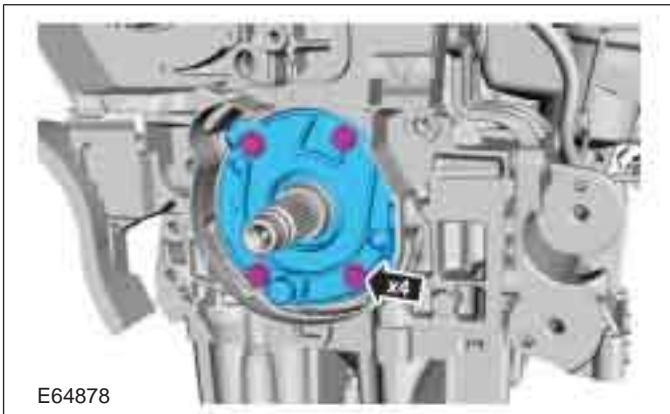
20.



23.



21.



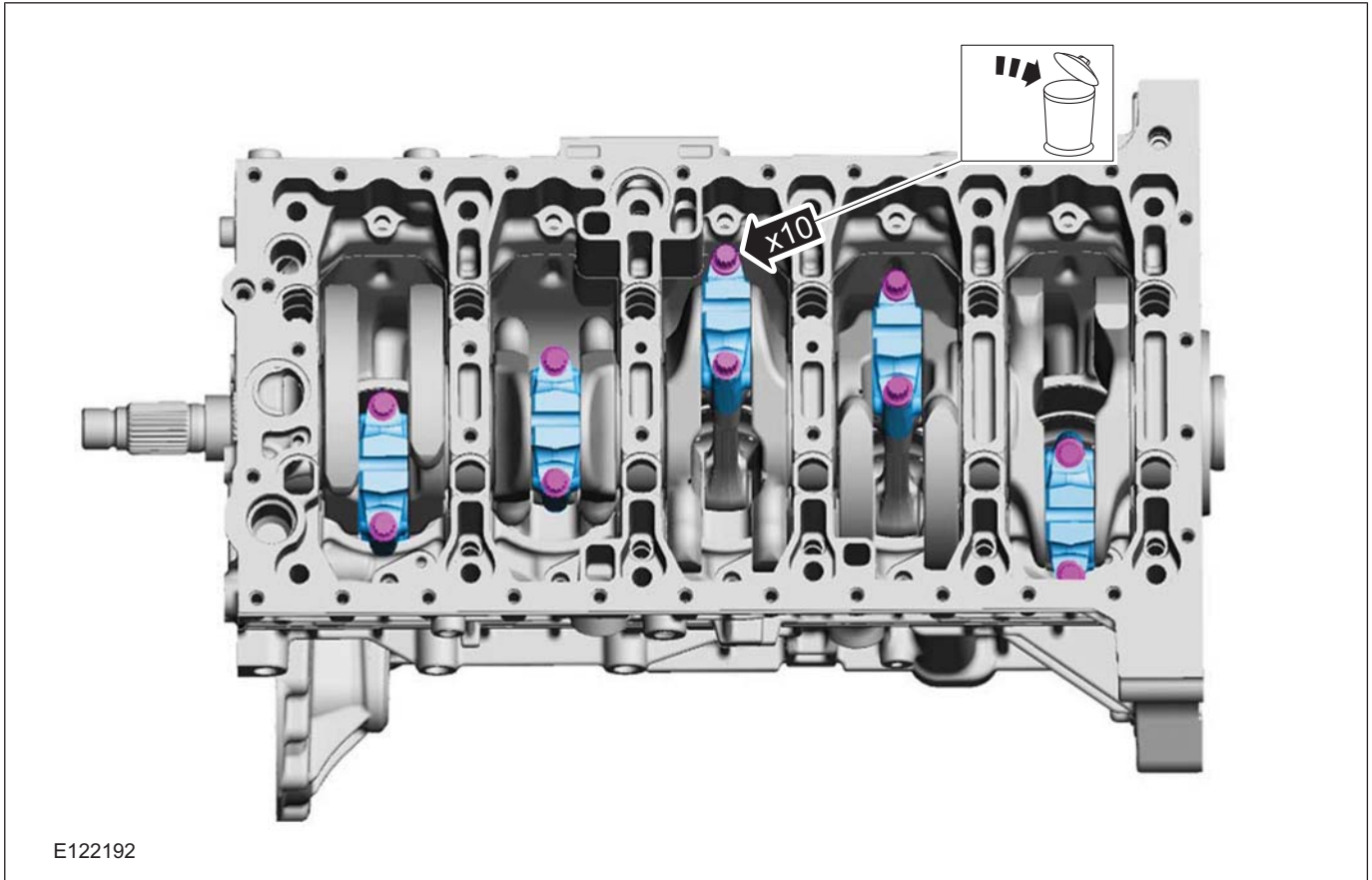
24.



25.  CAUTION: Note the position of the components before removal.



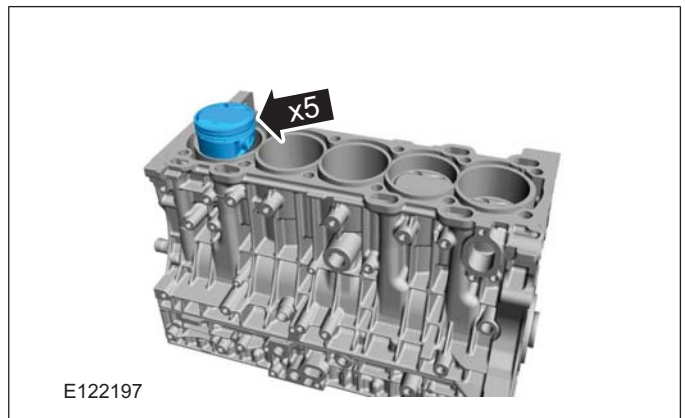
DISASSEMBLY



26. ⚠ CAUTION: Note the position of the components before removal.



27. ⚠ CAUTION: Note the position of the components before removal.



28.

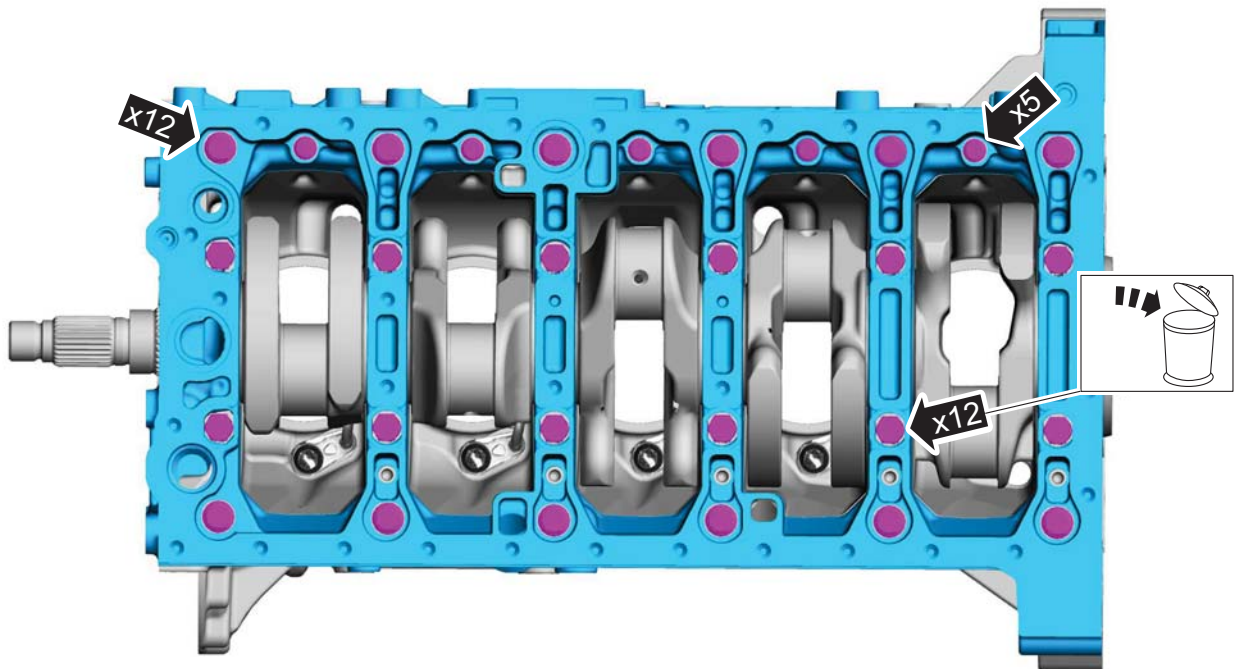


303-01-90

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-90

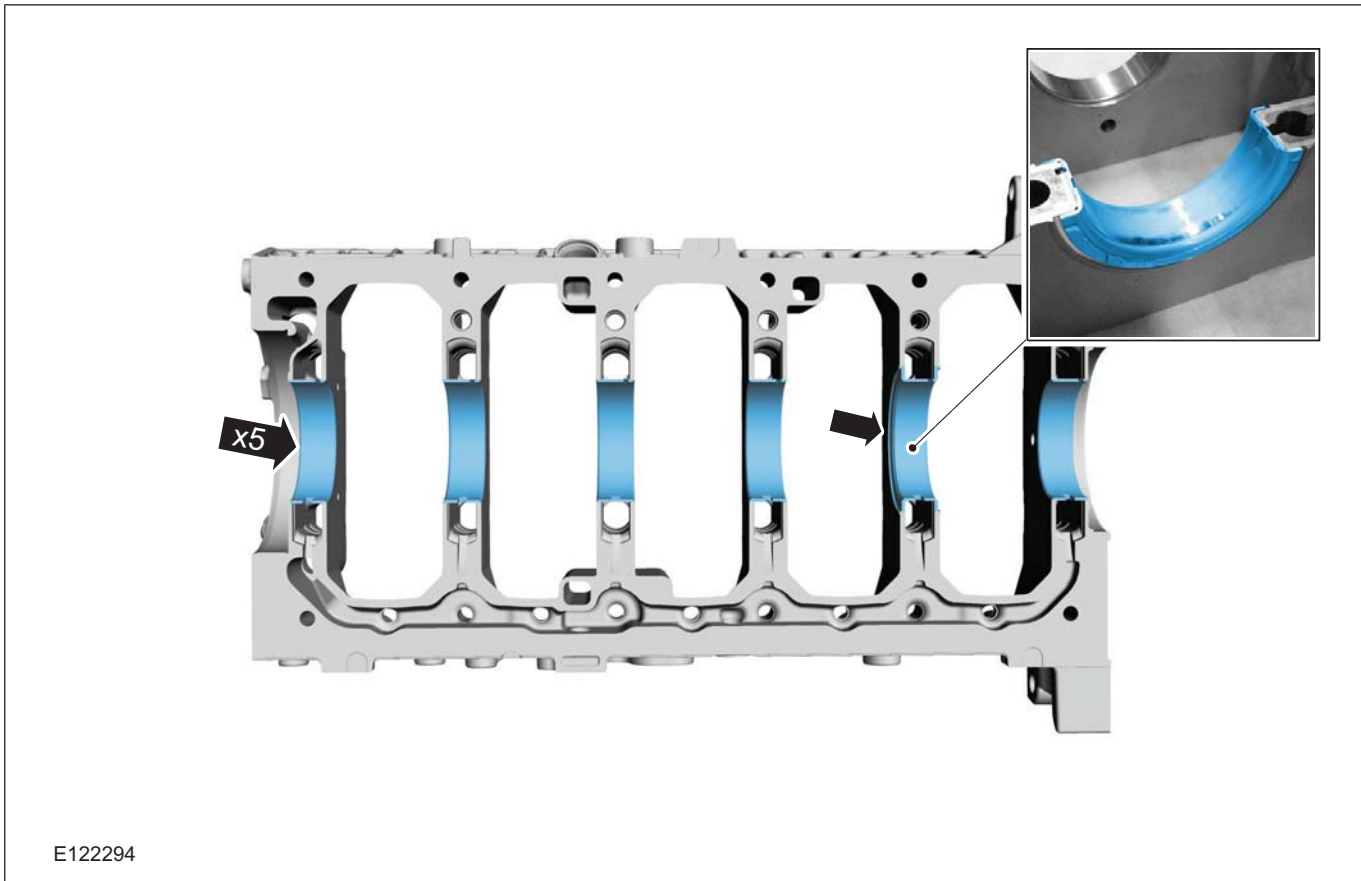
## DISASSEMBLY



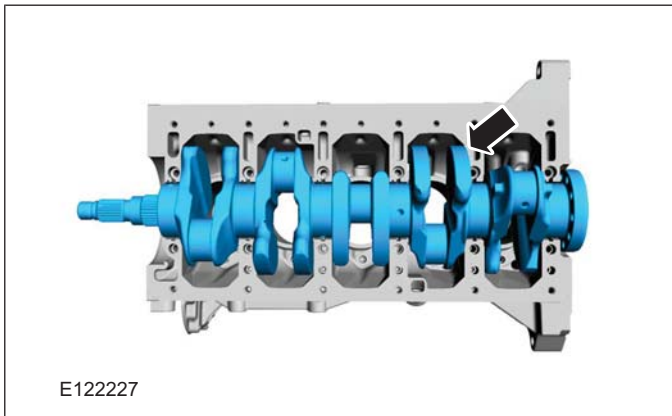
E122198

29.  **CAUTION:** Note the position of the components before removal.

DISASSEMBLY



30.



31.  CAUTION: Note the position of the components before removal.



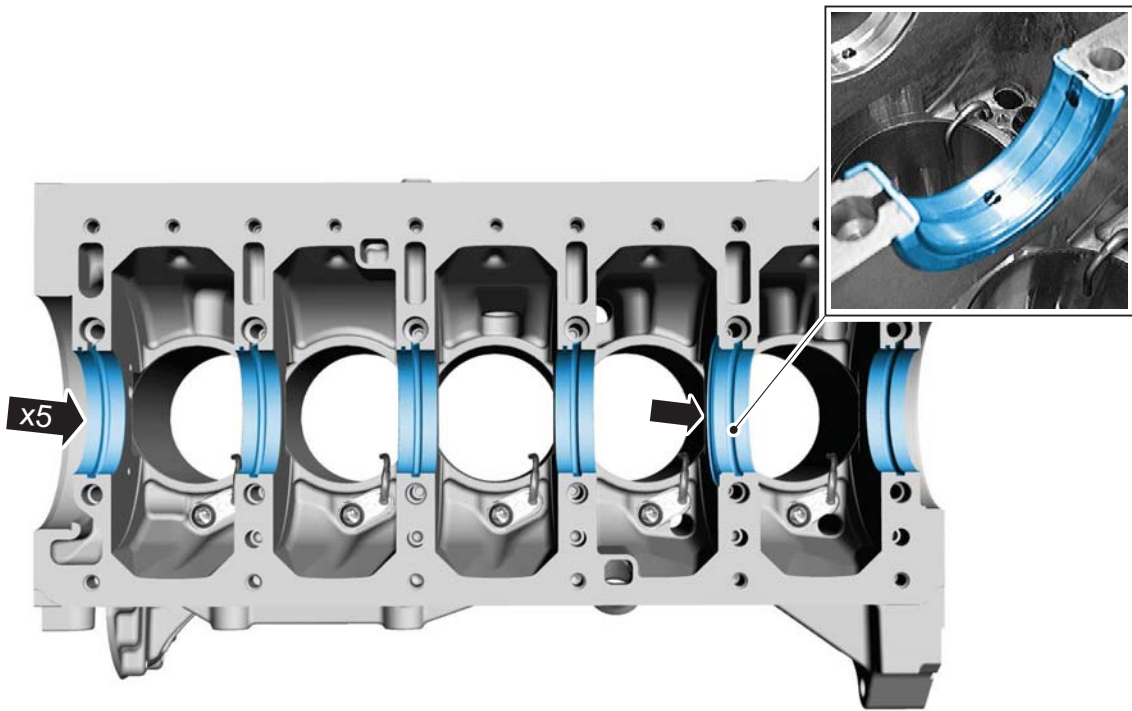
303-01-92

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-92



DISASSEMBLY



E122293

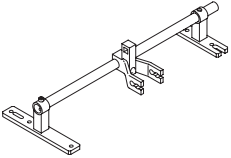
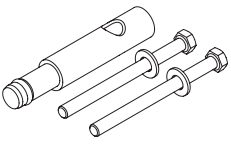
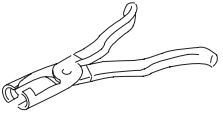




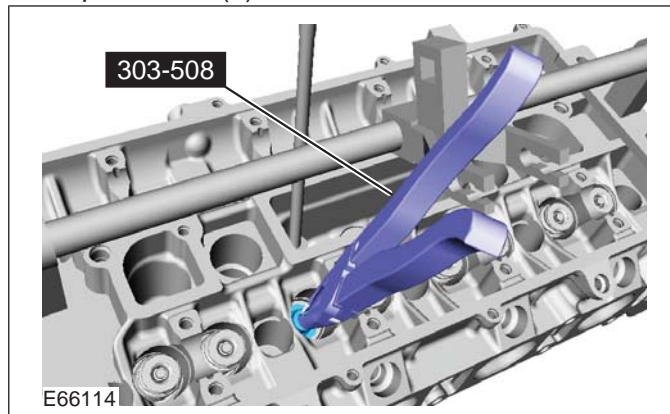
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Cylinder Head(21 165 6)

Special Tool(s)

 <p>E62757</p>	<p>303-361B Compressor, Valve Spring</p>
 <p>E62041</p>	<p>303-361B-06 Adapter for 303-361B</p>
 <p>21211</p>	<p>303-508 Pliers, Valve Stem Seal</p>

2. Special Tool(s): 303-508

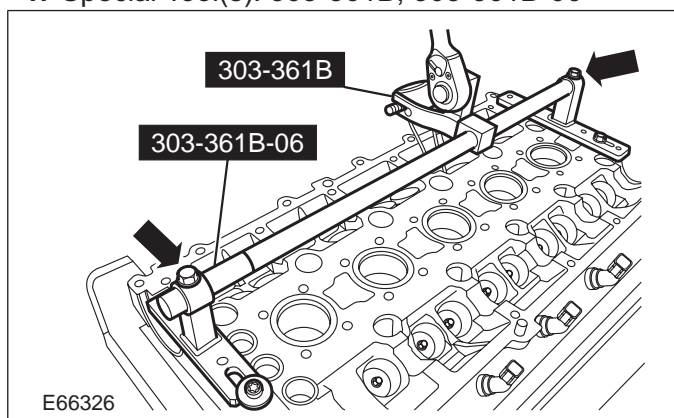


Assembly

3. To install, reverse the assembly procedure.

Disassembly

1. Special Tool(s): 303-361B, 303-361B-06

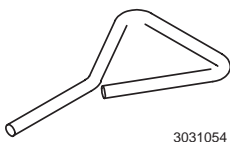
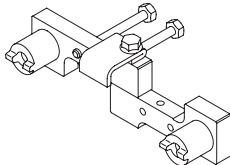
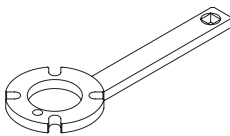
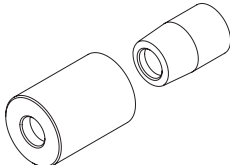


ASSEMBLY

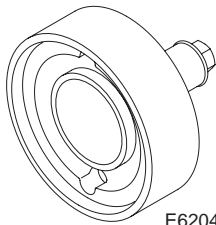
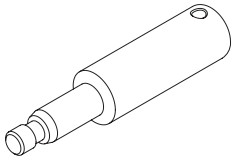
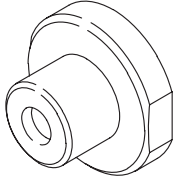
Engine(21 134 8)

Assembly

Special Tool(s) / General Equipment

 <p>3031054</p>	<p>303-1054 Locking Tool, Timing Belt Tensioner</p>
 <p>E62051</p>	<p>303-1178 Timing Tool Camshaft</p>
 <p>E62035</p>	<p>303-1179 Holding Wrench, Crankshaft</p>
 <p>E62050</p>	<p>303-1180 Installer, Crankshaft Front Seal</p>

Special Tool(s) / General Equipment

 <p>E62048</p>	<p>303-1181 Installer, Crankshaft Rear Seal</p>
 <p>E62027</p>	<p>303-1182 Timing Tool, Crankshaft</p>
 <p>21148</p>	<p>303-318 Aligner/Installer, Crankshaft Front Seal</p>

Piston Ring Compressor

Round-Ended Steel Rule

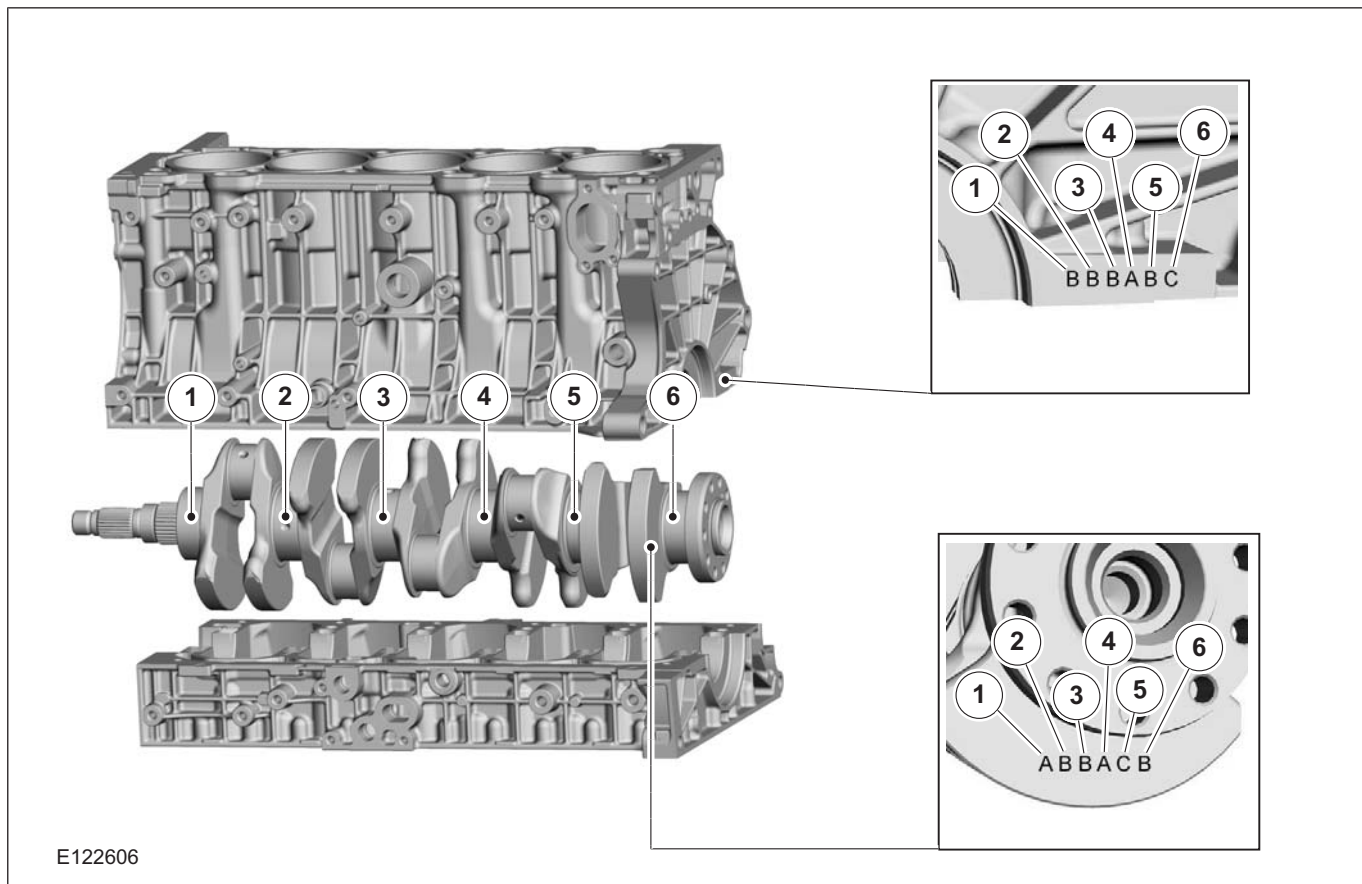
Materials

Name	Specification
Engine Oil - 5W-30	WSS-M2C913-C
Flange Sealant - Anaerobic LP	WSK-M2G348-A7 / 5U7J-M2G348-BA

1. **NOTE:** This step is only necessary when installing a new component.

Refer to: **Specifications** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Specifications).

ASSEMBLY



E122606

2.  **CAUTION:** Make sure that the components are installed to the position noted before removal.

Apply a thin coating.

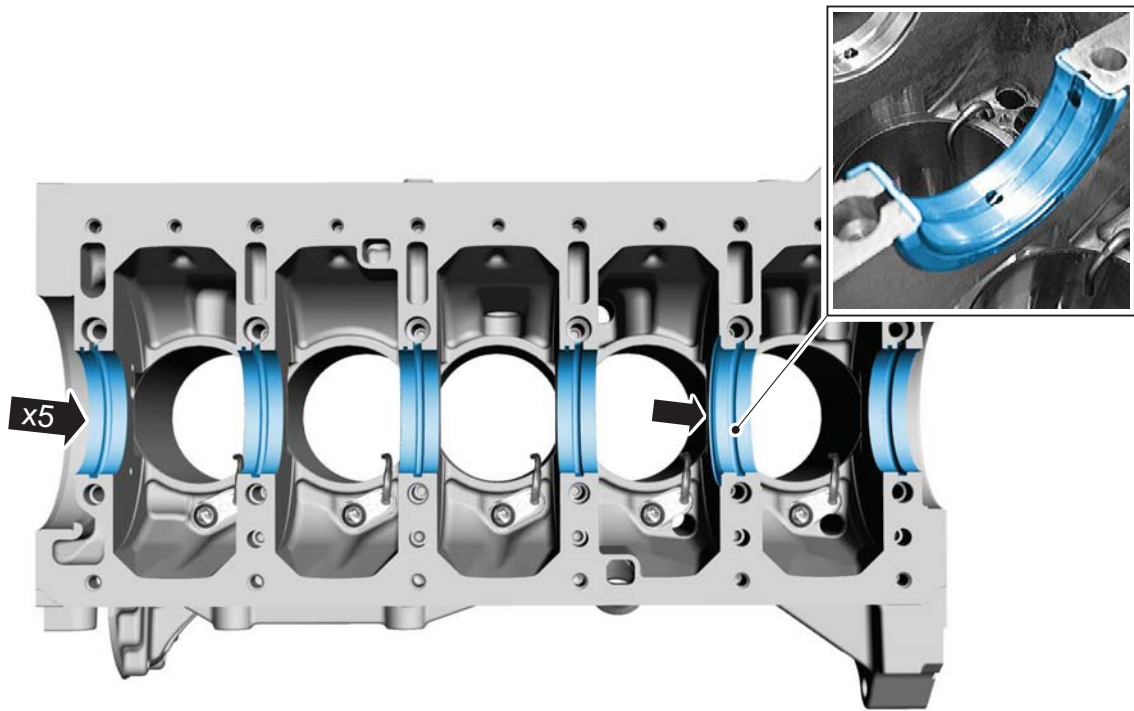
Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil

303-01-96

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-96

## ASSEMBLY



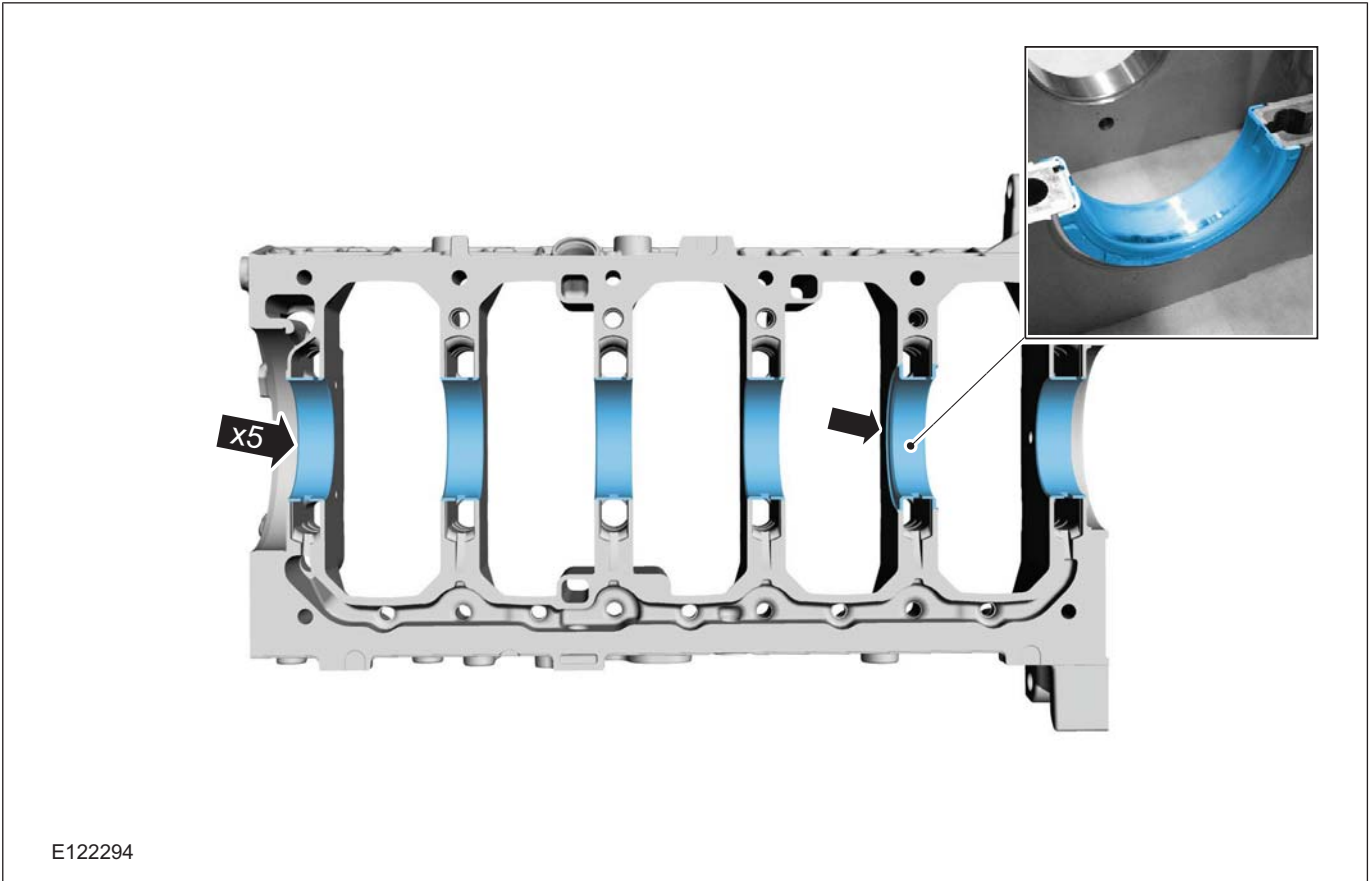
E122293

3.  **CAUTION:** Make sure that the components are installed to the position noted before removal.

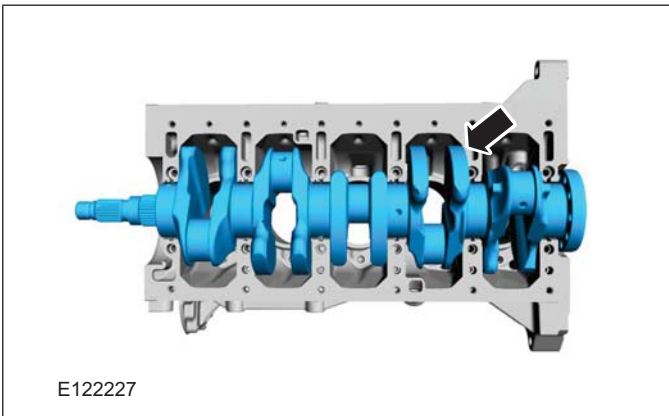
Apply a thin coating.

Material: Engine Oil - 5W-30 (WSS-M2C913-C)  
engine oil

ASSEMBLY



4.



5. **NOTE:** The component must be installed within 5 minutes of applying the sealant.

Material: Flange Sealant - Anaerobic LP  
(WSK-M2G348-A7 / 5U7J-M2G348-BA)  
sealant

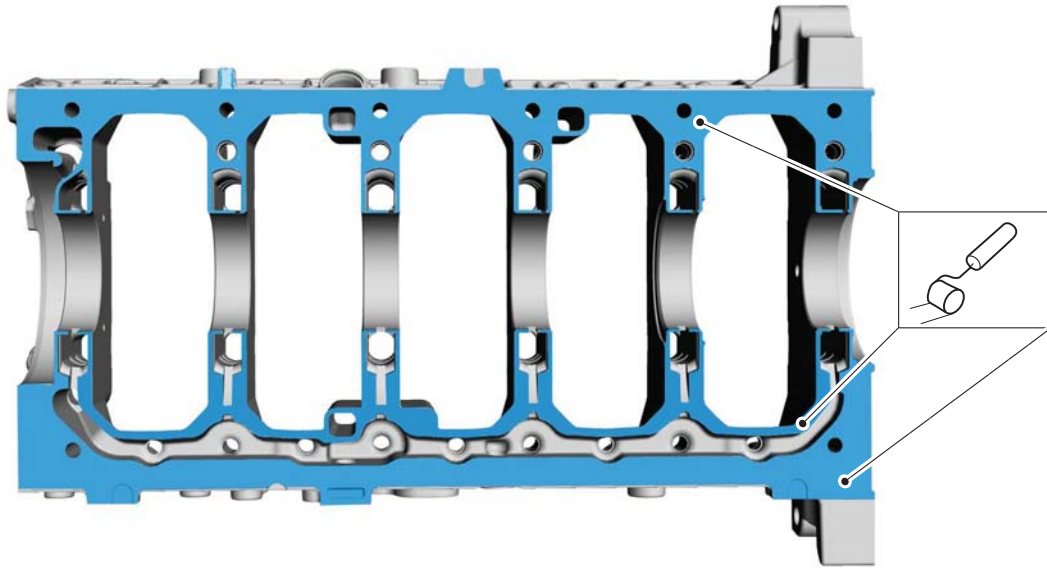


303-01-98

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-98

## ASSEMBLY



E122323

6.  **CAUTION:** Make sure that new bolts are installed.

Torque:

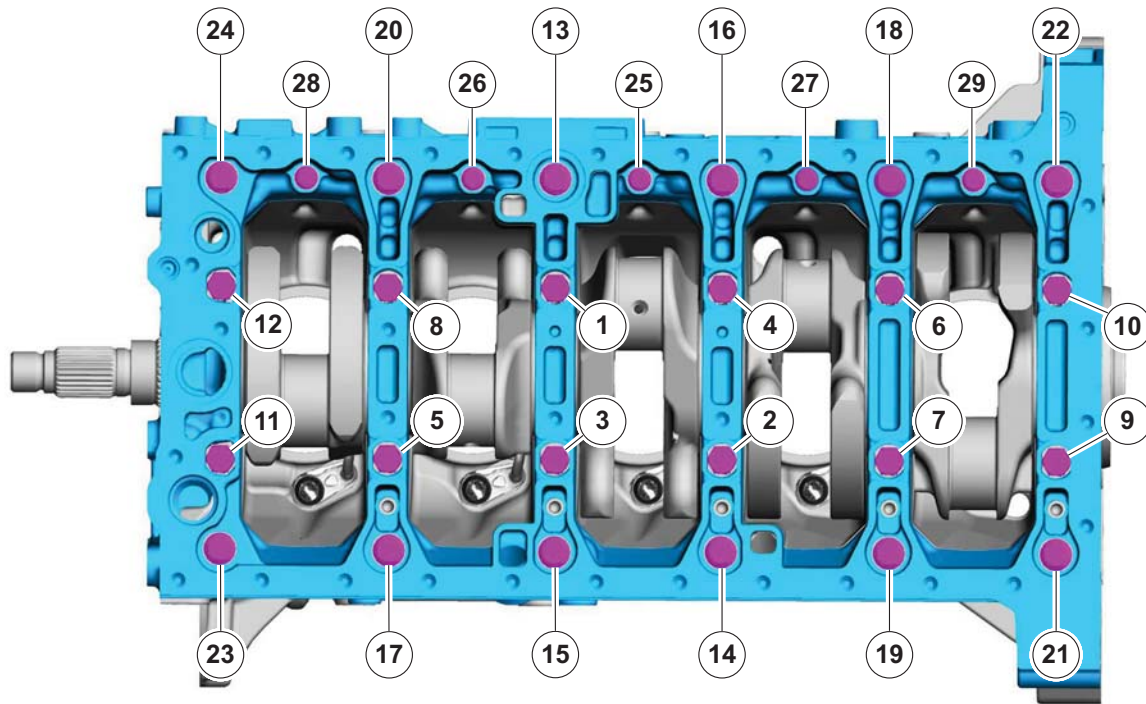
- Stage 1: M10: 1-12 20 Nm
- Stage 2: M10: 1-12 45 Nm

7. Torque:
- M8: 13-24 24 Nm

8. Torque:
- M7: 25-29 17 Nm

9. Torque:
- M10: 1-12 90°

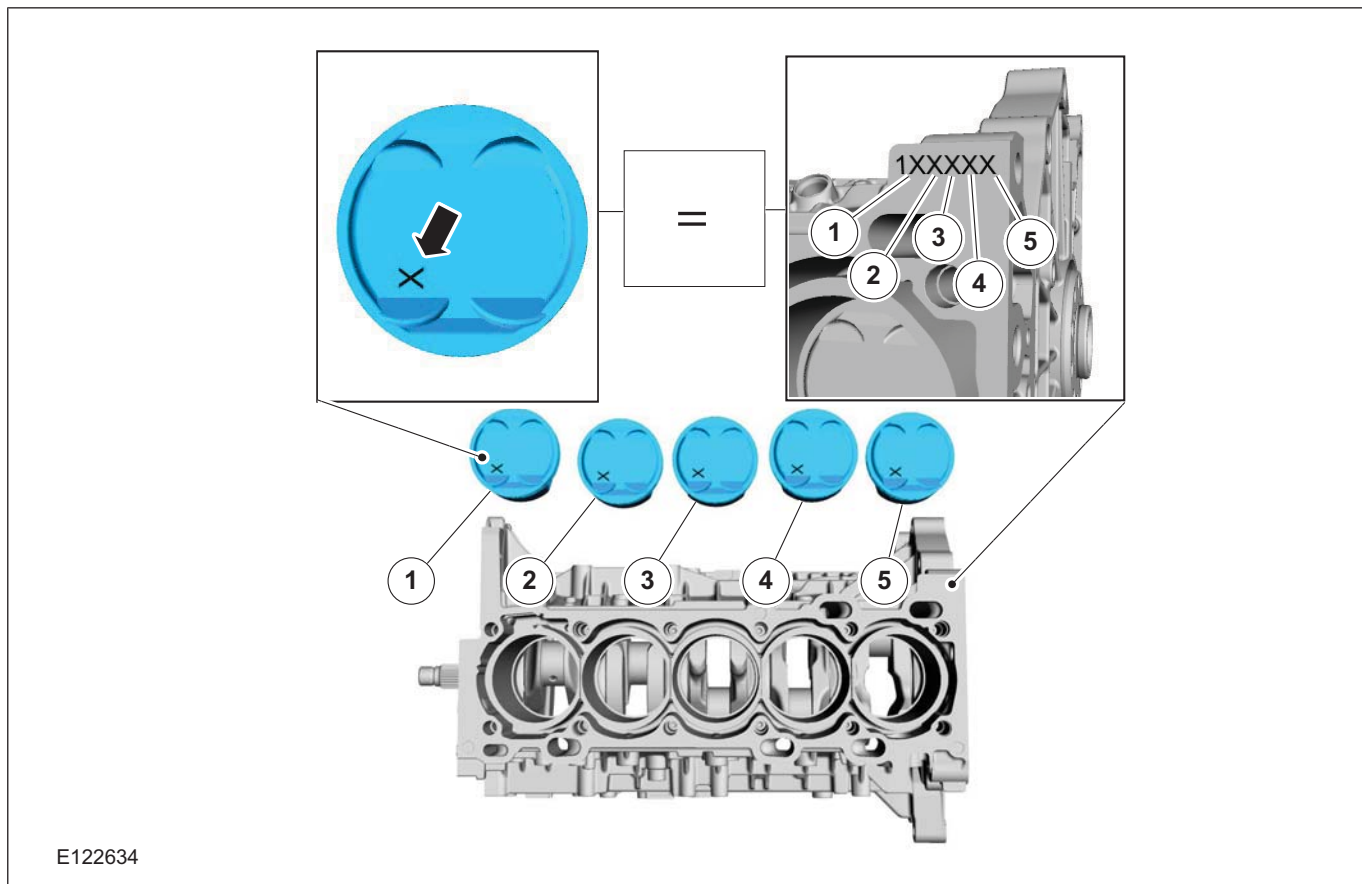
ASSEMBLY



E122331

**10. NOTE:** This step is only necessary when installing a new component.

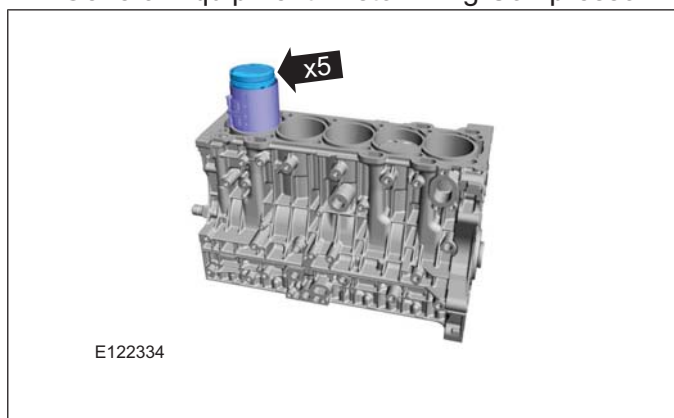
ASSEMBLY



E122634

11. **CAUTION:** Make sure that the components are installed to the position noted before removal.

General Equipment: Piston Ring Compressor



E122334

12. **CAUTION:** Make sure that the components are installed to the position noted before removal.

Apply a thin coating.

Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil



E77266

13. CAUTIONS:

- CAUTION:** Make sure that the components are installed to the position noted before removal.
- CAUTION:** Make sure that new bolts are installed.

303-01-101

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-101

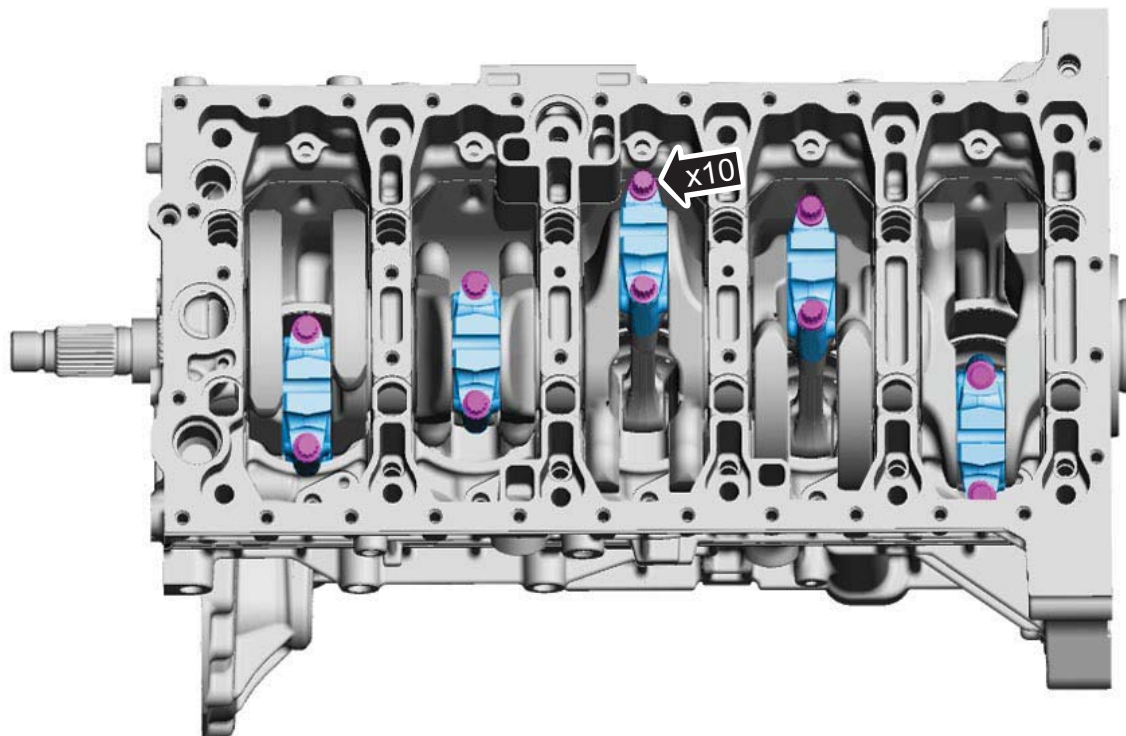
## ASSEMBLY

Apply a thin coating.

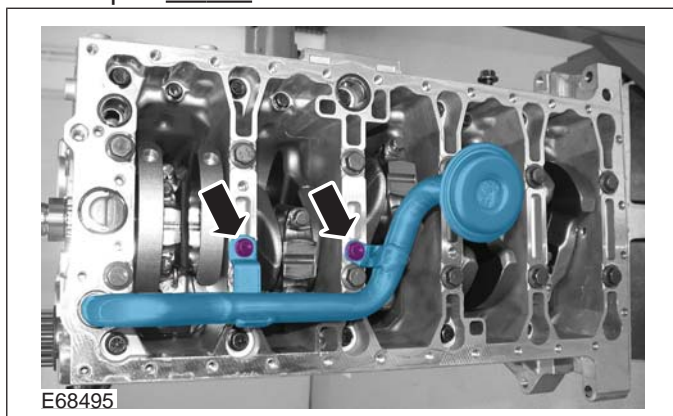
Material: Engine Oil - 5W-30 (WSS-M2C913-C)  
engine oil

Torque:

- Stage 1: 30 Nm
- Stage 2: 90°



E122335

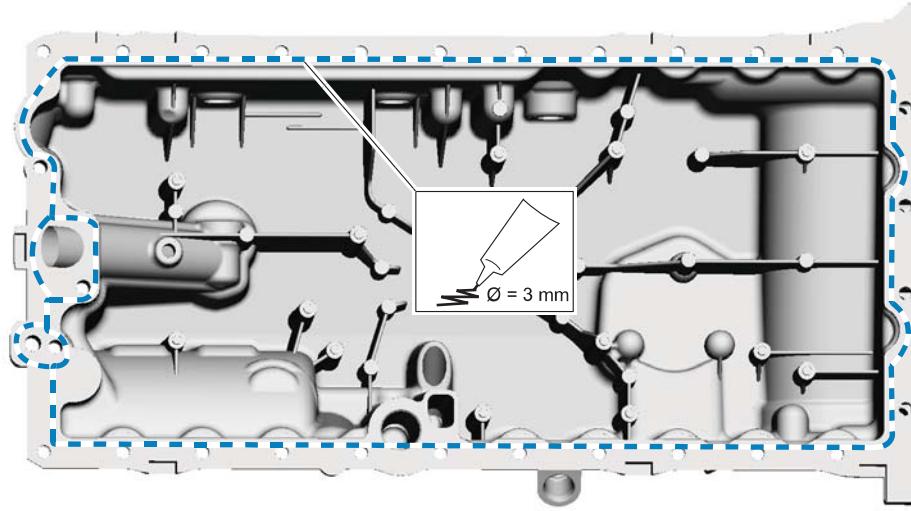
14. Torque: 10 Nm

E68495

15. **NOTE:** The component must be installed within  
5 minutes of applying the sealant.Material: Flange Sealant - Anaerobic LP  
(WSK-M2G348-A7 / 5U7J-M2G348-BA)  
sealant

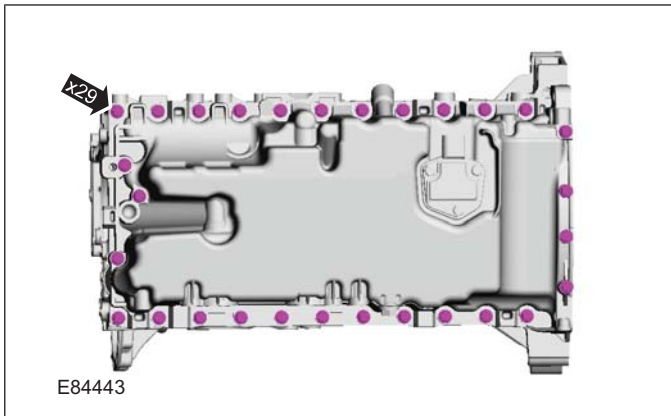


ASSEMBLY



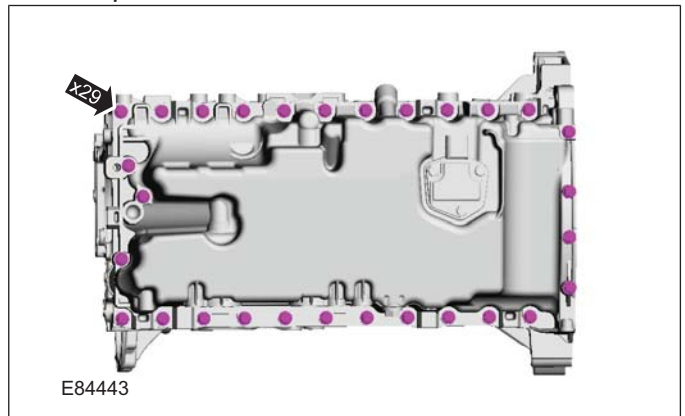
E84444

16. **NOTE:** Only tighten the bolts finger tight at this stage.



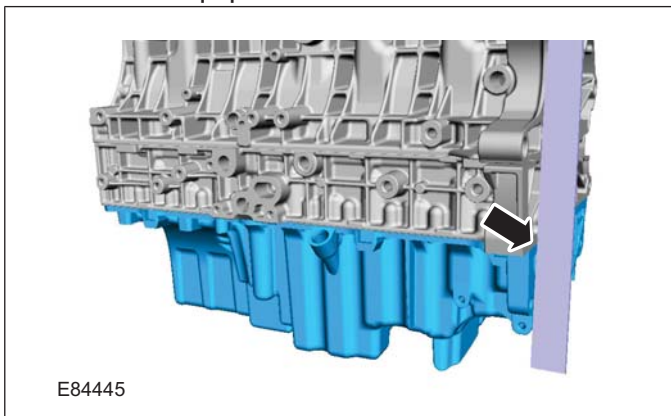
E84443

18. Torque: 17 Nm



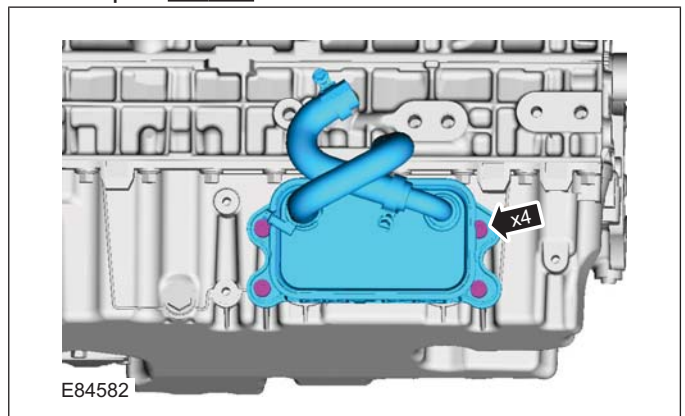
E84443

17. General Equipment: Round-Ended Steel Rule



E84445

19. Torque: 17 Nm



E84582





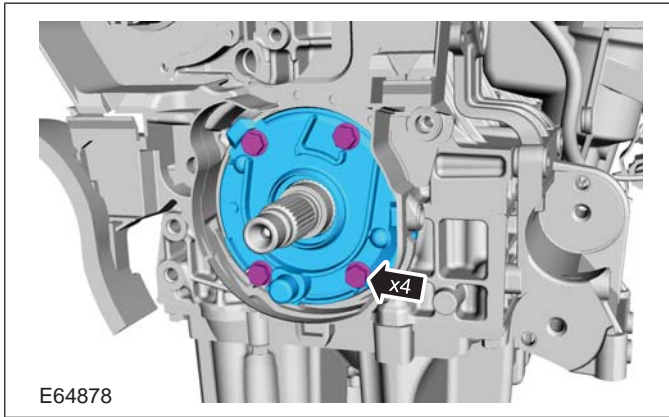
303-01-103

Engine — 2.5L Duratec (147kW/200PS) - VI5

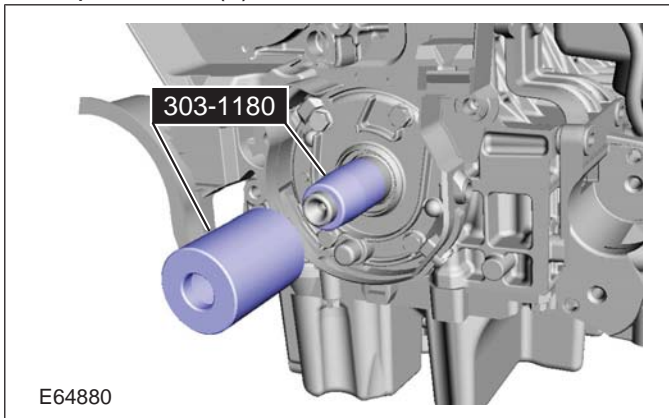
303-01-103

ASSEMBLY

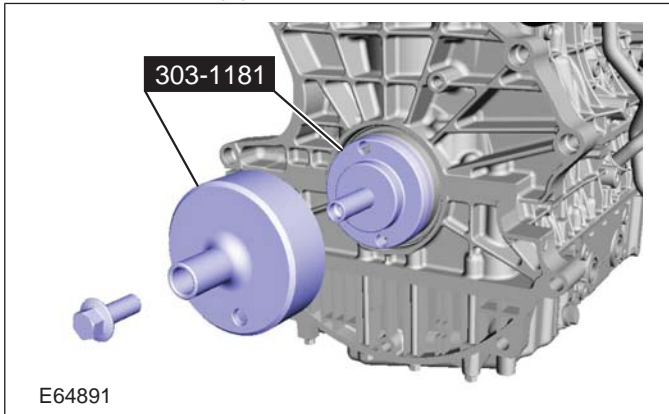
20. Torque: 6 Nm



21. Special Tool(s): 303-1180

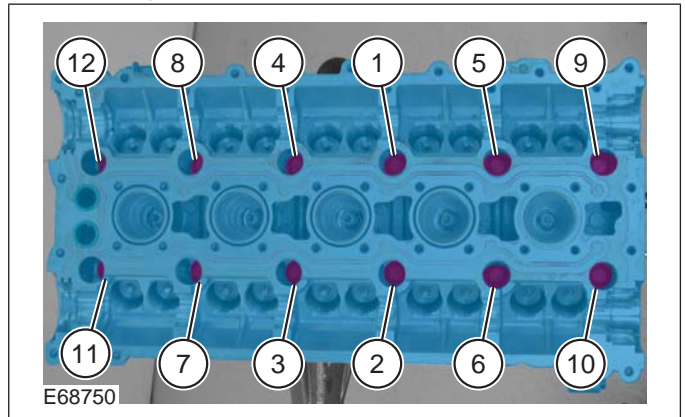


22. Special Tool(s): 303-1181

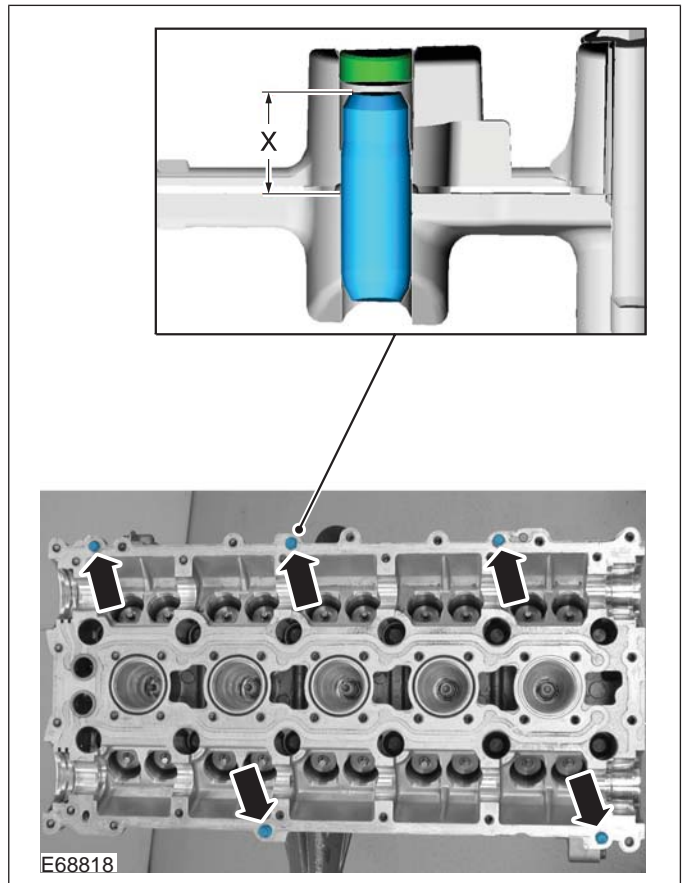


23. Torque:

- Stage 1: 20 Nm
- Stage 2: 60 Nm
- Stage 3: 130°



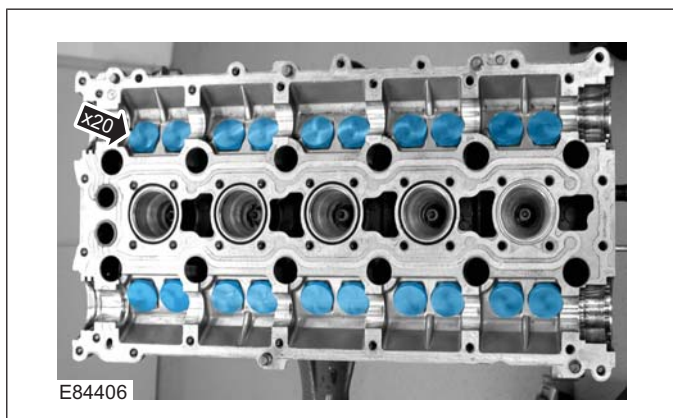
24. • X = 15 mm.





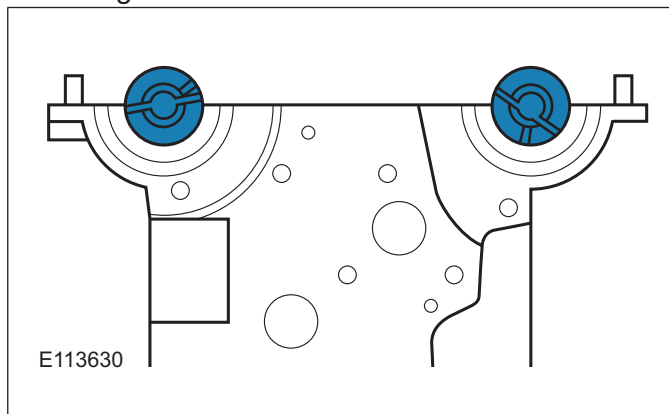
ASSEMBLY

25.

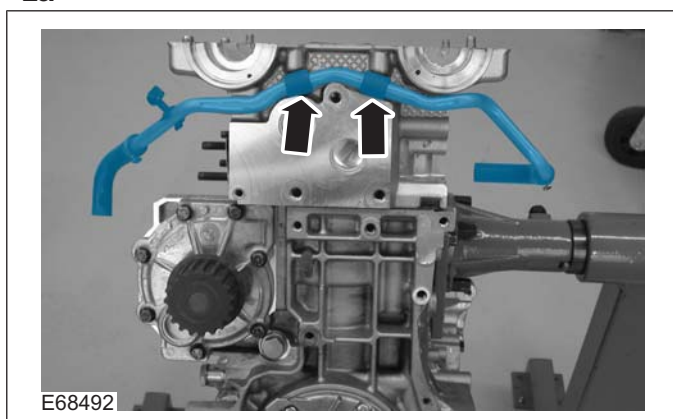


27. Apply a thin coating.

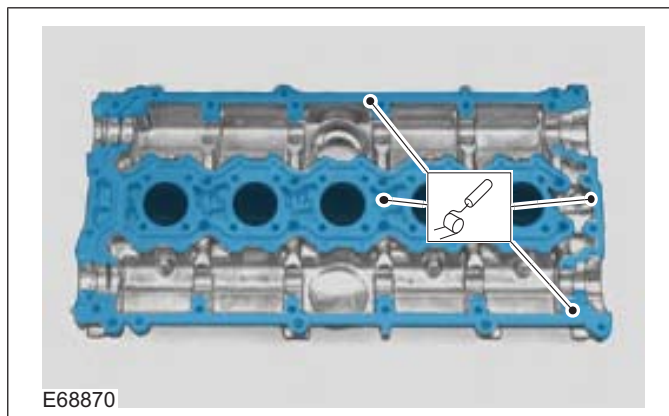
Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil



26.



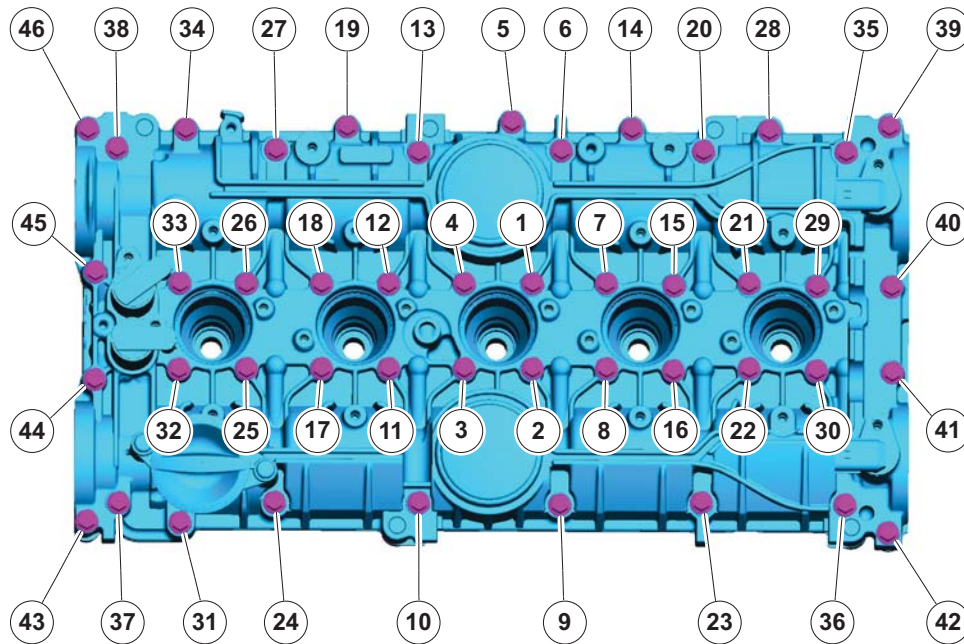
28. Material: Flange Sealant - Anaerobic LP (WSK-M2G348-A7 / 5U7J-M2G348-BA) sealant



29. Torque: 17 Nm

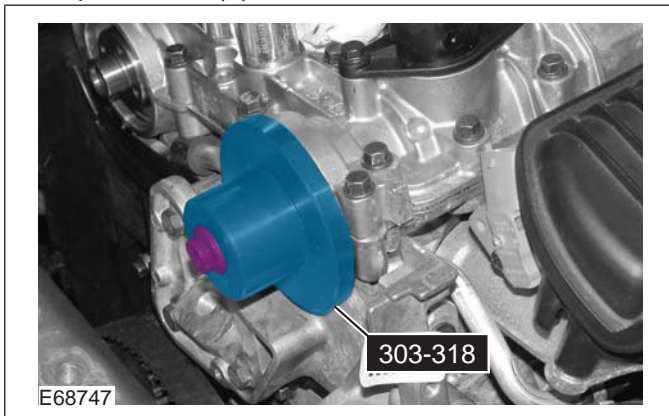


ASSEMBLY



E87508

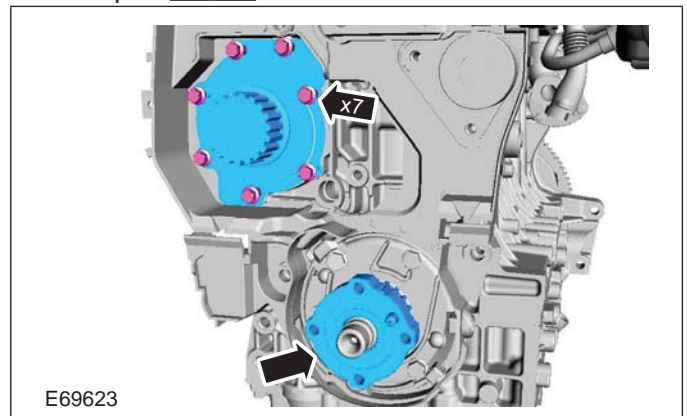
30. Special Tool(s): 303-318



E68747

31. **NOTE:** The crankshaft timing pulley can only be installed in 1 position on the crankshaft splines.

Torque: 17 Nm



E69623



303-01-106

Engine — 2.5L Duratec (147kW/200PS) - VI5

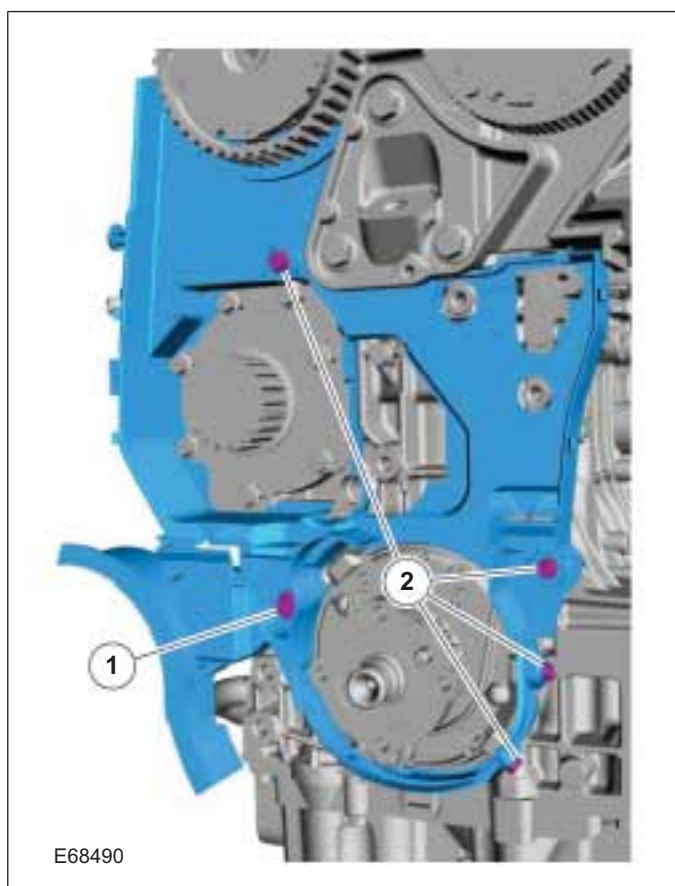
303-01-106

## ASSEMBLY

**32 NOTE:** Only tighten the bolts finger tight at this stage.

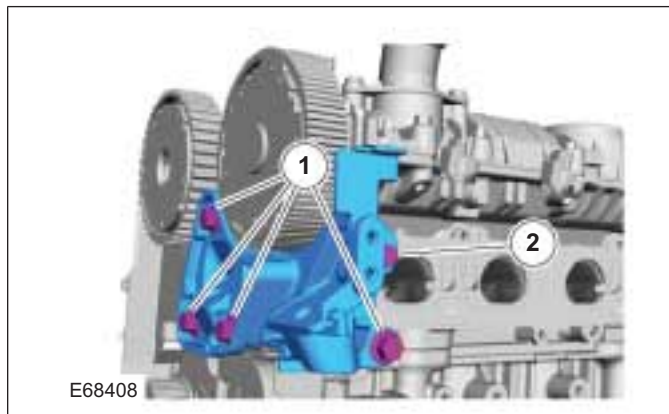


- 33.** 1. Torque: 25 Nm  
2. Torque: 12 Nm

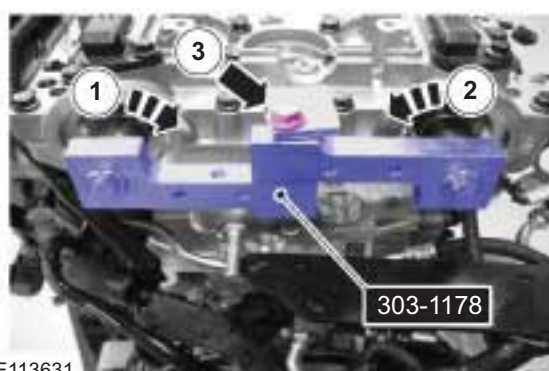
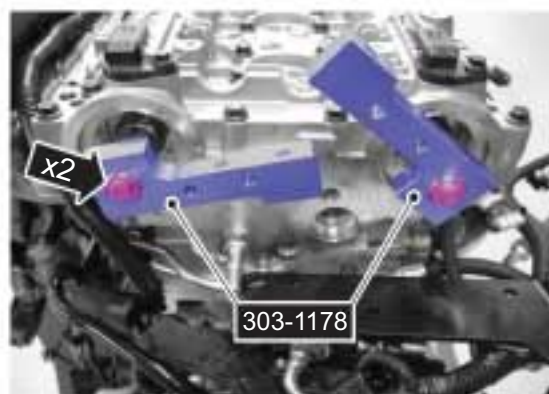


**34 NOTE:** Install all the bolts finger tight before final tightening.

1. Torque:
- Stage 1: 35 Nm
  - Stage 2: 75°
2. Torque:
- Stage 1: 15 Nm
  - Stage 2: 90°



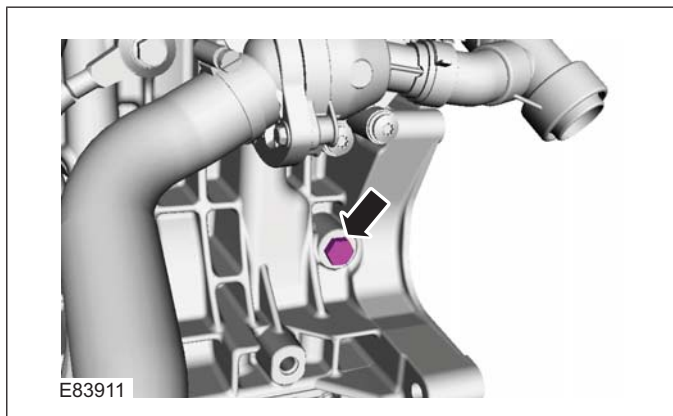
**35.** Install the Special Tool(s): 303-1178  
Torque: 10 Nm





ASSEMBLY

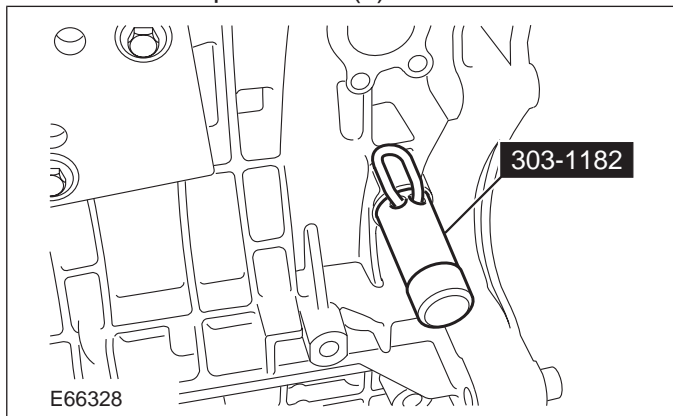
36.



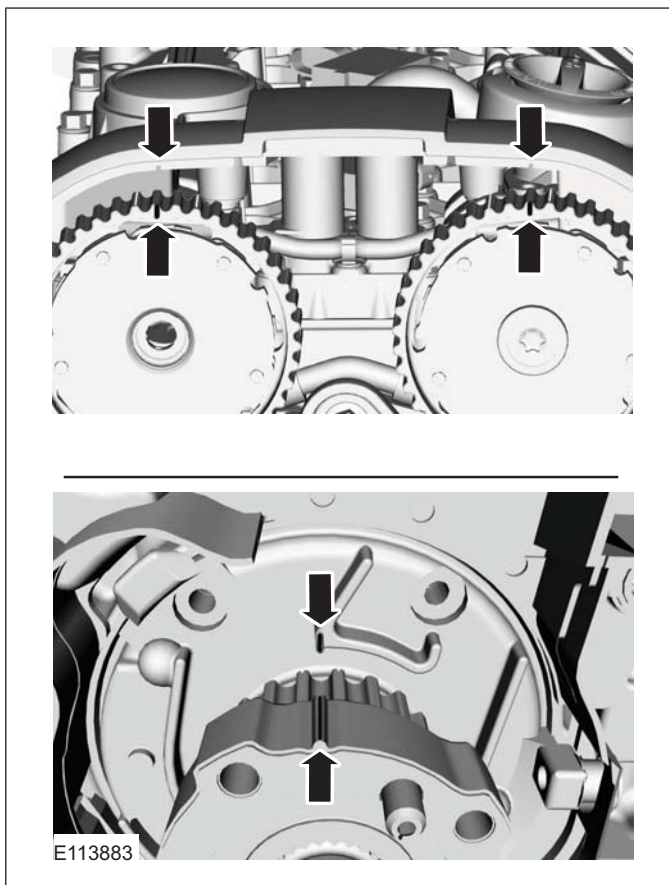
37. **⚠ CAUTION: Only rotate the crankshaft clockwise.**

Rotate the crankshaft slowly until the crankshaft stops.

Install the Special Tool(s): 303-1182



38. **⚠ CAUTION: Make sure that the installation marks are aligned.**



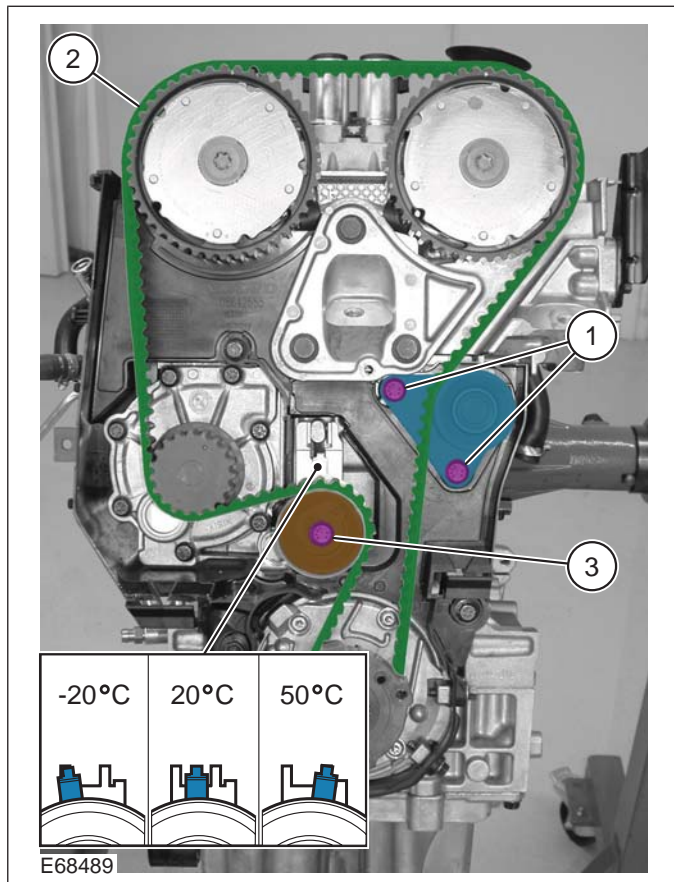


**ASSEMBLY**

Vehicles with mechanical timing belt tensioner

**39. NOTE:** Make sure that new components are installed.

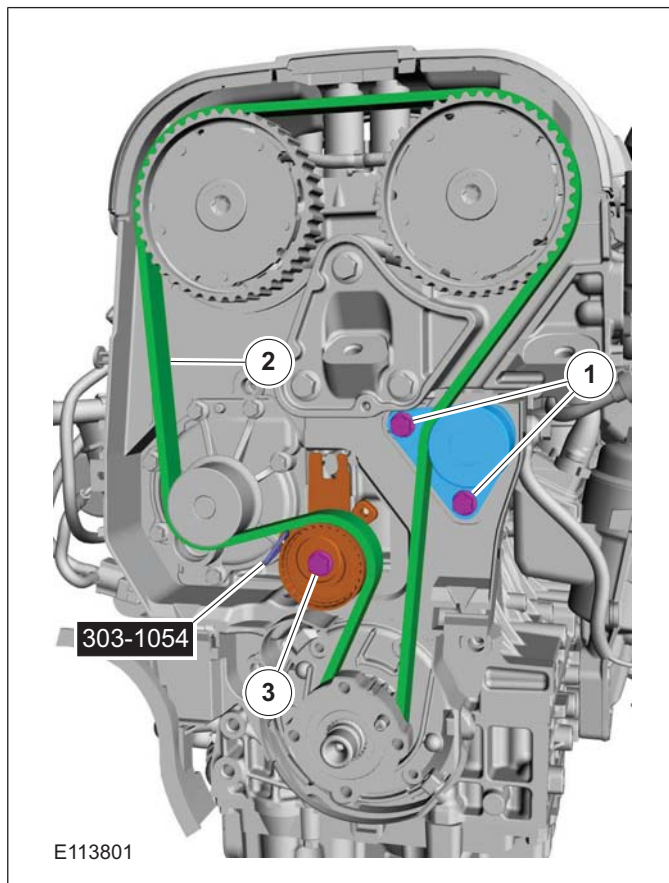
- 1. Torque: 25 Nm
- 3. Torque: 25 Nm



Vehicles with automatic timing belt tensioner

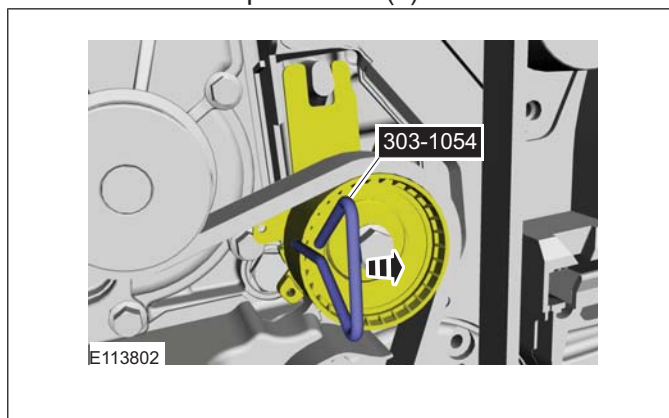
**40. NOTE:** Make sure that new components are installed.

- 1. Torque: 25 Nm
- 3. Special Tool(s): 303-1054  
Torque: 25 Nm



**41. ⚠ WARNING:** Take extra care when handling the compressed spring.

Remove the Special Tool(s): 303-1054

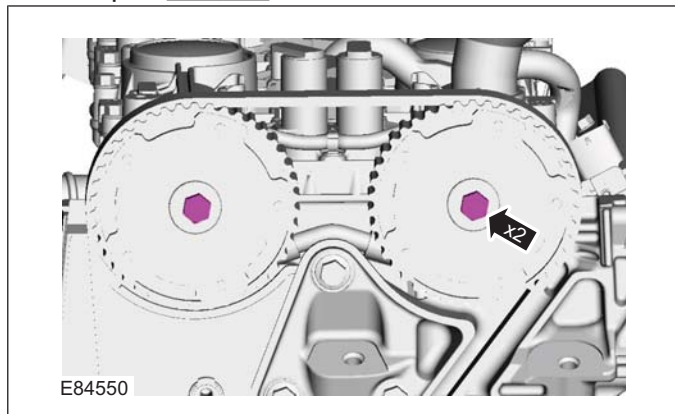




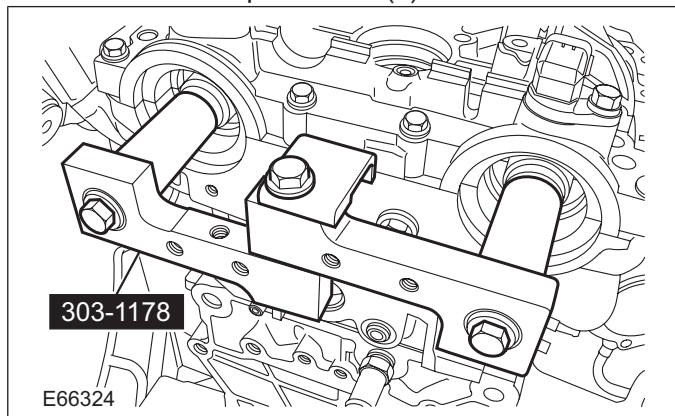
**ASSEMBLY**

All vehicles

42 Torque: 120 Nm



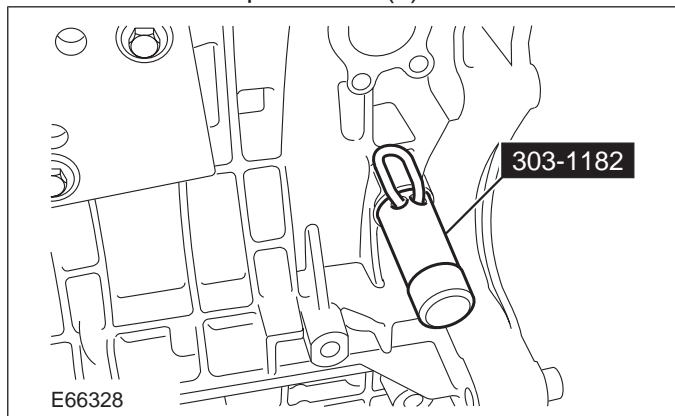
43. Remove the Special Tool(s): 303-1178



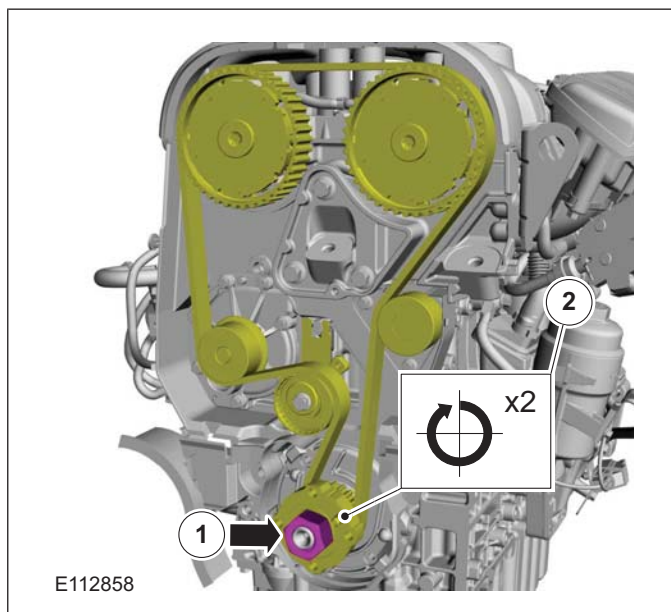
44. **⚠ CAUTION: Only rotate the crankshaft clockwise.**

Rotate the crankshaft slowly until the crankshaft stops.

Remove the Special Tool(s): 303-1182



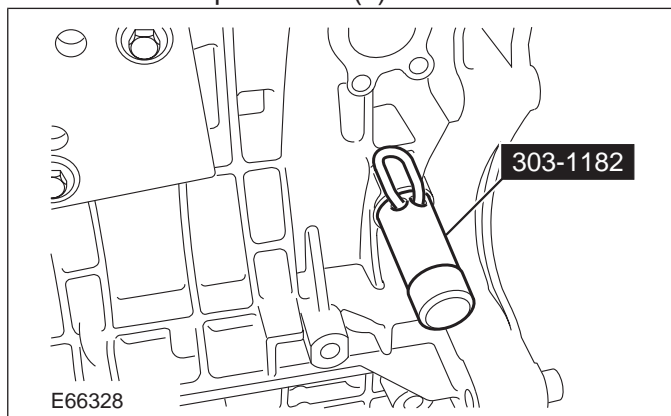
45.



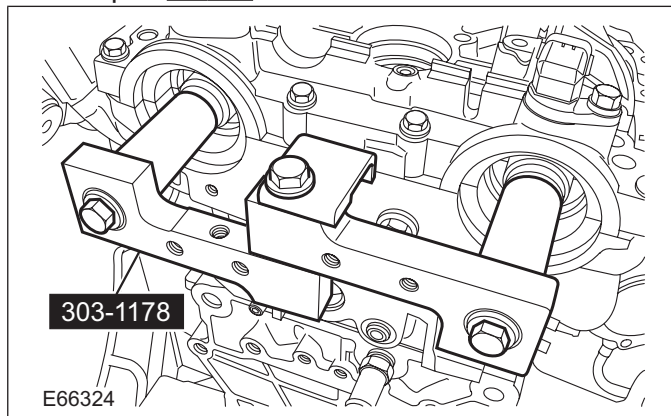
46. **⚠ CAUTION: Only rotate the crankshaft clockwise.**

Rotate the crankshaft slowly until the crankshaft stops.

Install the Special Tool(s): 303-1182



47. Install the Special Tool(s): 303-1178  
Torque: 10 Nm



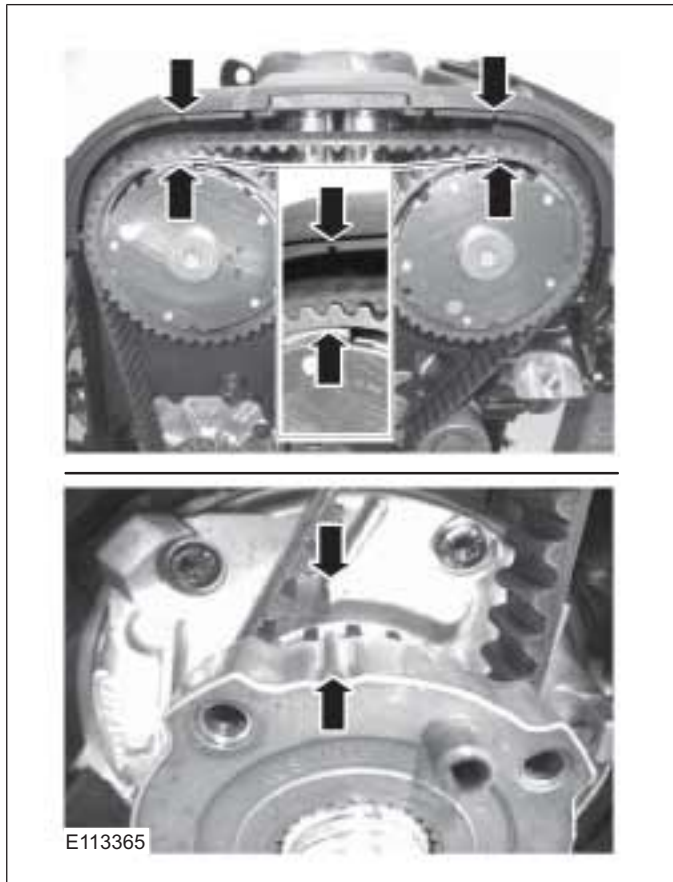
303-01-110

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-110

ASSEMBLY

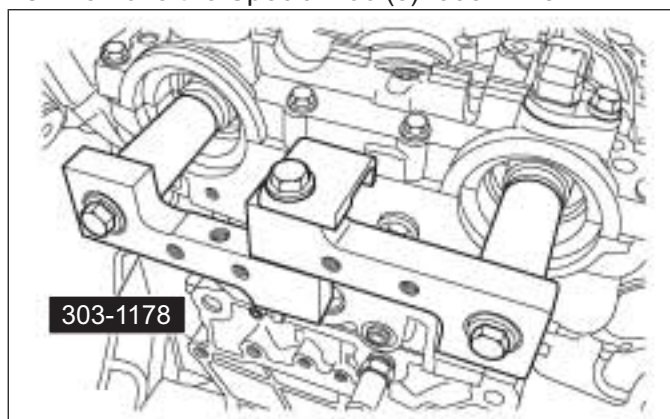
48.  **CAUTION:** Make sure that the installation marks are aligned.



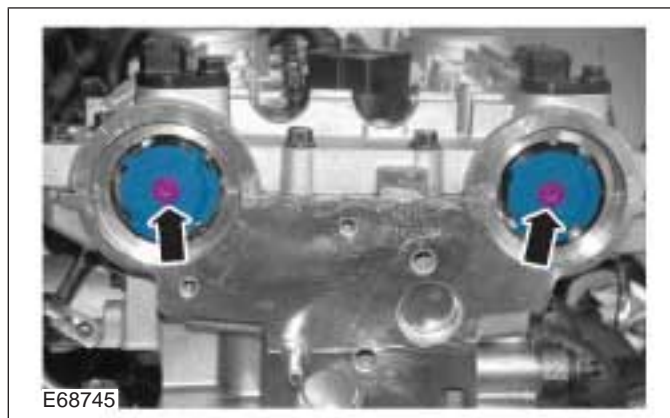
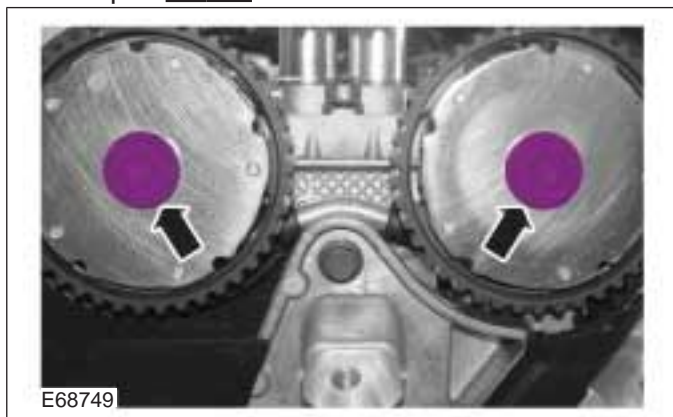
50. Remove the Special Tool(s): 303-1182



51. Remove the Special Tool(s): 303-1178



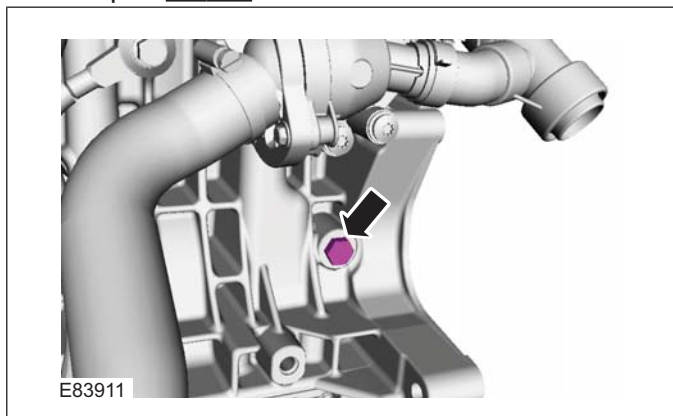
49. Torque: 35 Nm





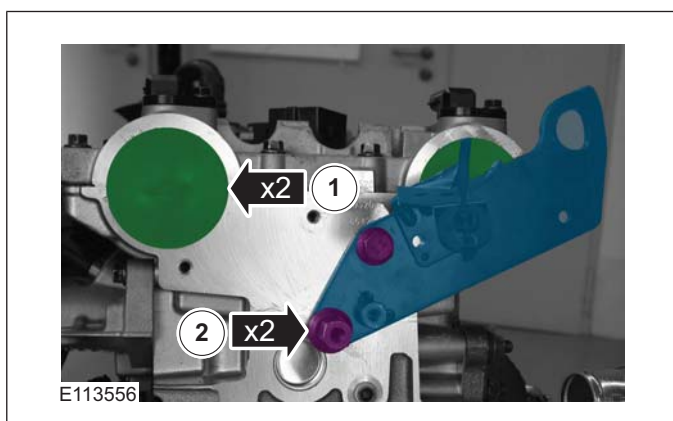
ASSEMBLY

53. Torque: 40 Nm

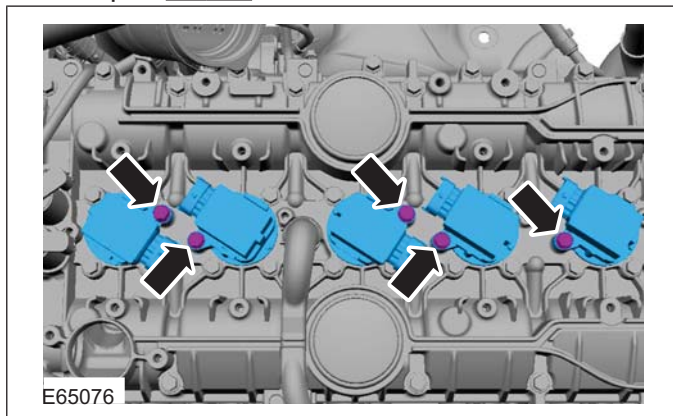


54. 1. **NOTE:** Make sure that new components are installed.

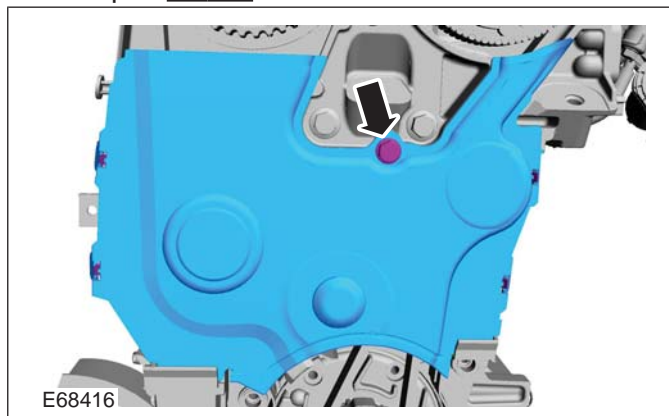
2. Torque: 40 Nm



55. Torque: 10 Nm



56. Torque: 10 Nm

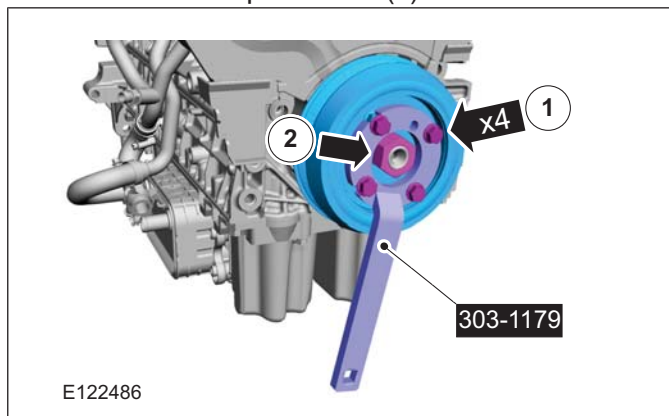


57. 1. **NOTE:** Only tighten the bolts finger tight at this stage.

Install the Special Tool(s): 303-1179

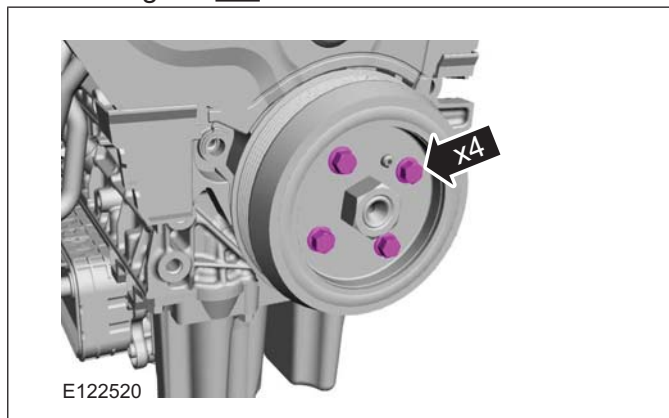
2. Torque: 180 Nm

58. Remove the Special Tool(s): 303-1179



59. Torque:

- Stage 1: 25 Nm
- Stage 2: 60°

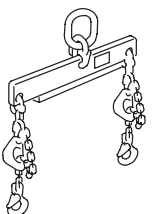
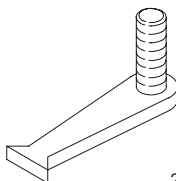
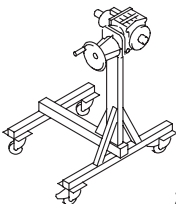
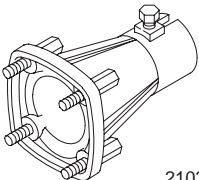
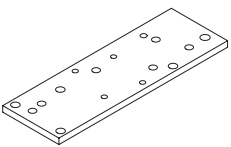


INSTALLATION

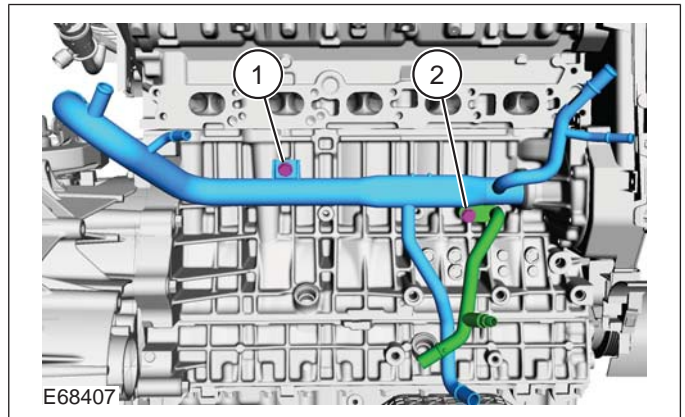
Engine Accessories(21 139 4)

Installation

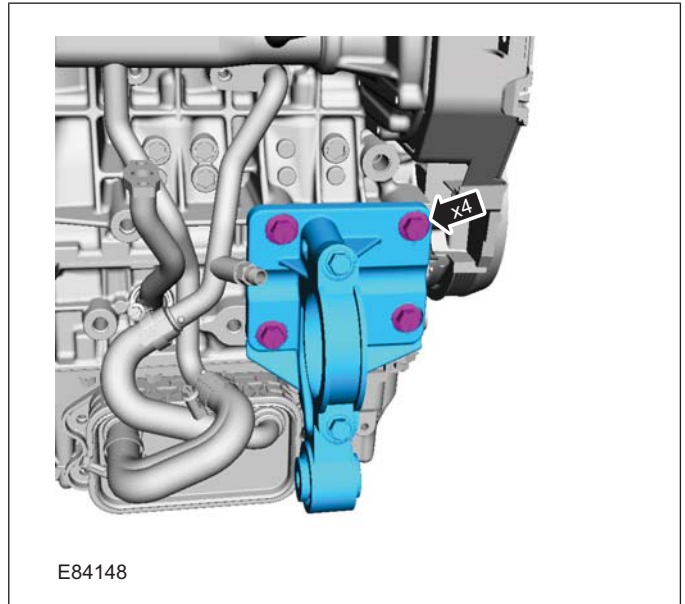
Special Tool(s)

 <p>21068A</p>	<p>303-122 Lifting Bracket, Engine</p>
 <p>21135</p>	<p>303-254 Locking Tool, Flywheel</p>
 <p>21187</p>	<p>303-435 Mounting Stand</p>
 <p>21031B</p>	<p>303-435-06 Mounting Bracket for 303-435</p>
 <p>E62805</p>	<p>303-435-14B Mounting Plate for 303-435-06</p>

1. • Torque: 17 Nm





2. Torque: 48 Nm



Vehicles with manual transmission

3. CAUTIONS:

-  Make sure that new bolts are installed.
-  Make sure that no excess sealant residue is evident.



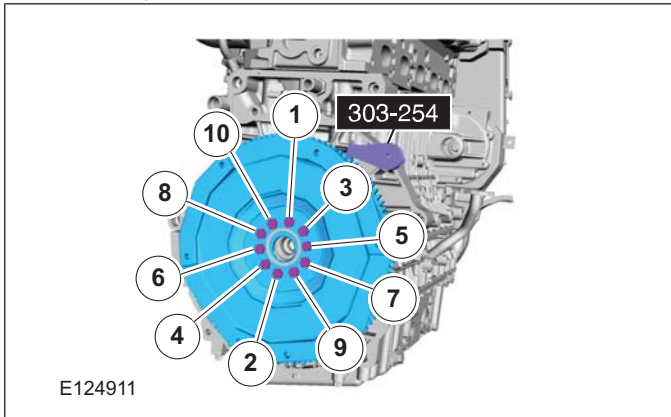
INSTALLATION

**NOTE:** Make sure that the locating pin on the crankshaft is aligned with the guide hole in the flywheel or flexplate.

Special Tool(s): 303-254

Torque:

- Stage 1: 45 Nm
- Stage 2: 65°



Vehicles with automatic transmission

4. CAUTIONS:

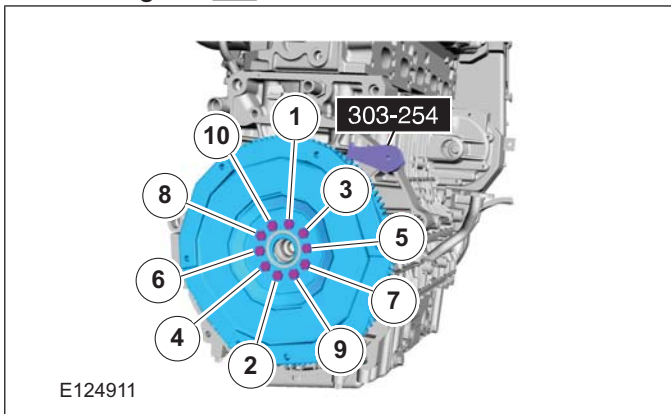
- ⚠ **Make sure that new bolts are installed.**
- ⚠ **Make sure that no excess sealant residue is evident.**

**NOTE:** Make sure that the locating pin on the crankshaft is aligned with the guide hole in the flywheel or flexplate.

Special Tool(s): 303-254

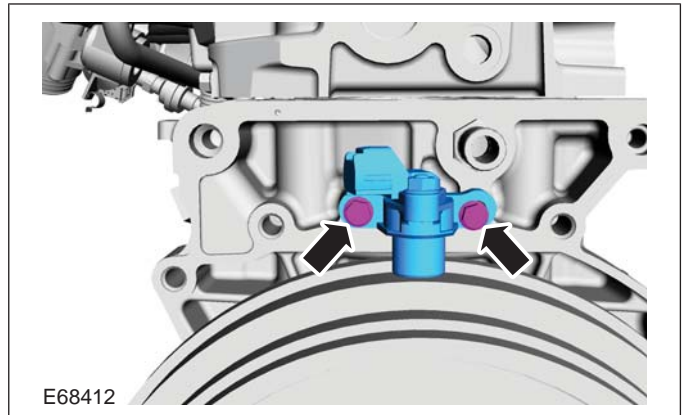
Torque:

- Stage 1: 45 Nm
- Stage 2: 50°

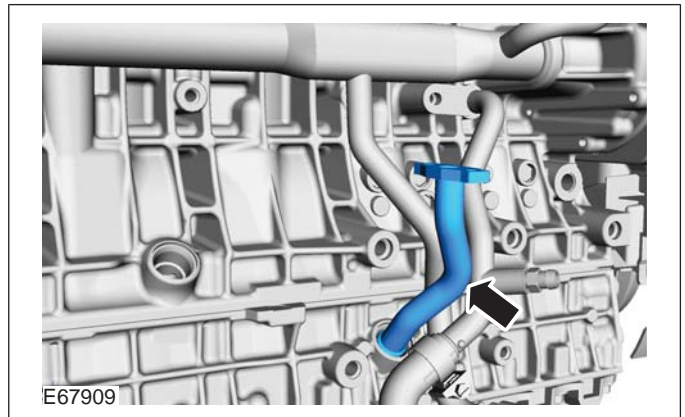


All vehicles

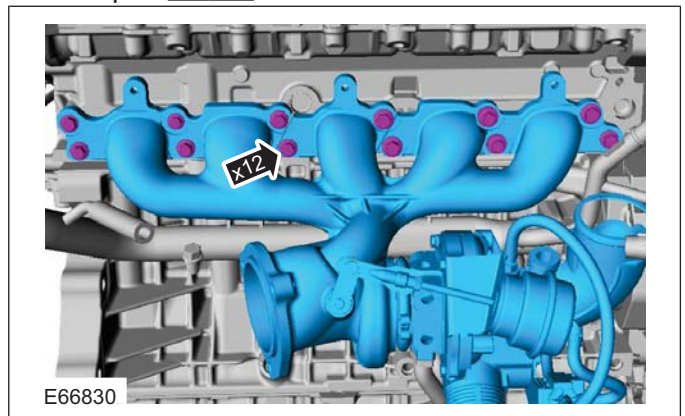
5. Torque: 17 Nm



6.



7. Torque: 24 Nm





303-01-114

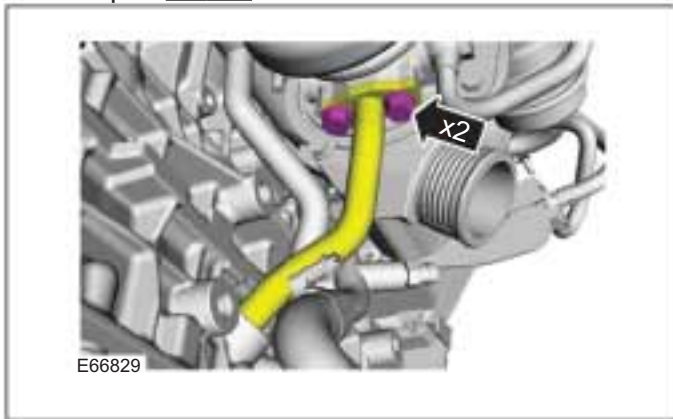
Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-114



INSTALLATION

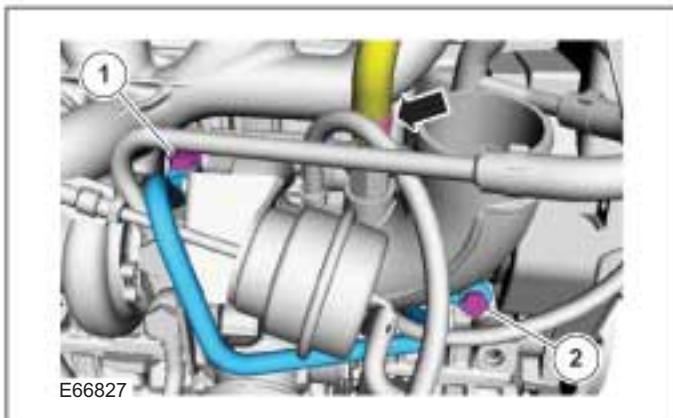
8. Torque: 12 Nm



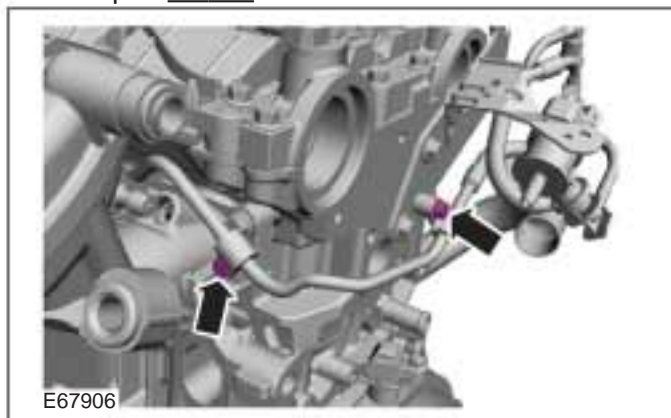
11. Torque: 19 Nm



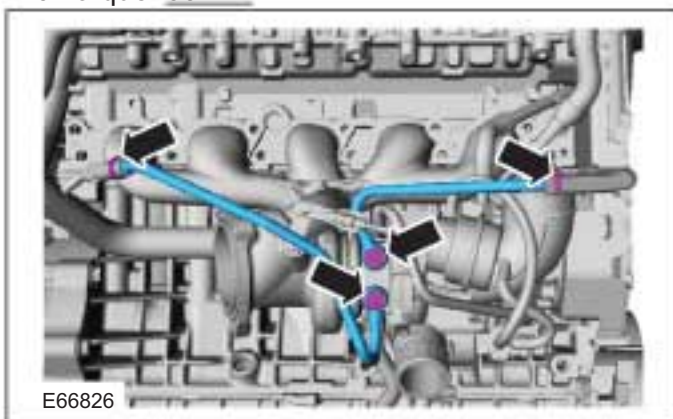
9. 1. Torque: 26 Nm  
2. Torque: 38 Nm



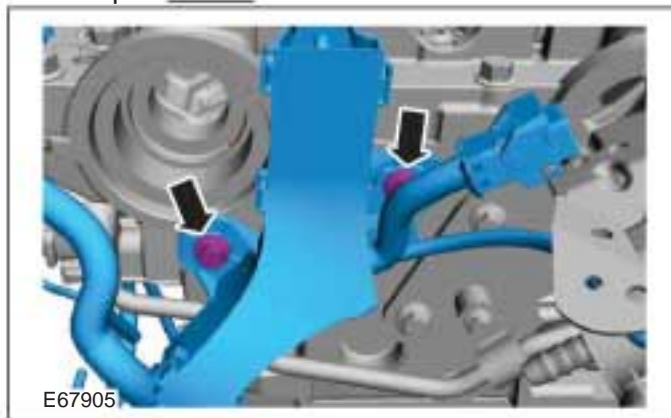
12 Torque: 10 Nm



10. Torque: 38 Nm



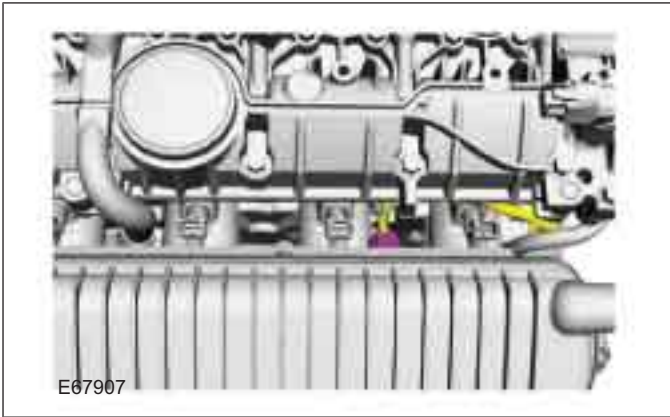
13. Torque: 10 Nm



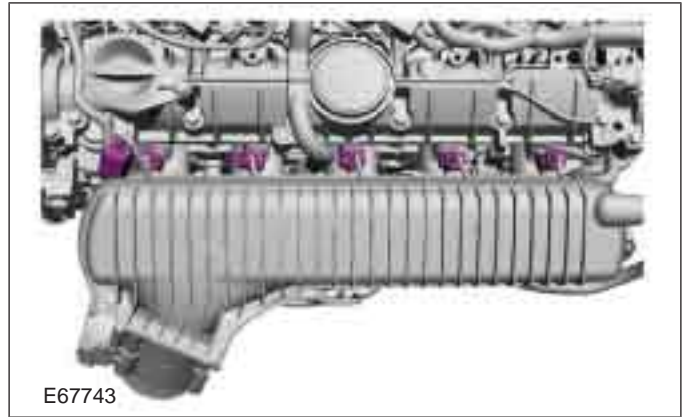


INSTALLATION

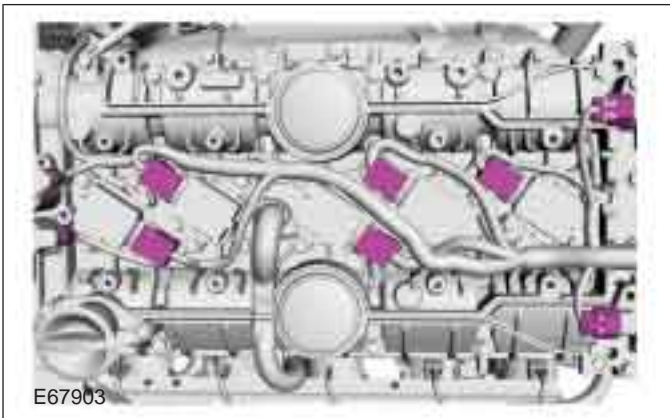
14.



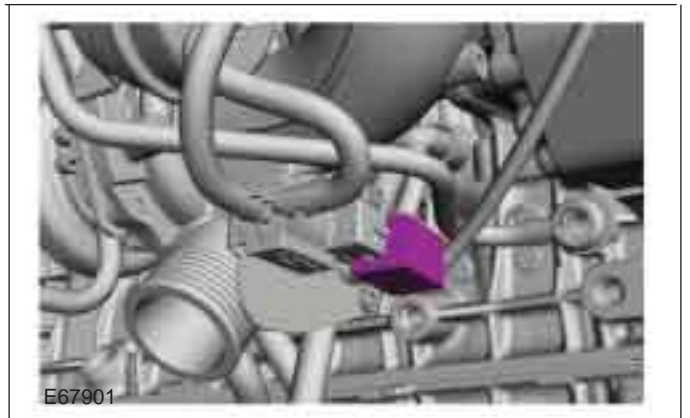
17.



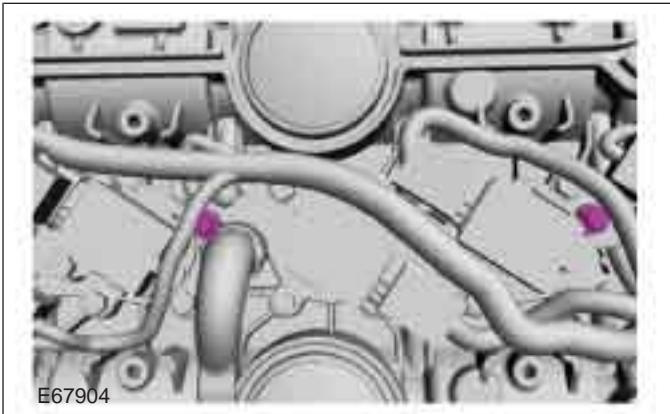
15.



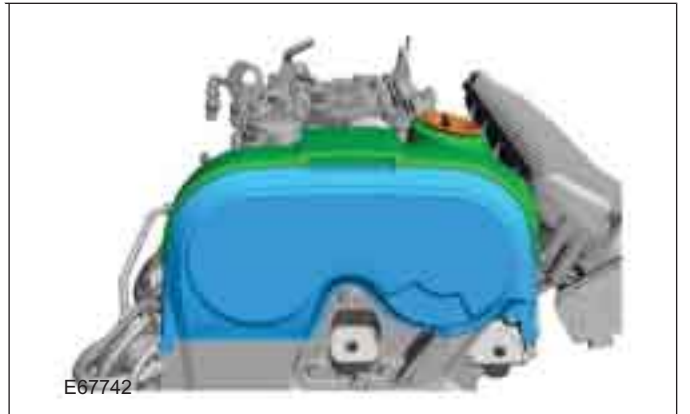
18.



16. Torque: 10 Nm



19.

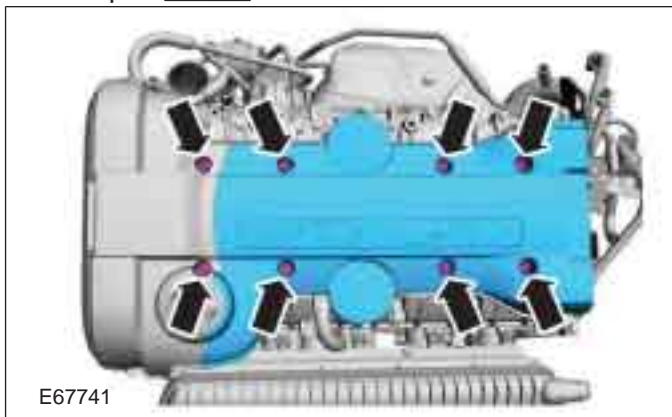




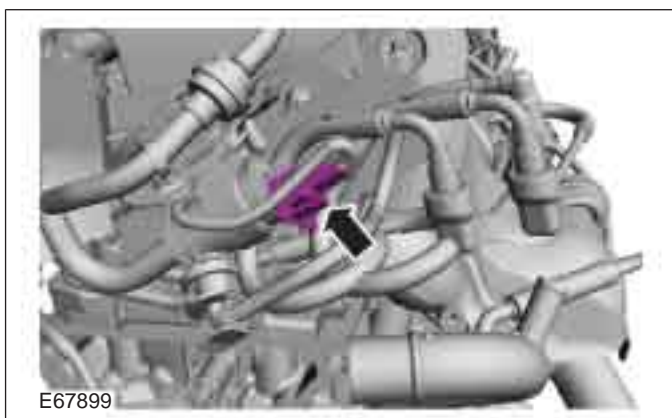


INSTALLATION

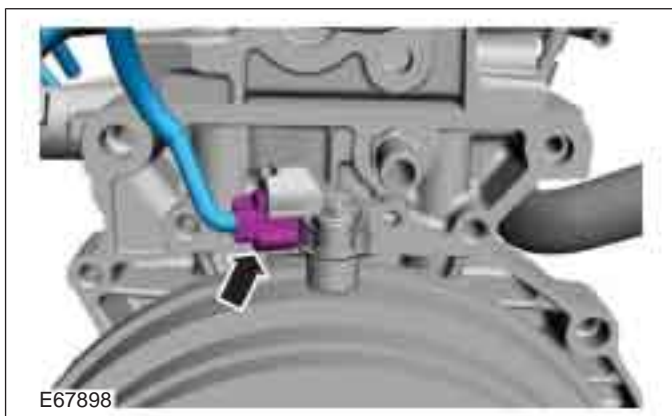
20. Torque: 10 Nm



21.



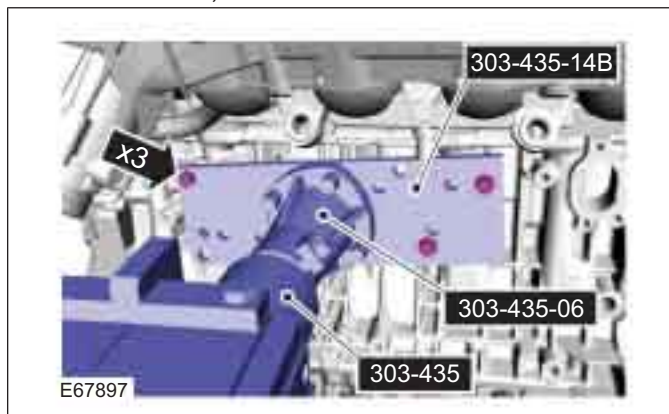
22.



23. Install the Special Tool(s): 303-122



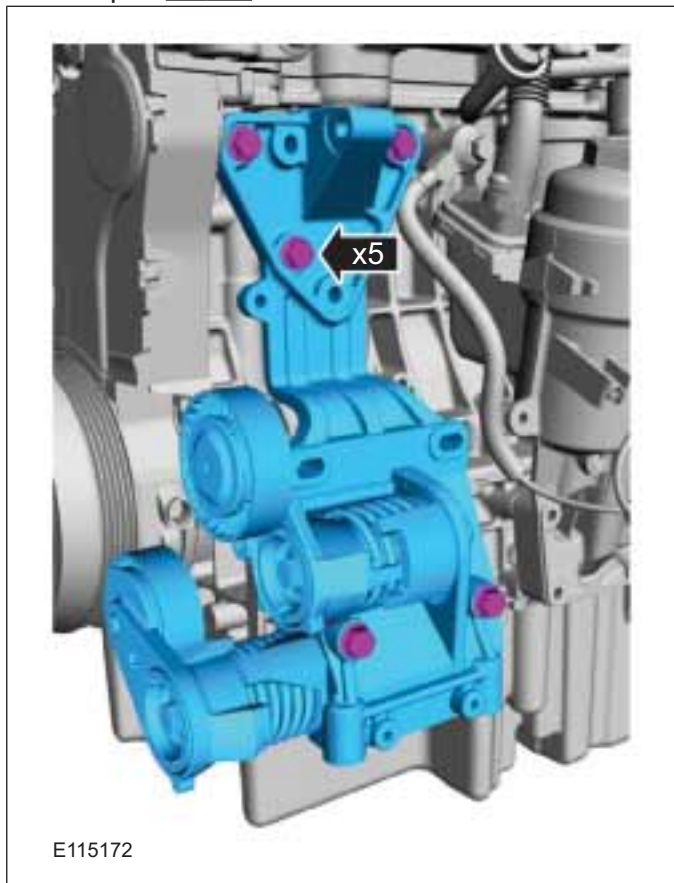
24. Remove the Special Tool(s): 303-435, 303-435-06, 303-435-14B



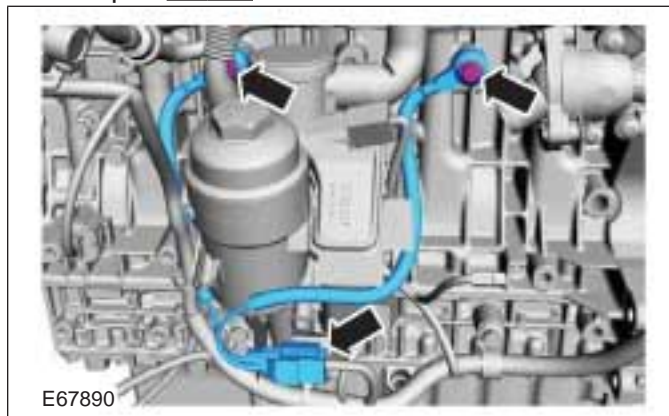


**INSTALLATION**

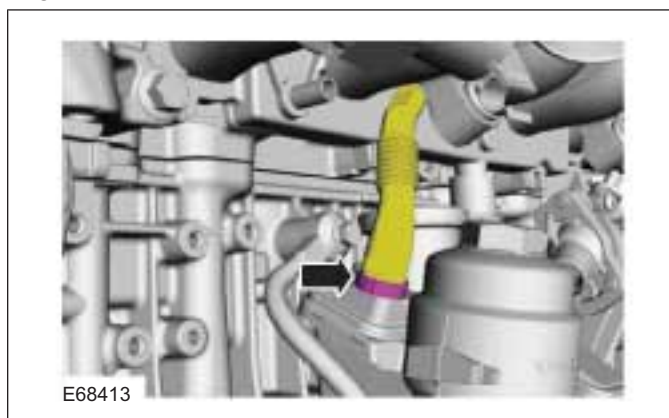
25. Torque: 24 Nm



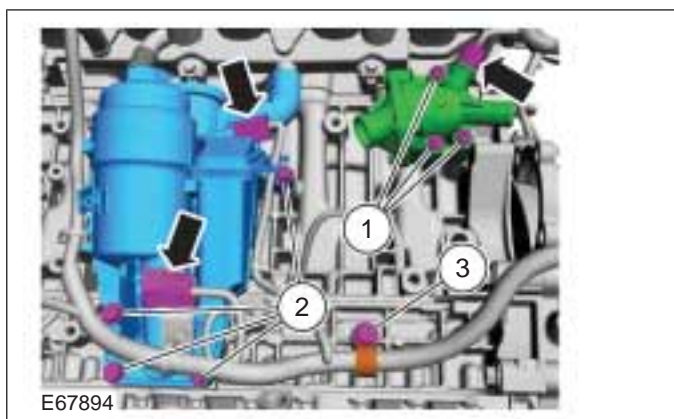
27. Torque: 20 Nm



28.



- 26. 1. Torque: 17 Nm
- 2. Torque: 16 Nm
- 3. Torque: 24 Nm



29.





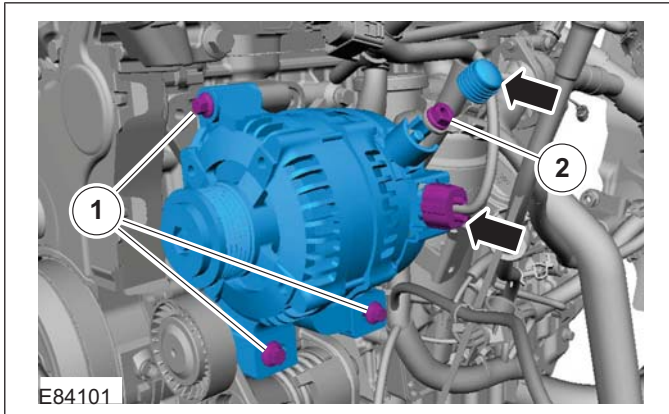
303-01-118

Engine — 2.5L Duratec (147kW/200PS) - VI5

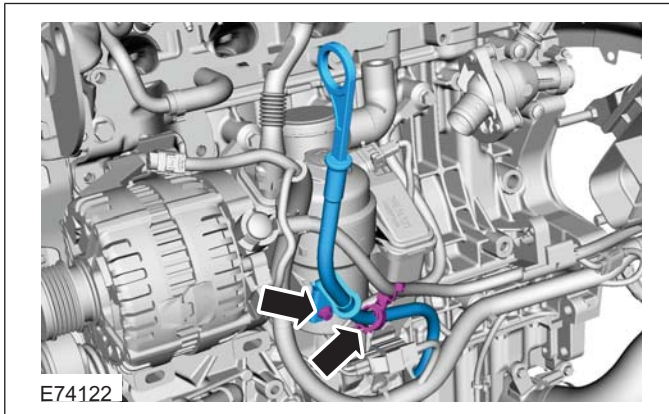
303-01-118

## INSTALLATION

1. Torque: 24 Nm
2. Torque: 15 Nm



31. Torque: 10 Nm

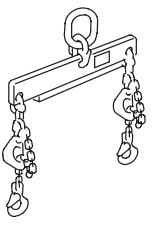


INSTALLATION

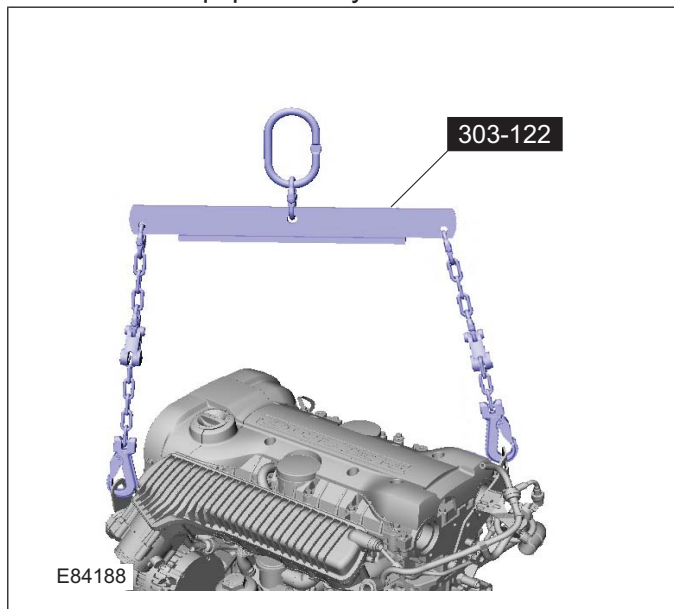
Engine — Vehicles With: 5-Speed Automatic Transaxle  
(AW55)(21 132 0; 21 132 6; 21 132 7)

Installation

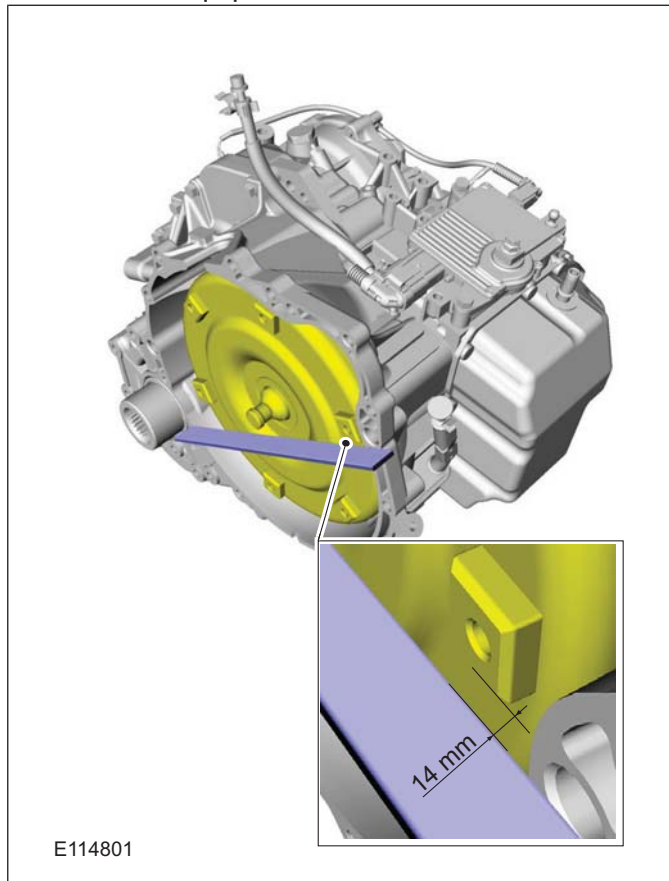
Special Tool(s) / General Equipment

 <p>21068A</p>	<p>303-122 Lifting Bracket, Engine</p>
<p>Hose Clamp Remover/Installer</p>	
<p>Hydraulic Jib Crane</p>	
<p>Mounting Table Set</p>	
<p>Retaining Strap</p>	
<p>Round-Ended Steel Rule</p>	
<p>Trolley Jack</p>	
<p>Wooden Block</p>	

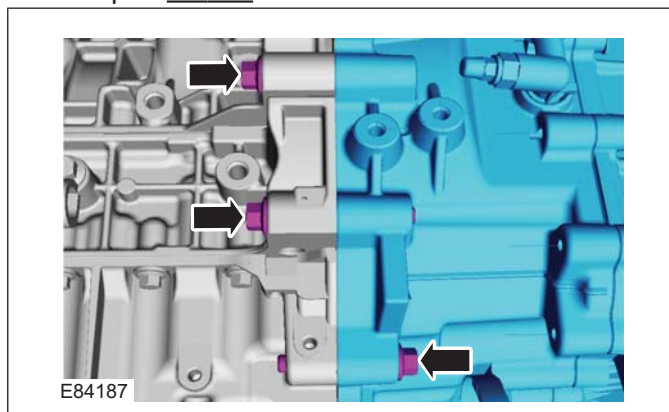
1. Special Tool(s): 303-122  
General Equipment: Hydraulic Jib Crane



2. General Equipment: Round-Ended Steel Rule



3. Torque: 48 Nm

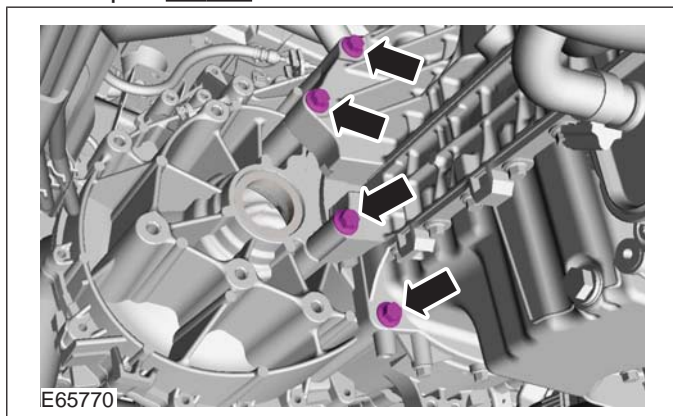
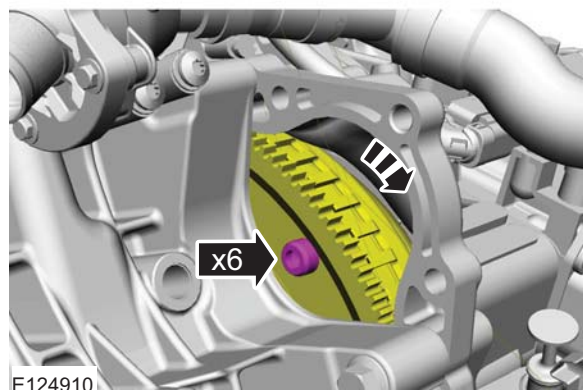
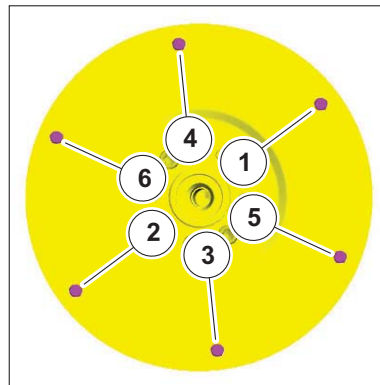


303-01-120

Engine — 2.5L Duratec (147kW/200PS) - VI5

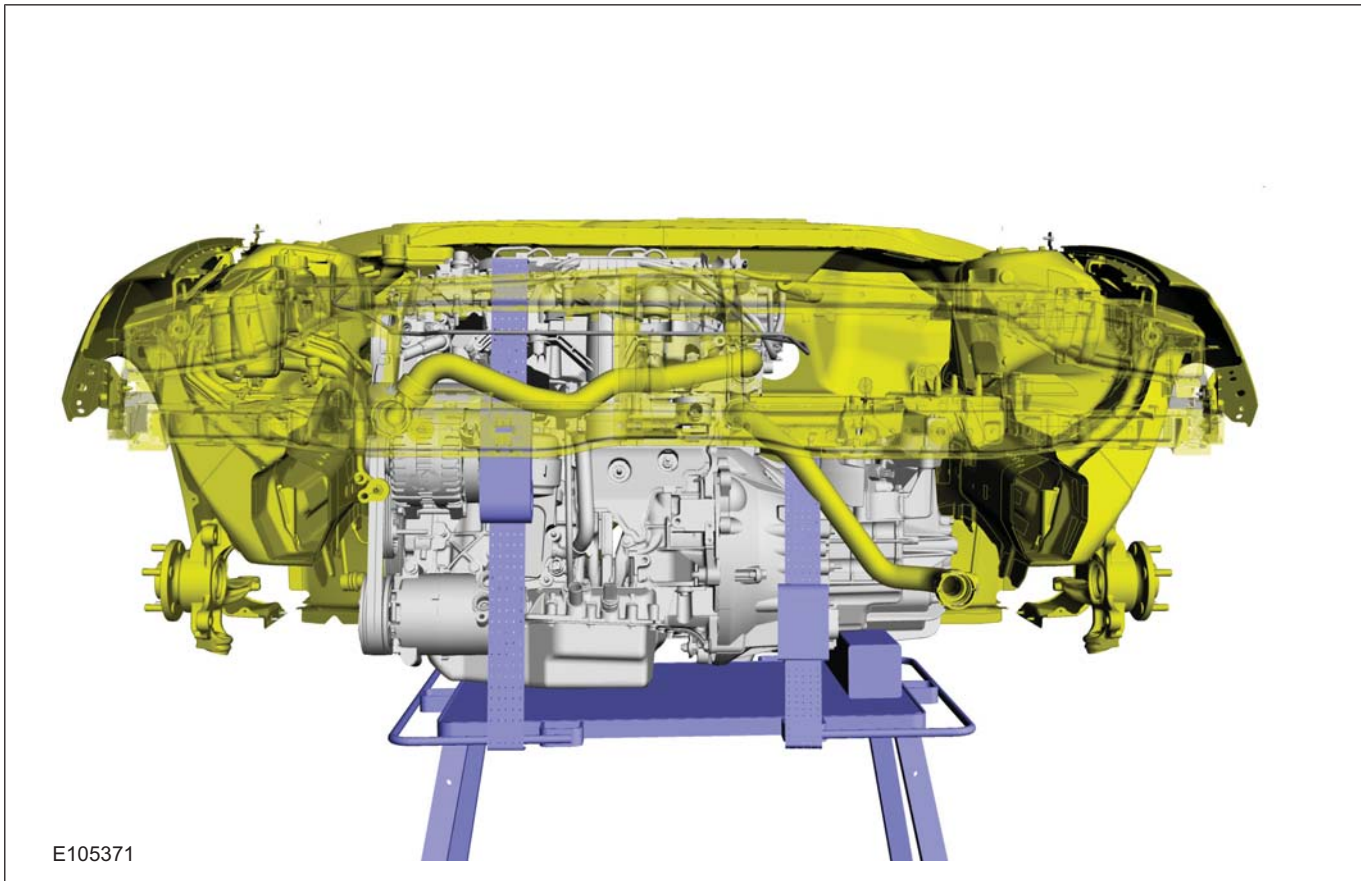
303-01-120

## INSTALLATION

4. Torque: 48 Nm5. **NOTE:** Install all the bolts finger tight before final tightening.Torque: 60 Nm6. **⚠ WARNING:** Make sure that the engine and transmission assembly is on wooden blocks and secured with suitable retaining straps.General Equipment: Retaining Strap  
General Equipment: Mounting Table Set  
General Equipment: Wooden Block



INSTALLATION

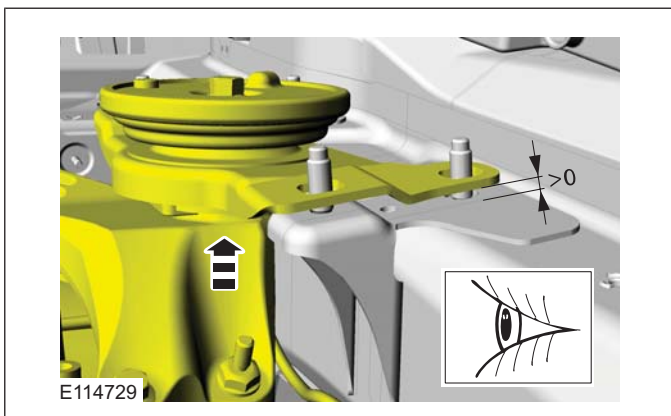


E105371

7. **CAUTION:** Make sure that no components catch.

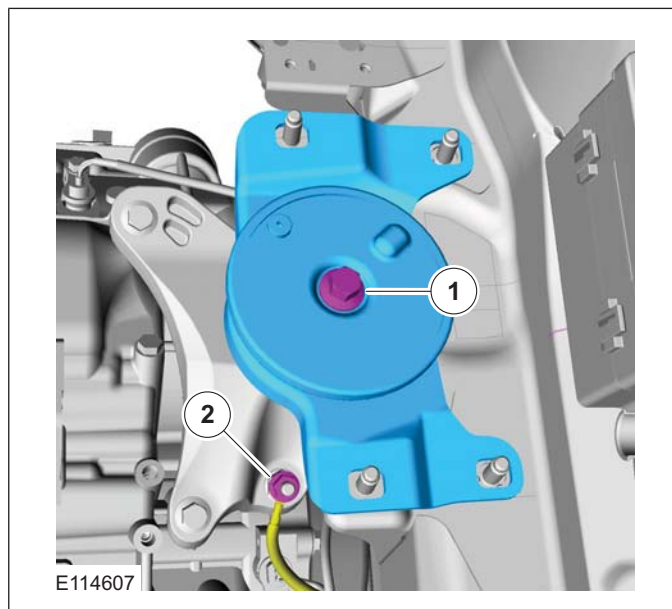
Lower the vehicle.

8.



E114729

9. 1. Torque: 148 Nm  
2. Torque: 10 Nm



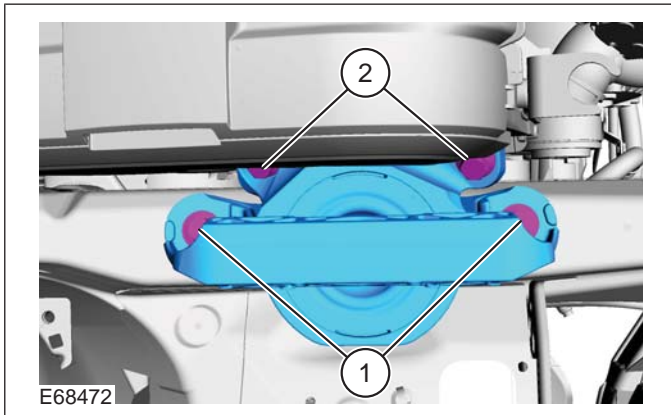
E114607





INSTALLATION

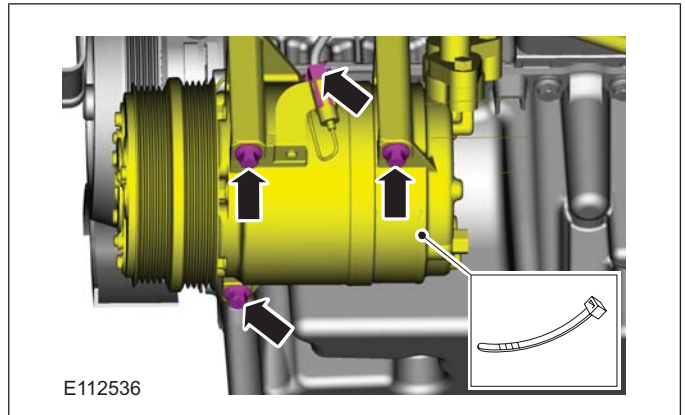
10. **NOTE:** Only tighten the nuts and bolts finger tight at this stage.



11. Remove the following items:

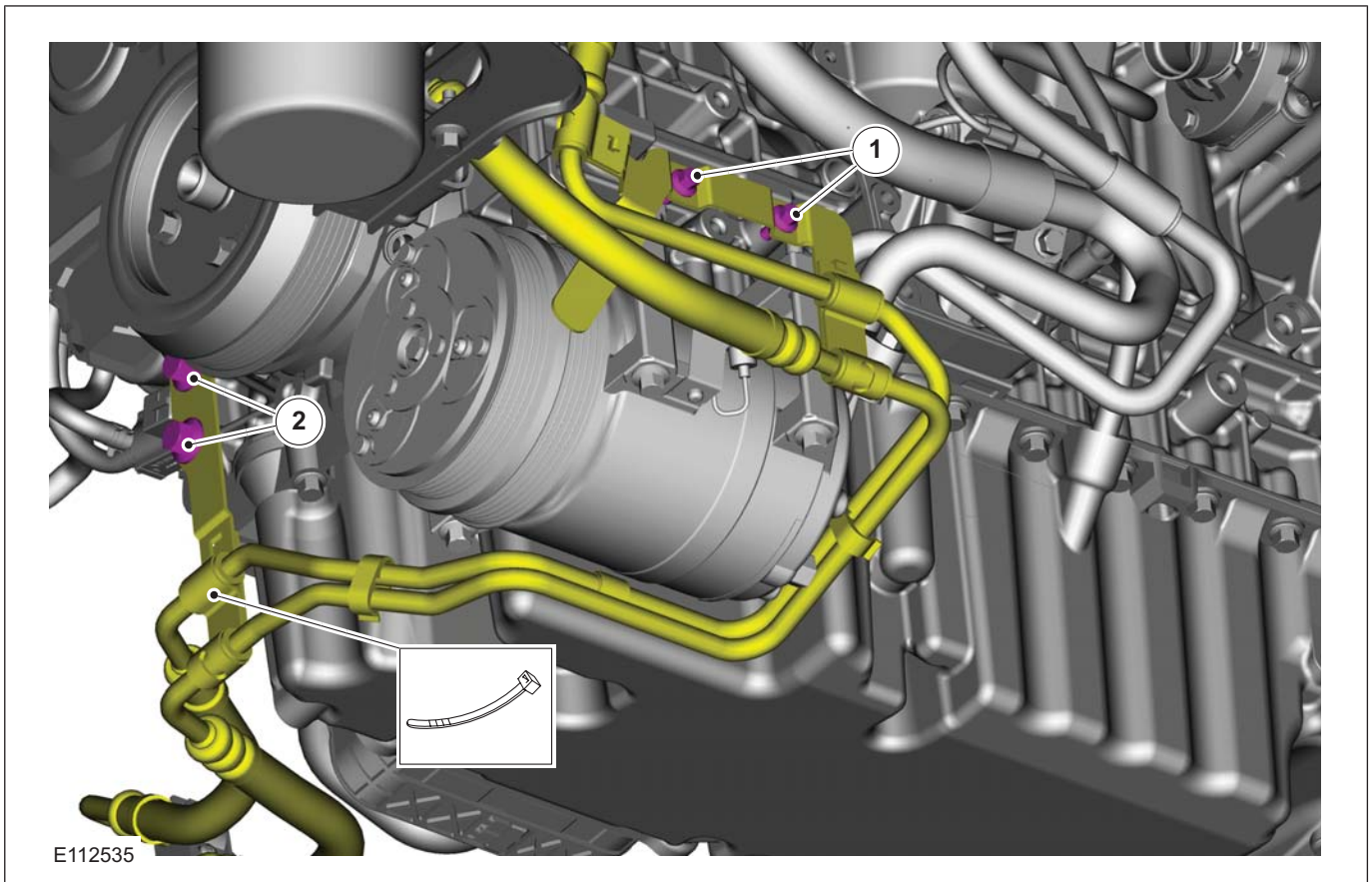
- General Equipment: Retaining Strap

12 Torque: 25 Nm



13. 1. Torque: 23 Nm

2. Torque: 7 Nm

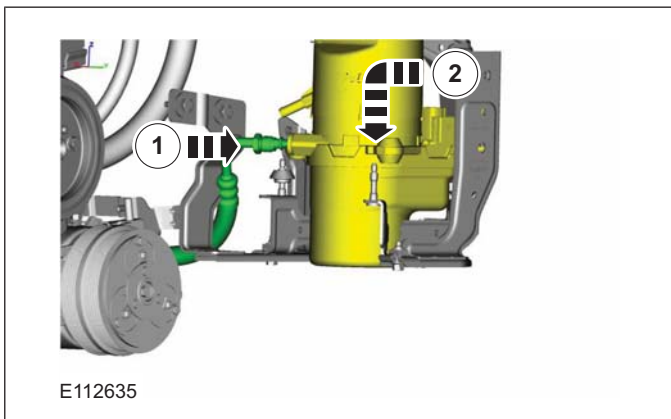






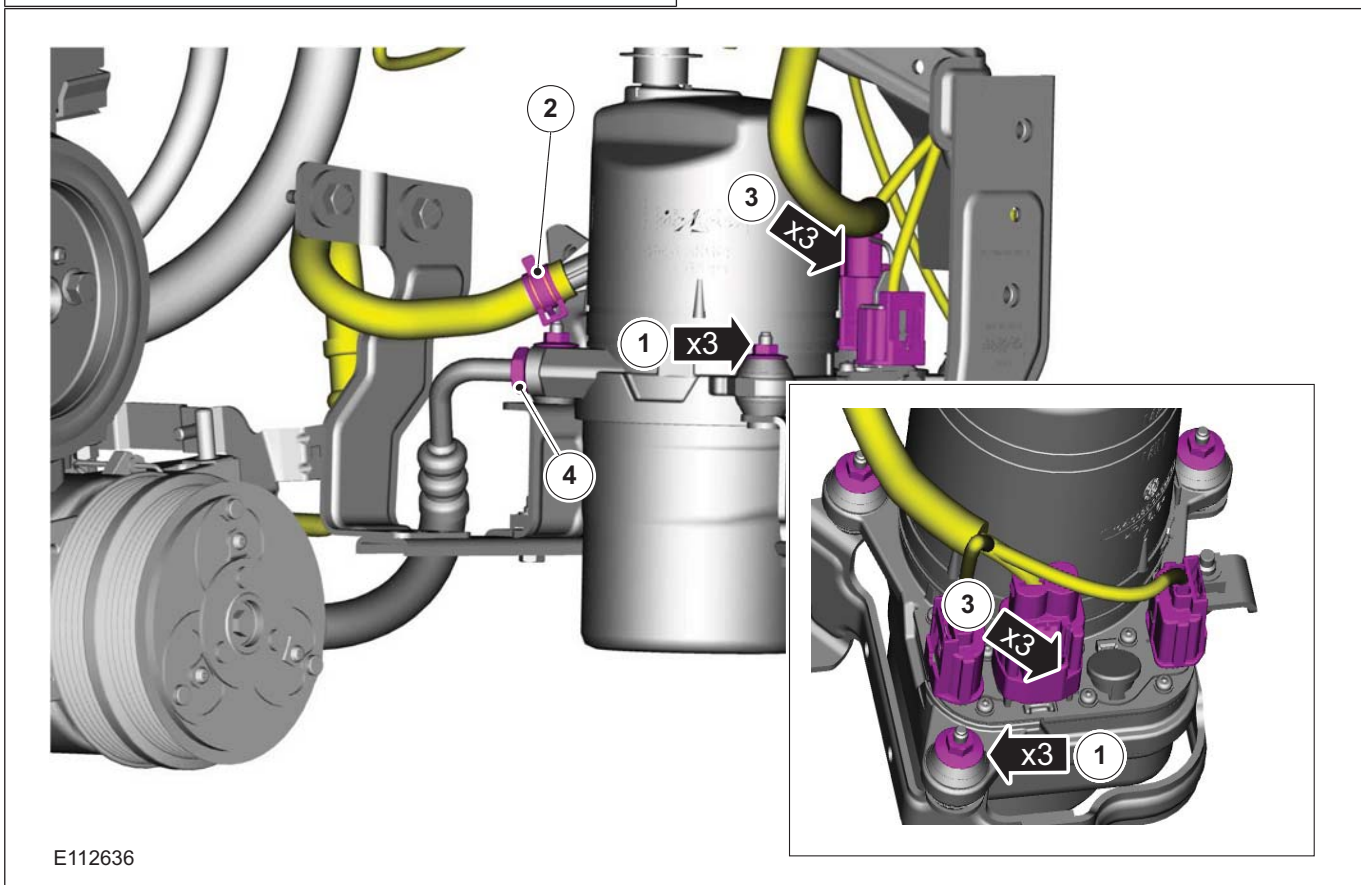
INSTALLATION

14.



E112635

15. 1. Torque: 10 Nm
2. General Equipment: Hose Clamp Remover/Installer
4. Torque: 30 Nm



E112636



303-01-124

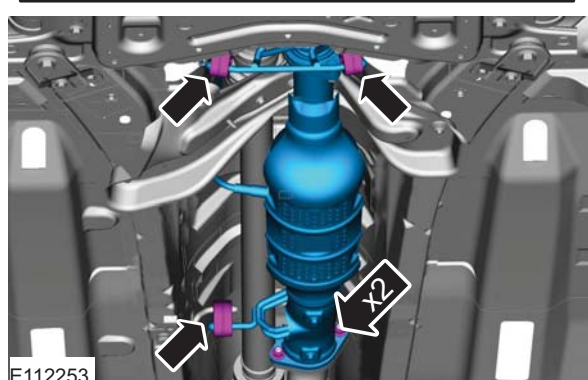
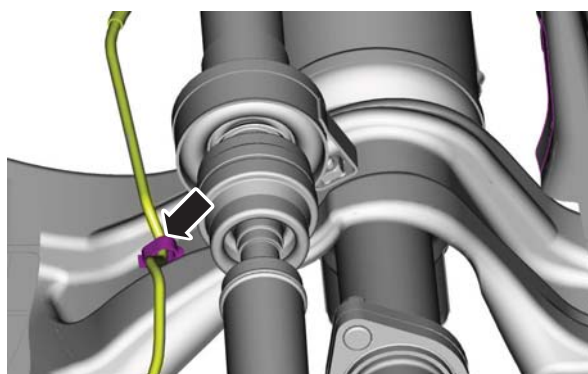
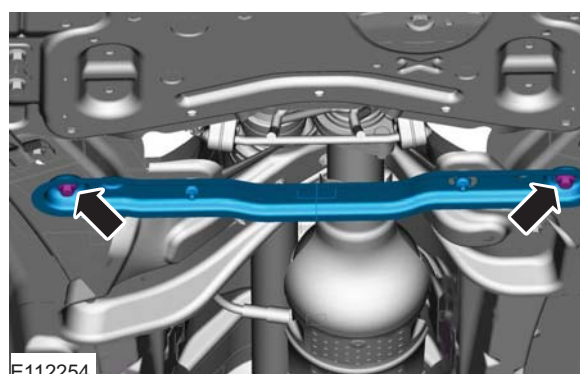
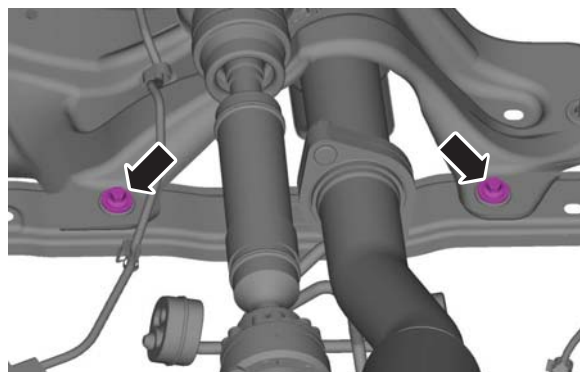
Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-124

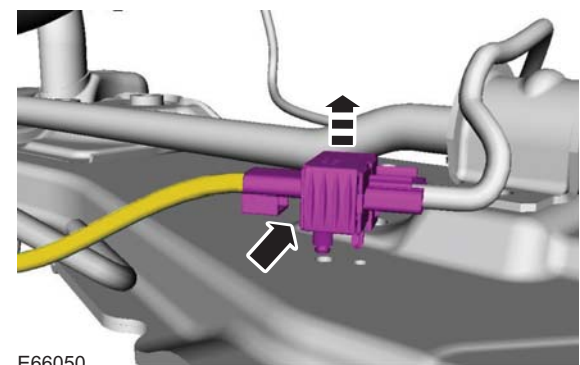
## INSTALLATION

16. Install the following items:

1. Refer to: **Transfer Case** (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Removal).
2. Refer to: **Front Halfshaft LH** (205-04 Front Drive Halfshafts, Removal and Installation).
3. Refer to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

17.  **CAUTION:** Make sure that the exhaust flexible pipe is not forcibly bent.Torque: 48 Nm18. Torque: 24 Nm

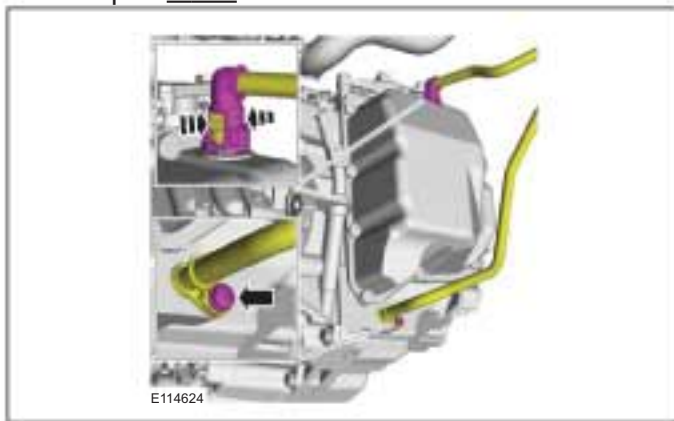
19.



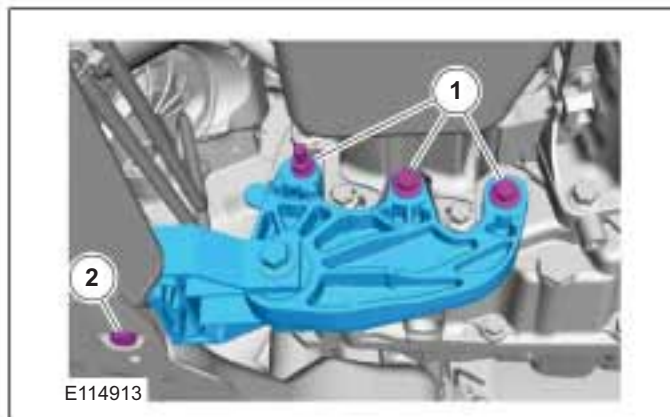


INSTALLATION

20. Torque: 6 Nm



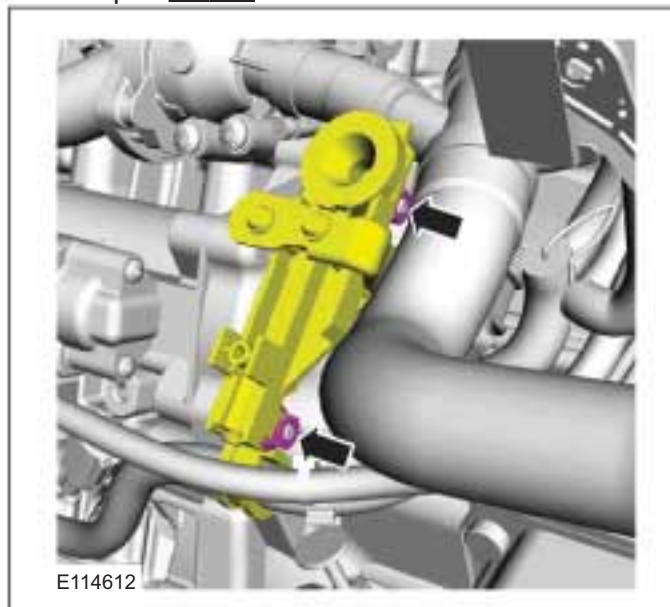
23. 1. Torque: 48 Nm  
2. Torque: 80 Nm



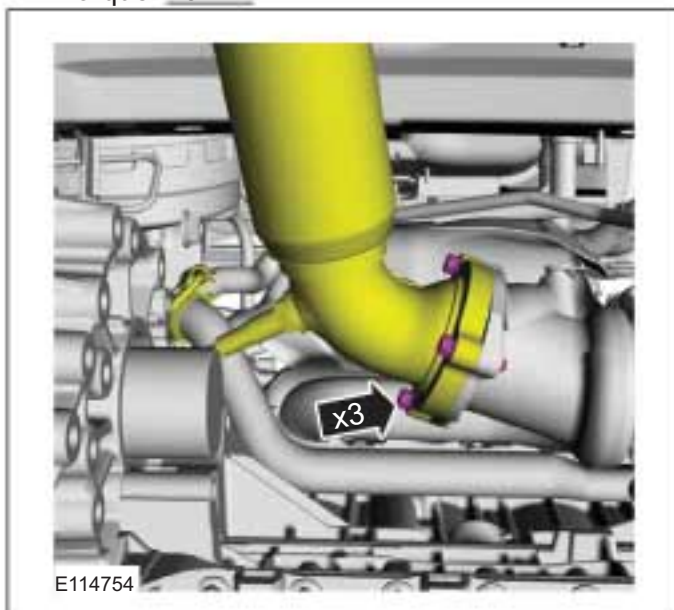
21. Torque: 50 Nm



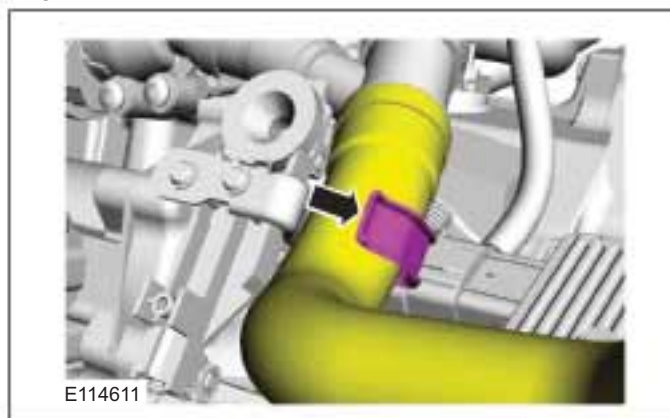
24. Torque: 10 Nm



22. **CAUTION:** Make sure that the exhaust flexible pipe is not forcibly bent.  
Torque: 28 Nm



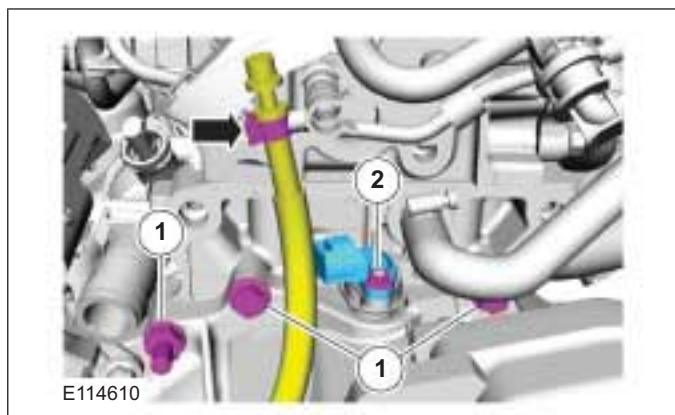
25.



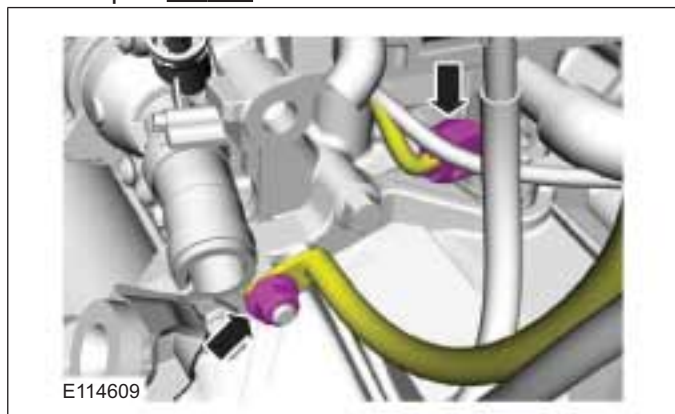


INSTALLATION

26. 1. Torque: 48 Nm  
2. Torque: 9 Nm



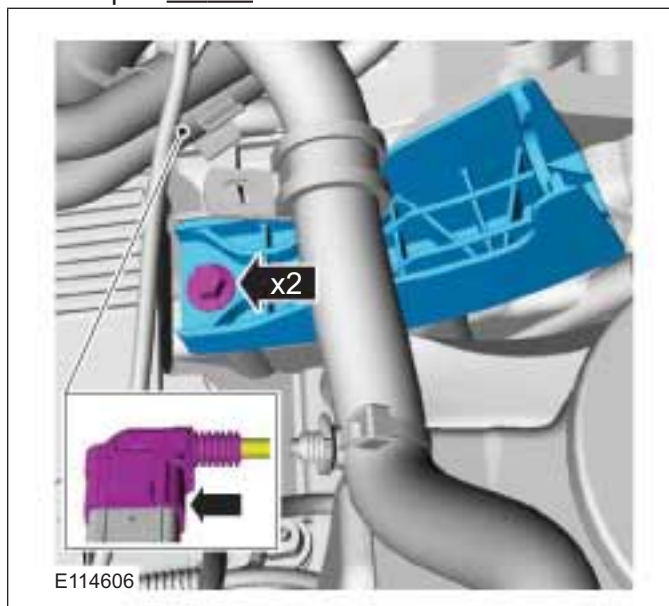
27. Torque: 25 Nm



28.

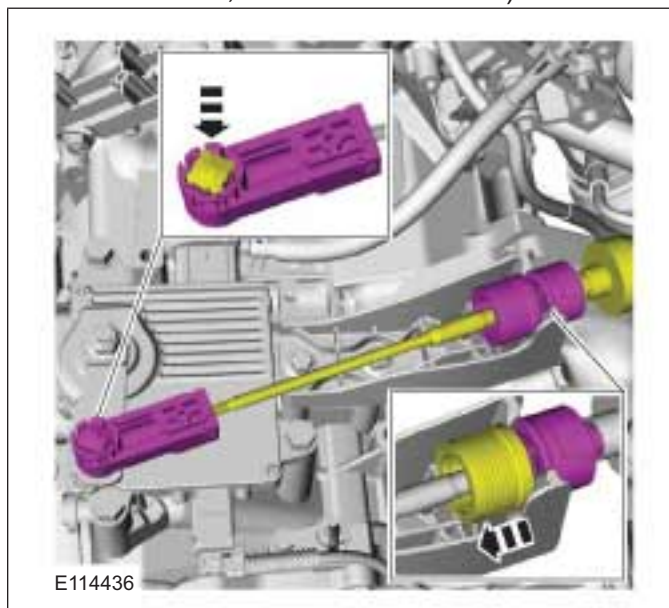


29. Torque: 25 Nm



30. **CAUTION:** Gearshift cables must not be kinked or bent.

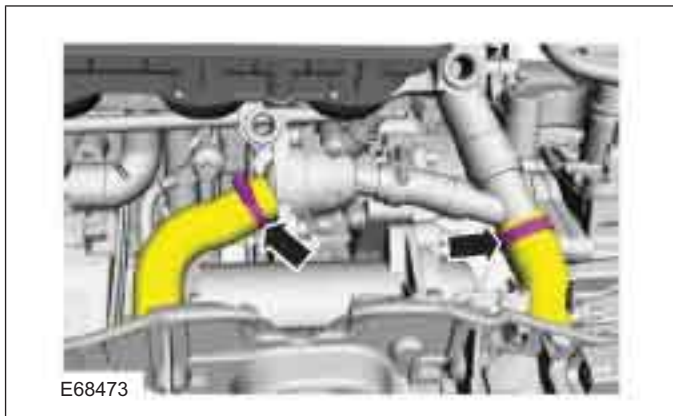
Refer to: **Selector Lever Cable Adjustment - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD** (307-05 Automatic Transmission/Transaxle External Controls - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, General Procedures).



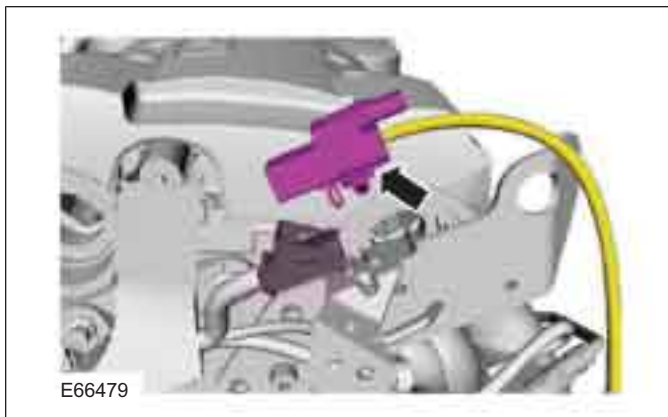


INSTALLATION

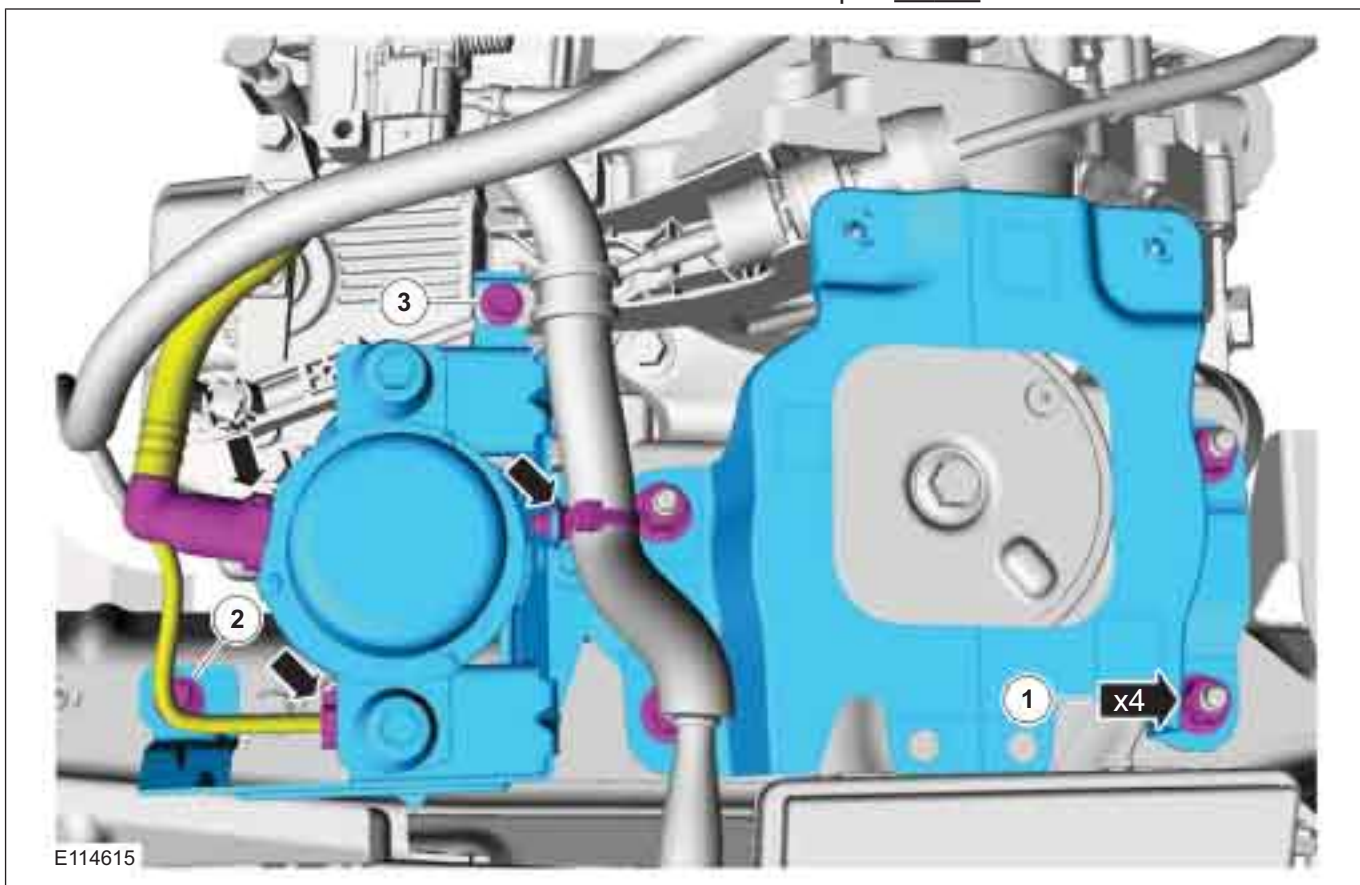
31. General Equipment: Hose Clamp  
Remover/Installer



32



- 33. 1. Torque: 48 Nm
- 2. Torque: 25 Nm
- 3. Torque: 10 Nm





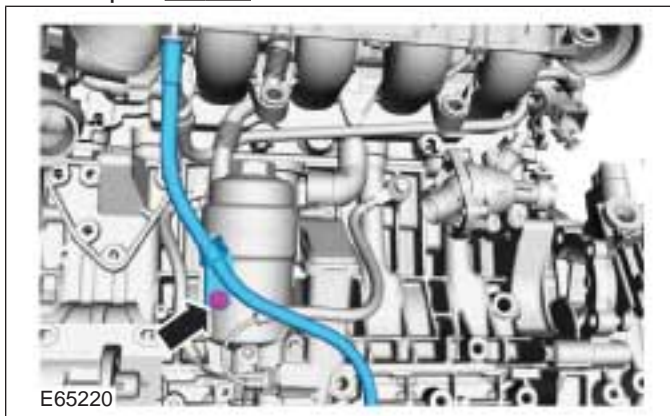


INSTALLATION

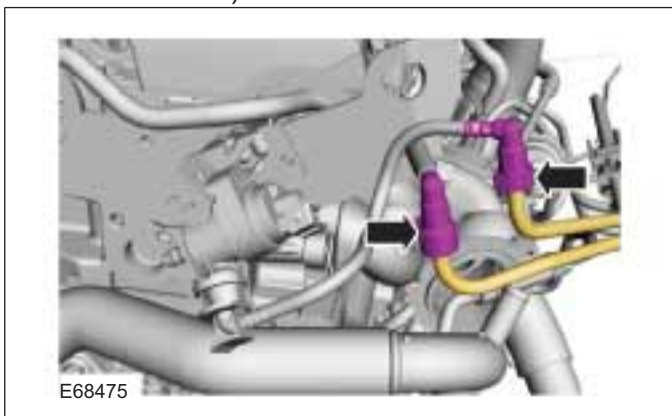
34.



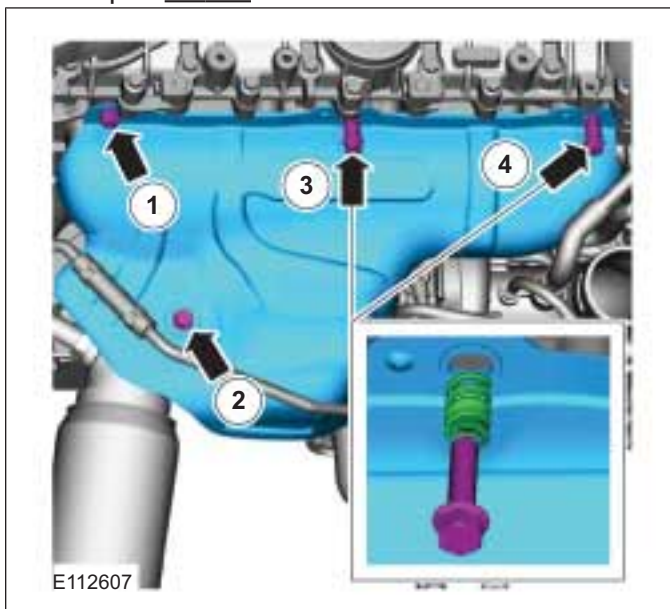
37. Torque: 10 Nm



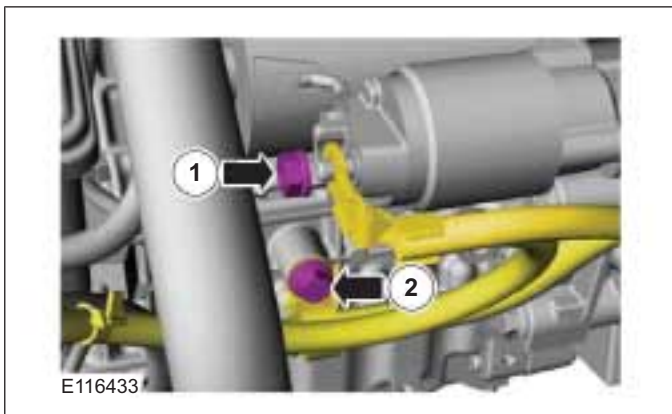
35. Refer to: **Quick Release Coupling** (310-00 Fuel System - General Information, General Procedures).



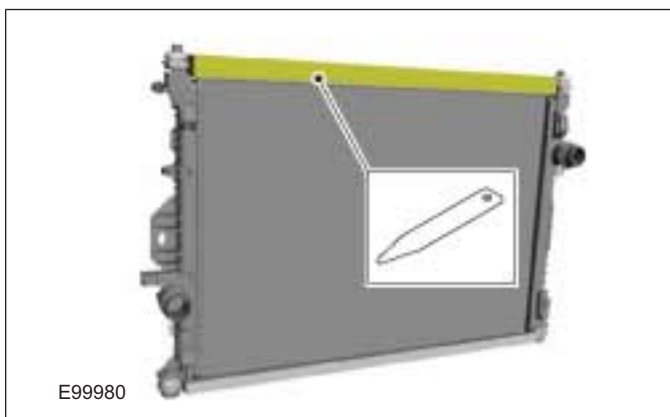
38. Torque: 20 Nm



- 36. • Torque: 12 Nm
- Torque: 24 Nm



39. **NOTE:** The gasket is to be reused unless damaged.



40.

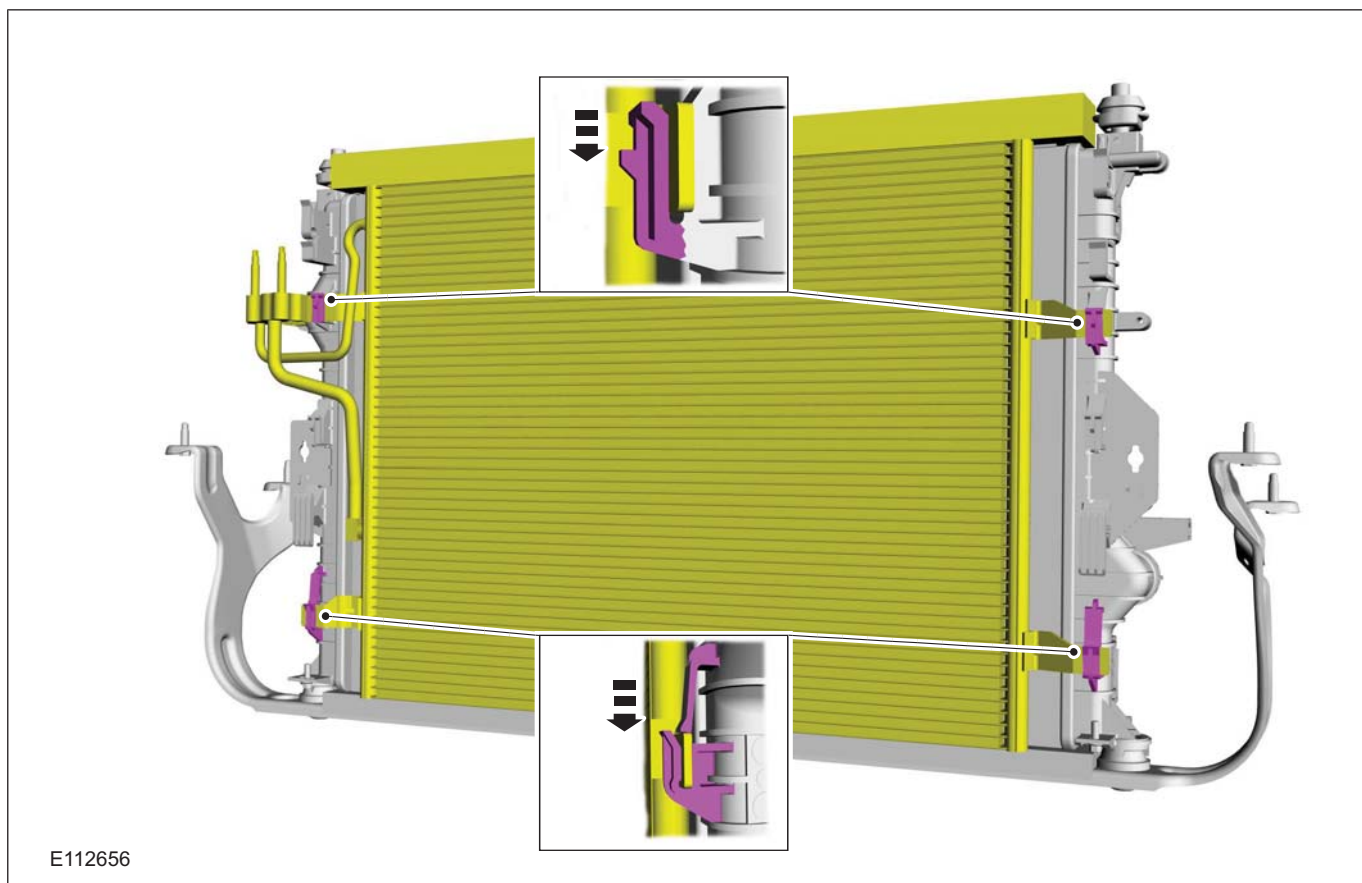


303-01-129

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-129

## INSTALLATION



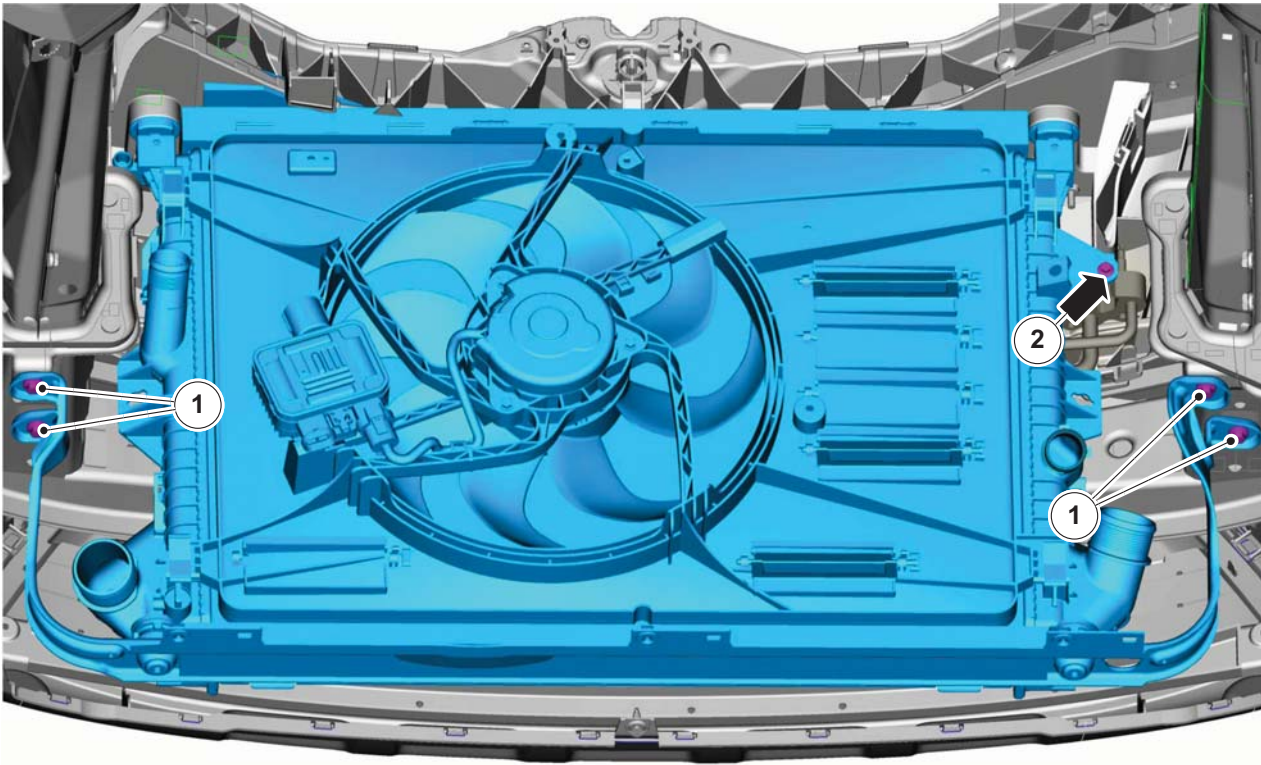
41. 1. Torque: 25 Nm
2. Torque: 5 Nm

303-01-130

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-130

## INSTALLATION



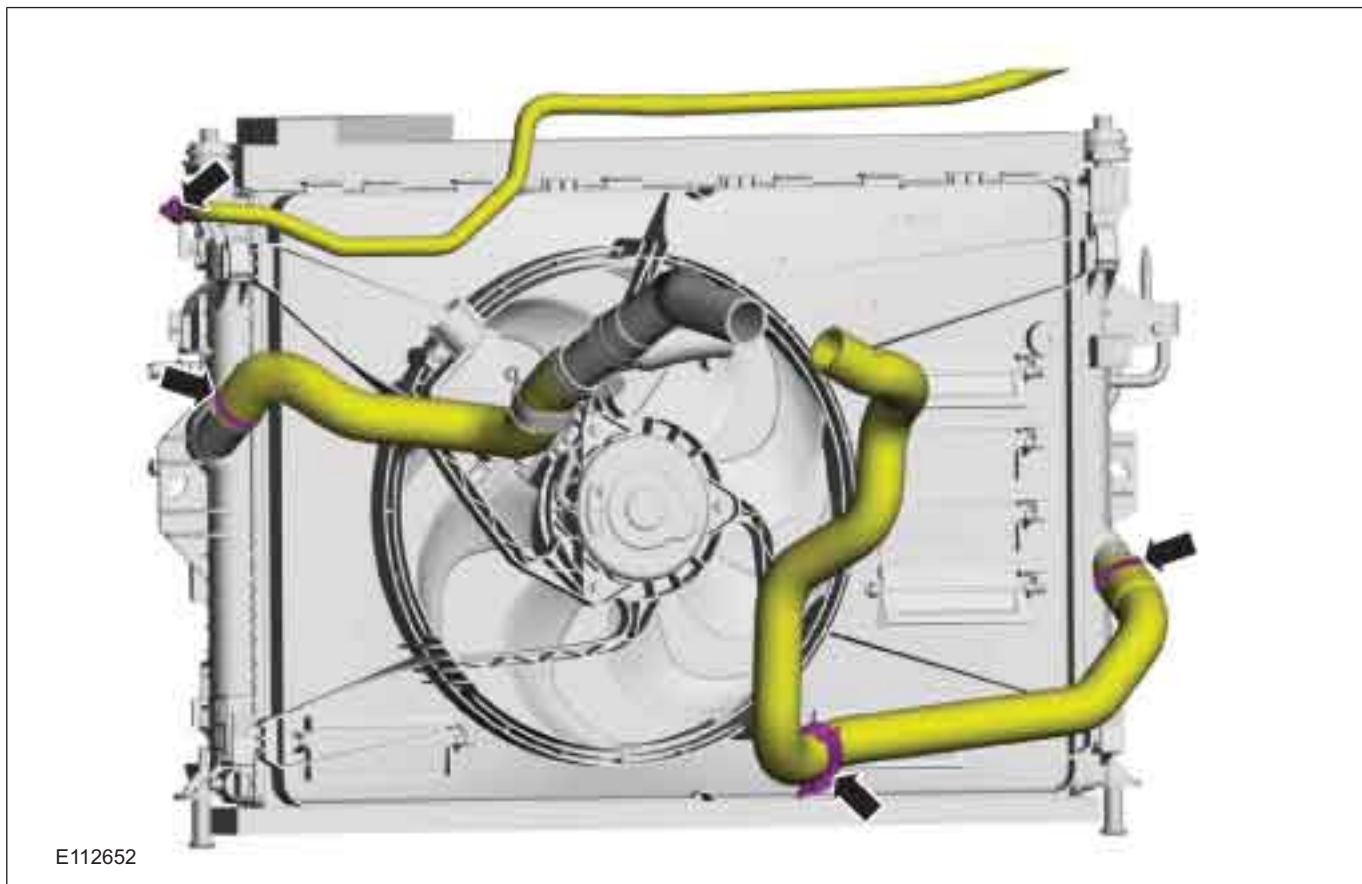
E112637

42 General Equipment: Hose Clamp  
Remover/Installer

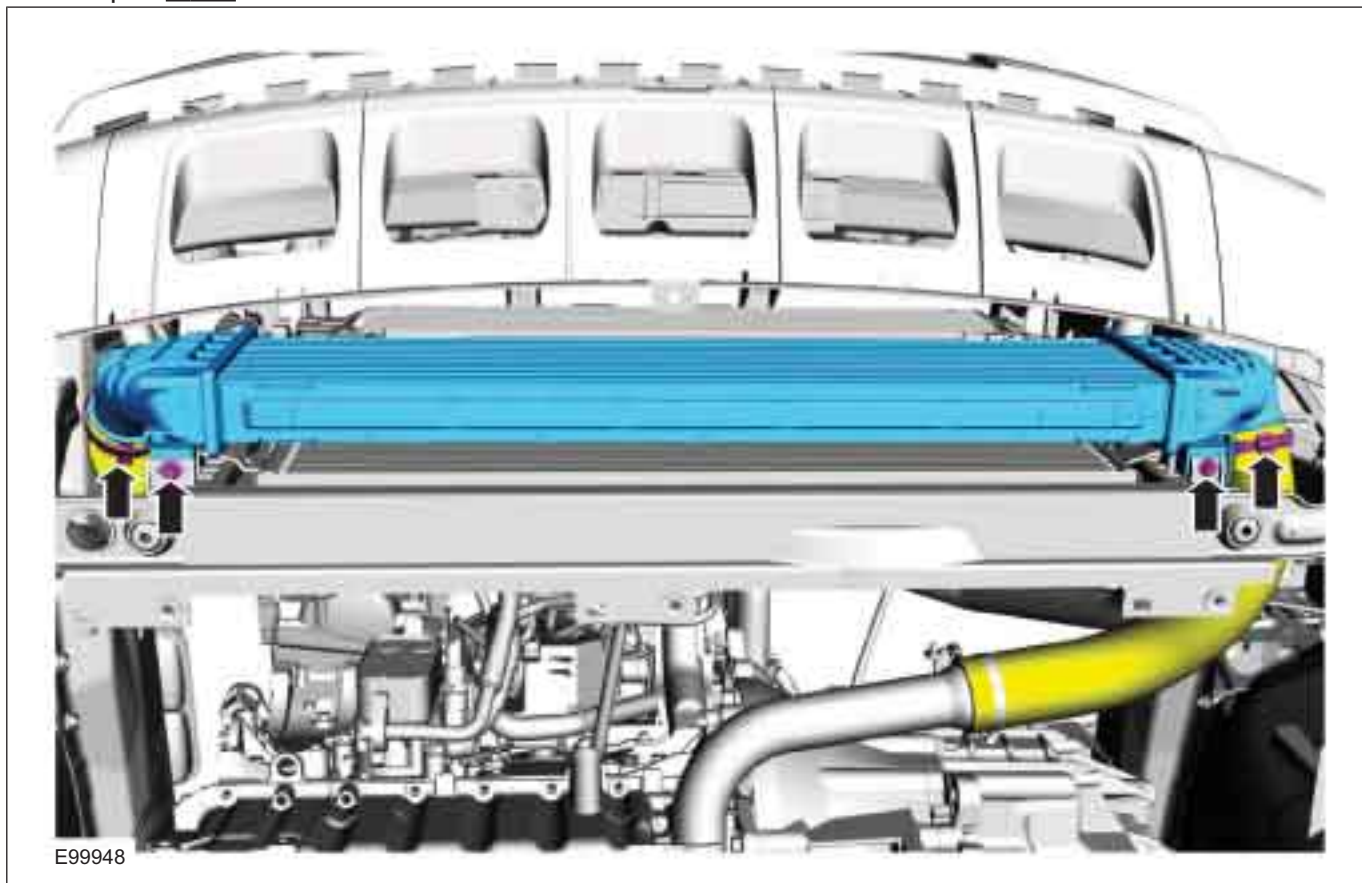




INSTALLATION



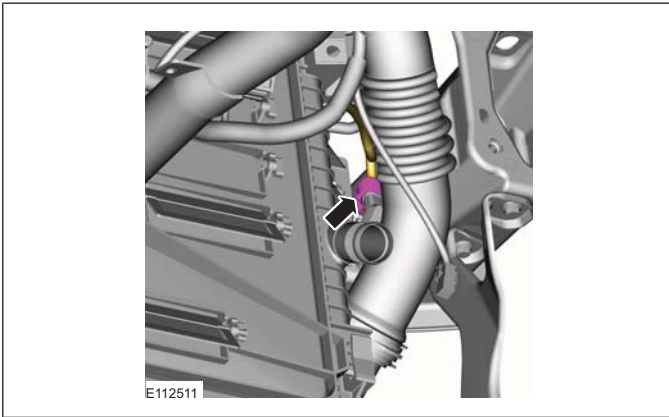
43. Torque: 5 Nm



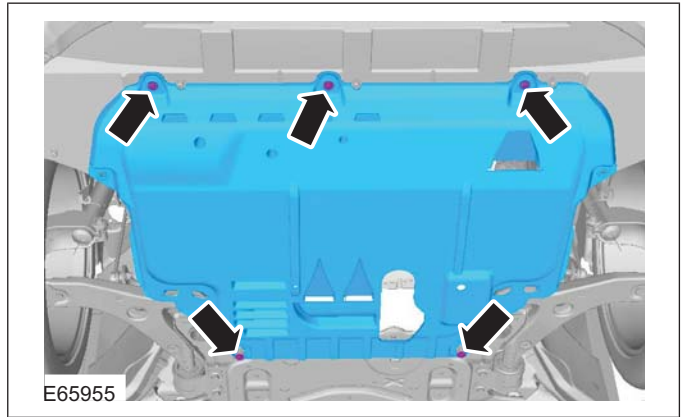


INSTALLATION

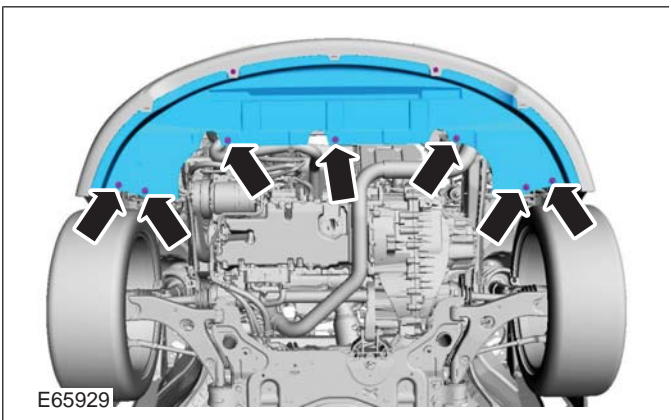
44.



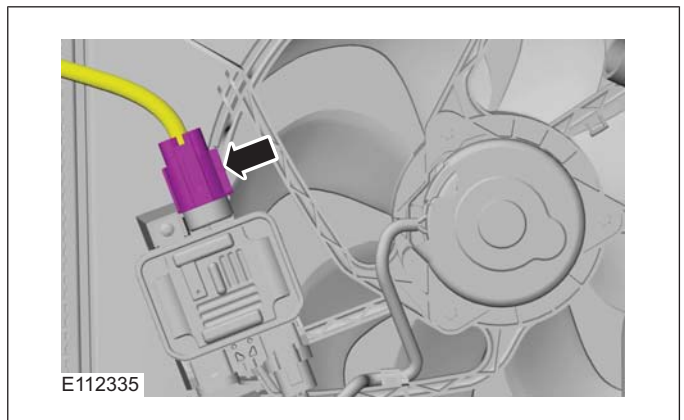
46.



45.



47.



48.



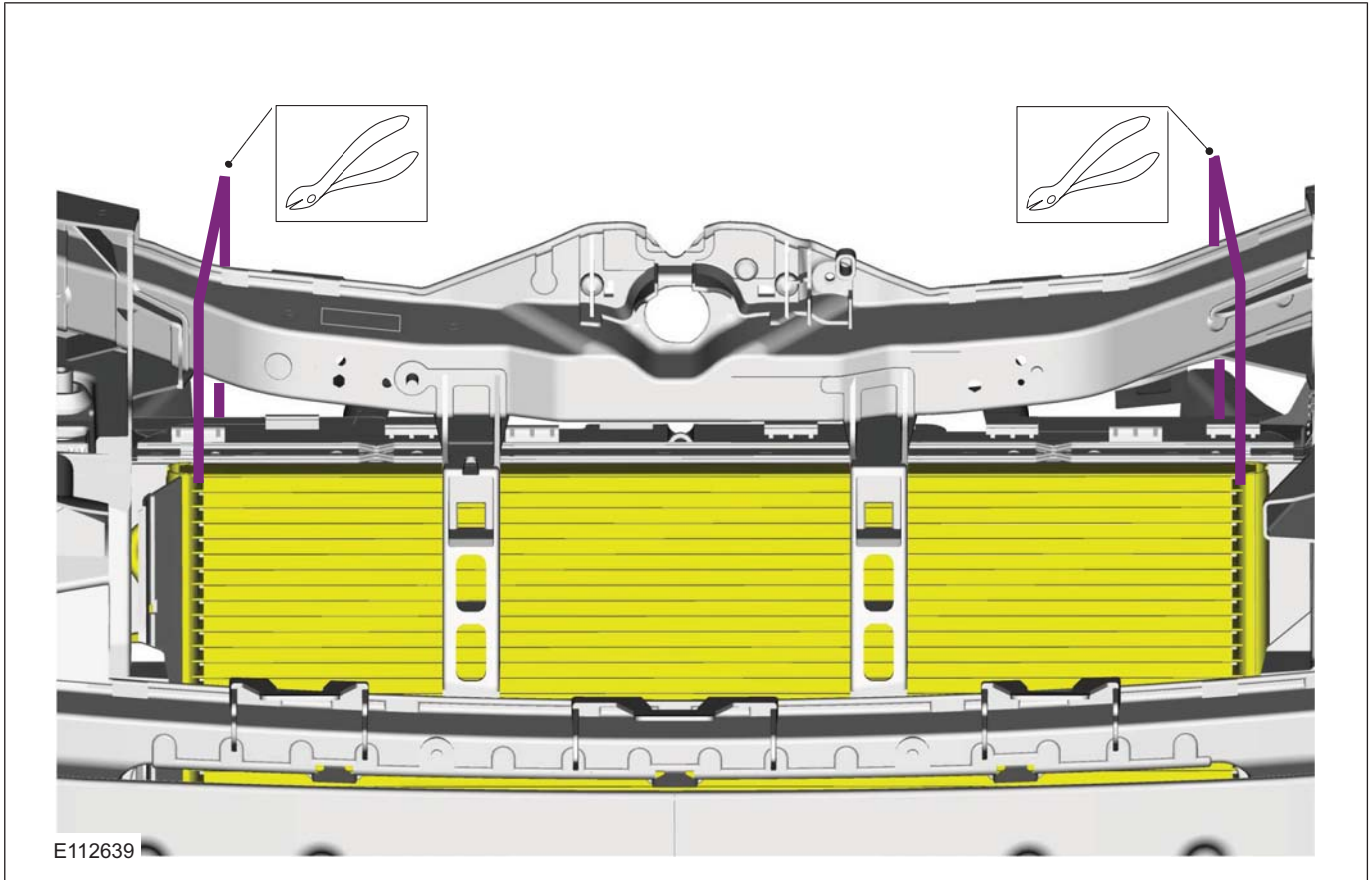


303-01-133

Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-133

INSTALLATION

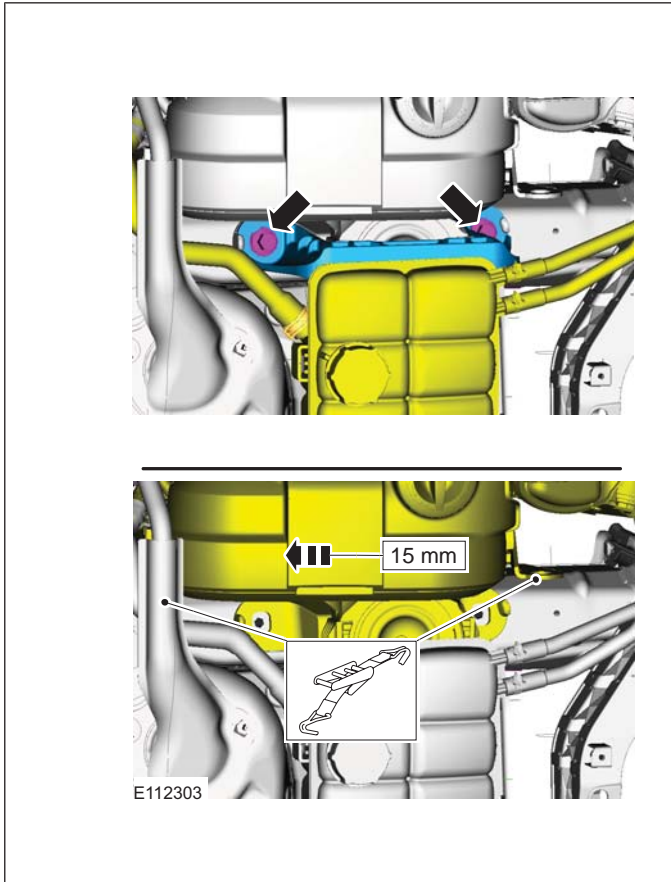




INSTALLATION

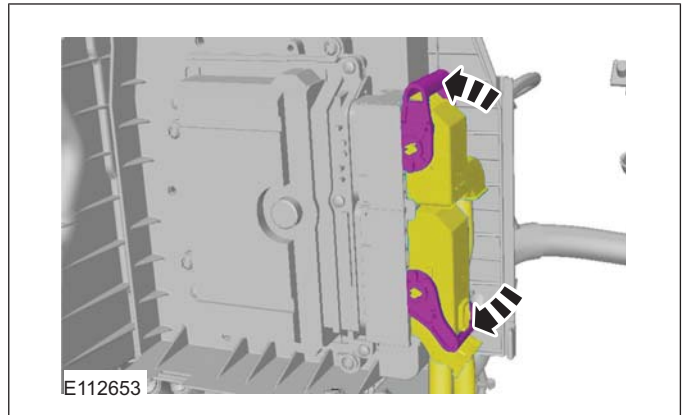
49. **CAUTION:** Make sure that no components catch.

General Equipment: Retaining Strap  
General Equipment: Trolley Jack

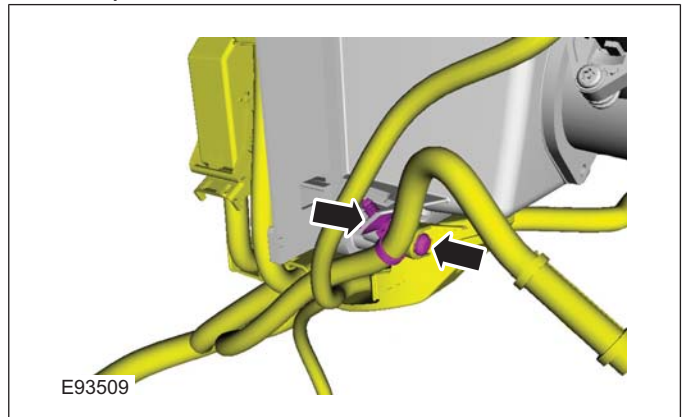


Vehicles without PCM security shield

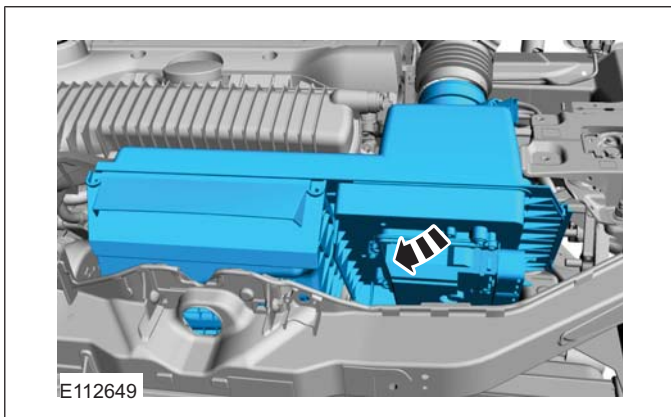
- 51.



- 52 Torque: 7 Nm



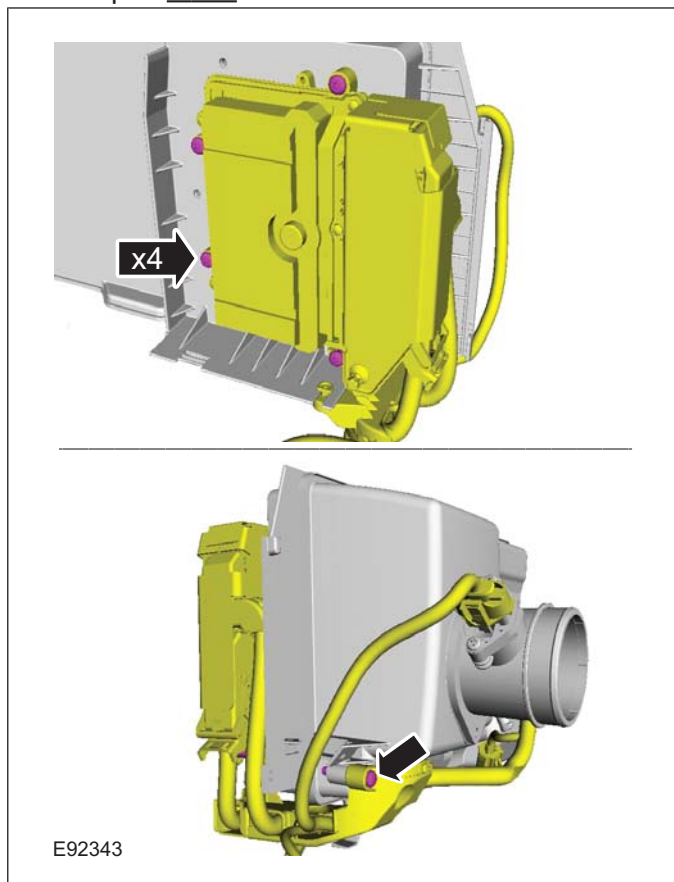
- 50.



## INSTALLATION

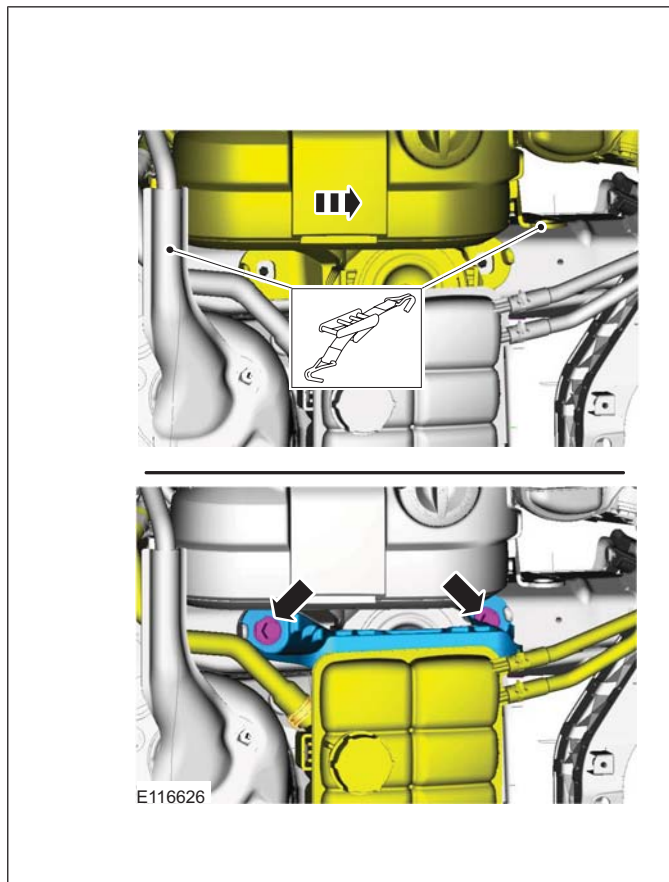
Vehicles with PCM security shield

53. Torque: 7 Nm



Remove the following items:

- General Equipment: Trolley Jack



All vehicles

54. **⚠ CAUTION:** Make sure that no components catch.

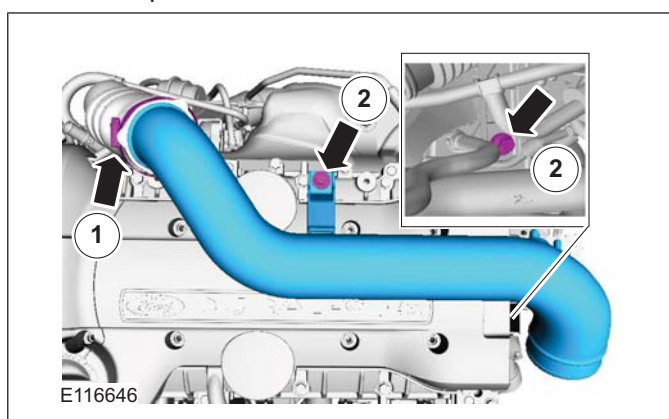
Remove the following items:

- General Equipment: Retaining Strap

55. **NOTE:** Only tighten the bolts finger tight at this stage.

56. **⚠ CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

1. Torque: 4 Nm
2. Torque: 10 Nm



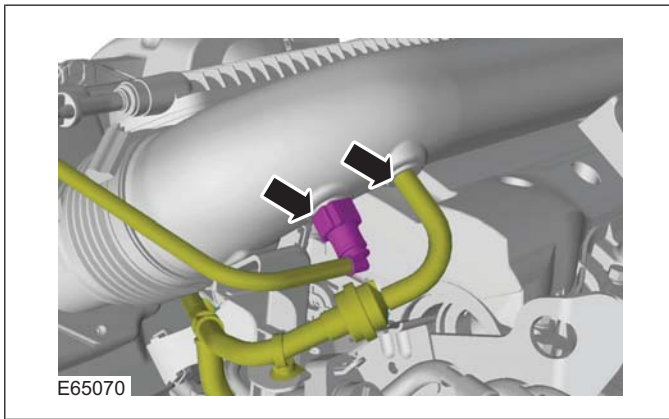
303-01-136

Engine — 2.5L Duratec (147kW/200PS) - V15

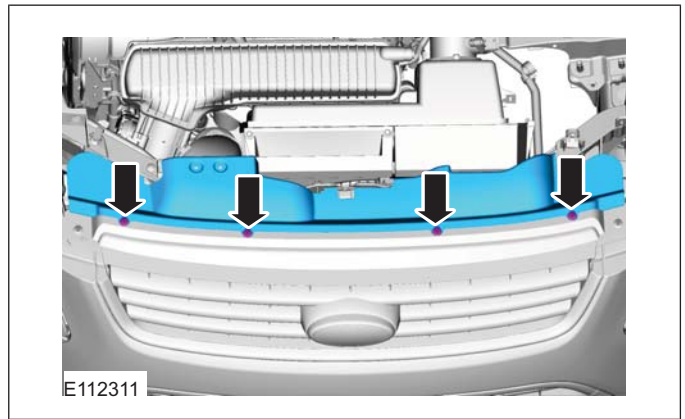
303-01-136

INSTALLATION

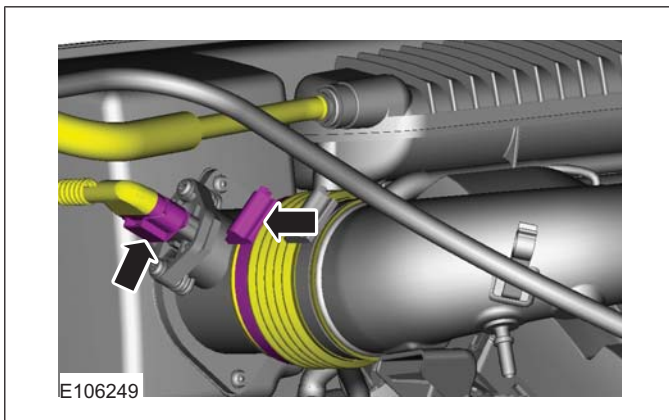
57.



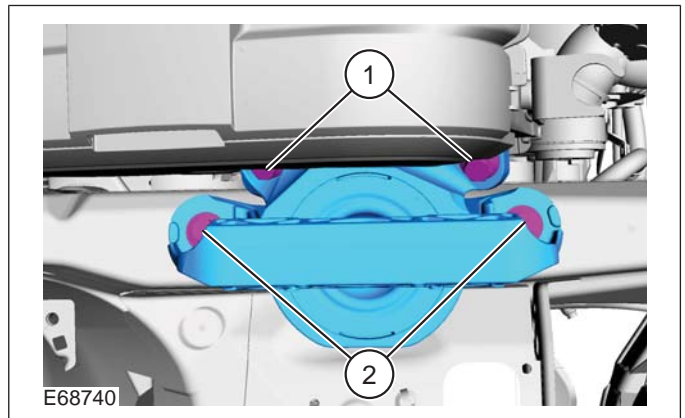
60.



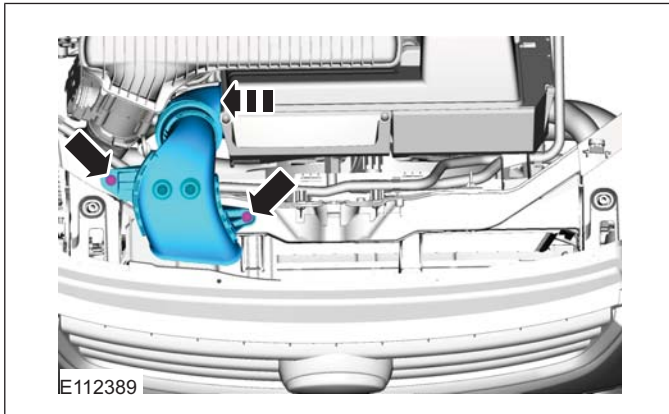
58.



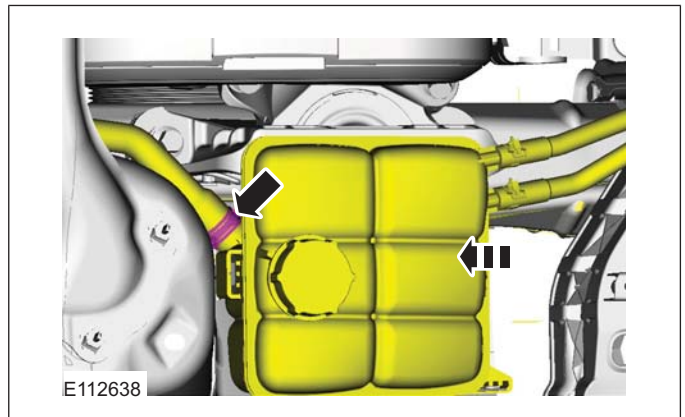
61. 1. Torque: 115 Nm  
2. Torque: 90 Nm



59.



62 General Equipment: Hose Clamp  
Remover/Installer







303-01-137

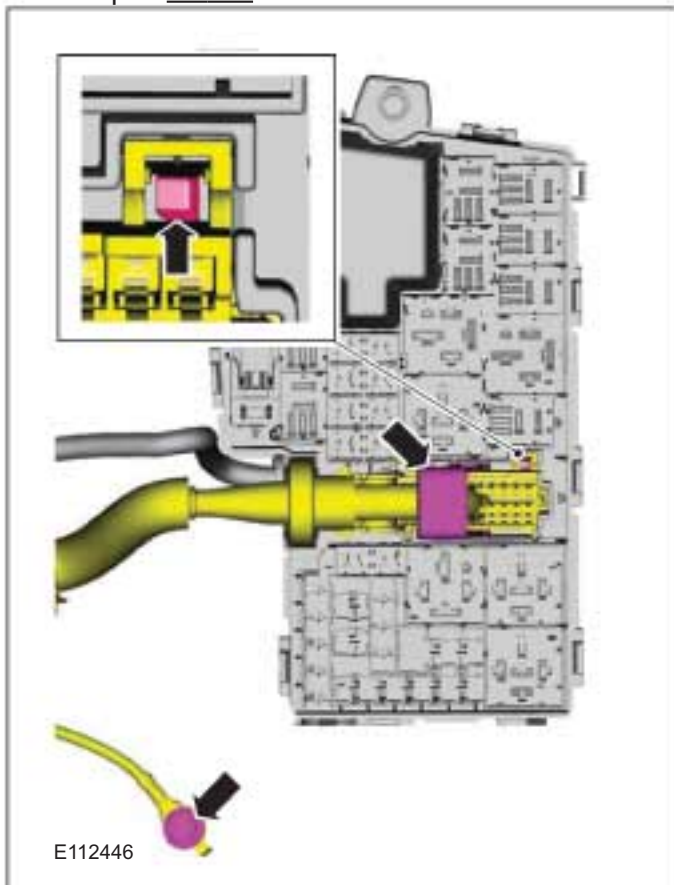
Engine — 2.5L Duratec (147kW/200PS) - VI5

303-01-137

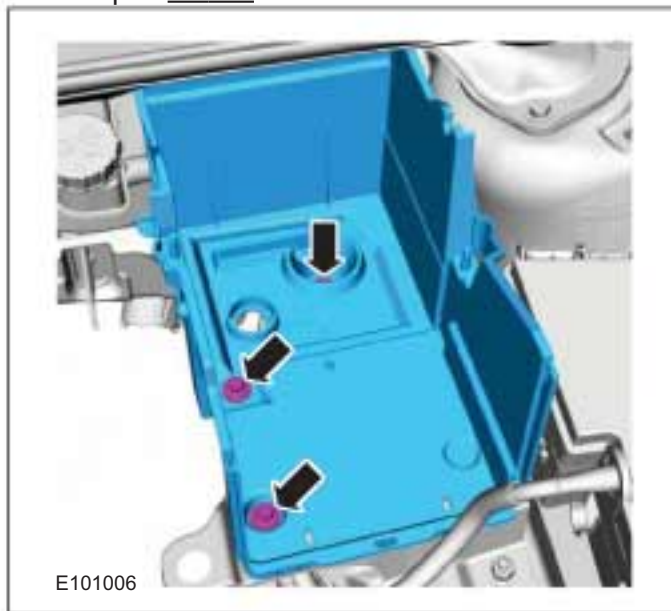


INSTALLATION

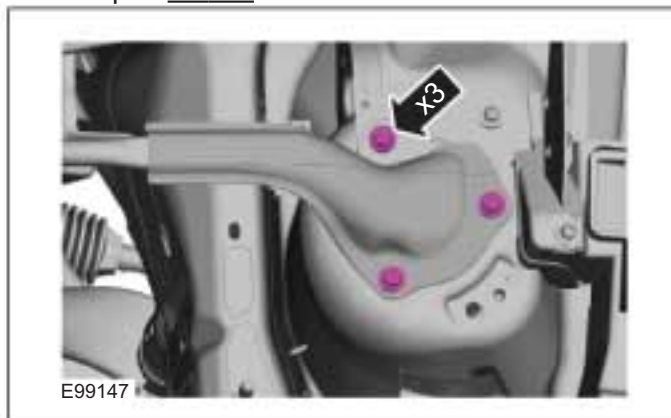
63. Torque: 10 Nm



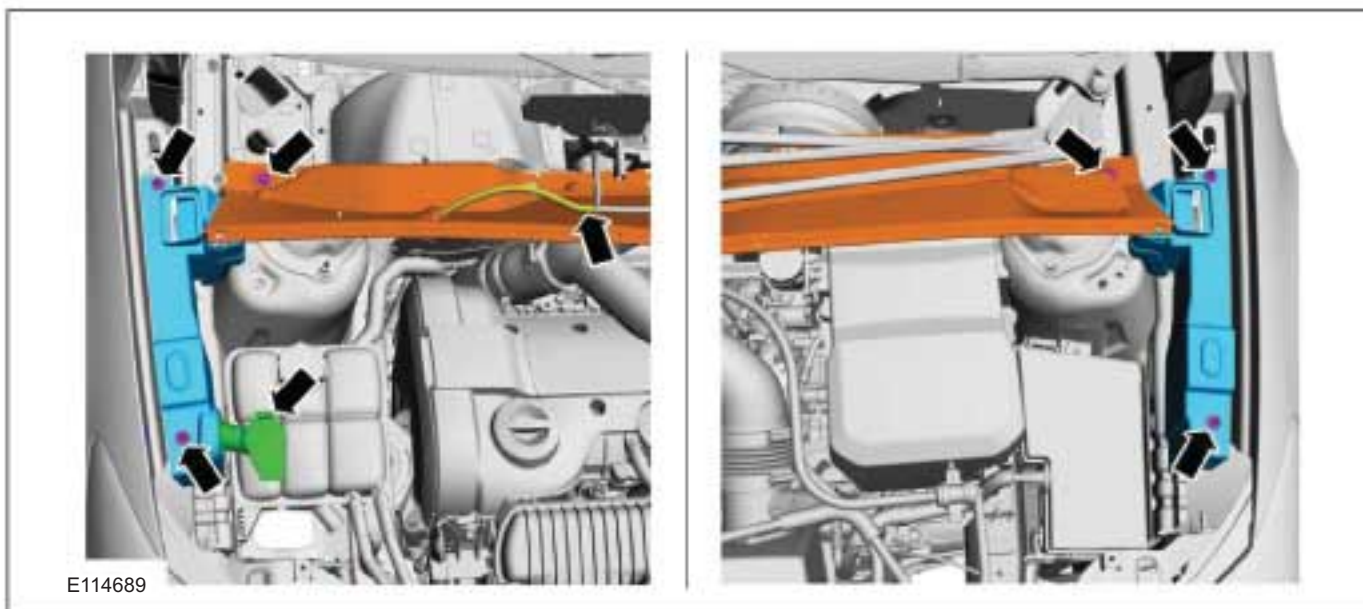
64. Torque: 12 Nm



65. On both sides.  
Torque: 35 Nm



66.





**INSTALLATION**

67. Install the following items:

1. Refer to: **Battery** (414-01 Battery, Mounting and Cables, Removal and Installation).
2. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).

68.



69. Refer to: **Cooling System Draining and Vacuum Filling** (303-03 Engine Cooling, General Procedures).

70. Refer to: **Power Steering System Filling** (211-00 Steering System - General Information, General Procedures).

71. Refer to: **Door Window Motor Initialization** (501-11 Glass, Frames and Mechanisms, General Procedures).

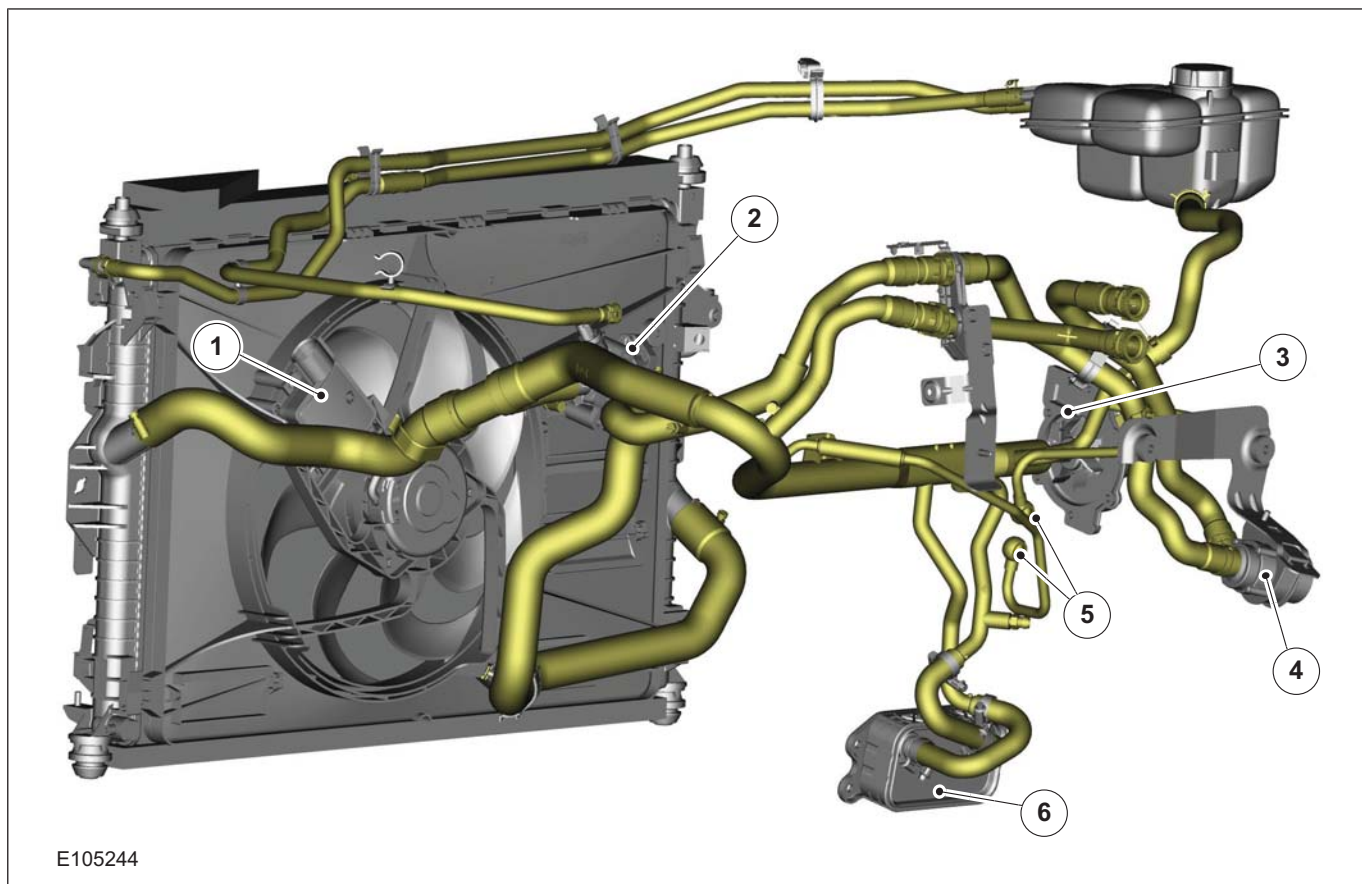
## SECTION 303-03 Engine Cooling

### VEHICLE APPLICATION: 2008.50 Kuga

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Auxiliary coolant pump.....	303-03-3
<b>DIAGNOSIS AND TESTING</b>	
Engine Cooling.....	303-03-4
Inspection and Verification.....	303-03-4
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Cooling Fan Motor and Shroud — 2.5L Duratec (147kW/200PS) - VI5..... (24 222 0)	303-03-11
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Thermostat — 2.5L Duratec (147kW/200PS) - VI5..... (24 454 0)	303-03-19
Thermostat Housing — 2.5L Duratec (147kW/200PS) - VI5..... (24 001 0)	303-03-20

DESCRIPTION AND OPERATION

Engine Cooling — 2.5L Duratec (147kW/200PS) - VI5 —  
Component Location



Item	Description
1	Cooling fan motor
2	Thermostat housing
3	Coolant pump

Item	Description
4	Auxiliary coolant pump <b>Comments:</b> Vehicles equipped with a trailer coupling or additional heating
5	Turbocharger coolant connections
6	Oil Cooler

**DESCRIPTION AND OPERATION****Engine Cooling — 2.5L Duratec (147kW/200PS) - VI5 – Overview****Auxiliary coolant pump**

An electrically operated auxiliary coolant pump is installed on vehicles with a trailer coupling and/or additional heating. The auxiliary coolant pump ensures that the coolant is circulated when the coolant pump (which is driven by the engine) is not running.

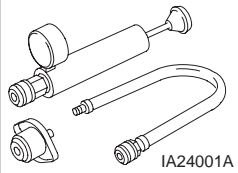
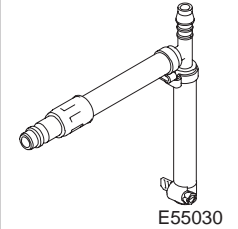
The additional heating uses the auxiliary coolant pump to circulate hot coolant through the heat exchanger and the engine.

On vehicles with a trailer coupling the auxiliary coolant pump is switched on for 6 minutes by the PCM (powertrain control module) if the coolant temperature exceeds 106°C when the engine is switched off. This prevents the coolant circuit from overheating. This could happen particularly if the engine is switched off after towing a heavy trailer up a steep hill before there has been sufficient time for cooling.

## DIAGNOSIS AND TESTING

## Engine Cooling

## Special Tool(s) / General Equipment

	Pressure Tester, Cooling System 303-396 (24-001 A)
	Adaptor for 303-396 303-396-09
Ford approved diagnostic tool	

## Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

## Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> <li>– Coolant leaks</li> <li>– Gaskets/seals</li> <li>– Core plug(s)</li> <li>– Hose(s)/hose joints</li> <li>– Coolant expansion tank cap and seal(s)</li> <li>– Coolant expansion tank</li> <li>– Radiator</li> <li>– Coolant pump</li> <li>– Thermostat</li> <li>– Heater core</li> <li>– Exhaust gas recirculation (EGR) cooler</li> </ul>	<ul style="list-style-type: none"> <li>– Fuse(s)</li> <li>– Wiring harness</li> <li>– Electrical connector(s)</li> <li>– Engine coolant temperature (ECT) sensor</li> <li>– Cooling fan motor</li> <li>– Cooling fan module</li> <li>– Powertrain control module (PCM)</li> <li>– Coolant shut off valve</li> <li>– Coolant degas shut off valve</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.



GENERAL PROCEDURES

Cooling System Draining and Vacuum Filling

General Equipment


Cooling System Vacuum Tester and Refiller	
Fluid Container	
Materials	
Name	Specification
Antifreeze Super Plus Premium	WSS-M97B44-D / 4U7J-19544-AA2A

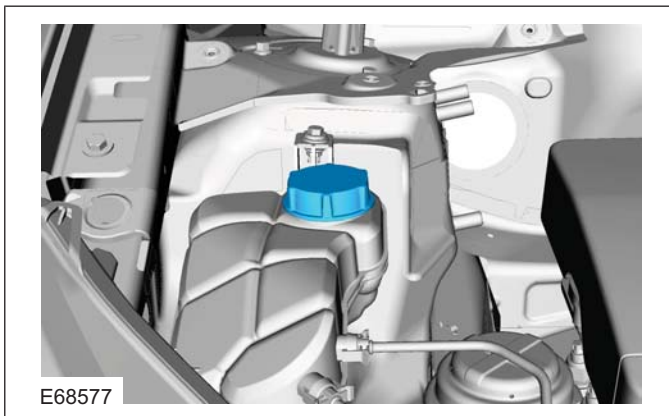
Draining

**WARNING:** When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

**NOTE:** Always follow the manufacturer's instructions when handling the equipment.

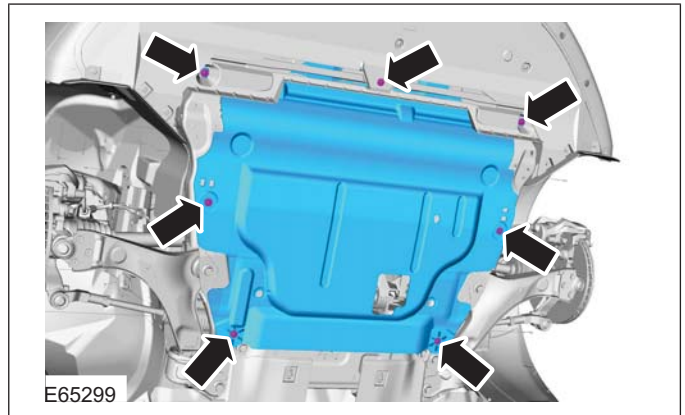
1. Refer to: **Engine Cooling System Health and Safety Precautions** (100-00 General Information, Description and Operation).

2.  Release the cooling system pressure by slowly turning the coolant expansion tank cap between 2 and 3 turns.



3. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

4.



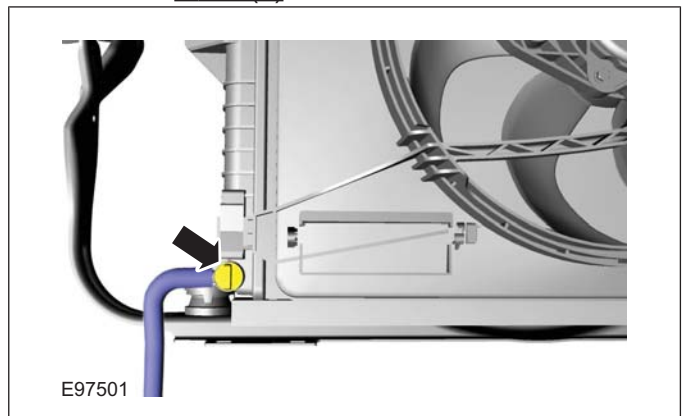
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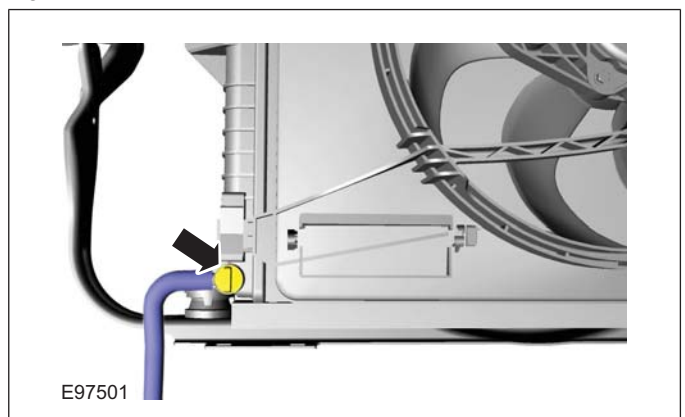
**WARNING:** Be prepared to collect escaping fluid.

Use a suitable coolant hose to drain the coolant.

General Equipment: Fluid Container  
Loosen: 4 turn(s)

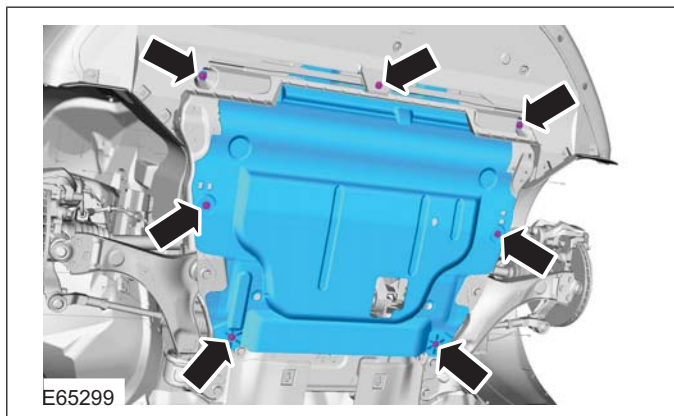


6.

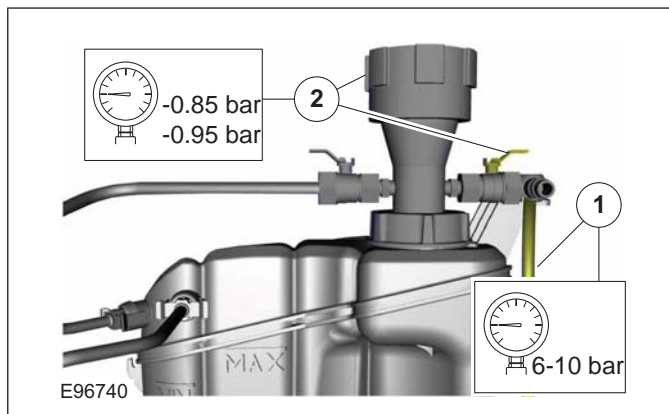


GENERAL PROCEDURES

7.



4. 2. Open the valve until the specified vacuum is achieved.



Evacuating and Filling

- 1. • If the cooling system was completely drained, fill the fluid container with the full cooling system fill capacity plus 0.5L of additional coolant.

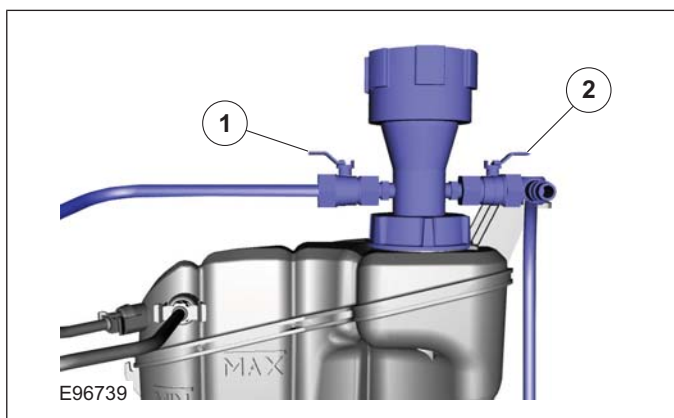
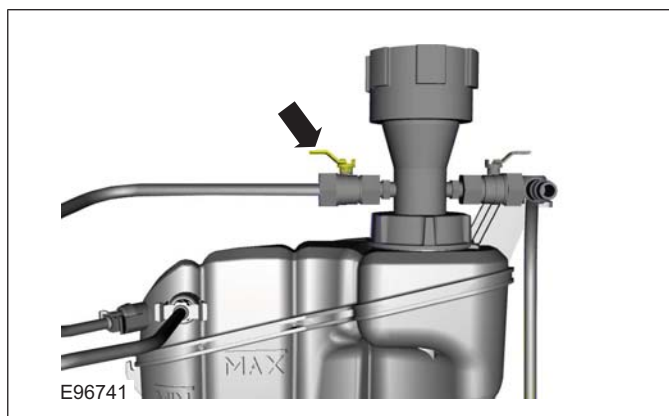
Material: Antifreeze Super Plus Premium (WSS-M97B44-D / 4U7J-19544-AA2A) antifreeze

- If the cooling system was partially drained, fill the fluid container with the removed and spilled amount of coolant plus 1.0L of additional coolant. When in doubt always use the full cooling system fill capacity plus 0.5L of additional coolant.

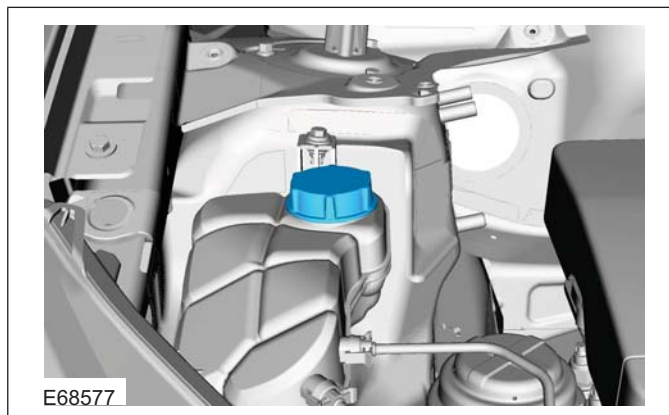
Material: Antifreeze Super Plus Premium (WSS-M97B44-D / 4U7J-19544-AA2A) antifreeze

- 2. • General Equipment: Cooling System Vacuum Tester and Refiller
- 3. 1. Close the valve, install the coolant hose and place it into the fluid container.
- 2. Close the valve and connect the compressed air hose.

- 5. • Open the valve until the coolant reservoir fluid level is at the MAX mark.
- If no coolant is visible in the coolant expansion tank, add 2.0L of coolant to the fluid container and repeat the evacuating and filling procedure.



6.



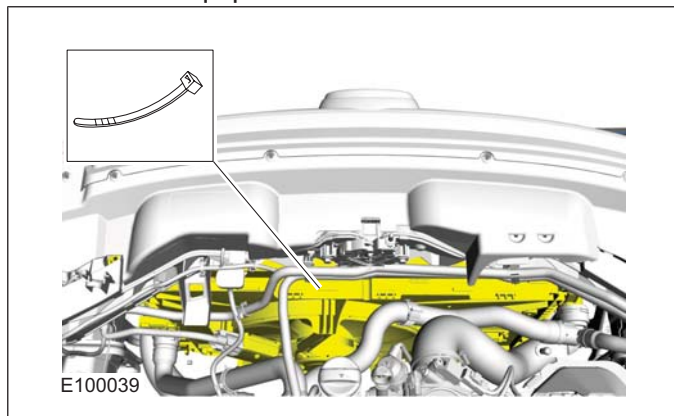
GENERAL PROCEDURES

Radiator Lower Mounting Repair

General Equipment

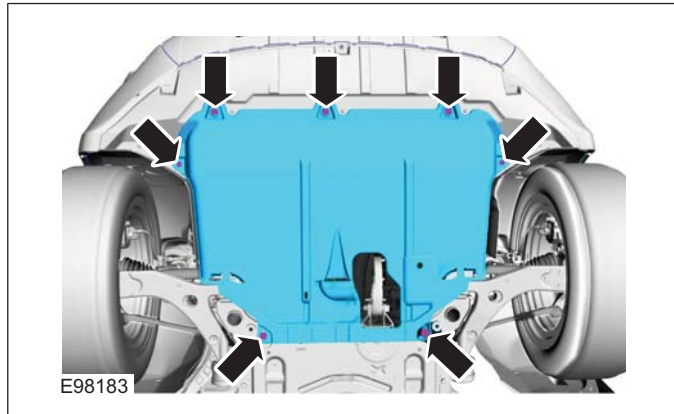
5 mm Drill Bit
Cable Ties
Flat File

1. General Equipment: Cable Ties

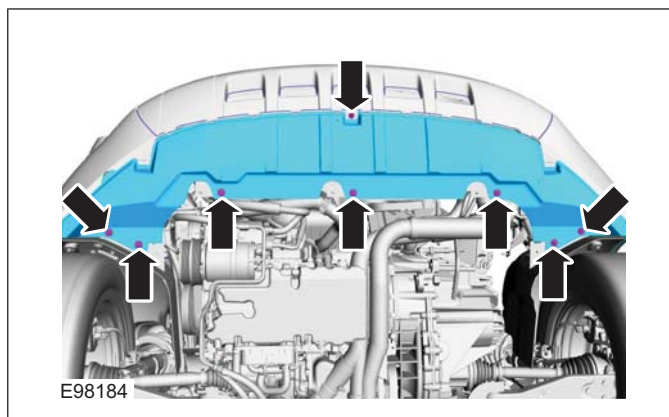


2. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

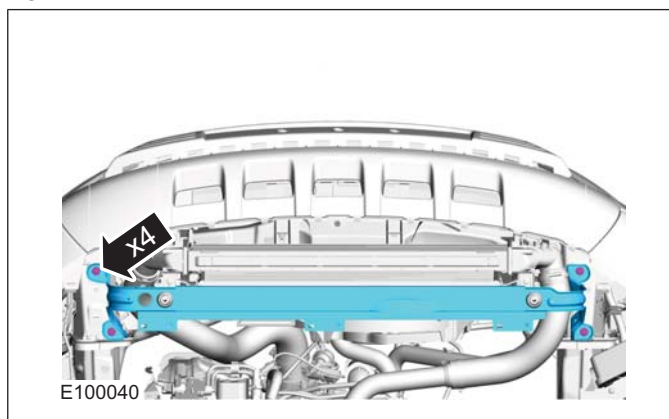
3.



4.

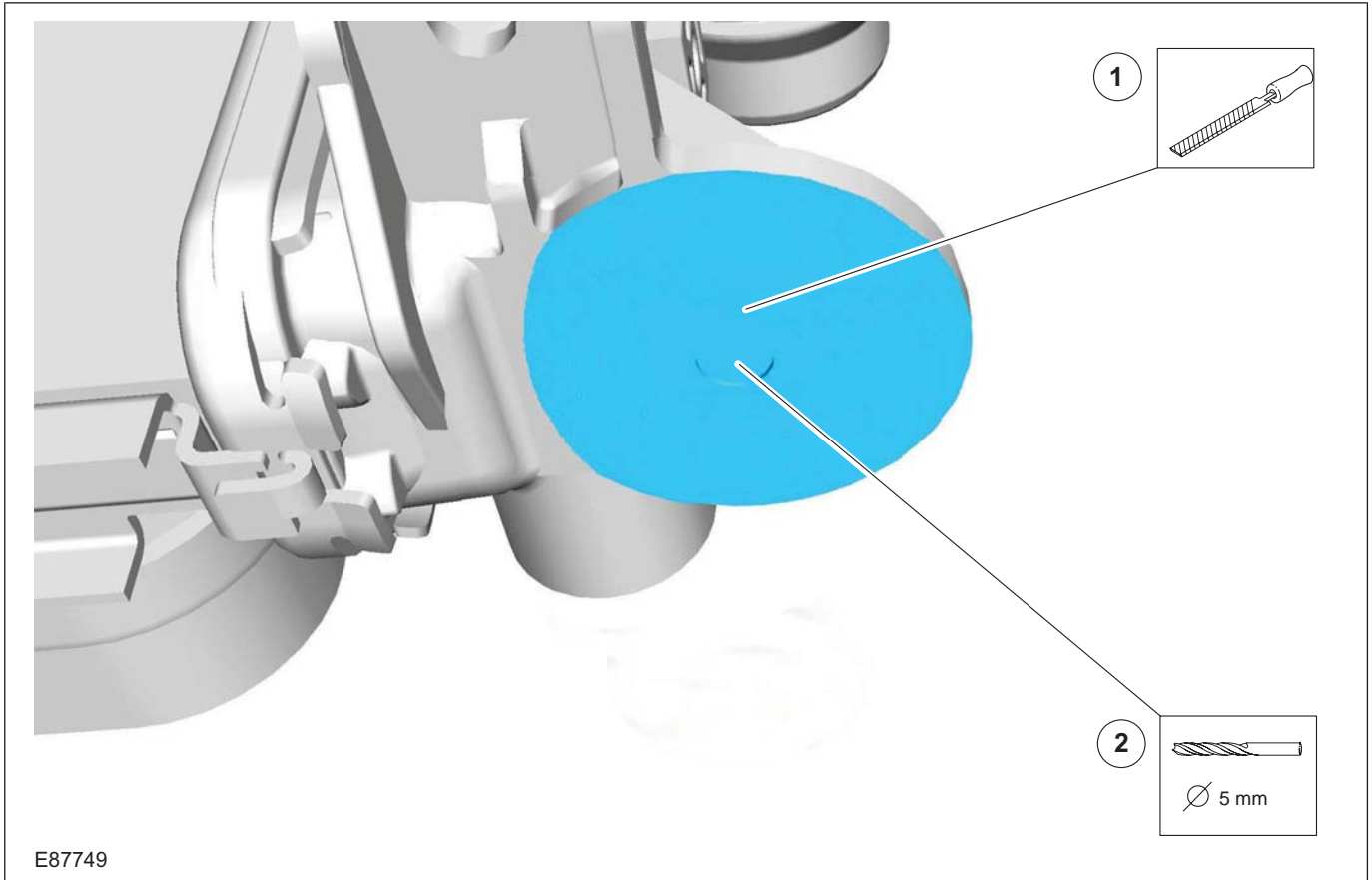


5.

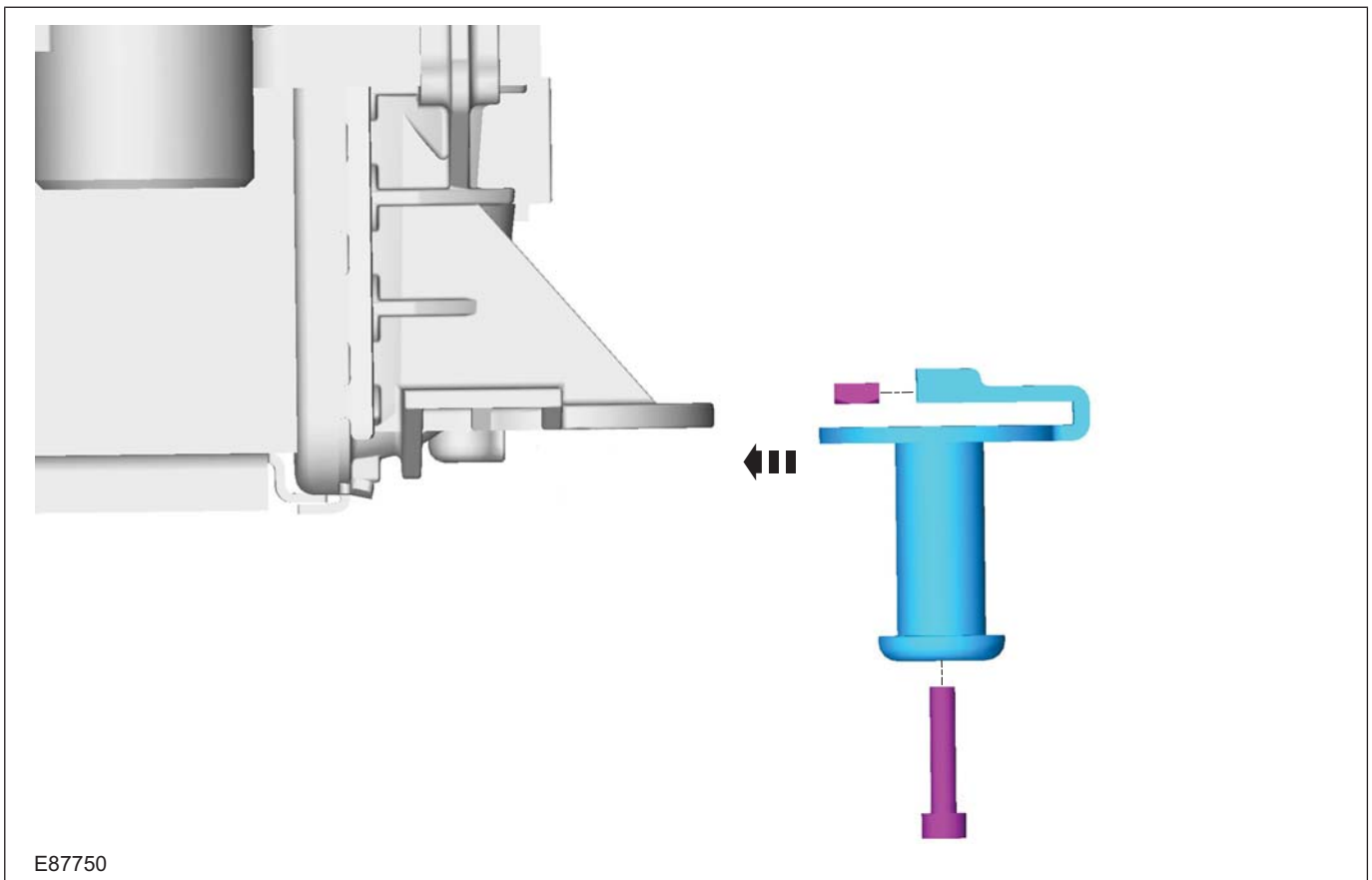


6. 1. General Equipment: Flat File  
2. General Equipment: 5 mm Drill Bit

GENERAL PROCEDURES



7.



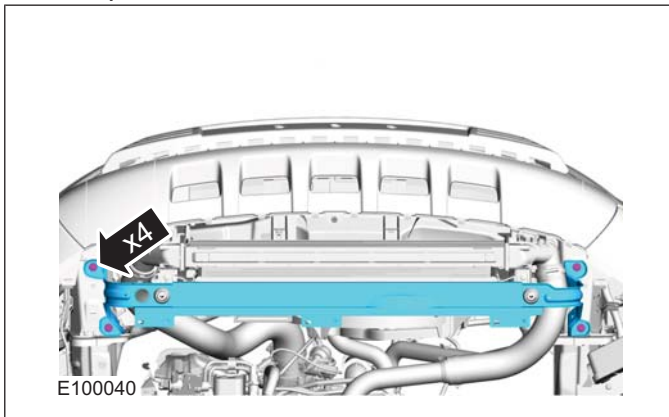


303-03-9

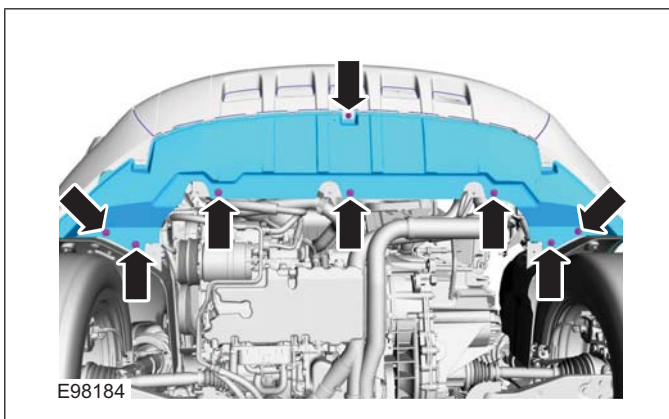
Engine Cooling

303-03-9

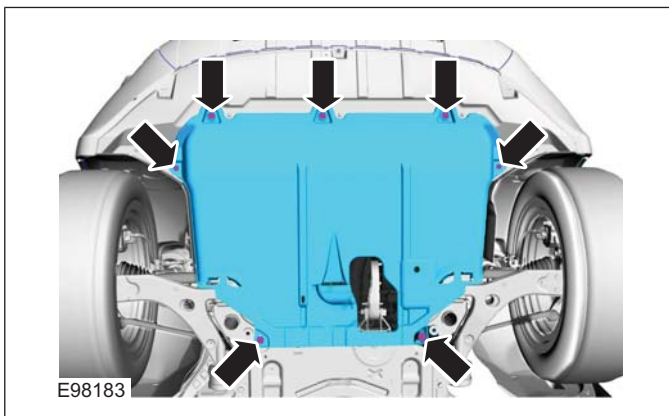
## GENERAL PROCEDURES

8. Torque: 25 Nm

9.



10.



11. Remove the cable ties securing the radiator and condenser assembly.



## REMOVAL AND INSTALLATION

## Coolant Pump — 2.5L Duratec (147kW/200PS) - VI5(24 404 0)

## General Equipment

Trolley Jack

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Drain the cooling system.

Refer to: **Cooling System Draining and Vacuum Filling** (303-03 Engine Cooling, General Procedures).

2. Remove the timing belt.

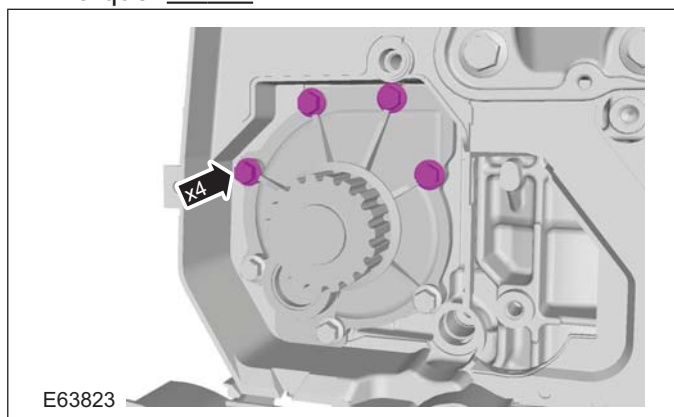
Refer to: **Timing Belt** (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

3. **CAUTION:** Use a wooden block to protect the oil pan when supporting the engine.

Position the trolley jack with the wooden block under the oil pan. Raise the trolley jack until the front of the engine is free from load and the coolant pump bolts can be accessed.

General Equipment: Trolley Jack

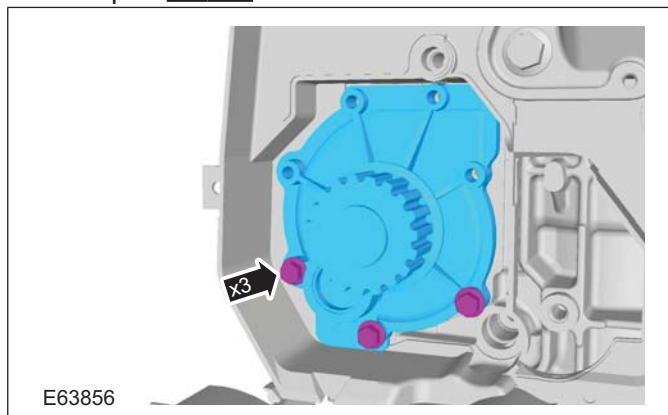
4. Torque: 17 Nm



5. Lower the engine.

General Equipment: Trolley Jack

6. Torque: 17 Nm



## Installation

1. **NOTE:** Install all the bolts finger tight before final tightening.

To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

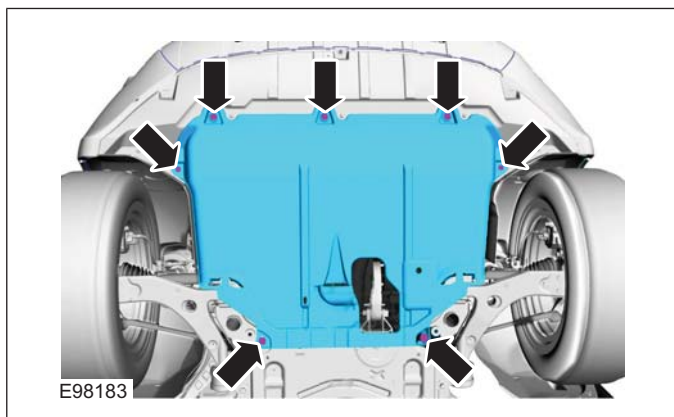
Cooling Fan Motor and Shroud — 2.5L Duratec (147kW/200PS)  
- VI5(24 222 0)

Removal

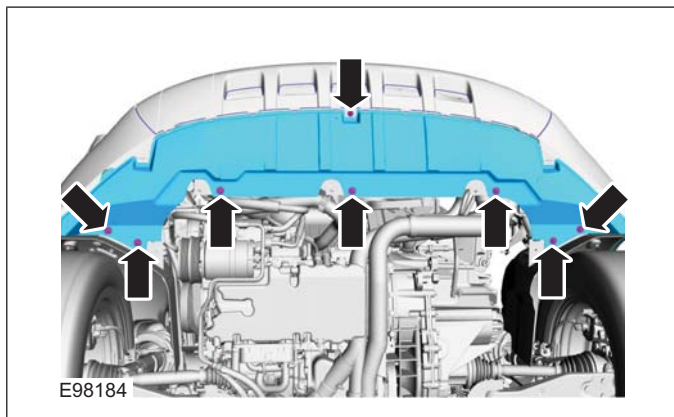
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

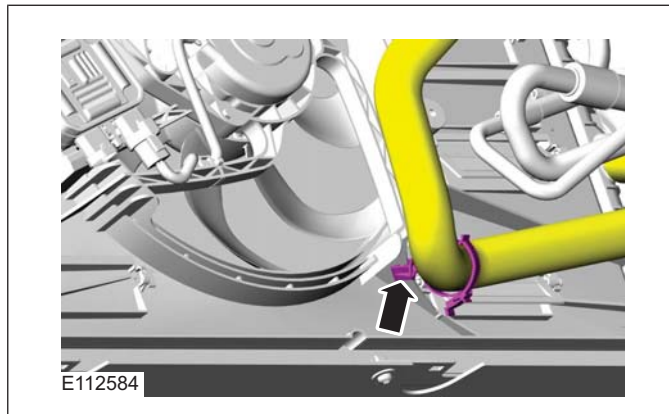
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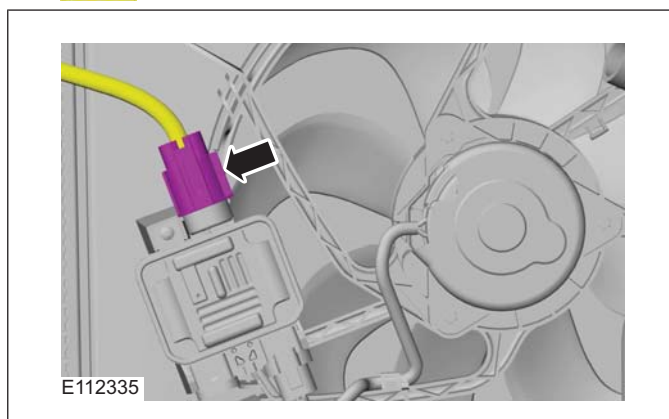
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4.



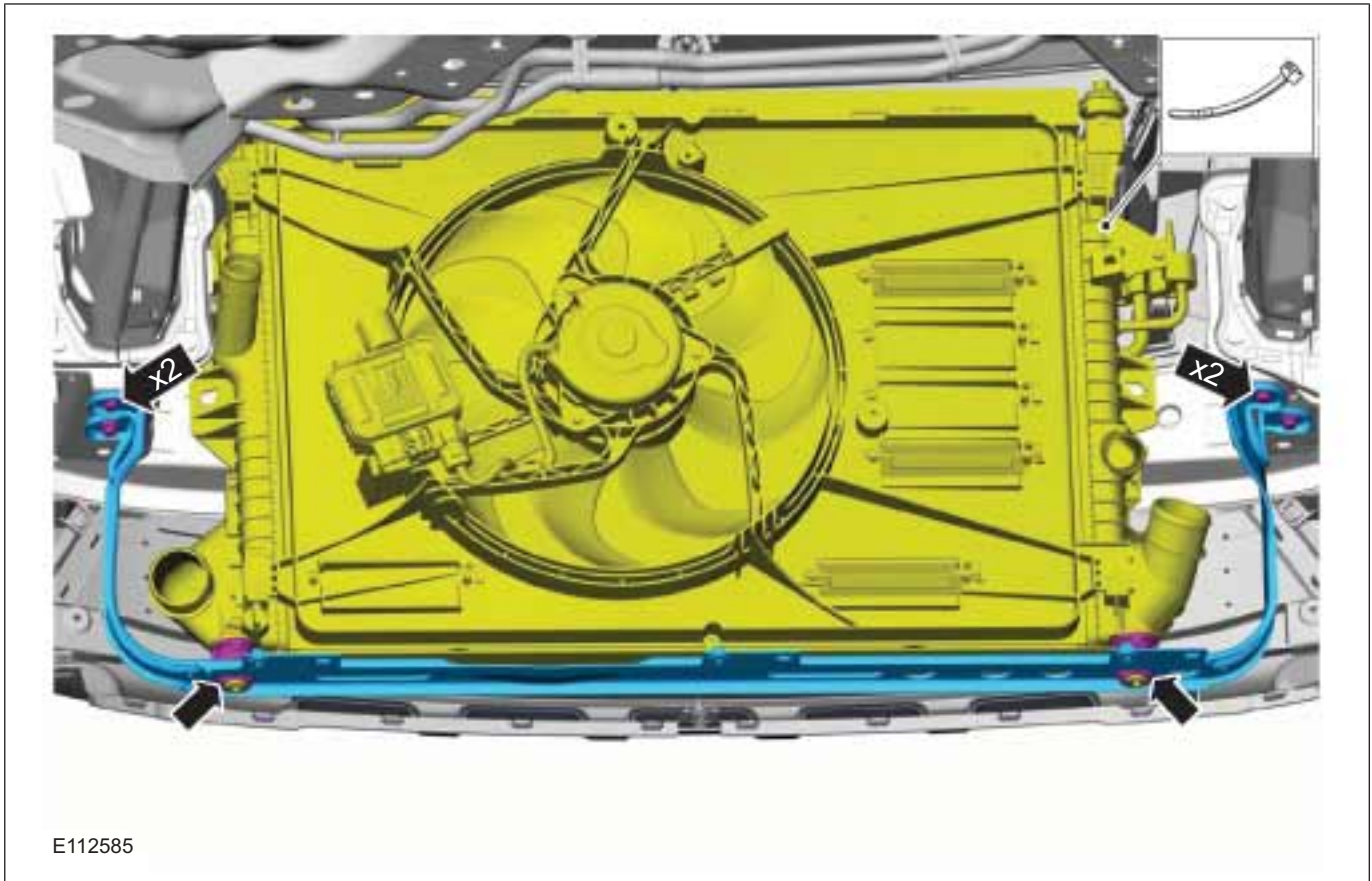
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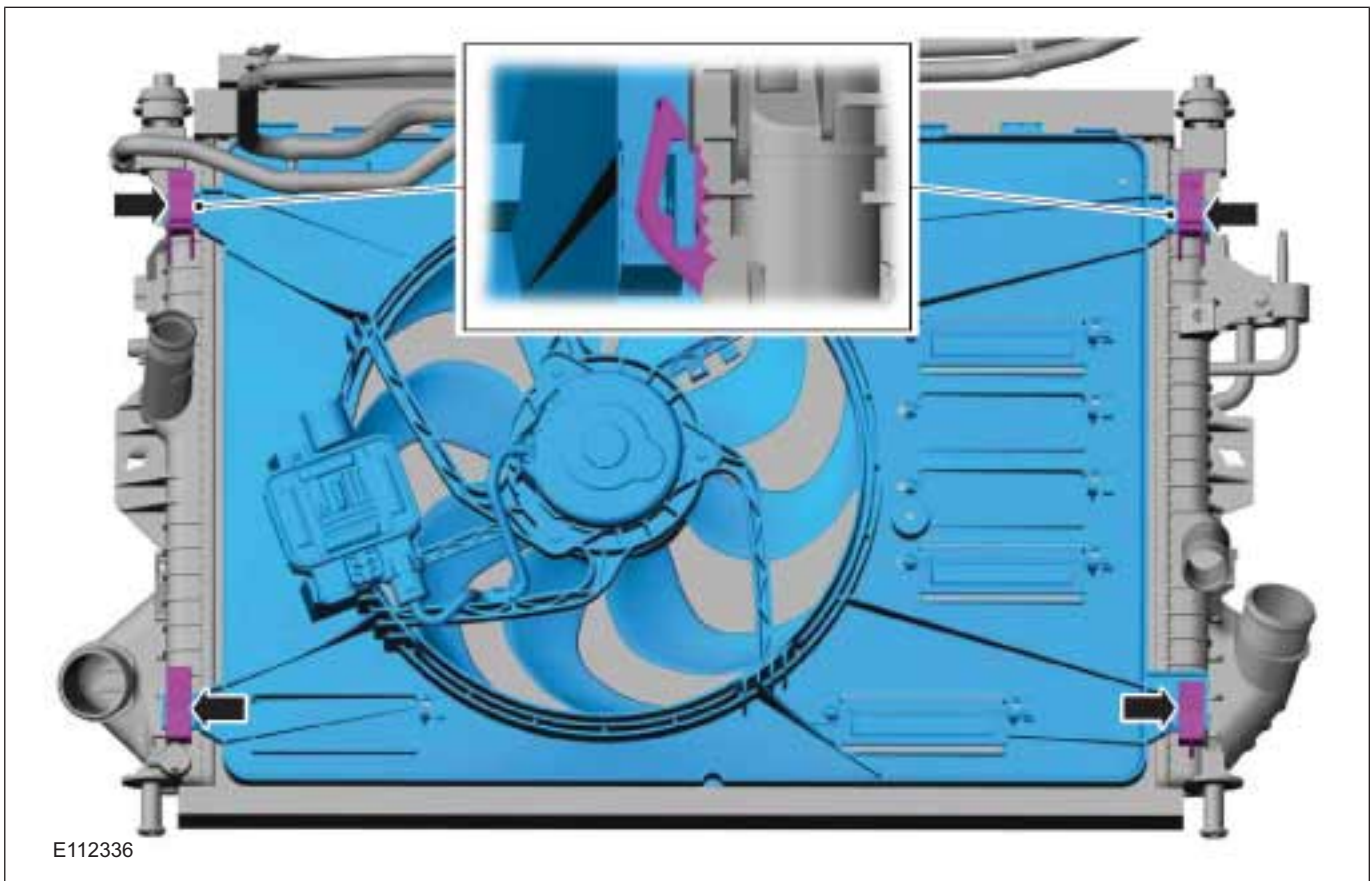
6. Torque: 25 Nm



REMOVAL AND INSTALLATION



7.



**303-03-13****Engine Cooling****303-03-13**

---

**REMOVAL AND INSTALLATION****Installation**

1. To install, reverse the removal procedure.





303-03-14

Engine Cooling

303-03-14

## REMOVAL AND INSTALLATION

## Radiator — 2.5L Duratec (147kW/200PS) - VI5(24 254 0)

## General Equipment

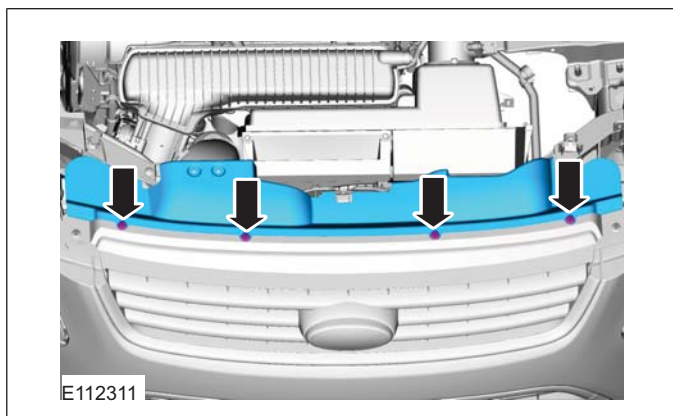
Cable Ties

Hose Clamp Remover/Installer

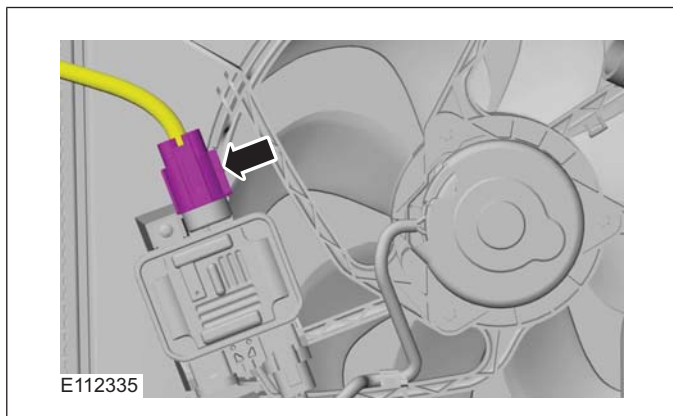
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

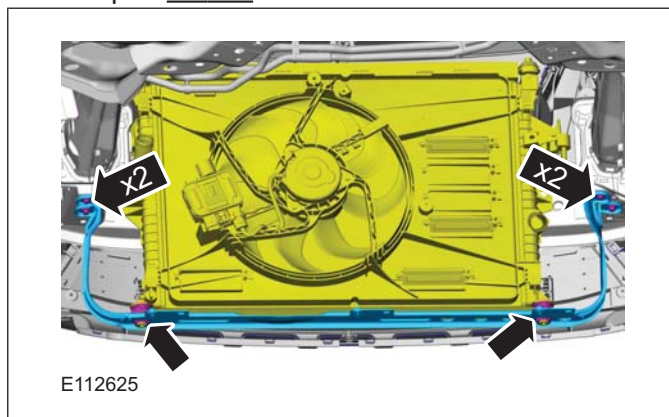
1.



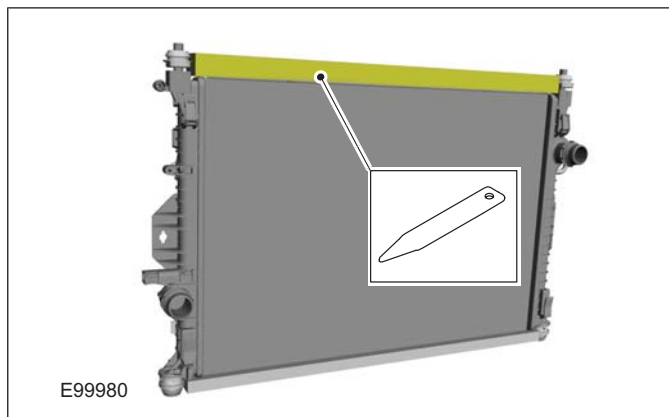
2.



3. Refer to: **Charge Air Cooler** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
4. Refer to: **Cooling System Draining and Vacuum Filling** (303-03 Engine Cooling, General Procedures).
5. Torque: 25 Nm



6. **NOTE:** The gasket is to be reused unless damaged.

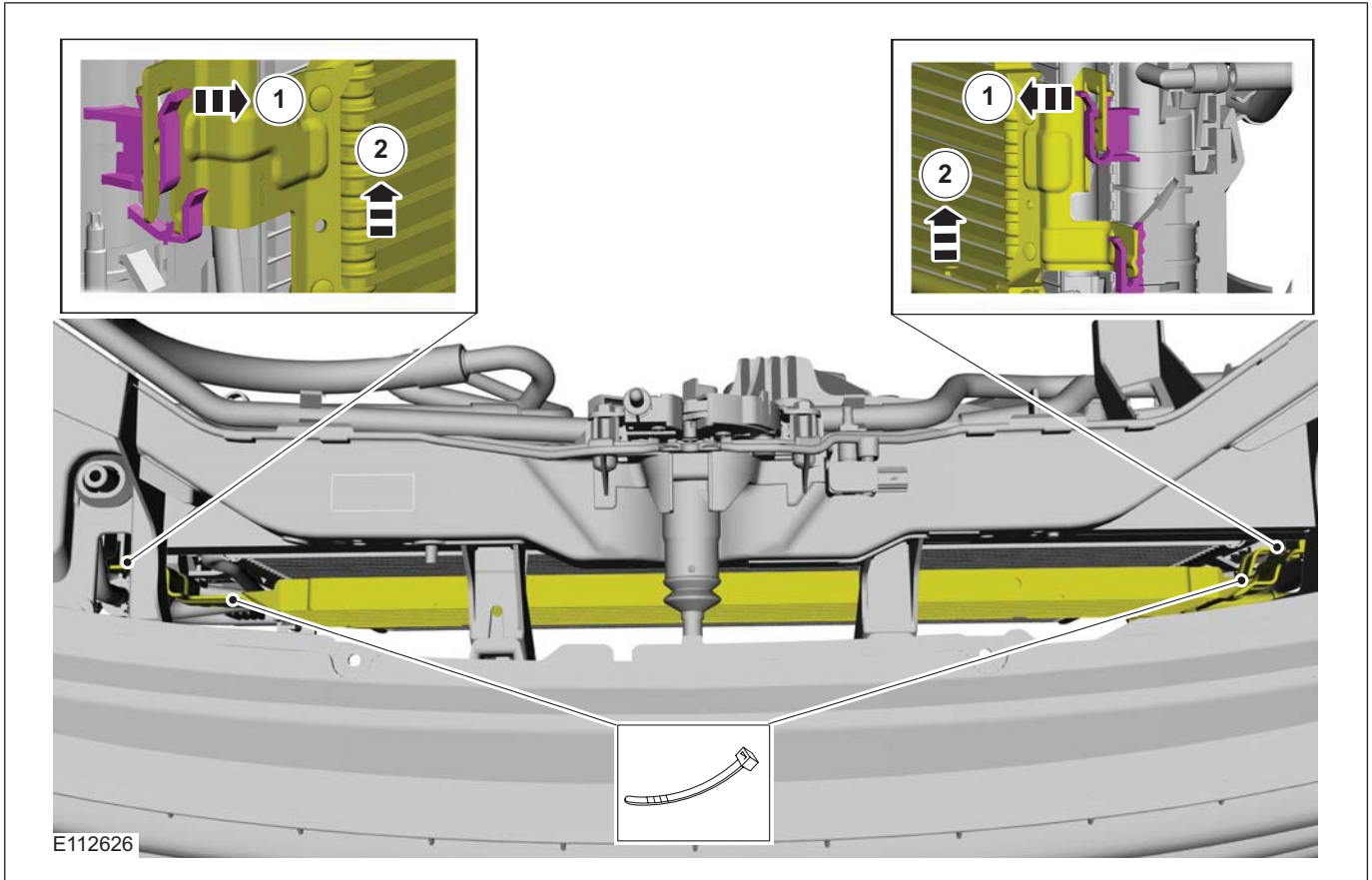


Vehicles with automatic transmission

7. General Equipment: Cable Ties



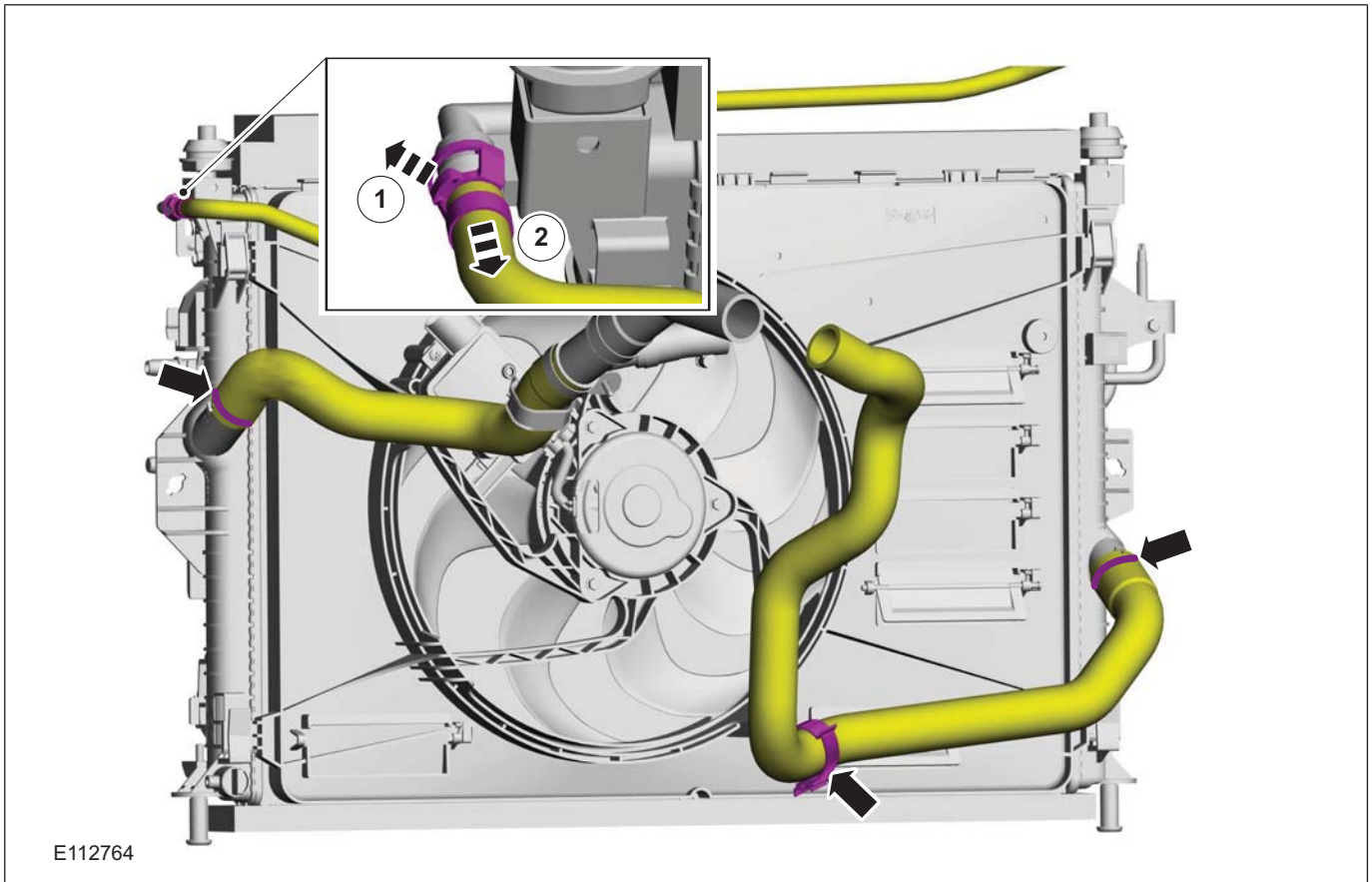
REMOVAL AND INSTALLATION



All vehicles

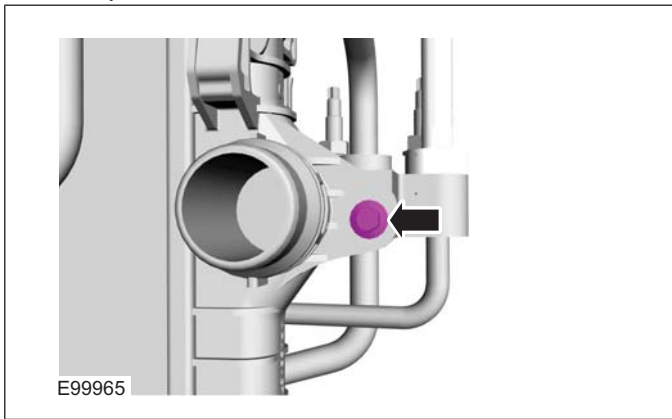
- 8. General Equipment: Hose Clamp Remover/Installer

REMOVAL AND INSTALLATION

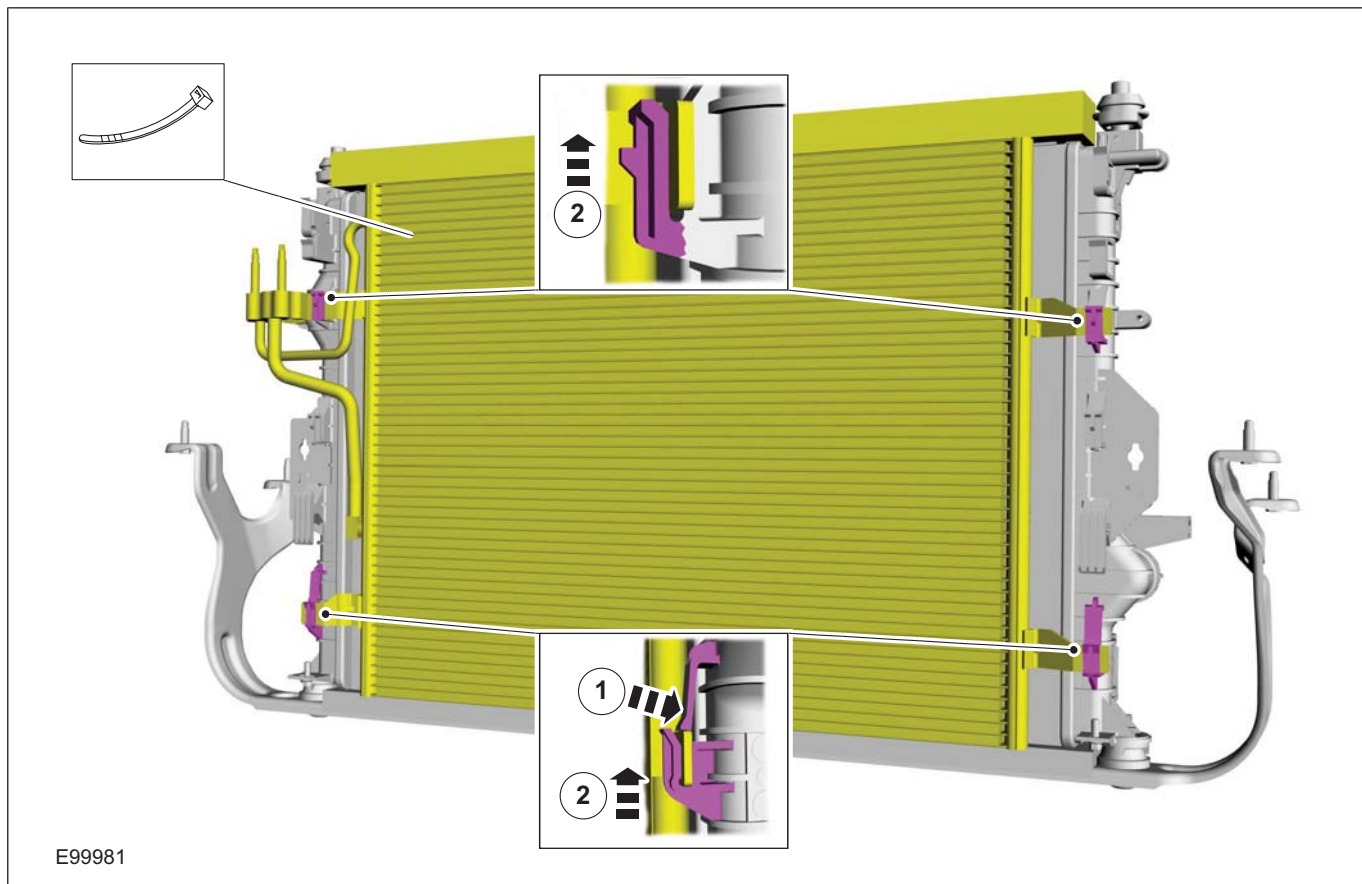


9. Torque: 5 Nm

10. General Equipment: Cable Ties

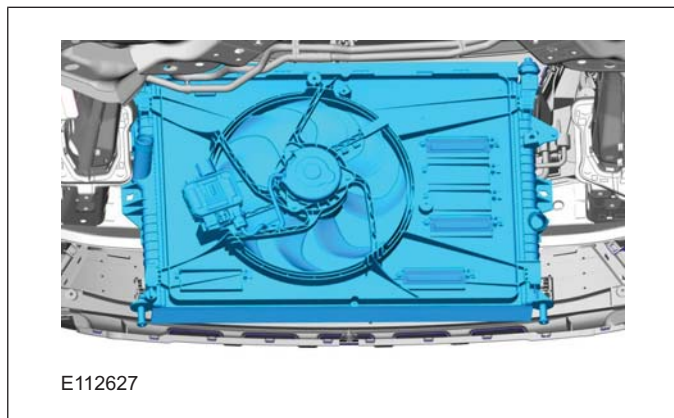


REMOVAL AND INSTALLATION



11.

12.

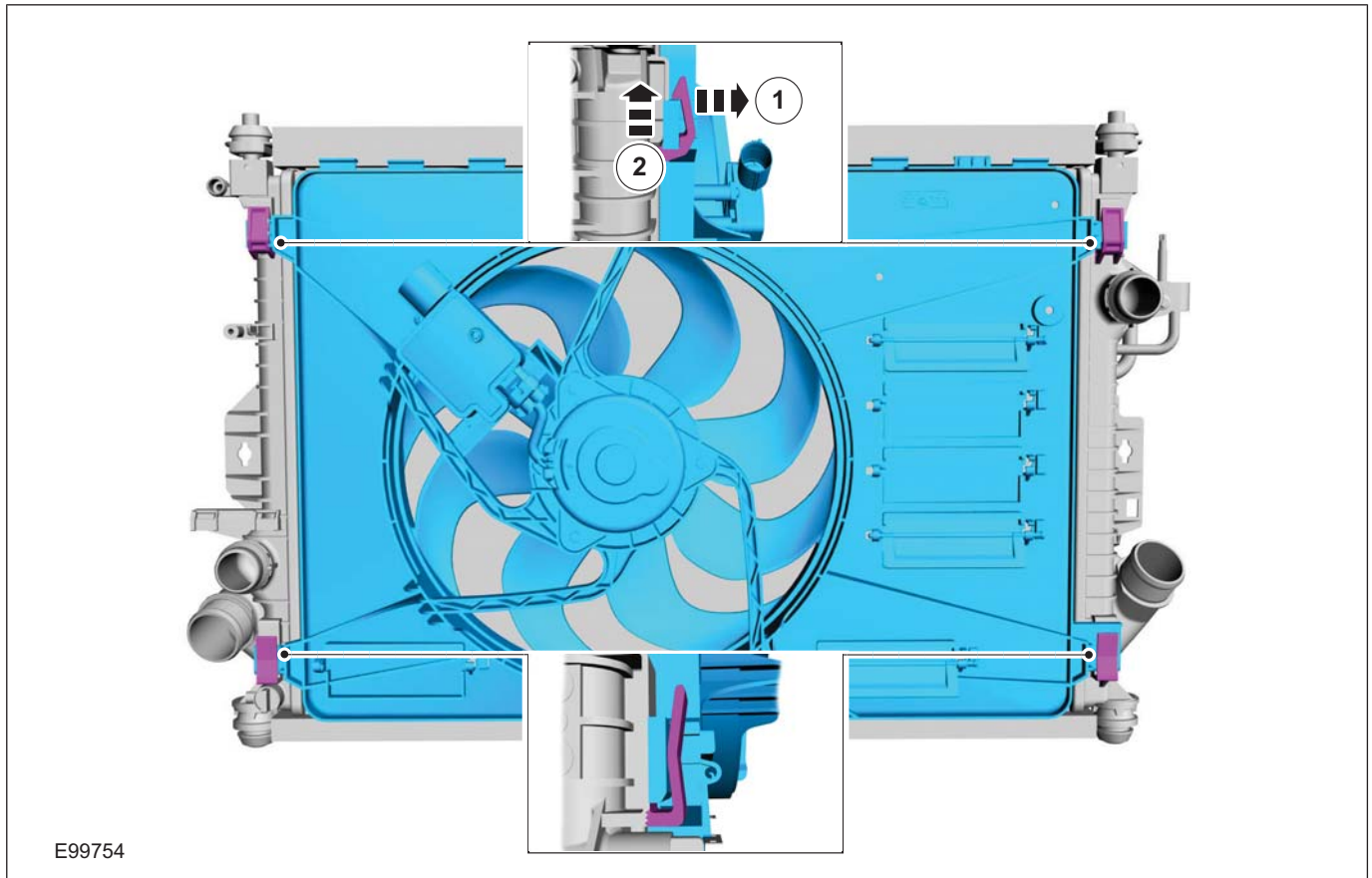


303-03-18

Engine Cooling

303-03-18

## REMOVAL AND INSTALLATION



## Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

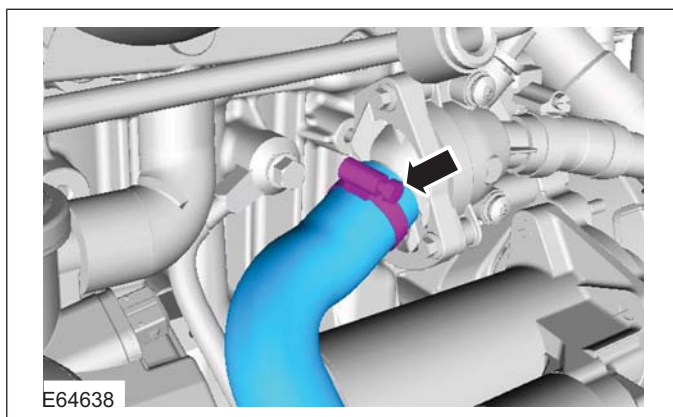
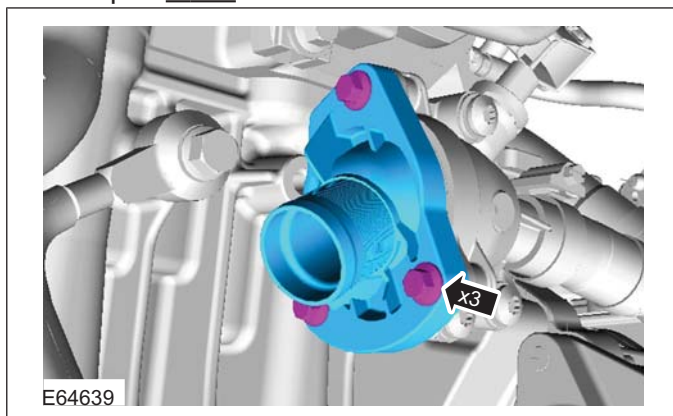
## Thermostat — 2.5L Duratec (147kW/200PS) - VI5(24 454 0)

## Removal

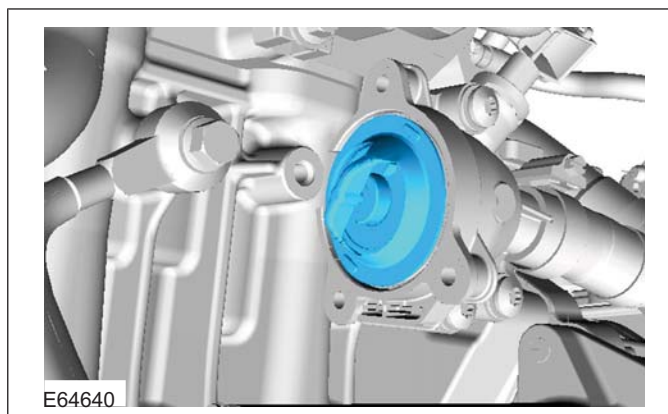
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Cooling System Draining and Vacuum Filling** (303-03 Engine Cooling, General Procedures).
2. Refer to: **Air Cleaner** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

3.

4. Torque: 8 Nm

5.



## Installation

1. To install, reverse the removal procedure.



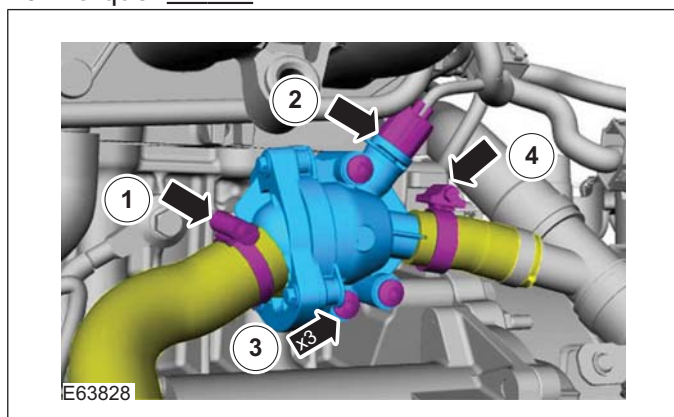
## REMOVAL AND INSTALLATION

Thermostat Housing — 2.5L Duratec (147kW/200PS) -  
VI5(24 001 0)

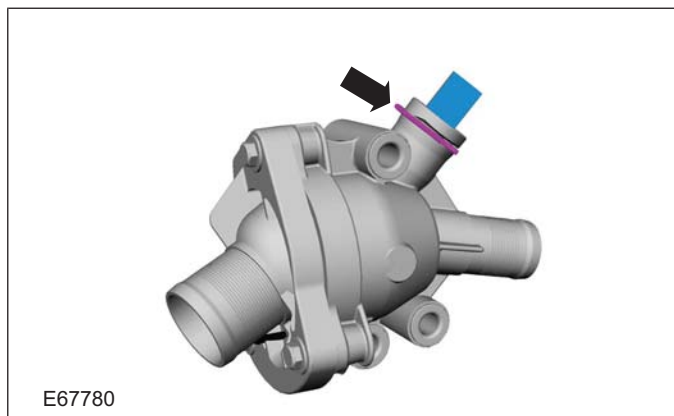
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Cooling System Draining and Vacuum Filling** (303-03 Engine Cooling, General Procedures).
2. Refer to: **Air Cleaner** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
3. Torque: 17 Nm



4.



## Installation

1. To install, reverse the removal procedure.

# SECTION 303-04A Fuel Charging and Controls — 2.5L Duratec

(147kW/200PS) - VI5

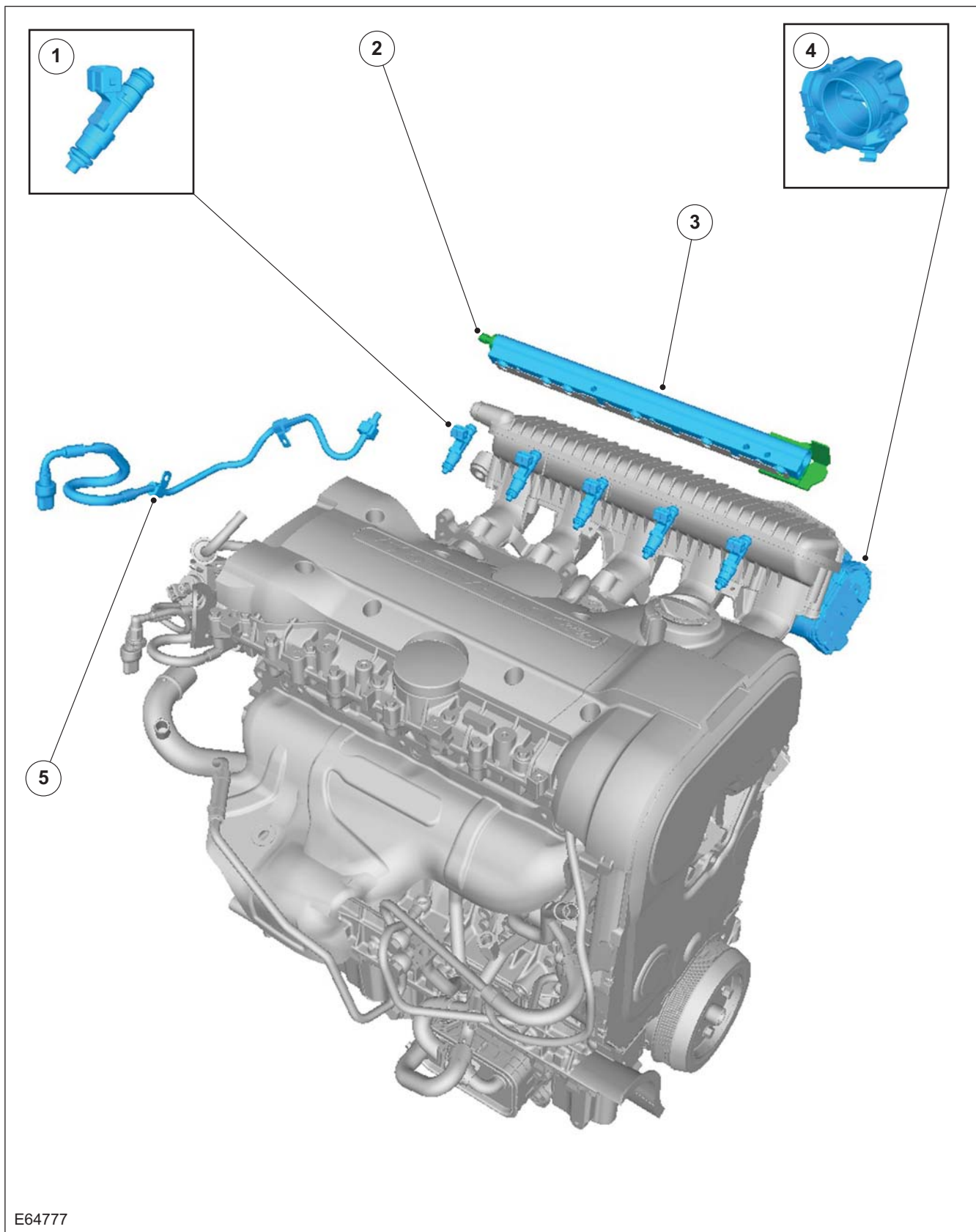
## VEHICLE APPLICATION: 2008.50 Kuga

CONTENTS	PAGE
<b>DESCRIPTION AND OPERATION</b>	
Fuel Charging and Controls.....	303-04A-2
<b>DIAGNOSIS AND TESTING</b>	
Fuel Charging and Controls.....	303-04A-4
Inspection and Verification.....	303-04A-4
Symptom Chart.....	303-04A-4
<b>REMOVAL AND INSTALLATION</b>	
Fuel Injectors.....	303-04A-22
Throttle Body..... (23 198 0)	303-04A-23
Fuel Rail.....	303-04A-24



DESCRIPTION AND OPERATION

Fuel Charging and Controls



**DESCRIPTION AND OPERATION**

Item	Description
1	Fuel Injectors
2	Valve
3	Fuel rail
4	Throttle body
5	Fuel tank to fuel rail fuel supply line

**DIAGNOSIS AND TESTING**

**Fuel Charging and Controls**

**General Equipment**

Ford diagnostic equipment

**Inspection and Verification**

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

Mechanical	Electrical
<ul style="list-style-type: none"> <li>- Fuel leaks</li> <li>- Blocked or contaminated fuel filter</li> <li>- Damaged fuel supply manifold</li> <li>- Damaged fuel line connections</li> <li>- Damaged vacuum hoses</li> <li>- Fuel rail pressure sensor</li> </ul>	<ul style="list-style-type: none"> <li>- Loose or corroded connector(s)</li> <li>- Wiring harness</li> <li>- Fuel injector(s)</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Ford diagnostic equipment.

**Symptom Chart**

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>• Engine does not crank</li> </ul>	<ul style="list-style-type: none"> <li>• PATS.</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK the PATS LED extinguishes within 3 seconds when the ignition is turned on.  REFER to: <b>Anti-Theft - Passive</b> (419-01 Anti-Theft - Passive, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>• Starting system.</li> </ul>	<ul style="list-style-type: none"> <li>• REFER to: <b>Starting System</b> (303-06 Starting System - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>• Ignition switch.</li> </ul>	<ul style="list-style-type: none"> <li>• REFER to the Wiring Diagrams.</li> </ul>
	<ul style="list-style-type: none"> <li>• Powertrain control module (PCM).</li> </ul>	<ul style="list-style-type: none"> <li>• Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
<ul style="list-style-type: none"> <li>• Engine cranks but does not start</li> </ul>	<ul style="list-style-type: none"> <li>• Inertia fuel shutoff (IFS) switch.</li> </ul>	<ul style="list-style-type: none"> <li>• RESET the IFS switch.</li> </ul>
	<ul style="list-style-type: none"> <li>• Low fuel system pressure.</li> </ul>	<ul style="list-style-type: none"> <li>• Check the fuel system pressure.</li> </ul>



## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Fuel lines damaged or blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel lines. INSTALL new components as necessary. TEST the system for normal operation.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel filter blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new fuel filter.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel pump and sender unit.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to: <b>Fuel Pump and Sender Unit - 2.5L Duratec (147kW/200PS) - VI5</b> (310-01 Fuel Tank and Lines, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Crankshaft position (CKP) sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Camshaft position (CMP) sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>PCM.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel rail fuel pressure sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel injectors.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> <li>REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Incorrect valve timing.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the valve timing.</li> <li>REFER to: <b>Timing Belt</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Low cylinder compression.</li> </ul>	<ul style="list-style-type: none"> <li>TEST the cylinder compression.</li> <li>REFER to: <b>Engine</b> (303-00 Engine System - General Information, Diagnosis and Testing).</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
• Poor starting	• Low fuel system pressure.	• Check the fuel system pressure.
	• Fuel system leak.	• CHECK the system for fuel leak(s). REPAIR the system as necessary.
	• Fuel system restriction.	• INSPECT the fuel system. INSTALL new components as necessary. TEST the system for normal operation.
	• Fuel filter blocked.	• INSTALL a new fuel filter.
	• Air cleaner element blocked.	• INSTALL a new air cleaner element.
	• Incorrect engine oil.	• INSTALL a new engine oil filter and engine oil.
	• Incorrect power steering fluid.	• DRAIN and REFILL the power steering system with the correct fluid.  REFER to: <b>Power Steering System Filling</b> (211-00 Steering System - General Information, General Procedures).
	• CKP sensor.	• Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.
	• Engine coolant temperature (ECT) sensor.	• Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.
	• Fuel injector(s).	• INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.  REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
• Fuel rail fuel pressure sensor.	• Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.	

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Catalytic converter blocked.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE and visually INSPECT the catalytic converter as necessary.</li> <li>REFER to: <b>Catalytic Converter</b> (309-00 Exhaust System - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Low cylinder compression.</li> </ul>	<ul style="list-style-type: none"> <li>TEST the engine cylinder compression.</li> <li>REFER to: <b>Engine</b> (303-00 Engine System - General Information, Diagnosis and Testing).</li> </ul>
<ul style="list-style-type: none"> <li>Engine starts but immediately stops</li> </ul>	<ul style="list-style-type: none"> <li>Air cleaner element blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new air cleaner element.</li> </ul>
	<ul style="list-style-type: none"> <li>CKP sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>CMP sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>PCM.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Low fuel system pressure.</li> </ul>	<ul style="list-style-type: none"> <li>Check the fuel system pressure.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel system restriction.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel system. INSTALL new components as necessary. TEST the system for normal operation.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel filter blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new fuel filter.</li> </ul>
<ul style="list-style-type: none"> <li>Poor idling</li> </ul>	<ul style="list-style-type: none"> <li>Air cleaner element blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new air cleaner element.</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Incorrect or contaminated fuel.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK for signs of contamination such as strange odors from the fuel tank.</li> <li>If contaminated fuel is found, DRAIN the complete fuel system. FLUSH the fuel system through with clean gasoline.</li> </ul> <p>REFER to: <b>Fuel Tank Draining</b> (310-00 Fuel System - General Information, General Procedures).</p> <p>INSTALL a new fuel filter. <ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> </ul> <p>REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p> <ul style="list-style-type: none"> <li>INSTALL a new fuel rail.</li> </ul> <p>REFER to: <b>Fuel Rail</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p> </p>
	<ul style="list-style-type: none"> <li>Low fuel system pressure.</li> </ul>	<ul style="list-style-type: none"> <li>Check the fuel system pressure.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel filter blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new fuel filter.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel injectors.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> </ul> <p>REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>
	<ul style="list-style-type: none"> <li>CKP sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Knock sensor (KS).</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Fuel injection supply manifold fuel pressure sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
<ul style="list-style-type: none"> <li>Engine stumbling</li> </ul>	<ul style="list-style-type: none"> <li>Engine ignition.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to: <b>Engine Ignition</b> (303-07 Engine Ignition - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel injectors.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> <li>REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Low fuel system pressure.</li> </ul>	<ul style="list-style-type: none"> <li>Check the fuel system pressure.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel rail fuel pressure sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
<ul style="list-style-type: none"> <li>Engine lacks power</li> </ul>	<ul style="list-style-type: none"> <li>Engine ignition.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to: <b>Engine Ignition</b> (303-07 Engine Ignition - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Brakes binding.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the braking system.</li> <li>REFER to: <b>Brake System</b> (206-00 Brake System - General Information, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Vehicle overloaded, or excessive wind resistance (roof racks, towing etc).</li> </ul>	<ul style="list-style-type: none"> <li>ADVISE the customer about the effects of overloading the vehicle and wind resistance on the fuel consumption.</li> </ul>
	<ul style="list-style-type: none"> <li>Air cleaner element blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new air cleaner element as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Low fuel system pressure.</li> </ul>	<ul style="list-style-type: none"> <li>Check the fuel system pressure.</li> </ul>
	<ul style="list-style-type: none"> <li>Kinked or restricted fuel lines.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel lines. INSTALL new components as necessary. TEST the system for normal operation.</li> </ul>



## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Incorrect or contaminated fuel.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK for signs of contamination such as strange odors from the fuel tank.</li> <li>If contaminated fuel is found, DRAIN the complete fuel system. FLUSH the fuel system through with clean gasoline.</li> </ul> <p>REFER to: <b>Fuel Tank Draining</b> (310-00 Fuel System - General Information, General Procedures).</p> <p>INSTALL a new fuel filter.</p> <ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> <li>INSTALL a new fuel rail.</li> </ul> <p>REFER to: <b>Fuel Rail</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>
	<ul style="list-style-type: none"> <li>Fuel filter blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new fuel filter.</li> </ul>
	<ul style="list-style-type: none"> <li>ECT sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel injectors.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> </ul> <p>REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>
	<ul style="list-style-type: none"> <li>Fuel rail fuel pressure sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Incorrect valve timing.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the valve timing.</li> </ul> <p>REFER to: <b>Timing Belt</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Low cylinder compression.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the cylinder compression.</li> </ul> <p>REFER to: <b>Engine</b> (303-00 Engine System - General Information, Diagnosis and Testing).</p>
	<ul style="list-style-type: none"> <li>Catalytic converter blocked.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE and visually INSPECT the catalytic converter for damage. INSTALL a new catalytic converter as necessary.</li> </ul> <p>REFER to: <b>Catalytic Converter</b> (309-00 Exhaust System - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>
<ul style="list-style-type: none"> <li>Black smoke at idle</li> </ul>	<ul style="list-style-type: none"> <li>Air cleaner element blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new air cleaner element as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel injectors.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> </ul> <p>REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>
	<ul style="list-style-type: none"> <li>ECT sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel rail fuel pressure sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Catalytic converter blocked.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE and visually INSPECT the catalytic converter for damage. INSTALL a new catalytic converter as necessary.</li> </ul> <p>REFER to: <b>Catalytic Converter</b> (309-00 Exhaust System - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Incorrect valve timing.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the valve timing. REFER to: <b>Timing Belt</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
<ul style="list-style-type: none"> <li>Excessive black smoke during acceleration</li> </ul>	<ul style="list-style-type: none"> <li>Air cleaner element blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new air cleaner element as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Incorrect or contaminated fuel.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK for signs of contamination such as strange odors from the fuel tank.</li> <li>If contaminated fuel is found, DRAIN the complete fuel system. FLUSH the fuel system through with clean gasoline. REFER to: <b>Fuel Tank Draining</b> (310-00 Fuel System - General Information, General Procedures). INSTALL a new fuel filter.</li> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> <li>INSTALL a new fuel rail. REFER to: <b>Fuel Rail</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>CKP sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>KS.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel injectors.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out. REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Fuel rail fuel pressure sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Catalytic converter blocked.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE and visually INSPECT the catalytic converter for damage. INSTALL a new catalytic converter as necessary.</li> </ul> <p>REFER to: <b>Catalytic Converter</b> (309-00 Exhaust System - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>
<ul style="list-style-type: none"> <li>Black smoke at cruising speeds</li> </ul>	<ul style="list-style-type: none"> <li>Air cleaner element blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new air cleaner element.</li> </ul>
	<ul style="list-style-type: none"> <li>ECT sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel injectors.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> </ul> <p>REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>
	<ul style="list-style-type: none"> <li>Fuel rail fuel pressure sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Catalytic converter blocked.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE and visually INSPECT the catalytic converter for damage. INSTALL a new catalytic converter as necessary.</li> </ul> <p>REFER to: <b>Catalytic Converter</b> (309-00 Exhaust System - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>
<ul style="list-style-type: none"> <li>Blue smoke</li> </ul>	<ul style="list-style-type: none"> <li>Engine burning oil.</li> </ul>	<ul style="list-style-type: none"> <li>CARRY OUT a controlled oil consumption test over 1000 km (600 miles). CONFIRM that the oil consumption is less than 0.1 litre per 1000 km (600 miles).</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Incorrect or contaminated fuel.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK for signs of contamination such as strange odors from the fuel tank.</li> <li>If contaminated fuel is found, DRAIN the complete fuel system. FLUSH the fuel system through with clean gasoline. REFER to: <b>Fuel Tank Draining</b> (310-00 Fuel System - General Information, General Procedures). INSTALL a new fuel filter.</li> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out. REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> <li>INSTALL a new fuel rail. REFER to: <b>Fuel Rail</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Positive crankcase ventilation (PCV) system.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT for visible signs of damage or blockage. CLEAN, REPAIR or INSTALL new parts as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Worn or damaged valve guide(s), piston ring(s), cylinder bore(s), cylinder head or gasket.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE the cylinder head. INSPECT the cylinder head, pistons and cylinder bores for signs of wear or damage. REFER to: <b>Cylinder Head</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>



## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
• White smoke	• Incorrect or contaminated fuel.	<ul style="list-style-type: none"> <li>• CHECK for signs of contamination such as strange odors from the fuel tank.</li> <li>• If contaminated fuel is found, DRAIN the complete fuel system. FLUSH the fuel system through with clean gasoline.</li> </ul> <p>REFER to: <b>Fuel Tank Draining</b> (310-00 Fuel System - General Information, General Procedures).</p> <p>INSTALL a new fuel filter.</p> <ul style="list-style-type: none"> <li>• INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> </ul> <p>REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p> <ul style="list-style-type: none"> <li>• INSTALL a new fuel rail.</li> </ul> <p>REFER to: <b>Fuel Rail</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>
	• Coolant in the combustion chamber.	<ul style="list-style-type: none"> <li>• CARRY OUT a cooling system pressure test.</li> </ul> <p>REFER to: <b>Engine Cooling</b> (303-03 Engine Cooling, Diagnosis and Testing).</p> <ul style="list-style-type: none"> <li>• REMOVE the cylinder head. INSPECT the cylinder head, cylinder head gasket and cylinder bores for wear or damage.</li> </ul> <p>REFER to: <b>Cylinder Head</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
• Engine misfire	• Engine ignition.	• REFER to: <b>Engine Ignition</b> (303-07 Engine Ignition - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing).
	• Incorrect or contaminated fuel.	<ul style="list-style-type: none"> <li>• CHECK for signs of contamination such as strange odors from the fuel tank.</li> <li>• If contaminated fuel is found, DRAIN the complete fuel system. FLUSH the fuel system through with clean gasoline.</li> </ul> REFER to: <b>Fuel Tank Draining</b> (310-00 Fuel System - General Information, General Procedures). INSTALL a new fuel filter. <ul style="list-style-type: none"> <li>• INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> <li>• INSTALL a new fuel rail.</li> </ul> REFER to: <b>Fuel Rail</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
	• Low fuel system pressure.	• Check the fuel system pressure.
	• Engine operating temperature too high.	• REFER to: <b>Engine Cooling</b> (303-03 Engine Cooling, Diagnosis and Testing).
	• ECT sensor.	• Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.
	• CKP sensor.	• Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.
	• CMP sensor.	• Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.
• KS.	• Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.	

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Fuel injectors.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> <li>REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel rail fuel pressure sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Low cylinder compression.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the engine compression.</li> <li>REFER to: <b>Engine</b> (303-00 Engine System - General Information, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Worn or damaged valve(s), tappet(s) or camshaft(s).</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE the cylinder head. INSPECT the cylinder head, valves, tappets and camshafts for signs of wear or damage.</li> <li>REFER to: <b>Cylinder Head</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Damaged cylinder head gasket.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE the cylinder head. INSPECT the cylinder head gasket and cylinder bores for wear or damage.</li> <li>REFER to: <b>Cylinder Head</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
<ul style="list-style-type: none"> <li>Engine knock at idle</li> </ul>	<ul style="list-style-type: none"> <li>Low engine oil level.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the engine oil level. REFILL as necessary.</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Incorrect or contaminated fuel.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK for signs of contamination such as strange odors from the fuel tank.</li> <li>If contaminated fuel is found, DRAIN the complete fuel system. FLUSH the fuel system through with clean gasoline. REFER to: <b>Fuel Tank Draining</b> (310-00 Fuel System - General Information, General Procedures). INSTALL a new fuel filter.</li> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out. REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> <li>INSTALL a new fuel rail. REFER to: <b>Fuel Rail</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>KS.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>CKP sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel injector(s).</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out. REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Incorrect valve timing.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the valve timing. REFER to: <b>Timing Belt</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Excessive carbon build up.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE the cylinder head. INSPECT the cylinder head and pistons for signs carbon build up. REFER to: <b>Cylinder Head</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Worn or damaged oil pump.</li> <li>Worn or damaged timing chain or sprocket.</li> <li>Major mechanical engine failure.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the engine components.</li> </ul>
<ul style="list-style-type: none"> <li>Engine knock during acceleration</li> </ul>	<ul style="list-style-type: none"> <li>KS.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel injectors.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out. REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Major mechanical engine failure.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to: <b>Engine</b> (303-00 Engine System - General Information, Diagnosis and Testing).</li> </ul>
<ul style="list-style-type: none"> <li>Excessive fuel consumption</li> </ul>	<ul style="list-style-type: none"> <li>Brakes binding.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the braking system. REFER to: <b>Brake System</b> (206-00 Brake System - General Information, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Vehicle overloaded, or excessive wind resistance (roof racks, towing etc).</li> </ul>	<ul style="list-style-type: none"> <li>ADVISE the customer about the effects of overloading the vehicle and wind resistance on the fuel consumption.</li> </ul>
	<ul style="list-style-type: none"> <li>Air cleaner element blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new air cleaner element.</li> </ul>



## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Fuel system leak(s).</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the system for fuel leak(s). REPAIR or INSTALL new parts as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel filter blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new fuel filter.</li> </ul>
	<ul style="list-style-type: none"> <li>Incorrect engine oil.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new oil filter and engine oil.</li> </ul>
	<ul style="list-style-type: none"> <li>Generator.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Slipping clutch.</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
	<ul style="list-style-type: none"> <li>ECT sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel injectors.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the fuel injectors. CLEAN the fuel injectors or INSTALL a new set of injectors as required only after the checks have been carried out.</li> <li>REFER to: <b>Fuel Injectors</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>PCM calibration.</li> </ul>	<ul style="list-style-type: none"> <li>Using the Ford diagnostic equipment, CHECK for the availability of a calibration update.</li> </ul>
	<ul style="list-style-type: none"> <li>Incorrect valve timing.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the valve timing.</li> <li>REFER to: <b>Timing Belt</b> (303-01 Engine - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Low cylinder compression.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the engine compression.</li> <li>REFER to: <b>Engine</b> (303-00 Engine System - General Information, Diagnosis and Testing).</li> </ul>
<ul style="list-style-type: none"> <li>Engine cuts out during hard acceleration</li> </ul>	<ul style="list-style-type: none"> <li>CMP sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>
	<ul style="list-style-type: none"> <li>CKP sensor.</li> </ul>	<ul style="list-style-type: none"> <li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li> </ul>

303-04A-21

VI5

303-04A-21

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"><li>Fuel rail fuel pressure sensor.</li></ul>	<ul style="list-style-type: none"><li>Carry out a full engine diagnosis using the guided diagnostic menu in the Ford diagnostic equipment.</li></ul>
	<ul style="list-style-type: none"><li>Low fuel system pressure.</li></ul>	<ul style="list-style-type: none"><li>Check the fuel system pressure.</li></ul>

## REMOVAL AND INSTALLATION

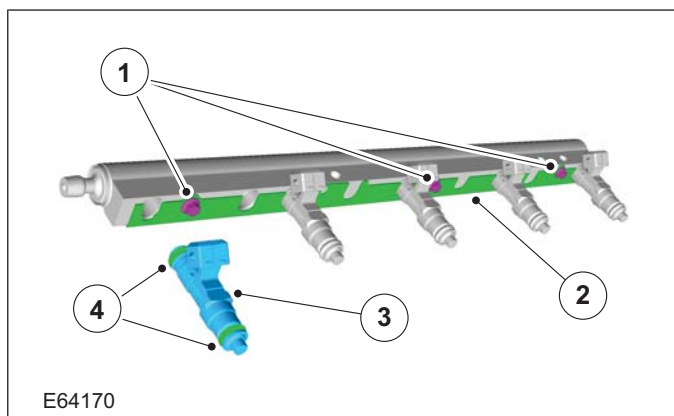
## Fuel Injectors

Materials	
Name	Specification
Engine Oil - 5W-30	WSS-M2C911-A

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Fuel Rail** (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
2. 1. Torque: 10 Nm  
4. Material: Engine Oil - 5W-30  
(WSS-M2C911-A) engine oil



## Installation

1. To install, reverse the removal procedure.

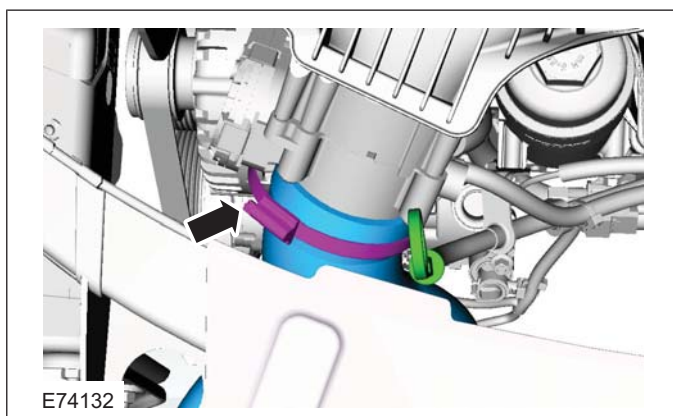
## REMOVAL AND INSTALLATION

## Throttle Body(23 198 0)

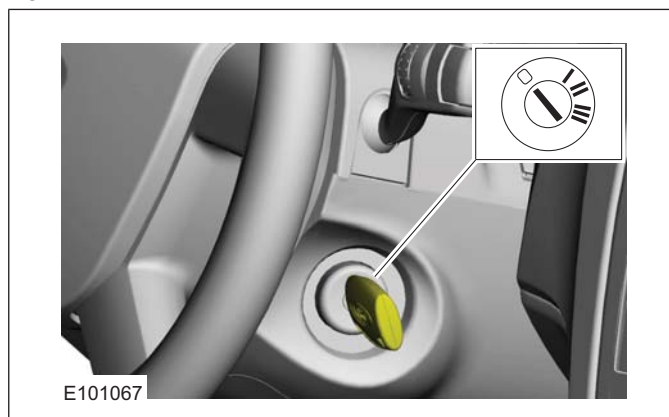
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Remove the right-hand side headlamp assembly.
- 2.

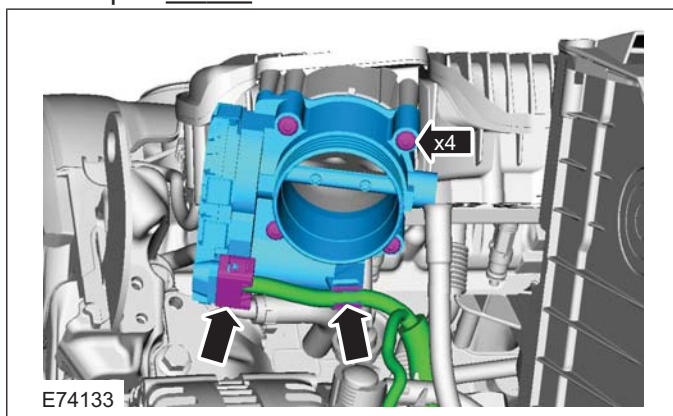


3.



3. **NOTE:** The gasket is to be reused unless damaged.

Torque: 10 Nm



## Installation

1. To install, reverse the removal procedure.
2. **NOTE:** Make sure that the pedals remain in the rest position.

Turn the ignition key to position II and wait for one minute to initialize the throttle body.

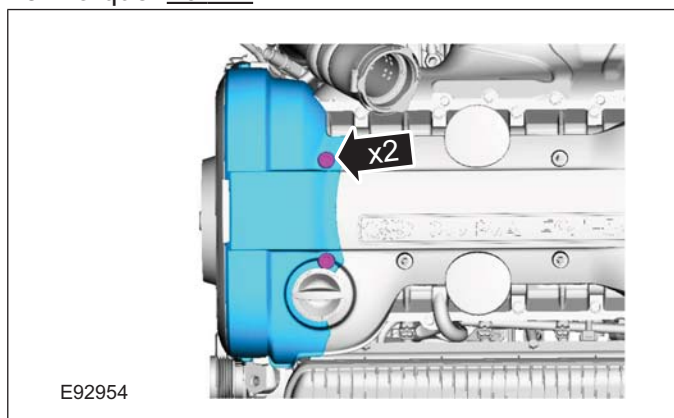
## REMOVAL AND INSTALLATION

## Fuel Rail

## Removal

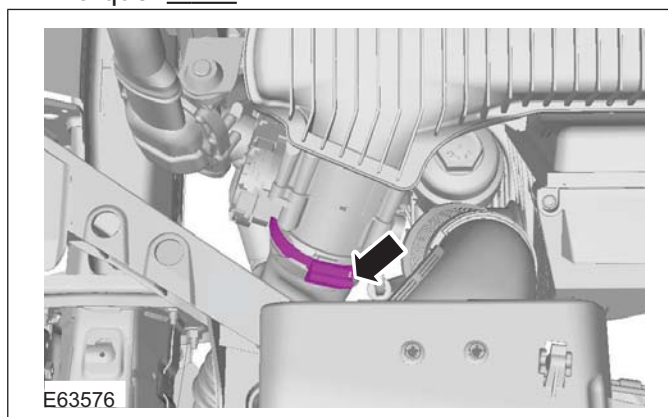
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Fuel System Pressure Release** (310-00 Fuel System - General Information, General Procedures).
3. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
4. Refer to: **Air Cleaner** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
5. Torque: 10 Nm

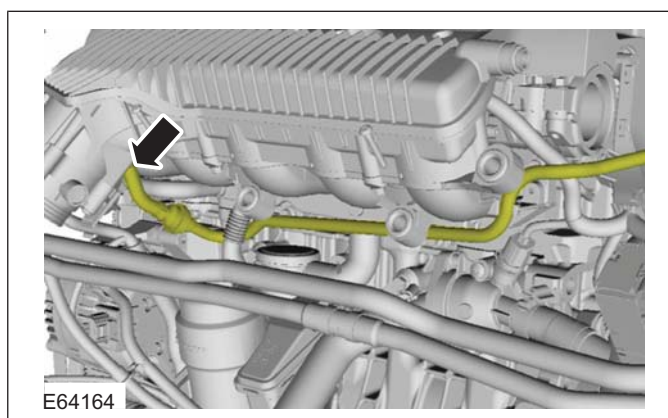


6. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

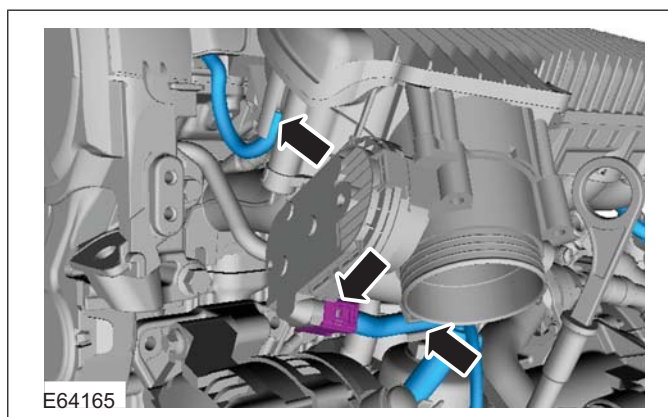
Torque: 4 Nm



7. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

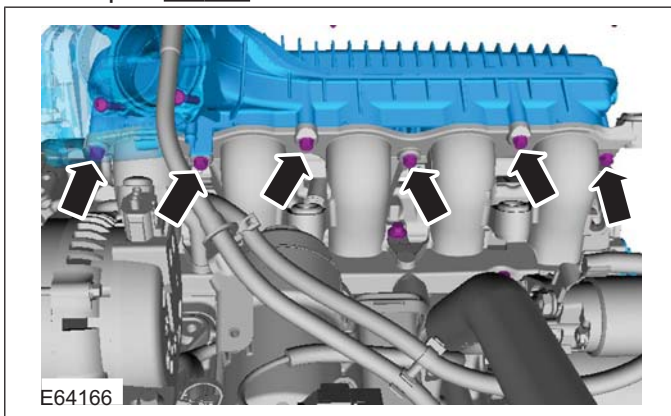
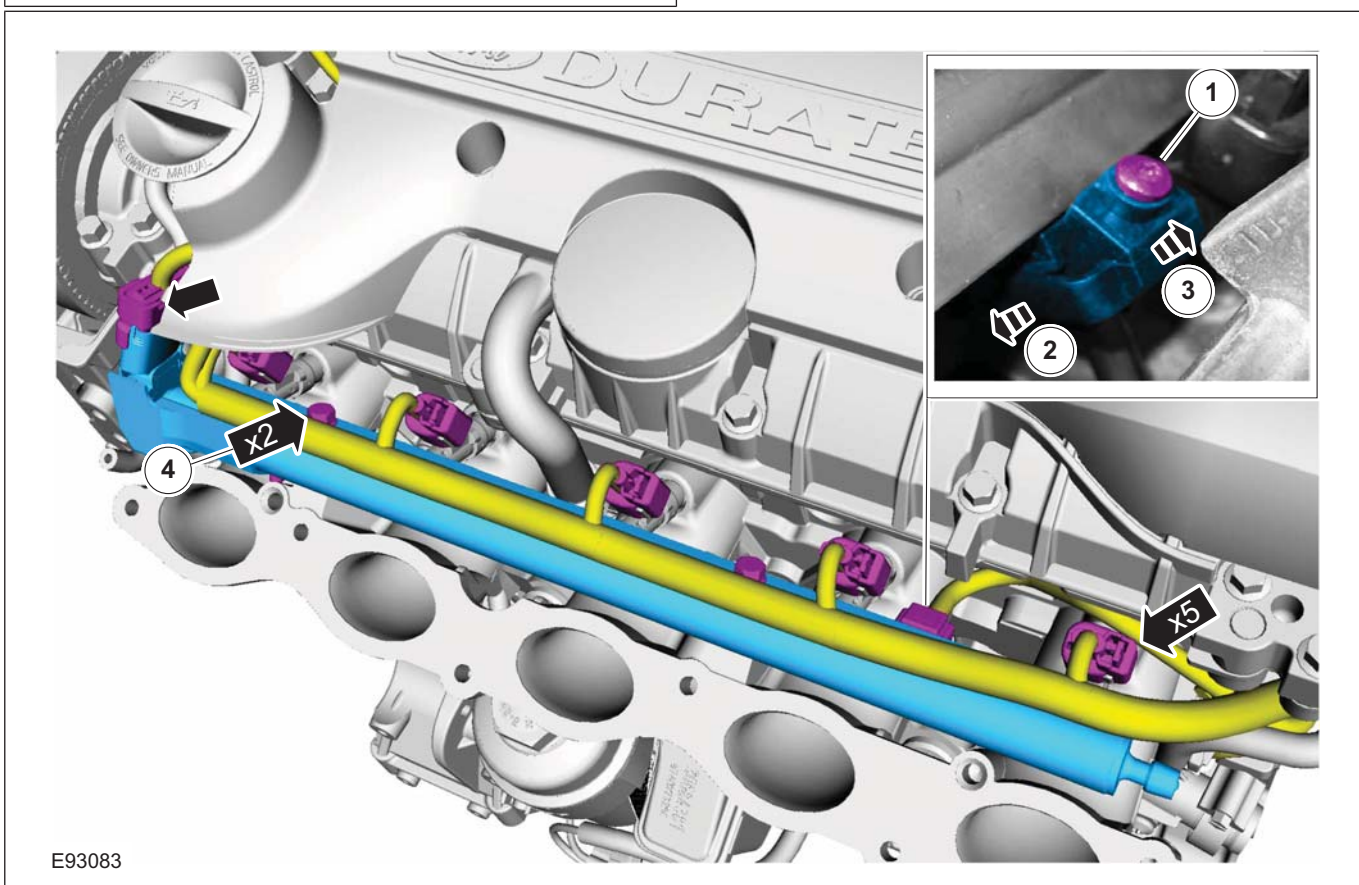


8. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.





## REMOVAL AND INSTALLATION

9. Torque: 10 Nm10. 1. Torque: 2 Nm4. **⚠ WARNING:** Be prepared to collect escaping fluid.Torque: 10 Nm

## Installation

1. To install, reverse the removal procedure.
2. Refer to: **Door Window Motor Initialization** (501-11 Glass, Frames and Mechanisms, General Procedures).

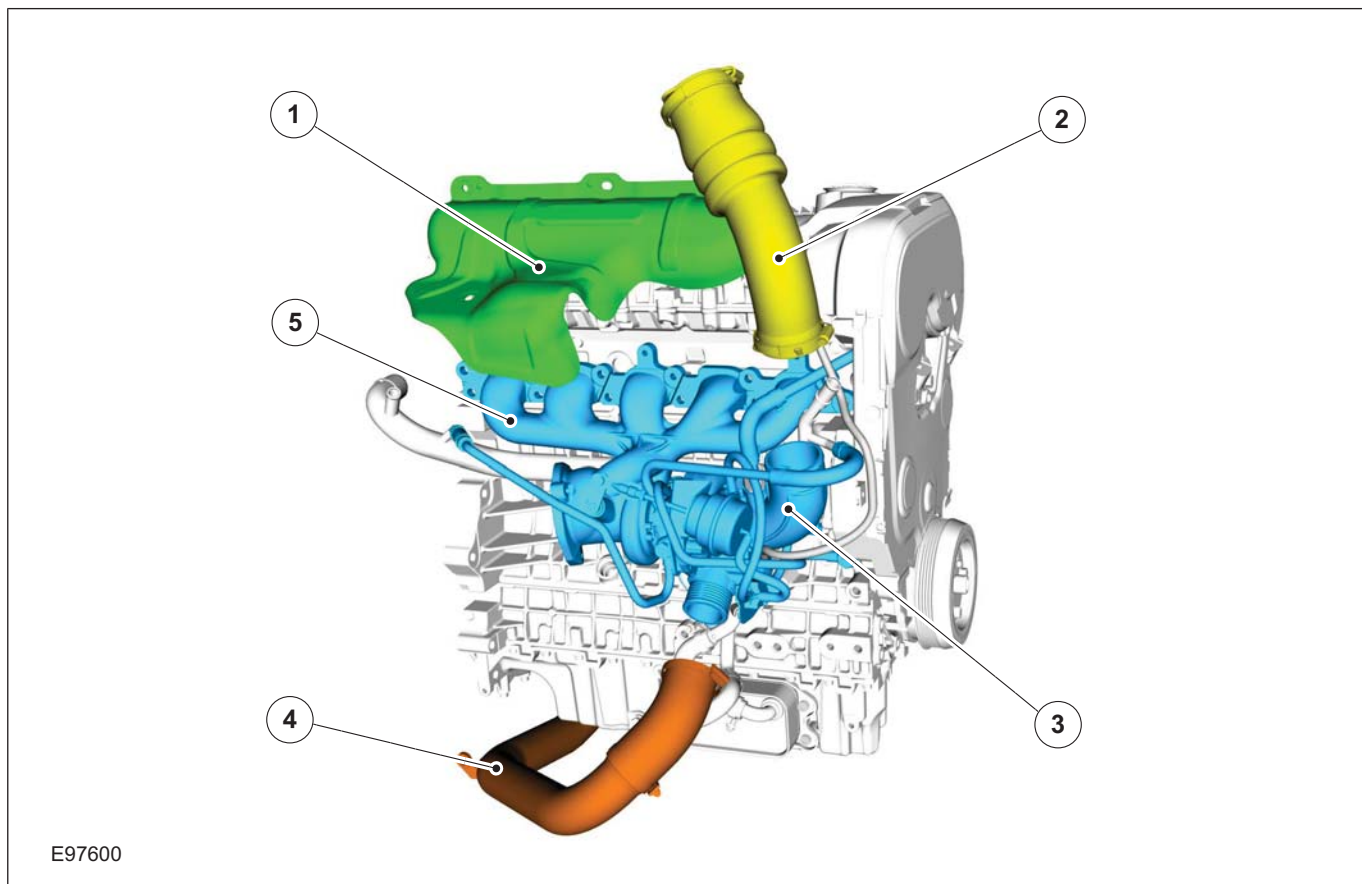
## SECTION 303-04B Fuel Charging and Controls - Turbocharger — 2.5L Duratec (147kW/200PS) - VI5

### VEHICLE APPLICATION: 2008.50 Kuga

CONTENTS	PAGE
<b>DESCRIPTION AND OPERATION</b>	
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Turbocharger..... (23 612 0)	303-04B-11

DESCRIPTION AND OPERATION

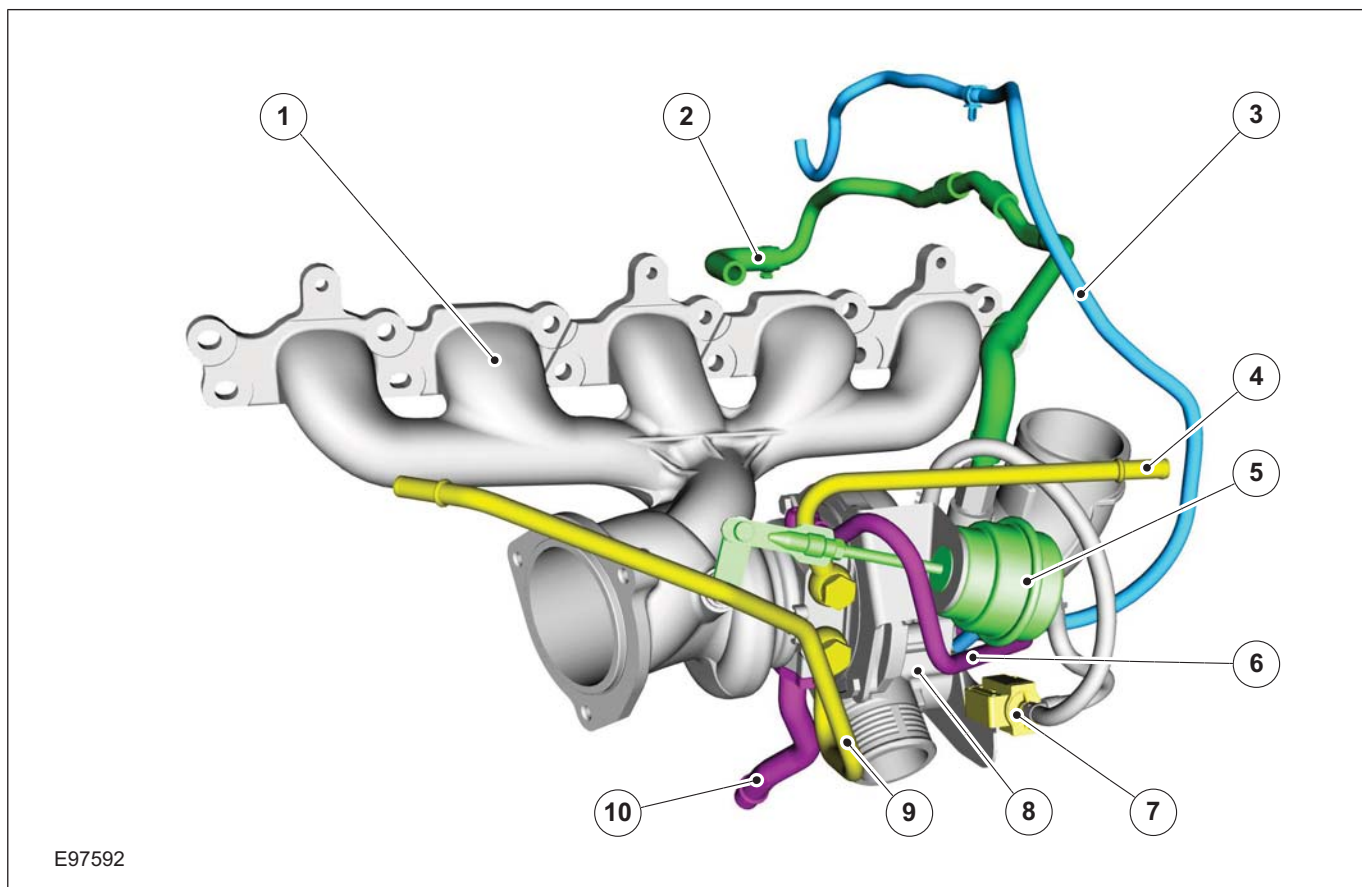
Turbocharger – Component Location



Item	Description
1	Turbocharger heat shield
2	from air filter

Item	Description
3	TC (turbocharger)
4	to intercooler
5	Exhaust manifold

DESCRIPTION AND OPERATION



E97592

Item	Description
1	Exhaust manifold
2	PCV (positive crankcase ventilation)- hose <b>Comments:</b> to cylinder head
3	Vacuum line - recirculated air valve <b>Comments:</b> to intake manifold
4	Coolant return pipe

Item	Description
5	Turbo boost pressure controller
6	Oil supply pipe - TC
7	Wastegate control valve
8	TC <b>Comments:</b> Contains the recirculated air valve
9	Coolant supply pipe
10	Oil return pipe - TC

## DESCRIPTION AND OPERATION

### Turbocharger – Overview

#### Turbocharger(s)

**⚠ CAUTION: Do not switch off the engine while it is running at high speed. If the engine is switched off while it is running at high speed, the turbocharger will continue to run after the engine oil pressure has already dropped to zero. This will cause premature wear in the turbocharger bearings.**

A TC consists of an exhaust turbine located in the exhaust gas flow, this turbine is connected to a compressor by a shaft. The turbine is made to rotate by the exhaust gas flow from the engine and thus drives the compressor. The compressor increases the pressure in the engine intake tract so that a greater mass of air enters the cylinder during the intake stroke.

The turbine housing of the TC is integrated into the exhaust manifold. This construction offers thermodynamic advantages compared with the usual construction, the maximum exhaust temperature is up to 1050°C.

The maximum boost pressure is 0.65 bar.

The exhaust manifold is secured to the exhaust side of the cylinder head with 12 self-locking nuts. The exhaust manifold gasket is a multi-layer steel gasket and cannot be reused. In order to compensate for the thermal expansion of the exhaust manifold, the flange of the TC is provided with two grooves.

The TC and the exhaust manifold are joined by a hose clip. The hose clip must not be loosened or removed. The TC and the exhaust manifold are not available as separate replacement parts, exchange is only possible as a complete unit.

The turbocharger heat shield is secured to the exhaust manifold by four bolts. Two of the bolts have spring washers underneath their heads. During removal, make a note of the installation location of the spring washers to refer to during installation.

The recirculated air valve is built into the TC housing and cannot be changed.

The Ford diagnostic unit can test the operation of the wastegate control valve using actuator diagnosis.

The boost pressure regulator is set in the factory. Adjustments to the boost pressure regulator must

never be attempted. A red colored seal is applied to the adjustment nut of the operating rod, in order to monitor the factory setting of the boost pressure.

The bearings of the TC are lubricated with engine oil. The engine oil passes from the cylinder block through the oil supply pipe to the TC. The oil is returned to the oil pan through the oil return pipe,

The TC is cooled by the engine coolant circuit.

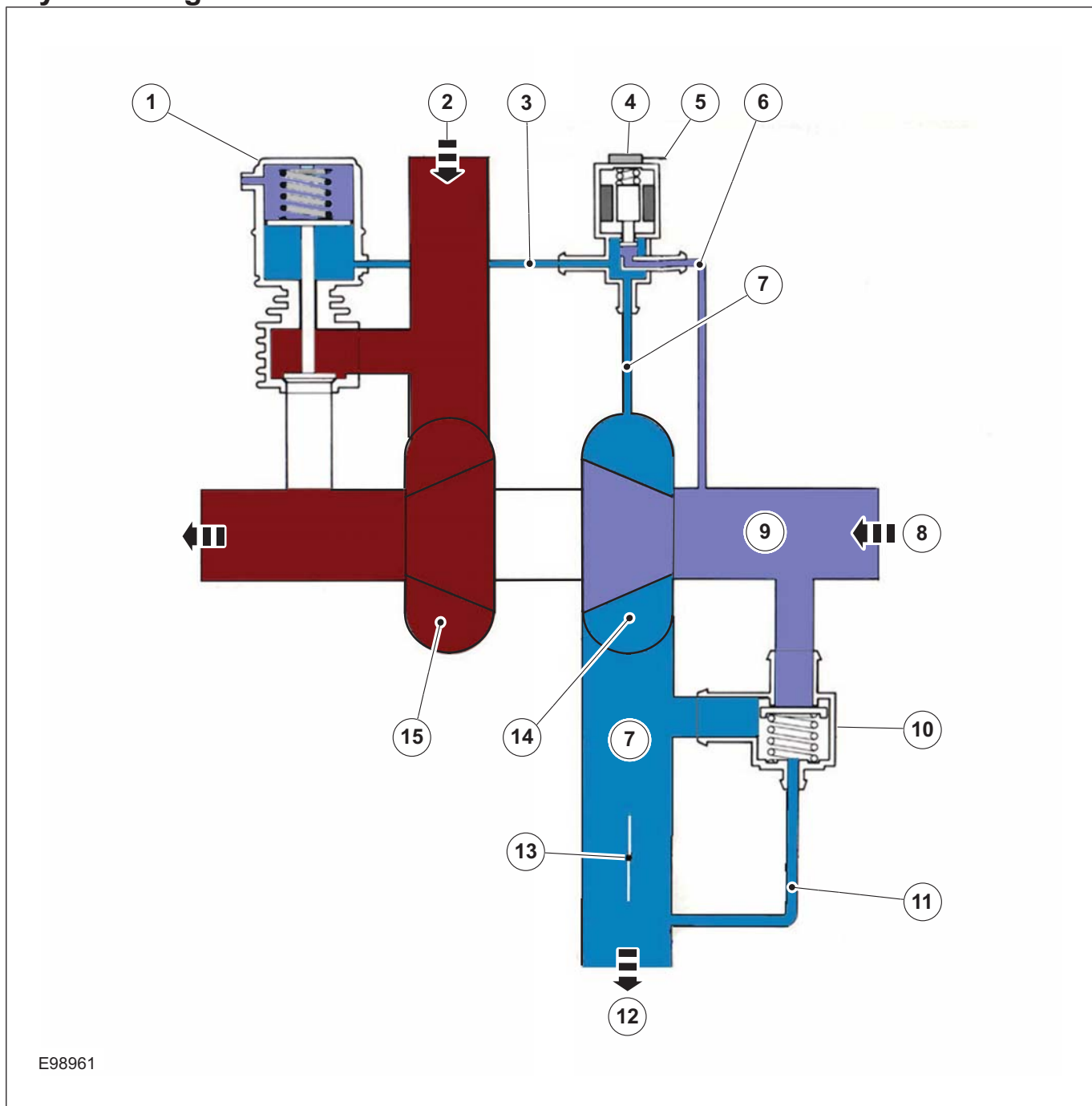
When installing hoses and lines, make certain that their ends are free of oil residues and dirt.



DESCRIPTION AND OPERATION

Turbocharger – System Operation and Component Description

System Diagram



E98961

Item	Description
1	Turbo boost pressure controller
2	from exhaust manifold
3	Pilot pressure

Item	Description
4	Wastegate control valve Refer to Component Description: (page 7) <b>Comments:</b> closed when de-energised

DESCRIPTION AND OPERATION

Item	Description
5	PWM (pulse width modulation) signal <b>Comments:</b> from PCM (powertrain control module)
6	Atmospheric pressure
7	Turbocharger boost pressure.
8	from air filter
9	Intake air

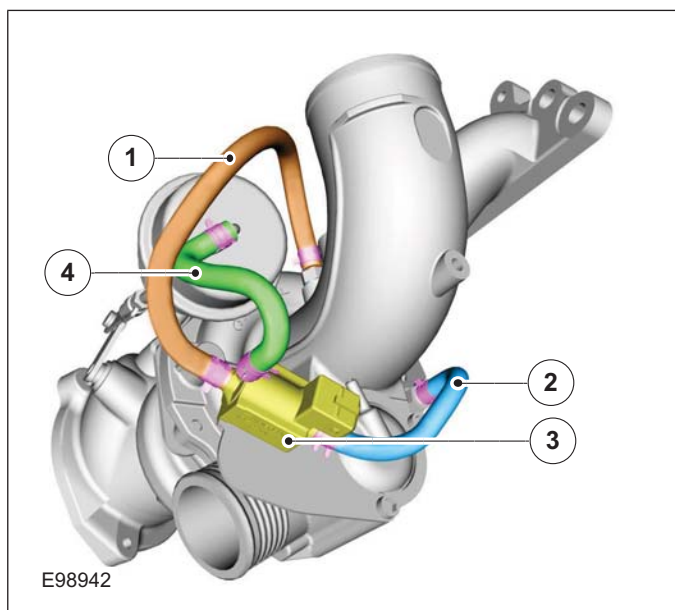
Item	Description
10	Recirculated air valve Refer to Component Description: (page 7)
11	Vacuum line, recirculated air valve
12	to intake manifold
13	Throttle plate
14	Compressor
15	Turbine

System Operation

Turbocharger(s)

The TC consists of a turbine and a compressor. The turbine is driven by the exhaust gas flow. A common shaft drives the compressor and this then compresses the intake air.

Turbocharger boost pressure control



Item	Description
1	Atmospheric pressure
2	Turbocharger boost pressure.
3	Wastegate control valve
4	Pilot pressure

The size of the TC is designed to produce a charge effect even at medium engine speeds and lower exhaust gas flows. This means that, when the

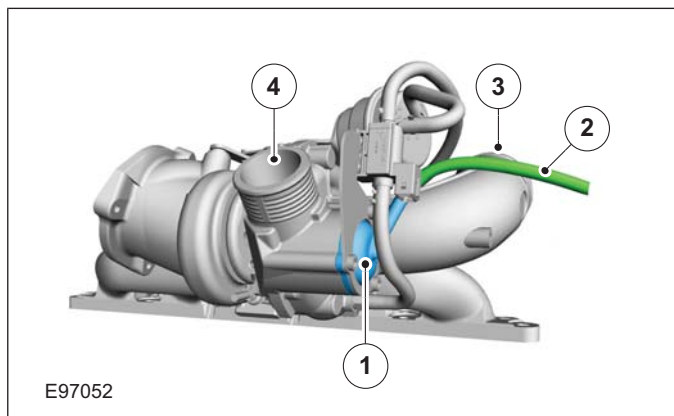
engine speed is high and there is a large amount of exhaust gas, either the boost pressure of the TC will become too high or its speed will be too high. The TC must therefore be regulated. The best regulation is achieved by an electronically controlled wastegate control valve. The wastegate control valve controls the pressure on the membrane in the boost pressure regulator.

The wastegate control valve is actuated by the PCM with a PWM signal according to a map. The boost pressure is applied to the wastegate control valve via the pressure line from the compressor. This pressure is passed to the boost pressure regulator via the wastegate control valve. This opens the bypass valve using a linkage. This channels a portion of the exhaust gases around the turbine. If the wastegate control valve is actuated by the PCM, a bypass is opened in the wastegate control valve. This causes the pressure which can act on the membrane in the boost pressure regulator to be reduced. This occurs until the boost pressure has reached a set value. By actuation with a PWM signal, it is also possible to partially open or close the wastegate control valve. This results in a constant boost pressure and therefore high torque over a wide range of engine speeds.

Because the PCM calculates the boost pressure using the signal from the boost pressure sensor and the IAT (intake air temperature) sensor, the atmospheric pressure and the temperature are automatically compensated for. Because of this compensation, the engine power is not noticeably affected by variations in atmospheric temperature or pressure.

## DESCRIPTION AND OPERATION

## Recirculated air valve



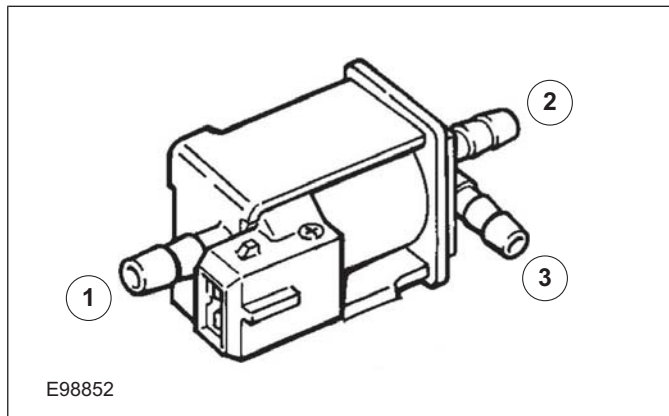
E97052

Item	Description
1	Recirculated air valve
2	Vacuum hose to intake manifold
3	Air ingress
4	Air discharge

If the throttle valve is closed quickly, the moving air column hits the throttle valve. The air column is reversed, flows back onto the rotating impeller of the TC and powerfully decelerates it. A recirculated air valve is installed to prevent this deceleration of the impeller and thus allow the TC to respond faster. The recirculated air valve is controlled via a vacuum line which is connected to the intake manifold. When the throttle valve is suddenly closed, a high vacuum occurs in the intake manifold. This opens the recirculated air valve and the compressed air is returned to a point before the compressor. This causes the speed of the turbocharger to drop less rapidly and the boost pressure can build up more rapidly when the accelerator pedal is pressed again.

## Component Description

## Wastegate control valve



E98852

Item	Description
1	from turbocharger (boost pressure)
2	from turbocharger (atmospheric pressure)
3	to boost pressure regulator (control pressure)

The wastegate control valve operates as a cycle valve. The pressure acting on the membrane in the boost pressure regulator is controlled by appropriate pulsing of the wastegate control valve. The pressure acting on the membrane in the boost pressure regulator is reduced when the wastegate control valve opens.

The operating voltage of the wastegate control valve is 12V.

The internal resistance of the wastegate control valve is  $28.5 \pm 1.5$  Ohms.

The operating states are:

- De-energised: gate open between 1 and 3
  - Boost pressure high > wastegate control valve closed > boost pressure regulator open > turbine receives restricted exhaust gas flow.
- Energised: gate open between 2 and 3
  - Boost pressure low > wastegate control valve open > boost pressure regulator closed > turbine receives full exhaust gas flow.

**DESCRIPTION AND OPERATION****Recirculated air valve**

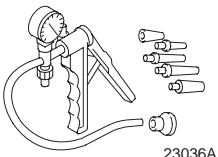
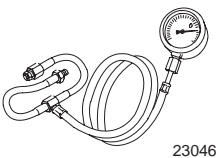
The recirculated air valve is a vacuum-controlled spring/membrane valve. If vacuum is applied to the recirculated air valve, the piston is pulled in against the spring pressure and a bypass bore is opened.

As the vacuum decreases, the spring pressure prevails and the piston re-closes the bypass bore.

DIAGNOSIS AND TESTING

Turbocharger

Special Tool(s) / General Equipment

 <p>23036A</p>	<p>Hand Vacuum/Pressure Pump 416 - D001 (23 - 036A)</p>
 <p>23046</p>	<p>Fuel Pressure Gauge 310-053 (23-046)</p>
<p>Ford diagnostic equipment</p>	

Inspection and Verification

**NOTE:** It is normal for a small amount of combustion gas to pass into the crankcase. This gas is scavenged into the air intake system through the positive crankcase ventilation (PCV) system, which incorporates a crankcase vent oil separator. Some engine oil, in the form of a vapor is carried into the air intake system with the blow-by gases (this engine oil also contributes to valve seat durability). This means that oil will collect inside the air intake components and the turbocharger. This is not an indication that the turbocharger oil seal has failed. The turbocharger oil seal will not fail unless the bearings fail first, which will cause the turbocharger to become noisy or seize. Do not install a new turbocharger due to oil inside the turbocharger or the air intake components. If a leak is detected in the oil supply or return tubes or

connections, locate and rectify the source. Do not install a new turbocharger due to an oil leak.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> <li>• Oil leak(s)</li> <li>• Air cleaner element</li> <li>• Air cleaner outlet pipe</li> <li>• Air cleaner intake pipe</li> <li>• Turbocharger oil supply or oil return tube</li> <li>• Turbocharger intake pipe</li> <li>• Turbocharger vacuum diaphragm unit</li> <li>• Turbocharger housing</li> <li>• Charge air cooler</li> <li>• Charge air cooler intake pipe and hose(s)</li> <li>• Charge air cooler outlet pipe and hose(s)</li> </ul>	<ul style="list-style-type: none"> <li>• Wiring harness</li> <li>• Boost control solenoid valve</li> <li>• Powertrain control module (PCM)</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

**NOTE:** The vacuum diaphragm unit is a fixed part of the turbocharger and cannot be adjusted or renewed.



## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>Blue smoke with excessive turbocharger noise</li> </ul>	<ul style="list-style-type: none"> <li>Turbocharger compressor rubbing on housing walls.</li> <li>Turbocharger turbine rubbing on housing walls.</li> <li>Turbocharger bearings and oil seal(s).</li> <li>Turbocharger oil supply tube blocked or damaged.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the turbocharger for signs of damage. INSTALL a new turbocharger as necessary.</li> <li>REFER to: <b>Turbocharger</b> (303-04 Fuel Charging and Controls - Turbocharger - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
<ul style="list-style-type: none"> <li>Blue smoke without excessive turbocharger noise</li> </ul>	<ul style="list-style-type: none"> <li>Turbocharger oil return tube blocked or damaged.</li> </ul>	<ul style="list-style-type: none"> <li>Check the oil return tube for blockage or damage, INSTALL a new oil return tube as necessary.</li> </ul>
<ul style="list-style-type: none"> <li>Poor engine performance</li> </ul>	<ul style="list-style-type: none"> <li>Vacuum diaphragm unit vacuum line(s).</li> </ul>	<ul style="list-style-type: none"> <li>CHECK all vacuum line(s) are installed and no signs of air leaks are present. REPAIR as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Charge air cooler system.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the charge air cooler, charge air cooler pipes and charge air cooler hoses for leaks and obstructions. REPAIR as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Air cleaner intake pipe.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the air cleaner intake pipe for obstruction. REPAIR the necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Unauthorized adjustment of the vacuum diaphragm unit actuator rod.</li> </ul>	<ul style="list-style-type: none"> <li>The turbocharger boost pressure is factory set and must not be adjusted. CHECK the paint seal on the vacuum diaphragm unit actuator rod has not been broken. If the paint seal has been broken, INSTALL a new turbocharger.</li> <li>REFER to: <b>Turbocharger</b> (303-04 Fuel Charging and Controls - Turbocharger - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> </ul>
	<ul style="list-style-type: none"> <li>Vacuum diaphragm unit actuator rod.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the vacuum diaphragm unit actuator rod moves freely, If the vacuum diaphragm unit actuator rod does not move freely. CHECK for signs of damage or signs of foreign material. REPAIR as necessary.</li> </ul>

REMOVAL AND INSTALLATION

Turbocharger(23 612 0)

General Equipment

Cable Ties
Hose Clamp Remover/Installer

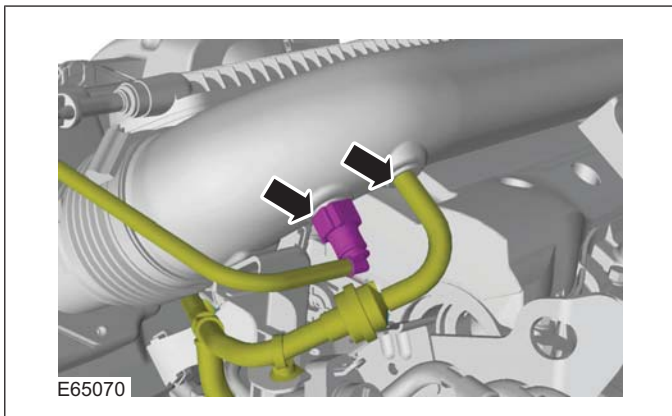
Materials

Name	Specification
Grease KS-PS	SA-M1C9107-A / YS5J-M1C9107-AA

Removal

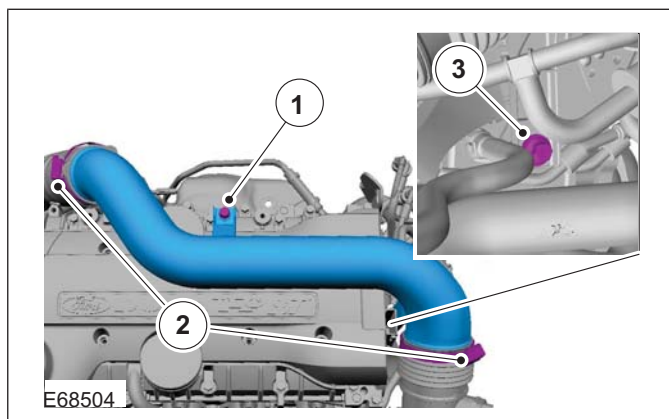
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: **Cooling System Draining and Vacuum Filling** (303-03 Engine Cooling, General Procedures).
3. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
- 4.

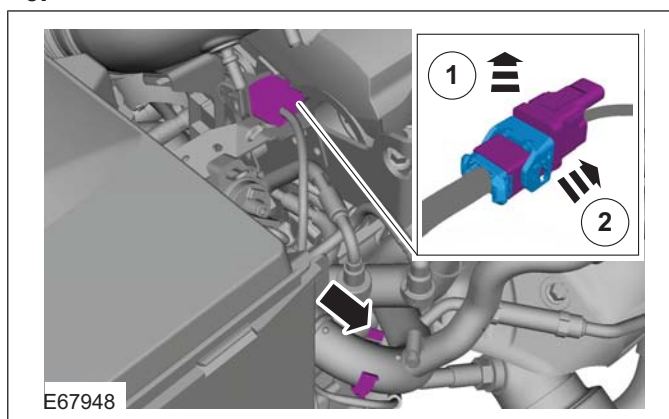


5. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

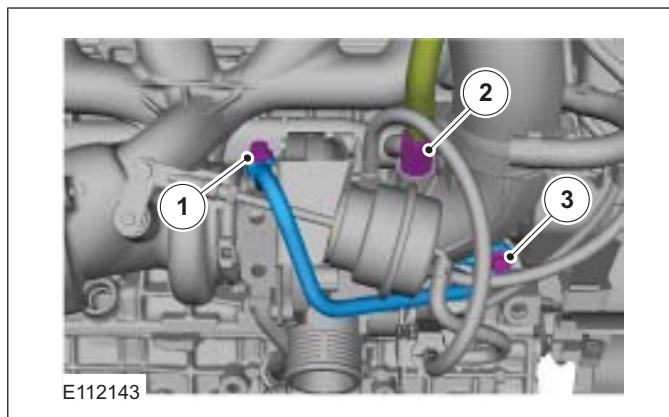
1. Torque: 10 Nm
2. Torque: 4 Nm
3. Torque: 10 Nm



- 6.

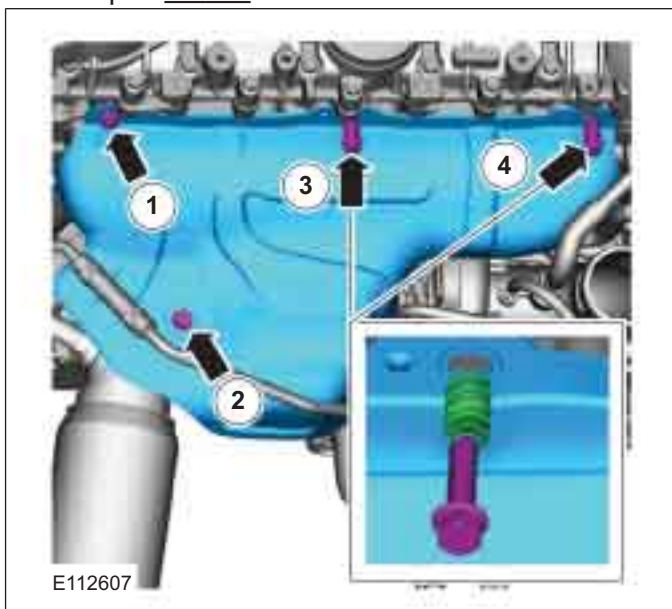


7. 1. Torque: 26 Nm
2. Torque: 26 Nm
3. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation). Torque: 38 Nm



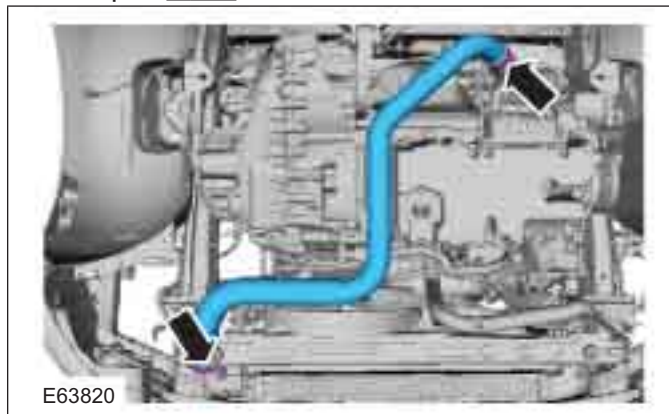
REMOVAL AND INSTALLATION

8. Torque: 24 Nm

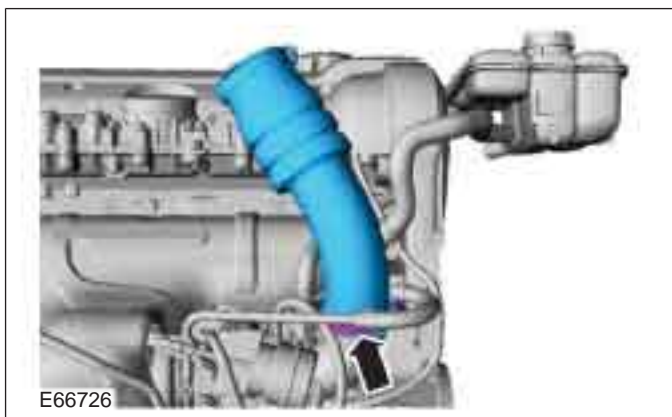


11. **⚠ CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

Torque: 4 Nm

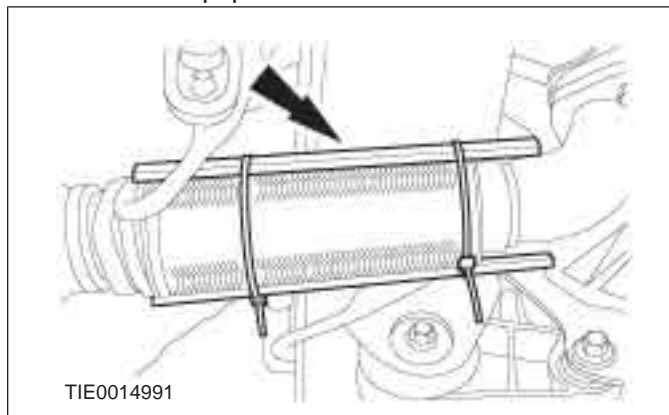


9. **⚠ CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

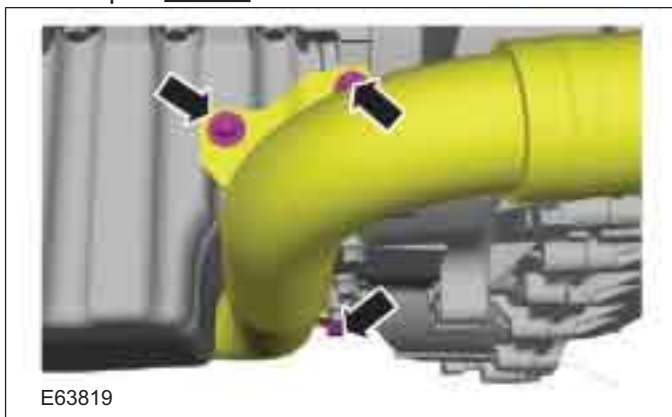


12

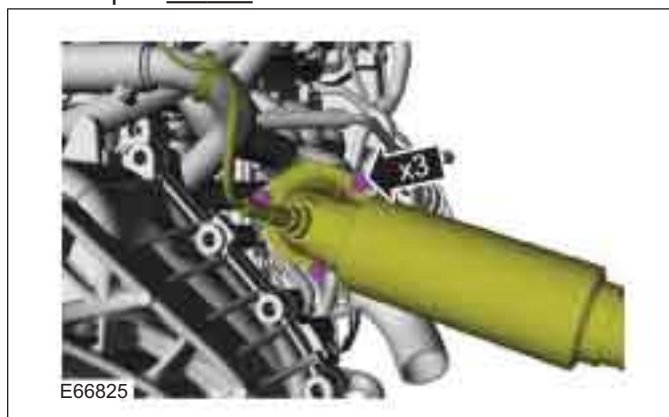
13. General Equipment: Cable Ties



10. Torque: 17 Nm



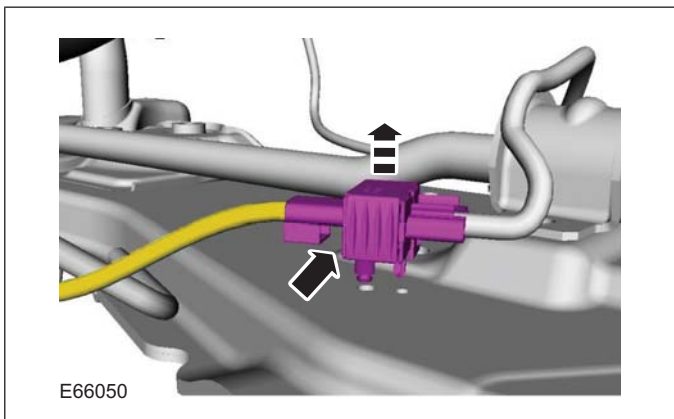
14. Torque: 28 Nm



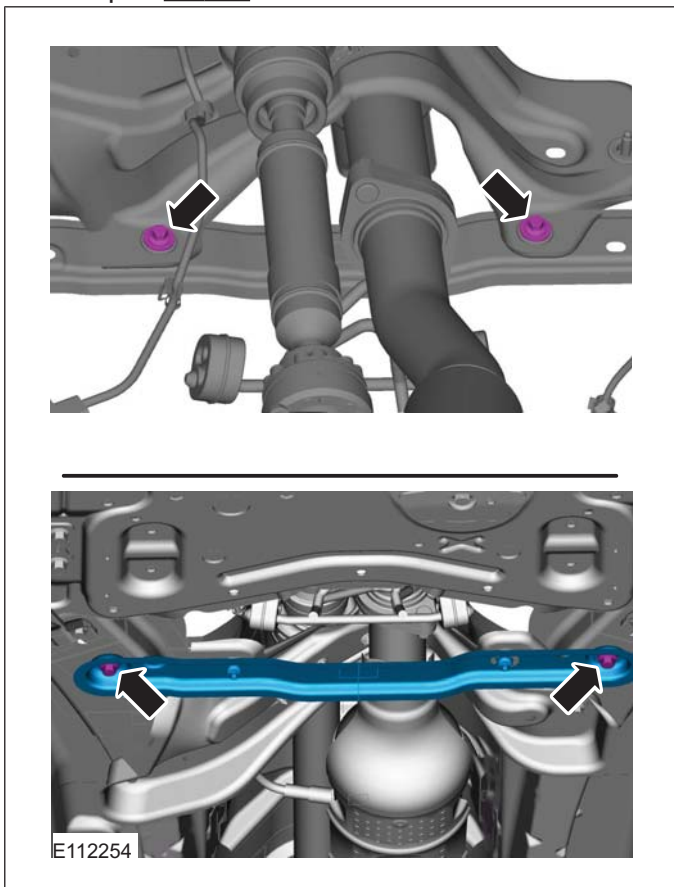


REMOVAL AND INSTALLATION

15.

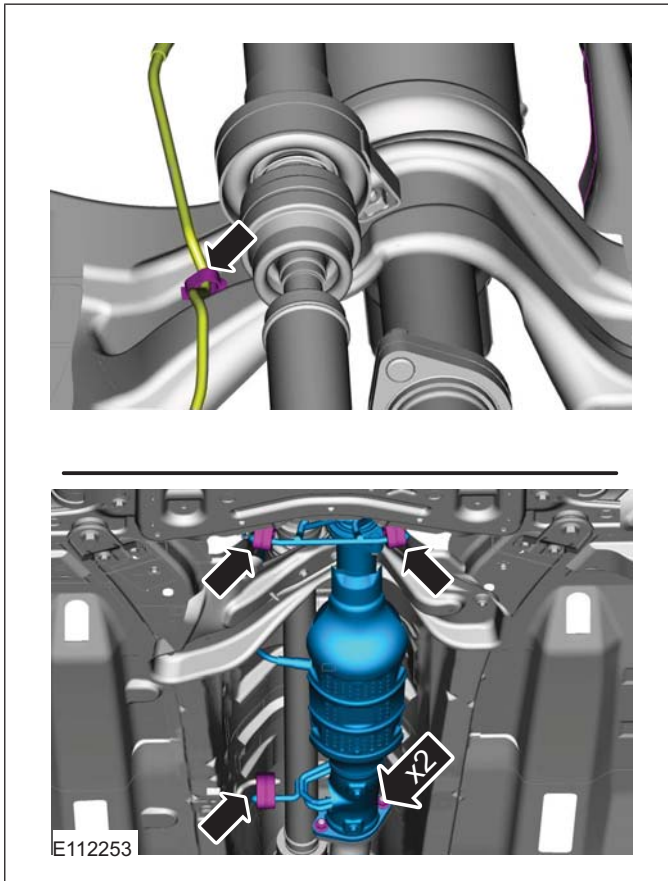


16. Torque: 24 Nm

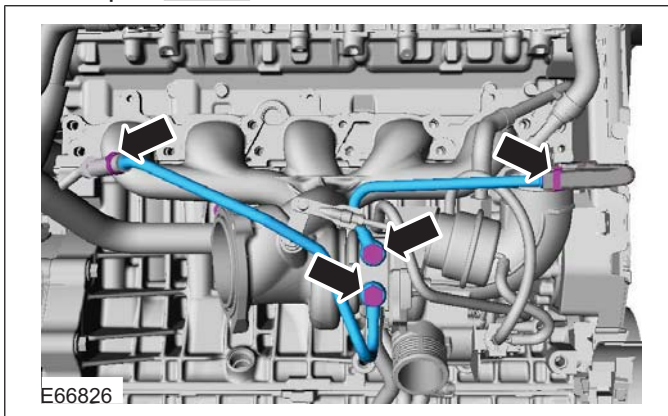


17. **⚠ CAUTION:** Make sure that the exhaust flexible pipe is not forcibly bent.

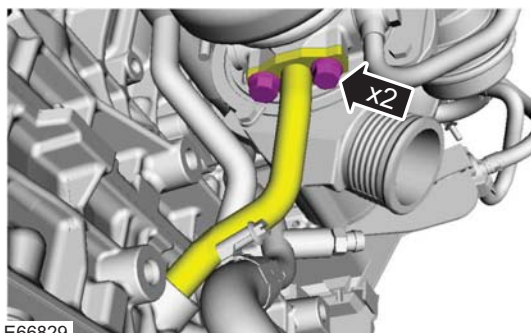
Material: Grease KS-PS (SA-M1C9107-A / YS5J-M1C9107-AA) grease  
Torque: 50 Nm



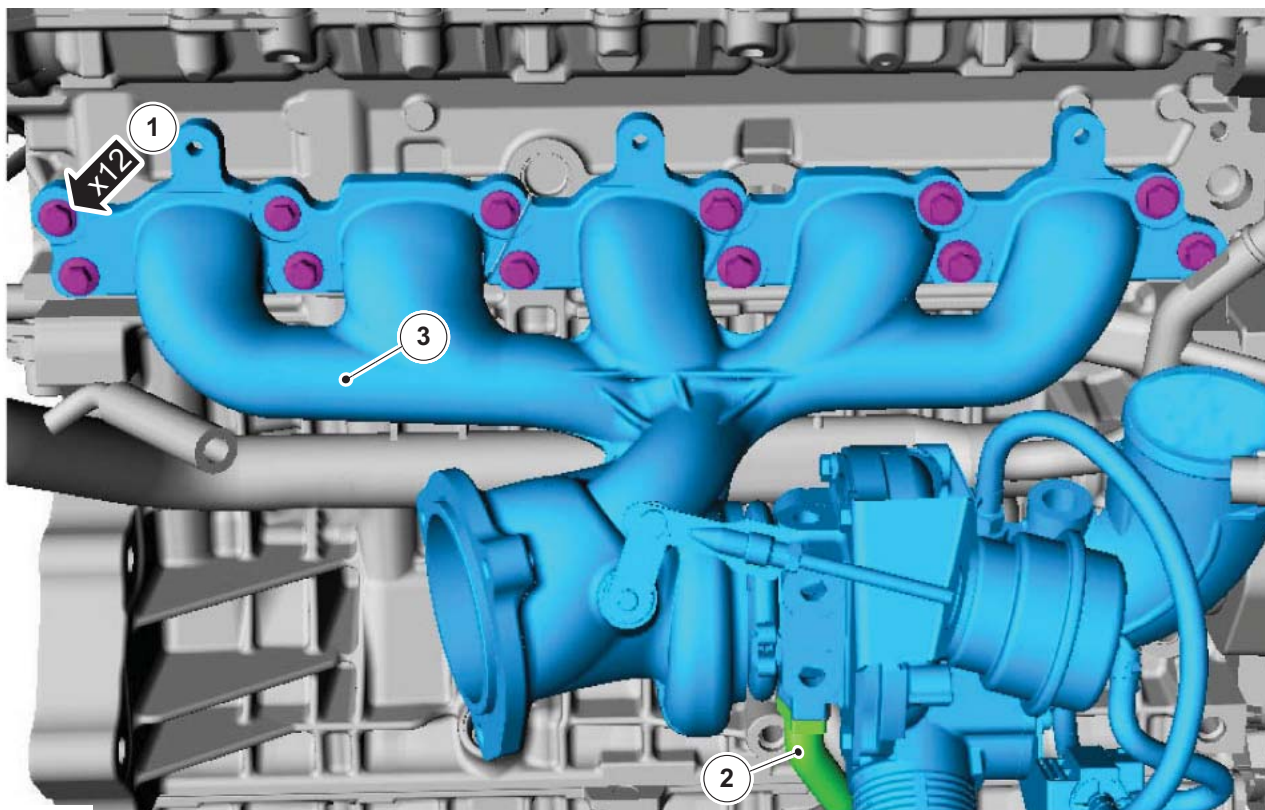
18. General Equipment: Hose Clamp  
Remover/Installer  
Torque: 38 Nm



## REMOVAL AND INSTALLATION

19. Torque: 12 Nm20. Torque: 24 Nm

E66829



E112772

## Installation

1. To install, reverse the removal procedure.
2. Refer to: **Door Window Motor Initialization** (501-11 Glass, Frames and Mechanisms, General Procedures).

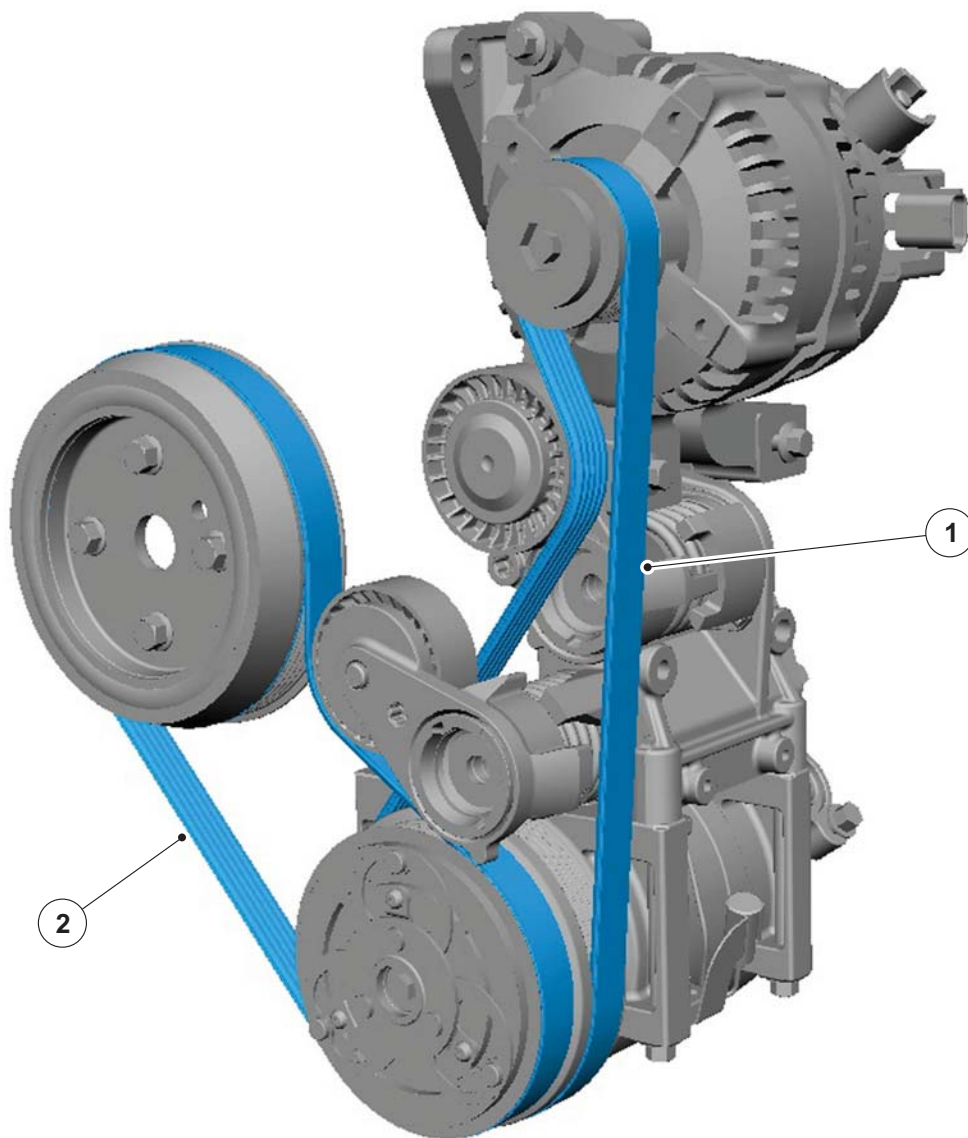


**SECTION 303-05 Accessory Drive** — 2.5L Duratec (147kW/200PS) - V15**VEHICLE APPLICATION: 2008.50 Kuga**

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DESCRIPTION AND OPERATION

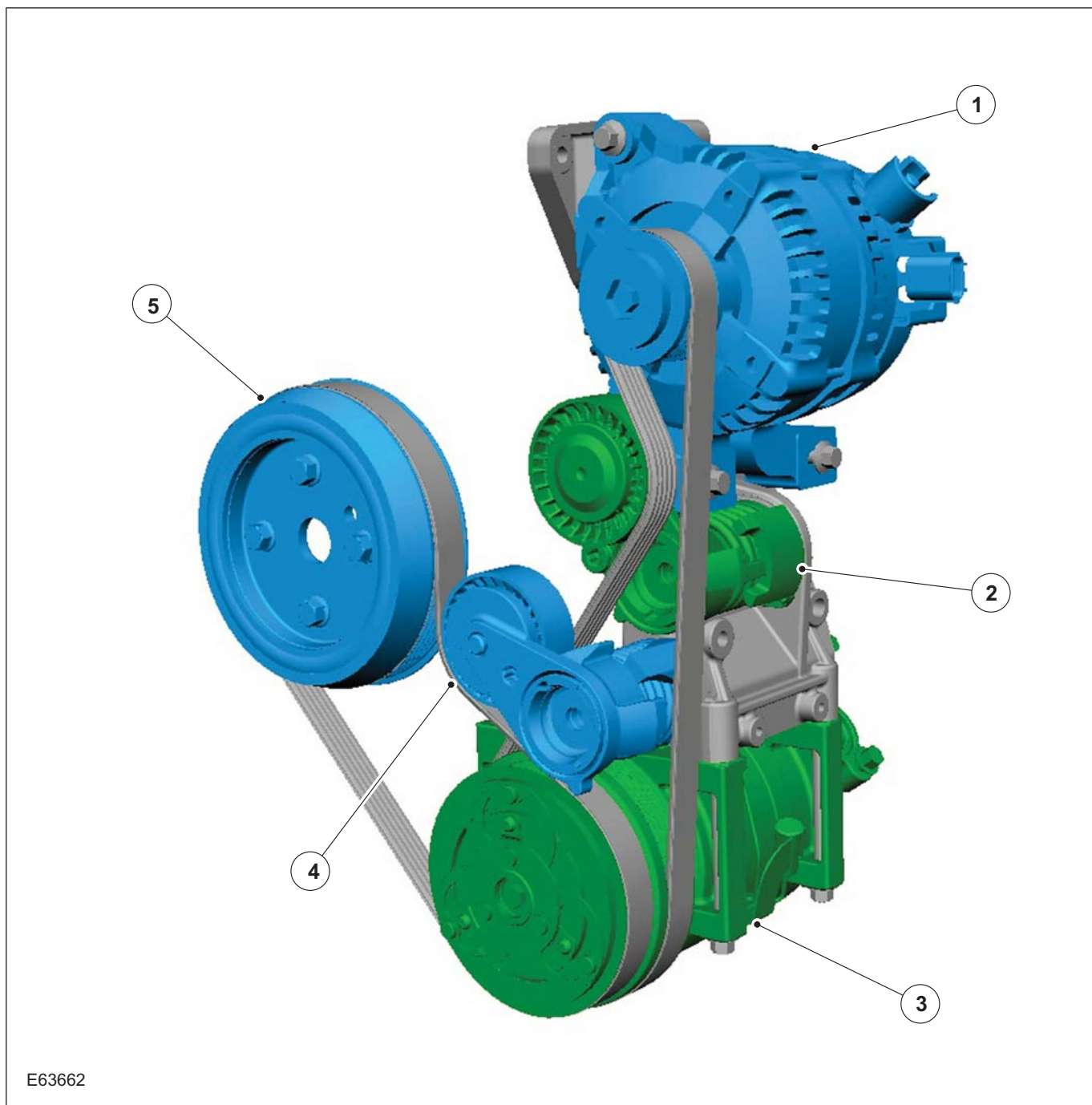
Accessory Drive



E63663

Item	Description
1	Accessory drive belt
2	Air conditioning (A/C) compressor belt

DESCRIPTION AND OPERATION



E63662

Item	Description
1	Generator
2	Accessory drive belt tensioner
3	A/C compressor
4	A/C drive belt tensioner
5	Crankshaft pulley

## DIAGNOSIS AND TESTING

## Accessory Drive

## Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical damage.

## Visual Inspection Chart

Mechanical
– Damaged or contaminated accessory drive belt or air conditioning (A/C) compressor belt
– Damaged or contaminated pulley(s)
– Incorrect accessory drive belt or A/C compressor belt
– Incorrect fitment of the accessory drive belt or A/C compressor belt
– Accessory drive belt tensioner
– Accessory drive belt idler pulley
– Generator
– A/C compressor
– A/C compressor belt tensioner
– Pulley(s)
– Loose hardware

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

## Accessory Drive Belt Concerns

**⚠ CAUTION:** Do not lubricate the accessory drive belt, accessory drive belt tensioner(s) or idler pulley(s) as potential damage to the accessory drive belt material construction, accessory drive belt tensioner damping mechanism, accessory drive belt tensioner pulley bearing and idler pulley(s) bearing may occur.

**NOTE:** All the diagnosis and testing information contained within this procedure can be used for the accessory drive belt and the A/C compressor belt.

## Cracking

Accessory drive belts are made from rubber which hardens with time and can develop cracks. As the accessory drive belt runs on the back of some of the pulleys, the cracks are opened up. Small cracks are not considered to be a failure of the accessory

drive belt. Only if the crack is deep enough to reach the bottom of the groove to expose the cord or any chunks are found to be missing from the accessory drive belt, is the accessory drive belt condition considered to be unacceptable.

1. Check the accessory drive belt for cracks. If the damage exceeds the acceptable limit, install a new accessory drive belt.

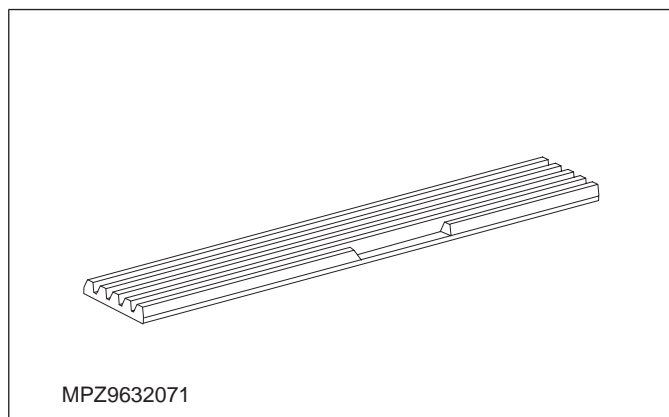
REFER to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

and/or

REFER to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

## Chunking

Chunking describes the condition where long lengths of rubber become detached from the ribs of the accessory drive belt. This is considered to be a failure of the accessory drive belt.



2. Check the accessory drive belt for damage. If any chunks are found to be missing, install a new accessory drive belt.

REFER to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

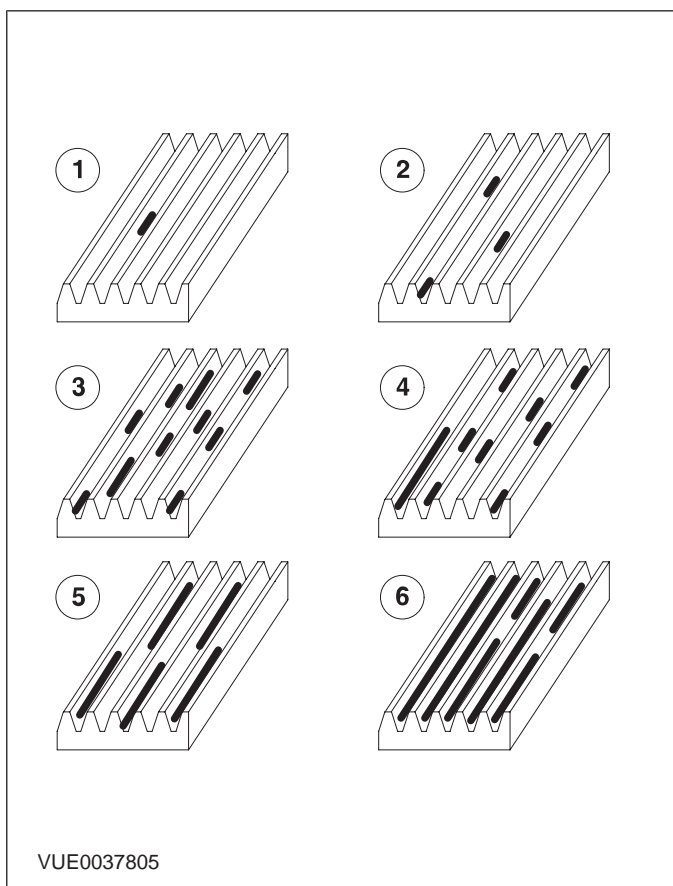
and/or

REFER to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

## DIAGNOSIS AND TESTING

## Pilling

Pilling is dust that forms in between the ribs of the accessory drive belt from rubber that is worn off the accessory drive belt when it is new. There may also be loose particles left on the accessory drive belt during the manufacturing process. These are worn off and form into small balls of rubber that then get trapped in the grooves of the accessory drive belt. This condition will usually clear itself within 4800 km - 8000 km (3000 miles - 5000 miles) of normal driving.



3. Check the accessory drive belt for pilling. The condition of the accessory drive belt should be compared against the illustration.

1. Small scattered pills. Not considered a concern. No action required.
2. Small scattered pills. Not considered a concern. No action required.
3. Longer pills up to 50% of the rib height. Possible noise concern. **INSTALL** a new accessory drive belt if noise is apparent.

REFER to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

and/or

REFER to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

4. Longer pills up to 50% of the rib height. Possible noise concern. **INSTALL** a new accessory drive belt if noise is apparent.

REFER to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

and/or

REFER to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

5. Heavy deposits in the grooves. Possible noise and stability concern. **INSTALL** a new accessory drive belt.

REFER to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

and/or

REFER to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

6. Heavy deposits in the grooves. Possible noise and stability concern. **INSTALL** a new accessory drive belt.

REFER to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

and/or

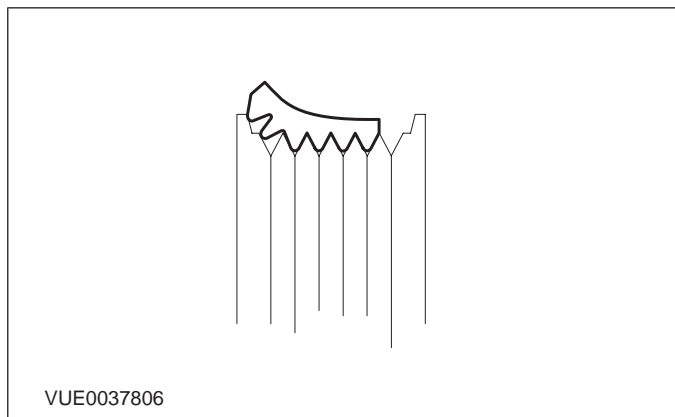
REFER to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

## Incorrect fitment

Accessory drive belt noise can be generated by the accessory drive belt being incorrectly fitted on the pulley as shown in the following illustration. Make sure that all the V grooves on the accessory drive belt contact correctly with the pulley.



DIAGNOSIS AND TESTING



4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>Accessory drive belt noise</li> </ul>	<ul style="list-style-type: none"> <li>Accessory drive system</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the system with the engine running and the accessory drive belt removed (only run the engine for a very short period). If a noise is apparent, the cause is not the accessory drive system. If a noise is not apparent, the cause is the accessory drive system. CHECK where the noise is coming from. Use a stethoscope or other listening device to determine the source of the noise. INSTALL new components as necessary. TEST the system for normal operation.</li> </ul>
	<ul style="list-style-type: none"> <li>Accessory drive belt incorrectly installed.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the accessory drive belt is correctly installed in the pulley grooves. INSTALL a new accessory drive belt as necessary.</li> <li>REFER to: <b>Accessory Drive Belt</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> <li>and/or</li> <li>REFER to: <b>Air Conditioning (A/C) Compressor Belt</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> <li>TEST the system for normal operation.</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Pulley(s).</li> <li>Lubricant or other contamination.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the pulley(s) for damage, freedom of rotation, stone entrapment and alignment. INSTALL new components as necessary. TEST the system for normal operation.</li> <li>CHECK the accessory drive belt for contamination or damage. RECTIFY the source of the leak and INSTALL a new accessory drive belt. REFER to: <b>Accessory Drive Belt</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). and/or REFER to: <b>Air Conditioning (A/C) Compressor Belt</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). TEST the system for normal operation.</li> </ul>
<p><b>NOTE:</b> Squeal is defined as a continuous shriek, most noticeable when the engine is being accelerated or with electrical load.</p> <ul style="list-style-type: none"> <li>Accessory drive belt squeal</li> </ul>	<ul style="list-style-type: none"> <li>Accessory drive belt tensioner worn, damaged or contaminated with oil.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the accessory drive belt tensioner for correct operation, damage or contamination. REFER to the Accessory Drive Belt Tensioner Component Test in this procedure. INSTALL a new accessory drive belt tensioner as necessary. REFER to: <b>Accessory Drive Belt Tensioner</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). or REFER to: <b>Air Conditioning (A/C) Compressor Belt Tensioner</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation). TEST the system for normal operation.</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
<p><b>NOTE:</b> Whine is defined as a continuous noise at the same frequency, generally associated with plastic pulleys.</p> <ul style="list-style-type: none"> <li>Accessory drive belt whine</li> </ul>	<ul style="list-style-type: none"> <li>Poor surface finish on accessory drive belt idler pulley flat surface(s).</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE the accessory drive belt.</li> <li>REFER to: <b>Accessory Drive Belt</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> <li>and/or</li> <li>REFER to: <b>Air Conditioning (A/C) Compressor Belt</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> <li>INSPECT the idler pulley(s) for surface finish. INSTALL a new idler pulley(s) as necessary.</li> <li>TEST the system for normal operation.</li> </ul>
	<ul style="list-style-type: none"> <li>Accessory drive belt idler pulley bearing failure.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE the accessory drive belt.</li> <li>REFER to: <b>Accessory Drive Belt</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> <li>and/or</li> <li>REFER to: <b>Air Conditioning (A/C) Compressor Belt</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</li> <li>INSPECT the idler pulley(s) for smooth rotation. INSTALL a new idler pulley(s) as necessary.</li> <li>TEST the system for normal operation.</li> </ul>
<p><b>NOTE:</b> Chirp is defined as a twittering noise, often intermittent</p> <ul style="list-style-type: none"> <li>Accessory drive belt chirp</li> </ul>	<ul style="list-style-type: none"> <li>Pulley misalignment (usually evident at idle).</li> </ul>	<ul style="list-style-type: none"> <li>CHECK that the accessory drive belt is running centrally on the flat pulleys. TEST the system for normal operation.</li> <li>CHECK the pulleys for excessive end float and bent flanges.</li> <li>With the engine running at idle, use a stethoscope to identify the source of the noise.</li> <li>INSTALL new components as necessary. TEST the system for normal operation.</li> </ul>

DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
<p><b>NOTE:</b> Rattle is defined as a metallic knocking noise</p> <ul style="list-style-type: none"> <li>Accessory drive belt rattle</li> </ul>	<ul style="list-style-type: none"> <li>Accessory drive belt tensioner hitting the end stops.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the accessory drive belt tensioner for correct operation or damage. REFER to the Accessory Drive Belt Tensioner Component Test in this procedure. INSTALL a new accessory drive belt tensioner as necessary.</li> </ul> <p>REFER to: <b>Accessory Drive Belt Tensioner</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p> <p>or</p> <p>REFER to: <b>Air Conditioning (A/C) Compressor Belt Tensioner</b> (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p> <p>TEST the system for normal operation.</p>
	<ul style="list-style-type: none"> <li>Loose components or hardware.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the components or hardware for correct installation and tighten as necessary. TEST the system for normal operation.</li> </ul>

Component Tests

Accessory Drive Belt Tensioner - Static Check

The accessory drive belt tensioner may be checked statically as follows:

1. Inspect the area surrounding the accessory drive belt tensioner for lubricant or other contamination. Rectify any leaks before installing a new accessory drive belt tensioner. If the accessory drive belt tensioner is contaminated, do not attempt to clean it as the damping mechanism inside may be damaged. INSTALL a new accessory drive belt tensioner as necessary.

REFER to: **Accessory Drive Belt Tensioner** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

or

REFER to: **Air Conditioning (A/C) Compressor Belt Tensioner** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

TEST the system for normal operation.

2. Detach the accessory drive belt in the area of the accessory drive belt tensioner.
3. **NOTE: The accessory drive belt tensioner has a damping feature, which is usually a friction device, therefore some friction within the system is normal.**

Using the correct tool, move the accessory drive belt tensioner from its relaxed position through its full stroke and back to the relaxed position to make sure there is no excessive stick, grab or bind, and to make sure there is tension on the accessory drive belt tensioner spring.

4. Rotate the accessory drive belt tensioner pulley and check for damage, freedom of rotation and

**DIAGNOSIS AND TESTING**

alignment. INSTALL a new accessory drive belt tensioner as necessary.

REFER to: **Accessory Drive Belt Tensioner** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

or

REFER to: **Air Conditioning (A/C) Compressor Belt Tensioner** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

TEST the system for normal operation.

5. If the accessory drive belt tensioner meets the above criteria, proceed to test the accessory drive belt tensioner dynamically. If the accessory drive belt tensioner does not meet the above criteria, INSTALL a new accessory drive belt tensioner.

REFER to: **Accessory Drive Belt Tensioner** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

or

REFER to: **Air Conditioning (A/C) Compressor Belt Tensioner** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

TEST the system for normal operation.

or

REFER to: **Air Conditioning (A/C) Compressor Belt Tensioner** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

TEST the system for normal operation.

2. Excessive accessory drive belt rideout (uneven depth of grooves in the accessory drive belt) may cause excessive accessory drive belt tensioner movement. Check the condition by installing a new accessory drive belt.

REFER to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

and/or

REFER to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

TEST the system for normal operation.

**Accessory Drive Belt Tensioner - Dynamic Check**

The accessory drive belt tensioner may be checked dynamically as follows:

1. With the engine running, observe the accessory drive belt tensioner movement. The accessory drive belt tensioner should move (respond) when the engine is accelerated rapidly or when the A/C clutch cycles ON and OFF (the degree of movement can be up to 4 mm). If the accessory drive belt tensioner movement is not constant without engine acceleration or A/C clutch cycling, a pulley or shaft is possibly bent, out of round, or the damping mechanism inside the accessory drive belt tensioner may be damaged. INSTALL a new accessory drive belt tensioner as necessary.

REFER to: **Accessory Drive Belt Tensioner** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).



## REMOVAL AND INSTALLATION

## Accessory Drive Belt Tensioner(21 569 0)

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

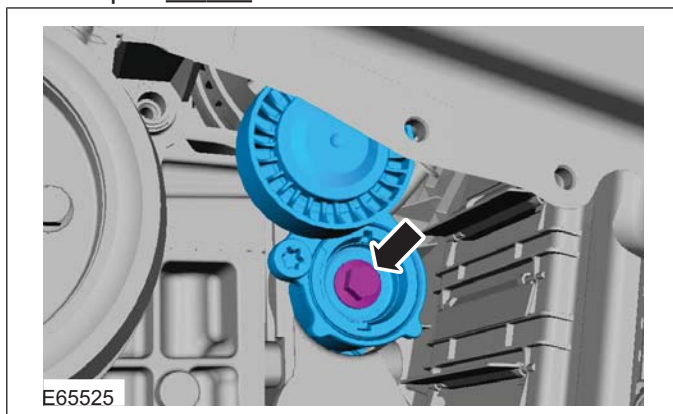
1. Remove the air conditioning (A/C) compressor belt tensioner.

Refer to: **Air Conditioning (A/C) Compressor Belt Tensioner** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

2. Remove the accessory drive belt.

Refer to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

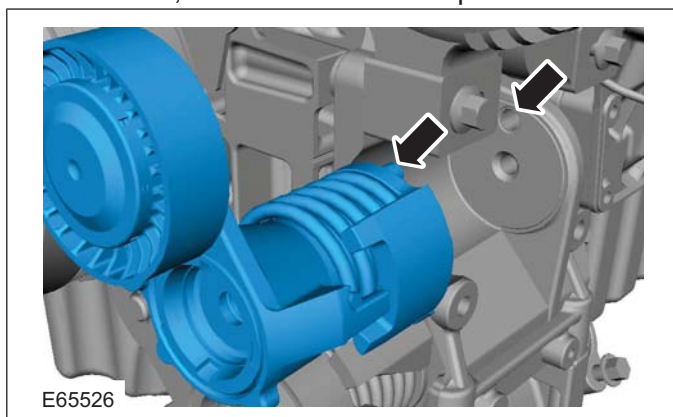
3. Torque: 45 Nm



## Installation

1. **NOTE:** Make sure that the belt tensioner is aligned to the belt tensioner bracket.

To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

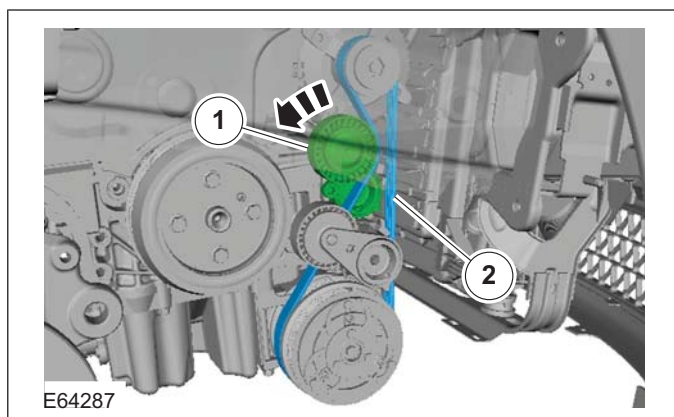
## Accessory Drive Belt(21 567 0)

## Removal

1. Remove the air conditioning (A/C) compressor belt.

Refer to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

2.



## Installation

1. To install, reverse the removal procedure.

303-05-13

Accessory Drive — 2.5L Duratec (147kW/200PS) - VI5

303-05-13

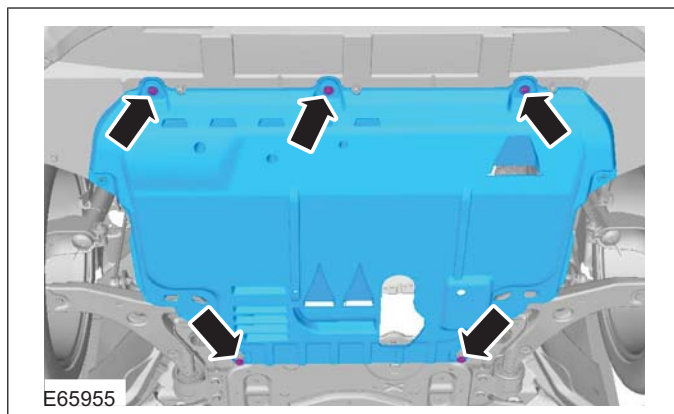
## REMOVAL AND INSTALLATION

## Air Conditioning (A/C) Compressor Belt(21 567 0)

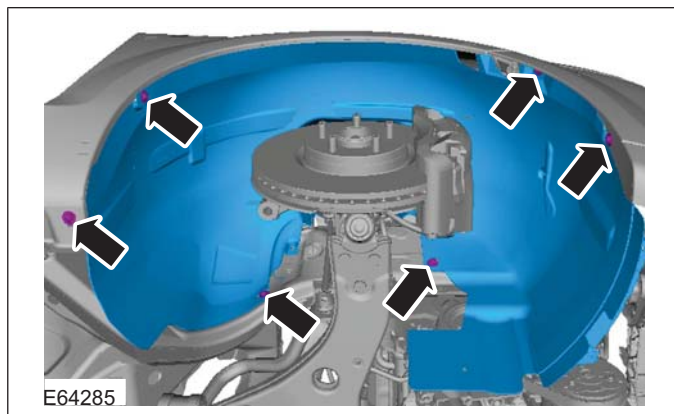
## Removal

1. Remove the right-hand front wheel and tire.  
Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

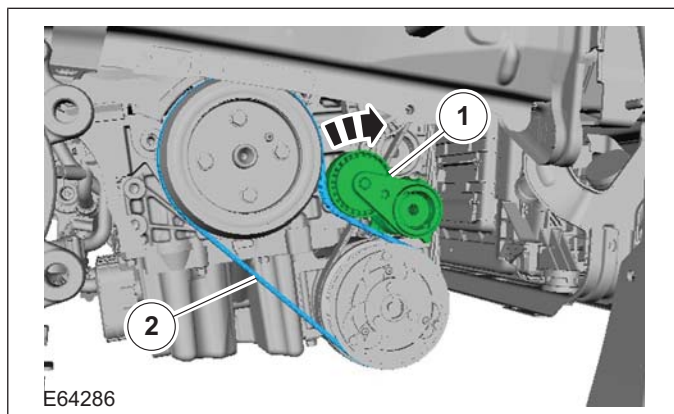
2.



3.



4.



## Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Air Conditioning (A/C) Compressor Belt Tensioner

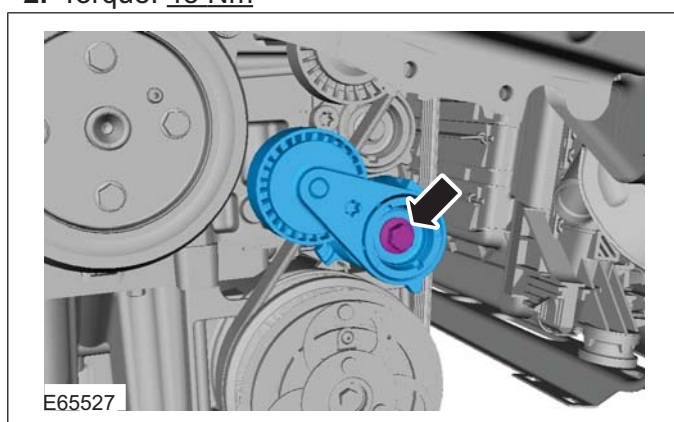
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Remove AC compressor belt.

Refer to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

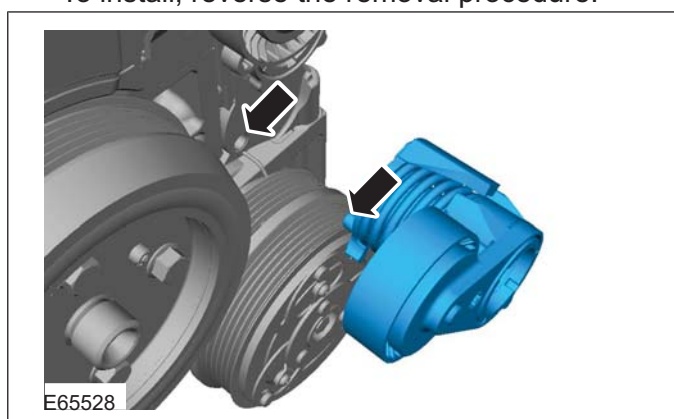
2. Torque: 45 Nm



## Installation

1. **NOTE:** Make sure that the belt tensioner is aligned to the belt tensioner bracket.

To install, reverse the removal procedure.



## SECTION 303-06 Starting System — 2.5L Duratec (147kW/200PS) - VI5

**VEHICLE APPLICATION: 2008.50 Kuga**

CONTENTS	PAGE
<b>DESCRIPTION AND OPERATION</b>	
Starting System (Component Location).....	303-06-2
Starting System (System Operation and Component Description).....	303-06-3
System Diagram.....	303-06-3
System Operation.....	303-06-8
Smart Start.....	303-06-8
Emergency starting function.....	303-06-8
<b>DIAGNOSIS AND TESTING</b>	
Starting System.....	303-06-9
Inspection and Verification.....	303-06-9
<b>REMOVAL AND INSTALLATION</b>	
Starter Motor..... (26 204 0)	303-06-10
Start Inhibit Switch.....	303-06-11



303-06-2

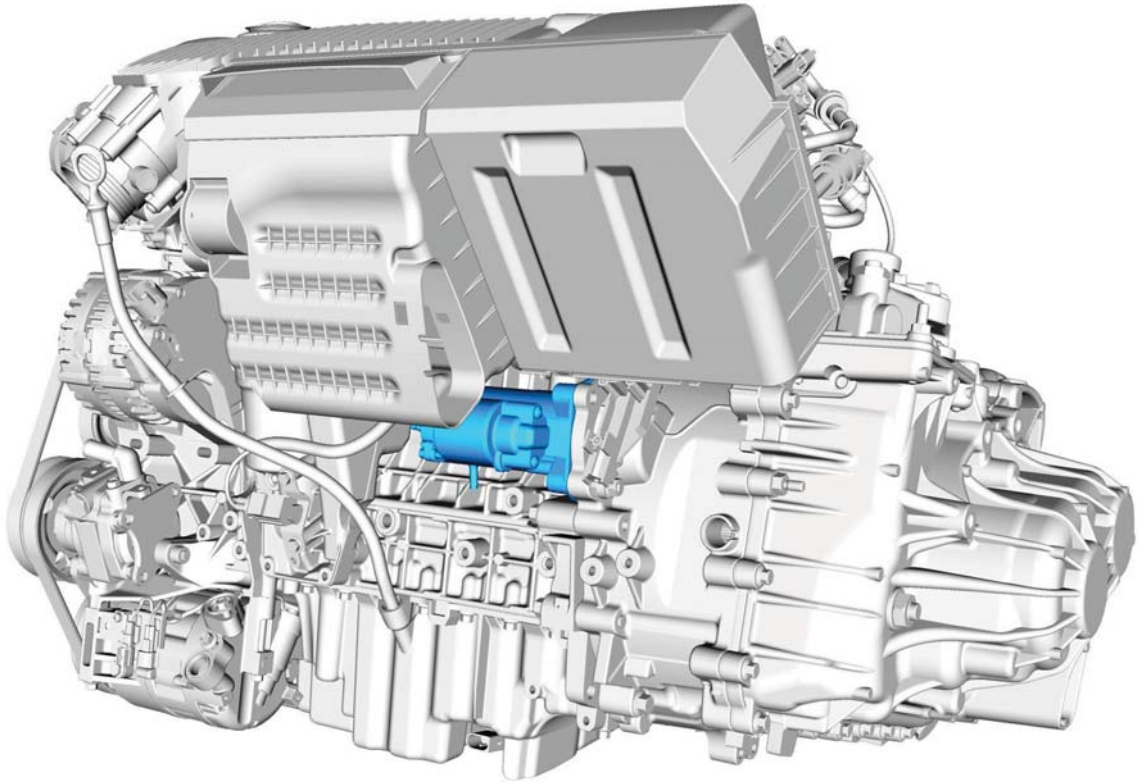
Starting System — 2.5L Duratec (147kW/200PS) - VI5

303-06-2

## DESCRIPTION AND OPERATION

## Starting System – Component Location

2.5L Duratec (VI5)



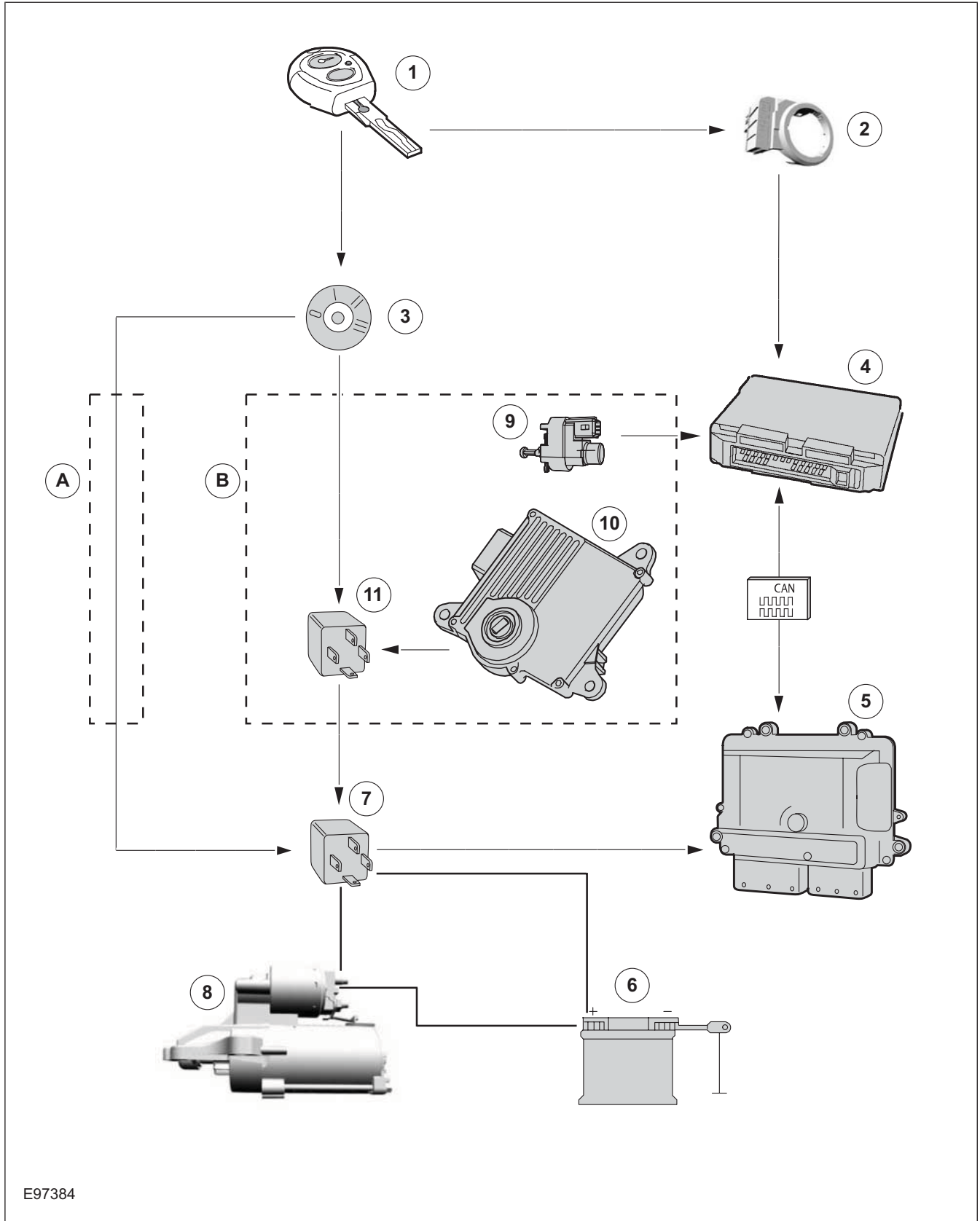
E97220

DESCRIPTION AND OPERATION

Starting System – System Operation and Component Description

System Diagram

Starter system with ignition key



E97384

303-06-4

## Starting System — 2.5L Duratec (147kW/200PS) - VI5

303-06-4

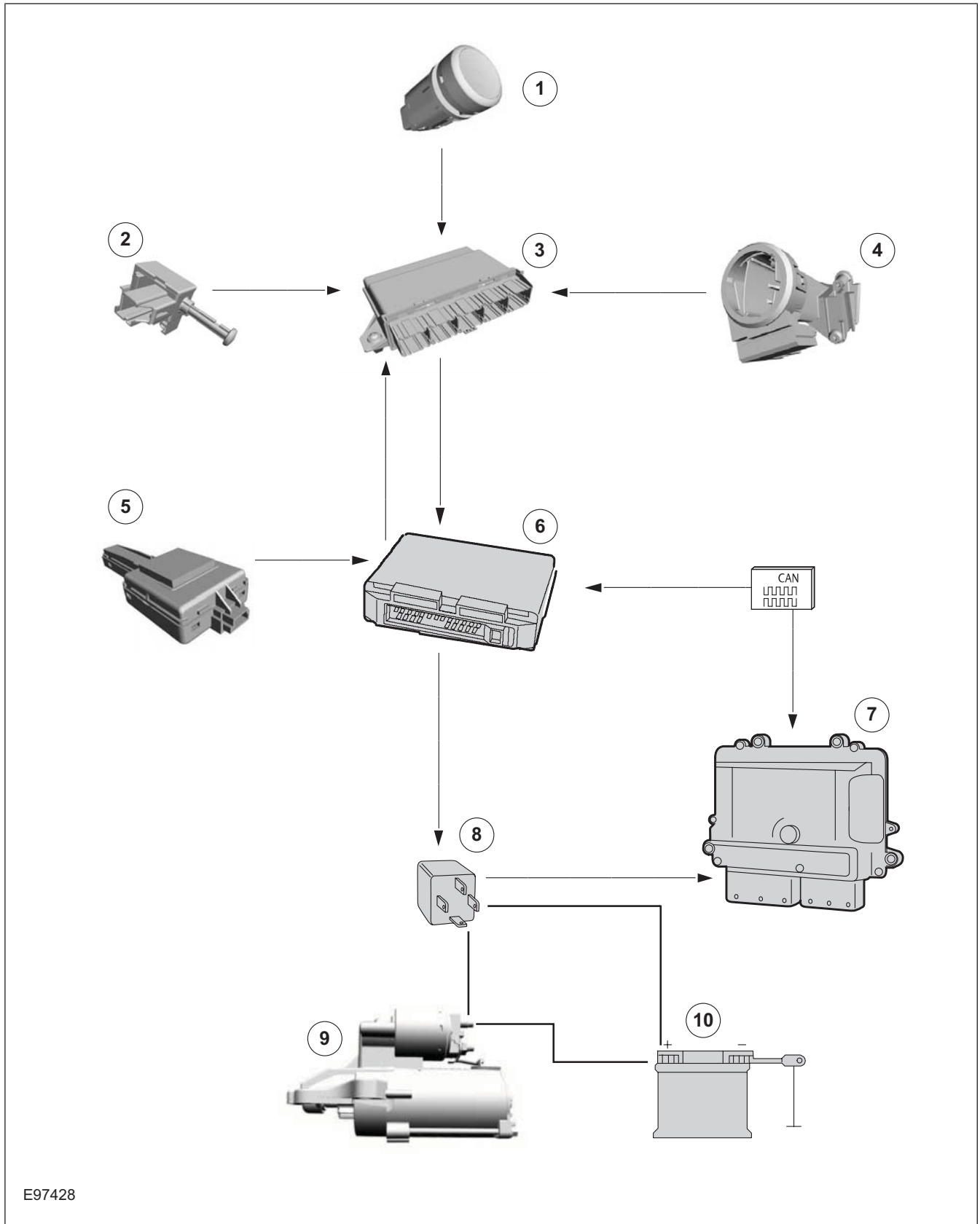
## DESCRIPTION AND OPERATION

Item	Description
A	Vehicles with manual transaxle.
B	If equipped with an automatic transaxle.
1	Ignition key <b>Comments:</b> With transponder for PATS (passive anti-theft system)
2	PATS
3	Ignition lock
4	GEM (generic electronic module)
5	PCM (powertrain control module)
6	Battery

Item	Description
7	Starter relay
8	Starter motor
9	Stoplight Switch <b>Comments:</b> If equipped with an automatic transaxle.
10	TCM (transmission control module) <b>Comments:</b> If equipped with an automatic transaxle.
11	Starting deactivation relay <b>Comments:</b> If equipped with an automatic transaxle.

DESCRIPTION AND OPERATION

Keyless starting system (vehicles with manual transmission)



E97428

303-06-6

## Starting System — 2.5L Duratec (147kW/200PS) - VI5

303-06-6

## DESCRIPTION AND OPERATION

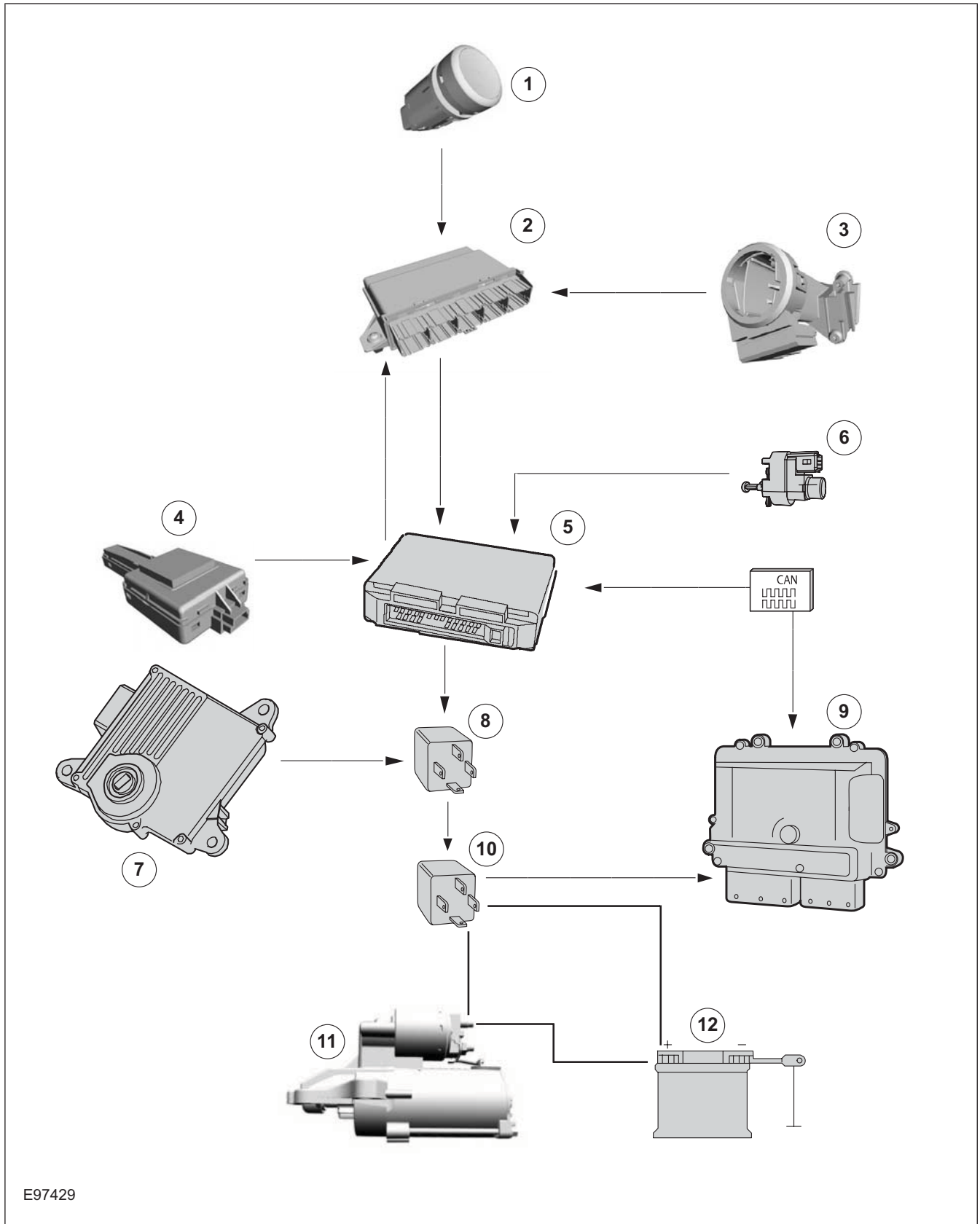
Item	Description
1	Start/stop button
2	CPP (clutch pedal position) switches <b>Comments:</b> Switches when the clutch pedal is operated
3	Keyless vehicle module
4	Electronic steering lock with mount - passive key and PATS transmitter/receiver unit <b>Comments:</b> for emergency start function

Item	Description
5	Radio frequency receiver <b>Comments:</b> Signal is only executed in GEM
6	GEM
7	PCM
8	Starter relay
9	Starter motor
10	Battery



DESCRIPTION AND OPERATION

Keyless starting system (vehicles with automatic transmission)



E97429

## DESCRIPTION AND OPERATION

Item	Description
1	Start/stop button
2	Keyless vehicle module
3	Electronic steering lock with mount - passive key and PATS transmitter/receiver unit <b>Comments:</b> for emergency start function
4	Radio frequency receiver <b>Comments:</b> Signal is only executed in GEM

Item	Description
5	GEM
6	Stoplight Switch
7	TCM
8	Starting deactivation relay
9	PCM
10	Starter relay
11	Starter motor
12	Battery

## System Operation

## Smart Start

The PCM enables the starting process when a key providing a valid code is read via the PATS. This code is then verified in the GEM and compared with the saved code. If this code is recognized as correct, synchronization with other modules is carried out. After successful synchronization, the engine is cleared to start in the PCM. The PCM connects earth to the starter relay, which then connects power to the starter solenoid. As soon as the engine reaches a certain speed, the PCM disconnects the starter relay and so turns off the starter. This protects the starter.

If the engine does not turn or turns only slowly, the starting process is aborted by the PCM.

The starter is **not** activated if:

- the engine is running (i.e. the engine speed is above a particular value),
- the PATS does not permit the engine to be started,
- the clutch pedal is not operated (vehicles with manual transmission),
- the gear selector level is not set to P or N (vehicles with automatic transmission),
- the brake pedal is not operated (vehicles with automatic transmission).

## Emergency starting function

If the keyless vehicle system is unable to recognize the passive key, the vehicle can be started via the emergency starting function.

In this case, there is a passive key mount on the steering wheel. A PATS transmission/reception unit is attached to this.

To start the engine, the passive key must be inserted into the passive key mount. The Start/Stop button can then be used to turn on the ignition and start the engine as normal. To deactivate the PATS, a transponder is fitted in the passive key, which is read by the transmission/reception unit.

**DIAGNOSIS AND TESTING****Starting System**

Refer to **Wiring Diagrams Section 303-06**, for schematic and connector information.

**General Equipment**

Ford diagnostic equipment
---------------------------

**Inspection and Verification**

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

**Visual Inspection Chart**

Electrical
<ul style="list-style-type: none"><li>• Fuse(s)</li><li>• Wiring harness</li><li>• Electrical connector(s)</li><li>• Relay</li><li>• Switch(es)</li><li>• Battery junction box (BJB)</li><li>• Engine junction box (EJB)</li><li>• Central junction box (CJB)</li><li>• Keyless vehicle module (KVM) (if equipped)</li><li>• Battery</li><li>• Starter motor</li><li>• Powertrain Control Module (PCM)</li></ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford diagnostic equipment.

303-06-10

Starting System — 2.5L Duratec (147kW/200PS) - V15

303-06-10

## REMOVAL AND INSTALLATION

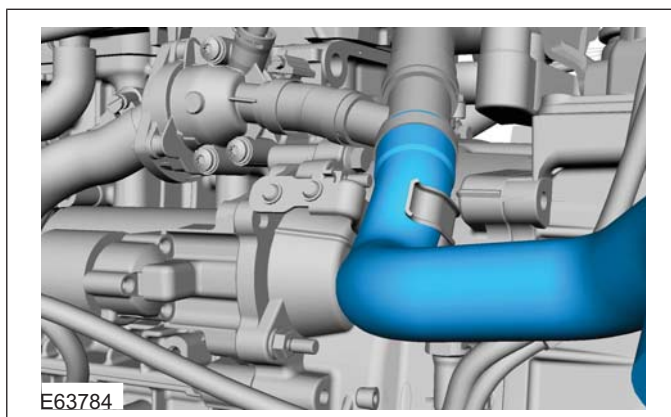
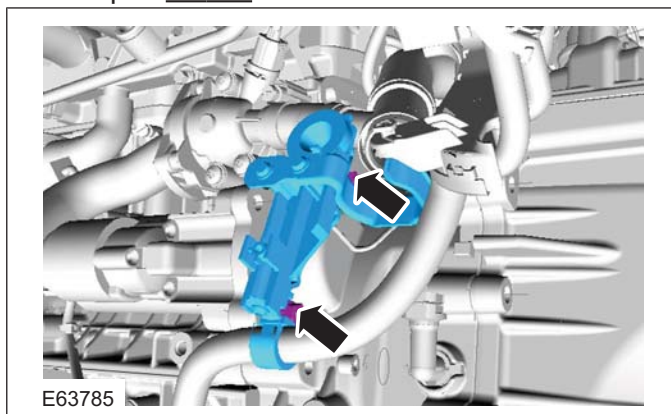
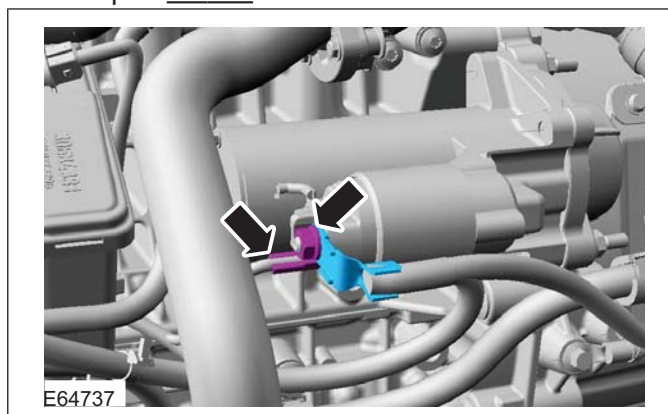
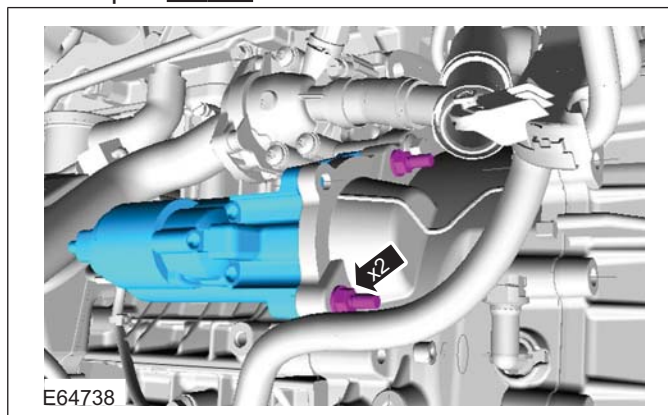
## Starter Motor(26 204 0)

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: **Air Cleaner** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - V15, Removal and Installation).

3.

4. Torque: 10 Nm5. Torque: 12 Nm6. Torque: 50 Nm

## Installation

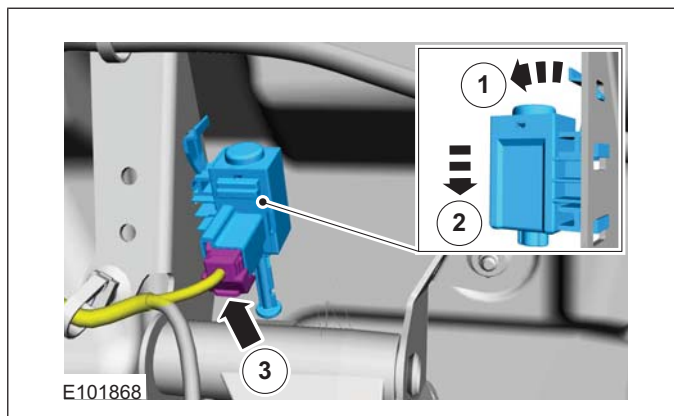
1. To install, reverse the removal procedure.
2. Refer to: **Door Window Motor Initialization** (501-11 Glass, Frames and Mechanisms, General Procedures).

## REMOVAL AND INSTALLATION


## Start Inhibit Switch

## Removal

1.  **CAUTION:** Make sure that the clutch pedal remains in the rest position.



## Installation

1.  **CAUTION:** Make sure that the clutch pedal remains in the rest position.  
To install, reverse the removal procedure.



**SECTION 303-07 Engine Ignition — 2.5L Duratec (147kW/200PS) - VI5****VEHICLE APPLICATION: 2008.50 Kuga**

CONTENTS	PAGE
<b>SPECIFICATIONS</b>	
Specifications.....	303-07-2
Spark plugs.....	303-07-2
<b>DIAGNOSIS AND TESTING</b>	
Engine Ignition.....	303-07-3
Inspection and Verification.....	303-07-3
Symptom Chart.....	303-07-3
<b>REMOVAL AND INSTALLATION</b>	
Ignition Coil-On-Plug..... (22 414 0)	303-07-4

303-07-2

**Engine Ignition** — 2.5L Duratec (147kW/200PS) - VI5

303-07-2

**SPECIFICATIONS****Spark plugs**

Description	mm
Spark plug gap	0.7

**Torque Specifications**

Item	Nm	lb-ft	lb-in
Spark plug	28		

## DIAGNOSIS AND TESTING

## Engine Ignition

## General Equipment

Ford diagnostic equipment
---------------------------

## Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

## Visual Inspection Chart

Electrical
<ul style="list-style-type: none"> <li>• Circuit(s)</li> <li>• Wiring harness</li> <li>• Electrical connector(s)</li> <li>• Spark plug(s)</li> <li>• Ignition coil-on-plug(s)</li> <li>• Powertrain control module (PCM)</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

## Symptom Chart

Symptom	Possible Sources	Action
• Engine misfire	• Spark plug(s).	• CARRY OUT a KV test using the Ford diagnostic equipment.
	• Circuit(s). • Ignition coil-on-plug(s). • PCM. • PCM calibration.	• REFER to the Ford diagnostic equipment.
• Engine stumbling	• Spark plug(s).	• CARRY OUT a KV test using the Ford diagnostic equipment.
	• Circuit(s). • Ignition coil-on-plug(s). • PCM. • PCM calibration.	• REFER to the Ford diagnostic equipment.
• Engine lacks power	• Spark plug(s).	• CARRY OUT a KV test using the Ford diagnostic equipment.
	• Circuit(s). • Ignition coil-on-plug(s).	• REFER to the Ford diagnostic equipment.

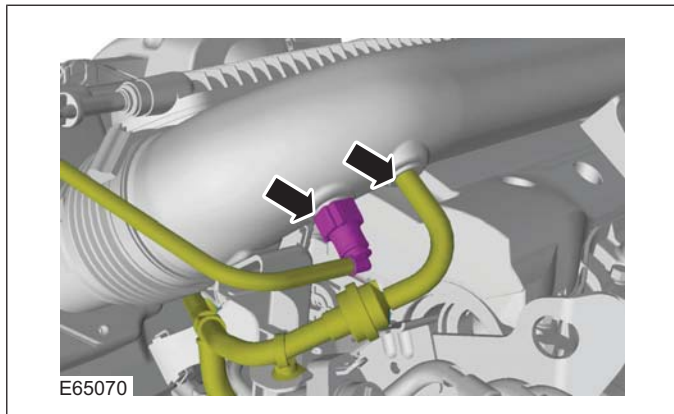
REMOVAL AND INSTALLATION

Ignition Coil-On-Plug(22 414 0)

Removal

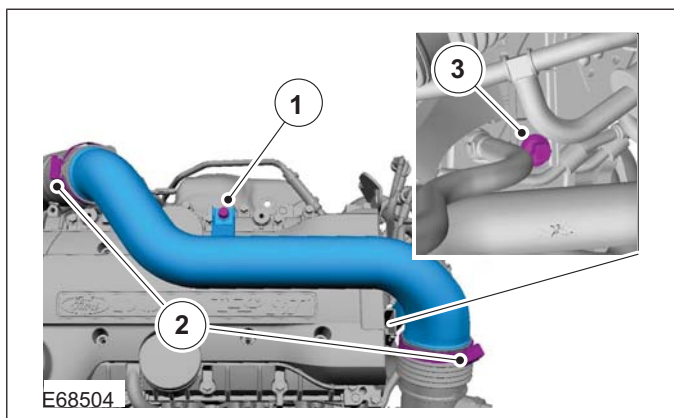
**NOTE:** Removal steps in this procedure may contain installation details.

1. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

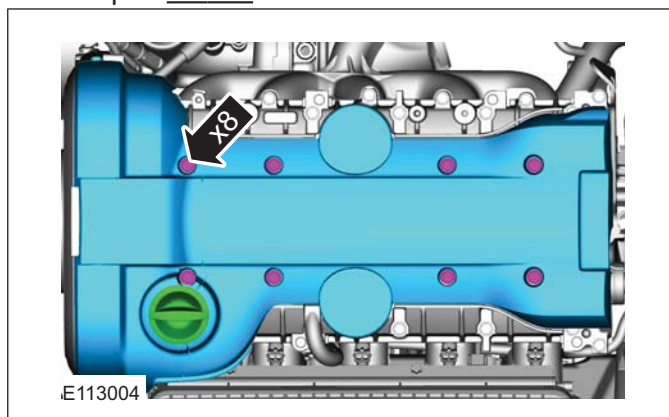


2. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

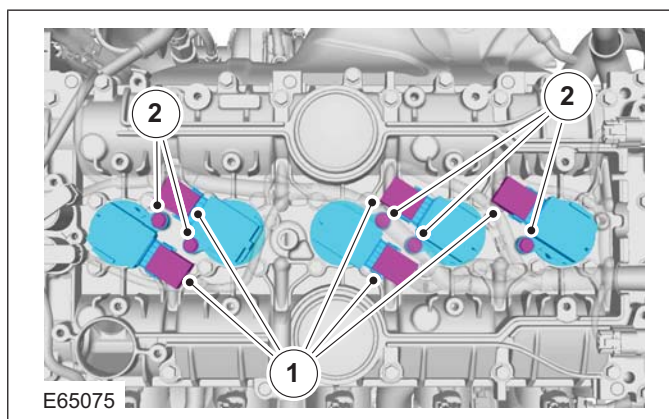
1. Torque: 10 Nm
2. Torque: 4 Nm
3. Torque: 10 Nm



3. Torque: 10 Nm



4. 2. Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.



# SECTION 303-08 Engine Emission Control — 2.5L Duratec

(147kW/200PS) - VI5

**VEHICLE APPLICATION: 2008.50 Kuga**

CONTENTS	PAGE
<b>DESCRIPTION AND OPERATION</b>	
Engine Emission Control.....	303-08-2
2.5L Duratec-ST (VI5).....	303-08-2
<b>DIAGNOSIS AND TESTING</b>	
Engine Emission Control.....	303-08-4
Inspection and Verification.....	303-08-4
Symptom Chart.....	303-08-4





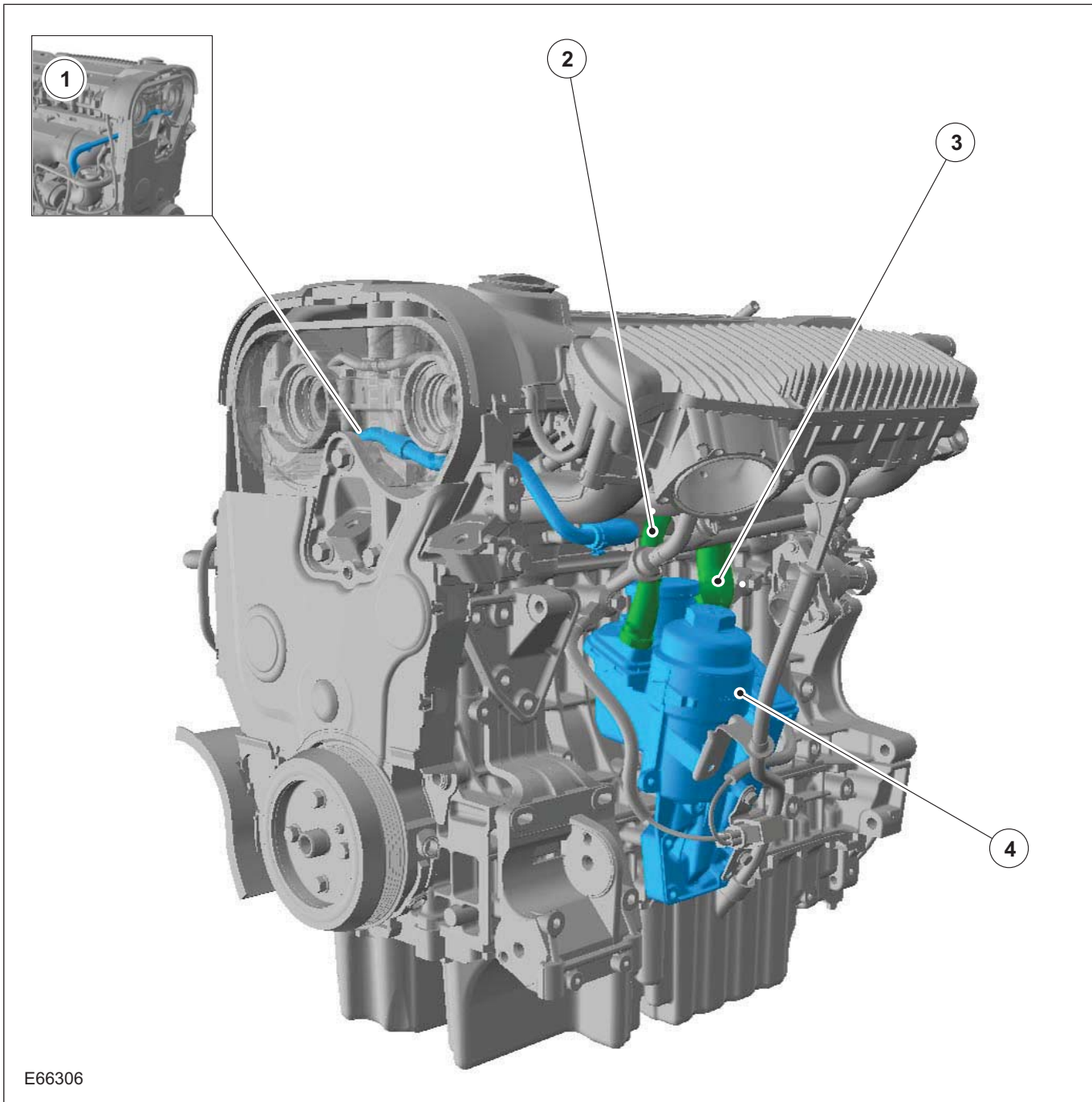


DESCRIPTION AND OPERATION

Engine Emission Control

2.5L Duratec-ST (VI5)

Engine Emission Components



**DESCRIPTION AND OPERATION**

Item	Description
1	Intake manifold to turbocharger breather hose
2	Crankcase vent oil separator to valve cover hose
3	Crankcase vent oil separator to intake manifold hose
4	Crankcase vent oil separator

## DIAGNOSIS AND TESTING

## Engine Emission Control

## Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical damage.
3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

## Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> <li>– Hose(s)/hose joints</li> <li>– Gasket(s)</li> <li>– Positive crankcase ventilation (PCV) valve</li> <li>– PCV crankcase vent oil separator</li> <li>– Turbocharger</li> </ul>	<ul style="list-style-type: none"> <li>– Electrical connector(s)</li> <li>– Wiring harness</li> <li>– Fuse(s)</li> <li>– Relay</li> <li>– Powertain control module (PCM)</li> </ul>

## Symptom Chart

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>• Excessive crankcase pressure</li> </ul>	<ul style="list-style-type: none"> <li>• Blocked PCV crankcase vent oil separator.</li> <li>• Blocked PCV hose.</li> </ul>	<ul style="list-style-type: none"> <li>• CLEAN or INSTALL new PCV components as necessary. TEST the system for normal operation.</li> </ul>
	<ul style="list-style-type: none"> <li>• Engine.</li> </ul>	<ul style="list-style-type: none"> <li>• Worn or damaged engine components.</li> </ul> <p>REFER to: <b>Engine</b> (303-00 Engine System - General Information, Diagnosis and Testing).</p>
<ul style="list-style-type: none"> <li>• Oil in the air intake system</li> </ul>	<ul style="list-style-type: none"> <li>• Crankcase vent oil separator.</li> </ul>	<ul style="list-style-type: none"> <li>• CLEAN or INSTALL a new crankcase vent oil separator. TEST the system for normal operation.</li> </ul>
	<ul style="list-style-type: none"> <li>• Turbocharger.</li> </ul>	<ul style="list-style-type: none"> <li>• Worn or damaged turbocharger.</li> </ul> <p>REFER to: <b>Turbocharger</b> (303-04 Fuel Charging and Controls - Turbocharger - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing).</p>

303-08-5

## Engine Emission Control — 2.5L Duratec (147kW/200PS) - VI5

303-08-5

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"><li>Excessive crankcase pressure.</li></ul>	<ul style="list-style-type: none"><li>Worn or damaged engine components.</li></ul> REFER to: <b>Engine</b> (303-00 Engine System - General Information, Diagnosis and Testing).

# SECTION 303-12 Intake Air Distribution and Filtering

— 2.5L Duratec (147kW/200PS) - VI5

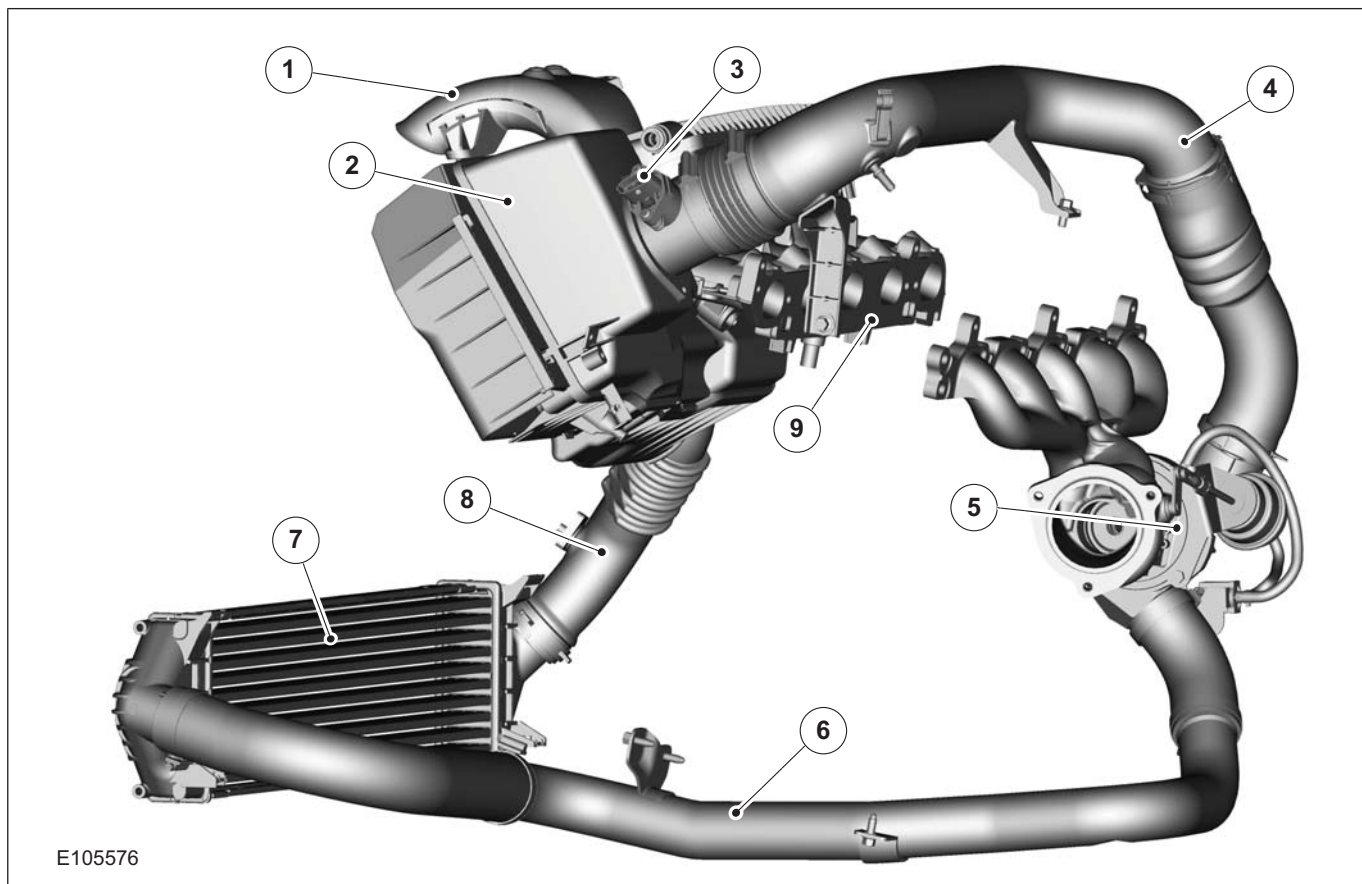
## VEHICLE APPLICATION: 2008.50 Kuga

CONTENTS	PAGE
<b>DESCRIPTION AND OPERATION</b>	
Intake Air Distribution and Filtering (Component Location).....	303-12-2
<b>DIAGNOSIS AND TESTING</b>	
Intake Air Distribution and Filtering.....	303-12-4
Inspection and Verification.....	303-12-4
Symptom Chart.....	303-12-4
<b>REMOVAL AND INSTALLATION</b>	
Air Cleaner.....	(23 174 0) 303-12-6
Charge Air Cooler.....	(23 620 0) 303-12-8



DESCRIPTION AND OPERATION

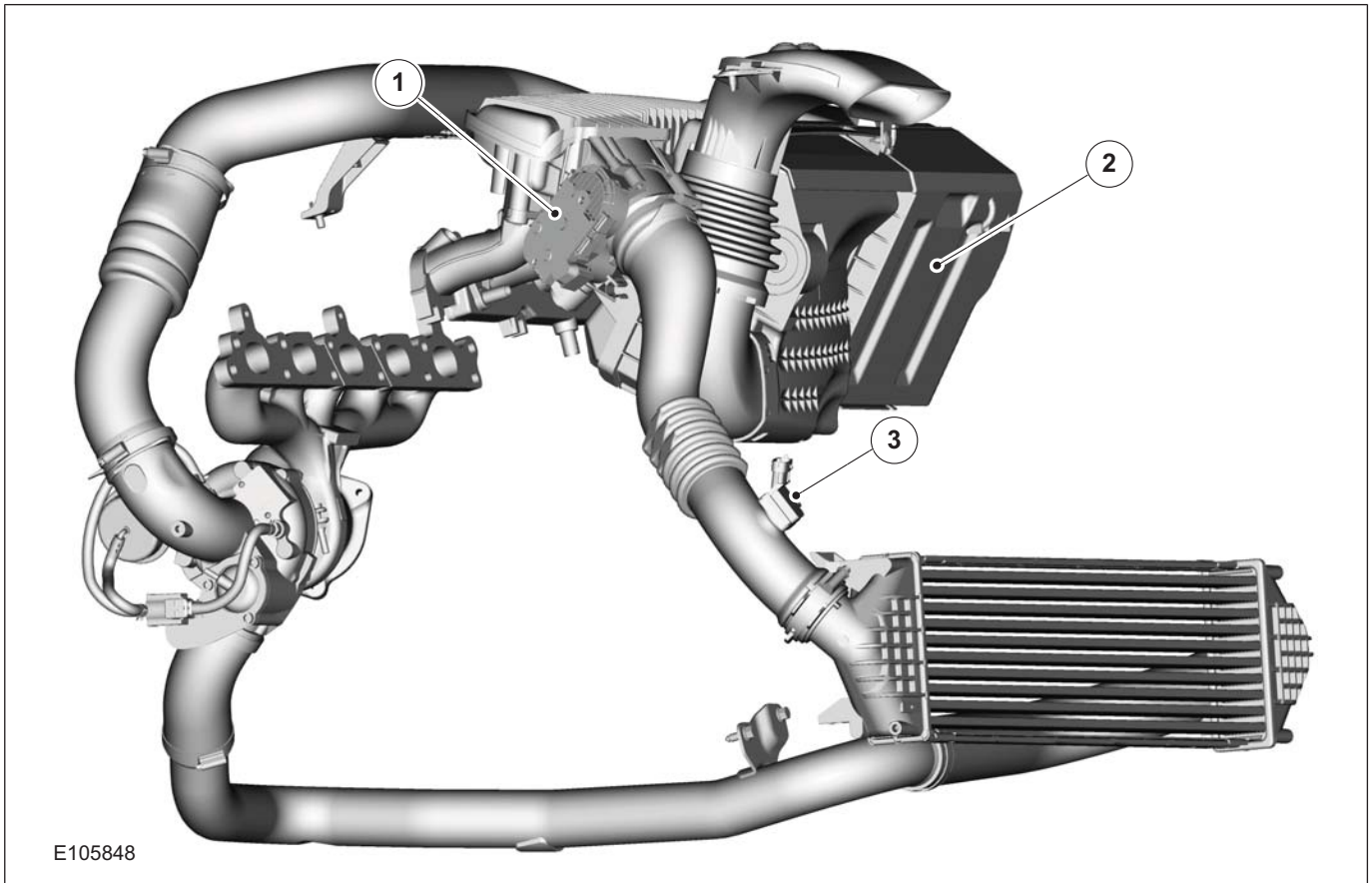
Intake Air Distribution and Filtering – Component Location



Item	Description
1	Intake manifold
2	Air cleaner
3	The MAF (mass air flow) sensor
4	Pipe, air filter to turbocharger

Item	Description
5	Turbocharger
6	Pipe, turbocharger to intercooler
7	Charge air cooler
8	Pipe, intercooler to intake manifold
9	Air Intake manifold

DESCRIPTION AND OPERATION



Item	Description
1	Throttle body mechanism <b>Comments:</b> Incorporates the TP (throttle position) sensor
2	PCM (powertrain control module) cover
3	The MAPT (manifold absolute pressure and temperature) sensor

## DIAGNOSIS AND TESTING

## Intake Air Distribution and Filtering

## Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

## Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> <li>– Air cleaner element</li> <li>– Air cleaner intake pipe</li> <li>– Air cleaner outlet pipe</li> <li>– Charge air cooler</li> <li>– Charge air cooler intake pipe</li> <li>– Charge air cooler outlet pipe</li> </ul>	<ul style="list-style-type: none"> <li>– Mass air flow (MAF) sensor</li> <li>– Manifold absolute pressure (MAP) sensor</li> <li>– Electrical connector(s)</li> </ul>

## Symptom Chart

Symptom	Possible Sources	Action
<ul style="list-style-type: none"> <li>• Excessive intake air noise</li> </ul>	<ul style="list-style-type: none"> <li>• Detached air cleaner pipe(s).</li> <li>• Detached turbocharger pipe(s).</li> <li>• Detached charge air cooler pipe(s).</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK the pipe(s) for security and leaks to atmosphere. INSTALL new intake air components as necessary. TEST the system for normal operation.</li> </ul>
<ul style="list-style-type: none"> <li>• Oil in the air intake system</li> </ul>	<ul style="list-style-type: none"> <li>• Blocked or damaged PCV pipe(s)/hose(s).</li> <li>• Blocked or damaged crankcase vent oil separator.</li> </ul>	<ul style="list-style-type: none"> <li>• REFER to: <b>Engine Emission Control</b> (303-08 Engine Emission Control - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>• Turbocharger.</li> </ul>	<ul style="list-style-type: none"> <li>• REFER to: <b>Turbocharger</b> (303-04 Fuel Charging and Controls - Turbocharger - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing).</li> </ul>
<ul style="list-style-type: none"> <li>• Water in the air cleaner</li> </ul>	<ul style="list-style-type: none"> <li>• Air intake pipe splash shield.</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK the air intake pipe splash shield for correct installation and alignment. REPAIR/INSTALL the air intake pipe splash shield as necessary. TEST the system for normal operation.</li> </ul>

## DIAGNOSIS AND TESTING

Symptom	Possible Sources	Action
	<ul style="list-style-type: none"> <li>Blocked air cleaner drain.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the air cleaner drain for blockage. TEST the system for normal operation.</li> </ul>
<ul style="list-style-type: none"> <li>Engine lacks power</li> </ul>	<ul style="list-style-type: none"> <li>Air cleaner element blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the air cleaner for signs of blockage. INSTALL a new air cleaner element as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Charge air cooler pipe(s).</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the charge air cooler pipes for damage. INSTALL a new charge air cooler pipe(s) as necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>Charge air cooler blocked.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the charge air cooler for blockage. INSTALL a new charge air cooler as necessary.</li> </ul> <p>REFER to: <b>Charge Air Cooler</b> (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).</p>
	<ul style="list-style-type: none"> <li>Fuel charging and controls.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to: <b>Fuel Charging and Controls</b> (303-04 Fuel Charging and Controls - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Turbocharger.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to: <b>Turbocharger</b> (303-04 Fuel Charging and Controls - Turbocharger - 2.5L Duratec (147kW/200PS) - VI5, Diagnosis and Testing).</li> </ul>
	<ul style="list-style-type: none"> <li>Engine.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to: <b>Engine</b> (303-00 Engine System - General Information, Diagnosis and Testing).</li> </ul>

REMOVAL AND INSTALLATION

Air Cleaner(23 174 0)

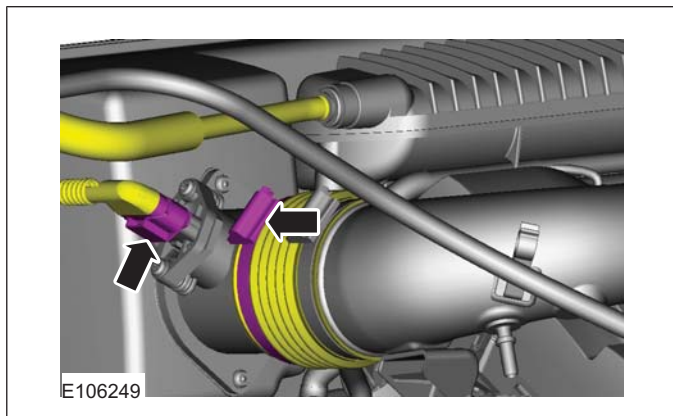
General Equipment

Retaining Strap
Trolley Jack

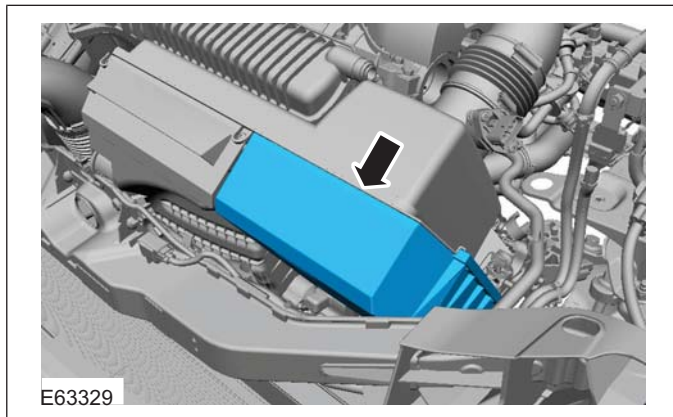
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

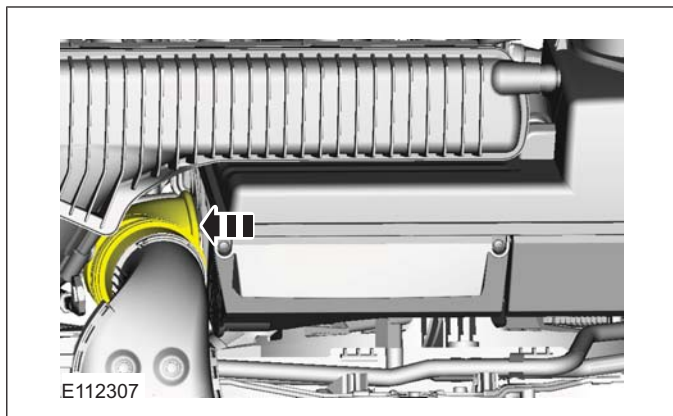
1.



2.

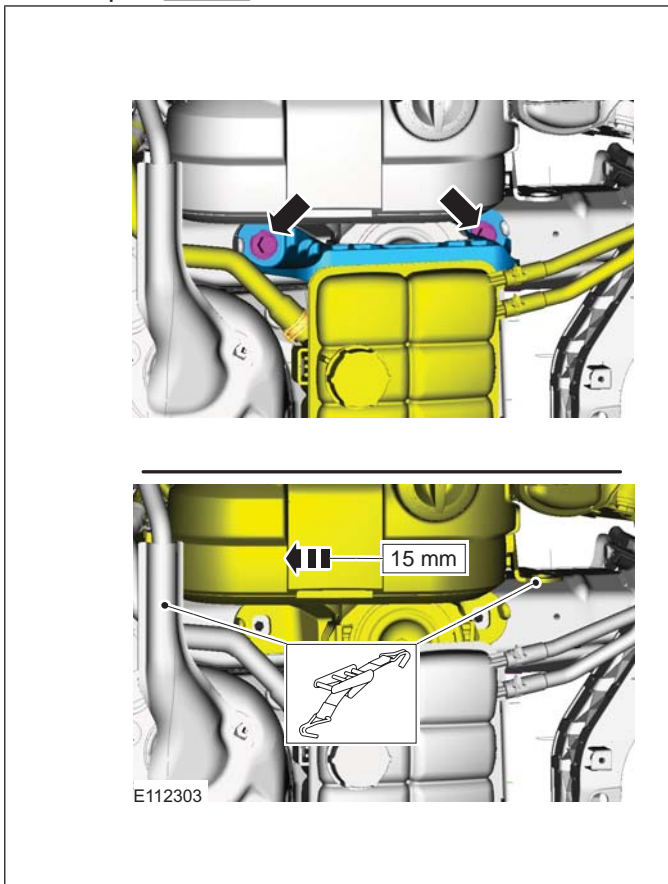


3.



4. **CAUTION:** Make sure that no components catch.

General Equipment: Retaining Strap  
 General Equipment: Trolley Jack  
 Torque: 90 Nm

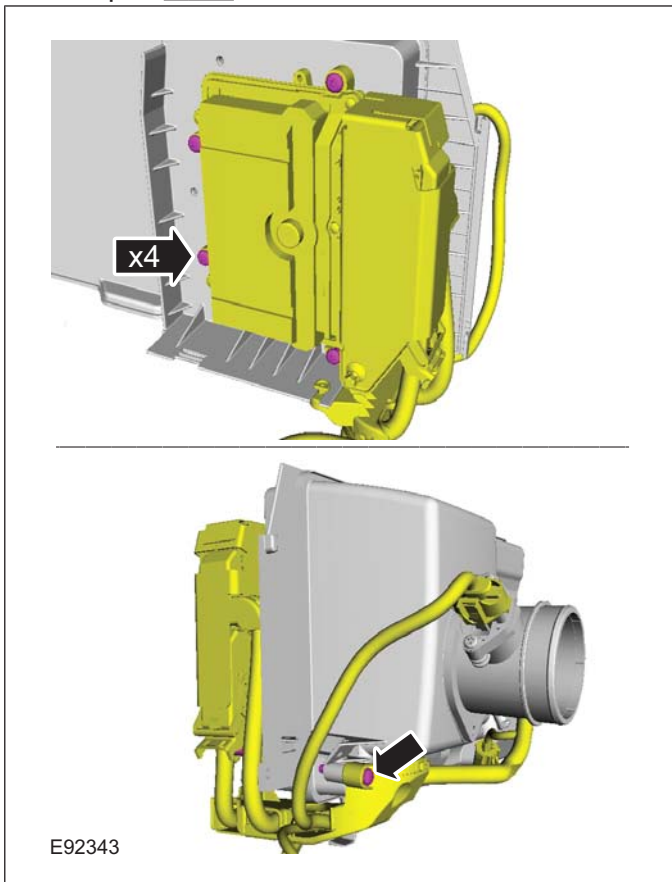




REMOVAL AND INSTALLATION

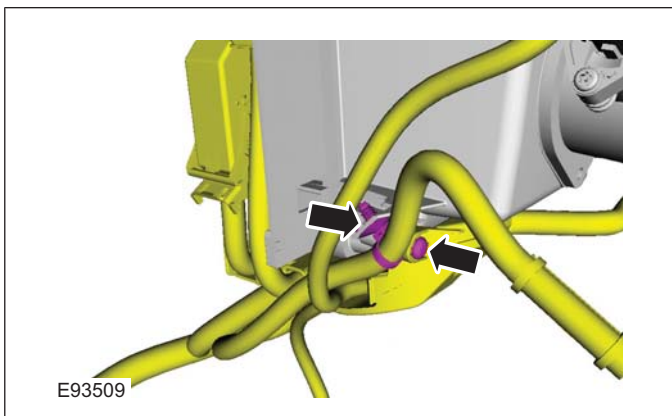
Vehicles with PCM security shield

5. Torque: 7 Nm

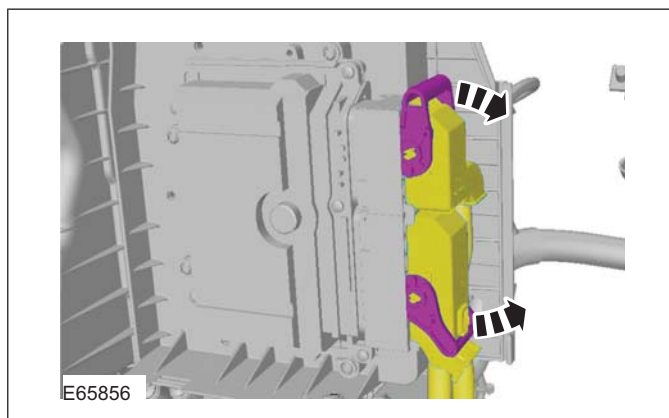


Vehicles without PCM security shield

6.

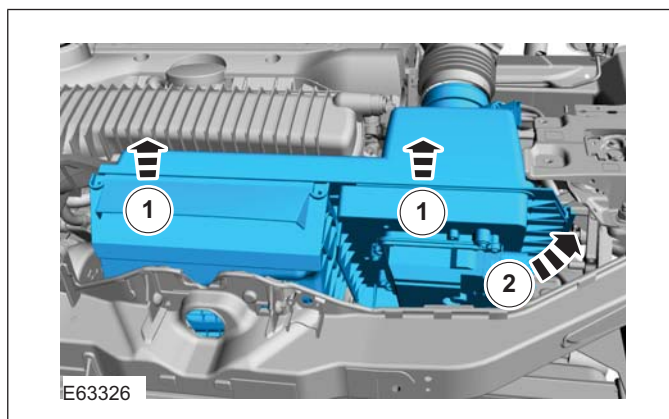


7.



All vehicles

8. **⚠ CAUTION:** Make sure that no components catch.



Installation

1. To install, reverse the removal.

303-12-8

(147kW/200PS) - VI5

303-12-8

## REMOVAL AND INSTALLATION

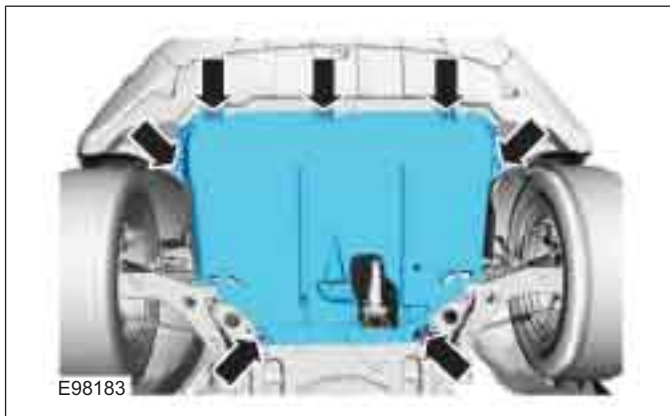
## Charge Air Cooler(23 620 0)

## Removal

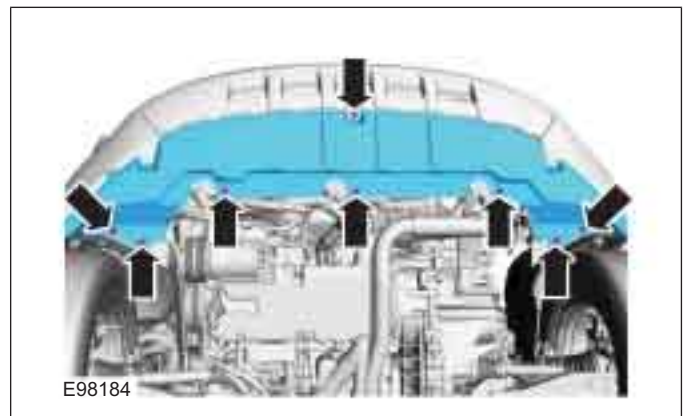
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

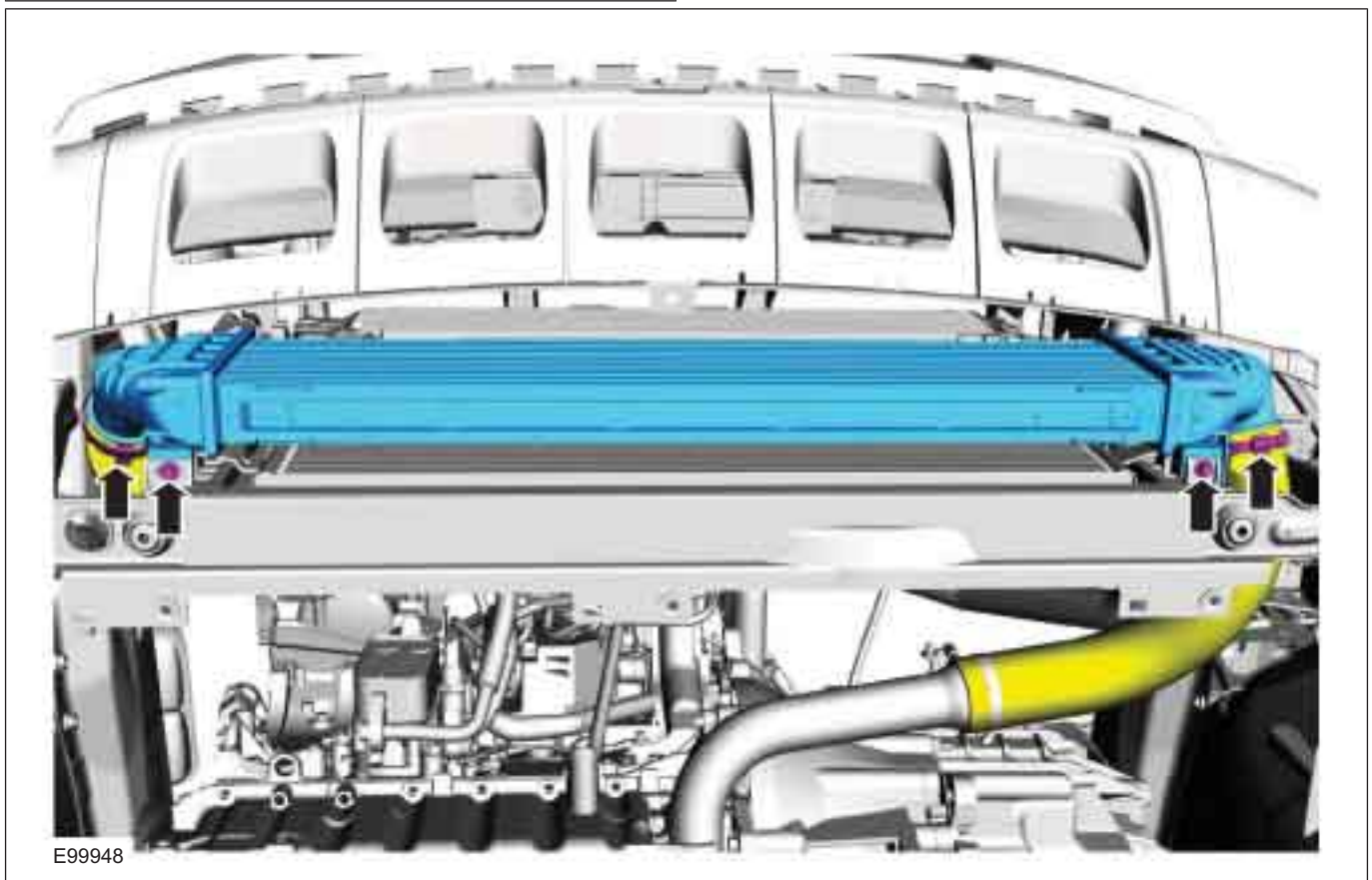
2.



3.



4. Torque: 5 Nm



## Installation

1. To install, reverse the removal.



# SECTION 303-13 Evaporative Emissions

VEHICLE APPLICATION: 2008.50 Kuga

CONTENTS	PAGE
<b>DIAGNOSIS AND TESTING</b>	
Evaporative Emissions.....	303-13-2
Inspection and Verification.....	303-13-2



**DIAGNOSIS AND TESTING****Evaporative Emissions****Inspection and Verification**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

<b>Mechanical</b>	<b>Electrical</b>
<ul style="list-style-type: none"><li>– Vacuum line(s)</li><li>– Evaporative emission canister</li><li>– Evaporative emission system hose(s)</li><li>– Evaporative emission canister purge valve</li></ul>	<ul style="list-style-type: none"><li>– Fuse(s)</li><li>– Wiring harness</li><li>– Electrical connector(s)</li></ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

# SECTION 303-14 Electronic Engine Controls — 2.5L Duratec

(147kW/200PS) - VI5

## VEHICLE APPLICATION: 2008.50 Kuga

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Wastegate control valve.....	303-14-33
Engine oil level, temperature and quality sensor.....	303-14-34



**PAGE 2 OF 2**

Exterior air temperature sensor..... 303-14-34

**DIAGNOSIS AND TESTING**

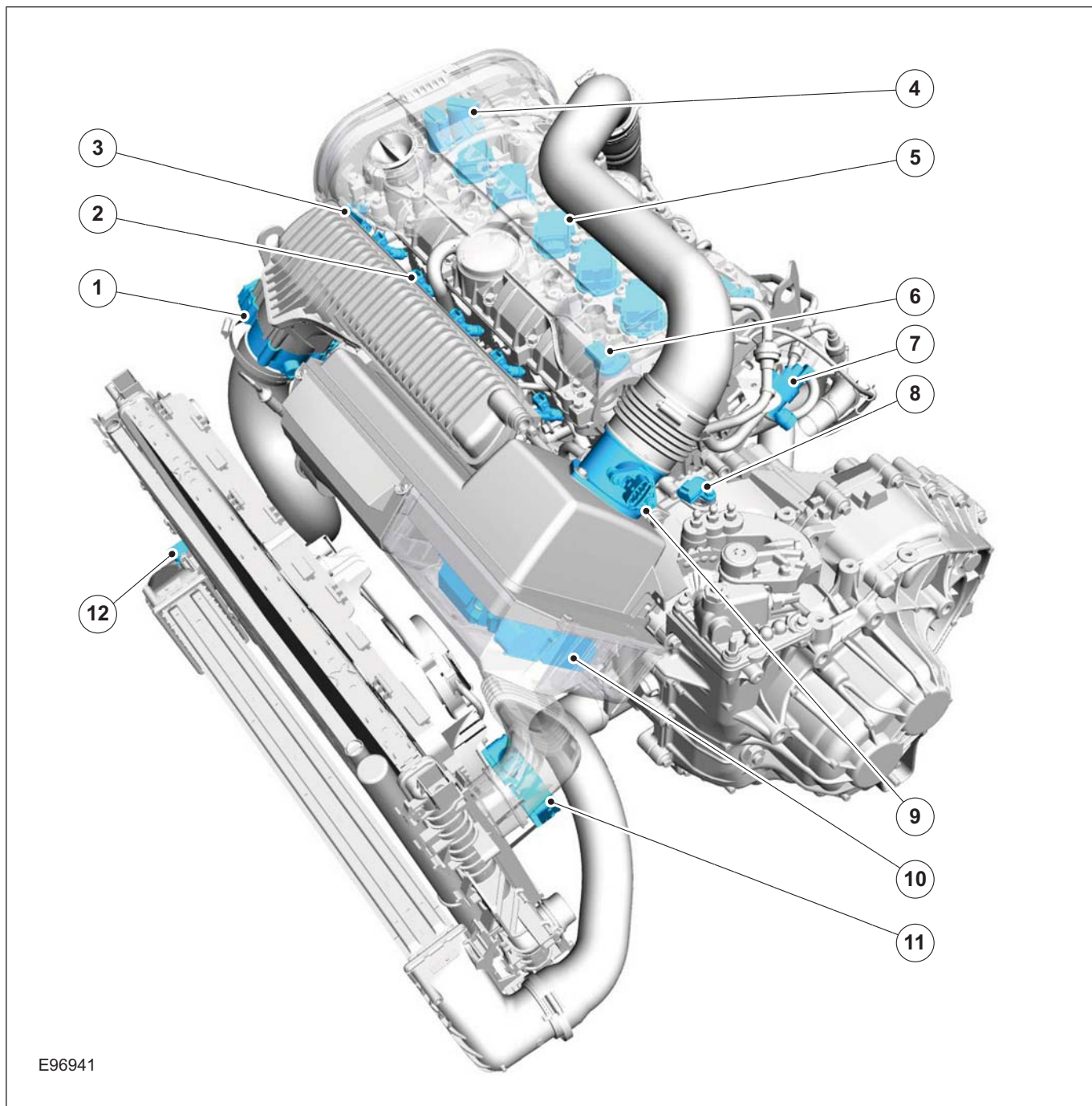
Electronic Engine Controls..... 303-14-35  
 Inspection and Verification..... 303-14-35

**REMOVAL AND INSTALLATION**

Camshaft Position (CMP) Sensor..... (29 232 0) 303-14-36  
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 Crankshaft Position (CKP) Sensor..... (29 230 0) 303-14-38  
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DESCRIPTION AND OPERATION

Electronic Engine Controls – Component Location



E96941

Item	Description
1	Throttle control unit
2	injectors <b>Comments:</b> One injector for each cylinder
3	Fuel pressure/fuel temperature sensor

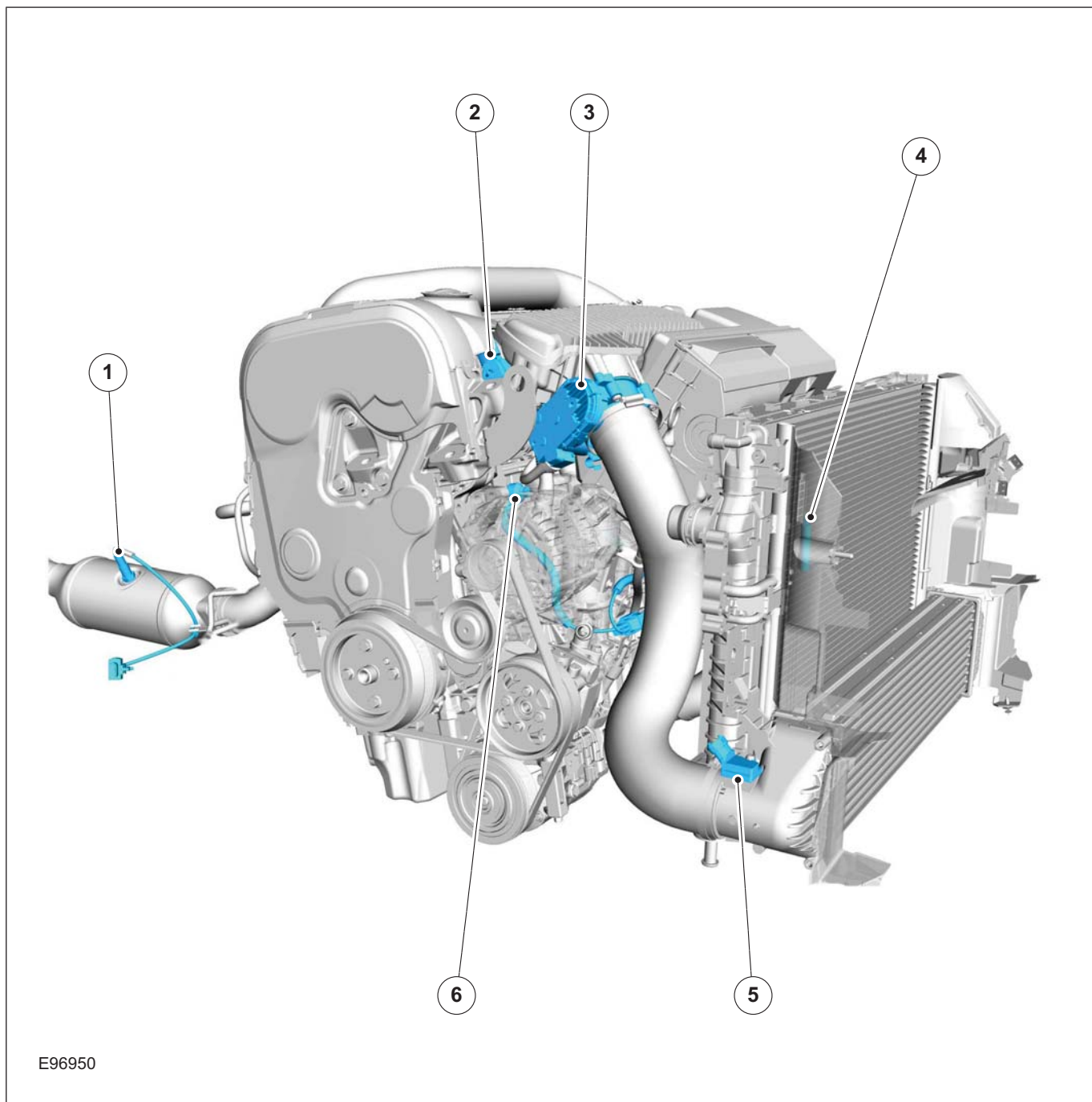
Item	Description
4	VVT (variable valve timing) - exhaust camshaft solenoid <b>Comments:</b> One each for the inlet and outlet camshaft
5	Ignition coil-on-plug <b>Comments:</b> One injection coil for each cylinder



DESCRIPTION AND OPERATION

Item	Description
6	CMP (camshaft position) sensor <b>Comments:</b> One each for the inlet and outlet camshaft
7	EVAP (evaporative emission) valve
8	CKP (crankshaft position) sensor

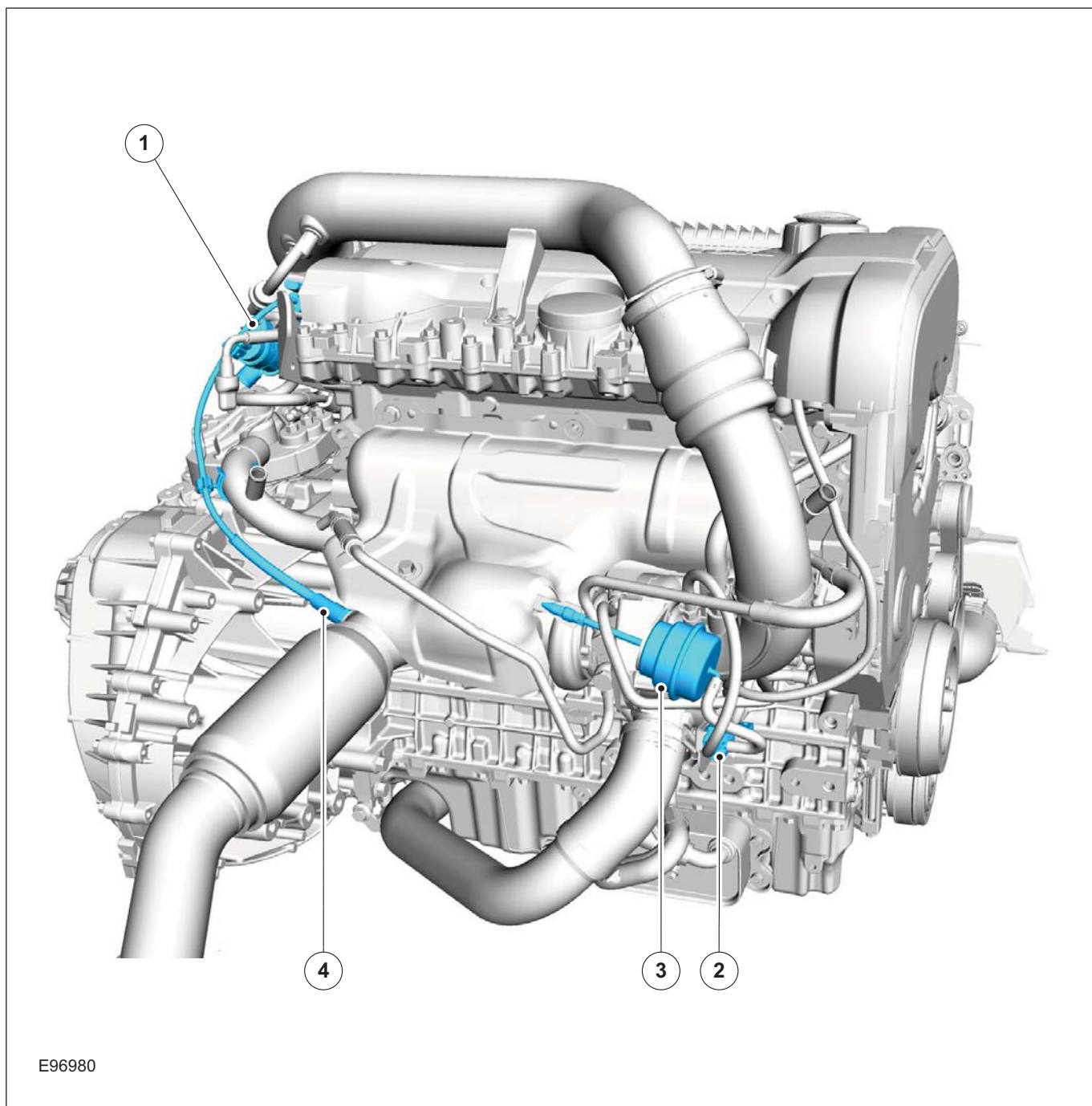
Item	Description
9	MAF (mass air flow) sensor
10	PCM (powertrain control module)
11	Fan control module
12	MAPT (manifold absolute pressure and temperature) sensor



DESCRIPTION AND OPERATION

Item	Description
1	Catalyst monitor sensor
2	Fuel pressure/fuel temperature sensor
3	Throttle control unit
4	Ambient air temperature sensor

Item	Description
5	MAPT sensor
6	KS (knock sensor) <b>Comments:</b> Two, on 2nd and 4th cylinder



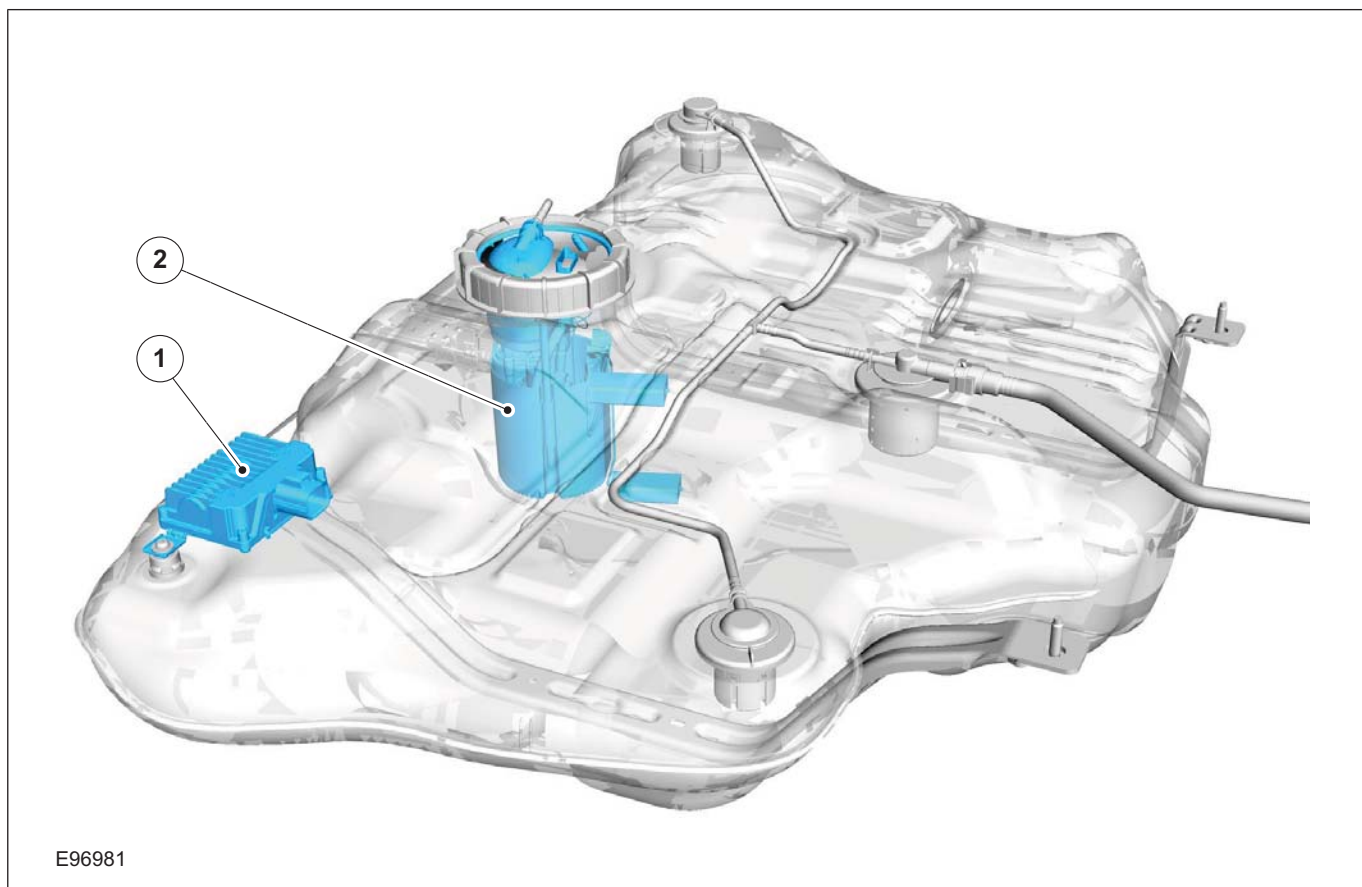
E96980

Item	Description
1	EVAP valve
2	Wastegate control valve

Item	Description
3	Turbo boost pressure controller
4	HO2S (heated oxygen sensor)



DESCRIPTION AND OPERATION



E96981

Item	Description
1	FPDM (fuel pump driver module)
2	Fuel pump



DESCRIPTION AND OPERATION

Electronic Engine Controls – Overview

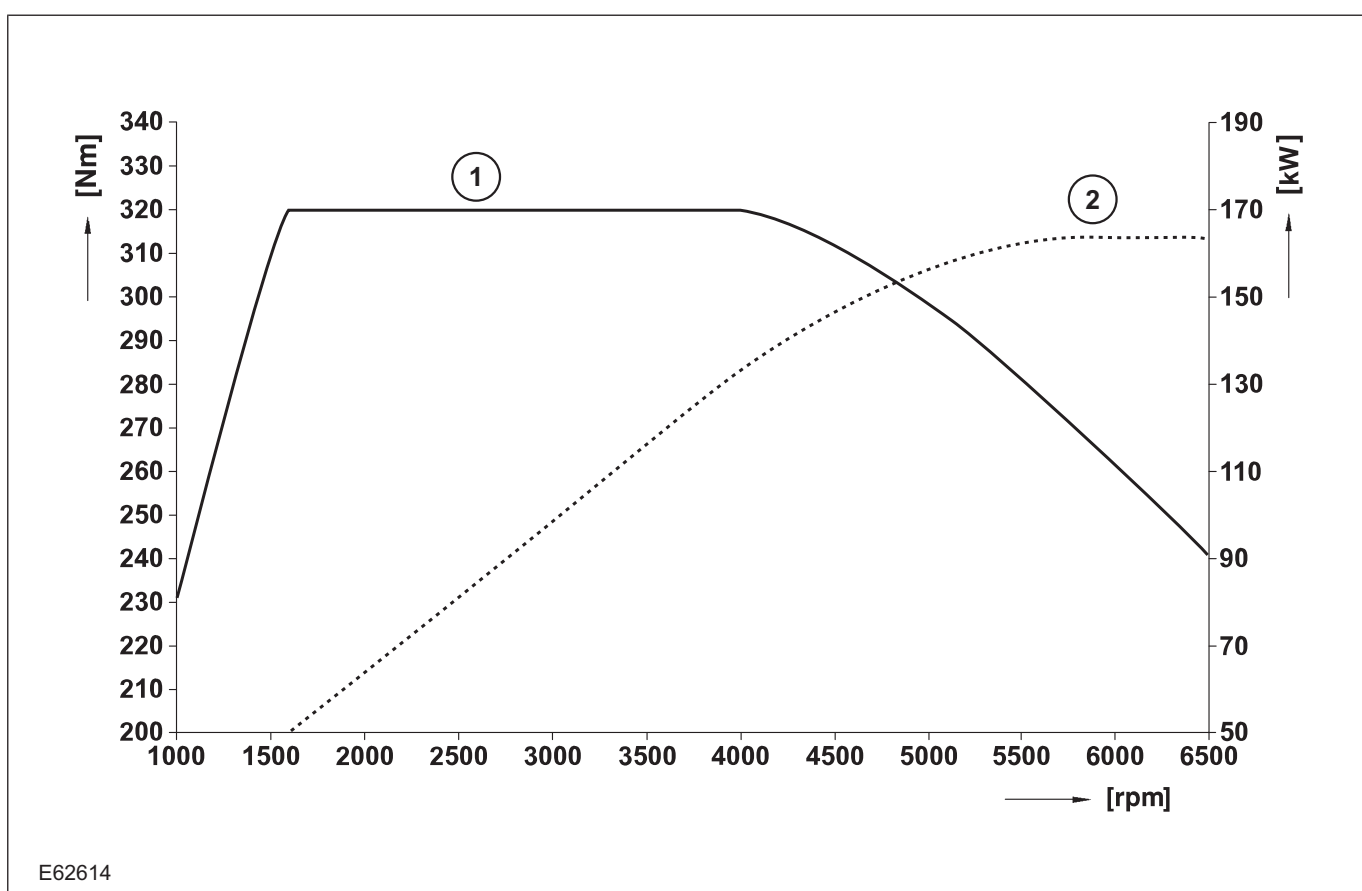
General overview

Engine Management System

- Bosch ME 9.0 engine management system
- Knock control with two knock sensors
- Electronic Throttle Control Unit.
- Electronic accelerator pedal
- Variable camshaft timing for intake and exhaust camshafts

- Fuel injection supply manifold with combined fuel pressure and temperature sensor
- Sequential multi-port fuel injection
- Camshaft position (CMP) sensors for intake and exhaust camshafts.
- satisfies the European exhaust emissions standard IV
- EOBD (European On-board Diagnostic) for the monitoring of emissions-related components.

Engine power output and engine speed



E62614

Item	Description
1	Torque
2	Power output

The engine is controlled by the PCM.

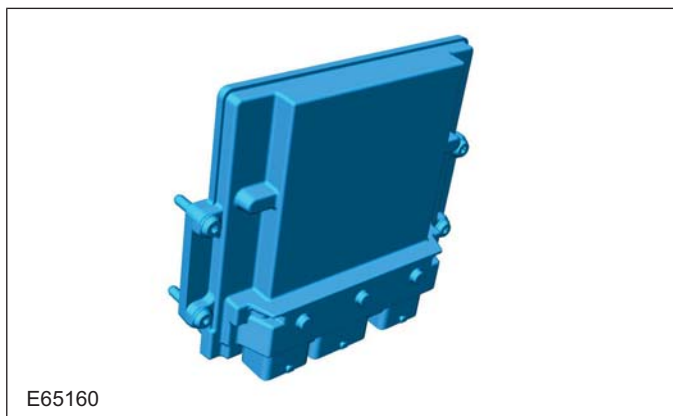
The PCM uses various sensors to calculate the optimum ignition timing, the optimum injection quantity and injection time and the position of the throttle. In addition, various corrections are carried out, including adjustment of the ignition timing using the KS and adjustment of the fuel quantity by the

Lambda control. Boost pressure control and fuel pressure control are also performed by the PCM.

**For all work on the engine electronics, it is essential to ensure that the connectors are seated and locked properly.**

## DESCRIPTION AND OPERATION

## Powertrain Control Module (PCM)



E65160

The PCM communicates with all engine sensors and the other modules. Communication of the PCM with the other modules and the system diagnostics takes place via the CAN (controller area network) data bus.

The following functions are regulated or controlled by the PCM:

- Fuel supply to the engine including lambda control
- Ignition setting including knock control
- Idle speed control
- Control of optimum valve timing via the camshaft adjustment for intake and exhaust camshafts
- The refrigerant compressor is controlled by the air conditioning clutch relay and the delivery of the refrigerant compressor is controlled by a PWM (pulse width modulation) signal.
- Control of EVAP purge valve
- Boost pressure control
- Control of the cooling fan
- Charging system (Smart Charge)
- Starting system (Smart Start)

If the PCM is isolated from the vehicle electrical system or the battery is disconnected, the throttle control unit **must** be initialized.

The PCM is fitted in the engine compartment in the air filter housing. On right hand drive vehicles a protective metal plate is also installed to prevent the plug connector from being pulled off, or make it harder to pull off, in case of theft. The protective plate is secured with a shear bolt. The shear bolt needs to be drilled out in order to remove the protective plate.

## Knock Sensor



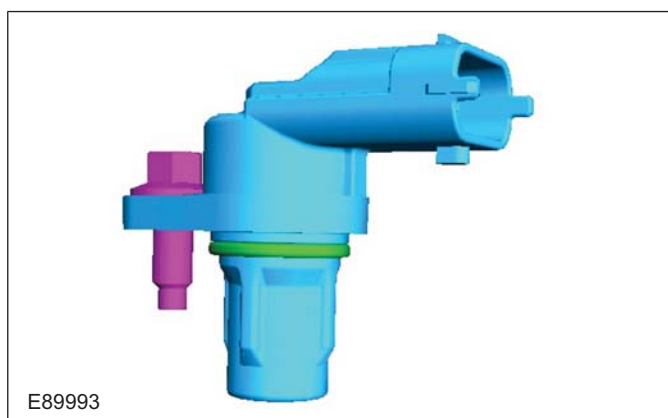
E96986

Two KSs are fitted. They are on the cylinder block, one close to the 2nd cylinder and one close to the 4th cylinder.

When fitting, adhere strictly to the specified tightening torque, otherwise the KS will not work properly.

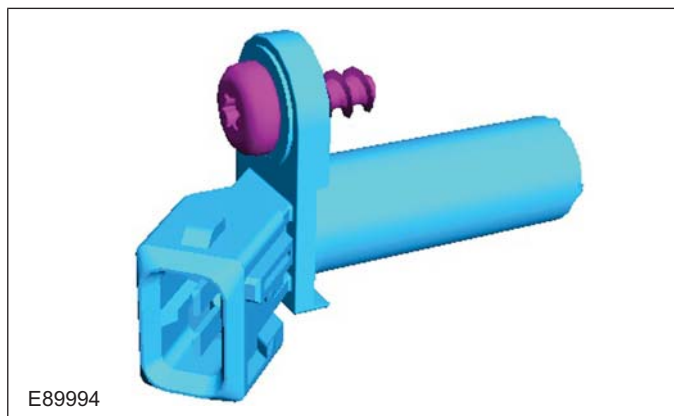
If the signal from one or both KS is implausible or absent, knock control is deactivated. The PCM switches to an ignition map that is further away from the knock limit. As a result, engine damage caused by combustion knock is avoided. If a fault occurs, a fault code is stored in the error memory of the PCM.

## Camshaft Position (CMP) Sensor



E89993

If one or both CMP sensors fail, a fault is saved in the error memory of the PCM and the camshaft adjustment and knock control are deactivated.

**DESCRIPTION AND OPERATION****Crankshaft Position (CKP) sensor**

E89994

The CKP sensor can be checked during starting by measuring the resistance and/or voltage with the oscilloscope.

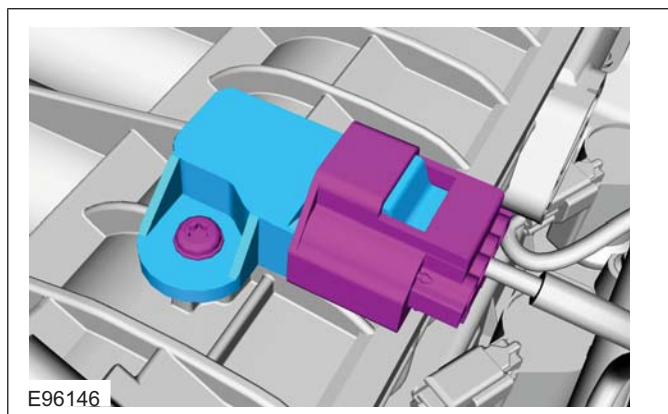
The engine cannot work without the CKP signal. A limp-home mode is therefore not possible. The engine is switched off or the engine will not start and a fault is stored in the error memory of the PCM.

**Camshaft adjuster solenoid valve**

E96870

For work on the camshaft adjuster solenoids, extreme cleanliness must be ensured as even slight impurities can result in failure. The camshaft adjustment solenoids for the intake and exhaust camshafts differ only in terms of the position of the fastening point by which they are fixed to the cylinder head cover.

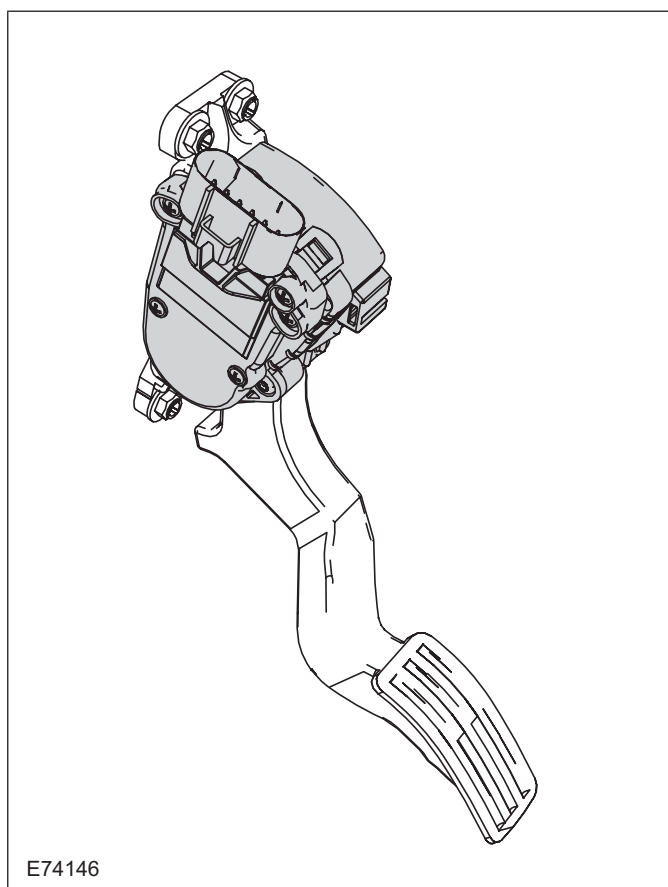
If a fault is detected in the camshaft adjustment solenoids, the solenoids are no longer actuated.

**Manifold absolute pressure and temperature sensor**

E96146

During installation of the MAPT sensor, correct sealing must be ensured to ensure that no infiltrated air can penetrate into the intake manifold from outside.

If the MAP (manifold absolute pressure) sensor fails, the PCM operates with a substitute value.

**Accelerator pedal position (APP) sensor**

E74146

The APP (accelerator pedal position) sensor comprises two separate sensors.

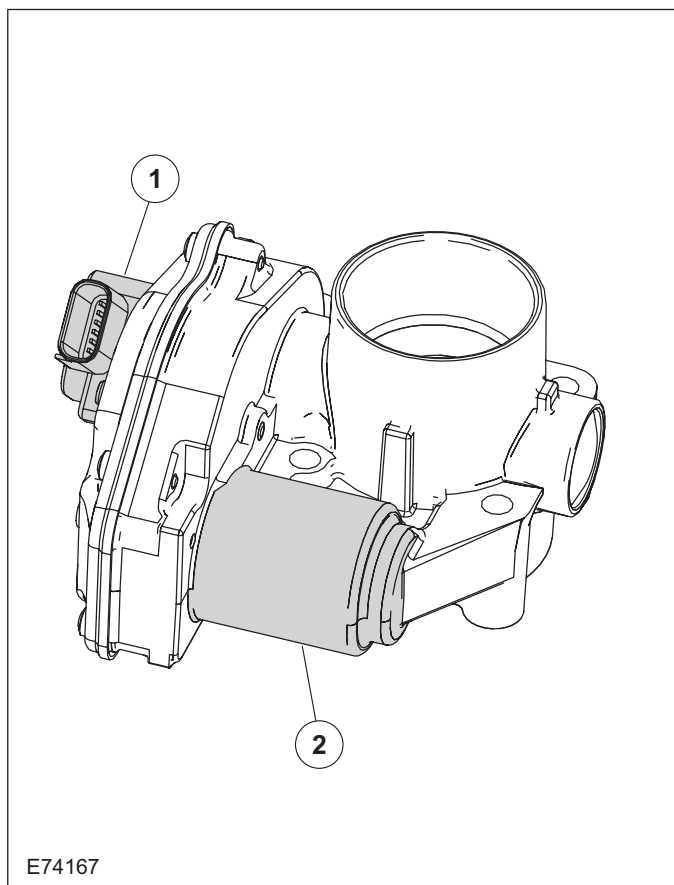
## DESCRIPTION AND OPERATION

If one of the two APP sensors fails, then only a proportion of the engine's power will be available when accelerating. Top speed can nevertheless be achieved.

If both of the APP sensors fail, the engine is regulated to a defined speed following a plausibility check after the BPP (brake pedal position) switch and brake light switch have been actuated once. The vehicle can then only be accelerated to a defined speed.

In either case, a fault is saved in the error memory of the PCM.

### Throttle control unit



E74167

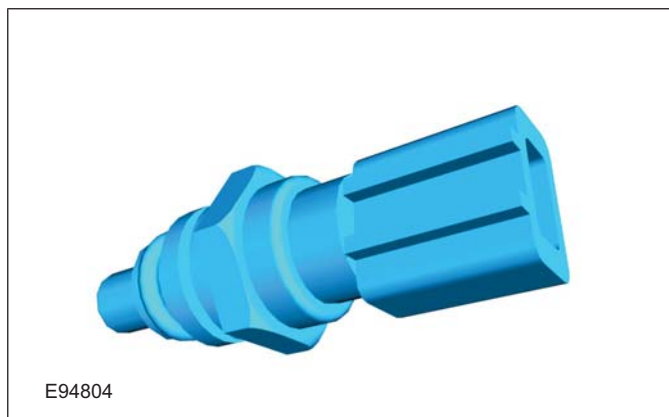
Item	Description
1	TP (throttle position) sensor
2	Electric motor

**CAUTION:** The throttle control unit must not be repaired or adjusted. The stop of the throttle valve must on no account be adjusted.

After disconnecting the battery or replacing the throttle control unit or the PCM, initialization is necessary.

- engine off
- Accelerator pedal not pressed
- Battery voltage 11 ... 14 V
- Ignition key in ON position
- Wait approximately 30 seconds until initialization is complete.

### Engine Coolant Temperature (ECT) sensor

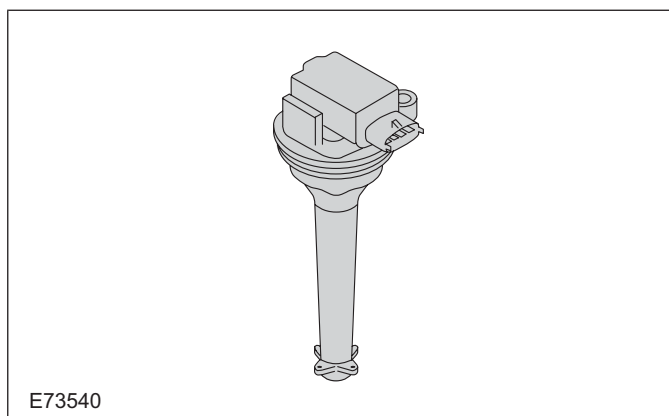


E94804

The ECT (engine coolant temperature) sensor is designed as an NTC (negative temperature coefficient) resistor.

If the signal from the ECT sensor fails, the cooling fan is on all the time and the A/C (air conditioning) is turned off. When the ignition is switched on, the value from the IAT (intake air temperature) sensor is read. When the engine is running, the temperature is calculated using a temperature map stored in the PCM according to how long the engine has been running. This substitute value is then used as the basis for calculating the injected fuel quantity and the ignition timing.

### Ignition coil-on-plug



E73540

 303-14-11**Electronic Engine Controls** — 2.5L Duratec (147kW/200PS) - VI5303-14-11 

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**DESCRIPTION AND OPERATION**

The resistance in the ignition coil primary circuit cannot be checked using a multimeter because the power output stage is integrated into the ignition coil.



**303-14-12****Electronic Engine Controls** — 2.5L Duratec (147kW/200PS) - VI5**303-14-12****DESCRIPTION AND OPERATION**

Electronic Engine Controls – System Operation and Component Description

**System Diagram**

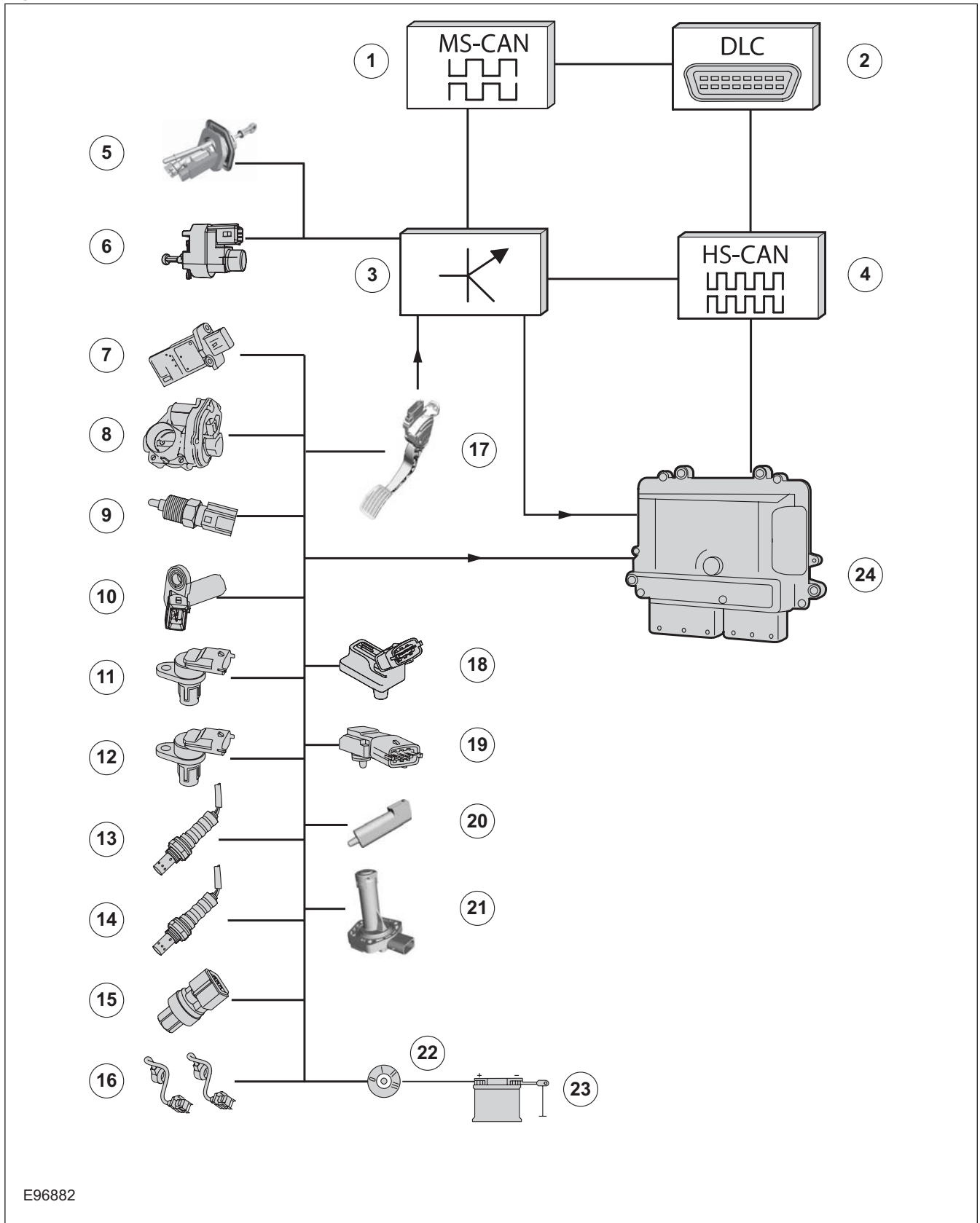
**VIEW DIAGRAM ON THE NEXT PAGE**





DESCRIPTION AND OPERATION

Inputs



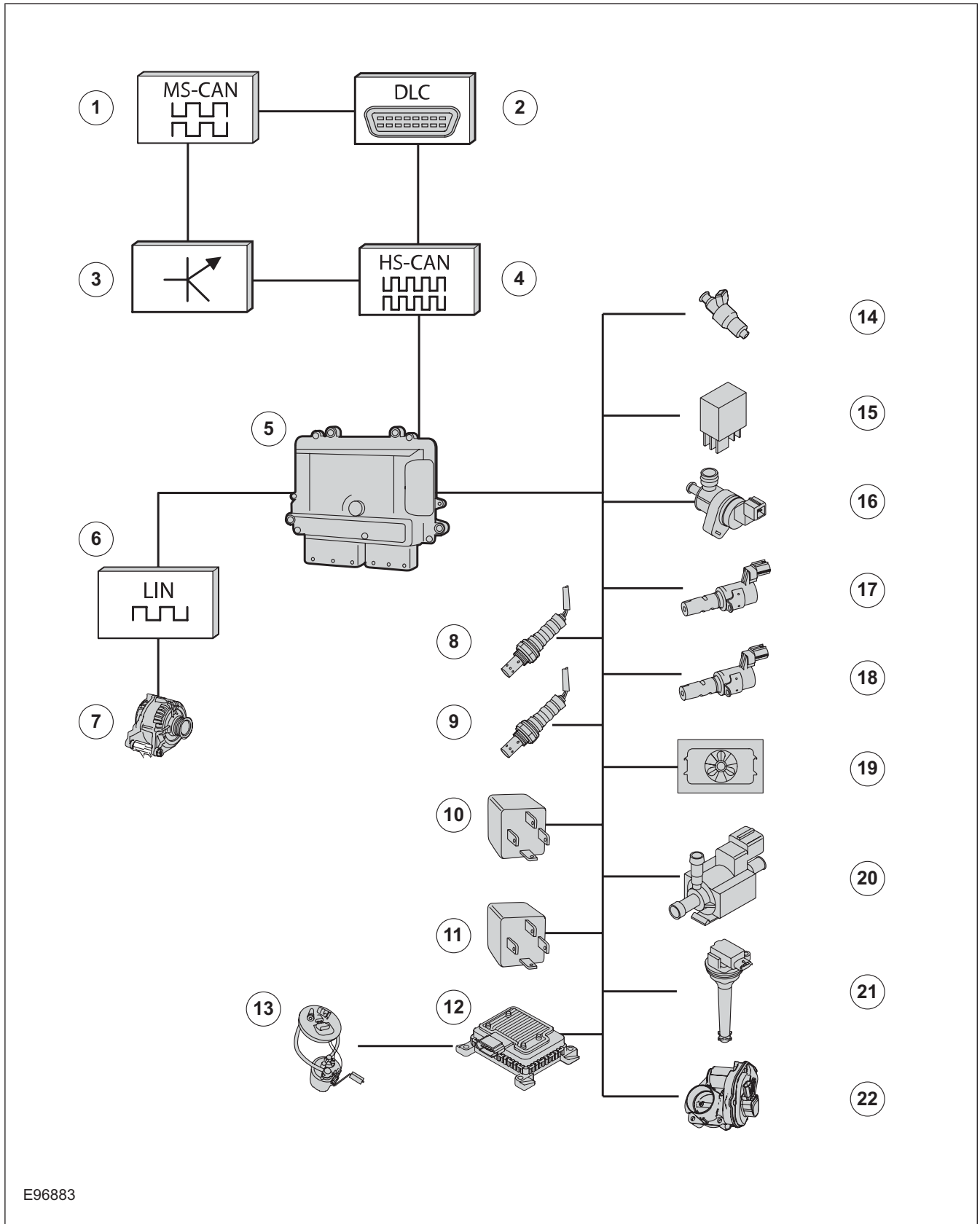
## DESCRIPTION AND OPERATION

Item	Description
1	Medium speed CAN data bus (MS-CAN)
2	DLC (data link connector)
3	GEM (generic electronic module) <b>Comments:</b> Serves as a gateway between the two CAN databus systems.
4	High speed CAN data bus (HS-CAN)
5	CPP (clutch pedal position) sensor Refer to Component Description: (page 29)
6	BPP switches Refer to Component Description: (page 29)
7	MAF sensor Refer to Component Description: (page 27)
8	TP sensor Refer to Component Description: Throttle control unit (page 33) <b>Comments:</b> It is incorporated into the throttle control unit
9	ECT sensor Refer to Component Description: (page 31)
10	CKP sensor Refer to Component Description: (page 24)
11	CMP sensor - intake camshaft Refer to Component Description: (page 8)
12	CMP sensor - exhaust camshaft Refer to Component Description: (page 8)

Item	Description
13	Broadband HO2S Refer to Component Description: (page 25)
14	Catalyst monitor sensor
15	Air conditioning (A/C) pressure sensor Refer to Component Description: (page 30)
16	KS Refer to Component Description: (page 8)
17	APP sensor Refer to Component Description: (page 28)
18	MAPT sensor Refer to Component Description: (page 9)
19	Fuel pressure/fuel temperature sensor Refer to Component Description: (page 33)
20	Exterior aor temperature sensor Refer to Component Description: (page 34)
21	Engine oil level, temperature and quality sensor Refer to Component Description: (page 34)
22	Ignition switch
23	Battery
24	PCM Refer to Component Description: (page 8)

DESCRIPTION AND OPERATION

Output signals



E96883

## DESCRIPTION AND OPERATION

Item	Description
1	Medium speed CAN data bus (MS-CAN)
2	DLC
3	GEM <b>Comments:</b> Serves as a gateway between the two CAN databus systems.
4	High speed CAN data bus (HS-CAN)
5	PCM Refer to Component Description: (page 8)
6	LIN (local interconnect network) databus
7	Alternator
8	Heating element - broadband HO2S
9	Catalyst monitor sensor heating element
10	Powertrain Control Module relay
11	Starter Relay
12	FPDM <b>Comments:</b> Refer to: <b>Fuel Tank and Lines - 2.5L Duratec (147kW/200PS) - VI5</b> (310-01 Fuel Tank and Lines, Description and Operation).
13	Fuel pump
14	injectors Refer to Component Description: (page ?) <b>Comments:</b> 5x

Item	Description
15	Air conditioning clutch relay <b>Comments:</b> Refer to: <b>Climate Control</b> (412-01 Climate Control, Description and Operation).
16	EVAP valve <b>Comments:</b>
17	VCT oil control solenoid, exhaust camshaft Refer to Component Description: solenoids (page 26)
18	VCT oil control solenoid, intake camshaft Refer to Component Description: solenoids (page 26)
19	Cooling fan module <b>Comments:</b> Refer to: <b>Engine Cooling - 2.5L Duratec (147kW/200PS) - VI5</b> (303-03 Engine Cooling, Description and Operation).
20	Wastegate control valve <b>Comments:</b> Refer to: <b>Turbocharger</b> (303-04 Fuel Charging and Controls - Turbocharger - 2.5L Duratec (147kW/200PS) - VI5, Description and Operation).
21	Ignition coil-on-plug Refer to Component Description: (page 10) <b>Comments:</b> 5x
22	Throttle control unit Refer to Component Description: (page 30) <b>Comments:</b> Actuator motor unit

## System Operation

The engine is controlled by the PCM. For this purpose, the PCM uses information from the sensors, sender units and switches. In addition, the PCM receives information from other control modules via the CAN data bus. All the information is processed in the PCM and is used to control or regulate the different actuators.

These are:

- the throttle control unit,
- the fuel injectors,

- the camshaft adjustment,
- the boost control solenoid valve
- and the ignition coils.

Some values are sent via the CAN databus to other systems.

The following functions are regulated or controlled by the PCM:



**DESCRIPTION AND OPERATION**

- Starting process
- Engine running
  - Fuel supply to the engine including lambda control
  - Ignition setting including knock control
  - Idle speed control
  - Boost pressure control
  - Valve timing via the camshaft adjuster for the intake and exhaust camshafts (including internal exhaust gas recirculation)
- Refrigerant compressor (activation, deactivation and delivery)
- EVAP purge valve
- Charging system

Fuel is supplied to the engine via a sequential multi-point injection system. Ignition is performed by a distributor-less ignition system with one ignition coil unit for each cylinder.

The PCM optimizes engine power and emissions at all times by processing the sensor signals and information received via the CAN databus and using these for open or closed loop control of the different variables.

The PCM contains part of the PATS (passive anti-theft system).

The PCM is supplied with battery voltage via a fuse in the BJB (battery junction box). This power supply is needed to ensure that saved data is not lost when the engine is switched off.

For other power supply requirements, the PCM switches on a relay in the BJB which is responsible for supplying power to the PCM and to some sensors and actuators. Each of these are protected by fuses in the BJB.

To guarantee optimum engine running at all times, the PCM has several adaptive (self-learning) functions. These adapt the output signals to changing circumstances, such as wear or system faults.

In some cases a faulty signal is replaced with a substitute value or limited. A substitute value can be calculated from other signals or it can be predefined by the PCM. The substitute value allows the vehicle to keep on running without the emission values changing unduly. Depending on the signal failure, the PCM operates in emergency mode. In this mode, the engine power and/or the engine speed is reduced to prevent further damage.

Depending on the faulty signal, a fault code is stored in the error memory of the PCM. These can

be read out using IDS (Integrated Diagnostic System) via the DLC.

The PCM processes and evaluates the signals from the sensors. The following sensors send signals to the PCM:

- CMP sensors
- CKP sensor
- MAF sensor
- KS
- ECT sensor
- TP sensor
- APP sensor
- Broadband HO2S
- Catalyst monitor sensor
- MAPT sensor
- Air conditioning (A/C) pressure sensor
- Alternator
- Fuel temperature and fuel pressure sensor
- Engine oil level, temperature and quality sensor
- Outside air temperature sensor

The following components receive signals from the PCM:

- Powertrain Control Module relay
- A/C clutch relay
- injectors
- Direct ignition coils
- Cooling fan module
- Throttle control unit
- Camshaft adjuster solenoid valve
- Starter Relay
- EVAP purge valve
- Alternator
- Heating element - broadband HO2S
- Catalyst monitor sensor heating element
- FPDM
- Wastegate control valve
- Air conditioning compressor

The PCM receives the following signals via the CAN databus:

- APP
- CPP
- BPP
- Vehicle speed.
- Refrigerant compressor request
- PATS

**DESCRIPTION AND OPERATION**

- Torque reduction request (stability assist module)
- Cruise control request

The PCM sends the following signals via the CAN databus:

- Fuel pump relay on/off
- Engine speed
- Warning lights on/off (MIL (malfunction indicator lamp), battery warning lamp)
- PATS
- ECT
- Air conditioning pressure transducer
- Outside air temperature

With the aid of the input and output signals listed above, the PCM controls / regulates engine starting, fuel injection and fuel pressure, ignition, boost pressure, camshaft adjustment, tank purging, the radiator fan and the refrigerant compressor.

**Speed and TDC recording**

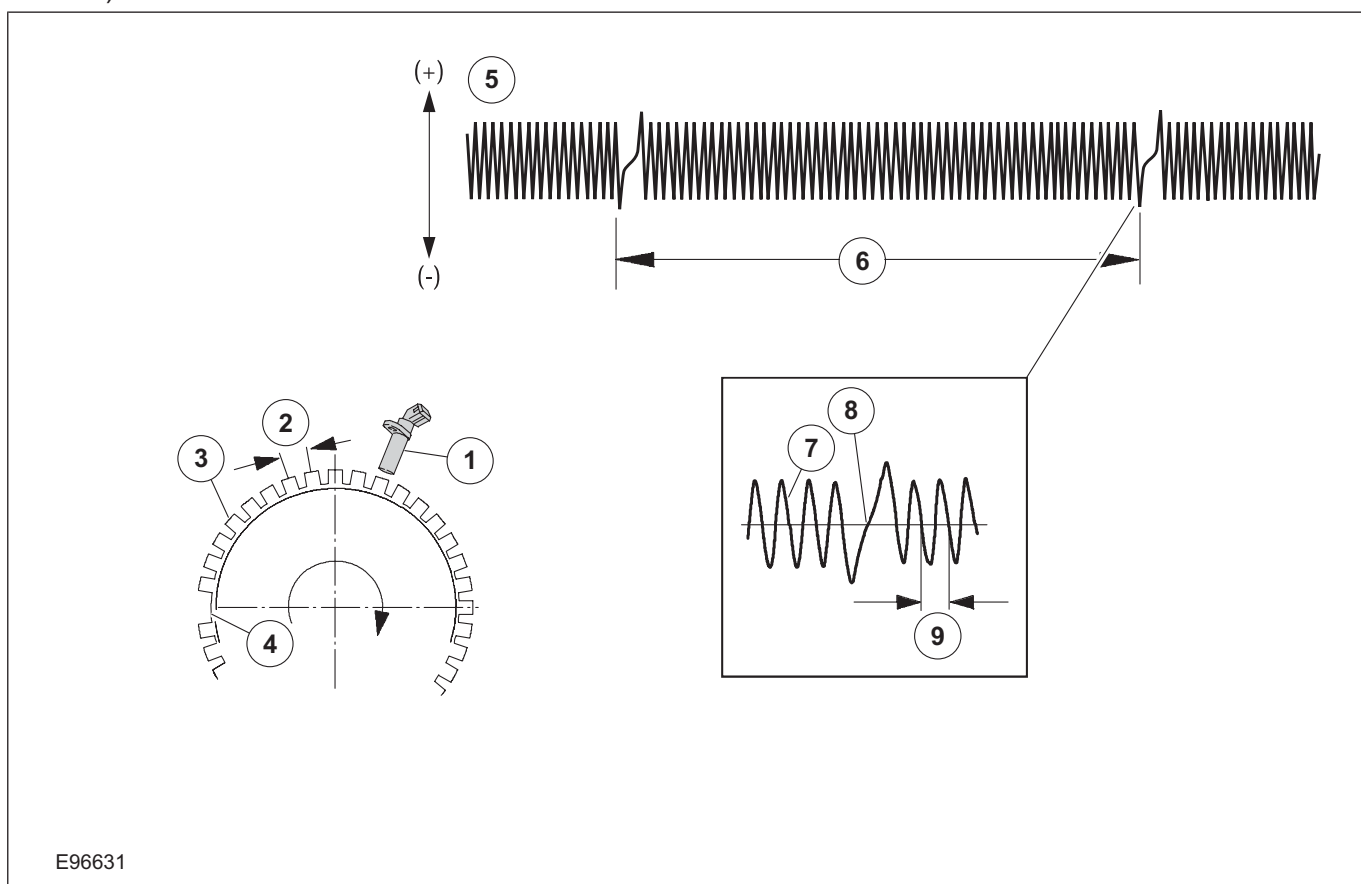
The CKP uses the PCM sensor to record engine speed and detect 1st cylinder TDC (top dead center).

An additional sensor wheel for the CKP sensor is located on the flywheel. This has 60-2 teeth. The gaps between the teeth are required for detection of TDC. The CKP sensor works according to the induction principle and generates a sinusoidal signal voltage whose level and frequency are speed-dependent.

From the frequency of the signal the PCM calculates the engine speed. Each time the engine rotates, the double gap in the sensor wheel alters the sinusoidal oscillation that is generated; this helps the PCM to detect the TDC position of cylinder 1.

The signal from the CKP sensor is used to determine

- the crankshaft position,
- the engine speed,
- the ignition timing,
- the injection timing and
- the adjustment angle of the VVT units.



## DESCRIPTION AND OPERATION

Item	Description
1	CKP sensor
2	Tooth pitch
3	Flywheel ring gear
4	Reference mark
5	Voltage (sinusoidal-like signal curve)

The acceleration of the flywheel at each power stroke results in a change in the CKP signal.

During the power stroke, the combustion pressure acting on the piston causes an acceleration of the crankshaft and thus also of the flywheel. This is apparent in the voltage curve from slightly higher frequencies and amplitudes of the CKP signal.

### Calculation of the ignition angle

Since propagation of the flame front in the air/fuel mixture always takes the same amount of time, the ignition of the air/fuel mixture has to take place earlier or later depending on the engine speed. The higher the speed, the earlier ignition must occur. This ensures that maximum combustion pressure is achieved immediately after Top Dead Center and that maximum combustion pressure acts on the piston.

When starting the engine, ignition timing is determined by the CMP purely from the ignition map and information on camshaft position (CKP sensors) and crankshaft position (PCM sensor). As soon as the engine is running, the following data are used as a basis for calculating the ignition angle:

- the engine speed,
- the engine load,
- the coolant temperature and
- the KS signal.

The ignition angle has a major impact on engine operation. It affects

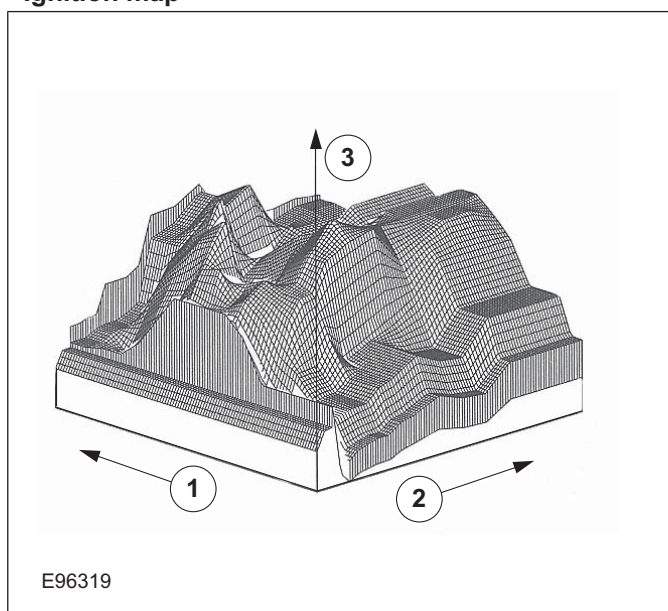
- engine performance
- exhaust emissions
- fuel consumption,
- combustion knock behavior and
- engine temperature.

The higher the engine load, i.e. the torque demand, the richer the air/fuel mixture, the longer the combustion period and the earlier the ignition.

Item	Description
6	60-2 pulses per revolution of the crankshaft
7	Tooth center
8	Reference mark
9	Tooth pitch

The PCM calculates engine load using the MAF sensor signal, the throttle position and engine speed. This is done using ignition maps that are stored in the PCM. The ignition timing is adjusted according to the operating condition of the engine, for cold starting for example.

### Ignition map



Item	Description
1	Engine load.
2	Engine speed
3	Ignition angle

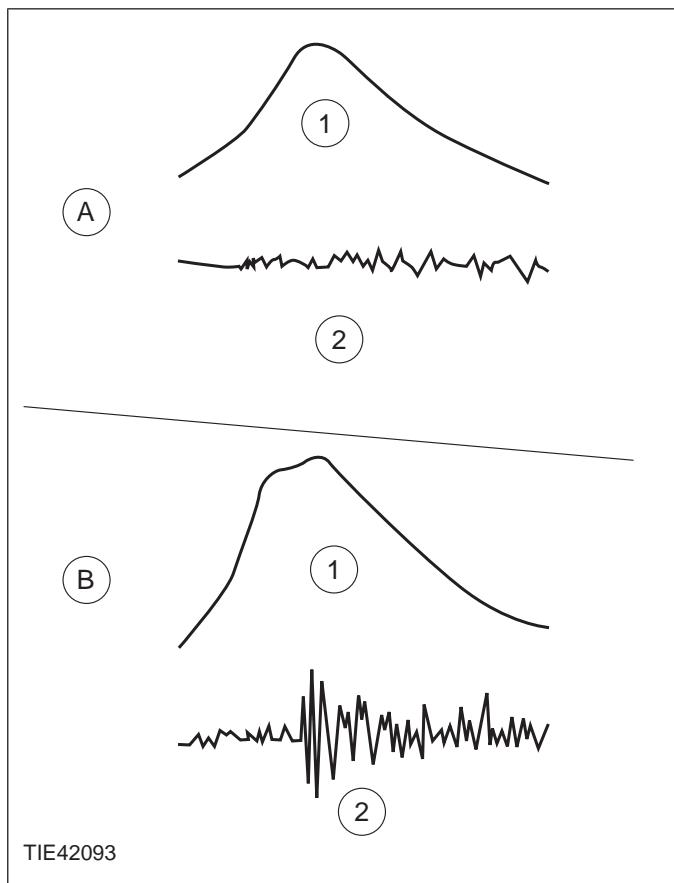
The ignition maps were calculated in a series of tests. Particular attention is paid to the emission behaviour, power and fuel consumption of the engine. The ignition map is stored in the data memory of the PCM.

By adjusting the ignition timing it is also possible to influence the engine speed to some extent without having to change the throttle valve position. This has advantages for idling stabilization, as the engine speed and hence the engine torque respond far more quickly to a change in the ignition timing

## DESCRIPTION AND OPERATION

than to a change in the throttle valve position. The ignition timing also changes much more quickly.

To keep the ignition point as close as possible to the knock limit and so optimize the efficiency of the engine, two KS are installed in the engine, which pick up the mechanical vibrations of the engine and convert them into an electrical signal for the PCM.



Item	Description
A	Normal combustion
B	Knocking combustion
1	Pressure characteristic in cylinder
2	Output signal from KS

The term "knocking" is used to describe combustion processes in which the flame front propagation speed reaches the speed of sound. This can happen towards the end of combustion in particular, when unburnt air/fuel mixture on the combustion chamber walls self-ignites due to the increase in pressure following initiation of regular combustion. The resulting pressure peaks damage the pistons, cylinder head gasket and cylinder head.

The cylinder in which combustion knock is occurring is identified from the camshaft position

(CMP sensors) and crankshaft position (CKP sensor) information.

If the PCM detects combustion knock, the ignition timing for the cylinder in question is gradually retarded for a few crankshaft revolutions until combustion knock stops. After that the ignition point is slowly returned to the calculated value. This facilitates individual cylinder ignition, which makes it possible for the engine to operate at optimum efficiency at the knock limit.

### Engine fueling

Fuel is supplied by a non-return fuel system.

Fuel pressure and fuel delivery rate are regulated by the PCM with the aid of the FPDM. The fuel pump is supplied with a cycled voltage by the FPDM. By cycling the voltage, the fuel pump output can be steplessly adjusted. The fuel pressure can be steplessly regulated between 3 and 5 bar.

Adjusting the fuel pump output has the following advantages:

- The fuel pump's power consumption is reduced, thereby reducing the load on the vehicle's power supply system.
- The fuel pump's service life is increased.
- Fuel pump noise is reduced.

### Fuel pressure regulator

The PCM calculates the required fuel pressure based on the operating conditions. The PCM transmits a corresponding PWM signal to the FPDM. With the aid of this signal, the FPDM actuates the pump by sending, in turn, a PWM signal to the ground connection of the fuel pump. The fuel pump can be steplessly regulated by varying the pulse width of the PWM signal.

The PCM continuously monitors the fuel pressure in the fuel rail by means of the fuel temperature/fuel pressure sensor. If the pressure deviates from the calculated value, the PCM adapts the PWM signal to the FPDM accordingly. Thus the fuel pressure levels out at approx. 4 bar.

For safety reasons, the PCM switches off fuel delivery if the SRS (supplemental restraint system) module detects a crash.

### Regulation of injected fuel quantity

The electromagnetically controlled injectors dose and atomize the fuel. The quantity of injected fuel is regulated by the duration of actuation of the fuel injectors. The fuel injectors are either closed (not



**DESCRIPTION AND OPERATION**

actuated) or opened (actuated). Each cylinder has its own injector. The injection is accurately dosed and takes place at a time determined by the PCM. Injection takes place immediately in front of the intake valves of the cylinder. The injectors are actuated ground side via end-stages integrated into the PCM and using the signal calculated by the engine management system. Power is supplied via the Powertrain Control Module relay in the BJB. The injected fuel quantity depends on the opening time, the fuel pressure and the diameter of the nozzle holes.

The fuel metering is determined via open or closed-loop control.

The open control loop differs from the closed control loop in that the lambda control is deactivated.

The PCM switches from closed to open-loop control if the HO<sub>2</sub>S cools down to below 600°C or fails, as well as when accelerating, coasting and at full load.

Regulation of injected fuel quantity via the PCM involves:

- controlling the fuel pump,
- calculating the required quantity of fuel for engine starting,
- observance of the desired air/fuel ratio,
- calculating air mass,
- and calculating the fuel quantity for the different operating states and corresponding fuel adjustment measures.

**Open loop control**

Open loop control is used primarily for fuel injection, as long as the signals of the HO<sub>2</sub>S are not involved in the calculation of the PCM.

The two most important reasons that make it absolutely essential to run the engine without lambda control (open-loop control) are the following operating conditions:

- Cold engine (starting, warm-up phase)
- Full-load operation (WOT (wide open throttle))

Under these operating conditions the engine needs a rich air/fuel mixture with lambda values below  $\lambda = 1$  in order to achieve optimum running or optimum performance.

It is possible to keep this unregulated range very small by using a broadband HO<sub>2</sub>S.

**Closed-loop control**

Closed loop control ensures strict control of exhaust emissions in conjunction with the TWC

(three-way catalytic converter) and economical fuel consumption. With closed loop control, the signals from the HO<sub>2</sub>S are analyzed by the PCM and the engine always runs in the optimum range of  $\lambda = 1$ . In addition to the normal HO<sub>2</sub>S, the signal from the monitoring sensor for the catalytic converter is also included in the control. The lambda control is optimized on the basis of this data.

Certain factors such as wear, component tolerances or more minor defects such as air leaks in the intake system are compensated for by lambda control. If the deviation occurs for a longer period of time, this is recorded by the adaptive (self-learning) function of lambda control. In this instance, the entire map is shifted by the corresponding amount, to enable control to commence once again from the virtual baseline.

These adaptive settings are stored in the PCM and are also used in open-loop control conditions.

If the adaptive value is too high or too low, an error is stored in the fault memory of the PCM.

**Oxygen sensor (HO<sub>2</sub>S) and catalyst monitor sensor**

A broadband HO<sub>2</sub>S is used as the HO<sub>2</sub>S. The HO<sub>2</sub>S is located in front of the TWC. The catalyst monitor sensor is located in the center of the TWC so that it can detect any deterioration in the cleaning performance of the TWC more quickly.

The HO<sub>2</sub>S measures the residual amount of oxygen in the exhaust before the TWC.

The catalyst monitor sensor measures the amount of oxygen in the exhaust gas after or in the TWC.

Both the HO<sub>2</sub>S and the catalyst monitor sensor transmit these data to the PCM.

The broadband HO<sub>2</sub>S works at temperatures of between 650°C and 900 °C. If the temperature rises above 1000°C, the oxygen sensor will be irreparably damaged.

To reach optimum operating temperature as quickly as possible, an electrically-heated oxygen sensor is installed. The heating also serves to maintain a suitable operating temperature while coasting, for example, when no hot gases are flowing past the oxygen sensor.

The heating element in the HO<sub>2</sub>S is a PTC (positive temperature coefficient) resistor. The heating element is supplied with battery voltage as soon as the Powertrain Control Module relay engages. The HO<sub>2</sub>S is earthed via the PCM. As the heating current is high when the element is cold, it is limited via PWM in the PCM until a certain



## DESCRIPTION AND OPERATION

current value is reached. The PCM then permanently connects the heating element to earth.

The catalyst monitor sensor is used by the PCM to measure the oxygen content in the exhaust gas in the TWC. If all the conditions for catalyst diagnostics are met, based on this information the PCM can check that the TWC is working satisfactorily. The information is also used to improve the air/fuel mixture adjustment.

The catalyst monitor sensor is similar in function to an HO<sub>2</sub>S. The signal transmitted by the catalyst monitor sensor changes sharply if the oxygen content in the exhaust gas changes. For this reason, catalyst monitor sensors are also called "jump lambda sensors".

### Fuel tank purging

The EVAP purge valve is only actuated by the PCM if the coolant temperature is at least 60°C. Actuation is done ground side by means of a PWM signal. This makes it possible to have the full range of opening widths, from fully closed to fully open. The PCM determines from the operating conditions when and how wide to open the EVAP tank purge valve. If the EVAP purge valve is opened, the engine sucks in ambient air through the activated charcoal in the evaporative emission canister as a result of the vacuum in the intake manifold. In this way the adsorbed hydrocarbons are led to the combustion chamber of the engine.

The EVAP tank purge valve is not actuated and system cleaning is interrupted if the engine switches to idle and/or a closed-loop control process is initiated.

Power (battery voltage) is supplied via the Powertrain Control Module relay in the BJB. The solenoid coil resistance is between 17 and 24 ohms at 20°C.

### Engine speed control

The APP sensor provides the PCM with information about the driver's request for acceleration.

The throttle control unit receives a corresponding input signal from the PCM. An electric motor then moves the throttle valve shaft by means of a set of gears. The position of the throttle is continuously recorded by the TP sensor. Information on throttle position is processed and monitored by the PCM. The TP sensor comprises two potentiometers. These work in opposite ways to each other. In one potentiometer, the resistance increases when the throttle is opened, in the other it decreases. This

allows the operation of the potentiometers to be checked. The signal from the TP sensor is amplified in the lower range (idle to a quarter open) by the PCM to enable more precise control of the throttle in this range. This is necessary because the engine is very sensitive to changes in throttle angle in this throttle opening range.

With the throttle valve position kept constant, the ignition angle and the injected fuel quantity are then varied to meet the torque demands. Depending on the operating state of the engine, a change in the position of the throttle flap may not be necessary when the APP sensor changes.

If a fault develops in the throttle control unit, a standby function is executed. This standby function allows a slight opening of the throttle flap, so that enough air passes through to allow limited engine operation. For this purpose, there is a throttle flap adjustment screw on the throttle housing. The return spring closes the throttle flap until the stop of the toothed segment touches the stop screw. In this way a defined throttle flap gap is formed for limp home mode.

The stop screw has a spring loaded pin, which holds the throttle flap open for limp home mode. In normal operating mode, this spring loaded pin is pushed in by the force of the electric motor when the throttle flap must be closed past the limp home position (e.g. for idle speed control or overrun shutoff).

### Oil monitoring

**The engine does not have an oil pressure switch.** The oil level and oil quality are calculated.

#### Calculating the engine oil level

The oil level is determined by continuous measurement of the capacitance (i.e. the ability to store an electrical charge) between the two capacitive elements of the engine oil level/temperature/quality sensor. The different oil levels cause the capacitance between the elements to change. The data are recorded by the PCM and converted into an oil level value. Temporary fluctuations in oil level are automatically filtered out by the PCM.

#### Calculating oil quality

The PCM calculates the oil quality from the oil level measurement and the oil temperature measured by the sensor, plus the engine speed and the average fuel consumption. The driver is informed about when an oil change is due.

**DESCRIPTION AND OPERATION****Calculation of valve timing adjustment angle**

The 2.5L Duratec (VI5) engine has two camshaft adjustment units which work independently of each other.

One camshaft adjustment solenoid is installed for each intake camshaft and exhaust camshaft.

This allows the PCM to continuously adjust the intake and exhaust-side camshaft adjustments independently of one another. The timing is adjusted by the PCM using curves; adjustment is primarily done as a function of engine load and engine speed.

In this way the engine performance is increased and internal exhaust gas recirculation is realized.

The advantages of camshaft adjustment are as follows:

- Higher torque and improved torque characteristics
- Reduced fuel consumption
- Improved emissions performance

The camshaft adjustment solenoids are actuated by the PWM by means of a PCM signal.

Continuous adjustment of the camshafts by the PCM is achieved by means of the camshaft adjustment solenoids, the camshaft adjustment units and two CMP sensors. A defined quantity of engine oil is supplied to or drained from the adjustment units via the camshaft adjustment solenoids. The existing EOP (engine oil pressure) is taken into account in the process. In this way the valve timings are adjusted according to the operating condition of the engine. The camshaft adjusters work according to the vane-cell principle. On starting the engine, both camshafts are mechanically locked in their starting positions. The intake camshaft is in the maximum late position and the exhaust camshaft in the maximum early position.

Control is divided into four main areas:

- Low engine speed and low load
- Partial load
- Low engine speed and high load
- High engine speed and high load

At low engine speed and low load, the exhaust valves open early and the intake valves open late. The result is reduced fuel consumption and more uniform idling.

In the partial load range, the exhaust valves and the intake valves open late. The late opening of the exhaust valves results in a good utilization of the expanding gases in the cylinder. Closing the exhaust valves after Top Dead Center allows internal exhaust gas recirculation through aspiration of exhaust gases into the combustion chamber. Moreover, the intake valves close after Bottom Dead Centre, allowing the fresh air/fuel mixture and exhaust gases to flow back into the intake tract. The result is reduced fuel consumption and low emissions.

At low engine speed and high engine load, the exhaust valves open late and the intake valves open early. Due to the resulting valve opening overlap at Top Dead Centre, the pulsating gas column within the combustion chamber is utilized to achieve better charging of the combustion chamber. The result is increased torque at lower RPM.

At high engine speeds and high engine load, the exhaust valves open early and the intake valves close late. Because a rapid gas exchange must be achieved at high engine speeds, the early opening of the exhaust valves achieves better expulsion of the exhaust gas and the late closing of the intake valves improves cylinder charge efficiency. Optimum power output is achieved.

Many other camshaft positions are possible in addition to these settings.

In order to avoid a malfunction in the camshaft adjustment units at excessively low ambient or engine-oil temperatures, they are activated by the PCM with a time delay via the camshaft adjustment solenoids. The PCM receives the information required for this from the ECT sensor and the outside air temperature sensor.

When idling and during deceleration, the camshaft adjustment solenoids are activated repeatedly by the PCM in order to remove any dirt which may be on the bore holes and ring grooves.

**Boost pressure control**

Optimum regulation is achieved by means of an electronically-controlled solenoid valve, the boost control solenoid valve.

Refer to: **Turbocharger** (303-04 Fuel Charging and Controls - Turbocharger - 2.5L Duratec (147kW/200PS) - VI5, Description and Operation).

**DESCRIPTION AND OPERATION****Starting process**

The PCM enables the starting process when a key providing a valid code is read via the PATS.

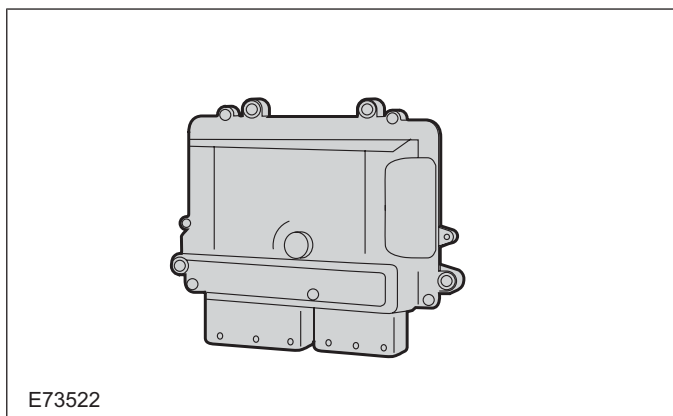
Refer to: **Starting System** (303-06 Starting System - 2.5L Duratec (147kW/200PS) - VI5, Description and Operation).

**Alternator control (Smart Charge)**

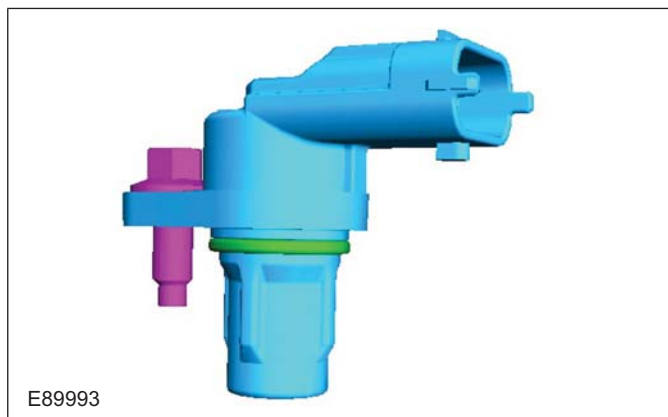
The vehicle is fitted with a Smart Charging charge system.

In this system, the charge voltage is regulated by the PCM.

Refer to: **Generator** (414-02 Generator and Regulator, Description and Operation).

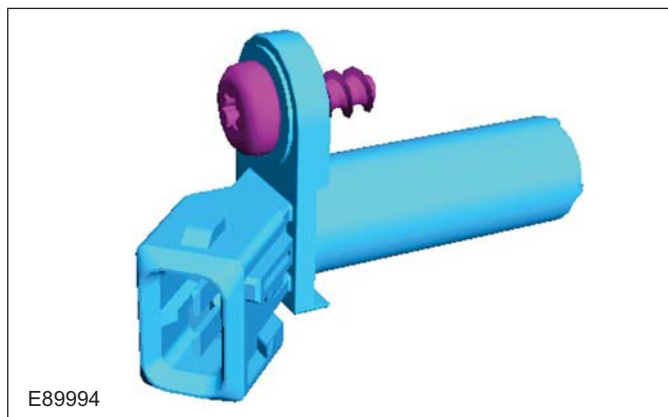
**Component Description****PCM**

A voltage transformer integrated into the PCM provides various components of the PCM and sensors on the engine with a 5 volt supply. Functions which work at battery voltage, such as the injectors, are controlled via internal power end stages or, like the ignition coils, via external power end stages in the ignition coils themselves.

**CMP**

The intake and exhaust camshafts each have a sensor installed on them.

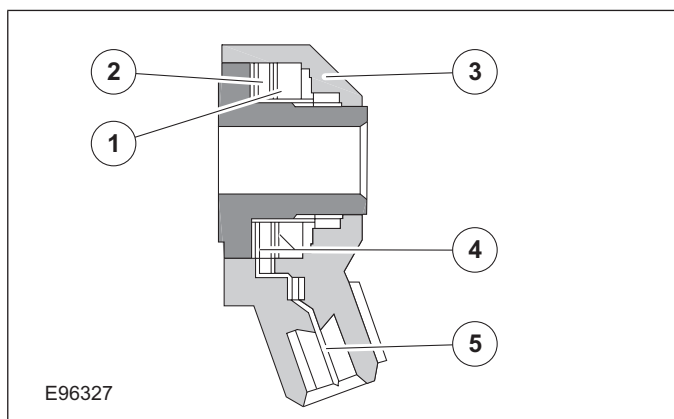
The CMP sensor is realized as a Hall effect sensor and is provided by the PCM with a 5 volt supply. The Hall effect sensor emits a signal when the pulse segments incorporated into the sensor wheel rotate past the tip of the sensor. If an increase occurs in the area of the sensor, the PCM receives a 'high' signal with a maximum voltage of 4.5V. If a gap occurs in the area of the sensor, a 'low' signal is sent to the PCM. Here the voltage is approx. 0.5V.

**CKP sensor**

The CKP sensor utilizes the induction principle. A sinusoidal voltage is sent to the PCM. When performing a voltage test, ensure that the CKP sensor is connected to the engine wiring harness. This is necessary, otherwise the sensor will not be subjected to any load and incorrect measurements will result.

DESCRIPTION AND OPERATION

KS



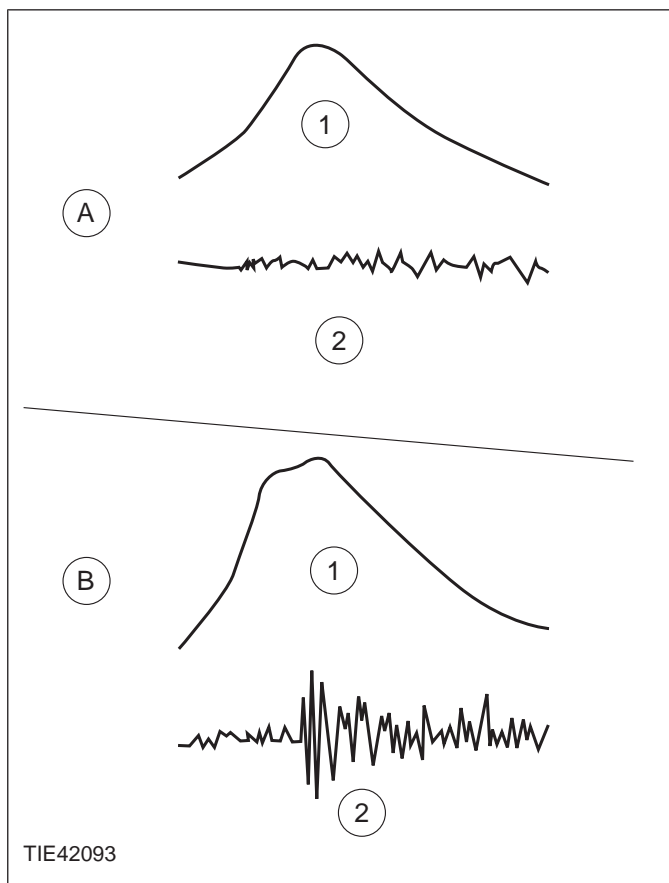
Item	Description
1	Seismic mass
2	Piezoceramic
3	Housing
4	Piezoceramic contact
5	Electrical connection

The KS converts mechanical vibrations of the cylinder block into electrical pulses which can then be processed by the PCM.

The KS consists of piezo-ceramic crystals that generate a voltage when subjected to a mechanical load.

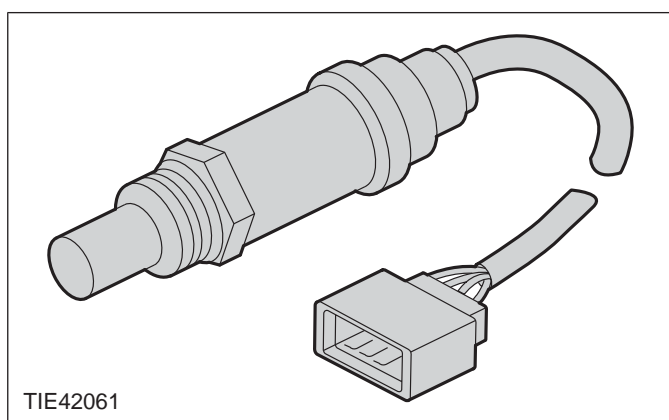
When fastening the KS, make sure the specified torque is adhered to. In this way a defined initial tension is applied to the crystals which exerts an influence on the operation of the KS.

When the engine is running, the pressure fluctuations arising due to the combustion process cause vibrations in the cylinder block. These act on the crystals in the KS, causing the sensors to produce an output signal. The stronger the vibrations, the higher the frequency and the AC voltage. These signals are evaluated by the PCM and compared with stored data.



Item	Description
A	Normal combustion
B	Knocking combustion
1	Pressure characteristic in cylinder
2	Output signal from KS

Broadband HO2S



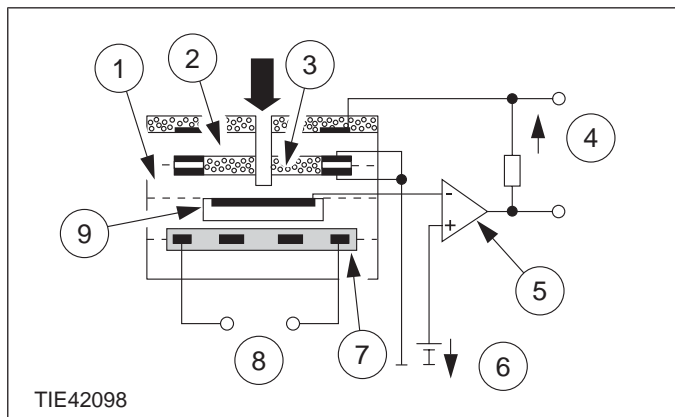
The planar broadband HO2S also allows measurements of the exhaust gas which deviates from the stoichiometric ratio ( $\lambda = 1$ ). The measuring range extends from  $\lambda$  0.7 to 2.8,



**DESCRIPTION AND OPERATION**

whereby the broadband HO<sub>2</sub>S emits a clear, constant signal.

The broadband HO<sub>2</sub>S consists of a Nernst concentration cell and an oxygen pump cell, which transports the oxygen ions.

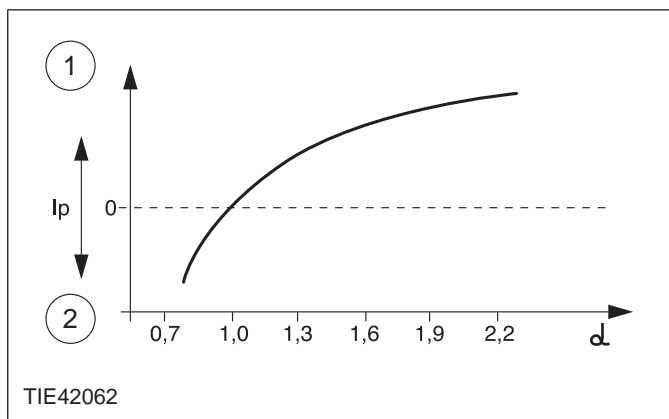


Item	Description
1	Nernst concentration cell
2	Oxygen pump cell
3	Measuring area
4	Pump current
5	Regulating switch
6	Reference voltage
7	Heater
8	Heating voltage
9	Reference air duct

Between the oxygen pump cell and the Nernst measuring electrode, there is a diffusion gap which acts as the measuring area and is connected to the exhaust gas. The Nernst concentration cell is connected via a duct with the ambient reference air and the measuring area. It detects the mixture composition in the measuring area. A concentration of  $\lambda = 1$  is set in the measuring area using the oxygen ion flow. This is done by applying a reference voltage which results in a pump current.

When the exhaust gas is lean, the oxygen pump cell is actuated in such a way that oxygen ions are pumped out of the measuring area. This is detected by the regulating switch, so that the flow can move (positive direction).

If the exhaust gas is rich, then the current direction is reversed, i.e. the cell pumps oxygen ions into the measuring area. The regulating switch detects this, so the flow is reversed (negative direction).



Item	Description
Ip	Pump current in mA
1	positive pump current
2	negative pump current

The pump current represents a direct measurement of the mixture composition. With  $\lambda = 1$  (14.7 kg air/1 kg fuel), the pump current is 0 mA. The relatively small measured current is converted into a voltage signal in the PCM using an evaluation circuit. The heating of the broadband HO<sub>2</sub>S is supplied with a reference voltage of 11 to 14V. The operating temperature of the broadband HO<sub>2</sub>S is 650 - 900 °C.

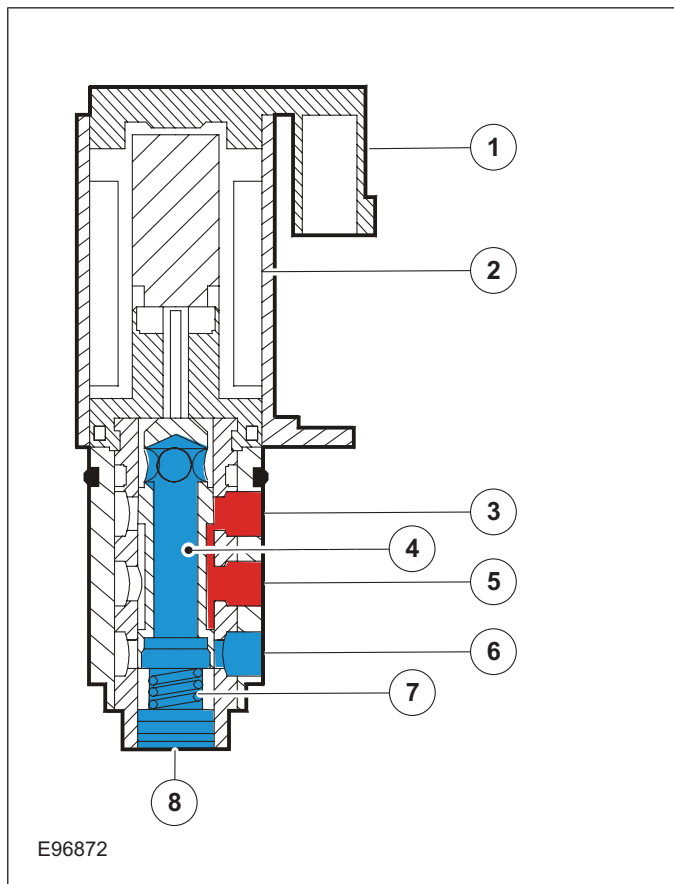
The characteristic curve of the broadband HO<sub>2</sub>S is constant (linear), without a  $\lambda$  jump.

**VCT (variable camshaft timing) solenoids**

The camshaft adjustment solenoids are multi-way solenoid valves that are actuated with a PWM signal, thereby allowing the valve plungers to be steplessly adjusted.



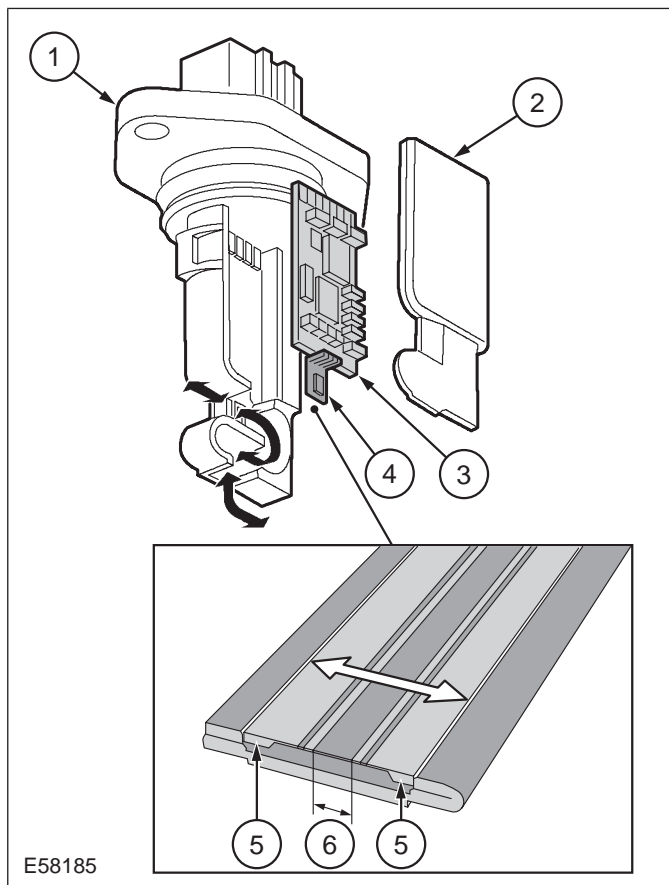
DESCRIPTION AND OPERATION



E96872

Item	Description
1	Electrical connection
2	Solenoid coil
3	Engine oil pressure supply bore and ring groove for camshaft adjustment unit chamber A
4	Tappet
5	Engine oil pressure supply bore for camshaft adjustment solenoid
6	Engine oil pressure supply bore and ring groove for camshaft adjustment unit chamber B
7	Spring
8	Engine oil return bore

MAF sensor



E58185

Item	Description
1	Housing
2	Housing cover
3	Control electronics
4	Sensor element
5	Sensor measuring cell
6	Heating zone

The MAF sensor works on the 'hot-film principle'.

The MAF sensor is powered via the Powertrain Control Module relay in the BJB. The MAF sensor is connected to ground via the PCM.

The MAF sensor sits in a molded part which protrudes into the center of the air cleaner's outlet pipe. From this position, it measures the air mass drawn in by the engine.

The air mass aspirated by the engine is determined on the basis of the cooling effect of the intake air via a hot-film element in the MAF sensor. The greater the aspirated air mass, the greater the cooling effect and the lower the electrical resistance of the hot-film element. The electronics in the MAF sensor process this resistance value and send a

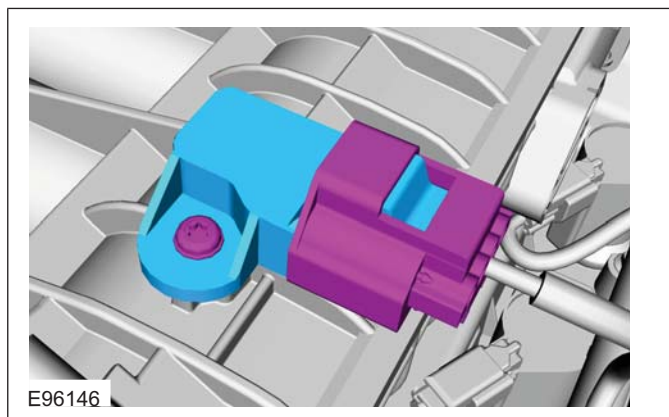
**DESCRIPTION AND OPERATION**

voltage signal to the PCM corresponding to the aspirated air mass.

This analogue voltage signal is between 0.5V and 5V. Low mass of intake air produces a low voltage signal. A high mass of intake air produces a correspondingly high voltage signal.

The MAF sensor is also capable of detecting the backflow of the intake air. A sensor element is heated electrically on the integrated chip and then cooled by the air flowing through. The regulating switch supplies the heating current in such a way that it attains a constant excess temperature in comparison to the intake air. The mass air flow and the direction of flow can be derived from this heating current (given in the form of a signal voltage). Below a certain voltage value there is a return flow. The direction of flow is registered by two sensors pointing in different directions. The measurement does not require a great deal of software processing effort, even with a strongly pulsating mass air flow.

**MAPT**

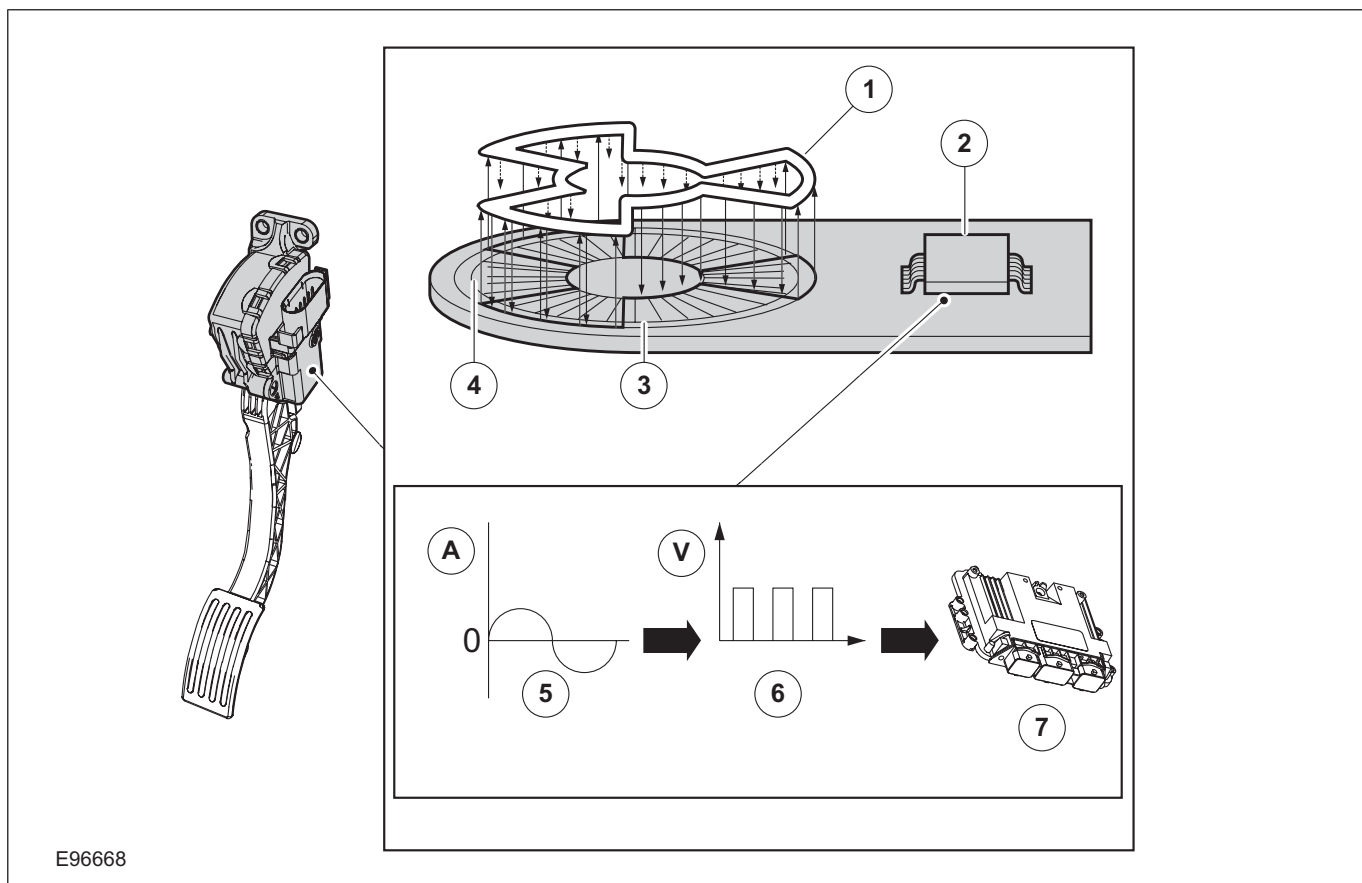


The MAPT sensor combines two sensors in one housing. These are the MAP sensor and the IAT sensor. They take the form of a piezoelectric resistor and an NTC resistor.

The MAP sensor receives a reference voltage of 5V from the PCM. The output signal from the MAP sensor element is an analog voltage signal which changes proportionately to the prevailing pressure in the intake manifold.

The IAT sensor records the temperature of the intake air downstream of the intercooler.

**APP sensor**



E96668

DESCRIPTION AND OPERATION

Item	Description
A	Amperes
V	Volts
1	Valve rotor
2	Electronics
3	Primary coil
4	Secondary coil

The APP sensor is a double contactless inductive sensor. The APP sensor is integrated with the accelerator pedal in the accelerator pedal module.

The inductive sensor essentially works in a similar way to a transformer. The incoming DC voltage first has to be converted into AC voltage. Depressing the accelerator pedal moves a rotor. This induces the AC voltage from the primary coil into the secondary coil. The strength of the induction depends on the position of the rotor:

- no accelerator-pedal actuation: low induction, i.e. low amplitude of the AC voltage,
- full accelerator-pedal actuation: high induction, i.e., high amplitude of the AC voltage.

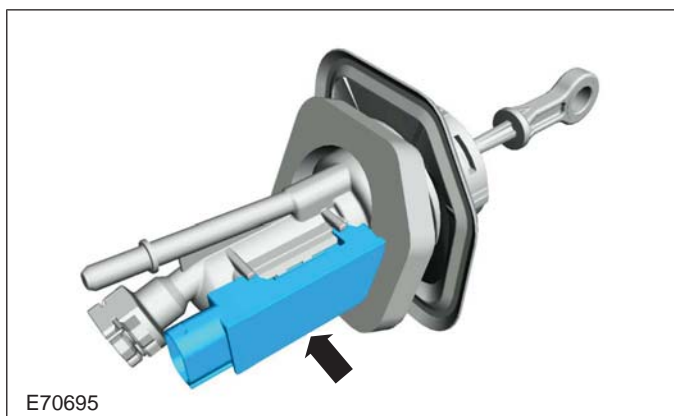
To allow the PCM to process the AC voltage signal output by the secondary coil, the signal must first be converted into a PWM signal in the sensor electronics.

In the APP sensor the signals are split as follows:

- APP 1 = PWM signal to the GEM and from there via the CAN data bus to the PCM.
- APP 2 = the analogue DC (direct current) signal is sent directly to the PCM.

Both signals are monitored by the PCM for plausibility.

CPP sensor

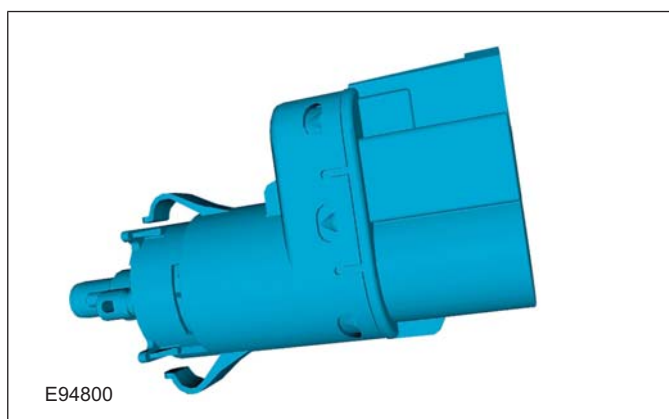


Item	Description
5	Analog alternating current
6	Generated PWM signal.
7	PCM <b>Comments:</b> PWM signal is converted in the GEM and forwarded via the CAN data bus.

The sensor works on the Hall-effect principle and records the position of the piston in the master cylinder without contact. The permanent magnet required for recording the position is located in the piston of the clutch master cylinder.

The signal from the CPP sensor is recorded by the GEM and transmitted to the CAN via the PCM bus.

BPP switches

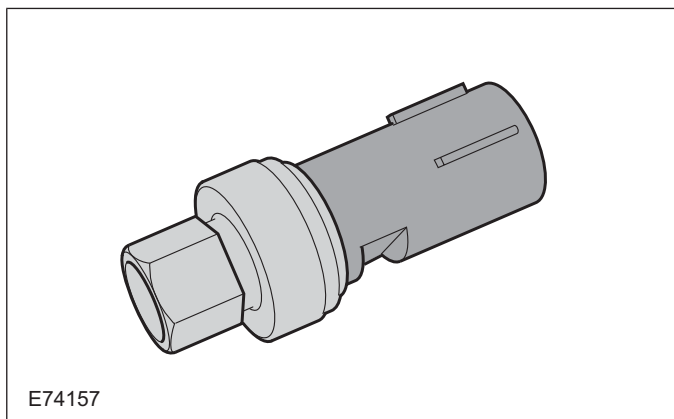


The BPP switch is designed as normally-closed contact. In its rest state the switch is closed and sends an earth signal to the GEM.

The brake light switch is designed as normally-open contact and is open in its rest state.

DESCRIPTION AND OPERATION

Air conditioning (A/C) pressure sensor

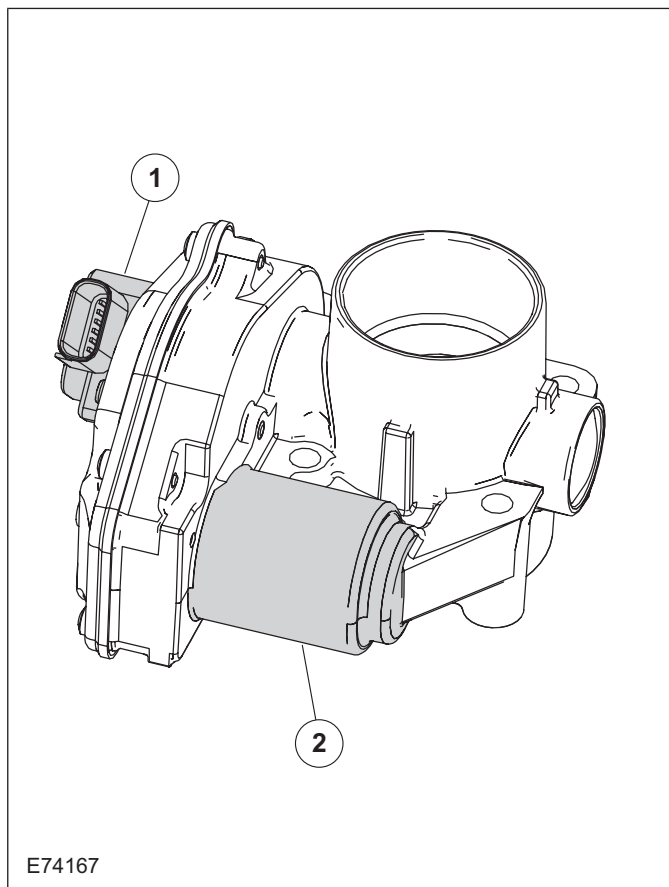


E74157

The A/C pressure sensor is installed on the high-pressure side of the A/C. The input voltage is 5V, the output voltage is between 0.5V and 4.5V depending on the cryogenic fluid pressure. When the cryogenic fluid pressure is low, the output voltage is also low.

Pressure (bar)	Voltage (Volts)
Approx. 30	3.9 - 4.0
Approx. 25	3.3 - 3.4
Approx. 20	2.7 - 2.8
Approx. 15	2.1 - 2.2
Approx. 10	1.6 - 1.7
Approx. 5	1.0 - 1.1
Approx. 1	0.5 - 0.7

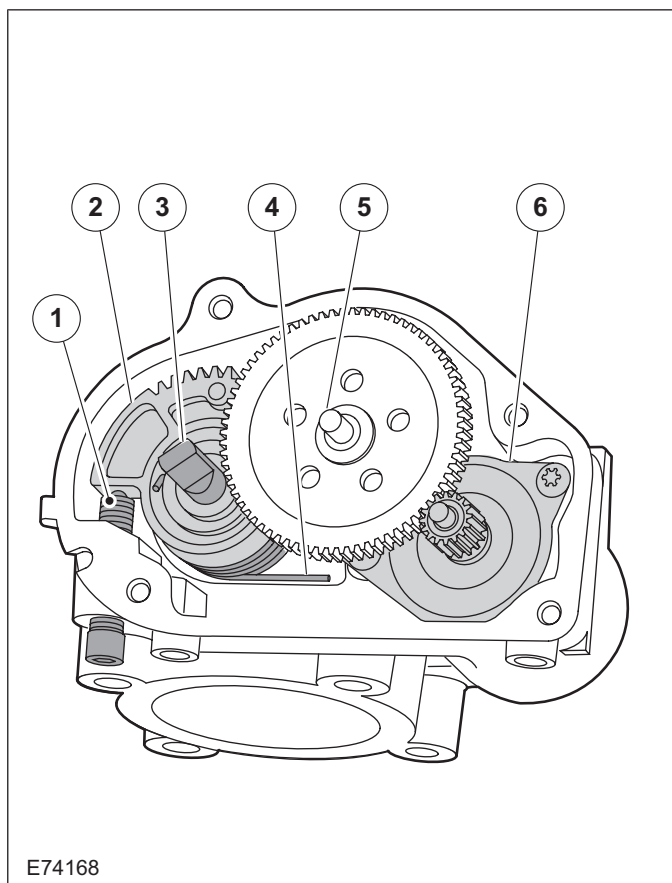
Throttle control unit



E74167

Item	Description
1	TP sensor
2	Electric motor

## DESCRIPTION AND OPERATION

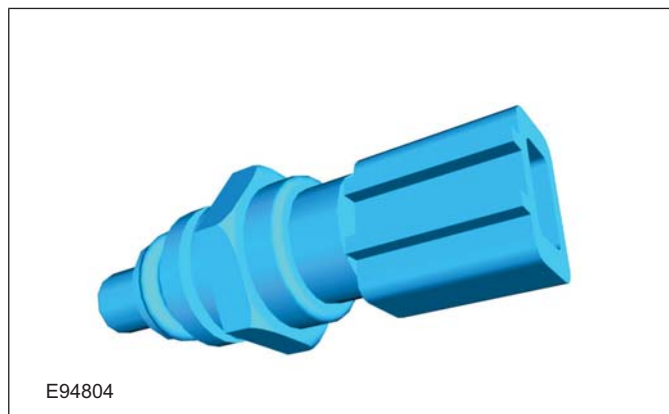


Item	Description
1	Stop screw
2	Toothed segment
3	Throttle flap spindle
4	Throttle flap return spring
5	Joint shaft
6	Electric motor with pinion

**⚠ CAUTION: The throttle control unit must not be repaired or adjusted. The stop of the throttle valve must on no account be adjusted.**

If there is a fault, the throttle is returned to its original position by means of the throttle valve return spring. In this position, the throttle valve is still slightly open. As a result, a higher idle speed is set, enabling the vehicle to be driven, though within narrow limits.

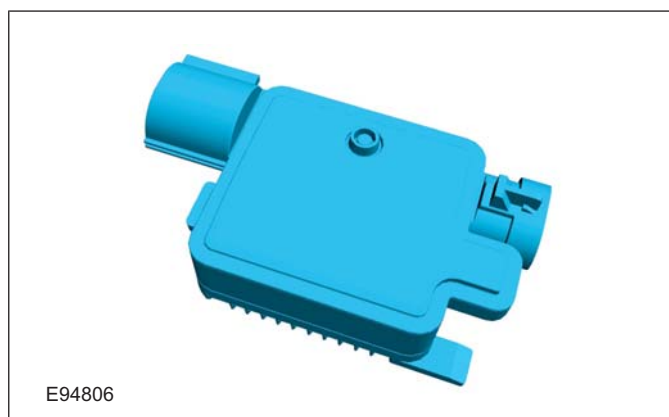
## ECT sensor



The ECT sensor is designed as an NTC resistor.

A voltage of 5V is applied to the ECT sensor by the PCM. The PCM is able to determine the coolant temperature from the temperature-dependent voltage drop at the sensor.

## Cooling fan module

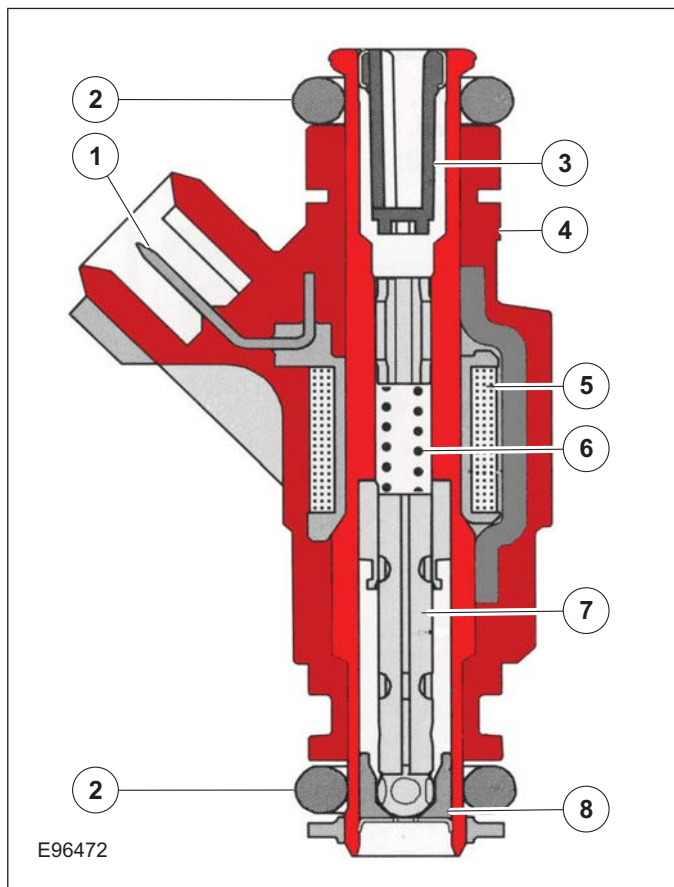


The cooling fan module is directly supplied with battery power via a 60A fuse in the BJB. The radiator fan speed is controlled by the PWM via a PCM signal.



DESCRIPTION AND OPERATION

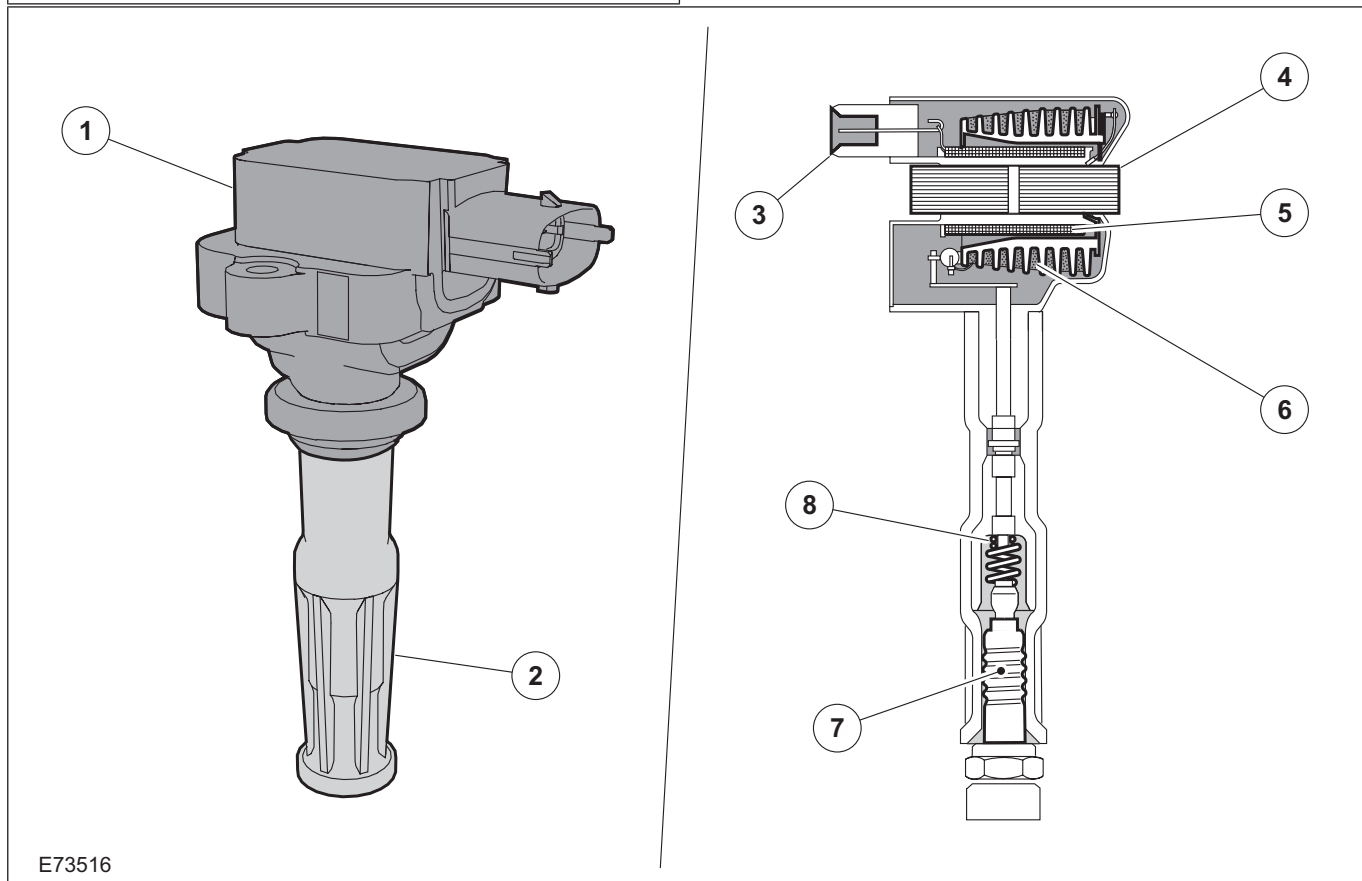
injectors



Item	Description
1	Electrical connector
2	Seal
3	Fuel inlet with fine sieve
4	Housing
5	Coil
6	Spring
7	Valve needle with solenoid armature
8	Valve seat with nozzle hole disk

The fuel injectors consist of a housing with fuel passages, a coil and an injector needle with a solenoid armature. The fuel inlet in the injector features a fine sieve. There are two holes in the nozzle hole disk. These are arranged so that two jets of fuel emerge. Each jet supplies one intake valve of the respective cylinder.

Ignition coil-on-plug

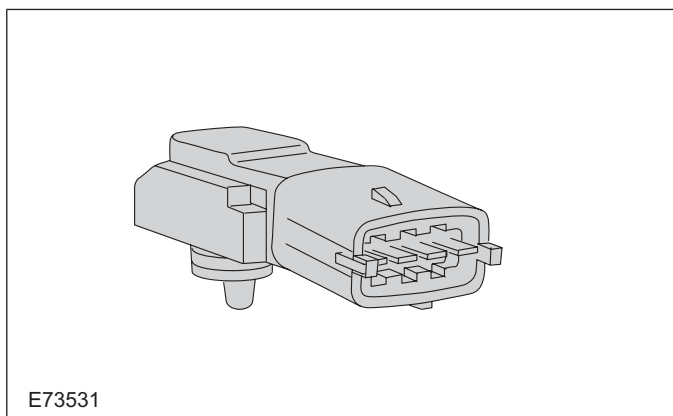


## DESCRIPTION AND OPERATION

Item	Description
1	Coil-on-plug ignition coil
2	Spark plug connector
3	Low-voltage connection
4	Laminated soft-iron core

In an ignition system with coil-on-plug ignition coils, each cylinder is actuated individually and only once per cycle (working stroke). The coil-on-plug ignition coils are mounted directly on the spark plugs, therefore no ignition cables are required between the ignition coils and the spark plugs.

Each individual ignition coil is actuated on the low-voltage side by the PCM. The power end-stages are incorporated into the coil-on-plug ignition coils. Only the actuating current for these power end-stages is controlled by the PCM.

**Fuel pressure/fuel temperature sensor**

E73531

The fuel pressure/fuel temperature sensor is a combination of two sensors, one for the fuel absolute pressure and one for the fuel temperature. The sensors register the fuel values in the fuel injection supply manifold. The sensor is supplied with a 5V voltage by the PCM.

The fuel pressure sensor is a piezoresistor and works using an analog signal. The change in output voltage mirrors the change in pressure in the fuel rail. If the pressure is low, the output voltage is also low.

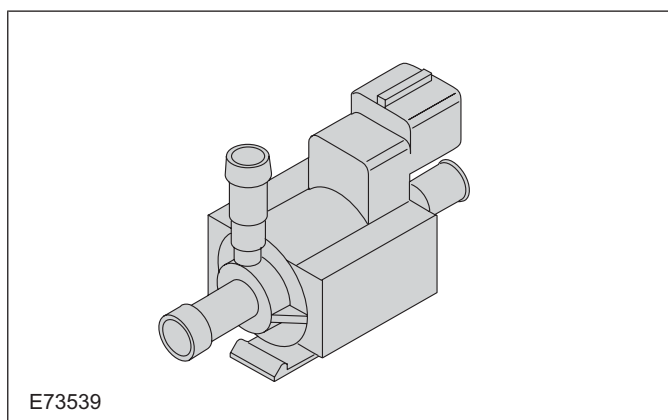
The fuel temperature sensor is an NTC resistor.

When the fuel pressure/fuel temperature sensor is disconnected, the resistance of the fuel temperature sensor between connections 1 and 2 of the sensor can be measured.

Item	Description
5	Primary winding
6	Secondary winding
7	Spark plug
8	High-voltage connection via spring contact

Temperature	Resistor
0° C	5896 Ohm
10° C	3792 Ohm
20° C	2500 Ohm
30° C	1707 Ohm
40° C	1175 Ohm

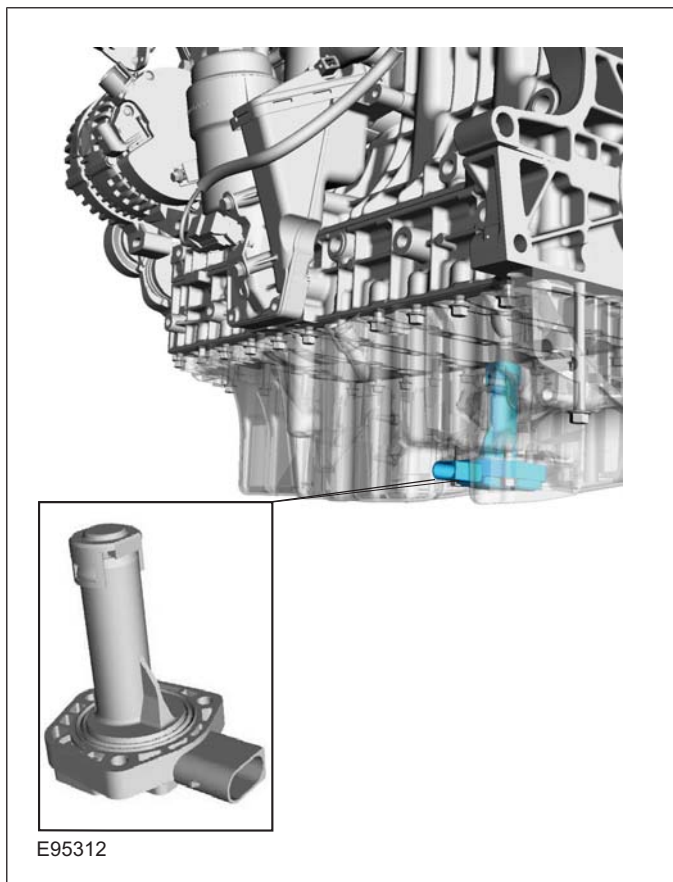
The values of the fuel pressure/fuel temperature sensor can be read out with IDS. The displayed values are absolute values (fuel pressure + atmospheric pressure).

**Wastegate control valve**

E73539

The boost control solenoid valve is a 2/3-way valve that is actuated with a PWM signal. This allows the valve opening to be steplessly adjusted.

Power (battery voltage) is supplied via the Powertrain Control Module relay in the BJB. The solenoid coil resistance is around 23 ohms at 20° C.

**DESCRIPTION AND OPERATION****Engine oil level, temperature and quality sensor**

The sensor is a combined oil level and oil temperature sensor.

The sensor consists of:

- Electrical connector
- Integral electronics
- PTC resistor
- Capacitive element consisting of two tubes with a space between them. The one tube represents the positive side, the other the negative. The oil between the tubes creates the capacitive properties.

The sensor receives a 5V voltage from the PCM. The sensor generates a PWM signal that is sent to the PCM.

**Exterior air temperature sensor**

The outside air temperature sensor is a NTC resistor and is supplied with a 5V voltage by the PCM.

The resistance of, and consequently the voltage from, the outside air temperature sensor changes as a function of temperature.

**DIAGNOSIS AND TESTING****Electronic Engine Controls****General Equipment**

Ford diagnostic equipment
---------------------------

**Inspection and Verification**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

<b>Electrical</b>
<ul style="list-style-type: none"><li>– Fuse(s)</li><li>– Wiring harness</li><li>– Electrical connector(s)</li><li>– Relay(s)</li><li>– Sensor(s)</li><li>– Switch(es)</li><li>– Powertrain control module (PCM)</li></ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. If the cause is not visually evident, verify the symptom and refer to the Ford diagnostic equipment to diagnose the system.

303-14-36

Electronic Engine Controls — 2.5L Duratec (147kW/200PS) - VI5

303-14-36

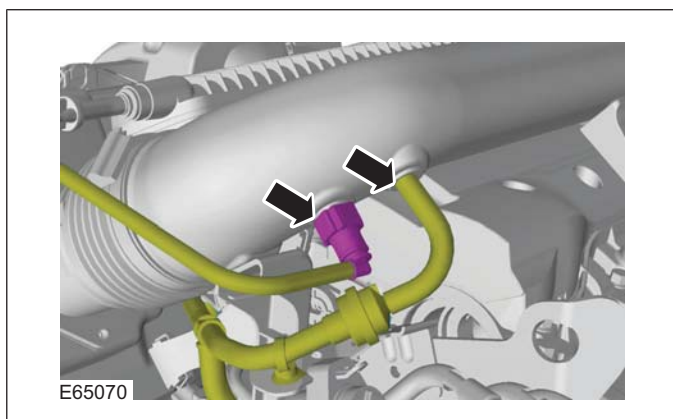
## REMOVAL AND INSTALLATION

## Camshaft Position (CMP) Sensor(29 232 0)

## Removal

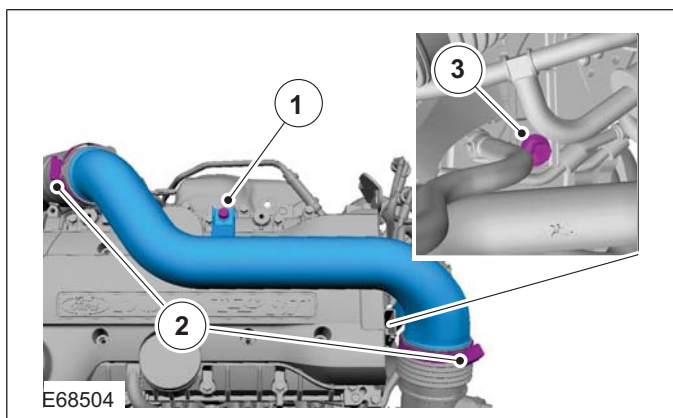
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
2. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

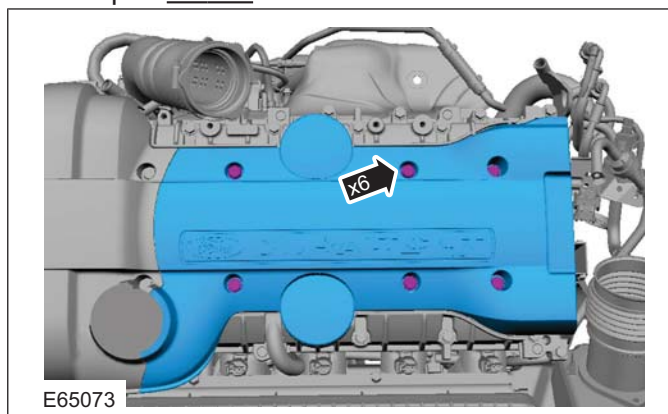


3. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

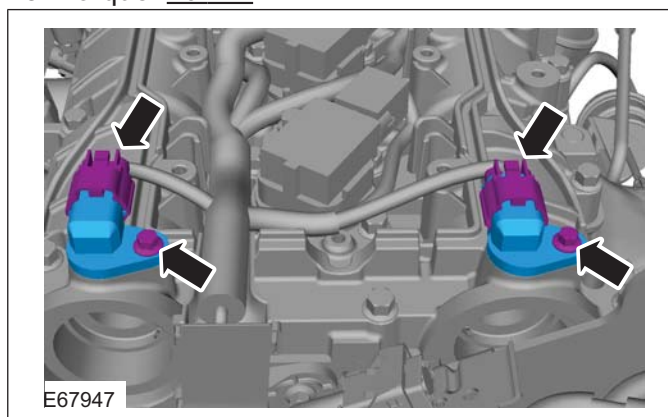
1. Torque: 10 Nm
2. Torque: 4 Nm
3. Torque: 10 Nm



4. Torque: 10 Nm



5. Torque: 10 Nm



## Installation

1. **NOTE:** Make sure that the sensor housing is clean and free of foreign material.

To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

## Catalyst Monitor Sensor(29 219 0)

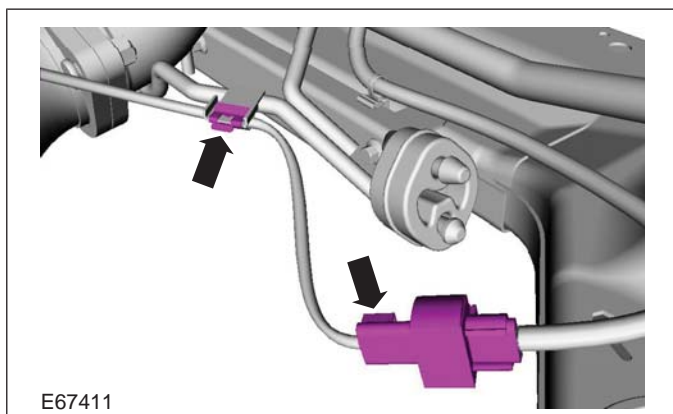
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

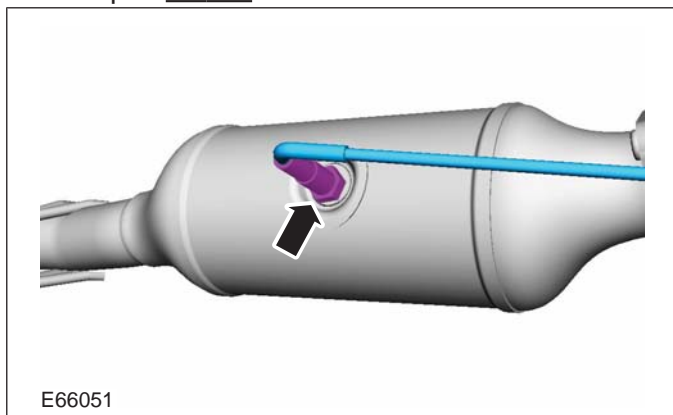
1. Raise and support the vehicle.

Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

- 2.



3. Torque: 47 Nm



## Installation

1. To install, reverse the removal procedure.

303-14-38

Electronic Engine Controls — 2.5L Duratec (147kW/200PS) - VI5

303-14-38

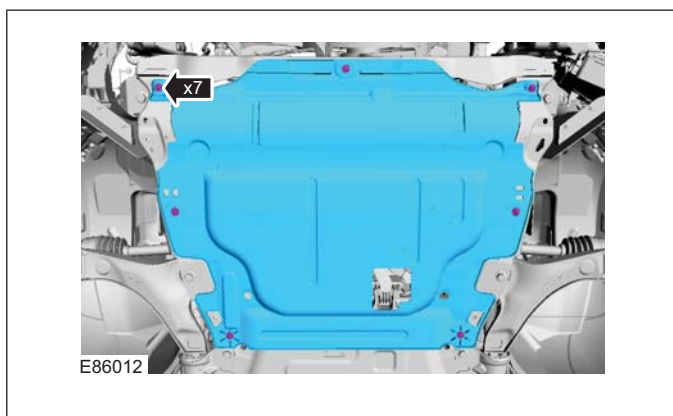
## REMOVAL AND INSTALLATION

## Crankshaft Position (CKP) Sensor(29 230 0)

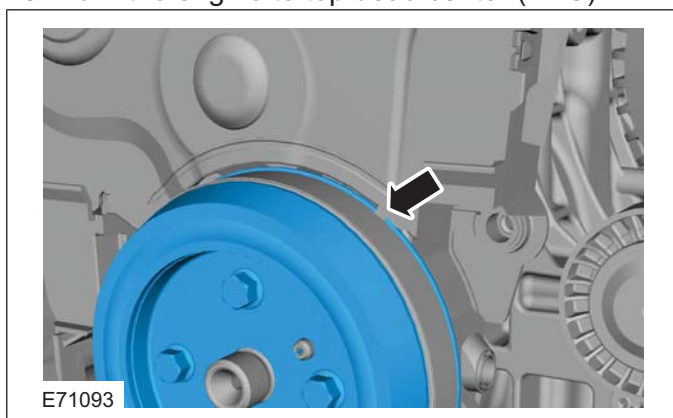
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
- 2.

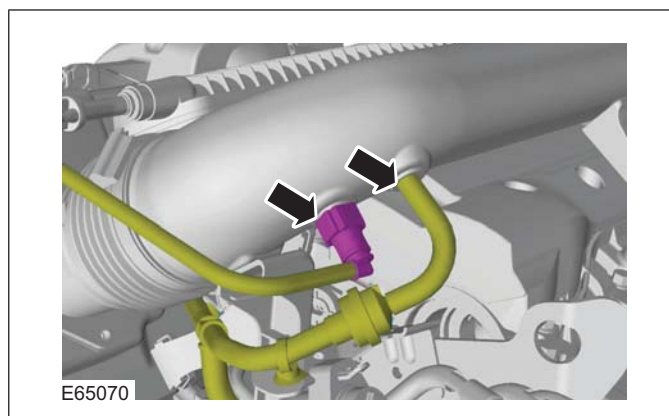


3. Turn the engine to top dead center (TDC).



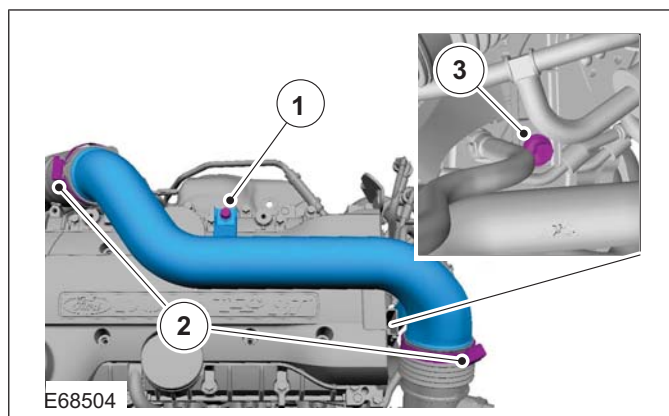
4. Refer to: **Air Cleaner** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

5. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.



6. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

1. Torque: 10 Nm
2. Torque: 4 Nm
3. Torque: 10 Nm

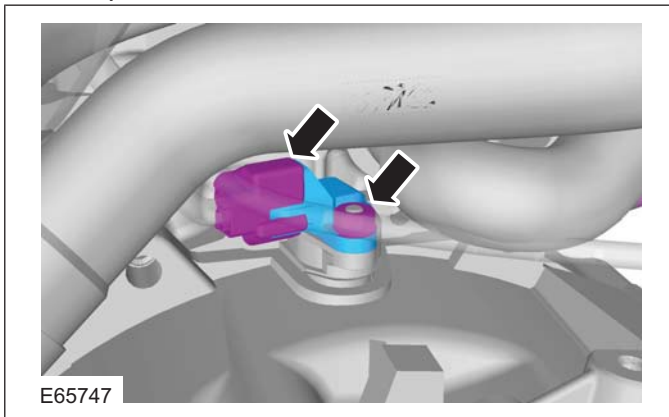


303-14-39

Electronic Engine Controls — 2.5L Duratec (147kW/200PS) - VI5

303-14-39

## REMOVAL AND INSTALLATION

7. Torque: 10 Nm

## Installation

1. **NOTE:** Make sure that the sensor housing is clean and free of foreign material.

To install, reverse the removal procedure.

303-14-40

Electronic Engine Controls — 2.5L Duratec (147kW/200PS) - VI5

303-14-40

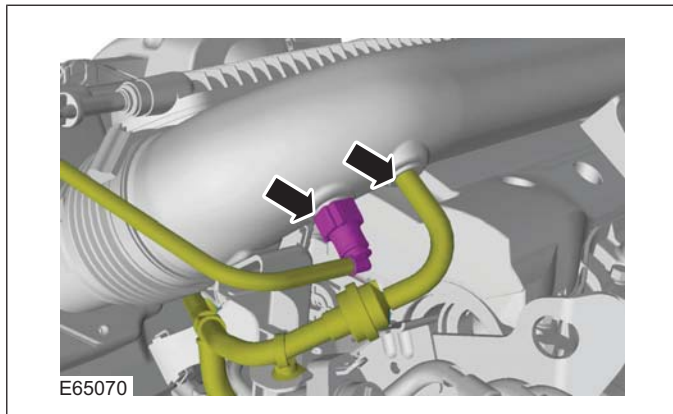
## REMOVAL AND INSTALLATION

## Heated Oxygen Sensor (HO2S)(29 220 0)

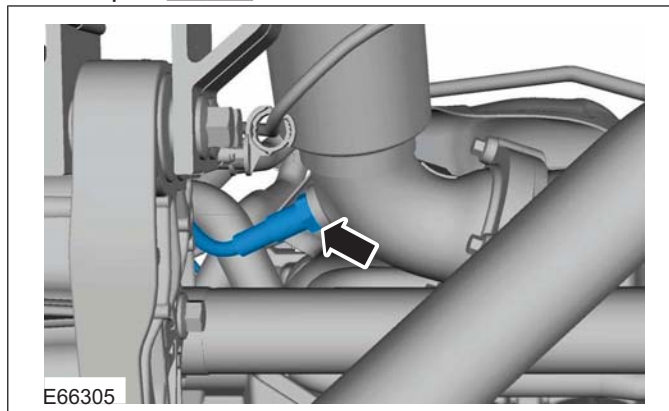
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1.  **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.



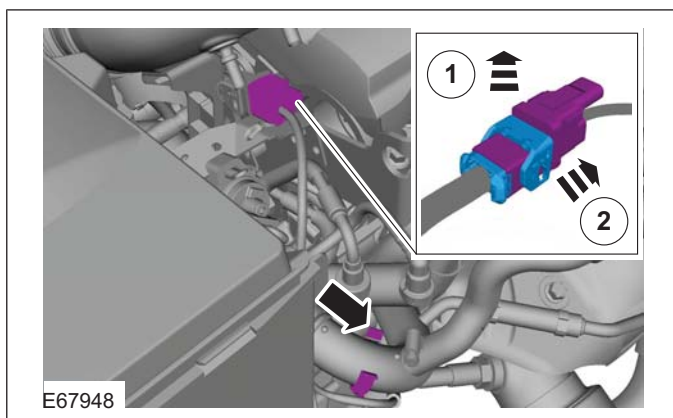
5. Torque: 45 Nm



## Installation

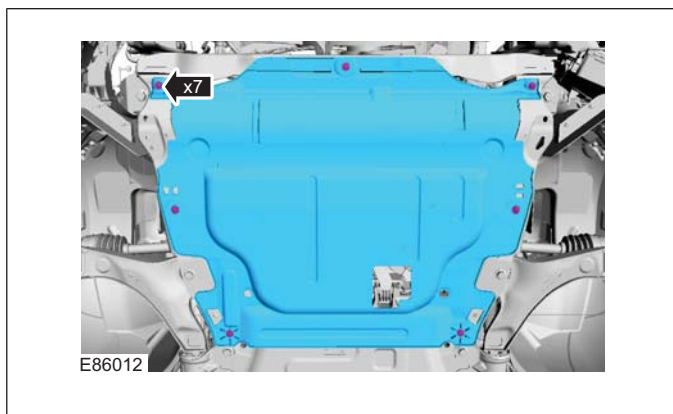
1. To install, reverse the removal procedure.

2.



3. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

4.



## REMOVAL AND INSTALLATION

## Knock Sensor (KS)(29 222 0)

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Air Cleaner** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
2. **NOTE:** Make sure that the sensor is installed in the same location as when removed.

Torque: 20 Nm



## Installation

1. To install, reverse the removal procedure.



303-14-42

Electronic Engine Controls — 2.5L Duratec (147kW/200PS) - VI5

303-14-42

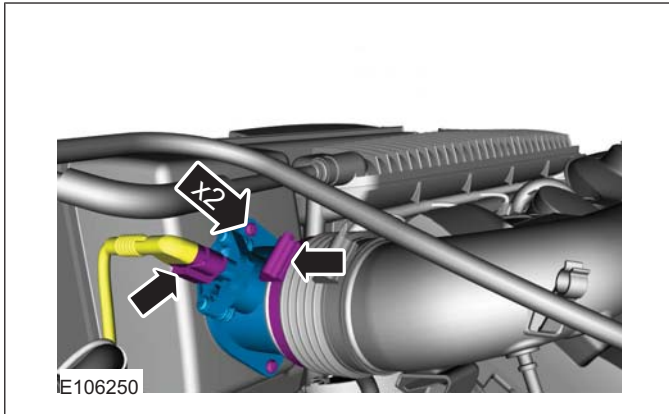
## REMOVAL AND INSTALLATION

## Mass Air Flow (MAF) Sensor(29 226 0)

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Torque: 10 Nm



## Installation

1. To install, reverse the removal.

303-14-43

Electronic Engine Controls — 2.5L Duratec (147kW/200PS) - VI5

303-14-43

## REMOVAL AND INSTALLATION

## Powertrain Control Module (PCM)(29 200 0)

## General Equipment

3.5 mm Drill Bit
Center Punch
Ford Diagnostic Equipment

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

- NOTE:** This step is only necessary when installing a new component.

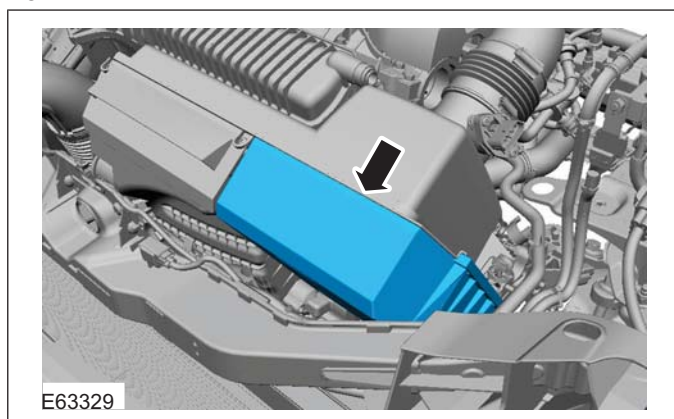
Download the PCM and throttle body configuration information into the diagnostic tool, using the Programmable Modules Installation routine.

General Equipment: Ford Diagnostic Equipment

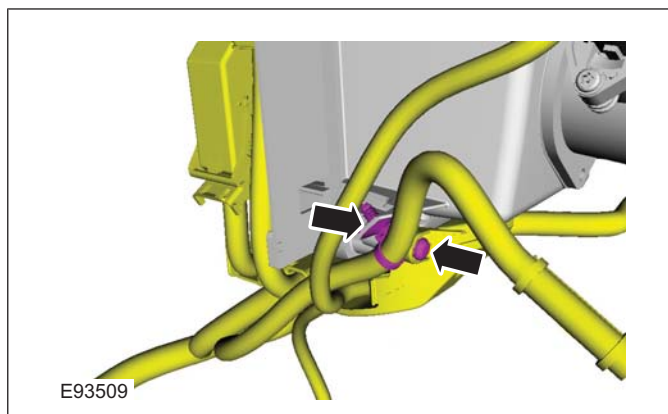
- Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).

## Vehicles without PCM security shield

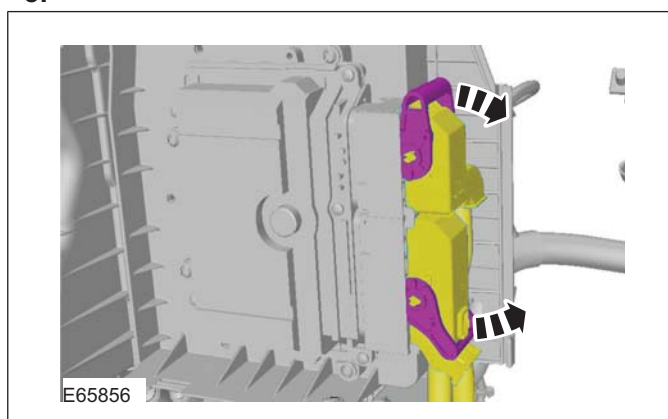
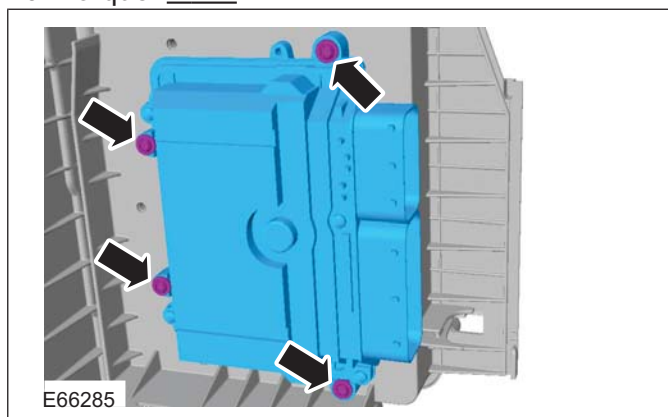
3.



4.



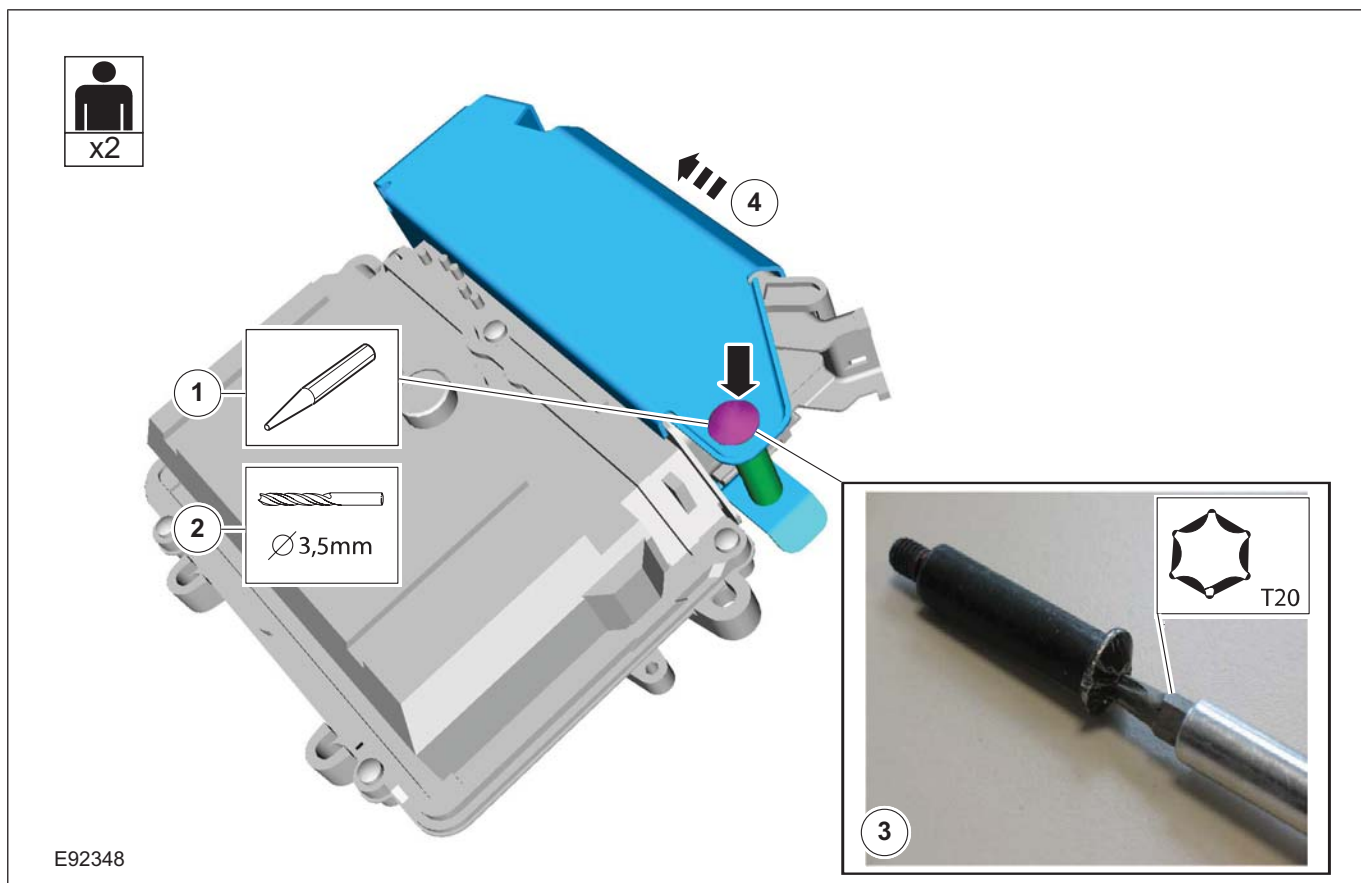
5.

6. Torque: 7 Nm

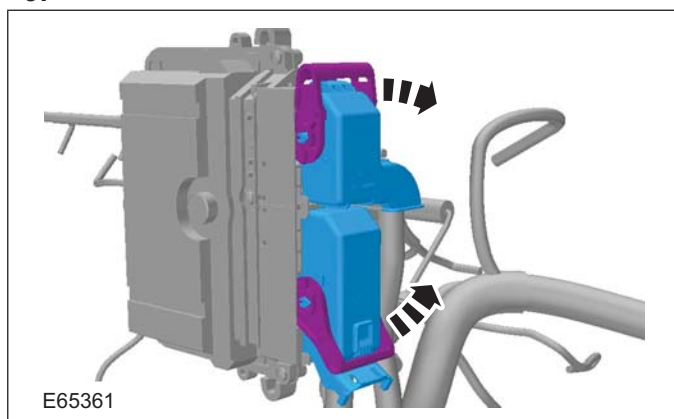
## Vehicles with PCM security shield

- Refer to: **Air Cleaner** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
1. General Equipment: Center Punch  
2. General Equipment: 3.5 mm Drill Bit

REMOVAL AND INSTALLATION



9.

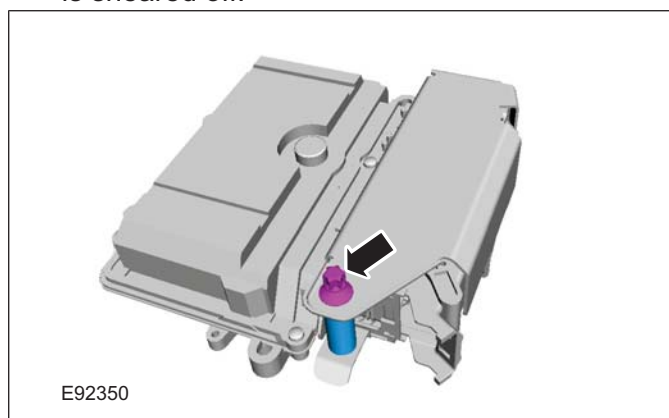


Installation

1. To install, reverse the removal.

Vehicles with PCM security shield

2. Tighten the shear bolt until the shear bolt head is sheared off.



All vehicles

3. **NOTE:** This step is only necessary when installing a new component.

Upload the PCM and throttle body configuration information into the PCM, using the Programmable Modules Installation routine.

General Equipment: Ford Diagnostic Equipment

303-14-45

Electronic Engine Controls — 2.5L Duratec (147kW/200PS) - VI5

303-14-45

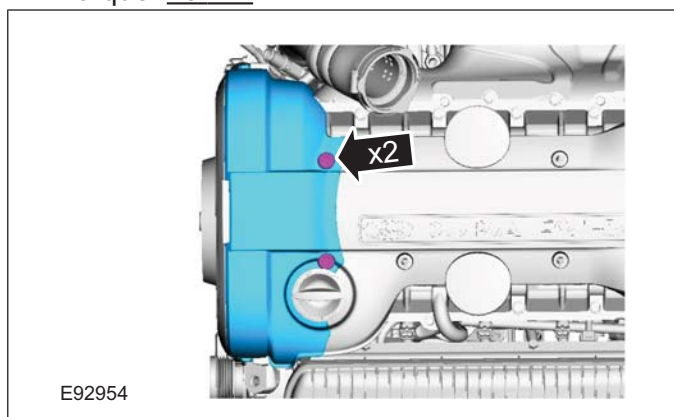
## REMOVAL AND INSTALLATION

## Variable Valve Timing (VVT) Oil Control Solenoid(29 233 0)

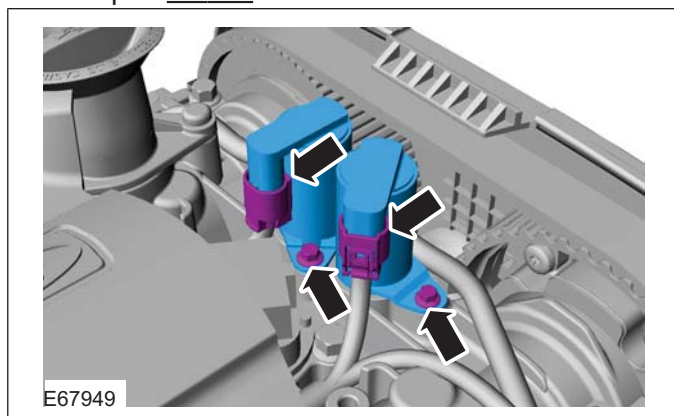
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Torque: 10 Nm



2. Torque: 10 Nm



## Installation

1. To install, reverse the removal procedure.

303-14-46

Electronic Engine Controls — 2.5L Duratec (147kW/200PS) - VI5

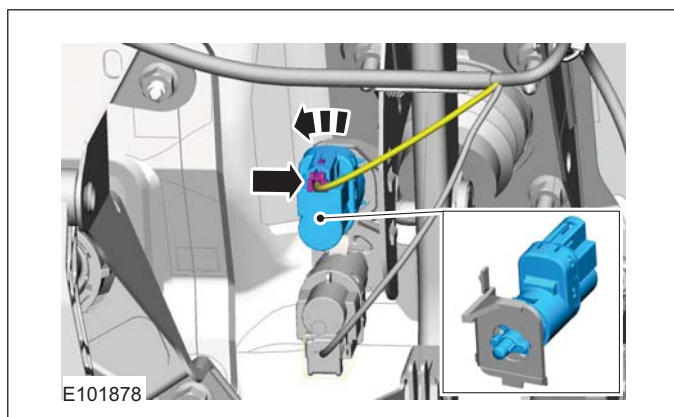
303-14-46

## REMOVAL AND INSTALLATION


## Brake Pedal Position (BPP) Switch(33 502 0)

## Removal

1.  **CAUTION:** Make sure that the brake pedal remains in the rest position.



## Installation

1.  **CAUTION:** Make sure that the brake pedal remains in the rest position.  
To install, reverse the removal procedure.

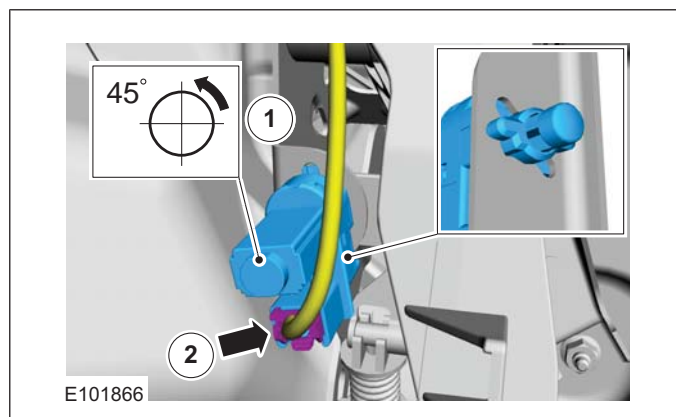


## REMOVAL AND INSTALLATION


## Clutch Pedal Position (CPP) Switch(33 503 0)

## Removal

1.  **CAUTION:** Make sure that the clutch pedal remains in the rest position.



## Installation

1.  **CAUTION:** Make sure that the clutch pedal remains in the rest position.  
To install, reverse the removal procedure.

## SECTION 307-01 Automatic Transmission/Transaxle

— Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD

### VEHICLE APPLICATION: 2008.50 Kuga

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**INSTALLATION**

Transmission.....	307-01-91
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## SPECIFICATIONS

## Lubricants, Fluids, Sealers and Adhesives

Item	Specification
Automatic transmission fluid	WSS-M2C924-A

## Capacities

	Litres
Automatic transmission fluid (including cooler an cooler hoses)	7.7 ± 0.2

## Gear Ratio

	Gear Ratio
1st gear	4.576
2nd gear	2.980
3rd gear	1.948
4th gear	1.318
5th gear	1.000
Reverse gear	5.024
Counter gear	1.018
Differential gear	2.652

## Line Pressure Chart

Transmis- sion Range	Idle (bar)	Idle (kPa)	Idle (psi)	Stall (bar)	Stall (kPa)	Stall (psi)
R	4,9 - 6,1	490 - 610	71 - 88	17,1 - 19,9	1710 - 1990	248 - 289
D	3,3 - 3,9	330 - 390	48 - 57	12,9 - 14,1	1290 - 1410	187 - 205



307-01-5

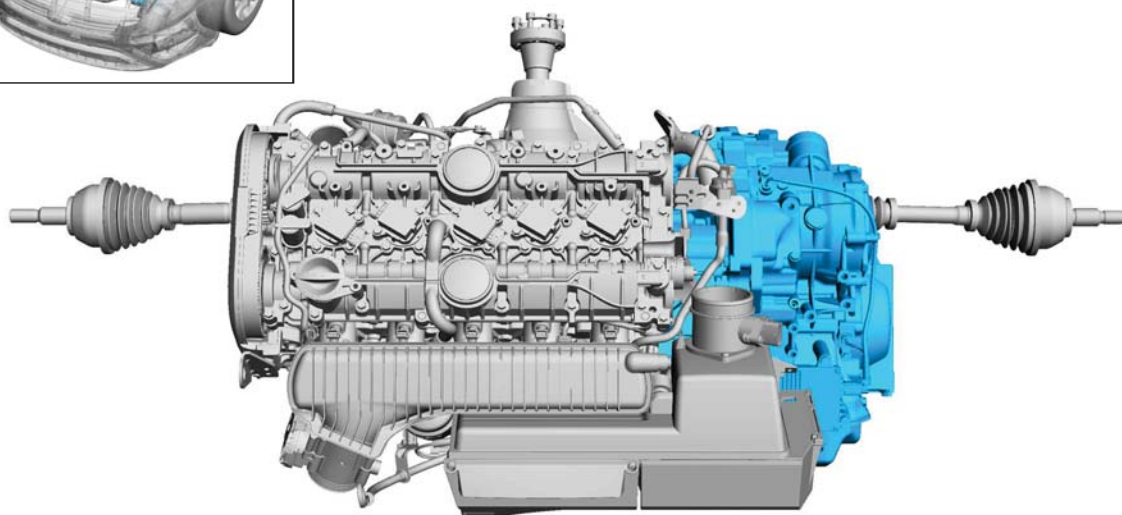
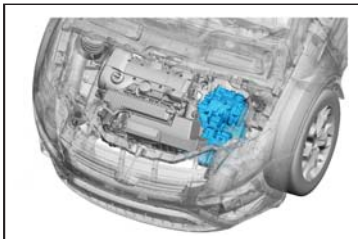
5-Speed Automatic Transaxle - AW55 AWD

307-01-5

## DESCRIPTION AND OPERATION

## Transmission Description – Component Location

AW55 automatic transaxle

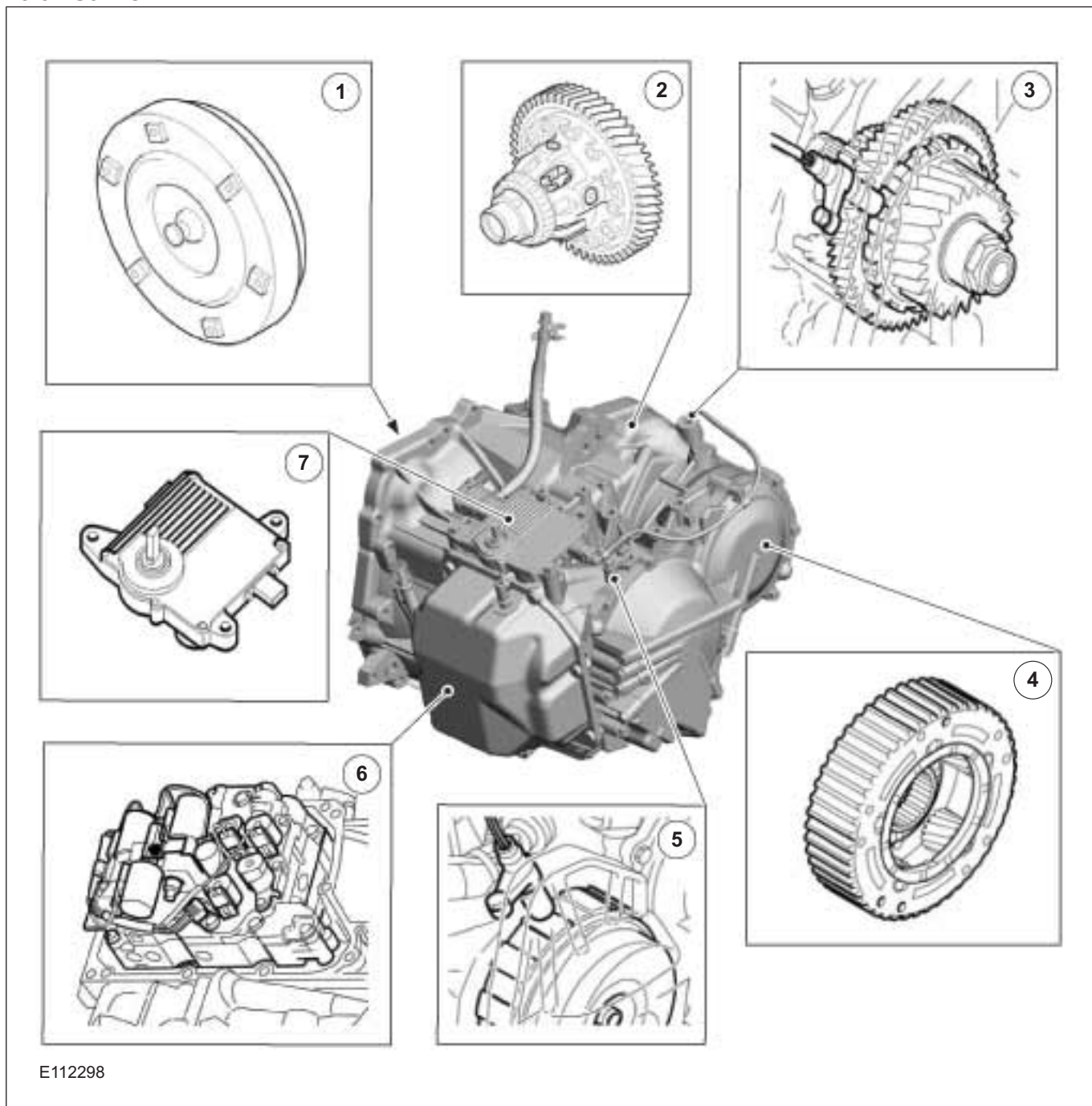


E112283

DESCRIPTION AND OPERATION

Transmission Description – Overview

Components of the AW55 automatic transaxle

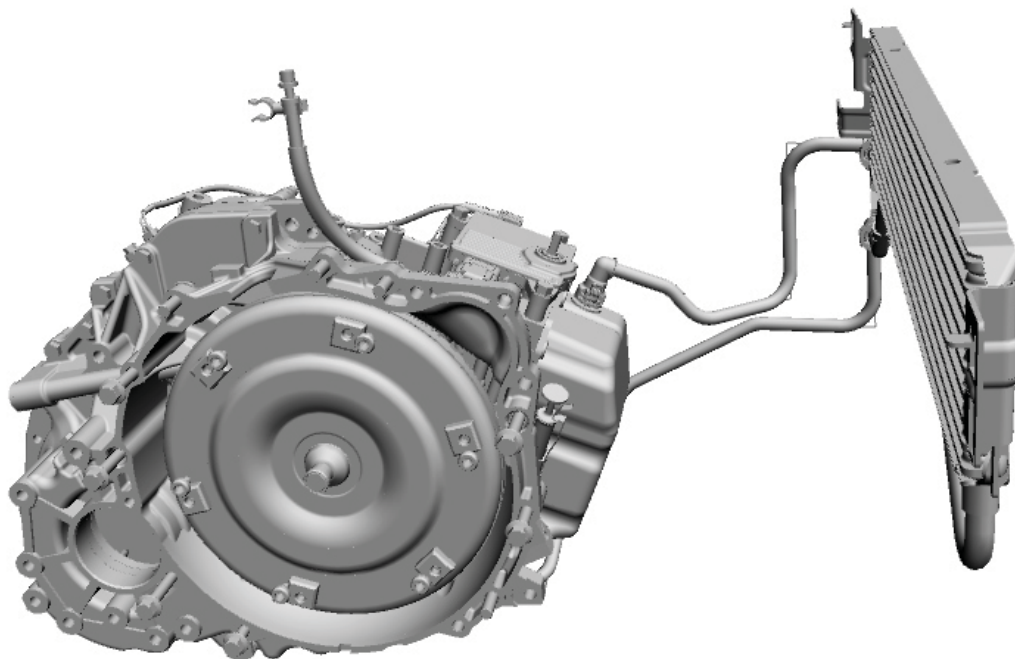


Item	Description
1	Torque converter
2	Differential
3	The OSS (output shaft speed) sensor

Item	Description
4	Planetary gear set.
5	The TSS (turbine shaft speed) sensor
6	Control valve assembly
7	TCM (transmission control module)

General overview

## DESCRIPTION AND OPERATION



E125525

## Design:

- The gear ratios are achieved by means of a combined planetary gear set on the input side and a Simpson set on the output side.
  - The combined planetary gear set consists of two different, simple planetary gear sets. It has a similar structure to a Ravigneaux set, but with just one sun gear that engages with the front planetary gears.
- Three multi-plate clutches
- Four multi-plate brakes

- One band brake
- Two one-way clutches

The TCM adapts the gear changing to ensure that the correct gear is selected for the style of driving, the engine load, driver requirements, vehicle speed etc.

The TCM features a self-learning strategy.

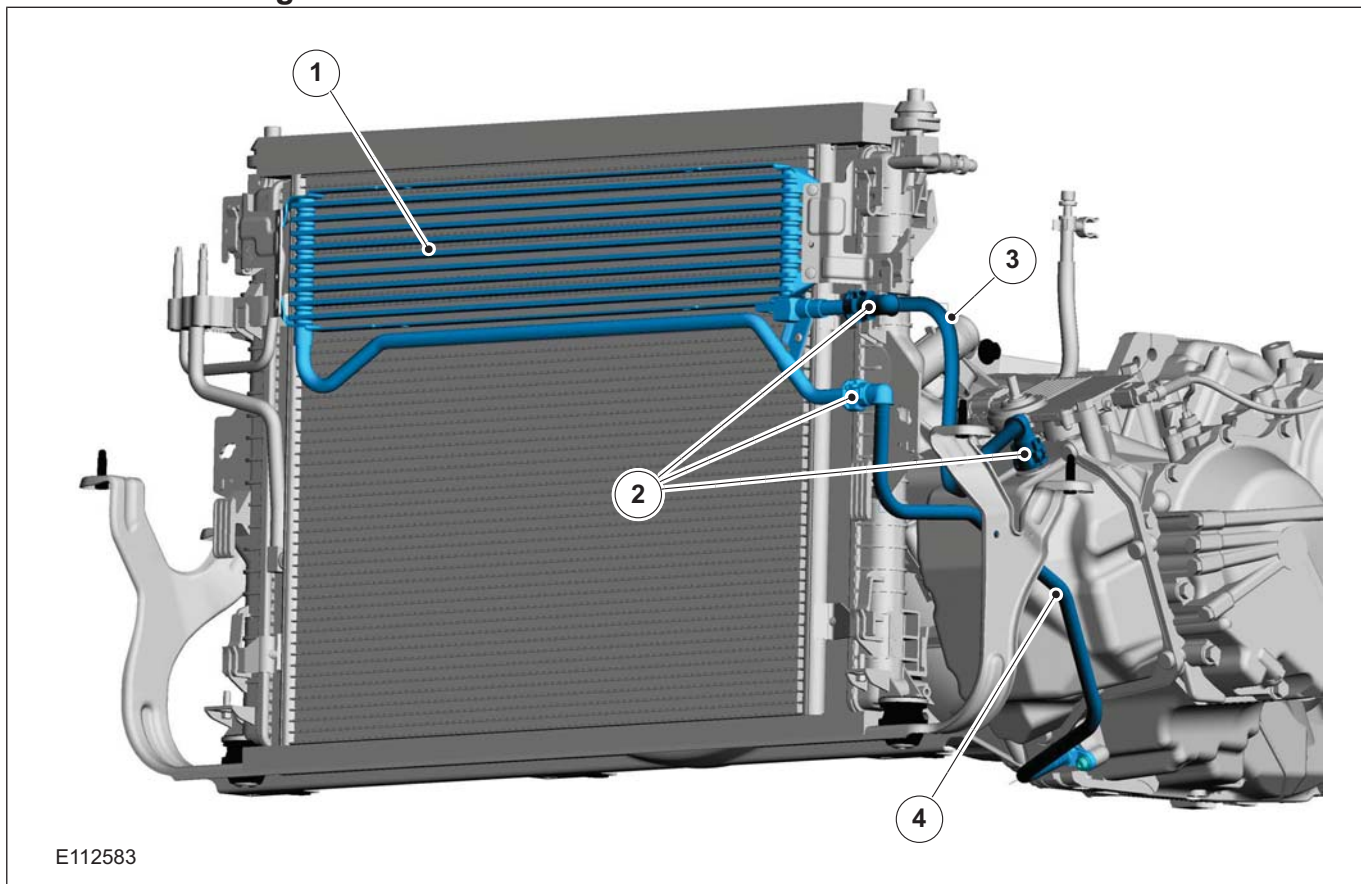
This leads to lower fuel consumption together with improved comfort through smoother gear changes and lower noise levels.

## Gear ratios of the individual gears

Gear	Transmission Ratio
First	4.576
Second	2.980
Third	1.948
Fourth	1.318
5th	1.000
Reverse	5.024
Intermediate shaft	1.018
Differential	2.652

DESCRIPTION AND OPERATION

Transaxle cooling



Item	Description
1	The transmission fluid cooler.
2	Quick-release couplings

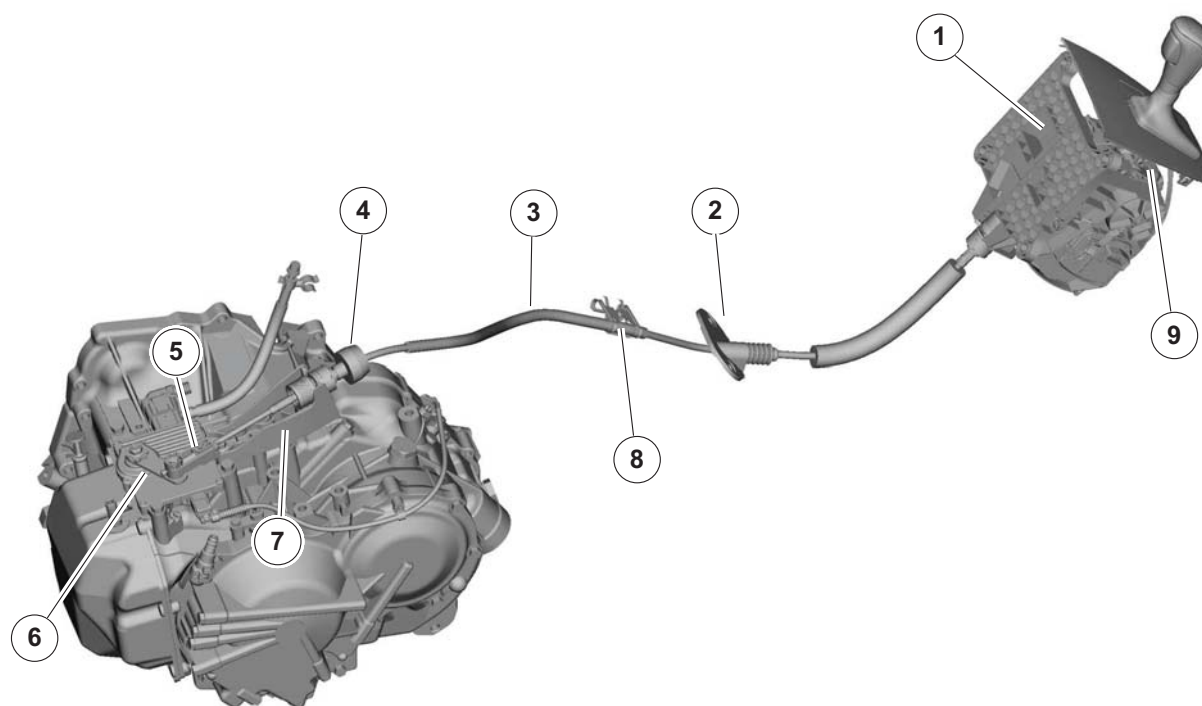
Item	Description
3	From transmission fluid cooler to transmission
4	From transmission to transmission fluid cooler

The transmission fluid cooler is mounted on the radiator. The transmission fluid cooler and the automatic transaxle are connected via two hose lines, which are equipped with quick-release couplings.

The transmission fluid cooler operates according to the heat exchanger principle. The ram air passing through the radiator withdraws heat from the transmission fluid.

External shift mechanism

## DESCRIPTION AND OPERATION



E112582

Item	Description
1	Gear selector mechanism
2	Selector lever cable guide
3	Selector cable
4	Damper weight

Item	Description
5	Adjusting mechanism for selector lever cable
6	Shift valve shaft lever
7	Selector lever cable bracket
8	Retaining clip
9	Emergency release lever

The transmission range selector is located on the center console and is mechanically connected to the transmission by a cable for operation of the gear selector shaft and the TR (transmission range) sensor.

As well as the positions P/R/N/D, the transmission range selector provides a position for the sport and select-shift mode (S). The manual gear position can be selected at any time while driving. The gear

selected is locked until the driver selects another gear.

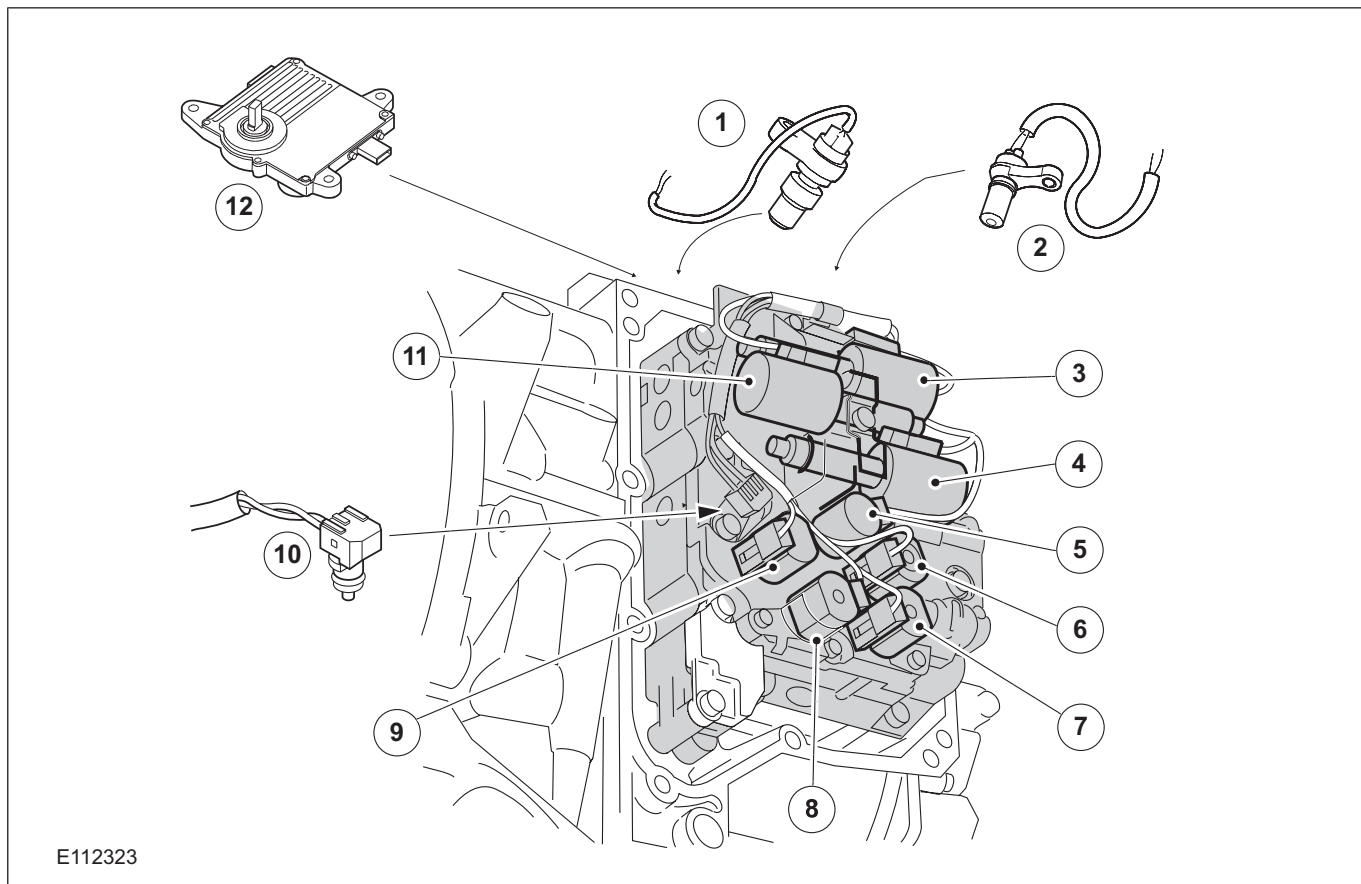
The engine can only be started in 'P' or 'N' position.

The selector cable adjustment mechanism is at the transmission end of the selector cable.

### Components of the electronic control



DESCRIPTION AND OPERATION



E112323

Item	Description
1	The TSS sensor
2	The OSS sensor
3	PWM (pulse width modulation)- solenoid valve – TCC (torque converter clutch) (SLU)
4	PWM solenoid valve – shift pressure (SLS)
5	Shift solenoid S1
6	Shift solenoid S4

Item	Description
7	Shift solenoid S3
8	Shift solenoid S5
9	Shift solenoid S2
10	The TFT (transmission fluid temperature) sensor
11	PWM solenoid valve for main line pressure (SLT)
12	TCM with integrated TR sensor

Depending on the input signals, the TCM mounted on the transaxle actuates the solenoid valves S1-S5 in the valve body. The solenoid valves are either in the "open" or "closed" state.

The (SLT and SLS) control valves regulate the hydraulic pressure according to the pulse/pause ratio of the electrical PWM signal. The controlled hydraulic pressure enables smooth shifting or the generation of a defined slip through actuation of the relevant clutches and brakes.

The shift timing is calculated by the TCM using the accelerator pedal position and vehicle speed.

Under normal conditions, gear shifting and torque converter lockup occur at low engine speeds to reduce fuel consumption.

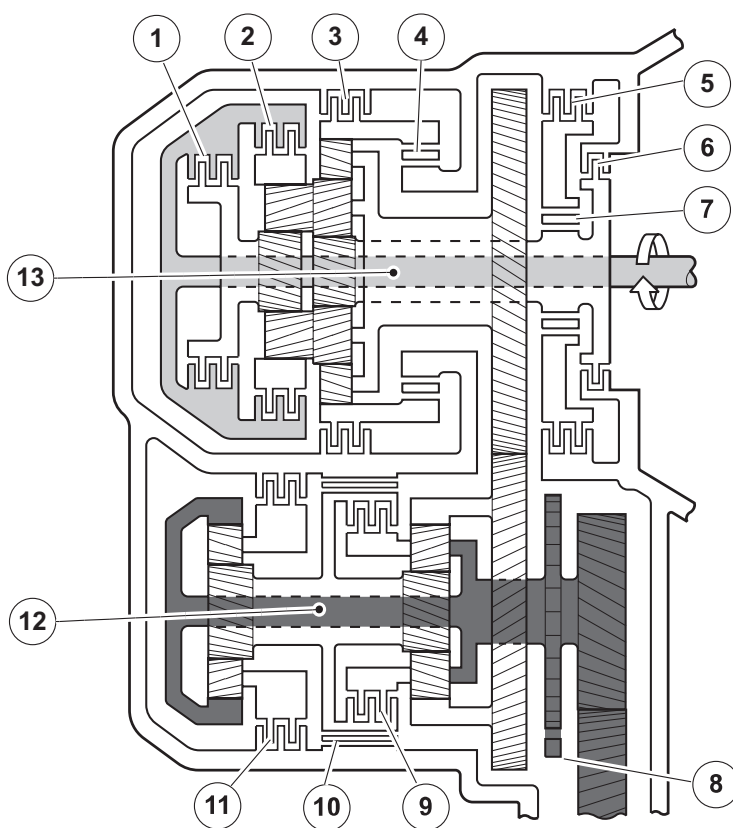
If the accelerator pedal is pressed down quickly, the TCM switches automatically into kickdown mode.

**DESCRIPTION AND OPERATION**

**Function of the shift solenoids in the gears**

Gear	S1	S2	S3	S4	S5
1	On	On	On	Off	Off
2	Off	Off	On	Off	Off
3	Off	Off	On	On	Off
4	Off	Off	Off	On	Off
5	Off	On	Off	On	Off

**Overview of the brakes, clutches and one-way clutches**



E112793

Item	Description
1	Clutch C2: Connects the input shaft with the sun gear.
2	Clutch C1: Connects the input shaft with the rear gear.
3	Brake B3: Locks the annulus of the front planetary gear.
4	One-way clutch F2: Locks the front annulus in the counterclockwise direction.
5	Brake B2: Prevents the sun gear on the input shaft from turning counterclockwise.

Item	Description
6	Brake B1: Locks the sun gear on the input shaft.
7	One-way clutch F1: Prevents the sun gear on the input shaft turning counterclockwise when B2 is activated.
8	Park System
9	Clutch C3: Connects the sun gear with the front planetary gear carrier on the output shaft.
10	Brake band B4: Blocks the the sun gear on the output shaft.

**DESCRIPTION AND OPERATION**

Item	Description
11	Brake B5: Locks the rear planetary gear carrier on the output shaft.

Item	Description
12	Output shaft – transaxle
13	Input shaft – transaxle

**Function of the clutches and brakes in the gears and during gear changes.**

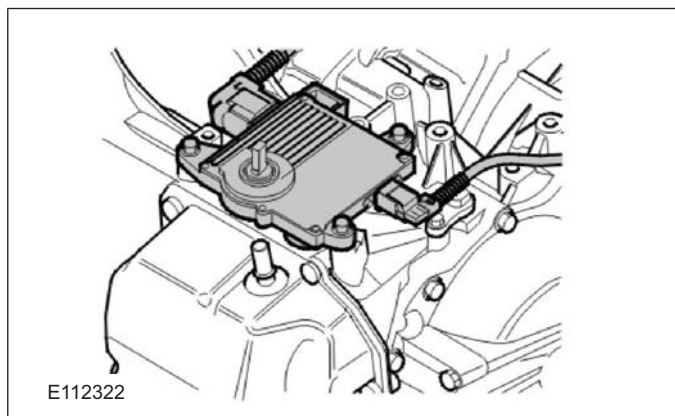
Gear	C1	C2	C3	B1	B2	B3	B4	B5	F1	F2
Park	Off	Off	Off	Off	Off	Off	Off	On	Off	Off
R (V<=7)	Off	On	Off	Off	Off	On	Off	On	Off	Off
R (V>7)	Off	Off	Off	Off	Off	Off	Off	On	Off	Off
N	Off	Off	Off	Off	Off	Off	Off	On	Off	Off
1	On	Off	Off	Off	Off	Off	Off	On	Off	On
1<=>2	On	Off	Off	Off-On	Off-On	Off	Off	On	Off-On	On-Off
2	On	Off	Off	On	On	Off	Off	On	On	Off
2<=>3	On	Off	Off	On	On	Off	Off-On	On-Off	On	Off
3	On	Off	Off	On	On	Off	On	Off	On	Off
3<=>4	On	Off	Off-On	On	On	Off	On-Off	Off	On	Off
4	On	Off	On	On	On	Off	Off	Off	On	Off
4<=>5	On	Off-On	On	On-Off	On	Off	Off	Off	On-Off	Off
5	On	On	On	Off	On	Off	Off	Off	Off	Off

V = vehicle speed in km/h

x<=>x = gear change up/down

**TCM**

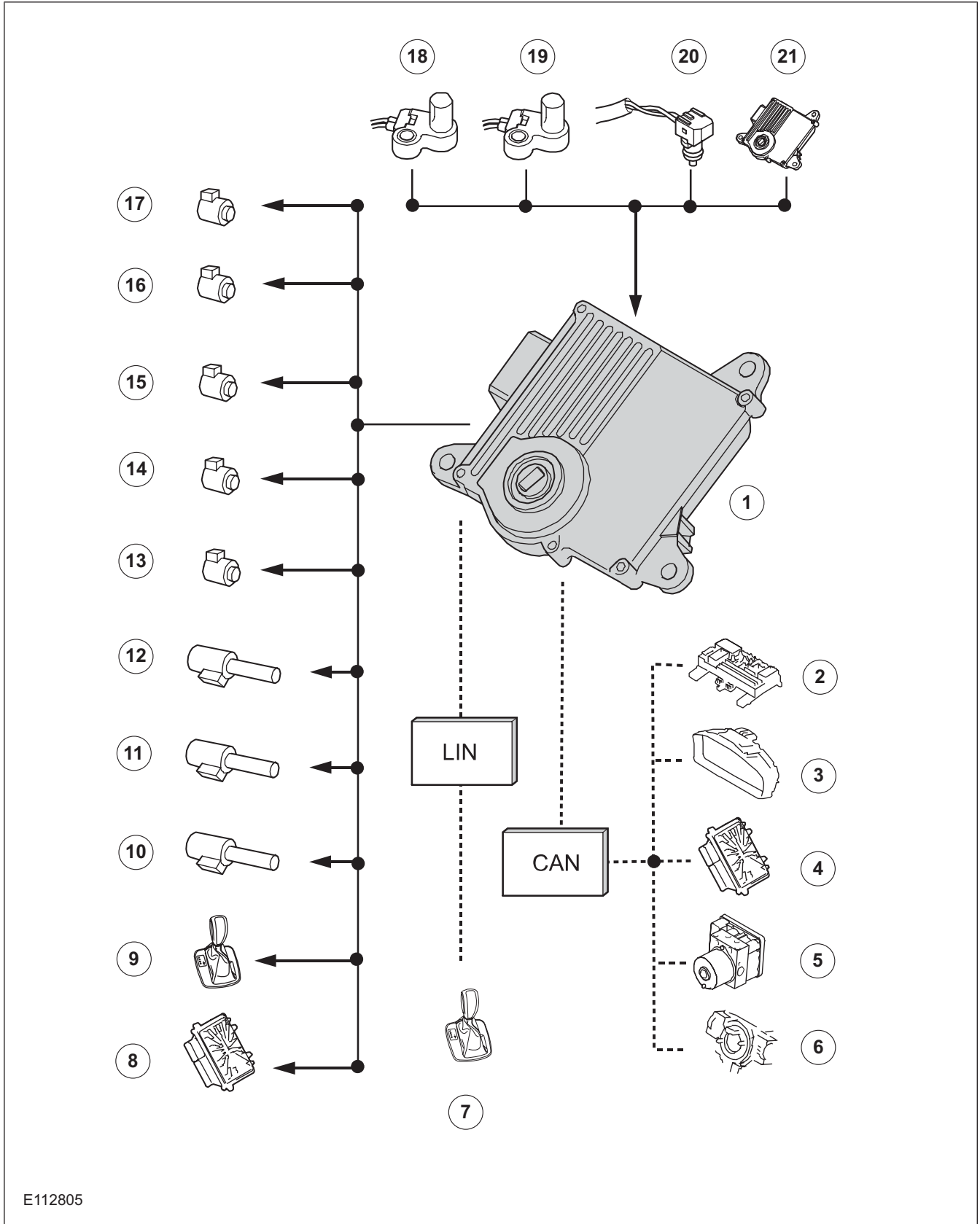
The TCM with integral TR sensor is mounted on the transaxle casing.



E112322

**Input and output signals at the TCM**

DESCRIPTION AND OPERATION



E112805

Item	Description
1	TCM
2	GEM (generic electronic module)

Item	Description
3	Instrument Cluster
4	PCM (powertrain control module)

## DESCRIPTION AND OPERATION

Item	Description
5	ABS (anti-lock brake system)
6	Speed control
7	Select-shift switch module
8	PCM
9	Selector lever lock
10	PWM solenoid valve – shift pressure (SLS)
11	PWM solenoid valve for main line pressure (SLT)
12	PWM- solenoid valve – TCC (SLU)

Item	Description
13	Shift solenoid S1 (open when dormant)
14	Shift solenoid S2 (closed when dormant)
15	Shift solenoid S3 (closed when dormant)
16	Shift solenoid S4 (open when dormant)
17	Shift solenoid S5 (closed when dormant)
18	The TSS sensor
19	The OSS sensor
20	The TFT sensor
21	TR sensor in TCM

### Knowing and Understanding Customer Concerns

Knowing and understanding customer concerns is necessary in order to perform diagnosis.

First of all, ask the customer under which operating conditions the problem occurs. If possible, try to reproduce the concern by road testing the vehicle with the customer.

You should be familiar with the following operating conditions:

- Engine operating state
  - Cold, warm-up phase, or at operating temperature
- Ambient temperature
  - Below 0 °C (32 °F), 0 to 20 °C (32 to 68 °F), or above 20 °C (68 °F)
- Road conditions
  - Good, poor, or off-road
- Vehicle load status
  - Unloaded, loaded, or fully loaded
- Transaxle status in manual mode
  - Upshift, downshift, overrun or acceleration

### Testing Possible Causes of Transmission Control Faults

Before performing a symptom-based diagnosis, first carry out checks to eliminate various other potential causes of the fault.

These situations include:

- Battery state of charge
- Defective fuses

- Loose or corroded cables or electrical connectors
- Ground connections to the transmission
- Retrofitted add-on units which are not approved by Ford, such as air conditioning, car telephone, cruise control
- Unapproved tire sizes
- Incorrect tire size programmed with IDS (Integrated Diagnostic System)
- Engine tuning

### IDS Diagnosis

**NOTE:** Customer concerns relating to the transaxle can also be caused by engine-related faults.

The transmission control system of the AW55 is closely linked to the engine management system. Faults in the engine management system may affect the transmission control system.

Before repairing the transaxle, it should be ensured that the fault is not caused by the engine management system or other non-transaxle components.

The diagnosis can be performed on the AW55 with the aid of von IDS.

### visual inspection

A thorough visual inspection of the transaxle is necessary for successful diagnosis.

A visual inspection is made of the following components:

- Connectors and plug connections
- Ease of operation of the selector lever



## DESCRIPTION AND OPERATION

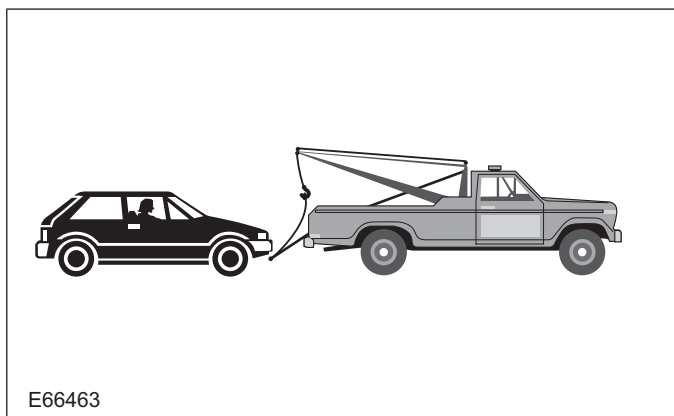
- Selector lever position and selector lever position display
- Fluid leakage
- Transmission fluid level check
- Transmission fluid quality check
- Modification/retrofitting
- Mechanical damage to the transmission

When inspecting connectors, remember that the plugs may only be disconnected when they are not energized.

The transaxle electronics may be destroyed by static charge. To prevent damage, it must be ensured that the technician complies with the corresponding safeguards.

**NOTE:** Refer to the service literature for an exact description of these safeguards.

### Towing the vehicle



In general, vehicles with the AW55 transaxle can be towed. **Vehicles must never be towed backwards.**

As a result of the reduced lubrication of the transaxle during towing, the following must be remembered:

- The selector lever must be in the 'N' position.
- The maximum towing speed must not exceed 50 km/h.
- The maximum towing distance must not exceed 50 kilometers.

### Push-starting the Vehicle

No torque is transmitted when towing or pushing the vehicle. For this reason, vehicles with an automatic transaxle cannot and must not be tow-started or push-started.

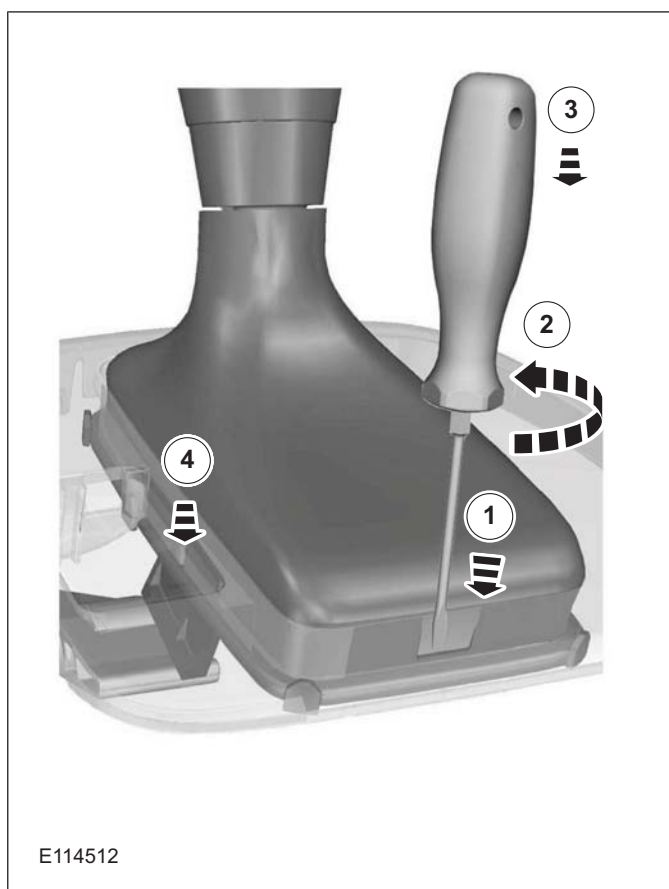
### Jump-starting the Vehicle

**CAUTION:** When jump-starting the vehicle using a jumper lead there may be voltage peaks. These may destroy the transaxle electronics.

**NOTE:** When jump-starting the vehicle, the external battery must remain connected for several minutes.

The voltage peaks dissipate after a few minutes. Only then may the external battery be disconnected without the risk of damage.

### Selector Lever Emergency Release



If release of the selector lever lock by means of the selector lever lock solenoid actuated by the TCM fails in selector lever position 'P', it is possible to perform an emergency release.

Procedure:

- Carefully slide a flat screwdriver into the slot (1).
- Turn the screwdriver (2).
- Press the screwdriver downwards to detach the gaiter frame from the trim panel (3).

307-01-16

5-Speed Automatic Transaxle - AW55 AWD

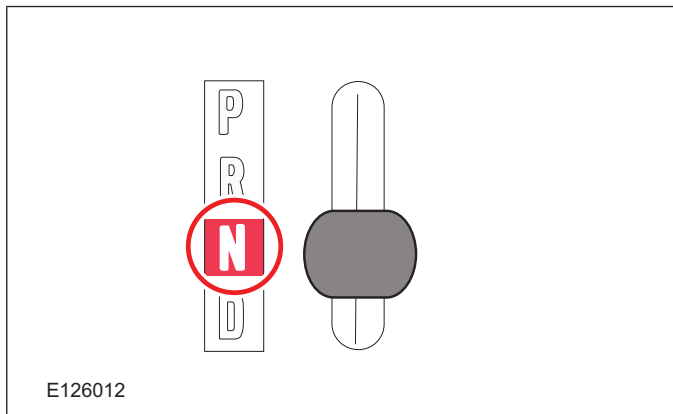
307-01-16

## DESCRIPTION AND OPERATION

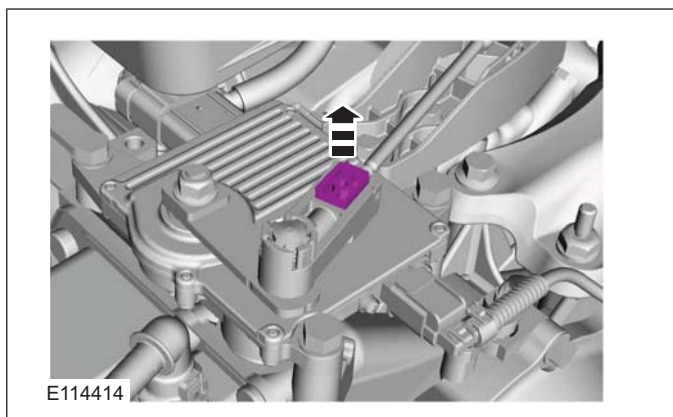
- Press the gaiter frame to move the emergency release downwards and move the selector lever out of position P (4).
- Pull the gaiter upwards until the gaiter frame engages in the gaiter frame.

## Adjusting the Selector Lever Cable

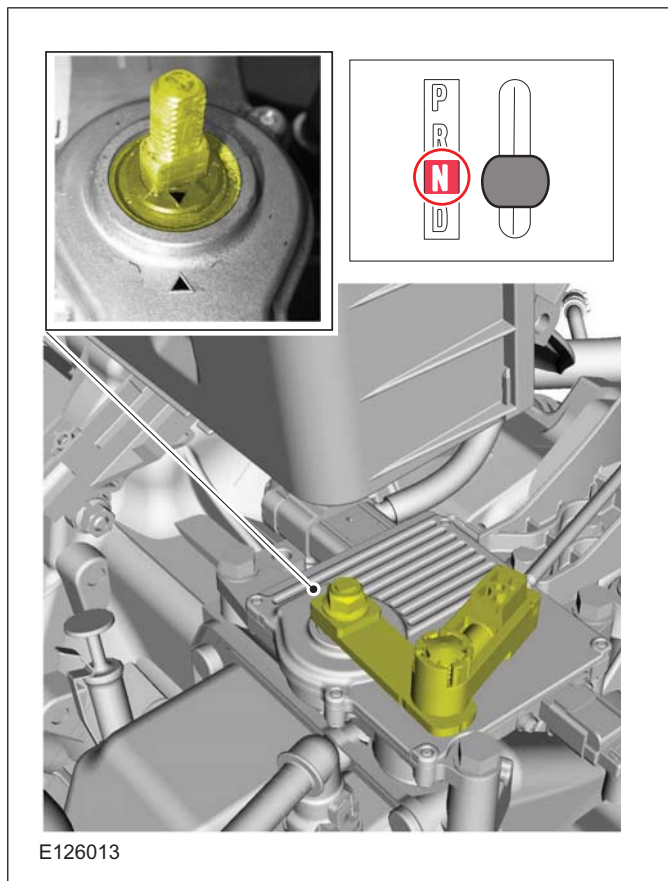
**NOTE:** Refer to the service literature for the exact procedure and specifications.



The selector lever cable is adjusted in selector lever position 'N'.



Release the lock on the transaxle-side adjusting mechanism.

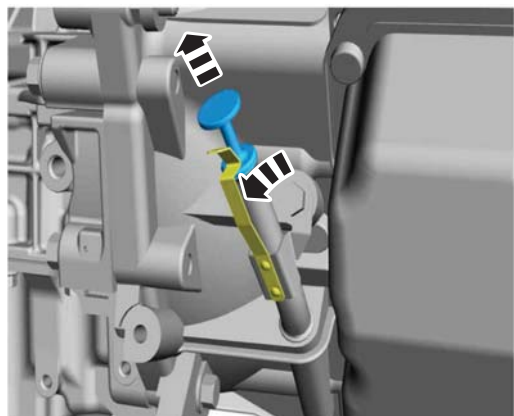


The selector lever and the gearshift mechanism must be in the 'N' position. In the case of the gearshift mechanism it must be ensured that the markings on the TCM and on the gearshift mechanism are opposite each other.

Close the lock on the transaxle-side adjusting mechanism.

## DESCRIPTION AND OPERATION

## Transmission Fluid Level Check



E126079

**⚠ WARNING: Beware, risk of scalding when checking the transmission fluid.**

**NOTE:** Refer to the service literature for the exact procedure and specifications.

In order for the transaxle to function properly, it is vital that the transmission fluid level is correct. If

the transmission fluid level is excessively low, this becomes noticeable by a rattling noise at the fluid pump, etc.

Always use transmission fluid to the indicated specification (WSS-M2C924-A).

The transmission fluid temperature is determined using IDS.

It must be ensured that the transmission fluid temperature is within the range specified in the workshop literature.

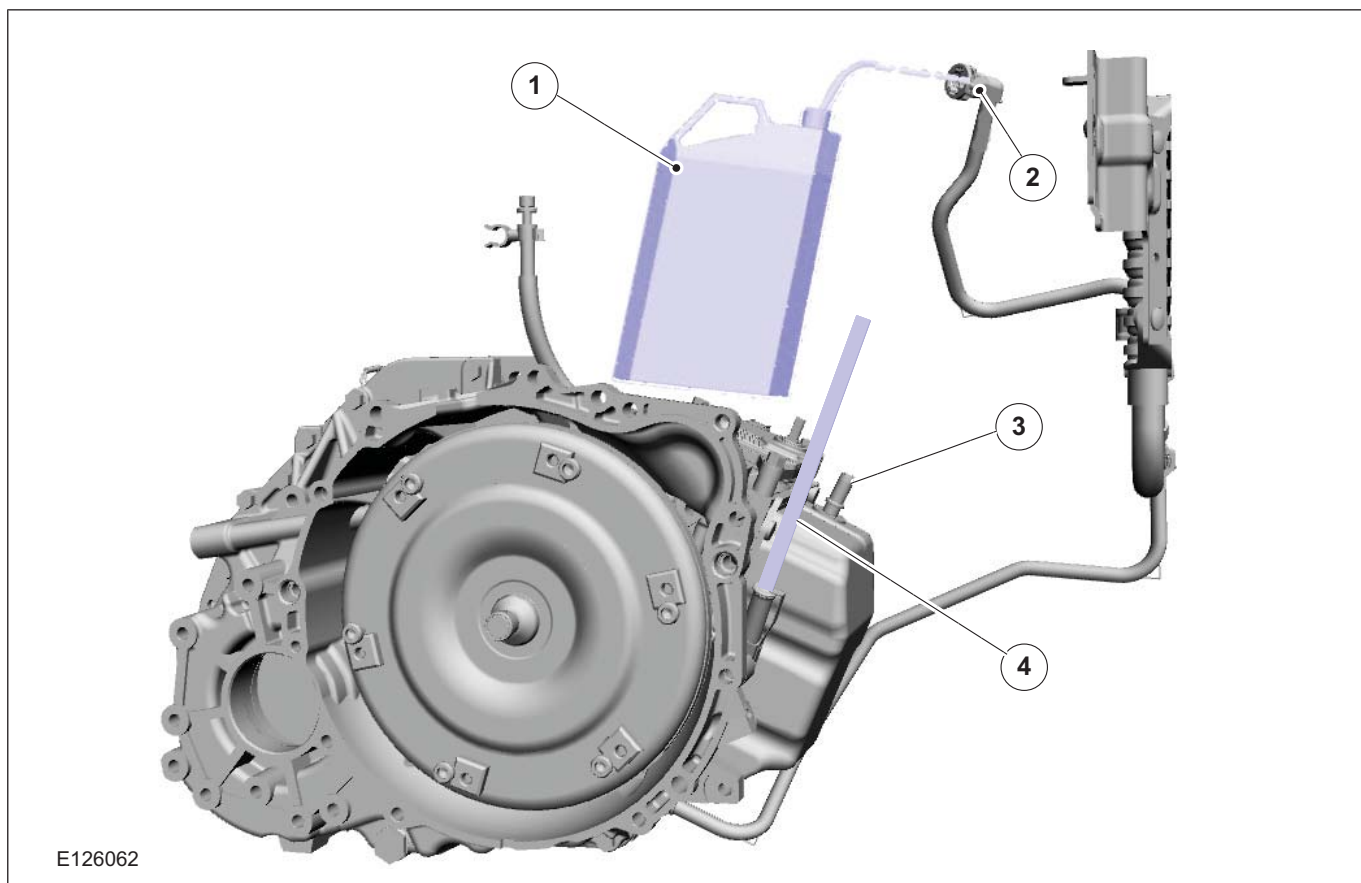
The following conditions must be met in order to carry out the transmission fluid level check correctly:

- Ensure that the transaxle is not in limp home mode.
- Place the vehicle on a level surface.
- Move the selector lever to the 'P' position.
- Make sure that the parking brake is fully applied.
- **Run the engine at idle speed.**
- Move the transmission selector lever to all positions. In doing so, wait until the transmission engages the corresponding range.
- Move the selector lever back to the 'P' position.
- Pull out the fluid dipstick.

When the predetermined transmission fluid temperature is reached, the fluid level shown on the dipstick must be in the middle between 'MIN' and 'MAX'. In this case, the fluid level is correct.

## Changing the Transmission Fluid

## DESCRIPTION AND OPERATION



Item	Description
1	Fluid reservoir
2	Connection for return line from fluid cooler

Item	Description
3	Connection for return line on transaxle
4	Hose

Under normal conditions, the transmission fluid is filled for the service life of the transaxle and does not need to be changed.

Under high loads (driving with a trailer or in mountains etc.) it may be necessary to change the transmission fluid.

To drain the transmission fluid, remove the fluid drain plug.

Proceed as follows when topping off the transmission fluid:

- Remove the return line from the fluid cooler to the transaxle on the transaxle. Close off the connection on the transaxle using a plastic plug.
- Join the return line to a transparent pipe. The transparent pipe ends in the fluid reservoir in order to collect the fluid.
- To top off the transmission fluid, insert a transparent pipe in the guide tube of the dipstick and add approx. 2.0 liters of transmission fluid.

- Move the selector lever to the 'P' position and allow the engine to run at idle speed.
- Switch off the engine if air bubbles become visible in the transparent pipe to the fluid reservoir.
- Top off approx. 2 liters of transmission fluid and allow the engine to run at idle speed. Switch off the engine if air bubbles become visible in the transparent pipe to the fluid reservoir.
- Top up the transmission fluid until the fluid level for cold fluid is indicated on the dipstick in the middle between 'MIN' and 'MAX'.
- Then check the transmission fluid level.

Refer to the service literature for the exact procedure and specifications.

**NOTE:** If the transmission fluid has been changed, the counter for fluid change intervals must be reset using IDS.

### Diagnosis with IDS

## DESCRIPTION AND OPERATION



E77584

**NOTE:** Due to static charging, measurements inside the transaxle using a multimeter are prohibited.

Stored DTCs in the engine management system may affect transmission control. As a result, faults in the transmission control system and engine management system must be rectified in accordance with the symptom-based diagnosis in FordEtis IDS.

Applications of IDS Standard include:

- Resetting the counter for fluid change intervals.
- Programming the selector lever position 'N'.
- Resetting the values learned by the TCM.

### Resetting the counter for fluid change intervals.

This function must be performed if the transmission fluid has been changed or a new automatic transaxle has been installed with the previous TCM.

This function resets the values stored for the pollution level of the transmission fluid.

### Programming the 'N' position of the TR sensor

This function must be executed if

- the TCM with integrated TR sensor is renewed,
- a new automatic transaxle is installed with the previous TCM.
- the selector lever cable or the selector mechanism assembly is renewed
- TR have been set due to a fault in the selector lever assembly or in the DTC (diagnostic trouble code) sensor.

The TCM learns and stores the voltage value in the 'N' position when this function is executed.

### Resetting the values learned by the TCM

This function must be executed if

- a new automatic transaxle is installed with the previous TCM.
- a component of the automatic transaxle has been renewed.



 **307-01-20**

5-Speed Automatic Transaxle - AW55 AWD

**307-01-20** 

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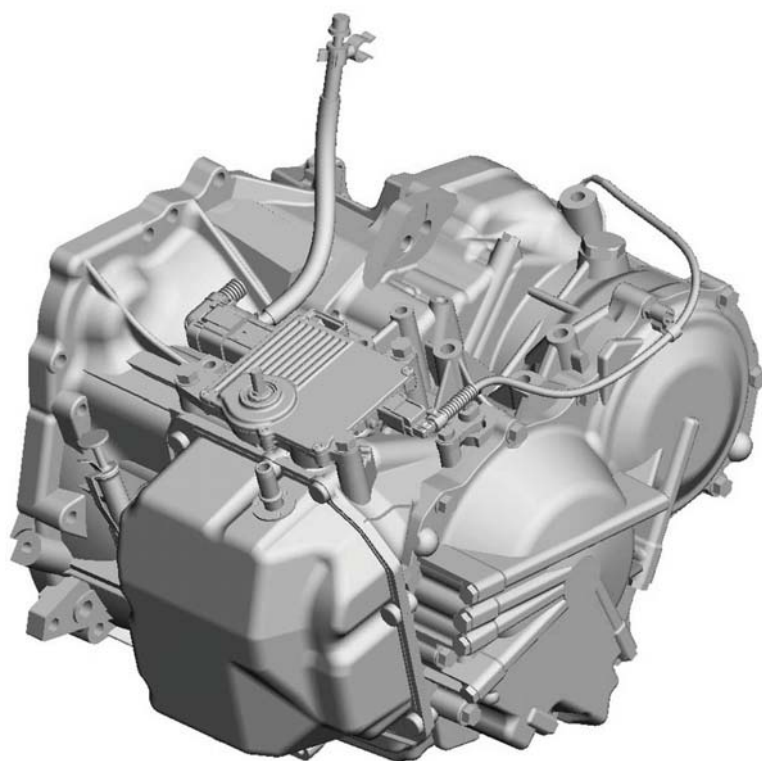
## DESCRIPTION AND OPERATION

The learned values are reset. Resetting the learned values can briefly impair shifting quality until the TCM has learned and stored the new values.

## DESCRIPTION AND OPERATION

### Transmission Description – System Operation and Component Description

#### System Operation



E112576

The AW55 5-gear automatic transaxle is a fully automatic, electronically controlled automatic transaxle. The fifth gear is an overdrive which saves fuel.

The maximum input torque is 330 Nm.

Gear changes are controlled by an electro-hydraulic system.

The gear ratios are achieved by means of a combined planetary gear set and a Simpson set.

Three multi-plate clutches, four multi-plate brakes and one band brake as well as two one-way clutches control the various ratios.

The clutches and brakes are hydraulically operated by electrically actuated solenoid valves. The valves are actuated by the TCM depending on the driving conditions and the driver's requirements.

The TCC is activated in gears 3, 4 and 5. The TCC is driven in interlock mode and in slip mode.

Defined slip achieves a smooth and therefore comfortable clutch engagement of the TCC.

Control of slip mode depends on the engine speed, accelerator pedal position and vehicle speed signals provided by the ECM (engine control module). This controls the rate of slip by comparing the engine speed and the turbine shaft speed.

The TSS sensor and the OSS sensor use the Hall effect principle. The TCM can regulate the slip in the torque converter by comparing the engine speed with the transmission speed.

All parameters for actuating the clutches and the TCC are determined by the TCM as a function of the operating parameters. The automatic transaxle features a self-learning strategy.

The fundamental parameters for gear shifting are the accelerator pedal position and the vehicle speed.

Gear selection can either be performed automatically or in select-shift mode. The selected

## DESCRIPTION AND OPERATION

transmission range or gear (in select-shift mode) is indicated to the driver in the instrument panel.

In selector lever position "S", the driver can manually select the gears (select-shift mode). Up (+) and down (-) shifts are made by moving the selector lever in the appropriate direction.

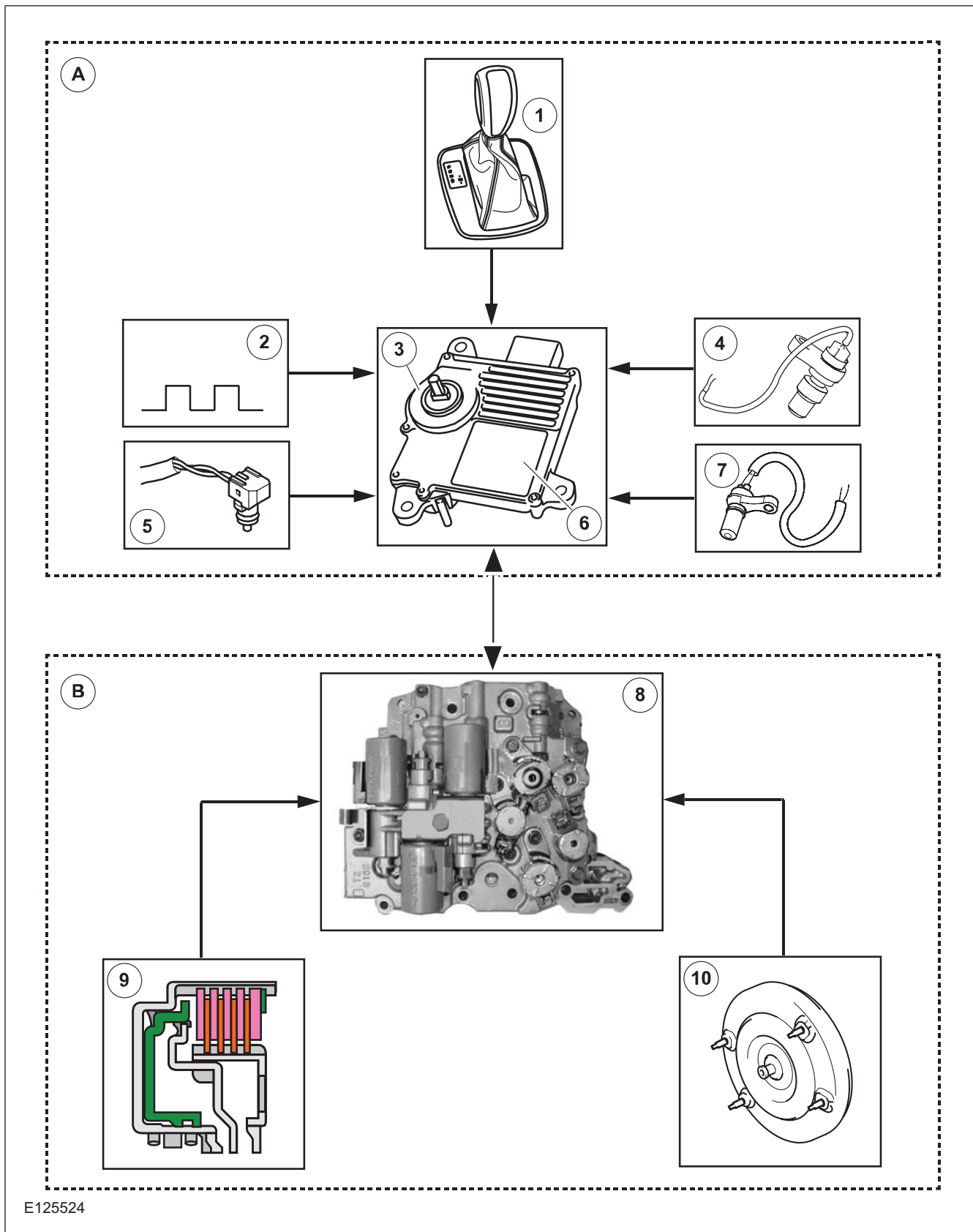
Hydraulic limp home modes maintain limited operation in the event of failure of important electrical components.

Under normal conditions, the transmission fluid is filled for the service life of the transaxle and does not need to be changed.

A dipstick is used to check the fluid level in the transmission.

## Functionality overview

DESCRIPTION AND OPERATION



E125524

Item	Description
A	Electronic Control System
B	Hydraulic Control System

Item	Description
1	Select-shift switch module
2	CAN (controller area network) bus input signals

## DESCRIPTION AND OPERATION

Item	Description
3	The TR sensor
4	The TSS sensor
5	The TFT sensor
6	TCM

The function is divided into an electronic and a hydraulic control system.

### Electronic Control System

Depending on the input signals, the TCM mounted on the transmission actuates the solenoid valves in the valve body. The TCM calculates and stores adaptive data, fault codes and values for diagnosis.

The TR sensor is integrated in the TCM.

### Hydraulic Control System

When the engine is running, a fluid pump integrated in the transaxle housing generates the hydraulic

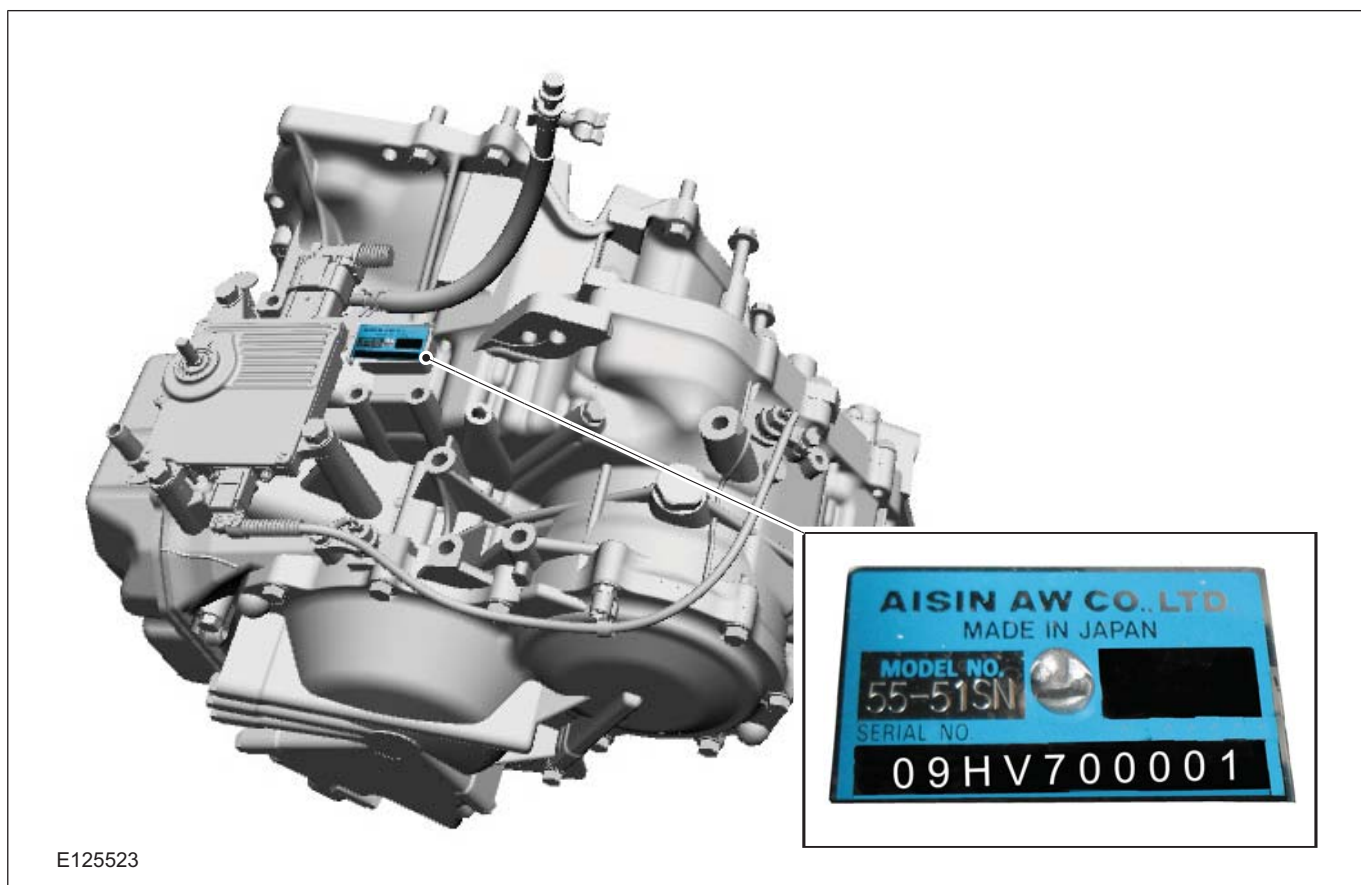
Item	Description
7	OSS (output shaft speed) sensor
8	Solenoid valves in valve body
9	Clutches and brakes
10	TCC

pressure required for controlling the automatic transaxle.

Through actuation of the solenoid valves, hydraulic pressure is applied to the clutches and brakes via hydraulic channels in the valve body and the transaxle. The control valves regulate the hydraulic pressure in accordance with the duty cycle of the electrical PWM signal. The controlled hydraulic pressure enables smooth shifting or the generation of a defined slip through actuation of the relevant clutches and brakes.

Solenoid valves are either in the 'open' or 'closed' state.

### Type plate



The transaxle identification is located on the rear/top of the transaxle housing in the direction of travel.



**DESCRIPTION AND OPERATION**

**Serial number of the transmission**

Example: **09HV70001**

- **09**: year of manufacture, 2009

- **H**: code letter for the month of manufacture, August
- **V7**: automatic transaxle type 55-51SN
- **00001**: Production number for the specified month

**Identification letter coding**

A	January
B	February
C	March
D	April
E	May
F	June
G	July
H.	August
J	September
K	October
left-hand	November
Ground	December

**Markings on the TCM**

The name plate is located on the TCM.

**Serial number of the TCM**

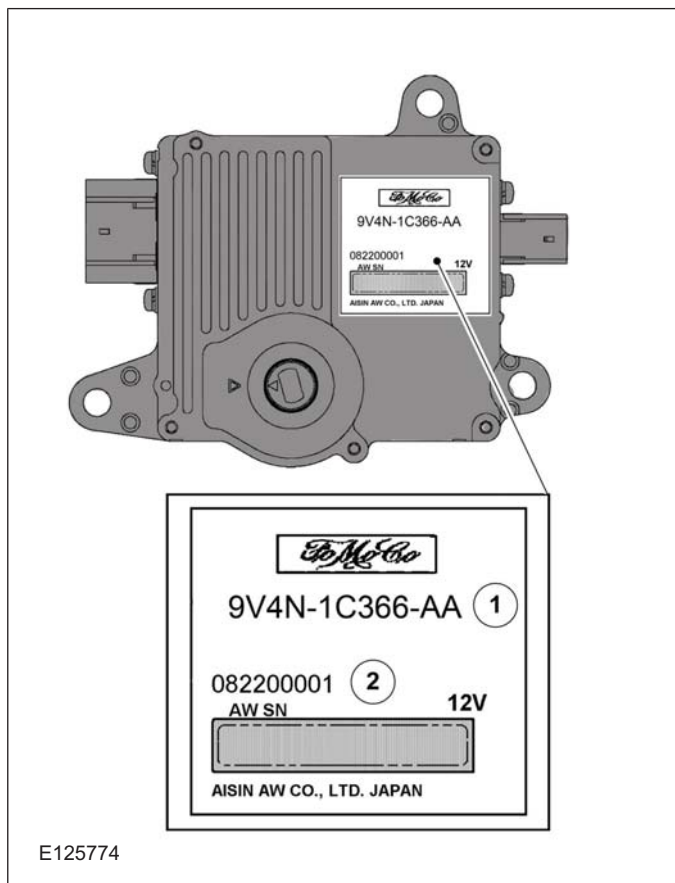
Example: **082200001**

- **08**: year of manufacture, 2008
- **22**: code for the calendar week
- **00001**: Production number for the specified calendar week

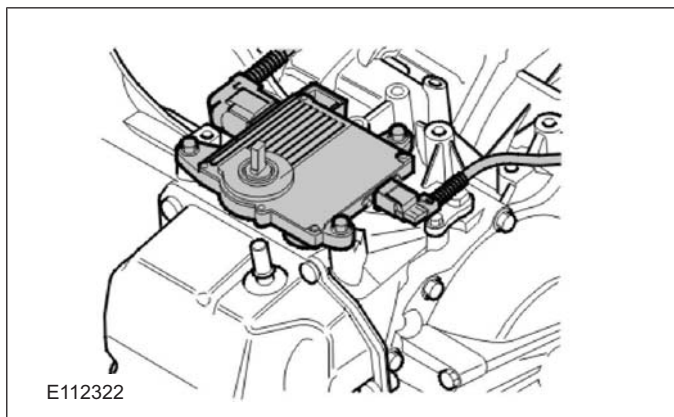
**Transmission Control**

Depending on the input signals, the TCM mounted on the transmission actuates the solenoid valves in the valve body. The TCM calculates and stores adaptive data, fault codes and values for diagnosis.

The TR sensor is integrated in the TCM.



**DESCRIPTION AND OPERATION**



The TCM adapts the gear changing to ensure that the correct gear is selected for the style of driving, the engine load, driver requirements, vehicle speed etc. This leads to lower fuel consumption together with improved comfort through smoother gear changes and lower noise levels.

The TCM receives information on the driver's desired transmission range and type of driving mode. In contrast to a transmission which is only controlled hydraulically, the control module can calculate the best times to shift gear and activate torque converter lockup by using the signals from the sensors in the transmission and the engine management system.

The control module enables small changes in the operating conditions to be made and adapts the

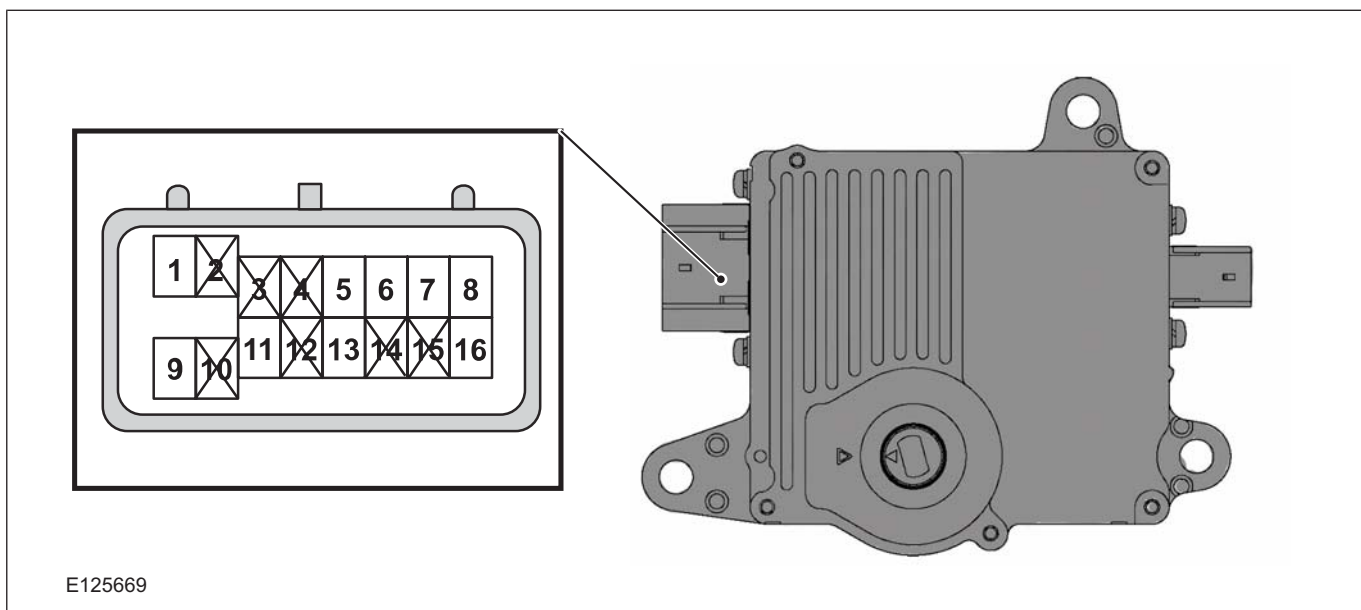
various transmission functions to ensure that the correct gear is always selected in relation to the type of driving mode.

The TCM has adaptive capabilities. This ensures smooth gear changes throughout the whole service life of the transmission.

To exactly determine the activation points of the gear shifts and torque converter lockup on the basis of the type of driving mode chosen, the TCM receives the following information:

- Transmission range chosen (TR sensor).
- Type of driving mode chosen (normal/sport/select-shift).
- Transmission input shaft speed (TSS sensor).
- Transmission output shaft speed (OSS sensor).
- Transmission fluid temperature (TFT sensor).
- The engine speed and the torque as well as the throttle plate opening - from the PCM via the CAN data bus.
- Actuation of the accelerator pedal - from the PCM via the CAN data bus.
- Coolant temperature - from the PCM via the CAN data bus.
- Vehicle speed - from the ABS via the CAN data bus.
- Actuation of the brake pedal - from the ABS via the CAN data bus.

**Pin assignment for TCM connector 'A' (connection to vehicle)**



Item	Description
1	Battery (+)
2	not assigned

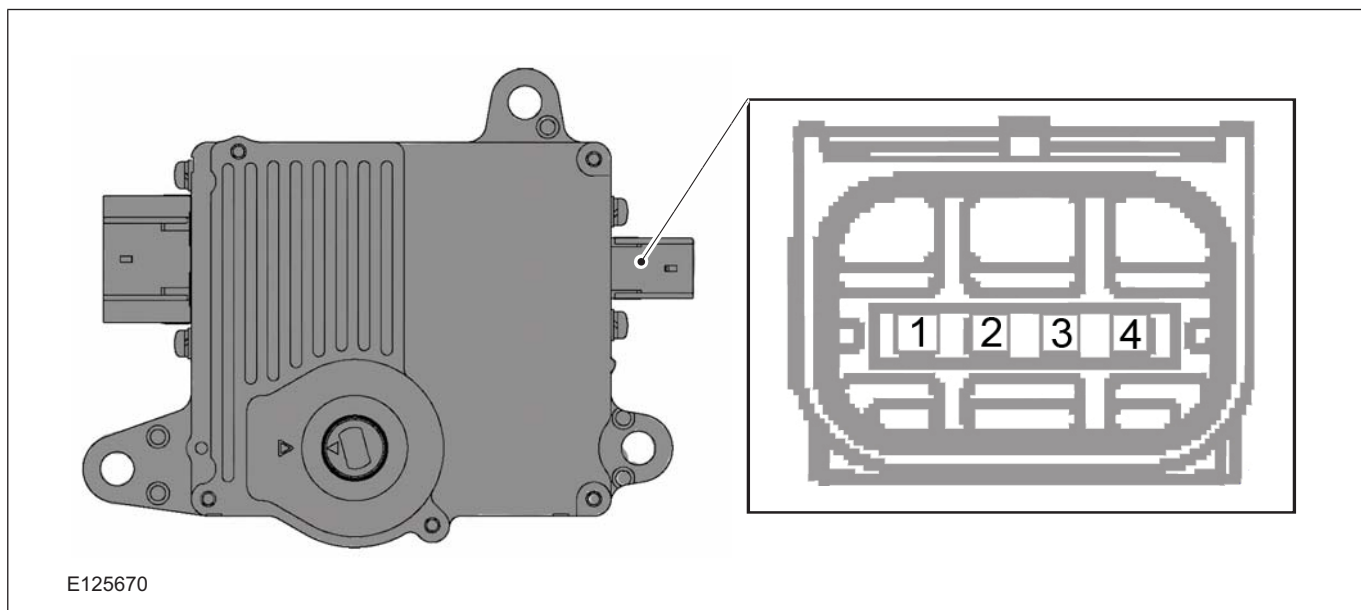
Item	Description
3	not assigned
4	not assigned

**DESCRIPTION AND OPERATION**

Item	Description
5	Starter motor inhibitor signal to the PCM
6	CAN (low)
7	LIN (local interconnect network)
8	CAN (high)
9	GND (ground)
10	not assigned

Item	Description
11	Battery (+) via ignition switch
12	not assigned
13	Selector lever lock
14	not assigned
15	not assigned
16	Voltage supply for select-shift switch module

**Pin assignment for TCM connector 'B' (connection to transaxle)**



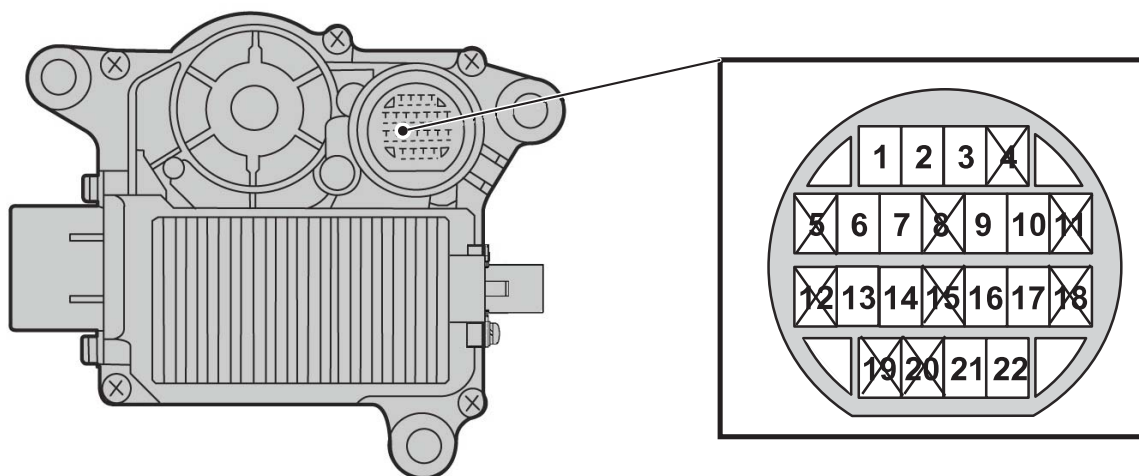
E125670

Item	Description
1	OSS(-)
2	OSS(+)

Item	Description
3	TSS(+)
4	TSS(-)

**Pin assignment for TCM connector 'C' (connection to transaxle)**

DESCRIPTION AND OPERATION



E125671

Item	Description
1	Shift solenoid valve S1 (+)
2	Shift solenoid valve (S2) (+)
3	PWM solenoid valve – main line pressure (SLT) (+)
4	not assigned
5	not assigned
6	PWM solenoid valve – main pressure line (SLT) (-)
7	PWM solenoid valve – TCC (SLU) (-)
8	not assigned
9	PWM solenoid valve – TCC (SLU) (+)
10	PWM solenoid valve – shift pressure (SLS) (-)

Item	Description
11	not assigned
12	not assigned
13	TFT sensor (-)
14	TFT sensor (+)
15	not assigned
16	PWM solenoid valve – shift pressure (SLS) (+)
17	Shift solenoid valve (S3) (+)
18	not assigned
19	not assigned
20	not assigned
21	Shift solenoid valve (S5) (+)
22	Shift solenoid valve (S4) (+)

Operation

Depending on the input signals, the TCM mounted on the transmission actuates the solenoid valves in the valve body. The TCM calculates and stores adaptive data, fault codes and values for diagnosis.

The TCM adapts the gear changing to ensure that the correct gear is selected for the style of driving, the engine load, driver requirements, vehicle speed etc. This leads to lower fuel consumption together with improved comfort through smoother gear changes and lower noise levels.

The TCM receives information on the driver's desired transmission range and type of driving mode. In contrast to a transmission which is only

controlled hydraulically, the control module can calculate the best times to shift gear and activate torque converter lockup by using the signals from the sensors in the transmission and the engine management system.

The control module enables small changes in the operating conditions to be made and adapts the various transmission functions to ensure that the correct gear is always selected in relation to the type of driving mode.

The TCM has adaptive capabilities. This ensures smooth gear changes throughout the whole service life of the transmission.

## DESCRIPTION AND OPERATION

To exactly determine the activation points of the gear shifts and torque converter lockup on the basis of the type of driving mode chosen, the TCM receives the following information:

- Selected transmission range (TR sensor)
- Selected driving mode (normal/sport/select-shift)
- Transmission input shaft speed (TSS sensor)
- Transmission output shaft speed (OSS sensor)
- Transmission fluid temperature (TFT sensor)
- The engine speed and the torque as well as the throttle plate opening - from the PCM via the CAN databus
- Actuation of accelerator – from the PCM via the CAN databus
- The coolant temperature – from the PCM via the CAN databus
- Road speed – from the ABS module via the CAN databus
- Actuation of brake pedal – from the PCM via the CAN databus

### Gearshift control

#### Adaptation

The TCM monitors every shift operation in all driving conditions to make even and smooth gear shifts possible. This is done by the control module, which either lowers or increases the hydraulic line pressure during gearshifts.

The changed pressure values are stored in the control module memory after the engine is switched off and retrieved during engine starting. This improves the shift comfort and extends the service life.

Full adaptability occurs when the following criteria are met:

- Throttle plate opening is constant.
- Transmission fluid temperature between 65 °C and 110 °C.

#### Shifting from 'P' to another transmission range

To be able to move the selector lever from 'P' into another transmission range, the ignition must be switched on and the brake pedal pressed (stoplamp switch on). The TCM detects the position of the brake pedal via the CAN data bus and the engaged transmission range from the TR sensor.

Based on this information, the TCM transmits a signal to the select-shift switch module. This activates the brake shift interlock actuator in the selector lever assembly.

When the brake shift interlock actuator is activated, the locking pin is retracted so that another transmission range can be selected.

The brake shift interlock actuator is deactivated when the ignition is switched off. It is mechanically locked when the gear selector lever is in 'P'.

#### Automatic transmission, selector lever in position "D".

The TCM adapts the shift points to match the driving conditions. Normally the TCM is in adaptive mode and gear changes take place adapted to the driving conditions. If special driving conditions are detected, the TCM switches to predefined characteristics.

When driving with normal acceleration, the TCM uses a preset shift program which is optimized for economical driving.

This shift program is suitable for "normal" driving and delivers early upward changes and torque converter lockup. Furthermore, the transmission fluid pressure is adapted to make smooth engagement of the gears possible.

#### Sport mode, selector lever in position "S"

The transmission switches from automatic operation into sport mode. In this mode the TCM switches to another set of characteristic curves. These characteristic curves for control of the gear changes are adapted to sporting calculations (e.g. gear change at higher engine speed).

In the sport mode shift program the shift points are set so that good performance is offered. Changing down occurs at lower engine speeds.

Manual gear changes (select-shift mode) can be made in sport mode by moving the selector lever in the (+) or (-) direction.

#### Changing gear in select-shift mode

If you move the selector lever to 'S', the automatic transaxle remains hydraulically in 'D' position. If you move the gear selector lever forwards (-), the



## DESCRIPTION AND OPERATION

select-shift switch module transmits a downshift signal to the TCM.

If you move the gear selector lever backwards (+), an upshift signal is transmitted to the TCM. In the instrument cluster, the symbol when the selector lever is in the 'S' position changes from 'D' to the current gear, for example 3.

The TCM transmits a signal to the select-shift switch module to switch on the light emitting diode for 'S' and to switch off all other light emitting diodes. The TCM decides whether the shift process is possible.

If the shift process is permitted, then the various valves are activated according to the intended combination for each gear.

In certain situations however, the TCM determines the gear shifting. The following applies:

- If the vehicle is stationary, only 1st, 2nd and 3rd gears can be selected. 4th gear can be selected at speeds over 30 km/h and 5th gear at speeds over 40 km/h.
- The kickdown function is only available in the automatic transmission range 'D'
- Automatic gear changes into the next higher or next lower gear occur at fixed vehicle speeds and fixed engine speeds
- The permitted engine speed for manual change down agree with that for the kickdown change up, i.e. an engine speed of approximately 6000 rpm.
- If the temperature inside the transmission rises too high, the TCM takes control of the shift decisions in order to select a gear in which activation of torque converter lockup at the current speed is possible
- Torque converter lockup is possible in 3rd, 4th and 5th gear. (1st and 2nd gears do not have torque converter lockup)

The signal that specifies the position of the lever to the select-shift switch module is generated as follows in the selector lever position 'S': there is a Hall sensor at the printed circuit board for the module for each of the three selector lever positions. A permanent magnet on the cover in the selector lever affects the output signals to the control module from the sensors. The control module recognizes the position of the lever by the differences in the signal properties.

### Selector lever from 'N' to 'R' position

The TCM only permits shifting to reverse gear if the vehicle speed is less than 4.35 mph.

If the vehicle speed is greater than 7 km/h (approx. 4.35 mph), the clutch (C2) and the multi-plate brake (B3) are not activated and the gearshift is thus prevented.

### Self-test and Diagnosis

The TCM monitors all the transaxle sensors and electronic components including the PCM. If a fault occurs, the driver is informed via a warning indicator and a text message in the instrument cluster. Faults are stored as DTCs in the fault memory of the TCM and can be read out and cleared using the IDS.

### Temperature controlled torque converter lockup

If heavy load and high ambient temperatures cause an abnormal rise in the transmission temperature, torque converter lockup is activated as often as possible (temperature controlled lockup).

This reduces the slip and the heat developed in the transmission. When the temperature drops below +20 °C, torque converter lockup is not used.

### Slip locking

When changing gear this function makes it possible for the gears to engage more smoothly with reduced vibration and less noise. In this mode, the torque converter clutch is activated but not fully locked.

The following conditions must be met for the function to activate:

- Gear selector lever in position D or S.
- Gear 3, 4 or 5.
- The transmission input speed is 1100 rpm or more and the throttle plate opening 20 - 35%.
- The transmission fluid temperature is 40 - 120 °C.

### Hill climbing

The TCM can change the shift pattern slightly when driving uphill to avoid changing gear too often.

## DESCRIPTION AND OPERATION

The TCM detects uphill driving by comparing the engine load transmitted by the PCM with the engine speed. If the engine load increases and the engine speed falls, then the TCM causes the transaxle to shift to a lower transmission range in order to increase the traction force.

### Downhill driving

The TCM detects downhill driving by comparing the engine load and engine speed values transmitted by the PCM with the OSS sensor signal. In order to prevent overloading of the vehicle brakes, the TCM causes the transaxle to shift to a lower transmission range.

### Hill-hold function

If the vehicle is stopped on an uphill incline, the TCM detects this through the faster drop in engine speed compared with the drop in engine speed when stopping on the flat. In this situation, the hydraulics are actuated by the TCM in such a way that the vehicle is prevented from rolling back. This function is not used on steep inclines.

If the vehicle is parked on an uphill incline (ignition switched off), the hill-hold function is not active when pulling away.

### Altitude correction

Lower air density results in reduced engine performance. In order to compensate for this operating situation, the TCM changes the shift points.

### Selector lever lock

To prevent the selector lever being accidentally moved from the P or N position, the vehicle also has an electrically operated selector lever lock. This blocks the locking pin in the locking segment and thus locks the selector lever in the P or N position.

### Shifting from P into another transmission range

To be able to move the selector lever from P into another transmission range, the ignition must be switched on and the brake pedal must be depressed (stop light switch on). The TCM detects the position of the brake pedal via the CAN data bus and the engaged transmission range from the TR sensor.

The signal is then transferred from the TCM to the select-shift switch module in order to activate the solenoid valve in the selector mechanism assembly.

In position P, the solenoid valve is activated and the locking pin is pulled in so that the lock button on the selector lever can be pressed as usual to engage another transmission range.

In the selector mechanism assembly there is a Hall sensor which is affected by a permanent magnet on the gate of the selector mechanism assembly. If the selector lever is moved from the P position, both the Hall sensor and the selector lever lock solenoid are simultaneously deactivated, to prevent the selector from being kept in the N position.

If the ignition is set to "I" or "0" the solenoid valve is deactivated. When the selector lever is in the P position, it is mechanically locked because it has no voltage.

### Shifting from N into another transmission range

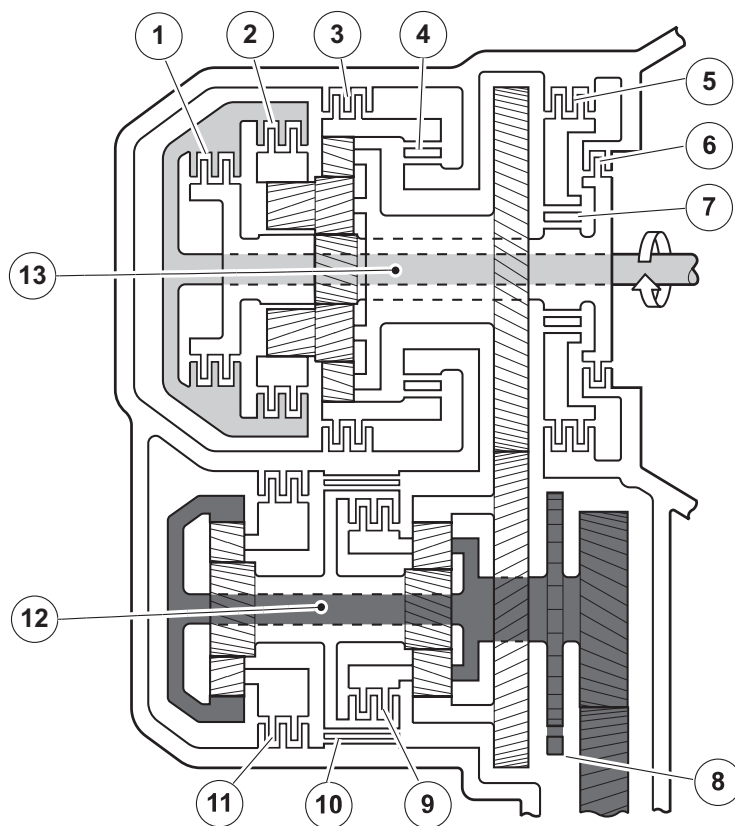
The conditions are the same as for shifting from P into another transmission range.

However, the lock button on the selector lever must be pressed to be able to select R or P.

### Power flow through the transmission

### Clutches and brakes

DESCRIPTION AND OPERATION



E127357

Item	Description
1	5th gear and reverse gear clutch (C2)
2	1st - 5th gear clutch (C1)
3	Reverse gear brake (B3)
4	1st gear one-way clutch (F2)
5	2nd - 5th gear brake (B2)
6	2nd - 4th gear brake (B1)
7	2nd - 4th gear one-way clutch (F1)

Item	Description
8	Parking lock
9	4th and 5th gear clutch (C3)
10	3rd gear brake (B4) (band brake)
11	1st and 2nd gear and reverse gear brake (B5)
12	Output shaft – transaxle
13	Input shaft – transaxle

The transaxle features three clutches, five brakes, and two one-way clutches.

The clutches are designed as multi-plate clutches.

There are four multi-plate brakes (B1, B2, B3, B5) and one band brake (B4).

Tasks of clutches and brakes

- **1st-5th gear clutch (C1):** Connects the input side with the ring gear.
- **5th gear and reverse clutch (C2):** Connects the input side with the sun gear.
- **4th and 5th gear clutch (C3):** Connects the sun gear with the front planetary gear carriers on the output side.

- **2nd-4th gear brake (B1):** Locks the sun gear on the input side.
- **2nd-5th gear brake (B2):** Locks the rotational movement of the sun gear on the input side in a counterclockwise direction.
- **Reverse gear brake (B3) and 1st gear brake in select-shift mode:** Locks the ring gear on the input side.
- **3rd gear brake (B4) (band brake):** Locks the two sun gears on the output side.
- **1st and 2nd gear and reverse gear brake (B5):** Locks the rear planetary gear carriers on the output side.

## DESCRIPTION AND OPERATION

- **2nd-4th one-way clutch (F1):** Locks the rotational movement of the sun gear on the input side in a counterclockwise direction, if 2nd-5th gear brake (B2) is applied.
- **1st gear one-way clutch (F2):** Locks the rotational movement of the ring gear on the input side in a counterclockwise direction.

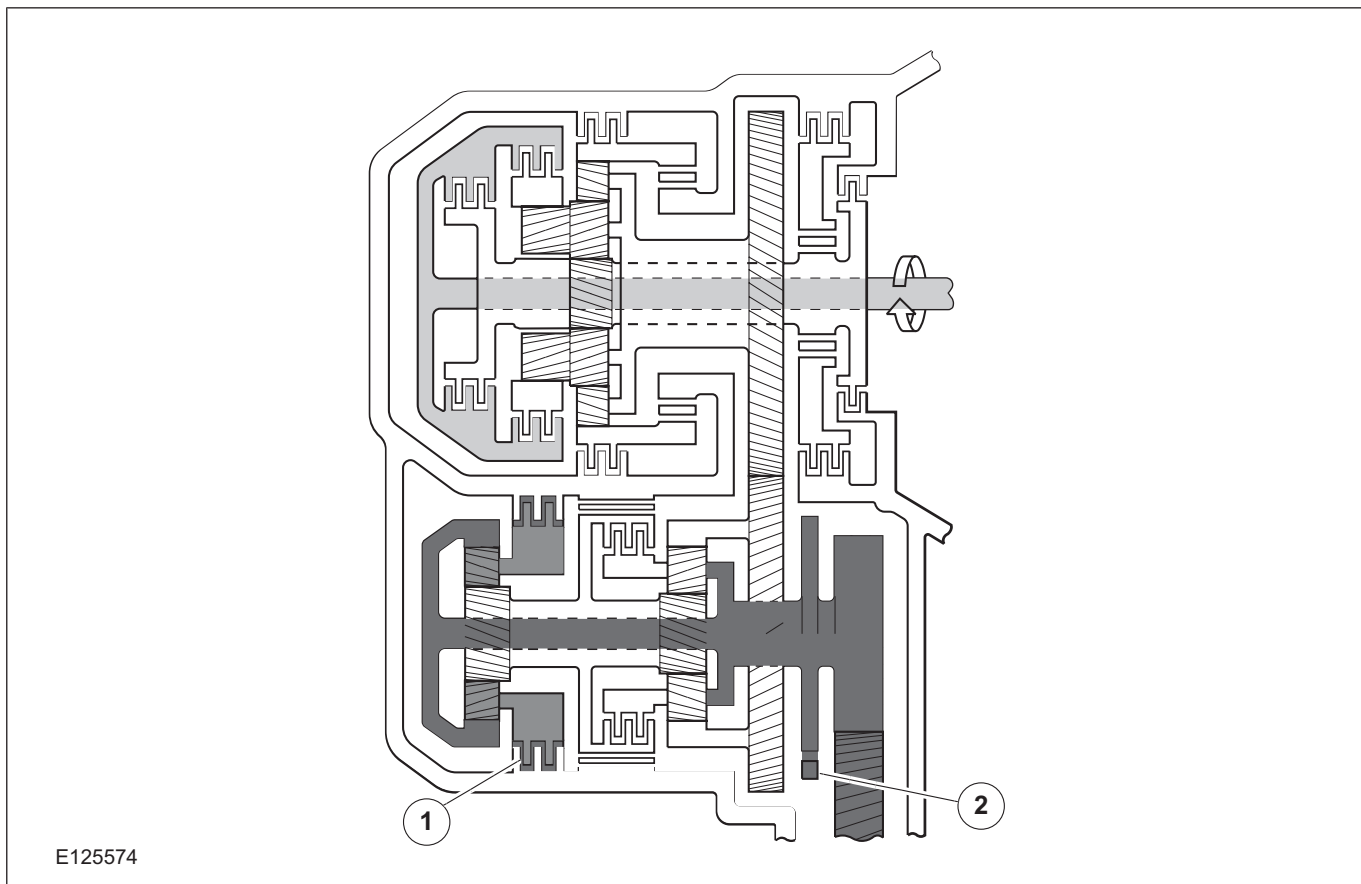
## Function of the clutches and brakes in the gears and when shifting gears in automatic mode and select-shift mode (manual shifting)

Gear	C1	C2	C3	B1	B2	B3	B4	B5	F1	F2
Park	–	–	–	–	–	–	–	0	–	–
R (V<=7)	–	0	–	–	–	0	–	0	–	–
R (V>7)	–	–	–	–	–	–	–	0	–	–
N	–	–	–	–	–	–	–	0	–	–
1	0	–	–	–	–	–*	–	0	–	0
1<=>2	0	–	–	–/0	–/0	–	–	0	–/0	0/–
2	0	–	–	0	0	–	–	0	0	–
2<=>3	0	–	–	0	0	–	–/0	0/–	0	–
3	0	–	–	0	0	–	0	–	0	–
3<=>4	0	–	–/0	0	0	–	0/–	–	0	–
4	0	–	0	0	0	–	–	–	0	–
4<=>5	0	–/0	0	0/–	0	–	–	–	0/–	–
5	0	0	0	–	0	–	–	–	–	–

- **V** = Road speed in km/h
- **0** = Actuated
- **–** = Not actuated
- **x<=>x** = Gear change "up/down"
- **\*** = Actuated in select-shift mode

## Position P (park)

DESCRIPTION AND OPERATION



Item	Description
1	1st and 2nd gear and reverse gear brake (B5)
2	Parking lock

The transmission input shaft rotates in the clockwise direction. All clutches and brakes are deactivated and no force is transferred to the planetary gear sets.

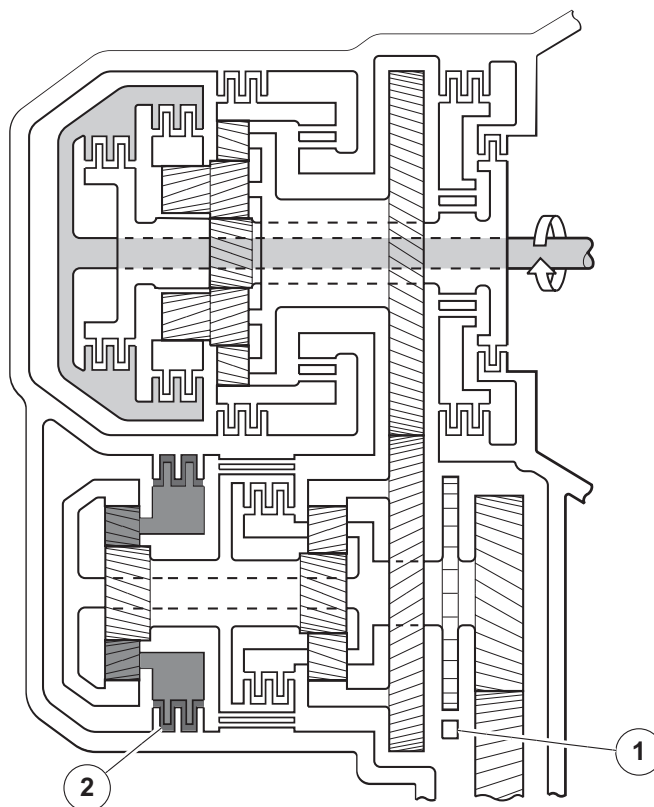
No force is transferred to the output shaft. The brake B5 (1) locks the rear planetary gear carrier

on the output side. The parking lock (2) engages in the output shaft and stops the vehicle rolling away.

**Position N (neutral)**



## DESCRIPTION AND OPERATION



E125575

Item	Description
1	Parking lock
2	1st and 2nd gear and reverse gear brake (B5)

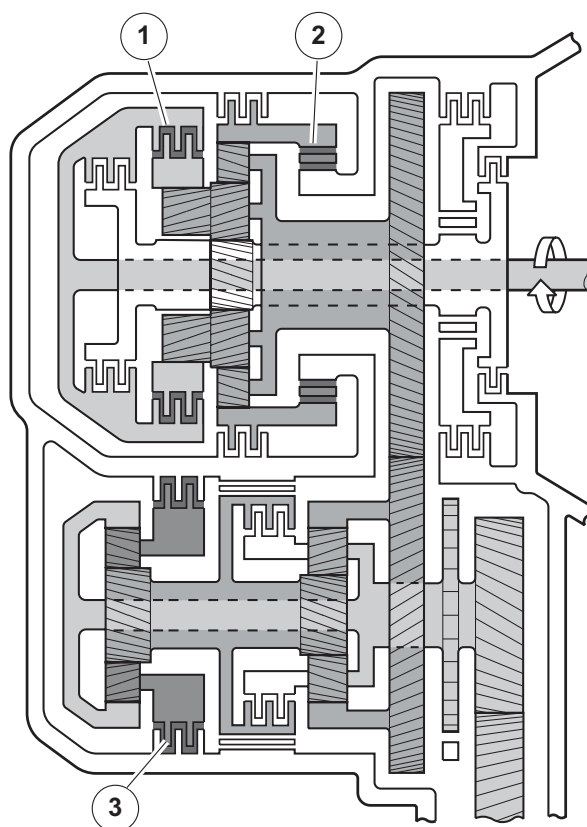
The transmission input shaft rotates in the clockwise direction. All clutches and brakes on the input side are deactivated and no power is transmitted to the planetary gear sets.

No force is transferred to the output shaft. The brake B5 (2) locks the rear planetary gear carrier on the output side. The parking lock (1) is not activated. Since the transaxle input shaft is not positively connected with the input side, the vehicle will start to roll away if it is on an incline.

The brake B5 is activated both in 'P' and in 'N' position to reduce the cut-in pressure that otherwise occurs if several brakes and clutches are activated simultaneously when the selector lever is moved to 'D' or 'R' position. Since the brake B5 is activated both in first and second as well as in reverse gear, this method reduces the total number of transient effects.

### Position D, 1st gear

## DESCRIPTION AND OPERATION



E127358

**Input shaft:**

The transmission input shaft rotates in the clockwise direction. Clutch C1 (1) joins the transaxle input shaft with the ring gear, which rotates in clockwise direction. The rear planetary gear set rotates in the clockwise direction. The front larger planetary gear set rotates clockwise with the rear planetary gear set as a single unit.

The front smaller planetary gear set rotates in the clockwise direction. The front annular gear rotates counterclockwise. One-way clutch F2 (2) blocks the front annular gear clockwise rotation.

The front and rear planetary gear carriers are turned clockwise because of the reactive forces from the small gear. The primary idler gear rotates clockwise with the front and rear planetary gear carriers as one unit.

**Output shaft:**

The secondary idler gear rotates counterclockwise. The front annular gear rotates counterclockwise with the secondary idler gear as a single unit.

The front planetary gear set rotates in the clockwise direction. The sun gear rotates clockwise.

The rear planetary gear set rotates counterclockwise. Brake B5 (3) prevents rotation of the rear planetary gear carrier. The rear annular gear rotates counterclockwise. The front planetary gear carrier and the final drive pinion rotate counterclockwise with the rear annular gear as one unit. The final drive rotates in the clockwise direction.

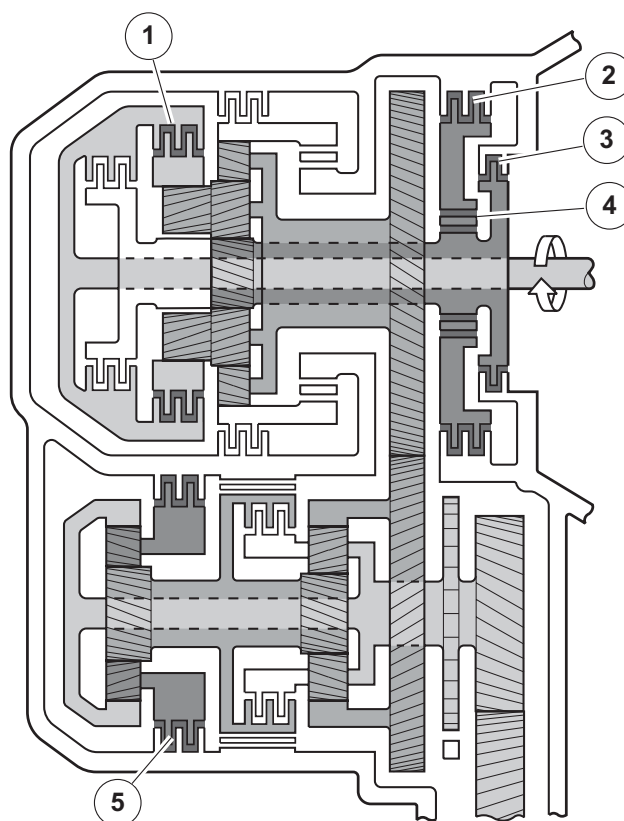
**Engine braking:**

The 1st gear has no engine braking function because the power flow is interrupted by the one-way clutch F2 rotating against the locking direction.

The brake B3 is additionally activated in select-shift mode to guarantee engine braking.

**Position D, 2nd gear**

## DESCRIPTION AND OPERATION



E127359

**Input shaft:**

The transmission input shaft rotates in the clockwise direction. The clutch C1 (1) joins the transaxle input shaft and the ring gear. The ring gear rotates in clockwise direction. The planetary gear set rotates in clockwise direction.

The front larger planet gear rotates clockwise with the rear planet gear as a single unit. Brakes B2 (2), brake B1 (3) and the one-way clutch F1 (4) prevent rotation of the sun gear.

The front and rear planetary gear carriers are turned clockwise by the front larger gear. The primary idler gear rotates clockwise with the front and rear planetary gear carriers as one unit.

**Output shaft:**

The secondary idler gear rotates counterclockwise. The front annular gear rotates counterclockwise

with the secondary idler gear as a single unit. The front planetary gear set rotates in the clockwise direction.

The sun gear rotates clockwise. The rear planetary gear set rotates counterclockwise. Brake B5 (5) prevents rotation of the rear planetary gear carrier. The rear annular gear rotates counterclockwise.

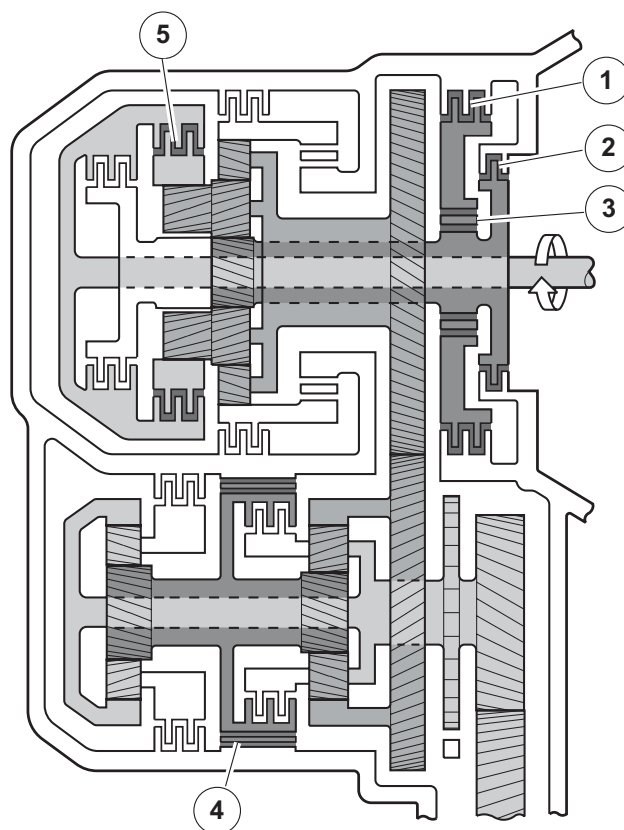
The front planetary gear carrier and the shaft drive pinion rotate in counterclockwise direction with the rear ring gear as one unit. The final drive rotates in the clockwise direction.

**Engine braking:**

The power is transferred directly to the transmission input shaft without one-way clutch involvement. Engine braking is thus applied.

**Position D, 3rd gear**

## DESCRIPTION AND OPERATION



E127360

**Input shaft:**

The transmission input shaft rotates in the clockwise direction. The clutch C1 (5) joins the transaxle input shaft and the ring gear. The ring gear rotates in clockwise direction. The rear planetary gear set rotates in the clockwise direction.

The front larger planet gear rotates clockwise with the rear planet gear as a single unit. Brakes B2 (1) and B1 (2) and also the one-way clutch F1 (3) prevent rotation of the sun gear.

The front and rear planetary gear carriers are turned clockwise because of the reactive forces from the front larger gear. The primary idler gear rotates clockwise with the front and rear planetary gear carriers as one unit.

**Output shaft:**

The secondary idler gear rotates counterclockwise. The front annular gear rotates counterclockwise with the secondary idler gear as a single unit. The front planetary gear set rotates in counterclockwise direction. The brake band B4 (4) locks the rotational movement of the sun gear.

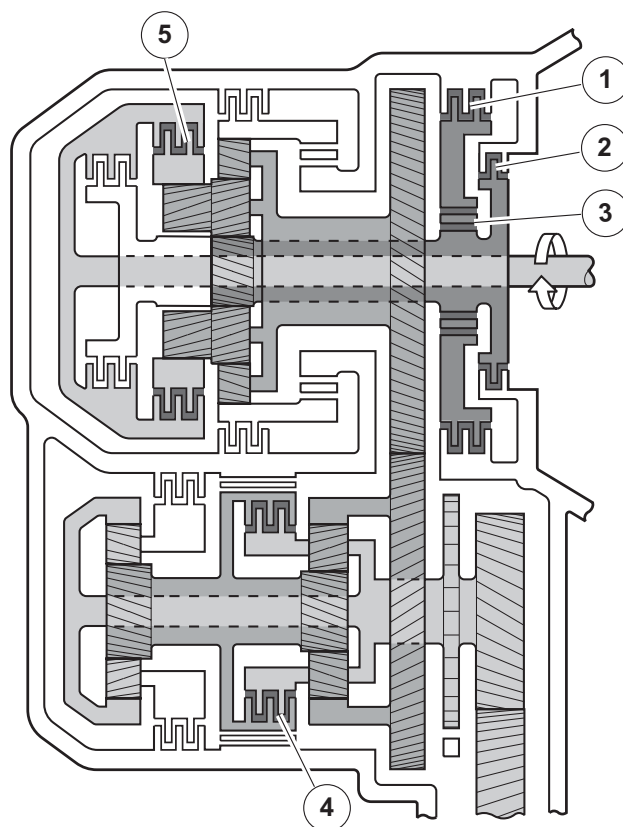
The front planetary gear carrier rotates in counterclockwise direction. The front planetary gear carrier and the shaft drive pinion rotate in counterclockwise direction with the rear ring gear as one unit. The final drive rotates in the clockwise direction.

**Engine braking:**

The power is transferred directly to the transmission input shaft without one-way clutch involvement. Engine braking is thus applied.

**Position D, 4th gear**

## DESCRIPTION AND OPERATION



E127361

**Input shaft:**

The transmission input shaft rotates in the clockwise direction. The clutch C1 (5) joins the transaxle input shaft and the ring gear. The ring gear rotates in clockwise direction. The rear planetary gear set rotates in the clockwise direction.

The front larger planet gear rotates clockwise with the rear planet gear as a single unit. Brake B2 (1), one-way clutch F1 (3) and brake B1 (2) prevent rotation of the sun gear.

The front and rear planetary gear carriers are turned clockwise because of the reactive forces from the front larger gear. The primary idler gear rotates clockwise with the front and rear planetary gear carriers as one unit.

**Output shaft:**

The secondary idler gear rotates clockwise. The front annular gear rotates counterclockwise with the secondary idler gear as a single unit. Clutch C3 (4) connects the sun gear with the front planetary gear carrier.

The front planetary gear set cannot rotate and the output shaft rotates counterclockwise as a single unit. The final drive rotates counterclockwise with the output shaft as a single unit. The final drive rotates in the clockwise direction.

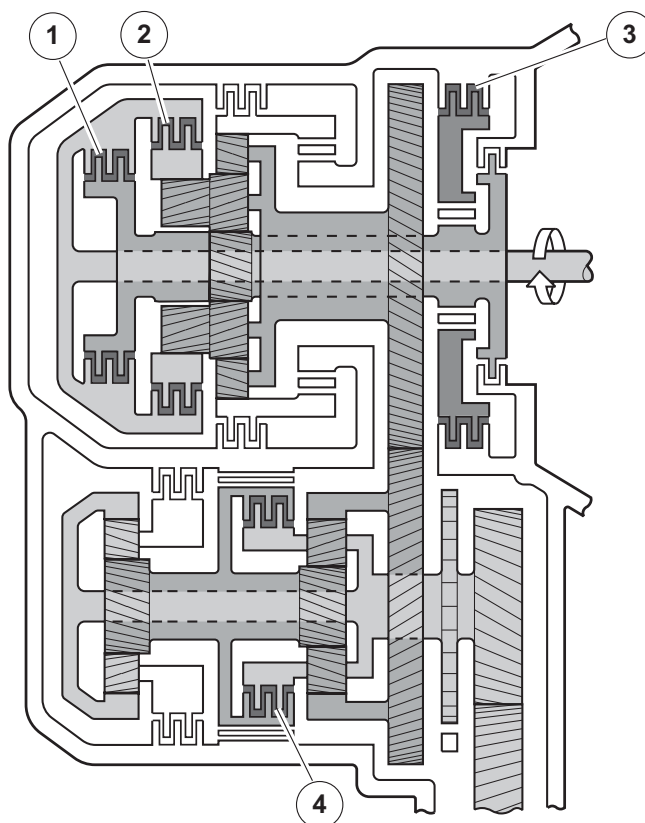
**Engine braking:**

The power is transferred directly to the transmission input shaft without one-way clutch involvement. Engine braking is thus applied.

**Position D, 5th gear**



## DESCRIPTION AND OPERATION



E125594

**Input shaft:**

The transmission input shaft rotates in the clockwise direction. The clutch C1 (2) joins the transaxle input shaft and the ring gear. Clutch C2 (1) connects the transmission input shaft with the sun gear.

The brake B2 (3) locks the rotational movement of the sun gear in a counterclockwise direction.

The rear planetary gear set cannot rotate and the rear planet gear unit rotates clockwise as a single unit. The front planetary gear set cannot rotate with the rear planetary gear set as a single unit. The front planetary gear unit rotates clockwise as one unit. The primary idler gear rotates clockwise with the front planetary gear unit as a single unit.

**Output shaft:**

The secondary idler gear rotates counterclockwise. The front annular gear rotates counterclockwise with the secondary idler gear as a single unit. Clutch C3 (4) connects the sun gear with the front planetary gear carrier.

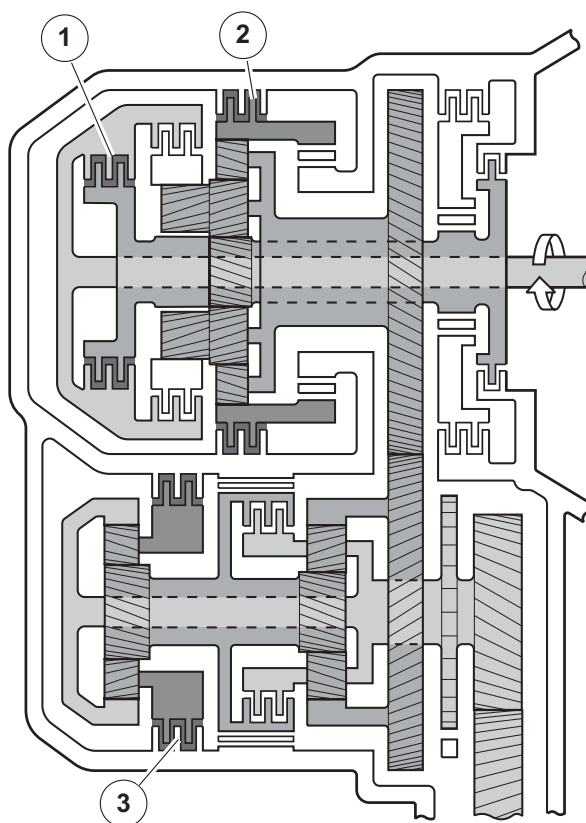
The front planetary gear set cannot rotate and the output shaft rotates counterclockwise as a single unit. The final drive rotates counterclockwise with the output shaft as a single unit. The final drive rotates in the clockwise direction.

**Engine braking:**

The power is transferred directly to the transmission input shaft without one-way clutch involvement. Engine braking is thus applied.

**Position R (reverse)**

## DESCRIPTION AND OPERATION



E127362

**Input shaft:**

The transmission input shaft rotates clockwise. Clutch C2 (1) connects the transmission input shaft with the sun gear. The sun gear rotates clockwise.

The rear planetary gear set rotates counterclockwise. The front larger planetary gear set rotates counterclockwise with the rear planetary gear set as a single unit. The front smaller planetary gear set rotates clockwise.

Brake B3 (2) blocks the ring gear in counterclockwise direction. The front and rear planetary gear carriers are turned clockwise by the front smaller gear. The primary idler gear rotates counterclockwise with the front and rear planetary gear carriers as one unit.

**Output shaft:**

The secondary idler gear rotates clockwise. The front annular gear rotates clockwise with the secondary idler gear as a single unit. The front planetary gear set rotates clockwise. The sun gear rotates in counterclockwise direction.

Brake B5 (3) prevents rotation of the rear planetary gear carrier. The rear annular gear rotates clockwise. The front planetary gear carrier and the final drive pinion rotate clockwise with the rear

annular gear as one unit. The final drive rotates counterclockwise.

**Engine braking:**

The power is transferred directly to the transmission input shaft without one-way clutch involvement. Engine braking is thus applied.

**NOTE:** The clutch C2 and the brake B3 are only activated at a speed below 7 km/h (approx. 4.35 mph) when shifting from a forward gear to the reverse gear.

**Service instructions****Towing procedure**

Towing is only permitted travelling forwards, at a maximum speed of 80 km/h and for up to 80 km. The gear selector lever must be in Neutral.

**⚠ CAUTION: The vehicle must never be towed backwards under any circumstances.**

## DESCRIPTION AND OPERATION

### Reset adaptation data

Adaptation values are stored in the software of the TCM:

- Adaptation should be reset after an internal component has been exchanged or the whole transmission has been changed.

The adaptation of the transmission is reset via IDS.

### Limp home mode

The TCM software contains functions which take control of the transmission if serious faults occur. The fault characteristic decides which strategies are to be used.

The vehicle remains capable of restricted operation.

The TCM strategy differentiates between four emergency modes adapted to the fault situation:

Mode	Position	Gear
Emergency 1	D, S+	4th
	S-	2nd
	Reverse	Reverse
Emergency 2	D, S+	3rd
	S-	2nd
	Reverse	Reverse
Emergency 3 (*)	D, S+	4th
	S-	2nd
	Reverse	Reverse
Emergency 4	D, S+, S-	4th
	Reverse	Reverse

(\*) As for Emergency 1 mode, the second gear will however be shifted using other solenoid valves.

Different measures are implemented, depending on the current gear position and driving situation when the fault occurs:

- When a fault occurs, the TCM makes it possible for the vehicle to maintain restricted operation. The distance travelled should be kept as short as possible.
- Torque limitation is activated in order to protect the transaxle components.
- When the engine is restarted (ignition switched off for approx. 15 seconds), the transaxle is no longer in limp home mode. There is no longer a fault indication on the instrument cluster, and the MIL (malfunction indicator lamp) is off. However, the fault remains stored in the TCM. If the fault is still present, limp home mode is reactivated.
- If limp home mode is reactivated after the ignition is switched on, the option exists in

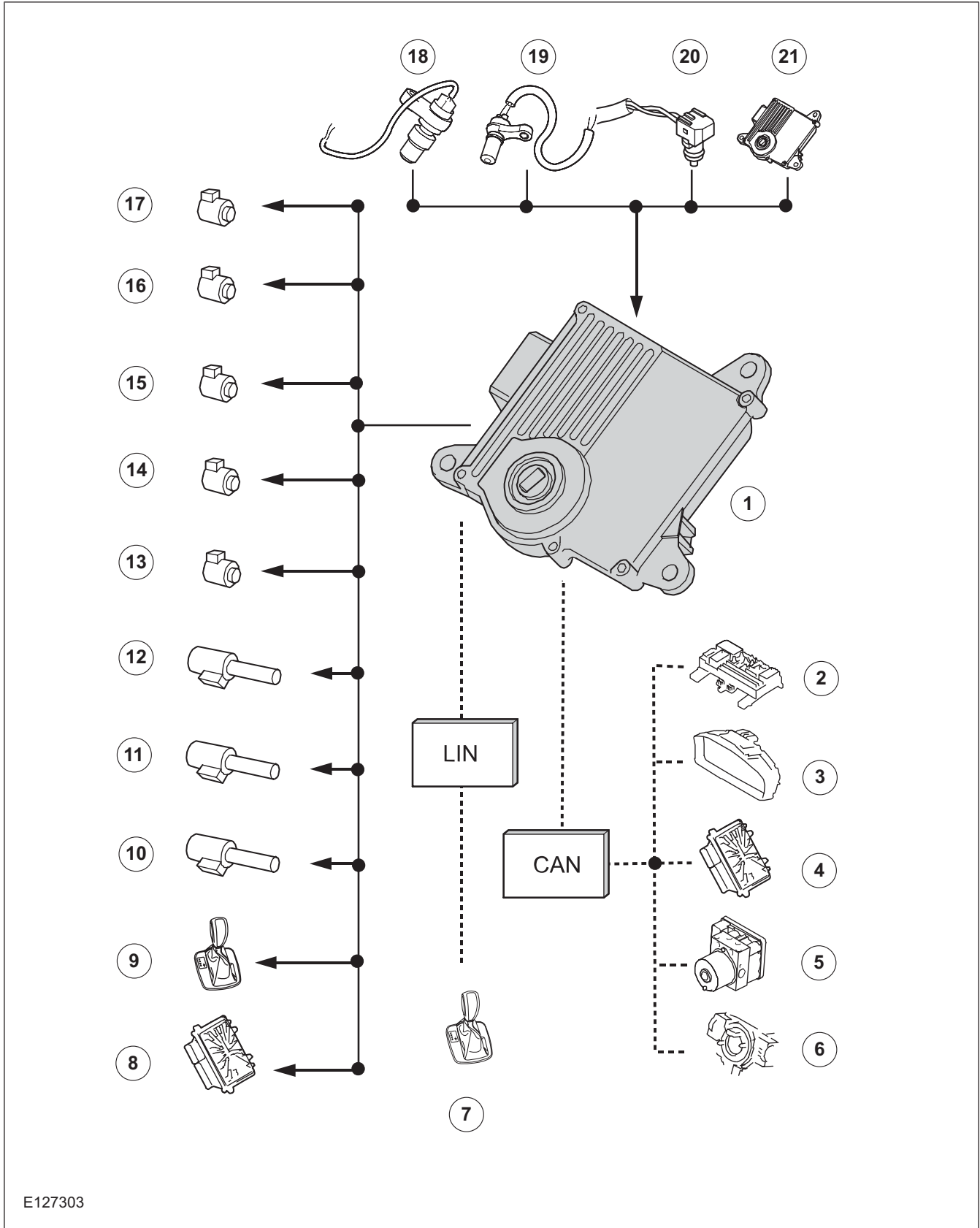
select-shift mode to pull away in 2nd gear. This is the case unless the transaxle is in emergency mode 4. Only 4th gear and the reverse gear are available in this mode.

## Component Description

### Tasks of the electronic components

The following overview summarizes the input and output signals from the transmission control module.

DESCRIPTION AND OPERATION



E127303

Item	Description
1	TCM
2	GEM

Item	Description
3	Instrument Cluster
4	PCM

## DESCRIPTION AND OPERATION

Item	Description
5	ABS
6	Cruise control
7	Select-shift switch module
8	PCM
9	Selector lever lock
10	PWM solenoid valve – shift pressure (SLS)
11	PWM solenoid valve for main line pressure (SLT)
12	PWM- solenoid valve – TCC (SLU)

Item	Description
13	Shift solenoid S1 (open when dormant)
14	Shift solenoid S2 (closed when dormant)
15	Shift solenoid S3 (closed when dormant)
16	Shift solenoid S4 (open when dormant)
17	Shift solenoid S5 (closed when dormant)
18	The TSS sensor
19	The OSS sensor
20	The TFT sensor
21	TR sensor in TCM

## Input signals

## Hard wired

- Item 18: ISS (input shaft speed) sensor
  - Supplies information on the transmission input shaft speed. Used for calculations, for instance the shift process, checking the torque converter lockup and for diagnosis of the hydraulic/mechanical operations in the transmission.
- Item 19: OSS sensor
  - Supplies information on the transmission output shaft speed. Used for calculations, for instance the vehicle speed and for diagnosis of the hydraulic/mechanical operations in the transmission.
- Item 20: TFT sensor
  - Supplies information on the transmission fluid temperature. This information is used to adjust the shift times and the fluid pressure.
- Item 21: TR sensor
  - Supplies the TCM with the information on the chosen transmission range. Starting is only possible when the selector lever is in the P or N position. The sensor is a permanent magnet which creates a magnetic field over the different Hall sensors and in this way creates a specific voltage for each shift operation.

## Via the LIN data bus

- Item 7: Selector lever module (select-shift module)
  - Indicates that the selector lever is locked in position P and supplies information on the sport mode status. Also transmits a control signal during select-shift gear changes and supplies information on the fault status in the

selector lever module, so that the fault codes in the module can be stored as required.

## Via the CAN data bus

- Item 4: PCM
  - Stop light switch ON/OFF, is used by the TCC.
  - Coolant temperature, used for diagnosis of the transmission temperature sensor and for activating the catalytic converter.
  - Engine speed >400 rpm = engine running. Used for starting the transmission fluid pressure and diagnosis functions.
  - Engine rpm. Used for checking the torque converter slip and the pressure build-up, which have an effect on the shift comfort.
  - Kickdown. If the accelerator pedal is pressed down and the throttle plate is wide open, the PCM transmits a kickdown signal to the TCM.
  - Current engine speed, used to check the line pressure of the transmission.
  - Throttle plate opening, used to calculate the gear changes. During sport mode and kickdown.
  - Accelerator pedal position, used to calculate the shift threshold timings.
- Item 5: ABS module
  - Supplies information on the vehicle speed and also on the difference in speed between the left-hand and right-hand wheels. Prevents changing up if the speed difference is greater than 40 km/h, to protect the differential in the transmission.
- Item 6: Vehicle speed control system
  - Is used to calculate the acceleration, depending on the position of the resume and set buttons.



## DESCRIPTION AND OPERATION

### Output signals

#### Hard wired

- Item 8: PCM
  - Start inhibitor. Supplies the PCM with a signal that indicates whether the engine can be started or not.
- Item 9: Selector lever module (select-shift module)
  - Controls the solenoid switch in the selector lever unit.
- Position 10: PWM solenoid valve – shift pressure (SLS)
  - Matches the line pressure to a shift pressure and is activated for certain gears.
- Position 11: PWM solenoid valve – main line pressure (SLT)
  - Adjusts the linear line pressure for gear changes without jolts.
- Position 12: PWM- solenoid valve – TCC (SLU)
  - Matches the line pressure to a torque converter lock-up pressure. Is also used for certain gearshifts.
- Items 13 - 17: Shift solenoids S1 – S5
  - The TCM checks which gear is engaged as the solenoids become active in different patterns.

#### Via the LIN data bus

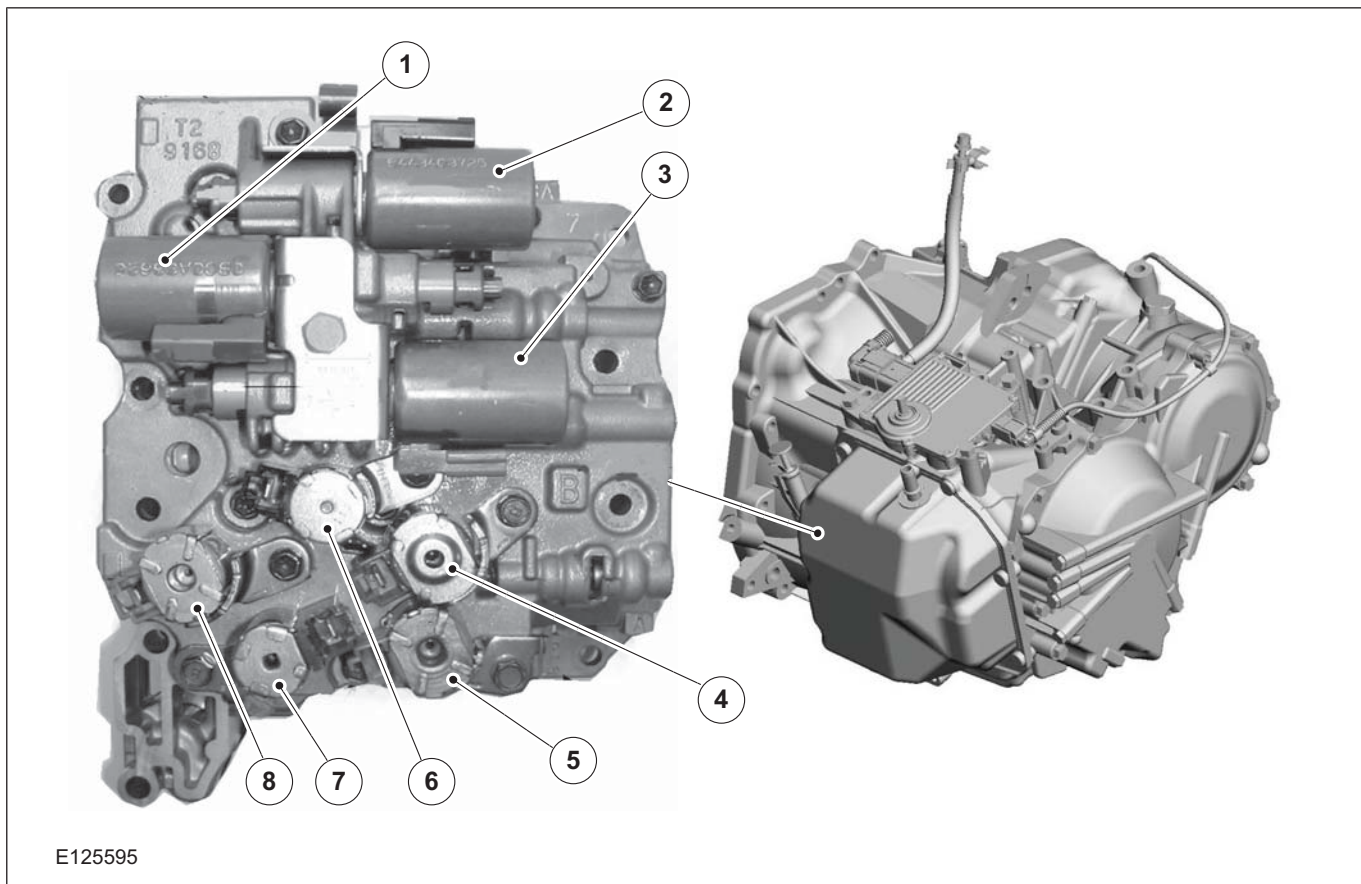
- Item 7: Selector lever module (select-shift module)
  - The TCM transmits a signal to the selector lever module which activates the LED (light emitting diode) in the selector mechanism assembly according to the selector lever position.

#### Via the CAN data bus

- Item 2: GEM
  - The selector lever module transmits a signal via the TCM, which indicates that the selector lever is locked in position P. The GEM uses this information to control the ignition switch key inhibit function.
  - The TCM transmits a signal via the GEM to activate the back-up lamps.
- Item 3: Instrument Cluster
  - Current selector lever position. Used to indicate the selector lever position in the instrument cluster.
  - Check the warning lamps via the GEM. In the event of a fault, the general warning lamp lights.
  - Text messages in the instrument cluster via the GEM. The driver receives various malfunction messages from the TCM.
  - The TCM transmits signals on the CAN data bus to the PCM so that the MIL lights up in the event of emissions-related faults.
- Item 4: PCM
  - Transmission fluid temperature, used to compensate for increased loads at low fluid temperatures.
  - Gear selected, used by the engine so that it can compensate for different loads.
  - Torque converter lockup, used by the engine so that it can compensate for different loads.
  - Next gear planned by the TCM, used by the engine to compensate for different loads.
  - Requirement for a reduced engine torque during gear shifts, the engine reduces the engine torque during gear shifts.
  - Torque limiting requirement, the engine limits the engine torque according to the gear engaged.
- Item 5: ABS module
  - Current gear, used to transmit a signal, not for shift control.
  - Vehicle speed, used as reserve.

### Control valve assembly

DESCRIPTION AND OPERATION



Item	Description
1	PWM solenoid valve for main line pressure (SLT)
2	PWM- solenoid valve – TCC (SLU)
3	PWM solenoid valve – shift pressure (SLS)
4	Shift solenoid S4

Item	Description
5	Shift solenoid S3
6	Shift solenoid S1
7	Shift solenoid S5
8	Shift solenoid S2

The hydraulic pressure is distributed to the individual clutches and brakes in the valve body.

The hydraulic paths and the hydraulic pressure are controlled electronically via three PWM solenoid valves and five shift solenoid valves.

The shift solenoid valves S1-S5 are either in the 'open' or 'closed' state.

The control valves (SLT and SLS) regulate the hydraulic pressure in accordance with the duty cycle of the electrical PWM signal. The controlled hydraulic pressure enables smooth shifting or the generation of a defined slip through actuation of the relevant clutches and brakes.

The control valve (SLU) regulates the hydraulic pressure in accordance with the duty cycle of the electrical PWM signal. It controls the torque converter clutch. The PWM control achieves smooth engagement of the gears.

The shift timing is calculated by the TCM using the accelerator pedal position and vehicle speed.

Under normal conditions, the gears are shifted and the torque converter lockup is activated at low engines speeds in order to reduce the fuel consumption.

If the accelerator pedal is pressed down quickly, the TCM switches automatically into kickdown mode.

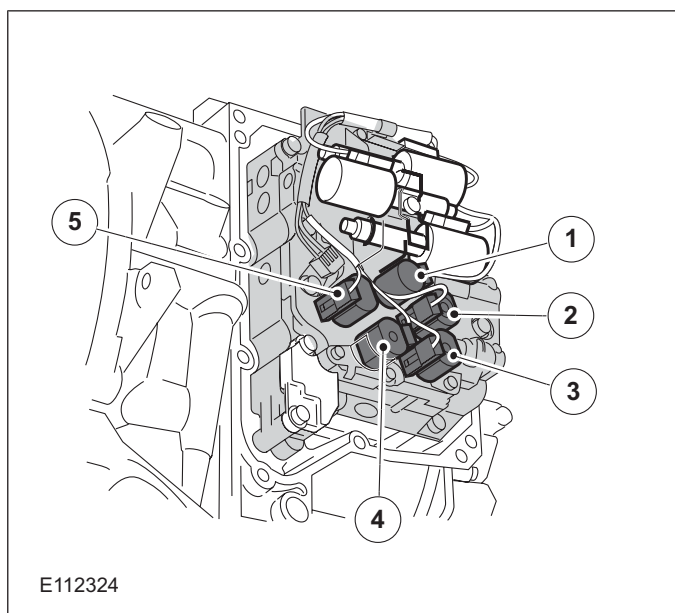
**DESCRIPTION AND OPERATION**

**Function of the shift solenoid valves in the gears and when shifting gears**

Gear	S1	S2	S3	S4	S5
Park	—	—	—	—	—
R (V<=7)	—	—	0	—	0
R (V>7)	0	—	—	—	—
N	—	—	—	—	—
1	0	0	0	—	—
1<=>2	—	—	0	—	—
2	—	—	0	—	—
2<=>3	—	—	0	0	0
3	—	—	0	0	—
3<=>4	—	—	—	0	0
4	—	—	—	0	—
4<=>5	—	0	—	0	—
5	—	0	—	0	—

- V = Road speed in km/h
- 0 = Actuated
- — = Not actuated
- x<=>x = Gear change "up/down"

**Shift solenoids S1 - S5**



Item	Description
4	Shift solenoid S5
5	Shift solenoid S2

Shift solenoids S1, S2, S3, S4 and S5 are located in the control valve assembly on the front of the transmission.

**Function**

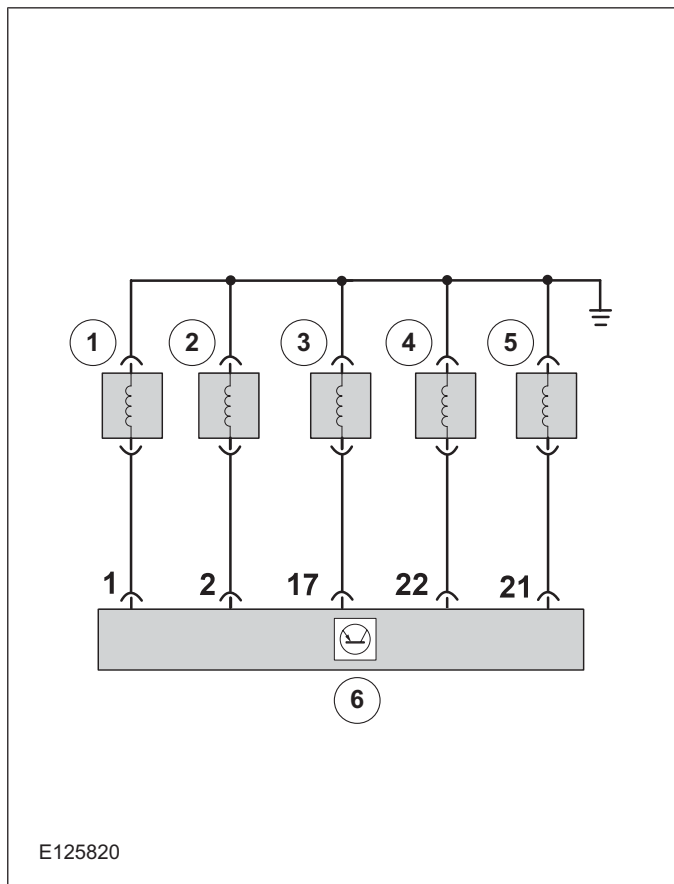
The shift solenoid valves are actuated by the TCM. The shift solenoid valves S1 and S4 are fully open when de-energized. The shift solenoid valves S2, S3, and S5 are fully closed when de-energized.

They control gearshifting, while the TCM decides which gear should be engaged by activating the shift solenoid valves in different combinations.

**Consequences of signal failure**

Item	Description
1	Shift solenoid S1
2	Shift solenoid S4
3	Shift solenoid S3

DESCRIPTION AND OPERATION



Item	Description
1	Shift solenoid S1
2	Shift solenoid S2
3	Shift solenoid S3
4	Shift solenoid S4
5	Shift solenoid S5
6	TCM connector 'C'

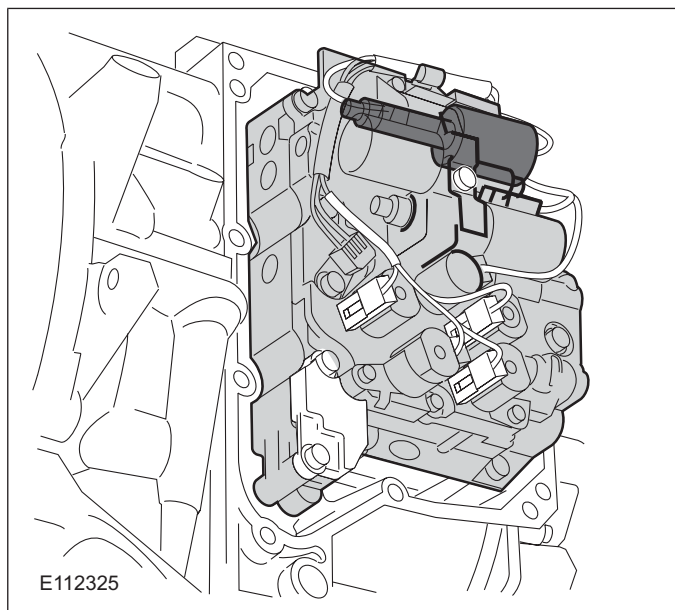
If a shift solenoid valve fails, the MIL is activated and the vehicle can be driven in the appropriate emergency mode.

Failure of the shift solenoids

Component	Reason	MIL	Emergency function
Shift solenoid S1	Short B+ / open circuit	On	Emergency Mode 1
	Short B-		No 1st gear / no N-D control
Shift solenoid S2	Short B+ / open circuit	On	Emergency Mode 1
	Short B-		No 1st or 5th gear
Shift solenoid S3	Short B+ / open circuit	On	Emergency Mode 2
	Short B-		Emergency Mode 4
Shift solenoid S4	Short B+ / open circuit	On	Emergency Mode 1
	Short B-		
Shift solenoid S5	Short B+ / open circuit	On	Emergency Mode 1
	Short B-		

**DESCRIPTION AND OPERATION**

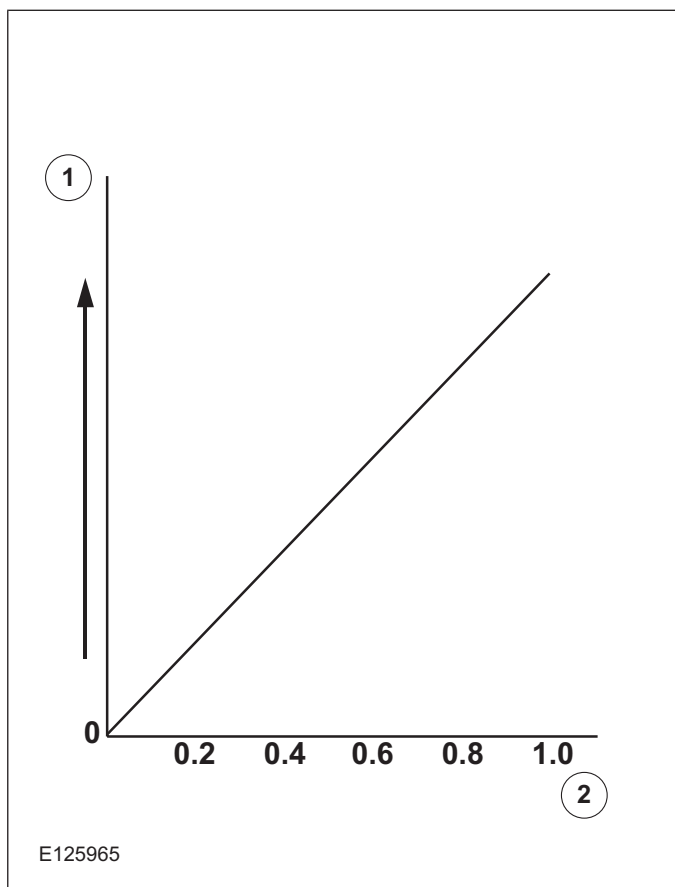
**PWM- solenoid valve – TCC (SLU)**



**Installation position**

The PWM solenoid valve for the TCC (SLU) is located in the valve body on the front of the transaxle.

**Function**



Item	Description
1	Hydraulic pressure
2	Average current (A)

The valve actuates the torque converter clutch as well as the reverse gear brake (B3) and 2nd - 5th gear brake (B2). The PWM control achieves smooth engagement of the gears. The two brakes are actuated in 1st and 2nd gear to guarantee engine braking.

The valve also actuates the torque converter in such a way that it works in three positions: 'open', 'controlled looping (slip lock-up mode)', and 'locked (full lock-up mode)'. The hydraulic function of the valve is linear.

In lockup mode the TCC is closed. The impeller and the turbine of the torque converter are friction locked. The engine torque acts directly on the transmission input shaft. Fuel consumption is reduced due to a reduction in the torque converter pump losses.

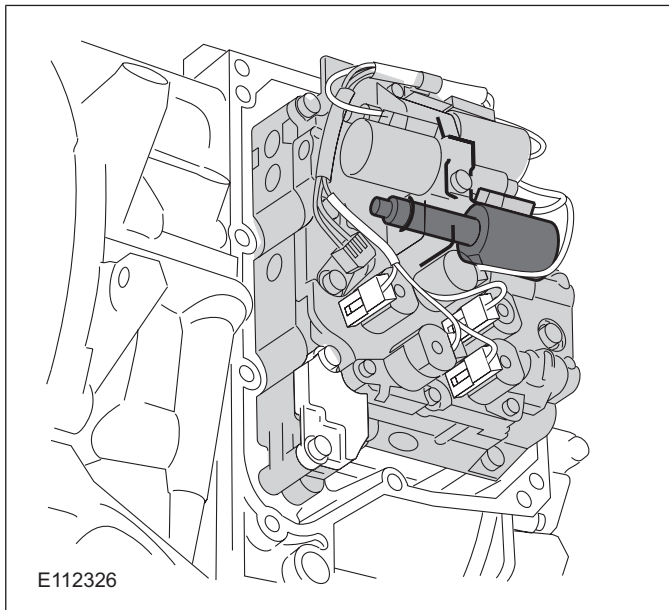
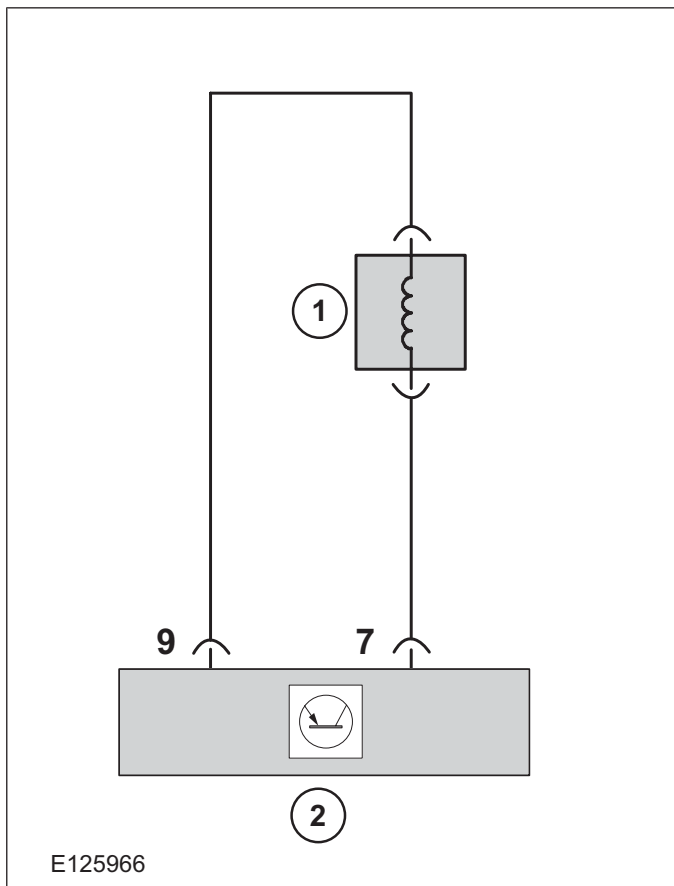
In slip lock-up mode, slip in the TCC is permitted in order to improve driving comfort. The hydraulic pressure acting on the TCM varies in accordance with the duty signal of the actuation signal generated by the PWM for the TCC solenoid valve for the TCC (SLU). The temperature of the transmission fluid increases in slip mode.

**Consequences of signal failure**



DESCRIPTION AND OPERATION

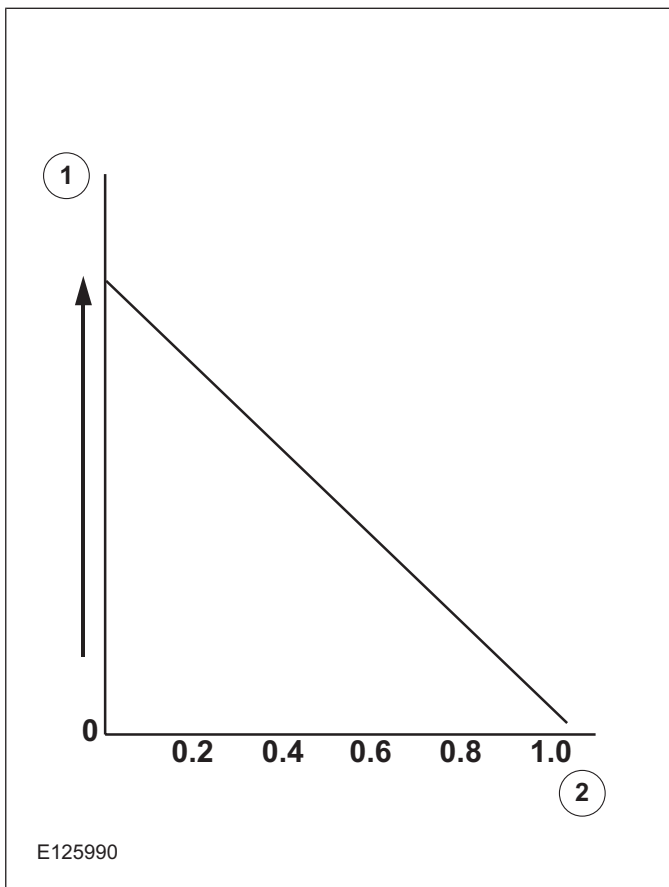
PWM solenoid valve – shift pressure (SLS)



Installation position

The PWM solenoid valve for shift pressure (SLS) is located in the valve body on the front of the transaxle.

Function



Item	Description
1	PWM- solenoid valve – TCC (SLU)
2	TCM connector 'C'

If the PWM solenoid valve for the TCC (SLU) fails, the MIL is activated and the vehicle can be driven in emergency mode 1.

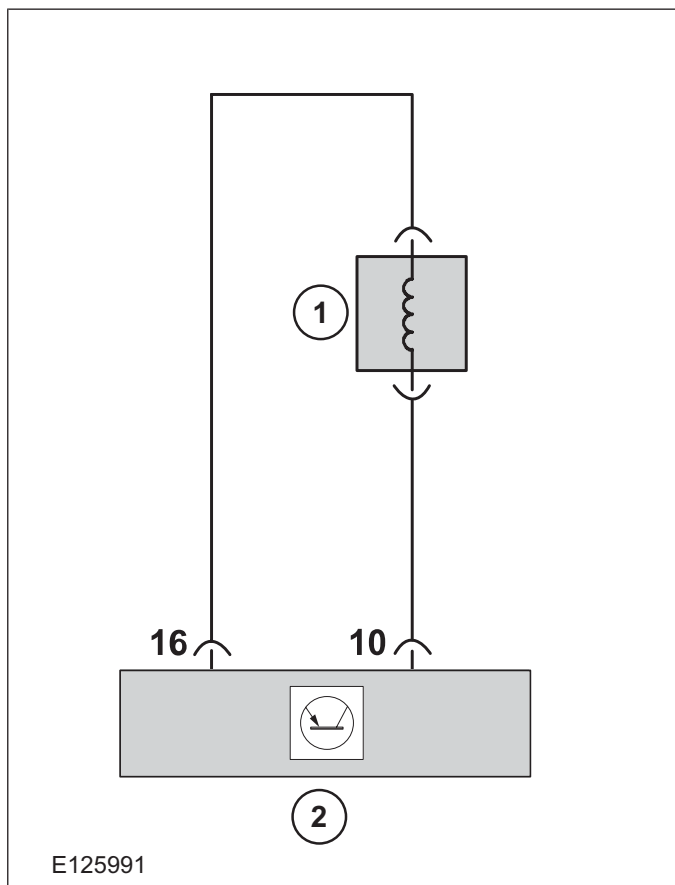
**DESCRIPTION AND OPERATION**

Item	Description
1	Hydraulic pressure
2	Average current (A)

The valve directly actuates the multi-plate brake (B1) in 2nd - 4th gear as well as the clutch (C2) in 5th and reverse gear. The PWM control achieves smooth engagement of the gears.

The hydraulic function of the valve is linear. The hydraulic valve is controlled by means of the varying current resulting from the current duty cycle. The system pressure is low with a high duty cycle, i.e. with high current intensity (approx. 1 A), and vice versa.

**Consequences of signal failure**

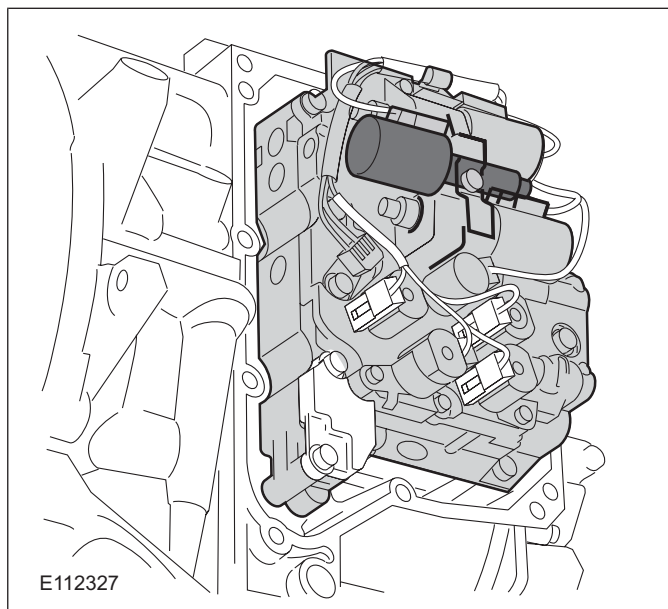


Item	Description
1	PWM solenoid valve – shift pressure (SLS)
2	TCM connector 'C'

The shift pressure increases to the maximum value in the event of interruptions, which leads to hard gearshifts when shifting to another gear. The valve is then fully open.

If the PWM solenoid valve for shift pressure (SLS) fails, the MIL is activated and the vehicle can be driven in emergency mode 3.

**PWM solenoid valve for main line pressure (SLT)**

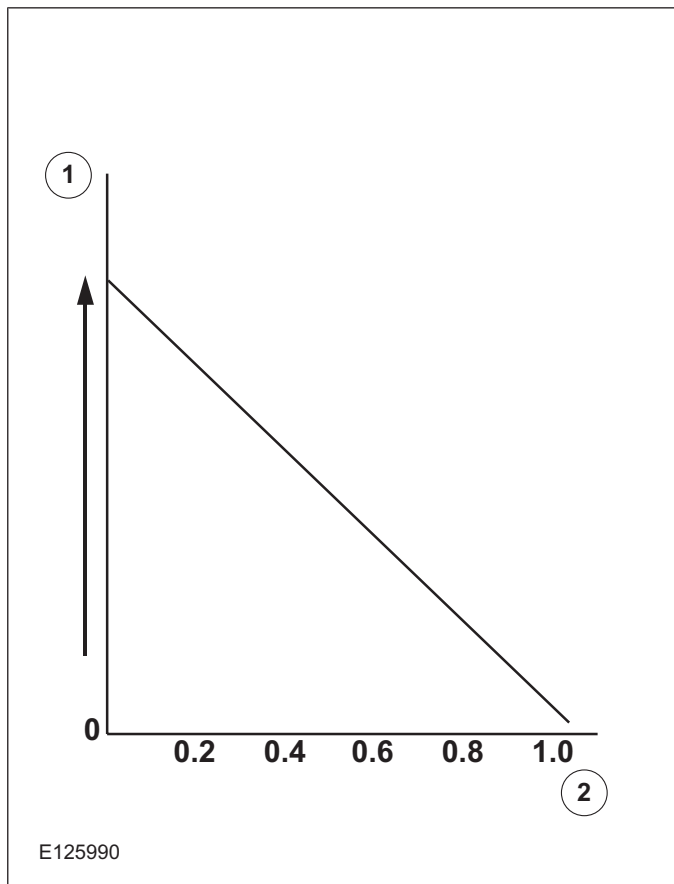


**Installation position**

The PWM solenoid valve – main line pressure (SLT) is located in the control valve assembly on the front of the transmission.

**Function**

DESCRIPTION AND OPERATION



Item	Description
1	Hydraulic pressure
2	Average current (A)

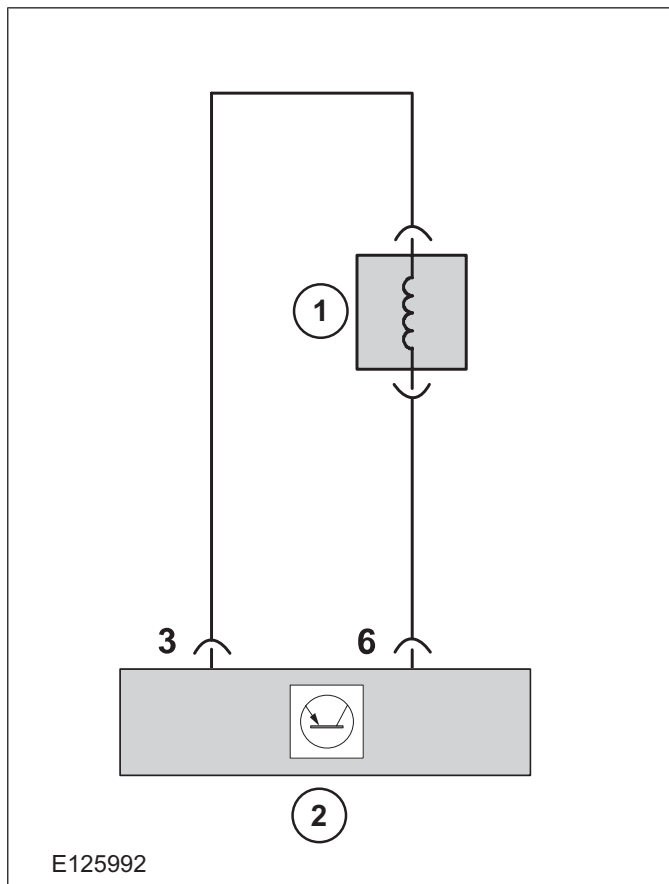
The PWM solenoid valve for main line pressure (SLT) is actuated proportionally by the TCM.

The TCM evaluates the accelerator pedal position and the current engine torque.

The main line pressure is adapted proportionally by the TCM via the PWM solenoid valve. This measure enables judder-free gearshifts.

The PWM solenoid valve is open when de-energized. In the case of faults and failure of the control system, the PWM solenoid valve remains fully open. The maximum main line pressure is applied.

**Consequences of signal failure**



Item	Description
1	PWM solenoid valve for main line pressure (SLT)
2	TCM connector 'C'

The system pressure increases to the maximum value in the event of interruptions, which leads to hard gearshifts when shifting to another gear. The valve is then fully open.

If the PWM solenoid valve – main line pressure (SLT) fails, the MIL is activated and the vehicle can be driven in emergency mode 1.

**TCC**

**Installation position**

The TCC is an integral component of the torque converter.

**Operation**

The TCM controls the PWM via the TCC solenoid valve for the TCC (SLU). Based on the signals for engine speed and accelerator pedal position as

## DESCRIPTION AND OPERATION

well as vehicle speed, driving comfort is improved by linear actuation of the TCC.

### Selector lever with integrated select-shift switch module



E112332

The selector lever unit is located in the central console. It is mechanically connected to the transmission by a selector cable which moves the gear selector shaft in the TR sensor.

The following components are integrated in the selector lever assembly:

- Select-shift switch module
- Selector lever lock solenoid.
- Switch contact for selector lever position 'P'
- LED for the selector lever position display

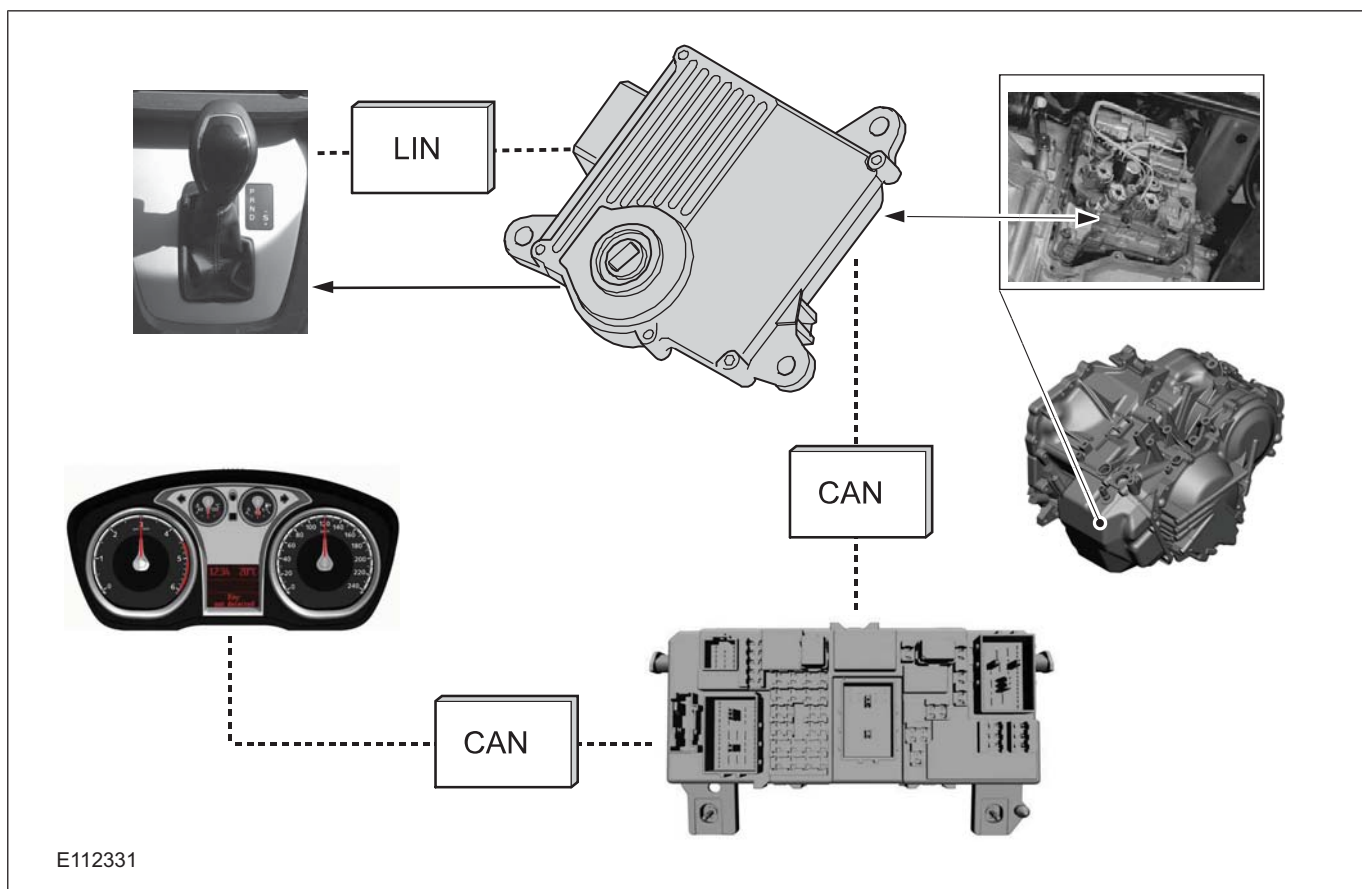
The selector lever has the following positions:

- P: Park position
- R: Reverse gear.
- N: Neutral position
- D: Automatically shift between all gears
- S: Sport and select-shift mode (manual gear changing)

If the selector lever is not in the 'P' position when the vehicle is exited, a signal is transmitted to the instrument cluster via the switch contact for selector lever position 'P'. When the driver door is opened, a message to move the selector lever to the 'P' position appears in the instrument cluster and the warning buzzer sounds. The vehicle cannot be electrically locked if the selector lever is not moved to the 'P' position.

DESCRIPTION AND OPERATION

Overview of the select-shift switch module



The select-shift switch module is located on the upper trim of the selector lever unit. The module is supplied with power by the TCM.

It uses the LIN databus to interact with the TCM, for instance to activate the selector lever position display.

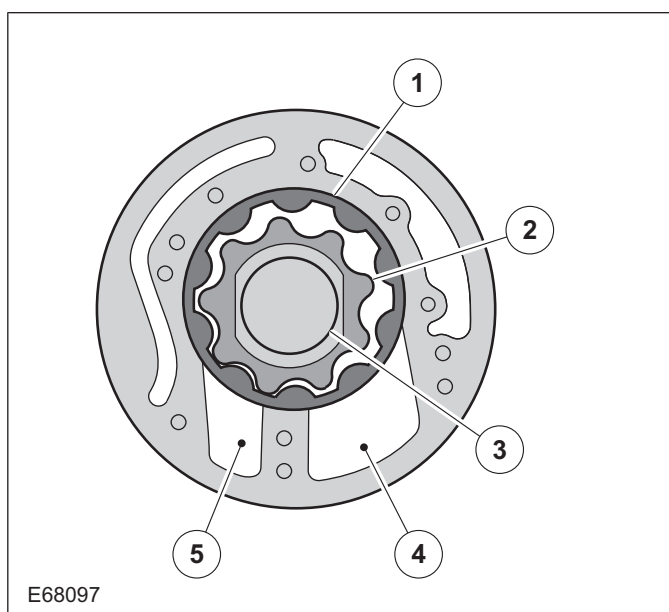
It allows the automatic transmission gears to be changed up and down manually via the signals of the Hall sensors.

The select-shift switch module detects the selector lever position 'P' and 'S' via the integrated selector lever position sensors (Hall sensors).

A cable leading from the TCM passes directly to the select-shift switch module and is used to control the solenoid of the selector lever lock. The switching solenoid receives its voltage supply directly from the module.

In the event of a fault, a signal is transmitted to the TCM where all DTCs are stored.

Oil pump



Item	Description
1	Fluid pump rotor, outer
2	Fluid pump rotor, inner



**DESCRIPTION AND OPERATION**

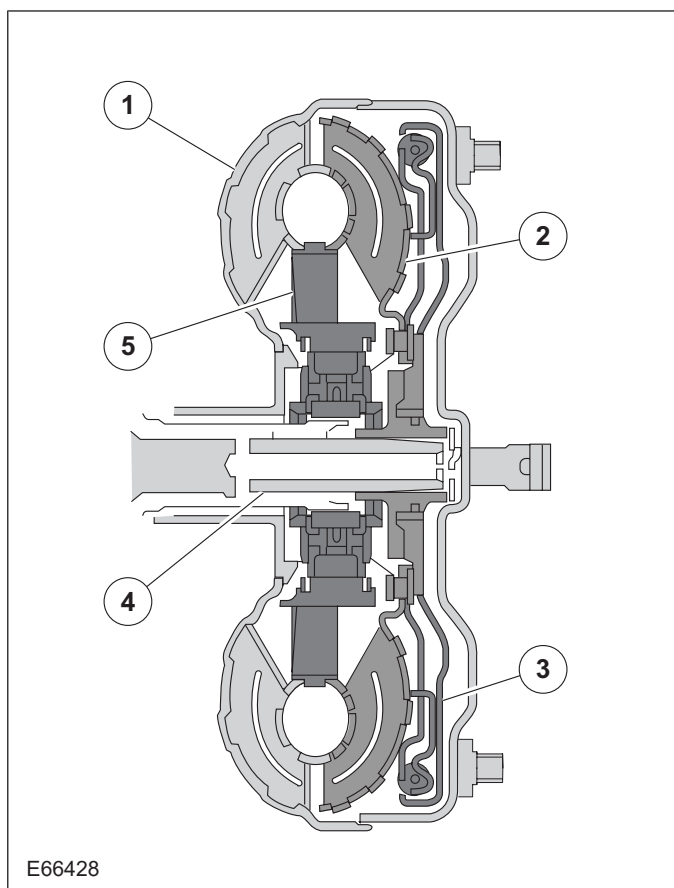
Item	Description
3	Drive
4	Intake side
5	Delivery side

The fluid pump operates on the principle of a G-rotor fluid pump.

The fluid pump draws transmission fluid from the fluid pan, builds up fluid pressure and then supplies it to the valve body.

The fluid pump is driven by the crankshaft via the torque converter housing.

**Torque converter with TCC**



Item	Description
1	Torque converter housing and impeller
2	Turbine
3	TCC
4	Transaxle input shaft
5	Stator with roller-type one-way clutch

The torque converter transmits the output torque hydraulically from the engine to the transaxle input shaft.

The stator increases the torque up to the clutch take-up point. At the clutch take-up point, the speed difference between impeller and turbine is approximately 90 %.

In order to improve the efficiency, the torque converter features a hydraulically-activated TCC.

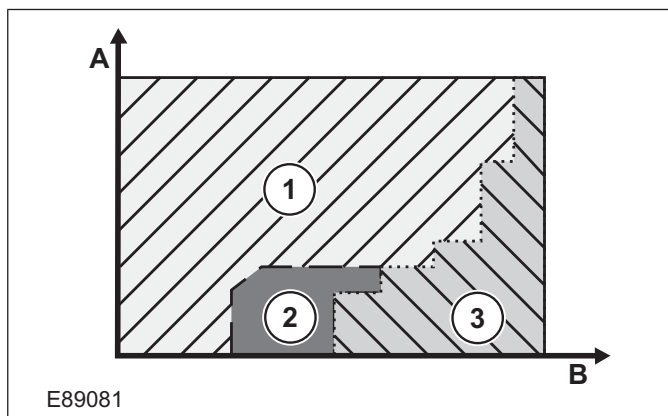
When the TCC is engaged, the torque is transmitted directly from the crankshaft via the torque converter housing to the transaxle input shaft.

**Installation position**

The TCC is an integral component of the torque converter.

**Function**

The TCM controls the PWM via the TCC solenoid valve for the TCC (SLU). Based on the signals for engine speed and accelerator pedal position as well as vehicle speed, driving comfort is improved by linear actuation of the TCC.



Item	Description
A	APP (accelerator pedal position)
B	Vehicle speed
1	TCC disengaged
2	Slip lock-up mode
3	Full lock-up mode

**Full lock-up mode**

In lockup mode the TCC is closed. The impeller and the turbine of the torque converter are friction locked. The engine torque acts directly on the transmission input shaft. Fuel consumption is reduced due to a reduction in the torque converter pump losses.

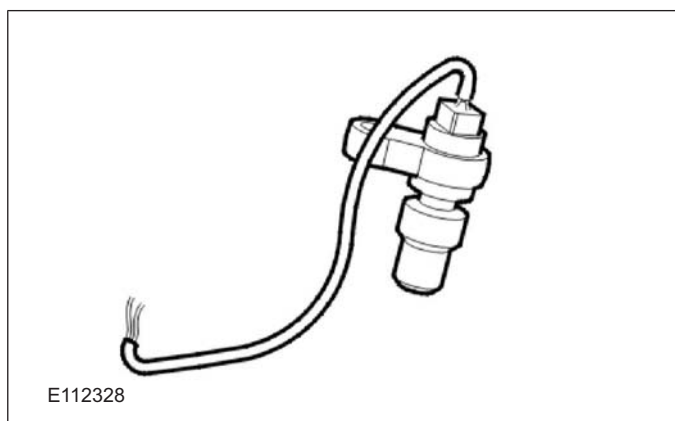
**DESCRIPTION AND OPERATION**

Full lock-up mode of the TCC is not generated at engine temperatures below 20 °C (68 °F).

**Slip lock-up mode**

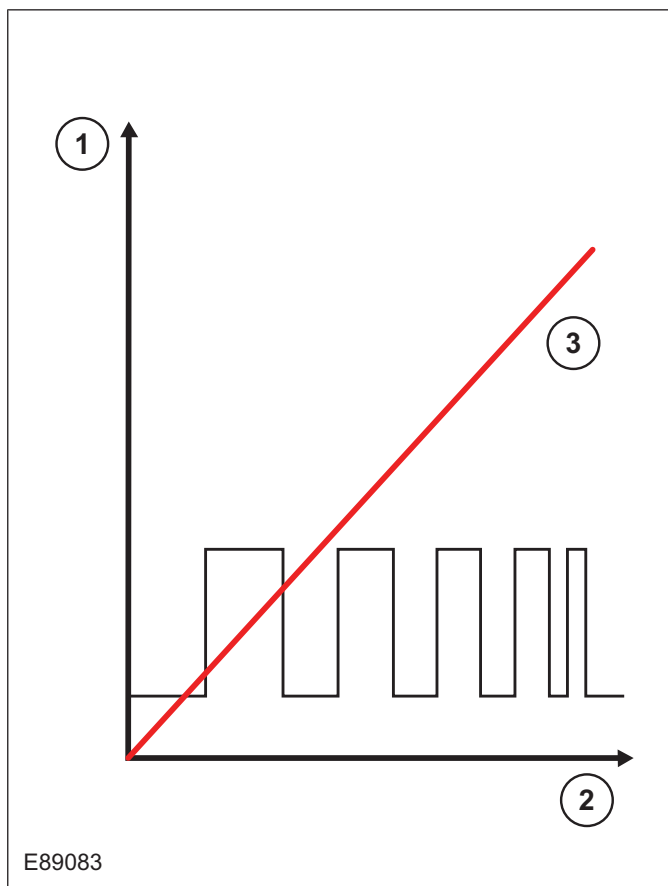
In slip lock-up mode, slip in the TCC is permitted in order to improve driving comfort. The hydraulic pressure acting on the TCM varies in accordance with the duty signal of the actuation signal generated by the PWM for the TCC solenoid valve for the TCC (SLU). The automatic transaxle temperature increases in slip lock-up mode.

**The TSS sensor**



The TSS sensor is mounted at the top of the transmission housing. It is an active sensor and is supplied with 12 V.

**Function**



E89083

Item	Description
1	Signal voltage
2	Signal frequency
3	Transmission input shaft speed

The TSS sensor is a Hall sensor. It generates a square-wave signal, the frequency of which varies depending upon the speed of the transmission input shaft.

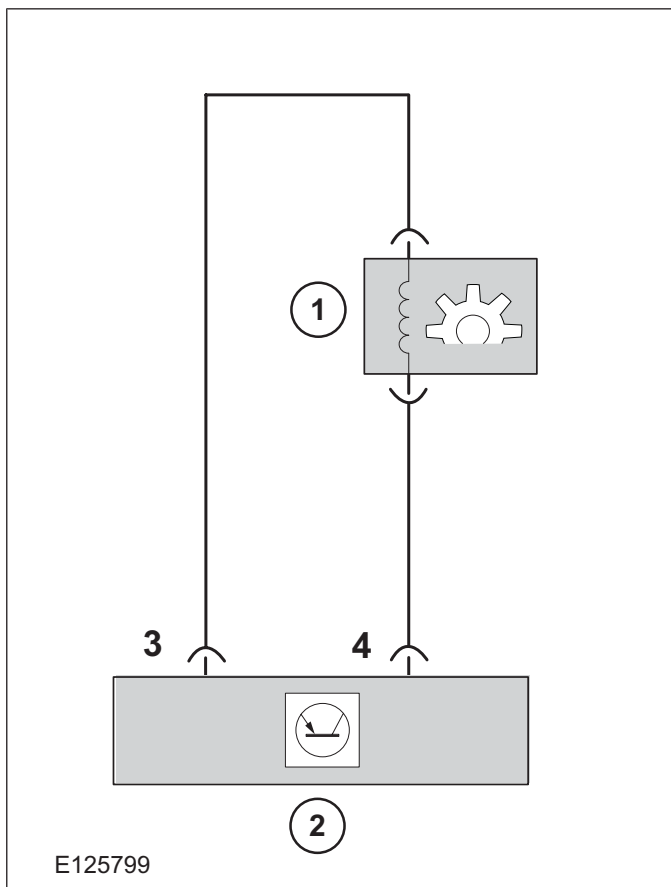
The frequency of the square-wave signal increases with the transmission input shaft speed. The TSS sensor picks up the speed at the housing of the 1st - 5th gear clutch (C1).

The TCM uses the information from the TSS sensor to determine the following parameters:

- Calculation of the torque reduction that needs to be requested by the PCM during shifting.
- Comparison of engine speed with transmission input shaft speed for calculation of torque converter slip.
- Calculation of the shift points.
- Calculation of the engaging and disengaging point for the TCC (lock-up function).
- Calculation of the current gear ratios by comparison of the OSS sensor signal.

**DESCRIPTION AND OPERATION**

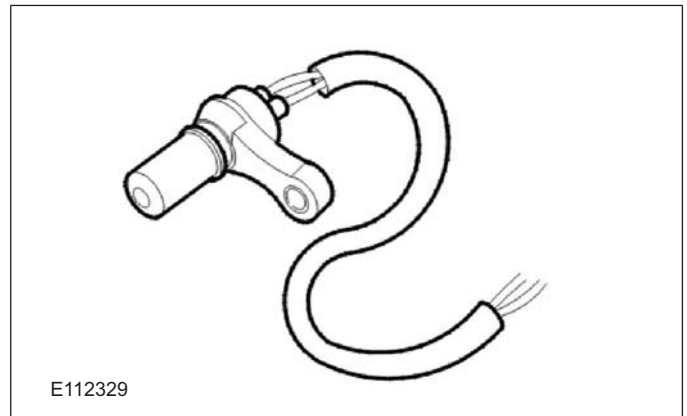
**Consequences of signal failure**



Item	Description
1	The TSS sensor
2	TCM connector 'B'

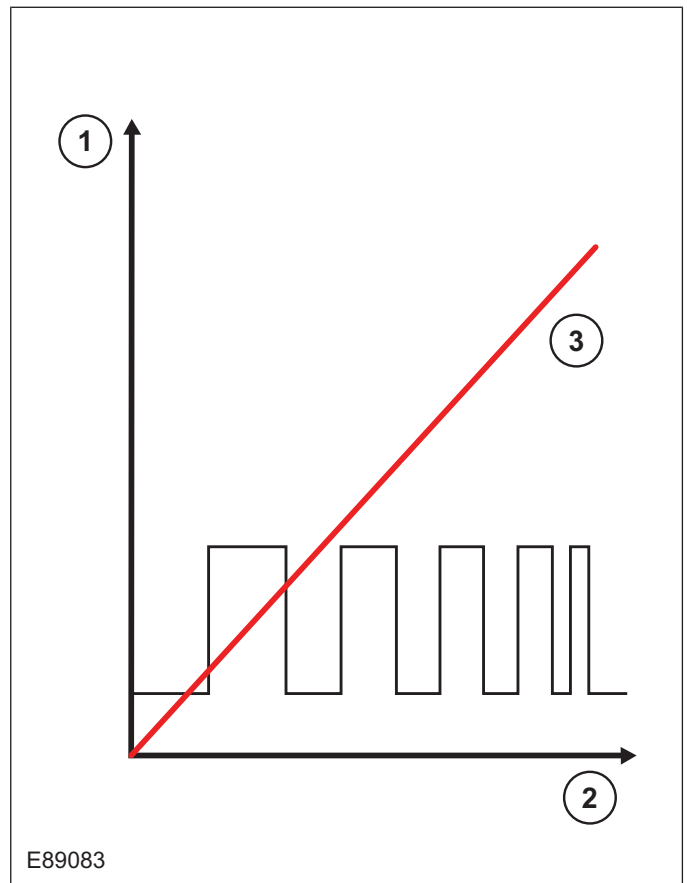
- Emergency mode 1
- Torque limitation is activated in order to protect the transaxle components from damage.
- The engine speed serves as a substitute value.
- When the engine is restarted (ignition switched off for approx. 15 seconds), the transaxle is no longer in limp home mode. There is no longer a fault indication on the instrument cluster, and the MIL is off. However, the fault remains stored in the TCM. If the fault is still present, limp home mode is reactivated.

**The OSS sensor**



The OSS sensor is located at the rear of the transmission casing. It supplies signals about the transaxle output speed to the TCM.

**Function**



Item	Description
1	Signal voltage
2	Signal frequency
3	Transmission input shaft speed

The OSS sensor is a Hall sensor. The OSS sensor generates a square-wave signal, the frequency of which varies depending upon the speed of the

## DESCRIPTION AND OPERATION

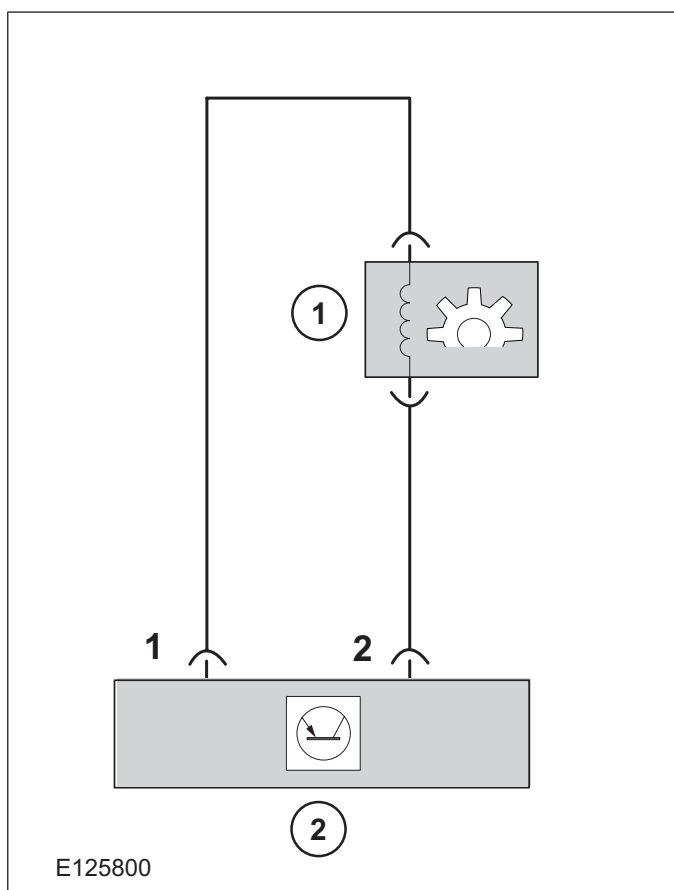
transaxle output shaft. The frequency of the square-wave signal increases with the speed of the transmission output shaft.

The OSS sensor picks up the speed at the gear of the parking lock.

The TCM uses the information from the OSS sensor for the following parameters:

- Calculation of the degree of torque reduction that needs to be requested by the PCM during shifting.
- Calculation of the shift points.
- Calculation of the engaging and disengaging point for the TCC (lock-up function).
- Calculation of the current gear ratios by comparison of the TSS sensor signal.

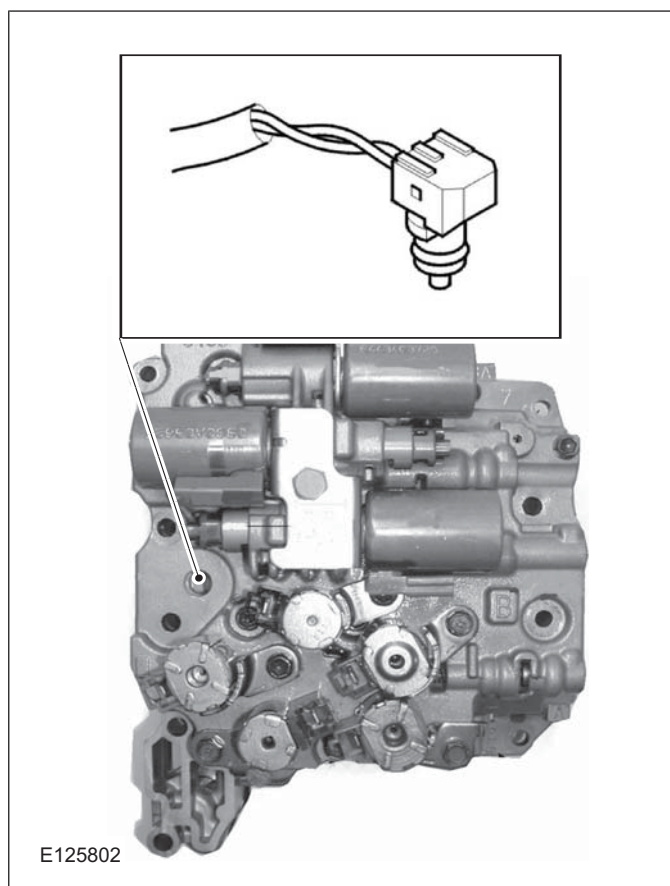
### Consequences of signal failure



Item	Description
1	The OSS sensor
2	TCM connector 'B'

- The torque converter lockup and adaptation functions are deactivated.
- The wheel speed signal is transmitted by the ABS to the TCM via the HS-CAN data bus. This signal serves as a substitute value.
- When the engine is restarted (ignition switched off for approx. 15 seconds), the transaxle is no longer in limp home mode. There is no longer a fault indication on the instrument cluster, and the MIL is off. However, the fault remains stored in the TCM. If the fault is still present, limp home mode is reactivated.

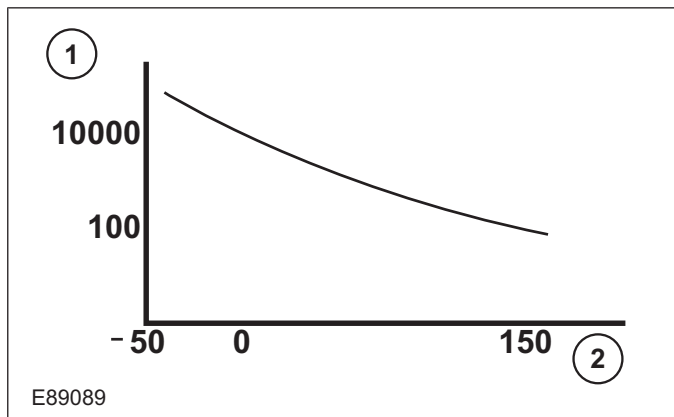
### The TFT sensor



The TFT sensor is located in the valve body and is an integral component of the internal transaxle wiring harness.

### Function

DESCRIPTION AND OPERATION



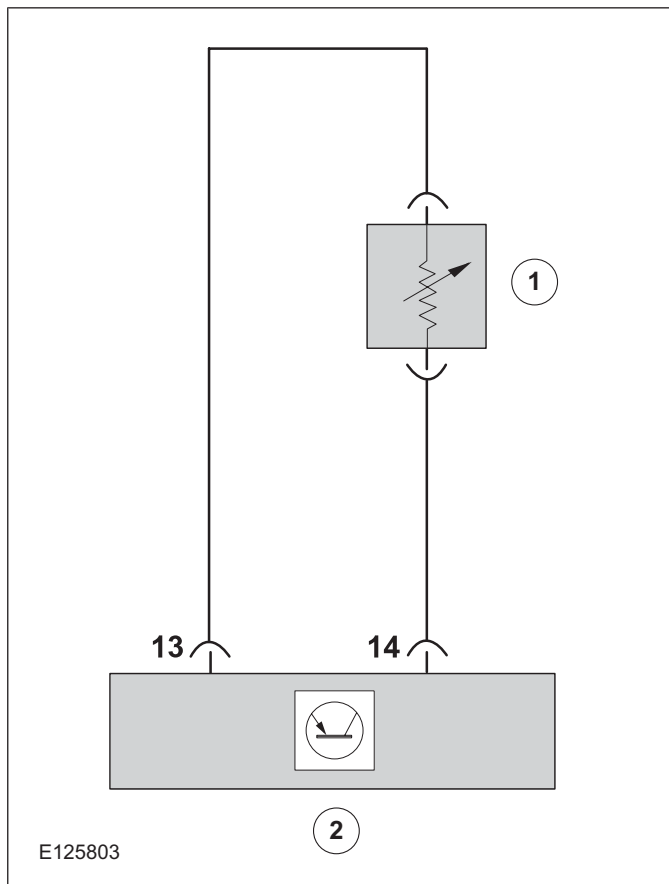
Item	Description
1	Resistance (Ohms)
2	Temperature (°C)

The sensor is an NTC (negative temperature coefficient) (negative temperature coefficient) sensor. The voltage supply is 5 V. The transmission fluid temperature is detected by measuring the voltage drop across the NTC resistor.

The TCM uses the transmission fluid temperature information for the following calculations:

- Transaxle shift points
- If the transmission fluid temperatures are too high, slip lock-up of the TCC is prevented.

Consequences of signal failure



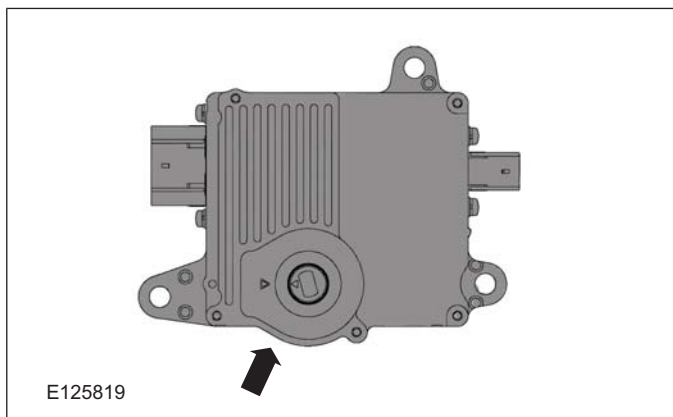
Item	Description
1	The TFT sensor
2	TCM connector 'C'

- No activation of TCC slip lock-up mode.
- No activation of TCC full lock-up mode.
- The MIL is activated.
- When the engine is restarted (ignition switched off for approx. 15 seconds), the transaxle is no longer in limp home mode. There is no longer a fault indication on the instrument cluster, and the MIL is off. However, the fault remains stored in the TCM. If the fault is still present, limp home mode is reactivated.
- If the sensor fails, a temperature substitute value of 30 °C (86 °F) is initially assumed. After 15 minutes driving, the substitute value is raised to 111 °C.



## DESCRIPTION AND OPERATION

### The TR sensor



The TR sensor and the TCM form one unit. This unit is located at the top of the transmission casing, on the gear linkage.

### Function

The TR sensor has three separate functions:

- Transmit a signal to the TCM about the selected transmission range.
- To transmit the signal to switch on the reversing lamps to the GEM when the selector lever is in the 'R' position.
- To transmit the start enable signal to the PCM when the selector lever is in the 'P' or 'N' position.

The TR sensor contains a permanent magnet and a linear Hall detector. It produces a signal voltage between 0 and 5 V. This signal voltage corresponds to the selector lever position currently chosen.

Voltage values for the different gears:

- P approximately 0.65 V
- R approximately 1.64 V
- N approximately 2.12 V
- D approximately 2.49 V

### Consequences of signal failure

If the TR sensor fails, the MIL is activated and the vehicle can be driven in emergency mode 4. The vehicle can no longer be started for safety reasons after the ignition is switched off because the TCM does not detect the current transmission range.

If a shift solenoid valve fails, the MIL is activated and the vehicle can be driven in the appropriate emergency mode.

GENERAL PROCEDURES

Transmission Fluid Level Check

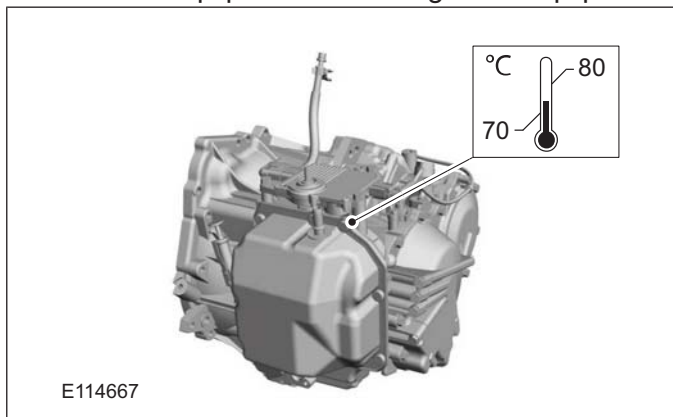
General Equipment

Ford Diagnostic Equipment	
---------------------------	--

Materials	
Name	Specification
Automatic Transmission Oil E-AW	WSS-M2C924-A / 4U7J-M2C924-AA

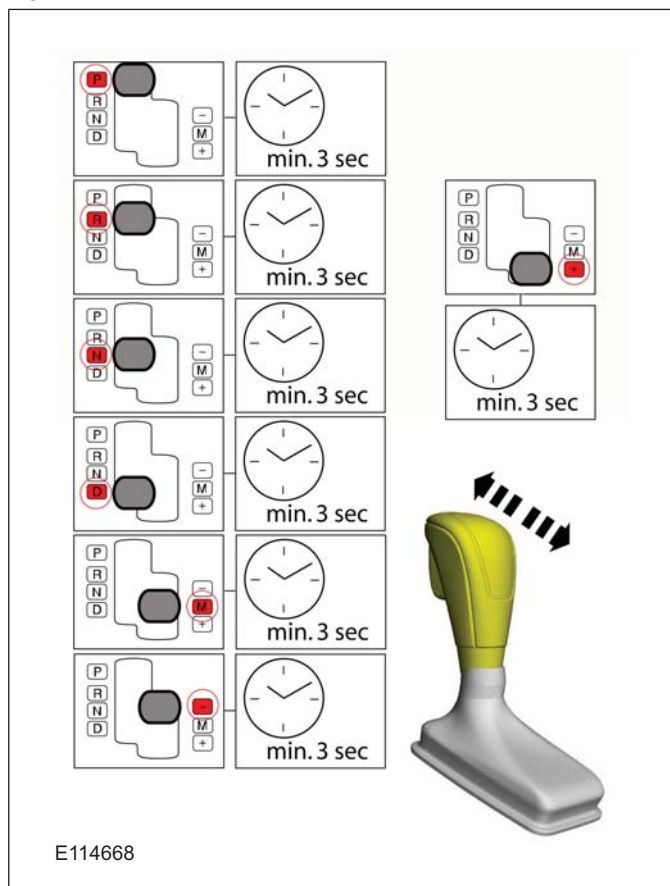
Inspection

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Connect the Ford diagnostic equipment.  
General Equipment: Ford Diagnostic Equipment
3. Make sure that the transmission is not in emergency operation mode.
4. Make sure that the transmission fluid temperature is between 70° and 80°C.  
General Equipment: Ford Diagnostic Equipment

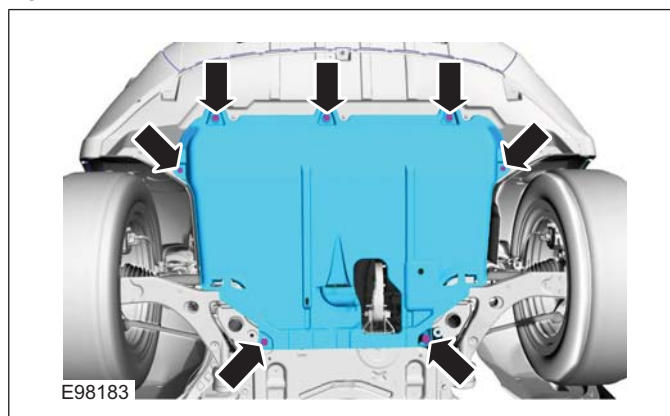


5. **WARNING:** Make sure that the brake pedal and parking brake are fully applied during the test.  
Start and run the engine at idle.

6.

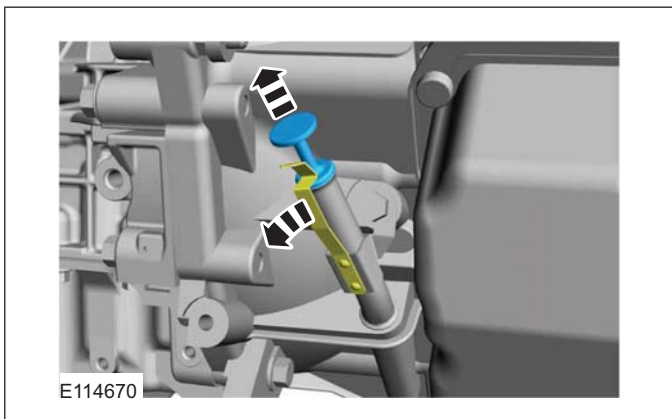


7. **NOTE:** Make sure that the selector lever and the gearshift mechanism are in the park (P) position.
8. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
- 9.

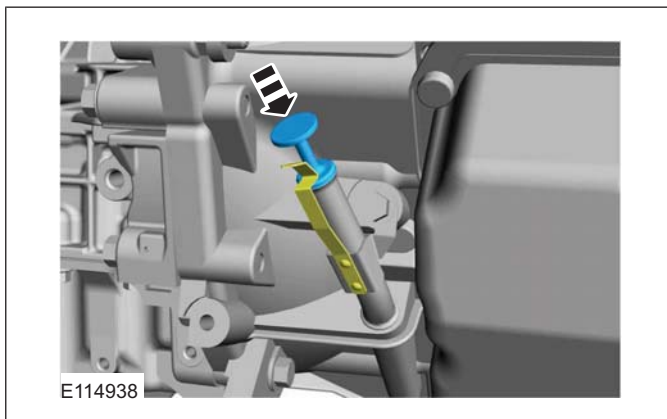


GENERAL PROCEDURES

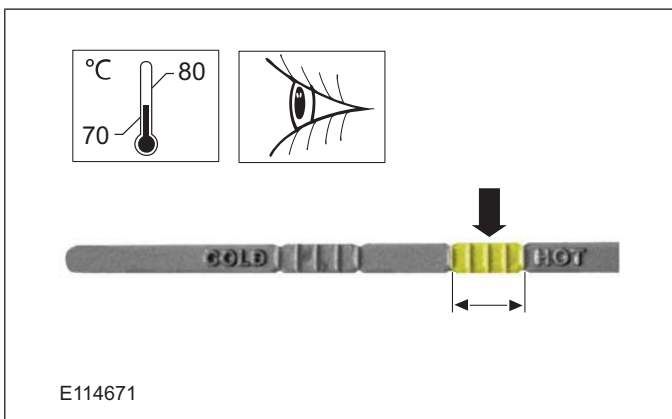
10.



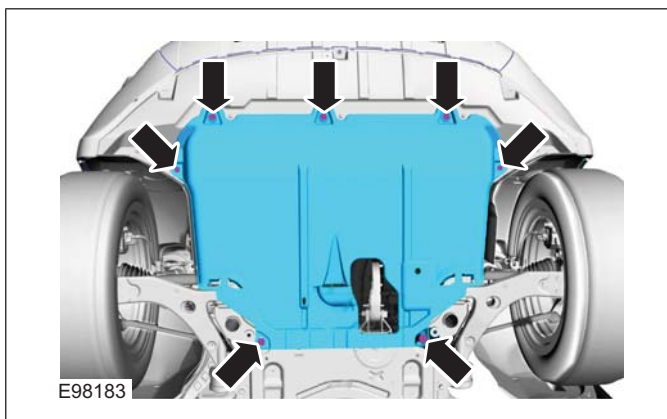
13.



11. **CAUTION:** Use lint free cloth.



14.



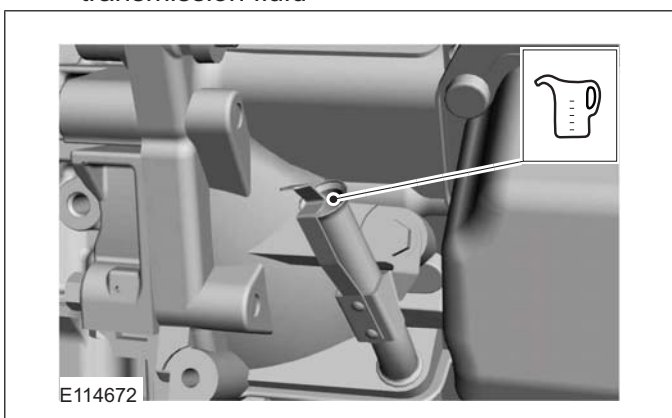
12 Adjust the fluid level in the automatic transmission if necessary.

Material: Automatic Transmission Oil E-AW (WSS-M2C924-A / 4U7J-M2C924-AA) transmission fluid

15. Switch off the engine.

16. Disconnect the Ford diagnostic equipment.

General Equipment: Ford Diagnostic Equipment



GENERAL PROCEDURES

Transmission Fluid Drain and Refill

General Equipment

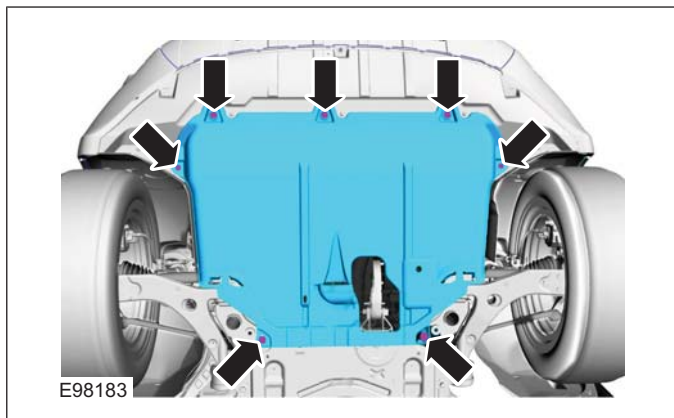
Fluid Container	
<b>Materials</b>	
<b>Name</b>	<b>Specification</b>
Automatic Transmission Oil E-AW	WSS-M2C924-A / 4U7J-M2C924-AA

Draining

17. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).

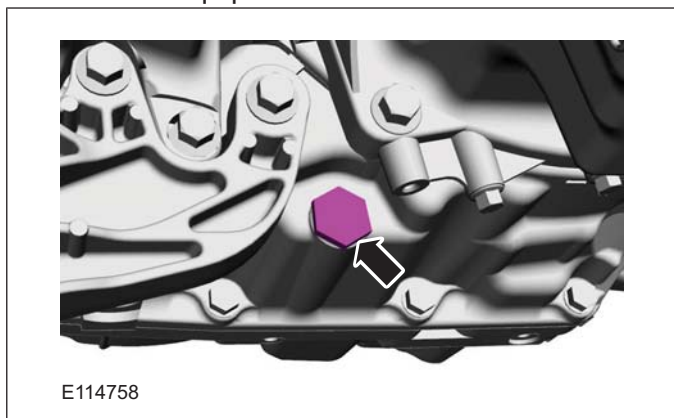
18. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

19.

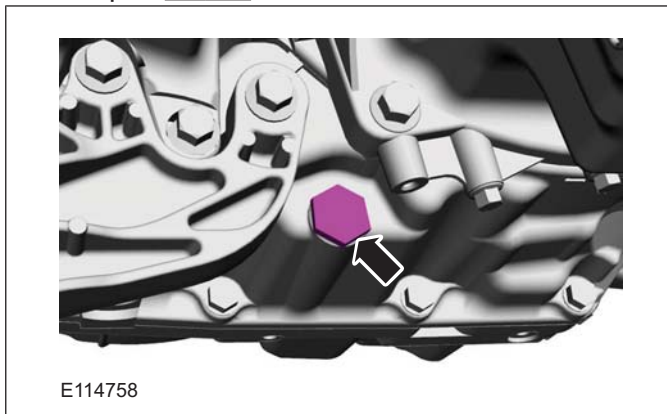


20. **WARNING:** Be prepared to collect escaping fluid.

General Equipment: Fluid Container

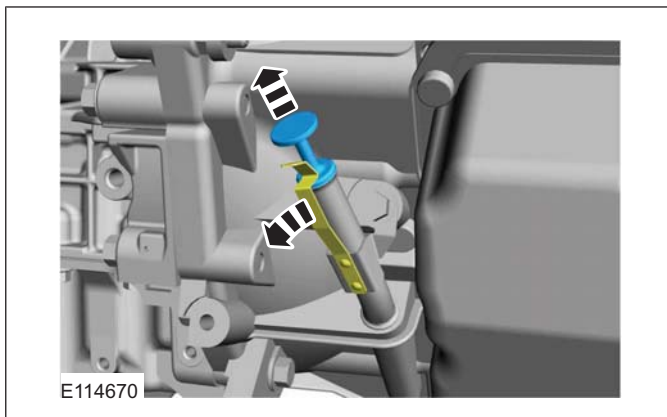


21. Torque: 40 Nm

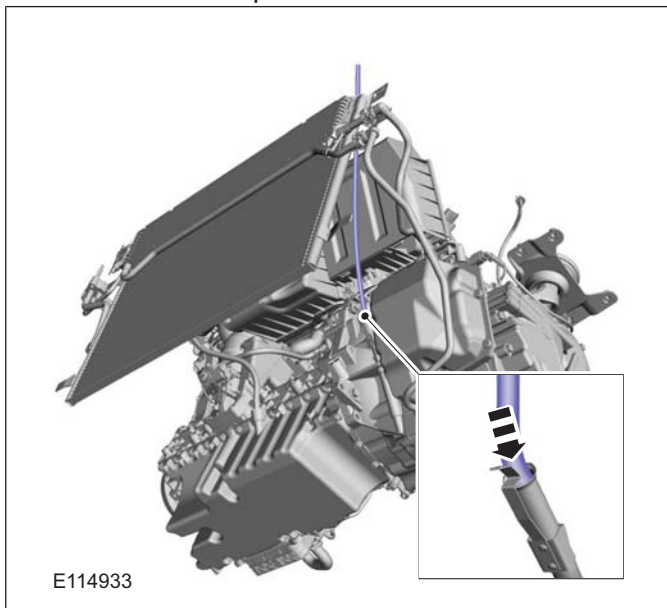


Filling

22



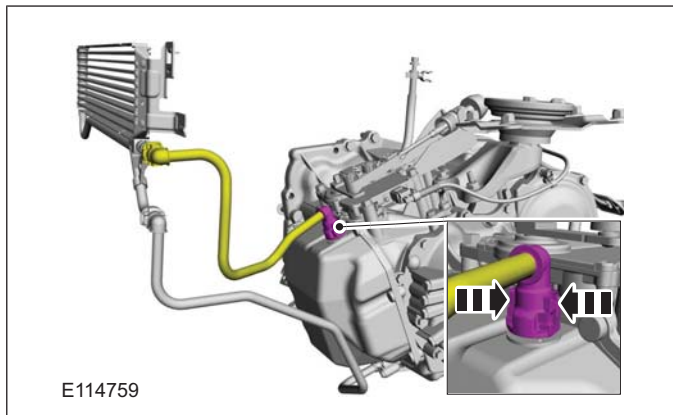
23. Use a suitable plastic tube.



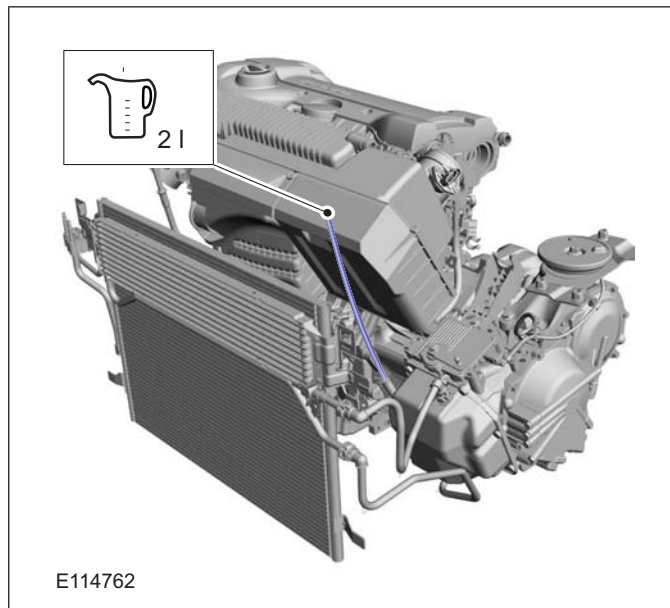


GENERAL PROCEDURES

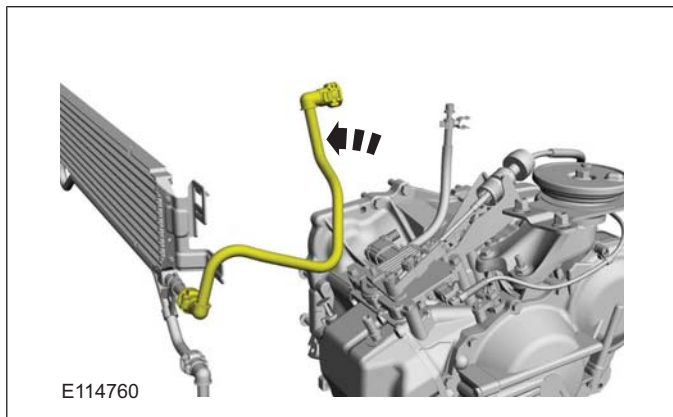
24.  **CAUTION:** Make sure that all openings are sealed.



27. Material: Automatic Transmission Oil E-AW (WSS-M2C924-A / 4U7J-M2C924-AA) transmission fluid



25.



28. **NOTE:** Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

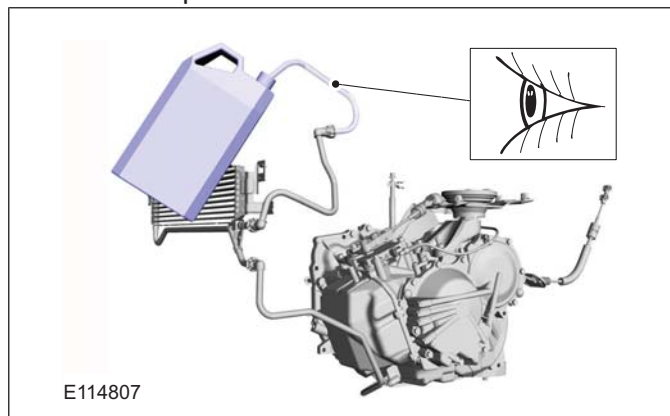
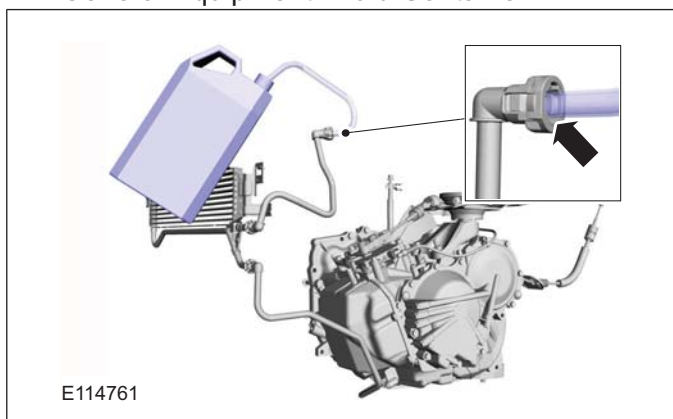
29. Start and run the engine at idle.

30. Switch off the engine, if bubbles are visible in the clear plastic tube.

26.  **CAUTION:** Take extra care not to damage the seal.

Use a suitable clear plastic tube.

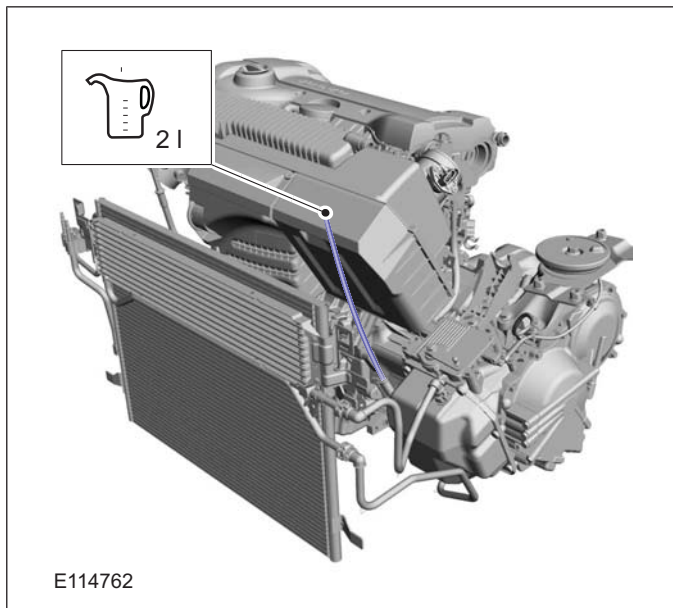
General Equipment: Fluid Container



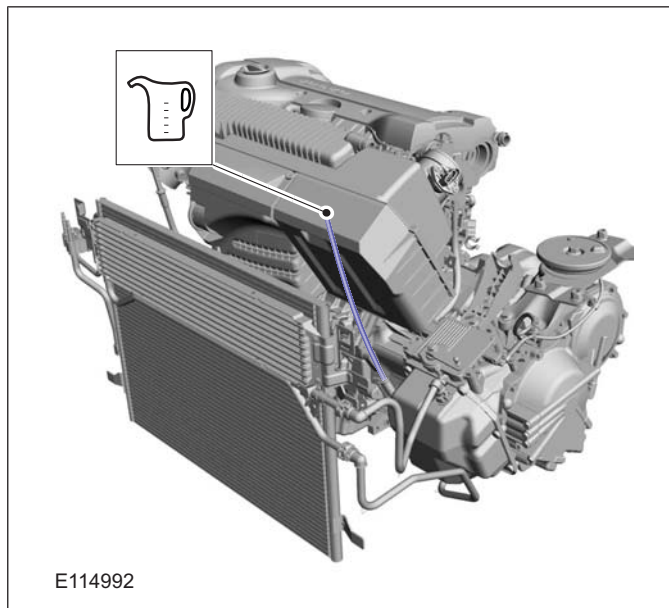


**GENERAL PROCEDURES**

**31.** Material: Automatic Transmission Oil E-AW (WSS-M2C924-A / 4U7J-M2C924-AA) transmission fluid

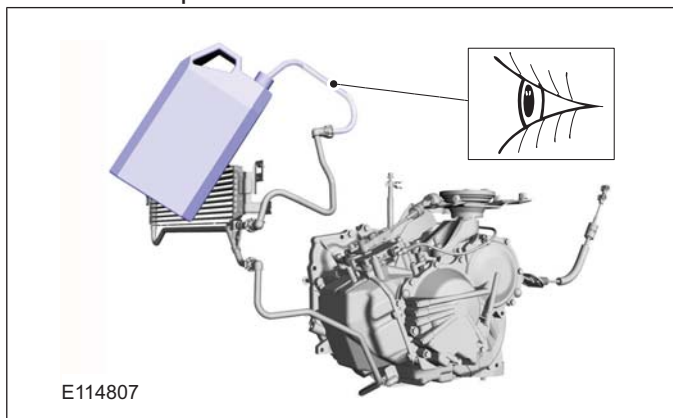


**35.** Material: Automatic Transmission Oil E-AW (WSS-M2C924-A / 4U7J-M2C924-AA) transmission fluid

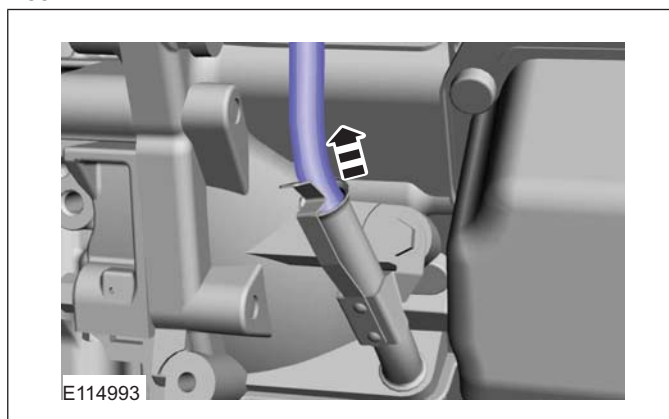


**32.** Start and run the engine at idle.

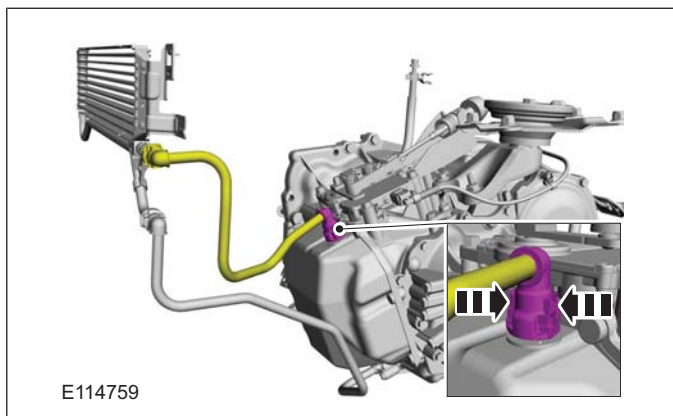
**33.** Switch off the engine, if bubbles are visible in the clear plastic tube.



**36.**

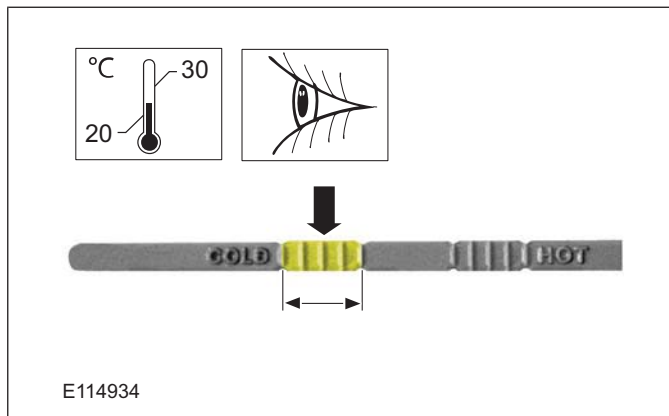


**34.**



**37.** Start and run the engine at idle.

**38.** ⚠ **CAUTION:** Use lint free cloth.



**39.** Switch off the engine.

## GENERAL PROCEDURES

40. Refer to: **Transmission Fluid Level Check**  
(307-01 Automatic Transmission/Transaxle -  
Vehicles With: 5-Speed Automatic Transaxle  
- AW55 AWD, General Procedures).

307-01-67

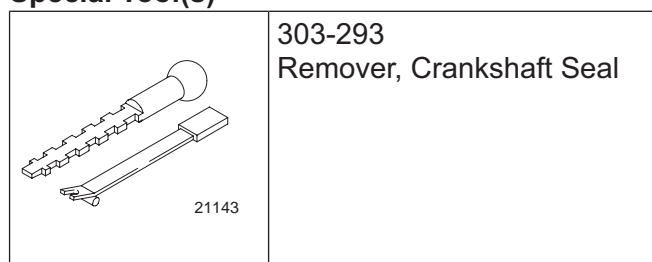
5-Speed Automatic Transaxle - AW55 AWD

307-01-67

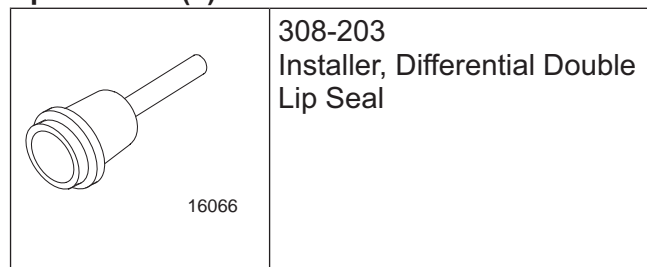
## REMOVAL AND INSTALLATION

## Halfshaft Seal LH

## Special Tool(s)

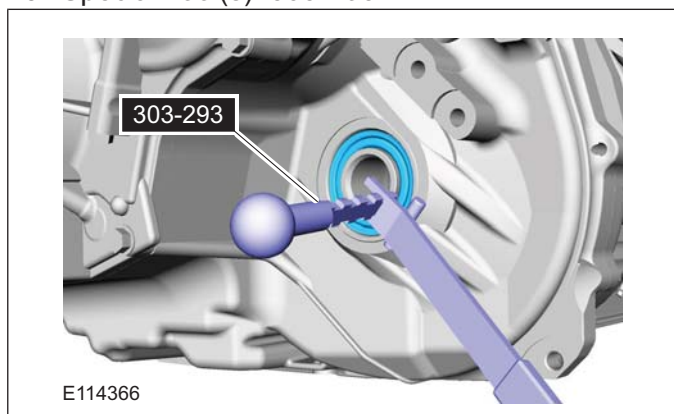


## Special Tool(s)



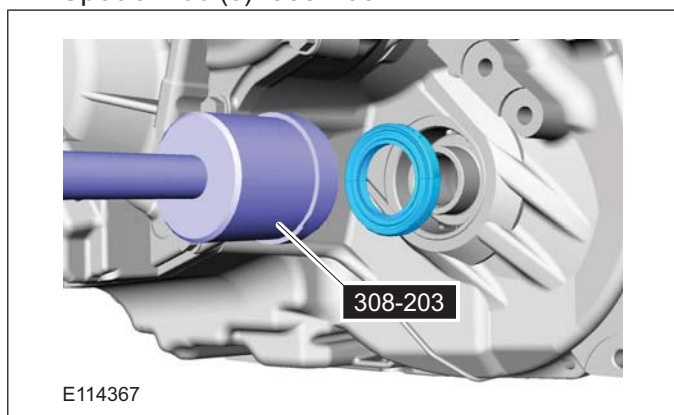
## Removal

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Front Halfshaft LH** (205-04 Front Drive Halfshafts, Removal and Installation).
3. Special Tool(s): 303-293



## Installation

1. Special Tool(s): 308-203



307-01-68

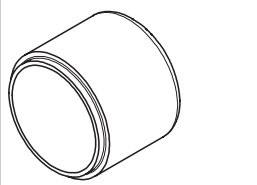
5-Speed Automatic Transaxle - AW55 AWD

307-01-68

## REMOVAL AND INSTALLATION

## Halfshaft Seal RH

## Special Tool(s) / General Equipment

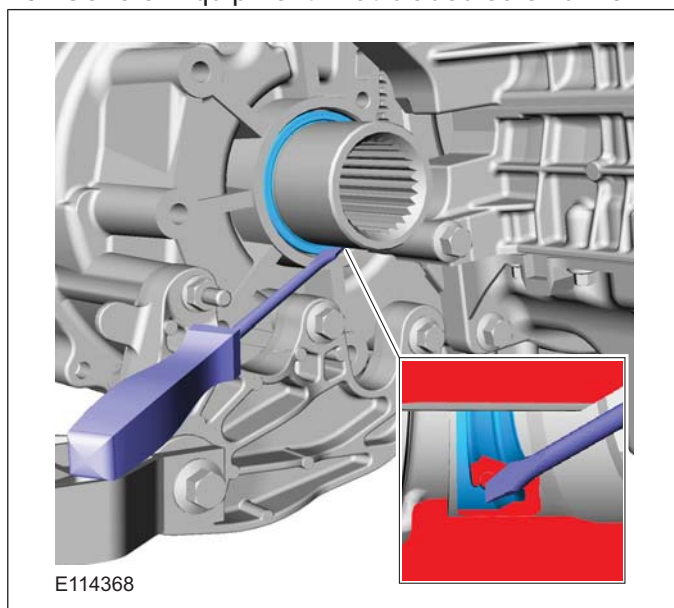
 <p>E115803</p>	<p>308-784 Installer, Halfshaft Seal</p>
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## Special Tool(s) / General Equipment

Flat-bladed screwdriver

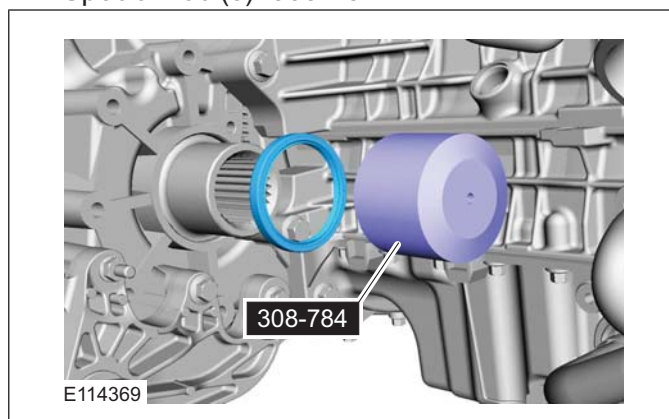
## Removal

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Transfer Case** (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Removal).
3. General Equipment: Flat-bladed screwdriver



## Installation

1. Special Tool(s): 308-784



2. Refer to: **Transfer Case** (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Installation).
3. Refer to: **Transfer Case Fluid Level Check** (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, General Procedures).

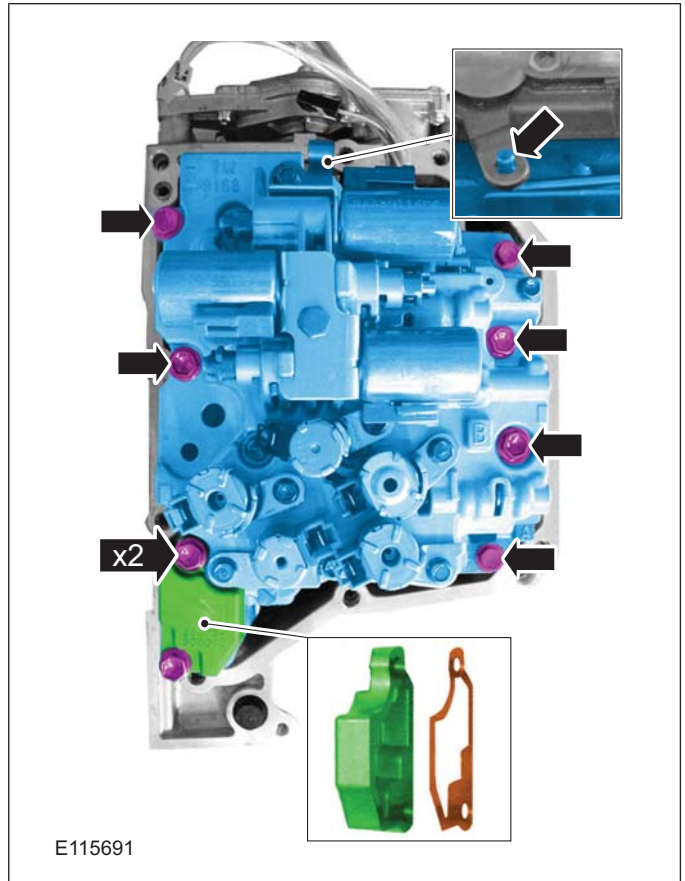
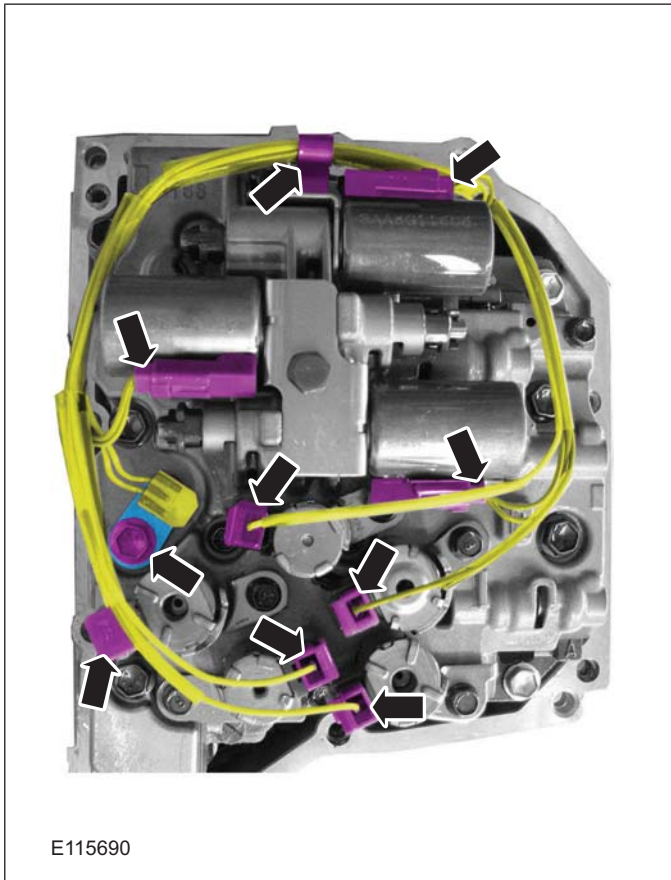
## REMOVAL AND INSTALLATION

### Main Control Valve Body

#### Removal

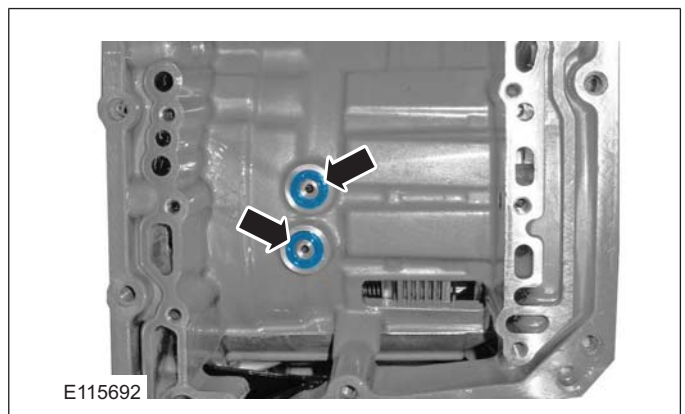
1. Refer to: **Transmission Fluid Pan** (307-01 Automatic Transmission/Transaxle - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD, Removal and Installation).
2. **NOTE:** Note the position of the electrical connectors.

**NOTE:** Note the different lengths of the bolts.



3. **CAUTION:** Make sure that no component falls off during removal.

4.

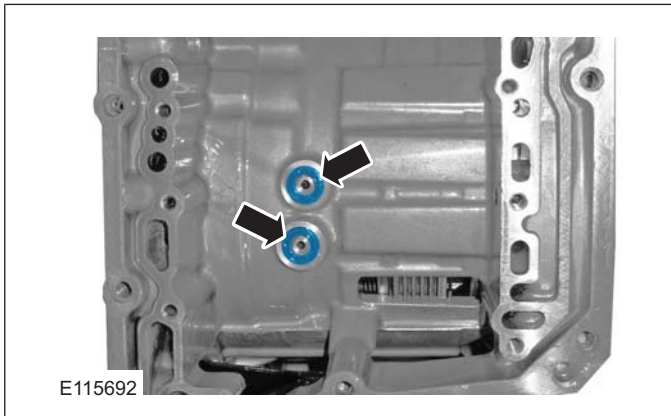




REMOVAL AND INSTALLATION

Installation

1. **NOTE:** Use new seals.

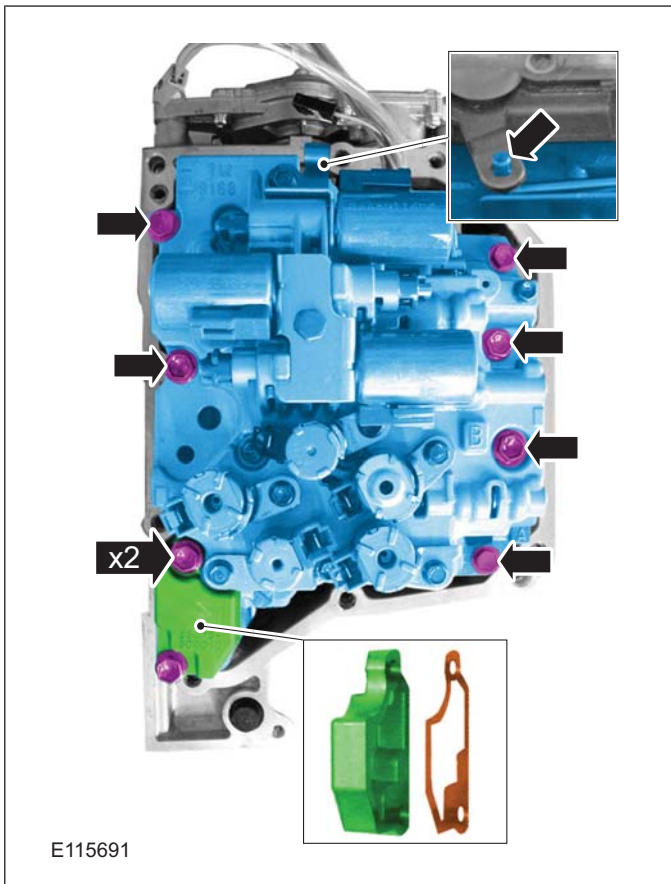


2. **CAUTION:** Make sure that the components are installed to the position noted before removal.

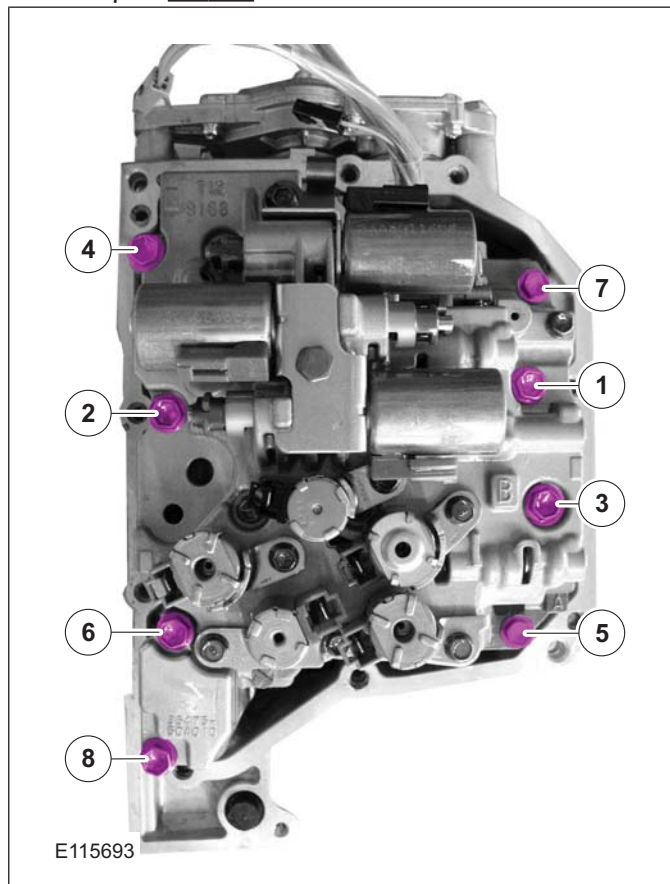
**NOTE:** Make sure that the selector lever is in the neutral (N) position.

**NOTE:** Use a new seal.

**NOTE:** Only tighten the bolts finger tight at this stage.



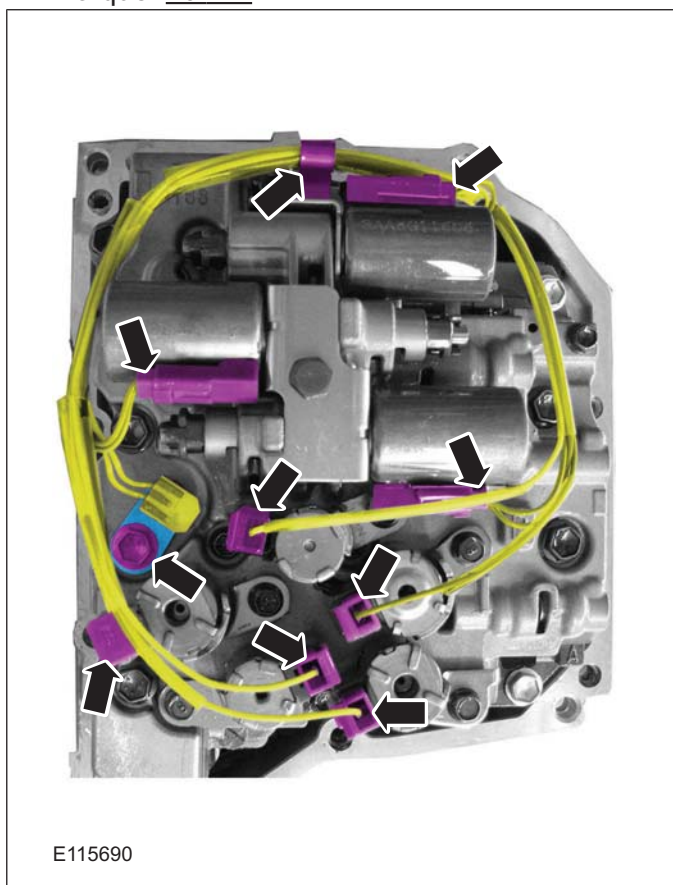
3. Torque: 10 Nm



## REMOVAL AND INSTALLATION

4.  **CAUTION:** Make sure that the components are installed to the position noted before removal.

Torque: 10 Nm



5. Refer to: **Transmission Fluid Pan** (307-01 Automatic Transmission/Transaxle - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD, Removal and Installation).

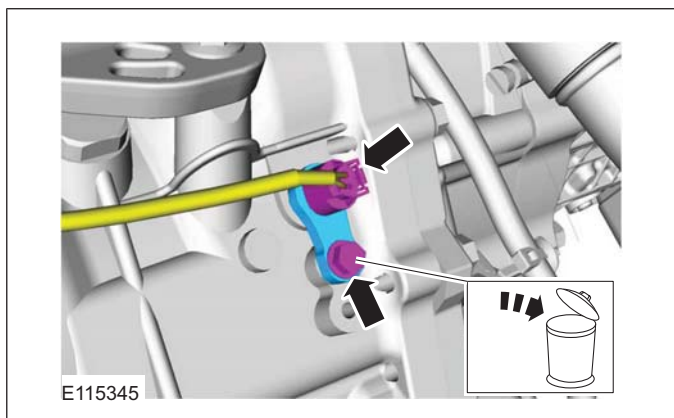
REMOVAL AND INSTALLATION

Output Shaft Speed (OSS) Sensor

Materials	
Name	Specification
Automatic Transmission Oil E-AW	WSS-M2C924-A / 4U7J-M2C924-AA

Removal

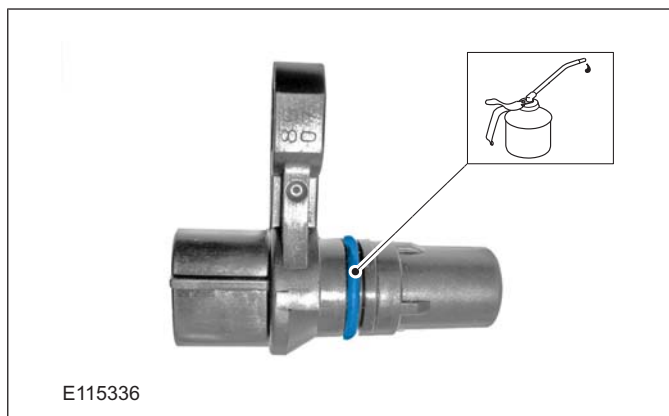
1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. **WARNING:** Be prepared to collect escaping fluid.



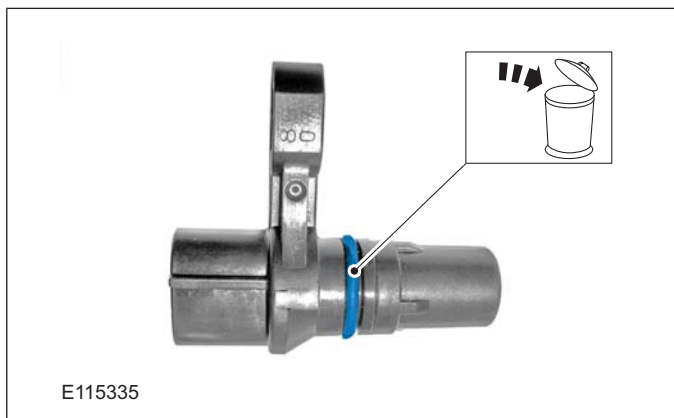
Installation

1. **NOTE:** Make sure that a new component is installed.

Material: Automatic Transmission Oil E-AW (WSS-M2C924-A / 4U7J-M2C924-AA) transmission fluid

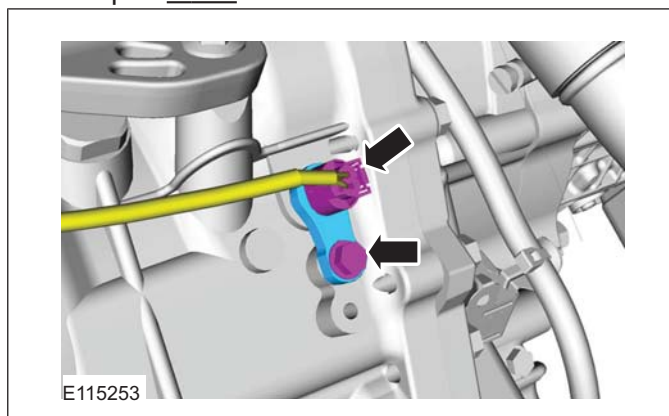


3.



2. **WARNING:** Make sure that a new bolt is installed.

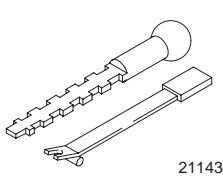
Torque: 5 Nm



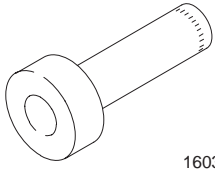
REMOVAL AND INSTALLATION

Torque Converter Seal

Special Tool(s) / General Equipment

 <p>21143</p>	<p>303-293 Remover, Crankshaft Seal</p>
--	---

Special Tool(s) / General Equipment

 <p>16038</p>	<p>308-095 Installer, Input Shaft Bearing</p>
<p>Round-Ended Steel Rule</p>	

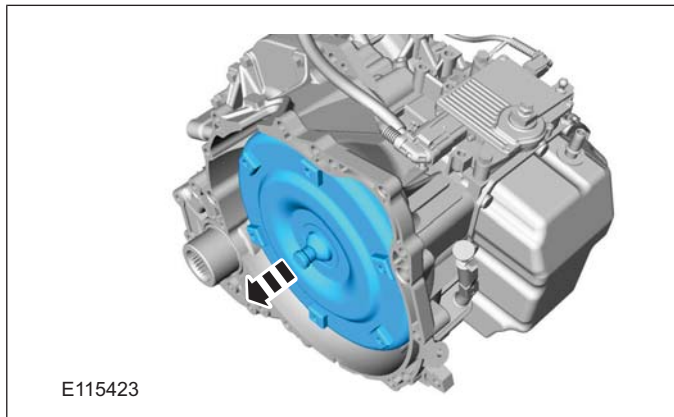
Materials

Name	Specification
Automatic Transmission Oil E-AW	WSS-M2C924-A / 4U7J-M2C924-AA

Removal

1. Refer to: **Transmission** (307-01 Automatic Transmission/Transaxle - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD, Removal).

2.



3. Special Tool(s): 303-293

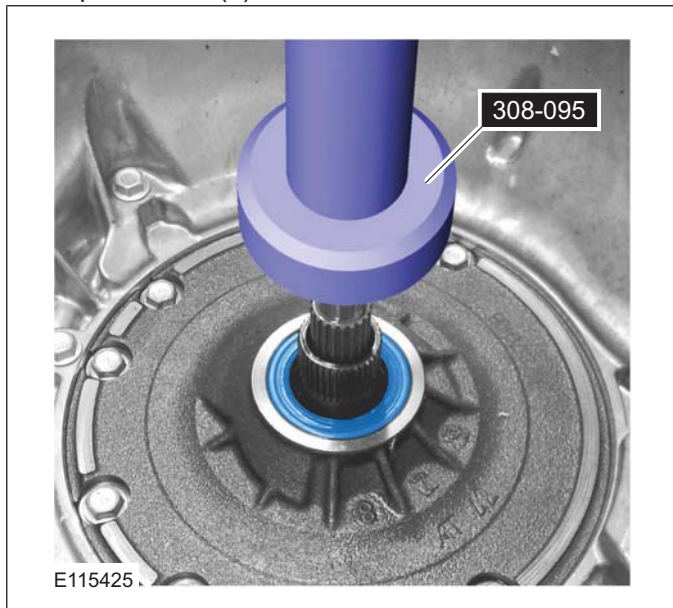




## REMOVAL AND INSTALLATION

### Installation

1. Special Tool(s): 308-095



E115425

2. Material: Automatic Transmission Oil E-AW (WSS-M2C924-A / 4U7J-M2C924-AA) transmission fluid



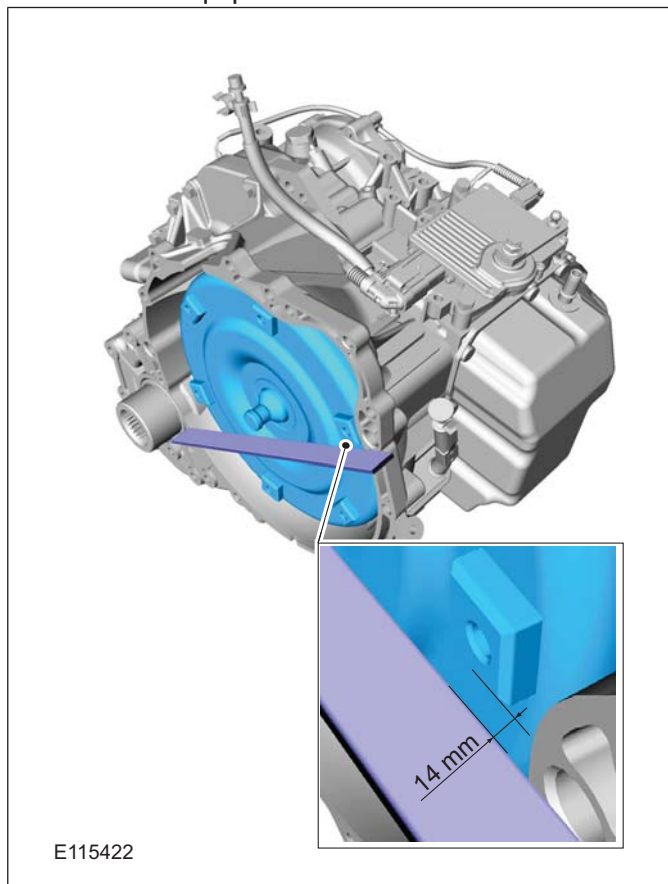
E115465

### 3. CAUTIONS:

- ⚠ Take extra care not to damage the seal.

- ⚠ Make sure that the specified installation depth is achieved.

General Equipment: Round-Ended Steel Rule



E115422

4. Refer to: **Transmission** (307-01 Automatic Transmission/Transaxle - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD, Installation).



307-01-75

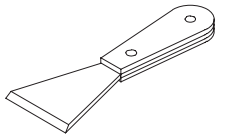
5-Speed Automatic Transaxle - AW55 AWD

307-01-75

REMOVAL AND INSTALLATION

Transmission Fluid Pan

Special Tool(s)

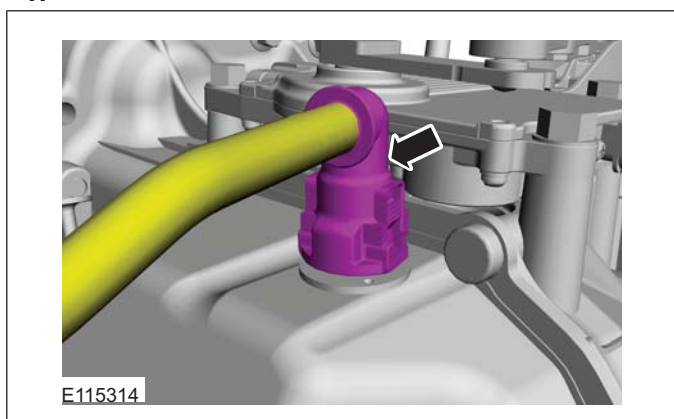
 <p>21179</p>	<p>303-428 Separator, Oil Pan</p>
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Materials

Name	Specification
Silicone Sealant LG	WSS-M4G320-A3 / 6G9N-M4G320-AA

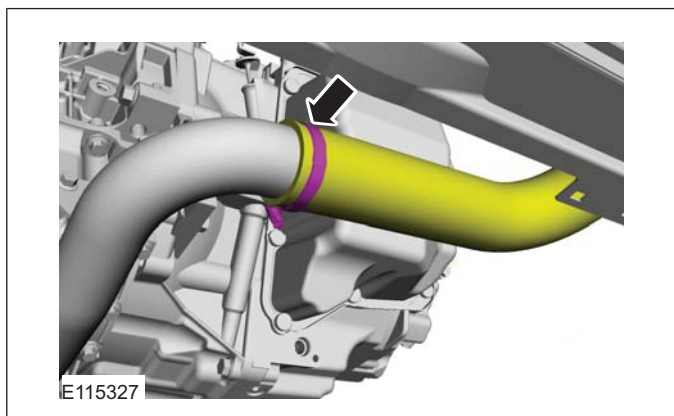
Removal

1.

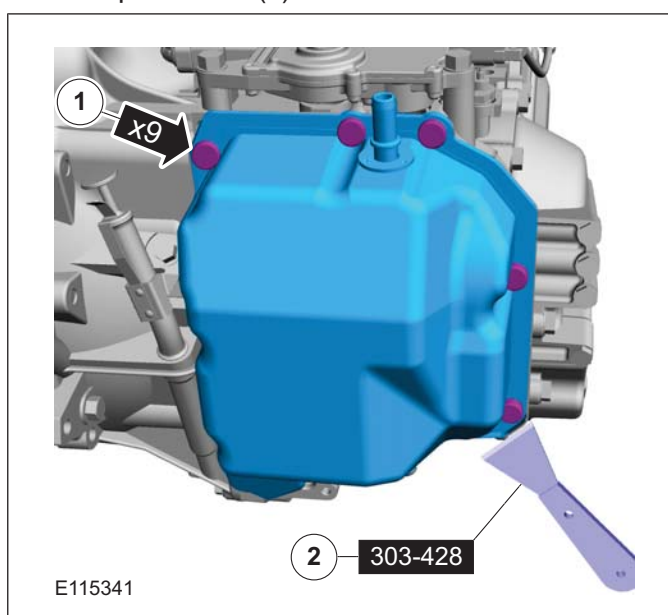


2. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

3.



4. 2. Special Tool(s): 303-428



307-01-76

5-Speed Automatic Transaxle - AW55 AWD

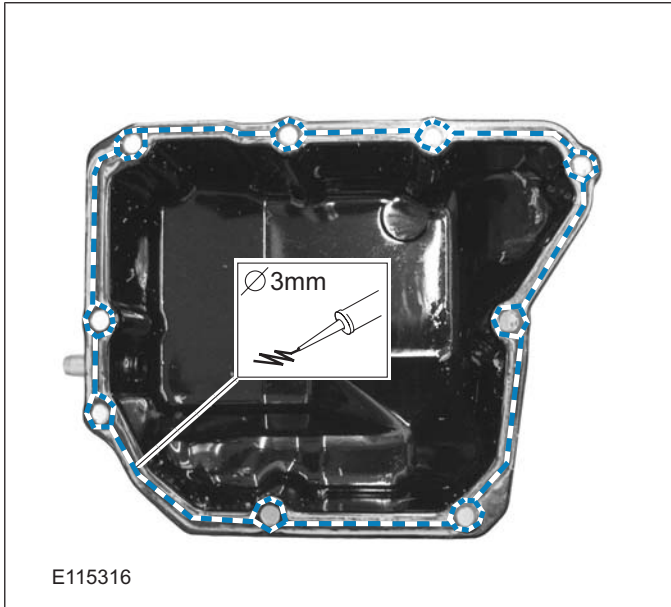
307-01-76

REMOVAL AND INSTALLATION

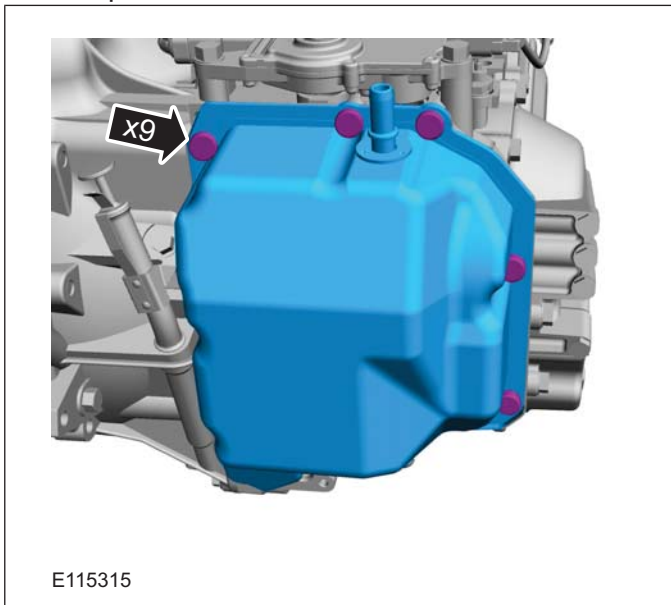
Installation

1.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

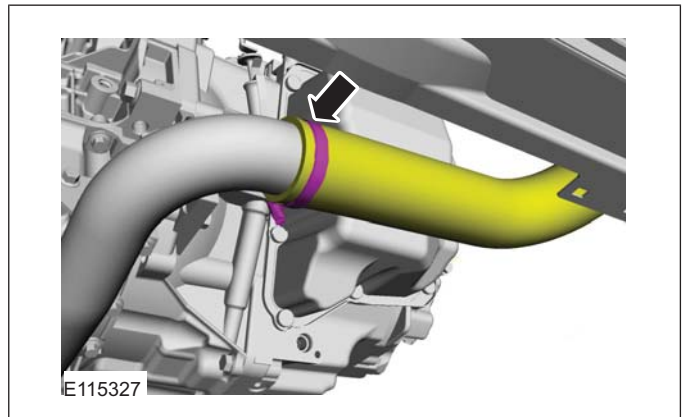
Material: Silicone Sealant LG (WSS-M4G320-A3 / 6G9N-M4G320-AA) sealant



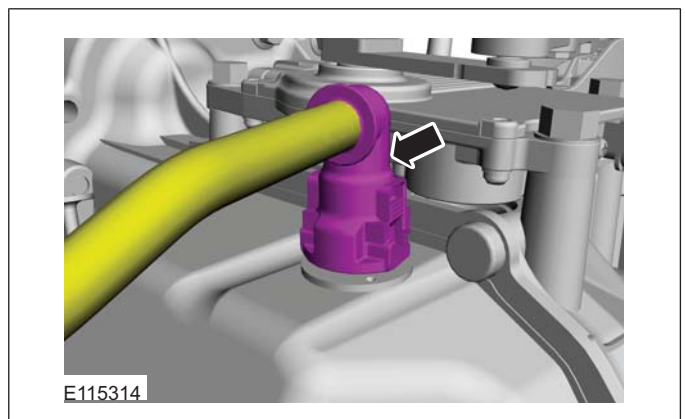
2. Torque: 18 Nm



- 3.



- 4.



5. Refer to: **Transmission Fluid Drain and Refill** (307-01 Automatic Transmission/Transaxle - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD, General Procedures).

307-01-77

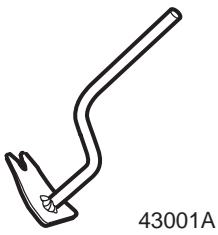
5-Speed Automatic Transaxle - AW55 AWD

307-01-77

## REMOVAL AND INSTALLATION

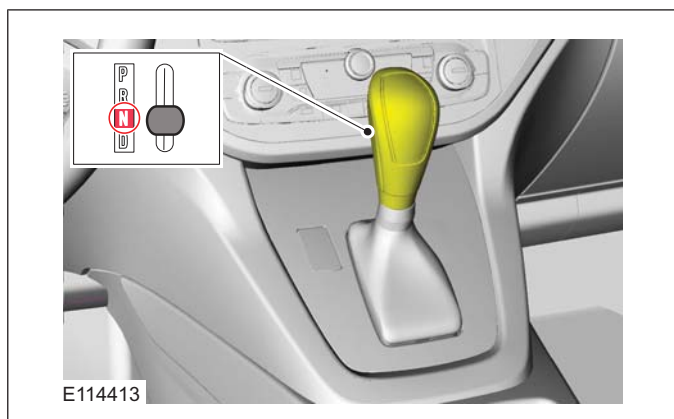
### Transmission Range (TR) Sensor

#### Special Tool(s)

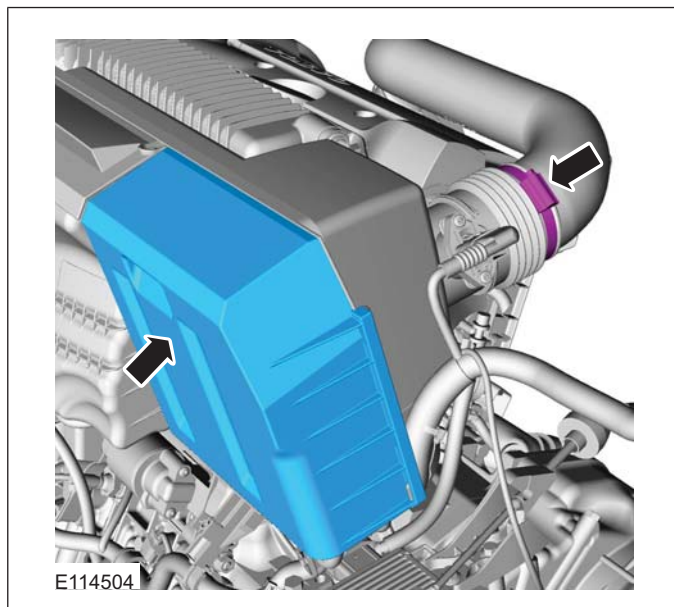
 <p>43001A</p>	<p>501-028A Pliers, Door Trim Removal</p>
---	---

#### Removal

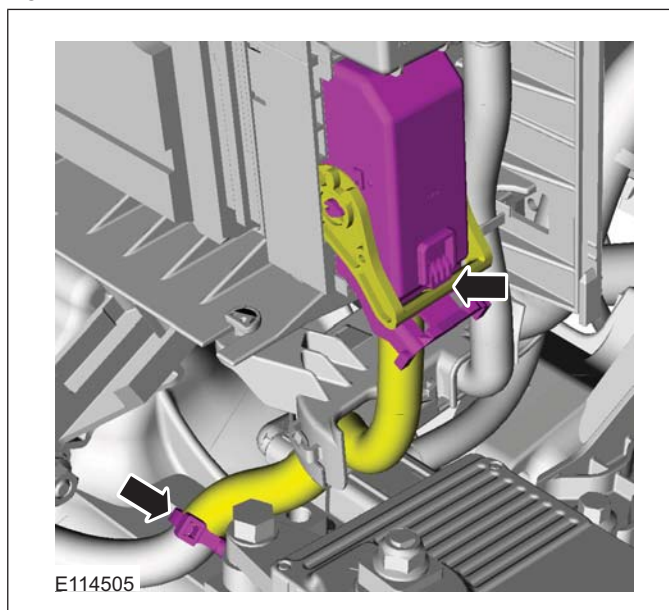
1.



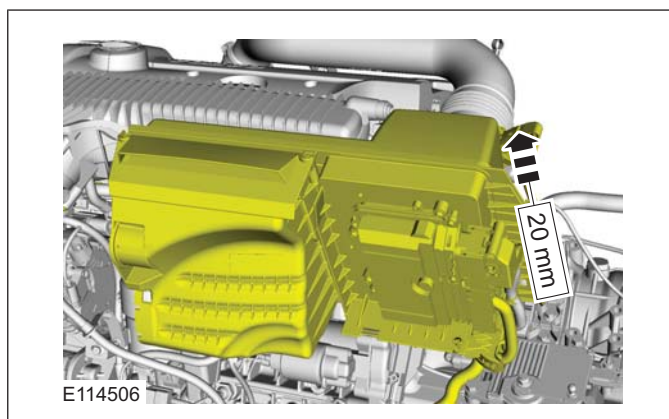
2.



3.



4.





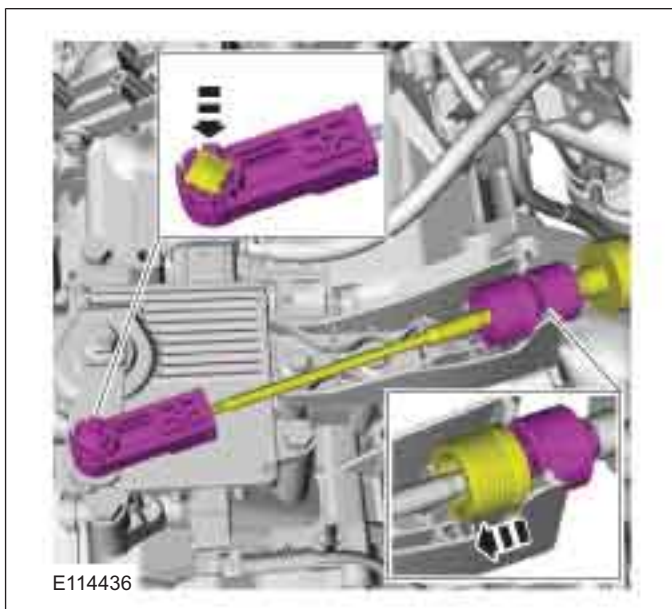
307-01-78

5-Speed Automatic Transaxle - AW55 AWD

307-01-78

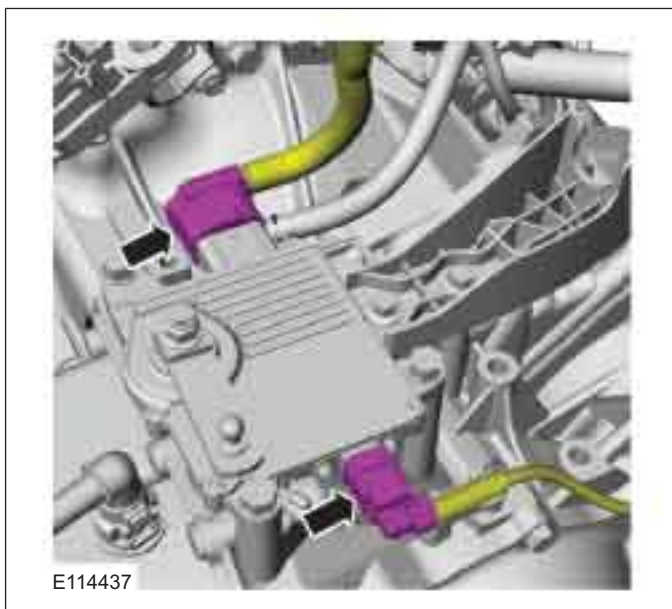
REMOVAL AND INSTALLATION

5.



E114436

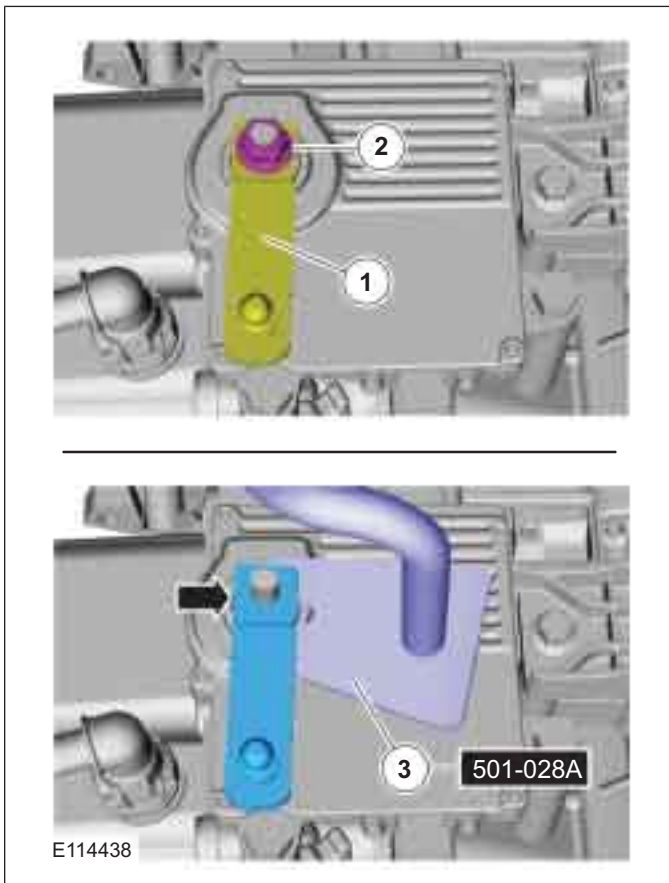
6.



E114437

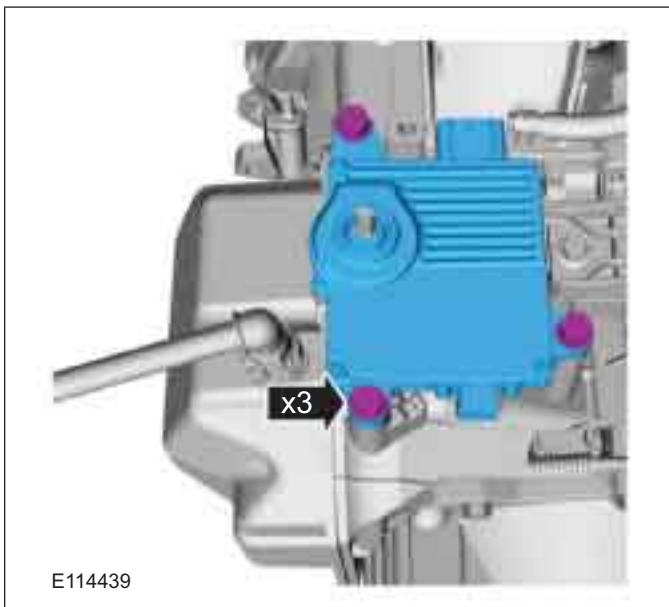
7. 1. **⚠ CAUTION:** Use an open-ended wrench to prevent the component from turning.

3. Special Tool(s): 501-028A



E114438

8.

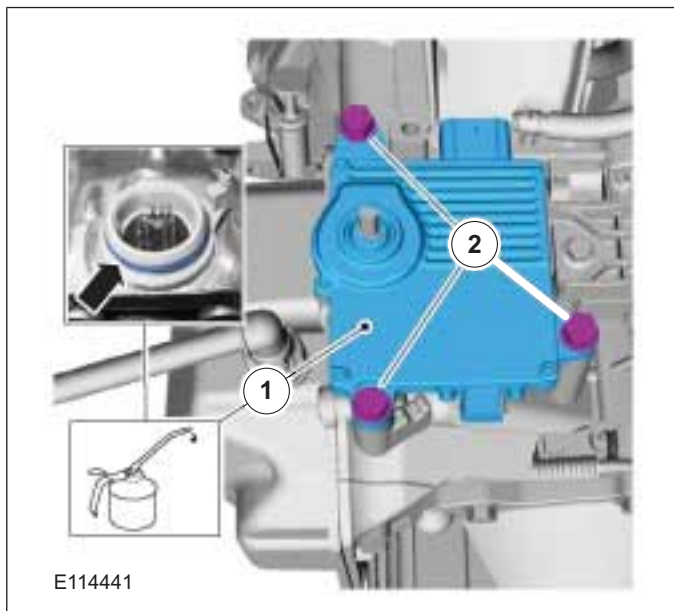


E114439

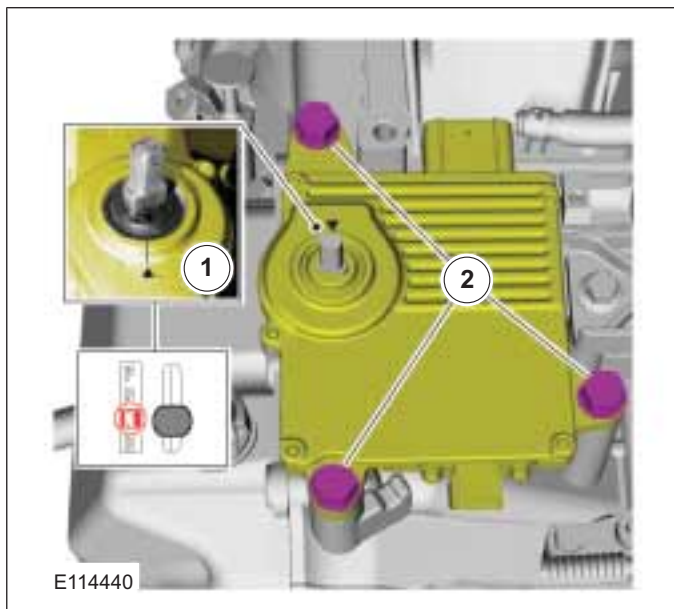
REMOVAL AND INSTALLATION

Installation

1. 1. **NOTE:** Make sure that a new component is installed.
2. **NOTE:** Only tighten the bolts finger tight at this stage.

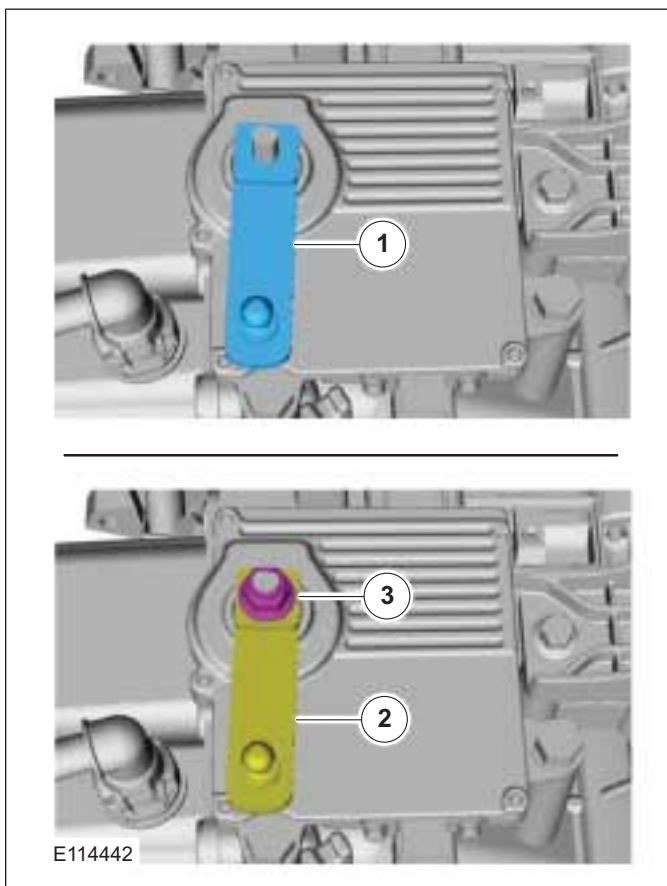


2. 2. Torque: 16 Nm

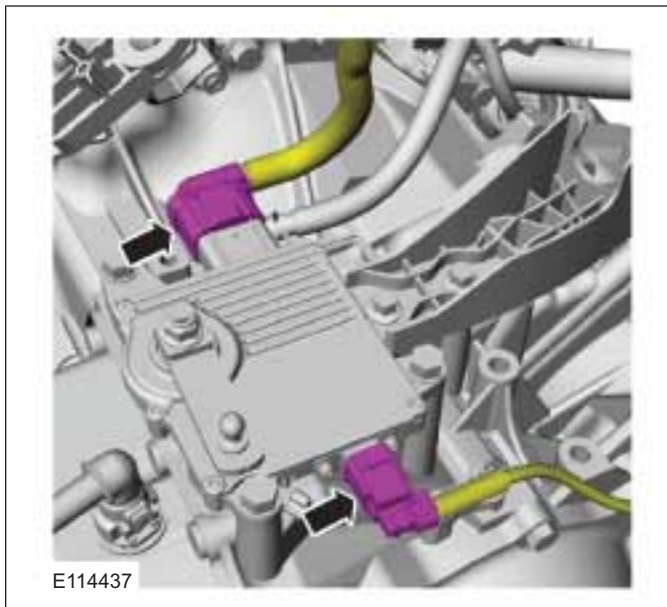


3. 2. **CAUTION:** Use an open-ended wrench to prevent the component from turning.

3. Torque: 25 Nm



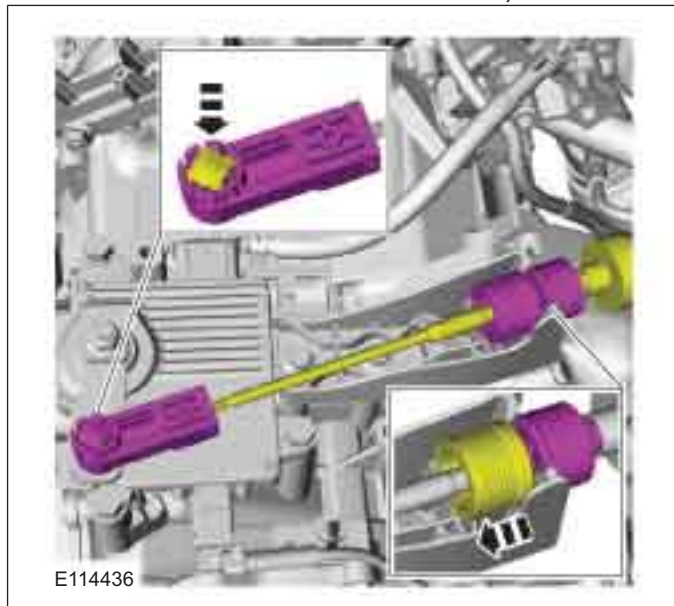
- 4.



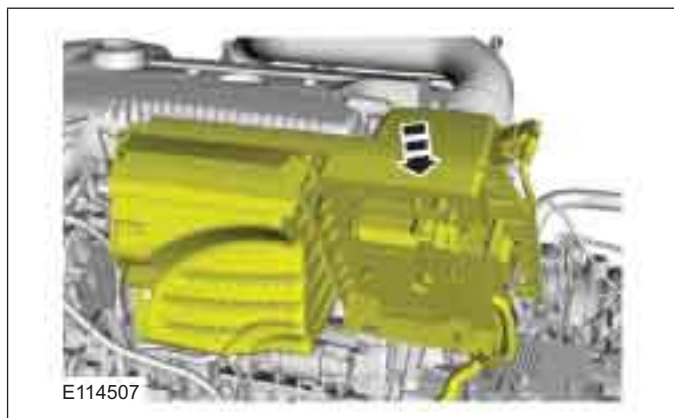


REMOVAL AND INSTALLATION

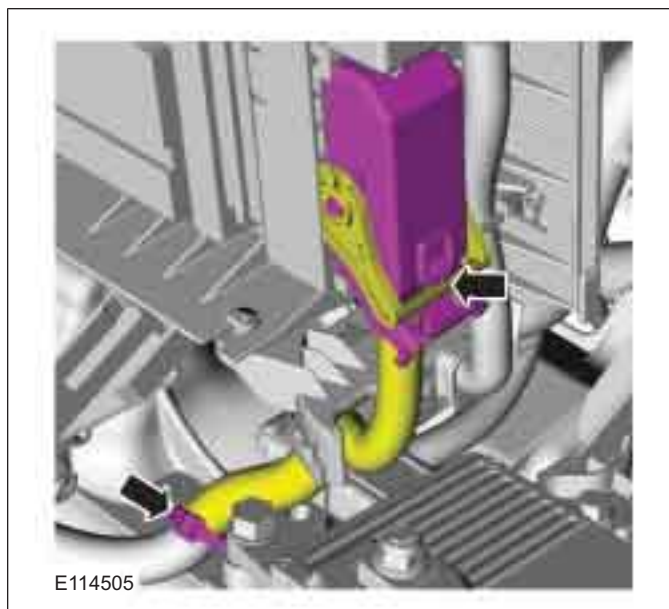
- Refer to: **Selector Lever Cable Adjustment - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD** (307-05 Automatic Transmission/Transaxle External Controls - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, General Procedures).



6.



7.



8.



## REMOVAL AND INSTALLATION

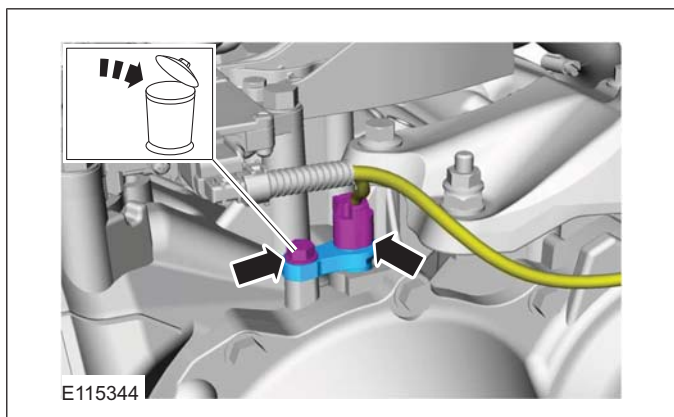
### Turbine Shaft Speed (TSS) Sensor

Materials	
Name	Specification
Automatic Transmission Oil E-AW	WSS-M2C924-A / 4U7J-M2C924-AA

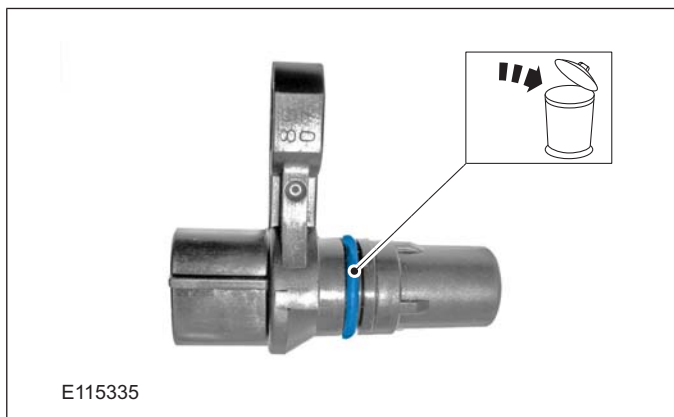
#### Removal

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).

2.



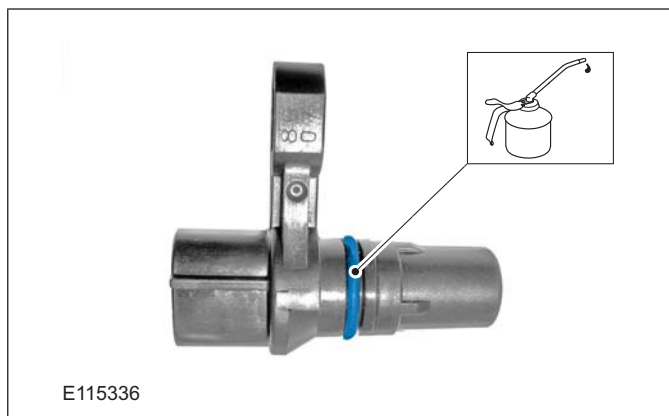
3.



#### Installation

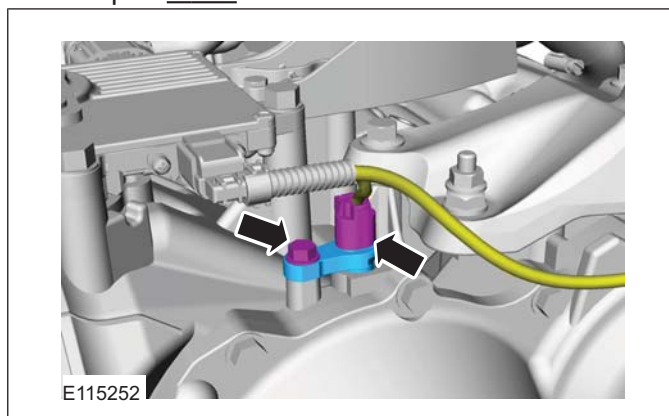
1. **NOTE:** Make sure that a new component is installed.

Material: Automatic Transmission Oil E-AW (WSS-M2C924-A / 4U7J-M2C924-AA) transmission fluid



2. **WARNING:** Make sure that a new bolt is installed.

Torque: 5 Nm

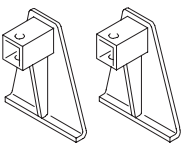
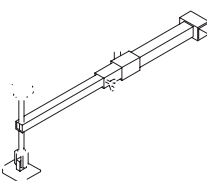
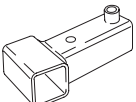


REMOVAL

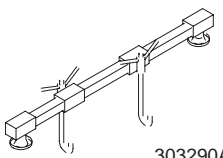
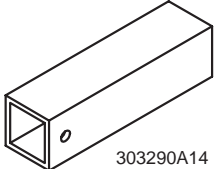
Transmission

Removal

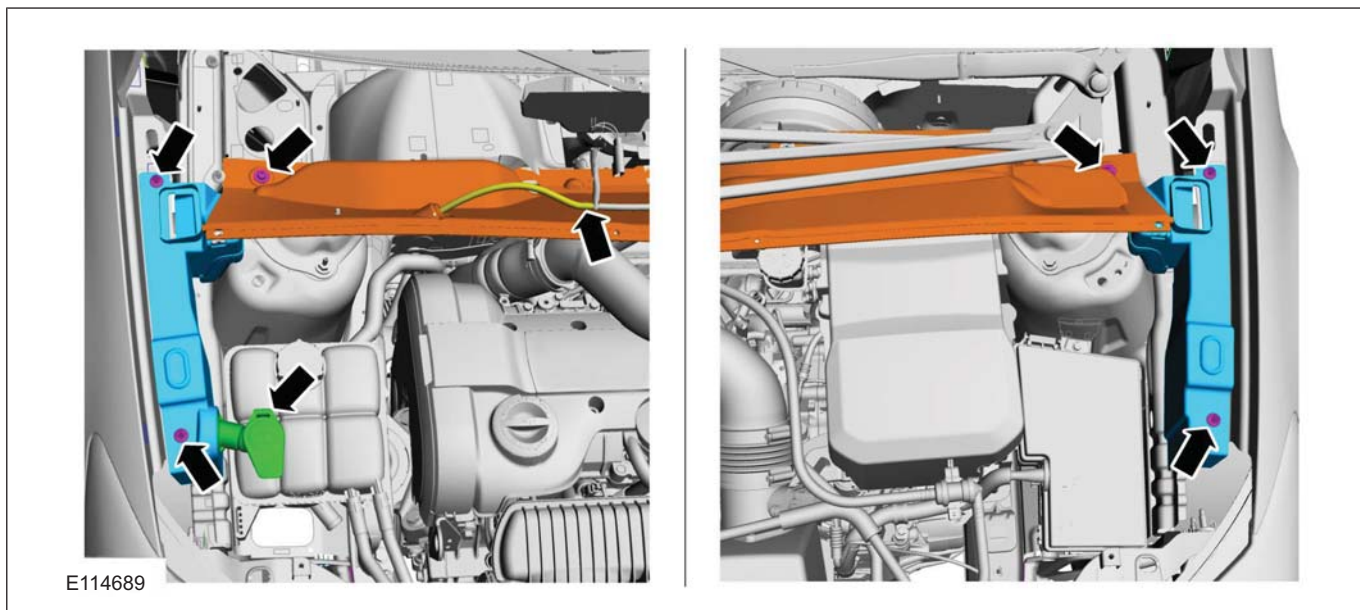
Special Tool(s) / General Equipment

 <p>2114001</p>	<p>303-290-01 Adapter for 303-290A</p>
 <p>30329003A</p>	<p>303-290-03A Adapter for 303-290A</p>
 <p>30329005A</p>	<p>303-290-05A Adapter for 303-290A</p>

Special Tool(s) / General Equipment

 <p>303290A</p>	<p>303-290A Support Bar, Engine</p>
 <p>303290A14</p>	<p>303-290A-14 Adapter for 303-290A</p>
<p>Cable Ties</p>	
<p>Transmission Jack</p>	
<p>Wooden Block</p>	

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
- 3.



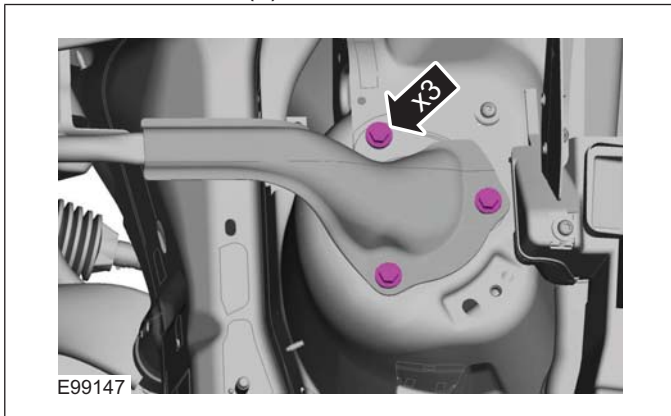
307-01-83

5-Speed Automatic Transaxle - AW55 AWD

307-01-83

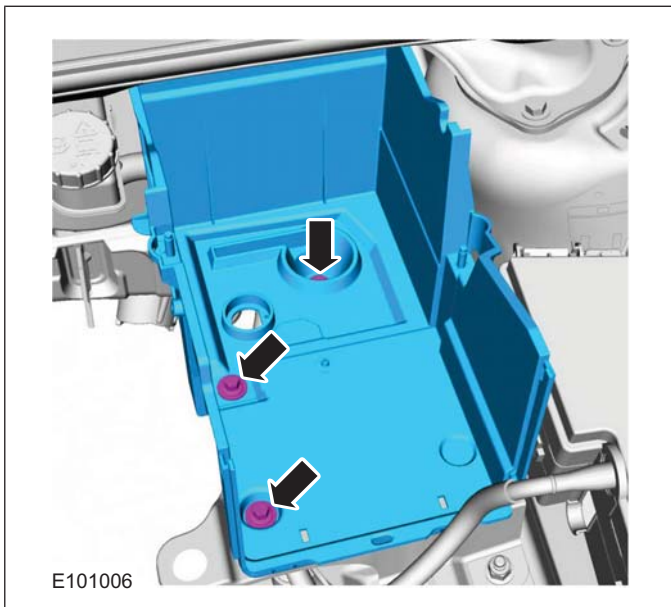
REMOVAL

4. On both sides.  
Loosen: 3 turn(s)



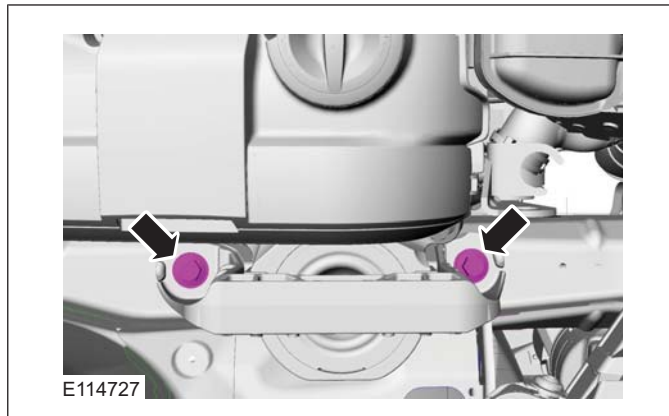
5. Refer to: **Battery** (414-01 Battery, Mounting and Cables, Removal and Installation).

- 6.



7. Refer to: **Air Cleaner** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

8. **NOTE:** Only tighten the bolts finger tight at this stage.



- 9.

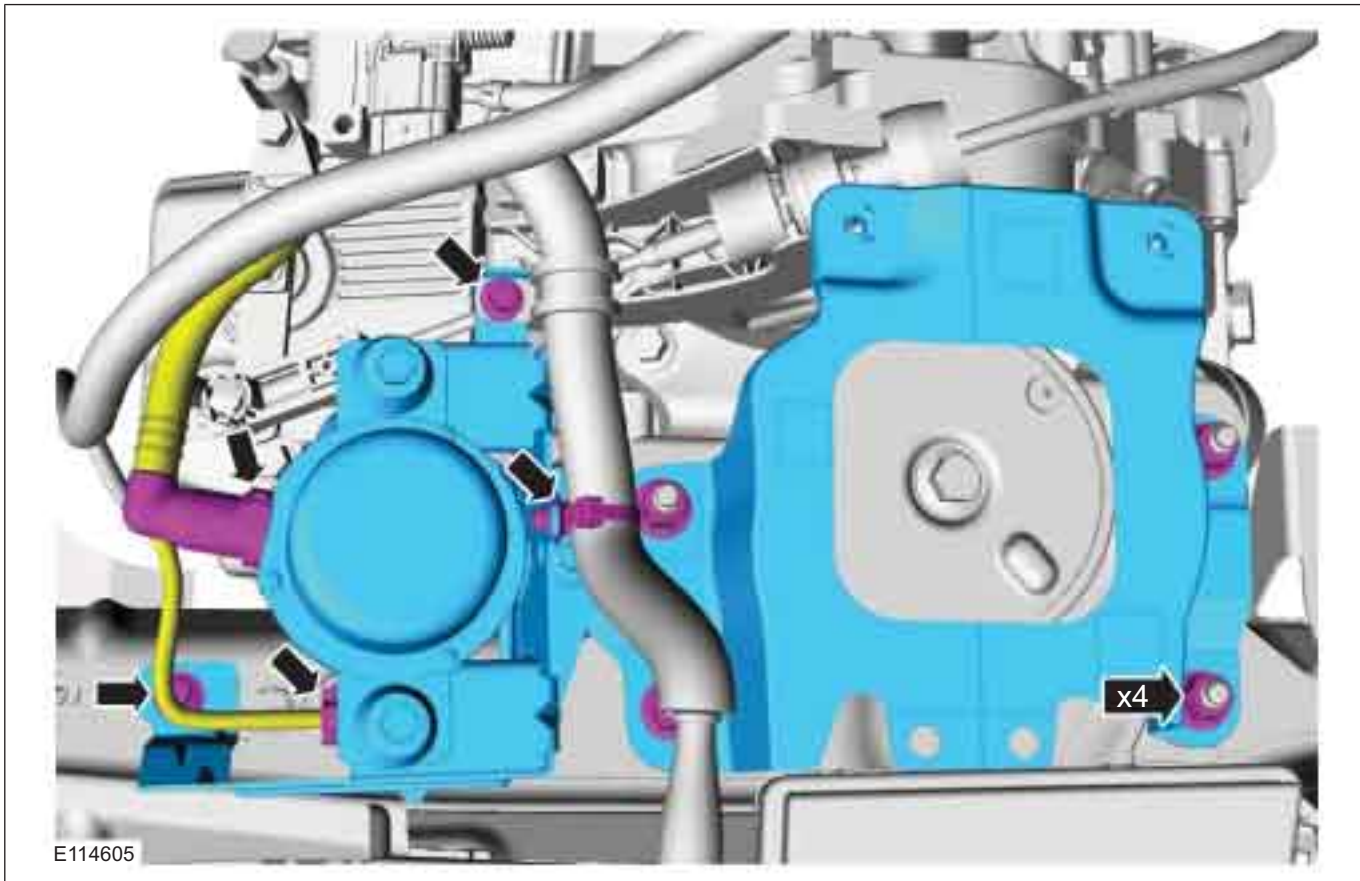


307-01-84

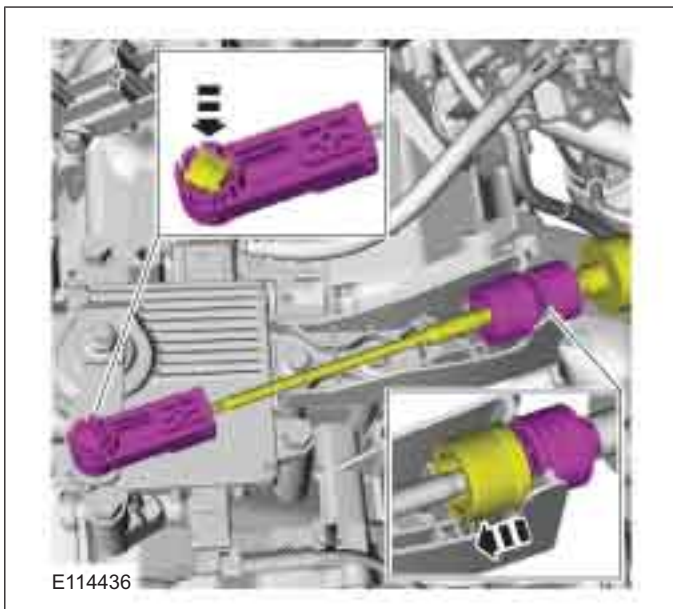
5-Speed Automatic Transaxle - AW55 AWD

307-01-84

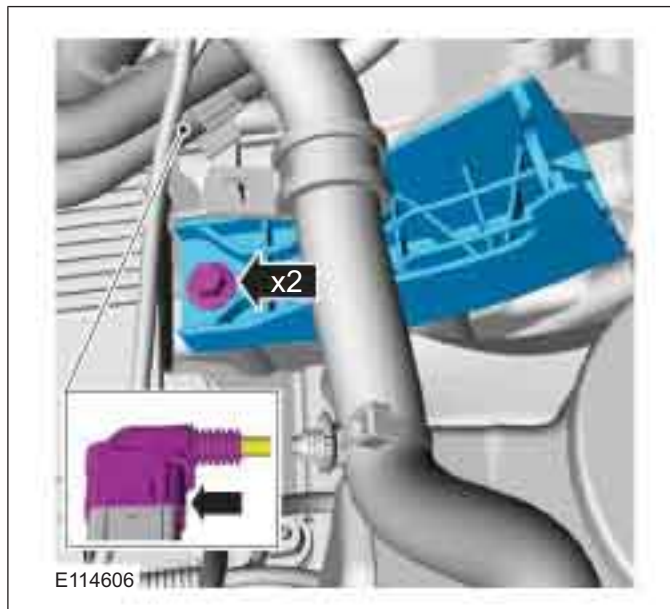
REMOVAL



10.



11.







307-01-85

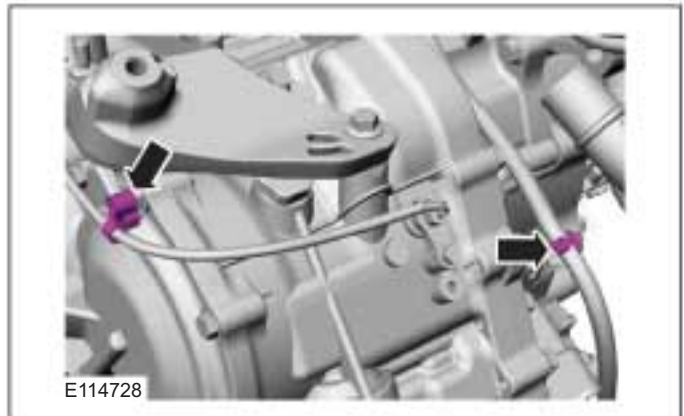
5-Speed Automatic Transaxle - AW55 AWD

307-01-85

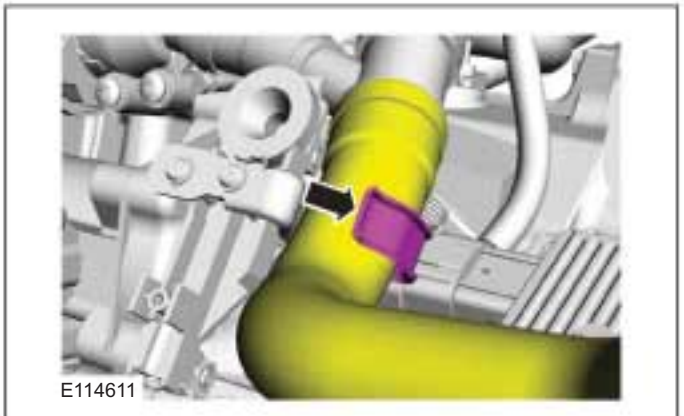


REMOVAL

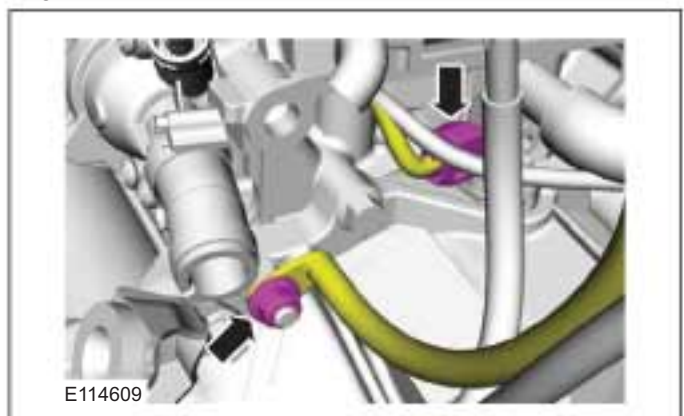
12.



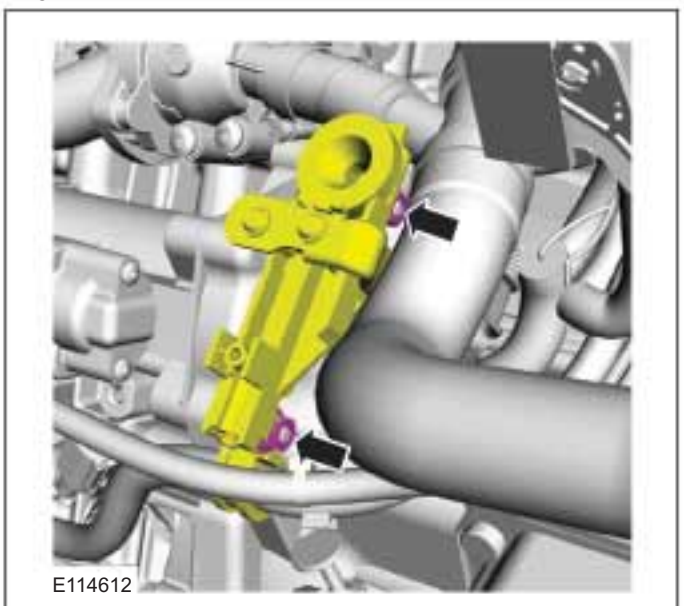
15.



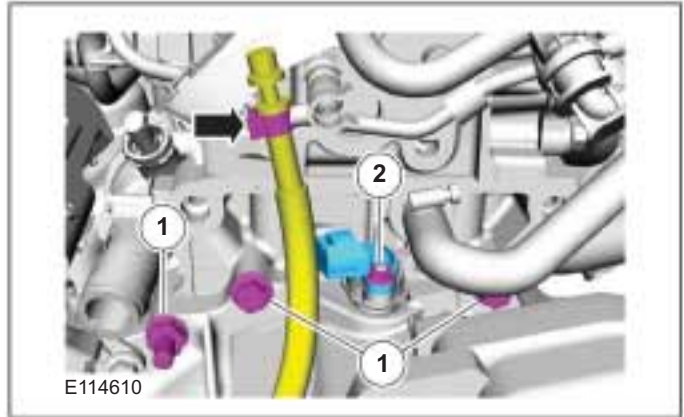
13.



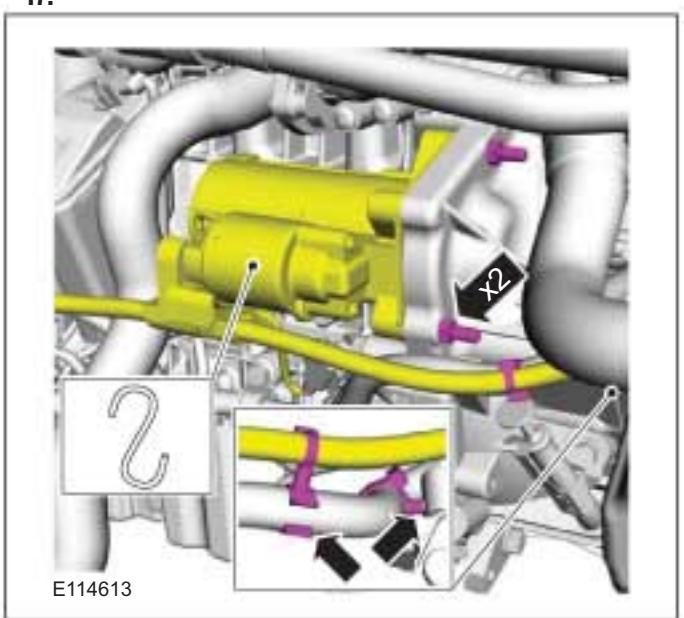
16.



14.



17.



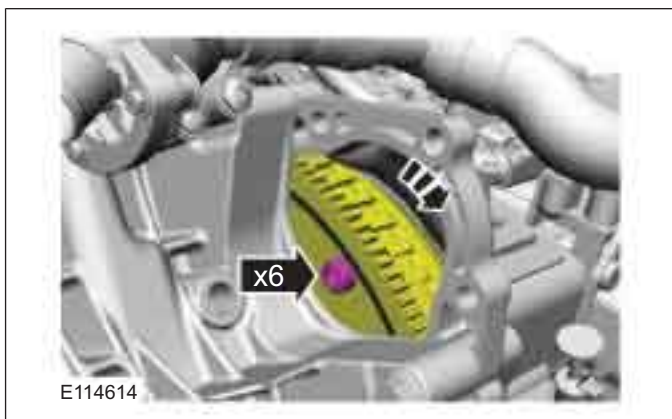
307-01-86

5-Speed Automatic Transaxle - AW55 AWD

307-01-86

REMOVAL

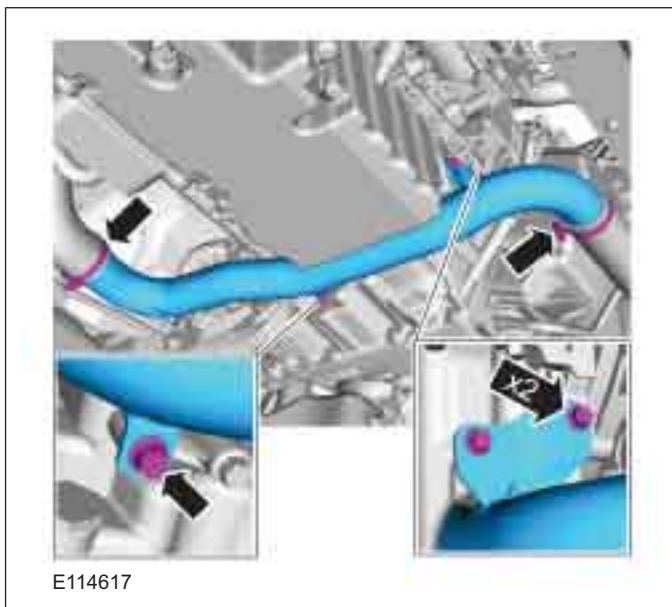
18.



E114614

19. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

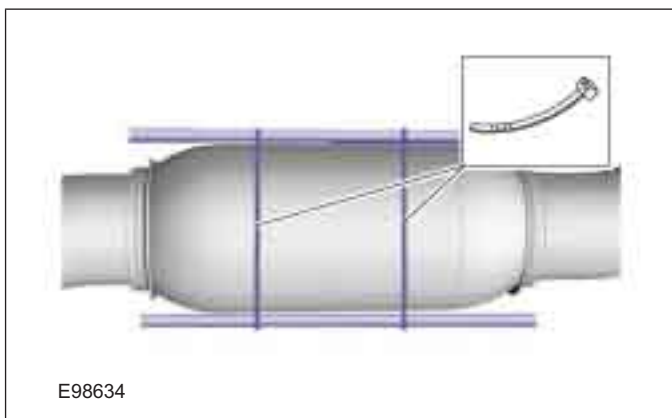
20.



E114617

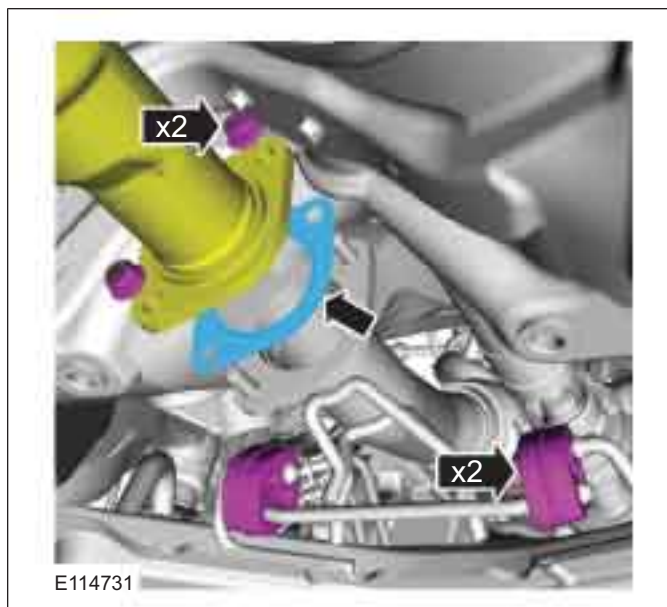
21. Install the following items:

1. General Equipment: Cable Ties



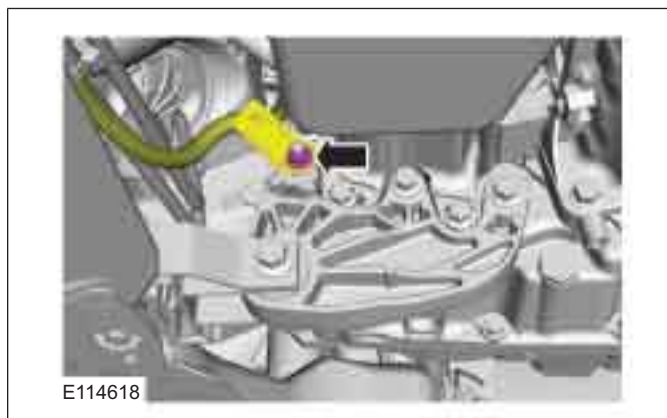
E98634

22.



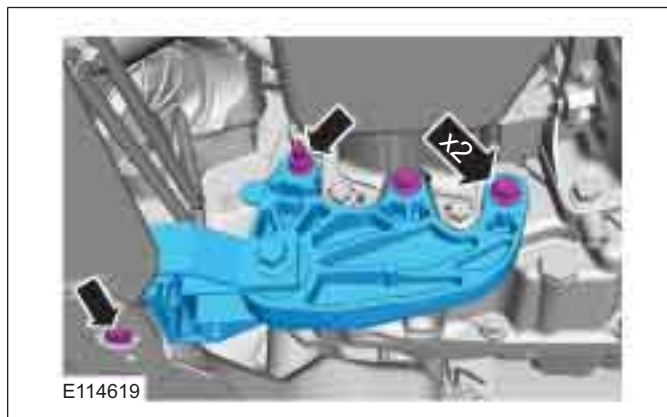
E114731

23.



E114618

24.



E114619

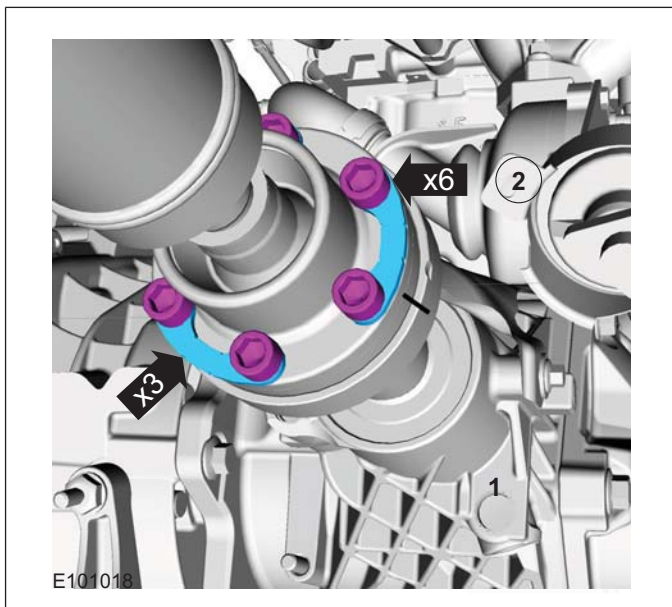


REMOVAL

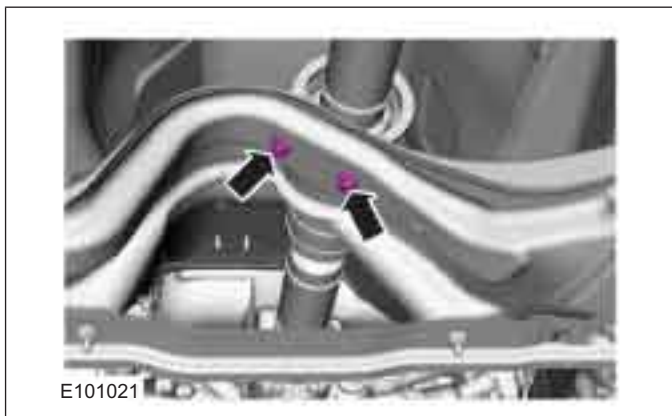
25. Refer to: **Front Halfshaft LH** (205-04 Front Drive Halfshafts, Removal and Installation).

Refer to: **Front Halfshaft RH - LHD 4WD/RHD 4WD** (205-04 Front Drive Halfshafts, Removal and Installation).

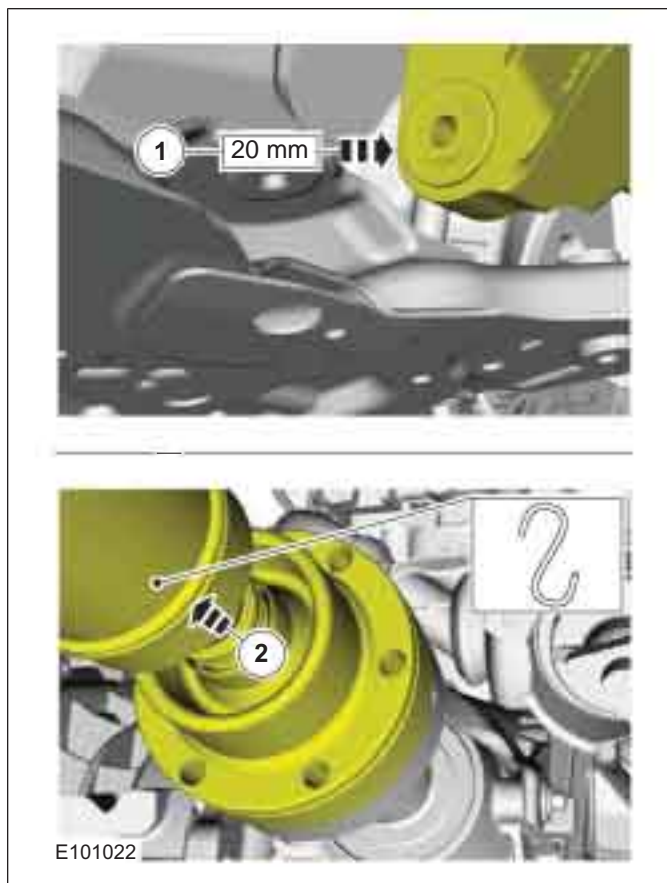
26. 1. **NOTE:** Note the position of the component before removal.



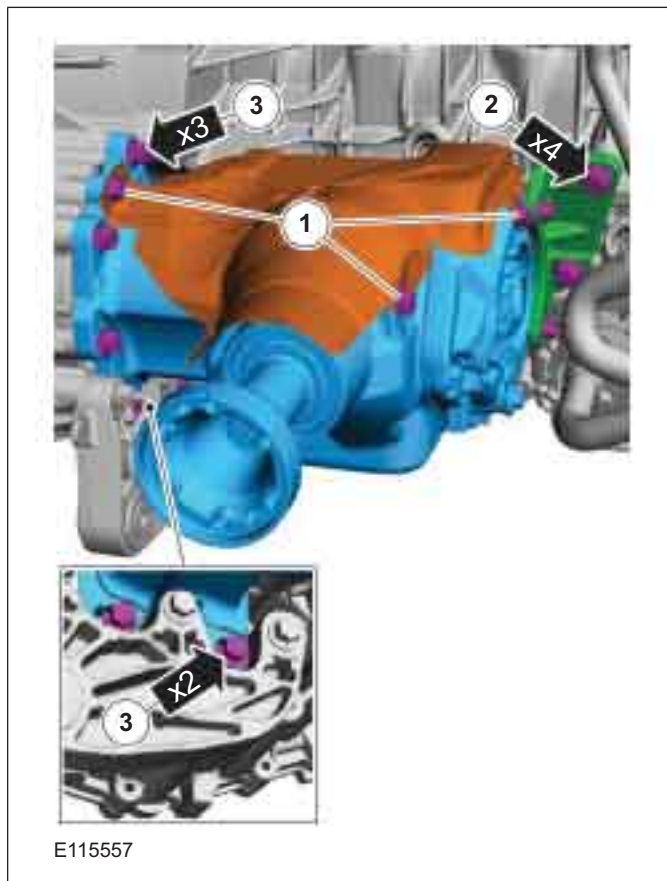
27.



28.



29.



307-01-88

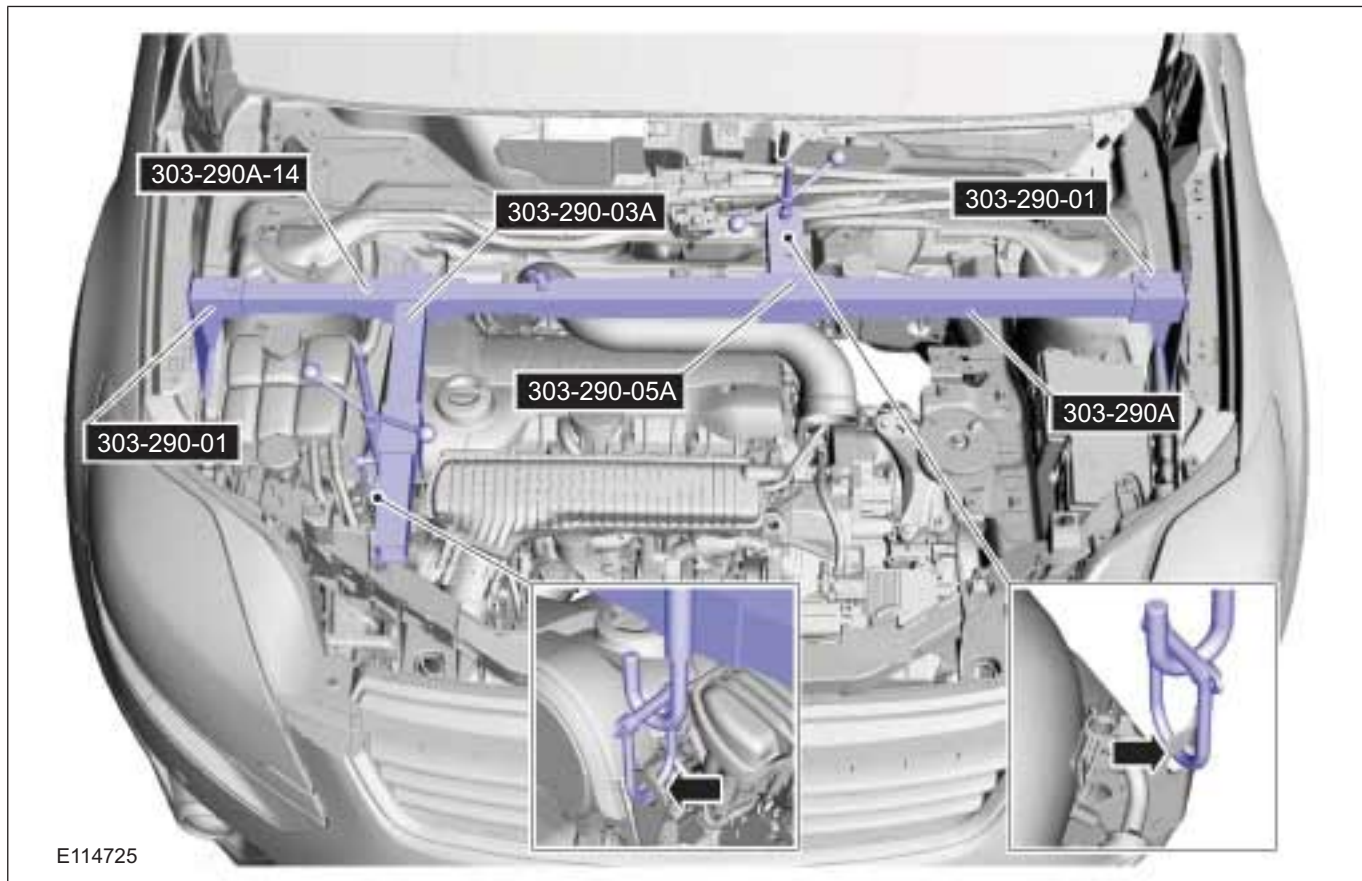
5-Speed Automatic Transaxle - AW55 AWD

307-01-88

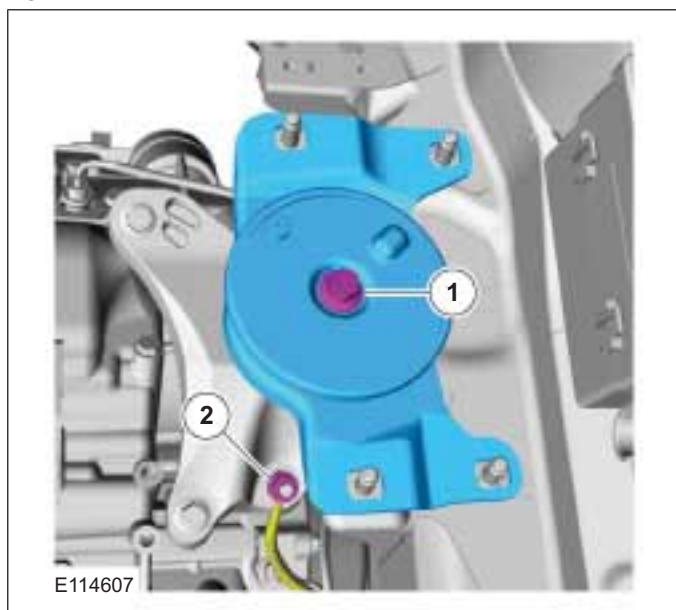
REMOVAL

30. Lower the vehicle.

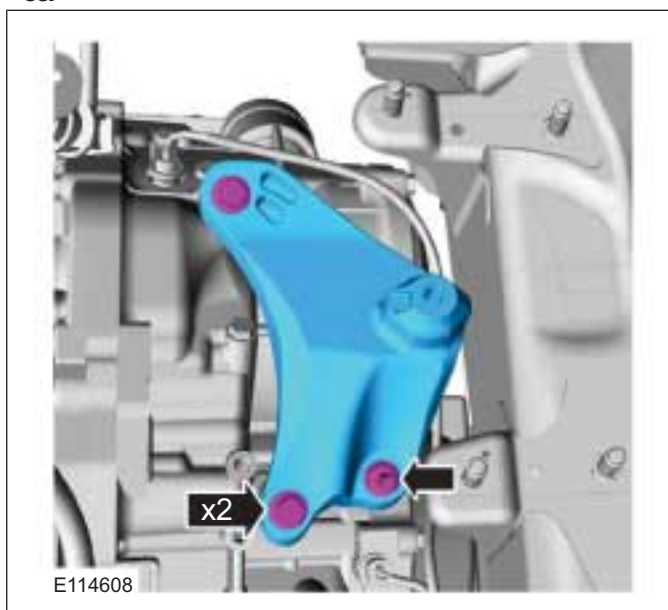
31. Install the Special Tool(s): 303-290-01, 303-290-03A, 303-290-05A, 303-290A, 303-290A-14



32



33



34. Special Tool(s): 303-290A

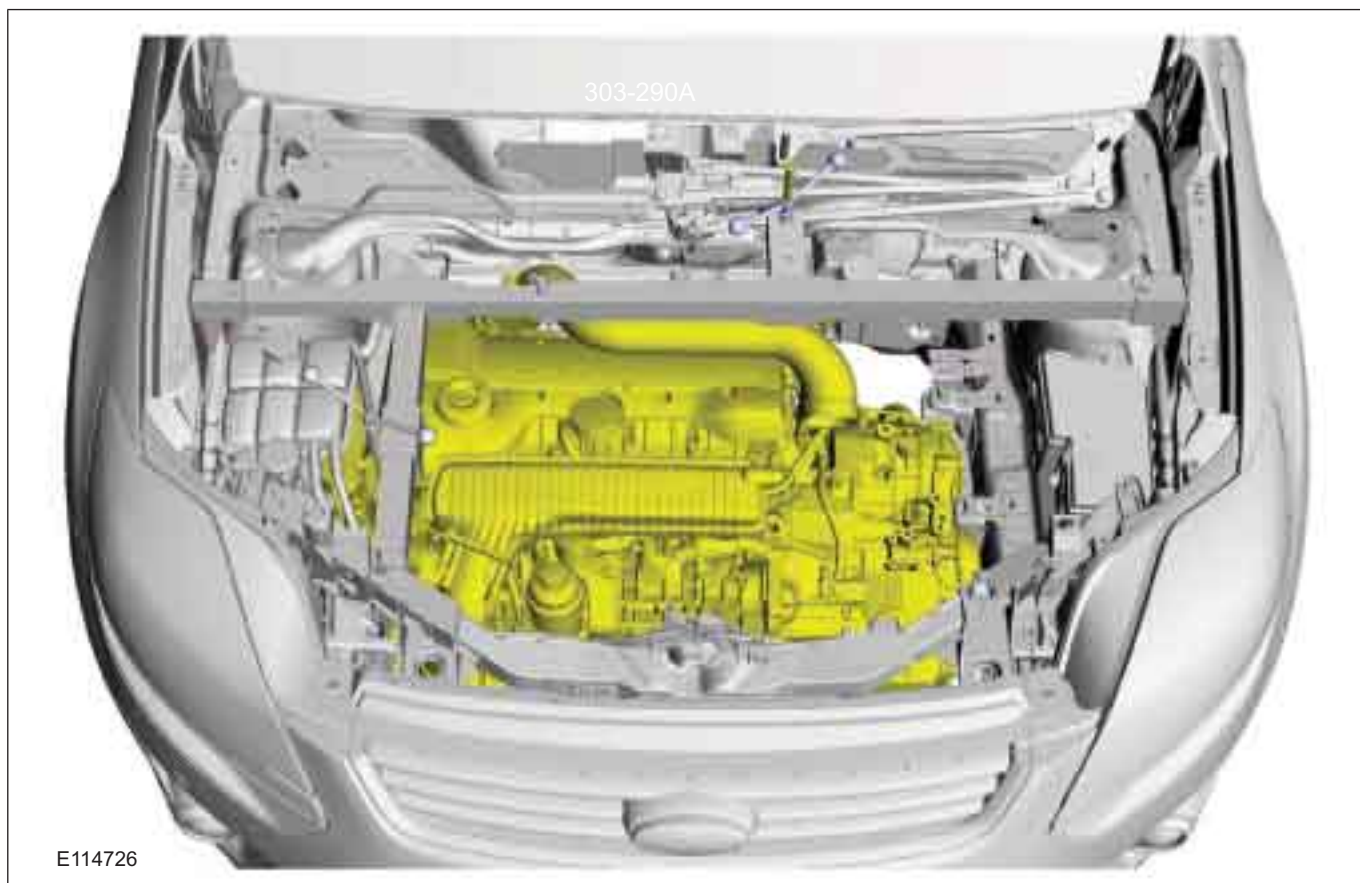


307-01-89

5-Speed Automatic Transaxle - AW55 AWD

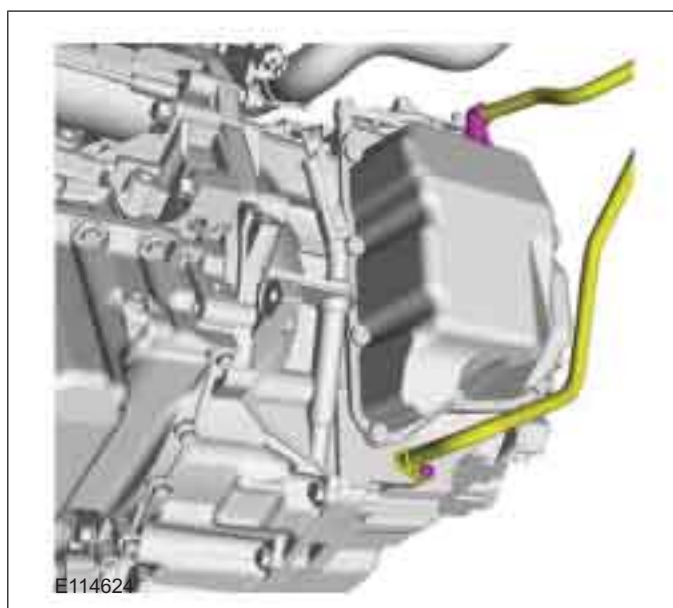
307-01-89

## REMOVAL

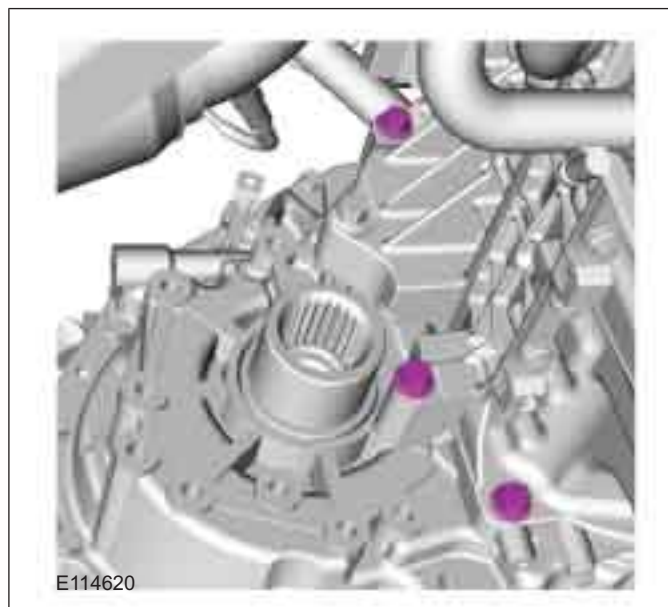


35. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

36. **CAUTION:** Make sure that all openings are sealed.



37.





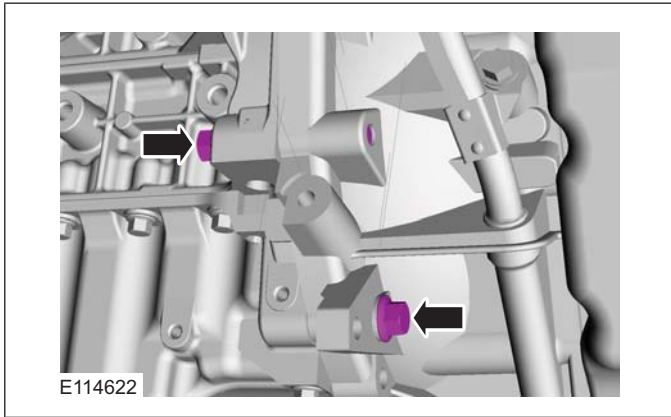
307-01-90

5-Speed Automatic Transaxle - AW55 AWD

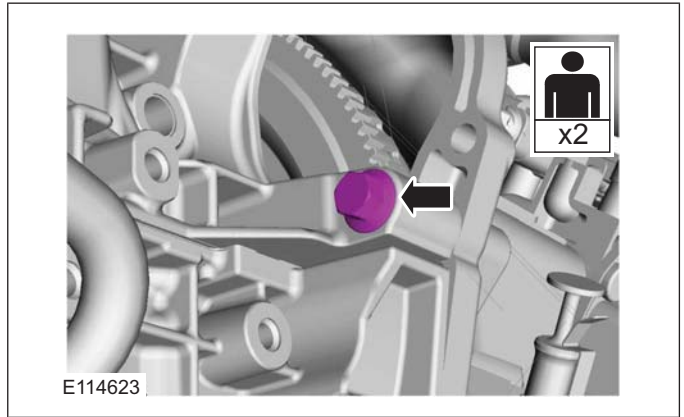
307-01-90

REMOVAL

38.



41.

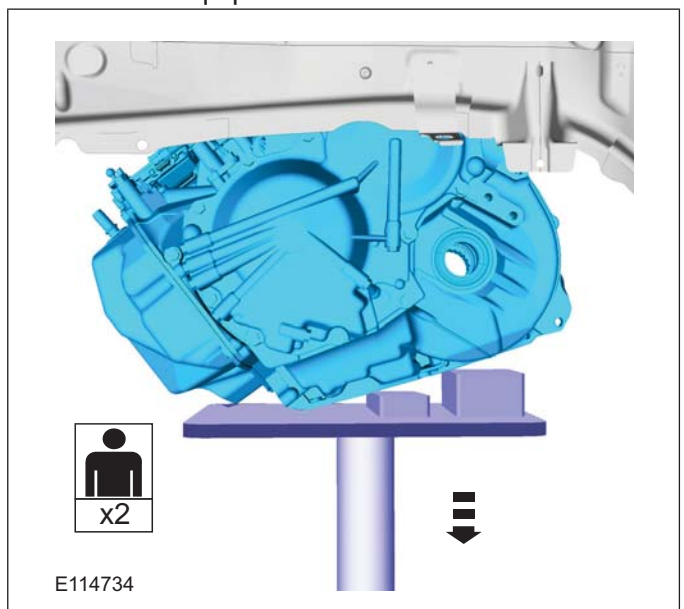
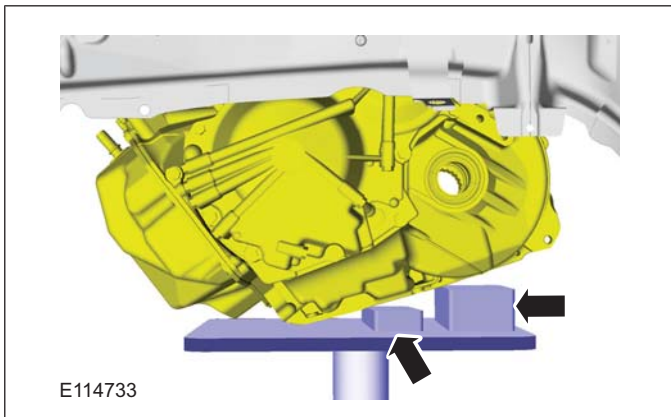


39. Install the following items:

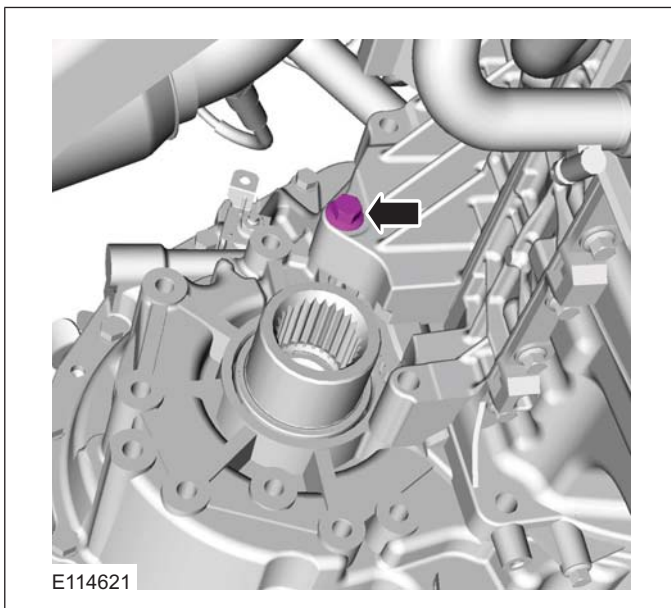
- 1. General Equipment: Wooden Block
- General Equipment: Transmission Jack

42. **WARNING:** This step requires the aid of another technician.

General Equipment: Transmission Jack



40.

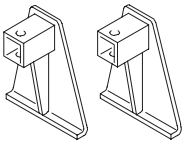
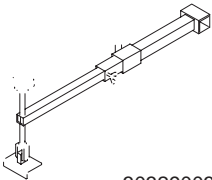
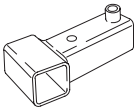
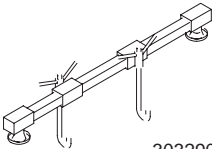
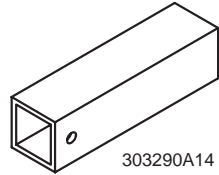


INSTALLATION

Transmission

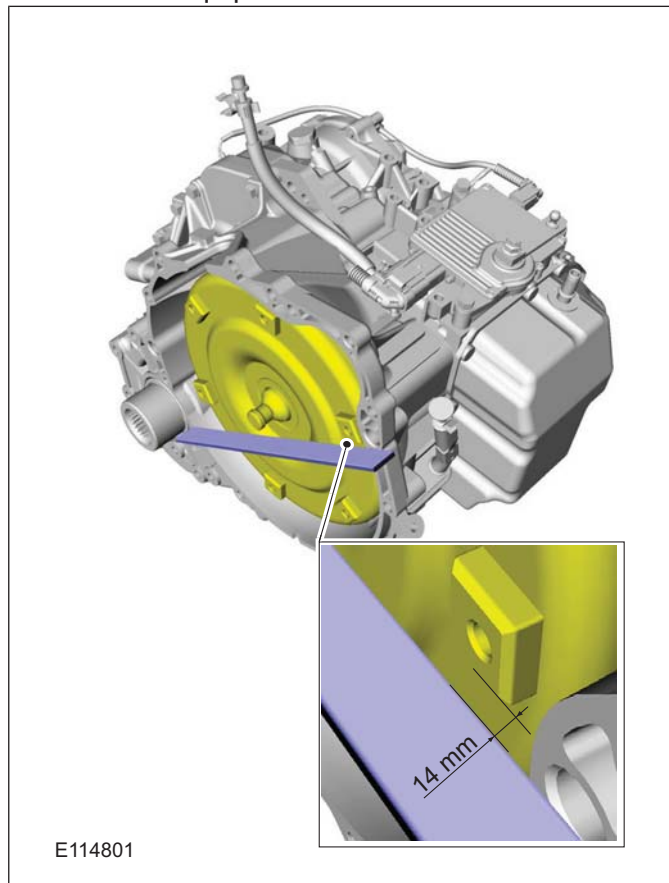
Installation

Special Tool(s) / General Equipment

 <p>2114001</p>	<p>303-290-01 Adapter for 303-290A</p>
 <p>30329003A</p>	<p>303-290-03A Adapter for 303-290A</p>
 <p>30329005A</p>	<p>303-290-05A Adapter for 303-290A</p>
 <p>303290A</p>	<p>303-290A Support Bar, Engine</p>
 <p>303290A14</p>	<p>303-290A-14 Adapter for 303-290A</p>
<p>Cable Ties</p>	
<p>Round-Ended Steel Rule</p>	
<p>Transmission Jack</p>	
<p>Wooden Block</p>	

Materials	
Name	Specification
Grease K-HT	ESD-M1C220-A / A88SX1C220AA
Grease KS-PS	SA-M1C9107-A / YS5J-M1C9107-AA

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
3. General Equipment: Round-Ended Steel Rule



4. **WARNING:** This step requires the aid of another technician.

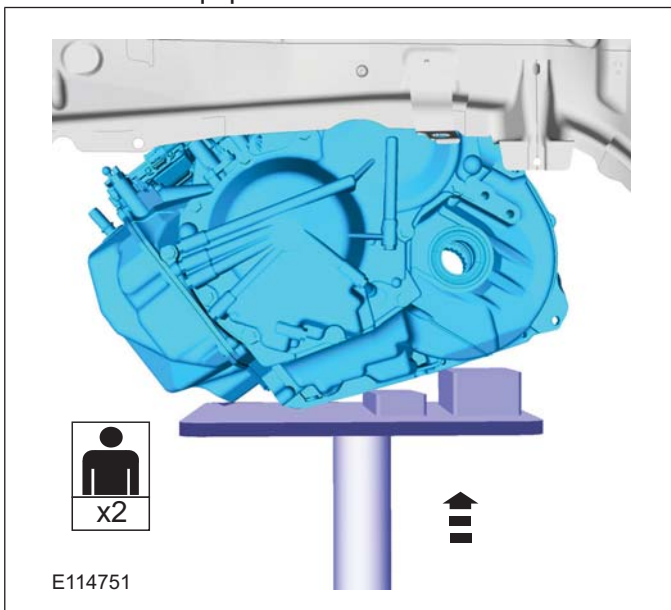
CAUTIONS:

- CAUTION:** Make sure that the locating dowels remain installed.

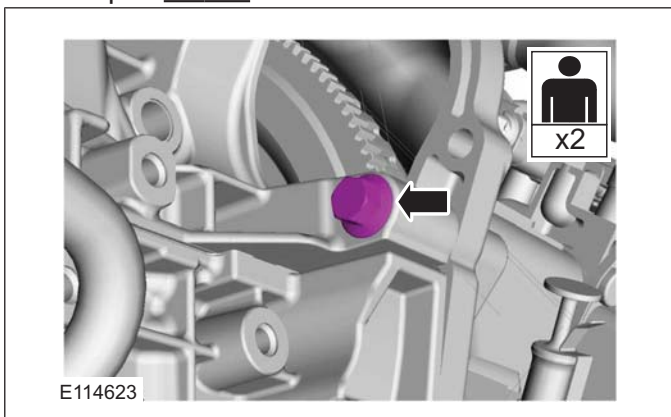
INSTALLATION

**⚠** Make sure that the torque converter remains in the transmission.

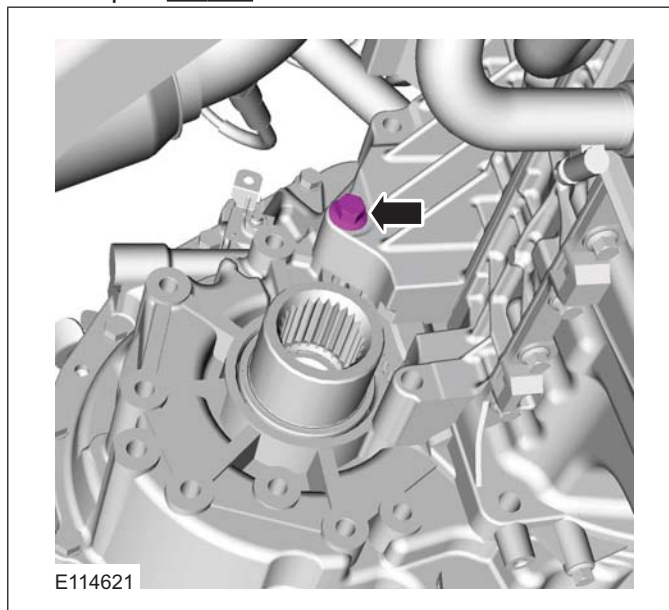
General Equipment: Transmission Jack



5. Perform this and the following operation simultaneously.  
Torque: 48 Nm

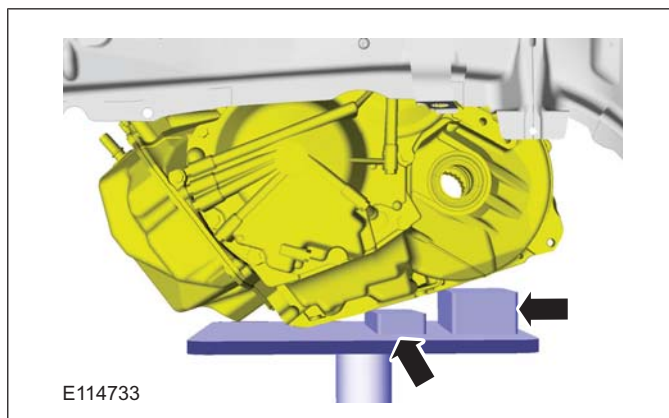


6. Torque: 48 Nm

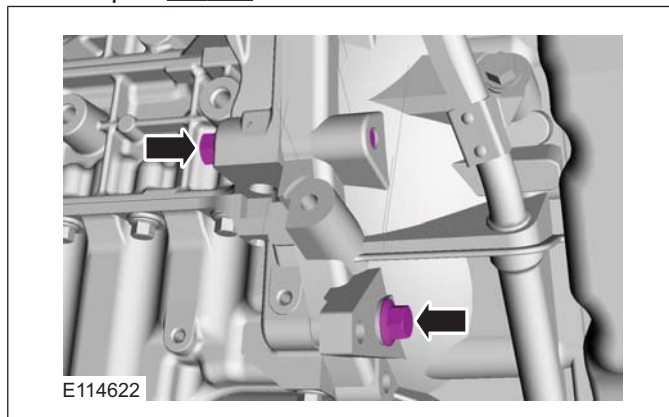


7. Remove the following items:

1. General Equipment: Wooden Block
- General Equipment: Transmission Jack



8. Torque: 48 Nm





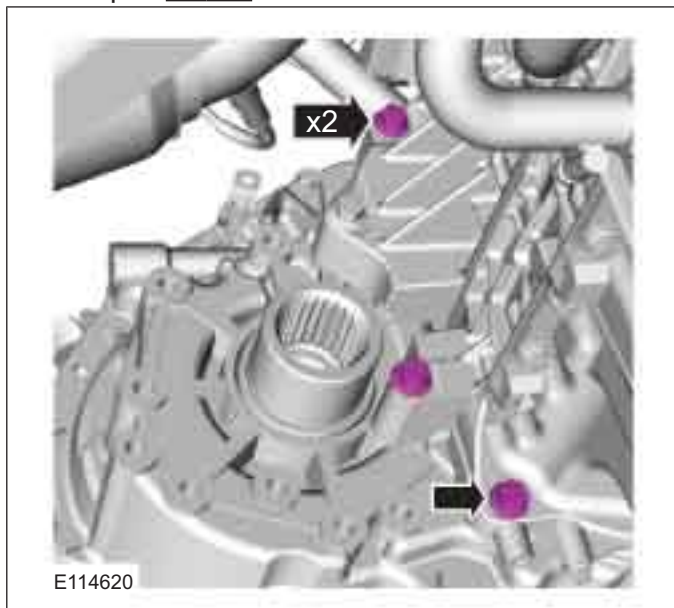
307-01-93

5-Speed Automatic Transaxle - AW55 AWD

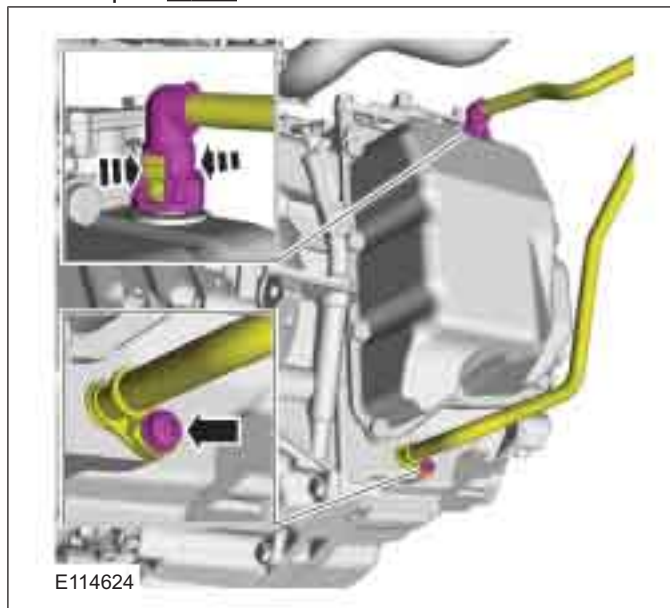
307-01-93

INSTALLATION

9. Torque: 48 Nm

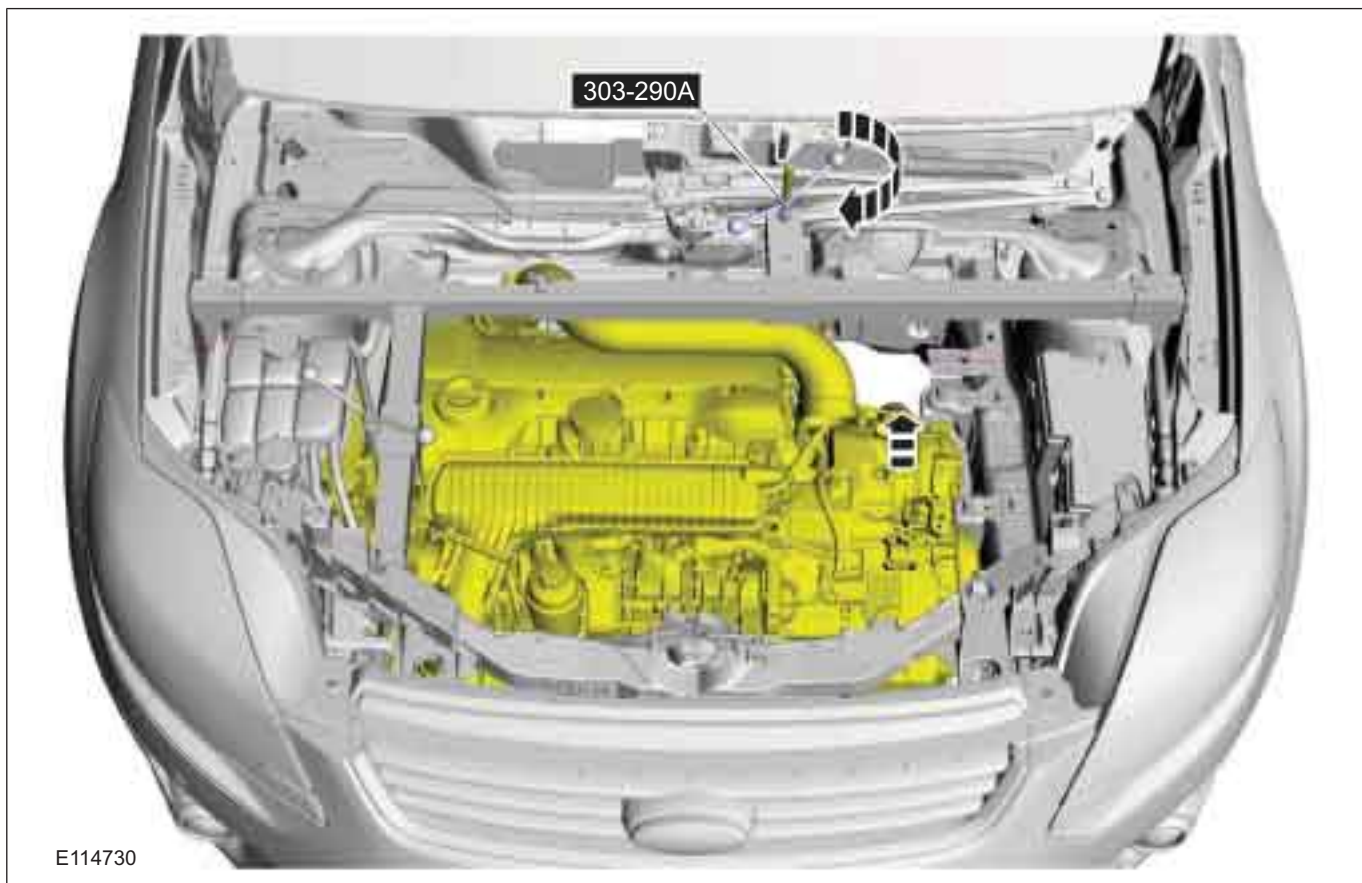


10. Torque: 6 Nm



11. Lower the vehicle.

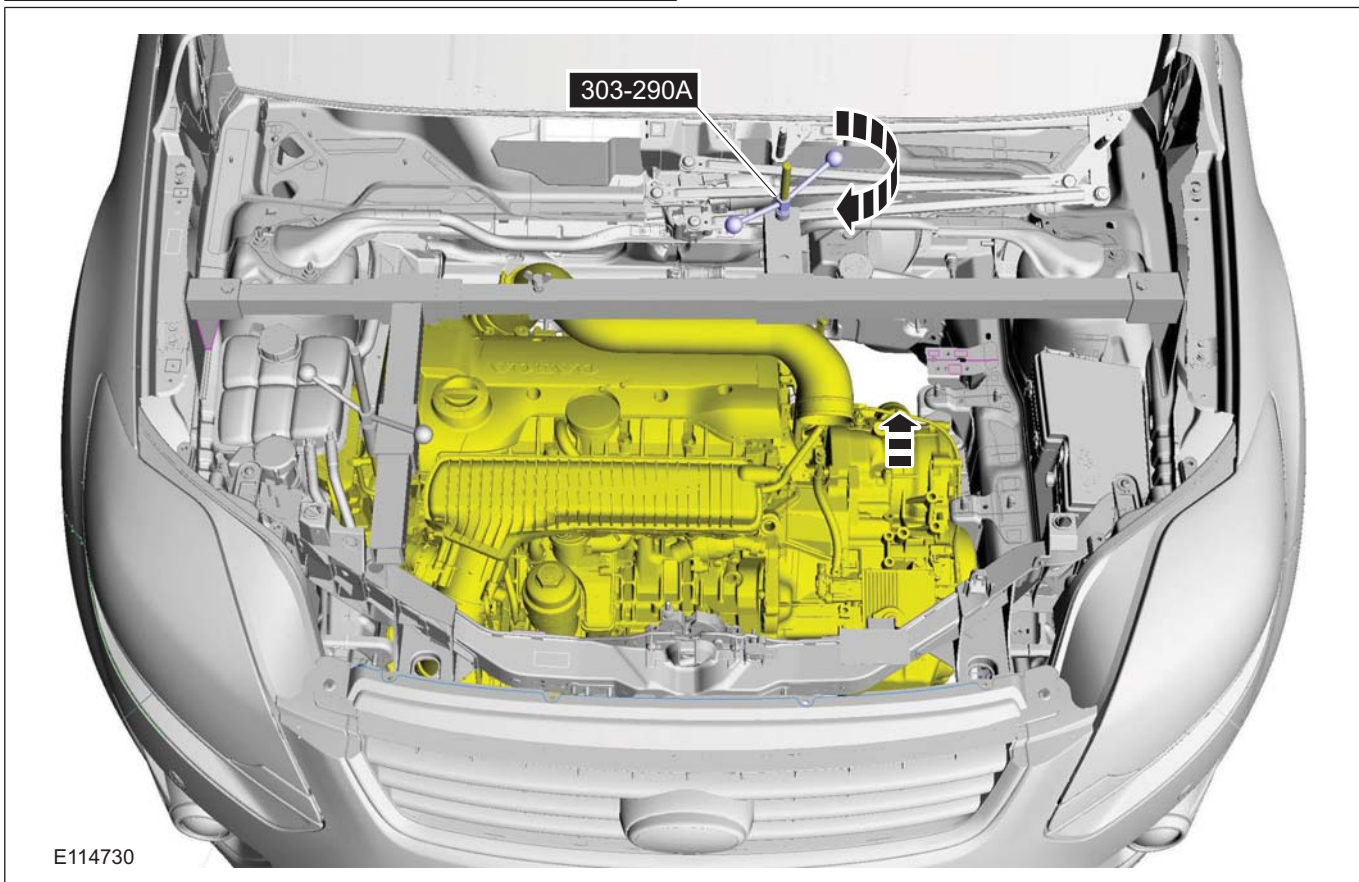
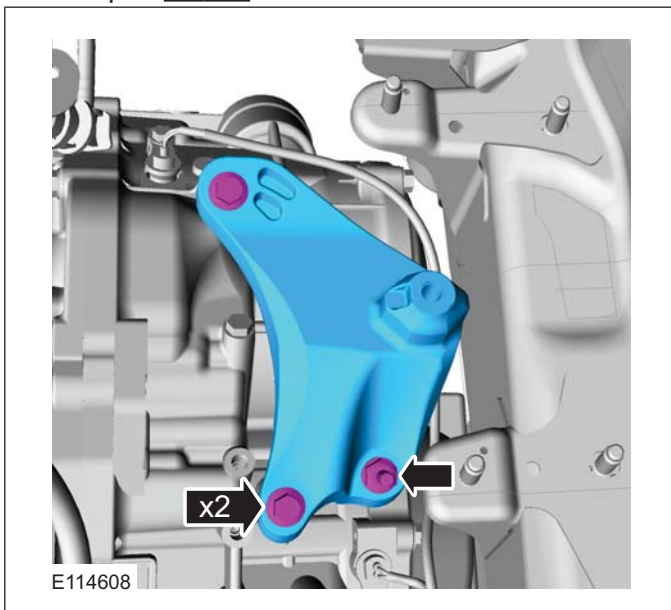
12 Special Tool(s): 303-290A



INSTALLATION

13. Torque: 80 Nm

14. Special Tool(s): 303-290A





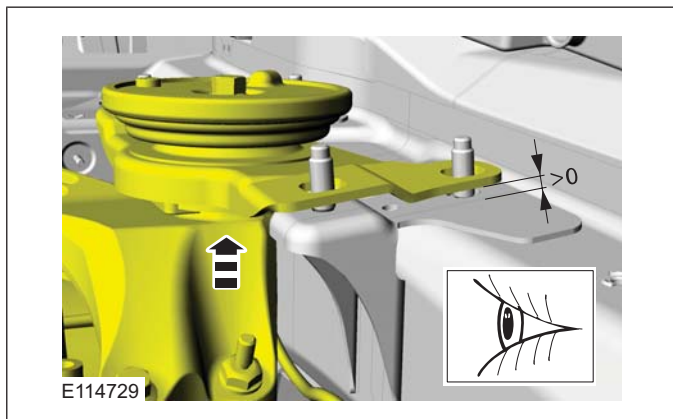
307-01-95

5-Speed Automatic Transaxle - AW55 AWD

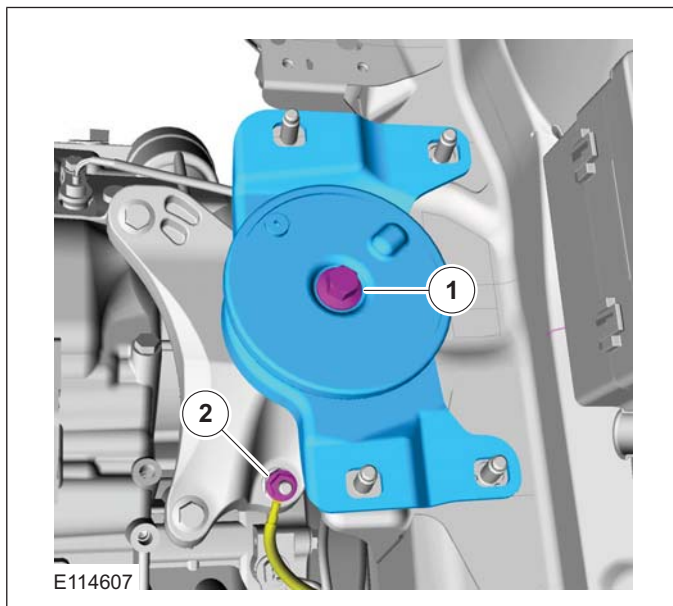
307-01-95

INSTALLATION

15.



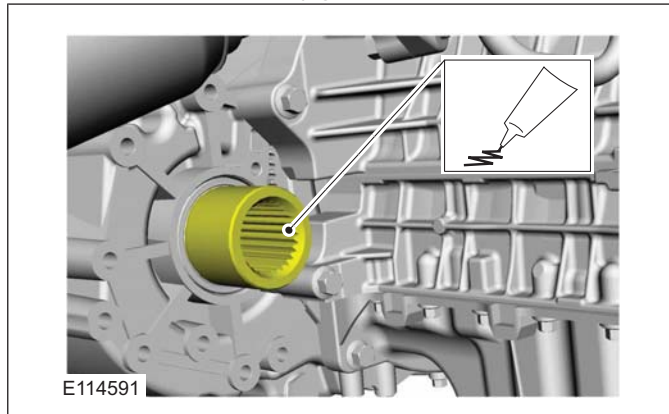
- 16. 1. Torque: 148 Nm
- 2. Torque: 10 Nm



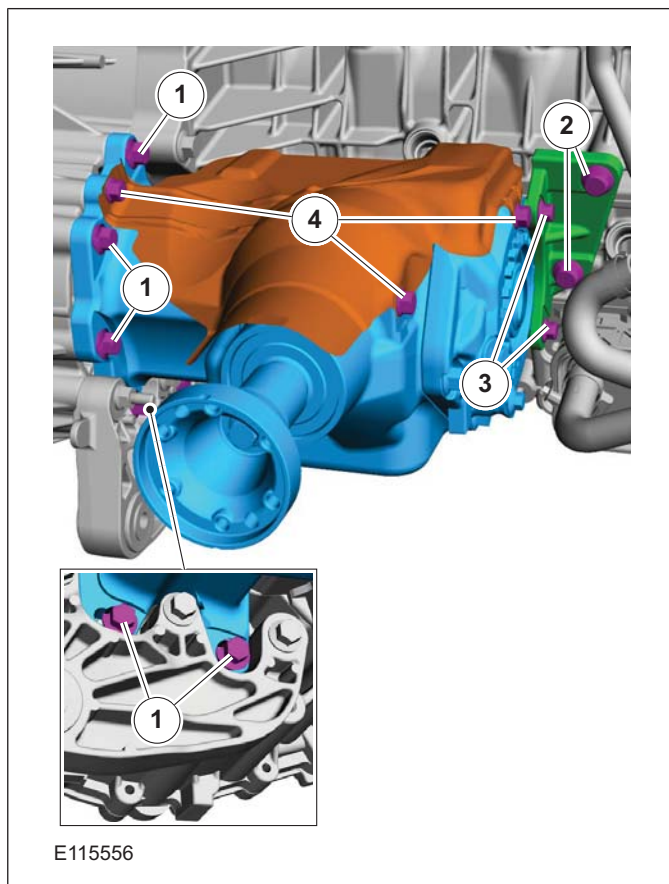
- 17. Remove the Special Tool(s): 303-290-01, 303-290-03A, 303-290-05A, 303-290A, 303-290A-14

- 18. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

- 19. Material: Grease K-HT (ESD-M1C220-A / A88SX1C220AA) grease

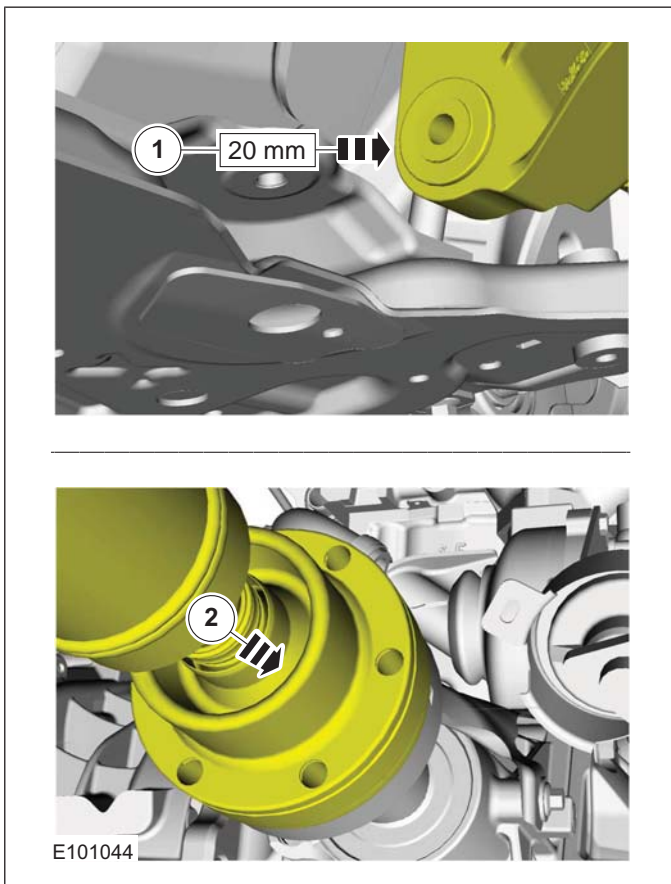


- 20. 1. Torque: 60 Nm
- 2. Torque: 60 Nm
- 3. Torque: 25 Nm
- 4. Torque: 9 Nm

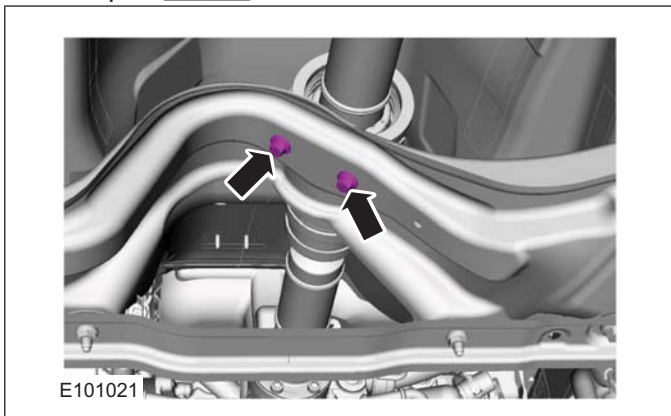


INSTALLATION

21.



22 Torque: 25 Nm

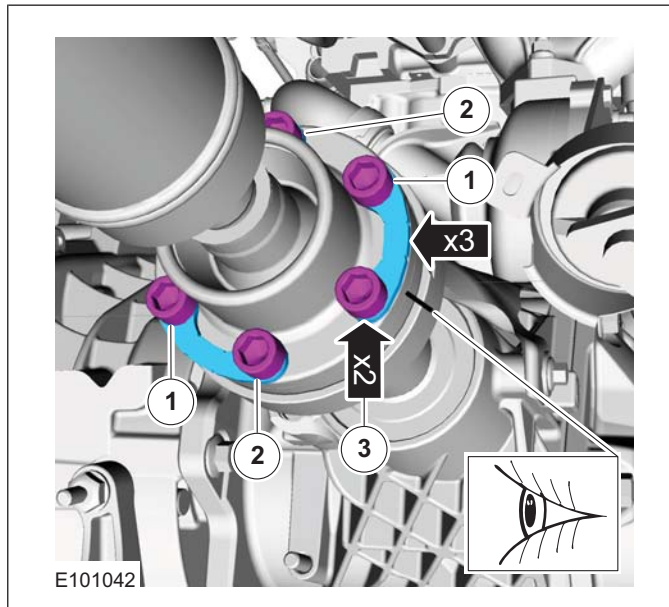


23. 1. **⚠ CAUTION:** Make sure that the installation marks are aligned.

Torque: 35 Nm

2. Torque: 35 Nm

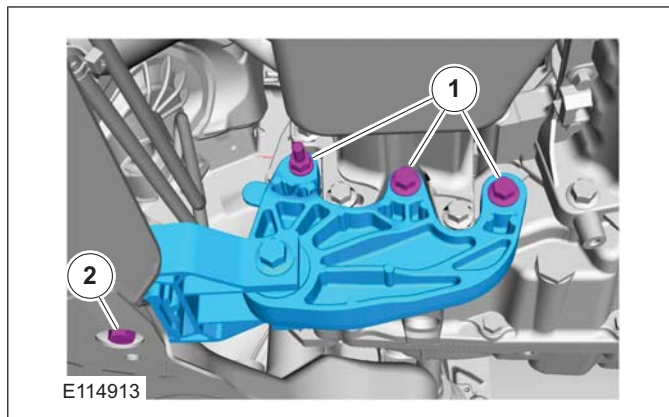
3. Torque: 35 Nm



24. Refer to: **Front Halfshaft LH** (205-04 Front Drive Halfshafts, Removal and Installation).

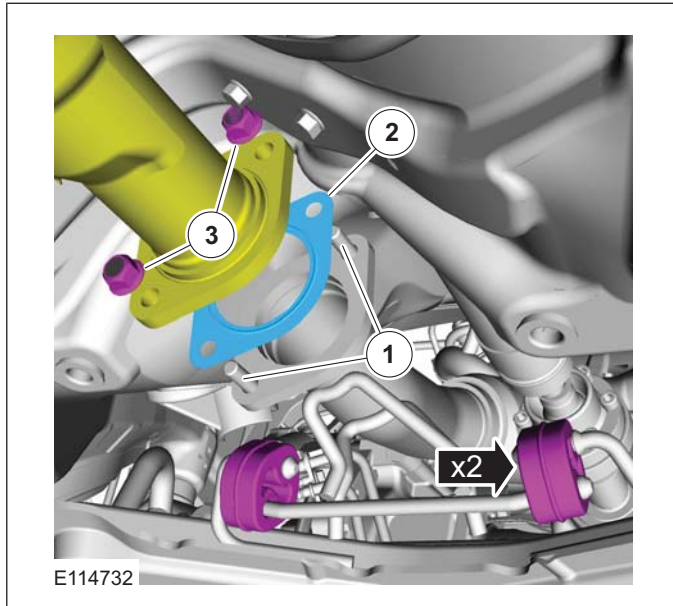
25. 1. Torque: 48 Nm

2. Torque: 80 Nm

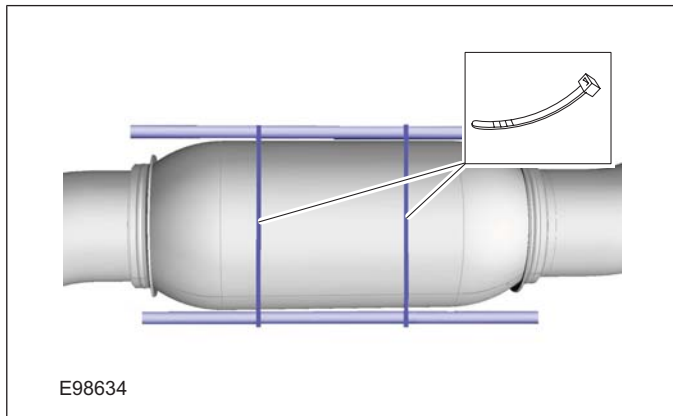


**INSTALLATION**

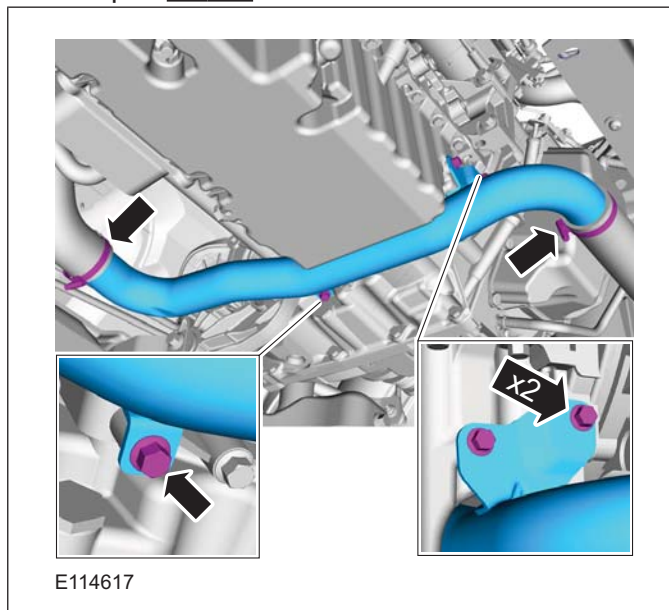
- 26. 1. Material: Grease KS-PS (SA-M1C9107-A / YS5J-M1C9107-AA) grease
- 2. **NOTE:** Make sure that a new component is installed.
- 3. Torque: 48 Nm



- 27. Remove the following items:
  - 1. General Equipment: Cable Ties



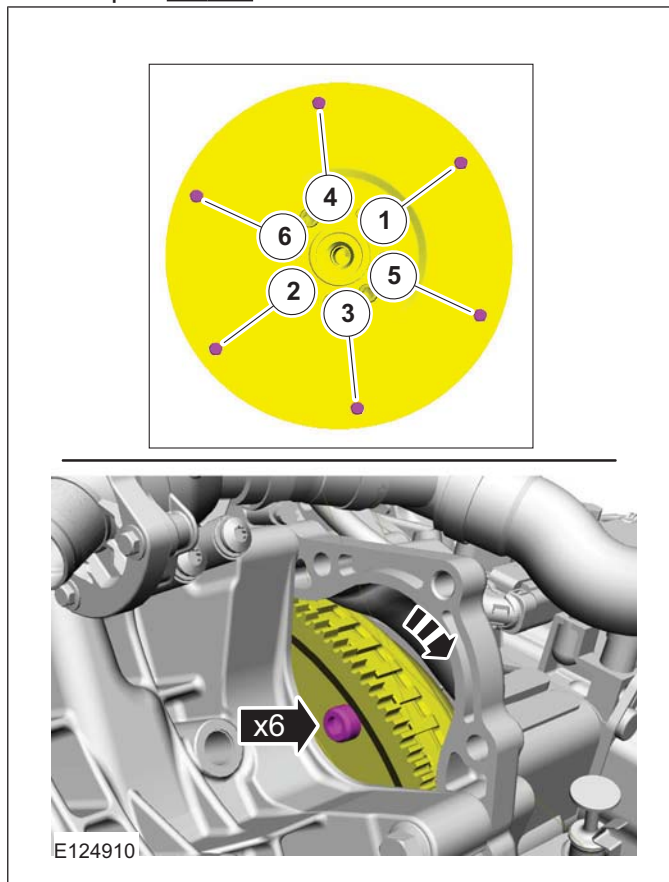
- 28. Torque: 10 Nm



- 29. Lower the vehicle.

- 30. **NOTE:** Install all the bolts finger tight before final tightening.

Torque: 60 Nm





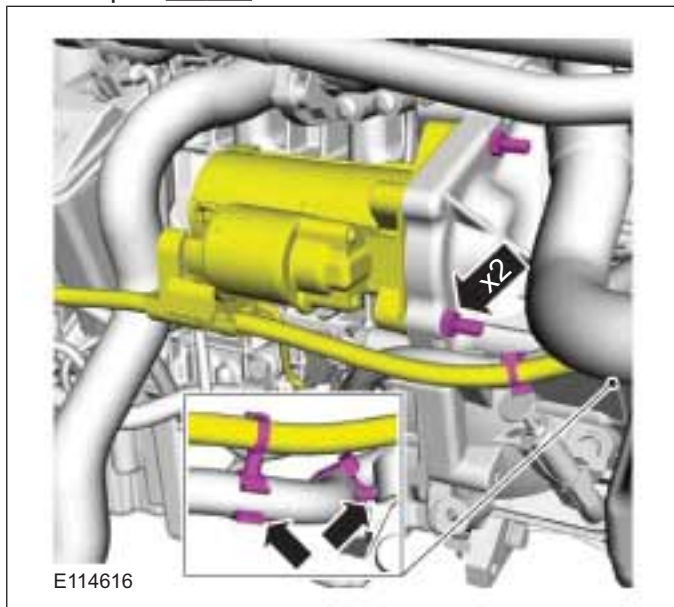
307-01-98

5-Speed Automatic Transaxle - AW55 AWD

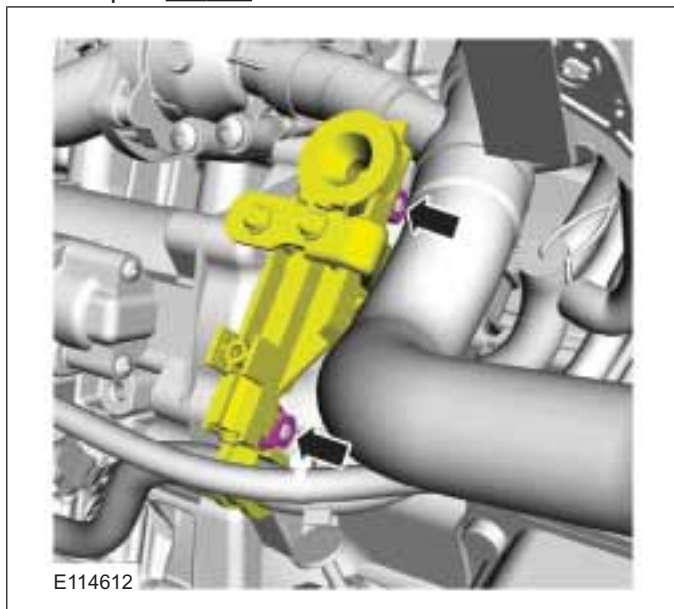
307-01-98

INSTALLATION

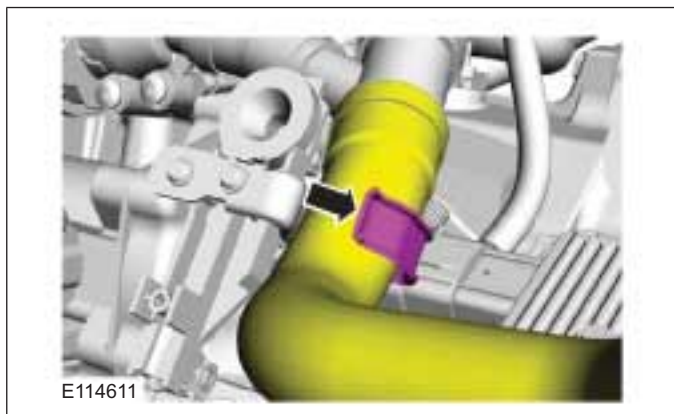
31. Torque: 40 Nm



32 Torque: 25 Nm

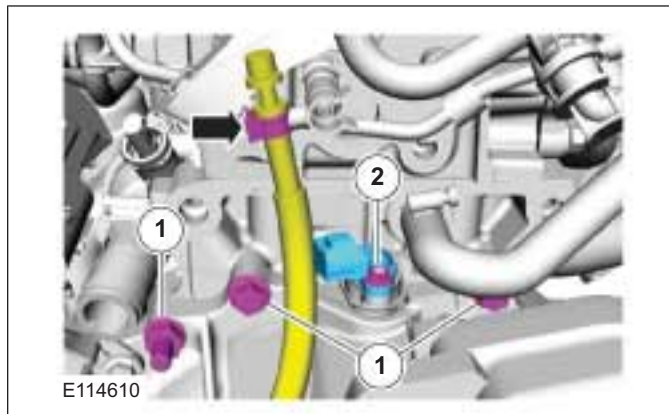


33.

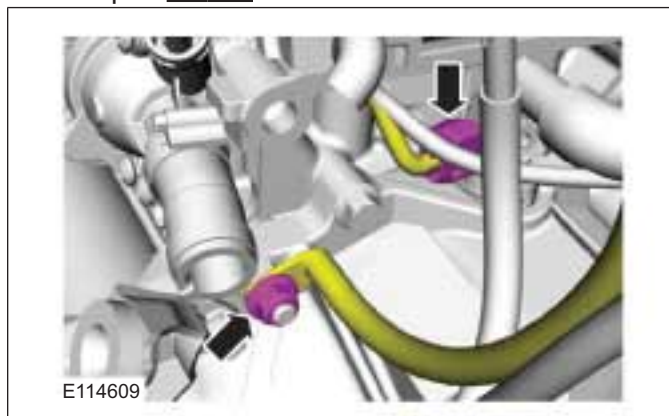


34. 1. Torque: 48 Nm

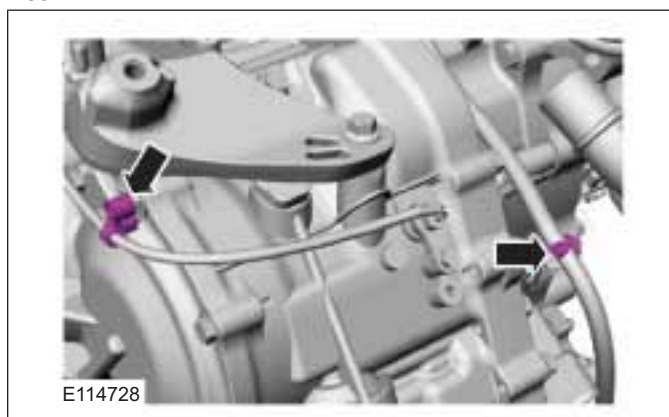
2. Torque: 9 Nm



35. Torque: 25 Nm



36.



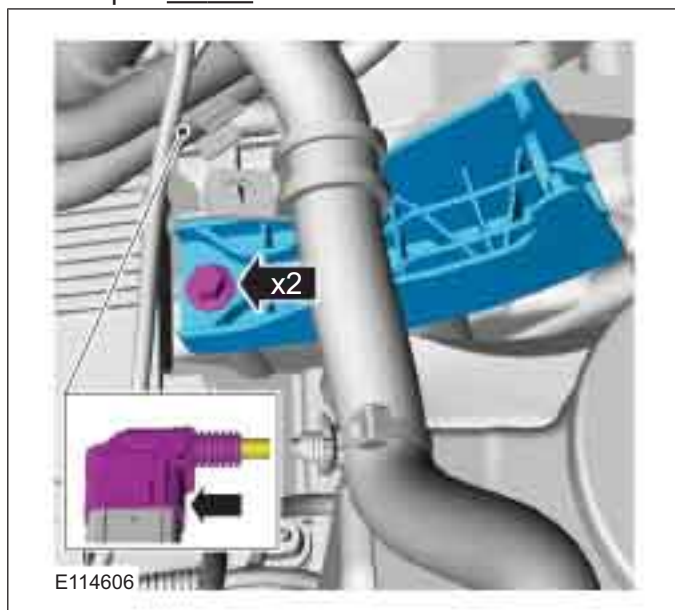
307-01-99

5-Speed Automatic Transaxle - AW55 AWD

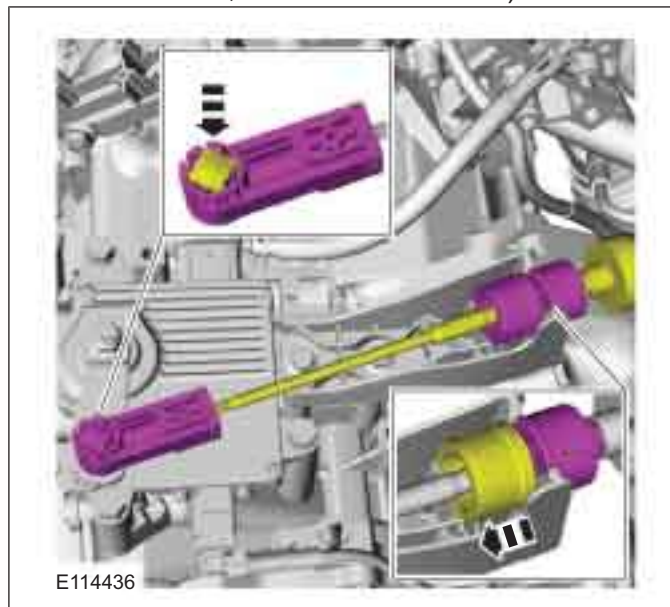
307-01-99

INSTALLATION

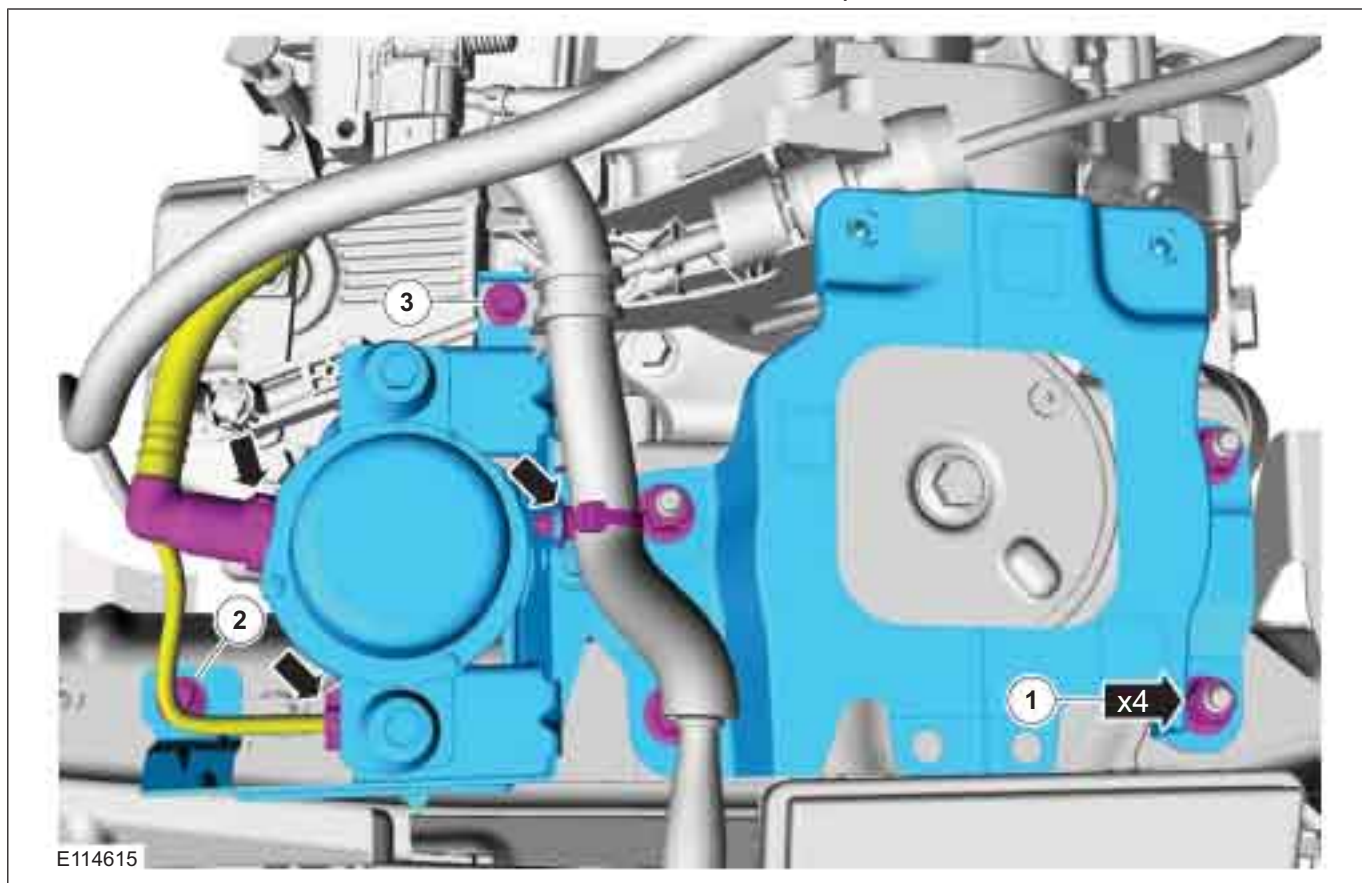
37. Torque: 25 Nm



38. Refer to: **Selector Lever Cable Adjustment - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD** (307-05 Automatic Transmission/Transaxle External Controls - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, General Procedures).



- 39. 1. Torque: 48 Nm
- 2. Torque: 25 Nm
- 3. Torque: 10 Nm



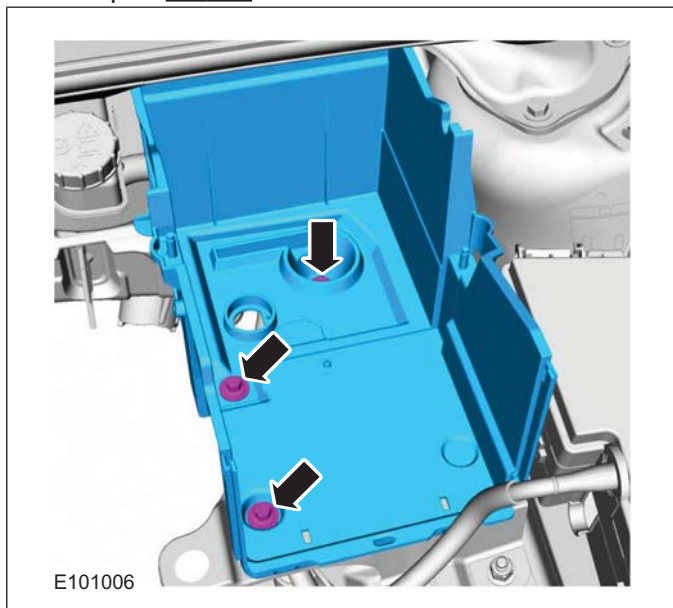
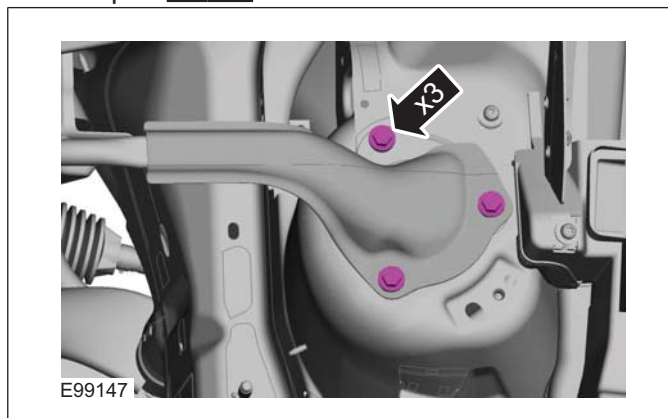


307-01-100

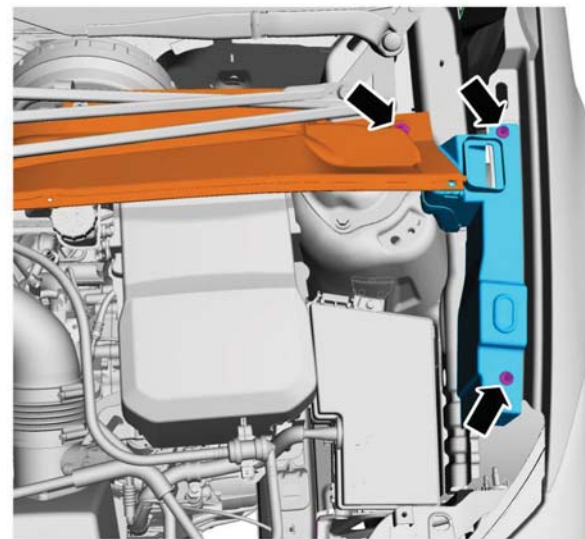
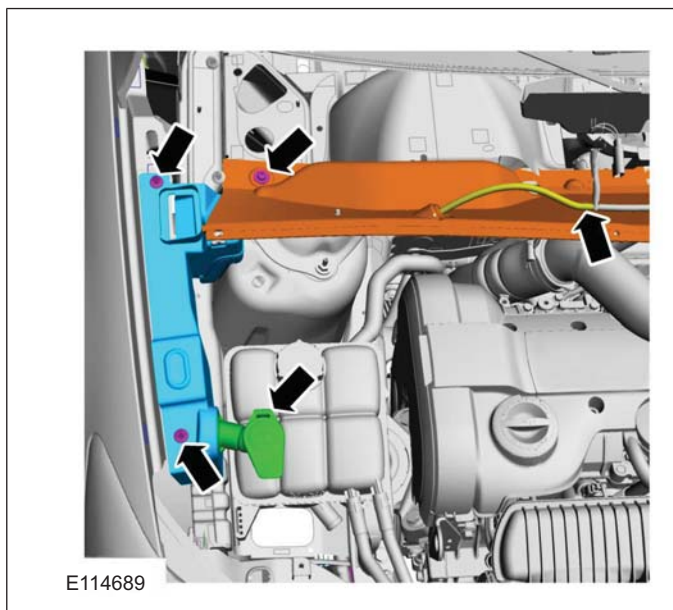
5-Speed Automatic Transaxle - AW55 AWD

307-01-100

## INSTALLATION

40. Torque: 10 Nm41. Refer to: **Battery** (414-01 Battery, Mounting and Cables, Removal and Installation).42. On both sides.  
Torque: 35 Nm43. Refer to: **Air Cleaner** (303-12 Intake Air Distribution and Filtering - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).

44.

45. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).  
Refer to: **Transmission Fluid Level Check** (307-01 Automatic Transmission/Transaxle - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD, General Procedures).

# SECTION 307-02 Transmission/Transaxle Cooling –

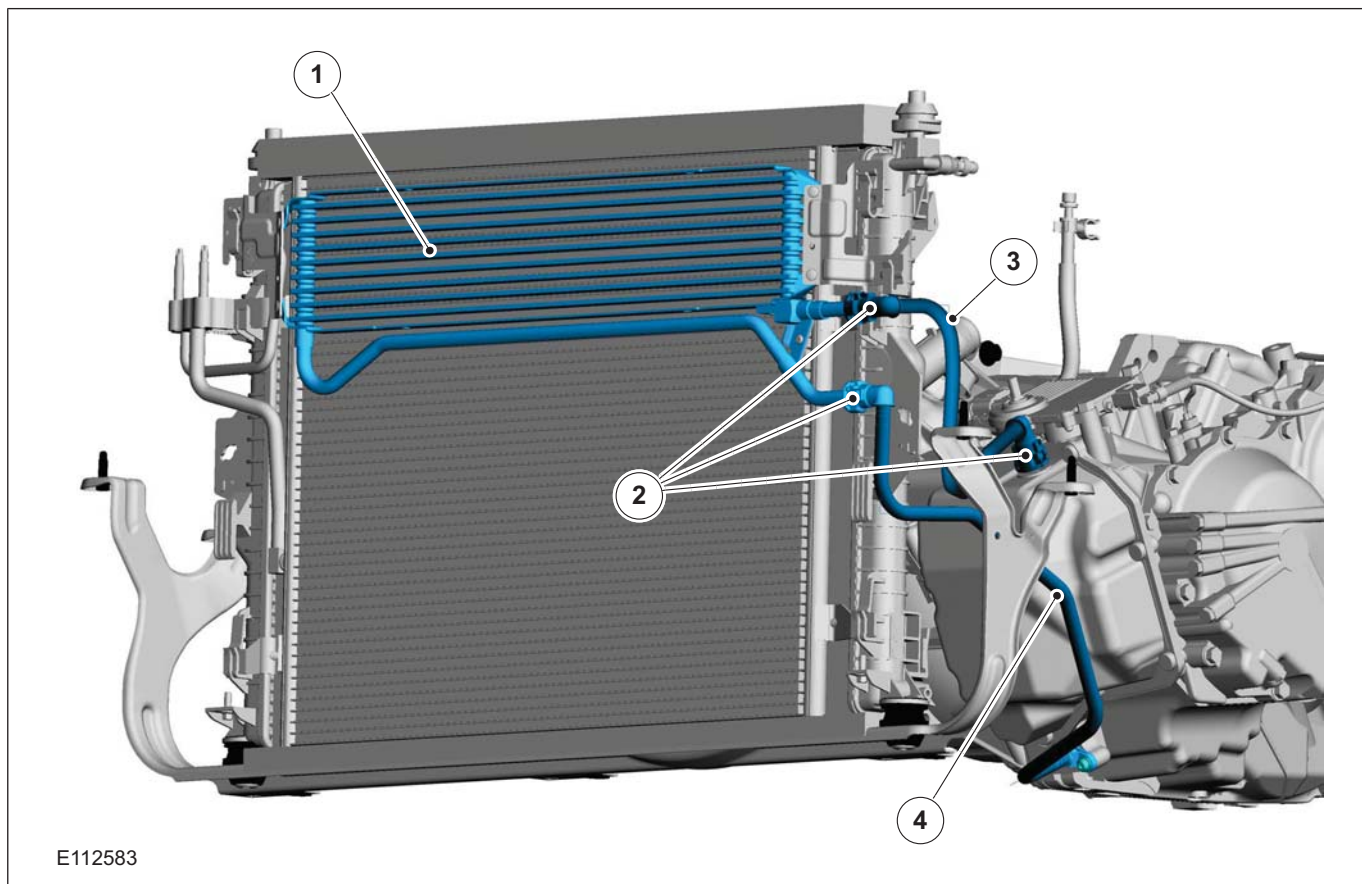
Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450

## VEHICLE APPLICATION: 2008.50 Kuga

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<b>DESCRIPTION AND OPERATION</b>	
Transmission Cooling (Component Location).....	307-02-2
Transmission Cooling (Overview).....	307-02-3
Overview.....	307-02-3
<b>REMOVAL AND INSTALLATION</b>	
Transmission Fluid Cooler — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD.	307-02-4
Transmission Fluid Cooler Tubes — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD.....	307-02-8

DESCRIPTION AND OPERATION

Transmission Cooling – Component Location



Item	Description
1	The transmission fluid cooler.
2	Push connect fittings

Item	Description
3	From transmission fluid cooler to transmission
4	From transmission to transmission fluid cooler

## DESCRIPTION AND OPERATION

### Transmission Cooling – Overview

#### Overview

The transmission fluid cooler is secured on the radiator.

The transmission fluid cooler operates according to the heat exchanger principle. The ram air passing through the radiator withdraws heat from the transmission fluid.

REMOVAL AND INSTALLATION

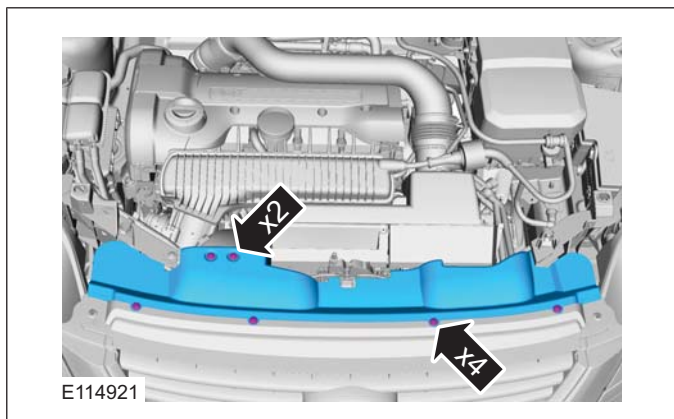
Transmission Fluid Cooler — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD

Removal

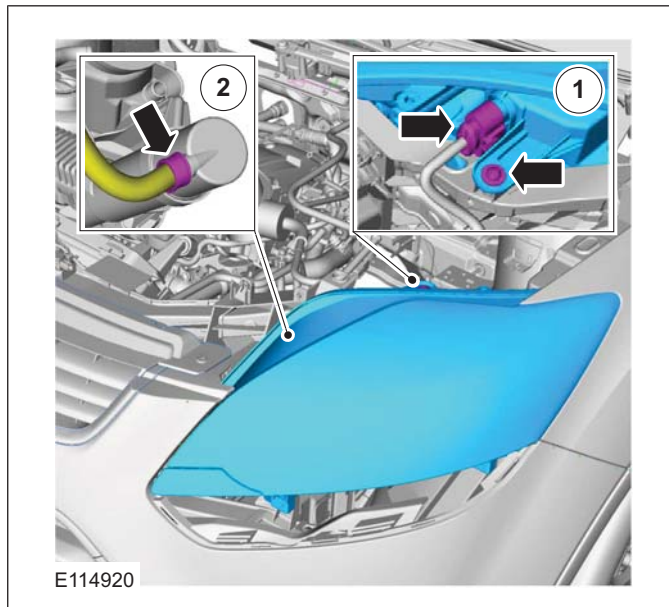
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).

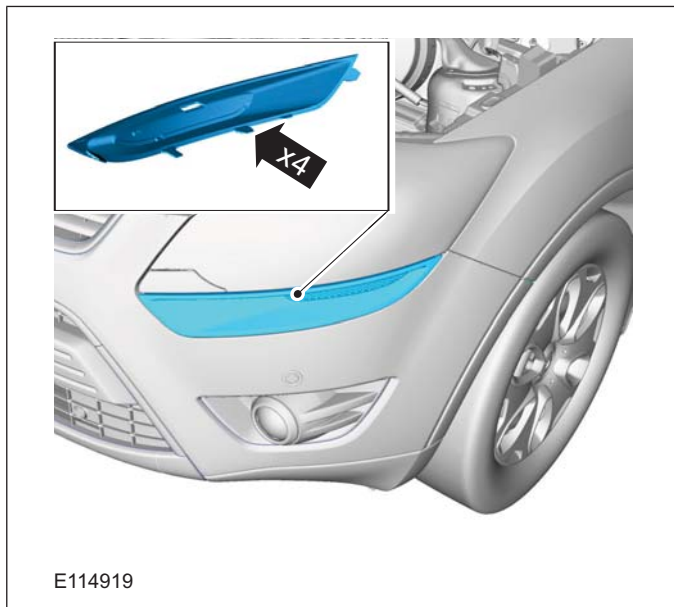
2.



4. 2. If equipped.



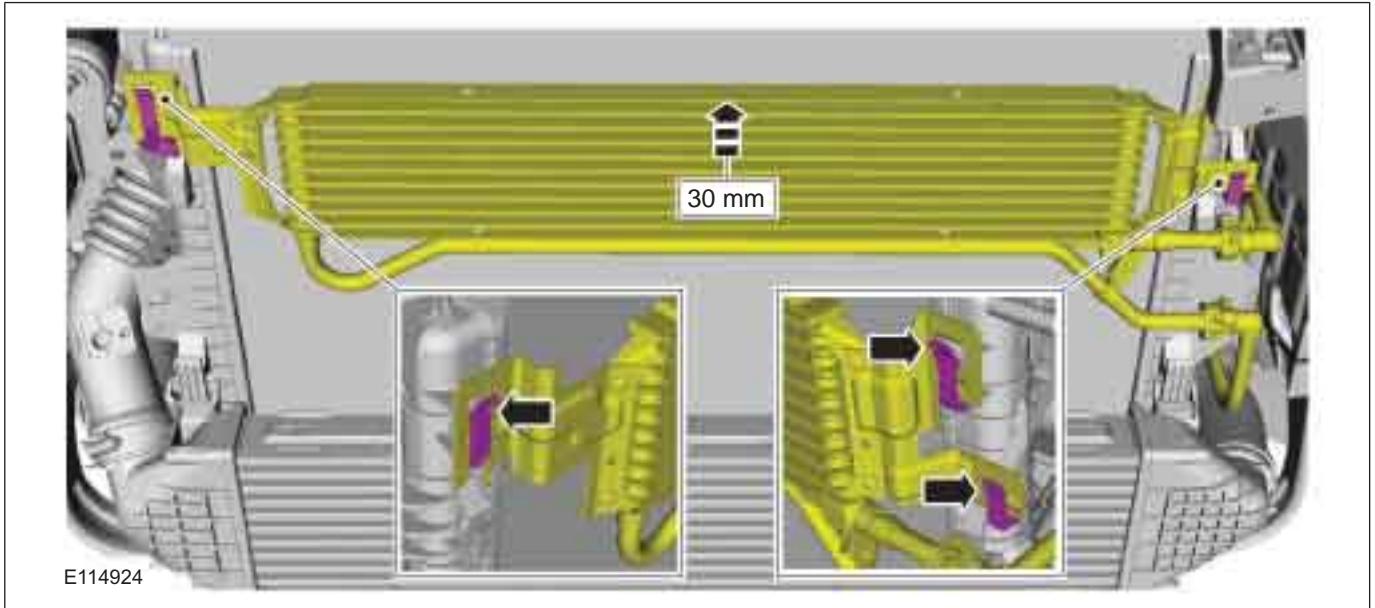
3.



5.

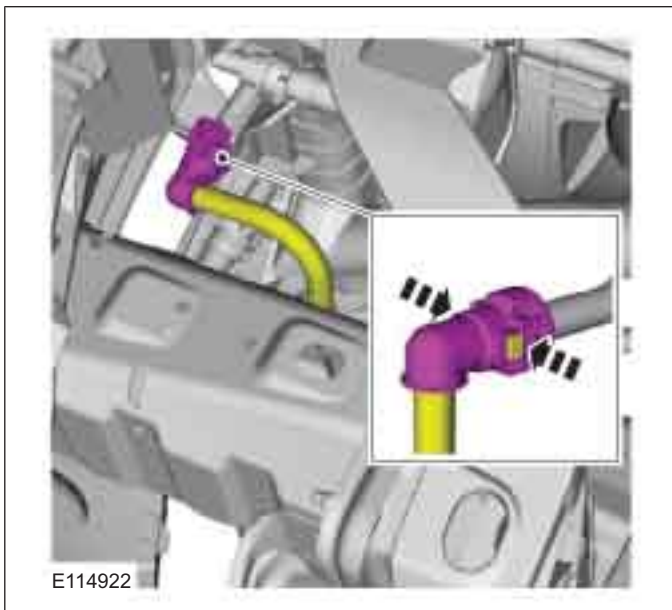


REMOVAL AND INSTALLATION

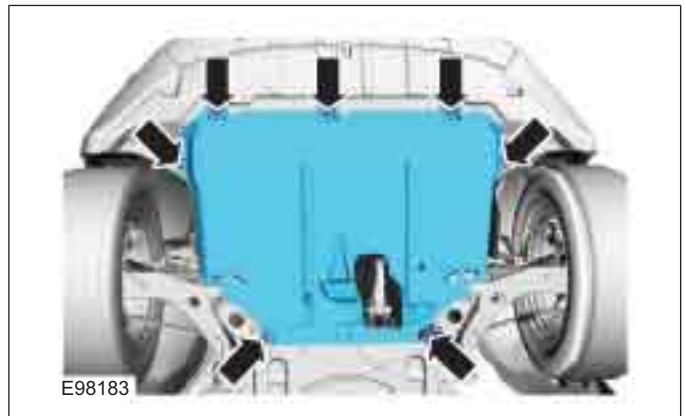


6. **CAUTION:** Make sure that all openings are sealed.

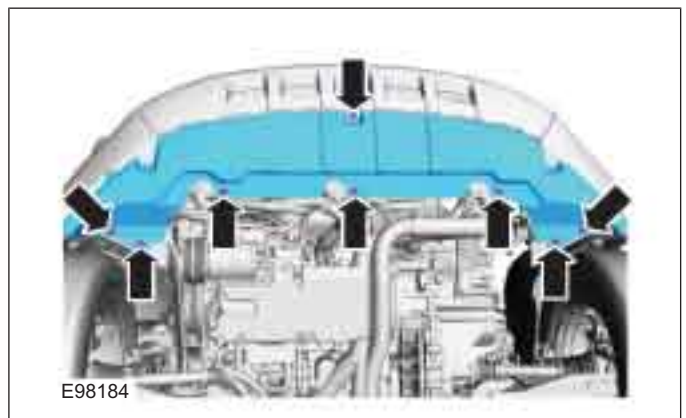
7. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).



8.

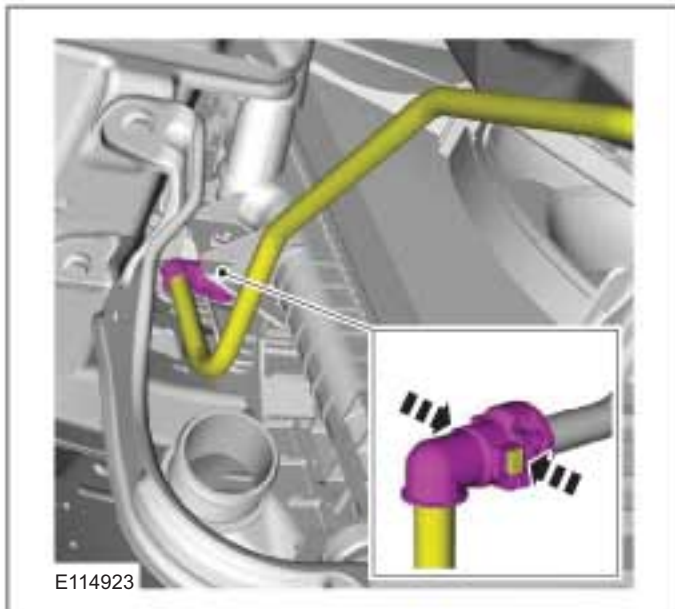


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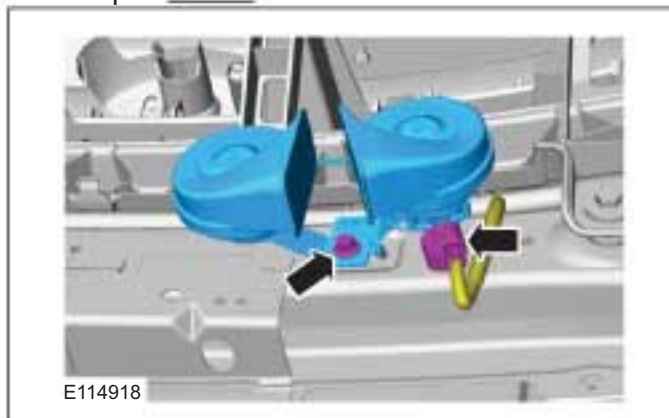


REMOVAL AND INSTALLATION

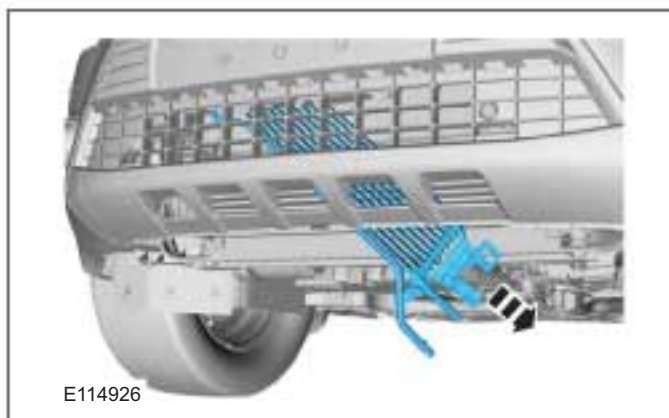
10.  **CAUTION:** Make sure that all openings are sealed.



11. Torque: 15 Nm

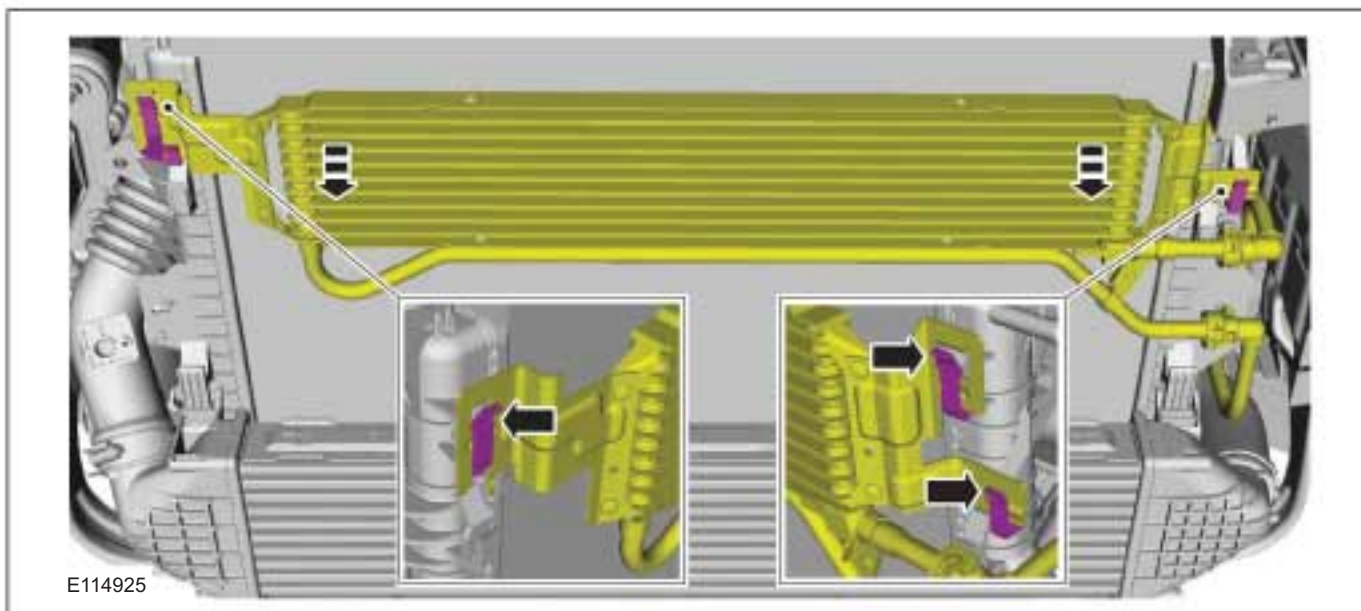


12



Installation

1. To install, reverse the removal procedure.
- 2.



## REMOVAL AND INSTALLATION

3. Refer to: **Transfer Case Fluid Level Check**  
(307-07 Transfer Case - Vehicles With:  
5-Speed Automatic Transaxle - AW55  
AWD/6-Speed Automatic Transaxle -  
6DCT450, General Procedures).

## REMOVAL AND INSTALLATION

## Transmission Fluid Cooler Tubes — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD

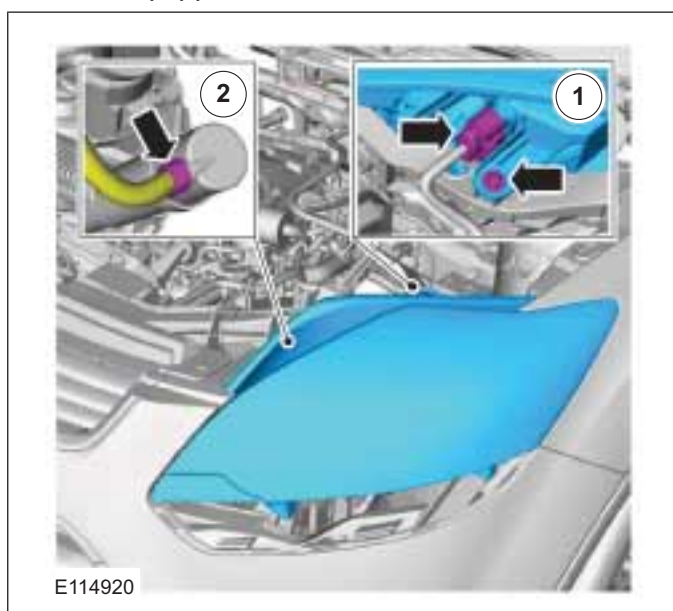
## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

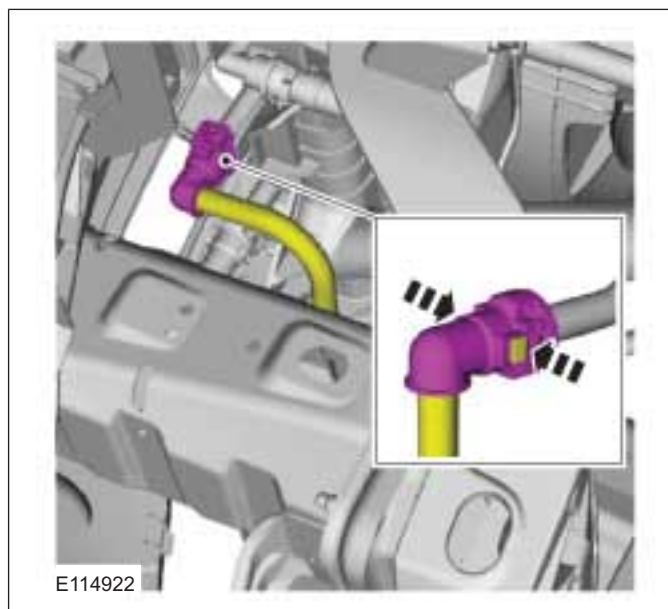
1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
- 2.



3. 2. If equipped.

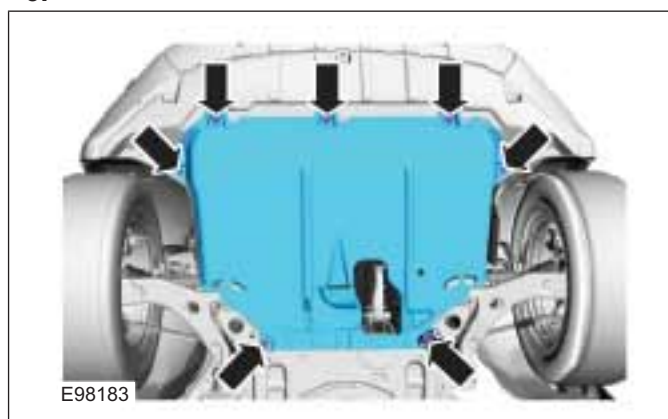


4. **CAUTION:** Make sure that all openings are sealed.



5. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

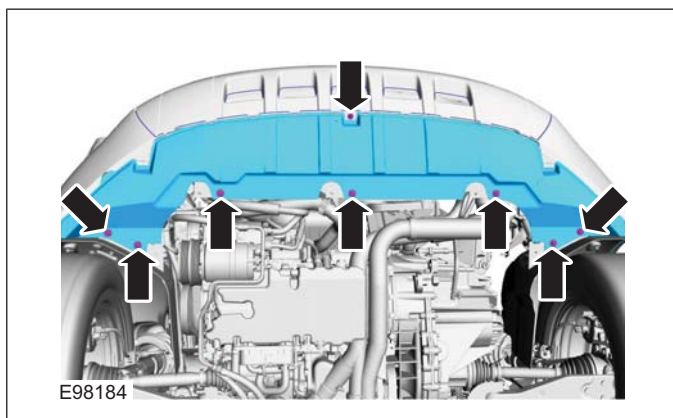
- 6.



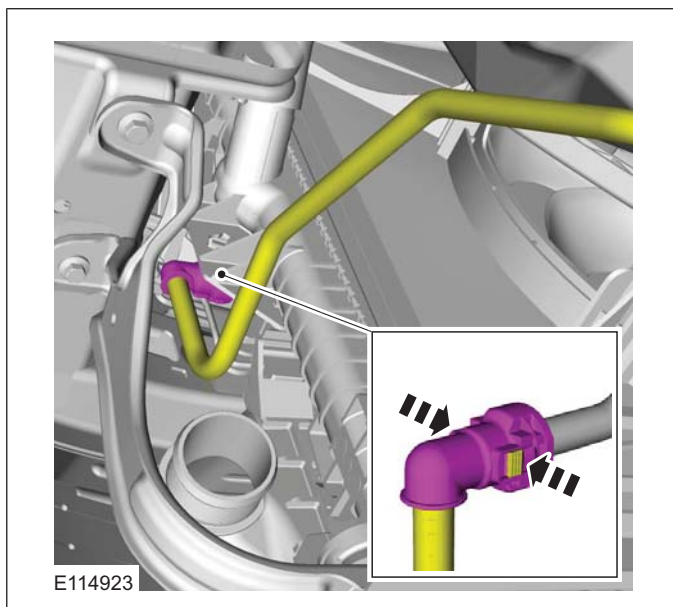


REMOVAL AND INSTALLATION

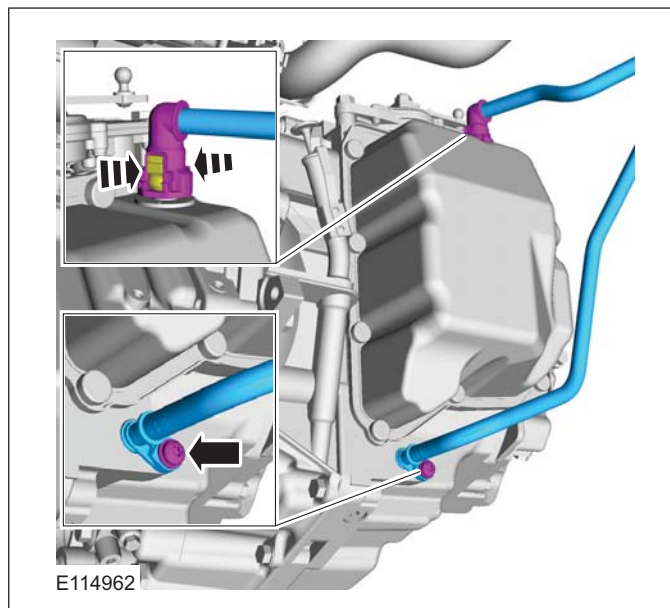
7.



8. **CAUTION:** Make sure that all openings are sealed.



9. **CAUTION:** Make sure that all openings are sealed.



Installation

1. To install, reverse the removal procedure.
2. Refer to: **Transmission Fluid Level Check** (307-01 Automatic Transmission/Transaxle - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD, General Procedures).



**Automatic Transmission/Transaxle External Controls** — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

307-05-1

Automatic Transaxle - 6DCT450

307-05-1

**SECTION 307-05 Automatic Transmission/Transaxle External Controls** — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

Automatic Transaxle - 6DCT450

**VEHICLE APPLICATION: 2008.50 Kuga**

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<b>DESCRIPTION AND OPERATION</b>	
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External Controls (Overview).....	307-05-4
Transmission range selector.....	307-05-4
Transmission range selector lever emergency release.....	307-05-4
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Selector Lever Cable Adjustment — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD.....	307-05-6
<b>REMOVAL AND INSTALLATION</b>	
Selector Lever Cable — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD.....	307-05-7
Selector Lever Assembly — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD..	307-05-11

## Automatic Transmission/Transaxle External Controls

— Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

Automatic Transaxle - 6DCT450

307-05-2

307-05-2

### SPECIFICATIONS

Information not available at this time.

# Automatic Transmission/Transaxle External Controls

— Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

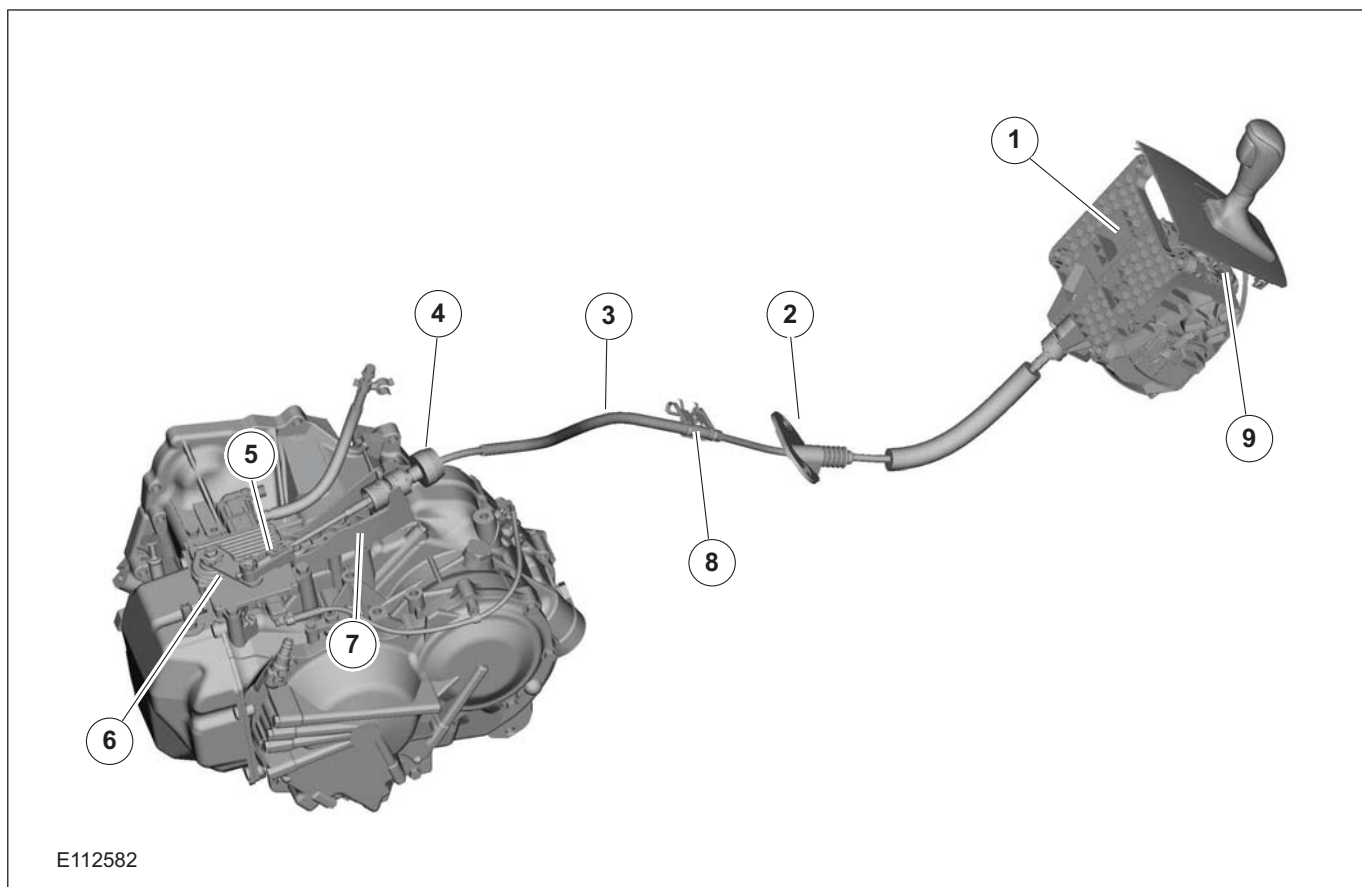
307-05-3

Automatic Transaxle - 6DCT450

307-05-3

## DESCRIPTION AND OPERATION

### External Controls – Component Location



Item	Description
1	Selector lever mechanism assembly
2	Selector lever cable guide
3	Selector cable
4	Damper weight

Item	Description
5	Adjusting mechanism for selector lever cable
6	Shift valve shaft lever
7	Selector lever cable bracket
8	Edge Clip

## Automatic Transmission/Transaxle External Controls

— Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

307-05-4

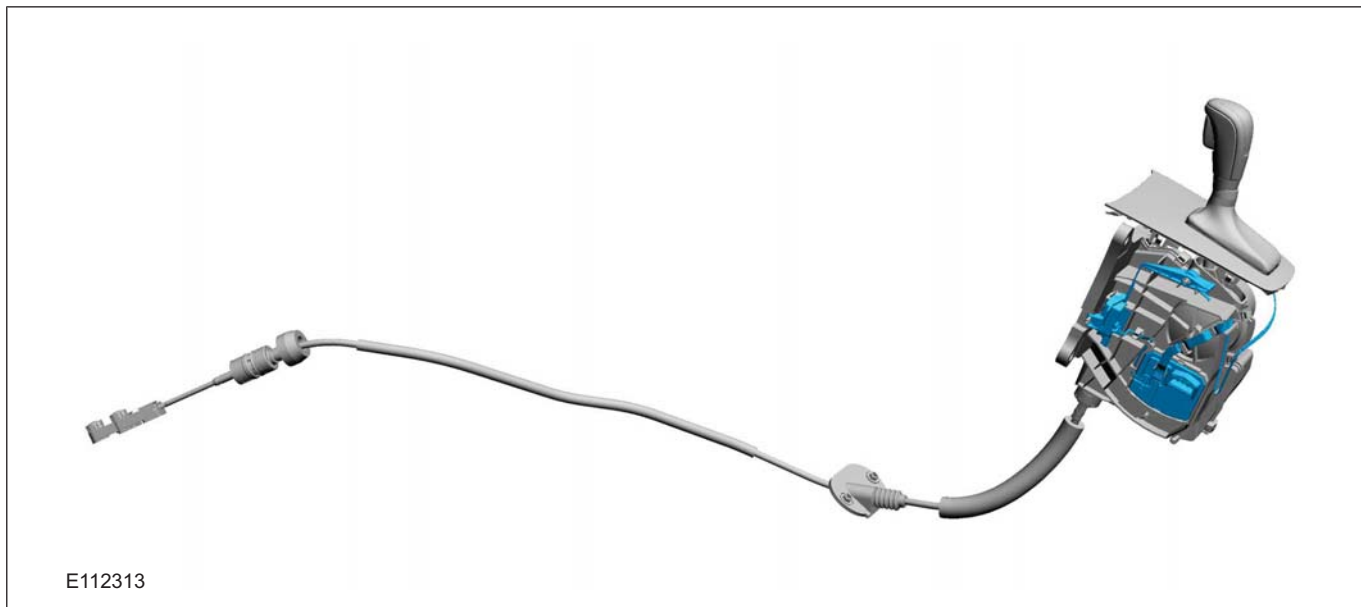
Automatic Transaxle - 6DCT450

307-05-4

### DESCRIPTION AND OPERATION

## External Controls – Overview

### Transmission range selector



The transmission range selector is located on the center console and is mechanically connected to the transmission by a cable for operation of the gear selector shaft and the TR (transmission range) sensor.

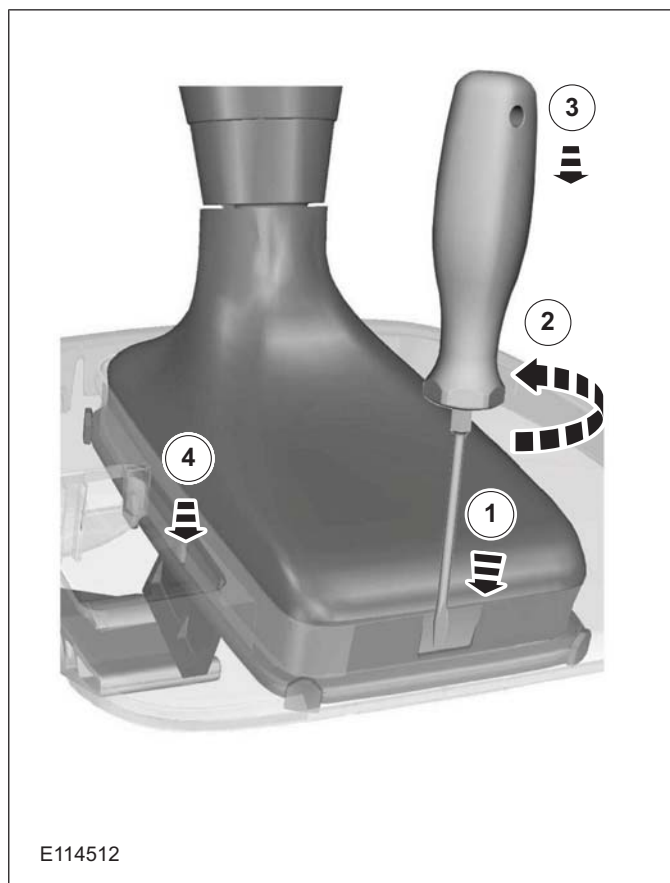
As well as the positions P/R/N/D, the transmission range selector provides a position for the sport and select-shift mode (S). The manual gear position can be selected at any time while driving. The gear selected is locked until the driver selects another gear.

The engine can only be started in positions P or N.

The selector cable adjustment mechanism is at the transmission end of the selector cable.

**NOTE:** Details of the exact procedure and specifications can be found in the current service literature.

### Transmission range selector lever emergency release



## Automatic Transmission/Transaxle External Controls

— Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

Automatic Transaxle - 6DCT450

307-05-5

307-05-5

### DESCRIPTION AND OPERATION

If the release mechanism of the selector lever lock fails when the selector lever is in the P position through the solenoid of the selector lever lock actuated by the TCM, it is possible to emergency release it.

Procedure:

- Carefully slide a flat screwdriver into the slot (1).
- Turn the screwdriver (2).
- Press the screwdriver downwards to detach the gaiter frame from the trim panel (3).
- Press the gaiter frame to move the emergency release downwards and move the selector lever out of position P (4).
- Pull the gaiter upwards until the gaiter frame engages in the gaiter frame.



Automatic Transmission/Transaxle External  
Controls — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

307-05-6

Automatic Transaxle - 6DCT450

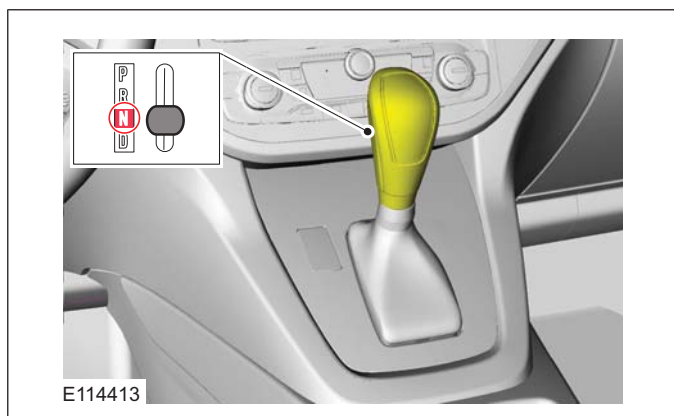
307-05-6

## GENERAL PROCEDURES

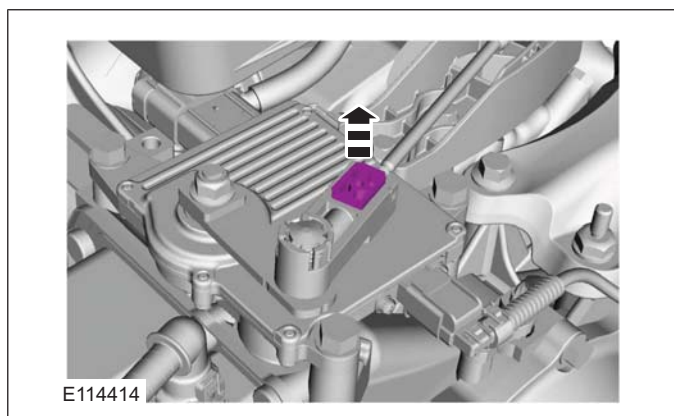
## Selector Lever Cable Adjustment — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD

## Adjustment

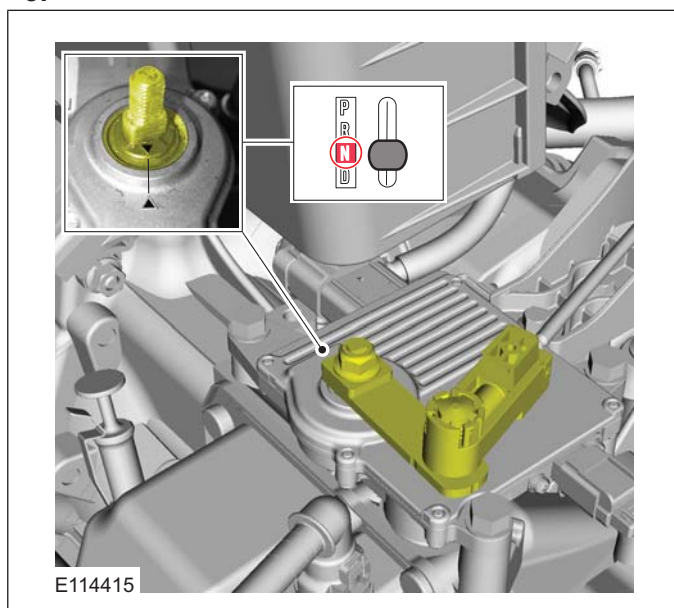
1.



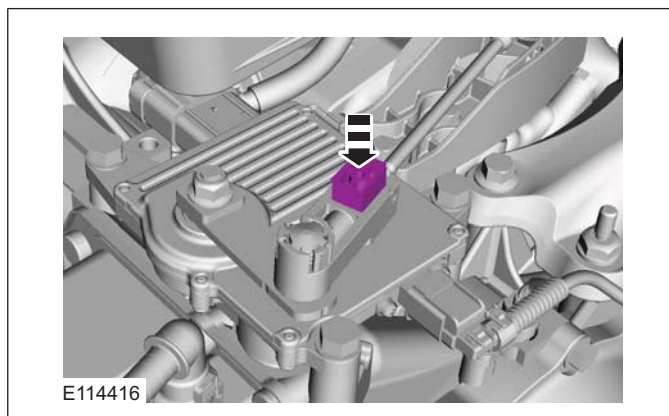
2.



3.



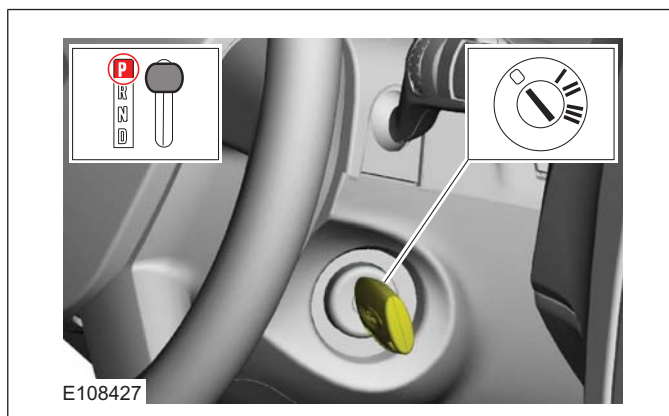
4.



5. Start the engine and move the selector lever through all the gear positions. Wait until each gear engages when moving through the gear positions.

6. Check that the selector lever position indicator corresponds to the position of the selector lever, repeat the adjustment procedure if necessary.

7.



# Automatic Transmission/Transaxle External Controls

— Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

Automatic Transaxle - 6DCT450

307-05-7

307-05-7

## REMOVAL AND INSTALLATION

### Selector Lever Cable — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD

#### General Equipment

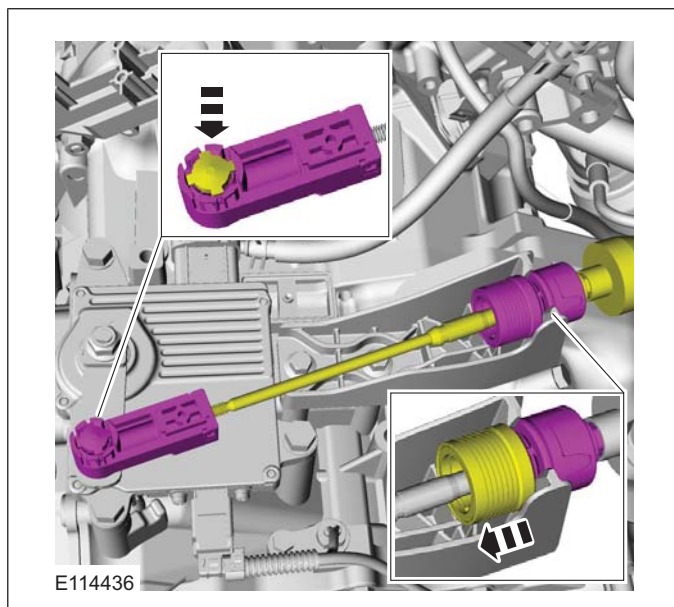
Knife

#### Removal

**NOTE:** Removal steps in this procedure may contain installation details.

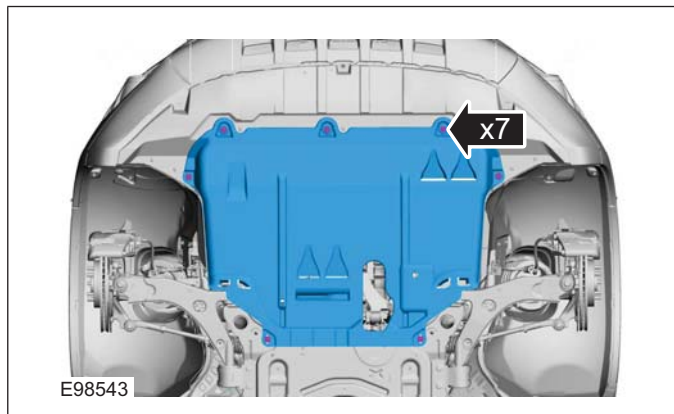
1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).

2.

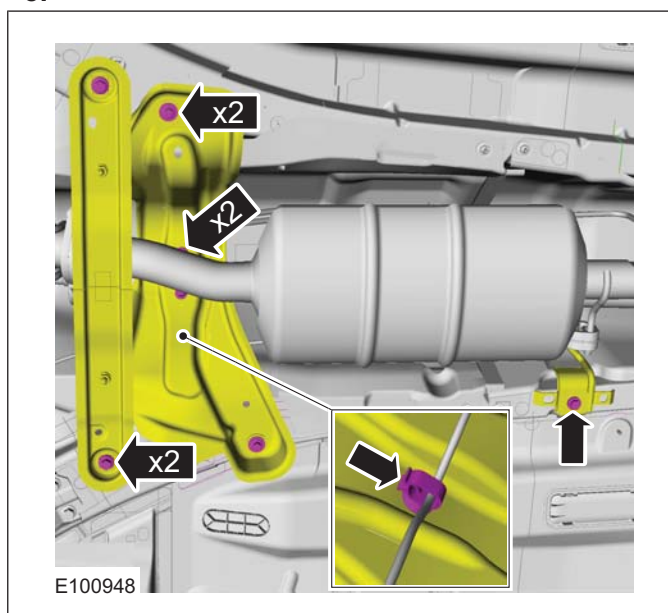


3. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

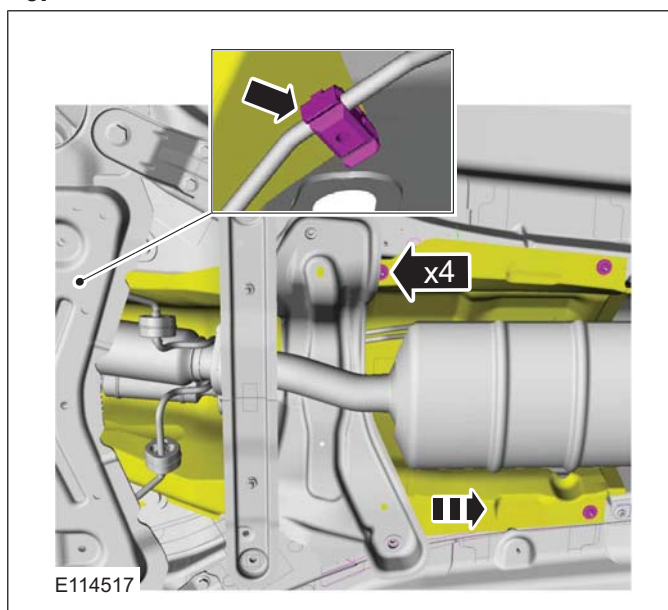
4.



5.



6.



# Automatic Transmission/Transaxle External Controls

— Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

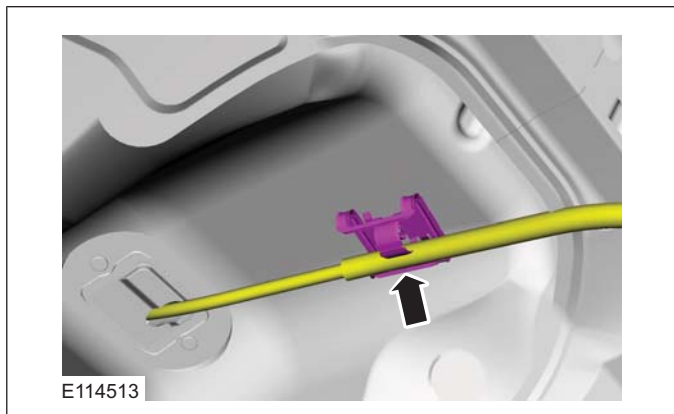
Automatic Transaxle - 6DCT450

307-05-8

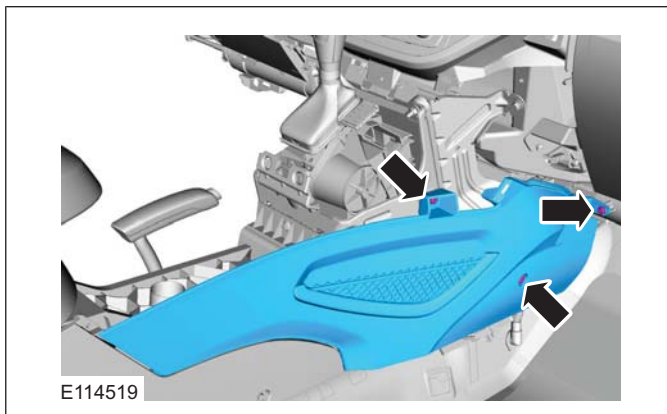
307-05-8

## REMOVAL AND INSTALLATION

7.



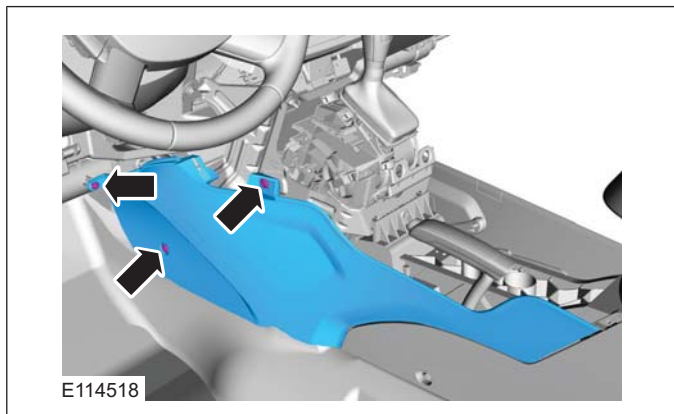
12.



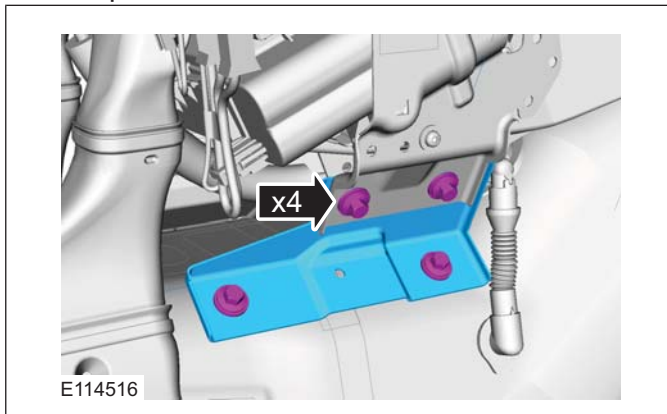
8. Lower the Vehicle.

9. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).

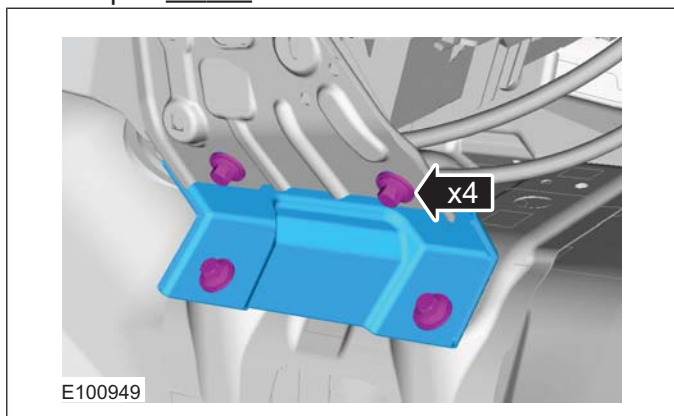
10.



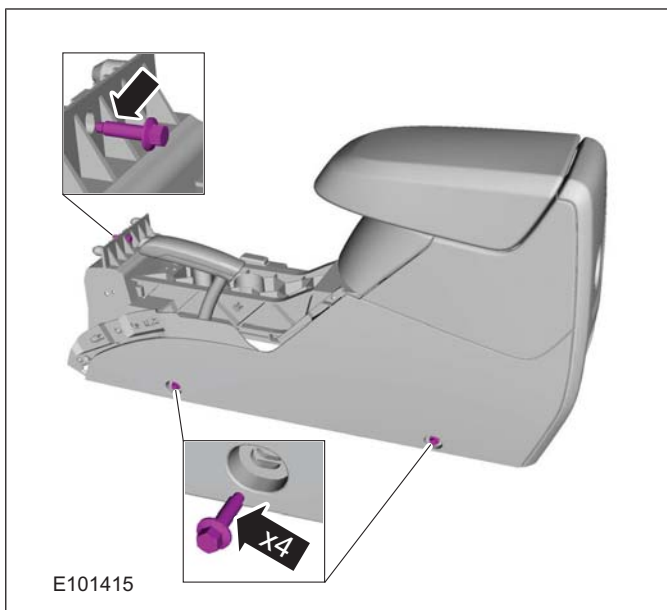
13. Torque: 25 Nm



11. Torque: 25 Nm



14.





# Automatic Transmission/Transaxle External Controls

— Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

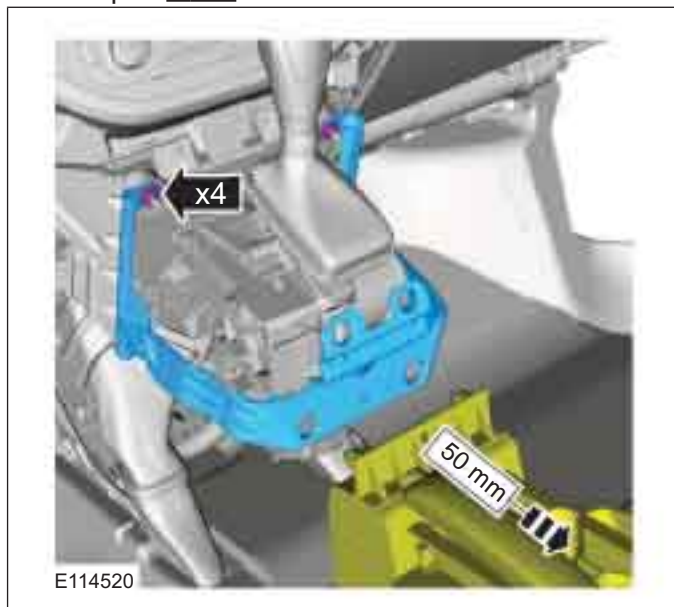
Automatic Transaxle - 6DCT450

307-05-9

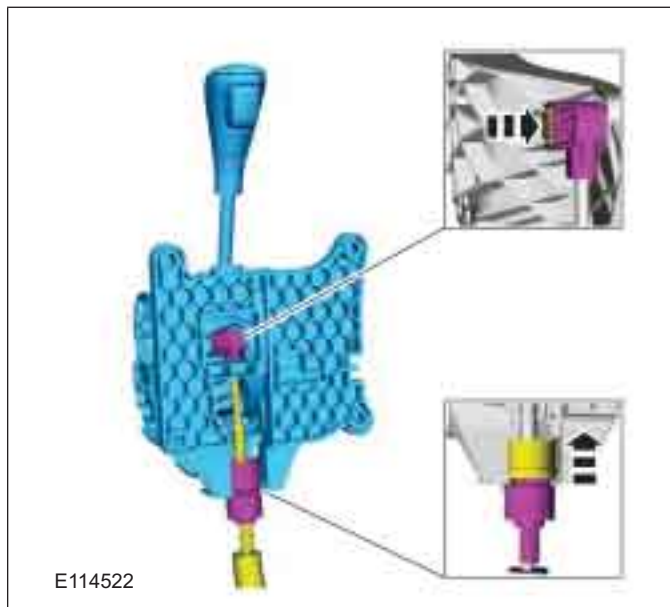
307-05-9

## REMOVAL AND INSTALLATION

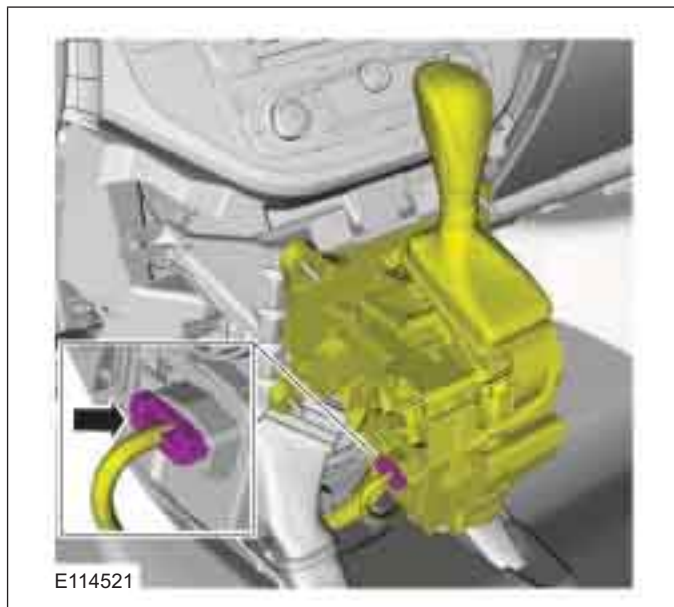
15. Torque: 9 Nm



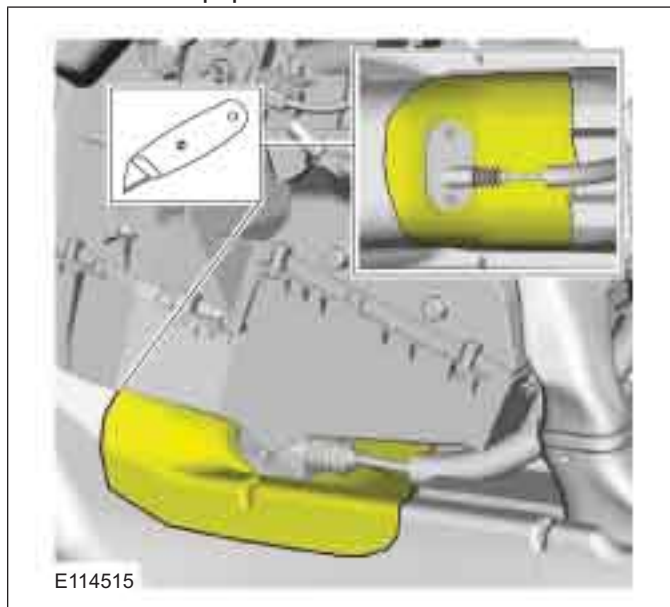
17.



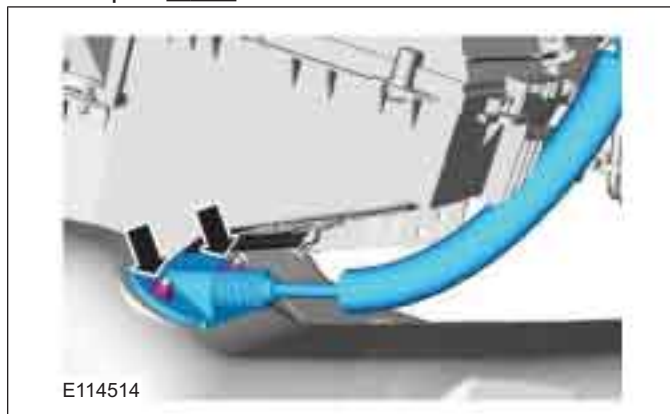
16.



18. General Equipment: Knife



19. Torque: 9 Nm



## Automatic Transmission/Transaxle External Controls

— Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

Automatic Transaxle - 6DCT450

307-05-10

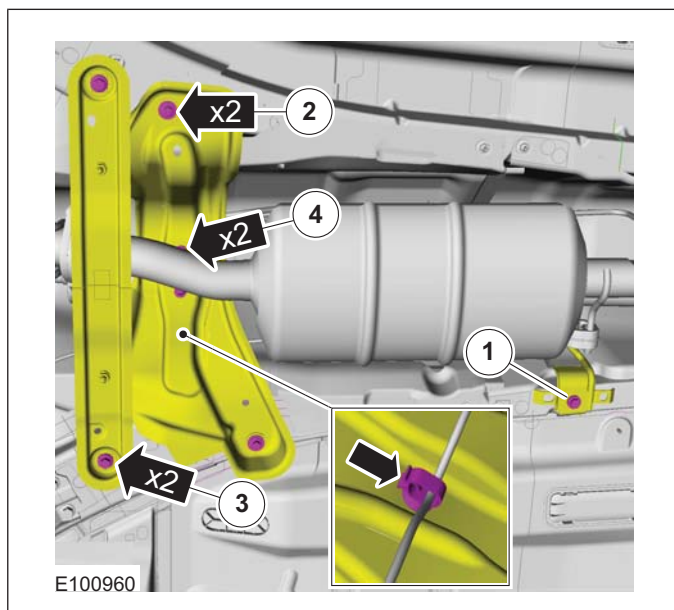
307-05-10

### REMOVAL AND INSTALLATION

#### Installation

**⚠ CAUTION:** Gearshift cables must not be kinked or bent.

1. To install, reverse the removal procedure.
2. 1. Torque: 25 Nm  
2. Torque: 25 Nm  
3. Torque: 30 Nm  
4. Torque: 25 Nm



3. Refer to: **Selector Lever Cable Adjustment - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD** (307-05 Automatic Transmission/Transaxle External Controls - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, General Procedures).



# Automatic Transmission/Transaxle External Controls

— Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

Automatic Transaxle - 6DCT450

307-05-11

307-05-11

## REMOVAL AND INSTALLATION

### Selector Lever Assembly — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD

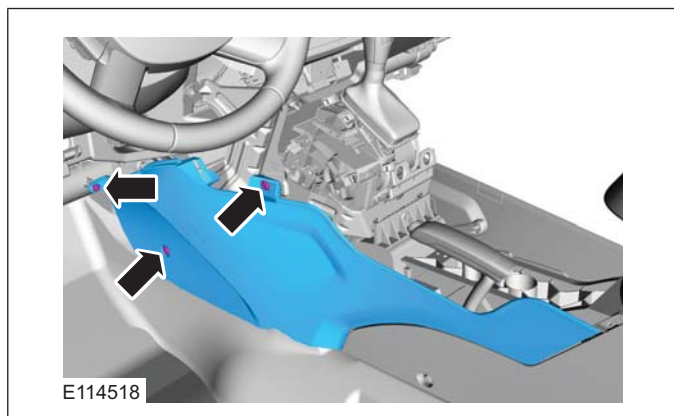
#### Removal

**CAUTION:** Gearshift cables must not be kinked or bent.

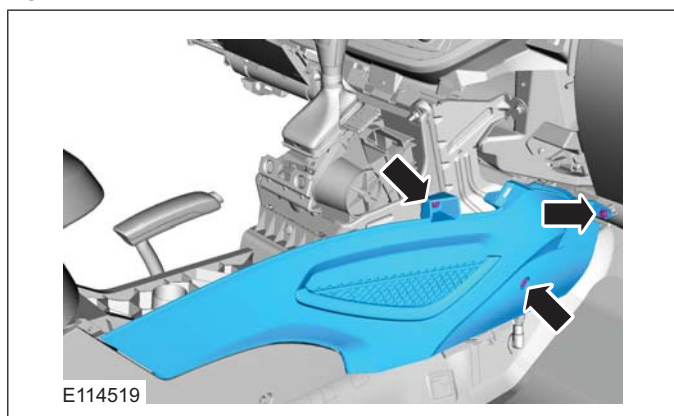
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Floor Console Extension - Vehicles With: Center Armrest** (501-12 Instrument Panel and Console, Removal and Installation).

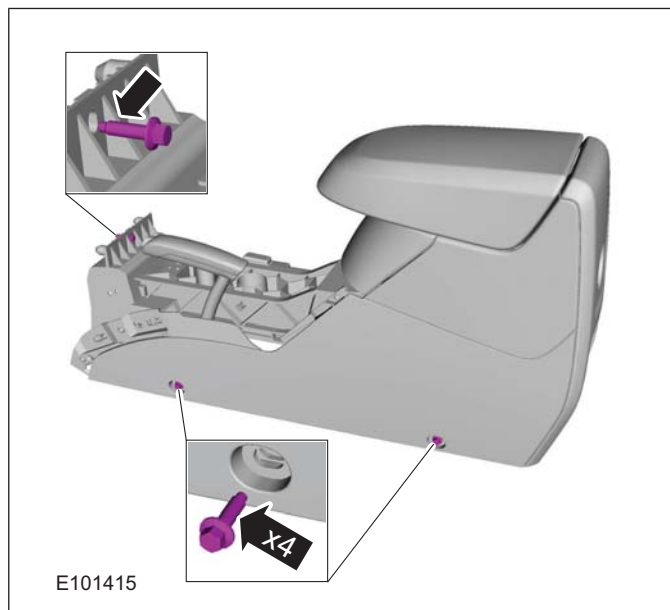
2.



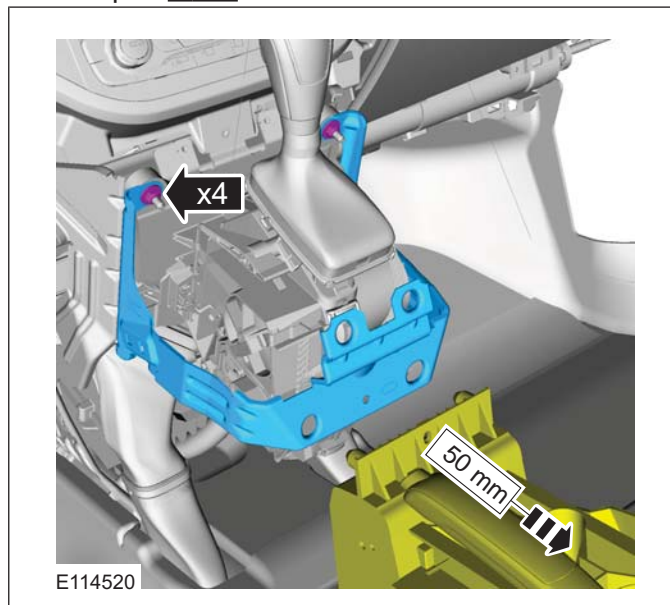
3.



4.



5. Torque: 9 Nm



Automatic Transmission/Transaxle External  
Controls — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed

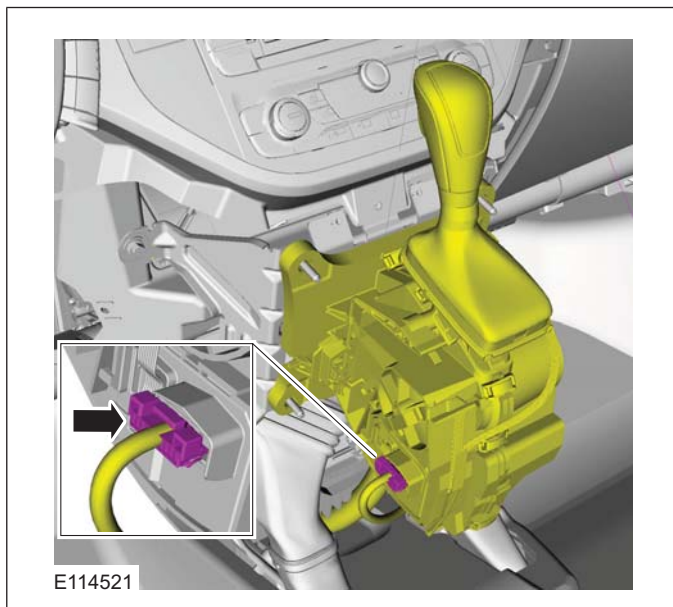
307-05-12

Automatic Transaxle - 6DCT450

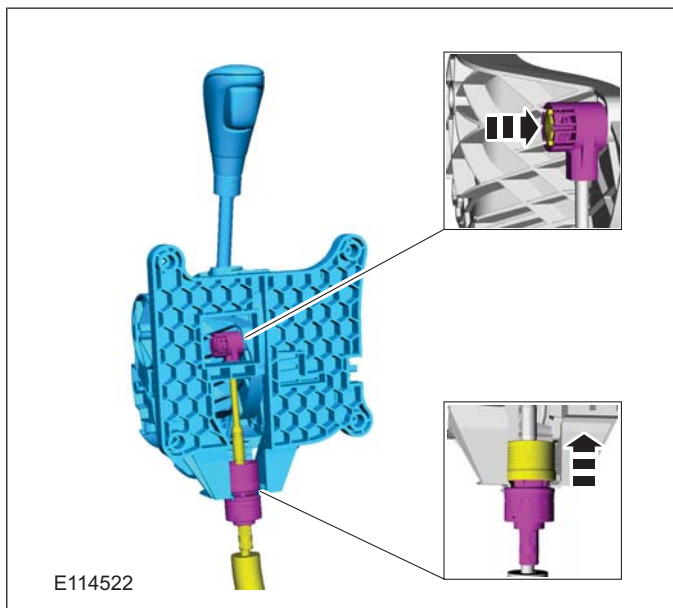
307-05-12

## REMOVAL AND INSTALLATION

6.



7.



## Installation

**⚠ CAUTION:** Gearshift cables must not be kinked or bent.

1. Install all components in reverse order.
2. Refer to: **Selector Lever Cable Adjustment - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD** (307-05 Automatic Transmission/Transaxle External Controls - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, General Procedures).

# SECTION 307-07 Transfer Case — Vehicles With: 5-Speed Automatic Transaxle

- AW55 AWD/6-Speed Automatic Transaxle - 6DCT450

## VEHICLE APPLICATION: 2008.50 Kuga

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Transfer Case (System Operation and Component Description).....	307-07-8
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Transfer Case Connecting Sleeve.....	307-07-10
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<b>INSTALLATION</b>	
Transfer Case.....	307-07-19

307-07-2

AWD/6-Speed Automatic Transaxle - 6DCT450

307-07-2

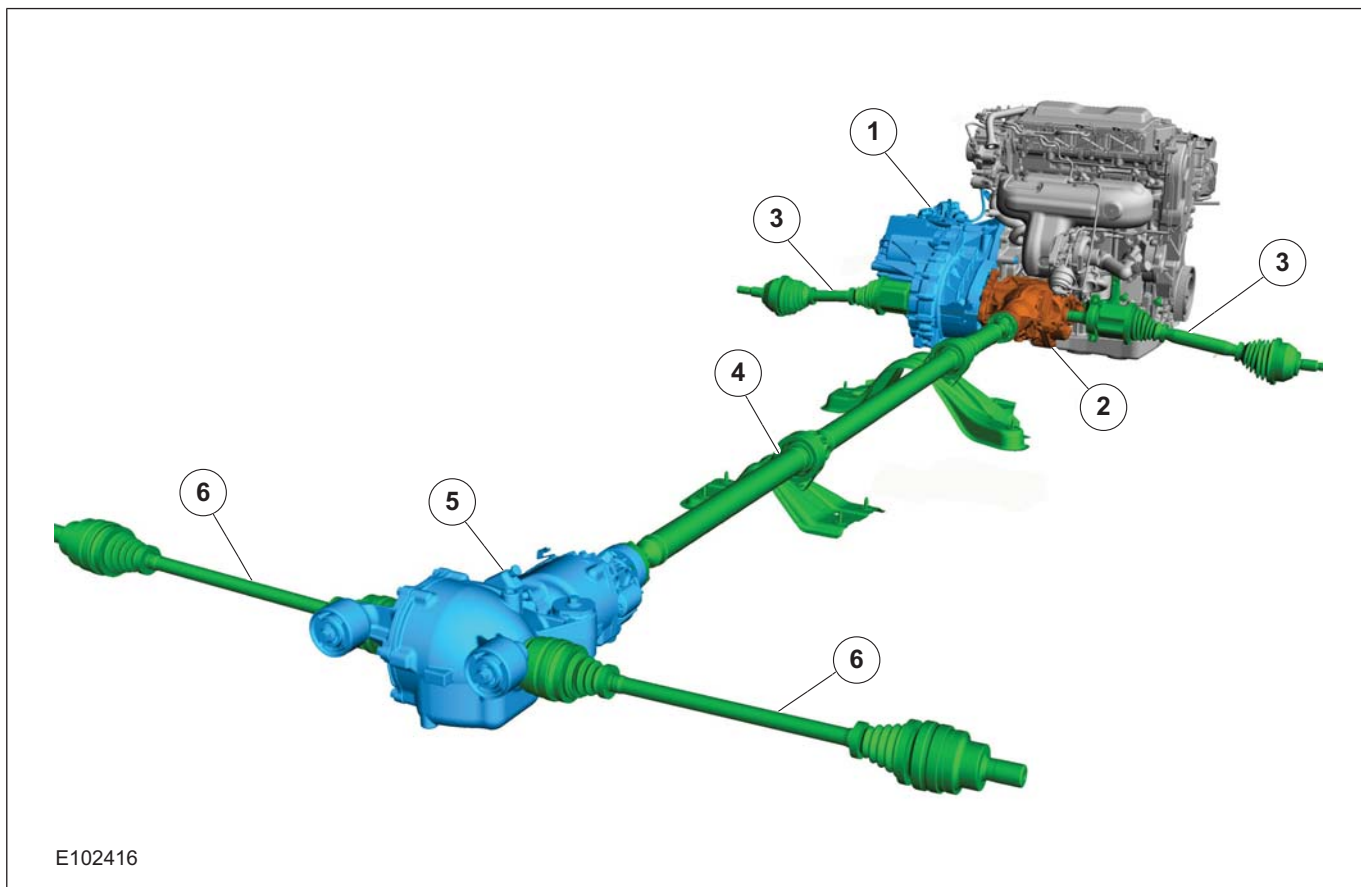
**SPECIFICATIONS****Capacities**

	<b>Litres</b>
Transmission Fluid 8U7J-19G518-BA	0.45

DESCRIPTION AND OPERATION

Transfer Case – Component Location

Powertrain overview



E102416

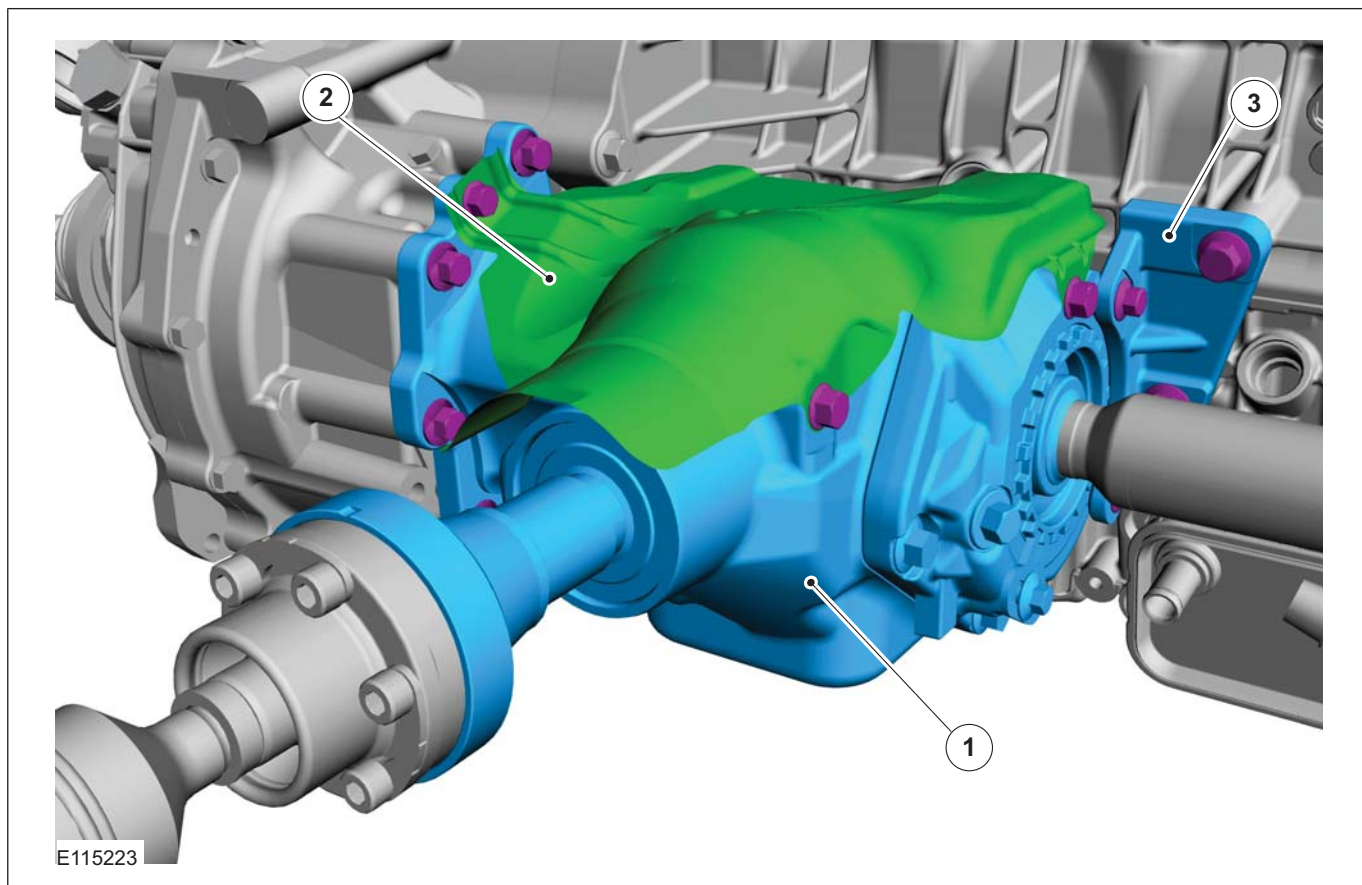
Item	Description
1	Transaxle with front axle differential
2	Transfer box
3	Front wheel half shafts

Item	Description
4	Drive shaft
5	Rear drive axle
6	Rear wheel half shafts



DESCRIPTION AND OPERATION

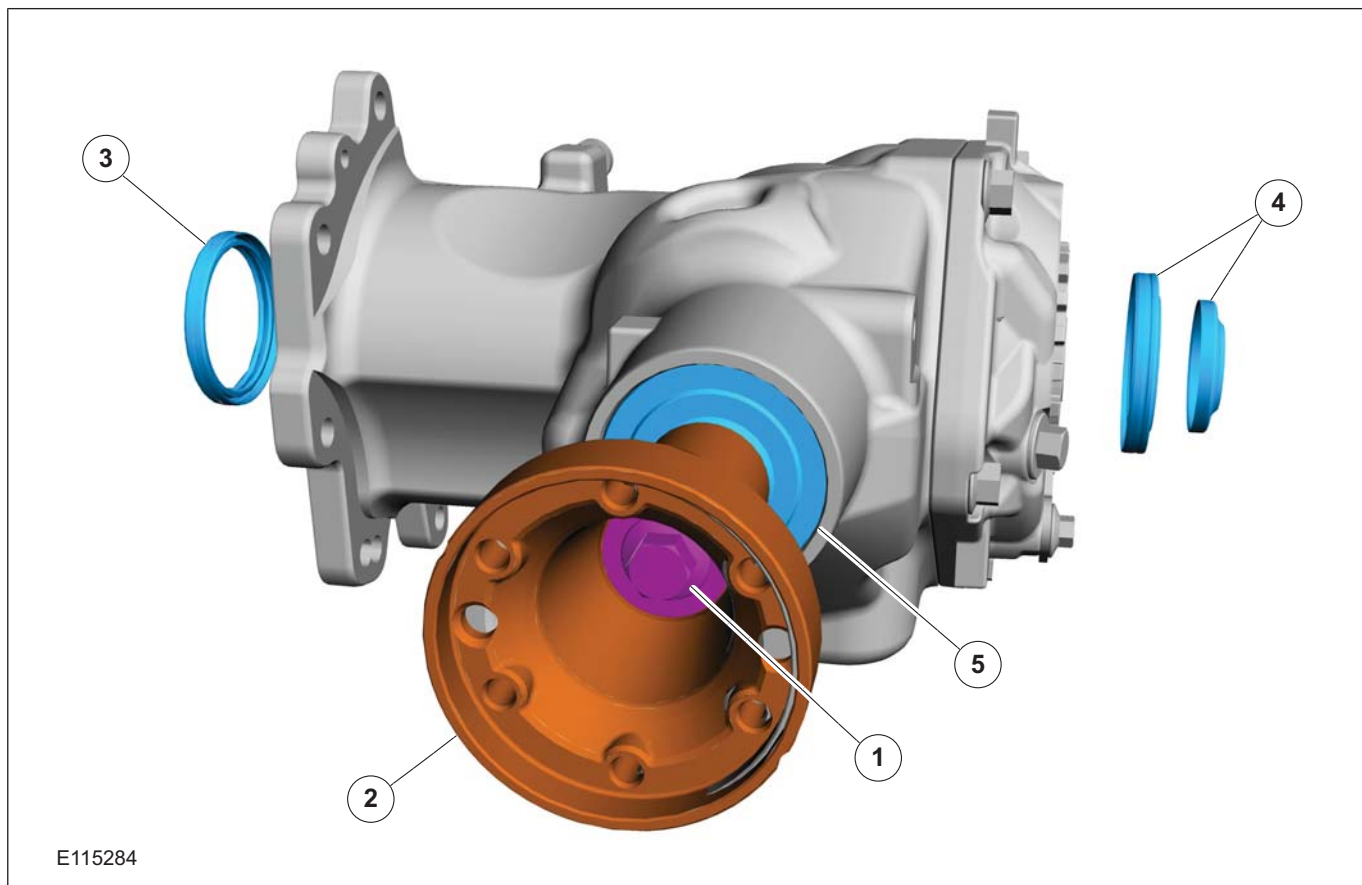
Transfer box



Item	Description
1	Transfer box
2	Heat deflector
3	Bracket, transfer box to engine

DESCRIPTION AND OPERATION

Transfer box seals



E115284

Item	Description
1	Output drive shaft flange retaining bolt
2	Output drive flange

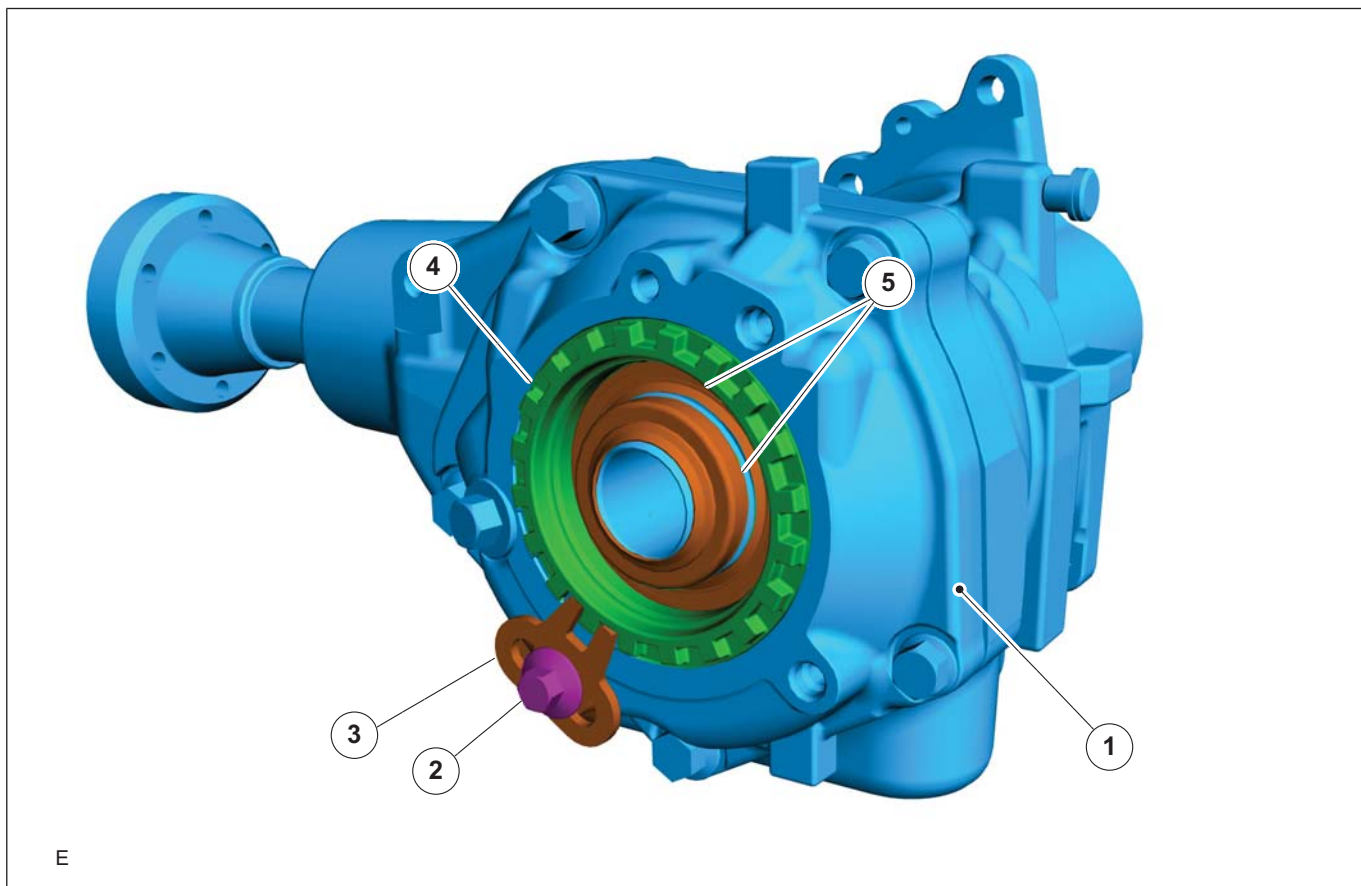
Item	Description
3	Hollow shaft seals, left
4	Hollow shaft seals, right
5	Output differential pinion gear seal

DESCRIPTION AND OPERATION

Hollow shaft seal, left



Hollow shaft seals, right

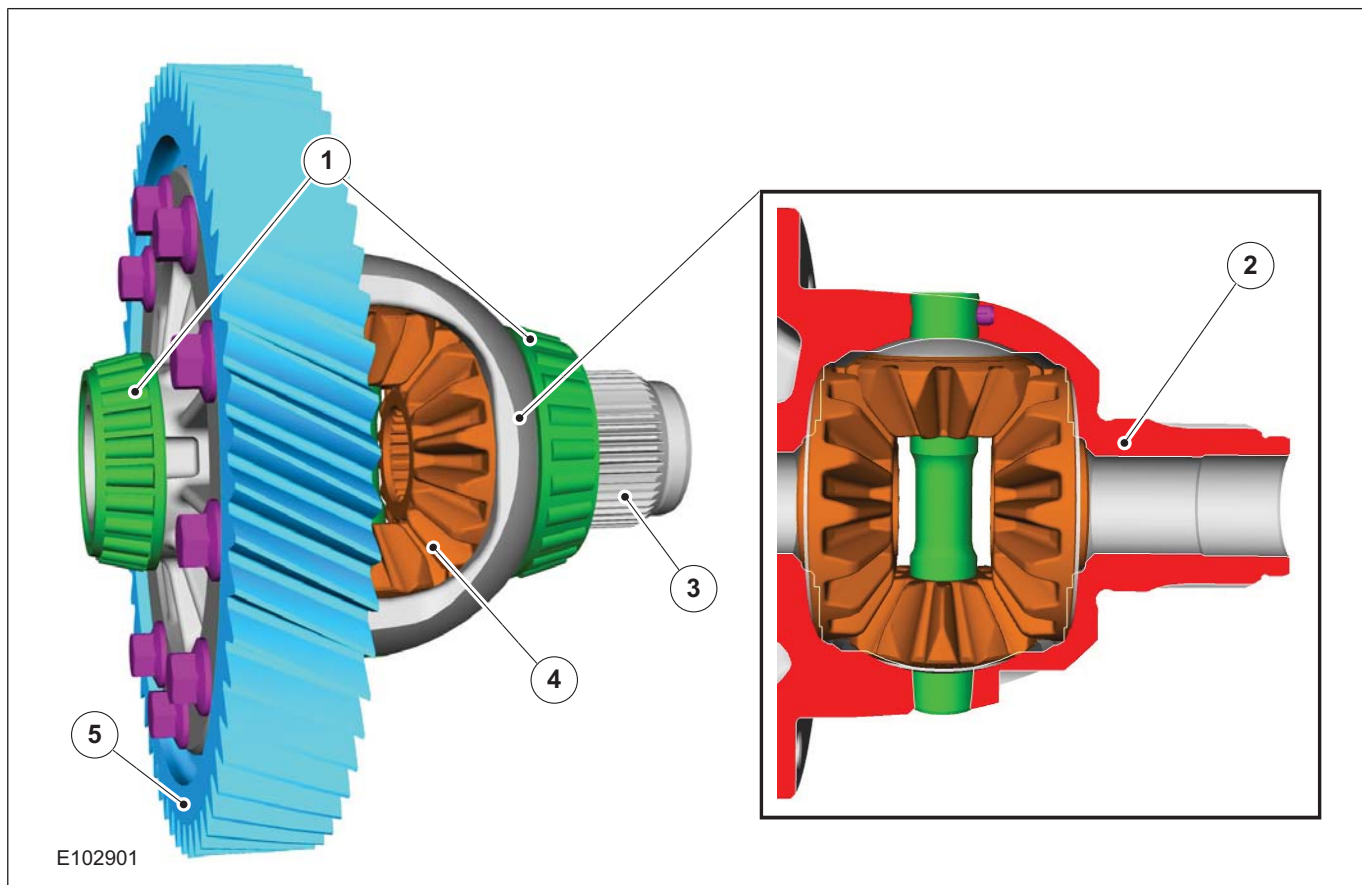


Item	Description
1	Transfer box
2	Bolt

Item	Description
3	Locking device
4	Adjustable bearing, transfer box
5	Oil seals

DESCRIPTION AND OPERATION

Differential/drive - transfer box



E102901

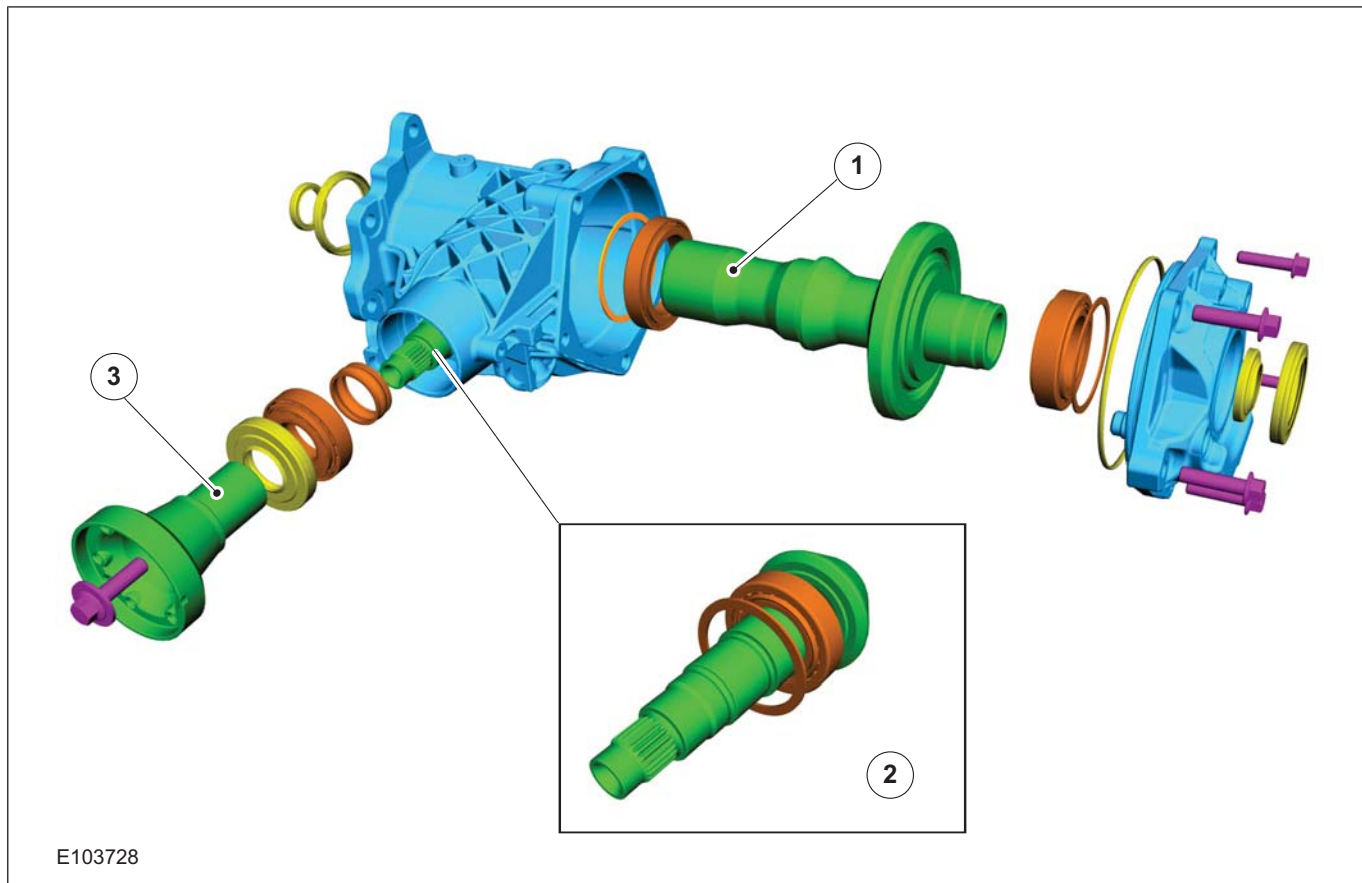
Item	Description
1	Taper roller bearing - differential
2	Differential case

Item	Description
3	Drive teeth - transfer box
4	Differential pinion gears
5	Spur gear

DESCRIPTION AND OPERATION

Transfer Case – System Operation and Component Description

System Operation



E103728

Item	Description
1	Hollow shaft
2	Output shaft
3	Output drive flange

**NOTE:** From the start of series production, the transfer box will be subject to a "Black Box Phase" and will therefore not be repaired.

To realise the all-wheel drive, a transfer box has been flange-mounted to the manual transaxle. The transfer box is designed as an angular gear to transfer the torque from the transaxle to the rear axle. The hollow shaft of the transfer box is inserted in a tooth on the gear case. From the hollow shaft, torque is transferred to the driveshaft through the output shaft/output flange via crown gear and differential pinion gear.



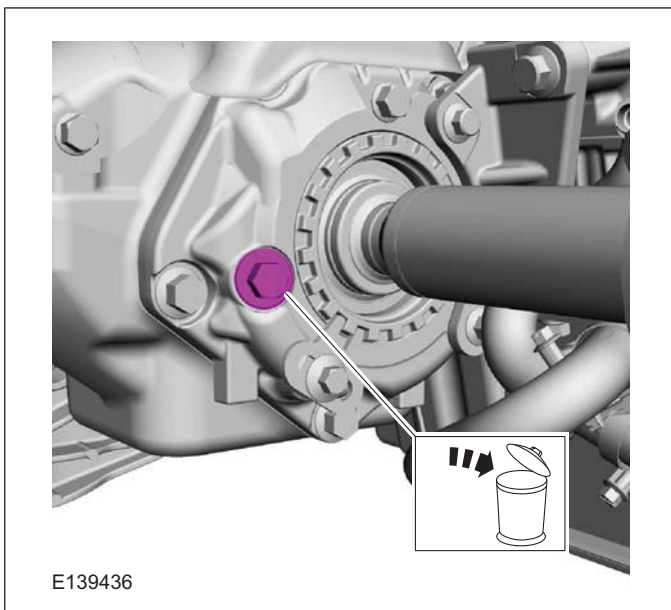
GENERAL PROCEDURES

Transfer Case Fluid Level Check

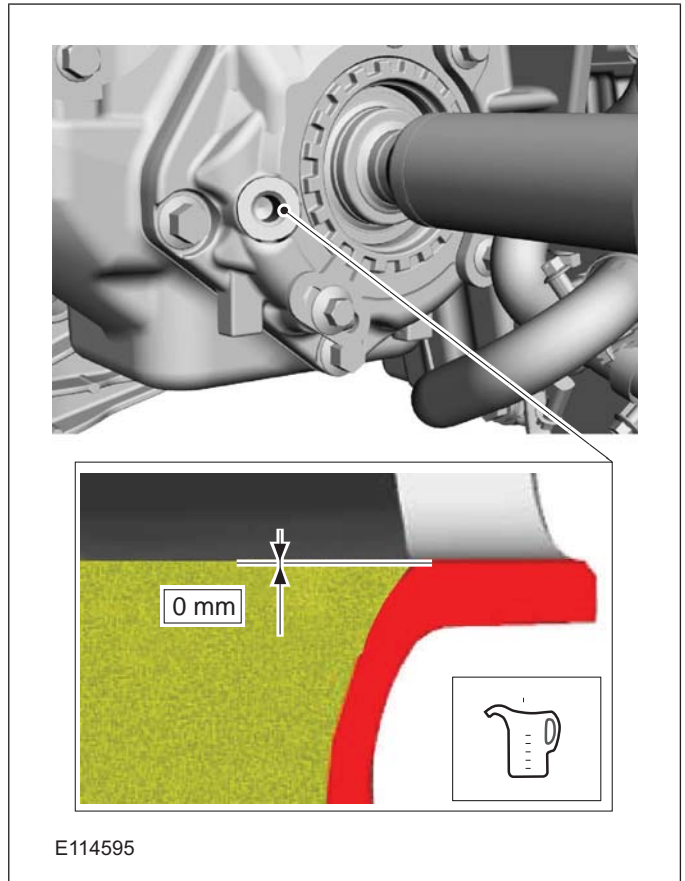
Materials	
Name	Specification
Rear Axle Oil SAE 75W-90	8U7J-19G518-BA

Inspection

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
- 2.

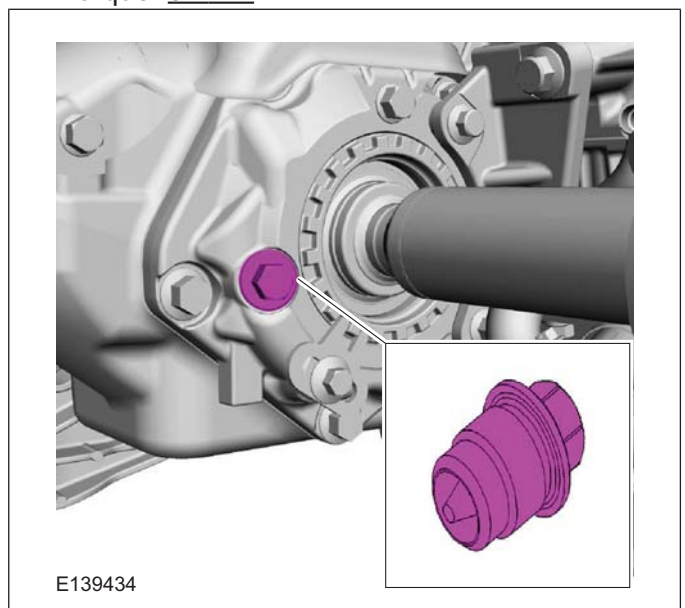


3. • Material: Rear Axle Oil SAE 75W-90 (8U7J-19G518-BA) transmission fluid
- Correct the rear axle oil level if necessary.
- 20 ml ~ 1 mm



4. **NOTE:** Make sure that a new component is installed.

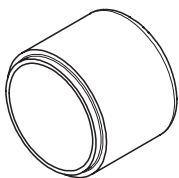
Torque: 34 Nm



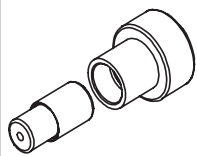
REMOVAL AND INSTALLATION

Transfer Case Connecting Sleeve

Special Tool(s) / General Equipment

 <p>E115803</p>	<p>308-784 Installer, Halfshaft Seal</p>
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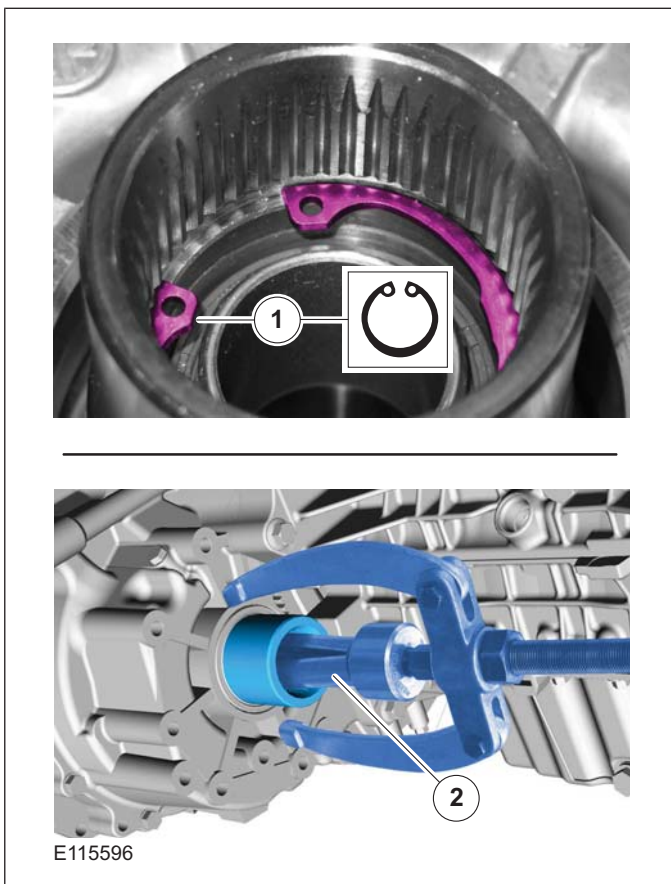
Special Tool(s) / General Equipment

 <p>E115804</p>	<p>308-785 Installer, Halfshaft Seal</p>
<p>Copper Hammer</p>	
<p>Flat-bladed screwdriver</p>	
<p>Hot Air Gun</p>	
<p>Puller</p>	
<p>Punch</p>	

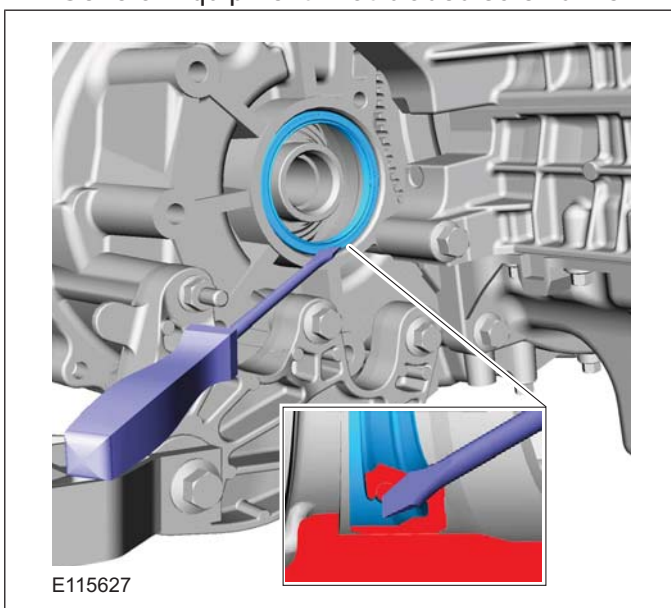
Removal

REMOVAL AND INSTALLATION

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Transfer Case** (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Removal).
3. 2. General Equipment: Puller



4. General Equipment: Flat-bladed screwdriver

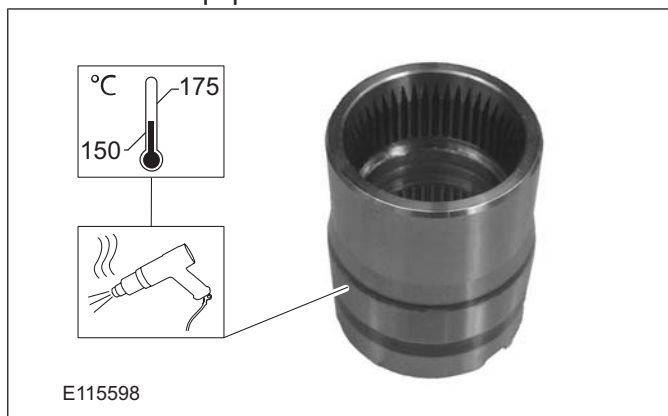


5. General Equipment: Punch



Installation

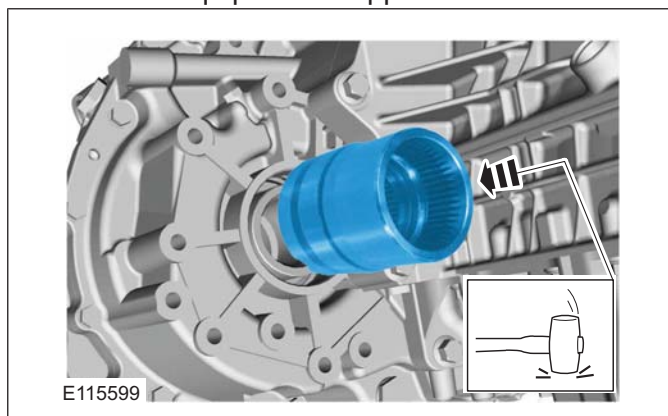
1. General Equipment: Hot Air Gun



- 2.



- General Equipment: Copper Hammer



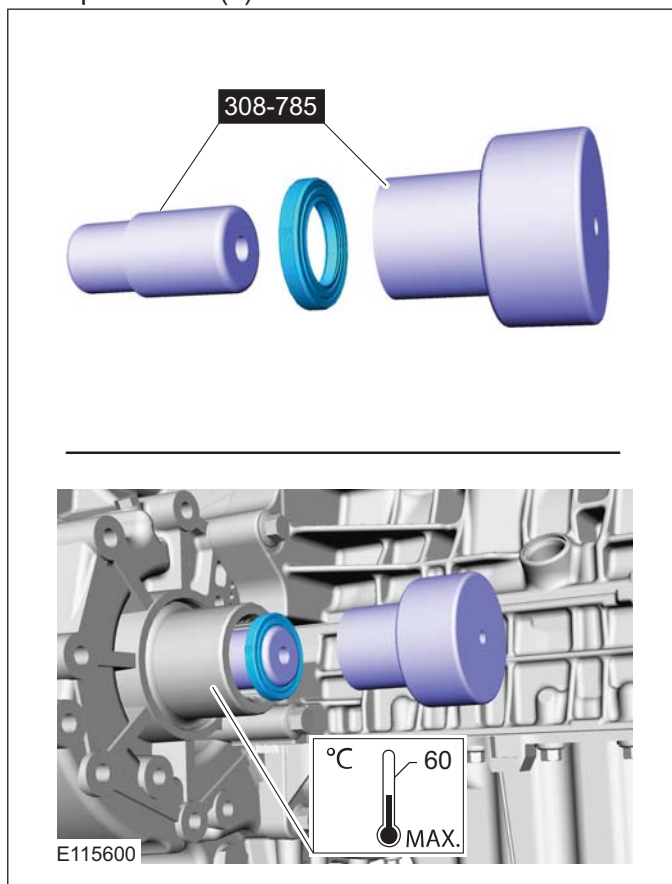
307-07-12

AWD/6-Speed Automatic Transaxle - 6DCT450

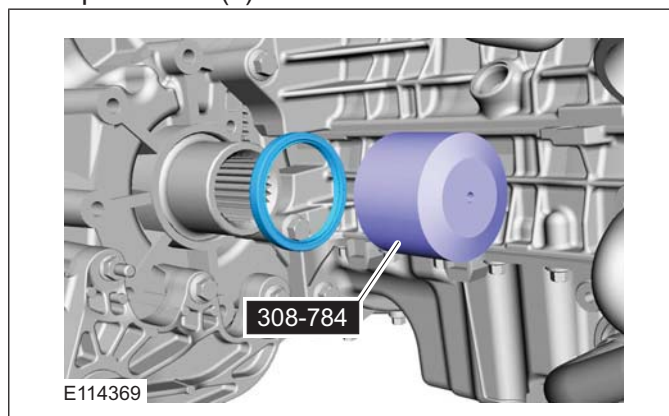
307-07-12

## REMOVAL AND INSTALLATION

## 3. Special Tool(s): 308-785



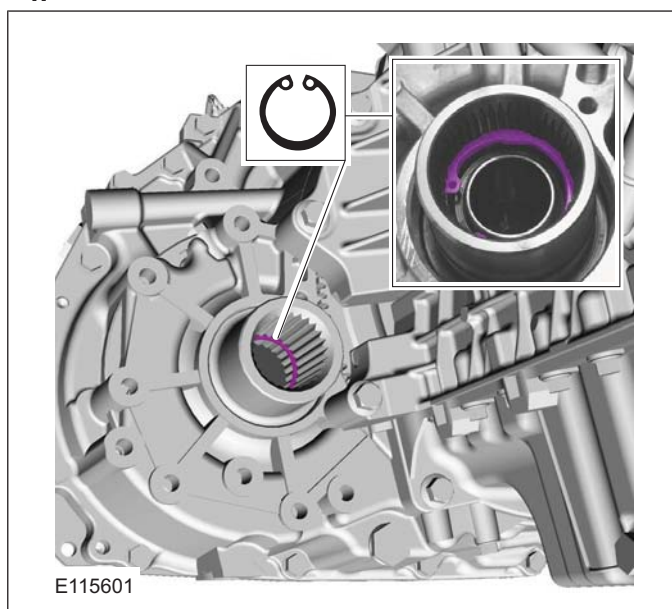
## 5. Special Tool(s): 308-784



6. Refer to: **Transfer Case** (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Installation).

7. Refer to: **Transfer Case Fluid Level Check** (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, General Procedures).

## 4.



## REMOVAL AND INSTALLATION

### Transfer Case Connecting Sleeve Seals — Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD

#### Removal

1. Refer to: **Transfer Case Connecting Sleeve** (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Removal and Installation).

#### Installation

1. To install, reverse the removal procedure.



## REMOVAL AND INSTALLATION

### Transfer Case Rear Seal

#### Removal

1. Refer to: Transfer Case Rear Seal (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Removal and Installation).

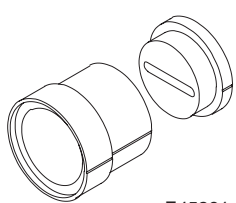
#### Installation

1. Refer to: Transfer Case Rear Seal (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Removal and Installation).

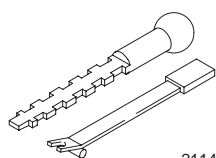
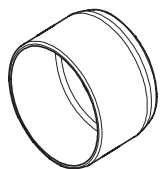
REMOVAL AND INSTALLATION

Transfer Case Seal LH

Special Tool(s)

 <p>E45281</p>	<p>204-351 Installer, Pivot Bushing</p>
---	---

Special Tool(s)

 <p>21143</p>	<p>303-293 Remover, Crankshaft Seal</p>
 <p>E115807</p>	<p>308-788 Protector, Transfer Case Seal</p>

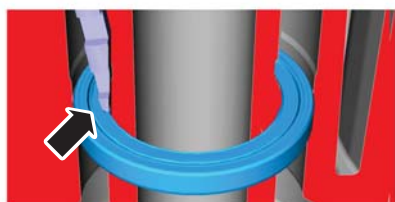
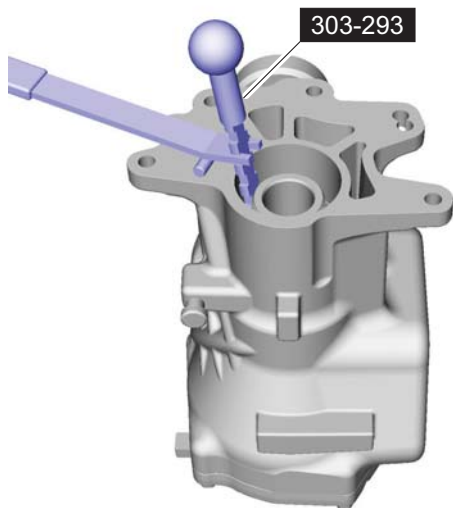
Removal

## REMOVAL AND INSTALLATION

1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).

Refer to: **Transfer Case** (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Removal).

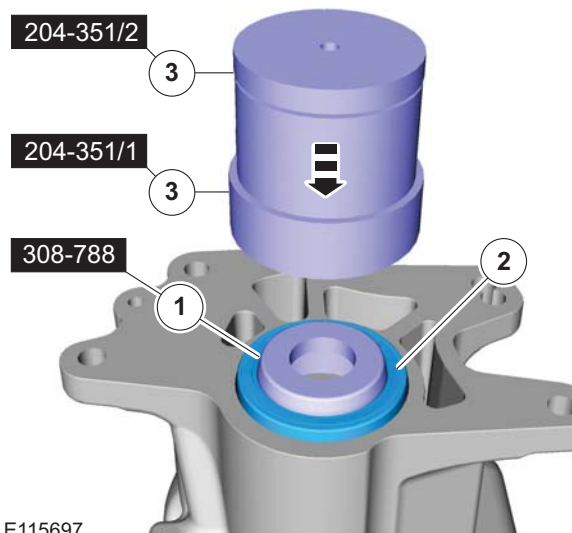
2. Special Tool(s): 303-293



E115696

## Installation

1. 1. Install the Special Tool(s): 308-788
3. Special Tool(s): 204-351



E115697

2. Remove the Special Tool(s): 308-788
3. Refer to: **Transfer Case** (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Installation).

Refer to: **Transfer Case Fluid Level Check** (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, General Procedures).

## REMOVAL AND INSTALLATION

### Transfer Case Seal RH

#### Removal

1. Refer to: Transfer Case Seal RH (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Removal and Installation).

#### Installation

1. Refer to: Transfer Case Seal RH (307-07 Transfer Case - Vehicles With: 5-Speed Automatic Transaxle - AW55 AWD/6-Speed Automatic Transaxle - 6DCT450, Removal and Installation).

307-07-18

AWD/6-Speed Automatic Transaxle - 6DCT450

307-07-18

**REMOVAL****Transfer Case****Removal**

1. Refer to: Transfer Case (307-07 Transfer Case
  - Vehicles With: 5-Speed Automatic Transaxle
  - AW55 AWD/6-Speed Automatic Transaxle
  - 6DCT450, Removal).



 307-07-19

AWD/6-Speed Automatic Transaxle - 6DCT450

307-07-19 

## INSTALLATION

# Transfer Case

### Installation

1. Refer to: Transfer Case (307-07 Transfer Case
  - Vehicles With: 5-Speed Automatic Transaxle
  - AW55 AWD/6-Speed Automatic Transaxle
  - 6DCT450, Installation).

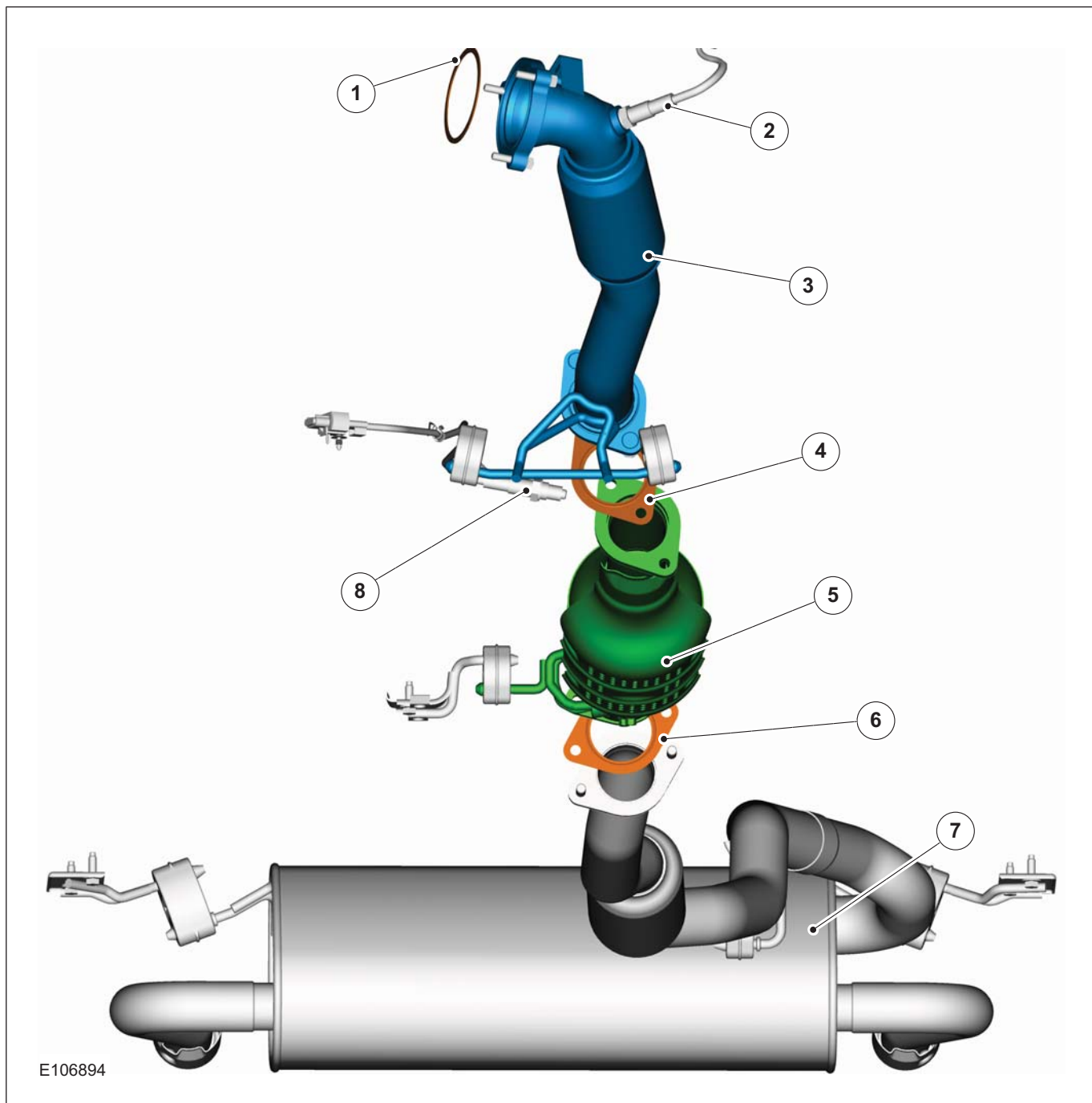
## SECTION 309-00 Exhaust System — 2.5L Duratec (147kW/200PS) - VI5

VEHICLE APPLICATION: **2008.50 Kuga**

CONTENTS	PAGE
<b>DESCRIPTION AND OPERATION</b>	
Exhaust System (Component Location).....	309-00-2
<b>REMOVAL AND INSTALLATION</b>	
Exhaust Flexible Pipe.....	309-00-3
Catalytic Converter.....	309-00-6

DESCRIPTION AND OPERATION

Exhaust System – Component Location



E106894

Item	Description
1	Exhaust flexible pipe gasket
2	HO2S (heated oxygen sensor)
3	Exhaust flexible pipe
4	Front gasket, catalytic converter

Item	Description
5	Exhaust catalytic convertor
6	Rear gasket, catalytic converter
7	Rear Muffler
8	Catalyst monitor sensor

REMOVAL AND INSTALLATION

Exhaust Flexible Pipe

General Equipment

Cable Ties

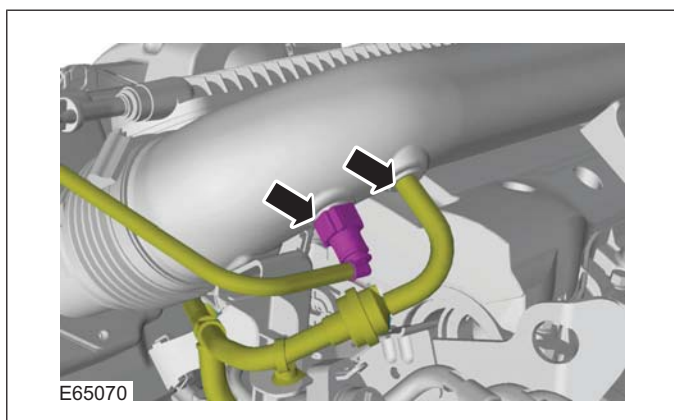
Materials

Name	Specification
Grease KS-PS	SA-M1C9107-A / YS5J-M1C9107-AA

Removal

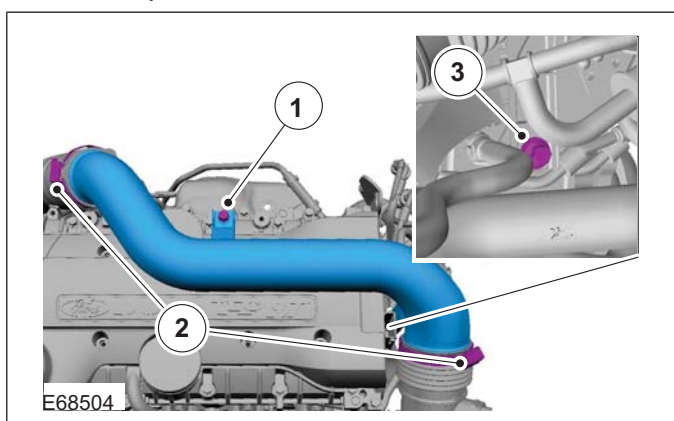
**NOTE:** Removal steps in this procedure may contain installation details.

1.

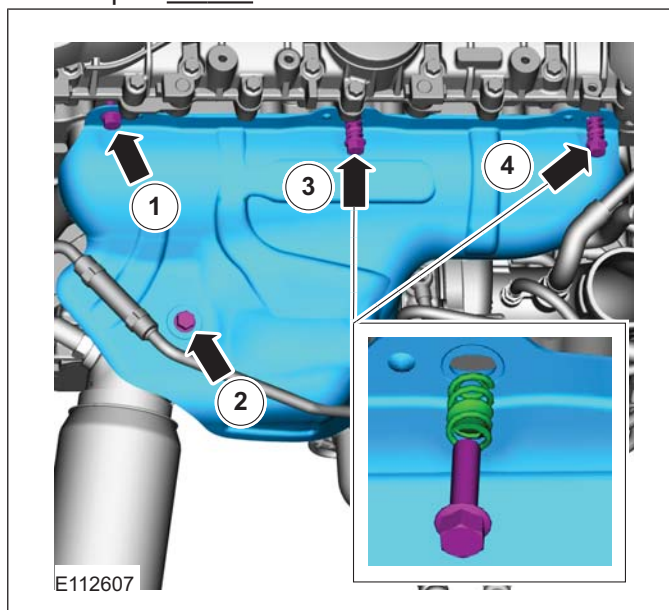


2. **CAUTION:** Make sure that the inside of the pipe ends are clean and free of oil residue.

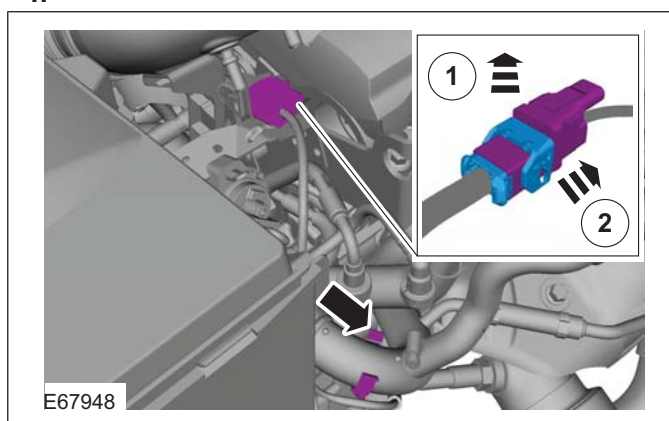
- 1. Torque: 10 Nm
- 2. Torque: 4 Nm
- 3. Torque: 10 Nm



3. Torque: 20 Nm



4.



5. **CAUTIONS:**

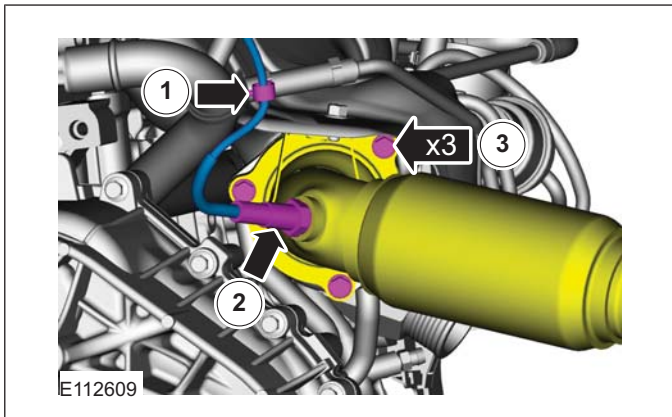
**CAUTION:** Jointing compound must not be used forward of the catalytic converter.

REMOVAL AND INSTALLATION

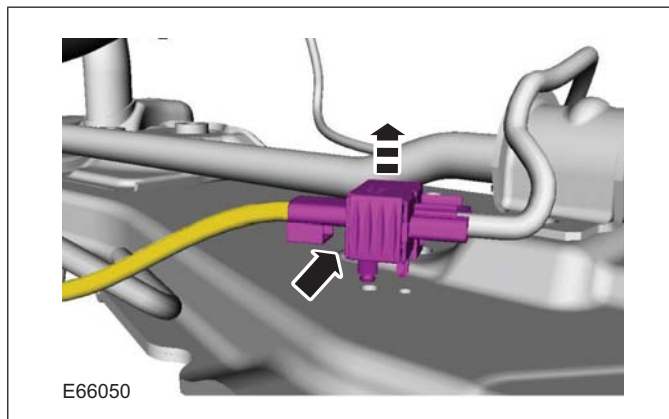
**⚠** Make sure that the exhaust flexible pipe is not forcibly bent.

2. Torque: 47 Nm

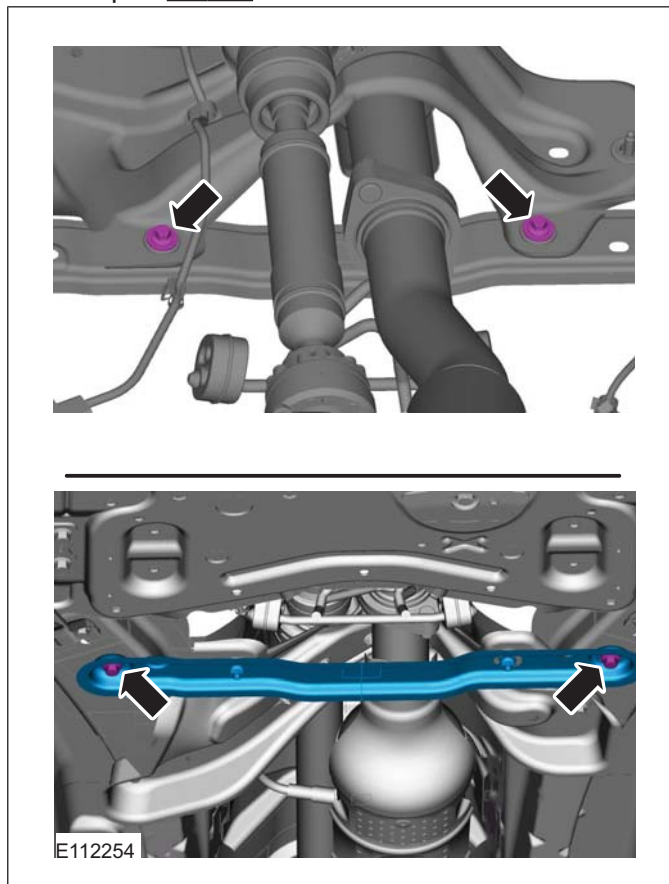
3. Torque: 28 Nm



9.

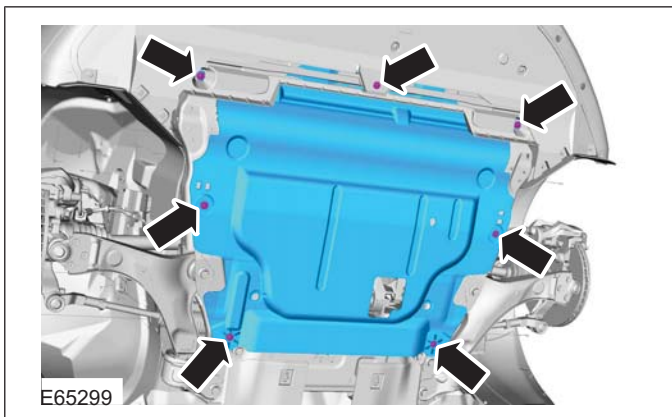


10. Torque: 30 Nm

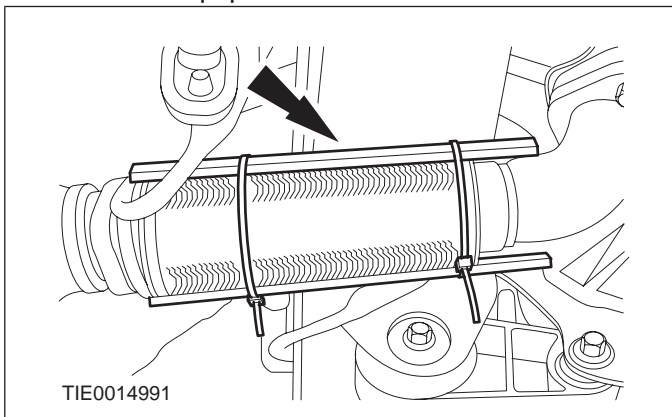


6. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

7.



8. General Equipment: Cable Ties





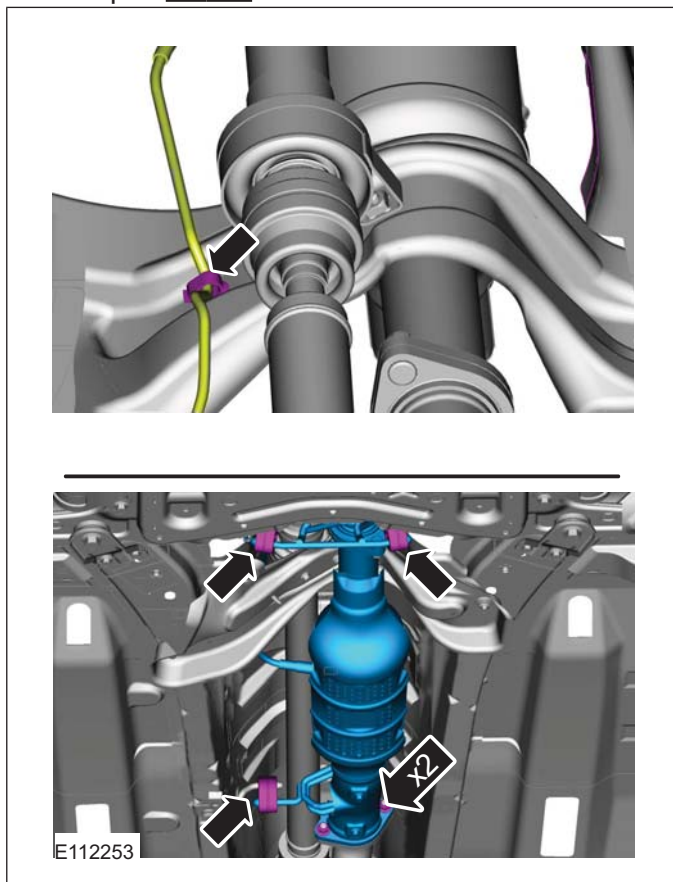
309-00-5

Exhaust System — 2.5L Duratec (147kW/200PS) - VI5

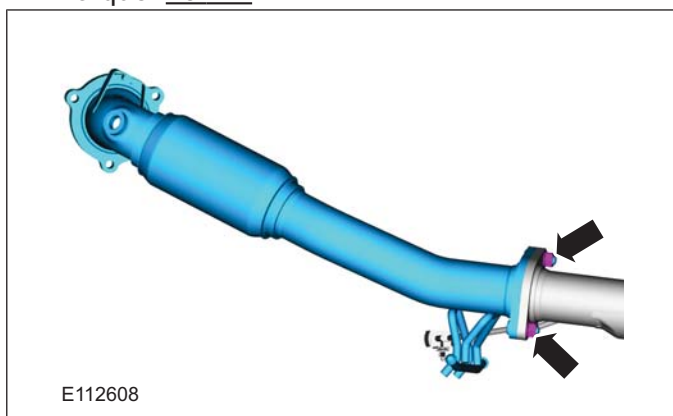
309-00-5

## REMOVAL AND INSTALLATION

11.  **CAUTION:** Make sure that the exhaust flexible pipe is not forcibly bent.

Torque: 48 Nm

- 12 Material: Grease KS-PS (SA-M1C9107-A / YS5J-M1C9107-AA) grease

Torque: 48 Nm

## Installation

1. To install, reverse the removal.

REMOVAL AND INSTALLATION

Catalytic Converter

General Equipment

Cable Ties

Materials

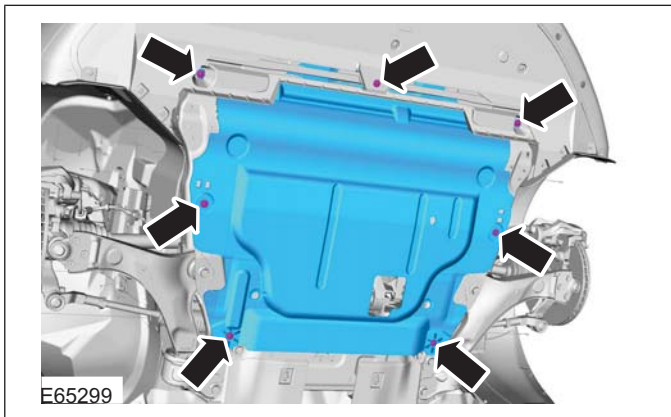
Name	Specification
Grease KS-PS	SA-M1C9107-A / YS5J-M1C9107-AA

Removal

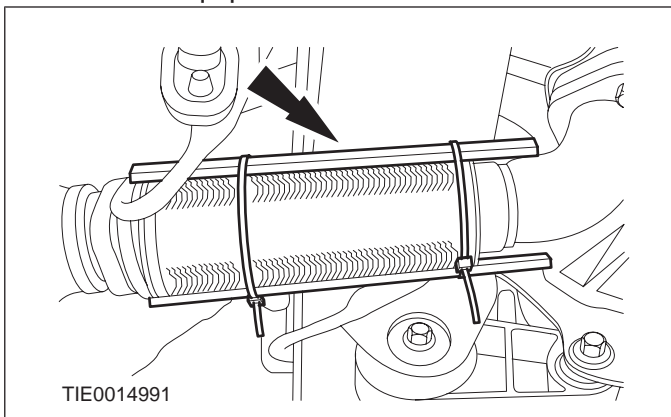
**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

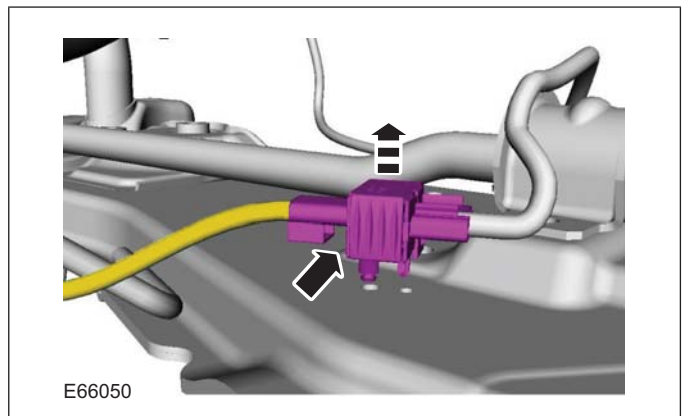
2.



3. General Equipment: Cable Ties



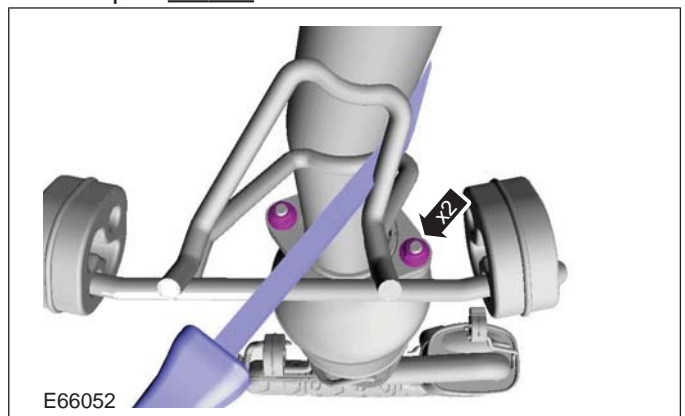
4.



5. CAUTIONS:

- ⚠ Jointing compound must not be used forward of the catalytic converter.
- ⚠ Make sure that the exhaust flexible pipe is not forcibly bent.

Material: Grease KS-PS (SA-M1C9107-A / YS5J-M1C9107-AA) grease  
Torque: 50 Nm



309-00-7

Exhaust System — 2.5L Duratec (147kW/200PS) - VI5

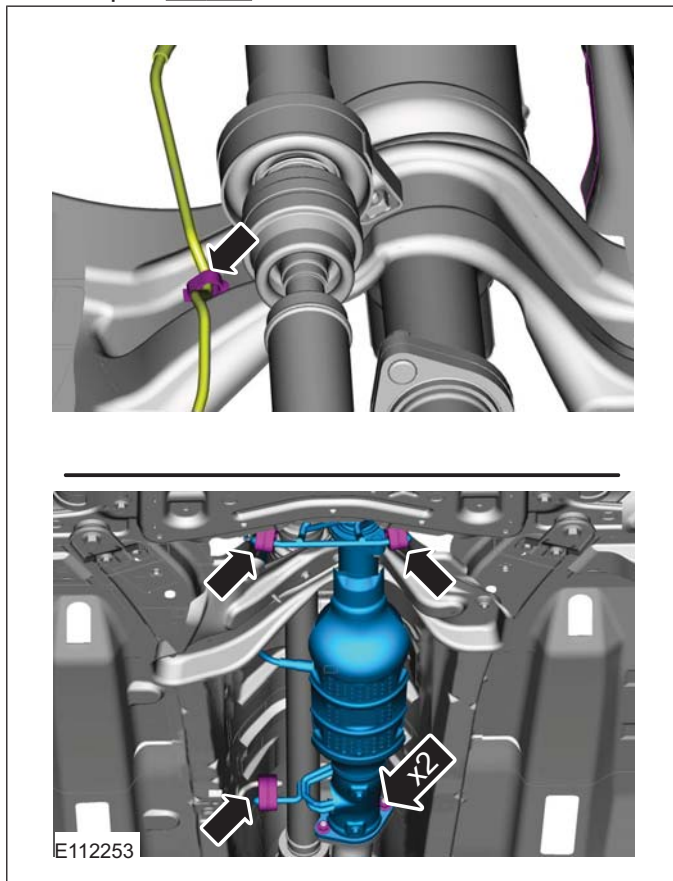
309-00-7

## REMOVAL AND INSTALLATION

6.  **CAUTION:** Make sure that the exhaust flexible pipe is not forcibly bent.

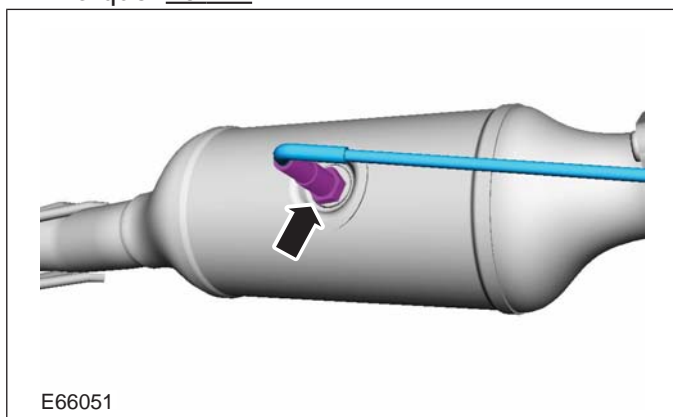
Material: Grease KS-PS (SA-M1C9107-A / YS5J-M1C9107-AA) grease

Torque: 50 Nm



7. **NOTE:** This step is not necessary when installing a new component.

Torque: 45 Nm



## Installation

1. To install, reverse the removal procedure.

## SECTION 310-00 Fuel System - General Information

**VEHICLE APPLICATION: 2008.50 Kuga**

CONTENTS	PAGE
<b>DIAGNOSIS AND TESTING</b>	
Fuel System — Vehicles With: Fuel Additive Tank.....	310-00-2
Principles of Operation.....	310-00-2
Inspection and Verification.....	310-00-2
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Fuel System Pressure Release.....	310-00-10
Release.....	310-00-10
Fuel Tank Draining.....	310-00-11

## DIAGNOSIS AND TESTING


## Fuel System — Vehicles With: Fuel Additive Tank


## General Equipment


Ford diagnostic equipment


## Principles of Operation


## WARNINGS:


 This procedure involves fuel additive handling. Be prepared for fuel additive spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.


 Eye, hand, ear protection and protective clothing are required to be worn during any general service or removal and installation service procedure of fuel additive system components. Failure to follow this instruction may result in personal injury.

 In case of fuel additive fluid contact with the skin or the eyes, flush immediately with water for a minimum of 15 minutes and seek prompt medical attention. Failure to follow these instructions may result in personal injury.

 If fuel additive fluid is swallowed, call a physician immediately. Rinse mouth immediately with water, do not induce vomiting. Failure to follow these instructions may result in personal injury.

 Always provide adequate ventilation when working on the fuel additive fluid system or related components. Failure to follow these instructions may result in personal injury.

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 **CAUTION:** Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from working on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

The fuel additive system is an on-board system that allows the injection of an additive at each refueling operation by the customer. The additive quantity is proportional to the fuel quantity that has been added. The fuel additive system module controls the amount of additive fluid entering the fuel tank at each refueling. A switch mounted on the fuel filler flap is used to detect the start of the refueling event and the fuel gauge that is mounted within the fuel tank informs the fuel additive tank module the quantity of actual fuel added.

## Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of leakage and mechanical or electrical damage.

## Visual Inspection Chart

Mechanical	Electrical
– Fuel additive tank	– Fuse(s)
– Fuel additive tank line(s)	– Fuel filler switch and magnet
– Fuel additive tank pipe(s)	– Wiring harness(s)
– Fuel additive tank connector(s)	– Electrical connector(s)
– Fuel tank filler cap	– Fuel additive system module
	– Fuel additive tank module
	– Instrument cluster
	– Powertrain Control Module (PCM)
	– Fuel level sensor

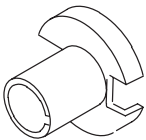
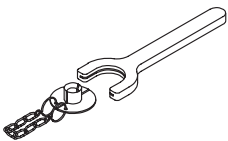
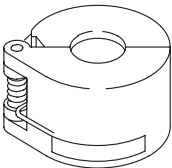
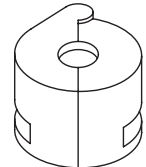
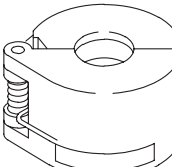
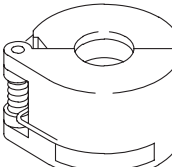
3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. If the cause is not visually evident, REFER to the Ford diagnostic equipment.



GENERAL PROCEDURES

Spring Lock Couplings

Special Tool(s)

 <p>23041</p>	<p>310-040 Disconnect Tool, Fuel Line (5/16")</p>
 <p>E51255</p>	<p>310-137 Disconnect Tool, Fuel Line</p>
 <p>23039</p>	<p>310-D004 Disconnect Tool, Spring Lock Coupling (3/8" yellow)</p>
 <p>23-040</p>	<p>310-D005 Disconnect Tool, Spring Lock Coupling (1/2" green)</p>
 <p>34003</p>	<p>412-038 Disconnect Tool, Spring Lock Coupling (5/8" black)</p>
 <p>34002</p>	<p>412-069 Disconnect Tool, Spring Lock Coupling (3/4" white)</p>

Materials	
Name	Specification
Engine Oil - 5W-30	WSS-M2C153-G

Disconnect

WARNINGS:

**▲** Refer to: **Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions** (100-00 General Information, Description and Operation).

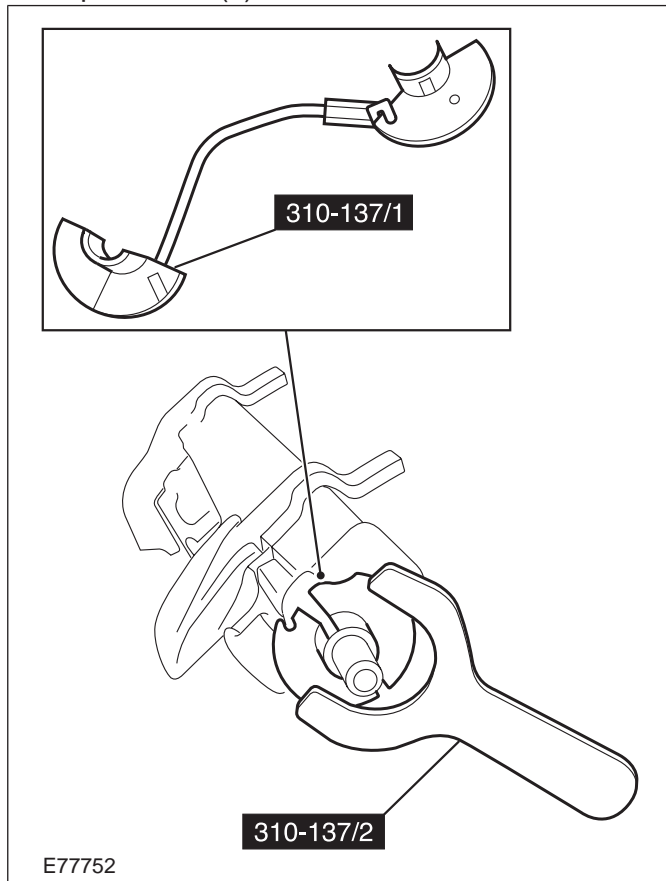


**NOTE:** Fuel supply line connectors are color coded white. Fuel return line connectors are color coded red.

1. Release the fuel system pressure

Refer to: **Fuel System Pressure Release** (310-00 Fuel System - General Information, General Procedures).

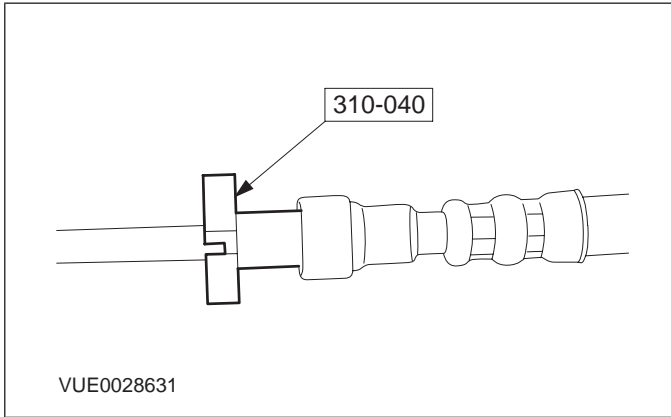
2. Special Tool(s): 310-137



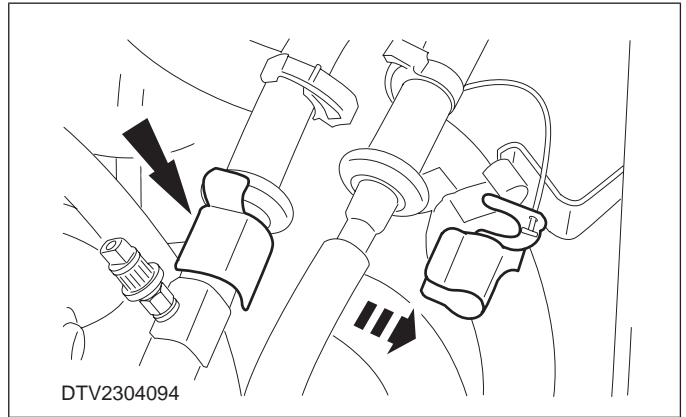


GENERAL PROCEDURES

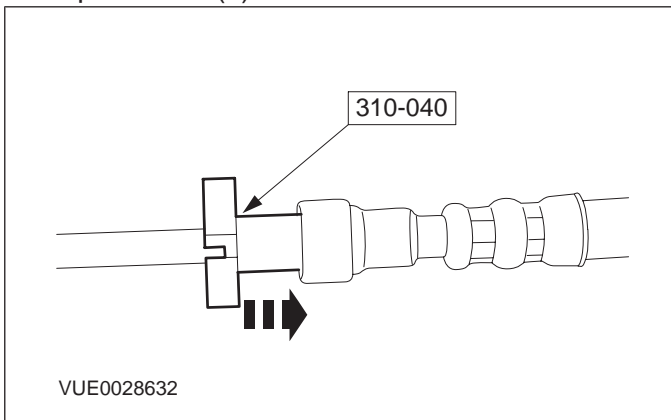
3. Special Tool(s): 310-040



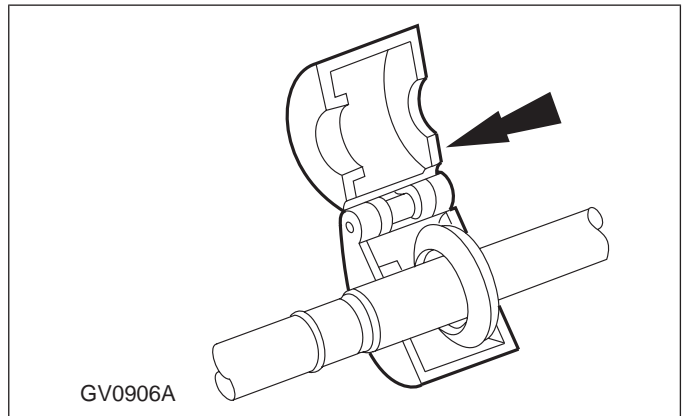
6.



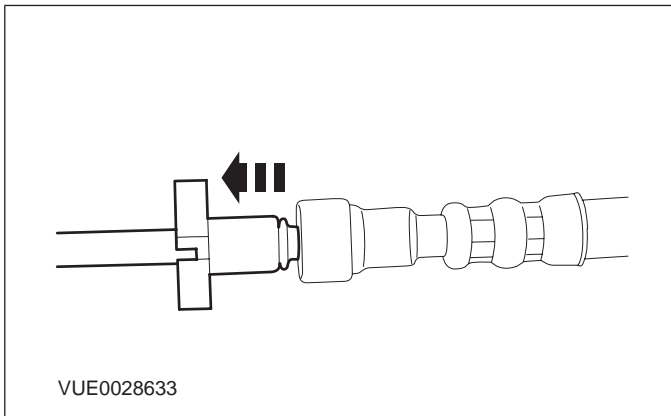
4. Special Tool(s): 310-040



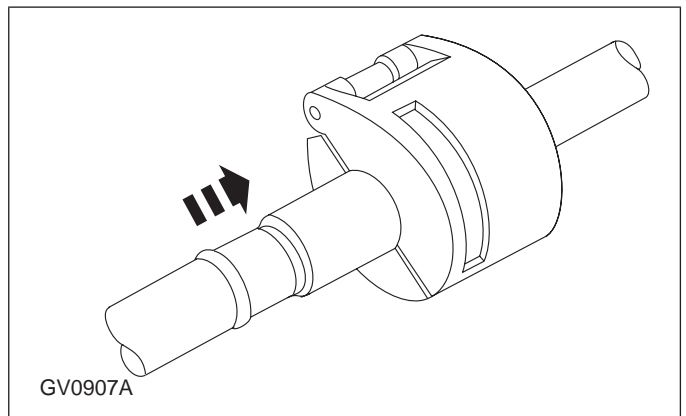
7. Special Tool(s): 310-D004, 310-D005, 412-038, 412-069



5.

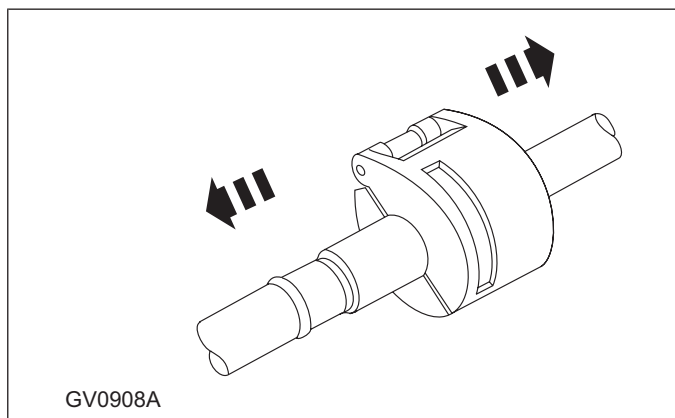


8. Special Tool(s): 310-D004, 310-D005, 412-038, 412-069

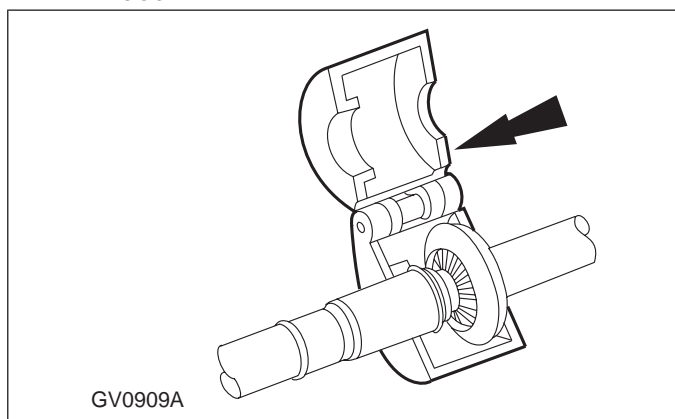


## GENERAL PROCEDURES

9.



10. Special Tool(s): 310-D004, 310-D005, 412-038,  
412-069

**Connect**

1.  **CAUTION: Only use the specified material to lubricate the seals.**

To connect, reverse the disconnect procedure.

Material: Engine Oil - 5W-30 (WSS-M2C153-G)  
engine oil

GENERAL PROCEDURES

Quick Release Coupling

General Equipment

Flat-bladed screwdriver

Disconnect

WARNINGS:

**▲** Refer to: **Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions** (100-00 General Information, Description and Operation).

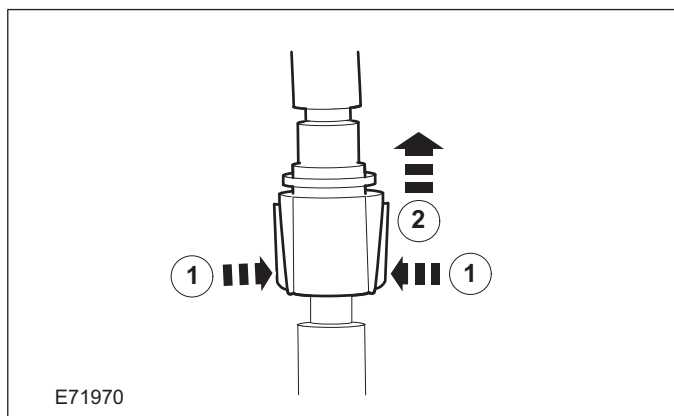


**NOTE:** Fuel supply line connectors are color coded white. Fuel return line connectors are color coded red.

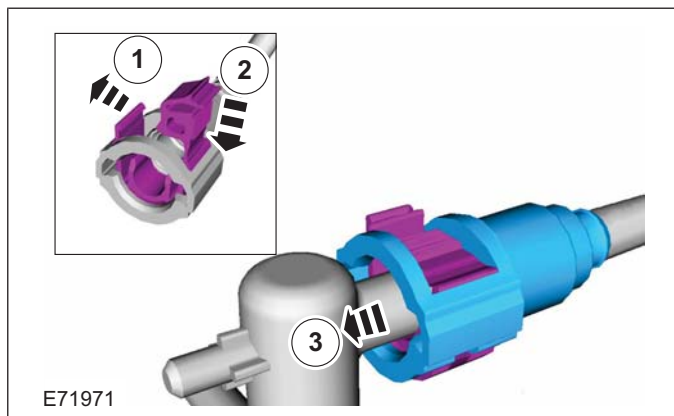
1. Release the fuel system pressure

Refer to: **Fuel System Pressure Release** (310-00 Fuel System - General Information, General Procedures).

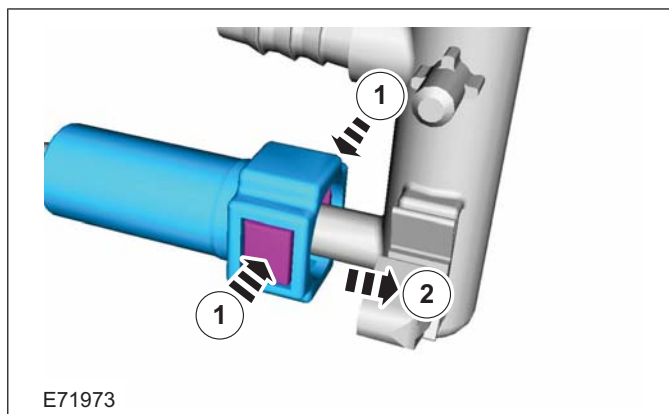
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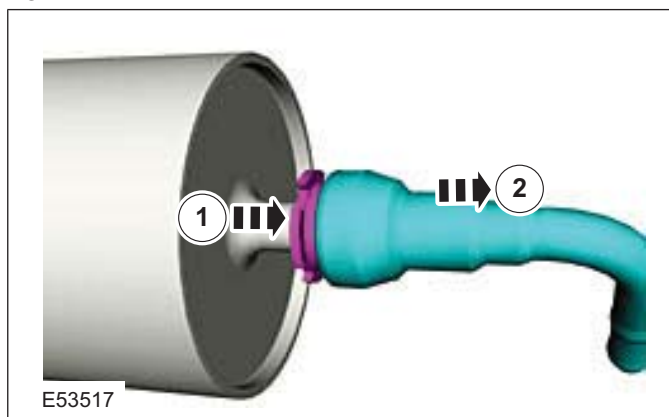
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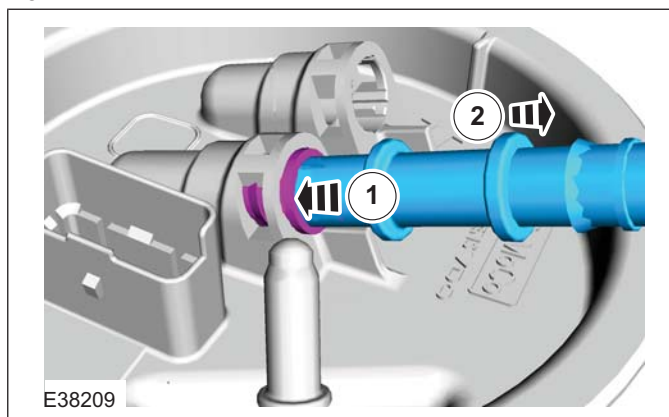
- 4.



- 5.

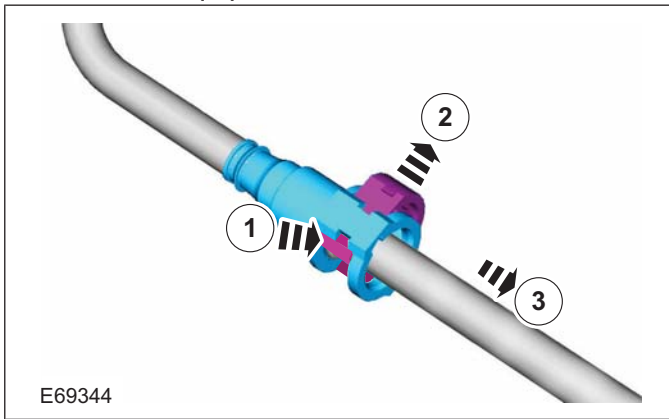


- 6.



**GENERAL PROCEDURES**

## 7. General Equipment: Flat-bladed screwdriver

**Connect**

1. To connect, reverse the disconnect procedure.



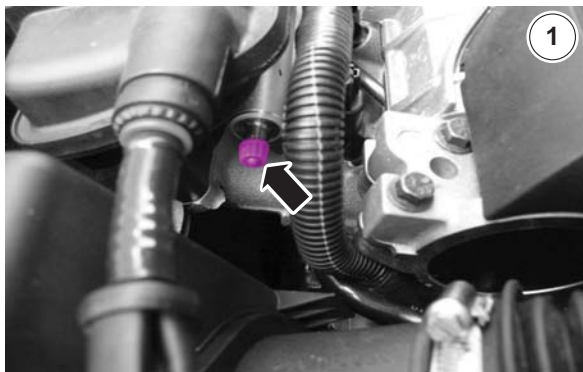
GENERAL PROCEDURES

Fuel System Pressure Check — 2.5L Duratec (162kW/220PS) - VI5

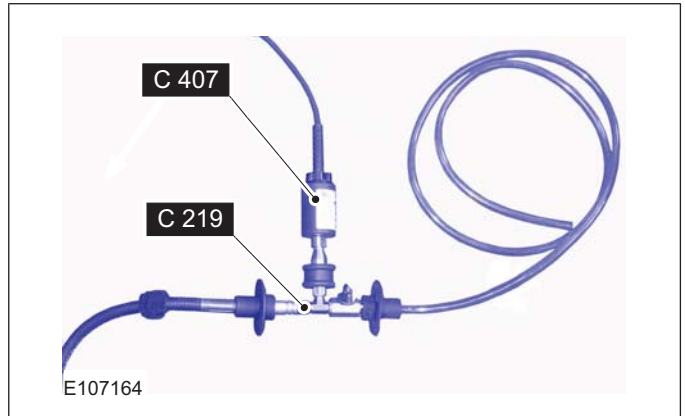
General Equipment

Adapter Pressure Vacuum Transducer (C219)
Ford Diagnostic Equipment
Pressure Vacuum Transducer (C407)

1. Refer to: **Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Fuel System Pressure Release** (310-00 Fuel System - General Information, General Procedures).
3. • General Equipment: Adapter Pressure Vacuum Transducer (C219)



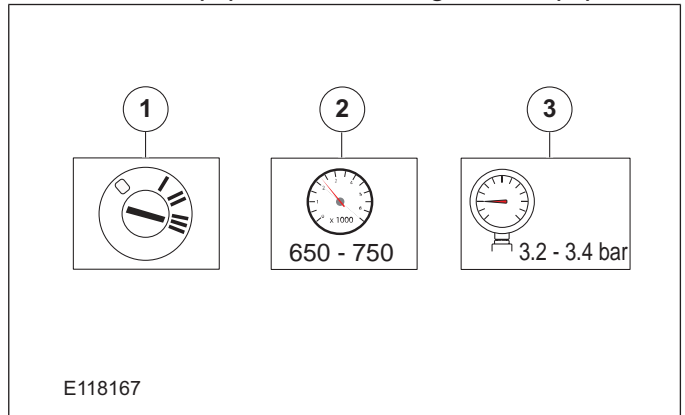
4. Connect the following items:
  - General Equipment: Adapter Pressure Vacuum Transducer (C219)
  - General Equipment: Pressure Vacuum Transducer (C407)



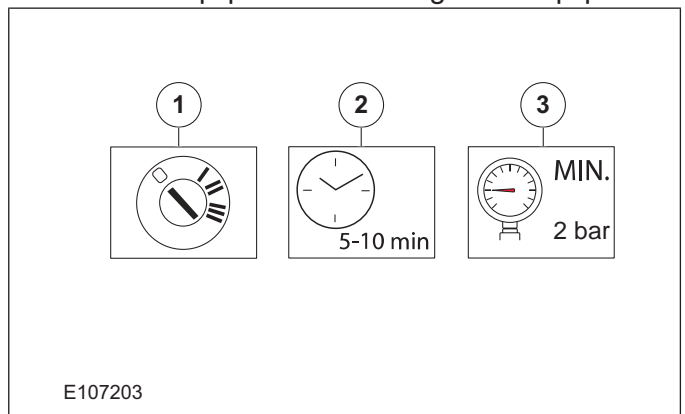
5. Using the digital multi-meter function, measure the fuel system pressure.

General Equipment: Ford Diagnostic Equipment

6. General Equipment: Ford Diagnostic Equipment

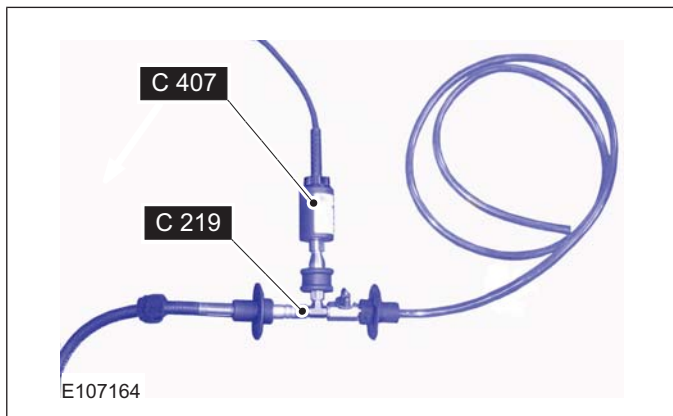


7. General Equipment: Ford Diagnostic Equipment

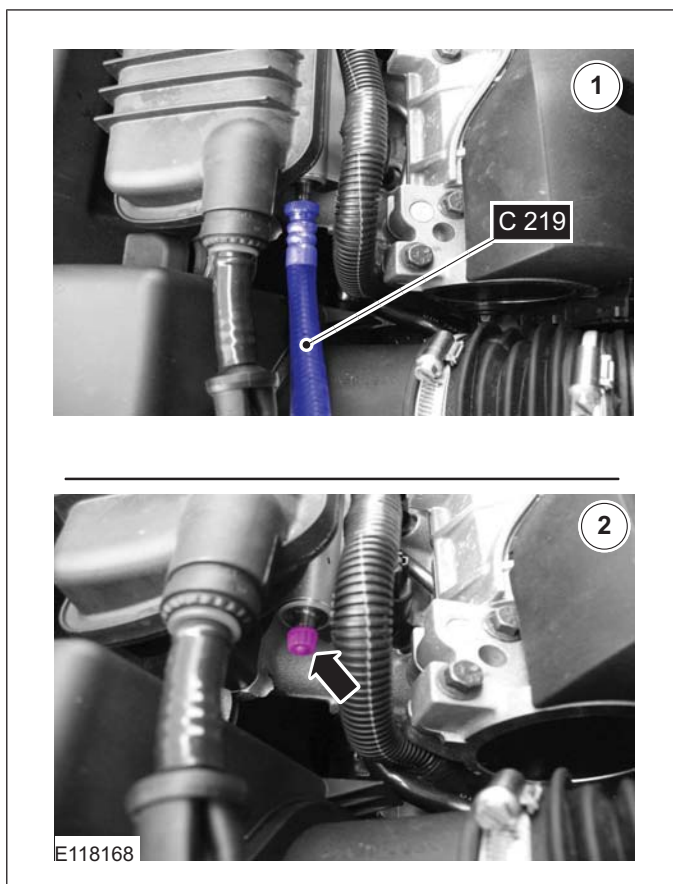


**GENERAL PROCEDURES**

8. Refer to: **Fuel System Pressure Release**  
(310-00 Fuel System - General Information, General Procedures).
9. Disconnect the following items:
  - General Equipment: Adapter Pressure Vacuum Transducer (C219)
  - General Equipment: Pressure Vacuum Transducer (C407)



10. • General Equipment: Adapter Pressure Vacuum Transducer (C219)



**GENERAL PROCEDURES****Fuel System Pressure Release****Release**

1. Refer to: **Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Remove the fuel pump and sender unit fuse.
3. Start the engine and allow it to idle until the engine stalls.
4. Crank the engine for approximately five seconds to make sure that the fuel rail pressure is released.
5. Install the fuel pump and sender unit fuse.

## GENERAL PROCEDURES

## Fuel Tank Draining

## General Equipment

Fluid Container
Fuel Tank Draining Equipment
Hose Clamp Remover/Installer

## Activation

**CAUTION:** If the fuel tank has been filled with the wrong type of fuel, the engine must not be started.

**NOTE:** Removal steps in this procedure may contain installation details.

6. Refer to: **Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions** (100-00 General Information, Description and Operation).

7. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

## 8. WARNINGS:

**WARNING:** Fuel may still be present in the fuel tank after draining.

**WARNING:** Be prepared to collect escaping fluids.

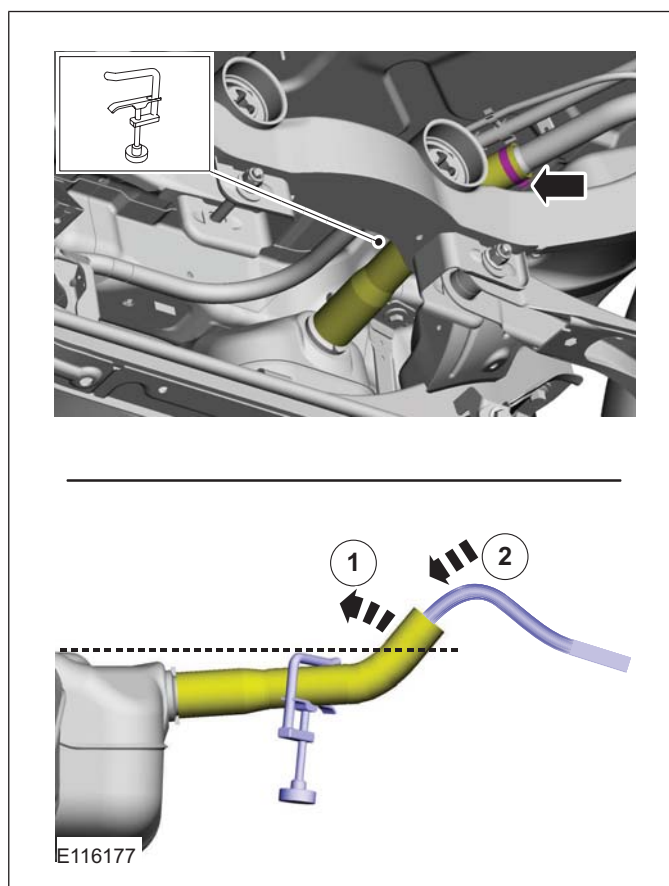
**CAUTION:** Use suitable paper to absorb any escaping fluid.

**NOTE:** Make sure that a new component is installed.

- General Equipment: Hose Clamp Remover/Installer
1. Make sure, that the fuel filler pipe is above the fuel level .
  2. Drain the reservoir.

General Equipment: Fuel Tank Draining Equipment

General Equipment: Fluid Container



9. Refer to: **Fuel Pump and Sender Unit - 2.5L Duratec (147kW/200PS) - VI5** (310-01 Fuel Tank and Lines, Removal and Installation).

10. **WARNING:** Be prepared to collect escaping fluids.

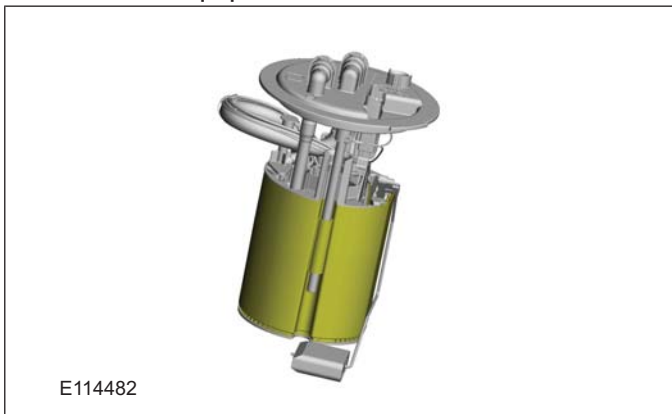
**CAUTION:** Use suitable paper to absorb any escaping fluid.



**GENERAL PROCEDURES**

Drain the reservoir.

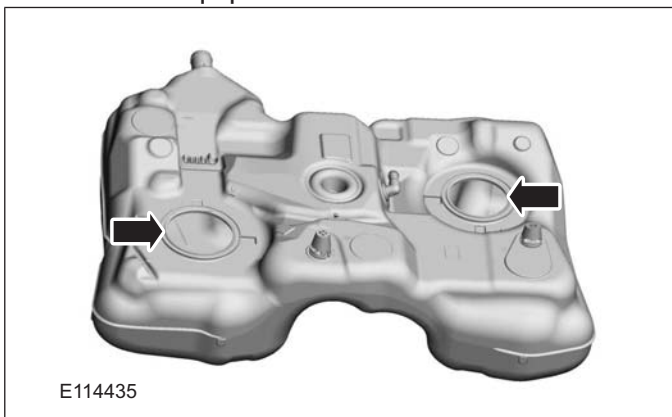
General Equipment: Fluid Container



**11. Drain the reservoir.**

General Equipment: Fuel Tank Draining  
Equipment

General Equipment: Fluid Container





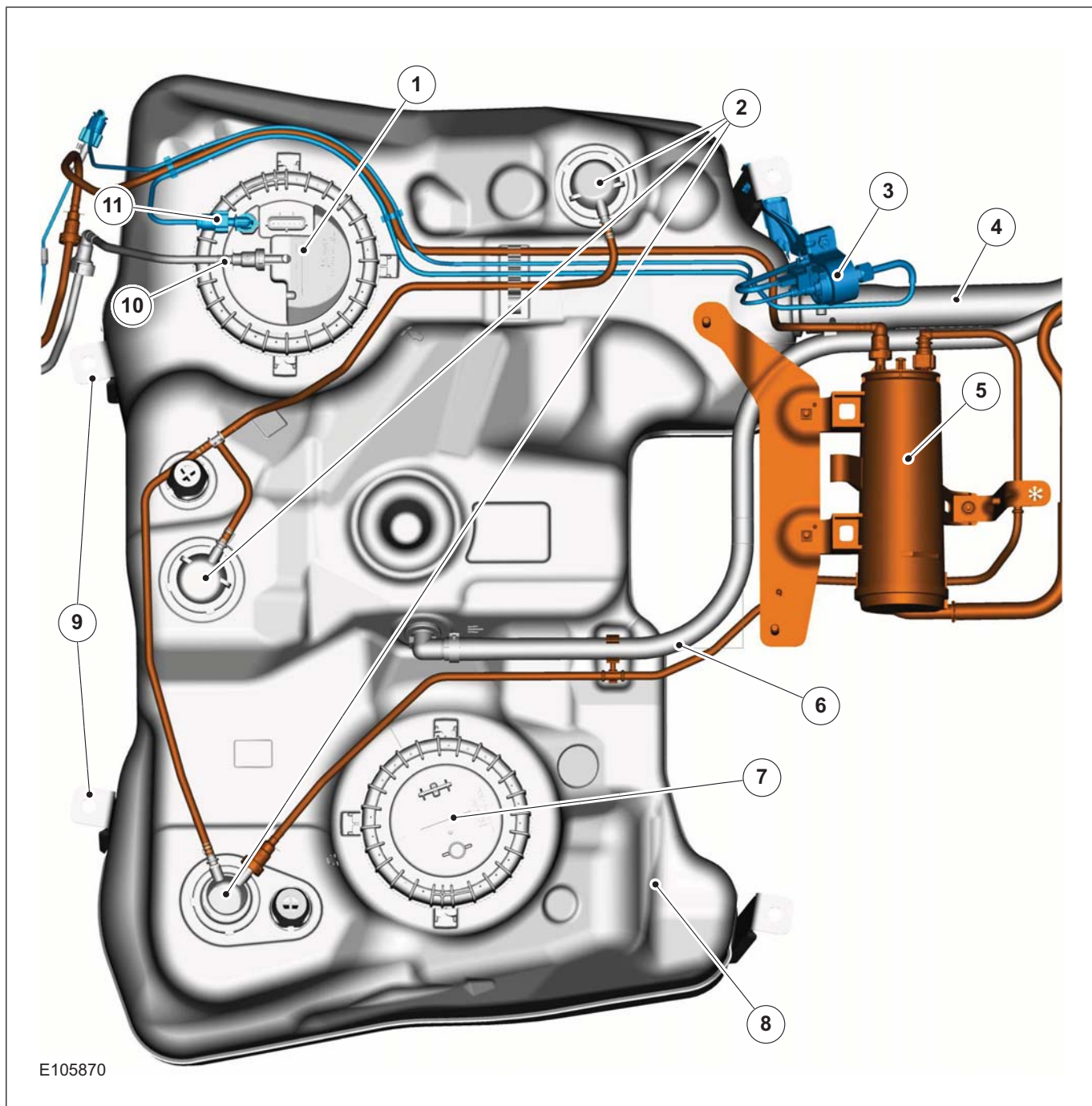
## SECTION 310-01 Fuel Tank and Lines

**VEHICLE APPLICATION: 2008.50 Kuga**

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Fuel Tank and Lines — 2.5L Duratec (147kW/200PS) - VI5 (Overview).....	310-01-5
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Fuel filler pipe and tank cap.....	310-01-6
<b>REMOVAL AND INSTALLATION</b>	
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Fuel Level Sensor — 2.5L Duratec (147kW/200PS) - VI5.....	310-01-11
Fuel Tank Filler Pipe.....	310-01-12
Fuel Filler Nozzle Inhibitor.....	310-01-14
Fuel Pump and Sender Unit — 2.5L Duratec (147kW/200PS) - VI5.....	310-01-18

DESCRIPTION AND OPERATION

Fuel Tank and Lines — 2.5L Duratec (147kW/200PS) - VI5 —  
Component Location



E105870

Item	Description
1	Fuel pump and level indicator module, right-hand side
2	EVAP (evaporative emission) extraction points
3	Fuel pump and lines for the fuel-fired booster heater/additional heater

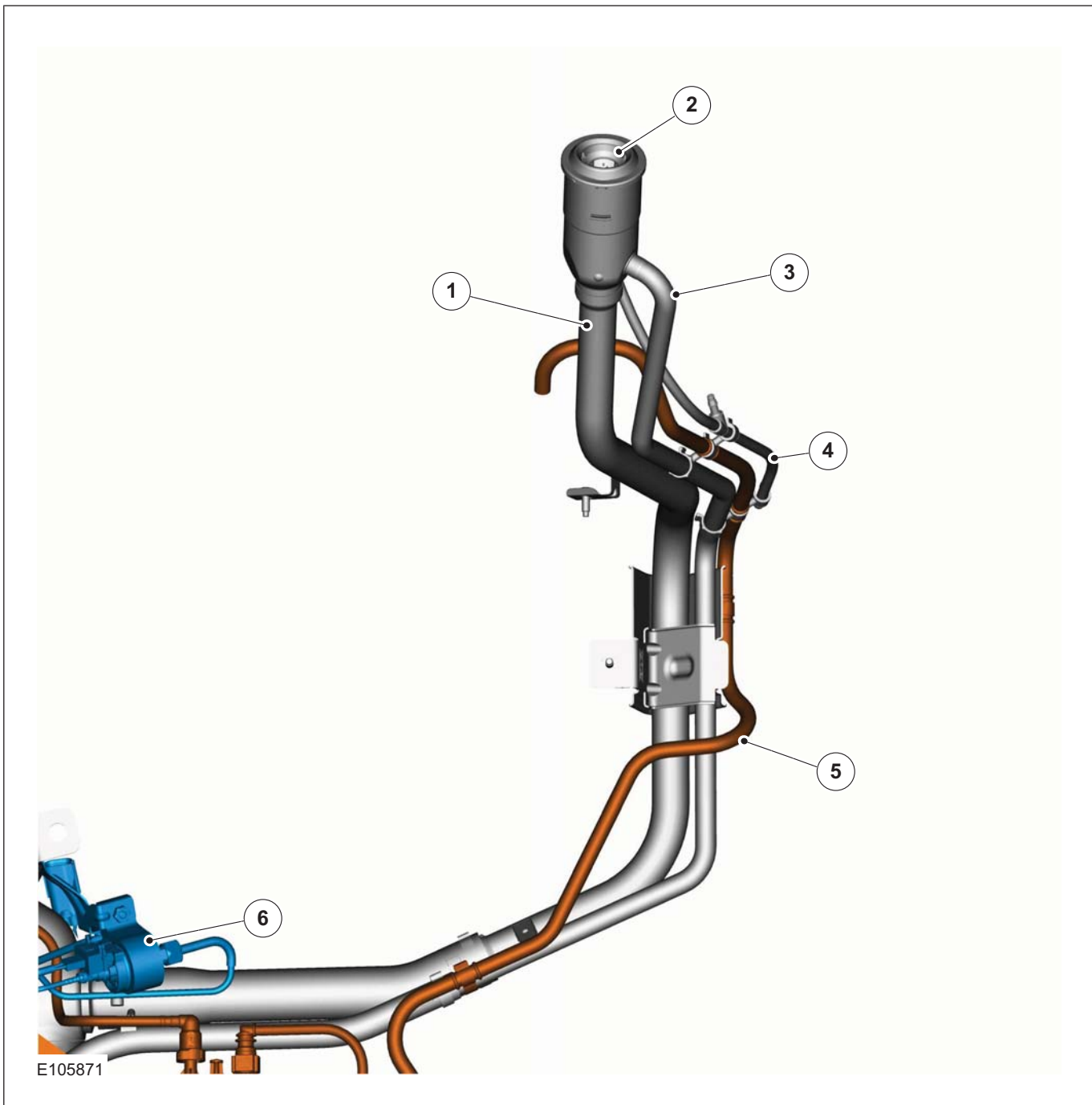
Item	Description
4	Fuel-filler pipe
5	EVAP container and lines
6	Vent hose, fuel filler pipe
7	Fuel pump and level indicator module, left-hand side
8	Fuel tank



DESCRIPTION AND OPERATION

Item	Description
9	Fuel tank retaining straps

Item	Description
10	Line, fuel tank to fuel distribution pipe
11	Connection, fuel-fired booster heater/additional heater



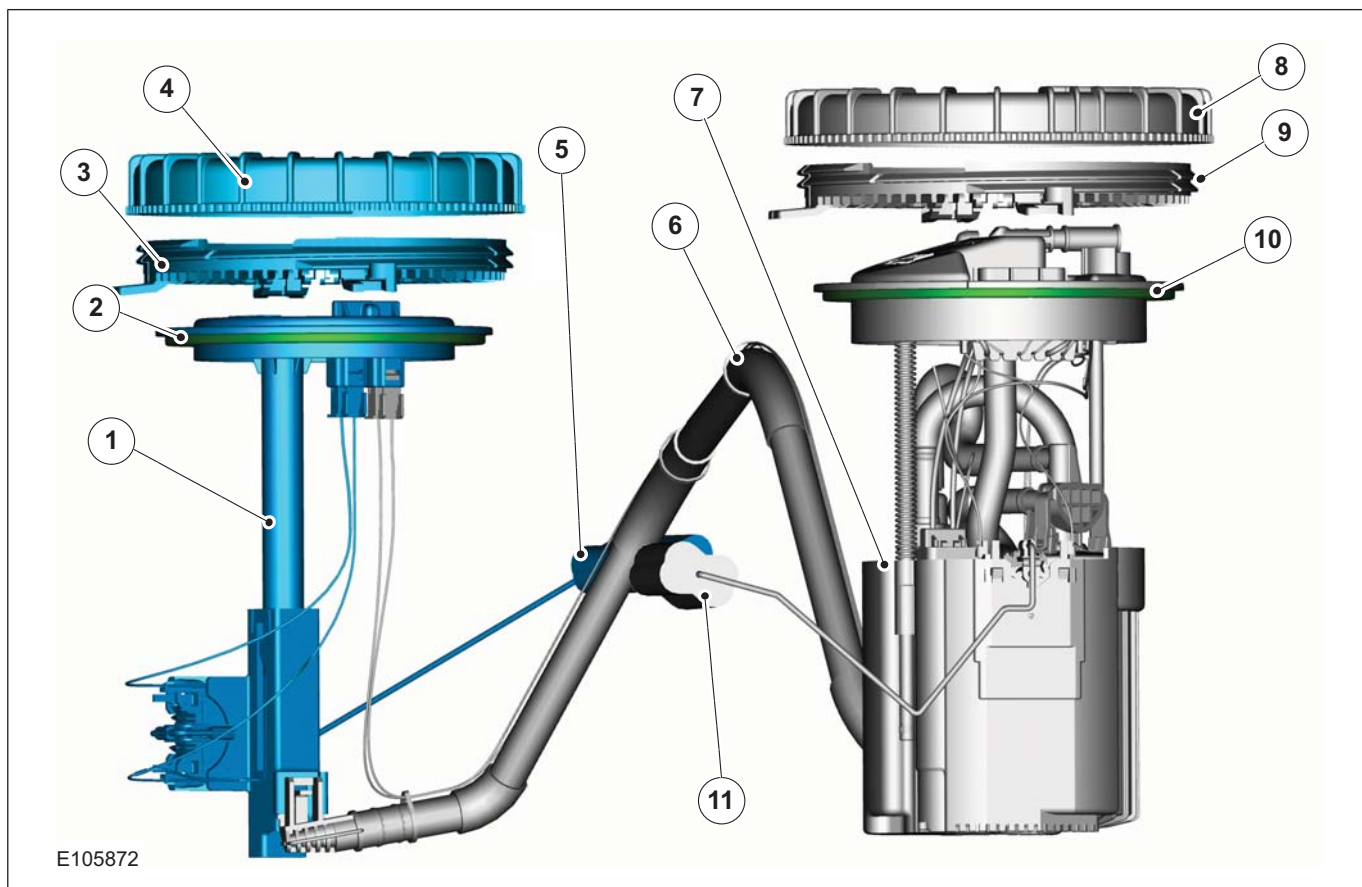
E105871

Item	Description
1	Fuel-filler pipe
2	Fuel filler opening, capless
3	Vent hose, fuel filler pipe

Item	Description
4	Overflow hose, fuel filler pipe
5	EVAP venting/breather hose
6	Fuel pump and lines for the fuel-fired booster heater/additional heater



DESCRIPTION AND OPERATION



Item	Description
1	Fuel pump and level indicator module, left-hand side
2	Seal, fuel pump and level indicator module, left-hand side
3	Retaining ring, fuel pump and level indicator module, left-hand side
4	Nut, fuel pump and level indicator module, left-hand side
5	Float, fuel pump and level indicator module, left-hand side

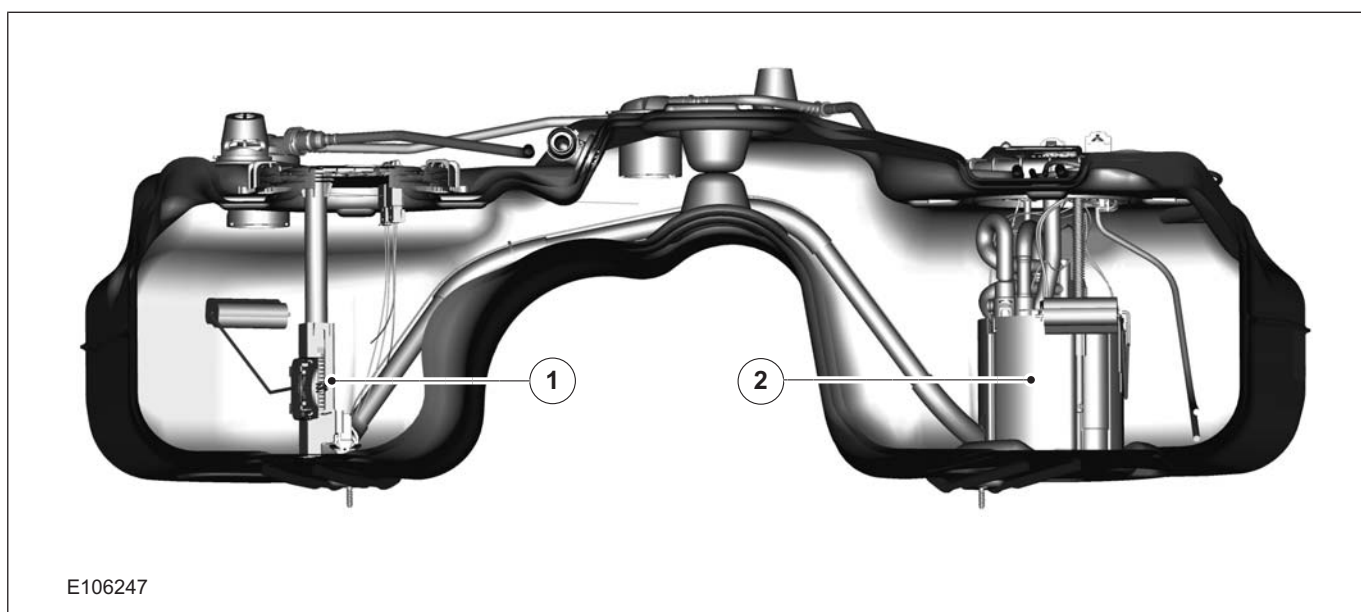
Item	Description
6	Suction hose, left-hand half of the fuel tank
7	Fuel pump and level indicator module, right-hand side
8	Nut, fuel pump and level indicator module, right-hand side
9	Retaining ring, fuel pump and level indicator module, right-hand side
10	Seal, fuel pump and level indicator module, right-hand side
11	Float, fuel pump and level indicator module, right-hand side

## DESCRIPTION AND OPERATION

Fuel Tank and Lines — 2.5L Duratec (147kW/200PS) - VI5 —  
Overview**Fuel tank**

The fuel tank is the same on vehicles with FWD and AWD. The fuel tank is saddle-shaped to

accommodate the drive shaft and the exhaust system. Depending on the design, the volume of the tank is 56 liters or 66 liters.

**Fuel pump and sender unit**

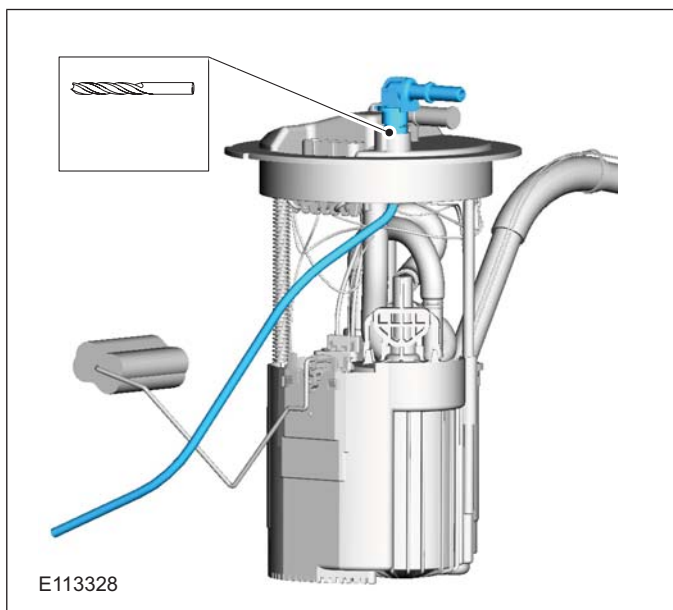
E106247

Item	Description
1	Fuel pump and level indicator module, left-hand side <b>Comments:</b> Inactive side without separate fuel pump
2	Fuel pump and level indicator module, right-hand side



## DESCRIPTION AND OPERATION

## Changing the right-hand fuel pump and level indicator module



If the right-hand fuel pump and level indicator module needs to be changed on a vehicle with a booster heater/additional heater, the bore for the connection to the fuel-fired booster heater/additional heater must be drilled.

The right-hand fuel pump and level indicator module contains a demand-switched electric fuel pump which drives two suction jet pumps. One of them ensures that fuel is pumped from the left-hand half of the tank into the right-hand half. On-demand switching is performed by the fuel pump module.

To remove the right-hand fuel pump and level indicator module it is necessary to detach the

left-hand fuel pump and level indicator module and pull it out slightly so that the connecting hose can be detached and the connector for the left-hand fuel pump and level indicator module can be disconnected. The left-hand fuel pump and level indicator module can be removed without detaching the right-hand fuel pump and level indicator module.

The instrument cluster uses the signals from both fuel fill level sensors to determine the fuel fill level.

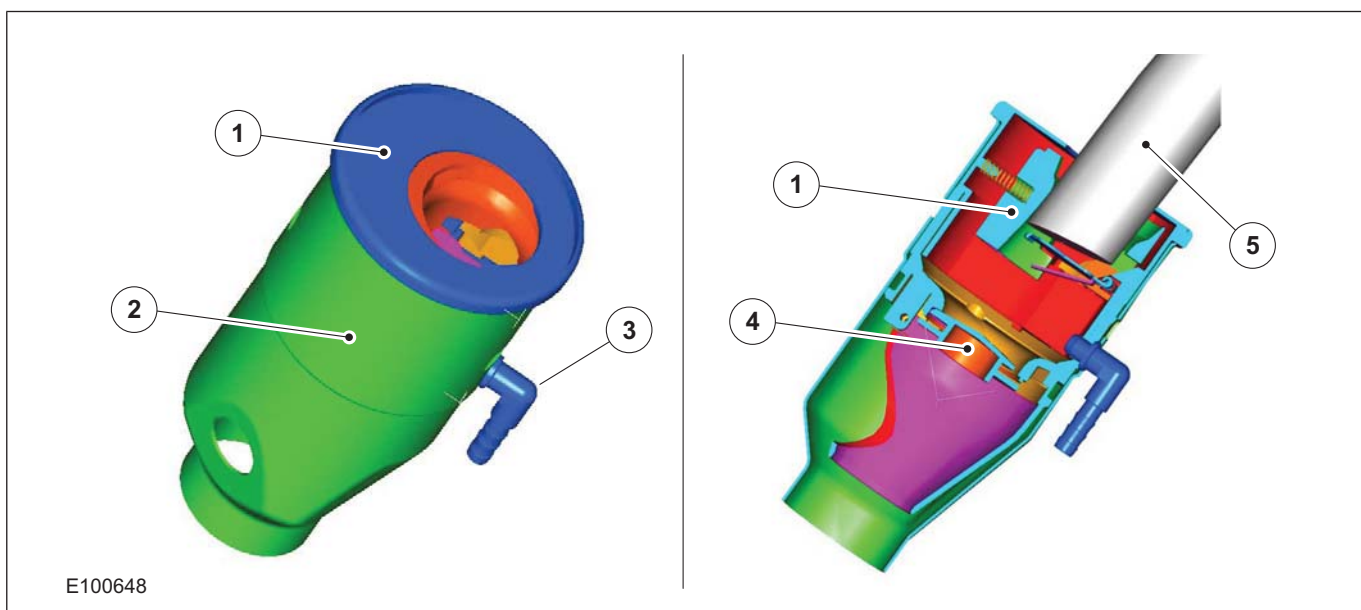
The resistor tracks of the fuel fill level sensors cannot be replaced individually.

The fuel filter is designed to last for the service life of the vehicle and does not need to be replaced.

The right-hand fuel pump and level indicator module contains an overpressure limiting valve. This overpressure limiting valve ensures that the fuel pressure between the injectors and the right-hand fuel pump and level indicator module does not exceed 3.3 bar after the engine is stopped. This reduces the formation of vapor bubbles and also prevents dripping from the injectors.

## Fuel filler pipe and tank cap

**NOTE:** Any water in the filling area can cause the mechanism to freeze at temperatures below 0 °C. In this case the closing mechanism will not open when the nozzle of the petrol/diesel pump is inserted.



**DESCRIPTION AND OPERATION**

Item	Description
1	Latch mechanism
2	Housing, capless fuel filler pipe
3	Overflow

Item	Description
4	Gasket
5	Filler nozzle

A spring-loaded fuel filler door closes off the upper end of the fuel tank filler pipe in place of the filler cap. The spring-loaded fuel filler door features a latching mechanism. The release mechanism is matched to the size of the filler nozzle. If the correct filler nozzle is inserted, the release lugs are pushed back. This releases the slide which can move upwards and opens the way to the spring-loaded fuel filler door for the filler nozzle.

## REMOVAL AND INSTALLATION

## Fuel Tank — 2.5L Duratec (147kW/200PS) - VI5

## Removal

**▲ WARNING: Avoid flames, sparks or lighted substances.**

**NOTE:** Removal steps in this procedure may contain installation details.

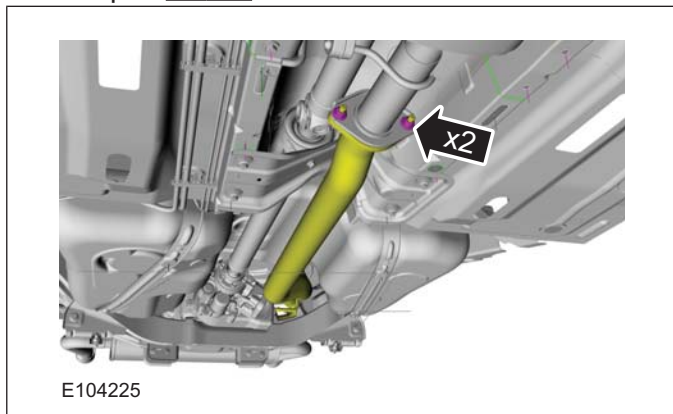
1. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).

4x4

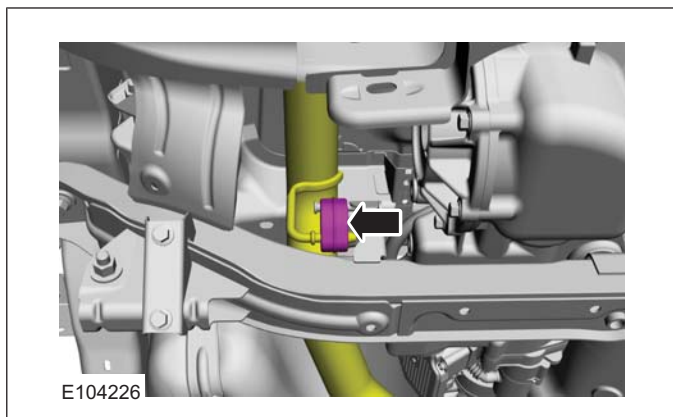
2. Refer to: **Driveshaft** (205-01 Driveshaft, Removal and Installation).

All vehicles

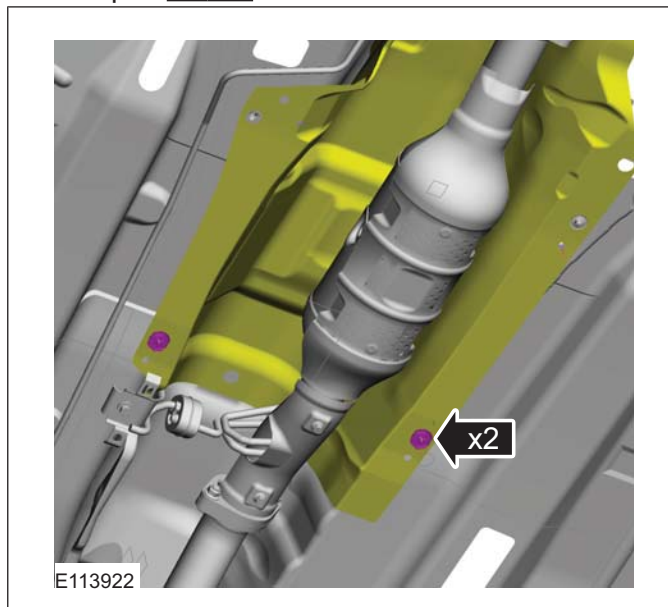
3. Torque: 48 Nm



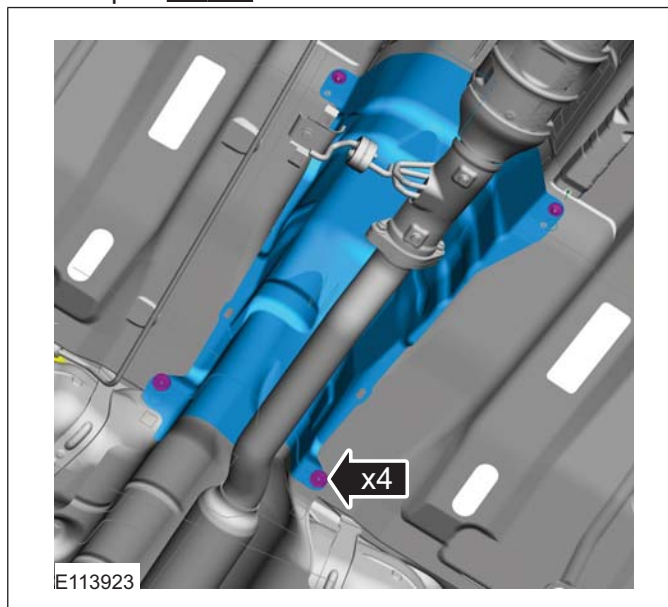
4.



5. Torque: 15 Nm

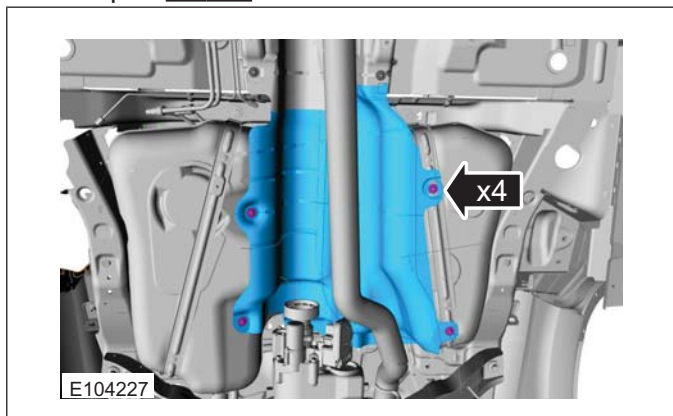


6. Torque: 15 Nm



REMOVAL AND INSTALLATION

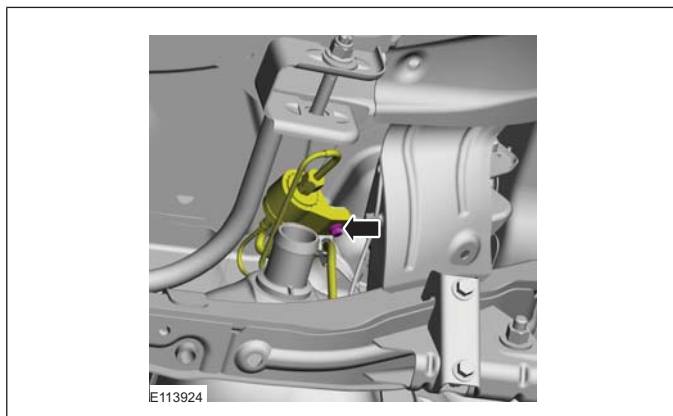
7. Torque: 15 Nm



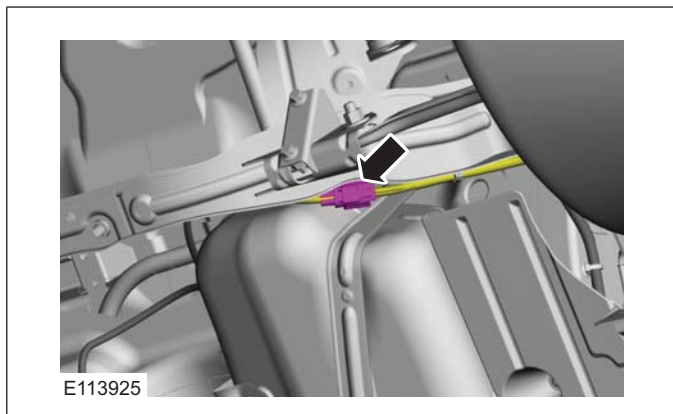
8. Refer to: **Fuel Tank Draining** (310-00 Fuel System - General Information, General Procedures).

Vehicles with fuel fired booster heater

9.



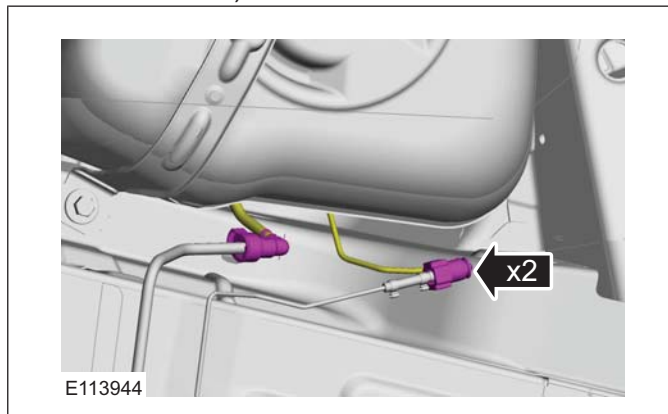
10.



11. **WARNING:** Be prepared to collect escaping fluids.

**CAUTION:** Use suitable paper to absorb any escaping fluid.

Refer to: **Quick Release Coupling** (310-00 Fuel System - General Information, General Procedures).

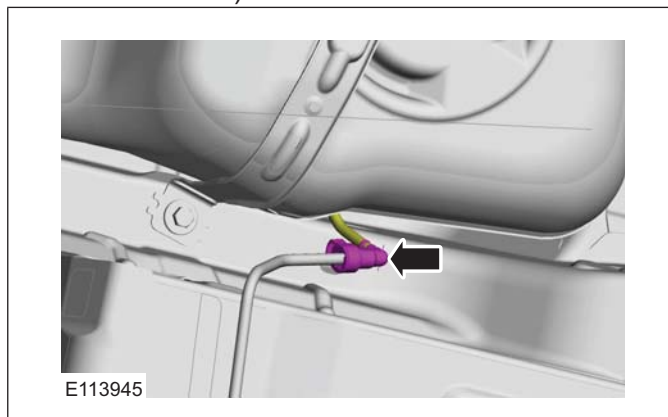


All vehicles

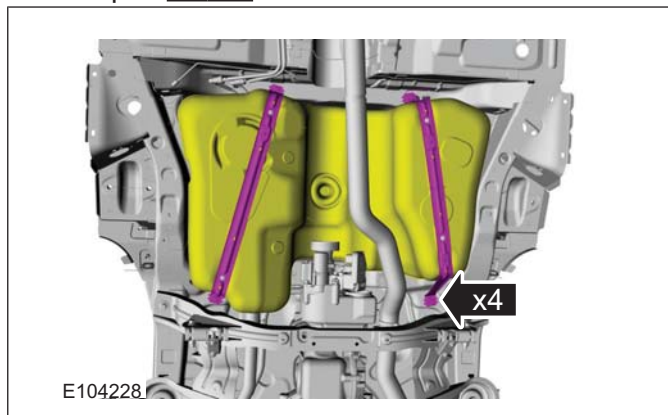
12. **WARNING:** Be prepared to collect escaping fluids.

**CAUTION:** Use suitable paper to absorb any escaping fluid.

Refer to: **Quick Release Coupling** (310-00 Fuel System - General Information, General Procedures).



13. Torque: 30 Nm





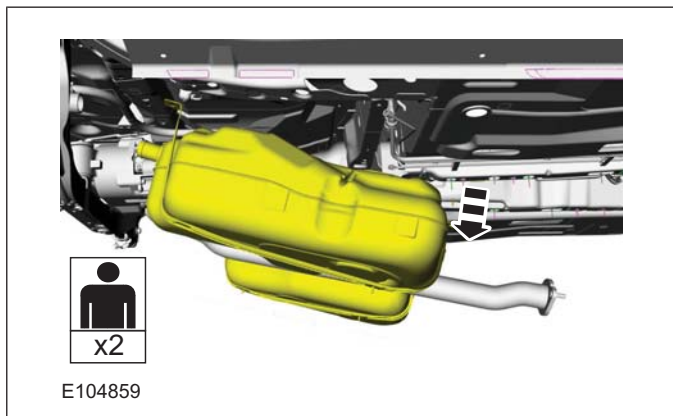
## 310-01-10

## Fuel Tank and Lines

## 310-01-10

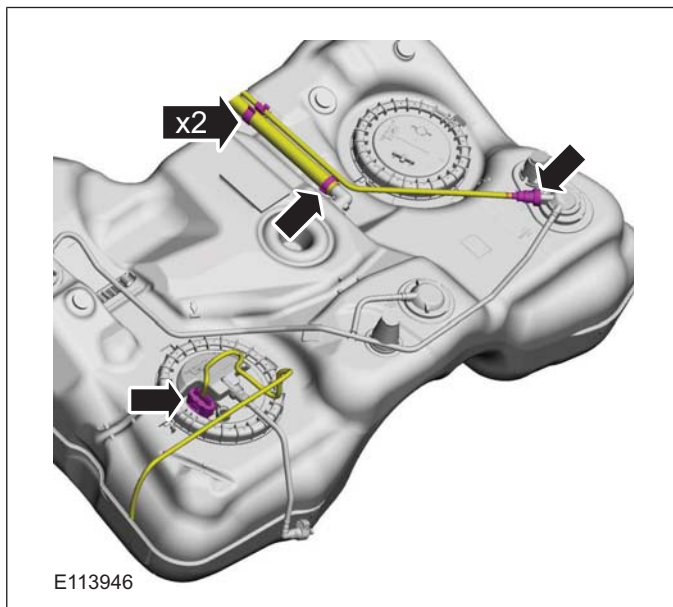
## REMOVAL AND INSTALLATION

14.

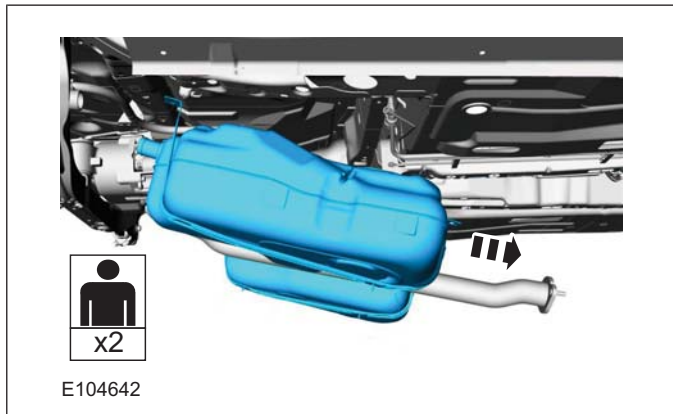


15. **WARNING:** Be prepared to collect escaping fluids.

**CAUTION:** Use suitable paper to absorb any escaping fluid.



16.



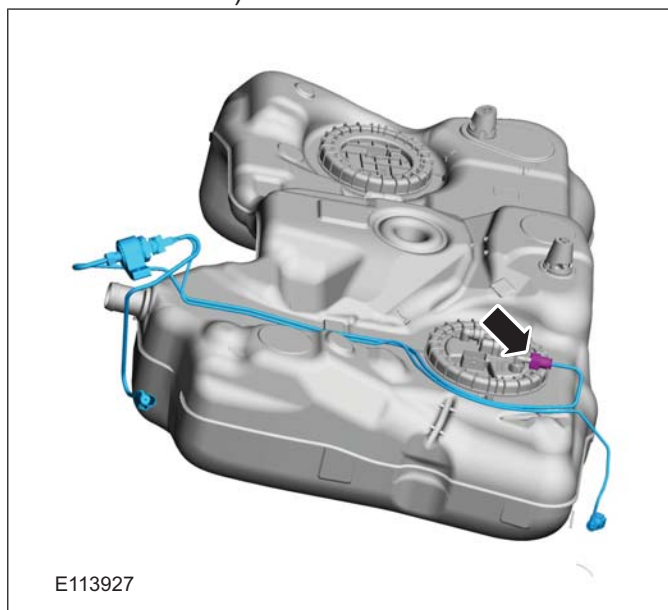
Vehicles with fuel fired booster heater

**NOTE:** This step is only necessary when installing a new component.

17. **WARNING:** Be prepared to collect escaping fluids.

**CAUTION:** Use suitable paper to absorb any escaping fluid.

Refer to: **Quick Release Coupling** (310-00 Fuel System - General Information, General Procedures).



All vehicles

**NOTE:** This step is only necessary when installing a new component.

18. Refer to: **Fuel Pump and Sender Unit - 2.5L Duratec (147kW/200PS) - VI5** (310-01 Fuel Tank and Lines, Removal and Installation).

Installation

1. To install, reverse the removal procedure.



**REMOVAL AND INSTALLATION****Fuel Level Sensor — 2.5L Duratec (147kW/200PS) - VI5**

## Removal

1. Refer to: **Fuel Pump and Sender Unit - 2.5L Duratec (147kW/200PS) - VI5** (310-01 Fuel Tank and Lines, Removal and Installation).

## Installation

1. To install, reverse the removal procedure.

## REMOVAL AND INSTALLATION

## Fuel Tank Filler Pipe

## General Equipment

Fluid Container

## General Equipment

Fuel Tank Draining Equipment

Hose Clamp Remover/Installer

## Removal

**WARNING:** Make sure that the fuel tank is no more than 3/4 full.

**NOTE:** Removal steps in this procedure may contain installation details.

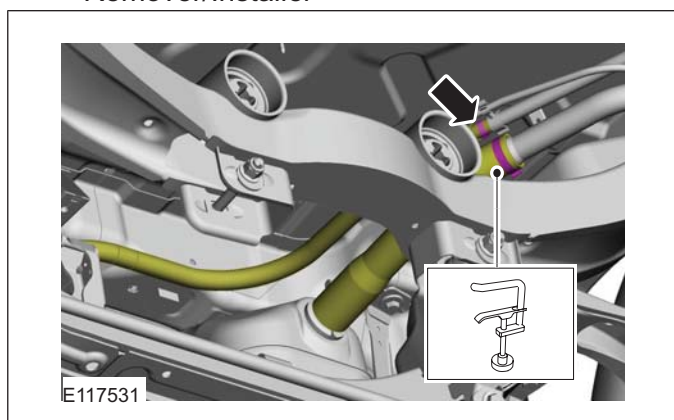
1. Remove the rear wheel on right-hand side.

Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

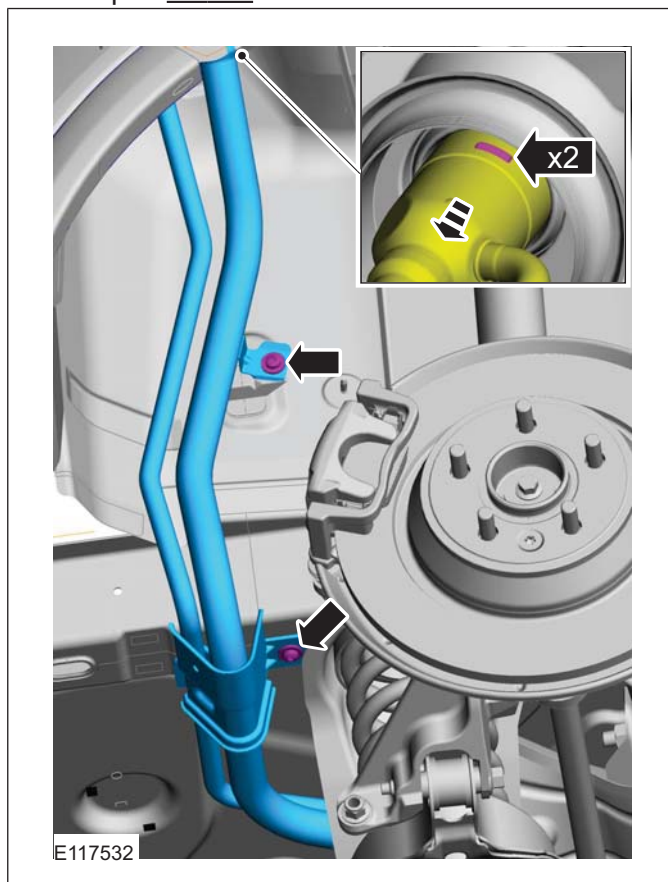
2. **WARNING:** Be prepared to collect escaping fluid.

**CAUTION:** Use suitable paper to absorb any escaping fluid.

General Equipment: Hose Clamp Remover/Installer



3. Torque: 10 Nm



## 310-01-13

## Fuel Tank and Lines

## 310-01-13

## REMOVAL AND INSTALLATION

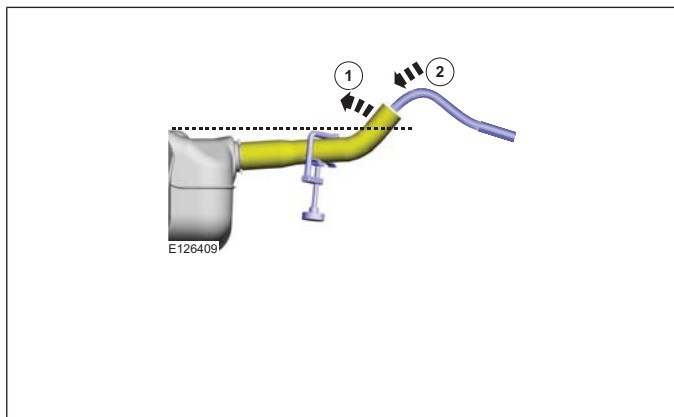
4. **⚠ WARNING:** Fuel may still be present in the fuel tank after draining.

1. Make sure, that the fuel filler pipe is above the fuel level.

General Equipment: Hose Clamp  
Remover/Installer

2. Drain the reservoir.

General Equipment: Fuel Tank Draining  
Equipment  
General Equipment: Fluid Container



## Installation

1. To install, reverse the removal procedure.

2. 1. **NOTE:** Make sure that a new component is installed.

**NOTE:** Make sure that a new clamp is installed.

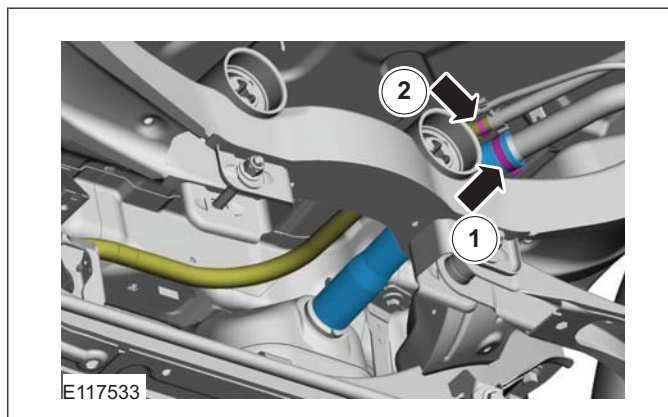
**NOTE:** Make sure that the clamp is installed to the same orientation as when removed.

General Equipment: Hose Clamp  
Remover/Installer

2. **NOTE:** Make sure that a new clamp is installed.

**NOTE:** Make sure that the clamp is installed to the same orientation as when removed.

General Equipment: Hose Clamp  
Remover/Installer



310-01-14

Fuel Tank and Lines

310-01-14

## REMOVAL AND INSTALLATION

## Fuel Filler Nozzle Inhibitor

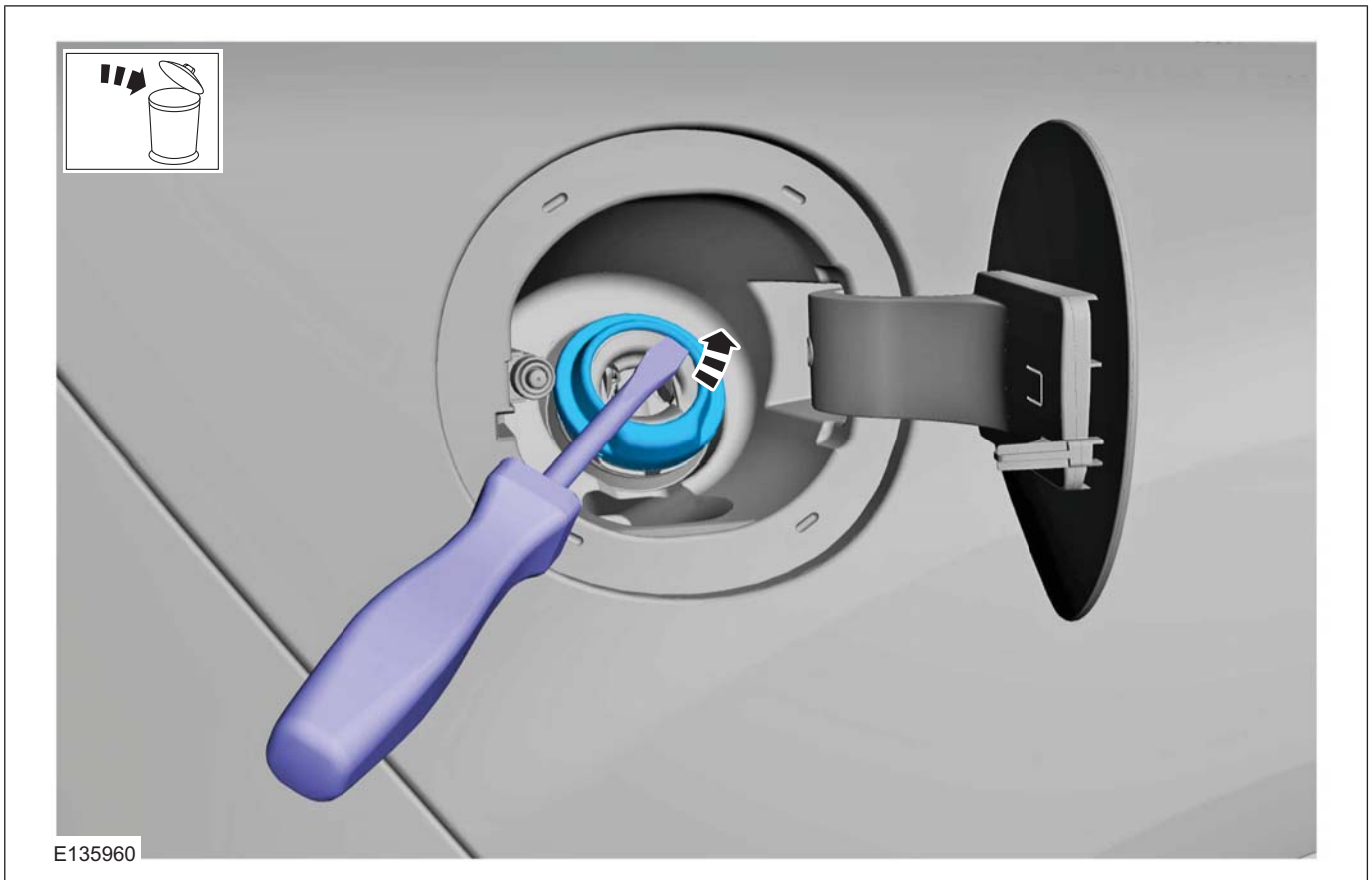
## Removal



**WARNING:** Avoid flames, sparks or lighted substances.

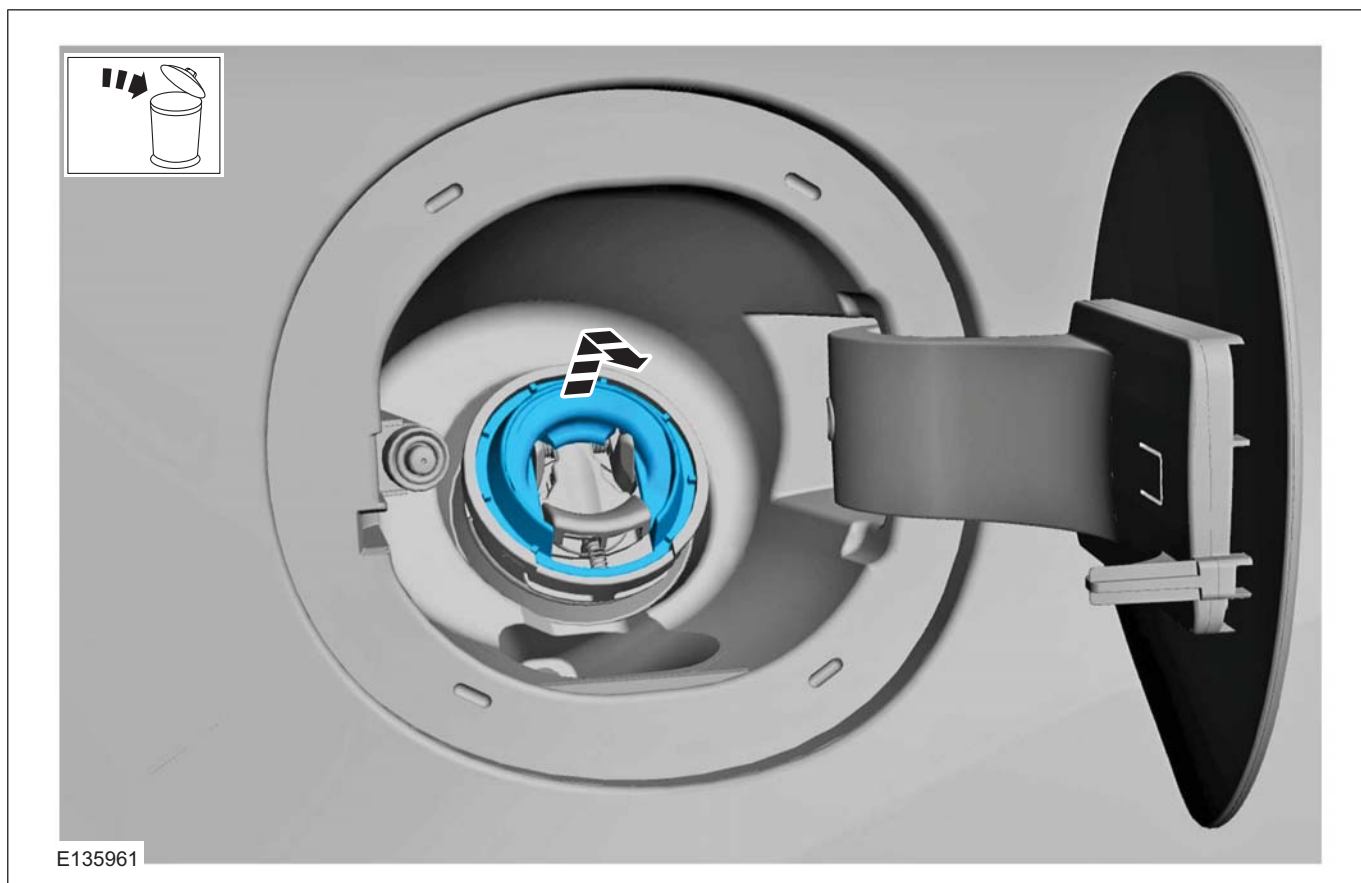
1. Refer to: **Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions** (100-00 General Information, Description and Operation).

- 2.



- 3.

## REMOVAL AND INSTALLATION

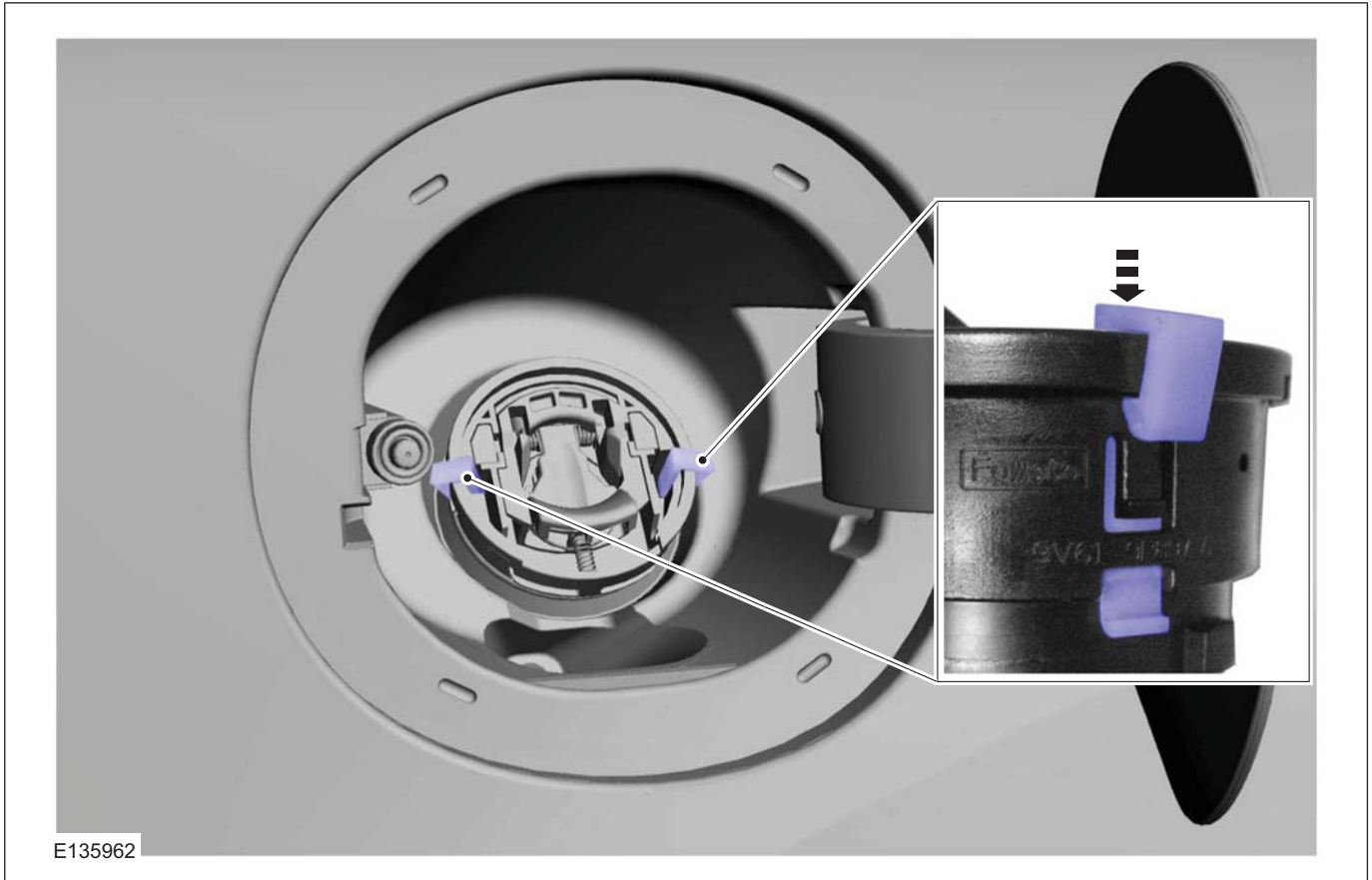


4. Install the special tool(s) (supplied in the parts kit).

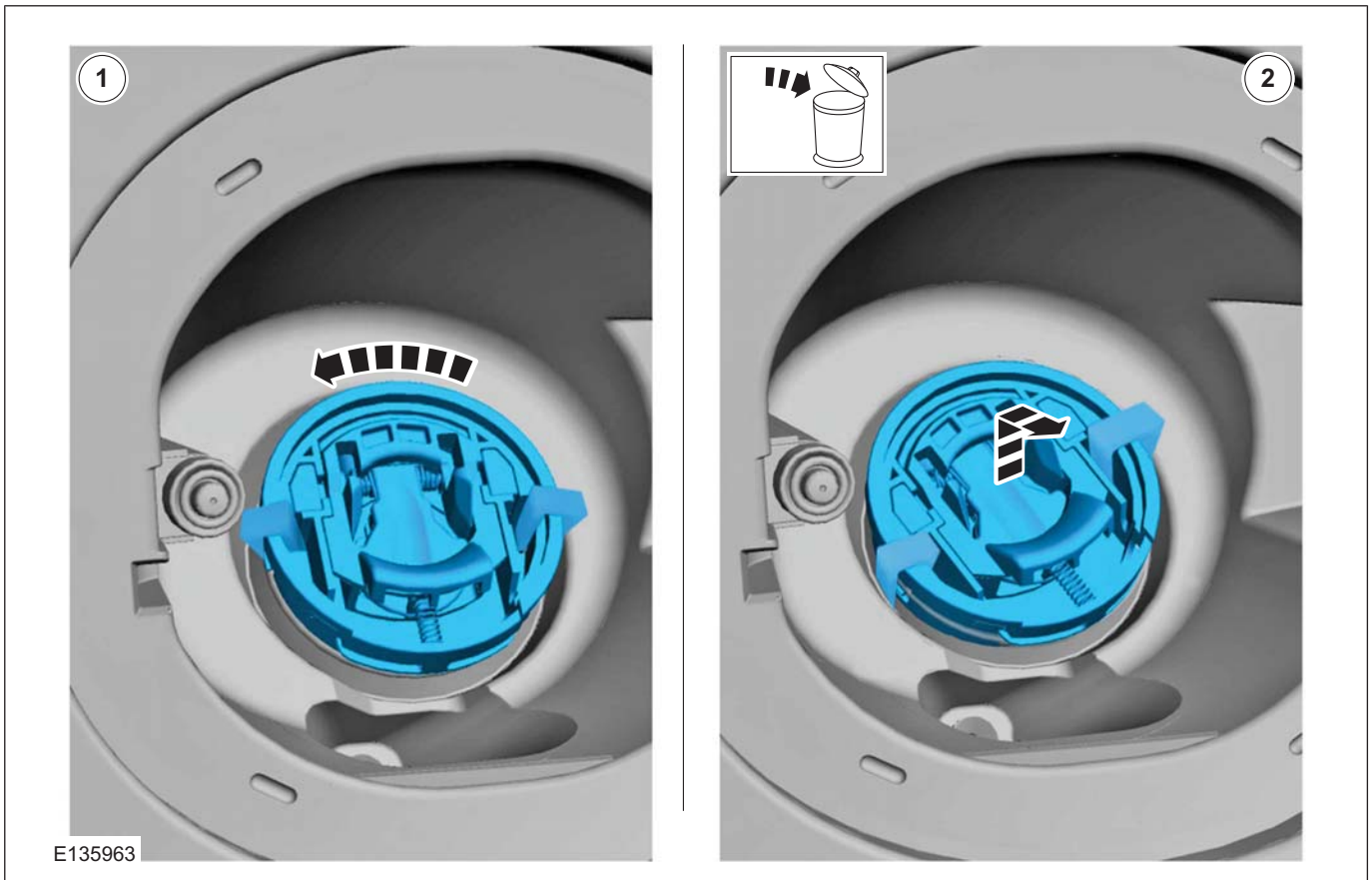




REMOVAL AND INSTALLATION



5. 1. Turn until resistance is felt.



310-01-17

Fuel Tank and Lines

310-01-17

## REMOVAL AND INSTALLATION

Installation

1. 1. **NOTE:** Make sure that a new component is

installed.

2. Turn until resistance is felt.



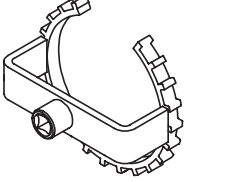
E135964



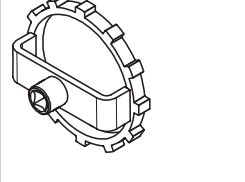
REMOVAL AND INSTALLATION

Fuel Pump and Sender Unit — 2.5L Duratec (147kW/200PS) - VI5

Special Tool(s) / General Equipment

 <p>E115757</p>	<p>310-210 Wrench, Fuel Tank Sender Unit</p>
--	--

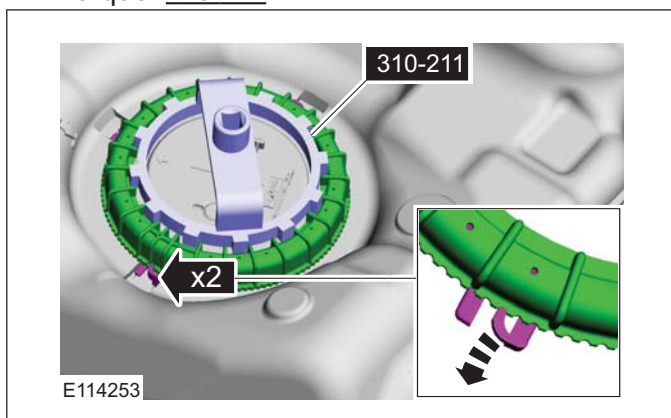
Special Tool(s) / General Equipment

 <p>E115758</p>	<p>310-211 Wrench, Fuel Tank Sender Unit</p>
<p>Fluid Container</p>	

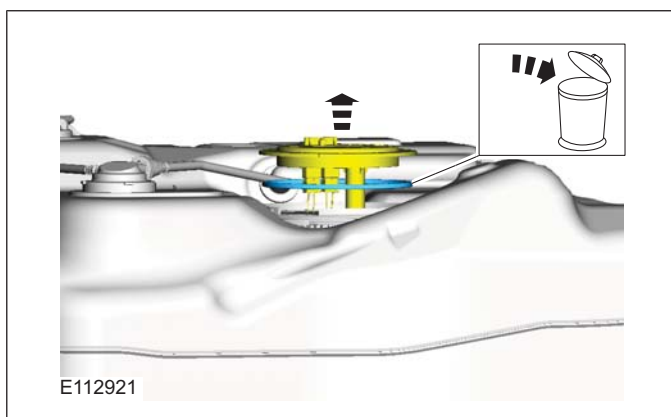
Removal

**NOTE:** Removal steps in this procedure may contain installation details.

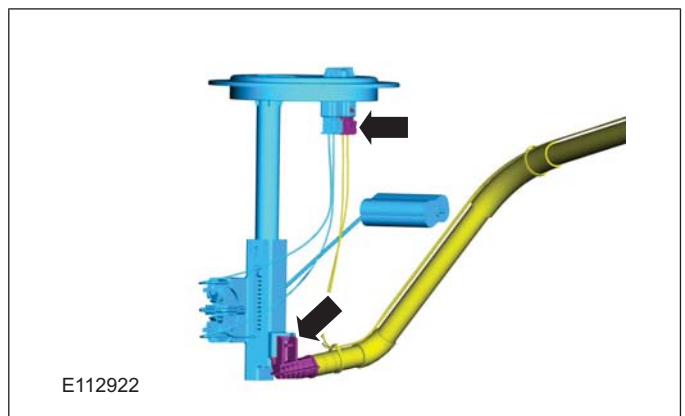
1. Refer to: **Fuel Tank - 2.5L Duratec (147kW/200PS) - VI5** (310-01 Fuel Tank and Lines, Removal and Installation).
2. Special Tool(s): 310-211  
Torque: 110 Nm



3. **CAUTION:** Take extra care not to damage the fuel tank level sensor float and arm.

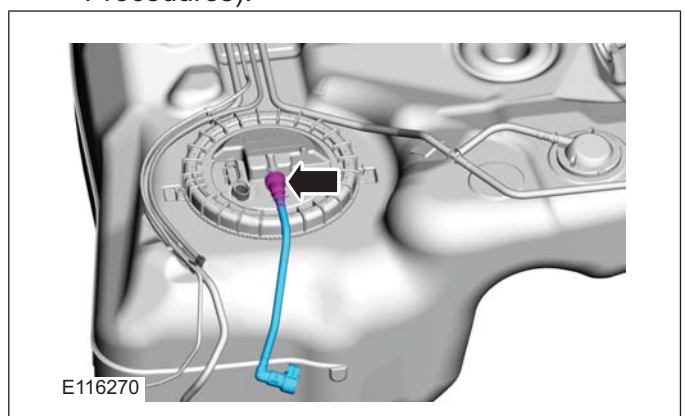


4.



Vehicles without fuel fired booster heater

5. Refer to: **Quick Release Coupling** (310-00 Fuel System - General Information, General Procedures).



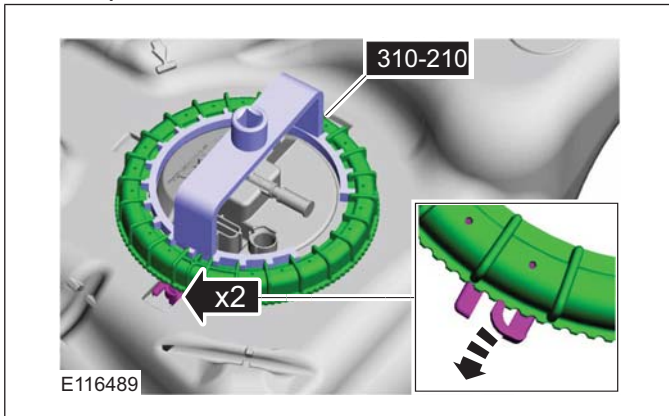
310-01-19

Fuel Tank and Lines

310-01-19

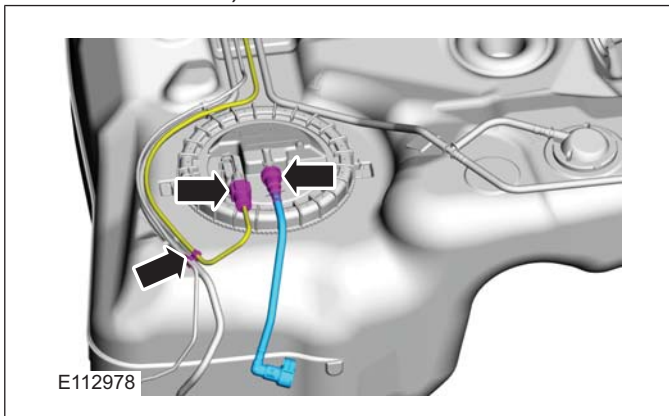
REMOVAL AND INSTALLATION

6. Special Tool(s): 310-210  
Torque: 110 Nm



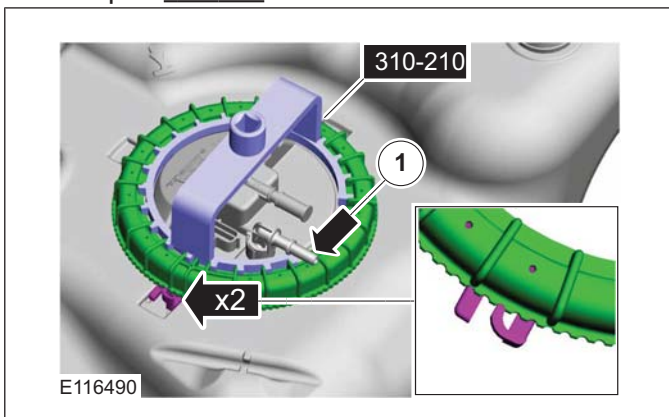
Vehicles with fuel fired booster heater

7. Refer to: **Quick Release Coupling** (310-00 Fuel System - General Information, General Procedures).



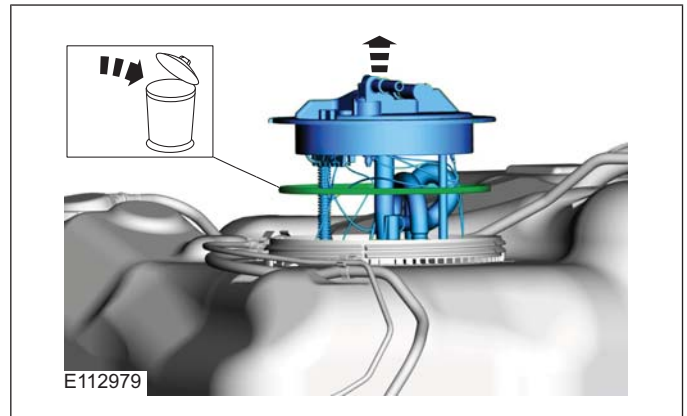
8. **CAUTION:** Take extra care when handling the component terminals.

Special Tool(s): 310-210  
Torque: 110 Nm



All vehicles

9. **CAUTION:** Take extra care not to damage the fuel tank level sensor float and arm.

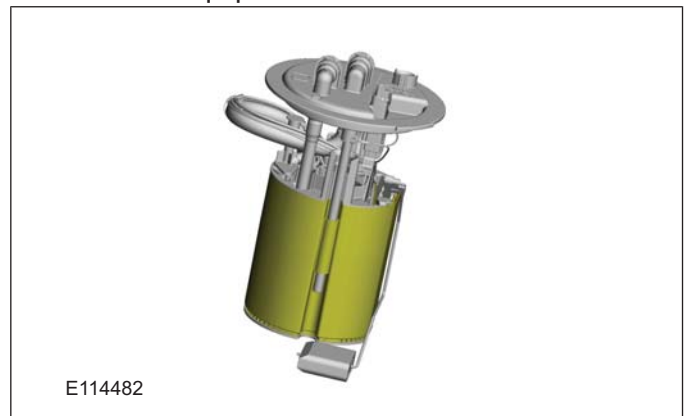


10. **WARNING:** Be prepared to collect escaping fluid.

- CAUTION:** Use suitable paper to absorb any escaping fluid.

Drain the reservoir.

General Equipment: Fluid Container



Vehicles with fuel fired booster heater

**NOTE:** This step is only necessary when installing a new component.



310-01-20

Fuel Tank and Lines

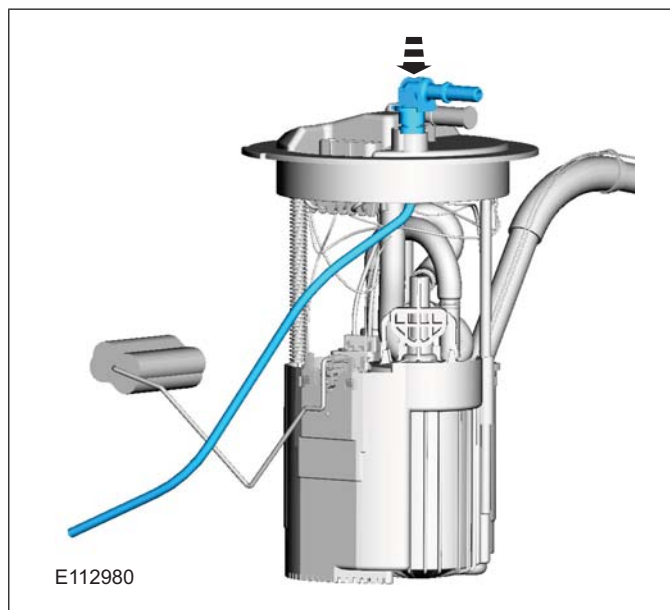
310-01-20

## REMOVAL AND INSTALLATION

11.  **CAUTION:** If either component is damaged, new paired components must be installed.



3.



## Installation

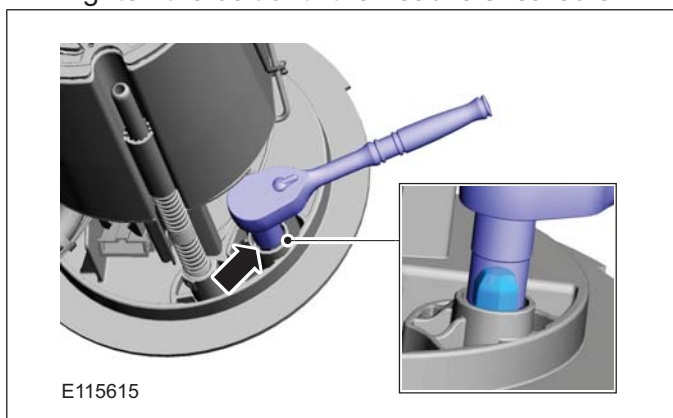
1. To install, reverse the removal procedure.

## Vehicles with fuel fired booster heater

**NOTE:** This step is only necessary when installing a new component.

2. **NOTE:** Make sure that the component is clean and free of foreign material.

Tighten the bolt until the head is sheared off.



**NOTE:** This step is only necessary when installing a new component.





## SECTION 310-02 Acceleration Control

**VEHICLE APPLICATION: 2008.50 Kuga**

CONTENTS	PAGE
<b>DIAGNOSIS AND TESTING</b>	
Acceleration Control.....	310-02-2
Inspection and Verification.....	310-02-2
<b>REMOVAL AND INSTALLATION</b>	
Accelerator Pedal.....	310-02-3



**DIAGNOSIS AND TESTING****Acceleration Control****Inspection and Verification**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

<b>Mechanical</b>	<b>Electrical</b>
<ul style="list-style-type: none"> <li>– Accelerator pedal</li> <li>– Throttle body</li> </ul>	<ul style="list-style-type: none"> <li>– Wiring harness(s)</li> <li>– Wiring harness retaining clips</li> <li>– Electrical connector(s)</li> <li>– Accelerator pedal</li> <li>– Powertrain control module (PCM)</li> <li>– Electronic throttle body</li> </ul>

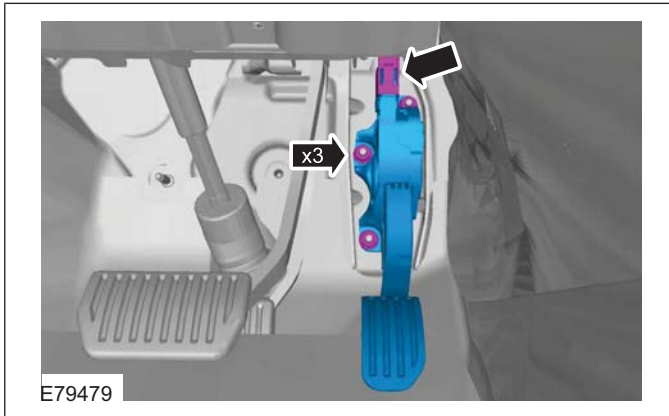
3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.

## REMOVAL AND INSTALLATION

## Accelerator Pedal

## Removal

1. Torque: 10 Nm



## Installation

1. To install, reverse the removal procedure.


## SECTION 310-03 Speed Control

**VEHICLE APPLICATION: 2008.50 Kuga**

CONTENTS	PAGE
<b>DESCRIPTION AND OPERATION</b>	
Speed Control (Overview).....	310-03-2
Speed Control.....	310-03-2
Speed Control (System Operation and Component Description).....	310-03-3
System Diagram.....	310-03-3
System Operation.....	310-03-4
Speed Control.....	310-03-4
Component Description.....	310-03-6
Speed control switches.....	310-03-6
<b>DIAGNOSIS AND TESTING</b>	
Speed Control.....	310-03-7
Inspection and Verification.....	310-03-7

**DESCRIPTION AND OPERATION****Speed Control – Overview****Speed Control**

The cruise control system keeps the vehicle to a target speed selected by the driver. The cruise control system is controlled by the PCM (powertrain control module)

 **WARNING: The cruise control system may not be used in heavy traffic, on winding roads or on a slippery road surface.**

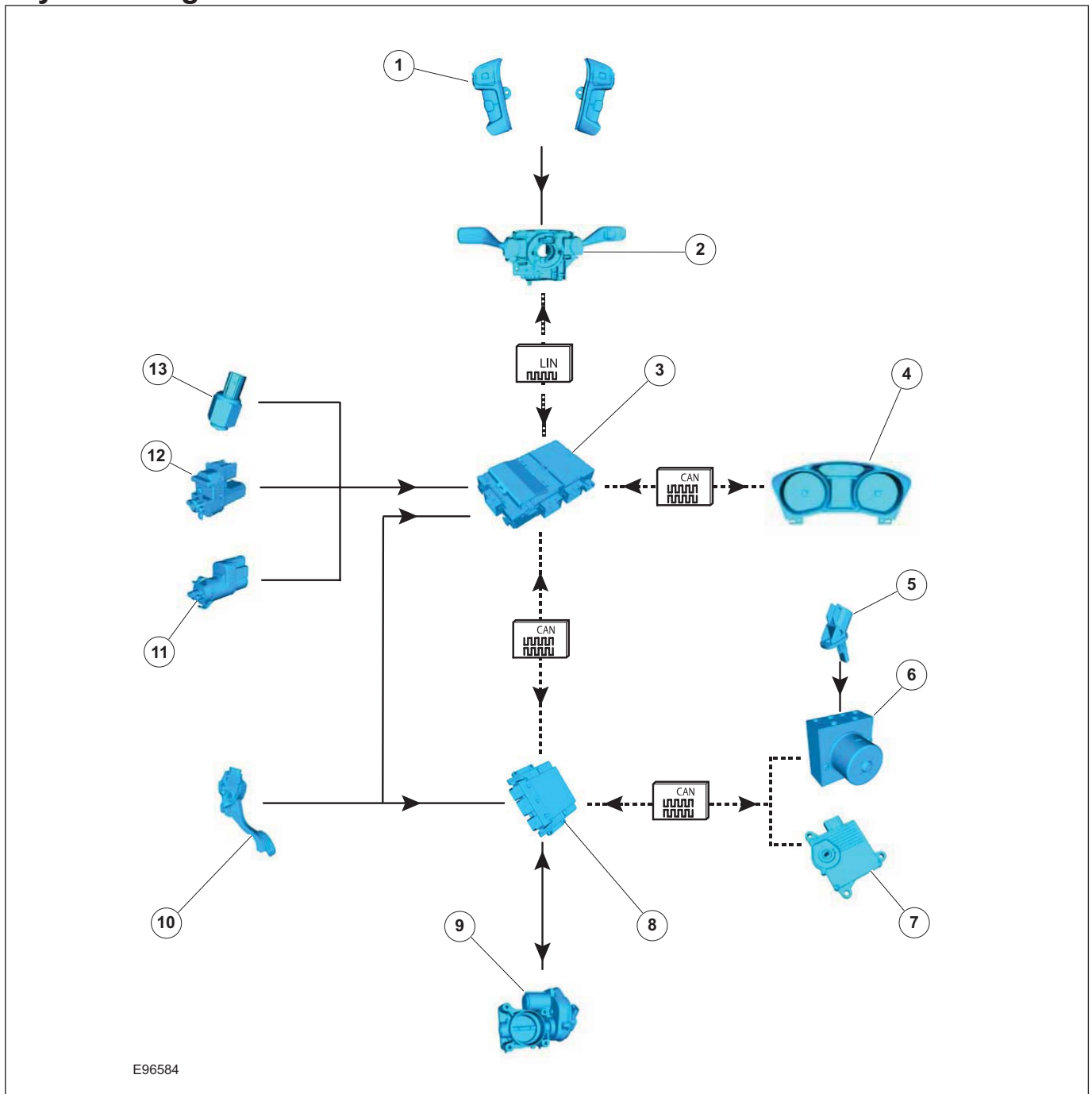
To remove the buttons for the cruise control system, the airbag must be removed. The buttons for the two control switch units cannot be replaced individually.



DESCRIPTION AND OPERATION

Speed Control – System Operation and Component Description

System Diagram



Item	Description
1	Control switch units - Cruise control Refer to Component Description: Speed control switches (page 6)
2	Steering wheel module <b>Comments:</b> Contains the coil spring
3	GEM (generic electronic module)

Item	Description
4	Instrument cluster
5	VSS (vehicle speed sensor)
6	ABS (anti-lock brake system) module
7	TCM (transmission control module) <b>Comments:</b> Vehicles with automatic transaxle.

## DESCRIPTION AND OPERATION

Item	Description
8	PCM
9	Throttle body <b>Comments:</b> Contains the TP (throttle position) sensor
10	The APP (accelerator pedal position) sensor.

Item	Description
11	CPP (clutch pedal position) switch <b>Comments:</b> Vehicles with manual transaxle.
12	BPP (brake pedal position) switch
13	Reverse gear solenoid <b>Comments:</b> Vehicles with manual transaxle.

## System Operation

## Speed Control

Cruise control is integrated into PCM and intervenes in engine management to automatically keep to the target speed selected by the driver. When the system is active, the vehicle can be accelerated or decelerated without the accelerator pedal being pressed. Cruise control is operated using the control switch units on the steering wheel.

The PCM controls the throttle to achieve this. The ABS module supplies the VSS signal for this.

On vehicles with automatic transmission, the TCM receives a notification via the CAN (controller area network) bus that cruise control is active. The TCM then controls the transmission based on special engine maps.

Cruise control recognizes three operating modes:

- "OFF": Control is switched off.
- "STANDBY": Control is switched on but not active. The speed of the vehicle is not regulated by the cruise control.
- "ACTIVE": Control is switched on and active. Cruise control adjusts the vehicle speed to the stored or desired target speed.

Every time the engine is started, cruise control is in the "OFF" mode. In this mode, only the "ON" button is operable.

Cruise control is initially set to "STANDBY" mode when the "ON" button is pressed. The green cruise control indicator lamp in the instrument cluster lights up. There is no target speed saved.

Cruise control can only be set to "STANDBY" mode under the following conditions:

- Engine speed is between idle speed and maximum permissible speed.

Cruise control can only be changed into "ACTIVE" mode under the following conditions:

- 2nd - 6th gear engaged.
- Engine speed between idle speed and maximum permissible speed.
- Vehicle speed at least 40 km/h.

Pressing the "SET+" or "SET-" button activates cruise control ("ACTIVE" mode). The green "Cruise control" indicator lamp in the instrument cluster lights up. The current vehicle speed is saved as the target.

In "ACTIVE" mode the "OFF", "SET+", "SET-" and "RES" buttons are active. If the "RES" button is pressed again, control is suspended. The "RES" button has a dual function and is used to resume and suspend the cruise control.

Tapping the "SET+" button (for less than 640 ms) increases the target speed by 1 km/h at a time. Holding down the "SET+" button (for longer than 640 ms) increases the target speed until the button is released. If the button is not released, cruise control accelerates the vehicle up to the maximum permissible vehicle speed (200 km/h) or up to the vehicle's maximum speed (whichever speed is lower). Tapping the "SET-" button (for less than 640 ms) reduces the target speed by 1 km/h at a time. When the the "SET-" button is held down, the control reduces the target speed until the button is released. If the "SET-" button is held down until the minimum speed of 40 km/h is reached, cruise control switches to "STANDBY" mode.

Cruise control is put into "STANDBY" mode when the "RES" button is pressed. Control to the stored target speed can be started again by pressing the "RES" button again. If the "SET+" or "SET-" button is pressed while the "RES" function is being performed (control to saved target speed), cruise

**DESCRIPTION AND OPERATION**

control saves the current speed as the target speed.

Cruise control goes into STANDBY mode in the following situations:

- Operation of the brake pedal
- Operation of the clutch pedal
- Operation of the parking brake
- If the driver operates the accelerator pedal and the saved target speed is subsequently exceeded for more than 5 minutes.
- Pressing any cruise control button for more than 2 minutes
- Intervention by the traction control or electronic stability program (for longer than 40 ms)
- Shifting of the gear selector lever to the "N" position (vehicles with automatic transmission only)
- Minimum speed falls below 40 km/h.
- Occurrence of particular DTC (diagnostic trouble code)
- faulty signal from the backup lamp switch

Cruise control is switched off when the "OFF" button is pressed.

If the accelerator pedal is pressed down, the vehicle speed increases. As soon as the pedal is released, the speed falls to the saved target value.

The following components supply the signals needed by the cruise control:

- The APP sensor.
  - The APP sensor identifies the current position of the accelerator pedal and sends a PWM (pulse width modulation) signal to the PCM and an analog DC (direct current) signal to the GEM.
  - If one or both of the APP sensors fails, a fault is stored in the PCM fault memory and cruise control cannot be activated.
- BPP switch
  - The BPP switch tells the PCM whether the vehicle is being braked. In its rest state the switch is closed and sends an earth signal to the GEM. This signal is sent via the CAN to the PCM.
  - The brake light switch is likewise connected to the GEM and is opened in the rest state. When the vehicle is braked, the brake light switch sends a signal to the GEM. This compares the signals from the BPP switch and the brake light switch. If a discrepancy occurs, a fault is stored in the error memory of the GEM. Cruise control cannot be activated.
- CPP switch
  - The CPP switch sends a ground signal to the GEM as soon as the clutch is operated. This signal is passed on by the GEM via the CAN bus to the PCM. This then supplies the signal to the cruise control.
  - If the CPP switch is incorrectly installed or set, cruise control cannot be activated.
- Wheel speed sensors
  - The wheel speed sensors record the speed of all the wheels. The recorded speed values are sent to the ABS module via a hard-wired connection. The ABS module calculates a vehicle speed signal (VS signal) from the speed values and the wheel diameter. This vehicle speed signal is transferred via the CAN bus to the PCM and supplied to the cruise control. If the vehicle speed signal is faulty, cruise control cannot be activated.

**DESCRIPTION AND OPERATION**

- Parking brake switch.
  - The parking brake switch is hard-wired to the GEM. The parking brake switch sends a signal to the GEM when the parking brake is operated. The GEM activates the parking brake indicator lamp in the instrument cluster. If the parking brake indicator lamp is lit, cruise control cannot be activated.
- Back-up light switch
  - The backup lamp switch is hard-wired to the

GEM. The backup lamp switch sends a signal to the GEM when reverse gear is engaged. The GEM activates the reversing lamp. Cruise control cannot be activated when reverse gear is engaged.

**Component Description**

**Speed control switches**



Item	Description
1	"ON" button <b>Comments:</b>
2	"OFF" button

Item	Description
3	"RES" button
4	"SET+" button
5	"SET-" button

The cruise control buttons are non-locking push buttons. They are connected to the coil spring via a hard-wired 9-pin plug connection.

The cruise control buttons operate according to the resistance bridge circuit principle. The buttons receive a 5 Volt reference voltage. When operated, each button passes a particular voltage to the GEM. The GEM measures this voltage and from it determines which button has been pressed.

The operation of the cruise control buttons can be checked by a simple measurement of the resistance between pin 4 and pin 5 at the coil spring 9-pin connector. A change of resistance must occur when a button is pressed.

**DIAGNOSIS AND TESTING****Speed Control****Inspection and Verification**

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

**Visual Inspection Chart**

<b>Mechanical</b>	<b>Electrical</b>
<ul style="list-style-type: none"> <li>– Brake pedal</li> <li>– Clutch pedal</li> </ul>	<ul style="list-style-type: none"> <li>– Fuse(s)</li> <li>– Connections</li> <li>– Wiring harness</li> <li>– Clockspring</li> <li>– Loose or corroded electrical connector(s)</li> <li>– Speed control switch</li> <li>– Brake pedal position (BPP) deactivation switch</li> <li>– Clutch pedal position (CPP) deactivation Switch</li> <li>– Powertrain control module (PCM)</li> <li>– Central junction box (CJB)</li> </ul>

**3. NOTE: Not all passenger junction box (PJB) variants support the speed control system.**

**NOTE:** If the PJB is configured for speed control disable, speed control operation is not transmitted, no Diagnostic Trouble Codes (DTCs) are generated.

If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.



## GROUP

## 4

## Electrical

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## SECTION 412-00 Climate Control System - General Information

**VEHICLE APPLICATION: 2008.50 Kuga**

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412-00-2

## Climate Control System - General Information

412-00-2

## SPECIFICATIONS

## Lubricants, Fluids, Sealers and Adhesives

	Specificat ions
Refrigerant R134a	WSH-M17 B19-A

	Specificat ions
Refrigerant oil	WSH-M1C 231-B

## Refrigerant Capacities (When Charging)




	grams
Air Conditioning	600 ± 15

## Refrigerant Oil Capacities (When Charging)

	millilitres
Air Conditioning	200

## Addition of Refrigerant Oil (When new components are installed)

## CAUTIONS:

-  The refrigerant oil top-up quantity must not exceed the refrigerant oil fill quantity.
-  If other A/C components are being renewed in addition to the A/C compressor, there is no need to top up with additional refrigerant oil, apart from filling the compressor.
-  Because the fill quantities differ, the refrigerant oil must be drained from the new A/C compressor.

	millilitres
After renewal of all lines and components.	add 200.
Air conditioning (A/C) compressor - if the quantity of refrigerant oil drained from the faulty compressor is less than 150 ml	add 150.
Air conditioning compressor (if the amount of refrigerant oil drained from the faulty compressor is more than 150 ml)	add 200.
A/C condenser	add 30.
A/C evaporator	add 30.
A/C dehydrator	add 90.
Always, if refrigerant was drained.	Add the same quantity as the quantity that was collected.

## Clutch air gap

	mm
Compressor clutch air gap	0,35 - 0,75

## Torque Specifications

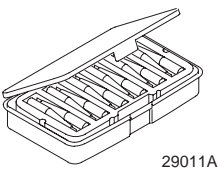
Item	Nm	lb-ft	lb-in
Compressor drive plate retaining bolt	13	10	-

## DIAGNOSIS AND TESTING

## Climate Control System

Refer to Wiring Diagrams Section 412-00, for schematic and connector information.

## Special Tool(s) / General Equipment

 29011A	Terminal Probe Kit 418-S035
Digital Multimeter (compatible with K-type thermocouple)	
The Ford approved diagnostic tool	
Refrigerant center	
Thermometer - Fluke 80 PK-8 (FSE number 260 4102 001 07)	

## Inspection and Checking

**NOTE:** The electronic automatic temperature control (EATC) module is integrated into the air conditioning control assembly.

1. VERIFY customer concern.
2. Visually CHECK for any obvious mechanical or electrical damage.

**NOTE:** Ensure correct locking of the wiring harness connector.

## Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> <li>• Refrigerant lines</li> <li>• Condenser core</li> <li>• Coolant level</li> <li>• Drive belt</li> <li>• A/C compressor</li> </ul>	<ul style="list-style-type: none"> <li>• Fuses</li> <li>• Wiring harness</li> <li>• Connector</li> </ul>

3. RECTIFY any obvious causes for a concern found during the visual inspection before performing any further tests. CHECK the operation of the system.
4. If the concern is still present after the visual inspection, perform fault diagnosis on the electronic engine management, the charging system, the generic electronic module (GEM) and the instrument cluster (vehicles with EATC: read out the EATC fault memory as well) using

the Ford approved diagnostic tool and RECTIFY the fault(s) displayed in accordance with the fault description. CHECK the operation of the system.

5. For vehicles with no stored fault(s), PROCEED in accordance with the Symptom Chart according to the fault symptom.
6. Following checking or elimination of the fault(s) and after completion of operations, the fault memories of all vehicle modules must be READ OUT and any stored faults must be DELETED.

## Refrigerant Circuit - Quick Check

**WARNING:** The air conditioning system is filled with refrigerant R134a. Observe "Health and Safety Precautions". For further information

REFER to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).

## Refrigerant circuit check

**WARNING:** Under certain circumstances, refrigerant lines and A/C components may be extremely hot or cold. Exercising care, touch the refrigerant lines or A/C components in order to check this. Failure to follow these instructions may result in personal injury.

When the A/C system is operating, the following conditions should apply:

- The refrigerant line from the refrigerant compressor to the condenser must be hot.
- The refrigerant line from the A/C condenser to the fixed orifice tube must be warm, but not so hot as the refrigerant line mentioned above.
- Determine the difference in temperature upstream and downstream of the A/C condenser by measuring the temperatures at the refrigerant lines. The temperature difference should be more than 20° C, depending on the ambient temperature. If the temperature difference is less, check the condenser for contamination or damage to the fins as well as operation of the radiator fans.

**DIAGNOSIS AND TESTING**

- The refrigerant line between the fixed orifice tube and the evaporator must be cold from the point where the fixed orifice tube is installed. Depending on the weather, the refrigerant line may also have ice on its surface.
- The refrigerant line between the evaporator and the A/C compressor including the dehydrator must be cold.

**Evaporator outlet line temperature test**

To test the power of the A/C system, the temperature at the evaporator outlet line must be measured. To do this, the following preconditions must be met:

- Open all windows.
- Set the air distribution to the defrost/dashboard position and open all the ventilation nozzles.
- DO NOT switch on recirculated air.
- Select lowest blower switch setting.
- Select lowest temperature setting.

**NOTE:** The temperature measurement cannot be done with a thermometer which makes no contact. The surface reflection from the metal line may cause incorrect readings.

Connect the temperature sensor (Fluke 80 PK-8) to the outlet line of the evaporator. Locate the temperature sensor as close as possible to the evaporator. Connect the temperature sensor to the multimeter.

Start the engine and allow it to run at idle speed for several minutes.

Switch on the A/C.

After three minutes, measure the surface temperature of the evaporator outlet line.

If the temperature measured is 4° C or lower, the A/C system is OK. If the temperature is higher, the A/C system may be under-filled. For further information, refer to

REFER to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

**Frequent faults and their causes**

If the cooling power of the A/C system is not adequate, make certain that the temperature control flap(s) is/are operating correctly.

- No or poor cooling performance:
  - Blockage or narrowing of a refrigerant line or in the dehydrator. The location of the blockage or narrowing can easily be located by temperature comparisons at the refrigerant lines and the dehydrator. The blockage or restriction is located at the point where the temperature difference is identified. **Note: A temperature difference in the area of the fixed orifice tube is normal.** If the location of the blockage or narrowing is found, check the corresponding component and renew as applicable.
- Sudden drop in cooling performance (after the air conditioning has been switched off for approx. 5 minutes, the cooling performance returns to normal):
  - The cause is an iced-up fixed orifice tube because of moisture in the refrigerant circuit. In order to ensure that moisture is completely removed from the refrigerant circuit, the dehydrator should be renewed and the evacuation time should be extended to 2-3 hours. For further information

REFER to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

**Sequence of A/C Request Signal**

**NOTE:** The electronic automatic temperature control (EATC) module is integrated into the air conditioning control assembly.

**NOTE:** The generic electronic module (GEM) is an integral part of the central junction box (CJB).

After actuating the A/C ON/OFF switch integrated into the A/C control assembly, an A/C request signal is sent from the A/C control assembly (vehicles with EATC: EATC module) to the GEM.

From there, the signal is sent to the instrument cluster via the MS-CAN bus. A gateway is installed in the instrument cluster, which establishes the connection between the MS-CAN bus and the HS-CAN bus.

After the signal has been converted in the gateway, it is relayed to the powertrain control module (PCM) via the HS-CAN bus. Once all the required parameters have been met, the PCM switches on the refrigerant compressor and thus the A/C system via the A/C clutch relay.



**DIAGNOSIS AND TESTING**

1. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
2. If the cause is not visually evident, verify the symptom and refer to the diagnostic tab within the Ford approved diagnostic tool.



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**GENERAL PROCEDURES**

## Air Conditioning (A/C) System Flushing

9. Information not available at this time.



## GENERAL PROCEDURES

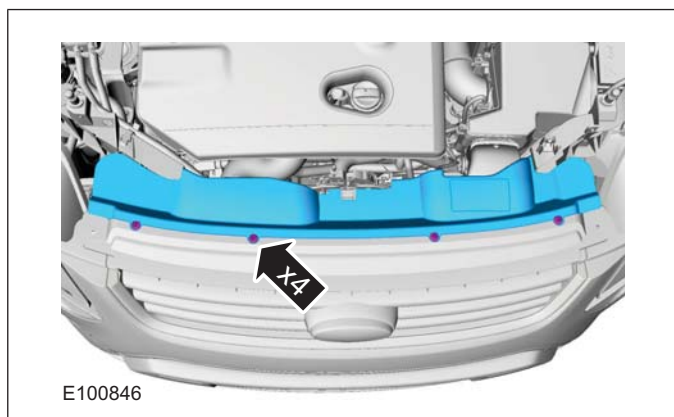
## Air Conditioning (A/C) System Recovery, Evacuation and Charging

## General Equipment

Air Conditioning Service Unit
Automatic Calibration Halogen Leak Detector
Electronic Leak Detector
Refrigerant Identification Equipment
UV Leak Detector

1. Refer to: **Air Conditioning (A/C) System Health and Safety Precautions** (100-00 General Information, Description and Operation).

2.



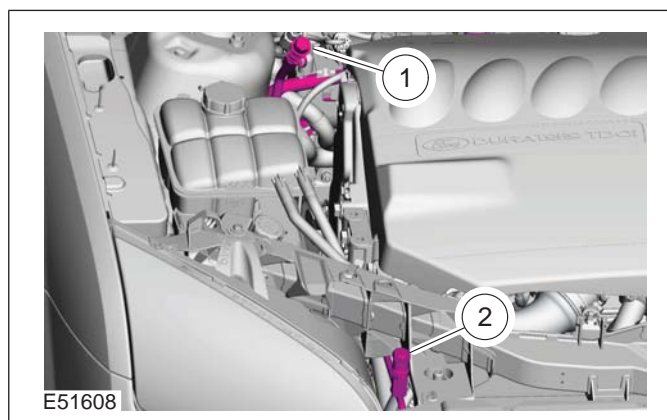
3. **CAUTION:** The refrigerant analyzer must be used before recovery, otherwise the refrigerant center may become contaminated. Contaminated refrigerant must be disposed of as hazardous waste. Always follow the manufacturer's instructions when using the refrigerant center and the refrigerant analyzer.

Unscrew and remove the protective caps from the A/C charging connections.

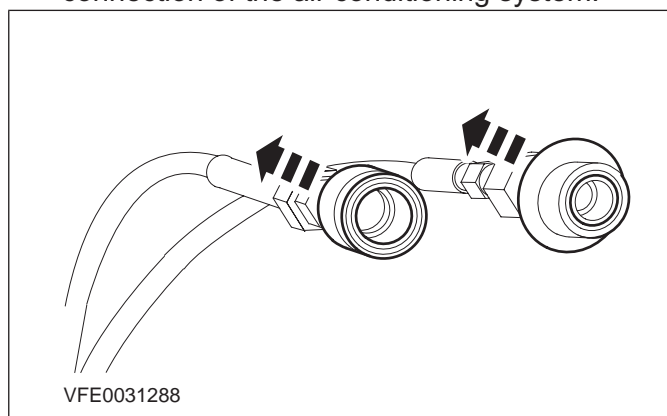
General Equipment: Air Conditioning Service Unit

General Equipment: Refrigerant Identification Equipment

1. Low-pressure connection
2. High-pressure connection



5. Connect the service unit lines to the filling connection of the air conditioning system.



6. Drain the air conditioning system via the low-pressure port in accordance with the service unit manufacturer instructions.

7. **CAUTION:** Make sure that the specified amount of refrigerant oil is added.

**NOTE:** This step is only required when installing a new component.

Fill up with refrigerant oil.

Refer to: **Specifications** (412-00 Climate Control System - General Information, Specifications).  
Refer to: **Refrigerant Oil Adding** (412-00 Climate Control System - General Information, General Procedures).

8. Evacuate the air conditioning system in accordance with the service unit manufacturer instructions.

9. **NOTE:** The system is leak-tight if the pressure increase does not exceed 20 mbar.

**GENERAL PROCEDURES**

Perform the leak test, by closing the hand valves on the gauge set, switching off the service unit vacuum pump and observing the low pressure gauge.

- 10. NOTE:** This step is only necessary if the pressure increase exceeds 20 mbar.

Locate and rectify any leaks in the A/C refrigerant circuit using a leak tester.

General Equipment: UV Leak Detector  
General Equipment: Electronic Leak Detector  
General Equipment: Automatic Calibration  
Halogen Leak Detector

- 11.** Add refrigerant oil to the air conditioning system.

Refer to: **Specifications** (412-00 Climate Control System - General Information, Specifications).

Refer to: **Refrigerant Oil Adding** (412-00 Climate Control System - General Information, General Procedures).

- 12.** Fill the air conditioning system with liquid through the high-pressure connection.

Refer to: **Specifications** (412-00 Climate Control System - General Information, Specifications).

- 13.** 1. Open the shut-off valve on the high-pressure side.  
2. Switch the service unit to "Fill" mode and fill the system with the specified quantity of liquid refrigerant (R134a).

- 14.** Fill the air conditioning system with gas through the low-pressure connection.

Refer to: **Specifications** (412-00 Climate Control System - General Information, Specifications).

- 15.** 1. Open the shut-off valve on the low-pressure side.  
2. Switch the service unit to "Fill" mode and fill the system with the specified quantity of gaseous refrigerant.  
3. Add the remaining amount of refrigerant with the air conditioning switched on. To do so run the engine at about 1200-1500 rev/min. Set the air conditioning system to full cooling power and fresh air mode. Set the blower motor to the highest setting. Fill with the remainder of the specified fill capacity.

- 16.** Disconnect the service unit.

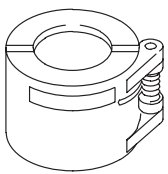
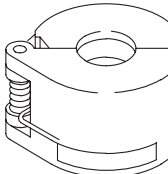
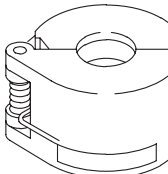
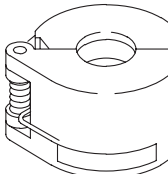
- 17.** 1. Close the shut-off valve.  
2. Switch off the service unit.  
3. Disconnect the service unit lines from the filling connections of the air conditioning system.  
4. Screw the protective caps onto the charging connections.

- 18.** Install all components in reverse order.

GENERAL PROCEDURES

Spring Lock Coupling

Special Tool(s)

 <p>23023A</p>	<p>412-026 Disconnect Tool, Spring Lock Coupling (3/8" red)</p>
 <p>34001</p>	<p>412-027 Disconnect Tool, Spring Lock Coupling (1/2" blue)</p>
 <p>34003</p>	<p>412-038 Disconnect Tool, Spring Lock Coupling (5/8" black)</p>
 <p>34002</p>	<p>412-069 Disconnect Tool, Spring Lock Coupling (3/4" white)</p>

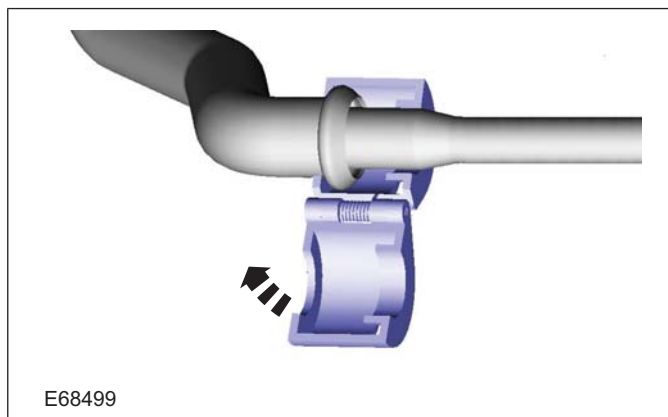
Materials

Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

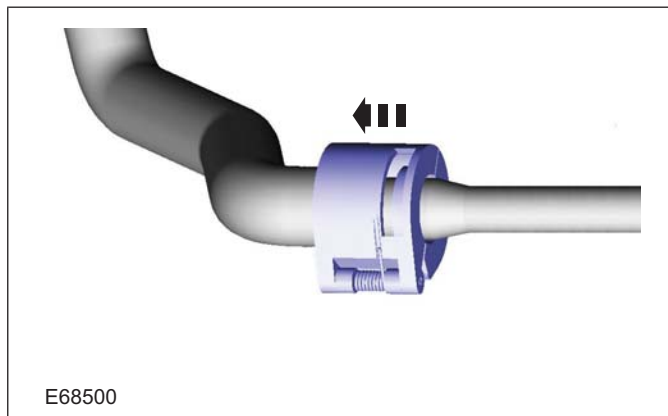
1. Refer to: **Air Conditioning (A/C) System Health and Safety Precautions** (100-00 General Information, Description and Operation).

2. **NOTE:** Choose the special tool according to the line diameter.

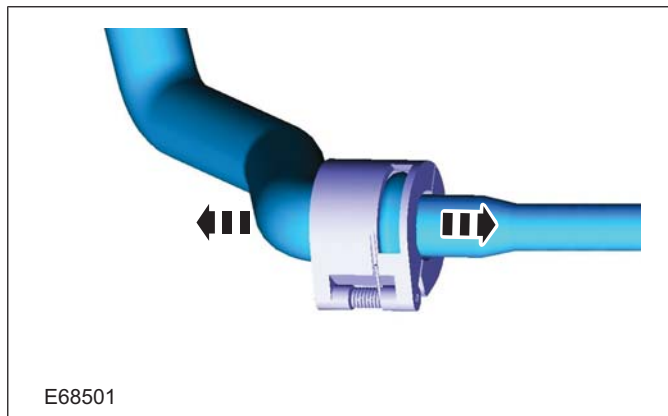
Special Tool(s): 412-026, 412-027, 412-038, 412-069



3.



4. **CAUTION:** Make sure that all openings are sealed.

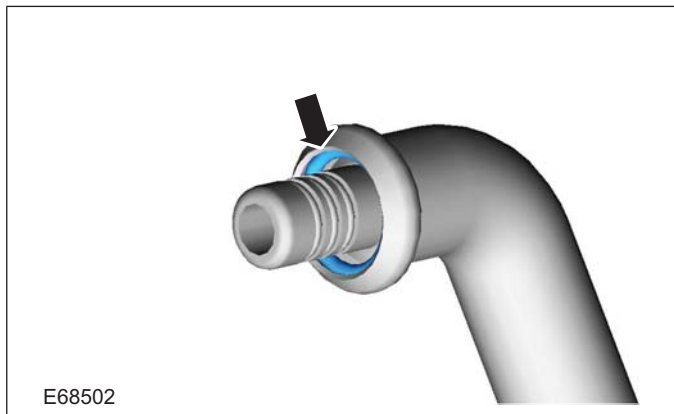




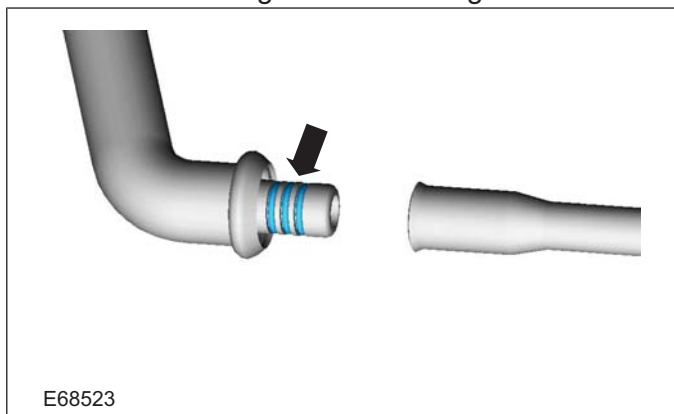
## GENERAL PROCEDURES

5.  **CAUTION: Make sure that all openings are sealed.**

- Check the locking spring for damage.
- Carefully remove damaged locking springs with a thin wire, and renew them.



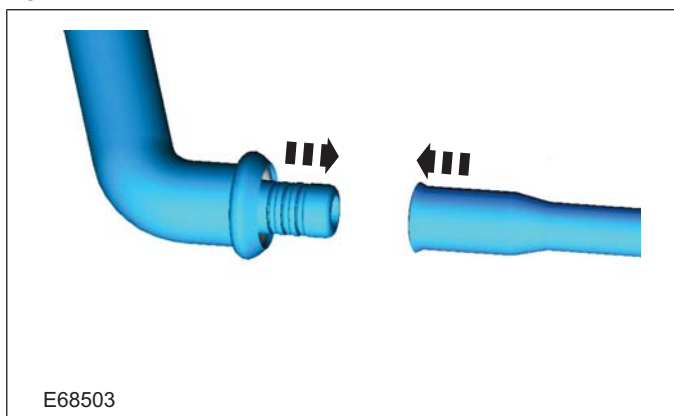
## 6. Install new refrigerant line O-rings.

7.  **CAUTION: Never lubricate connections and O-rings with mineral oil.**

Coat the O-rings for the refrigerant line with clean refrigerant oil.

Material: Compressor Oil - Air Conditioning  
(WSH-M1C231-B / 6U7J-M1C231-AA)  
refrigerant oil

## 8.

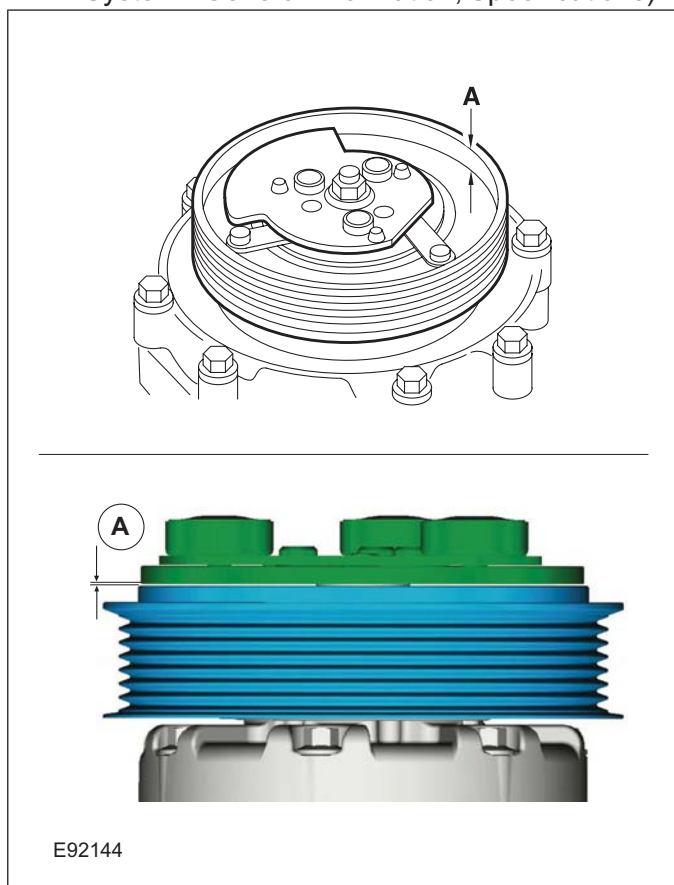


## GENERAL PROCEDURES

## Air Conditioning (A/C) Clutch Air Gap Adjustment

1. Check the gap A (measure the difference between the engaged and disengaged positions of the air conditioning clutch) at 60° intervals around the circumference of the pulley. Operate the air conditioning clutch several times with the aid of a 5 A fused cable. Refer to the relevant wiring diagram for the correct electrical connection.

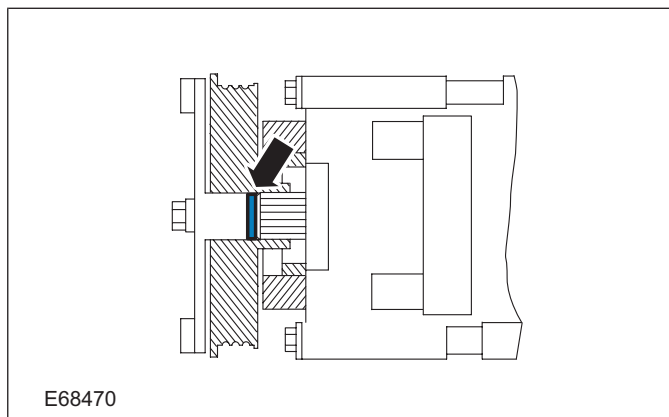
Refer to: **Specifications** (412-00 Climate Control System - General Information, Specifications).



- 2.



3. If necessary correct the gap A using spacer washers.



4. Refer to: **Specifications** (412-00 Climate Control System - General Information, Specifications).



5. Check the gap A as described in step 1. If necessary, repeat steps 2-5.

**GENERAL PROCEDURES****Refrigerant Oil Adding**

 **CAUTION:** Collect the refrigerant oil in a clean measuring cylinder.


1. **NOTE:** This step only needs to be carried out when removing the A/C compressor.

**NOTE:** Rotate the compressor shaft at least 6 to 8 turns when draining the refrigerant oil.

Drain the refrigerant oil from the defective A/C compressor and dispose of it.

**2. CAUTIONS:**


 The refrigerant oil top-up quantity must not exceed the refrigerant oil fill quantity.

 If other A/C components are being renewed in addition to the A/C compressor, there is no need to top up with additional refrigerant oil, apart from filling the compressor.

Top up with the calculated quantity of new refrigerant oil. See: **Specifications** (412-00 Heating, Ventilation, Air-Conditioning - General information, Specifications).

## GENERAL PROCEDURES

### Contaminated Refrigerant Handling

1.  **CAUTION:** Any R134a or R12 refrigerant which is contaminated with unsuitable refrigerant should be extracted only by means of a suitable servicing unit designed for the purpose of collecting and storing contaminated refrigerant, so that the spread to other vehicles can be prevented.

Use refrigerant identification equipment to check that there is contaminated refrigerant in the air conditioning system.


2. Inform the customer about the additional costs involved to repair the system because of the contamination.
3. Extract the contaminated refrigerant.


## GENERAL PROCEDURES

### Electronic Leak Detection

1. Refer to: **Air Conditioning (A/C) System Health and Safety Precautions** (100-00 General Information, Description and Operation).

#### 2. WARNINGS:

 Before starting leak detection, make sure that the area where it is to be done is well ventilated. If the surrounding air is contaminated with refrigerant gas, the leak detector will indicate this gas all the time. Odors from other chemicals such as antifreeze, diesel fuel, disc brake cleaner, or other cleaning solvents can cause the same problem. Prevent air movement while performing leak detection.

 The refrigerant identification equipment must be used before attaching the manifold gauge set. Otherwise the manifold gauge set may become contaminated. Contaminated refrigerant must be disposed of as special waste. Follow the manufacturer's instructions when working with the service unit.

**NOTE:** At 24°C with the engine switched off, both manifold gauges should show 4.1 to 5.5 bar.

Attach the manifold gauge set to the service gauge port valves.

3. For the leak test, close the manual valves on the gauge set.
4. If little or no pressure is indicated, charge the system with approx. 300g of refrigerant. Refer to: Air Conditioning System - Evacuate and Refill.
5. Use the R-134a Automatic Calibration Halogen Leak Detector to leak test the refrigerant system. Follow the instructions included with leak detector for handling and operation techniques.
6. If any leak is found, extract the refrigerant under suction. Refer to: Air Conditioning System - Evacuate and Refill.



**GENERAL PROCEDURES****Fluorescent Dye Leak Detection****General Equipment**

UV Leak Detector
------------------

1. Refer to: **Air Conditioning (A/C) System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. **NOTE:** Some vehicles may have signs of refrigerant oil at the spring lock couplers. The cause of this may be a procedure used in production before installation of the fittings in order to assist their assembly. When a spring lock coupler is suspected of leaking, always wipe the fitting clean and verify the leak with R-134a Automatic Calibration Halogen Leak Detector.  
**NOTE:** The exact location of leaks can be pinpointed by the bright yellow - green glow of the tracer dye. Since more than one leak can exist, always inspect each component.
  - Locate the leaks. Check all components, fittings and lines of the A/C system for leaks.  
General Equipment: UV Leak Detector
3. After the leak is found and rectified, remove any traces of dye with a general purpose solvent.
4. Check the repair by operating the system for some minutes and inspecting with the UV lamp again.

---

**GENERAL PROCEDURES**

## Vacuum Leak Detection

1. Carry out the air conditioning (A/C) system recovery procedure.

Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).

## SECTION 412-01 Climate Control

### VEHICLE APPLICATION: 2008.50 Kuga

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**SPECIFICATIONS****A/C compressor**

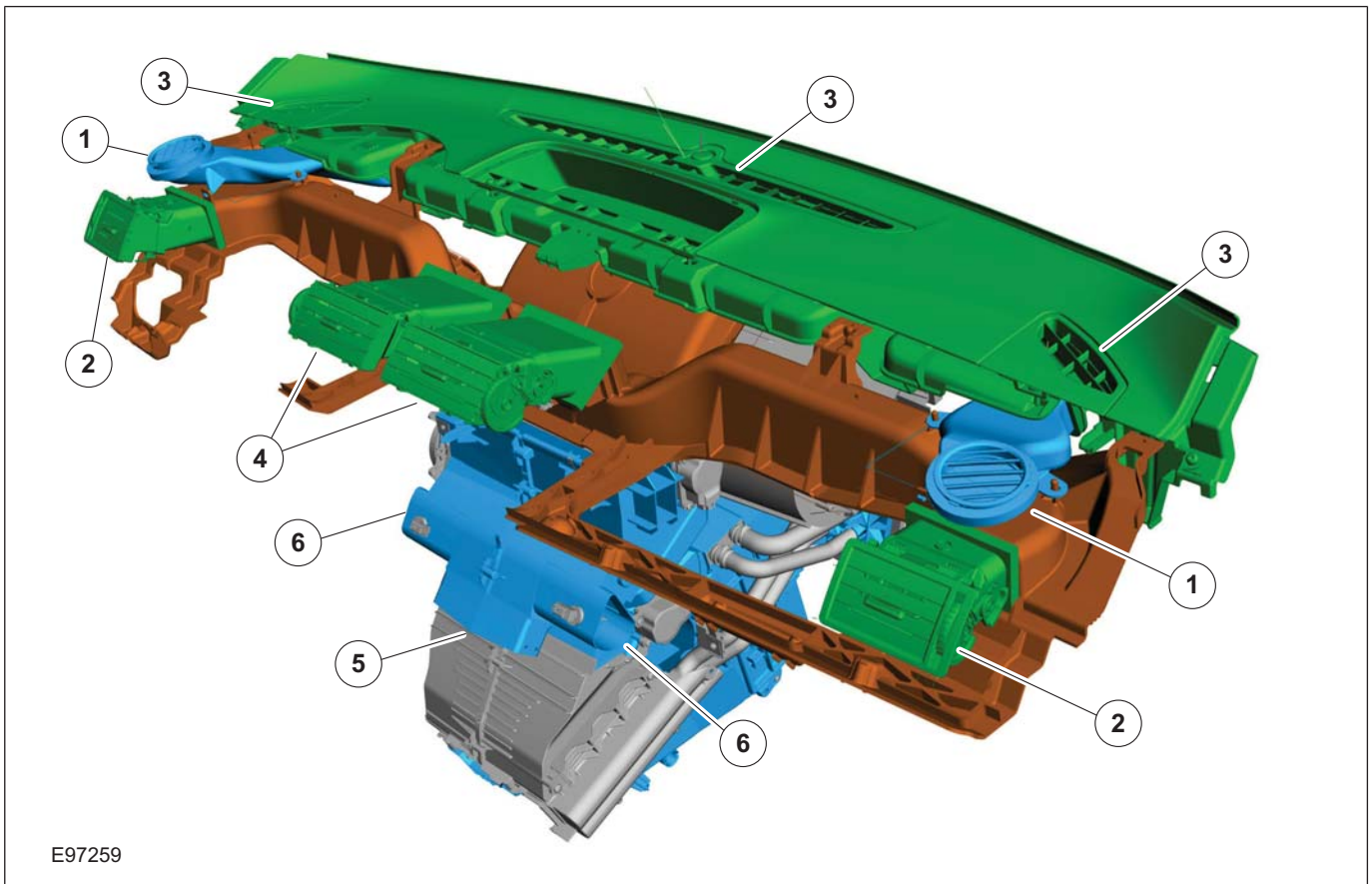
	<b>Description</b>
A/C compressor (vehicles with 2.0L Duratorq-TDCi (DW 10) engines)	Visteon VS16
A/C compressor (vehicles with 2.5L Duratec-ST (VI5) engine)	Zexel KC88



DESCRIPTION AND OPERATION

Climate Control – Component Location

Air distribution, instrument cluster



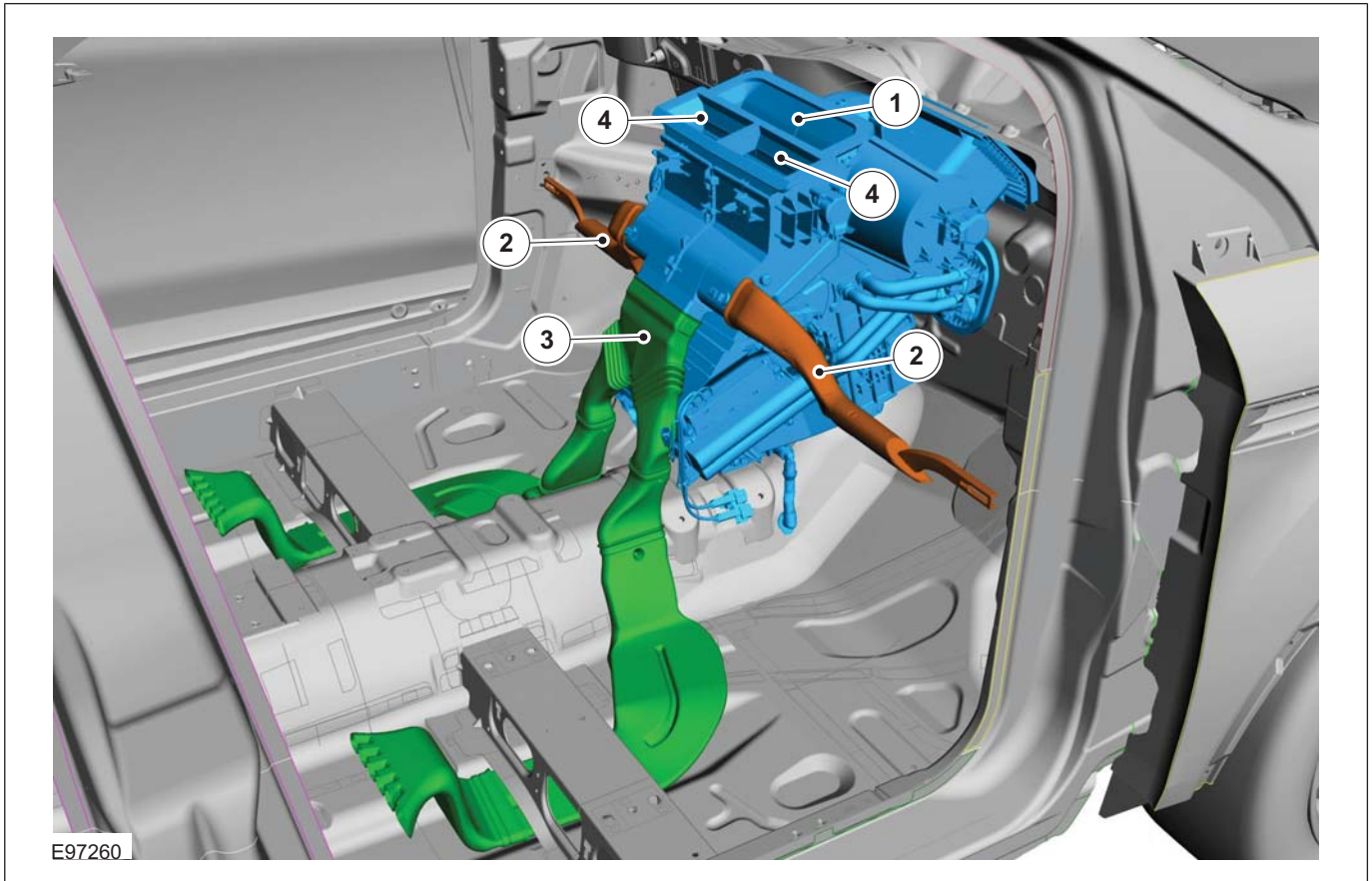
E97259

Item	Description
1	Air passages - side window defroster vents
2	Air passages - side vents (adjustable)
3	Air passages – defroster vents

Item	Description
4	Air passages - center vents
5	Air ducts, rear footwell
6	Air ducts, front footwell

DESCRIPTION AND OPERATION

Air distribution, passenger compartment

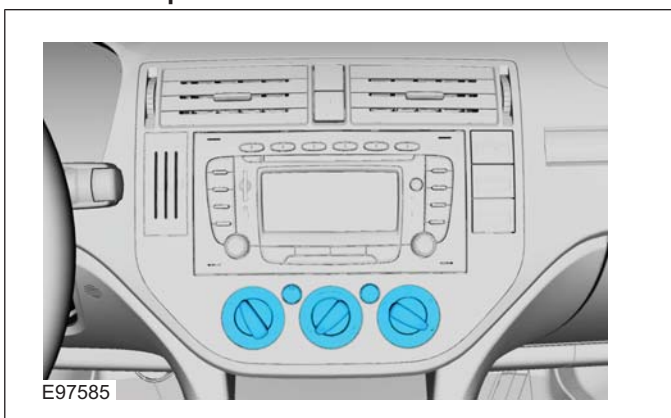


E97260

Item	Description
1	Air duct, demister vents
2	Air ducts, front footwell

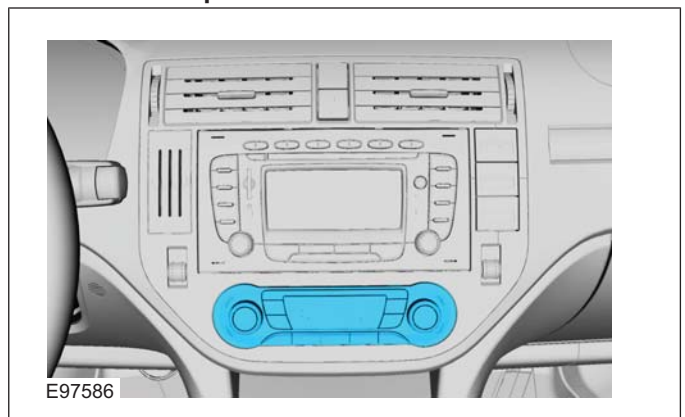
Item	Description
3	Air ducts, rear footwell
4	Air passages - center vents

Control assembly, climate control - vehicles with manual temperature control



E97585

Control assembly, climate control - vehicles with automatic temperature control



E97586

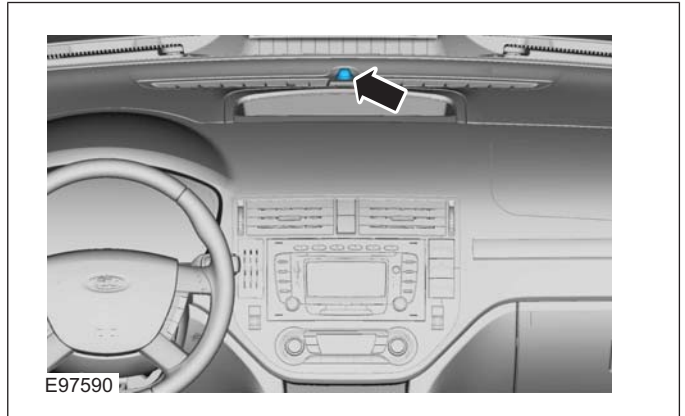


**DESCRIPTION AND OPERATION**

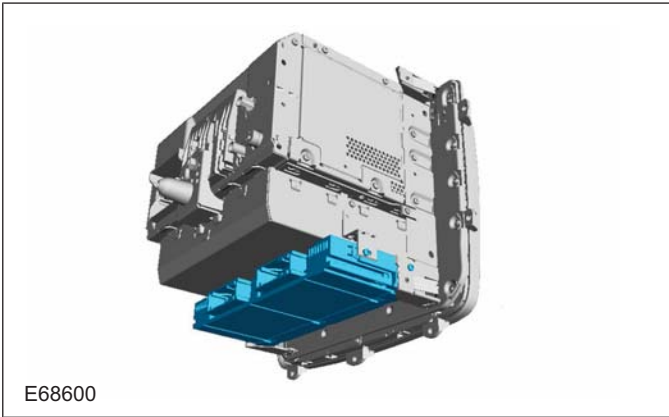
**Control assembly, climate control - vehicles with DVD navigation system with a touch screen**



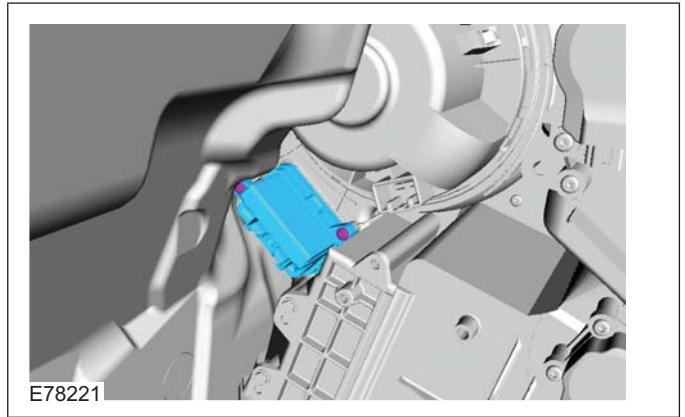
**Sun sensor - vehicles with automatic temperature control**



**Climate control module - vehicles with DVD navigation system with a touch screen**



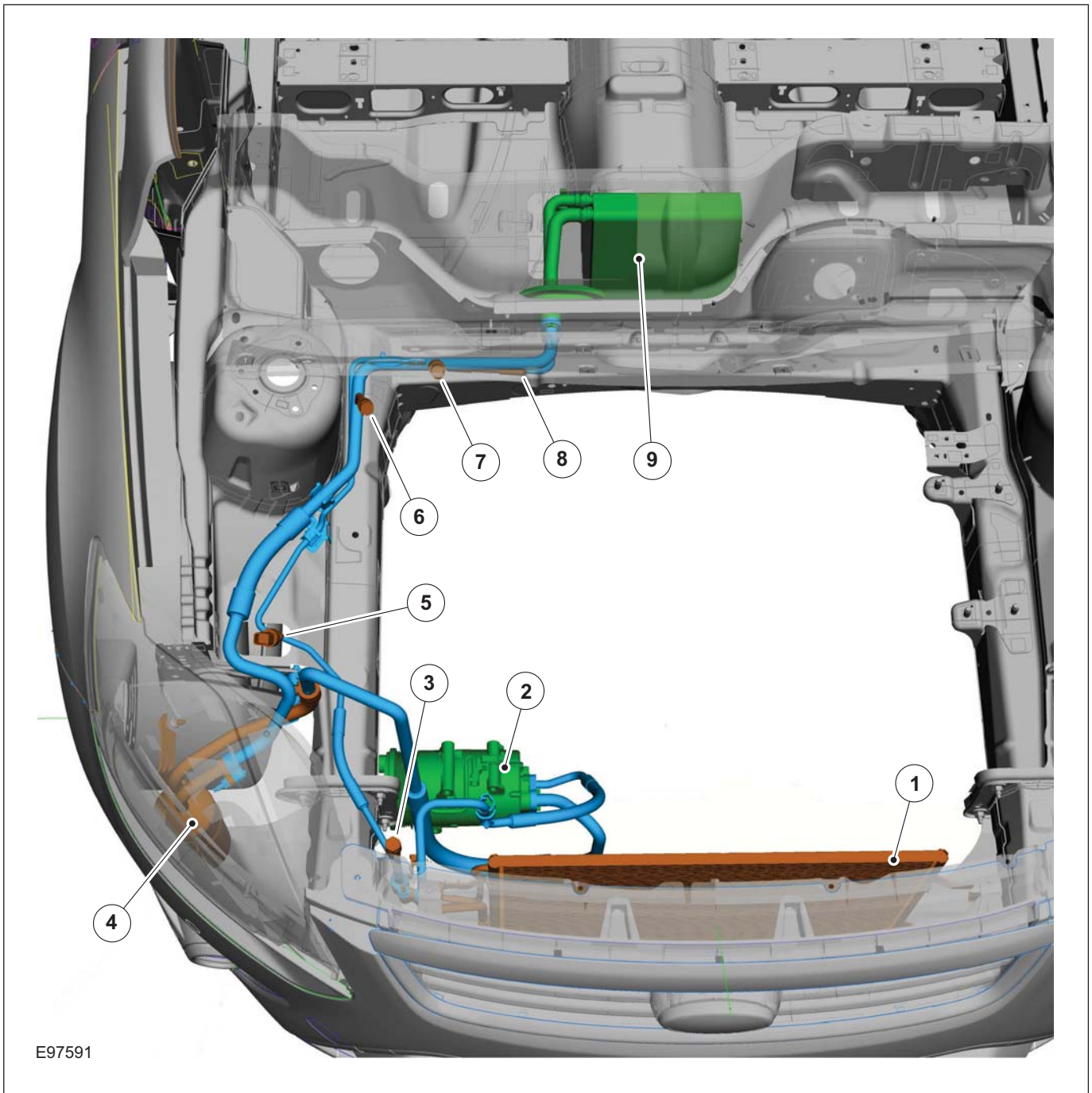
**Blower control module - vehicles equipped with automatic temperature control**





DESCRIPTION AND OPERATION

Climate control



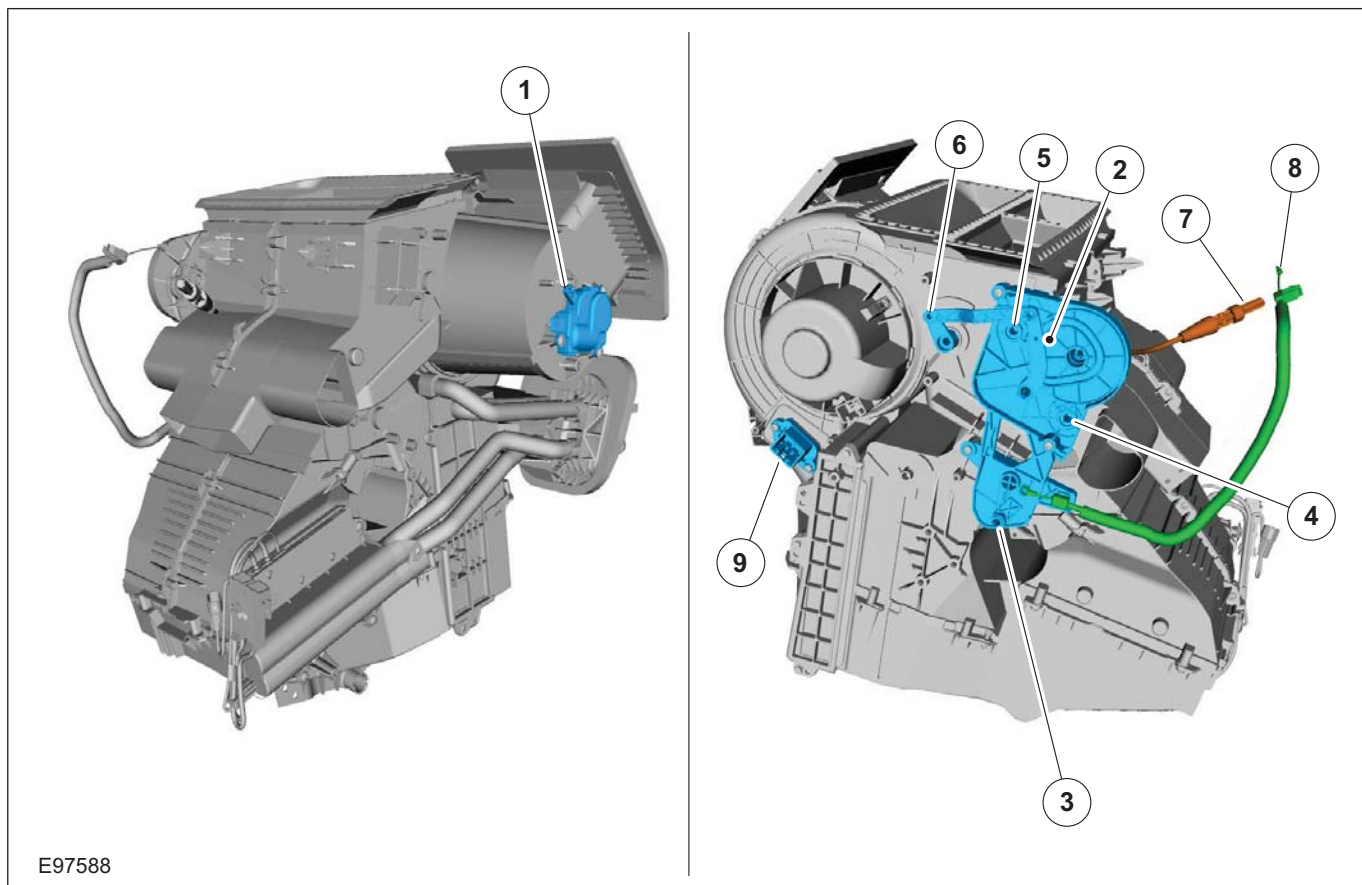
E97591

Item	Description
1	Condenser
2	Air conditioning compressor
3	High pressure filling connection
4	Refrigerant drier

Item	Description
5	Dual pressure switch
6	Low pressure filling connection
7	Low pressure limiting switch
8	Evaporator Core Orifice Tube
9	Evaporator assembly

DESCRIPTION AND OPERATION

Climate control housing - vehicles with manual temperature control



E97588

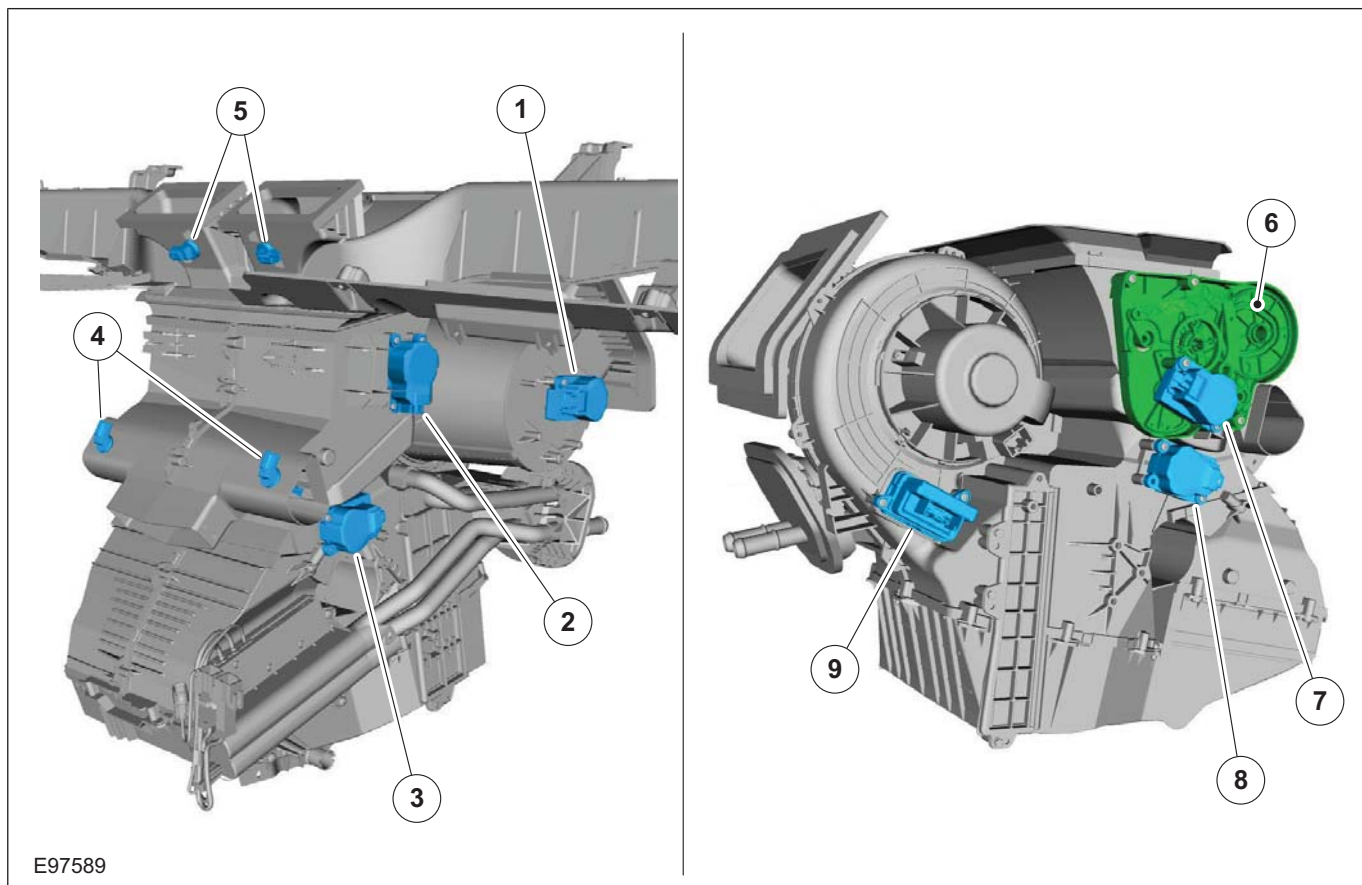
Item	Description
1	Air flap actuator
2	Control unit - air distribution flap/temperature control flap
3	Operating lever - temperature control flap
4	Operating lever - air distribution flap - footwell

Item	Description
5	Operating lever - air distribution flap - central nozzles
6	Operating lever - air distribution flap - demister vents
7	Rod - air distribution flap
8	Operating cable - temperature control flap
9	Blower motor resistor



DESCRIPTION AND OPERATION

Climate control housing - vehicles with automatic temperature control



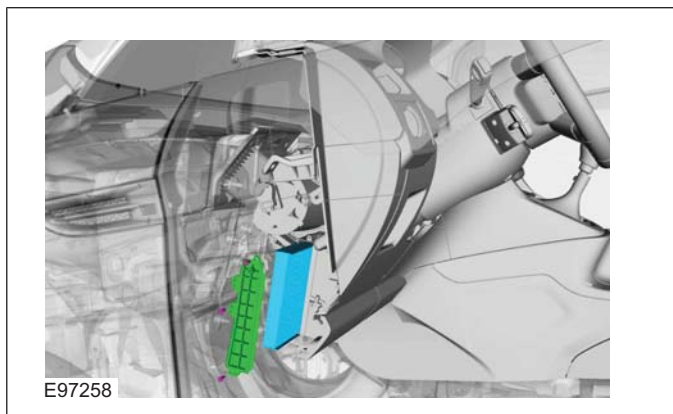
Item	Description
1	Air flap actuator
2	Actuator - air distribution flap - demister vents
3	Actuator - right-hand temperature control flap
4	Air outlet temperature sensors - footwell

Item	Description
5	Air outlet temperature sensors - center vents
6	Operating unit - air distribution flaps
7	Actuator - air distribution flap - center vents
8	Actuator - left-hand temperature control flap
9	Blower control module

## DESCRIPTION AND OPERATION

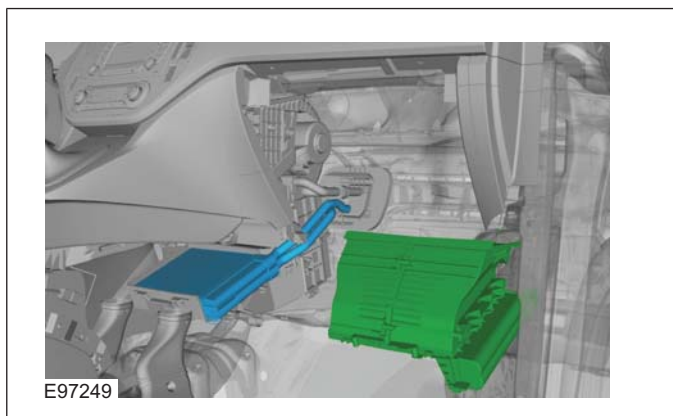
## Climate Control – Overview

## Pollen filter



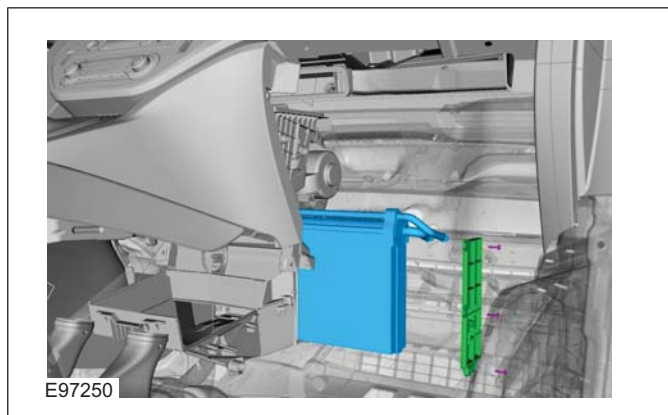
The pollen filter must be changed at intervals in accordance with the service schedule. A special production pollen filter is installed in the factory, and this must be cut through when the filter is changed. The service pollen filter is flexible and can be pushed together during installation or removal.

## Heat exchanger



The heat exchanger is accessible from the right-hand side of the climate control housing (LHD and RHD). It can be removed and installed with the climate control housing still installed in the vehicle. During removal, the coolant pipes of the production heater core must be sawn through. During servicing, a heater core with separate coolant pipes is installed.

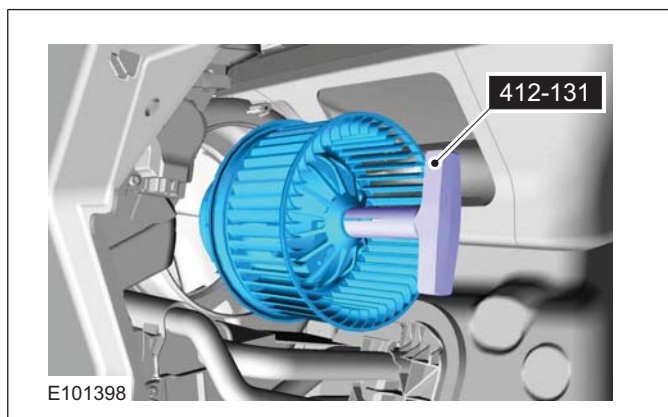
## Evaporator assembly



The evaporator is located on the right-hand side of the climate control housing (LHD and RHD). It can only be removed and installed with the climate control housing still installed in the vehicle, and the heat exchanger must be removed at the same time.

## Blower motor

**CAUTION:** Make sure that the blower motor and fan assembly is placed on the bench with the fan pointing upwards.



To prevent damage to the fan wheel vanes, the fan wheel must not be touched. For this reason, a special tool (412-131) has been introduced for removal and installation of the blower motor. This tool is pushed onto the central shaft in order to lift out the blower motor.

**DESCRIPTION AND OPERATION****Fault Memory Interrogation without diagnostics unit - vehicles with automatic temperature control**

**NOTE:** On vehicles equipped with a DVD navigation system with touchscreen, the fault memory can only be interrogated using the Ford diagnostic tool.

The climate control and heating system features a on-board diagnosis function which can detect and store both current permanent faults as well as intermittent faults which have occurred during normal operation of the vehicle. It is also possible to read out these faults via the display on the control panel of the climate control system. To read out the fault memory, the ignition key must be turned to the "ON" position and the battery voltage must be between 9 V and 16 V.

To activate the on-board diagnosis at the control panel for the climate control system, PRESS the "OFF" and "FOOTWELL" buttons simultaneously for exactly 2 seconds, then PRESS "AUTO" within 1.5 seconds. The on-board diagnosis which then starts lasts a few seconds. An animated display appears in the display of the control panel for the climate control system during this time. Any faults found are displayed on both displays of the control panel for the climate control system in the form of trouble codes.

To read out saved errors at the control panel for the climate control system, PRESS the "OFF" and "FOOTWELL" buttons simultaneously for exactly 2 seconds, then PRESS "HEAD AREA" within 1.5 seconds. Any stored faults are shown on the display of the control panel for the climate control system and should be noted for safety reasons. By PRESSING the "DEFROST" button, the fault memory is cleared and diagnosis mode is ended. To end the diagnostic mode without clearing the DTCs, PRESS any other operating button on the control panel for the climate control system.

To read out the software version at the control panel for the climate control system, PRESS the "OFF" and "FOOTWELL" buttons simultaneously for exactly 2 seconds, then PRESS "A/C" within 1.5 seconds. The software version is shown on the display of the control panel for the climate control system. The output mode can be exited by PRESSING any button on the control panel for the climate control system.

**Switch over from Celsius to Fahrenheit**

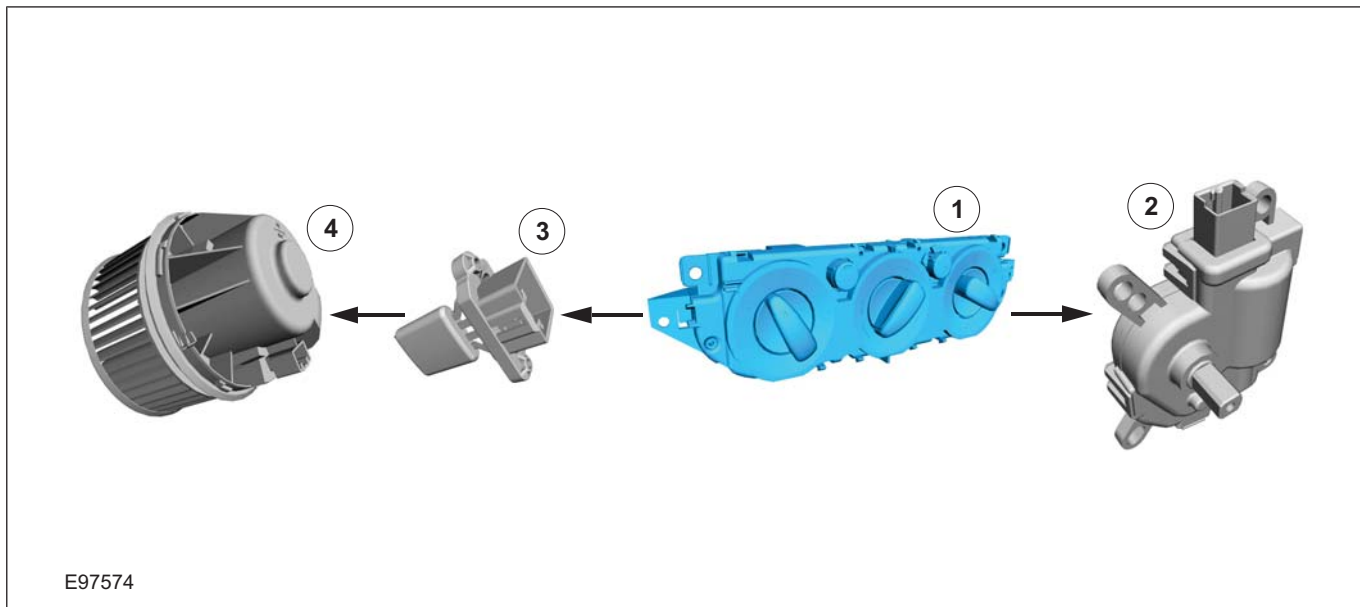
The switch from Celsius to Fahrenheit is performed on the display of the instrument cluster and is then transmitted via the CAN bus to the module of the two-zone air conditioning system.

DESCRIPTION AND OPERATION

Climate Control – System Operation and Component Description

System Diagram

Climate control system - vehicles with manual temperature control

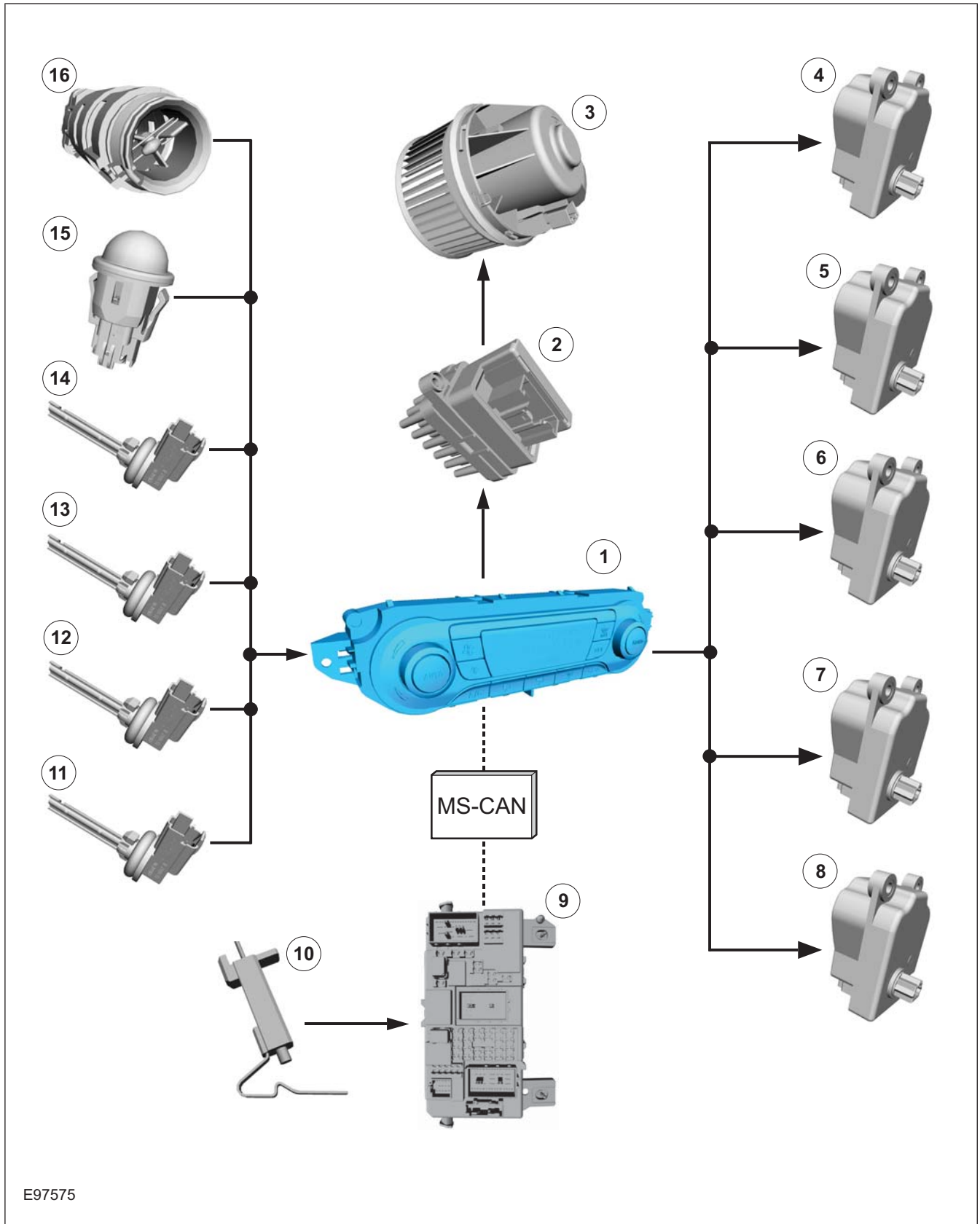


Item	Description
1	Climate control system control assembly Refer to Component Description: Control assembly, climate control - vehicles with manual temperature control (page 24)
2	Air flap actuator

Item	Description
3	Blower motor resistor
4	Blower motor

DESCRIPTION AND OPERATION

Climate control system - vehicles with automatic temperature control



E97575



412-01-14

Climate Control

412-01-14

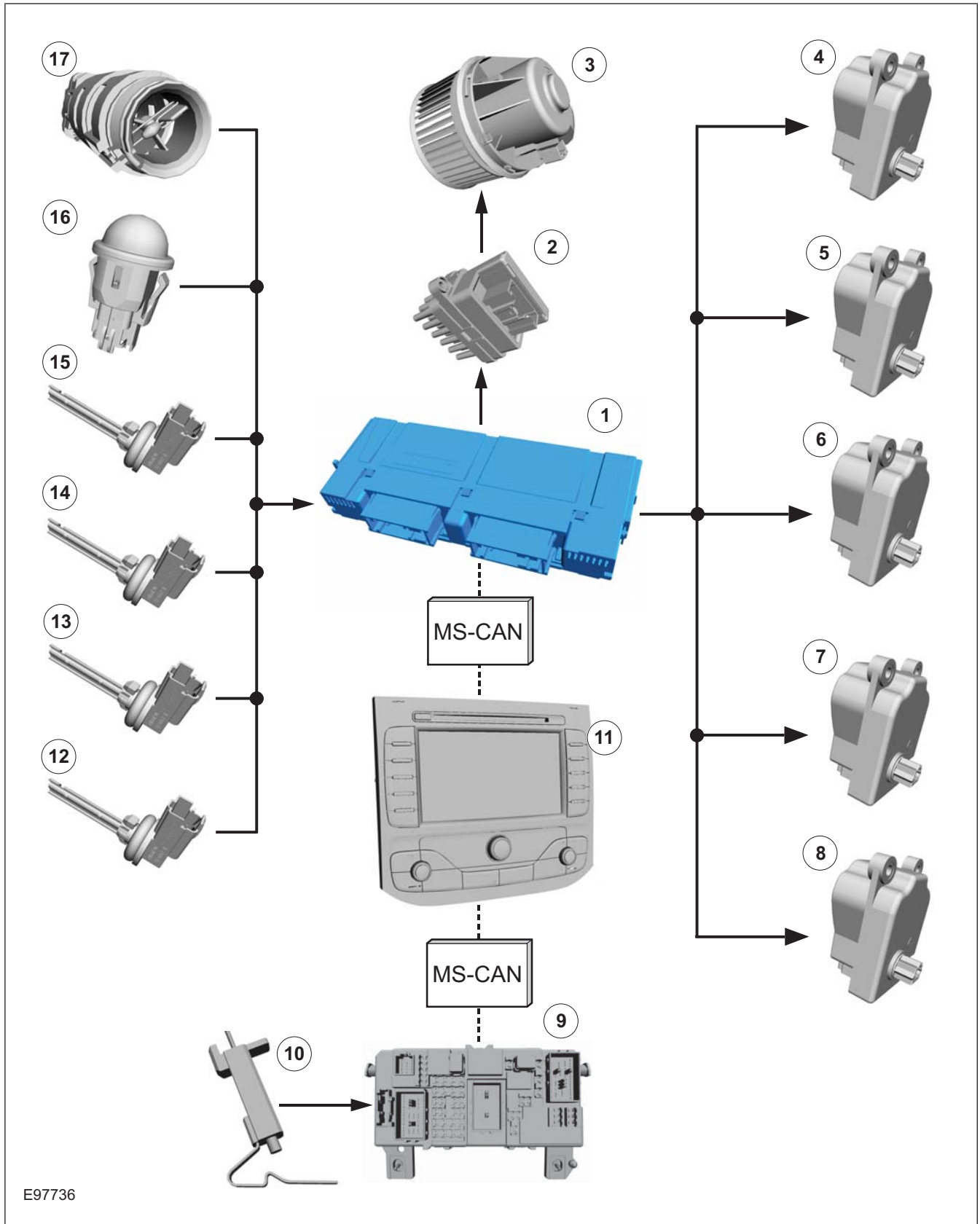
## DESCRIPTION AND OPERATION

Item	Description
1	Climate control system control assembly Refer to Component Description: Control assembly, climate control - vehicles with automatic temperature control (page 25)
2	Blower control module Refer to Component Description: Blower control module - vehicles equipped with automatic temperature control (page 26)
3	Blower motor Refer to Component Description: (page 26)
4	Air flap actuator
5	Actuator - right-hand temperature control flap
6	Actuator - left-hand temperature control flap
7	Actuator - air distribution flap - demister vents
8	Actuator - air distribution flap - center vents

Item	Description
9	Genetic electronic module (GEM).
10	Ambient air temperature sensor Refer to Component Description: Ambient temperature sensor (page 26)
11	Air outlet temperature sensor - left-hand center vents
12	Air outlet temperature sensor - right-hand center vents
13	Air outlet temperature sensor - left-hand footwell
14	Air outlet temperature sensor - right-hand footwell
15	Solar sensor Refer to Component Description: Sun sensor - vehicles with automatic temperature control (page 25)
16	In-vehicle temperature sensor Refer to Component Description: (page 26)

DESCRIPTION AND OPERATION

Climate control system - vehicles with DVD navigation system with a touch screen



412-01-16

Climate Control

412-01-16

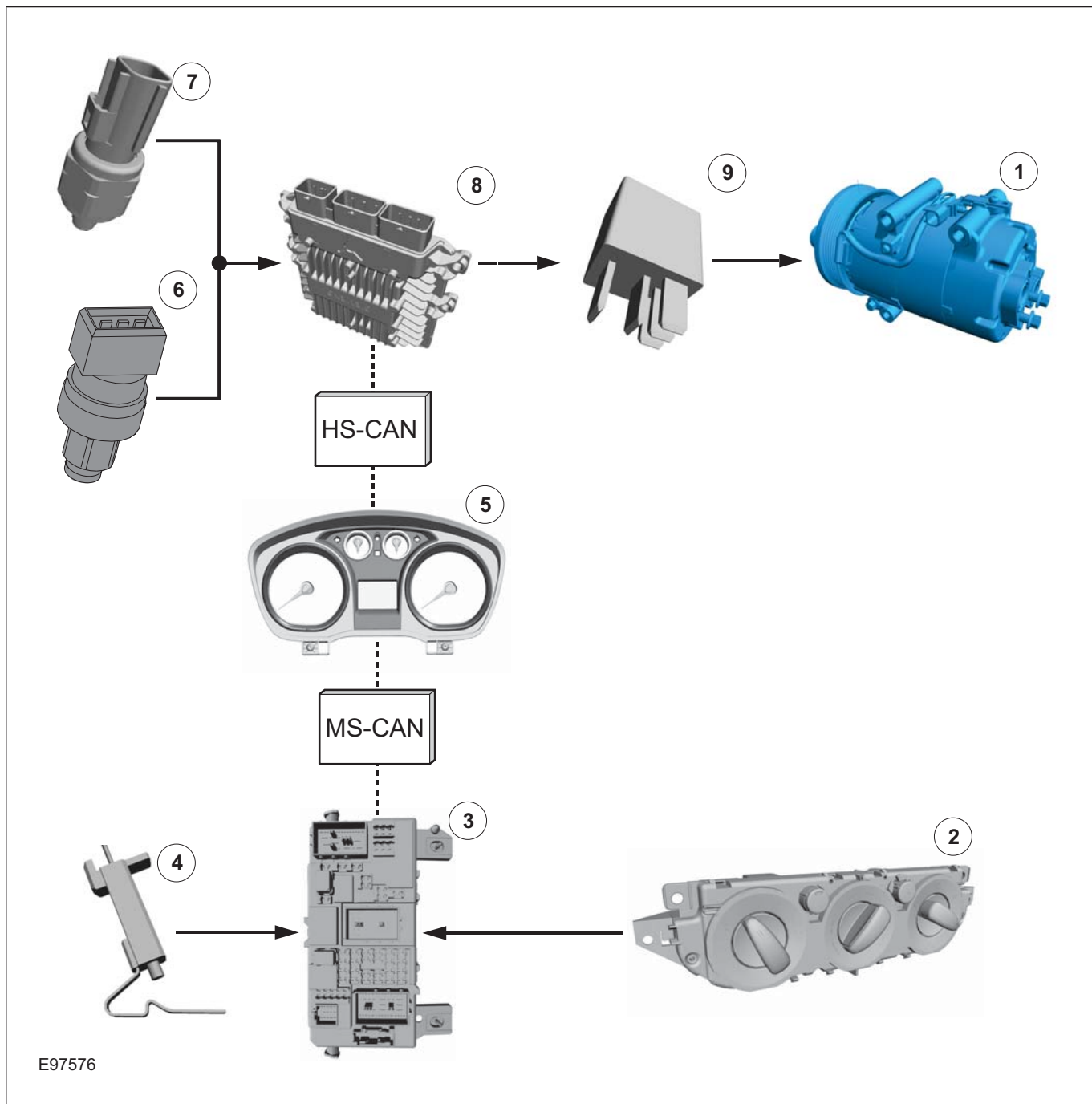
## DESCRIPTION AND OPERATION

Item	Description
1	Climate control module Refer to Component Description: Climate control module - vehicles with DVD navigation system with a touch screen (page 25)
2	Blower control module Refer to Component Description: Blower control module - vehicles equipped with automatic temperature control (page 26)
3	Blower motor Refer to Component Description: (page 26)
4	Air flap actuator
5	Actuator - right-hand temperature control flap
6	Actuator - left-hand temperature control flap
7	Actuator - air distribution flap - demister vents
8	Actuator - air distribution flap - center vents

Item	Description
9	Genetic electronic module (GEM).
10	Ambient air temperature sensor Refer to Component Description: Ambient temperature sensor (page 26)
11	DVD navigation system with touchscreen
12	Left-hand air outlet temperature sensor - left-hand center vents
13	Air outlet temperature sensor - right-hand center vents
14	Air outlet temperature sensor - left-hand footwell
15	Air outlet temperature sensor - right-hand footwell
16	Solar sensor Refer to Component Description: Sun sensor - vehicles with automatic temperature control (page 25)
17	In-vehicle temperature sensor Refer to Component Description: (page 26)

DESCRIPTION AND OPERATION

Air conditioning system - vehicles with manual temperature control



Item	Description
1	Air conditioning compressor
2	Climate control system control assembly Refer to Component Description: Control assembly, climate control - vehicles with manual temperature control (page 24)
3	Genetic electronic module (GEM).

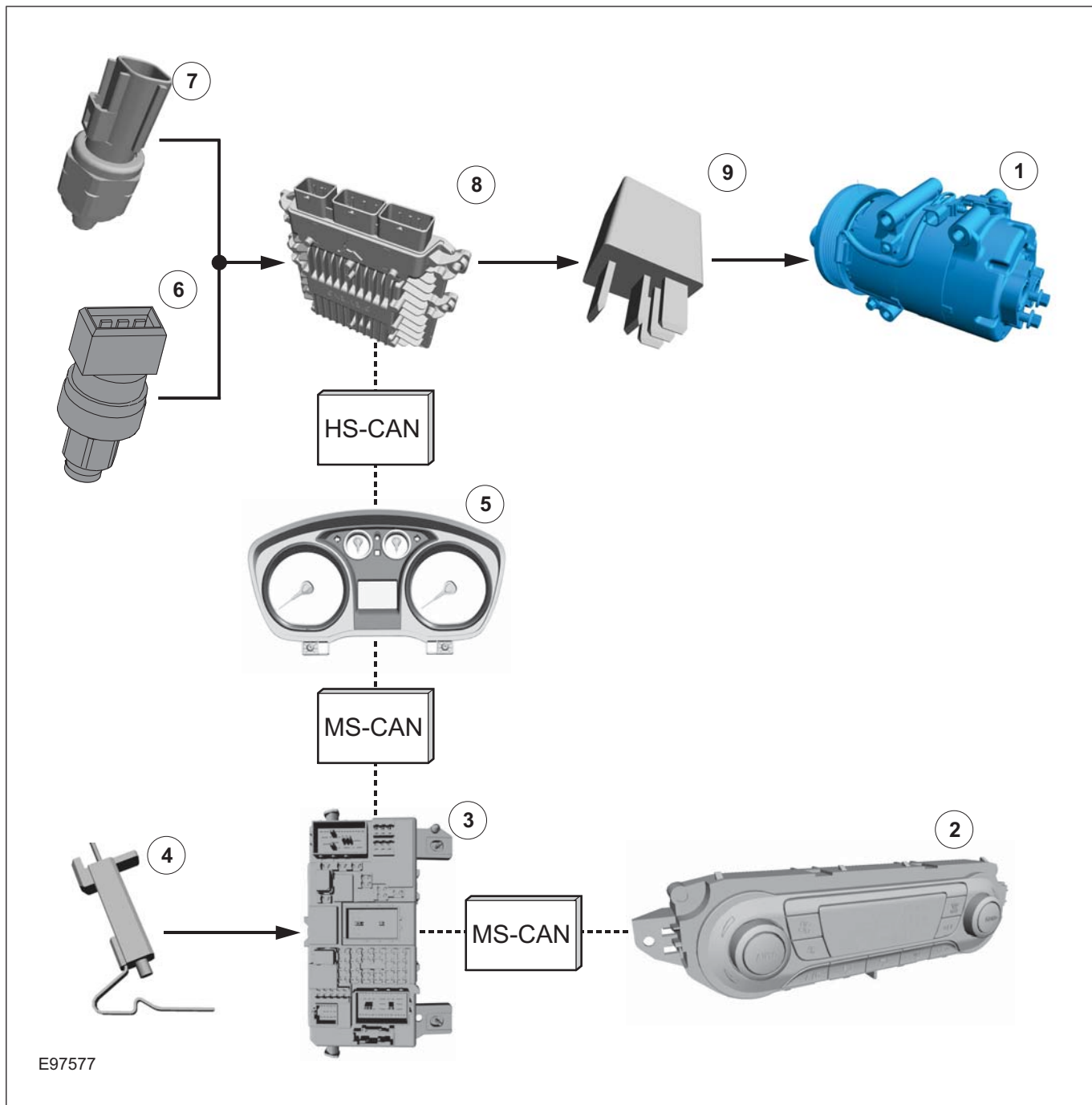
Item	Description
4	Ambient air temperature sensor Refer to Component Description: Ambient temperature sensor (page 26)
5	instrument cluster
6	High pressure limiting switch
7	Dual pressure switch

DESCRIPTION AND OPERATION

Item	Description
8	Powertrain control module (PCM)

Item	Description
9	Air conditioning clutch relay

Air conditioning system - vehicles with automatic temperature control



E97577

Item	Description
1	Air conditioning compressor
2	Climate control system control assembly Refer to Component Description: Control assembly, climate control - vehicles with automatic temperature control (page 25)

Item	Description
3	Genetic electronic module (GEM).
4	Ambient air temperature sensor Refer to Component Description: Ambient temperature sensor (page 26)
5	instrument cluster



DESCRIPTION AND OPERATION

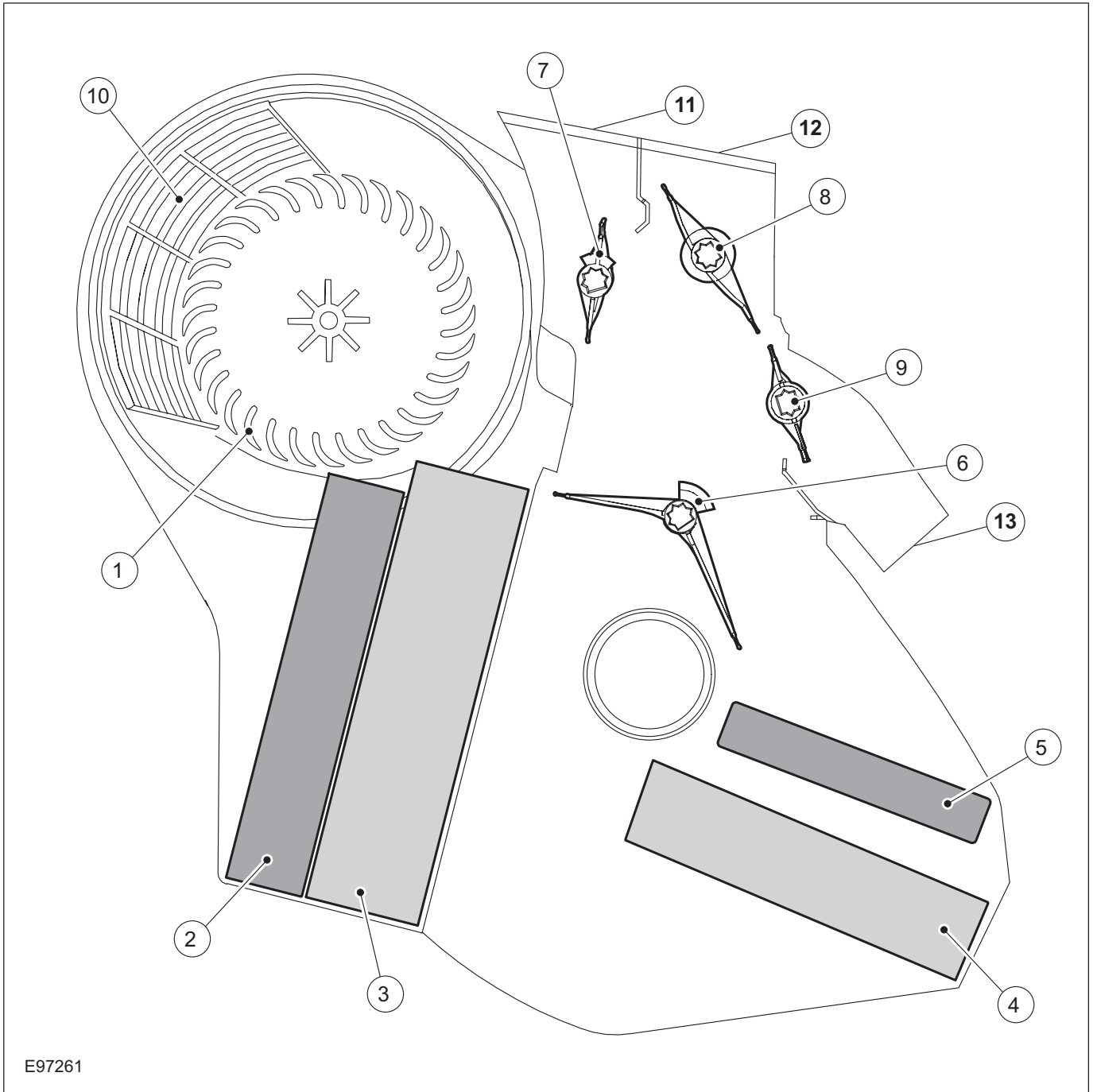
Item	Description
6	High pressure limiting switch
7	Dual pressure switch

Item	Description
8	Powertrain control module (PCM)
9	Air conditioning clutch relay

System Operation

Climate control housing

General overview



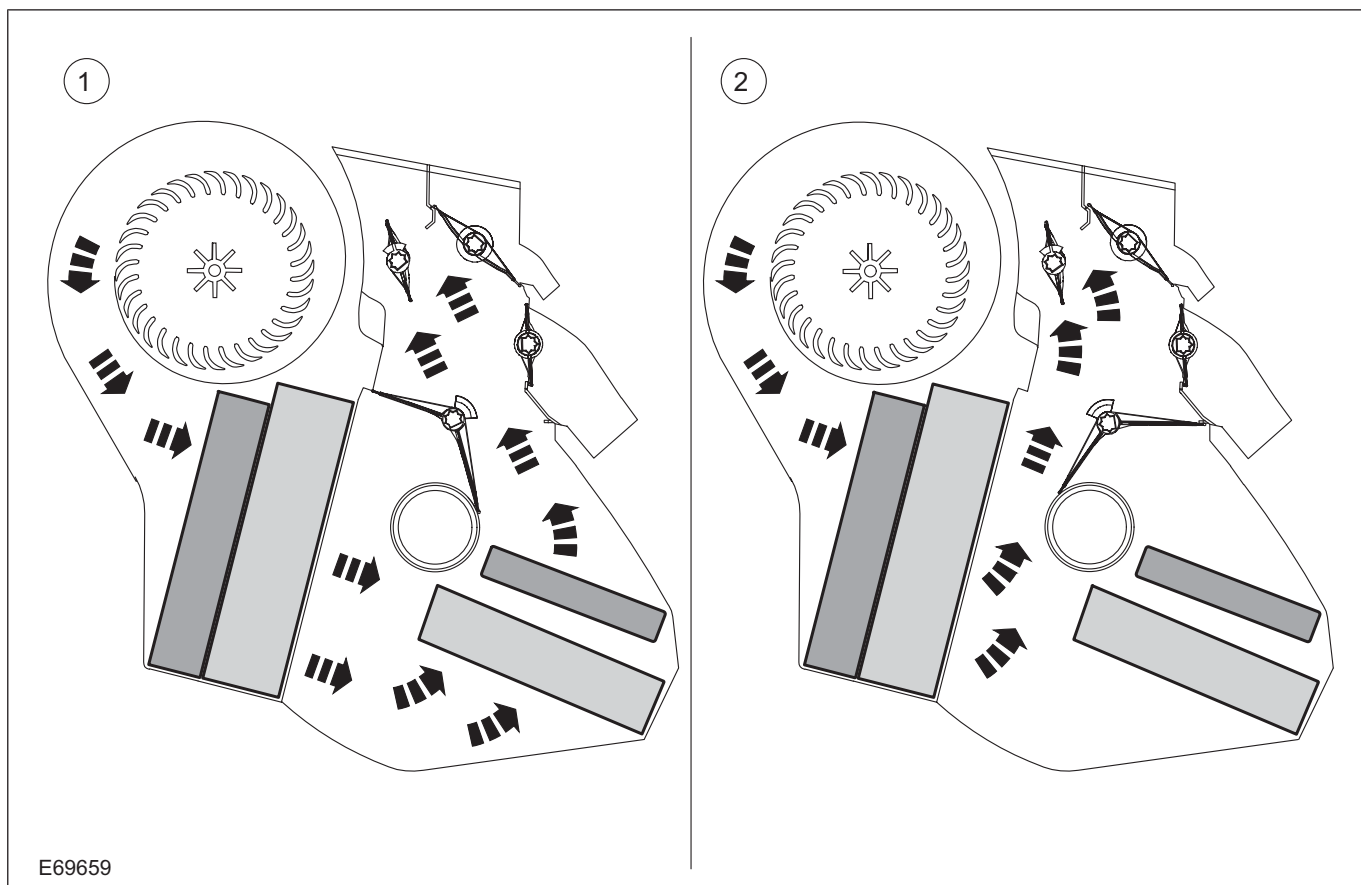
E97261

DESCRIPTION AND OPERATION

Item	Description
1	Blower motor Refer to Component Description: (page 26)
2	Pollen filter Refer to Component Description: (page 24)
3	Evaporator assembly
4	Heat exchanger
5	Electric booster heater (if equipped)

Item	Description
6	Temperature blend door motor
7	Air distribution flap, demister vents
8	Air distribution door - center vents
9	Air distribution door - footwell
10	Air intake door
11	Air duct, demister vents
12	Air passages - center vents
13	Air ducts, rear footwell

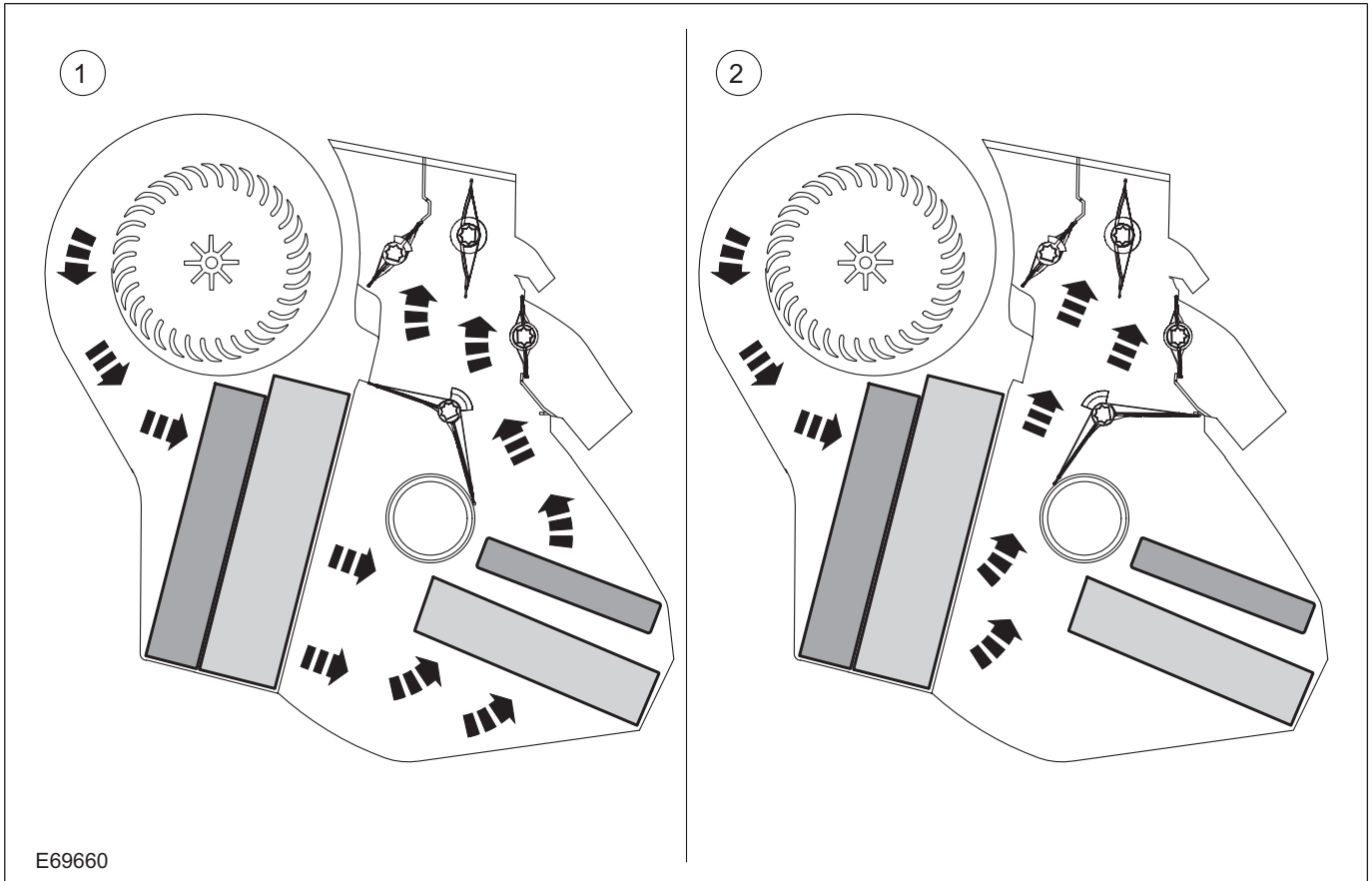
Air flow - defroster vents



Item	Description
1	Warm air
2	Cold air

DESCRIPTION AND OPERATION

Air flow - center vents



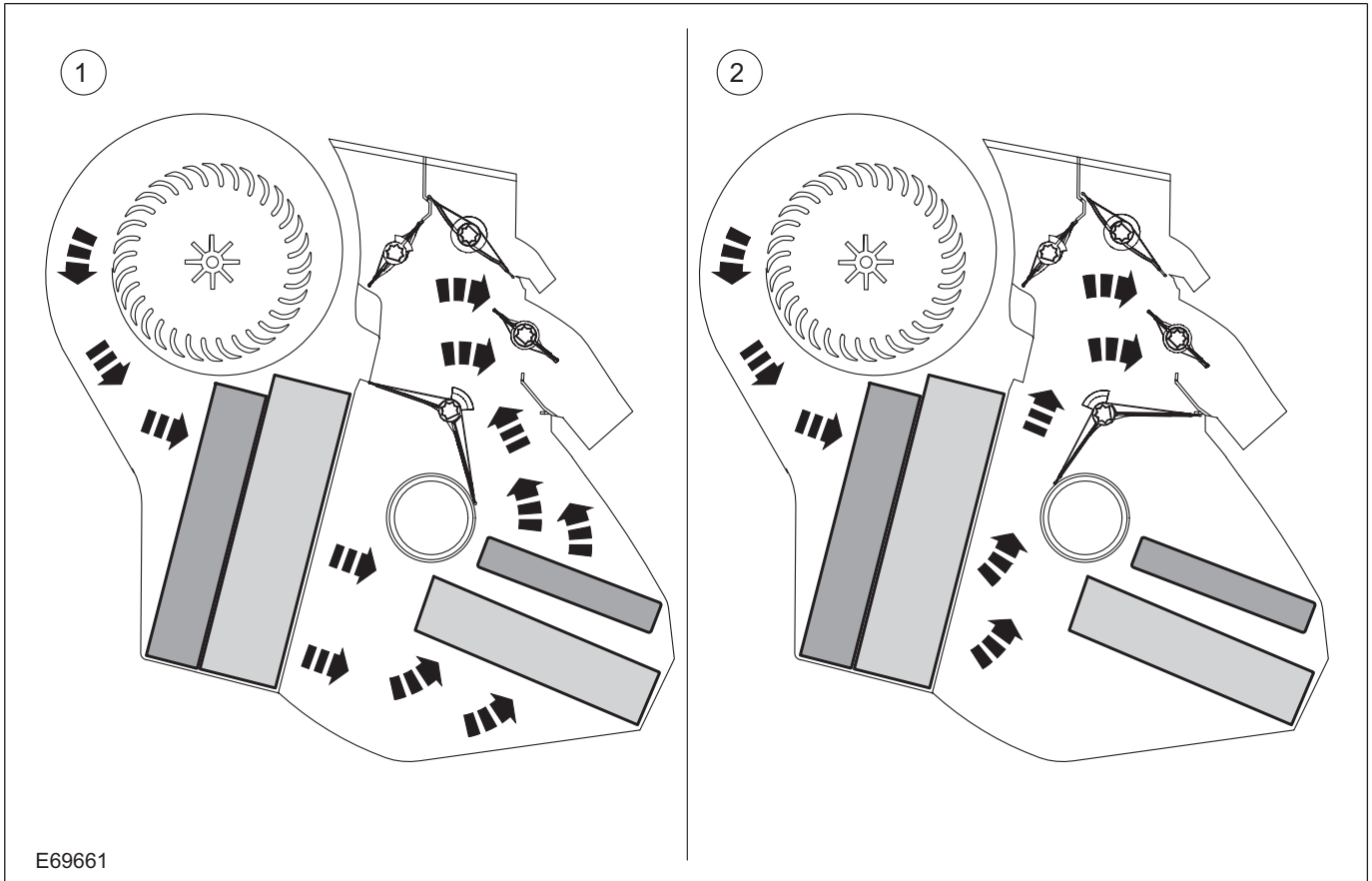
E69660

Item	Description
1	Warm air
2	Cold air



**DESCRIPTION AND OPERATION**

**Air flow – footwell**



E69661

Item	Description
1	Warm air
2	Cold air

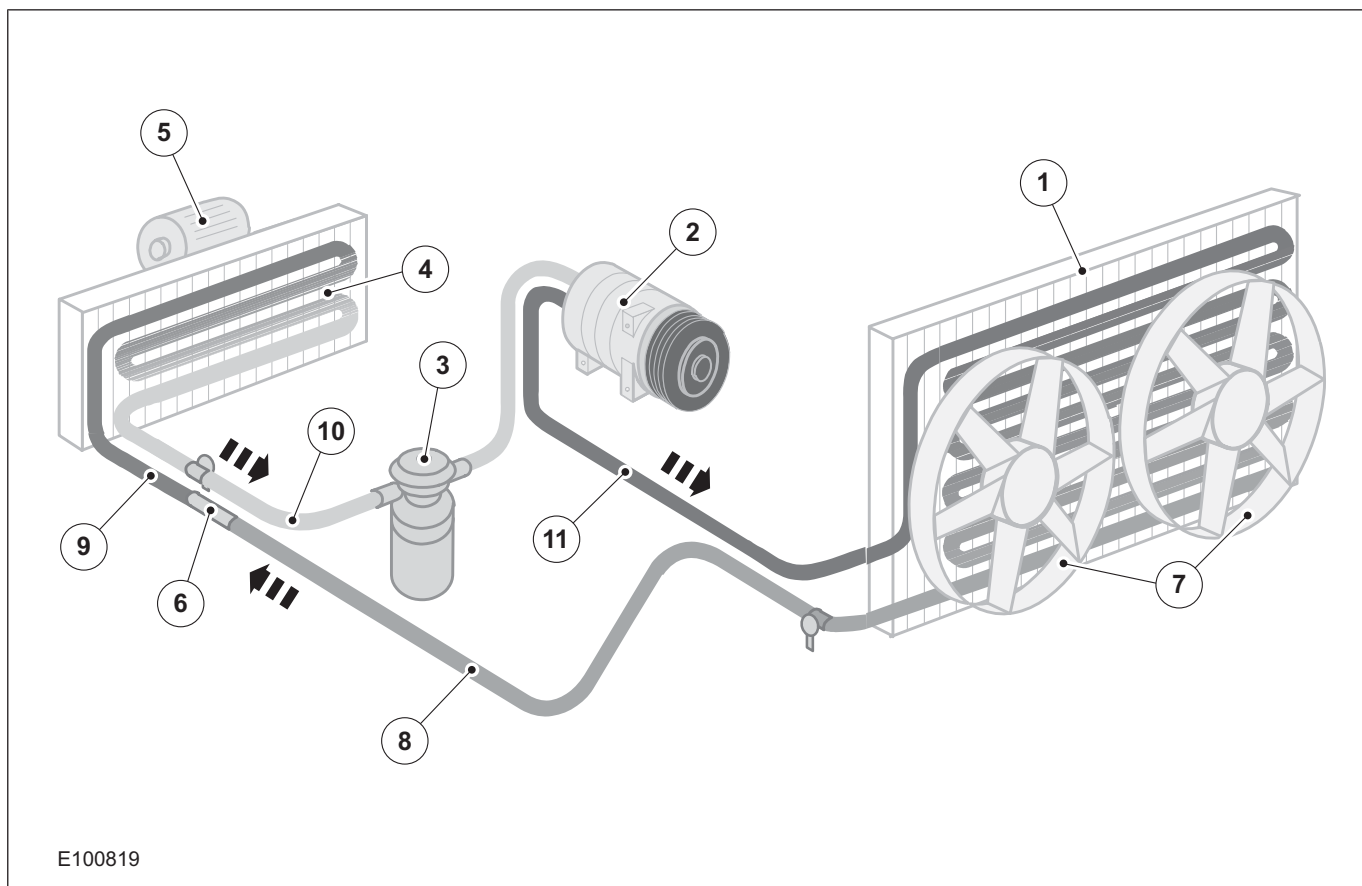
**Climate control**

Two options are available:

- manual climate control
- Air conditioning system with automatic temperature control (DEATC)



DESCRIPTION AND OPERATION



Item	Description
1	Condenser
2	Air conditioning compressor
3	Suction accumulator
4	Evaporator assembly
5	Blower motor

Item	Description
6	Evaporator Core Orifice Tube
7	Cooling fans.
8	High - pressure (liquid and warm)
9	Low - pressure (liquid and cool)
10	Low pressure (gaseous and cold)
11	High pressure (gaseous and hot)

The engine driven refrigerant compressor (2) sucks in gaseous refrigerant from the suction accumulator and compresses it. The temperature of the refrigerant rises to a value between 70 °C and 110 °C. It passes to the condenser (1) under high pressure.

At this point heat is drawn from the refrigerant by the air being forced past the cooling fins. Because of this heat loss, the refrigerant liquefies and leaves the condenser.

A fixed orifice tube (6), which separates the refrigerant at high pressure from that at low pressure, is located between the condenser and the evaporator (5). This fixed orifice tube slows down the flow of the refrigerant from the

compressor, so that pressure builds up in the condenser.

After passing through the fixed orifice tube the liquid refrigerant expands in the circuit to the evaporator, where it becomes gaseous. This causes heat to be extracted from the air coming into the vehicle. The air cools down, and excess moisture contained in it is condensed and is drained off. The refrigerant coming from the evaporator flows into the refrigerant accumulator and is again sucked in by the refrigerant compressor.

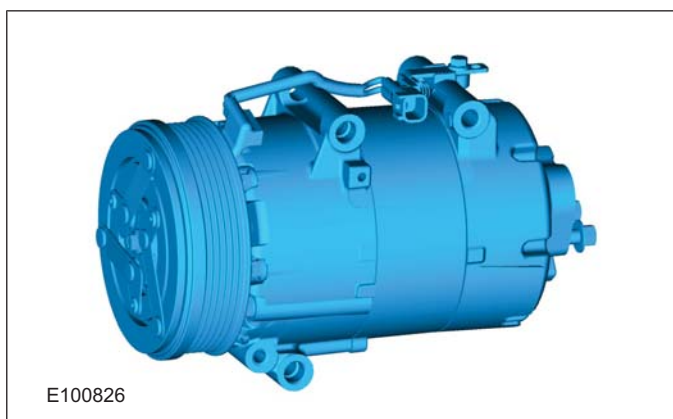
The system is protected by a high-pressure limiting switch, in order to prevent damage by excessive pressure (e.g. because of overfilling with refrigerant). If the pressure exceeds the maximum



**DESCRIPTION AND OPERATION**

permitted, the high-pressure switch turns off the refrigerant compressor.

The compressor on-off cycle is controlled by the dual pressure switch depending on the pressure in the refrigerant accumulator. The dual pressure switch turns the refrigerant compressor off permanently if the pressure falls below a permitted value (e.g. if there is a leak).

**Component Description****Air conditioning compressor**

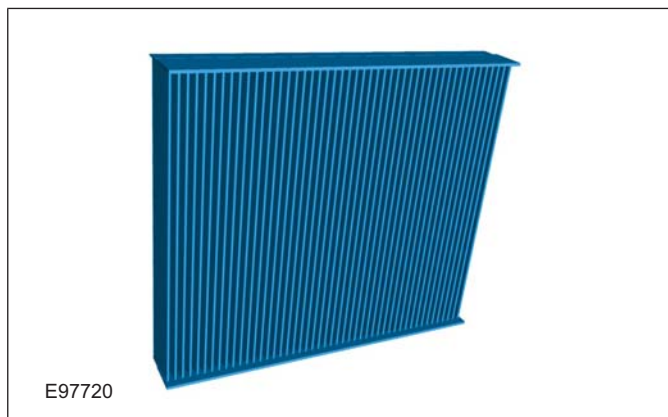
The special feature of a compressor with variable swash plate is that the stroke of the pistons can be varied by means of the variable swash plate. The swash plate is mounted on a slide rail in the axial direction.

The piston stroke and thus the delivery rate are determined by means of the variable obliqueness of the swash plate.

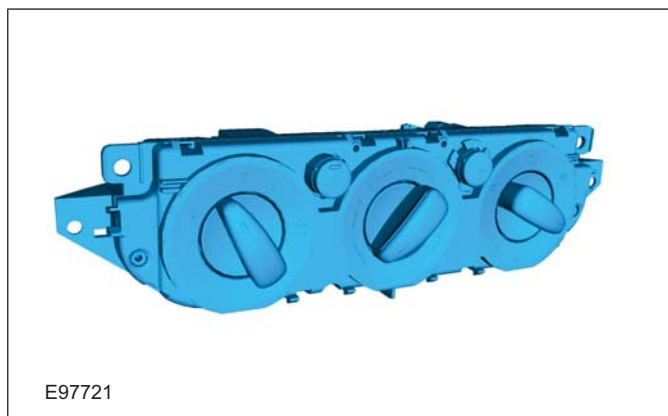
The obliqueness of the swash plate is dependent upon the chamber pressure and thus on the pressure conditions at the top and bottom of the piston. This is supported by springs in front of and behind the swash plate.

The chamber pressure is determined by the high and low pressure applied to the control valve and by a calibrated orifice bore. If the low pressure is relatively high, the control valve is opened and the chamber pressure is reduced.

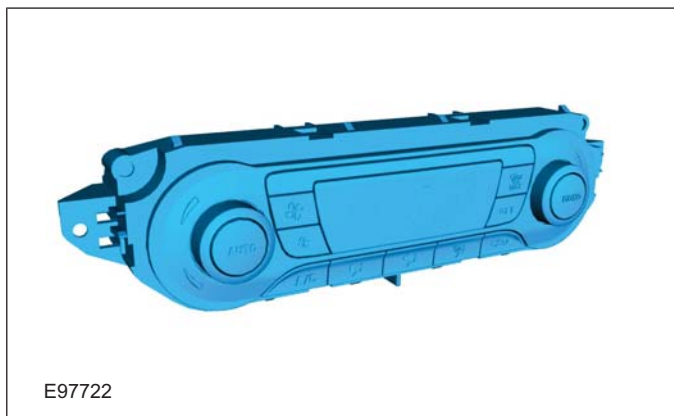
If the low pressure is relatively low, the control valve is closed and the chamber pressure is increased. The force due to the chamber pressure exerted on the piston bottom, is higher than the sum of the force due to the low pressure on the piston top and the spring force.

**Pollen filter**

The fresh air flowing into the vehicle through the air inlet housing passes through a pollen filter which is located on the left-hand side of the climate control housing (LHD and RHD) and removes pollen and dust particles measuring 0.003 mm or more.

**Control assembly, climate control - vehicles with manual temperature control**

In vehicles with manual temperature control, the heating and air conditioning are operated using three rotary switches. The air distribution flaps are actuated via the air distribution flap/temperature control flap actuating unit, which is connected via a rod to the control assembly for the climate control. The temperature control flap is also actuated via the air distribution flap/temperature control flap actuating unit, which is connected via a cable to the control assembly. In addition, the operating switch for recirculated air mode and the on/off switch for the air conditioning are located on the control assembly.

**DESCRIPTION AND OPERATION****Control assembly, climate control - vehicles with automatic temperature control**

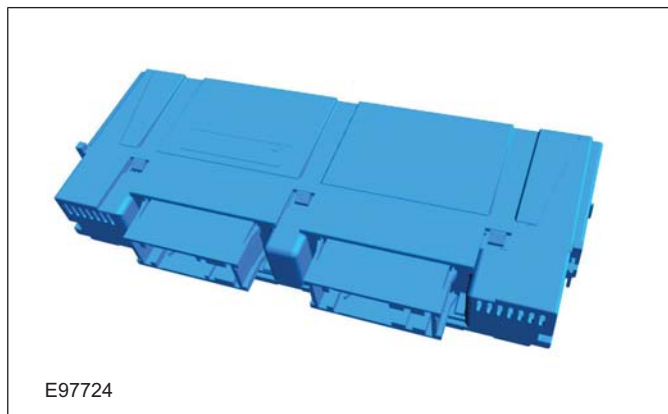
Vehicles with automatic temperature control have a control assembly with the following button operated functions:

- Switching the air conditioning system on and off
- Temperature adjustment for the driver's side/front passenger's side
- Switching the windshield defrost function on and off
- Switching the electronic automatic climate control and the dual mode on and off
- Air distribution
- Blower Control
- Switching off the dual automatic climate control
- Recirculated air control

**Control assembly, climate control - vehicles with DVD navigation system with a touch screen**

On vehicles with a DVD navigation system with a touch screen, the control buttons for the automatic temperature control (climate control) are integrated

in this unit. In addition, all heating and air conditioning functions can be controlled via the touchscreen. The information exchange takes place on the mid-speed CAN bus (MS-CAN).

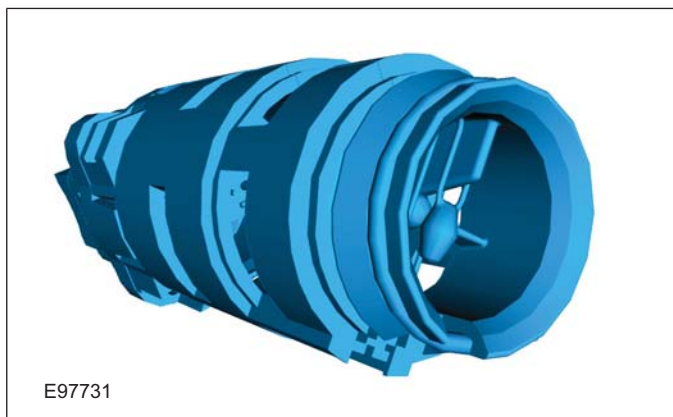
**Climate control module - vehicles with DVD navigation system with a touch screen**

On vehicles with a DVD navigation system with a touch screen, the climate control module is provided as a separate component underneath the DVD navigation unit. It is actuated via control buttons or via the navigation touch screen.

**Sun sensor - vehicles with automatic temperature control**

For vehicles with automatic temperature control the sun sensor determines the intensity of the sunload. The sunload serves as an additional parameter for determining the blower air temperature, the air distribution and the blower speed.

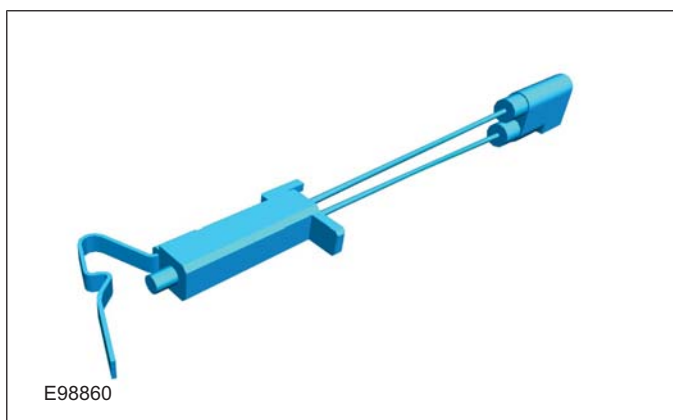
## DESCRIPTION AND OPERATION

**In-vehicle temperature sensor**

E97731

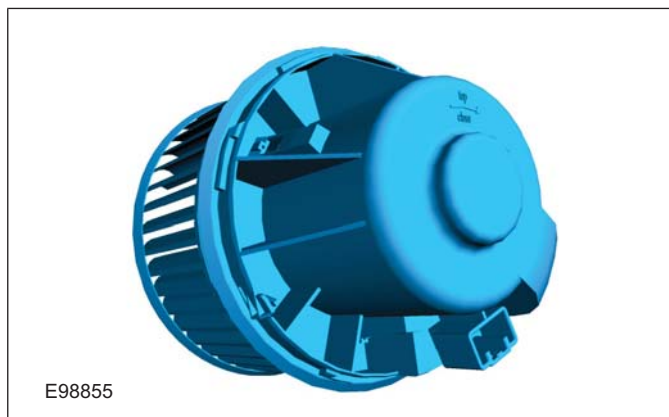
The interior temperature sensor measures the temperature in the passenger compartment and thereby also helps to control the pre-selected interior temperature. This is an NTC resistor.

In order to achieve optimum measurement values, an integrated blower draws air from the interior into the in-vehicle temperature sensor.

**Ambient temperature sensor**

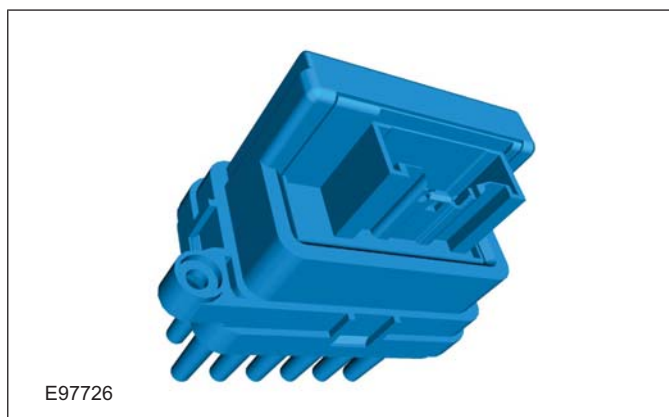
E98860

The outside-temperature sensor measures the ambient temperature outside the vehicle. The resistance, and so the voltage drop at the sensor, alter depending on the outside-air temperature. This is an NTC resistor.

**Blower motor**

E98855

On vehicles with electronic automatic temperature control (EATC), a blower motor with brushes is used.

**Blower control module - vehicles equipped with automatic temperature control**

E97726

On vehicles with electronic automatic temperature control (EATC) a blower control module is fitted instead of the conventional blower motor resistor. This is located in the usual position next to the blower motor, so that the cooling fins of the module are cooled by the air flow.

The climate control module regulates the blower control module via a PWM signal, which in turn regulates the voltage at the blower motor to between 3 V and 12.8 V, in an infinitely variable manner.

The blower control module is fitted with a temperature monitor which continuously monitors the internal temperature of the module. If the temperature rises above 105°C, the blower motor is switched off until the temperature in the module falls to below 100°C.

If the current rises above the value of 26 A ± 3 A defined in the blower control module (e.g. high

**DESCRIPTION AND OPERATION**

dynamic pressure in blower housing during fast motorway driving), the current flow through the blower motor is limited by the blower control module, until a safe value is reached. If this value cannot be achieved (e.g. blower motor blocked or partially seized or dynamic pressure in the blower housing permanently too high), the value is limited to  $6\text{ A} \pm 2\text{ A}$ .

Under normal conditions, the blower motor control returns to the normal state.



## REMOVAL AND INSTALLATION

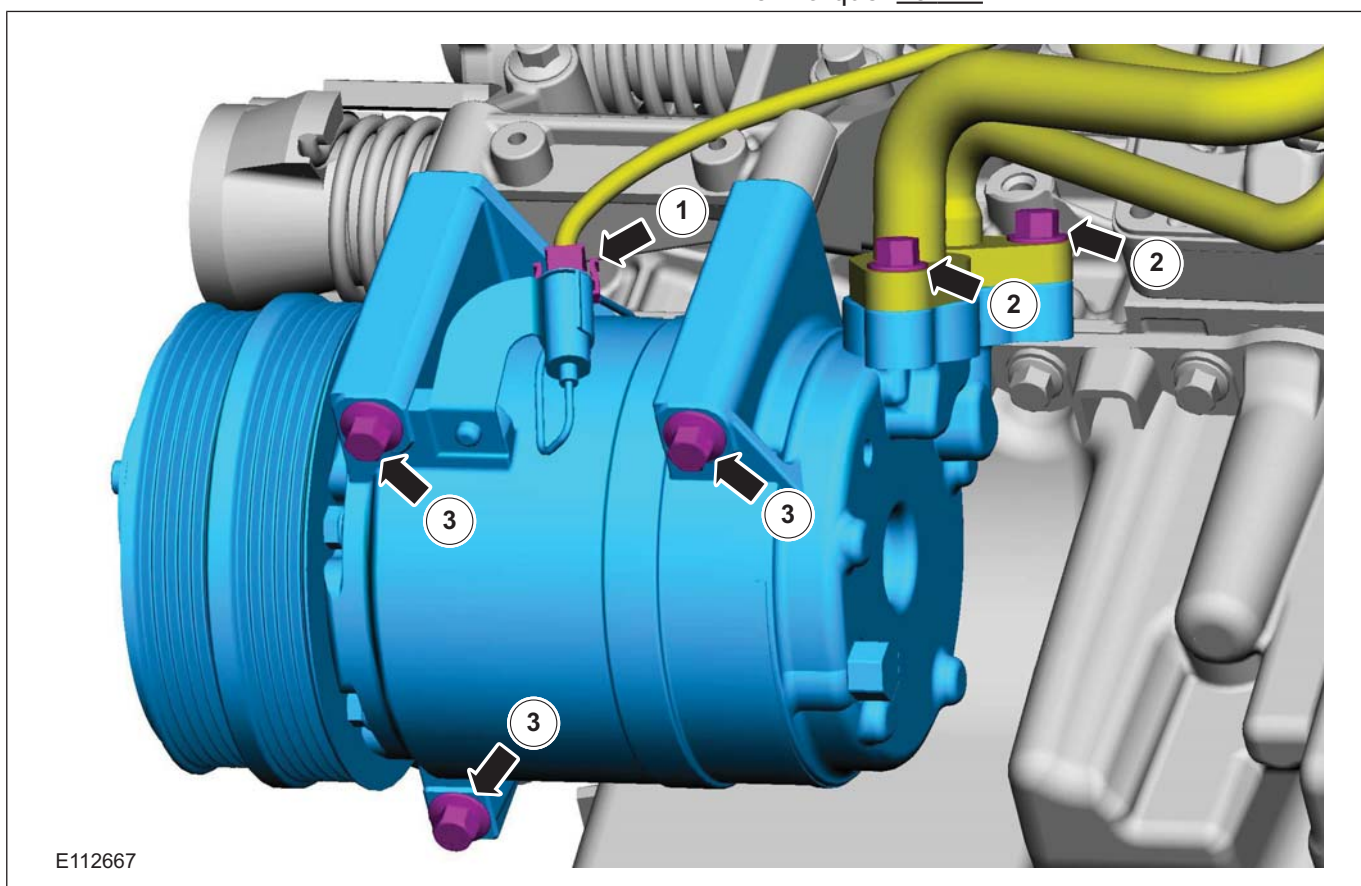
Air Conditioning (A/C) Compressor — 2.5L Duratec  
(147kW/200PS) - VI5(34 626 4)

Materials	
Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).
2. Refer to: **Air Conditioning (A/C) Compressor Belt** (303-05 Accessory Drive - 2.5L Duratec (147kW/200PS) - VI5, Removal and Installation).
3. **CAUTION:** Make sure that all openings are sealed.
  2. Torque: 20 Nm
  3. Torque: 25 Nm



E112667

## Installation

1. To install, reverse the removal procedure.
2. Coat the O-ring seals on the refrigerant lines.

Material: Compressor Oil - Air Conditioning  
(WSH-M1C231-B / 6U7J-M1C231-AA)  
refrigerant oil



## REMOVAL AND INSTALLATION

## Air Conditioning (A/C) Compressor to Condenser Discharge Line

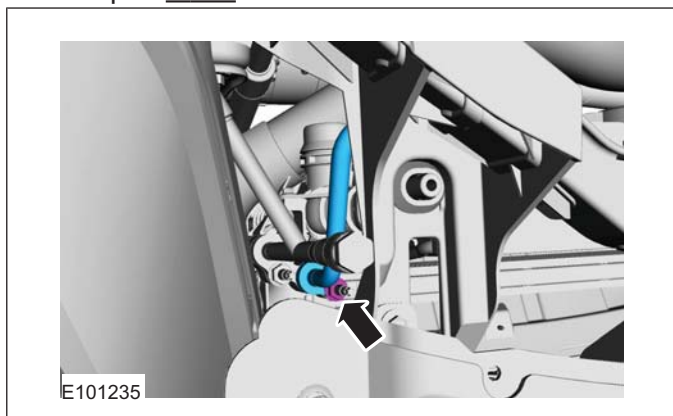
Materials	
Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

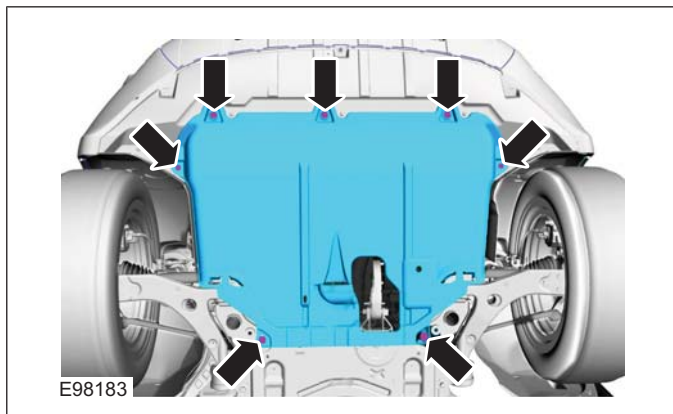
1. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).
2. **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Torque: 8 Nm



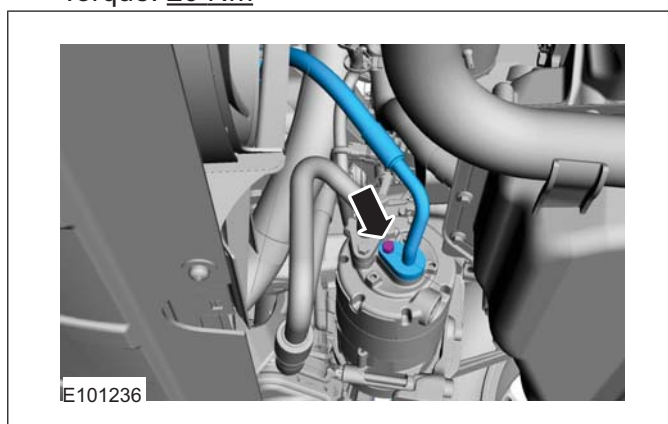
3. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

4.



5. **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Torque: 20 Nm



## Installation

1. To install, reverse the removal procedure.
2. Coat the O-ring seals on the refrigerant lines.

Material: Compressor Oil - Air Conditioning (WSH-M1C231-B / 6U7J-M1C231-AA) refrigerant oil

## REMOVAL AND INSTALLATION

Air Conditioning (A/C) Compressor to Condenser Discharge Line  
— 2.5L Duratec (147kW/200PS) - VI5

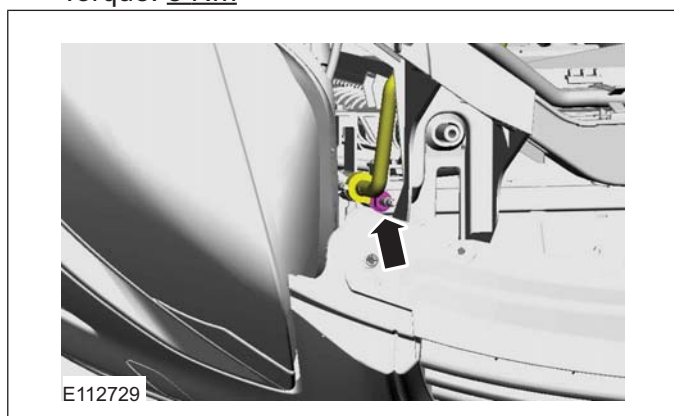
Materials	
Name	Specification
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

## Removal

**NOTE:** Removal steps in this procedure may contain installation details.

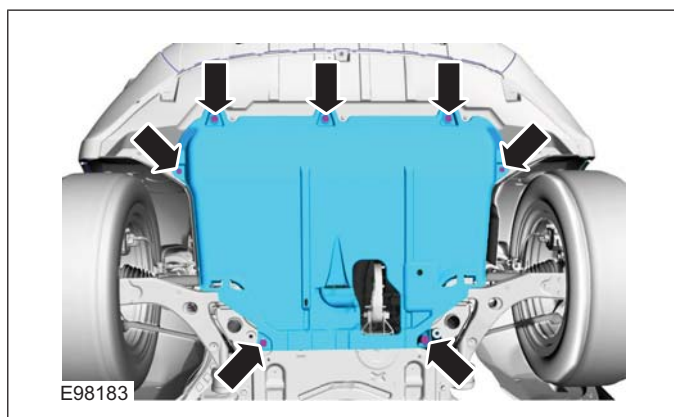
1. Refer to: **Air Conditioning (A/C) System Recovery, Evacuation and Charging** (412-00 Climate Control System - General Information, General Procedures).
2. **CAUTION:** Make sure that all openings are sealed.

Torque: 8 Nm



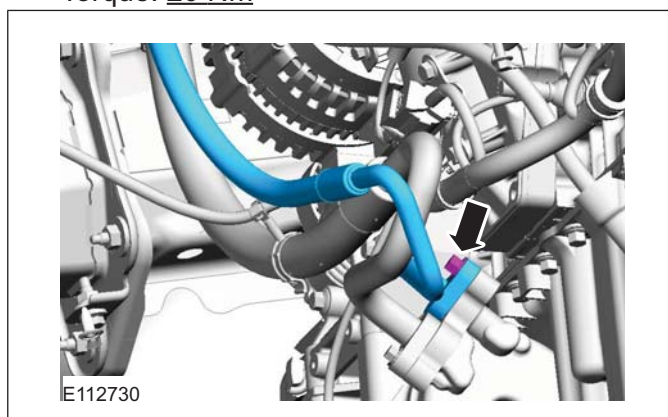
3. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

4.



5. **CAUTION:** Make sure that all openings are sealed.

Torque: 20 Nm



## Installation

1. To install, reverse the removal procedure.
2. Coat the O-ring seals on the refrigerant lines.

Material: Compressor Oil - Air Conditioning (WSH-M1C231-B / 6U7J-M1C231-AA) refrigerant oil