FOREWORD

To the best of our knowledge, the illustrations, technical information, data and descriptions in this issue were correct at the time of going to print. The right to change prices, specifications, and equipment and maintenance instructions at any time without notice is reserved as part of FORD policy of continuous development and improvement for the benefit of our customers.

2011.50 Ranger

Workshop Manual

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GROUP 4 Electrical

GROUP 5 Body & Paint

GROUP

1

General Information

SECTION TITLE PAGE

Service Information

SECTION 100-00 General Information

VEHICLE APPLICATION: 2011.50 Ranger

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DESCRIPTION AND OPERATION

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DESCRIPTION AND OPERATION

About This Manual

Introduction

This manual covers diagnosis and testing and repair procedures.

This manual is structured into groups and sections, with specific system sections collected 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.

If components need to be removed or disassembled in sequence, the sequence will be identified numerically in a graphic and the corresponding text will be numbered accordingly.

All left-hand and right-hand references to the vehicle are taken from a position sitting in the driver seat looking forward.

All left-hand and right-hand references to the engine are taken from a position at the flywheel looking towards the front camshaft pulley.

How to Use This Manual - Repair Procedures

This manual has been written in a format that is designed to meet the needs of technicians worldwide. The objective is to use common formats and include similar content in each manual.

This manual provides general descriptions for accomplishing diagnosis and testing, service and repair work with tested, effective techniques. Following them will help assure reliability.

Special Tools

The special tool(s) table provided at the beginning of each procedure shows all special tools required to carry out a repair. Where possible, illustrations are provided to assist in identifying the special tool required.

Important Safety Instructions

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

This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Anyone who departs from the instructions provided in this manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, 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.

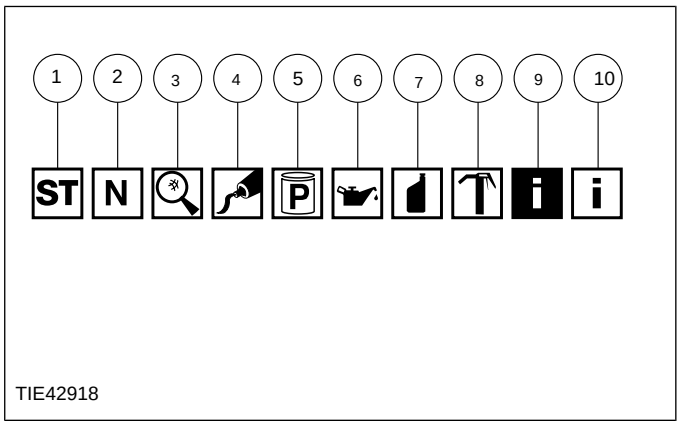
A warning, caution or note is placed at the beginning of a series of steps if it applies to multiple steps. If the warning, caution or note only applies to one step, it is placed at the beginning of the specific step (after the step number).

Overview Procedures

Overview procedures contain an exploded view illustration(s). The numbered sequence within the illustration(s) indicate the order to be followed when removing/disassembling or when installing/assembling a component. Additional information, symbol(s) or a torque figure, may also be shown alongside the component.

There are ten symbols used to give additional information when removing/disassembling or when installing/assembling a component.

DESCRIPTION AND OPERATION

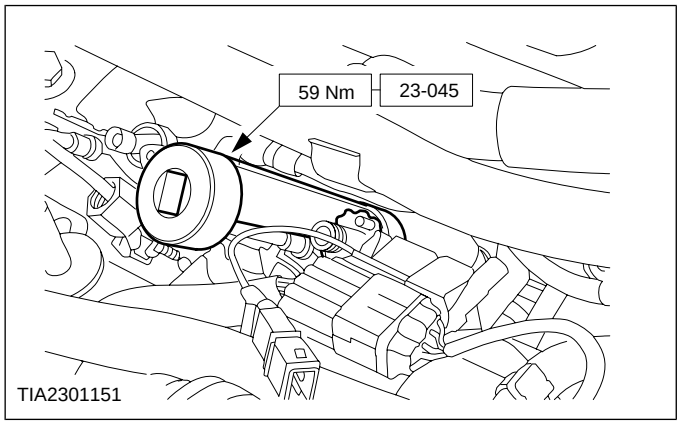


TIE42918

Item	Designation	Description
1	Special tool	A special tool is required for this component. There will also be a removal or installation symbol alongside the special tool symbol.
2	Install new component	Discard the old component and install a new component.
3	Inspect	Check the component for damage.
4	Apply sealant	Apply sealant to the component as specified in the materials table.
5	Apply petroleum jelly	Apply petroleum jelly to the component as specified in the materials table.
6	Apply oil	Apply oil to the component as specified in the materials table.
7	Apply fluid	Apply fluid to the component as specified in the materials table.
8	Apply grease	Apply grease to the component as specified in the materials table.
9	Removal or Disassembly detail	Go to the removal or disassembly detail for additional information to remove or disassemble a component
10	Installation or Assembly detail	Go to the installation or assembly detail for additional information to install or assemble a component

Special Tools and Torque Figures

Any requirement for special tools will picture the tool, showing it in use and with its tool number shown. Torque settings will be given at the relevant point in the procedure.



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DESCRIPTION AND OPERATION

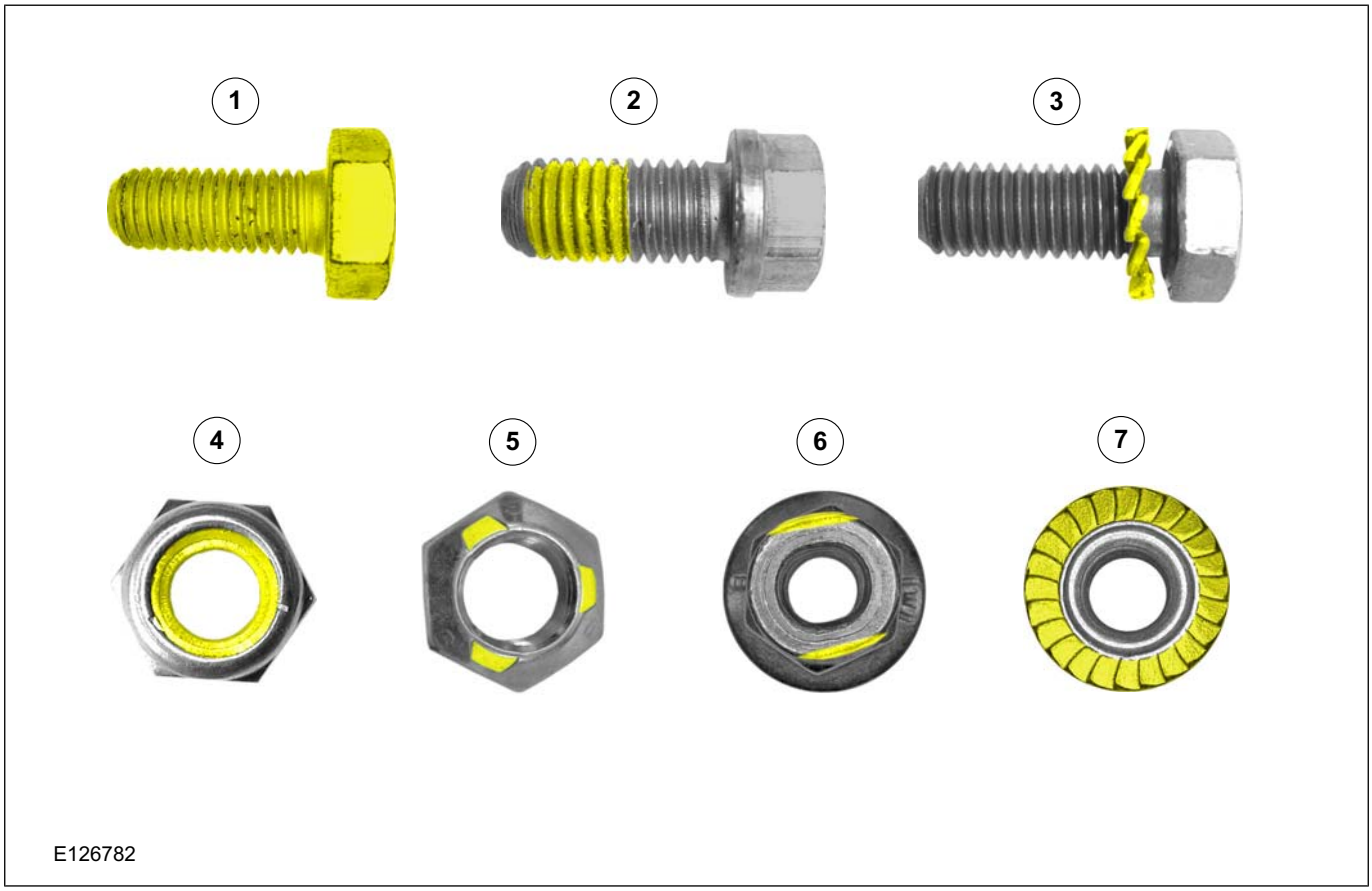
Trustmark Authoring Standards (TAS) Procedures

NOTE: TAS 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 TAS 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.

Types of self-locking nuts and bolts

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



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 dents)
6	Self-locking nut with thread deformation (squeeze of thread to oval shape)
7	Self-locking nut with integrated locking ring

Many of the TAS 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.

- 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

DESCRIPTION AND OPERATION

otherwise stated within the procedure, recognizable by a tightening torque with more than one stage together with a torque angle.

Specification procedures will contain all technical data that are not part of a repair procedure.

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.

TAS Graphics

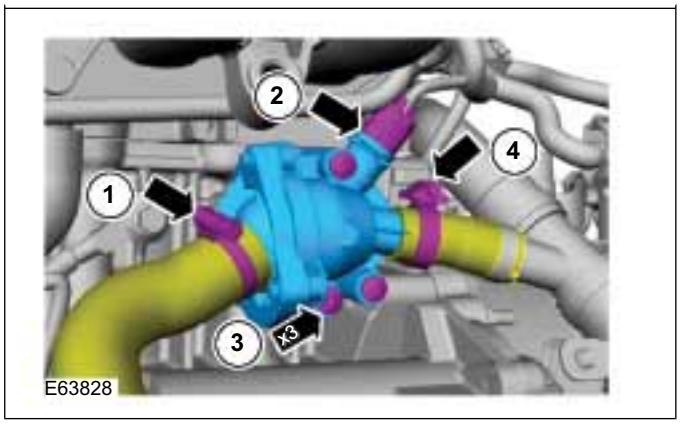
Colors used in the graphic are as follows:

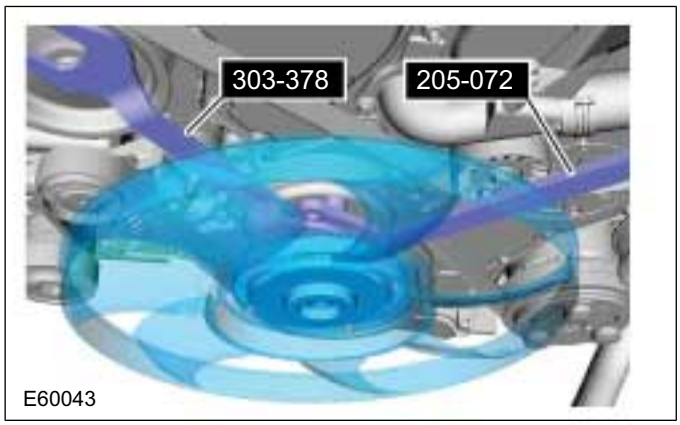
- Blue - Indicates the target item, item to be removed/installed or disassembled/assembled
- Green and Brown - Indicates a secondary item that needs to be detached, removed/installed or disassembled/assembled prior to the target item
- Yellow - Component that is touched or affected in a way but remains in the vehicle. It may be detached, attached, moved, modified, checked, adjusted etc.
- Magenta - Indicates electrical connectors and fasteners such as nuts, bolts, clamps or clips
- Pale Blue - is for the special tool(s) and general equipment

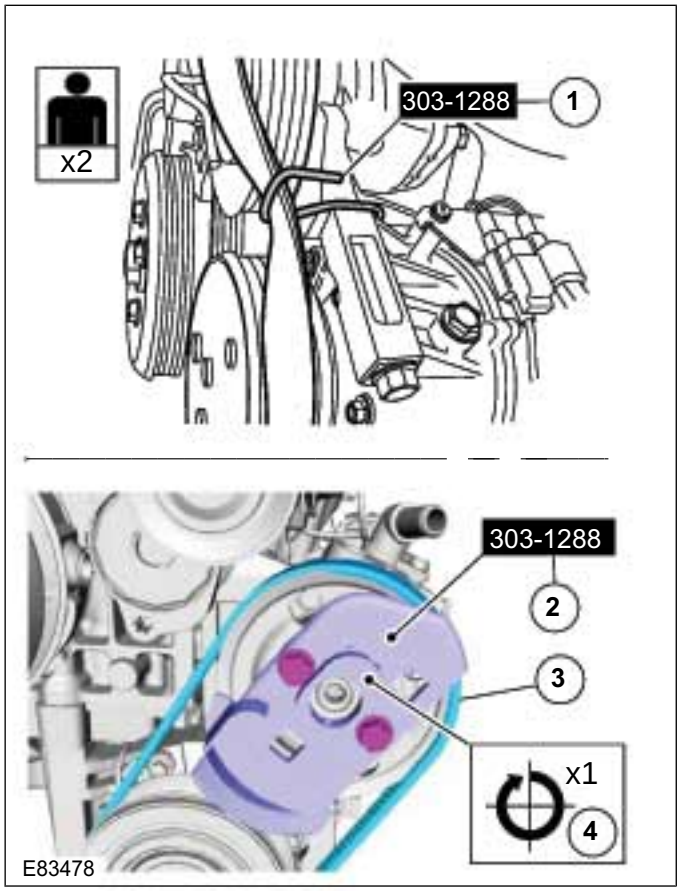
One illustration may have multiple steps assigned to it.

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

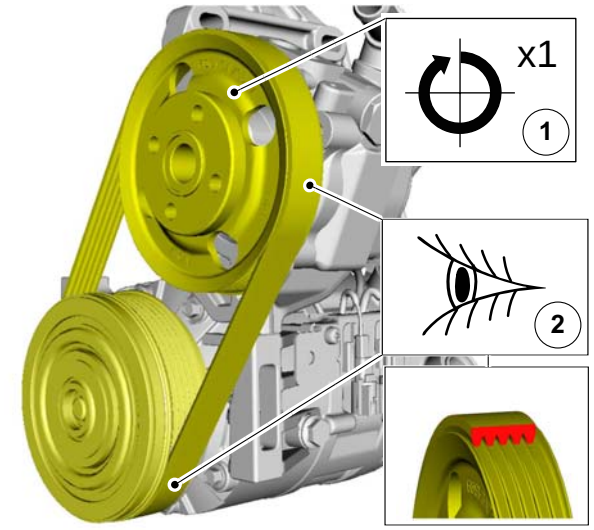
Items in the illustration can be transparent or use cutouts to show hidden detail(s).







DESCRIPTION AND OPERATION

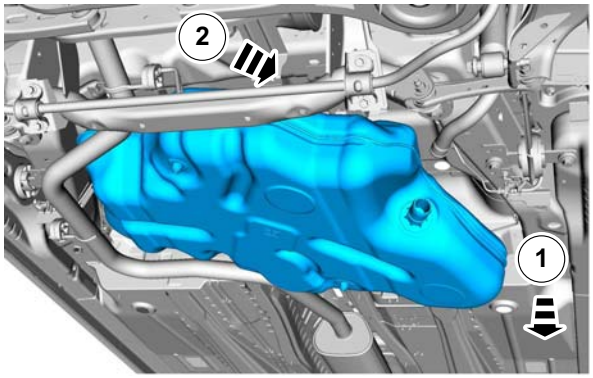


E92595

TAS Symbols

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.

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

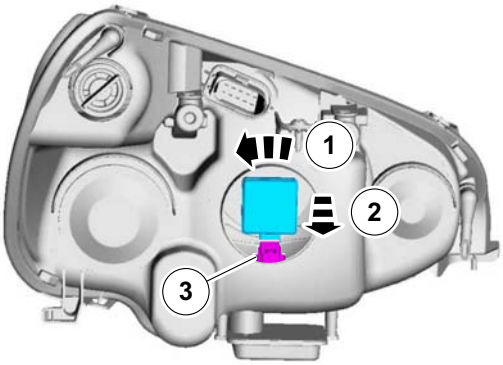


4. 

E85026

DESCRIPTION AND OPERATION

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

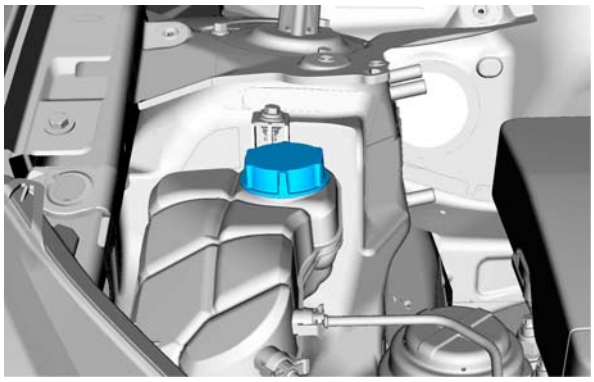


2. 

E85027

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

DESCRIPTION AND OPERATION

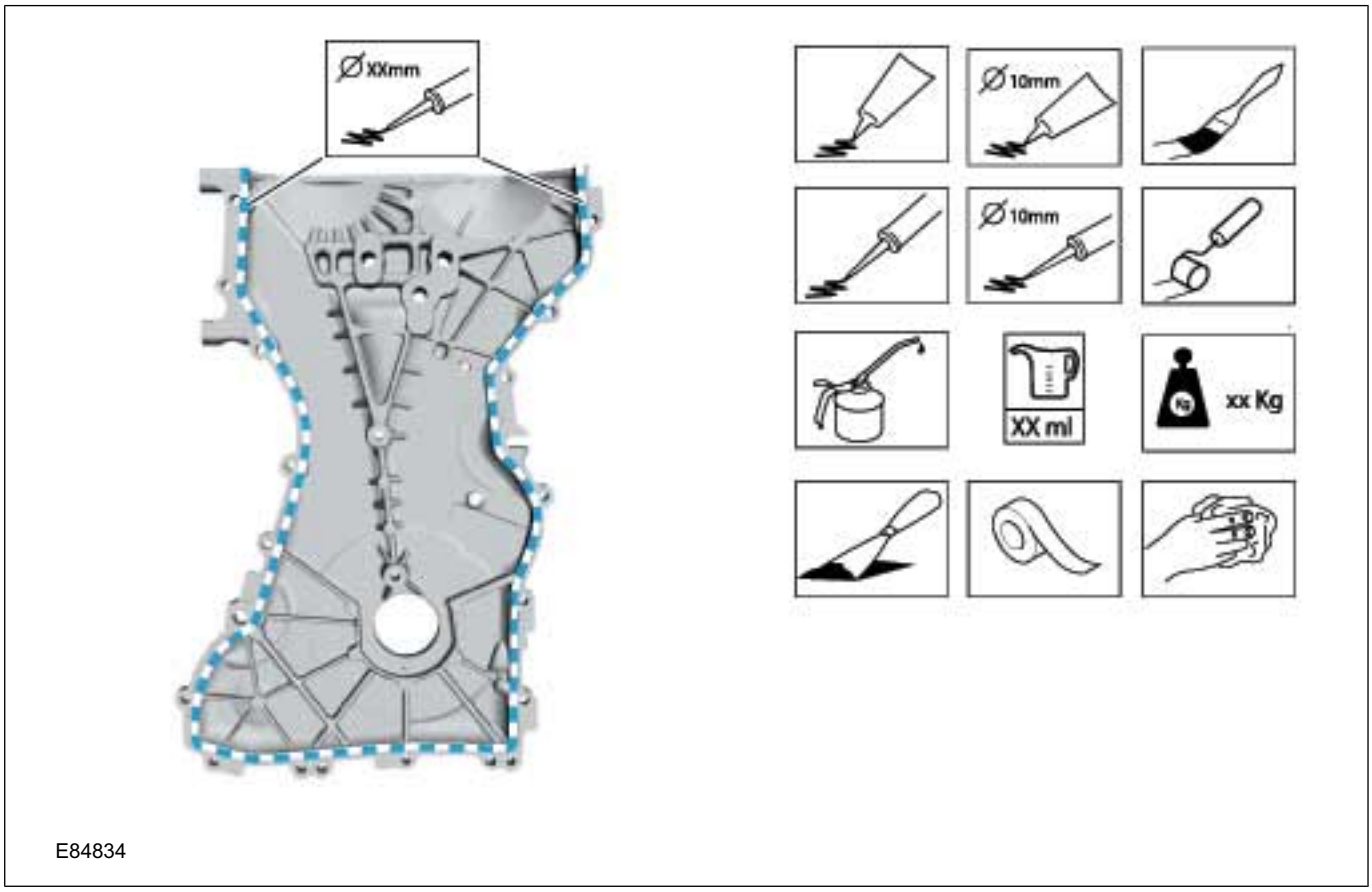


3. 

E85028

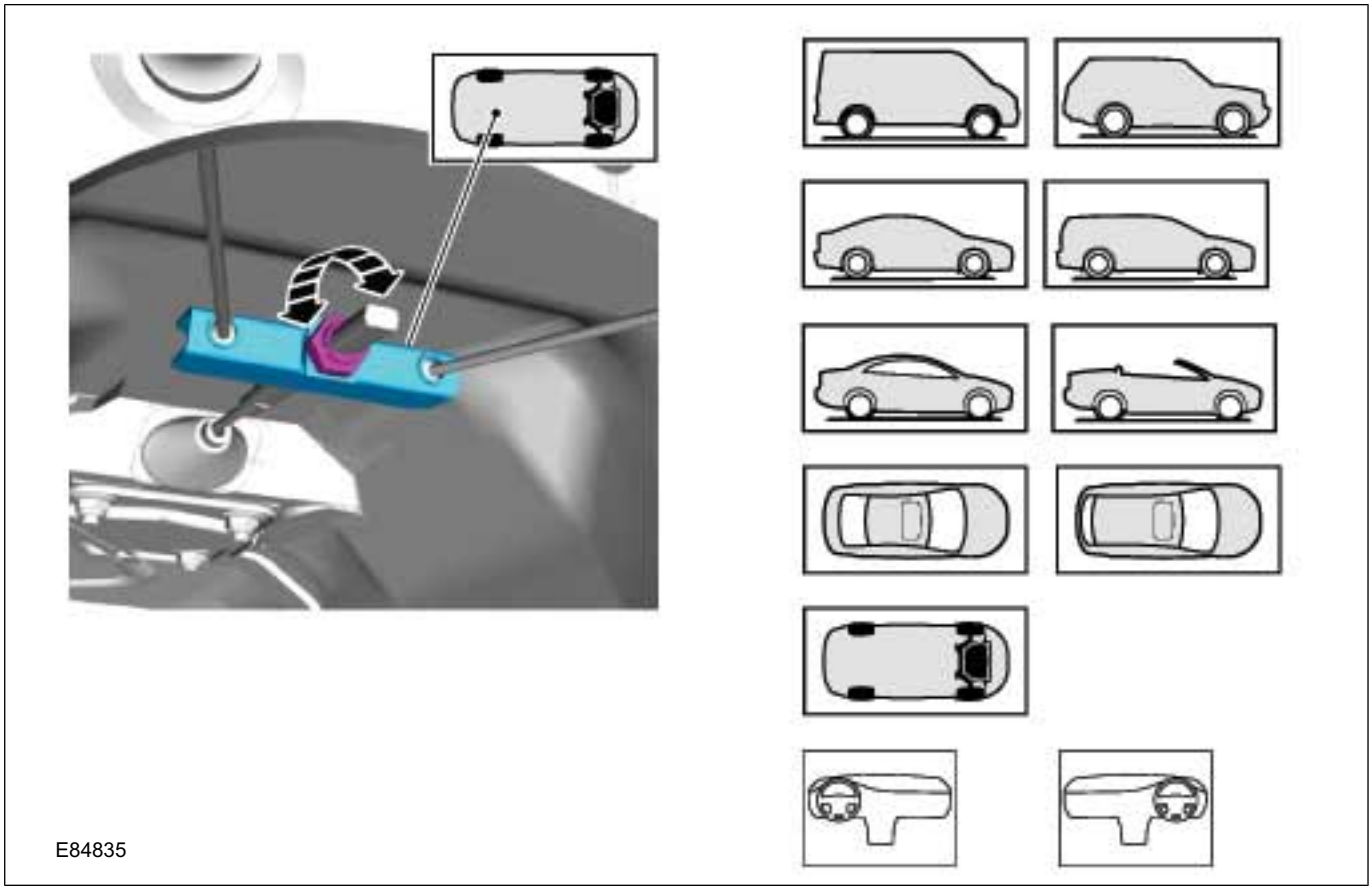
Instruction symbols are used to apply sealer, lubricant, weight, tape or cleaning detergent to a component.

DESCRIPTION AND OPERATION



E84834

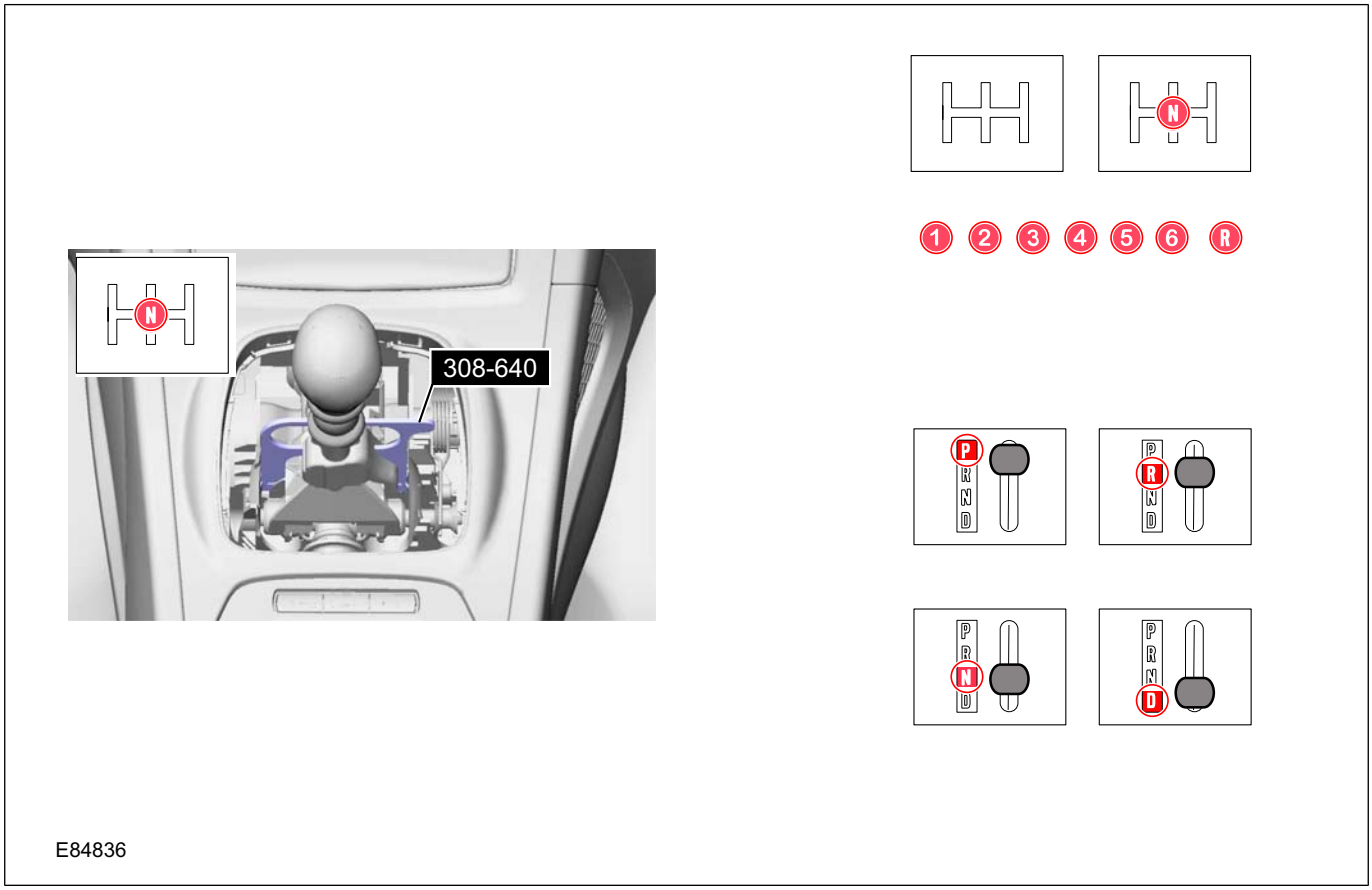
Location symbols are used to show the location of a component or system within the vehicle.



E84835

DESCRIPTION AND OPERATION

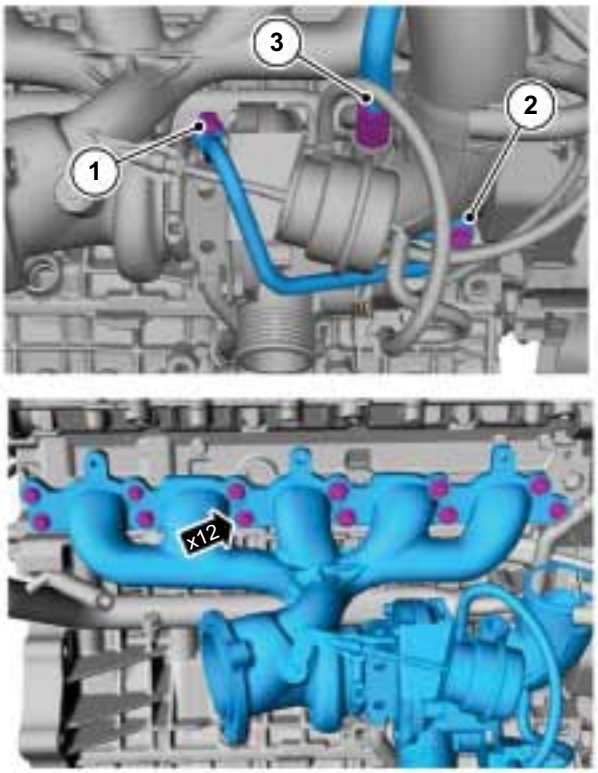
Gearshift lever or selector lever position symbols are used to show which gearshift lever or selector lever position is to be set.



E84836

Pointer symbols are used to draw the 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.

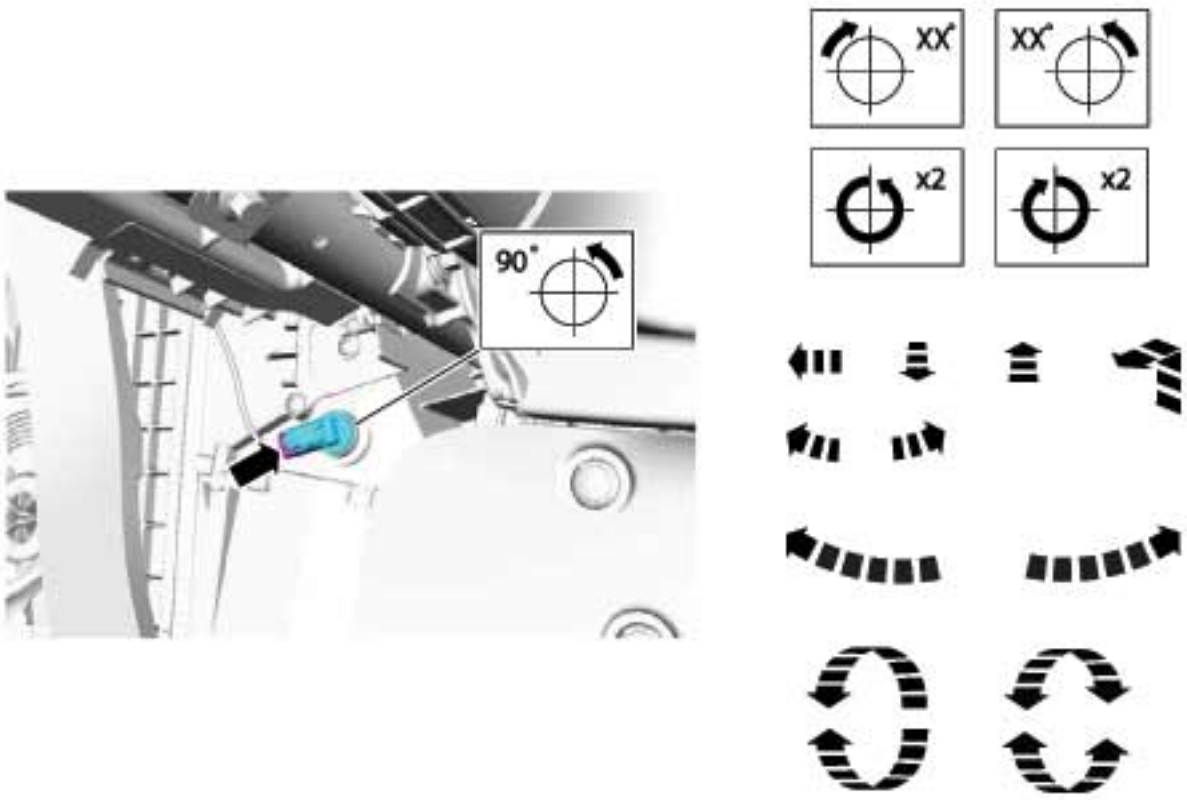
DESCRIPTION AND OPERATION



E84837

TO BE UPDATED LATER

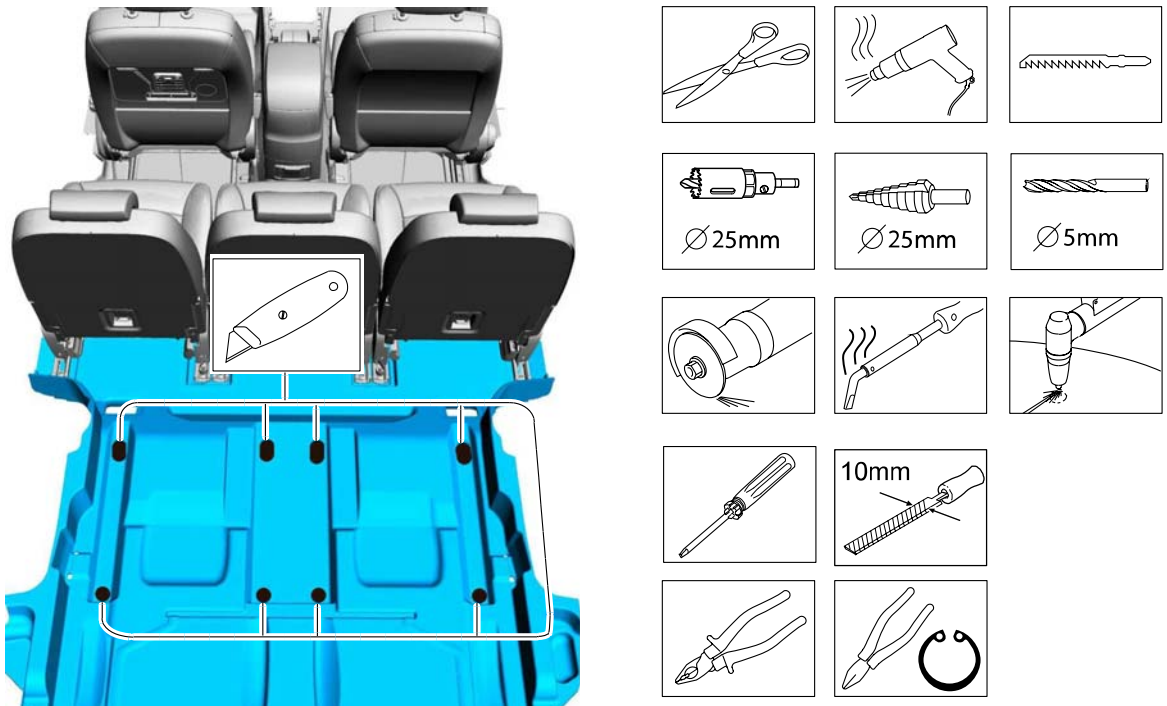
Movement arrows are used to show three dimensional or rotational movements. These movements can include specific values inside the symbol if required.



E84838

DESCRIPTION AND OPERATION

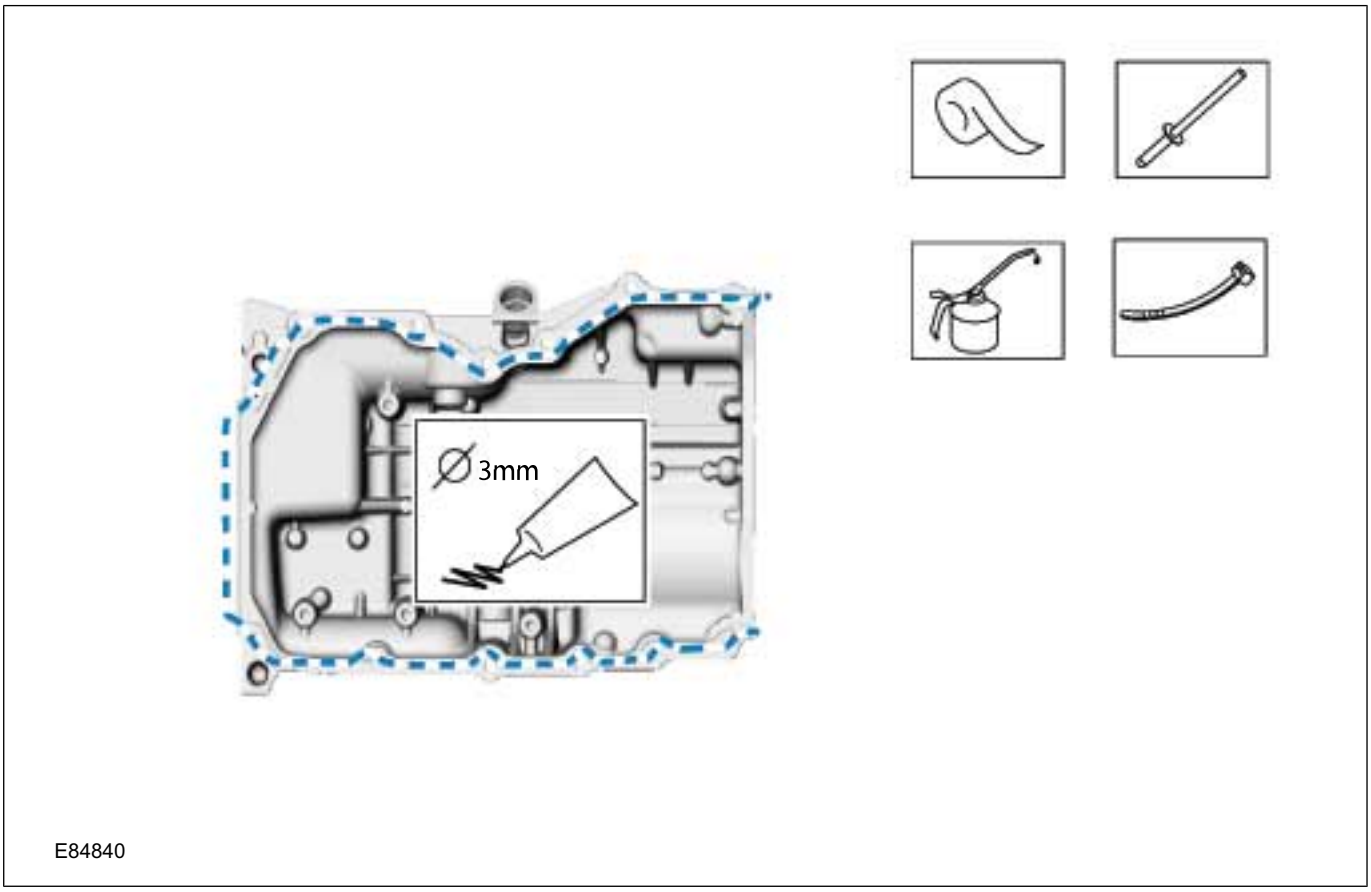
Standard tool symbols recommend the use of certain standard tools. These tools can include dimension values if required.



E84839

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

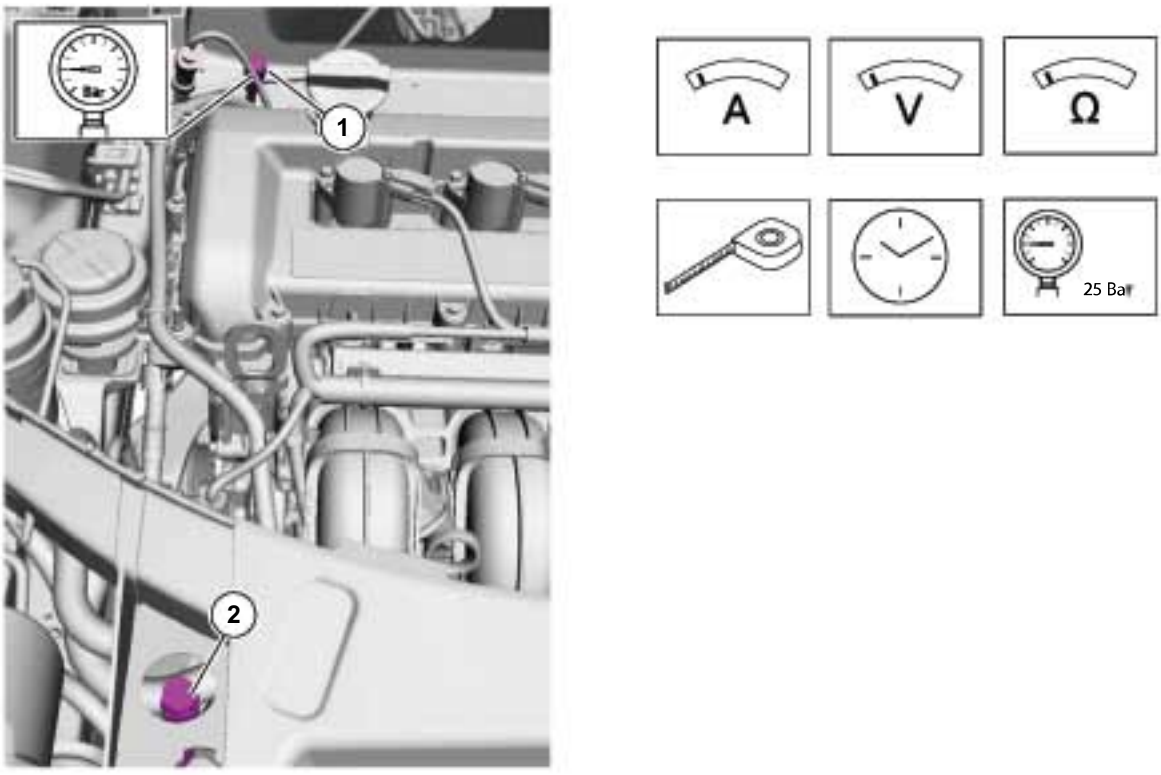
DESCRIPTION AND OPERATION



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

Special Tools and Torque Figure(s)

Special tools will be shown with the tool number in the illustration. The special tool number(s), general equipment, material(s) and torque figure(s) used for the procedure step will be shown in the text column.

How to Use This Manual - Diagnosis and Testing procedures

This manual covers diagnosis and testing, service and repair procedures.

This manual is structured into groups and sections, with specific system sections collected 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.

Pages at the start of the manual list all sections available. Each section has a contents list detailing Specifications, Description and Operation, Diagnosis and Testing, In Vehicle Repairs, Disassembly and Assembly, Removal and Installation.

If components need to be removed or disassembled in sequence, the sequence will be identified numerically in a graphic and the corresponding text will be numbered accordingly.

All left and right-hand references to the vehicle are taken from a position sitting in the driver seat looking forward.

All left and right-hand references to the engine are taken from a position at the flywheel looking towards the front camshaft pulley.

Where appropriate, instructions will be given for the use of the diagnostic tool.

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 performed.

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 performed 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.

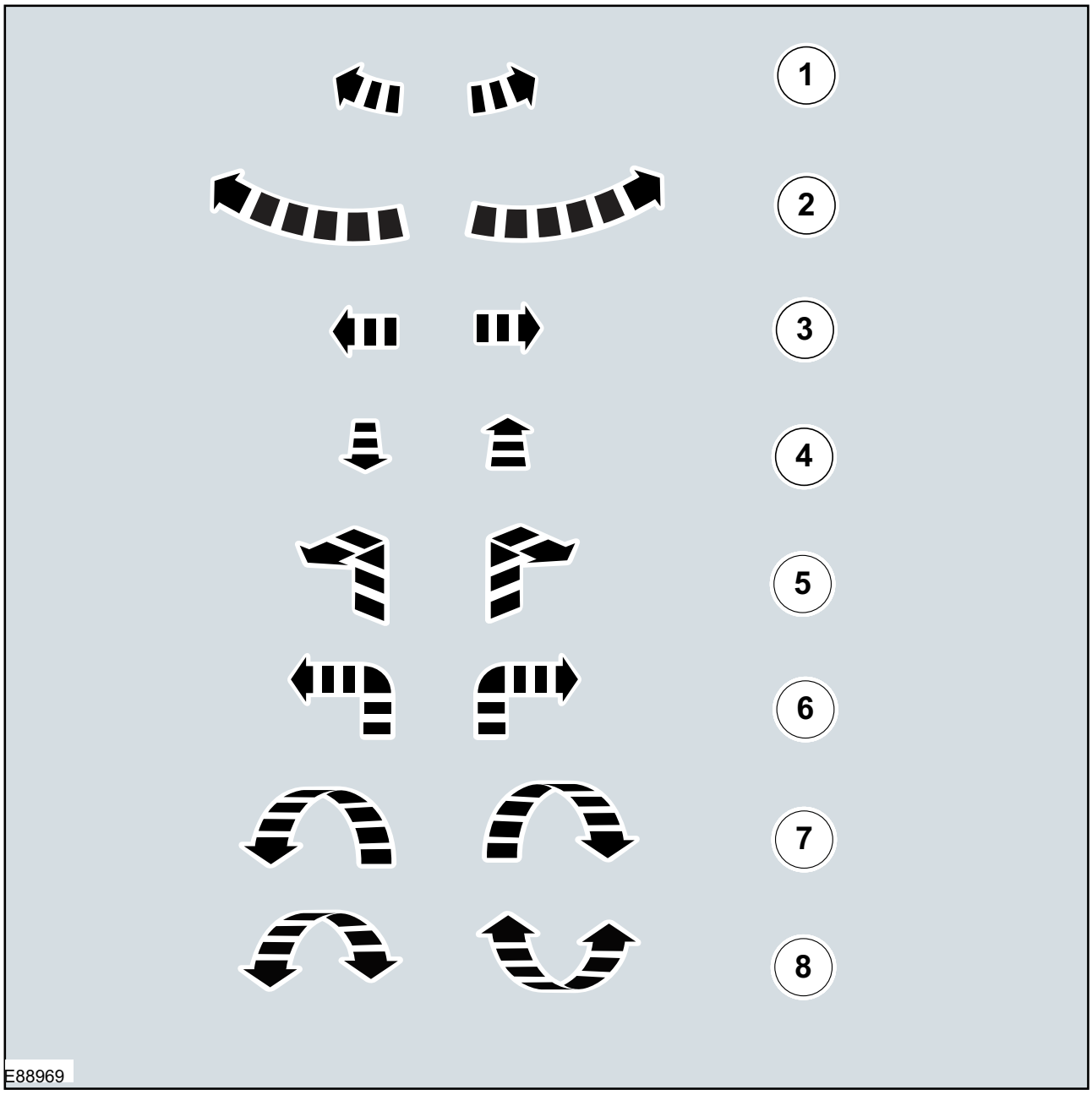
DESCRIPTION AND OPERATION

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.



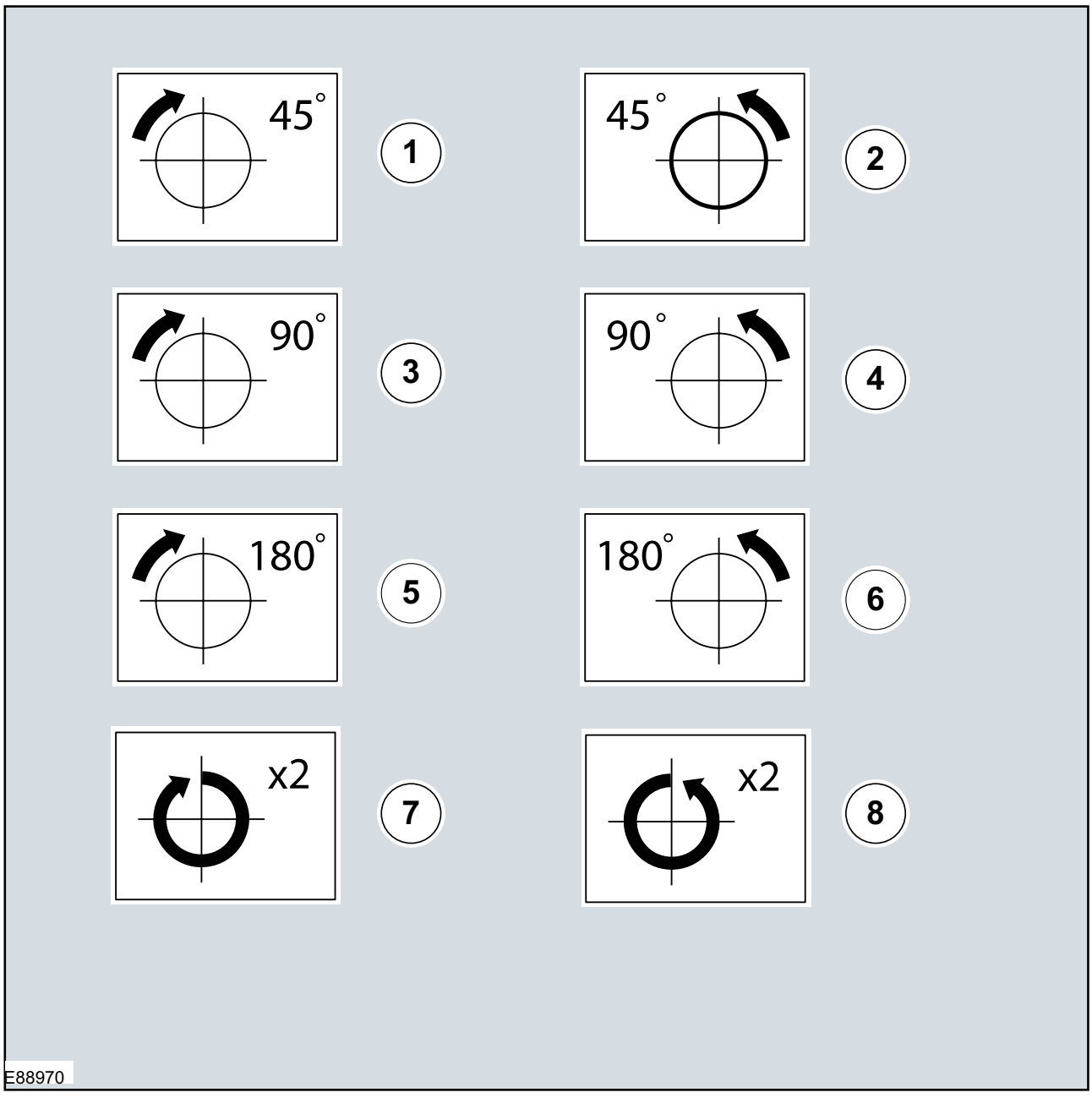
DESCRIPTION AND OPERATION

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.



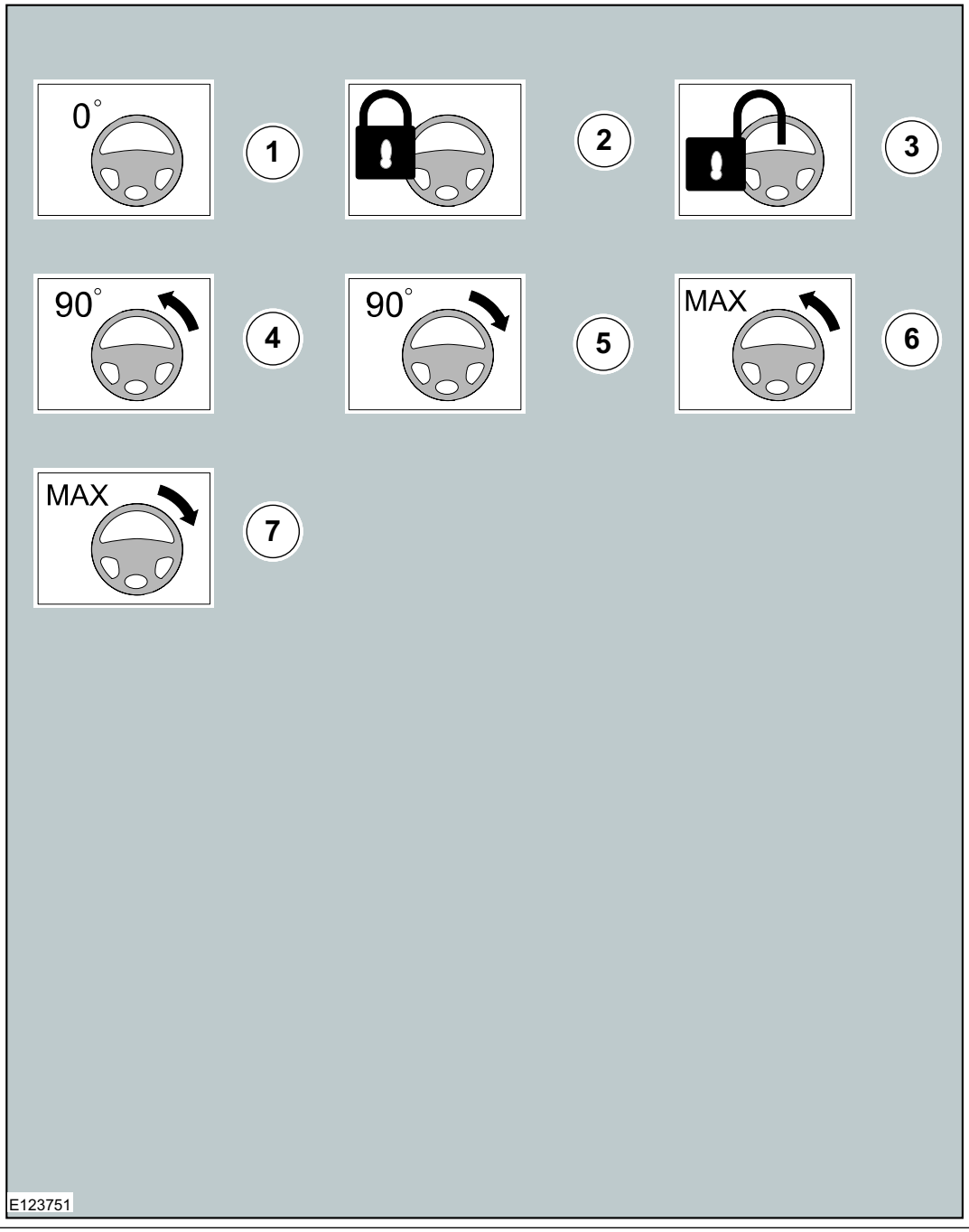
DESCRIPTION AND OPERATION

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

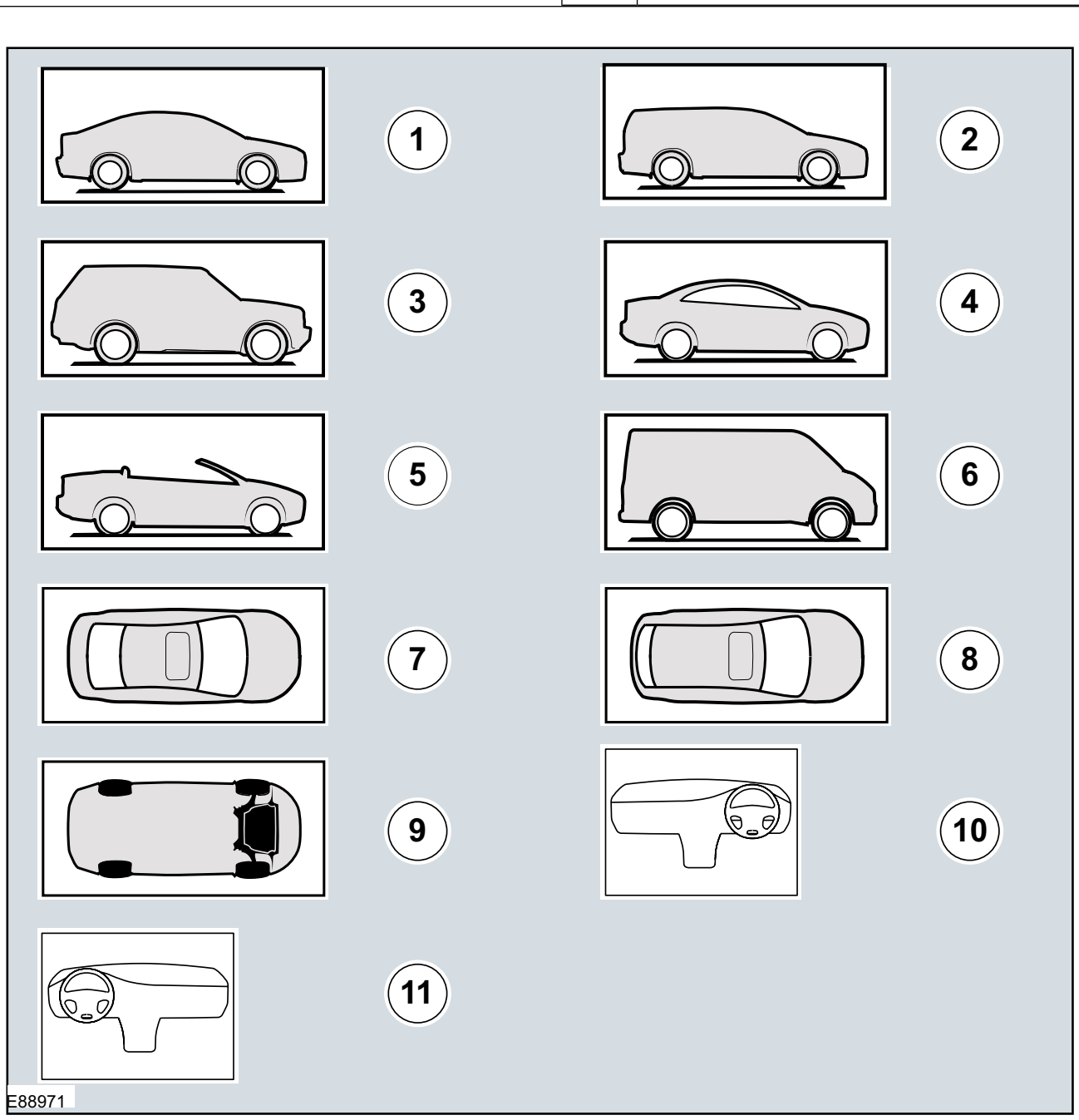
Steering wheel symbols are used to provide further information to a required steering wheel position or steering column lock status.



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



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

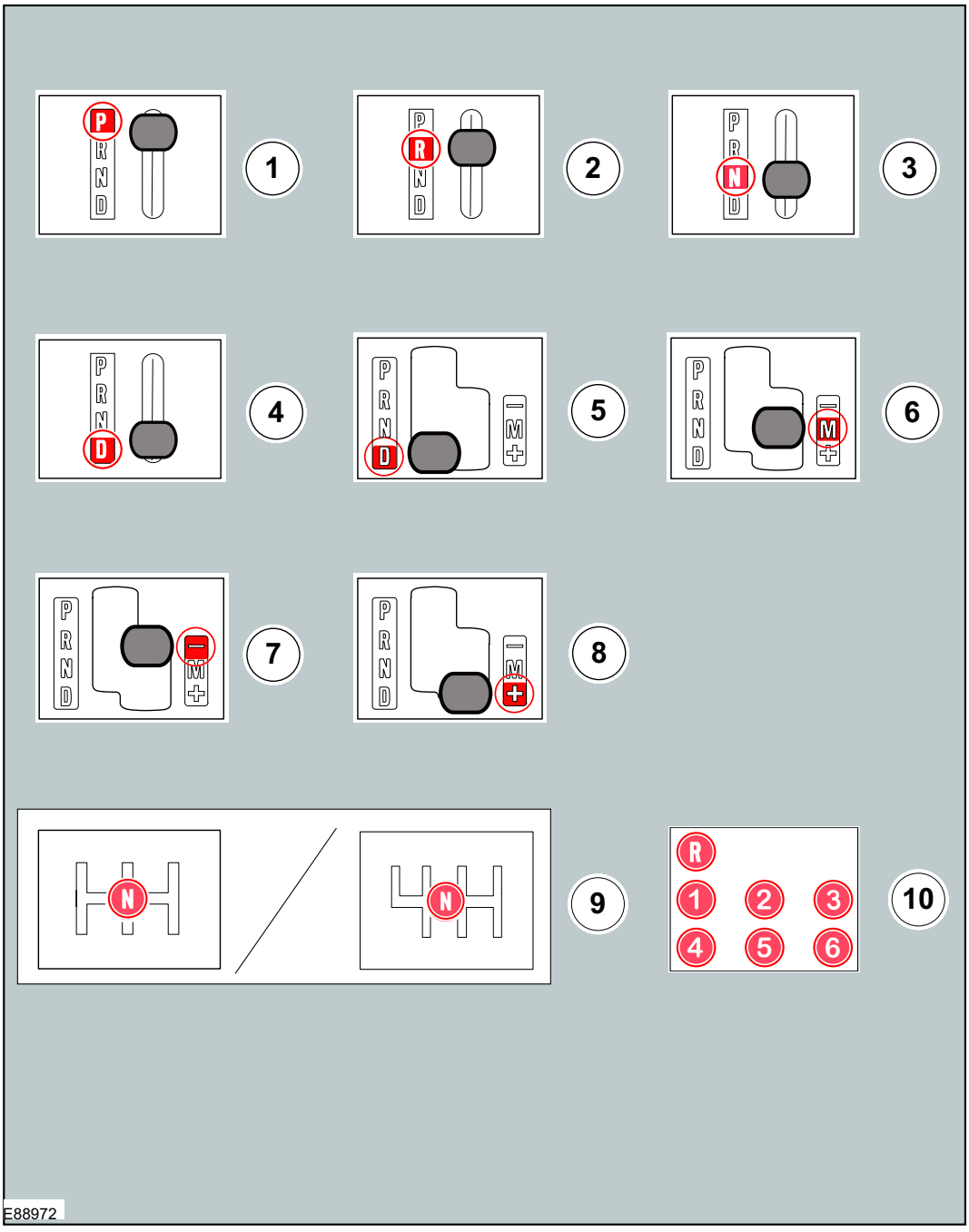
DESCRIPTION AND OPERATION

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.



DESCRIPTION AND OPERATION

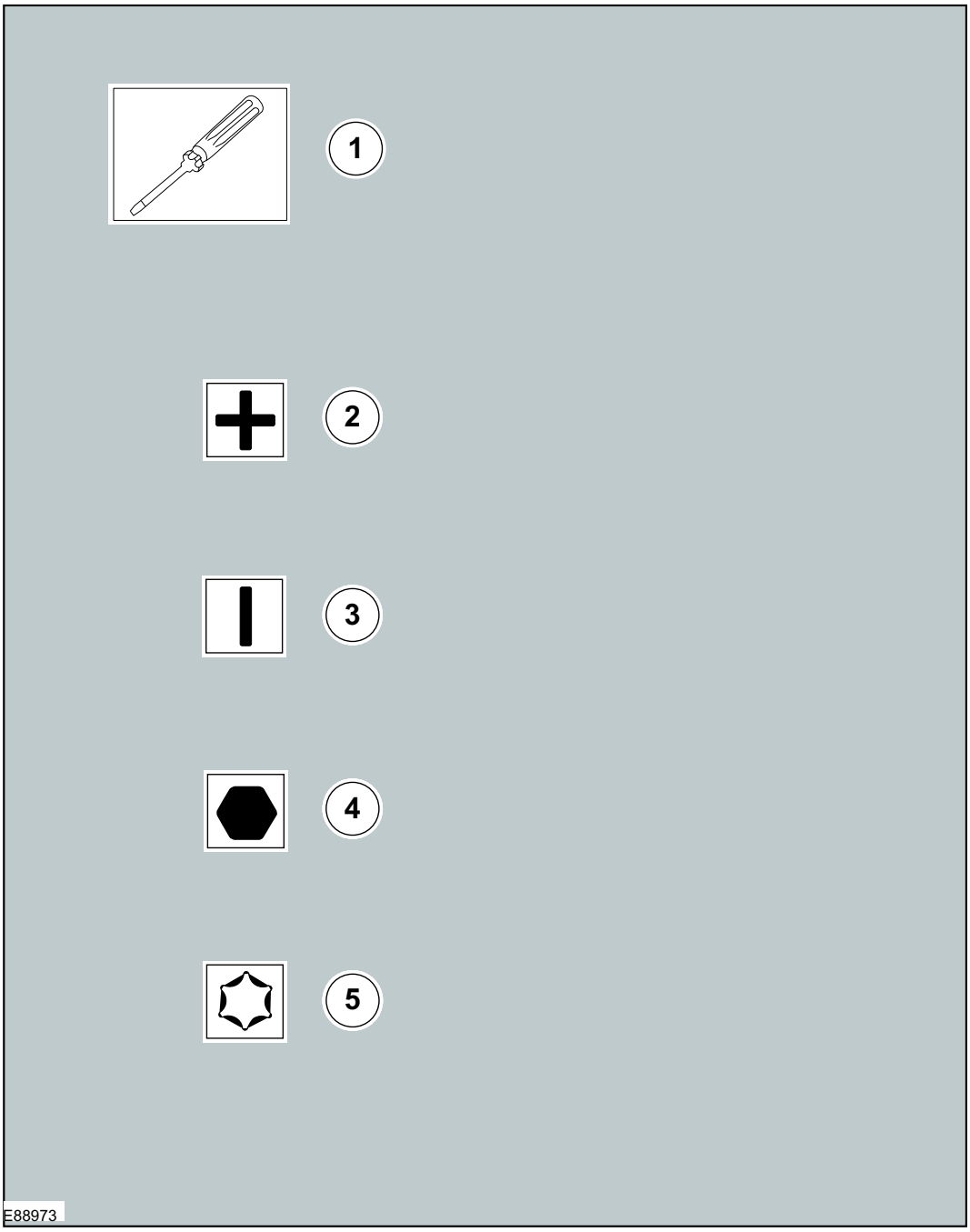
Item	Description
1	Set the selector lever to the park (P) position
2	Set the selector lever to the reverse (R) position
3	Set the selector lever to the neutral (N) position
4	Set the selector lever to the drive (D) position
5	Set the selector lever with manual shift pattern to the park (D) position
6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



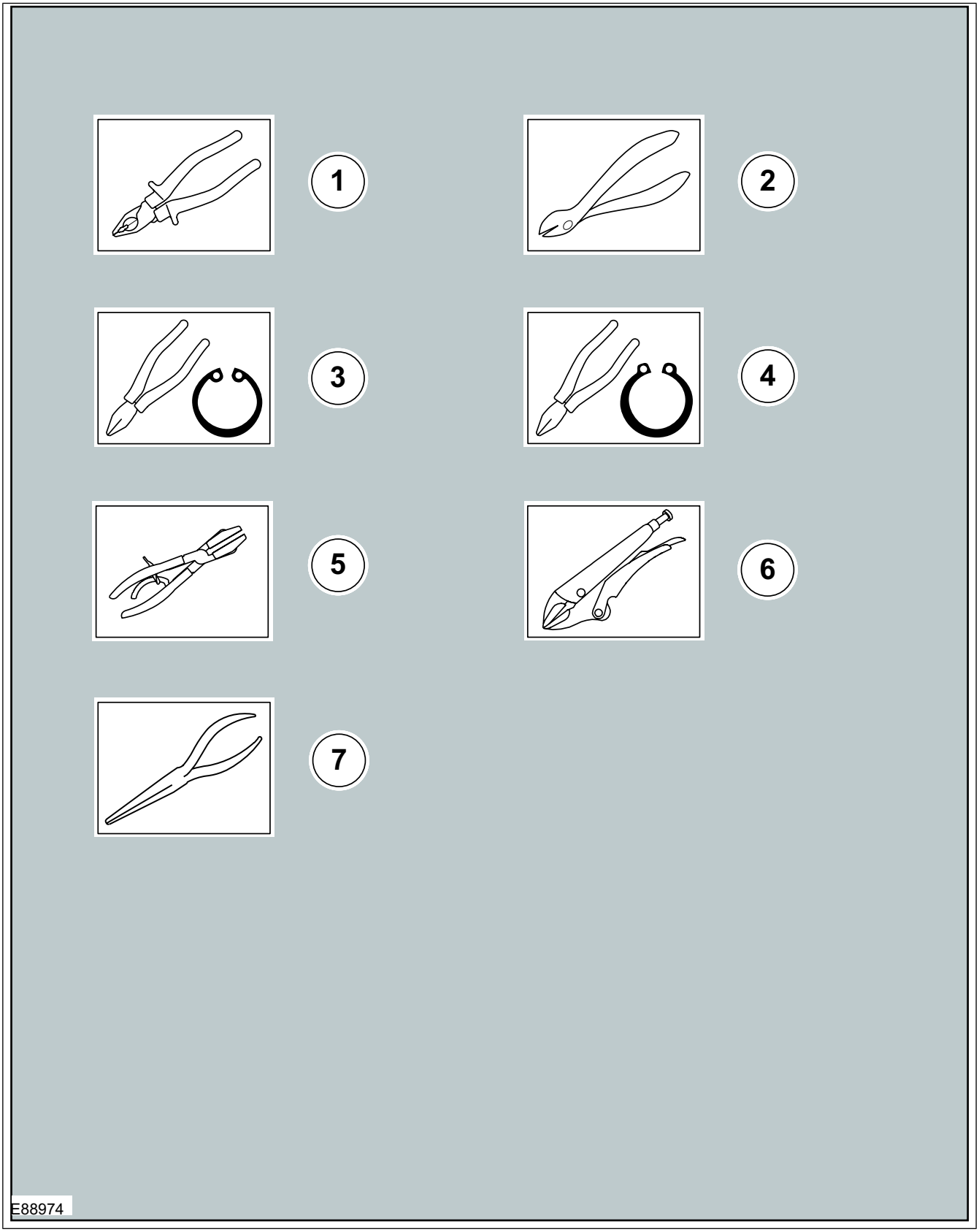
Item	Description
1	Screwdriver
2	Cross bladed screwdriver
3	Flat bladed screwdriver

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



Item	Description
1	Combination pliers
2	Side cutter pliers

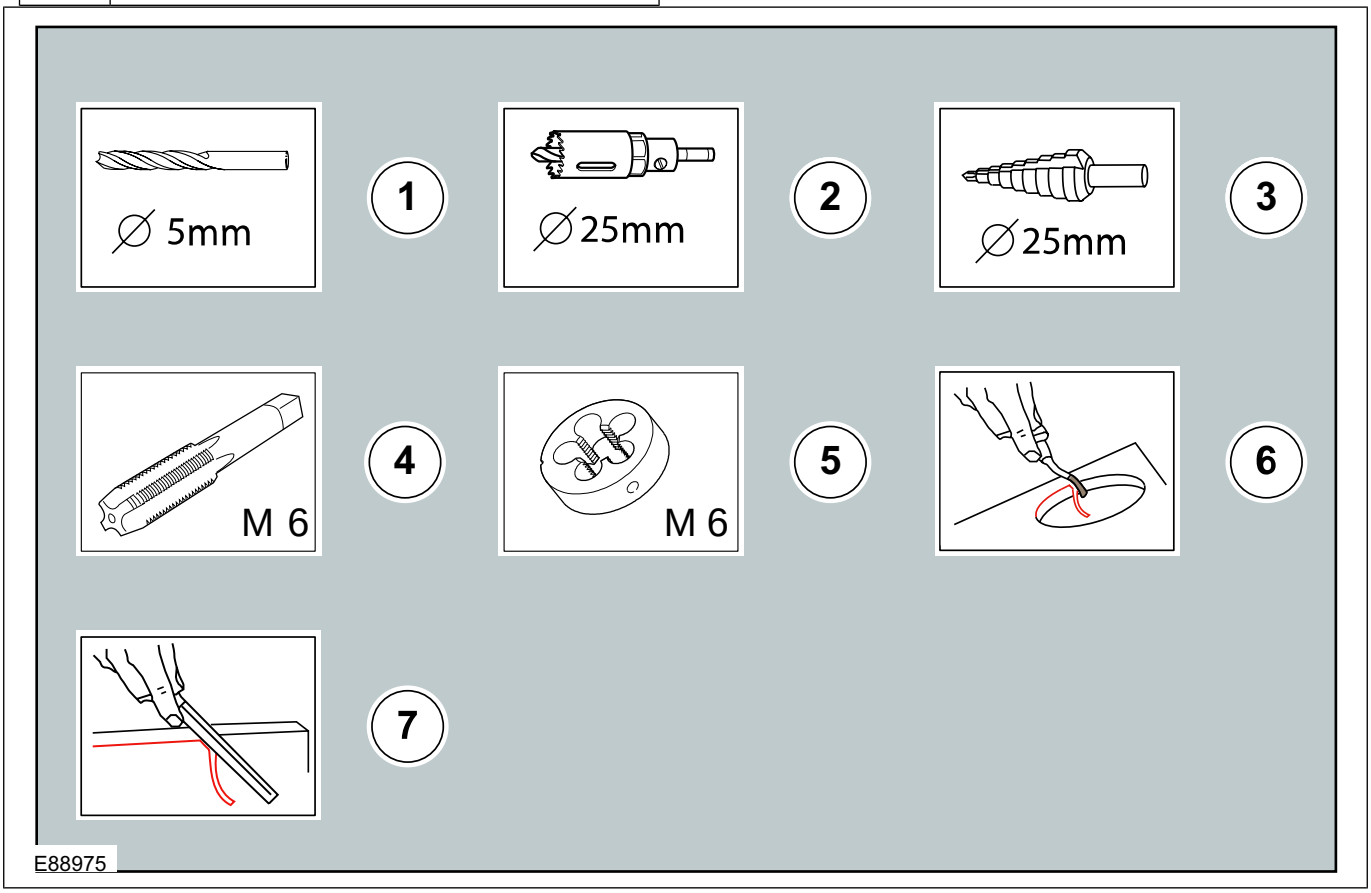
Item	Description
3	Securing ring pliers - inner
4	Securing ring pliers - outer

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.



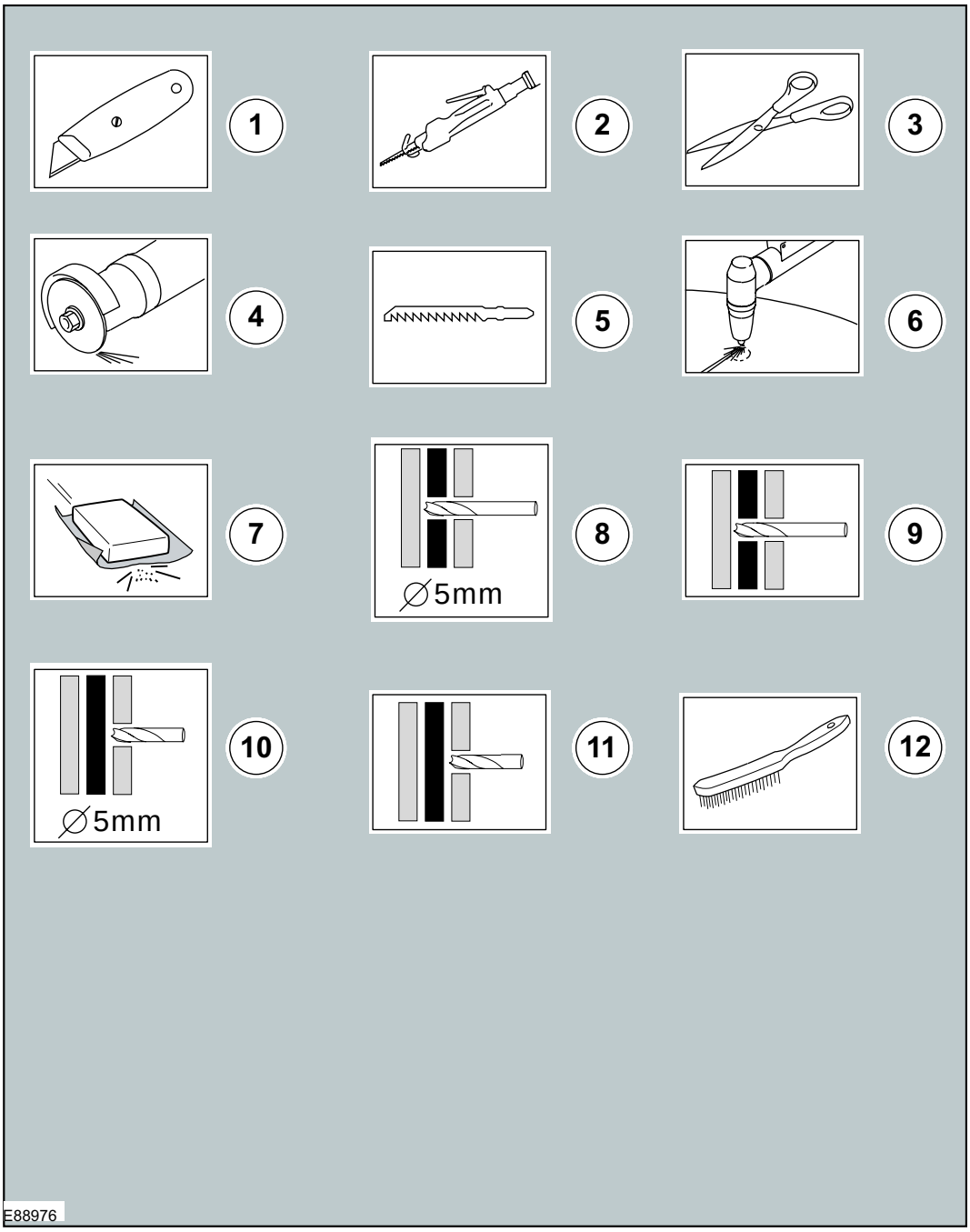
Item	Description
1	Drill bit with a specified diameter
2	Hole saw with a specified diameter
3	Stepped drill bit with a specified diameter
4	Tap with a specified diameter
5	Die with a specified diameter

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



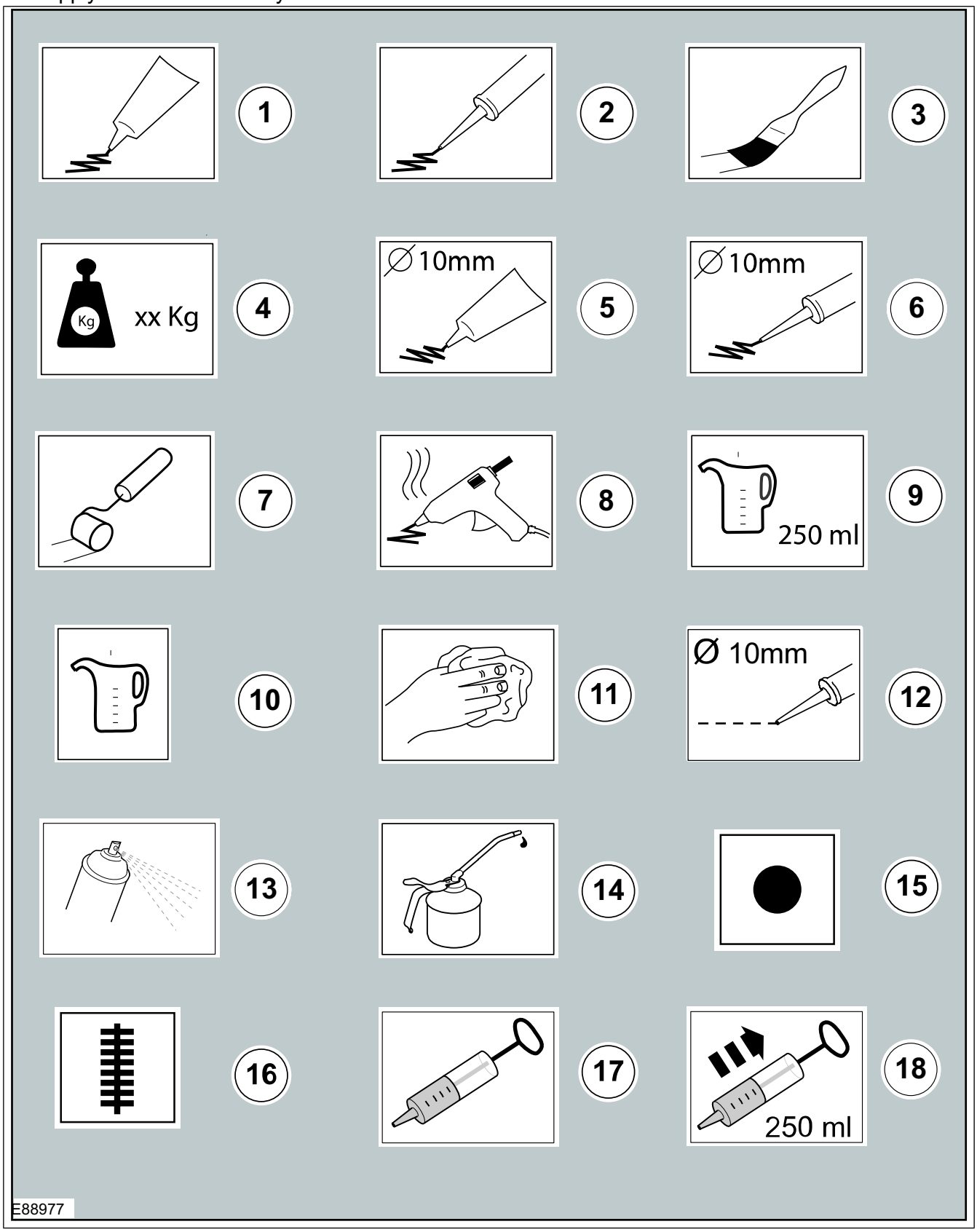
Item	Description
1	Cutting knife
2	Air body saw
3	Scissors
4	Grinder
5	Jig saw
6	Plasma cutter
7	Sanding Paper

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

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



DESCRIPTION AND OPERATION

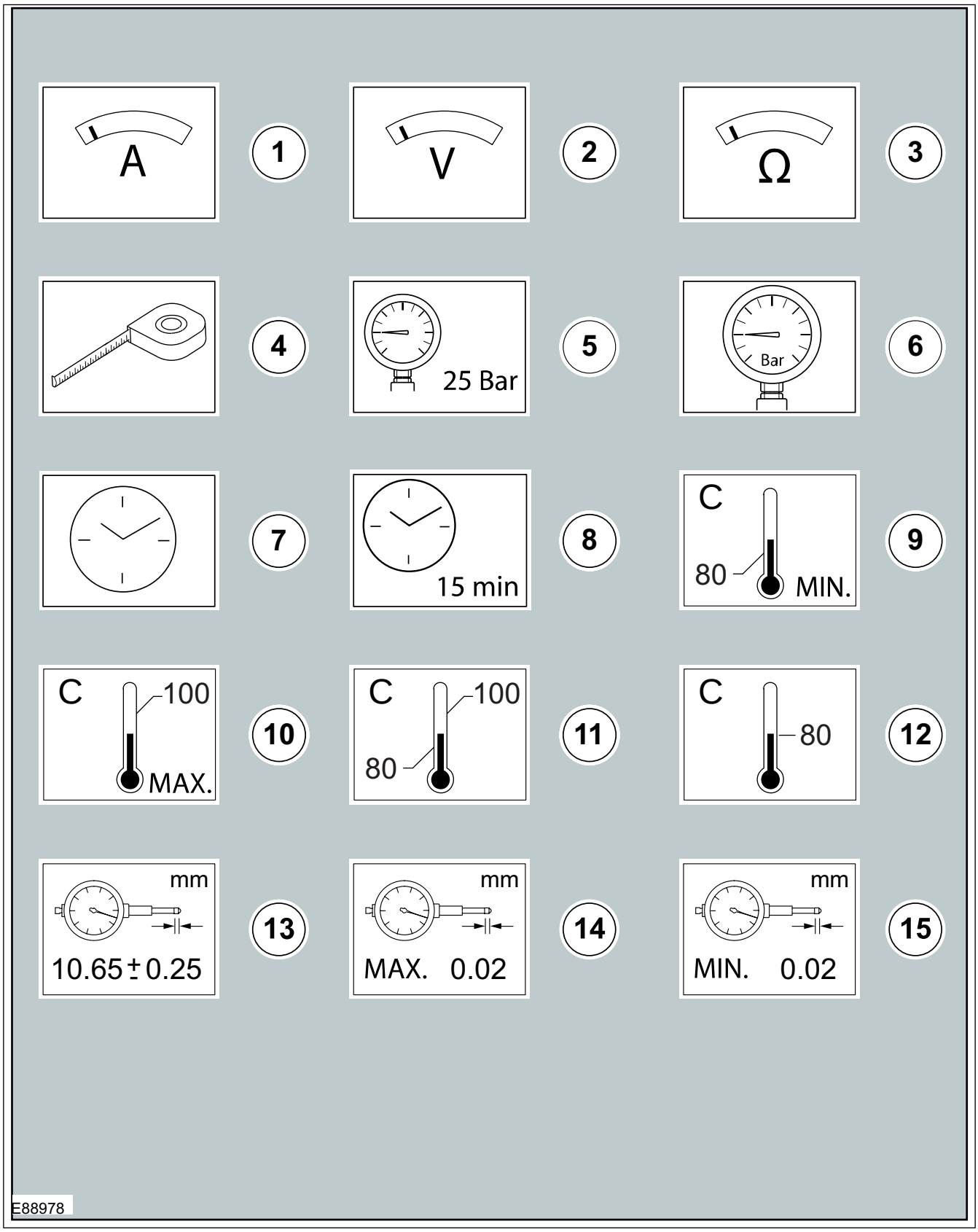
Item	Description
1	Apply the substance from the specified tube
2	Apply the substance from the specified cartridge
3	Apply the specified chemical with a brush
4	Apply the specified load to the specified component
5	Apply a bead with a specific diameter from the specified tube
6	Apply a bead with a specific 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



DESCRIPTION AND OPERATION

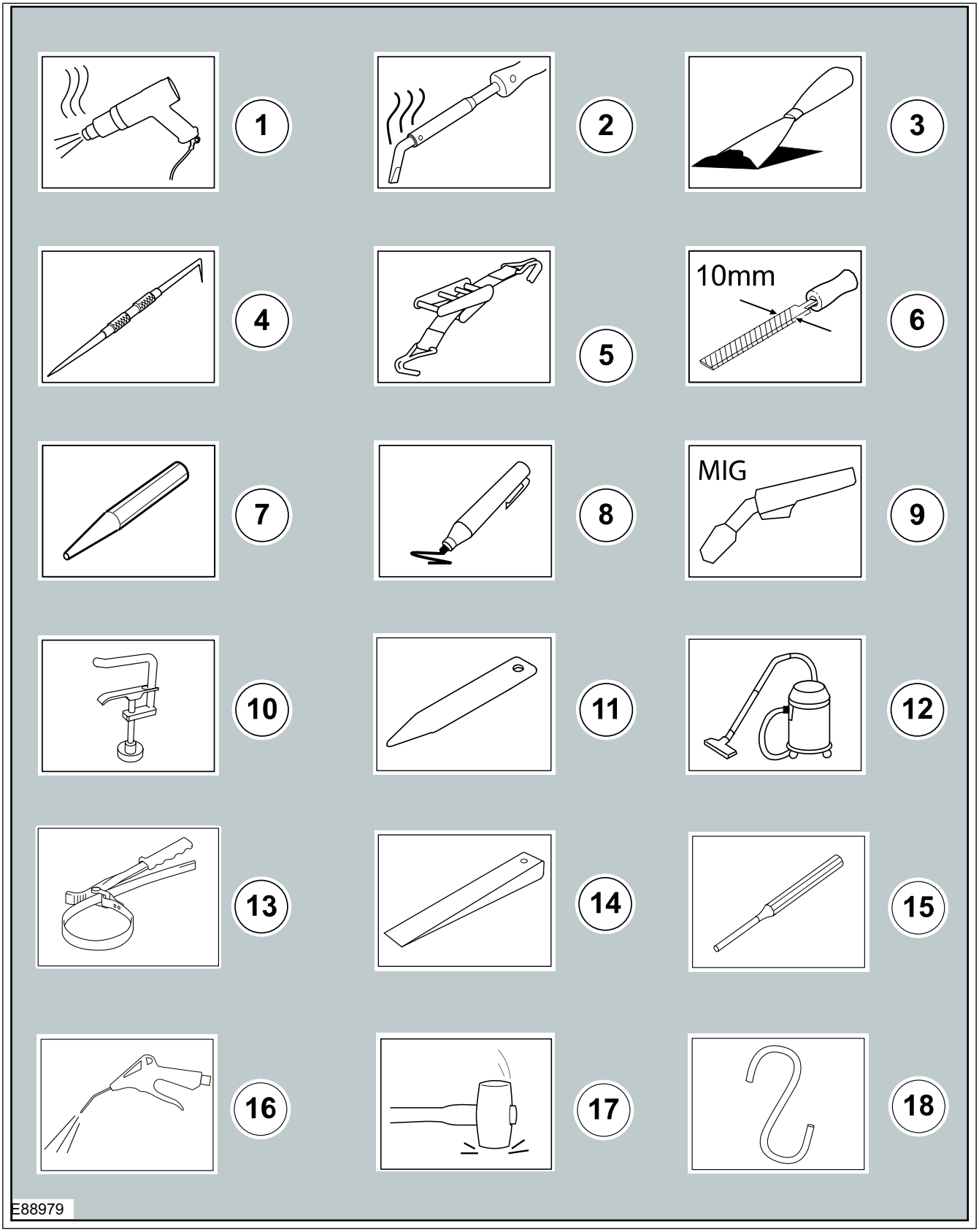
Item	Description
1	Measure the current using a digital multimeter
2	Measure the voltage using a digital multimeter
3	Measure the resistance using a digital multimeter
4	Measure the length/distance
5	Check that the specified pressure is available using a suitable pressure gauge
6	Measure the pressure 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	Hot air gun
2	Soldering iron

Item	Description
3	Scraper
4	Scriber

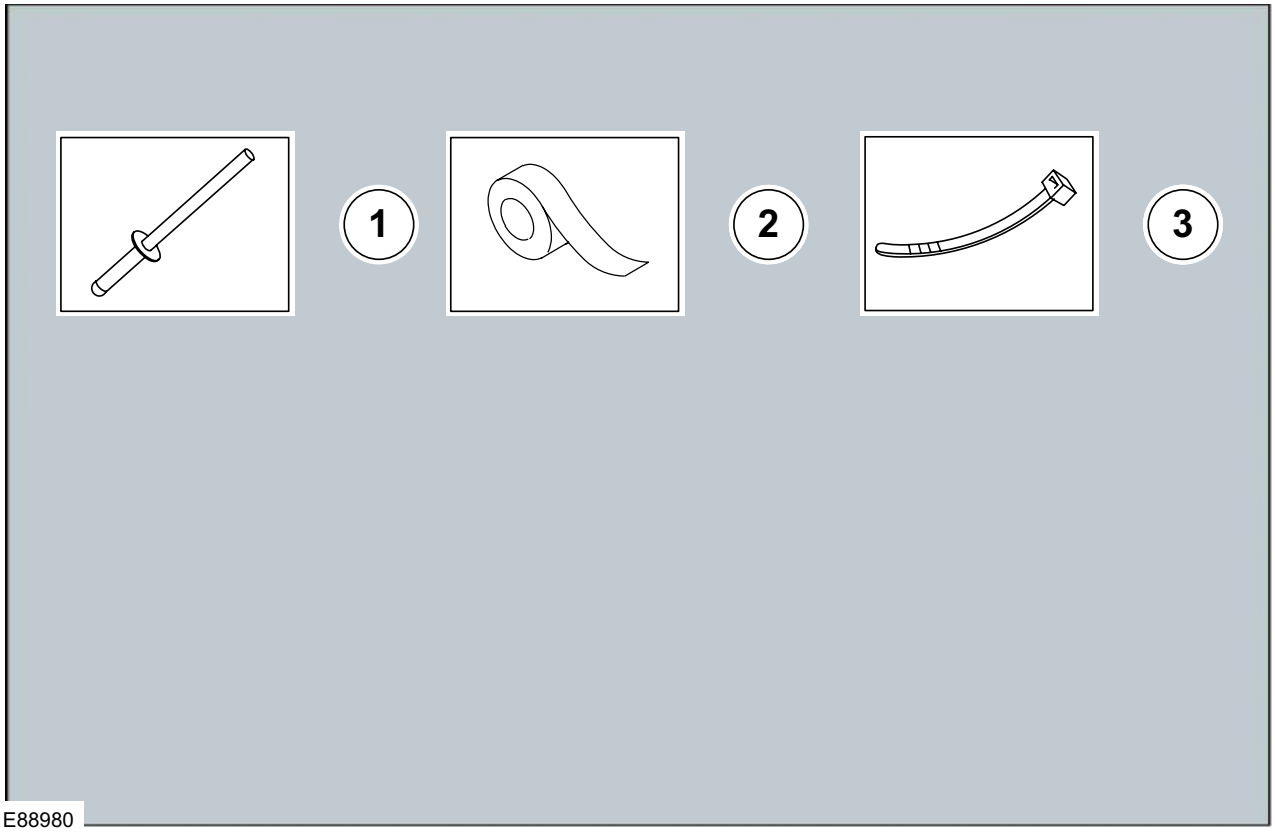
DESCRIPTION AND OPERATION

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.

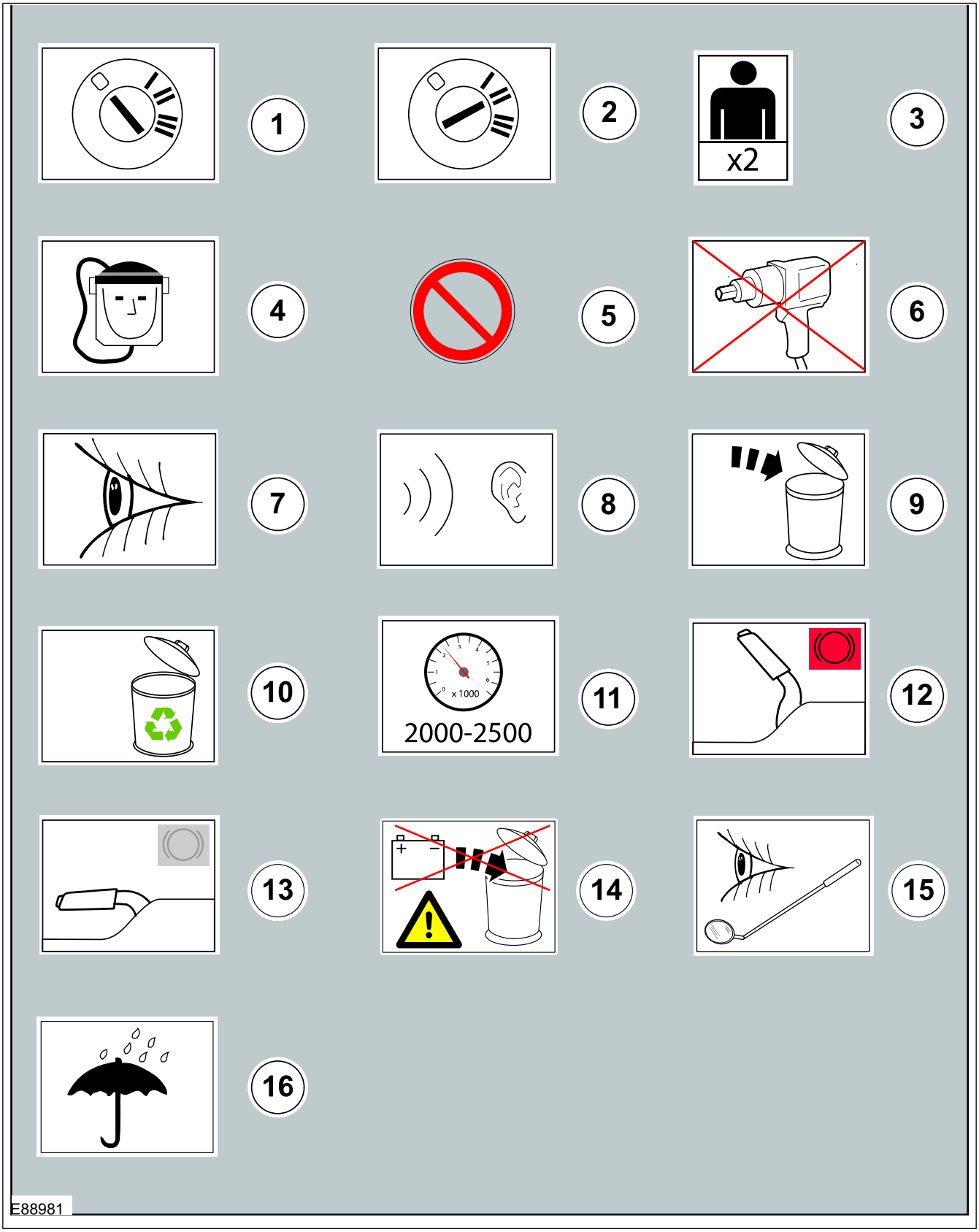


Item	Description
1	Remove/Install the specified blind rivet
2	Apply tape to the specified component/area
3	Remove/Install the specified cable tie

Miscellaneous symbols

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

DESCRIPTION AND OPERATION



Item	Description
1	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

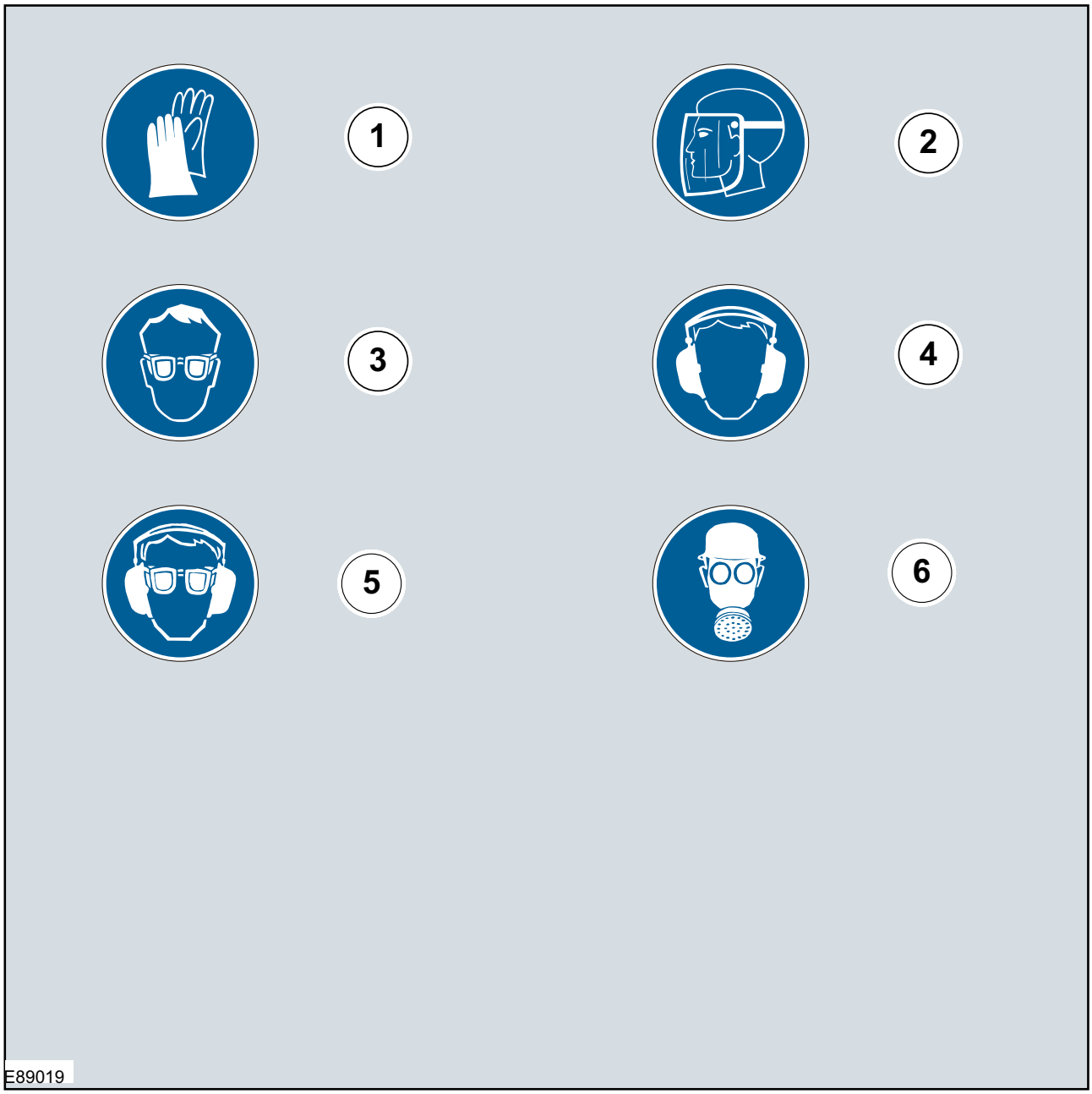
Item	Description
4	Self contained breathing apparatus
5	General prohibition used in combination with another symbol
6	Do not use power tools
7	Visual check
8	Noise check
9	Dispose the specified component
10	Replaced by item 9 (Dispose the specified component)
11	Set the engine speed to the specified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

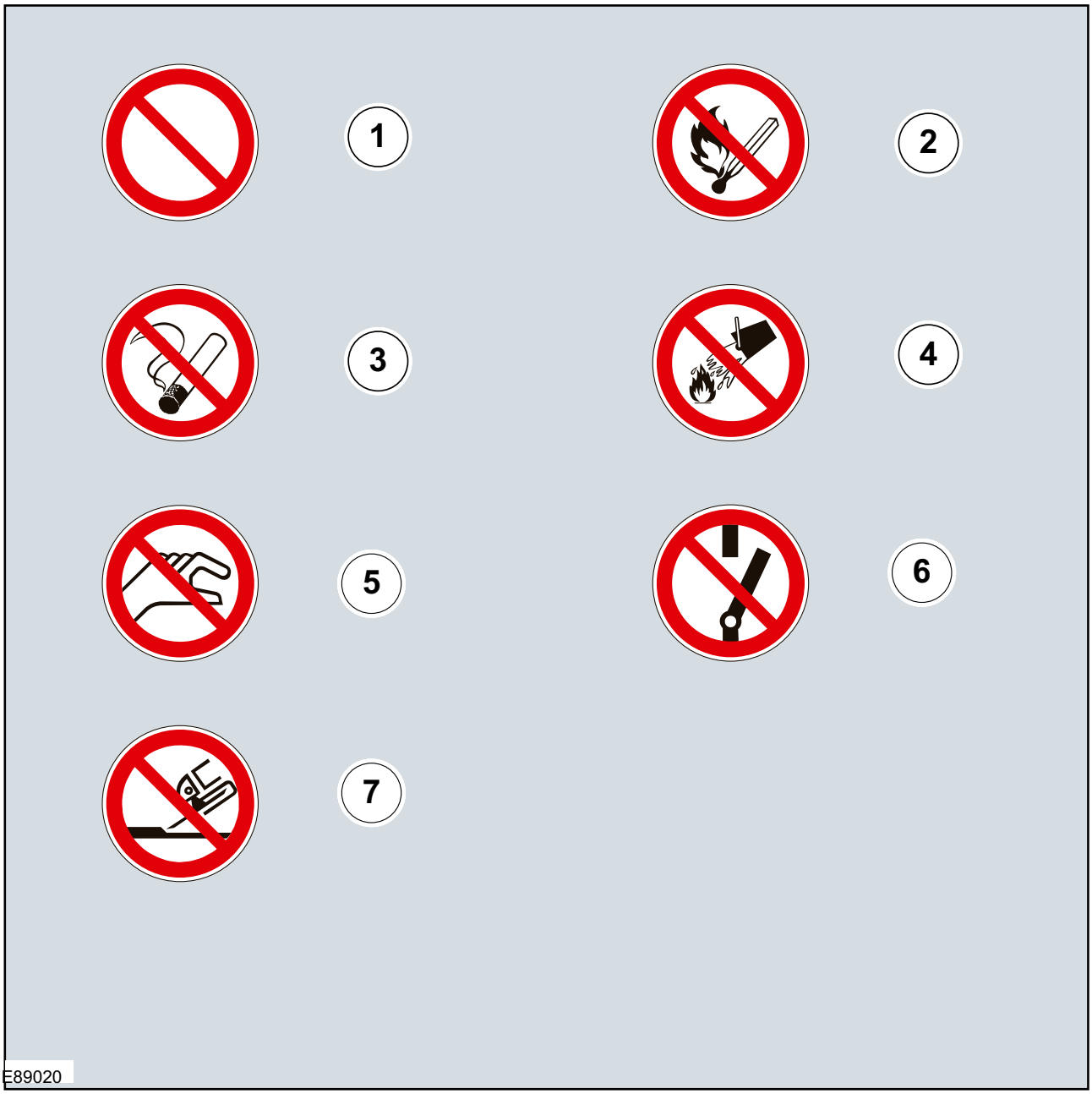


Item	Description
1	Wear protective gloves
2	Wear face guard
3	Wear safety goggles
4	Wear ear protectors
5	Wear safety goggles and ear protectors
6	Wear a respirator

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



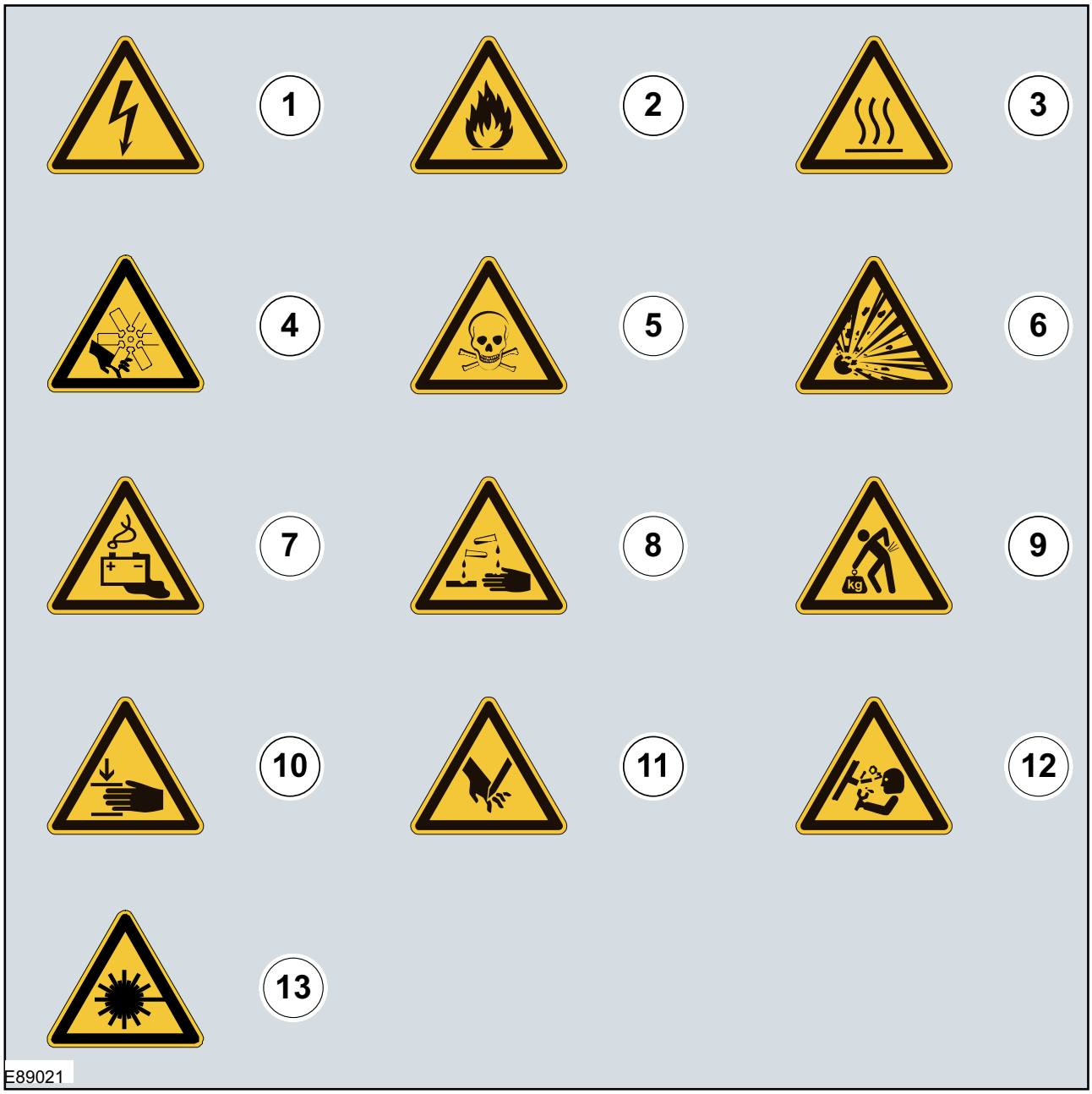
Item	Description
1	General prohibition symbol
2	No naked flames
3	No smoking
4	No water
5	Do not touch

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



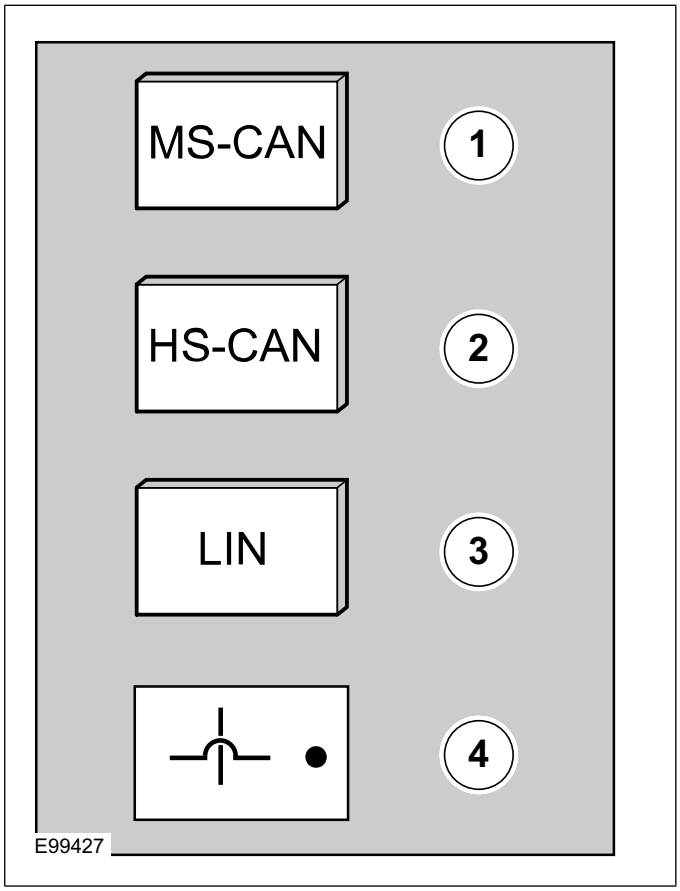
Item	Description
1	Hazardous voltage/Electrical shock/Electrocution
2	Fire Hazard/Highly flammable
3	Burn hazard/Hot surface
4	Automatic start-up
5	Toxic
6	Explosive material
7	Battery hazard

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

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.

Following any direct contact with gas generant.

- wash affected areas thoroughly with water.
- seek medical assistance if necessary.

Air Bags - Do's

- Do store modules in an upright position.
- Do keep modules dry.
- Do carry modules with the cover side pointing away from the body.
- Do place modules with their cover side upwards.
- Do carefully inspect modules for damage.
- Do stand to one side when connecting modules.
- Do make sure all test equipment is properly calibrated and maintained.
- Do wash hands after handling deployed air bags.

Air Bags - Do Nots

- Do not store highly flammable material together with modules or gas generators.
- Do not store gas generators at temperatures exceeding 80°C.
- Do not store modules upside down.
- Do not attempt to open a gas generator housing.
- Do not expose gas generators to open flame or sources of heat.
- Do not place anything on top of a module cover.
- Do not use damaged modules.
- Do not touch a fired module or gas generator for at least 10 minutes.
- Do not use any electrical probes on the wiring circuit.

Air Conditioning Refrigerant

See also Chlorofluorocarbon, Chemical Materials

Highly flammable, combustible – observe No Smoking policy.

DESCRIPTION AND OPERATION

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.

Air Conditioning Refrigerant - Do Nots

- Do not expose refrigerant bottles to sunlight or heat.
- Do not stand refrigerant bottles upright; when filling, hold them with the valve downwards.
- Do not expose refrigerant bottles to frost.
- Do not drop refrigerant bottles.
- Do not vent refrigerant to atmosphere under any circumstance.
- Do not mix refrigerants, for example R12 (Freon) and R134a.

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.

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.

Vapors may be given off from coolant antifreeze (glycol) when heated. Avoid breathing these vapors.

Antifreeze may be absorbed through the skin in toxic or harmful quantities. Antifreeze, if swallowed, can be fatal and MEDICAL ATTENTION SHOULD BE SOUGHT IMMEDIATELY.

These products must not be used in any cooling or industrial water system that is connected or linked to general, food preparation or drinking water supplies.

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.

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.

Gases released during charging are explosive. Never use naked flames or allow sparks near charging or recently charged batteries.

Make sure there is adequate ventilation.

Brake and Clutch Linings and Pads

See Asbestos.

Brake Fluids (Polyalkylene Glycols)

See also Fire.

Splashes to the skin and eyes are slightly irritating. Avoid skin and eye contact as far as possible. Inhalation vapor hazards do not arise at ambient temperatures because of the very low vapor pressure.

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

DESCRIPTION AND OPERATION

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 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).

DESCRIPTION AND OPERATION

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.

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.

DESCRIPTION AND OPERATION

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 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.

Swallowing can result in mouth and throat irritation and absorption from the stomach can result in drowsiness and unconsciousness. Small amounts can be fatal to children. Aspiration of liquid into the lungs, through vomiting, is a very serious hazard.

Gasoline dries the skin and can cause irritation and dermatitis on prolonged or repeated contact. Liquid in the eye causes severe smarting.

Motor gasoline may contain appreciable quantities of benzene, which is toxic upon inhalation, and the concentration of gasoline vapors must be kept very low. High concentrations will cause eye, nose and throat irritation, nausea, headache, depression and symptoms of drunkenness. Very high concentrations will result in rapid loss of consciousness.

Make sure there is adequate ventilation when handling and using gasoline. Great care must be taken to avoid the serious consequences of inhalation in the event of vapor build up arising from spillages in confined spaces.

Special precautions apply to cleaning and maintenance operations on gasoline storage tanks.

Gasoline should not be used as a cleaning agent. It must not be siphoned by mouth. See First Aid.

Gas-oil (Diesel Fuel)

Combustible.

DESCRIPTION AND OPERATION

Gross or prolonged skin contact with high boiling point gas oils may also cause serious skin disorders including skin cancer.

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.

Alternative Fuel

Highly flammable. Observe ``NO SMOKING" signs.

Make sure there is adequate ventilation when working on alternative fuelled vehicles. Great care must be taken to avoid the serious consequences of inhalation in the event of vapor build up in confined spaces.

Inhalation in high concentrations may cause dizziness, headache, nausea and loss of co-ordination. Very high concentrations may result in loss of consciousness.

Contact with liquefied petroleum gas (LPG) or compressed natural gas (CNG) to the skin may cause cold burns and frost bite.

Long sleeved cotton overalls, steel toe capped safety boots and rubber neoprene gloves should be worn during removal and installation of LPG/CNG fuel system components.

LPG/CNG fuel leaks could cause a fire and be a hazard to health that can lead to personal injury, illness or even death.

If a leak is detected, under no circumstances attempt to seal the leak by tightening the union/connection until the fuel in the system or component is depressurized. Once tightened the system should be checked for integrity following the specified procedures.

If the fuel tank is to be removed for service or repair the fuel must be evacuated using dedicated equipment and following the specified procedures.

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.

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

DESCRIPTION AND OPERATION

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.

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.

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.

DESCRIPTION AND OPERATION

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.

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.

DESCRIPTION AND OPERATION

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'.

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.

DESCRIPTION AND OPERATION

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.

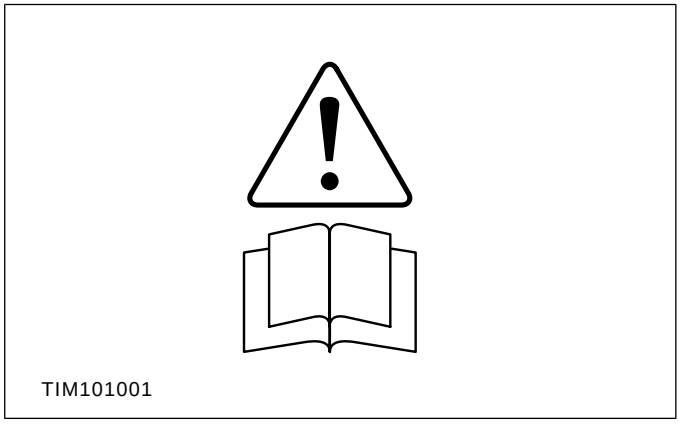
SPECIAL PRECAUTIONS MUST BE TAKEN BEFORE ANY WELDING OR CUTTING TAKES PLACE ON VESSELS, WHICH HAVE CONTAINED COMBUSTIBLE MATERIALS, FOR EXAMPLE BOILING OR STEAMING OUT OF FUEL TANKS.

Warning Symbols on Vehicles

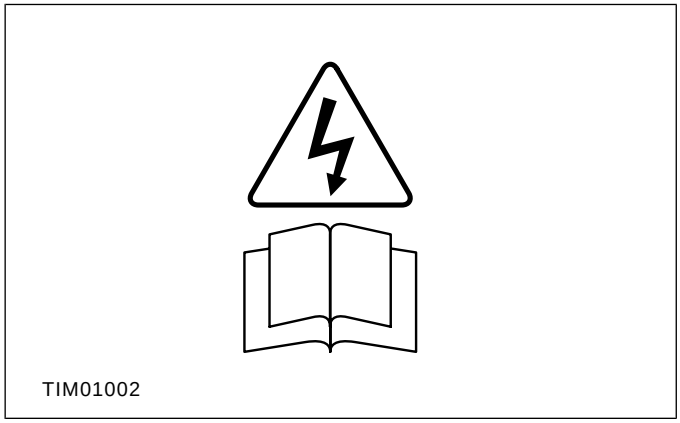
Decals showing warning symbols will be found on various vehicle components.

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.

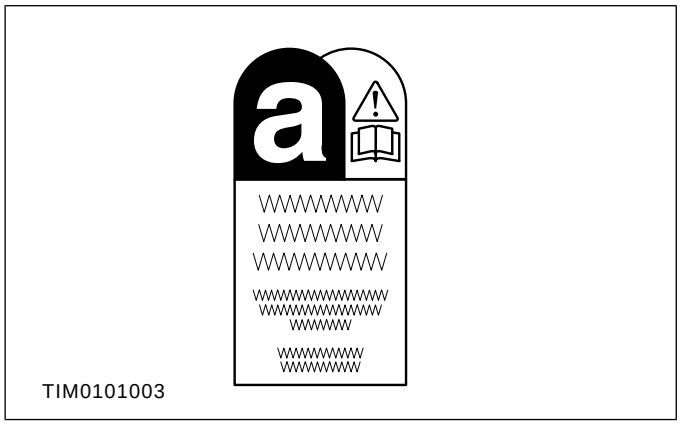
The most commonly found decals are reproduced below together with an explanation of the warnings.


TIM101001

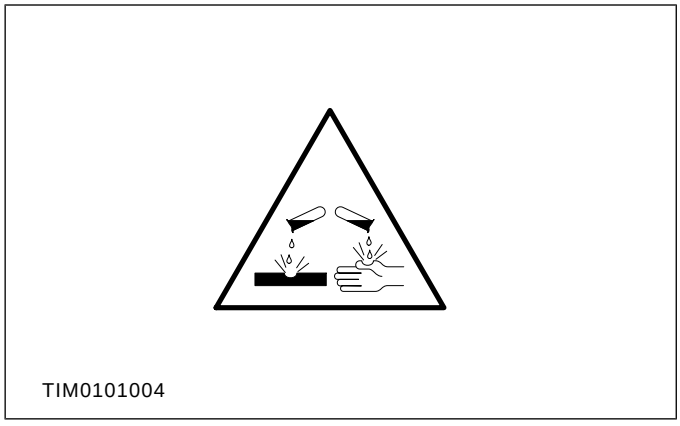
1. Components or assemblies displaying the caution triangle and open book symbol advise consultation of the relevant section of the owner literature before touching or attempting adjustments of any kind.


TIM01002

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.

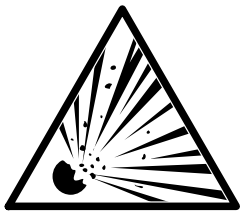

TIM0101004

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

DESCRIPTION AND OPERATION

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.



TIM0101006

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

TI0101008

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.

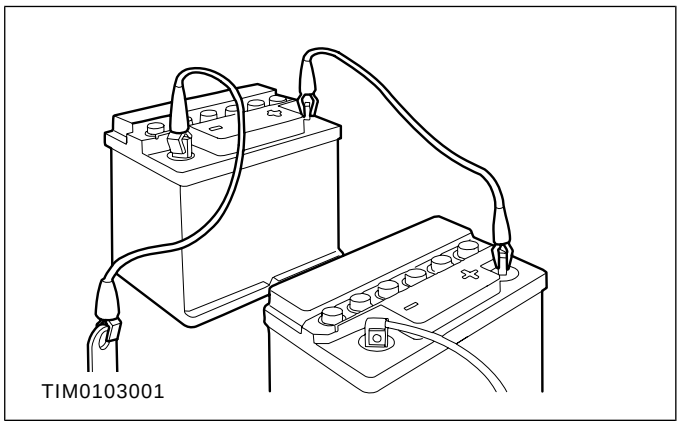
CAUTIONS:

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.

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


TIM0103001

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:

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

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

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

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

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.

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:

- 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.

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

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

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

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

Diesel Fuel System 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.

Provide adequate ventilation when working on fuel systems.

Extreme care must be exercised when handling hot fluids. Always wash off spilled fluids from affected areas of skin immediately.

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: 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.

SKIN CONTACT: Excessive or prolonged skin contact with diesel fuel may cause serious skin disorders including skin cancer.

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.

Make sure that non-plated tools are used.

Tools must be cleaned using a new brush and fresh suitable evaporative cleaning agent.

Make sure to use a steel topped workbench covered with clean, lint-free, non-flocking material.

Make sure that all parts removed from the vehicle are placed on the lint-free, non-flocking material.

Make sure that any protective clothing worn is clean and made from lint-free, non-flocking material.

Make sure to wear non-powdered latex type gloves.

Make sure to protect all electrical components and connectors with lint-free non-flocking material before using the suitable evaporative cleaning agent.

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

DESCRIPTION AND OPERATION

Liquefied Petroleum Gas (LPG) Fuel Systems Health and Safety Precautions

WARNING: Only fully trained technicians, who are conversant with local regulations, are to work on gas fuel systems.

Make sure that all components of the liquefied petroleum gas (LPG) fuel system are labeled with the ECE R 67.01 approval label.

Highly flammable. Observe "NO SMOKING" signs.

Fuel may not giie adequate warning before toxic or harmful effects arise.

Exposure to fuel can be harmful and can cause severe health damage or death.

Only work on a vehicle in a designated area, that is well ventilated and with access restricted to authorized personnel.

If the smell of gas fuel is present, immediately advise all persons in the area to take preventative actions to prevent explosion or fire and evacuate the area.

Make sure that the area is ventilated and that no smell of gas fuel is present before returning to the area.

Long sleeved cotton overalls and rubber neoprene gloves must be worn during removal and installation of gas fuel system components.

EYE CONTACT: If liquefied petroleum gas (LPG) comes into contact with the eyes, immediately flush the eyes with plenty of running water for 15 minutes. Seek immediate medical attention.

INHALED: If liquefied petroleum gas (LPG) is inhaled, move a victim to fresh air. Keep a victim warm and at rest. If breathing stops, provide artificial respiration. Seek immediate medical attention.

SKIN CONTACT: If liquefied petroleum gas (LPG) comes into contact with the skin, it produces severe frostbite. Immediately flush affected areas with plenty of cold running water. Seek immediate medical attention.

If possible always close the gas fuel tank valve and run the engine on gas fuel until it automatically switches to petrol prior to taking the vehicle into the workshop area.

Make sure that the gas fuel system pressure has been released before starting work on the gas fuel circuit.

Do not use compressed air to force gas fuel out of the fuel tank.

Keep fuel containers tightly closed, out of direct sunlight and in a cool area. Keep away from heat sources, ignition sources and oxidizing agents.

The gas fuel tank must be removed prior to moving the vehicle into paint drying ovens above 40°C.

Situations, such as extremely hot days, may cause the gas fuel system to vent off.

Install new warning labels to the original locations.

CAUTION: 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

Compressed Natural Gas (CNG) Fuel Systems Health and Safety Precautions

WARNINGS:

Highly flammable and explosive 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.

Only qualified technicians are allowed to work on CNG (compressed natural gas) systems.

Make sure that all components of the CNG fuel system are labeled with the ECE R 110 approval label.

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.

EYE CONTACT: If CNG comes into contact with the eyes, immediately flush the eyes with plenty of running water for 15 minutes. Seek immediate medical attention.

INHALED: If CNG is inhaled, move a victim to fresh air. Keep a victim warm and at rest. If breathing stops, provide artificial respiration. Seek immediate medical attention.

SKIN CONTACT: If CNG comes into contact with the skin, it produces severe frostbite. Immediately flush affected areas with plenty of cold running water. Seek immediate medical attention.

Provide adequate ventilation when working on fuel systems.

Keep fuel containers tightly closed, out of direct sunlight and in a cool area. Keep away from heat sources, ignition sources and oxidizing agents.

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 permenantly 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

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.

SECTION 100-01 Identification Codes

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

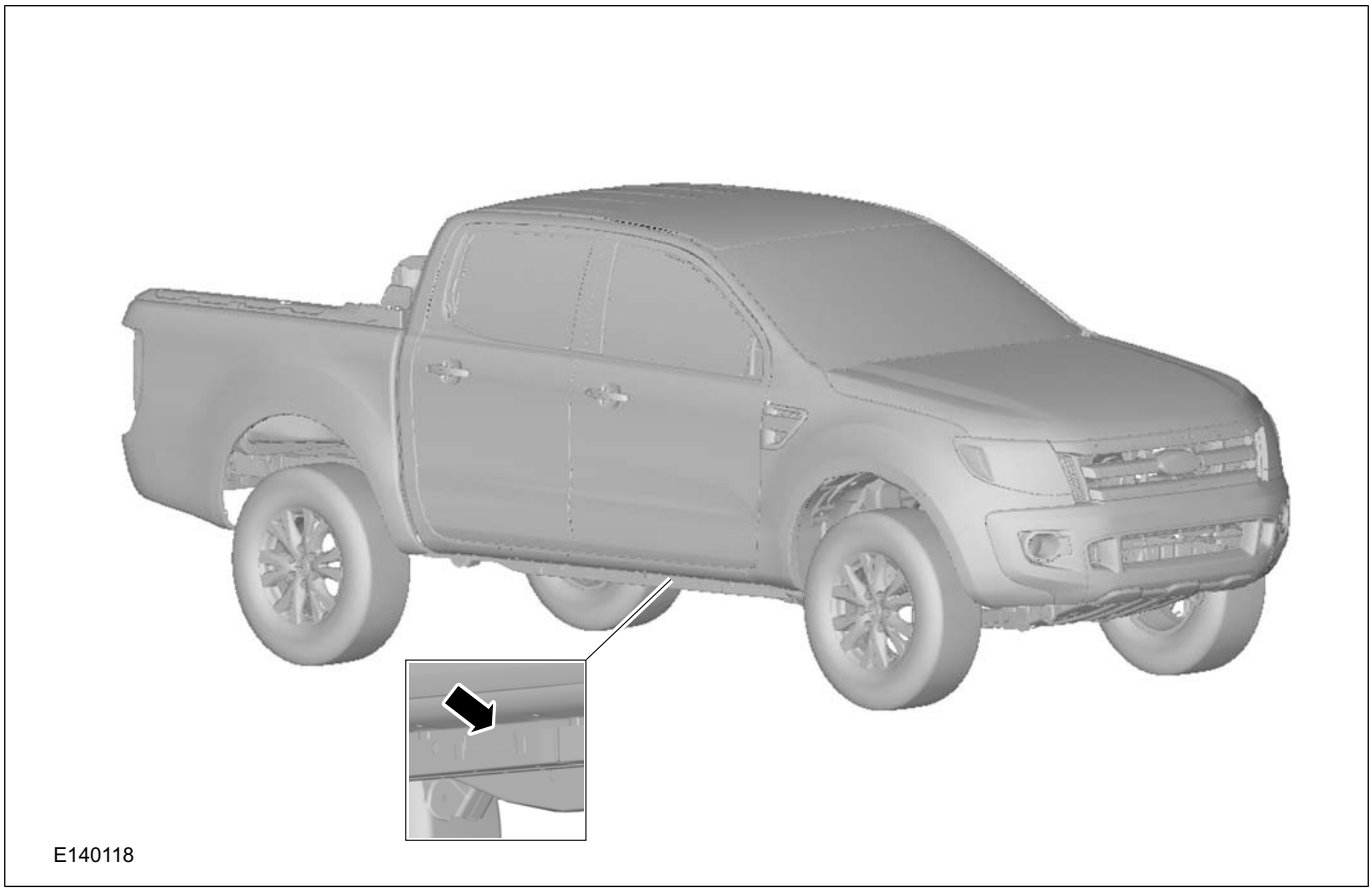
DESCRIPTION AND OPERATION

DESCRIPTION AND OPERATION

Identification Codes

NOTE: The vehicle identification number (VIN) can be identified by an asterisk (*) at its start and finish.

The vehicle identification number (VIN) is stamped on RH side of ladder frame of the vehicle . The VIN plate is located on the inside of the LH fender body panel, near to PCM (powertrain control module). The code is stamped during production to enable the precise details of the vehicle build specification to be established.



E140118

Unique VIN - Manufactured in FMSA

- Market List for VIN Structure 'A'

Afghanistan, Albania, Algeria, Andorra, Angola, Cape Verde Islands, Anguilla, Antigua, Armenia, Aruba, Austria, Azerbaijan, Bahamas, Barbados, Belarus, Belgium, Luxembourg, Belize, Benin, Bonaire, Bosnia & Herzegovina, Botswana, British Virgin Isl, Bulgaria, Burkina Faso, Burundi, Cameroon, Cayman Islands, Costa Rica, Croatia, Curacao, Cyprus, Czech Republic, Democratic Republic of Congo, Denmark , Iceland, Faroe Islands, Dominica islands, Dominica Rep, Egypt, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Finland, Estonia, Latvia, Lithuania, France, Monaco, Martinique, French Guiana, Gabon, Gambia, Georgia, Germany, Ghana, Gibraltar, Greece, Grenada, Guadeloupe, Guinea-Bissau, Guyana, Haiti, Honduras, HungaryIreland, Italy, San Marino, Vatican City, Ivory Coast, Kazakhstan, Kenya, Kyrgyzstan, Liberia, Libya, Macedonia, Madagascar, Malawi, Mali, Malta, Mauritania, Mauritius, Moldova, Montenegro, Morocco, Mozambique, N. Antilles, Namibia, Netherlands, Nicaragua, Nigeria, Norway, Pakistan, Panama, Poland, Portugal, Rep. of Rwanda Republic of Congo, Republic of Guinea, Romania, Reunion Isl, Russia, Senegal, Serbia, Seychelles, Sierra Leone, Slovakia, Slovenia, Spain, Canary Island, St. Kitts, St. Lucia, St. Maarten, St. Vincent, Sudan, Suriname, Sweden, Switzerland, Liechtenstein, Tajikistan, Tanzania, Togo, Trinidad & Tobago, Tunisia, Turkey, Northern Cyprus, Turkmenistan, Uganda, Ukraine, United Kingdom, Uzbekistan, Zambia, Zimbabwe.

DESCRIPTION AND OPERATION

Vehicle Identification Number

*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	*
Start Marking	World Mfr. Index			Body Type	Constant Figure	Constant Figure	Product Source	Assembly Plant	Model Line	Body Type	Year of Manufacture	Month of Manufacture	Vehicle Sequence Number					End Marking
*	6	F	P	N/G/P/4/6/5	X	X	M	J	P	N/G/P/4/6/5	B/C/D/E/F	#	1	2	3	4	5	*
				Vehicle Descriptor Selection (VDS)						Vehicle Indicator Section(VIS)								

Variable
Vehicle Identification Number: Character 1 to 17

E139898

Item	Description
1-3	VIN Positions 1, 2 and 3 — World Manufacturer Identifier
4	VIN Position 4 — Body type
5	VIN Positions 5 — Constant figure
6	VIN Position 6 — Constant figure
7	VIN Position 7 — Product source

Item	Description
8	VIN Position 8 — Assembly plant
9	VIN Position 9 — Model line
10	VIN Position 10 — Body type
11	VIN Position 11 — Year of Manufacture
12	VIN Position 12 — Month of Manufacture
13-17	VIN Positions 13-17 — Vehicle Sequence Number

VIN Positions 1, 2 and 3 — World Manufacturer Identifier

Code	World Manufacturer
6FP	Ranger

VIN Positions 4 — Body Type

Code	Body Type
N	Regular cab
G	RAP cab
P	Double cab
4	Regular cab - chassis
6	RAP cab - chassis
5	Double cab - chassis

VIN Positions 5 — Constant Figure

Code	Constant Figure
X	

DESCRIPTION AND OPERATION

VIN Positions 6 — Constant Figure

Code	Constant Figure
X	

VIN Position 7— Product Source

Code	Product Source
M	Ford Motor Company of Southern Africa

VIN Position 8 — Assembly Plant

Code	Assembly Plant
J	Silverton Assembly Plant

VIN Position 9 — Model Line

Code	Check Digit
P	Ranger

VIN Position 10 — Body Type

Code	Body Type
N	Regular cab
G	RAP cab
P	Double cab
4	Regular cab - chassis
6	RAP cab - chassis
5	Double cab - chassis

VIN Position 11 — Year of Manufacture

Code	Year of Manufacture
B	2011
C	2012
D	2013
E	2014
F	2015

VIN Position 12 — Month of Manufacture

Month	2011	2012	2013	2014	2015
Jan	C	B	J	L	C
Feb	K	R	U	Y	K
Mar	D	A	M	S	D
Apr	E	G	P	T	E
May	L	C	B	J	L
Jun	Y	K	R	U	Y
July	S	D	A	M	S

DESCRIPTION AND OPERATION

Month	2011	2012	2013	2014	2015
Aug	T	E	G	P	T
Sep	J	L	C	B	J
Oct	U	Y	K	R	U
Nov	M	S	D	A	M
Dec	P	T	E	G	P

VIN Positions 13 to 17 — Vehicle Sequence Number

Five digit number.

NOTE: The vehicle identification number (VIN) can be identified by an asterisk (*) at its start and finish.

Vehicle Identification Number

*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	*
Start Marking	World Mfr. Index			Brake, Gross Weight Rating	Model Line	Series	Engine Type	Body Type	Check Digit	Model Year	Assembly Plant	Month of Manufacture	Vehicle Sequence Number					End Marking
*	A	F	A		P	#	L/A/E/R/M	N/G/P/4/6/5	#	B/C/D/E/F	J	#	1	2	3	4	5	*
	Vehicle Descriptor Selection (VDS)									Vehicle Indicator Section(VIS)								

Variable
Vehicle Identification Number: Character 1 to 17

E139899

Item	Description
1-3	VIN Positions 1, 2 and 3 — World Manufacturer Identifier
4	VIN Position 4 — Brake, Gross Weight Rating
5	VIN Positions 5 — Model line
6	VIN Position 6 — Series
7	VIN Position 7 — Engine Type

Item	Description
8	VIN Position 8 — Body Type
9	VIN Position 9 — Check Digit
10	VIN Position 10 — Model Year
11	VIN Position 11 — Year of Manufacture
12	VIN Position 12 — Month of Manufacture
13-17	VIN Positions 13-17 — Vehicle Sequence Number

VIN Positions 1, 2 and 3 — World Manufacturer Identifier

Code	World Manufacturer
AFA	Ranger

- Market List for VIN Structure 'B'

Bahrain, Guatemala, Iraq, Jamaica, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, UAE, Yemen.

DESCRIPTION AND OPERATION

VIN Positions 4 — Brake, Gross Weight Rating

Code	Brake, Gross Weight Rating
E	Hydraulic brake, GVM 2722-3175 kg
F	Hydraulic brake, GVM 3176-3629 kg

VIN Positions 5 — Model line

Code	Model line
P	Ranger

VIN Positions 6 — Series

Code	Series
1	Base
2	XL
3	XLS
4	XLT
5	Wildtrak
6	Titanium
7	Limited

VIN Position 7— Engine Type

Code	Engine Type
L	I4 2.5L Petrol
A	I4 2.2L Diesel low power
E	I4 2.2L Diesel mid power
R	I4 2.2L Diesel High power
M	I4 3.2L Diesel

VIN Position 8 — Body Type

Code	Body Type
N	Regular cab
G	RAP cab
P	Double cab
4	Regular cab - chassis
6	RAP cab - chassis
5	Double cab - chassis

VIN Position 9 — Check Digit

Code	Check Digit
#	

DESCRIPTION AND OPERATION

VIN Position 10 — Model Year

Code	Body Type
N	Regular cab
G	RAP cab
P	Double cab
4	Regular cab - chassis
6	RAP cab - chassis
5	Double cab - chassis

VIN Position 11 — Assembly Plant

Code	Assembly Plant
J	Silverton Assembly Plant

VIN Position 12 — Month of Manufacture

Month	2011	2012	2013	2014	2015
Jan	C	B	J	L	C
Feb	K	R	U	Y	K
Mar	D	A	M	S	D
Apr	E	G	P	T	E
May	L	C	B	J	L
Jun	Y	K	R	U	Y
July	S	D	A	M	S
Aug	T	E	G	P	T
Sep	J	L	C	B	J
Oct	U	Y	K	R	U
Nov	M	S	D	A	M
Dec	P	T	E	G	P

VIN Positions 13 to 17 — Vehicle Sequence Number

Five digit number.

The vehicle identification number (VIN) is stamped in to the floor panel below the driver side front seat. The code is stamped during production to enable the precise details of the vehicle build specification to be established.

NOTE: The vehicle identification number (VIN) can be identified by an asterisk (*) at its start and finish.

- Market List for VIN Structure 'C'

South Africa only.

DESCRIPTION AND OPERATION

Vehicle Identification Number

*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	*
Start Marking	World Mfr. Index			Body Type	Constant Figure	Constant Figure	Product Source	Assembly Plant	Model Line	Body Type	Year of Manufacture	Month of Manufacture	Vehicle Sequence Number					End Marking
*	A	F	A	N/G/P/4/6/5	X	X	M	J	P	N/G/P/4/6/5	B/C/D/E/F	#	1	2	3	4	5	*
				Vehicle Descriptor Selection (VDS)						Vehicle Indicator Section(VIS)								

Variable
Vehicle Identification Number: Character 1 to 17

E139900

Item	Description
1-3	VIN Positions 1, 2 and 3 — World Manufacturer Identifier
4	VIN Position 4 — Body type
5	VIN Positions 5 — Constant figure
6	VIN Position 6 — Constant figure
7	VIN Position 7 — Product source

Item	Description
8	VIN Position 8 — Assembly plant
9	VIN Position 9 — Model line
10	VIN Position 10 — Body type
11	VIN Position 11 — Year of Manufacture
12	VIN Position 12 — Month of Manufacture
13-17	VIN Positions 13-17 — Vehicle Sequence Number

VIN Positions 1, 2 and 3 — World Manufacturer Identifier

Code	World Manufacturer
AFA	Ranger

VIN Positions 4 — Body Type

Code	Body Type
N	Regular cab
G	RAP cab
P	Double cab
4	Regular cab - chassis
6	RAP cab - chassis
5	Double cab - chassis

VIN Positions 5 — Constant Figure

Code	Constant Figure
X	

DESCRIPTION AND OPERATION

VIN Positions 6 — Constant Figure

Code	Constant Figure
X	

VIN Position 7— Product Source

Code	Product Source
M	Ford Motor Company of Southern Africa

VIN Position 8 — Assembly Plant

Code	Assembly Plant
J	Silverton Assembly Plant

VIN Position 9 — Model Line

Code	Check Digit
P	Ranger

VIN Position 10 — Body Type

Code	Body Type
N	Regular cab
G	RAP cab
P	Double cab
4	Regular cab - chassis
6	RAP cab - chassis
5	Double cab - chassis

VIN Position 11 — Year of Manufacture

Code	Year of Manufacture
B	2011
C	2012
D	2013
E	2014
F	2015

VIN Position 12 — Month of Manufacture

Month	2011	2012	2013	2014	2015
Jan	C	B	J	L	C
Feb	K	R	U	Y	K
Mar	D	A	M	S	D
Apr	E	G	P	T	E
May	L	C	B	J	L
Jun	Y	K	R	U	Y
July	S	D	A	M	S

DESCRIPTION AND OPERATION

Month	2011	2012	2013	2014	2015
Aug	T	E	G	P	T
Sep	J	L	C	B	J
Oct	U	Y	K	R	U
Nov	M	S	D	A	M
Dec	P	T	E	G	P

VIN Positions 13 to 17 — Vehicle Sequence Number

Five digit number.

Unique VIN - Manufactured in AutoAlliance Thailand (AAT)

Vehicle Identification Number

*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	*
Start Marking	World Mfr. Index			Body Type	Constant Figure	Constant Figure	Product Source	Assembly Plant	Model Line	Body Type	Year of Manufacture	Month of Manufacture	Vehicle Sequence Number					End Marking
*	A	F	A	N/G/P/4/6/5	X	X	M	J	P	N/G/P/4/6/5	B/C/D/E/F	#	1	2	3	4	5	*
				Vehicle Descriptor Selection (VDS)						Vehicle Indicator Section(VIS)								

Variable
Vehicle Identification Number: Character 1 to 17

E139900

Item	Description
1-3	VIN Positions 1, 2 and 3 — World Manufacturer Identifier
4	VIN Position 4 — Air bag
5	VIN Positions 5 — Production source
6	VIN Position 6 — Body style
7	VIN Position 7 — GVM

Item	Description
8	VIN Position 8 — Engine type
9	VIN Position 9 — Constant Value
10	VIN Position 10 — Production Year / Model year
11	VIN Position 11 — Plant
12-17	VIN Positions 12-17 — Serial Number

VIN Positions 1, 2 and 3 — World Manufacturer Identifier

Code	World Manufacturer
MNA	Australia(RHD),Newzeland(RHD)
MNB	Thailand (RHD),RHD Markets - Indonesia, Malaysia,Bangladesh, Brunei, Fiji, Singapore, Sri Lanka, Papua New Guinea,Hong Kong, Samoa
MNC	LHD Markets - Philippines, Vietnam,Cambodia, New Caledonia, Wallis & Vanuatu, Palau, Micronesia, French Polynesia, Mongolia, Laos

DESCRIPTION AND OPERATION

VIN Positions 4 — Air bag

Code	Air bag
B	Seat belts only
D	Driver air bag
L	Driver airbag + passenger airbag
U	Driver airbag + passenger airbag + Side airbags + Side Curtain Airbags
W	Driver airbag + passenger airbag+ Side Curtain Airbags

VIN Positions 5 — Production source

Code	Production source
M	Thailand

VIN Positions 6 — Body style

Code	Body style
A	Regular cab-chassis
B	Regular cab
E	Double cab-chassis
F	Double cab
1	RAP cab-chassis
2	RAP cab

VIN Position 7— GVM

Code	GVM
E	2722 to ≤ 3175 kg
F	E >3175 to 3629 kg

VIN Position 8 — Engine type

Code	Engine type
3	I4 2.5l Petrol
0	I4 2.2l Diesel low power
2	I4 2.2l Diesel mid power
8	I4 2.2l Diesel high power
5	I5 3.2l Diesel

VIN Position 9 — Constant Value

Code	Constant Value
0	0

DESCRIPTION AND OPERATION

VIN Position 10 — Production Year/Model year

Code	Year	Production year for markets	Model year for markets
B	2011	**RHD:** Indonesia, Thailand, Australia, NewZealand **LHD:** Philippines	**RHD:** Malaysia, Bangladesh, Brunei, Fiji, Singapore, Sri Lanka, Papua New Guinea,Hong Kong, Samoa **LHD:** Vietnam, Cambodia, New Caledonia, Wallis & Vanuatu, Palau, Micronesia, French Polynesia, Mongolia, Laos
C	2012		
D	2013		
E	2014		
F	2015		

VIN Position 11 — Plant

Code	Plant
W	AutoAlliance Thailand

VIN Positions 12 to 17 — Serial Number

Six digit number (Last four must be numerical)

SECTION 100-02 Jacking and Lifting

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

DESCRIPTION AND OPERATION

Jacking

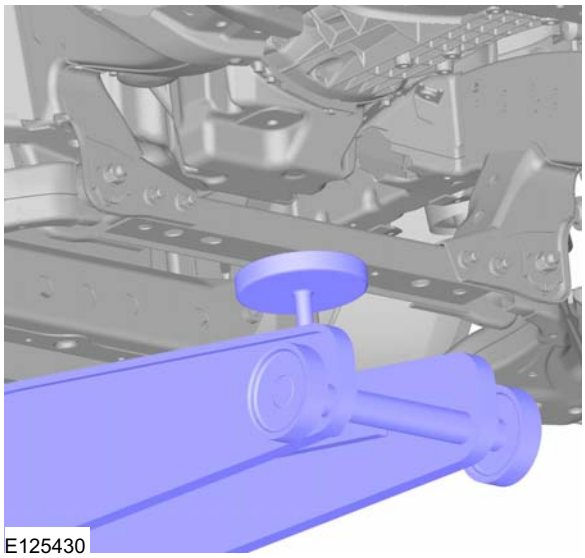
WARNING: Lifting a vehicle that is not stabilized is dangerous. The vehicle can slip off the lift and cause serious injury and/or vehicle damage. Make sure that the vehicle is on the lift horizontally by adjusting the height of the support at the end of the arm of the lift.

Use safety stands to support the vehicle after it has been lifted.

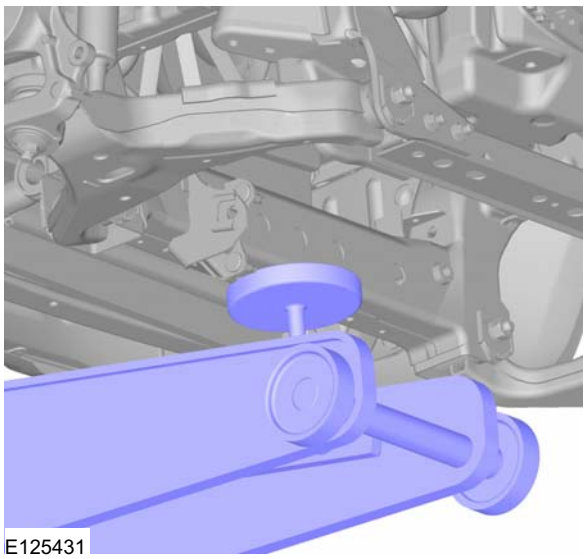
Front

4X2

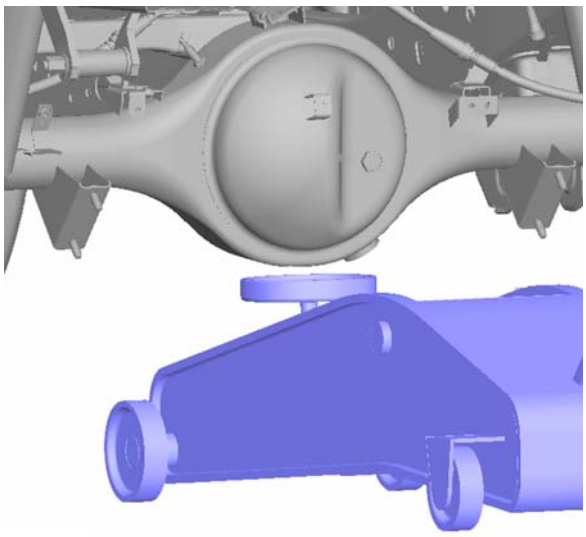
Near the center of the crossmember.


E125430

4X4


E125431

Rear


E125432

At the center of the rear differential.

DESCRIPTION AND OPERATION

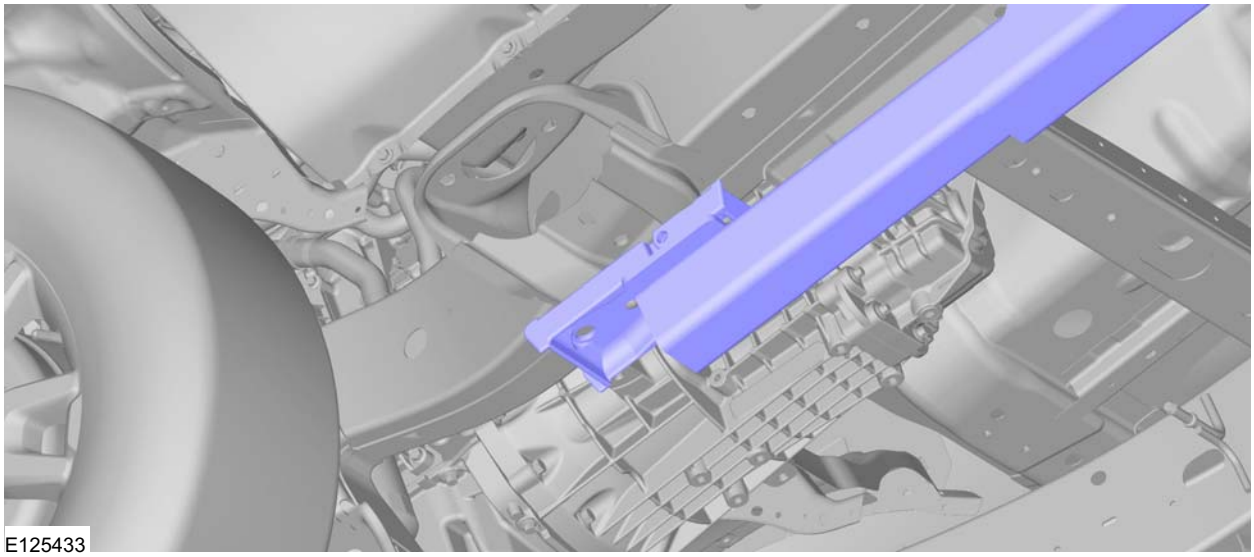
Lifting

Vehicle Lift Positions

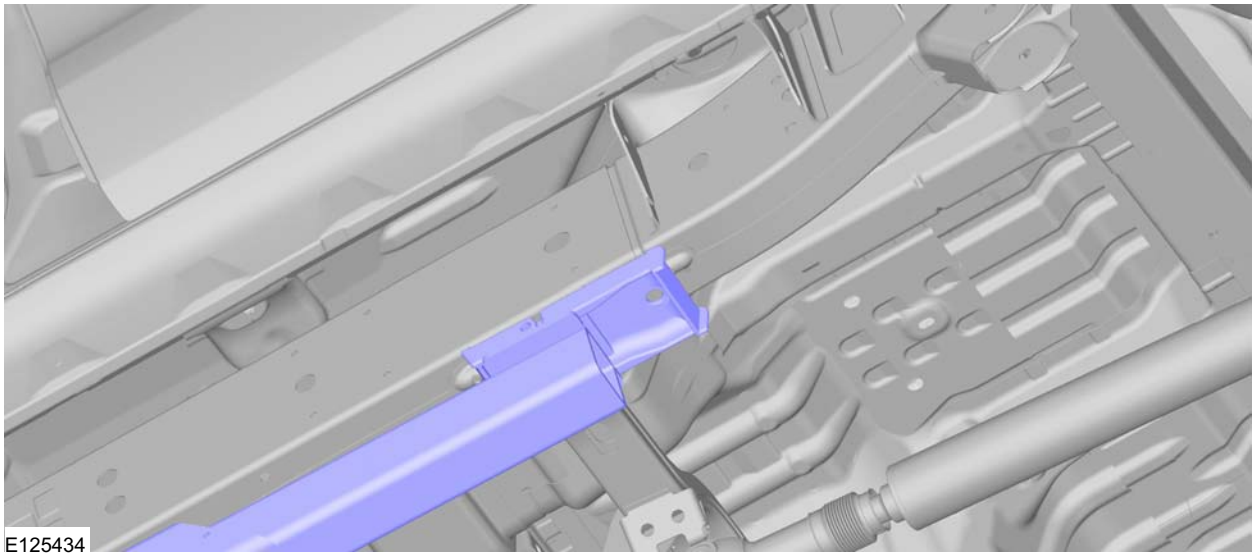
WARNING: Lifting a vehicle that is not stabilized is dangerous. The vehicle can slip off the lift and cause serious injury and/or vehicle damage. Make sure that the vehicle is on the lift horizontally by adjusting the height of the support at the end of the arm of the lift.

Use safety stands to support the vehicle after it has been lifted.

Front


E125433

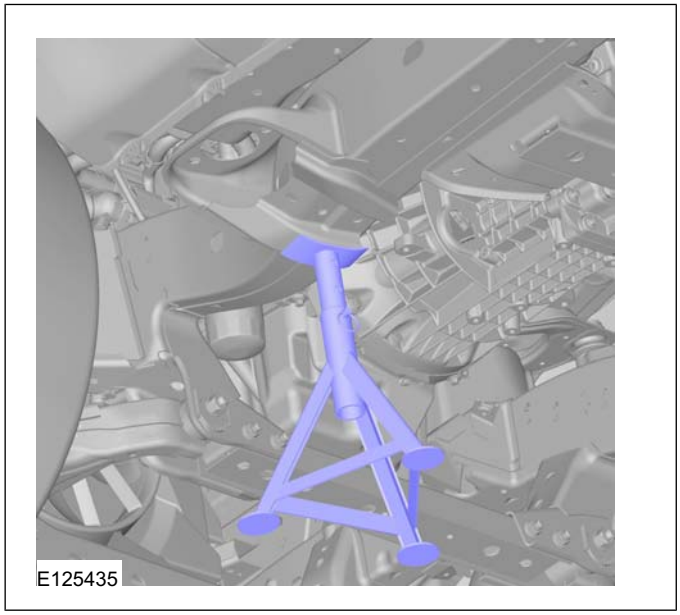
Rear


E125434

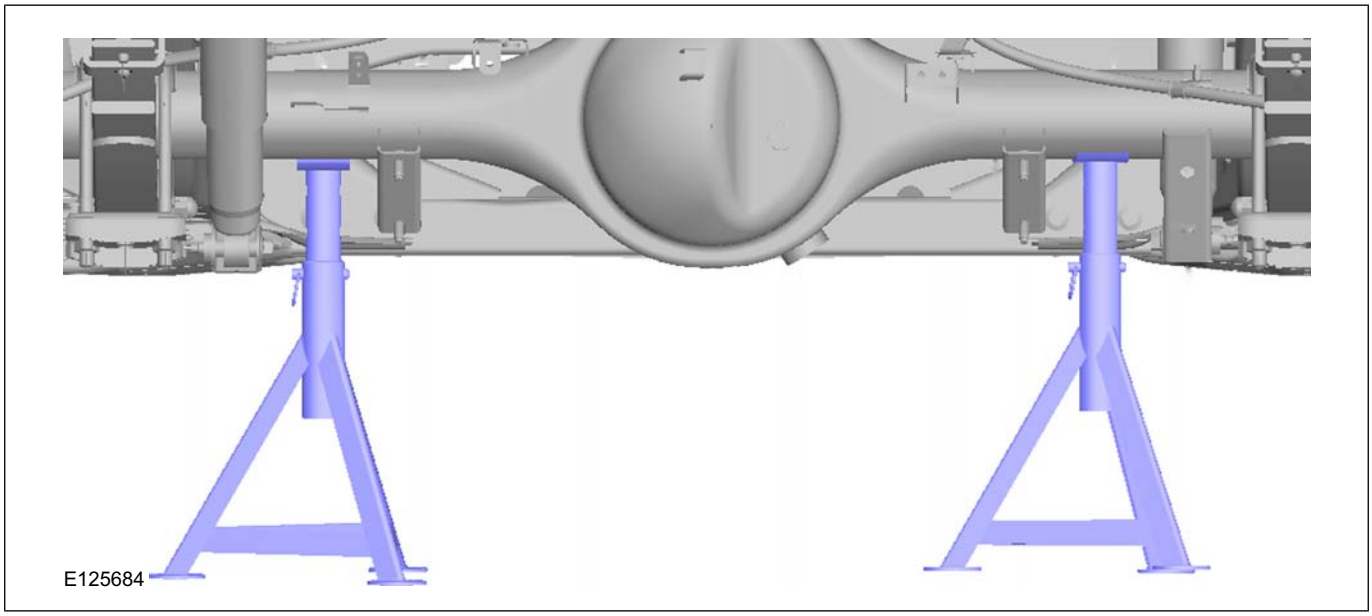
DESCRIPTION AND OPERATION

Safety Stand Positions

Front



Rear



SECTION 100-04 Noise, Vibration and Harshness

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

DESCRIPTION AND OPERATION

Noise, Vibration and Harshness (NVH)

Noise, vibration and harshness (NVH) is becoming more important as vehicles become more sophisticated and passenger comfort levels increase. This section is designed to aid in the diagnosis and testing and repair of NVH concerns.

- Noise is defined as sounds not associated with the operation of passenger compartment equipment that interface with customer satisfaction.
- Vibration is defined as impulses felt by the customer that are not caused by road surface changes.
- Harshness is a ride quality issue where the customer feels that the vehicle response to the road surface is sharply transmitted to the customer.

Diagnostic Theory

Diagnosis is more than just following a series of interrelated steps in order to find the solution to the specific condition. It is a way of looking at systems that are not functioning the way they should and finding out why. Also it is knowing how the system should work and whether it is working correctly.

There are basic rules for diagnosis. If these rules are followed, the cause of the condition is usually found the first time through the system.

Know the System

- Know how the parts go together.
- Know how the system operates as well as its limits and what happens when the system goes wrong.
- Sometimes this means checking the system against one that is known to be working correctly.

Know the History of the System

A clue in any one of these areas may save time:

- How old or new is the system?
- What kind of treatment has it had?
- Has it been serviced in the past in such a manner that might relate to the present condition?
- What is the service history?

Know the History of the Condition

- Did it start suddenly or appear gradually?
- Was it related to some other occurrence such as a collision or previous part replacement?
- Know how the condition made itself known; it may be an important clue to the cause.

Know the Probability of Certain Conditions Developing

- Look for the simple rather than the complex.
- For example:
  - Electrical conditions usually occur at connections rather than components.
  - An engine no-start is more likely to be caused by a loose wire or small adjustment rather than a sheared-off camshaft.
- Know the difference between impossible and improbable. Certain failures in a system can be improbable but still happen.
- New parts are just that, new. It does not mean they are always good functioning parts.

Do Not Cure the Symptom and Leave the Cause

Lowering the pressure in a front tire may correct the condition of a vehicle leaning to one side, but it does not correct the original condition.

Be Positive the Cause is Found

- Double check findings.
- What caused a worn component?
- A loose transmission or engine mount could indicate that other mounts are also loose.

Diagnostic Charts

Charts are a simple way of expressing the relationship between basic logic and a physical system of components. They help discover the cause of a condition in the least time. Diagnostic charts combine many areas of diagnosis into one visual display:

DESCRIPTION AND OPERATION

- Probability of certain things occurring in a system.
- Speed of checking certain components or functions before others.
- Simplicity of performing certain tests before others.
- Elimination of checking huge portions of a system by performing simple tests.
- Certainty of narrowing down the search to a small portion before performing in-depth testing.

The fastest way to find a condition is to work with the tools that are available. This means working with proven diagnostic charts and the correct special equipment for the system.

GROUP 2

Chassis

SECTION 204-00 Suspension System - General Information

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

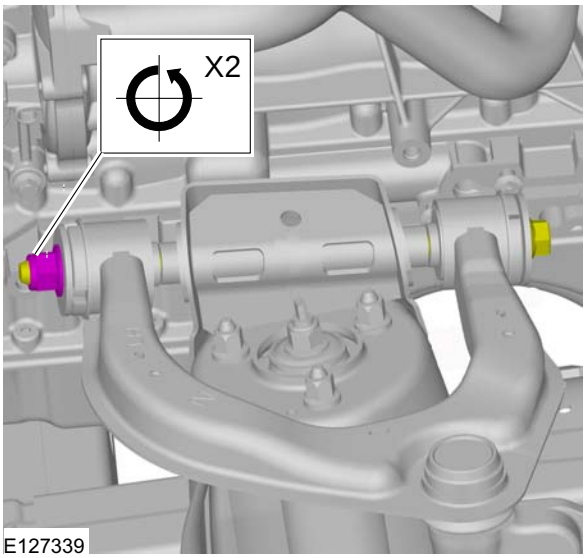
GENERAL PROCEDURES

GENERAL PROCEDURES

Camber and Caster Adjustment

NOTE: Make sure that the tire pressures are to specification and that the vehicle is unladen.

1. **Using alignment equipment and the manufacturer's instructions, measure the front caster and camber.**
2. **Loosen the upper arm nut.**

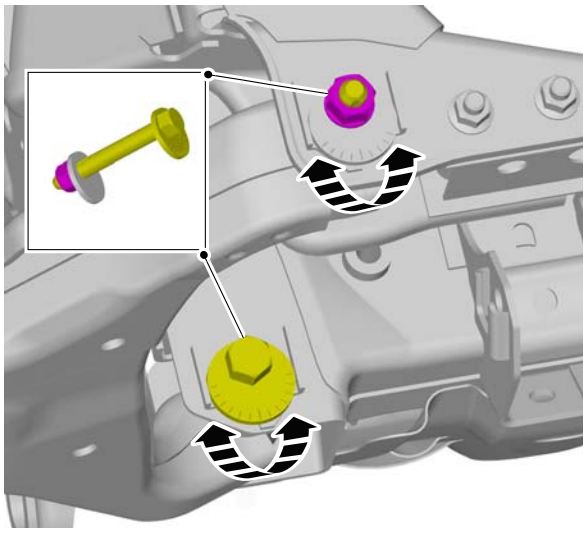


3. **Loosen the lower arm bolt(s) and adjust the caster and camber settings according to manufacturer's instructions.**
4. **NOTE: Make sure that the weight of the vehicle is on the wheels and that the caster and camber settings are not disturbed while tightening the bolt(s).**

   After adjustment, tighten the upper arm shaft bolt and lower arm bolts to the specified torque .

   1. Tightening torque of upper arm bolt : 86 Nm .
   2. Tightening torque of Lower arm bolt : 270 Nm
5. **Confirm the front wheel alignment as in the specification.**

1. If not within the specification, adjust the front wheel alignment again.



GENERAL PROCEDURES

Front Toe Adjustment(14 117 3)

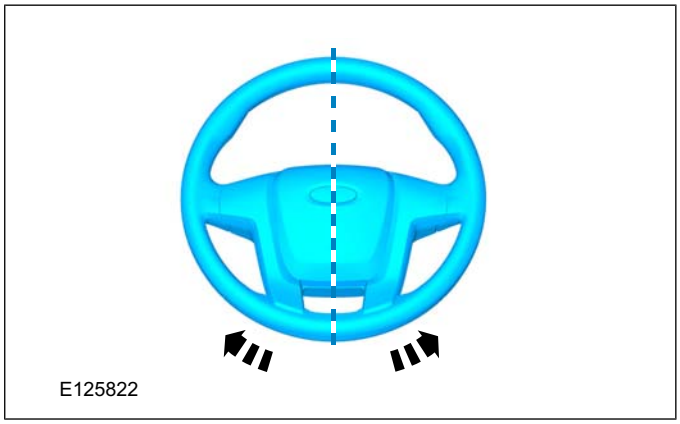
General Equipment

Wheel alignment system

NOTE: Make sure that the vehicle is standing on a level surface.

NOTE: Make sure that the tire pressures are to specification and that the vehicle is unladen.

1.

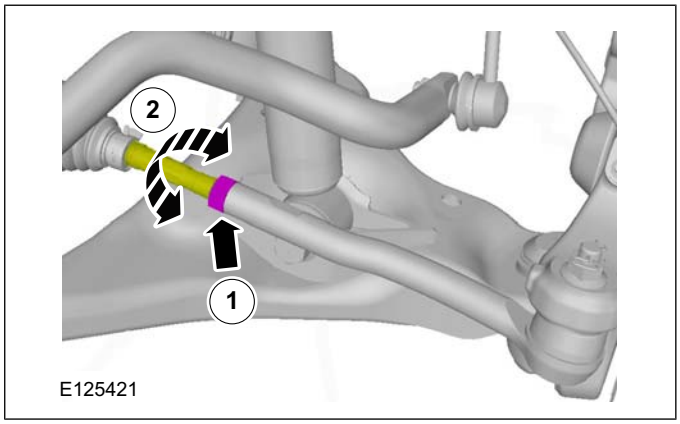

E125822

CAUTION: Make sure that the steering wheel lock is engaged.

NOTE: Make sure that the road wheels are in the straight ahead position.

2. Loosen the locknut of the tie-rod end.

3. Turn the tie rods by the same amount in the opposite direction.



E125421

4. NOTE: One turn of the tie rod (both sides) changes the toe-in by about approx. 30 mm (1.18 in).

NOTE: The left and right tie rods are both right threaded. To increase the toe-in, turn the right tie rod toward the front of the vehicle and the left tie rod equally toward the rear.

Tighten the tie-rod end locknuts.

- 73 Nm

SECTION 204-01 Front Suspension

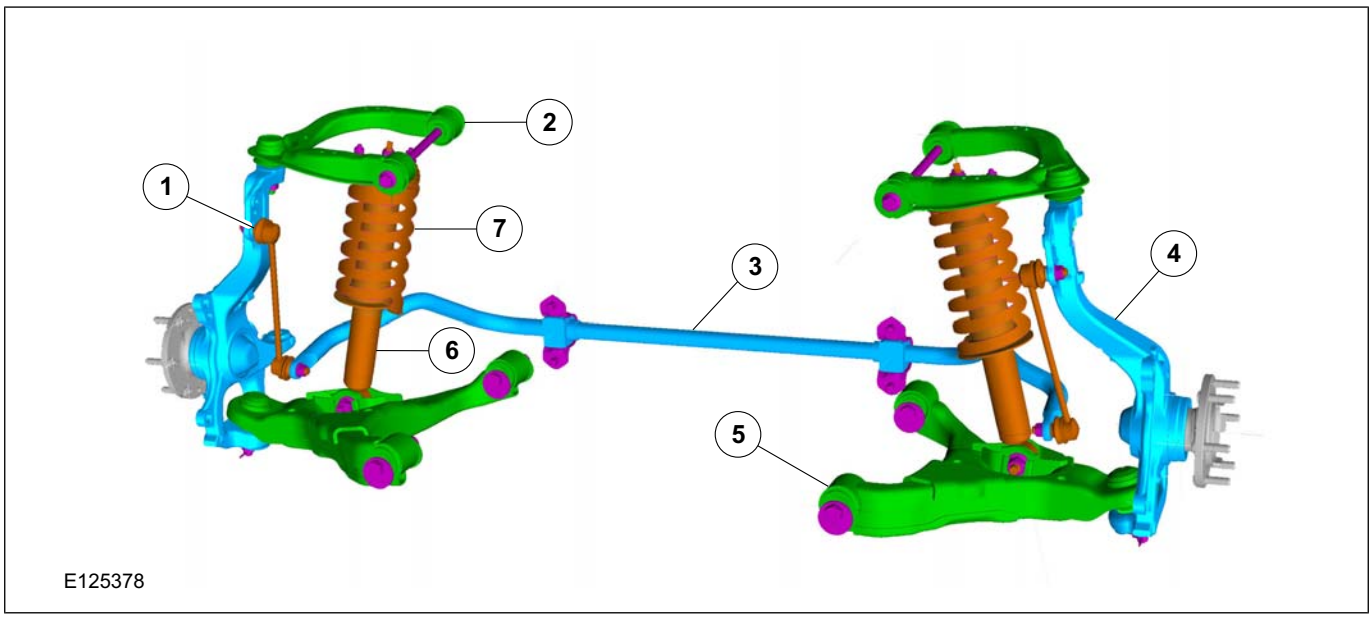
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Front Suspension

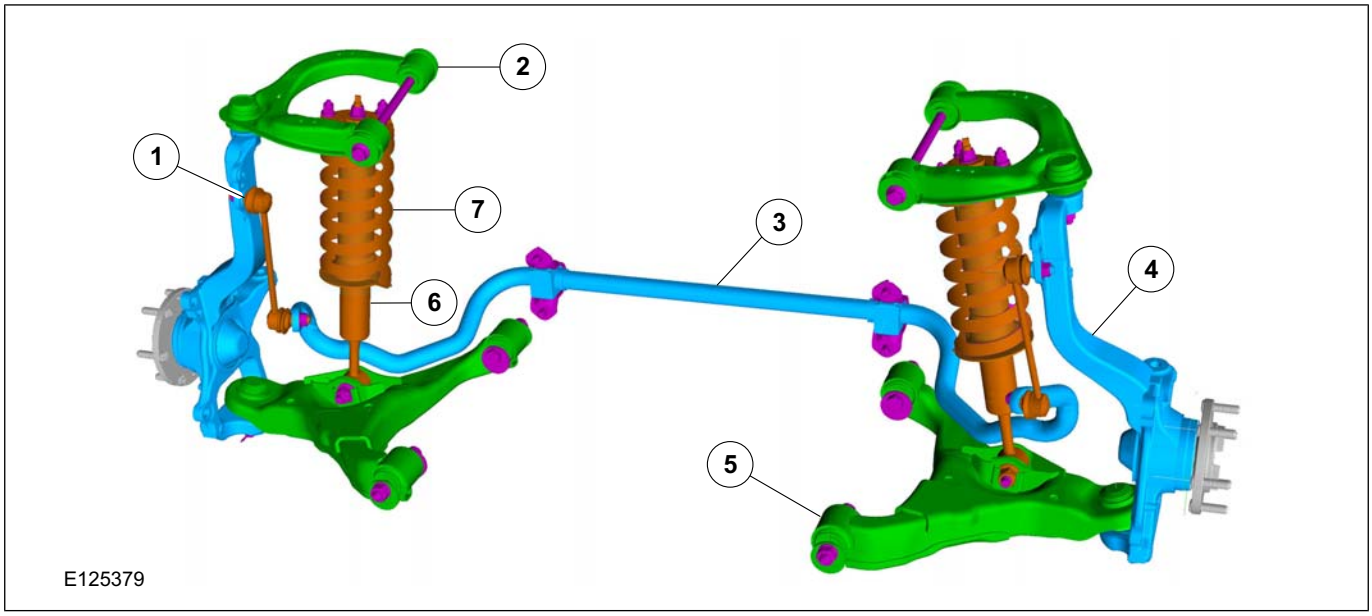
4X2



Item	Description
1	Stabilizer bar link
2	Upper arm
3	Stabilizer bar

Item	Description
4	Knuckle
5	Lower arm
6	Shock absorber unit
7	Suspension unit

4X2 Hi-Rider



Item	Description
1	Stabilizer bar link
2	Upper arm

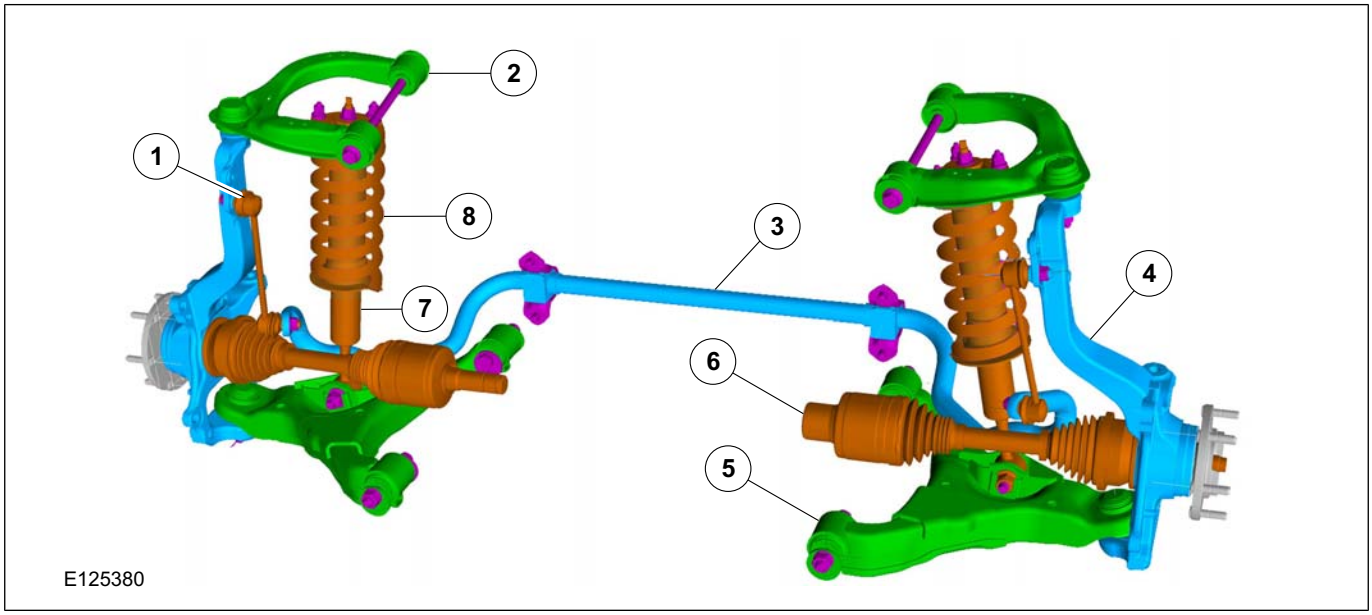
Item	Description
3	Stabilizer bar
4	Knuckle

DESCRIPTION AND OPERATION

Item	Description
5	Lower arm

Item	Description
6	Shock absorber unit
7	Suspension unit

4X4

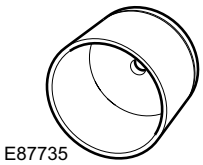
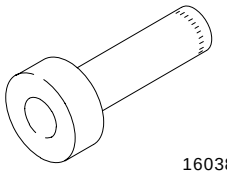
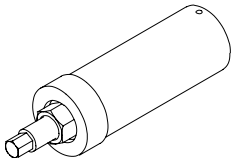
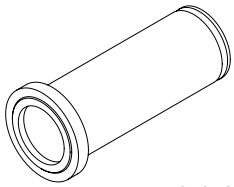


Item	Description
1	Stabilizer bar link
2	Upper arm
3	Stabilizer bar
4	Knuckle
5	Lower arm
6	Half Shafts
7	Shock absorber unit
8	Suspension unit

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

204-348/3  E87735	204-348/3 Remover/Installer, Wheel Hub/Wheel Bearing
 16038	308-095 Installer, Input Shaft Bearing
 E49064	308-604 Installer, Output Drive Flange Seal
 E65343	308-643 Installer, Input Shaft Seal
Hydraulic Press	

Removal

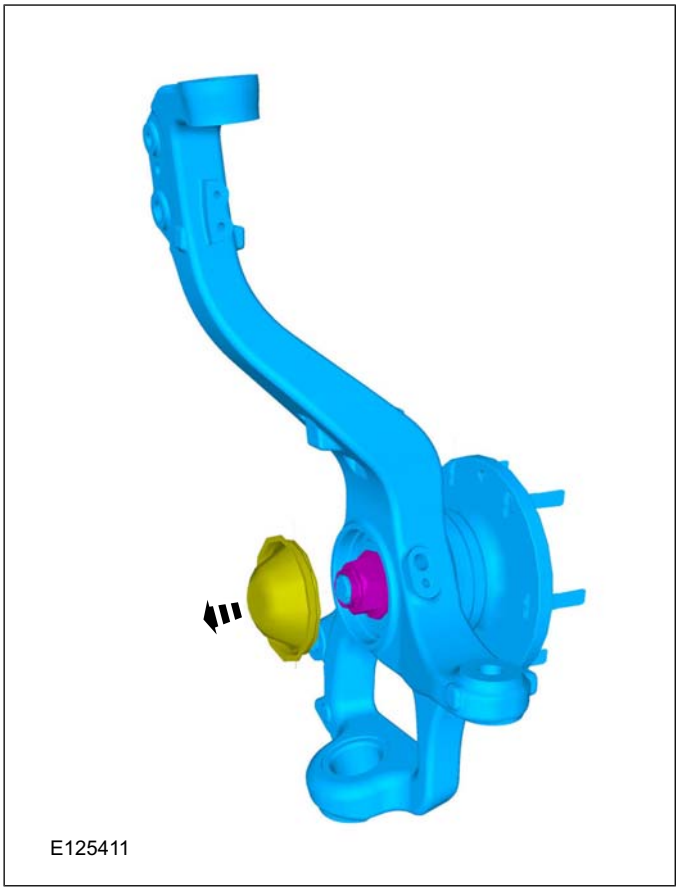
NOTE: Removal steps in this procedure may contain installation details.

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

4x2

2. Refer to: Wheel Knuckle - 2WD (204-01 Front Suspension, Removal and Installation).

3.



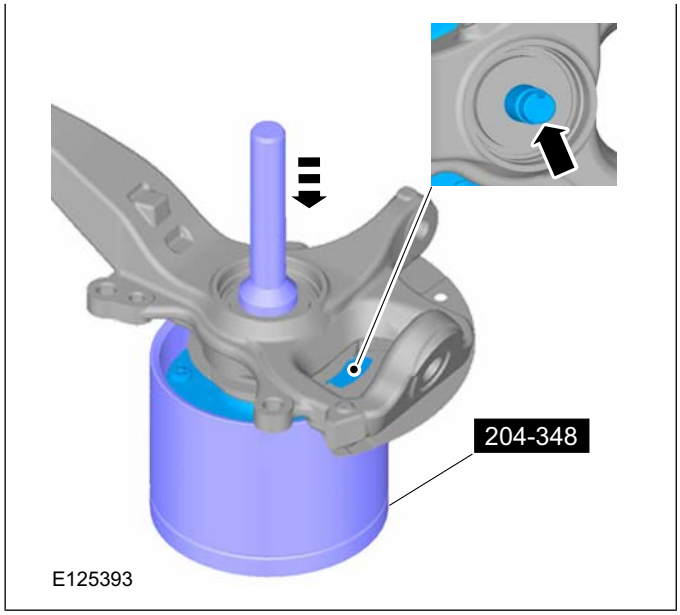
REMOVAL AND INSTALLATION

4x4

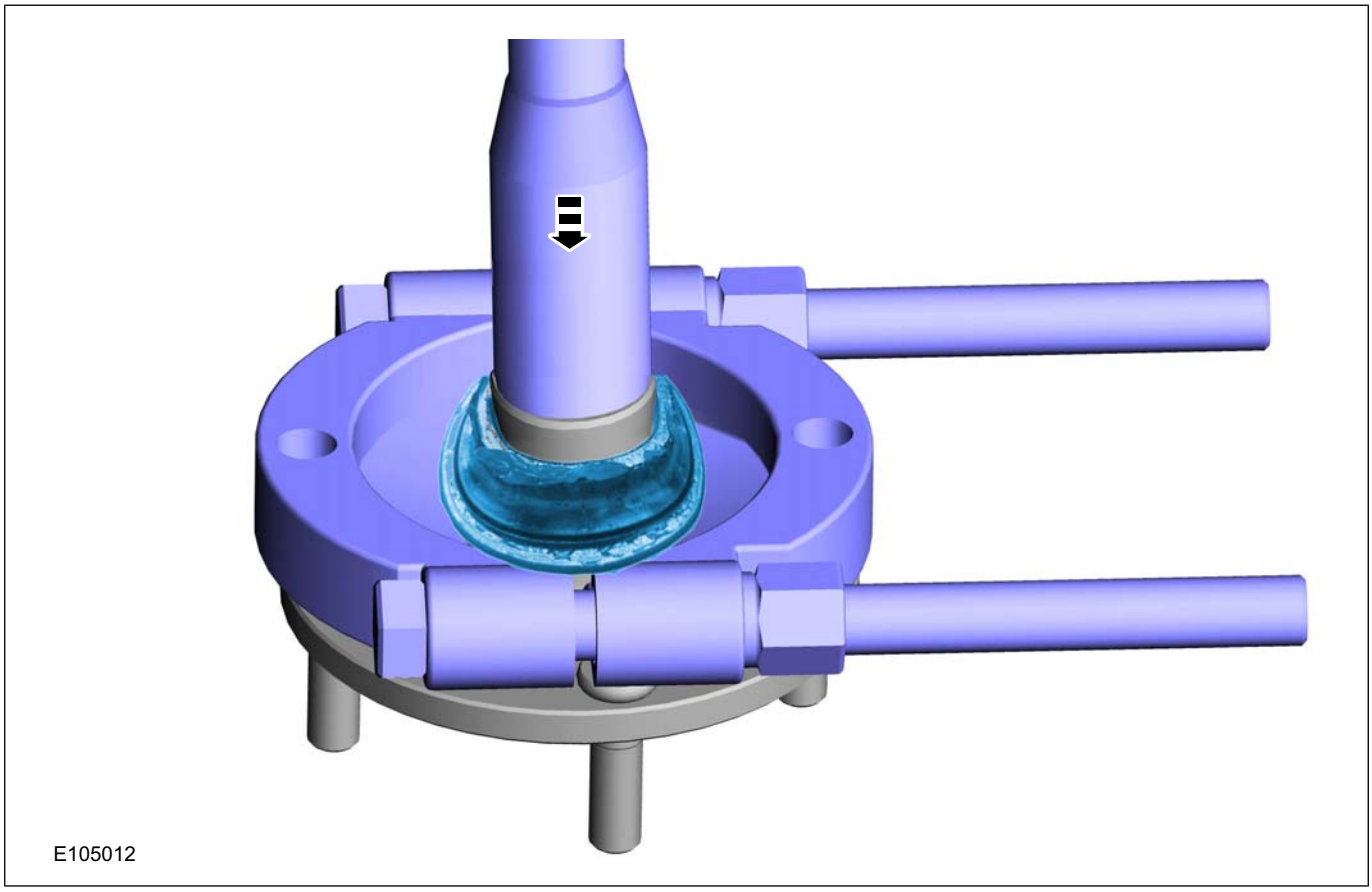
4. Refer to: Wheel Knuckle - 4WD (204-01 Front Suspension, Removal and Installation).

All vehicles

5. Special Tool(s): 204-348/3
General Equipment: Hydraulic Press

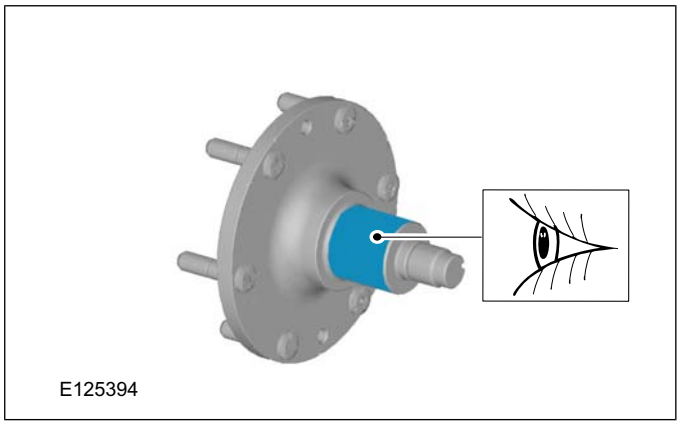


6. General Equipment: Hydraulic Press



REMOVAL AND INSTALLATION

7.



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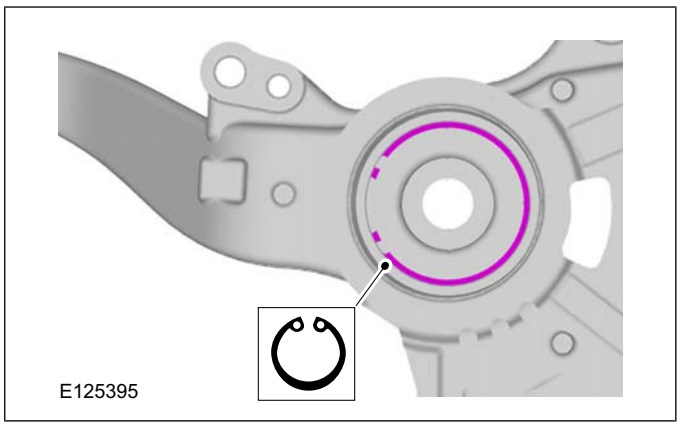
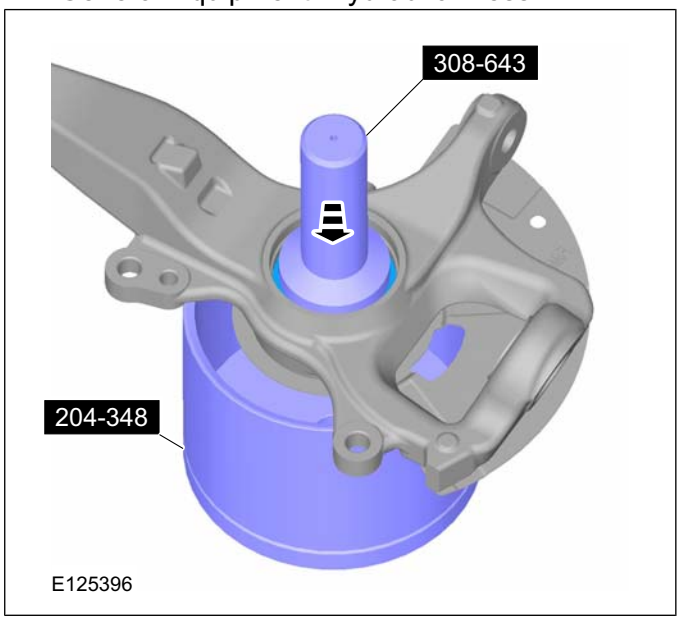


9. Special Tool(s): 204-348/3, 308-643
General Equipment: Hydraulic Press

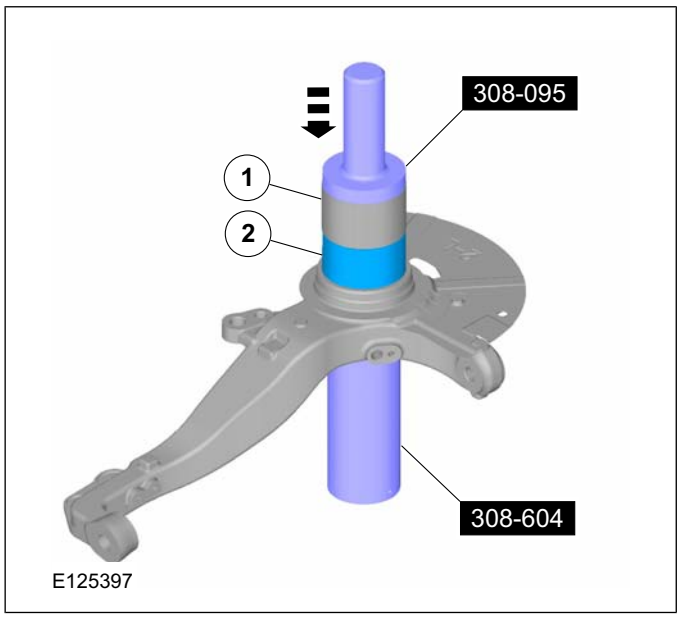


Installation

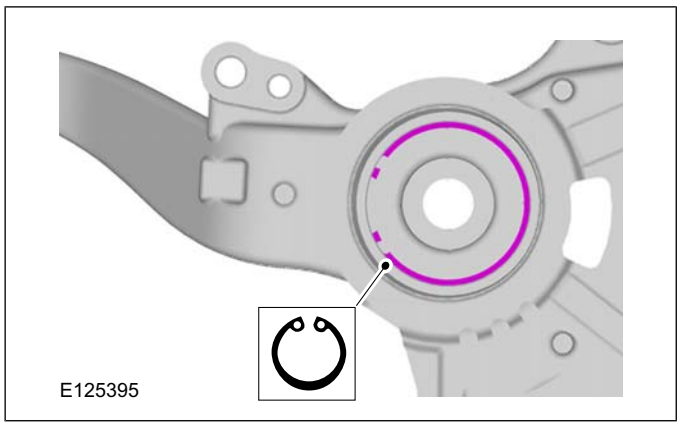
1. NOTE: Make sure that the sensor ring is correctly located.

- 1. Old Front wheel bearing. 2. New Front wheel bearing.
- Press and install the new wheel bearing.

  Special Tool(s): 308-095, 308-604
  General Equipment: Hydraulic Press

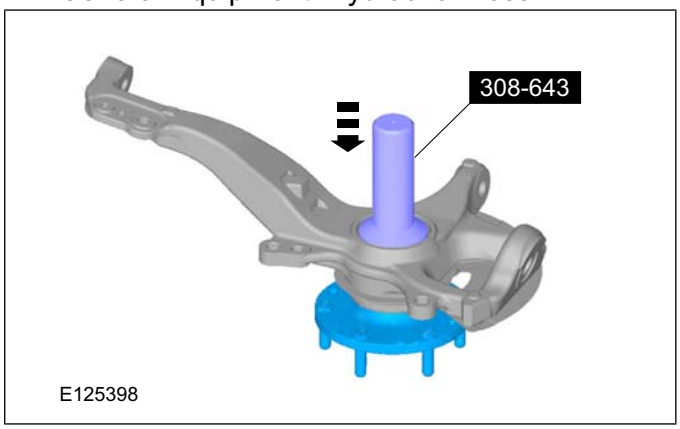


2.



REMOVAL AND INSTALLATION

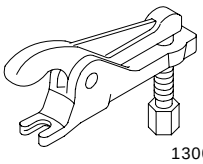
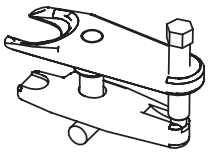
3. Special Tool(s): 308-643
General Equipment: Hydraulic Press



REMOVAL AND INSTALLATION

Wheel Knuckle — 2WD(14 343 0)

Special Tool(s)

 13005	211-020 Separator, Ball Joint
 E139377	49-T028-3A0 Remover, Ball Joint Puller Set

Removal

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

1. **CAUTIONS:**

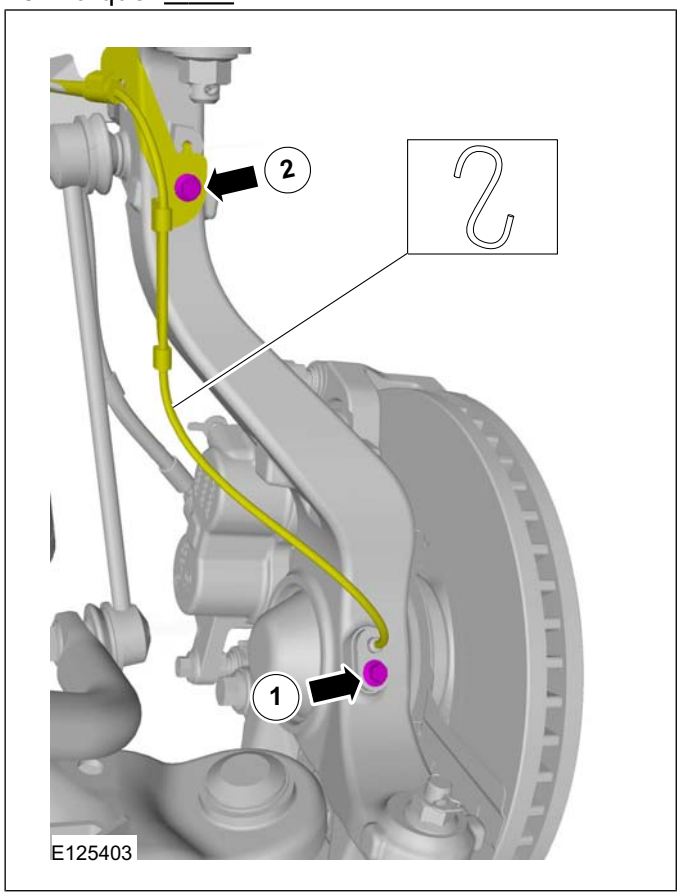
   Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

   Performing the following procedures without first removing the ABS wheel-speed sensor may possibly cause an open circuit in the harness if it is pulled by mistake. Before performing the following procedures, remove the ABS wheel-speed sensor (axle side) and fix it to an appropriate place where the sensor will not be pulled by mistake while the vehicle is being serviced.

   Refer to: 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. Torque: 7 Nm



4. **WARNING: Make sure that no load is placed on the brake hose.**

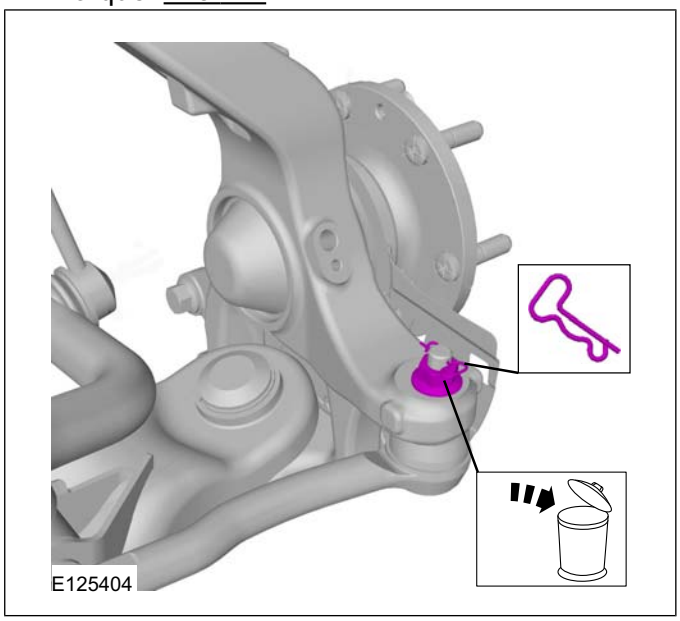
   Refer to: Brake Disc (206-03 Front Disc Brake, Removal and Installation).

5. **WARNING: Make sure that a new nut is installed.**

REMOVAL AND INSTALLATION

CAUTION: Make sure that ball joint does not rotate.

Torque: 125 Nm



6. **CAUTIONS:**

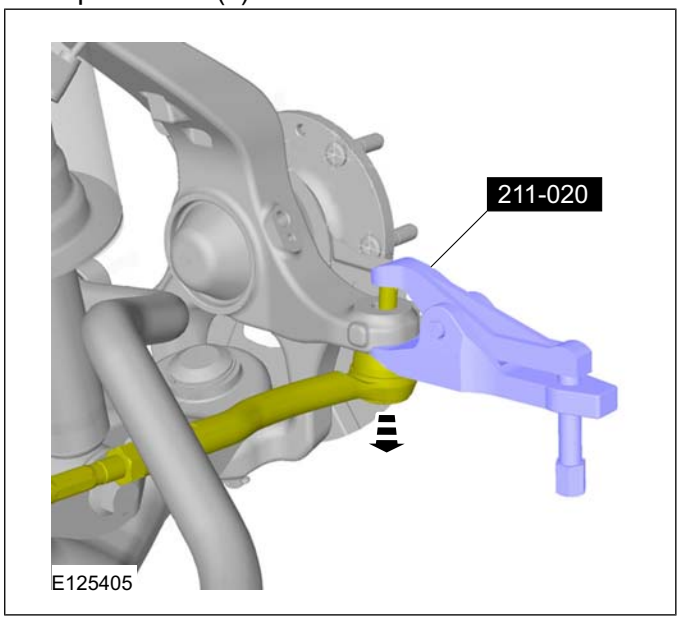
Do not use a hammer to separate the tie rod from the wheel knuckle or damage to the wheel knuckle can result.

Do not damage the tie-rod boot while installing the special tool.

Leave the tie-rod end retaining nut in place to protect the ball joint stud.

Protect the ball joint seal using a soft cloth to prevent damage.

Special Tool(s): 211-020



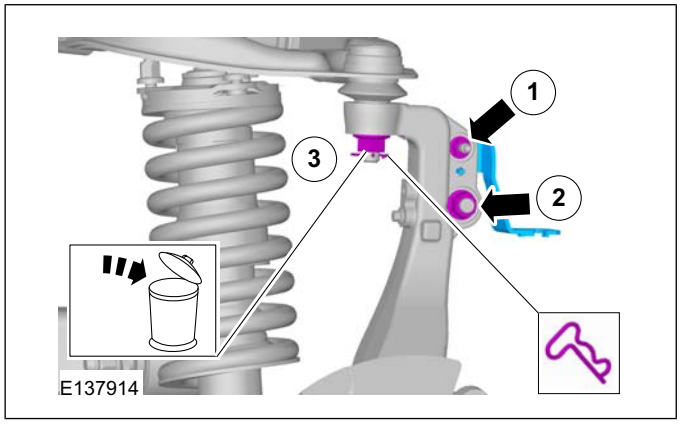
7. **WARNING: Make sure that a new nut is installed.**

CAUTIONS:

Use suitable packing material to prevent damage to the component.

Make sure that the ball joint ball does not rotate.

1. Torque: 14 Nm
2. Torque: 80 Nm
3. Torque: 65 Nm



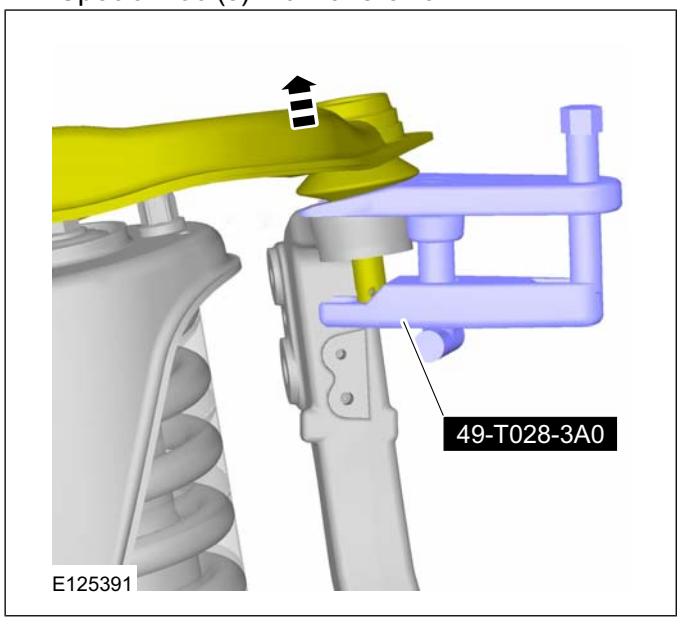
8. **CAUTIONS:**

Protect the ball joint seal using a soft cloth to prevent damage.

Do not damage the ball joint boot while installing the special tool.

Protect the ball joint seal using a soft cloth to prevent damage.

Special Tool(s): 49-T028-3A0

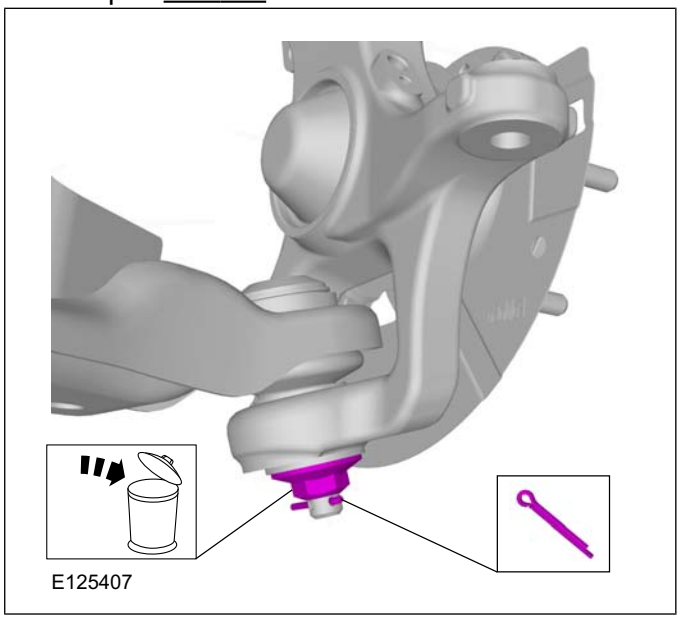


REMOVAL AND INSTALLATION

9. **WARNING: Make sure that a new nut is installed.**

   NOTE: Make sure that the wheel knuckle is correctly secured.

   Torque: 175 Nm

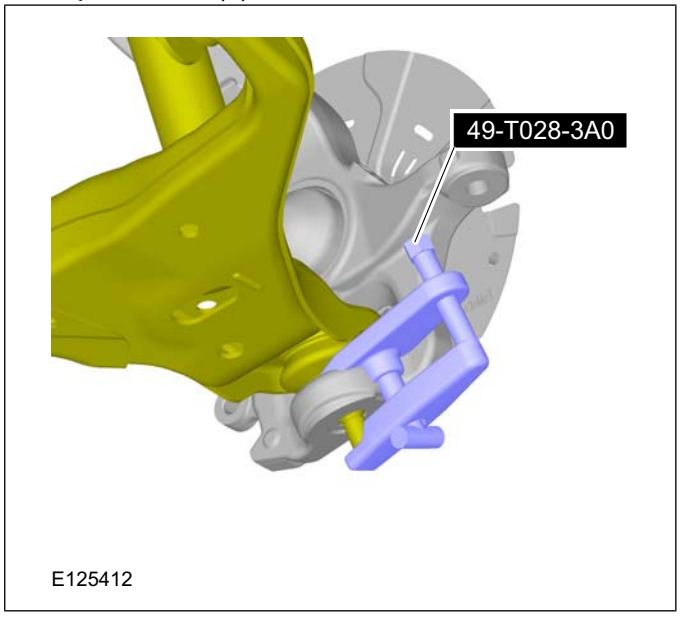


10. **CAUTIONS:**

    Do not use a hammer to separate the ball joint from the wheel knuckle or damage to the wheel knuckle can result.

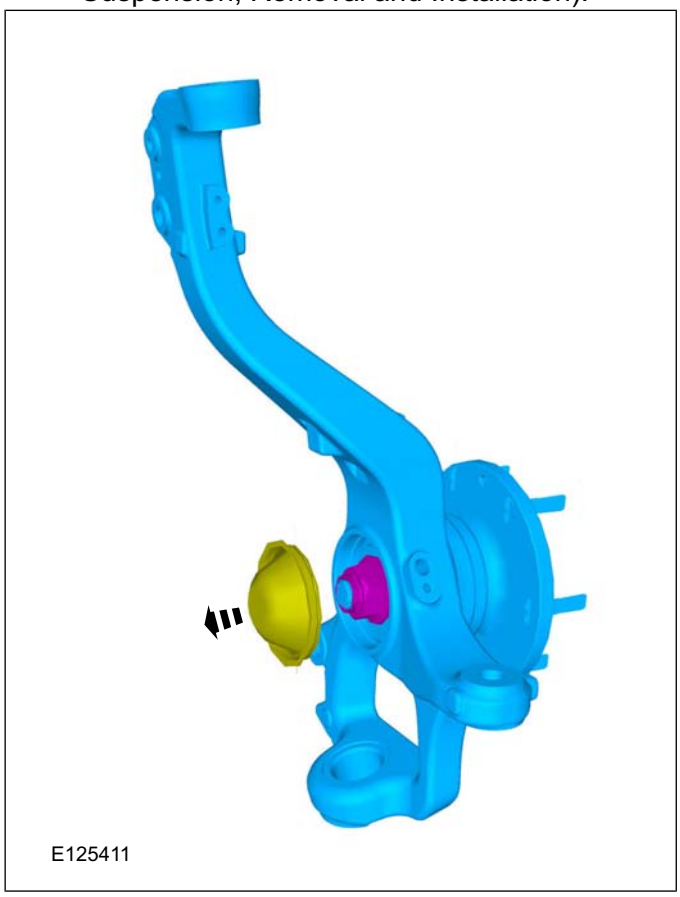
    Do not damage the ball joint boot while installing the special tool.

    Special Tool(s): 49-T028-3A0



11. **NOTE:** This step is only necessary when installing a new component.

    Refer to: Front Wheel Bearing (204-01 Front Suspension, Removal and Installation).



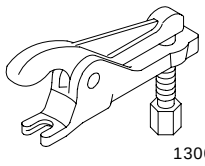
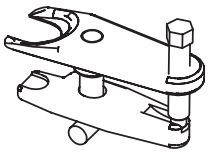
Installation

1. To install, reverse the removal procedure.
2. Refer to: Front Toe Adjustment (204-00 Suspension System - General Information, General Procedures).

REMOVAL AND INSTALLATION

Wheel Knuckle — 4WD(14 343 0)

Special Tool(s) / General Equipment

 13006	211-020 Separator, Ball Joint
 E139377	49-T028-3A0 Remover, Ball Joint Puller Set
Puller	
Two Leg Puller	

Removal

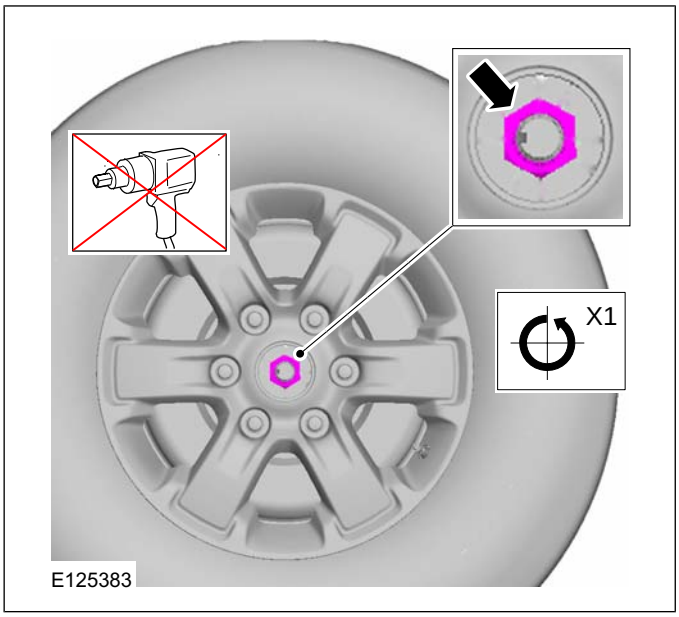
NOTE: Removal steps in this procedure may contain installation details.

1. **CAUTIONS:**

   Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

   Performing the following procedures without first removing the ABS wheel-speed sensor may possibly cause an open circuit in the harness if it is pulled by mistake. Before performing the following procedures, remove the ABS wheel-speed sensor (axle side) and fix it to an appropriate place where the sensor will not be pulled by mistake while the vehicle is being serviced.

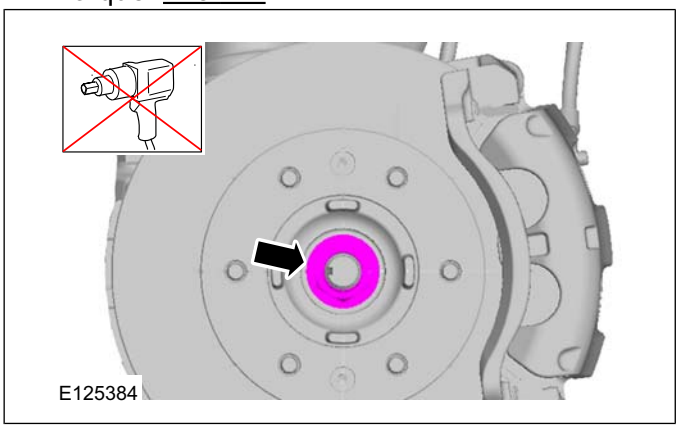
   Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).

2. 

3. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

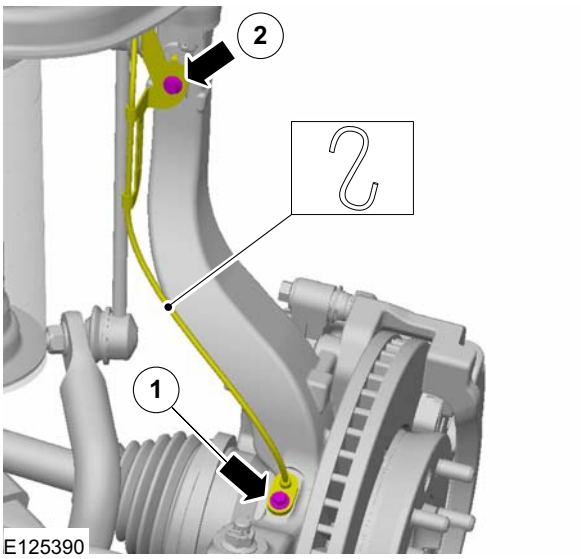
4. **CAUTION: If the outer constant velocity (CV) joint boot is damaged a new halfshaft must be installed.**

   Torque: 275 Nm



REMOVAL AND INSTALLATION

5. Torque: 7 Nm

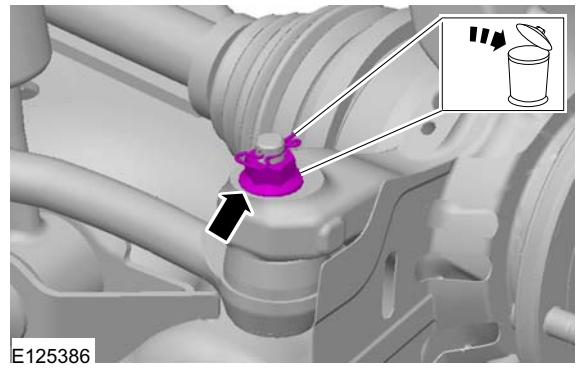


6. **WARNING: Make sure that no load is placed on the brake hose.**

   Refer to: Brake Disc (206-03 Front Disc Brake, Removal and Installation).

7. **CAUTION: Make sure that the ball joint ball does not rotate.**

   Torque: 125 Nm



8. CAUTIONS:

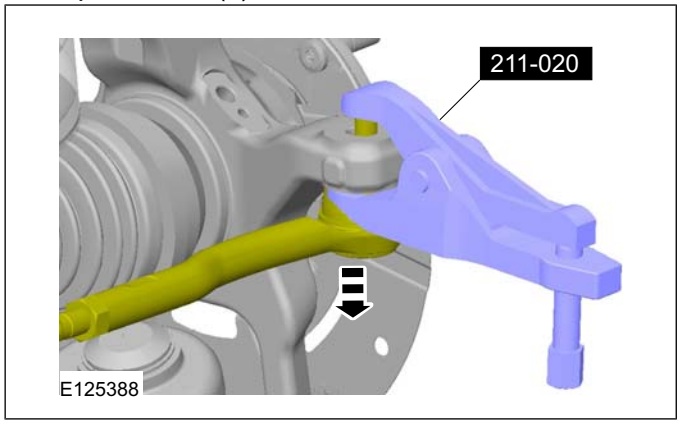
   Do not use a hammer to separate the tie rod from the wheel knuckle or damage to the wheel knuckle can result.

   Do not damage the tie-rod boot while installing the special tool.

   Leave the tie-rod end retaining nut in place to protect the ball joint stud.

Protect the ball joint seal using a soft cloth to prevent damage.

Special Tool(s): 211-020



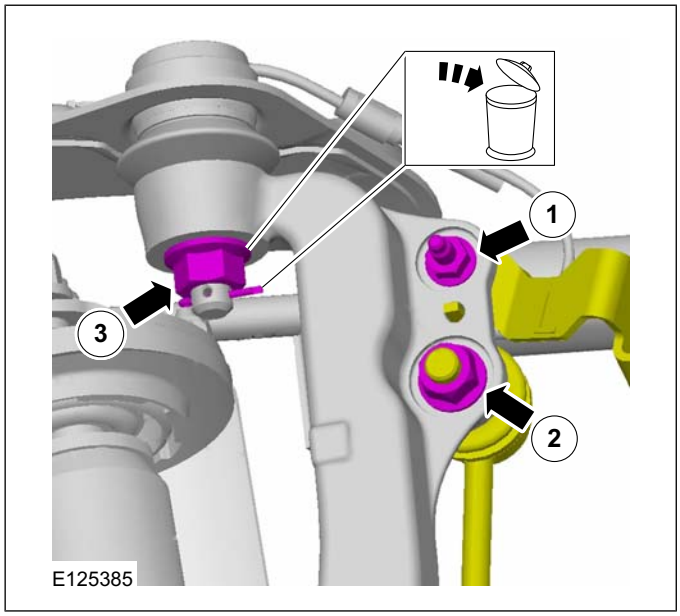
9. **WARNING: Make sure that a new nut is installed.**

   CAUTIONS:

   Use suitable packing material to prevent damage to the component.

   Make sure that the ball joint ball does not rotate.

   1. Torque: 14 Nm
   2. Torque: 80 Nm
   3. Torque: 65 Nm



10. CAUTIONS:

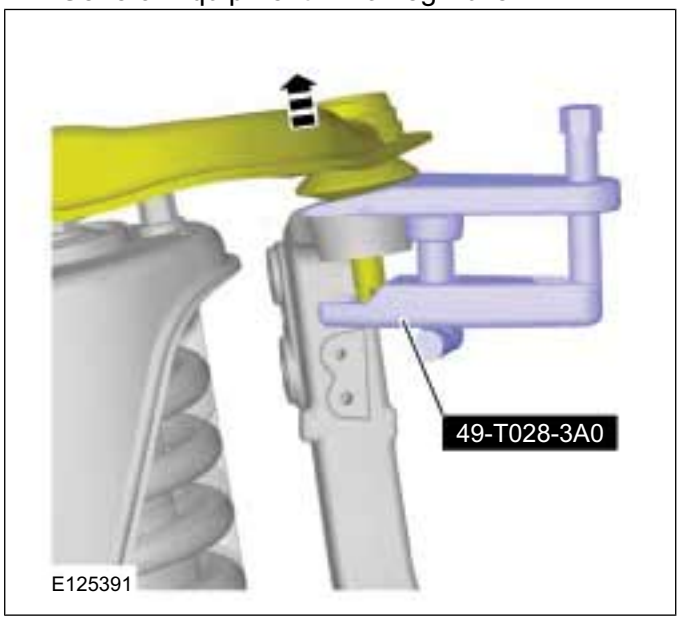
    Do not use a hammer to separate the ball joint from the wheel knuckle or damage to the wheel knuckle can result.

    Do not damage the ball joint boot while installing the special tool.

REMOVAL AND INSTALLATION

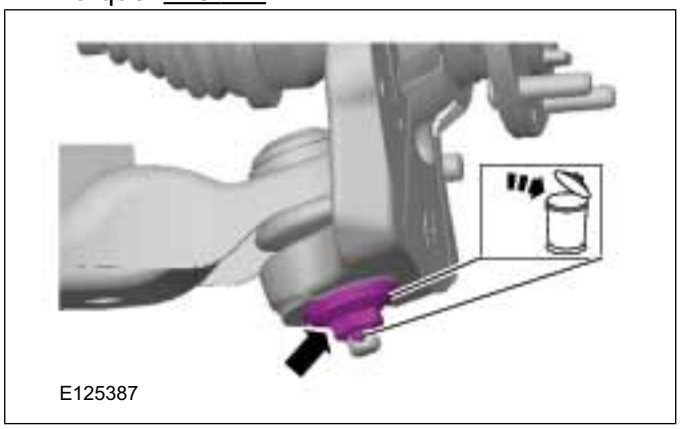
Protect the ball joint seal using a soft cloth to prevent damage.

Special Tool(s): 49-T028-3A0
General Equipment: Two Leg Puller



11. **NOTE:** Make sure that the wheel knuckle and halfshaft are correctly secured.

Torque: 175 Nm

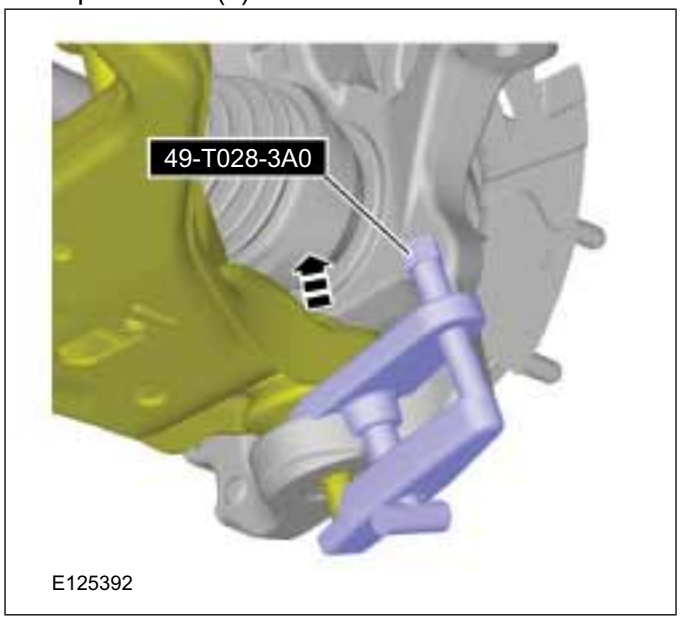


12. **CAUTIONS:**

Do not use a hammer to separate the ball joint from the wheel knuckle or damage to the wheel knuckle can result.

Do not damage the ball joint boot while installing the special tool.

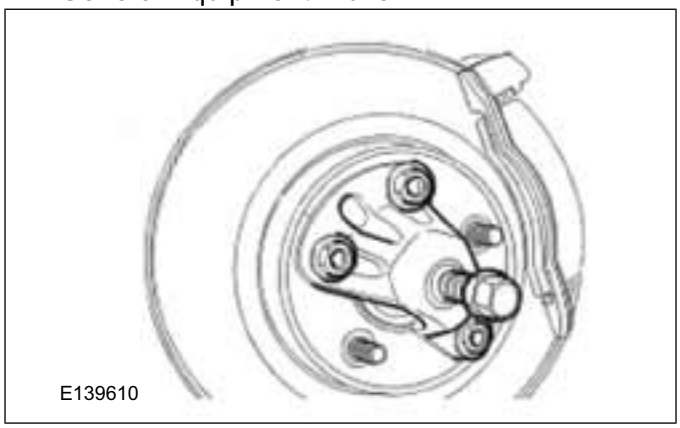
Special Tool(s): 49-T028-3A0



13. **CAUTION: Do not use a hammer to separate the outboard CV joint from the hub. Damage to the threads and internal CV joint components can result.**

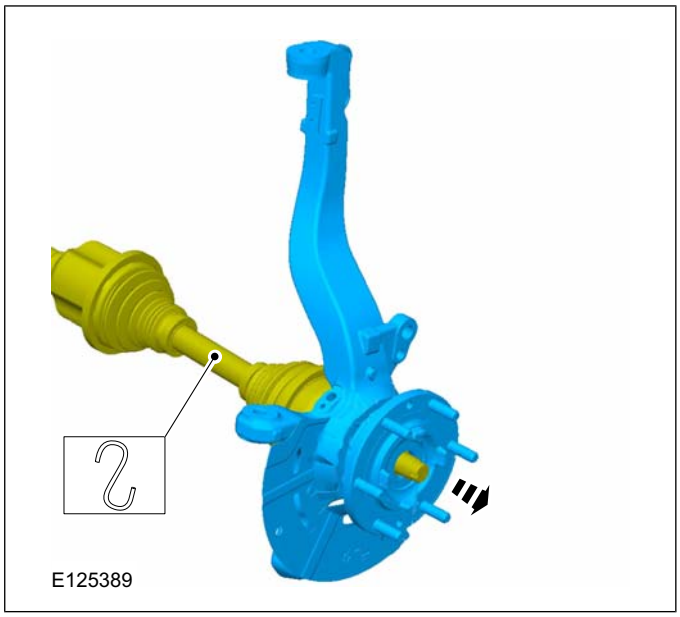
Using the special tool, press the outboard CV joint until it is loose in the hub.

General Equipment: Puller



REMOVAL AND INSTALLATION

14. **CAUTION: Do not damage the axle shaft oil seal or the machined sealing surface on the outboard CV joint housing.**



Installation

1. **WARNINGS:**

   Install a new lower arm ball joint retaining nut. Failure to follow this instruction may result in personal injury.

   Install a new tie-rod end retaining nut. Failure to follow this instruction may result in personal injury.

   CAUTION: Make sure that the ball joint ball does not rotate.

   NOTE: The dust cover does not need to be removed unless it is being replaced. Mark the dust cover and steering knuckle for proper installation.

   Refer to: Front Toe Adjustment (204-00 Suspension System - General Information, General Procedures).

2. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Shock Absorber

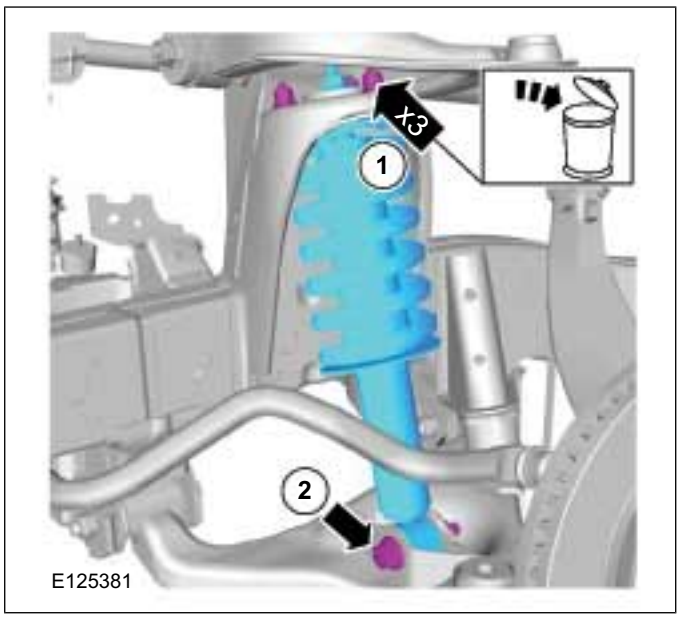
Removal

WARNING: All vehicles are equipped with gas-pressurized shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component servicing. Failure to follow these instructions may result in personal injury.

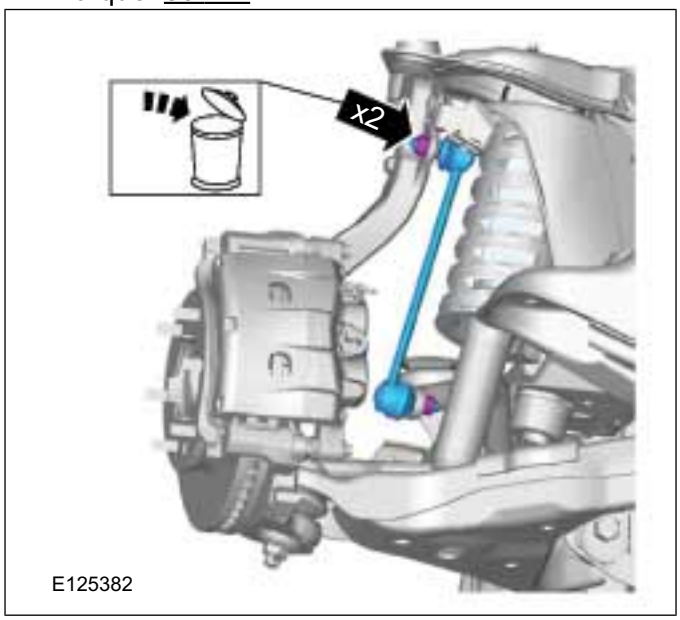
CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

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

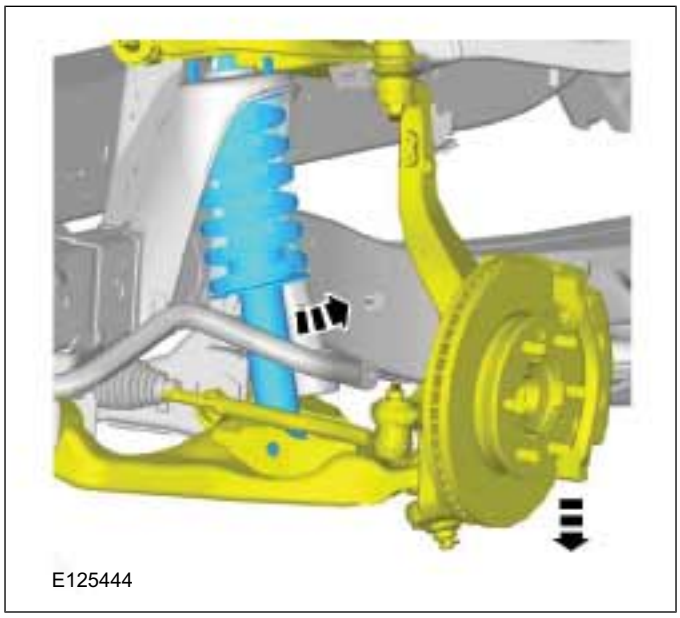
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
2. 1. Torque: 30 Nm
   2. Torque: 250 Nm



3. Using a suitable jack support the lower control arm near the lower ball joint.
4. Torque: 80 Nm



5. Lower the jack support to lower the control arm.
6.



Installation

CAUTION: Before tightening any suspension bushing fasteners, use a suitable jack to raise the suspension.

REMOVAL AND INSTALLATION

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Lower Arm(14 706 0; 14 707 0; 14 709 0)

General Equipment

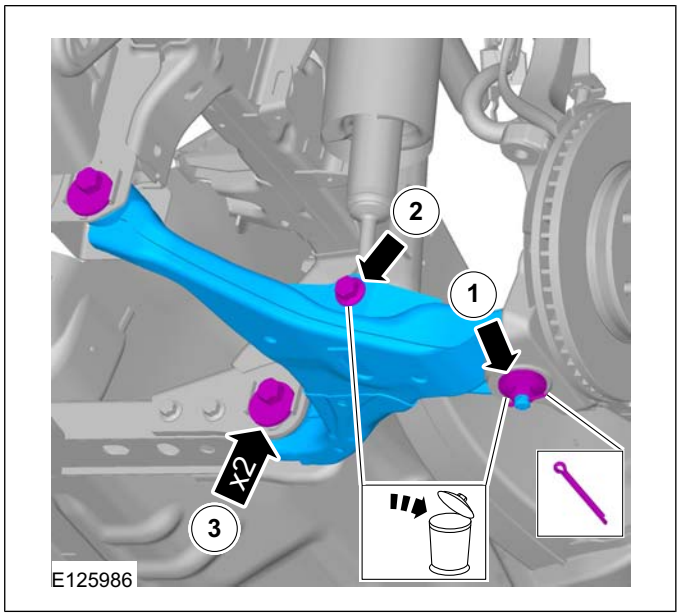
Two Leg Puller

Removal

CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

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

1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
2. 1. Torque: 85 Nm
   2. Torque: 57 Nm
   3. Torque: 67 Nm



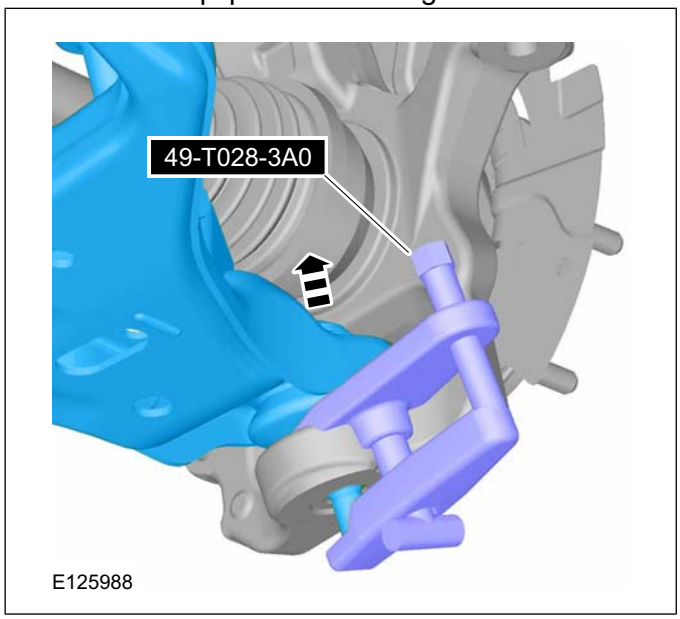
3. **CAUTIONS:**

Do not damage the ball joint boot while installing the special tool.

Do not use a hammer to separate the ball joint from the wheel knuckle or damage to the wheel knuckle can result.

Make sure that the wheel knuckle is correctly secured.

General Equipment: Two Leg Puller



Installation

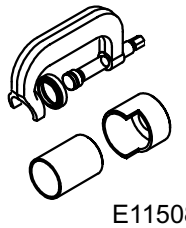
CAUTION: Before tightening any suspension bushing fasteners, use a suitable jack to raise the suspension.

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Upper Arm

Special Tool(s) / General Equipment

 E115081	204-288A Remover/Installer, Ball Joint

Special Tool(s) / General Equipment

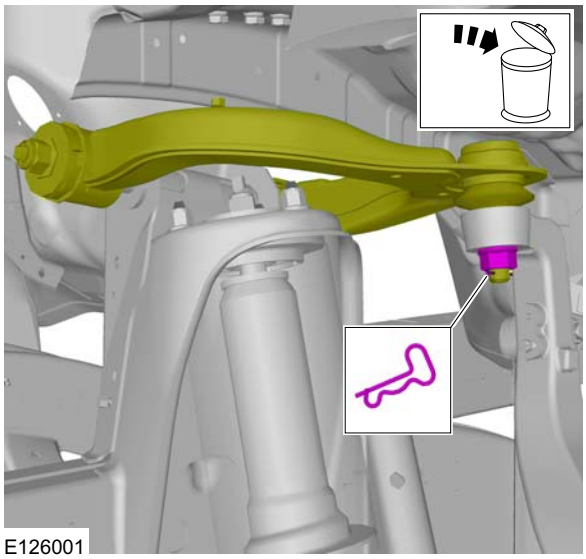
Two Leg Puller

Removal

CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

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

1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
2. Refer to: Front Wheel Speed Sensor (206-09 Anti-Lock Control, Removal and Installation).
3. Torque: 70 Nm


E126001

4. **CAUTIONS:**

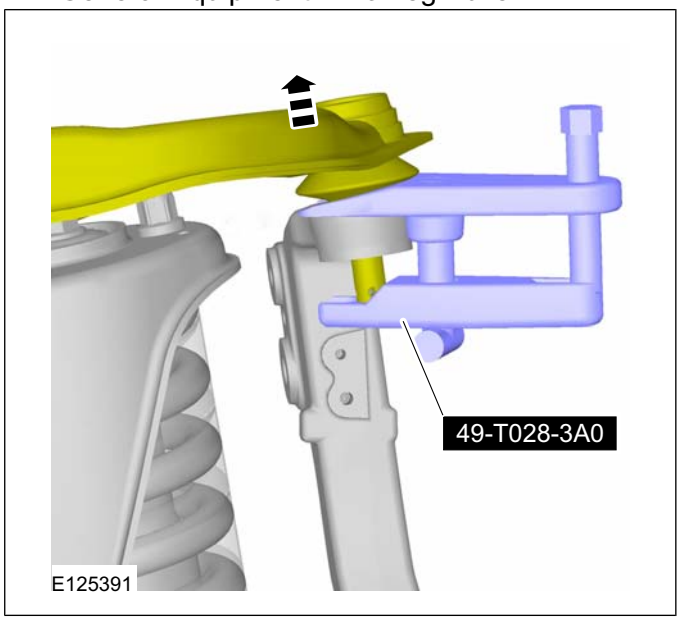
   Do not use a hammer to separate the ball joint from the wheel knuckle or damage to the wheel knuckle can result.

   Do not damage the ball joint boot while installing the special tool.

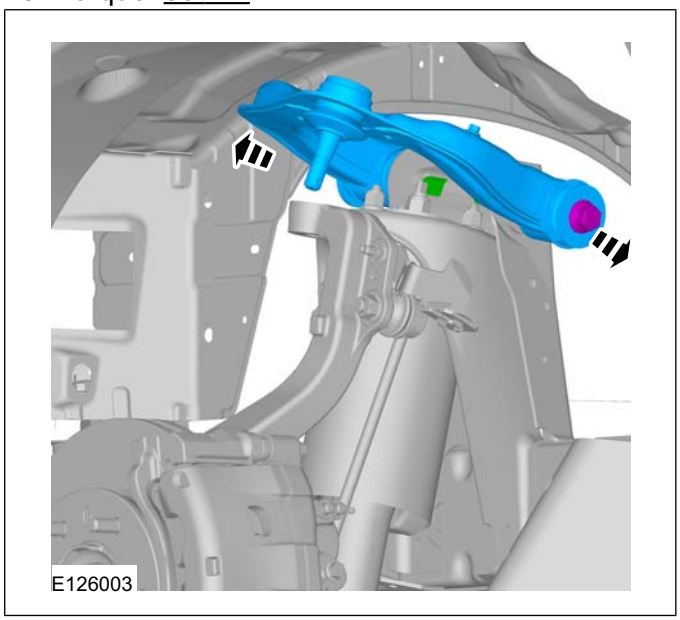
REMOVAL AND INSTALLATION

Make sure that the knuckle assembly is secured secured with suitable retaining straps.

Remove the Special Tool(s): 204-288A
General Equipment: Two Leg Puller



5. Torque: 80 Nm



Installation

CAUTION: Before tightening any suspension bushing fasteners, use a suitable jack to raise the suspension.

1. To install, reverse the removal procedure.

SECTION 204-02 Rear Suspension

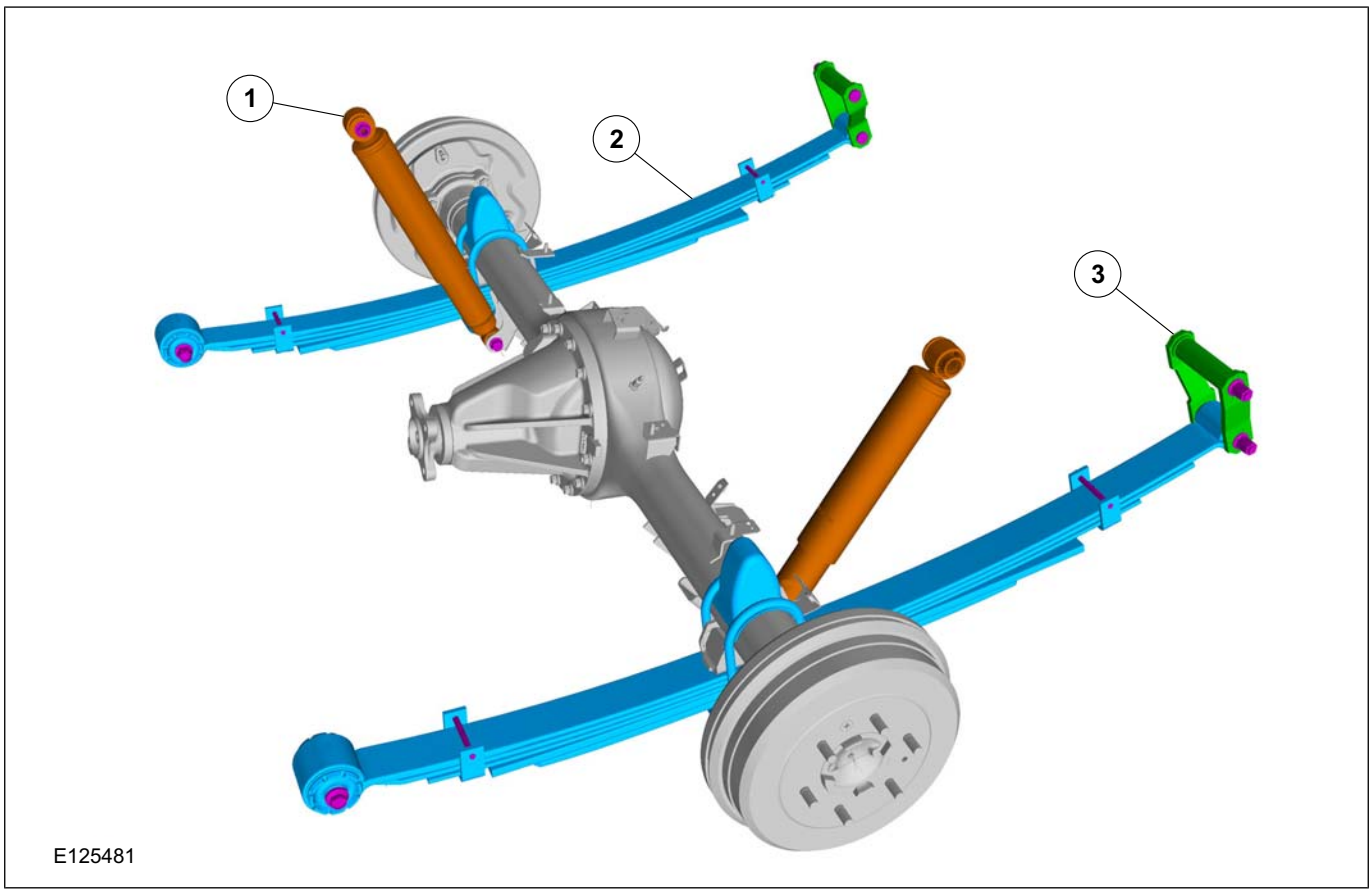
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Rear Suspension

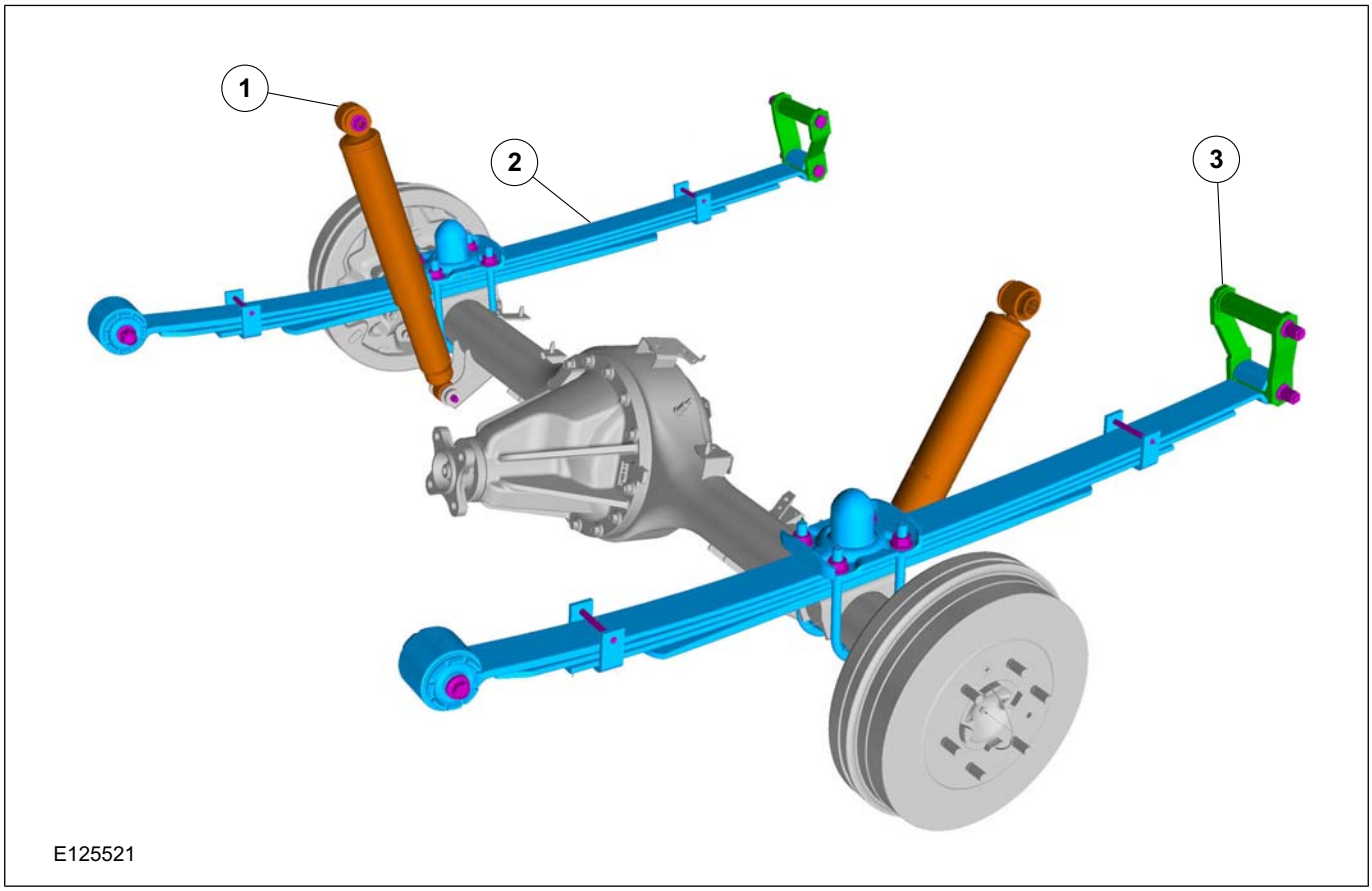
4x2



Item	Description
1	Shock absorber
2	Leaf Spring
3	Shackle Assembly

DESCRIPTION AND OPERATION

Hi-Rider and 4x4



Item	Description
1	Shock absorber
2	Leaf Spring
3	Shackle Assembly

REMOVAL AND INSTALLATION

Spring(15 621 0)

Removal

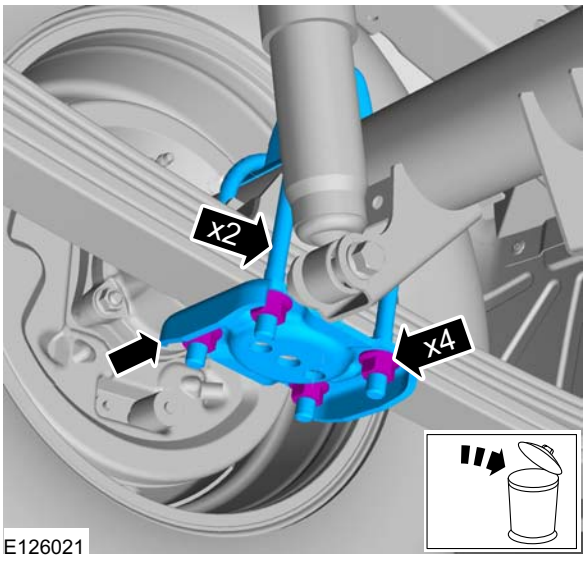
CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

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

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

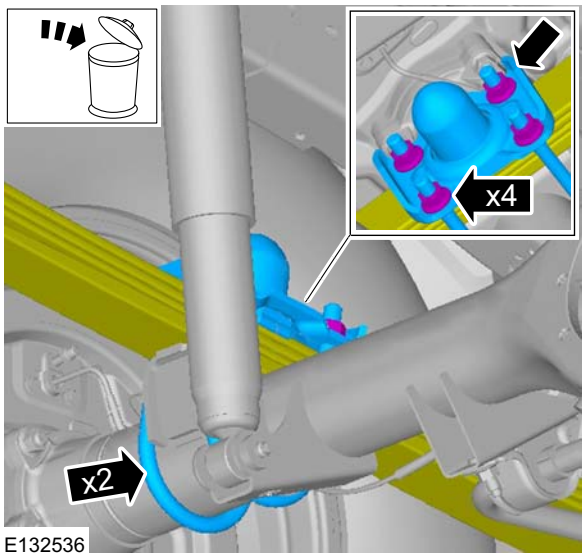
4x2

2. Torque: 120 Nm



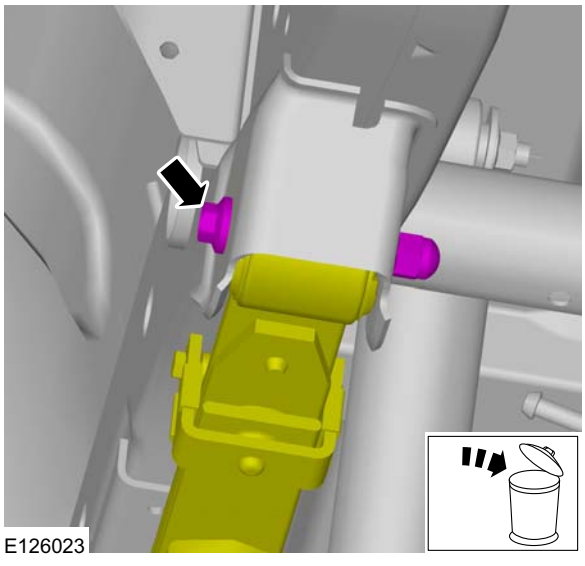
4x4

3. Torque: 120 Nm



All vehicles

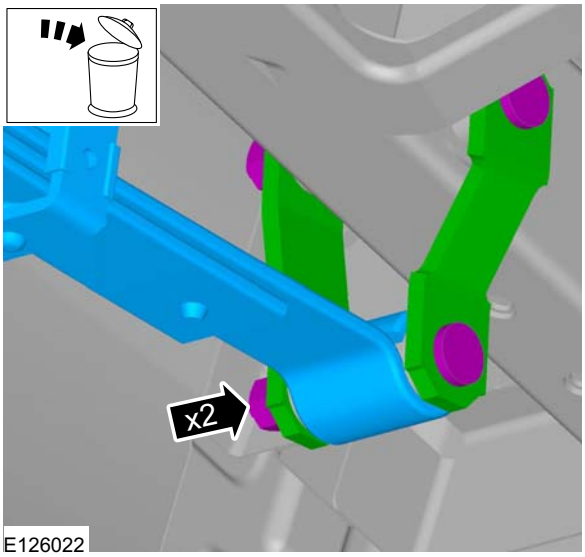
4. Torque: 162 Nm



REMOVAL AND INSTALLATION

5. **NOTE:** Note the position of the bracket.

   Torque: 103 Nm



Installation

CAUTION: Install new spring locknuts and U-bolt nuts.

NOTE: Final tightening of the rear suspension components should be carried out when the vehicle weight is on the road wheels.

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

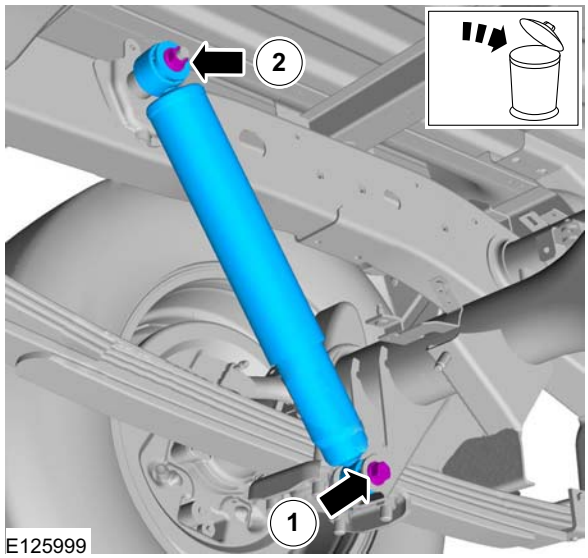
Rear Shock Absorber(15 791 0)

Removal

CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

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

1. Torque:
   - 1. Torque: 47 Nm
   - 2. Torque: 47 Nm



Installation

1. **NOTE:** Do not fully tighten the shock absorber lower mounting bolt. The final tightening should be carried out when the vehicle weight is on the road wheels.

2. To install, reverse the removal procedure.

SECTION 204-04 Wheels and Tires

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

Wheel and Tire

Removal

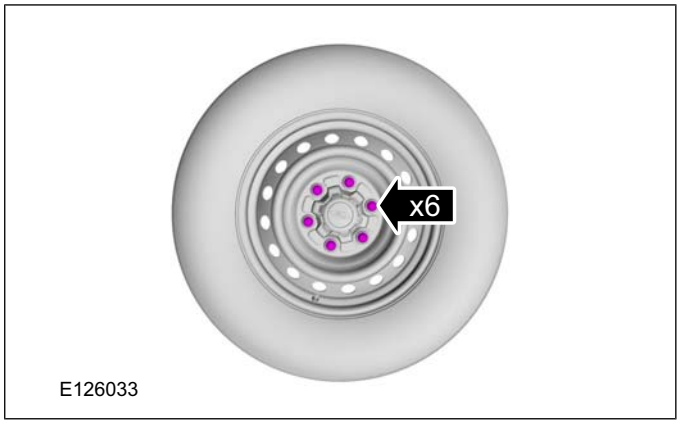
CAUTIONS:

Do not use heat to loosen a seized wheel nut.

Do not use power tools on locking wheel nuts.

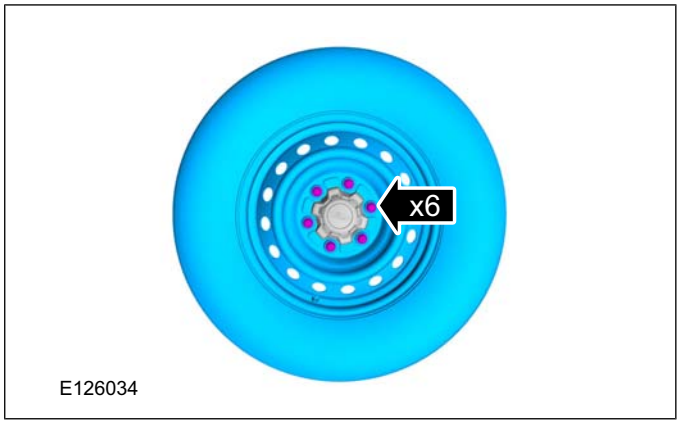
1. Loosen

1.



2. For additional information, refer to: Jacking (100-02 Jacking and Lifting, Description and Operation) / Lifting (100-02 Jacking and Lifting, Description and Operation).

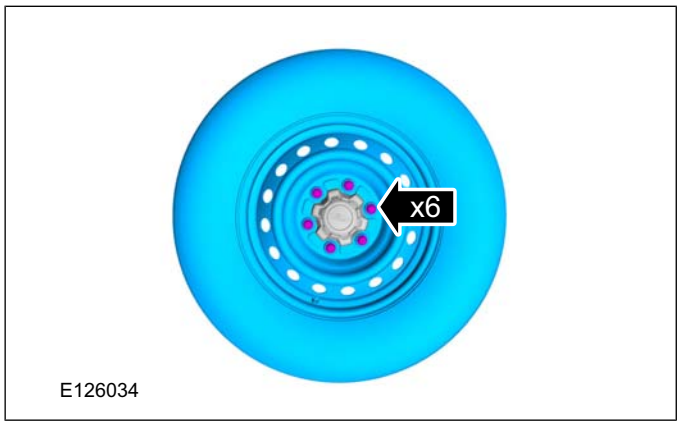
3.



Installation

1. WARNING: Make sure that the mating faces are clean and free of corrosion and foreign material

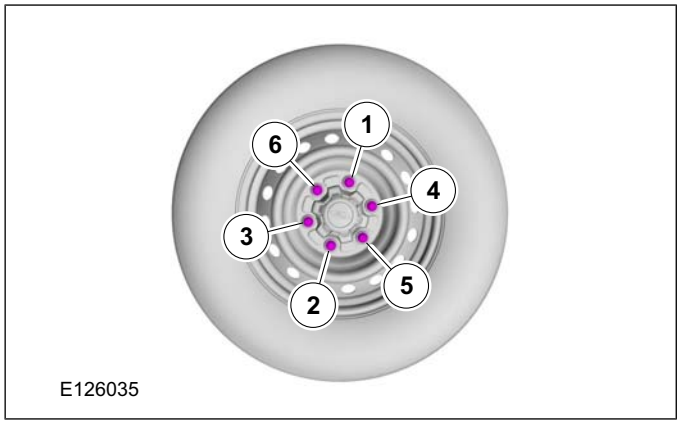
NOTE: Only tighten the nuts finger tight at this stage.



2. Lower the vehicle.

3. When installing the wheels and tires, tighten the wheel nuts in a criss-cross pattern to the following tightening torque.

- Tightening torque 88.2—117.6 Nm {9.00—11.99 Kgf·m, 65.06—86.73 ft·lbf}.



SECTION 205-01 Driveshaft

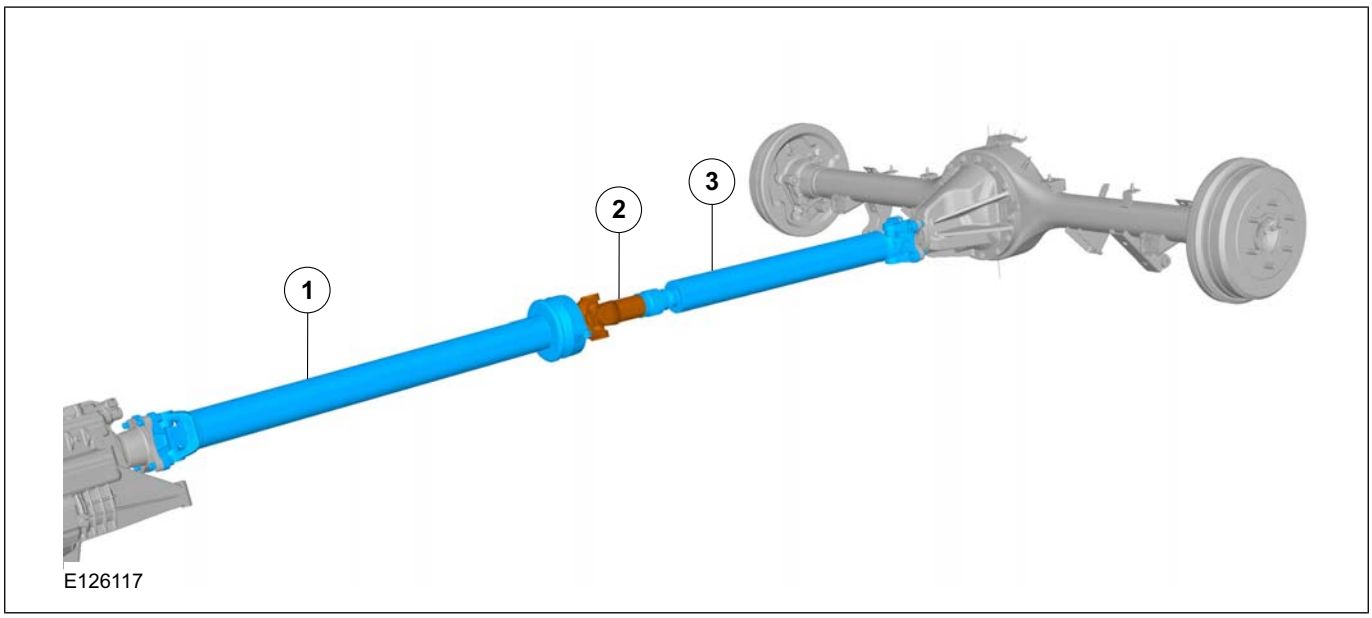
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

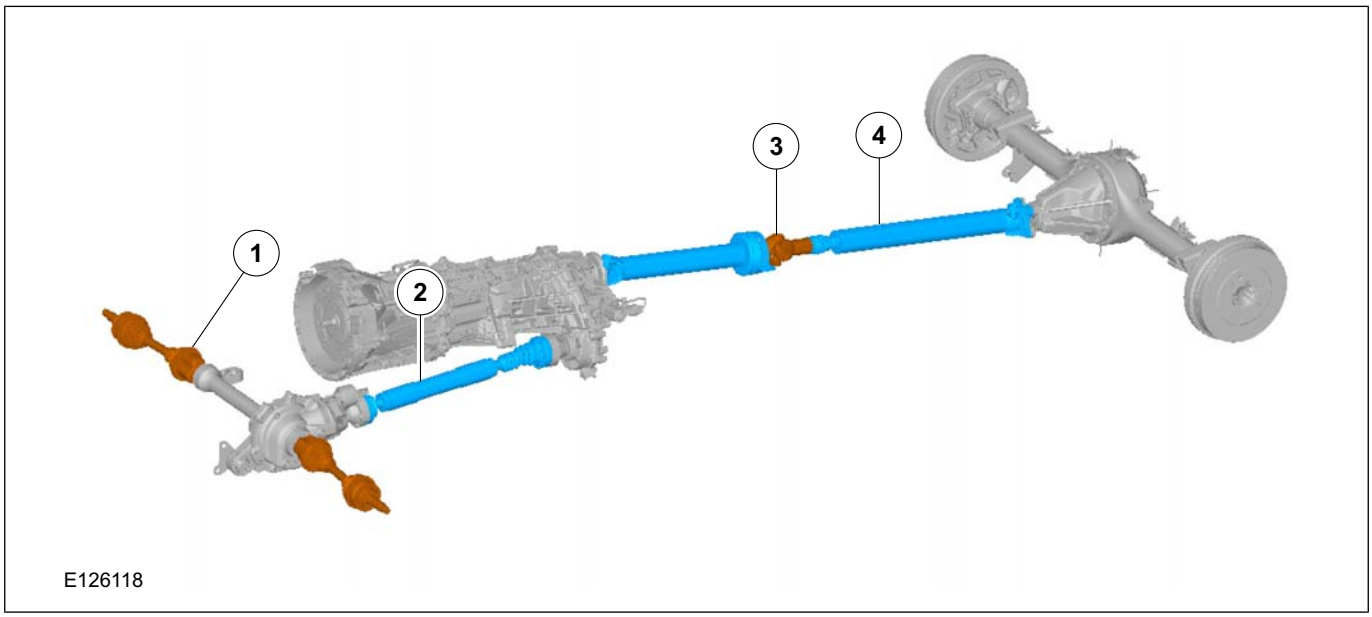
Driveshaft

4x2



Item	Description
1	Coupling shaft
2	Universal joint
3	Rear propeller shaft

4x4



Item	Description
1	Front half shafts
2	Front propeller shaft

Item	Description
3	Universal joint
4	Rear propeller shaft

REMOVAL AND INSTALLATION

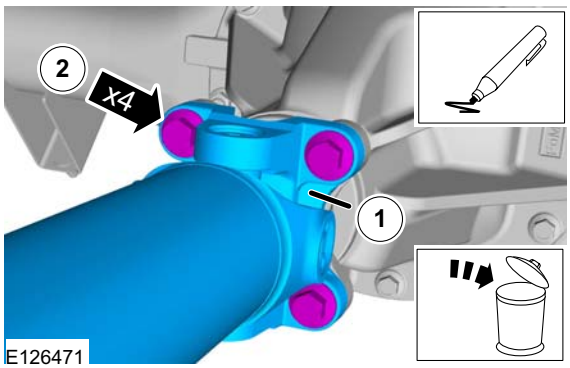
Driveshaft — 2WD(15 514 0)

Removal

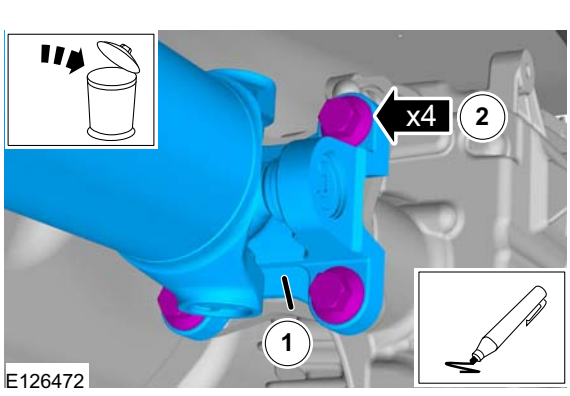
WARNING: The normal operating temperature of the exhaust system is very high. Never attempt to remove any part of the system until it has cooled. Be especially careful when working around the catalytic converters. The temperature of the converter rises to a high level after only a few minutes of engine operation. Failure to follow these instructions may result in personal injury.

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

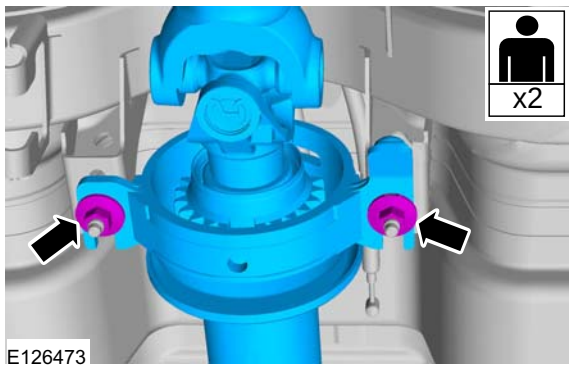
1. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
2. **CAUTION: Do not reuse the bolts, install new bolts or damage to the vehicle may occur.**
   Torque: 140 Nm



3. **CAUTION: Do not reuse the bolts, install new bolts or damage to the vehicle may occur.**
   Torque: 140 Nm



4. Torque: 50 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Driveshaft — 4WD(15 514 0)

Removal

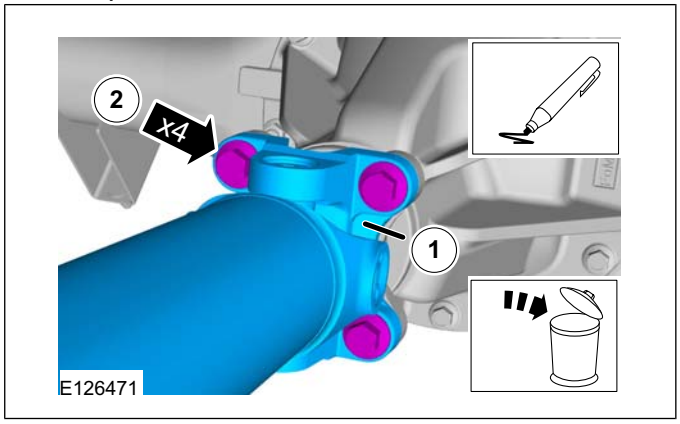
WARNING: The normal operating temperature of the exhaust system is very high. Never attempt to remove any part of the system until it has cooled. Be especially careful when working around the catalytic converters. The temperature of the converter rises to a high level after only a few minutes of engine operation. Failure to follow these instructions may result in personal injury.

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

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

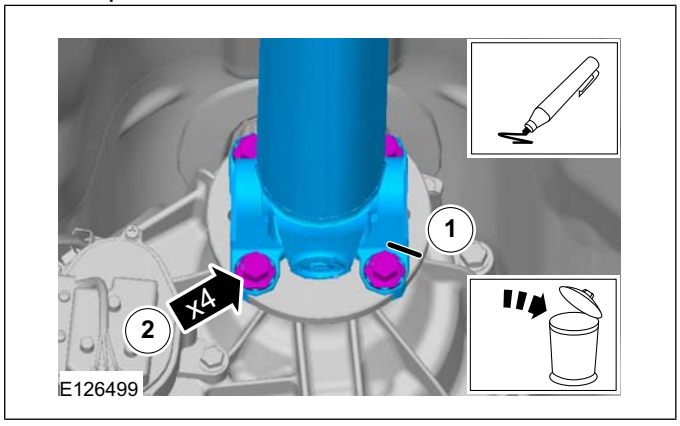
2. **CAUTION: Do not reuse the bolts, install new bolts or damage to the vehicle may occur.**

   Torque: 140 Nm

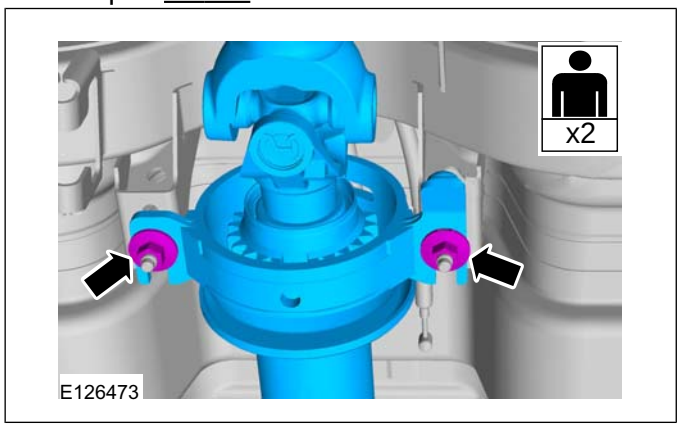


3. **CAUTION: Do not reuse the bolts, install new bolts or damage to the vehicle may occur.**

   Torque: 140 Nm



4. Torque: 50 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Driveshaft — 4WD

Removal

CAUTIONS:

Always disconnect the front driveshaft from the transfer case first. Otherwise, the weight of the driveshaft can pinch the boot between the driveshaft and the constant velocity (CV) joint flange which can cause the boot to tear.

It is possible to fit the driveshaft incorrectly. Note the orientation before removal.

NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

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

1. **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

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

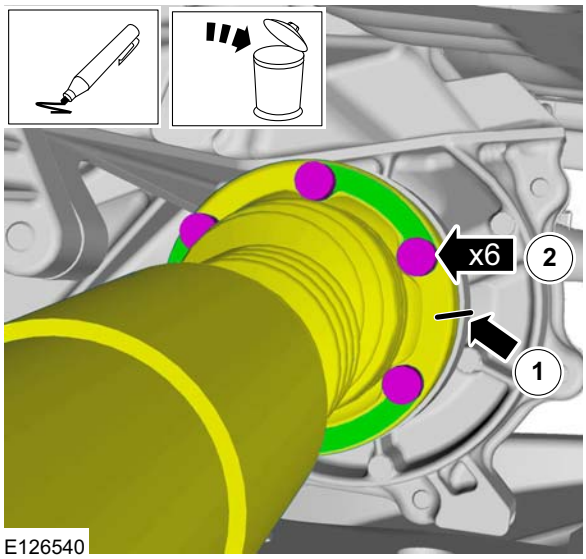
2. **CAUTIONS:**

   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Do not reuse the bolts, install new bolts or damage to the vehicle may occur.

NOTE: Lock the driveshaft before removing the bolts to avoid slipping.

Torque: 15 Nm



3. **CAUTIONS:**

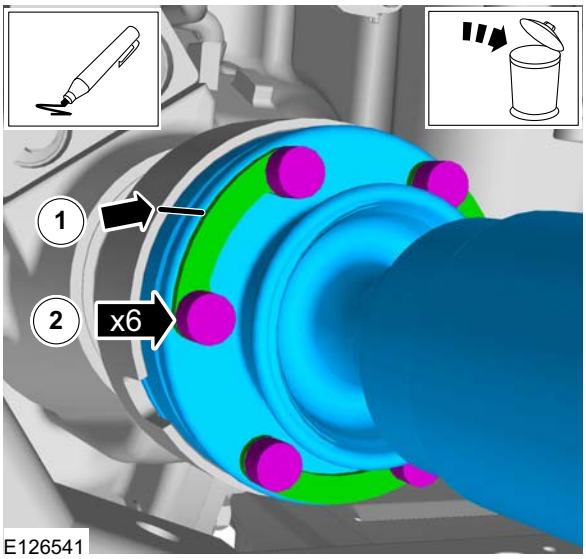
   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Do not reuse the bolts, install new bolts or damage to the vehicle may occur.

REMOVAL AND INSTALLATION

NOTE: Lock the driveshaft before removing the bolts to avoid slipping.

Torque: 15 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 205-02 Rear Drive Axle/Differential

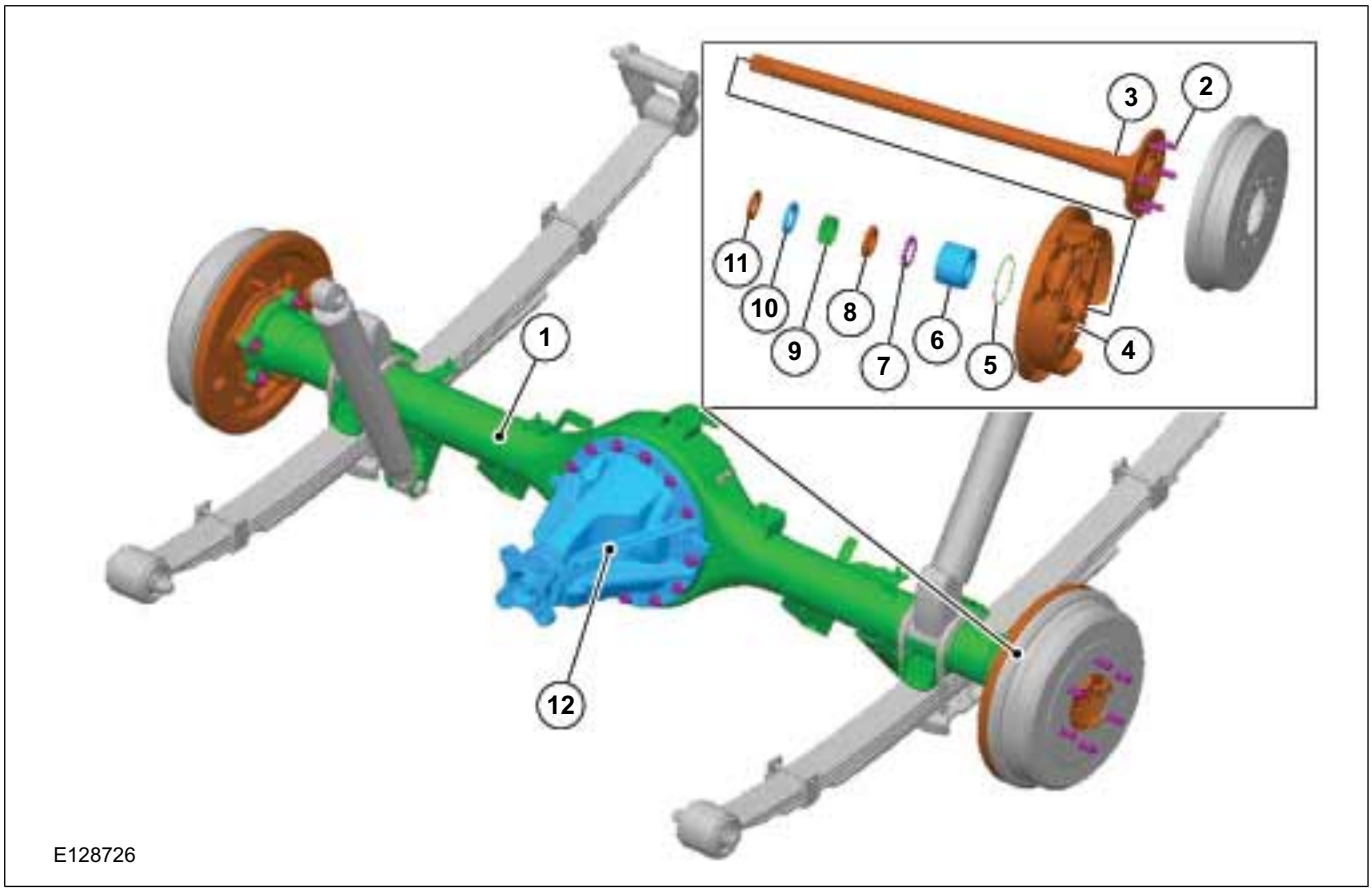
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Rear Drive Axle and Differential

Hi-Rider 4x2

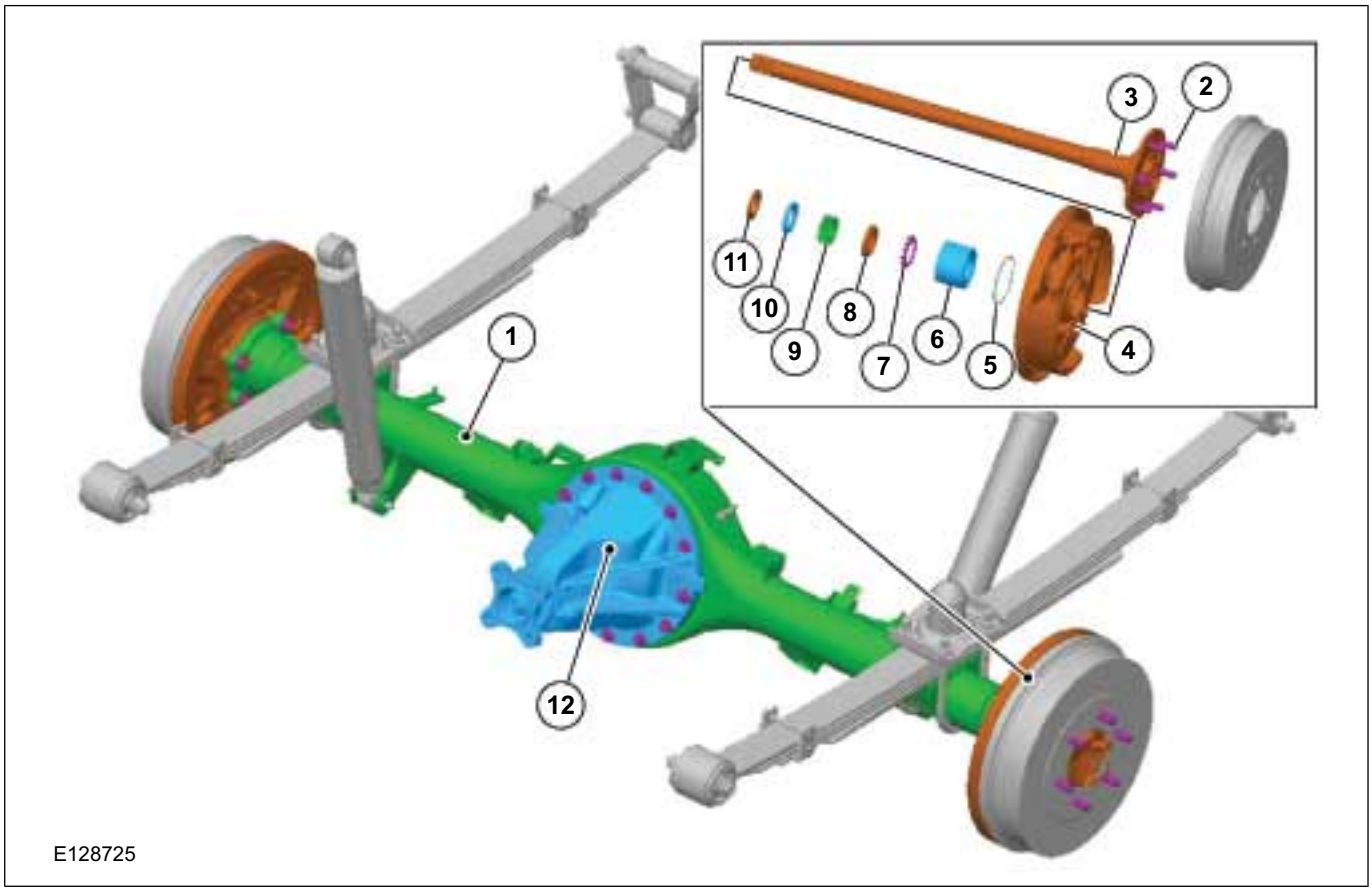


Item	Description
1	Axle housing
2	Wheel stud
3	Axle shaft
4	Brake shoe and wheel cylinder
5	O ring
6	Bearing assembly
7	Lock washer

Item	Description
8	Bearing retainer nut
9	Tone wheel ring
10	Axle shaft guide
11	Oil seal
12	Rear differential

Hi-Rider 4x4

DESCRIPTION AND OPERATION

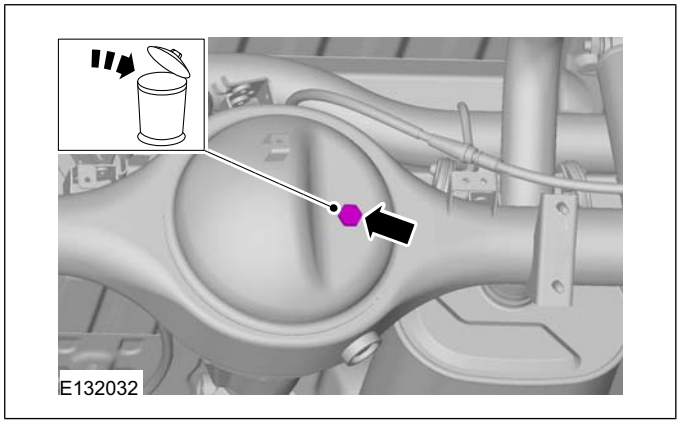


Item	Description
1	Axle housing
2	Wheel stud
3	Axle shaft
4	Brake shoe and wheel cylinder
5	O ring
6	Bearing assembly
7	Lock washer
8	Bearing retainer nut
9	Tone wheel ring
10	Axle shaft guide
11	Oil seal
12	Rear differential

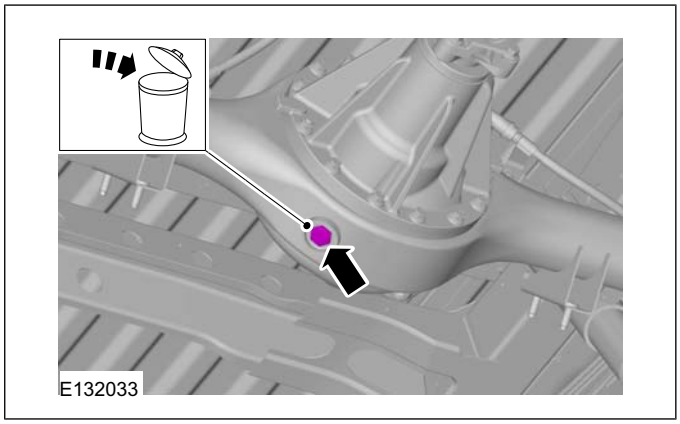
GENERAL PROCEDURES

Differential Draining and Filling

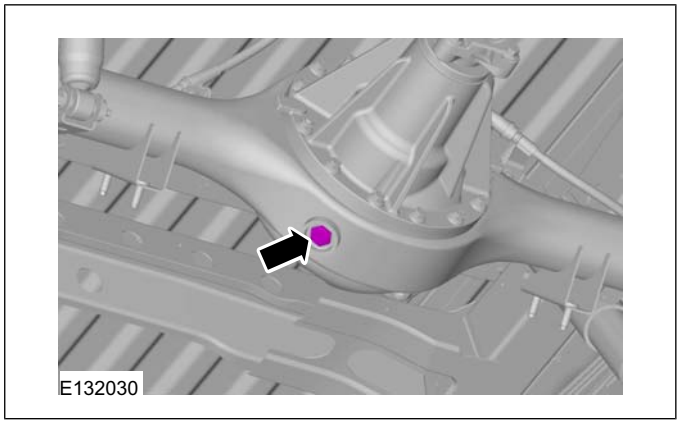
1. **For additional information, refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).**
2. **Remove the oil-fill plug.**



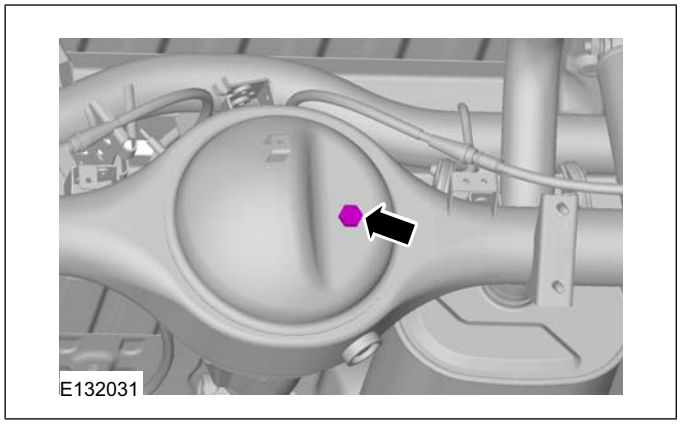
3. **Remove the drain plug and drain the oil.**



4. **Install the drain plug with a new washer and tighten.**
   - Tightening torque 45 Nm.



5. **Fill up with the specified rear axle oil to the lower edge of the filler hole.**
   - Rear differential oil [standard differential & LSD] Type: API service GL-5 Viscosity: SAE 90 Oil capacity (approx. quantity): 2.85—3.05 L.
6. **After adding the oil, perform the oil level inspection.**
7. **Install the oil-fill plug with a new washer and tighten.**
   - Tightening torque 45 Nm.



REMOVAL AND INSTALLATION

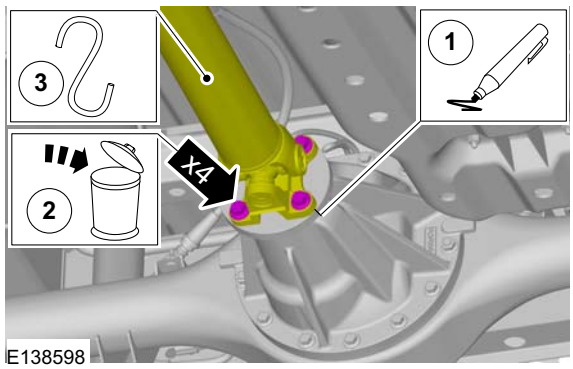
Axle Assembly — 2WD

General Equipment

Trolley 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: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. 

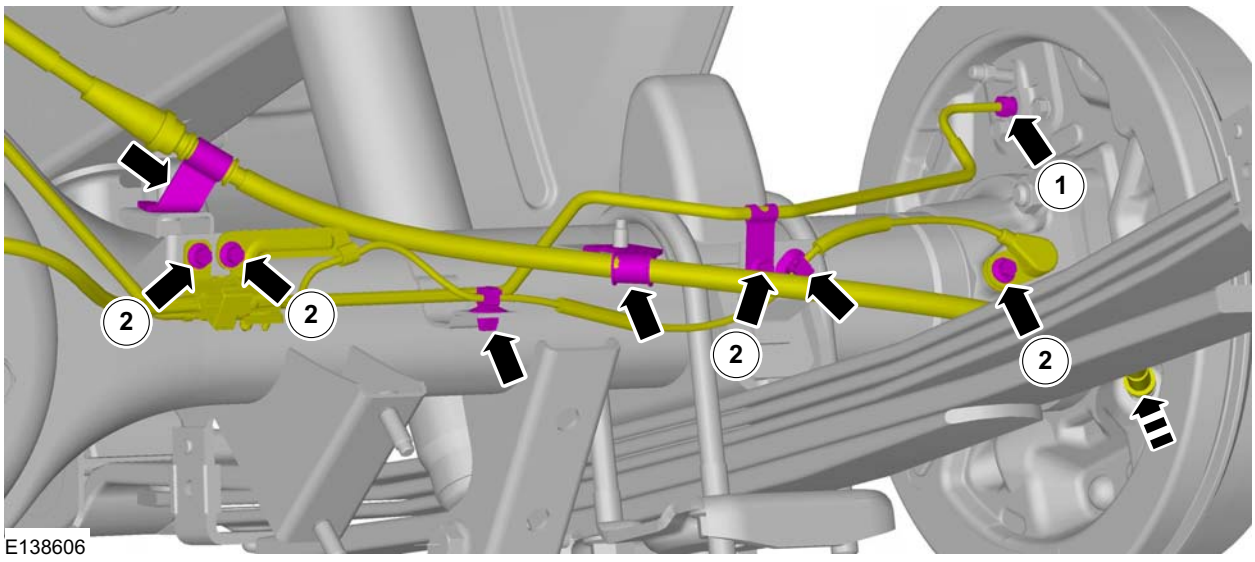
4. 1. **WARNING: Be prepared to collect escaping fluid.**

   CAUTIONS:

   If the fluid is spilled on the paintwork, the affected area must be immediately washed down with cold water.

   Make sure that all openings are sealed with new blanking caps.

   Torque: 19 Nm
   2. Torque: 7 Nm



REMOVAL AND INSTALLATION

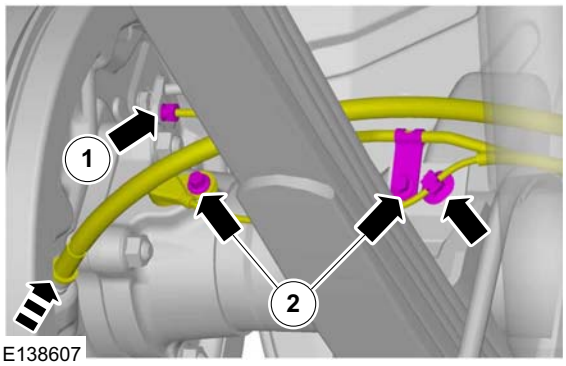
5. 1. **WARNING: Be prepared to collect escaping fluid.**

   CAUTIONS:

   If the fluid is spilled on the paintwork, the affected area must be immediately washed down with cold water.

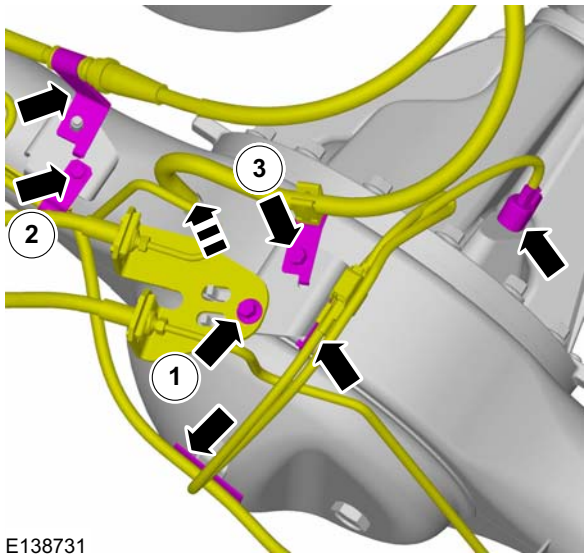
   Make sure that all openings are sealed with new blanking caps.

   Torque: 19 Nm
   2. Torque: 7 Nm



E138607

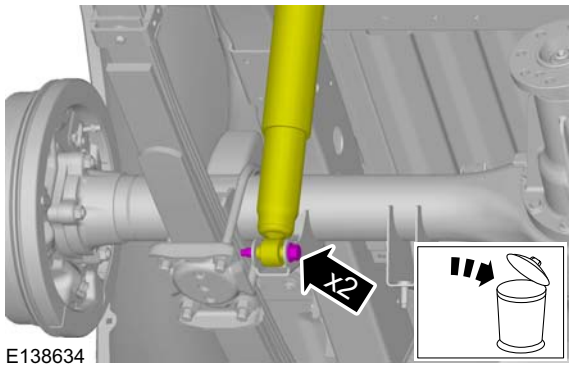
6. 1. Torque: 14 Nm
   2. Torque: 7 Nm
   3. Torque: 25 Nm



E138731

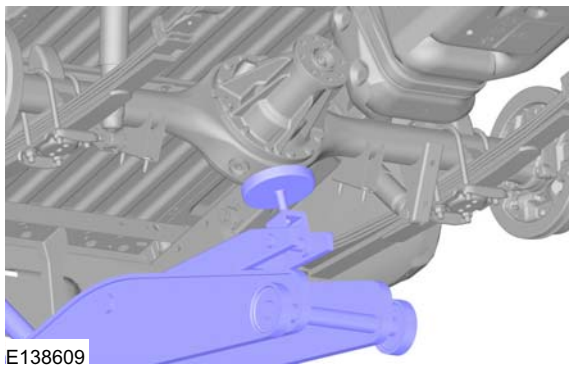
7. **CAUTION: Make sure that new bolts are installed.**

   General Equipment: Trolley Jack
   Torque: 48 Nm



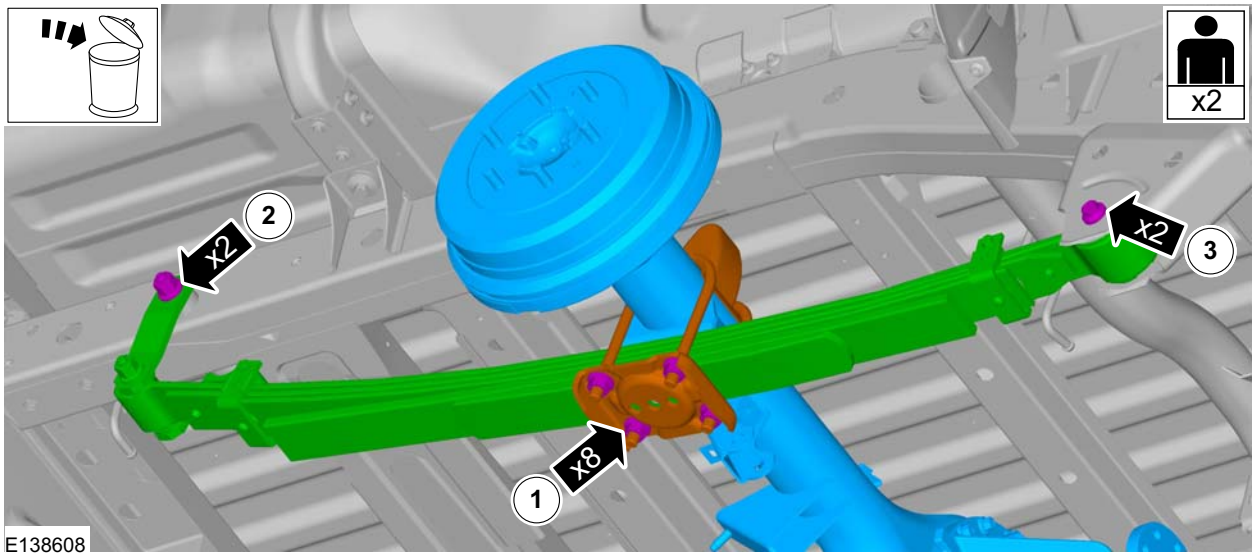
E138634

8. General Equipment: Trolley Jack


E138609

9. On both sides.

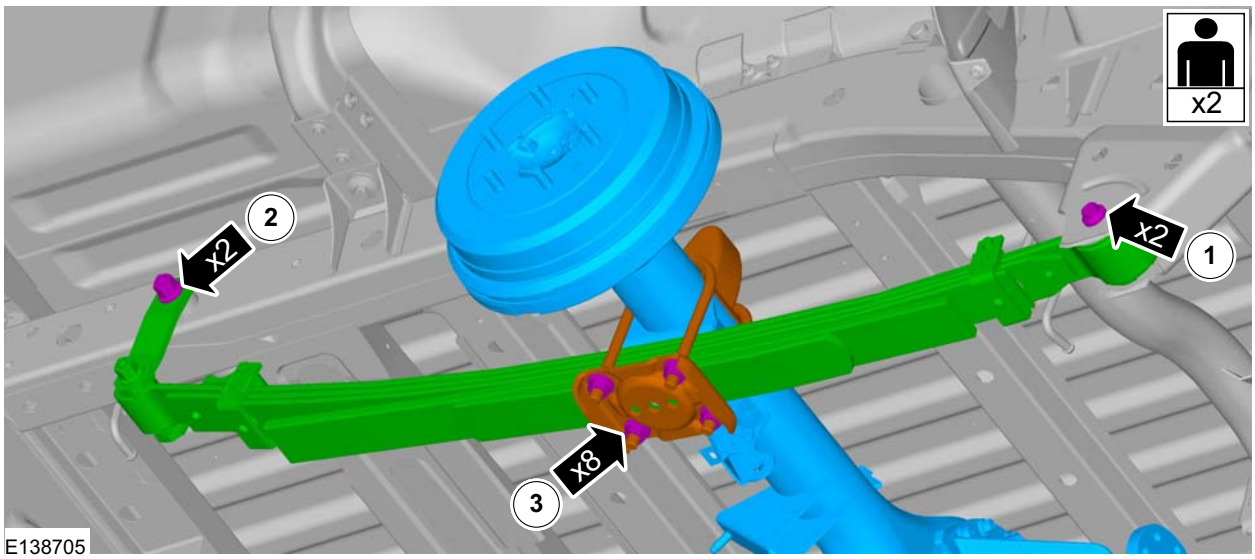
REMOVAL AND INSTALLATION



Installation

1. **CAUTION: Make sure that new bolts are installed.**
   1. On both sides.
      Torque: 170 Nm
   2. On both sides.
      Torque: 50 Nm
   3. **NOTE:** Hand tighten the nuts at this stage.

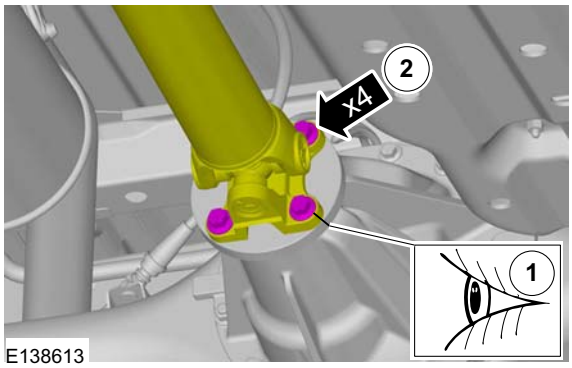
On both sides.



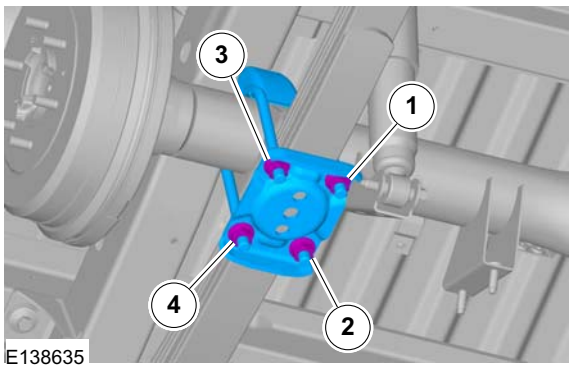
2. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

3. ⚠ **CAUTION: Make sure that new bolts are installed.**
   Torque: 135 Nm



4. On both sides.
   Torque:
   - Stage 1: 25 Nm
   - Stage 2: 50 Nm
   - Stage 3: 75 Nm
   - Stage 4: 100 Nm
   - Stage 5: 105 Nm



5. 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).

6. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

REMOVAL AND INSTALLATION

Axle Assembly — 4WD

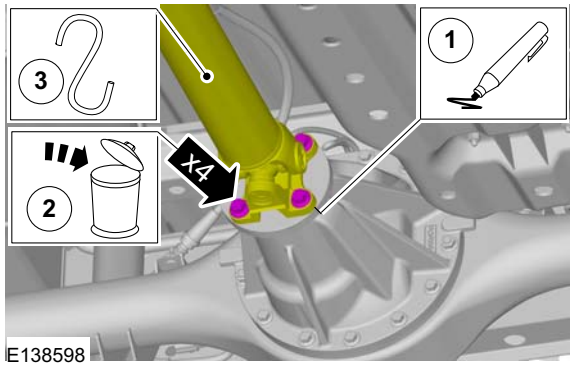
General Equipment

Trolley 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: Lifting (100-02 Jacking and Lifting, Description and Operation).
3.



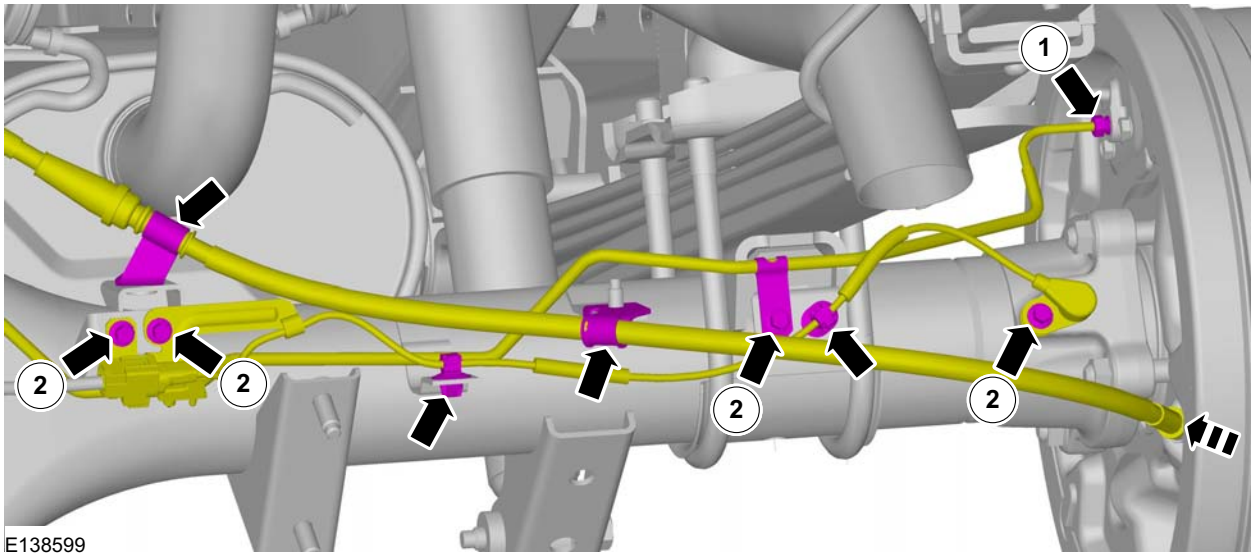
4. 1. **WARNING: Be prepared to collect escaping fluid.**

   CAUTIONS:

   If the fluid is spilled on the paintwork, the affected area must be immediately washed down with cold water.

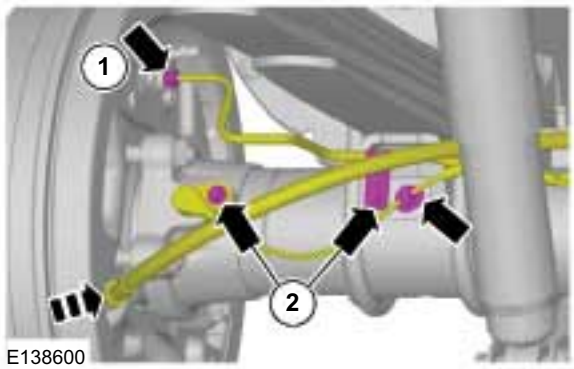
   Make sure that all openings are sealed with new blanking caps.

   Torque: 19 Nm
   2. Torque: 7 Nm

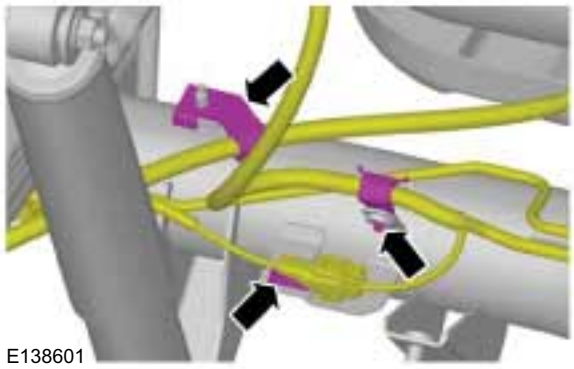


REMOVAL AND INSTALLATION

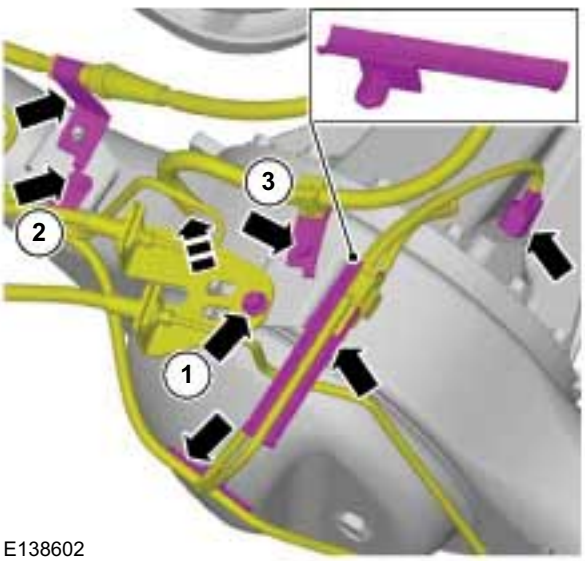
5. 1. Torque: 19 Nm
2. Torque: 7 Nm



6. Torque: 7 Nm

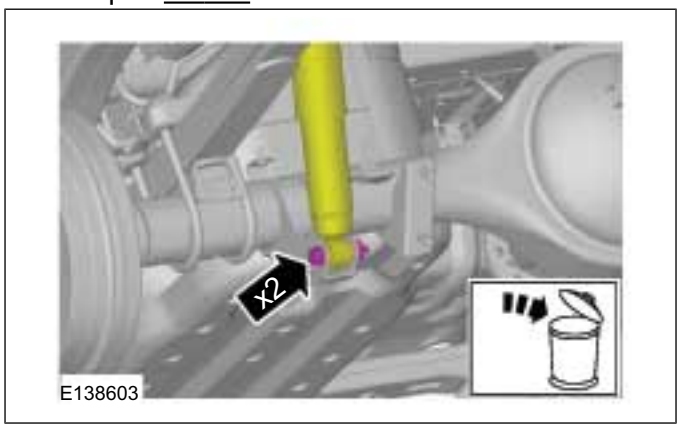


7. 1. Torque: 14 Nm
2. Torque: 7 Nm
3. Torque: 25 Nm

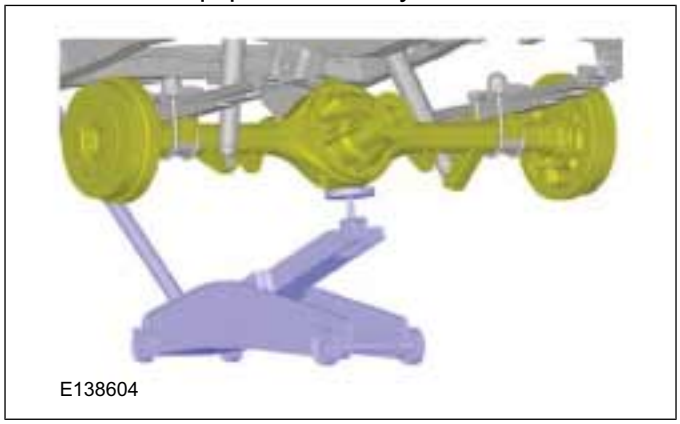


8. ⚠ **CAUTION: Make sure that new bolts are installed.**

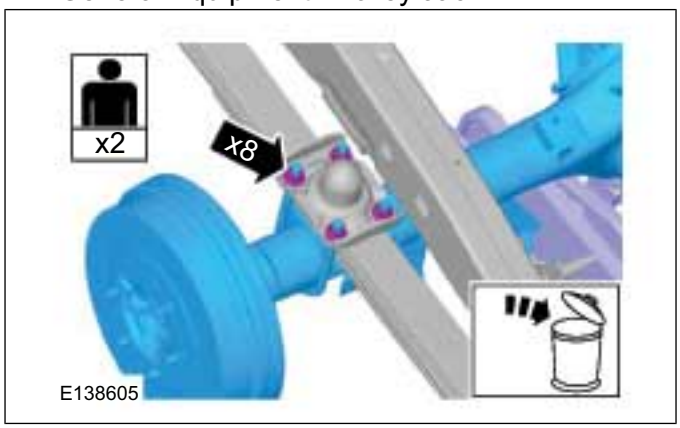
On both sides.
Torque: 48 Nm



9. General Equipment: Trolley Jack



10. On both sides.
General Equipment: Trolley Jack



Installation

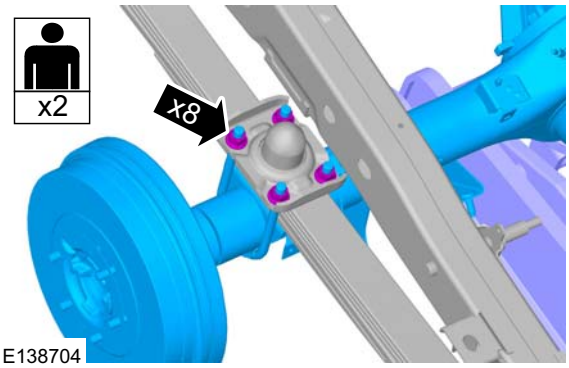
1. ⚠ **CAUTION: Make sure that new bolts are installed.**

NOTE: Hand tighten the nut at this stage.

REMOVAL AND INSTALLATION

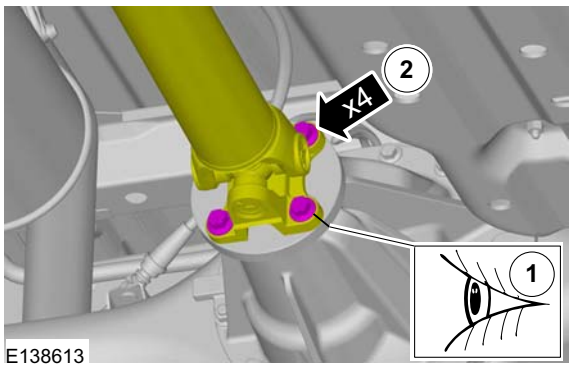
On both sides.

General Equipment: Trolley Jack



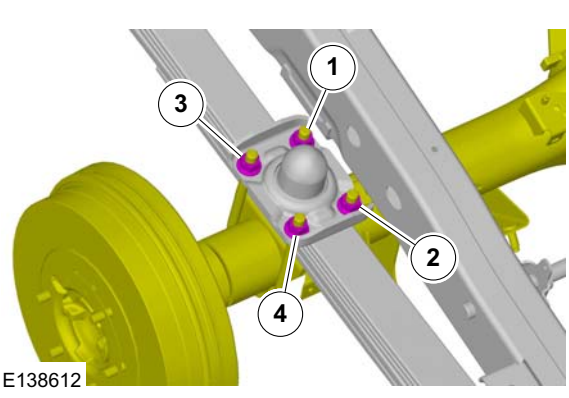
2. To install, reverse the removal procedure.
3. **CAUTION: Make sure that new bolts are installed.**

   Torque: 135 Nm



4. On both sides.

   Torque:
   - Stage 1: 25 Nm
   - Stage 2: 50 Nm
   - Stage 3: 75 Nm
   - Stage 4: 100 Nm
   - Stage 5: 105 Nm



5. 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).
6. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

REMOVAL AND INSTALLATION

Differential Carrier

Removal

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

1. **CAUTIONS:**

   Clean away the old sealant before applying the new sealant.

   Install the differential carrier 10 min. after applying sealant.

   Allow the sealant to set at least 30 min. after installation before filling the differential with the specified oil.

   Drain the rear differential oil.

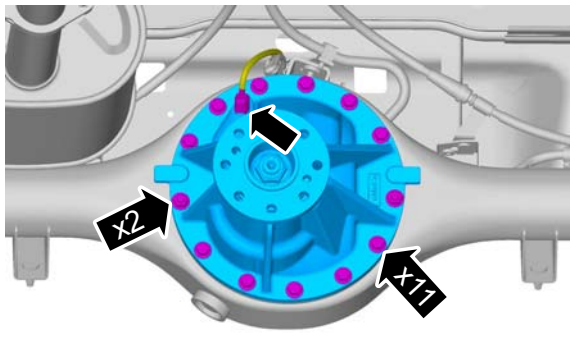
   Refer to: Differential Draining and Filling (205-03 Front Drive Axle/Differential, General Procedures).

2. **NOTE:** The driveshaft flange fits tightly on the pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the driveshaft flange from the pinion flange or damage to the component may occur.

   Refer to: Driveshaft - 2WD (205-01 Driveshaft, Removal and Installation).
   Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).

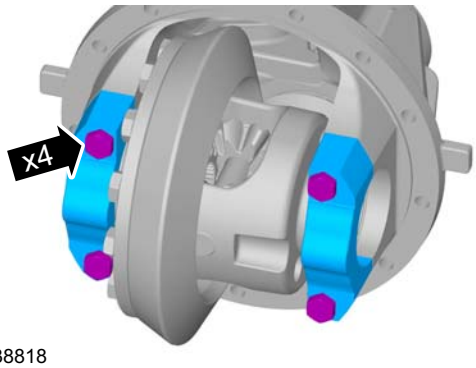
3. Refer to: Rear Halfshaft (205-05 Rear Drive Halfshafts, Removal and Installation).

4. Torque: 60 Nm



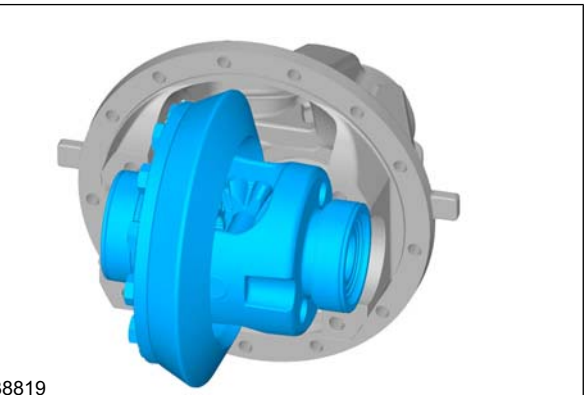
E132048

5. Torque: 105 Nm



E138818

6.


E138819

Installation

1. To install, reverse the removal procedure.

2. Fill the rear differential oil.

   Refer to: Differential Draining and Filling (205-03 Front Drive Axle/Differential, General Procedures).

SECTION 205-03 Front Drive Axle/Differential

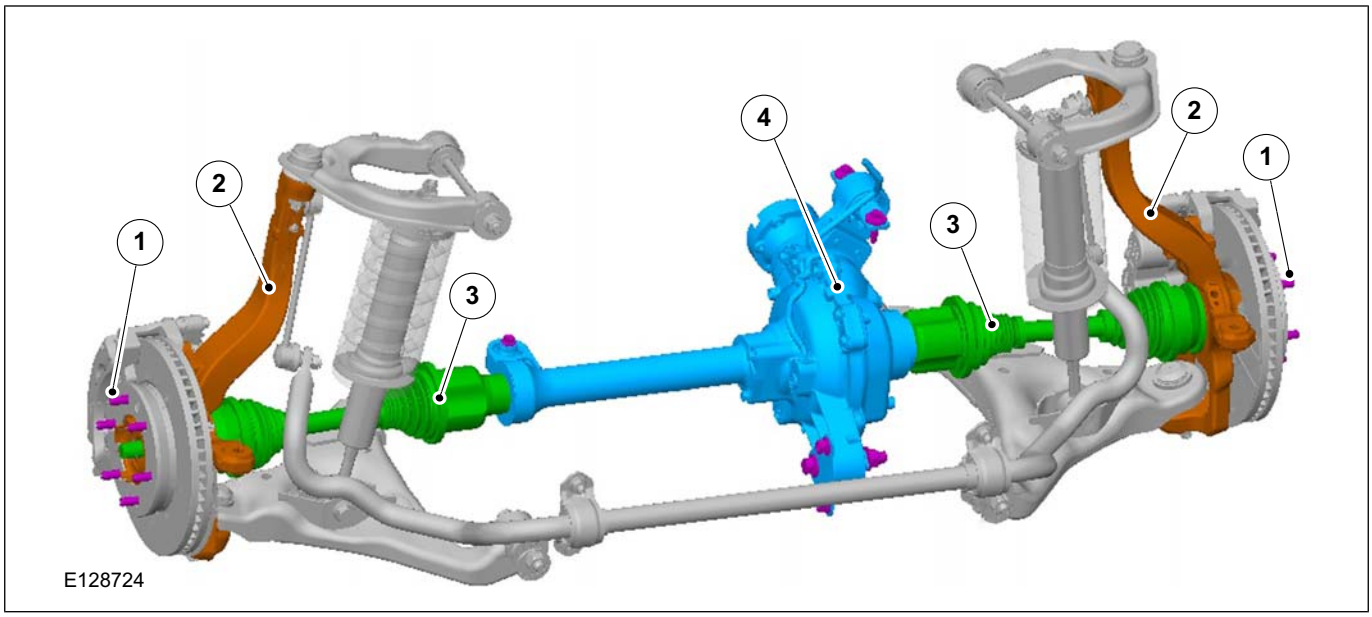
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Front Drive Axle and Differential

4x4 Hi-rider

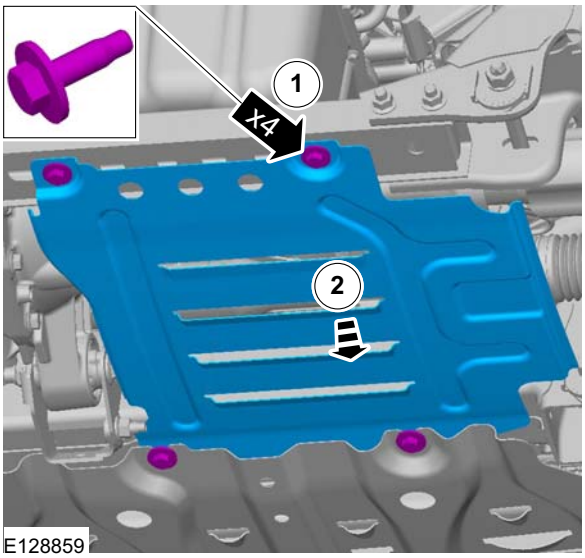


Item	Description
1	Wheel hub bolt
2	Wheel hub, steering knuckle
3	Front half shafts
4	Front differential

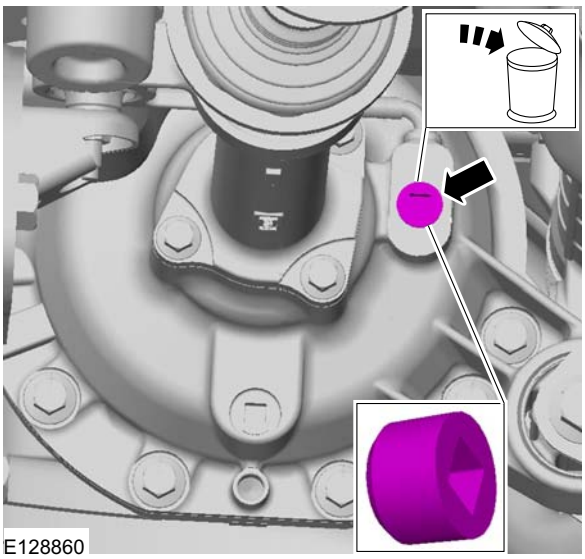
GENERAL PROCEDURES

Differential Draining and Filling

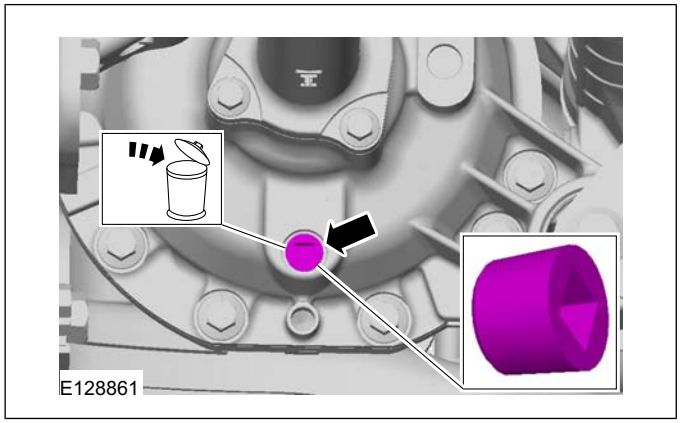
1. For additional information, refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
2.
   - Tightening torque 30 Nm.



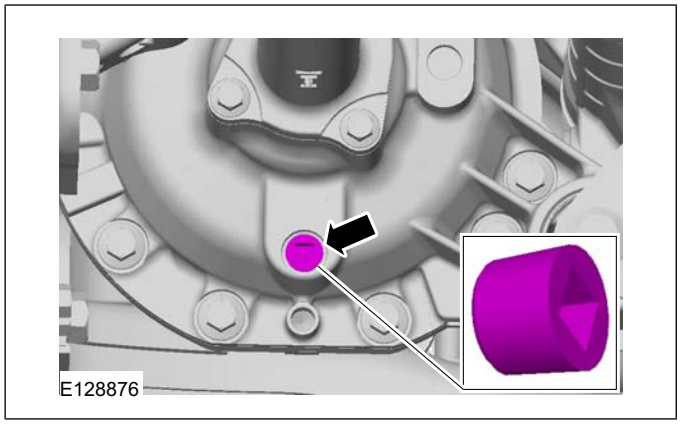
3. Position the vehicle on level ground.
4. Remove the oil-fill plug.



5. Remove the drain plug and drain the oil.



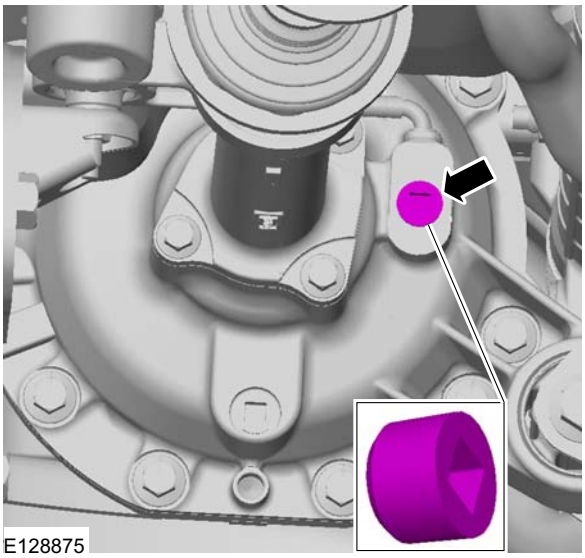
6. Install a new drain plug and tighten.
   - Tightening torque 30 Nm.



7. Add the specified oil through the oil-fill plug hole.
   - Front differential oil spec: WSP-M2C197-A and fill to 1.275L +/-0.10L.
8. After adding the oil, perform the oil level inspection.
9. Install a new oil-fill plug and tighten.

GENERAL PROCEDURES

- Tightening torque 30 Nm.


E128875

REMOVAL AND INSTALLATION

Axle Assembly

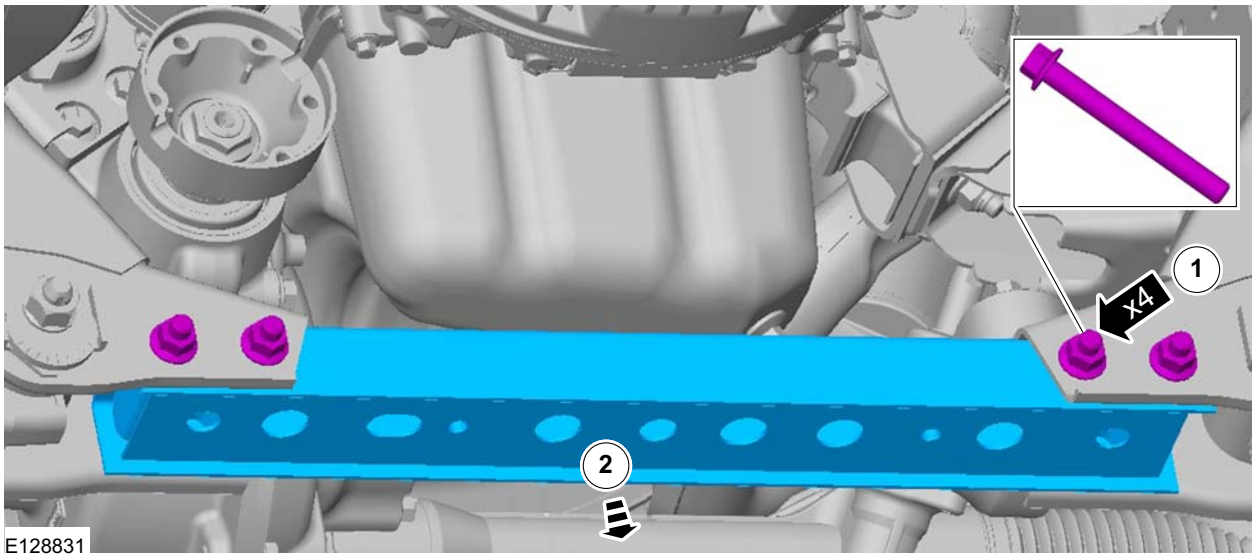
General Equipment

Transmission Jack

Removal

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

1. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
2. Refer to: Differential Draining and Filling (205-03 Front Drive Axle/Differential, General Procedures).
3. Refer to: Front Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).
4. Refer to: Front Halfshaft LH (205-04 Front Drive Halfshafts, Removal and Installation).
   Refer to: Front Halfshaft RH (205-04 Front Drive Halfshafts, Removal and Installation).
5. Torque: 90 Nm



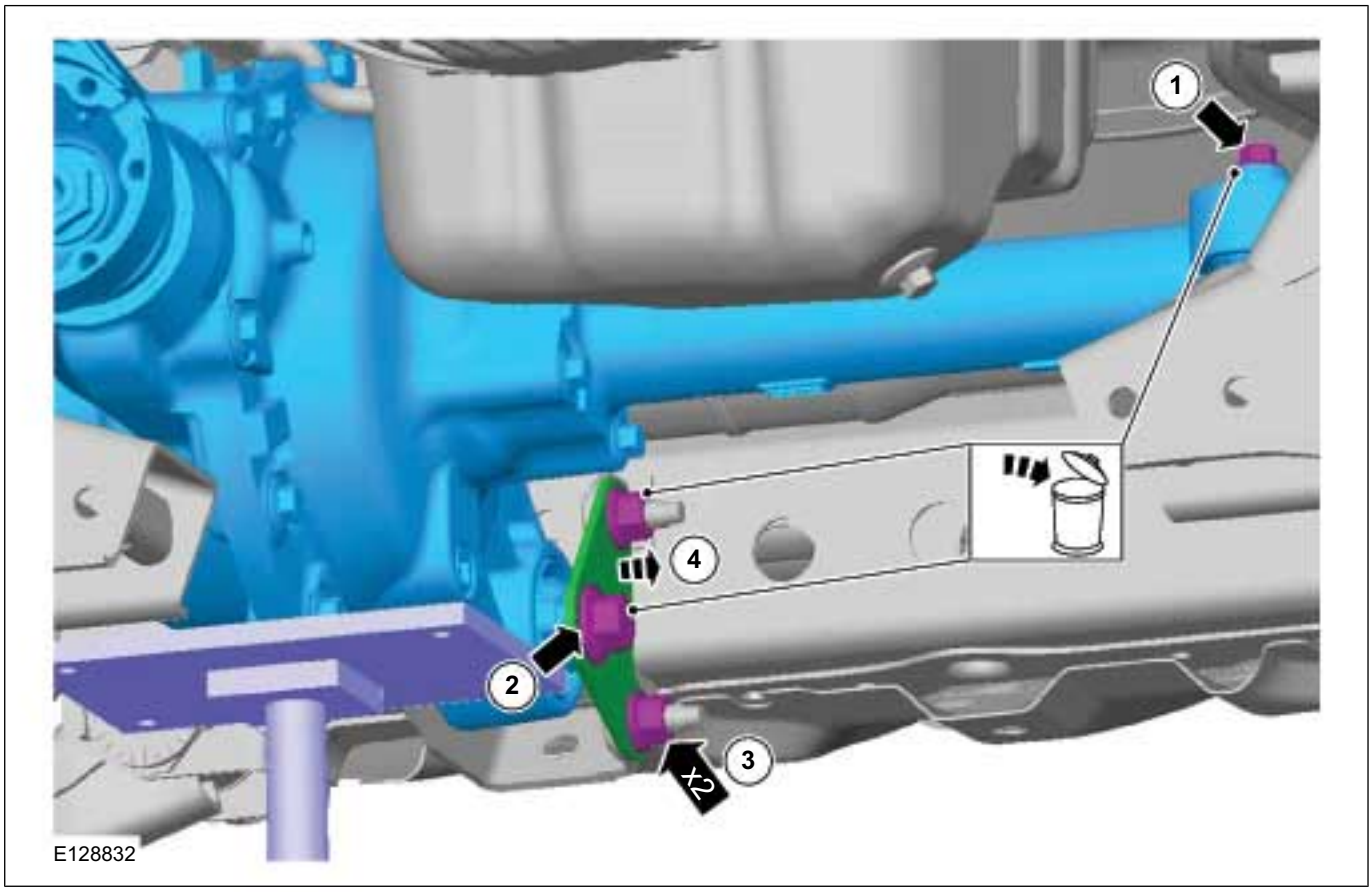
6. **WARNING: Make sure that a new bolt and nut is installed.**

NOTE: Position a suitable transmission jack under the front axle. Securely strap the jack to the axle.

- General Equipment: Transmission Jack

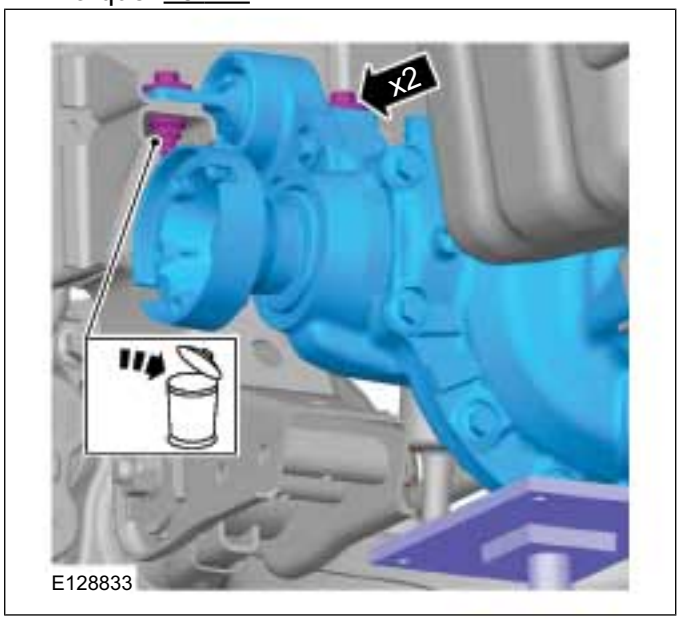
1. Torque: 70 Nm
2. Torque: 300 Nm
3. Torque: 125 Nm

REMOVAL AND INSTALLATION

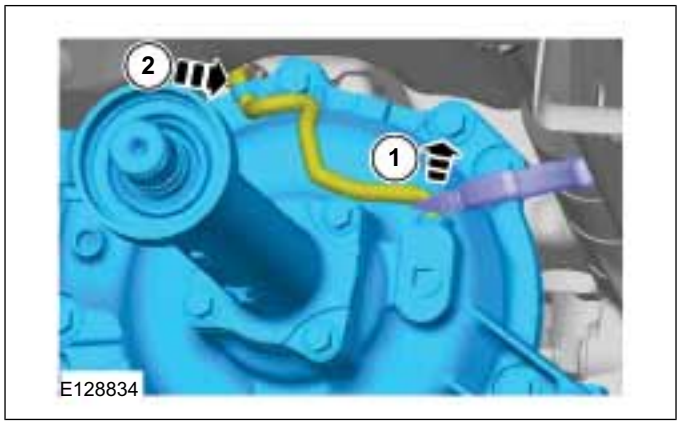


7. **WARNING: Make sure that a new bolt and nut is installed.**

   Torque: 48 Nm



8. **NOTE:** Lower the axle to gain access to the axle vent hose.



Installation

1. To install, reverse the removal procedure.

SECTION 205-04 Front Drive Halfshafts

VEHICLE APPLICATION: 2011.50 Ranger

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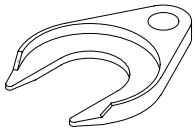
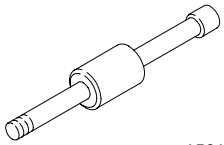
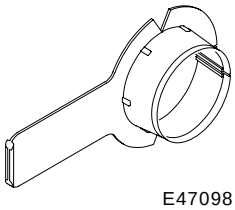
REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

Front Halfshaft LH(14 320 0)

Special Tool(s)

 16092	204-226 Remover, Halfshaft
 15011	205-047 Slide Hammer
 E47098	205-775 Protector, Halfshaft Seal

Removal

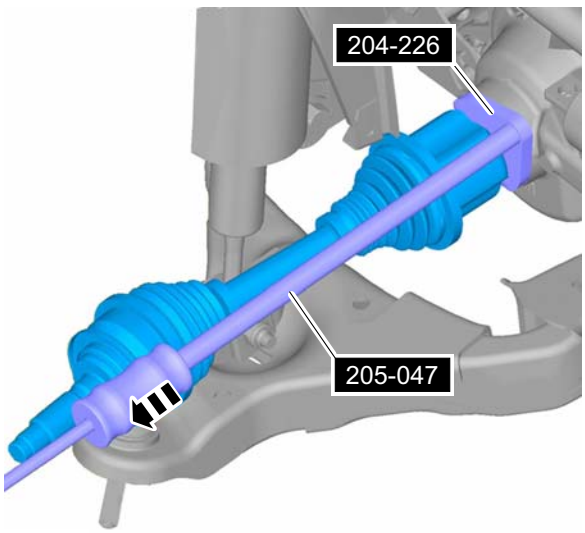
CAUTIONS:

Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

Never pick up or hold the halfshaft by the inboard or outboard CV joint only.

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

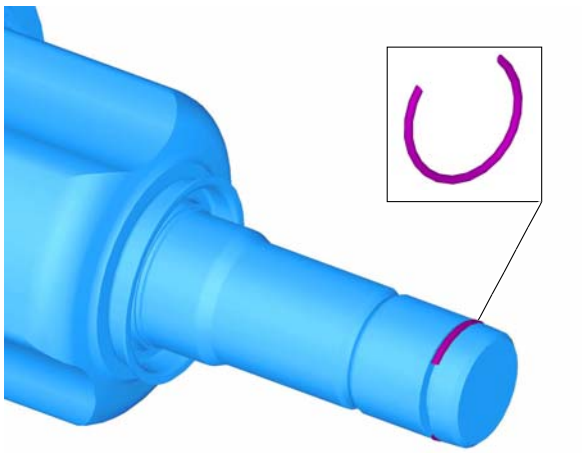
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Wheel Knuckle - 4WD (204-01 Front Suspension, Removal and Installation).
3. Special Tool(s): 205-047, 204-226



E129046

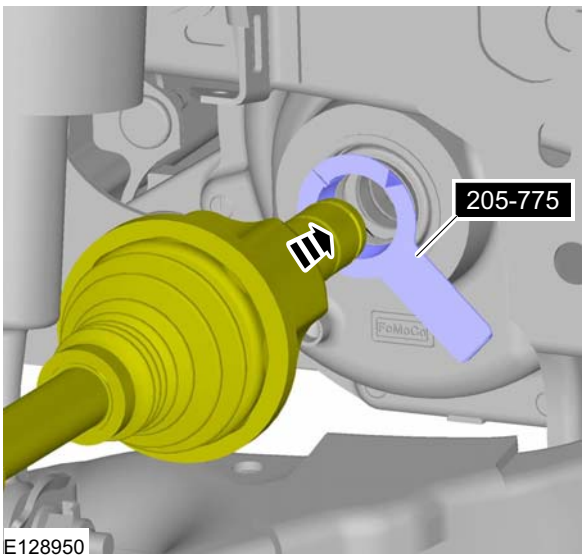
Installation

1. **NOTE:** Install a new retainer ring every time the halfshaft is removed.


E128951

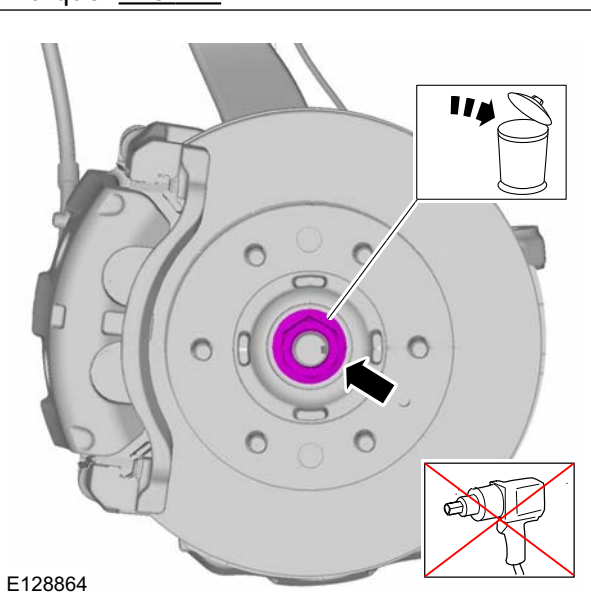
REMOVAL AND INSTALLATION

2. Special Tool(s): 205-775



3. ⚠ **CAUTION: Make sure that a new halfshaft retaining nut is installed.**

Torque: 275 Nm



4. Refer to: Wheel Knuckle - 4WD (204-01 Front Suspension, Removal and Installation).

REMOVAL AND INSTALLATION

Front Halfshaft RH(14 321 0)

Removal

CAUTIONS:

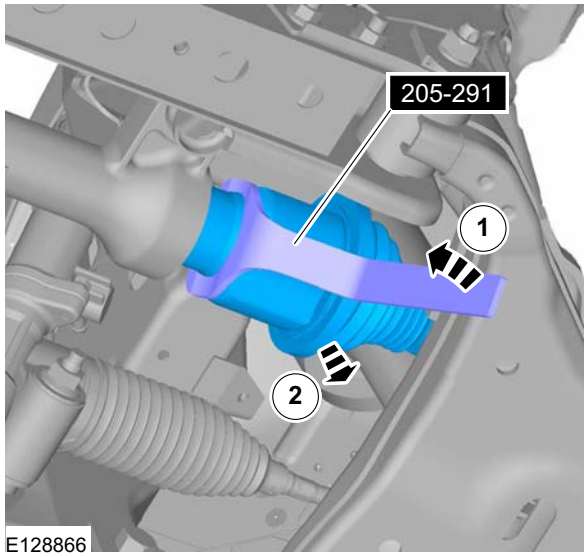
⚠ **Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.**

⚠ **Never pick up or hold the halfshaft by the inboard or outboard CV joint only.**

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

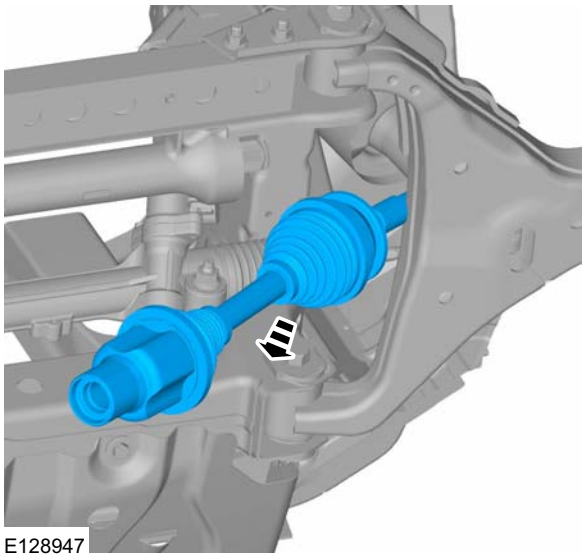
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Wheel Knuckle - 4WD (204-01 Front Suspension, Removal and Installation).
3. ⚠ **CAUTION: Do not damage the axle shaft oil seal, the machined sealing surface on the inboard CV joint housing or the axle shaft splines.**

   NOTE: A ring retainer retains the inboard CV joint housing to the differential side gear in the axle.



E128866

4.

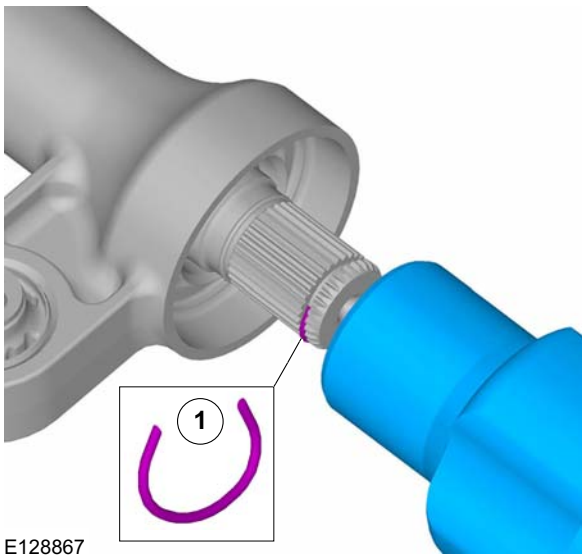

E128947

Installation

1. ⚠ **CAUTION: Install a new retainer every time the halfshaft is removed.**

   NOTE: Start one end of the retainer in the groove and work it over the halfshaft and into the groove to prevent the retainer from over expanding.

   1. Ring retainer.

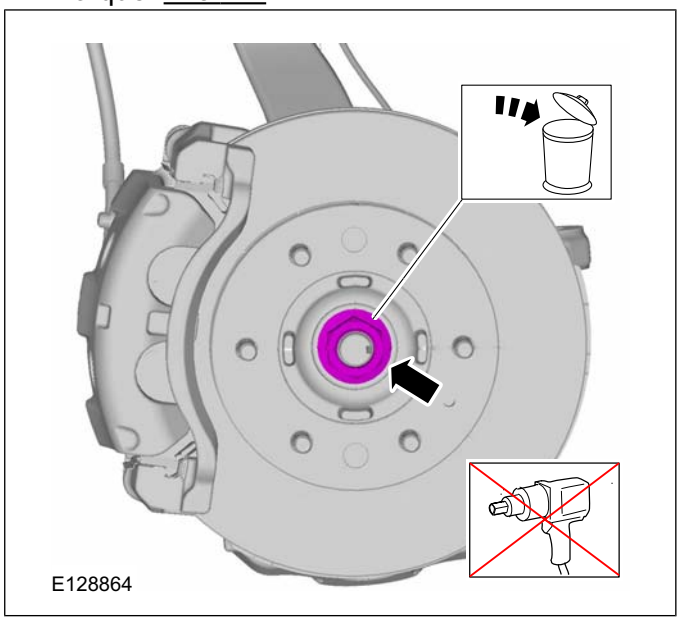


E128867

REMOVAL AND INSTALLATION

2. **CAUTION: Make sure that a new halfshaft retaining nut is installed.**

   Torque: 275 Nm

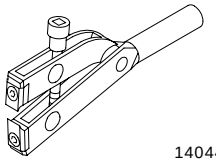
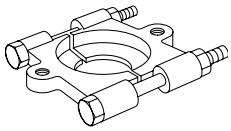
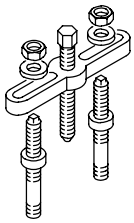
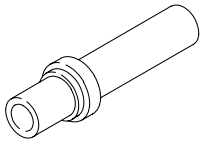


3. Refer to: Wheel Knuckle - 4WD (204-01 Front Suspension, Removal and Installation).

REMOVAL AND INSTALLATION

Inner Constant Velocity (CV) Joint Boot(14 336 0)

Special Tool(s) / General Equipment

 14044	204-169 Clamping Tool, Boot Retaining Clamp
 TI15091	205-310 Remover, Bearing/Gear
 15092	205-311 Remover, Bearing/Gear
 16016	308-046 Installer, Transmission Extension Housing Bushing/Seal
Vise	
Vise Jaw Protectors	

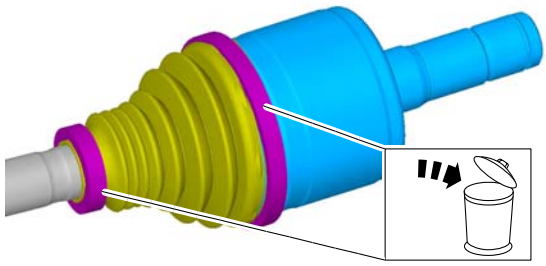
Materials	
Name	**Specification**
Grease FD-R	WSS-M1C259-A1 / 3M5J-M1C259-AA

Removal

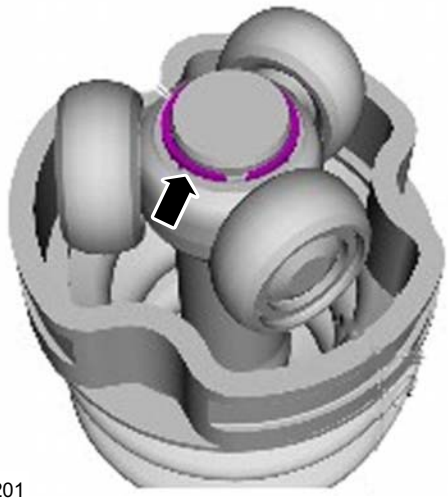
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Front Halfshaft LH (205-04 Front Drive Halfshafts, Removal and Installation).
   Refer to: Front Halfshaft RH (205-04 Front Drive Halfshafts, Removal and Installation).
2. **CAUTION: Use vise jaw protectors.**

   General Equipment: Vise
   General Equipment: Vise Jaw Protectors


E139200

3. General Equipment: Vise
   General Equipment: Vise Jaw Protectors

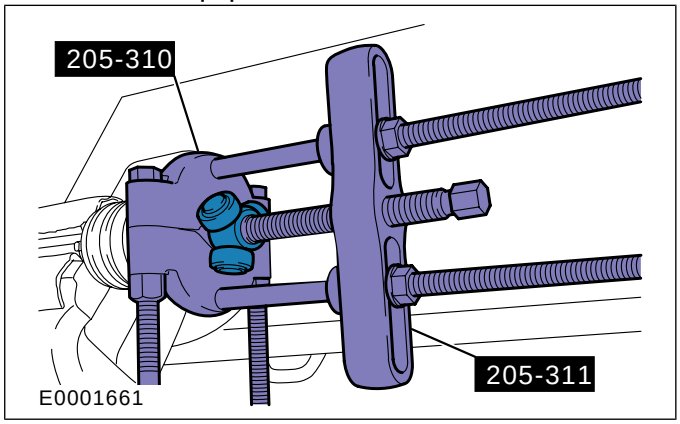

E139201

4. **CAUTION: Use vise jaw protectors.**

REMOVAL AND INSTALLATION

Discard the CV joint boot .

Install the Special Tool(s): 205-310, 205-311
General Equipment: Vise
General Equipment: Vise Jaw Protectors

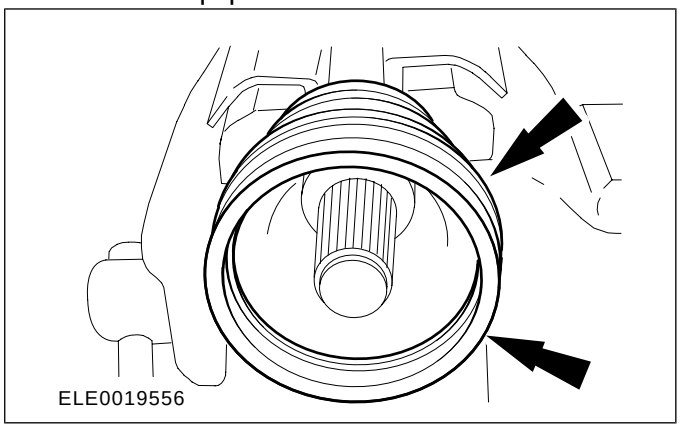


Installation

1. **CAUTION: Use vise jaw protectors.**

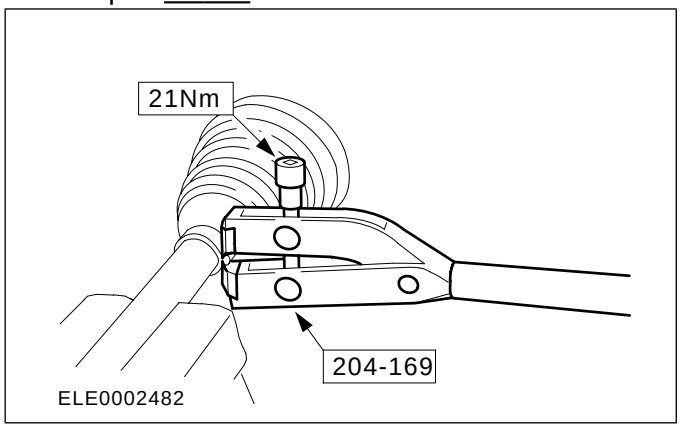
   NOTE: Make sure that a new inner constant velocity (CV) joint boot is installed.

   General Equipment: Vise
   General Equipment: Vise Jaw Protectors



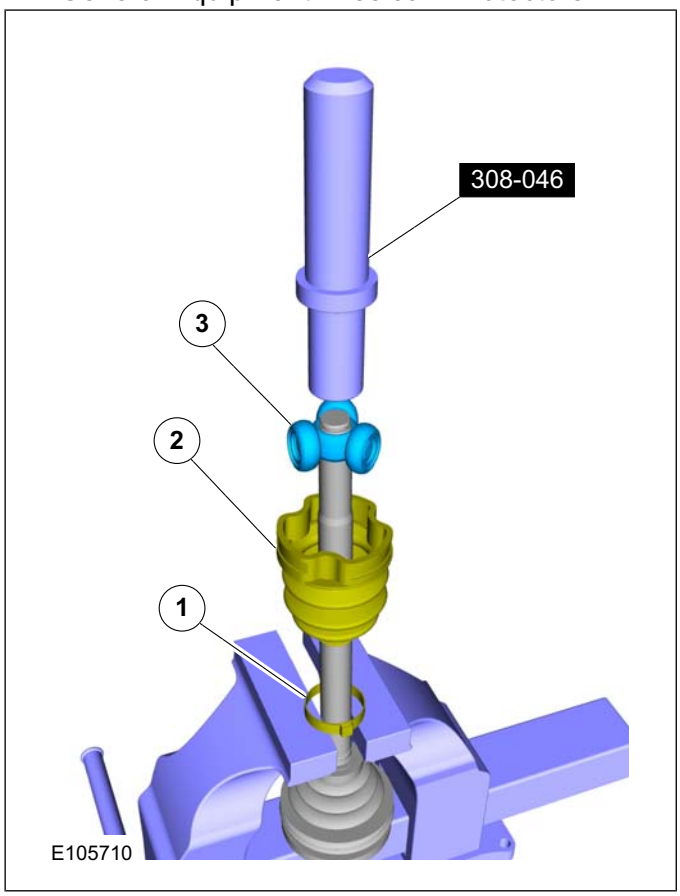
2. **NOTE:** Install a new CV joint boot retaining clamp.

   Special Tool(s): 204-169
   General Equipment: Vise
   General Equipment: Vise Jaw Protectors
   Torque: 21 Nm



3. **CAUTION: Do not damage the CV joint bearings.**

   Special Tool(s): 308-046
   General Equipment: Vise
   General Equipment: Vise Jaw Protectors



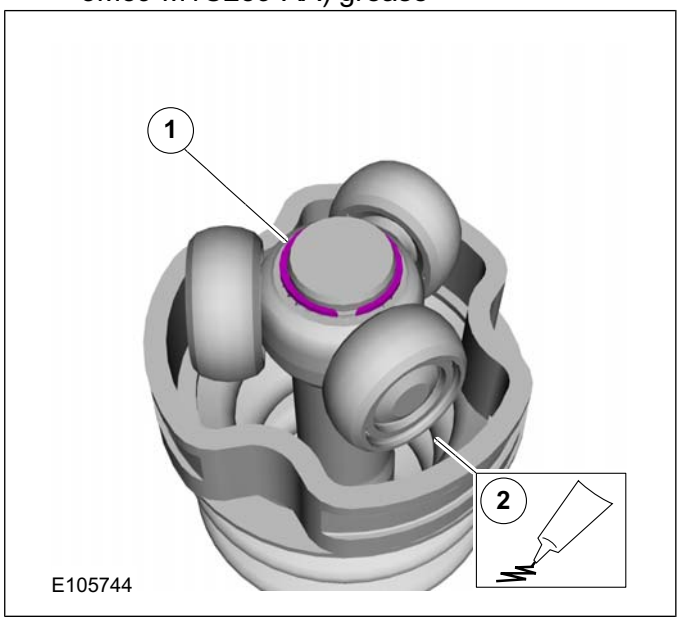
4. **CAUTION: The total amount of grease in the CV joint must not exceed 160**

REMOVAL AND INSTALLATION

grams for 85 PS vehicles and 255 grams for 110/130 PS vehicles.

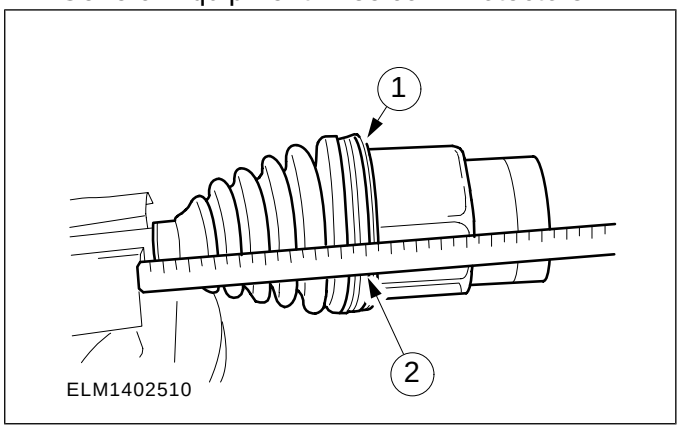
NOTE: Make sure that a new component is installed.

Material: Grease FD-R (WSS-M1C259-A1 / 3M5J-M1C259-AA) grease



5. With the CV joint housing installed, measure the distance from the inner end of the CV joint boot to the outer end. The distance needs to be 90 mm.

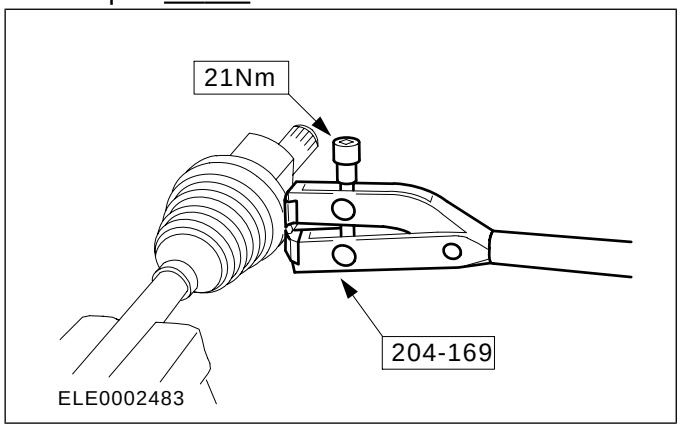
   General Equipment: Vise
   General Equipment: Vise Jaw Protectors



6. **NOTE:** Install a new CV joint boot retaining clamp.

NOTE: Do not move the CV joint housing. Make sure that the CV joint boot is installed at the measured position.

Special Tool(s): 204-169
General Equipment: Vise
General Equipment: Vise Jaw Protectors
Torque: 21 Nm

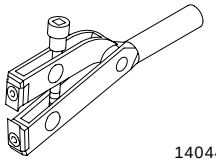


7. Refer to: Front Halfshaft LH (205-04 Front Drive Halfshafts, Removal and Installation).
   Refer to: Front Halfshaft RH (205-04 Front Drive Halfshafts, Removal and Installation).

REMOVAL AND INSTALLATION

Outer Constant Velocity (CV) Joint Boot(14 338 0)

Special Tool(s) / General Equipment

 14044	204-169 Clamping Tool, Boot Retaining Clamp
Vise	
Vise Jaw Protectors	

Materials	
Name	**Specification**
Grease FD-R	WSS-M1C259-A1 / 3M5J-M1C259-AA

Removal

CAUTION: The outer CV joint is a press fit. Do not disassemble. Failure to follow this instruction may result in damage to the outer CV joint.

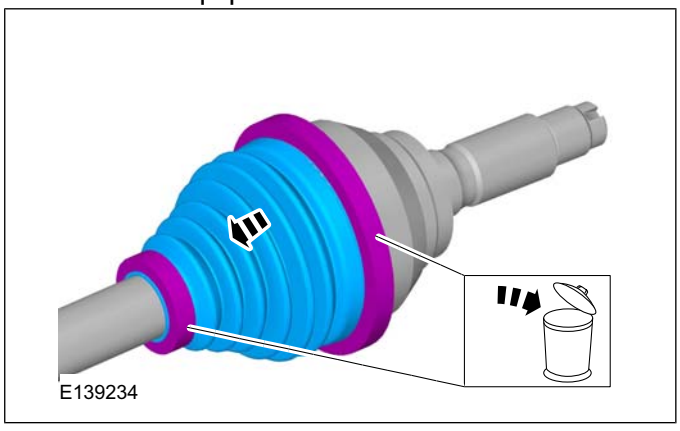
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Inner Constant Velocity (CV) Joint Boot (205-04 Front Drive Halfshafts, Removal and Installation).

2. **CAUTION: Use vise jaw protectors.**

   Discard the CV joint boot.

   General Equipment: Vise
   General Equipment: Vise Jaw Protectors

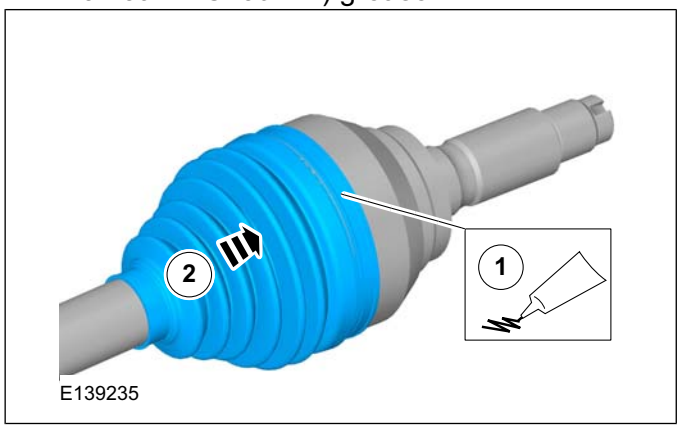


Installation

1. **CAUTION: The total amount of grease in the CV joint must not exceed 165 grams for 85 PS vehicles and 250 grams for 110/130 PS vehicles.**

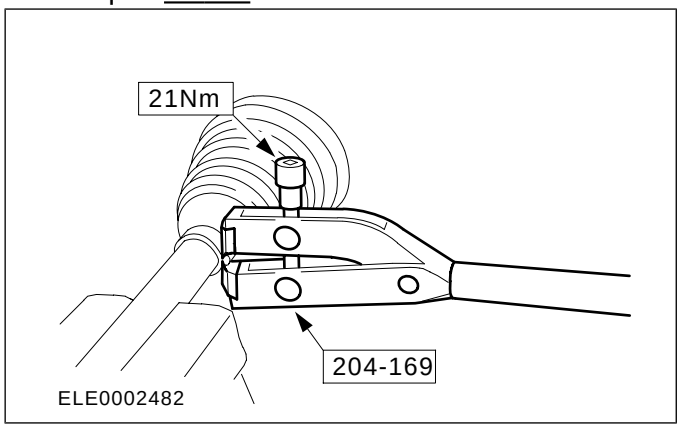
   NOTE: Make sure that a new component is installed.

   General Equipment: Vise
   General Equipment: Vise Jaw Protectors
   Material: Grease FD-R (WSS-M1C259-A1 / 3M5J-M1C259-AA) grease



2. **NOTE:** Install a new CV joint boot retaining clamp.

   Special Tool(s): 204-169
   General Equipment: Vise
   General Equipment: Vise Jaw Protectors
   Torque: 21 Nm

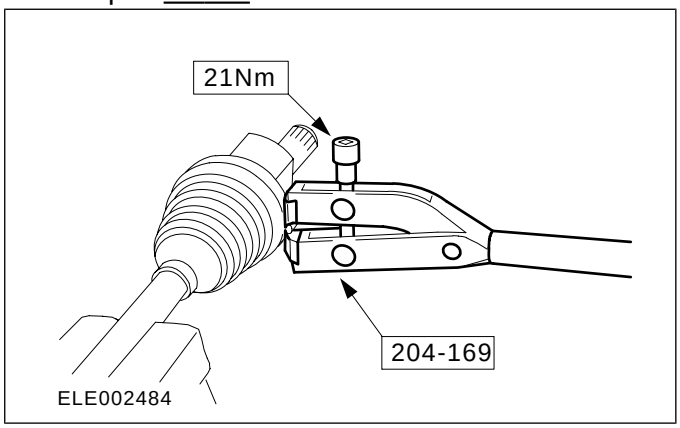


3. **NOTE:** Install a new CV joint boot retaining clamp.

REMOVAL AND INSTALLATION

NOTE: Do not move the CV joint housing. Make sure that the CV joint boot is installed at the measured position.

Special Tool(s): 204-169
General Equipment: Vise
General Equipment: Vise Jaw Protectors
Torque: 21 Nm



4. Refer to: Inner Constant Velocity (CV) Joint Boot (205-04 Front Drive Halfshafts, Removal and Installation).

SECTION 205-05 Rear Drive Halfshafts

VEHICLE APPLICATION: 2011.50 Ranger

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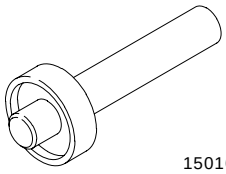
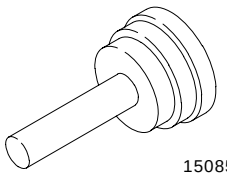
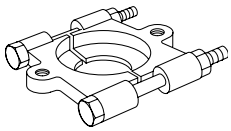
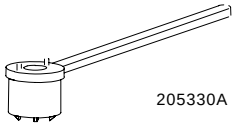
Rear Halfshaft

Special Tool(s) / General Equipment

 15016	205-052 Installer, Rear Wheel Hub Bearing/Seal
 15085	205-296 Installer, Wheel Hub Bearing Cone/Seal
 TI15091	205-310 Remover, Bearing/Gear

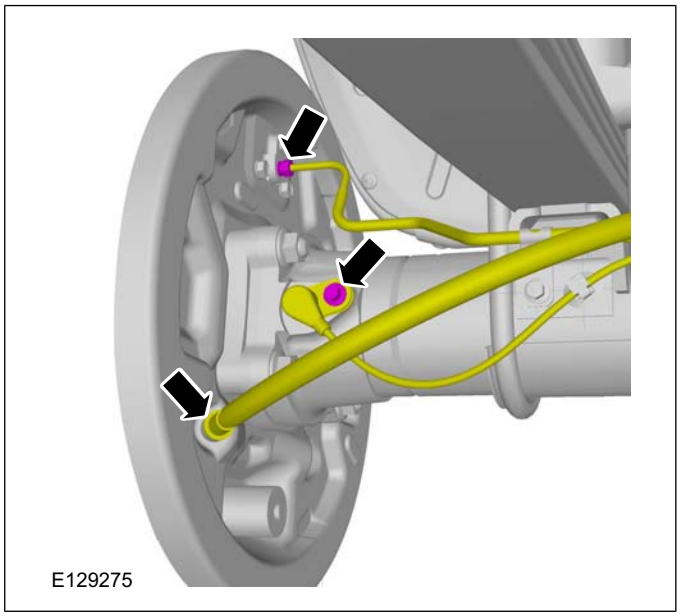
Special Tool(s) / General Equipment

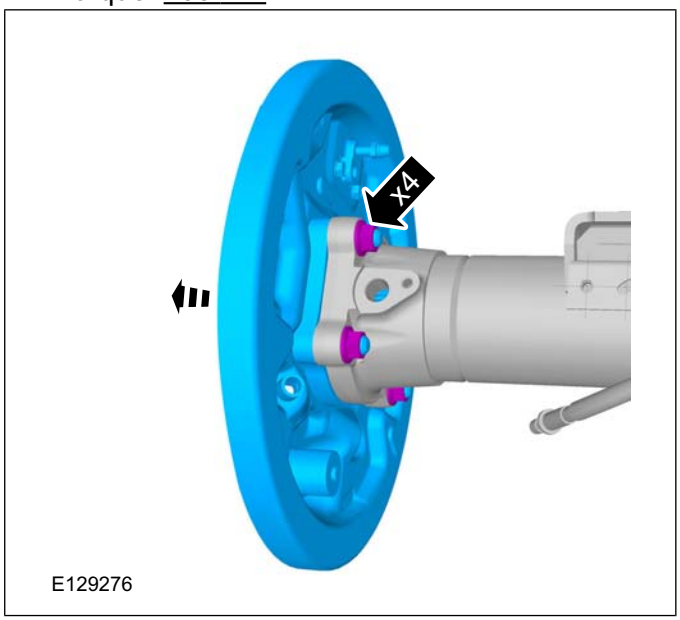
IMAGE NOT AVAILABLE	205-311-05 Adapter for 205-311
 205330A	205-330A Wrench, Axle Shaft Nut
Hydraulic Press	
Vise	

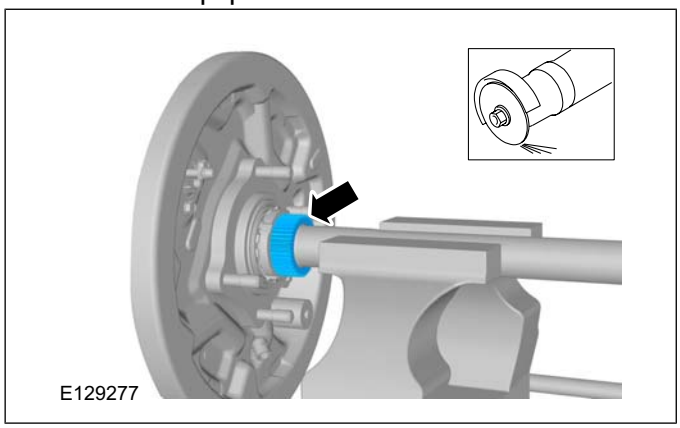
Materials	
Name	**Specification**
Contact Grease	WSB-M1C239-A / YS5J-M1C239-AA

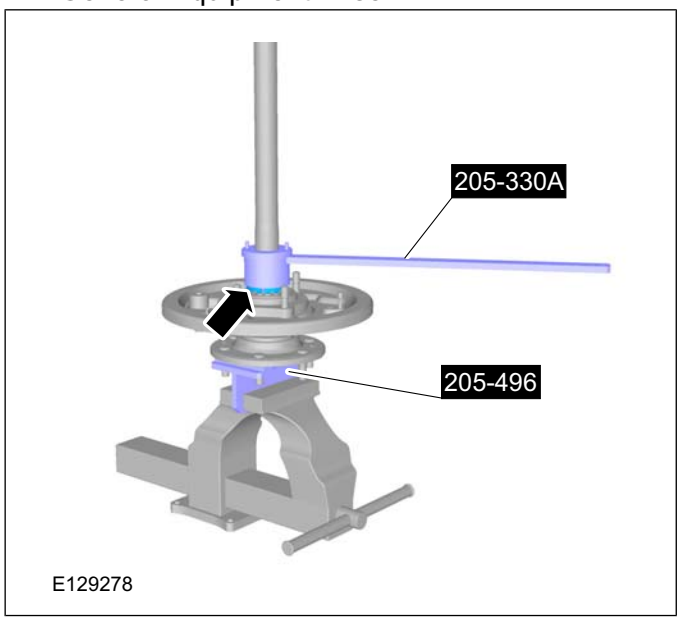
Removal

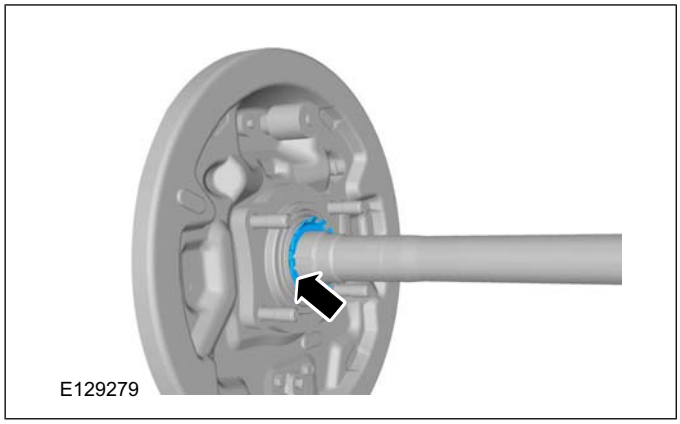
REMOVAL AND INSTALLATION

1. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
2. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
3. Refer to: Wheel Cylinder (206-02 Drum Brake, Removal and Installation).
   Refer to: Brake Shoes (206-02 Drum Brake, Removal and Installation).
4. 

5. **CAUTION: Be careful not to damage the oil seal while pulling out the axle shaft.**
   Torque: 108 Nm


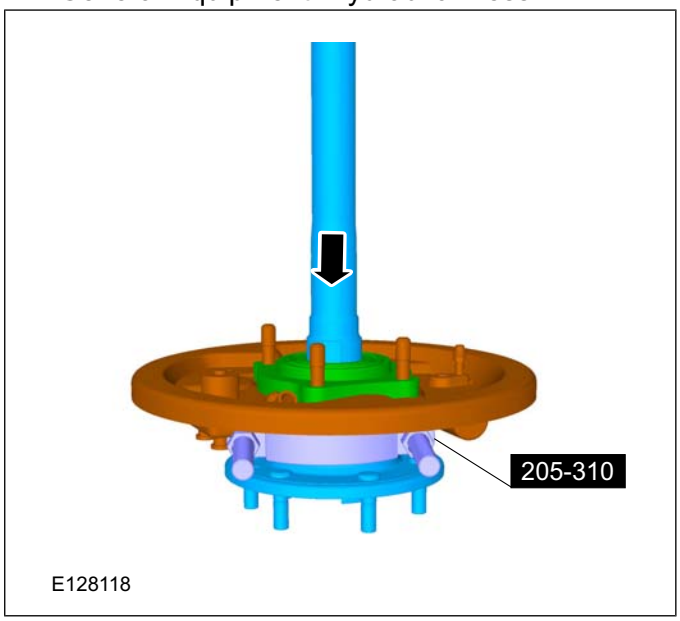
6. 
CAUTION: Because the ABS sensor rotor and rear wheel hub edge are almost flush even if the axle shaft is moved as far as it will go, be careful not to damage the rear wheel hub when grinding.
   General Equipment: Vise


7. Special Tool(s): 205-330A
   General Equipment: Vise


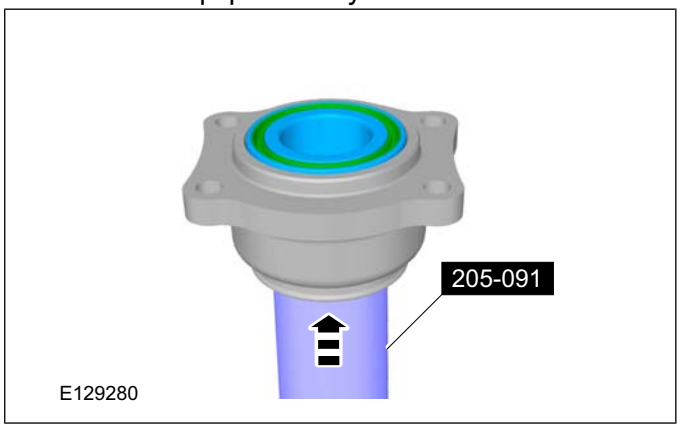
8. 

REMOVAL AND INSTALLATION

9. Special Tool(s): 205-310
General Equipment: Hydraulic Press



10. General Equipment: Hydraulic Press



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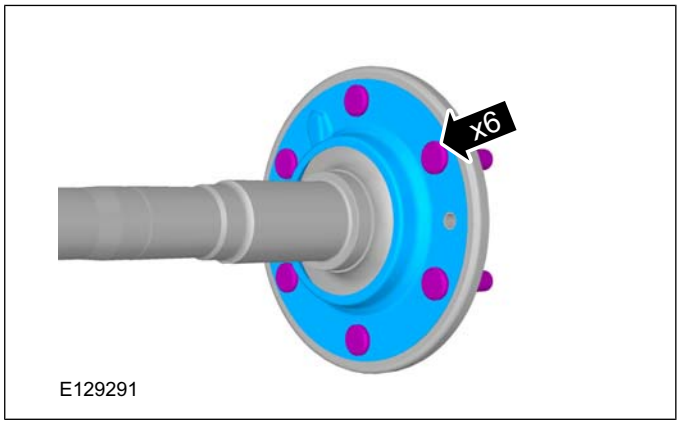

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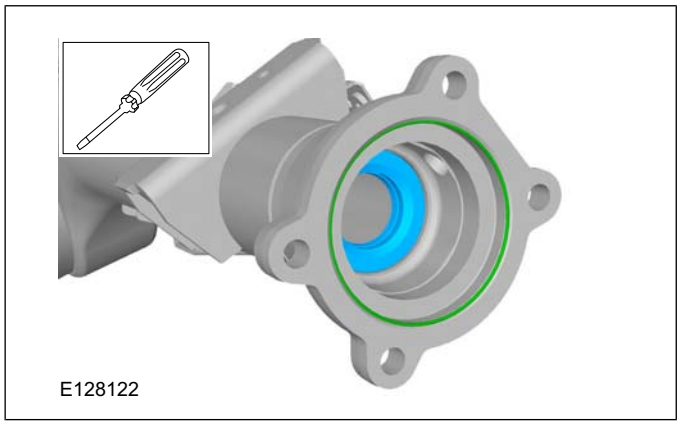
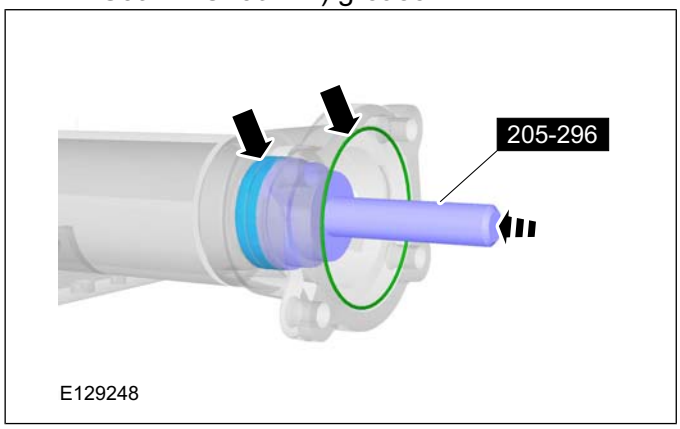
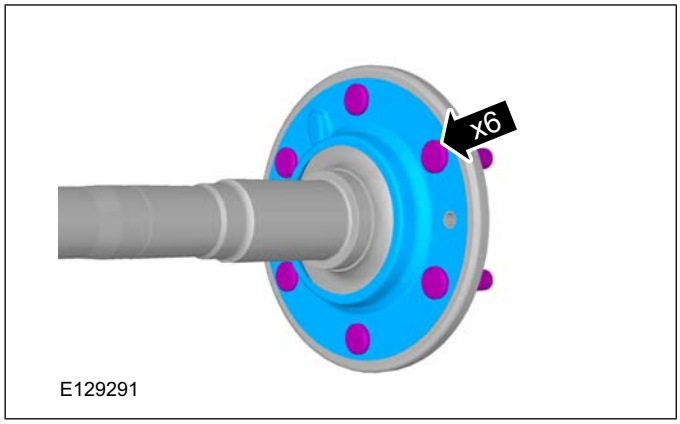


Installation

1. Special Tool(s): 205-296
Material: Contact Grease (WSB-M1C239-A / YS5J-M1C239-AA) grease

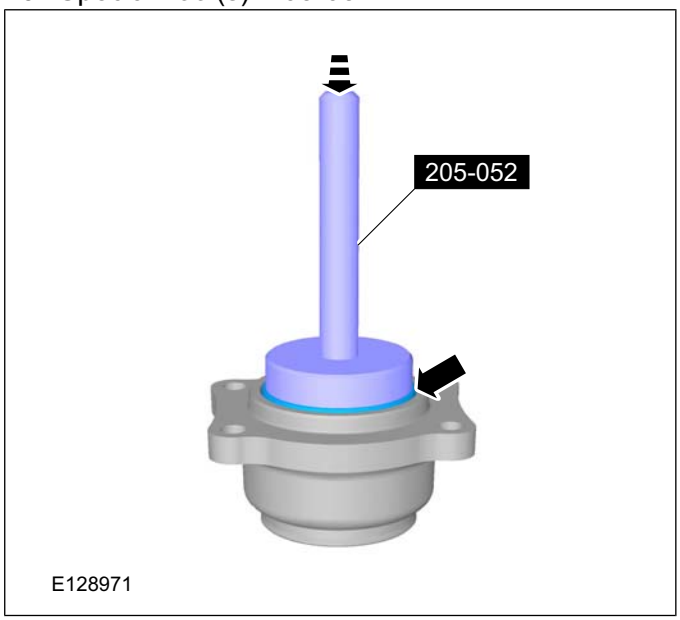


2.

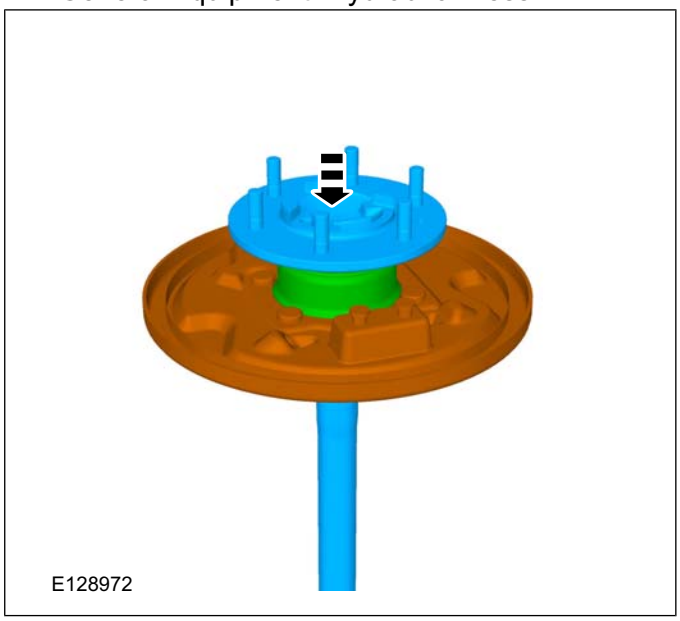


REMOVAL AND INSTALLATION

3. Special Tool(s): 205-052



4. General Equipment: Hydraulic Press



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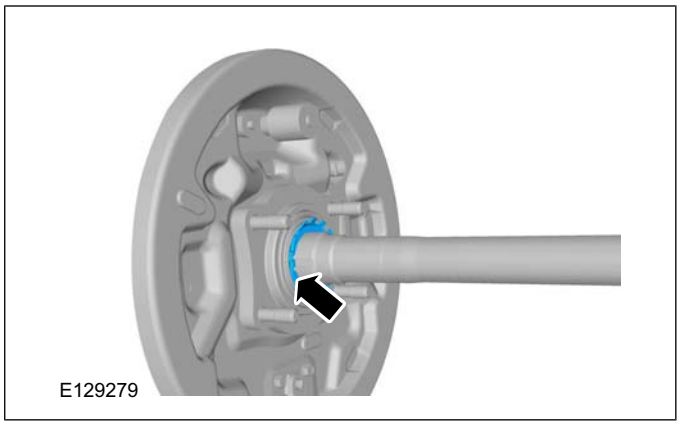
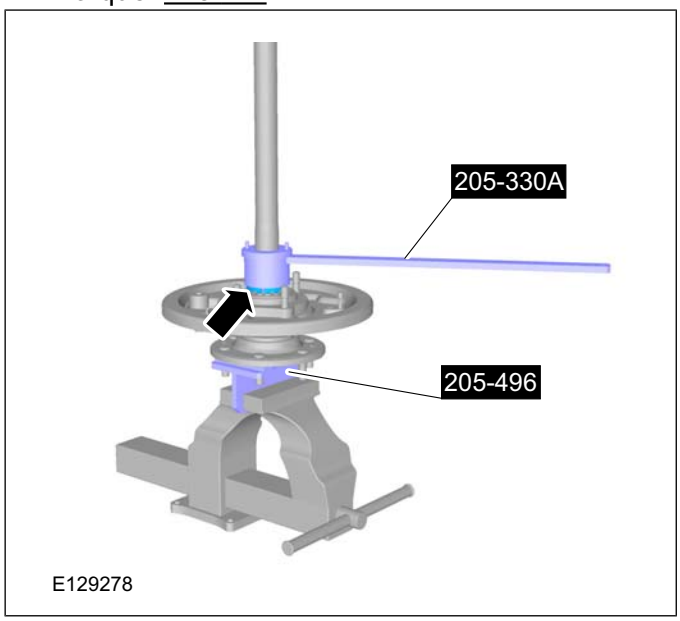
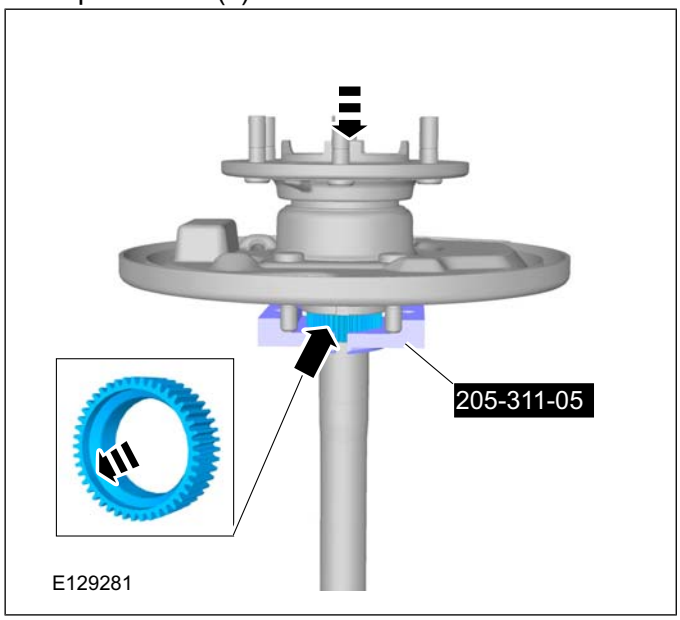


6. Special Tool(s): 205-330A
Torque: 275 Nm



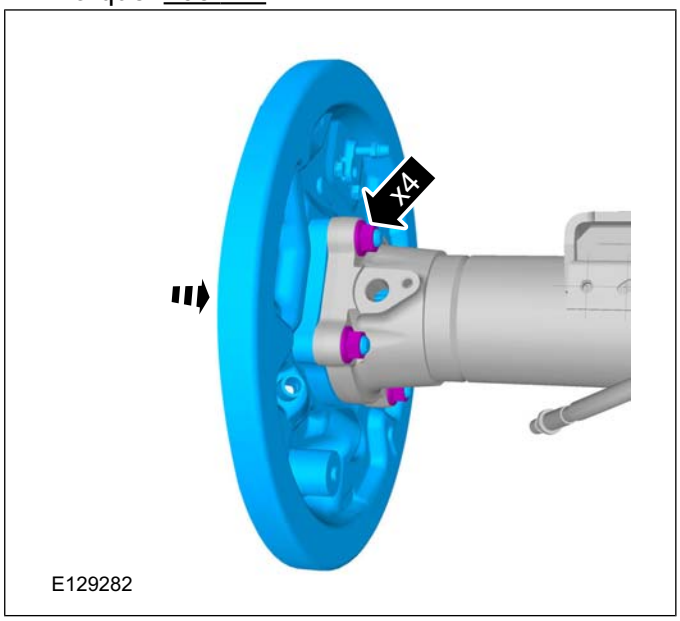
7. Special Tool(s): 205-311-05



REMOVAL AND INSTALLATION

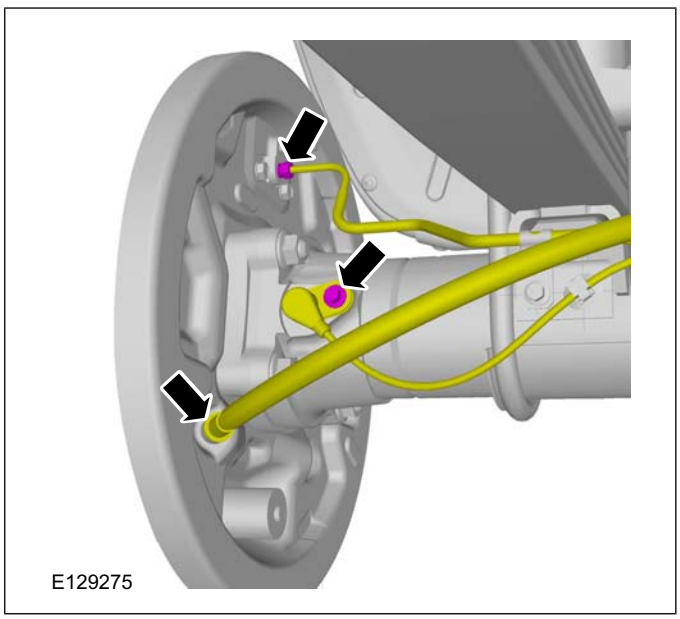
8. **CAUTION: Be careful not to damage the oil seal while installing the axle shaft.**

   Torque: 108 Nm



E129282

9.


E129275

10. Refer to: Wheel Cylinder (206-02 Drum Brake, Removal and Installation).
    Refer to: Brake Shoes (206-02 Drum Brake, Removal and Installation).

11. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

SECTION 206-00 Brake System - General Information

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

SPECIFICATIONS

BRAKE TECHNICAL DATA

ITEM	SPECIFICATION
Brake fluid type	SAE J1703, FMVSS 116 DOT-3
Brake pedal height	214—219 mm {8.43—8.62 in}
Standard pedal play	3.0—8.0 mm {0.12—0.31 in}
Standard pedal-to-floor clearance	105 mm {4.14 in} or more
Power brake unit fluid pressure when pedal depressed at 200 N {20 kgf, 45 lbf}	At 0 kPa {0 mmHg, 0 inHg}: 237 kPa or more
Power brake unit fluid pressure when pedal depressed at 200 N {20 kgf, 45 lbf}	At 67 kPa {500 mmHg, 20 inHg}:8.75 kpa or more
Minimum front disc pad thickness	1.5 mm min
Minimum front disc plate thickness	30 mm
Minimum front disc plate thickness after machining using a brake lathe on-vehicle	30.8 mm
Front disc plate runout limit	0.05 mm {0.002 in} max
Minimum rear brake lining thickness	1.0 mm {0.04 in}
Maximum rear brake drum diameter	4x2 (except Hi-Rider): 271.5 mm {10.68 in} Hi-Rider, 4x4: 296.5 mm {11.67 in}
Parking brake lever stroke when pulled at 98 N {10 kgf, 22 lbf}	3—6 notches

Load sensing proportioning valve (LSPV) fluid pressure

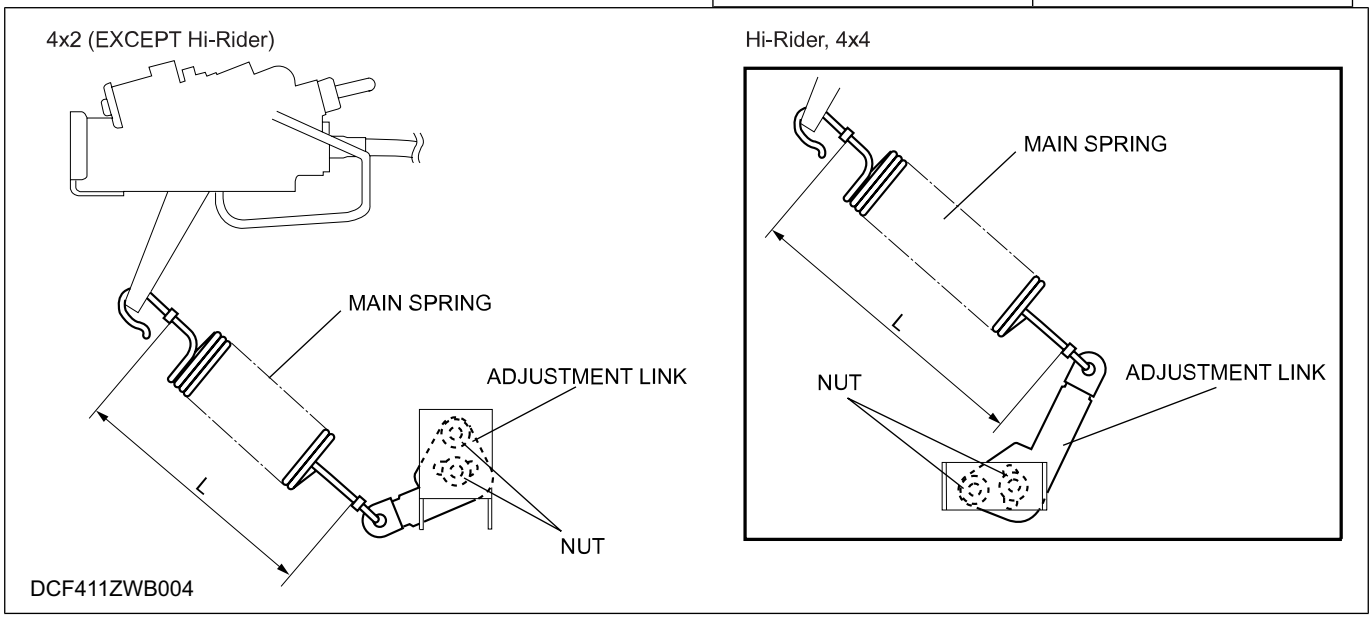
Type	Front wheel cylinder fluid pressure (kPa)	Rear wheel cylinder (kPa)
4x2 (except Hi-Rider)	4,900	1,950-2,470
	9,800	3,070-3,910
Hi-Rider, 4x4 & 4x2	4,900	1,820-2,320
	9,800	2,950-3,750

GENERAL PROCEDURES

Brake Load Sensor Proportioning Valve Adjustment(12 136 0)

1. **Place the unloaded vehicle on level ground. Unloaded: Fuel tank is full. Jack and tools are in designated position.**
2. **A change of 5 mm (0.20 in) in dimension L results in a change of the following.**

Type	Change (kPa {kgf/cm2, psl})
4x2 (except Hi-Rider) Without 4W-ABS	625 (8.7, 123)
Hi-Rider, 4x4 Without 4W-ABS	510 (11, 154)



3. **Adjust main spring dimension L between the LSPV and the adjustment link loosening and repositioning the LSPV.**

   · Decrease dimension L if the fluid pressure is low.

   · Increase dimension L if the fluid pressure is high.

4. **Specification Dimension L**

Type	Dimension x (mm {in})
4x2 (except Hi-Rider) Without 4W-ABS	166.0—173.0 (5.808—6.082)
Hi-Rider, 4x4 Without 4W-ABS	184.5—191.5 (6.910—7.185)

If not as specified, replace the LSPV as a component.

5. **Tightening the nut.**

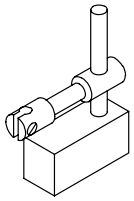
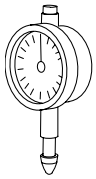
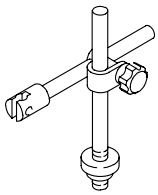
   Specification 11.4—15.6 Nm (1.90—2.59 kgfm, 13.8—18.7 ftlbf).

6. **After adjustment, recheck the fluid pressure.**

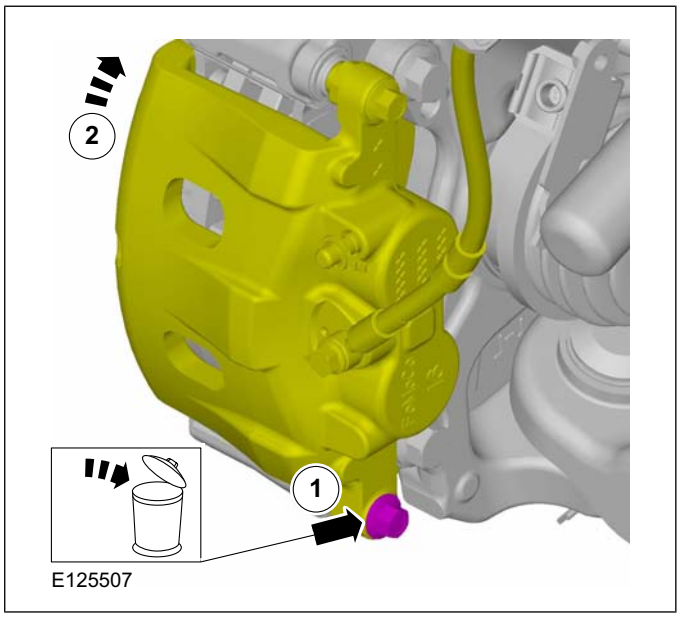
GENERAL PROCEDURES

Front Brake Disc Runout Check

Special Tool(s) / General Equipment

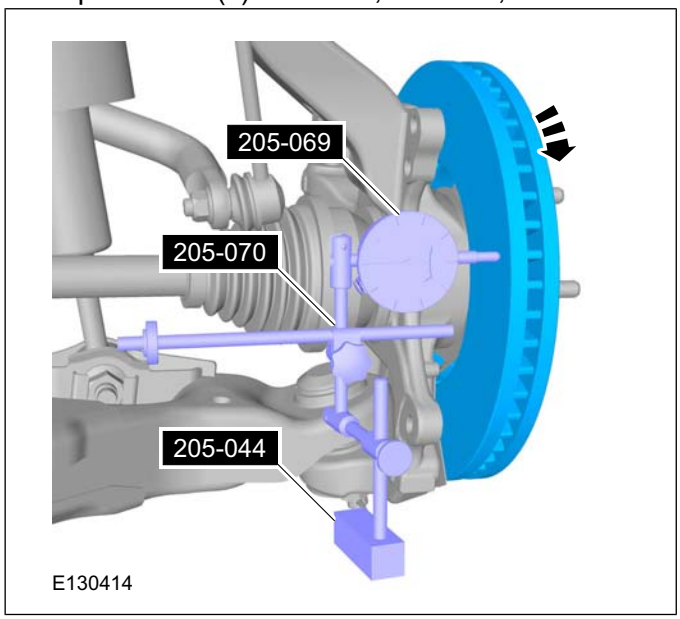
 15008	205-044 Holding Fixture, Dial Indicator Gauge
 15046	205-069 Dial Indicator Gauge (Metric)
 15022A	205-070 Holding Fixture, Dial Indicator Gauge
Calliper Gauge	

Activation

1. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
2. 

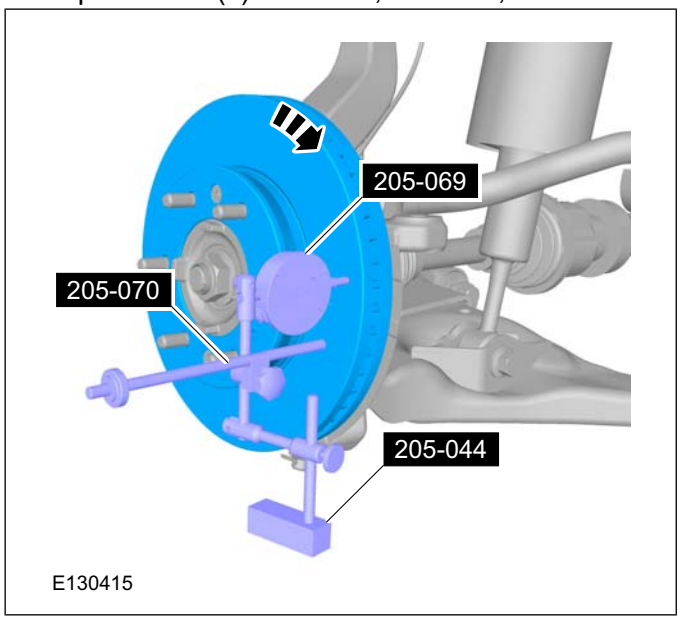
E125507
3. **NOTE:** The total dial indicator gauge reading should not exceed specification.

   Special Tool(s): 205-069, 205-070, 205-044



E130414
4. **NOTE:** The total dial indicator gauge reading should not exceed specification.

   Special Tool(s): 205-069, 205-070, 205-044



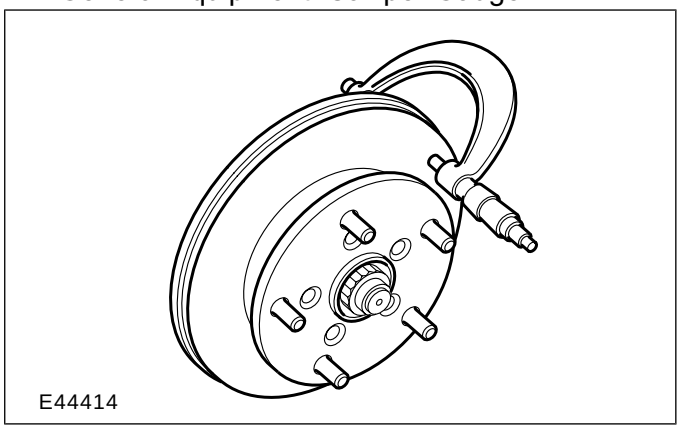
E130415
5. **NOTE:** If any of the measurements exceed the run out specification of 0.05 mm or the brake disc thickness variation is more than 0.018 mm, a new brake disc must be installed and the brake disc runout re-checked.

   Using a suitable micrometer, measure the brake disc thickness at eight positions, 45 degrees

GENERAL PROCEDURES

apart and approximately 10 mm from the outer edge of the brake disc.

General Equipment: Calliper Gauge


E44414

GENERAL PROCEDURES

Brake System Leak Check

Check

1. NOTE: Brake fluid is water soluble and it is possible that all evidence of fluid leakage has been washed off if the vehicle has been operated in rain or snow.

   Check the brake fluid level. Add brake fluid as necessary.

2. Apply the brakes several times and make sure the pedal feel is not spongy. If necessary, bleed the brake system.

   For additional information, refer to Brake System Bleeding in this section.

3. Check the brake fluid level and verify that the fluid level is actually dropping.

4. NOTE: If the brake fluid level drops and no external leak is evident, check for a brake master cylinder bore end seal leak.

   Locate and correct the external leak.

GENERAL PROCEDURES

Brake System Bleeding(12 141 0)

General Equipment

Worldwide Diagnostic System (WDS)

Bleeding

All Vehicles

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with the eyes. Wash hands thoroughly after handling. If brake fluid contacts the eyes, flush the eyes for 15 minutes with cold running water. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately. Failure to follow these instructions may result in personal injury.

CAUTION: If brake fluid is spilt on the paintwork, the affected area must be immediately washed down with cold water.

NOTE: Make sure that the vehicle is standing on a level surface.

NOTE: The system consists of separate circuits for each front and diagonally opposite rear wheel. Each circuit can be bled independently.

1. **CAUTION: The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.**

   Install the bleed tube to the bleed nipple.
2. **Immerse the end of the bleed tube in a bleed jar containing a small quantity of approved brake fluid.**
3. **Position the bleed jar base at least 300 mm above the bleed nipple to maintain fluid pressure and prevent air leaking past the threads of the bleed nipple.**
4. **Loosen the rear left bleed nipple by one-half turn.**
5. **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.**
6. **NOTE: Rear brakes only.**

   Rapidly operate the parking brake control several times.
7. **Fill the brake fluid reservoir to the MAX mark.**
8. **Continue operating the brake pedal until air-free fluid is being pumped into the bleed jar.**
9. **With the brake pedal fully depressed tighten the bleed nipple.**
10. **CAUTION: Make sure that the bleed nipple cap is installed after bleeding the brake line(s). This will prevent corrosion to the bleed nipple. Failure to follow this instruction may result in the bleed nipple becoming seized.**

    Repeat the procedure for the remaining brake lines in the following order:

    1. Front left.
    2. Front right.
    3. Rear right.

Vehicles with anti-lock brakes

11. **NOTE: This step is only necessary when changing the brake fluid to remove the used brake fluid from the hydraulic control unit (HCU).**

    Using WDS, bleed the brake system.

GENERAL PROCEDURES

Brake System Pressure Bleeding(12 141 0)

General Equipment

Worldwide Diagnostic System (WDS)
Brake/clutch system pressure bleeder/filler

Bleeding

All vehicles

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with the eyes. Wash hands thoroughly after handling. If brake fluid contacts the eyes, flush the eyes for 15 minutes with cold running water. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately. Failure to follow these instructions may result in personal injury.

CAUTION: If brake fluid is spilt on the paintwork, the affected area must be immediately washed down with cold water.

NOTE: Make sure that the vehicle is standing on a level surface.

NOTE: The system consists of separate circuits for each front and diagonally opposite rear wheel. Each circuit can be bled independently.

1. **Fill the brake fluid reservoir to the MAX mark.**
2. **CAUTIONS:**

   Make sure that the pressure within the brake system does not exceed 1 bar.

   Make sure that the pressure bleeding equipment is filled with new brake fluid to the correct specification.

   Using the brake/clutch system pressure bleeder/filler, pressure bleed the system in accordance with the manufacturer's instructions in the following order:

   1. Rear left.
      - Rapidly operate the parking brake control several times.
   2. Front left.
   3. Front right.
   4. Rear right.
      - Rapidly operate the parking brake control several times.

   CAUTION: Make sure that the bleed nipple cap is installed after bleeding the brake line(s). This will prevent corrosion to the bleed nipple. Failure to follow this instruction may result in the bleed nipple becoming seized.
3. **Fill the brake fluid reservoir to the MAX mark as necessary.**

Vehicles with anti-lock brakes

4. **NOTE: This step is only necessary when changing the brake fluid to remove the used brake fluid from the hydraulic control unit (HCU).**

   Using WDS, bleed the brake system.

SECTION 206-02 Drum Brake

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

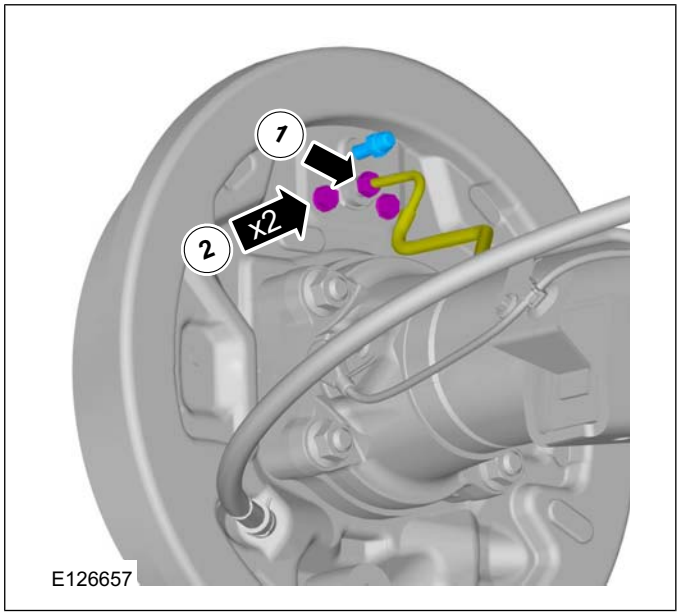
REMOVAL AND INSTALLATION

Wheel Cylinder

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: Brake Shoes (206-02 Drum Brake, Removal and Installation).
3. 1. Torque: 19 Nm
   2. Torque: 13 Nm



Installation

1. To install, reverse the removal procedure.
2. Refer to: Brake System Bleeding (206-00 Brake System - General Information, General Procedures).

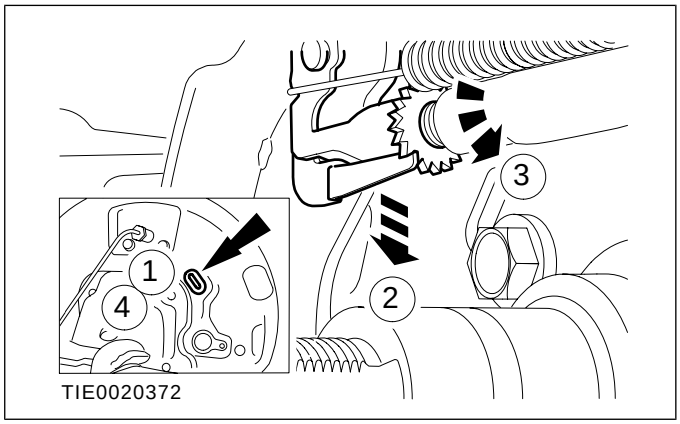
REMOVAL AND INSTALLATION

Brake Shoes

Removal

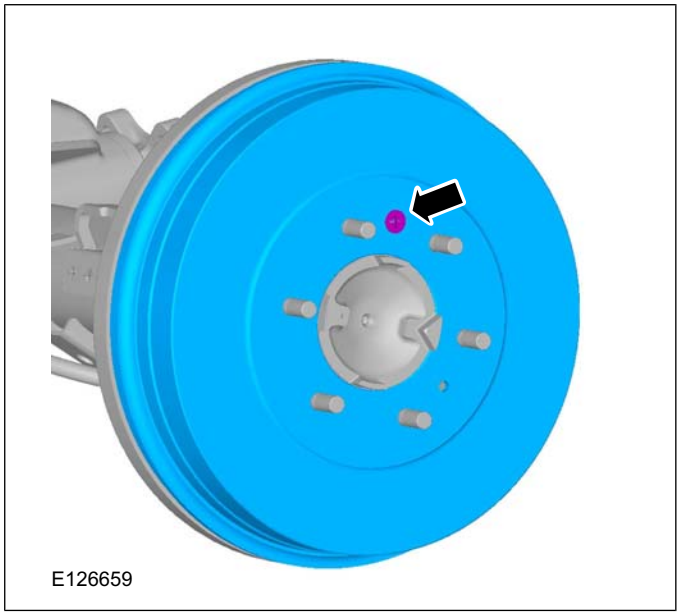
NOTE: Removal steps in this procedure may contain installation details.

1.



2. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

3.



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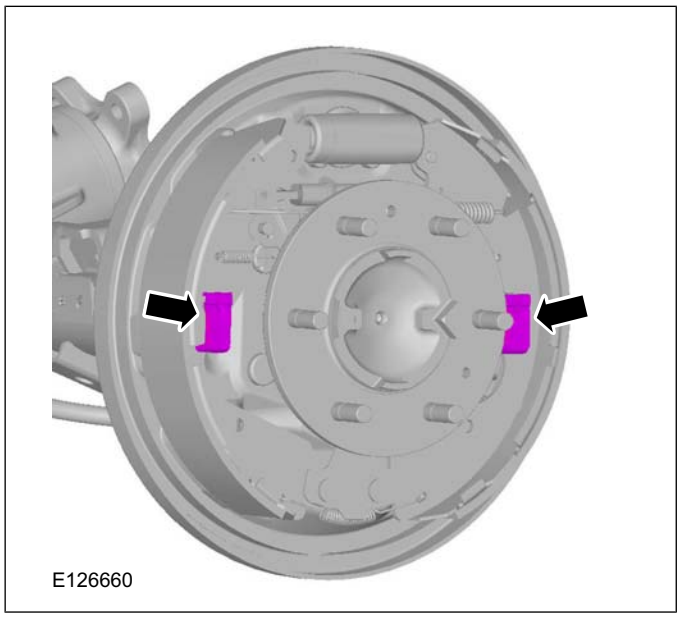

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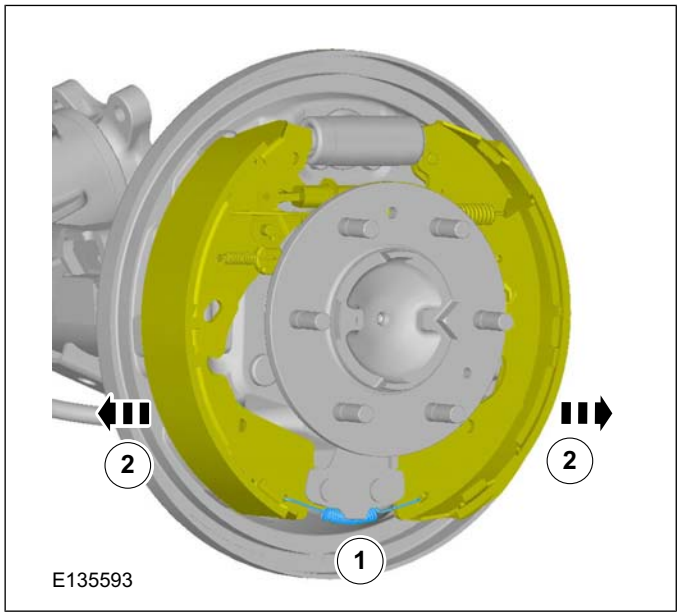
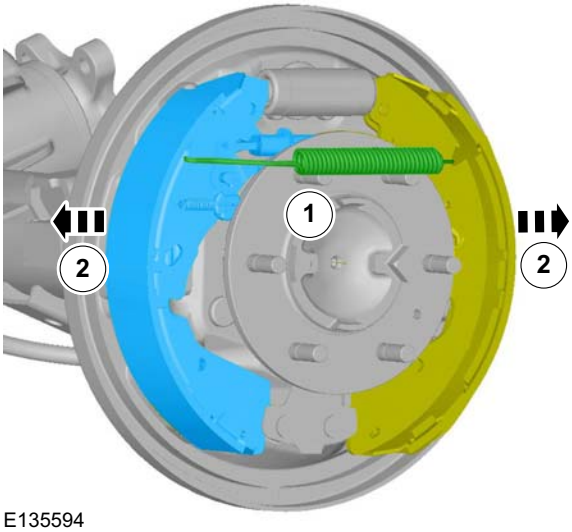


6. Hold the wheel cylinder pistons in place with a plastic band before removal of shoes.

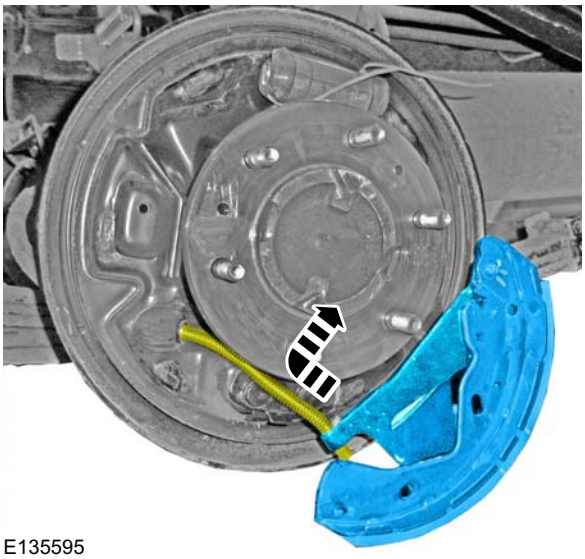
REMOVAL AND INSTALLATION

7. ⚠ **CAUTION: Do not damage the wheel cylinder boots.**



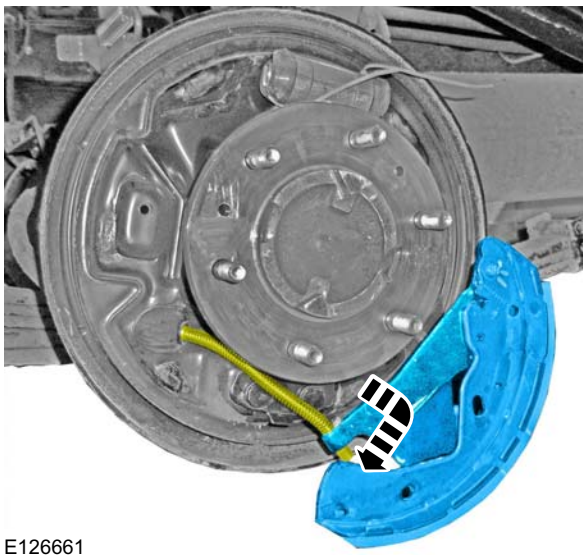
E135594

8.

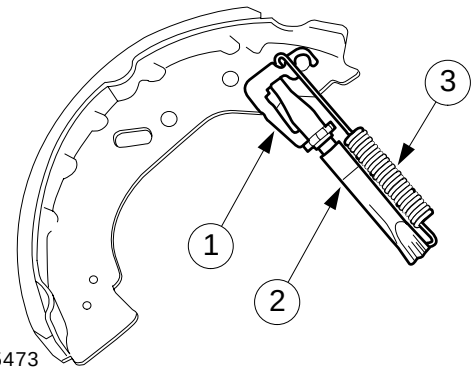

E135595

Installation

1.


E126661

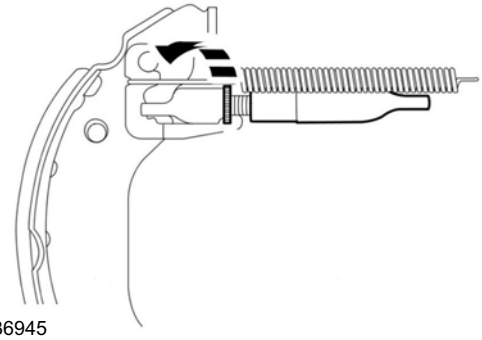
2.



TIE0005473

3. Turn the adjuster on the adjustment strut to adjust the brake shoe until the outer diameter of the brake shoe is as specified.

   Refer to: Specifications (206-00 Brake System - General Information, Specifications).


E136945

REMOVAL AND INSTALLATION

4. To install, reverse the removal procedure.
5. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
6. Depress the brake pedal to adjust the brake shoes.

SECTION 206-03 Front Disc Brake

VEHICLE APPLICATION: 2011.50 Ranger

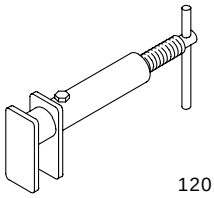
CONTENTS PAGE

REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

Brake Pads(12 234 0)

Special Tool(s)

 12014	206-005 Retractor, Brake Caliper Piston

Materials	
Name	**Specification**
Brake Fluid - Super DOT4	WSS-M6C57-A2

Removal

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

1. **WARNINGS:**

   Use of any other than approved DOT 4 motor vehicle brake fluid will cause permanent damage to brake components and will render the brakes inoperative. Failure to follow these instructions may result in personal injury.

   Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately. Failure to follow these instructions may result in personal injury.

   CAUTIONS:

   Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

   If brake fluid is spilt on the paintwork, the affected area must be immediately washed down with cold water.

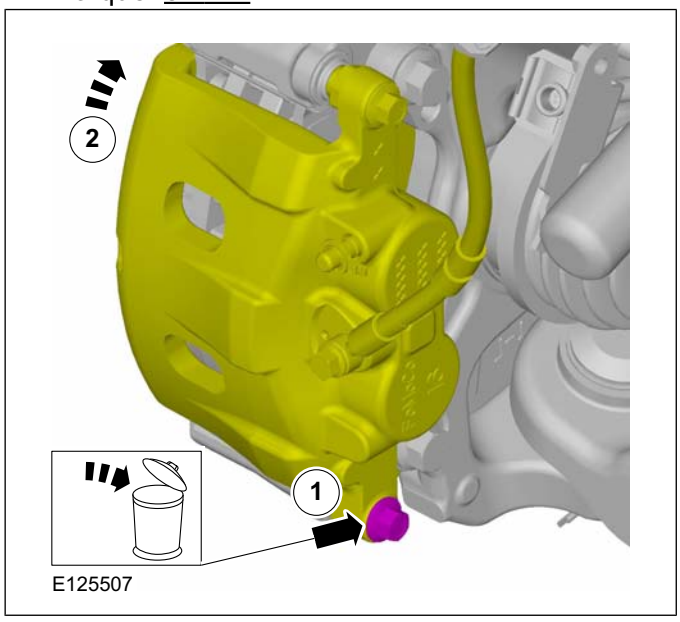
   Refer to: Brake System Health and Safety Precautions (100-00 General Information, Description and Operation).

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.**

   CAUTION: Do not pry in the brake caliper sight hole to retract the pistons as this can damage the pistons and boots.

   Torque: 52 Nm



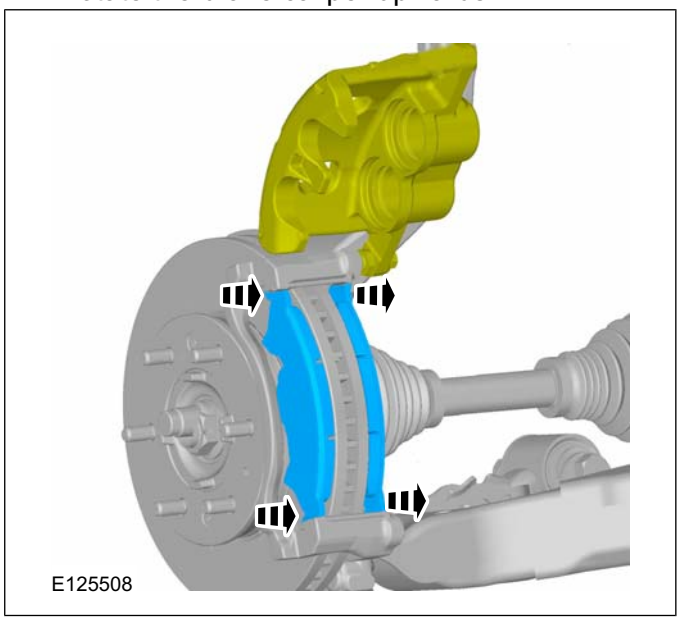
E125507

4. **NOTE:** Note the position of the brake pads to aid installation.

   NOTE: One brake disc pad kit contains the pads and pad clips required for both sides.

REMOVAL AND INSTALLATION

Rotate the brake caliper upwards

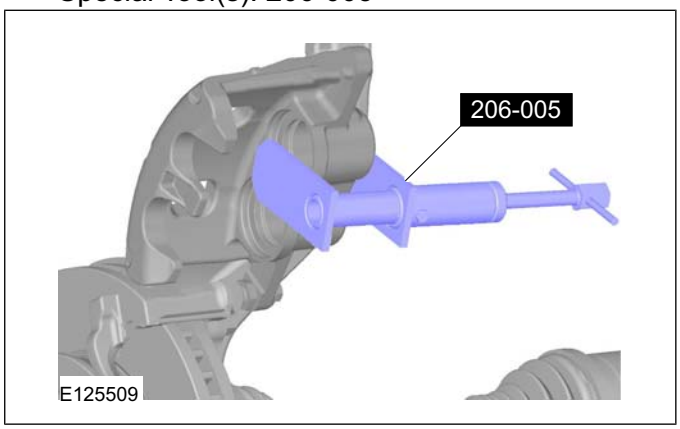


5. **CAUTION: When the brake caliper piston is retracted into the piston housing, brake fluid will be displaced into the brake fluid reservoir.**

   NOTE: Make sure the brake pad contact points are clean and free from contamination.

   NOTE: Remove the adhesive foil from the rear of the brake pad.

   Special Tool(s): 206-005



Installation

1. **CAUTIONS:**

   Make sure that the mating faces are clean and free of foreign material and that no grease is applied to the brake pad guides.

   Do not allow grease, oil, brake fluid or other contaminants to contact the pad lining material. Do not install contaminated pads.

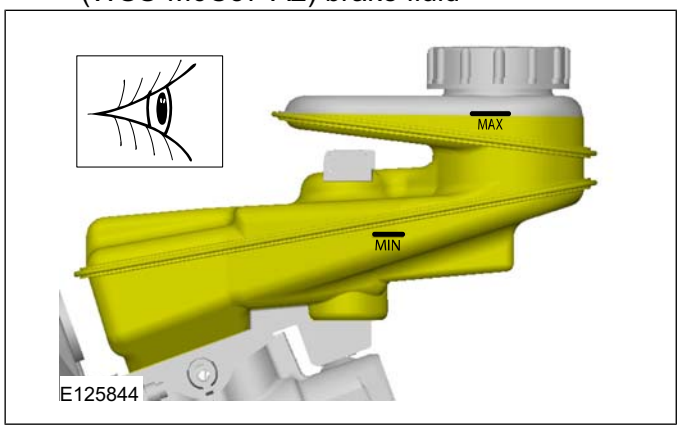
   Protect the piston and boots when pushing the caliper piston into the caliper piston bores.

2. To install, reverse the removal procedure.

3. **CAUTION: The fluid level must remain between the MAX and MIN marks.**

   NOTE: 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)

Removal

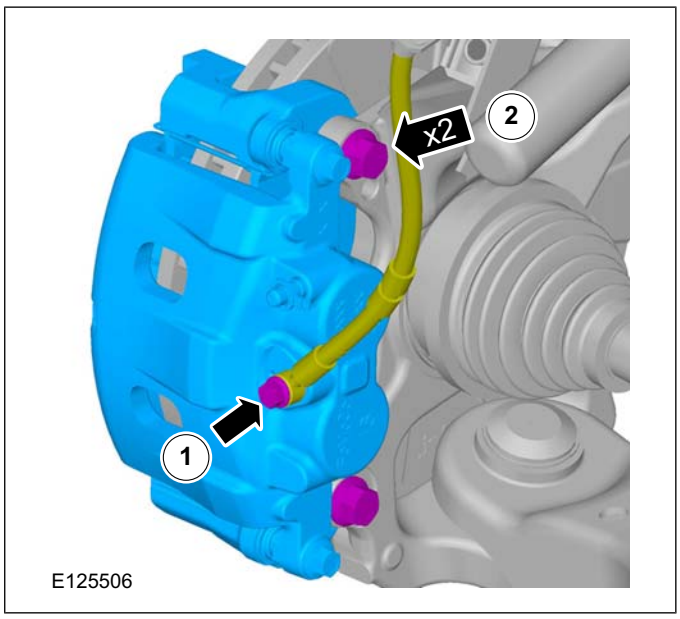
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Brake System Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
2. **WARNING: Be prepared to collect escaping fluids.**

   NOTE: Use suitable paper to absorb any escaping fluid.

   NOTE: Make sure that the brake fluid level does not drop below the min mark.

   1. Torque: 27 Nm
   2. Torque: 115 Nm



Installation

1. To install , reverse the removal procedure.
2. **NOTE:** Make sure that replace the new packings for flexible hose.

   Refer to: Brake System Bleeding (206-00 Brake System - General Information, General Procedures).

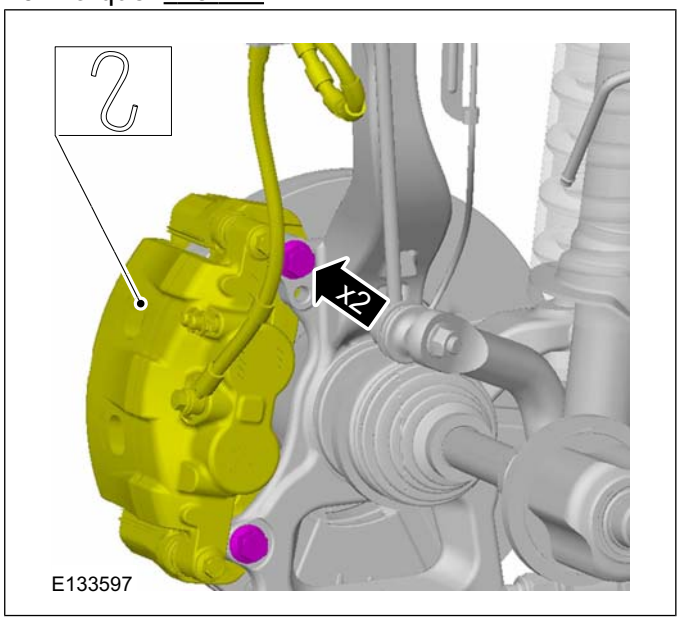
REMOVAL AND INSTALLATION

Brake Disc(12 223 0)

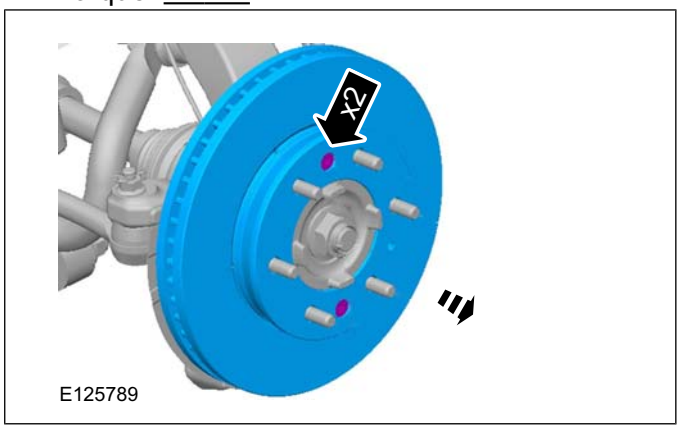
Removal

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. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
3. Torque: 115 Nm



4. Torque: 12 Nm



Installation

1. To install, reverse the removal procedure.

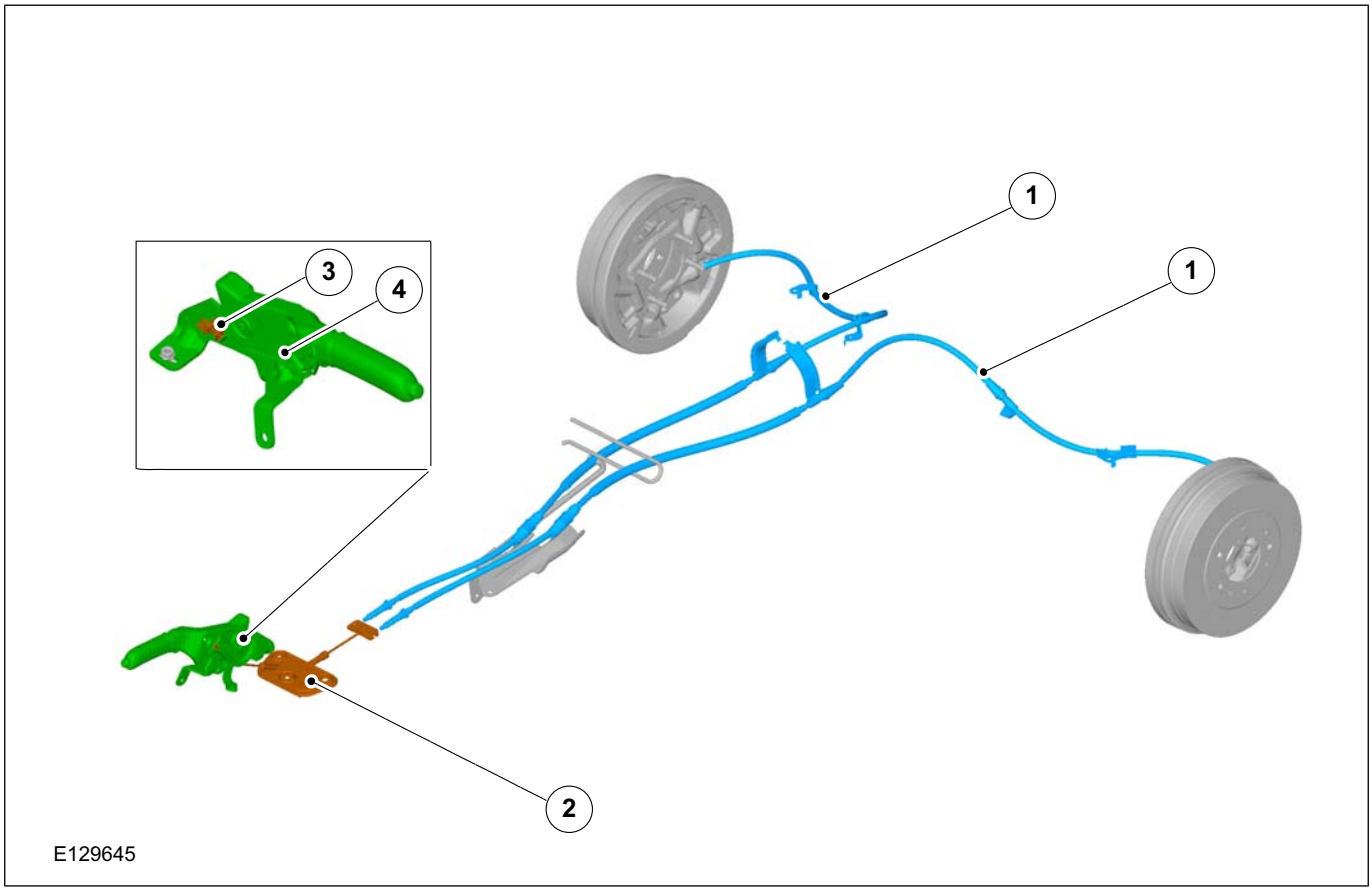
SECTION 206-05 Parking Brake and Actuation

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Parking Brake

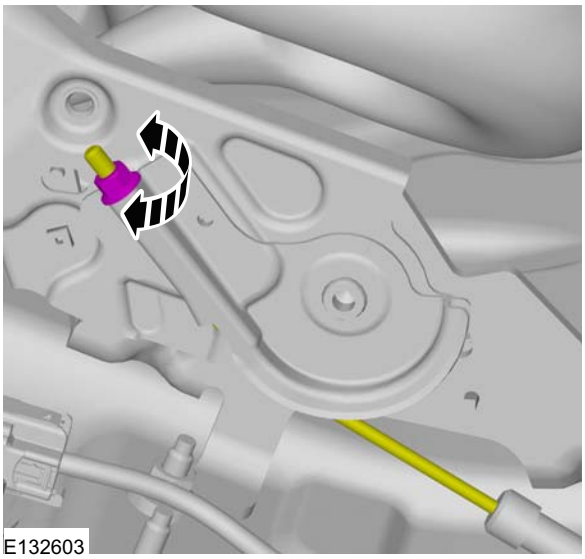


Item	Description
1	Parking brake rear cables
2	Parking brake front cable
3	Parking brake switch
4	Parking brake lever assembly

GENERAL PROCEDURES

Parking Brake Cable Adjustment(12 662 0)

1. **Before adjustment, depress the brake pedal several times while the vehicle is moving in reverse.**
2. **Pull the parking lever two to three times and turn the adjustment nut until the stroke reaches within range.**
   - Parking brake lever stroke when pulled at 98 N (10 kgf, 22 lbf) 3-6 notches.



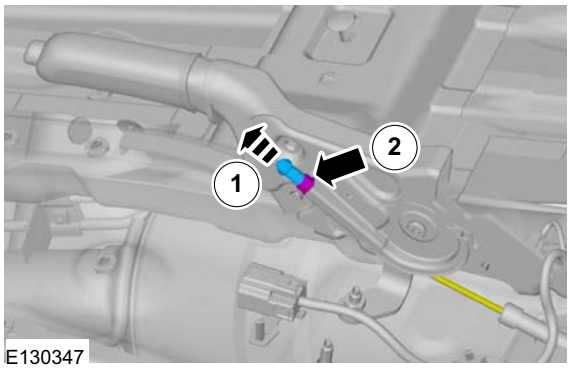
3. **After adjustment, pull the parking brake lever one notch and verify that the parking brake warning light illuminates.**
4. **Verify that the rear brakes do not drag.**

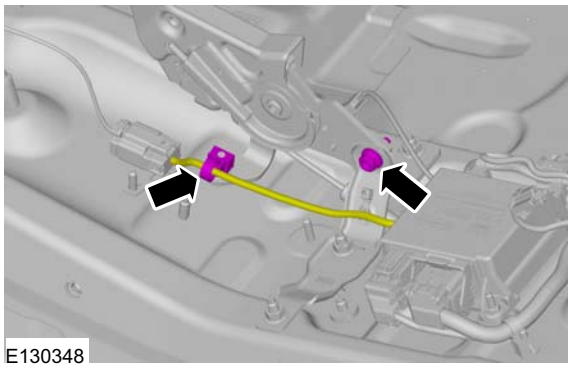
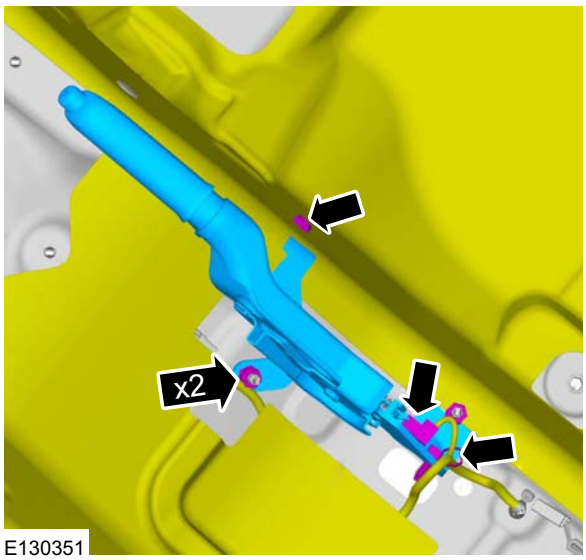
REMOVAL AND INSTALLATION

Parking Brake Control(12 664 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. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
   Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).
3. 

E130347
4. Torque: 22 Nm

E130348
5. Torque: 22 Nm


E130351

Installation

1. To install, reverse the removal procedure.
2. Refer to: Parking Brake Cable Adjustment (206-05 Parking Brake and Actuation, General Procedures).

REMOVAL AND INSTALLATION

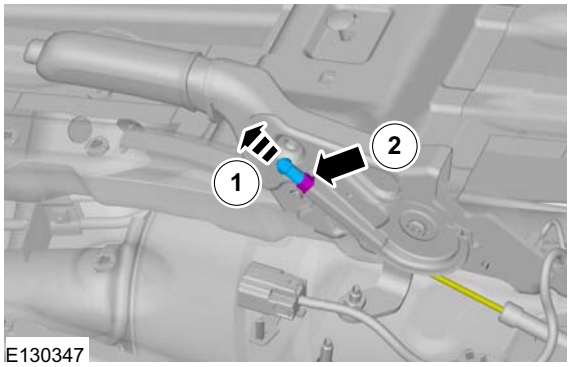
Parking Brake Front Cable

Removal

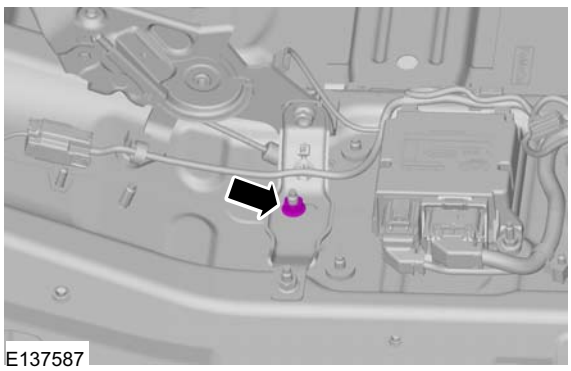
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
   Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

2.

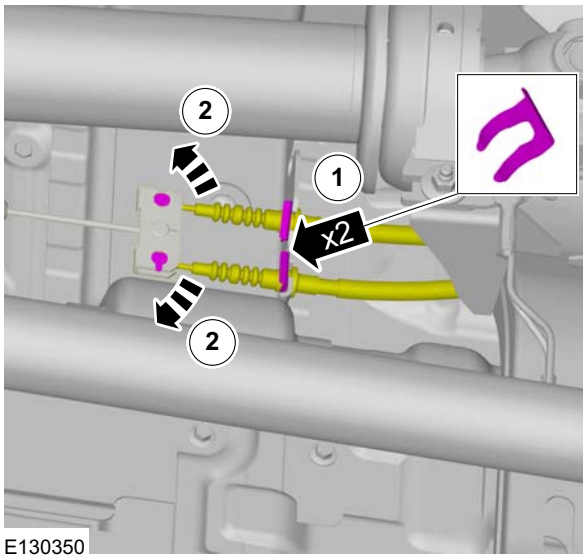


3. Torque: 18 Nm

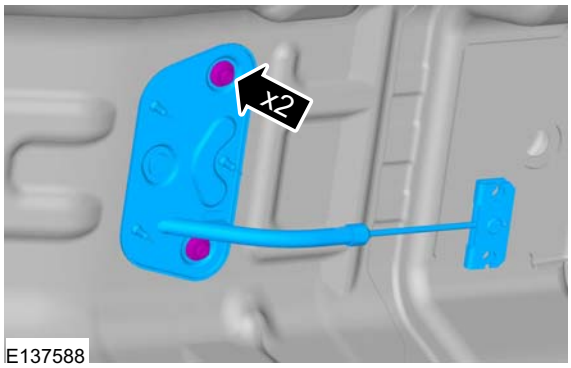


4. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

5.



6. Torque: 18 Nm



Installation

1. To install, reverse the removal procedure.
2. Refer to: Parking Brake Cable Adjustment (206-05 Parking Brake and Actuation, General Procedures).

REMOVAL AND INSTALLATION

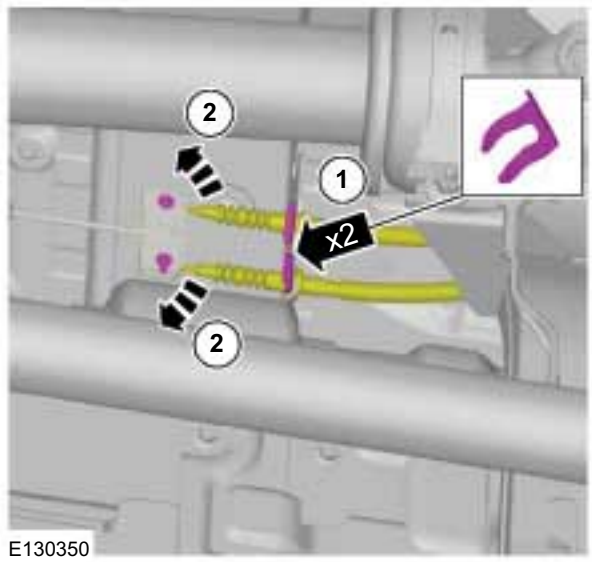
Parking Brake Rear Cables

Removal

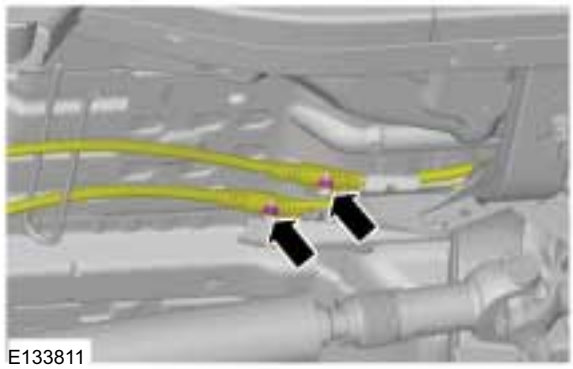
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Brake Shoes (206-02 Drum Brake, Removal and Installation).

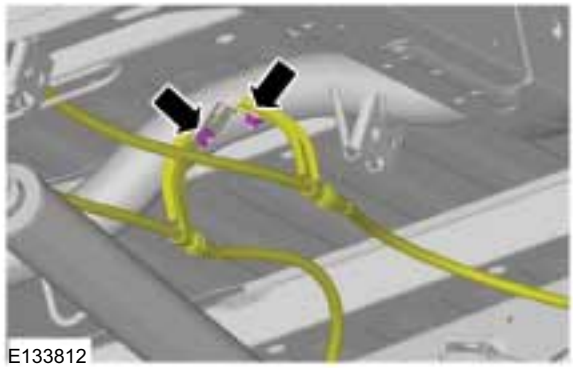
2.



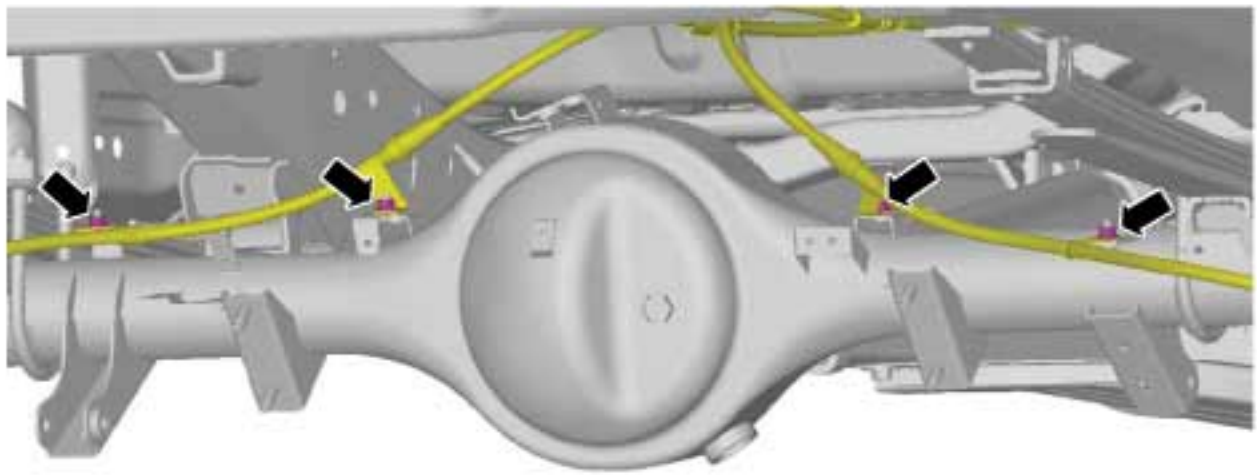
3. Torque: 17 Nm



4. Torque: 17 Nm

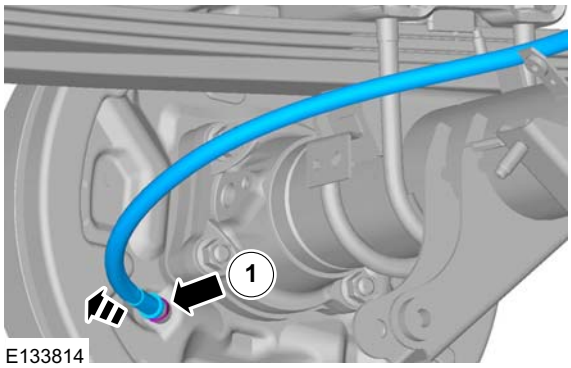


5. Torque: 17 Nm



REMOVAL AND INSTALLATION

6. On both sides.



Installation

1. To install, reverse the removal procedure.

2. Refer to: Parking Brake Cable Adjustment (206-05 Parking Brake and Actuation, General Procedures).

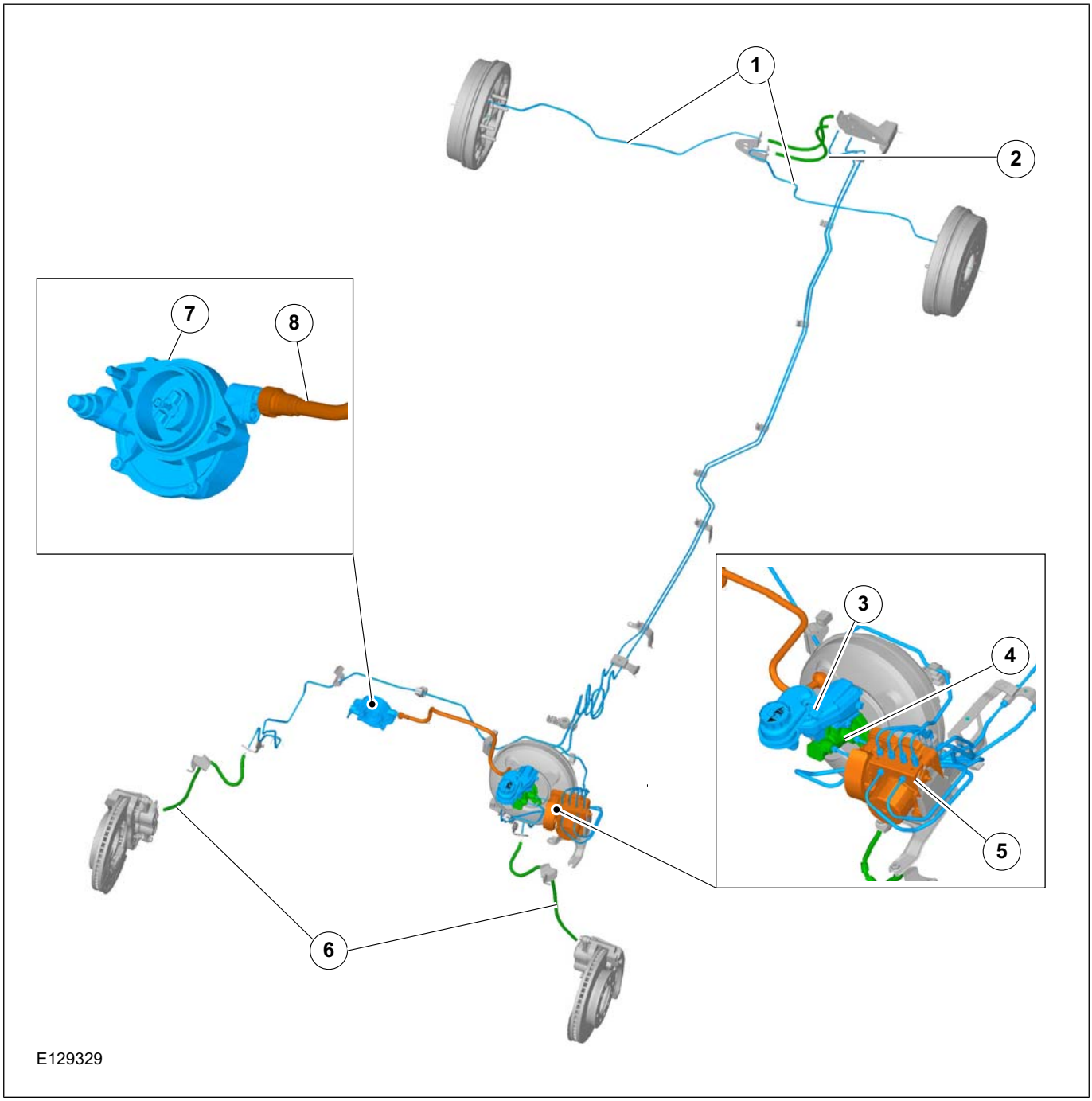
SECTION 206-06 Hydraulic Brake Actuation

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Hydraulic Brake Actuation



Item	Description
1	Rear Brake tubes
2	Rear brake flexible hoses
3	Brake fluid reservoir
4	Brake Master cylinder
5	Hydraulic control unit (HCU)
6	Front Brake flexible hoses

Item	Description
7	Vacuum pump
8	Vacuum hose

REMOVAL AND INSTALLATION

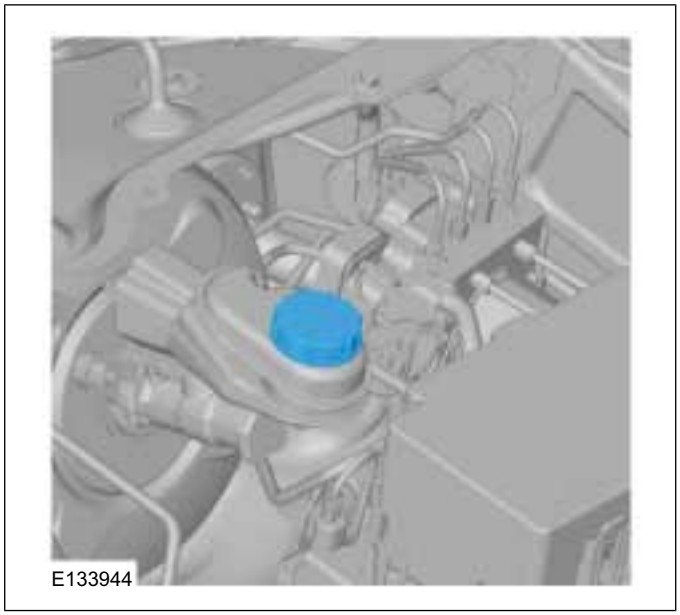
Brake Master Cylinder — LHD 4WD/LHD RWD(12 343 0)

Removal

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

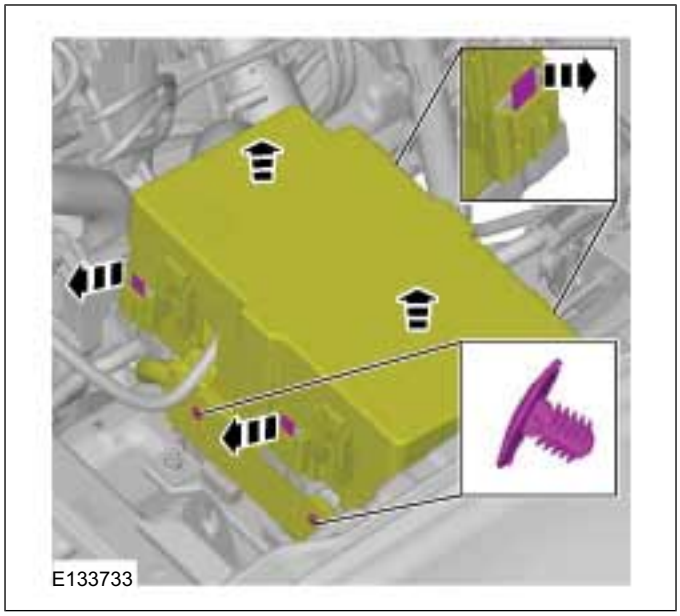
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).

2.

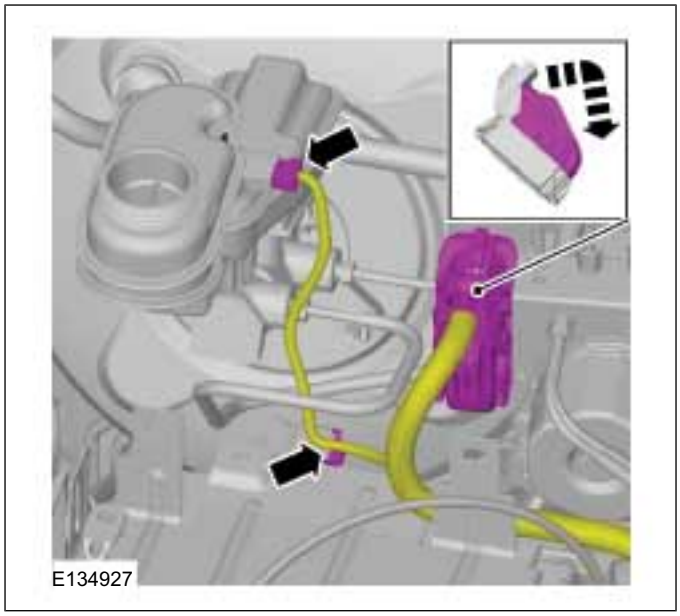


3.
1. Connect one end of a suitable piece of clear plastic pipe to the brake caliper bleed nipple and place the other end into a suitable container.
2. Loosen the bleed nipple.
3. Depress the brake pedal until no more brake fluid comes through the bleed nipple.
4. Tighten the bleed nipple.
5. Repeat the draining procedure on the opposite side brake caliper.

4.



5.

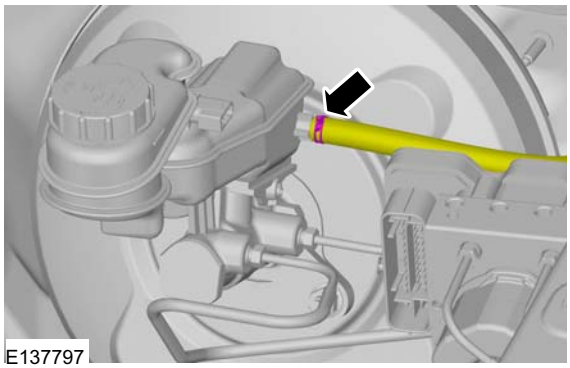


REMOVAL AND INSTALLATION

Vehicles with manual transmission

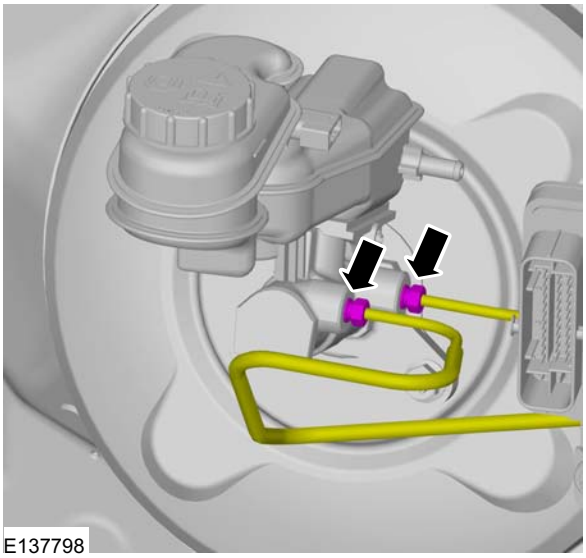
6.

WARNING: Be prepared to collect escaping fluids.


E137797

All vehicles

7. Torque: 17 Nm


E137798

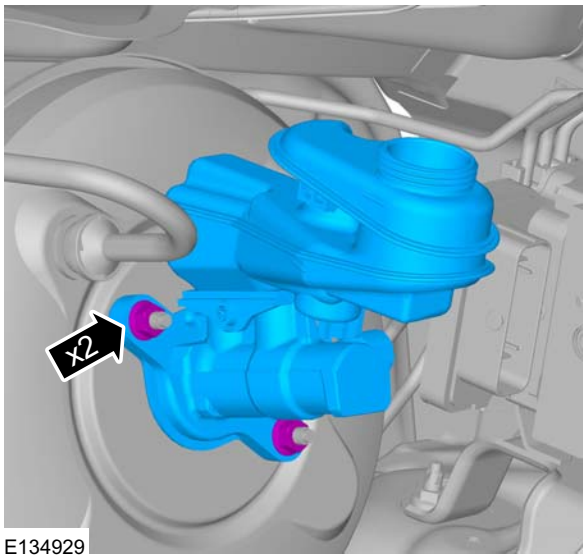
8. CAUTIONS:

Make sure that all openings are sealed.

Take extra care when handling the components.

NOTE: Depress the brake pedal 3 to 4 times to release the vacuum from brake booster.

Torque: 13 Nm



E134929

Installation

1. 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).

2. To install, reverse the removal procedure.

Vehicles with manual transmission

3. Refer to: Clutch System Bleeding - Vehicles With: MT82 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).
Refer to: Clutch System Bleeding - Vehicles With: MT-75 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).

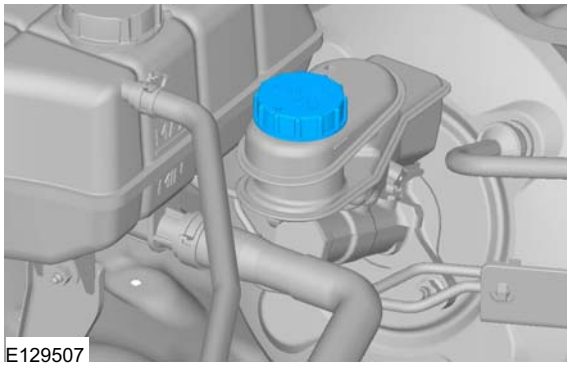
REMOVAL AND INSTALLATION

Brake Master Cylinder — RHD 4WD/RHD RWD(12 343 0)

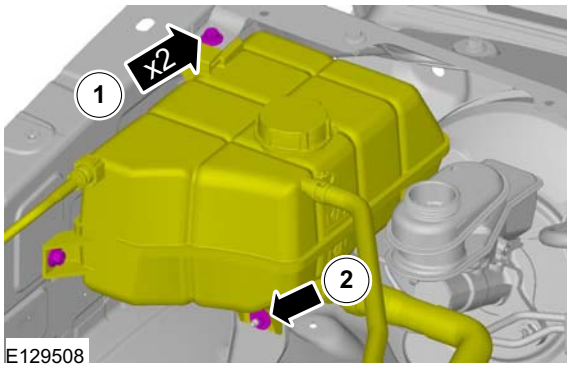
Removal

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. 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.

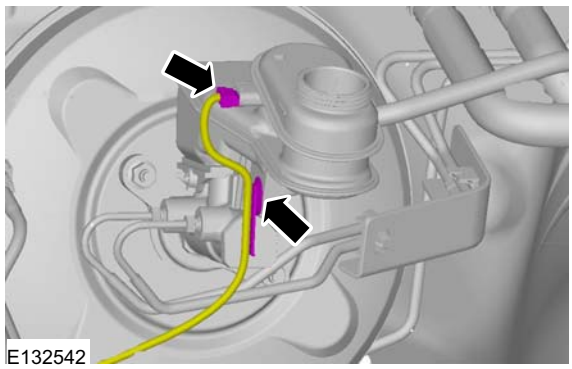

E129507

3. 1. Torque: 6 Nm
   2. Torque: 6 Nm



E129508

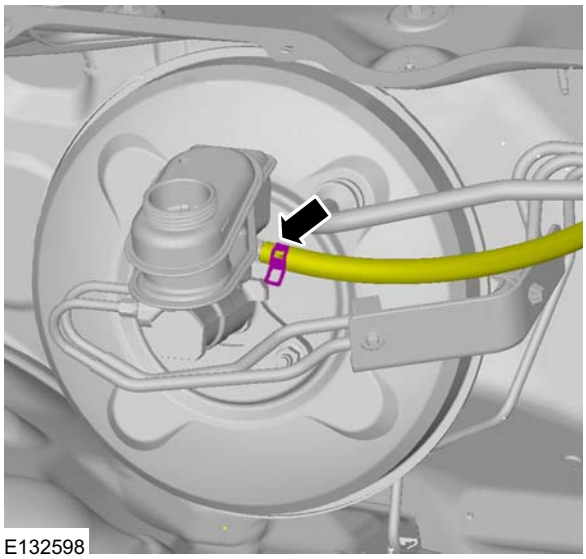
4.


E132542

Vehicles with manual transmission

5.

WARNING: Be prepared to collect escaping fluids.


E132598

All vehicles

6.

WARNING: Be prepared to collect escaping fluids.

CAUTIONS:

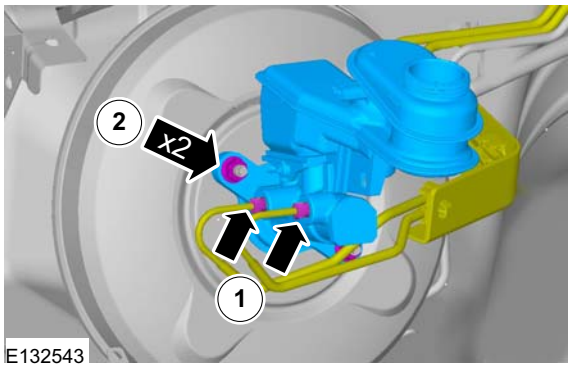
Make sure that all openings are sealed.

Take extra care when handling the components.

REMOVAL AND INSTALLATION

NOTE: Depress the brake pedal 3 or 4 times to release the vacuum from brake booster.

1. Torque: 17 Nm
2. Torque: 13 Nm



Installation

1. To install, reverse the removal procedure.

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).

Vehicles with manual transmission

2. Refer to: Clutch System Bleeding - Vehicles With: MT-75 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).
Refer to: Clutch System Bleeding - Vehicles With: MT82 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).

REMOVAL AND INSTALLATION

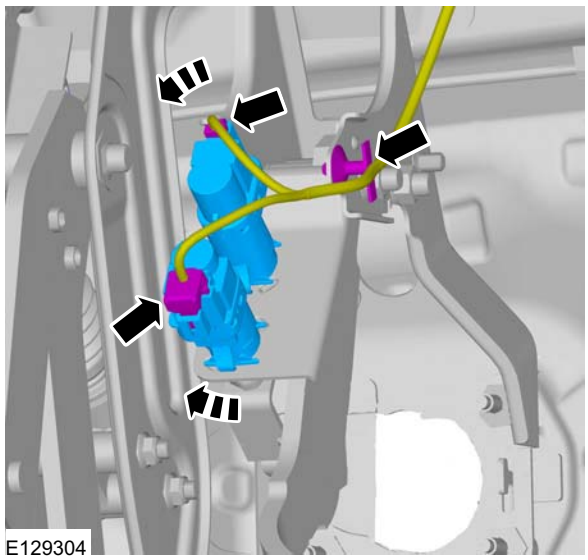
Brake Pedal and Bracket

Removal

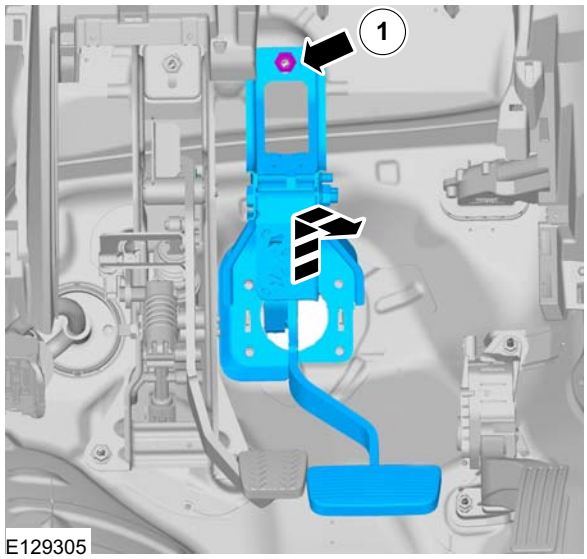
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Brake Booster - RHD 4WD/RHD RWD (206-07 Power Brake Actuation, Removal and Installation).
   Refer to: Brake Booster - LHD 4WD/LHD RWD (206-07 Power Brake Actuation, Removal and Installation).

2.



3. Torque : 15 Nm



Installation

1. **CAUTION: Make sure that the brake booster push rod is correctly located.**
   To install, reverse the removal procedure.

SECTION 206-07 Power Brake Actuation

VEHICLE APPLICATION: 2011.50 Ranger

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REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

Brake Booster — LHD 4WD/LHD RWD(12 451 0)

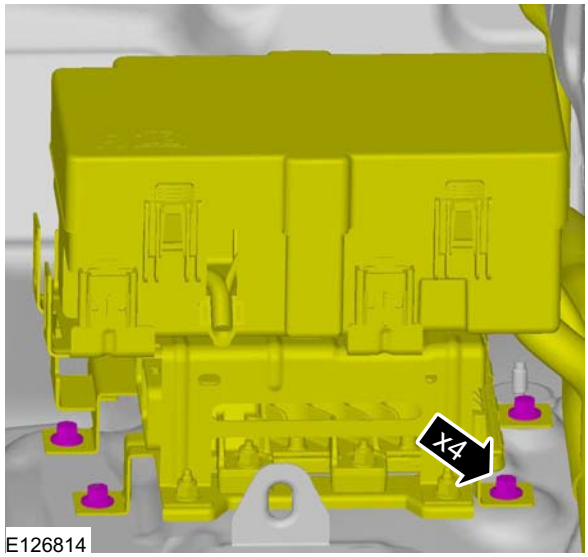
Removal

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. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

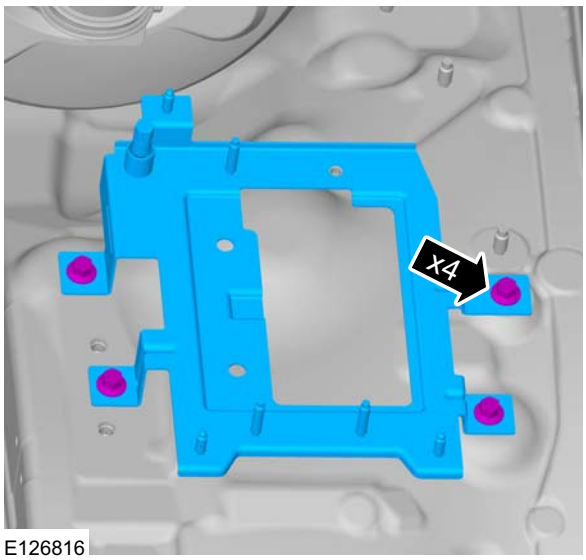
Vehicles with 2.5L engine

3. Torque: 25 Nm



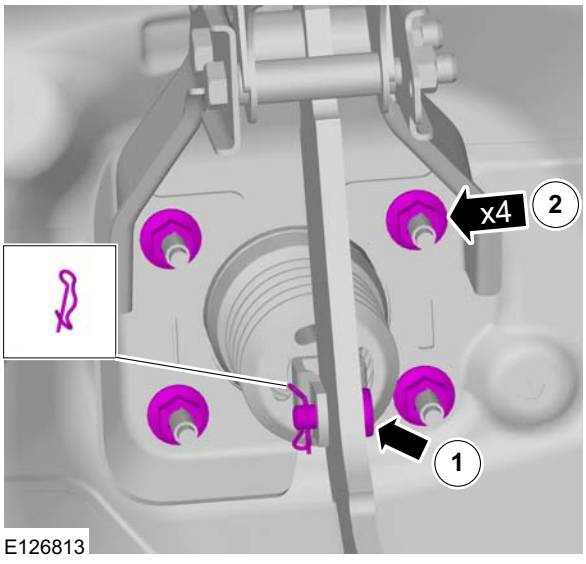
Vehicles with diesel engine

4. Refer to: Hydraulic Control Unit (HCU) - LHD 4WD/LHD RWD (206-09 Anti-Lock Control, Removal and Installation).
5. Torque: 25 Nm



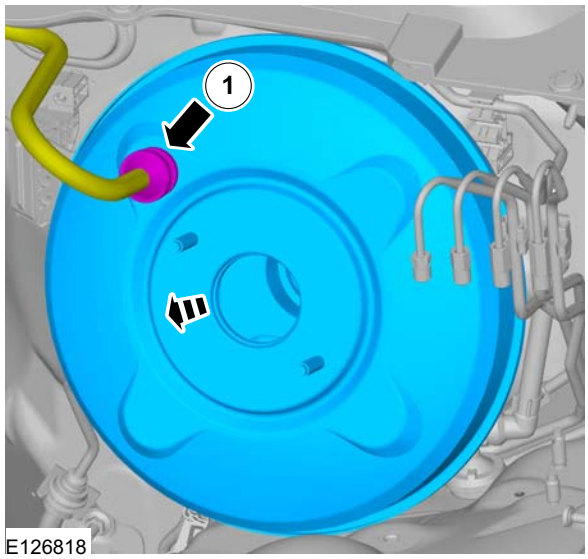
All vehicles

6. Refer to: Brake Master Cylinder - LHD 4WD/LHD RWD (206-06 Hydraulic Brake Actuation, Removal and Installation).
7. 2. Torque: 15 Nm



REMOVAL AND INSTALLATION

8.



Installation

CAUTION: Make sure that the brake booster pushrod is correctly located.

1. To install, reverse the removal procedure.

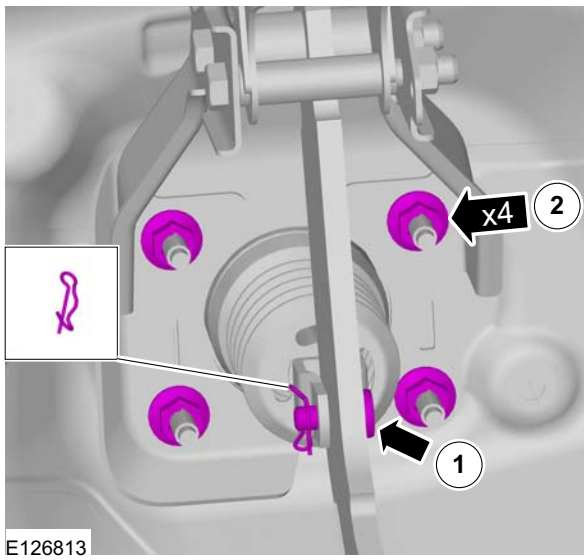
REMOVAL AND INSTALLATION

Brake Booster — RHD 4WD/RHD RWD(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. Refer to: Brake Master Cylinder - RHD 4WD/RHD RWD (206-06 Hydraulic Brake Actuation, Removal and Installation).
3. Torque: 15 Nm



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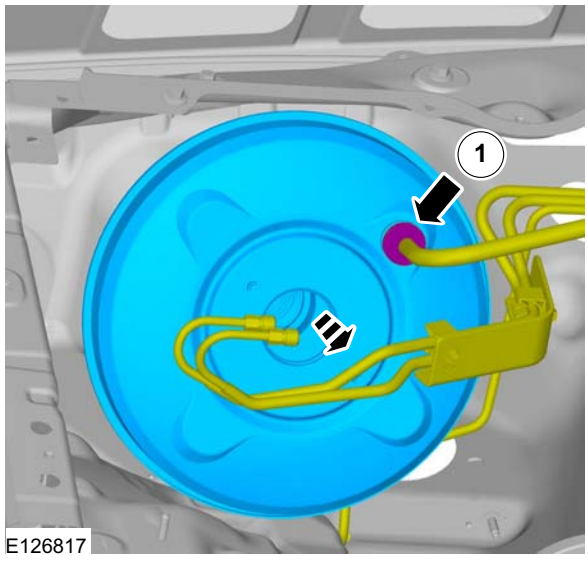


Installation

CAUTION: Make sure that the brake booster pushrod is correctly located.

1. To install , reverse the removal procedure.

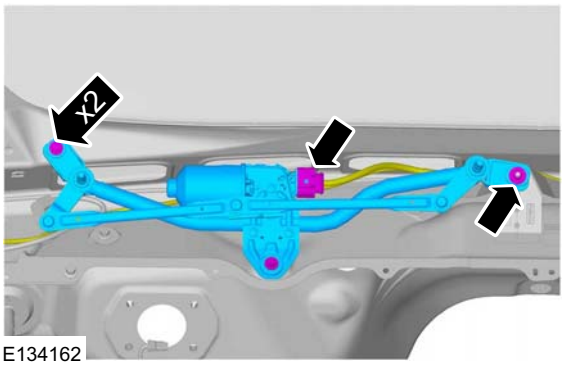
REMOVAL AND INSTALLATION

Brake Vacuum Pump — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma(12 414 0)

Removal

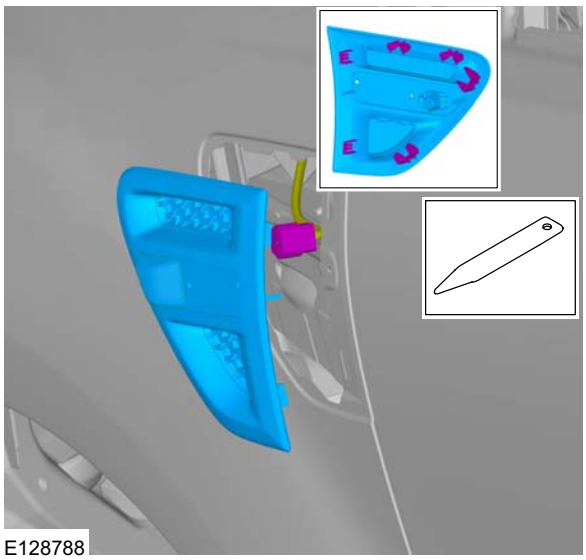
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Brake System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).
3. Torque: 10 Nm

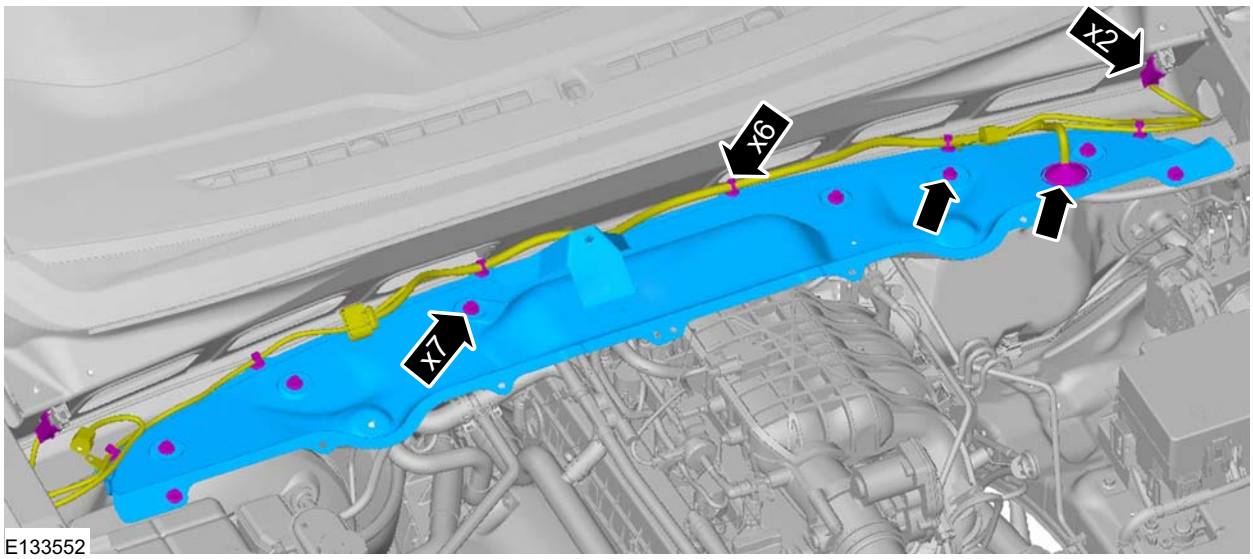


E134162

4. On both sides


E128788

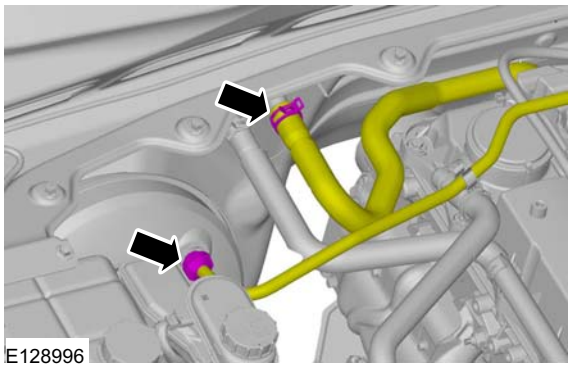
5. Torque: 10 Nm



E133552

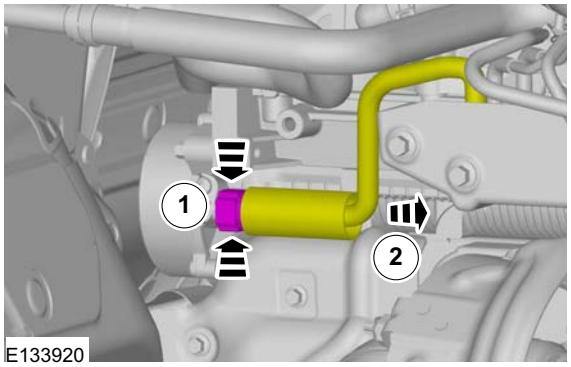
REMOVAL AND INSTALLATION

6.



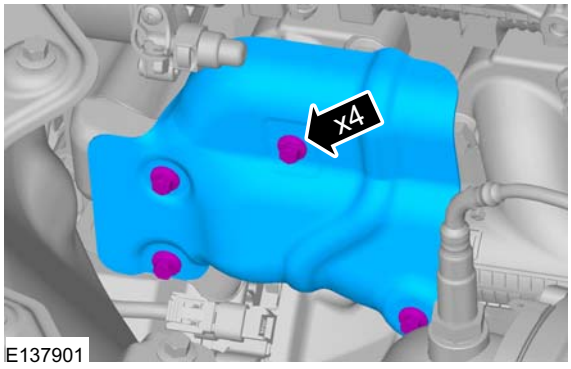
Vehicles with fixed vane turbocharger

7.

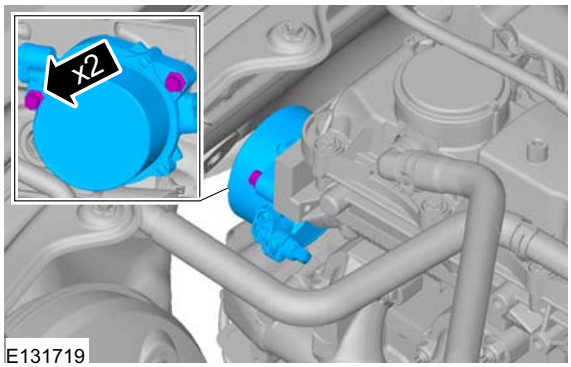


All vehicles

8. Torque: 9 Nm



9. Torque: 22 Nm



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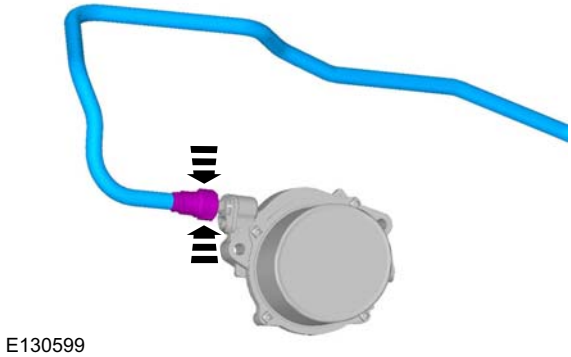


Installation

1. **CAUTION: Make sure that the couplings are aligned.**

   To install, reverse the removal procedure.

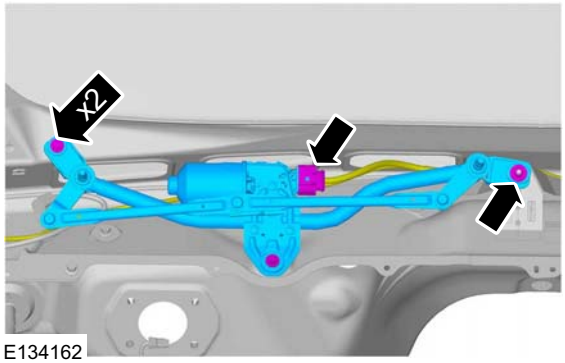
REMOVAL AND INSTALLATION

Brake Vacuum Pump — 3.2L Duratorq-TDCi (148kW/200PS) - Puma(12 414 0)

Removal

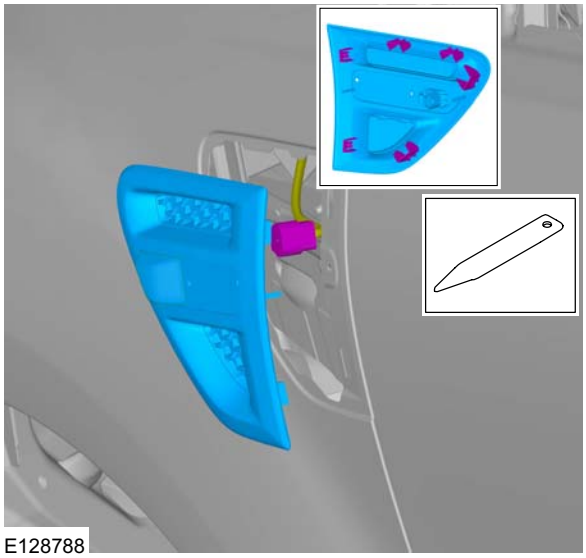
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Brake System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).
3. Torque: 10 Nm

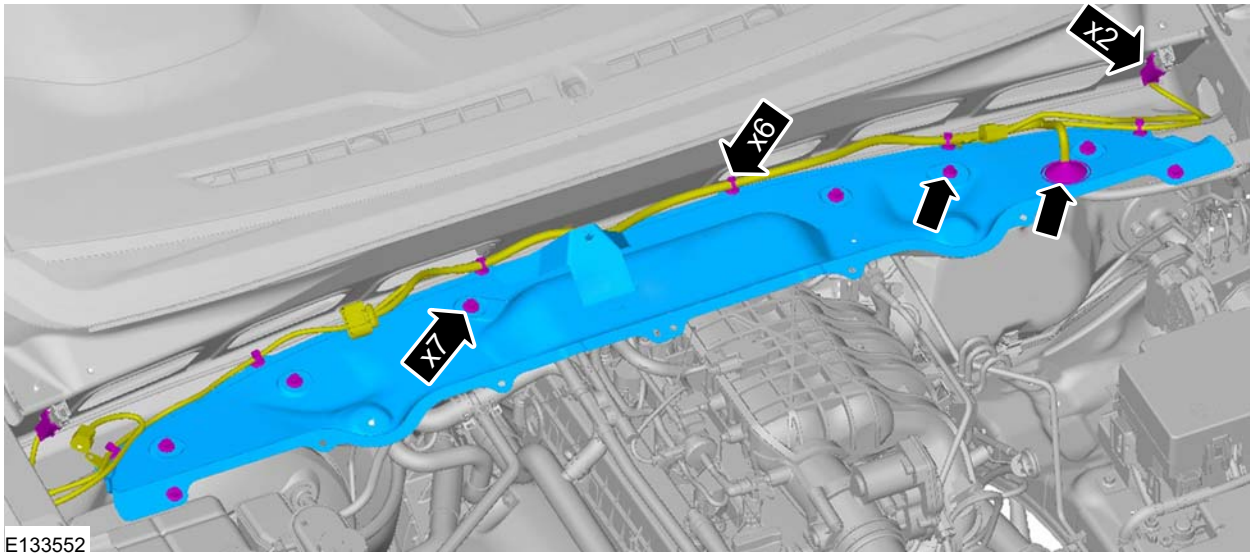


E134162

4. On both sides


E128788

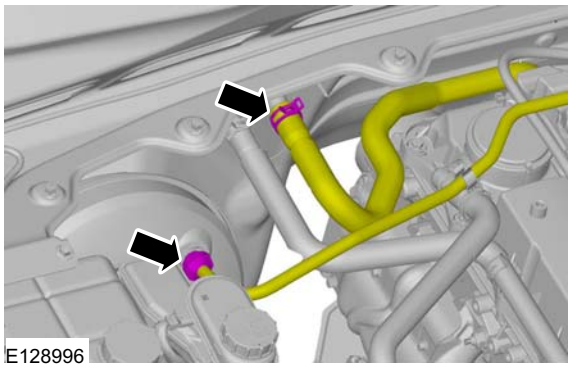
5. Torque: 10 Nm



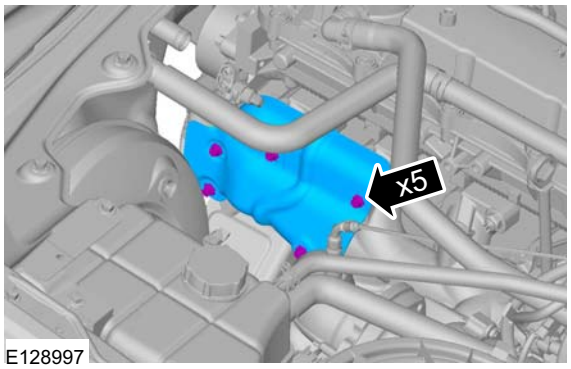
E133552

REMOVAL AND INSTALLATION

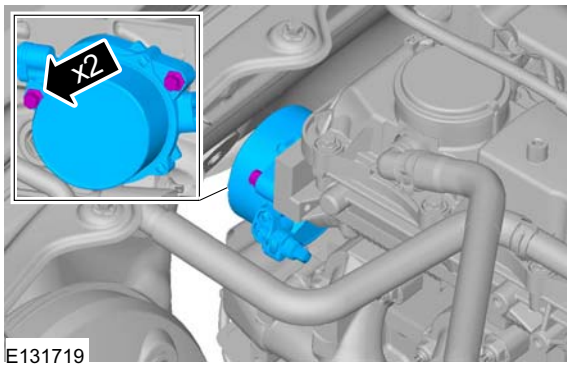
6.



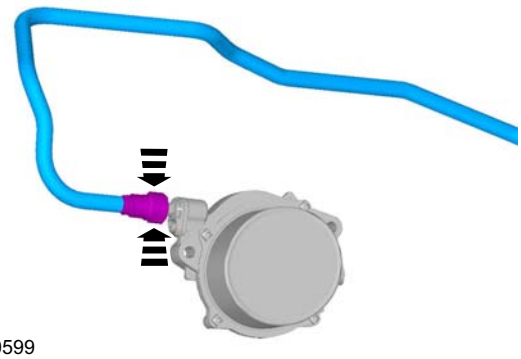
7. Torque: 9 Nm



8. Torque: 22 Nm



9.



Installation

1. **CAUTION: Make sure that the couplings are aligned.**

   To install, reverse the removal procedure.

SECTION 206-09A Anti-Lock Control

VEHICLE APPLICATION: 2011.50 Ranger

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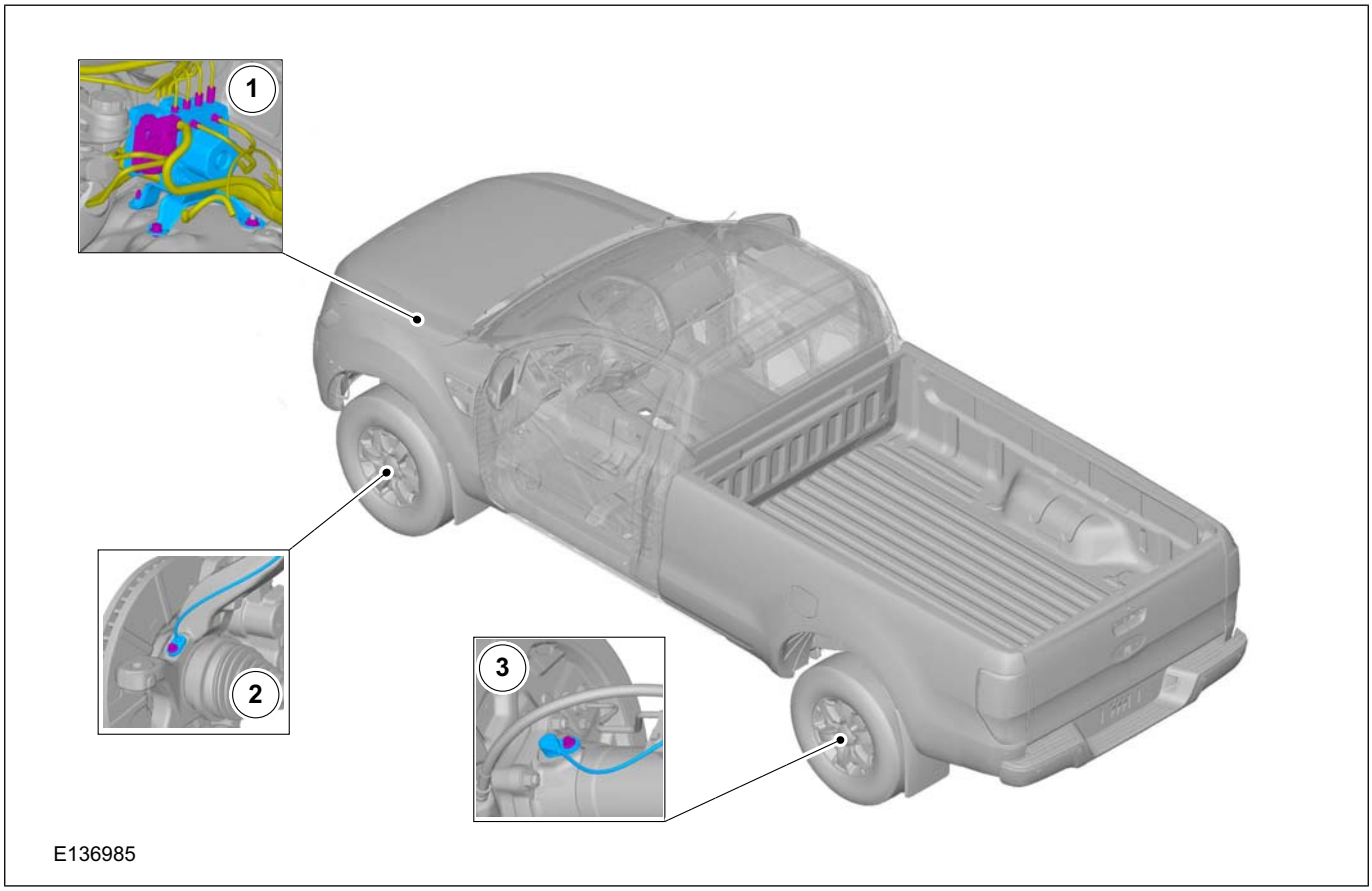
DESCRIPTION AND OPERATION

Anti-Lock Control



Item	Description
1	Hydraulic Control Unit (HCU)
2	Front Wheel Speed Sensor
3	Rear Wheel Speed Sensor

REMOVAL AND INSTALLATION

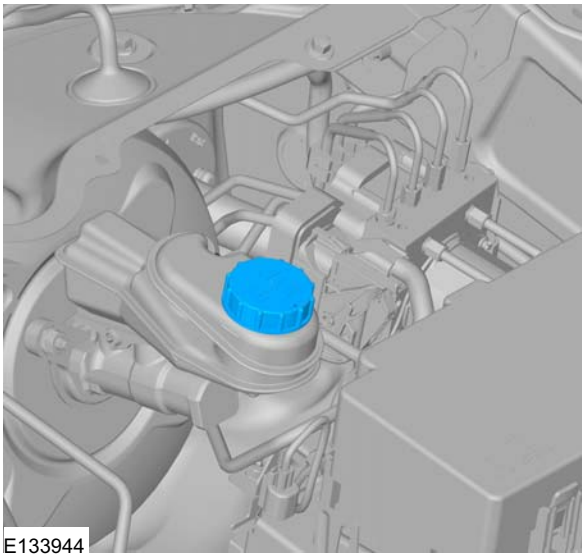
Hydraulic Control Unit (HCU) — LHD 4WD/LHD RWD

Removal

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

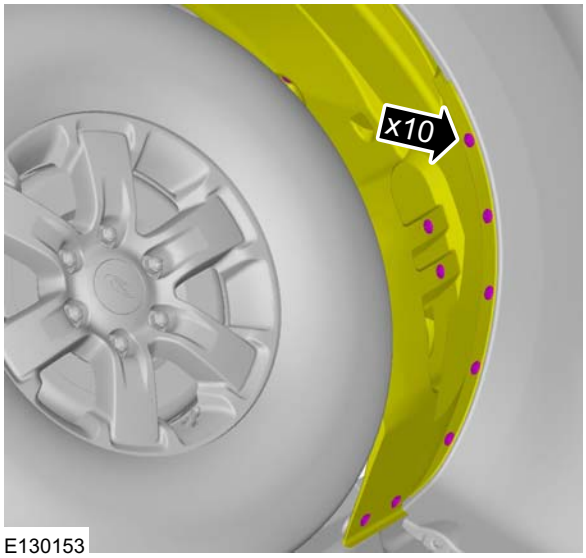
1. Refer to: Brake System Health and Safety Precautions (100-00 General Information, Description and Operation).

2.



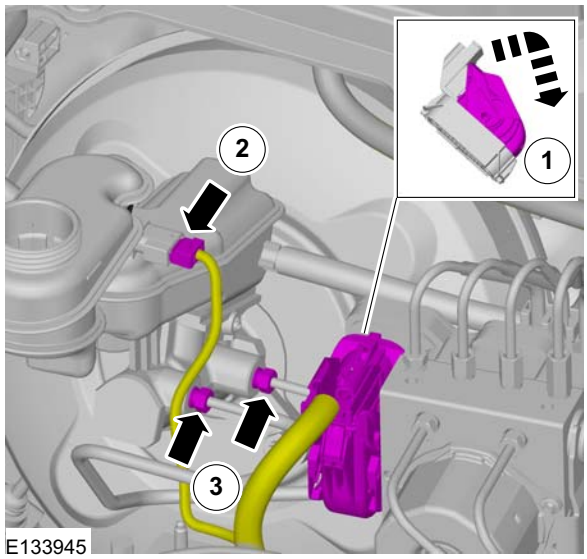
3. 1. Connect one end of a suitable piece of clear plastic pipe to the brake caliper bleed nipple and place the other end into a suitable container.
   2. Loosen the bleed nipple.
   3. Depress the brake pedal until all the brake fluid is drained from the brake fluid reservoir.
   4. Tighten the bleed nipple.
   5. Repeat the draining procedure on the opposite side brake caliper and rear brake wheel cylinder.

4.

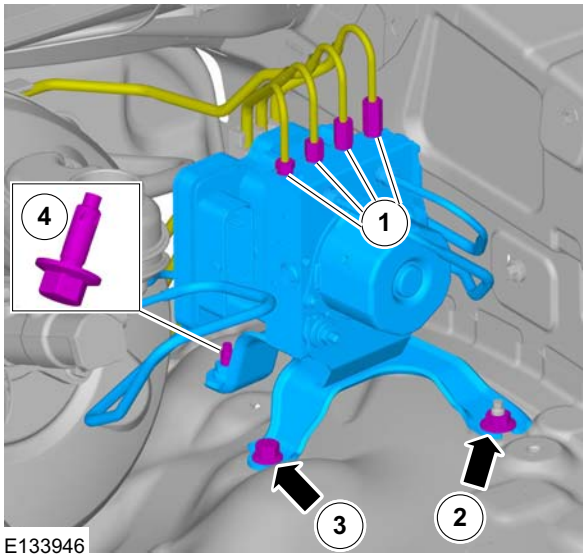


REMOVAL AND INSTALLATION

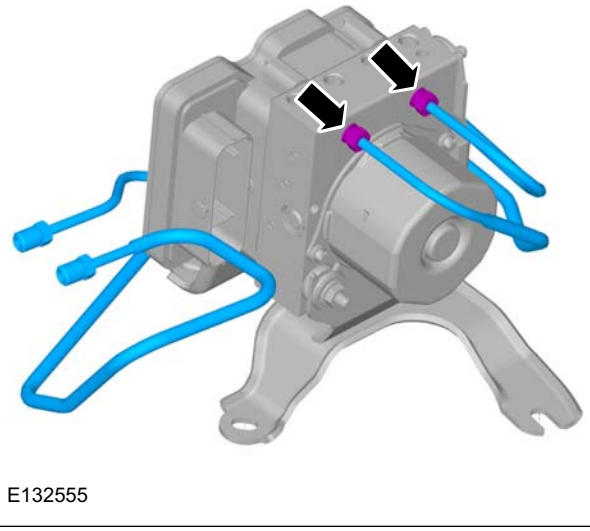
5. Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
   Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
6. **CAUTION: Make sure that all openings are sealed.**
   3. Torque: 18 Nm



7. 1. Torque: 18 Nm
   2. Torque: 25 Nm
   3. Torque: 25 Nm
   4. Torque: 25 Nm

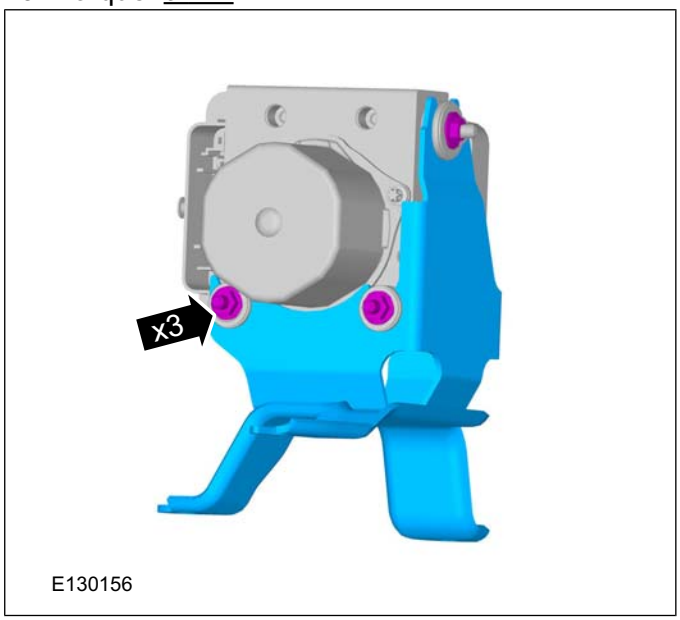


8. **NOTE:** Make sure that all openings are sealed.
   Torque: 18 Nm



REMOVAL AND INSTALLATION

9. Torque: 9 Nm



Installation

1. CAUTIONS:

If accidentally dropped or knocked install a new hydraulic control unit (HCU) and module assembly.

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

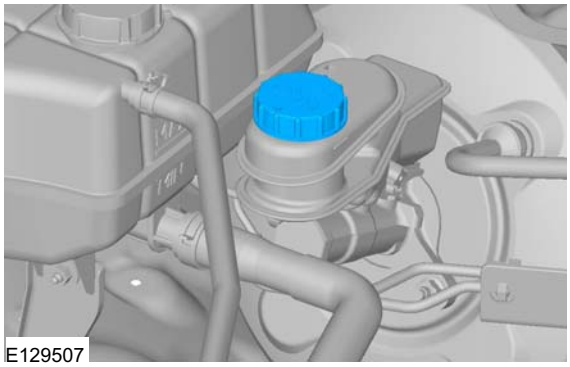
Hydraulic Control Unit (HCU) — RHD 4WD/RHD RWD

Removal

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

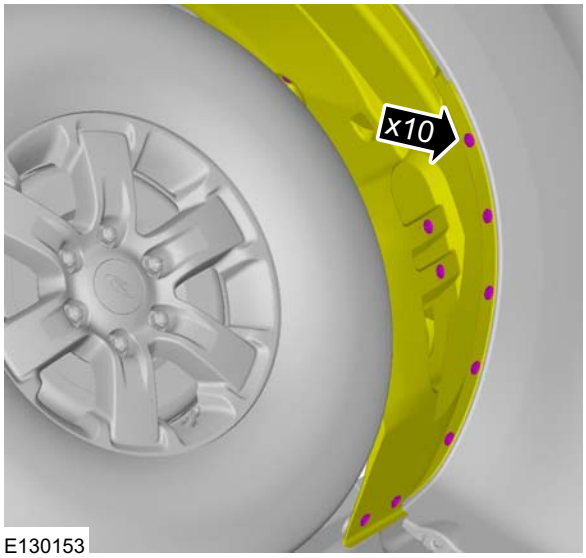
1. Refer to: Brake System Health and Safety Precautions (100-00 General Information, Description and Operation).

2.



3. 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 and rear brake wheel cylinder.

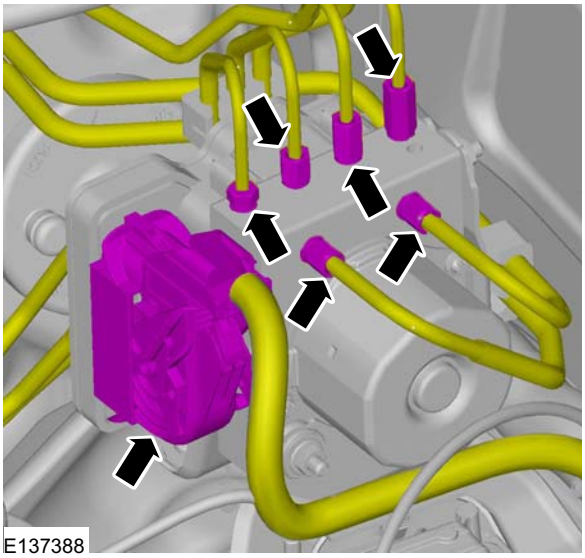
4.



REMOVAL AND INSTALLATION

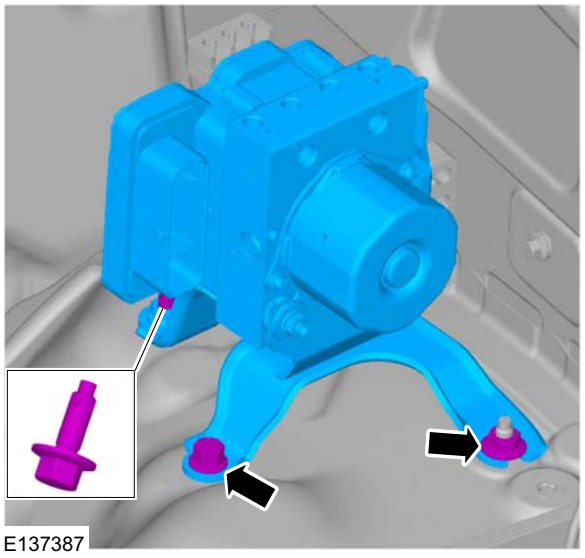
5. **CAUTION: Make sure that all openings are sealed.**

   Torque: 18 Nm

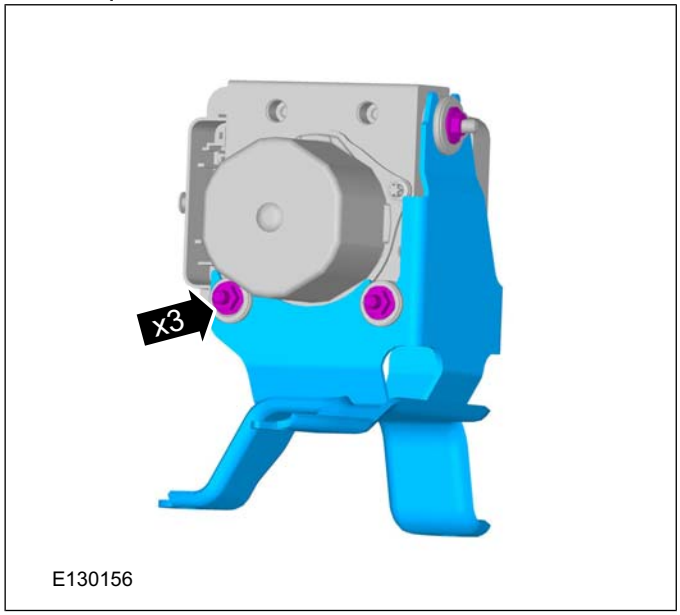


6. **CAUTION: Make sure that all openings are sealed.**

   Torque: 25 Nm



7. Torque: 9 Nm



Installation

1. **CAUTIONS:**

   If accidentally dropped or knocked install a new hydraulic control unit (HCU) and module assembly.

   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

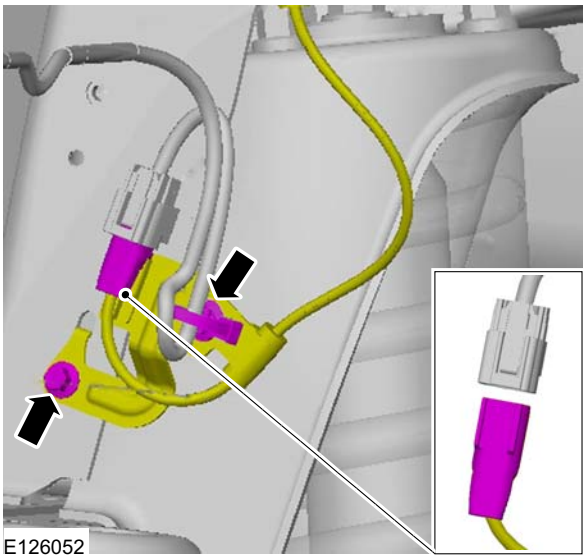
Front Wheel Speed Sensor(12 784 0)

Removal

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

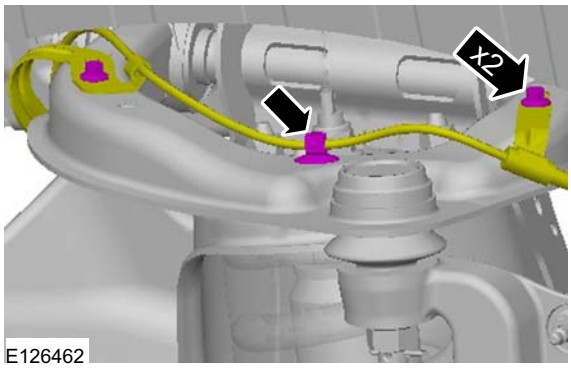
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. **NOTE:** Note the position of the component before removal.

   Torque: 7 Nm



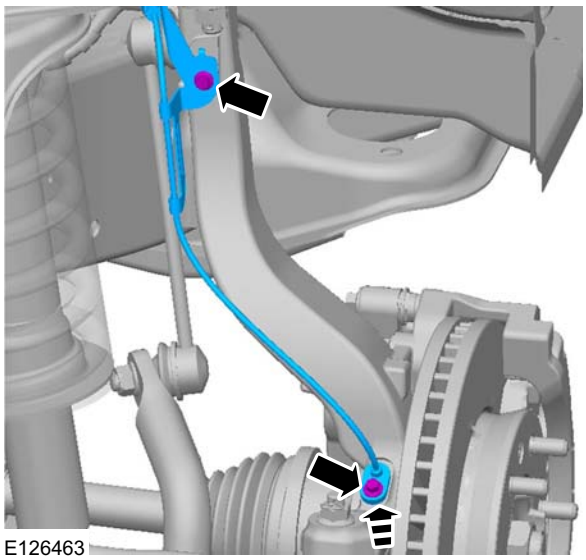
3. **NOTE:** Note the position of the component before removal.

   Torque: 7 Nm



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

   Torque: 7 Nm



Installation

1. **CAUTIONS:**

   Make sure that the area around the component is clean and free of foreign material.

   Make sure that this component is installed to the noted removal position.

   NOTE: Apply grease to O-ring of wheel speed sensor before installation.

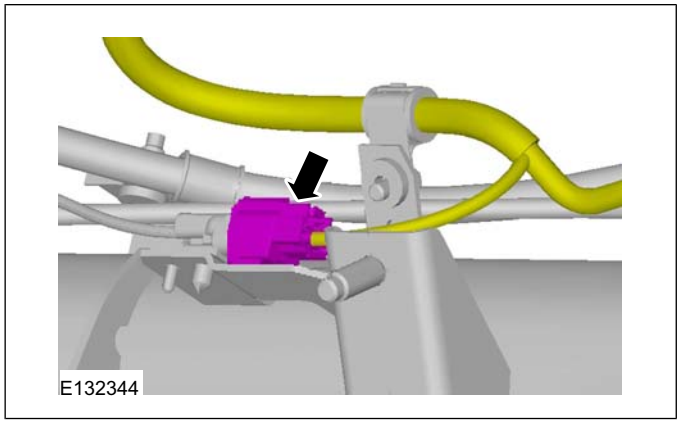
   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

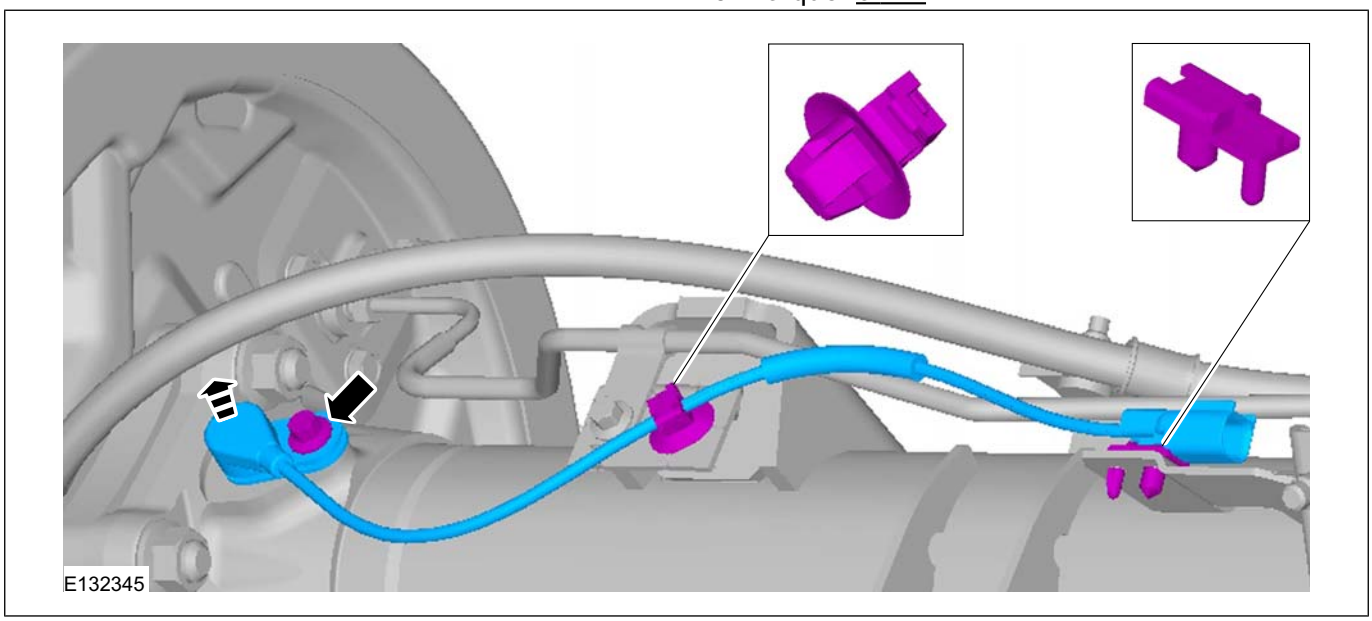
Rear Wheel Speed Sensor(12 785 0)

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. 

3. Torque: 6 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 206-09B Anti-Lock Control - Traction Control

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Anti-Lock Control - Traction Control

The traction control system is integrated into the anti-lock brake system and uses the same wheel speed sensors and hydraulic control unit (HCU).

The HCU has additional internal solenoid valves and a self priming pump incorporated to enable brake pressure increases without pressure in the master cylinder.

Brake Traction Control System (BTCS)

Brake traction control uses controlled braking of the spinning driving wheel when there is a variation in traction at the driven wheels.

The BTCS assists traction in a pull away from rest situation and can become active at road speeds . When the BTCS is active the driver is made aware of the fact by the flashes of a warning indicator located in the instrument cluster.

The spinning wheel is braked by the anti-lock braking system (ABS) which transfers a greater proportion of the engine torque, via the differential, to the other driven wheel, thereby increasing the utilization of the available traction.

To prevent the risk of stalling the engine, the BTCS reads engine speed data from the high speed CAN bus. If this data is faulted or not available, the BTCS will not function and the warning will be permanently on.

There is no driver disable switch for BTCS, BTCS is turned off when the ESP Off switch is pushed at 2WD mode in 2WD and 4WD vehicle. And, BTCS is not turned off even if the ESP Off switch is pushed when the mode is 4WD Hi and 4WD Lo in 4WD vehicle. Also, BTCS is always off regardless of ON/OFF of the ESP Off switch when ELRD(electronic Locking Rear Differential) is on.

ESP has the logic of the brake fade detection named BTM(Brake Temperature Mode). This logic presumes the temperature of the brake pad, and prohibits BTCS when state of the brake fade(overheat). And, it lights up the ESP warning indicator. When the brake gets cold, ESP warning indicator is turned off. And, it returns to the state that BTCS can be operated again. As a result, the thermal destruction of the base brake is prevented.

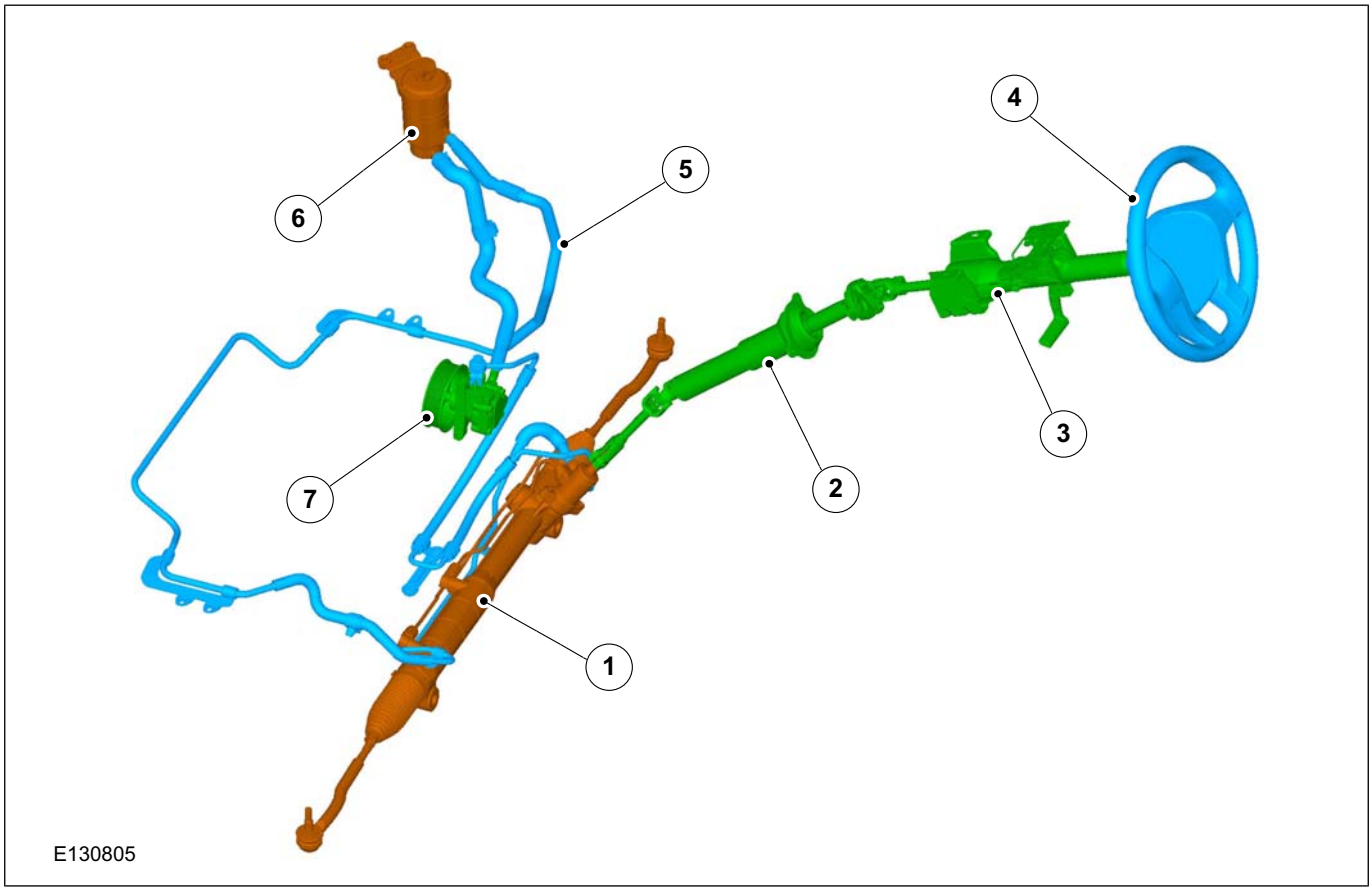
SECTION 211-00 Steering System - General Information

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Steering System



Item	Description
1	Steering gear and linkage
2	Steering shaft
3	Steering column
4	Steering wheel
5	Power steering lines
6	Power steering fluid reservoir
7	Power steering pump

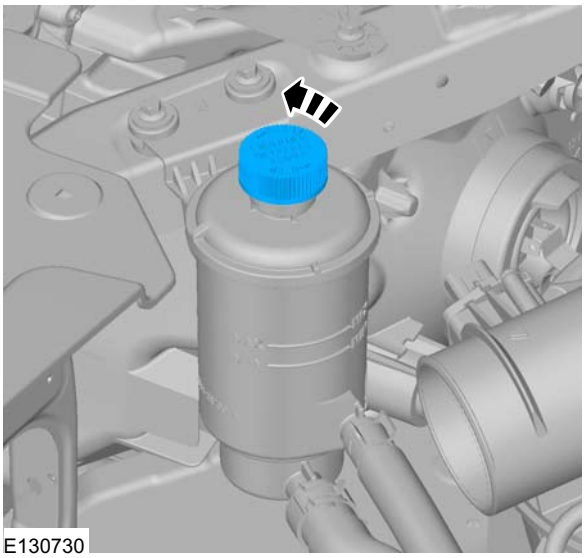
GENERAL PROCEDURES

Power Steering System Flushing

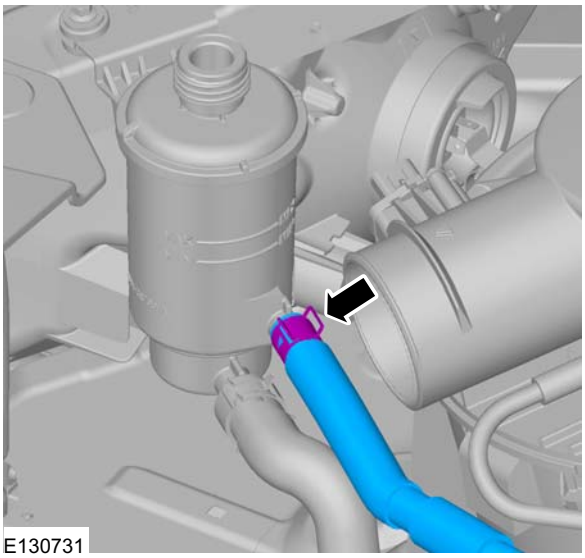
Activation

CAUTION: Do not mix fluid types. Any mixture or any unapproved fluid may lead to seal deterioration and leaks. A leak may ultimately cause loss of fluid, which may result in a loss of power steering assist.

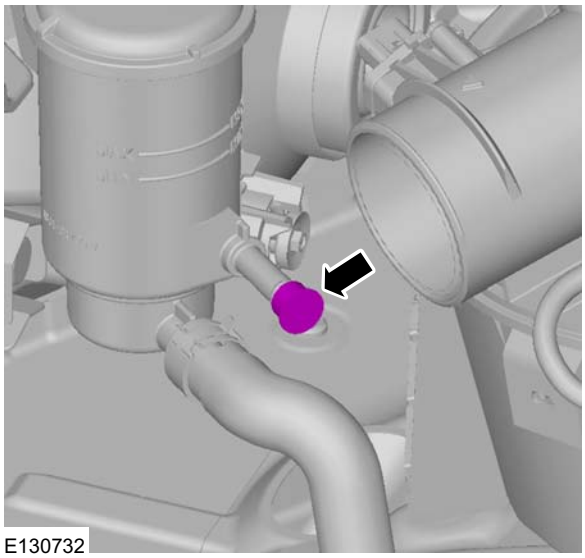
1.


E130730

2. Using a suitable suction device, remove the power steering fluid from the reservoir.
3. Remove the clamp from the hose and allow the remaining fluid to drain out of the reservoir.


E130731

4. Plug the power steering fluid reservoir inlet port.


E130732

5. Attach an extension hose to the return hose.
6. **NOTE:** Do not reuse the power steering fluid that has been flushed from the power steering system.

   Place the open end of the extension hose into a suitable container.
7. If equipped with Hydro-Boost®, apply the brake pedal 4 times.
8. **NOTE:** Do not overfill the reservoir.

   Fill the reservoir as needed with the specified fluid.
9. **CAUTION: Do not allow the power steering pump to run completely dry of power steering fluid. Damage to the power steering pump may occur.**

   Start the engine and let it idle, simultaneously turn the steering wheel to lock and then immediately turn the ignition switch to the OFF position.
10. **CAUTION: Avoid turning the steering wheel without the engine running as this may cause air to be pulled into the steering gear.**

    NOTE: Do not overfill the reservoir.

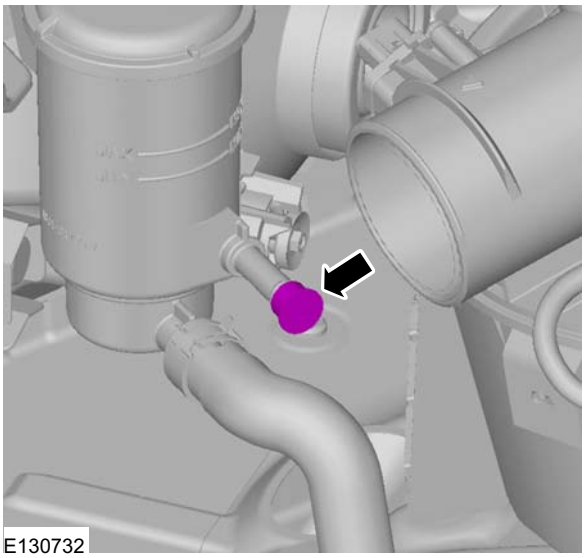
    Fill the reservoir as needed with the specified fluid.

GENERAL PROCEDURES

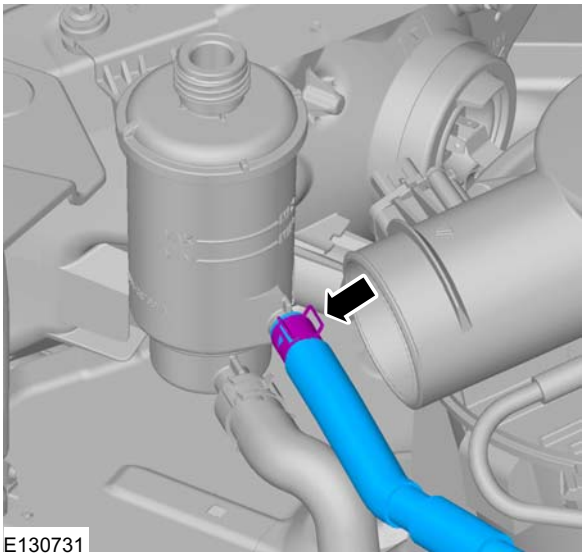
11. Repeat Steps 8 and 9, turning the steering wheel in the opposite direction each time, until the fluid exiting the power steering fluid return hose is clean and clear of foreign material.

12. Remove the extension hose from the return hose.

13. Remove the plug from the fluid reservoir inlet port.


E130732

14. Install the clamp and connect the power steering return hose to the reservoir.


E130731

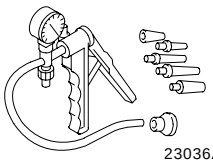
15. **NOTE:** If, after correctly filling the power steering system, there is power steering noise accompanied by evidence of aerated fluid and there are no fluid leaks, it may be necessary to bleed the power steering system.

Refer to: Power Steering System Filling (211-00 Steering System - General Information, General Procedures).
Refer to: Power Steering System Bleeding (211-00 Steering System - General Information, General Procedures).

GENERAL PROCEDURES

Power Steering System Bleeding

Special Tool(s)

 23036A	416-D001 Hand Vacuum Pump/Pressure Pump

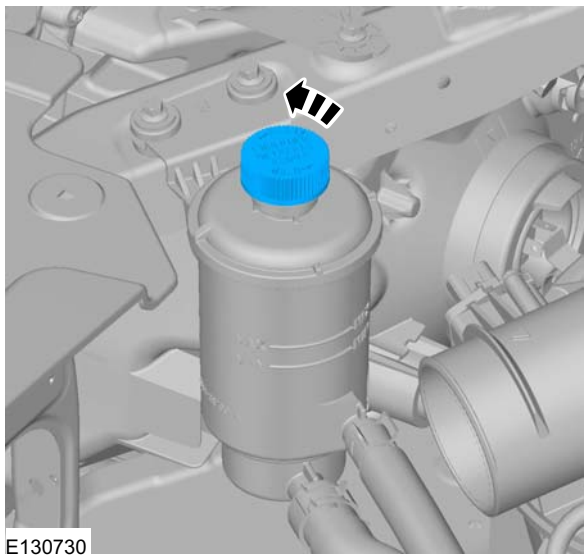
Activation

CAUTION: If the air is not purged from the power steering system correctly, premature power steering pump failure may result. The condition may occur on pre-delivery vehicles with evidence of aerated fluid or on vehicles that have had steering component repairs.

NOTE: When filling the power steering fluid reservoir, make sure that the power steering fluid is clean and not agitated prior to use. The power steering fluid should be poured slowly into the reservoir to minimize the possibility of aeration.

16. **NOTE:** Make sure that the power steering fluid in the power steering fluid reservoir does not fall below the MIN mark, as air could enter the system.

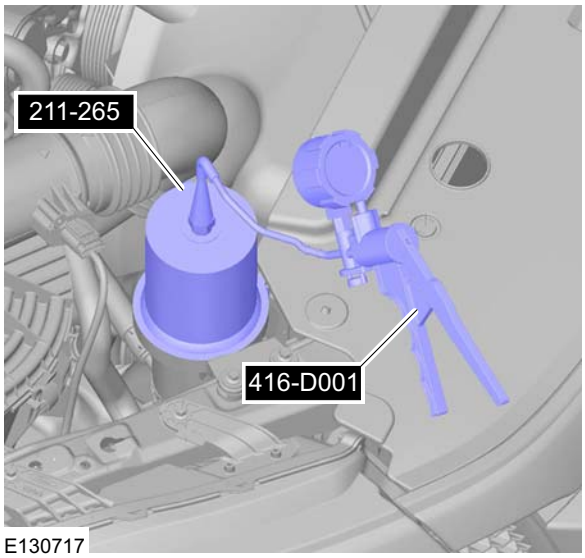
    Remove the power steering reservoir cap. Check the fluid.


E130730

17. Raise and support the vehicle making sure that the road wheels are just clear of the floor.

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

18. Special Tool(s): 416-D001



E130717

19. Start the engine and let it idle.

20. Using the Vacuum Pump Kit, apply vacuum and maintain the maximum vacuum of 68-85 kPa (20-25 in-Hg).

21. If the vacuum decreases by more than 5cm-Hg in 5 minutes,check the power steering system for leaks .

22. If equipped with Hydro-Boost®, apply the brake pedal 4 times.

23. **CAUTION: Do not hold the steering wheel against the stops for more than 5 seconds. Damage to the power steering pump may occur.**

    Cycle the steering wheel fully from stop-to-stop 10 times.

24. Stop the engine.

25. Release the vacuum and remove the Vacuum Pump Kit.

26. **NOTE:** Do not overfill the reservoir.

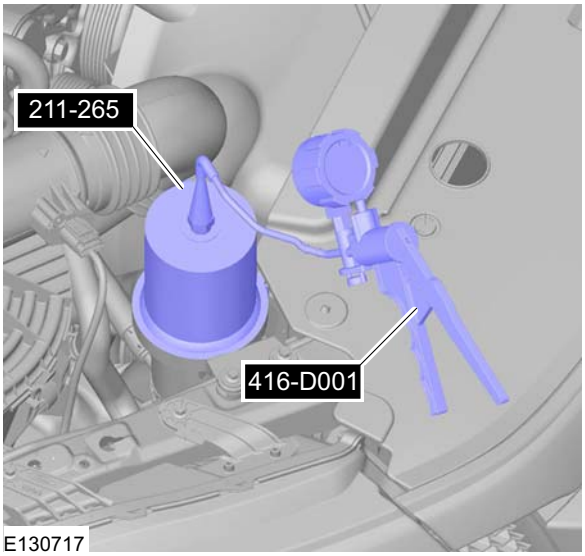
    Fill the power steering fluid reservoir to the MAX mark with the appropriate power steering fluid.

27. Start the engine and let it idle.

GENERAL PROCEDURES

28. Install the Vacuum Pump Kit. Apply and maintain the maximum vacuum of 68-85 kPa (20-25 in-Hg).

    Special Tool(s): 416-D001



29. **CAUTION: Do not hold the steering wheel against the stops for more than 5 seconds. Damage to the power steering pump may occur.**

    Cycle the steering wheel fully from stop-to-stop 10 times.

30. Stop the engine, release the vacuum and remove the Vacuum Pump Kit.

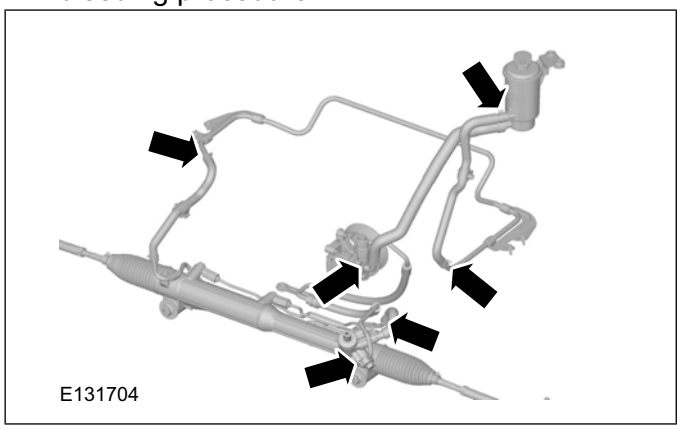
31. **NOTE:** Do not overfill the reservoir.

    Fill the power steering fluid reservoir to the MAX mark with the appropriate power steering fluid.

32. **CAUTION: Do not hold the steering wheel against the stops for more than 5 seconds. Damage to the power steering pump may occur.**

    NOTE: The points where fluid leakage may occur are indicated in the figure.

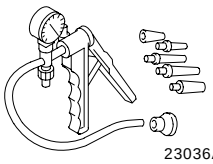
    Visually inspect the power steering system for leaks. Start the engine and let it idle, turn the steering wheel from lock to lock. If excessive noise is apparent, repeat the power steering bleeding procedure.



GENERAL PROCEDURES

Power Steering System Filling

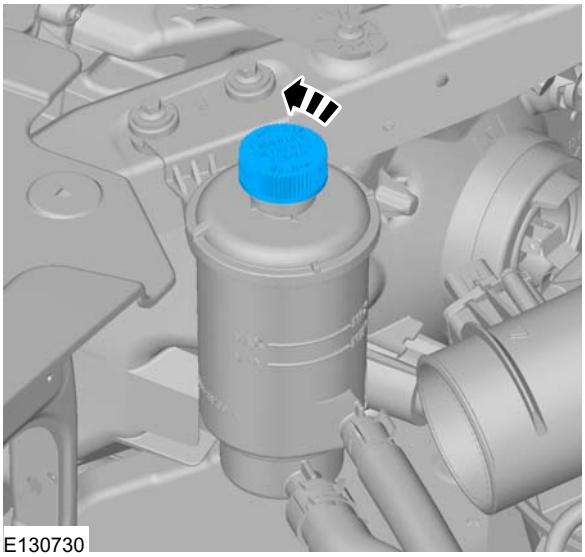
Special Tool(s)

 23036A	416-D001 Hand Vacuum Pump/Pressure Pump

Activation

NOTE: When filling the power steering fluid reservoir, make sure that the power steering fluid is clean and not agitated prior to use. The power steering fluid should be poured slowly into the reservoir to minimize the possibility of aeration.

33.


E130730

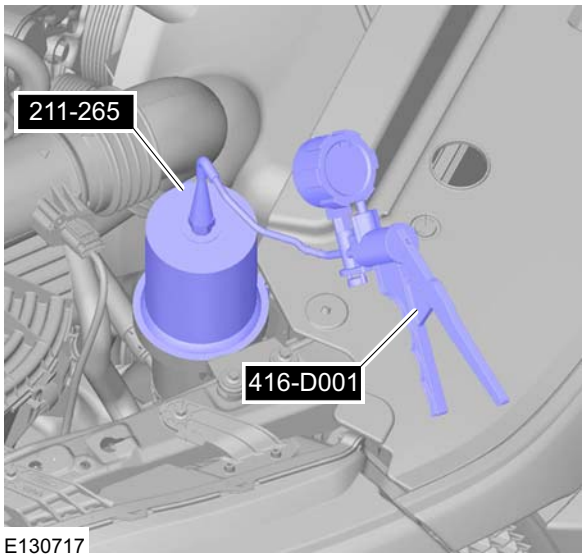
34. **NOTE:** Make sure that the power steering fluid in the power steering fluid reservoir does not fall below the MIN mark, as air could enter the system.

Fill the reservoir as needed with the specified fluid.

35. Raise and support the vehicle making sure that the road wheels are just clear of the floor.

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

36. Special Tool(s): 416-D001



E130717

37. Using the Vacuum Pump Kit, apply vacuum and maintain the maximum vacuum of 68-85 kPa (20-25 in-Hg).

38. If the vacuum decreases by more than 5cm-Hg in 5 minutes,check the power steering system for leaks .

39. Remove the Power Steering Evacuation Cap and Vacuum Pump Kit.

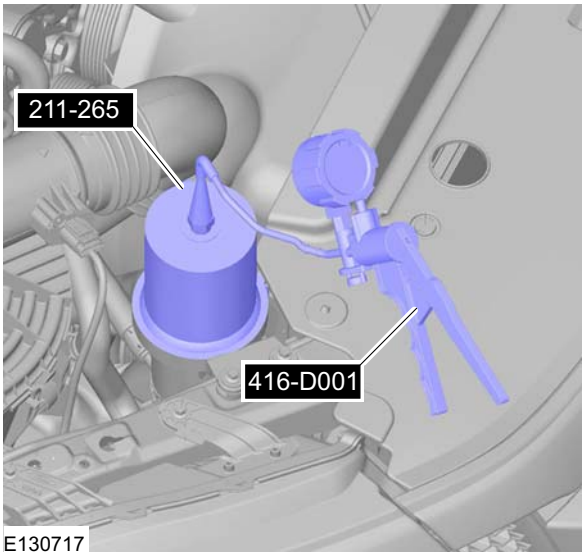
40. **NOTE:** Do not overfill the reservoir.

Fill the power steering fluid reservoir to the MAX mark with the appropriate power steering fluid.

GENERAL PROCEDURES

41. Install the Vacuum Pump Kit. Apply and maintain the maximum vacuum of 68-85 kPa (20-25 in-Hg).

    Special Tool(s): 416-D001



42. Start the engine and let it idle.

43. **CAUTION: Do not hold the steering wheel against the stops for more than 5 seconds. Damage to the power steering pump may occur.**

    NOTE: There will be a slight drop in the power steering fluid level in the reservoir when the engine is started.

    Cycle the steering wheel fully from stop-to-stop 10 times.

44. Stop the engine, release the vacuum and remove the Vacuum Pump Kit.

45. **NOTE:** Do not overfill the reservoir.

    Fill the power steering fluid reservoir to the MAX mark with the appropriate power steering fluid.

SECTION 211-02 Power Steering

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

Power Steering Pump — 2.5L Duratec-HE (122kW/165PS) - MI4(13 434 0)

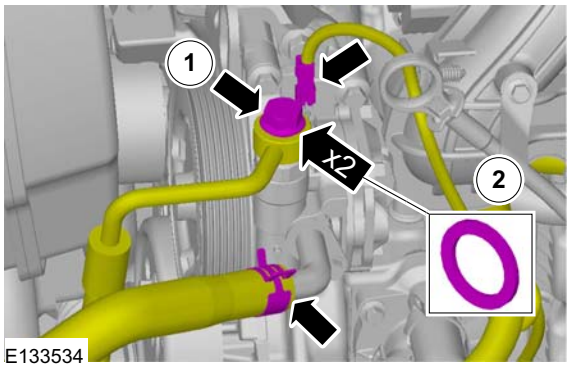
Removal

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

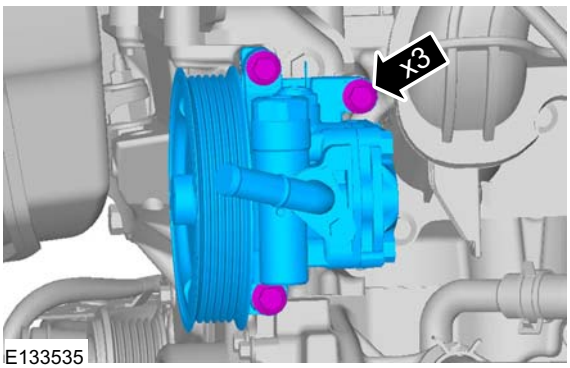
1. Refer to: Accessory Drive Belt (303-05 Accessory Drive - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. **WARNING: Be prepared to collect escaping fluids.**

   CAUTION: Make sure that all openings are sealed.

   Torque: 35 Nm



4. Torque: 20 Nm



Installation

1. To install, reverse the removal procedure.
2. Fill the power steering system.

   Refer to: Power Steering System Filling (211-00 Steering System - General Information, General Procedures).
3. Bleed the power steering system.

   Refer to: Power Steering System Bleeding (211-00 Steering System - General Information, General Procedures).

REMOVAL AND INSTALLATION

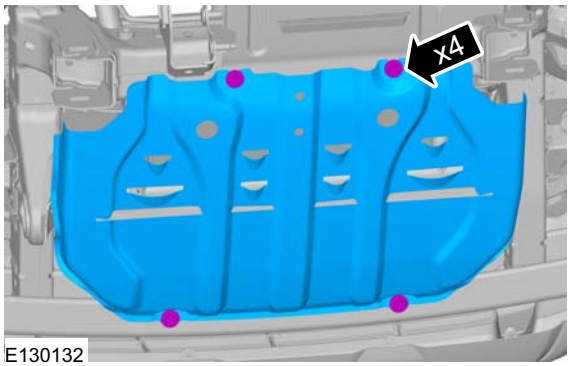
Power Steering Pump — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma(13 434 0)

Removal

CAUTION: While repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.

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

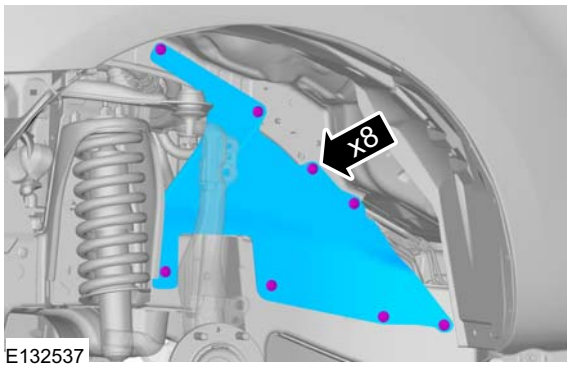
1. Refer to: Steering System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
4. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
5. Torque: 30 Nm



6. Remove front RH side wheel only.

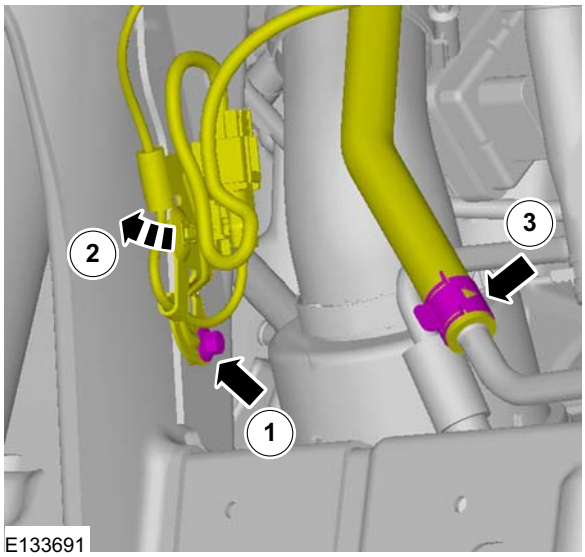
   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

7.



8. **CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.**

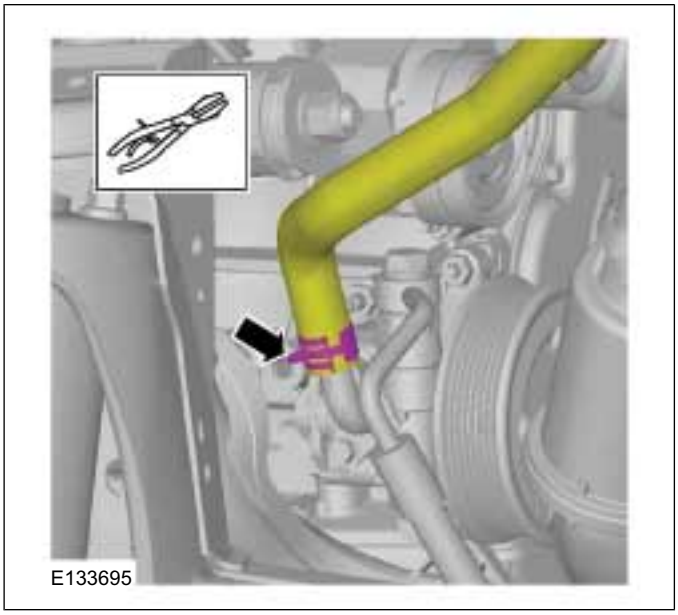
   Torque: 7 Nm



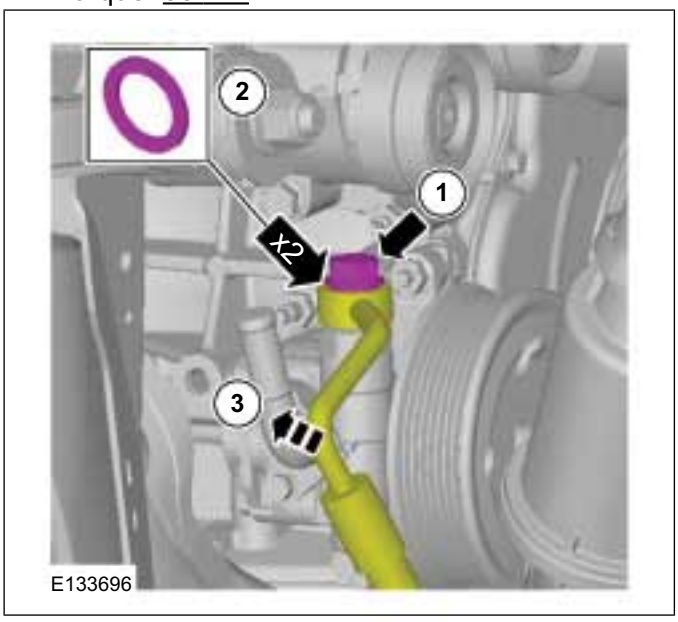
9. **WARNING: Be prepared to collect escaping fluid.**

REMOVAL AND INSTALLATION

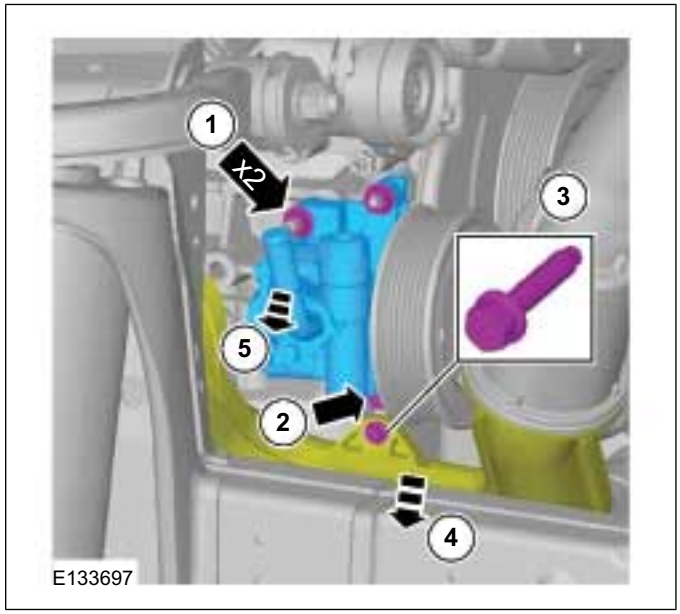
CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.



10. **CAUTION: Make sure that all openings are sealed with new blanking caps.**
    Torque: 35 Nm

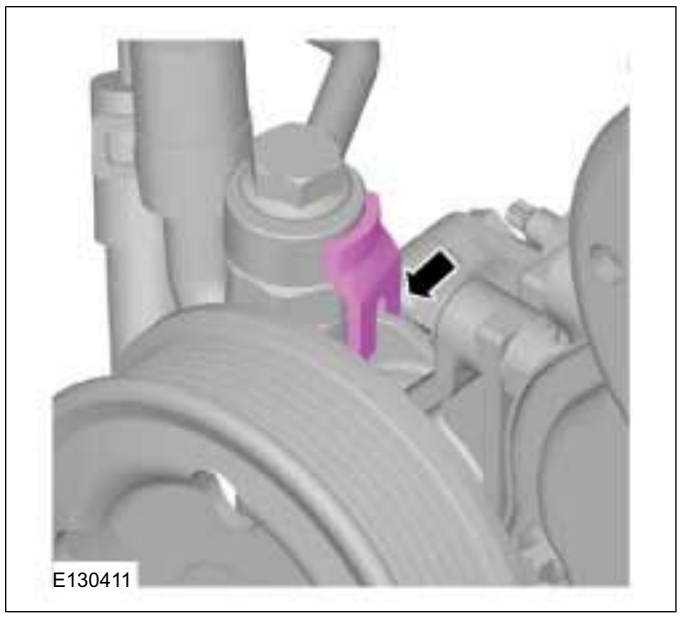


11. 1. Torque: 20 Nm
    2. Torque: 20 Nm
    3. Torque: 10 Nm



Installation

1. **NOTE:** Make sure that the high pressure line is located correctely.



2. To install, reverse the removal procedure.
3. Refer to: Power Steering System Filling (211-00 Steering System - General Information, General Procedures).
4. Refer to: Power Steering System Bleeding (211-00 Steering System - General Information, General Procedures).

REMOVAL AND INSTALLATION

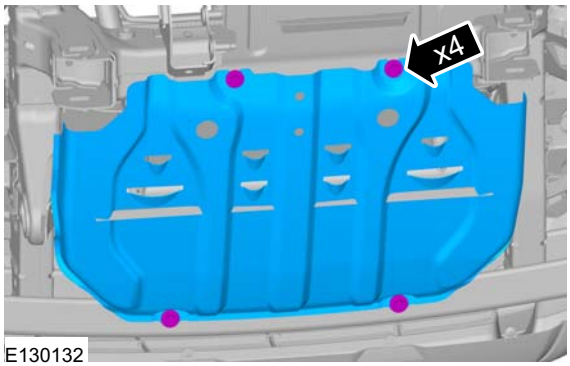
Power Steering Pump — 3.2L Duratorq-TDCi (148kW/200PS) - Puma(13 434 0)

Removal

CAUTION: While repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.

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

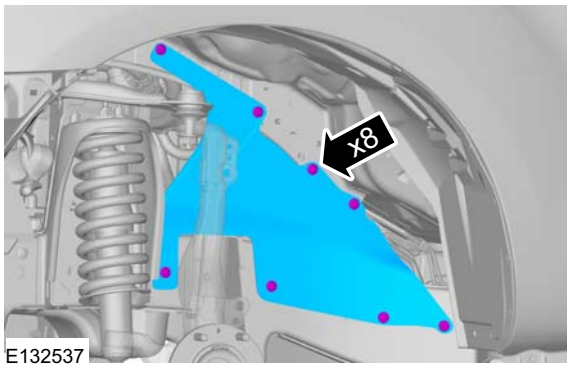
1. Refer to: Steering System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
4. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
5. Torque: 25 Nm



6. Remove front RH side wheel only.

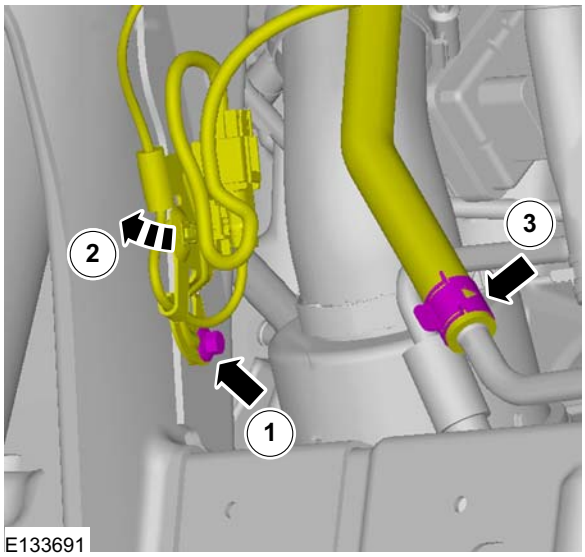
   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

7.



8. **CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.**

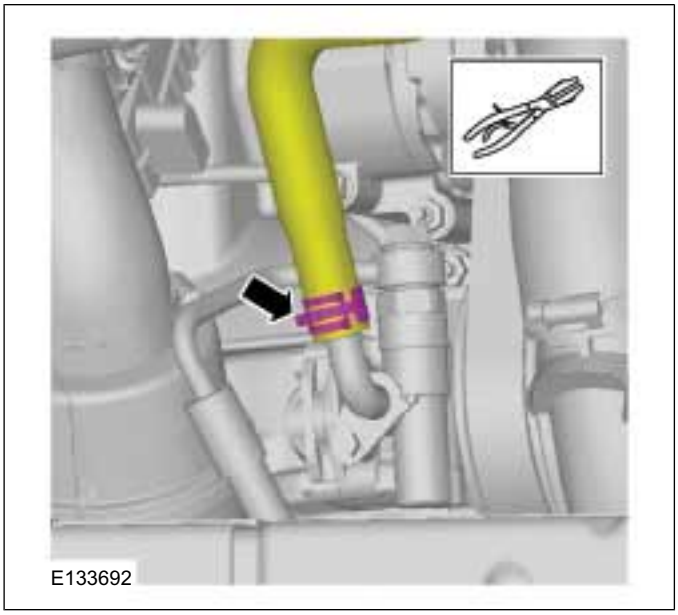
   Torque: 7 Nm



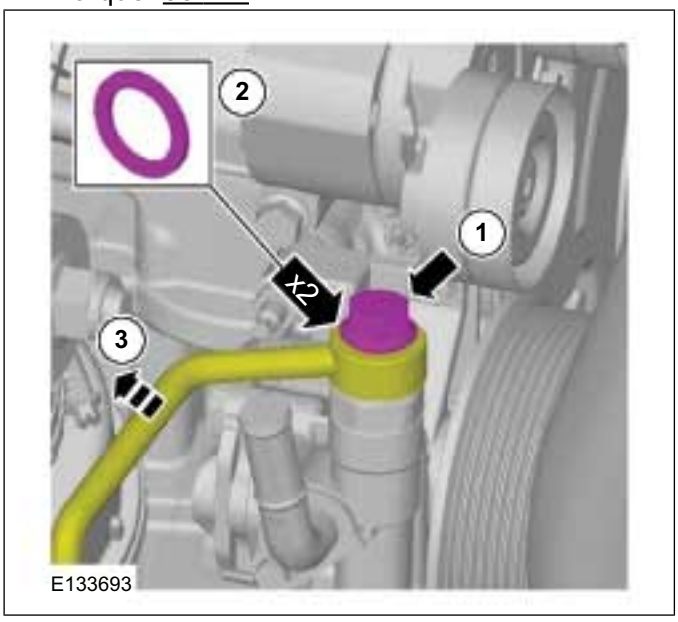
9. **WARNING: Be prepared to collect escaping fluid.**

REMOVAL AND INSTALLATION

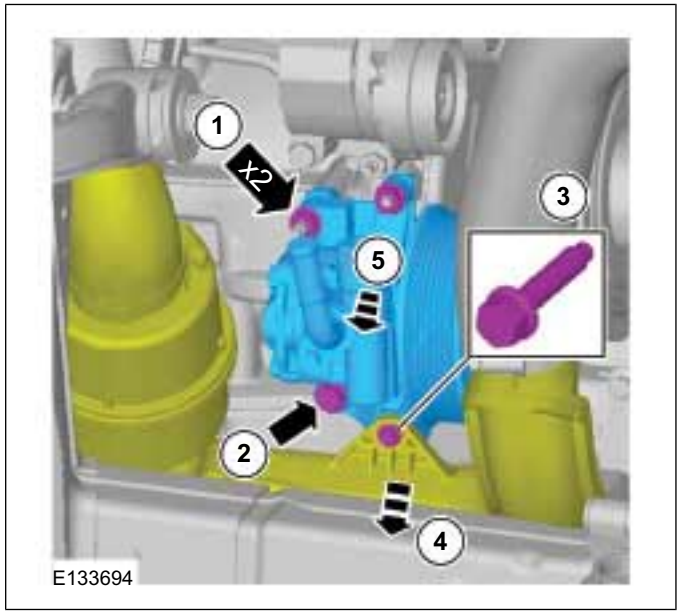
CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.



10. **CAUTION: Make sure that all openings are sealed with new blanking caps.**
    Torque: 35 Nm

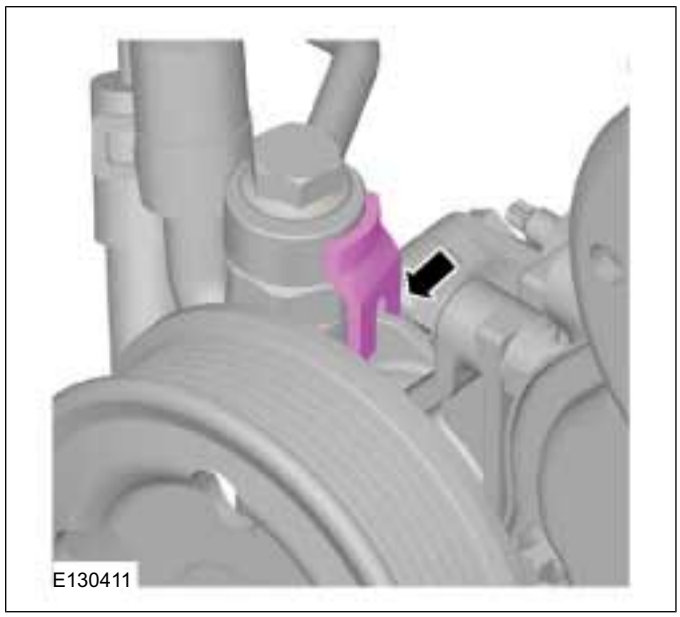


11. 1. Torque: 20 Nm
    2. Torque: 20 Nm
    3. Torque: 10 Nm



Installation

1. **NOTE:** Make sure that the high pressure line is located correctely.

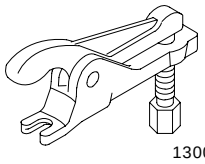


2. To install, reverse the removal procedure.
3. Refer to: Power Steering System Filling (211-00 Steering System - General Information, General Procedures).
4. Refer to: Power Steering System Bleeding (211-00 Steering System - General Information, General Procedures).

REMOVAL AND INSTALLATION

Steering Gear(13 116 0)

Special Tool(s)

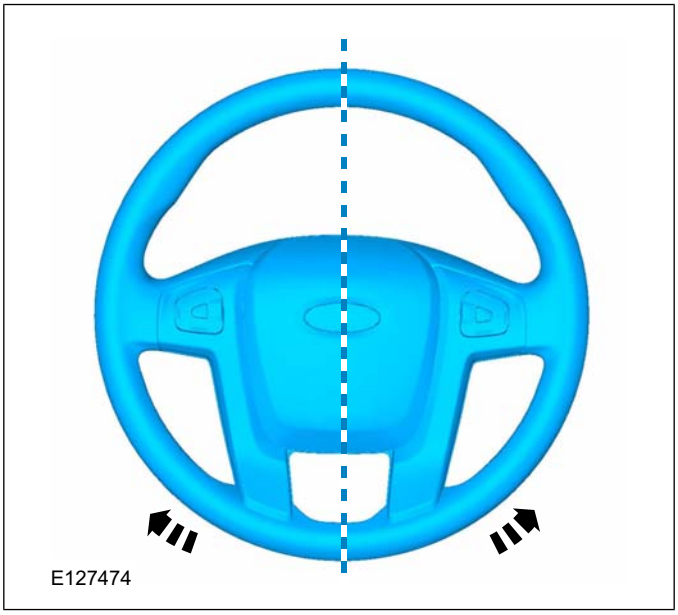
 13006	211-020 Separator, Ball Joint

Removal

CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

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: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. **NOTE:** Make sure that the road wheels are in the straight ahead position.



4. Remove both front wheels.

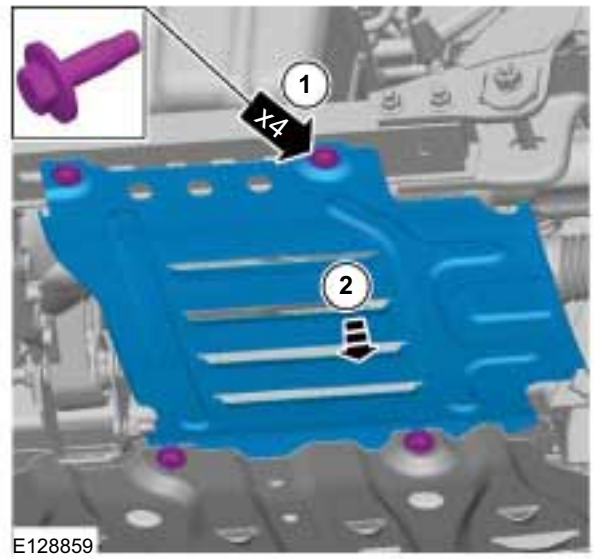
   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

REMOVAL AND INSTALLATION

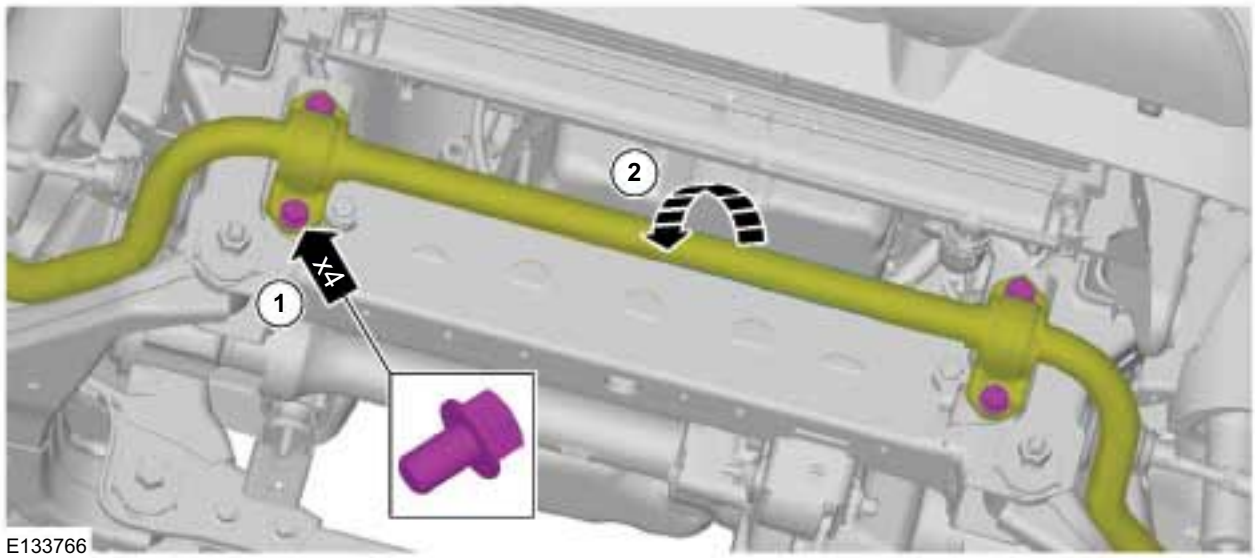
5. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

4x4

6. Torque: 30 Nm



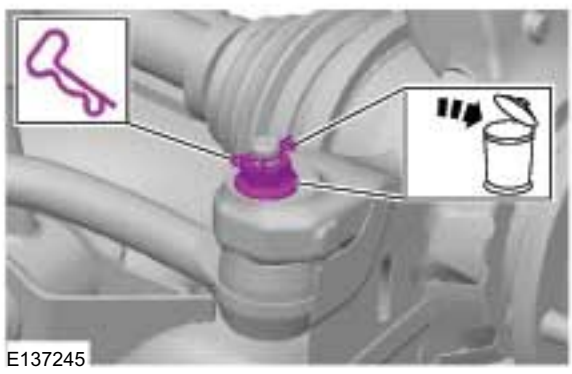
7. Torque: 30 Nm



All vehicles

8. **NOTE:** Make sure that the ball joint ball does not rotate.

On both sides.
Torque: 63 Nm

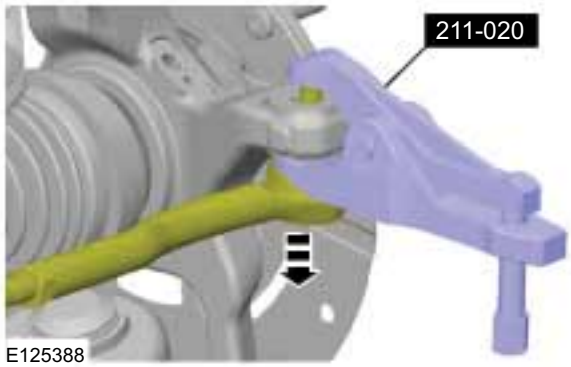


REMOVAL AND INSTALLATION

9. **CAUTION: Do not use a hammer to separate the tie rod from the wheel knuckle or damage to the wheel knuckle can result.**

   On both sides.

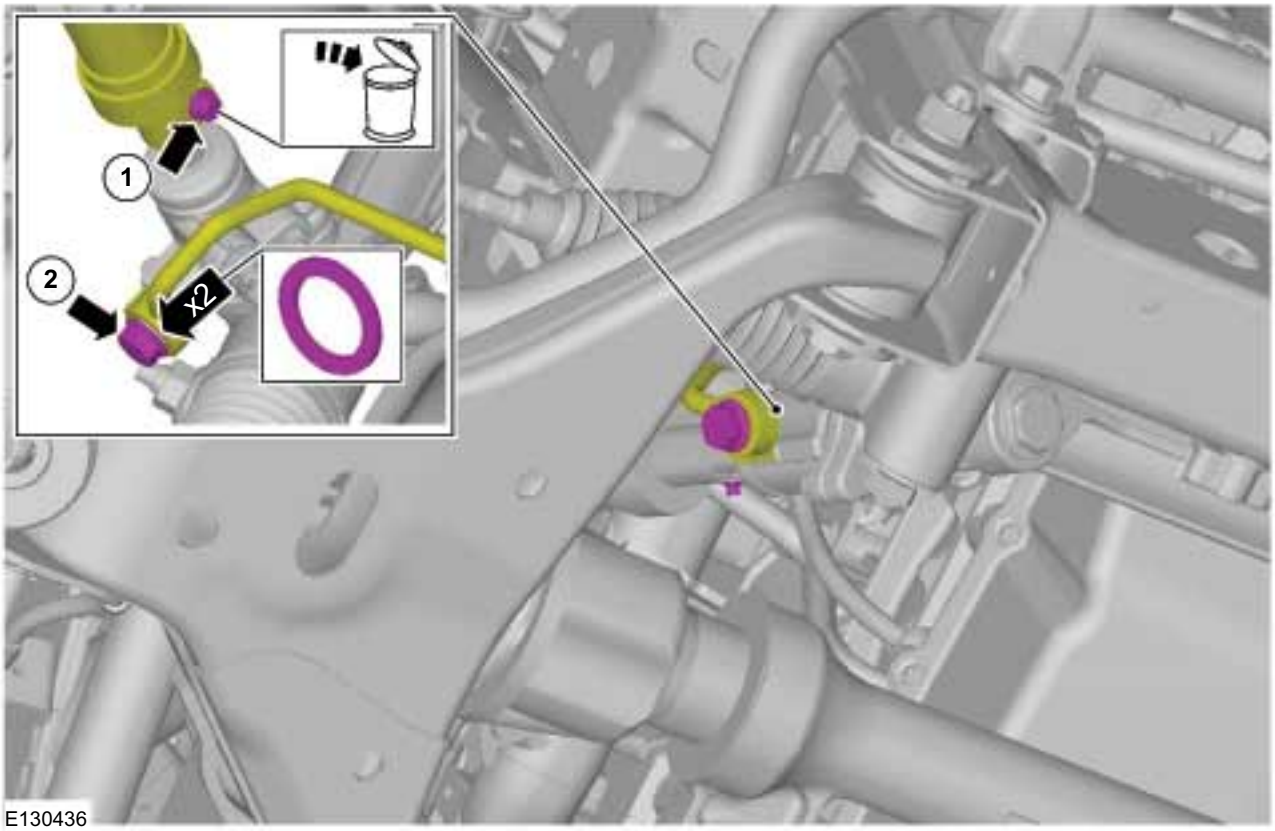
   Special Tool(s): 211-020



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

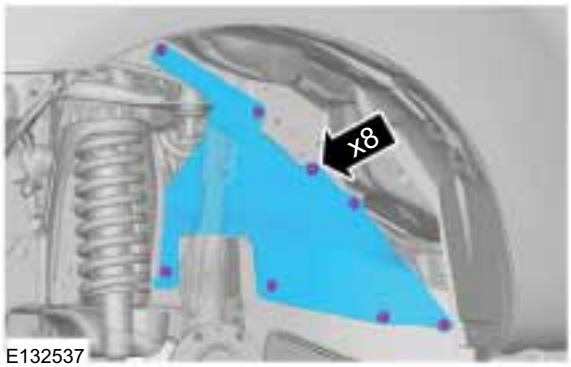
    CAUTION: Cap the power steering line and steering gear body to prevent fluid loss or dirt ingress.

    1. Torque: 15 Nm
    2. Torque: 35 Nm



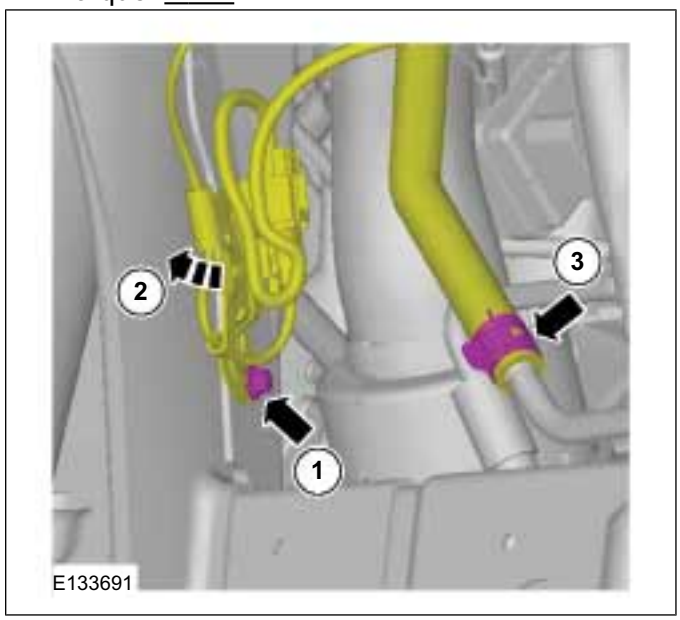
REMOVAL AND INSTALLATION

11.



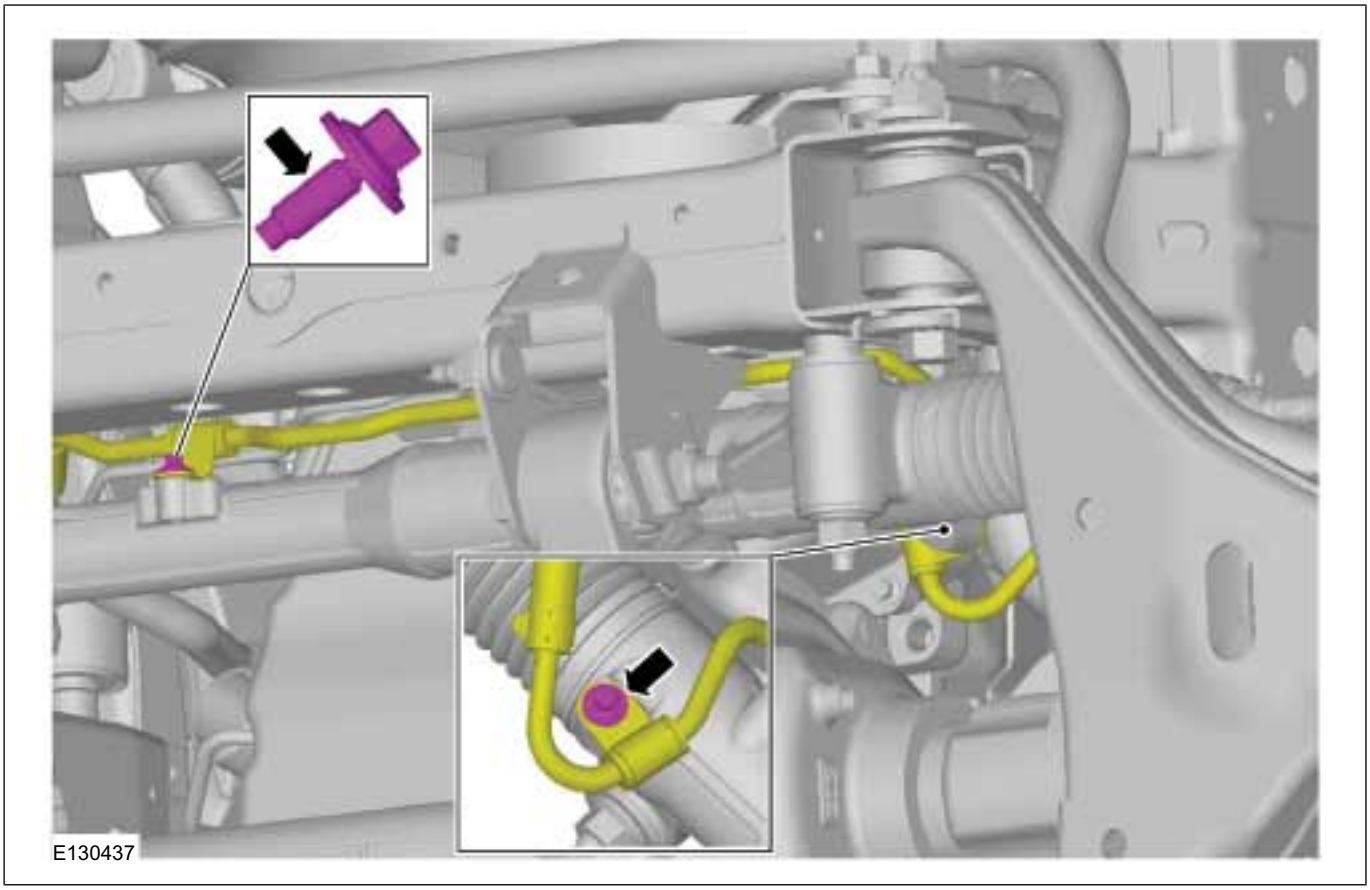
12. **CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.**

Torque: 7 Nm



Vehicles with diesel engine

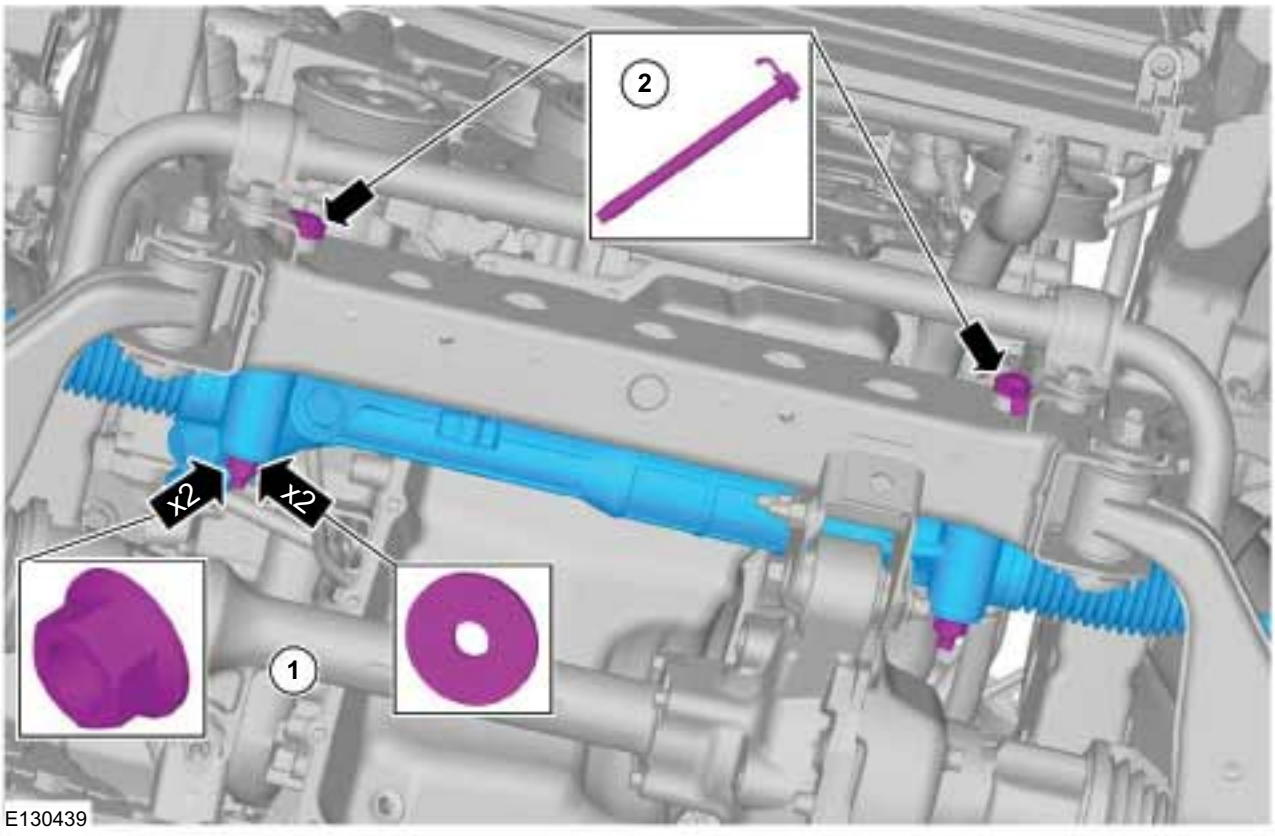
13. Torque: 10 Nm



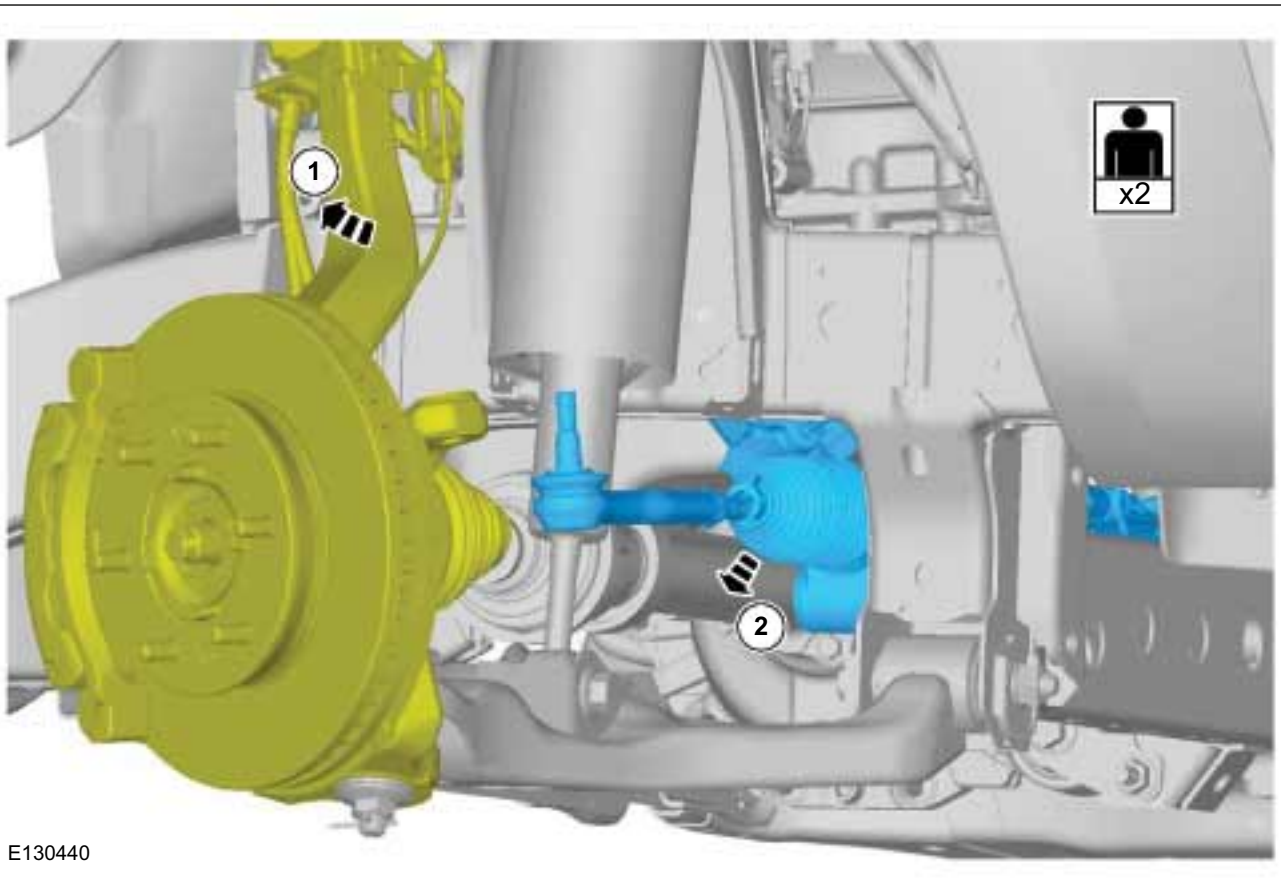
All vehicles

14. Torque: 150 Nm

REMOVAL AND INSTALLATION



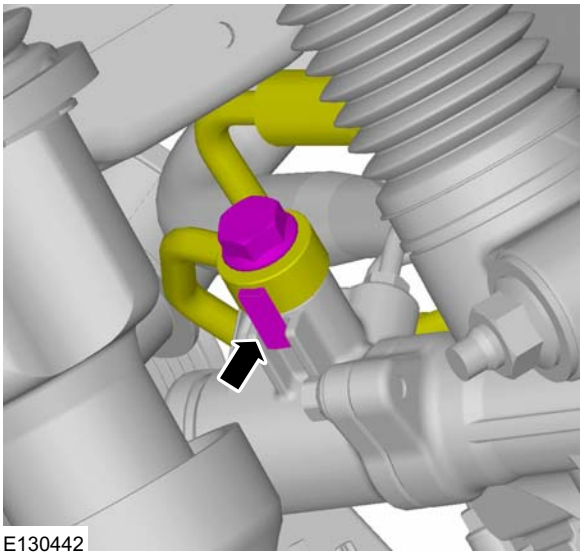
15.



REMOVAL AND INSTALLATION

Installation

1. To install, reverse the removal procedure.
2. **NOTE:** Make sure that the high pressure pipe line is located correctely.


E130442

3. Refer to: Power Steering System Filling (211-00 Steering System - General Information, General Procedures).
4. Refer to: Power Steering System Bleeding (211-00 Steering System - General Information, General Procedures).

REMOVAL AND INSTALLATION

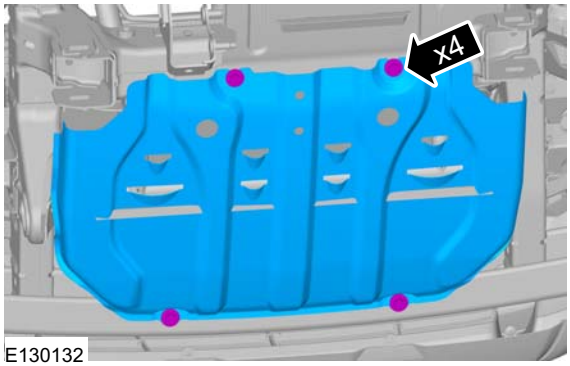
Power Steering Pump to Steering Gear Pressure Line — 2.5L Duratec-HE (122kW/165PS) - MI4(13 440 0; 13 443 0)

Removal

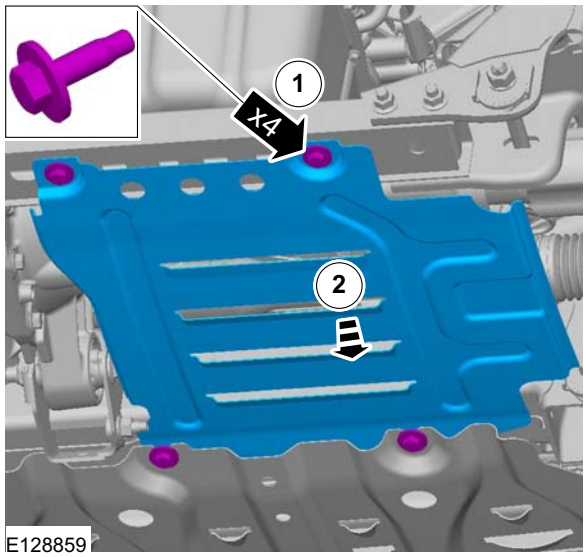
CAUTION: While repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.

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: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Torque: 30 Nm



5. Torque: 30 Nm

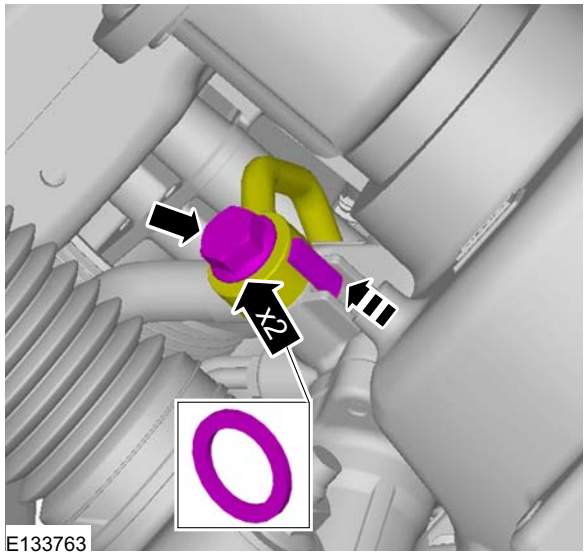


Left-hand drive vehicles

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

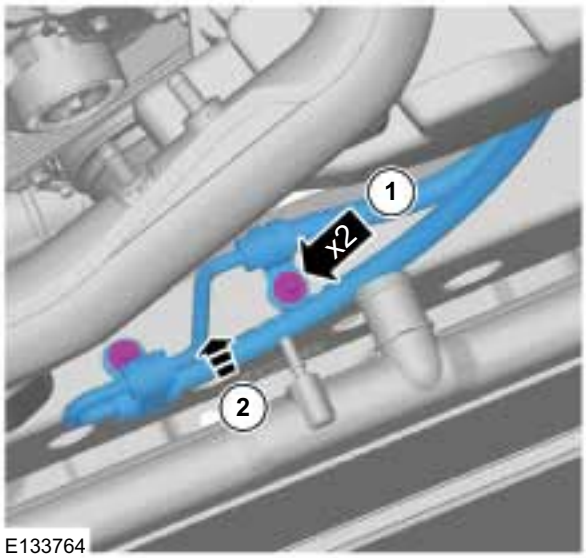
   CAUTION: Cap the steering gear body to prevent fluid loss or dirt ingress.

   Torque: 35 Nm



REMOVAL AND INSTALLATION

7. Torque: 10 Nm

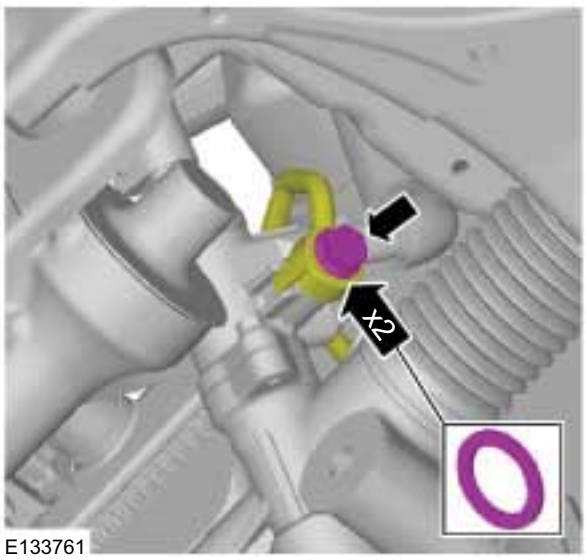


Right-hand drive vehicles

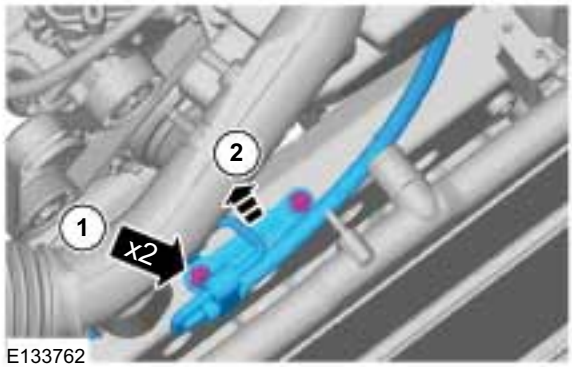
8. **WARNING: Be prepared to collect escaping fluid.**

CAUTION: Cap the steering gear body to prevent fluid loss or dirt ingress.

Torque: 35 Nm



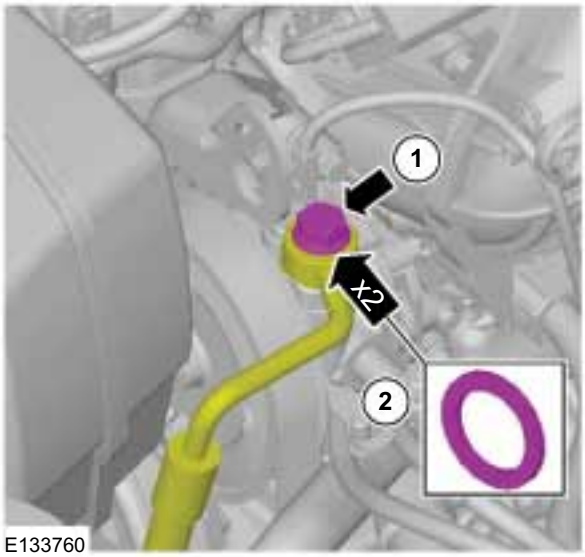
9. Torque: 10 Nm



All vehicles

10. **CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.**

Torque: 35 Nm



Installation

1. To install, reverse the removal procedure.
2. Refer to: Power Steering System Filling (211-00 Steering System - General Information, General Procedures).
3. Refer to: Power Steering System Bleeding (211-00 Steering System - General Information, General Procedures).

REMOVAL AND INSTALLATION

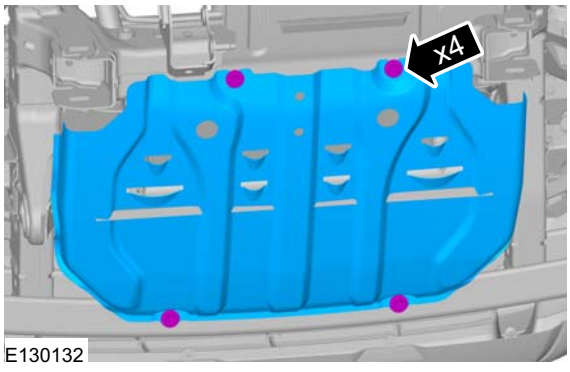
Power Steering Pump to Steering Gear Pressure Line — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma(13 440 0; 13 443 0)

Removal

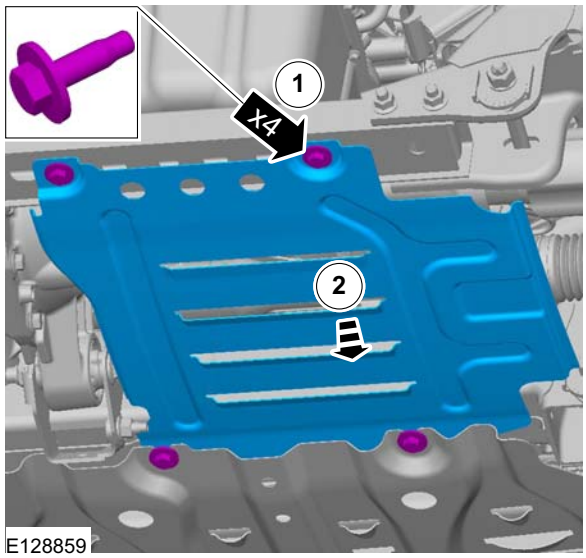
CAUTION: While repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.

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: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Torque: 30 Nm



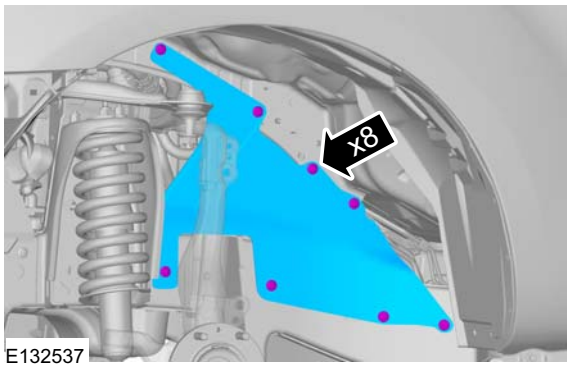
5. Torque: 30 Nm



6. Remove front RH side wheel only.

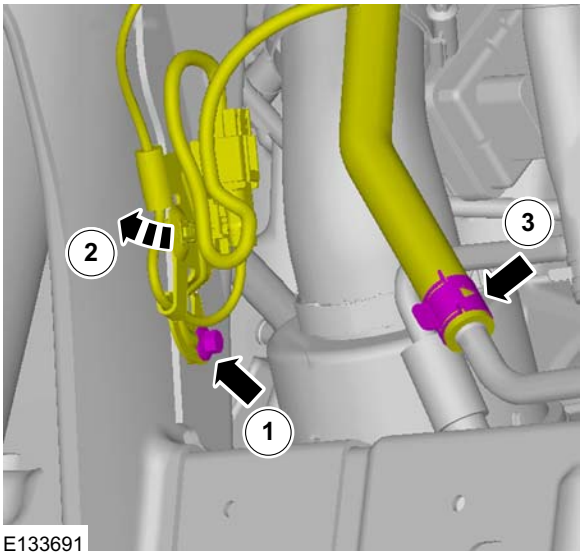
   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

7.



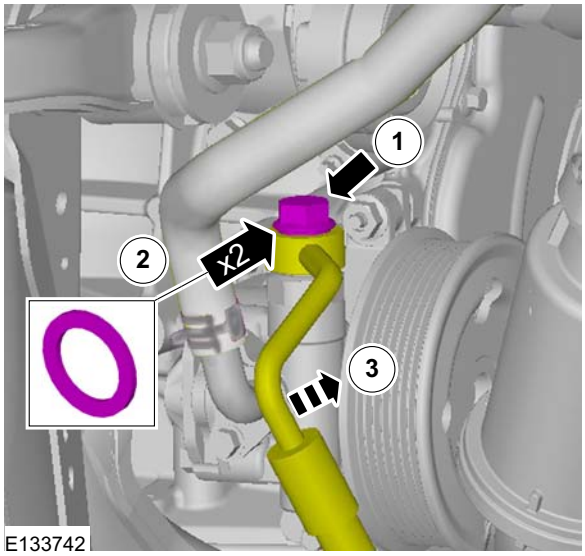
REMOVAL AND INSTALLATION

8. Torque: 7 Nm



9. **CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.**

Torque: 35 Nm



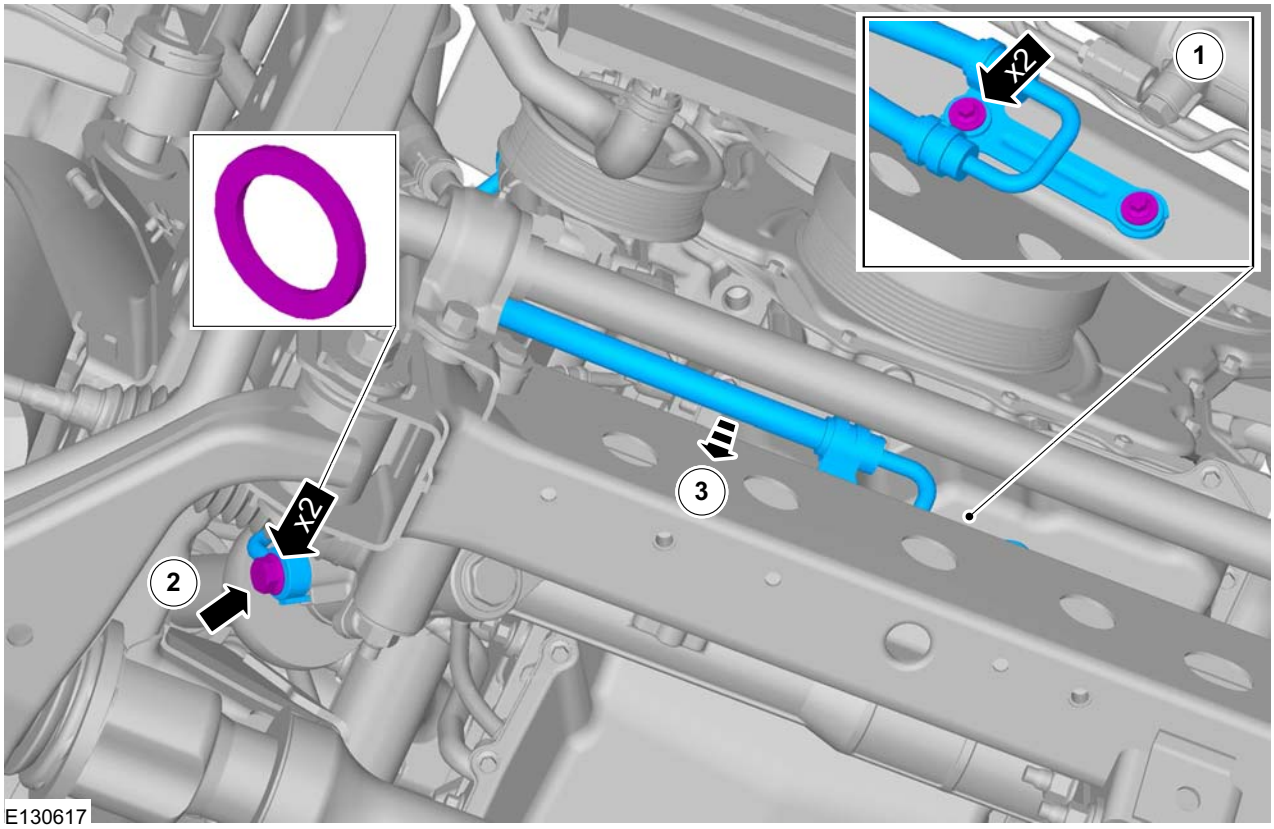
Right-hand drive vehicles

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

CAUTION: Cap the steering gear body to prevent fluid loss or dirt ingress.

1. Torque: 10 Nm
2. Torque: 35 Nm

REMOVAL AND INSTALLATION



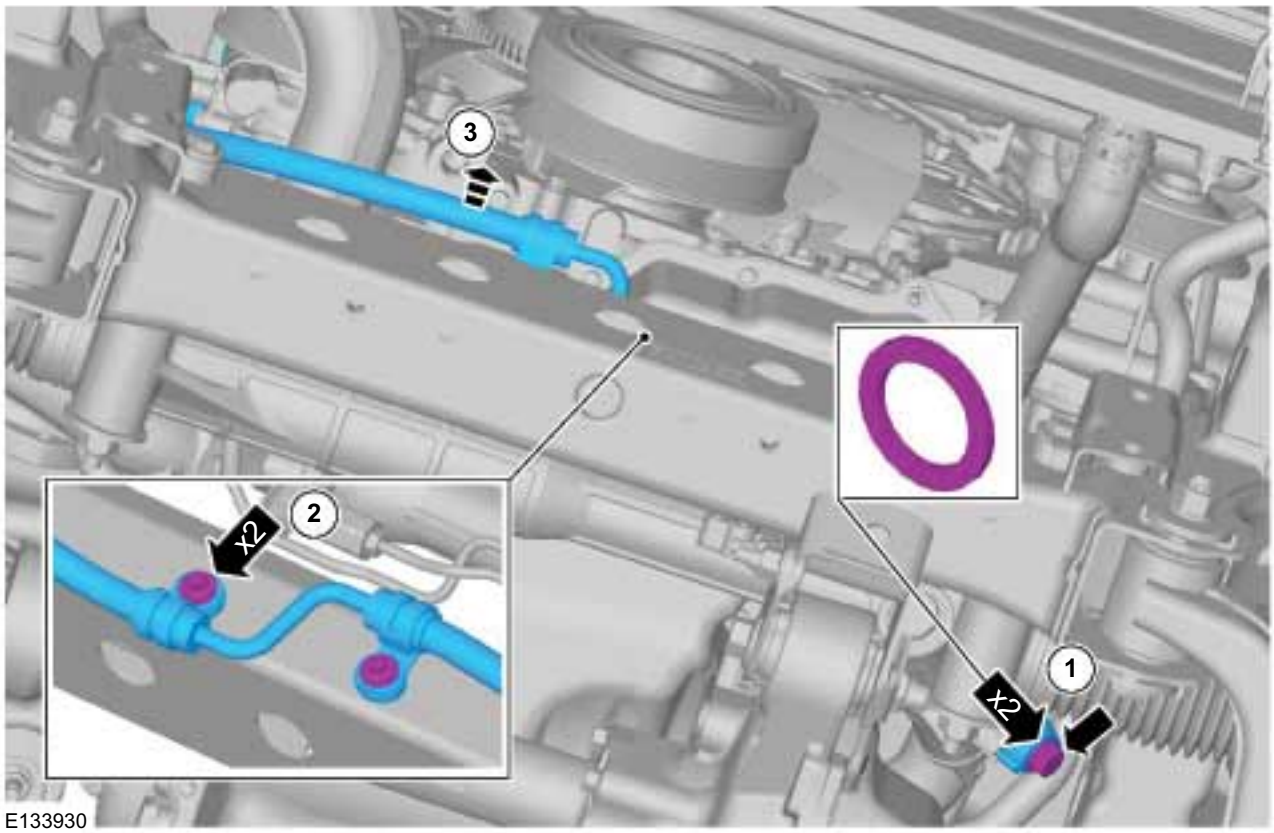
Left-hand drive vehicles

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

CAUTION: Cap the steering gear body to prevent fluid loss or dirt ingress.

1. Torque: 35 Nm
2. Torque: 10 Nm

REMOVAL AND INSTALLATION



Installation

1. To install, reverse the removal procedure.
2. Refer to: Power Steering System Filling (211-00 Steering System - General Information, General Procedures).
3. Refer to: Power Steering System Bleeding (211-00 Steering System - General Information, General Procedures).

SECTION 211-03 Steering Linkage

VEHICLE APPLICATION: 2011.50 Ranger

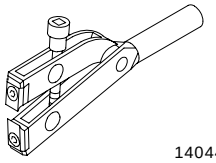
CONTENTS PAGE

REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

Tie Rod(13 263 0)

Special Tool(s) / General Equipment

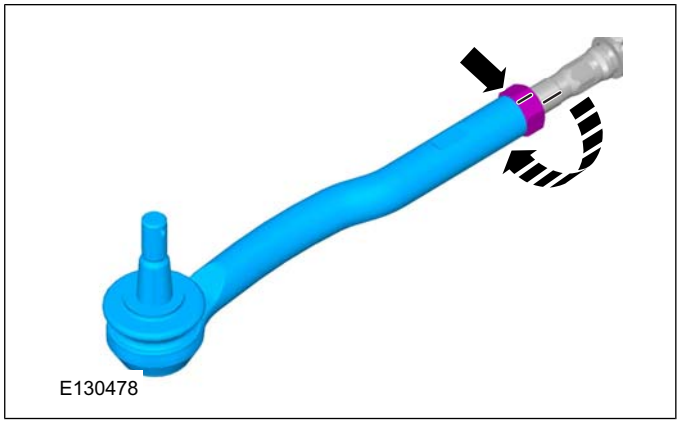
 14044	204-169 Clamping Tool, Boot Retaining Clamp
Flat Headed Screw Driver	
Vise	
Vise Jaw Protectors	

Materials	
Name	**Specification**
Silicone Grease	ESE-M1C171-A / 2S5J-M1C171-AA

Removal

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

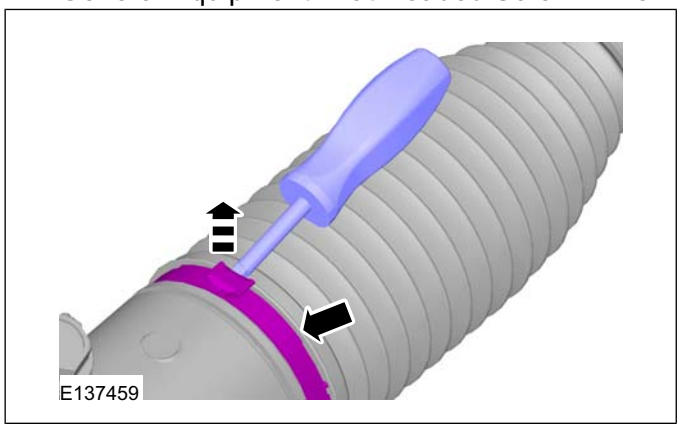
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
   Refer to: Steering System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Steering Gear (211-02 Power Steering, Removal and Installation).
3. On both sides.



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

   On both sides.

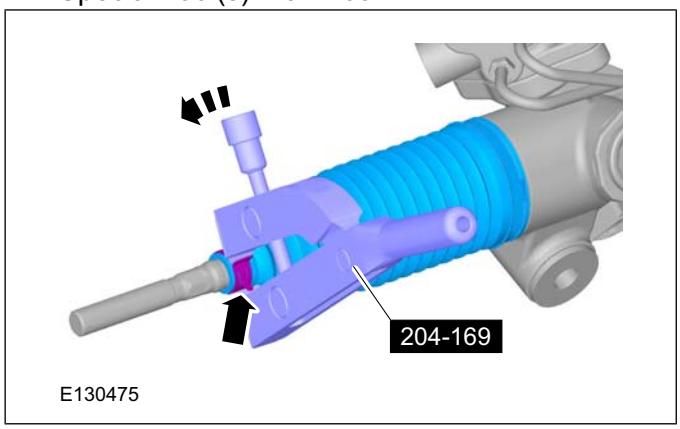
   General Equipment: Flat Headed Screw Driver



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

   On both sides.

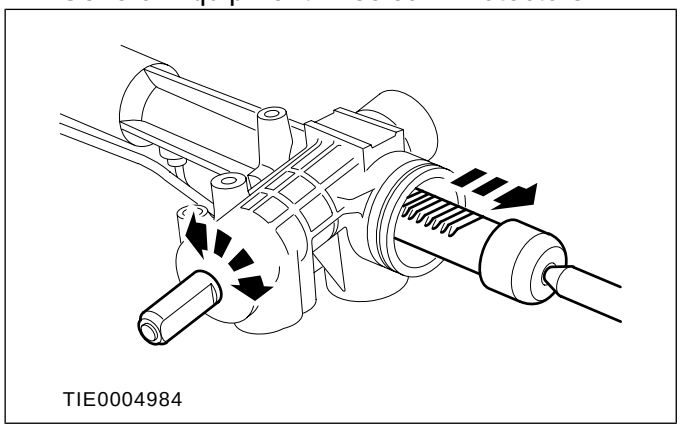
   Special Tool(s): 204-169



6. **CAUTION: Use vise jaw protectors.**

   Rotate the steering gear pinion to expose the steering rack.

   General Equipment: Vise
   General Equipment: Vise Jaw Protectors



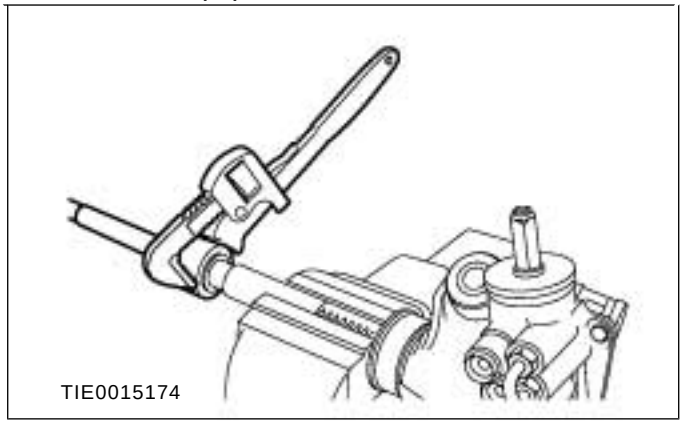
REMOVAL AND INSTALLATION

7. **CAUTIONS:**

   Do not clamp the steering rack on exposed hydraulic sealing surfaces.

   Use vise jaw protectors.

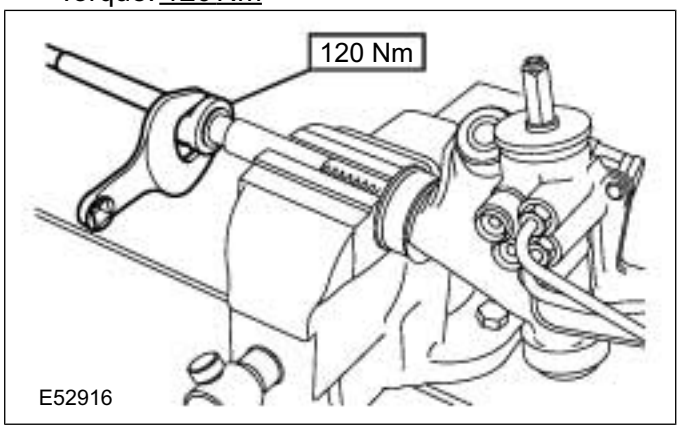
   General Equipment: Vise
   General Equipment: Vise Jaw Protectors



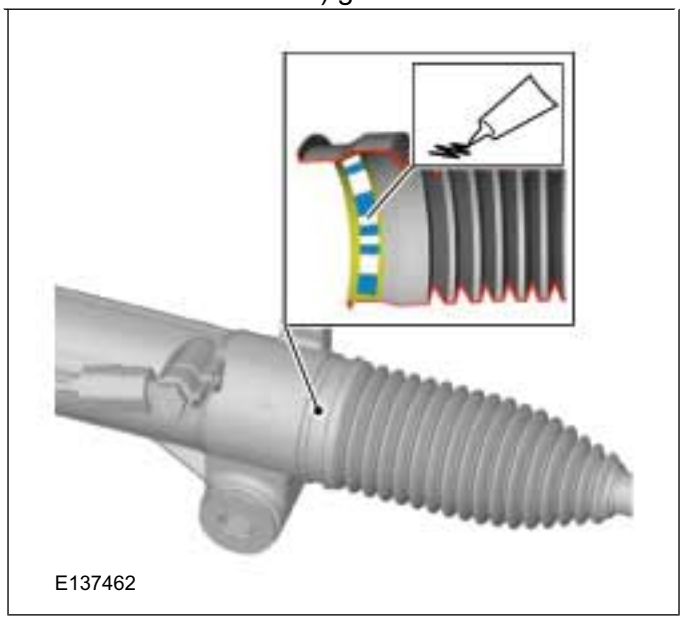
Installation

1. To install, reverse the removal procedure.
2. **CAUTION: Use vise jaw protectors.**

   General Equipment: Vise
   General Equipment: Vise Jaw Protectors
   Torque: 120 Nm

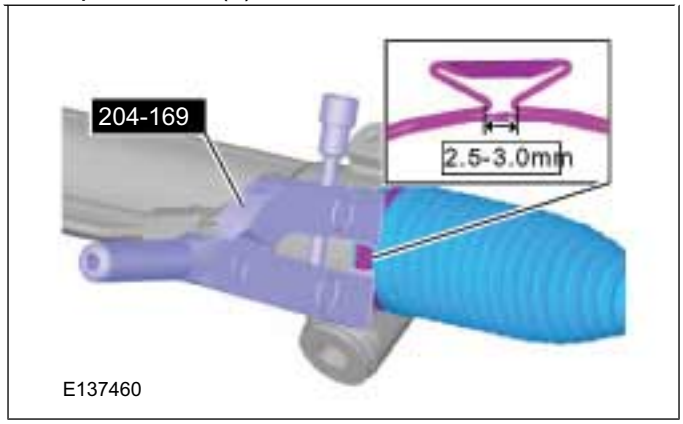


3. Material: Silicone Grease (ESE-M1C171-A / 2S5J-M1C171-AA) grease



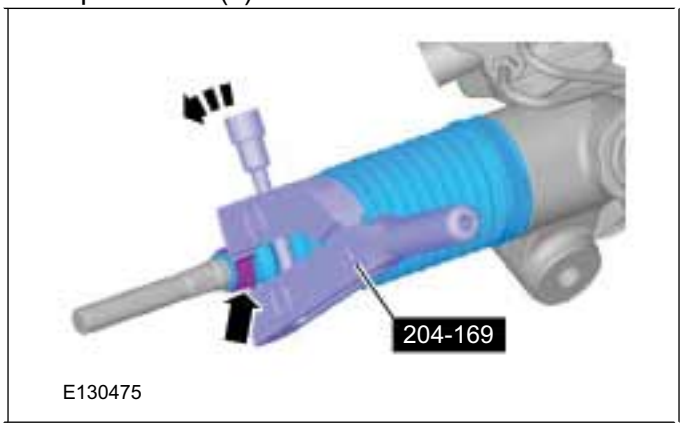
4. **NOTE:** Make sure that a new clamp is installed.

   Special Tool(s): 204-169



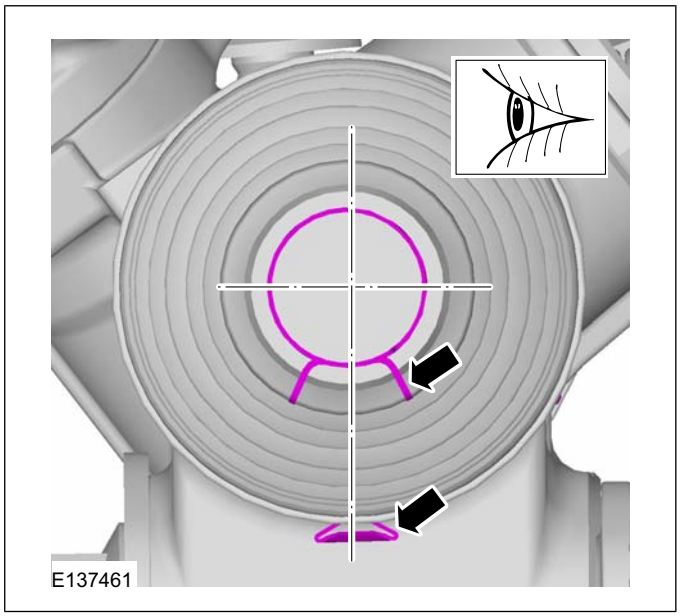
5. **NOTE:** Make sure that a new clamp is installed. On both sides.

   Special Tool(s): 204-169



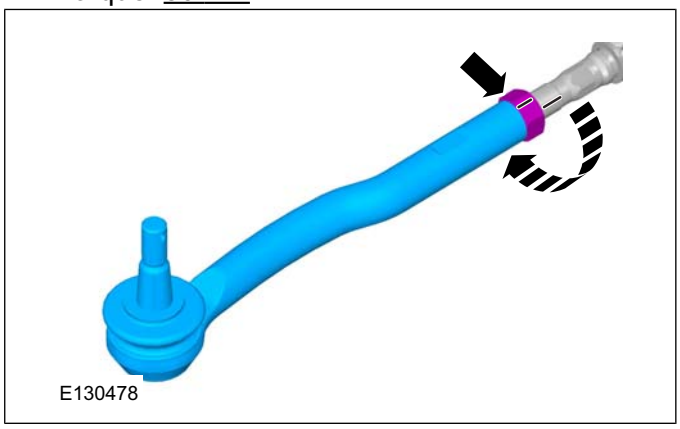
REMOVAL AND INSTALLATION

6.



7. **NOTE:** Make sure that the installation marks are aligned.

   On both sides.
   Torque: 80 Nm

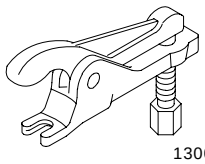


8. Refer to: Front Toe Adjustment (204-00 Suspension System - General Information, General Procedures).

REMOVAL AND INSTALLATION

Tie Rod End(13 273 0)

Special Tool(s)

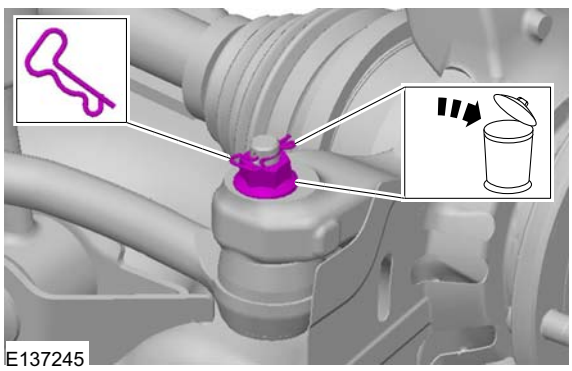
 13006	211-020 Separator, Ball Joint

Removal

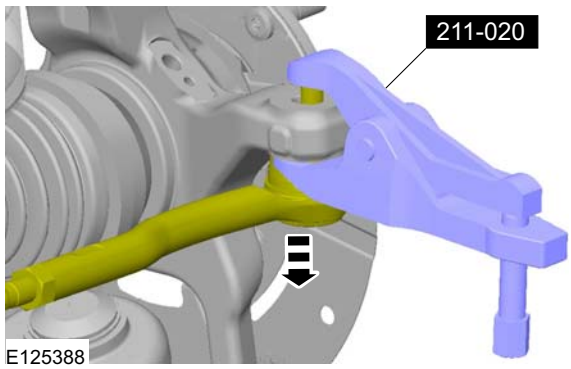
CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

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

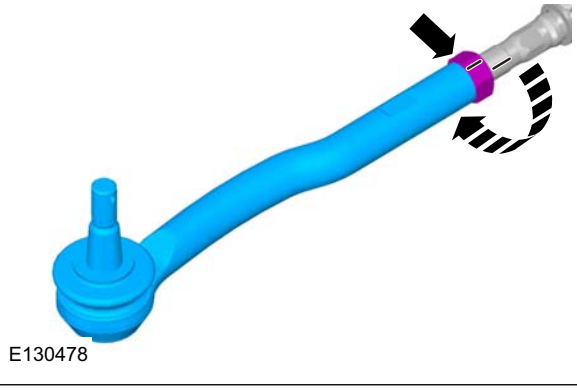
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
   Refer to: Steering System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
3. **CAUTION: Make sure that the ball joint ball does not rotate.**
   Torque: 63 Nm



4. **CAUTION: Do not use a hammer to separate the tie rod from the wheel knuckle or damage to the wheel knuckle can result.**
   Special Tool(s): 211-020



5. **NOTE:** Make sure that the installation marks are aligned.
   Torque: 80 Nm



Installation

1. To install, reverse the removal procedure.
2. Refer to: Front Toe Adjustment (204-00 Suspension System - General Information, General Procedures).

SECTION 211-04 Steering Column

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

Steering Wheel(13 524 0)

General Equipment

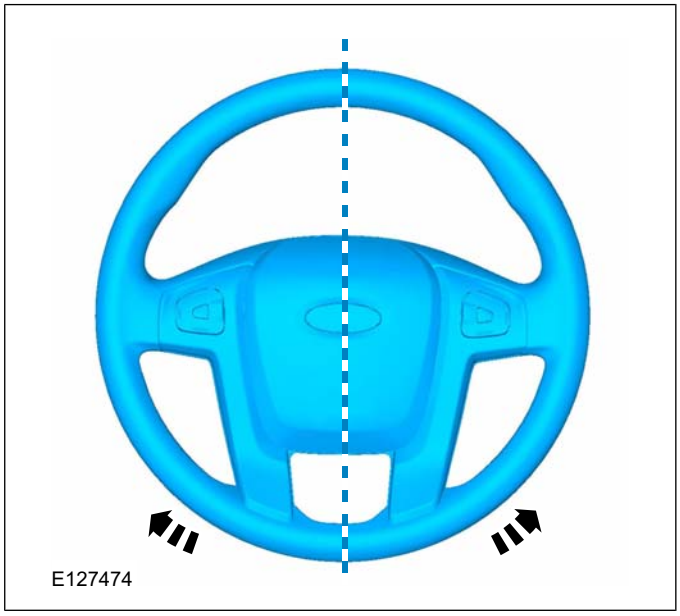
Adhesive Tape

Removal

CAUTION: Make sure that the steering wheel lock is engaged.

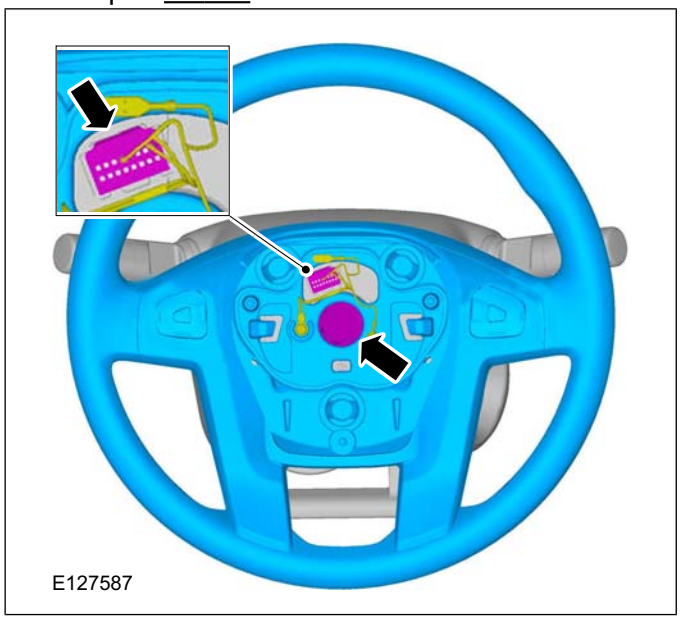
NOTE: Removal steps in this procedure may contain installation details.

1.



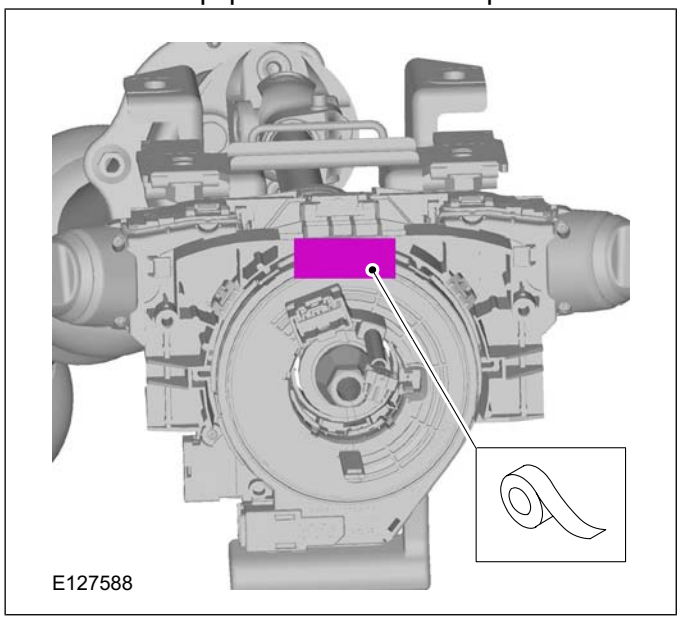
2. Refer to: Driver Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation).

3. Torque: 40 Nm



CAUTION: Make sure that the clockspring rotor does not rotate.

4. General Equipment: Adhesive Tape



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

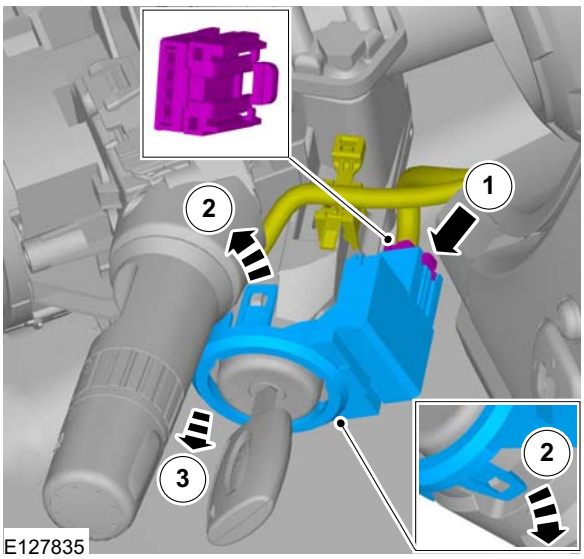
Steering Column(13 542 0)

General Equipment

Ford Diagnostic Equipment

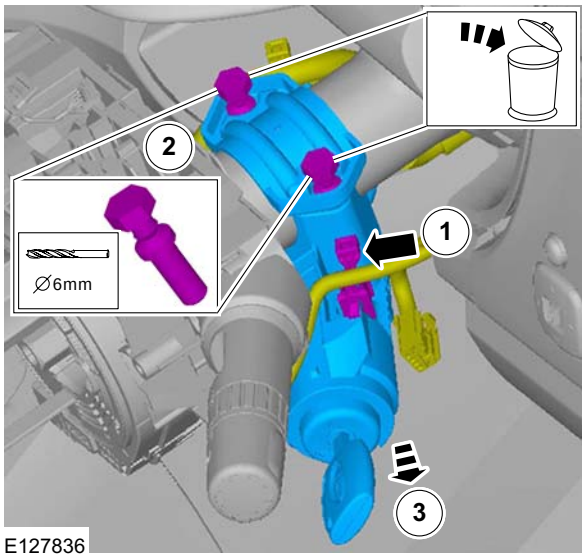
Removal

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: Ignition Switch (211-05 Steering Column Switches, Removal and Installation).
3. Refer to: Steering Wheel (211-04 Steering Column, Removal and Installation).
4. 

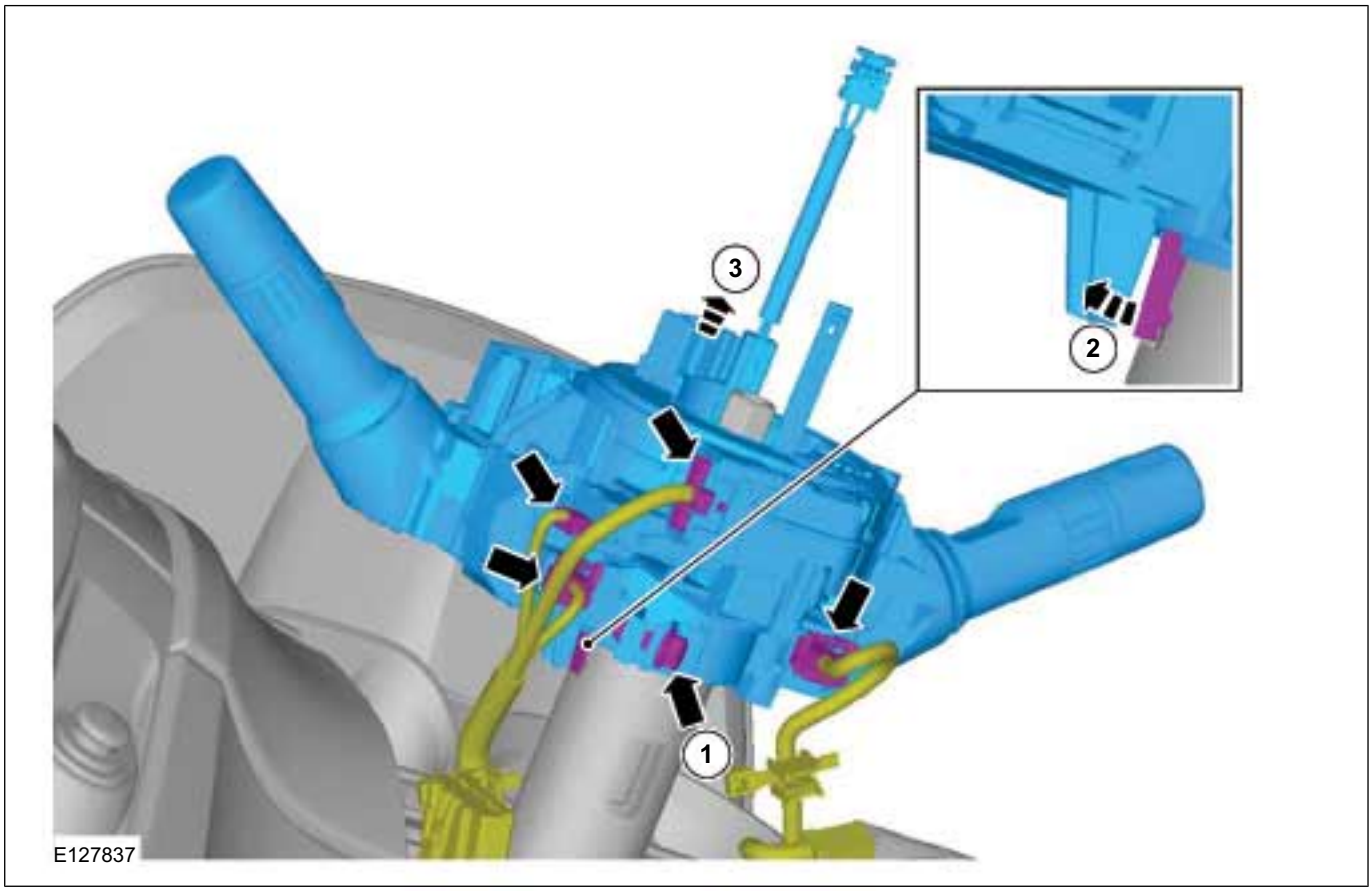
5. **NOTE:** This step is only necessary when installing a new component.

   Torque: 25 Nm



6. Torque: 7 Nm

REMOVAL AND INSTALLATION

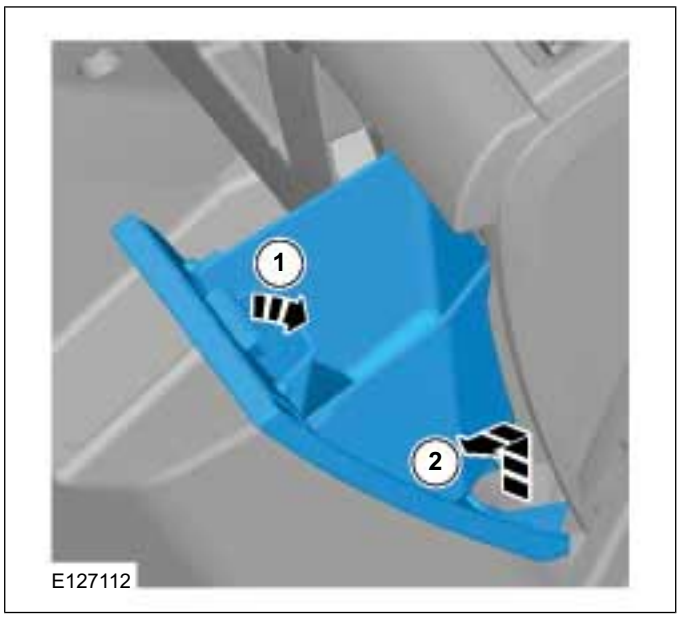


Vehicles with driver lower air bag

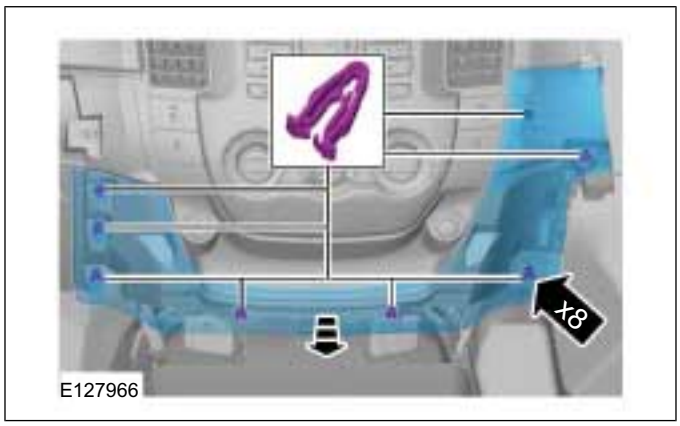
7. Refer to: Driver Lower Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation).

Vehicles without driver lower air bag

8.

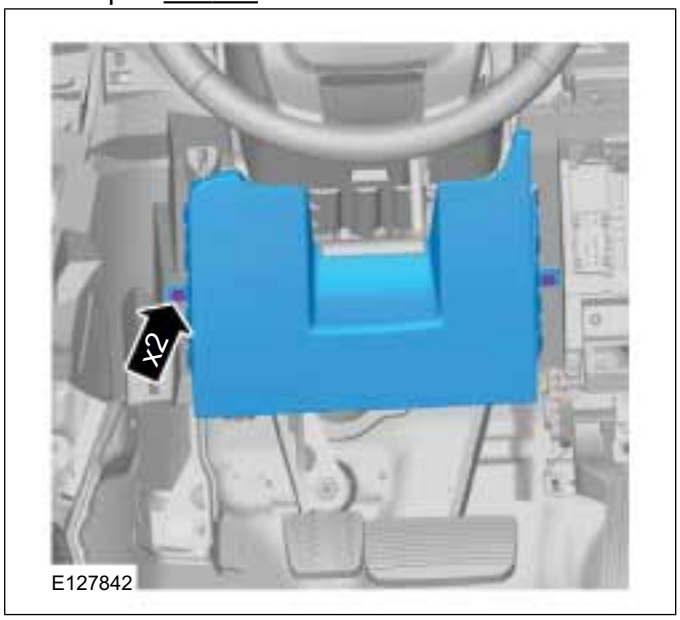


9.



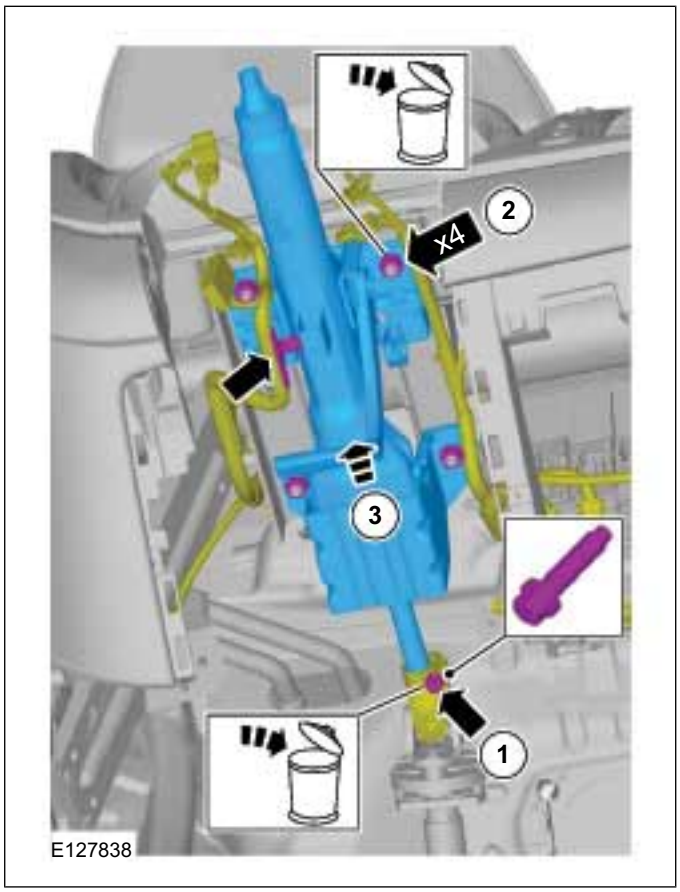
REMOVAL AND INSTALLATION

10. Torque: 2.5 Nm

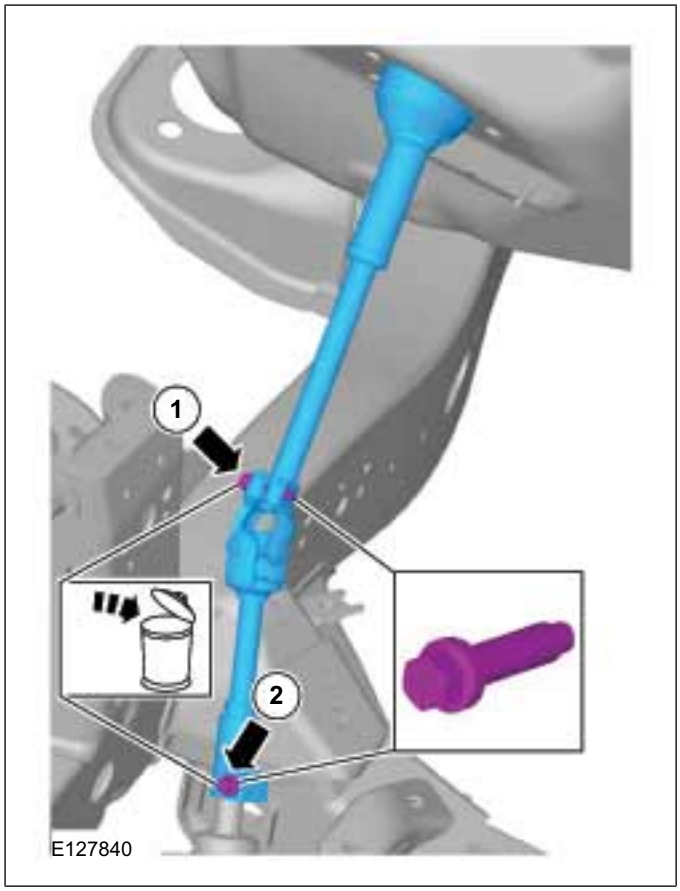


All vehicles

11. **NOTE:** Make sure that the nuts are not tightened with tilt lever released in position during installation.
    1. Torque: 22 Nm
    2. Torque: 15 Nm



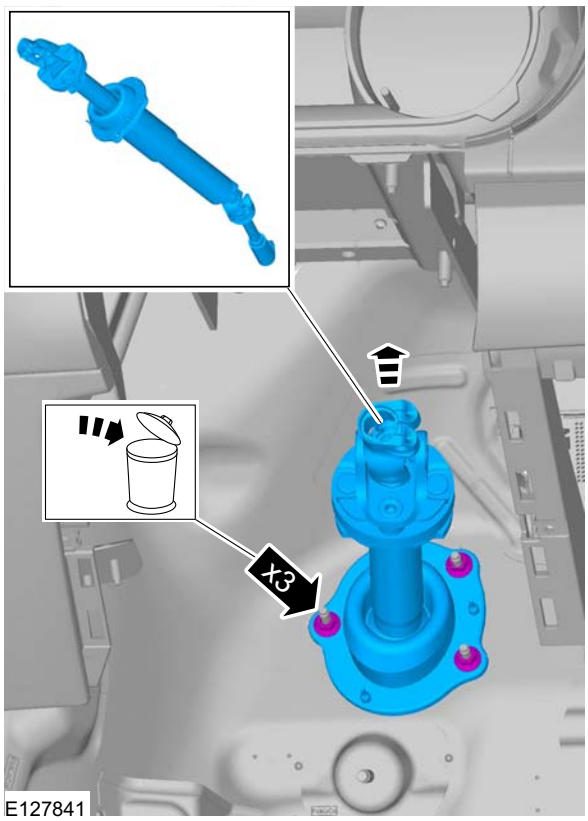
12. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
13. 1. If necessary.
        Torque: 23 Nm
    2. Torque: 23 Nm



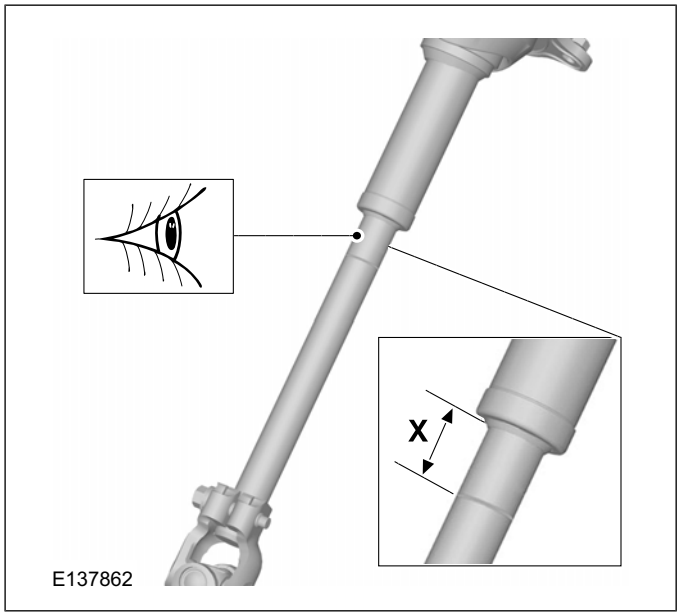
REMOVAL AND INSTALLATION

14. **NOTE:** Make sure that the plastic caps are removed.

    Torque: 7 Nm



NOTE: Do not shorten the shaft until the groove is covered. Replace it, if the shaft has been shortened.



3. Refer to: Clockspring Adjustment (501-20 Supplemental Restraint System, General Procedures).

4. Configure the steering column module.

   General Equipment: Ford Diagnostic Equipment

Installation

1. To install, reverse the removal procedure.

2. **CAUTION: Take extra care not to shorten the shaft.**

SECTION 211-05 Steering Column Switches

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

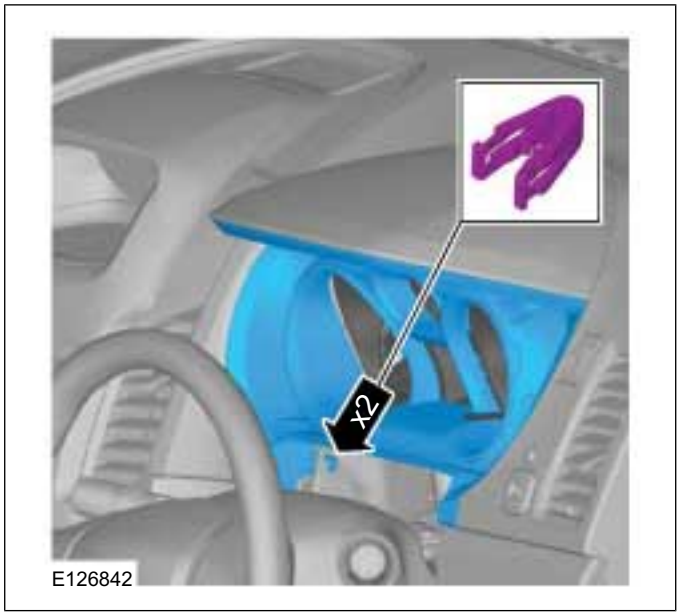
Ignition Switch(33 616 0)

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.



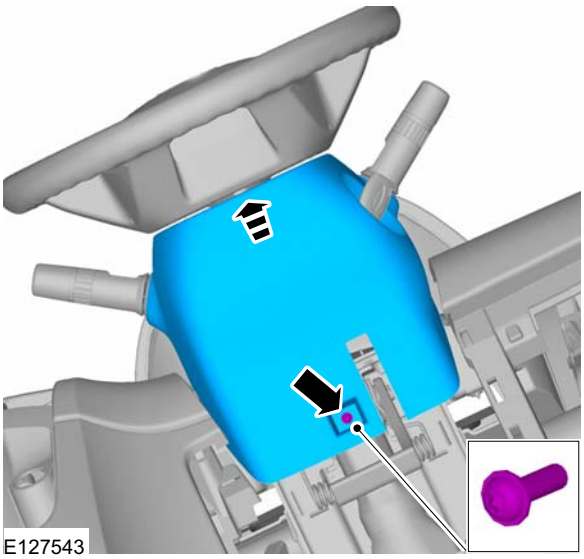
3.

4.

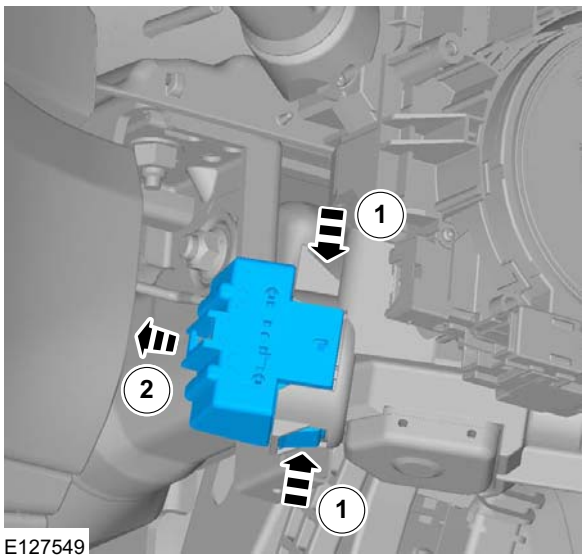
5.

REMOVAL AND INSTALLATION

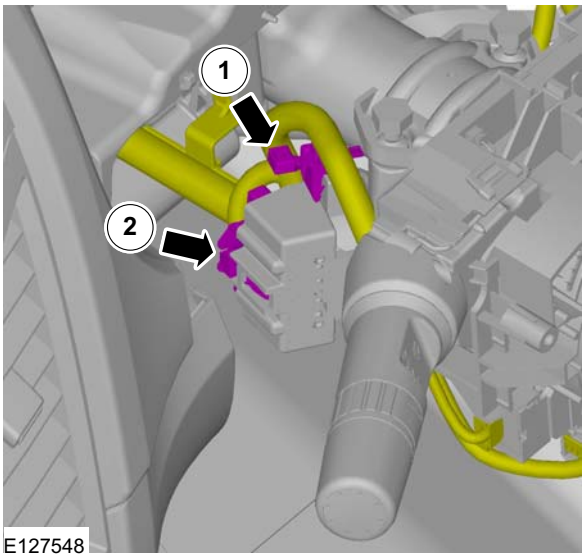
6.



8.



7.



Installation

1. To install, reverse the removal procedure.

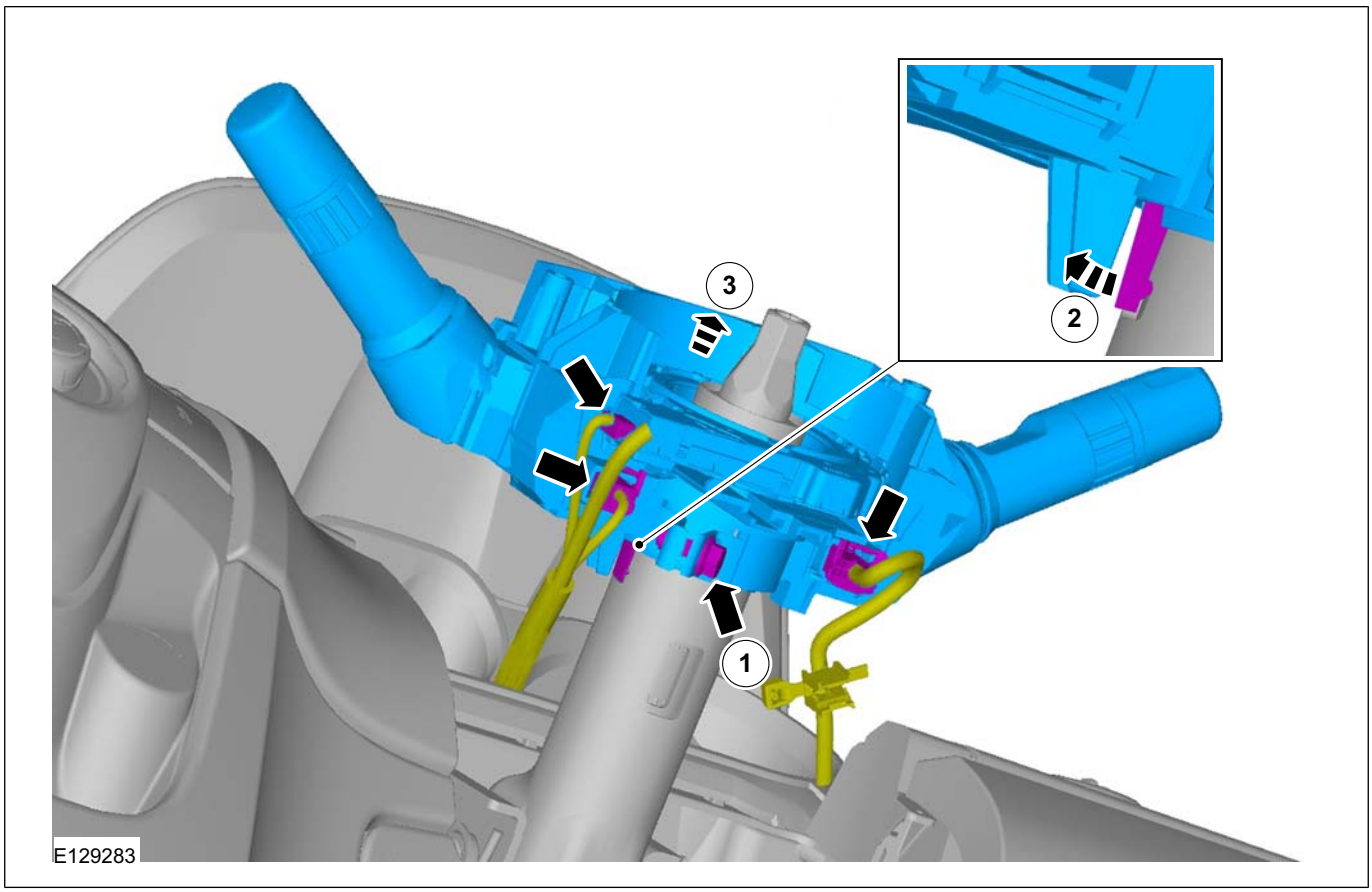
REMOVAL AND INSTALLATION

Steering Column Multifunction Switch(33 612 0)

Removal

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

1. Refer to: Clockspring (501-20 Supplemental Restraint System, Removal and Installation).
2. 1. Torque: 7 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

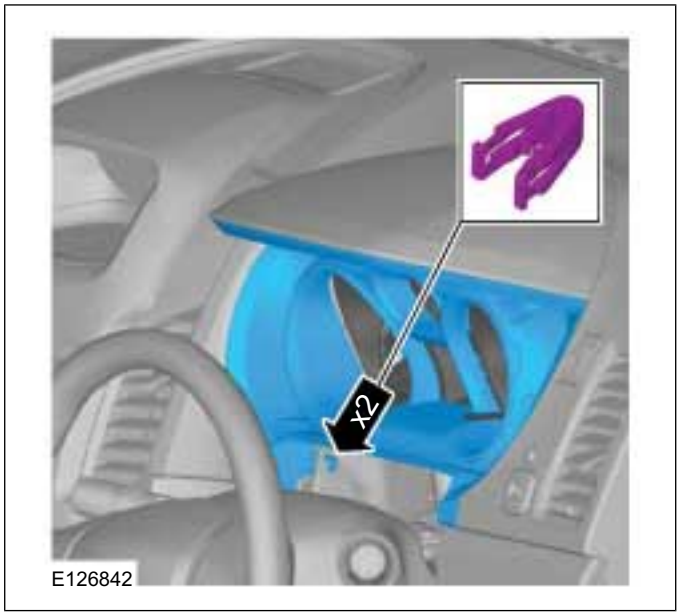
Steering Column Multifunction Switch LH

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.



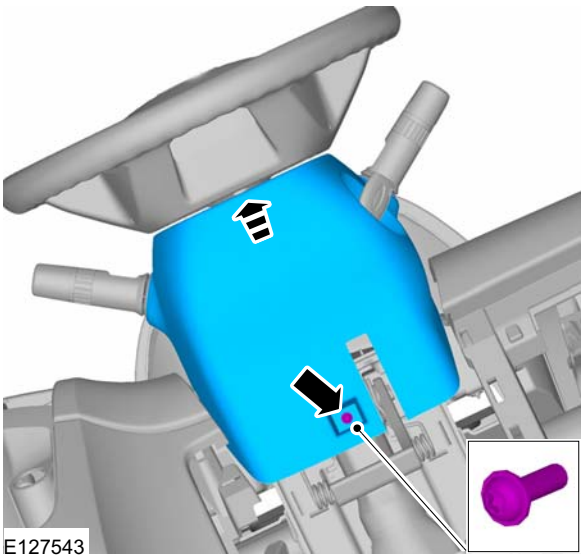
3.

4. Torque: 1.5 Nm

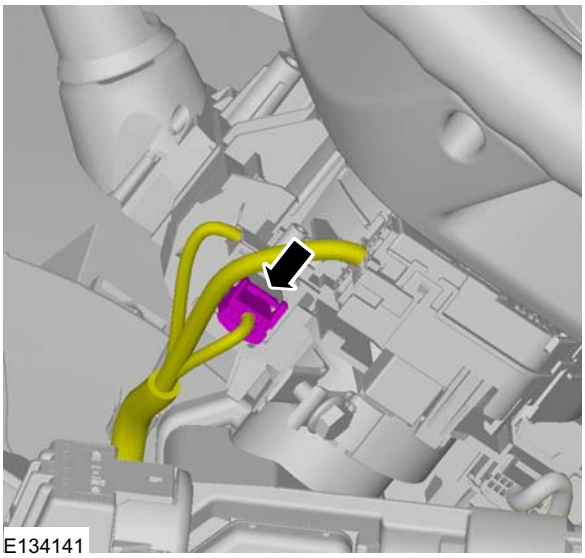
5. Torque: 1.5 Nm

REMOVAL AND INSTALLATION

6. Torque: 2.5 Nm



7.



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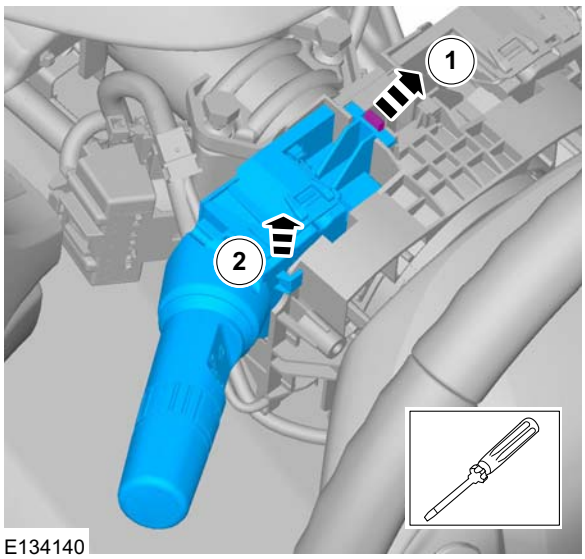


Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

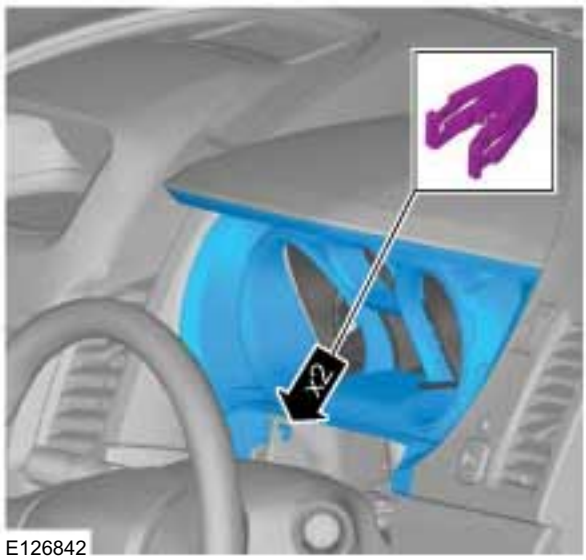
Steering Column Multifunction Switch RH

Removal

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

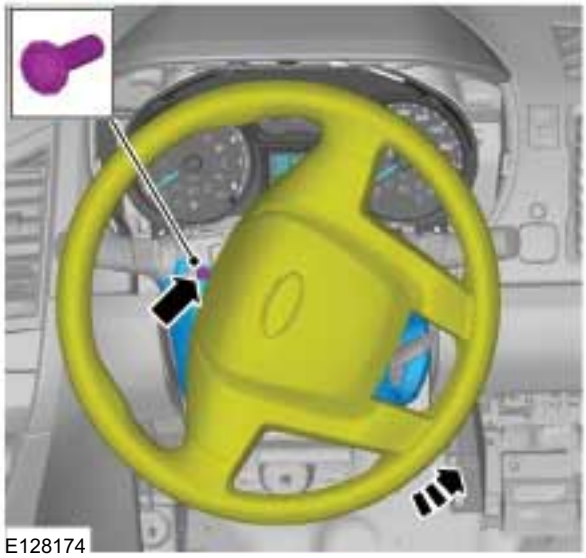
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

2.



3.

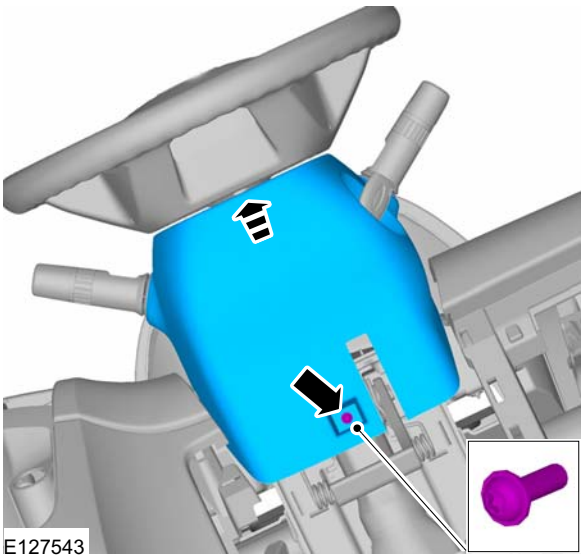
4. Torque: 1.5 Nm



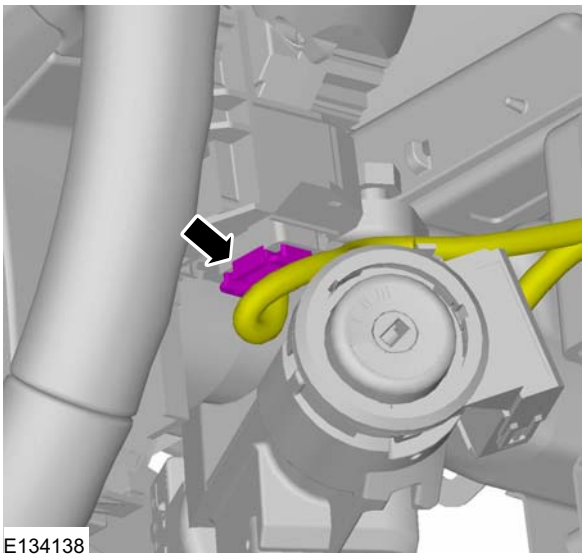
5. Torque: 1.5 Nm

REMOVAL AND INSTALLATION

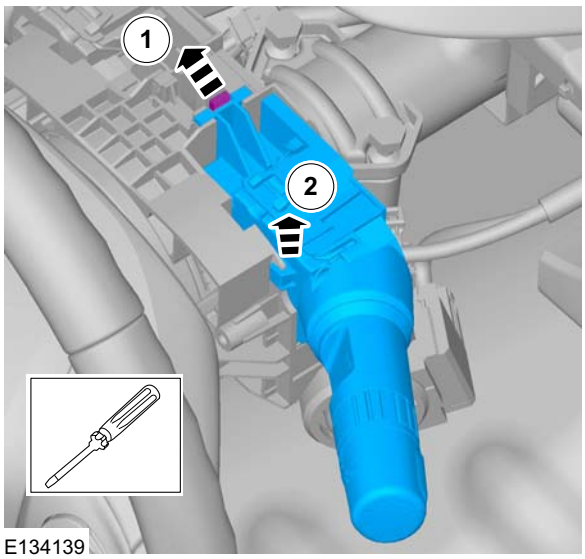
6. Torque: 2.5 Nm



7.



8.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Steering Column Lock and Ignition Switch Housing

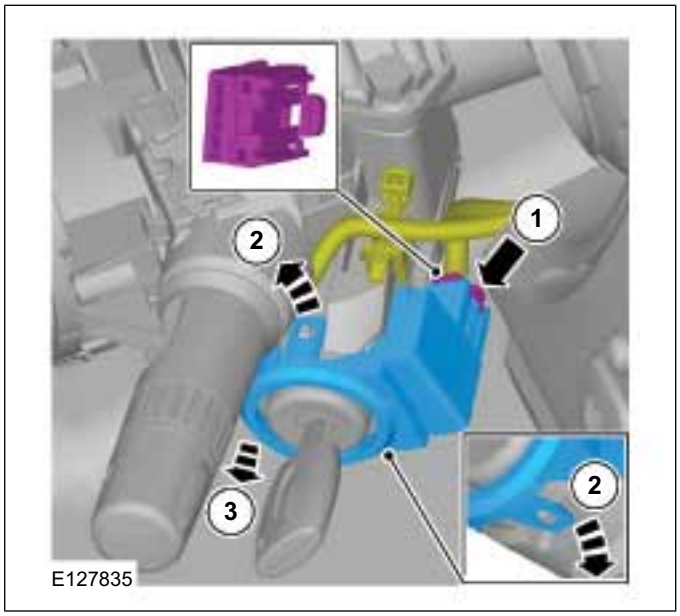
General Equipment

Punch

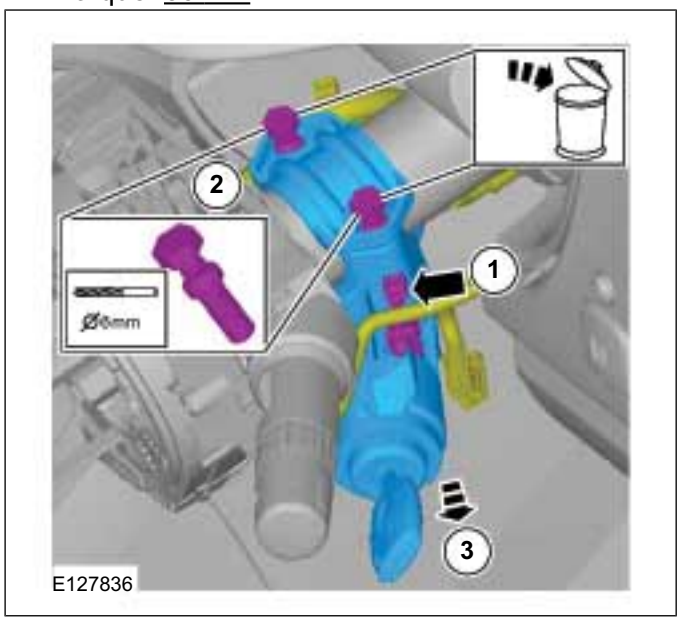
Removal

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

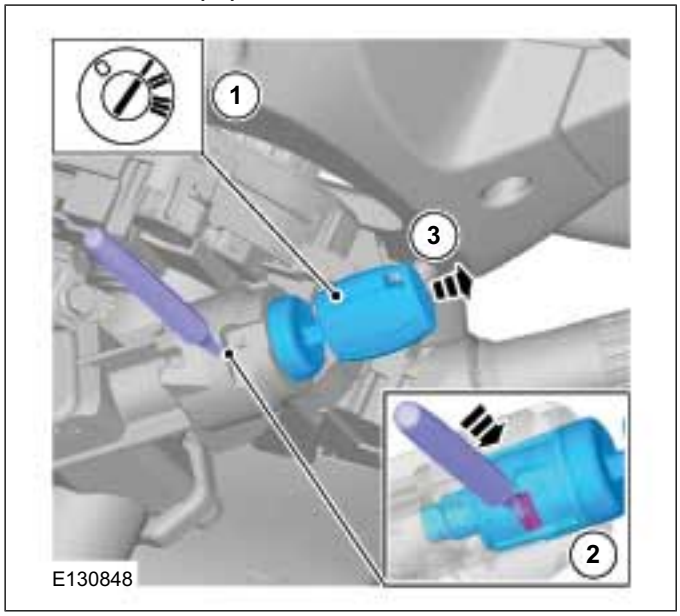
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
   Refer to: Steering System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Ignition Switch (211-05 Steering Column Switches, Removal and Installation).
3.



4. **NOTE:** This step is only necessary when installing a new component.
   Torque: 30 Nm



5. Turn the ignition key to position I.
   General Equipment: Punch



Installation

1. To install, reverse the removal procedure.

GROUP

3 Powertrain

SECTION TITLE PAGE

Engine

SECTION 303-00 Engine System - General Information

VEHICLE APPLICATION: 2011.50 Ranger

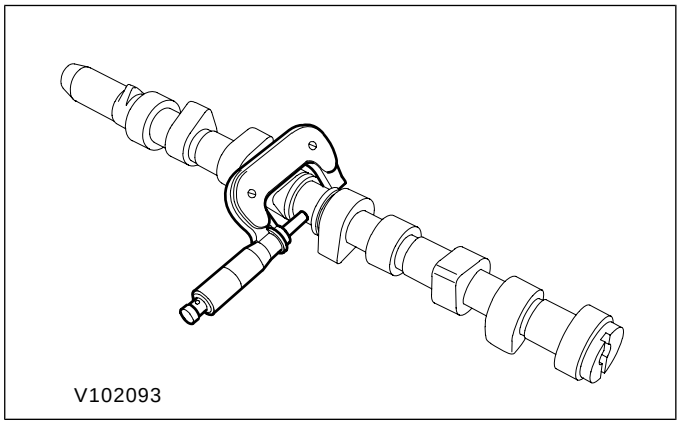
CONTENTS PAGE

GENERAL PROCEDURES

GENERAL PROCEDURES

Camshaft Bearing Journal Diameter

1. **Determine the diameter of the camshaft journals.**
   - Using a micrometer measure the diameter at 90 degrees intervals to determine if the journals are out-of-round.
   - Measure at two different points on the journal to determine if there is any tapering.
   - If the measurements are out of the specified range, install a new camshaft.



GENERAL PROCEDURES

Camshaft Bearing Journal Clearance

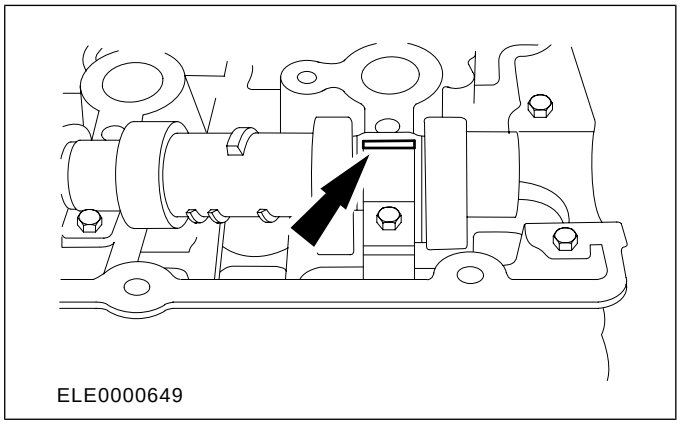
1. **NOTE: Make sure that the following stages are followed exactly. The tappets or followers must be removed to carry out this measurement.**

   NOTE: Make sure that the camshaft is to specification.

   NOTE: The bearing caps and journals should be free from engine oil and dirt.

   Position on a width of plastigage on the bearing cap.

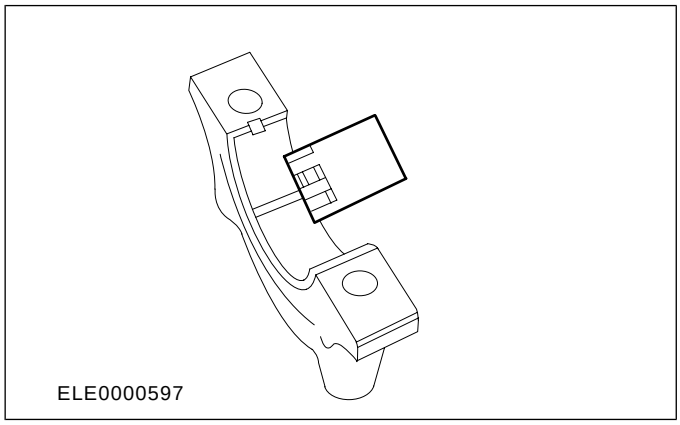
   - Insert the camshaft, without lubrication, into the cylinder head.
   - Position a plastigage strip, which should be equal to the width of the bearing cap, on the bearing journal.



2. **Following the tightening specification, install the camshaft bearing caps. Refer to the corresponding Section 303-01.**
3. **NOTE: Do not strike the bearing caps.**

   Remove the camshaft bearing caps, refer to the corresponding Section 303-01.
4. **Using the Plastigage, read off the measurement.**

   - Compare the width of plastigage with the plastigage scale.
   - The value that is read off is the bearing clearance.



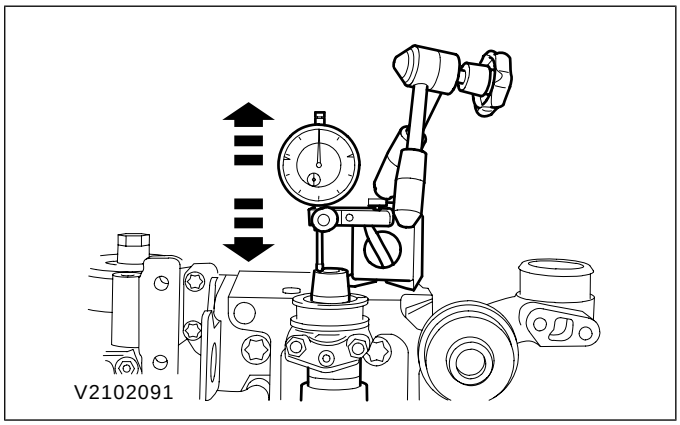
GENERAL PROCEDURES

Camshaft End Play

1. **NOTE: Make sure that the camshaft is to specification.**

   Using a Dial Indicator Gauge, measure the end play.

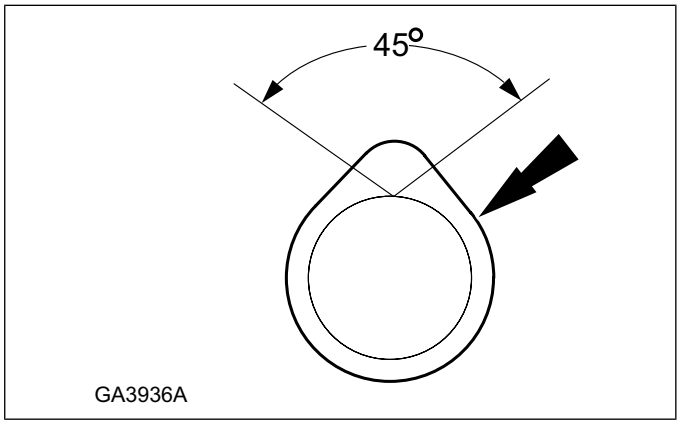
   - Slide the camshaft in both directions. Read and note the maximum and minimum values on the Dial Indicator Gauge.
     - End play = maximum value minus minimum value
   - If the measurement is out of specification, install new components.



GENERAL PROCEDURES

Camshaft Surface Inspection

1. **Inspect the camshaft lobes for pitting or damage in the active area. Minor pitting is acceptable outside the active area.**

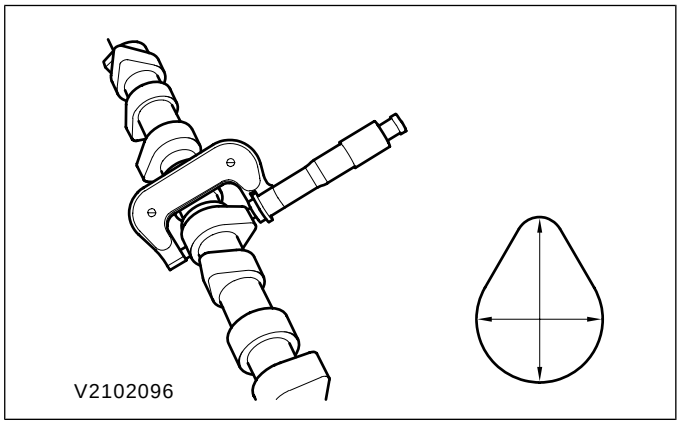


GENERAL PROCEDURES

Camshaft Lobe Lift

1. Determine the cam lift.

- Using a micrometer measure the cam in two directions.
- The difference between the two measurements is the cam lift.



GENERAL PROCEDURES

Crankshaft Main Bearing Journal Clearance

1. **Information not available at time of going to press.**

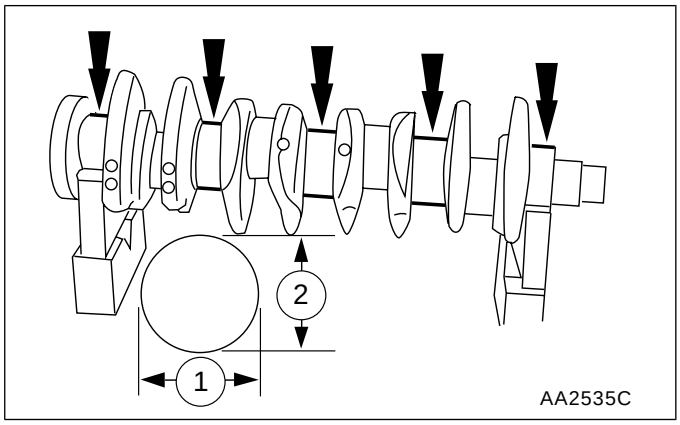
GENERAL PROCEDURES

Crankshaft Main Bearing Journal Diameter

General Equipment

Micrometer

1. **Measure the diameter of the main bearing journals and the big-end bearing journals.**
   - Repeat the measurement with the micrometer offset by 90°, in order to determine any eccentricity which may be present.
   - Measure the journal at two different positions to determine any conicity which may be present.



GENERAL PROCEDURES

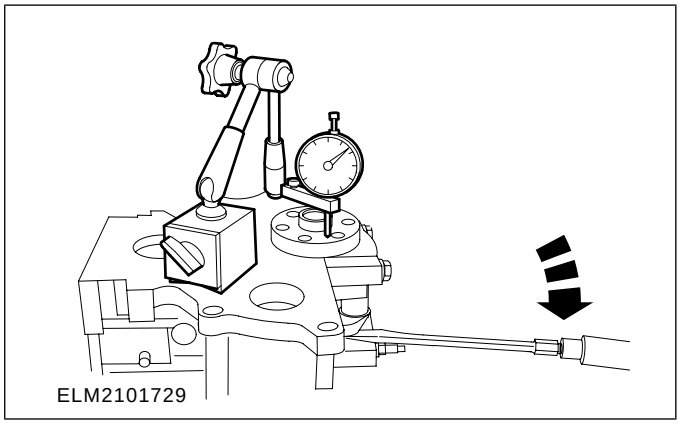
Crankshaft End Play

General Equipment

Dial indicator
Dial indicator fixture

1. Determine the end float

- Place on the dial indicator and bracket .
- Determine the end float by raising the crankshaft with the aid of a screwdriver.
- If necessary, correct the end float by using new thrust half washers.



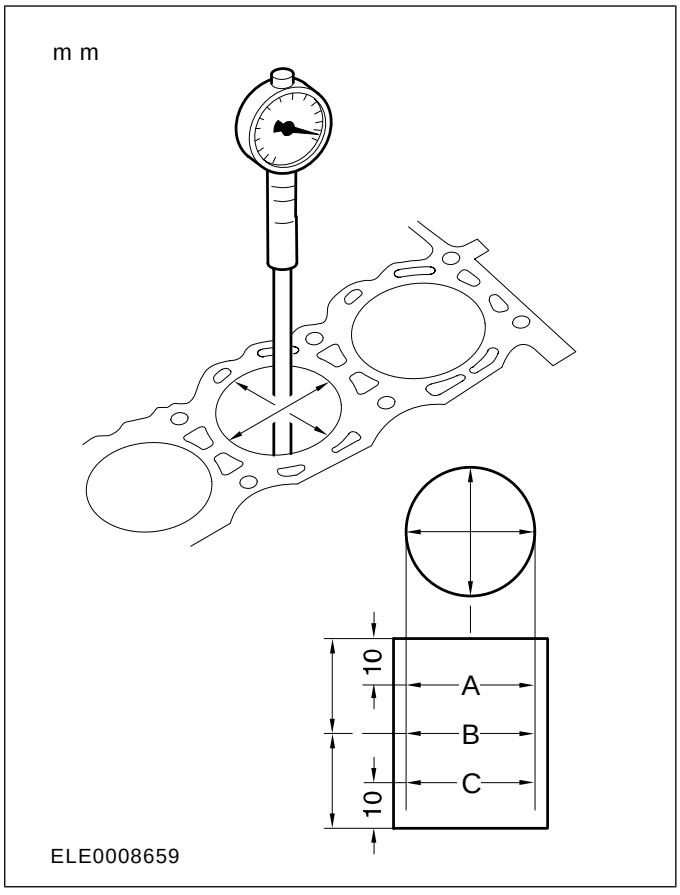
GENERAL PROCEDURES

Cylinder Bore Taper

1. **NOTE: The main bearing caps or lower crankcase must be in place and tightened to the specified torque; however, the bearing shells should not be installed.**

   Measure the cylinder bore with an internal micrometer.

   - Carry out the measurements in different directions and at different heights to determine if there is any out-of-roundness or tapering.
   - If the measurement is out of the specified range, install a new block or hone out the cylinder block (if aplicable/allowed).



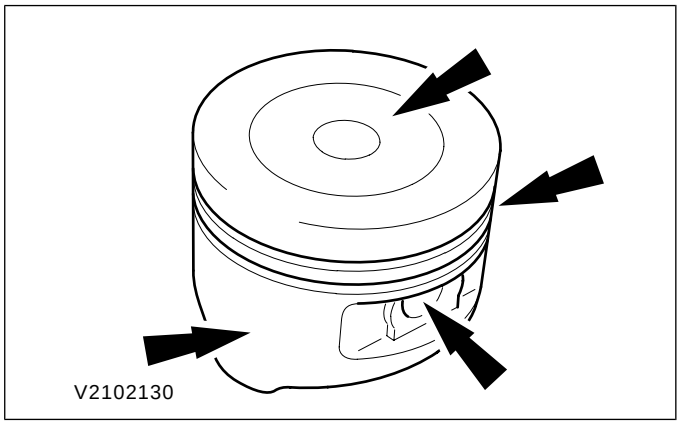
GENERAL PROCEDURES

Piston Inspection

1. **CAUTION: Do not use any aggressive cleaning fluid or a wire brush to clean the piston.**

   Carry out a visual inspection.

   - Clean the piston skirt, pin bush, ring grooves and crown and check for wear or cracks.
   - If there are signs of wear on the piston skirt, check whether the connecting rod is twisted or bent.



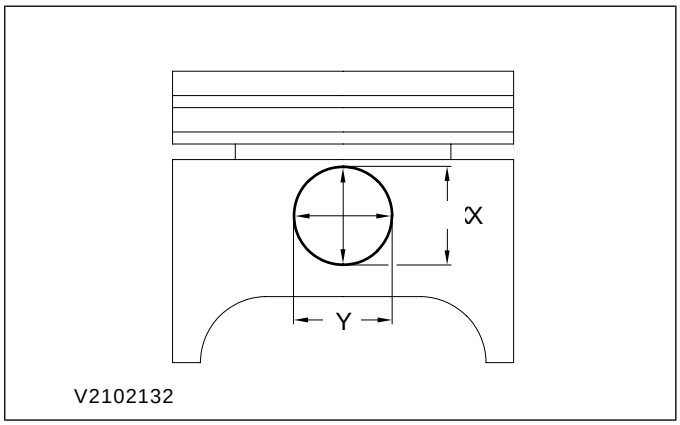
GENERAL PROCEDURES

Piston Pin to Bore Diameter

1. **NOTE: The piston and piston pin form a matched pair. Do not mix up the components.**

   Measure the diameter of the piston pin bore.

   - Measure the diameter in two directions.
   - If the values are not to specification, install both a new piston and a new piston pin.



GENERAL PROCEDURES

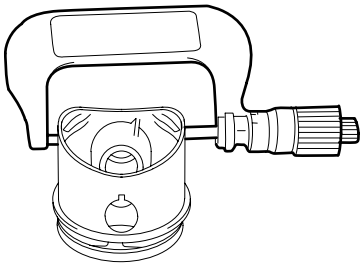
Piston Diameter

General Equipment

Micrometer

1. **NOTE: Mark the piston to make sure the piston is installed correctly.**

   Using a Micrometer measure the piston diameter.



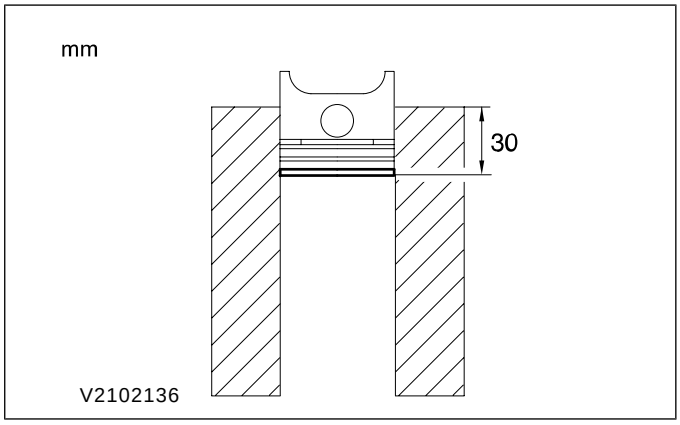
IAV2102103

GENERAL PROCEDURES

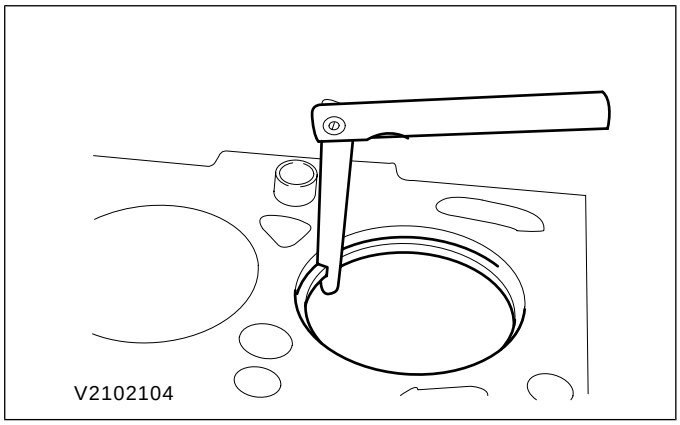
Piston Ring End Gap

1. **CAUTION: Do not mix up the piston rings. Install the piston rings in the same position and location.**

   Take the piston ring and use a piston without rings to push the piston ring about 30 mm into the cylinder bore.



2. **Using the Feeler Gauge, measure the piston ring gap.**



GENERAL PROCEDURES

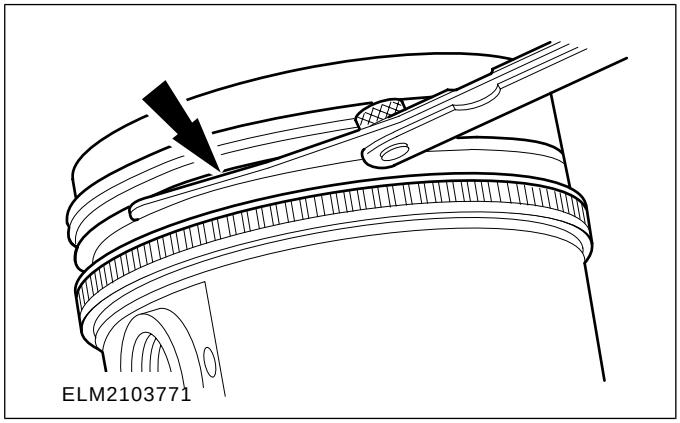
Piston Ring-to-Groove Clearance

General Equipment

Feeler Gauge

1. **NOTE: The piston ring must protrude from the piston groove. To determine the piston ring clearance, insert the Feeler Gauge right to the back of the groove, behind the wear ridge.**

   Using the Feeler Gauge , measure the piston ring clearance.



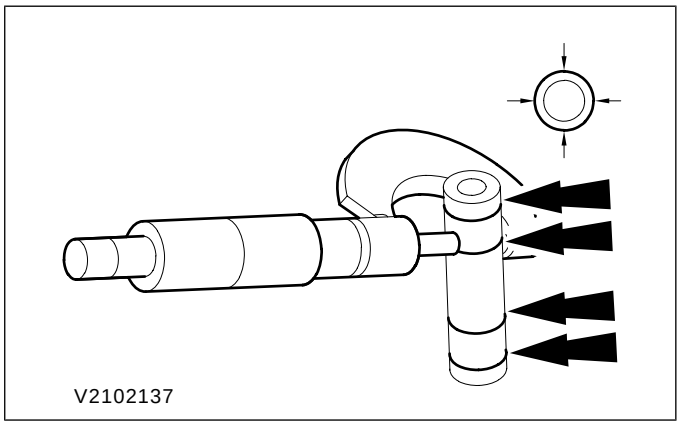
GENERAL PROCEDURES

Piston Pin Diameter

1. **NOTE: The piston and piston pin are a matched pair. Do not mix up the components.**

   Measure the piston pin diameter.

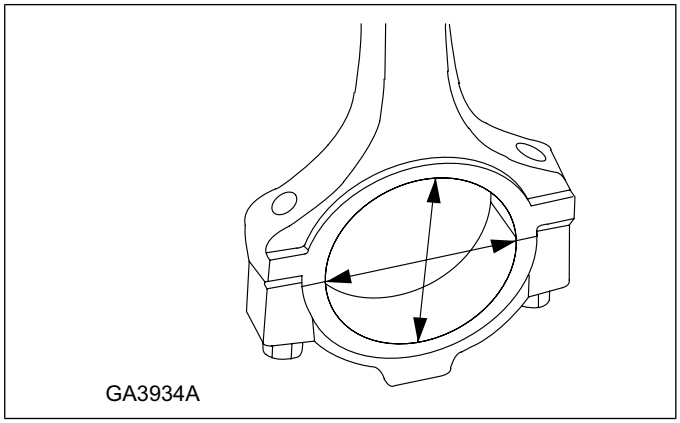
   - Measure the diameter in two directions.
   - If the values are not to specification, install a new piston and a new piston pin.



GENERAL PROCEDURES

Connecting Rod Large End Bore

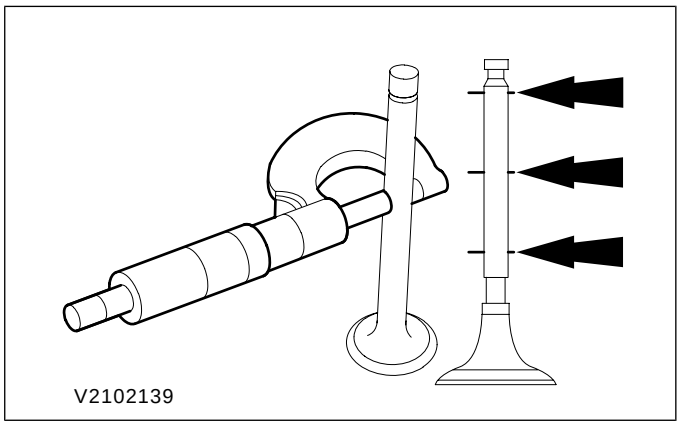
1. **Measure the bearing bore in two directions. The difference is the connecting rod bore out-of-round. Verify the out-of-round and the bearing bore is within specification.**



GENERAL PROCEDURES

Valve Stem Diameter

1. **Using a micrometer measure the diameter of the valve stems.**
   - If the measurements are not to specification, install a new valve.



GENERAL PROCEDURES

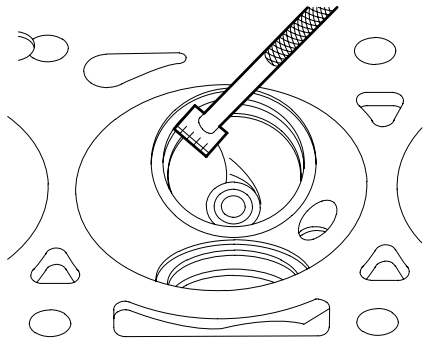
Valve Seat Inspection

General Equipment

Valve seat width scale

1. Measure the width of the valve seat.

- Measure the valve seat width using the Valve seat width scale.
- If the value is not to specification rework the valve seat.



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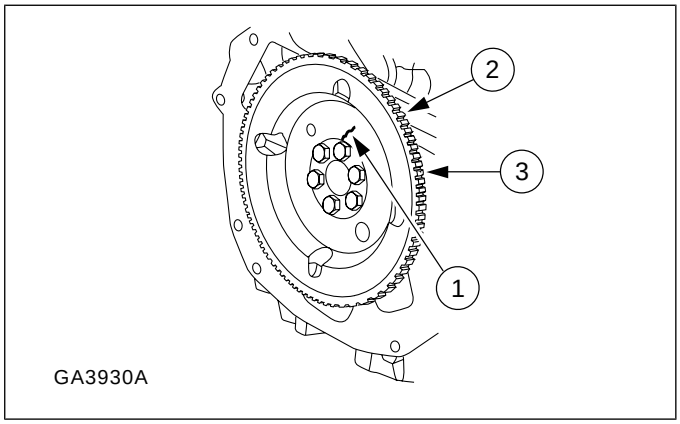
GENERAL PROCEDURES

Flywheel Inspection

1. Inspect the flywheel. If there is evidence of the following, install a new flywheel.

1. Cracks.
2. Worn ring gear teeth.
3. Chipped or cracked ring gear teeth.

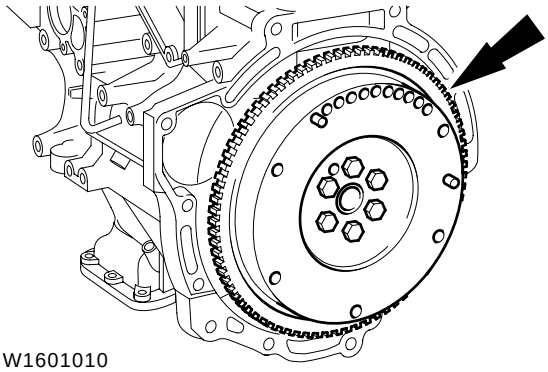


GENERAL PROCEDURES

Flywheel Clutch Surface Inspection

1. Check the flywheel for:

- burning
- grooves
- cracks
- Renew the flywheel if necessary.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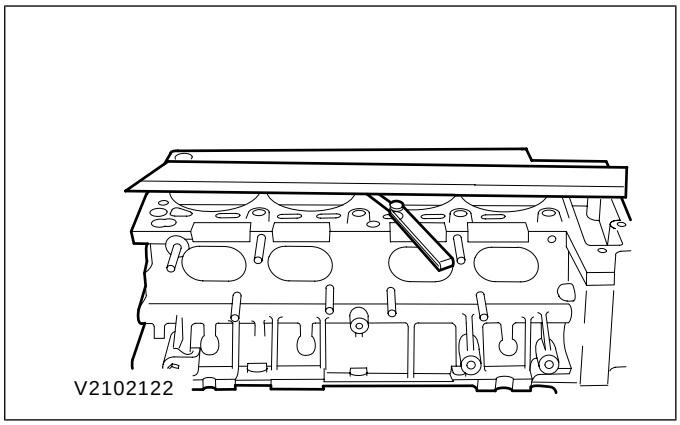
GENERAL PROCEDURES

Cylinder Head Distortion

General Equipment

Feeler gauge
Straight edge

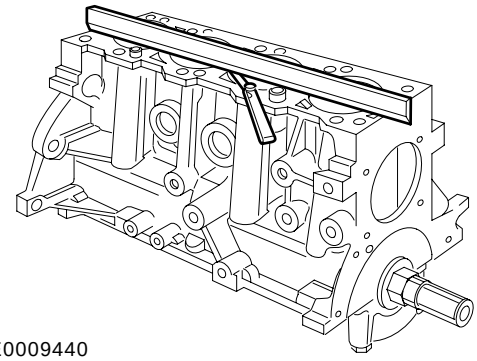
1. **Using a straight edge and feeler gauge, measure the cylinder head distortion.**
   - Measure the mating face distortion.
   - Refer to Specifications in the appropriate engine section.



GENERAL PROCEDURES

Cylinder Block Distortion

1. **Using a Straight Edge and a Feeler Gauge, measure the cylinder block/cylinder head distortion.**
   - Measure the mating face distortion.
   - If the value is not to specification rework the mating face (if allowed).



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GENERAL PROCEDURES

Exhaust Manifold Cleaning and Inspection

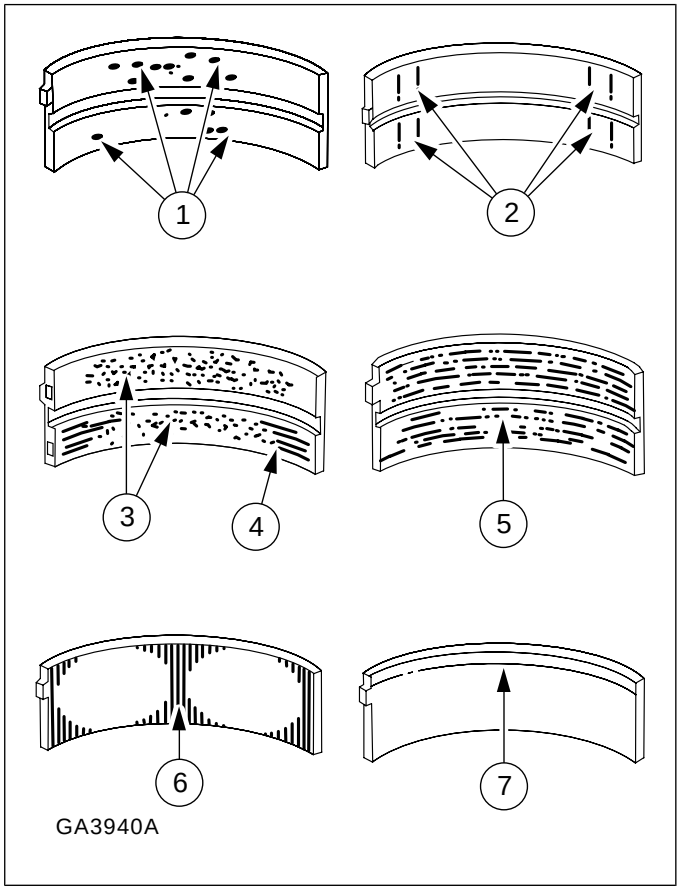
1. **Inspect the cylinder head joining flanges of the exhaust manifold for evidence of exhaust gas leaks.**
2. **Inspect the exhaust manifold for cracks, damaged gasket surfaces, or other damage that would make it unfit for further use.**

GENERAL PROCEDURES

Bearing Inspection

1. Inspect bearings for the following defects.

1. Cratering - fatigue failure
2. Spot polishing - incorrect seating.
3. Imbedded dirt engine oil.
4. Scratching - dirty engine oil.
5. Base exposed - poor lubrication.
6. Both edges worn - journal damaged.
7. One edge worn - journal tapered or bearing not seated.



SECTION 303-01A Engine — 2.5L Duratec-HE (122kW/165PS) - MI4

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

ASSEMBLY

INSTALLATION

SPECIFICATIONS

Engine data

Description	Specification
Engine code	GBVAF EV,GBVAL EV,GBVAK EV
Firing order	1-3-4-2
Emission level	Stage IV
Displacement	2.5L
No. of cylinders	4
Bore	89 mm
Stroke	100 mm
Cubic capacity	2488.5 cm^3
Compression ratio	9.7 : 1
Number of main bearings	5
Camshaft drive	Chain
Oil pressure (hot @ 2,000 rpm)	200-268 kPa (29-39 psi)
Engine weight (without accessory drive components and flexplate or flywheel)	203.8 kg

Engine oil

Viscosity / ambient temperature	Type	Specification
Recommended engine oil		
SAE 5W-30 / below -20°C to over +40°C	Castrol Engine Oil	WSS M2C930-A / WSS M2C929-A
Alternative engine oils (for top-up only)		
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

Cylinder block

Description	mm
Cylinder bore diameter	89.0 - 89.03 mm
Cylinder bore maximum out-of-round	0.008 mm
Main bearing bore diameter	57.018 - 57.040 mm
Head gasket surface flatness	0.1 mm/general and 0.05 mm/200 x 200

Piston

Description	mm
Diameter (1)	88.965 - 88.975 mm
Diameter (2)	88.975 - 88.985 mm
Diameter (3)	88.985 - 88.995 mm

SPECIFICATIONS

Description	mm
Piston-to-bore clearance	0.025 - 0.045 mm
Ring groove width - top	1.203 - 1.205 mm
Ring groove width - 2nd	1.202 - 1.204 mm
Ring groove width - oil	2.501 - 2.503 mm
Piston skirt coating thickness	0.008 - 0.016 mm

Piston pin

Description	mm
Diameter	19.995 - 20.0 mm
Length	54.7 - 55.0 mm

Valve

Description	mm and degree
Valve head diameter - intake	34.85 - 35.15 mm
Valve head diameter - exhaust	29.85 - 30.15 mm
Valve stem diameter - intake	5.470 - 5.485 mm
Valve stem diameter - exhaust	5.465 - 5.480 mm
Valve stem-to-guide clearance - intake	0.0027 mm
Valve stem-to-guide clearance - exhaust	0.0029 mm
Valve face runout	0.05 mm
Valve face angle	45 degrees

Valve spring - compression pressure

Description	kg and mm
Intake and exhaust (installed)	17.5 kg
Intake (valve open) 8.9 mm of lift	44 kg
Exhaust (valve open) 7.4 mm of lift	42 kg
Free length	44.92 mm
Assembled height	37.9 mm

Cylinder head

Description	mm and degree
Cylinder head flatness	0.08 maximum overall, a maximum of 0.05 mm within 150 mm
Valve lift @ zero lash (exhaust)	7.7 mm
Valve lift @ zero lash (intake)	8.8 mm
Valve guide diameter	5.509 - 5.539 mm
Valve seat width - intake/exhaust	0.99 - 1.84 mm
Valve seat angle	45 degrees

SPECIFICATIONS

Description	mm and degree
Valve seat runout	0.075 mm
Valve lash adjuster bore diameter	31.00 - 31.03 mm
Cam bore diameter	25.015 - 25.040 mm

Crankshaft

Description	mm
Main bearing journal diameter	51.978 - 52.002 mm
Production repair	51.730 - 51.750 mm
Main bearing clearance	0.016 - 0.047 mm
Connecting rod journal diameter	51.978 - 52.002 mm
Production repair	51.730 - 51.750 mm
End play	0.220 - 0.450 mm

Rings

Description	mm
Width - top	1.17 - 1.185 mm
Width - 2nd	1.197 - 1.199 mm
Width - oil	2.38 - 2.45 mm
Ring gap (in bore) - top	0.16 - 0.31 mm
Ring gap (in bore) - 2nd	0.31 - 0.46 mm
Ring gap (in bore) - oil	0.2 - 0.7 mm

Valve tappet

Description	mm
Diameter	30.97 - 30.98 mm
Tappet-to-valve clearance -intake	0.22 - 0.28 mm
Tappet-to-valve clearance -exhaust	0.27 - 0.33 mm
Tappet-to-bore clearance	0.02 - 0.06 mm

Camshaft

Description	mm
Intake camshaft lobe lift	8.24999 mm
Exhaust camshaft lobe lift	7.80007 mm
Runout (1)a	0.03 mm
Thrust clearance	0.09 - 0.24 mm
Journal diameter	24.96 - 24.98 mm
Journal-to-bore clearance	0.035 - 0.080 mm
a - No. 3 journal - supported by No. 1 and No. 5 journals.	

SPECIFICATIONS

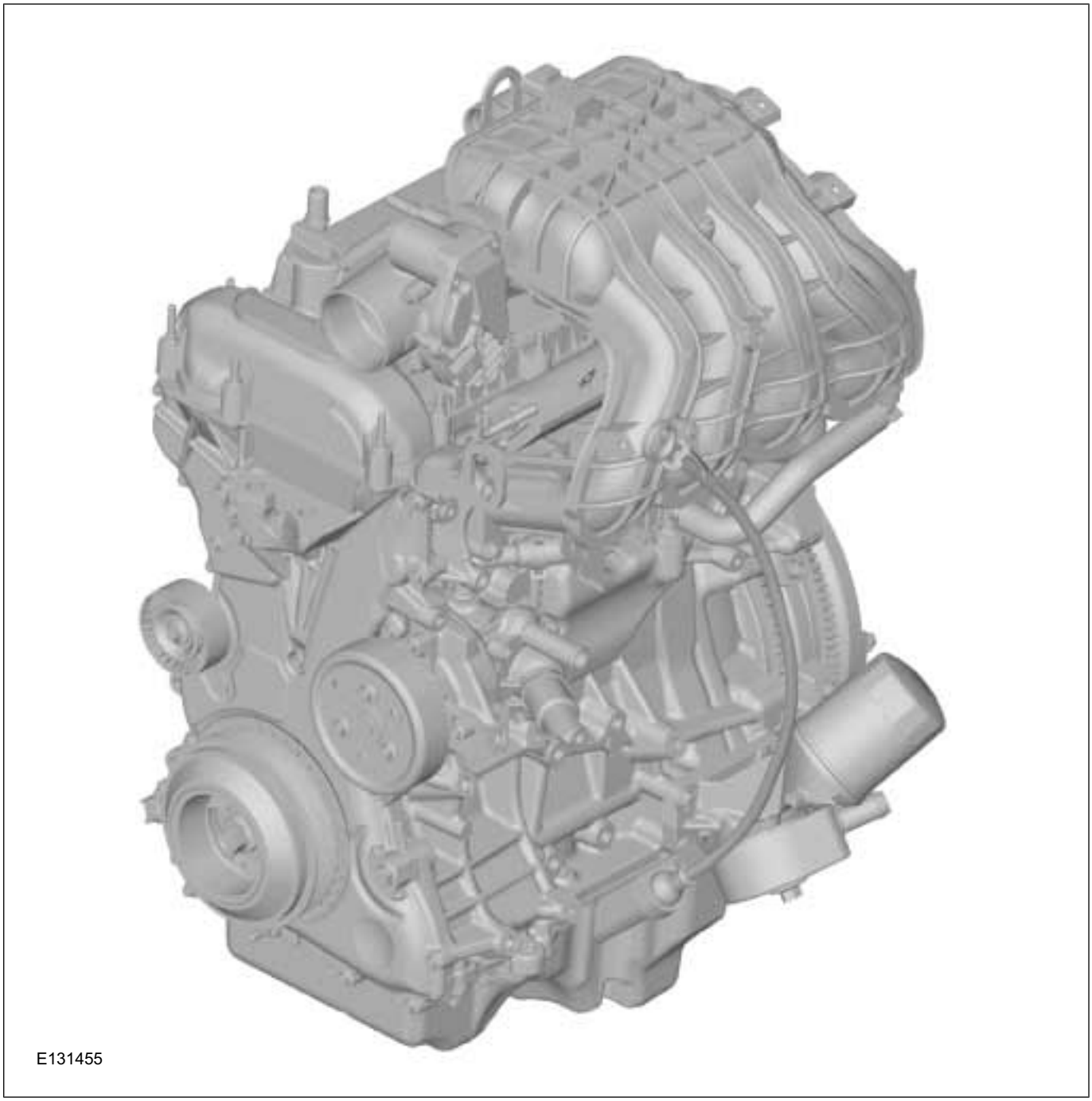
Connecting rod

Description	mm
Bearing clearance	0.027 - 0.052 mm
Bearing thickness	1.496 - 1.520 mm
Crank bore diameter	55.023 - 55.047 mm
Pin bore diameter	20.965 - 20.985 mm
Length (center-to-center)	151.8 mm
Side clearance	1.95 - 3.05 mm
Axial clearance	0.14 - 0.36 mm

DESCRIPTION AND OPERATION

Engine – Overview

General View



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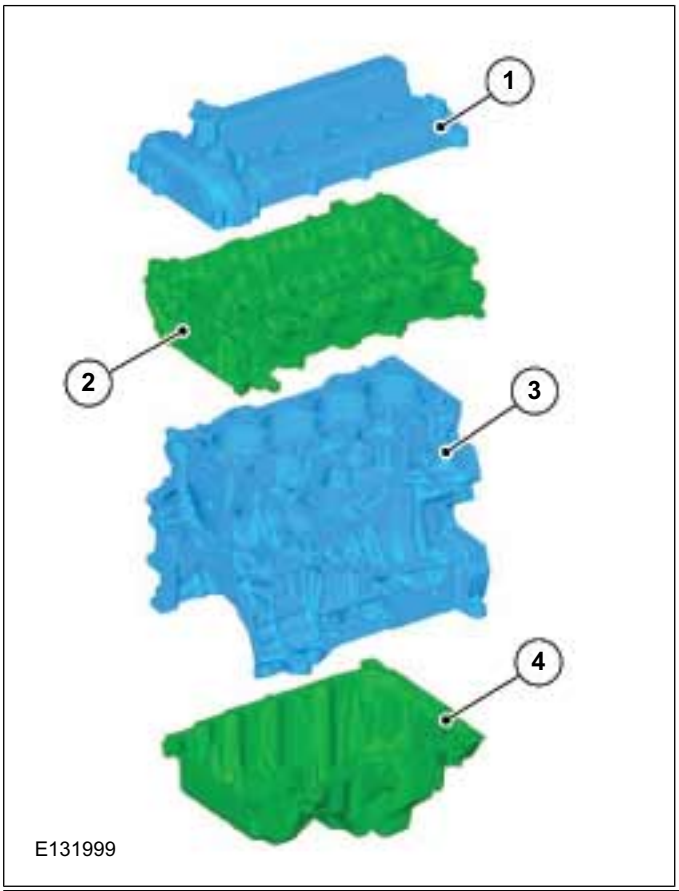
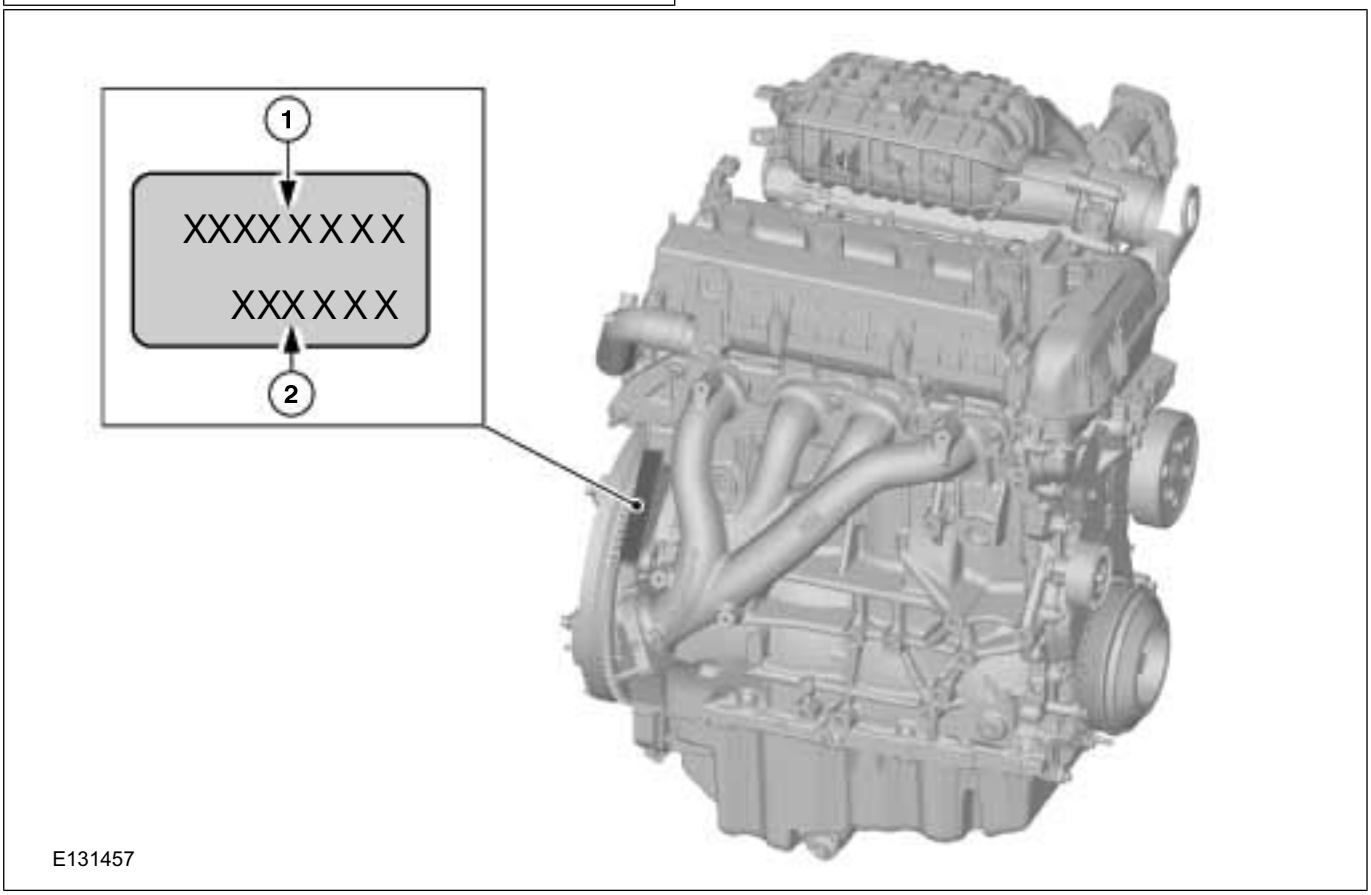
DESCRIPTION AND OPERATION



Item	Description
1	Valve cover
2	Cylinder head
3	Cylinder block
4	Oil pan

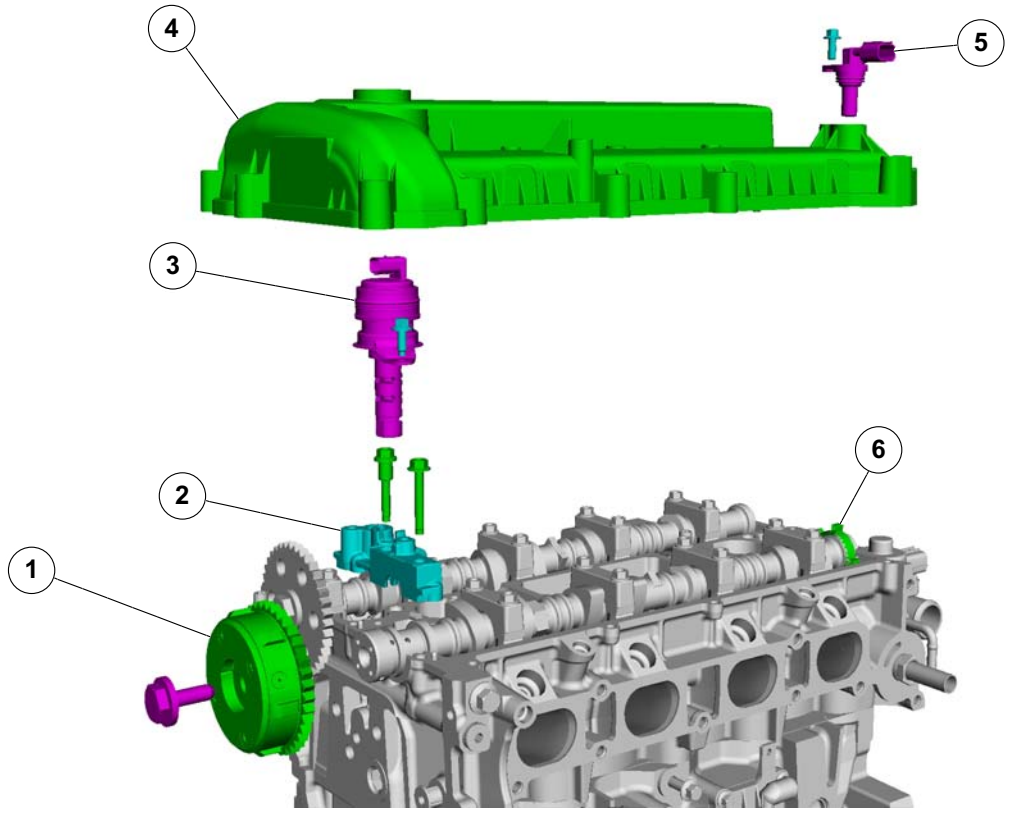


DESCRIPTION AND OPERATION

Item	Description
1	Engine code

Item	Description
2	Engine serial number

Variable camshaft timing (VCT)



Item	Description
1	Control unit - variable camshaft timing
2	Camshaft bearing cap
3	VCT oil control solenoid

Item	Description
4	Valve cover
5	Camshaft Position Sensor
6	Camshaft sensor ring

This system is an electronically controlled camshaft adjuster that allows variable timing for the inlet camshaft.

The valves are driven by a timing chain which drives the inlet camshaft timing control unit. This unit drives the associated camshafts. The timing chain is tensioned using a conventional timing chain tensioner.

The inlet camshaft is fitted with a sensor ring for the active camshaft position (CMP) sensor.

This CMP sensor is mounted inside the valve cover.

Timing chain replacement does not require the variable camshaft timing control unit to be disconnected.

To ensure trouble-free operation of the variable camshaft timing system and optimum engine performance, it is essential to adhere precisely to the valve timing adjustment procedure.

A special tool is needed to fix the camshafts in the adjustment position.

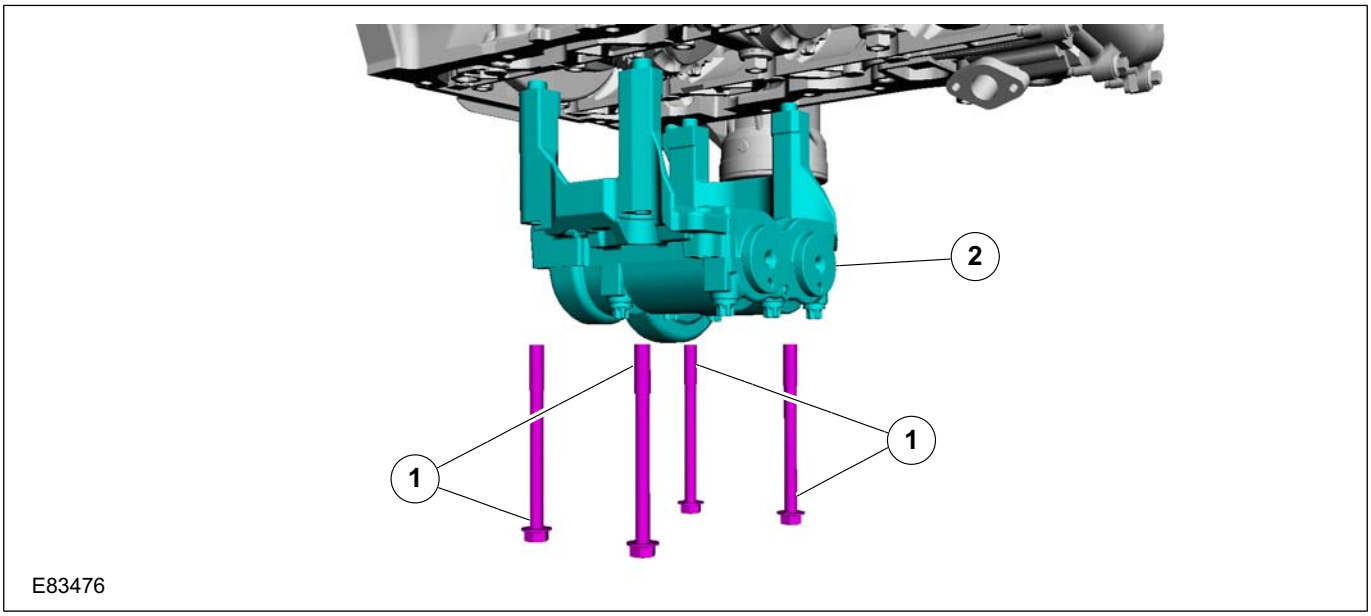
Remember that this special tool must not be used to keep the camshaft from rotating when mounting the camshaft sprocket. They may only be kept from rotating by using the hexagon, which has been specially provided for this purpose.

Advantages of variable camshaft timing (VCT).

- Lower fuel consumption due to improved volumetric efficiency

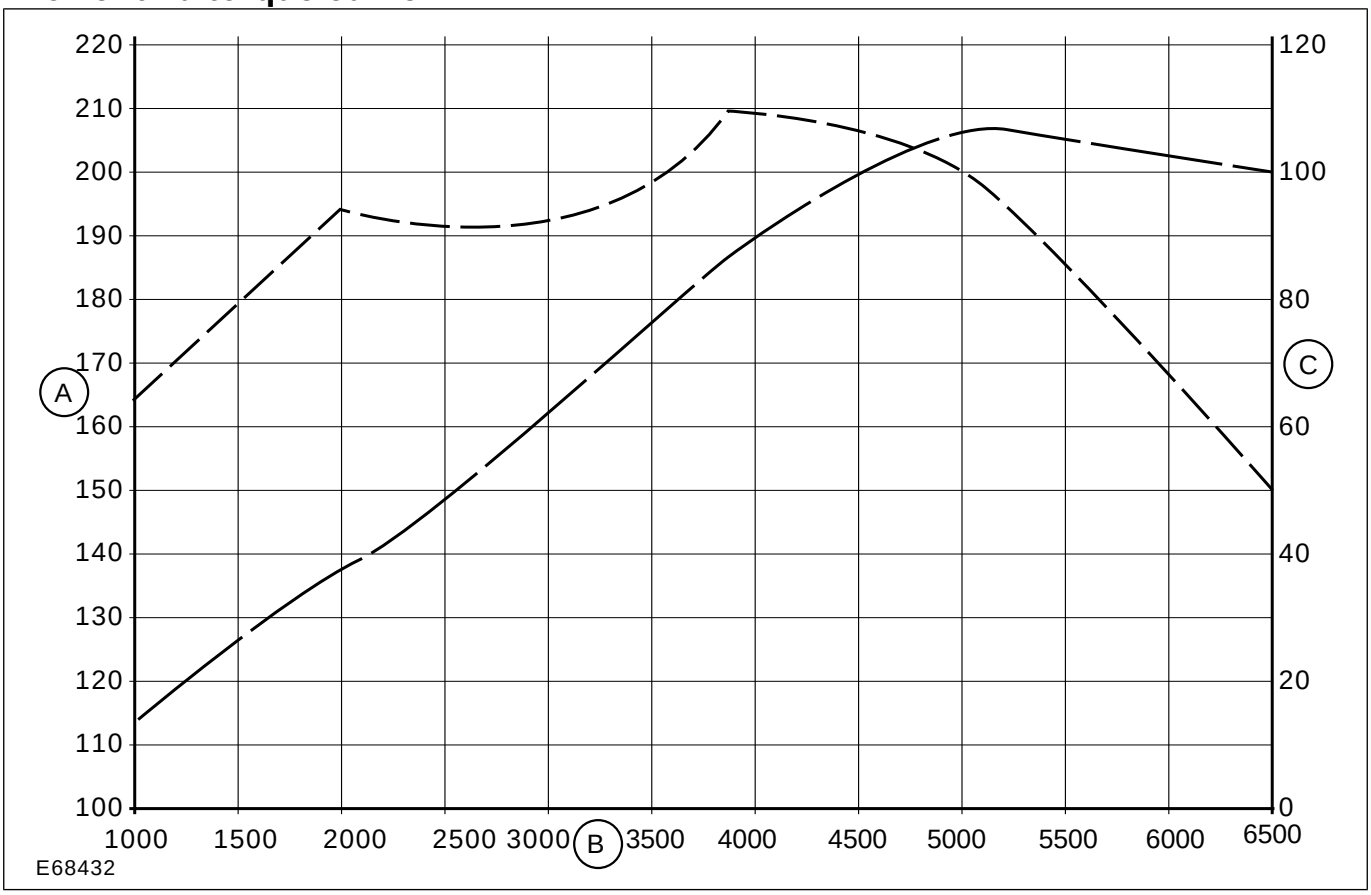
DESCRIPTION AND OPERATION

- Enhanced engine power and torque
- Improved idling characteristics



Item	Description
1	Bolts - Balancer shafts
2	Balancer shaft unit

Power and torque curve



DESCRIPTION AND OPERATION

Item	Description
A	Torque (Nm)
B	Engine speed (rpm)

Item	Description
C	Power output (kW)

Service note:

The valve clearance of the engine only needs to be monitored if the engine is converted to operation using alternative fuel (every 60,000 km).

Conversion of the engine to operation with alternative fuel requires no modification to the engine as the valve seats are reinforced as standard. All that is required is an adaptation of the fuel system.

Valves and valve seats

The engines for petrol operation and gas operation are basically identical. Because gas is a dry fuel and combusts at a higher temperature, the valve train is under higher stress. The adaptations described below are therefore necessary.

Because of the higher stress involved in gas operation:

- The inlet and exhaust valves are made of a harder material.
- The inlet and exhaust valve seats and the valve stems are made of a harder material.
- The valve clearances must be checked more frequently and corrected if necessary.

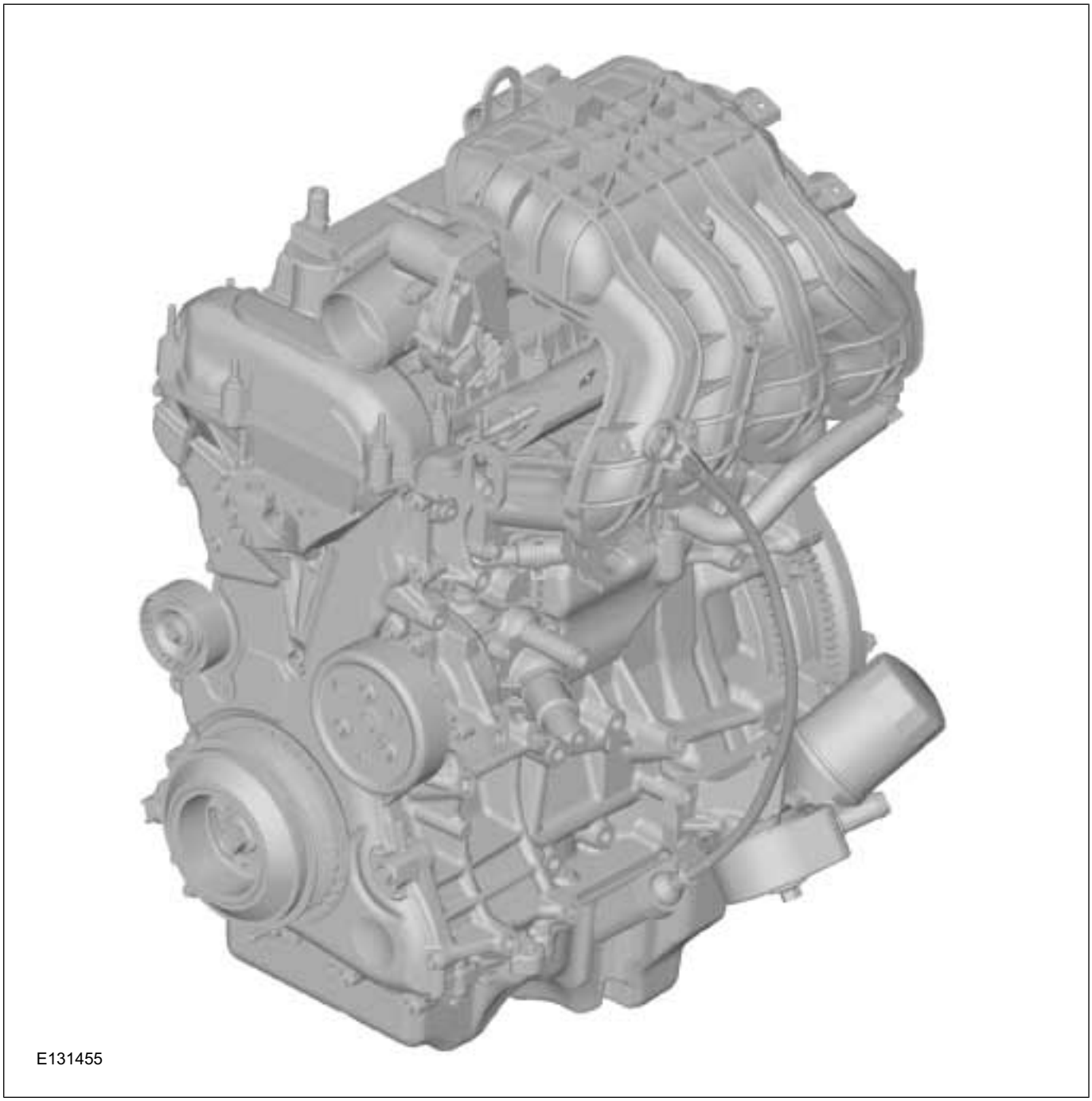
Lubrication System

The engine lubrication system operates as follows:

- Oil is drawn into the oil pump through the oil pump screen cover and tube in the sump of the oil pan.
- Oil is pumped through the oil filter on the right front side of the cylinder block.
- Oil enters the main gallery where it is distributed to the crankshaft main journals and to the cylinder head.
- From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is slung radially outward to cool and lubricate the cylinder walls as well as the entire connecting rod, piston and piston ring assembly.

DESCRIPTION AND OPERATION

Engine – Component Location



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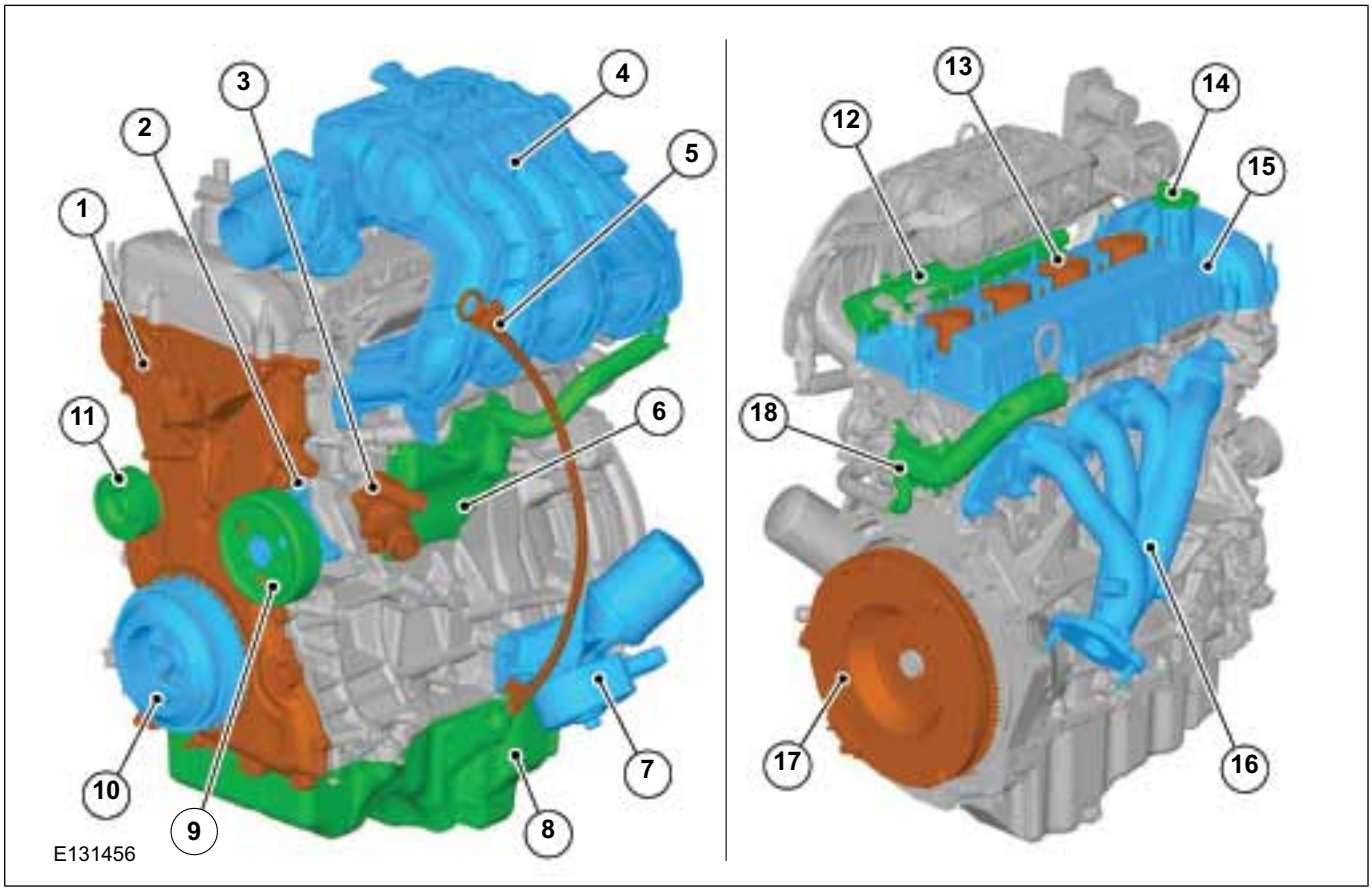
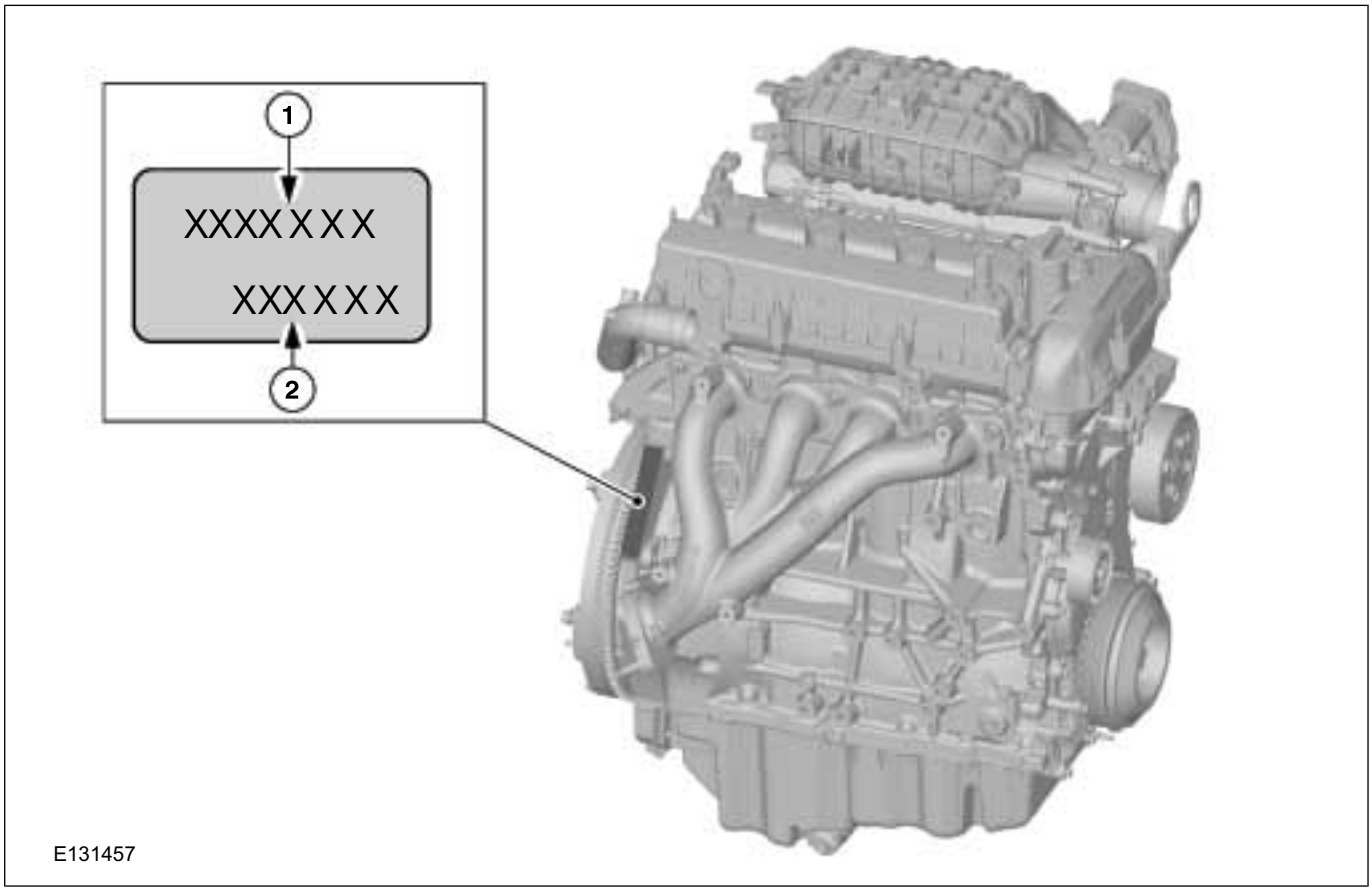
DESCRIPTION AND OPERATION



Item	Description
1	Engine front cover
2	Coolant pump
3	Thermostat
4	Intake manifold
5	Oil level indicator
6	Crankcase ventilation oil separator
7	Oil filter and cooler
8	Oil pan
9	Coolant pump pulley

Item	Description
10	Cranksahft pulley
11	Accessory drive belt idler pulley
12	Fuel rail
13	Ignition coils
14	Oil filler cap
15	Valve cover
16	Exhaust manifold
17	Flywheel
18	Water outlet connector

DESCRIPTION AND OPERATION

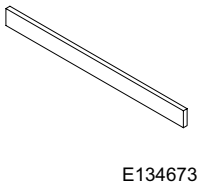
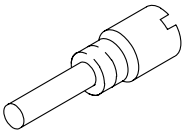


Item	Description
1	Engine code
2	Engine serial number

GENERAL PROCEDURES

Valve Clearance Adjustment

Special Tool(s) / General Equipment

 E134673	303-465 Tool, Camshaft Align Timing
 PZ21210	303-507 Timing Peg, Crankshaft TDC
2 mm Punch	

Materials	
Name	**Specification**
Hypoid Oil 85W-90	SQ-M2C9002-AA / A72SX-19K261-CA
Thread Locking MS	WSK-M2G349-A7 / 2U7J-M2G349-AA

1. Refer to: Accessory Drive Belt (303-05 Accessory Drive - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

2. Refer to: Valve Cover (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

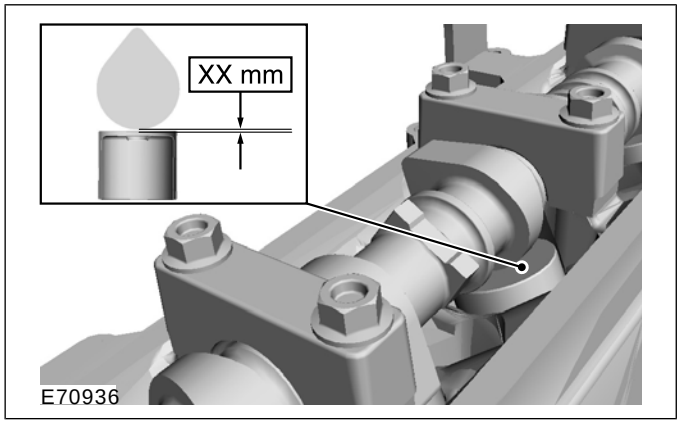
3. **CAUTION: Only rotate the crankshaft clockwise.**

   NOTE: Before removing the camshafts, measure the clearance of each valve at base circle, with the lobe pointed away from the tappet. Failure to measure all clearances prior to removing the camshafts will necessitate repeated removal and installation and wasted labor time.

   NOTE: If the valve clearance is less than 0.2mm, adjust the valves to the maximum clearance.

   Rotate the crankshaft until the cam pair of the cylinder to be adjusted are pointing upwards.

   Using a suitable feeler gauge, measure the valve clearance.



4. Make a note of each cylinder number with the corresponding valve clearance.

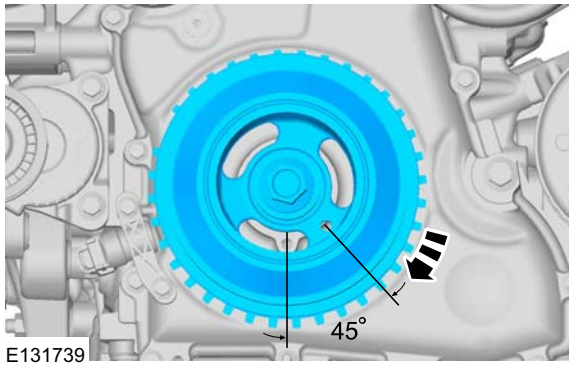
5. Compare the measured valve clearance(s) with the specifications.

   Refer to: Specifications (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Specifications).

6. **NOTE:** Only carry out the following steps when the valve clearance(s) require adjustment.

7. **WARNING: Only rotate the crankshaft clockwise.**

   Turn the crankshaft until no. 1 piston is at about 45° before TDC.



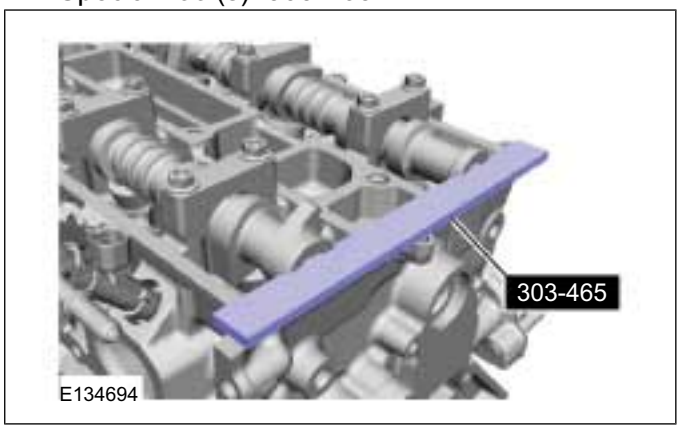
8. **CAUTION: The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   NOTE: The camshaft timing slots are offset. If the Camshaft Alignment Plate cannot be installed, rotate the crankshaft one complete

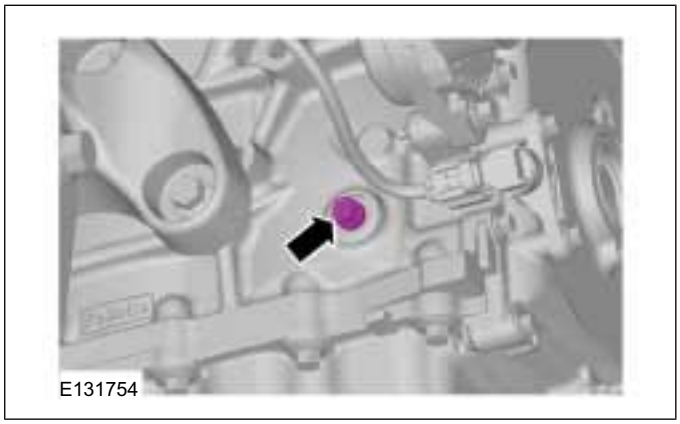
GENERAL PROCEDURES

revolution clockwise to correctly position the camshafts.

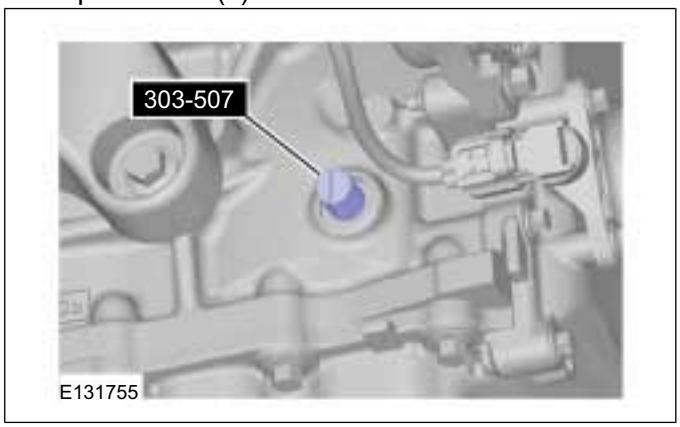
Special Tool(s): 303-465



9.

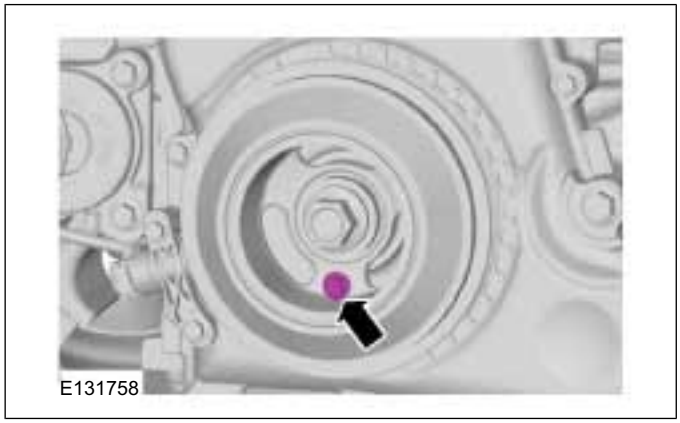


10. Special Tool(s): 303-507

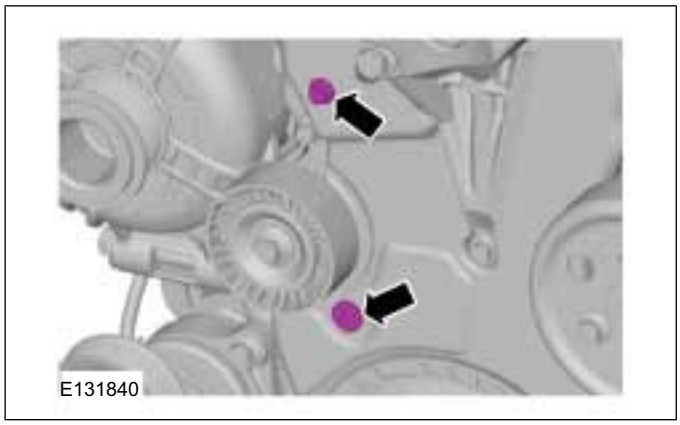


11. **NOTE:** Only tighten the bolt finger tight at this stage.

- Bolt M6 x 18 mm

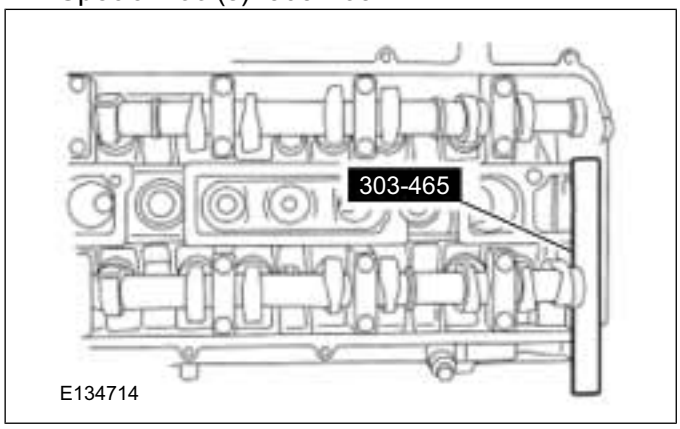


12.



13. Reposition the camshaft alignment plate to the slot on the rear of the intake camshaft only.

Special Tool(s): 303-465



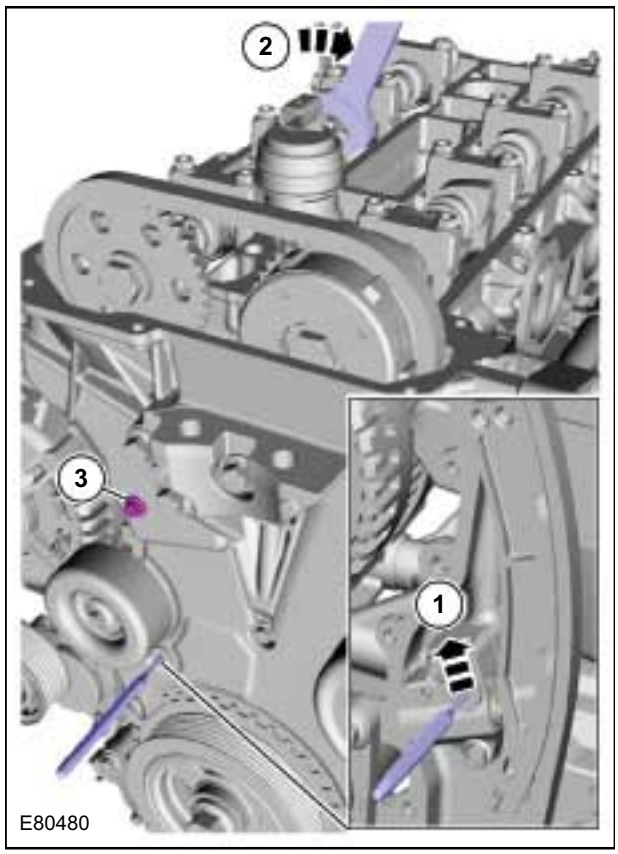
14. **CAUTION: Releasing the ratcheting mechanism in the timing chain tensioner allows the plunger to collapse and create slack in the timing chain. Installing an M6 x 30 mm bolt into the upper front cover timing hole will hold the tensioner arm in a retracted position**

GENERAL PROCEDURES

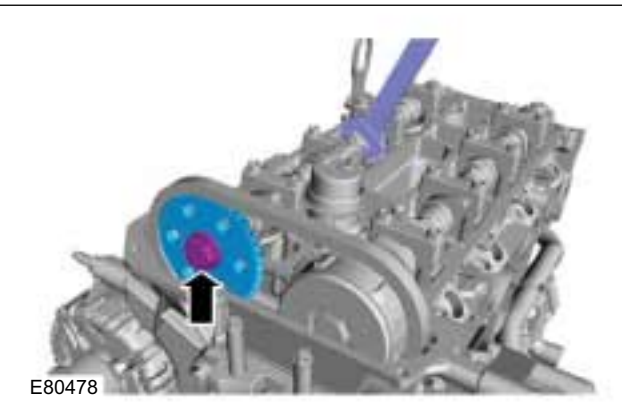
and allow enough slack in the timing chain for removal of the exhaust camshaft gear.

1. **NOTE:**

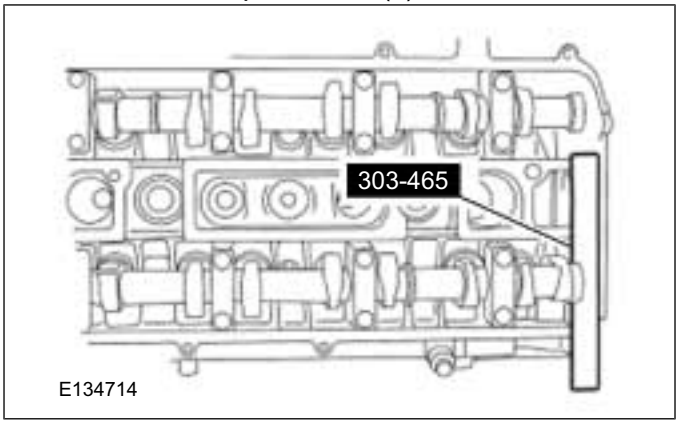
   General Equipment: 2 mm Punch
3. Bolt M6 x 25 mm



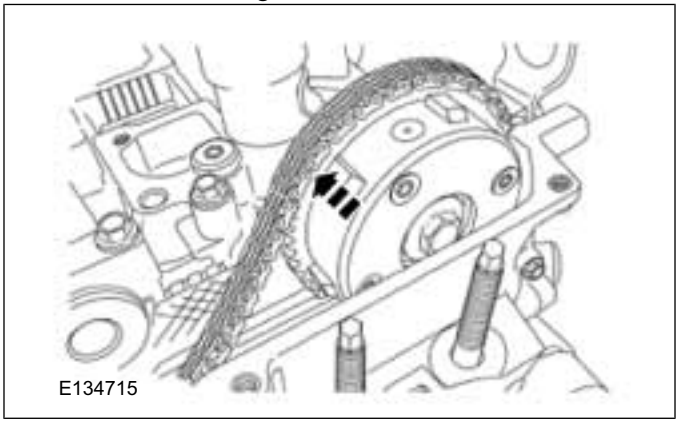
15. **CAUTION: Counterhold the camshaft at the hexagon with a wrench to prevent the camshaft from rotating.**



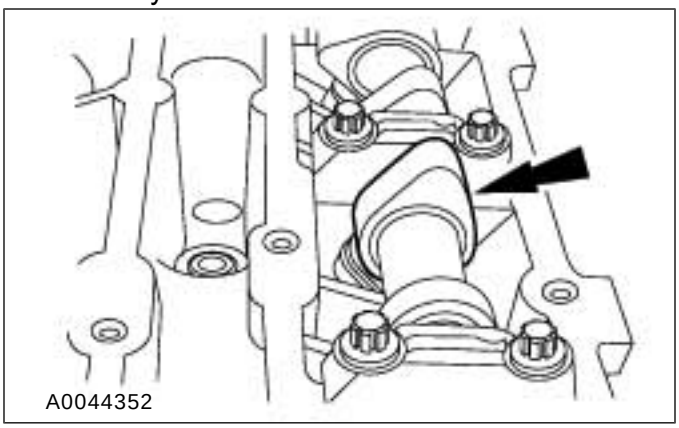
16. Remove the Special Tool(s): 303-465



17. Remove the timing chain from the intake camshaft drive gear.



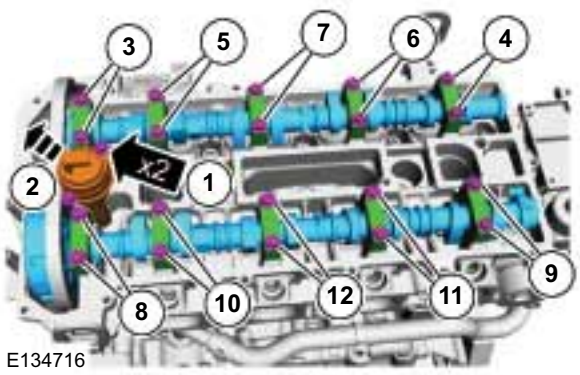
18. Mark the position of the camshaft lobes on the No. 1 cylinder for installation reference.



19. **CAUTION: Failure to follow the camshaft loosening procedure can result in damage to the camshafts.**

GENERAL PROCEDURES

NOTE: Mark the location and orientation of each camshaft bearing cap.



E134716

20. • Remove the valve tappet and read the thickness from the underside.

21. **NOTE:** The number on the valve tappet only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

NOTE: The nominal clearance is: intake: 0.25 mm (0.0095 in). exhaust: 0.30 mm (0.0115 in).

NOTE: The acceptable clearances after being fully installed are: intake: 0.22-0.28 mm (0.008-0.011 in). exhaust: 0.27-0.33 mm (0.010-0.013 in).

- Calculate the required thickness of the valve tappet with the following formula: **X = S + M - V**
- Required thickness of tappet = **X**
- Thickness of currently fitted tappet = **S**
- Measurement of existing valve clearance (actual value) = **M**
- Desired valve clearance = **V**

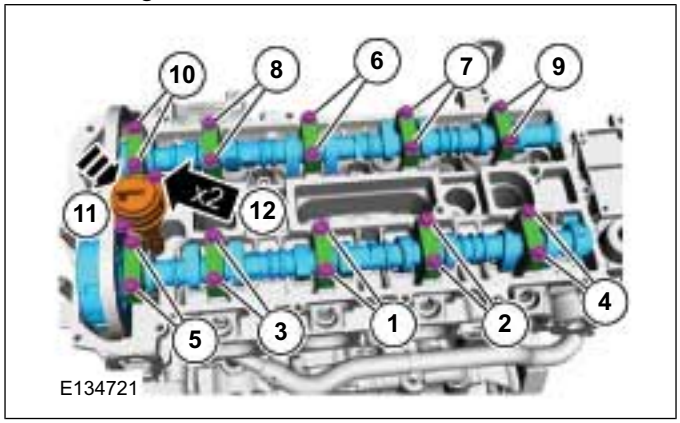
22. Install the correct valve tappet.

23. ⚠ **CAUTION: Make sure that the camshafts and camshaft bearing caps are installed in their original locations.**

NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil.

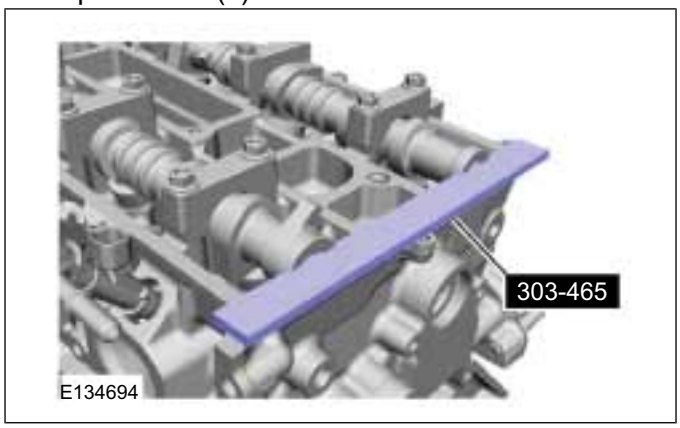
Coat the camshaft bearing caps with oil and install the camshafts approximately at valve overlap position cylinder No. 4.

Material: Hypoid Oil 85W-90 (SQ-M2C9002-AA / A72SX-19K261-CA) transmission fluid
Torque:
- Stage 1: 7 Nm
- Stage 2: 16 Nm



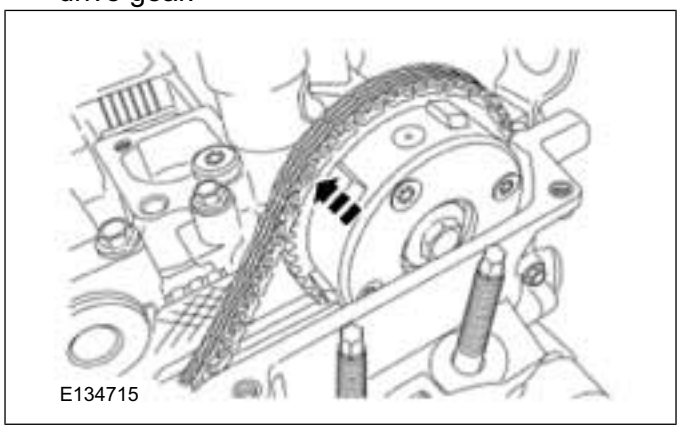
E134721

24. Special Tool(s): 303-465



E134694

25. Install the timing chain on the intake camshaft drive gear.

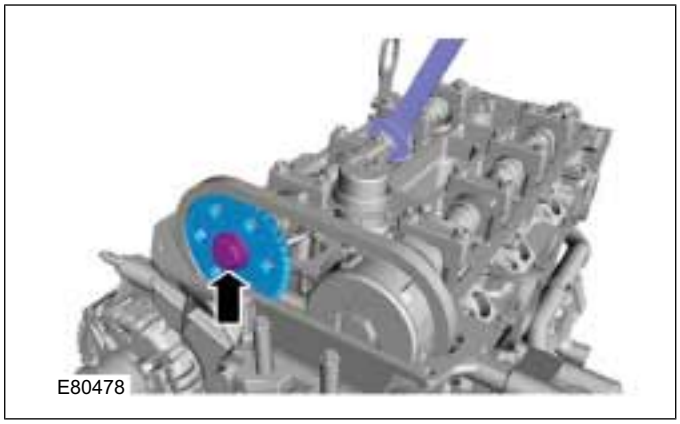

E134715

26. **NOTE:** Only tighten the bolt finger tight at this stage.

GENERAL PROCEDURES

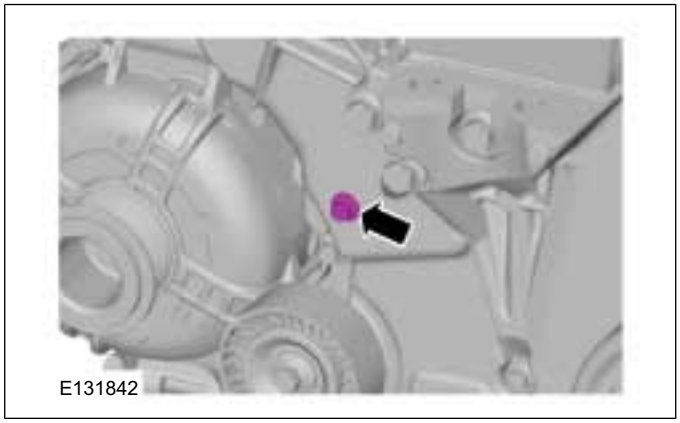
NOTE: Make sure that the camshaft sprockets can rotate on the camshafts.

NOTE: The timing chain must be correctly engaged on the teeth of the crankshaft timing sprocket and the intake camshaft drive gear in order to install the exhaust camshaft drive gear onto the exhaust camshaft.



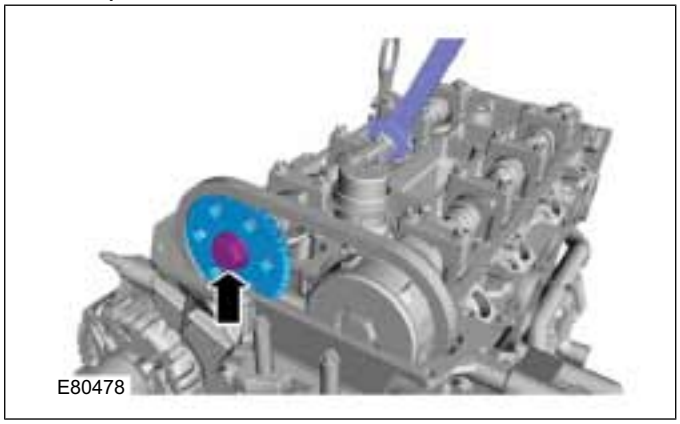
27. **NOTE:** Releasing the tensioner arm will remove the slack from the timing chain.

Remove the bolt M6 x 30mm.

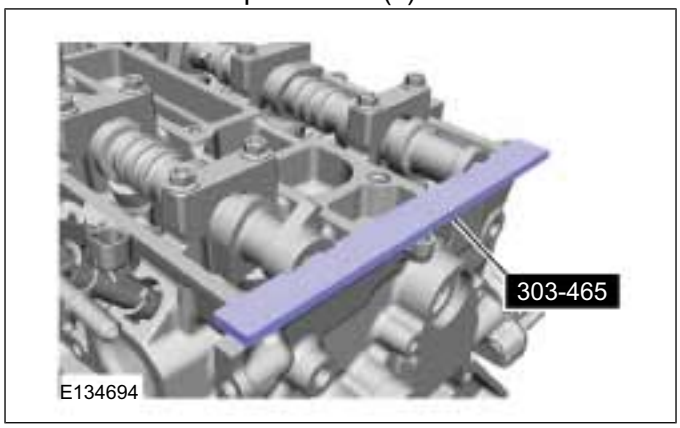


28. ⚠ **CAUTION: Counterhold the camshaft at the hexagon with a wrench to prevent the camshaft from rotating.**

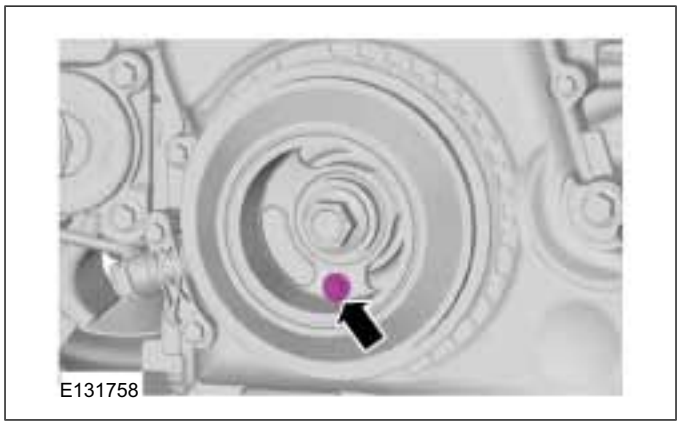
Torque: 72 Nm



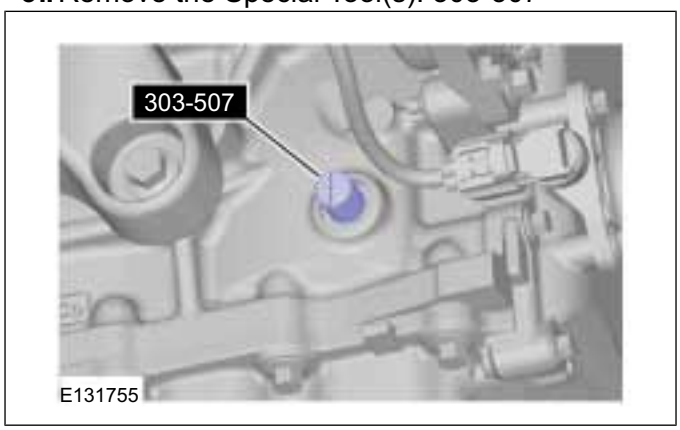
29. Remove the Special Tool(s): 303-465



30. Remove the bolt M6 x 18 mm.

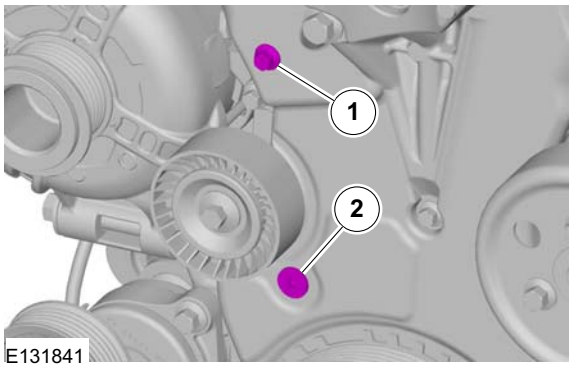


31. Remove the Special Tool(s): 303-507

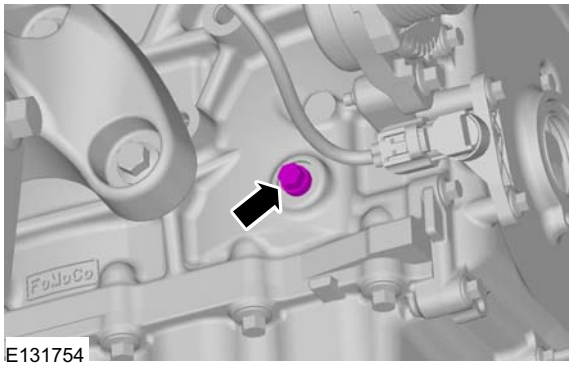


GENERAL PROCEDURES

32. • Material: Thread Locking MS (WSK-M2G349-A7 / 2U7J-M2G349-AA) adhesive
    1. Torque: 10 Nm
    2. Torque: 12 Nm



33. Torque: 20 Nm



34. **CAUTION: Only rotate the crankshaft clockwise.**

    Check that the valve clearance on all cylinders meets the specified tolerances.

35. If necessary, repeat the steps until the valve clearance on each cylinder meets the specified tolerance.

36. Refer to: Valve Cover (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

37. Refer to: Accessory Drive Belt (303-05 Accessory Drive - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

GENERAL PROCEDURES

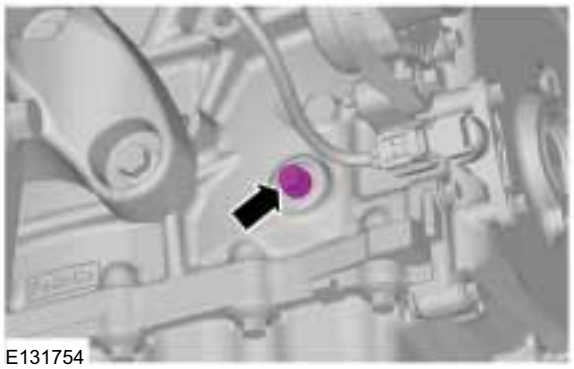
Balance Shaft Backlash

Special Tool(s)

 E139373	100-002 Holding Fixture with Dial Indicator Gauge
 PZ21210	303-507 Timing Peg, Crankshaft TDC

Adjustment

38. Remove the timing peg bolt.

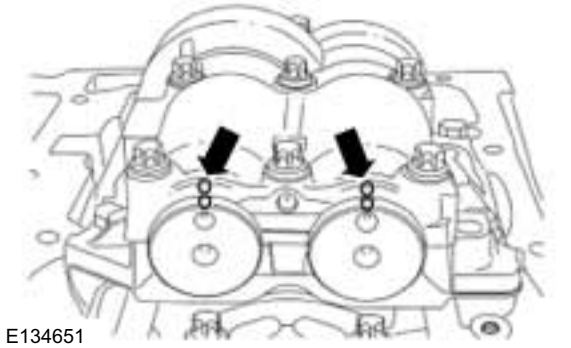

E131754

39. Install the crankshaft TDC timing peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the crankshaft TDC timing peg. The engine is now at TDC.

Special Tool(s): 303-507

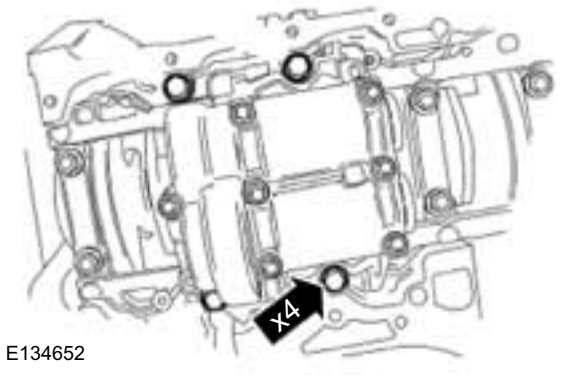
E131755

40. Mark the balancer unit and shafts on the top for reference that the balancer unit is at TDC.


E134651

41. **NOTE:** Due to the precision interior construction of the balancer unit, it should not be disassembled.

Remove the 4 bolts and the balancer unit.



E134652

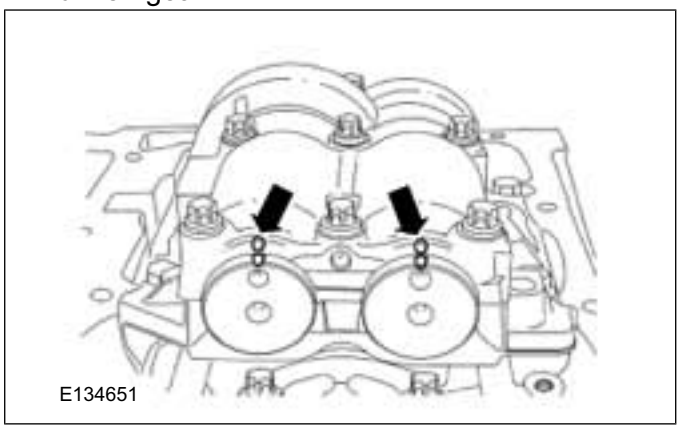
42. Remove the adjustment shims from the seat faces of the balancer unit.

GENERAL PROCEDURES

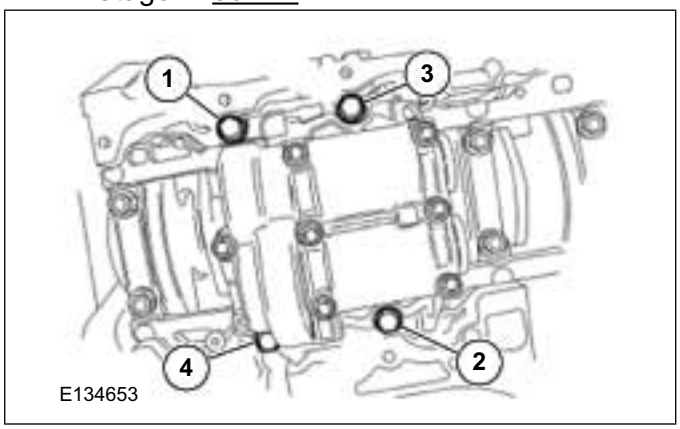
43. **NOTE:** Visually inspect the balancer unit gear for damage and verify that the shaft turns smoothly. If there is any damage or malfunction, replace the balancer unit.

    Install the master adjustment shims (No. 50) on the seat faces of the balancer unit.

44. With the balancer unit shaft marks at the TDC position, slowly install the balancer unit to the cylinder block to avoid interference between the crankshaft drive gear and the balancer unit driven gear.


E134651

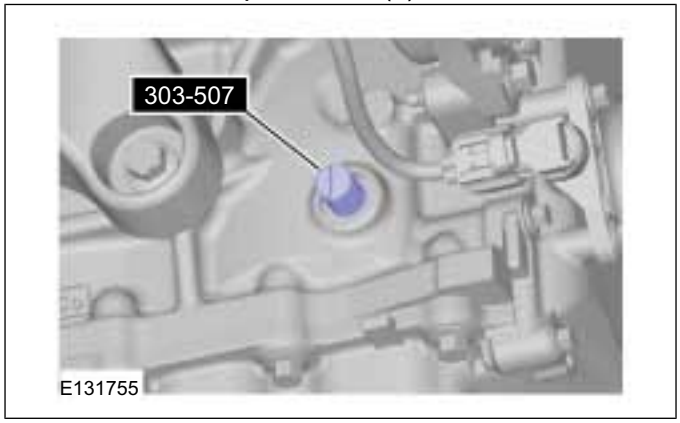
45. Install the balancer unit bolts.
    Torque:
    - Stage 1: 25 Nm
    - Stage 2: 50 Nm



E134653

46. Rotate the crankshaft to confirm that there are no meshing problems between the balancer unit gear and the crankshaft gear.

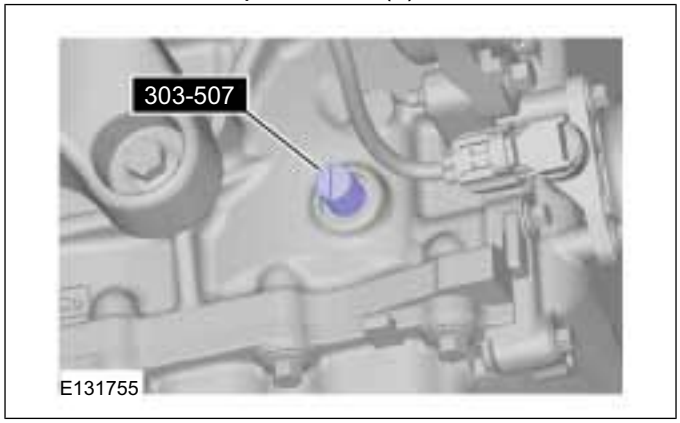
    Remove the Special Tool(s): 303-507



E131755

47. Install the crankshaft TDC timing peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the crankshaft TDC timing peg.

    Remove the Special Tool(s): 303-507



E131755

48. **NOTE:** Measure the backlash and verify that it is within specified range at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees. It will be necessary to reset the measuring equipment between measurements.

    NOTE: The measurement must be taken with the Dial Indicator Gauge with Holding Fixture, a 5-mm Allen wrench and worm clamp set up as shown. Mark the Allen wrench with a file 80 mm (3.149 in) above the driven gear shaft center. Make sure the worm clamp and Allen wrench are not touching the balance shaft housing.

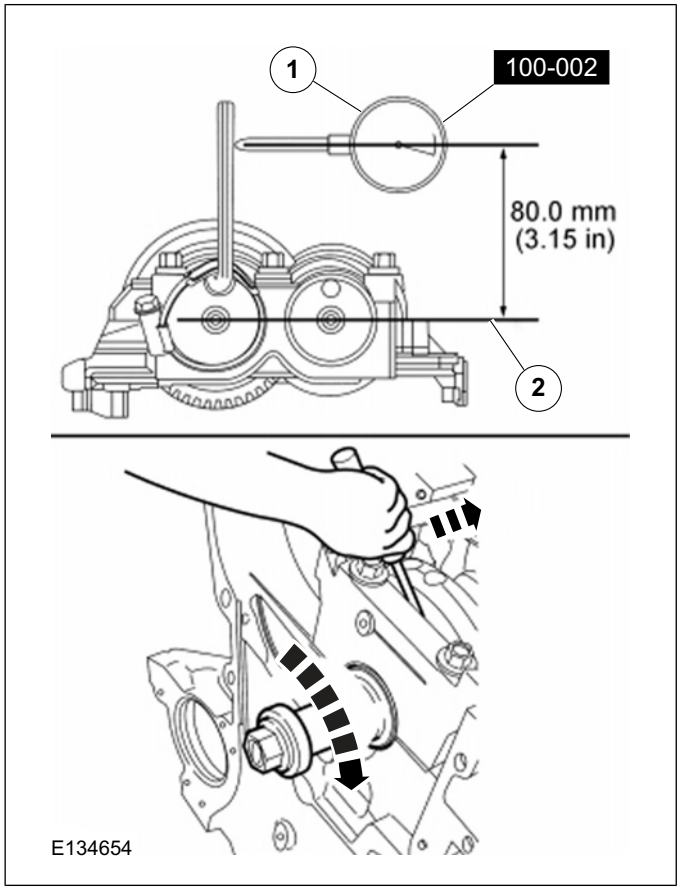
    NOTE: For an accurate measurement while measuring the gear backlash, insert a screwdriver as shown into the crankshaft No. 1 crankweight area and set both the rotation and

GENERAL PROCEDURES

the thrust direction with the screwdriver, using a prying action as shown.

- Position the dial indicator gauge with holding fixture (1) on the Allen wrench 80 mm (3.149 in) above the driven gear shaft center (2) on the balancer unit.

  Special Tool(s): 100-002
- Rotate the crankshaft clockwise and measure the backlash at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees.



49. **NOTE:** If maximum backlash exceeds 0.101 mm (0.003 in), install a new balancer unit.
    - Remove the balancer unit from the cylinder block.
    - Install the selected adjustment shims on the seat faces of the balancer unit.

GENERAL PROCEDURES

ADJUSTMENT SHIM SELECTION TABLE

Backlash mm (in)	Selection shim (No.)	Shim thicness mm (in)
0.516-0.528 (0.0203-0.0207)	15	1.15 (0.0452)
0.502-0.514 (0.0197-0.0202)	16	1.16 (0.0456)
0.489-0.500 (0.0192-0.0196)	17	1.17 (0.0460)
0.475-0.487 (0.0187-0.0191)	18	1.18 (0.0464)
0.462-0.473 (0.0181-0.0186)	19	1.19 (0.0468)
0.448-0.460 (0.0176-0.0181)	20	1.20 (0.0472)
0.435-0.446 (0.0171-0.0175)	21	1.21 (0.0476)
0.421-0.433 (0.0165-0.0170)	22	1.22 (0.0480)
0.408-0.419 (0.0160-0.0164)	23	1.23 (0.0484)
0.394-0.406 (0.0155-0.0159)	24	1.24 (0.0488)
0.381-0.392 (0.0150-0.0154)	25	1.25 (0.492)
0.367-0.379 (0.0144-0.0149)	26	1.26 (0.0496)
0.354-0.365 (0.0139-0.0143)	27	1.27 (0.0499)
0.340-0.352 (0.0133-0.0138)	28	1.28 (0.0503)
0.327-0.338 (0.0128-0.0133)	29	1.29 (0.0507)
0.313-0.325 (0.0123-0.0127)	30	1.30 (0.0511)
0.300-0.311 (0.0118-0.0122)	31	1.31 (0.0515)
0.286-0.298 (0.0112-0.0117)	32	1.32 (0.0519)
0.272-0.284 (0.0107-0.0111)	33	1.33 (0.0523)
0.259-0.271 (0.0101-0.0106)	34	1.34 (0.0527)
0.245-0.257 (0.0096-0.0101)	35	1.35 (0.0531)
0.232-.0243 (0.0091-0.0095)	36	1.36 (0.535)
0.218-0.230 (0.0085-0.0090)	37	1.37 (0.539)
0.205-.0216 (0.0080-0.0085)	38	1.38 (0.0543)
0.191-0.203 (0.0075-0.0079)	39	1.39 (0.0547)
0.178-0.189 (0.0070-0.0074)	40	1.40 (0.0551)
0.164-0.176 (0.0064-0.0069)	41	1.41 (0.0555)
0.151-0.162 (0.0059-0.0063)	42	1.42 (0.0559)
0.137-0.149 (0.0053-0.0058)	43	1.43 (0.0562)
0.124-0.135 (0.0048-0.0053)	44	1.44 (0.0566)
0.110-0.122 (0.0043-0.0048)	45	1.45 (0.0570)
0.097-0.108 (0.0038-0.0042)	46	1.46 (0.0574)
0.083-0.095 (0.0032-0.0037)	47	1.47 (0.0578)
0.070-0.081 (0.0027-0.0031)	48	1.48 (0.0582)
0.056-0.068 (0.0022-0.0026)	49	1.49 (0.0586)
0.043-0.054 (0.0016-0.0021)	50 (master)	1.50 (0.0590)
0.029-0.041 (0.0011-0.0016)	51	1.51 (0.0594)
0.015-0.027 (0.0005-0.0010)	52	1.52 (0.0598)
0.002-0.014 (0.00007-0.0005)	53	1.53 (0.0602)
0.000-0.000 (0.0000-0.0000)	54	1.54 (0.0606)

E134655

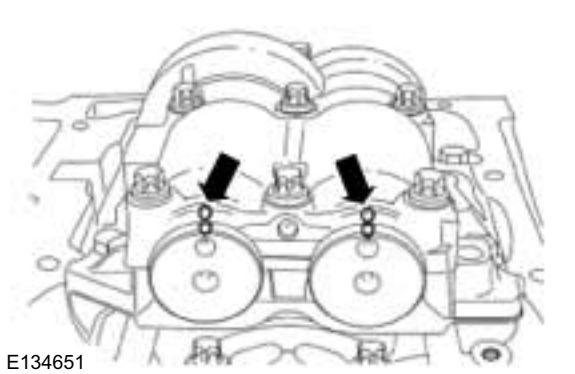
50. Install the crankshaft TDC timing peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the

GENERAL PROCEDURES

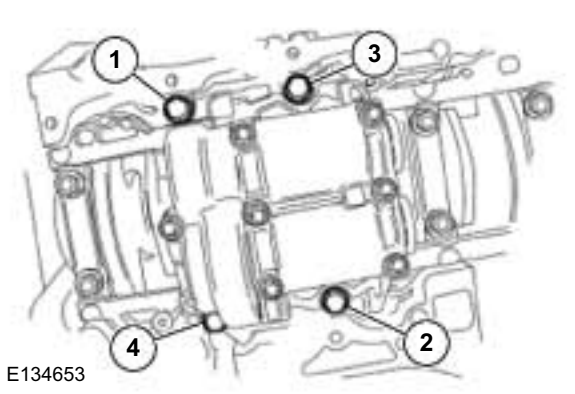
crankshaft TDC timing peg. The engine is now at TDC.

Special Tool(s): 303-507

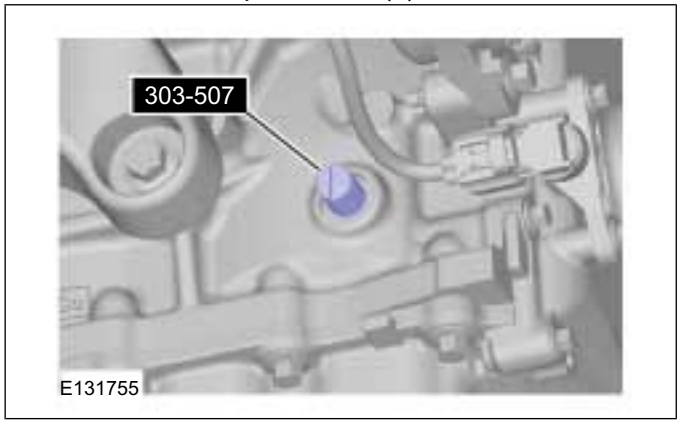
51. With the balancer unit shaft marks in the TDC position, slowly install the balancer unit to the cylinder block to avoid interference between the crankshaft drive gear and the balancer unit driven gear.



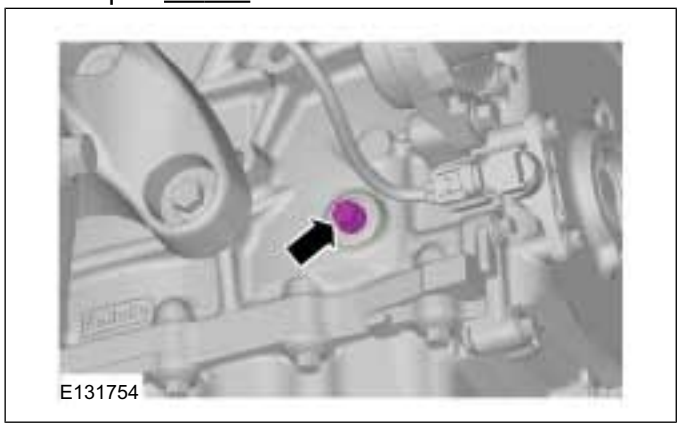
52. Install the balancer unit bolts.
Torque:
- Stage 1: 25 Nm
- Stage 2: 50 Nm



53. Remove the Special Tool(s): 303-507



54. Install the timing peg bolt.
Torque: 20 Nm



55. **NOTE:** Remeasure the backlash and verify that it is within specified range at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees. It will be necessary to reset the measuring equipment between measurements.

NOTE: The measurement must be taken with the dial indicator gauge with holding fixture, a 5-mm allen wrench and worm clamp set up as shown. Mark the Allen wrench with a file 80 mm (3.149 in) above the driven gear shaft center. Make sure the worm clamp and allen wrench are not touching the balance shaft housing.

NOTE: For an accurate measurement while measuring the gear backlash, insert a screwdriver as shown into the crankshaft No. 1 crankweight area and set both the rotation and the thrust direction with the screwdriver, using a prying action as shown.

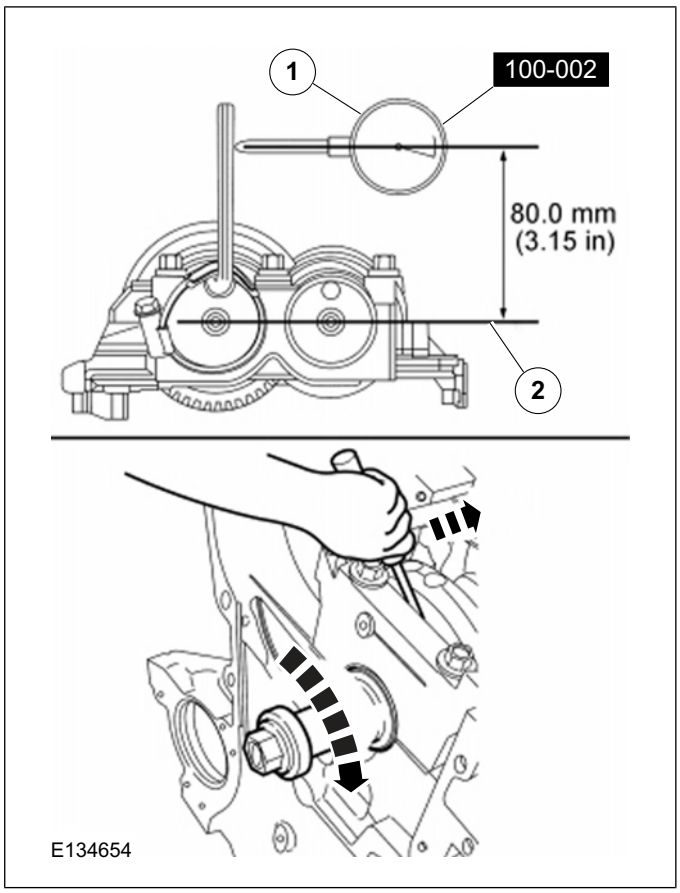
- Position the dial indicator gauge with holding fixture (1) on the allen wrench 80 mm (3.149

GENERAL PROCEDURES

in) above the driven gear shaft center (2) on the balancer unit.

Special Tool(s): 100-002

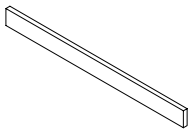
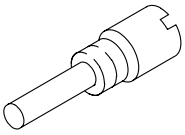
- Rotate the crankshaft clockwise and measure the backlash at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees.
- If the backlash exceeds the specified range of 0.005 to 0.101 mm (0.00019 to 0.0039 in), install a new balancer unit and repeat the procedure.



REMOVAL AND INSTALLATION

Camshafts(21 284 0)

Special Tool(s) / General Equipment

 E134673	303-465 Tool, Camshaft Align Timing
 PZ21210	303-507 Timing Peg, Crankshaft TDC
2 mm Punch	

Materials	
Name	**Specification**
Hypoid Oil 85W-90	SQ-M2C9002-AA / A72SX-19K261-CA
Thread Locking MS	WSK-M2G349-A7 / 2U7J-M2G349-AA

Removal

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

1. Refer to: Accessory Drive Belt (303-05 Accessory Drive - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

2. **CAUTIONS:**

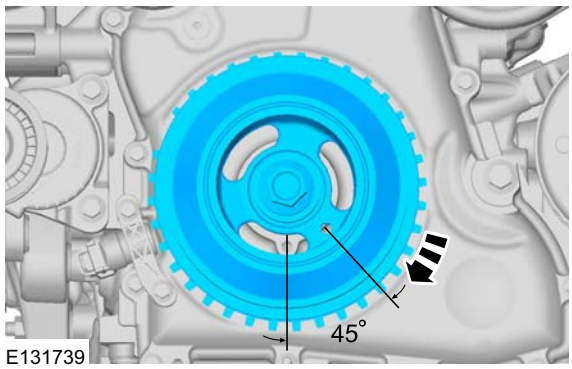
   During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan can cause engine failure.

   Do not rotate the camshafts unless instructed to in this procedure. Rotating the camshafts or crankshaft with timing components loosened or removed can cause serious damage to the valves and pistons.

   Refer to: Valve Cover (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

3. **WARNING: Only rotate the crankshaft clockwise.**

   Turn the crankshaft until no. 1 piston is at about 45° before TDC.

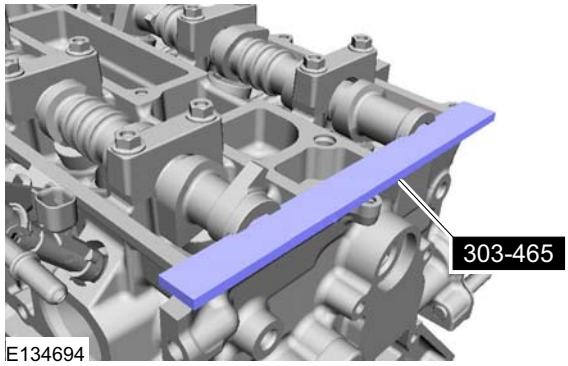


E131739

4. **CAUTION: The camshaft alignment plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   NOTE: The camshaft timing slots are offset. If the camshaft alignment plate cannot be installed, rotate the crankshaft one complete revolution clockwise to correctly position the camshafts.

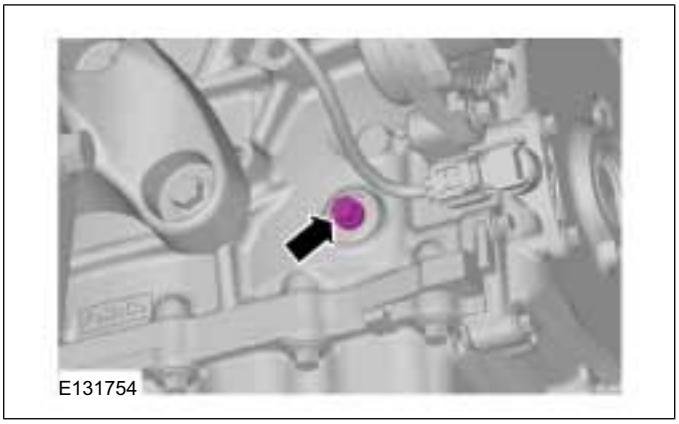
   Special Tool(s): 303-465



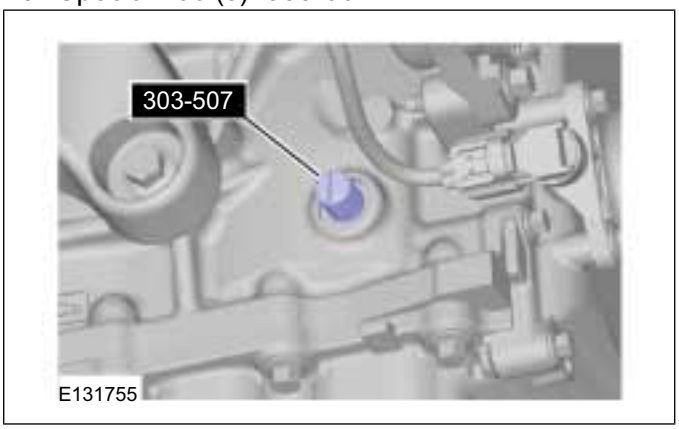
E134694

REMOVAL AND INSTALLATION

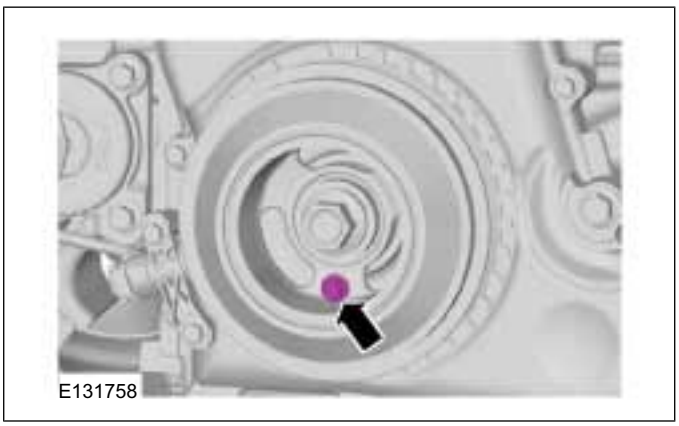
5.



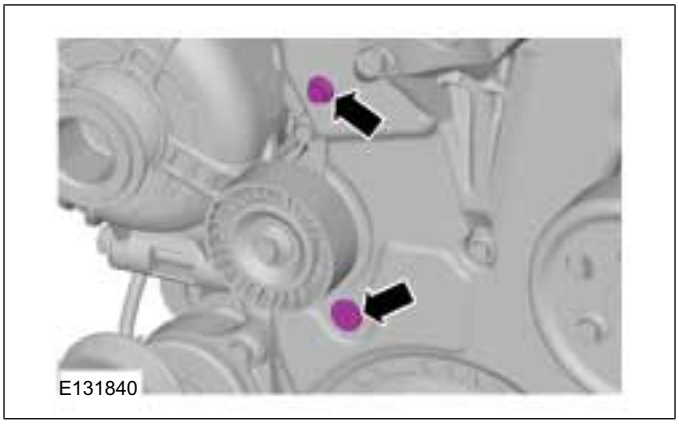
6. Special Tool(s): 303-507



7. **NOTE:** Only tighten the bolt finger tight at this stage.
   - Bolt M6 x 18 mm

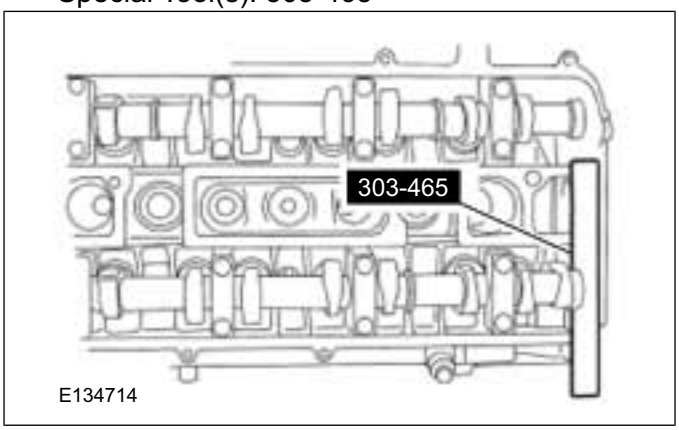


8.



9. Reposition the camshaft alignment plate to the slot on the rear of the intake camshaft only.

   Special Tool(s): 303-465

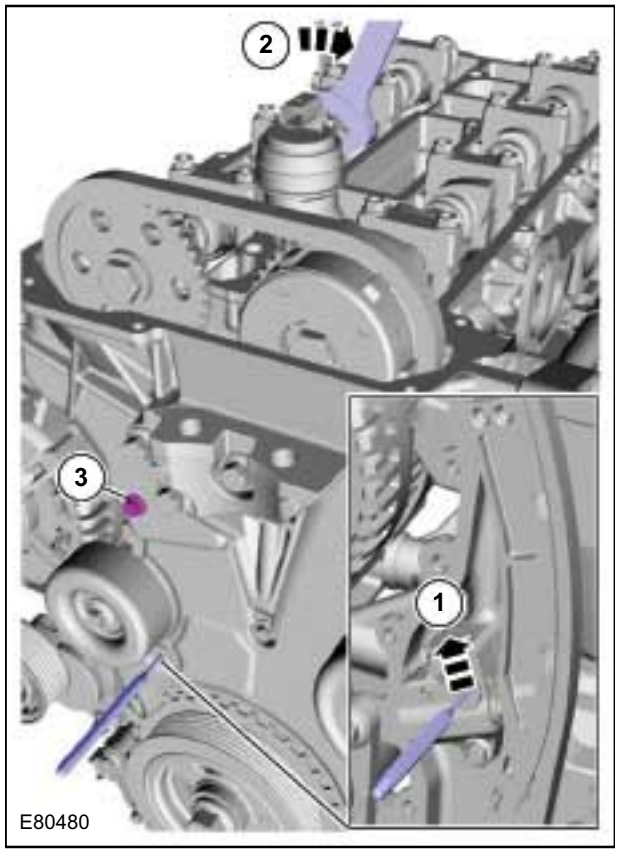


10. **CAUTION: Releasing the ratcheting mechanism in the timing chain tensioner allows the plunger to collapse and create slack in the timing chain. Installing an M6 x 30 mm bolt into the upper front cover timing hole will hold the tensioner arm in a retracted position and allow enough slack in the timing**

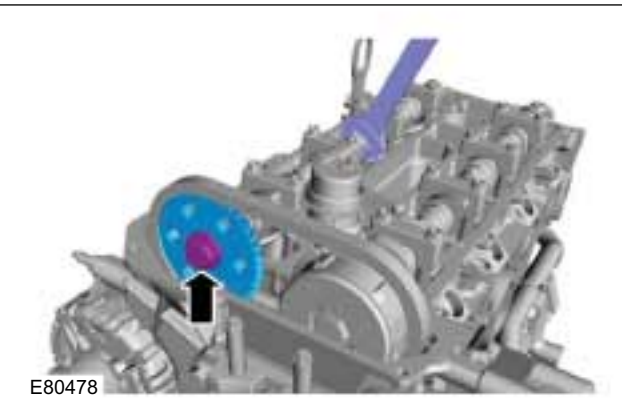
REMOVAL AND INSTALLATION

chain for removal of the exhaust camshaft gear.

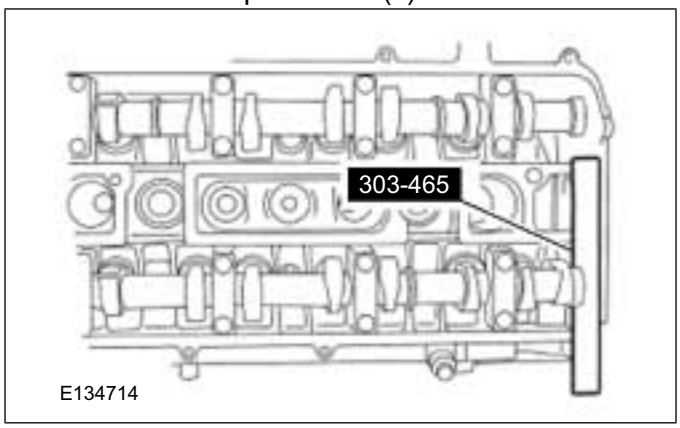
1. General Equipment: 2 mm Punch
3. Bolt M6 x 25 mm



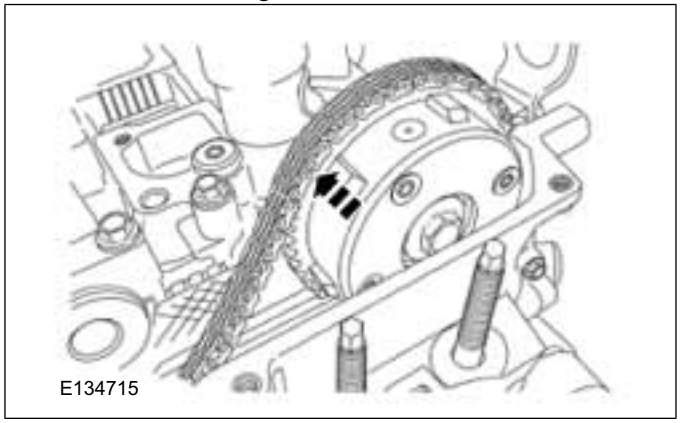
11. ⚠ **CAUTION: Counterhold the camshaft at the hexagon with a wrench to prevent the camshaft from rotating.**



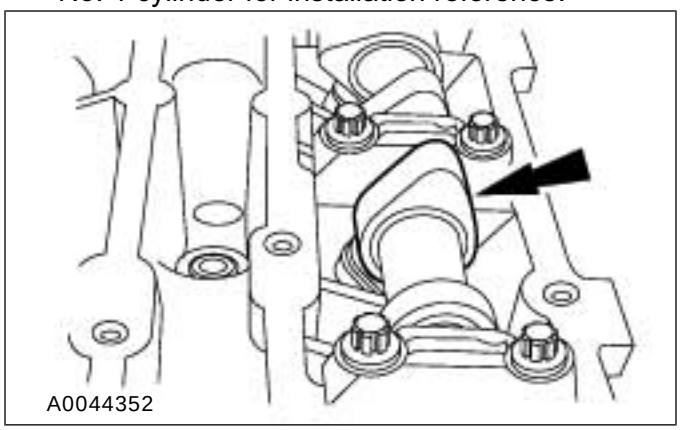
12. Remove the Special Tool(s): 303-465



13. Remove the timing chain from the intake camshaft drive gear.



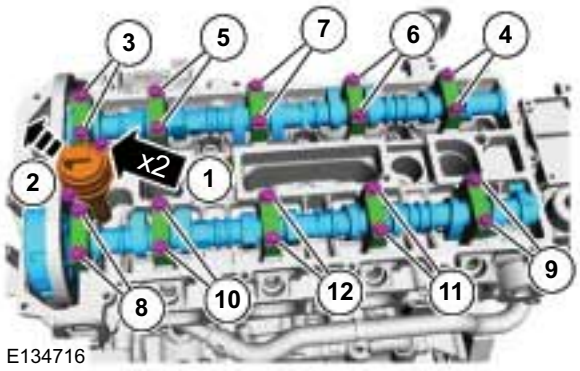
14. Mark the position of the camshaft lobes on the No. 1 cylinder for installation reference.



15. ⚠ **CAUTION: Failure to follow the camshaft loosening procedure can result in damage to the camshafts.**

REMOVAL AND INSTALLATION

NOTE: Mark the location and orientation of each camshaft bearing cap.



E134716

Installation

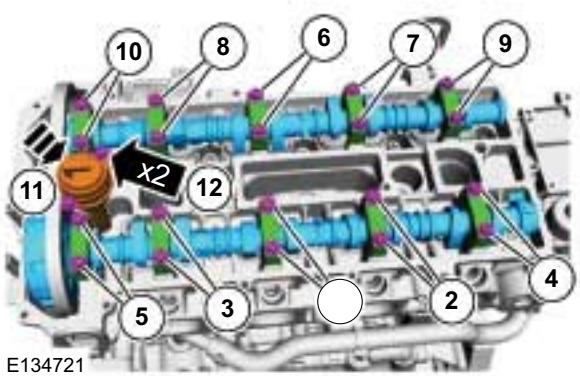
1. ⚠ **CAUTION: Make sure that the camshafts and camshaft bearing caps are installed in their original locations.**

   NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil.

   Coat the camshaft bearing caps with oil and install the camshafts approximately at valve overlap position cylinder No. 4.

   Material: Hypoid Oil 85W-90 (SQ-M2C9002-AA / A72SX-19K261-CA) transmission fluid

   Torque:
   - Stage 1: 7 Nm
   - Stage 2: 16 Nm



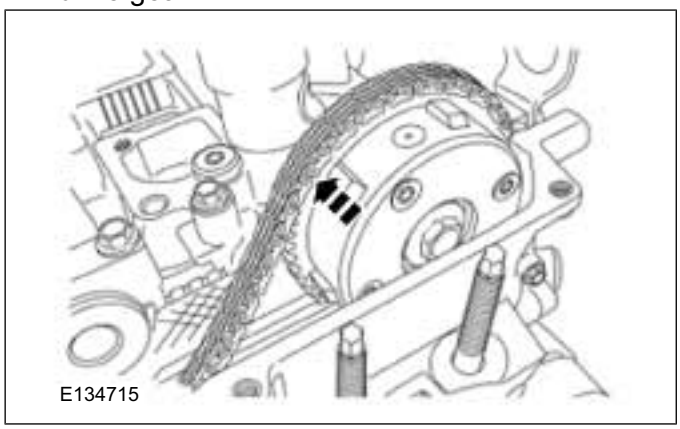
E134721

2. **NOTE:** This step is only necessary when installing a new component.

   Adjust the valve clearance.

   Refer to: Valve Clearance Adjustment (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, General Procedures).

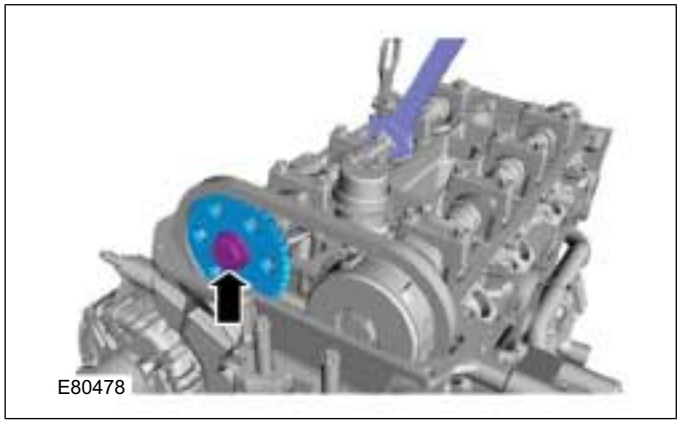
3. Install the timing chain on the intake camshaft drive gear.


E134715

4. **NOTE:** Only tighten the bolt finger tight at this stage.

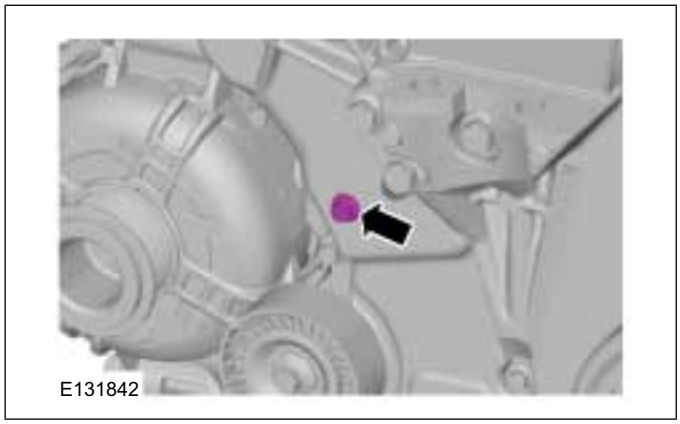
   NOTE: Make sure that the camshaft sprockets can rotate on the camshafts.

   NOTE: The timing chain must be correctly engaged on the teeth of the crankshaft timing sprocket and the intake camshaft drive gear in order to install the exhaust camshaft drive gear onto the exhaust camshaft.


E80478

5. **NOTE:** Releasing the tensioner arm will remove the slack from the timing chain.

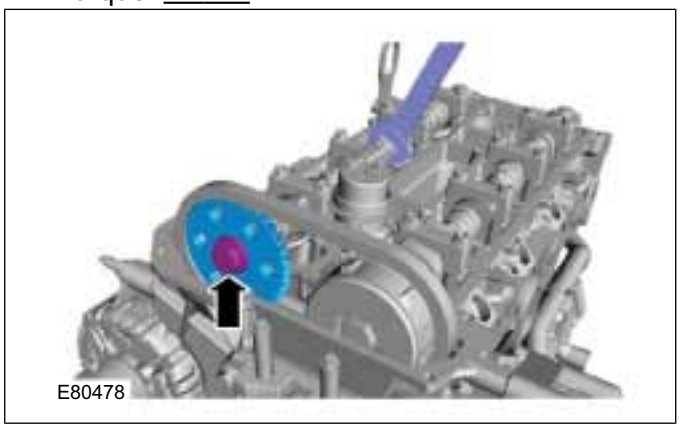
   Remove the bolt M6 x 30mm.


E131842

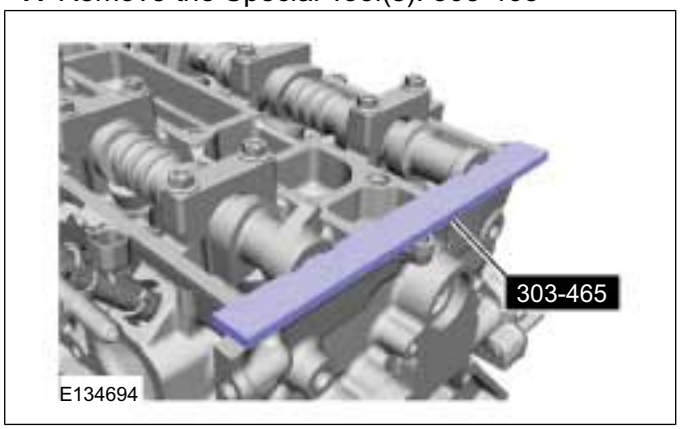
REMOVAL AND INSTALLATION

6. ⚠ **CAUTION: Counterhold the camshaft at the hexagon with a wrench to prevent the camshaft from rotating.**

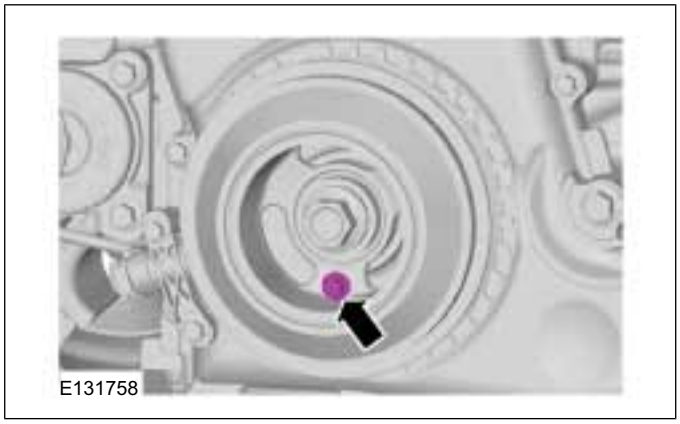
   Torque: 72 Nm



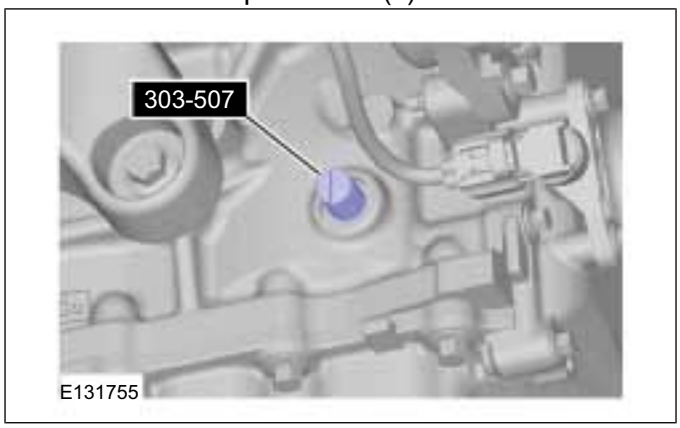
7. Remove the Special Tool(s): 303-465



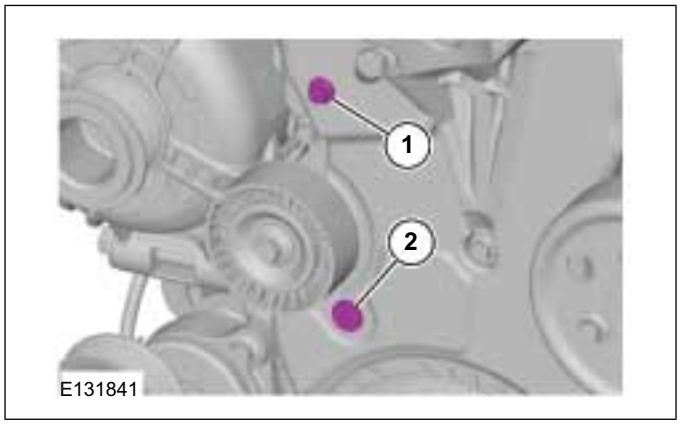
8. Remove the bolt M6 x 18 mm.



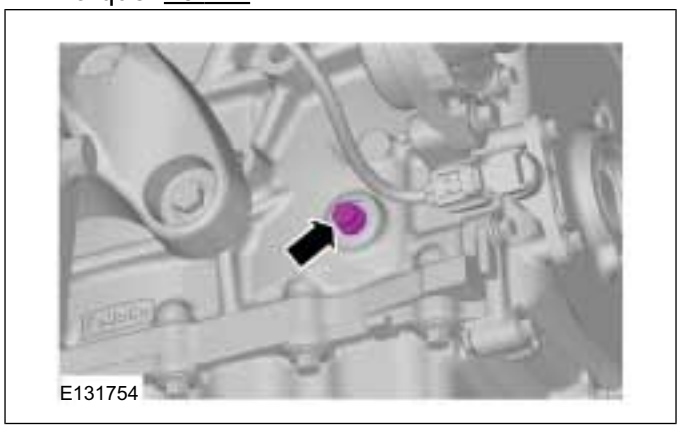
9. Remove the Special Tool(s): 303-507



10. • Material: Thread Locking MS (WSK-M2G349-A7 / 2U7J-M2G349-AA) adhesive
    1. Torque: 10 Nm
    2. Torque: 12 Nm



11. Torque: 20 Nm



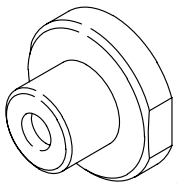
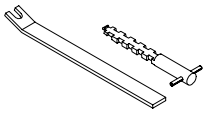
12. Refer to: Valve Cover (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

13. Refer to: Accessory Drive Belt (303-05 Accessory Drive - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

REMOVAL AND INSTALLATION

Crankshaft Front Seal(21 467 0)

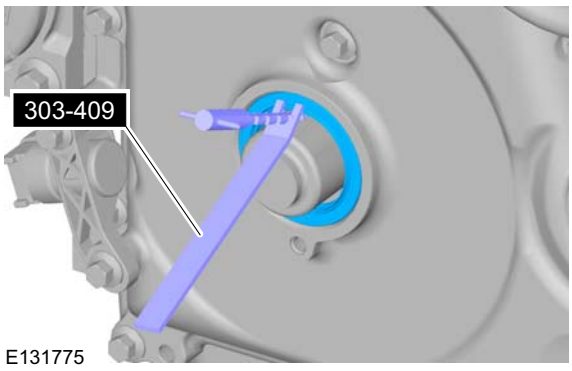
Special Tool(s)

 21148	303-318 Aligner/Installer, Crankshaft Front Seal
 E134603	303-409 Remover Crankshaft Seal

Removal

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

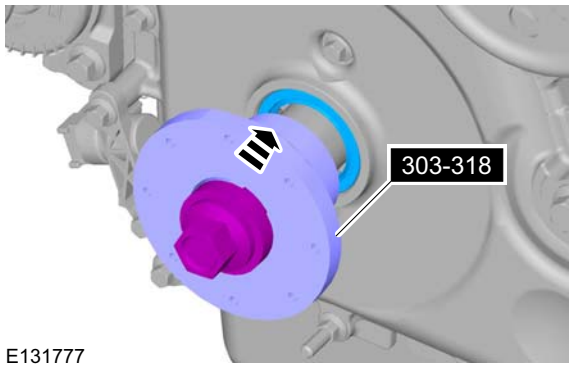
1. Refer to: Crankshaft Pulley (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
2. Special Tool(s): 303-409



E131775

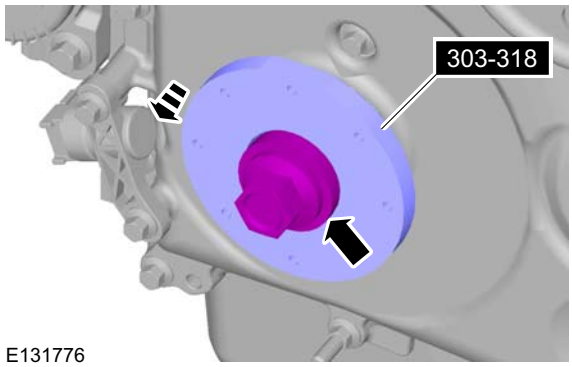
Installation

1. Special Tool(s): 303-318



E131777

2. Remove the Special Tool(s): 303-318



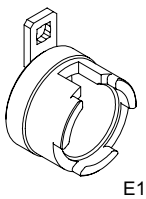
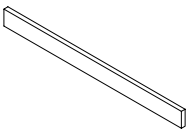
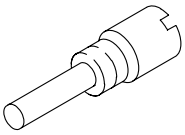
E131776

3. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Crankshaft Pulley(21 572 0)

Special Tool(s)

 E134674	303-1416 Tool, Crank Damper Holding
 E134673	303-465 Tool, Camshaft Align Timing
 PZ21210	303-507 Timing Peg, Crankshaft TDC

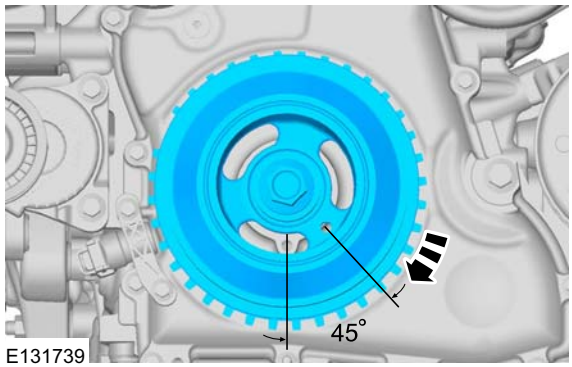
Removal

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

1. Refer to: Accessory Drive Belt (303-05 Accessory Drive - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
2. **CAUTION: During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

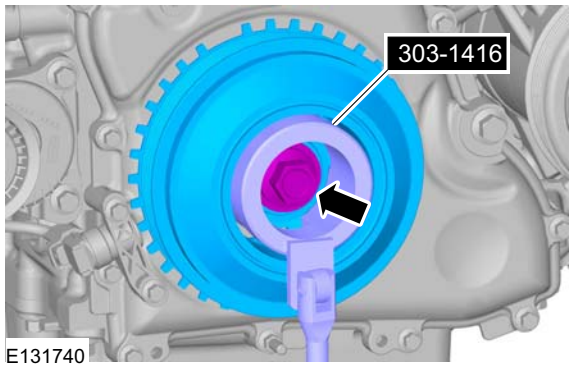
   Refer to: Valve Cover (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
3. **WARNING: Only rotate the crankshaft clockwise.**

   Turn the crankshaft until no. 1 piston is at about 45° before TDC.



E131739

4. Special Tool(s): 303-1416

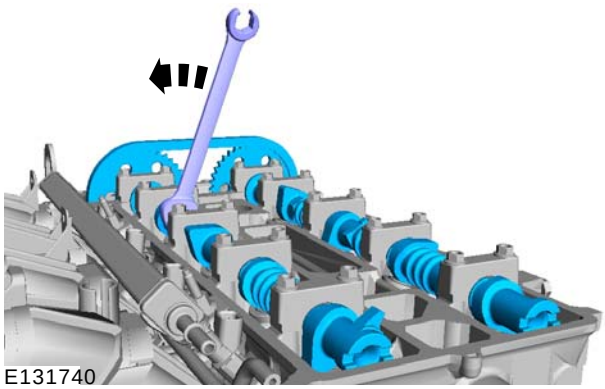


E131740

Installation

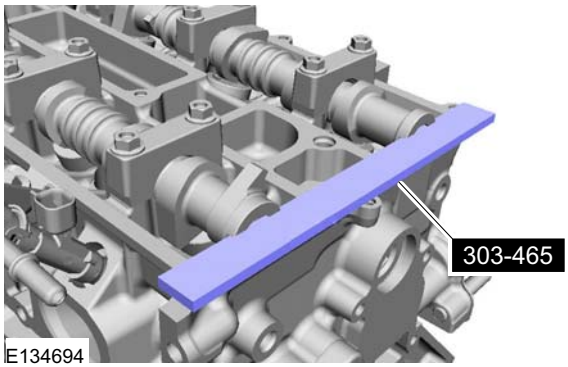
1. **WARNING: Only rotate the camshaft clockwise.**

   Turn the camshafts to cylinder no. 4 valve overlap position.

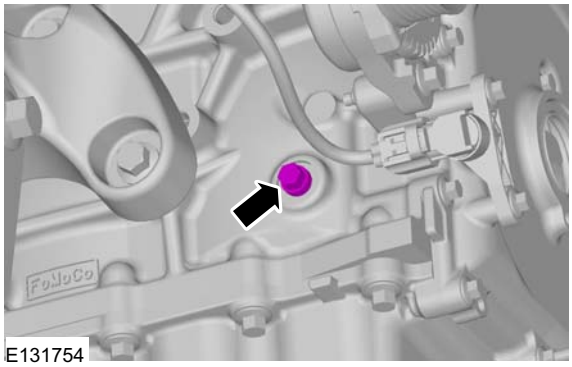

E131740

REMOVAL AND INSTALLATION

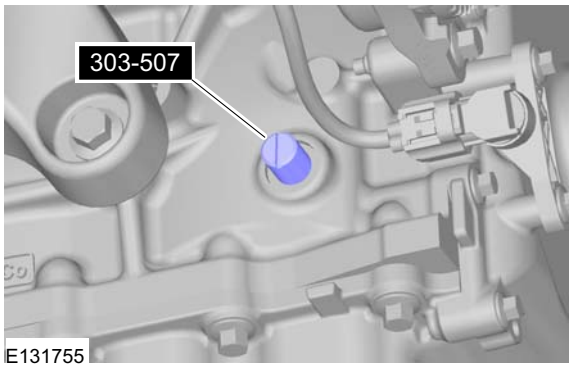
2. Special Tool(s): 303-465



3.

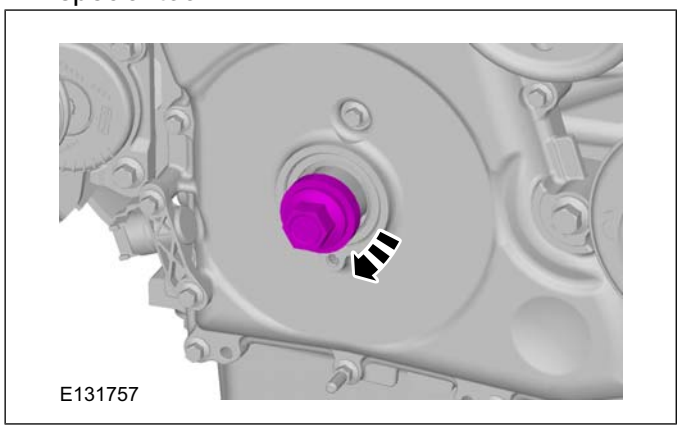


4. Special Tool(s): 303-507

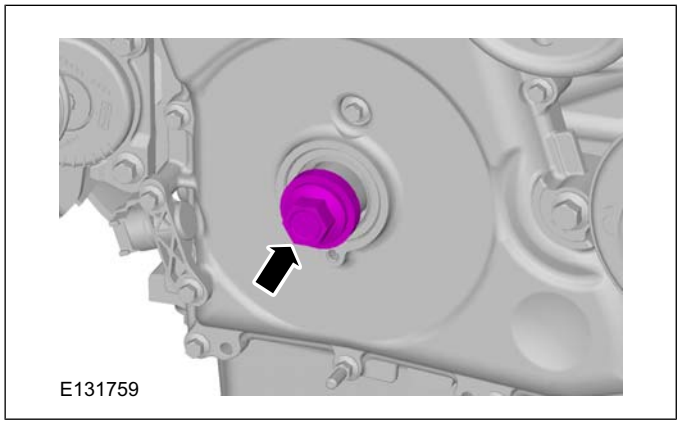


5. **WARNING: Only rotate the crankshaft clockwise.**

Turn the crankshaft until it stops against the special tool.

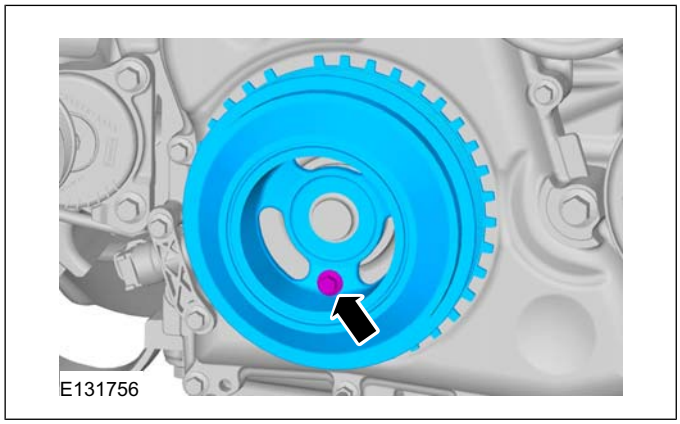


6.



7. **NOTE:** Only tighten the bolt finger tight at this stage.

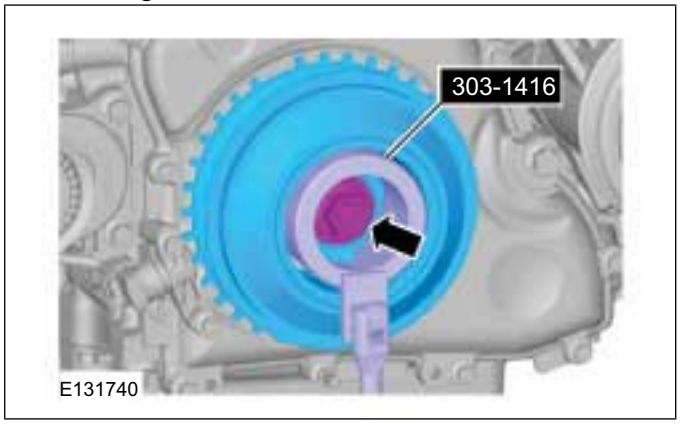
- Install the bolt M6 x 18 mm.



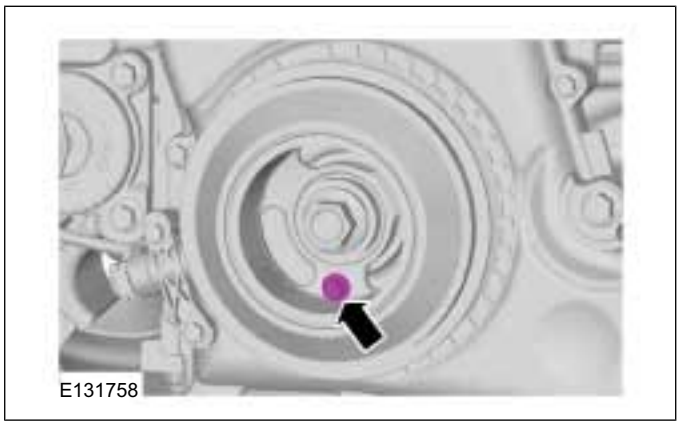
REMOVAL AND INSTALLATION

8. **CAUTION: Make sure that a new bolt is installed.**

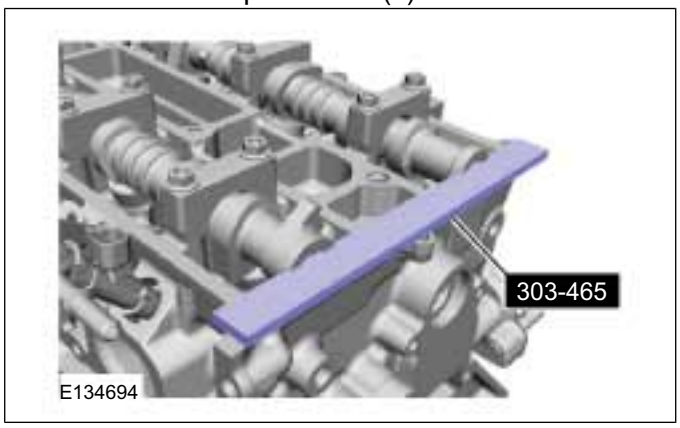
   Special Tool(s): 303-1416
   Torque:
   - Stage 1: 100 Nm
   - Stage 2: 90°



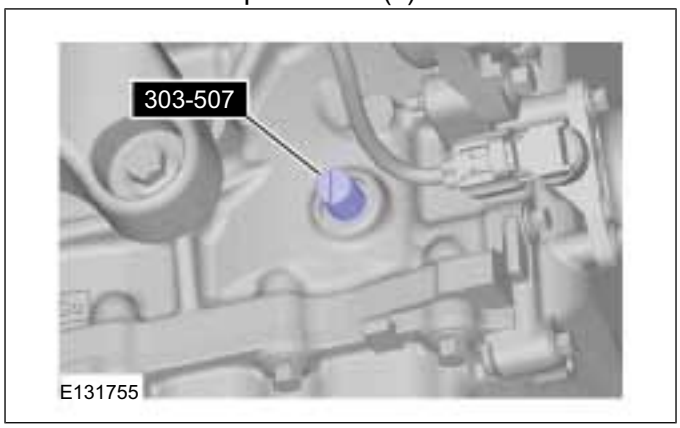
9. Remove the bolt M6 x 18 mm.



10. Remove the Special Tool(s): 303-465

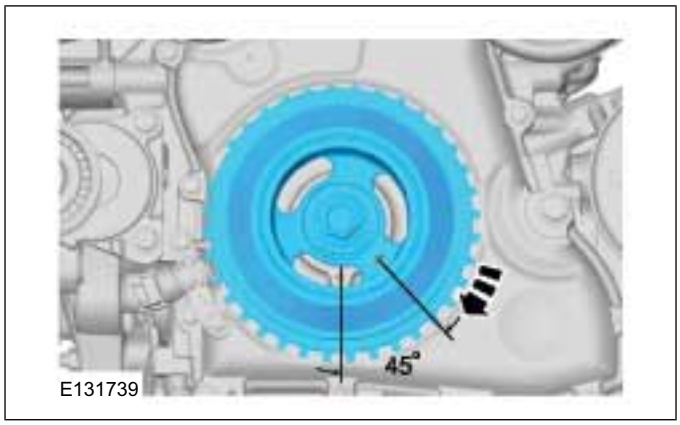


11. Remove the Special Tool(s): 303-507



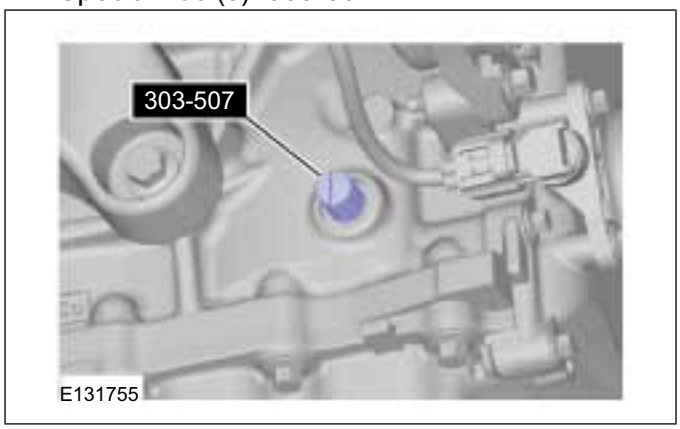
12. **WARNING: Only rotate the crankshaft clockwise.**

    Turn the crankshaft one and three quarters of a turn until no. 1 piston is at about 45° before TDC.



13. Install the crankshaft TDC timing peg.

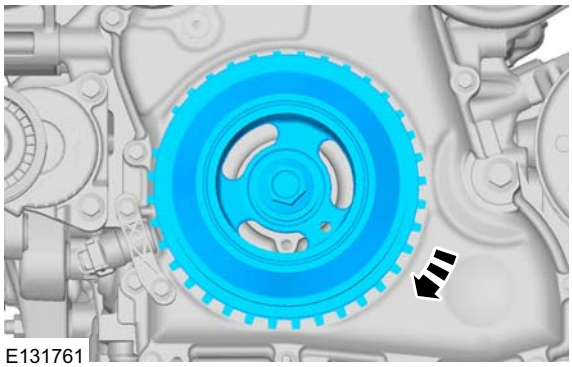
    Special Tool(s): 303-507



14. **WARNING: Only rotate the crankshaft clockwise.**

REMOVAL AND INSTALLATION

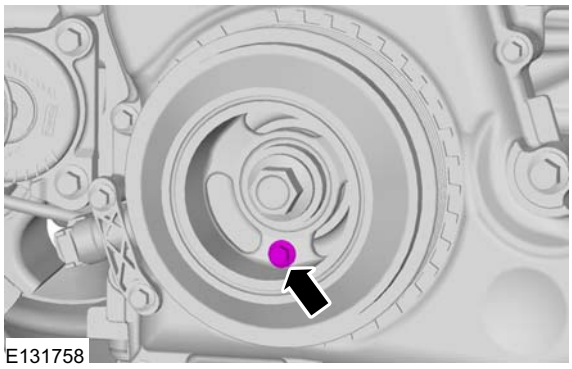
Turn the crankshaft until it stops against the special tool.


E131761

15. **NOTE:** Only tighten the bolt finger tight at this stage.

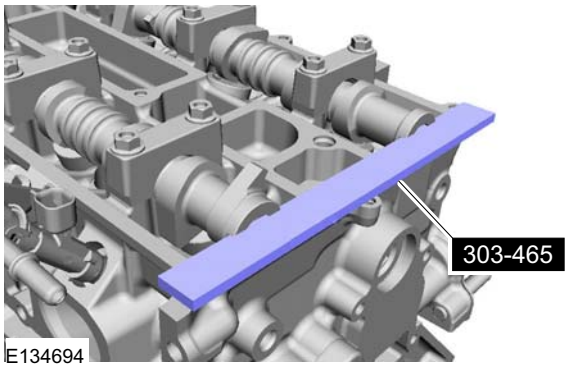
NOTE: The bolt can only be installed if the valve timing is correct.

- Install the bolt M6 x 18 mm.


E131758

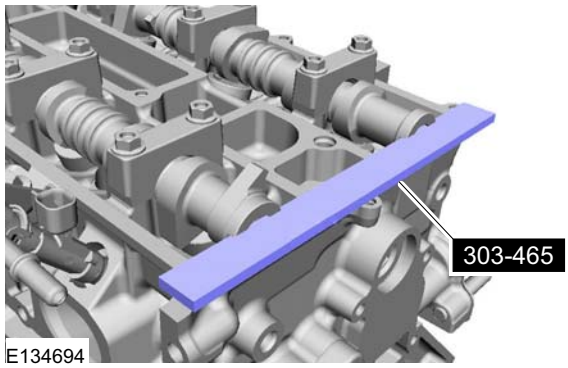
16. **NOTE:** The special tool may only be installed if the valve timings are correct.

Special Tool(s): 303-465



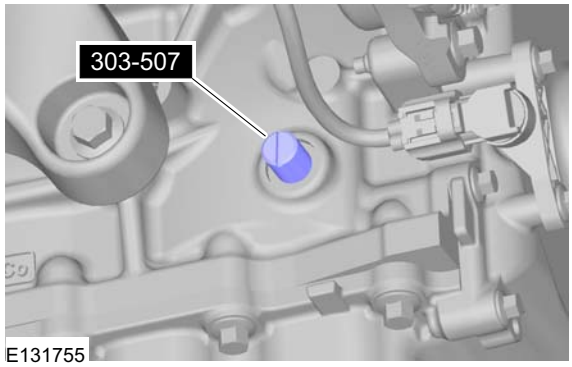
E134694

17. Remove the Special Tool(s): 303-465



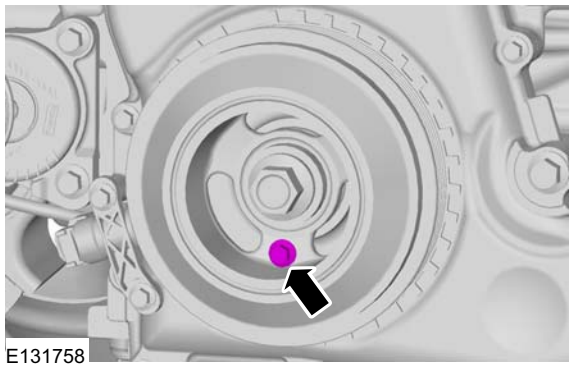
E134694

18. Remove the Special Tool(s): 303-507



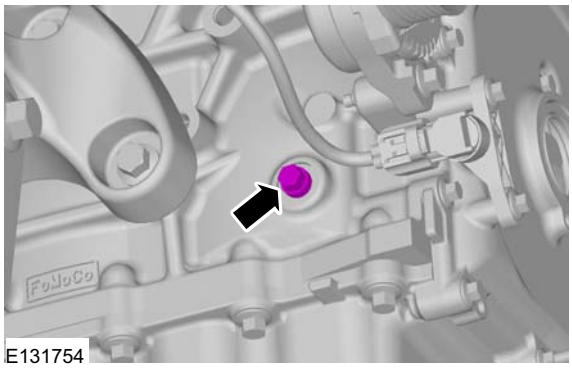
E131755

19. Remove the bolt M6 x 18 mm.


E131758

REMOVAL AND INSTALLATION

20. Torque: 20 Nm

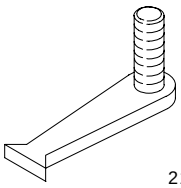
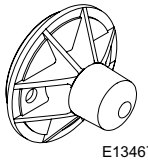


21. To install reverse the removal procedure.

REMOVAL AND INSTALLATION

Crankshaft Rear Seal(21 468 4)

Special Tool(s)

 21135	303-254 Locking Tool, Flywheel
 E134675	303-328 Replacer, Rear Oil Seal

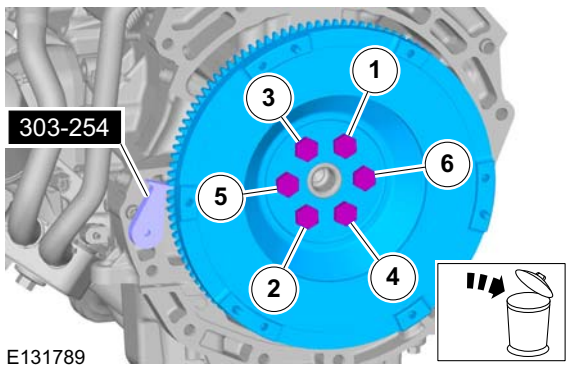
Materials	
Name	**Specification**
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

Removal

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

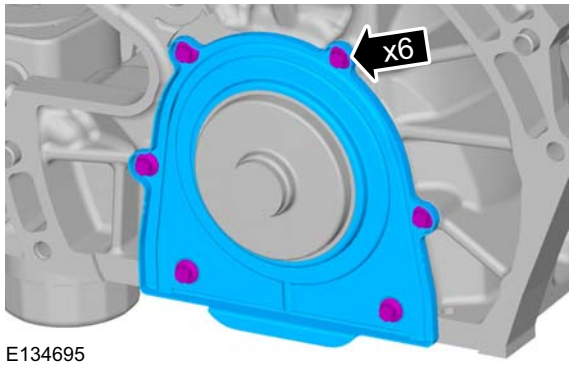
1. Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).
2. Discard the flywheel bolts.

   Special Tool(s): 303-254
   Torque:
   - Stage 1: 50 Nm
   - Stage 2: 80 Nm
   - Stage 3: 112 Nm



E131789

3. Refer to: Oil Pan (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
4.



E134695

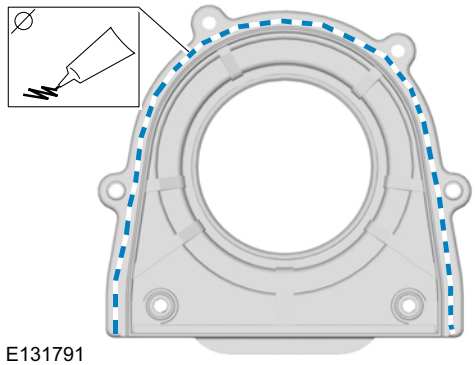
Installation

1. **CAUTION: Install the crankshaft rear seal carriers within five minutes of applying the sealer.**

   NOTE: Do not damage the mating faces.

   NOTE: Mating surface should not have traces of oil to improve the adhesion.

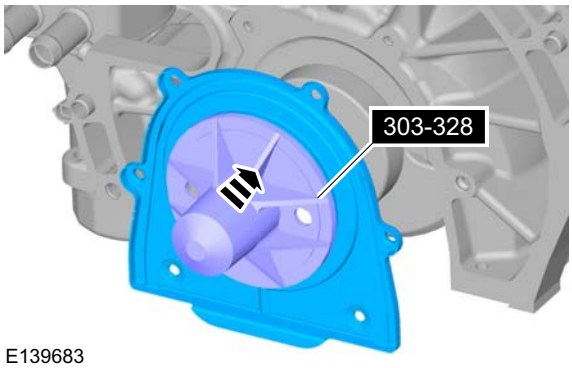
   Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant


E131791

REMOVAL AND INSTALLATION

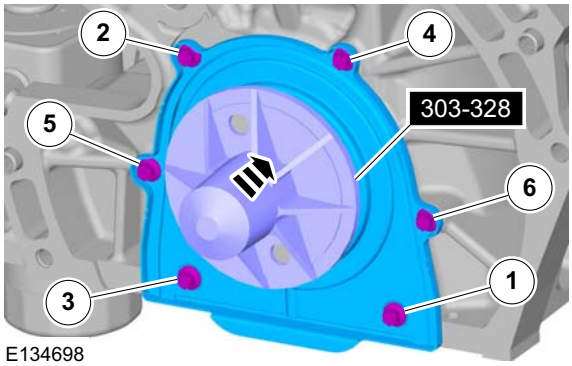
2. Using the crankshaft rear main oil seal installer, position the crankshaft rear oil seal with retainer plate onto the crankshaft.

   Special Tool(s): 303-328



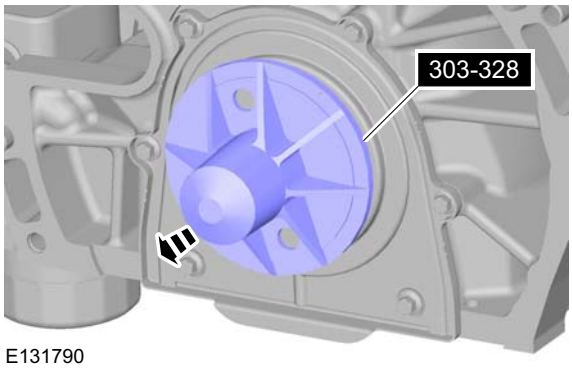
E139683

3. Special Tool(s): 303-328
   Torque: 10 Nm



E134698

4. Remove the Special Tool(s): 303-328



E131790

5. To install, reverse the removal procedure.

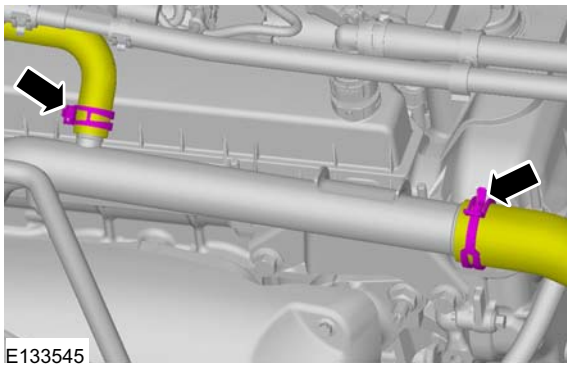
REMOVAL AND INSTALLATION

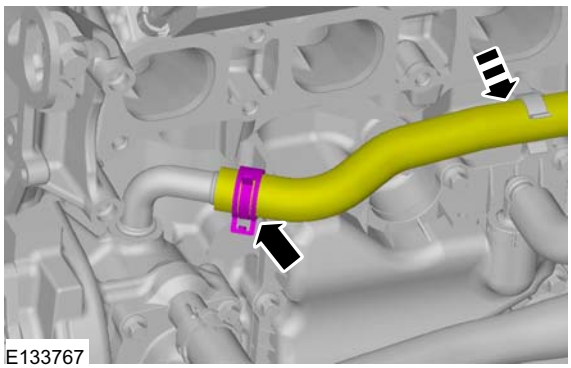
Cylinder Head(21 163 0)

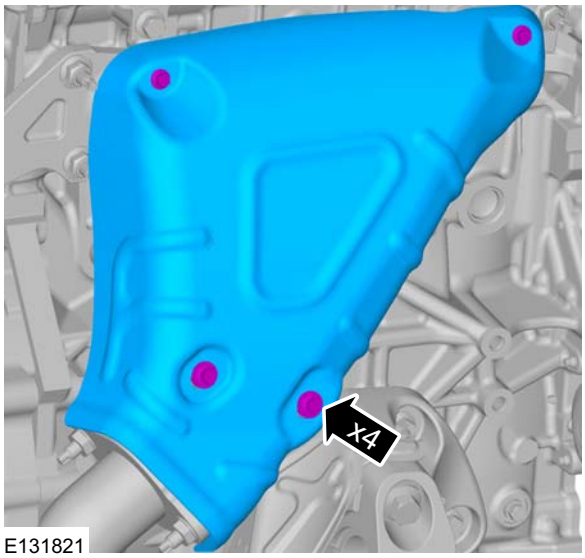
Materials	
Name	**Specification**
Hypoid Oil 85W-90	SQ-M2C9002-AA / A72SX-19K261-CA

Removal

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

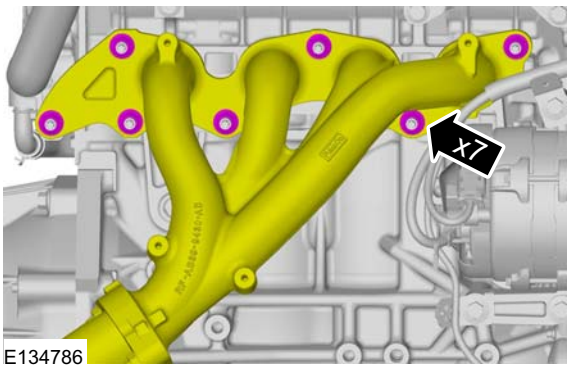
1. Refer to: Cooling System Draining, Filling and Bleeding (303-03 Engine Cooling, General Procedures).
2. Refer to: Timing Chain (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
3. 

4. 

5. Torque: 10 Nm


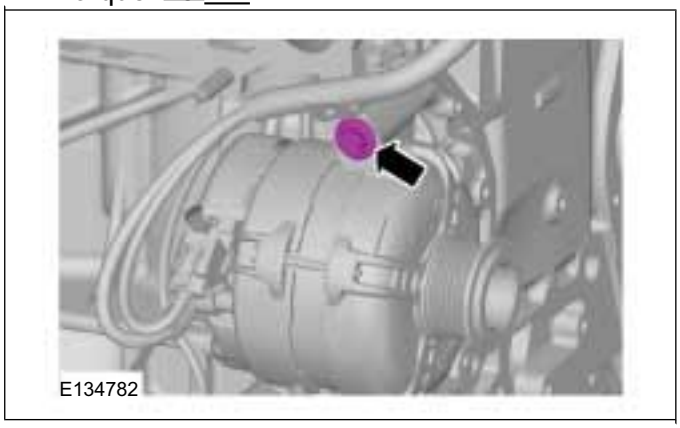
6. **CAUTIONS:**
   - **Over bending the exhaust flexible pipe may cause damage resulting in failure.**
   - **Make sure that the catalytic converter is supported with suitable retaining straps.**

   NOTE: The gasket is to be reused unless damaged.

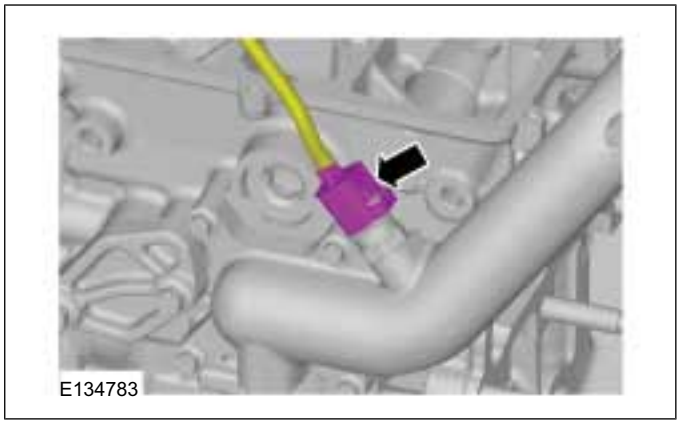
   Torque: 48 Nm


REMOVAL AND INSTALLATION

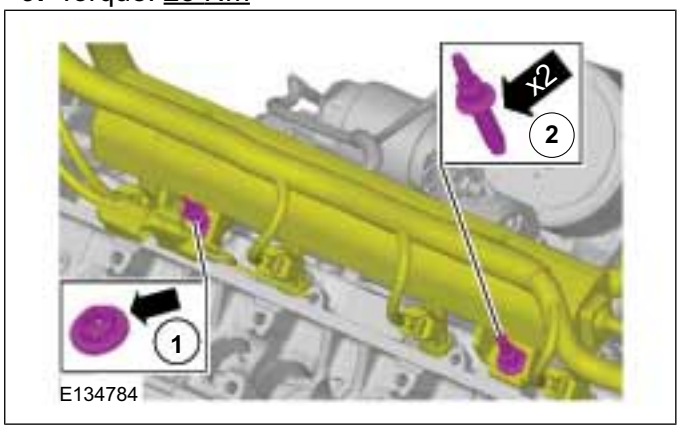
7. Torque: 48 Nm



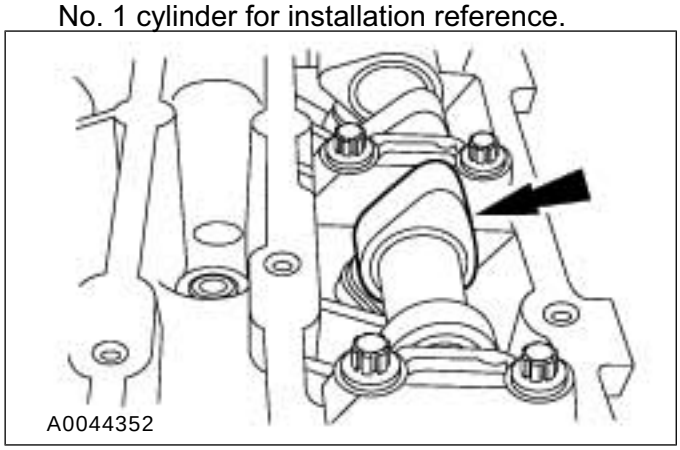
8.



9. Torque: 23 Nm



10. Mark the position of the camshaft lobes on the No. 1 cylinder for installation reference.

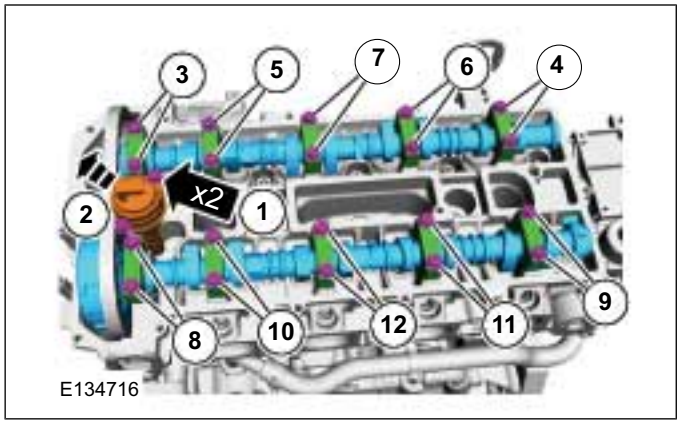


11. CAUTIONS:

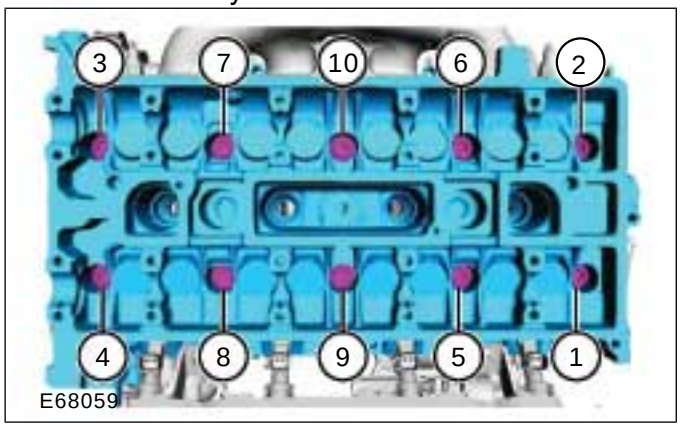
Failure to follow the camshaft loosening procedure can result in damage to the camshafts.

Note the position of each component before removal.

NOTE: Mark the location and orientation of each camshaft bearing cap.



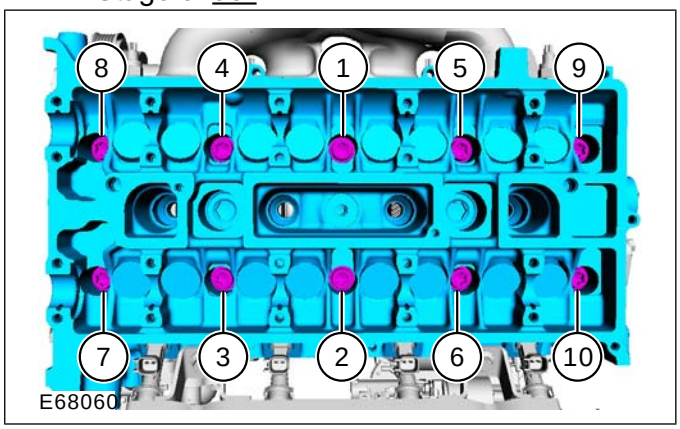
12. Discard the cylinder head bolts.



REMOVAL AND INSTALLATION

Installation

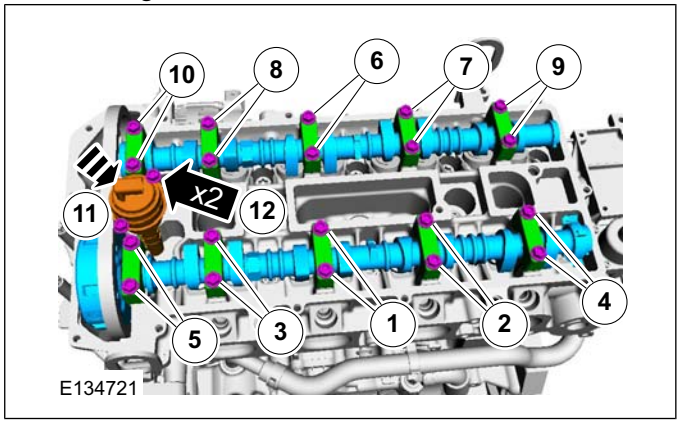
1. Install new cylinder head bolts.
   Torque:
   - Stage 1: 5 Nm
   - Stage 2: 15 Nm
   - Stage 3: 45 Nm
   - Stage 4: 90°
   - Stage 5: 90°



2. **CAUTION: Make sure that the camshafts and camshaft bearing caps are installed in their original locations.**

   Apply hypoid gear oil to the camshaft bearing caps. Install the camshafts approximately at valve overlap position cylinder No. 4.

   Material: Hypoid Oil 85W-90 (SQ-M2C9002-AA / A72SX-19K261-CA) transmission fluid
   Torque:
   - Stage 1: 7 Nm
   - Stage 2: 16 Nm

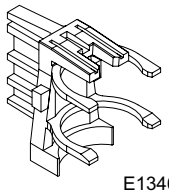


3. To install reverse the removal procedure.

REMOVAL AND INSTALLATION

Engine Front Cover

Special Tool(s)

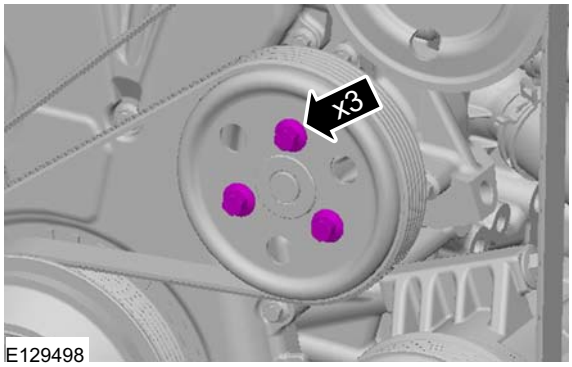
 E134676	303-1417 Tool, Crank Sensor Alignment

Materials	
Name	**Specification**
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

Removal

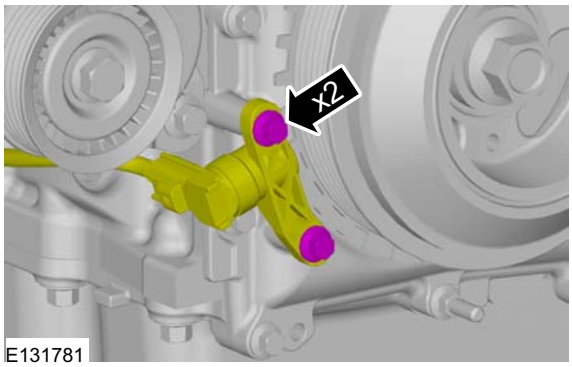
NOTE: Removal steps in this procedure may contain installation details.

1. Loosen: 3 turn(s)



E129498

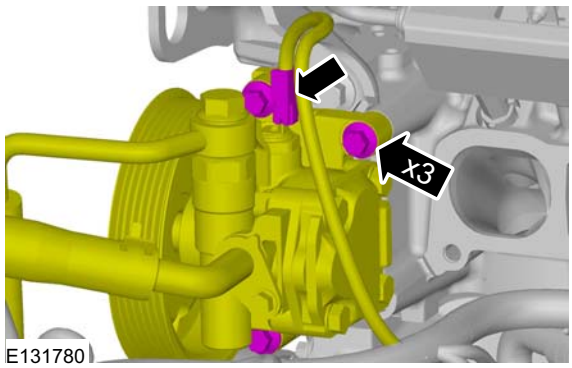
2.



E131781

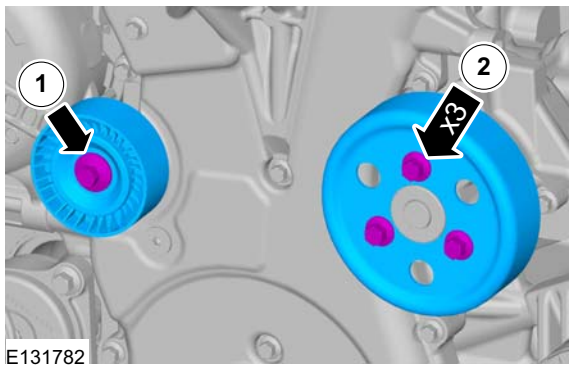
3. Refer to: Crankshaft Pulley (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

4. Torque: 20 Nm



E131780

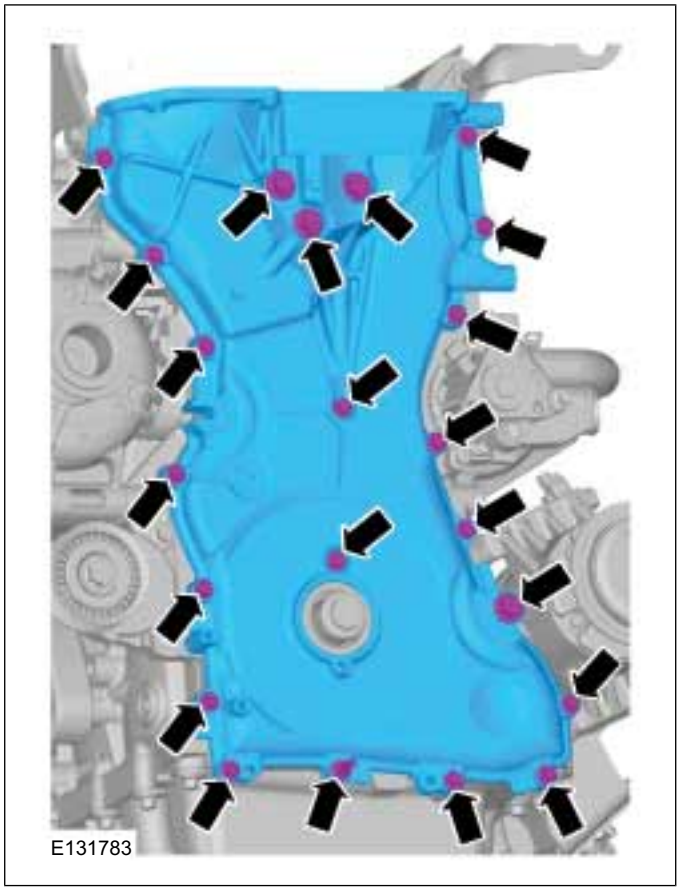
5. 1. Torque: 25 Nm
2. Torque: 20 Nm



E131782

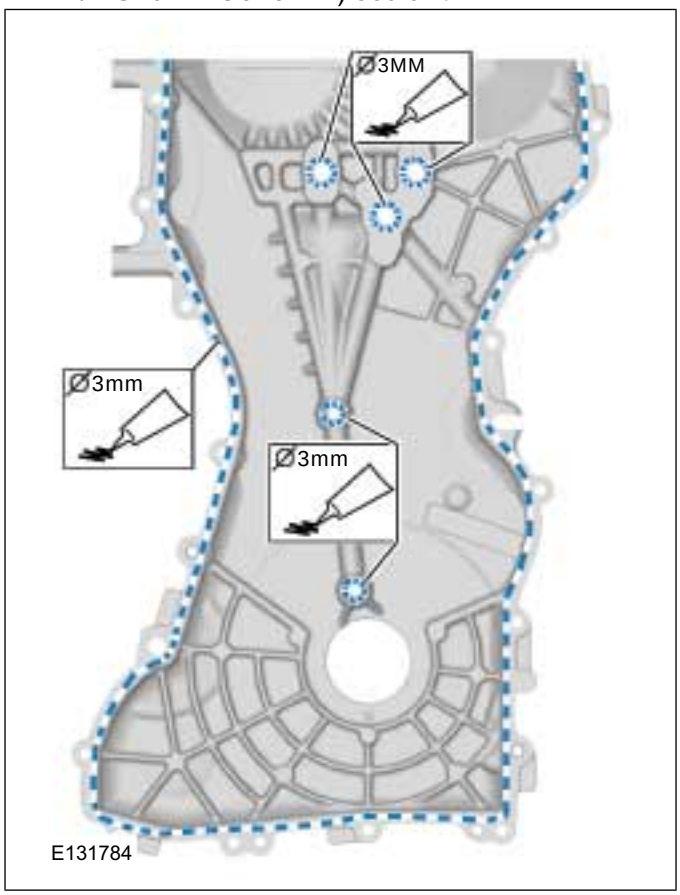
REMOVAL AND INSTALLATION

6.



Apply sealant to the engine front cover (bead diameter: 3 mm).

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



Installation

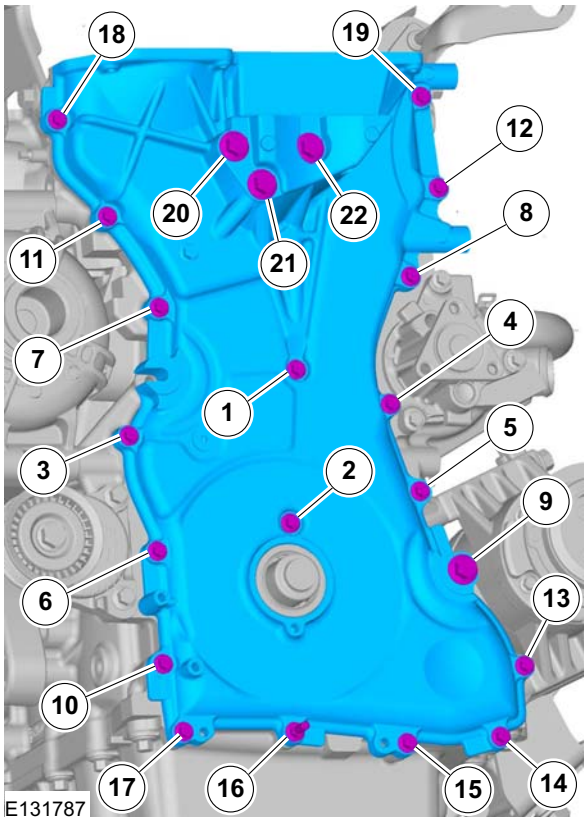
1. **CAUTION: Install the engine front cover within five minutes of applying the sealer.**

   NOTE: Do not damage the mating faces.

   NOTE: Mating surface should not have traces of oil to improve the adhesion.

REMOVAL AND INSTALLATION

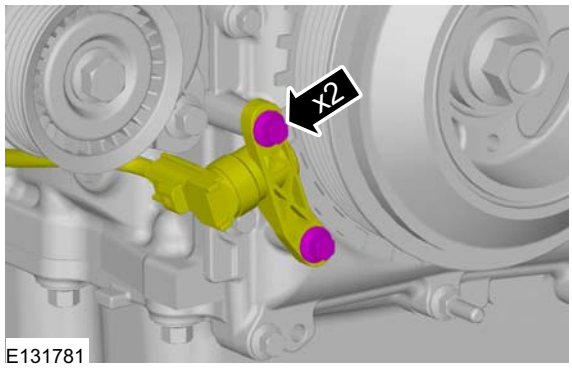
2. Torque:
- 1 - 8 10 Nm
- 9 48 Nm
- 10 - 19 10 Nm
- 20 - 22 48 Nm



3. To install, reverse the removal procedure.

4. Special Tool(s): 303-1417

5. Torque: 7 Nm



REMOVAL AND INSTALLATION

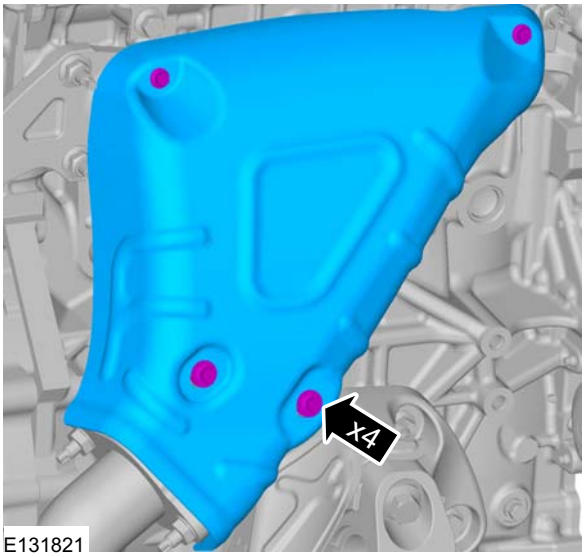
Exhaust Manifold(21 187 0)

Removal

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

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

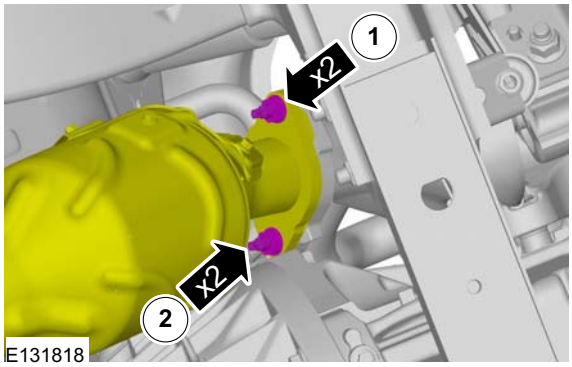
2. Torque: 10 Nm



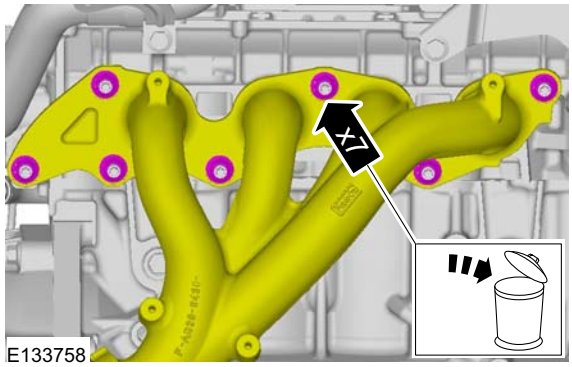
3. ⚠ **CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.**

   NOTE: Securely strap the exhaust flexible pipe to the frame.

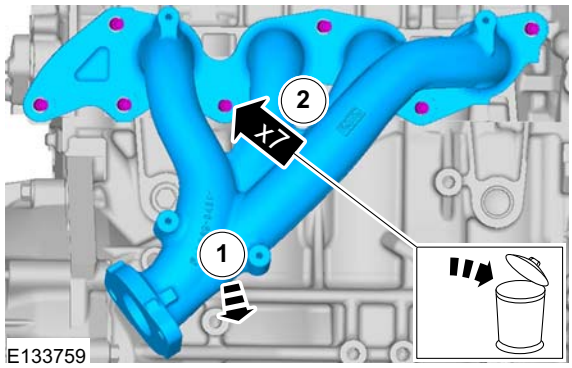
   1. Remove the exhaust pipe flange nuts. Torque: 48 Nm
   2. Remove the exhaust pipe flange studs. Torque: 25 Nm



4.

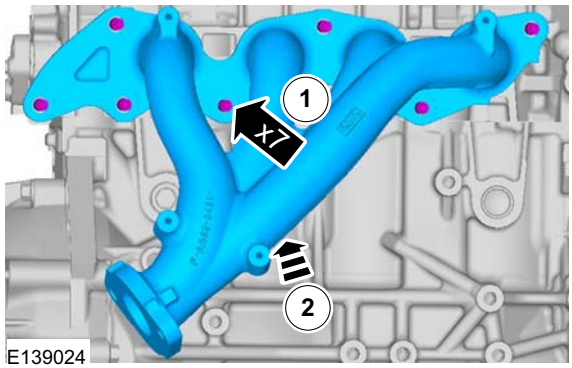


5.



Installation

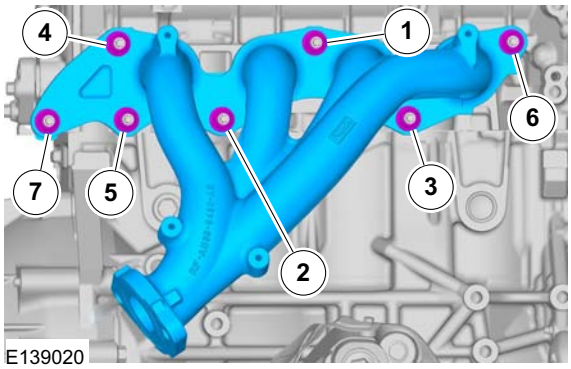
1. Torque: 17 Nm



REMOVAL AND INSTALLATION

2. **NOTE:** Make sure that a new exhaust manifold gasket is installed.

   Torque: 55 Nm



3. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Intake Manifold(21 183 0)

Removal

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

1. **WARNINGS:**

   Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

   Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

   Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

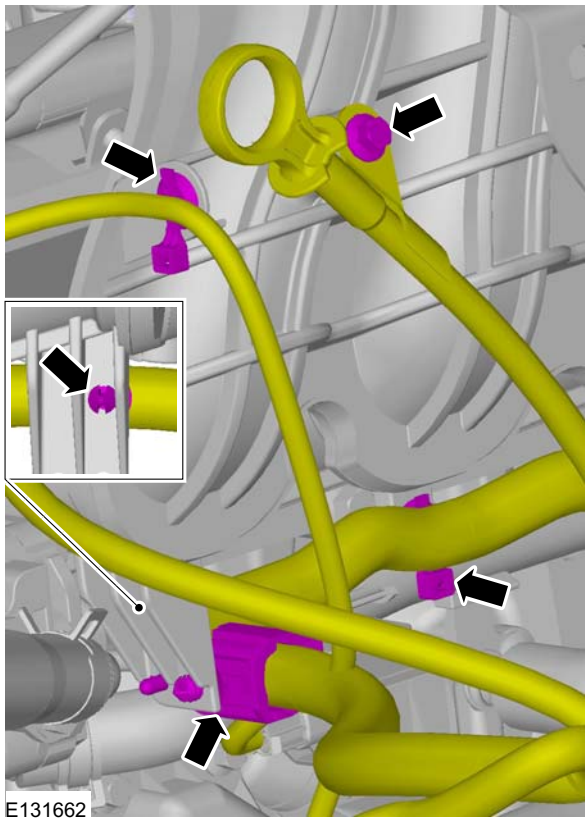
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

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

3. Refer to: Throttle Body (303-04 Fuel Charging and Controls - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

4. Refer to: Fuel System Pressure Release (310-00 Fuel System - General Information - 2.5L Duratec-HE (122kW/165PS) - MI4, General Procedures).

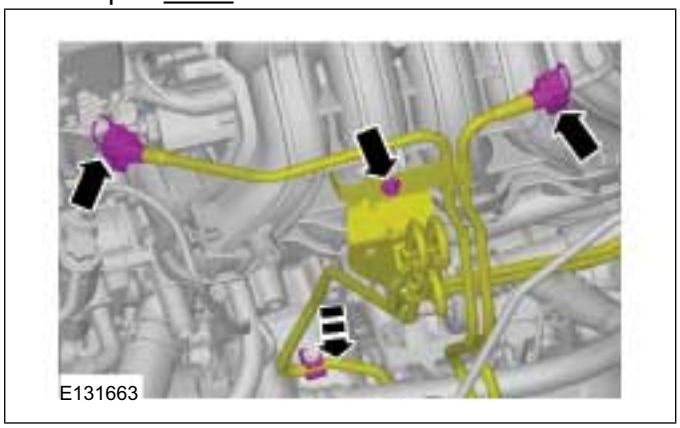
5. Torque: 10 Nm



REMOVAL AND INSTALLATION

6. **NOTE:** Securely strap the fuel and breather tubes.

   Torque: 8 Nm



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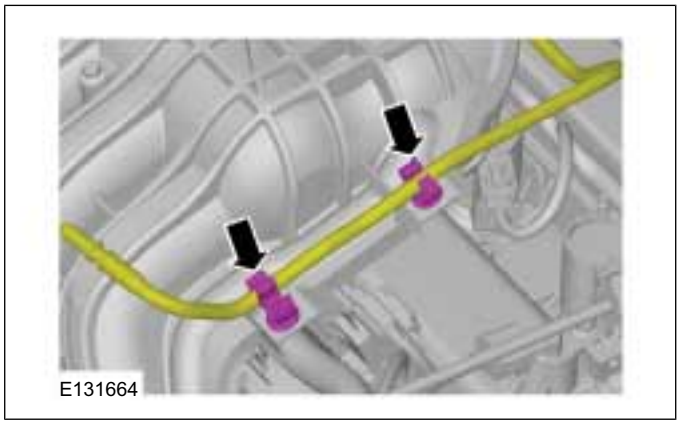

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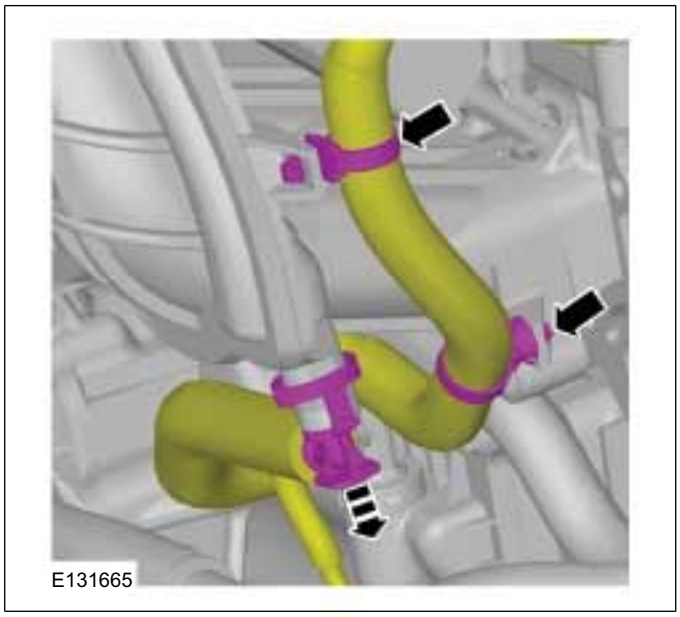
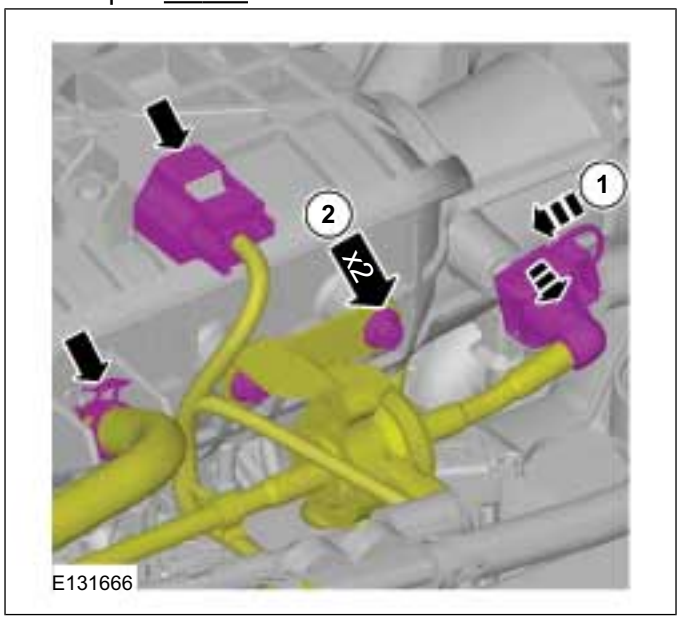
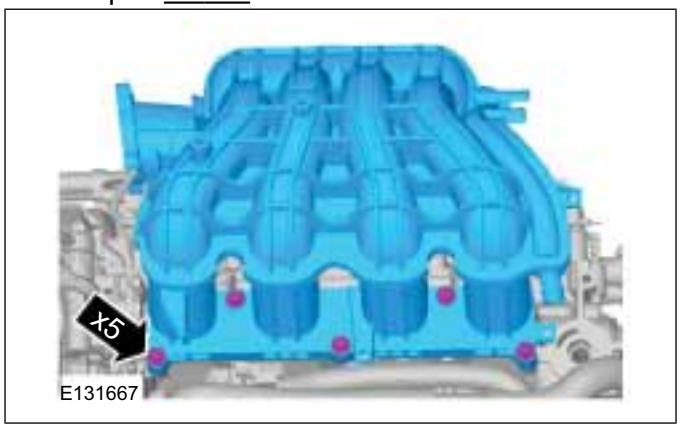


9. Torque: 11 Nm



10. **NOTE:** The gasket is to be reused unless damage.

    Torque: 19 Nm



Installation

1. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools can cause scratches and gouges which can make leak paths. Use a plastic scraping tool to remove all traces of the old intake manifold gaskets.

   NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

   Clean the sealing surfaces and inspect the gaskets. Install new gaskets if necessary.

REMOVAL AND INSTALLATION

2. To install, reverse the removal procedure.
3. **NOTE:** Make sure that the pedals remain in the rest position.

   Turn the ignition key to position II and then wait one minute in order to initialise the throttle valve.
4. Turn the ignition key to the OFF position.

REMOVAL AND INSTALLATION

Timing Chain(21 314 0)

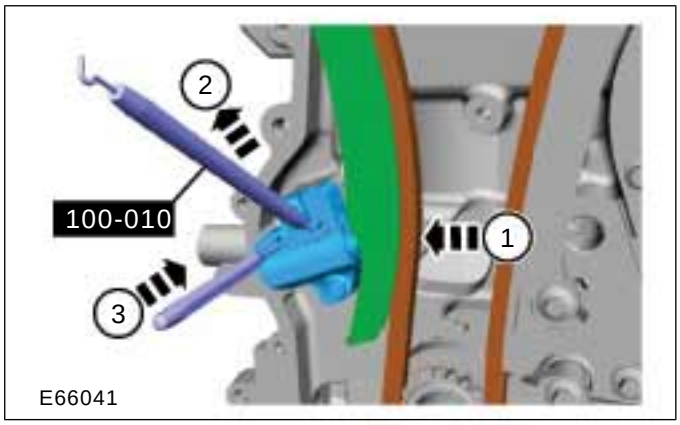
Special Tool(s) / General Equipment

 17063	100-010 Remover, O-Ring Seal
 E134673	303-465 Tool, Camshaft Align Timing
2 mm Punch	

Removal

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

1. Refer to: Engine Front Cover (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
2. 2. Special Tool(s): 100-010
   3. General Equipment: 2 mm Punch



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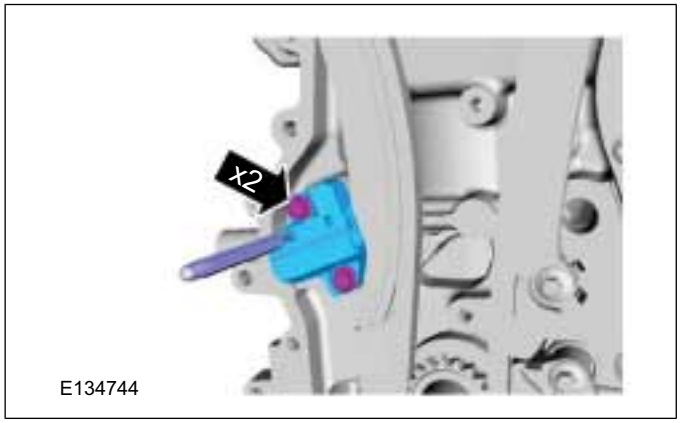
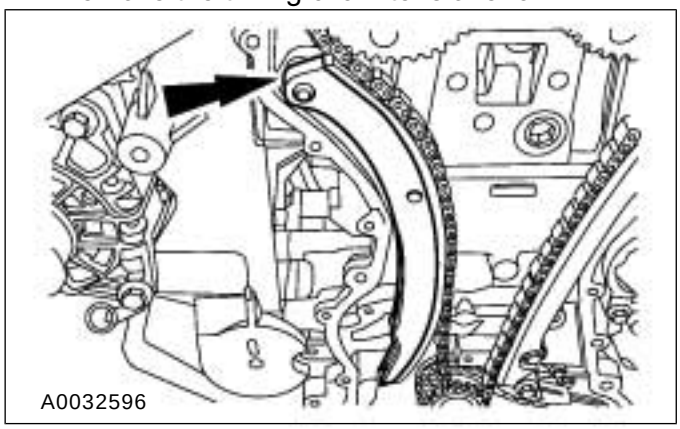
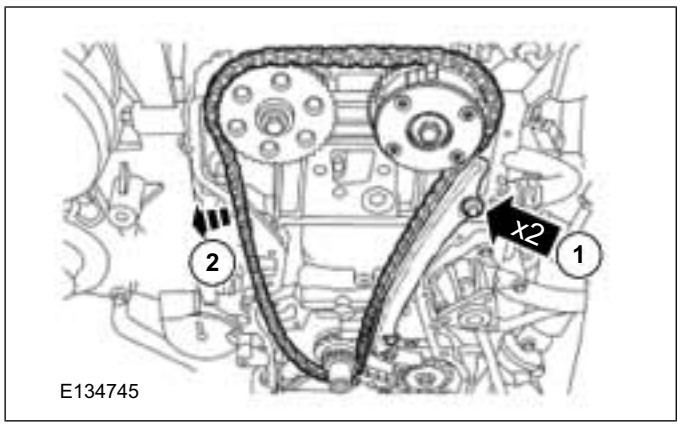


4. Remove the timing chain tensioner arm.



5.



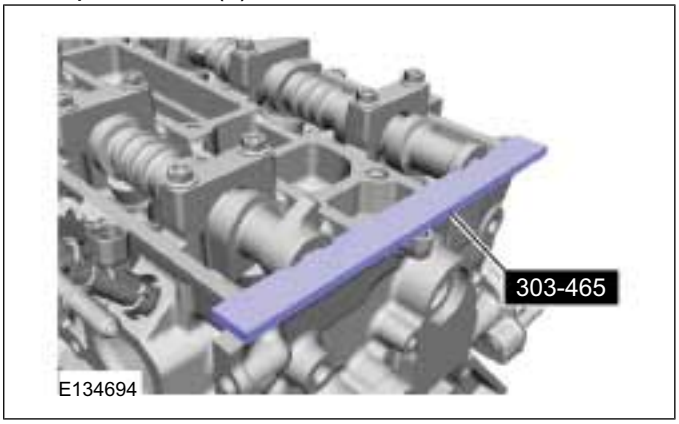
Installation

1. **CAUTION: Only rotate the camshaft clockwise.**

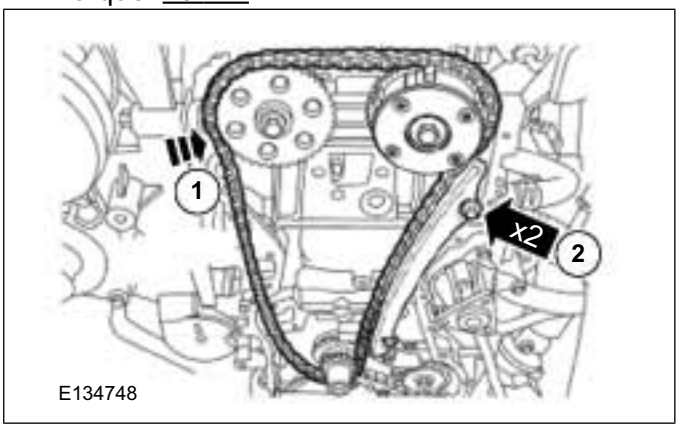
REMOVAL AND INSTALLATION

Turn the camshafts to cylinder no. 4 valve overlap position.

Special Tool(s): 303-465



2. Torque: 10 Nm



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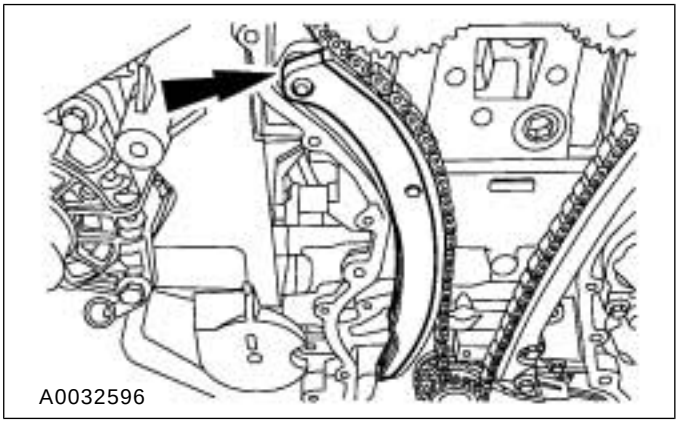
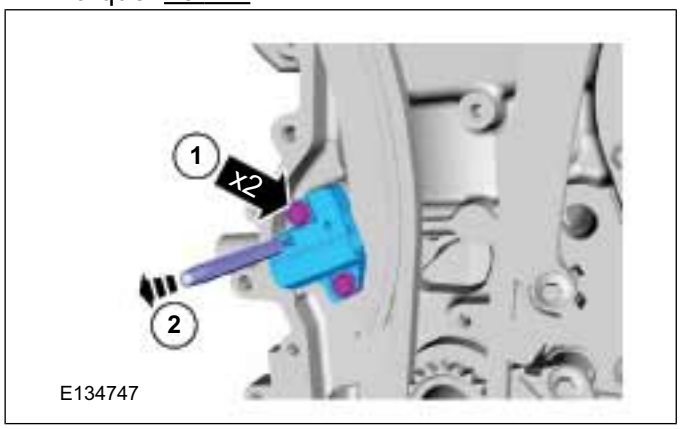


4. Torque: 10 Nm

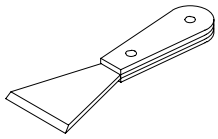


5. Refer to: Engine Front Cover (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

REMOVAL AND INSTALLATION

Oil Pan(21 154 0)

Special Tool(s)

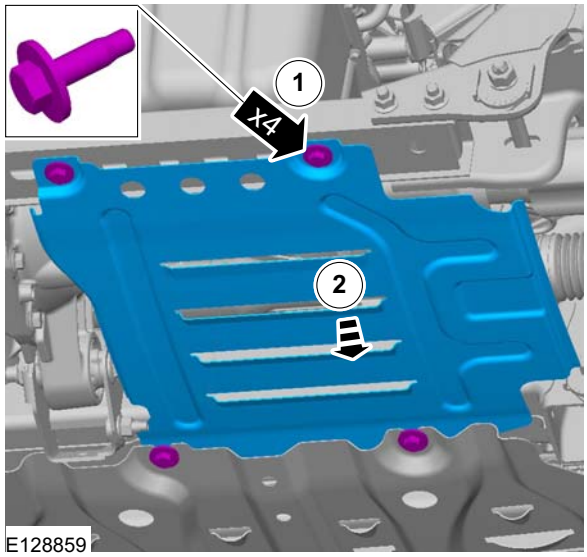
 21179	303-428 Separator, Oil Pan

Materials	
Name	**Specification**
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

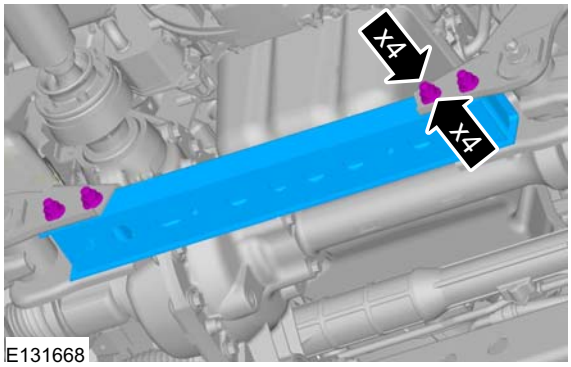
Removal

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. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Torque: 30 Nm



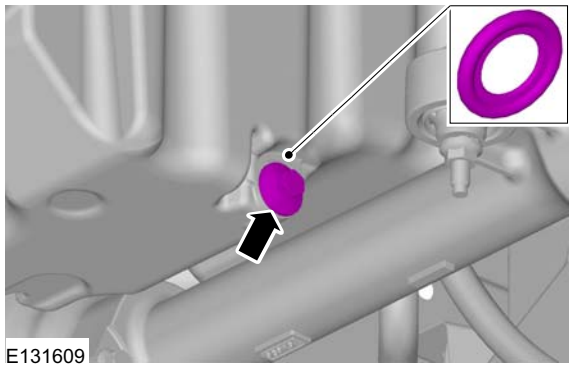
4. Torque: 90 Nm



5. **WARNING: Be prepared to collect escaping fluids.**

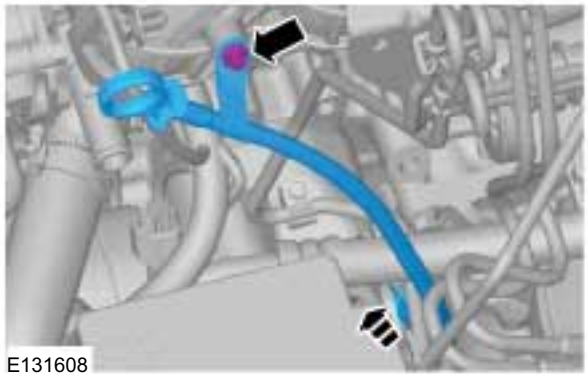
   NOTE: The seal is to be reused unless damaged.

   Drain the oil into a suitable container.
   Torque: 28 Nm



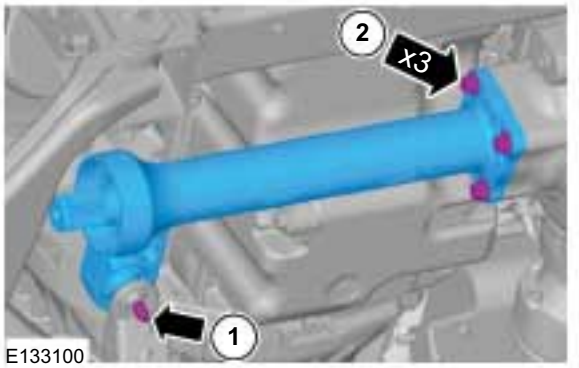
REMOVAL AND INSTALLATION

6. Torque: 10 Nm

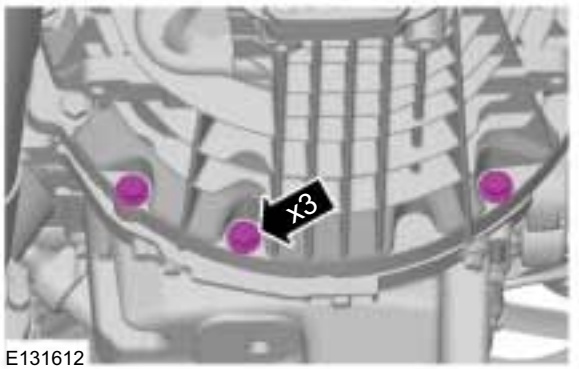


7. Refer to: Front Halfshaft RH (205-04 Front Drive Halfshafts, Removal and Installation).

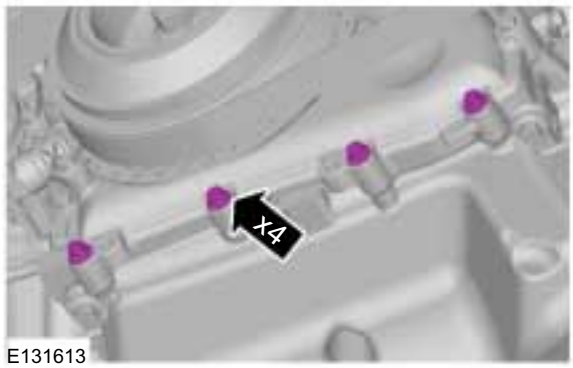
8. 1. Torque: 70 Nm
2. Torque: 40 Nm



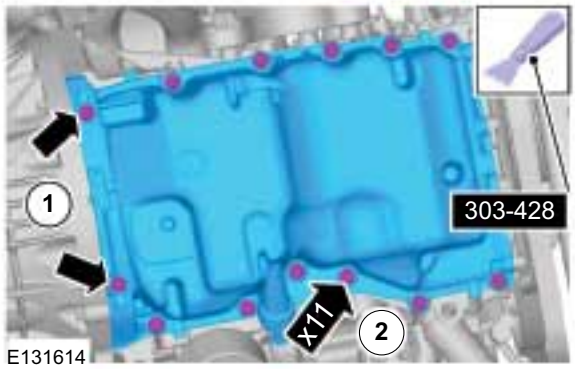
9. Torque: 48 Nm



10. Torque: 10 Nm



11. Special Tool(s): 303-428



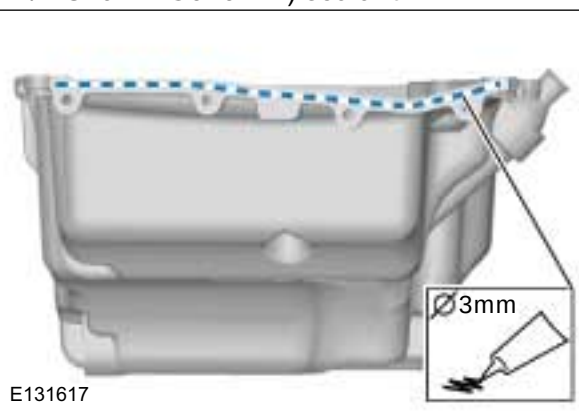
Installation

1. ⚠ **CAUTION: Install the oil pan within five minutes of applying the sealer.**

NOTE: Do not damage the mating faces.

NOTE: Mating surface should not have traces of oil to improve the adhesion.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



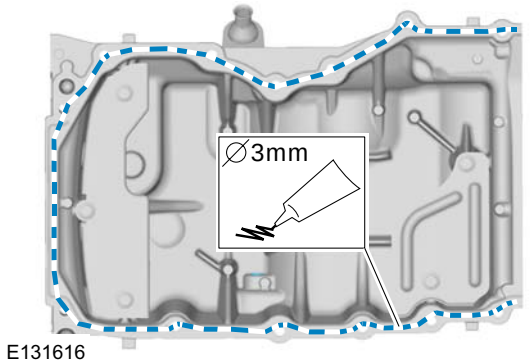
2. ⚠ **CAUTION: Install the oil pan within five minutes of applying the sealer.**

REMOVAL AND INSTALLATION

NOTE: Do not damage the mating faces.

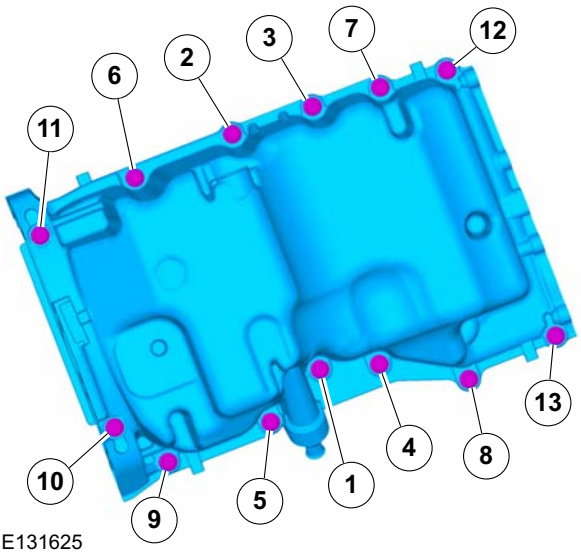
NOTE: Mating surface should not have traces of oil to improve the adhesion.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



E131616

3. To install, reverse the removal procedure.
4. Install the oil pan.
   Torque: 25 Nm



E131625

5. Fill the oil pan with clean engine oil.

   Refer to: Specifications (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Specifications).

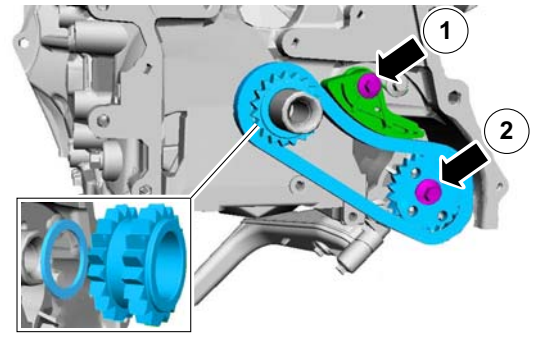
REMOVAL AND INSTALLATION

Oil Pump(21 714 0)

Removal

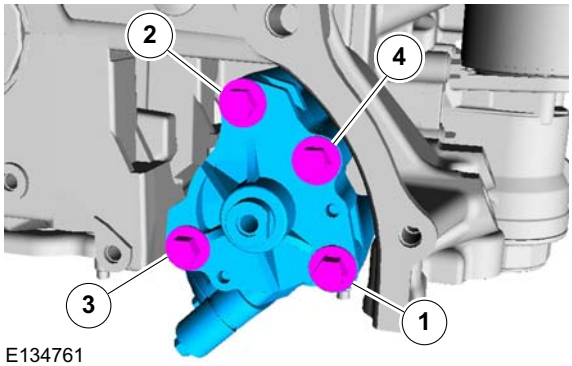
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Timing Chain (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
2. Refer to: Oil Pan (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
3. **CAUTION: Make sure that a new friction washer is installed.**
   1. Torque: 10 Nm
   2. Torque: 25 Nm



E134760

4. Remove the 2 bolts and the oil pump screen and pickup tube.
   Torque: 10 Nm
5. Torque:
   - Stage 1: 10 Nm
   - Stage 2: 20 Nm



E134761

Installation

1. To install, reverse removal procedure.

REMOVAL AND INSTALLATION

Valve Cover(21 141 0)

Materials	
Name	**Specification**
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

Removal

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

1. **WARNINGS:**

   Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

   Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

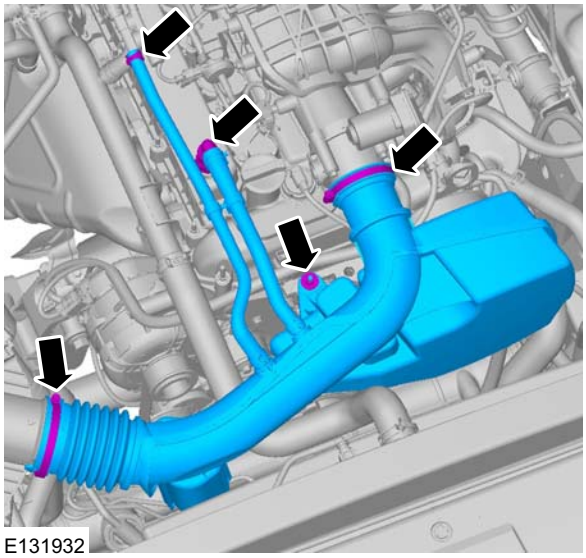
   Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

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

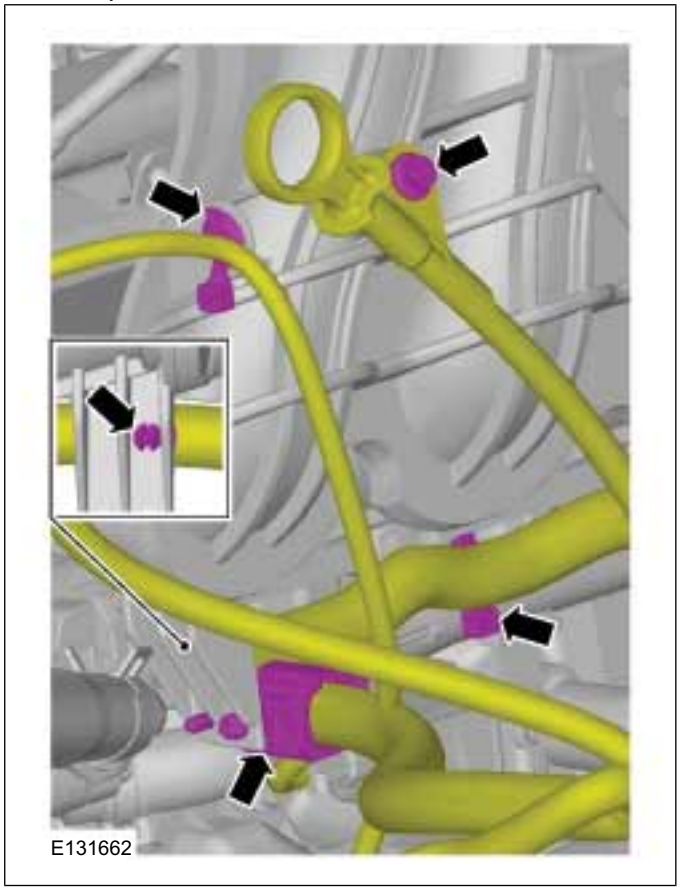
3. Refer to: Fuel System Pressure Release (310-00 Fuel System - General Information - 2.5L Duratec-HE (122kW/165PS) - MI4, General Procedures).

4. Torque: 10 Nm


E131932

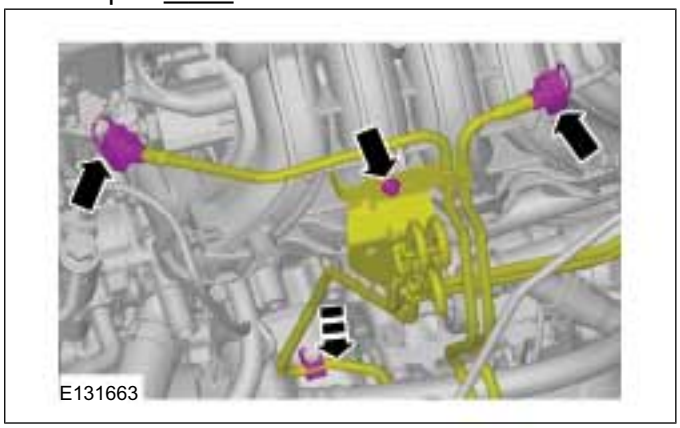
REMOVAL AND INSTALLATION

5. Torque: 10 Nm

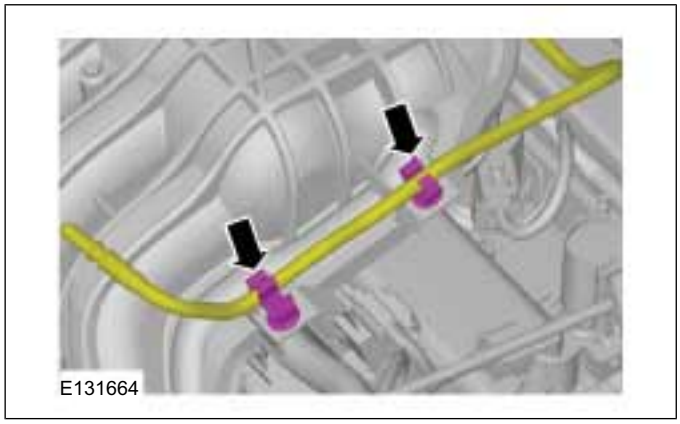


6. **NOTE:** Securely strap the fuel and breather tubes.

   Torque: 8 Nm



7.



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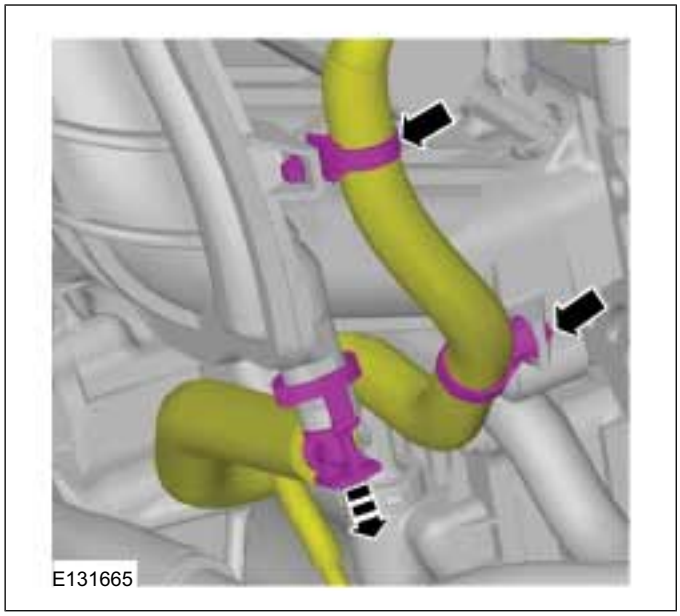
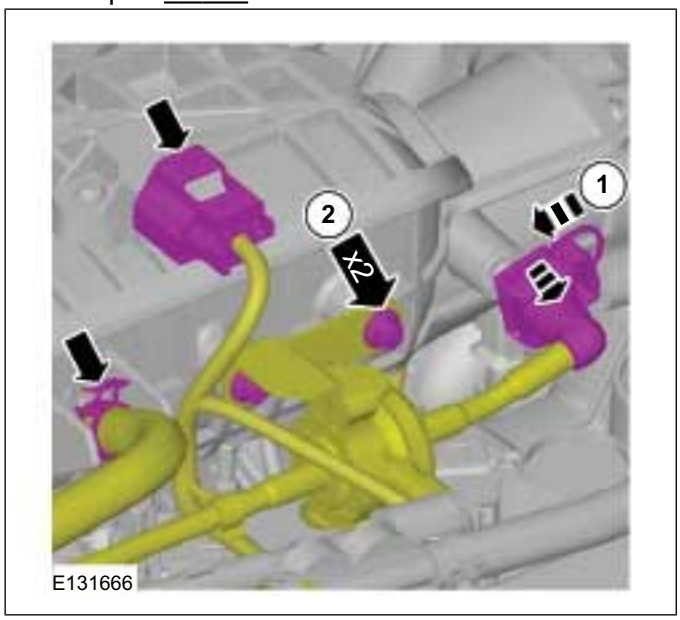
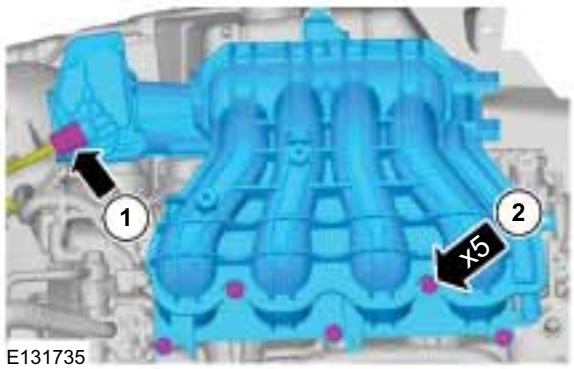


9. Torque: 11 Nm



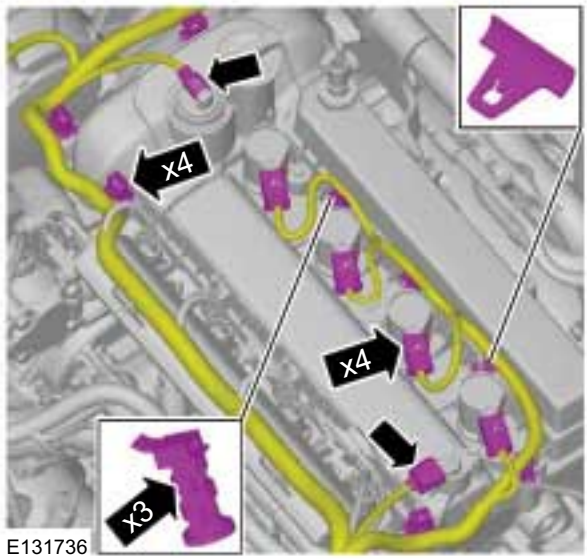
REMOVAL AND INSTALLATION

10. Torque: 19 Nm



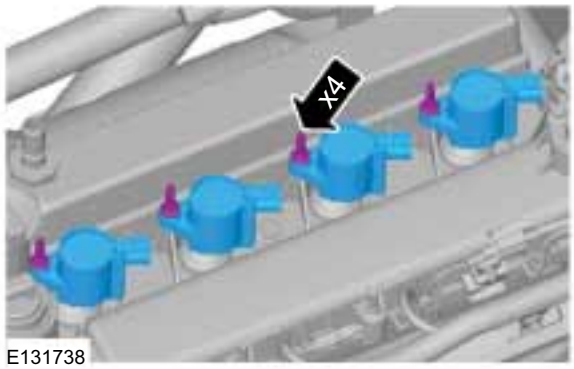
E131735

11.



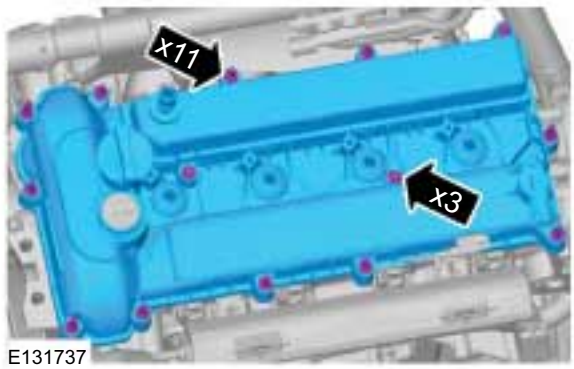
E131736

12. Torque: 8 Nm



E131738

13.

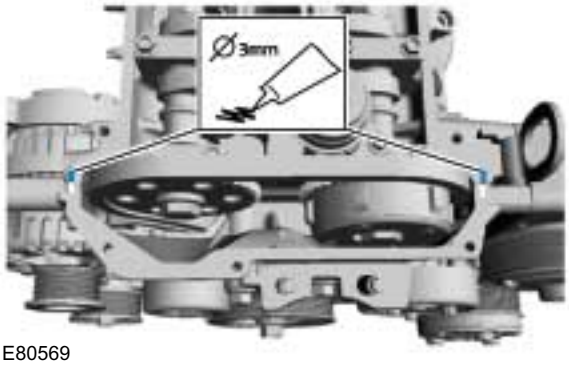


E131737

Installation

1. **NOTE:** The valve cover must be secured within 4 minutes of silicone gasket application. If the valve cover is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with metal surface prep.

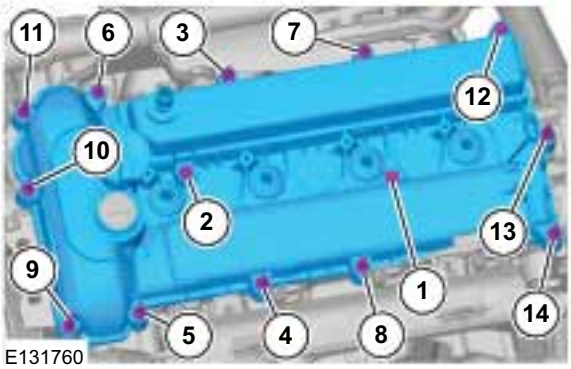
   Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



E80569

2. **NOTE:** The gasket is to be reused unless damaged.

   Torque: 10 Nm



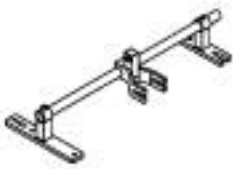
E131760

3. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

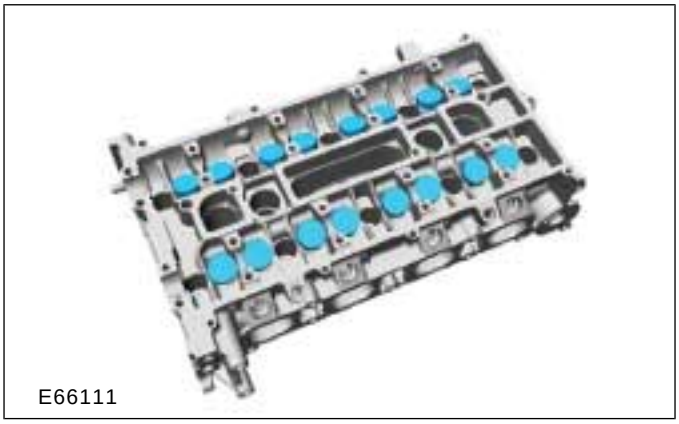
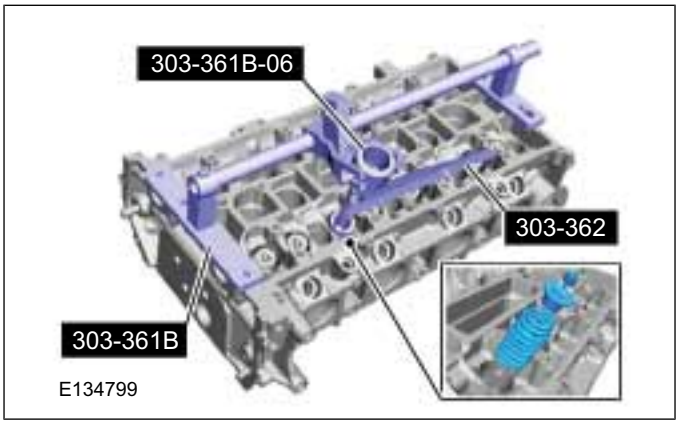
Valve Stem Seals(21 238 0)

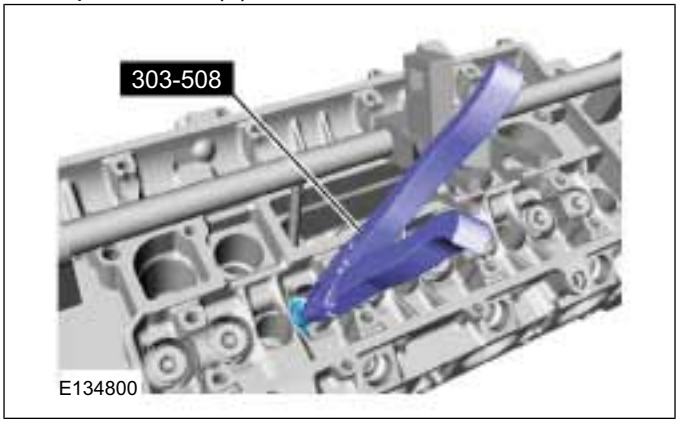
Special Tool(s)

 E62757	303-361B Compressor, Valve Spring
 E62041	303-361B-06 Adapter for 303-361B
 21156	303-362 Installer, Valve Stem Collets
 21211	303-508 Pliers, Valve Stem Seal

Removal

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

1. Refer to: Camshafts (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
2. 
E66111
3. Special Tool(s): 303-361B, 303-361B-06, 303-362


E134799
4. Special Tool(s): 303-508


E134800

Installation

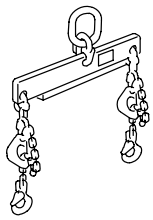
1. To install, reverse the removal procedure.

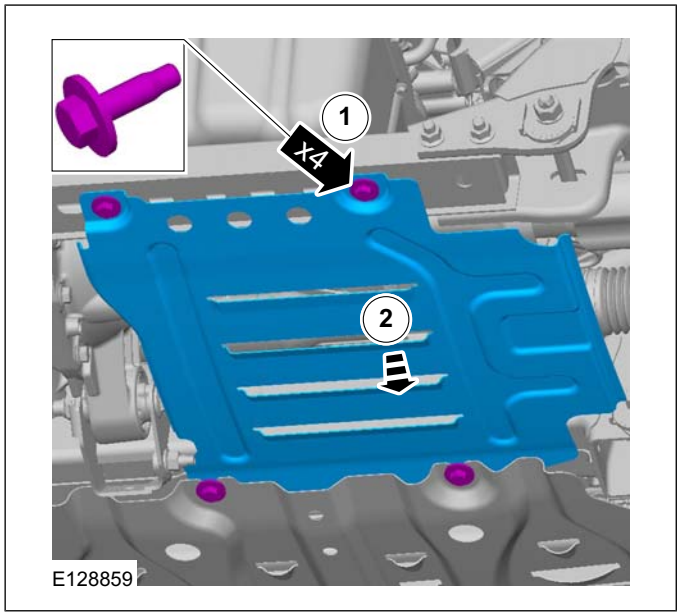
REMOVAL

Engine — Vehicles With: 5-Speed Manual Transmission - MT75(21 132 0; 21 132 6; 21 132 7)

Removal

Special Tool(s) / General Equipment

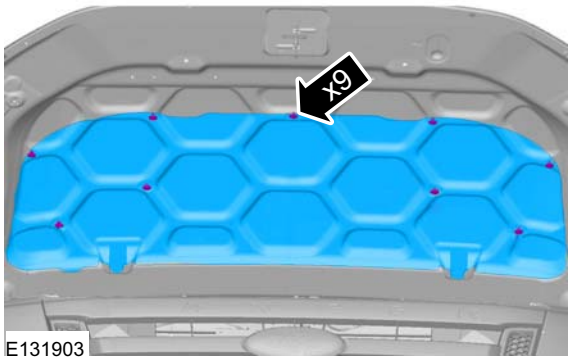
 21068A	303-122 Lifting Bracket, Engine
Hydraulic Jib Crane	
Transmission Jack	

1. Refer to: Cooling System Draining, Filling and Bleeding (303-03 Engine Cooling, General Procedures).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Refer to: Starter Motor (303-06 Starting System - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
5. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).
6. Refer to: Brake System Health and Safety Precautions (100-00 General Information, Description and Operation).
7. Refer to: Fuel System Pressure Release (310-00 Fuel System - General Information - 2.5L Duratec-HE (122kW/165PS) - MI4, General Procedures).
8. 

E128859

REMOVAL

9.



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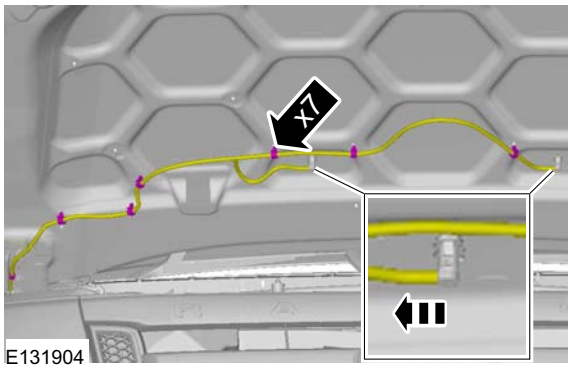

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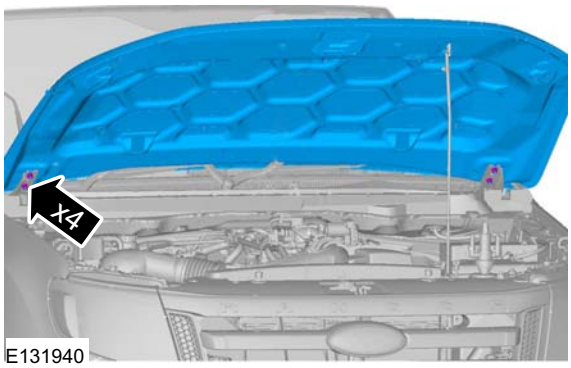
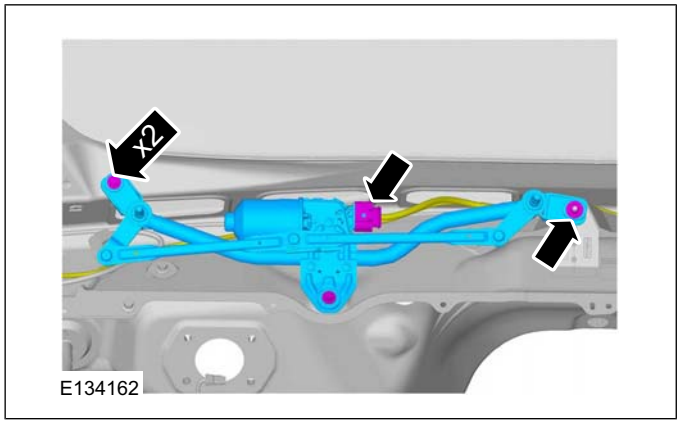
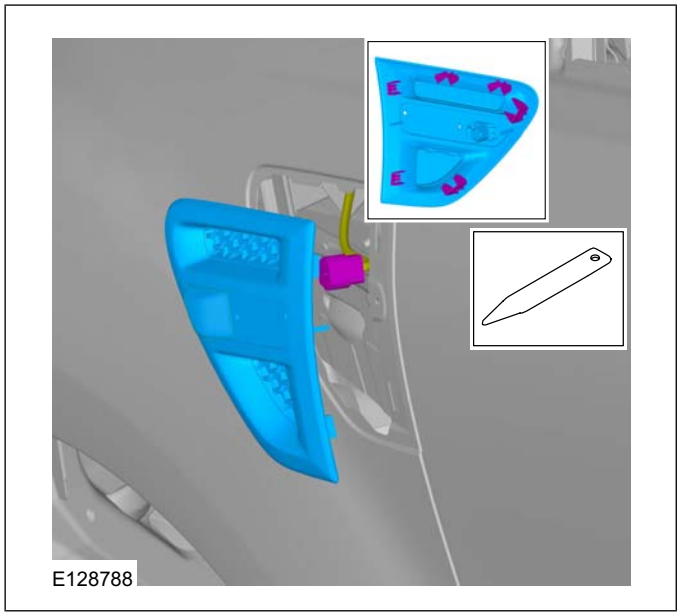


12. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

13.



14. On both sides.



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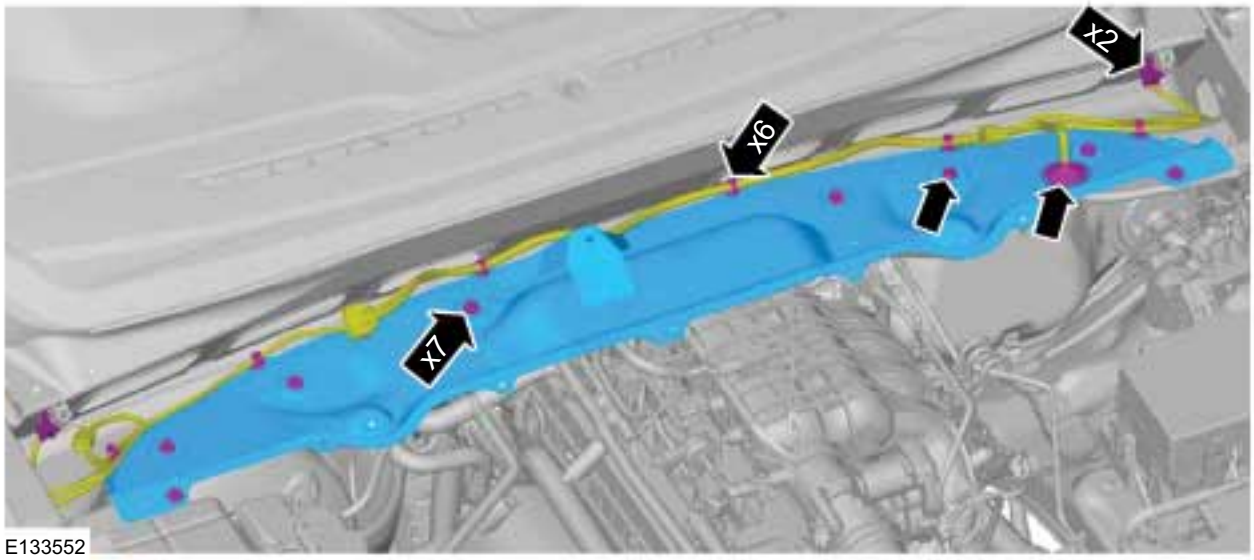
REMOVAL



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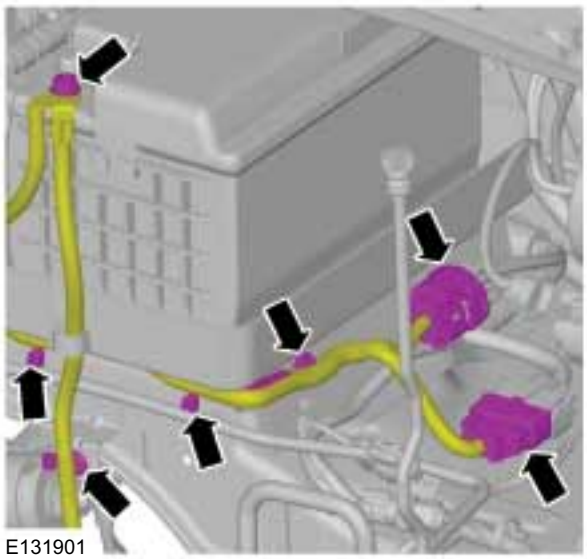

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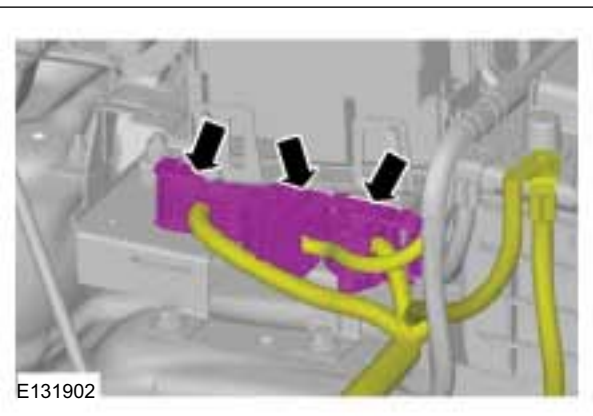

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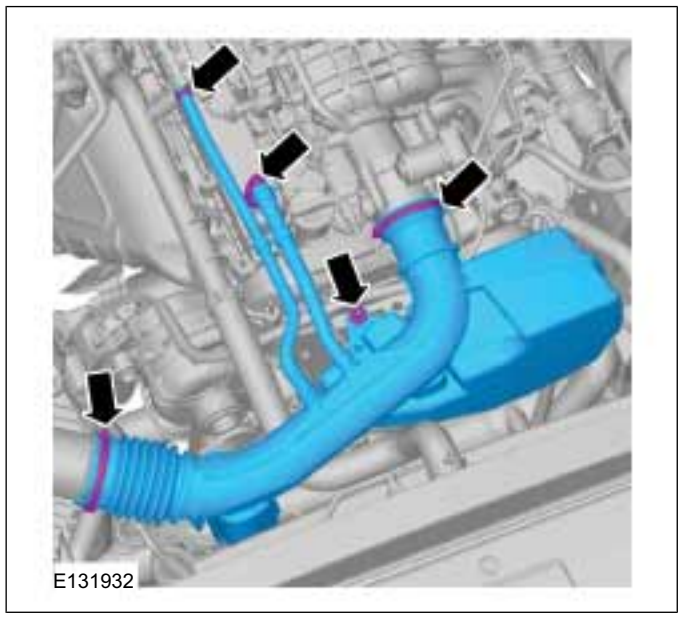
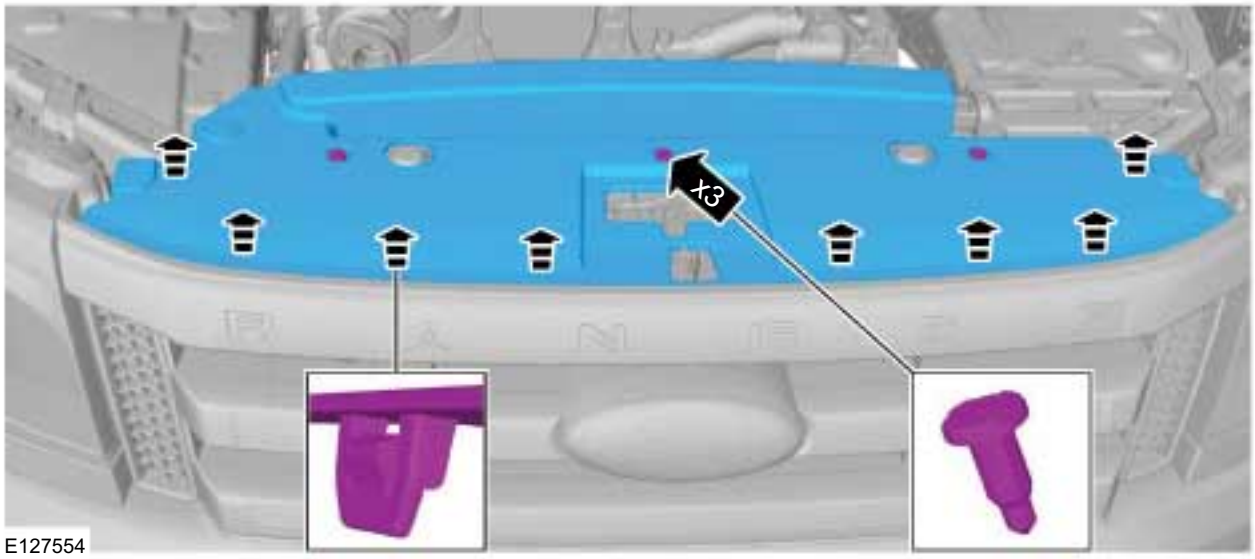


19.

REMOVAL



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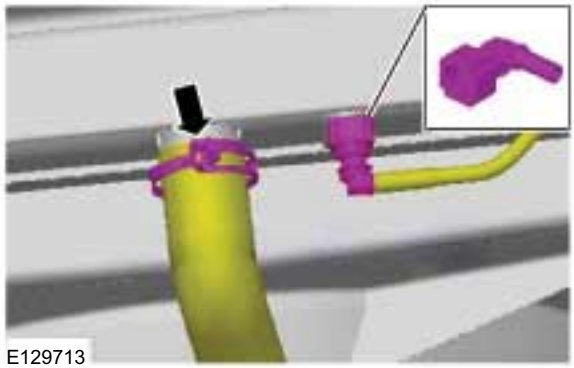

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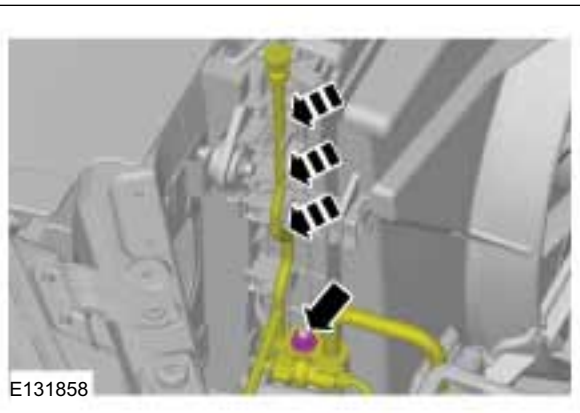

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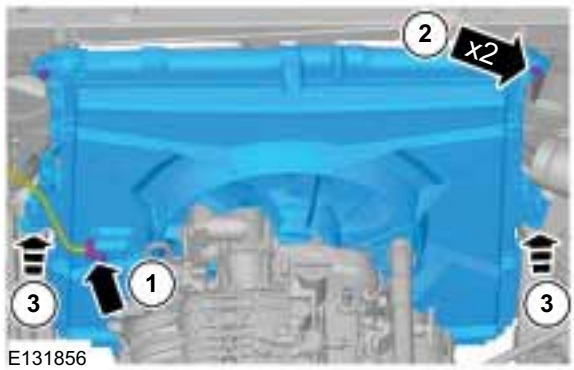
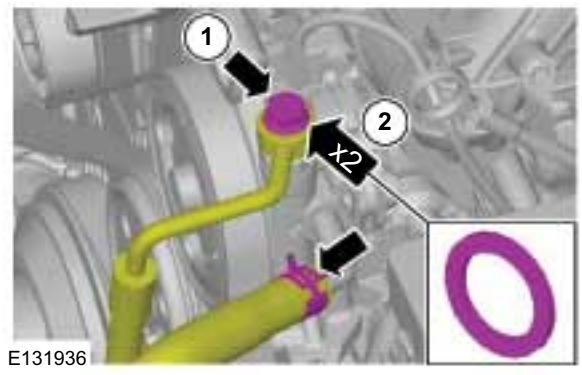


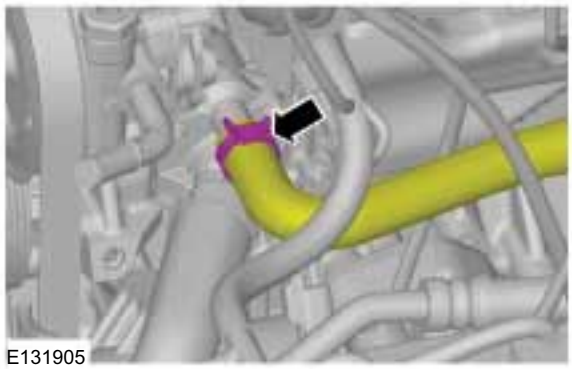
23. **WARNING: Be prepared to collect escaping fluids.**

CAUTION: Make sure that all openings are sealed.



REMOVAL

24.



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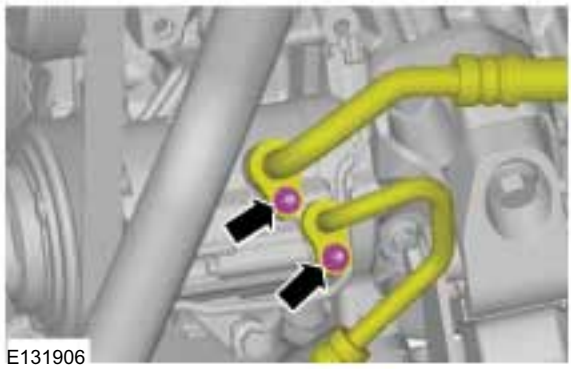

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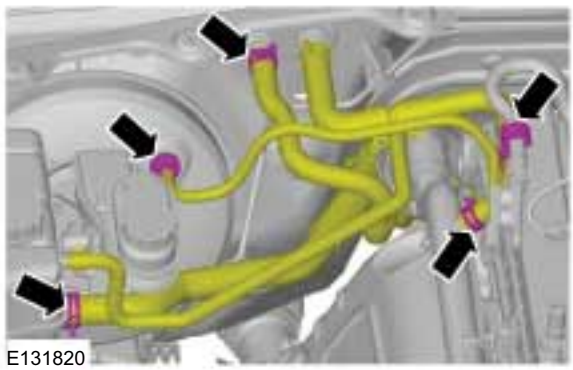

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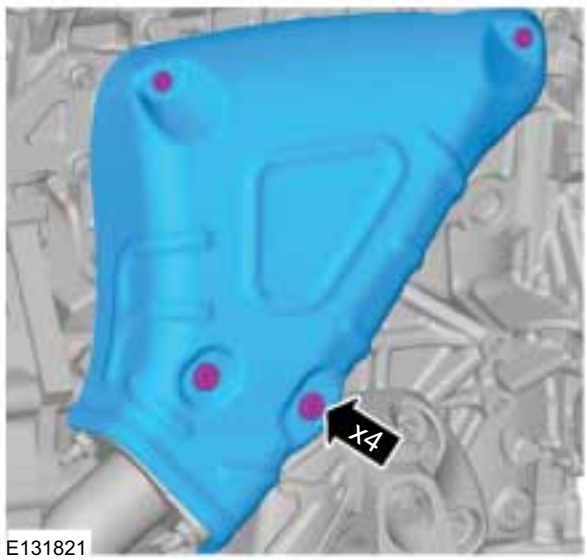
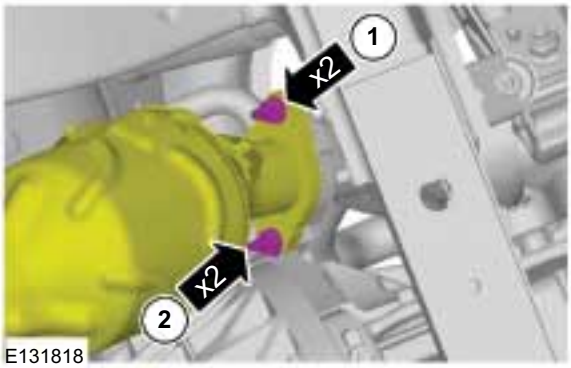


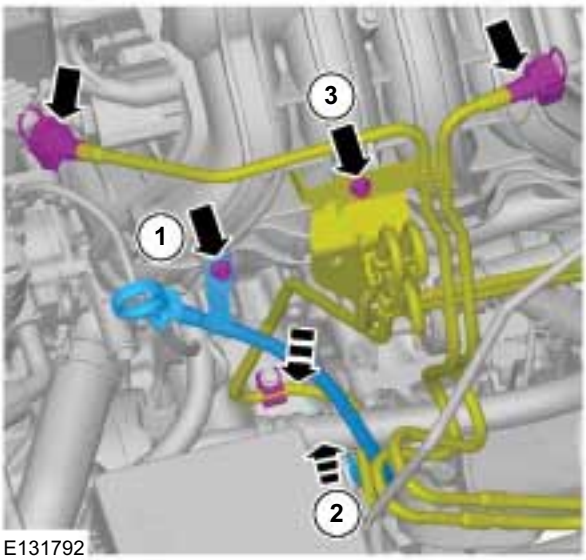
28. CAUTIONS:

- **Over bending the exhaust flexible pipe may cause damage resulting in failure.**
- **Make sure that the catalytic converter is supported with suitable retaining straps.**



REMOVAL

29.



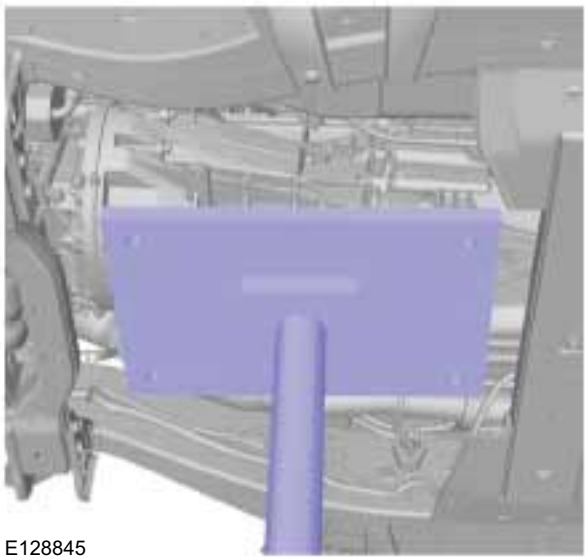
30.

31. **WARNING: Make sure that transmission assembly is on wooden blocks and secured with suitable retaining straps.**

CAUTION: Do not tilt the transmission. This may cause damage to the pilot bearing.

Tie and support the transmission to the chassie with a suitable strap.

General Equipment: Transmission Jack



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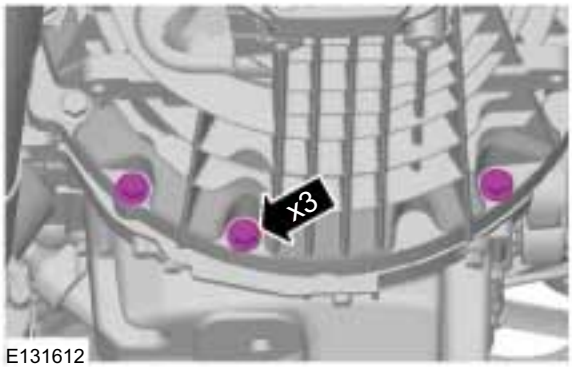

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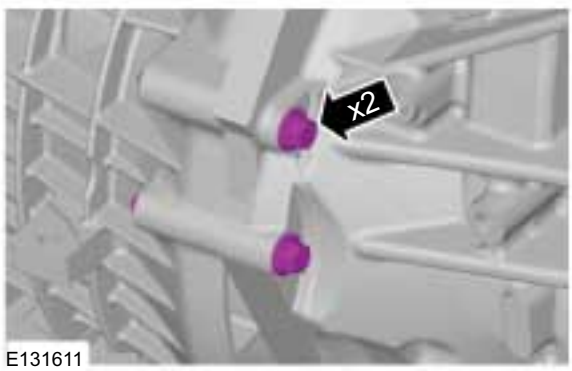
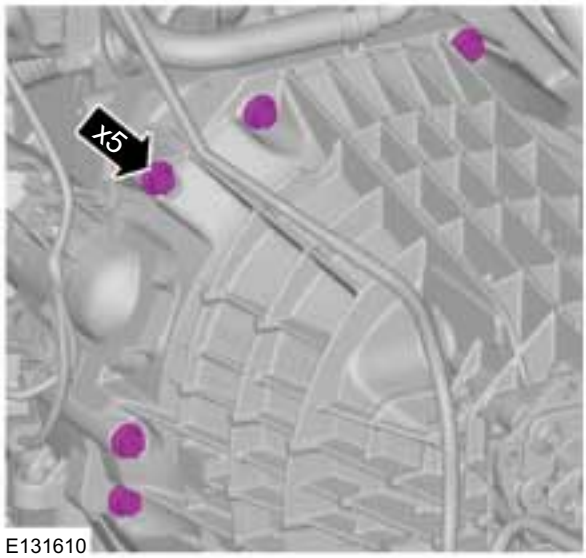


REMOVAL

34.

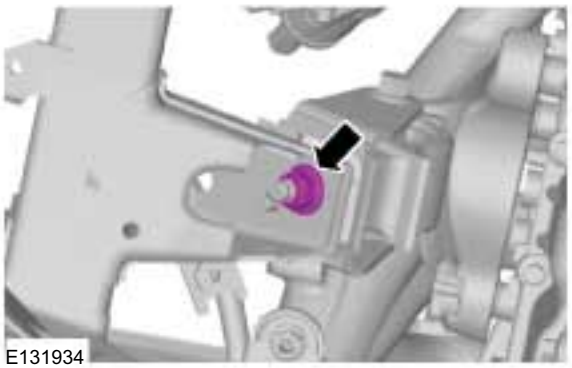


E131610

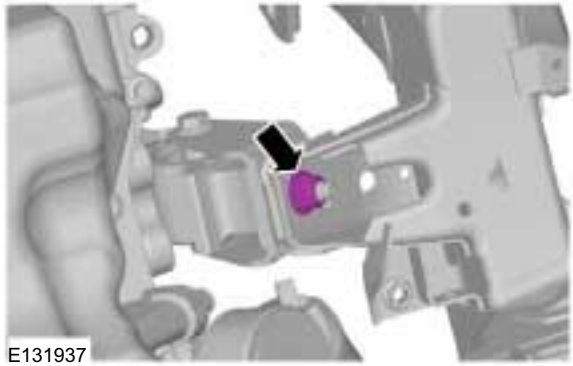
35.


E131935

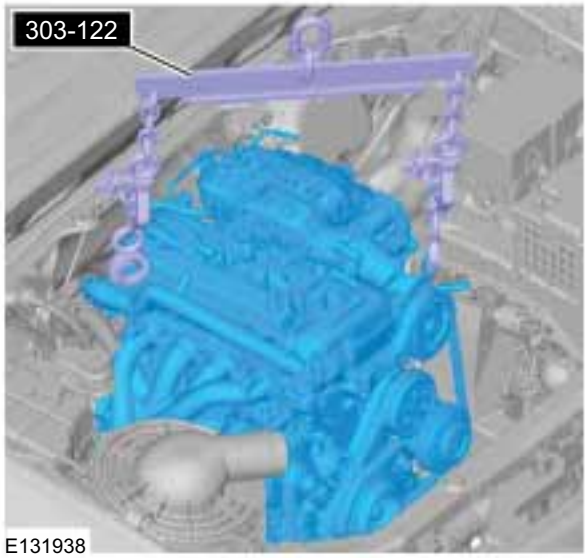
36.


E131934

37.

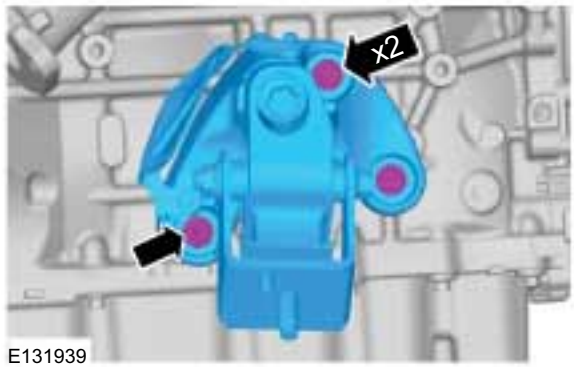

E131937

38. Special Tool(s): 303-122
General Equipment: Hydraulic Jib Crane



E131938

39.



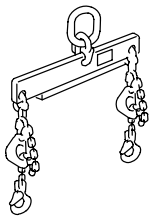
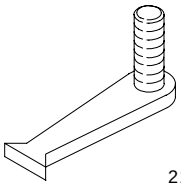
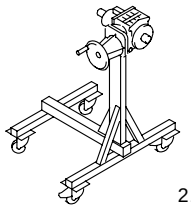
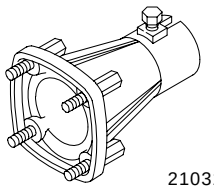
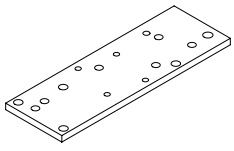
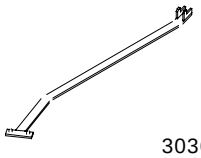
E131939

REMOVAL

Engine Accessories(21 139 4)

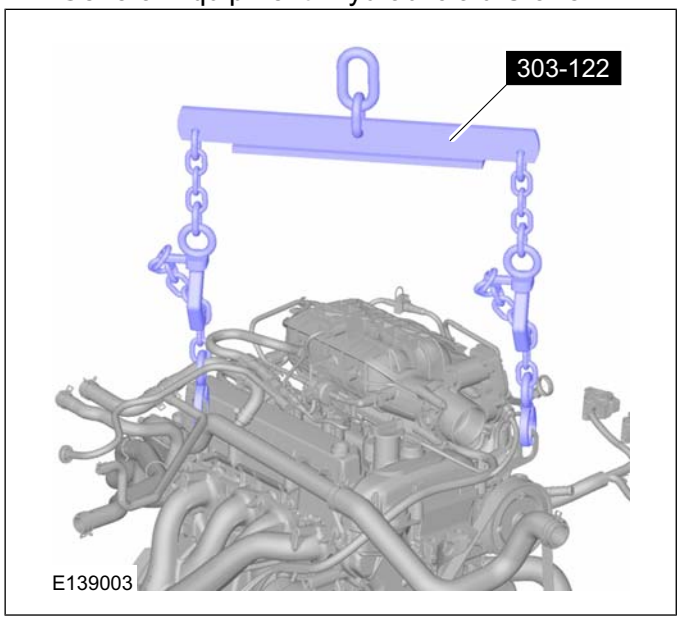
Removal

Special Tool(s) / General Equipment

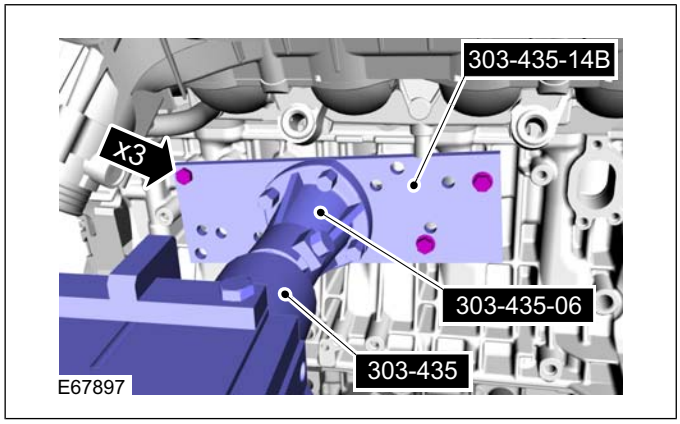
 21068A	303-122 Lifting Bracket, Engine
 21135	303-254 Locking Tool, Flywheel
 21187	303-435 Mounting Stand
 21031B	303-435-06 Mounting Bracket for 303-435
 E62805	303-435-14B Mounting Plate for 303-435-06
 303676	303-676 Release Tool, Belt Tensioner
Hydraulic Jib Crane	

All vehicles

1. Special Tool(s): 303-122
   General Equipment: Hydraulic Jib Crane

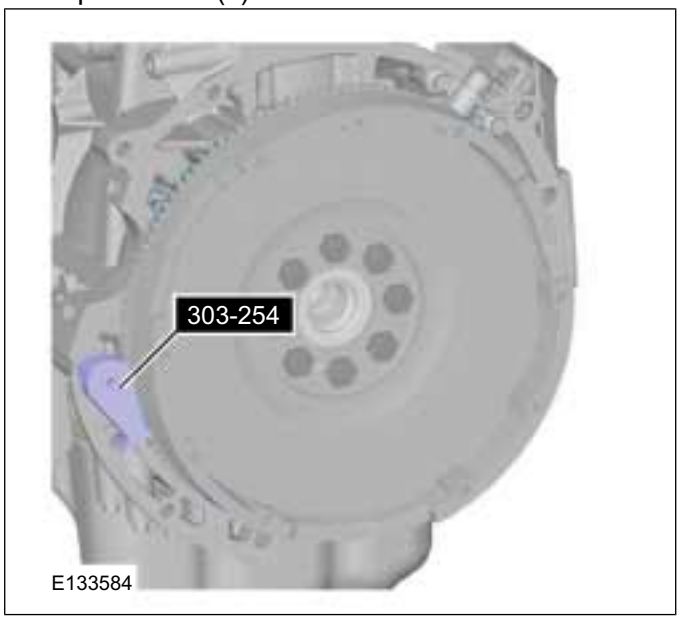


2. Special Tool(s): 303-435, 303-435-06, 303-435-14B

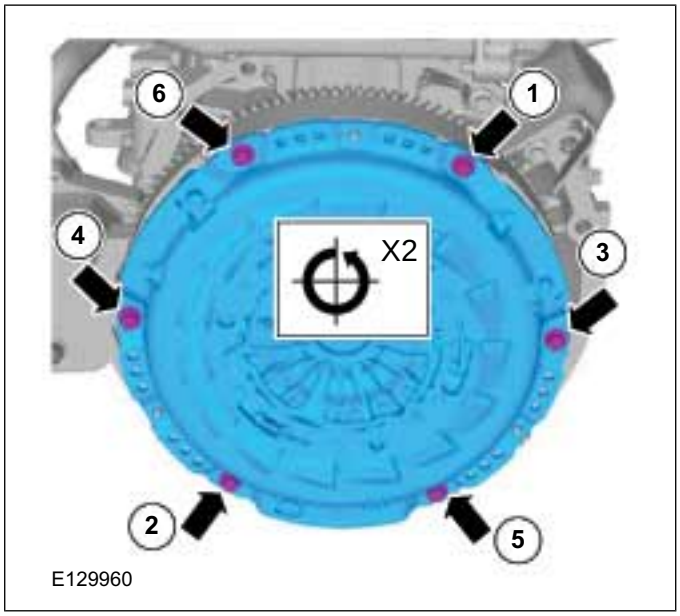


REMOVAL

3. Special Tool(s): 303-254

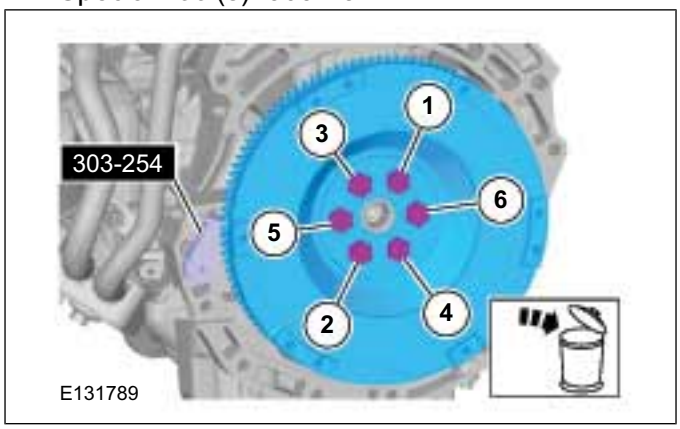


4. ⚠ **CAUTION: Loosen the clutch pressure plate retaining bolts by two turns at a time in the sequence shown.**

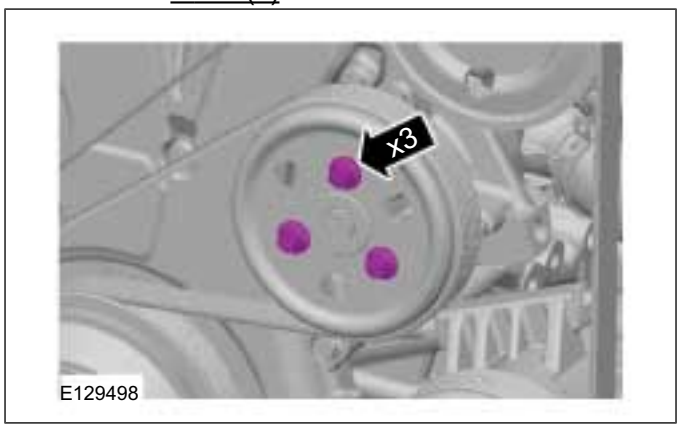


5. Discard the flywheel bolts.

Special Tool(s): 303-254

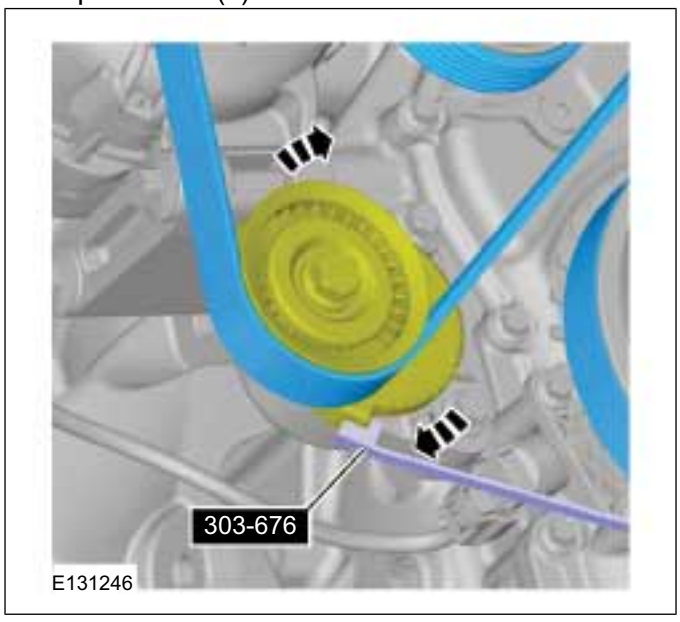


6. Loosen: 3 turn(s)



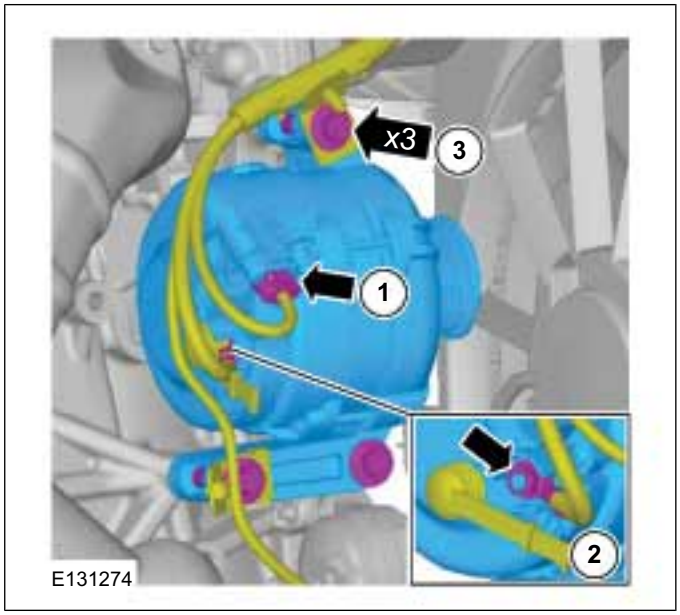
7. Rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt.

Special Tool(s): 303-676

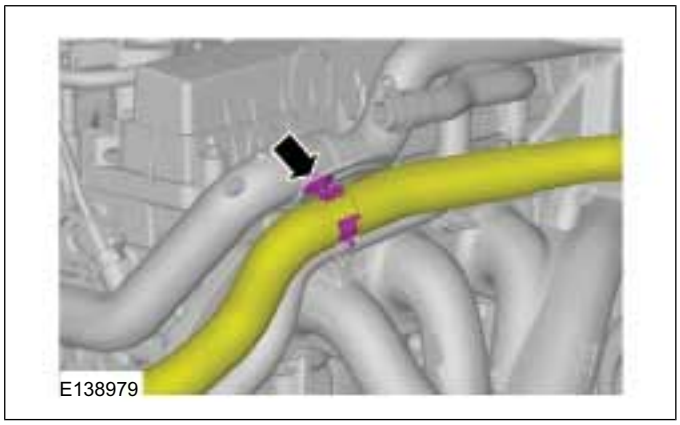


REMOVAL

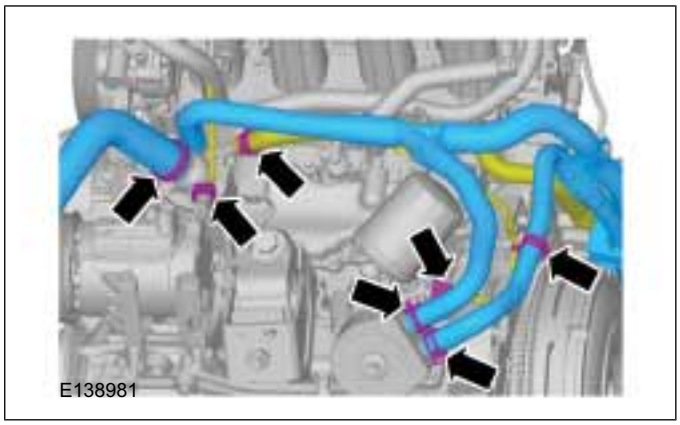
8. ⚠ **CAUTION: Take extra care not to damage the wiring harnesses.**



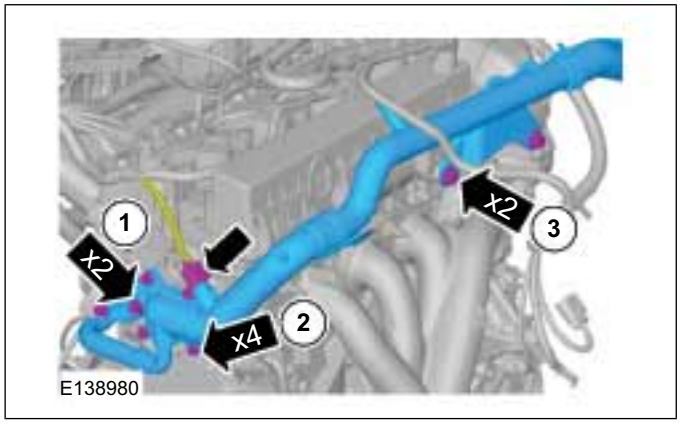
9.



10. **NOTE:** Make sure that the hoses are installed to the noted removal position.



11. **NOTE:** Make sure that the hoses are installed to the noted removal position.



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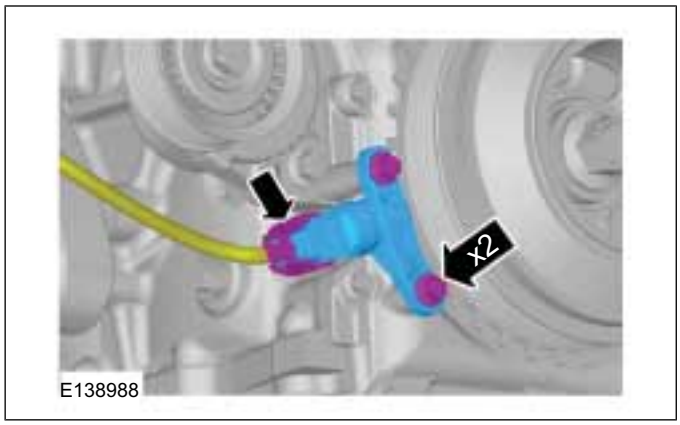
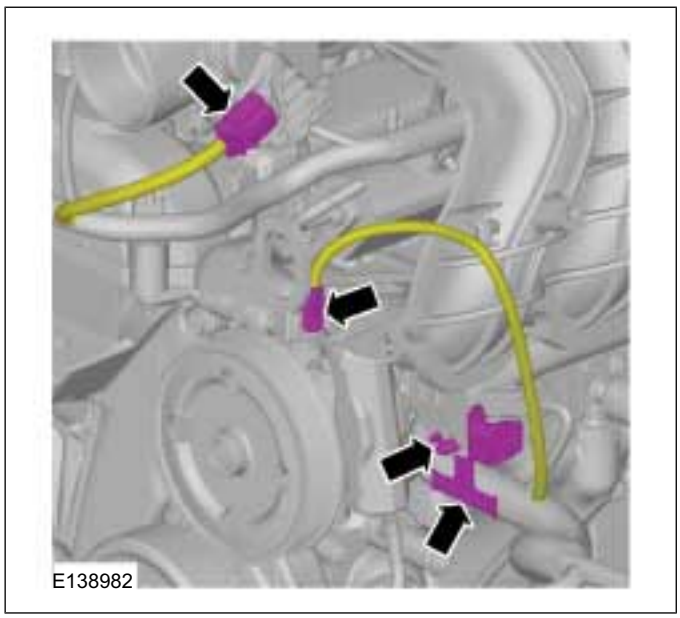


13.



REMOVAL

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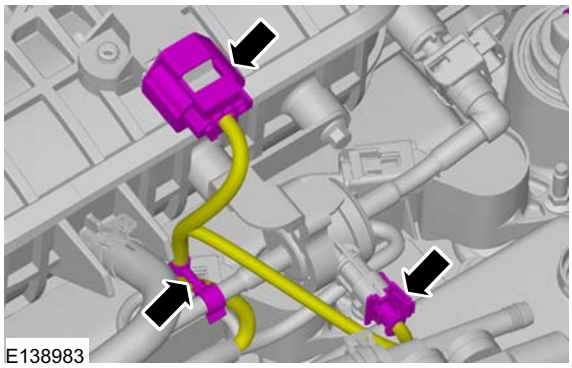

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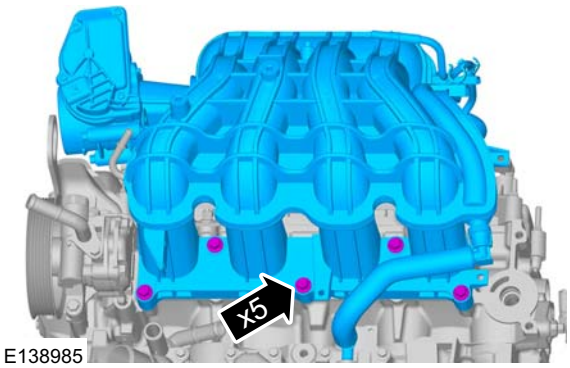

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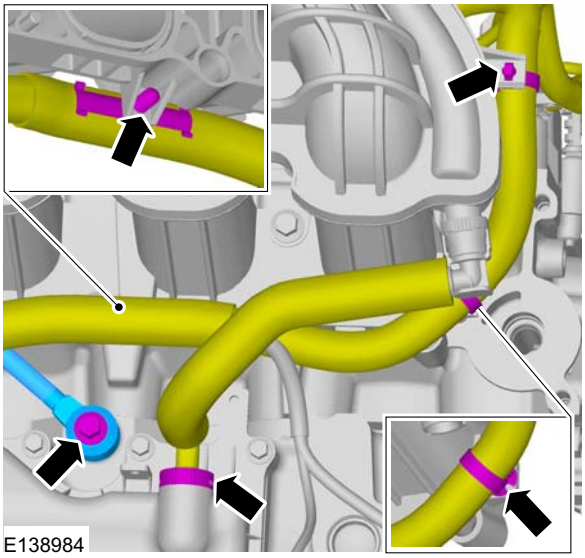

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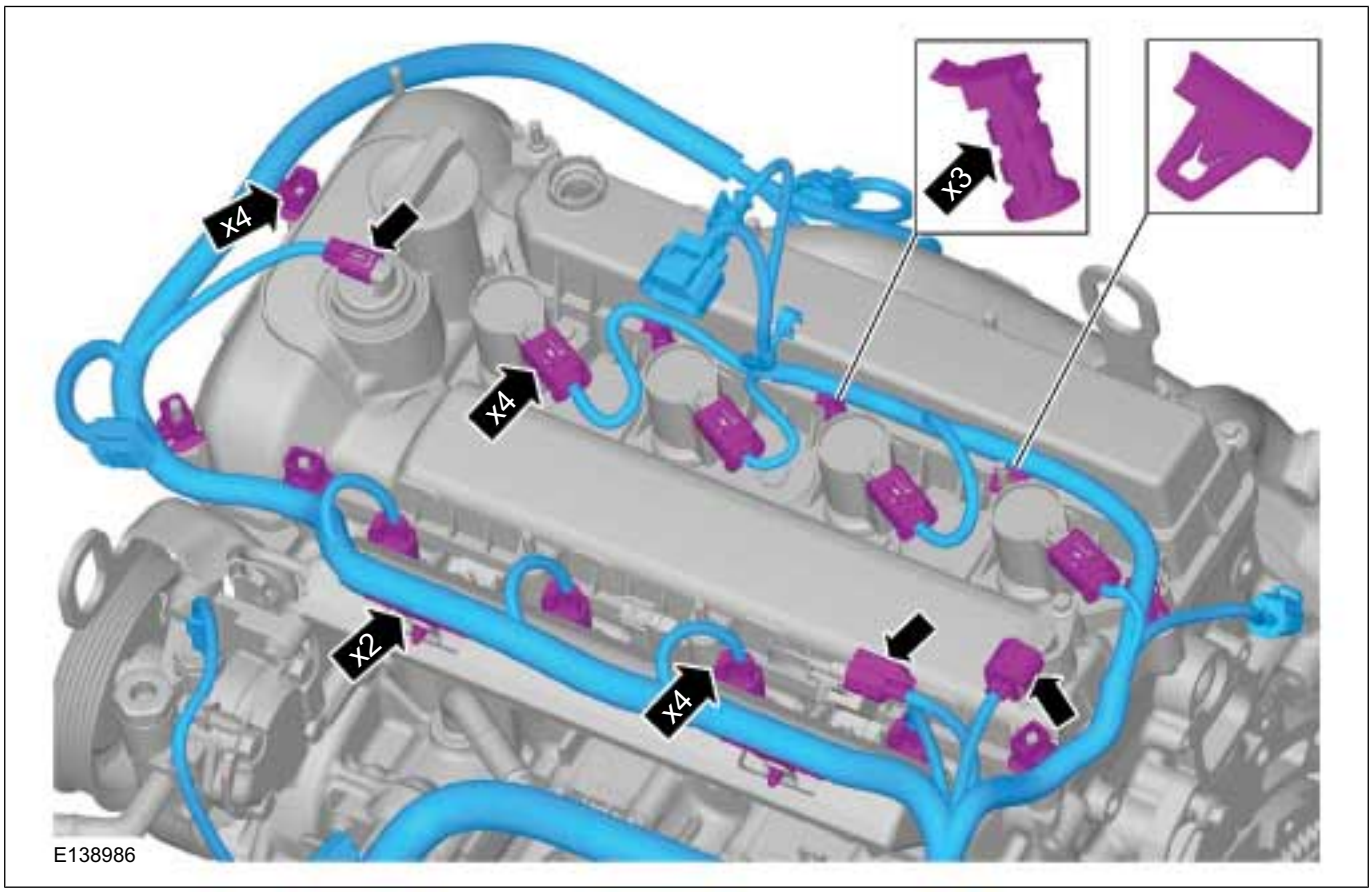

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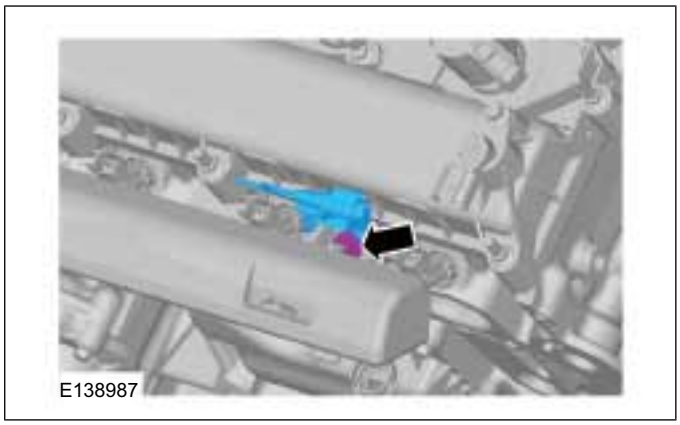

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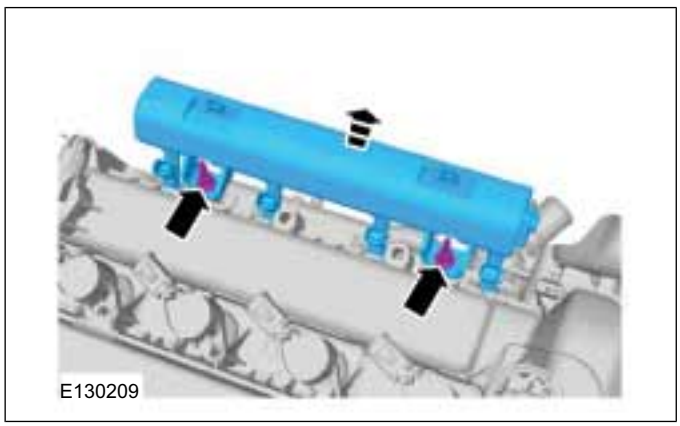

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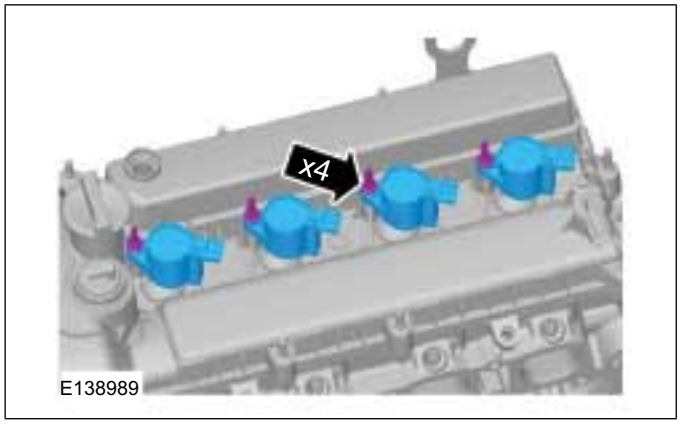

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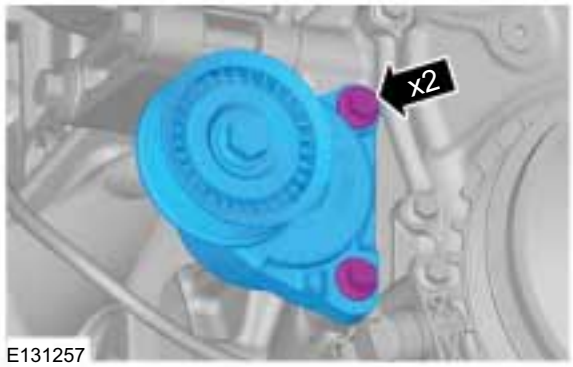

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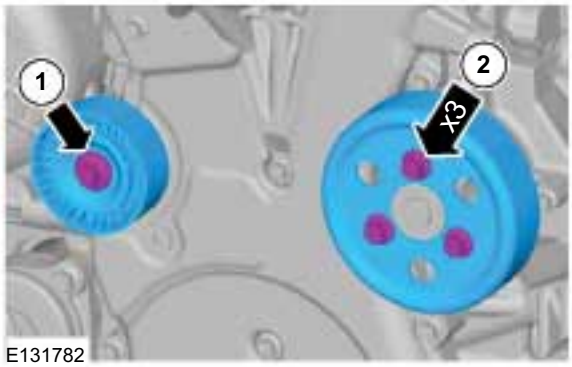

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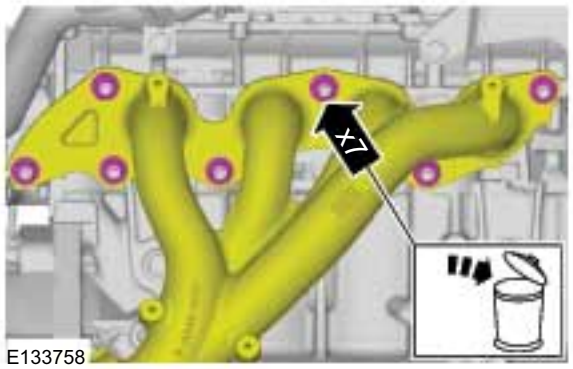

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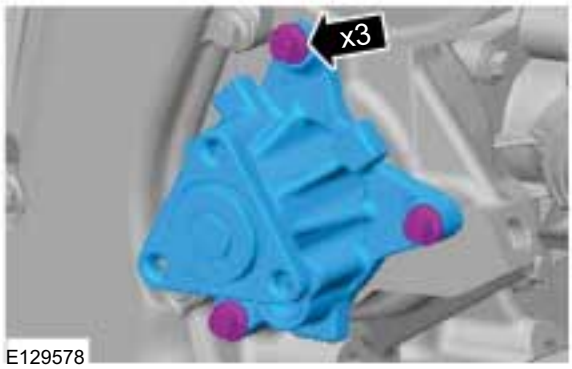

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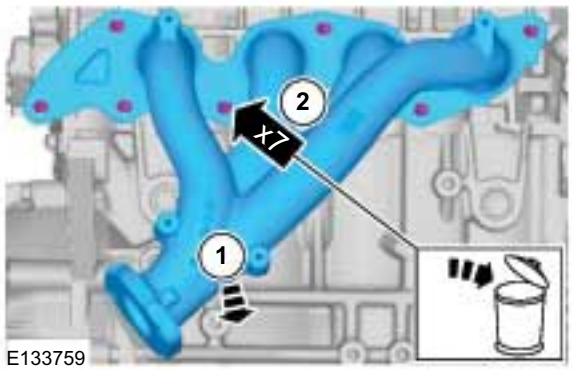

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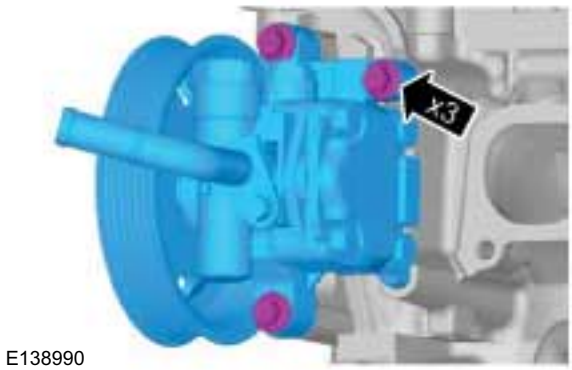

REMOVAL

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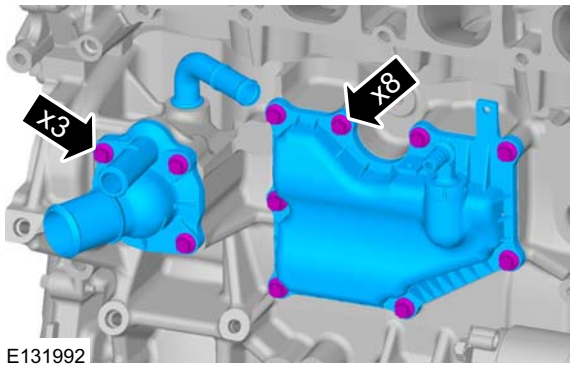

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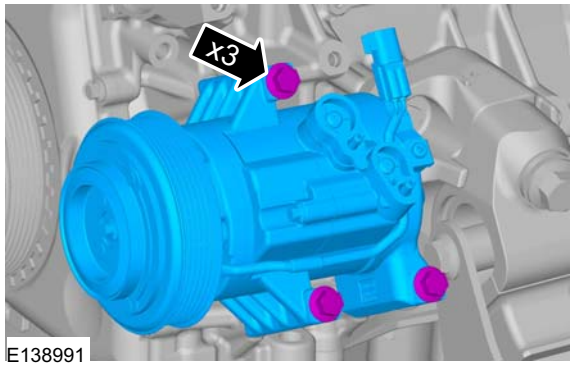

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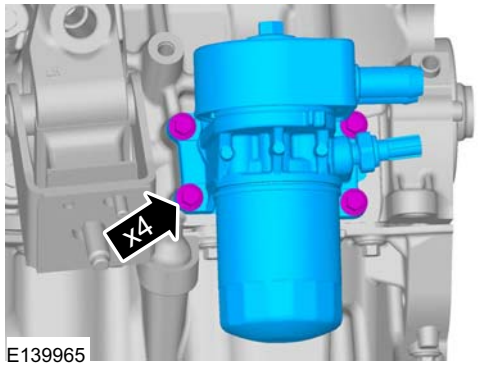

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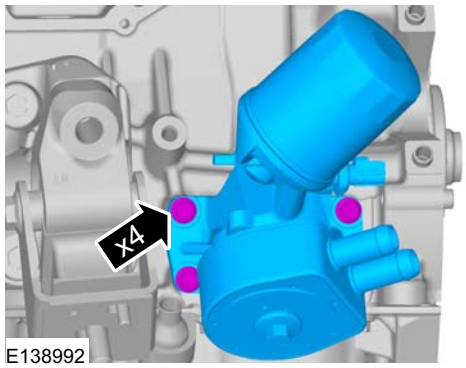
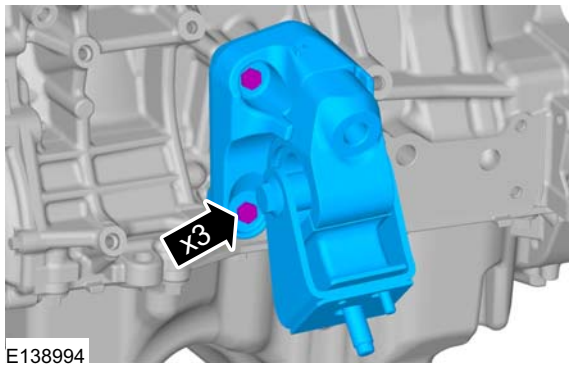


All vehicles

31.

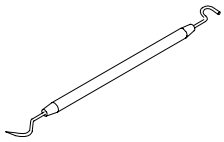
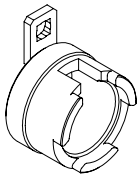
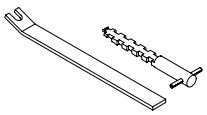
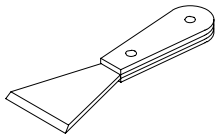
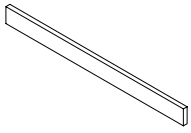


DISASSEMBLY

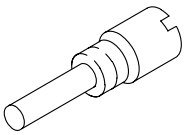
Engine(21 134 8)

Disassembly

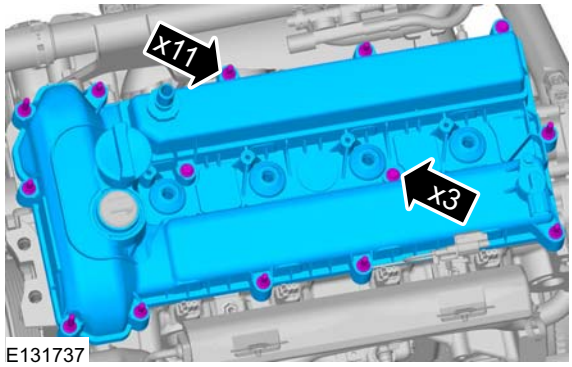
Special Tool(s) / General Equipment

 17063	100-010 Remover, O-Ring Seal
 E134674	303-1416 Tool, Crank Damper Holding
 E134603	303-409 Remover Crankshaft Seal
 21179	303-428 Separator, Oil Pan
 E139375	303-462 Installer, Connecting Rod
 E134673	303-465 Tool, Camshaft Align Timing

Special Tool(s) / General Equipment

 PZ21210	303-507 Timing Peg, Crankshaft TDC
2 mm Punch	

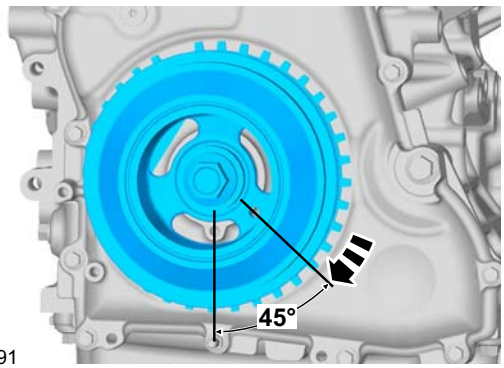
1.



E131737

2. ⚠ **CAUTION: Only rotate the crankshaft clockwise.**

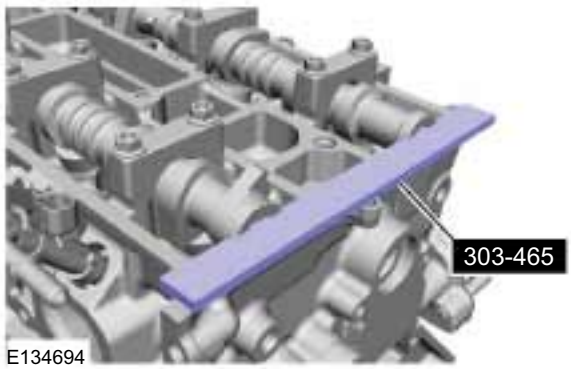
Rotate the crankshaft until piston No. 1 is approximately 45 degrees before top dead center (TDC).



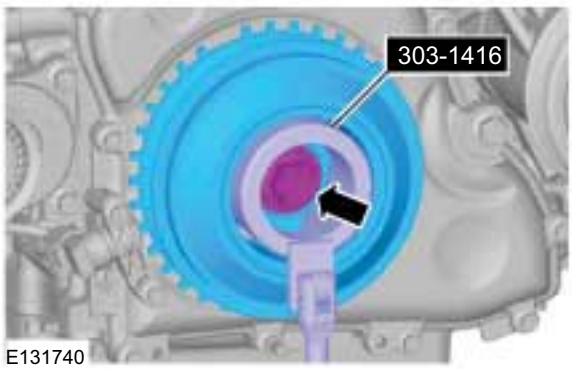
E131991

DISASSEMBLY

3. Special Tool(s): 303-465



6. Special Tool(s): 303-1416



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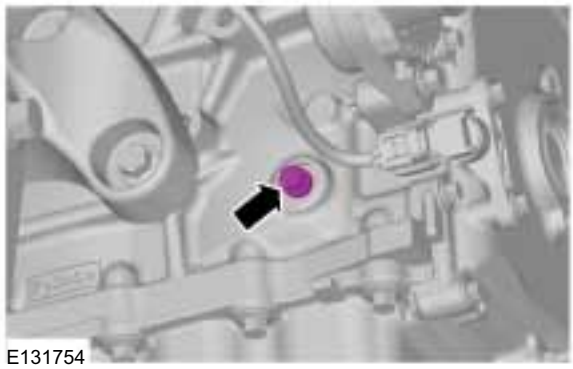
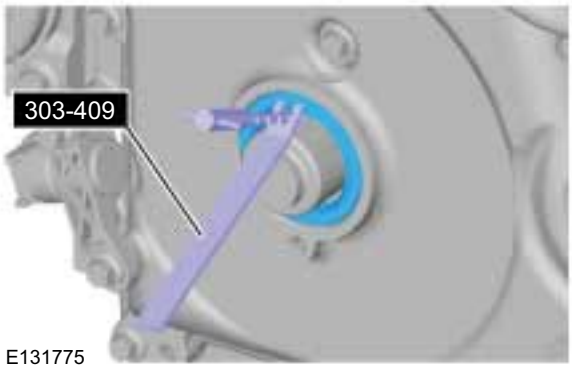


7. Special Tool(s): 303-409



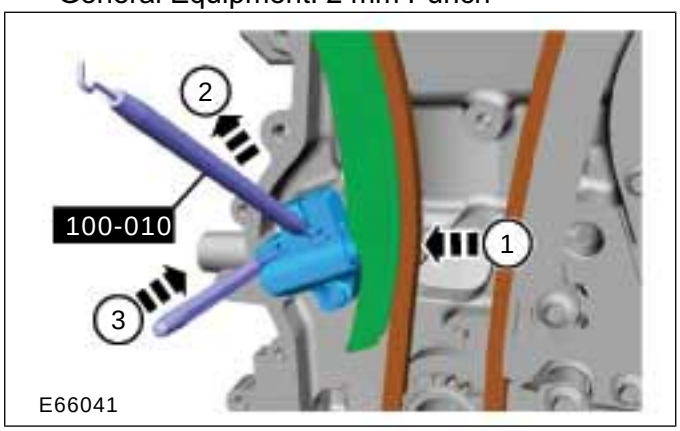
5. Special Tool(s): 303-507

8. Discard the friction washer.

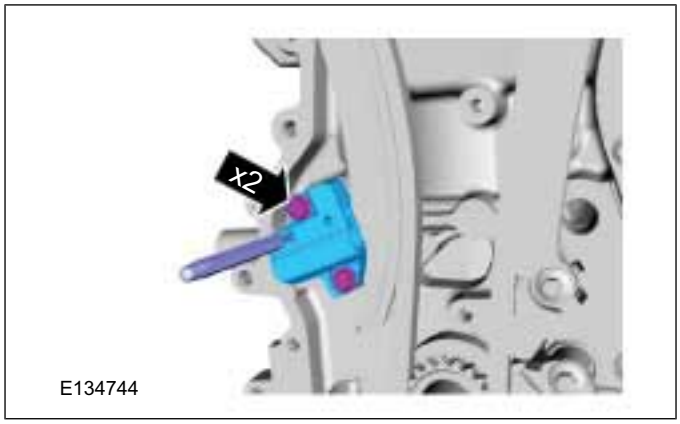
DISASSEMBLY

9.

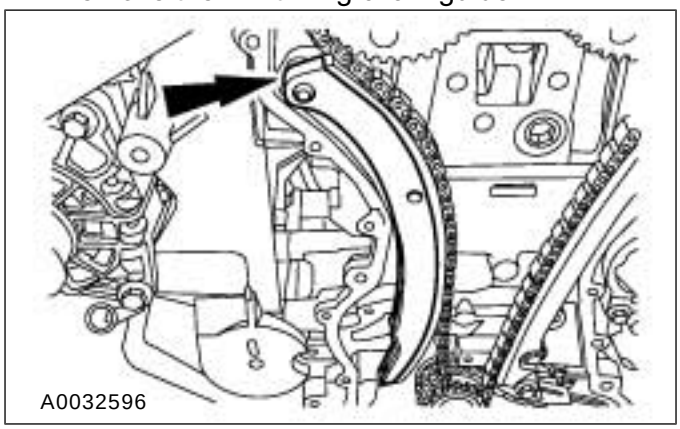
10. Special Tool(s): 100-010
General Equipment: 2 mm Punch



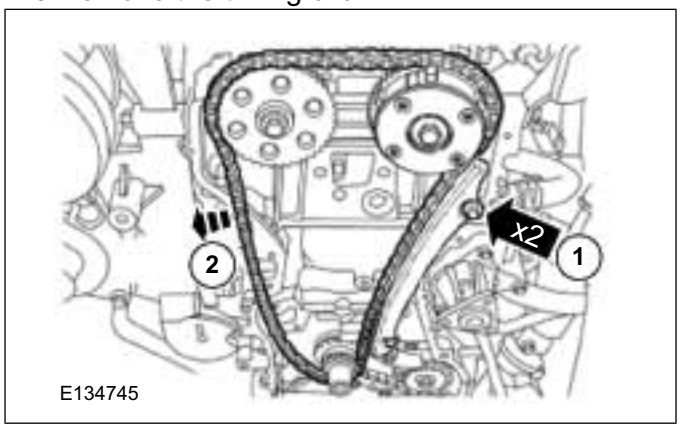
11.



12. Remove the RH timing chain guide.



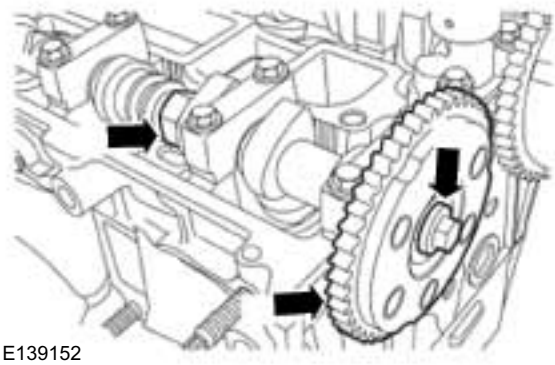
13. Remove the timing chain.



14. ⚠ **CAUTION: Use an open-ended wrench to hold the camshafts by the hexagon to prevent the camshafts from turning.**

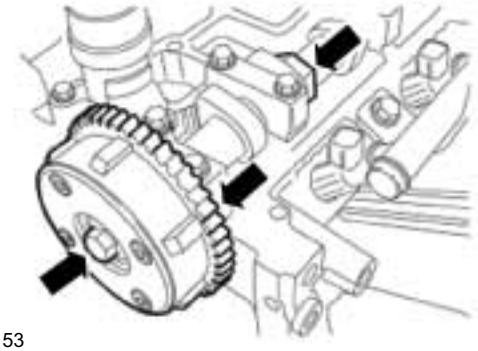
DISASSEMBLY

Remove the bolt and the exhaust camshaft sprocket.

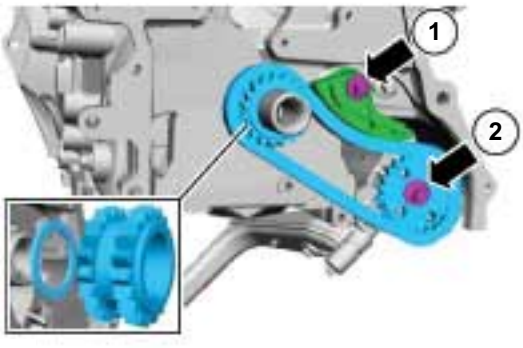

E139152

15. ⚠ **CAUTION: Use an open-ended wrench to hold the camshafts by the hexagon to prevent the camshafts from turning.**

Remove the bolt and the camshaft phaser and sprocket.

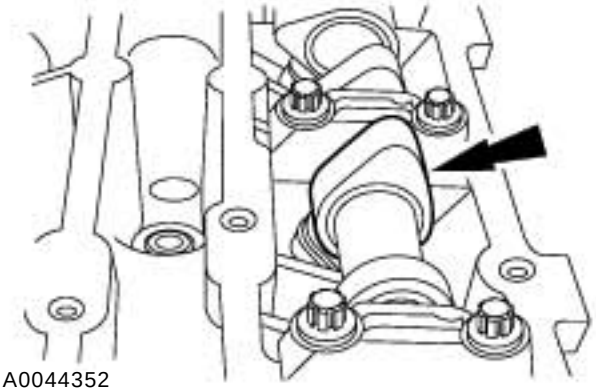

E139153

16. ⚠ **CAUTION: Make sure that a new friction washer is installed.**

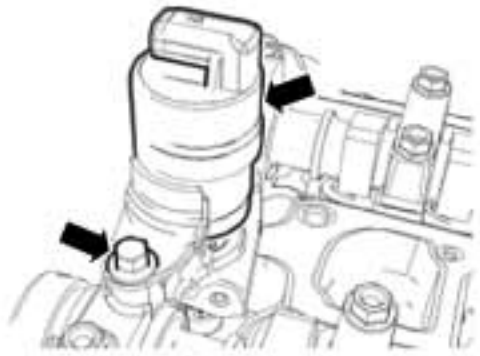


E134760

17. Mark the position of the camshaft lobes on the No. 1 cylinder for assembly reference.


A0044352

18. Remove the bolt and the VCT solenoid.

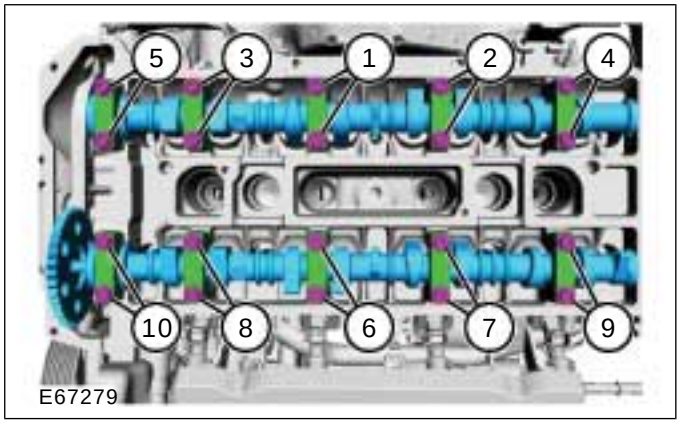

E139154

19. Remove the plug and the VCT system oil filter from the intake camshaft thrust cap.

20. ⚠ **CAUTION: Failure to follow the camshaft loosening procedure can result in damage to the camshafts.**

DISASSEMBLY

NOTE: Mark the location and orientation of each camshaft bearing cap.

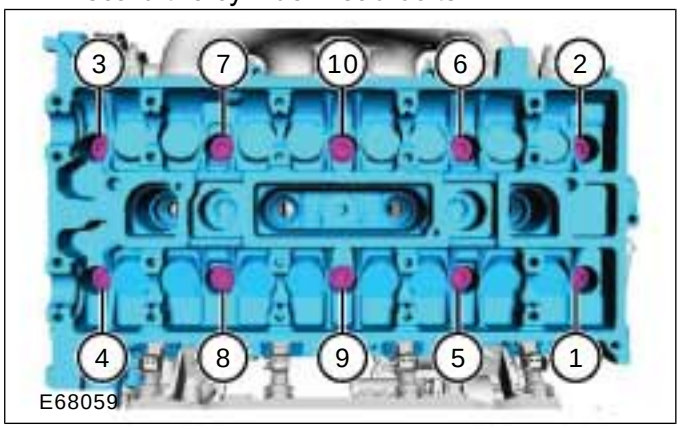


21. **NOTE:** If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions.

    NOTE: The number on the valve tappets only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

    Remove and inspect the valve tappets.

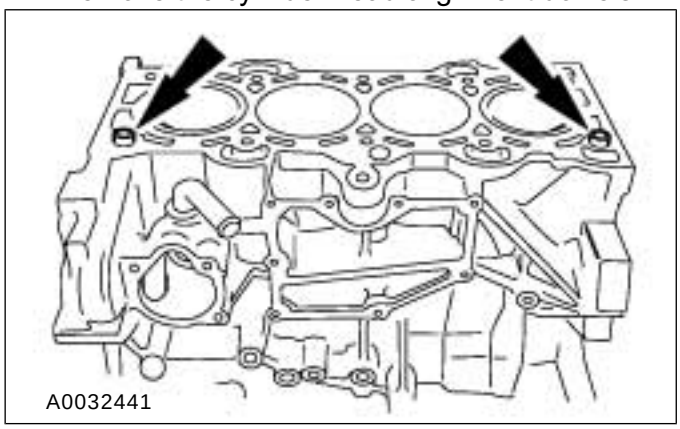
22. Discard the cylinder head bolts.



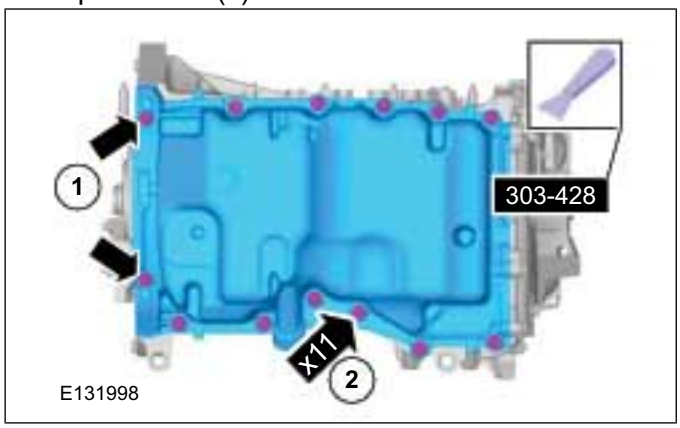
23. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion.

    Refer to: Cylinder Head Distortion (303-00 Engine System - General Information, General Procedures).
    Refer to: Cylinder Block Distortion (303-00 Engine System - General Information, General Procedures).

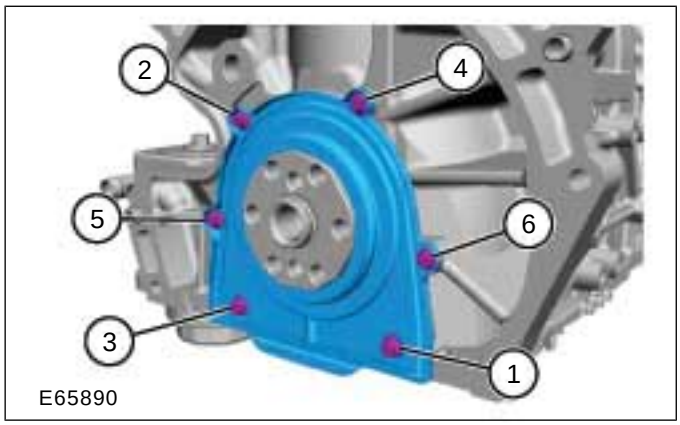
24. Remove the cylinder head alignment dowels.



25. Special Tool(s): 303-428

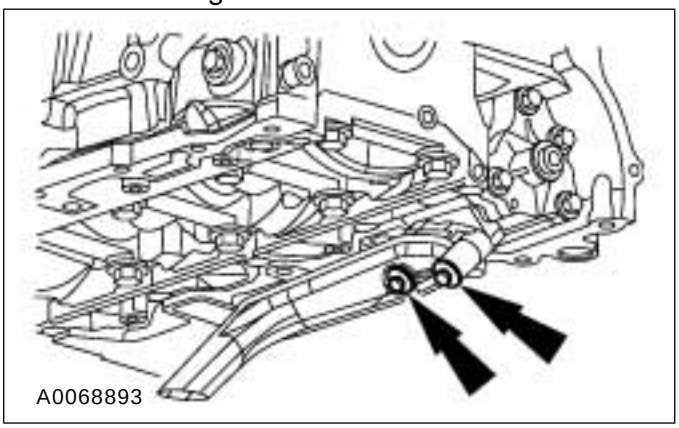


26.

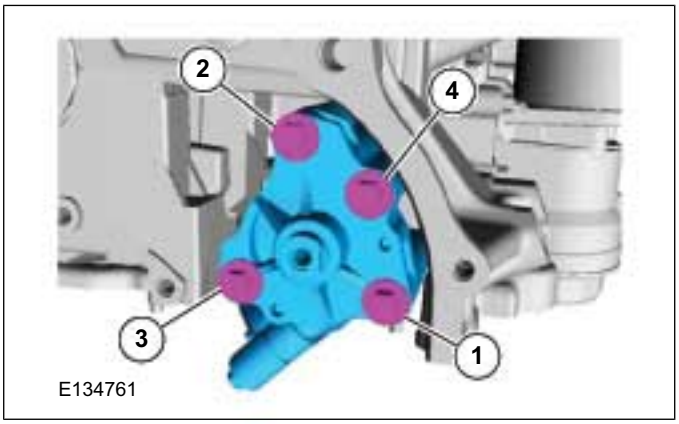


DISASSEMBLY

27. Remove the bolts, oil pump pickup tube and discard the gasket.

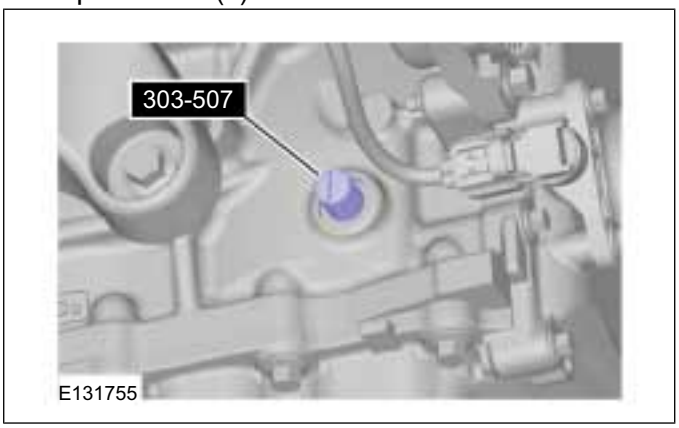


28.

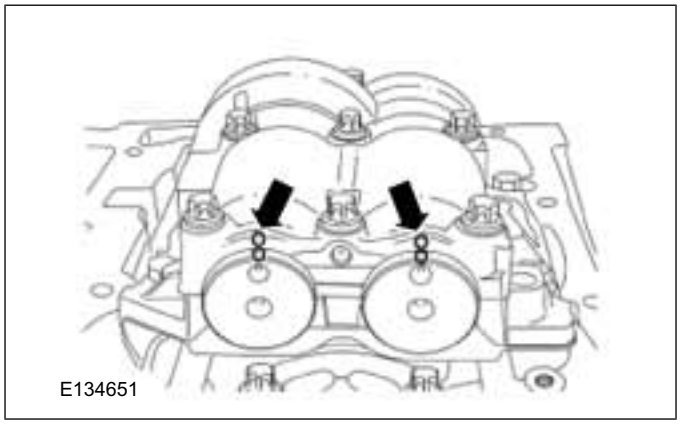


29. Rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the crankshaft TDC timing peg.

Special Tool(s): 303-507

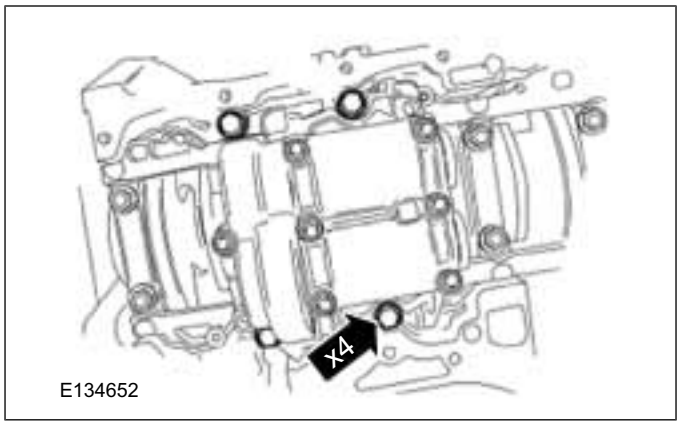


30. Mark the balancer unit front shafts on the top for reference that the balancer unit is at TDC.

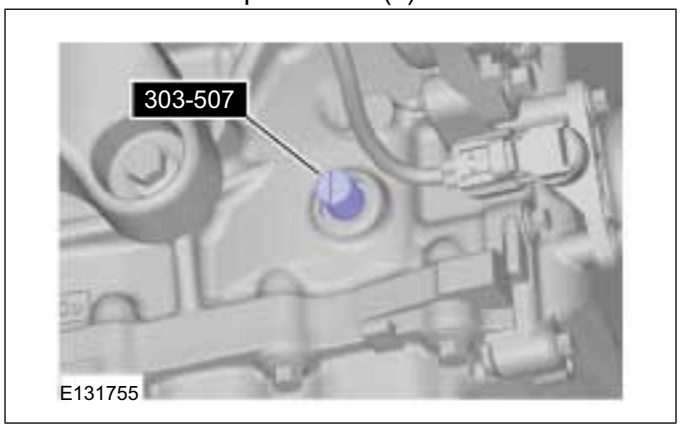


31. **NOTE:** Due to the precision interior construction of the balancer unit, it should not be disassembled.

Remove the 4 bolts and the balancer unit.



32. Remove the Special Tool(s): 303-507



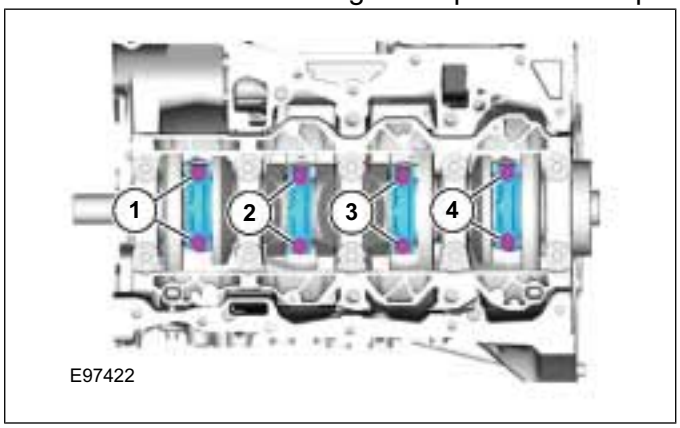
33. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following manufacturer's instructions.

34. **NOTE:** Clearly mark the connecting rods, connecting rod caps and connecting rod

DISASSEMBLY

bearings in numerical order for correct orientation for reassembly.

Remove the connecting rod cap bolts and cap.

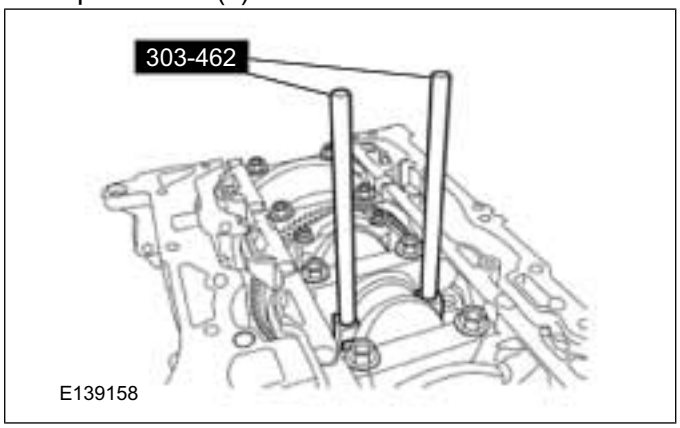


E97422

35. **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

Using the connecting rod installer, remove the piston or rod assembly from the engine block.

Special Tool(s): 303-462



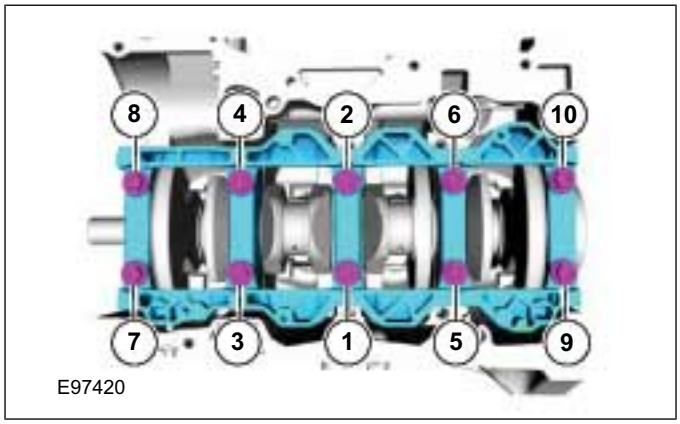
E139158

36. **NOTE:** Note the position of each component before removal.


E97390

37. Repeat the previous 2 steps until all the piston or rod assemblies are removed from the engine block.

38. • Remove the main bearing beam.
• Discard the bolts.



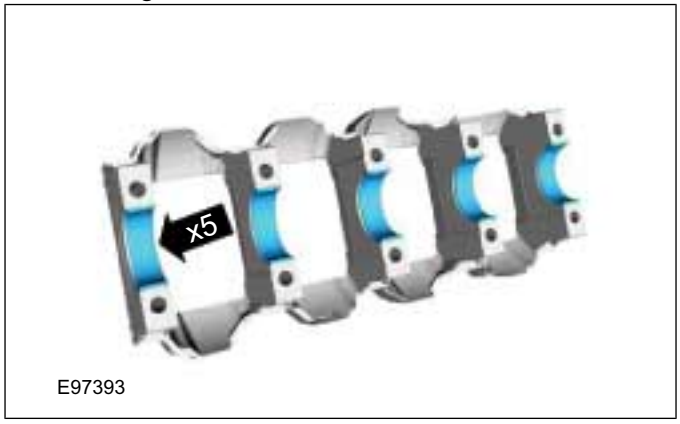
E97420

39. Remove the crankshaft from the engine block.


E97394

40. **NOTE:** If the main bearings are being reused, mark them in order for correct orientation and reassembly.

Remove the main bearings from the main bearing beam.



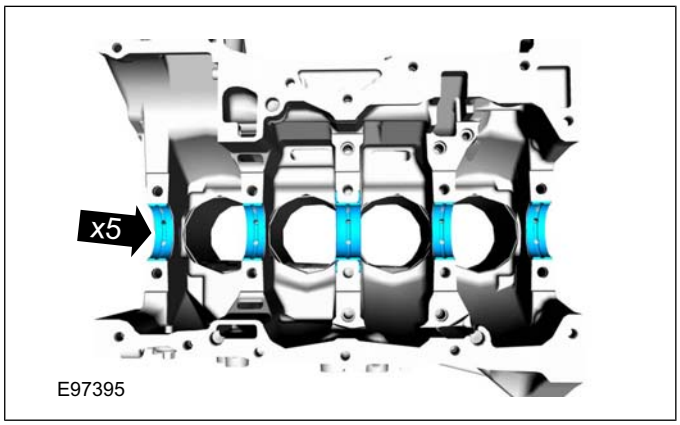
E97393

41. **NOTE:** If the main bearings are being reused, mark them in order for correct orientation and reassembly.

DISASSEMBLY

NOTE: The center bulkhead has the thrust bearing.

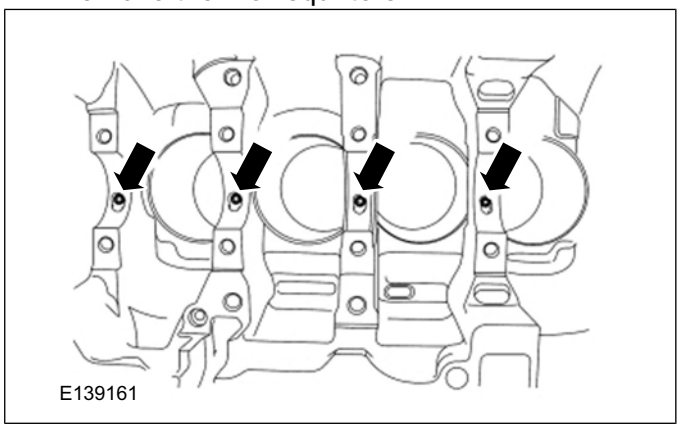
Remove the main bearings from the cylinder block.



42. **NOTE:** If the oil squirters are being reused, mark them in order for correct location during reassembly.

NOTE: The front bulkhead does not have an oil squirter.

Remove the 4 oil squirters.



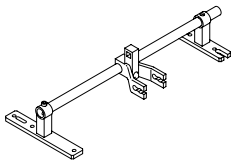
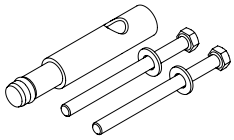
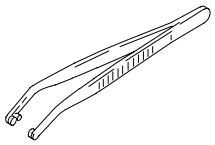
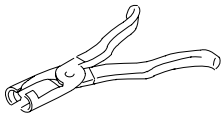
43. Inspect the cylinder block, main bearing beam, pistons and connecting rods.

Refer to: Piston Inspection (303-00 Engine System - General Information, General Procedures).
Refer to: Bearing Inspection (303-00 Engine System - General Information, General Procedures).
Refer to: Connecting Rod Large End Bore (303-00 Engine System - General Information, General Procedures).
Refer to: Cylinder Block Distortion (303-00 Engine System - General Information, General Procedures).

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Cylinder Head(21 165 6)

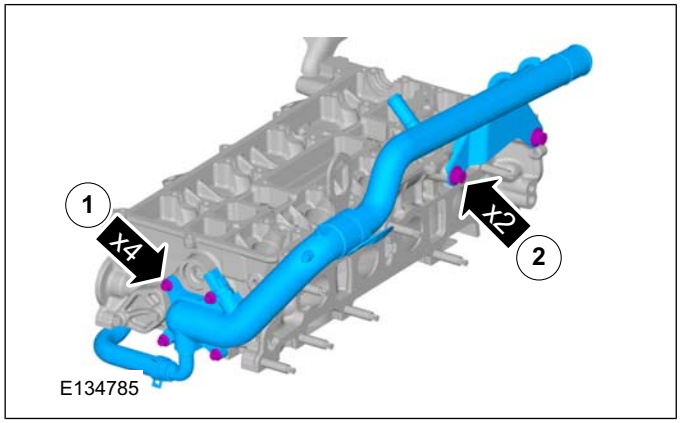
Special Tool(s)

 E62757	303-361B Compressor, Valve Spring
 E62041	303-361B-06 Adapter for 303-361B
 21156	303-362 Installer, Valve Stem Collets
 21211	303-508 Pliers, Valve Stem Seal

Disassembly

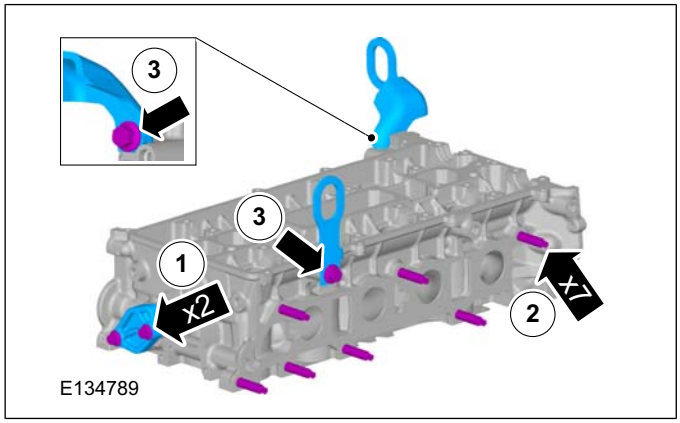
NOTE: Disassembly steps in this procedure may contain assembly details.

1. Refer to: Cylinder Head (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
2. 1. Torque: 10 Nm
   2. Torque: 48 Nm



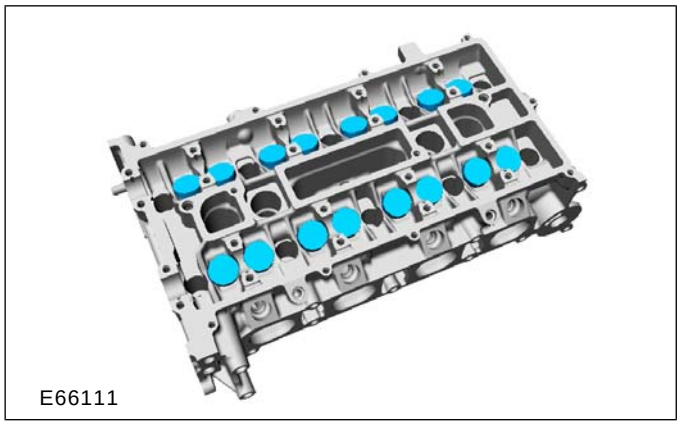
E134785

3. 1. Torque: 25 Nm
   2. Torque: 17 Nm
   3. Torque: 45 Nm



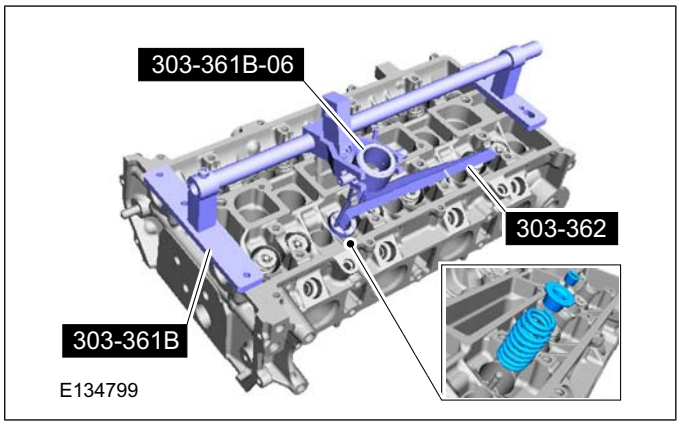
E134789

4.

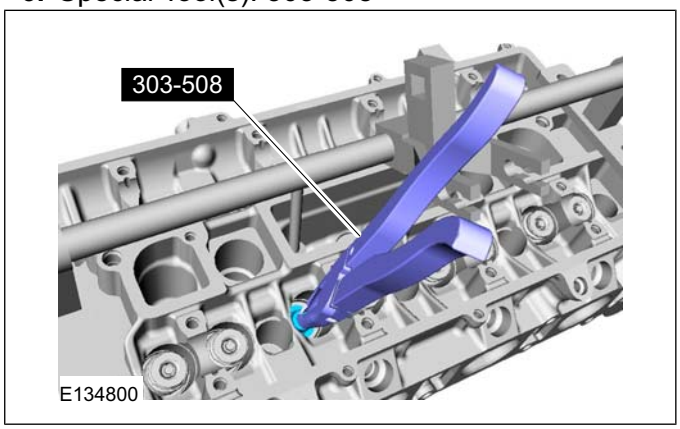

E66111

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

5. Special Tool(s): 303-361B, 303-361B-06, 303-362



6. Special Tool(s): 303-508



Assembly

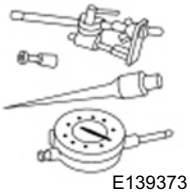
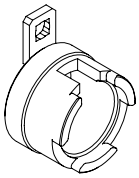
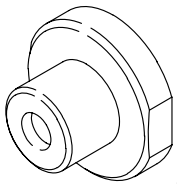
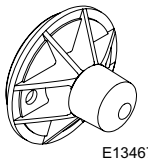
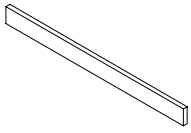
7. To assemble, reverse the disassembly procedure.

ASSEMBLY

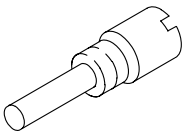
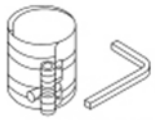
Engine(21 134 8)

Assembly

Special Tool(s)

 E139373	100-002 Holding Fixture with Dial Indicator Gauge
 E134674	303-1416 Tool, Crank Damper Holding
 21148	303-318 Aligner/Installer, Crankshaft Front Seal
 E134675	303-328 Replacer, Rear Oil Seal
 E139375	303-462 Installer, Connecting Rod
 E134673	303-465 Tool, Camshaft Align Timing

Special Tool(s)

 PZ21210	303-507 Timing Peg, Crankshaft TDC
 E139376	303-D032 Compressor, Piston Ring

Materials	
Name	**Specification**
Hypoid Oil 85W-90	SQ-M2C9002-AA / A72SX-19K261-CA
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

1. CAUTIONS:

Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools, otherwise severe engine damage may occur.

During engine repair procedures, cleanliness is extremely important. All parts must be thoroughly cleaned and any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages,

ASSEMBLY

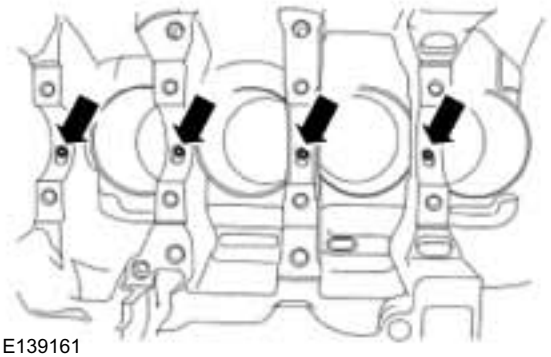
coolant passages or the oil pan, can cause engine failure.

NOTE: Assembly of the engine requires various inspections/measurements of the engine components (engine block, crankshaft, connecting rods, pistons and piston rings). These inspections/measurements will aid in determining if the engine components will require replacement.

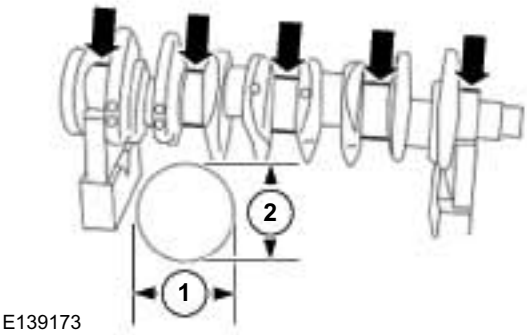
2. **NOTE:** If the oil squirters are being reused, they must be installed in the same location as marked during disassembly.

   NOTE: The front bulkhead does not have an oil squirter.

   Install the 4 oil squirters.
   Torque: 4 Nm

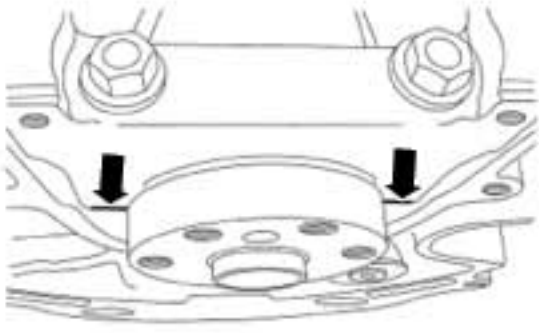

E139161

3. Measure each of the crankshaft main bearing journal diameters in at least 2 directions and record the smallest diameter for each journal.

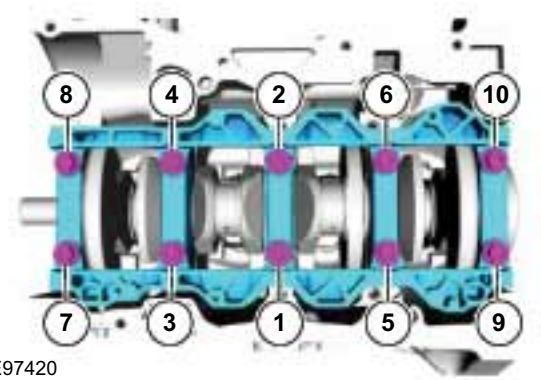


E139173

4. Position the main bearing beam in the engine block with the main bearing beam mounted flush with the rear face of the engine block.

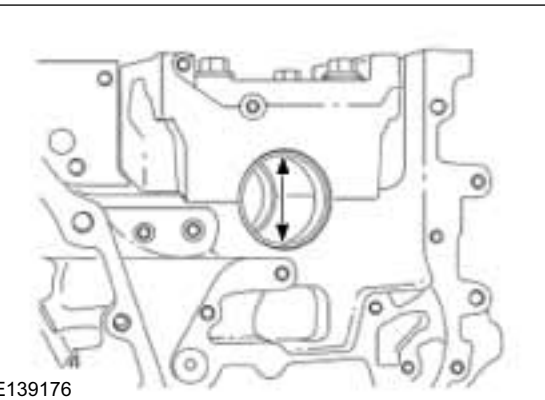

E139174

5. Using the original main bearing beam bolts, install and tighten the 10 main bearing beam bolts.
   Torque:
   - Stage 1: 5 Nm
   - Stage 2: 25 Nm
   - Stage 3: 90 °



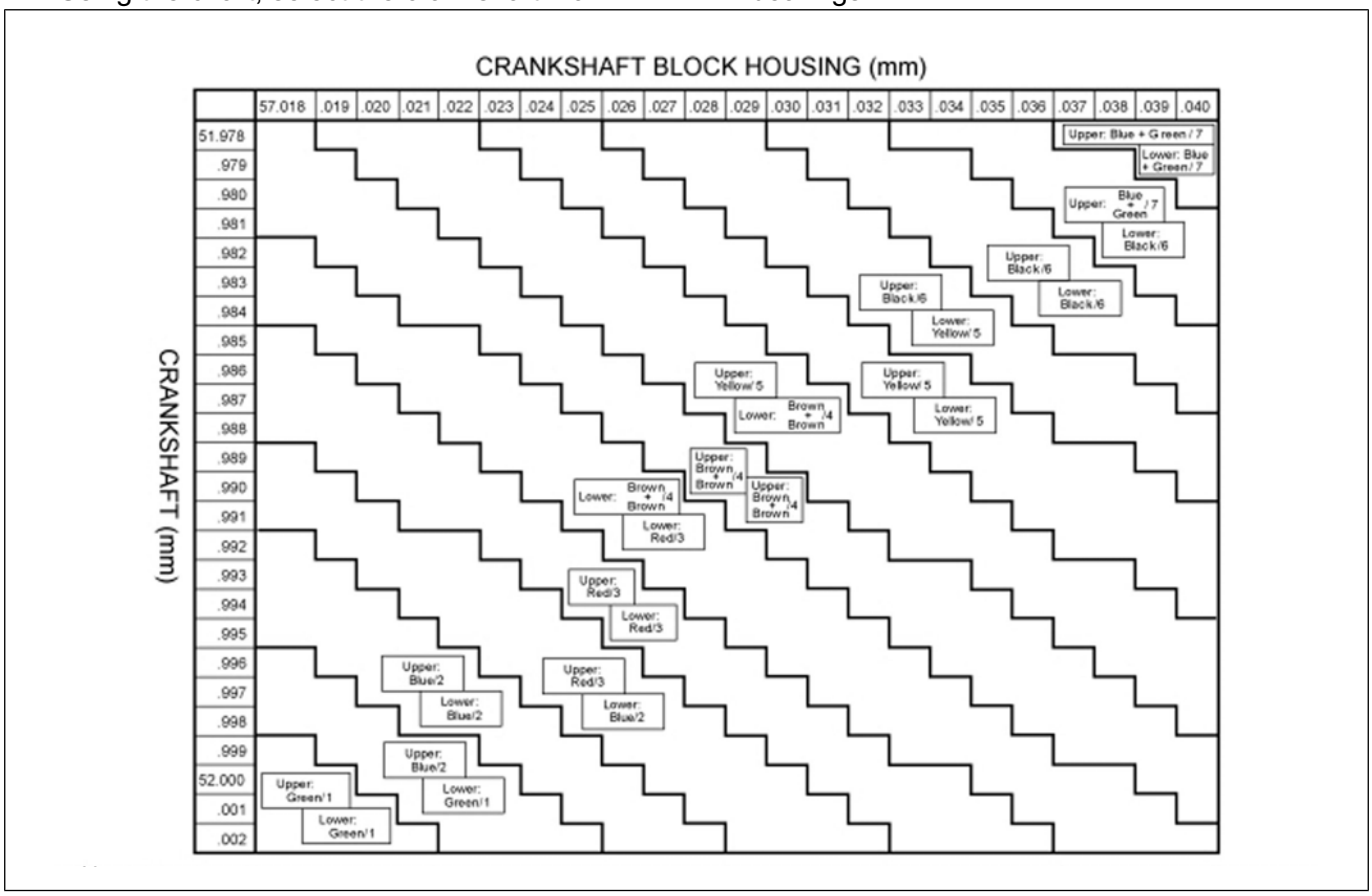
E97420

6. • Measure each crankshaft block main bearing bore diameter.
   • Remove the bolts and the main bearing beam.
   • Discard the main bearing beam bolts.


E139176

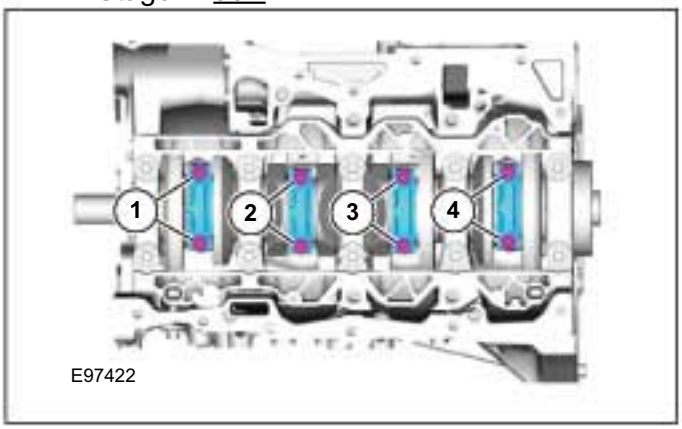
ASSEMBLY

7. Using the chart, select the crankshaft main bearings.

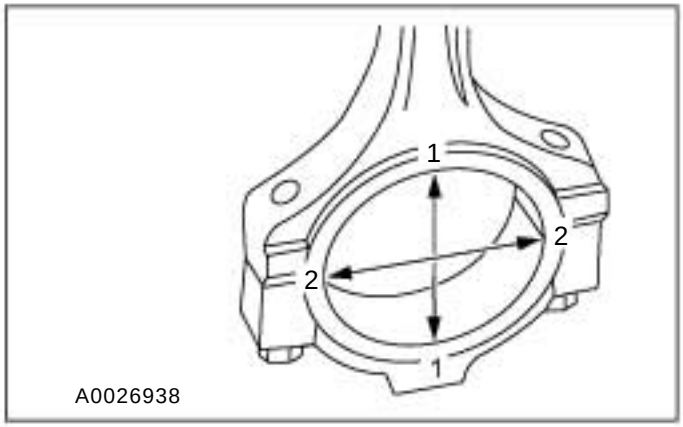


8. ⚠ **CAUTION: The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

   Using the original connecting rod cap bolts, install the connecting caps and bolts.
   Torque:
   - Stage 1: 29 Nm
   - Stage 2: 90 °



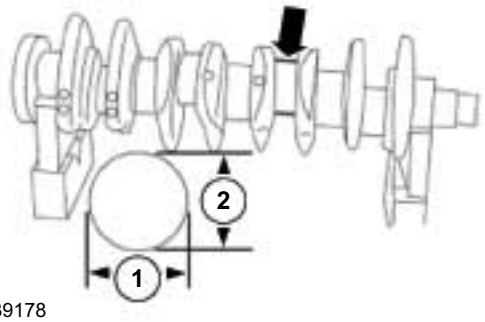
9. - Measure the connecting rod large end bore in 2 directions. Record the smallest measurement for each connecting rod.
   - Remove the bolts and the connecting rod cap.
   - Discard the connecting rod cap bolts.



10. Measure each of the crankshaft connecting rod bearing journal diameters in at least 2 directions.

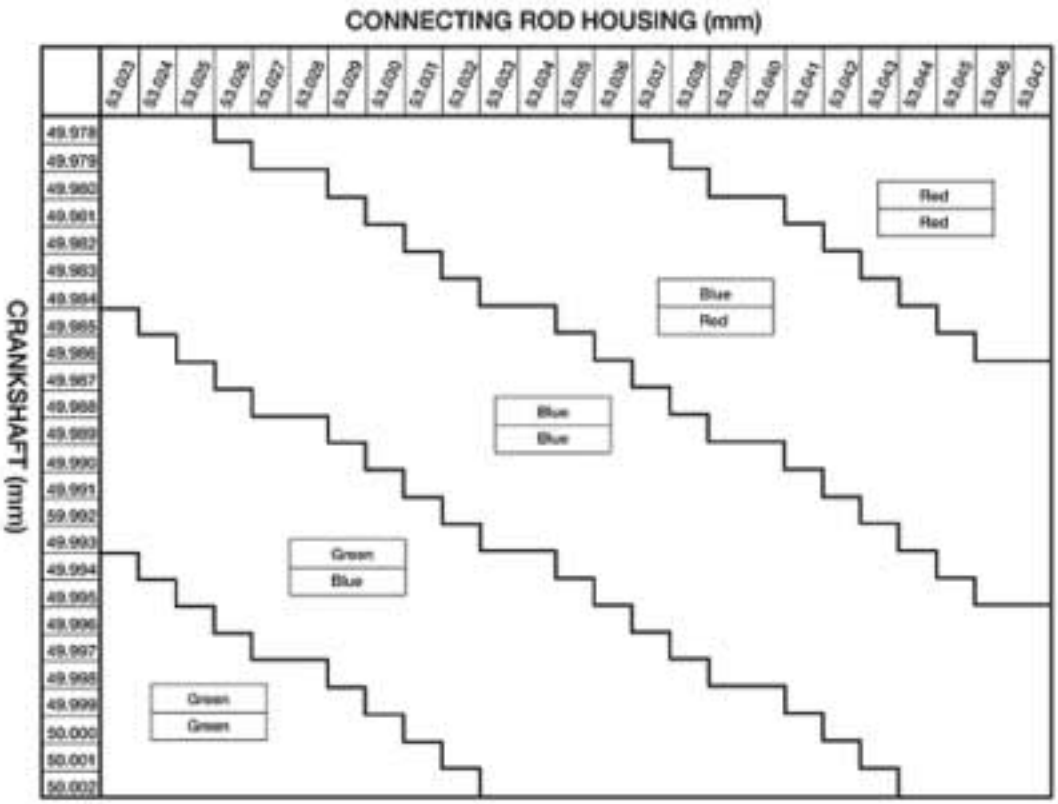
ASSEMBLY

Record the smallest measurement for each connecting rod journal.



E139178

11. Using the chart, select the correct connecting rod bearings for each crankshaft connecting rod journal.



E139179

12. **NOTE:** Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

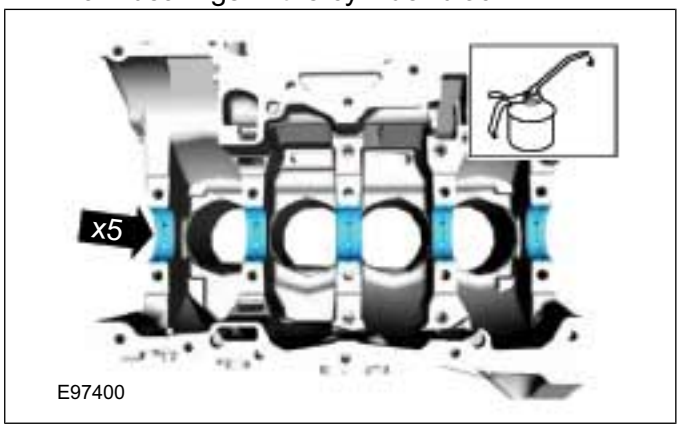
NOTE: If reusing the crankshaft main bearings, install them in their original positions and orientation as noted during disassembly.

NOTE: The center bulkhead is the thrust bearing.

NOTE: Make sure that these components are installed to the noted removal position.

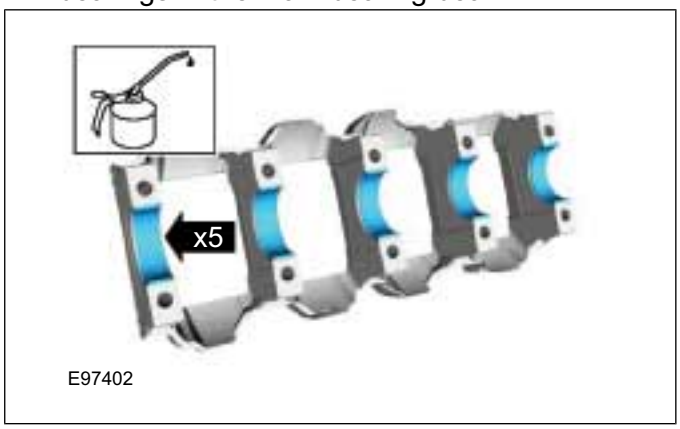
ASSEMBLY

Lubricate the upper crankshaft main bearings with clean engine oil and install the 5 crankshaft main bearings in the cylinder block.



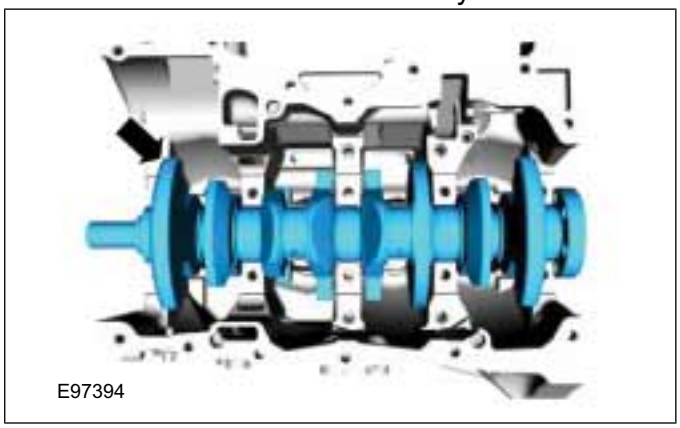
13. **NOTE:** If reusing the crankshaft main bearings, install them in their original positions and orientation as noted during disassembly.

    Lubricate the crankshaft main bearings with clean engine oil and install the 5 crankshaft main bearings in the main bearing beam.

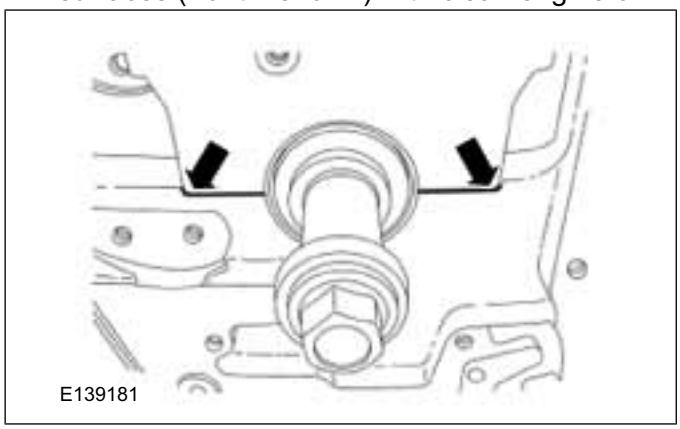


14. Lubricate journals on the crankshaft with clean engine oil.

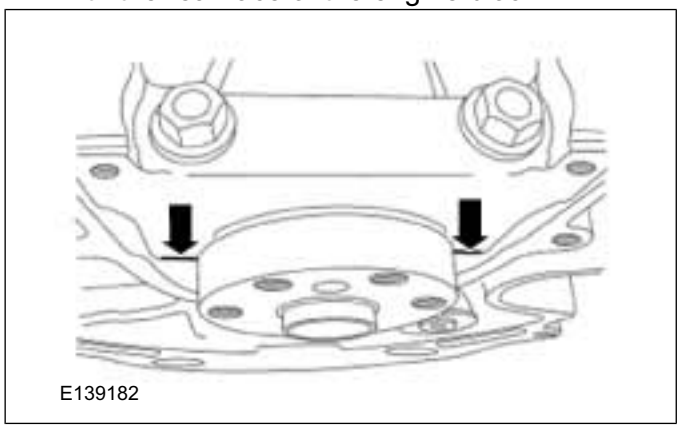
15. Position the crankshaft in the cylinder block.



16. Lubricate the 10 main bearing beam side fit surfaces (front 2 shown) with clean engine oil.



17. Lubricate the crankshaft bearing journals on the main bearing beam with clean engine oil. Then position the main bearing beam in the engine block with the main bearing beam mounted flush with the rear face of the engine block.



18. **CAUTION: Make sure that new bolts are installed.**

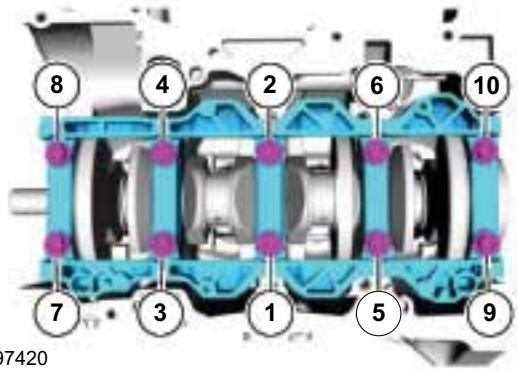
    NOTE: Lubricate the main bearing beam bolts threads and under the bolt heads with clean engine oil.

    NOTE: Position the crankshaft to the rear of the cylinder block, then position the crankshaft to

ASSEMBLY

the front of the cylinder block before tightening the main bearing beam bolts.

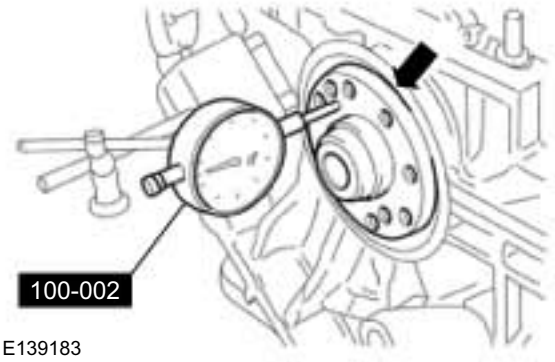
Torque:
- Stage 1: 5 Nm
- Stage 2: 25 Nm
- Stage 3: Loosen: 90°



E97420

19. • Using the dial indicator gauge with holding fixture, measure crankshaft end play.

Special Tool(s): 100-002
- Position the crankshaft to the rear of the cylinder block.
- Zero the dial indicator gauge with holding fixture.
- Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.
- Acceptable crankshaft end play is 0.22-0.43 mm (0.008-0.016 in). If the crankshaft end play exceeds the specified range, install new parts as necessary.



E139183

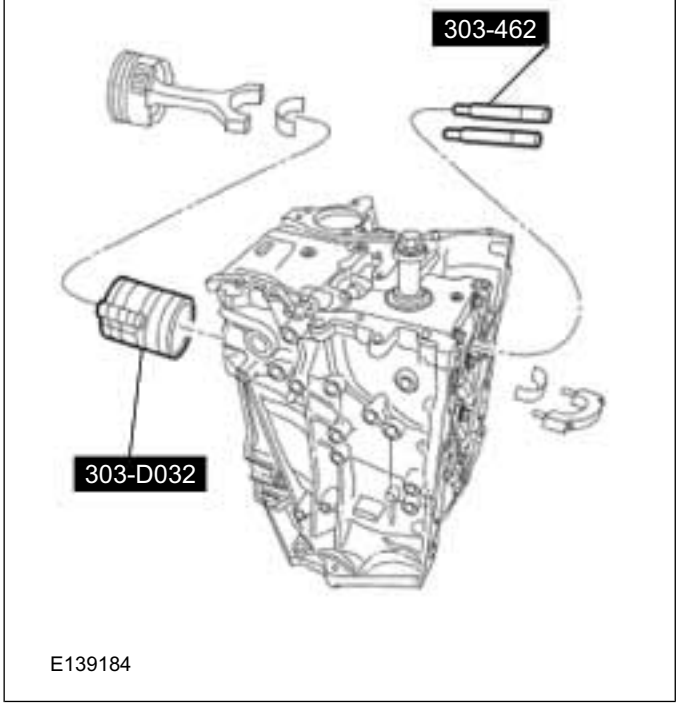
20. ⚠ **CAUTION: Be sure not to scratch the cylinder wall or crankshaft journal with the connecting rod. Push the piston down until the connecting rod bearing seats on the crankshaft journal.**

NOTE: Lubricate the pistons, piston rings, connecting rod bearings and the entire cylinder bores with clean engine oil.

NOTE: Make sure the piston arrow on top is facing toward the front of the engine.

- Using the piston ring compressor and the connecting rod installer, install the piston and connecting rod assemblies.

  Special Tool(s): 303-D032, 303-462
- When installing the pistons and connecting rod assemblies, the oil ring gaps must be positioned 60 degrees apart from each other and a minimum of 90 degrees from the expander gap.
- The position of the upper and lower compression ring gaps are not controlled for installation.



E139184

21. ⚠ **CAUTION: The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

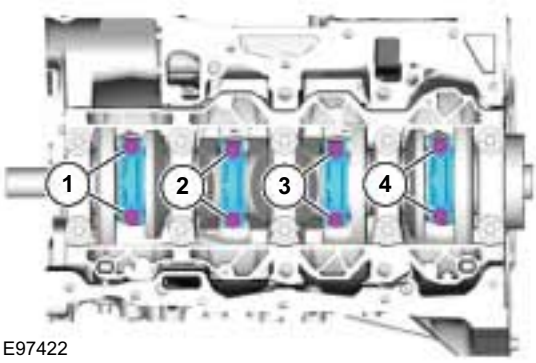
NOTE: Install connecting rod caps and bolts on the connecting rods for cylinders 1 and 4 first and tighten. Then rotate crankshaft 180 degrees and install connecting rod caps and bolts on

ASSEMBLY

connecting rods for cylinders 2 and 3 and tighten.

NOTE: After installation of each connecting rod cap, rotate the crankshaft to verify smooth operation.

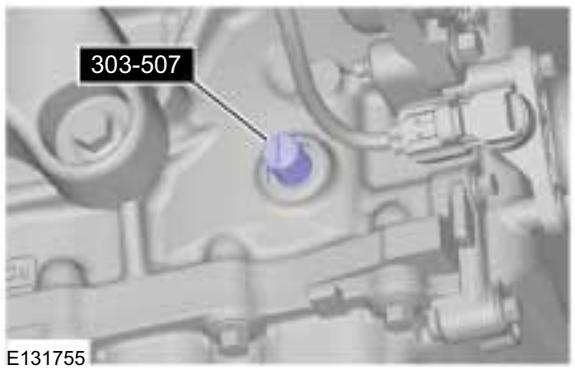
Install the connecting rod caps and the new bolts.
Torque:
- Stage 1: 29 Nm
- Stage 2: 90 °



E97422

22. Install the crankshaft TDC timing peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the crankshaft TDC timing peg. The engine is now at TDC.

Special Tool(s): 303-507



E131755

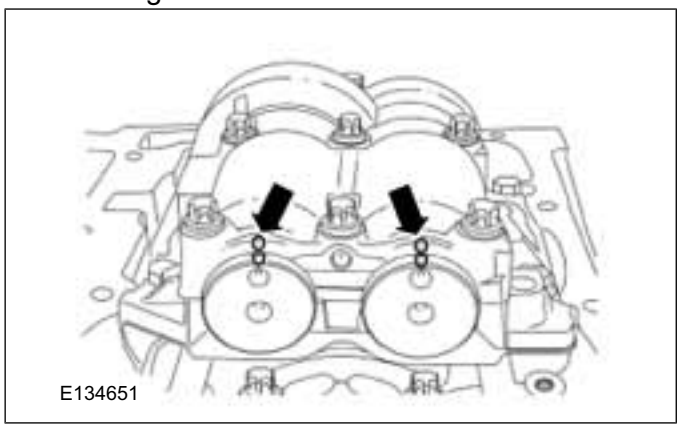
23. **NOTE:** Due to the precision interior construction of the balancer unit, it should not be disassembled.

NOTE: The original adjustment shims must be installed in their original positions.

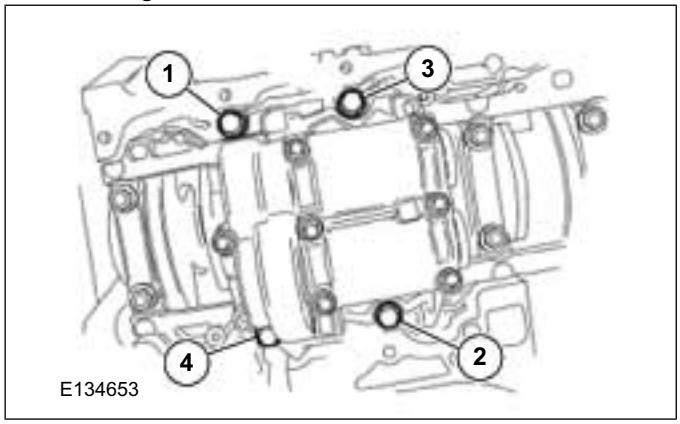
NOTE: Confirm by visual inspection that there is no damage to the balancer unit gear and verify that the shaft turns smoothly. If there is any damage or malfunction, replace the balancer unit.

Install the adjustment shims in their original positions on the seat faces of the balancer unit.

24. With the balancer unit shaft marks in the TDC position, slowly install the balancer unit to the cylinder block to avoid interference between the crankshaft drive gear and the balancer unit driven gear.

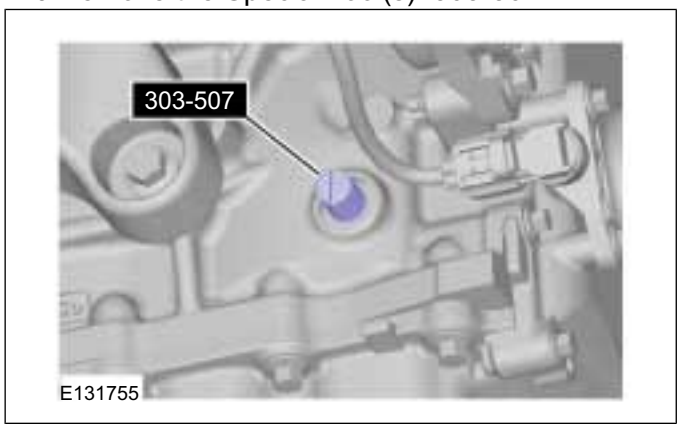

E134651

25. Install the balancer unit bolts.
Torque:
- Stage 1: 25 Nm
- Stage 2: 50 Nm



E134653

26. Remove the Special Tool(s): 303-507



E131755

ASSEMBLY

27. Rotate the crankshaft to confirm that there are no meshing problems between the balancer unit gear and the crankshaft gear.
28. • Install the crankshaft TDC timing peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the crankshaft TDC timing peg.

    Special Tool(s): 303-507

29. Remove the Special Tool(s): 303-507

30. **NOTE:** Measure the backlash and verify that it is within specified range at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees. It will be necessary to reset the measuring equipment between measurements.

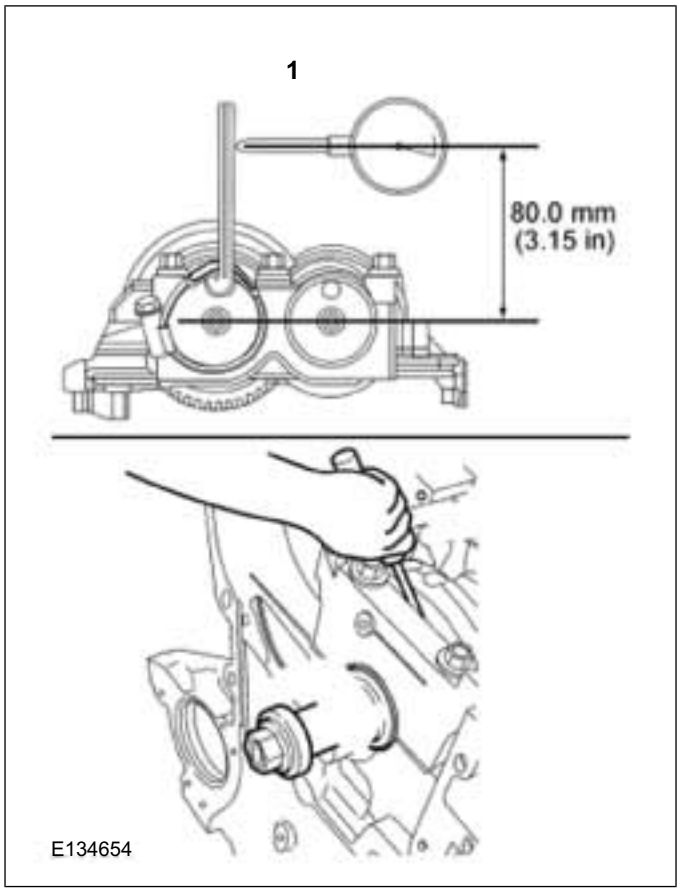
    NOTE: The measurement must be taken with the dial indicator gauge with holding fixture, a 5 mm allen wrench and worm clamp set up as shown. Mark the allen wrench with a file 80 mm (3.149 in) above the driven gear shaft center. Make sure the worm clamp and allen wrench are not touching the balance shaft housing.

    NOTE: For an accurate measurement while measuring the gear backlash, insert a screwdriver as shown into the crankshaft No. 1 crankweight area and set both the rotation and the thrust direction with the screwdriver, using a prying action as shown.

    - Position the dial indicator gauge with holding fixture as shown. Measure the gear backlash.

      Special Tool(s): 100-002
    - Position the dial indicator gauge with holding fixture (1) on the allen wrench 80 mm (3.149 in) above the driven gear shaft center (2) on the balancer unit.
    - Rotate the crankshaft clockwise and measure the backlash at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees.
    - Backlash specifications are 0.005 to 0.101 mm (0.00019 to 0.0039 in).
    - If the backlash exceeds the specified range, carry out the balance shaft backlash procedure.

      Refer to: Balance Shaft Backlash (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, General Procedures).



31. ⚠ **CAUTION: Failure to position the No. 1 piston at TDC can result in damage to the engine. Turn the engine in the normal direction of rotation only.**

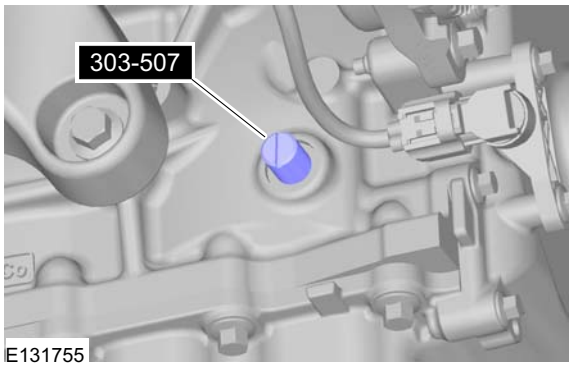
ASSEMBLY

Turn the crankshaft clockwise to position the No. 1 piston at TDC.

32. **NOTE:** The crankshaft TDC timing peg will contact the crankshaft and prevent it from turning past TDC. However, the crankshaft can still be rotated in the counterclockwise direction. The crankshaft must remain at the TDC position until the timing drive components and crankshaft pulley are installed. Install the crankshaft TDC timing peg.

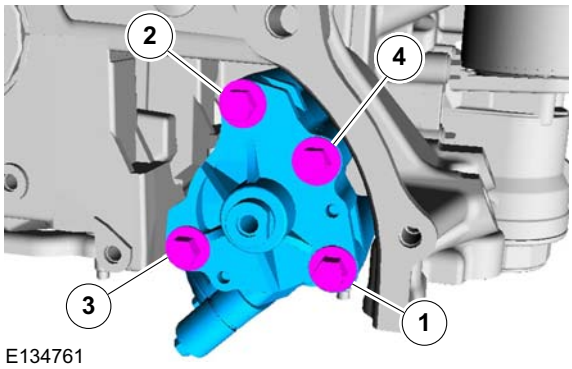
    Install the crankshaft TDC timing peg.

    Special Tool(s): 303-507

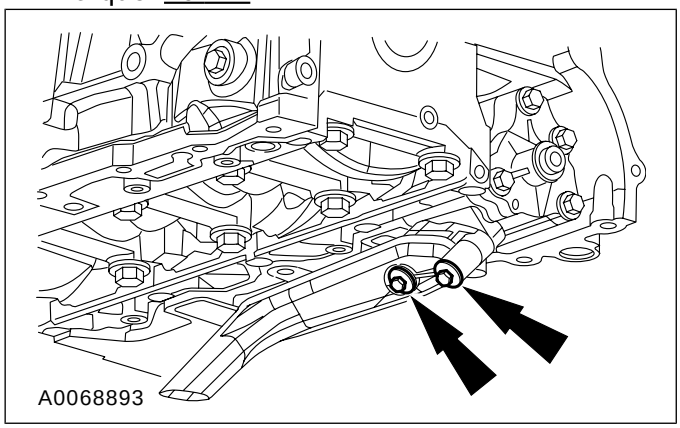


33. **NOTE:** Clean the oil pump and cylinder block mating surfaces with metal surface prep.

    Torque:
    - Stage 1: 10 Nm
    - Stage 2: 20 Nm



34. Install a new oil pump pickup tube gasket and the pickup tube.
    Torque: 10 Nm

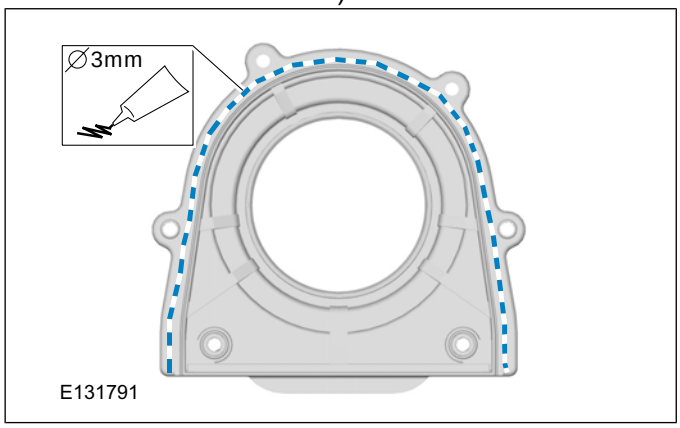


35. **CAUTION: Install the crankshaft rear seal carriers within five minutes of applying the sealer.**

    NOTE: Do not damage the mating faces.

    NOTE: Mating surface should not have traces of oil to improve the adhesion.

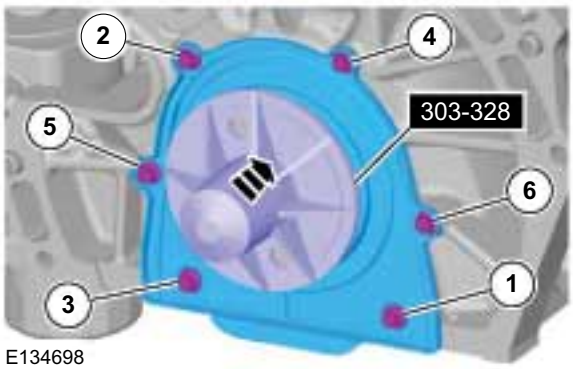
    Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



ASSEMBLY

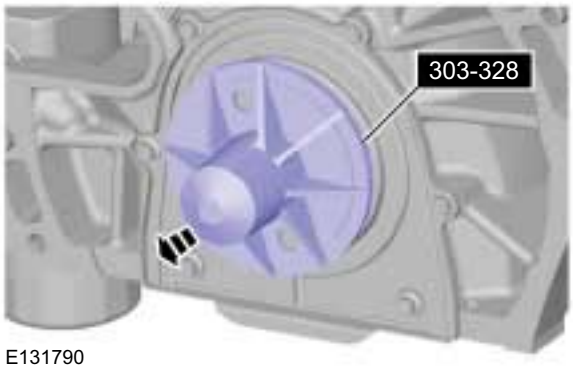
36. **NOTE:** New crankshaft rear seal carriers are supplied with an alignment sleeve which must be removed after installation.

    Special Tool(s): 303-328
    Torque: 10 Nm



E134698

37. Remove the Special Tool(s): 303-328

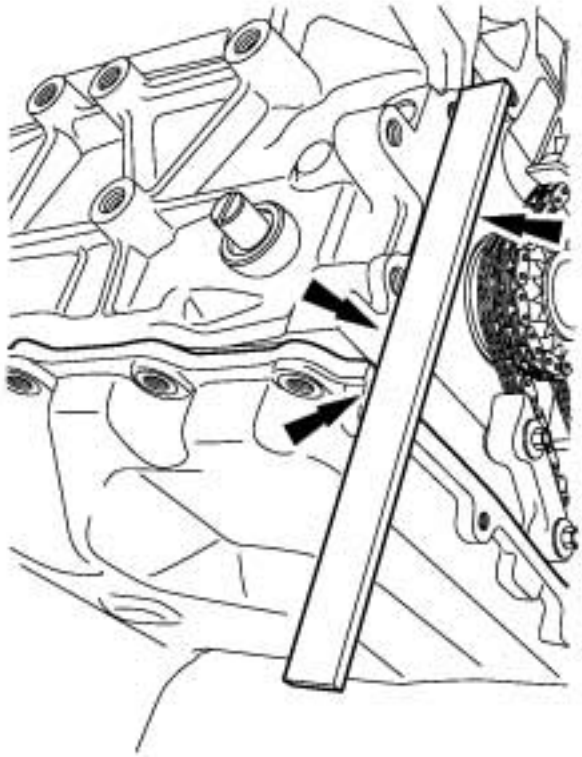


E131790

38. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.**

    Clean and inspect all mating surfaces.

39. Using a suitable straight edge, align the front surface of the oil pan flush with the front surface of the engine block.

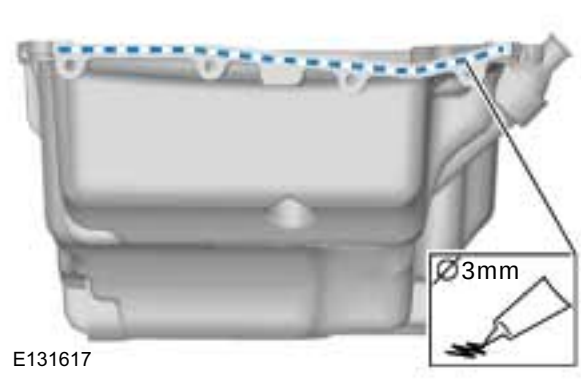

N0039349

40. **CAUTION: Install the oil pan within five minutes of applying the sealer.**

    NOTE: Do not damage the mating faces.

    NOTE: Mating surface should not have traces of oil to improve the adhesion.

    Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



E131617

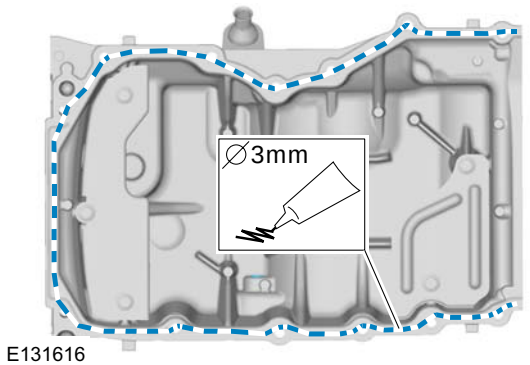
41. **CAUTION: Install the oil pan within five minutes of applying the sealer.**

    NOTE: Do not damage the mating faces.

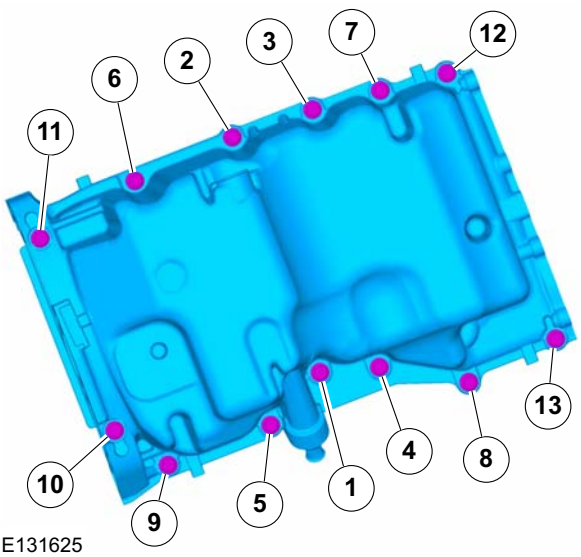
ASSEMBLY

NOTE: Mating surface should not have traces of oil to improve the adhesion.

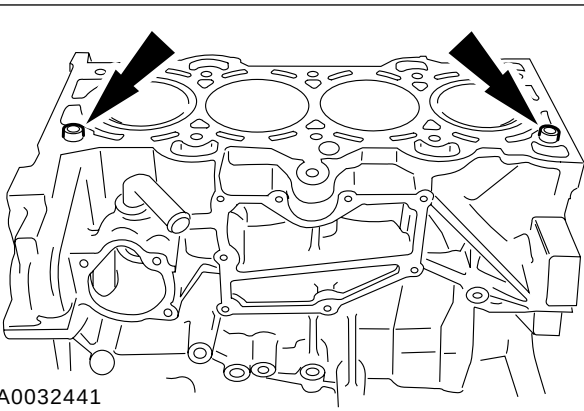
Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



42. Install the oil pan.
Torque: 25 Nm



43.
- Install the cylinder head alignment dowels.
- Dowels must be fully seated in the cylinder block.



44. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

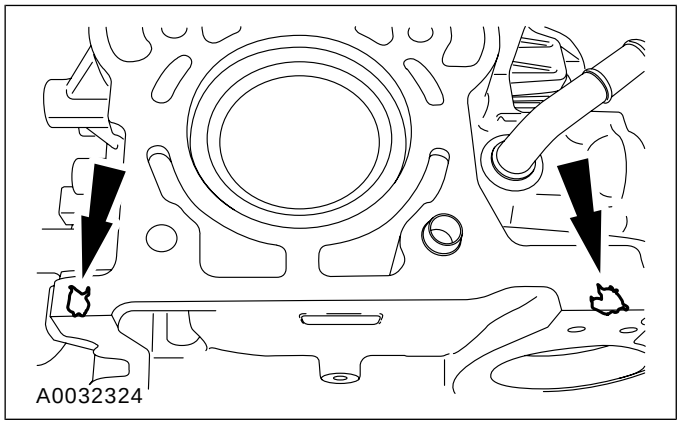
NOTE: Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

- Clean the cylinder head-to-cylinder block mating surface of both the cylinder head and the cylinder block in the following sequence.

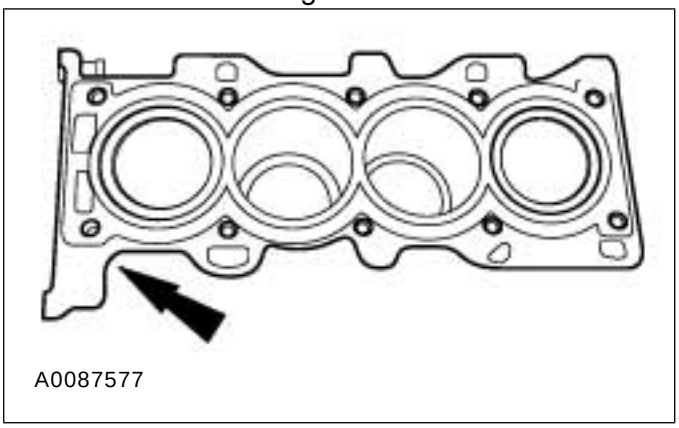
1. Remove any large deposits of silicone or gasket material with a plastic scraper.
2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
4. Apply metal surface prep, following package directions, to remove any traces of oil or coolant, and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

45. Apply silicone gasket and sealant to the locations shown.



ASSEMBLY

46. Install a new head gasket.

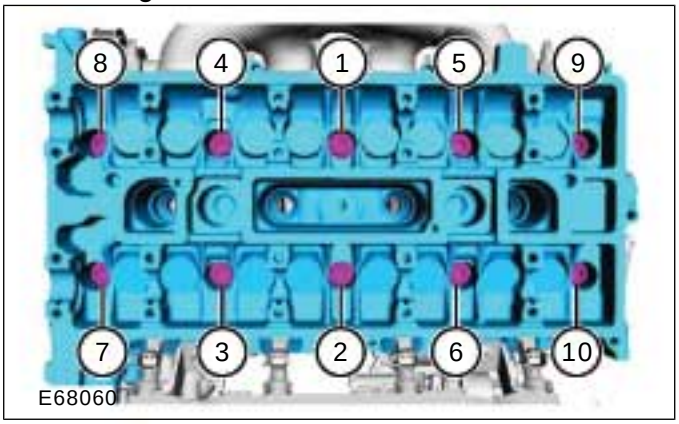


47. ⚠ **CAUTION: Make sure that new bolts are installed.**

NOTE: The cylinder head bolts are torque-to-yield and must not be reused.

NOTE: Lubricate the bolts with clean engine oil prior to installation.

Torque:
- Stage 1: 5 Nm
- Stage 2: 15 Nm
- Stage 3: 45 Nm
- Stage 4: Loosen: 90°
- Stage 5: Loosen: 90°



48. **NOTE:** Coat the valve tappets with clean engine oil prior to installation.

Install the valve tappets.

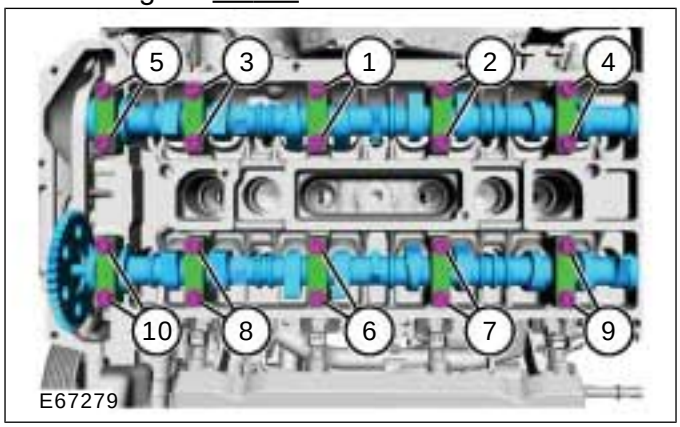
49. ⚠ **CAUTION: Make sure that the camshafts and camshaft bearing caps are installed in their original locations.**

NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil.

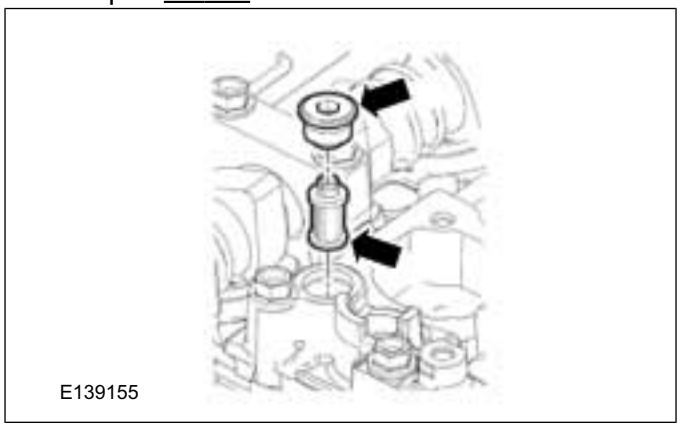
Install the camshafts approximately at valve overlap position cylinder No. 4 and tighten the camshaft bearing cap bolts one at a time until finger-tight.

Material: Hypoid Oil 85W-90 (SQ-M2C9002-AA / A72SX-19K261-CA) transmission fluid

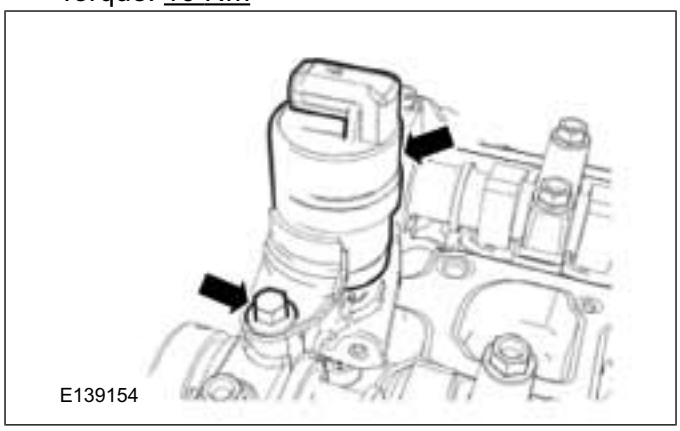
Torque:
- Stage 1: 7 Nm
- Stage 2: 16 Nm



50. Install the variable camshaft timing (VCT) system oil filter and the plug in the intake camshaft thrust cap.
Torque: 17 Nm

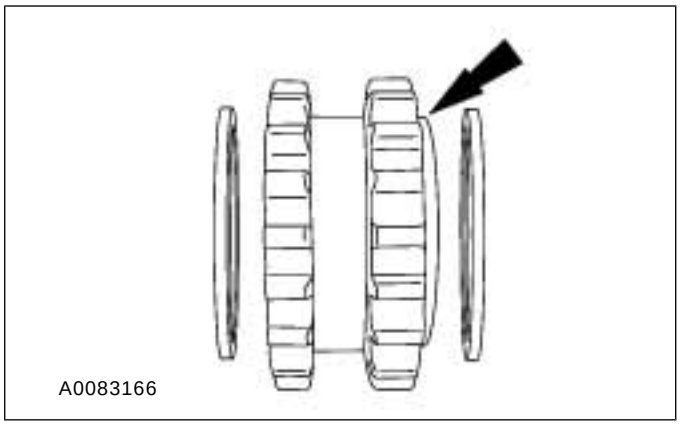


51. Install the VCT solenoid and the bolt.
Torque: 10 Nm

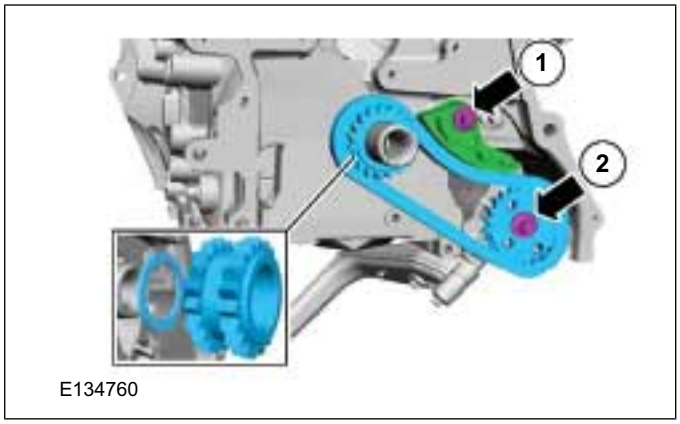


ASSEMBLY

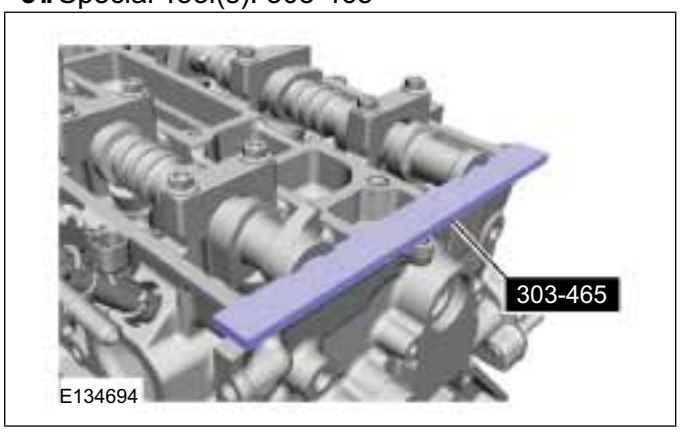
52. **NOTE:** Install a new crankshaft sprocket diamond washer on both sides of the crankshaft sprocket.
    - Install the crankshaft sprocket, new crankshaft sprocket diamond washers, oil pump chain and oil pump sprocket.
    - The crankshaft sprocket flange must be facing away from the engine block.



53. ⚠ **CAUTION: Make sure that a new friction washer is installed.**
    1. Torque: 10 Nm
    2. Torque: 25 Nm

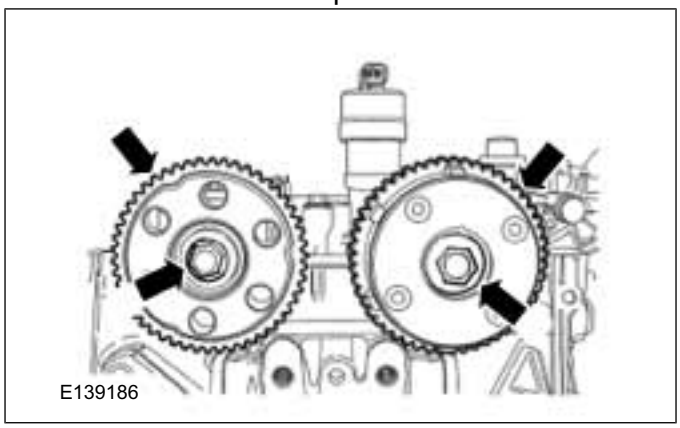


54. Special Tool(s): 303-465

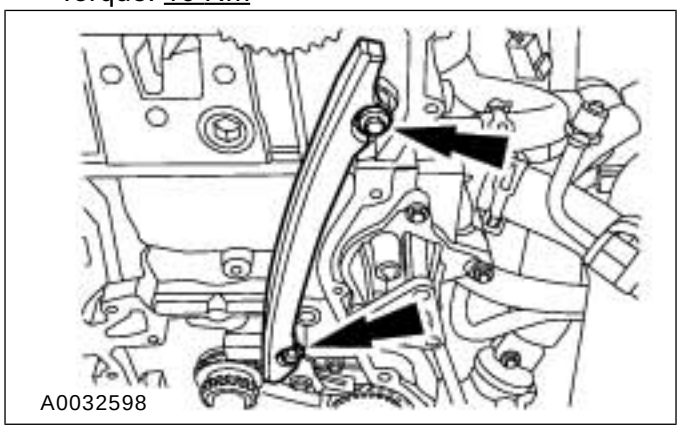


55. **NOTE:** Hand tighten the bolts at this stage.

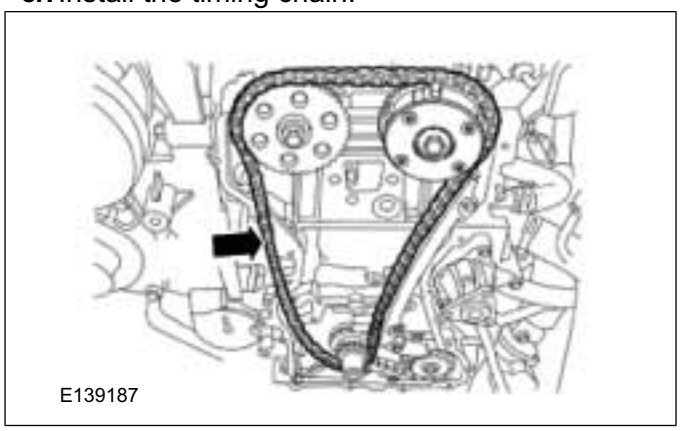
Install the camshaft sprockets and the bolts.



56. Install the timing chain guide and the bolts.
    Torque: 10 Nm



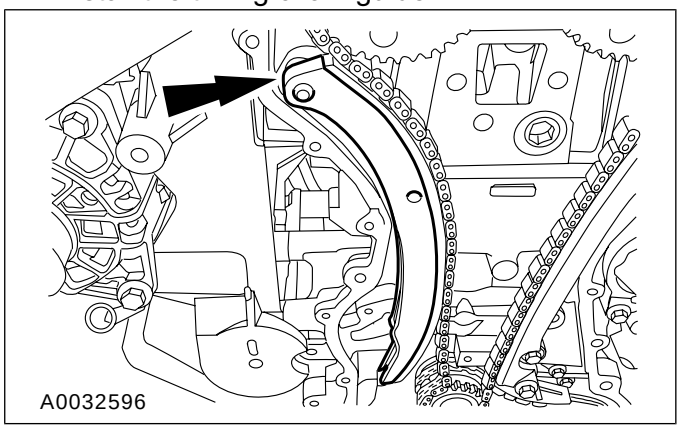
57. Install the timing chain.



58. **NOTE:** If the timing chain tensioner plunger and ratchet assembly are not pinned in the compressed position, follow the next 4 steps.

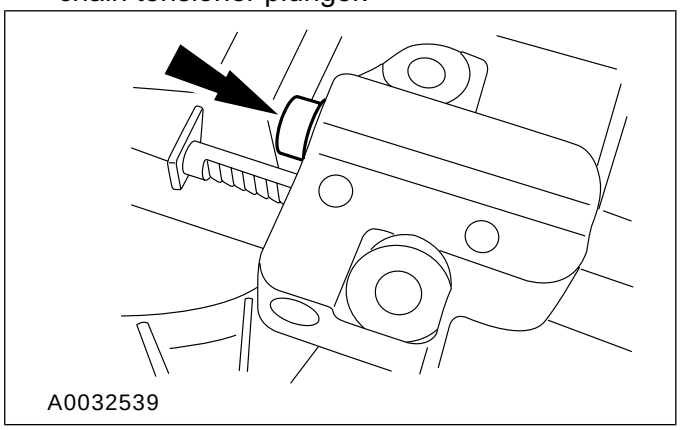
ASSEMBLY

Install the timing chain guide.

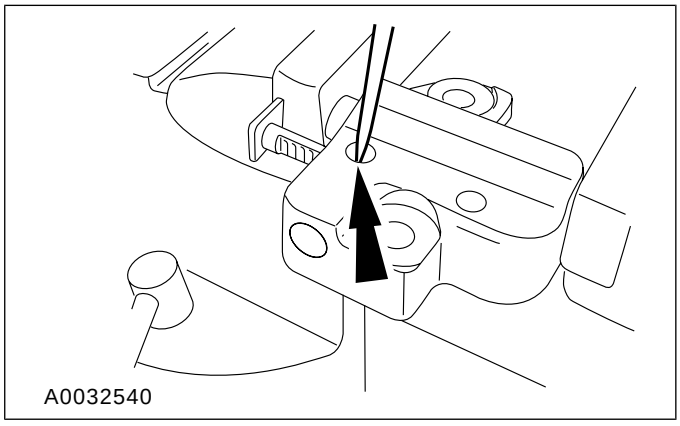


59. ⚠ **CAUTION: Do not compress the ratchet assembly. This will damage the ratchet assembly.**

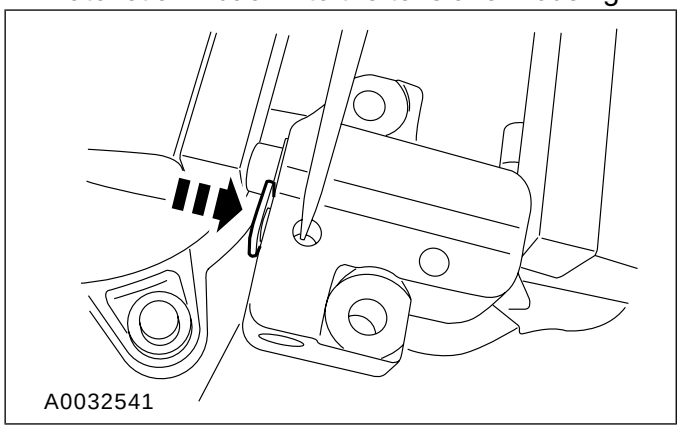
Using the edge of a vise, compress the timing chain tensioner plunger.



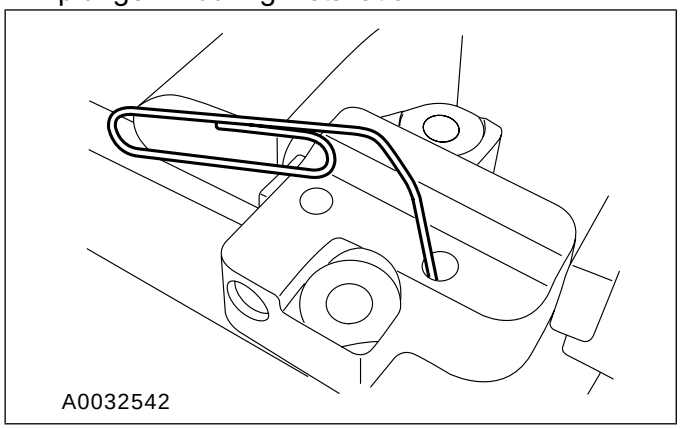
60. Using a small pick, push back and hold the ratchet mechanism.



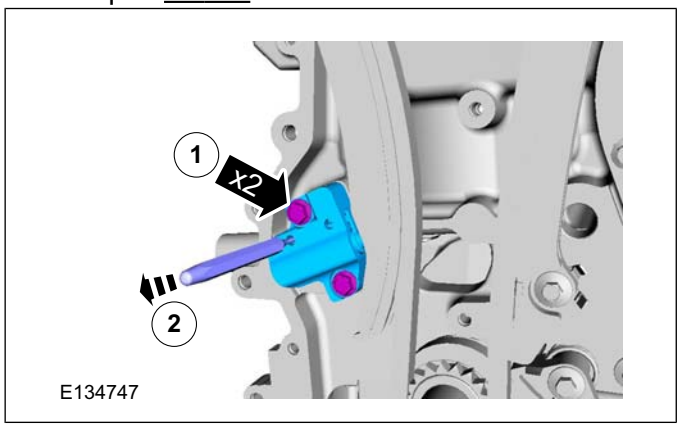
61. While holding the ratchet mechanism, push the ratchet arm back into the tensioner housing.



62. Install a paper clip into the hole in the tensioner housing to hold the ratchet assembly and the plunger in during installation.



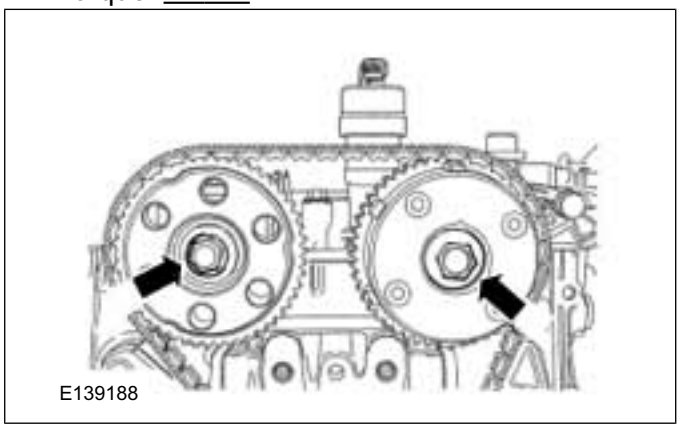
63. Install the timing chain tensioner and the bolts.
Torque: 10 Nm



ASSEMBLY

64. **CAUTION: Use an open-ended wrench to hold the camshafts by the hexagon to prevent the camshafts from turning.**

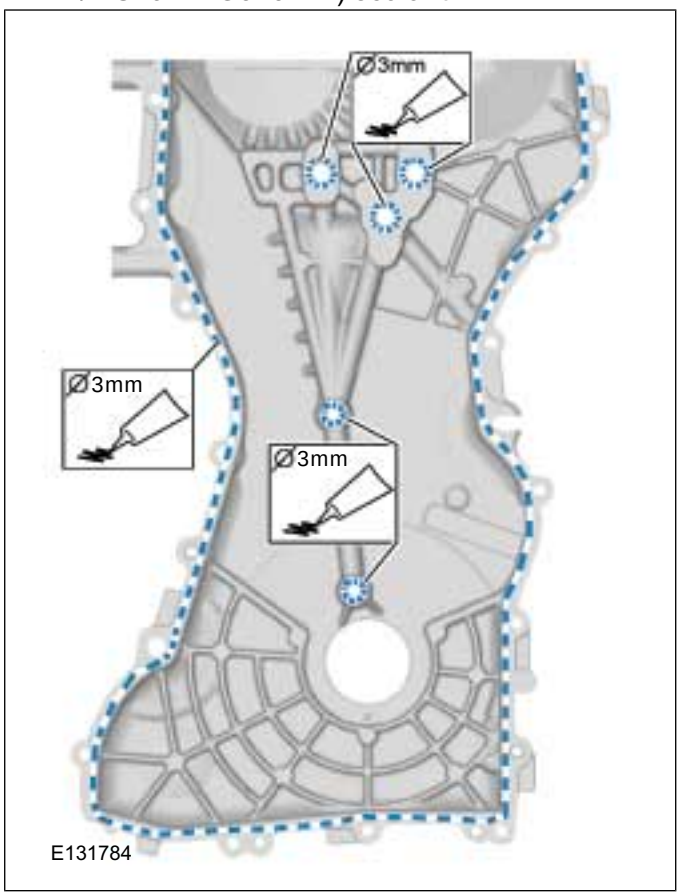
Torque: 72 Nm



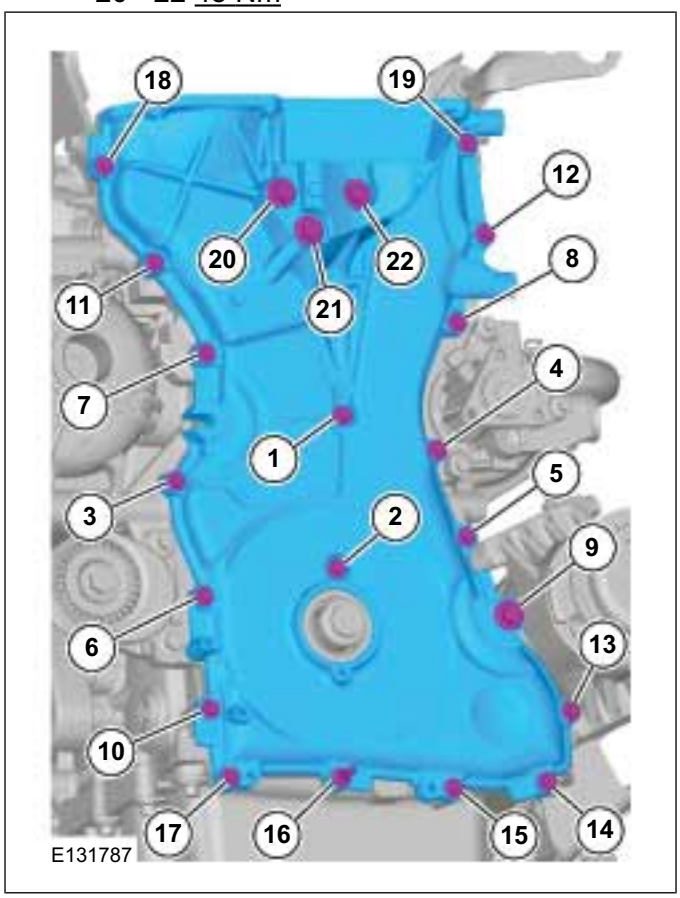
65. **CAUTION: Install the engine front cover within five minutes of applying the sealer.**

NOTE: The engine front cover must be installed and the bolts tightened within 4 minutes of applying the silicone gasket and sealant.

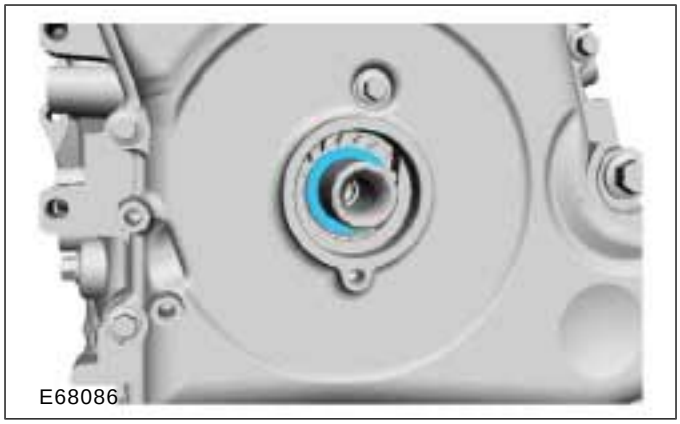
Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



66. Torque:
- 1 - 8 10 Nm
- 9 48 Nm
- 10 - 19 10 Nm
- 20 - 22 48 Nm



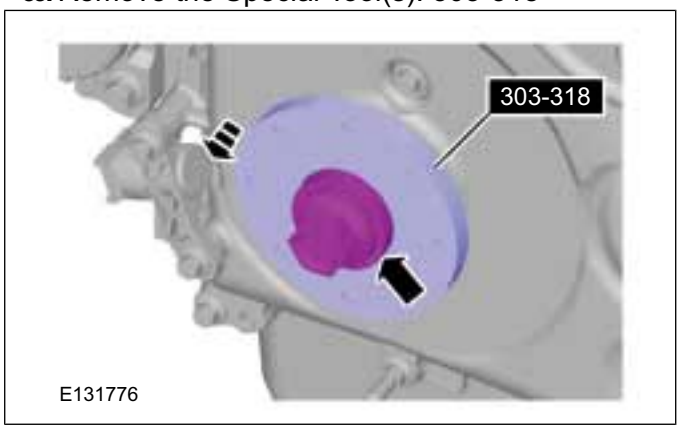
67. **CAUTION: Make sure that a new friction washer is installed.**



ASSEMBLY

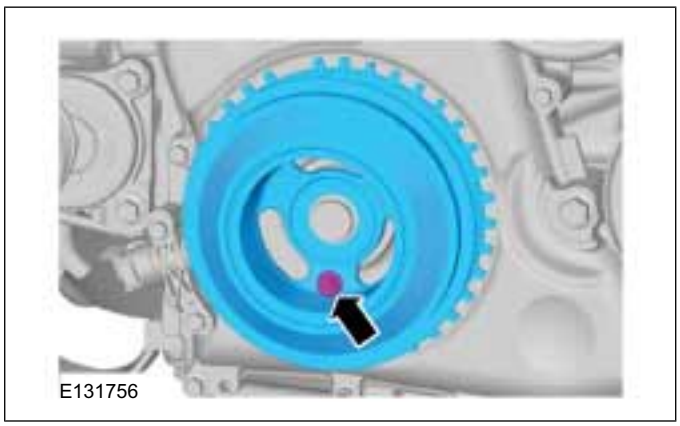
68. Special Tool(s): 303-318
Torque: 50 Nm

69. Remove the Special Tool(s): 303-318



70. **NOTE:** Hand tighten the bolt at this stage.

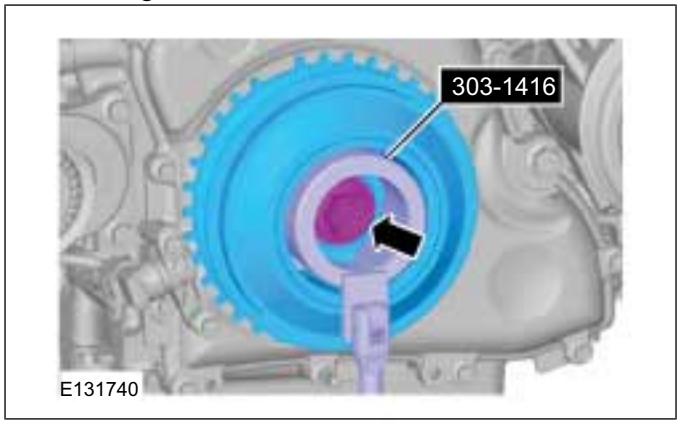
- Bolt M6 x 18 mm



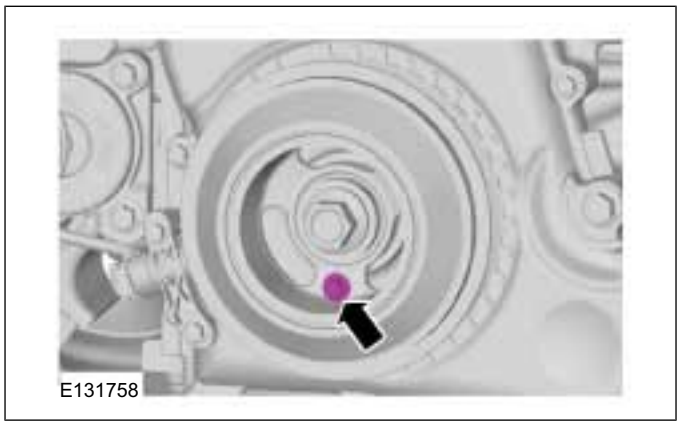
71. ⚠ **CAUTION: Make sure that a new bolt is installed.**

Special Tool(s): 303-1416
Torque:

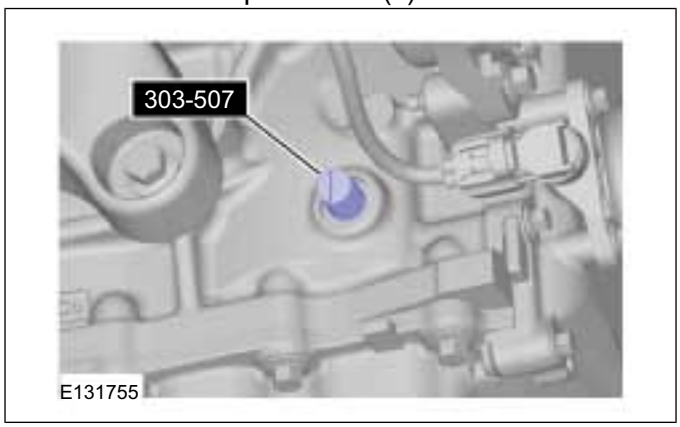
- Stage 1: 100 Nm
- Stage 2: 90°



72. Remove the 6 mm x 18 mm bolt.

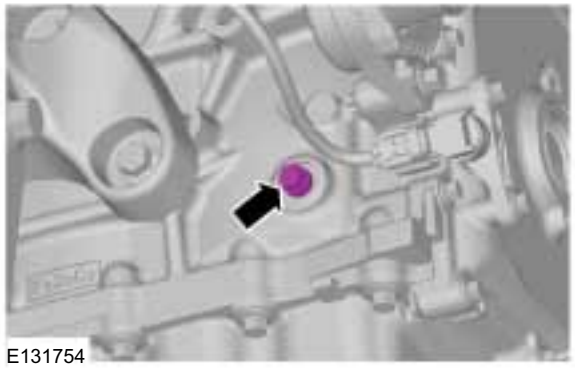


73. Remove the Special Tool(s): 303-507

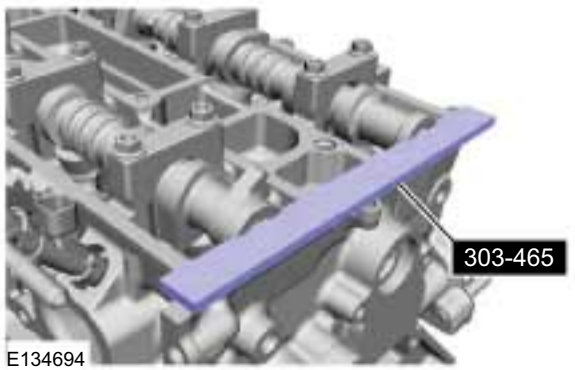


ASSEMBLY

74. Install the engine plug bolt.
Torque: 20 Nm

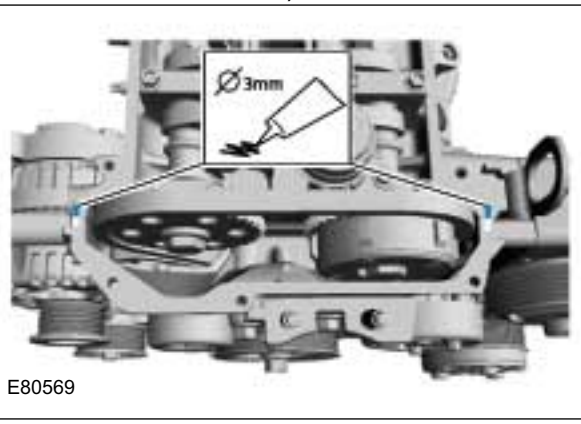


75. Remove the Special Tool(s): 303-465



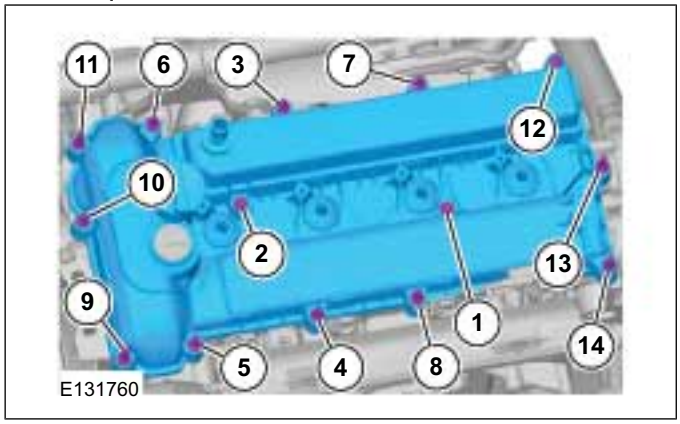
76. **NOTE:** The valve cover must be secured within 4 minutes of silicone gasket application. If the valve cover is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with metal surface prep.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



77. **NOTE:** The gasket is to be reused unless damaged.

Torque: 10 Nm



INSTALLATION

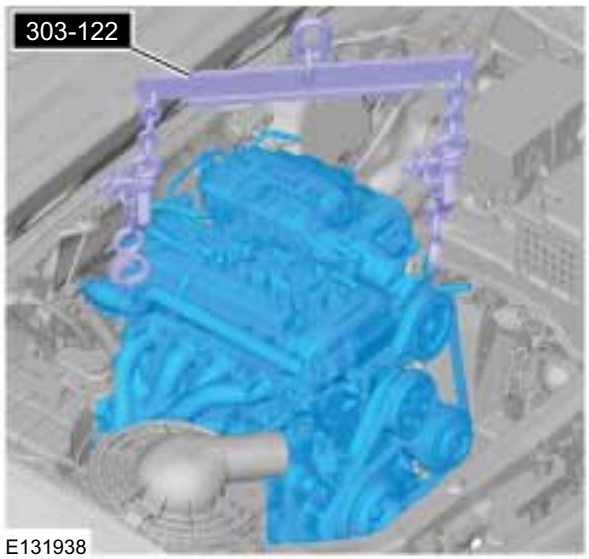
Engine — Vehicles With: 5-Speed Manual Transmission - MT75(21 132 0; 21 132 6; 21 132 7)

Installation

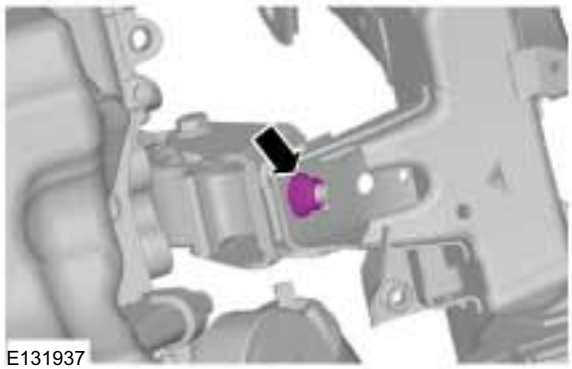
Special Tool(s) / General Equipment

 21068A	303-122 Lifting Bracket, Engine
Hydraulic Jib Crane	

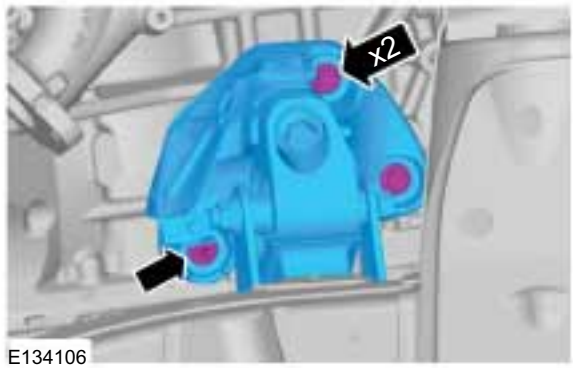
1. Special Tool(s): 303-122
   General Equipment: Hydraulic Jib Crane



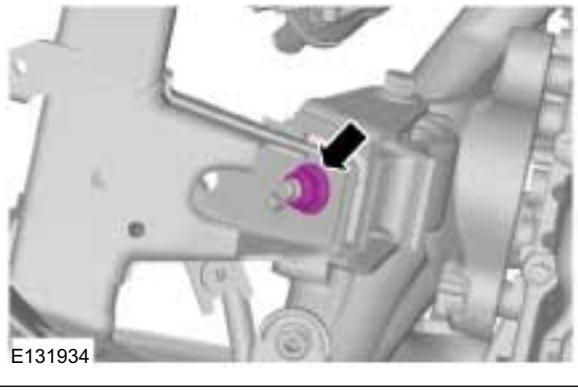
2. **NOTE:** Hand tighten the nut at this stage.



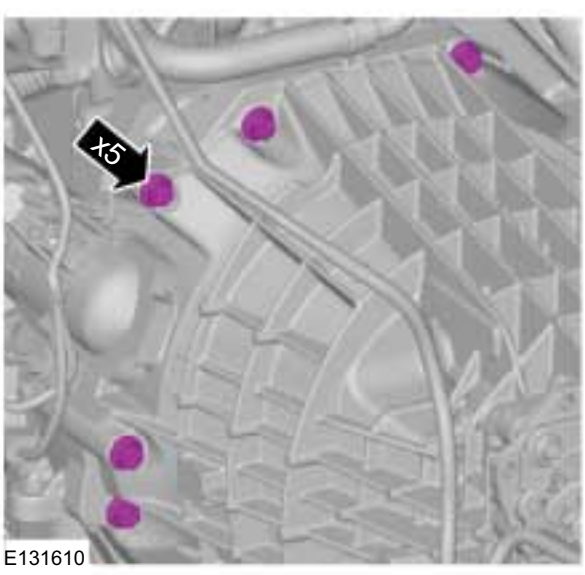
3. **NOTE:** Hand tighten the bolts at this stage.



4. **NOTE:** Hand tighten the nut at this stage.

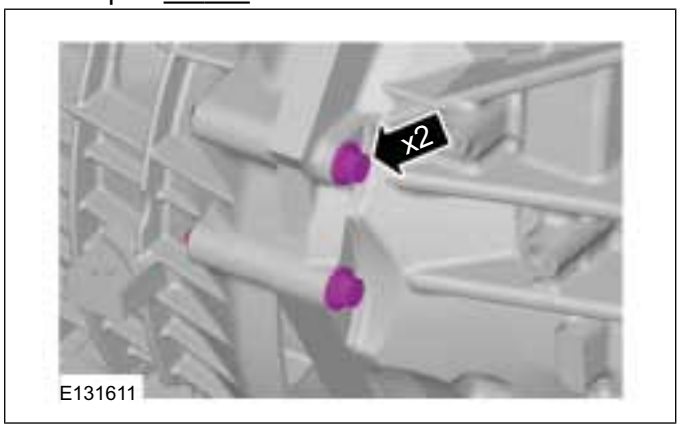


5. Initially hand tighten the bolts.
   Torque: 48 Nm

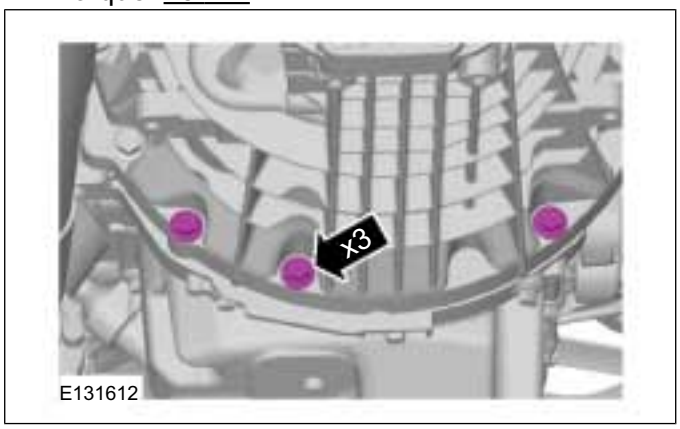


INSTALLATION

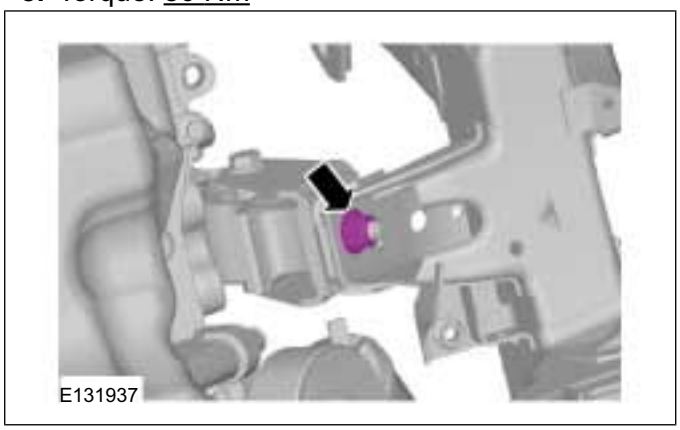
6. Initially hand tighten the bolts.
Torque: 48 Nm



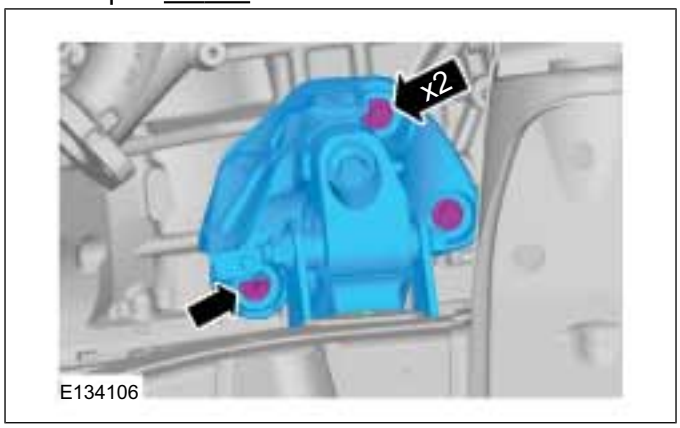
7. Initially hand tighten the bolts.
Torque: 48 Nm



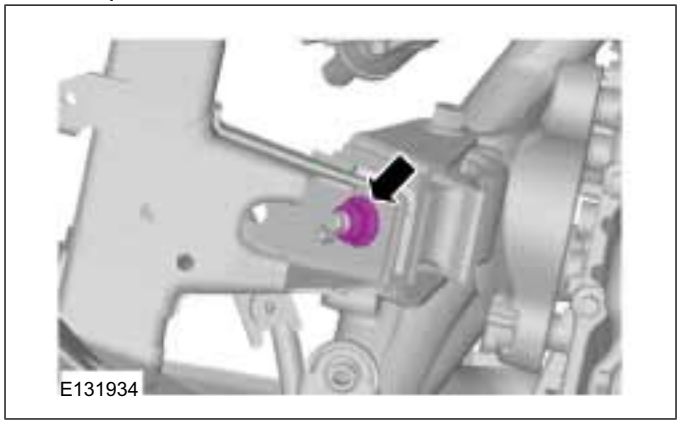
8. Torque: 80 Nm



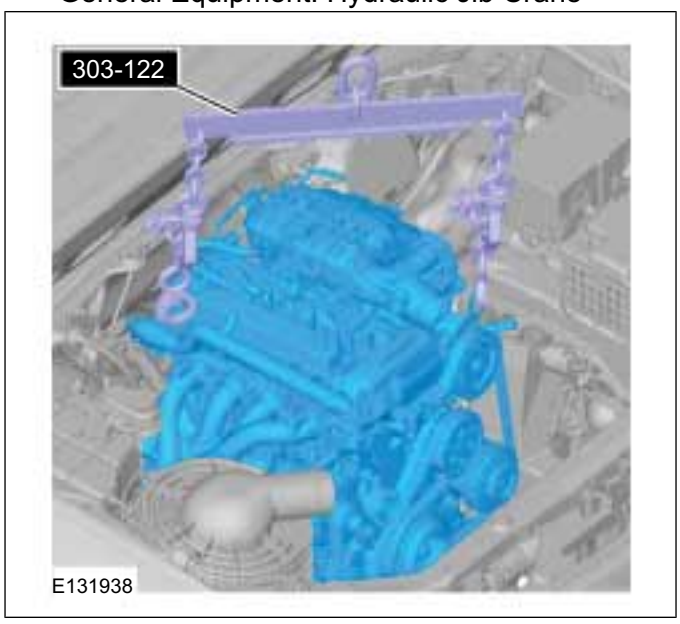
9. Torque: 48 Nm



10. Torque: 80 Nm

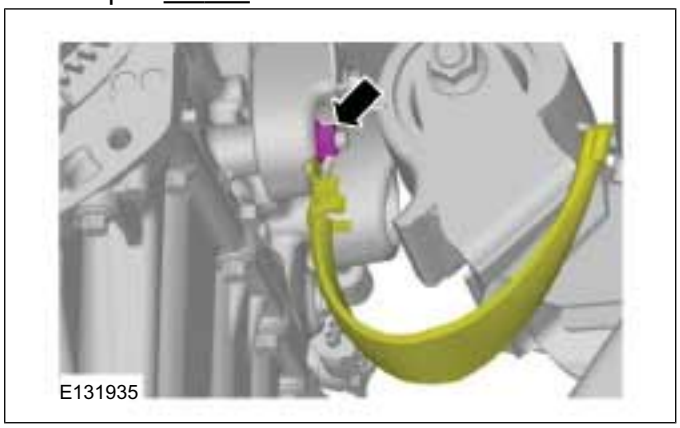


11. Remove the Special Tool(s): 303-122
General Equipment: Hydraulic Jib Crane

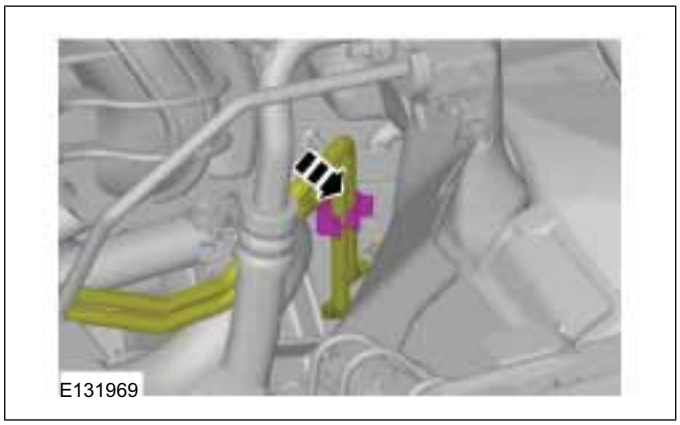


INSTALLATION

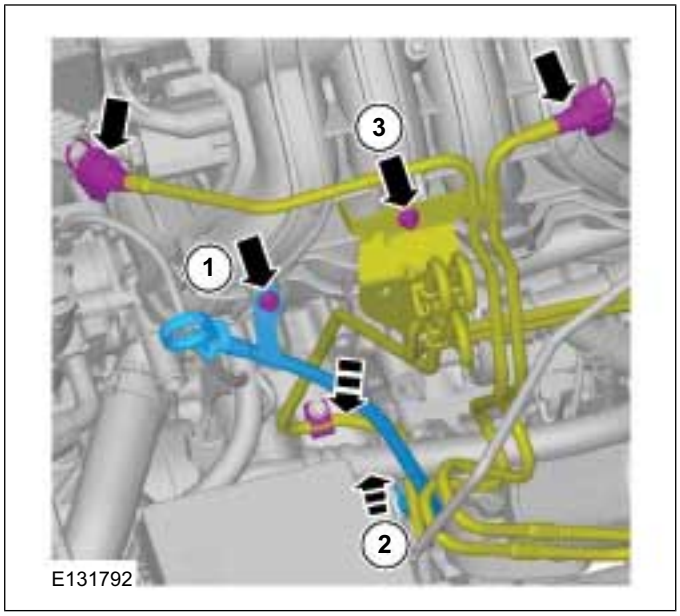
12. Torque: 30 Nm



13.

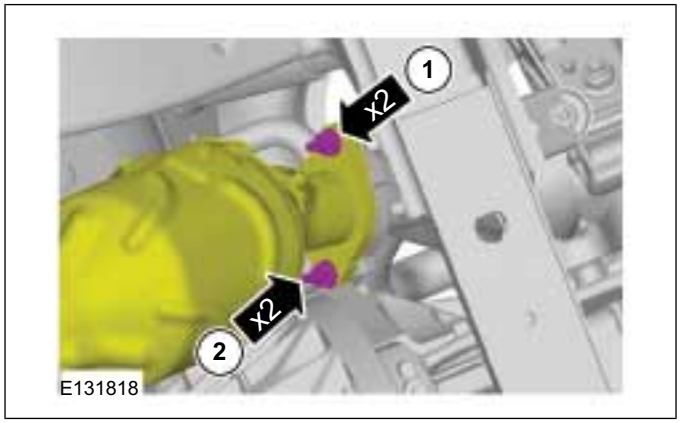


14. 1. Torque: 10 Nm
3. Torque: 10 Nm



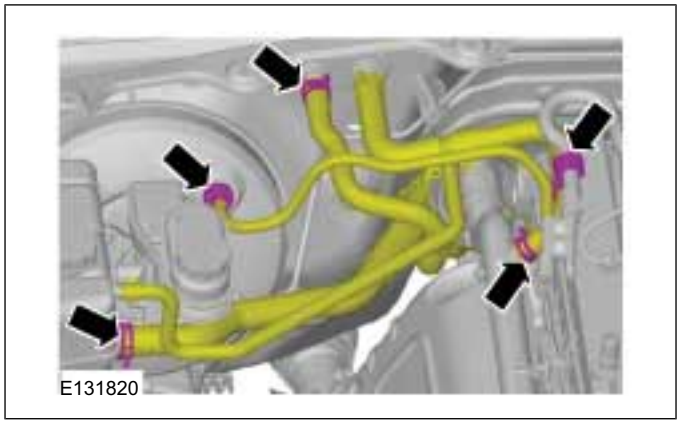
15. ⚠ **CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.**

1. Install the exhaust flexible pipe flange nuts. Torque: 48 Nm
2. Install the exhaust flexible pipe flange studs. Torque: 25 Nm



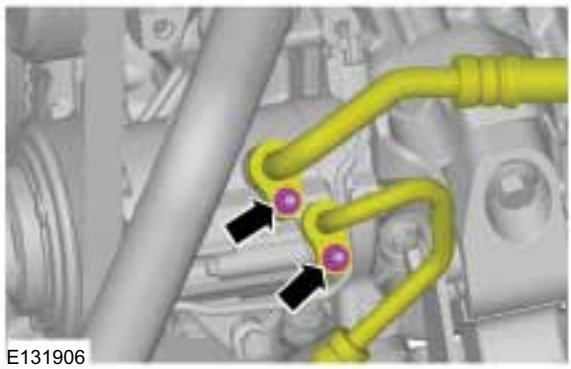
16. Torque: 10 Nm

17.

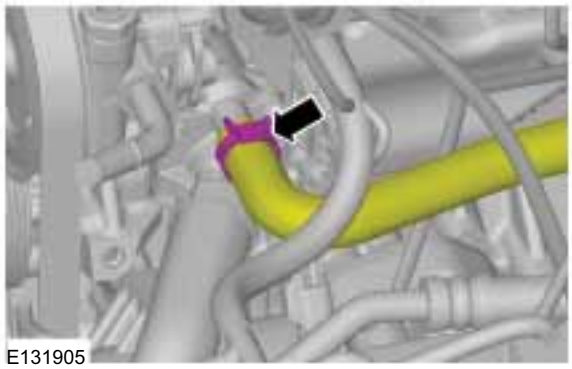


INSTALLATION

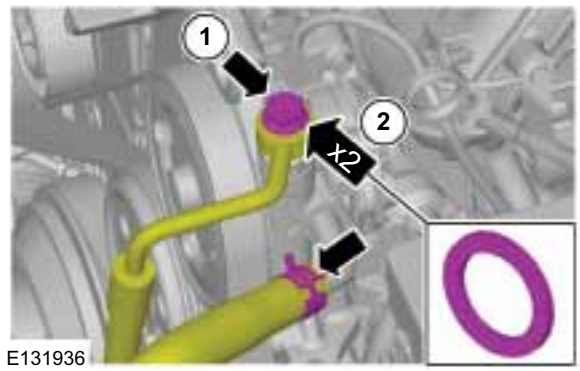
18. Torque: 11 Nm



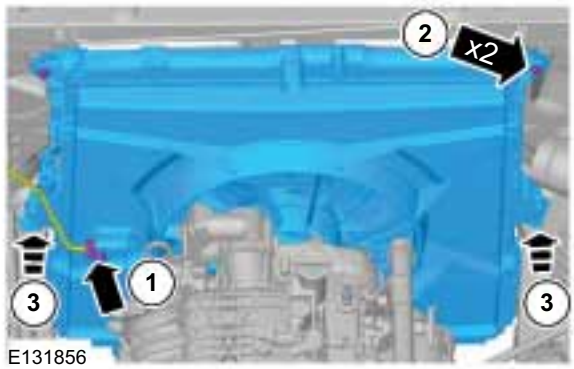
19.



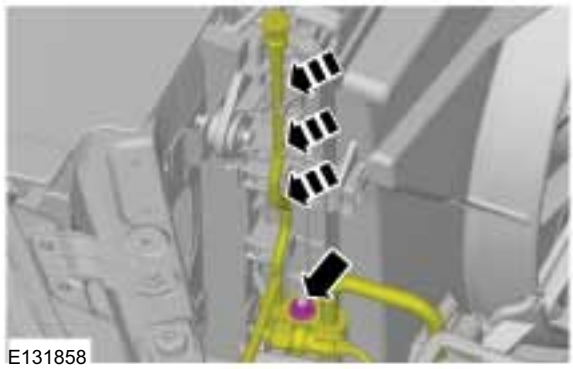
20. Torque: 35 Nm



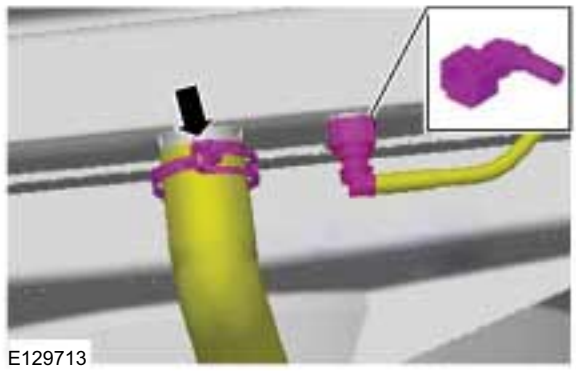
21. Torque: 20 Nm



22. Torque: 23 Nm

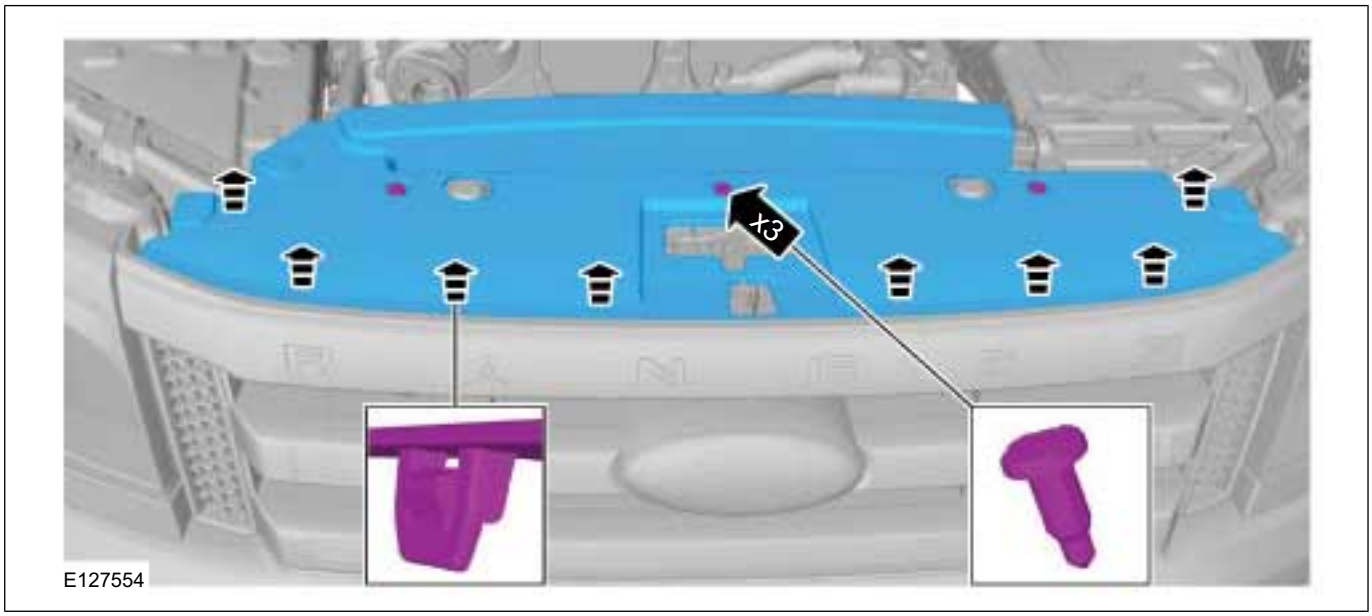


23.

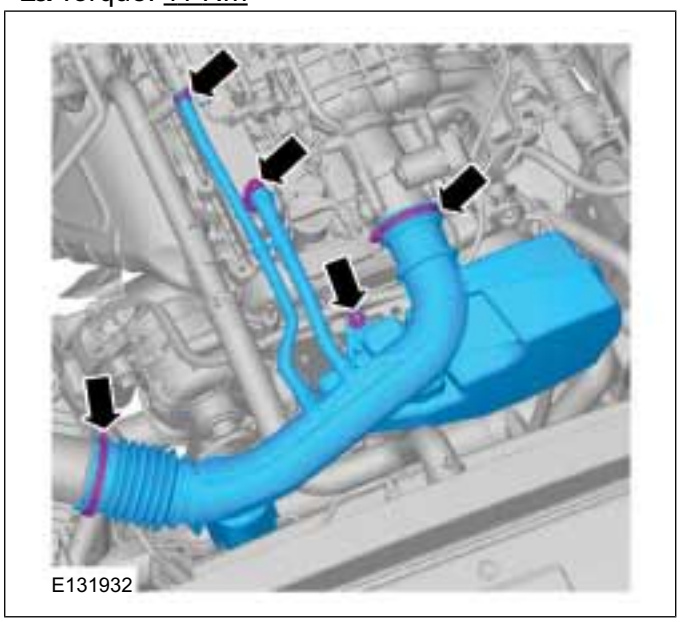


24.

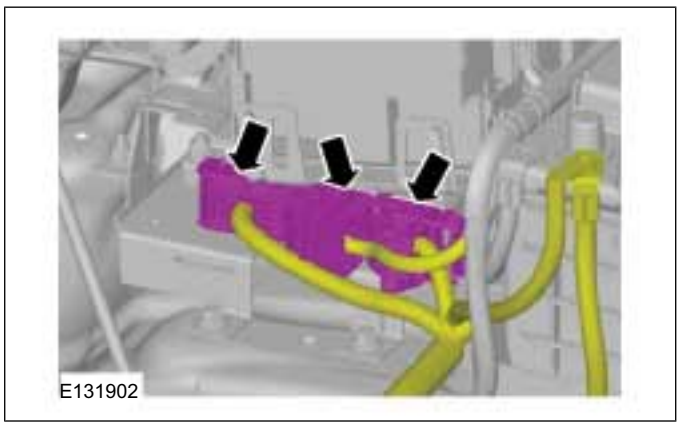
INSTALLATION



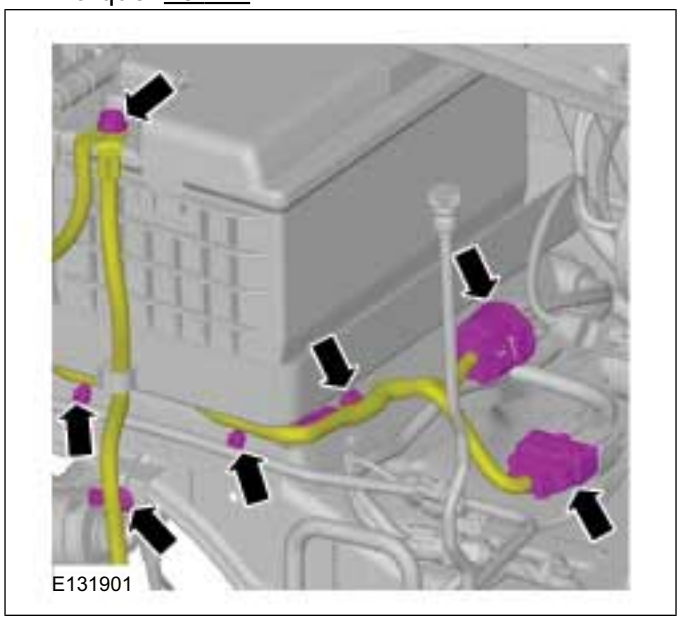
25. Torque: 11 Nm



26.

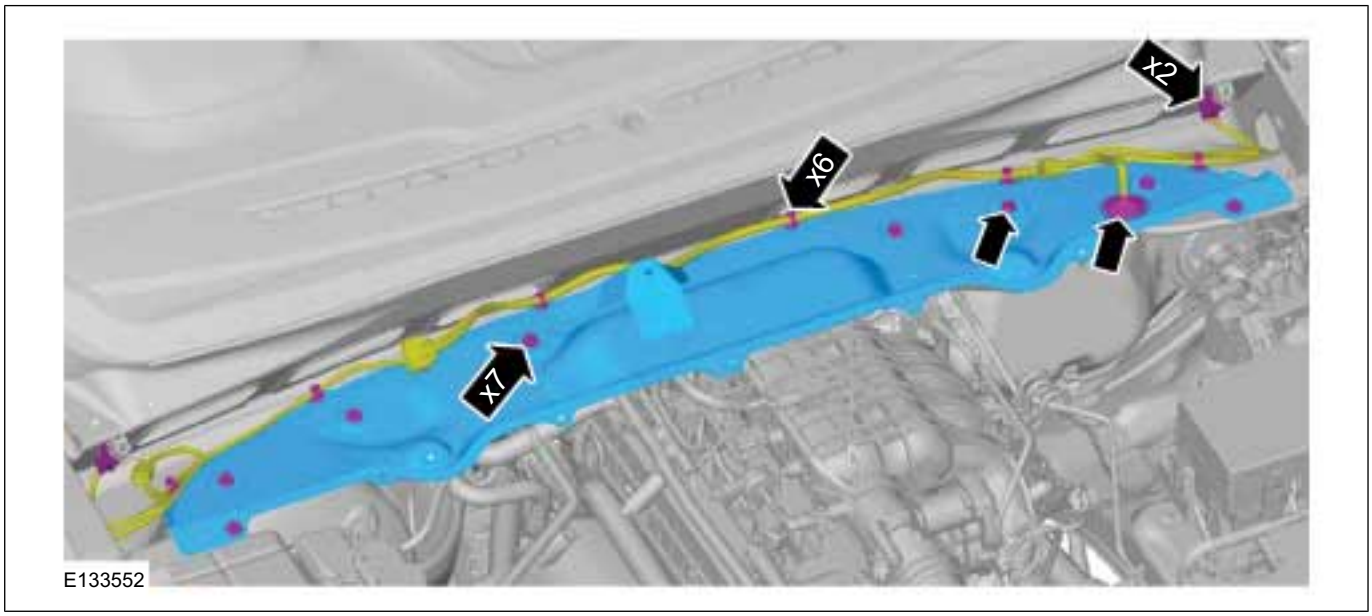


27. Torque: 10 Nm

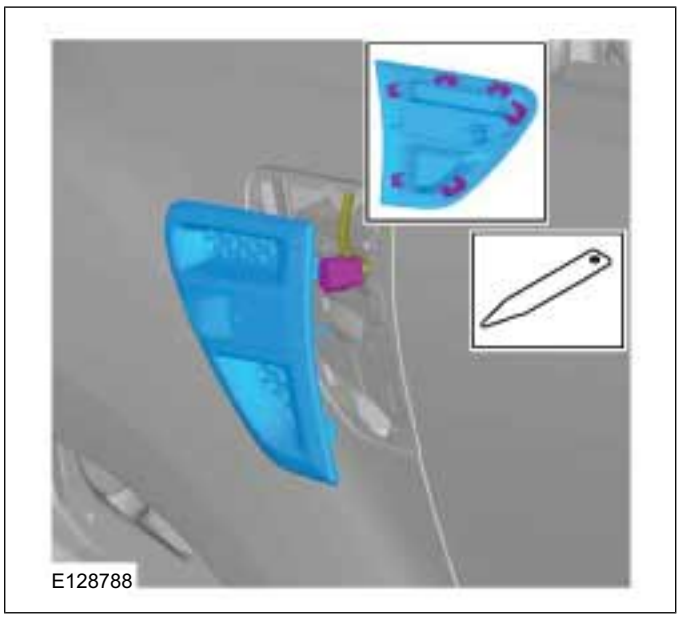


28. Torque: 14 Nm

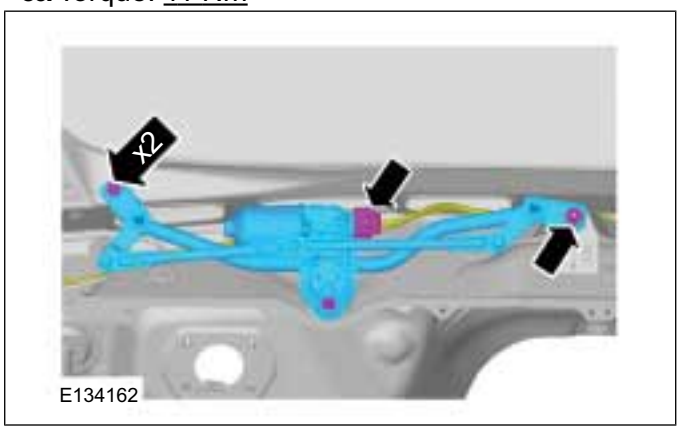
INSTALLATION



29. On both sides.

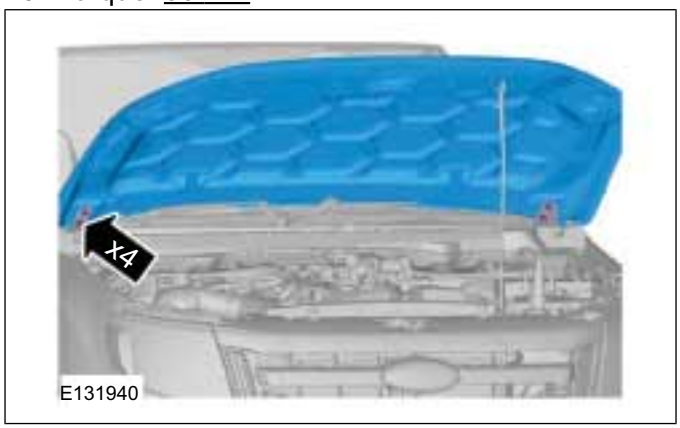


30. Torque: 11 Nm

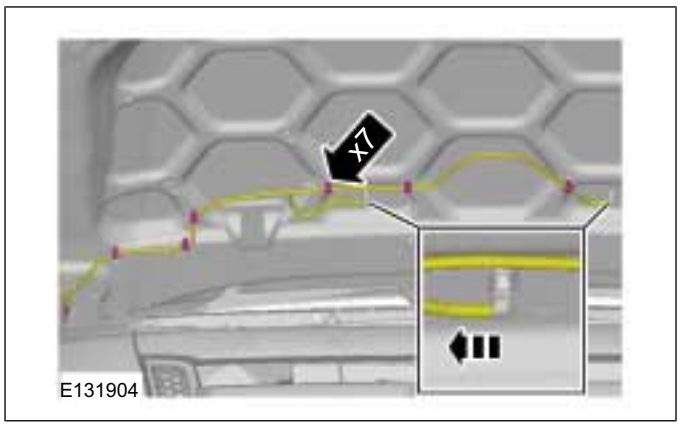


31. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

32. Torque: 30 Nm

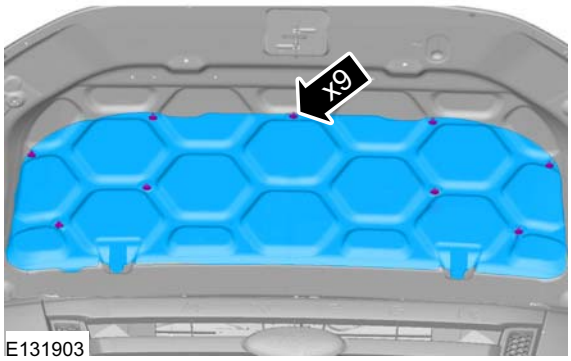


33.

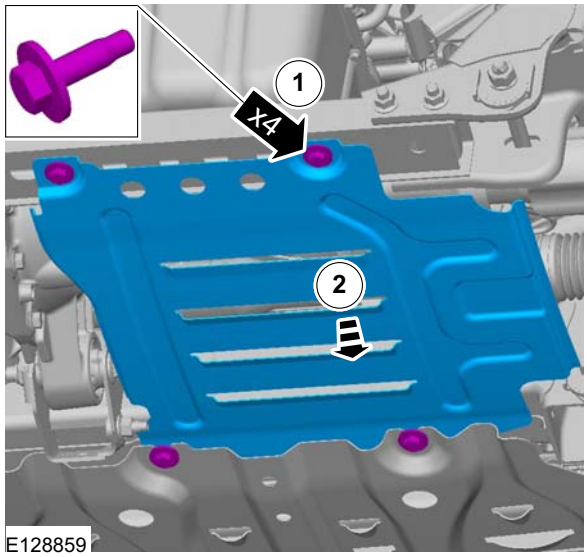


INSTALLATION

34.



35. Torque: 30 Nm



36. Refer to: Fuel System Pressure Release (310-00 Fuel System - General Information - 2.5L Duratec-HE (122kW/165PS) - MI4, General Procedures).

37. Refer to: Brake System Health and Safety Precautions (100-00 General Information, Description and Operation).

38. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

39. Refer to: Starter Motor (303-06 Starting System - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

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

41. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

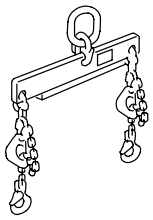
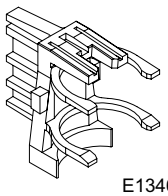
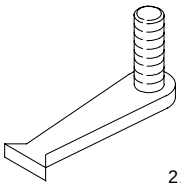
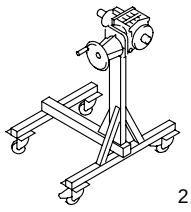
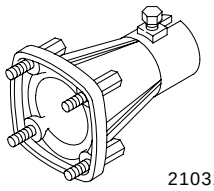
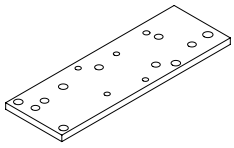
42. Refer to: Cooling System Draining, Filling and Bleeding (303-03 Engine Cooling, General Procedures).

INSTALLATION

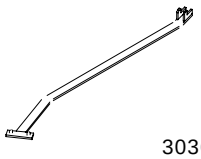
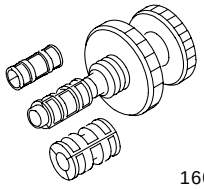
Engine Accessories(21 139 4)

Installation

Special Tool(s) / General Equipment

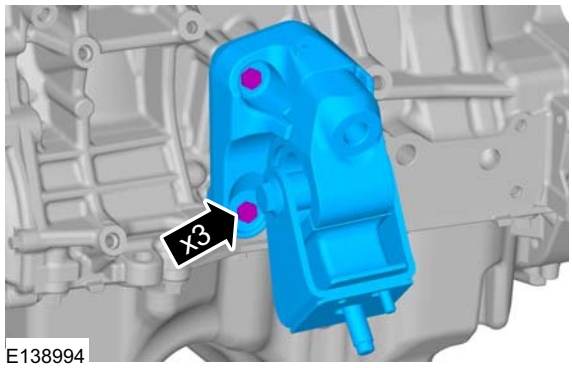
 21068A	303-122 Lifting Bracket, Engine
 E134676	303-1417 Tool, Crank Sensor Alignment
 21135	303-254 Locking Tool, Flywheel
 21187	303-435 Mounting Stand
 21031B	303-435-06 Mounting Bracket for 303-435
 E62805	303-435-14B Mounting Plate for 303-435-06

Special Tool(s) / General Equipment

 303676	303-676 Release Tool, Belt Tensioner
 16067	308-204 Aligner, Clutch Disc
Hydraulic Jib Crane	

All vehicles

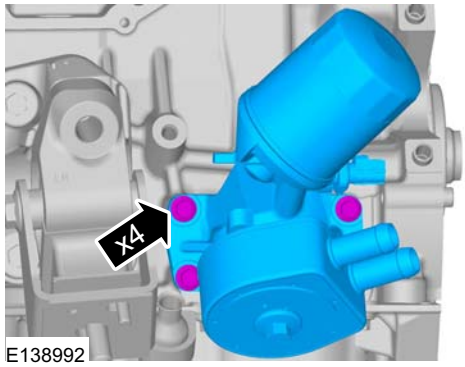
1. Torque: 48 Nm



E138994

4x4

2. Torque: 25 Nm

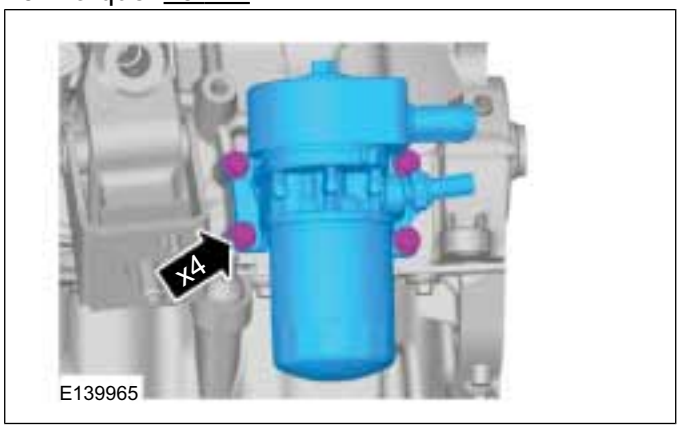


E138992

INSTALLATION

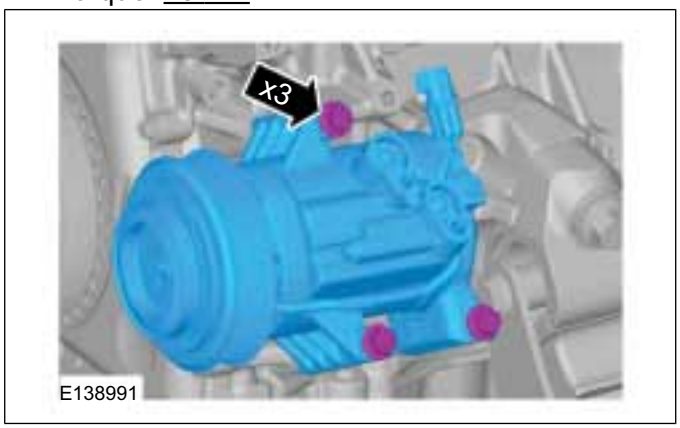
4x2

3. Torque: 25 Nm



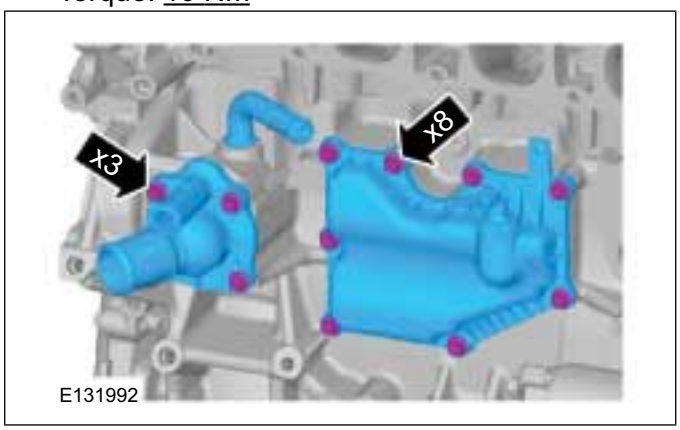
All vehicles

4. Torque: 25 Nm

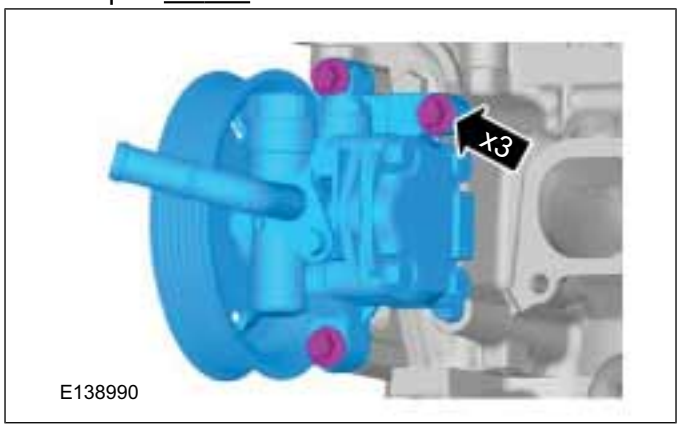


5. **NOTE:** The gasket is to be reused unless damaged.

   Torque: 25 Nm

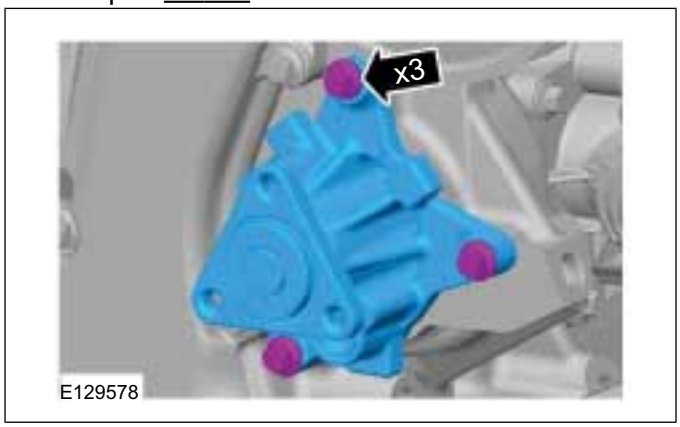


6. Torque: 23 Nm

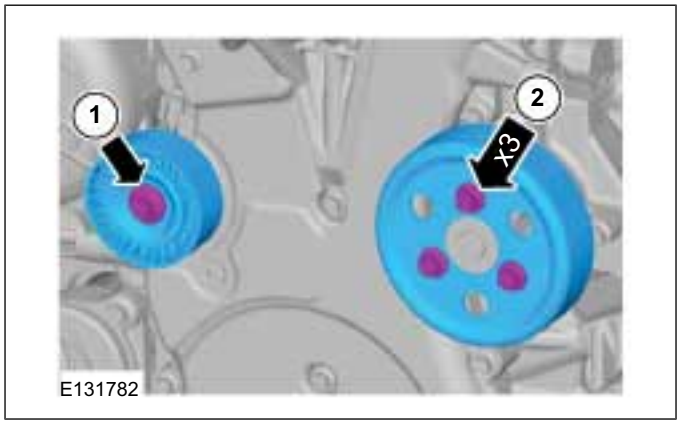


7. **NOTE:** Make sure that the mating faces are clean and free of foreign material.

   Torque: 10 Nm

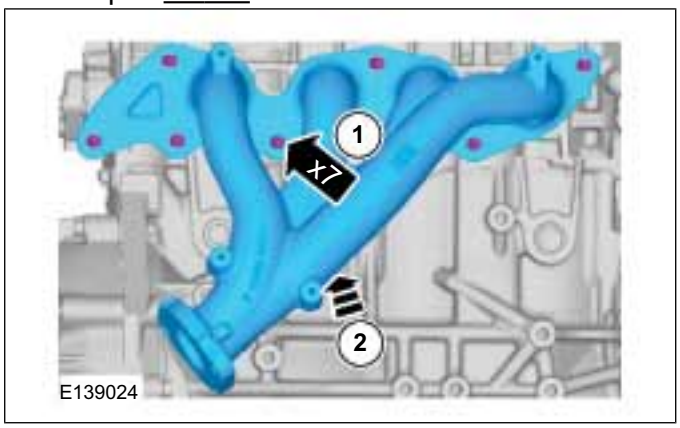


8. 1. Torque: 25 Nm
   2. **NOTE:** Install all the bolts finger tight before final tightening.



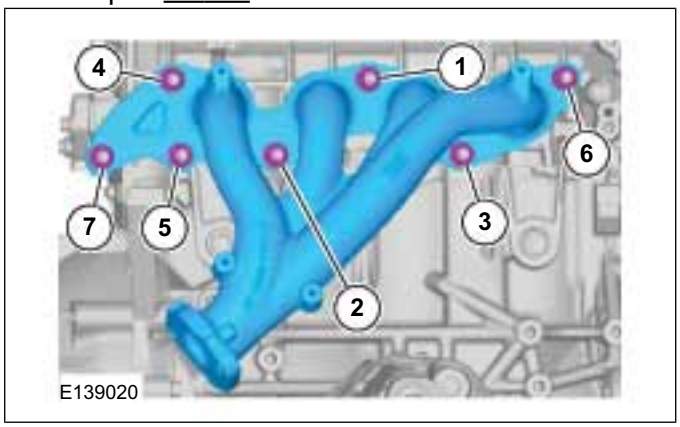
INSTALLATION

9. Torque: 17 Nm



10. NOTE: Make sure that a new exhaust manifold gasket is installed.

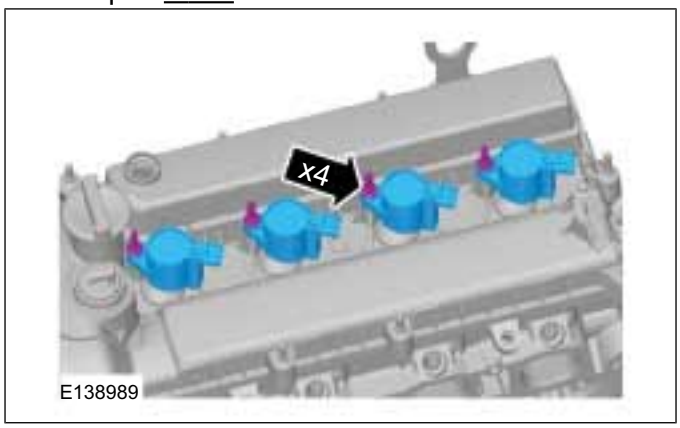
Torque: 55 Nm



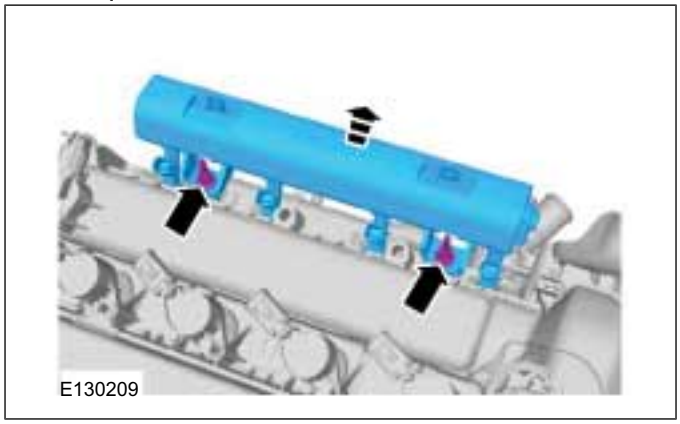
11. NOTE: The accessory drive belt tensioner must be replaced as a complete unit.

Torque: 25 Nm

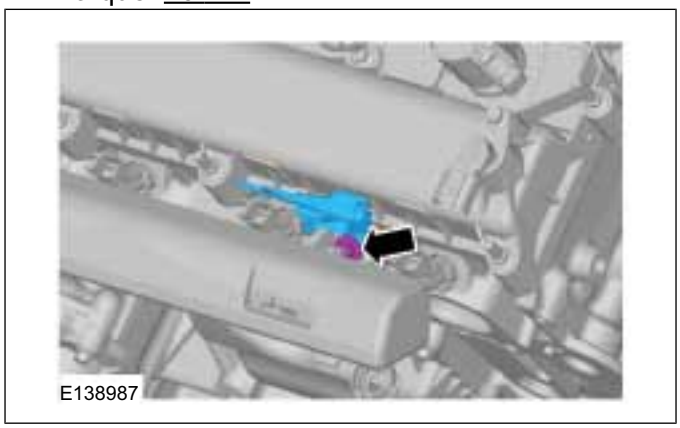
12. Torque: 8 Nm



13. Torque: 23 Nm

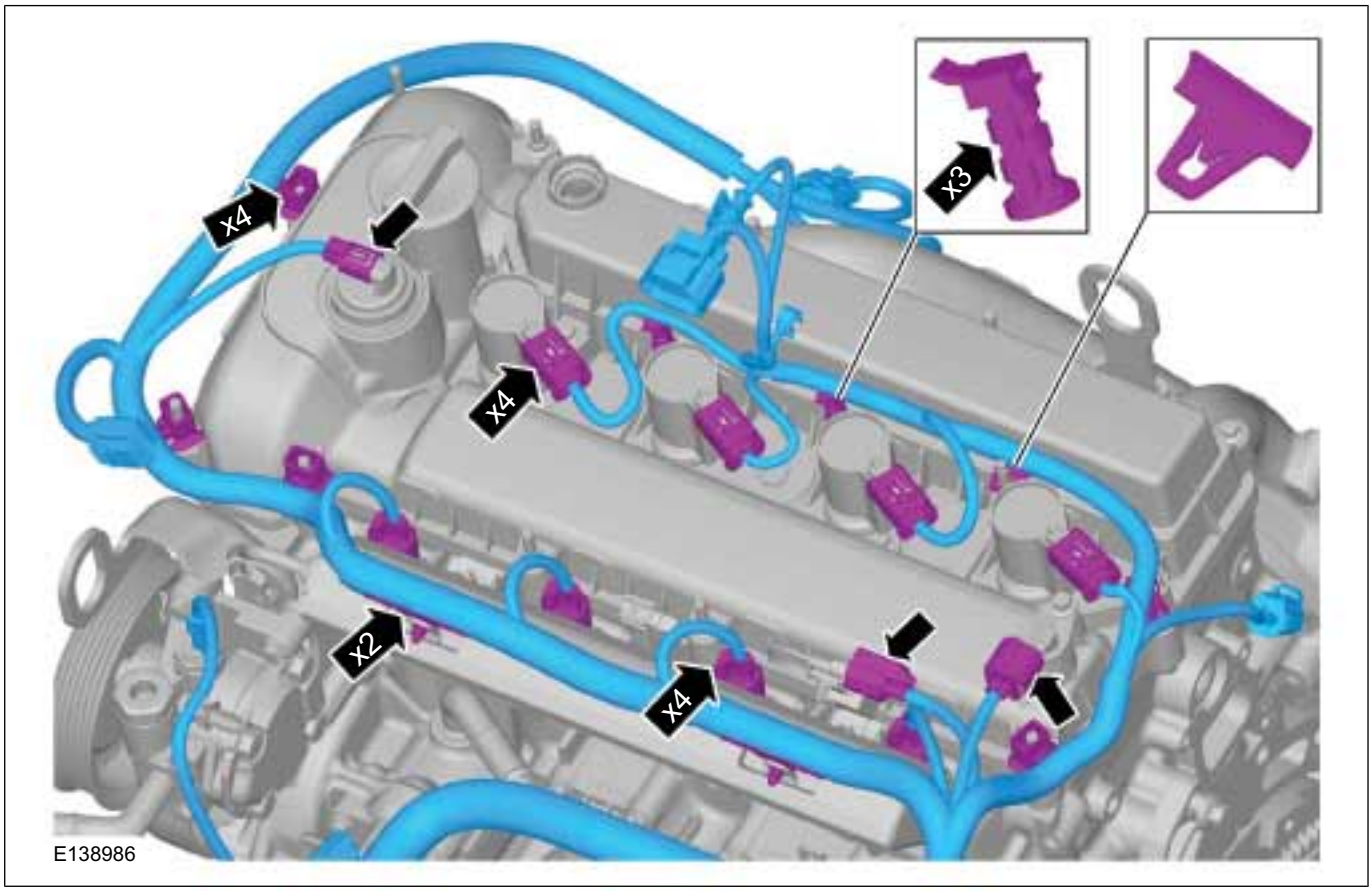


14. Torque: 10 Nm



15.

INSTALLATION

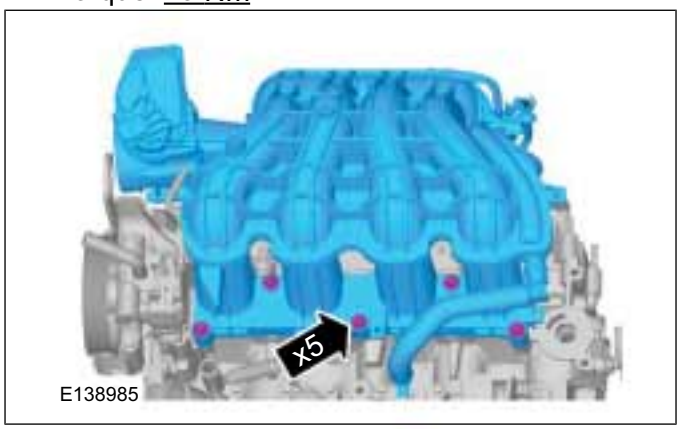


16. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools can cause scratches and gouges which can make leak paths. Use a plastic scraping tool to remove all traces of the old intake manifold gaskets.

    NOTE: If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

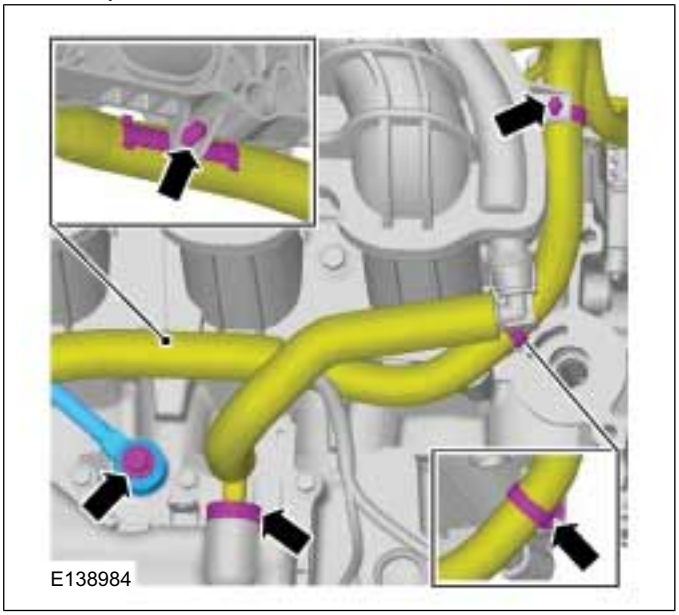
    NOTE: The gasket is to be reused unless damage.

    Clean the sealing surfaces and inspect the gaskets. Install new gaskets if necessary.
    Torque: 19 Nm



INSTALLATION

17. Torque: 20 Nm



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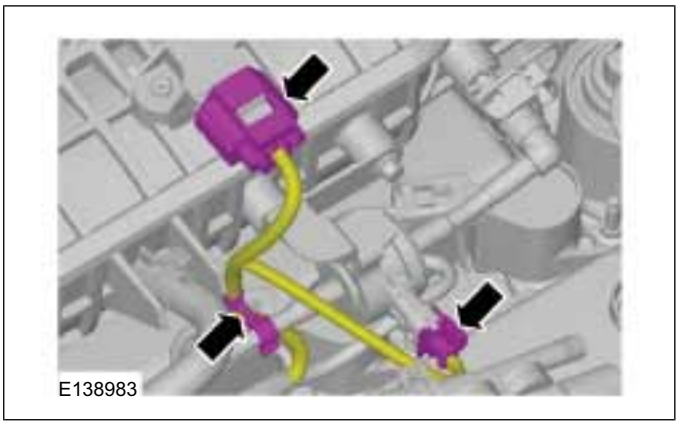

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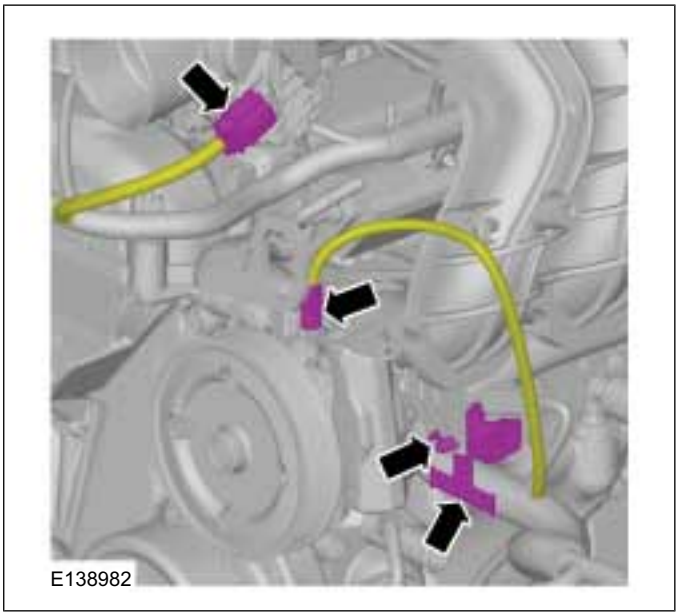
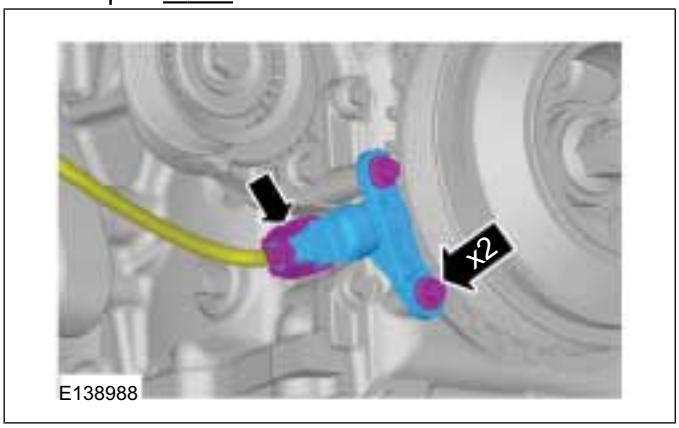


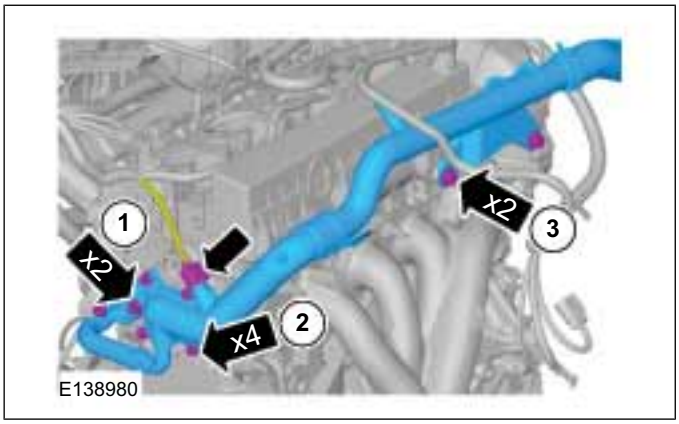
20. Special Tool(s): 303-1417

21. Torque: 7 Nm



22. **NOTE:** The gasket is to be reused unless damaged.

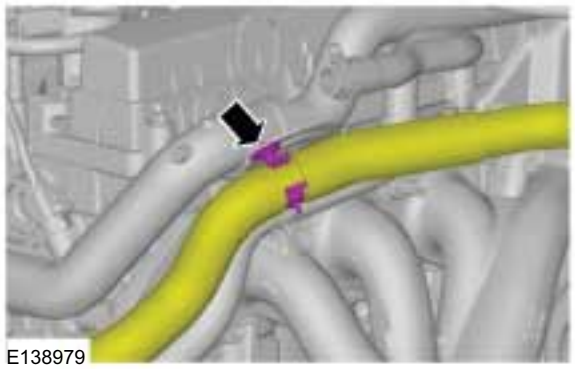
1. Torque: 25 Nm
2. Torque: 10 Nm
3. Torque: 48 Nm



INSTALLATION

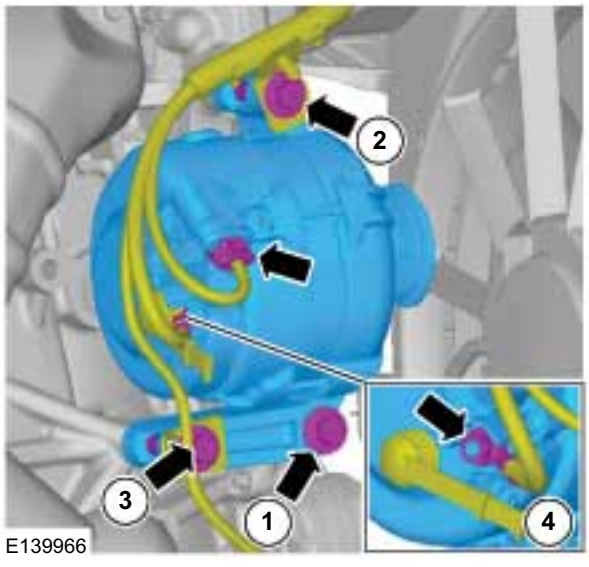
23.

24.



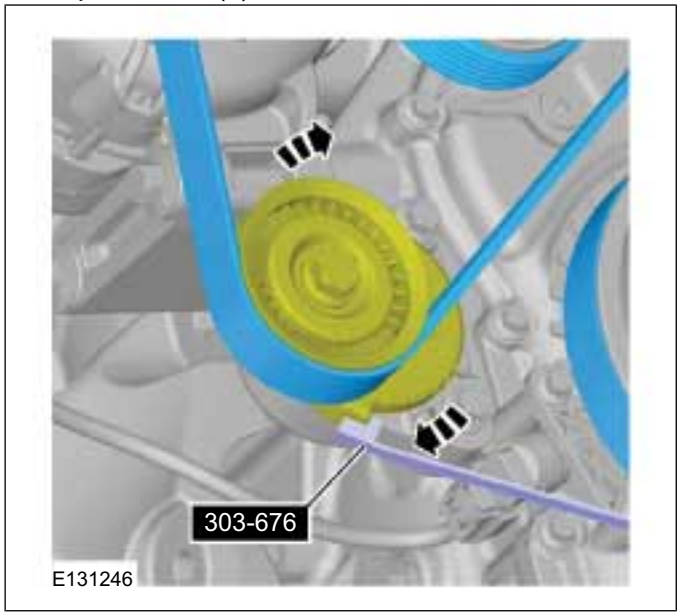
25. ⚠ **CAUTION: Take extra care not to damage the wiring harnesses.**

1. Torque: 48 Nm
2. Torque: 48 Nm
3. Torque: 48 Nm
4. Torque: 15 Nm

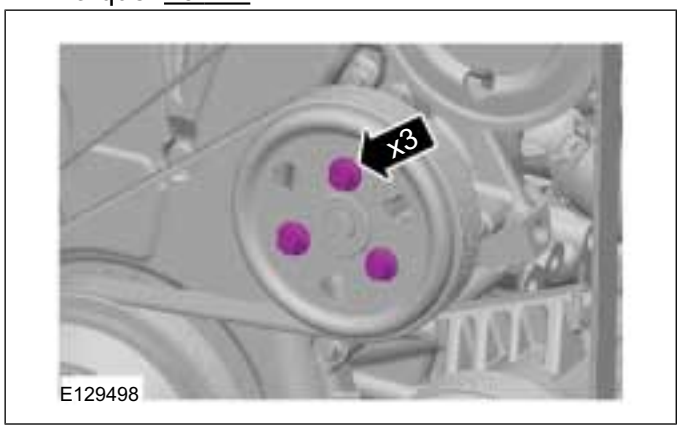


26. Rotate the accessory drive belt tensioner clockwise and install the accessory drive belt.

Special Tool(s): 303-676



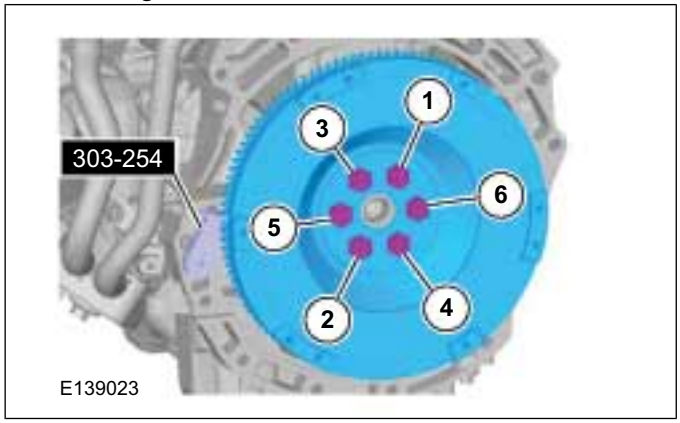
27. Torque: 20 Nm



28. Special Tool(s): 303-254

Torque:

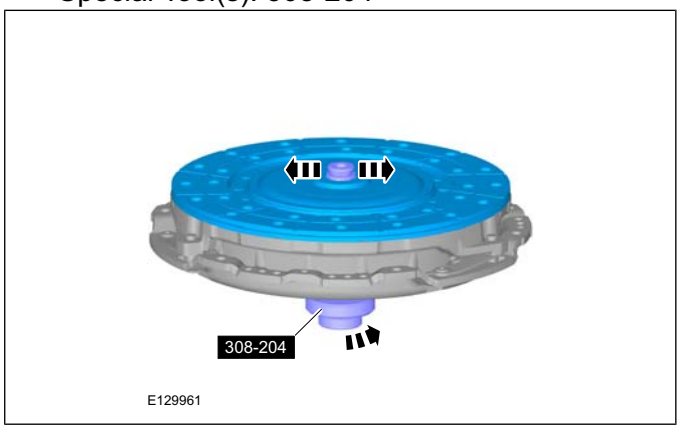
- Stage 1: 50 Nm
- Stage 2: 80 Nm
- Stage 3: 112 Nm



INSTALLATION

29. **NOTE:** The cone on the special tool must only be tightened finger tight to prevent damage to the clutch disc.

    Special Tool(s): 308-204

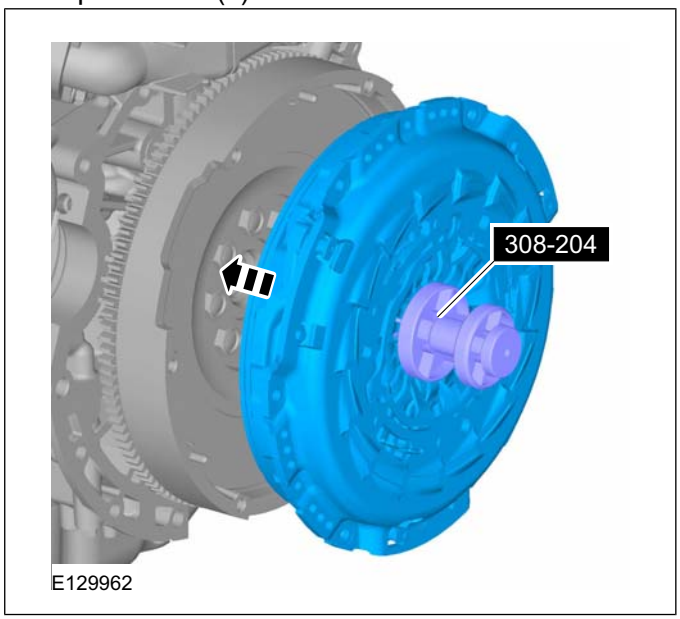


30. **NOTE:** Check the pilot bearing for damage. Replace it, if necessary.

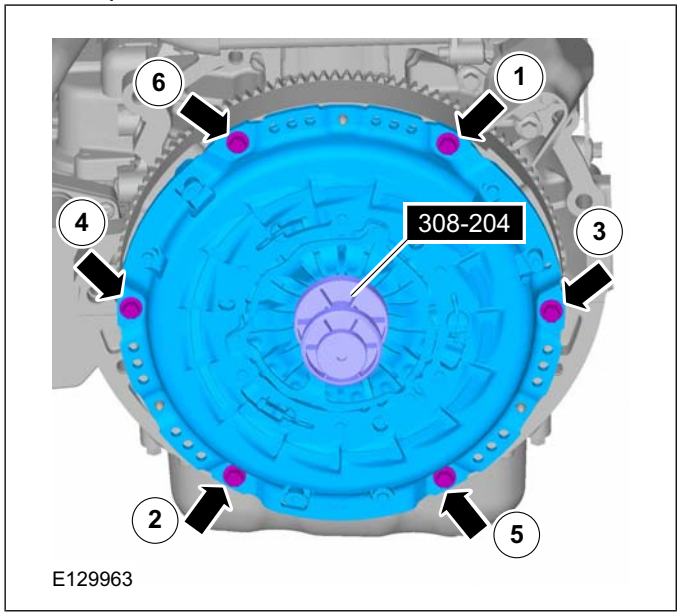
    Refer to: Pilot Bearing - 2.5L Duratec-HE (122kW/165PS) - MI4 (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).

31. **NOTE:** Only tighten the bolt finger tight at this stage.

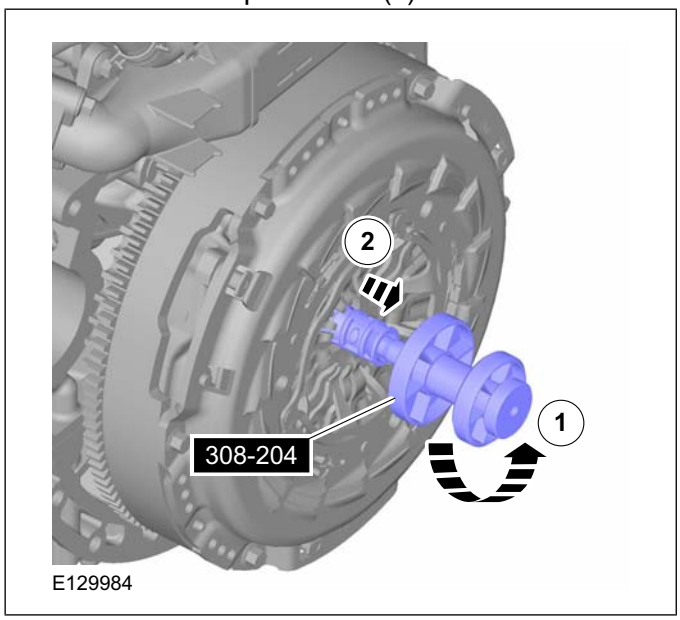
    Special Tool(s): 308-204



32. Special Tool(s): 308-204
    Torque: 30 Nm

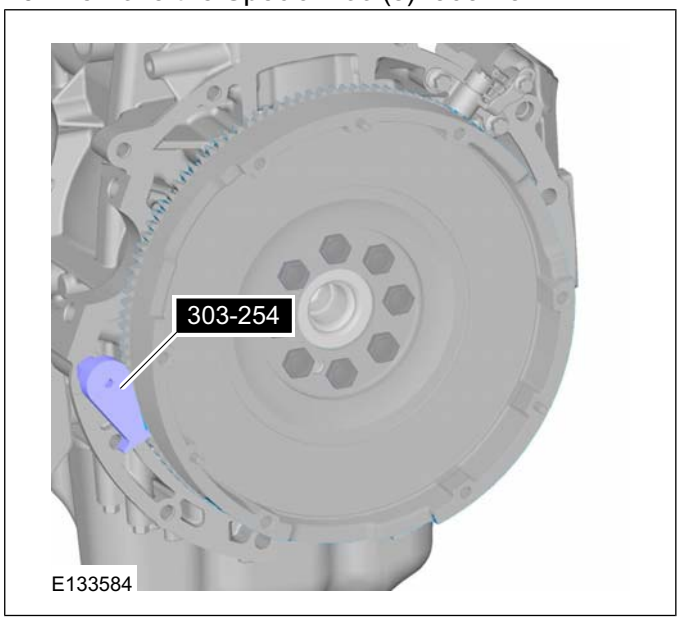


33. Remove the Special Tool(s): 308-204

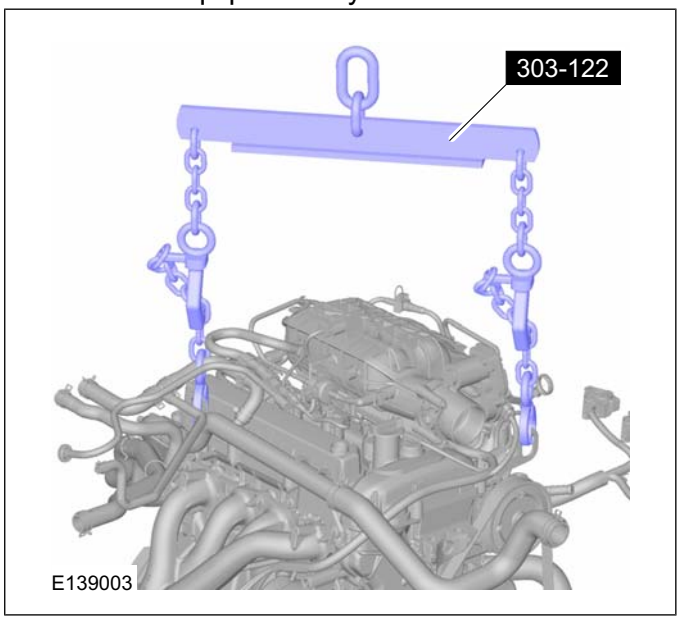


INSTALLATION

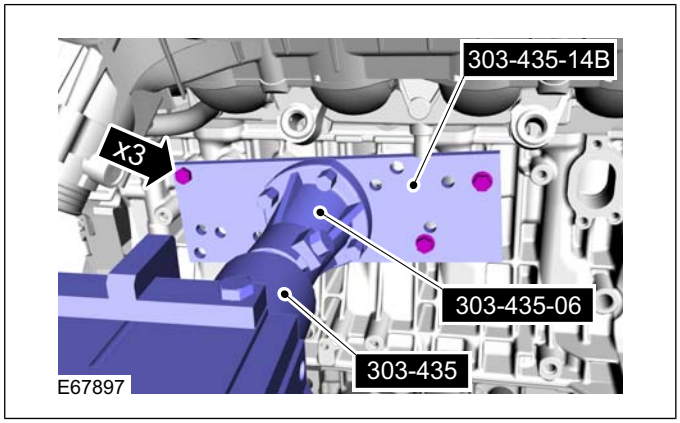
34. Remove the Special Tool(s): 303-254



35. Special Tool(s): 303-122
General Equipment: Hydraulic Jib Crane



36. Remove the Special Tool(s): 303-435, 303-435-06, 303-435-14B



SECTION 303-01B Engine — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

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SPECIFICATIONS

DESCRIPTION AND OPERATION

REMOVAL AND INSTALLATION

REMOVAL

DISASSEMBLY

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

ASSEMBLY

INSTALLATION

SPECIFICATIONS

Engine Data — 120 PS

Description	
Code	GBVAJPF
Firing order	1-3-4-2
Bore diameter	86 mm
Stroke	94.6 mm
Displacement	2198 cc
Compression ratio	
compression pressure value	
Power output at _ rpm	88 kW (120 PS)
Torque between 1500 to 2200 rpm	Nm
Idle speed	rpm

Engine Data — 125 PS

Description	
Code	GBVAJQW
Firing order	1-3-4-2
Bore diameter	86 mm
Stroke	94.6 mm
Displacement	2198 cc
Compression ratio	
compression pressure value	
Power output at _ rpm	92 kW (125 PS)
Torque between 1500 to 2200 rpm	Nm
Idle speed	rpm

Engine Data — 150 PS

Description	
Code	GBVAJQJ
Firing order	1-3-4-2
Bore diameter	86 mm
Stroke	94.6 mm
Displacement	2198 cc
Compression ratio	
compression pressure value	
Power output at _ rpm	110 kW (150 PS)
Torque between 1500 to 2200 rpm	Nm
Idle speed	rpm

SPECIFICATIONS

Engine Oil Capacity

Description	Liters
Initial fill including oil filter	8.89
Service fill including oil filter	8.55

Cylinder Block Dimensions

Description	mm
Cylinder bore diameter — Class A	86.000-86.010
Cylinder bore diameter — Class B	86.010-86.020
Cylinder bore diameter — Class C	86.020-86.030
Main bearing shells 1 to 4 inner diameter — bearings installed	65.003-65.030
Main bearing shell 5 inner diameter — bearings installed	70.004-70.033
Main bearings 1 to 4 radial clearance	0.033-0.080
Main bearing 5 radial clearance	0.034-0.083
Main bearings 1 to 4 parent bore diameter — vertical measurement	69.504-64.520
Main bearing 5 parent bore diameter — vertical measurement	74.504-74.520
Main bearings 1 to 4 parent bore diameter — horizontal measurement	69.502-69.525
Main bearing 5 parent bore diameter — horizontal measurement	74.502-74.525

Piston Dimensions

Description	mm
Piston diameter — Class A	85.94-85.95
Piston diameter — Class B	85.95-85.96
Piston diameter — Class C	85.96-85.97
Piston clearance in cylinder	0.05-0.07
Piston ring end gaps	
— upper compression ring	0.25-0.50
— lower compression ring	0.50-0.75
— oil control ring	0.25-0.50
Piston ring gap position: The piston ring gaps must be distributed evenly around the circumference of the piston. This also applies to the oil control ring elements. Align the piston ring gaps at 120 degrees to each other.	

Crankshaft Dimensions

Description	mm
Main bearing journal end float	0.090-0.305
Main bearing journals 1 to 4 diameter	64.950-64.970
Main bearing journal 5 diameter	69.950-69.970
Connecting rod bearing journal diameter	52.980-53.000

SPECIFICATIONS

Connecting Rod Dimensions

Description	mm
Large end bore diameter	55.096-56.015
Small end bore diameter	30.010-30.018
Connecting rod bearing shell inner diameter — bearings installed	53.017-53.043
Connecting rod bearing radial clearance	0.034-0.100
Connecting rod bearing axial clearance	0.100-0.320

Piston Pin Dimensions

Description	mm
Piston pin length	66.700
Piston pin diameter	30.000
Piston pin slide clearance	0.002-0.012

Camshaft Dimensions

Description	mm
Camshaft end float	0.014-0.20
Camshaft bearing journal diameter	26.450
Camshaft bearing clearance — radial measurement	0.065

Valve Dimensions

Description	mm
Valve stem to valve guide clearance — intake valve	0.045
Valve stem to valve guide clearance — exhaust valve	0.055

Cylinder Head Dimensions

Description	mm
Maximum distortion — measured longitudinally and diagonally	0.10
Peak to valley height of mating surface	0.02
Thickness of cylinder head gasket with piston protrusion of 0.430 - 0.520 mm	1.1
Thickness of cylinder head gasket with piston protrusion of 0.521 - 0.570 mm	1.15(two hole/teeth)
Thickness of cylinder head gasket with piston protrusion of 0.571 - 0.620 mm	1.2(three holes/teeth)

Oil Pressure Specifications

Description	bar
Minimum oil pressure at idle speed	1.25
Minimum oil pressure at 2000 rpm	2.0

SPECIFICATIONS

Lubricants, Fluids, Sealers and Adhesives

Item	Specification
Ford Formula E SAE 5W-30 engine oil	WSS-M2C913-c
Sealer — oil pan, camshaft carrier and engine front cover	WSE-M4G323-A4

DESCRIPTION AND OPERATION

Engine – Overview

General

- The 2.2L Duratorq-TDCi (Puma) Diesel is available in three different power output versions: 88 kW (120 PS), 92 kW (125 PS) and 110 kW (150 PS).
- The 88 kW (120 PS) version has fixed vane turbocharger with a wastegate is used.
- The 92 kW (125 PS) version is available with fixed type and adjustable guide vane type also.
- The 110 kW (150 PS) version has a turbocharger with electrically adjustable guide vane geometry as well as fuel injectors with an increased flow rate.

Features

- 4-cylinder turbodiesel in-line engine with two overhead camshafts and 16 valve technology
- Cast iron cylinder block with cast-in cylinder liners
- Ladder frame for extending the cylinder block
- Two-part cylinder head made from aluminium
- Exhaust camshaft driven by a timing belt
- Intake camshaft driven via a timing chain (driven by the exhaust camshaft)
- Valves actuated by roller cam followers with hydraulic tappets
- Variable-geometry turbocharger for optimum cylinder charging

Fuel system

- Bosch common rail system with maximum fuel pump pressure of 1600 bar (also up to 1800 bar for a limited time)
- Fuel injectors with piezo technology
- Oil temperature sensor as an input variable for calculating the oil quality

Engine management

- Bosch PCM (powertrain control module) EDC16CP39
- Fuel metering valve, fuel pressure regulator and fuel pressure sensor for efficient regulation of the fuel pressure
- Actuator motor-controlled EGR (exhaust gas recirculation) valve

Engine-emission control

- Meets EURO 5
- Actuator motor-controlled EGR valve
- Intake manifold flap with position sensor
- Broadband Lambda probe for correcting the injection volume and for optimizing the EGR
- Coated DPF (diesel particulate filter) to minimize rust particle emissions

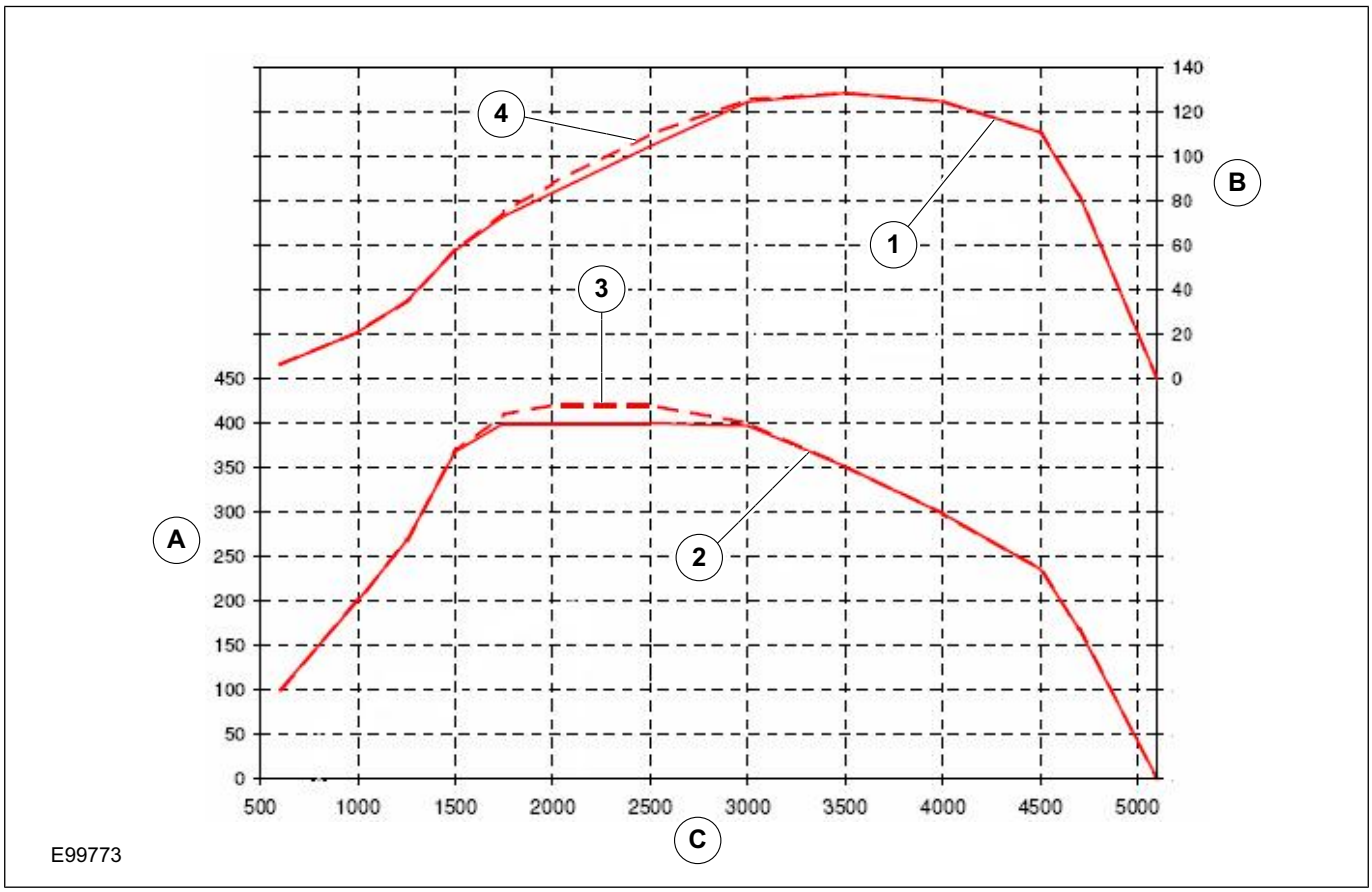
Diagnosis

- Via the DLC (data link connector)with IDS (Integrated Diagnostic System)

Specification

Torque and power output:

DESCRIPTION AND OPERATION

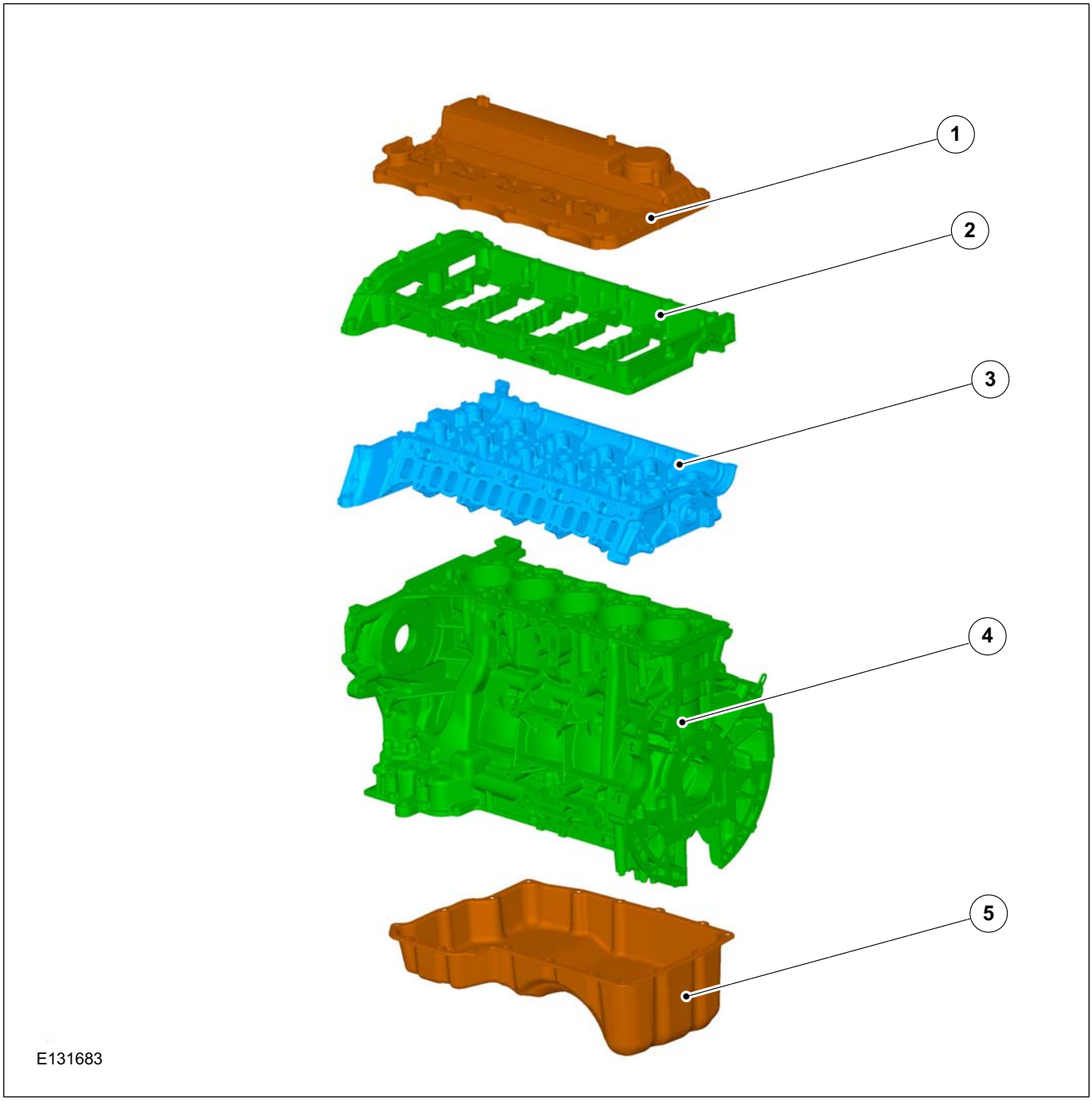


Item	Description
A	Torque (nm)
B	Power output(Kw)
c	Engine speed
1	Power output curve

Item	Description
2	Engine speed curve
3	Torque during the overtorque function
4	Power output during the overtorque function

DESCRIPTION AND OPERATION

Overview of the main engine components



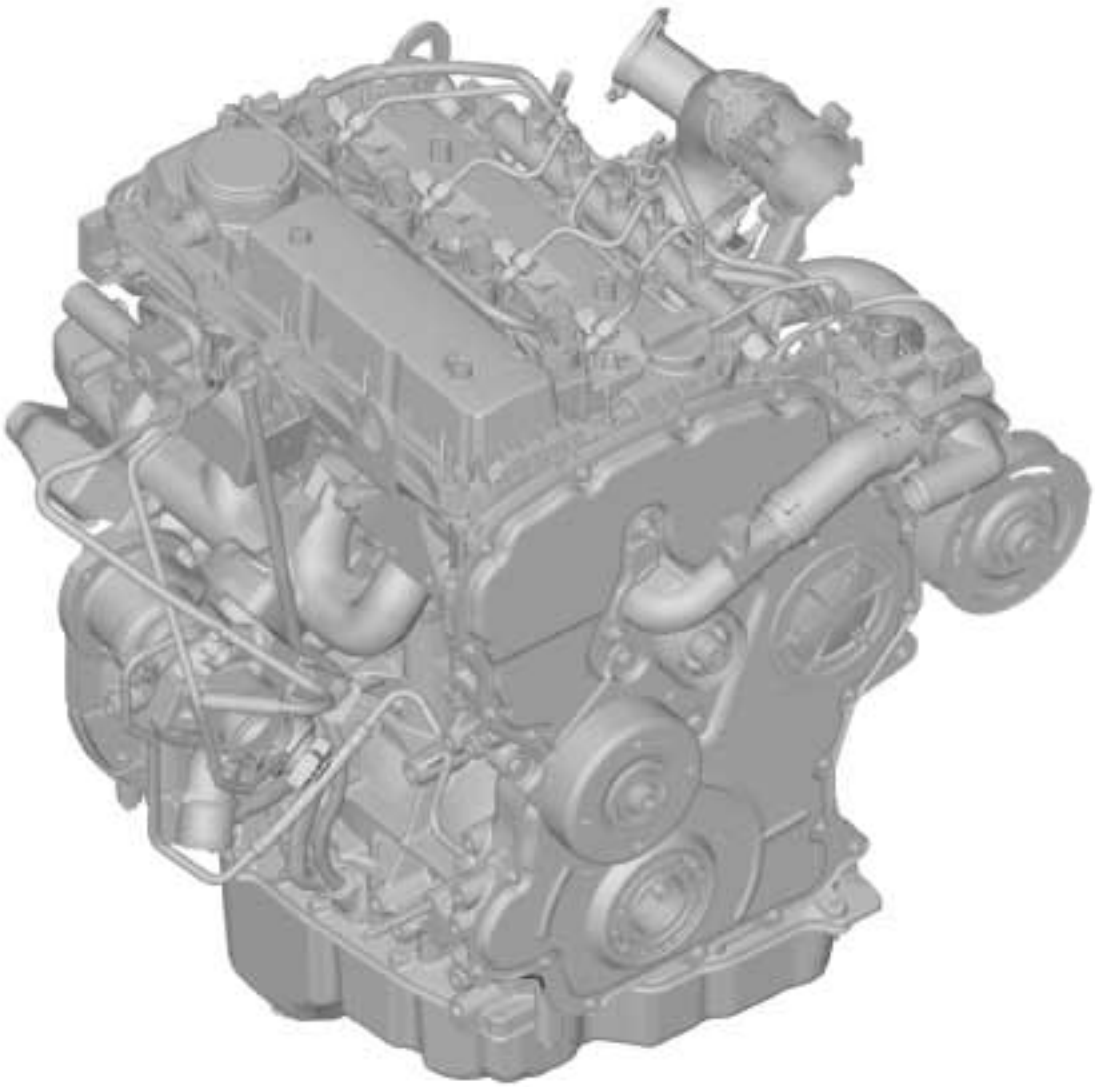
Item	Description
1	Valve cover
2	Cylinder head - upper part
3	Cylinder head - lower part

Item	Description
4	Cylinder block
5	Oil pan extension
6	Oil sump

DESCRIPTION AND OPERATION

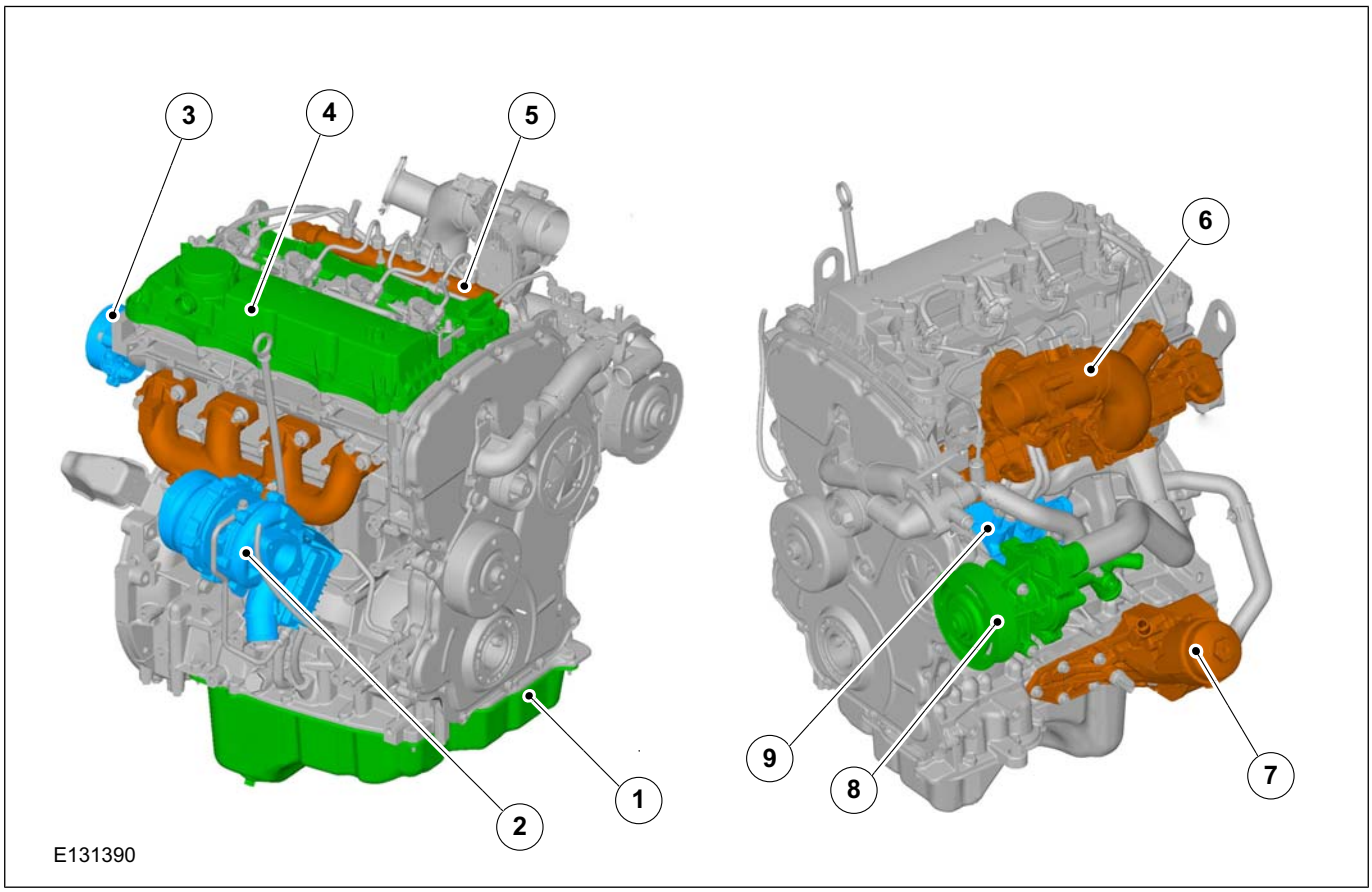
Engine

Engine -component location



E131389

DESCRIPTION AND OPERATION

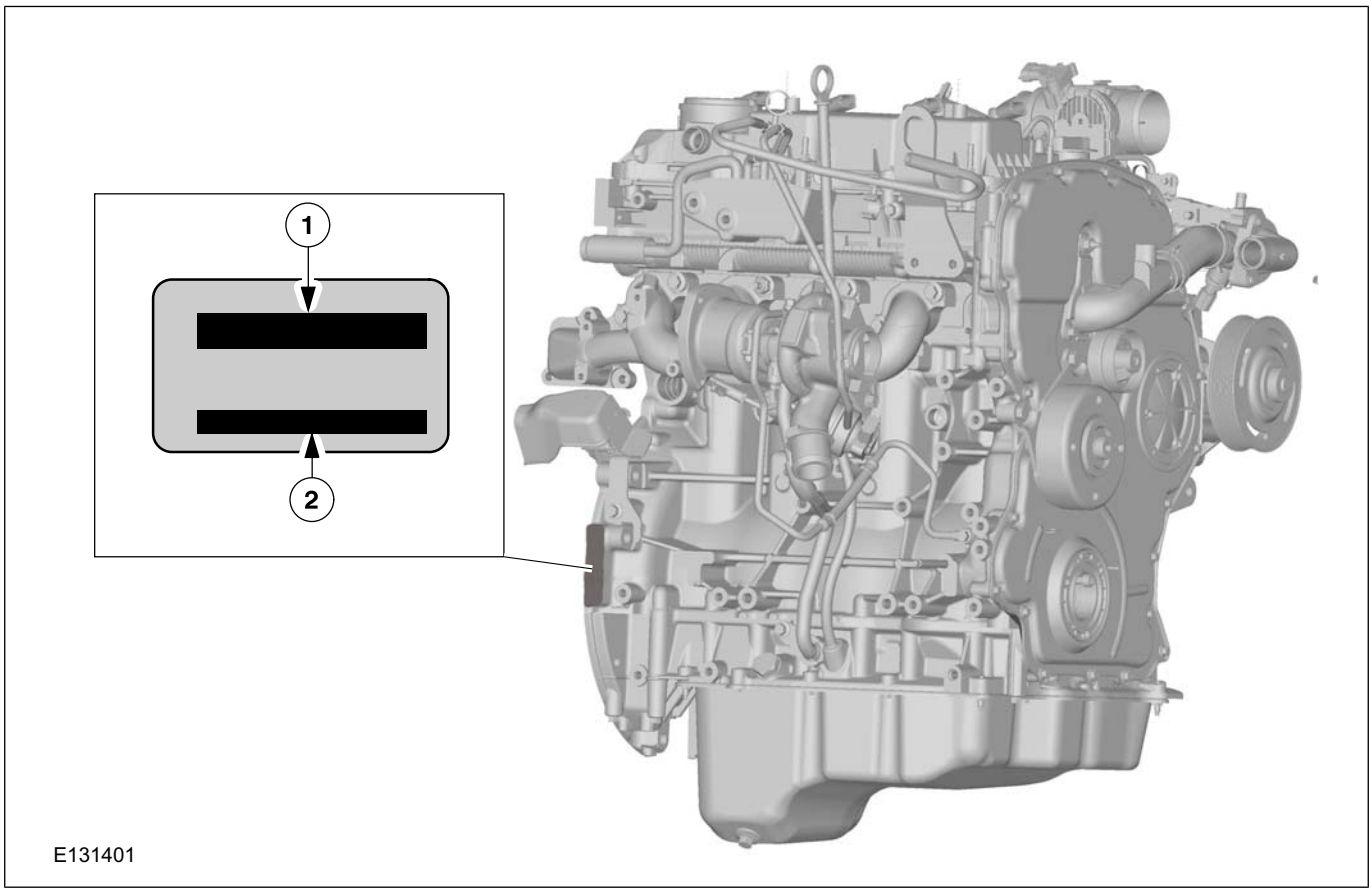


1.

Item	Description
1	Oil sump
2	Turbocharger
3	vacuum pump
4	Valve cover

Item	Description
5	Fuel injection rail
6	Intake manifold
7	Oil cooler
8	Coolant pump
9	Fuel pump

DESCRIPTION AND OPERATION



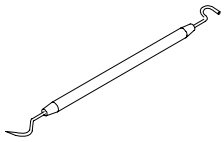
2.

Item	Description
1	Engine code
2	Engine serial number

REMOVAL AND INSTALLATION

Camshafts(21 284 0)

Special Tool(s) / General Equipment

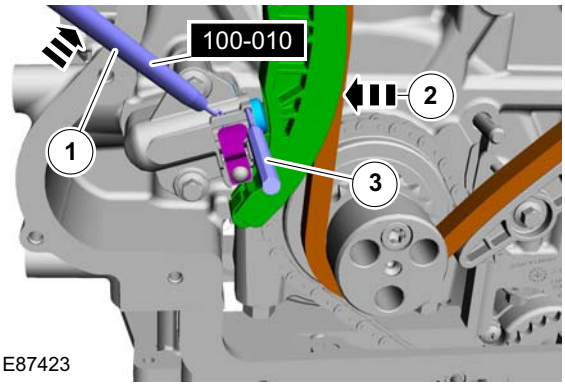
 E131853	100-010 Remover, O-Ring Seal
 E131853	303-1562 Timing Tool
2 mm Punch	
6 mm Drill Bit	

Removal

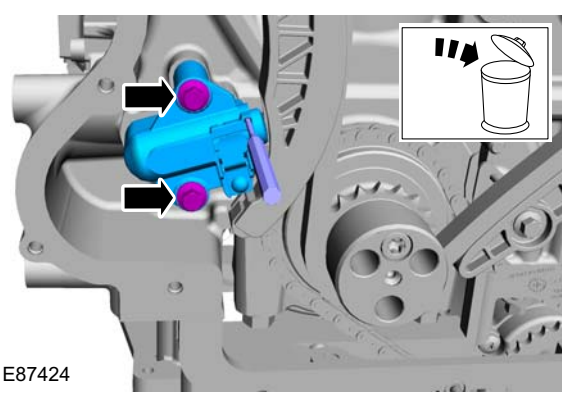
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

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

1. Refer to: Fuel Rail (303-04 Fuel Charging and Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).
2. Refer to: Valve Cover (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).
3. Refer to: Timing Cover (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).
4. Refer to: Brake Vacuum Pump - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (206-07 Power Brake Actuation, Removal and Installation).
5. Special Tool(s): 100-010
   General Equipment: 2 mm Punch

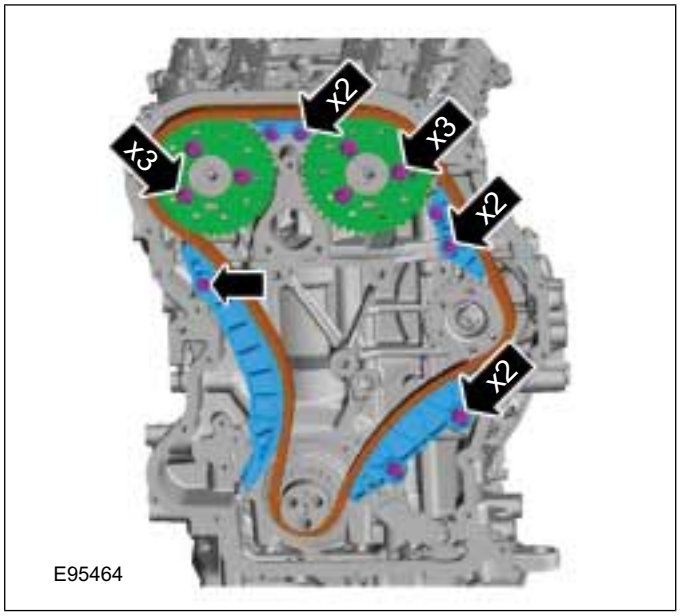


6. General Equipment: 2 mm Punch

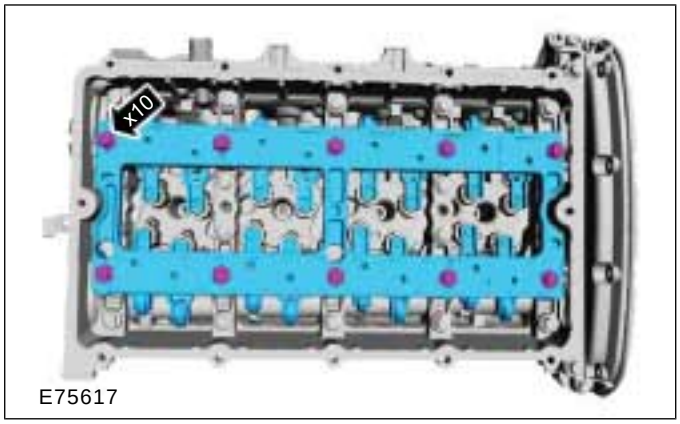


REMOVAL AND INSTALLATION

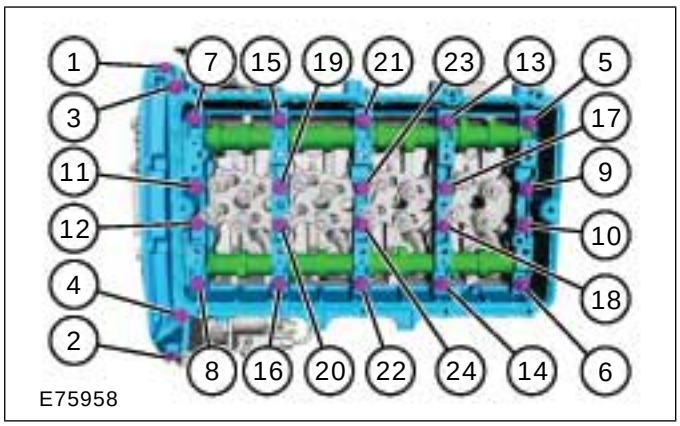
7.



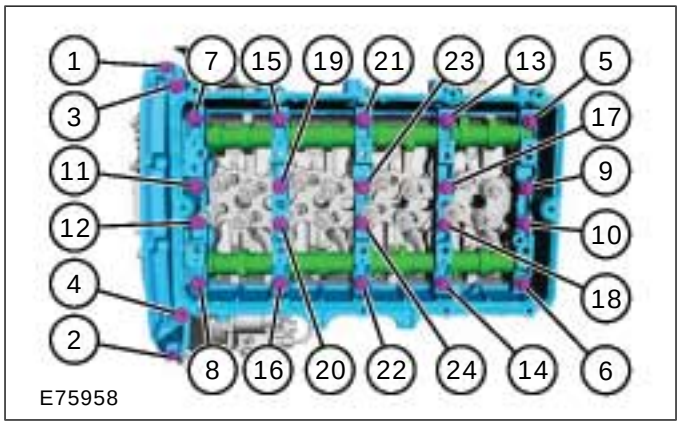
8.



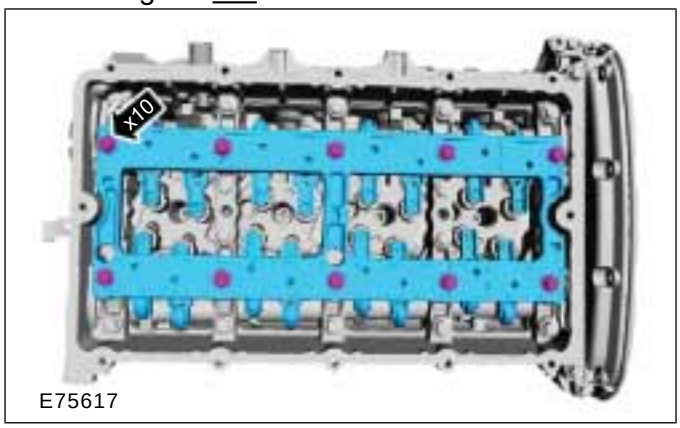
9. ⚠ **CAUTION: Remove the camshaft carrier bolts in the sequence shown.**



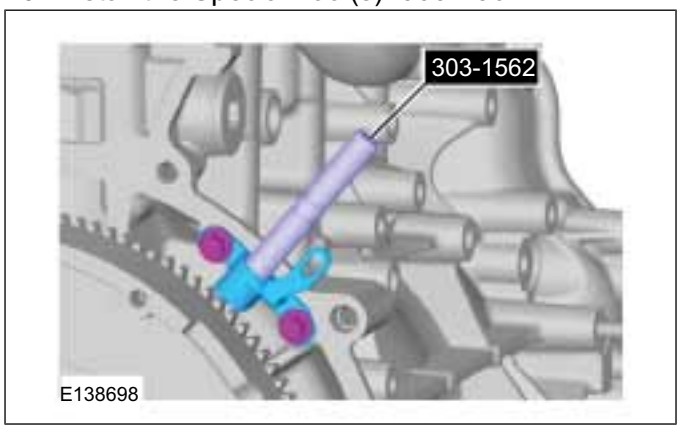
1.
- Bolts 1 to 22
  Torque: 23 Nm
- Bolts 23 to 25
  Torque: 10 Nm



2. Torque:
- Stage 1: 10 Nm
- Stage 2: 30°



3. Install the Special Tool(s): 303-1562



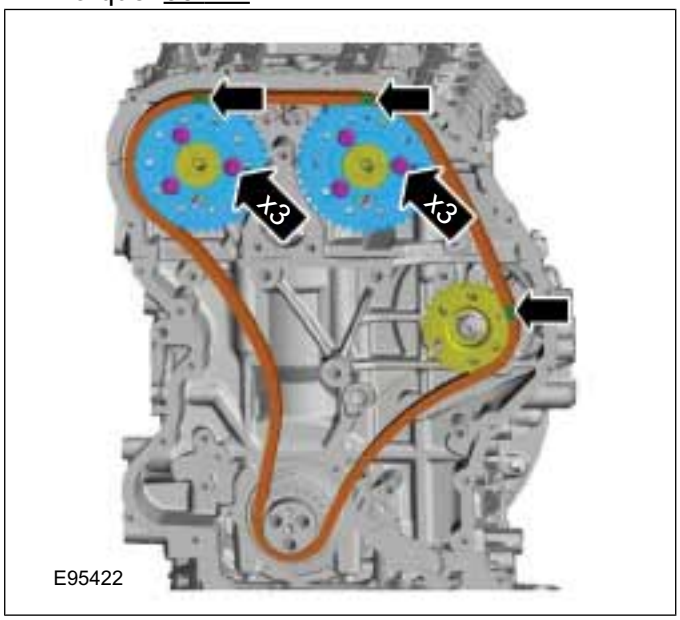
Installation

NOTE: Clean the mating faces of the camshaft carrier and the cylinder head.

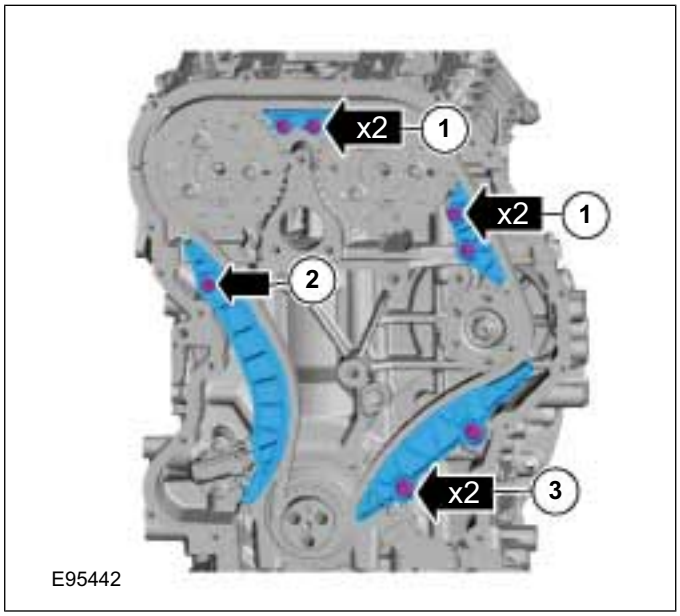
REMOVAL AND INSTALLATION

4. **NOTE:** Make sure that the installation marks are aligned.

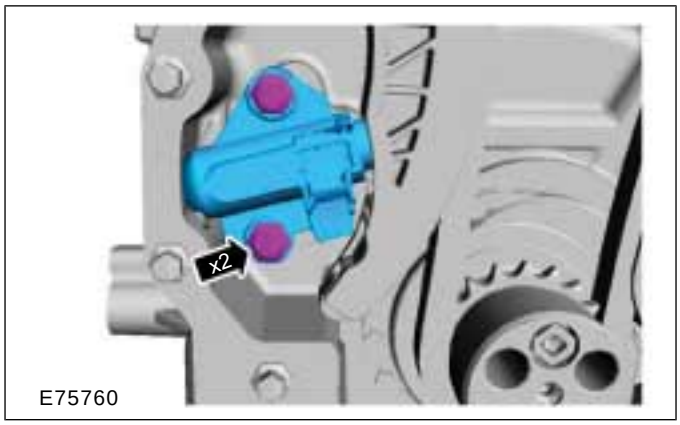
   General Equipment: 6 mm Drill Bit
   Torque: 33 Nm



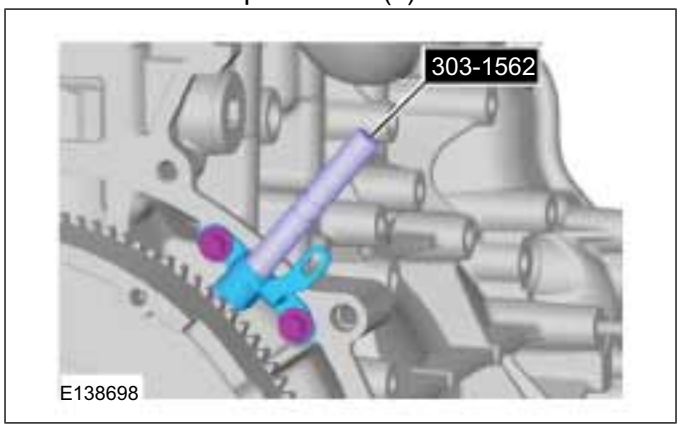
5. Remove the 6 mm drill bits.
6. 1. Torque: 15 Nm
   2. Torque: 40 Nm
   3. Torque: 40 Nm



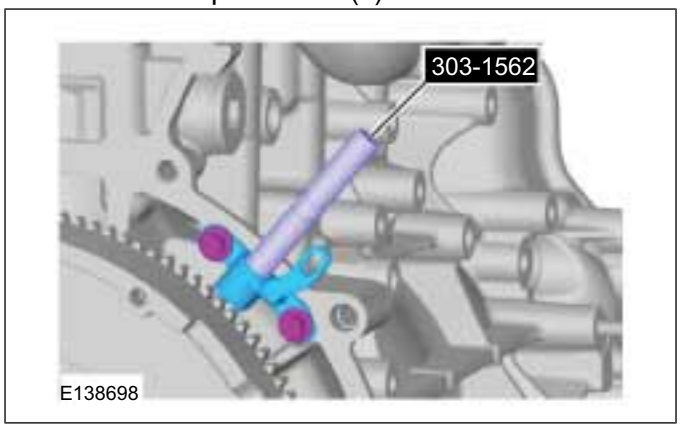
7. **NOTE:** Make sure that a new component is installed.



8. Remove the Special Tool(s): 303-1562



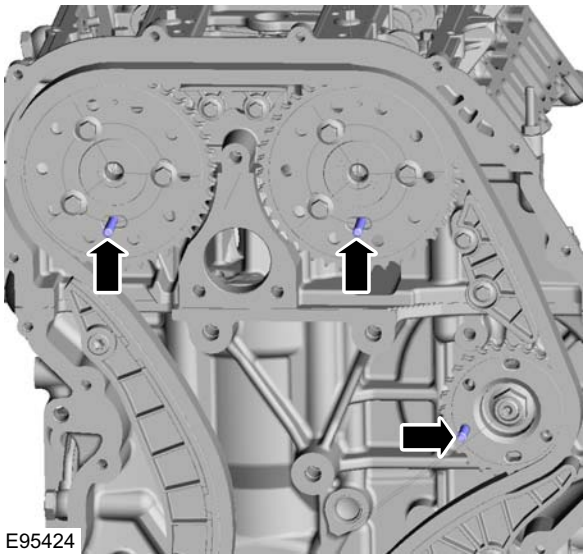
9. Rotate the engine two revolutions.
10. Install the Special Tool(s): 303-1562



REMOVAL AND INSTALLATION

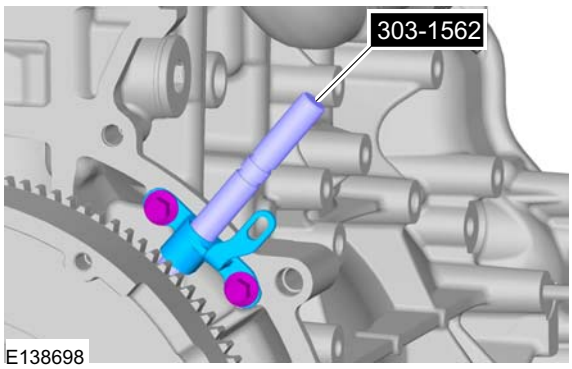
11. Check the valve timing by inserting the drill bits. If the drill bits cannot be inserted repeat the timing steps.

    General Equipment: 6 mm Drill Bit


E95424

12. Remove the 6 mm drill bits.

13. Remove the Special Tool(s): 303-1562



E138698

14. Refer to: Brake Vacuum Pump - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (206-07 Power Brake Actuation, Removal and Installation).

15. Refer to: Timing Cover (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

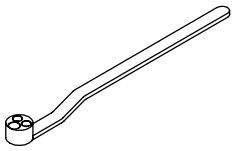
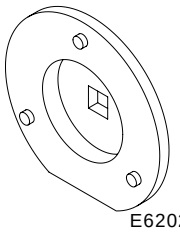
16. Refer to: Valve Cover (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

17. Refer to: Fuel Rail (303-04 Fuel Charging and Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

REMOVAL AND INSTALLATION

Crankshaft Front Seal(21 467 0)

Special Tool(s)

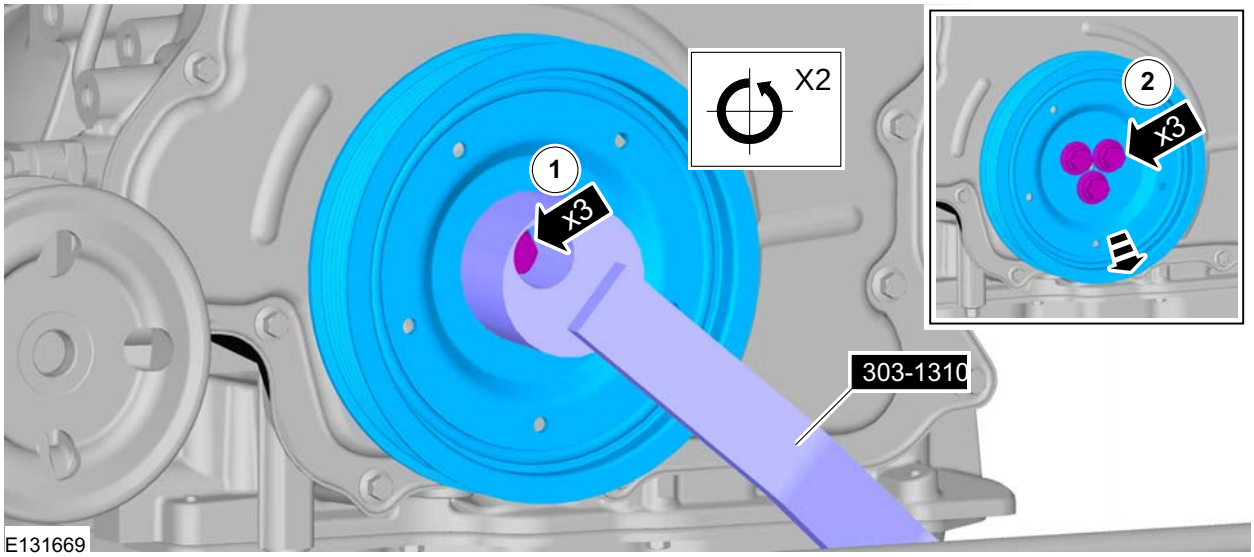
 E87614	303-1310 Holding Wrench, Crankshaft
 E62024	303-679A Remover/Installer, Engine Front Cover Inspection Plate

Removal

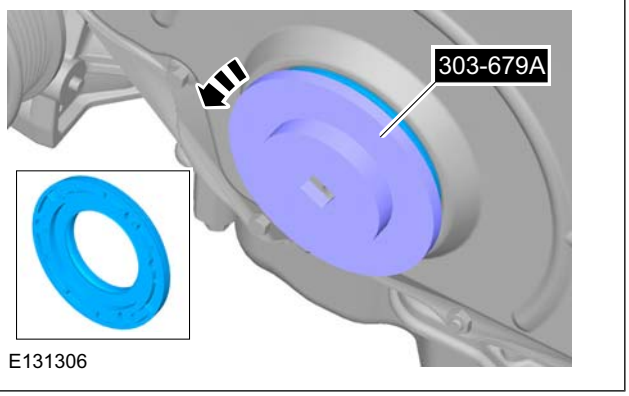
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).
2. 1. Do not completely loosen the crankshaft pulley bolts.

   Special Tool(s): 303-1310



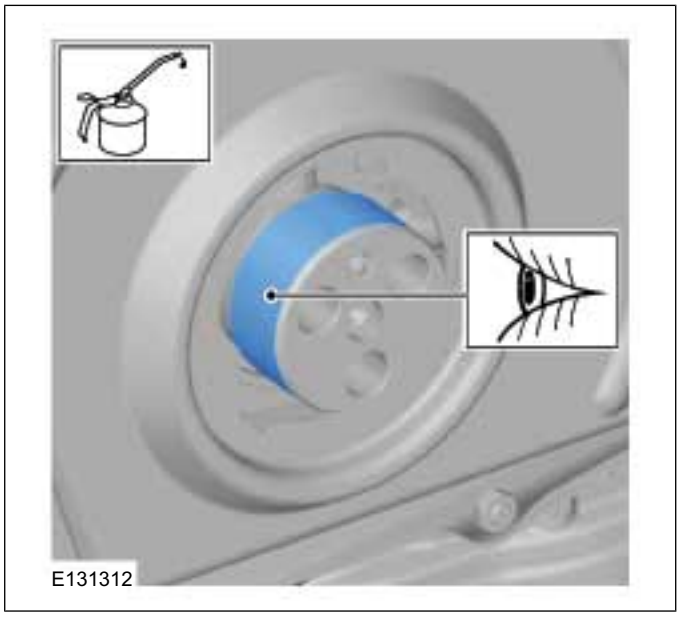
3. Special Tool(s): 303-679A



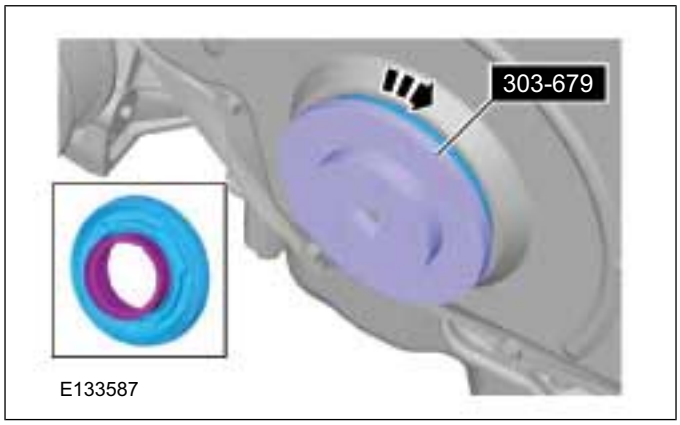
REMOVAL AND INSTALLATION

Installation

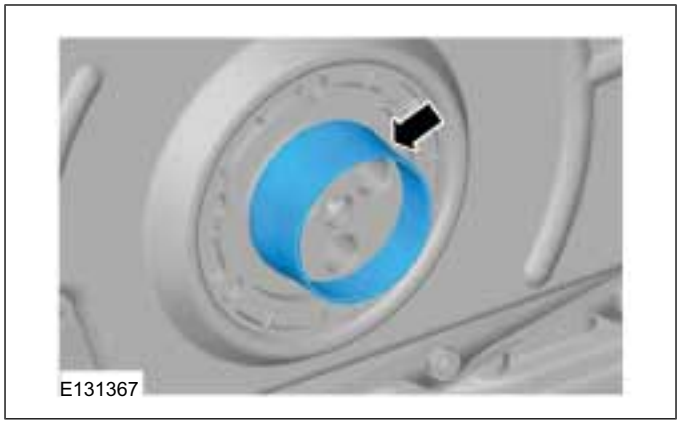
1. **NOTE:** Make sure that mounting face is clean and lubricated.



2. **CAUTION: A new crankshaft seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft seal if fully installed. Failure to follow this instruction may result in damage to the crankshaft.**

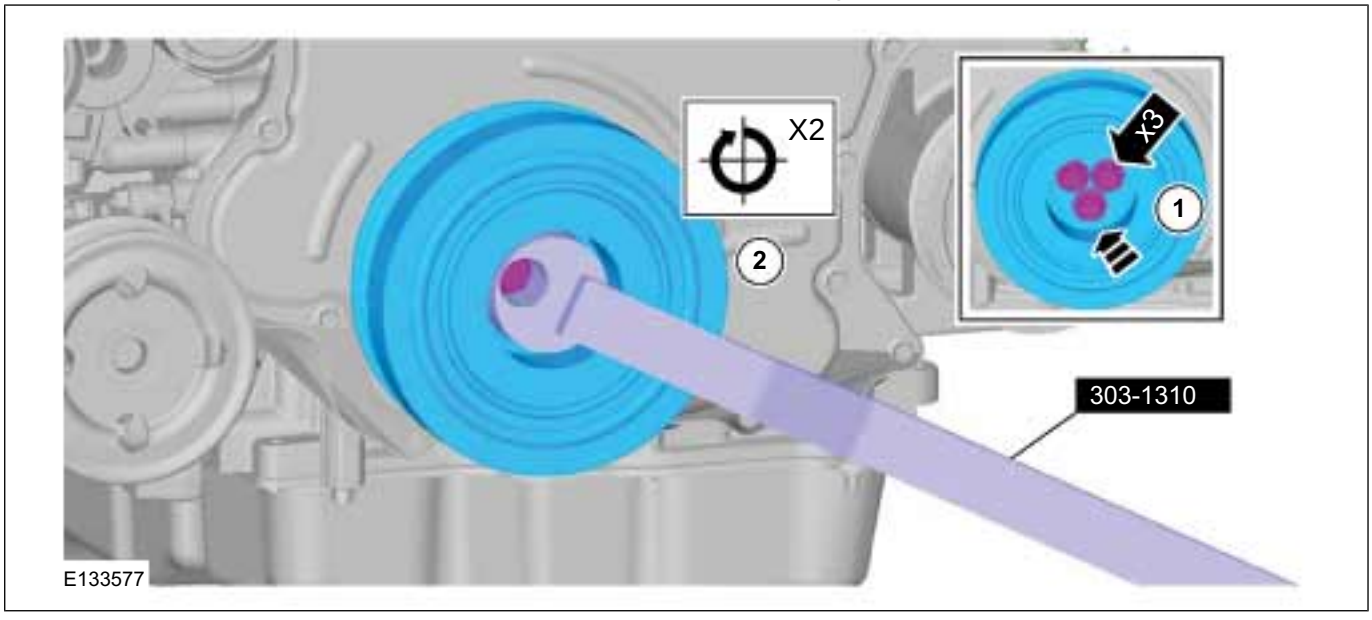


3.



4. **NOTE:** Initially hand tighten the fastners.

   Torque:
   - Stage 1: 45 Nm
   - Stage 2: 120°



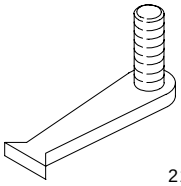
REMOVAL AND INSTALLATION

5. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

REMOVAL AND INSTALLATION

Crankshaft Rear Seal(21 468 4)

Special Tool(s)

 21135	303-254 Locking Tool, Flywheel

Materials	
Name	**Specification**
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

Removal

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

Vehicles with automatic transmission

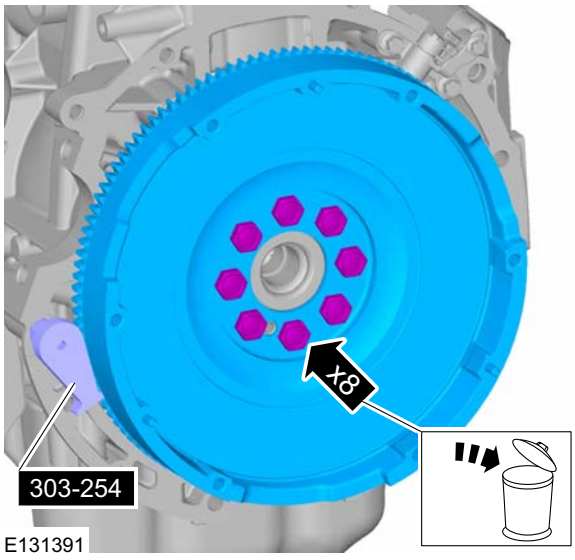
1. Refer to: Transmission - 2WD (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, Removal).
   Refer to: Transmission - 4WD (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, Removal).

Vehicles with manual transmission

2. Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).
   Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 6-Speed Manual Transmission - MT82, Removal and Installation).

All vehicles

3. Special Tool(s): 303-254



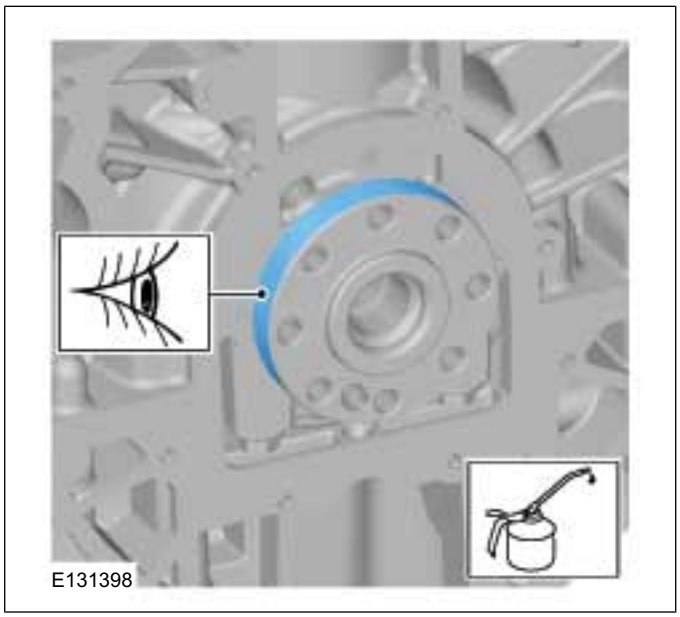
REMOVAL AND INSTALLATION

4.

Installation

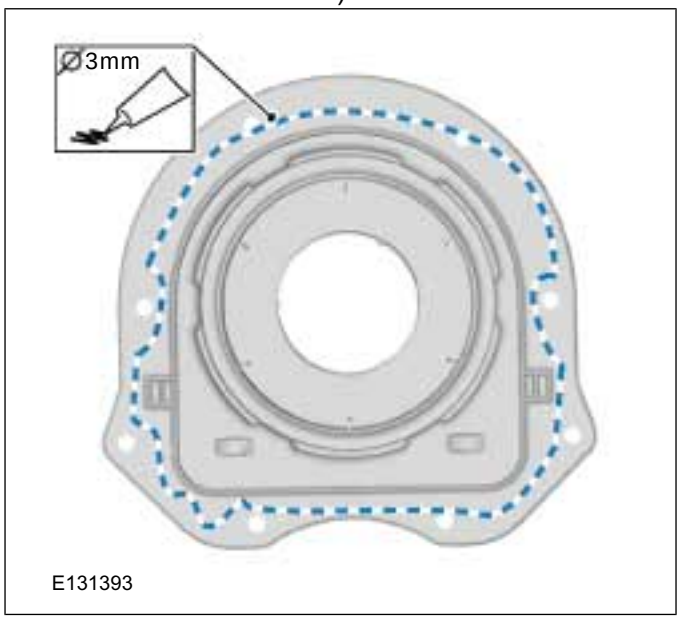
All vehicles

1.



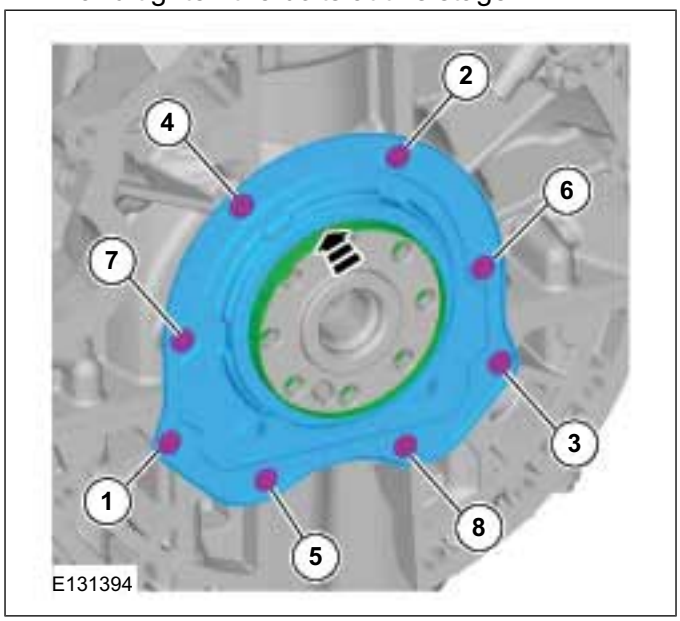
2. NOTE: Install new crankshaft rear seal carrier with in five minutes after applying the recomended sealent.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



3. CAUTION: A new crankshaft rear seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft rear seal is fully installed. Failure to follow this instruction may result in damage to the vehicle.

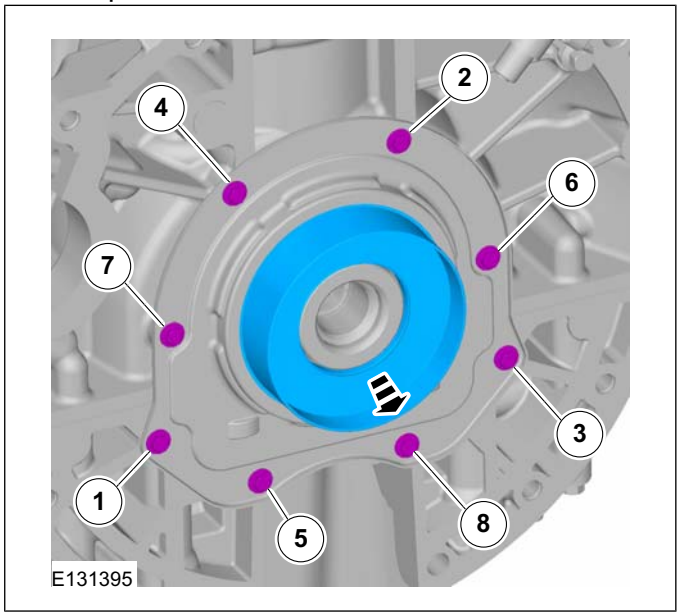
Hand tighten the bolts at this stage.



REMOVAL AND INSTALLATION

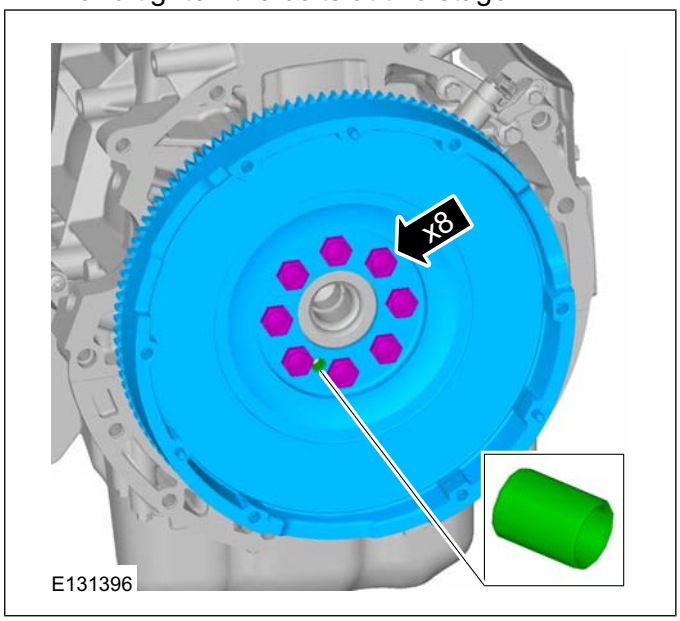
4. **NOTE:** New crankshaft seal carriers are supplied with an alignment sleeve which must be removed after installation.

   Torque: 10 Nm

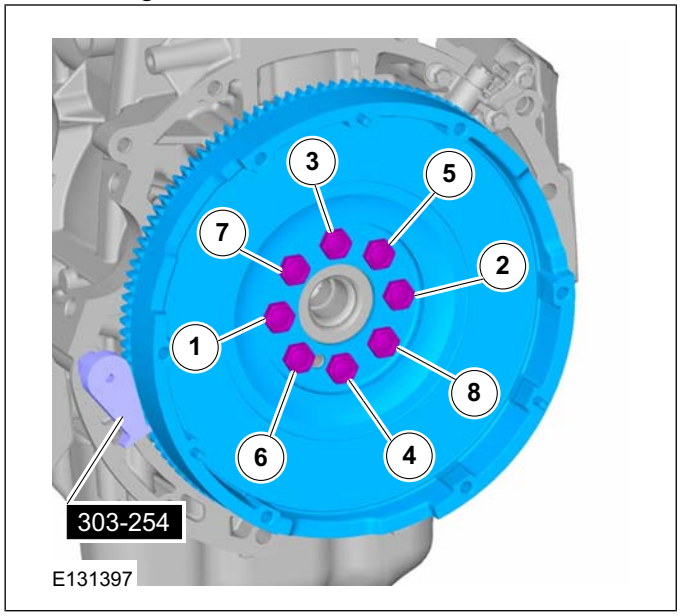


5. **NOTE:** Make sure that flywheel is in full contact with flywheel flange before installing the flywheel bolts.

   Hand tighten the bolts at this stage.



6. Torque:
   - Stage 1: 15 Nm
   - Stage 2: 30 Nm
   - Stage 3: 75 Nm
   - Stage 4: 45°



Vehicles with manual transmission

7. Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).
   Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 6-Speed Manual Transmission - MT82, Removal and Installation).

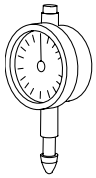
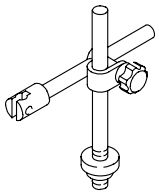
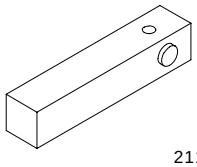
Vehicles with automatic transmission

8. Refer to: Transmission - 2WD (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, Installation).
   Refer to: Transmission - 4WD (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, Installation).

REMOVAL AND INSTALLATION

Cylinder Head(21 163 0)

Special Tool(s)

 15046	205-069 Dial Indicator Gauge (Metric)
 15022A	205-070 Holding Fixture, Dial Indicator Gauge
 21183A	303-432 Holding Fixture, Dial Indicator Gauge (Cylinder Liner Protrusion)

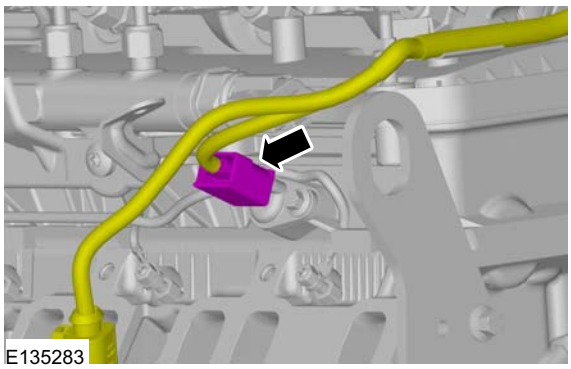
Removal

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

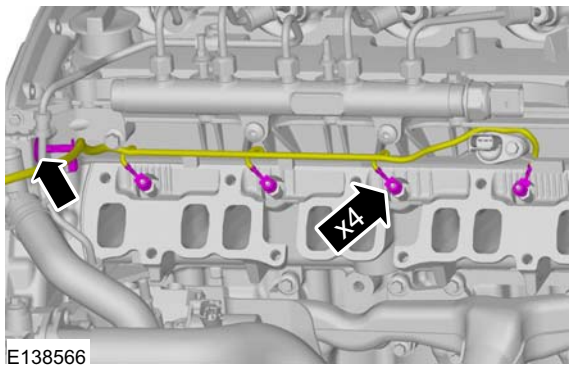
All vehicles

1. Refer to: Intake Manifold (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

2.

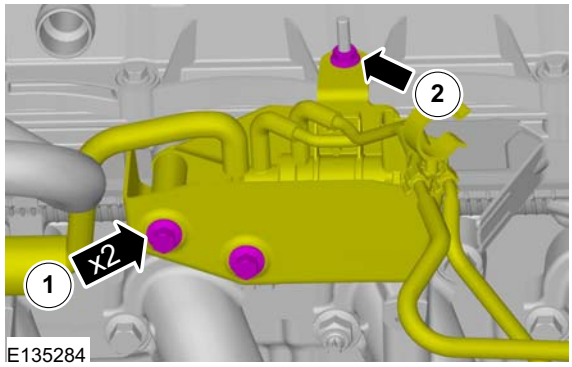


3. Torque: 3 Nm



Vehicles with fixed vane turbocharger

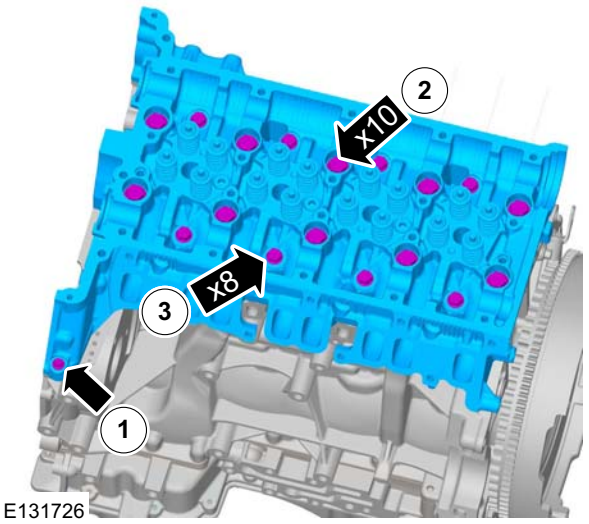
4. 1. Torque: 10 Nm
   2. Torque: 12 Nm



REMOVAL AND INSTALLATION

All vehicles

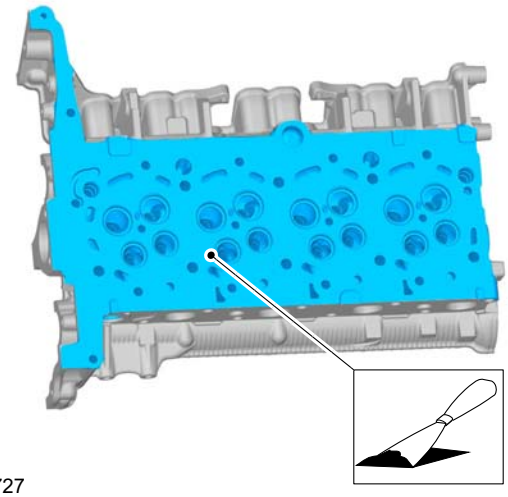
5. Refer to: Exhaust Gas Recirculation (EGR) Valve - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-08 Engine Emission Control - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
6. Refer to: Exhaust Manifold (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).
7. Refer to: Camshafts (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).
8.



E131726

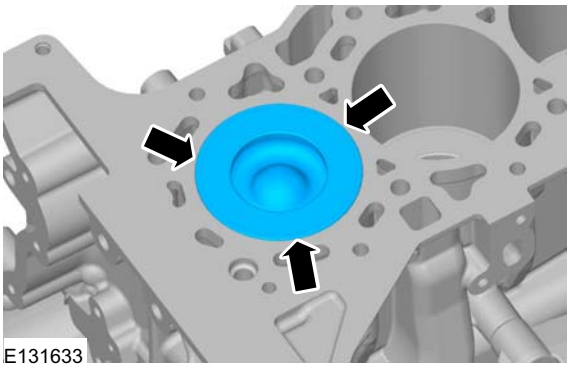
Installation

1. **WARNING: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**


E131727

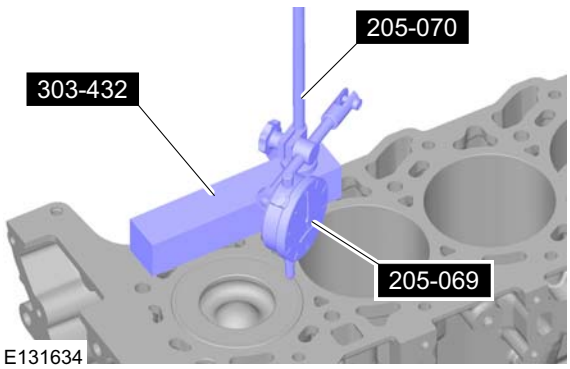
2. **NOTE:** Measure the piston protrusion of each cylinder at top dead center (TDC)

   Measure the distance between the piston crown and the cylinder block at the points indicated.


E131633

3. **NOTE:** The largest measurement determines the choice of the cylinder head gasket.

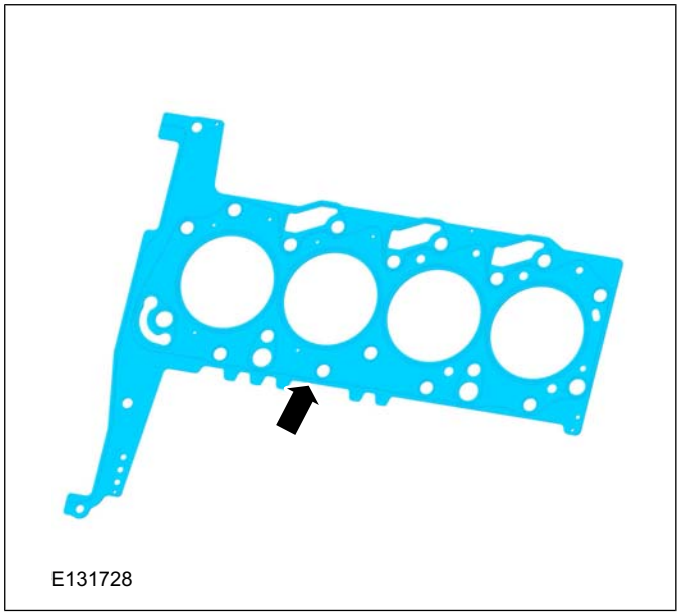
   Special Tool(s): 303-432, 205-070, 205-069



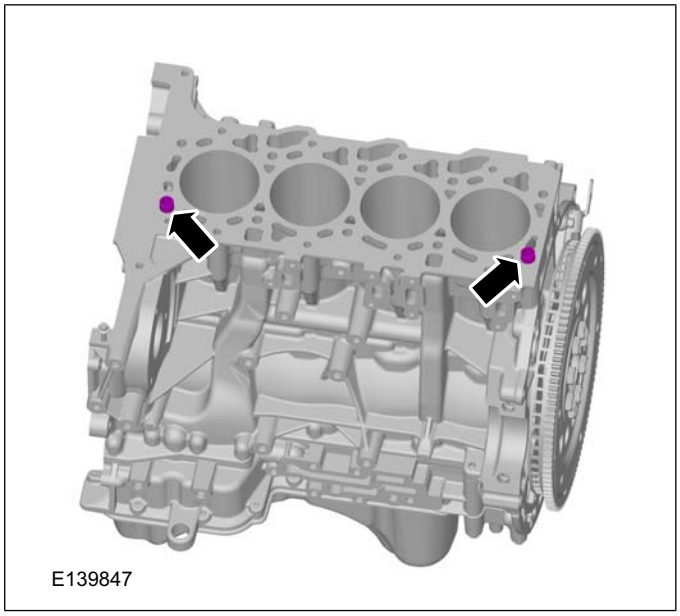
E131634

REMOVAL AND INSTALLATION

4. **NOTE:** Make sure that new component is installed.

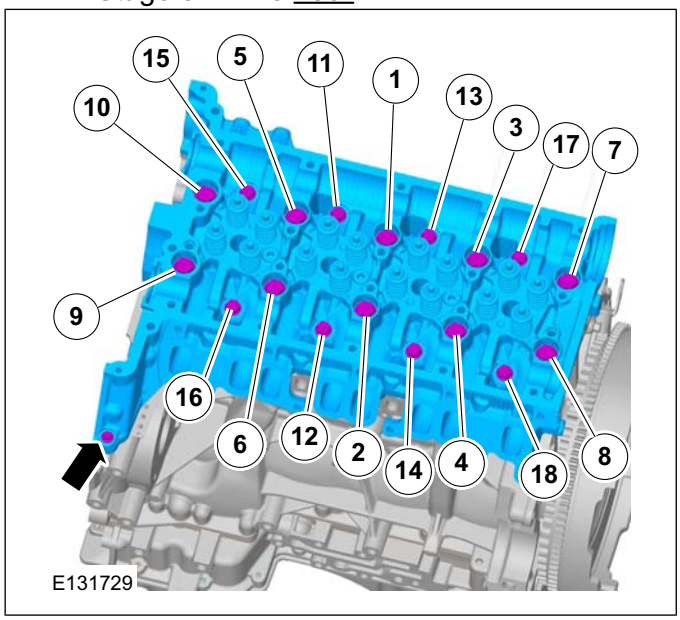

E131728

5.


E139847

6. ⚠ **CAUTION: Make sure that new cylinder head bolts are installed.**

Torque:
- Stage 1: 1 -10 10 Nm
- Stage 2: 11-18 5 Nm
- Stage 3: 1-10 20 Nm
- Stage 4: 11-18 10 Nm
- Stage 5: 1-10 40 Nm
- Stage 6: 11-18 20 Nm
- Stage 7: 1-10 180°
- Stage 8: 11-18 180°



E131729

7. To install, reverse the removal procedure.

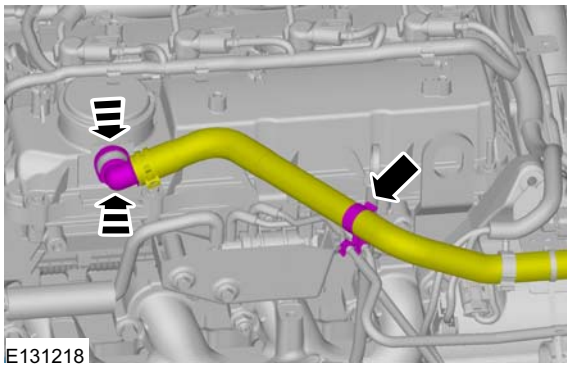
REMOVAL AND INSTALLATION

Exhaust Manifold(21 187 0)

Removal

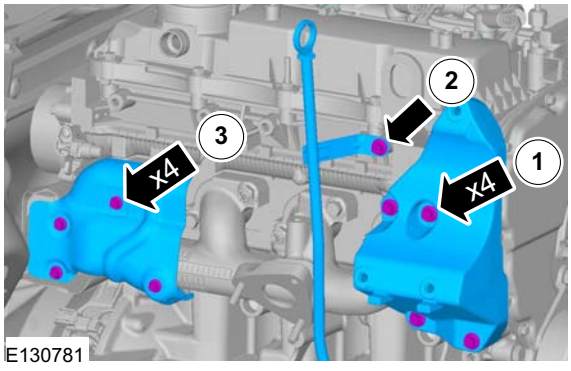
NOTE: Removal steps in this procedure may contain installation details.

1.

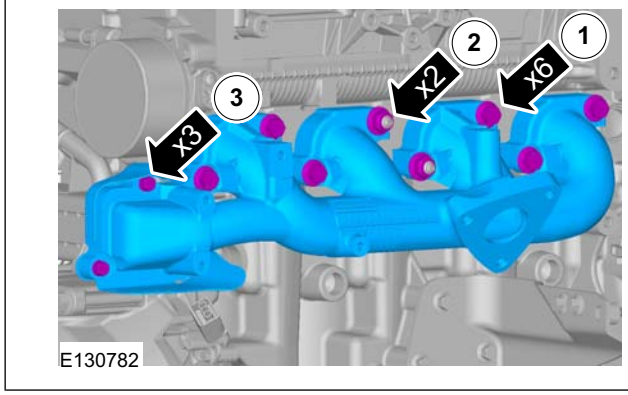


2. Refer to: Turbocharger - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, LHD 4WD/LHD RWD (303-04 Fuel Charging and Controls - Turbocharger, Removal and Installation).
Refer to: Generator - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (414-02 Generator and Regulator, Removal and Installation).
Refer to: Turbocharger - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, RHD 4WD/RHD RWD (303-04 Fuel Charging and Controls - Turbocharger, Removal and Installation).

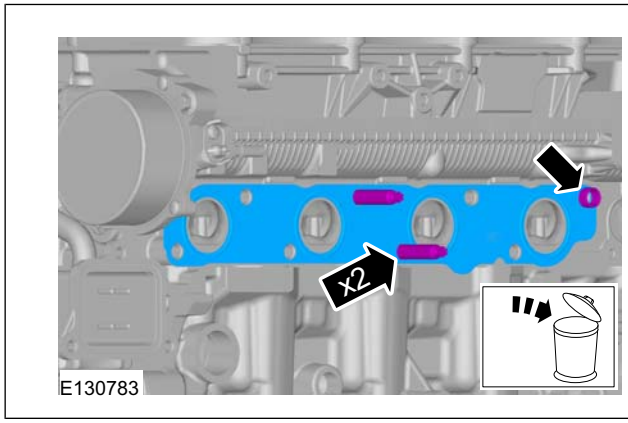
3. 1. Torque: 25 Nm
2. Torque: 23 Nm
3. Torque: 9 Nm



4. 1. Torque: 55 Nm
2. Torque: 40 Nm
3. Torque: 15 Nm



5.



Installation

NOTE: Install new exhaust manifold studs, bolts, nuts, gaskets and O-ring seals.

1. To install , reverse the removal procedure.

REMOVAL AND INSTALLATION

Intake Manifold(21 183 0)

Removal

WARNINGS:

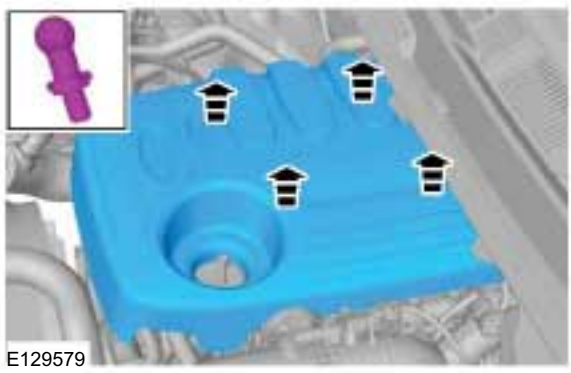
Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

Do not carry out any repairs to the fuel injection system with the engine running. The fuel pressure within the system is approximately 1600 bars. Failure to follow this instruction may result in personal injury.

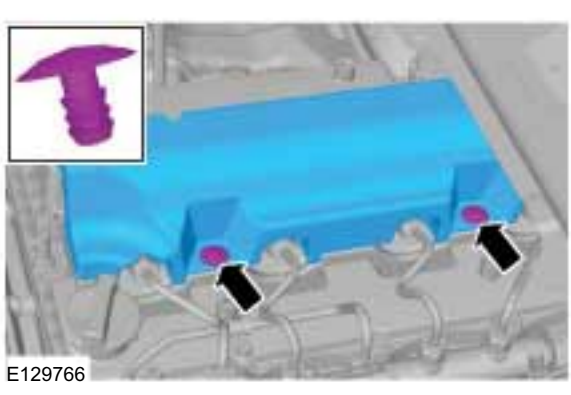
Wait at least one minute after the engine stops before commencing any repair to the fuel injection system. Failure to follow this instruction may result in personal injury.

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

1.

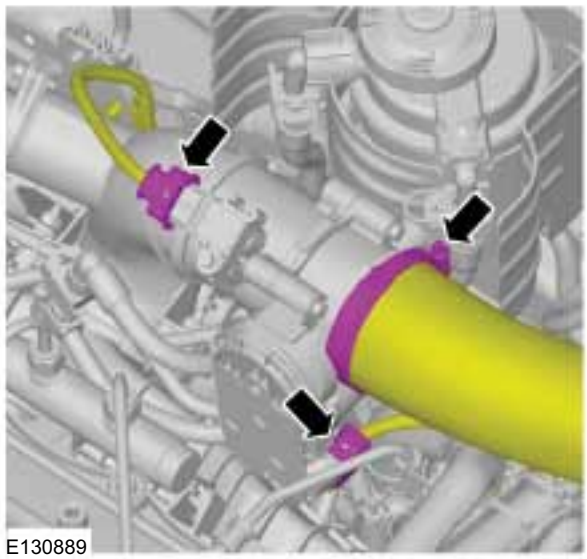

E129579

2.

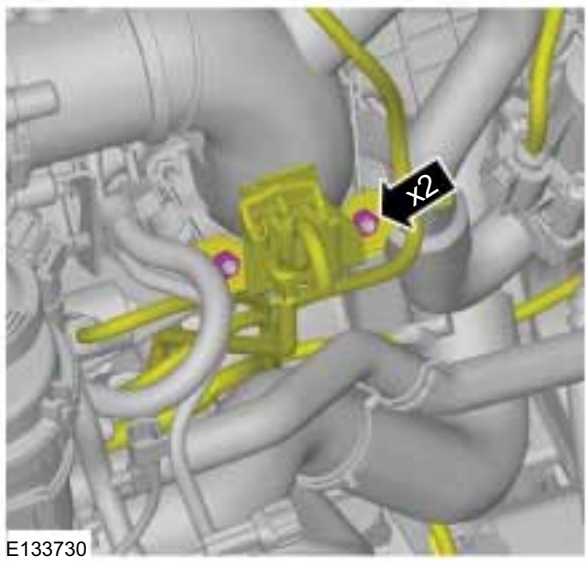

E129766

3. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

4.


E130889

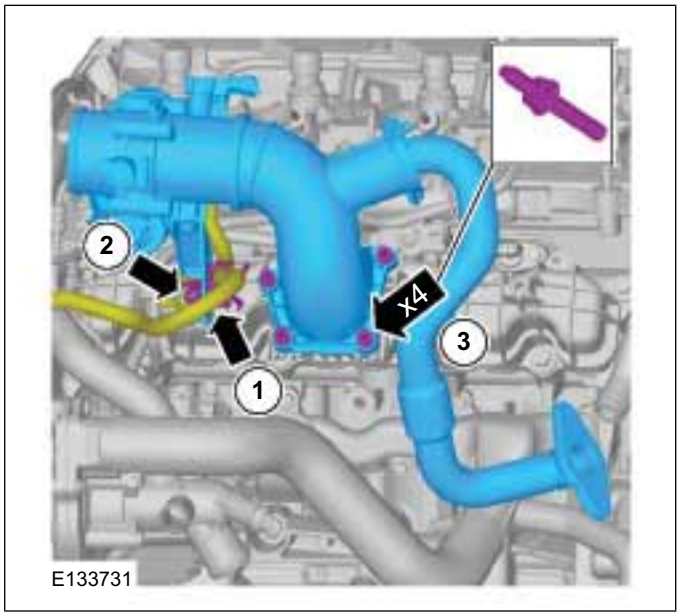
5. Torque: 11 Nm



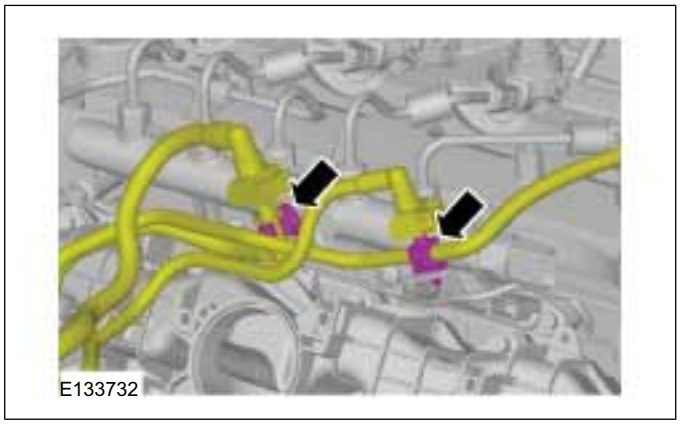
E133730

REMOVAL AND INSTALLATION

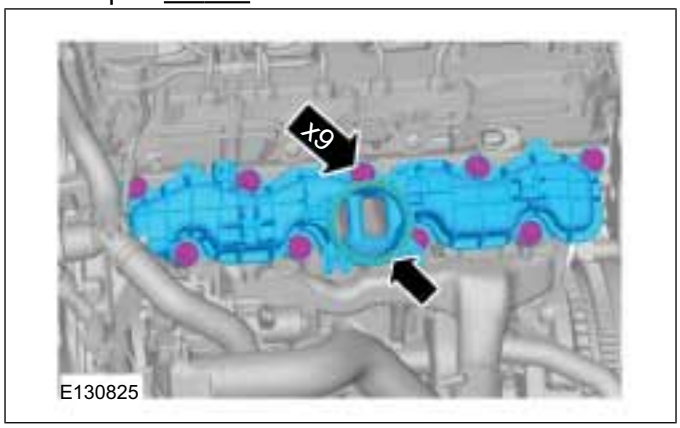
6. Refer to: Exhaust Gas Recirculation (EGR) Valve - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-08 Engine Emission Control - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
7. 2. Torque: 10 Nm
   3. Torque: 15 Nm



8.



9. Torque: 25 Nm



Installation

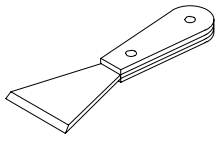
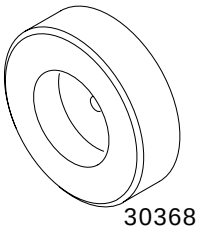
1. **NOTE:** Inspect the intake manifold gaskets, Install new intake manifold gaskets if necessary.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Timing Cover(21 146 0)

Special Tool(s)

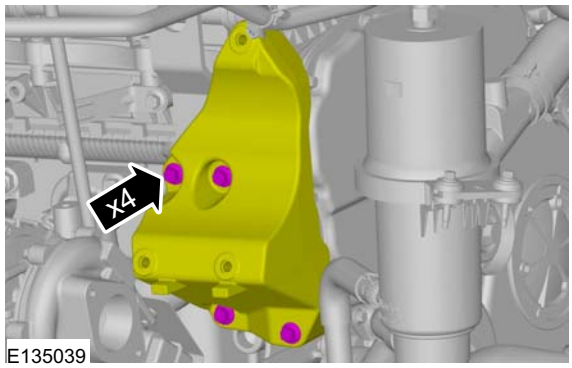
 21179	303-428 Separator, Oil Pan
 303682	303-682 Aligner, Engine Front Cover

Materials	
Name	**Specification**
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

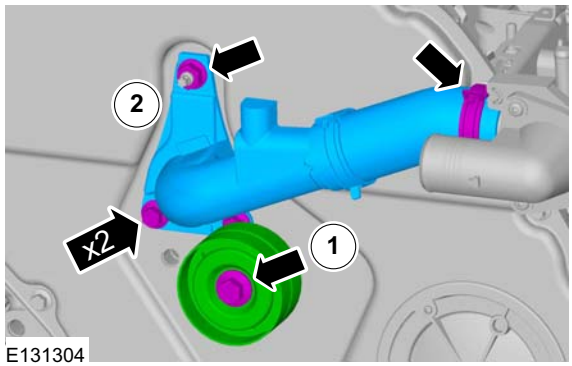
Removal

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 Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).
3. Refer to: Generator - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (414-02 Generator and Regulator, Removal and Installation).
4. Torque: 25 Nm

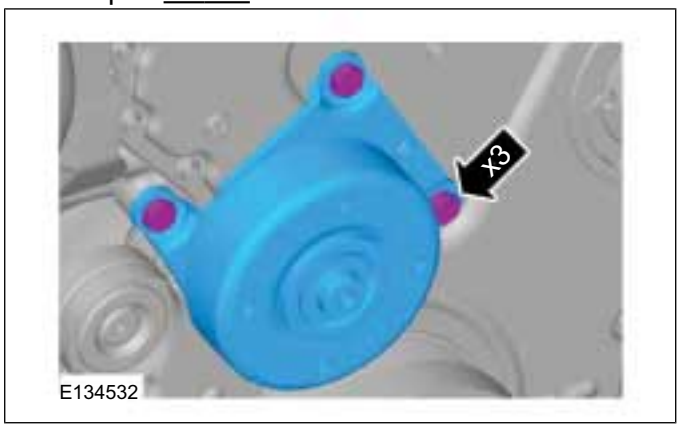


5. 1. Torque: 48 Nm
   2. Torque: 23 Nm



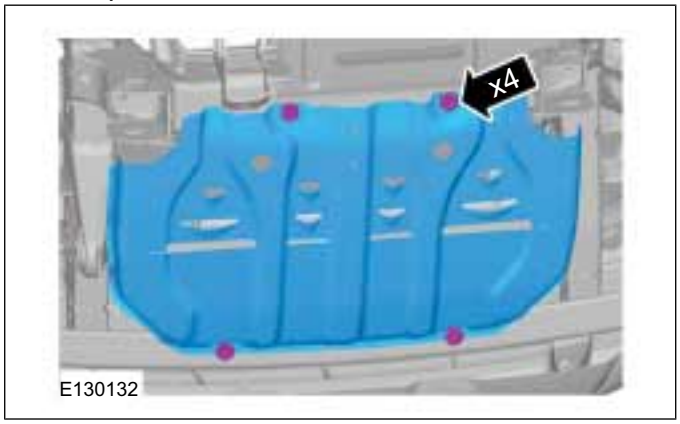
REMOVAL AND INSTALLATION

6. Torque: 48 Nm



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

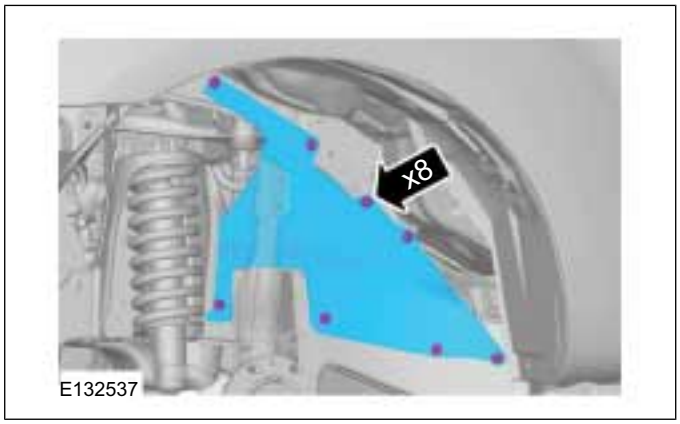
8. Torque: 30 Nm



9. **NOTE:** Remove front RH wheel only.

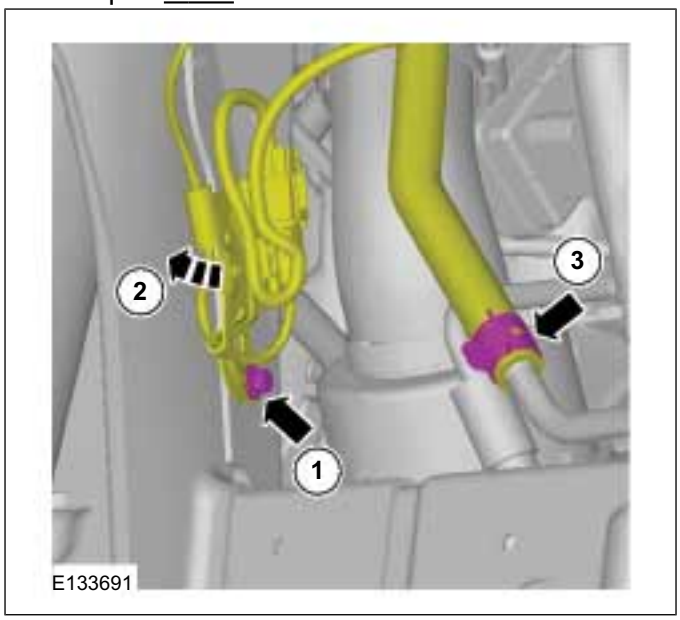
   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

10.

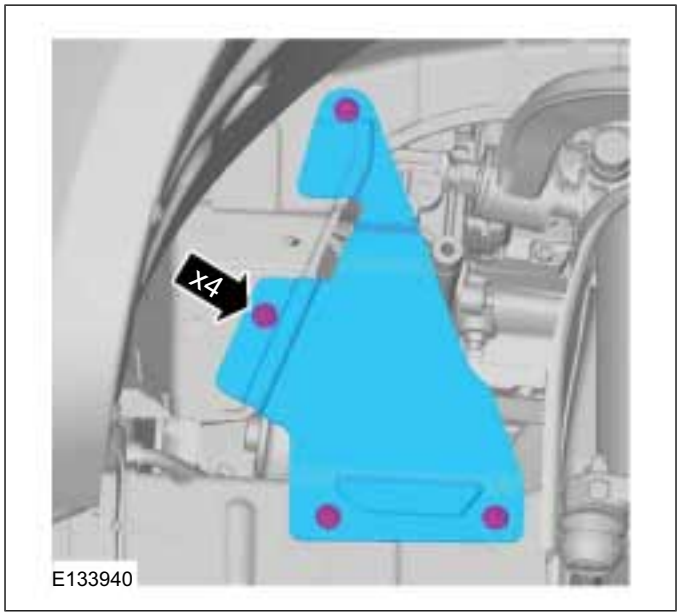


11. ⚠ **CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.**

    Torque: 7 Nm

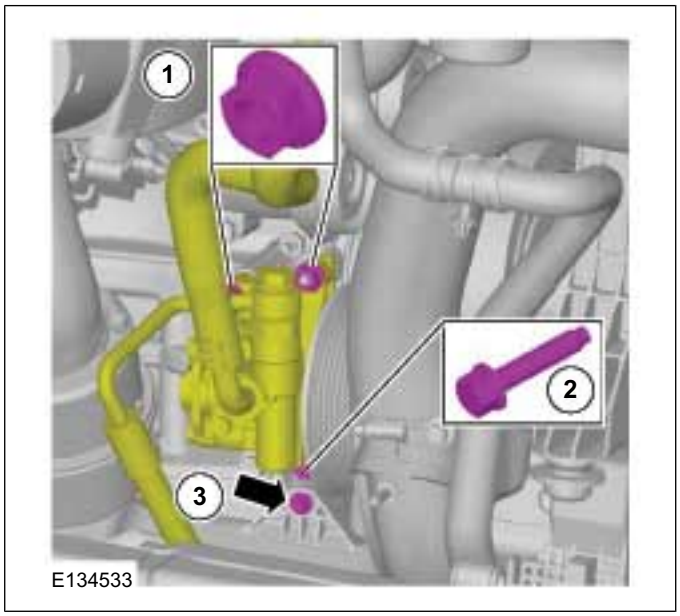


12.

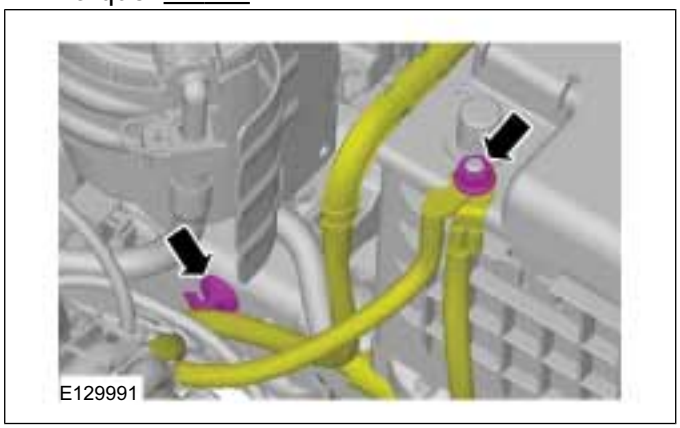


REMOVAL AND INSTALLATION

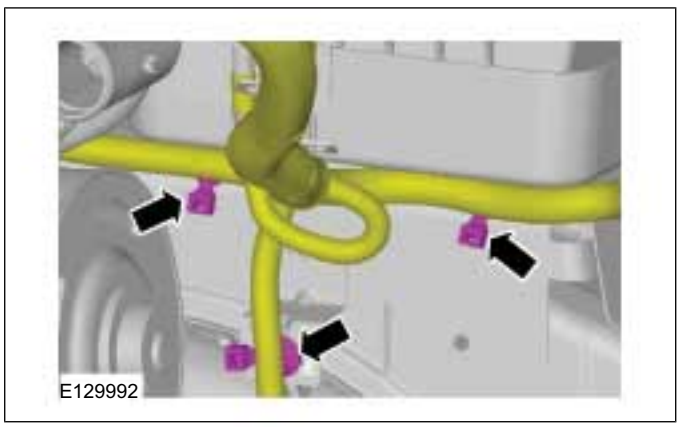
13. 1. Torque: 20 Nm
2. Torque: 20 Nm
3. Torque: 18 Nm



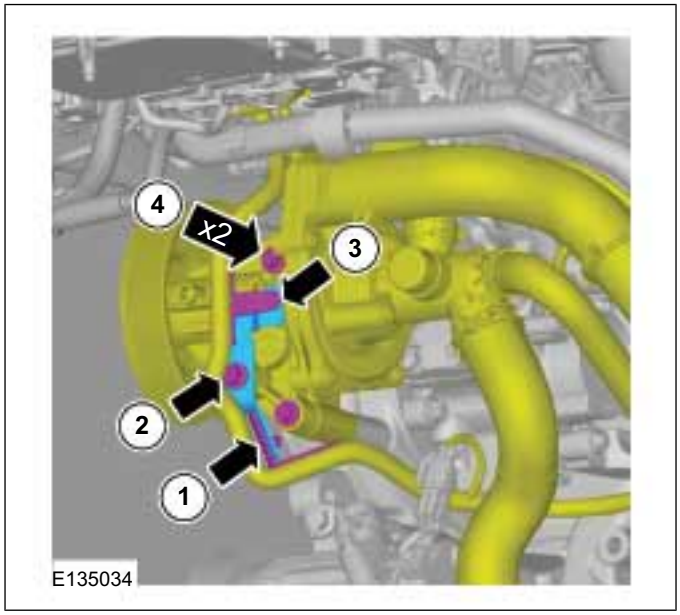
14. Torque: 22 Nm



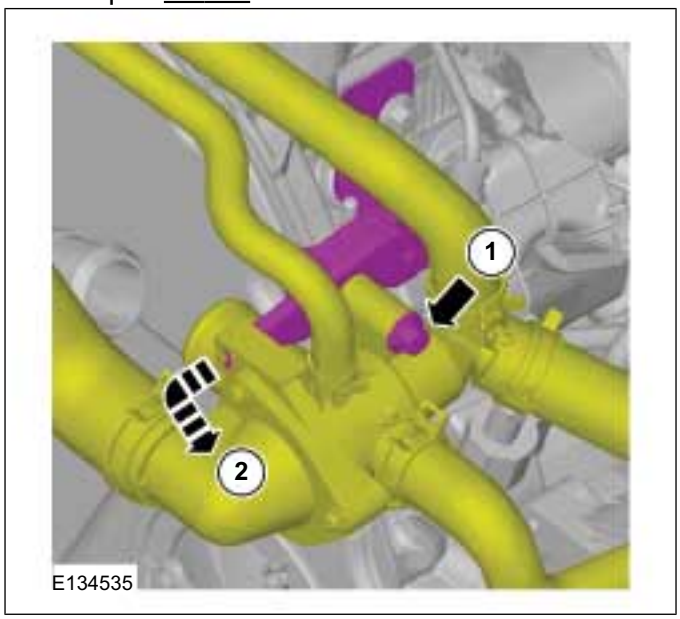
15.



16. 2. Torque: 23 Nm
4. Torque: 23 Nm



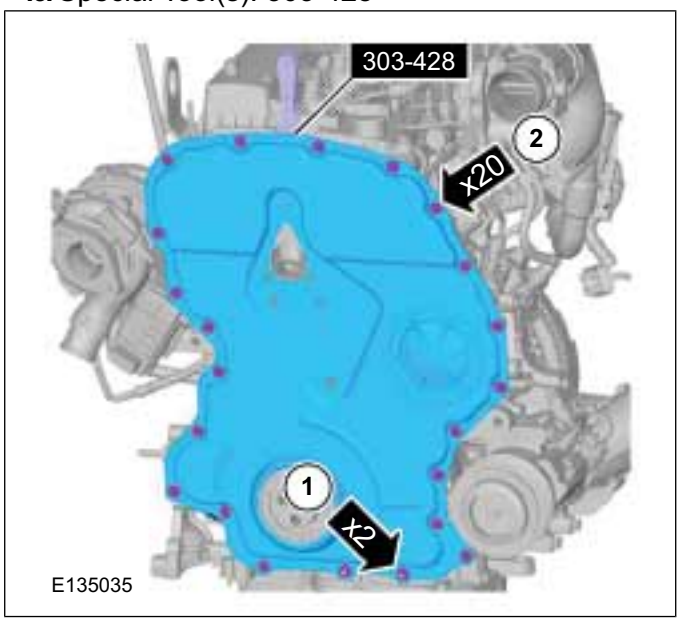
17. Torque: 23 Nm



REMOVAL AND INSTALLATION

18. Refer to: Crankshaft Front Seal (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

19. Special Tool(s): 303-428

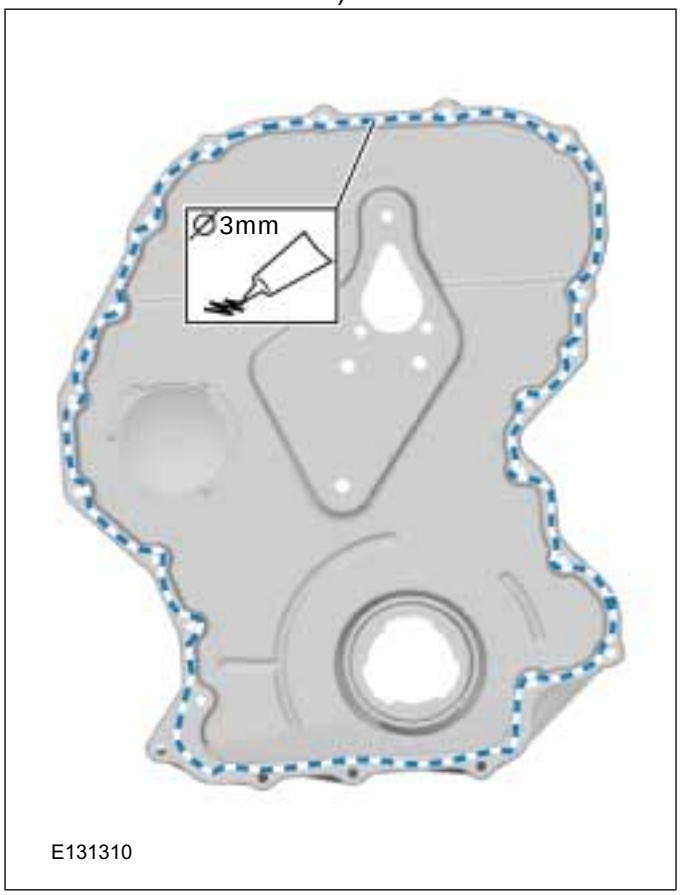


Installation

1. **CAUTION: Install timing cover with in five minutes of applying the sealent.**

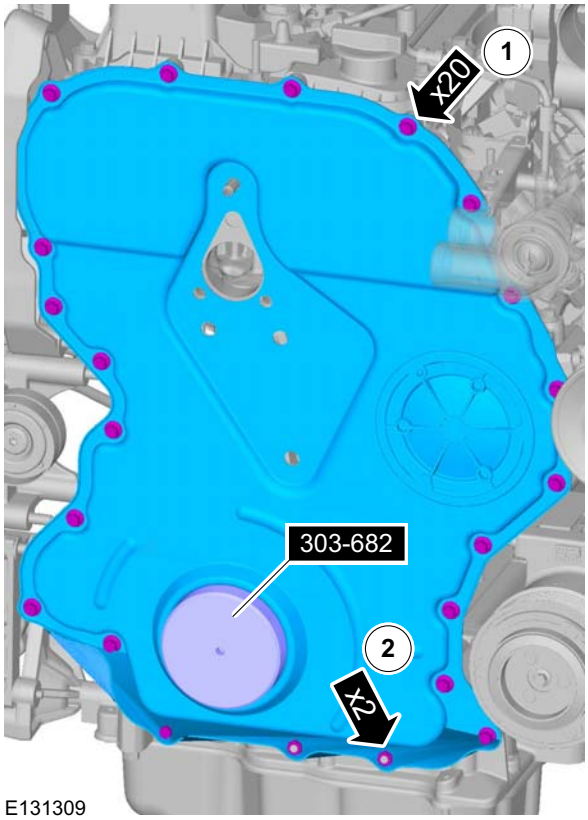
NOTE: Do not damage the mating surfaces.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



REMOVAL AND INSTALLATION

2. 1. Special Tool(s): 303-682
Torque: 14 Nm
2. Torque: 10 Nm

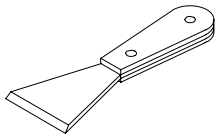


3. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Oil Pan(21 154 0)

Special Tool(s)

 21179	303-428 Separator, Oil Pan

Materials	
Name	**Specification**
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

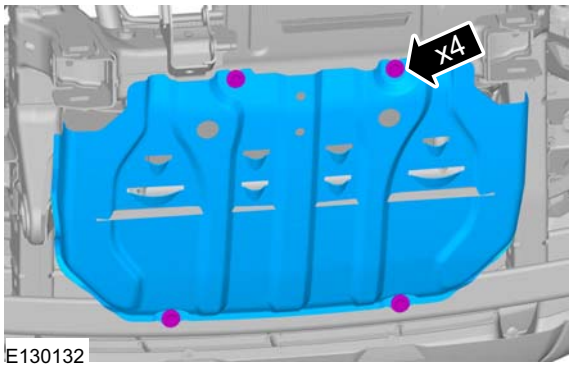
Removal

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).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

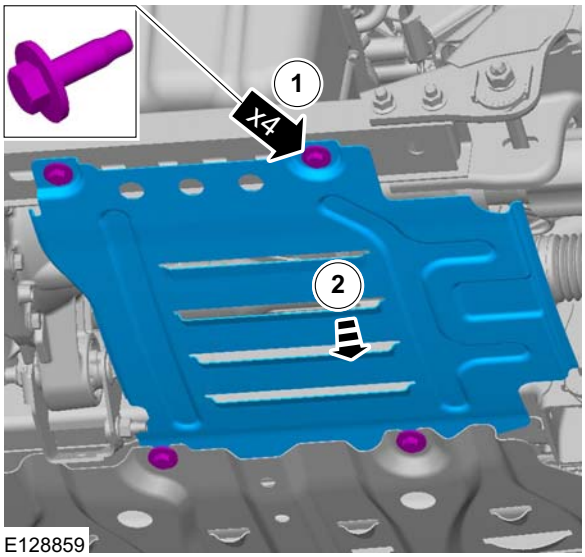
4x4

4. Torque: 30 Nm

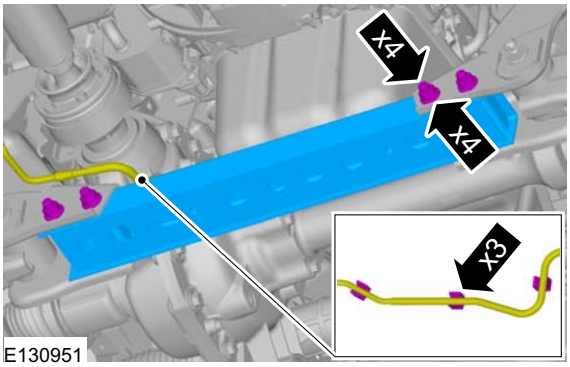


All vehicles

5. Torque: 30 Nm



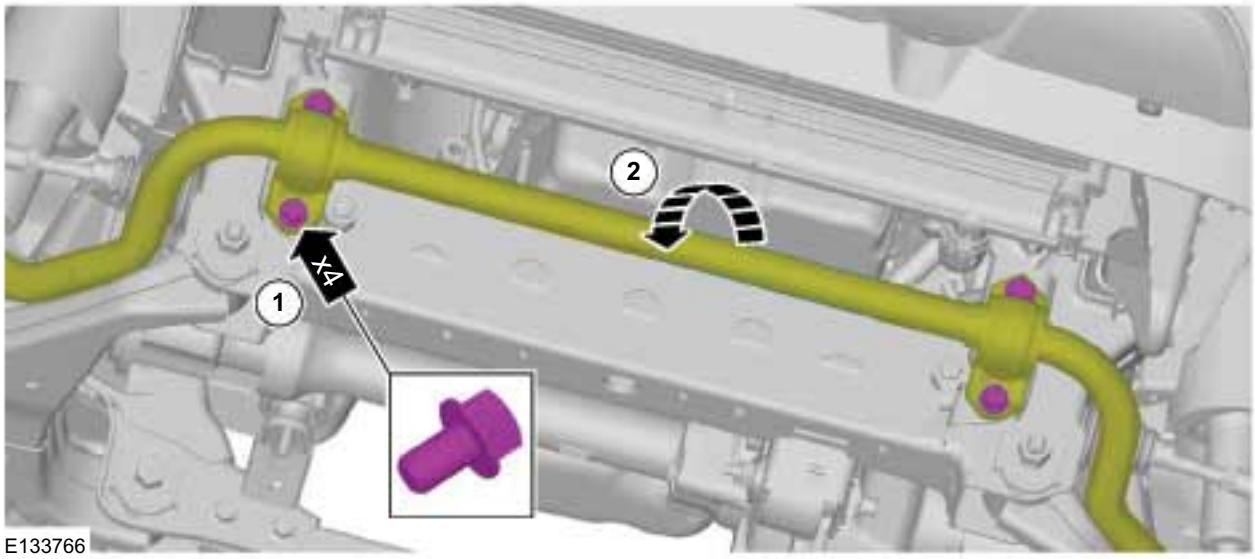
6. Torque: 90 Nm



4x4

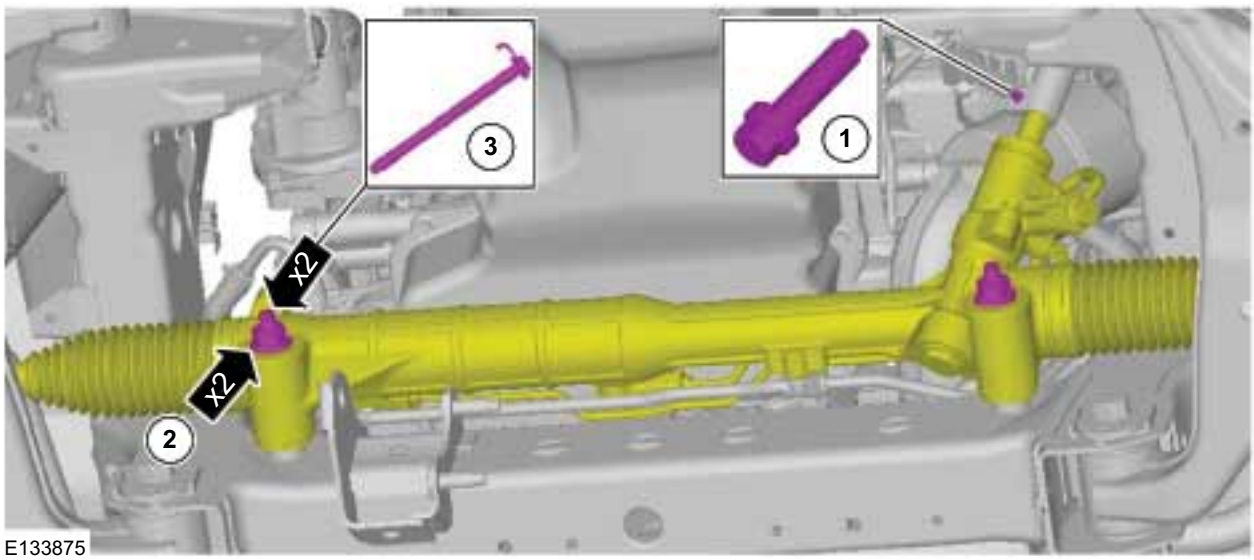
7. Torque: 30 Nm

REMOVAL AND INSTALLATION



All vehicles

8. 1. Torque: 23 Nm
2. Torque: 150 Nm

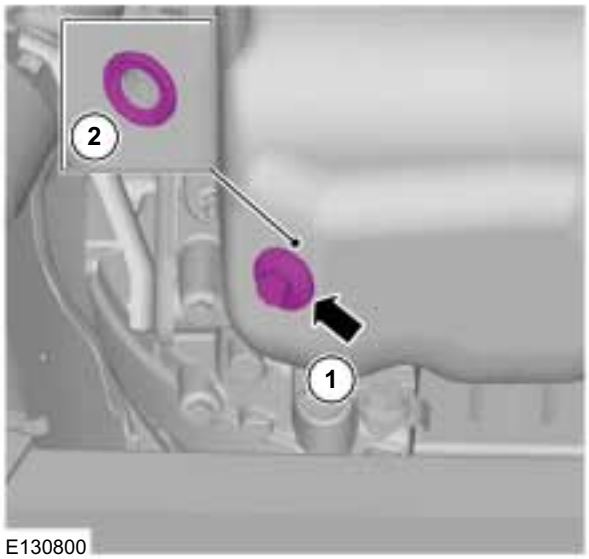


9. **NOTE:** Be prepared to collect escaping fluid.

NOTE: Inspect the oil pan drain plug seal for damage. Install a new drain plug and seal if required.

REMOVAL AND INSTALLATION

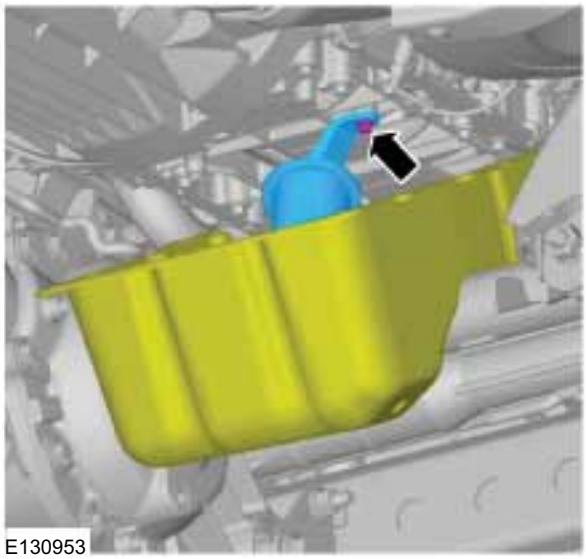
Drain the oil into a suitable container.
Torque: 39 Nm



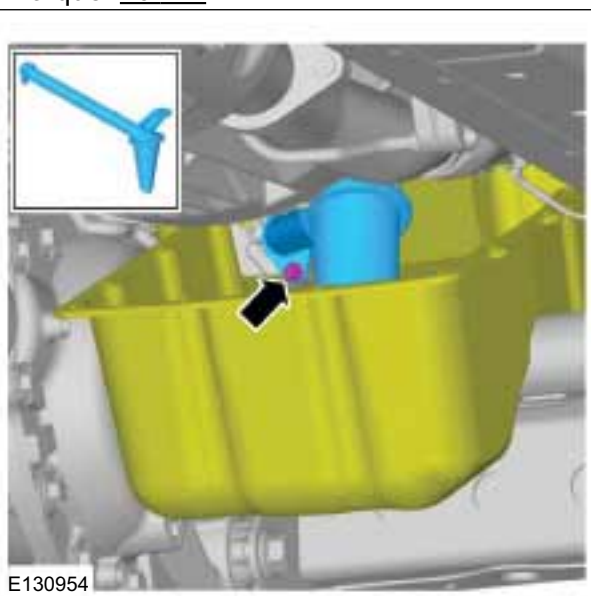
10. Special Tool(s): 303-428

4x4

11. Torque: 10 Nm

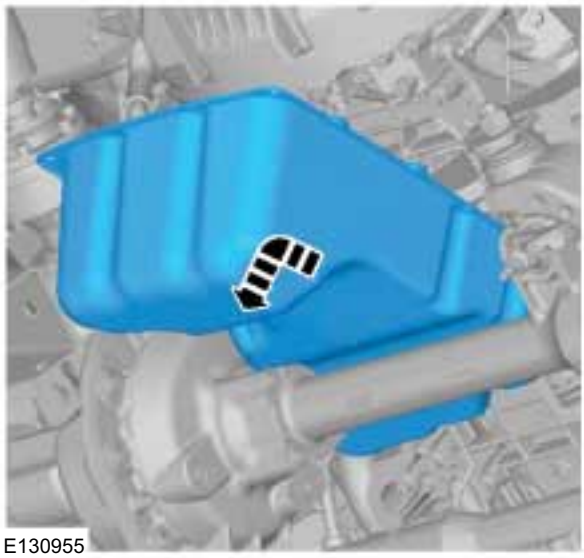


12. Torque: 10 Nm



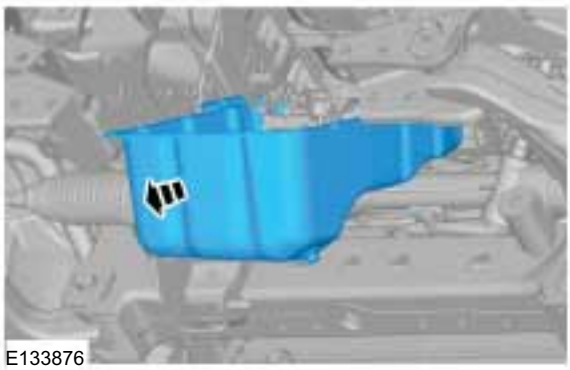
REMOVAL AND INSTALLATION

13.


E130955

All vehicles

14.


E133876

Installation

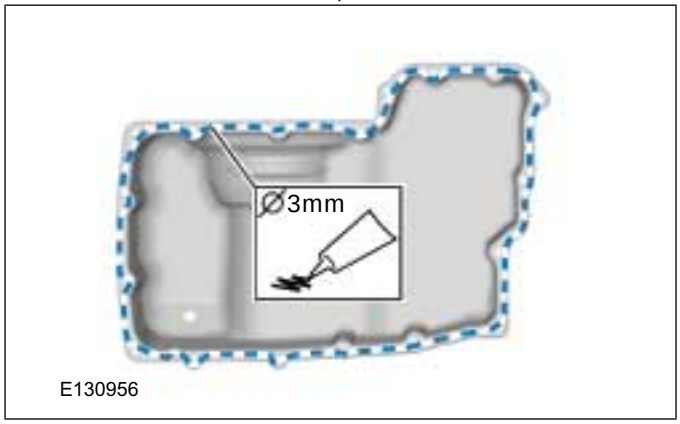
1. **WARNING: Take extra care not to damage the mating faces.**


E133927

2. **CAUTION: Install the oil pan within five minutes of applying the sealer.**

NOTE: Take extra care not to damage the mating faces.

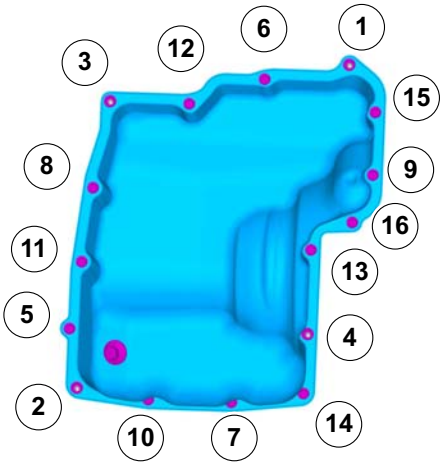
Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



E130956

REMOVAL AND INSTALLATION

3. Torque:
   - Stage 1: 7 Nm
   - Stage 2: 14 Nm



E133897

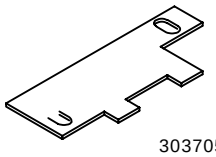
4. To install, reverse the removal procedure.
5. Fill the engine with clean engine oil.

   Refer to: Specifications (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Specifications).

REMOVAL AND INSTALLATION

Oil Pump(21 714 0)

Special Tool(s)

 303705	303-705 Aligner, Oil Pump

Removal

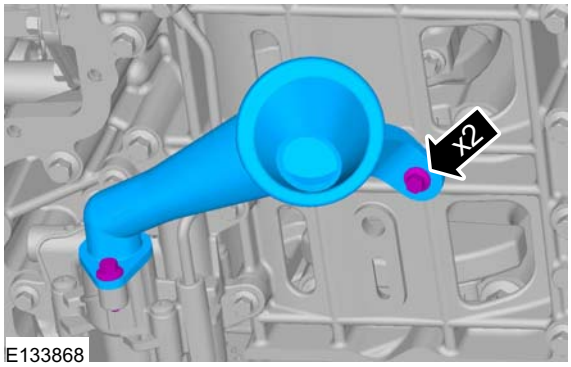
NOTE: Removal steps in this procedure may contain installation details.

All vehicles

1. Refer to: Oil Pan (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

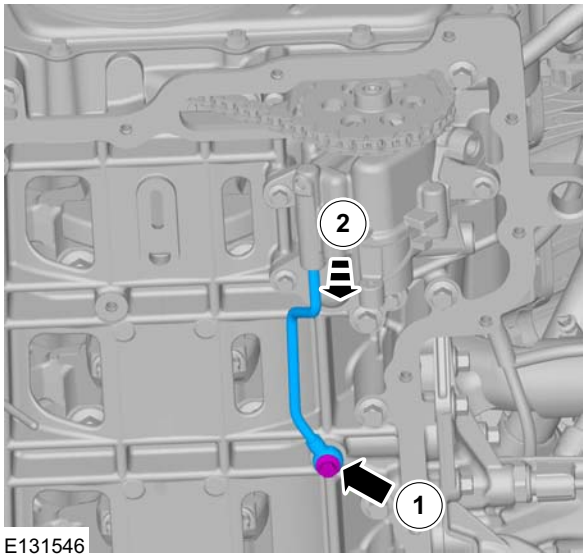
4x2

2.



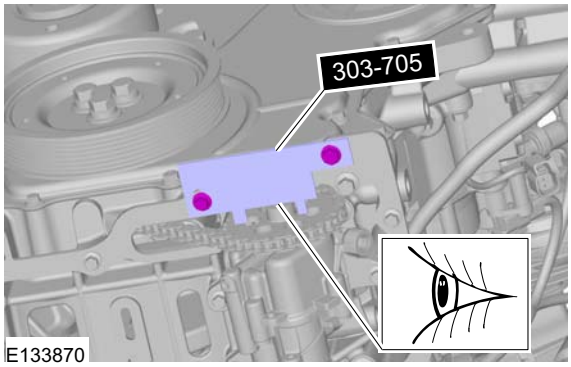
All vehicles

3. **WARNING: Be prepared to collect escaping fluids.**



4. **NOTE:** The profile of the special tool must be in contact with the oil pump sprocket.

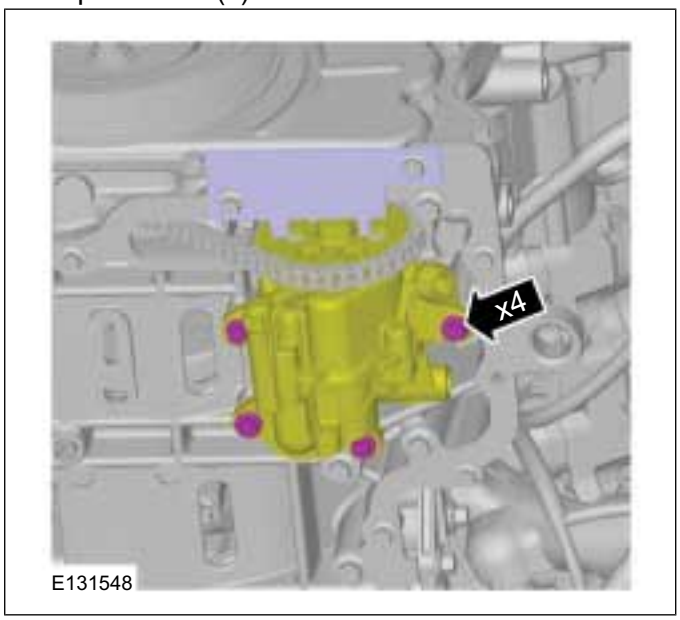
   Install the Special Tool(s): 303-705



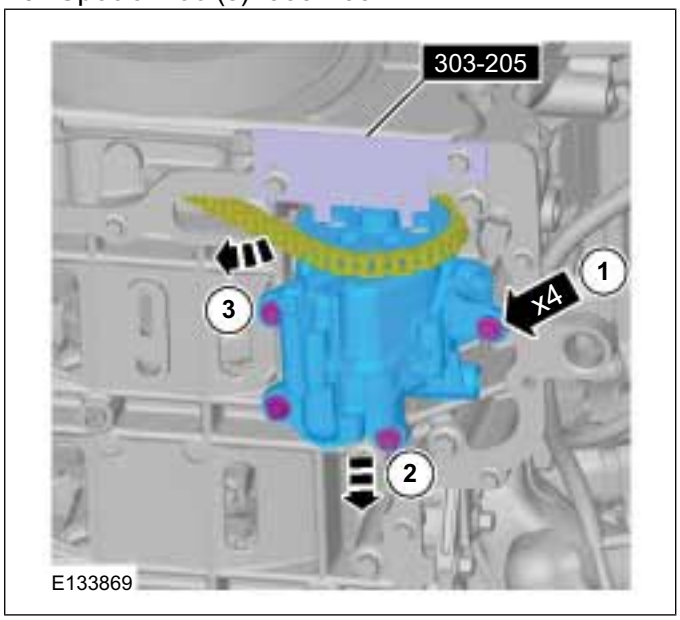
REMOVAL AND INSTALLATION

5. **NOTE:** Do not completely loosen the bolts at this stage.

   Special Tool(s): 303-705



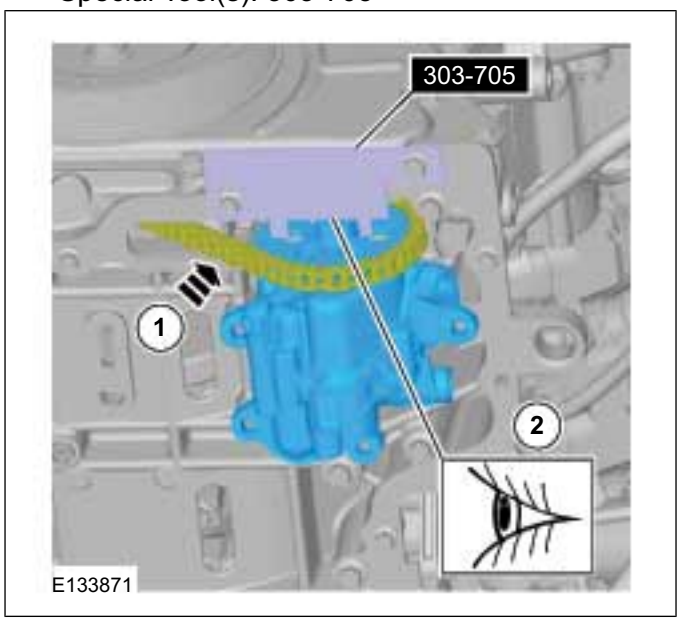
6. Special Tool(s): 303-705



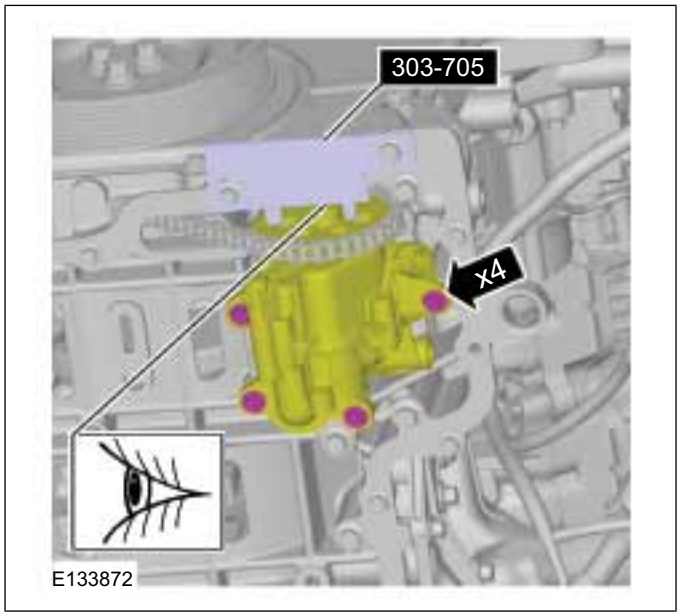
Installation

1. **NOTE:** The profile of the special tool must be in contact with the oil pump sprocket.

   Special Tool(s): 303-705

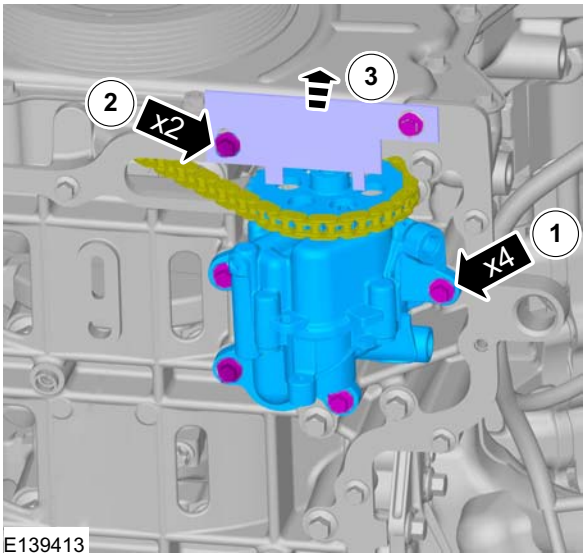


2. **NOTE:** Hand tighten the bolts at this stage.

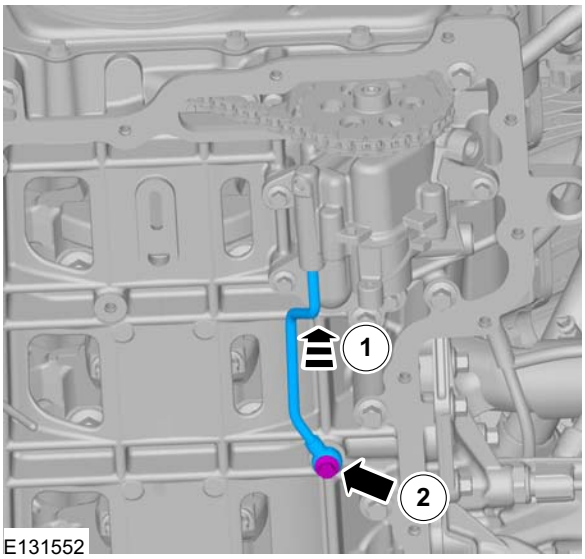


REMOVAL AND INSTALLATION

3. 1. Torque: 10 Nm

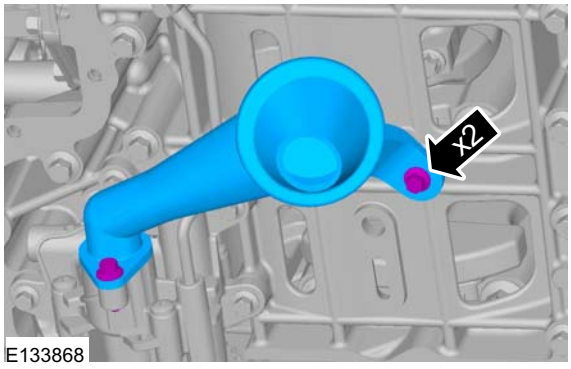


4. Torque: 13 Nm



4x2

5. Torque: 10 Nm



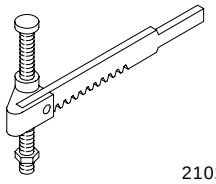
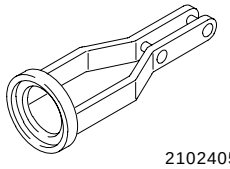
All vehicles

6. Refer to: Oil Pan (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

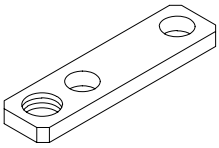
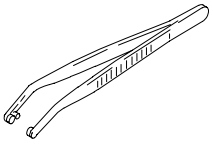
REMOVAL AND INSTALLATION

Valves

Special Tool(s)

 21024	303-060 Compressor, Valve Spring
 2102405	303-060-05 Adapter for 303-060

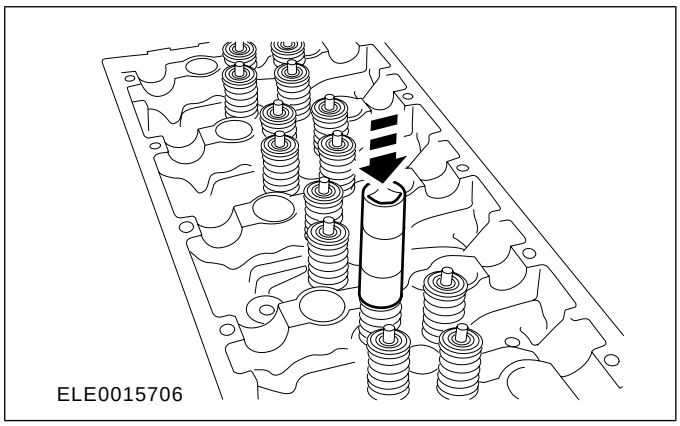
Special Tool(s)

	303-060-07 Adapter for 303-060
 21156	303-362 Installer, Valve Stem Collets

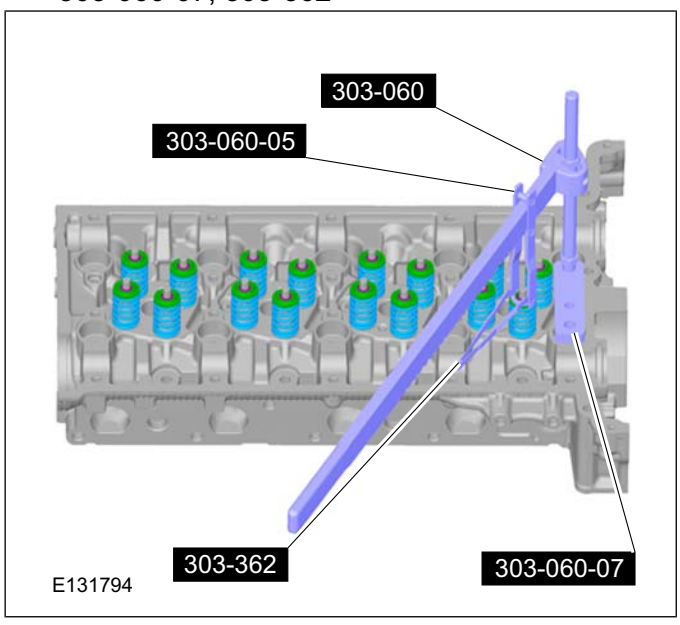
Removal

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

1. Refer to: Cylinder Head (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).
2. **NOTE:** Position a socket on the valve spring seat and gently strike it with a hammer.

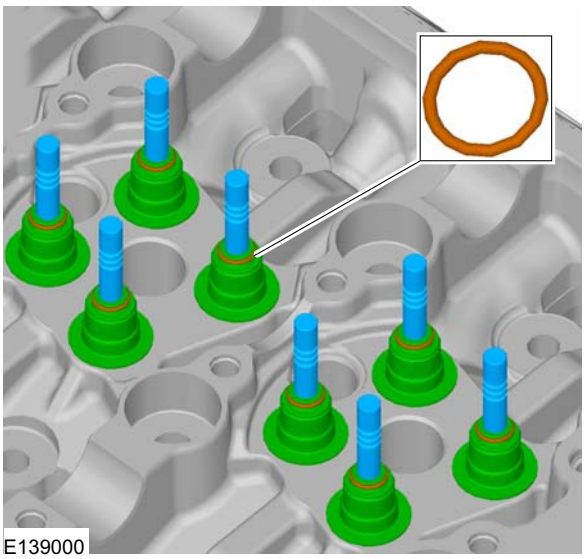


3. Special Tool(s): 303-060, 303-060-05, 303-060-07, 303-362



REMOVAL AND INSTALLATION

4.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

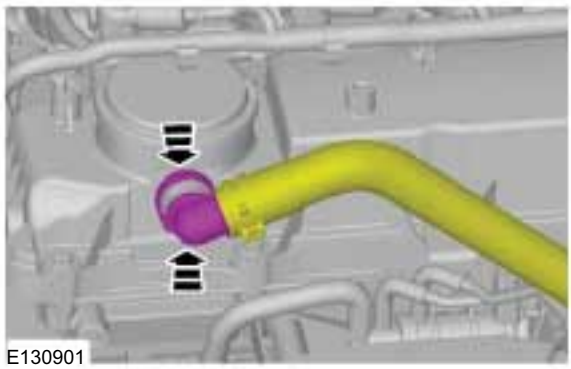
Valve Cover(21 141 0)

Removal

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

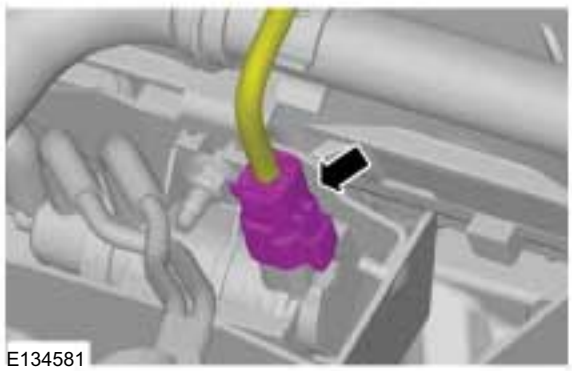
All vehicles

1.

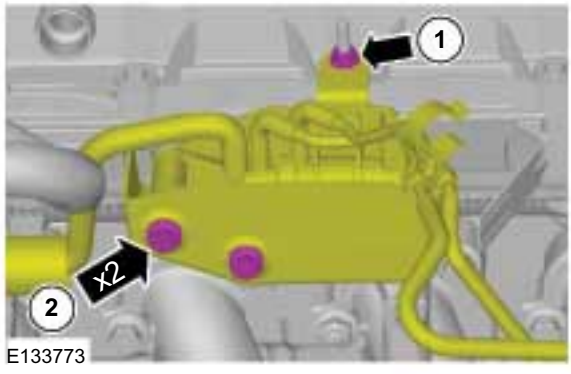


Vehicles with fixed vane turbocharger

2.



3. 1. Torque: 10 Nm
2. Torque: 23 Nm

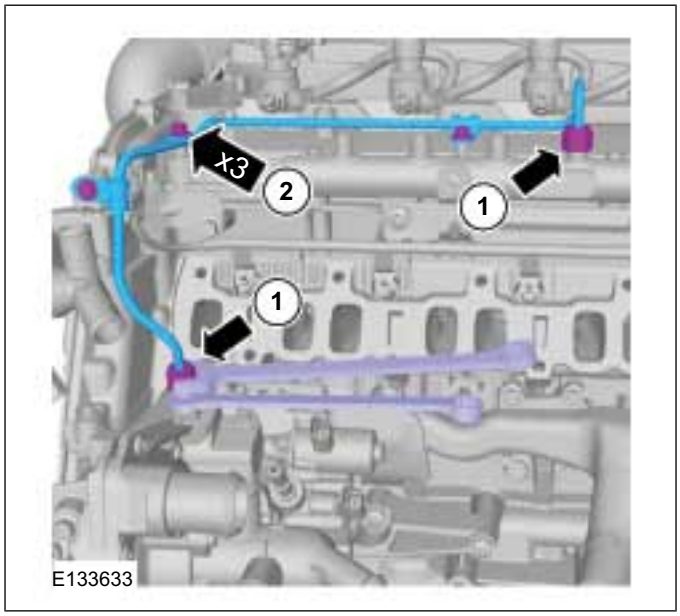


All vehicles

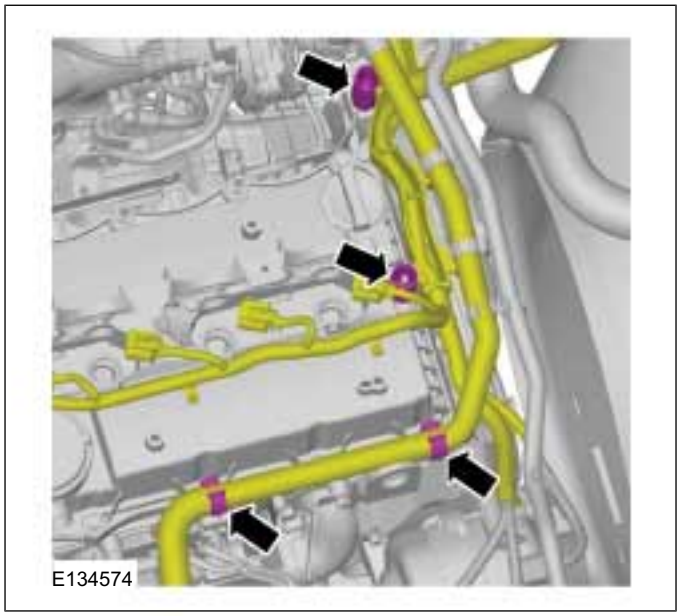
4. Refer to: Fuel Injectors (303-04 Fuel Charging and Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

5. 1. Torque:
- Stage 1: 5 Nm
- Stage 2: 35 Nm

2. Torque: 10 Nm

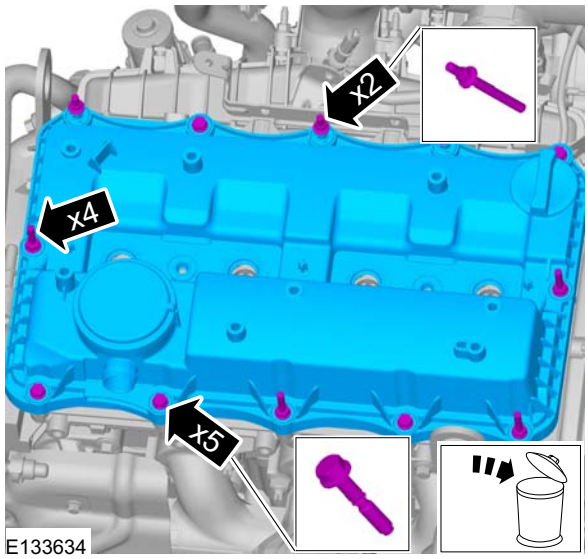


6.

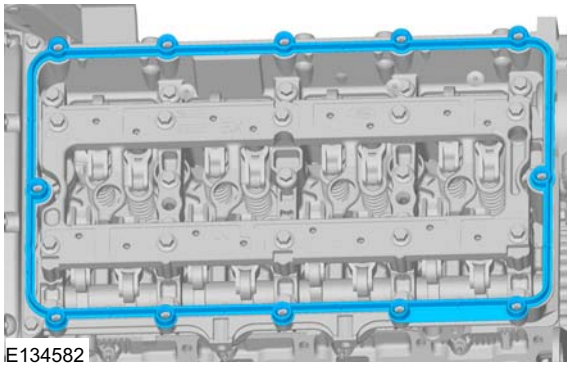


REMOVAL AND INSTALLATION

7. Torque: 10 Nm



8.



Installation

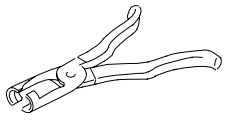
NOTE: Install a new valve cover gasket as necessary.

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

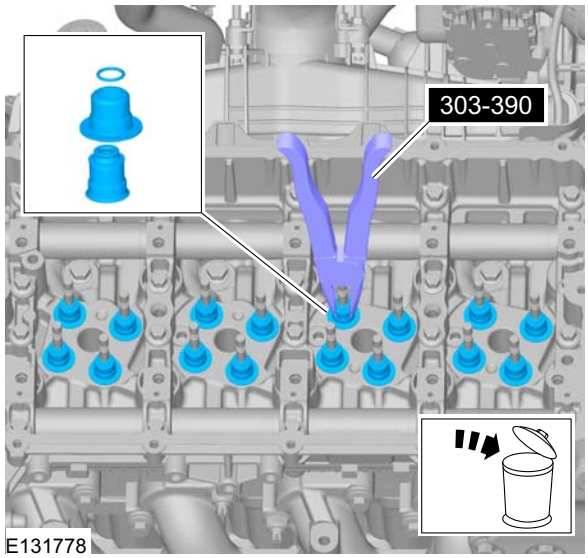
Valve Stem Seals(21 238 0)

Special Tool(s)

 21165	303-390 Pliers, Valve Stem Seal

Removal

1. Refer to: Valve Springs (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).
2. Special Tool(s): 303-390



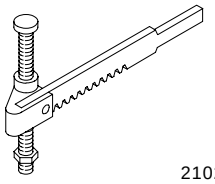
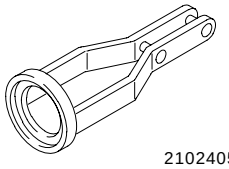
Installation

1. To install, reverse the removal procedure.

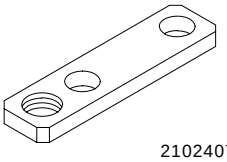
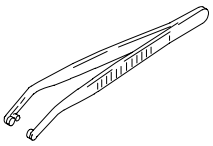
REMOVAL AND INSTALLATION

Valve Springs

Special Tool(s)

 21024	303-060 Compressor, Valve Spring
 2102405	303-060-05 Adapter for 303-060

Special Tool(s)

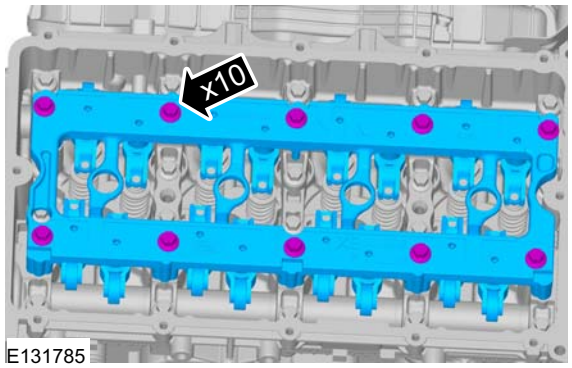
 2102407	303-060-07 Adapter for 303-060
 21156	303-362 Installer, Valve Stem Collets

Removal

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

1. Refer to: Valve Cover (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

2.

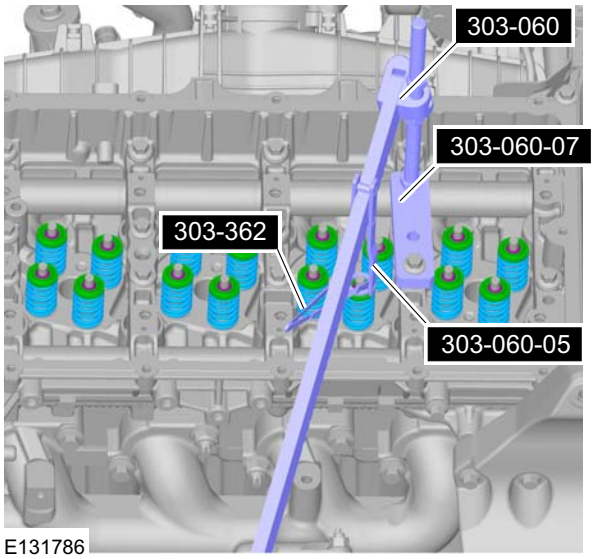


E131785

3. Position the appropriate piston at top dead center (TDC).

4. Using the special tools, remove the valve collets.

   Special Tool(s): 303-060, 303-060-05, 303-060-07, 303-362

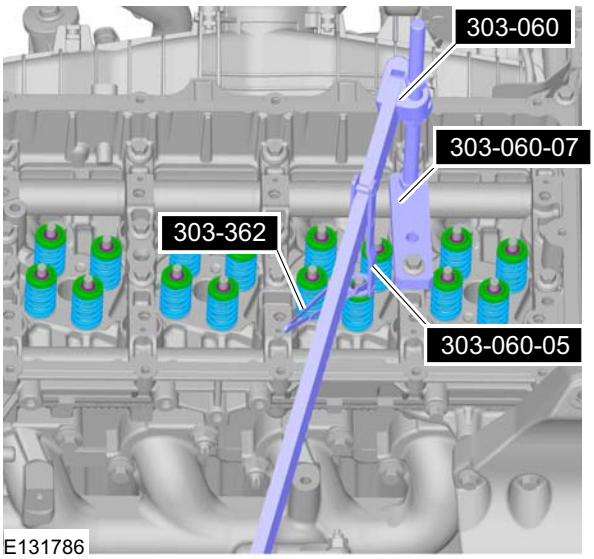


E131786

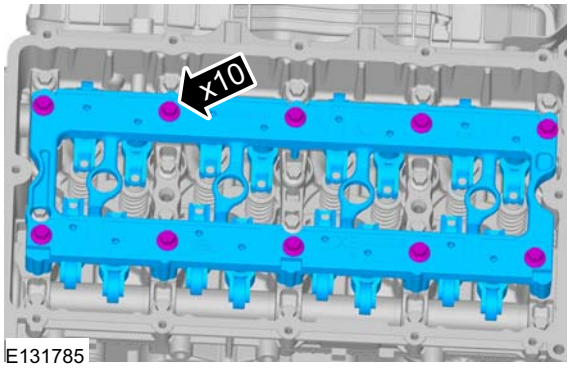
REMOVAL AND INSTALLATION

Installation

1.



2. Torque:
- Stage 1: 10 Nm
- Stage 2: 30°



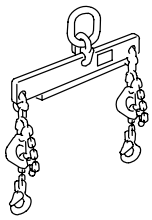
3. Refer to: Valve Cover (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

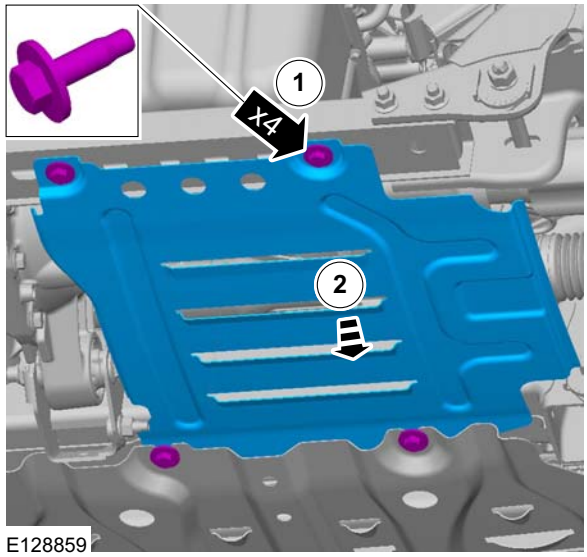
REMOVAL

Engine — Vehicles With: 5-Speed Manual Transmission - MT75(21 132 0; 21 132 6; 21 132 7)

Removal

Special Tool(s) / General Equipment

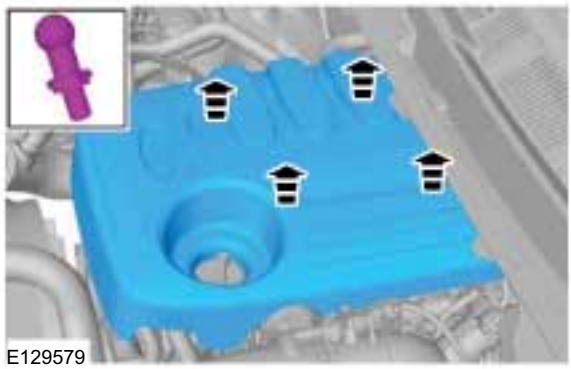
 21068A	303-122 Lifting Bracket, Engine
Transmission Jack	

1. Refer to: 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: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).
4. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).
5. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
6. 

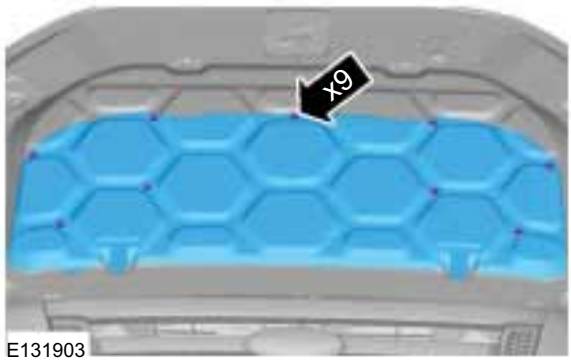
E128859

REMOVAL

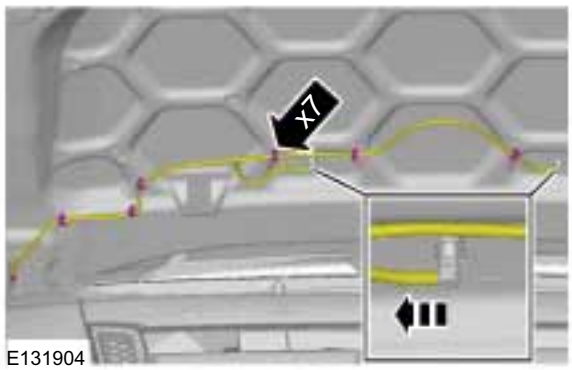
7.



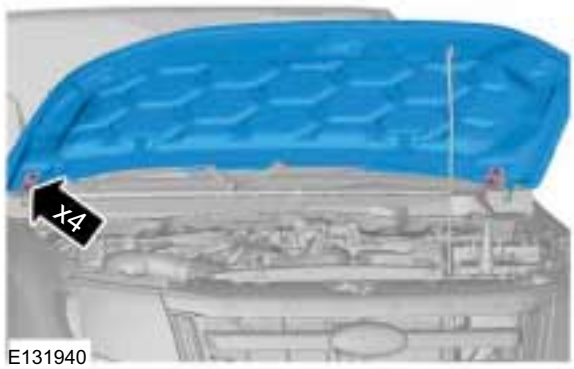
8.



9.

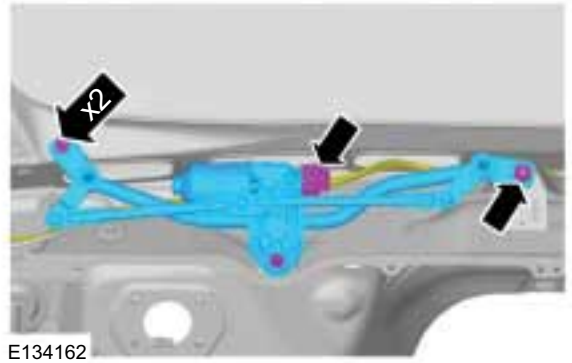


10.

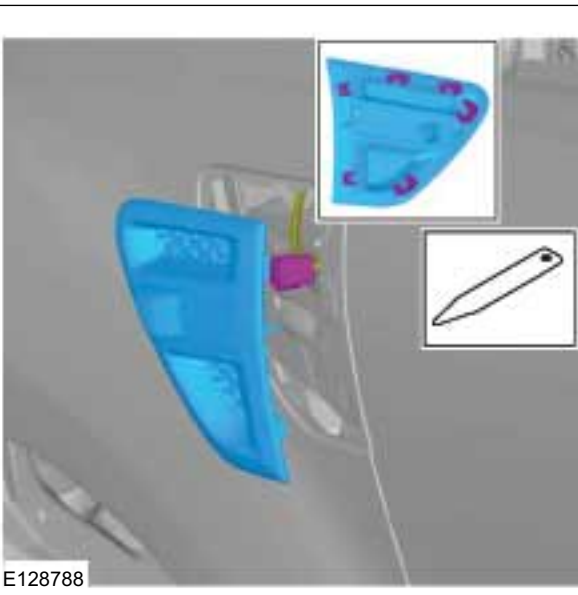


11. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

12.

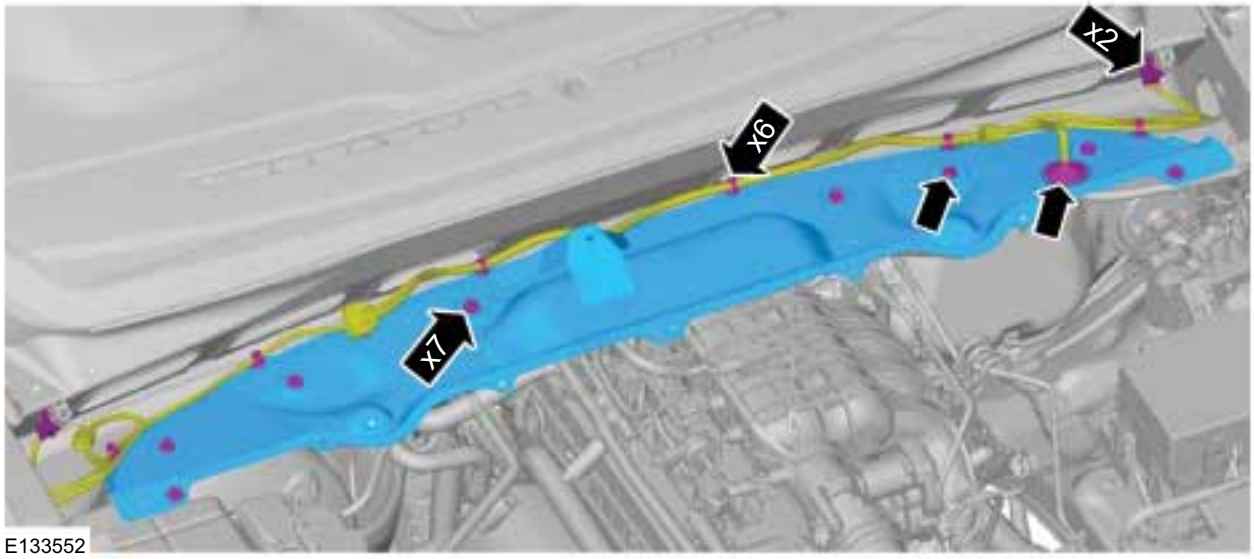


13. On both sides.



14.

REMOVAL



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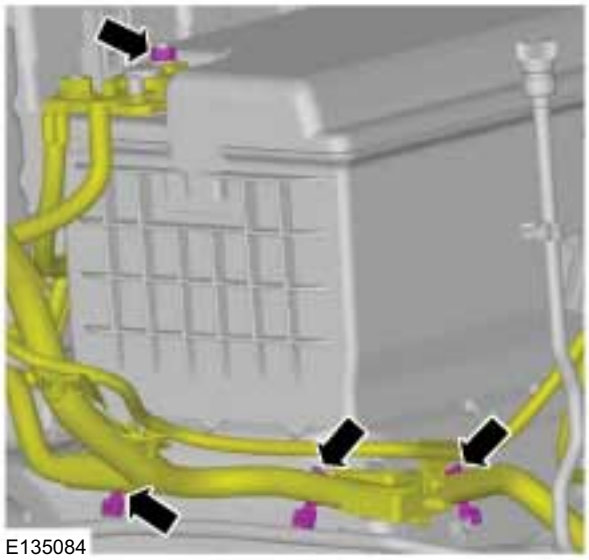
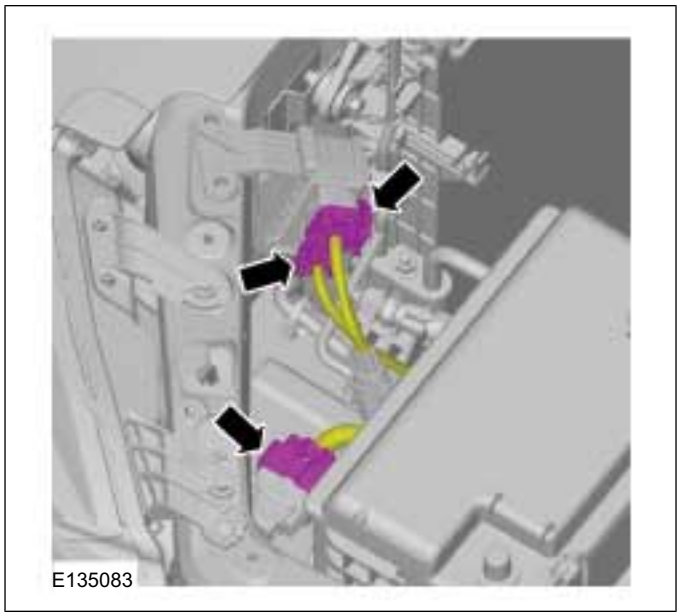


16.



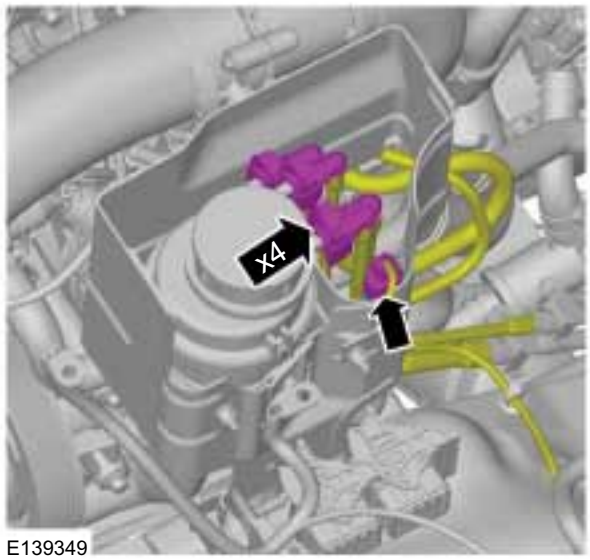
REMOVAL

17. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

18. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

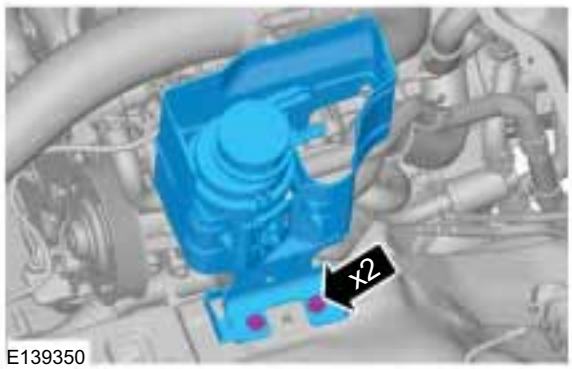
19. Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

20.



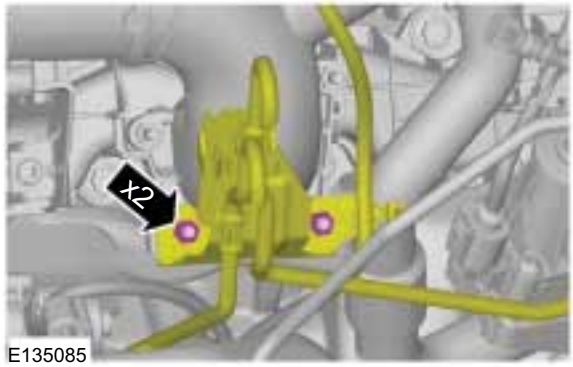
E139349

21.



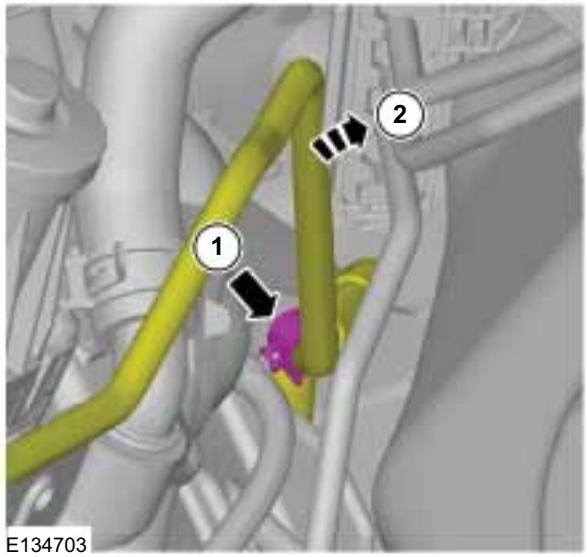
E139350

22.



E135085

23.



E134703

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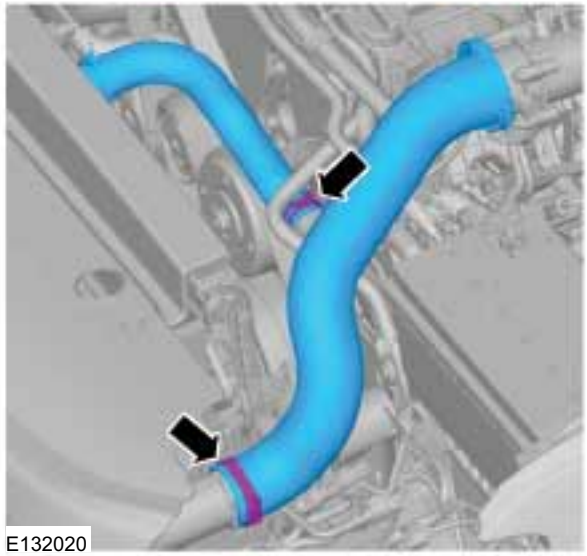

E132020

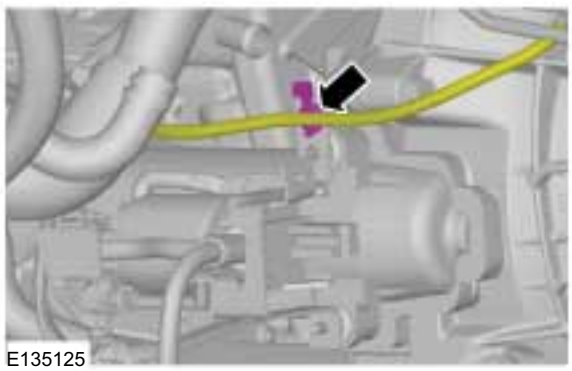
REMOVAL

25. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

26. Refer to: Radiator (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

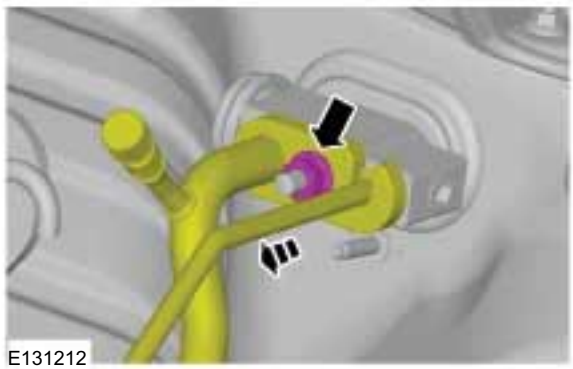
27. Refer to: Condenser - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (412-01 Climate Control, Removal and Installation).

28.

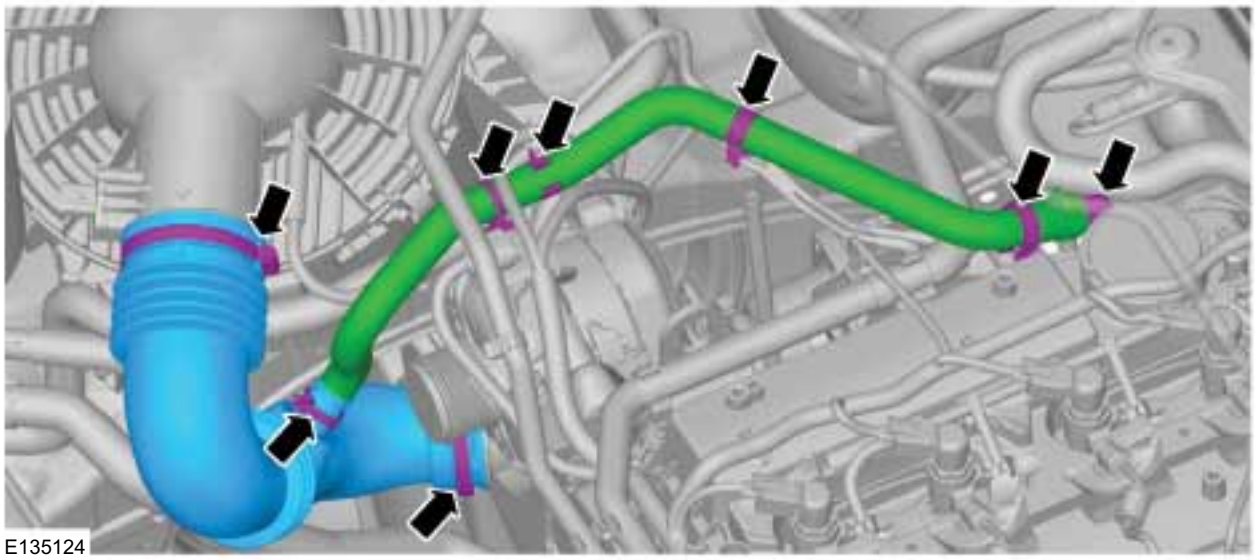

E135125

29. Refer to: Starter Motor - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-06 Starting System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

30.


E131212

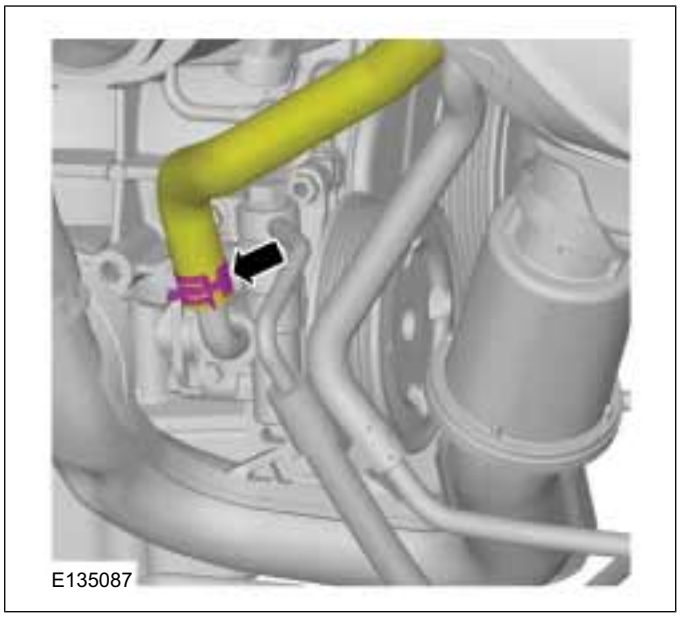
31.


E135124

REMOVAL

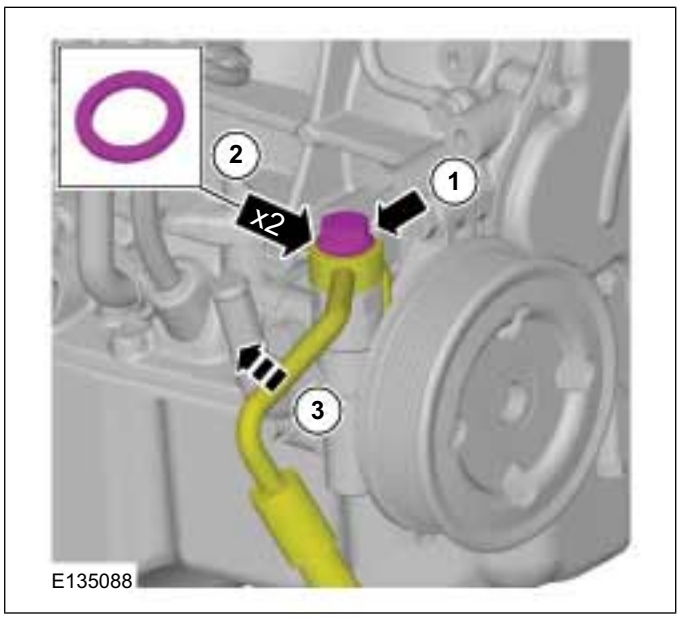
32. Refer to: Air Cleaner - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

33. **NOTE:** Make sure that all openings are sealed.


E135087

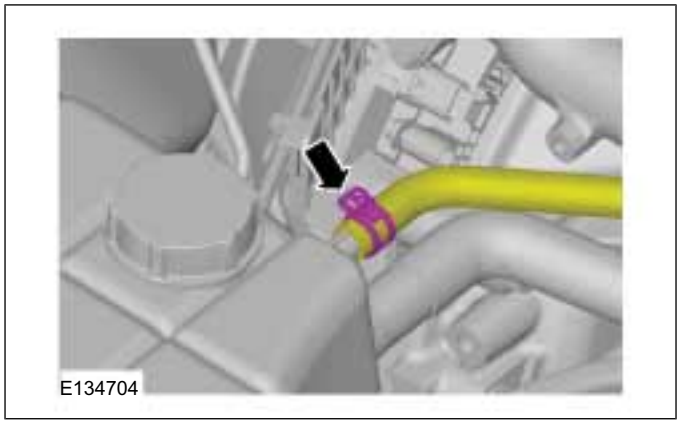
34. **CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.**

NOTE: The washers can be reused unless damaged.

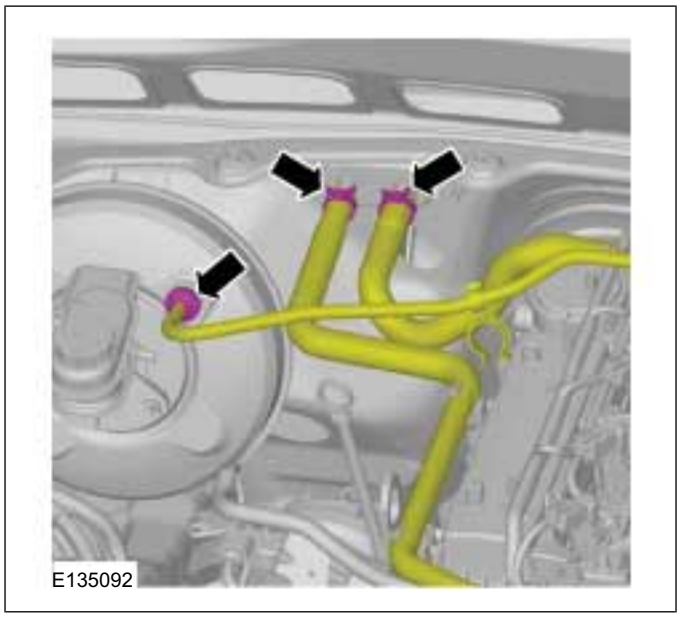


E135088

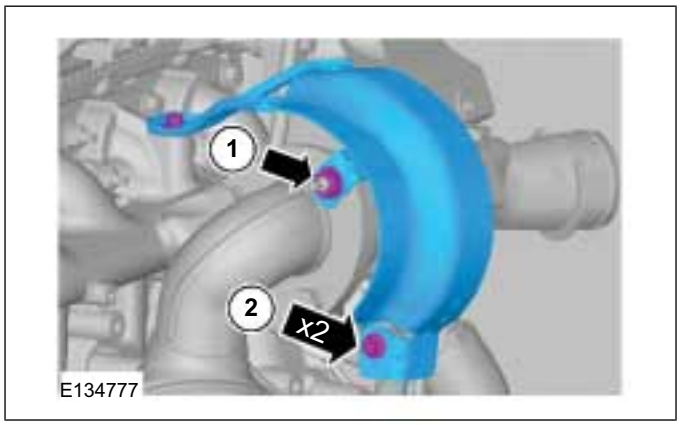
35.


E134704

36.


E135092

37.

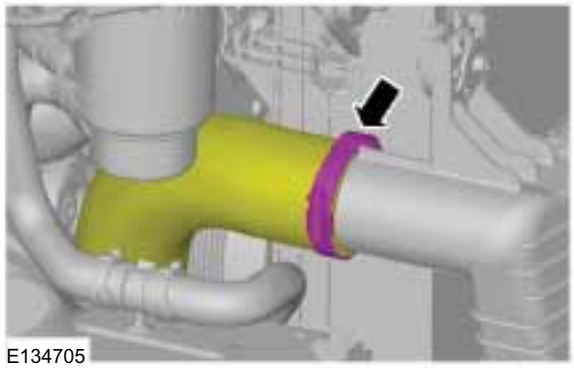


E134777

REMOVAL

38. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

39.



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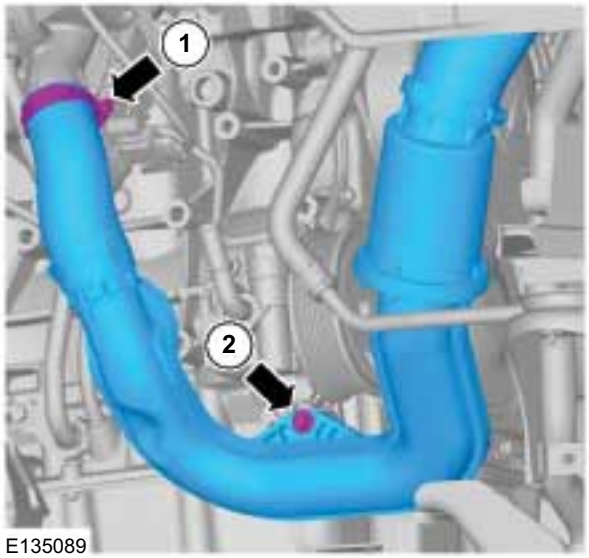
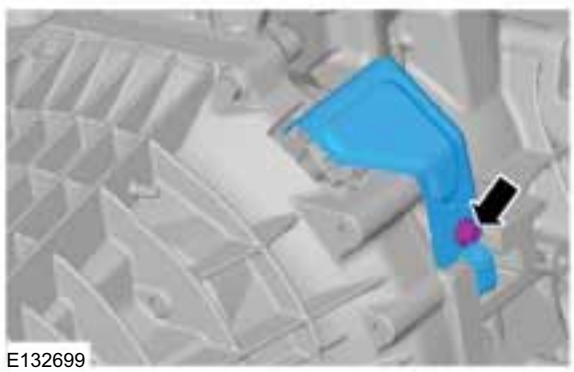
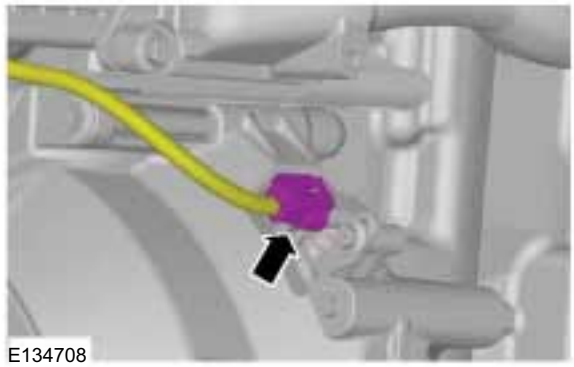


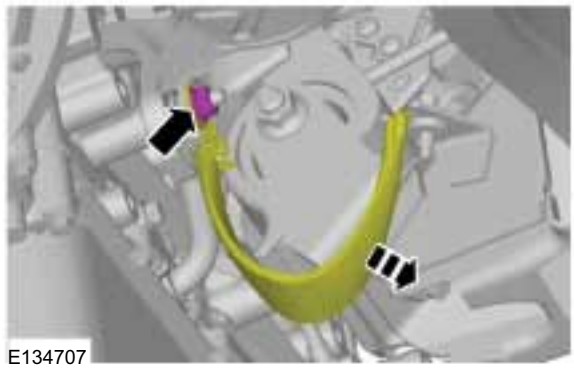
41.



42.



43.



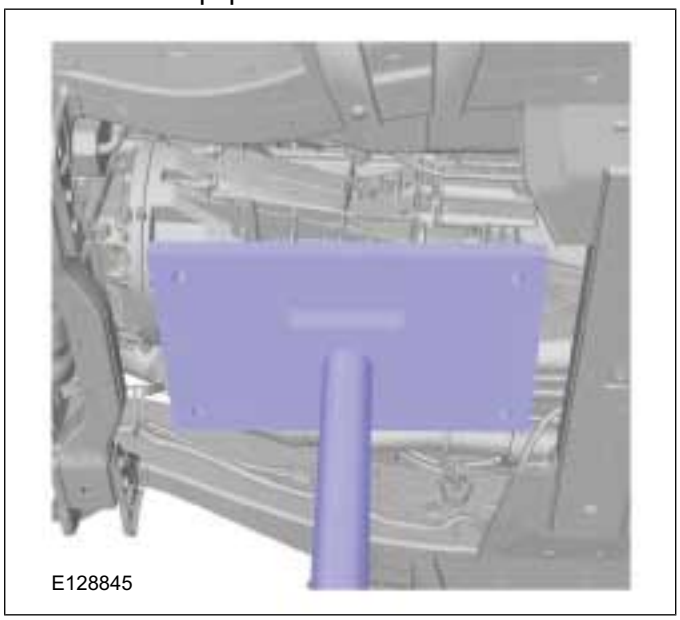
44. **WARNING: Make sure that transmission assembly is on wooden blocks and secured with suitable retaining straps.**

CAUTION: Do not tilt the transmission.This may cause damage to the pilot bearing.

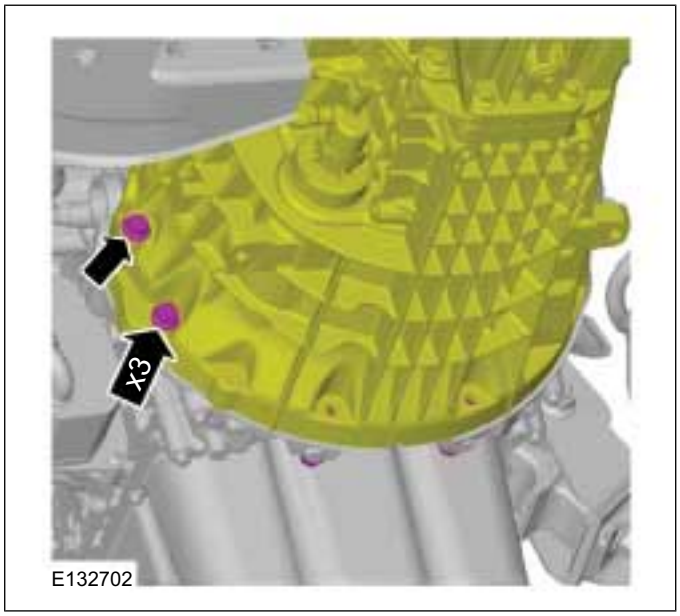
REMOVAL

Tie and support the transmission to the chassie with a suitable strap.

General Equipment: Transmission Jack

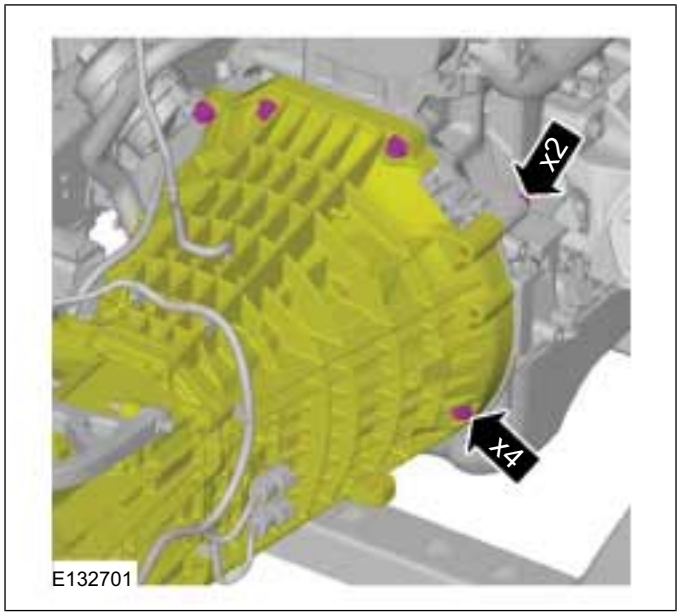

E128845

45.



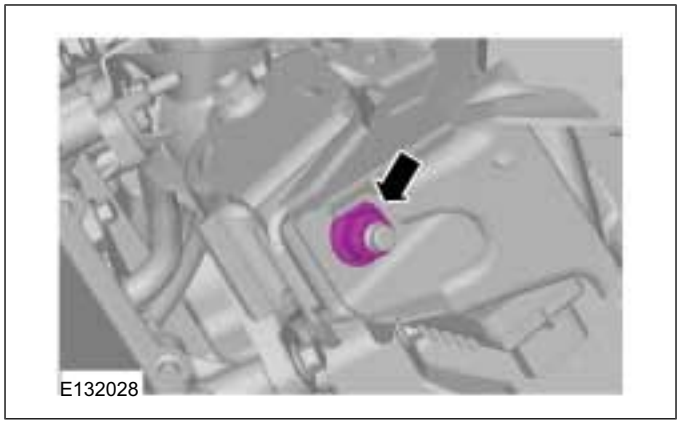
E132702

46.



E132701

47. On both sides.

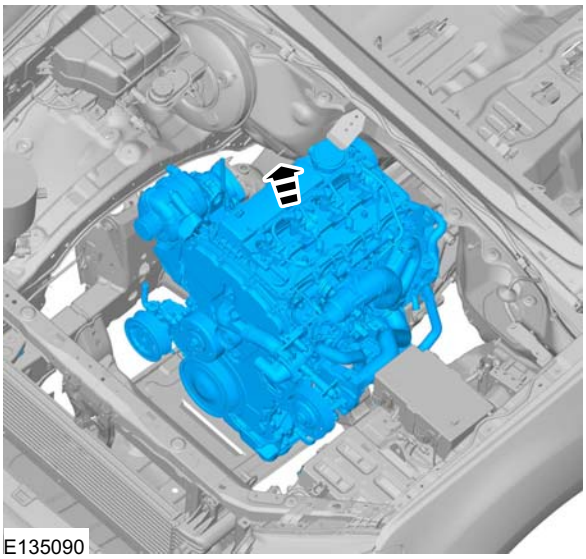

E132028

48. Special Tool(s): 303-122

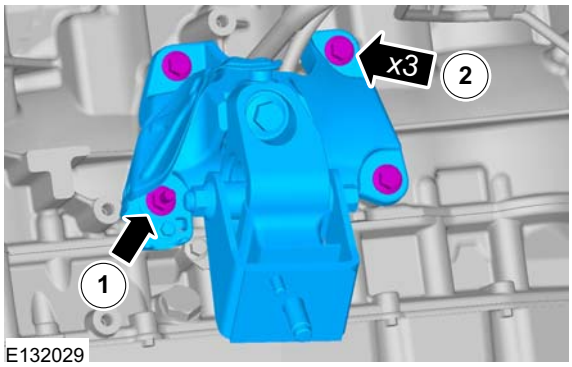
E68699

REMOVAL

49.


E135090

50.



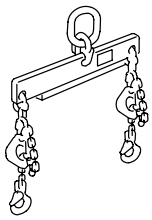
E132029

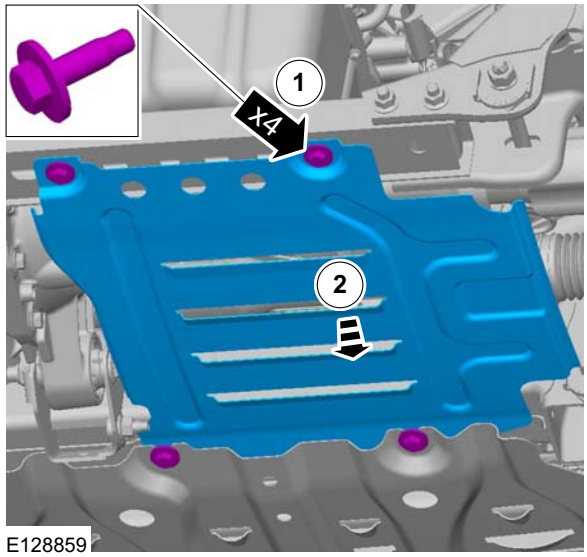
REMOVAL

Engine — Vehicles With: 6-Speed Manual Transmission - MT82(21 132 0; 21 132 6; 21 132 7)

Removal

Special Tool(s) / General Equipment

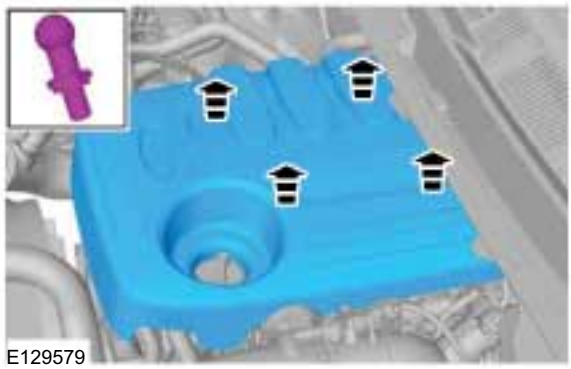
 21068A	303-122 Lifting Bracket, Engine
Transmission Jack	

1. Refer to: 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: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).
4. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).
5. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
6. 

E128859

REMOVAL

7.



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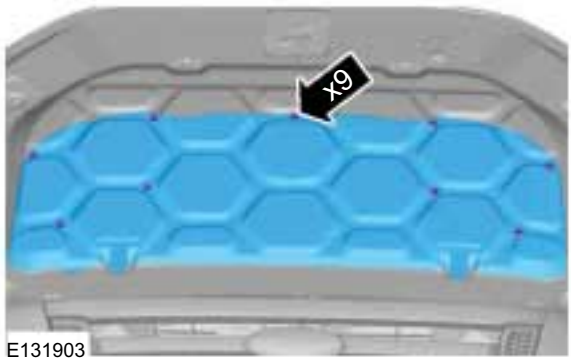

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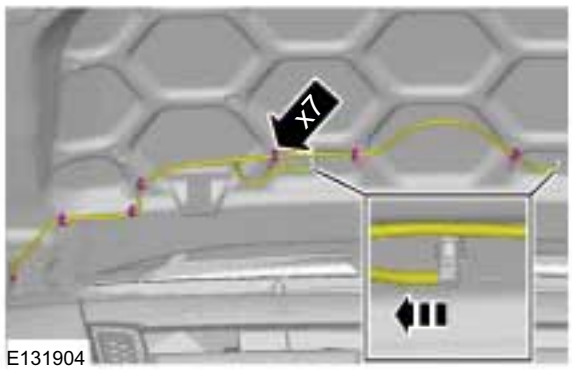
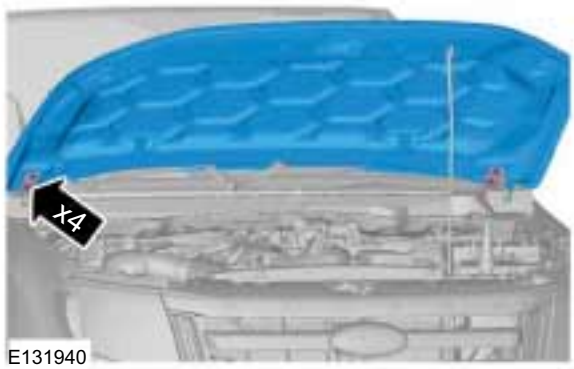
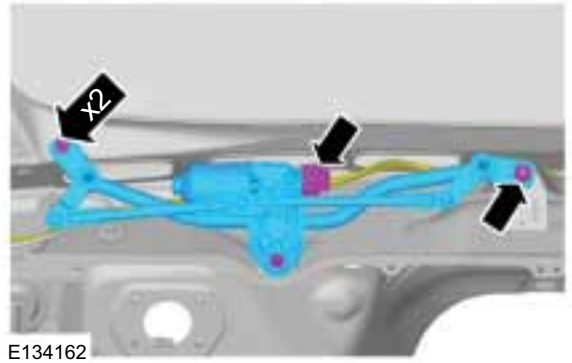


10.

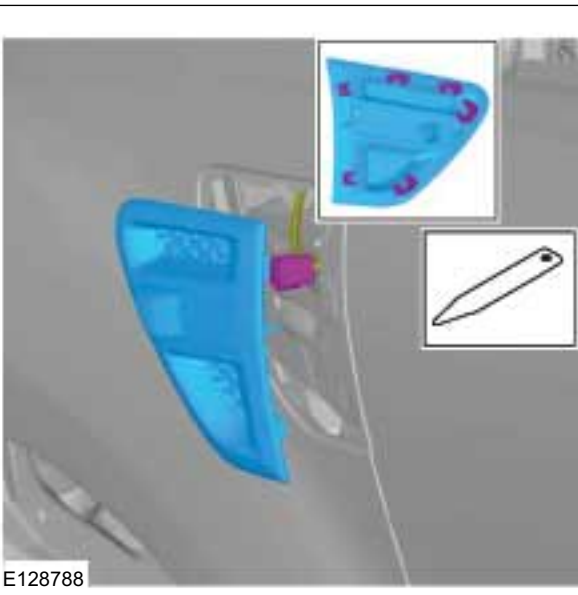


11. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

12.

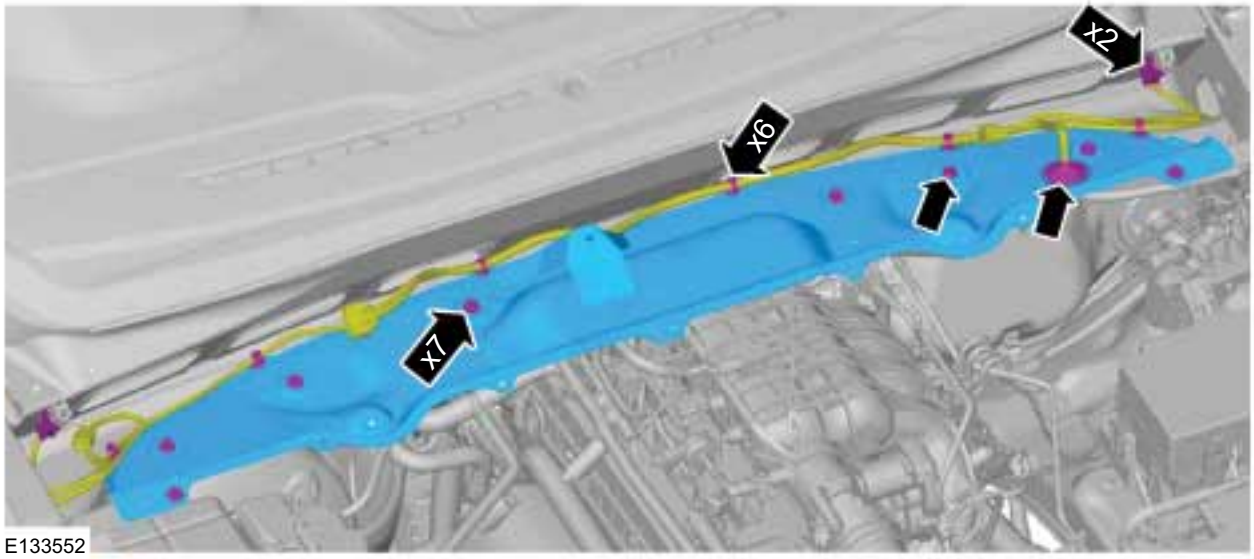


13. On both sides.



14.

REMOVAL



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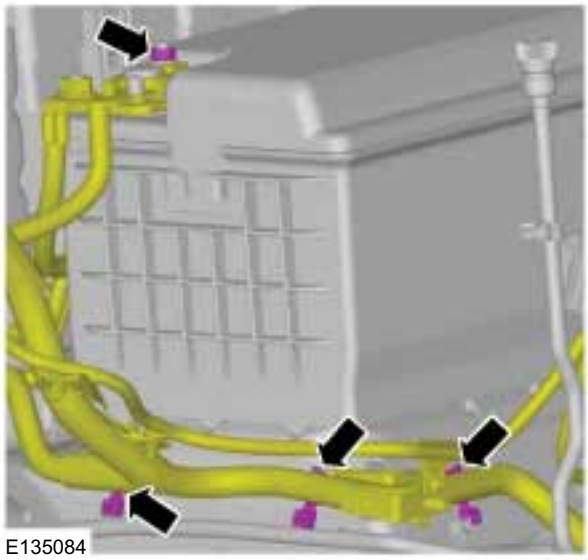
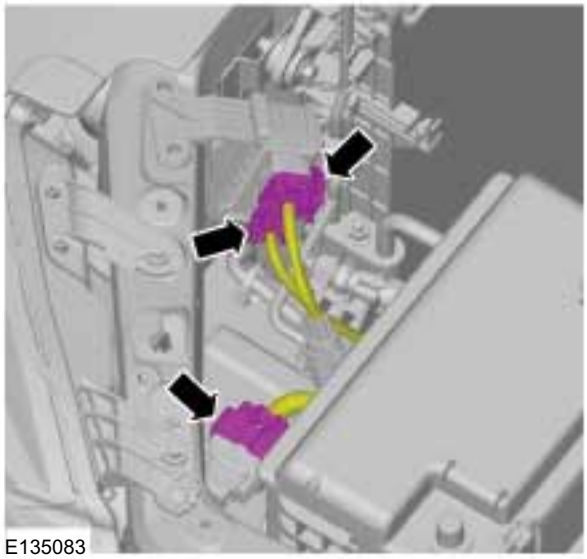


16.



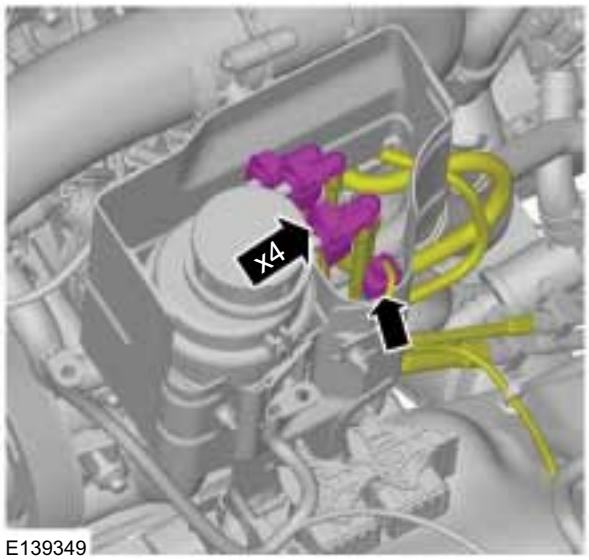
REMOVAL

17. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

18. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

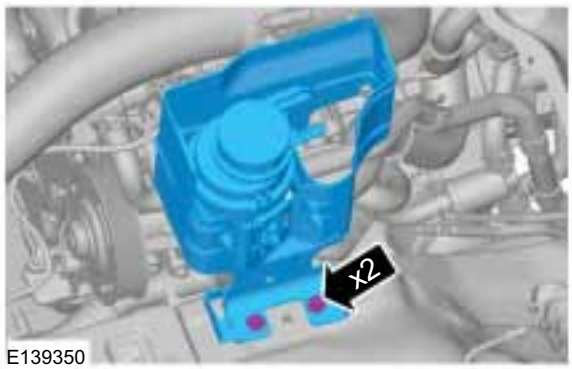
19. Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

20.



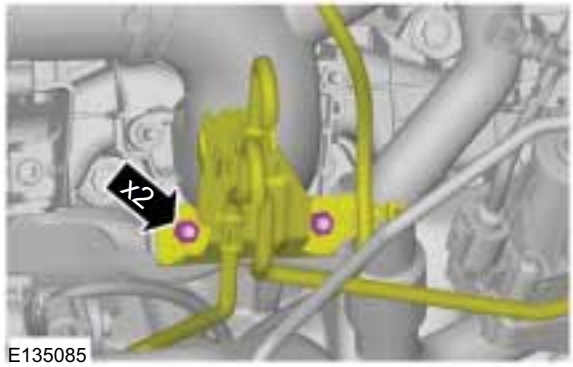
E139349

21.



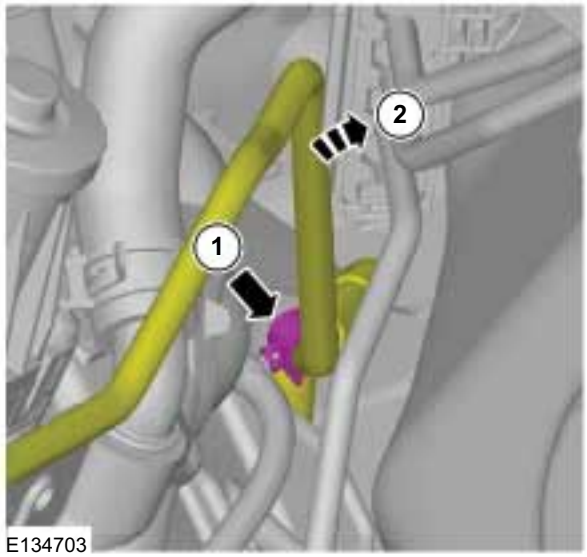
E139350

22.



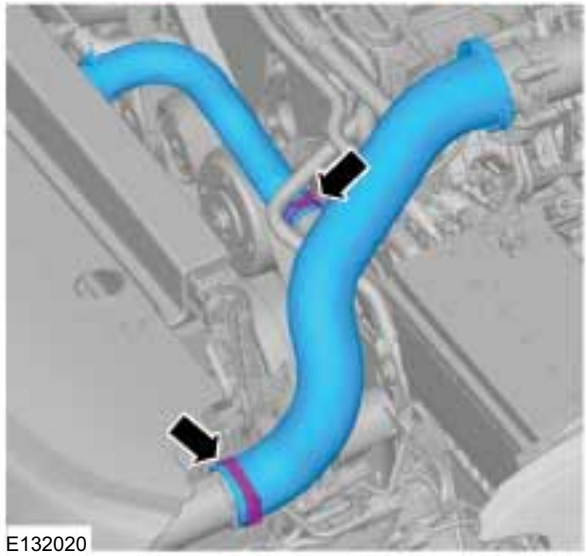
E135085

23.



E134703

24.


E132020

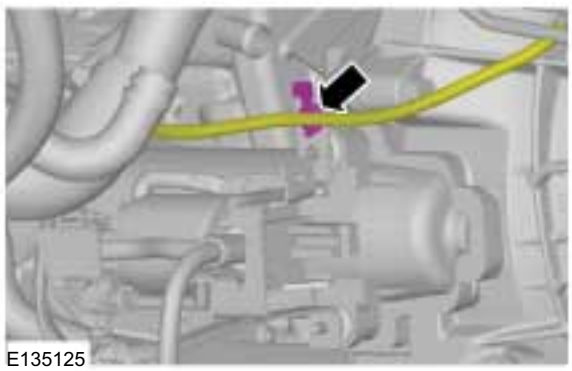
REMOVAL

25. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

26. Refer to: Radiator (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

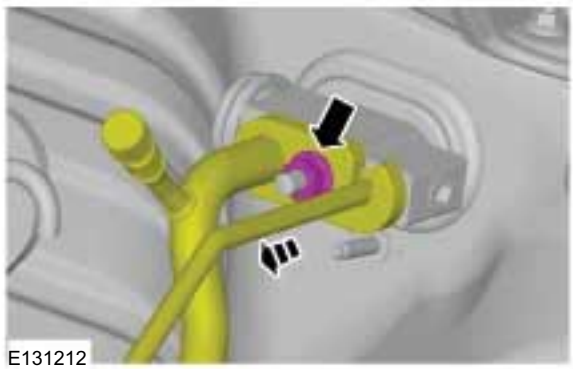
27. Refer to: Condenser - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (412-01 Climate Control, Removal and Installation).

28.

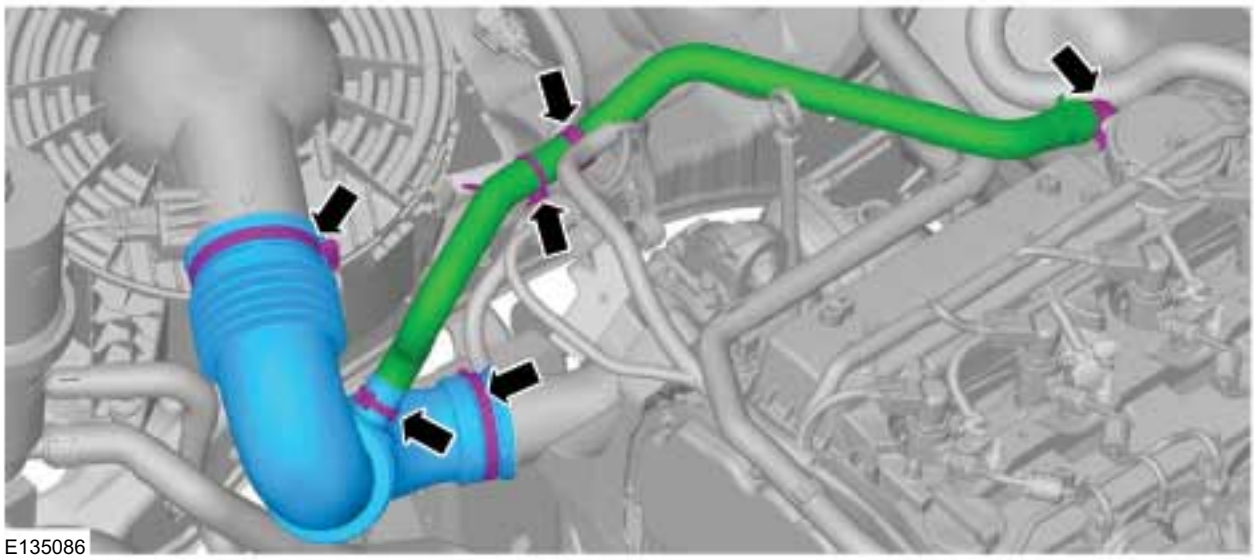

E135125

29. Refer to: Starter Motor - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-06 Starting System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

30.


E131212

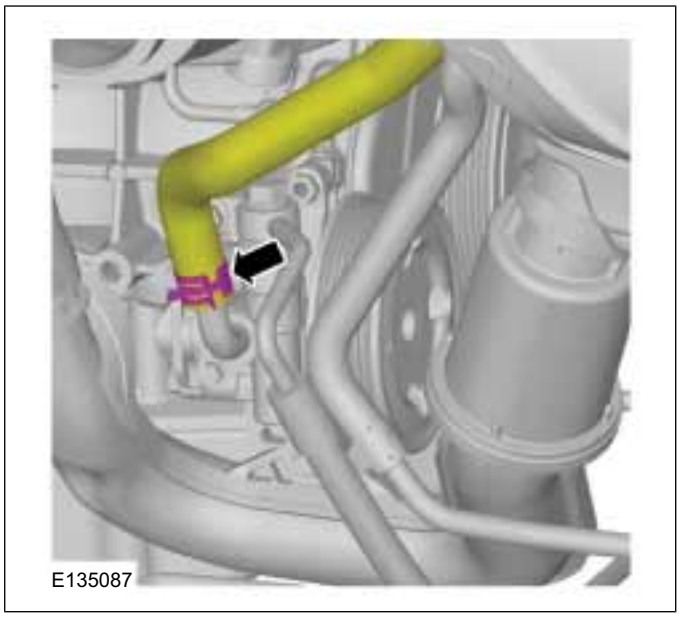
31.


E135086

REMOVAL

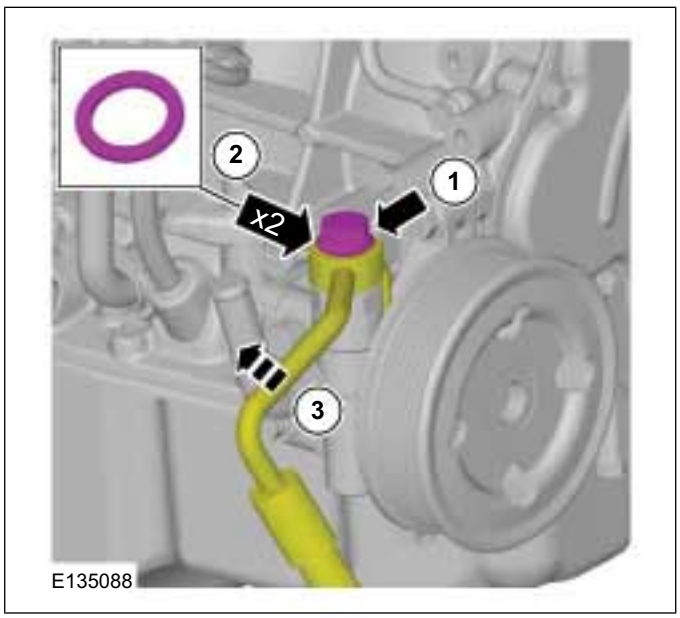
32. Refer to: Air Cleaner - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

33. **NOTE:** Make sure that all openings are sealed.


E135087

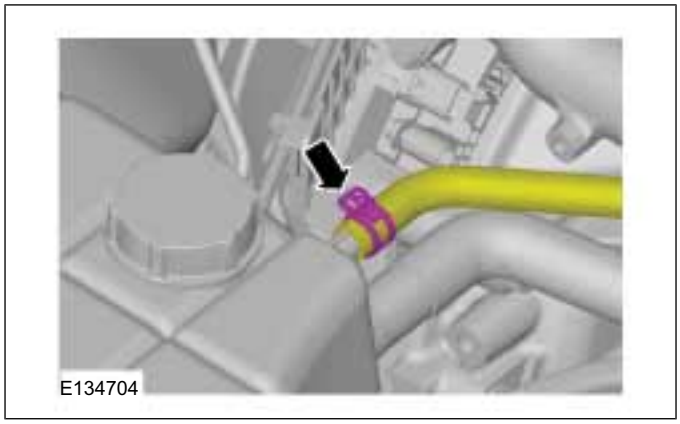
34. **CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.**

NOTE: The washers can be reused unless damaged.

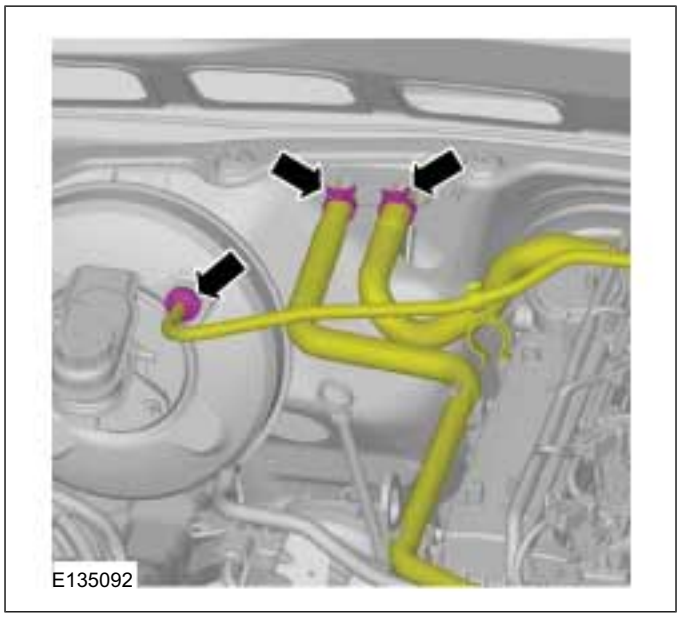


E135088

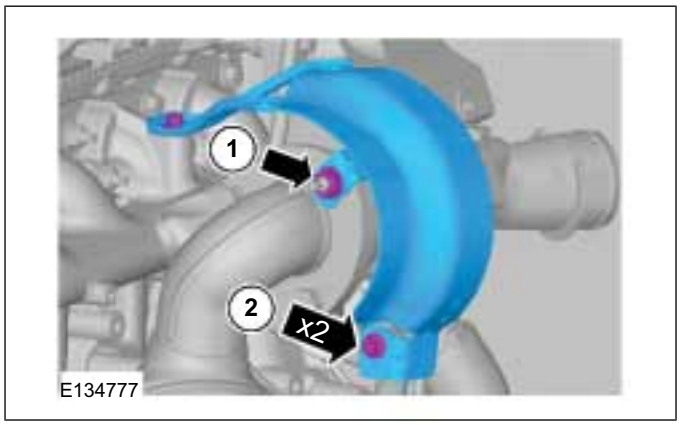
35.


E134704

36.


E135092

37.

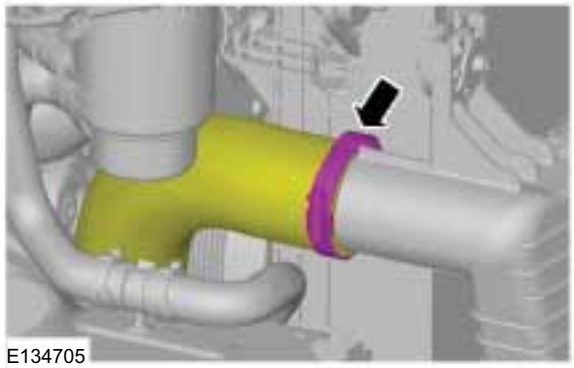


E134777

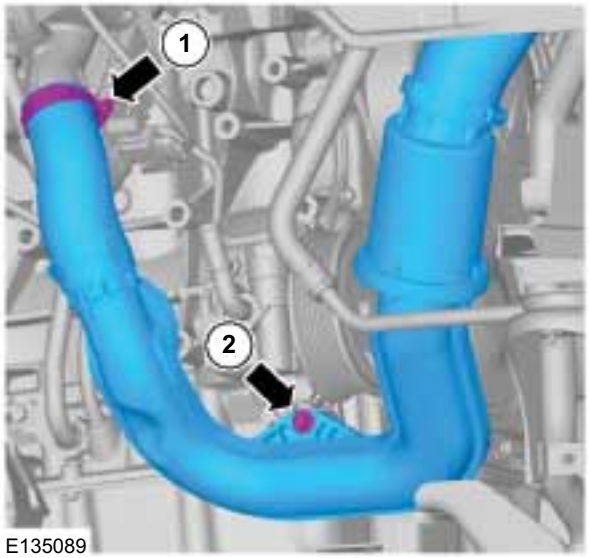
REMOVAL

38. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

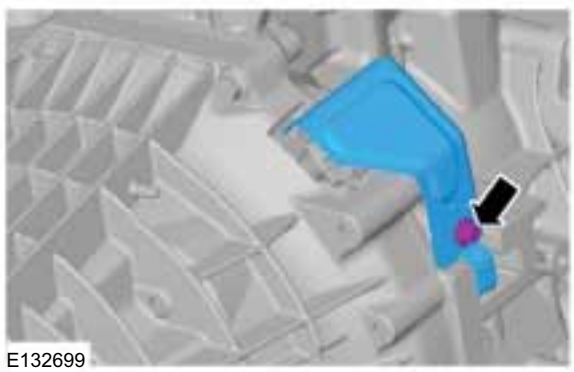
39.



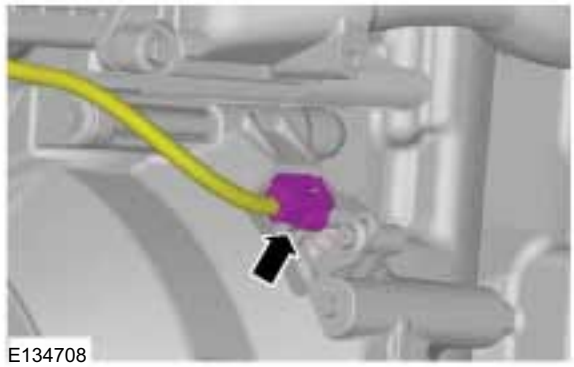
40.



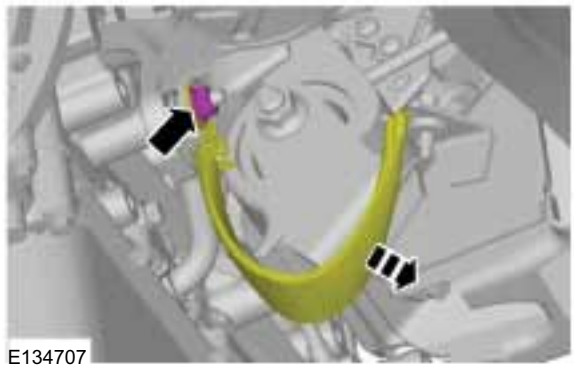
41.



42.



43.



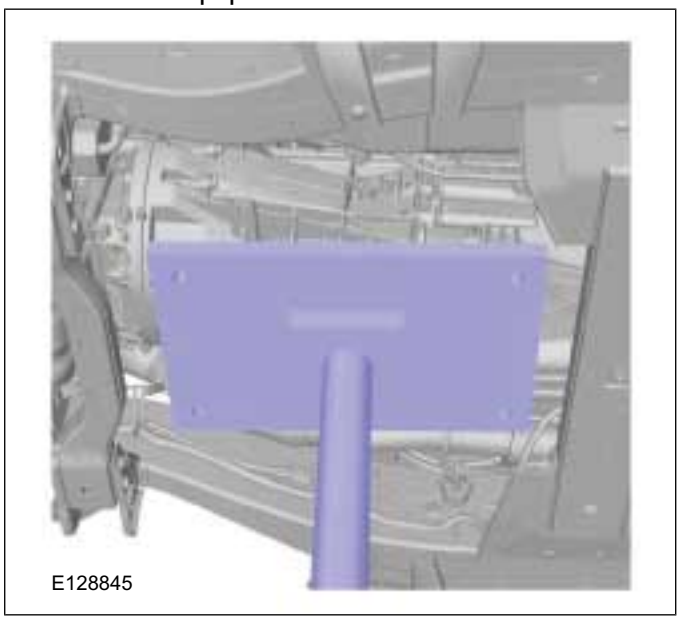
44. **WARNING: Make sure that transmission assembly is on wooden blocks and secured with suitable retaining straps.**

CAUTION: Do not tilt the transmission.This may cause damage to the pilot bearing.

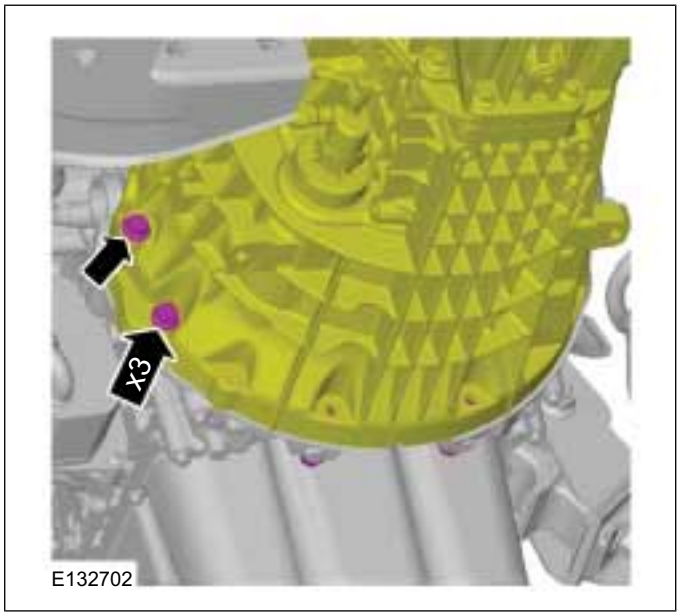
REMOVAL

Tie and support the transmission to the chassis with a suitable strap.

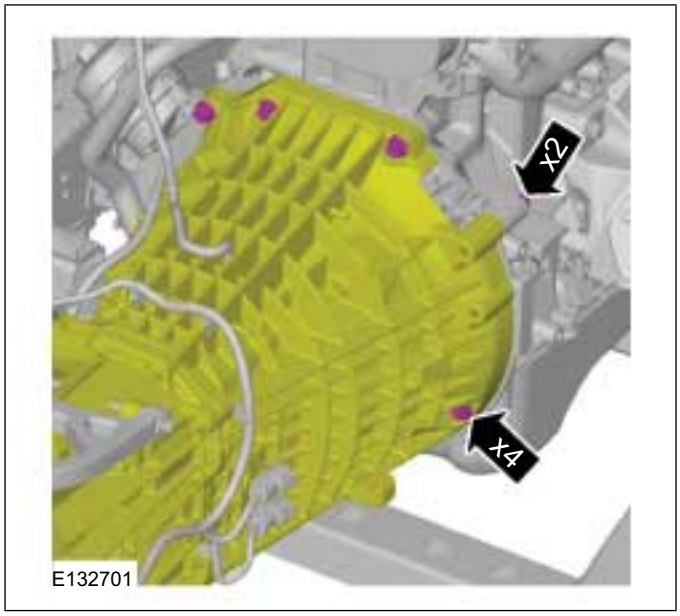
General Equipment: Transmission Jack



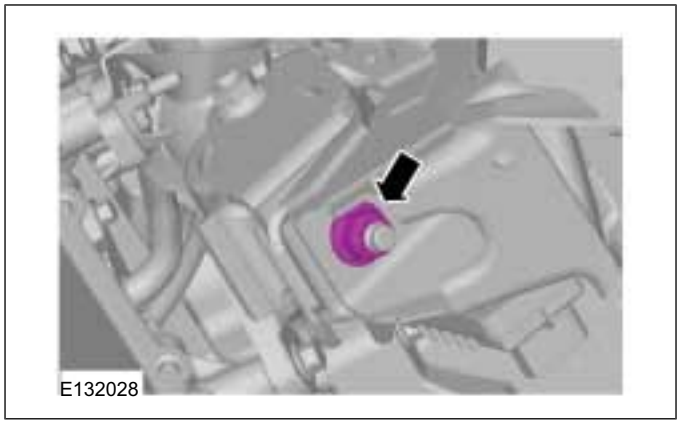
45.



46.



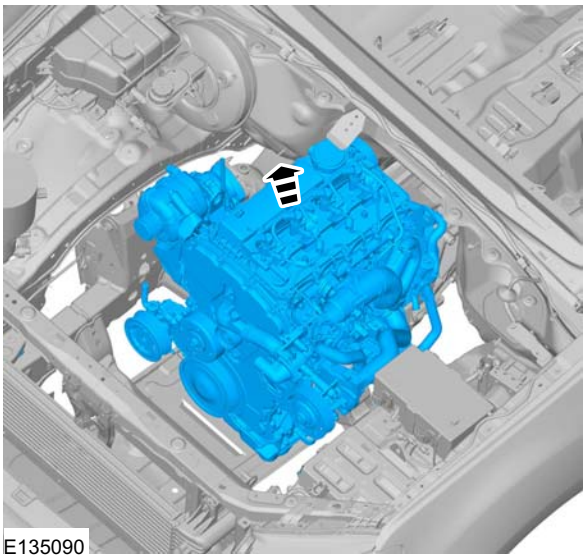
47. On both sides.



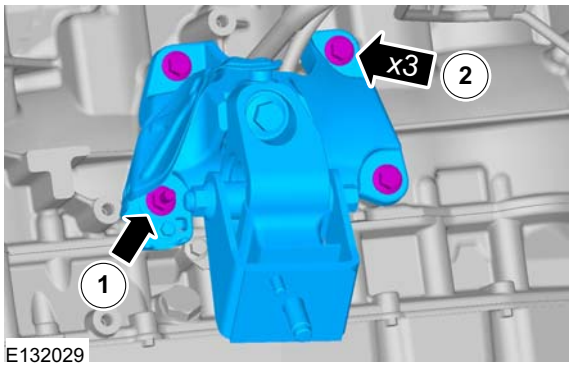
48. Special Tool(s): 303-122

REMOVAL

49.



50.

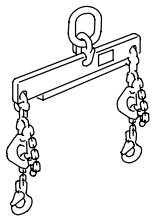


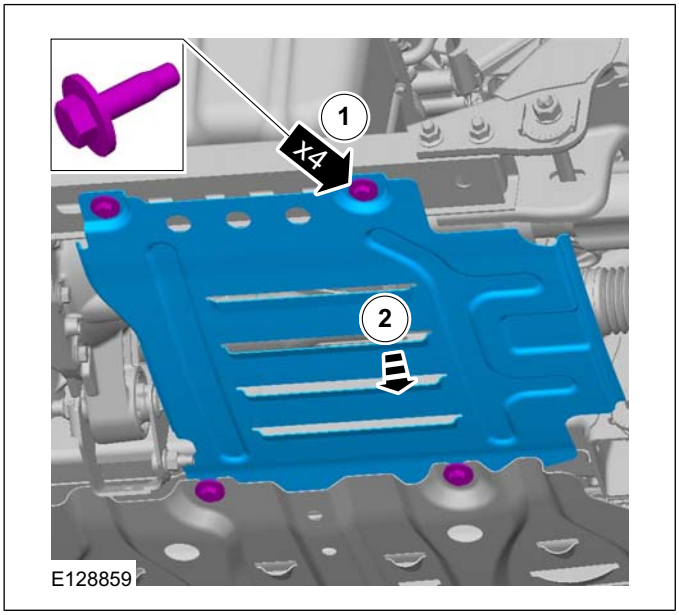
REMOVAL

Engine — Vehicles With: 6-Speed Automatic Transaxle - 6R80(21 132 0; 21 132 6; 21 132 7)

Removal

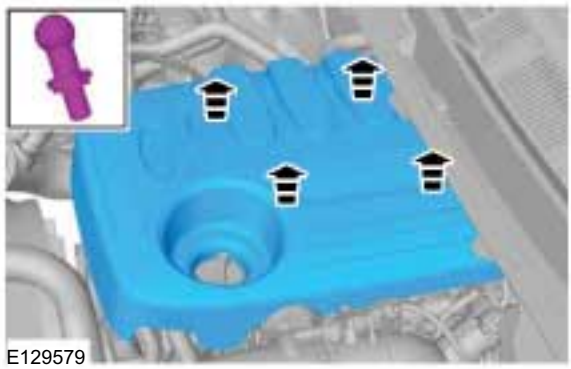
Special Tool(s) / General Equipment

 21068A	303-122 Lifting Bracket, Engine
Transmission Jack	

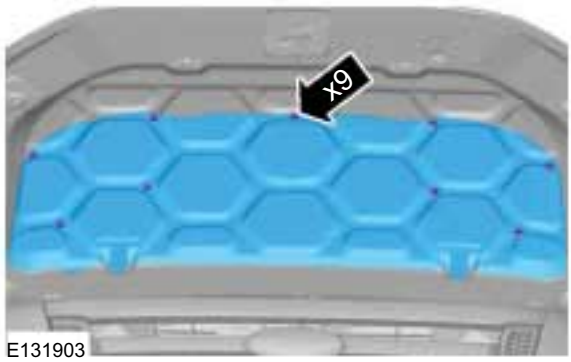
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).
4. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).
5. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
6. 

REMOVAL

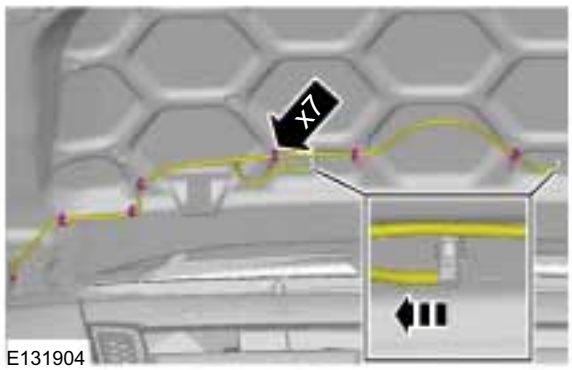
7.



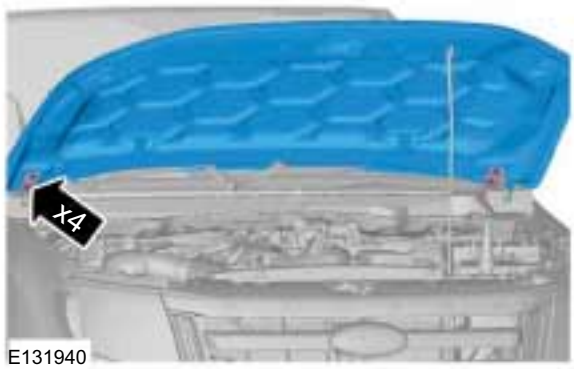
8.



9.

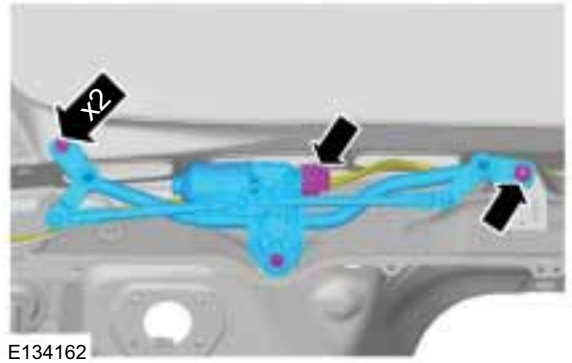


10.

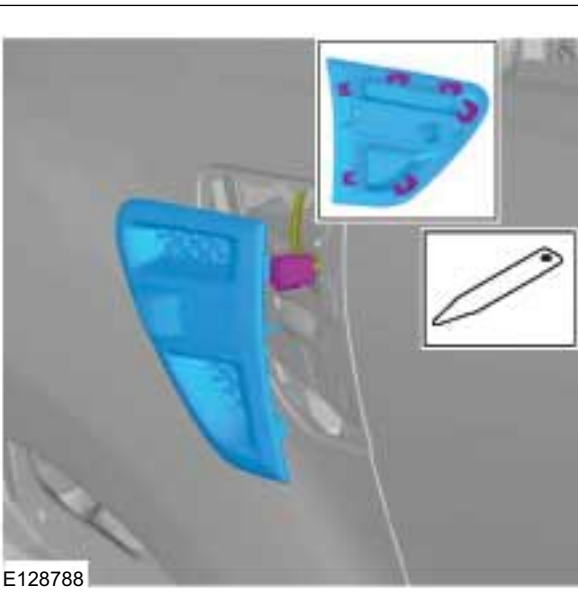


11. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

12.

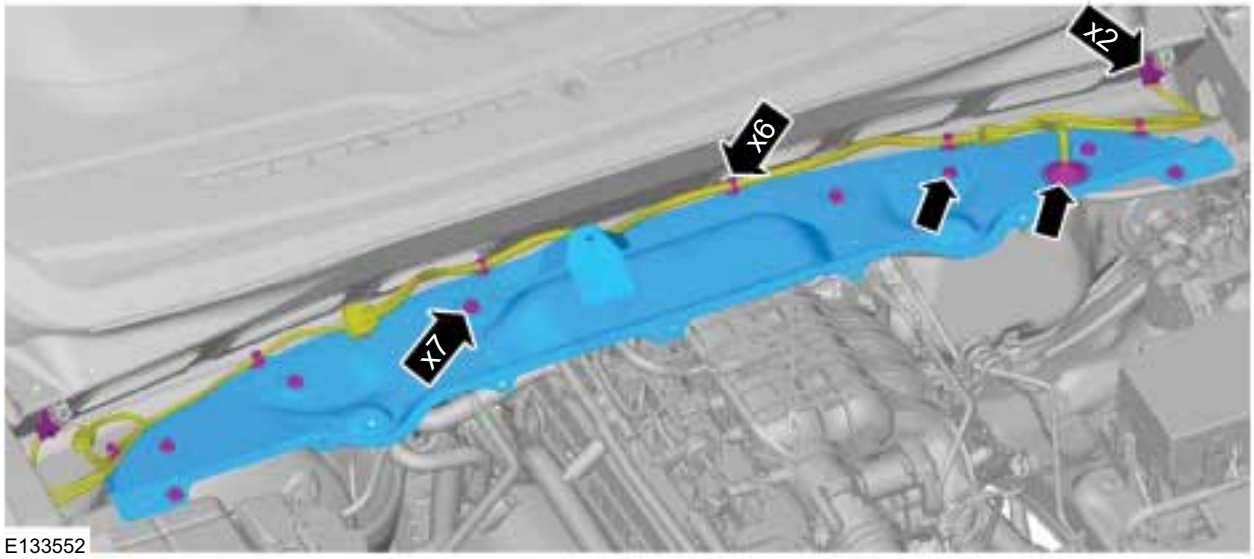


13. On both sides.



14.

REMOVAL



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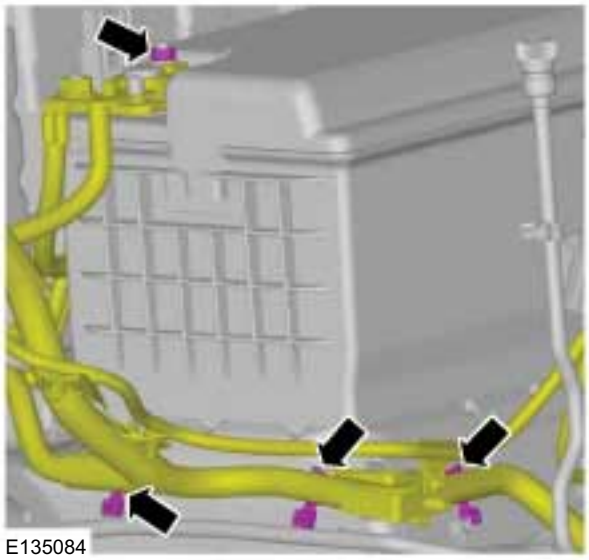
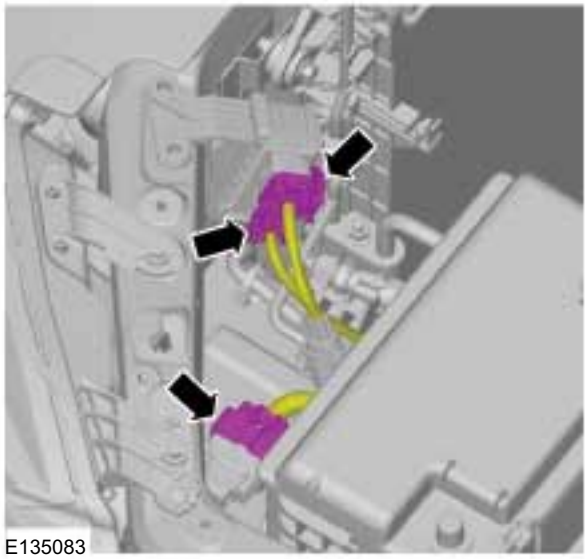


16.



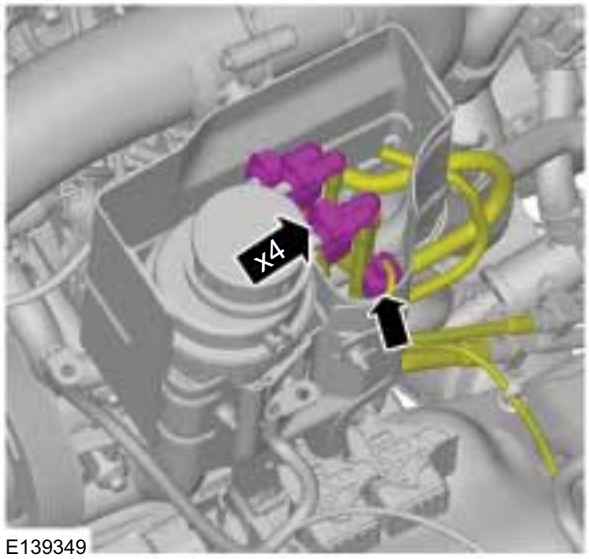
REMOVAL

17. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

18. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

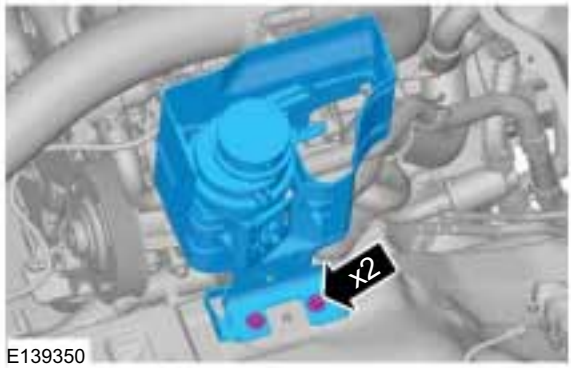
19. Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

20.



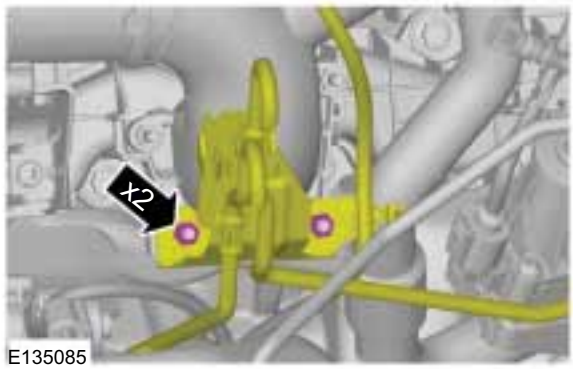
E139349

21.



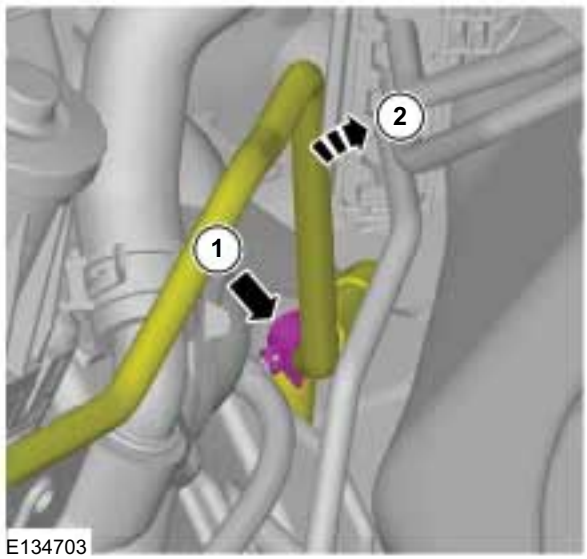
E139350

22.



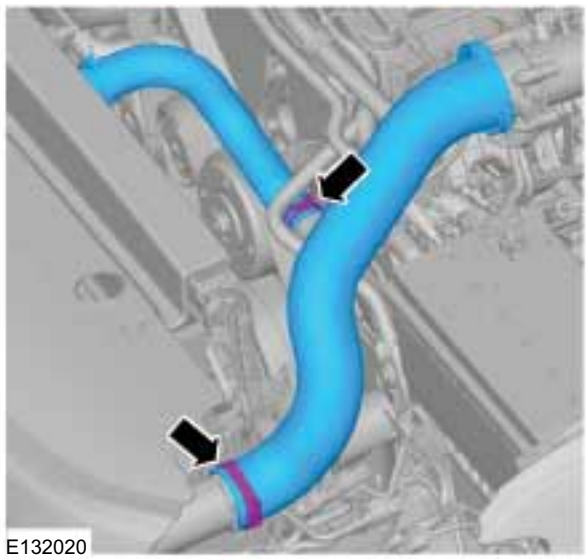
E135085

23.



E134703

24.


E132020

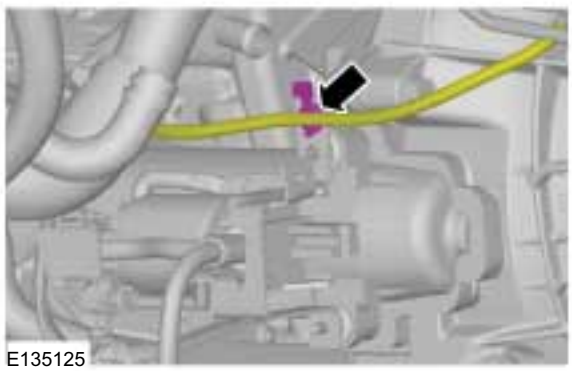
REMOVAL

25. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

26. Refer to: Radiator (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

27. Refer to: Condenser - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (412-01 Climate Control, Removal and Installation).

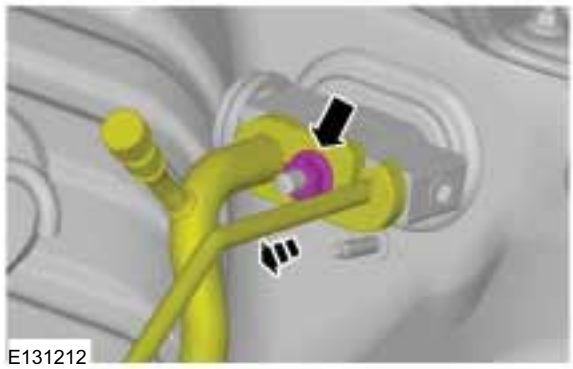
28.


E135125

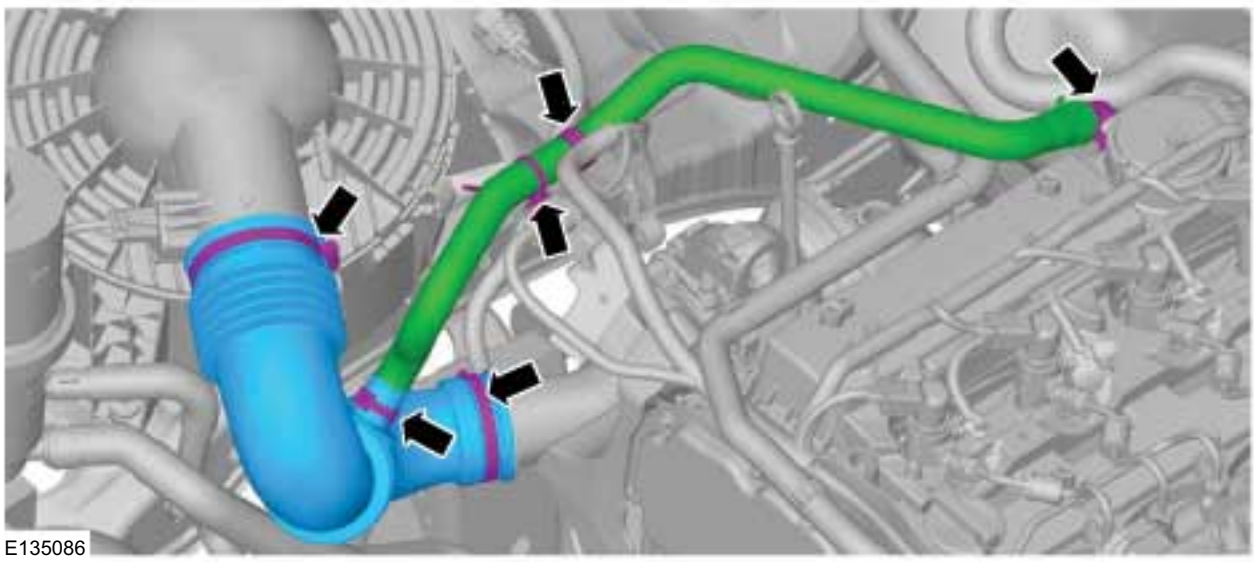
29. Refer to: Starter Motor - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-06 Starting System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

30. Refer to: Transmission Fluid Cooler (307-02 Transmission/Transaxle Cooling, Removal and Installation).

31.


E131212

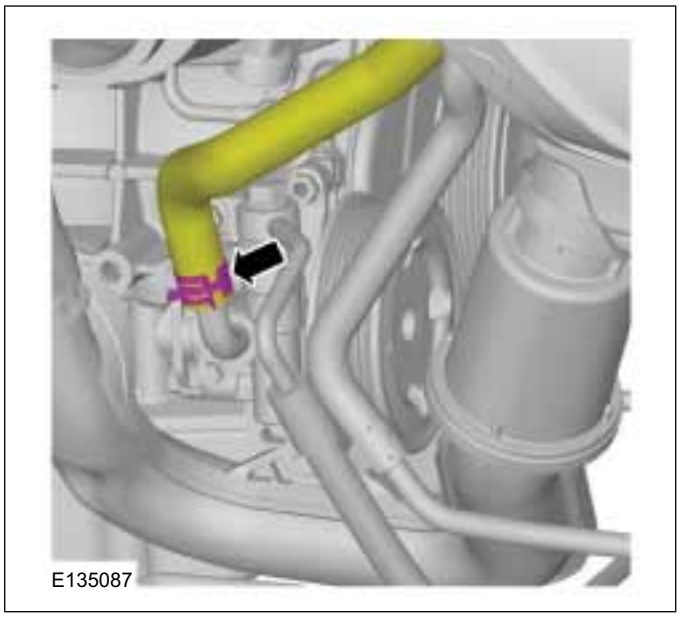
32.


E135086

REMOVAL

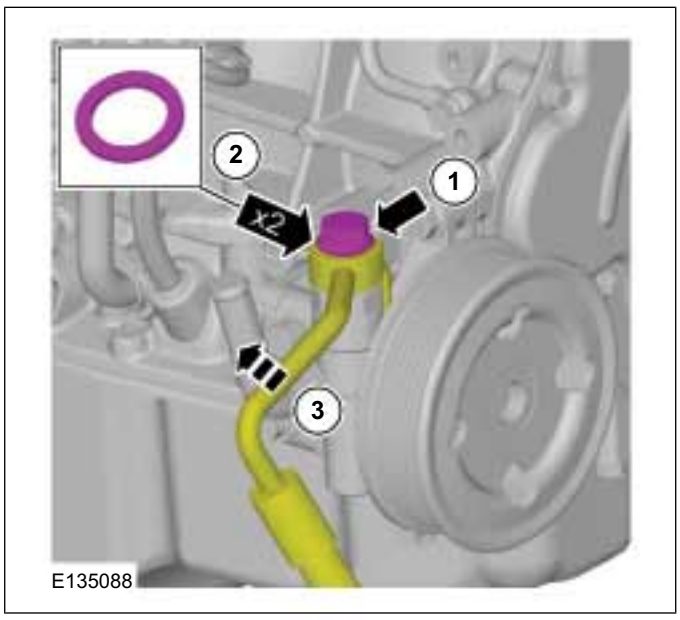
33. Refer to: Air Cleaner - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

34. **NOTE:** Make sure that all openings are sealed.


E135087

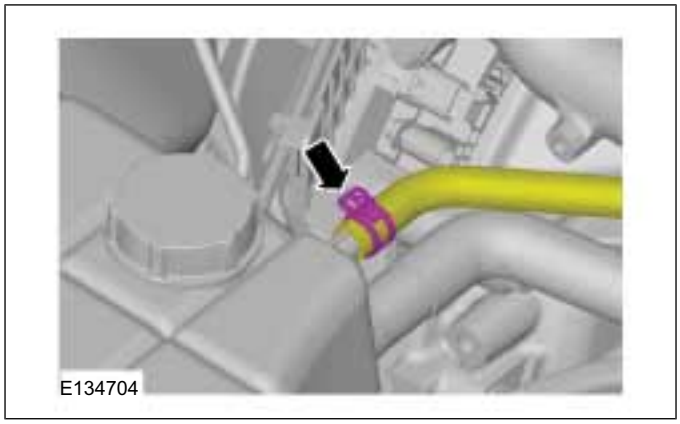
35. **CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.**

NOTE: The washers can be reused unless damaged.

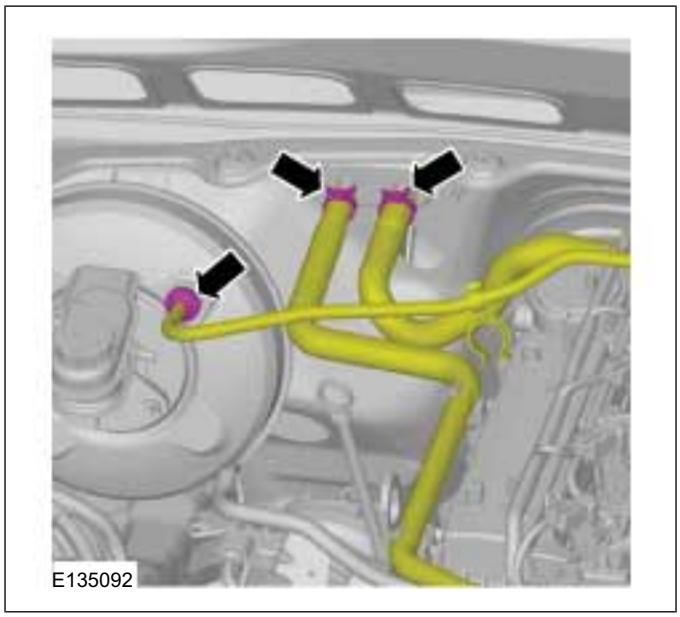


E135088

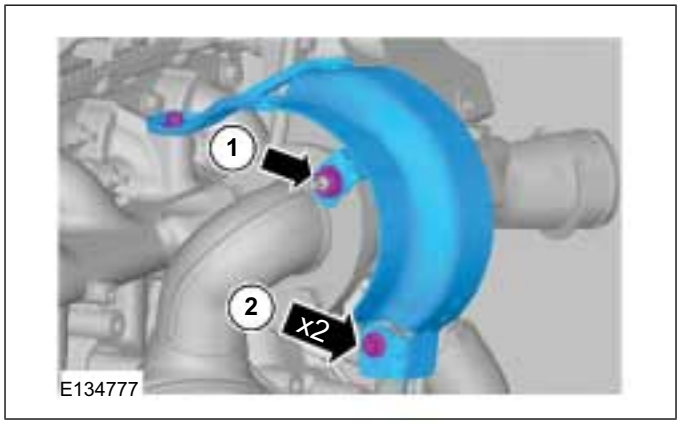
36.


E134704

37.


E135092

38.

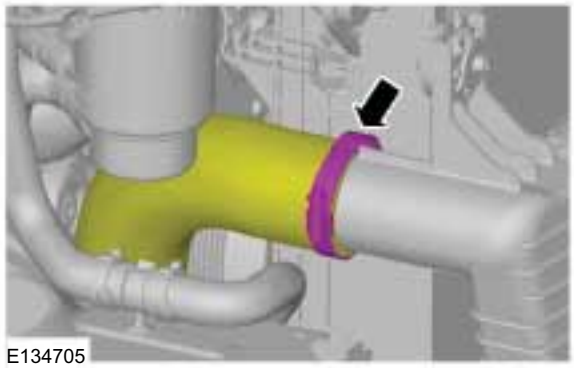


E134777

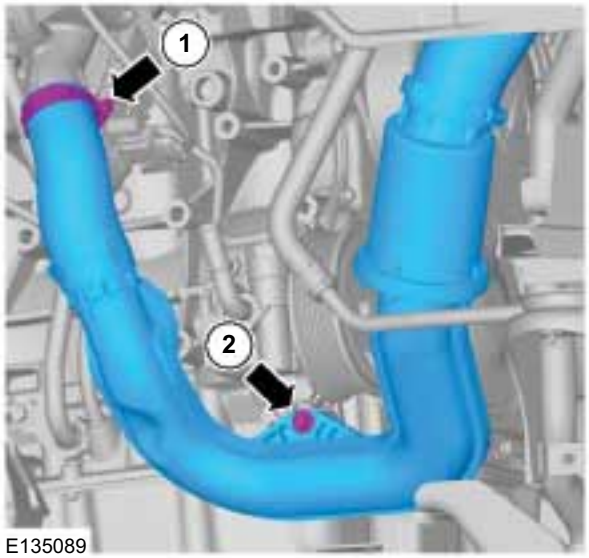
REMOVAL

39. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

40.



41.



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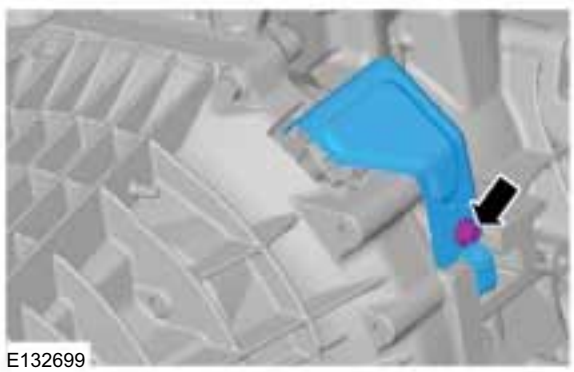

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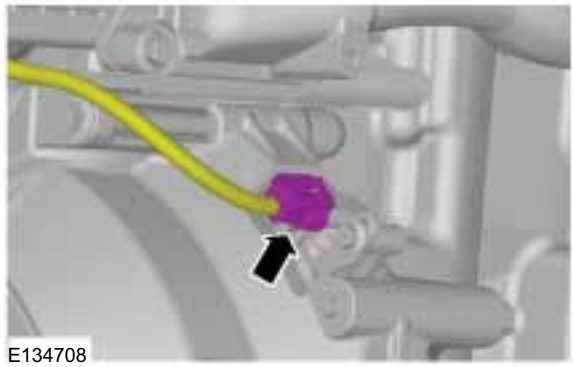

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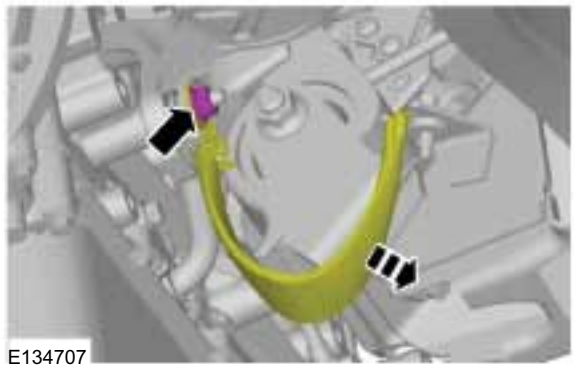


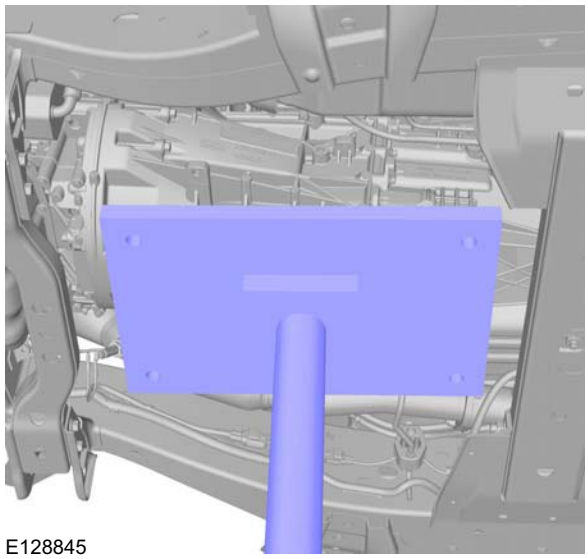
45. **WARNING: Make sure that transmission assembly is on wooden blocks and secured with suitable retaining straps.**

CAUTION: Do not tilt the transmission. This may cause damage to the pilot bearing.

REMOVAL

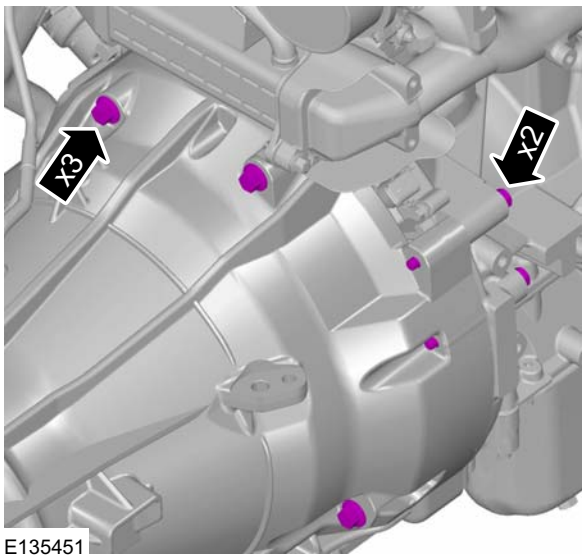
Tie and support the transmission to the chassis with a suitable strap.

General Equipment: Transmission Jack



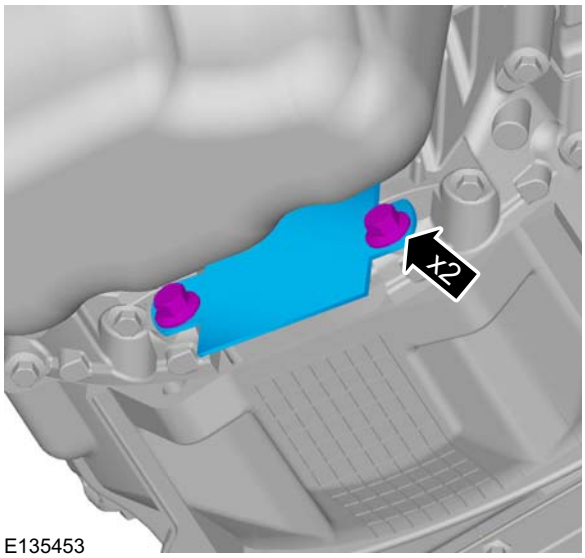
E128845

46.



E135451

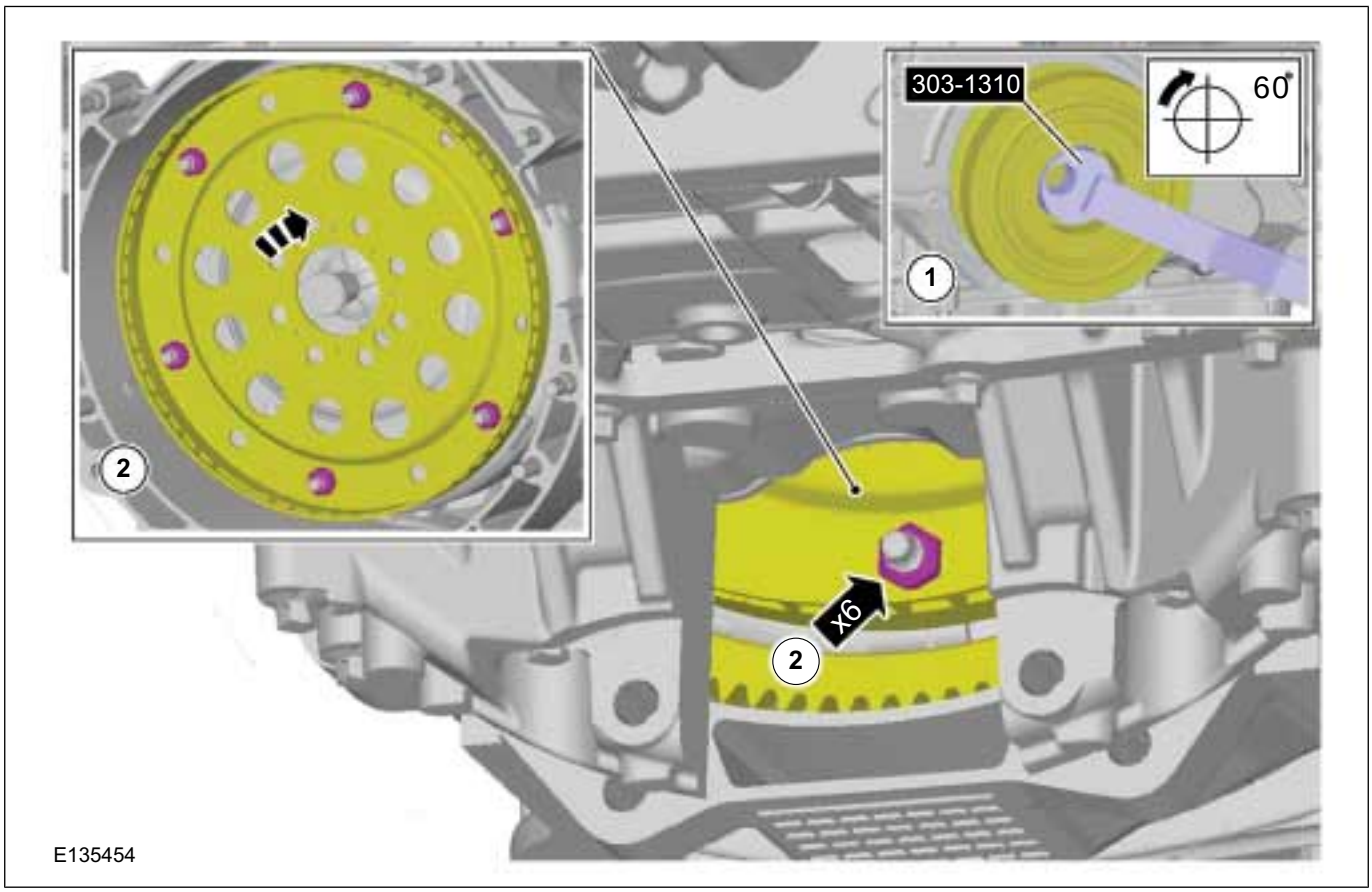
47.



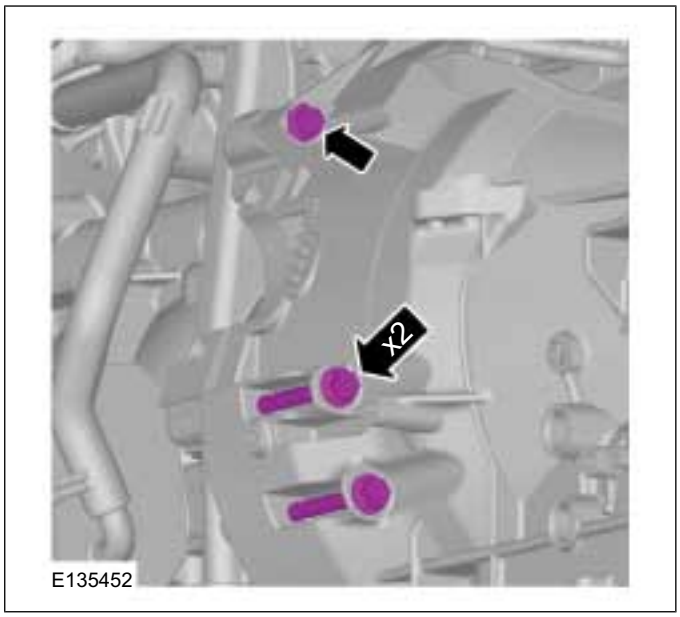
E135453

48.

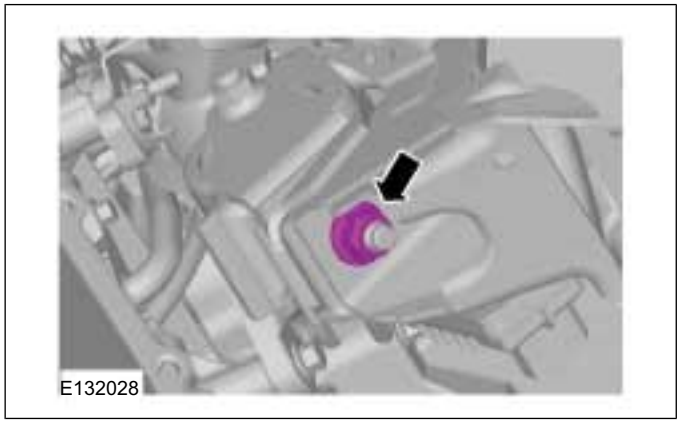
REMOVAL



49.



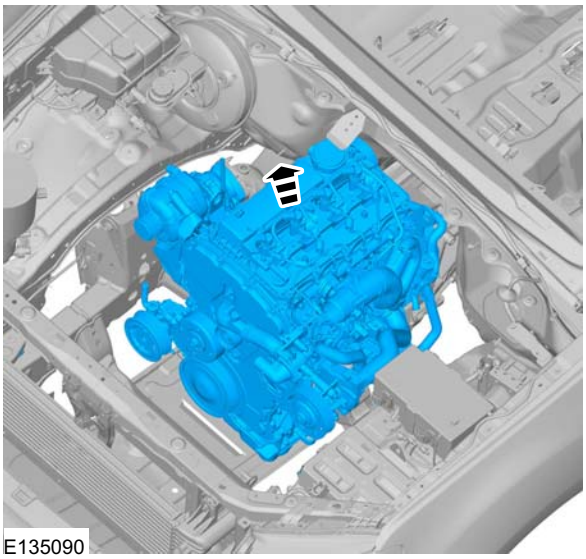
50. On both sides.



51. Special Tool(s): 303-122

REMOVAL

52.



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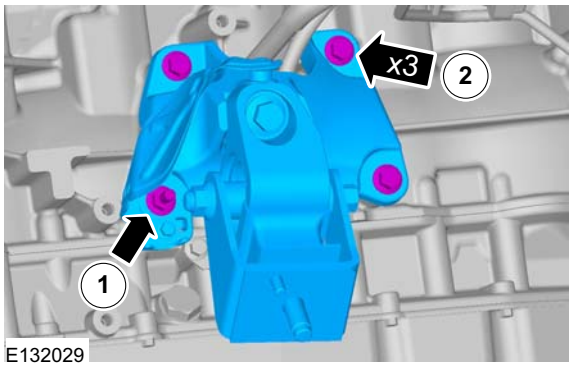
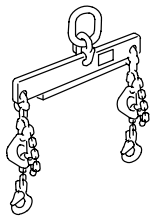
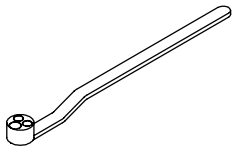
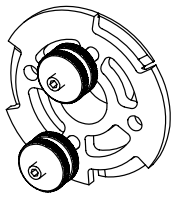
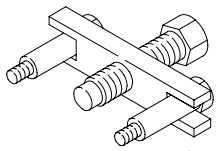
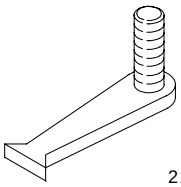
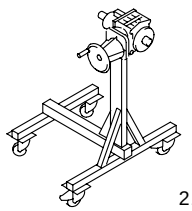


REMOVAL

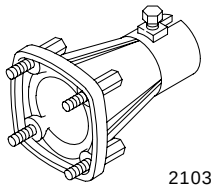
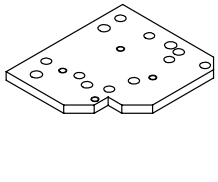
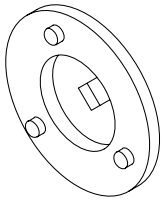
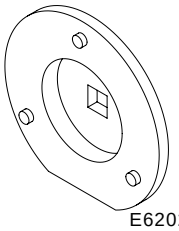
Engine Accessories(21 139 4)

Removal

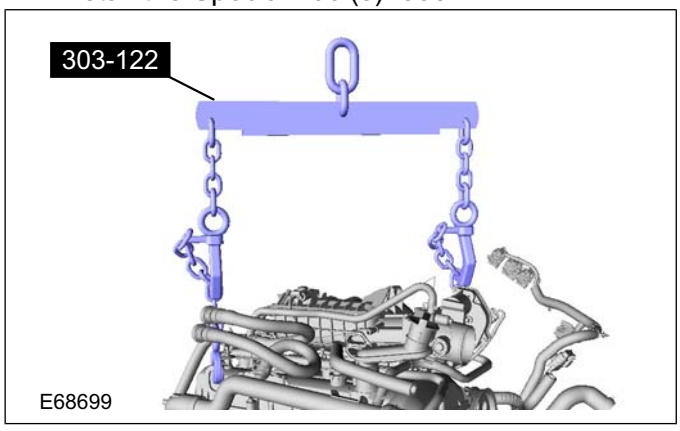
Special Tool(s) / General Equipment

 21068A	303-122 Lifting Bracket, Engine
 E87614	303-1310 Holding Wrench, Crankshaft
 E75376	303-1317 Locking Tool, Fuel Injection Pump Sprocket
 21132	303-249 Remover, Crankshaft Timing Pulley
 21135	303-254 Locking Tool, Flywheel
 21187	303-435 Mounting Stand

Special Tool(s) / General Equipment

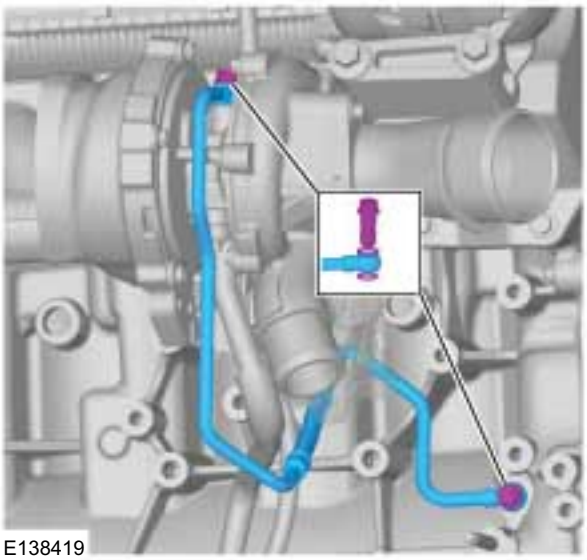
 21031B	303-435-06 Mounting Bracket for 303-435
 E68386	303-435-11B Mounting Plate for 303-435-06
	303-679 Remover/Installer, Engine Front Cover Inspection Plate
 E62024	303-679A Remover/Installer, Engine Front Cover Inspection Plate
1/2 Inch Square Drive Breaker Bar	
Dowel with a Diameter of 6 mm	

1. Install the Special Tool(s): 303-122

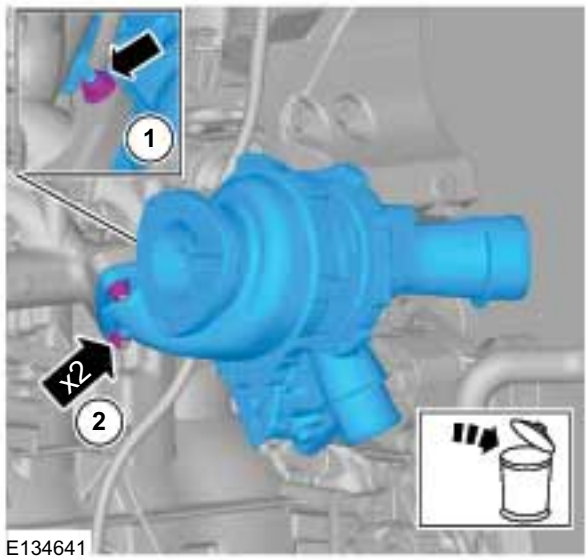


REMOVAL

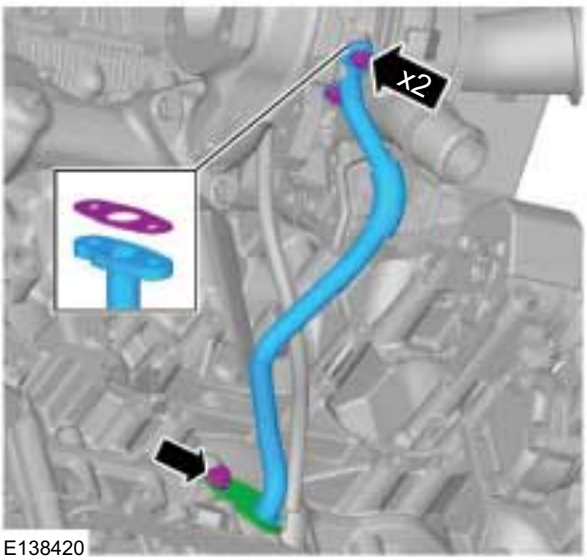
2.



5.



3.



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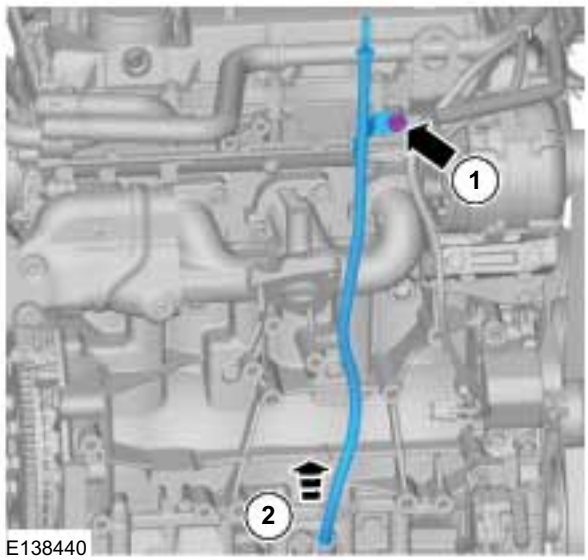

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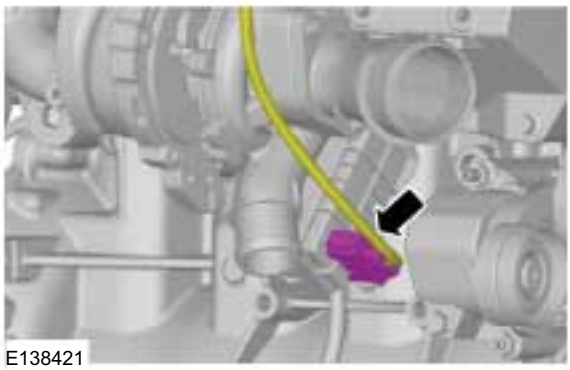
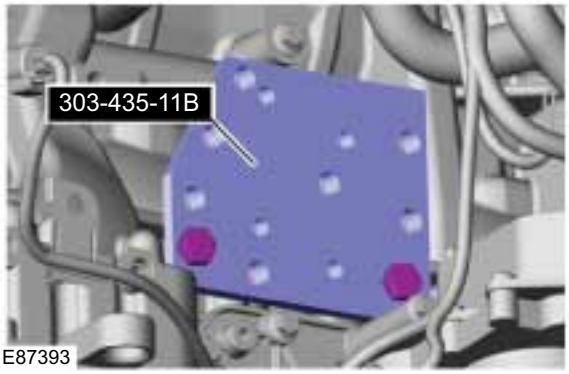
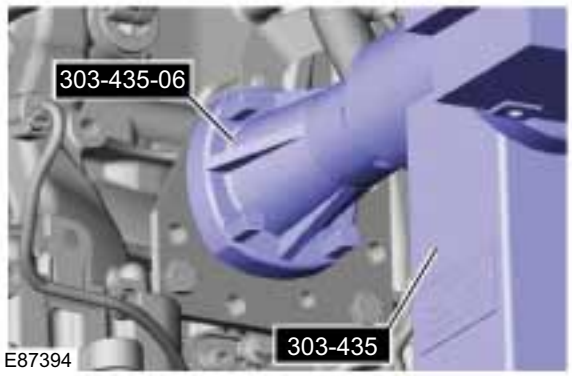


7. Install the Special Tool(s): 303-435-11B



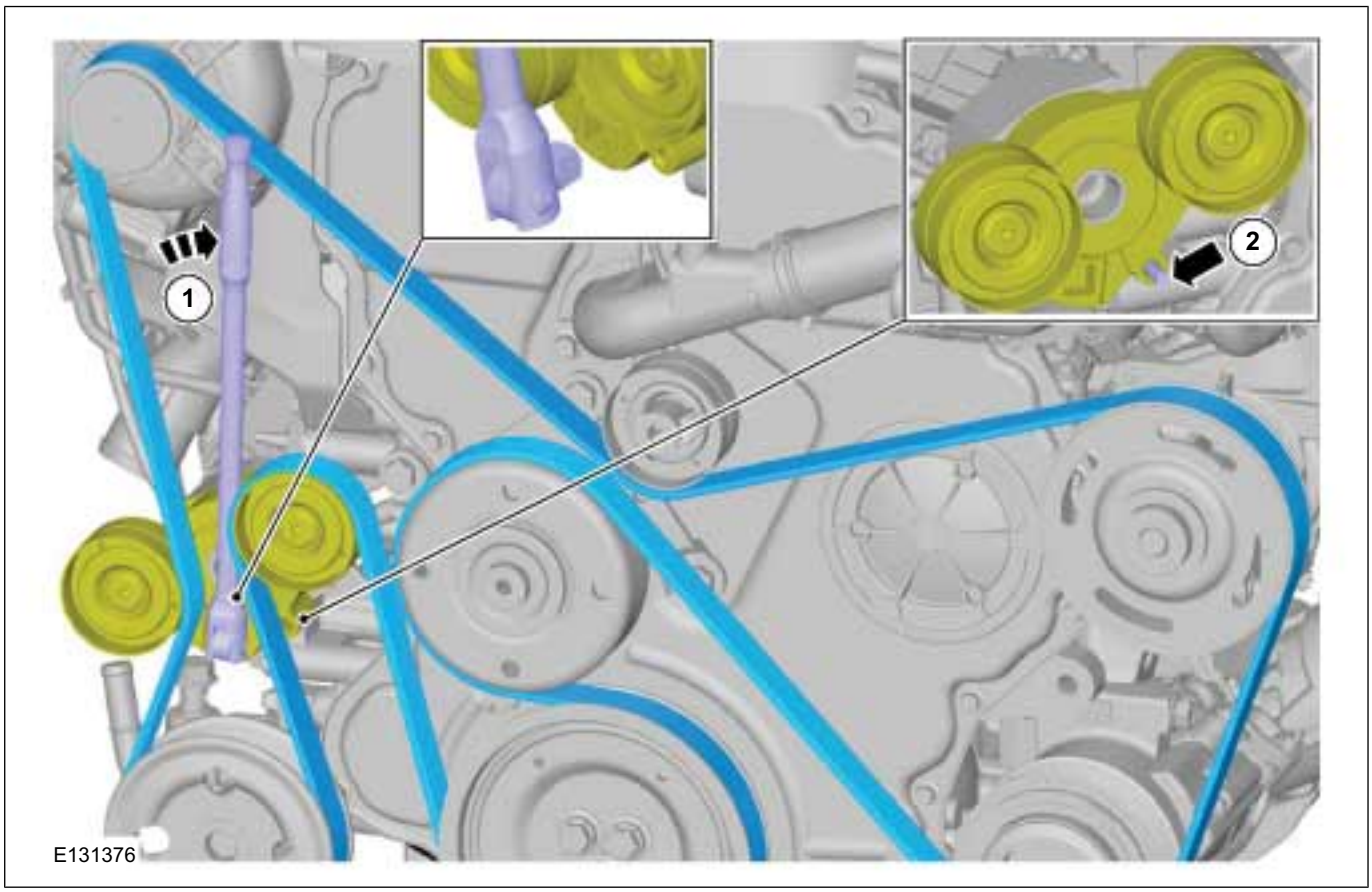
REMOVAL

8. Install the Special Tool(s): 303-435, 303-435-06



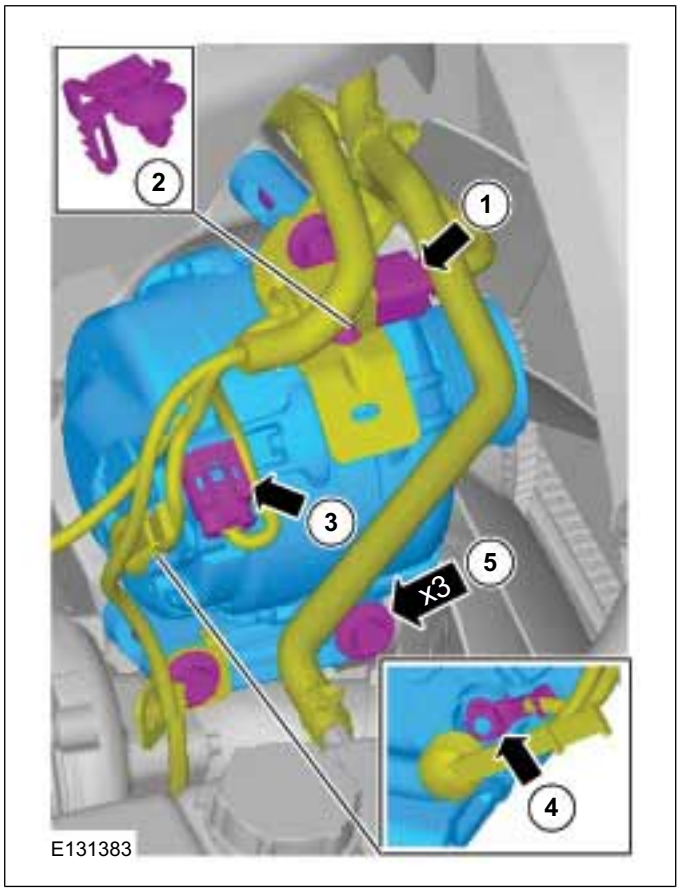
9. Remove the Special Tool(s): 303-122

10. General Equipment: 1/2 Inch Square Drive Breaker Bar
General Equipment: Dowel with a Diameter of 6 mm

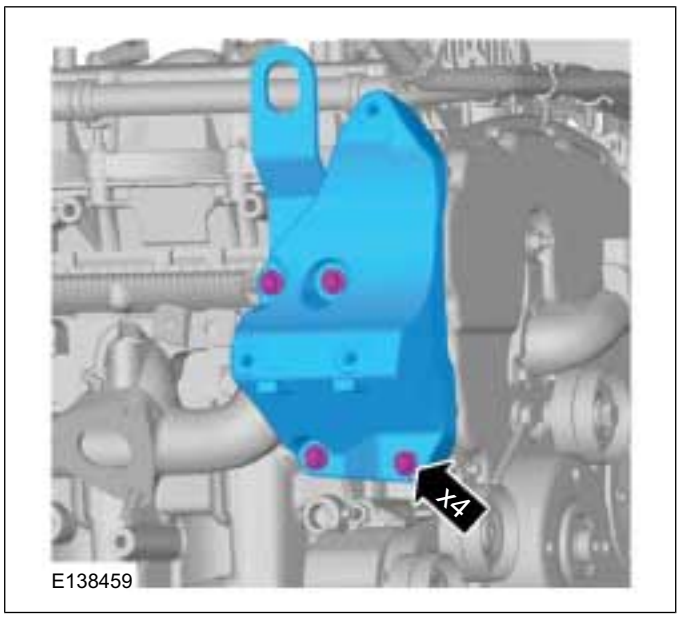


REMOVAL

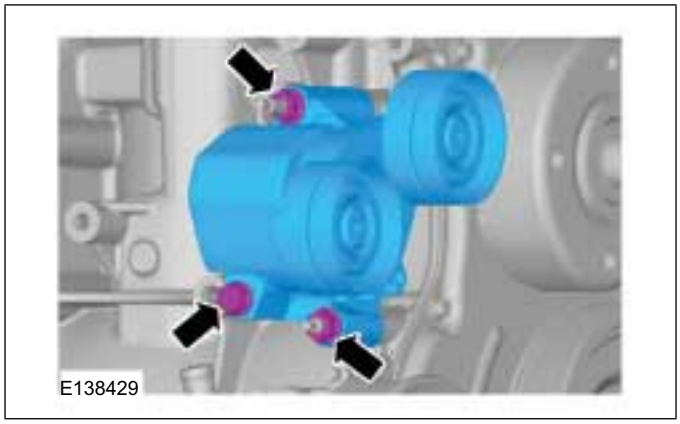
11. ⚠ **CAUTION: Take extra care not to damage the wiring harnesses.**



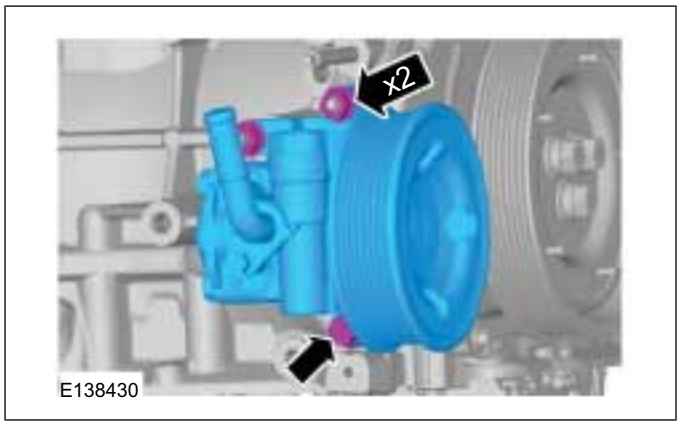
12.



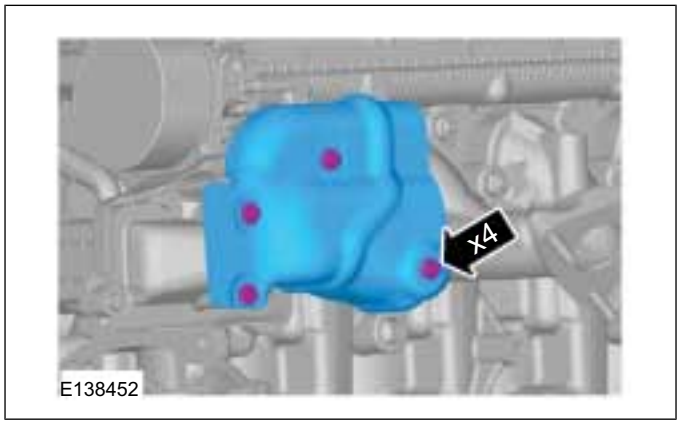
13.



14.

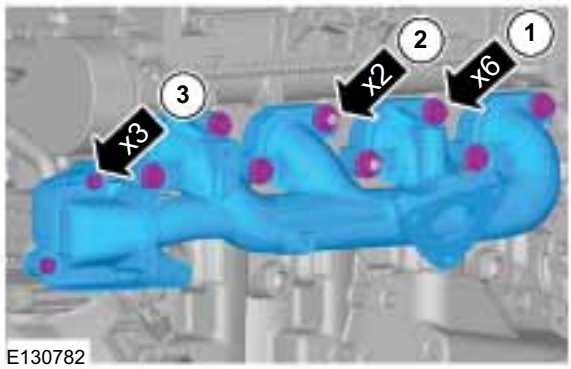


15.



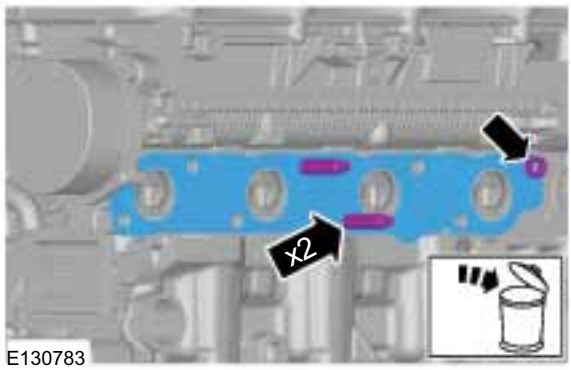
REMOVAL

16.

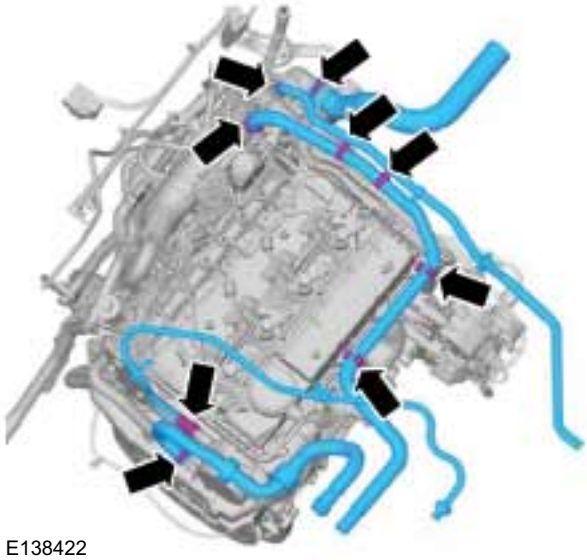


17. **NOTE:** The gasket is to be reused unless damaged.

NOTE: The studs are to be reused unless damaged.

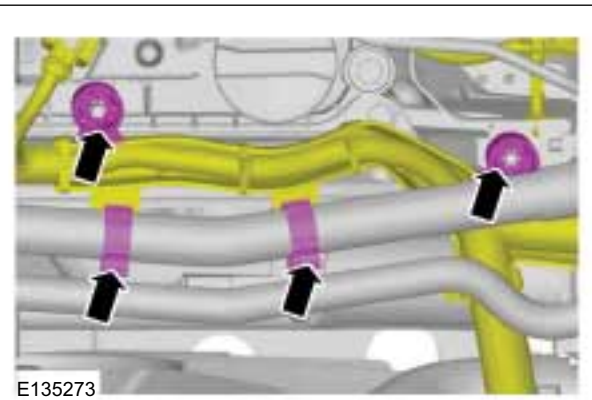


18.



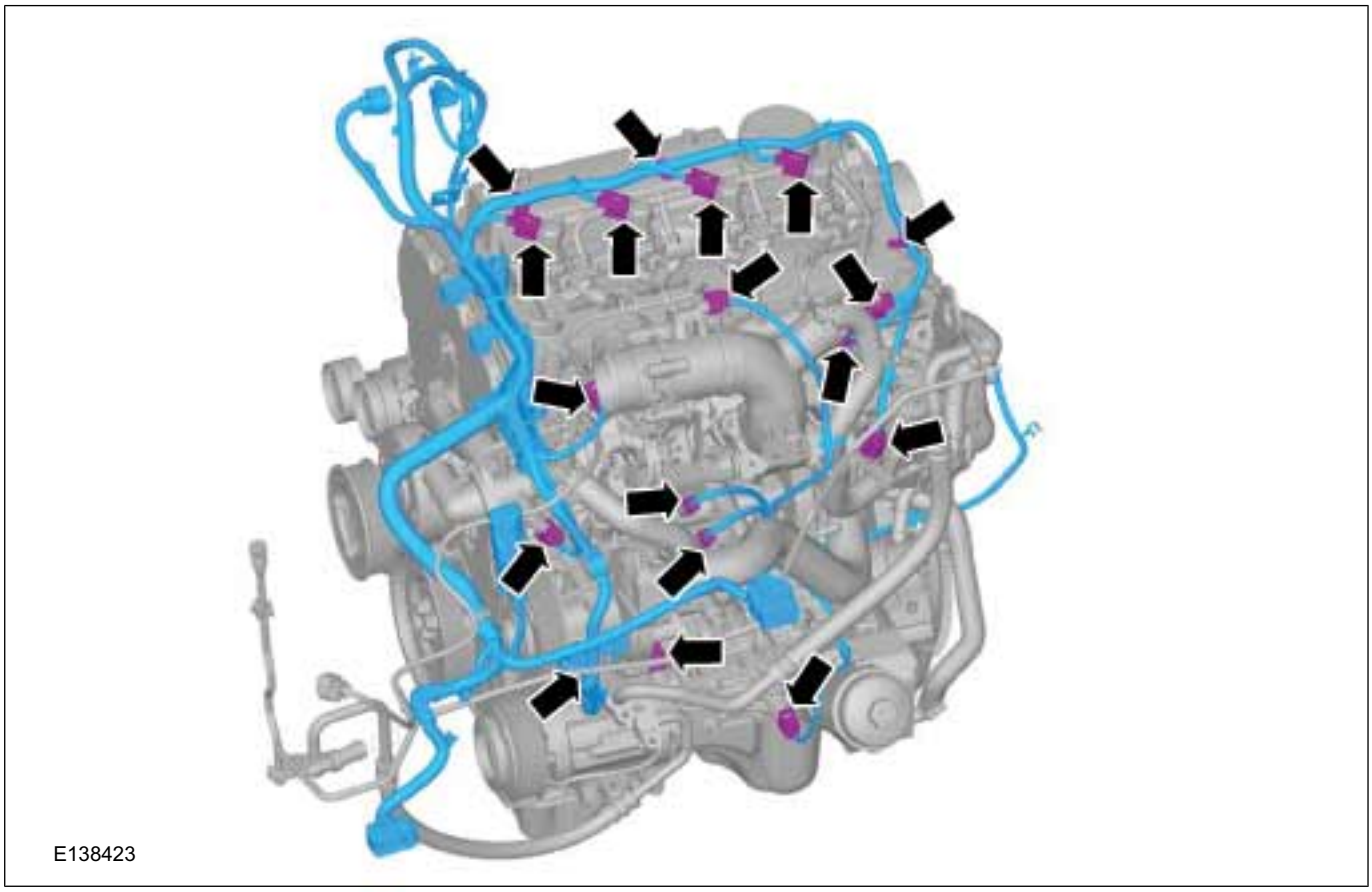
19.

20.

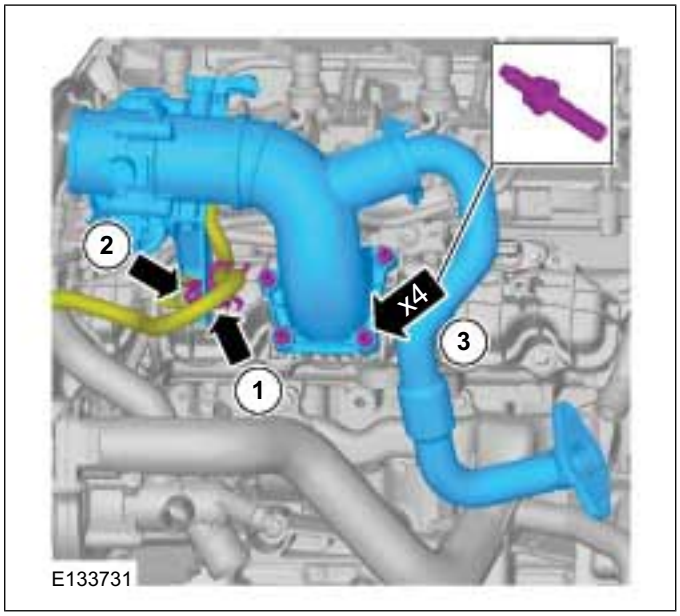


21.

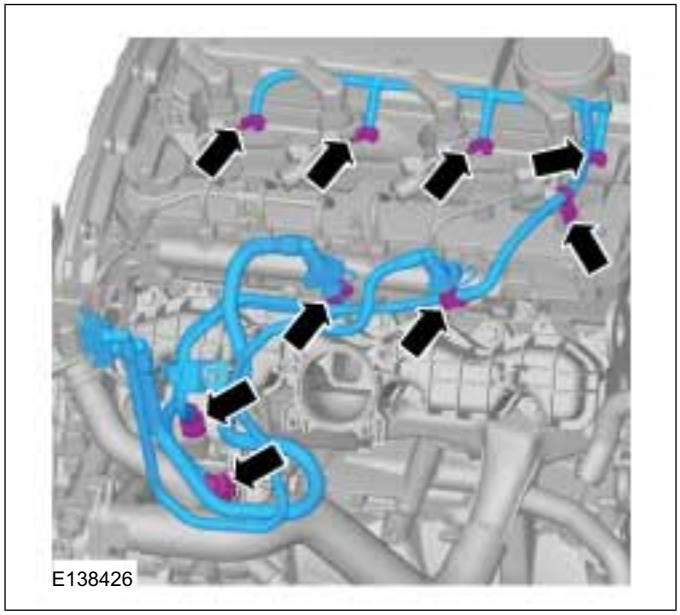
REMOVAL



22.

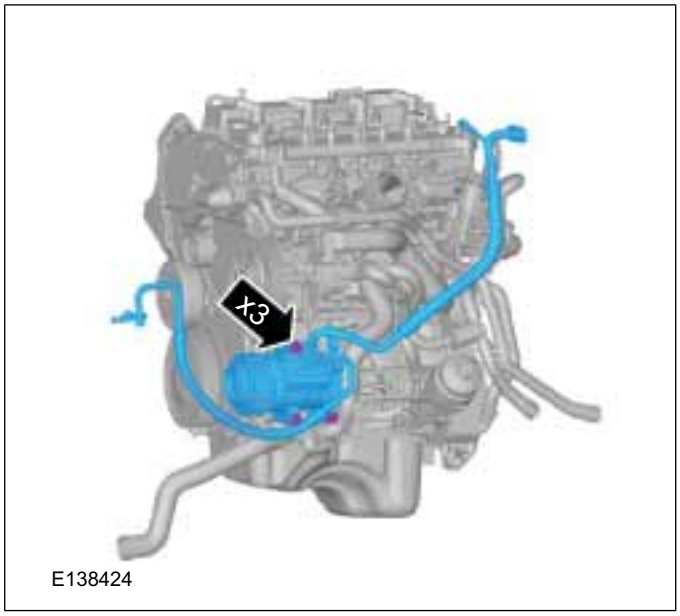


23. ⚠ **CAUTION: Make sure that all openings are sealed. Use new blanking caps.**



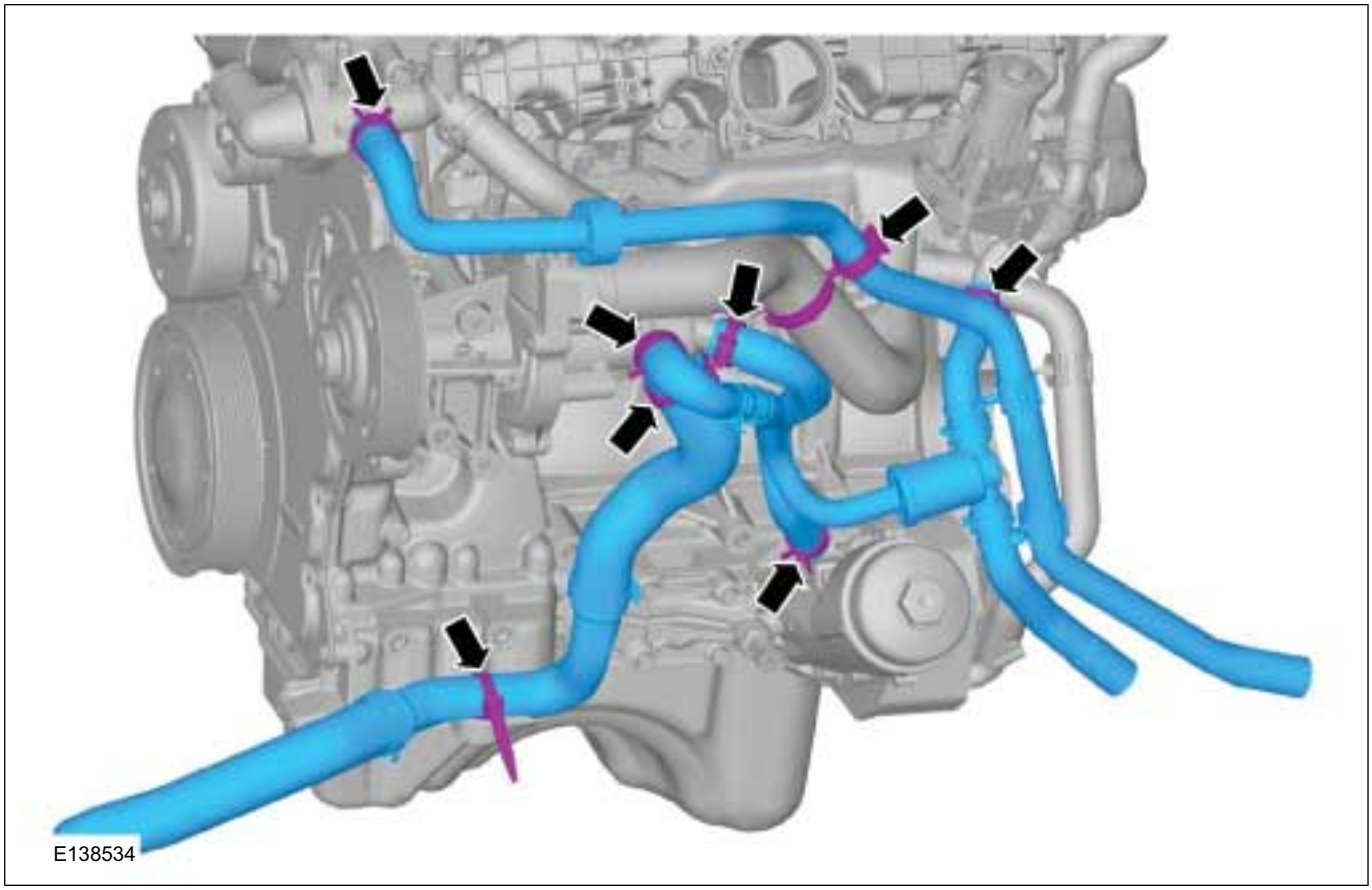
REMOVAL

24.



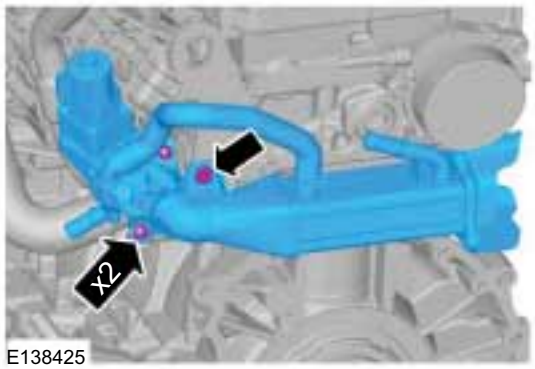
E138424

25.

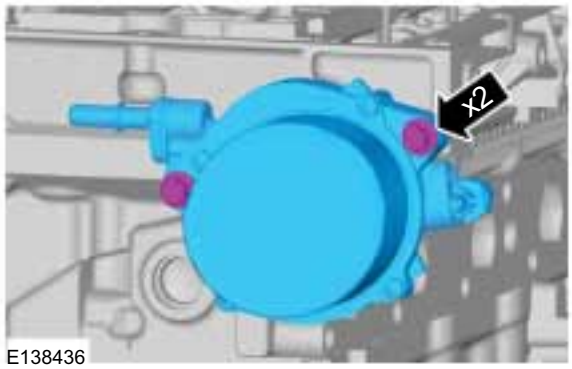

E138534

REMOVAL

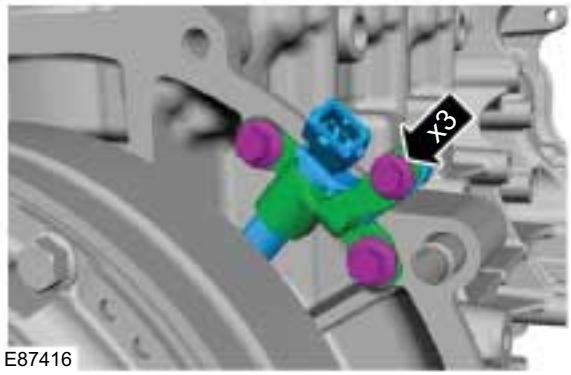
26.



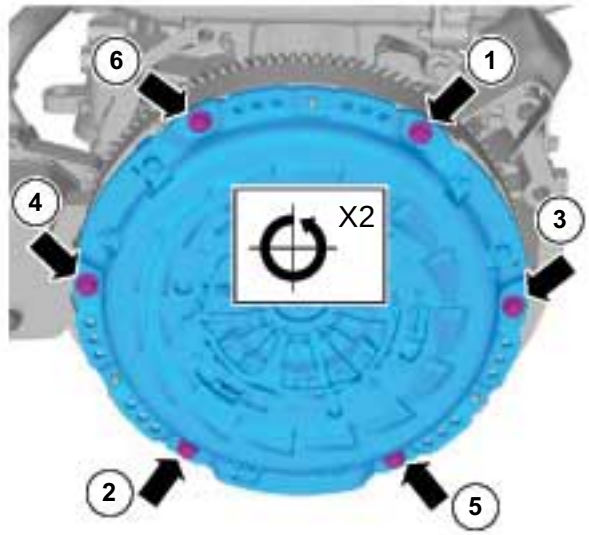
27.



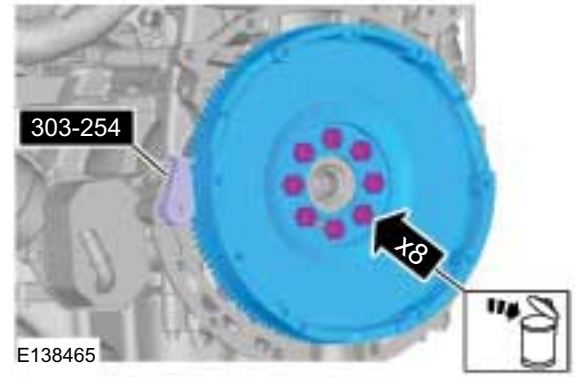
28.



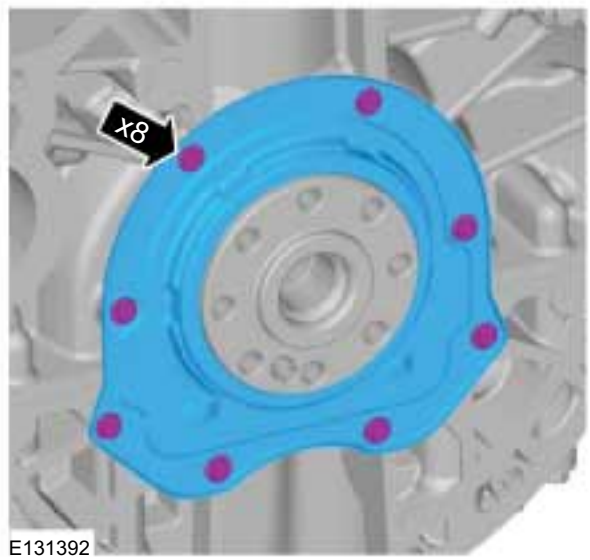
29. NOTE: Do not loosen the bolts more than 2 turns.



30. Special Tool(s): 303-254

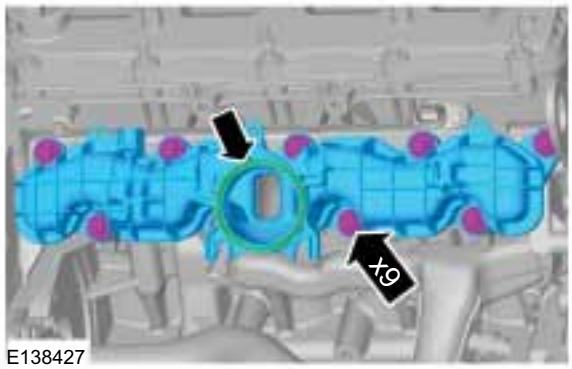


31.

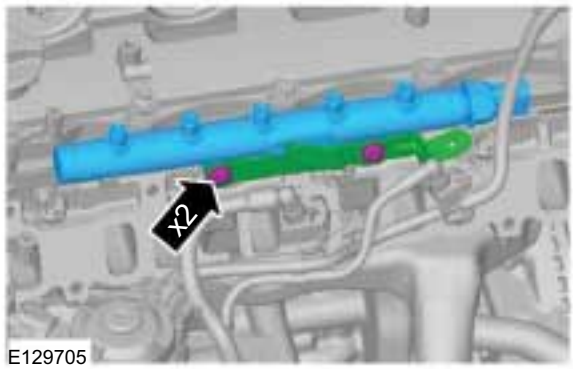


REMOVAL

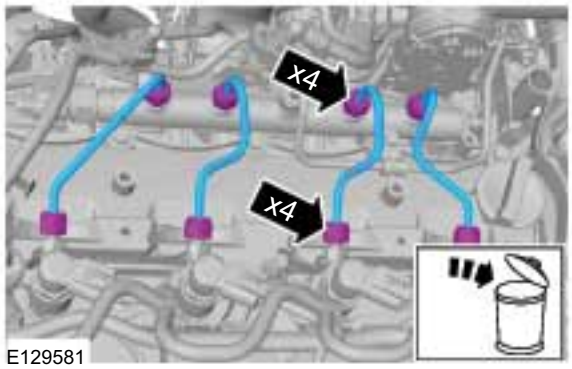
32.



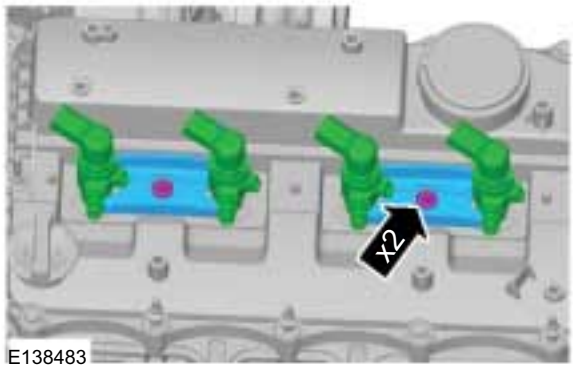
35.



33.

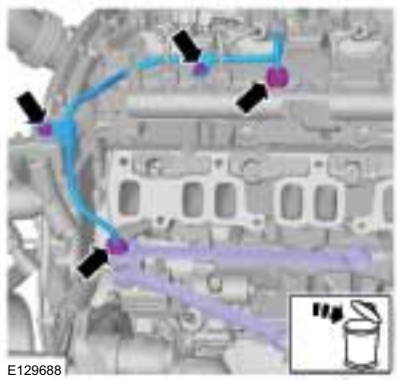


36.



34. CAUTIONS:

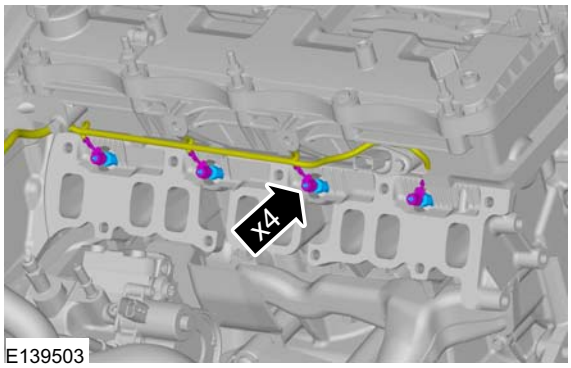
- **Make sure that the fuel line remains in contact at both ends until both unions nuts have been unscrewed and the area around the joints thoroughly cleaned.**
- **Make sure that the high-pressure fuel supply line remains in contact with both the fuel pump and the fuel rail until both unions have been detached and cleaned.**
- **Make sure that all openings are sealed. Use new blanking caps.**



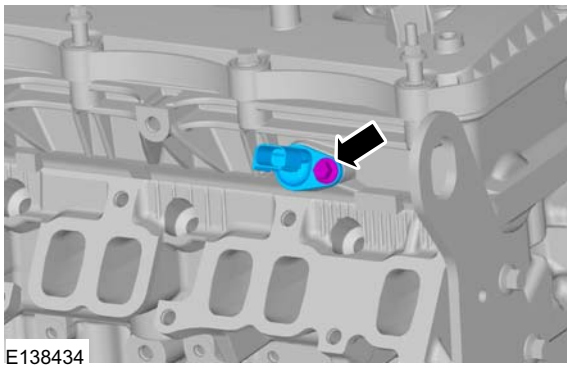
37.

REMOVAL

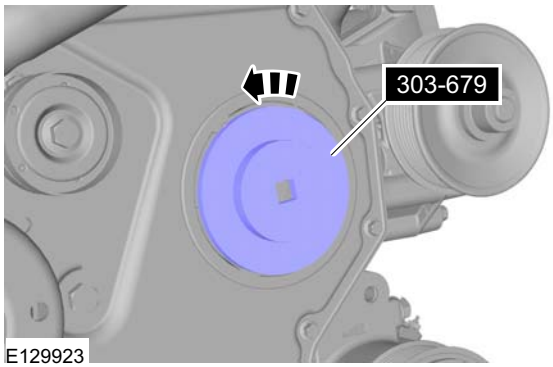
38.



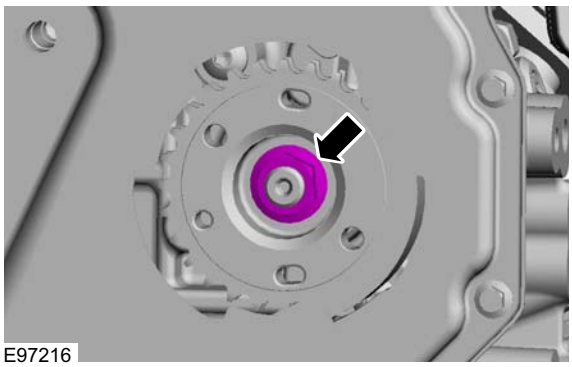
39.



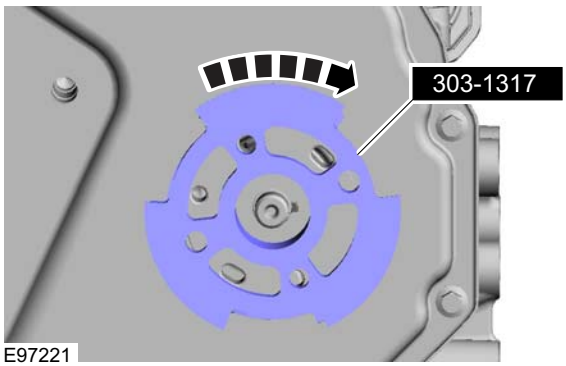
40. Special Tool(s): 303-679



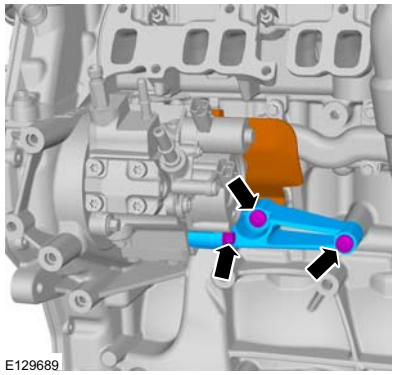
41.



42. Install the Special Tool(s): 303-1317

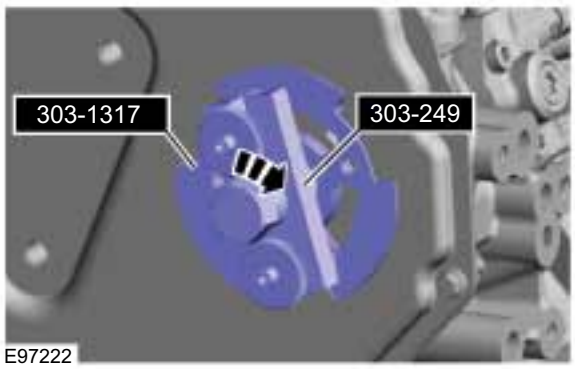


43.



REMOVAL

44. Special Tool(s): 303-1317, 303-249



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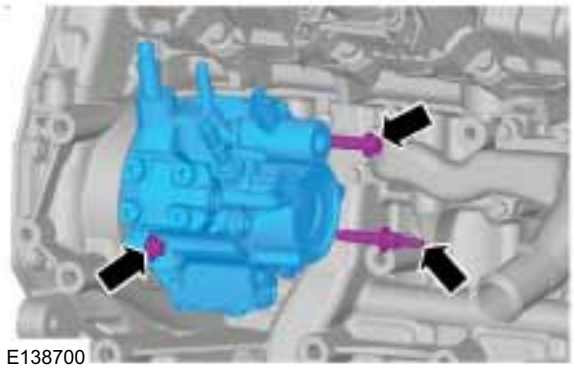

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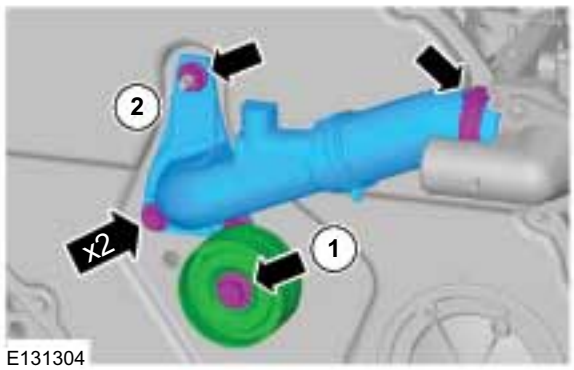

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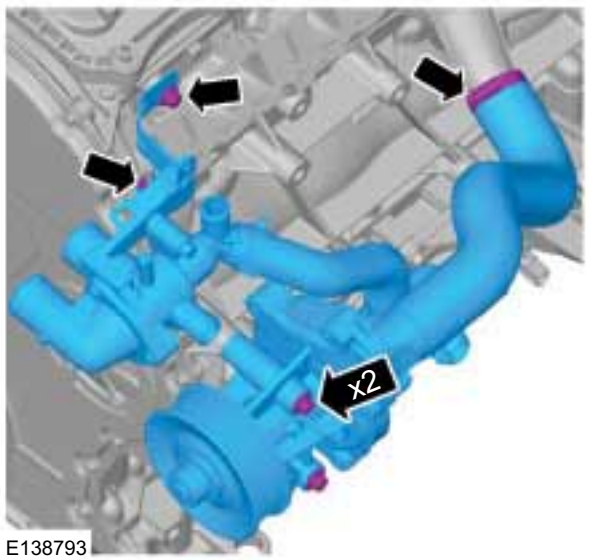

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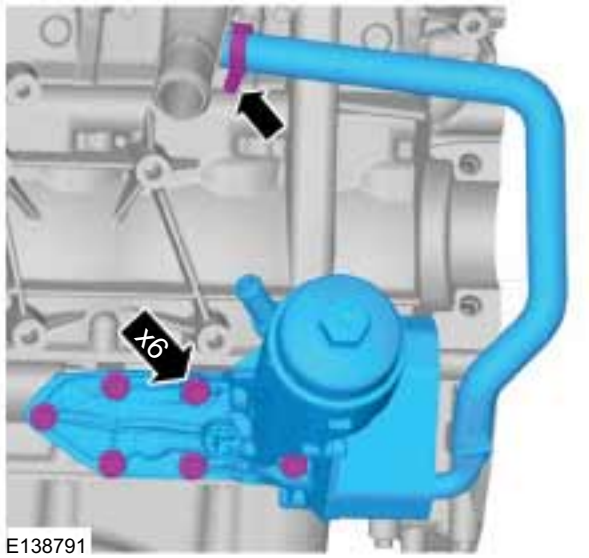
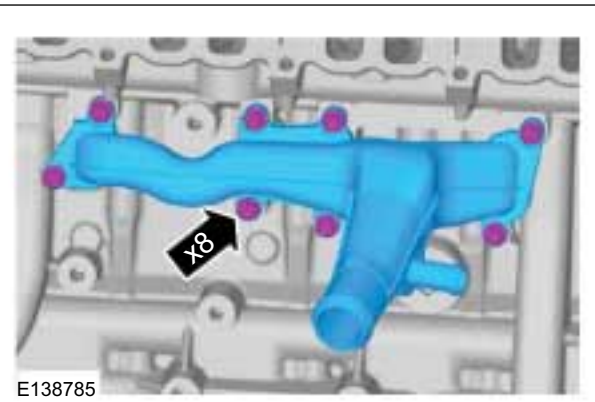
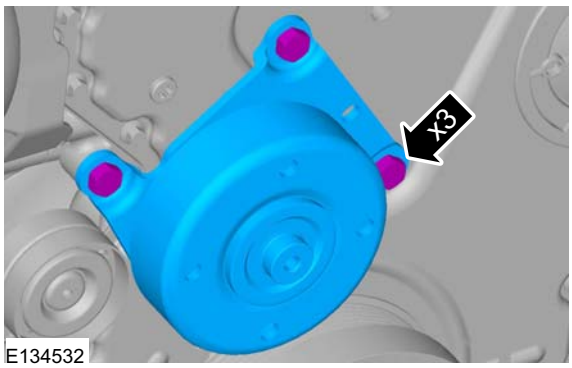


49.

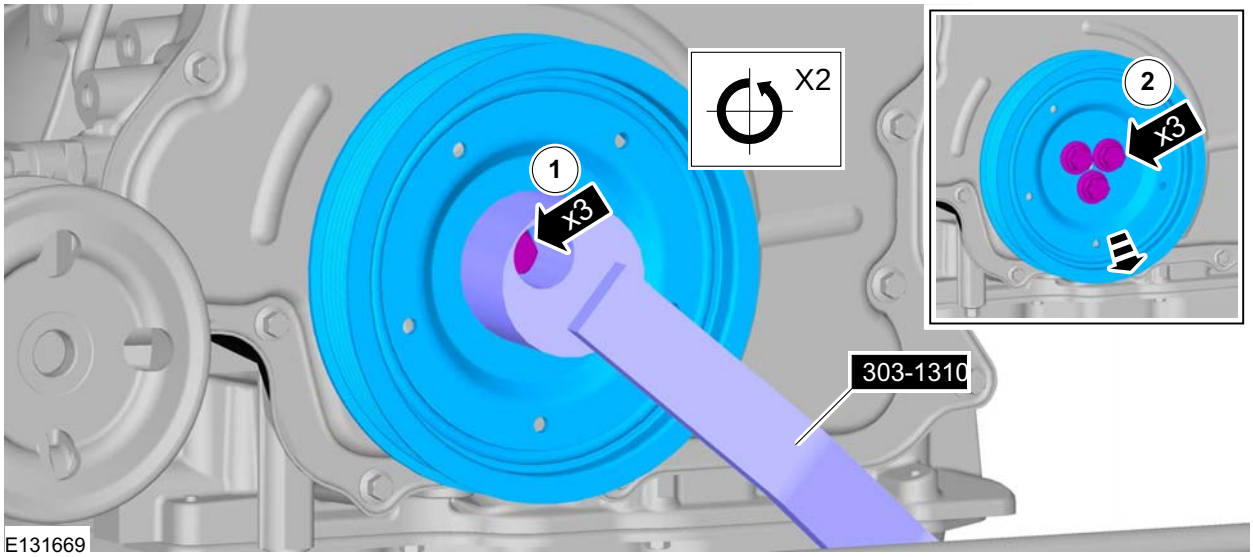


REMOVAL

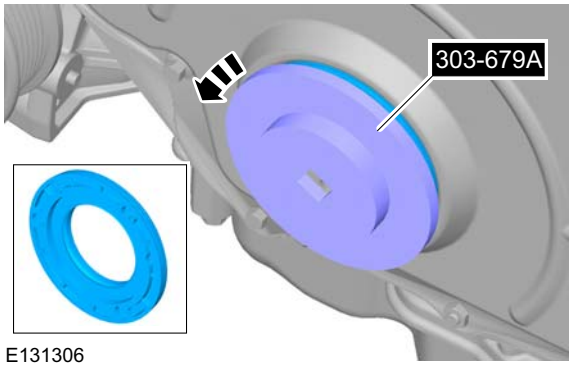
50.



51. Special Tool(s): 303-1310



52. Special Tool(s): 303-679A

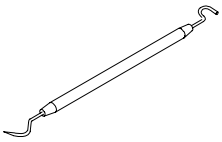
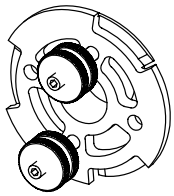
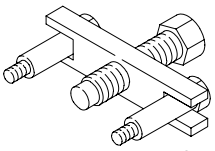
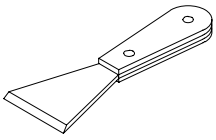
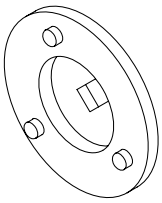


DISASSEMBLY

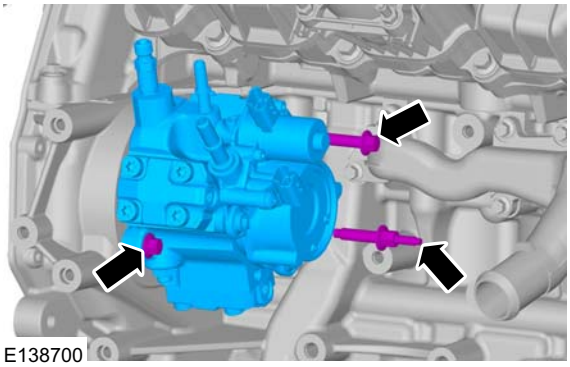
Engine(21 134 8)

Disassembly

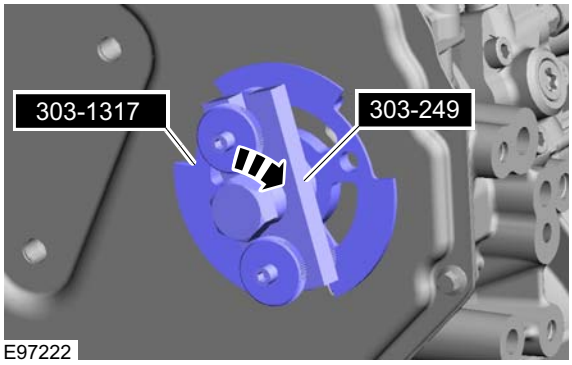
Special Tool(s) / General Equipment

 17063	100-010 Remover, O-Ring Seal
 E75376	303-1317 Locking Tool, Fuel Injection Pump Sprocket
 21132	303-249 Remover, Crankshaft Timing Pulley
 21179	303-428 Separator, Oil Pan
 303679	303-679 Remover/Installer, Engine Front Cover Inspection Plate
2 mm Punch	

1. Torque: 25 Nm

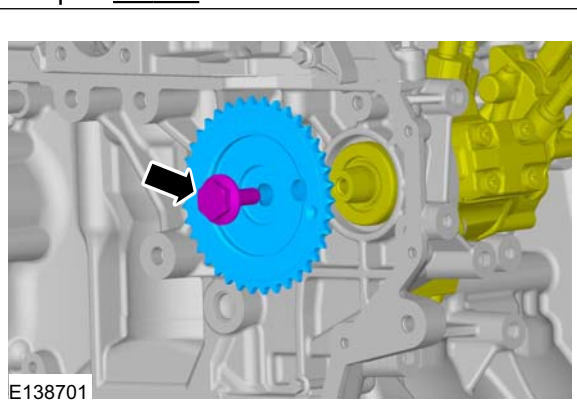


2. Remove the Special Tool(s): 303-249



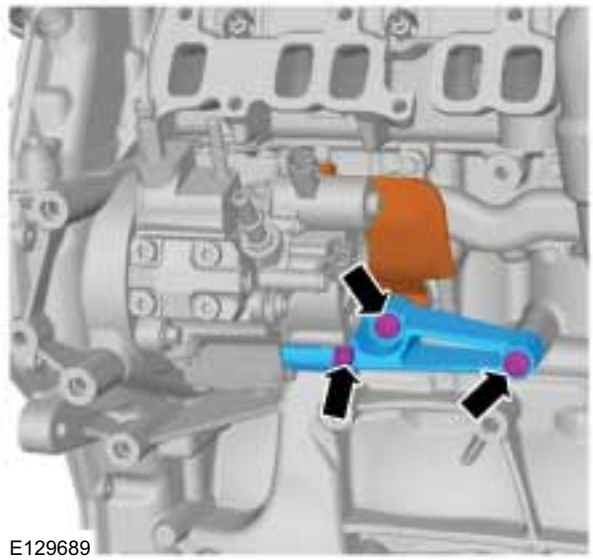
3. **NOTE:** Make sure that a new component is installed.

   Torque: 45 Nm

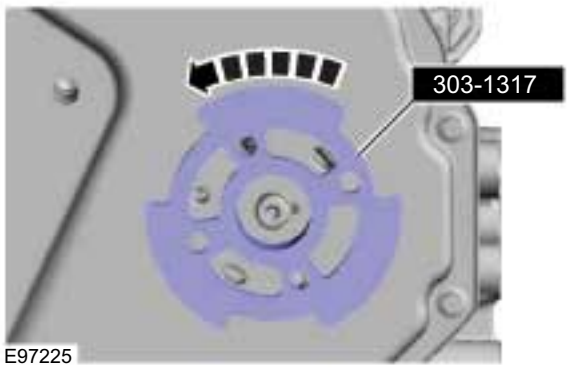


DISASSEMBLY

4. Torque: 22 Nm


E129689

5. Remove the Special Tool(s): 303-1317

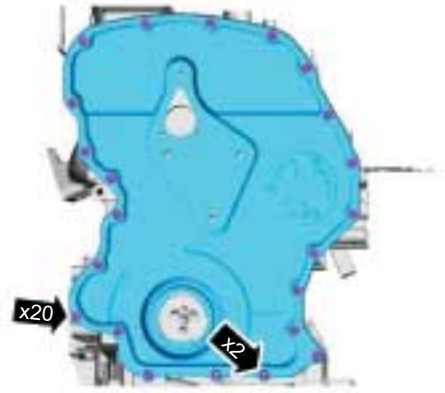


E97225

6. Remove the Special Tool(s): 303-679

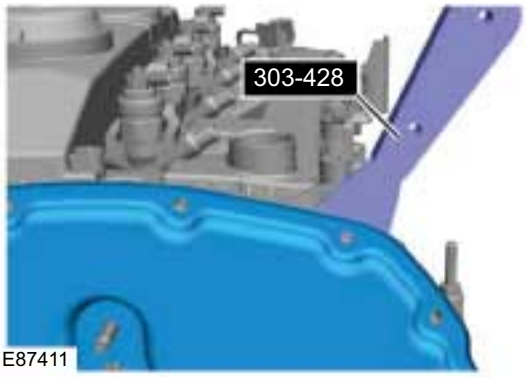
E73839

7.



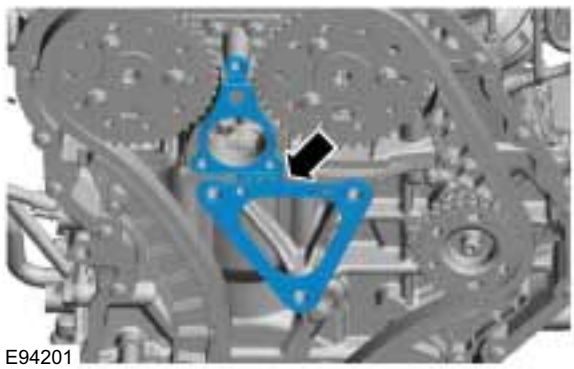
E75620

8. Special Tool(s): 303-428



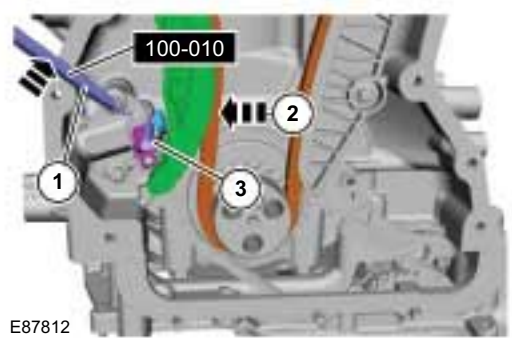
E87411

9.


E94201

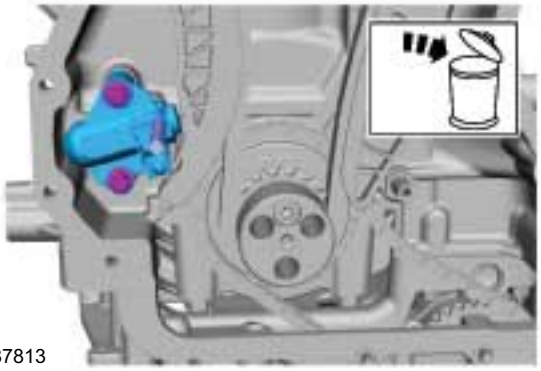
DISASSEMBLY

10. Special Tool(s): 100-010
General Equipment: 2 mm Punch

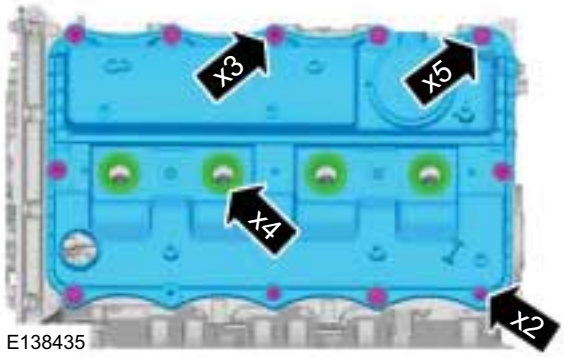


E87812

11. Remove and discard the timing chain tensioner.
General Equipment: 2 mm Punch

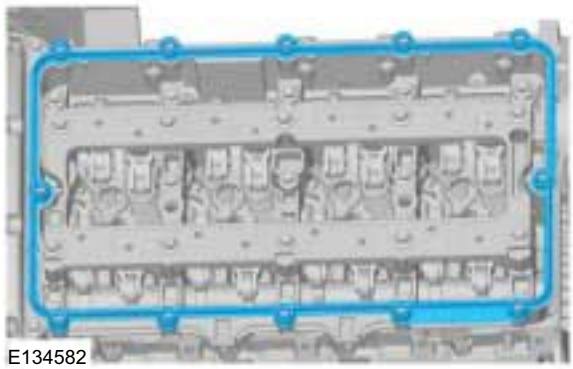

E87813

12.



E138435

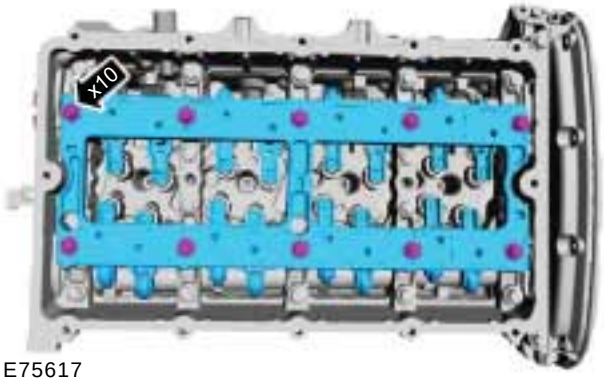
13.


E134582

14.

E95464

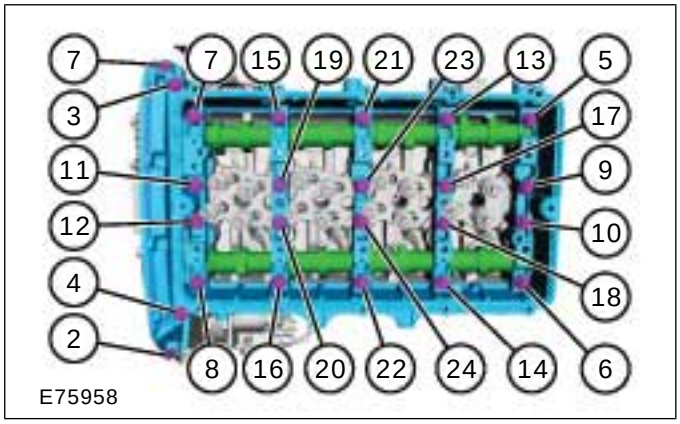
15.



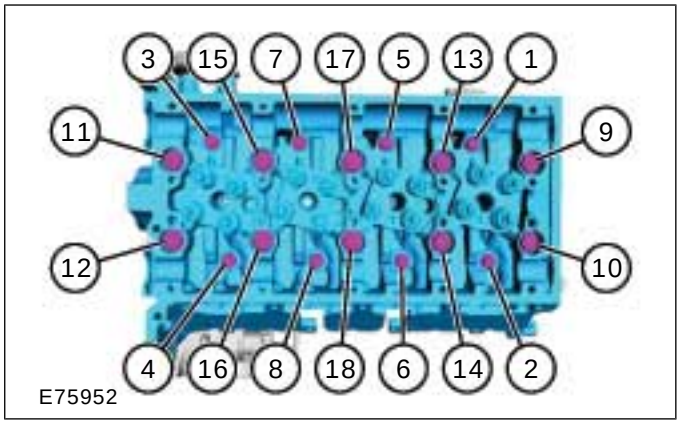
E75617

DISASSEMBLY

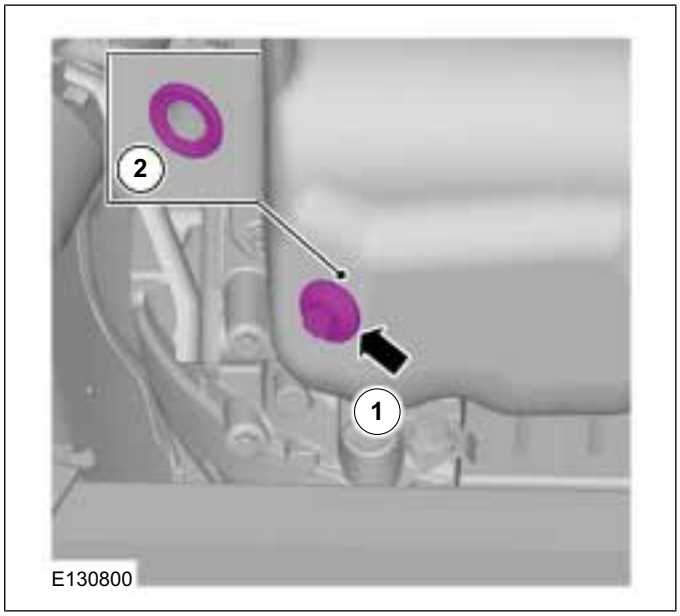
16.



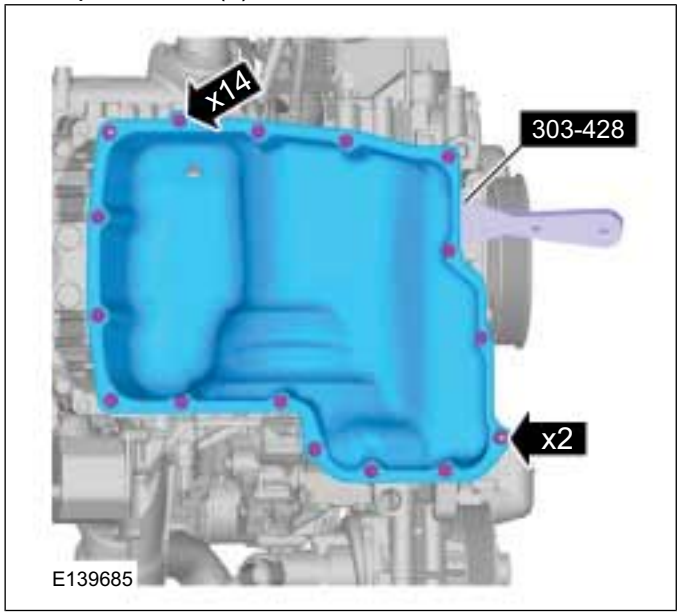
17.



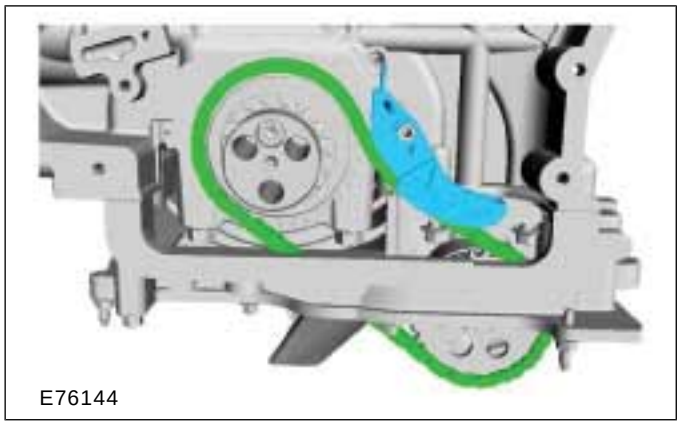
18. **WARNING: Be prepared to collect escaping fluid.**



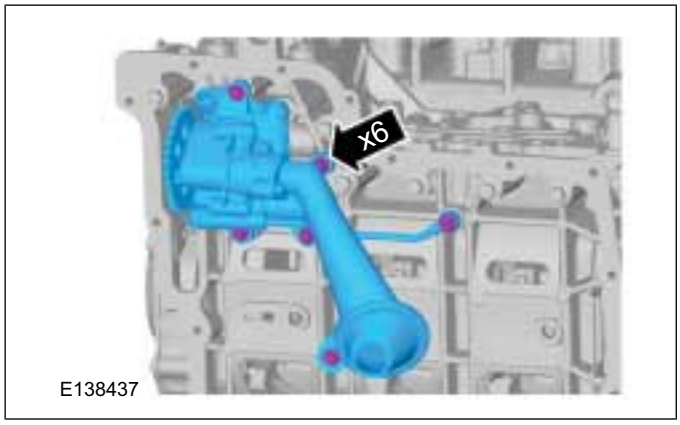
19. Special Tool(s): 303-428



20.

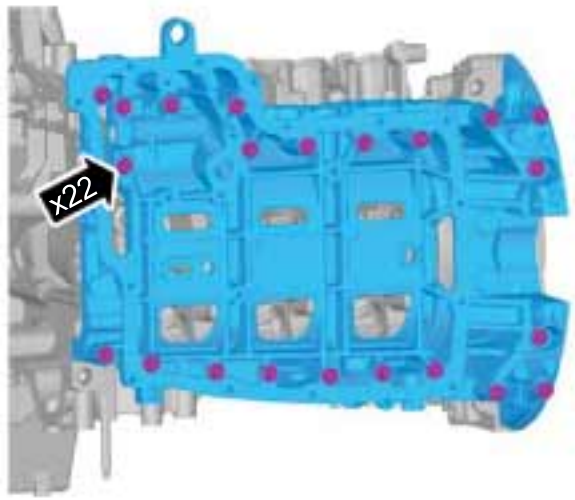


21.



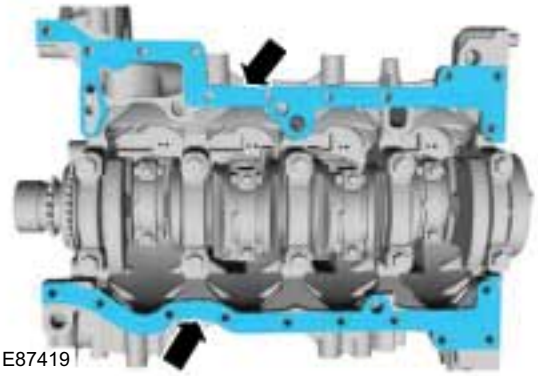
DISASSEMBLY

22.

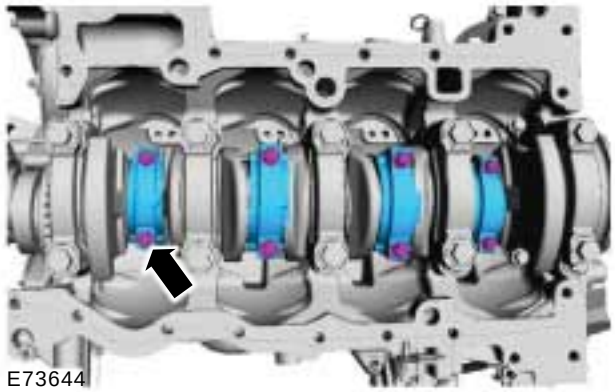


E138703

23.


E87419

24. **NOTE:** Note the position of each component before removal.


E73644

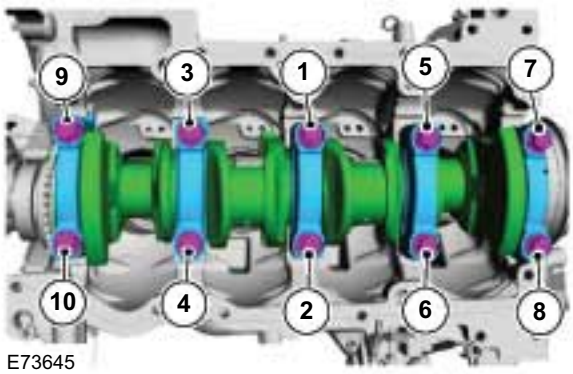
25. **NOTE:** Note the position of each component before removal.


E77286

26.


E76386

27. **NOTE:** Note the position of each component before removal.



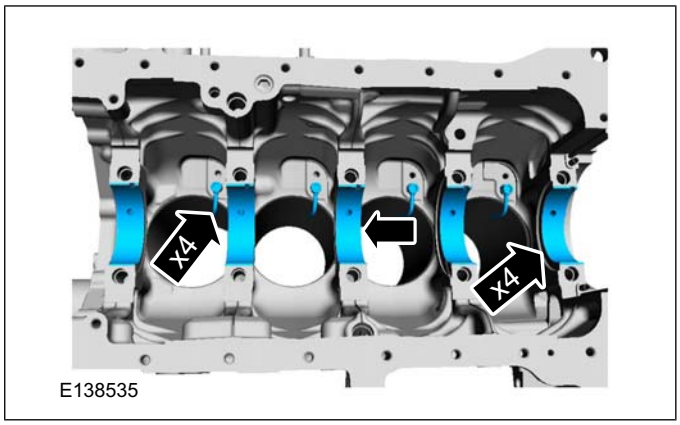
E73645

DISASSEMBLY

28. **NOTE:** Note the position of each component before removal.


E77266

29. **NOTE:** Note the position of each component before removal.



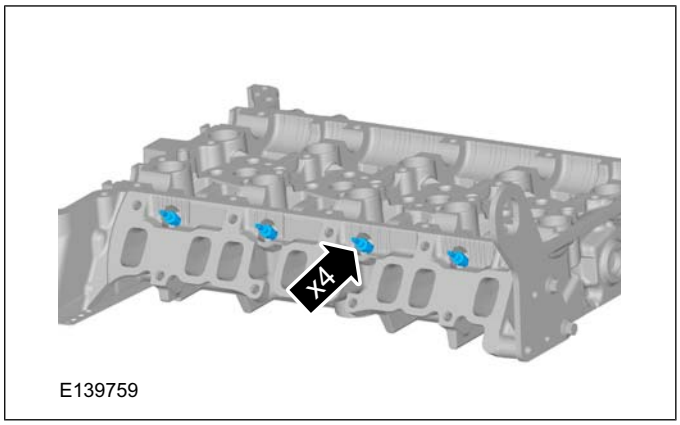
E138535

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Cylinder Head(21 165 6)

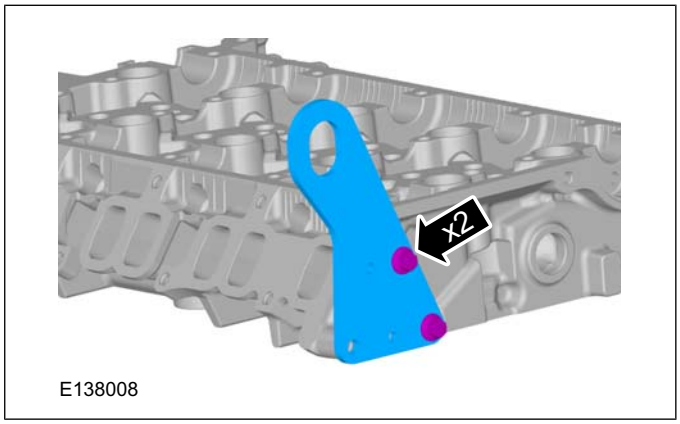
Disassembly

1. **For additional information, refer to: Valves (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).**
2. **Torque : 13 Nm**



E139759

3. **Torque : 23 Nm**



E138008

Assembly

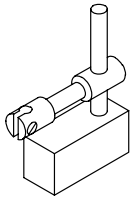
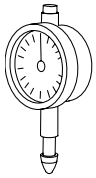
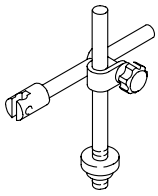
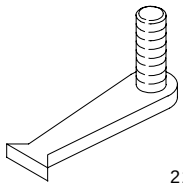
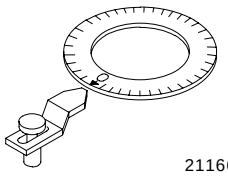
1. **To assemble, reverse the disassembly procedure.**

ASSEMBLY

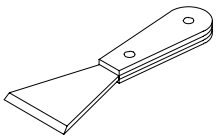
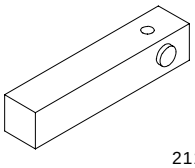
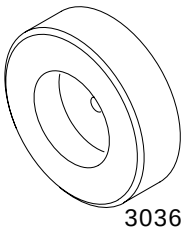
Engine(21 134 8)

Assembly

Special Tool(s) / General Equipment

 15008	205-044 Holding Fixture, Dial Indicator Gauge
 15046	205-069 Dial Indicator Gauge (Metric)
 15022A	205-070 Holding Fixture, Dial Indicator Gauge
 E131853	303-1562 Timing Tool
 21135	303-254 Locking Tool, Flywheel
 21166	303-391 Setting Gauge, Crankshaft

Special Tool(s) / General Equipment

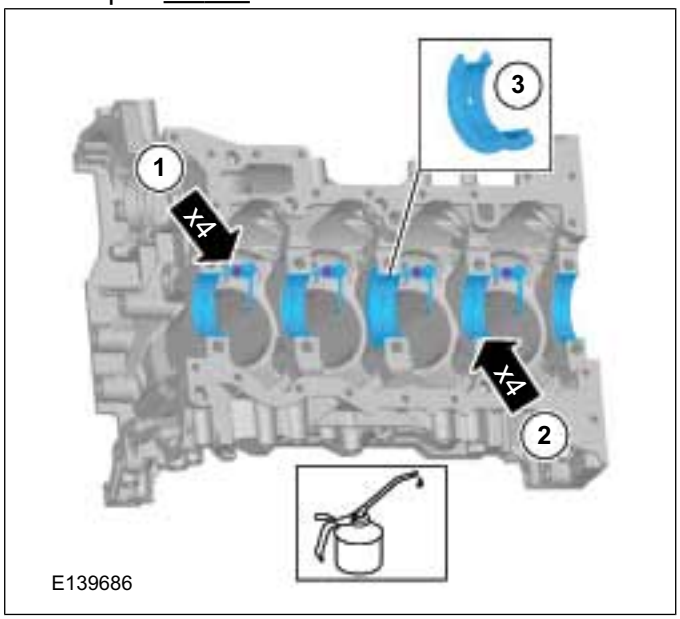
 21179	303-428 Separator, Oil Pan
 21183	303-432 Holding Fixture, Dial Indicator Gauge (Cylinder Liner Protrusion)
 303682	303-682 Aligner, Engine Front Cover
6 mm Drill Bit	
Piston Ring Compressor	
Round-Ended Steel Rule	

Materials	
Name	**Specification**
Engine Oil - 5W-30	WSS-M2C913-C
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

ASSEMBLY

1. **NOTE:** Make sure that these components are installed to the noted removal position.

   Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil
   Torque: 10 Nm



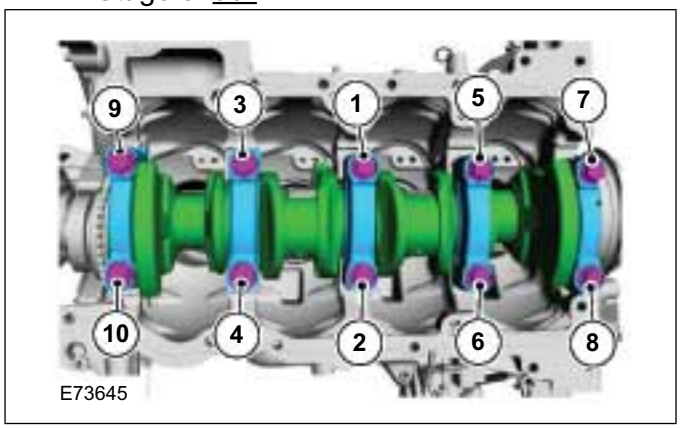
2. **NOTE:** Make sure that these components are installed to the noted removal position.

   Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil

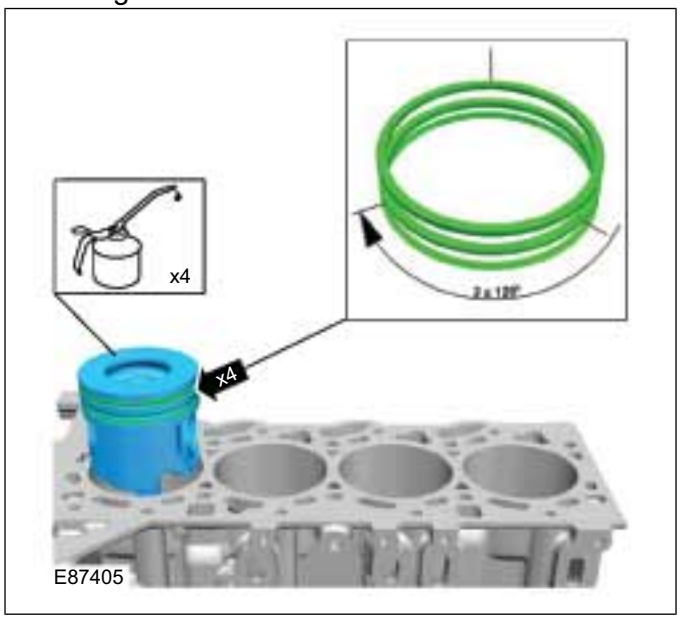
3. **NOTE:** Make sure that these components are installed to the noted removal position.

   NOTE: Install all the bolts finger tight before final tightening.

   Torque:
   - Stage 1: 15 Nm
   - Stage 2: 20 Nm
   - Stage 3: 35 Nm
   - Stage 4: 80 Nm
   - Stage 5: 90°



4. General Equipment: Piston Ring Compressor
   Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil



ASSEMBLY

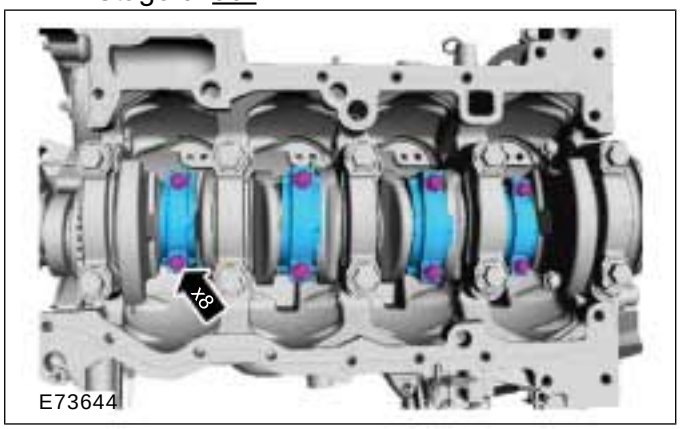
5. **NOTE:** Make sure that these components are installed to the noted removal position.

   Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil

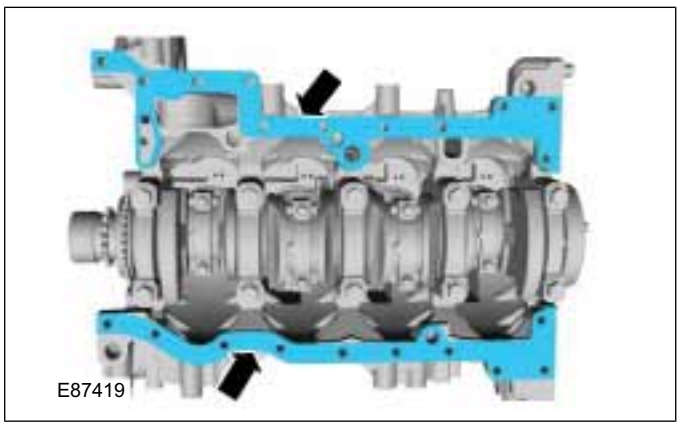
6. **NOTE:** Make sure that these components are installed to the noted removal position.

   NOTE: Install all the bolts finger tight before final tightening.

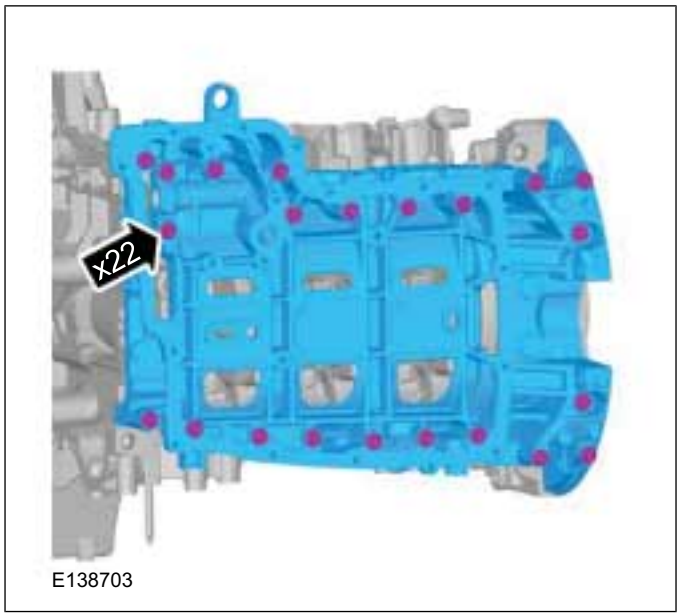
   Torque:
   - Stage 1: 25 Nm
   - Stage 2: 60 Nm
   - Stage 3: 90°



7.

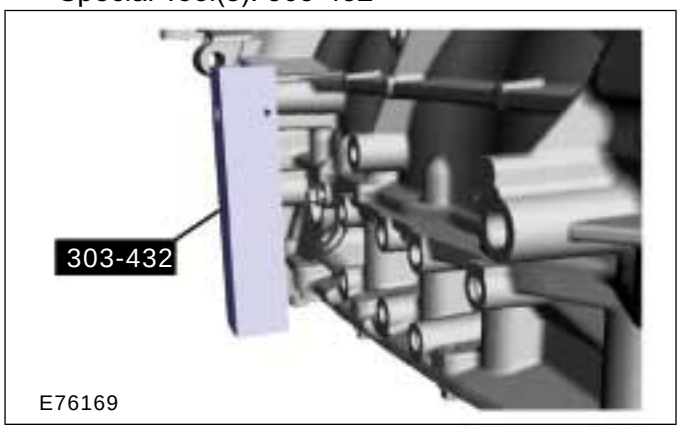


8. **NOTE:** Only tighten the bolts finger tight at this stage.



9. The ladder frame and the cylinder block must be aligned so that the side clearance does not exceed 0.05 mm overlap to 0.05 mm gap.

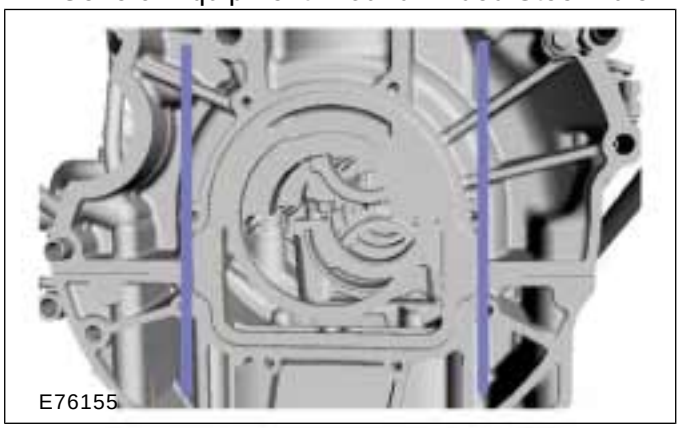
   Special Tool(s): 303-432



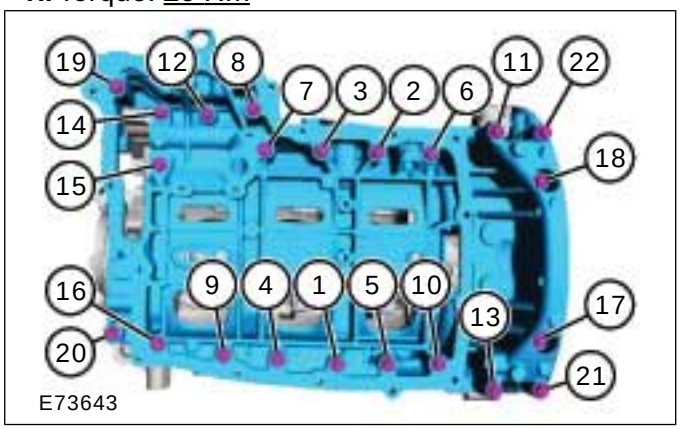
ASSEMBLY

10. The ladder frame and the cylinder block must be aligned so that the rear clearance does not exceed 0.01 mm overlap to 0.2 mm gap.

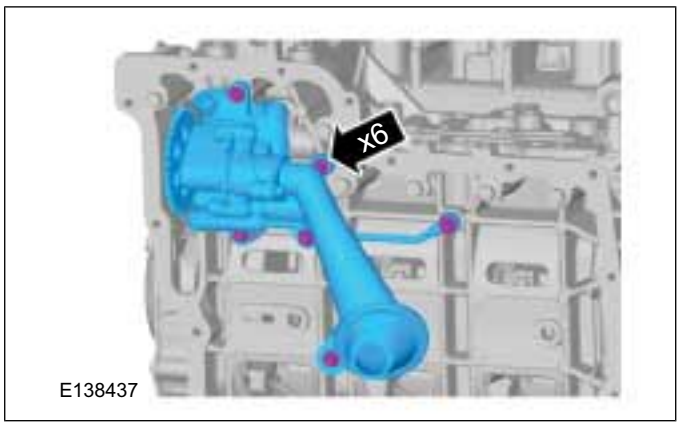
General Equipment: Round-Ended Steel Rule



11. Torque: 23 Nm

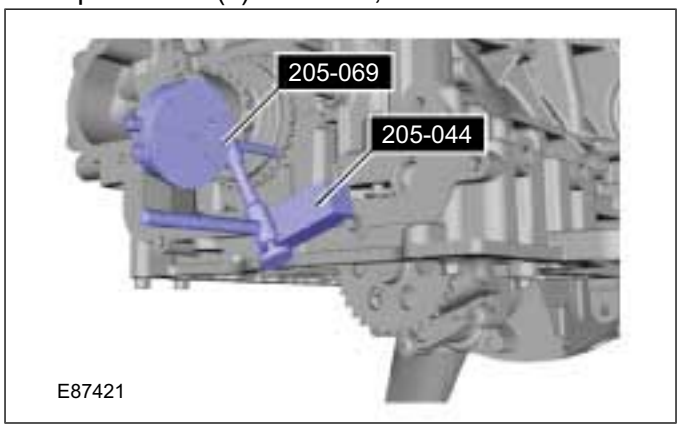


12. NOTE: Only tighten the bolts finger tight at this stage.



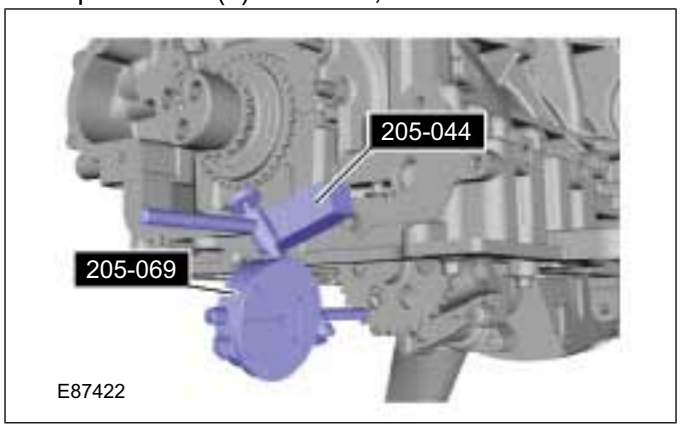
13. Take a reference measurement from the front face of the crankshaft sprocket.

Special Tool(s): 205-044, 205-069

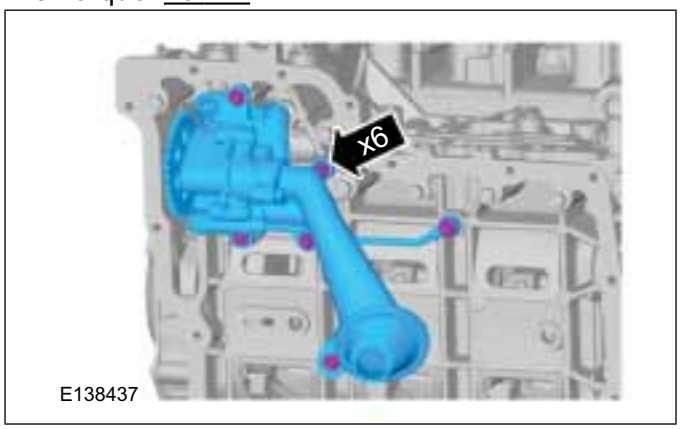


14. Take measurements at two different points on the oil pump sprocket and align the oil pump sprocket.

Special Tool(s): 205-044, 205-069

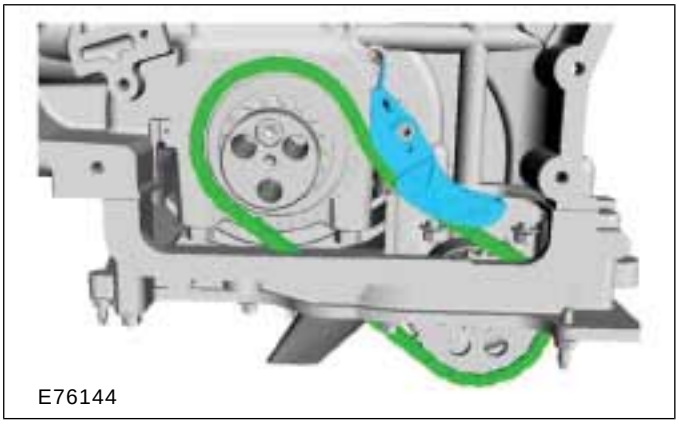


15. Torque: 10 Nm

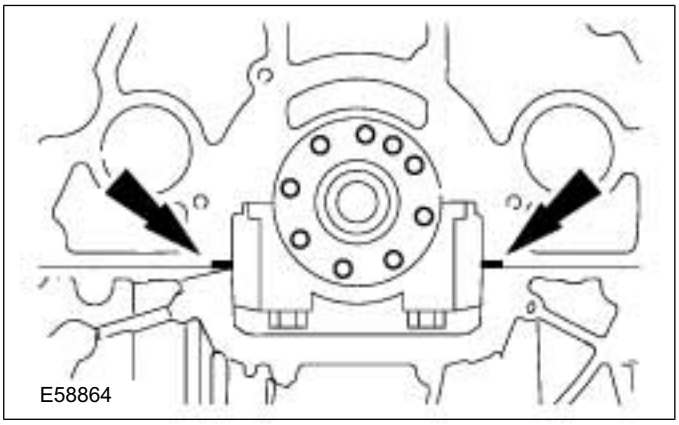


ASSEMBLY

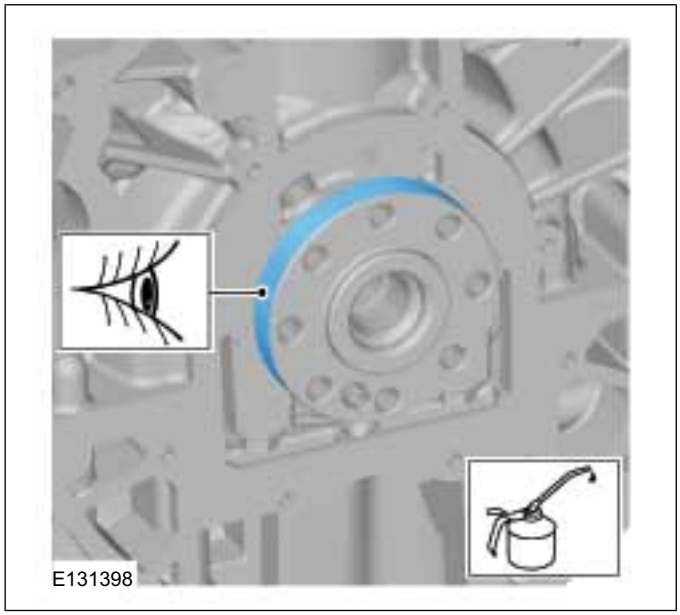
16.



17. **NOTE:** A new crankshaft rear seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft rear seal is fully installed. Failure to follow this instruction may result in damage to the vehicle.
    - Clean the area on the engine before installing a new crankshaft rear seal carrier.
    - Check the two foam pads are located as shown on the ladder frame gasket.

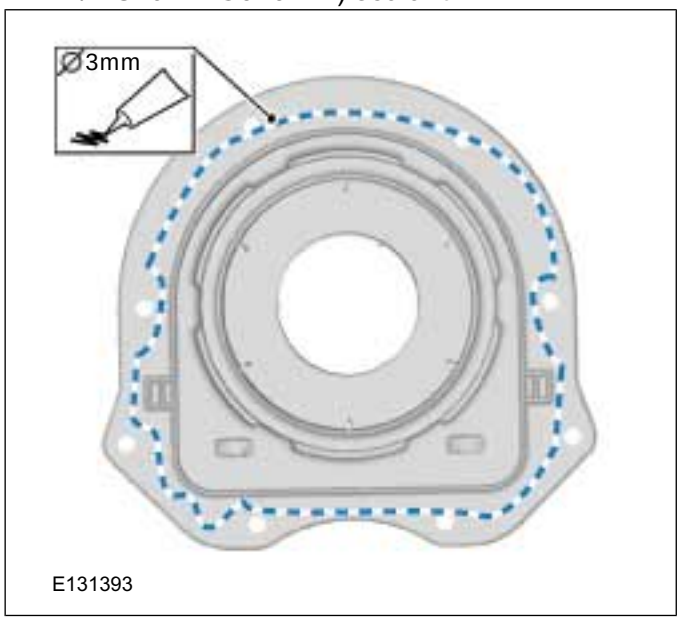


18.



19. **NOTE:** Install new crankshaft rear seal carrier with in five minutes after applying the recomended sealent.

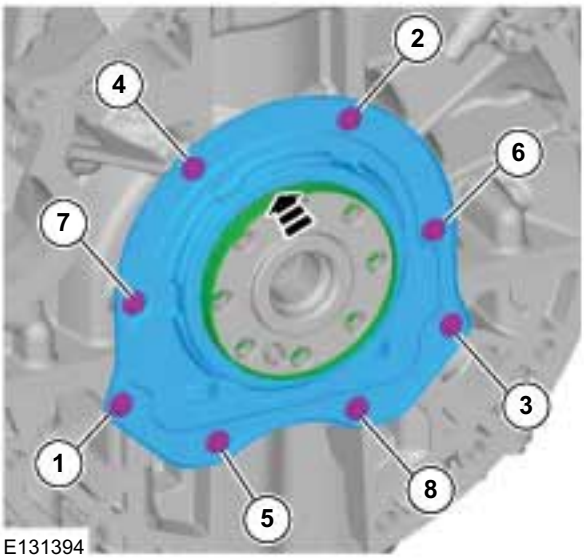
    Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



20. **CAUTION: A new crankshaft rear seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft rear seal is fully installed. Failure to follow this instruction may result in damage to the vehicle.**

ASSEMBLY

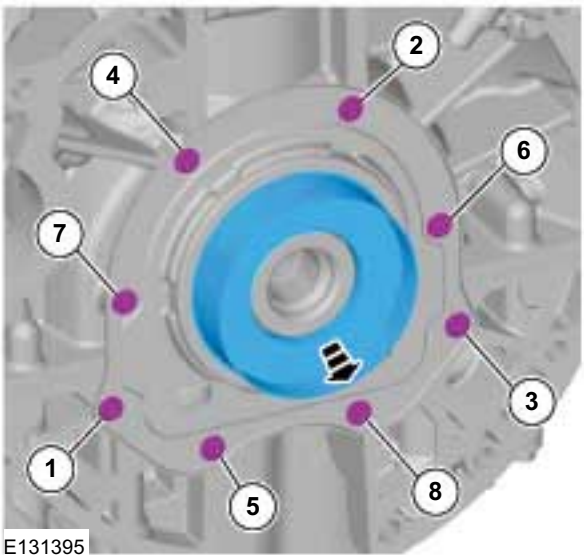
NOTE: Initially hand tighten the fasteners.



E131394

21. **NOTE:** New crankshaft seal carriers are supplied with an alignment sleeve which must be removed after installation.

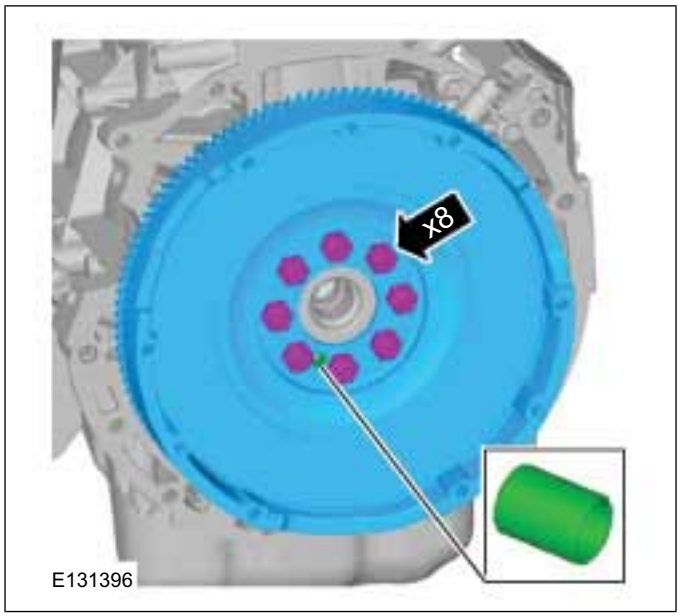
Torque: 20 Nm



E131395

22. **NOTE:** Make sure that flywheel is in full contact with flywheel flange before installing the flywheel bolts.

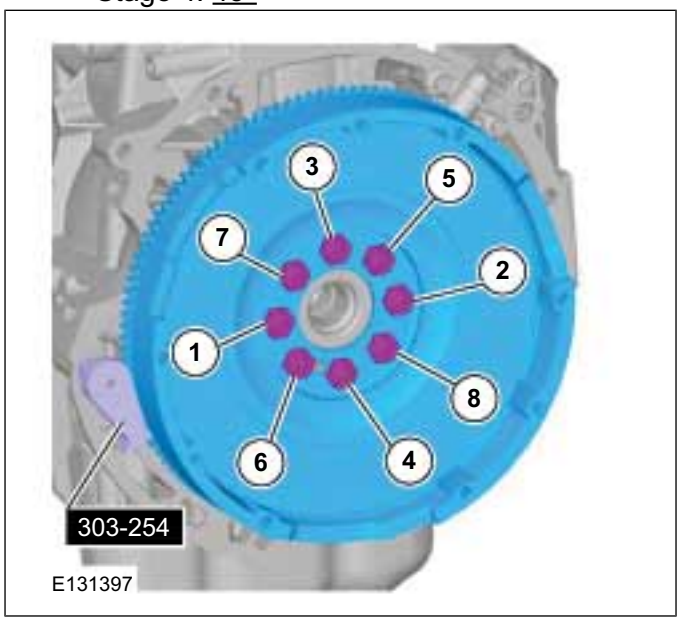
NOTE: Only tighten the bolts finger tight at this stage.



E131396

23. **CAUTION: Make sure that the flywheel is in full contact with the crankshaft flange before installing the flywheel bolts.**

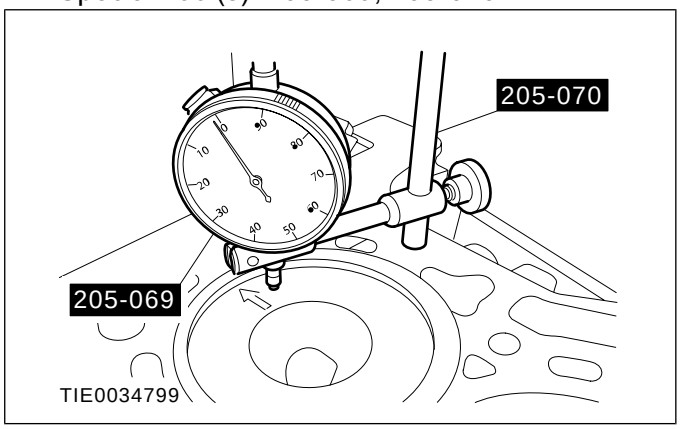
Special Tool(s): 303-254
Torque:
- Stage 1: 15 Nm
- Stage 2: 30 Nm
- Stage 3: 75 Nm
- Stage 4: 45°



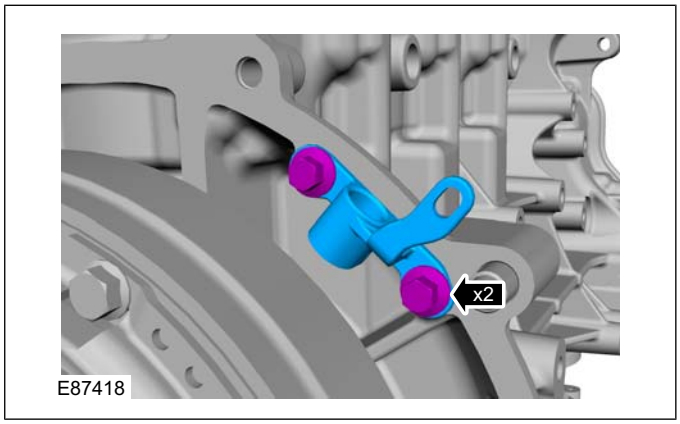
E131397

ASSEMBLY

24. Special Tool(s): 205-069, 205-070

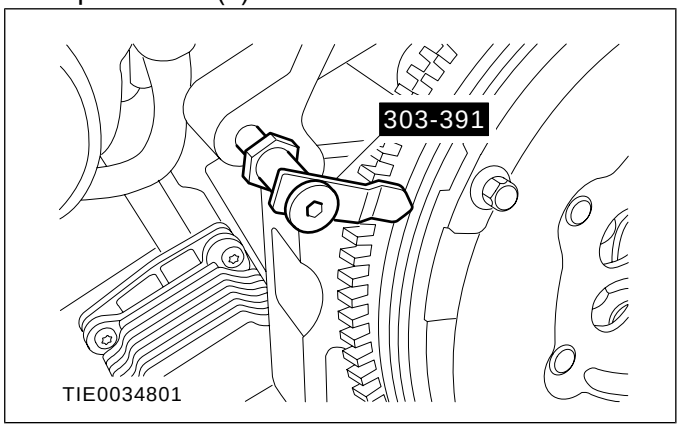


25. NOTE: Do not fully tighten the crankshaft position sensor bracket retaining bolts at this stage.



26. NOTE: After installation do not move the special tool.

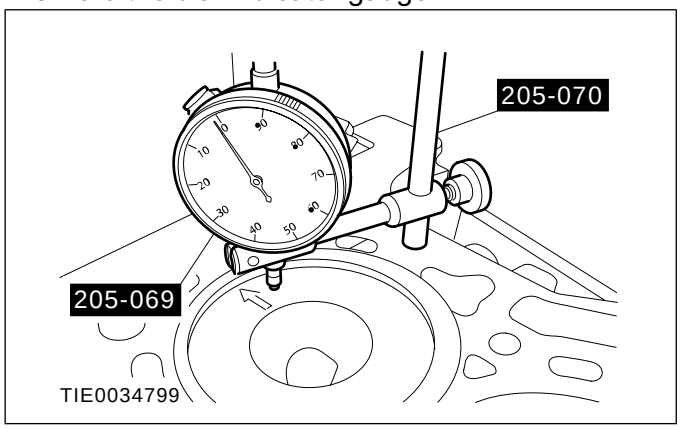
Special Tool(s): 303-391



27. Rotate the crankshaft until piston No. one is approximately 10 mm before top dead center (TDC).

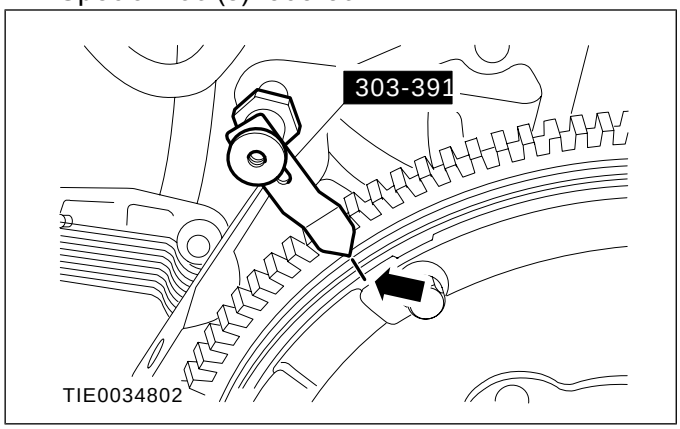
Special Tool(s): 205-069, 205-070

28. Zero the dial indicator gauge.



29. Mark the position on the flywheel primary mass.

Special Tool(s): 303-391

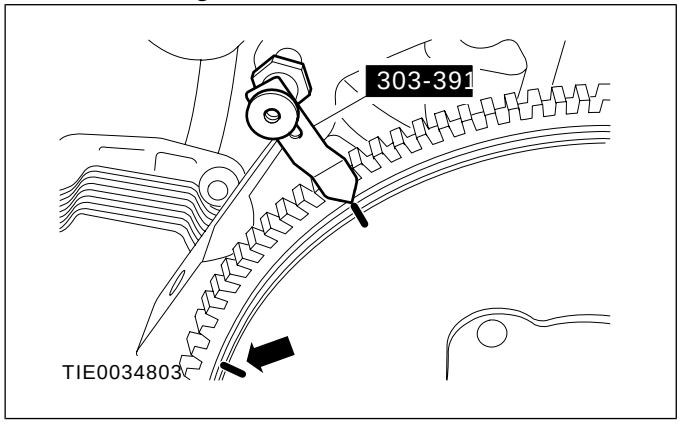


30. NOTE: Rotate the crankshaft counterclockwise.

1. Rotate the crankshaft until the piston No. one achieves zero on the dial indicator gauge.
2. Mark the position on the flywheel primary mass.

   Special Tool(s): 303-391

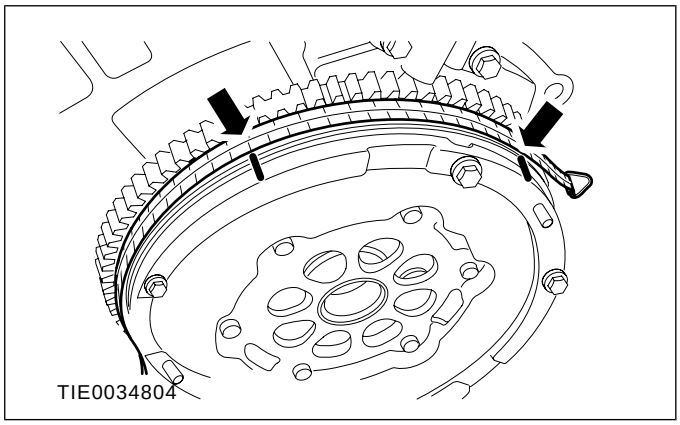
31. Repeat the previous steps to make sure that the marking is correct.



32. NOTE: The middle of the markings is TDC.

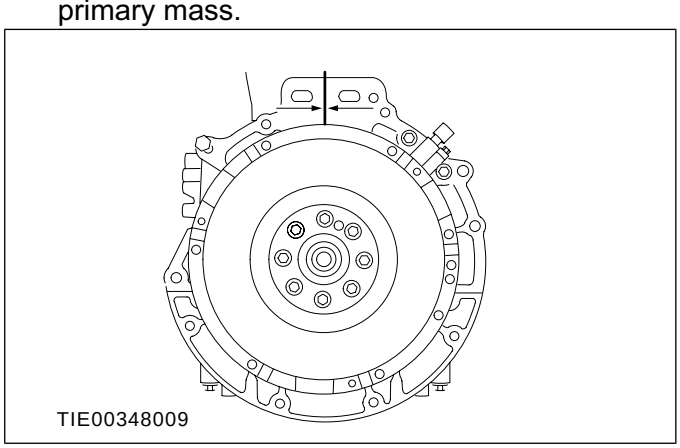
ASSEMBLY

Measure the distance between the two marks.


TIE0034804

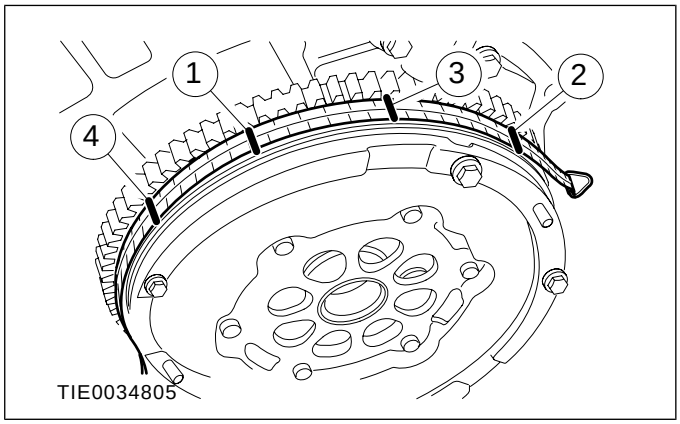
33. Divide the amount by two and mark the position TDC on the flywheel primary mass.

34. Measure the circumference of the flywheel primary mass.


TIE00348009

35. Multiply the circumference by 0.1388 and mark the calculated amount on the flywheel primary mass by measuring from TDC counterclockwise.

36.
1. First mark.
2. Second mark.
3. Determined TDC.
4. Determined 50 degrees before top dead center (BTDC).



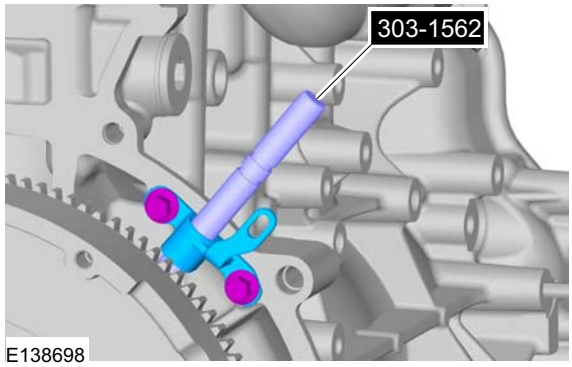
TIE0034805

37. **CAUTION: Do not turn the crankshaft when the special tool is fully located into the flywheel. Failure to follow this instruction will cause damage to the CKP sensor hole.**

NOTE: Rotate the crankshaft in the normal direction of rotation to the mark of the calculated 50 degrees BTDC.

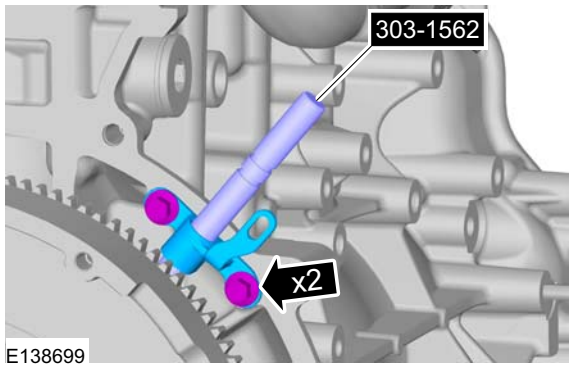
NOTE: Make sure that the special tool is fully located in the flywheel so that the engine cannot be rotated in either direction.

Special Tool(s): 303-1562



E138698

38. Remove the Special Tool(s): 303-1562
Torque: 25 Nm

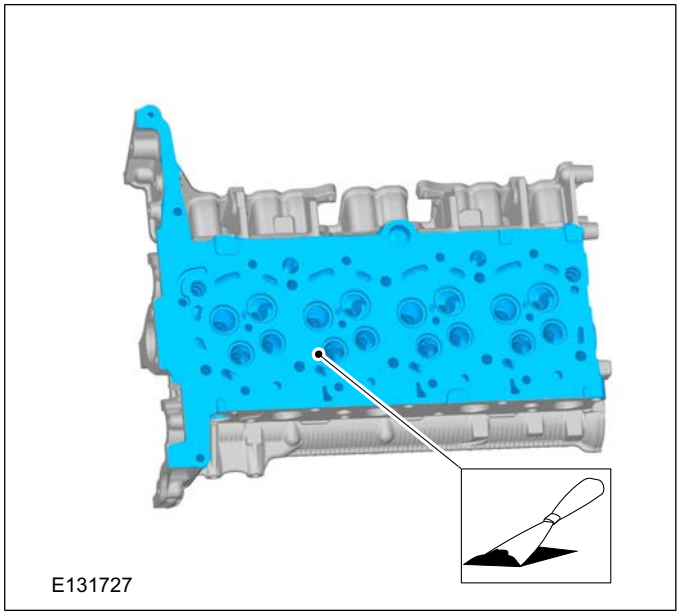


E138699

39. **WARNING: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak**

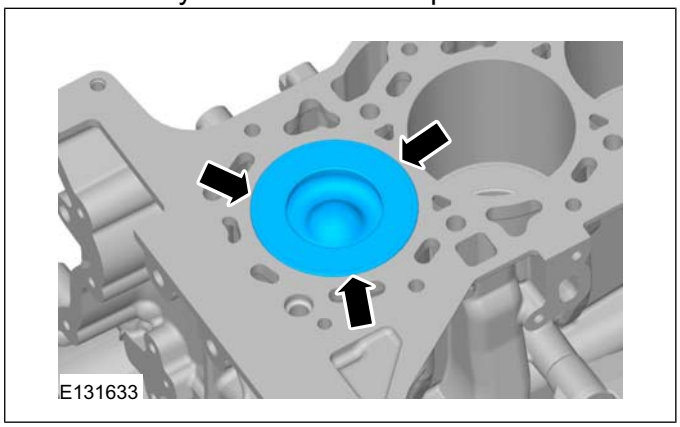
ASSEMBLY

paths. Use a plastic scraping tool to remove all traces of the head gasket.



40. **NOTE:** Measure the piston protrusion of each cylinder at top dead center (TDC).

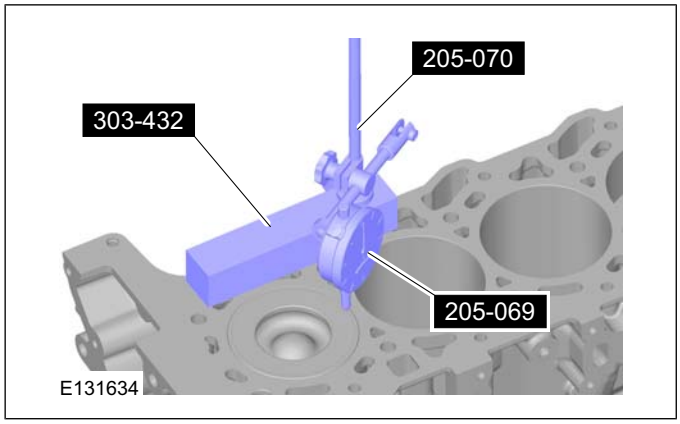
    Measure the distance between the piston crown and the cylinder block at the points indicated.



41. **NOTE:** The largest measurement determines the choice of the cylinder head gasket.

    - Using the special tools, measure the piston protrusion.

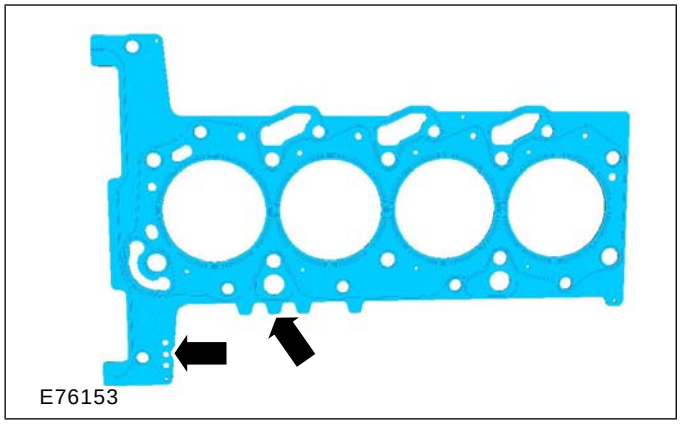
      Special Tool(s): 205-070, 205-069, 303-432



42. Determine the cylinder head gasket.

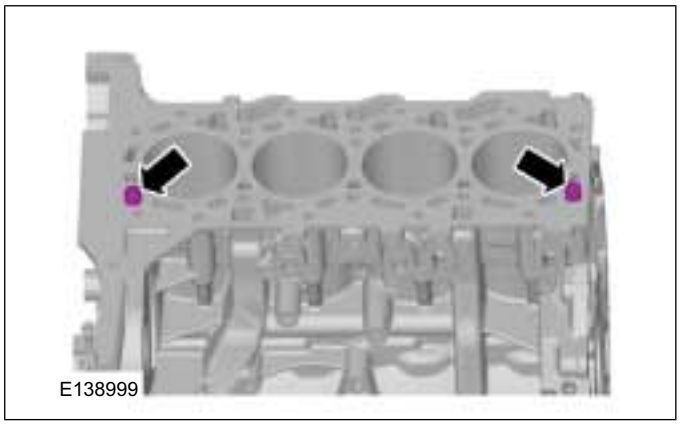
    Refer to: Specifications (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Specifications).

43. **NOTE:** Make sure that a new component is installed.



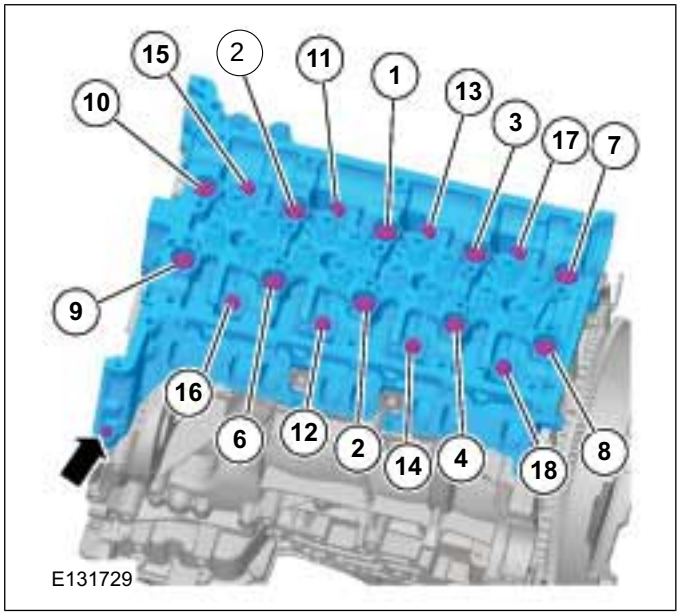
ASSEMBLY

44.

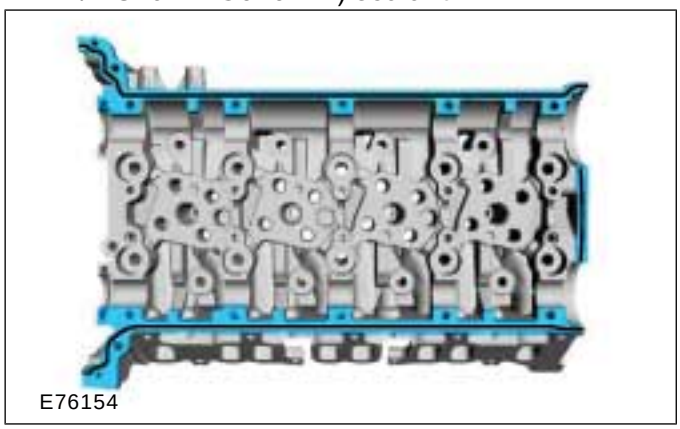


45. NOTE: Install all the bolts finger tight before final tightening.

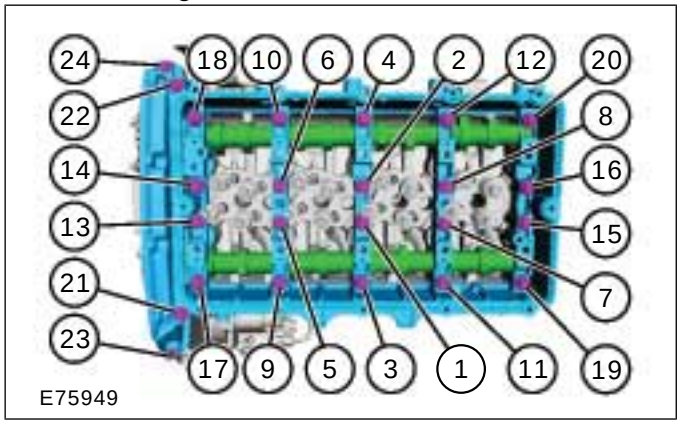
Torque:
- Bolts 1 to 10 10 Nm
- Bolts 11 to 18 5 Nm
- Bolts 1 to 10 20 Nm
- Bolts 11 to 18 10 Nm
- Bolts 1 to 10 40 Nm
- Bolts 11 to 18 20 Nm
- Bolts 1 to 10 180°
- Bolts 11 to 18 180°



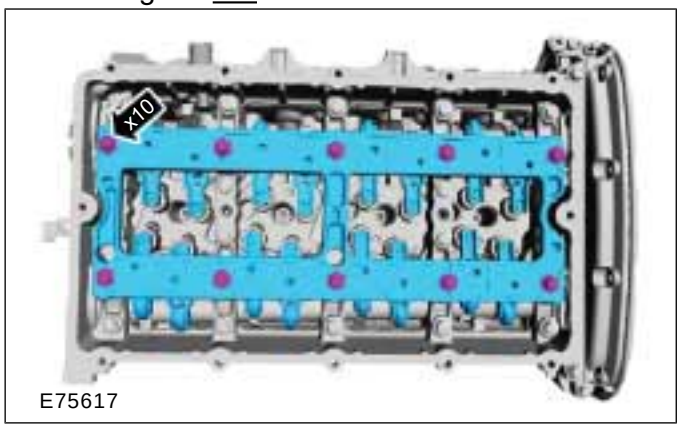
46. Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



47. Torque:
- Bolts 1 to 22
  - Stage 1: 5 Nm
  - Stage 2: 23 Nm
- Bolts 23 to 24
  - Stage 1: 5 Nm
  - Stage 2: 10 Nm

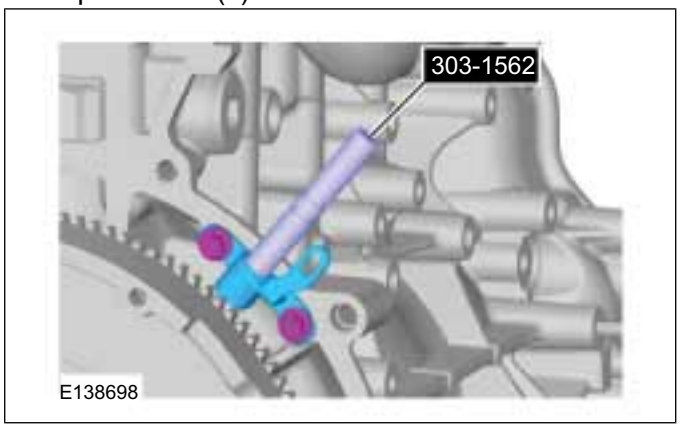


48. Torque:
- Stage 1: 10 Nm
- Stage 2: 30°



ASSEMBLY

49. Special Tool(s): 303-1562



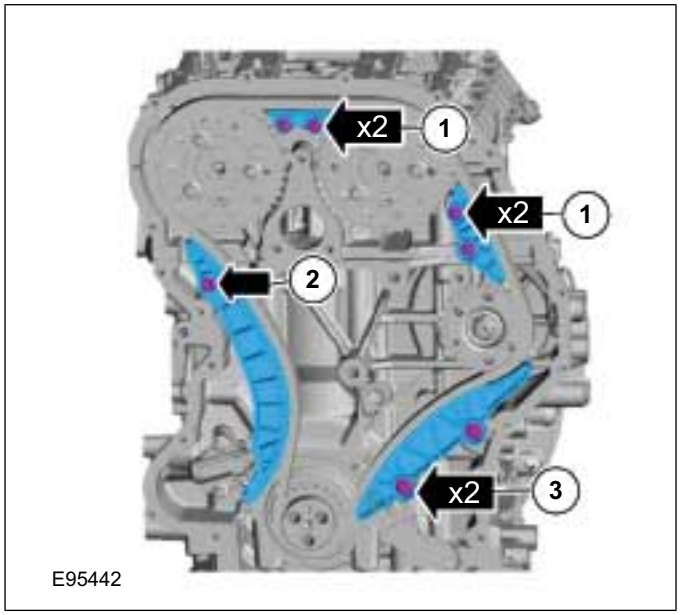
50. **NOTE:** Make sure that the installation marks are aligned.

General Equipment: 6 mm Drill Bit
Torque: 33 Nm

51. Remove the 6 mm drill bits.

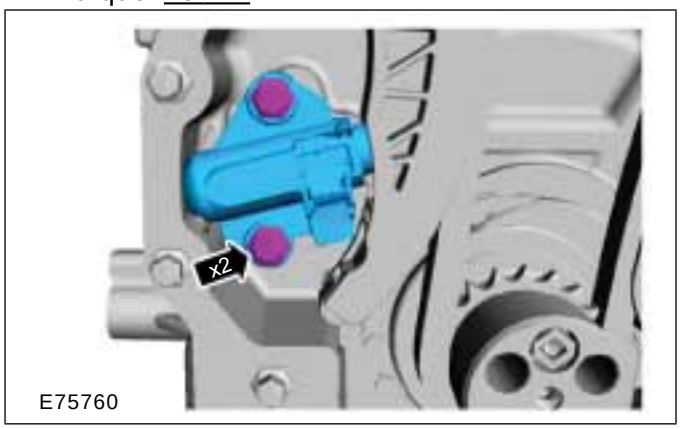
52. ⚠ **CAUTION: Make sure that new bolts are installed.**

1. Torque: 15 Nm
2. Torque: 40 Nm

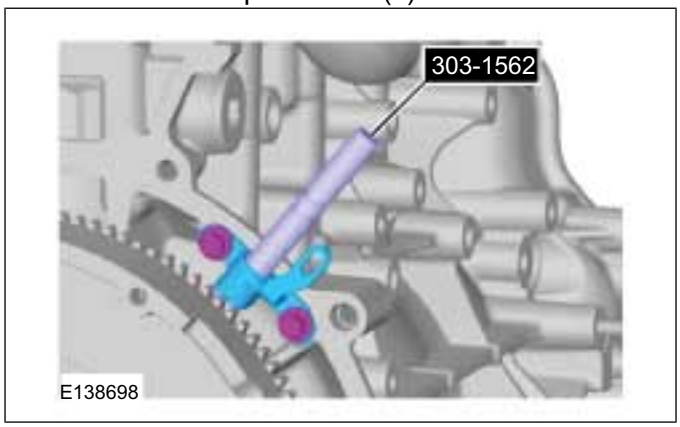


53. **NOTE:** Make sure that a new component is installed.

Torque: 15 Nm



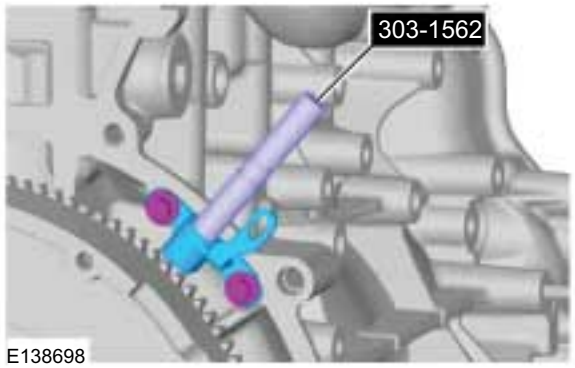
54. Remove the Special Tool(s): 303-1562



ASSEMBLY

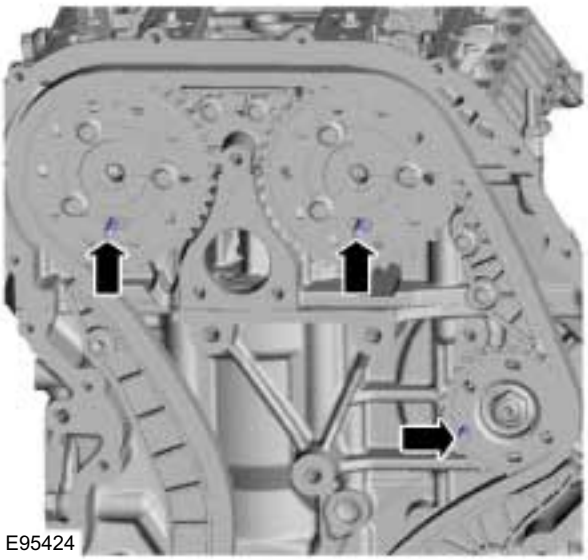
55. Rotate the engine two revolutions.

56. Special Tool(s): 303-1562

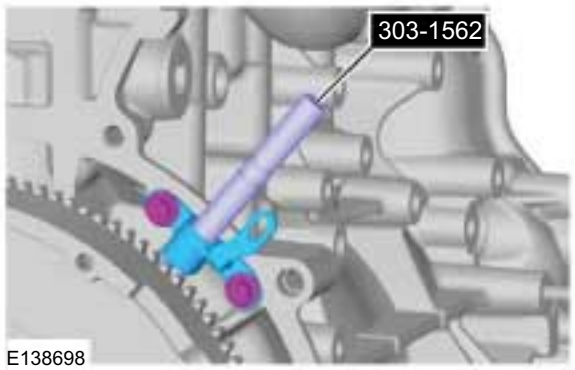


57. Check the position of the timing marks and correct if necessary.

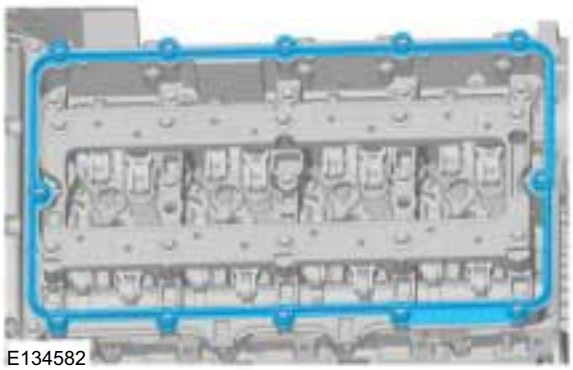
58. Remove the 6 mm drill bits.



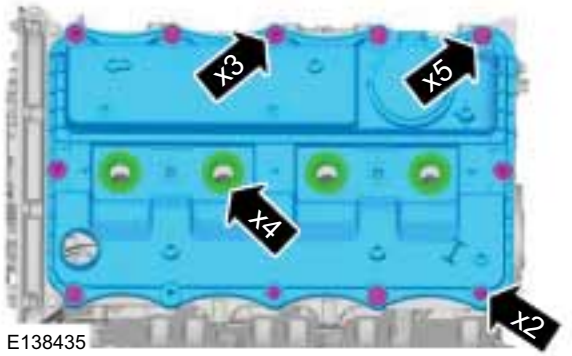
59. Remove the Special Tool(s): 303-1562



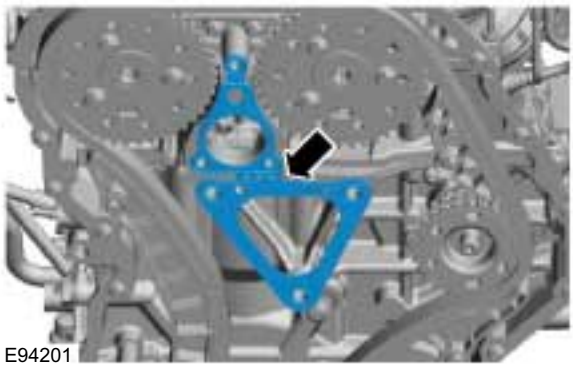
60.



61. Torque: 10 Nm



62. **NOTE:** Make sure that a new component is installed.

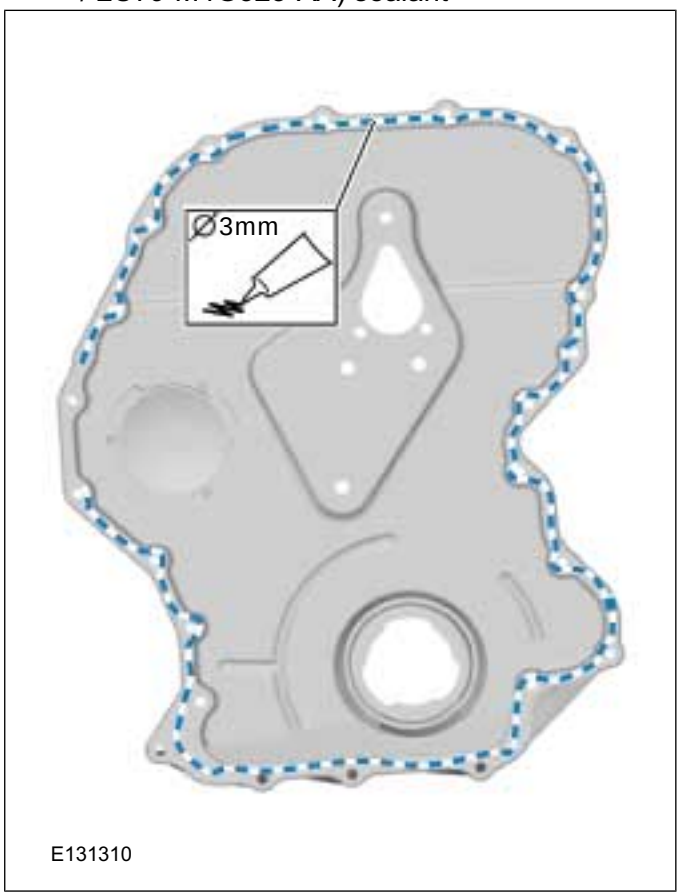


63. **NOTE:** The component must be installed within 5 minutes of applying the sealant.

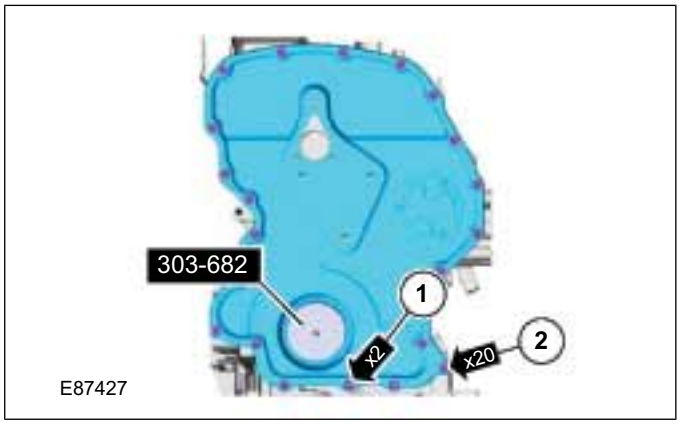
ASSEMBLY

NOTE: Make sure that a new component is installed.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant

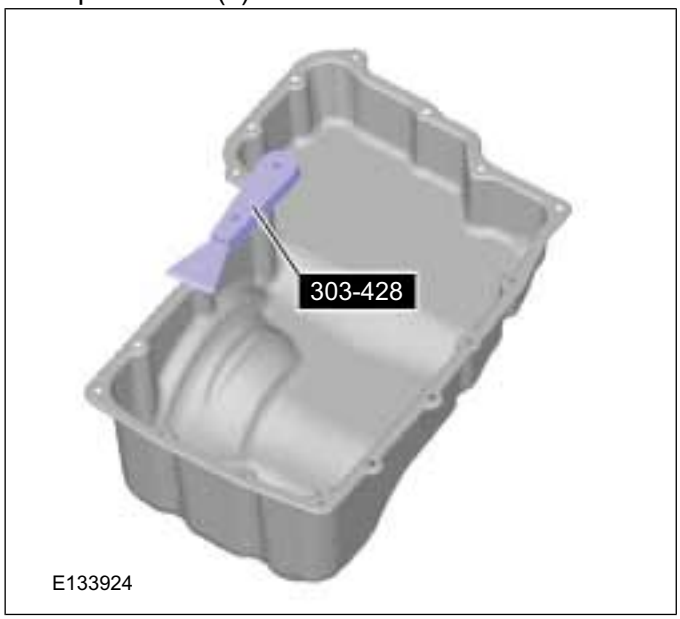


64. Special Tool(s): 303-682
Torque:
- 1 10 Nm
- 2 11 Nm



65. **NOTE:** Do not damage the mating faces.

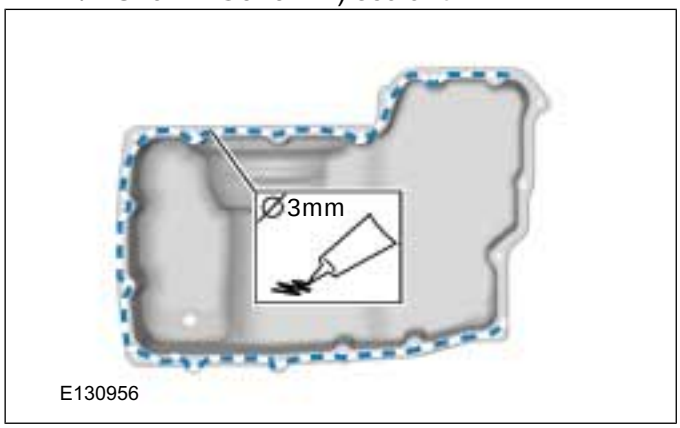
Special Tool(s): 303-428



66. **CAUTION: Install the oil pan within five minutes of applying the sealer.**

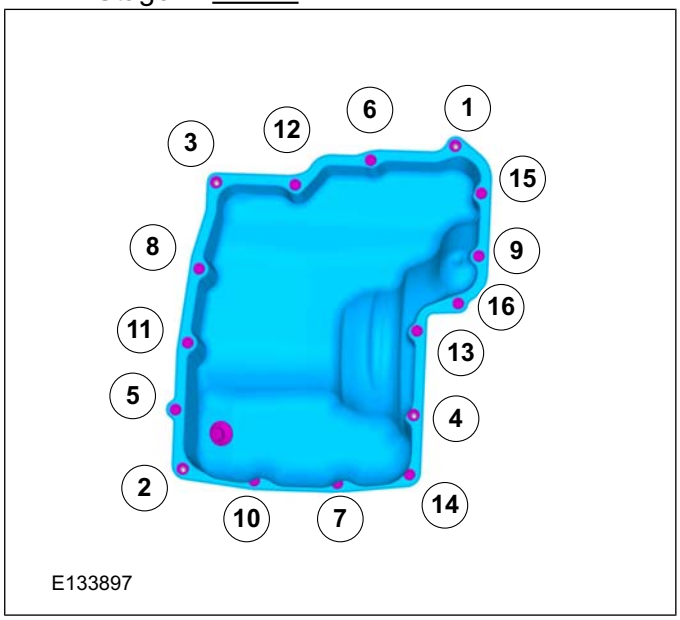
NOTE: Do not damage the mating faces.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



ASSEMBLY

67. Torque:
- Stage 1: 7 Nm
- Stage 2: 14 Nm



E133897

INSTALLATION

Engine — Vehicles With: 5-Speed Manual Transmission - MT75(21 132 0; 21 132 6; 21 132 7)

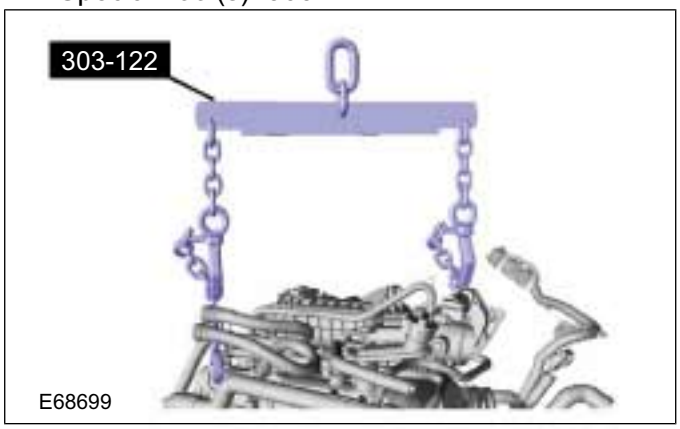
Installation

Special Tool(s)

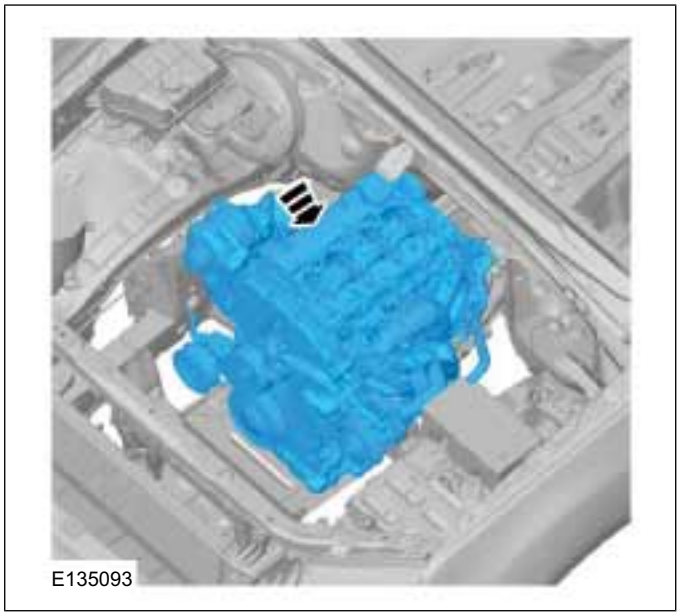
 21068A	303-122 Lifting Bracket, Engine

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

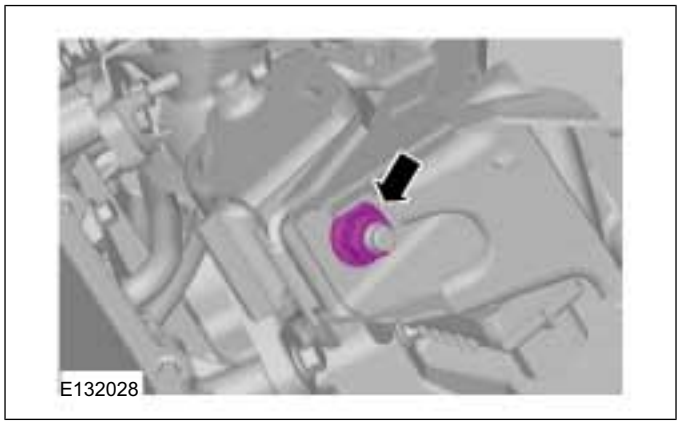
2. Special Tool(s): 303-122



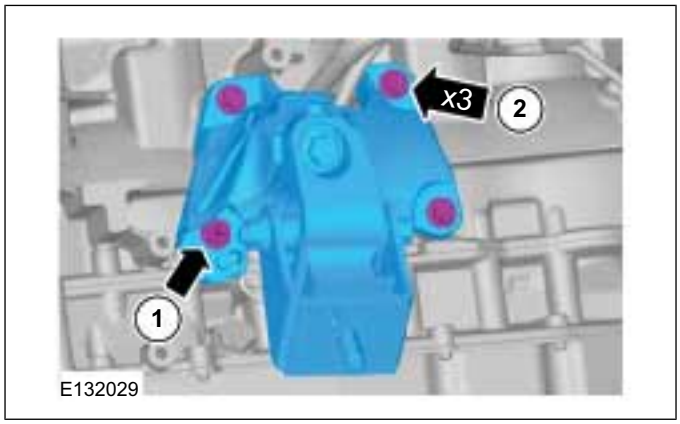
3.



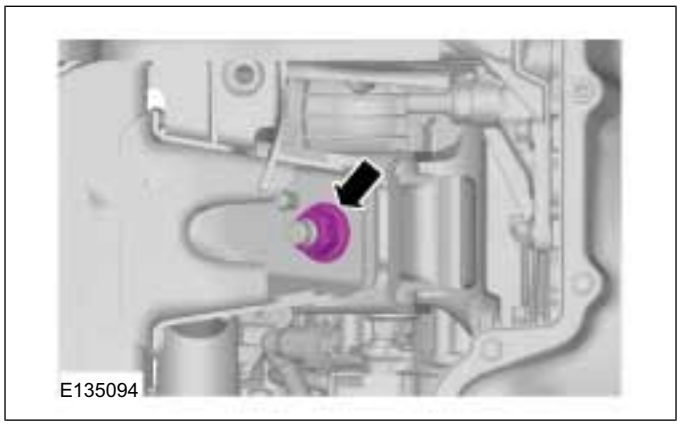
4. **NOTE:** Hand tighten the nut at this stage.



5. **NOTE:** Hand tighten the nut at this stage.

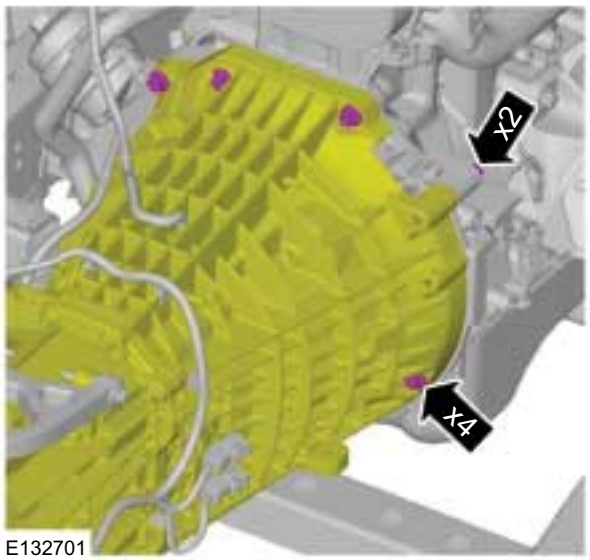


6. **NOTE:** Hand tighten the nut at this stage.



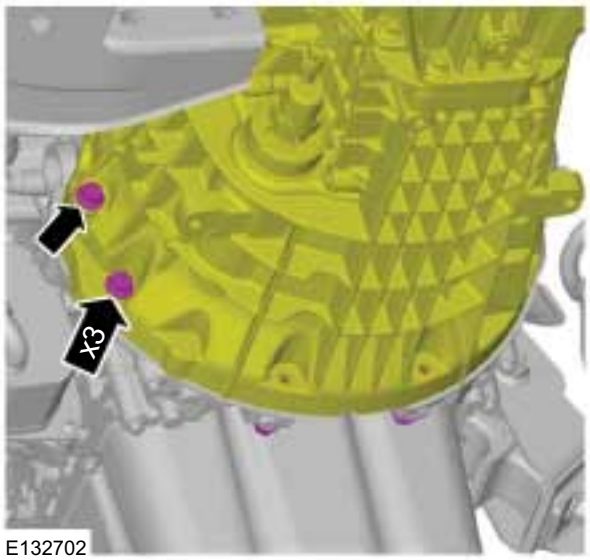
INSTALLATION

7. Initially hand tighten the fasteners.
Torque: 48 Nm



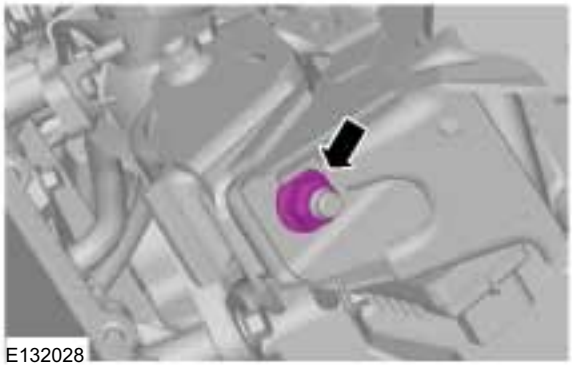
E132701

8. Initially hand tighten the fasteners.
Torque: 48 Nm

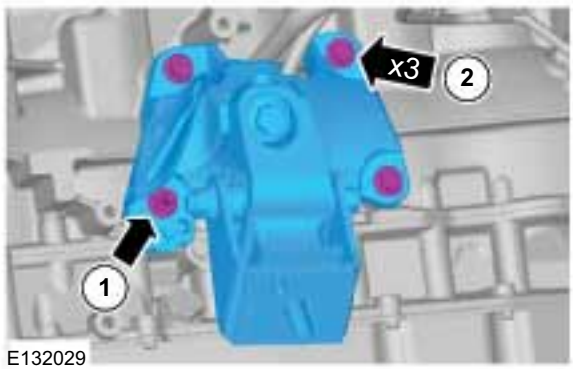


E132702

9. Torque: 80 Nm

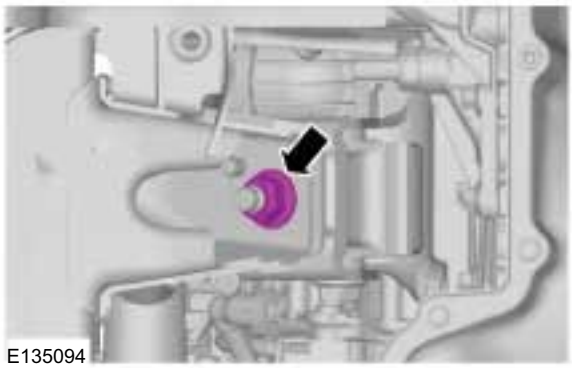

E132028

10. 1. Torque: 48 Nm
2. Torque: 48 Nm



E132029

11. Torque: 80 Nm

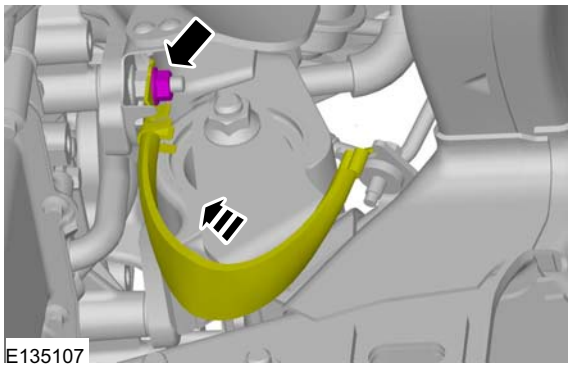

E135094

12. Remove the Special Tool(s): 303-122

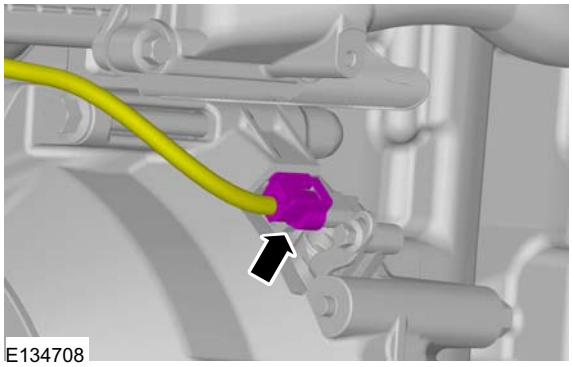
E68699

INSTALLATION

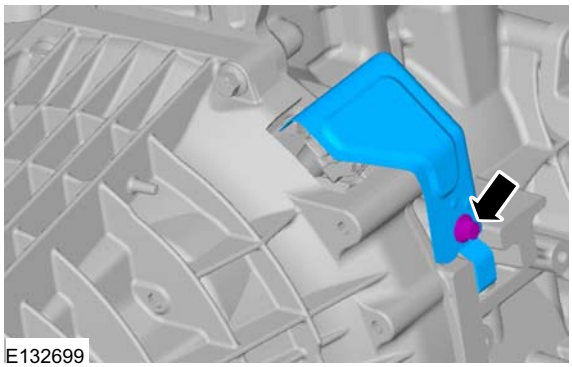
13. Torque: 13 Nm


E135107

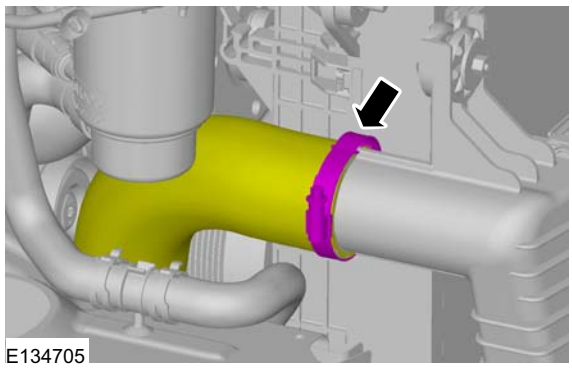
14.


E134708

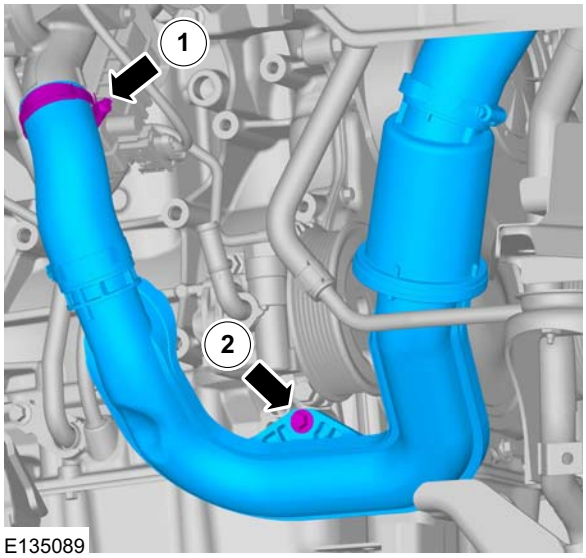
15. Torque: 22 Nm


E132699

16.


E134705

17. 2. Torque: 10 Nm

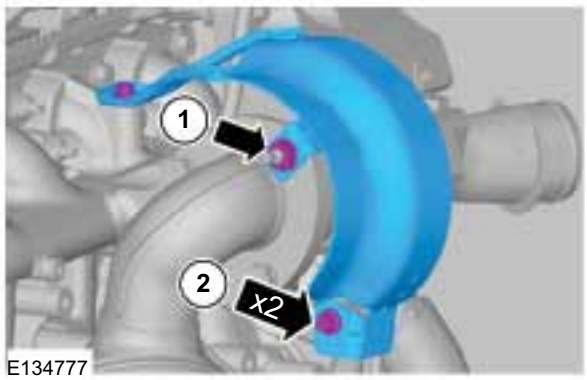


E135089

INSTALLATION

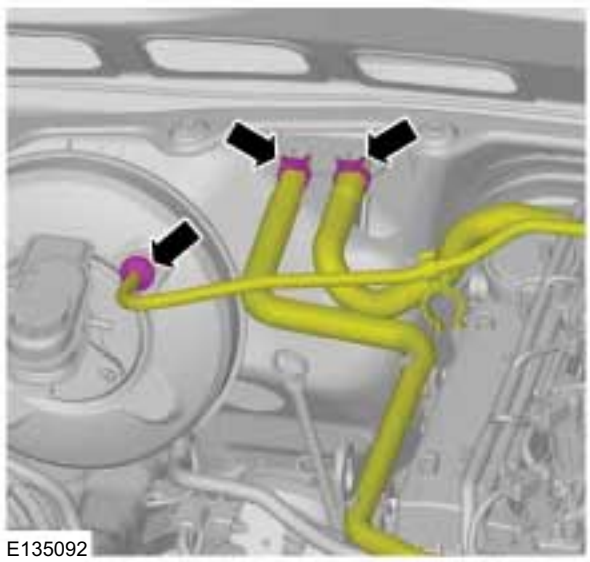
18. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

19. 1. Torque: 47 Nm
    2. Torque: 22 Nm

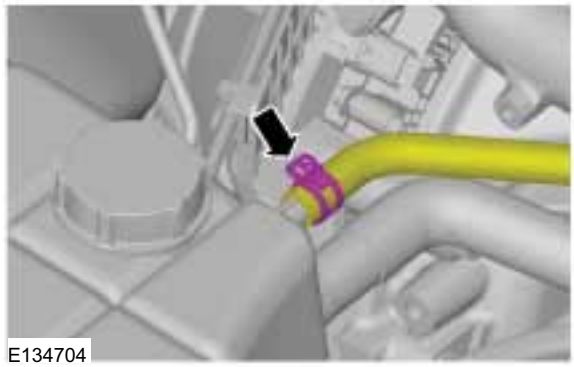


E134777

20.

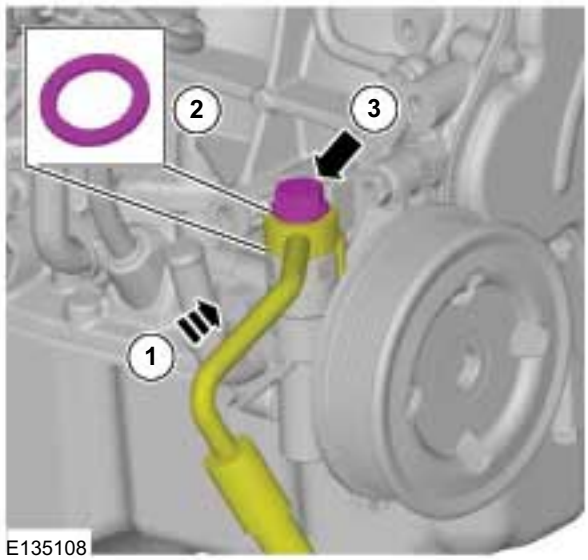

E135092

21.


E134704

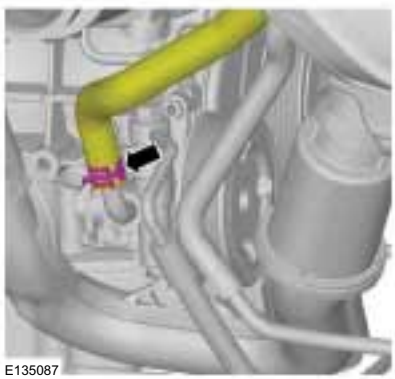
22. **NOTE:** The washers can be reused unless damaged.

    3. Torque: 35 Nm



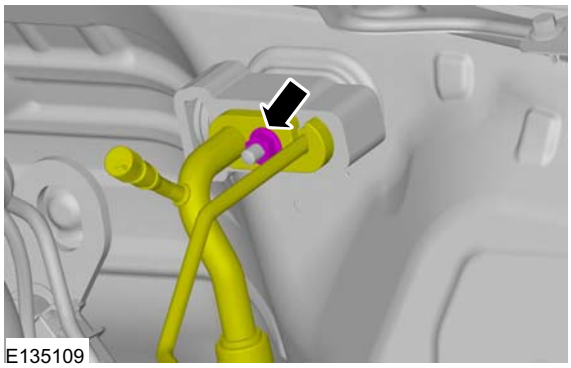
E135108

23.


E135087

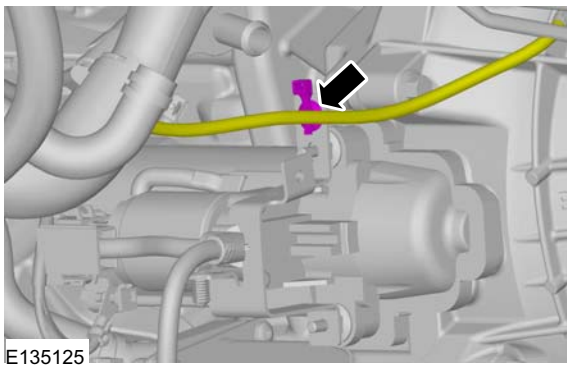
INSTALLATION

24. Torque: 22 Nm


E135109

25. Refer to: Starter Motor - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-06 Starting System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

26.


E135125

27. Refer to: Condenser - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (412-01 Climate Control, Removal and Installation).

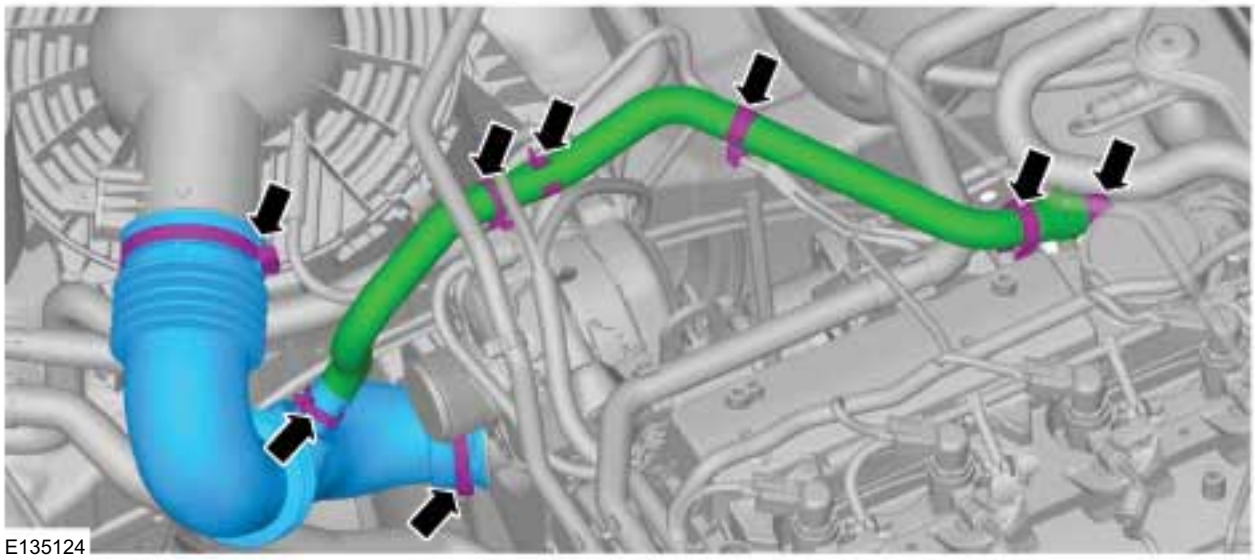
28. Refer to: Radiator (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

29. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

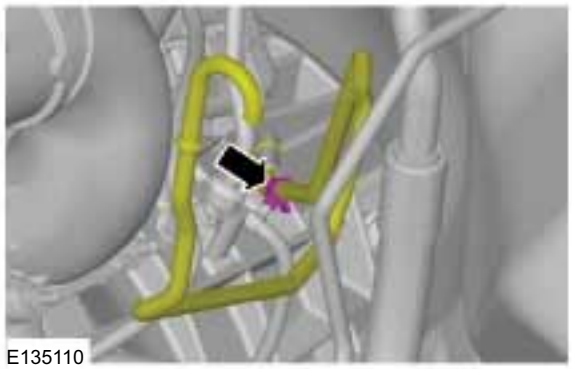
30. Refer to: Air Cleaner - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

31.

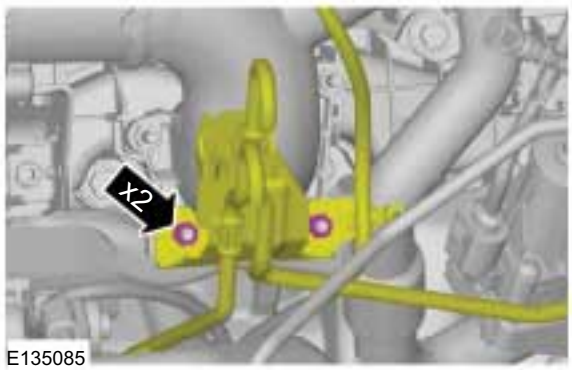
INSTALLATION


E135124

32.

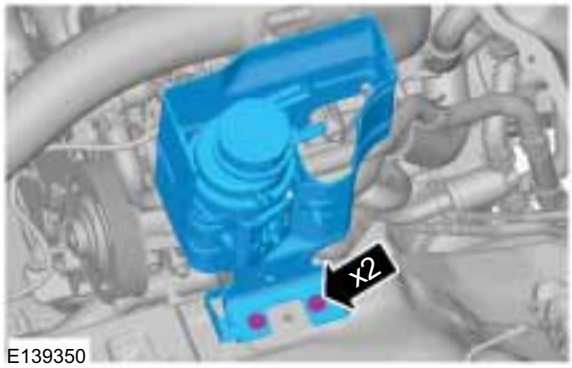

E135110

33. Torque: 10 Nm



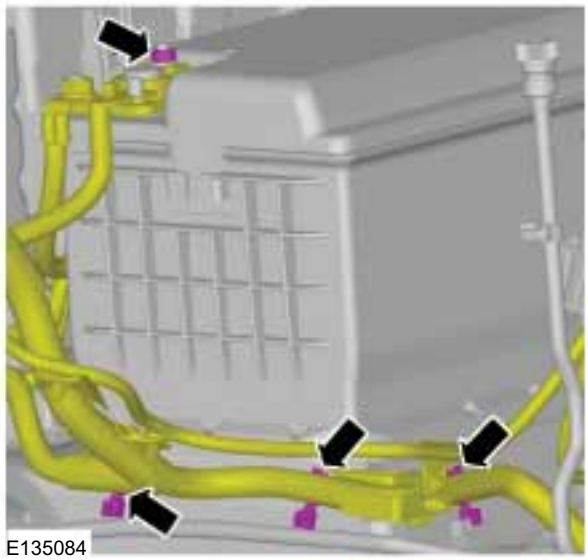
E135085

34. Torque: 18 Nm



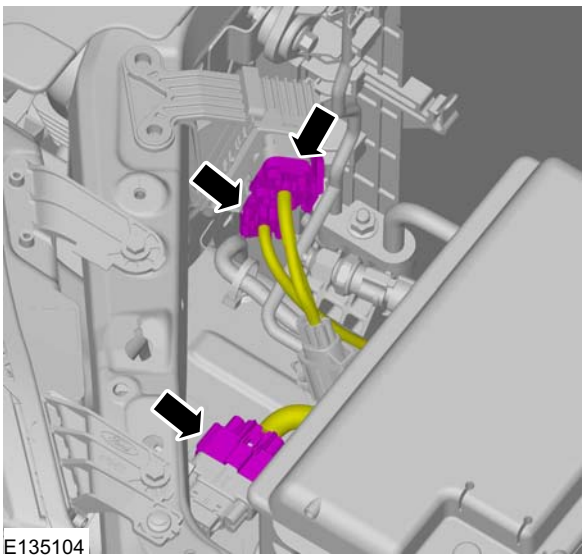
E139350

35. Torque: 5 Nm

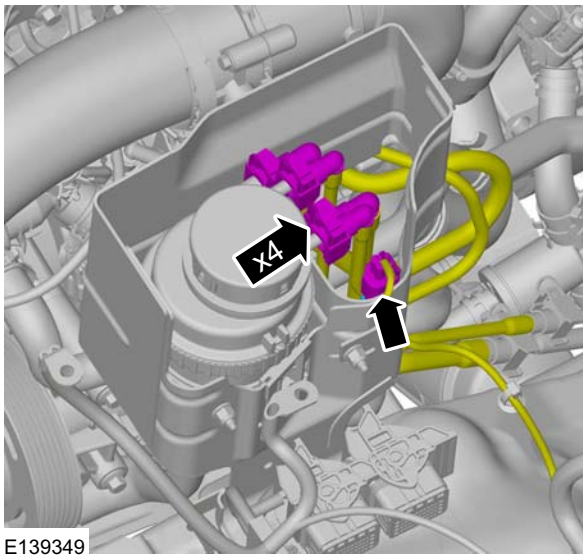

E135084

INSTALLATION

36.



37.



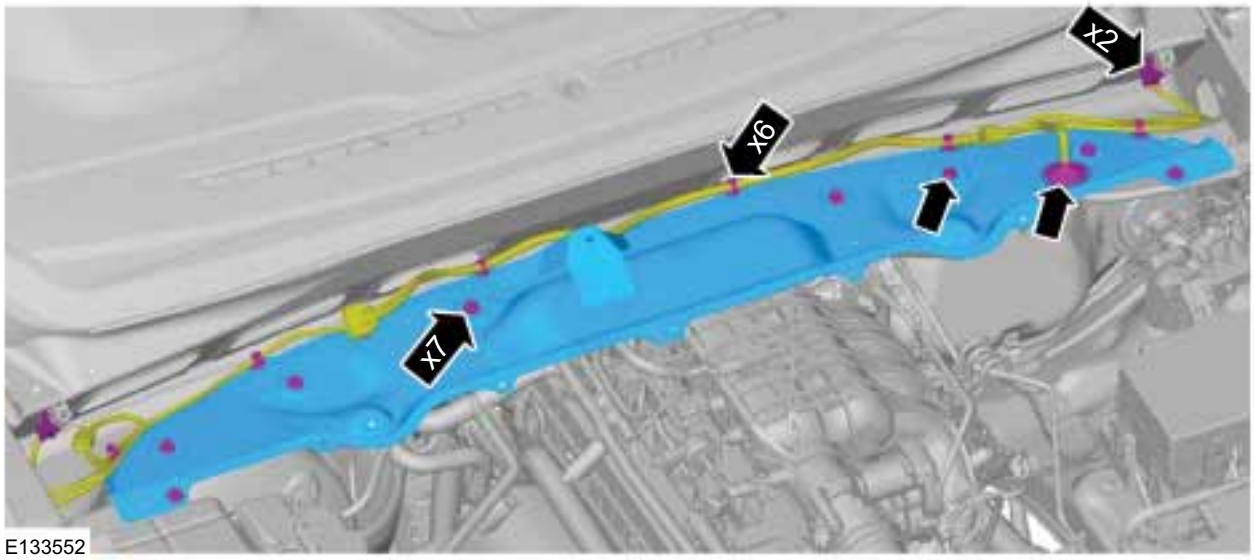
38. Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

39. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

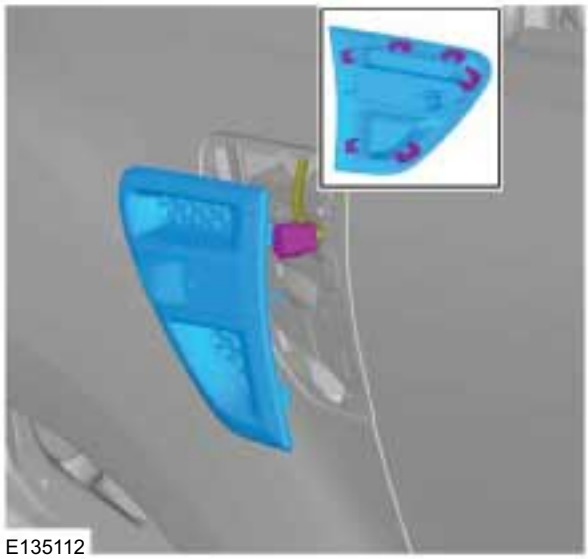
40. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

41. Torque: 10 Nm

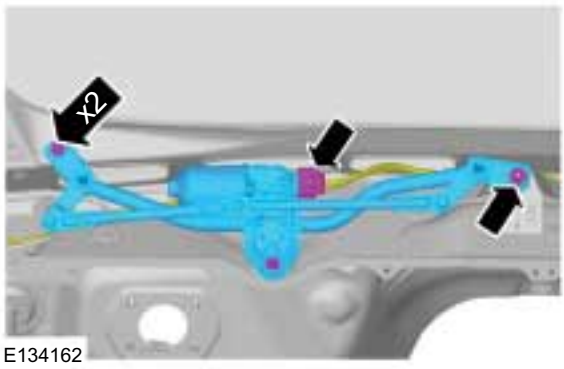
INSTALLATION



42. On both sides.

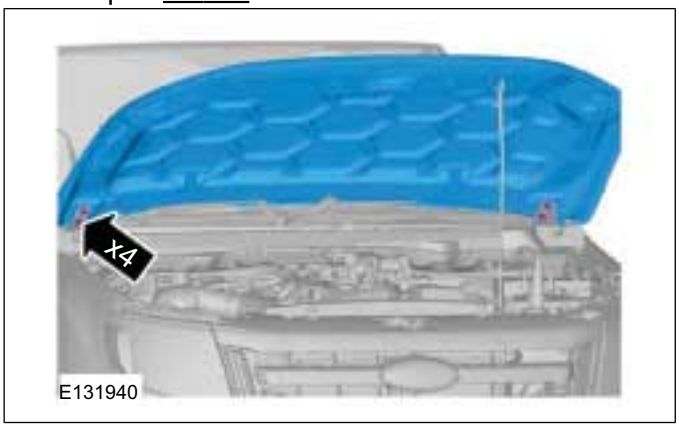


43. Torque: 10 Nm

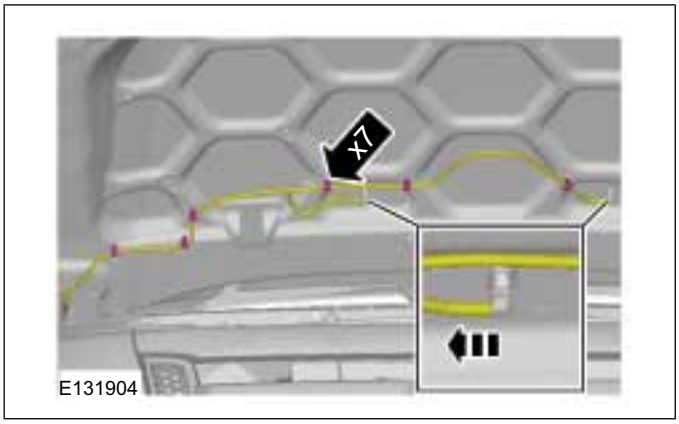


44. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

45. Torque: 25 Nm

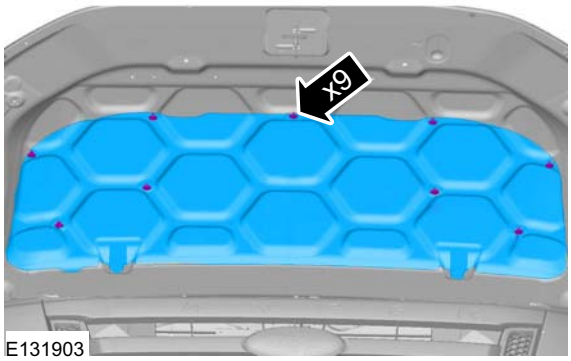


46.

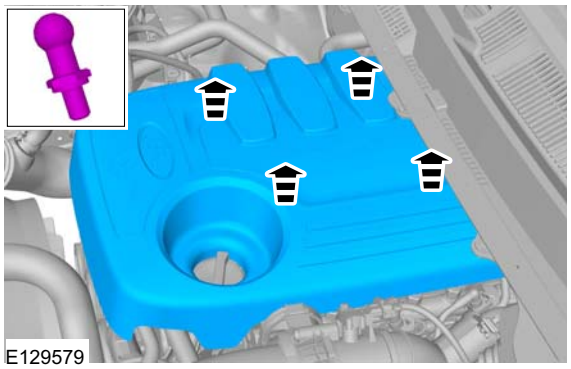


INSTALLATION

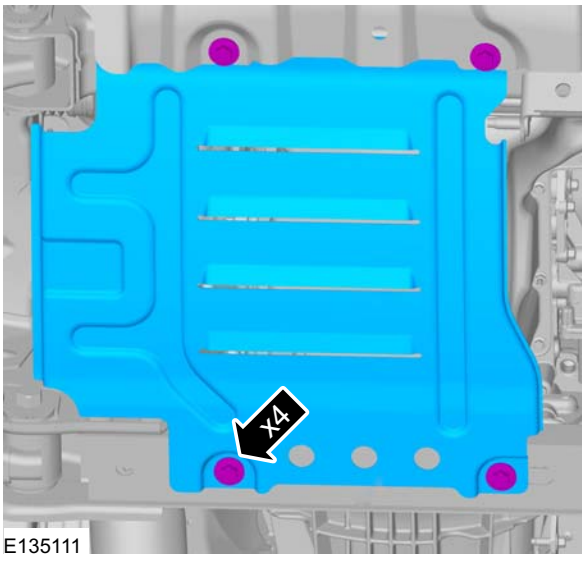
47.



48.



49. Torque: 30 Nm



50. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

51. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

52. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

INSTALLATION

Engine — Vehicles With: 6-Speed Manual Transmission - MT82(21 132 0; 21 132 6; 21 132 7)

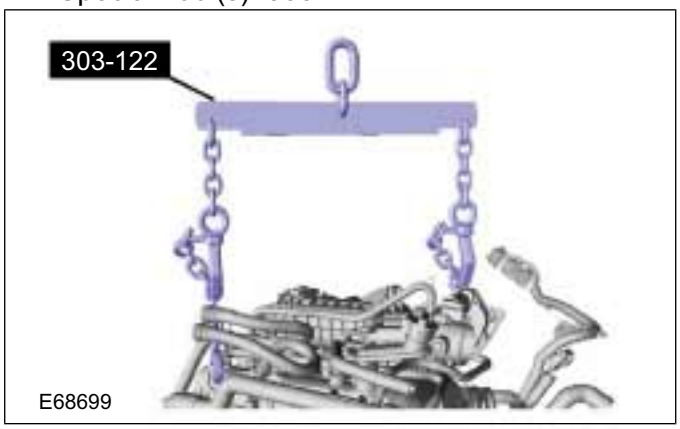
Installation

Special Tool(s)

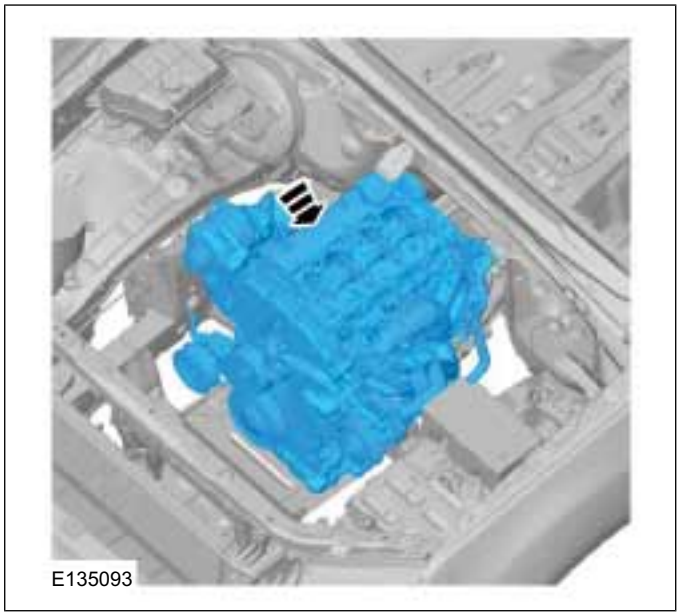
 21068A	303-122 Lifting Bracket, Engine

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

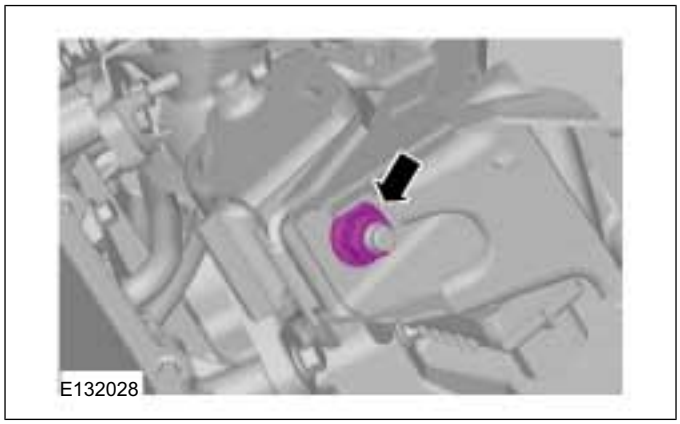
2. Special Tool(s): 303-122



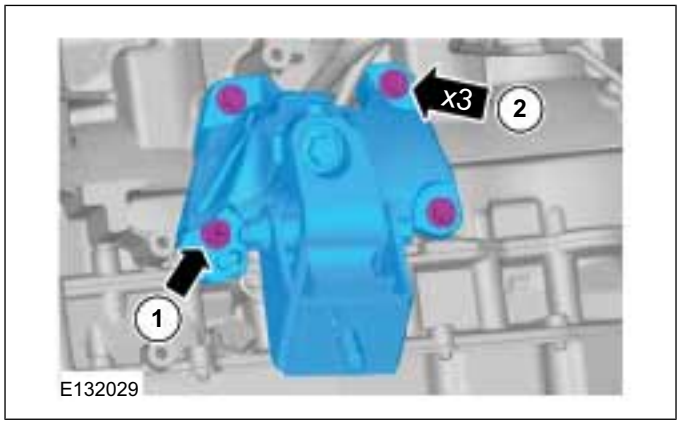
3.



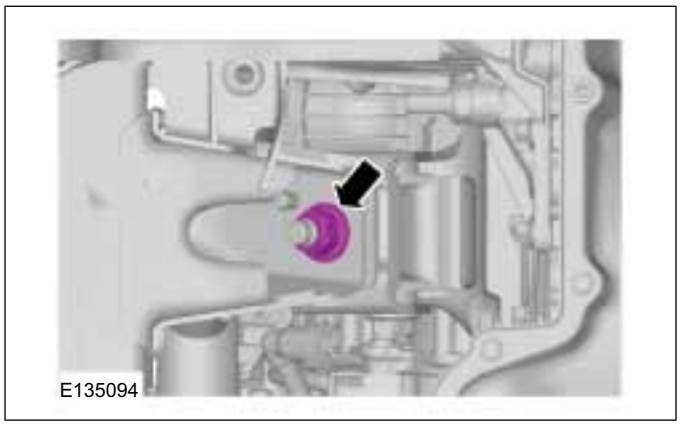
4. **NOTE:** Hand tighten the nut at this stage.



5. **NOTE:** Hand tighten the nut at this stage.

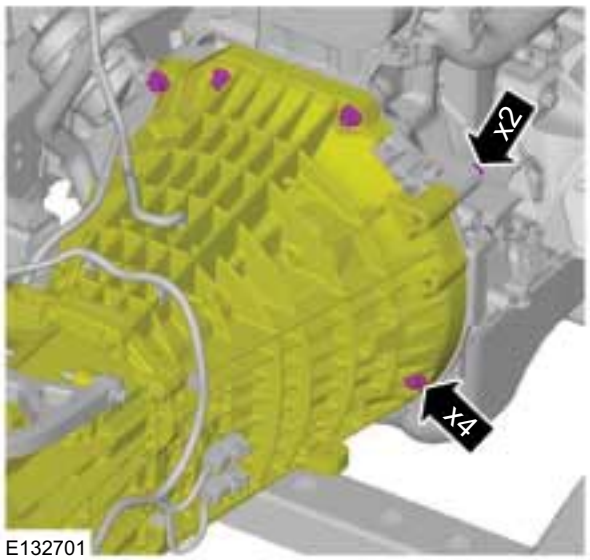


6. **NOTE:** Hand tighten the nut at this stage.



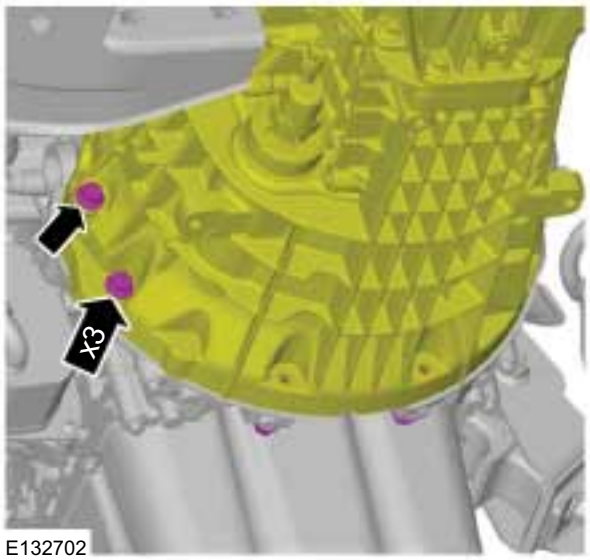
INSTALLATION

7. Initially hand tighten the fasteners.
Torque: 48 Nm



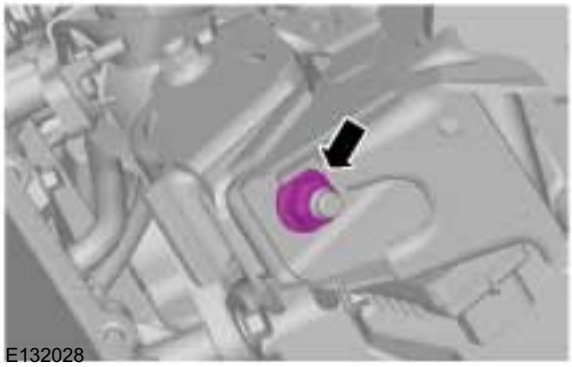
E132701

8. Initially hand tighten the fasteners.
Torque: 48 Nm

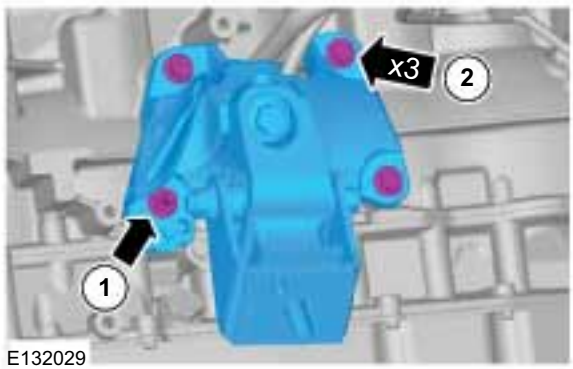


E132702

9. Torque: 80 Nm

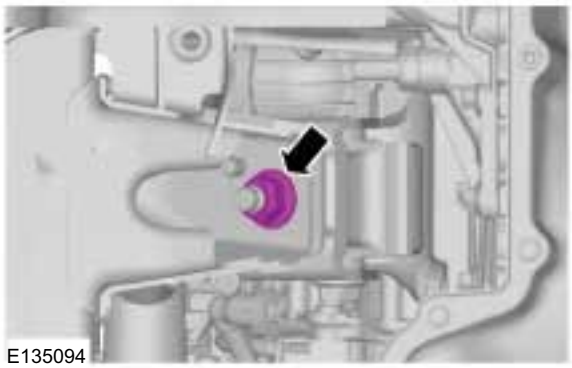

E132028

10. 1. Torque: 48 Nm
2. Torque: 48 Nm



E132029

11. Torque: 80 Nm

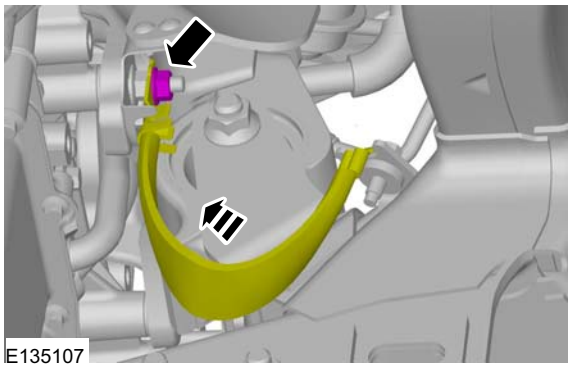

E135094

12. Remove the Special Tool(s): 303-122

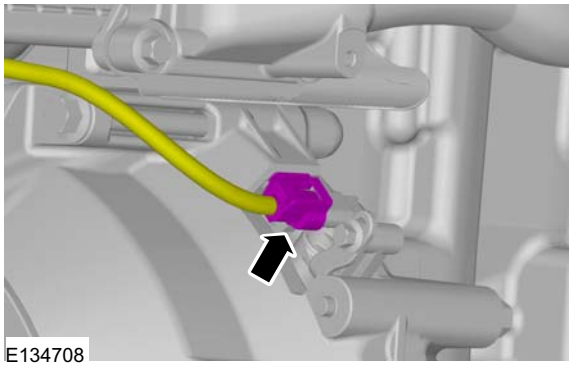
E68699

INSTALLATION

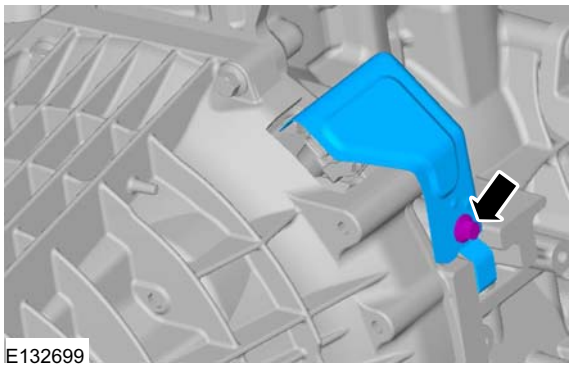
13. Torque: 13 Nm


E135107

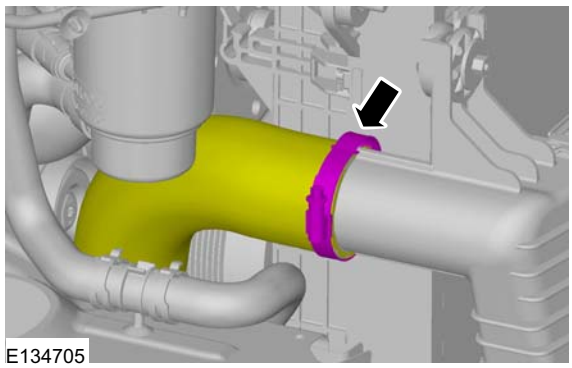
14.


E134708

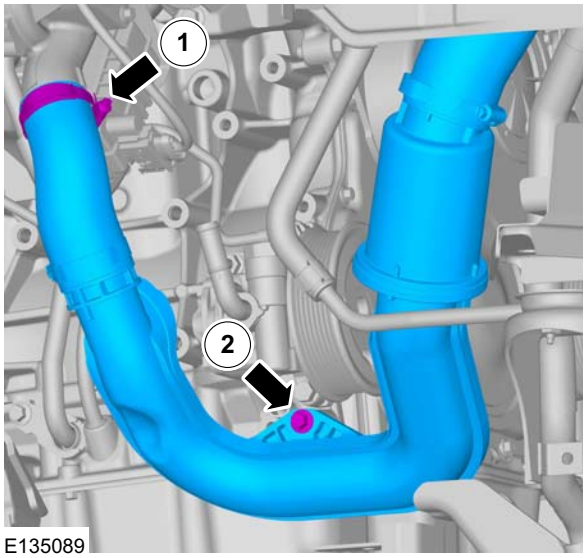
15. Torque: 22 Nm


E132699

16.


E134705

17. 2. Torque: 10 Nm

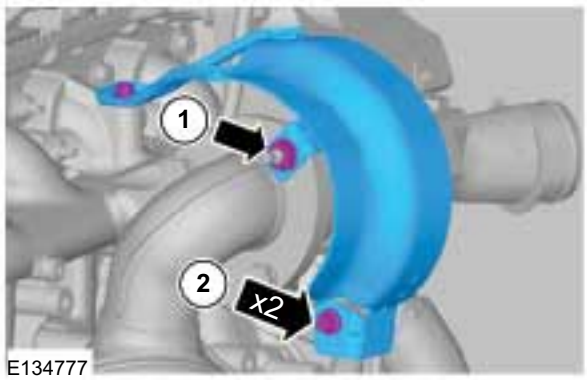


E135089

INSTALLATION

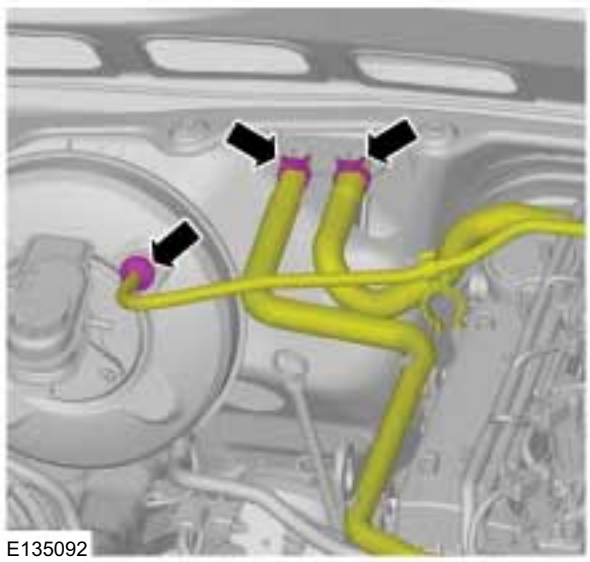
18. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

19. 1. Torque: 47 Nm
    2. Torque: 22 Nm

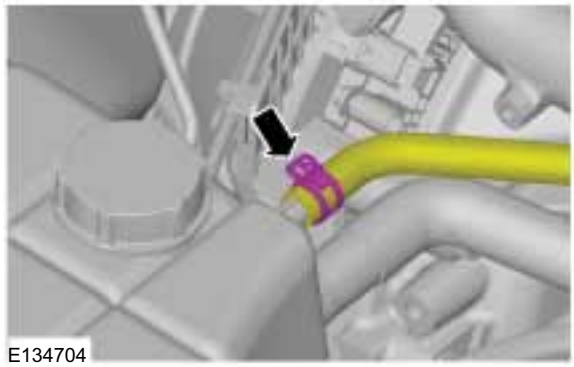


E134777

20.

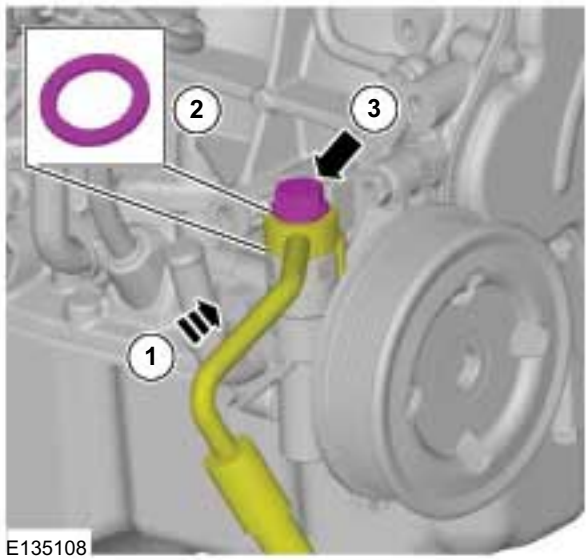

E135092

21.


E134704

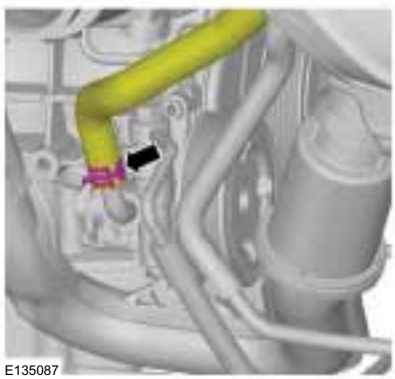
22. **NOTE:** The washers can be reused unless damaged.

    3. Torque: 35 Nm



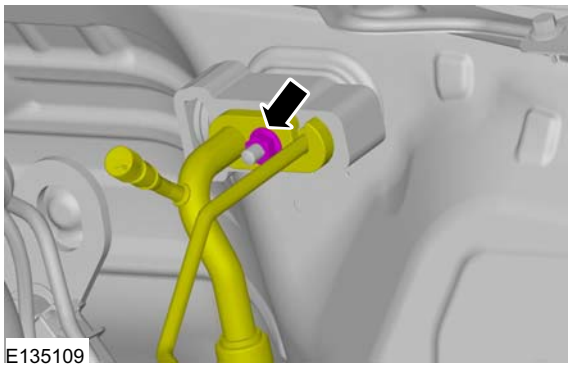
E135108

23.


E135087

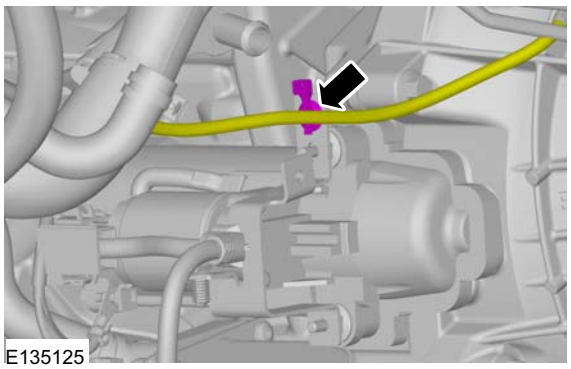
INSTALLATION

24. Torque: 22 Nm


E135109

25. Refer to: Starter Motor - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-06 Starting System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

26.


E135125

27. Refer to: Condenser - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (412-01 Climate Control, Removal and Installation).

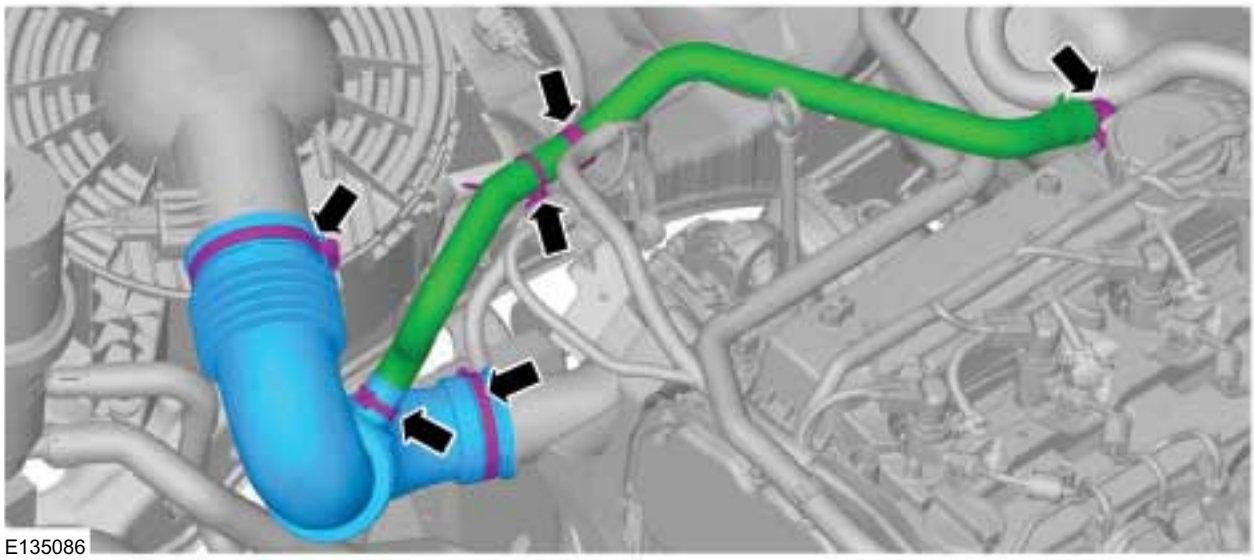
28. Refer to: Radiator (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

29. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

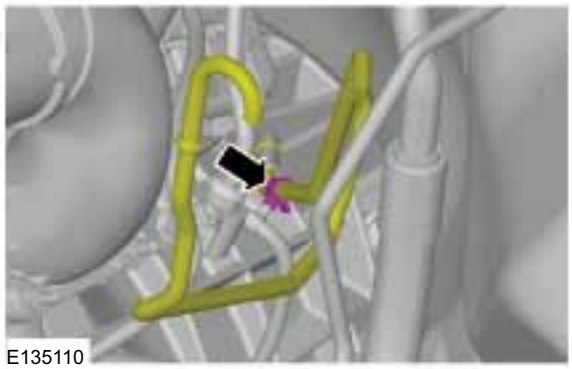
30. Refer to: Air Cleaner - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

31.

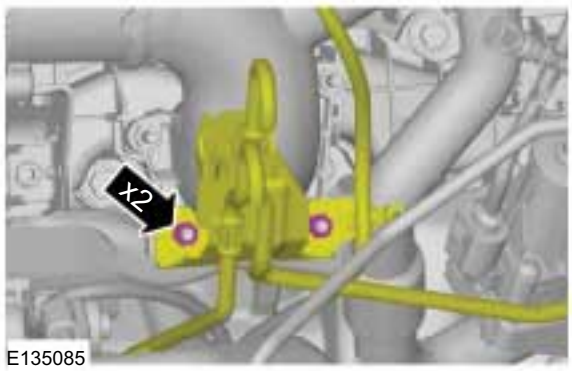
INSTALLATION



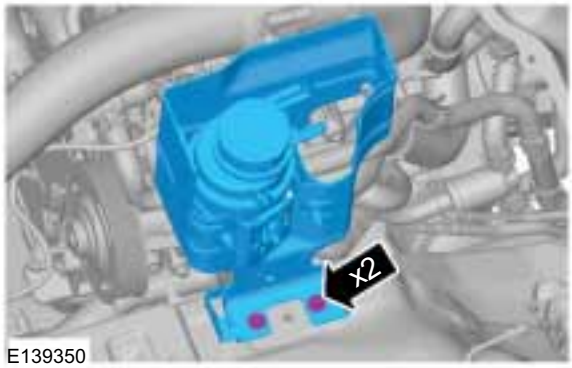
32.



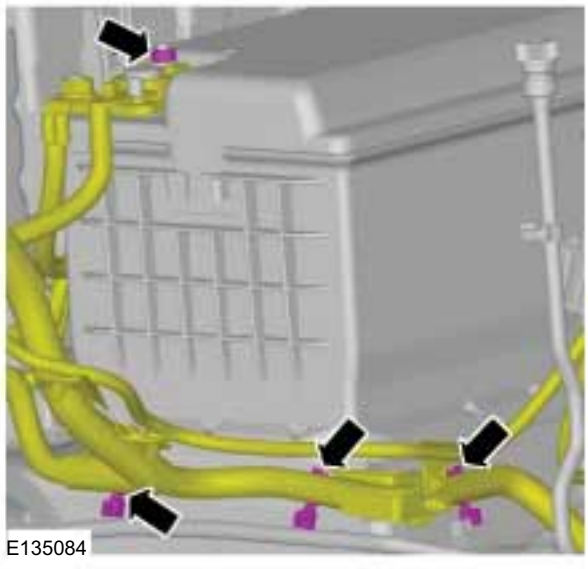
33. Torque: 10 Nm



34. Torque: 18 Nm

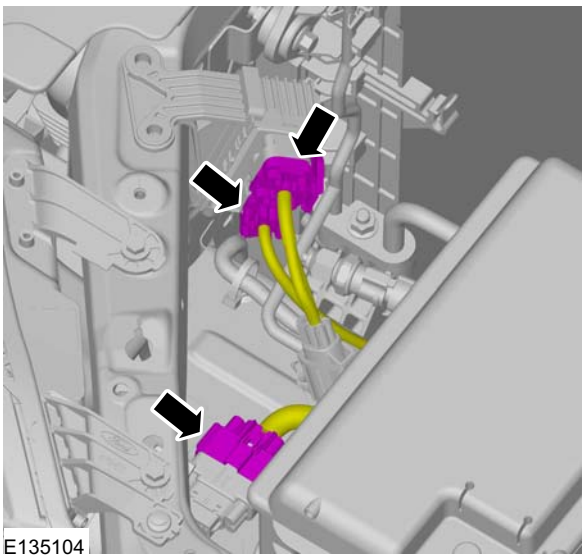


35. Torque: 5 Nm

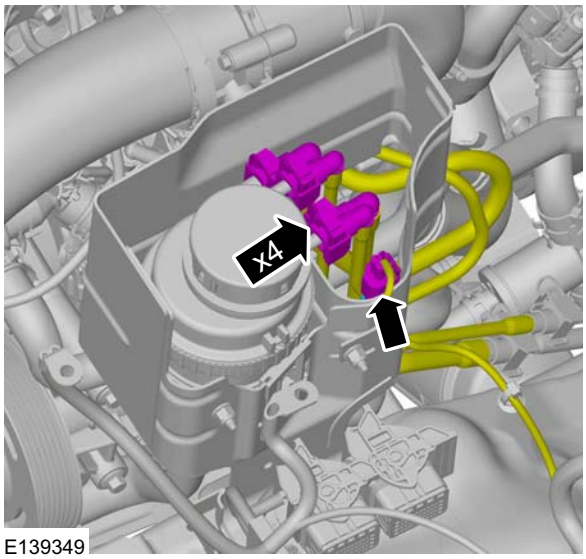


INSTALLATION

36.



37.



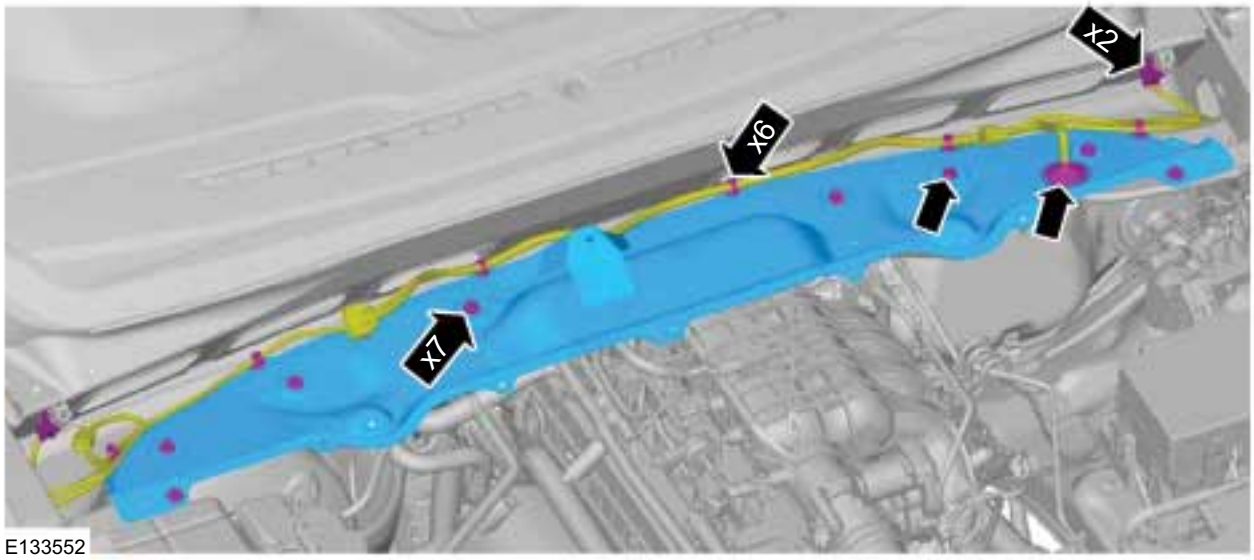
38. Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

39. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

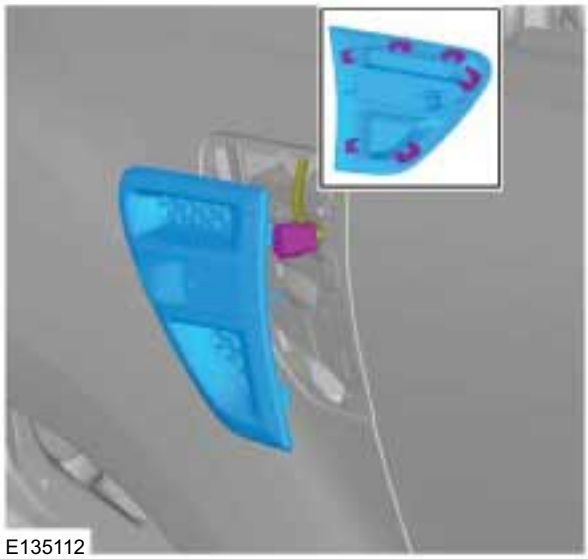
40. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

41. Torque: 10 Nm

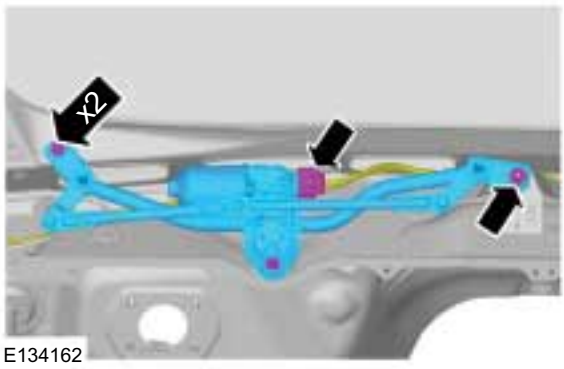
INSTALLATION



42. On both sides.

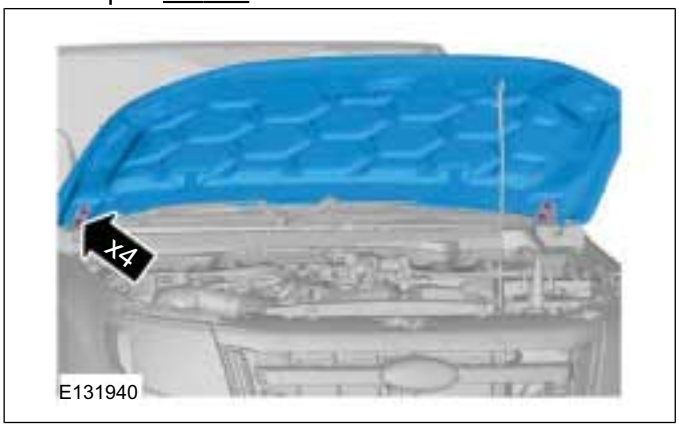


43. Torque: 10 Nm

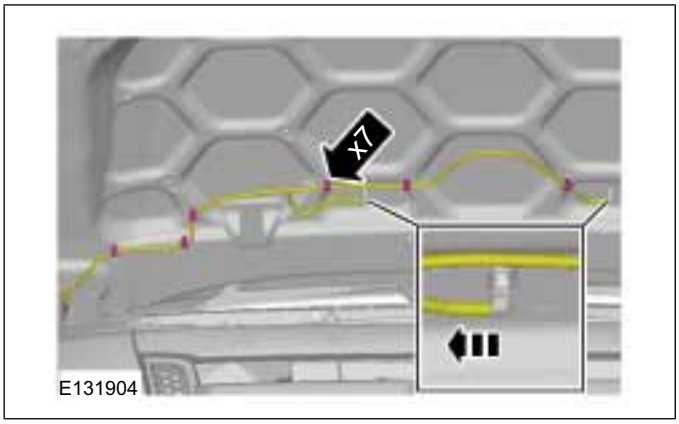


44. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

45. Torque: 25 Nm

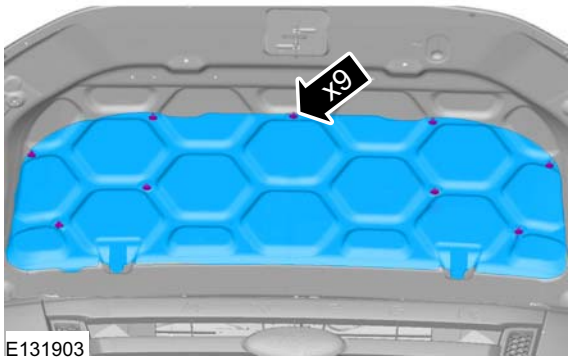


46.

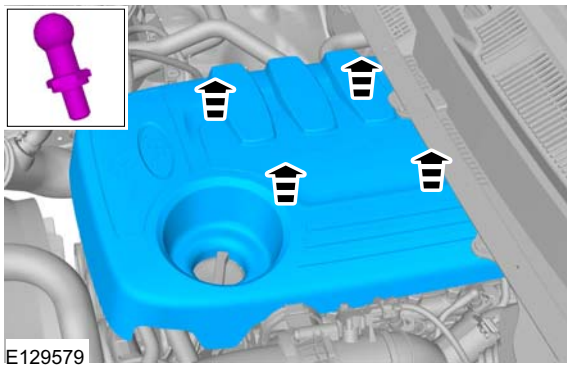


INSTALLATION

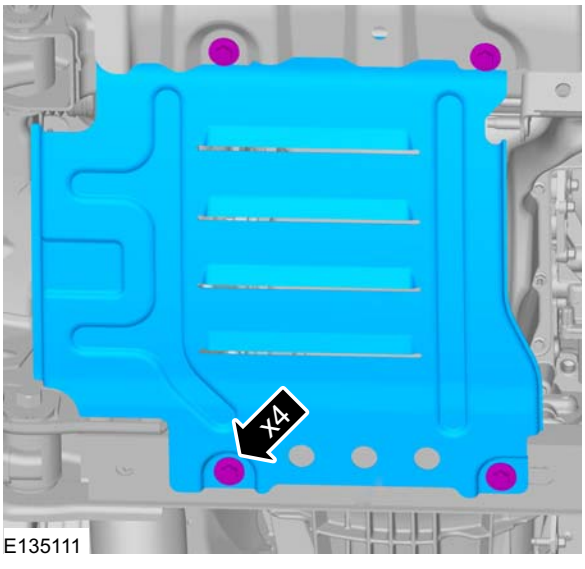
47.



48.



49. Torque: 30 Nm



50. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

51. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

52. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

INSTALLATION

Engine — Vehicles With: 6-Speed Automatic Transaxle - 6R80(21 132 0; 21 132 6; 21 132 7)

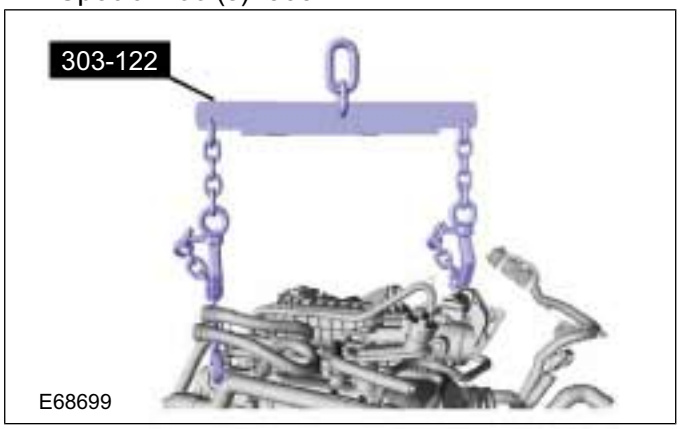
Installation

Special Tool(s)

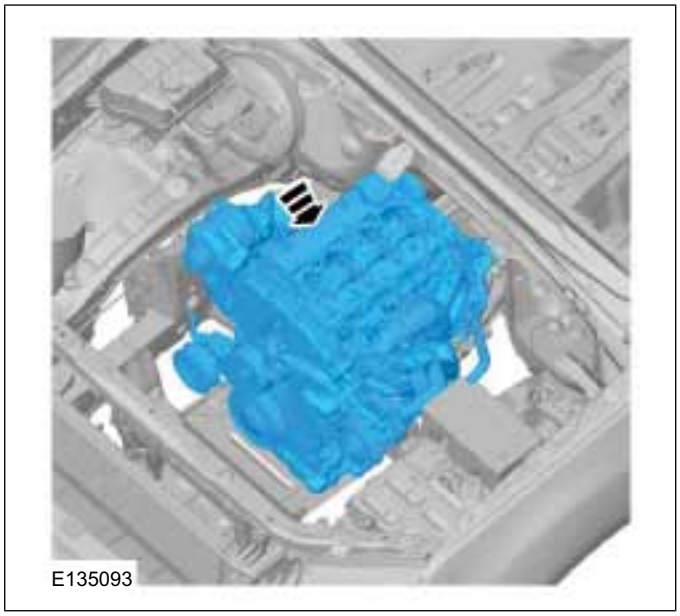
 21068A	303-122 Lifting Bracket, Engine

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

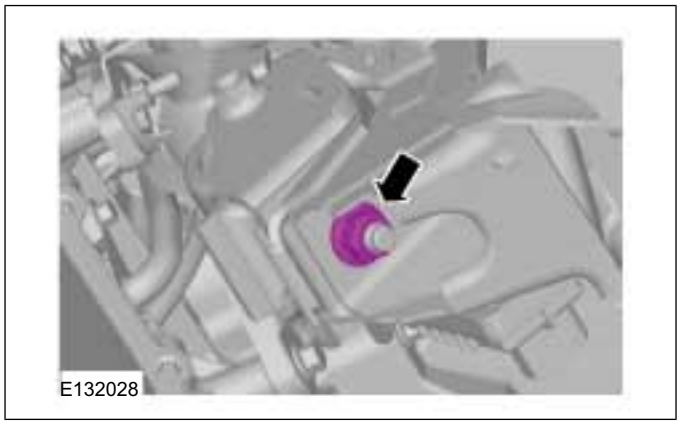
2. Special Tool(s): 303-122



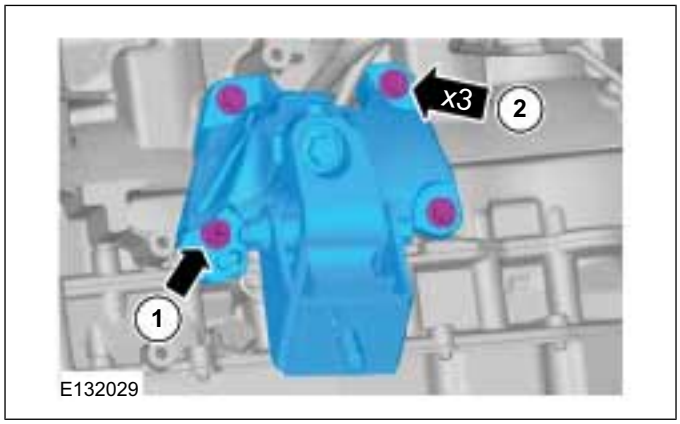
3.



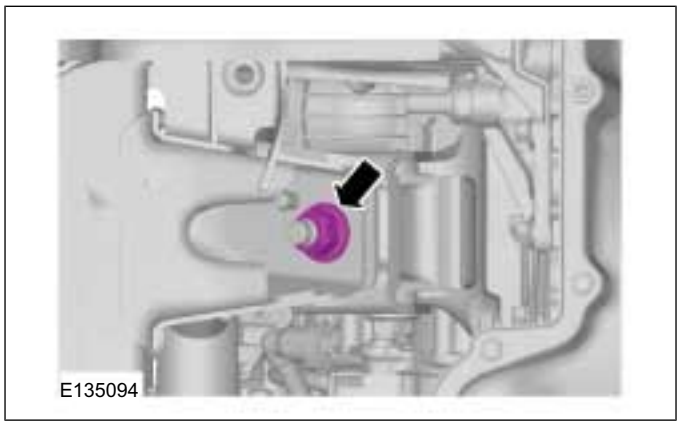
4. **NOTE:** Hand tighten the nut at this stage.



5. **NOTE:** Hand tighten the nut at this stage.

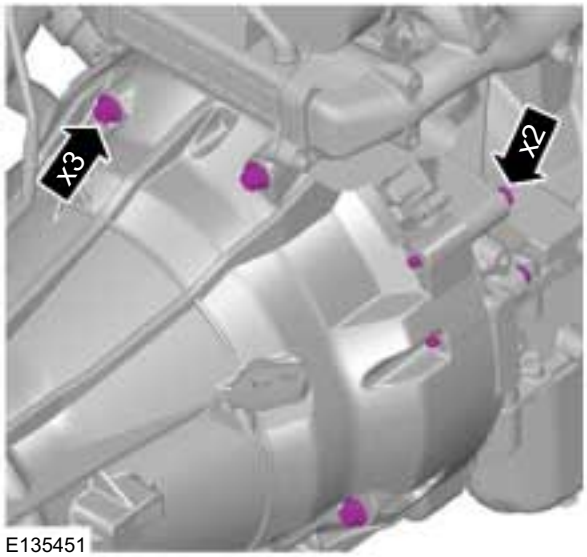


6. **NOTE:** Hand tighten the nut at this stage.



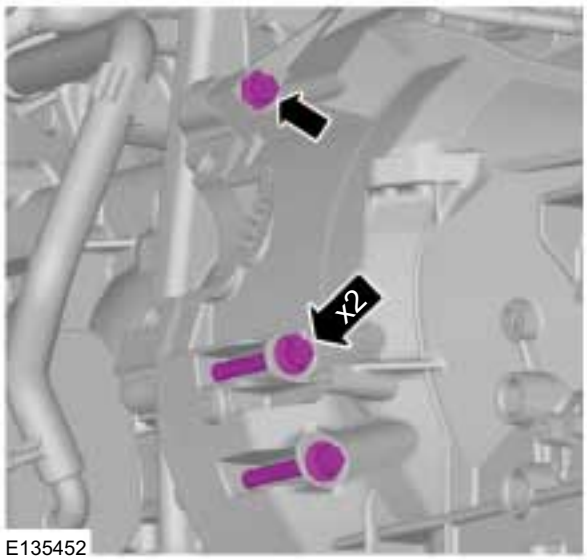
INSTALLATION

7. Initially hand tighten the fasteners.
Torque: 48 Nm



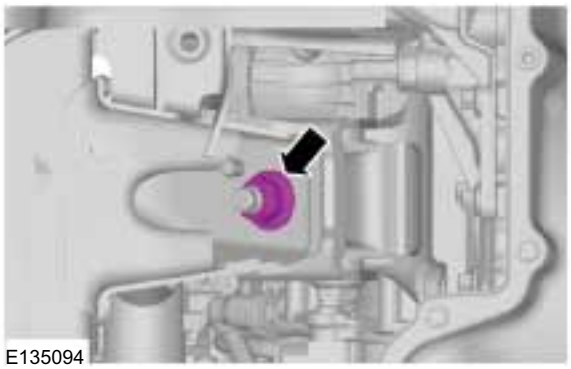
E135451

8. Initially hand tighten the fasteners.
Torque: 48 Nm

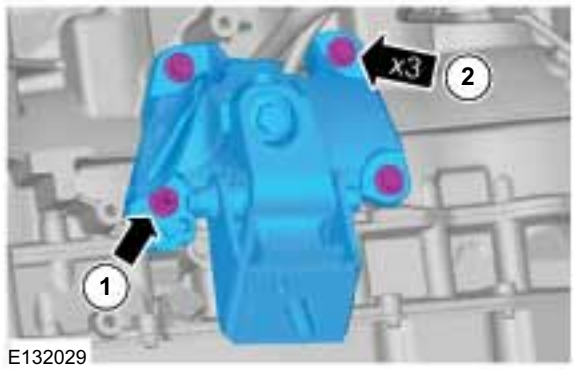


E135452

9. Torque: 80 Nm

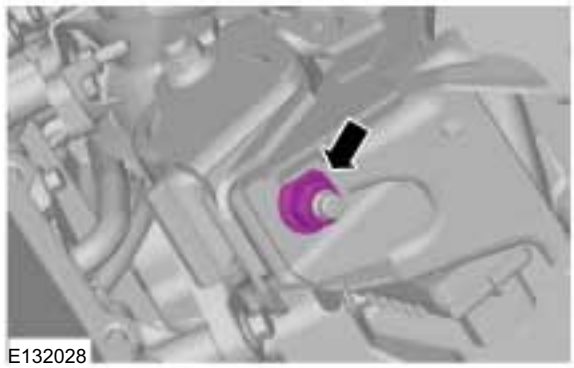

E135094

10. 1. Torque: 48 Nm
2. Torque: 48 Nm



E132029

11. Torque: 80 Nm

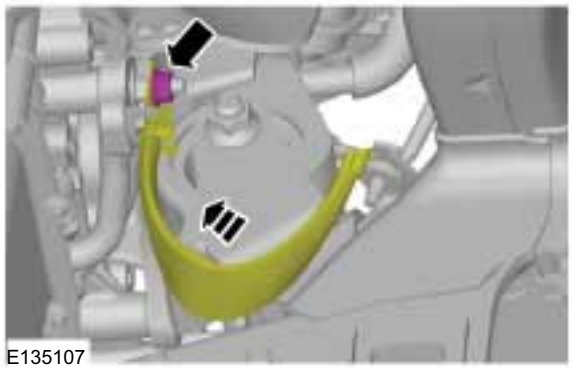

E132028

12. Remove the Special Tool(s): 303-122

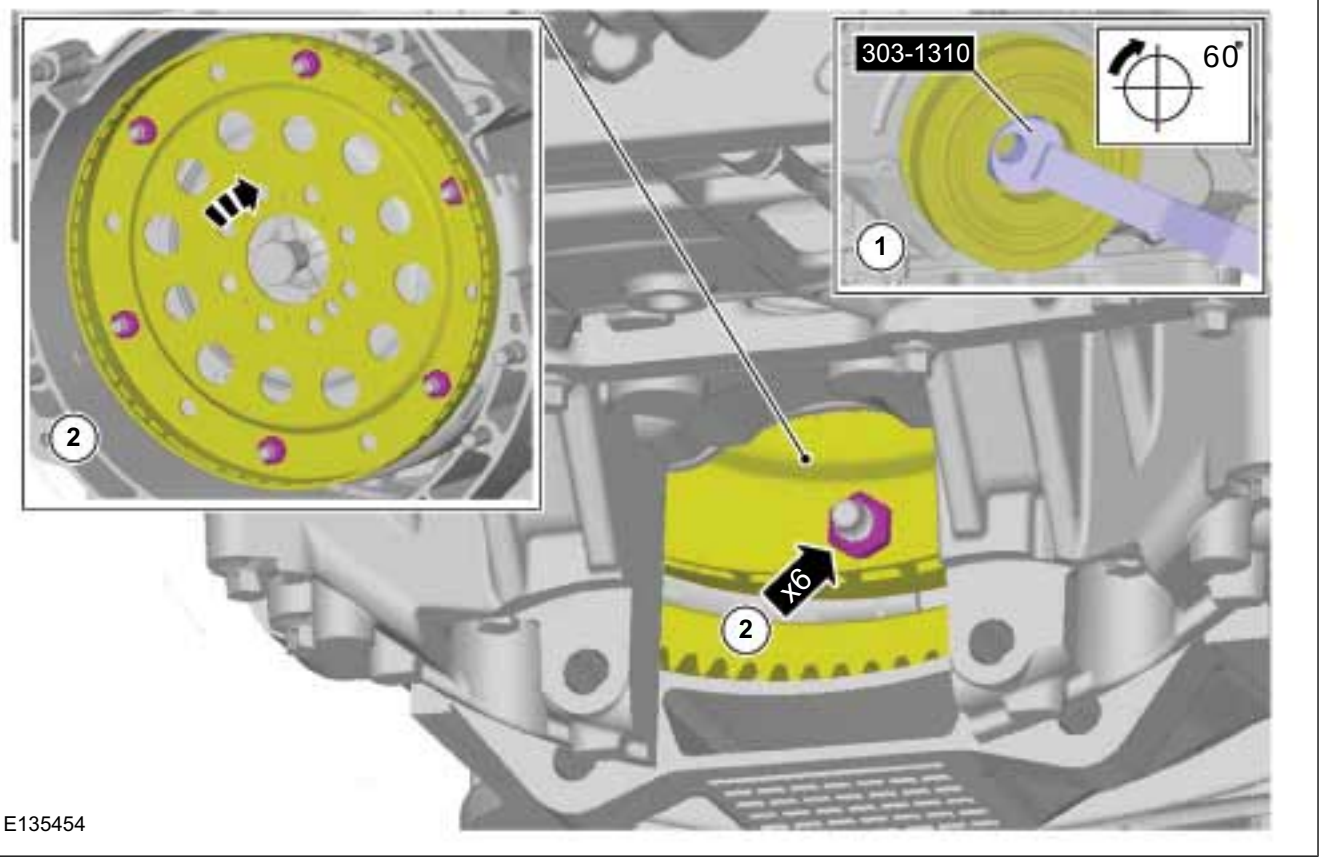
E68699

INSTALLATION

13. Torque: 13 Nm

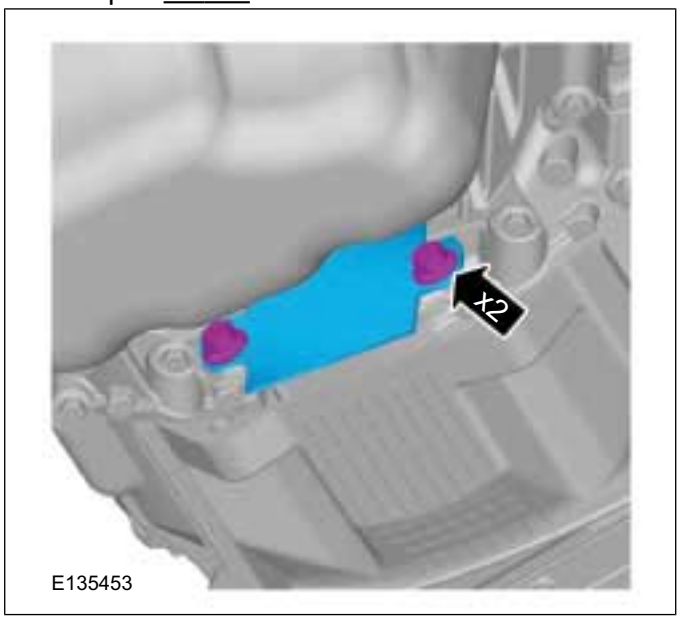


14. Torque: 40 Nm

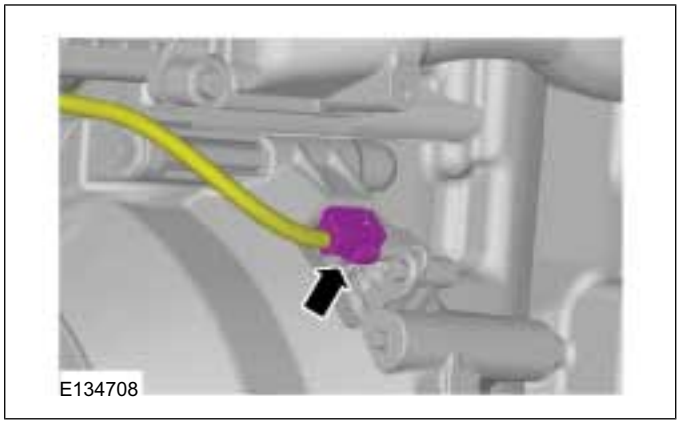


INSTALLATION

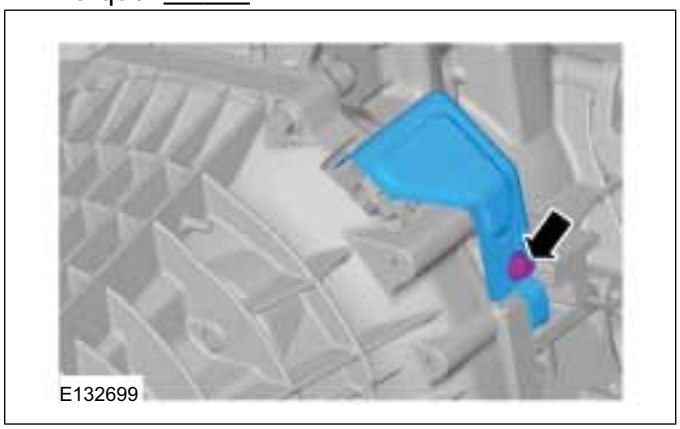
15. Torque: 22 Nm



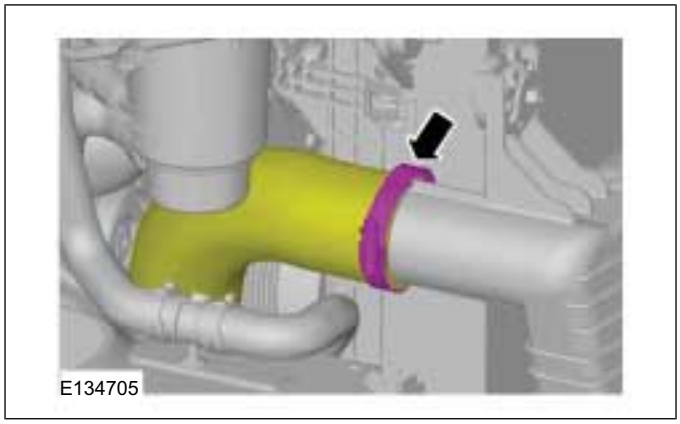
16.



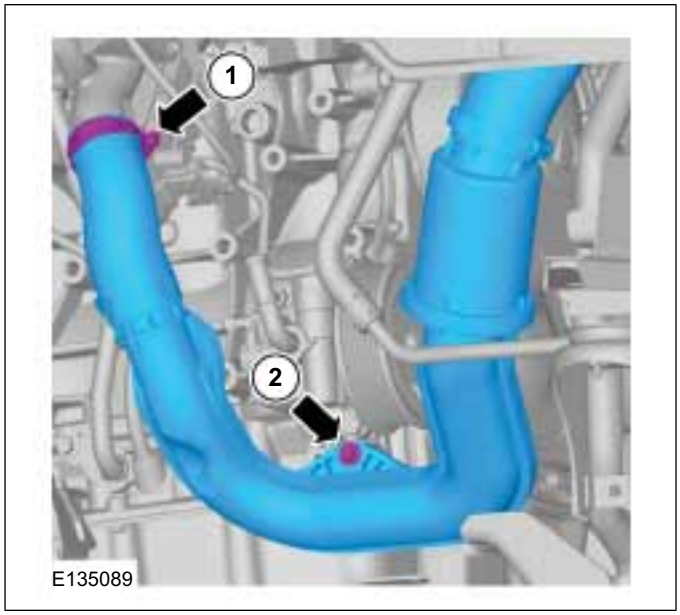
17. Torque: 22 Nm



18.

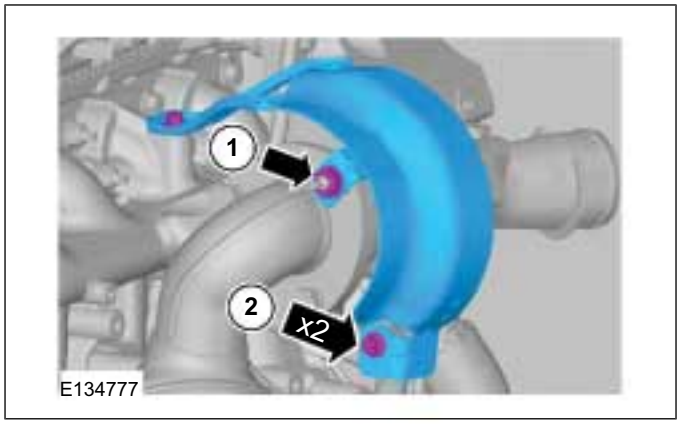


19. 2. Torque: 10 Nm



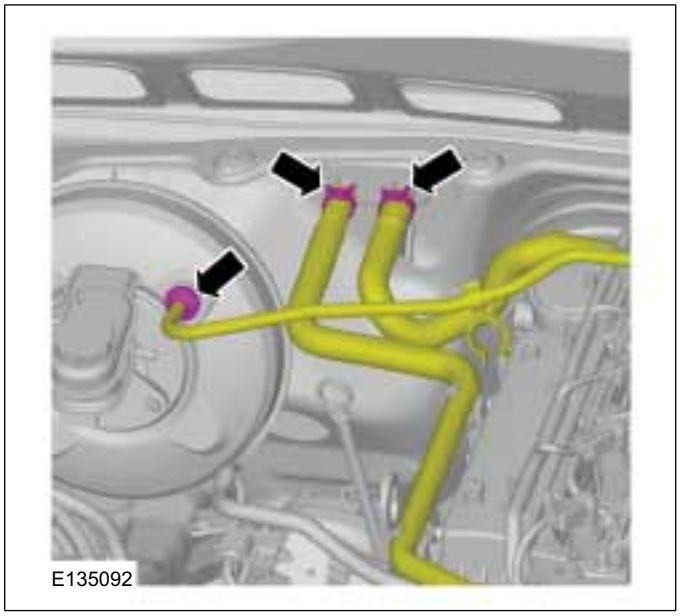
20. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

21. 1. Torque: 47 Nm
2. Torque: 22 Nm

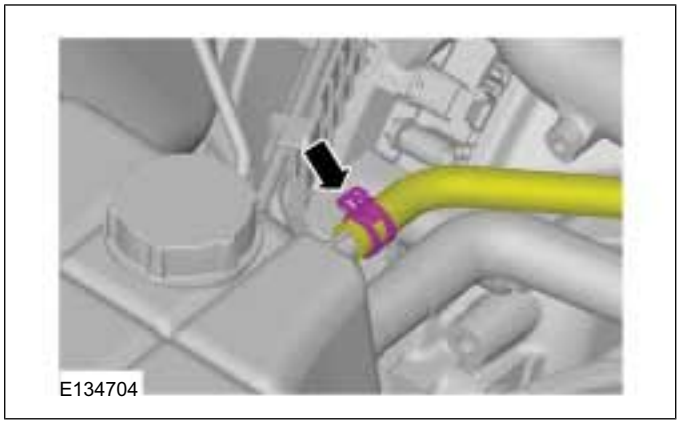


INSTALLATION

22.

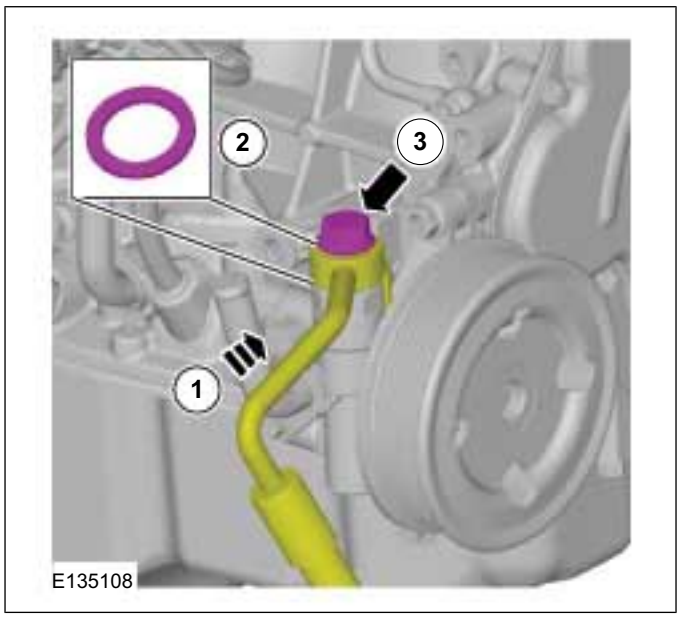


23.

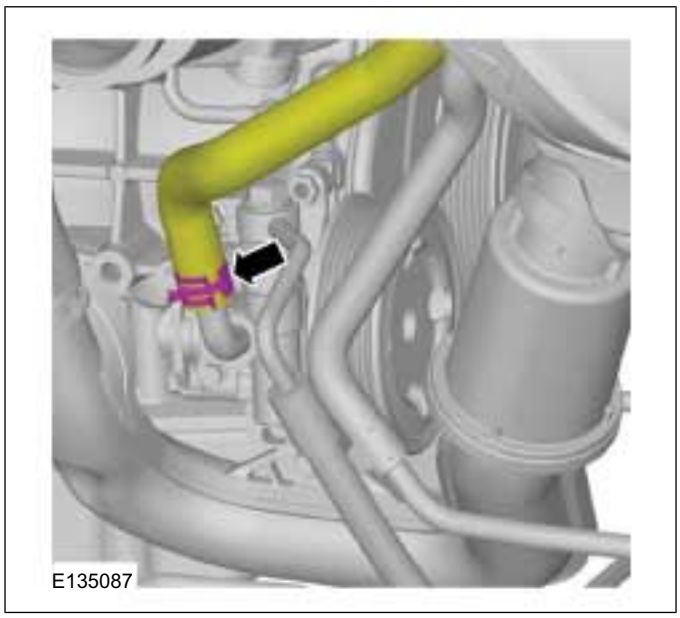


24. **NOTE:** The washers can be reused unless damaged.

3. Torque: 35 Nm



25.



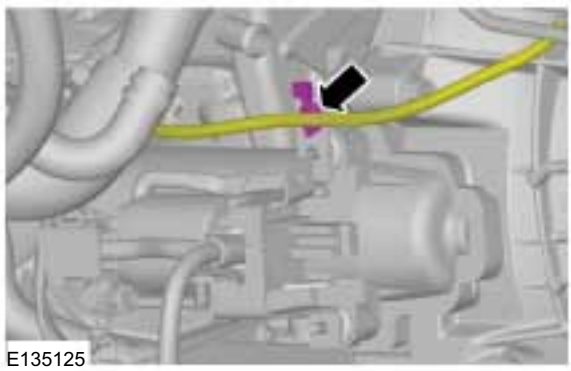
INSTALLATION

26. Torque: 22 Nm


E135109

27. Refer to: Starter Motor - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-06 Starting System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

28.


E135125

29. Refer to: Transmission Fluid Cooler (307-02 Transmission/Transaxle Cooling, Removal and Installation).

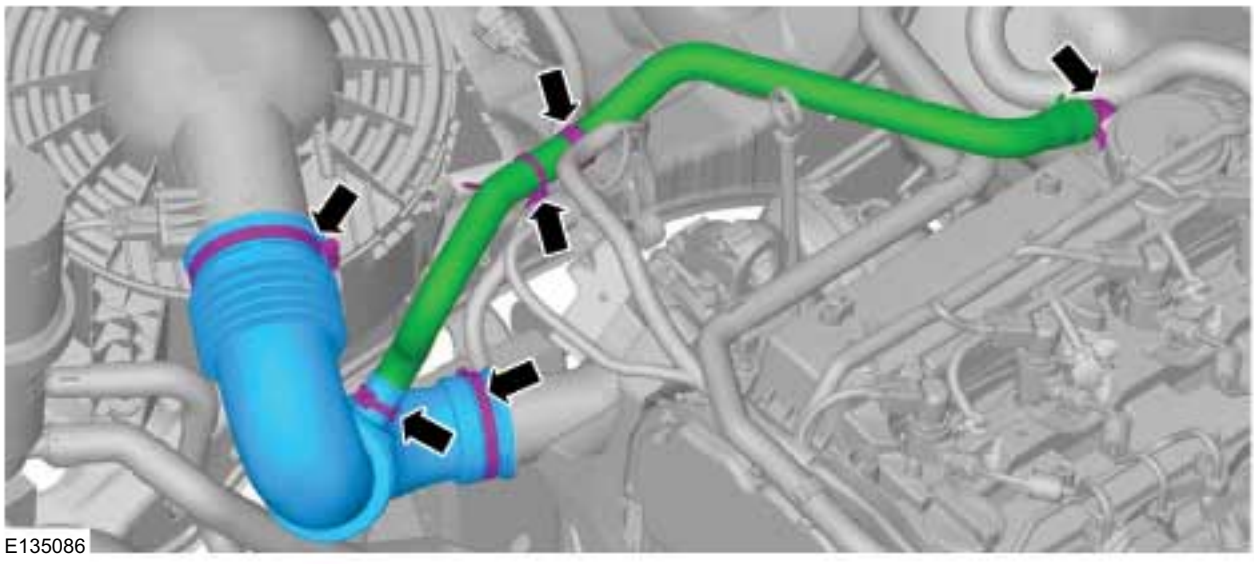
30. Refer to: Condenser - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (412-01 Climate Control, Removal and Installation).

31. Refer to: Radiator (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

32. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

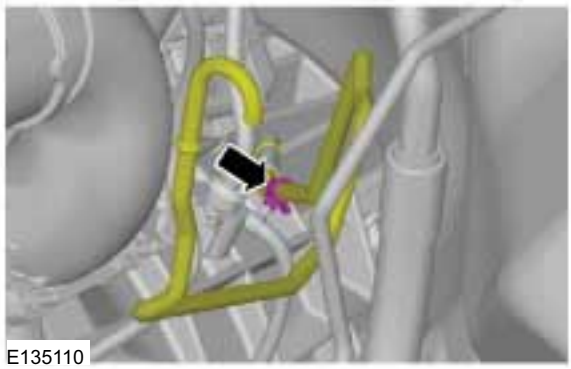
33. Refer to: Air Cleaner - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

34.

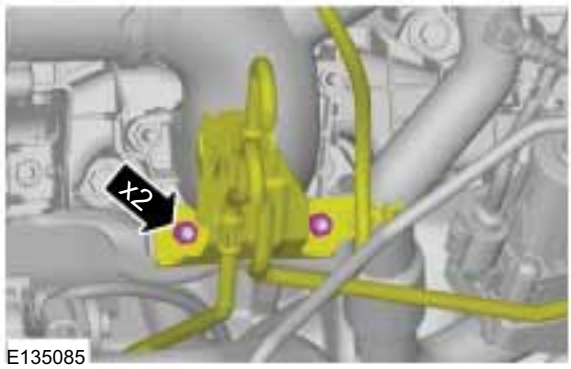

E135086

INSTALLATION

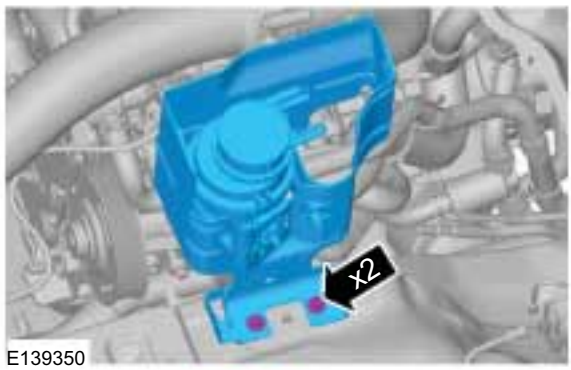
35.



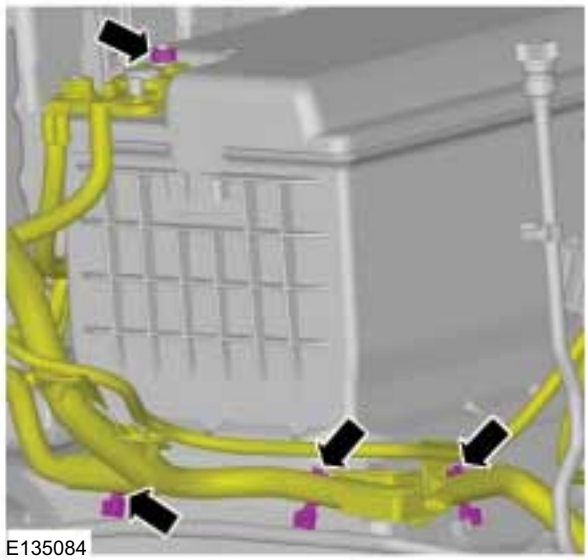
36. Torque: 10 Nm



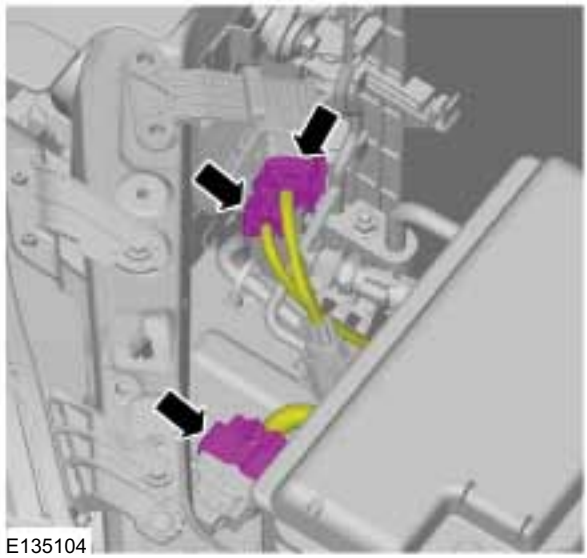
37. Torque: 18 Nm



38. Torque: 5 Nm

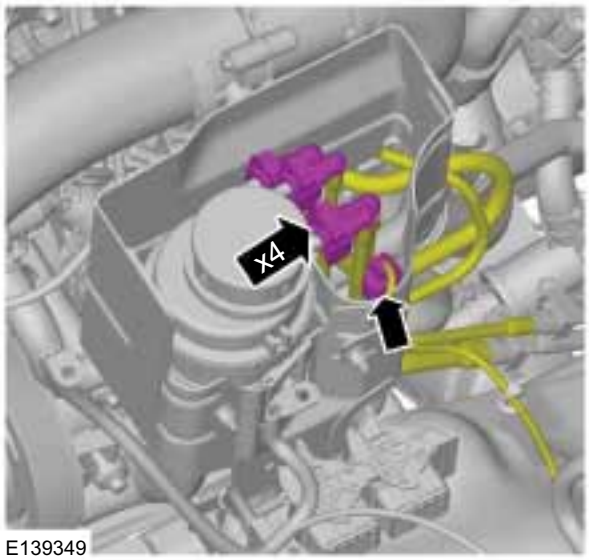


39.



INSTALLATION

40.



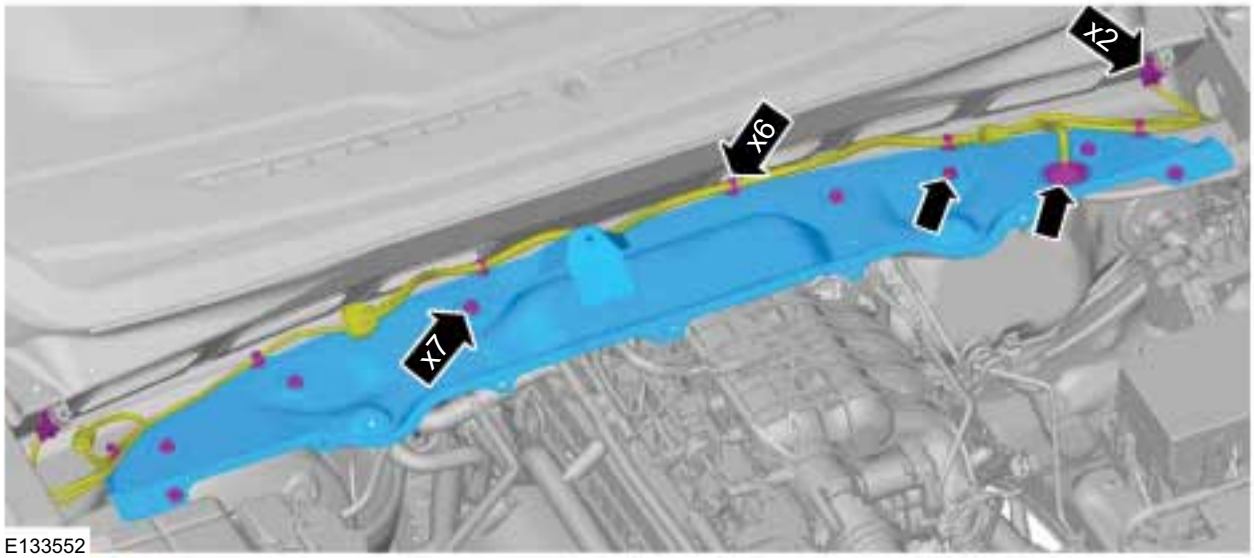
E139349

41. Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

42. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

43. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

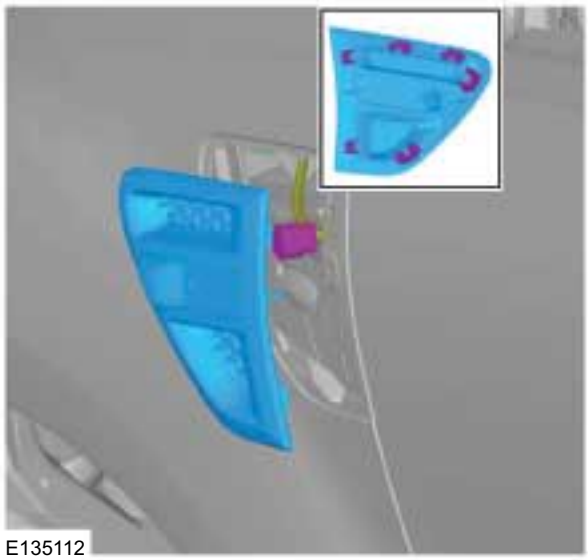
44. Torque: 10 Nm



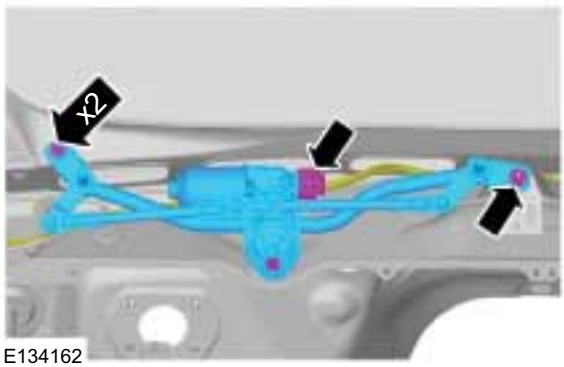
E133552

INSTALLATION

45. On both sides.


E135112

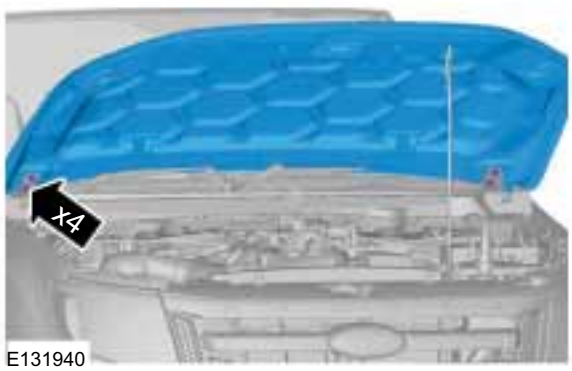
46. Torque: 10 Nm



E134162

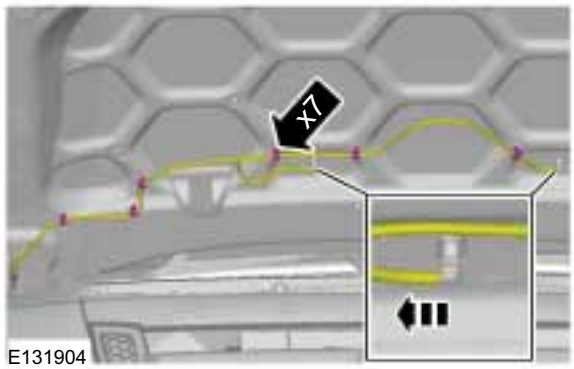
47. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

48. Torque: 25 Nm



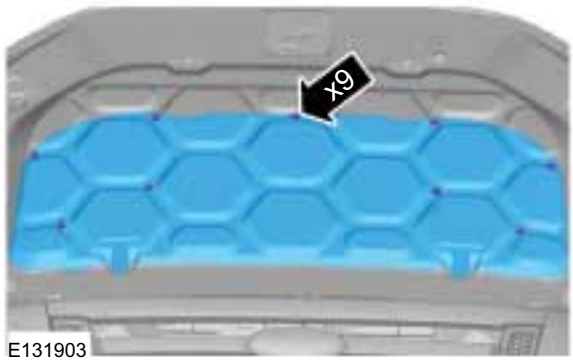
E131940

49.



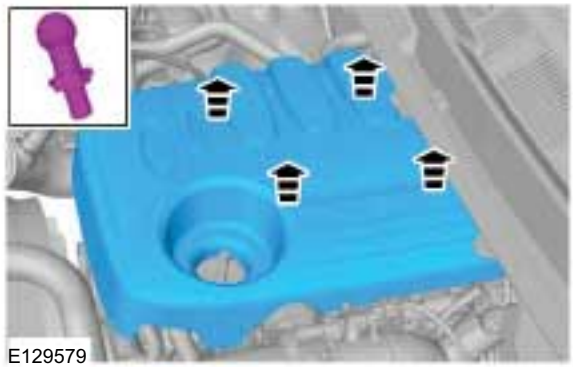
E131904

50.



E131903

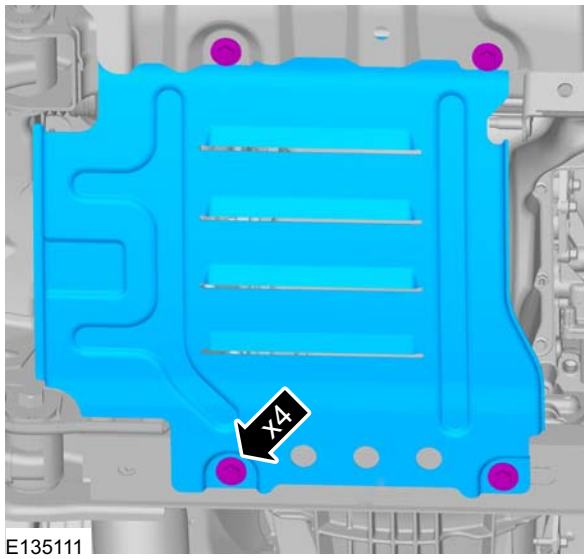
51.


E129579

INSTALLATION

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

53. Torque: 30 Nm



54. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

55. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

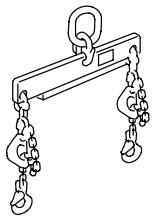
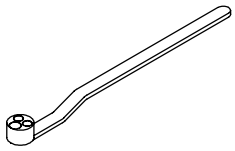
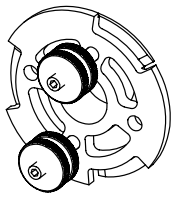
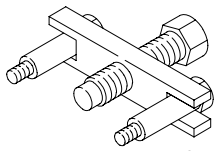
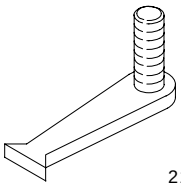
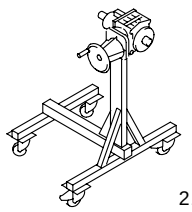
56. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

INSTALLATION

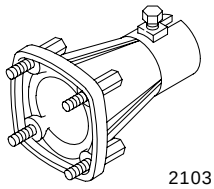
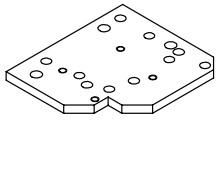
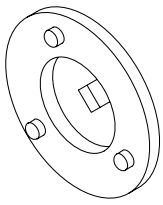
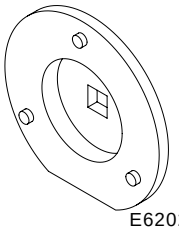
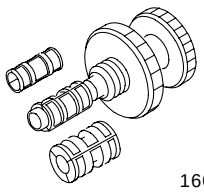
Engine Accessories(21 139 4)

Installation

Special Tool(s) / General Equipment

 21068A	303-122 Lifting Bracket, Engine
 E87614	303-1310 Holding Wrench, Crankshaft
 E75376	303-1317 Locking Tool, Fuel Injection Pump Sprocket
 21132	303-249 Remover, Crankshaft Timing Pulley
 21135	303-254 Locking Tool, Flywheel
 21187	303-435 Mounting Stand

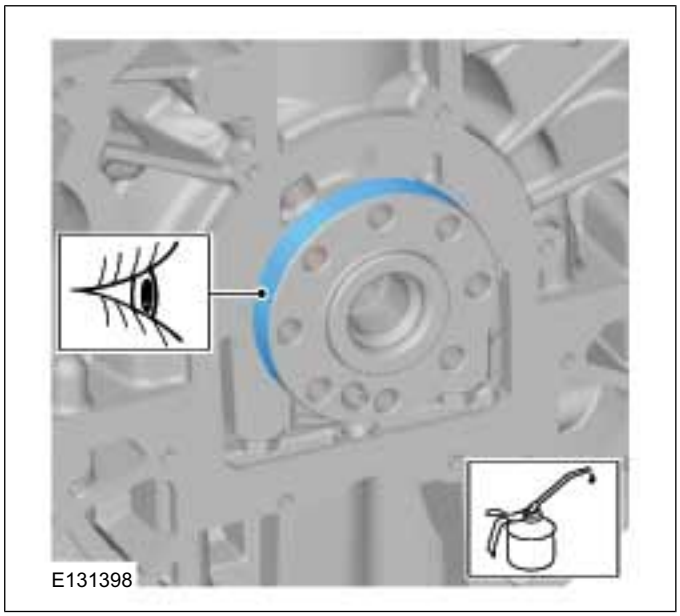
Special Tool(s) / General Equipment

 21031B	303-435-06 Mounting Bracket for 303-435
 E68386	303-435-11B Mounting Plate for 303-435-06
 303679	303-679 Remover/Installer, Engine Front Cover Inspection Plate
 E62024	303-679A Remover/Installer, Engine Front Cover Inspection Plate
 16067	308-204 Aligner, Clutch Disc
1/2 Inch Square Drive Breaker Bar	
Dowel with a Diameter of 6 mm	

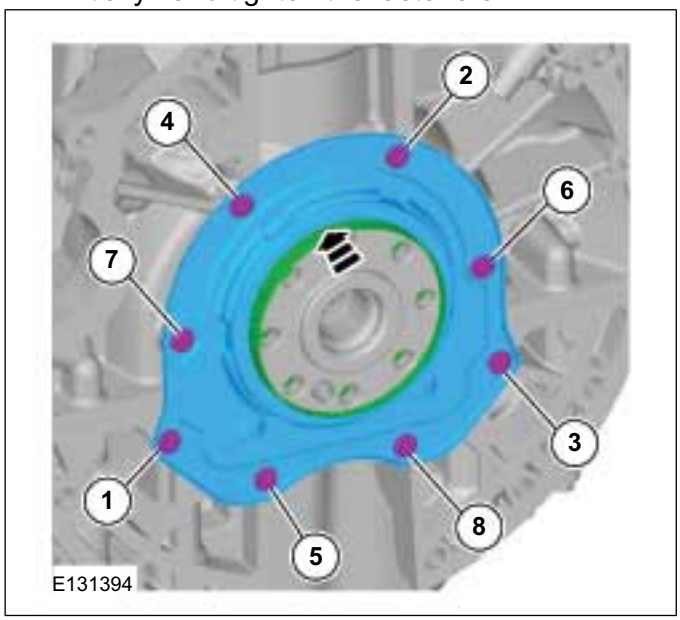
Materials	
Name	**Specification**
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

INSTALLATION

1.

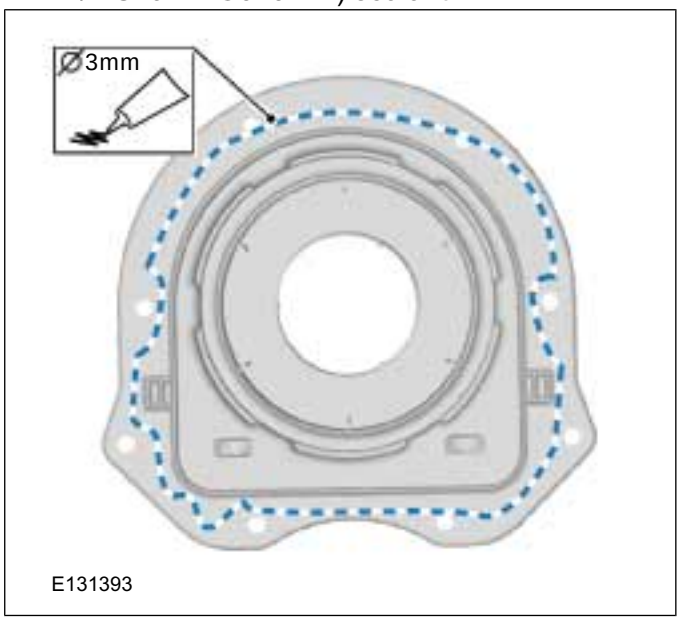


Initially hand tighten the fasteners.



2. **NOTE:** Install the new crankshaft rear seal carrier within five minutes of applying the recommended sealant.

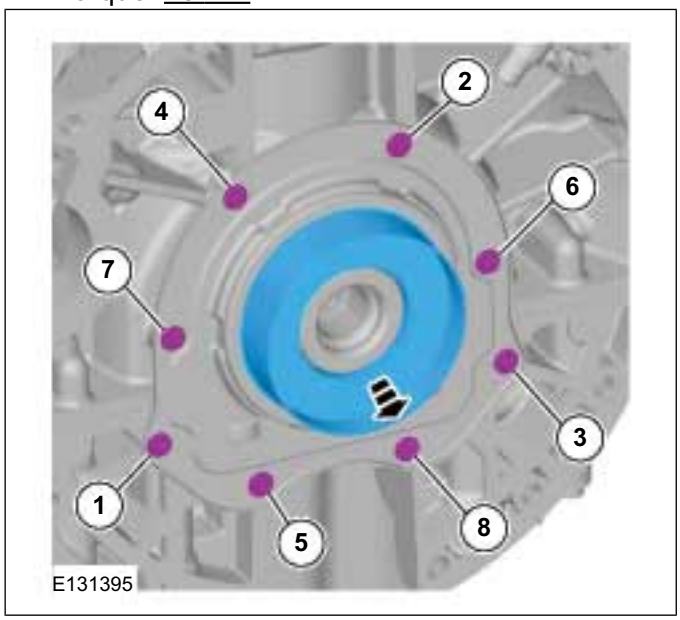
   Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



3. ⚠ **CAUTION: A new crankshaft rear seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft rear seal is fully installed. Failure to follow this instruction may result in damage to the vehicle.**

4. **NOTE:** New crankshaft rear seal carriers are supplied with an alignment sleeve which must be removed after installation.

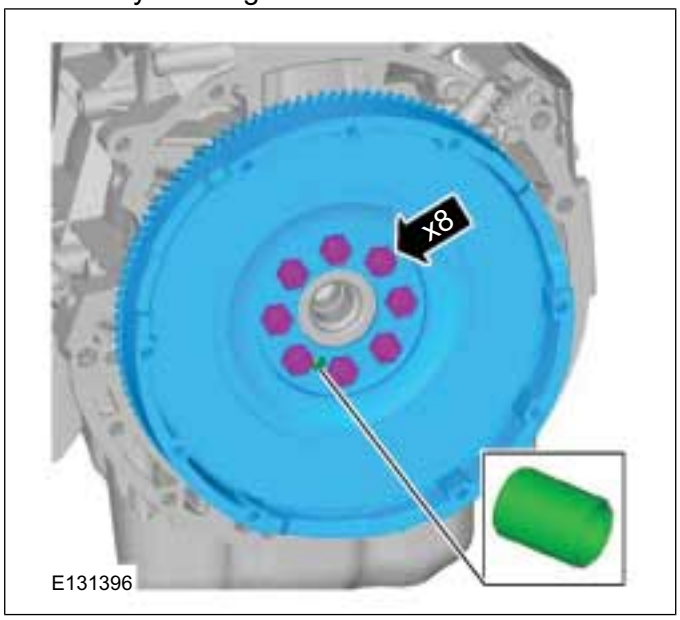
   Torque: 10 Nm



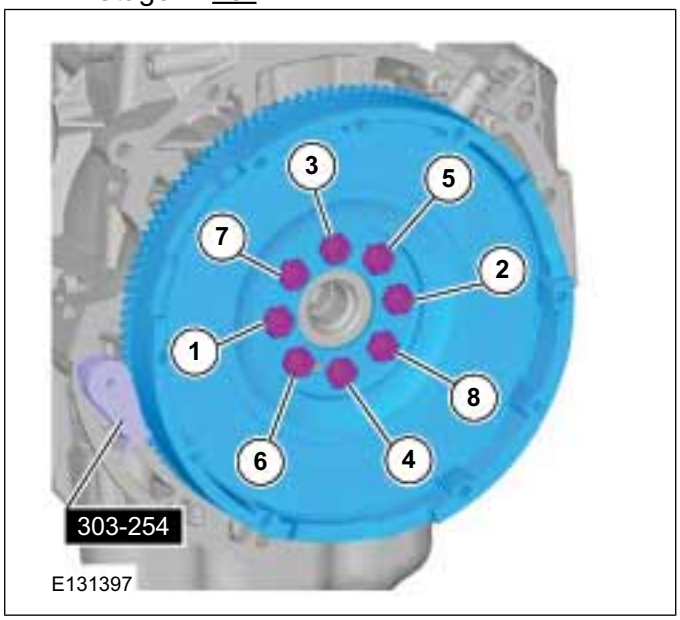
5. **NOTE:** Make sure that the flywheel is in full contact with the crankshaft flange before installing the flywheel bolts.

INSTALLATION

Initially hand tighten the fasteners.

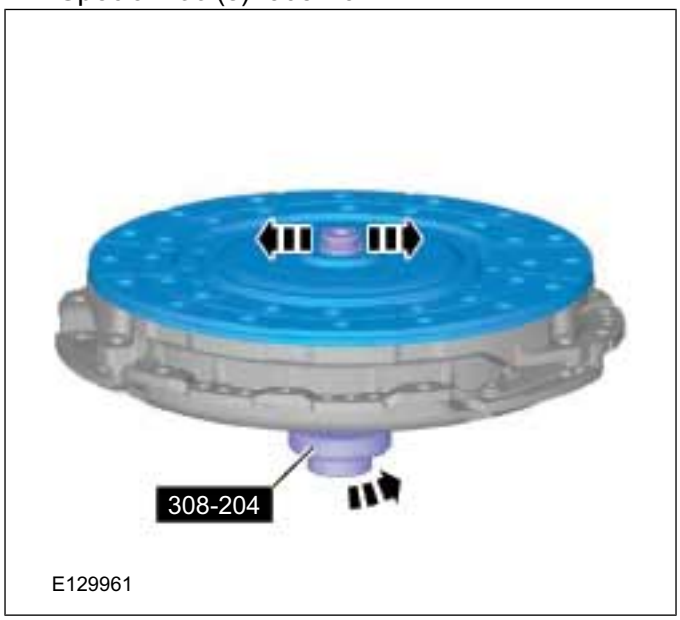


6. Special Tool(s): 303-254
   Torque:
   - Stage 1: 15 Nm
   - Stage 2: 30 Nm
   - Stage 3: 75 Nm
   - Stage 4: 45°



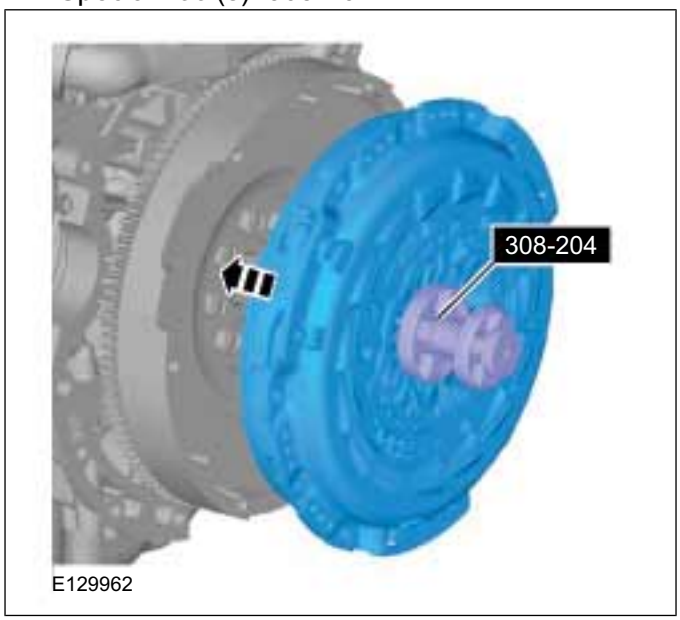
7. **NOTE:** The cone on the special tool must only be tightened finger tight to prevent damage to the clutch disc.

   Special Tool(s): 308-204



8. **NOTE:** Only tighten the bolt finger tight at this stage.

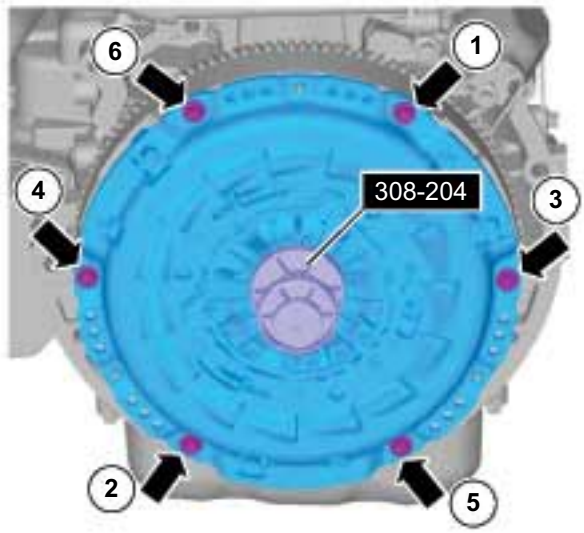
   Special Tool(s): 308-204



INSTALLATION

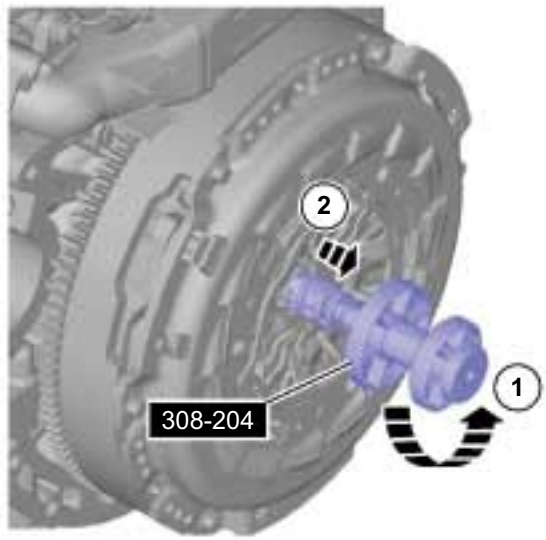
9. ⚠ **CAUTION: Tighten the clutch pressure plate retaining bolts by two turns at a time in the sequence shown.**

Special Tool(s): 308-204
Torque: 45 Nm



E129963

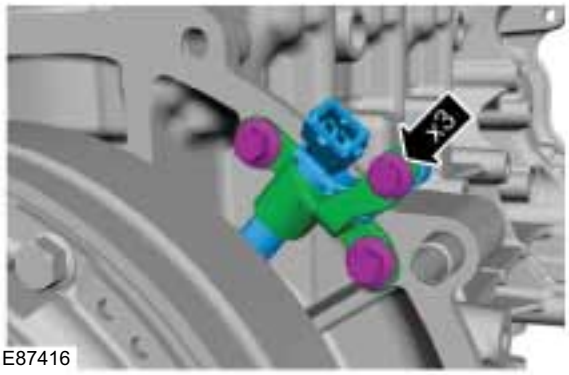
10. Remove the Special Tool(s): 308-204



E129984

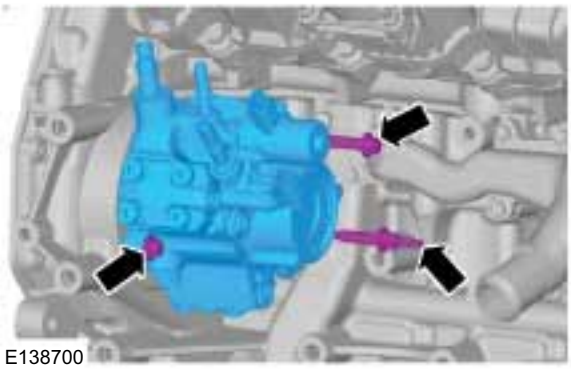
11. **NOTE:** Make sure that a new component is installed.

Torque: 7 Nm

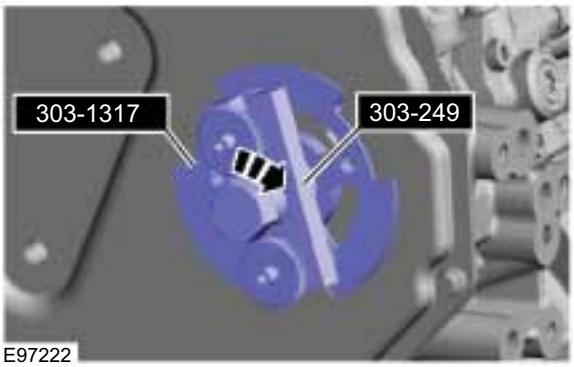


E87416

12. Torque: 25 Nm


E138700

13. Remove the Special Tool(s): 303-249

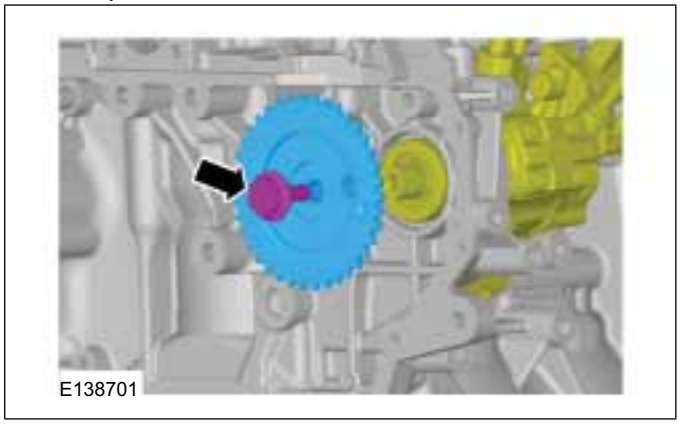


E97222

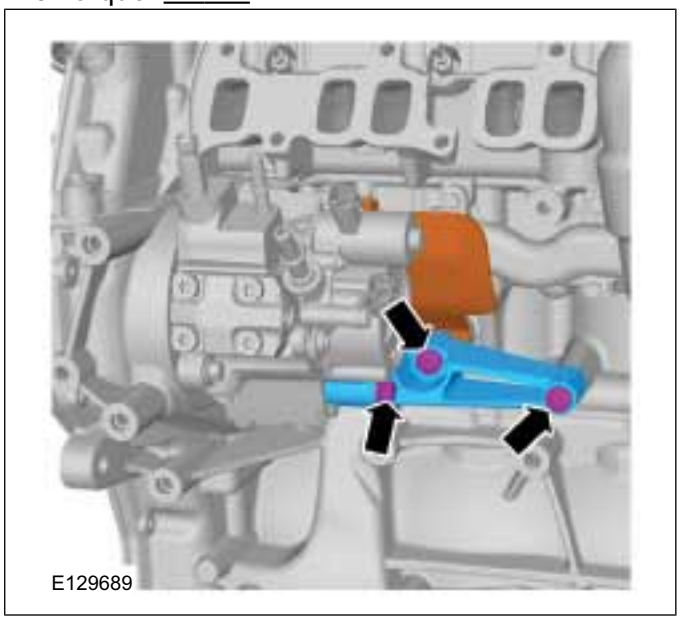
INSTALLATION

14. **NOTE:** Make sure that a new component is installed.

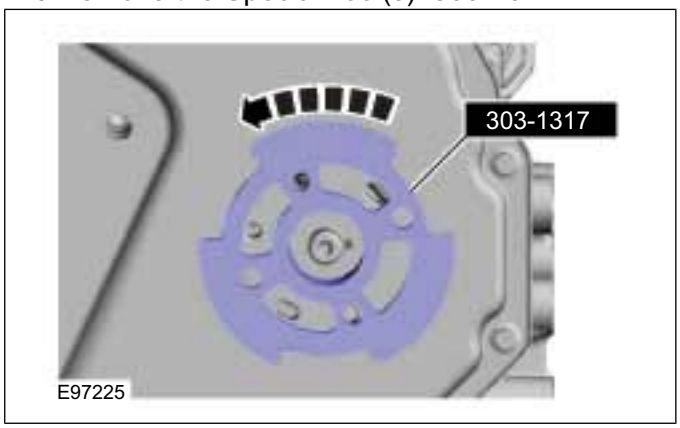
    Torque: 45 Nm



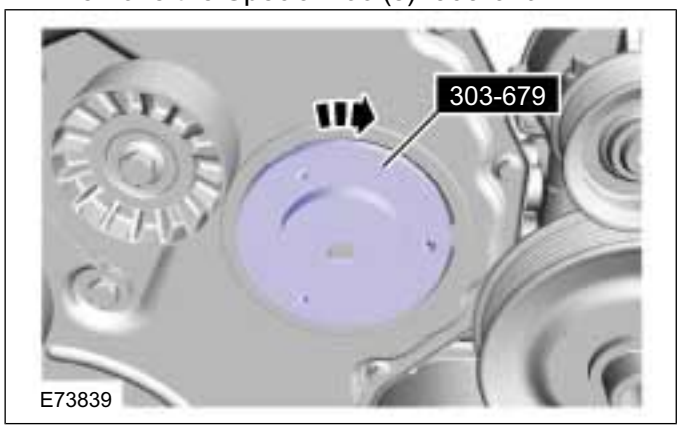
15. Torque: 22 Nm



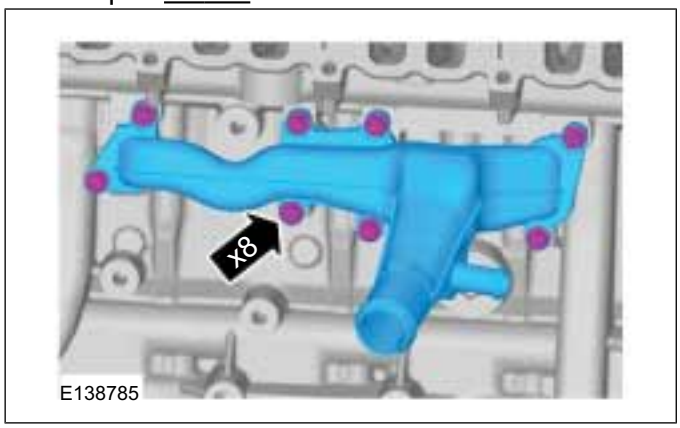
16. Remove the Special Tool(s): 303-1317



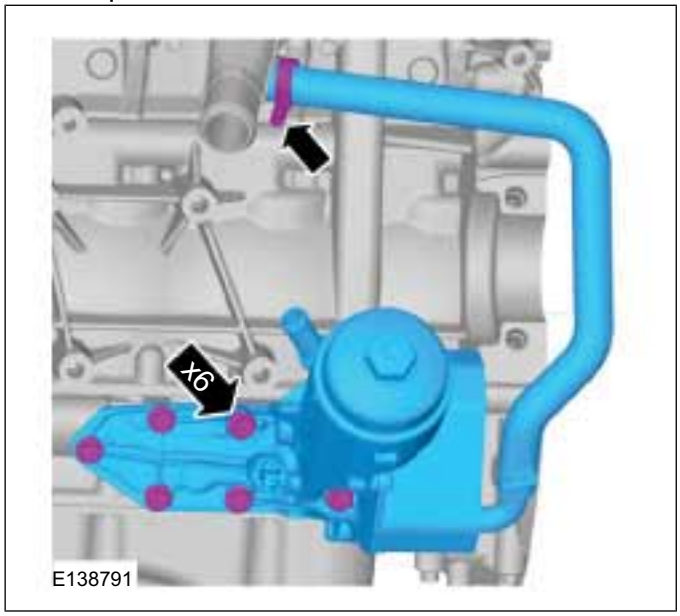
17. Remove the Special Tool(s): 303-679



18. Torque: 12 Nm

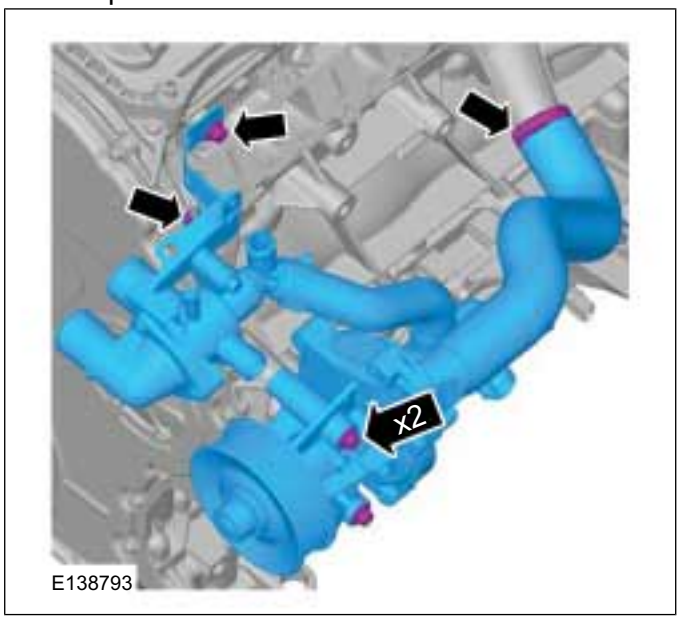


19. Torque: 23 Nm

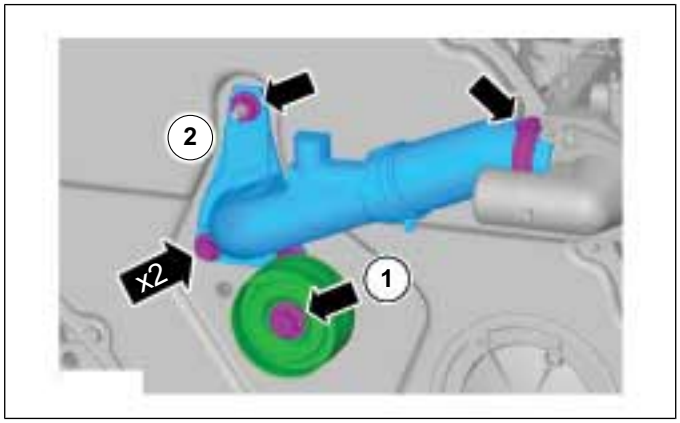


INSTALLATION

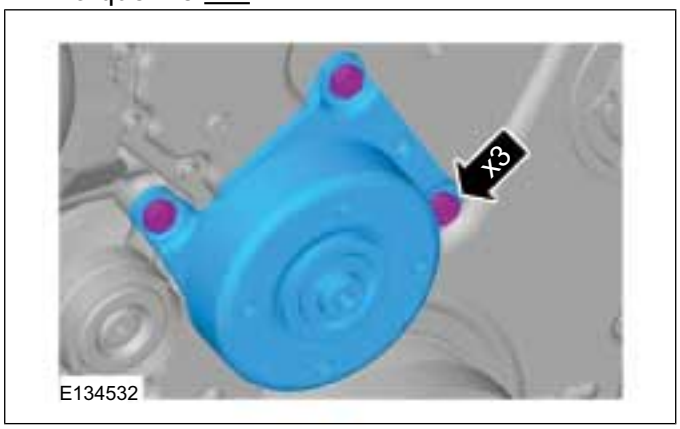
20. Torque: 23 Nm



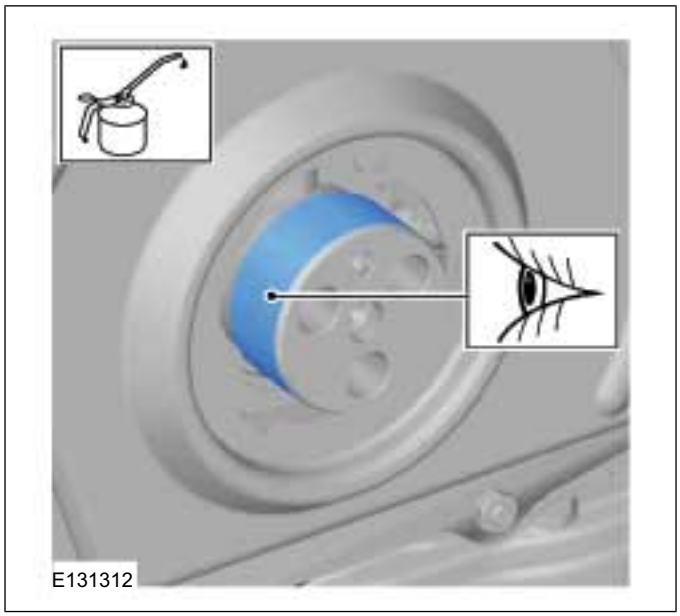
21. 1. Torque: 48 Nm
2. Torque: 23 Nm



22. Torque: 48 Nm



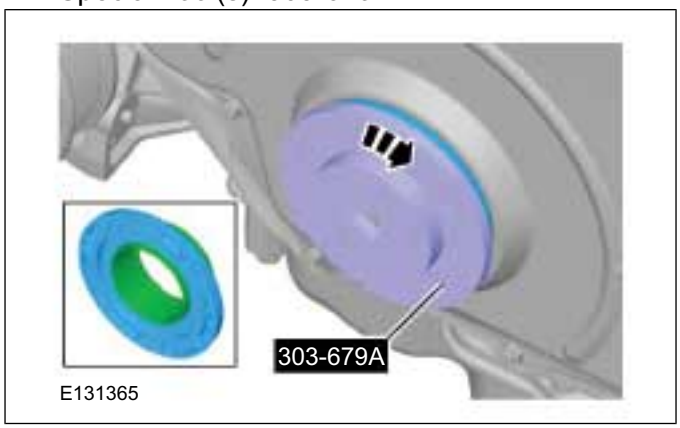
23. **NOTE:** Make sure that the mounting face is clean and lubricated.



24. **CAUTION: Rotate the seal assembly until it locks. Failure to follow this instruction may result in damage to the seal assembly.**

NOTE: A new crankshaft front seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft rear seal is fully installed.

Special Tool(s): 303-679A



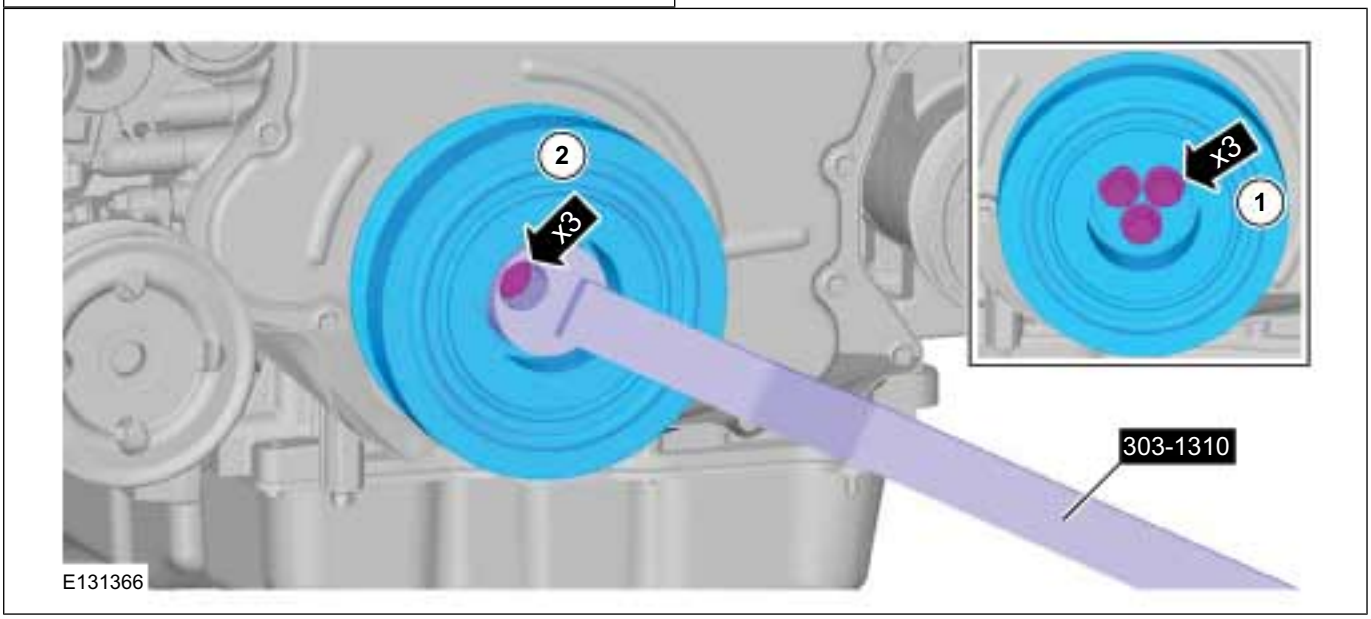
INSTALLATION

25. Remove the alignment sleeve after the seal is fully installed.

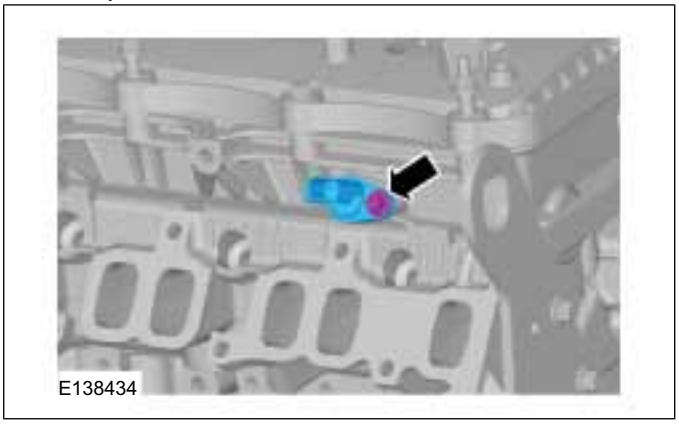
26. **CAUTION: Crankshaft pulley retaining bolts must only be used three times.**

NOTE: Initially hand tighten the fasteners.

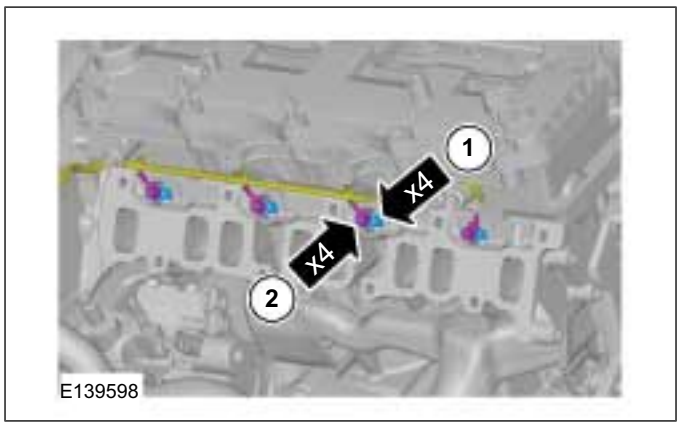
Special Tool(s): 303-1310
Torque:
- Stage 1: 45 Nm
- Stage 2: 120°



27. Torque: 9 Nm

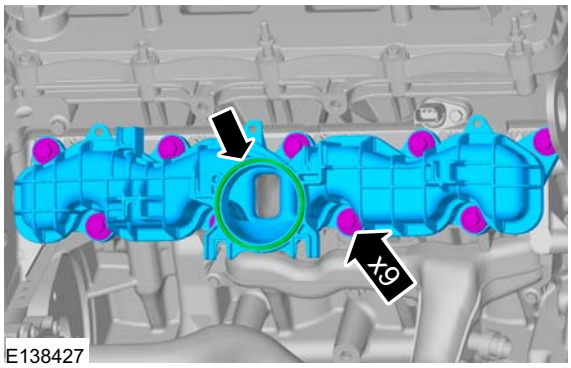


28. 1. Torque: 13 Nm
2. Torque: 3 Nm

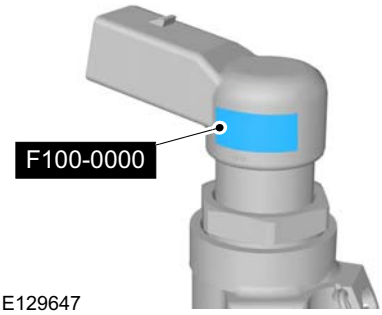


INSTALLATION

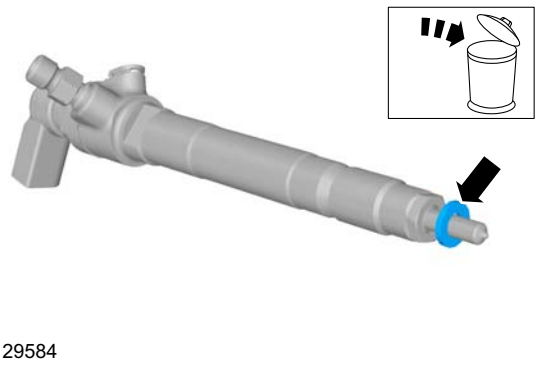
29. Torque: 10 Nm



30. Record the new fuel injector correction factor code.

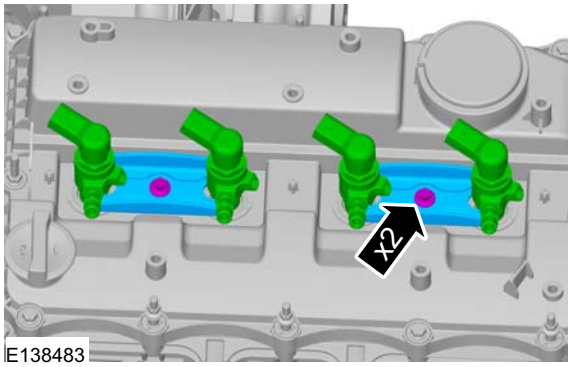


31. **NOTE:** Using a socket (or similar), press the new fuel injector copper seals onto the fuel injectors making sure that the copper seals are pushed fully home to prevent uneven clamping.

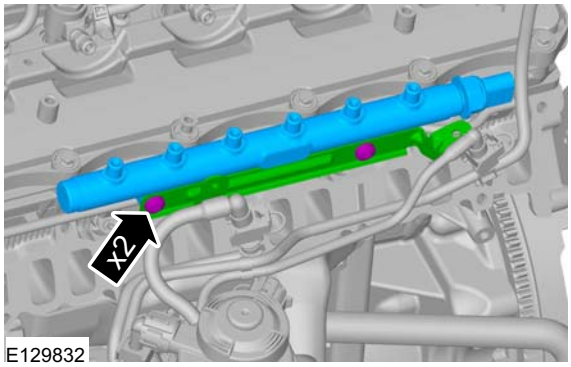


32. ⚠ **CAUTION: Make sure that new bolts are installed.**

Torque:
- Stage 1: 5 Nm
- Stage 2: 180°



33. Torque:
- Stage 1: 6 Nm
- Stage 2: 23 Nm



34. **CAUTIONS:**

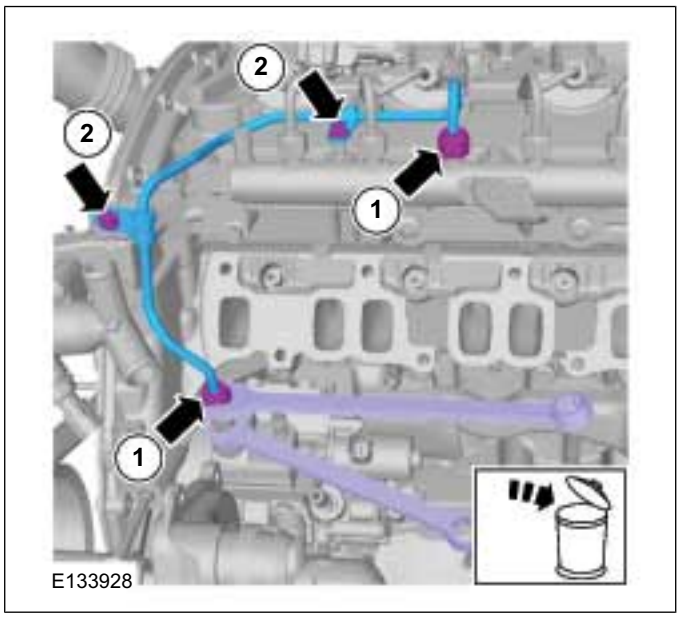
⚠ **Make sure that the fuel line remains in contact at both ends until both unions nuts have been unscrewed and the area around the joints thoroughly cleaned.**

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

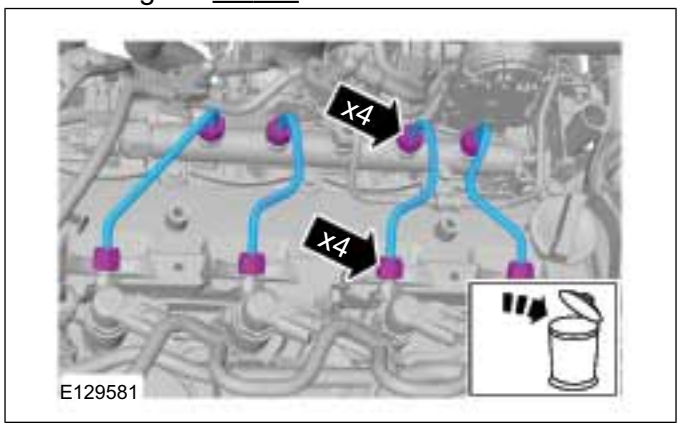
INSTALLATION

NOTE: Vacuum foreign material from the high-pressure fuel supply line, the fuel pump and the fuel rail.

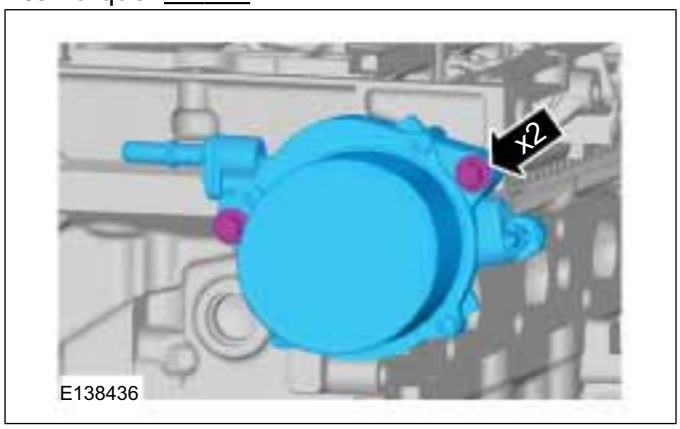
1. Torque:
   - Stage 1: 10 Nm
   - Stage 2: 35 Nm
2. Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).
   Torque: 12 Nm



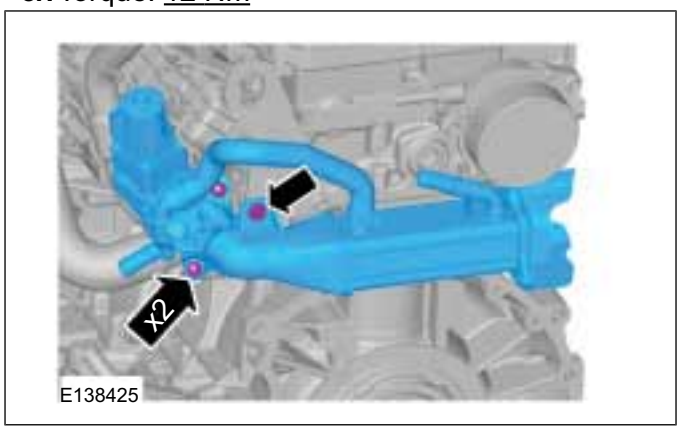
35. Torque:
   - Stage 1: 20 Nm
   - Stage 2: 25 Nm



36. Torque: 22 Nm

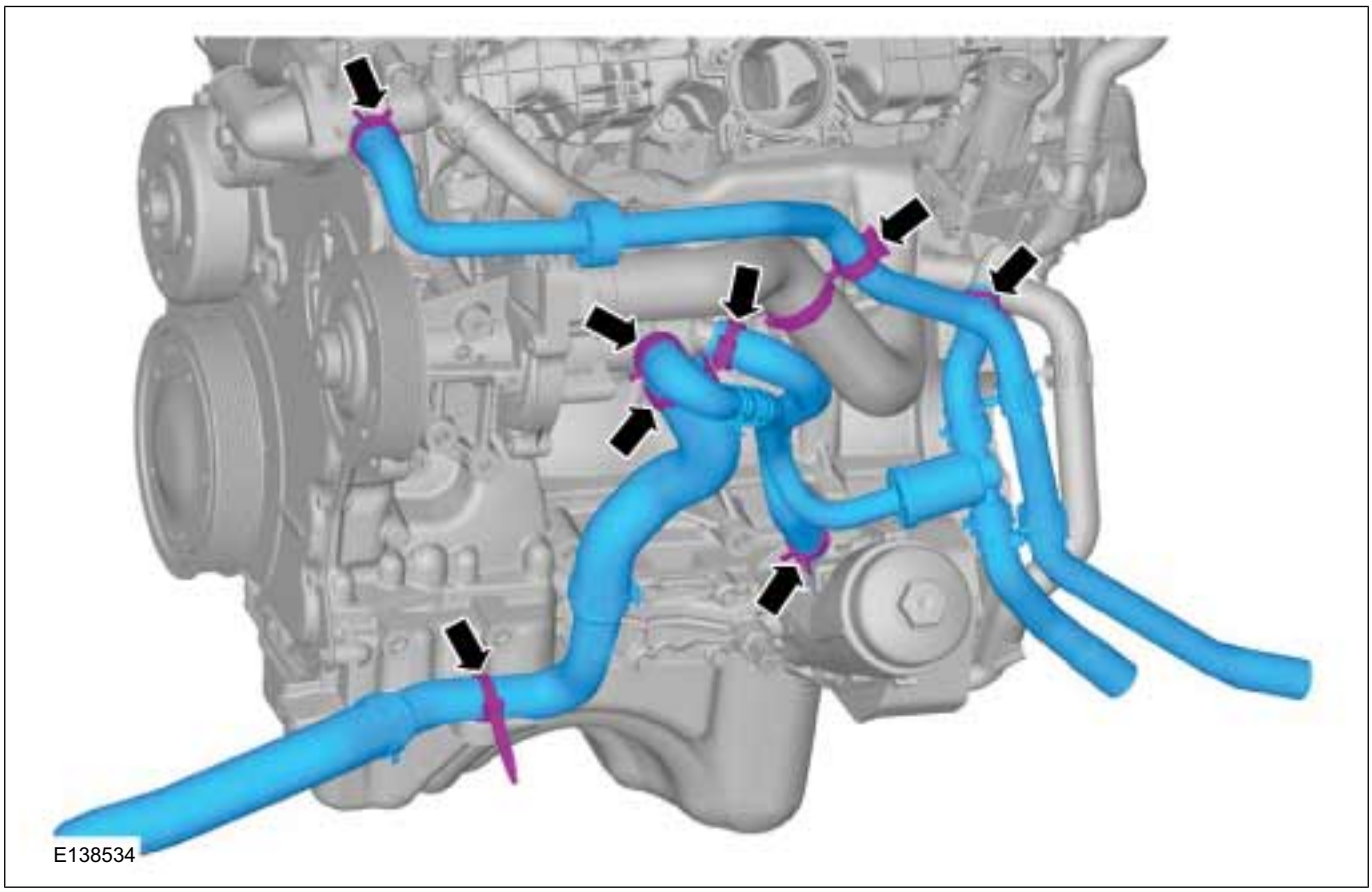


37. Torque: 12 Nm

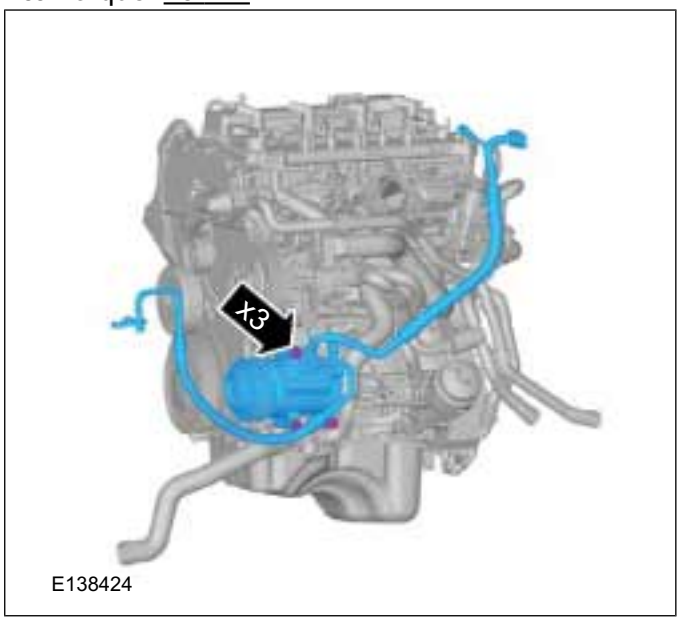


38.

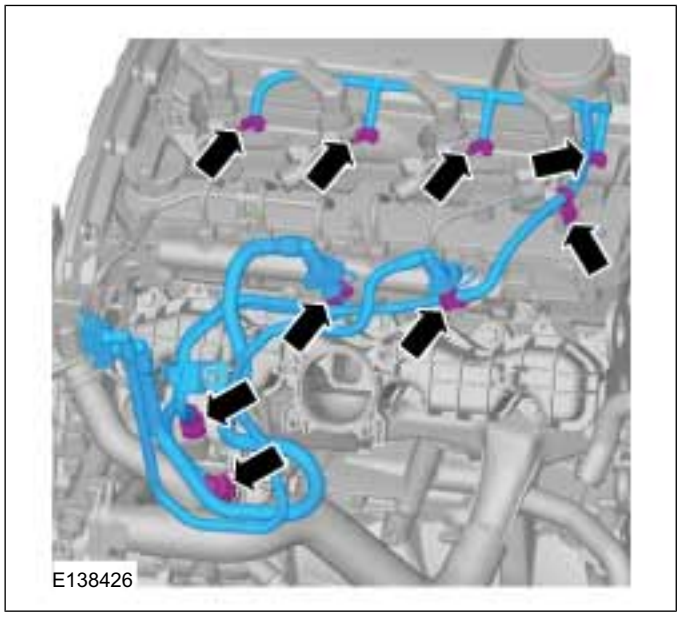
INSTALLATION



39. Torque: 25 Nm

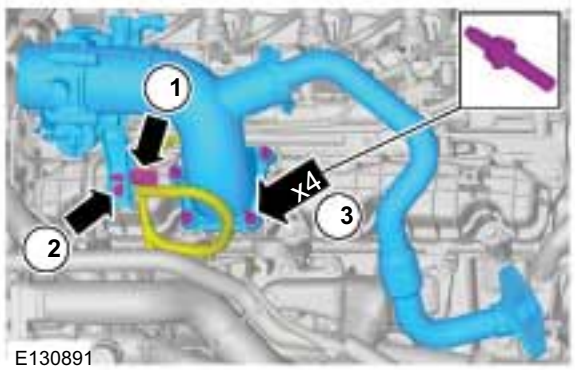


40. ⚠ **CAUTION: Make sure that all openings are sealed. Use new blanking caps.**



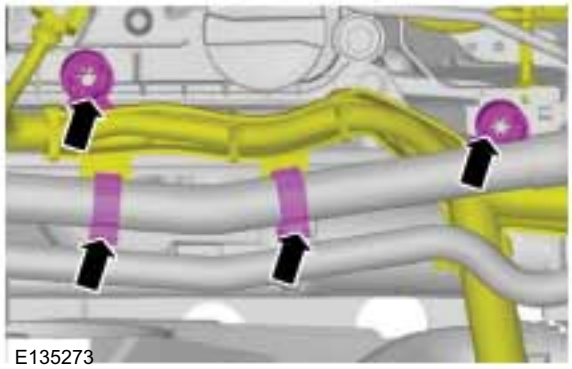
INSTALLATION

41. Torque: 25 Nm

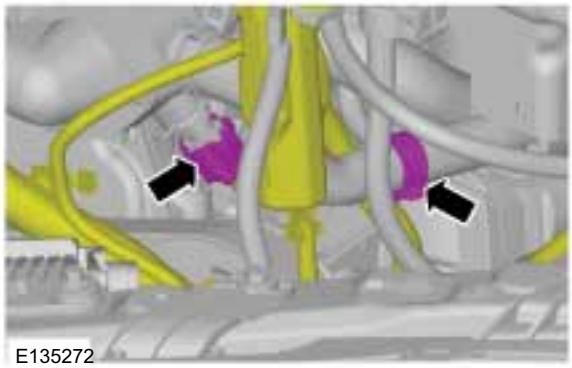


E130891

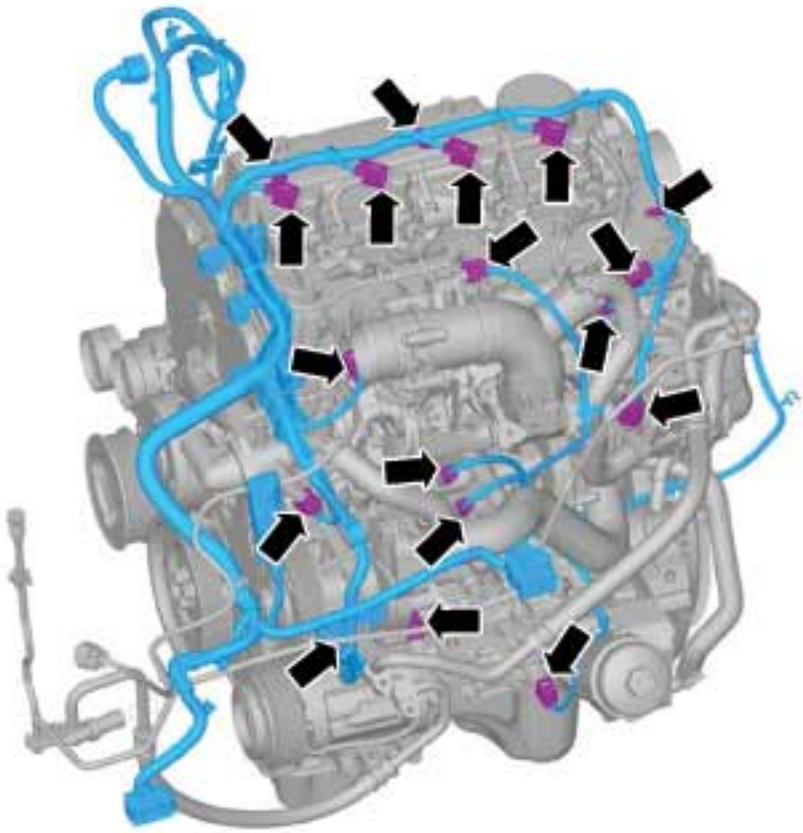
42.


E135273

43.

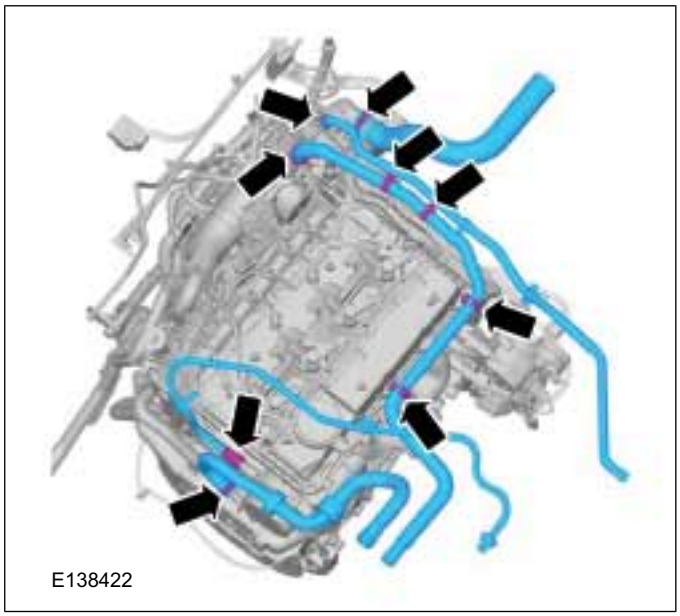

E135272

44.


E138423

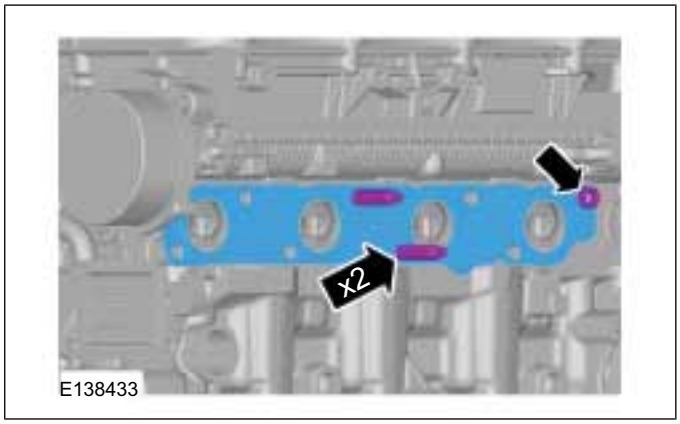
INSTALLATION

45.

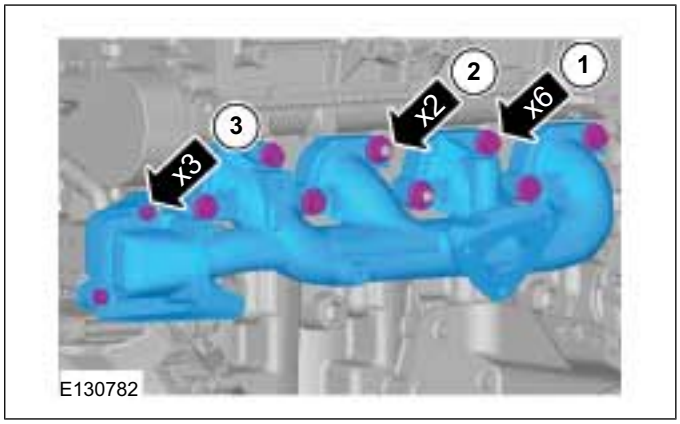


46. **NOTE:** The gasket is to be reused unless damaged.

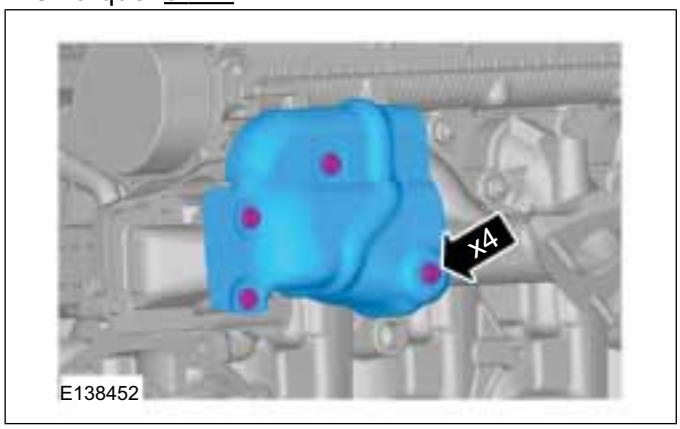
NOTE: The studs are to be reused unless damaged.



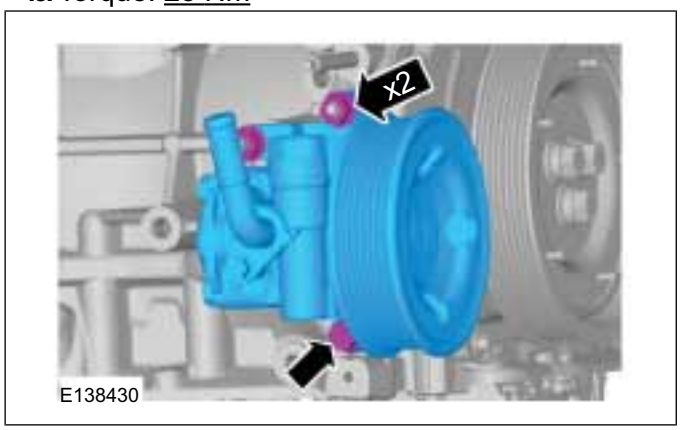
47. 1. Torque: 55 Nm
2. Torque: 40 Nm
3. Torque: 15 Nm



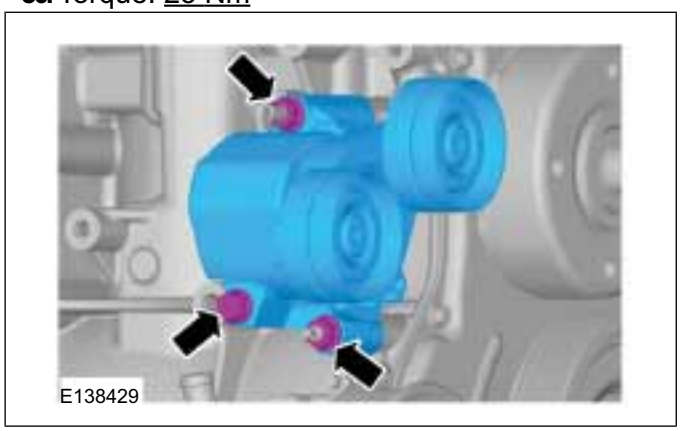
48. Torque: 9 Nm



49. Torque: 25 Nm

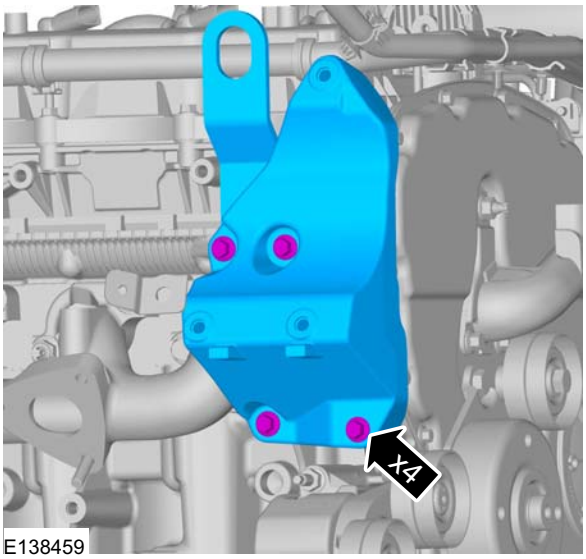


50. Torque: 25 Nm



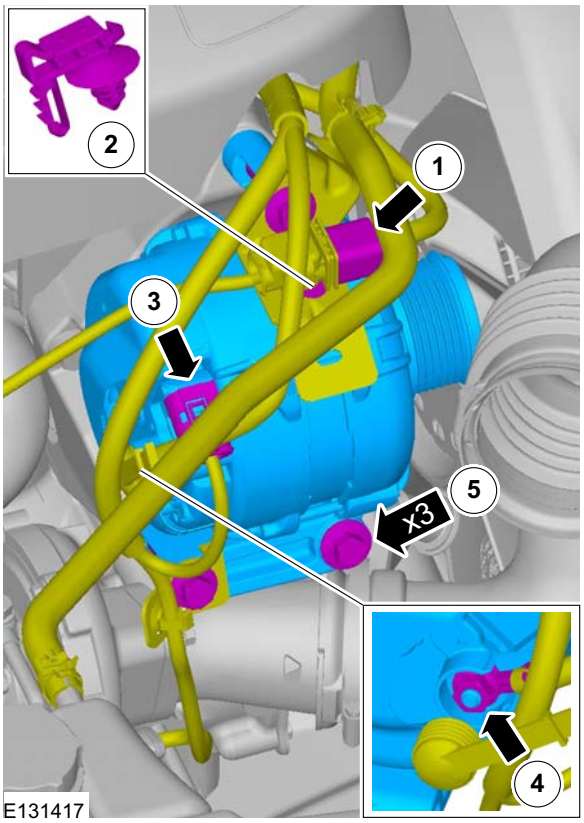
INSTALLATION

51. Torque: 25 Nm



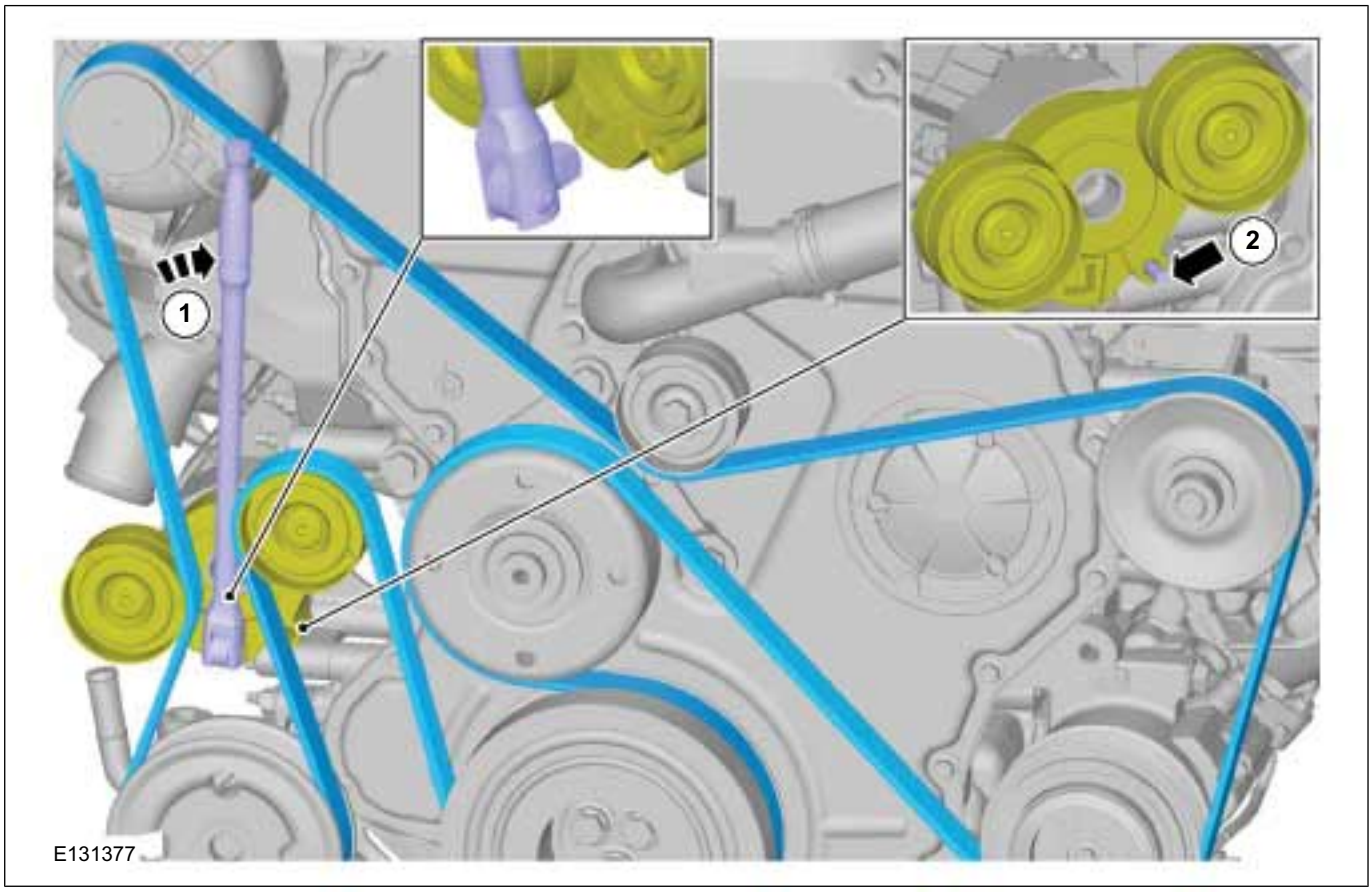
52. ⚠ **CAUTION: Take extra care not to damage the wiring harnesses.**

4. Torque: 15 Nm
5. Torque: 48 Nm

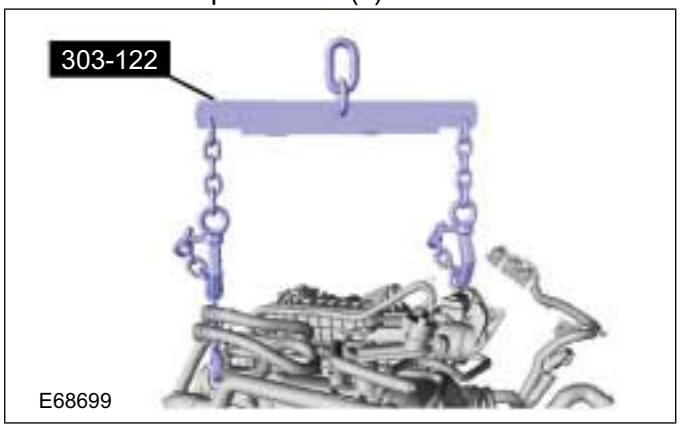


53. General Equipment: 1/2 Inch Square Drive Breaker Bar
General Equipment: Dowel with a Diameter of 6 mm

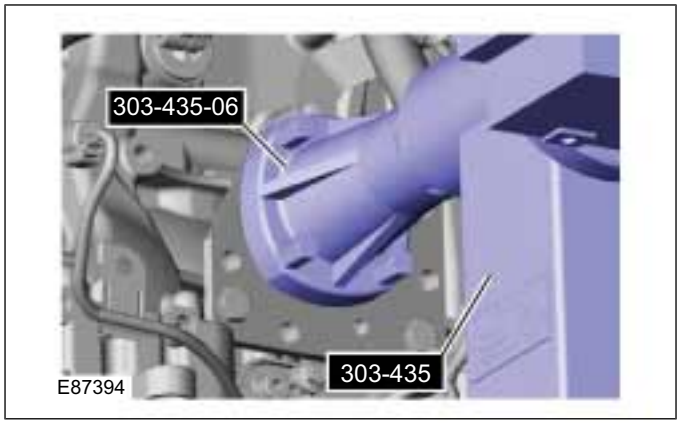
INSTALLATION



54. Install the Special Tool(s): 303-122

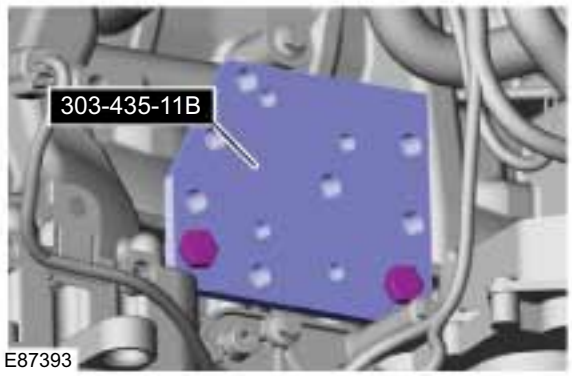


55. Remove the Special Tool(s): 303-435-06, 303-435

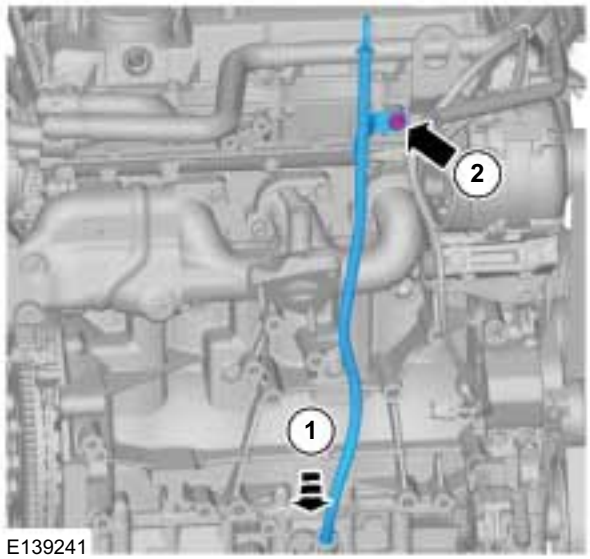


INSTALLATION

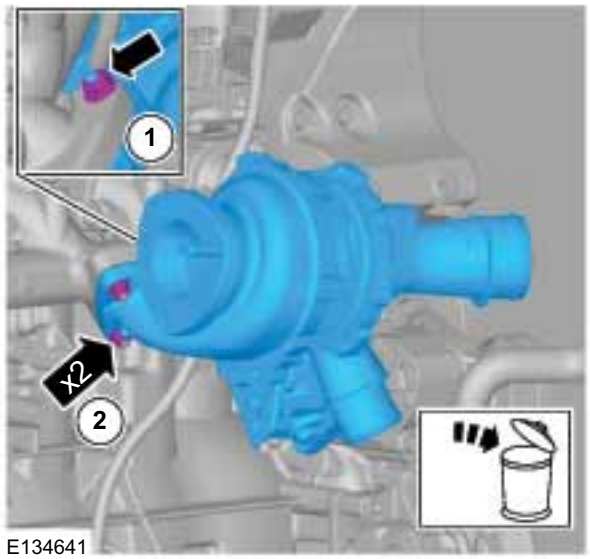
56. Remove the Special Tool(s): 303-435-11B



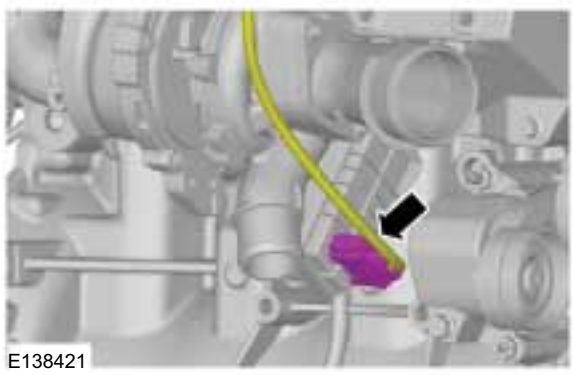
57. Torque: 9 Nm



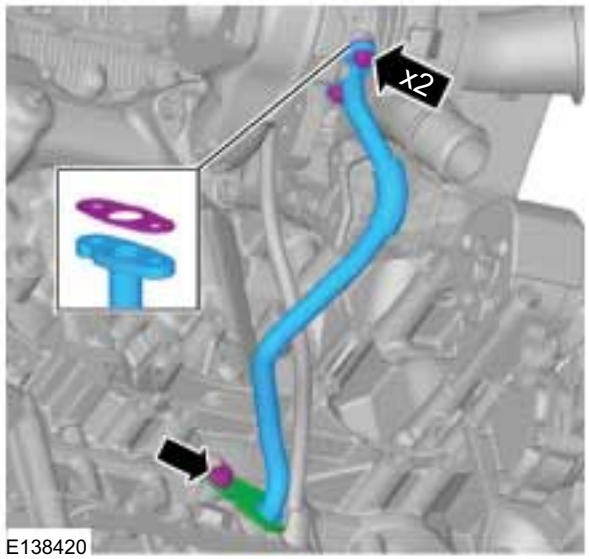
58. Torque: 23 Nm



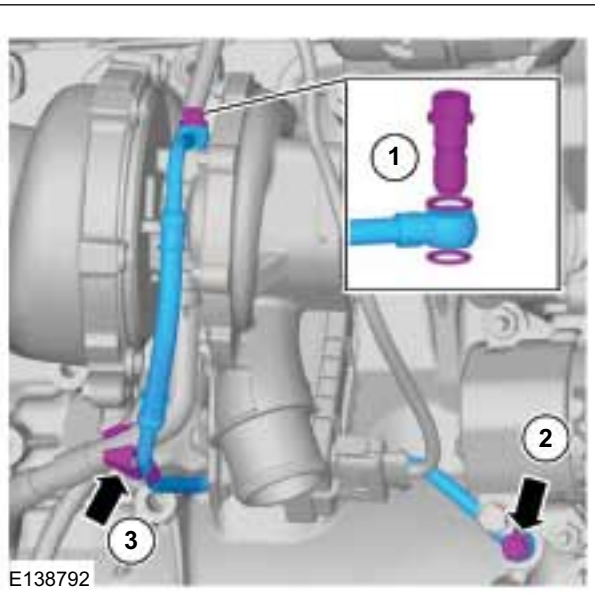
59.



60. Torque: 10 Nm



61. 1. Torque: 35 Nm
2. Torque: 32 Nm



SECTION 303-01C Engine — 3.2L Duratorq-TDCi (148kW/200PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

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SPECIFICATIONS

DESCRIPTION AND OPERATION

REMOVAL AND INSTALLATION

REMOVAL

DISASSEMBLY

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

ASSEMBLY

INSTALLATION

SPECIFICATIONS

Engine Data

Description	
Code	SAFA
Firing order	1-2-4-5-3
Bore diameter	89.9 mm
Stroke	100.76 mm
Displacement	3198 cc
Compression ratio	17.5:1
Power output at 3500 rpm	147 kW (200 PS)
Torque between 2000 to 2500 rpm	470 Nm
Idle speed	800 +/- 50 rpm
Maximum oil consumption	0.1L / 1000 Km

Engine Oil Capacity

Description	Liters
Initial fill including oil filter	12,6
Service fill including oil filter	11,4
Service fill without oil filter	11,0

Cylinder Block Dimensions

Description	mm
Cylinder bore diameter — Class 1	89.900 - 89.910
Cylinder bore diameter — Class 2	89.910 - 89.920
Cylinder bore diameter — Class 3	89.920 - 89.930
Main bearing shells 1 to 5 inner diameter — bearings installed	64.994 - 65.022
Main bearing shell 6 inner diameter — bearings installed	69.994- 70.022
Main bearings 1 to 5 radial clearance	0.024 - 0.072
Main bearing 6 radial clearance	0.024 - 0.072
Main bearings 1 to 5 parent bore diameter — vertical measurement	69.504 - 64.520
Main bearing 6 parent bore diameter — vertical measurement	74.504 - 74.520
Main bearings 1 to 5 parent bore diameter — horizontal measurement	69.502 - 69.525
Main bearing 6 parent bore diameter — horizontal measurement	74.502 - 74.525

Piston Dimensions

Description	mm
Piston diameter — Class 1	89.84 - 89.85
Piston diameter — Class 2	89.85 - 89.86
Piston diameter — Class 3	89.86 - 89.87
Piston clearance in cylinder	0.05 - 0.07
Piston ring end gaps	

SPECIFICATIONS

Description	mm
— upper compression ring	0.25 - 0.40
— lower compression ring	0.50 - 0.75
— oil control ring	0.25 - 0.50
Piston ring gap position: The piston ring end gaps must be distributed evenly around the circumference of the piston. This also applies to the oil control ring elements. Align the piston ring end gaps at 120 degrees to each other.	

Crankshaft Dimensions

Description	mm
Main bearing journal end float	0.090 - 0.305
Main bearing journals 1 to 5 diameter	64.950 - 64.970
Main bearing journal 6 diameter	69.950 - 69.970
Connecting rod bearing journal diameter	52.980 - 53.000

Connecting Rod Dimensions

Description	mm
Large end bore diameter	55.996 - 56.016
Small end bore diameter	32.010 - 32.018
Connecting rod bearing shell inner diameter — bearings installed	53.016 - 53.046
Connecting rod bearing radial clearance	0.026 - 0.084
Connecting rod bearing axial clearance	0.100 - 0.320

Piston Pin Dimensions

Description	mm
Piston pin length	73.95
Piston pin diameter	31.998 - 32.002
Piston pin slide clearance	0.008 - 0.018

Camshaft Dimensions

Description	mm
Camshaft end float	0.014 - 0.200
Camshaft bearing journal diameter	26.440 - 26.465
Camshaft bearing clearance — radial measurement	0.04 - 0.09

Valve Dimensions

Description	mm
Valve stem to valve guide clearance — intake valve	0.0625 - 0.0275
Valve stem to valve guide clearance — exhaust valve	0.0725 - 0.0375

Cylinder Head Dimensions

Description	mm
Maximum distortion — measured longitudinally and diagonally	0.10

SPECIFICATIONS

Description	mm
Peak to valley height of mating surface	0.02
Cylinder head gasket thickness	
Piston protrusion of 0.310 - 0.400 mm	1.1 (one hole/tooth)
Piston protrusion of 0.401 - 0.450 mm	1.15 (two holes/teeth)
Piston protrusion of 0.451 - 0.500 mm	1.2 (three holes/teeth)

Oil Pressure Specifications

Description	bar
Minimum oil pressure at idle speed	1.25
Minimum oil pressure at 2000 rpm	2.5

Lubricants, Fluids, Sealers and Adhesives

Item	Specification
Ford Formula E SAE 5W-30 engine oil	WSS-M2C913-B
Sealer — oil pan, camshaft carrier and engine front cover	WSE-M4G323-A4

DESCRIPTION AND OPERATION

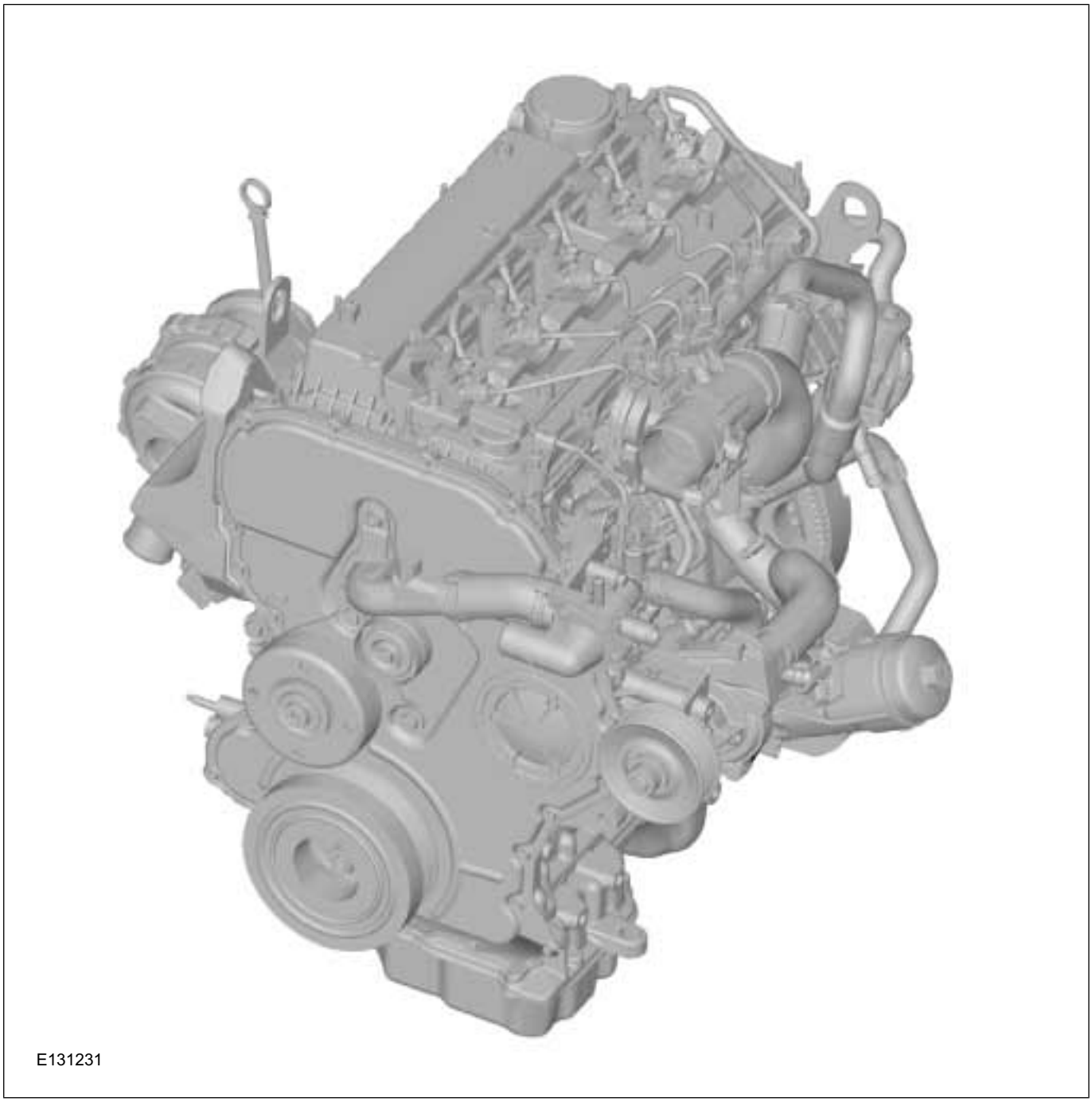
Engine – Overview

General View

- The 3.2L Duratorq-TDCi (Puma) diesel engine is a five-cylinder inline engine which delivers a power of 147kW (200 PS).
- The engine is additionally equipped with an oil level/oil temperature sensor .
- The cylinder head consists of two parts and is made of aluminum. Both parts are bolted to each other.
- The lower part contains four valves for each combustion chamber and the two camshafts.
- The upper part houses the rocker arm frame with the roller rocker arms. The hydraulic valve clearance adjustment is integrated in the roller rocker arms.
- The camshafts and the fuel injection pump are driven by the crankshaft via the timing chain.
- The oil pump is located inside the oil pan and is driven by the crankshaft via a chain.

NOTE: Cylinder 1 is located on the timing chain end.

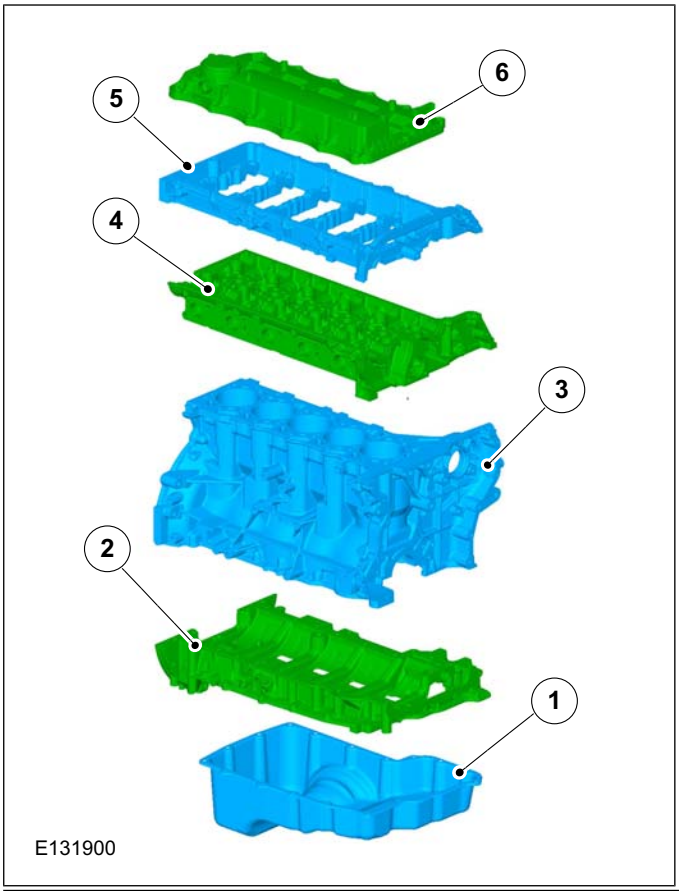
DESCRIPTION AND OPERATION



E131231

DESCRIPTION AND OPERATION

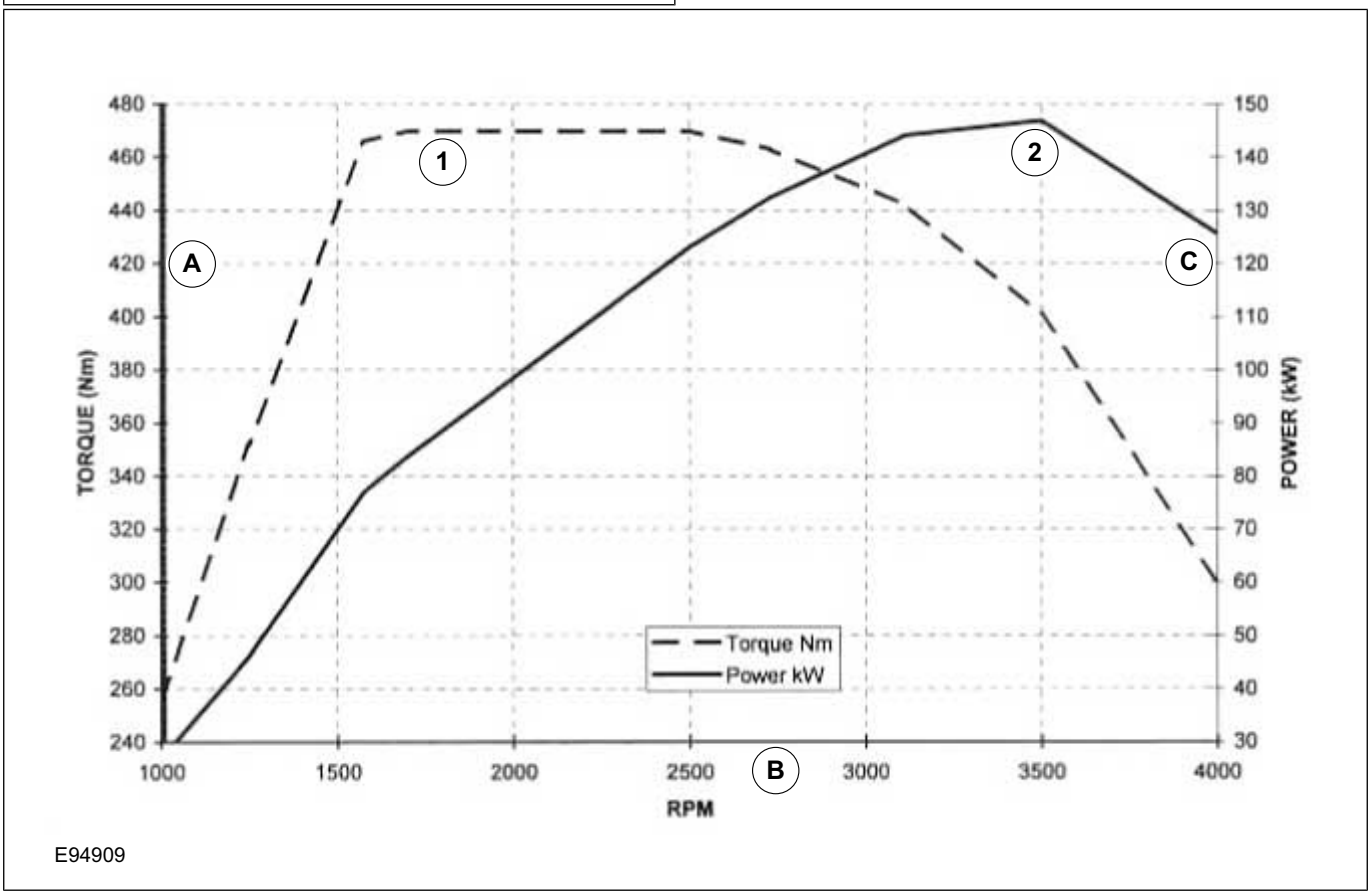
Engine overview



E131900

Item	Description
1	Oil pan
2	Oil pan extension
3	Cylinder block
4	Cylinder head lower part
5	Cylinder head upper part
6	Valve cover

Power and torque curves



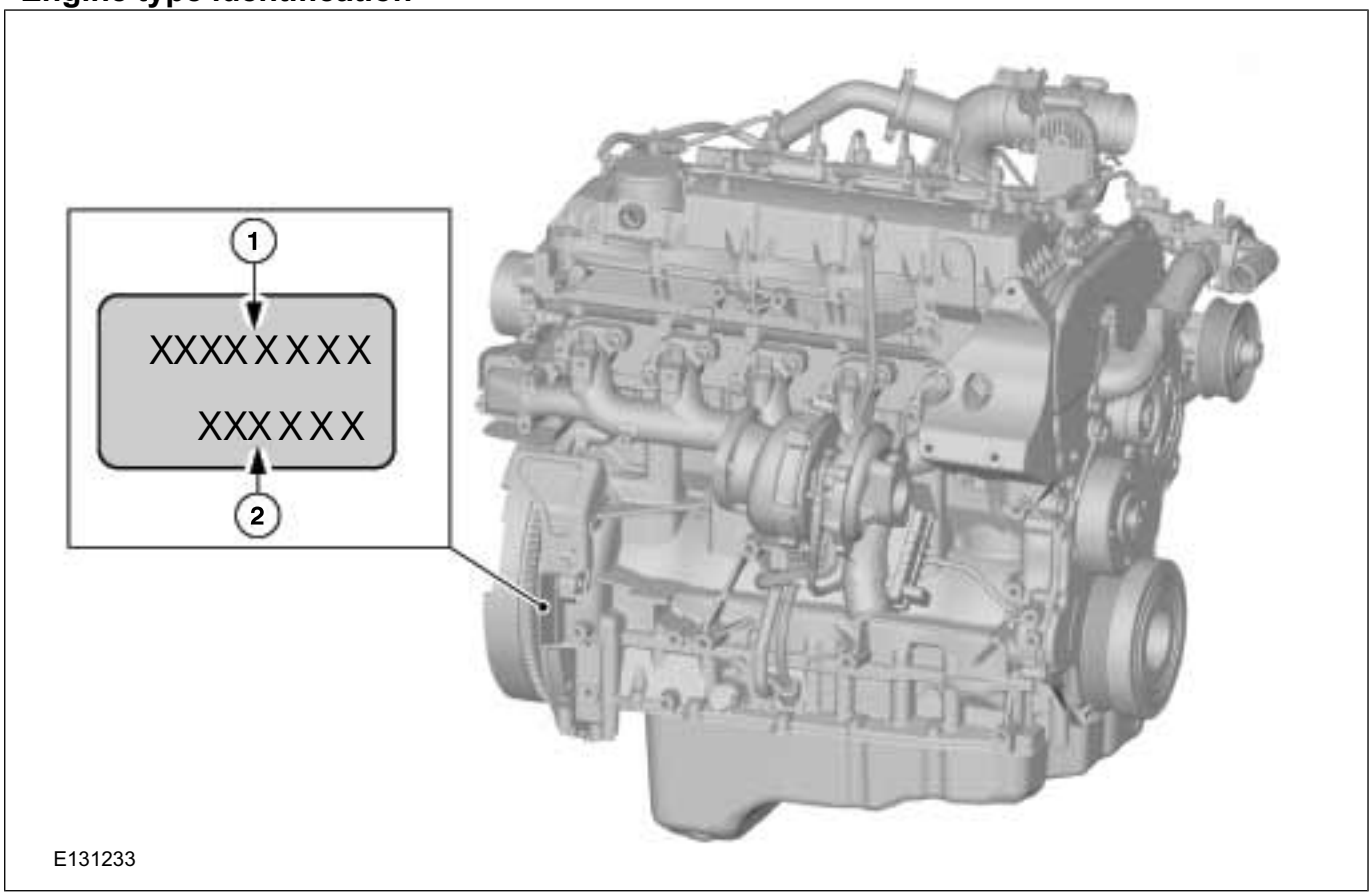
E94909

DESCRIPTION AND OPERATION

Item	Description
A	Torque (Nm)
B	Engine speed (rpm)
C	Power (kW)

Item	Description
1	Torque curve for the 147 kW engine (200 PS)
2	Power curve for the 147 kW engine (200 PS)

Engine type identification



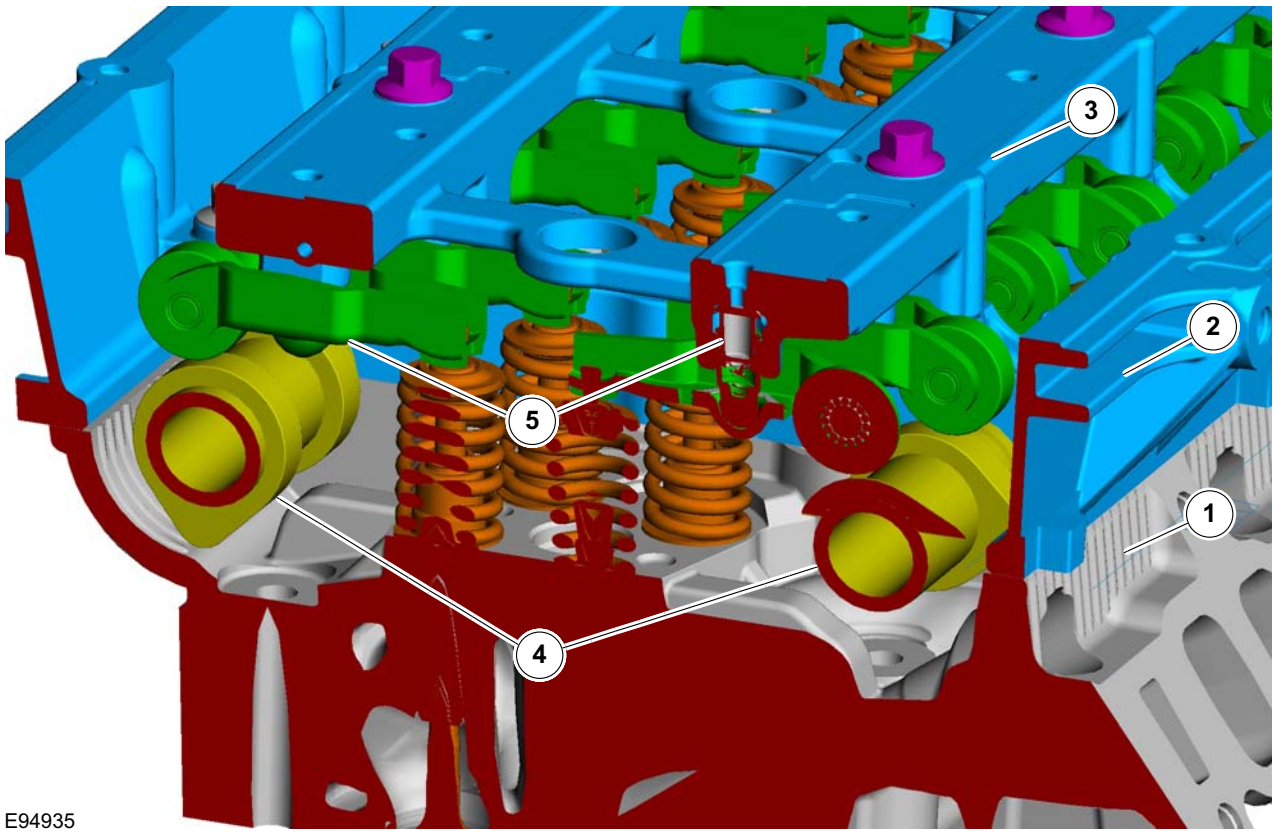
Item	Description
1	Engine code
2	Engine serial number

On the 3.2L engine the engine code (4 digits) and the engine serial number (2 letters for the year and month and 5 figures for the serial number) are stamped in the cylinder block on the exhaust side (in line with cylinder no. 5).

If the engine or cylinder block is changed, the vehicle identification number must be stamped in the indicated location.

Cylinder head

DESCRIPTION AND OPERATION

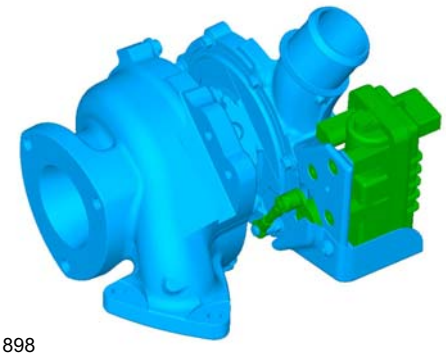


Item	Description
1	Cylinder head lower part
2	Cylinder head upper part
3	Rocker arm frame

Item	Description
4	Camshafts
5	Roller rocker arms with hydraulic valve clearance adjustment

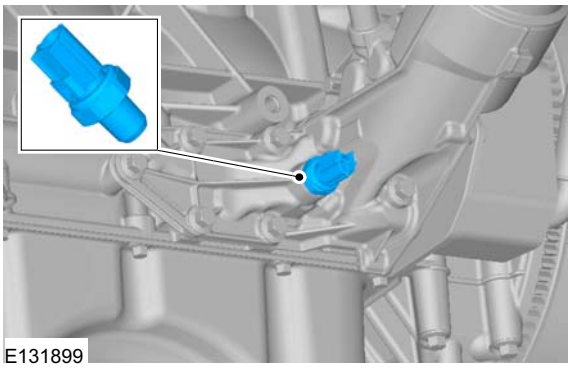
DESCRIPTION AND OPERATION

Electronic turbocharger guide vane adjustment


E131898

Item	Description
1	Electric actuator for turbocharger guide vane adjustment

Oil level/temperature sensor


E131899

An oil level/temperature sensor located on the front of the engine directly beside the engine oil dipstick is provided for the service interval indicator.

A wire coil that is fitted inside the sensor and continuously supplied with current is used to measure the oil level.

The resistance of the wire coil changes according to how deeply the sensor is immersed in the oil. The measurement values are registered by the Powertrain Control Module (PCM).

The change in the voltage drop serves as an input variable for calculating the oil level. The oil temperature is sensed simultaneously via the integrated temperature sensor. The temperature is used as a corrective factor in the calculation.

The PCM calculates the next oil change on the basis of an integrated strategy (which also takes into consideration the mileage and engine operating conditions) and displays it in the instrument panel.

In addition, a separate indicator in conjunction with a corresponding message in the instrument cluster display warns the driver when the oil quantity falls below the minimum level.

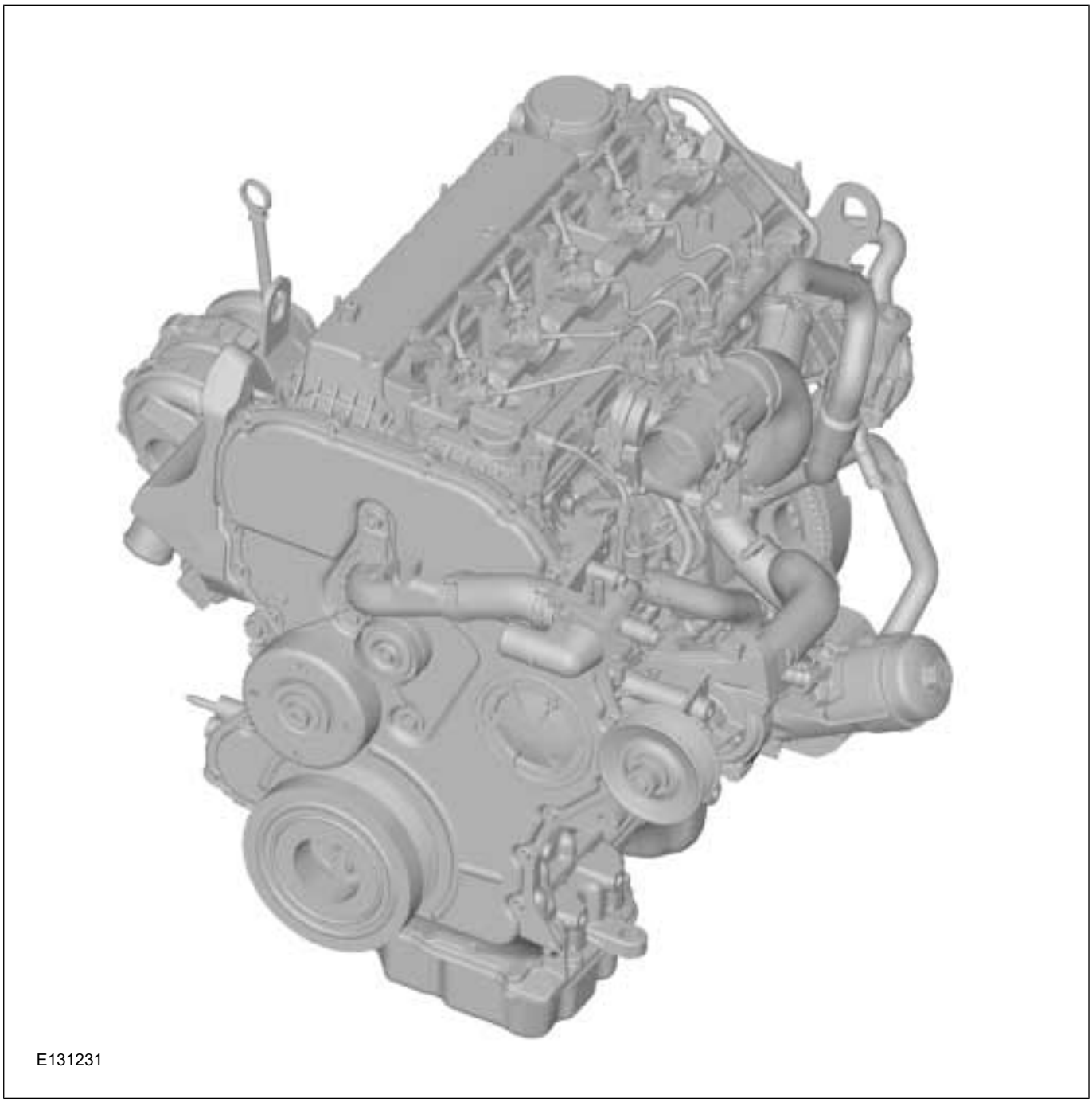
Service instruction

The interval indicator must be reset after an oil change on all vehicles with a diesel engine.

It must be ensured that the vehicle is standing on level ground.

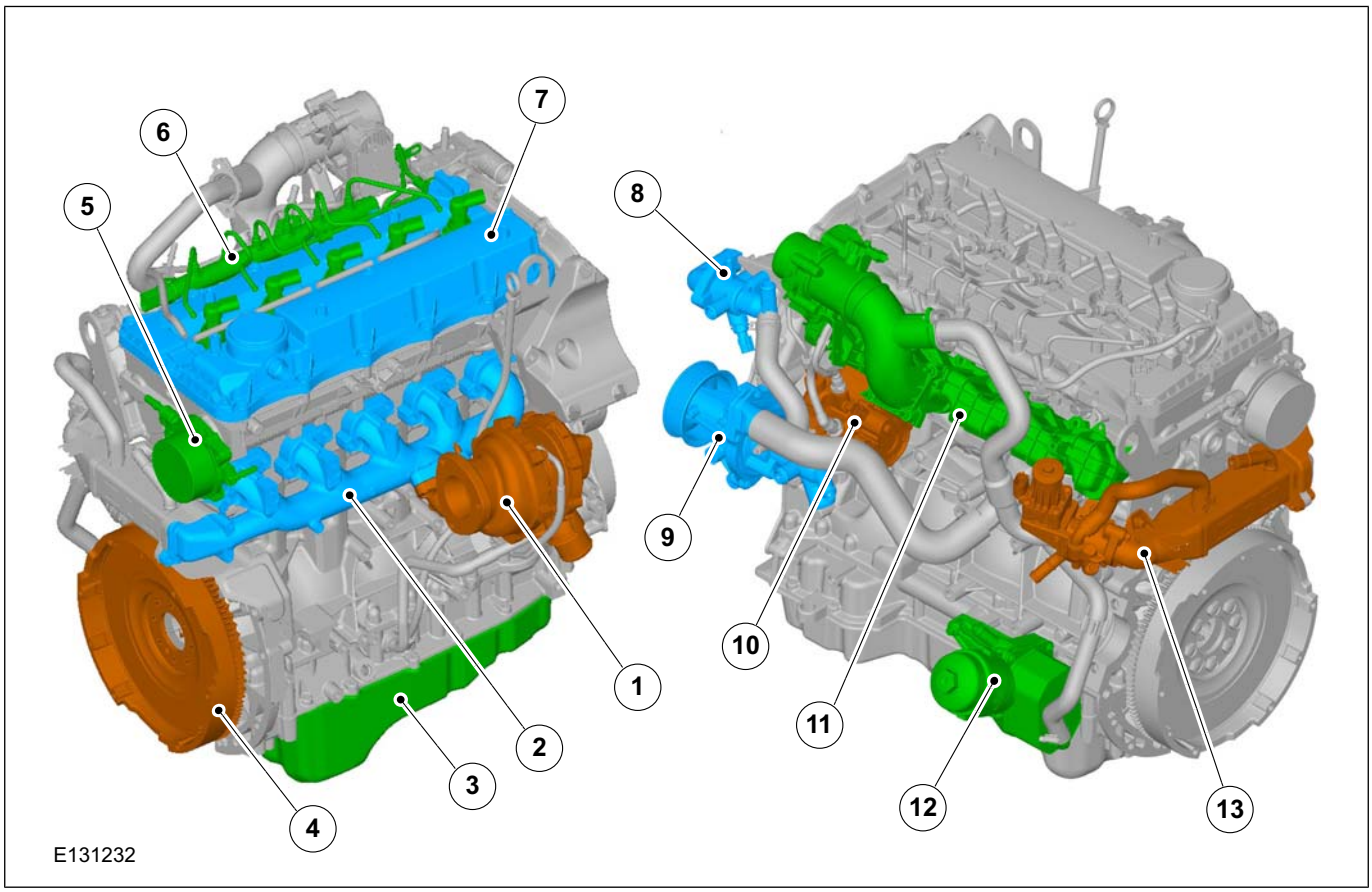
DESCRIPTION AND OPERATION

Engine – Component Location



E131231

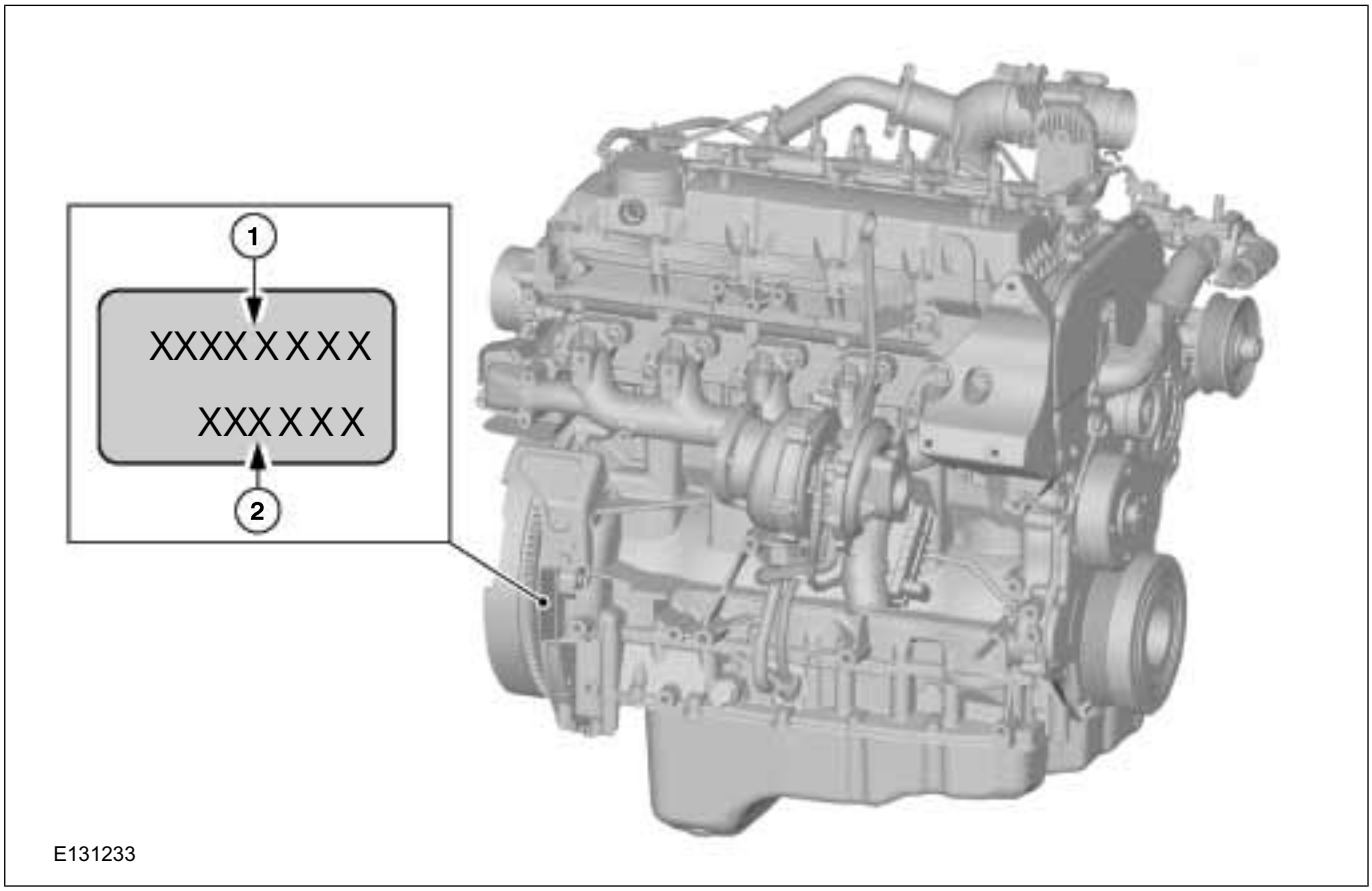
DESCRIPTION AND OPERATION



Item	Description
1	Turbocharger
2	Exhaust manifold
3	Oil pan
4	Flywheel
5	Vacuum pump
6	Fuel rail

Item	Description
7	Valve cover
8	Thermostat
9	Coolant pump
10	Fuel pump
11	Intake manifold
12	Oil cooler
13	EGR valve

DESCRIPTION AND OPERATION



Item	Description
1	Engine code
2	Engine serial number

REMOVAL AND INSTALLATION

Intake Manifold(21 183 0)

Removal

WARNINGS:

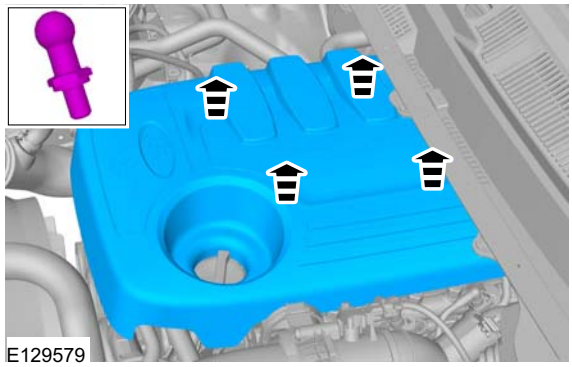
Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

Wait at least one minute after the engine stops before commencing any repair to the fuel injection system. Failure to follow this instruction may result in personal injury.

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. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

3.



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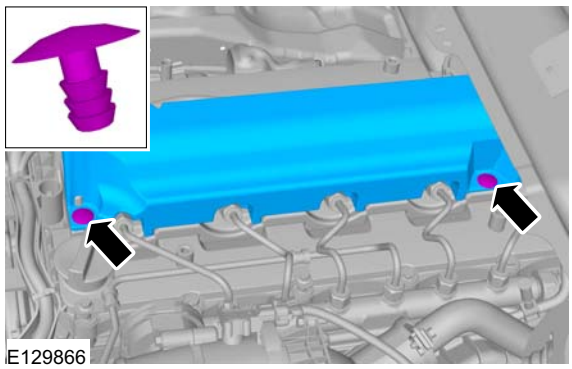

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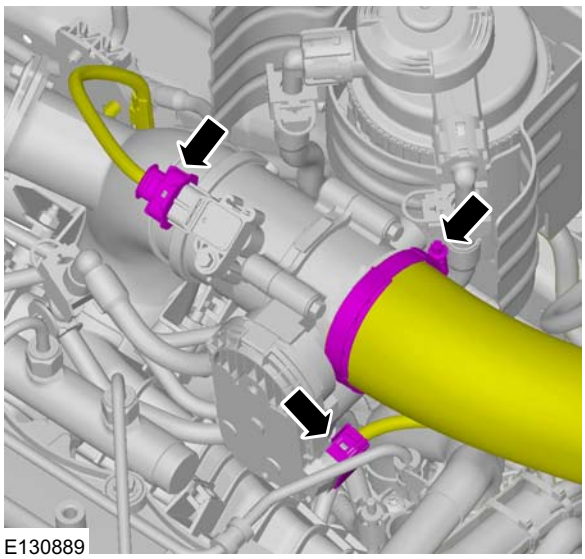
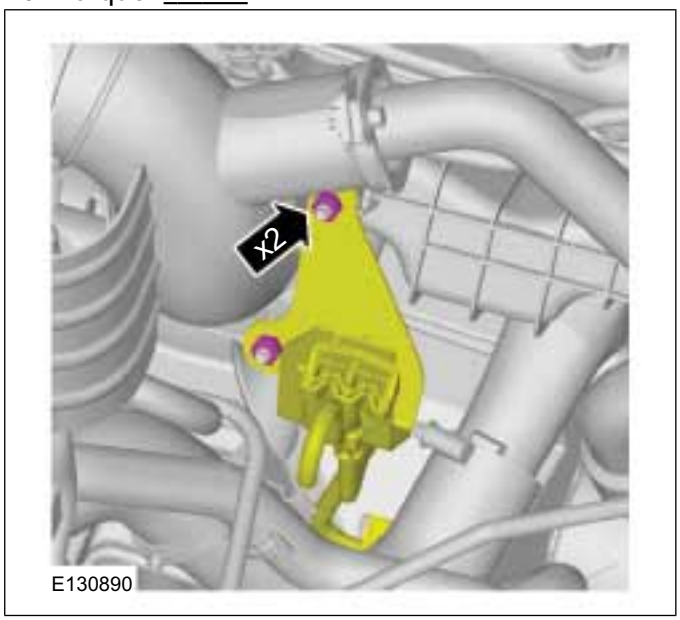


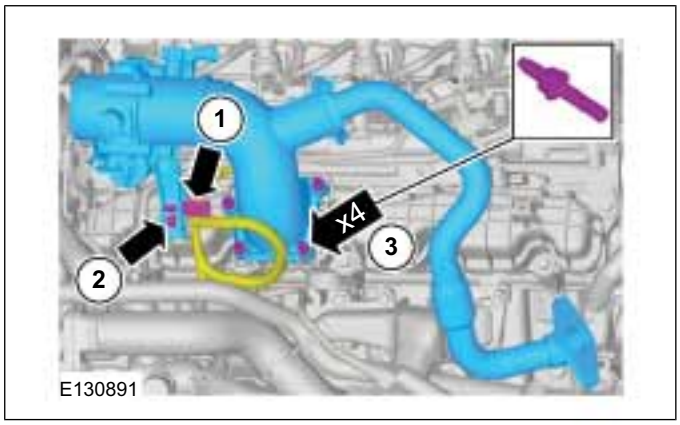
REMOVAL AND INSTALLATION

6. Torque: 11 Nm

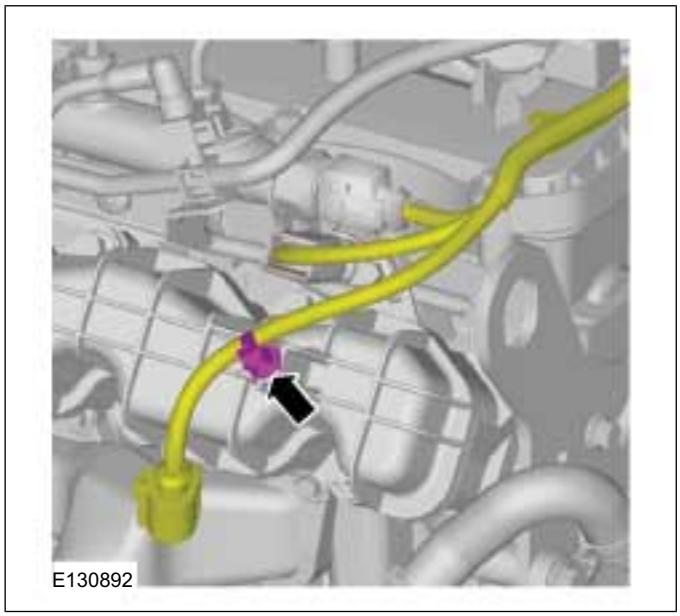


7. Refer to: Exhaust Gas Recirculation (EGR) Valve - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-08 Engine Emission Control - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

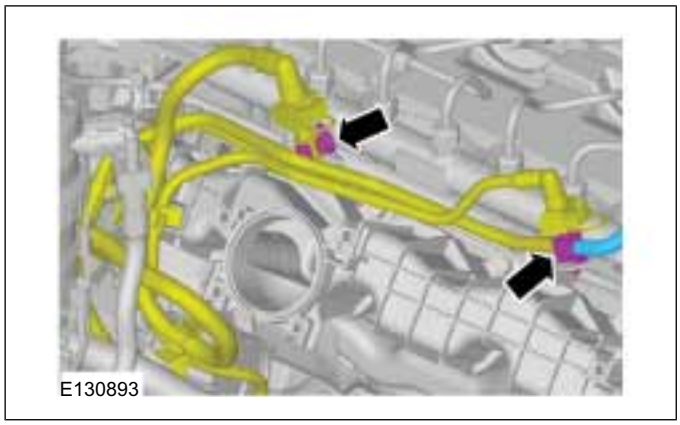
8. 2. Torque: 10 Nm
   3. Torque: 15 Nm



9.



10.



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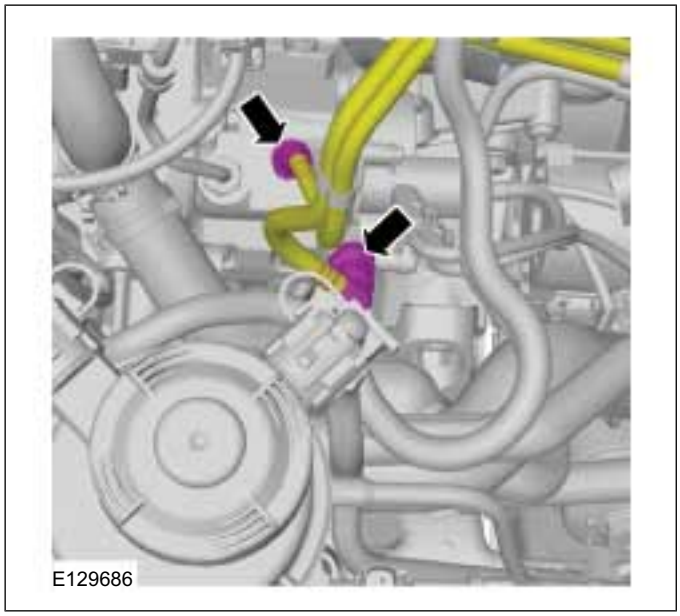
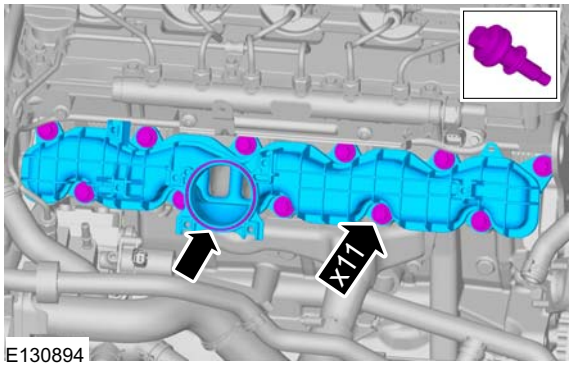


REMOVAL AND INSTALLATION

12 **NOTE:** Replace the o-ring, if necessary.

NOTE: The gasket is to be reused unless damaged.

Torque: 15 Nm



Installation

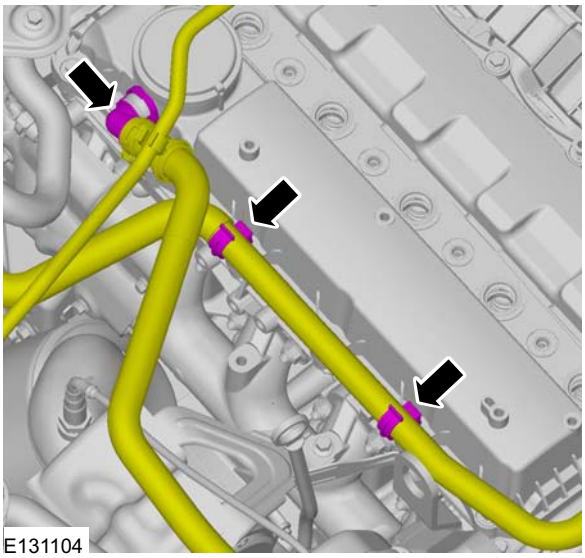
1. To install, reverse the removal procedure.

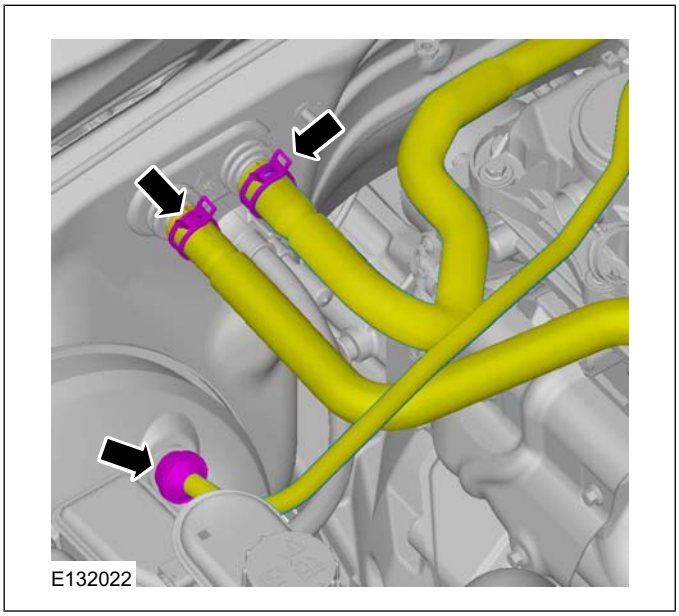
REMOVAL AND INSTALLATION

Exhaust Manifold(21 187 0)

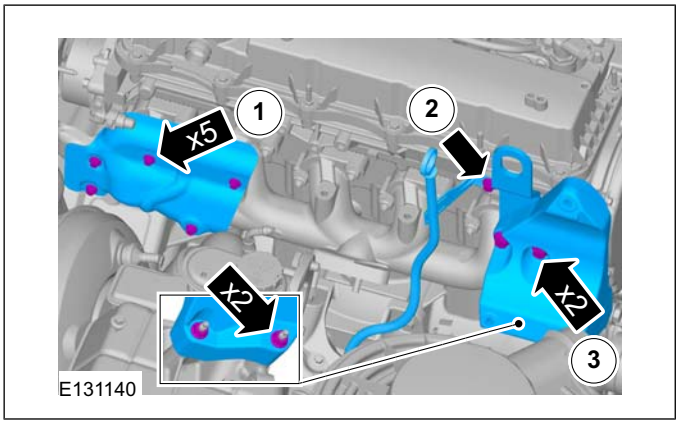
Removal

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. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. 

4. Refer to: Turbocharger - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, LHD 4WD/LHD RWD (303-04 Fuel Charging and Controls - Turbocharger, Removal and Installation).
   Refer to: Turbocharger - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, RHD 4WD/RHD RWD (303-04 Fuel Charging and Controls - Turbocharger, Removal and Installation).
   Refer to: Generator - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (414-02 Generator and Regulator, Removal and Installation).
5. 

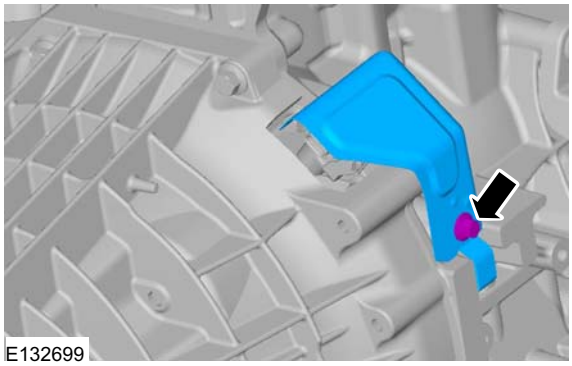
6. 1. Torque: 9 Nm
   2. Torque: 22 Nm
   3. Torque: 25 Nm



REMOVAL AND INSTALLATION

7. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
8. Remove front RH side wheel only.

   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
9. Torque: 10 Nm

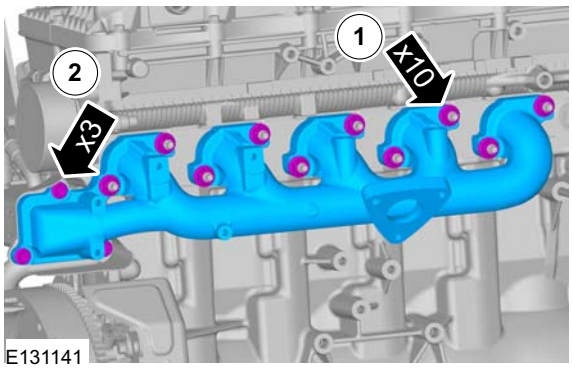

E132699

10. **CAUTIONS:**

    Make sure that new nuts are installed.

    Make sure that new bolts are installed.

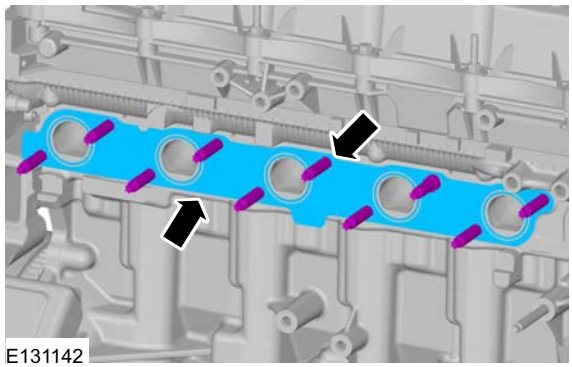
    1. Torque: 40 Nm
    2. Torque: 23 Nm



E131141

11. **CAUTION: Make sure that new studs are installed.**

NOTE: The gasket is to be reused unless damaged.


E131142

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

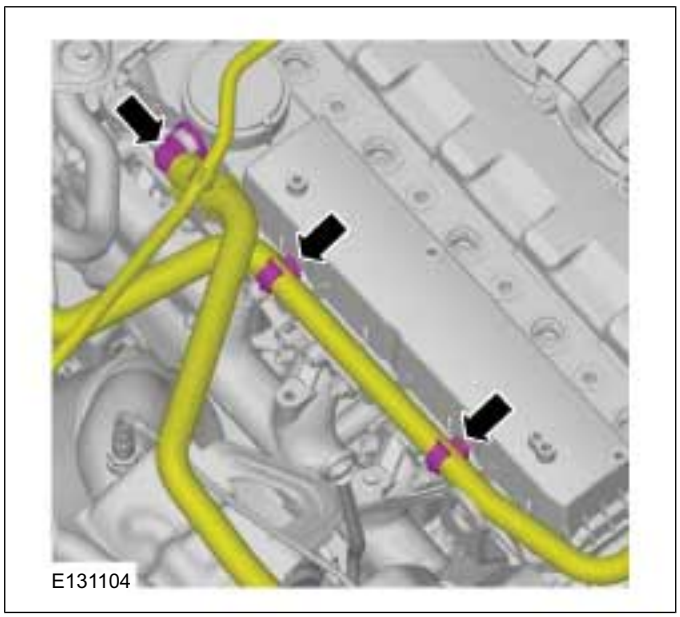
Valve Cover(21 141 0)

Removal

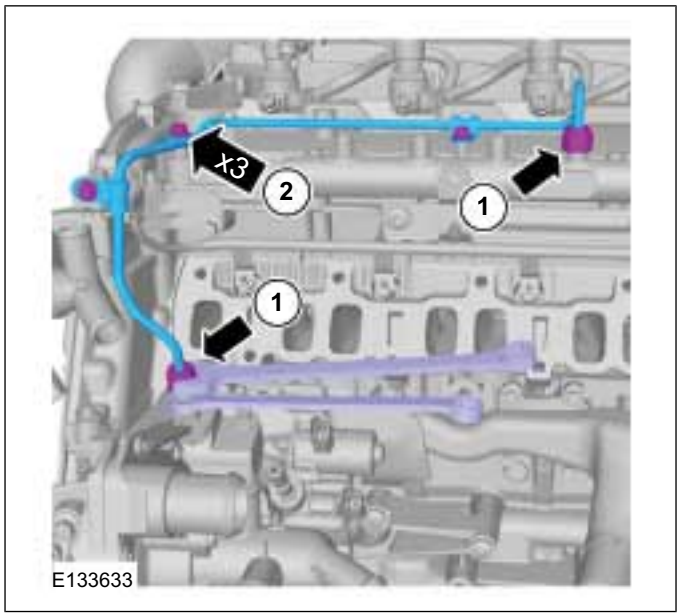
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

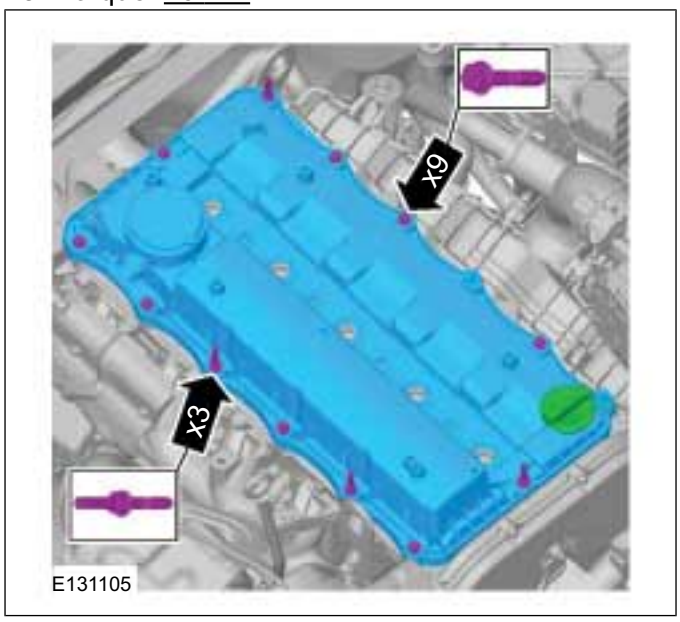
2.



3. Refer to: Fuel Injectors (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
4. 1. Torque:
   - Stage 1: 5 Nm
   - Stage 2: 35 Nm
   2. Torque: 10 Nm

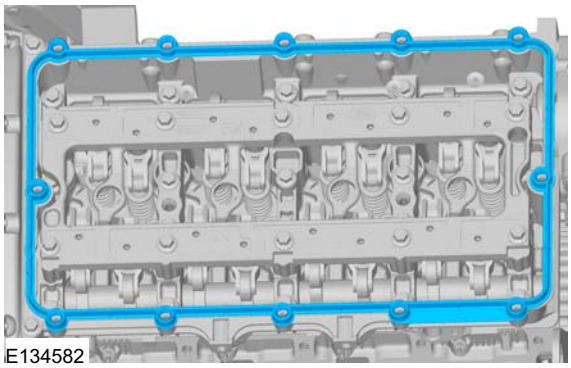


5. Torque: 10 Nm



REMOVAL AND INSTALLATION

6. **NOTE:** The gasket is to be reused unless damaged.


E134582

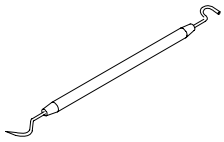
Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Camshafts(21 284 0)

Special Tool(s) / General Equipment

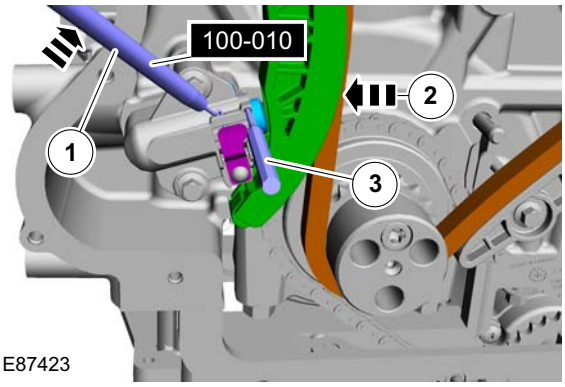
 17063	100-010 Remover, O-Ring Seal
 E131853	303-1562 Timing Tool
2 mm Punch	
6 mm Drill Bit	

Removal

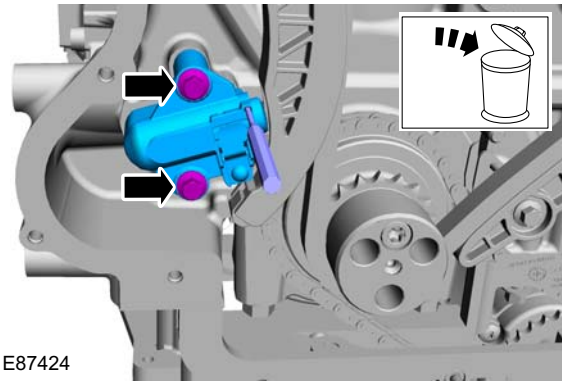
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

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

1. Refer to: Fuel Rail (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
   Refer to: Valve Cover (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
   Refer to: Timing Cover (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
   Refer to: Brake Vacuum Pump - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (206-07 Power Brake Actuation, Removal and Installation).
2. Special Tool(s): 100-010
   General Equipment: 2 mm Punch

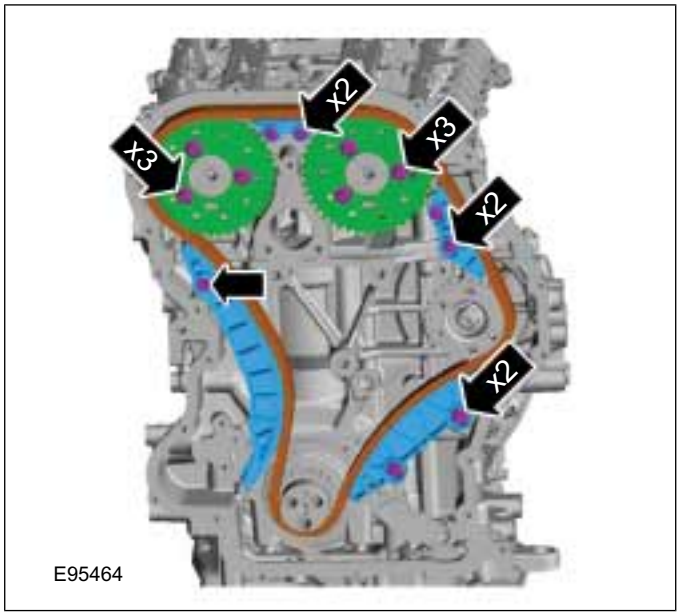


3. General Equipment: 2 mm Punch

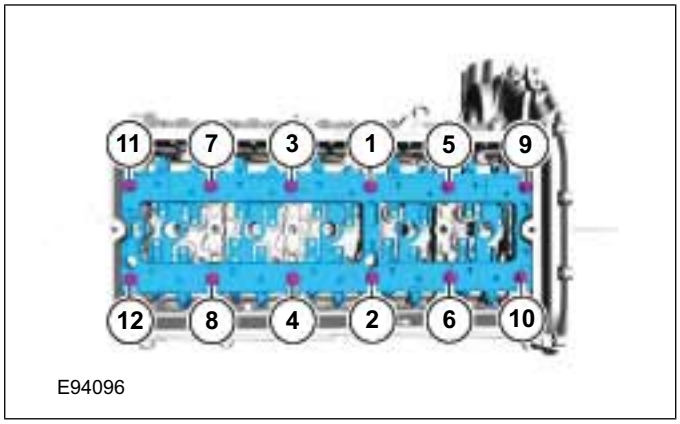


REMOVAL AND INSTALLATION

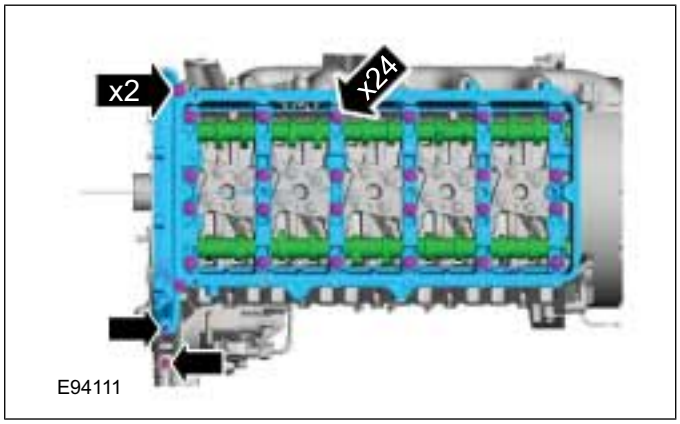
4.



5.



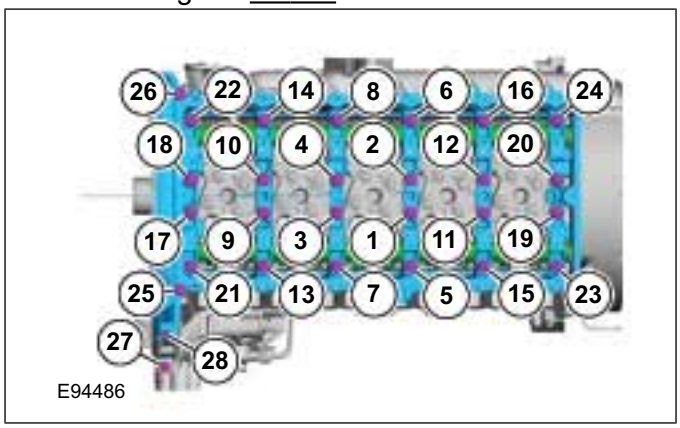
6.



Installation

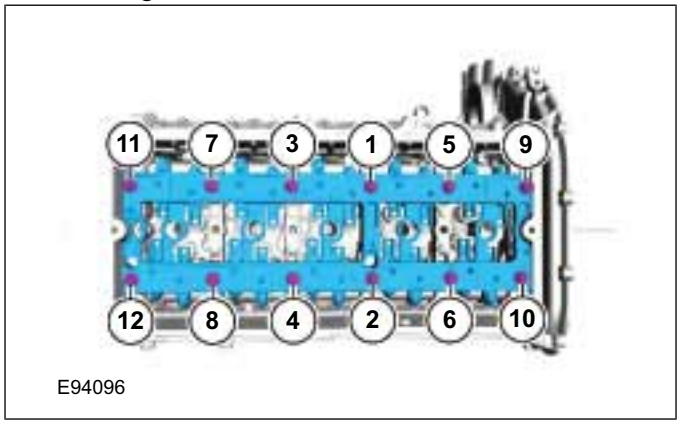
1. **NOTE:** Clean the mating faces of the camshaft carrier and the cylinder head.

   Torque:
   - Bolts 1 to 26
     - Stage 1: 3,5 Nm
     - Stage 2: 15 Nm
     - Stage 3: 23 Nm
   - Bolts 27 and 28
     - Stage 1: 3,5 Nm
     - Stage 2: 7,5 Nm
     - Stage 3: 10 Nm



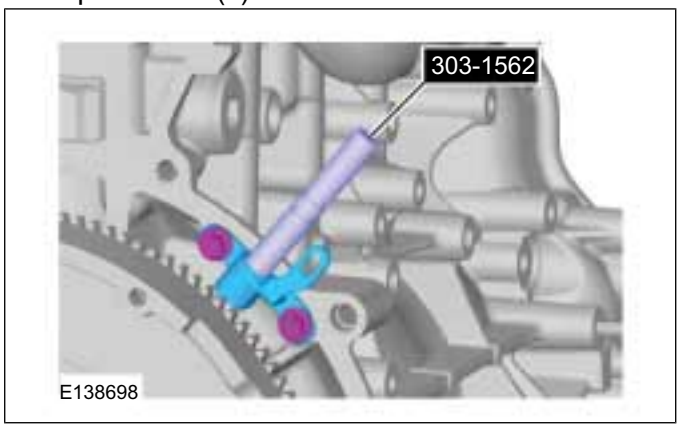
2. **NOTE:** Make sure that the rocker arms do not separate.

   Torque:
   - Stage 1: 10 Nm
   - Stage 2: 30°



REMOVAL AND INSTALLATION

3. Special Tool(s): 303-1562

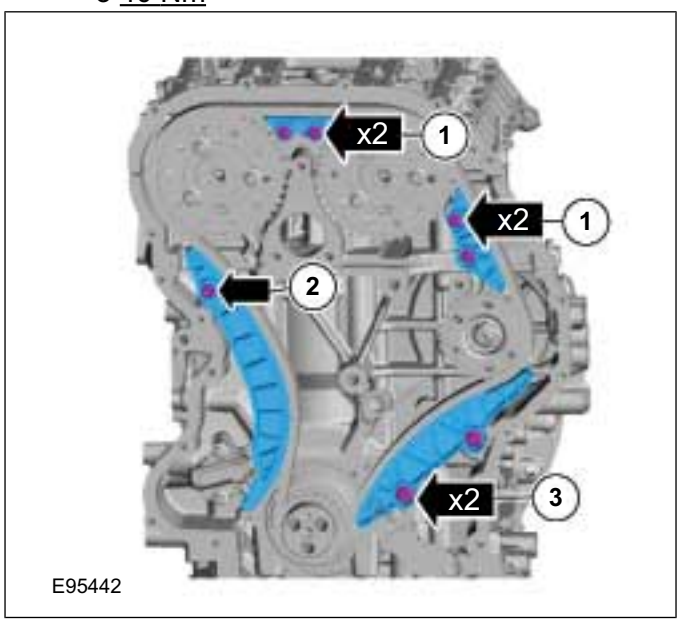


4. **NOTE:** Make sure that the installation marks are aligned.

   General Equipment: 6 mm Drill Bit
   Torque: 33 Nm

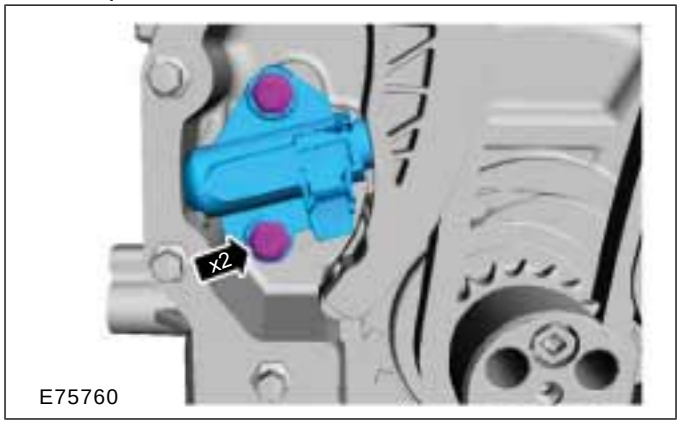
5. Remove the 6 mm drill bit.

6. Torque:
   - 1 15 Nm
   - 2 40 Nm
   - 3 40 Nm

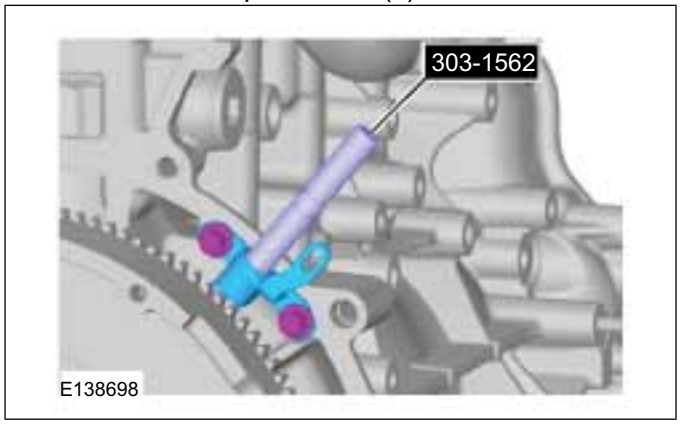


7. **NOTE:** Make sure that a new component is installed.

   Torque: 15 Nm



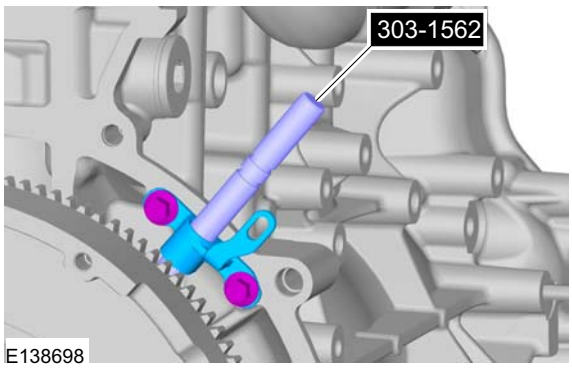
8. Remove the Special Tool(s): 303-1562



9. Rotate the engine two revolutions.

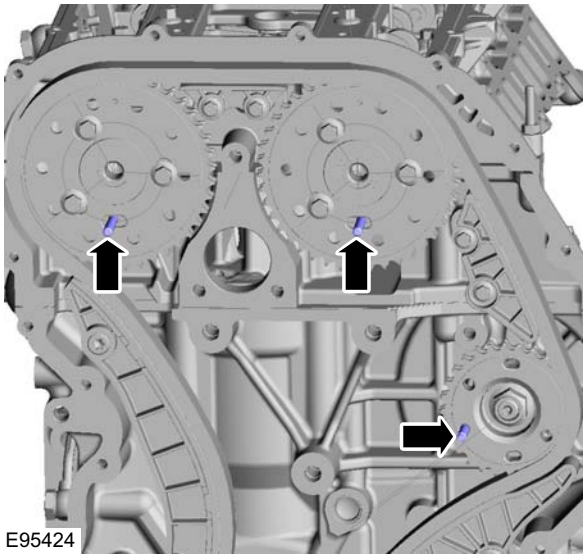
REMOVAL AND INSTALLATION

10. Special Tool(s): 303-1562



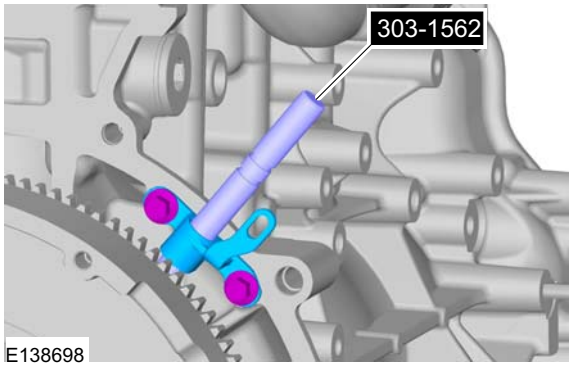
11. Check the valve timing by inserting the drill bits. If the drill bits cannot be inserted repeat the timing steps.

General Equipment: 6 mm Drill Bit



12. Remove the 6 mm drill bits.

13. Remove the Special Tool(s): 303-1562

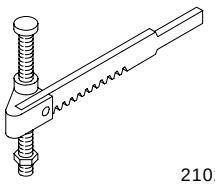
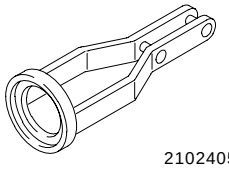


14. Refer to: Brake Vacuum Pump - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (206-07 Power Brake Actuation, Removal and Installation).
Refer to: Timing Cover (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
Refer to: Valve Cover (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
Refer to: Fuel Rail (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

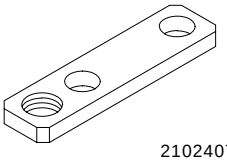
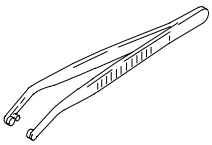
REMOVAL AND INSTALLATION

Valves

Special Tool(s)

 21024	303-060 Compressor, Valve Spring
 2102405	303-060-05 Adapter for 303-060

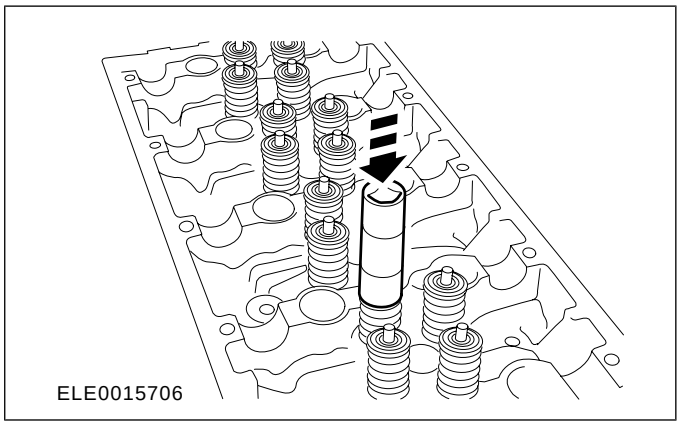
Special Tool(s)

 2102407	303-060-07 Adapter for 303-060
 21156	303-362 Installer, Valve Stem Collets

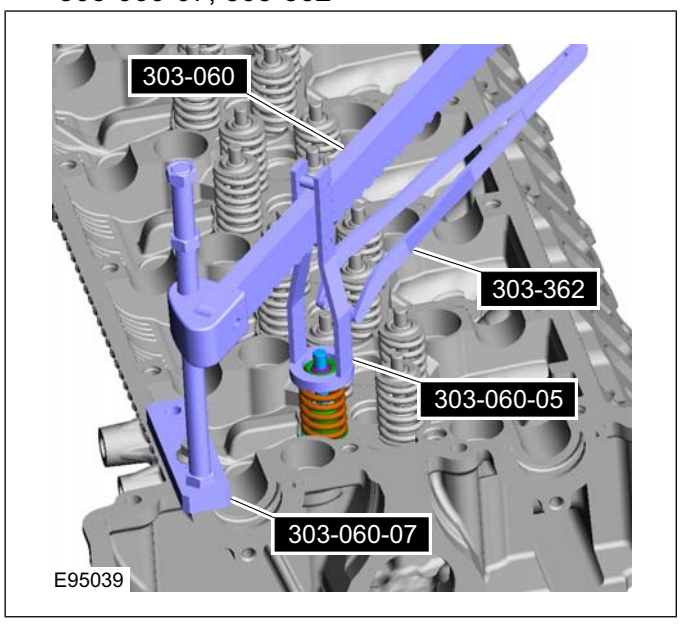
Removal

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

1. Refer to: Cylinder Head (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
2. **NOTE:** Position a socket on the valve spring seat and gently strike it with a hammer.

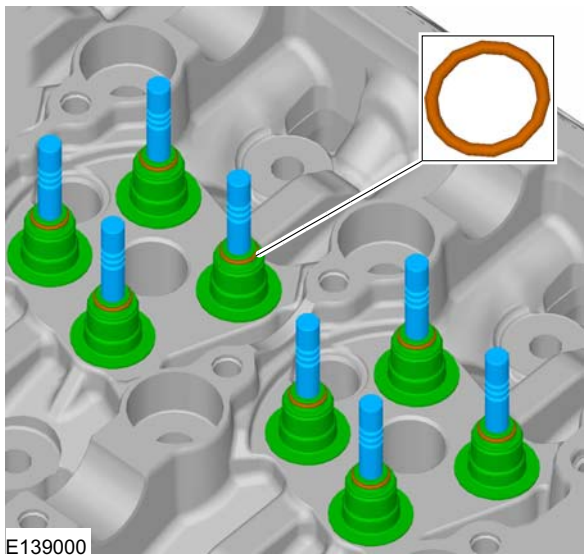


3. Special Tool(s): 303-060, 303-060-05, 303-060-07, 303-362



REMOVAL AND INSTALLATION

4.



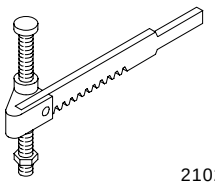
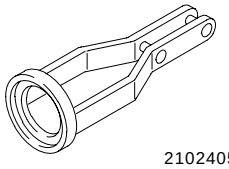
Installation

1. To install, reverse the removal procedure.

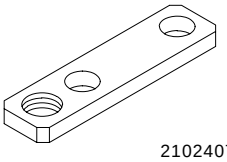
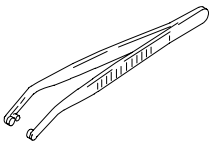
REMOVAL AND INSTALLATION

Valve Springs

Special Tool(s)

 21024	303-060 Compressor, Valve Spring
 2102405	303-060-05 Adapter for 303-060

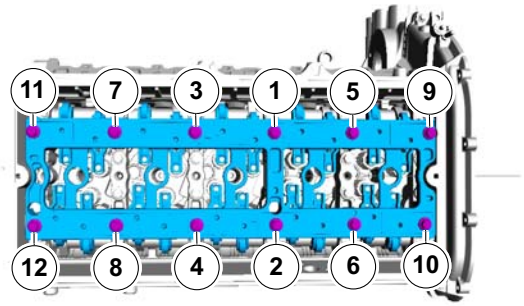
Special Tool(s)

 2102407	303-060-07 Adapter for 303-060
 21156	303-362 Installer, Valve Stem Collets

Removal

1. Refer to: Valve Cover (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

2.



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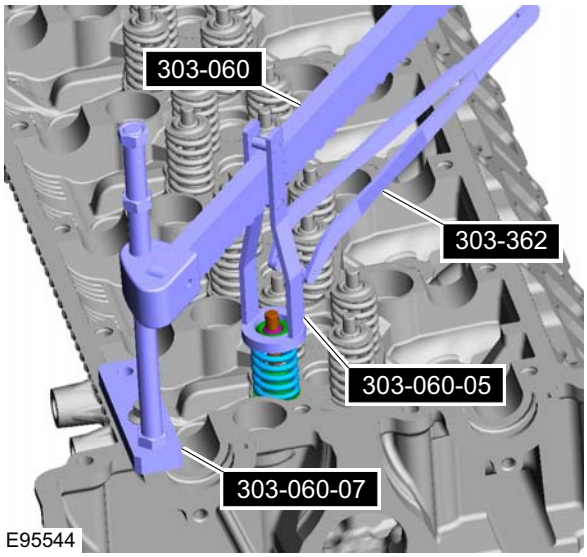
3. Position the appropriate piston at top dead center (TDC).

4. Special Tool(s): 303-060, 303-060-05, 303-060-07, 303-362

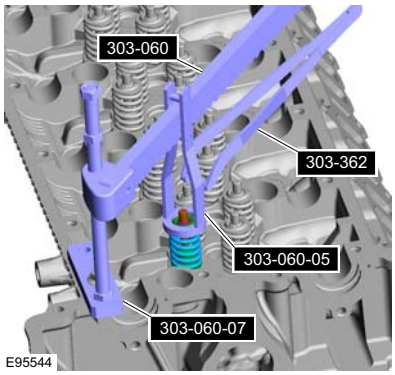


E95544

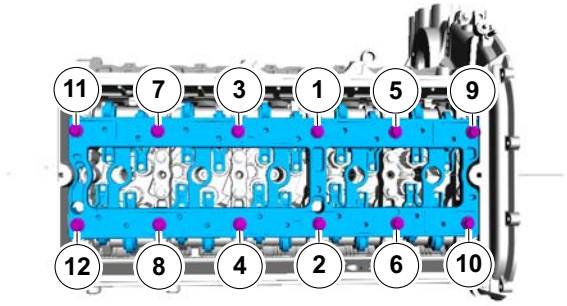
REMOVAL AND INSTALLATION

Installation

1. Special Tool(s): 303-060, 303-060-05, 303-060-07, 303-362



2. Torque:
   - Stage 1: 10 Nm
   - Stage 2: 30°

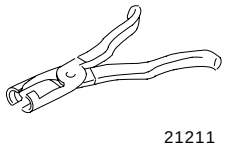


3. Refer to: Valve Cover (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

REMOVAL AND INSTALLATION

Valve Stem Seals(21 238 0)

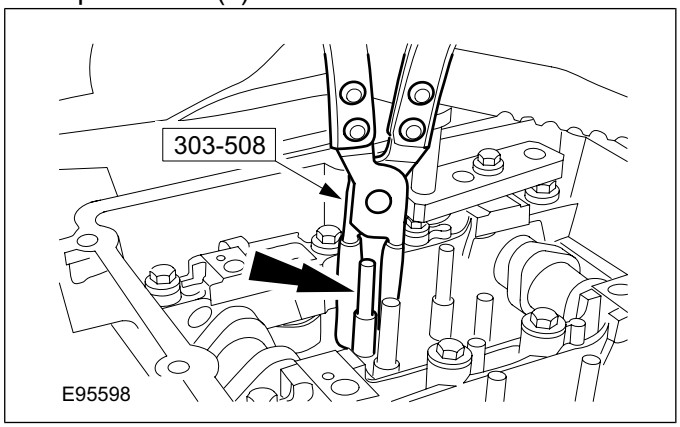
Special Tool(s)

 21211	303-508 Pliers, Valve Stem Seal

Removal

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

1. Refer to: Valve Springs (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
2. Special Tool(s): 303-508



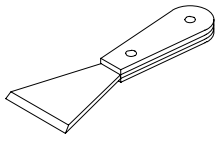
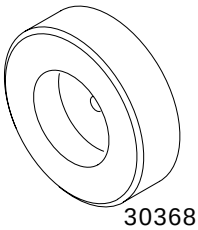
Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Timing Cover(21 146 0)

Special Tool(s)

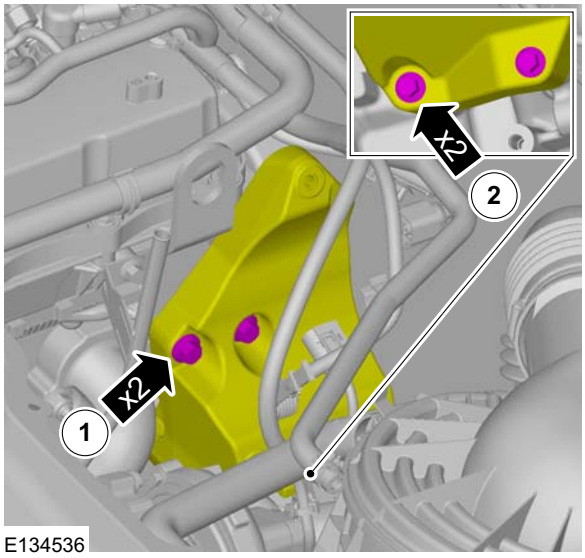
 21179	303-428 Separator, Oil Pan
 303682	303-682 Aligner, Engine Front Cover

Materials	
Name	**Specification**
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

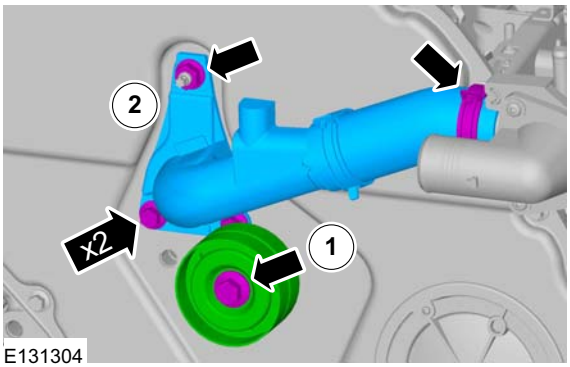
Removal

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 Fan Motor and Shroud (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
3. Refer to: Generator - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (414-02 Generator and Regulator, Removal and Installation).
4. 1. Torque: 35 Nm
   2. Torque: 35 Nm

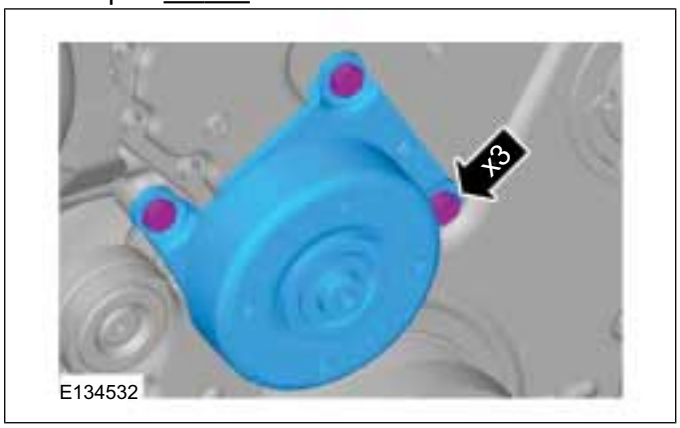


5. 1. Torque: 48 Nm
   2. Torque: 23 Nm



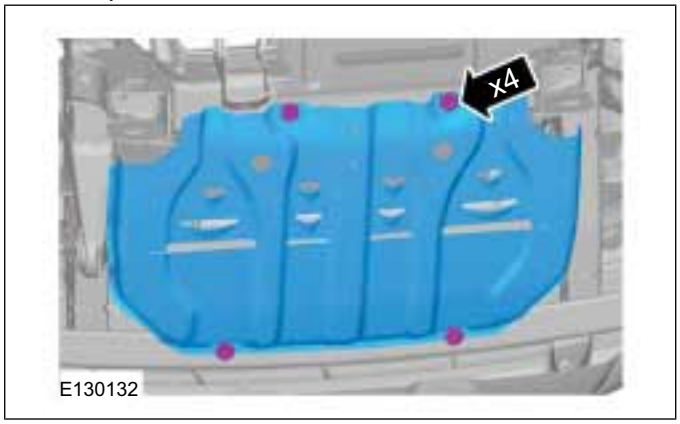
REMOVAL AND INSTALLATION

6. Torque: 48 Nm



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

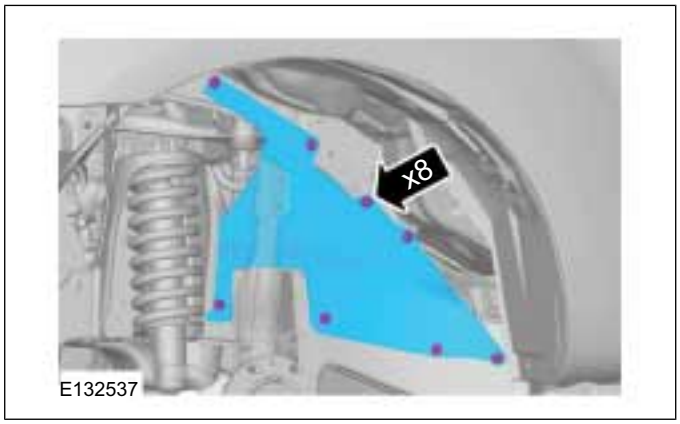
8. Torque: 30 Nm



9. **NOTE:** Remove front RH side wheel only.

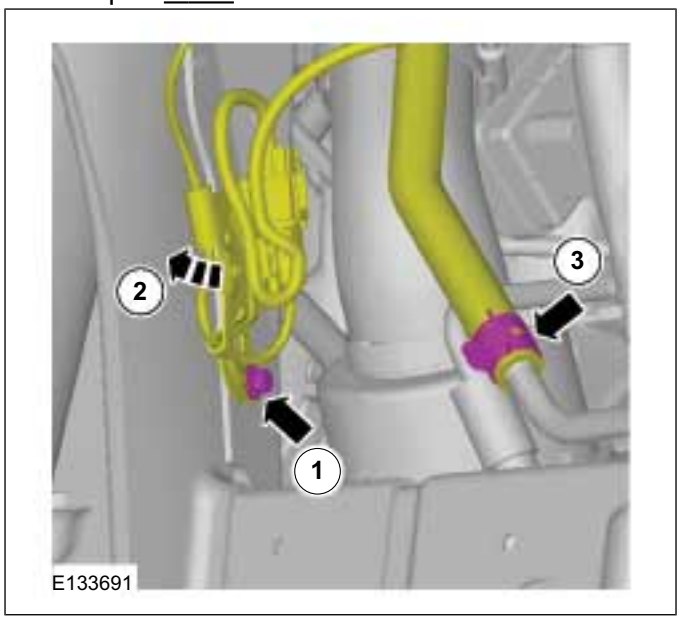
   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

10.

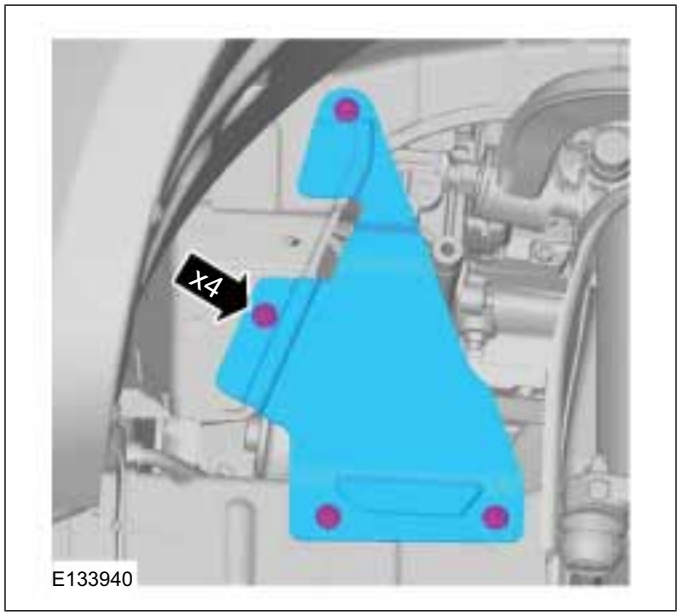


11. **CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.**

    Torque: 7 Nm

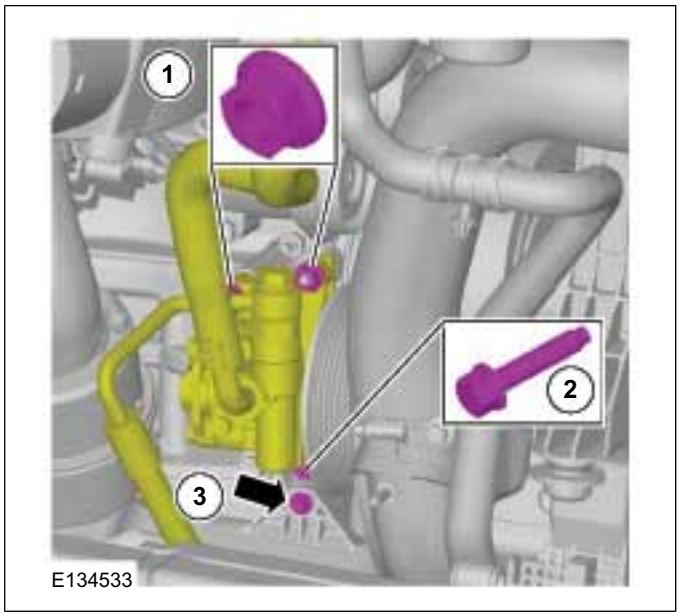


12.

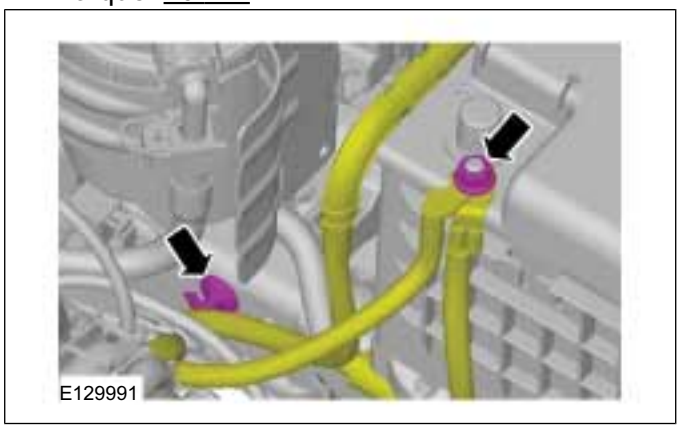


REMOVAL AND INSTALLATION

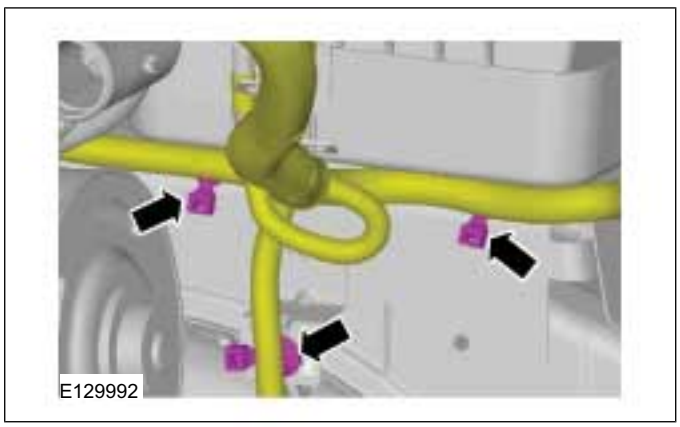
13. 1. Torque: 20 Nm
2. Torque: 20 Nm
3. Torque: 18 Nm



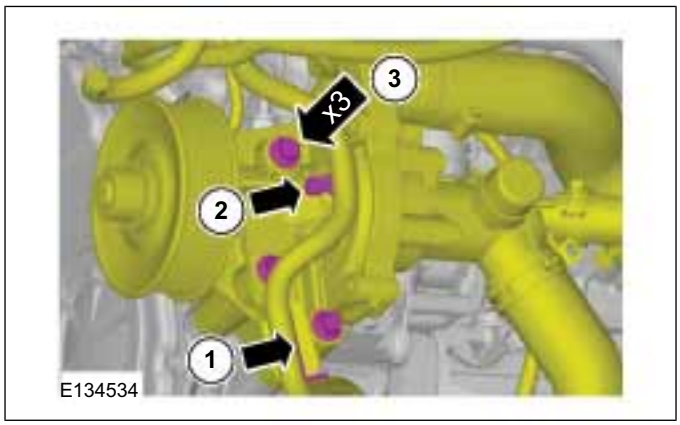
14. Torque: 10 Nm



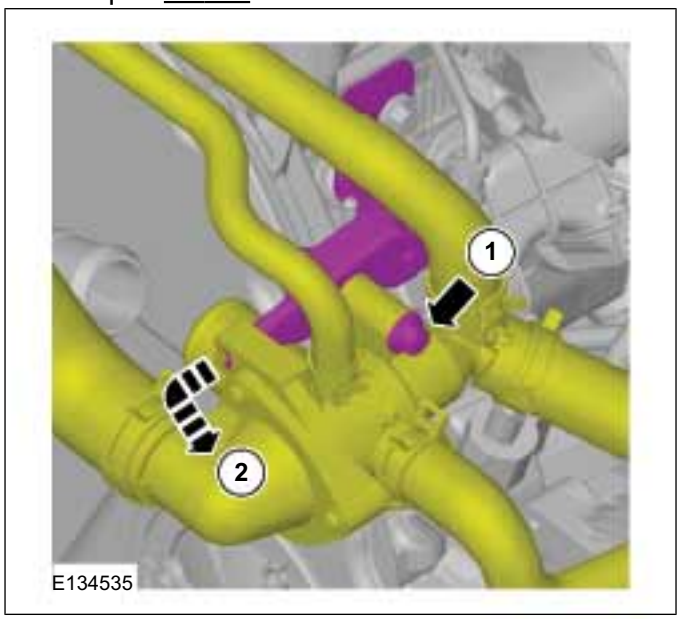
15.



16. 3. Torque: 23 Nm



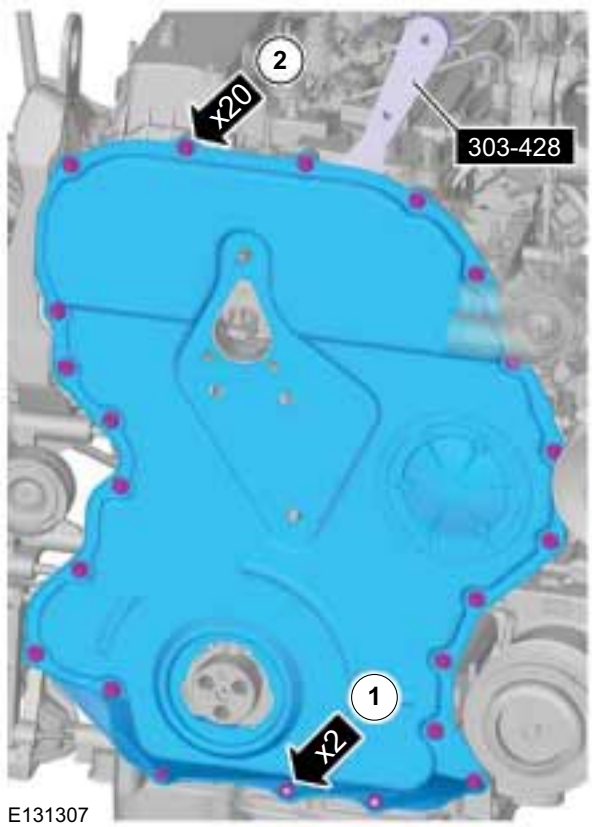
17. Torque: 23 Nm



REMOVAL AND INSTALLATION

18. Refer to: Engine Front Seal (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

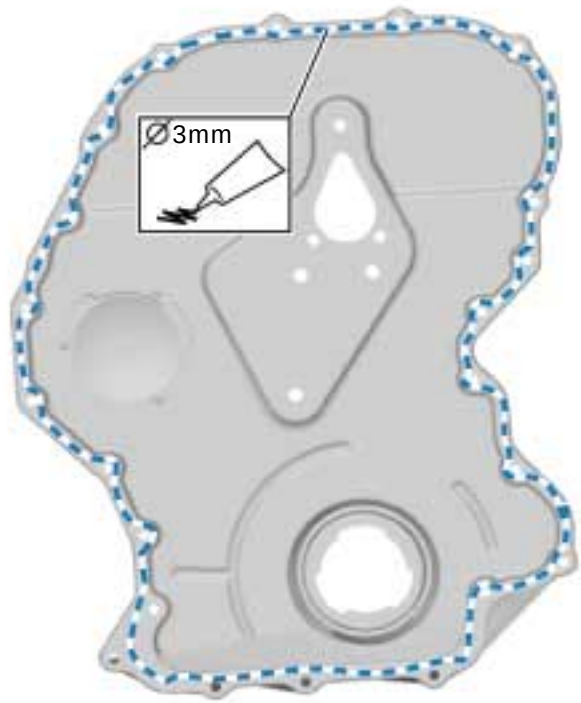
19. Special Tool(s): 303-428



E131307

NOTE: Do not damage the mating faces.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



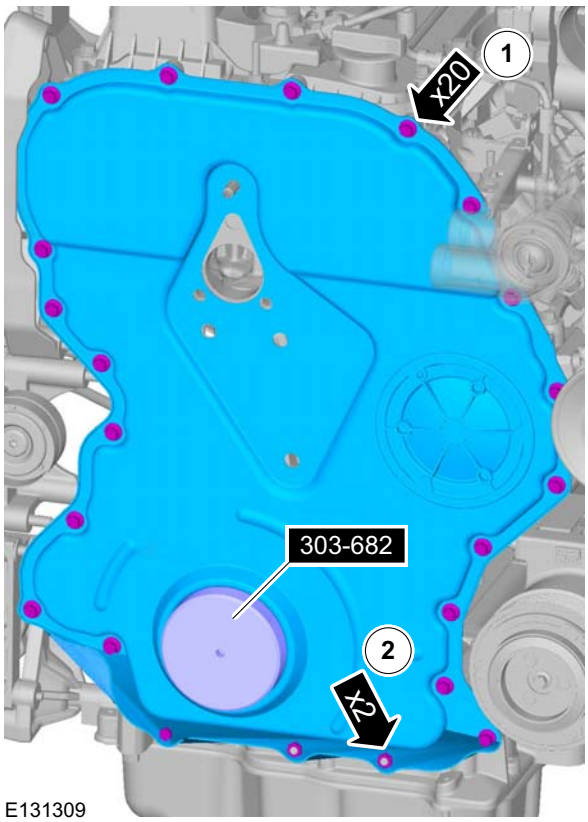
E131310

Installation

1. ⚠ **CAUTION: Install the timing cover within five minutes of applying the sealer.**

REMOVAL AND INSTALLATION

2. 1. Special Tool(s): 303-682
Torque: 10 Nm
2. Torque: 14 Nm

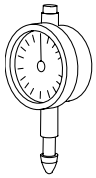
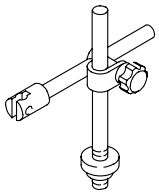
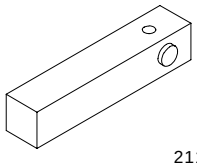


3. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

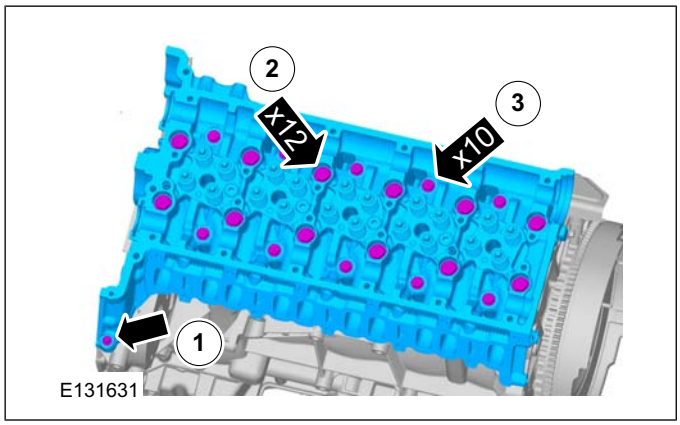
Cylinder Head(21 163 0)

Special Tool(s)

 15046	205-069 Dial Indicator Gauge (Metric)
 15022A	205-070 Holding Fixture, Dial Indicator Gauge
 21183	303-432 Holding Fixture, Dial Indicator Gauge (Cylinder Liner Protrusion)

Removal

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

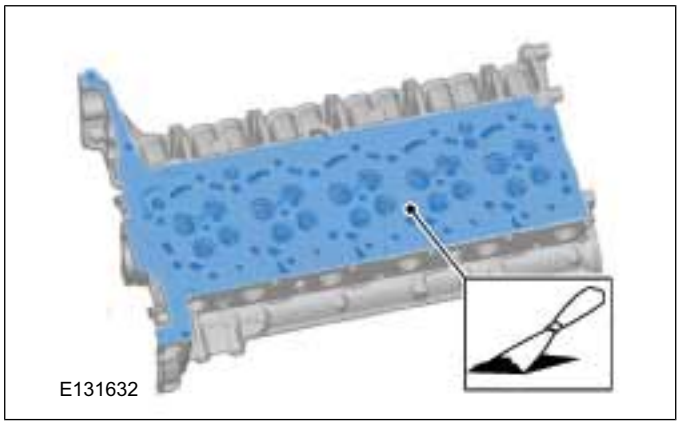
1. Refer to: Intake Manifold (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
   Refer to: Brake Vacuum Pump - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (206-07 Power Brake Actuation, Removal and Installation).
   Refer to: Exhaust Gas Recirculation (EGR) Cooler - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-08 Engine Emission Control - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
   Refer to: Exhaust Manifold (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
   Refer to: Camshafts (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
2. 

Installation

1. **WARNING: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak**

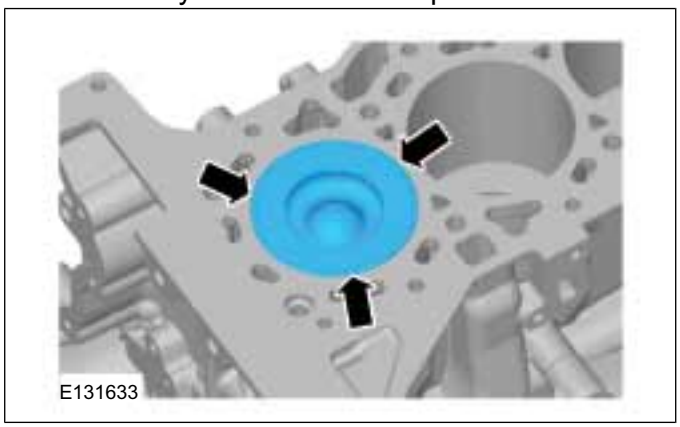
REMOVAL AND INSTALLATION

paths. Use a plastic scraping tool to remove all traces of the head gasket.



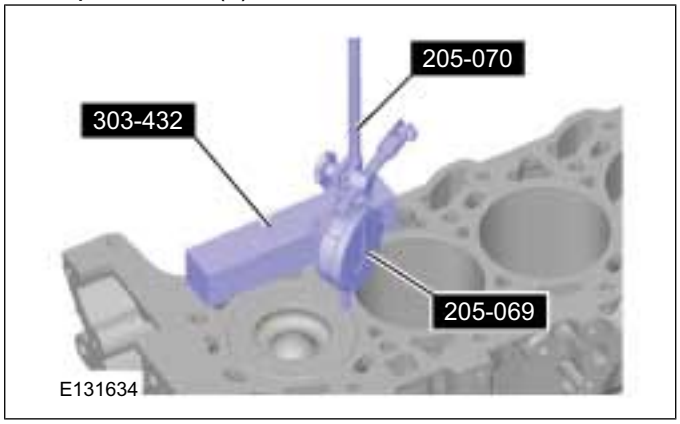
2. **NOTE:** Measure the piston protrusion of each cylinder at top dead center (TDC).

   Measure the distance between the piston crown and the cylinder block at the points indicated.



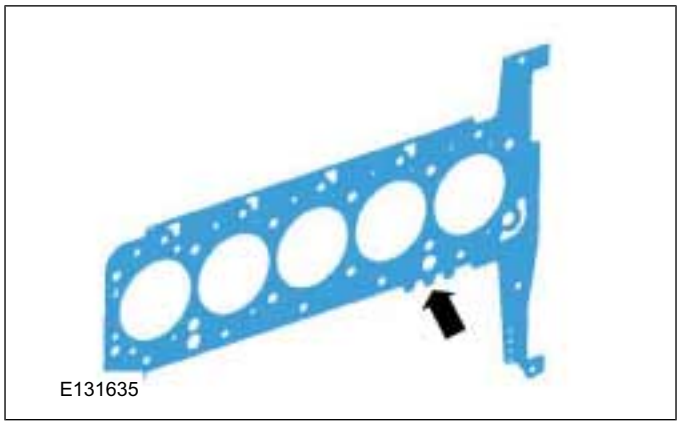
3. **NOTE:** The largest measurement determines the choice of the cylinder head gasket.

   Special Tool(s): 205-069, 205-070, 303-432

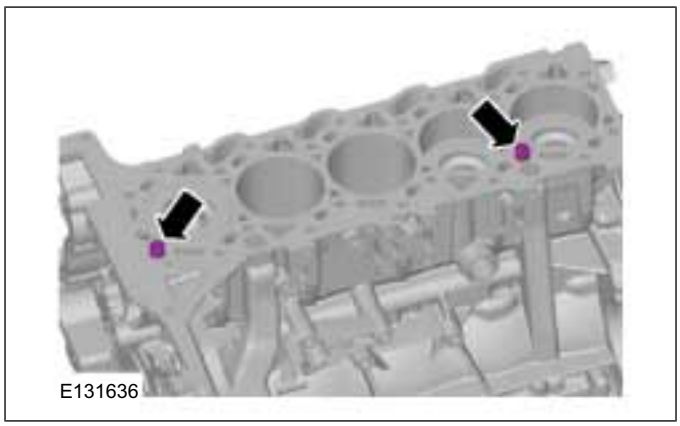


4. **NOTE:** Note the thickness of the gasket.

NOTE: Make sure that a new component is installed.

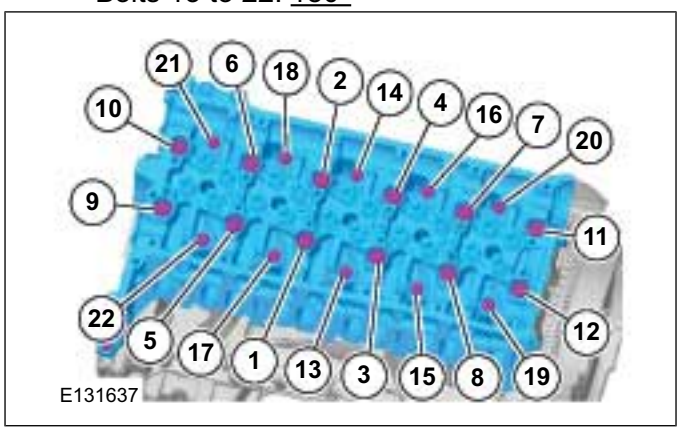


5.



6. **CAUTION: Make sure that new cylinder head bolts are installed.**

   Torque:
   - Bolts 1 to 12: 10 Nm
   - Bolts 13 to 22: 5 Nm
   - Bolts 1 to 12: 20 Nm
   - Bolts 13 to 22: 10 Nm
   - Bolts 1 to 12: 50 Nm
   - Bolts 1 to 12: 180°
   - Bolts 13 to 22: 25 Nm
   - Bolts 13 to 22: 180°



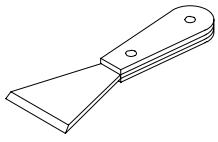
REMOVAL AND INSTALLATION

7. Refer to: Camshafts (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
   Refer to: Exhaust Manifold (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
   Refer to: Exhaust Gas Recirculation (EGR) Cooler - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-08 Engine Emission Control - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
   Refer to: Brake Vacuum Pump - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (206-07 Power Brake Actuation, Removal and Installation).
   Refer to: Intake Manifold (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

REMOVAL AND INSTALLATION

Oil Pan(21 154 0)

Special Tool(s)

 21179	303-428 Separator, Oil Pan

Materials	
Name	**Specification**
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

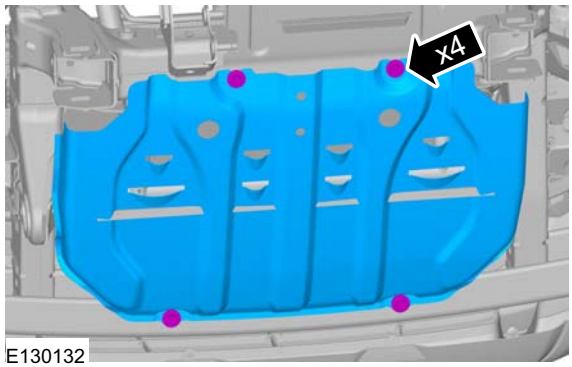
Removal

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

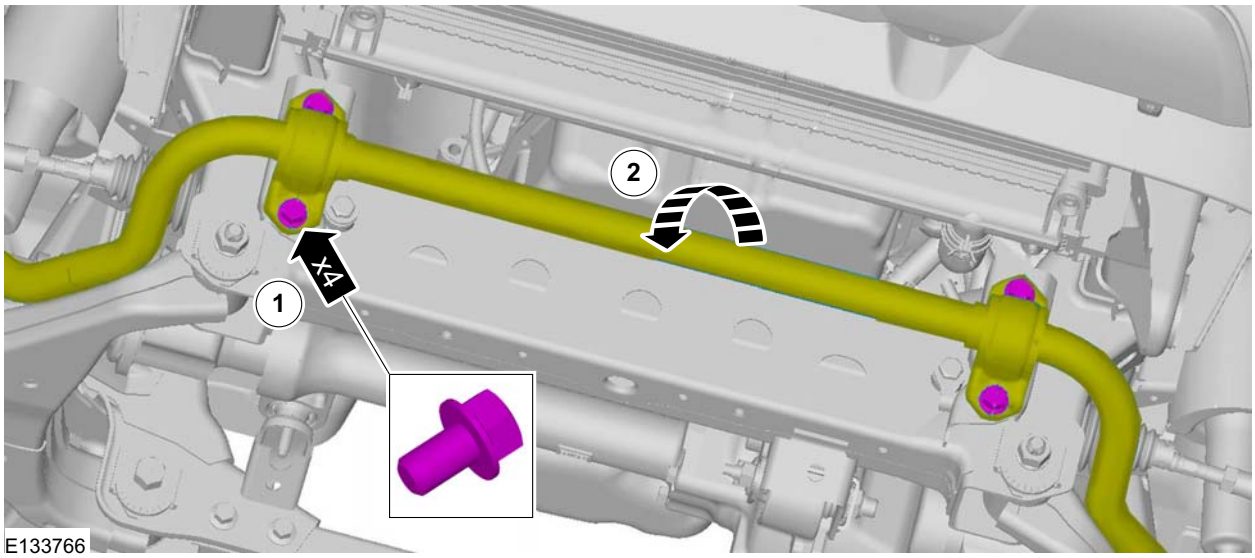
1. Refer to: Engine Cooling System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

4x4

4. Torque: 30 Nm



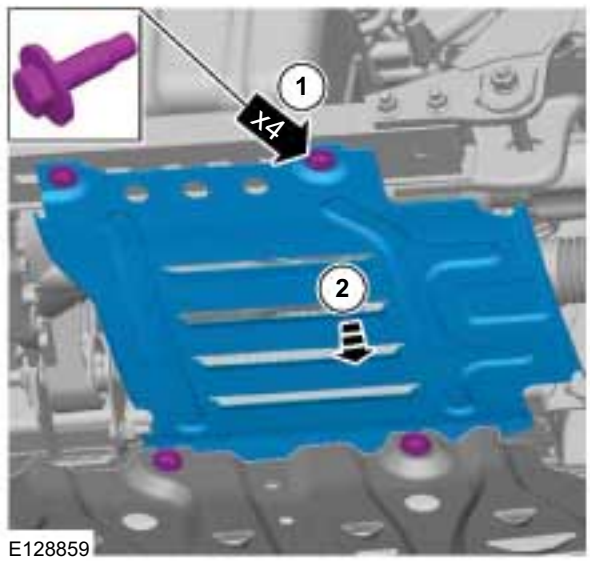
5. Torque: 30 Nm



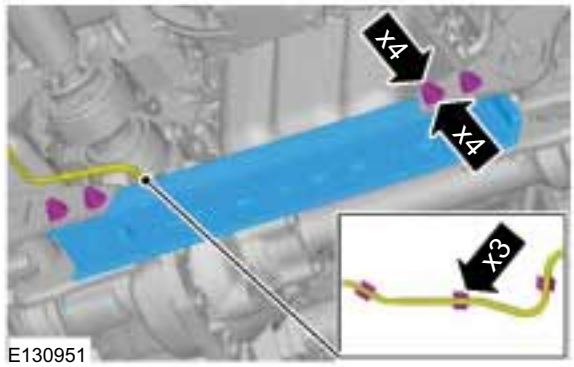
REMOVAL AND INSTALLATION

All vehicles

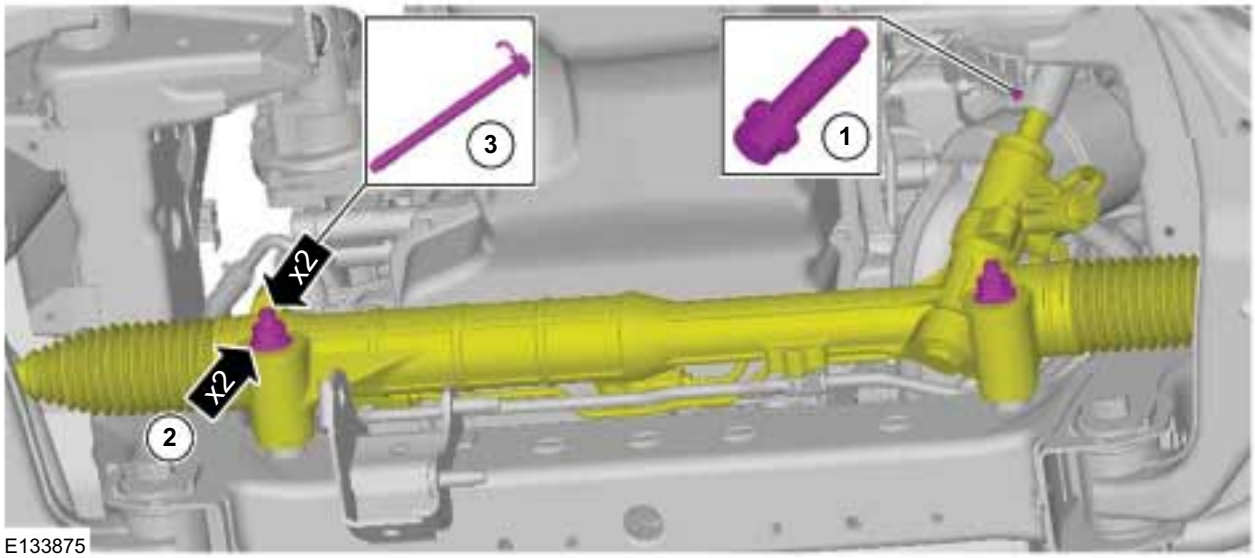
6. Torque: 30 Nm



7. Torque: 35 Nm



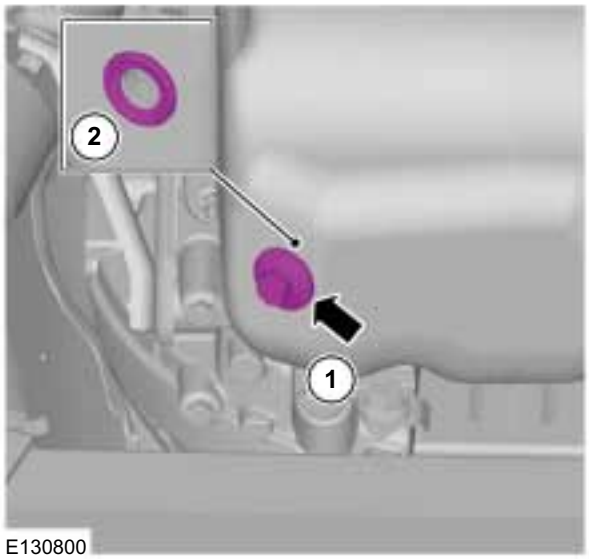
8. **CAUTION: Take extra care when handling steering gear rack.**
   1. Torque: 23 Nm
   2. Torque: 150 Nm



9. **WARNING: Be prepared to collect escaping fluids.**

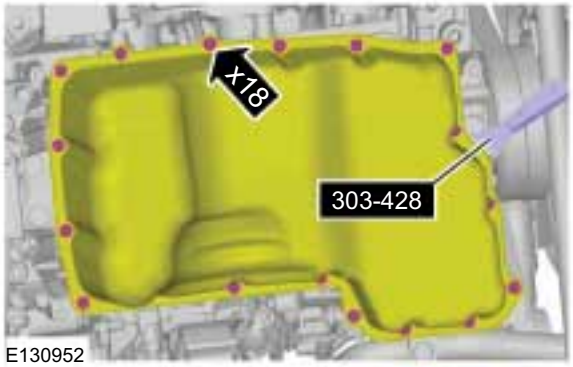
REMOVAL AND INSTALLATION

Drain the oil pan into a suitable container.
Torque: 39 Nm



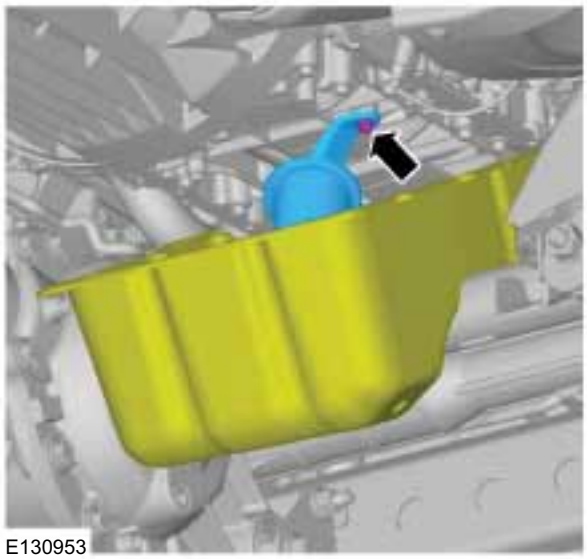
E130800

10. Special Tool(s): 303-428

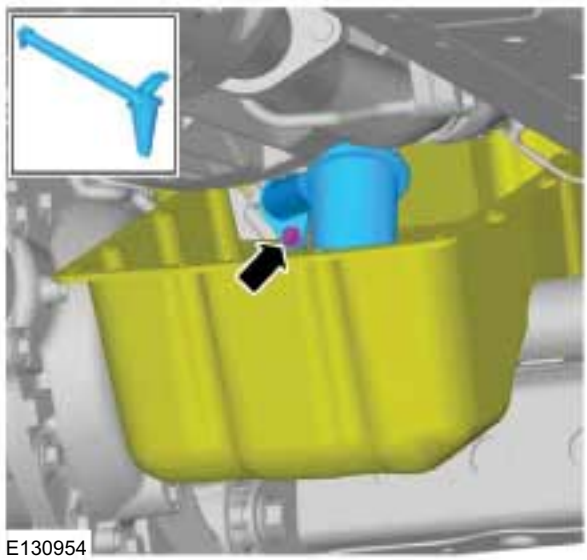


E130952

11. Torque: 10 Nm

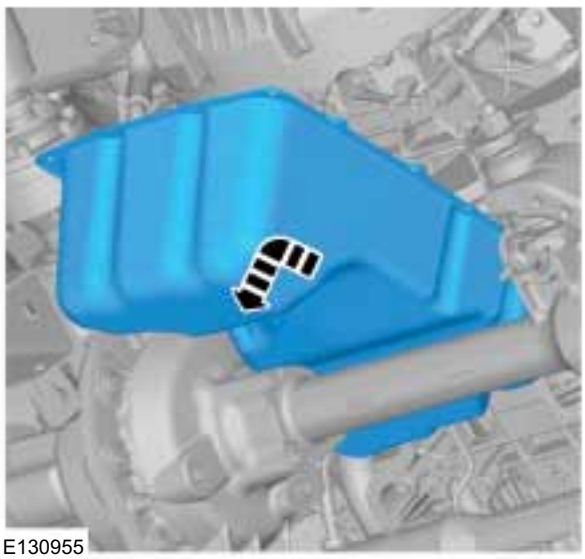

E130953

12. Torque: 10 Nm


E130954

4x4

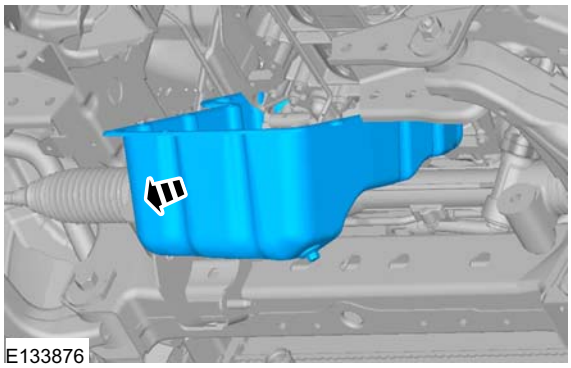
13.


E130955

REMOVAL AND INSTALLATION

4x2

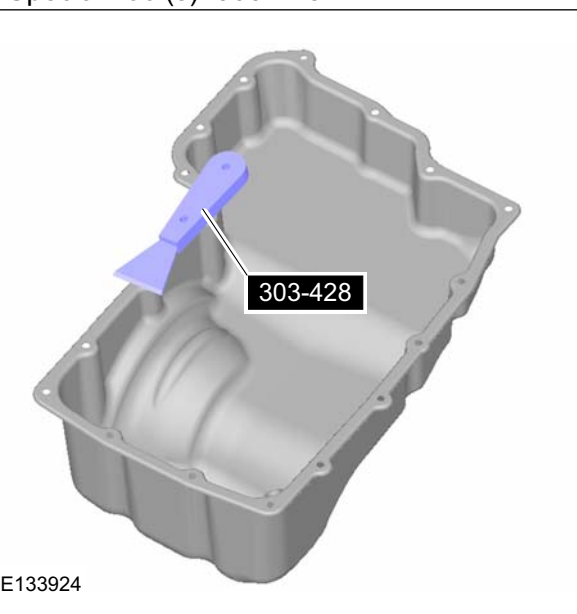
14.



Installation

1. **NOTE:** Do not damage the mating faces.

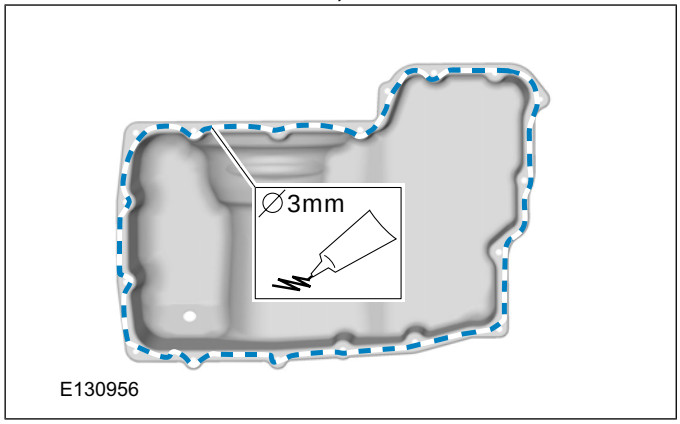
   Special Tool(s): 303-428



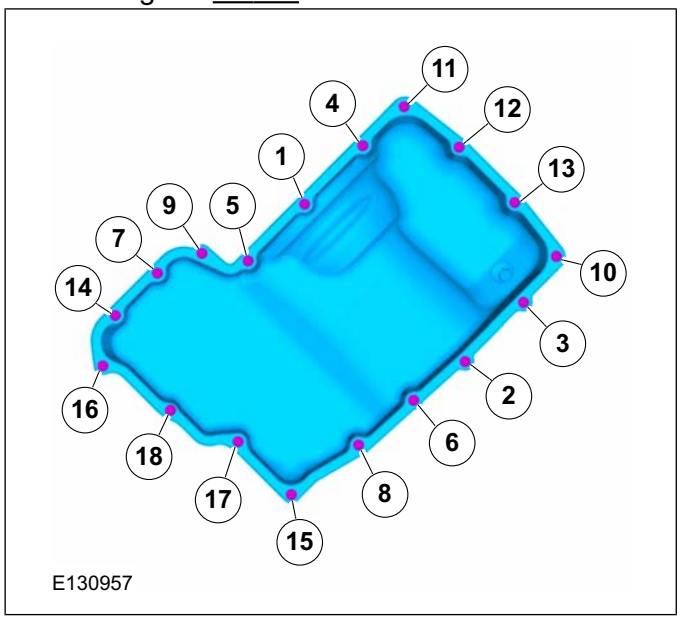
2. ⚠ **CAUTION: Install the oil pan within five minutes of applying the sealer.**

NOTE: Do not damage the mating faces.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



3. Torque:
   - Stage 1: 7 Nm
   - Stage 2: 14 Nm



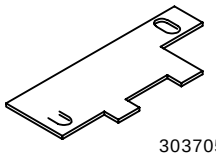
4. To install, reverse the removal procedure.
5. Fill the oil pan with clean engine oil.

   Refer to: Specifications (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Specifications).

REMOVAL AND INSTALLATION

Oil Pump(21 714 0)

Special Tool(s)

 303705	303-705 Aligner, Oil Pump

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).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

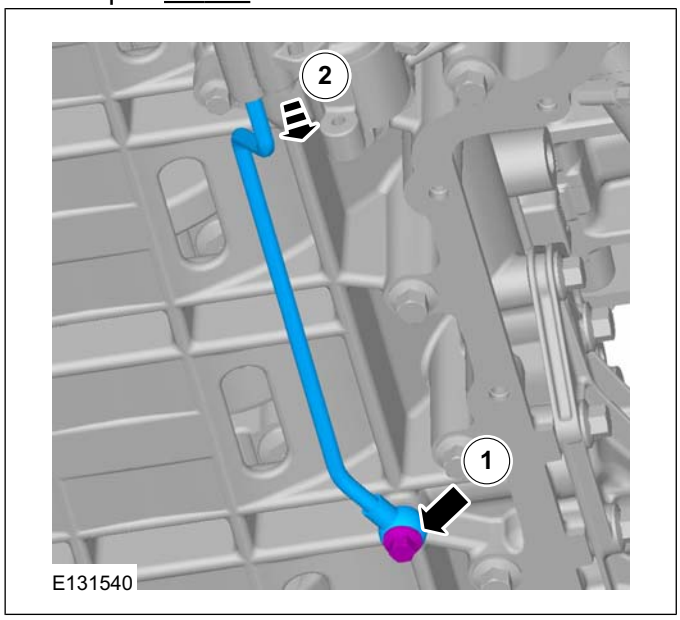
2. Refer to: Oil Pan (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

3. Hand tighten the bolts at this stage.

   Special Tool(s): 303-705
   Torque: 15 Nm

4. **WARNING: Be prepared to collect escaping fluids.**

   Torque: 13 Nm

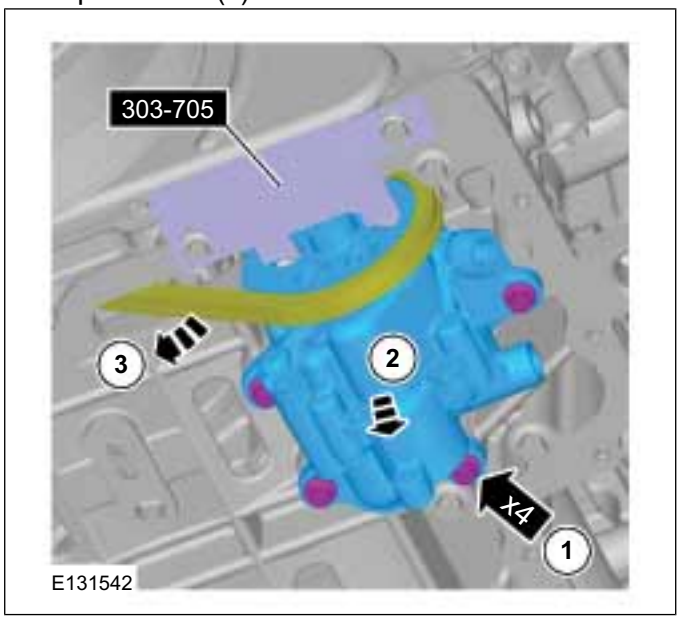


5. **NOTE:** Do not completely loosen the bolts at this stage.

   Special Tool(s): 303-705

REMOVAL AND INSTALLATION

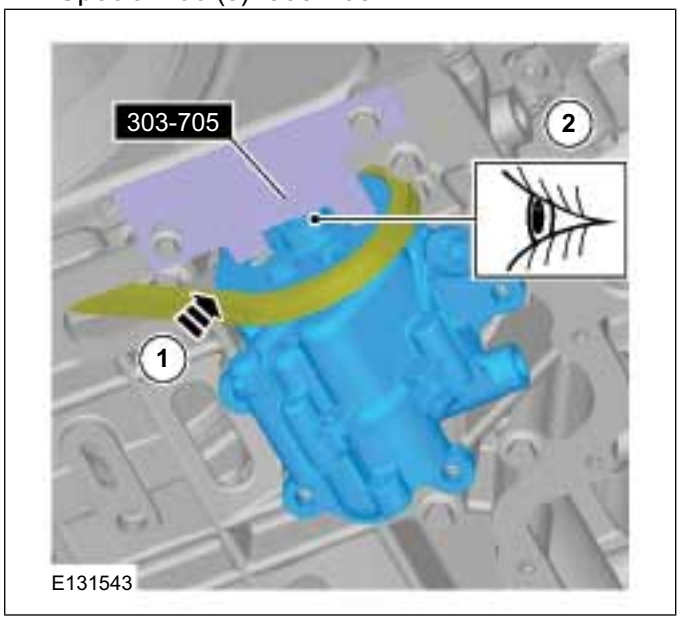
6. Special Tool(s): 303-705



Installation

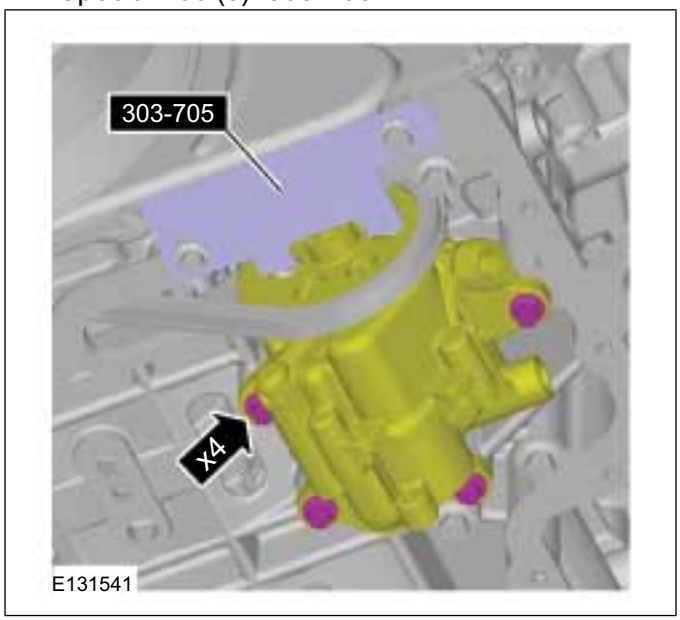
1. **NOTE:** The profile of the special tool must be in contact with the oil pump sprocket.

   Special Tool(s): 303-705

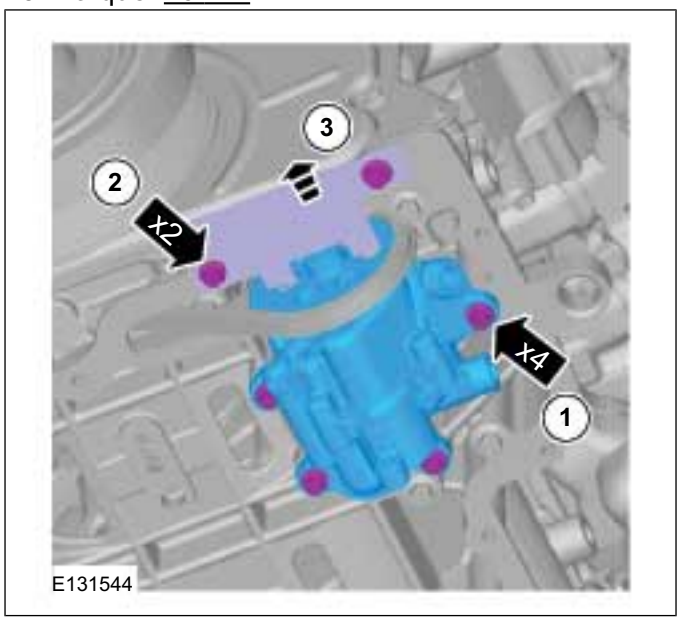


2. **NOTE:** Hand tighten the bolts at this stage.

   Special Tool(s): 303-705



3. Torque: 10 Nm

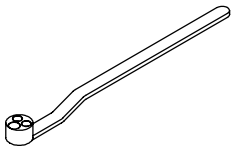


4. Refer to: Oil Pan (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

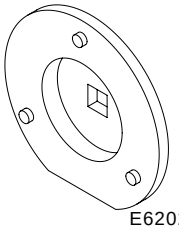
REMOVAL AND INSTALLATION

Engine Front Seal

Special Tool(s)

 E87614	303-1310 Holding Wrench, Crankshaft

Special Tool(s)

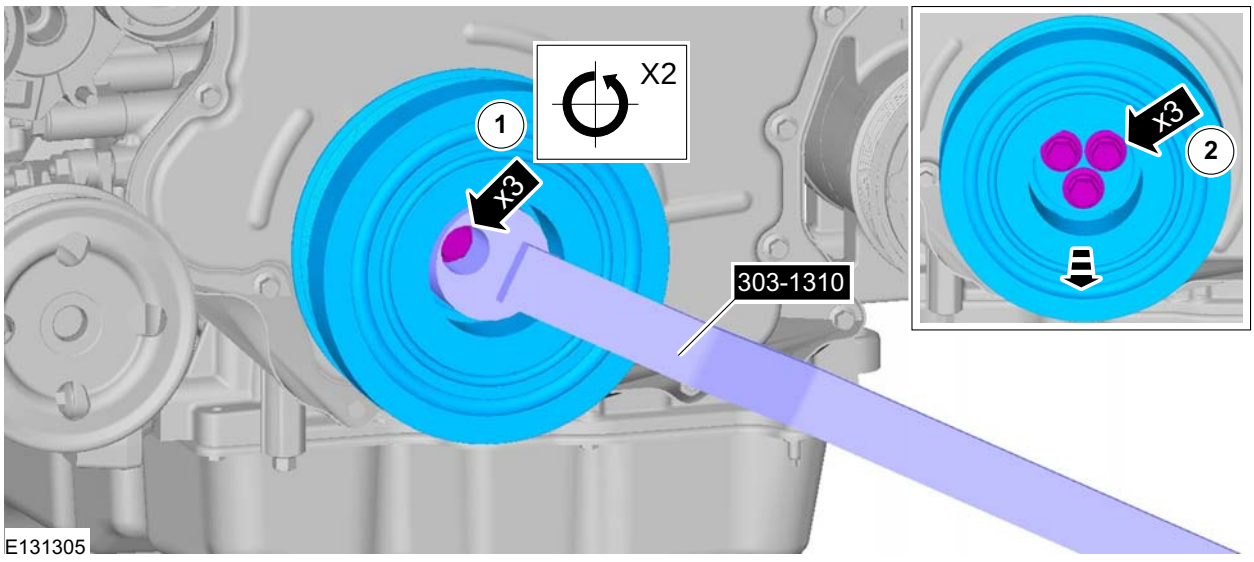
 E62024	303-679A Remover/Installer, Engine Front Cover Inspection Plate

Removal

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

1. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
2. 1.Do not completely loosen the crankshaft pulley bolts.

   Special Tool(s): 303-1310

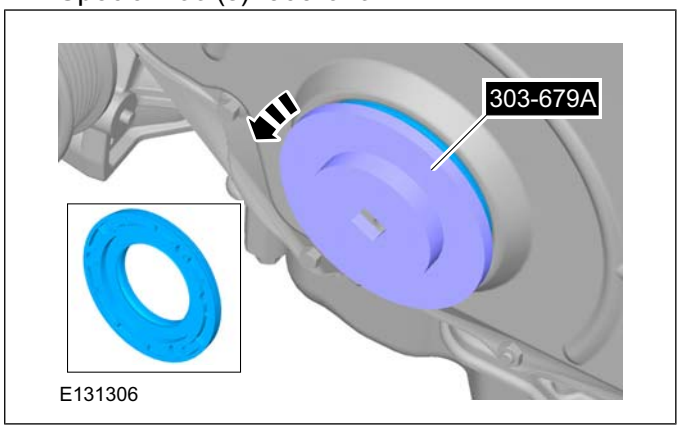


3. ⚠ **CAUTION: Rotate the seal assembly until it releases. Failure to follow this**

REMOVAL AND INSTALLATION

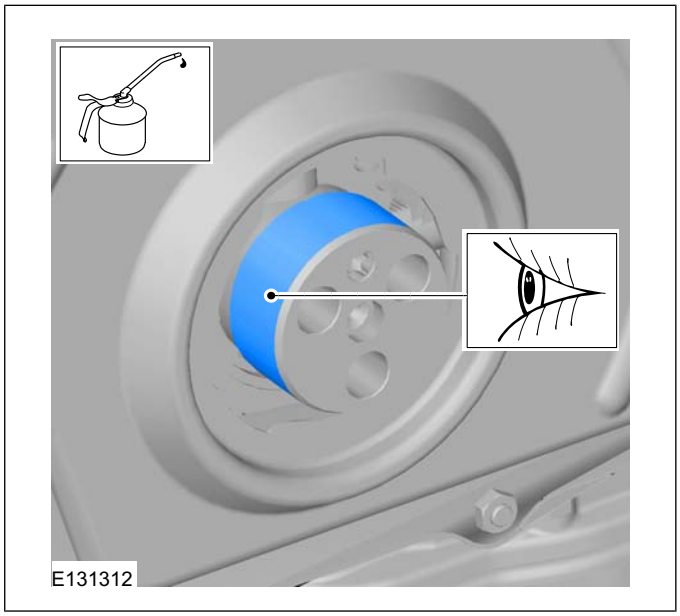
instruction may result in damage to the seal assembly.

Special Tool(s): 303-679A



Installation

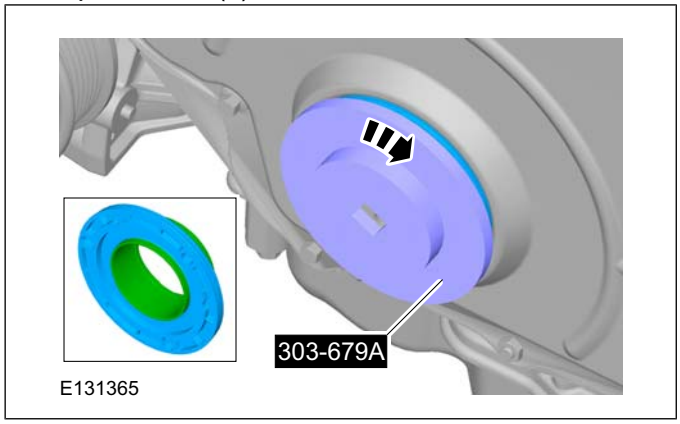
1. **NOTE:** Make sure that the mounting face is clean and lubricated.



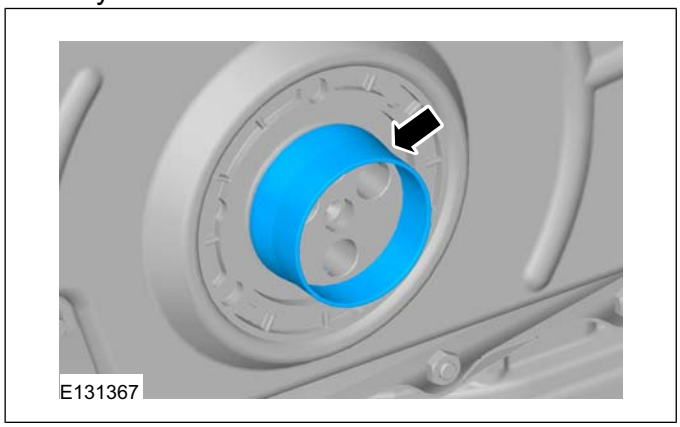
2. ⚠ **CAUTION: Rotate the seal assembly until it locks. Failure to follow this instruction may result in damage to the seal assembly.**

NOTE: A new crankshaft front seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft rear seal is fully installed.

Special Tool(s): 303-679A



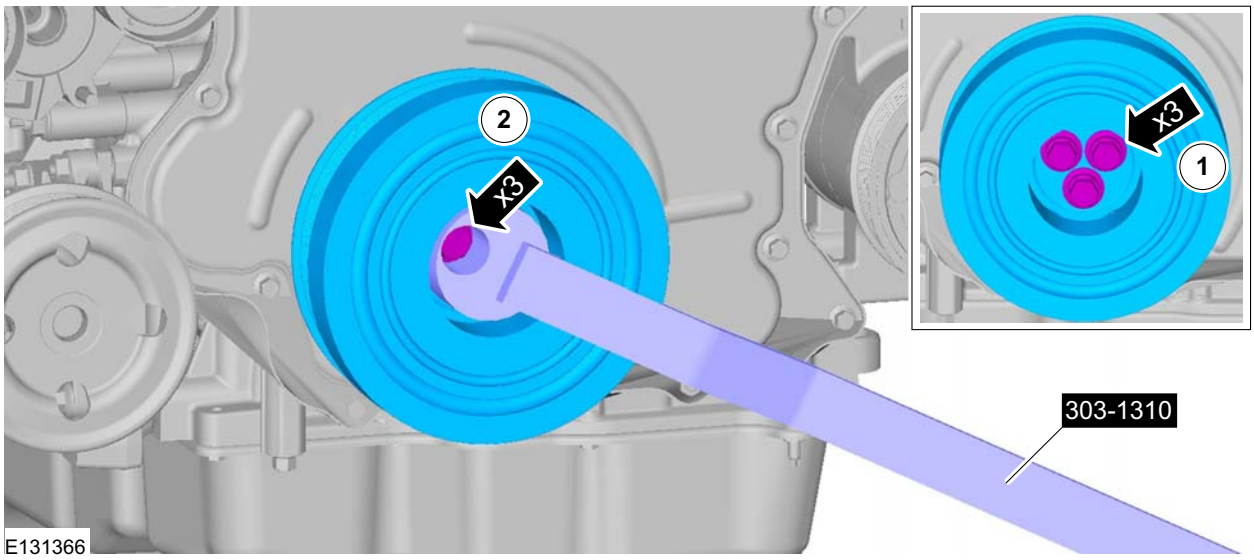
3. Remove the alignment sleeve after the seal is fully installed.



4. ⚠ **CAUTION: The crankshaft pulley bolts must not be used more than 3 times.**

Special Tool(s): 303-1310
Torque:
- Stage 1: 45 Nm
- Stage 2: 120°

REMOVAL AND INSTALLATION

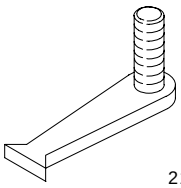


5. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

REMOVAL AND INSTALLATION

Crankshaft Rear Seal(21 468 4)

Special Tool(s)

 21135	303-254 Locking Tool, Flywheel

Materials	
Name	**Specification**
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

Removal

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

Vehicles with automatic transmission

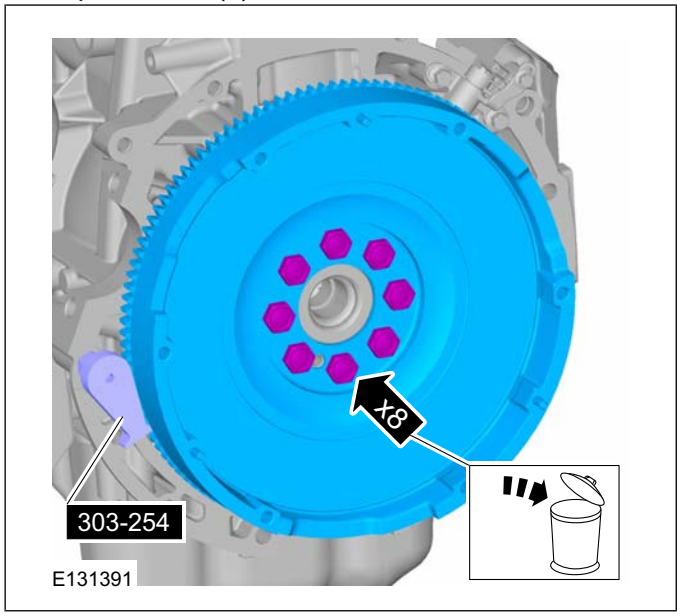
1. Refer to: Transmission - 2WD (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, Removal).
   Refer to: Transmission - 4WD (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, Removal).

Vehicles with manual transmission

2. Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 6-Speed Manual Transmission - MT82, Removal and Installation).

All vehicles

3. Special Tool(s): 303-254



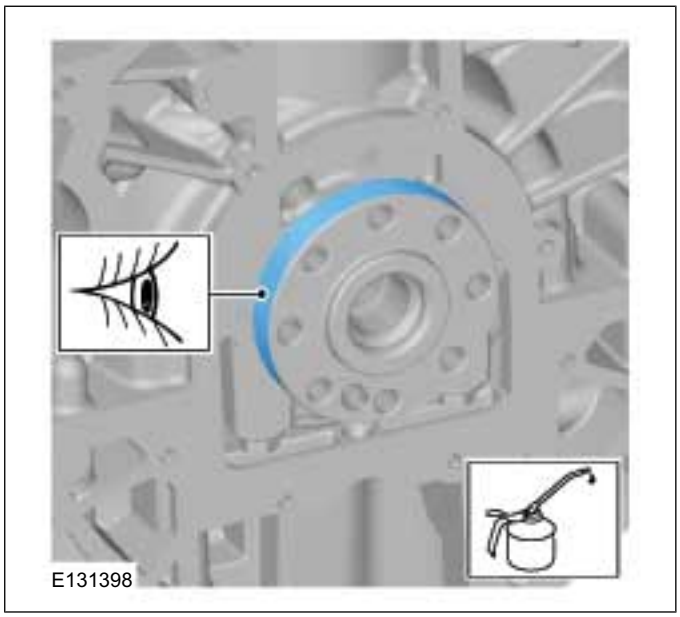
REMOVAL AND INSTALLATION

4.

Installation

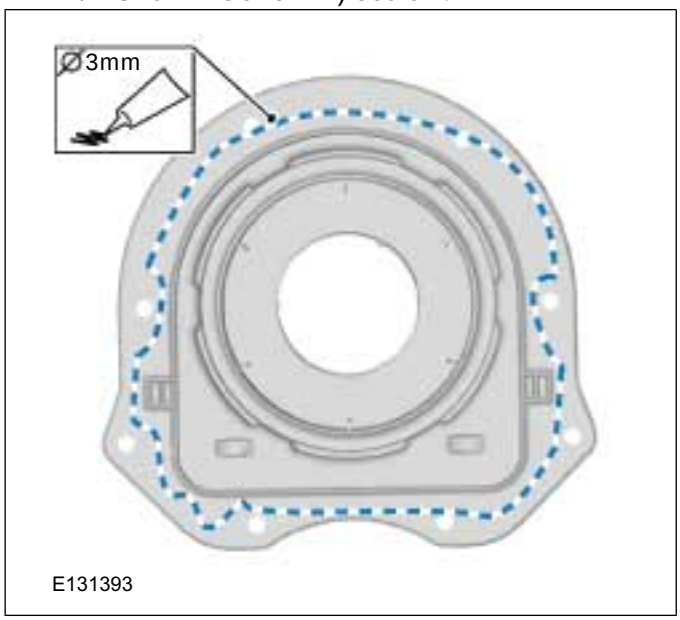
All vehicles

1.



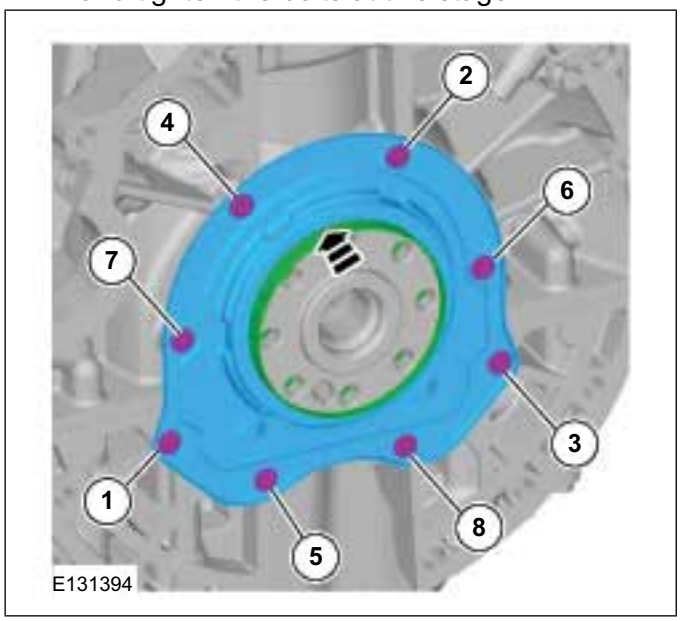
2. NOTE: Install the new crankshaft rear seal carrier within five minutes of applying the recommended sealant.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



3. CAUTION: A new crankshaft rear seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft rear seal is fully installed. Failure to follow this instruction may result in damage to the vehicle.

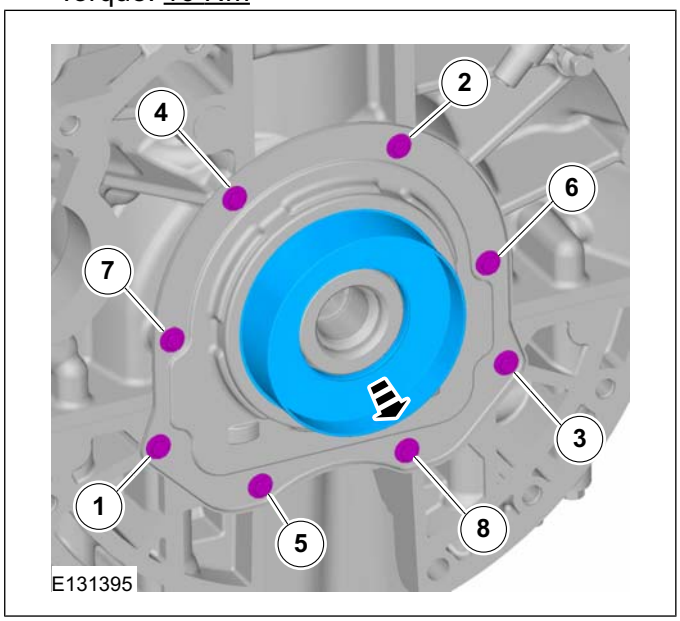
Hand tighten the bolts at this stage.



REMOVAL AND INSTALLATION

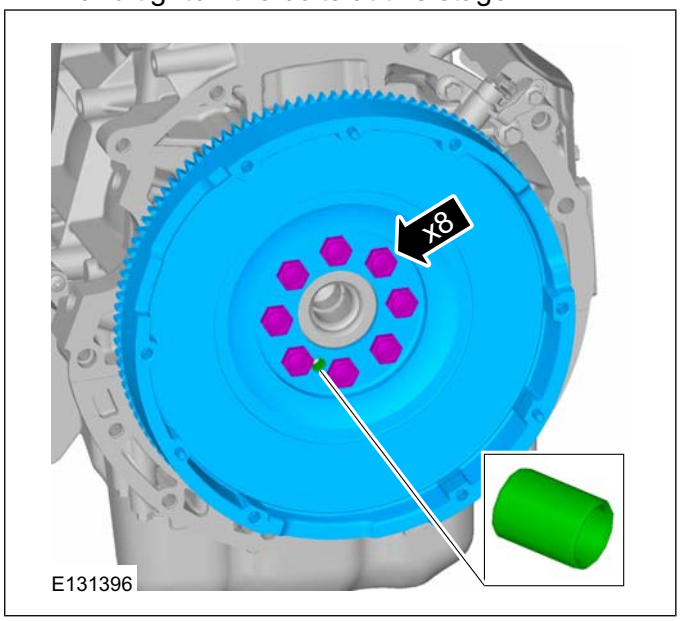
4. **NOTE:** New crankshaft rear seal carriers are supplied with an alignment sleeve which must be removed after installation.

   Torque: 10 Nm

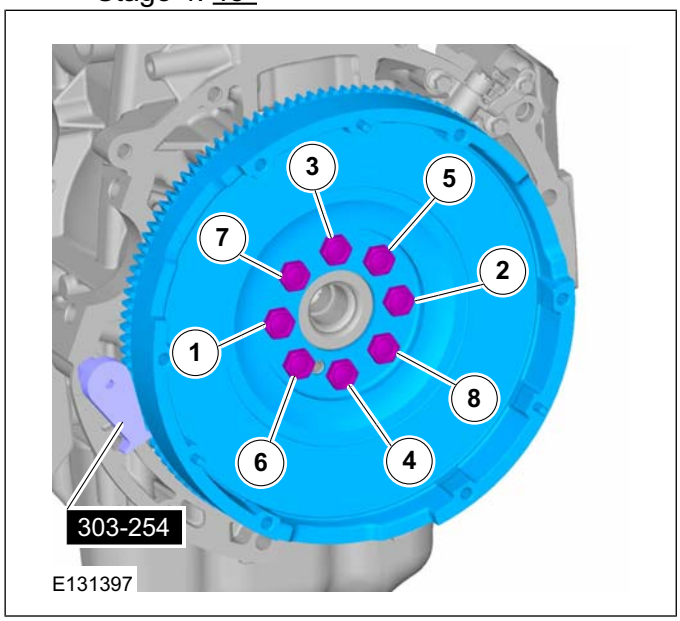


5. **NOTE:** Make sure that the flywheel is in full contact with the crankshaft flange before installing the flywheel bolts.

   Hand tighten the bolts at this stage.



6. Special Tool(s): 303-254
   Torque:
   - Stage 1: 15 Nm
   - Stage 2: 30 Nm
   - Stage 3: 75 Nm
   - Stage 4: 45°



Vehicles with manual transmission

7. Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 6-Speed Manual Transmission - MT82, Removal and Installation).

Vehicles with automatic transmission

8. Refer to: Transmission - 2WD (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, Installation).
   Refer to: Transmission - 4WD (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, Installation).

REMOVAL

Engine — Vehicles With: 6-Speed Manual Transmission - MT82(21 132 0; 21 132 6; 21 132 7)

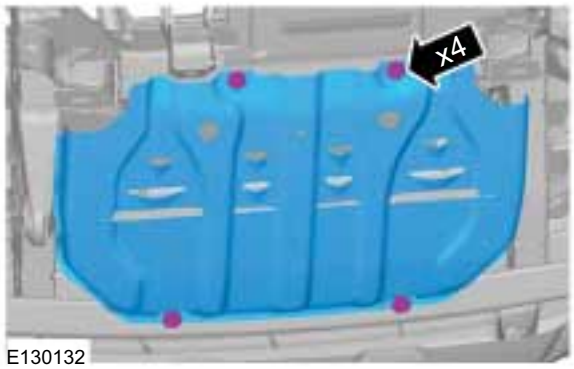
Removal

Special Tool(s) / General Equipment

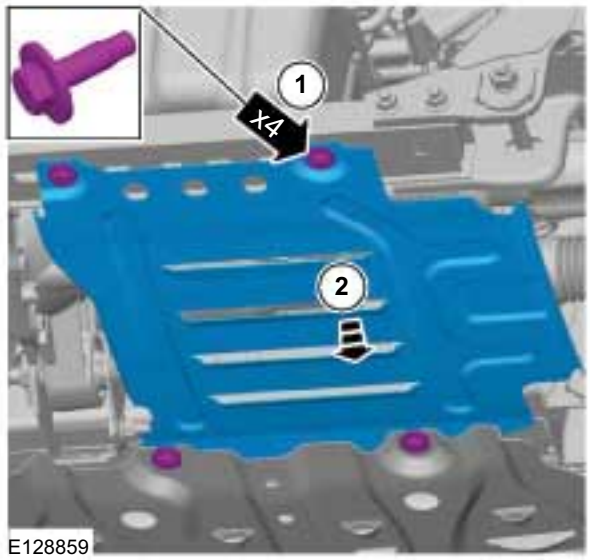
 21068A	303-122 Lifting Bracket, Engine
Transmission Jack	

1. Refer to: 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: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).
4. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).
5. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

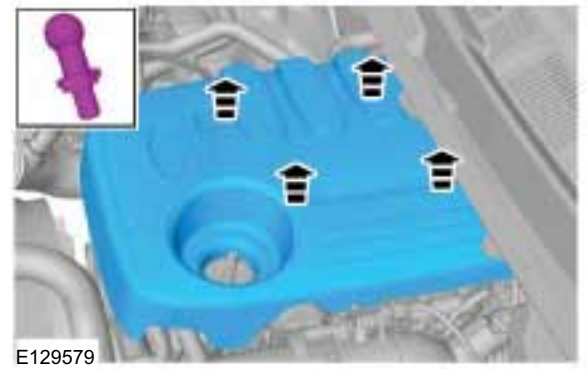
6.



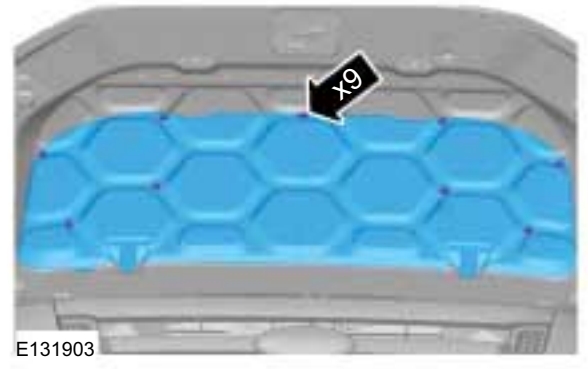
7.



8.

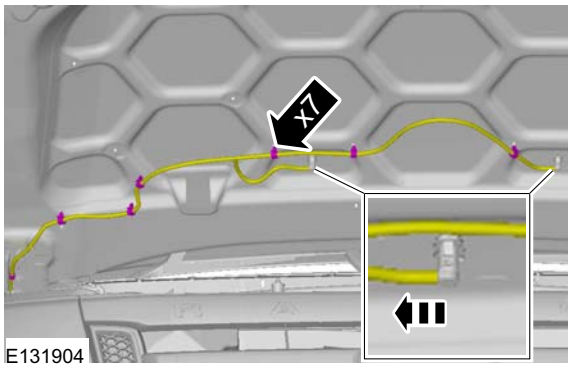


9.

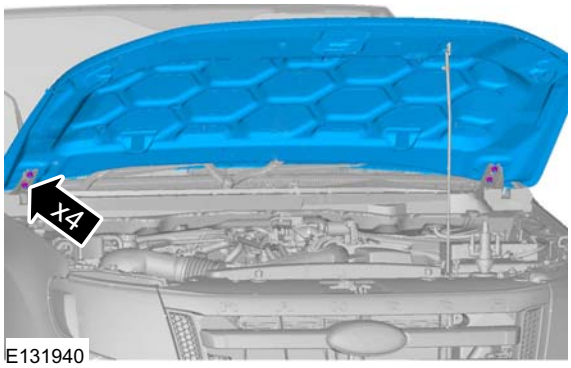


REMOVAL

10.

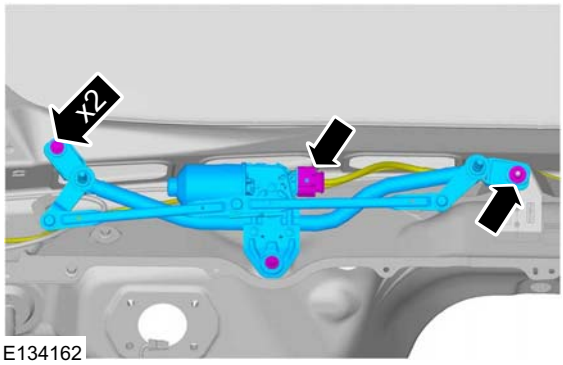


11.

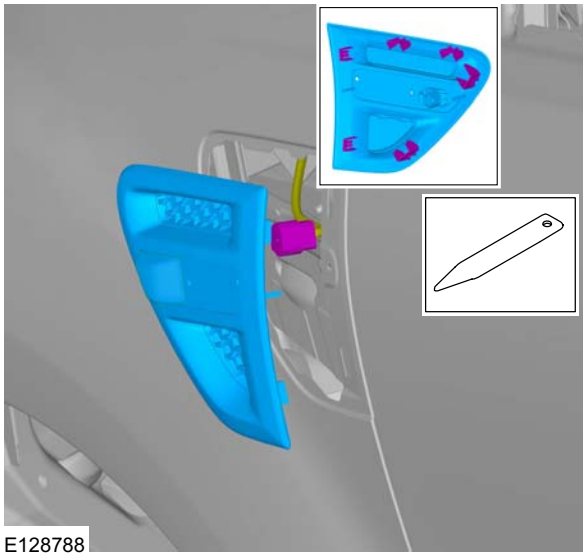


12. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

13.

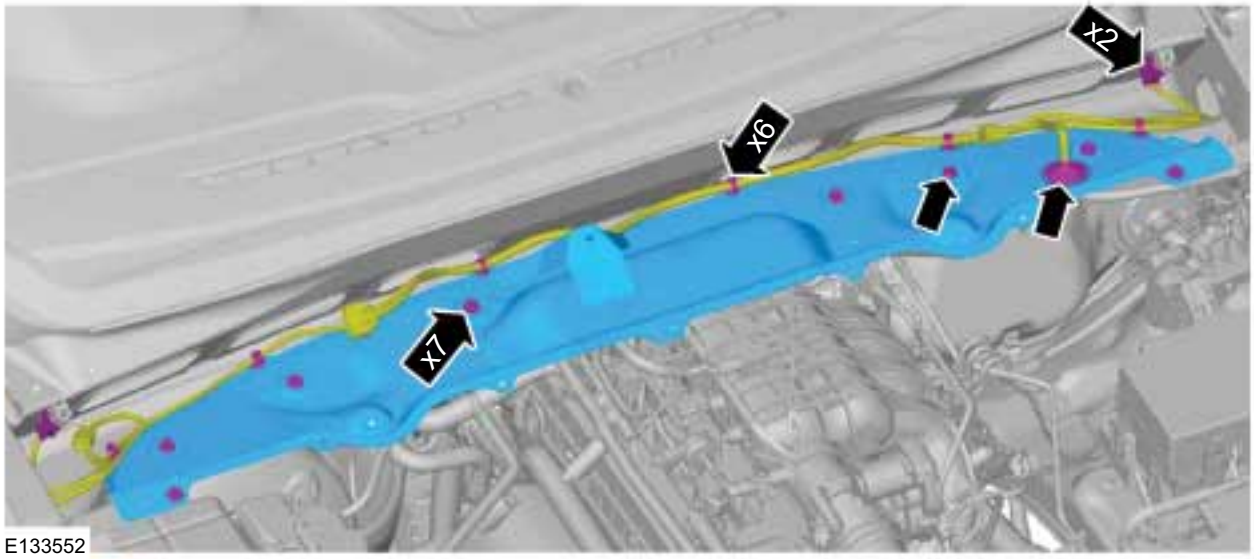


14. On both sides.

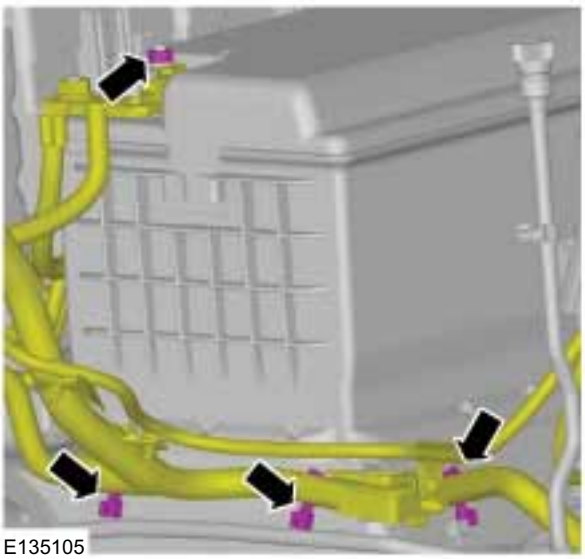


15.

REMOVAL



16.



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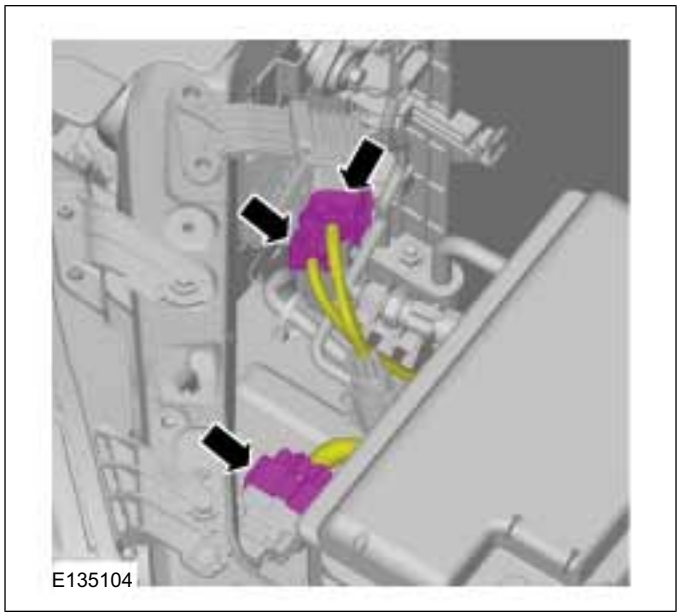


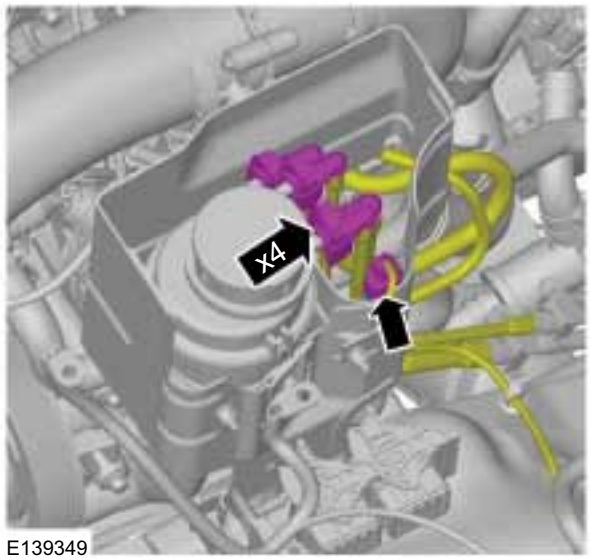
REMOVAL

18. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

19. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

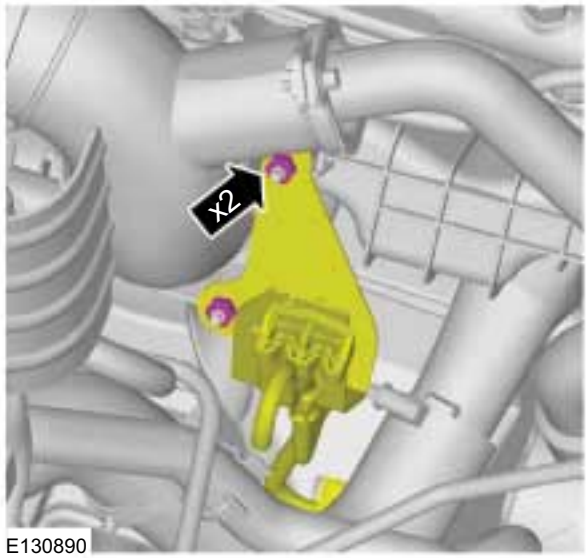
20. Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

21.

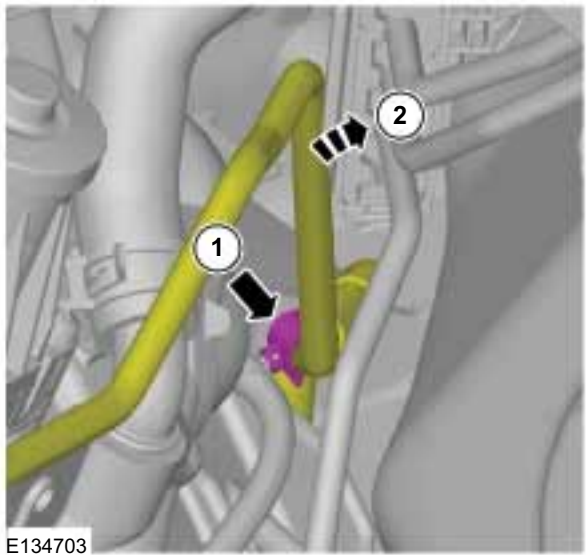


22.

23.

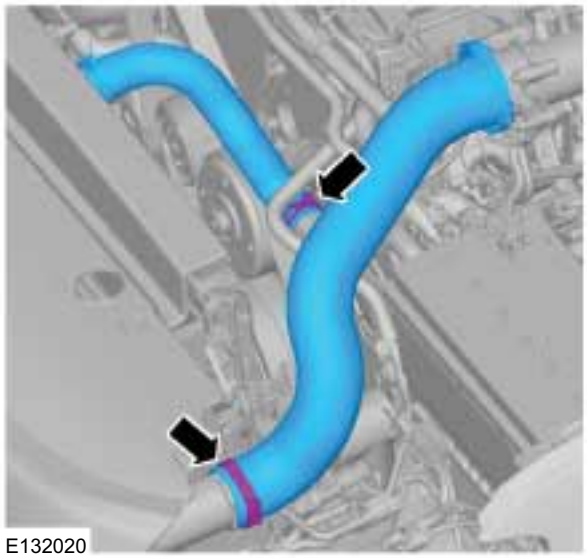


24.



REMOVAL

25.

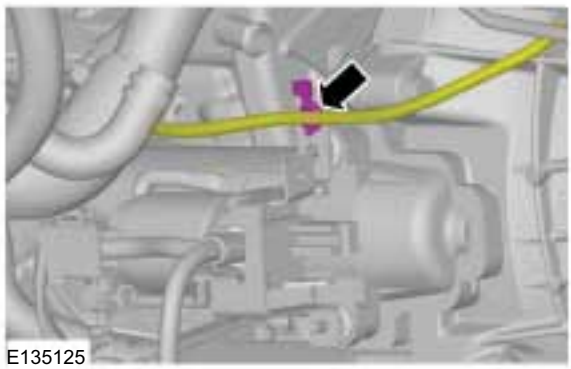

E132020

26. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

27. Refer to: Radiator (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

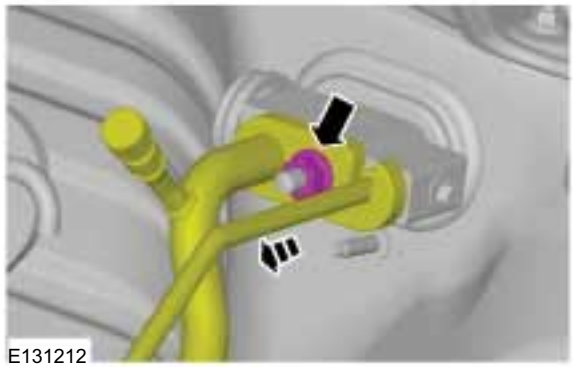
28. Refer to: Condenser - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (412-01 Climate Control, Removal and Installation).

29.

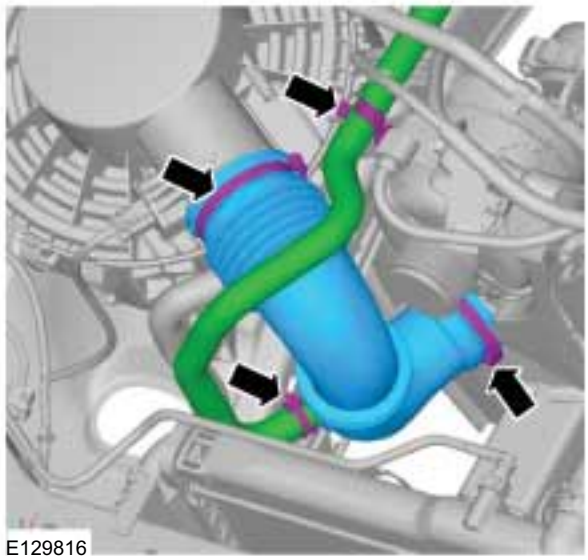

E135125

30. Refer to: Starter Motor - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-06 Starting System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

31.


E131212

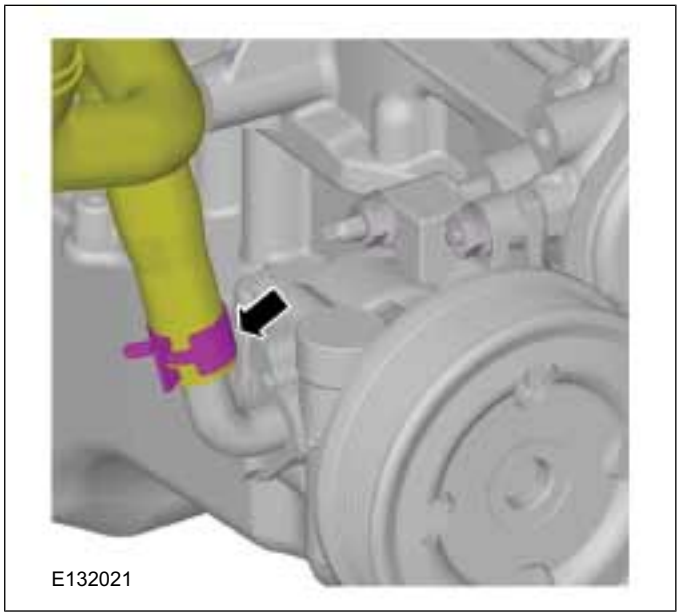
32.


E129816

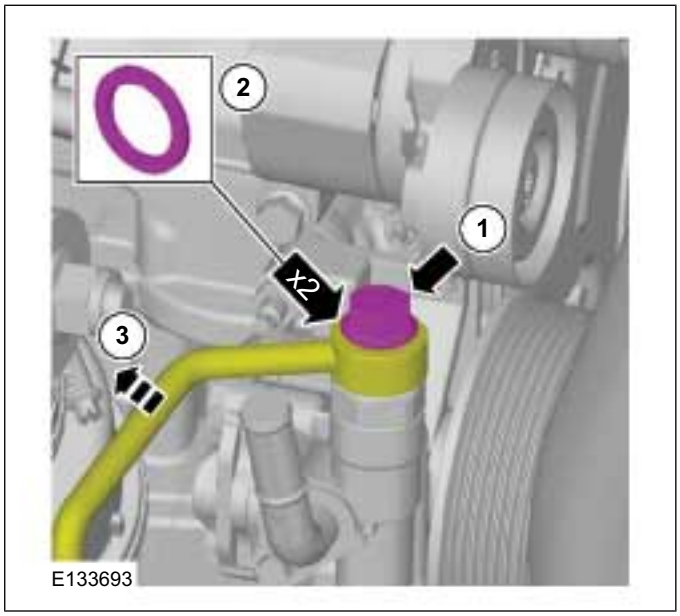
REMOVAL

33. Refer to: Air Cleaner - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

34. **NOTE:** Make sure that all openings are sealed.

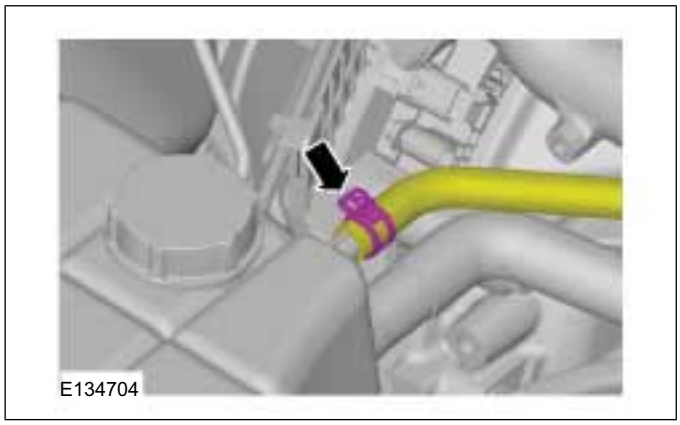

E132021

35. ⚠ **CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.**

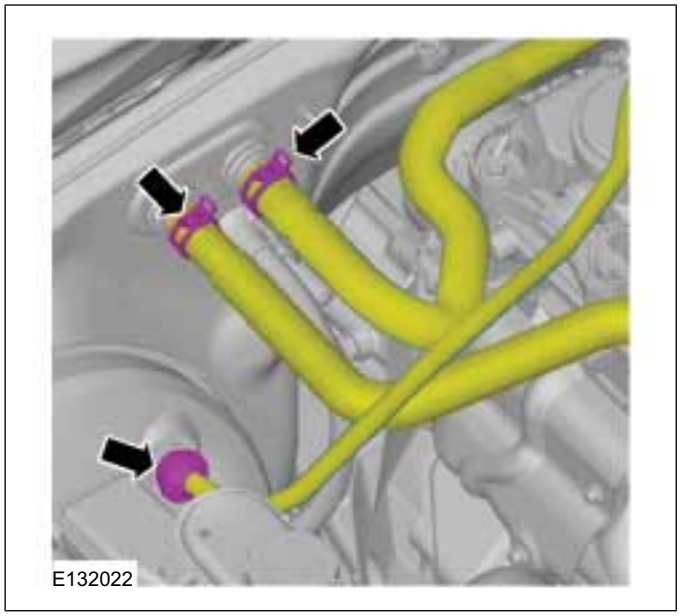


E133693

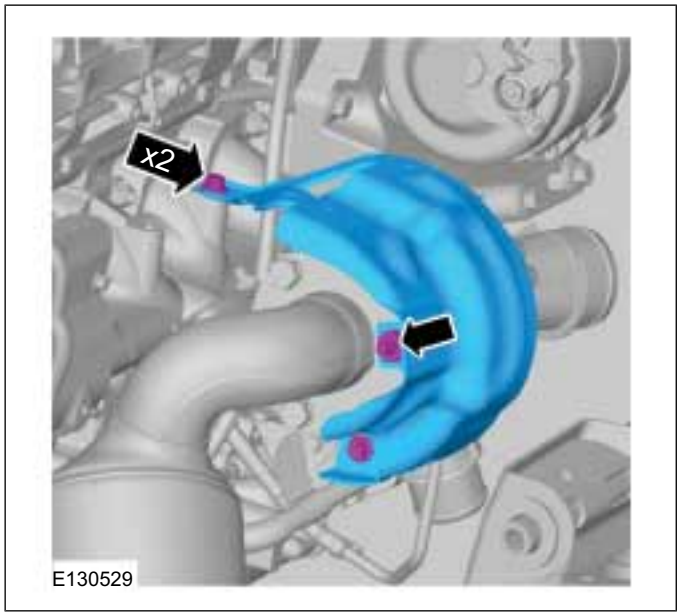
36.


E134704

37.


E132022

38.

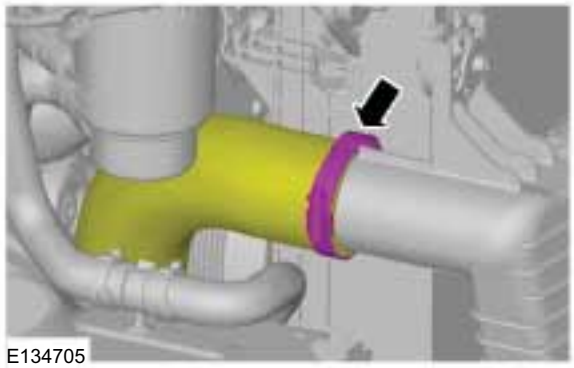


E130529

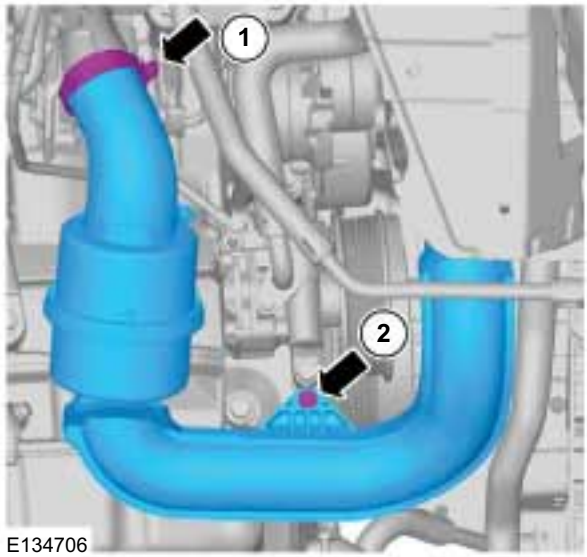
REMOVAL

39. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

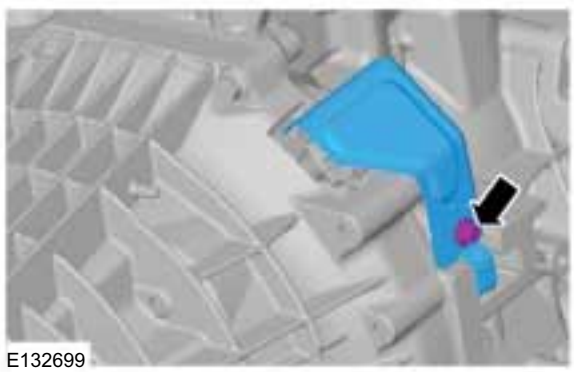
40.



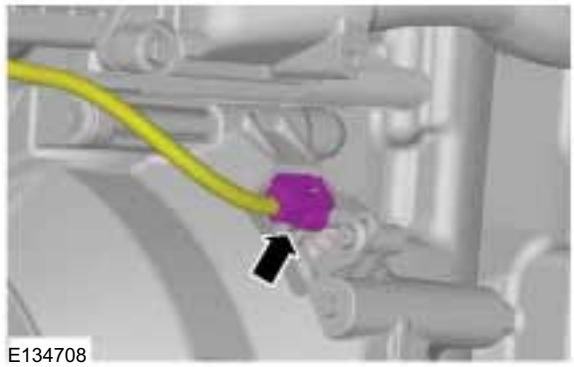
41.



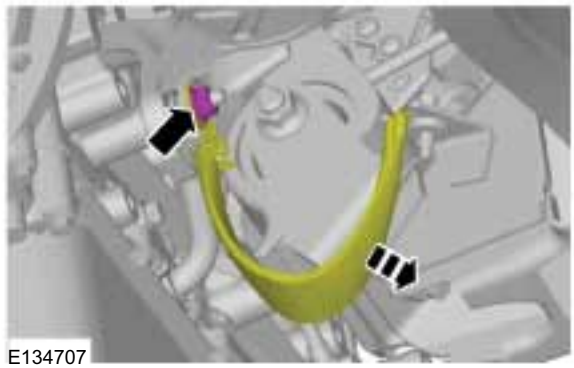
42.



43.



44.



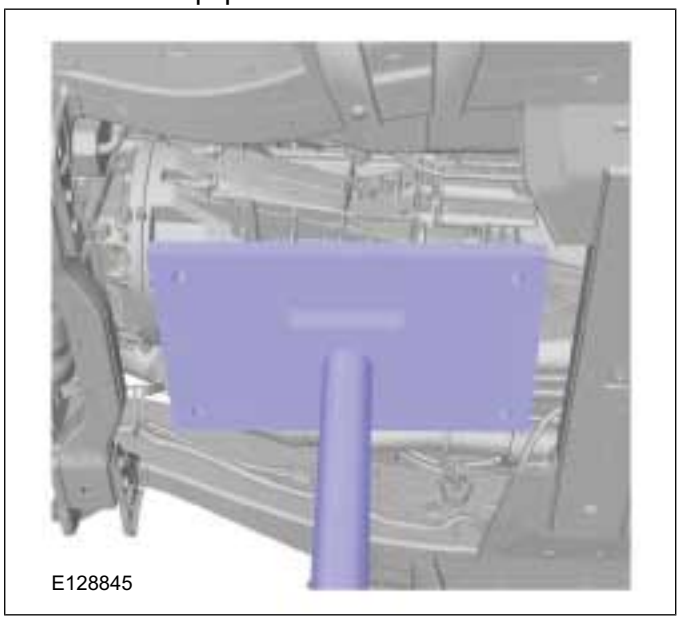
45. **WARNING: Make sure that transmission assembly is on wooden blocks and secured with suitable retaining straps.**

CAUTION: Do not tilt the transmission. This may cause damage to the pilot bearing.

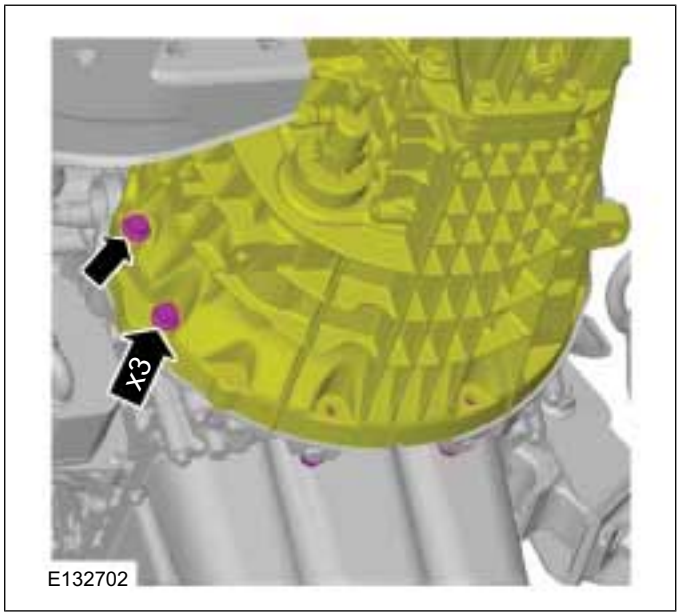
REMOVAL

Tie and support the transmission to the chassis with a suitable strap.

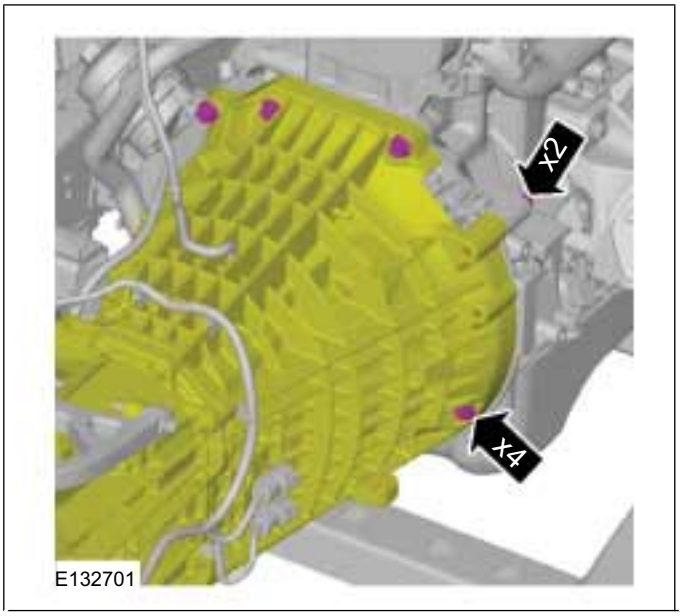
General Equipment: Transmission Jack



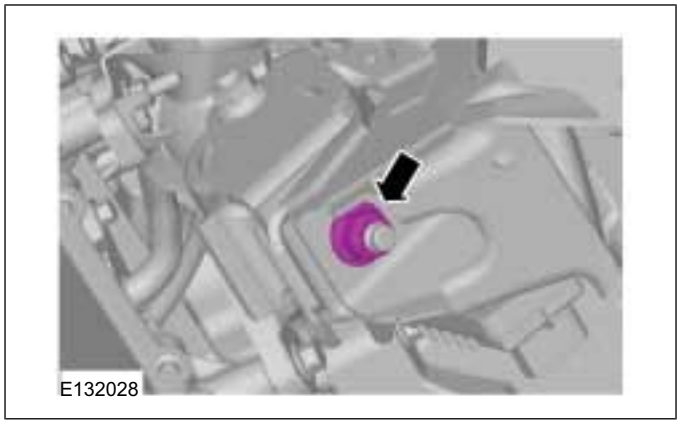
46.



47.



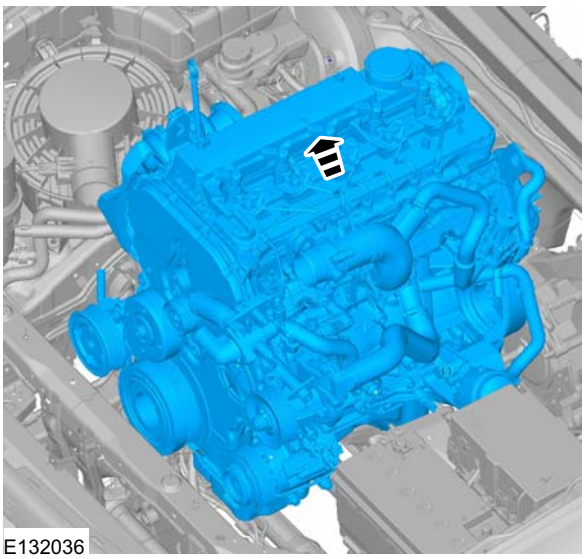
48. On both sides.



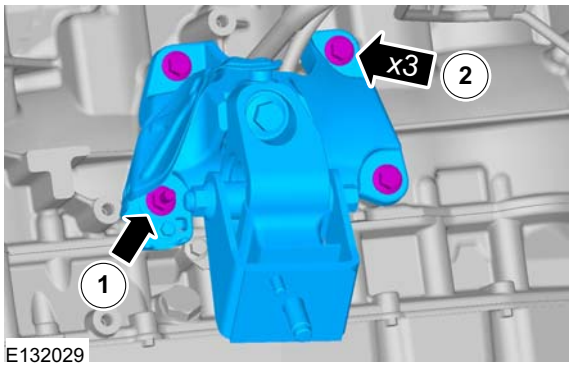
49. Special Tool(s): 303-122

REMOVAL

50.



51.



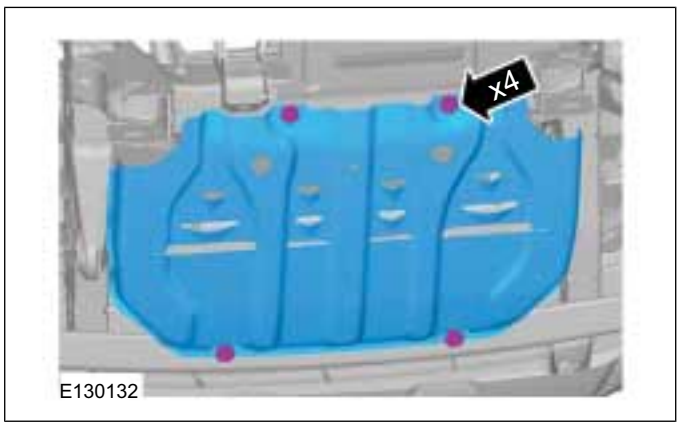
REMOVAL

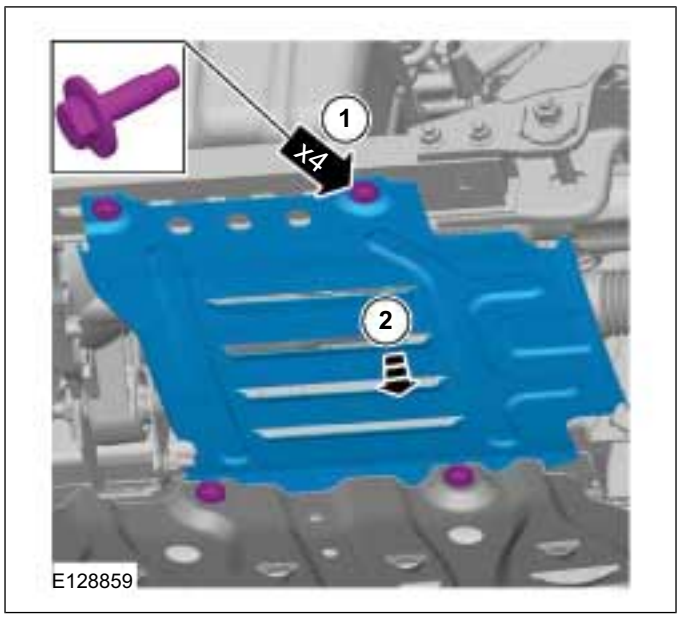
Engine — Vehicles With: 6-Speed Automatic Transaxle - 6R80(21 132 0; 21 132 6; 21 132 7)

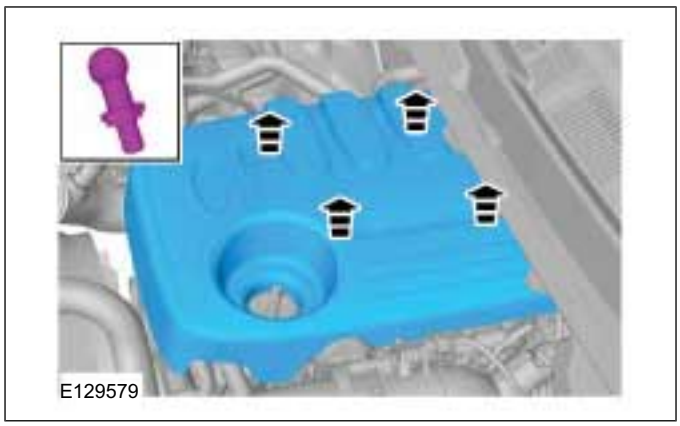
Removal

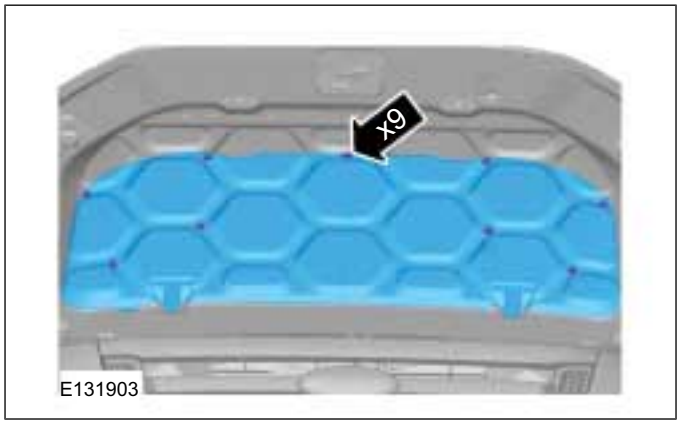
Special Tool(s) / General Equipment

 21068A	303-122 Lifting Bracket, Engine
Transmission Jack	

1. Refer to: 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: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).
4. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).
5. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
6. 

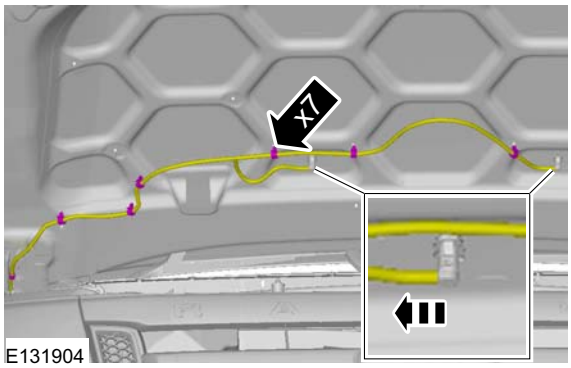
7. 

8. 

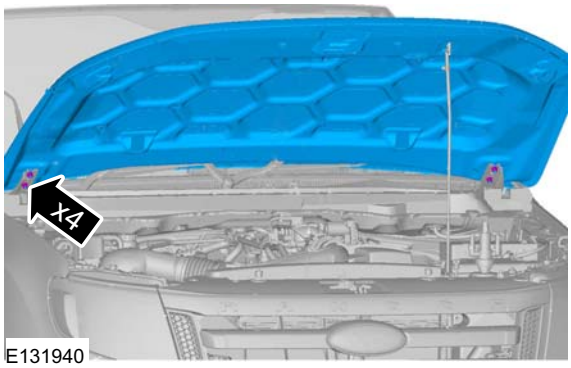
9. 

REMOVAL

10.

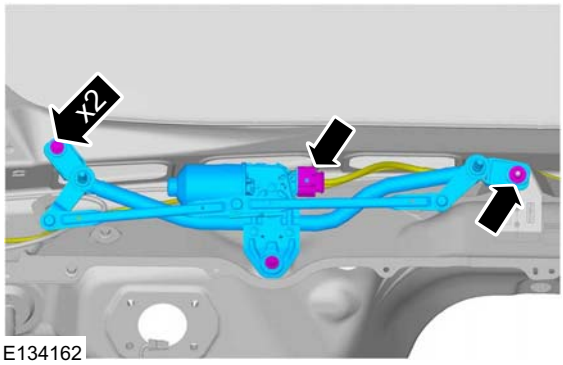


11.

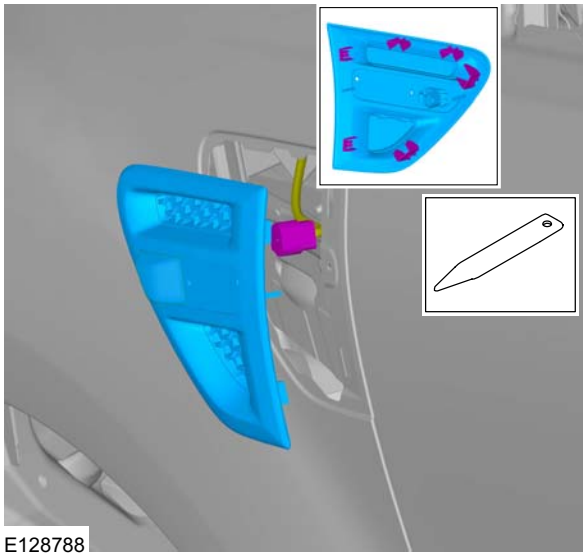


12. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

13.

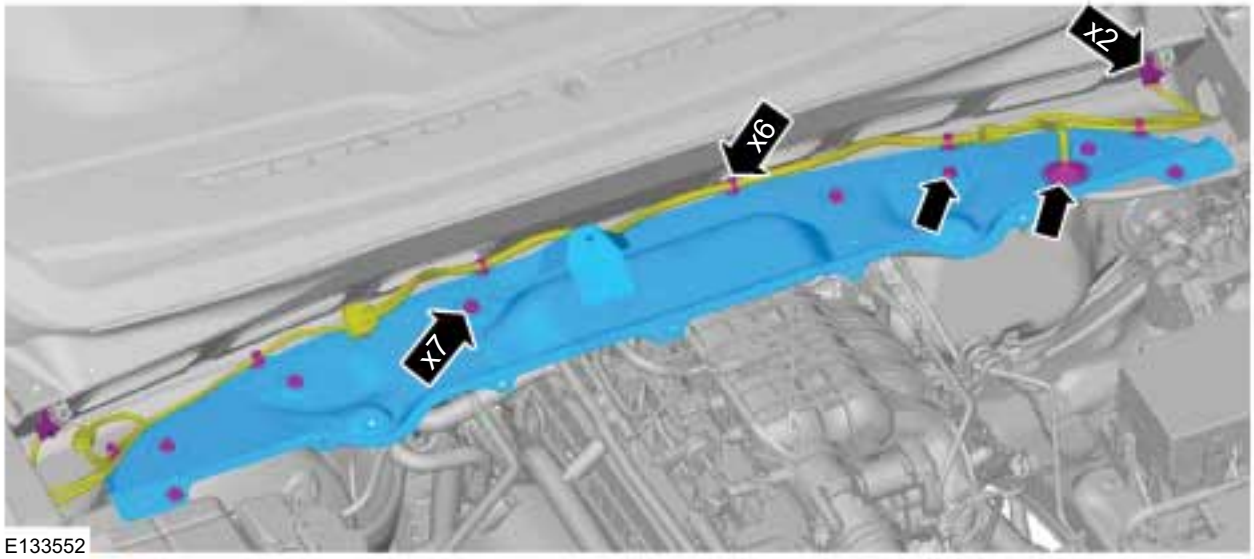


14. On both sides.

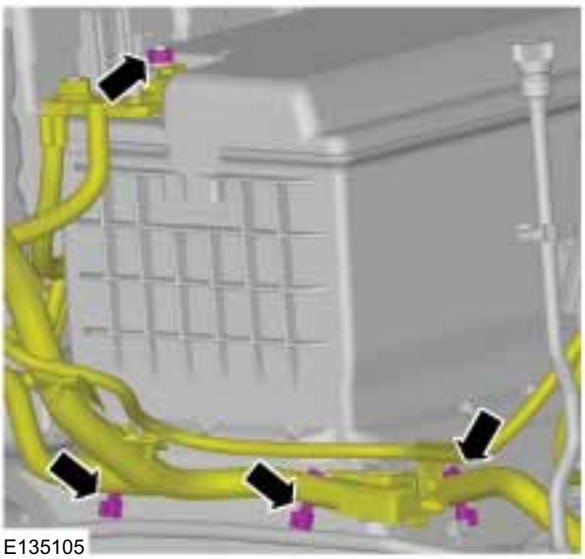


15.

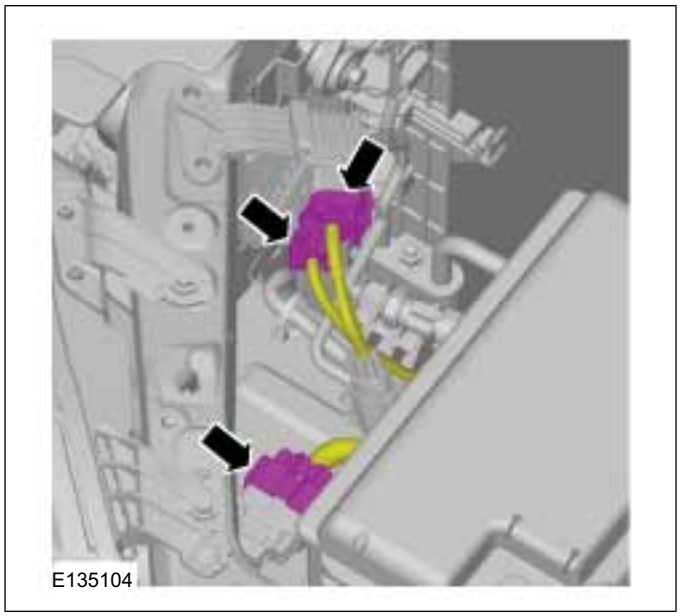
REMOVAL



16.



17.



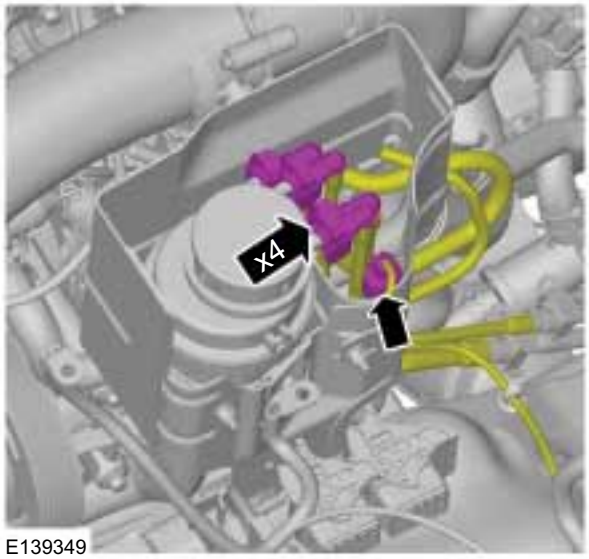
REMOVAL

18. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

19. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

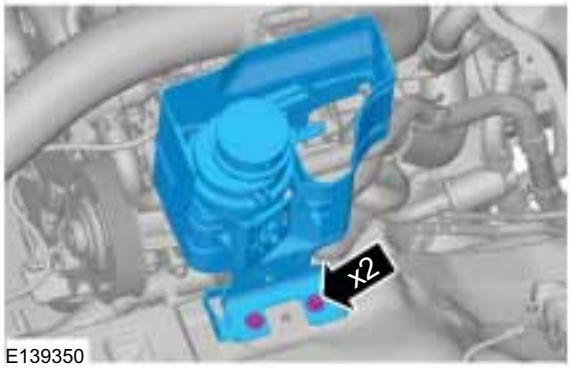
20. Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

21.



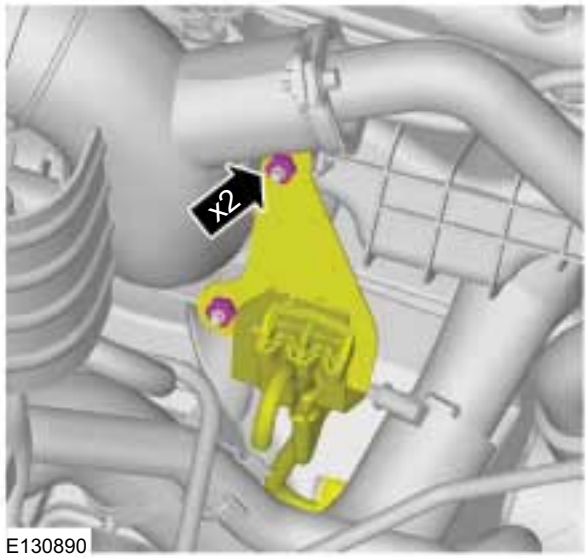
E139349

22.



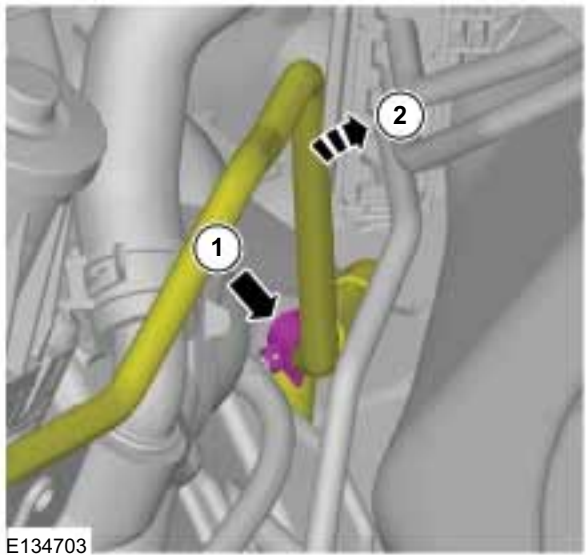
E139350

23.



E130890

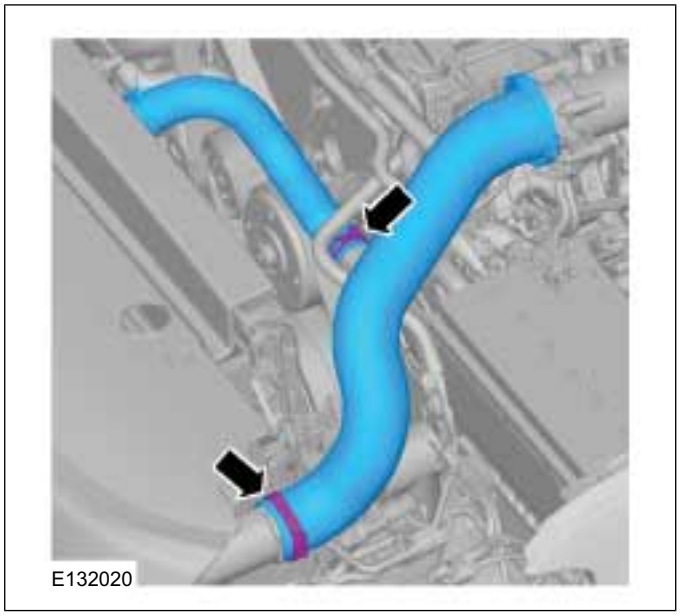
24.



E134703

REMOVAL

25.

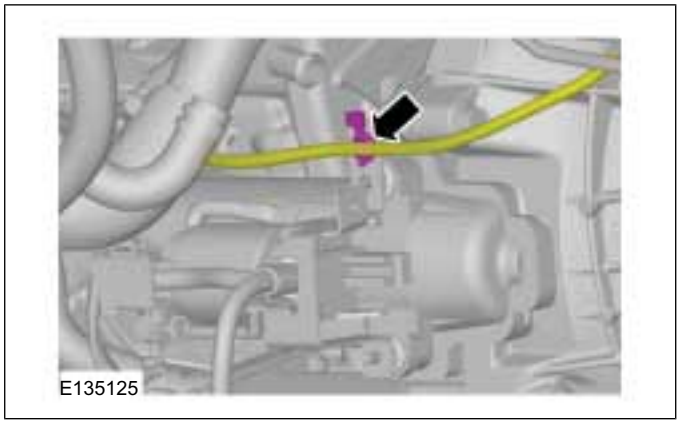


26. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

27. Refer to: Radiator (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

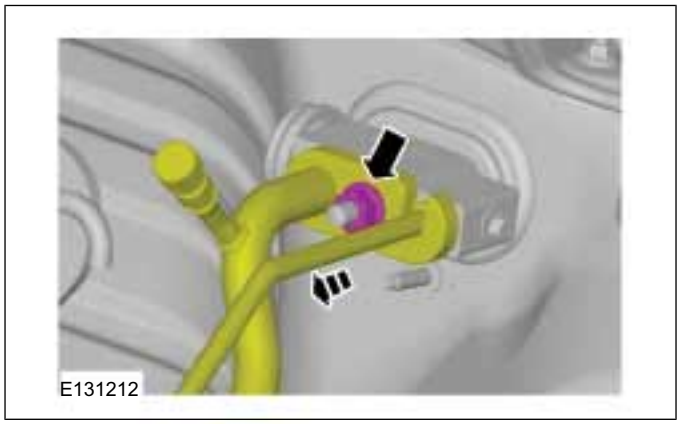
28. Refer to: Condenser - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (412-01 Climate Control, Removal and Installation).

29.



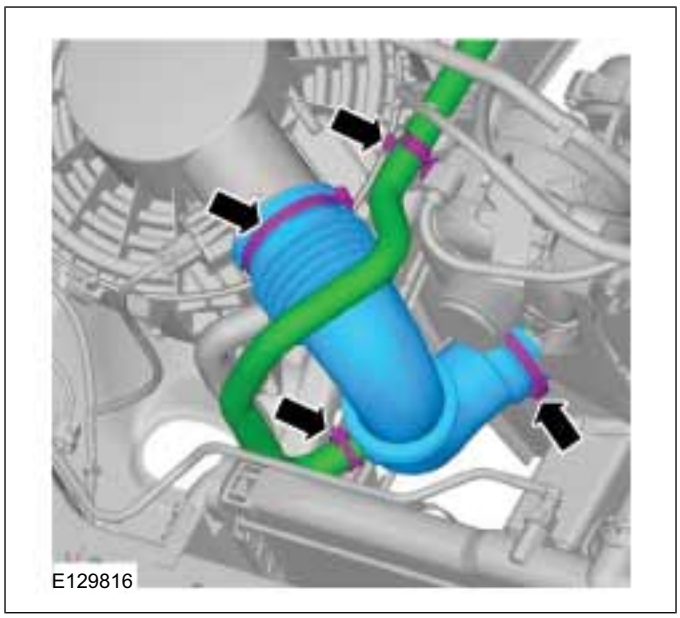
30. Refer to: Starter Motor - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-06 Starting System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

31.



32. Refer to: Transmission Fluid Cooler (307-02 Transmission/Transaxle Cooling, Removal and Installation).

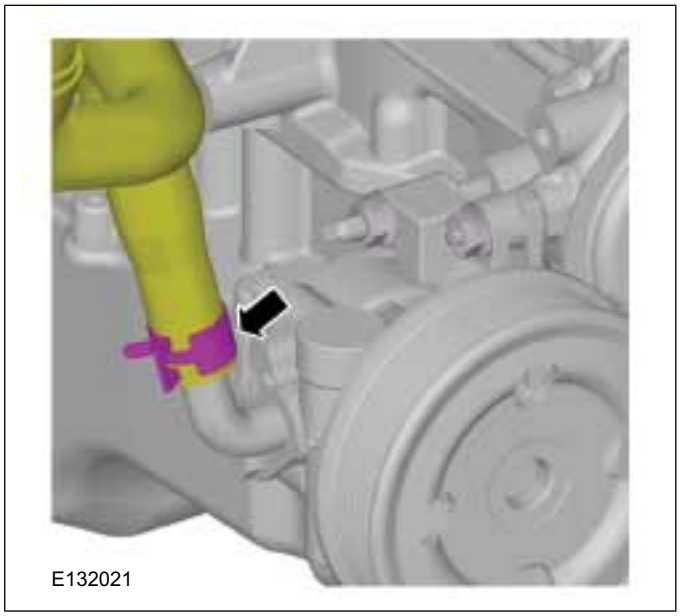
33.



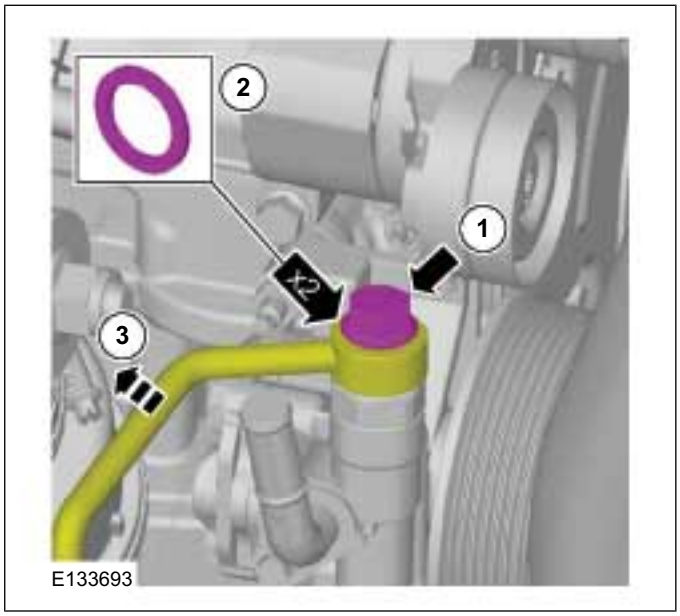
REMOVAL

34. Refer to: Air Cleaner - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

35. **NOTE:** Make sure that all openings are sealed.

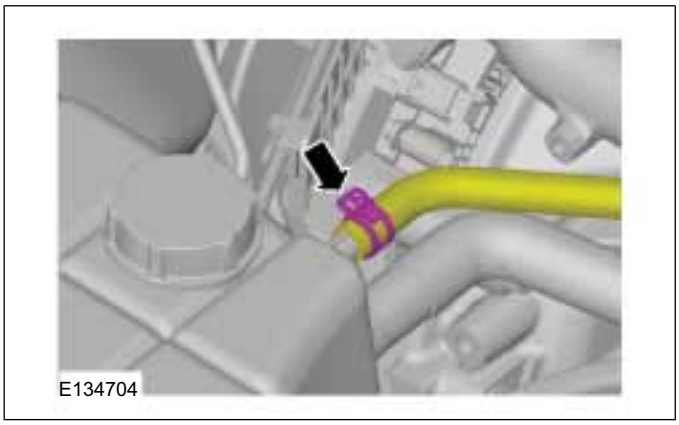

E132021

36. **CAUTION: Cap the power steering line to prevent fluid loss or dirt ingress.**

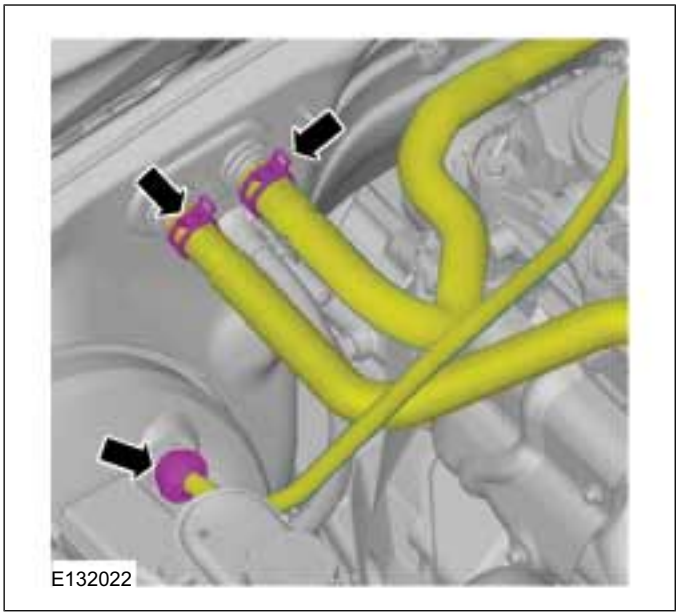


E133693

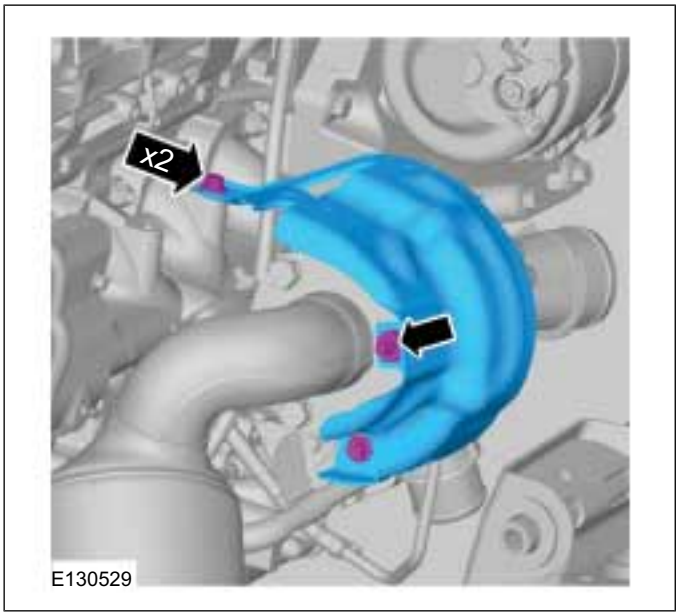
37.


E134704

38.


E132022

39.

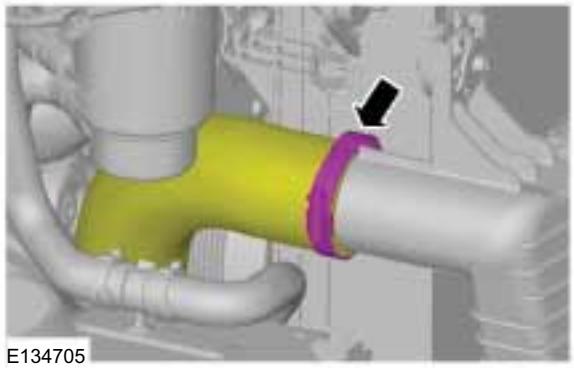


E130529

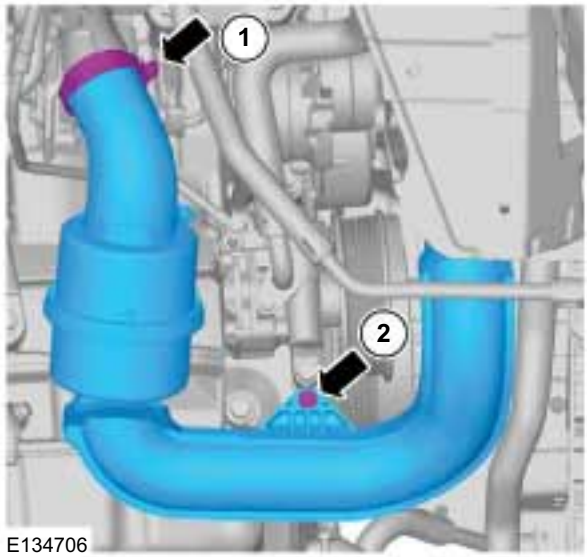
REMOVAL

40. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

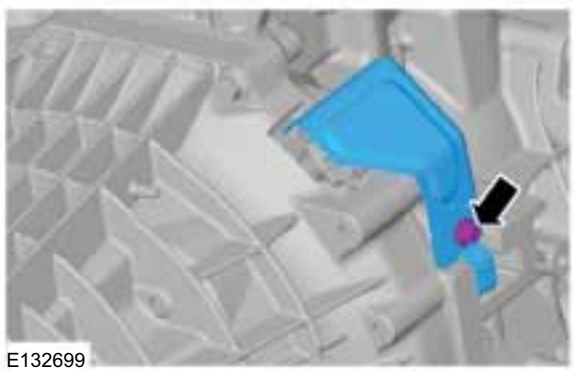
41.



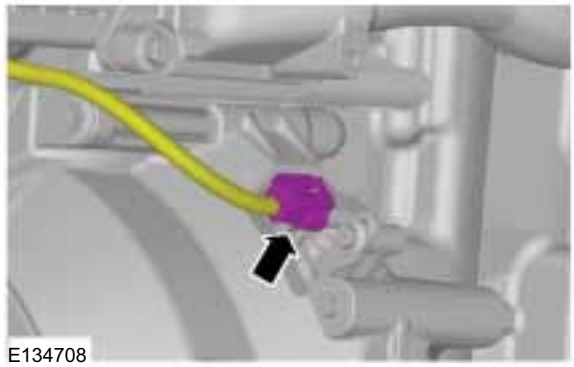
42.



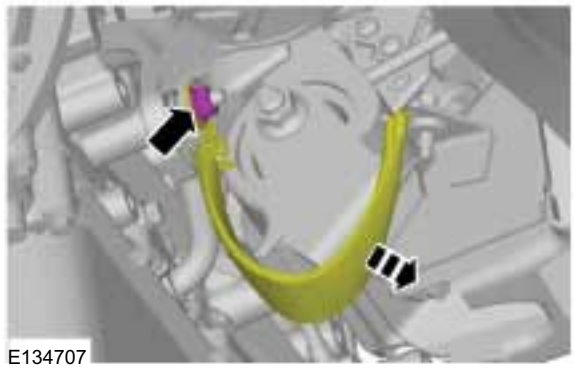
43.



44.



45.



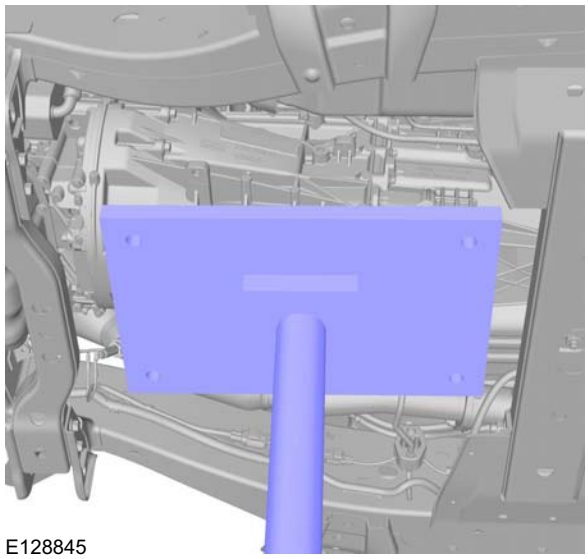
46. **WARNING: Make sure that transmission assembly is on wooden blocks and secured with suitable retaining straps.**

CAUTION: Do not tilt the transmission. This may cause damage to the pilot bearing.

REMOVAL

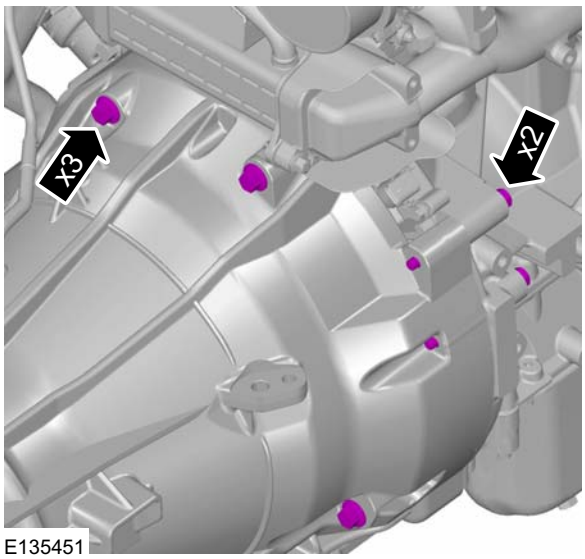
Tie and support the transmission to the chassis with a suitable strap.

General Equipment: Transmission Jack



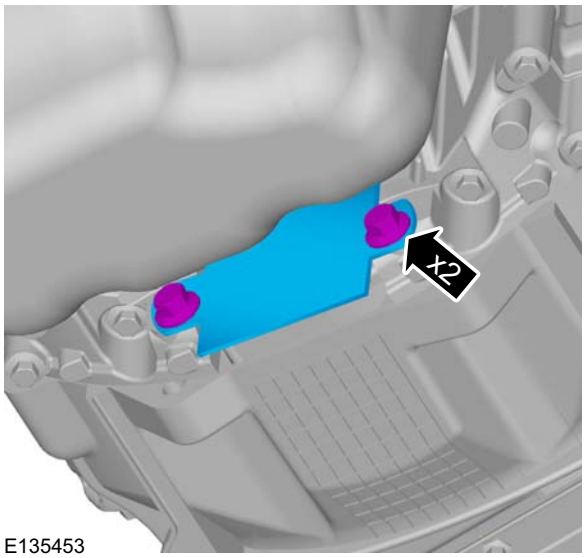
E128845

47.



E135451

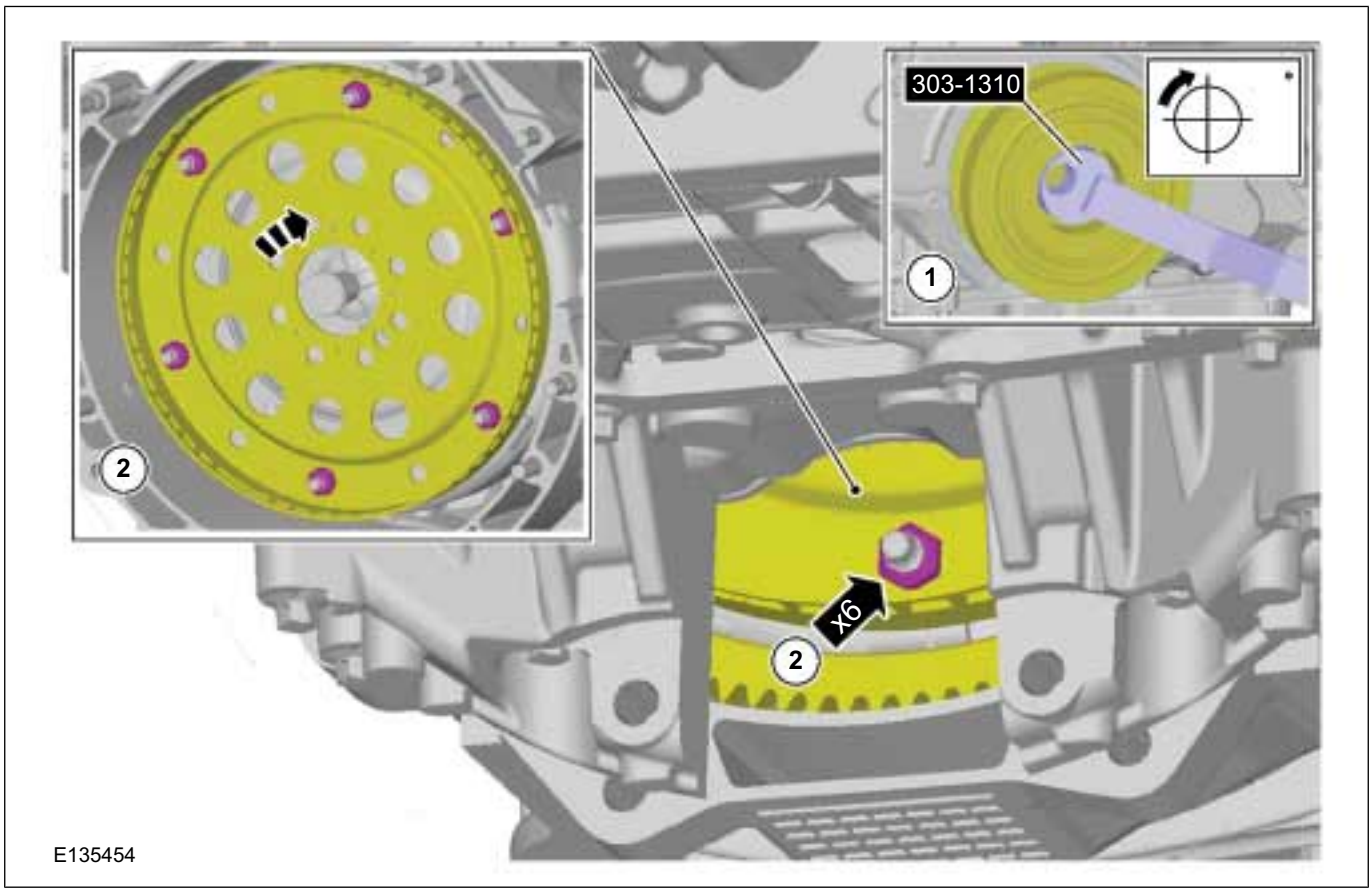
48.



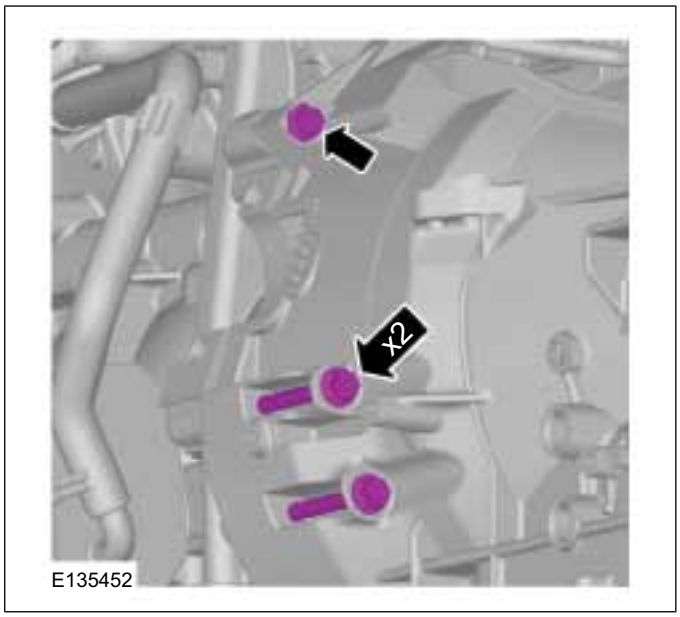
E135453

49.

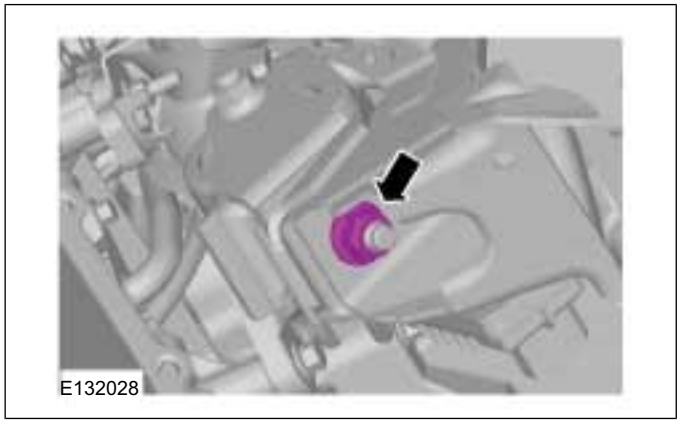
REMOVAL



50.



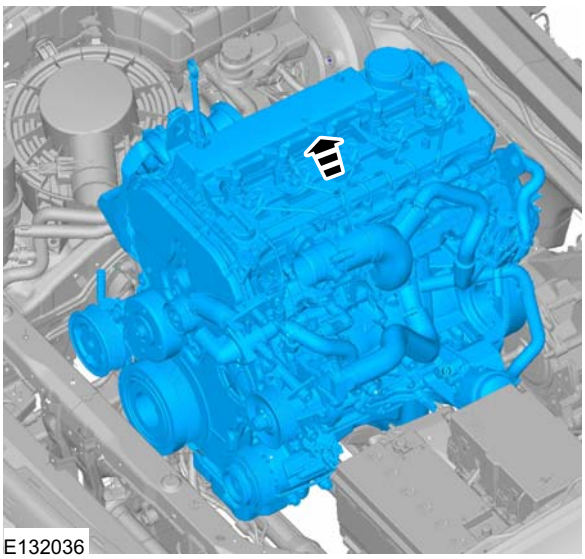
51. On both sides.



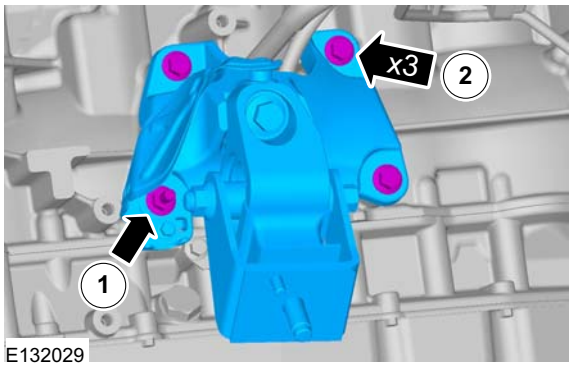
52. Special Tool(s): 303-122

REMOVAL

53.



54.

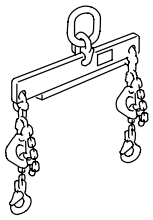
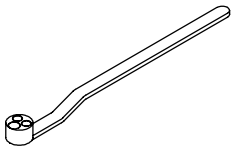
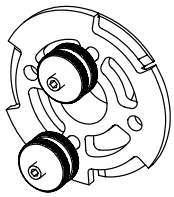
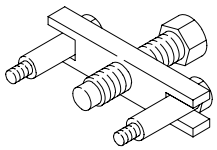
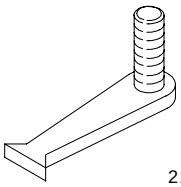
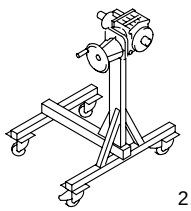


REMOVAL

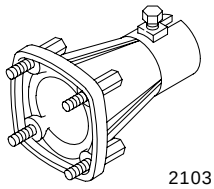
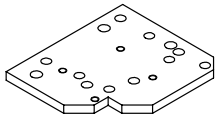
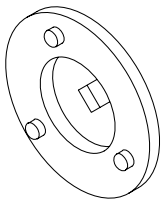
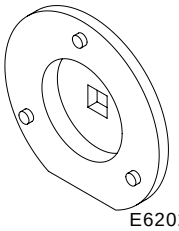
Engine Accessories(21 139 4)

Removal

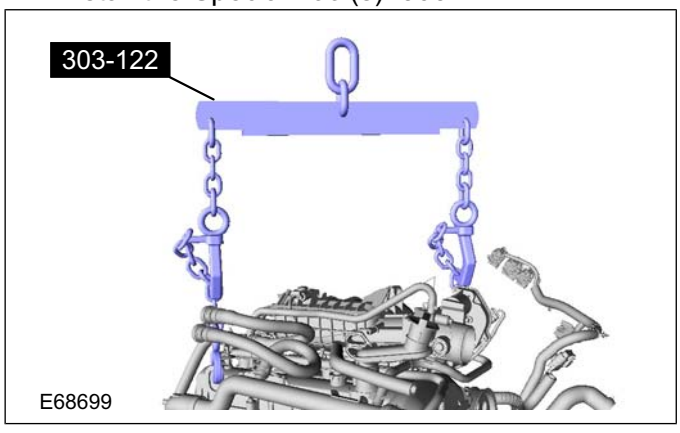
Special Tool(s) / General Equipment

 21068A	303-122 Lifting Bracket, Engine
 E87614	303-1310 Holding Wrench, Crankshaft
 E75376	303-1317 Locking Tool, Fuel Injection Pump Sprocket
 21132	303-249 Remover, Crankshaft Timing Pulley
 21135	303-254 Locking Tool, Flywheel
 21187	303-435 Mounting Stand

Special Tool(s) / General Equipment

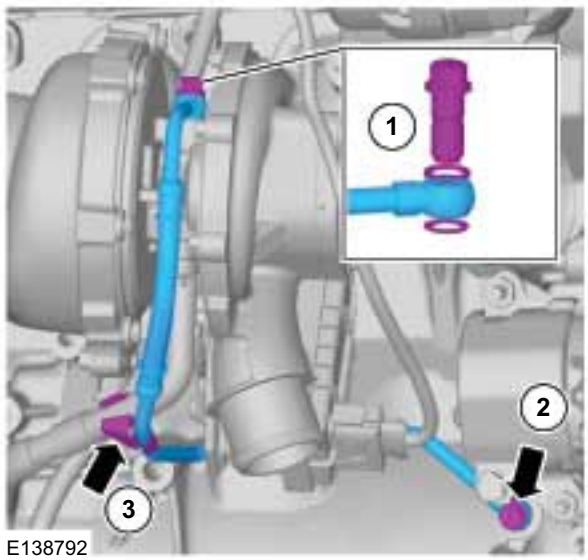
 21031B	303-435-06 Mounting Bracket for 303-435
 E68386	303-435-11B Mounting Plate for 303-435-06
 E62024	303-679 Remover/Installer, Engine Front Cover Inspection Plate
 E62024	303-679A Remover/Installer, Engine Front Cover Inspection Plate
1/2 Inch Square Drive Breaker Bar	
Dowel with a Diameter of 6 mm	

1. Install the Special Tool(s): 303-122



REMOVAL

2.



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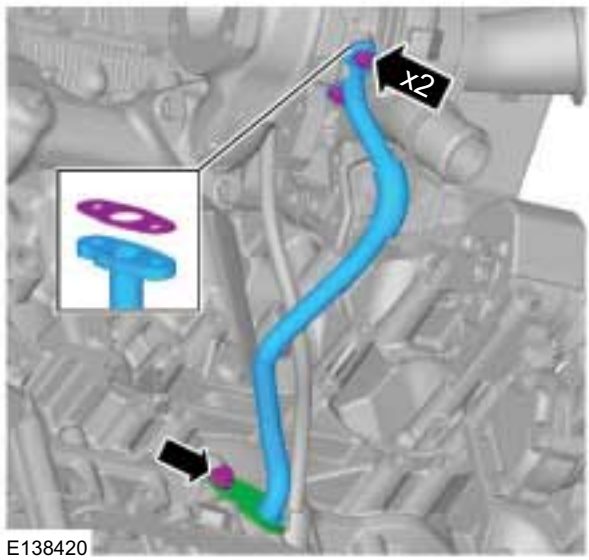

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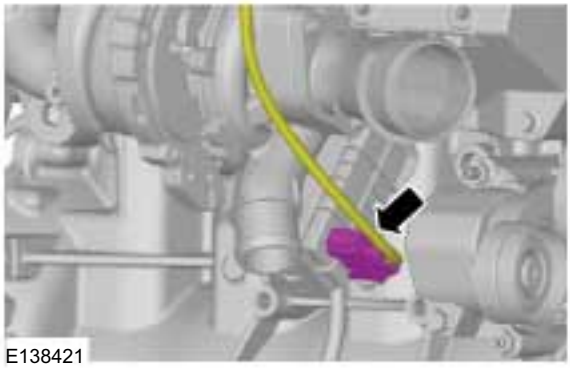

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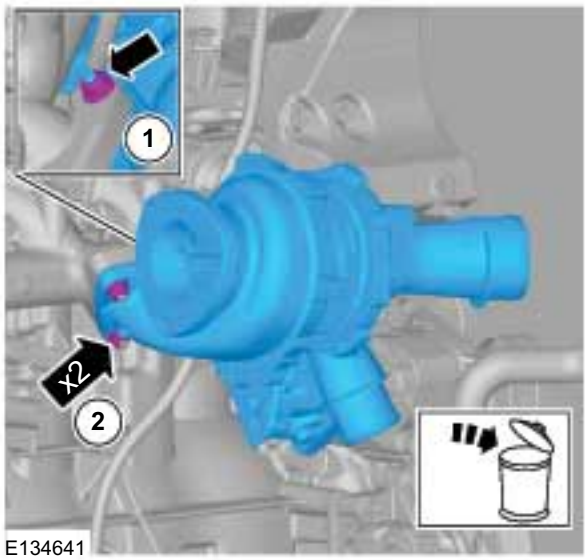

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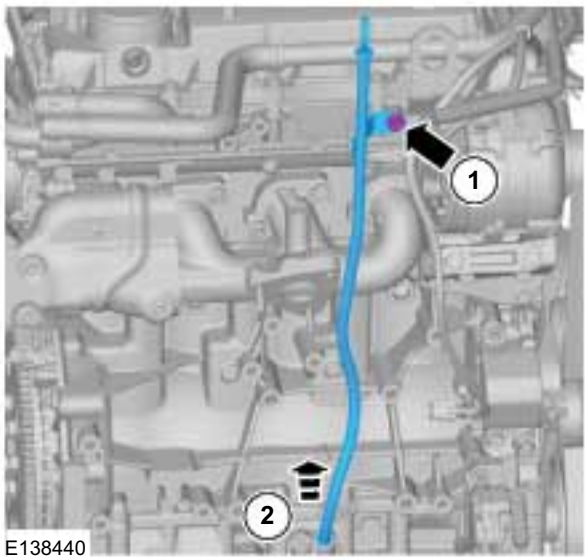
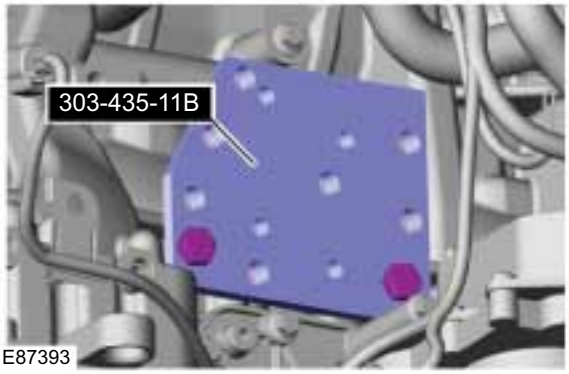
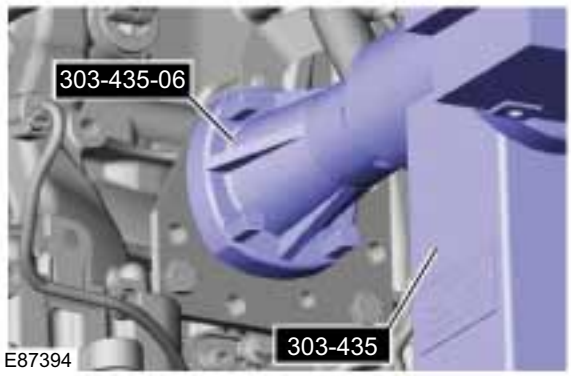


7. Install the Special Tool(s): 303-435-11B



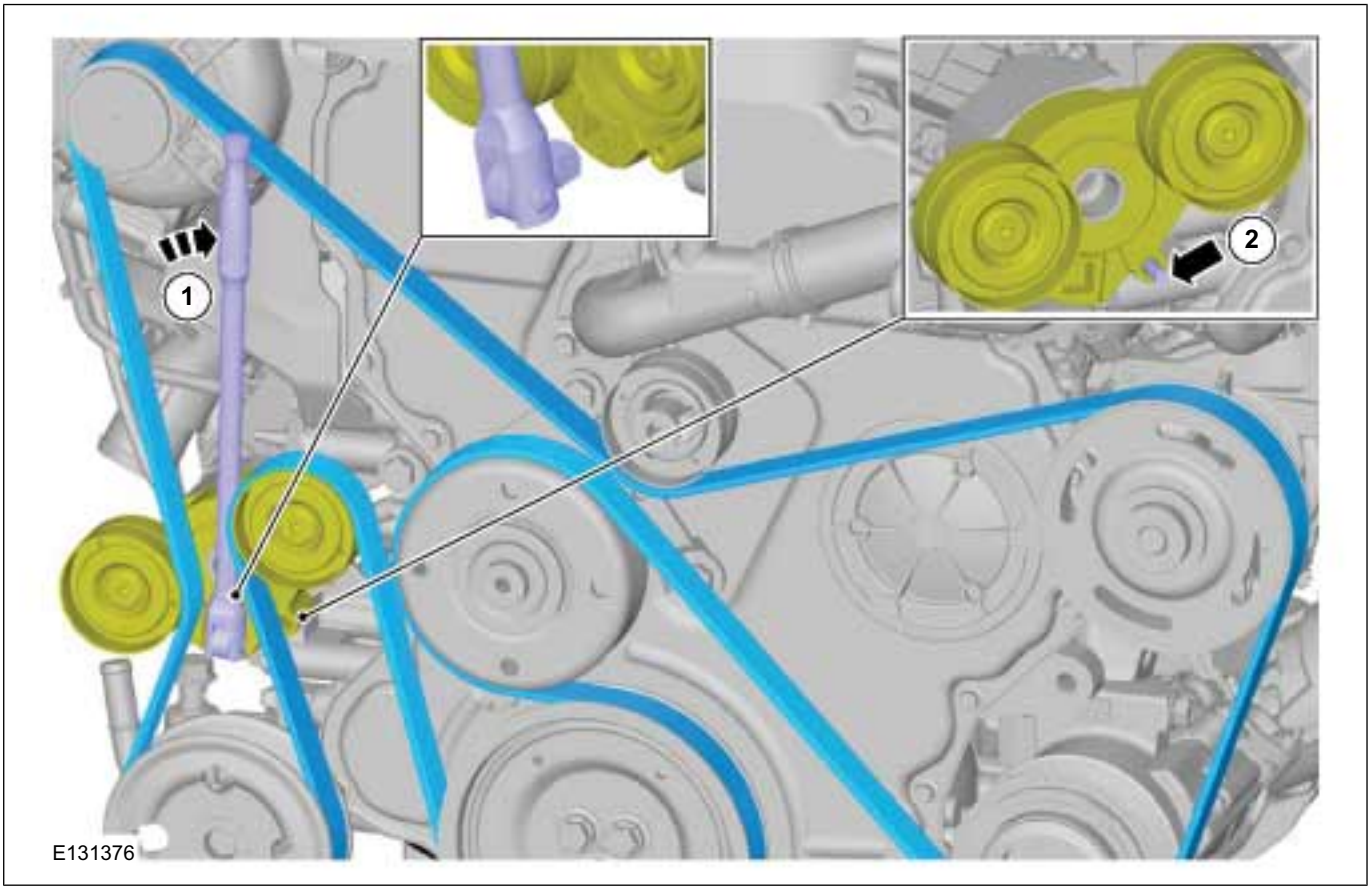
REMOVAL

8. Install the Special Tool(s): 303-435-06, 303-435



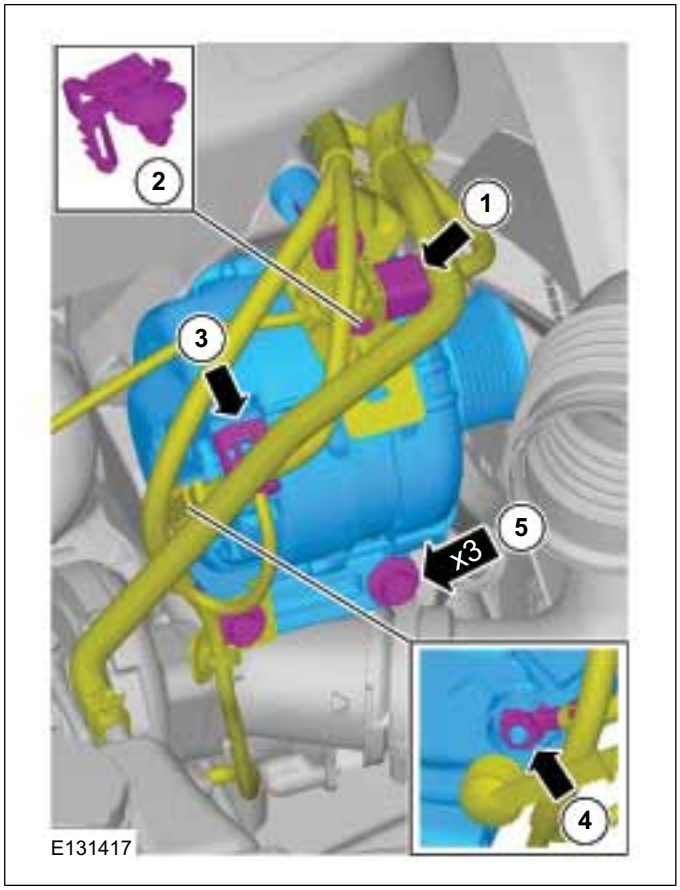
9. Remove the Special Tool(s): 303-122

10. General Equipment: 1/2 Inch Square Drive Breaker Bar
General Equipment: Dowel with a Diameter of 6 mm

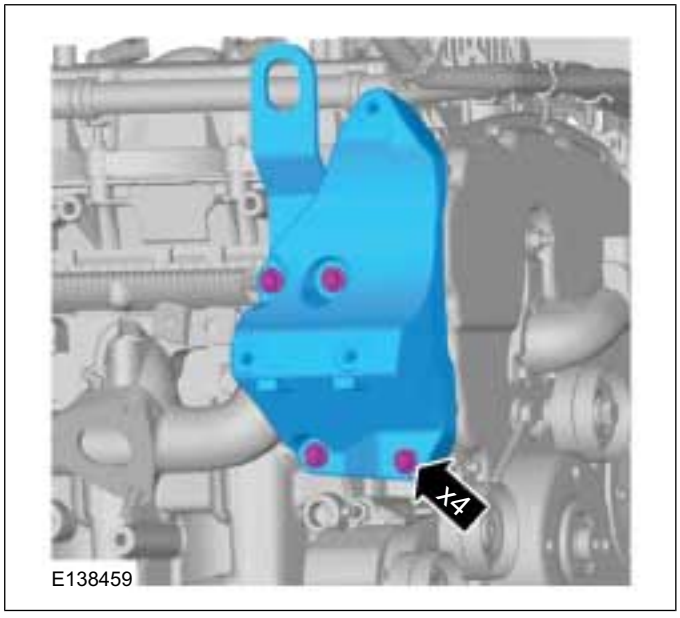


REMOVAL

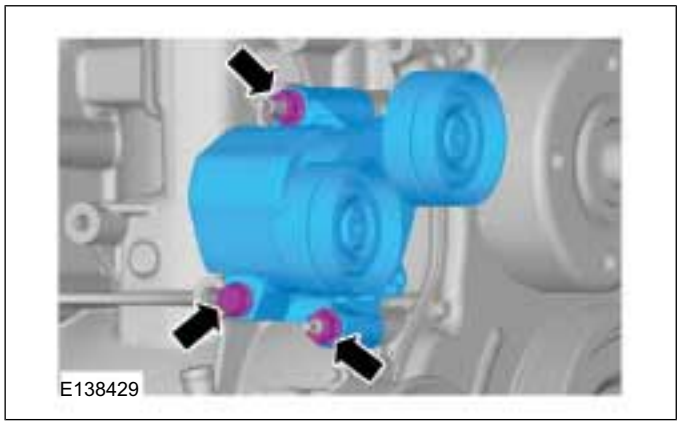
11. ⚠ **CAUTION: Take extra care not to damage the wiring harnesses.**



12.



13.



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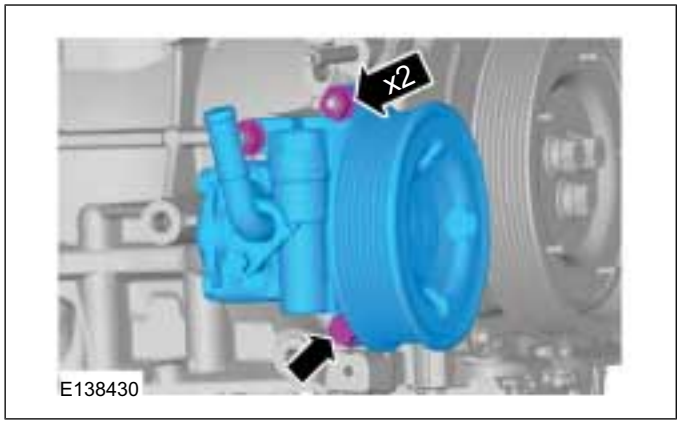

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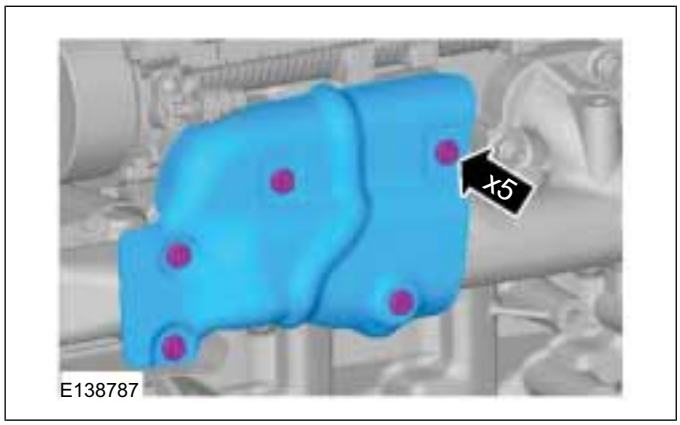
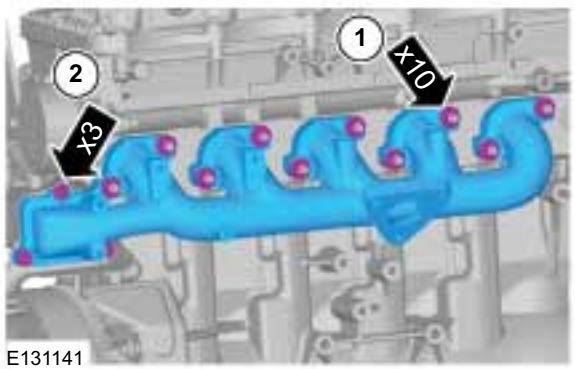


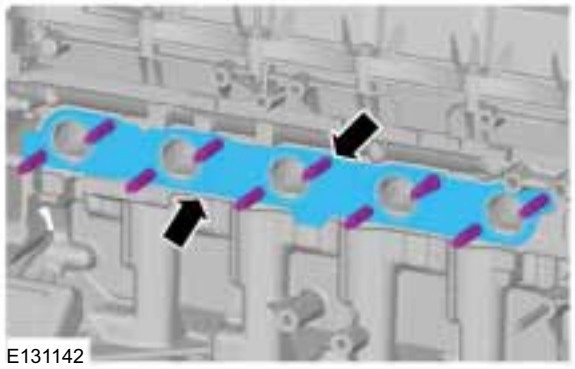
REMOVAL

16.

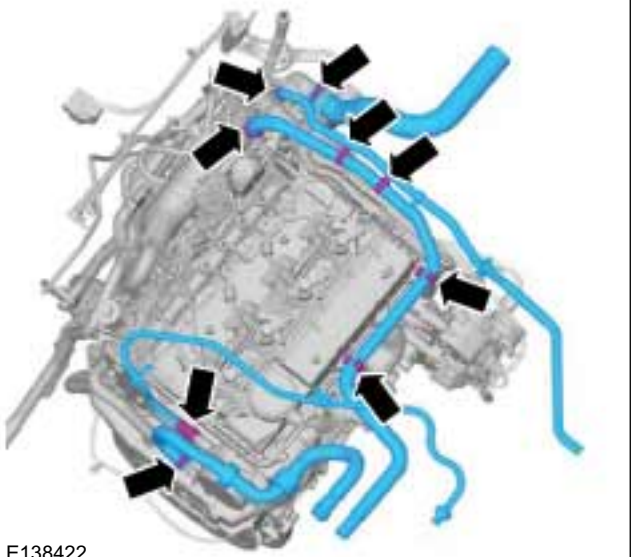


17. **NOTE:** The gasket is to be reused unless damaged.

NOTE: The studs are to be reused unless damaged.

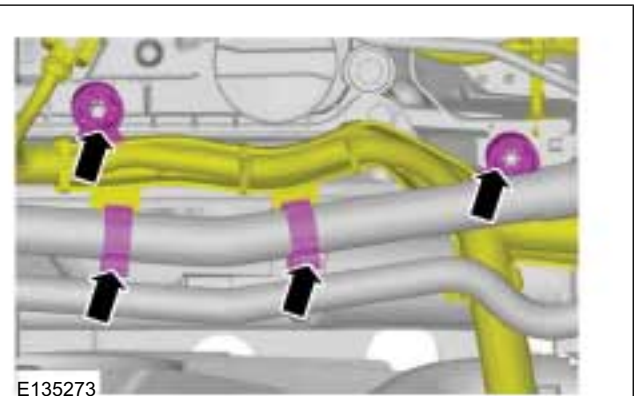


18.



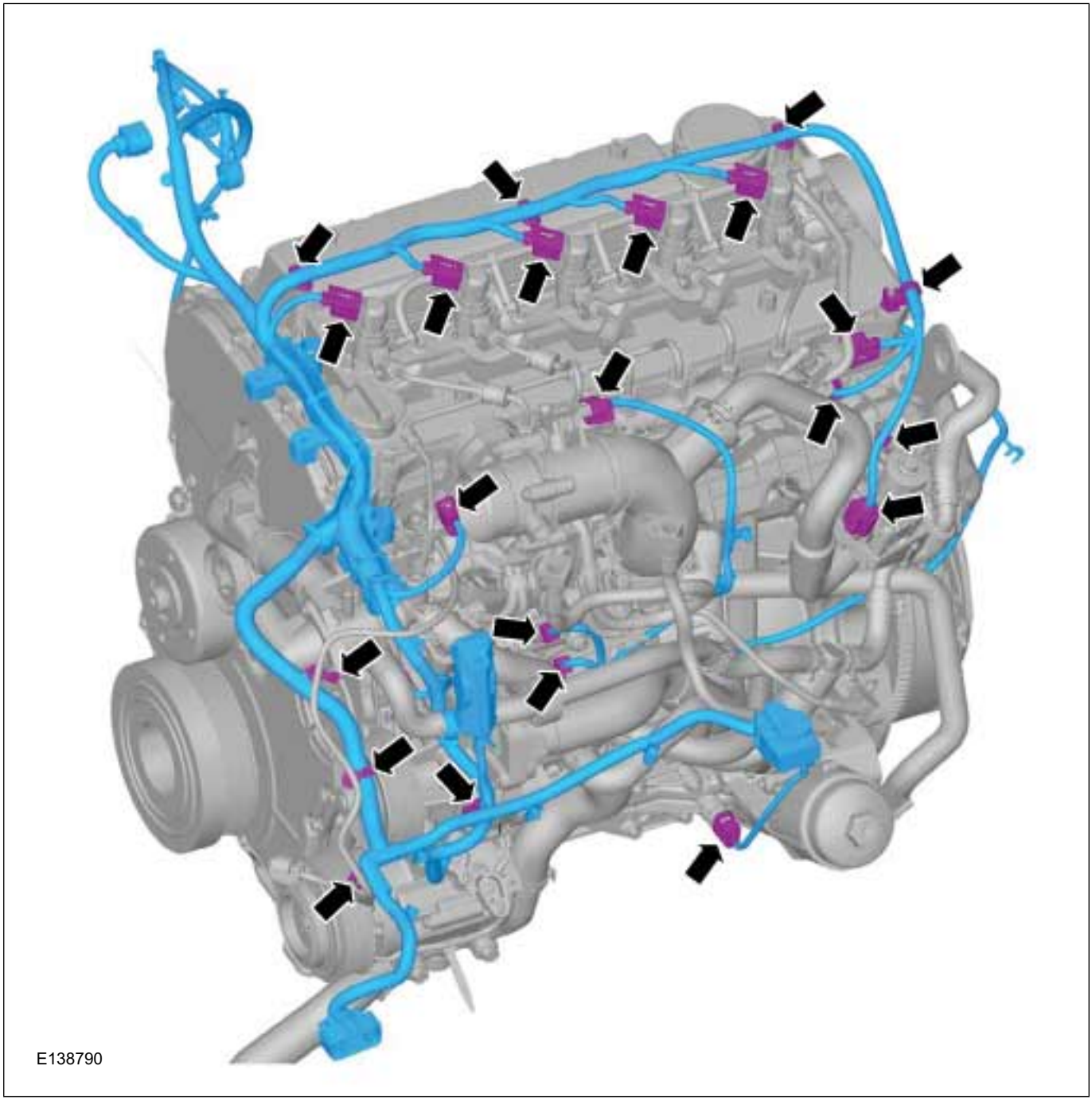
19.

20.



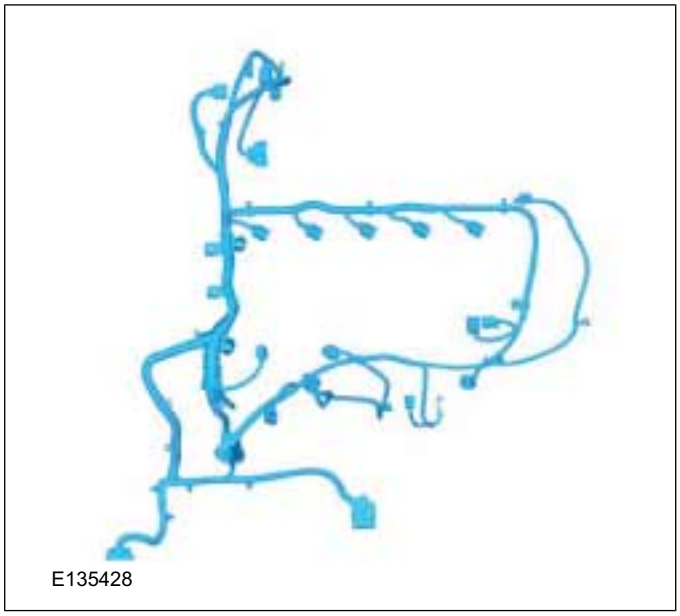
21.

REMOVAL



REMOVAL

22.



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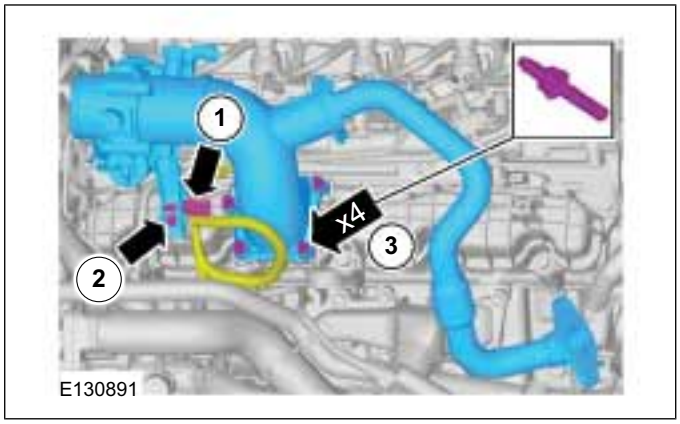

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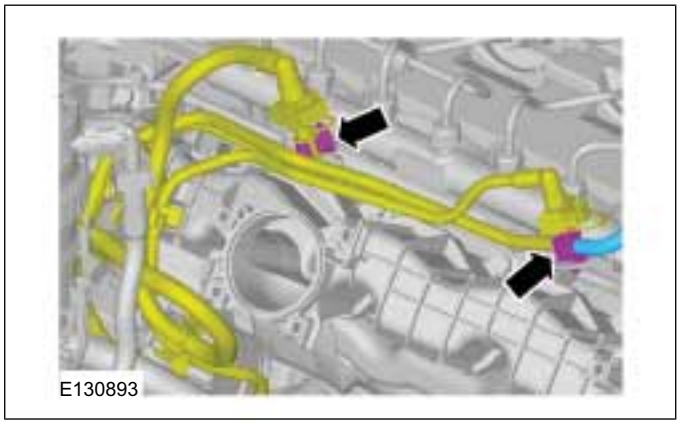
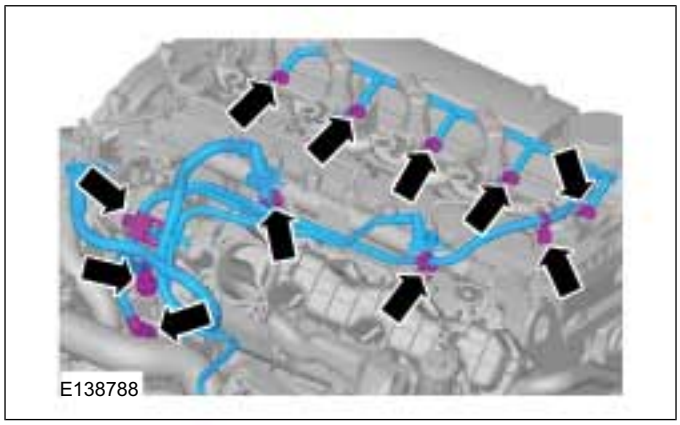
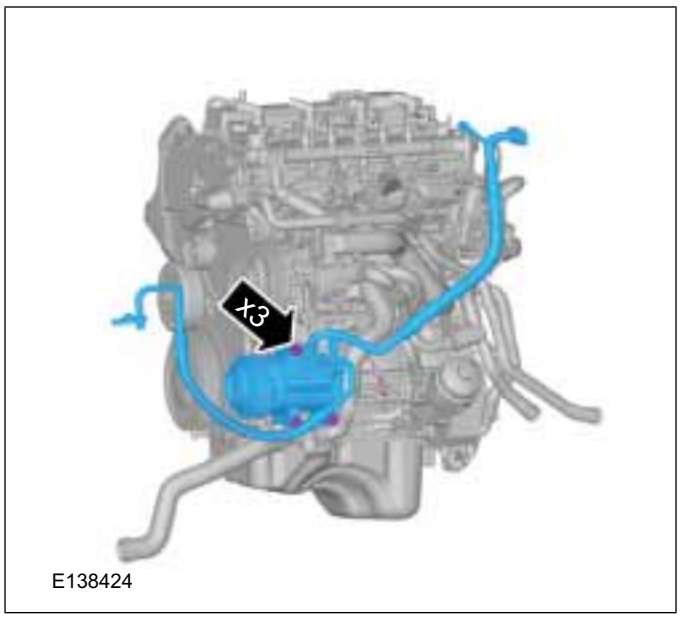


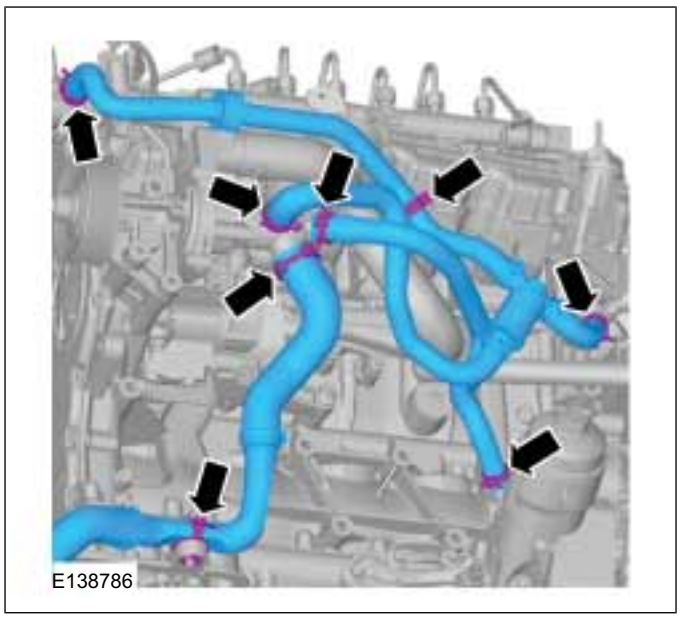
25. ⚠ **CAUTION: Make sure that all openings are sealed. Use new blanking caps.**



26.

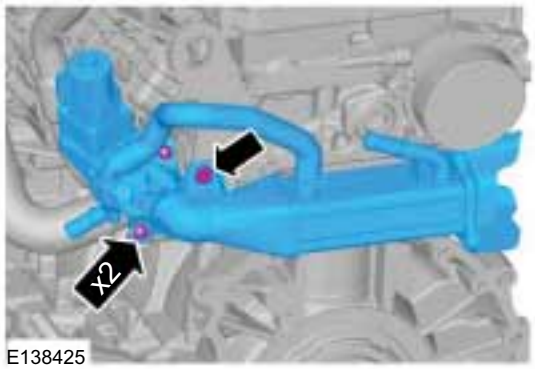


27.



REMOVAL

28.



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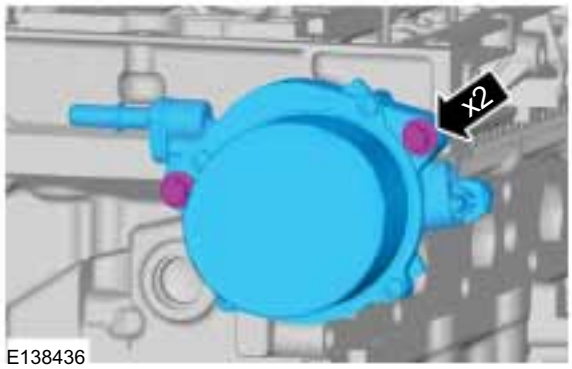

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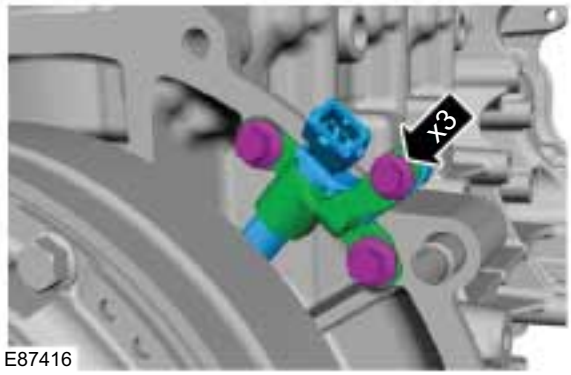
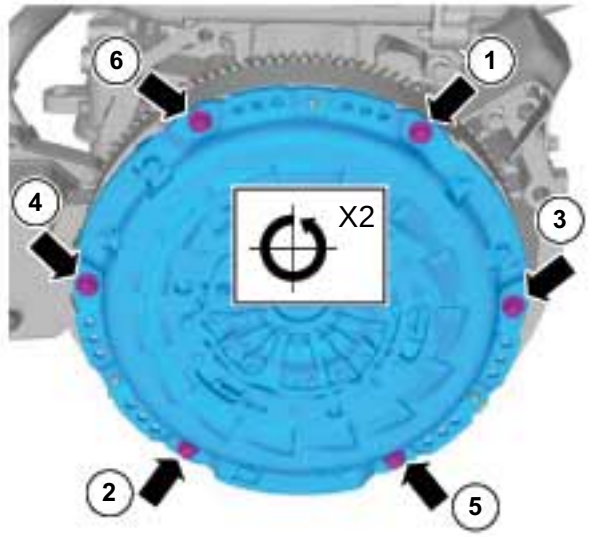


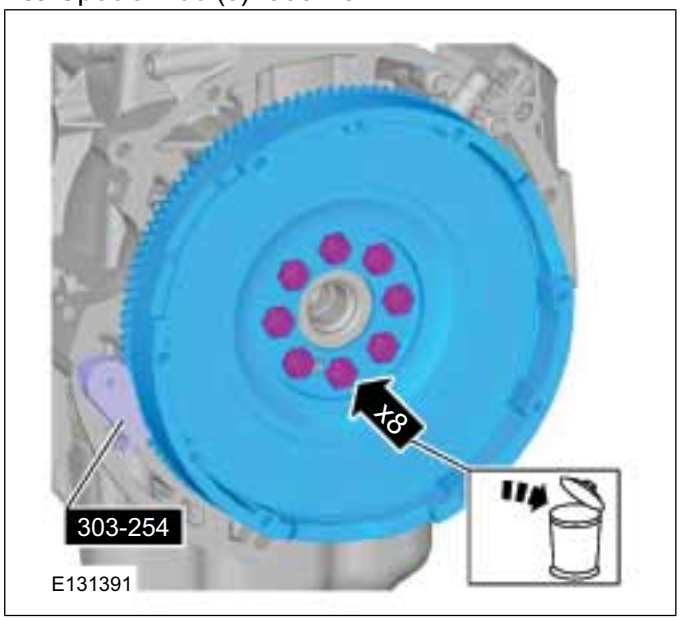
31. Special Tool(s): 303-254

32. NOTE: Do not loosen the bolts more than 2 turns.



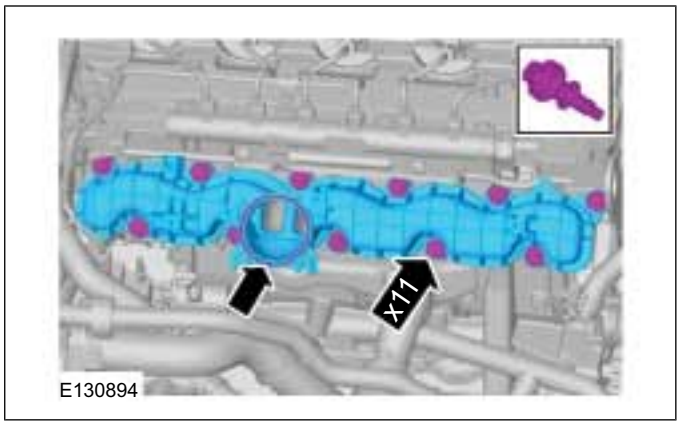
REMOVAL

33. Special Tool(s): 303-254

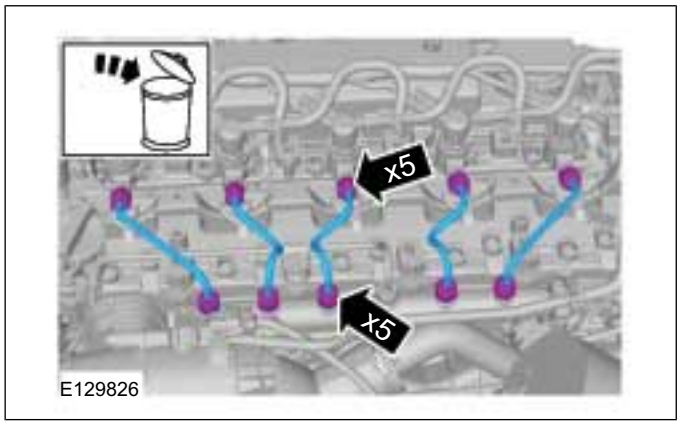


34.

35.



36.

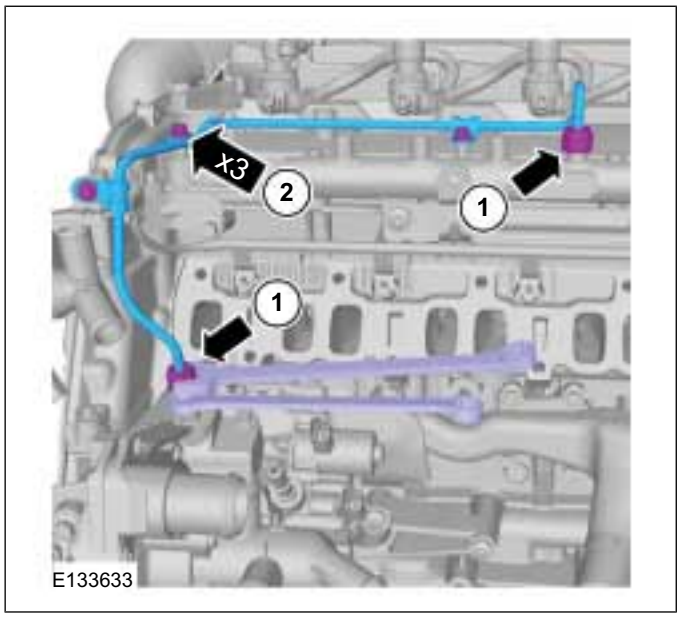


37. CAUTIONS:

Make sure that the fuel line remains in contact at both ends until both unions nuts have been unscrewed and the area around the joints thoroughly cleaned.

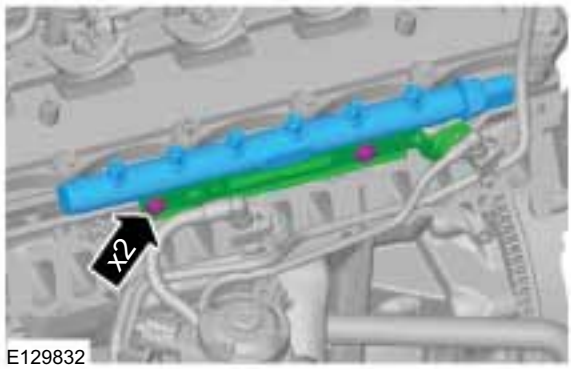
Make sure that the high-pressure fuel supply line remains in contact with both the fuel pump and the fuel rail until both unions have been detached and cleaned.

Make sure that all openings are sealed. Use new blanking caps.

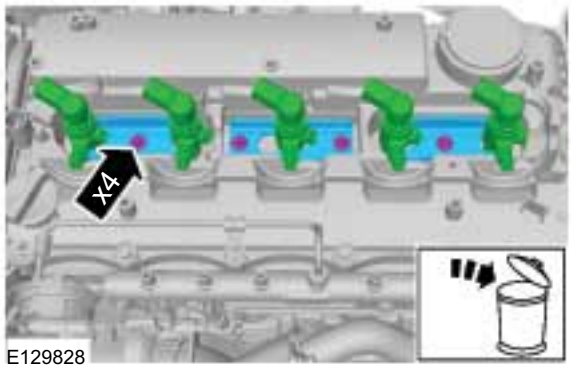


REMOVAL

38.

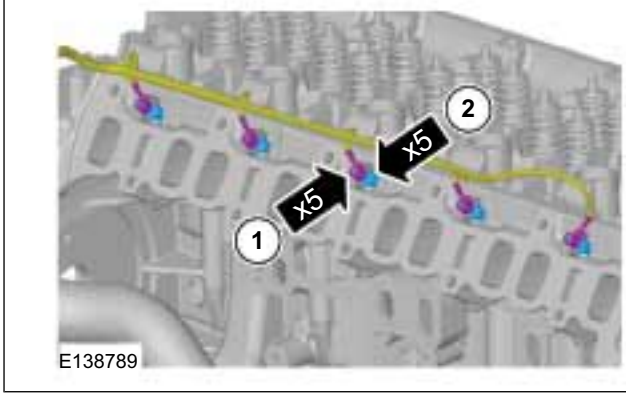


39.



40.

41.



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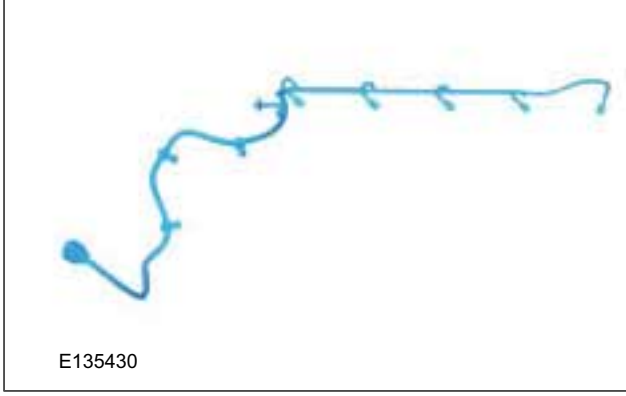

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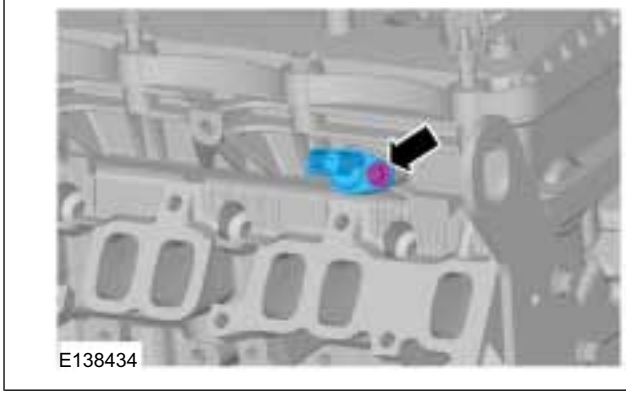
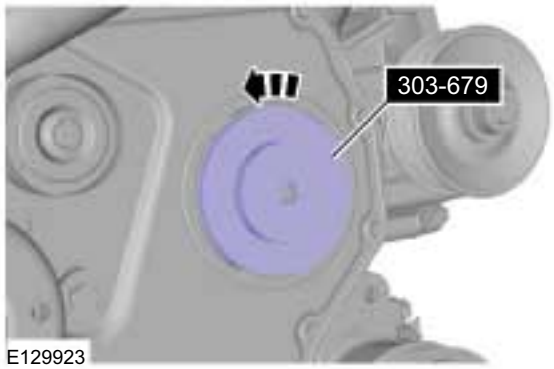


REMOVAL

44. Special Tool(s): 303-679



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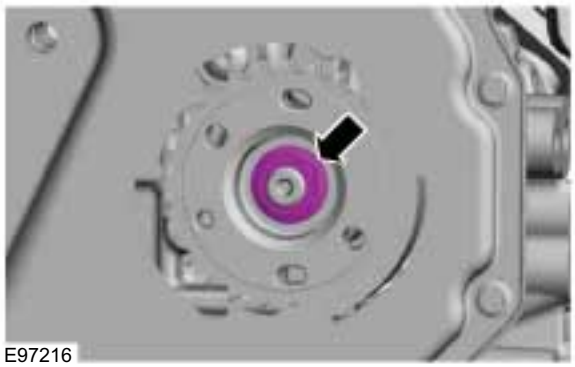
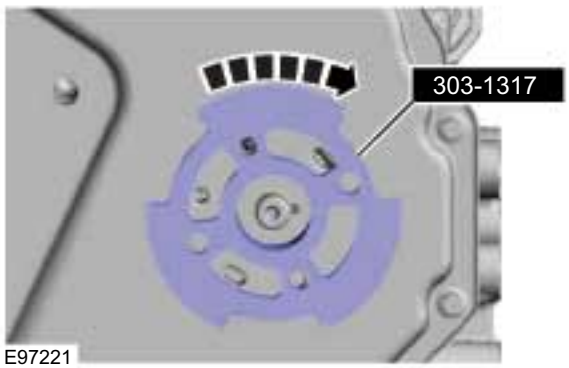
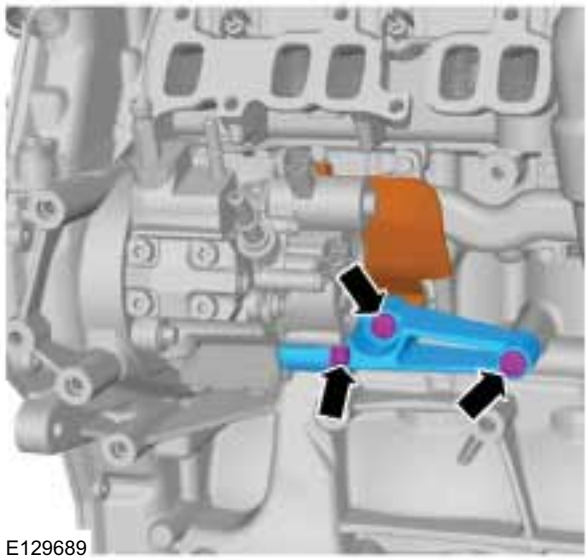


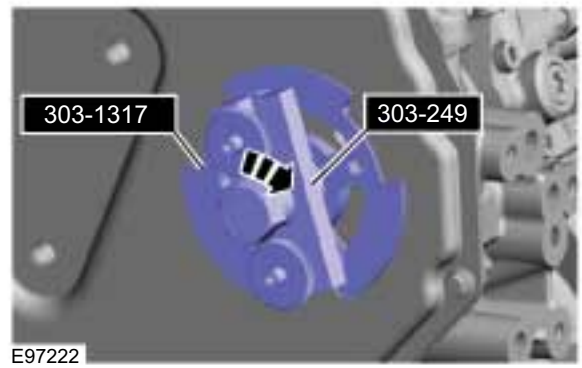
46. Special Tool(s): 303-1317



47.



48. Special Tool(s): 303-1317, 303-249



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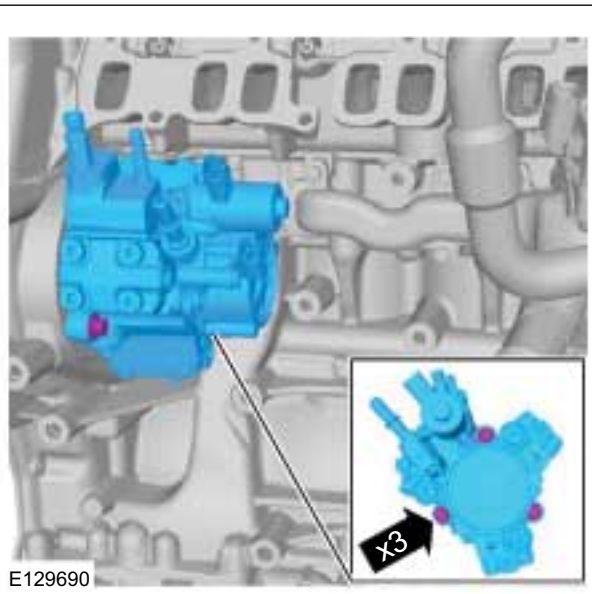
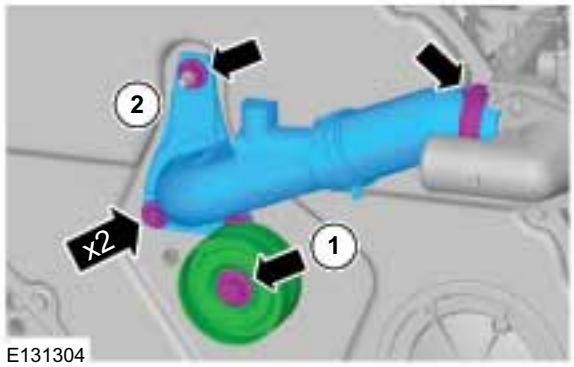


REMOVAL

50.



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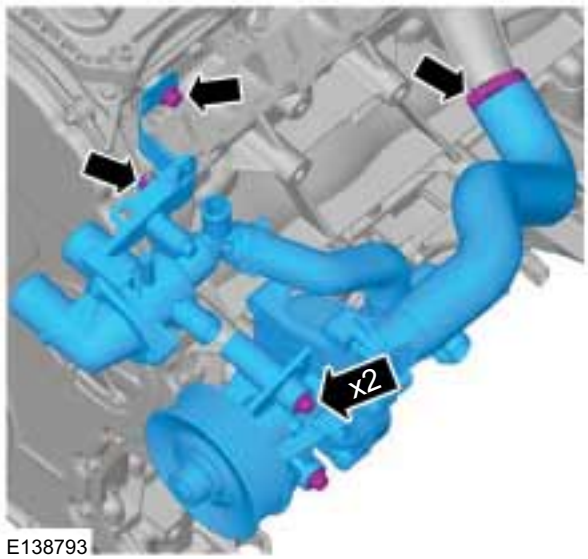

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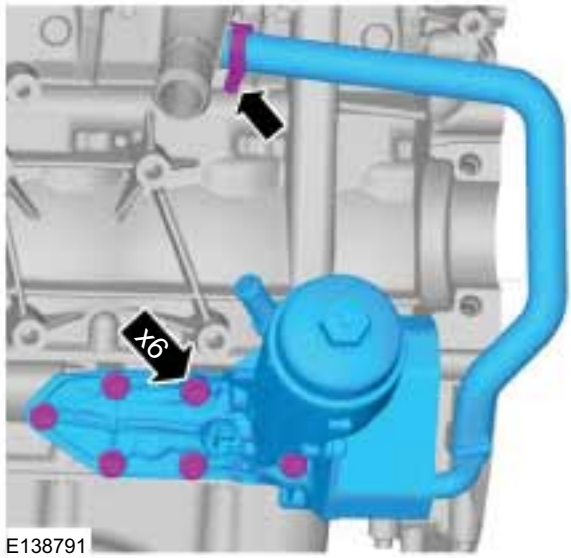
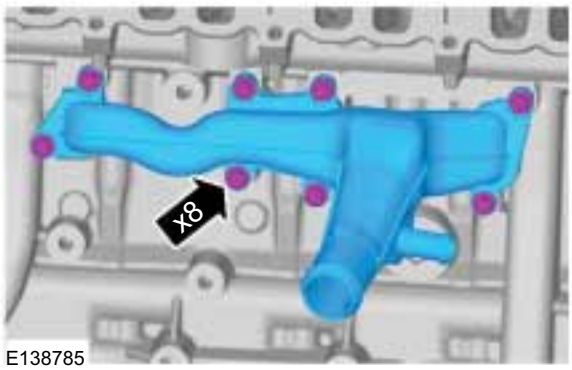
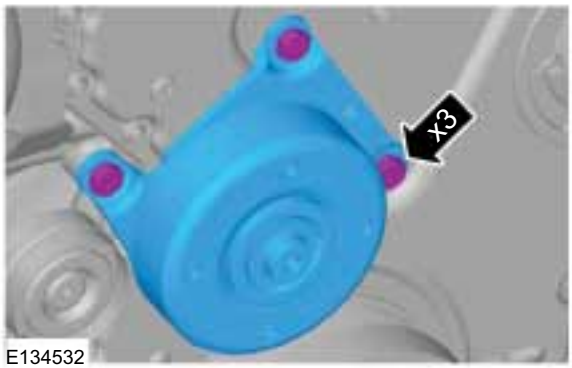


53.

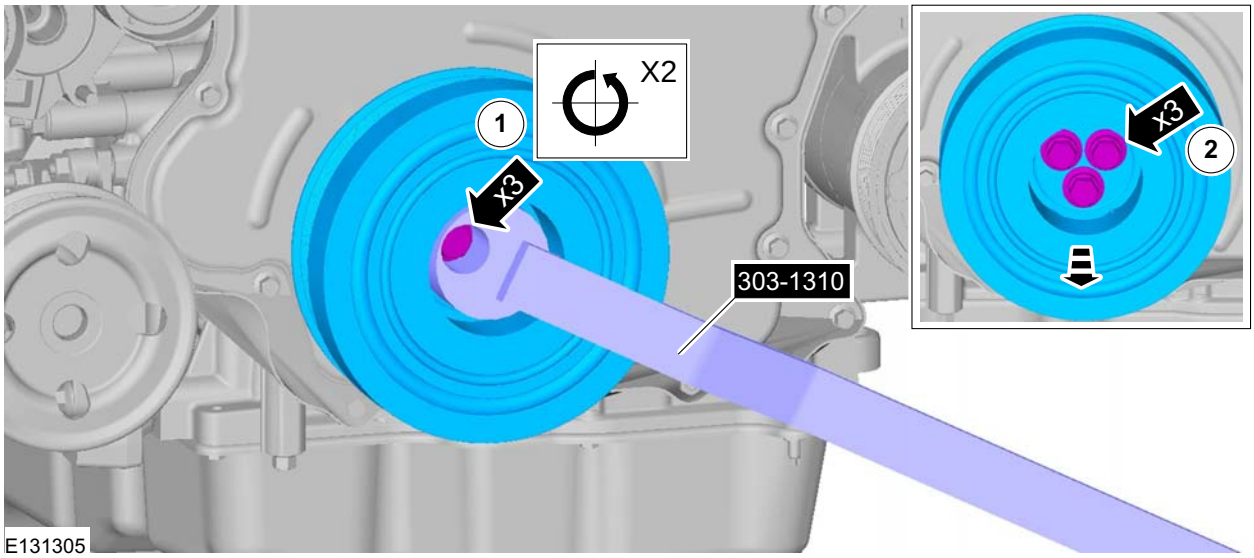


54.

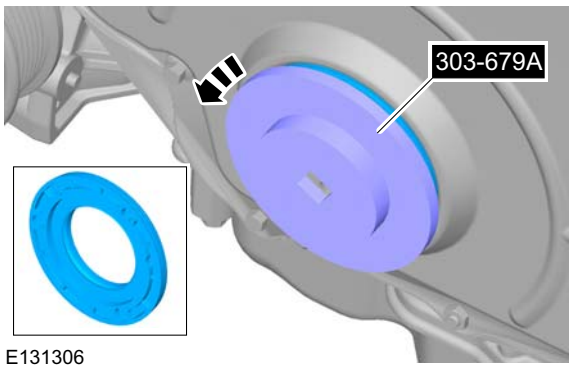


55. Special Tool(s): 303-1310

REMOVAL



56. Special Tool(s): 303-679A

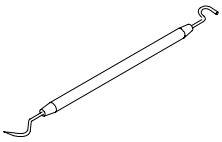
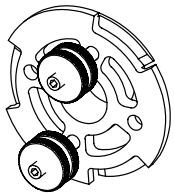
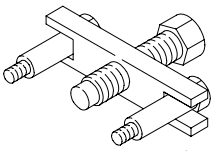
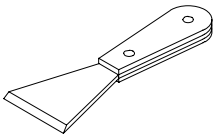
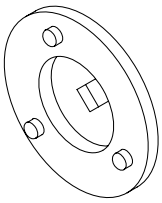


DISASSEMBLY

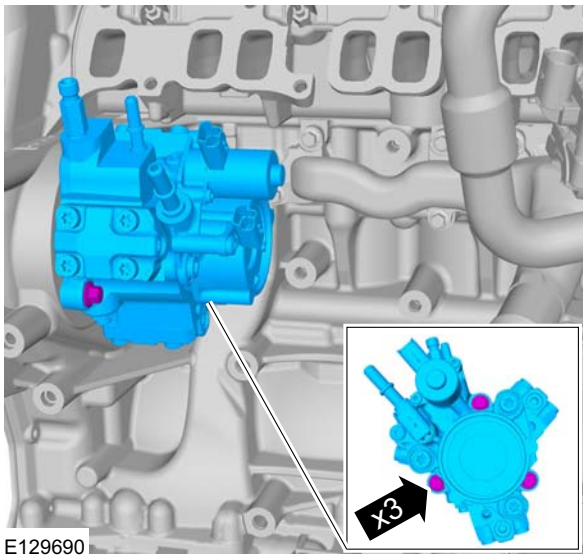
Engine(21 134 8)

Disassembly

Special Tool(s) / General Equipment

 17063	100-010 Remover, O-Ring Seal
 E75376	303-1317 Locking Tool, Fuel Injection Pump Sprocket
 21132	303-249 Remover, Crankshaft Timing Pulley
 21179	303-428 Separator, Oil Pan
 303679	303-679 Remover/Installer, Engine Front Cover Inspection Plate
2 mm Punch	

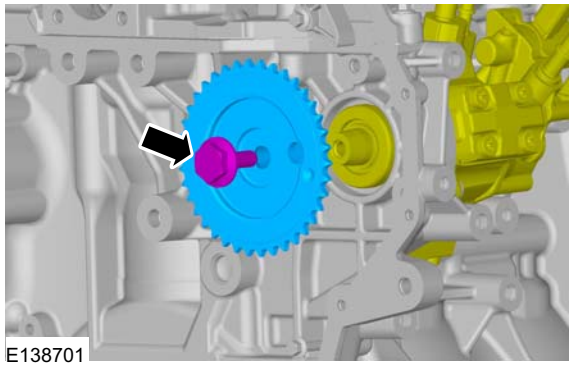
1. Torque: 23 Nm



E129690

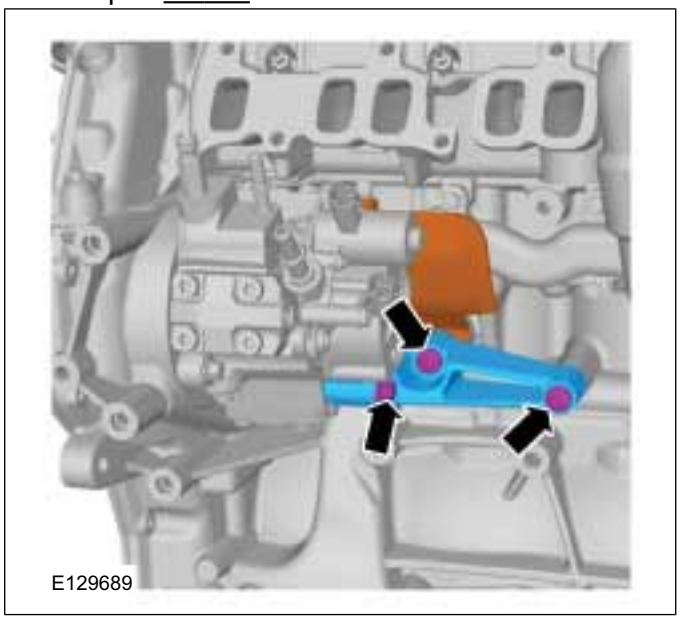
2. **NOTE:** Make sure that a new component is installed.

   Torque: 45 Nm

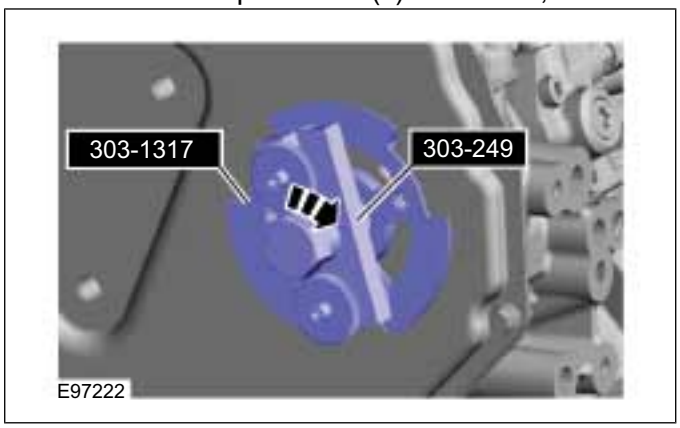

E138701

DISASSEMBLY

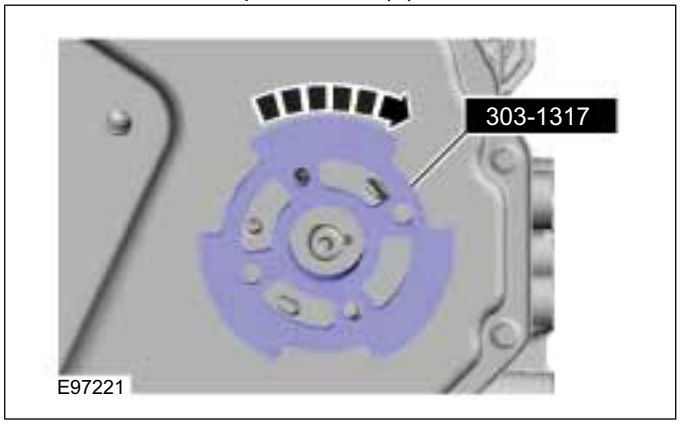
3. Torque: 22 Nm



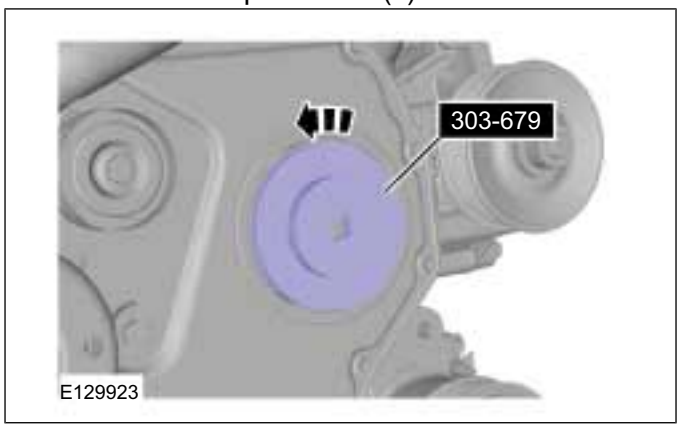
4. Remove the Special Tool(s): 303-1317, 303-249



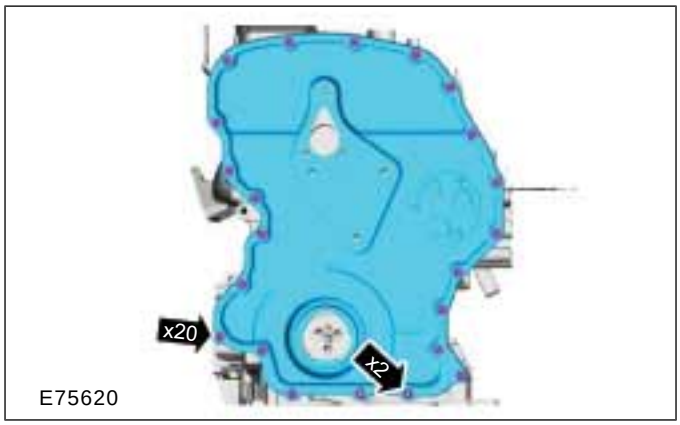
5. Remove the Special Tool(s): 303-1317



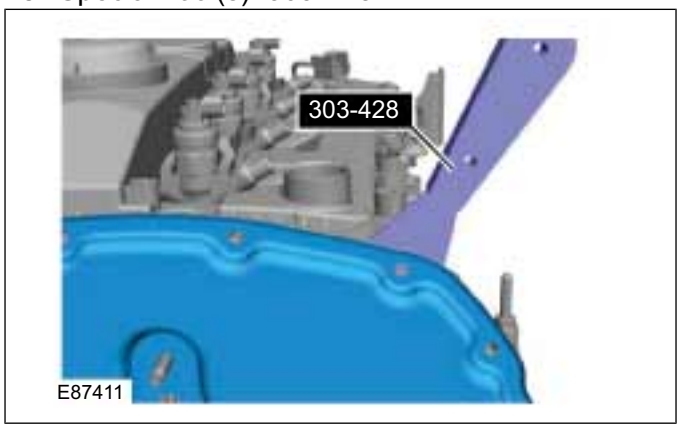
6. Remove the Special Tool(s): 303-679



7.

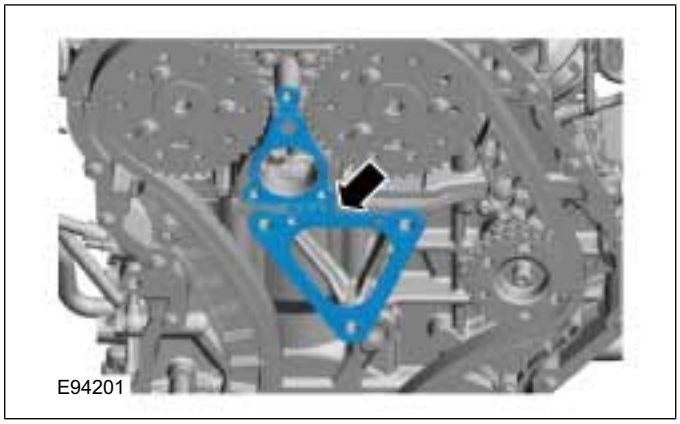


8. Special Tool(s): 303-428

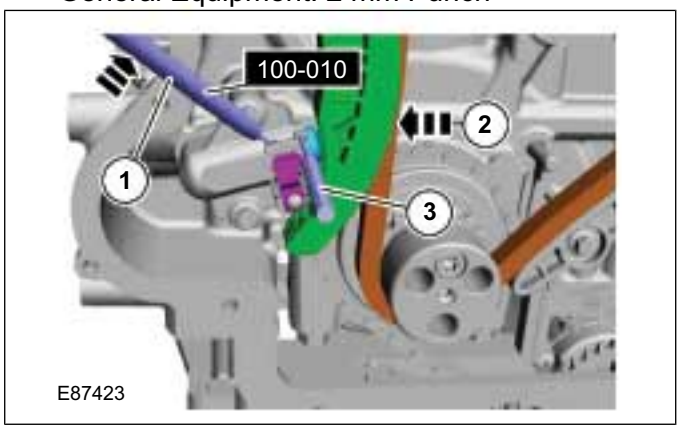


DISASSEMBLY

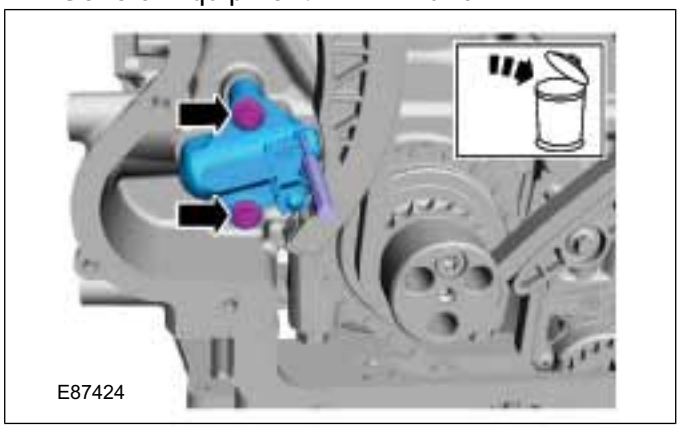
9.



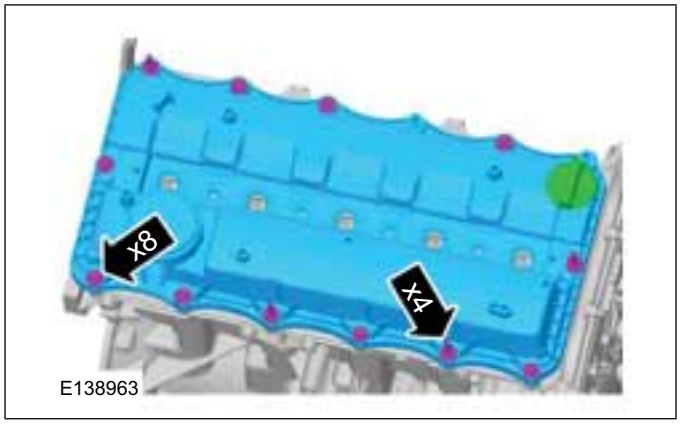
10. Special Tool(s): 100-010
General Equipment: 2 mm Punch



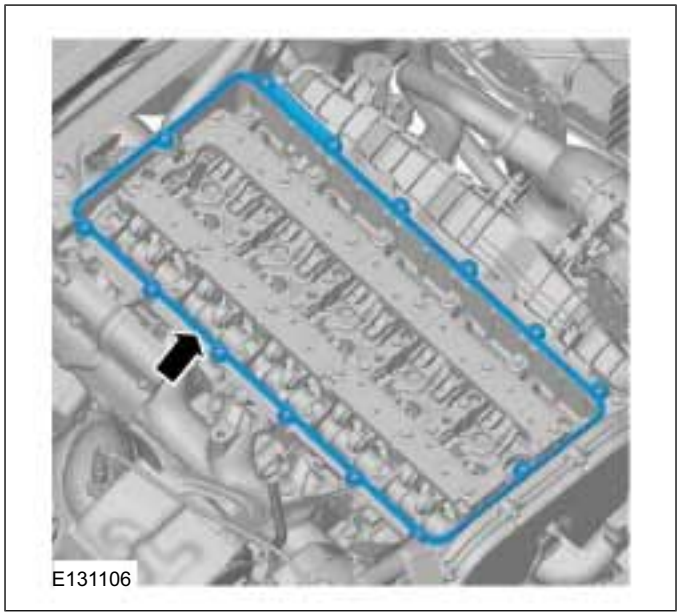
11. Remove and discard the timing chain tensioner.
General Equipment: 2 mm Punch



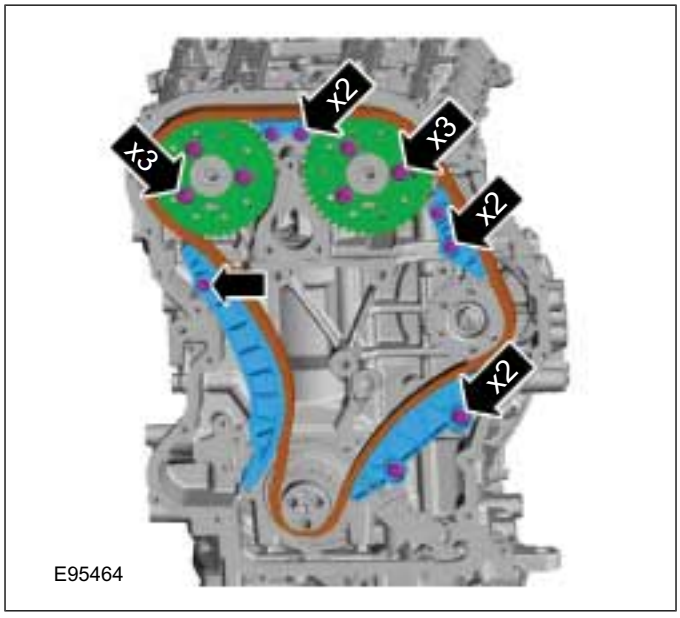
12.



13. NOTE: The gasket is to be reused unless damaged.

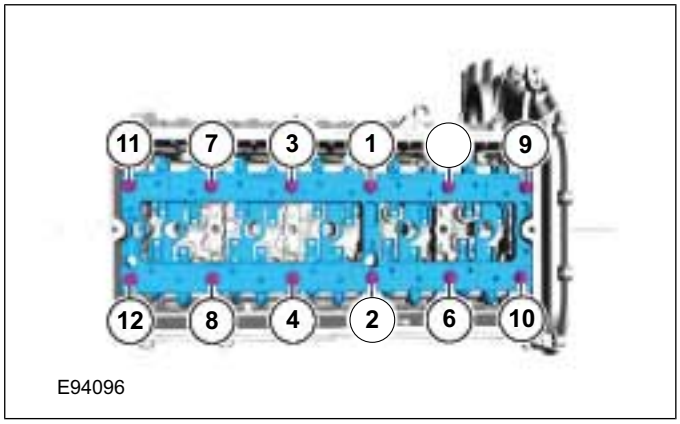


14.



DISASSEMBLY

15.



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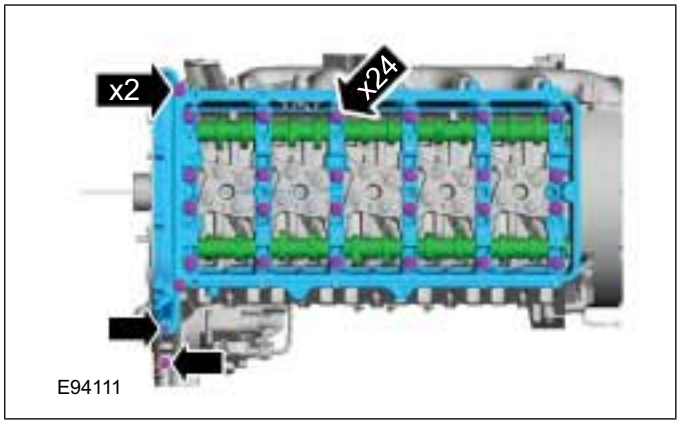
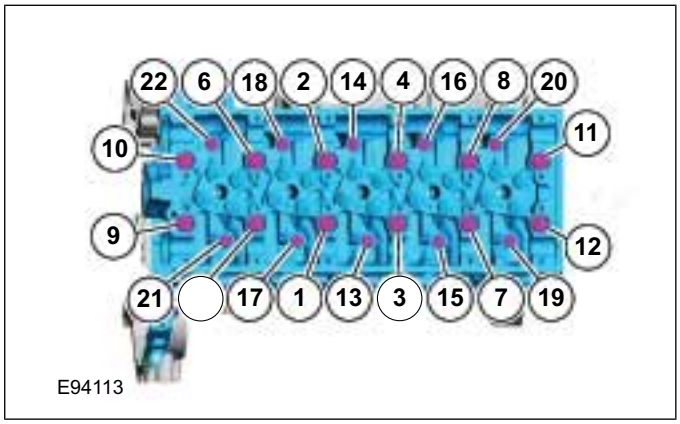
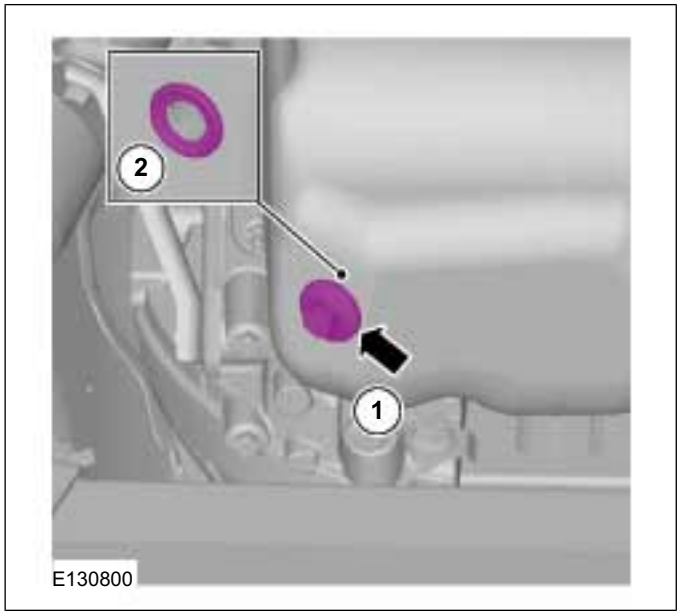


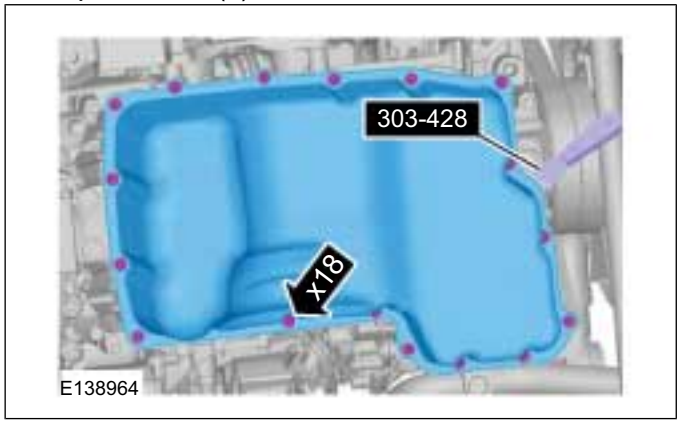
17.



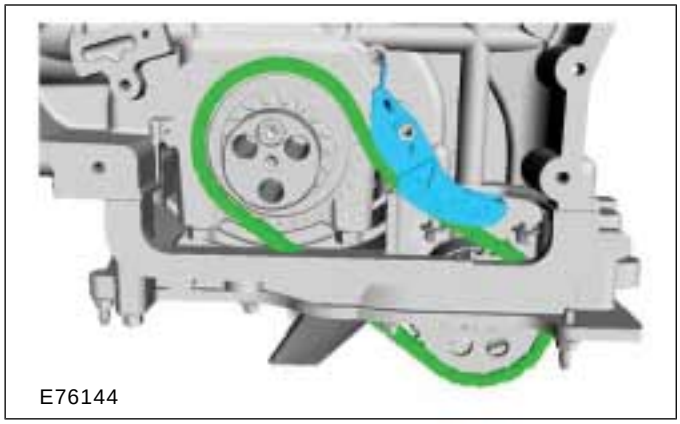
18. ⚠ **WARNING: Be prepared to collect escaping fluid.**



19. Special Tool(s): 303-428

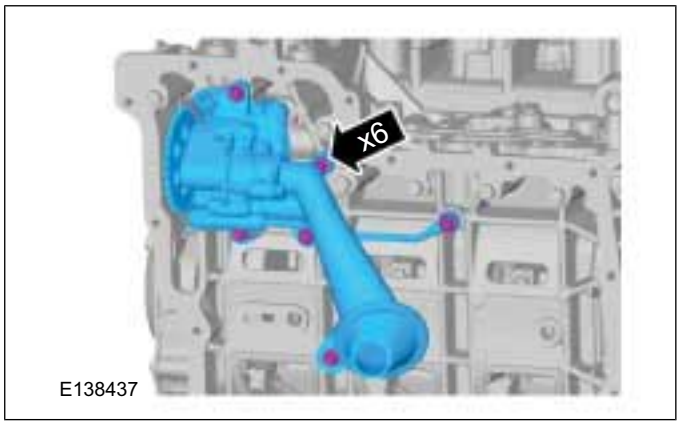


20.

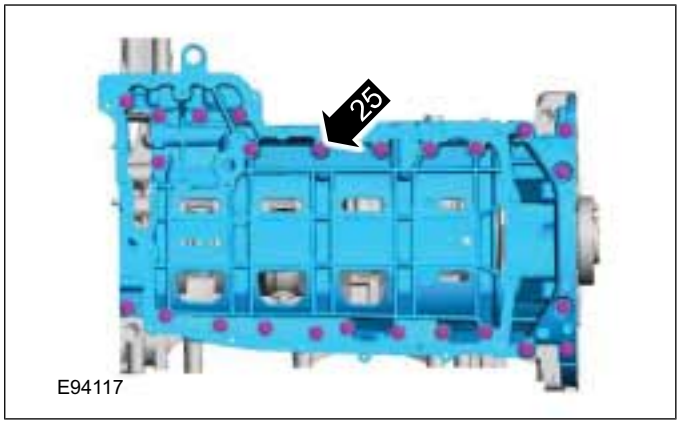


DISASSEMBLY

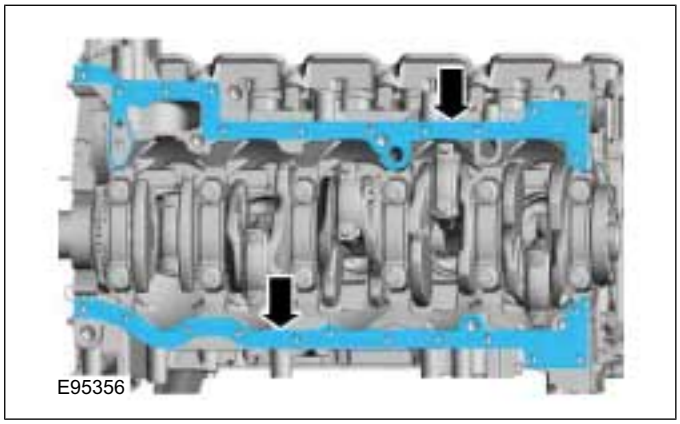
21.



22.

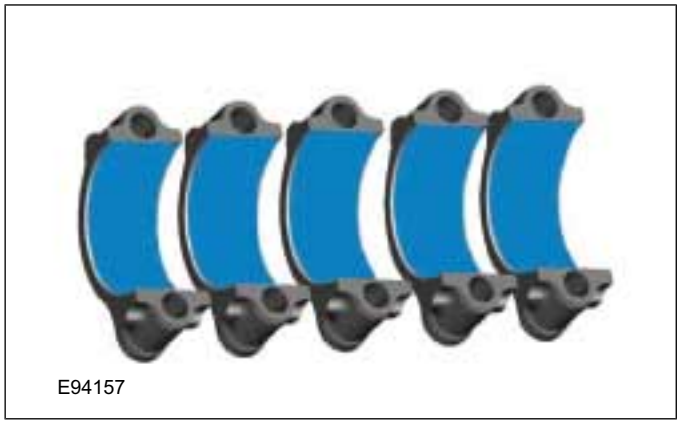


23.

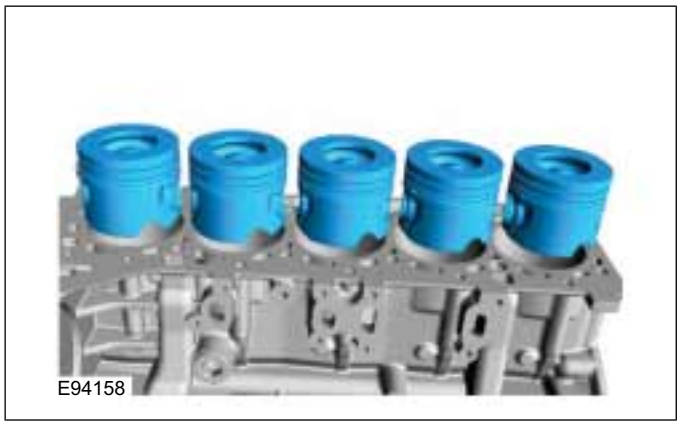


24. **NOTE:** Note the position of each component before removal.

25. **NOTE:** Note the position of each component before removal.

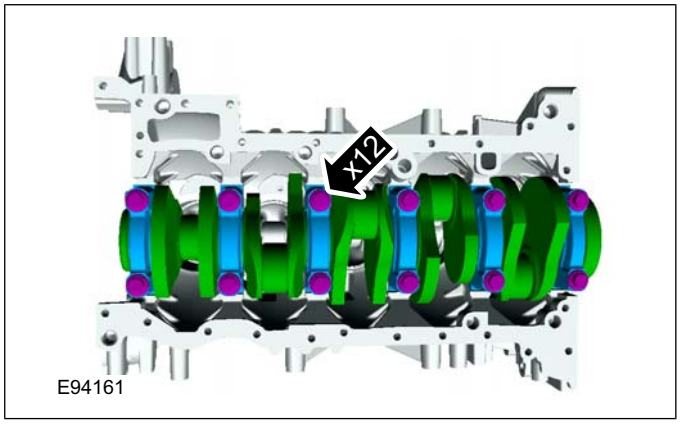


26. **NOTE:** Note the position of each component before removal.

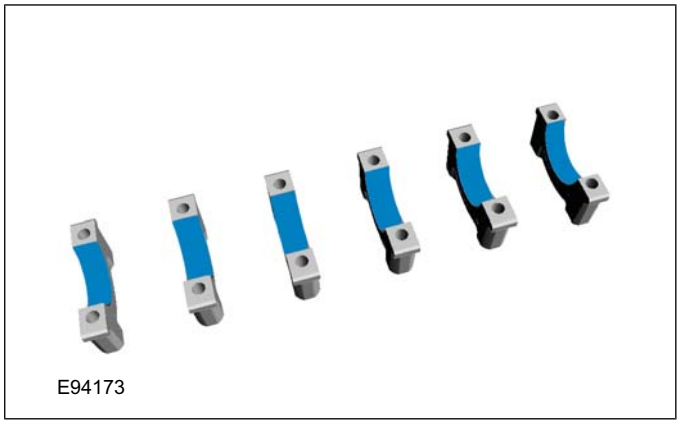


DISASSEMBLY

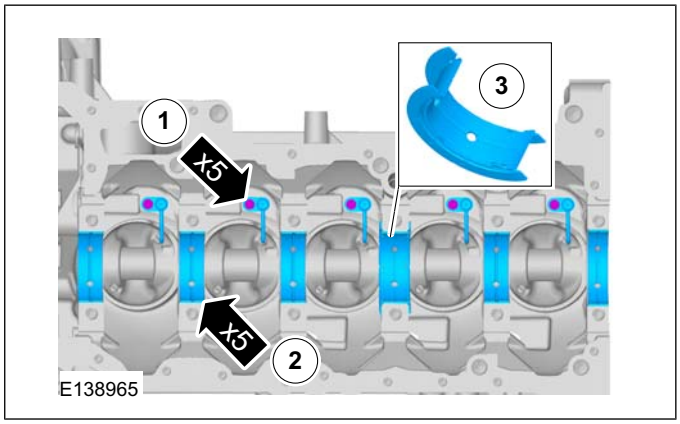
27. **NOTE:** Note the position of each component before removal.



28. **NOTE:** Note the position of each component before removal.



29. **NOTE:** Note the position of each component before removal.

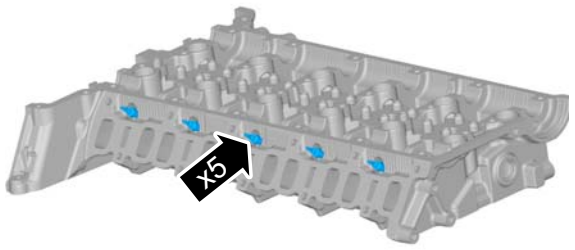


DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Cylinder Head(21 165 6)

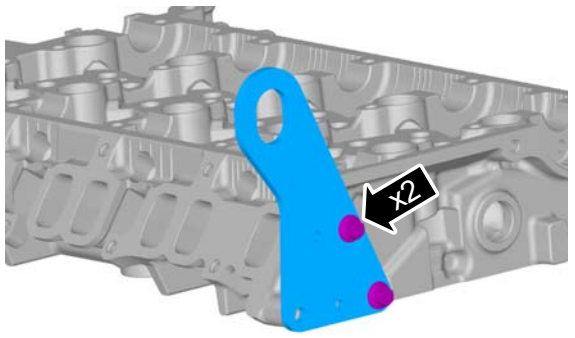
Disassembly

1. **For additional information, refer to: Valves (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).**
2. **Torque : 13Nm**



E138395

3. **Torque : 23Nm**



E138008

Assembly

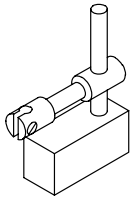
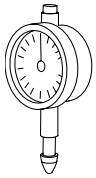
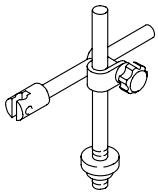
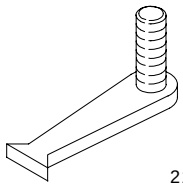
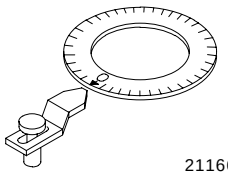
1. **To assemble, reverse the disassembly procedure.**

ASSEMBLY

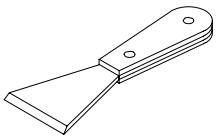
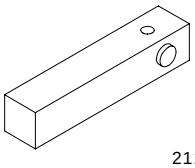
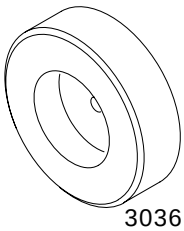
Engine(21 134 8)

Assembly

Special Tool(s) / General Equipment

 15008	205-044 Holding Fixture, Dial Indicator Gauge
 15046	205-069 Dial Indicator Gauge (Metric)
 15022A	205-070 Holding Fixture, Dial Indicator Gauge
 E131853	303-1562 Timing Tool
 21135	303-254 Locking Tool, Flywheel
 21166	303-391 Setting Gauge, Crankshaft

Special Tool(s) / General Equipment

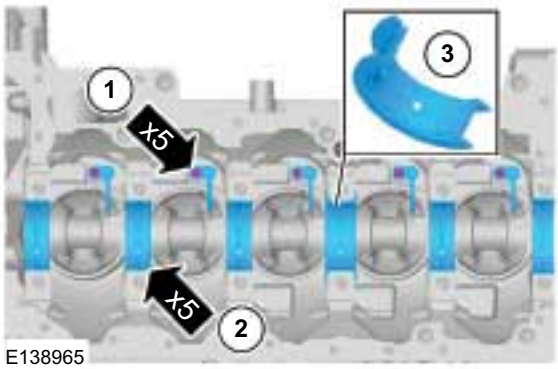
 21179	303-428 Separator, Oil Pan
 21183	303-432 Holding Fixture, Dial Indicator Gauge (Cylinder Liner Protrusion)
 303682	303-682 Aligner, Engine Front Cover
6 mm Drill Bit	
Piston Ring Compressor	
Round-Ended Steel Rule	

Materials	
Name	**Specification**
Engine Oil - 5W-30	WSS-M2C913-C
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

ASSEMBLY

1. **NOTE:** Make sure that these components are installed to the noted removal position.

   Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil
   Torque: 10 Nm



E138965

2. **NOTE:** Make sure that these components are installed to the noted removal position.

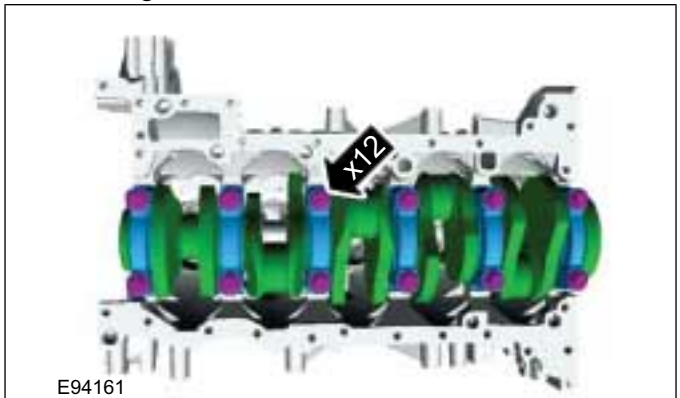
   Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil


E94362

3. **NOTE:** Make sure that these components are installed to the noted removal position.

   NOTE: Install all the bolts finger tight before final tightening.

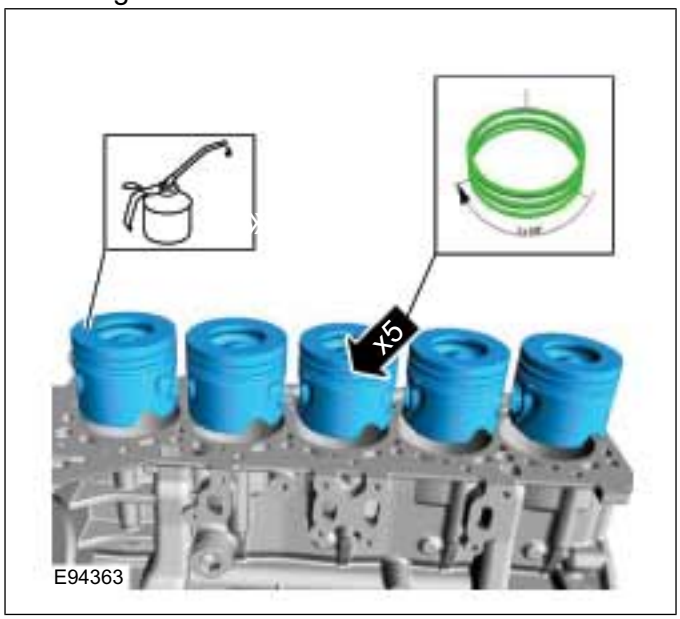
   Torque:
   - Stage 1: 15 Nm
   - Stage 2: 20 Nm
   - Stage 3: 35 Nm
   - Stage 4: 80 Nm
   - Stage 5: 90°



E94161

4. **NOTE:** Make sure that these components are installed to the noted removal position.

   General Equipment: Piston Ring Compressor
   Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil

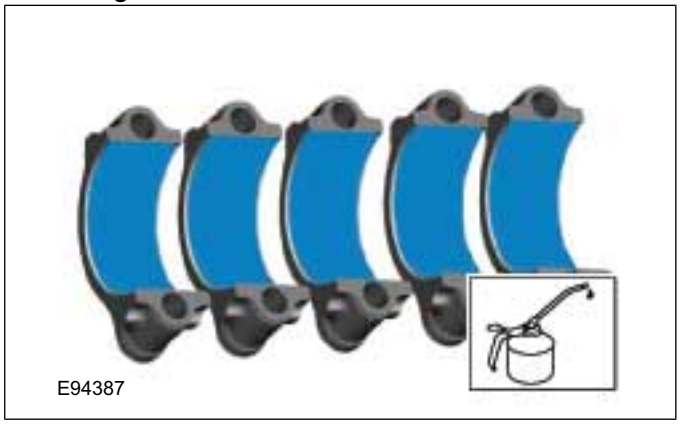


E94363

ASSEMBLY

5. **NOTE:** Make sure that these components are installed to the noted removal position.

   Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil

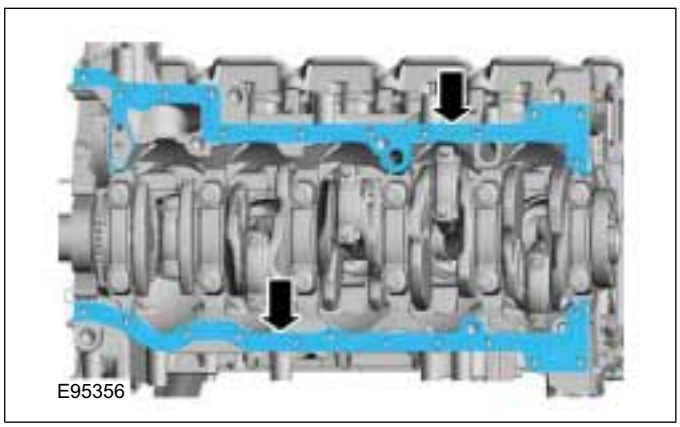


6. **NOTE:** Make sure that these components are installed to the noted removal position.

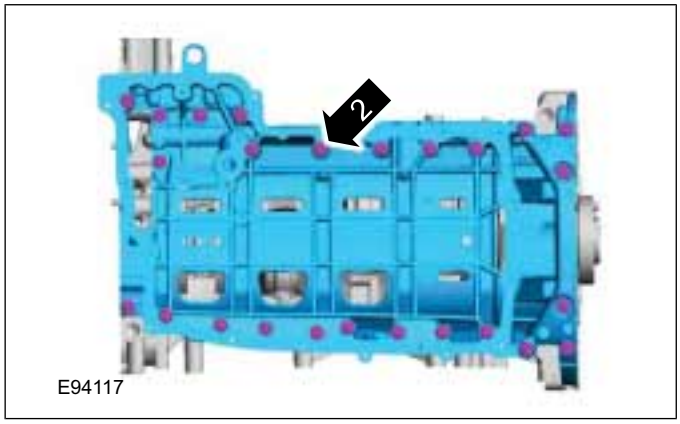
   NOTE: Install all the bolts finger tight before final tightening.

   Torque:
   - Stage 1: 25 Nm
   - Stage 2: 60 Nm
   - Stage 3: 90°

7.

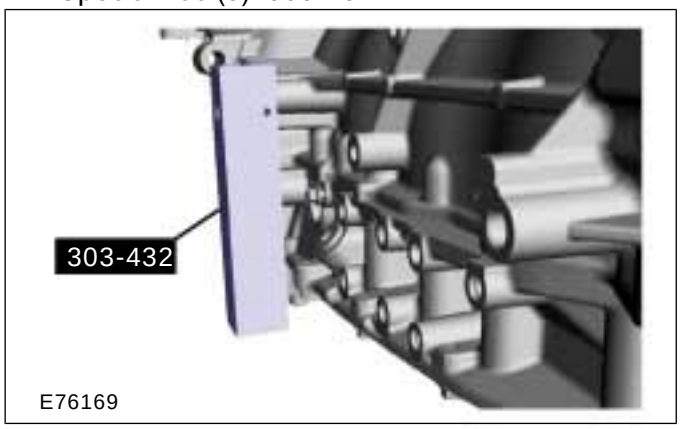


8. **NOTE:** Only tighten the bolts finger tight at this stage.



9. The ladder frame and the cylinder block must be aligned so that the side clearance does not exceed 0.05 mm overlap to 0.05 mm gap.

   Special Tool(s): 303-432

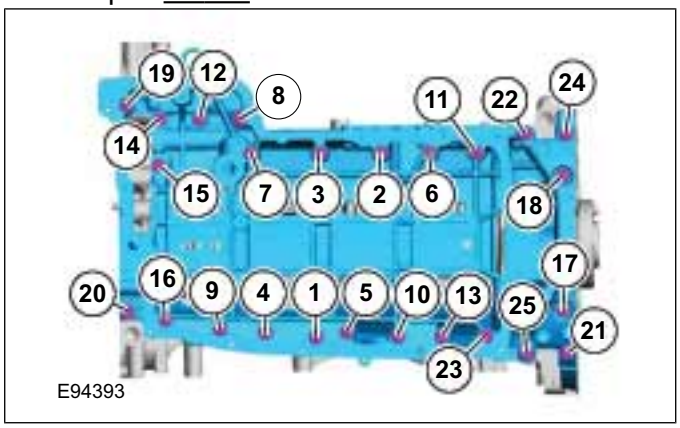


10. The ladder frame and the cylinder block must be aligned so that the rear clearance does not exceed 0.01 mm overlap to 0.2 mm gap.

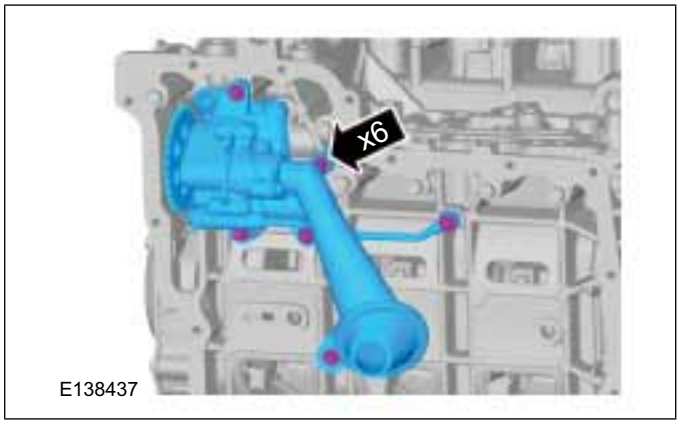
    General Equipment: Round-Ended Steel Rule

ASSEMBLY

11. Torque: 23 Nm

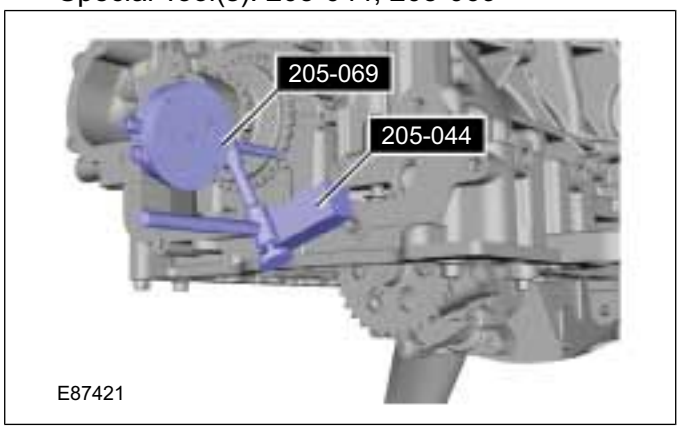


12. NOTE: Only tighten the bolts finger tight at this stage.



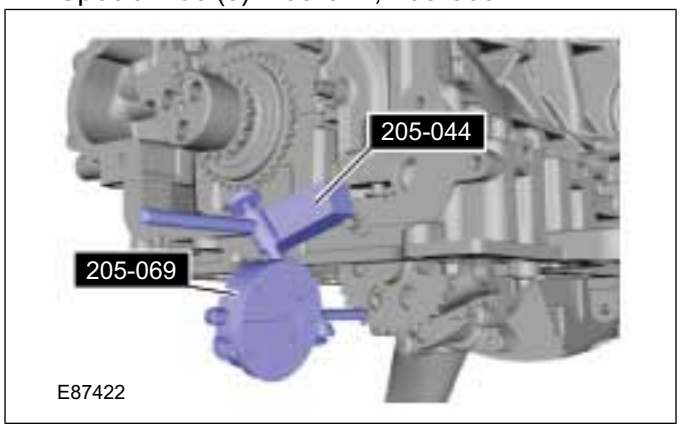
13. Take a reference measurement from the front face of the crankshaft sprocket.

Special Tool(s): 205-044, 205-069

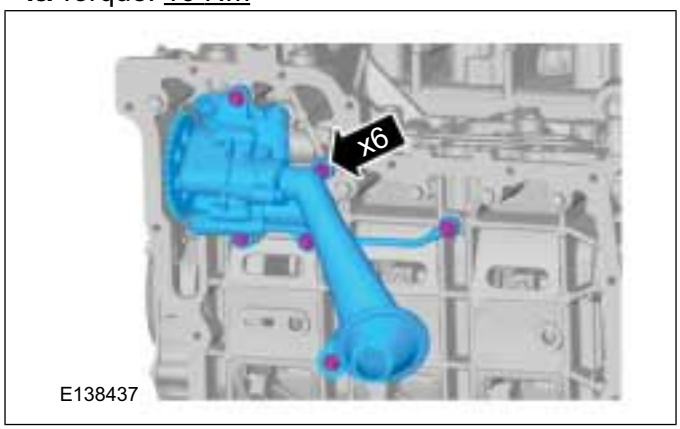


14. Take measurements at two different points on the oil pump sprocket and align the oil pump sprocket.

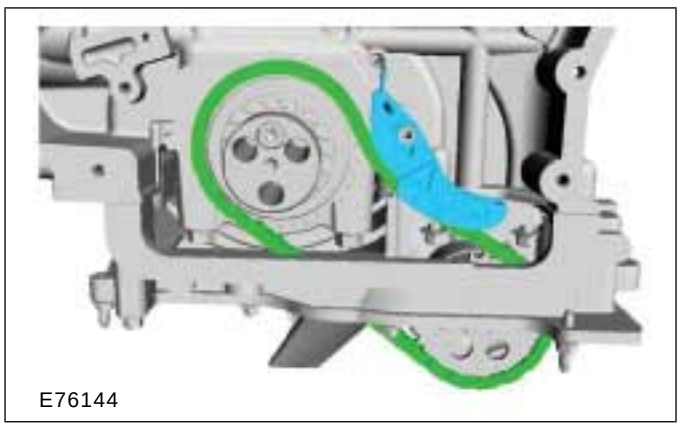
Special Tool(s): 205-044, 205-069



15. Torque: 10 Nm



16.

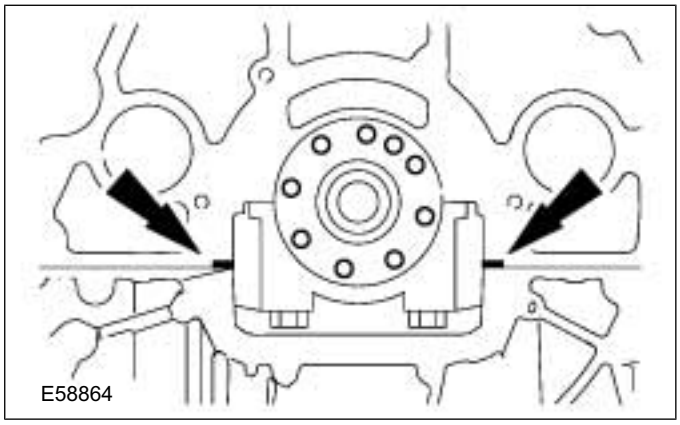


17. NOTE: A new crankshaft rear seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft rear seal is fully

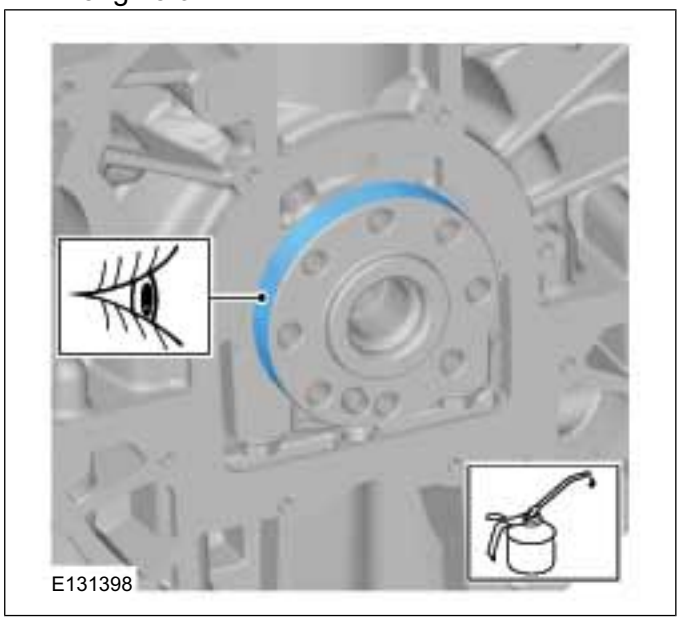
ASSEMBLY

installed. Failure to follow this instruction may result in damage to the vehicle.

- Clean the area on the engine before installing a new crankshaft rear seal carrier.
- Check the two foam pads are located as shown on the ladder frame gasket.

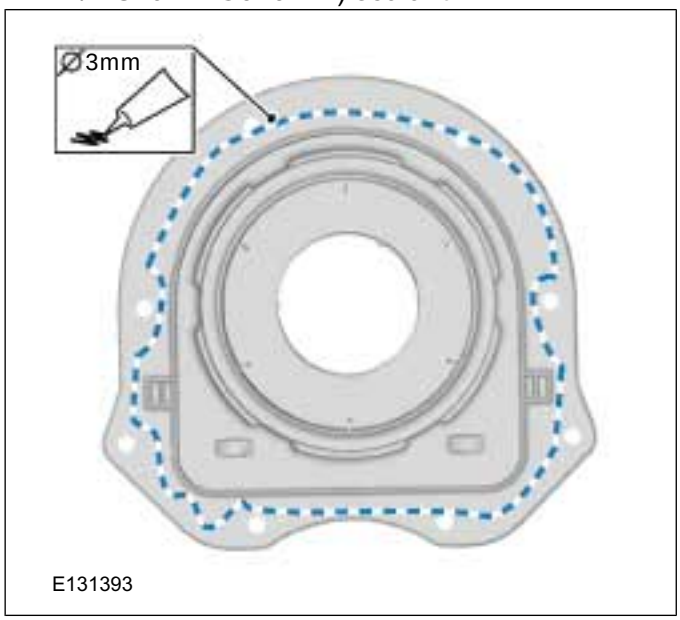


18. Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil



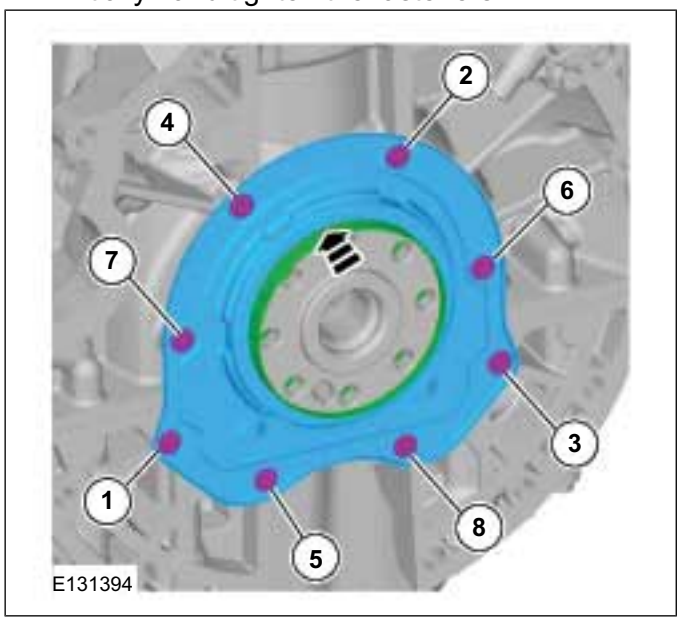
19. **NOTE:** Install the new crankshaft rear seal carrier within five minutes of applying the recommended sealant.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



20. **CAUTION: A new crankshaft rear seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft rear seal is fully installed. Failure to follow this instruction may result in damage to the vehicle.**

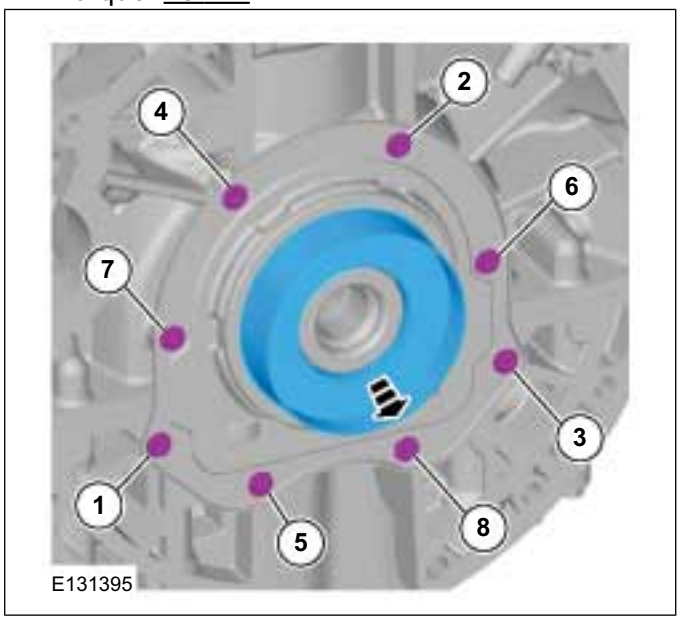
Initially hand tighten the fasteners.



ASSEMBLY

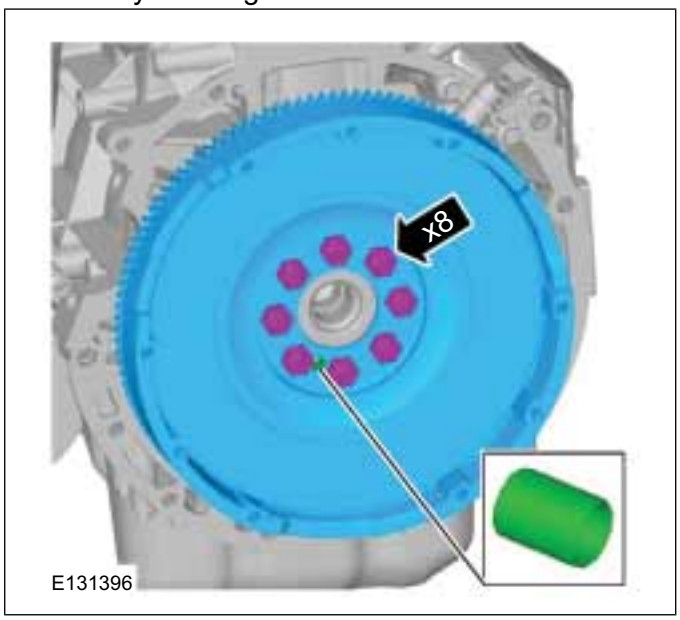
21. **NOTE:** New crankshaft rear seal carriers are supplied with an alignment sleeve which must be removed after installation.

    Torque: 20 Nm

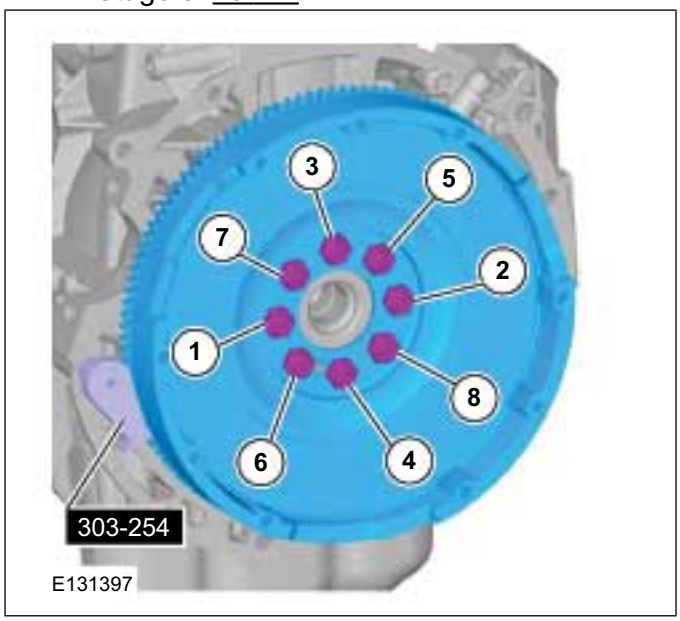


22. **NOTE:** Make sure that the flywheel is in full contact with the crankshaft flange before installing the flywheel bolts.

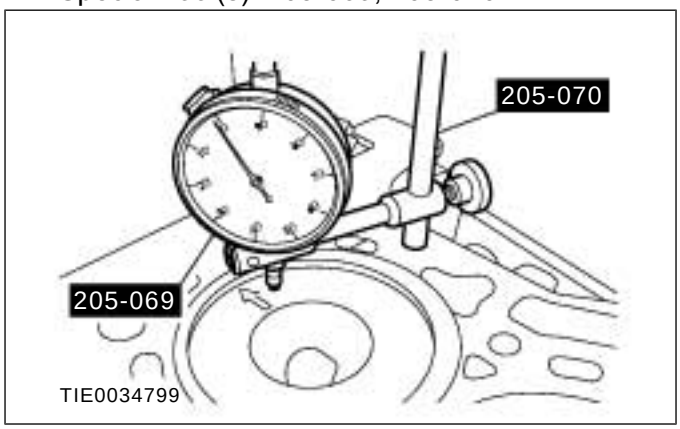
    Initially hand tighten the fasteners.



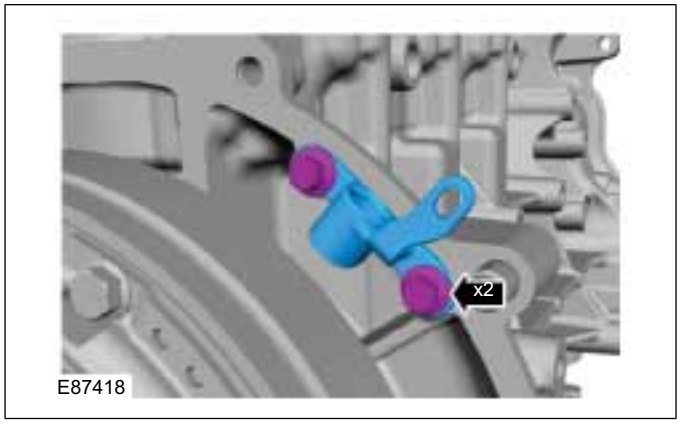
23. Special Tool(s): 303-254
    Torque:
    - Stage 1: 15 Nm
    - Stage 2: 30 Nm
    - Stage 3: 75 Nm



24. Special Tool(s): 205-069, 205-070



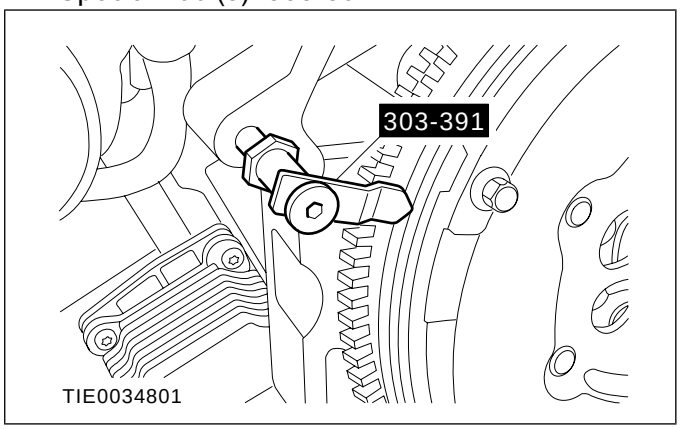
25. **NOTE:** Do not fully tighten the crankshaft position sensor bracket retaining bolts at this stage.



ASSEMBLY

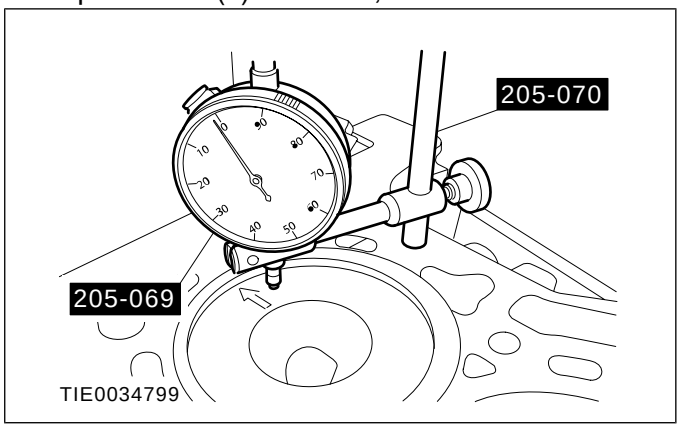
26. **NOTE:** After installation do not move the special tool.

    Special Tool(s): 303-391



27. Rotate the crankshaft until piston No. one is approximately 10 mm before top dead center (TDC).

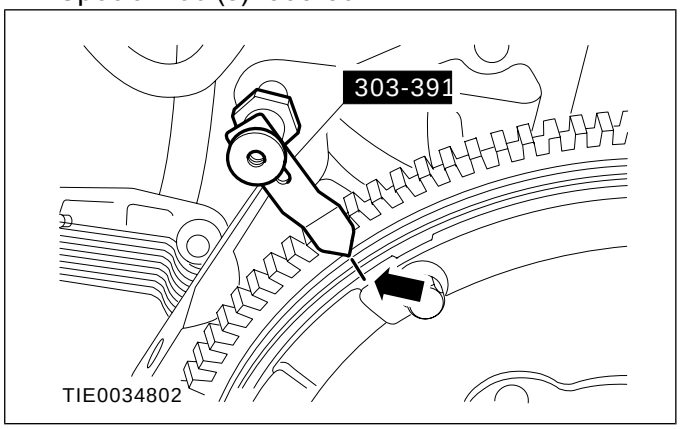
    Special Tool(s): 205-069, 205-070



28. Zero the dial indicator gauge.

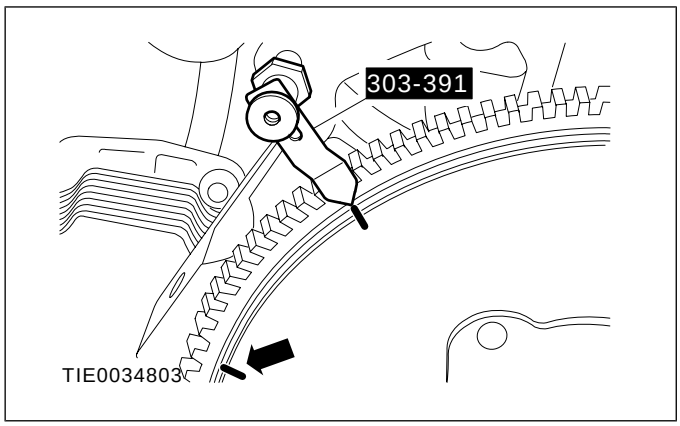
29. Mark the position on the flywheel primary mass.

    Special Tool(s): 303-391



30. **NOTE:** Rotate the crankshaft counterclockwise.
    1. Rotate the crankshaft until the piston No. one achieves zero on the dial indicator gauge.
    2. Mark the position on the flywheel primary mass.

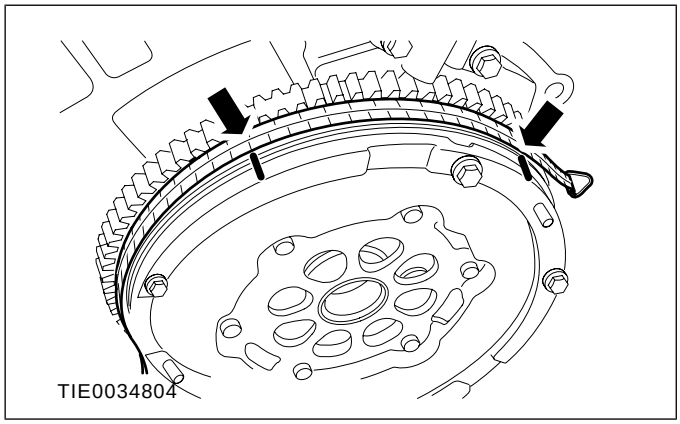
    Special Tool(s): 303-391



31. Repeat the previous steps to make sure that the marking is correct.

32. **NOTE:** The middle of the markings is TDC.

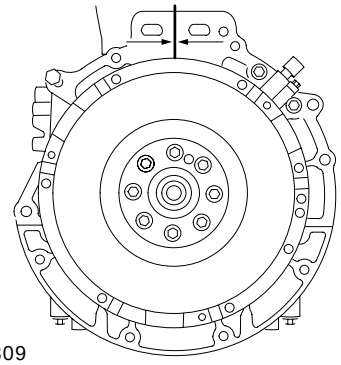
    Measure the distance between the two marks.



33. Divide the amount by two and mark the position TDC on the flywheel primary mass.

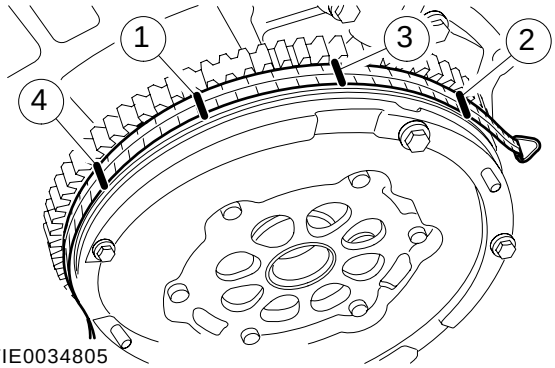
ASSEMBLY

34. Measure the circumference of the flywheel primary mass.


TIE0034809

35. Multiply the circumference by 0.1388 and mark the calculated amount on the flywheel primary mass by measuring from TDC counterclockwise.

36. 1. First mark.
    2. Second mark.
    3. Determined TDC.
    4. Determined 50 degrees before top dead center (BTDC).



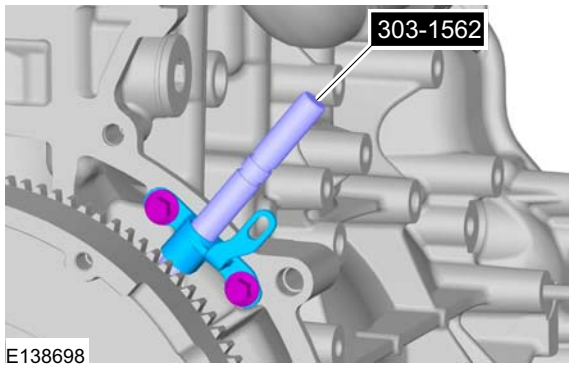
TIE0034805

37. **CAUTION: Do not turn the crankshaft when the special tool is fully located into the flywheel. Failure to follow this instruction will cause damage to the CKP sensor hole.**

NOTE: Rotate the crankshaft in the normal direction of rotation to the mark of the calculated 50 degrees BTDC.

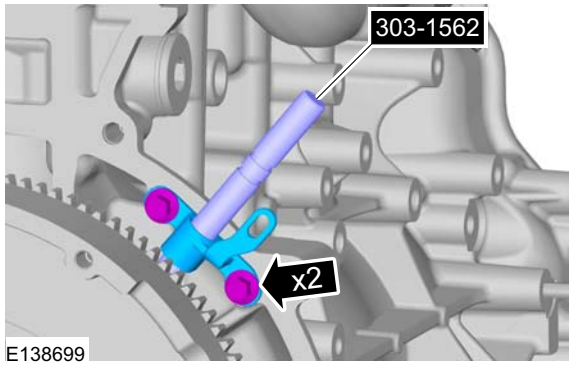
NOTE: Make sure that the special tool is fully located in the flywheel so that the engine cannot be rotated in either direction.

Special Tool(s): 303-1562



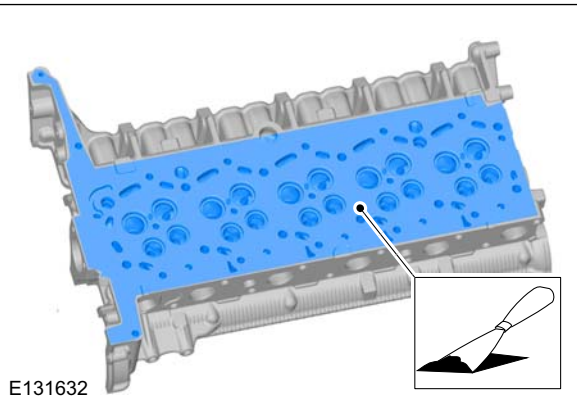
E138698

38. Remove the Special Tool(s): 303-1562
Torque: 25 Nm



E138699

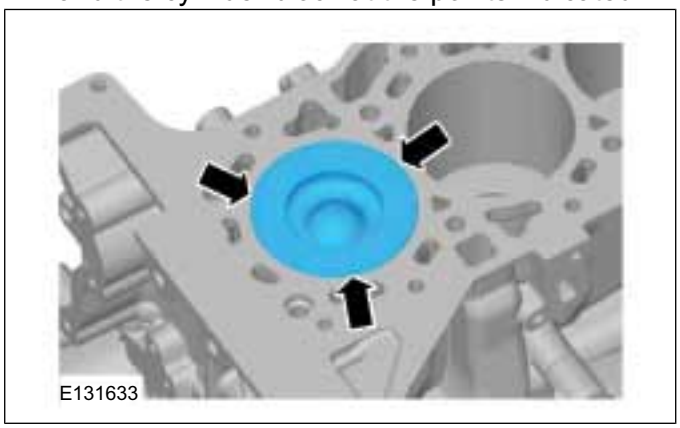
39. **WARNING: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**


E131632

ASSEMBLY

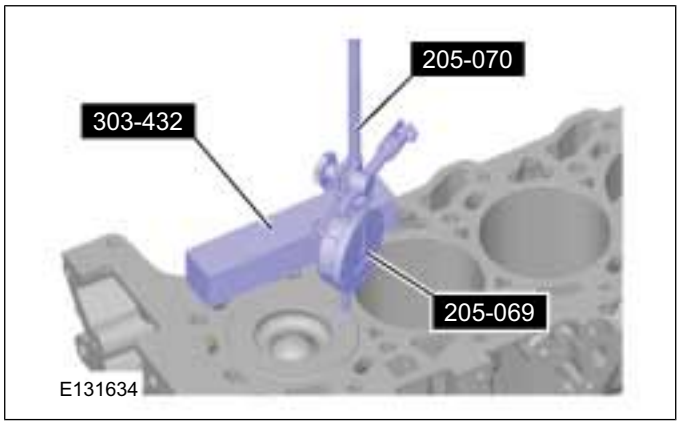
40. **NOTE:** Measure the piston protrusion of each cylinder at top dead center (TDC).

    Measure the distance between the piston crown and the cylinder block at the points indicated.



41. **NOTE:** The largest measurement determines the choice of the cylinder head gasket.
    - Using the special tools, measure the piston protrusion.

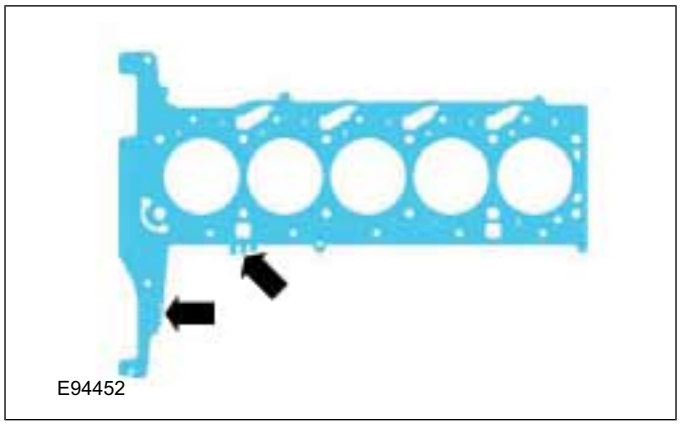
      Special Tool(s): 205-070, 205-069, 303-432



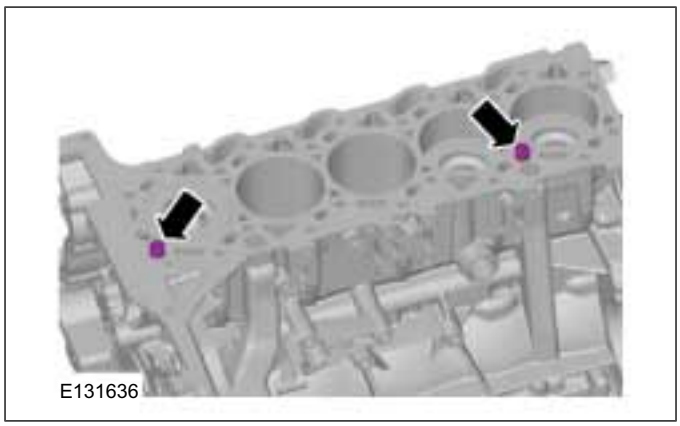
42. Determine the cylinder head gasket.

    Refer to: Specifications (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Specifications).

43. **NOTE:** Make sure that a new component is installed.

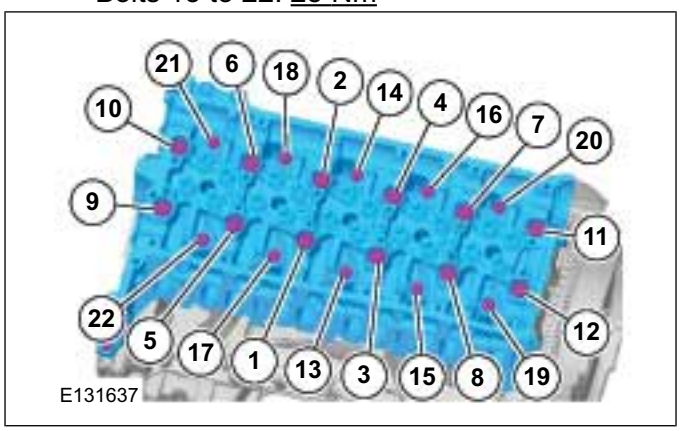


44.



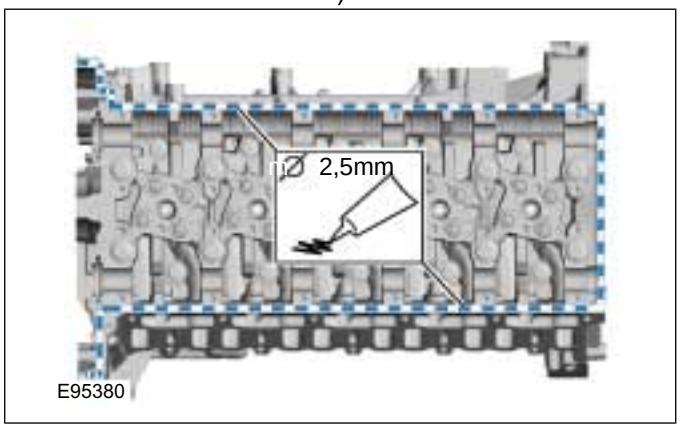
45. **CAUTION: Make sure that new cylinder head bolts are installed.**

    Torque:
    - Bolts 1 to 12: 10 Nm
    - Bolts 13 to 22: 5 Nm
    - Bolts 1 to 12: 20 Nm
    - Bolts 13 to 22: 10 Nm
    - Bolts 1 to 12: 180°
    - Bolts 1 to 12: 50 Nm
    - Bolts 13 to 22: 180°
    - Bolts 13 to 22: 25 Nm

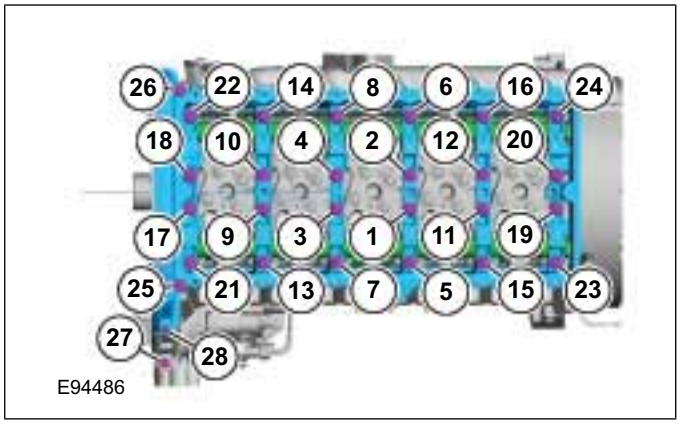


ASSEMBLY

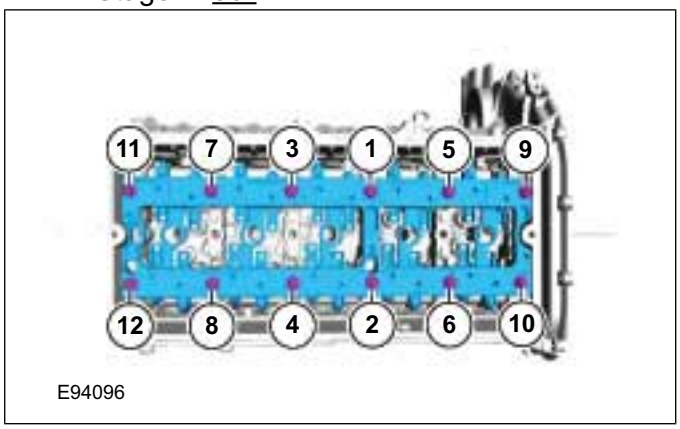
46. Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



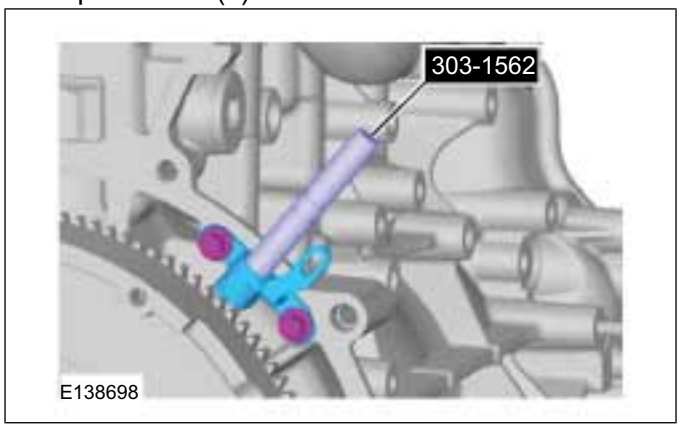
47. Torque:
- Bolts 1 to 26 23 Nm
- Bolts 27, 28 10 Nm



48. Torque:
- Stage 1: 10 Nm
- Stage 2: 30°

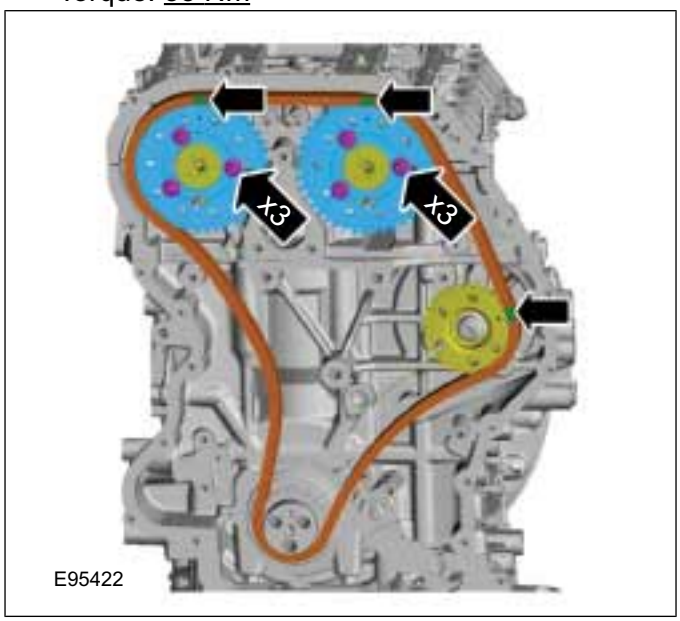


49. Special Tool(s): 303-1562



50. **NOTE:** Make sure that the installation marks are aligned.

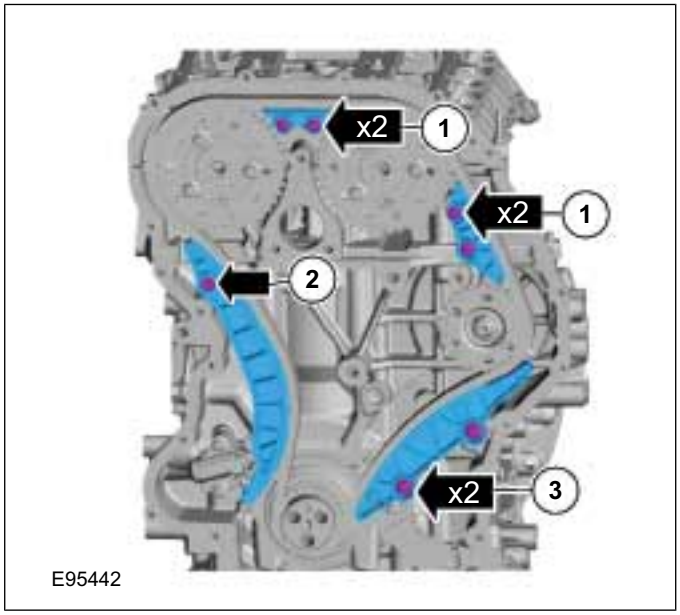
General Equipment: 6 mm Drill Bit
Torque: 33 Nm



51. Remove the 6 mm drill bits.

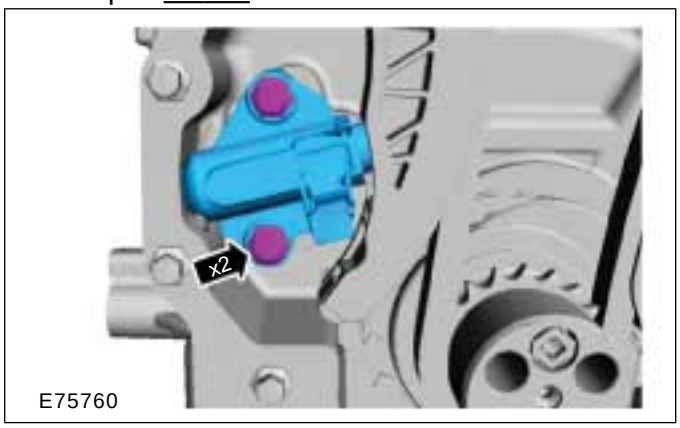
ASSEMBLY

52. 1. Torque: 15 Nm
    2. Torque: 40 Nm
    3. ⚠ **CAUTION: Make sure that new bolts are installed.**

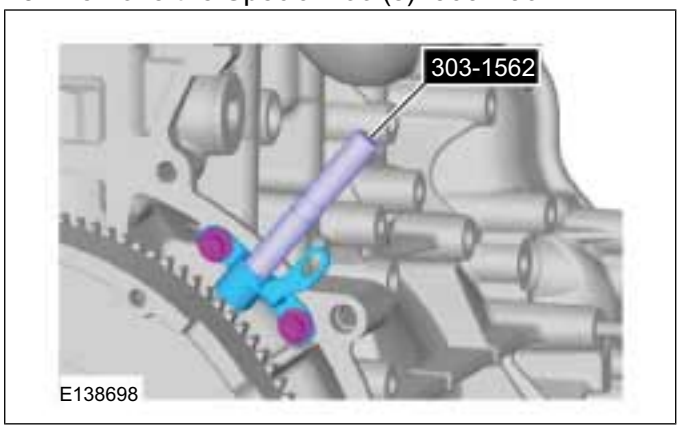


53. **NOTE:** Make sure that a new component is installed.

    Torque: 15 Nm

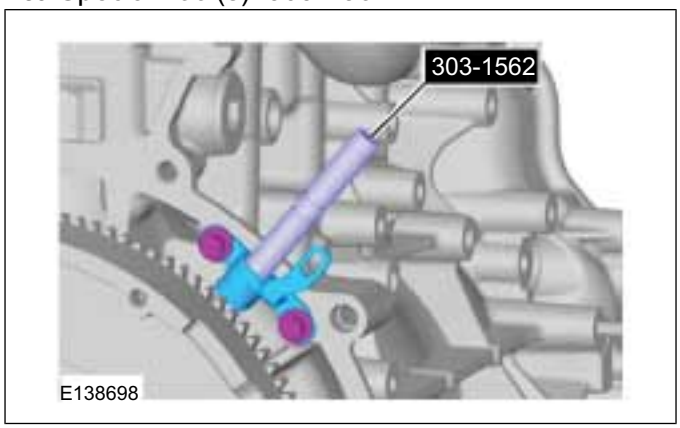


54. Remove the Special Tool(s): 303-1562



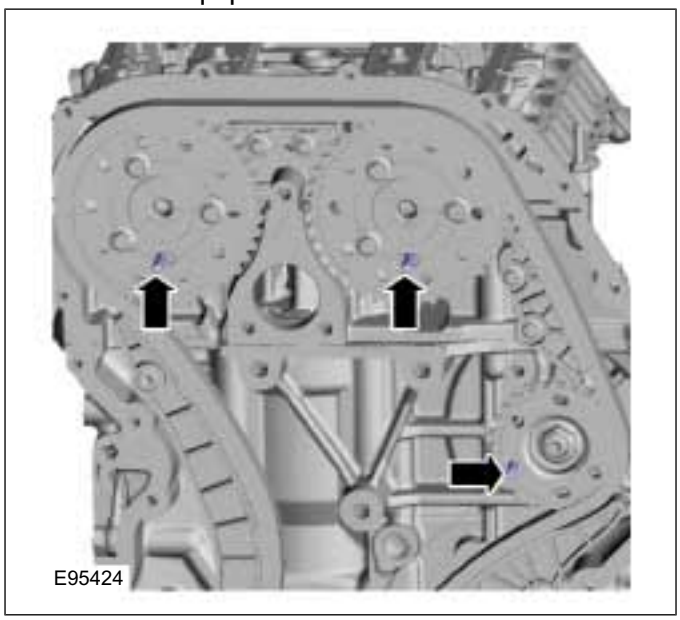
55. Rotate the engine two revolutions.

56. Special Tool(s): 303-1562



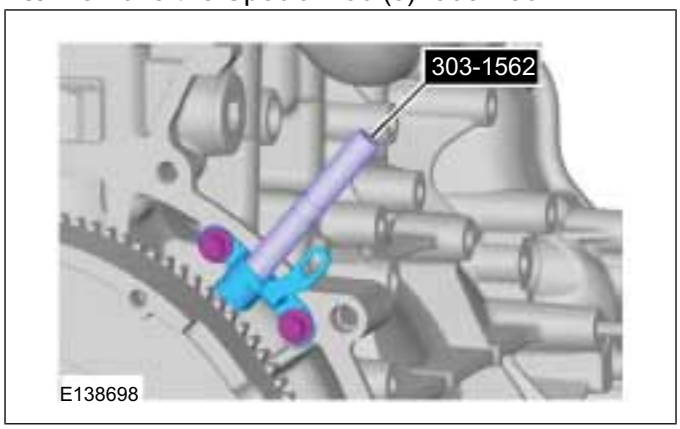
57. Check the position of the timing marks and correct if necessary.

    General Equipment: 6 mm Drill Bit



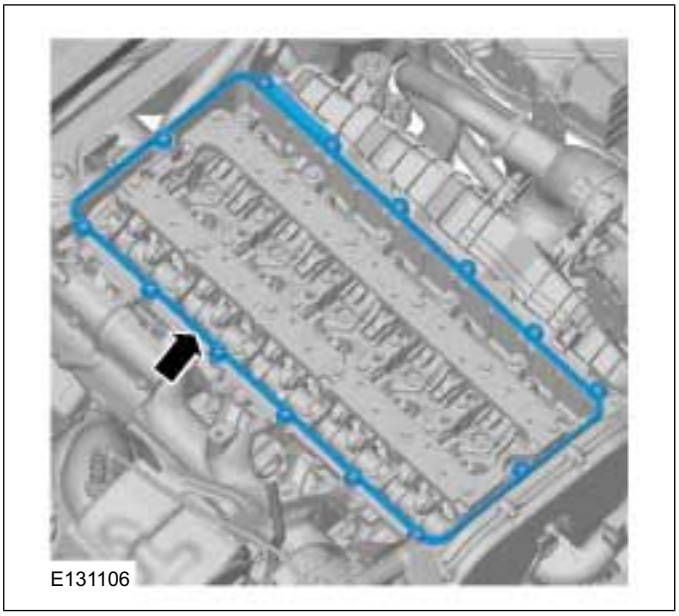
58. Remove the 6 mm drill bits.

59. Remove the Special Tool(s): 303-1562

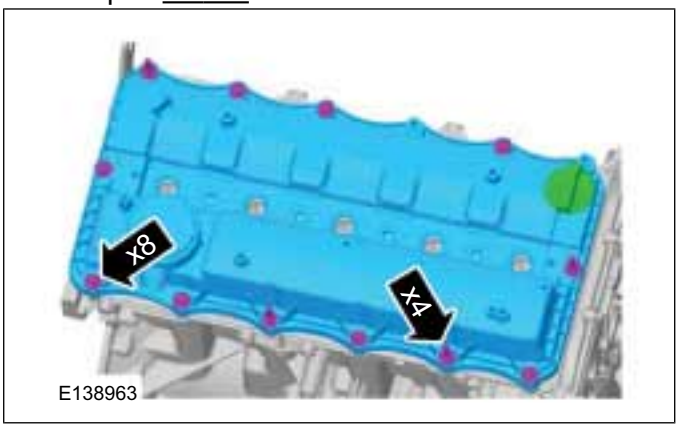


ASSEMBLY

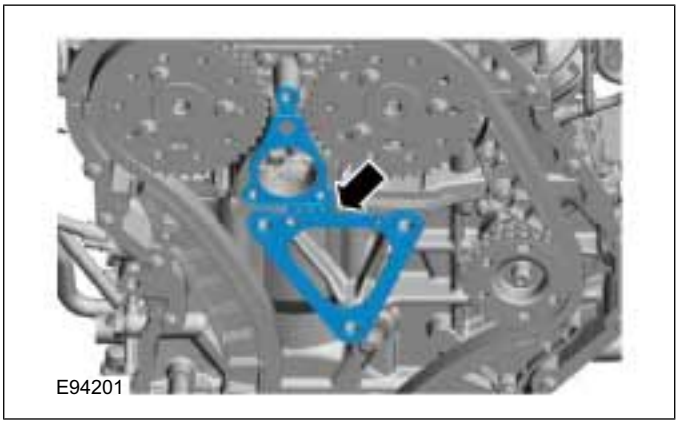
60.



61. Torque: 10 Nm



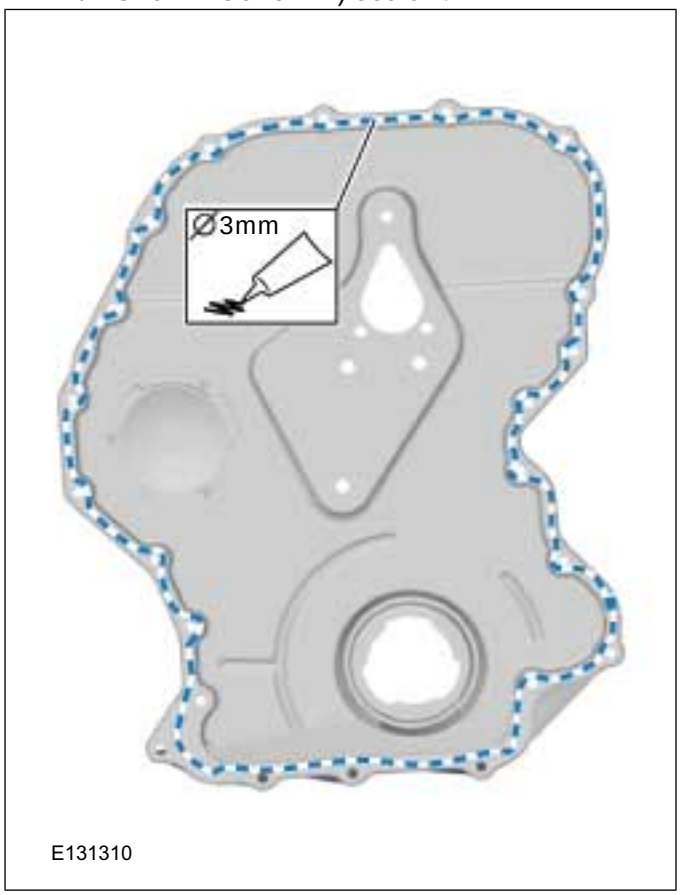
62. NOTE: Make sure that a new component is installed.



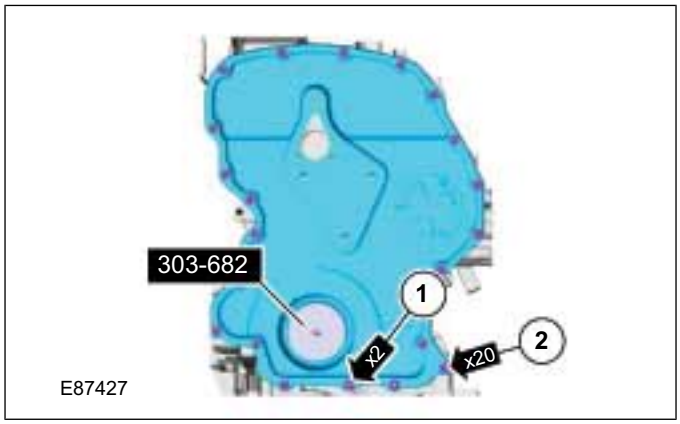
63. NOTE: The component must be installed within 5 minutes of applying the sealant.

NOTE: Make sure that a new component is installed.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



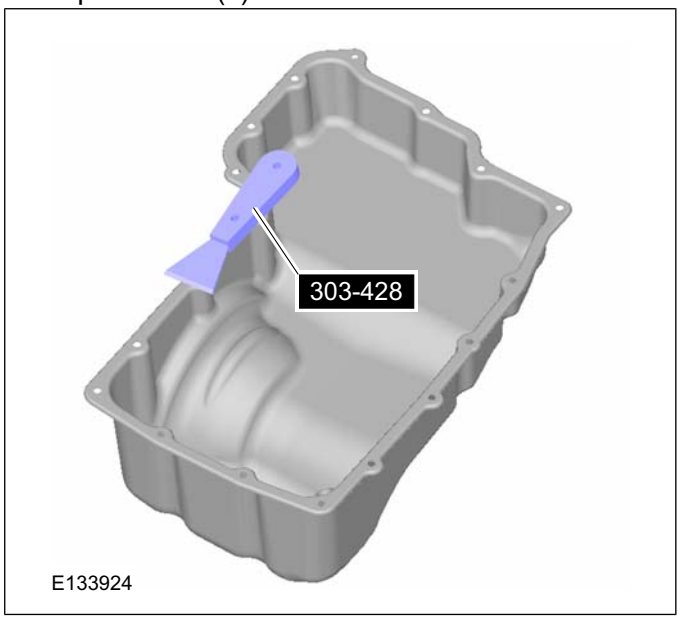
64. Special Tool(s): 303-682
Torque:
- 1 10 Nm
- 2 14 Nm



ASSEMBLY

65. **NOTE:** Do not damage the mating faces.

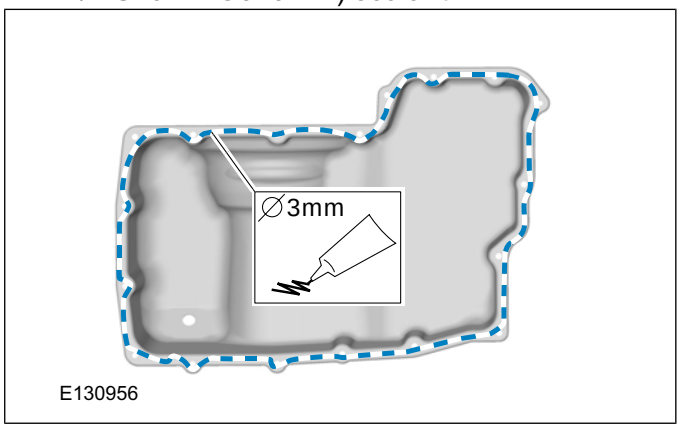
Special Tool(s): 303-428



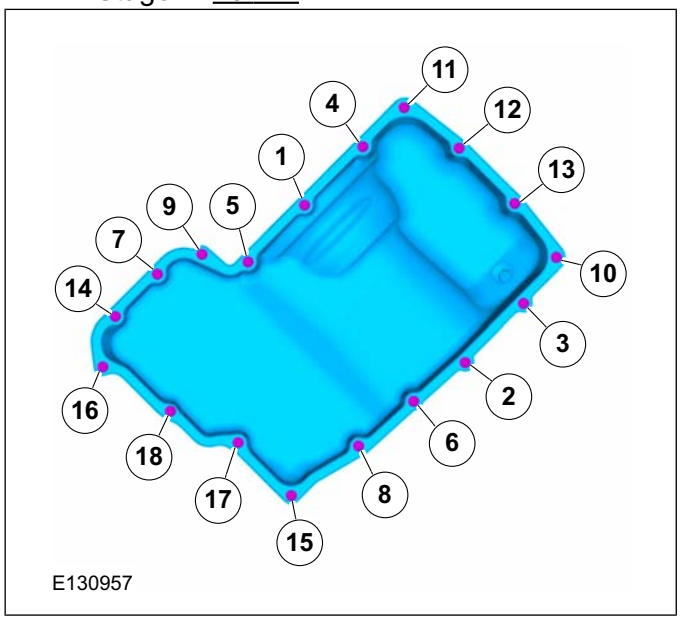
66. **CAUTION: Install the oil pan within five minutes of applying the sealer.**

NOTE: Do not damage the mating faces.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant

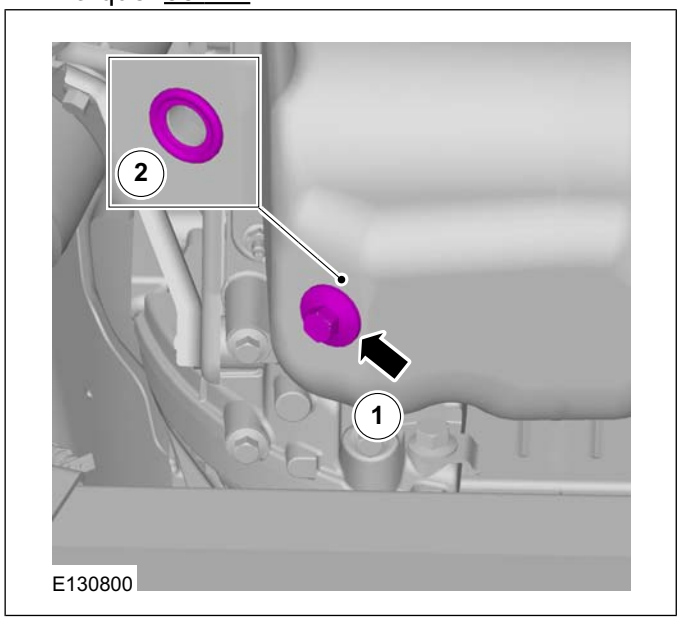


67. Torque:
- Stage 1: 12 Nm
- Stage 2: 15 Nm



68. **NOTE:** The seal is to be reused unless damaged.

Torque: 35 Nm



INSTALLATION

Engine — Vehicles With: 6-Speed Manual Transmission - MT82(21 132 0; 21 132 6; 21 132 7)

Installation

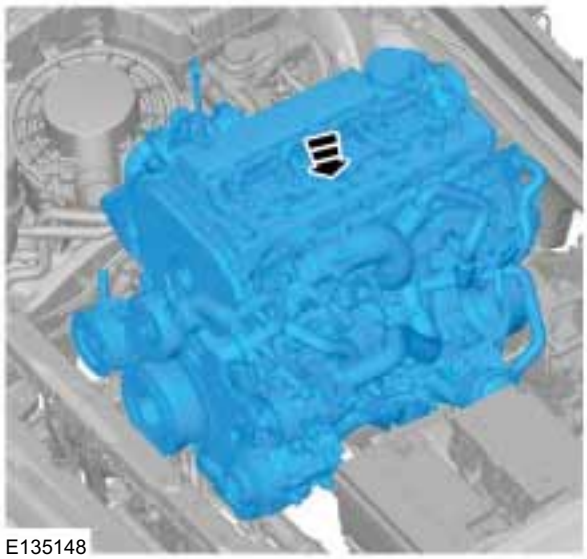
Special Tool(s)

 21068A	303-122 Lifting Bracket, Engine

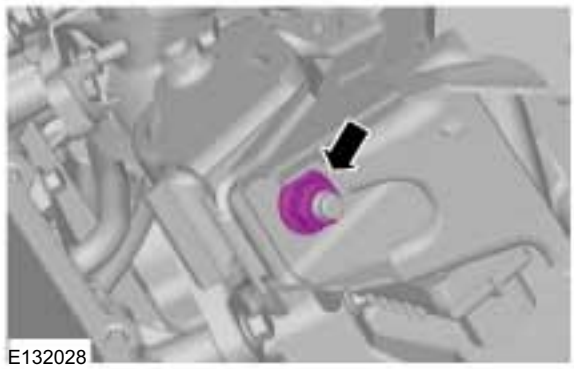
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Special Tool(s): 303-122

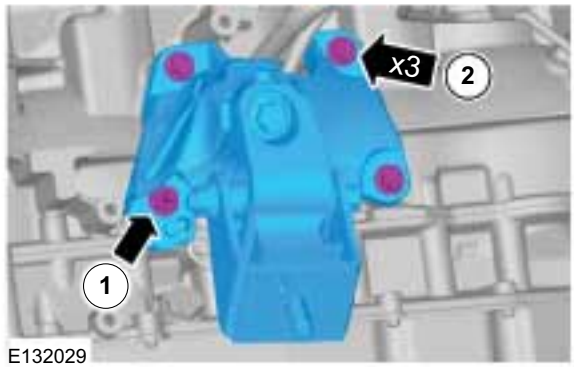
3.



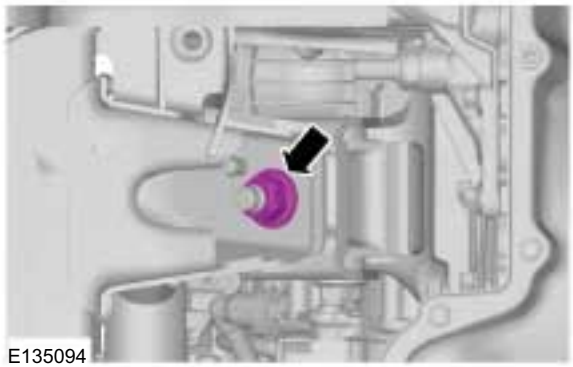
4. **NOTE:** Hand tighten the nut at this stage.



5. **NOTE:** Hand tighten the nuts at this stage.

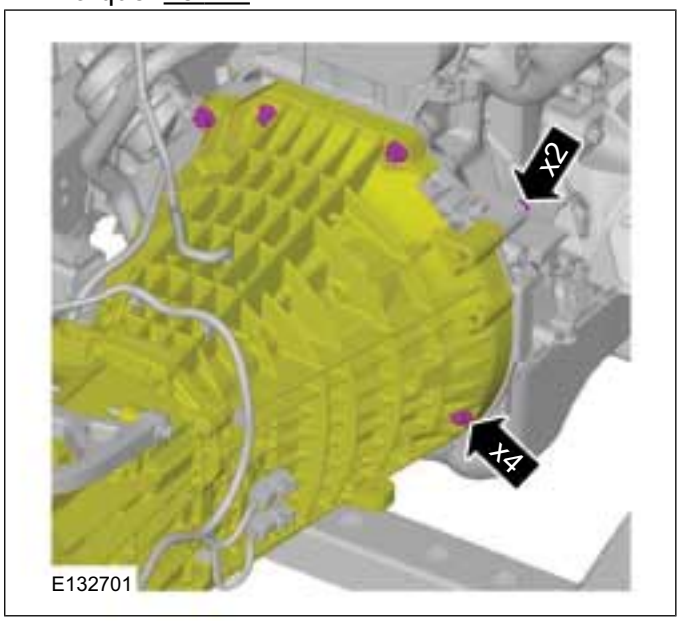


6. **NOTE:** Hand tighten the nut at this stage.

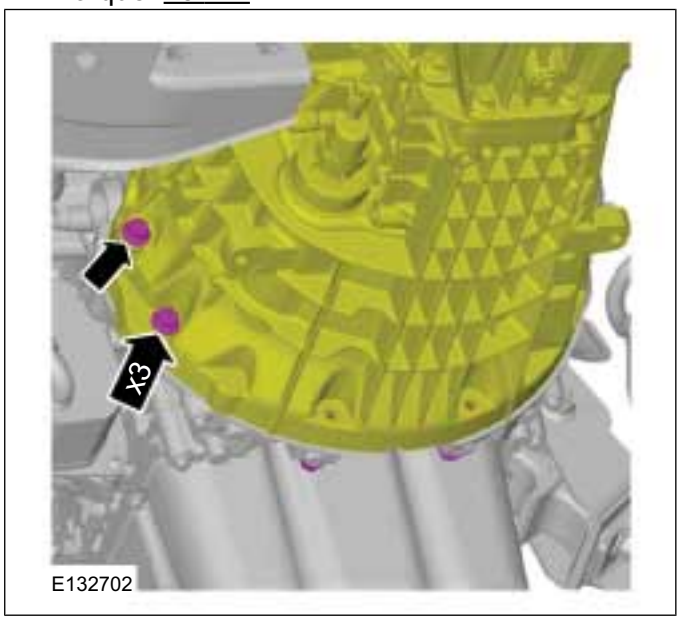


INSTALLATION

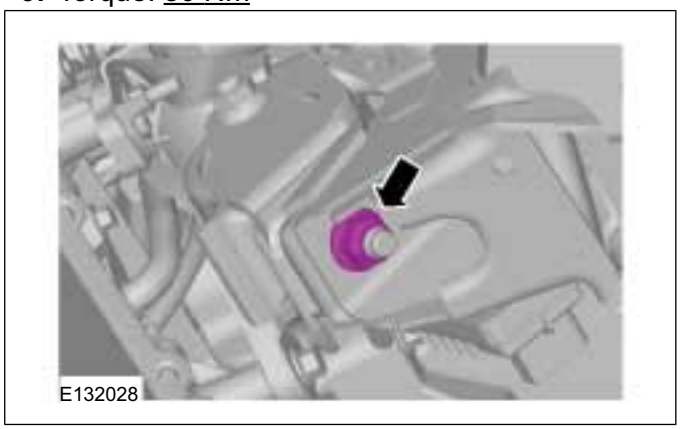
7. Initially hand tighten the fasteners.
Torque: 48 Nm



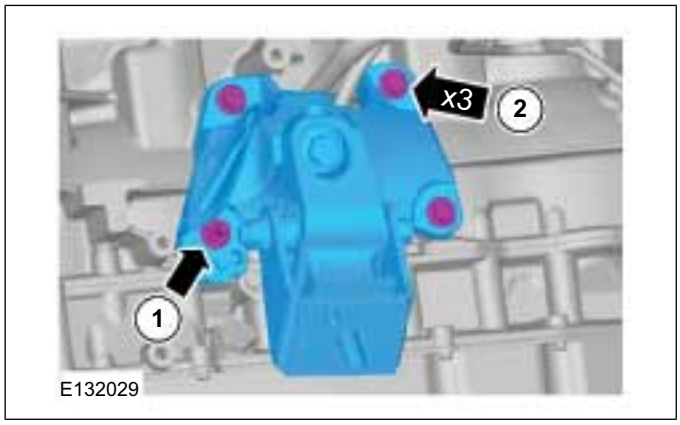
8. Initially hand tighten the fasteners.
Torque: 48 Nm



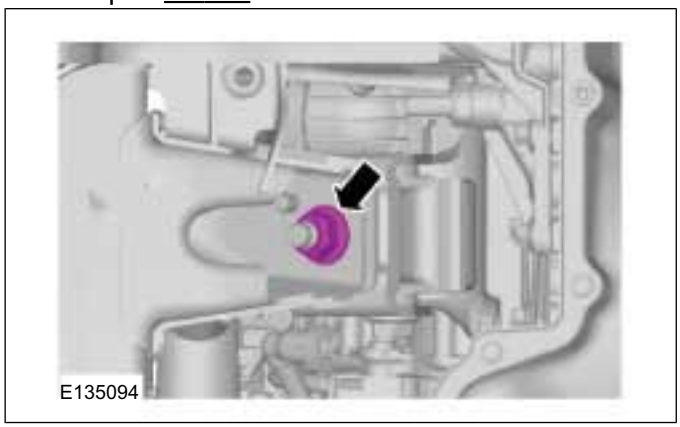
9. Torque: 80 Nm



10. 1. Torque: 48 Nm
2. Torque: 25 Nm



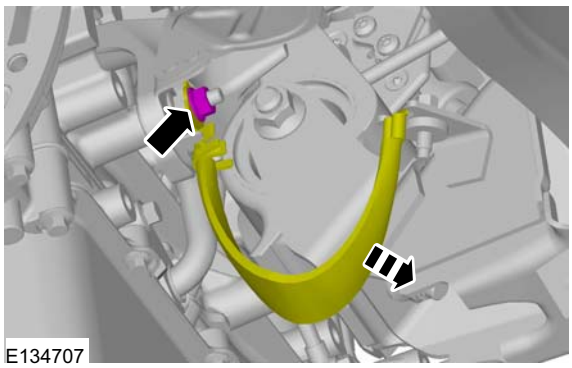
11. Torque: 80 Nm



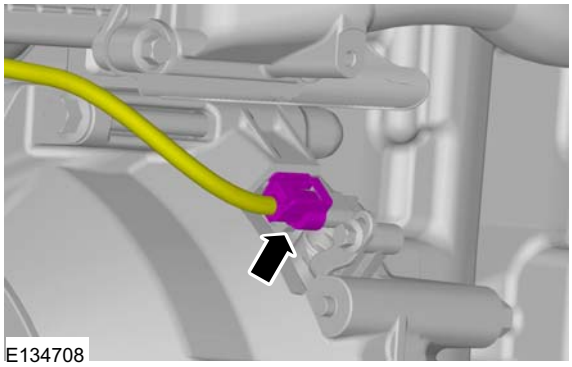
12. 1. Remove the Special Tool(s): 303-122

INSTALLATION

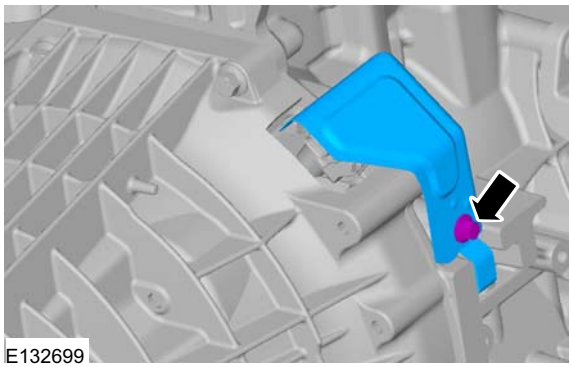
13. Torque: 13 Nm


E134707

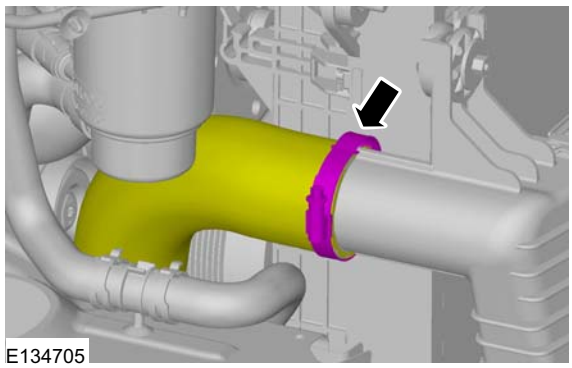
14.


E134708

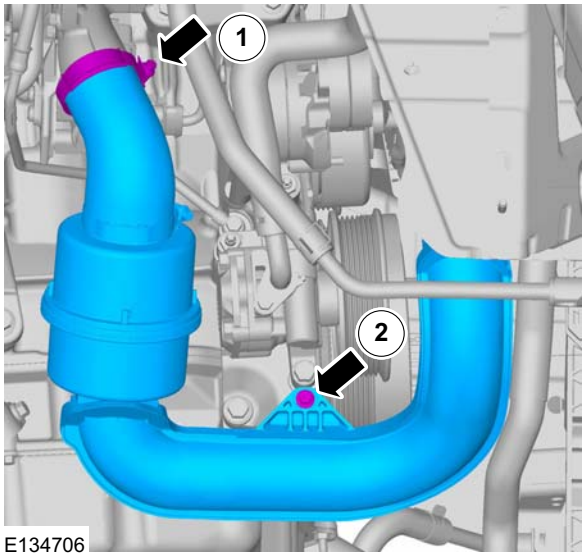
15. Torque: 12 Nm


E132699

16.


E134705

17. Torque: 10 Nm

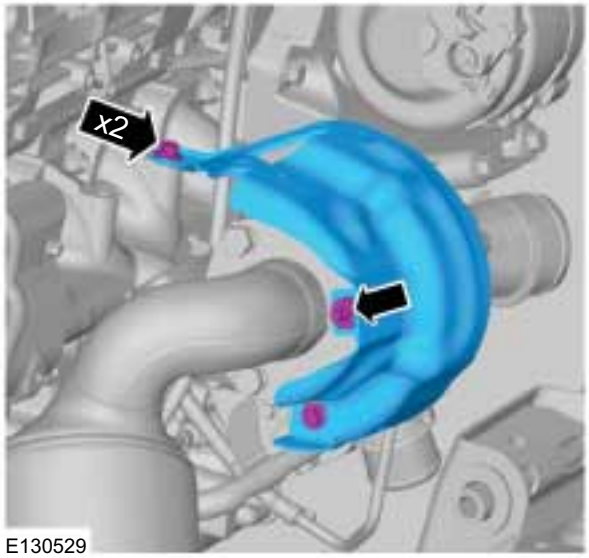


E134706

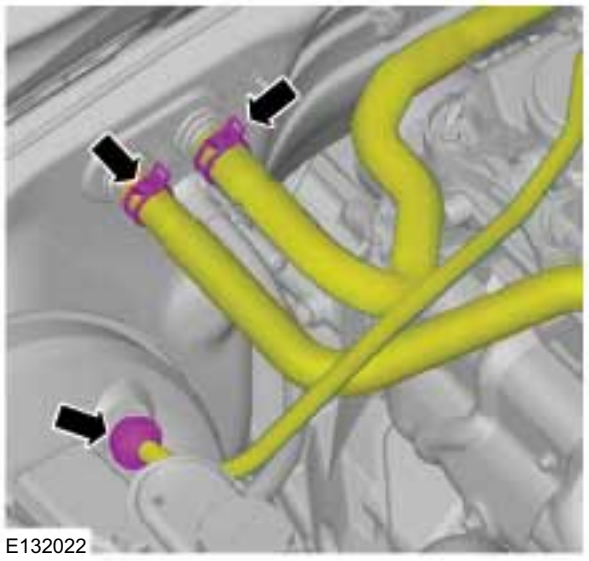
INSTALLATION

18. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

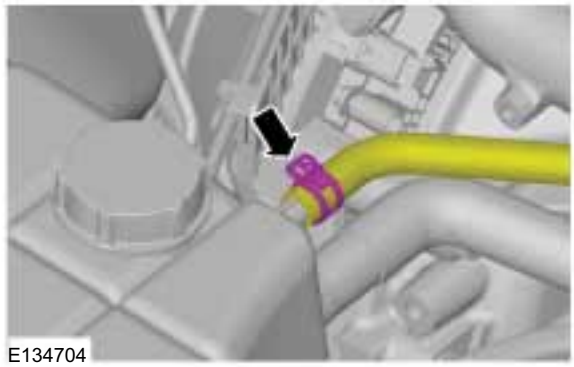
19. Torque: 22 Nm



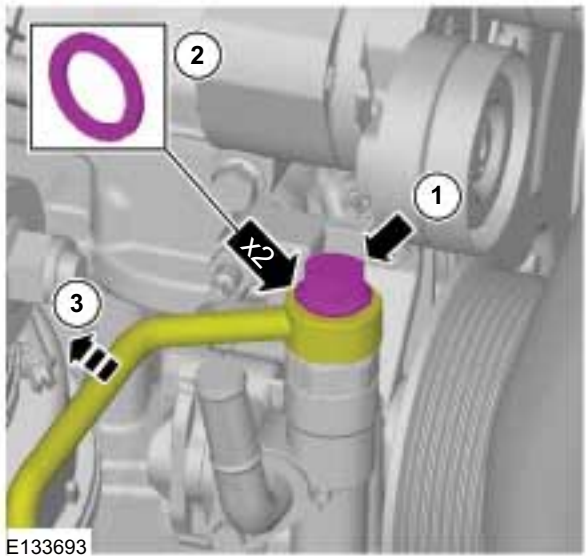
20.



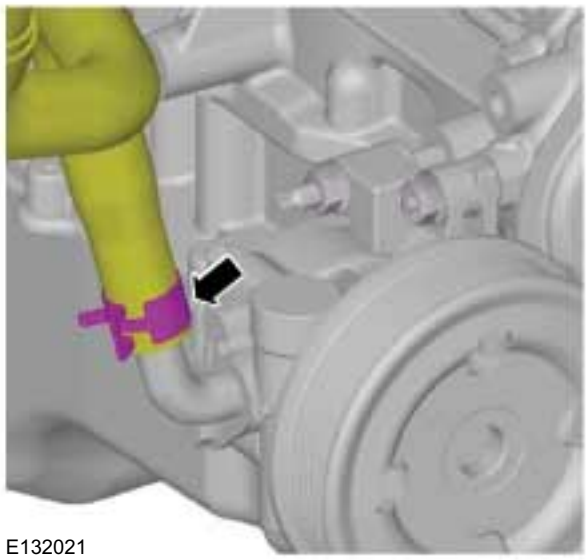
21.



22. Torque: 35 Nm

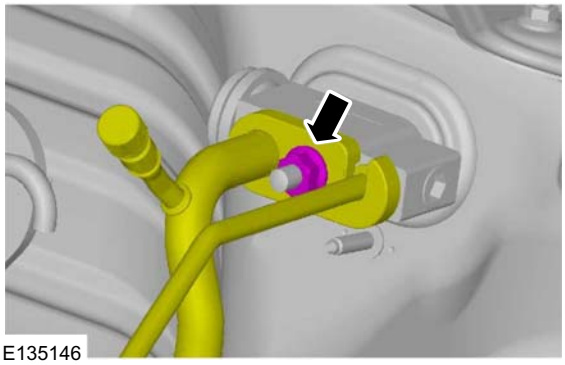


23.



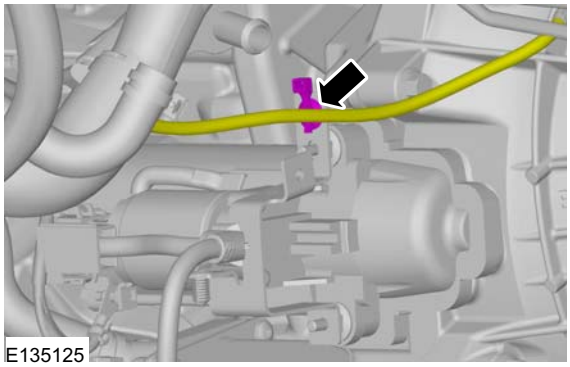
INSTALLATION

24. Torque: 22 Nm


E135146

25. Refer to: Starter Motor - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-06 Starting System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

26.


E135125

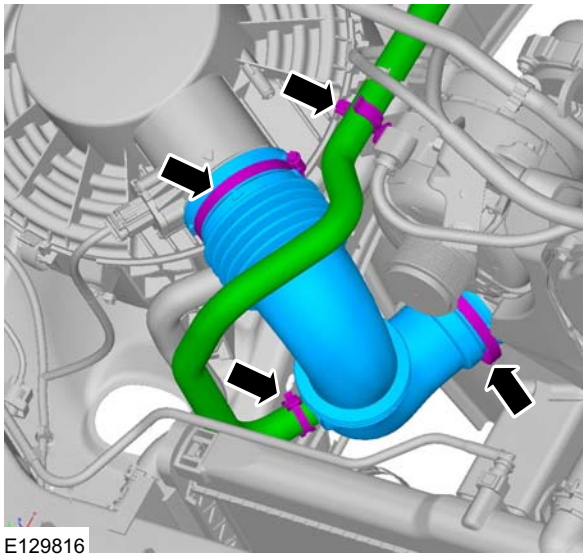
27. Refer to: Condenser - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (412-01 Climate Control, Removal and Installation).

28. Refer to: Radiator (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

29. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

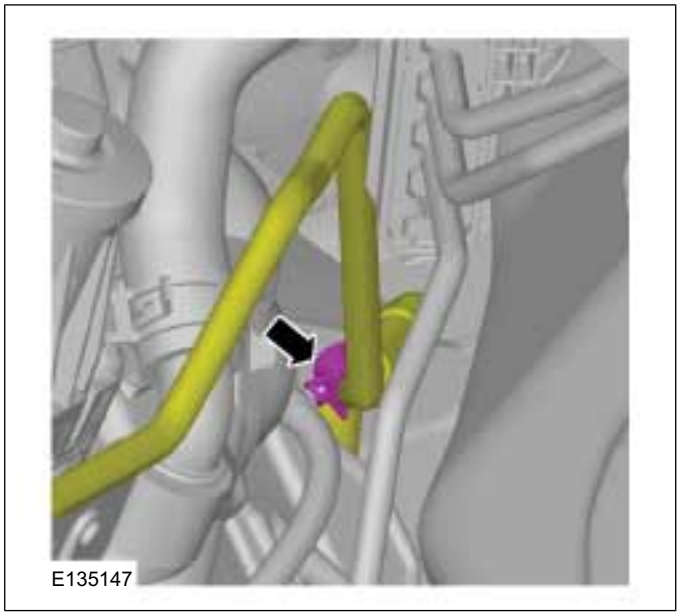
30. Refer to: Air Cleaner - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

31.

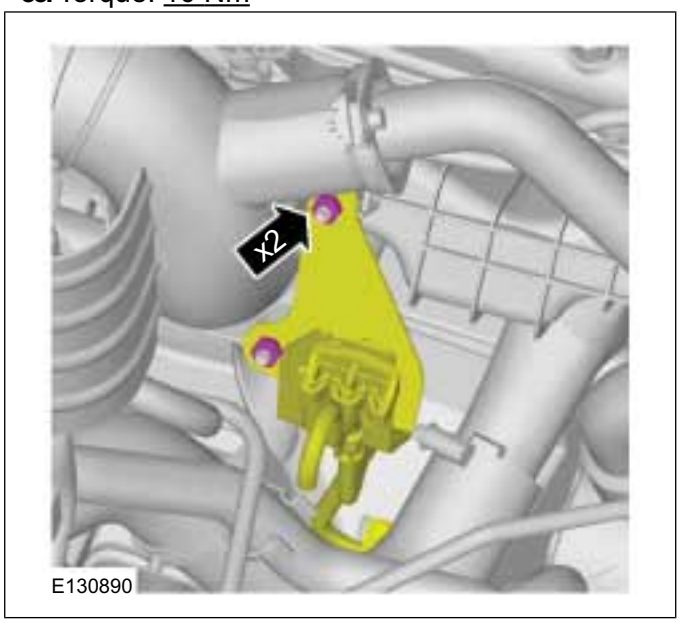

E129816

INSTALLATION

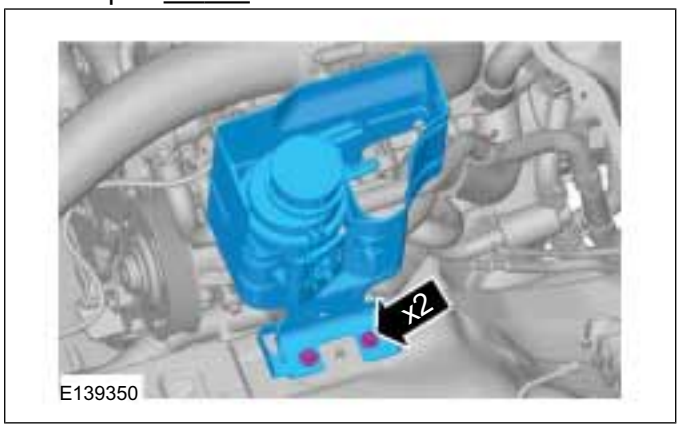
32.



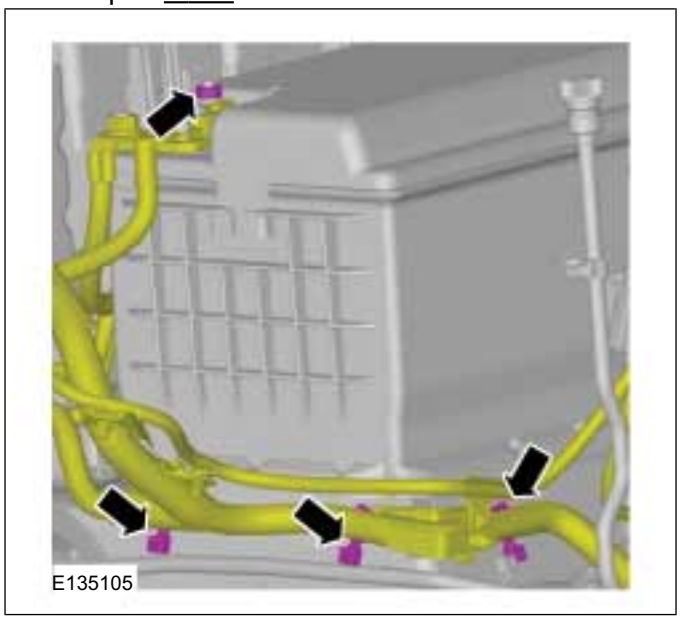
33. Torque: 10 Nm



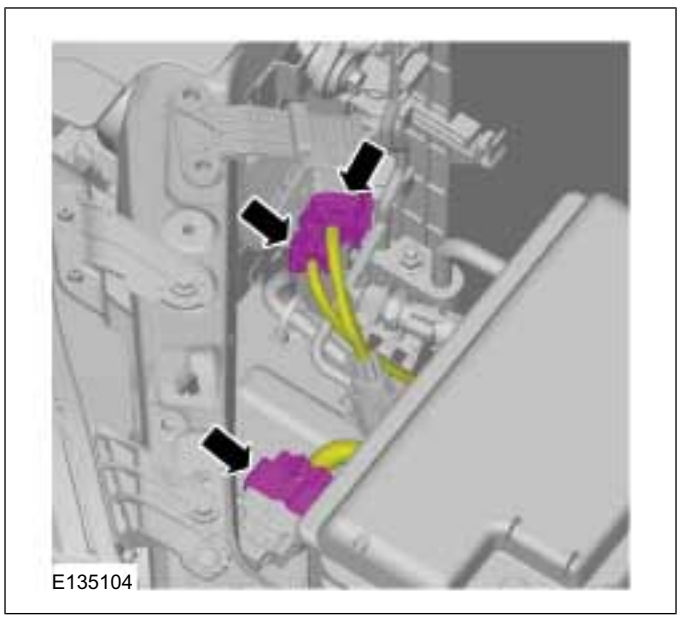
34. Torque: 18 Nm



35. Torque: 5 Nm

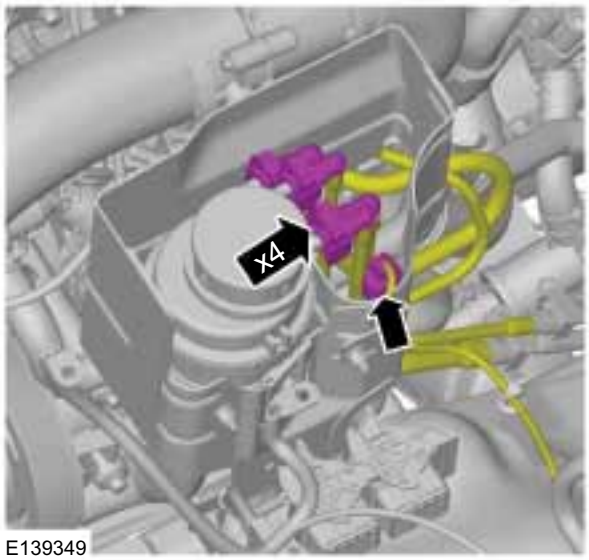


36.



INSTALLATION

37.



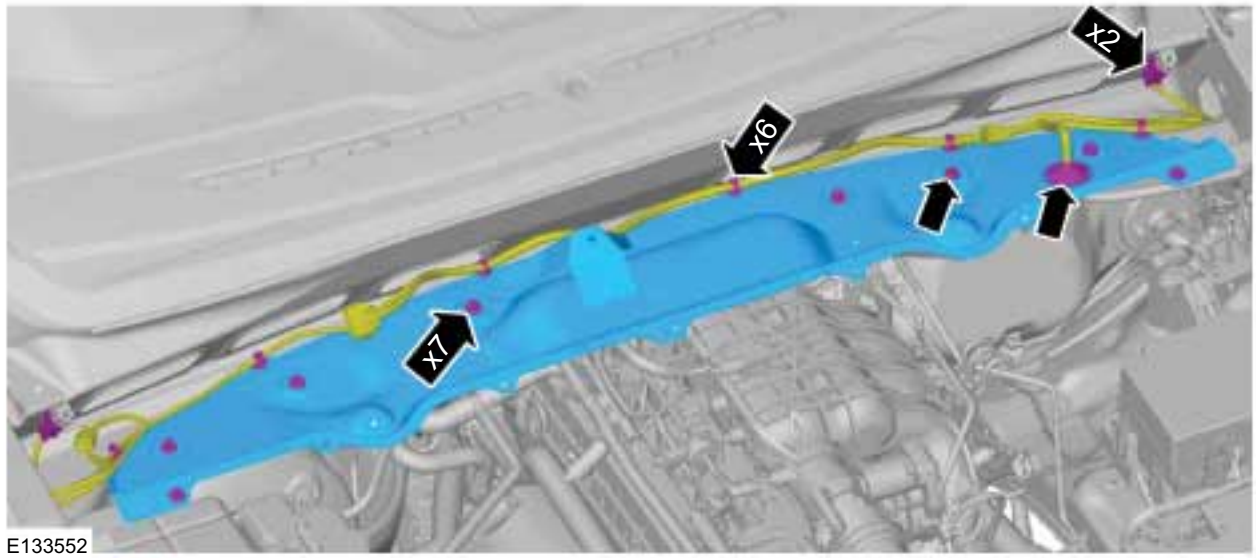
E139349

38. Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

39. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

40. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

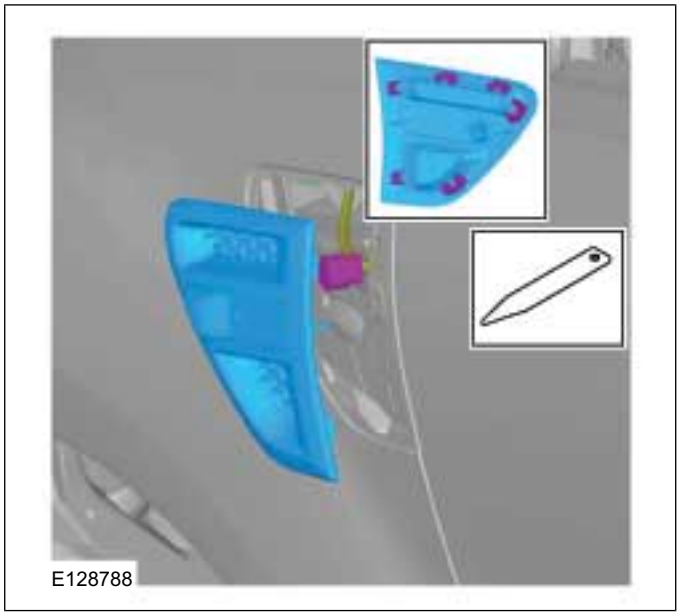
41. Torque: 10 Nm



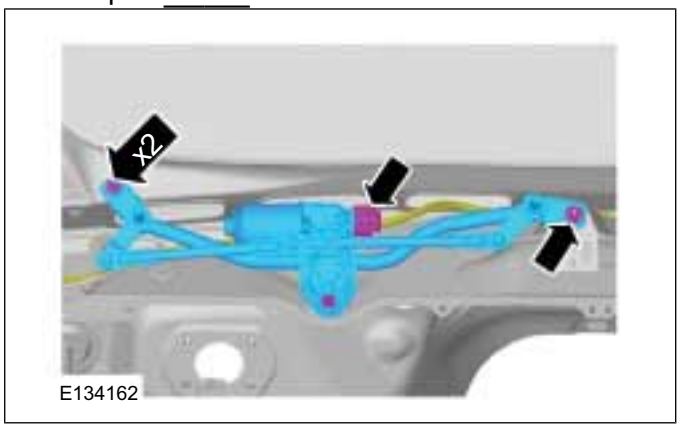
E133552

INSTALLATION

42. On both sides.

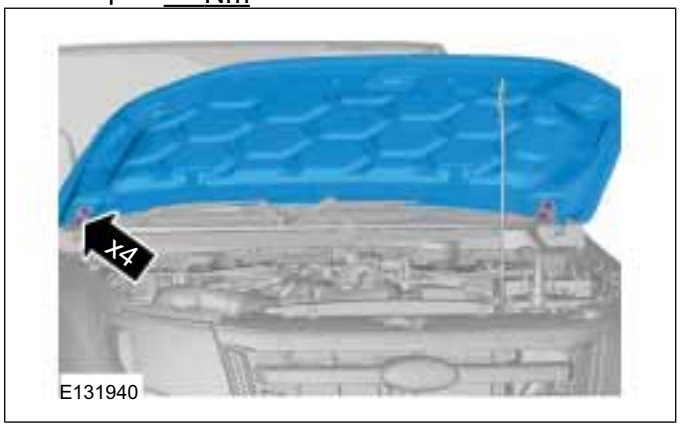


43. Torque: 10 Nm

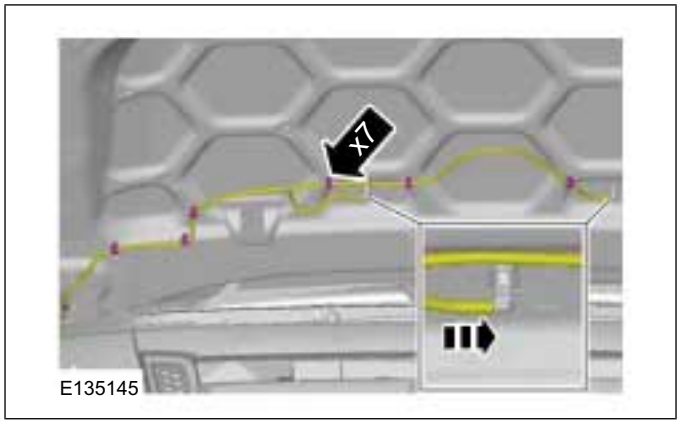


44. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

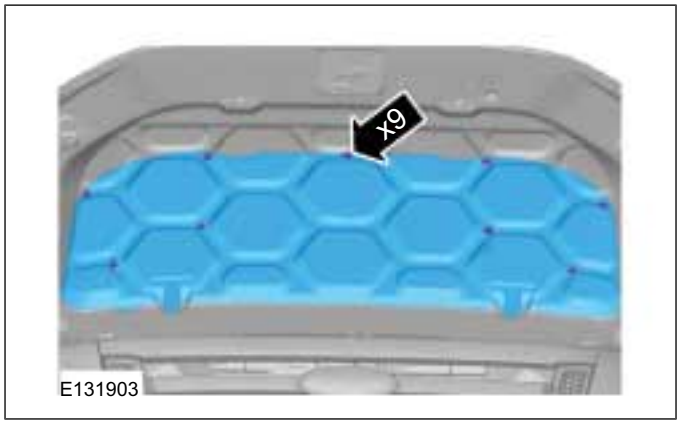
45. Torque: 25 Nm



46.

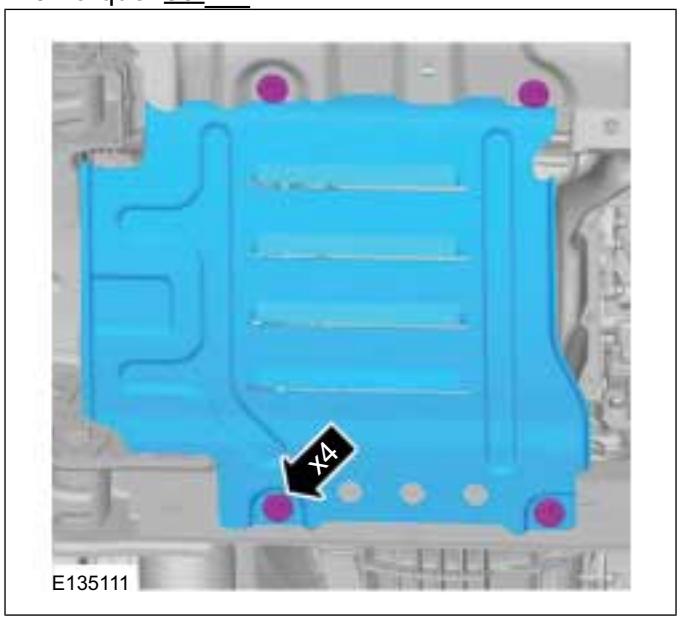


47.



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

49. Torque: 30 Nm



INSTALLATION

50. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

51. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

52. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

INSTALLATION

Engine — Vehicles With: 6-Speed Automatic Transaxle - 6R80(21 132 0; 21 132 6; 21 132 7)

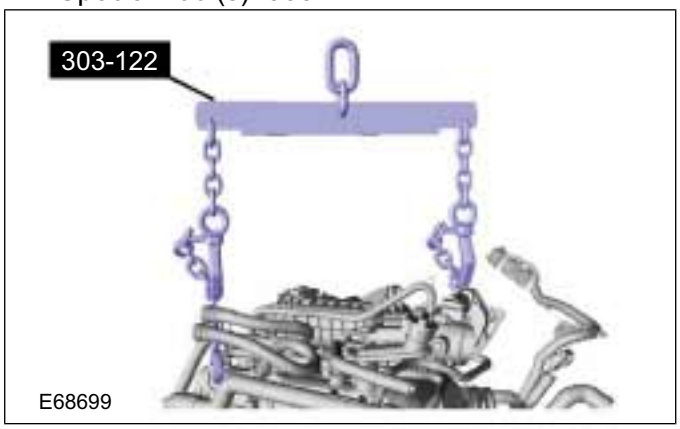
Installation

Special Tool(s)

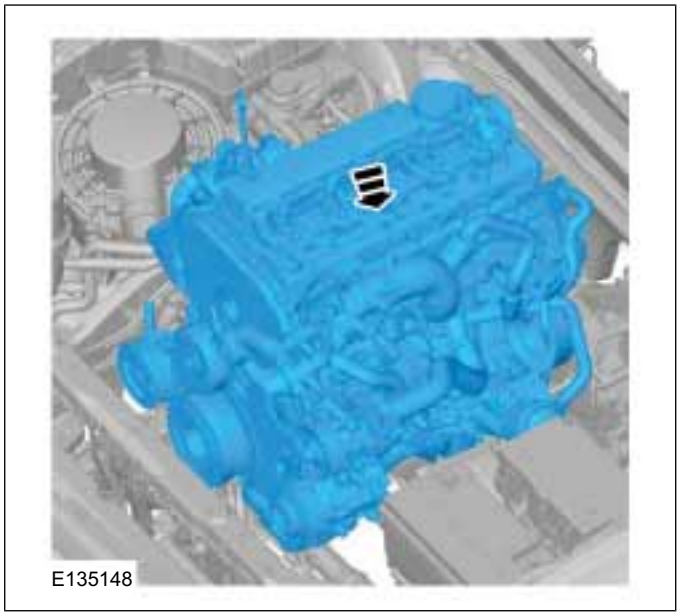
 21068A	303-122 Lifting Bracket, Engine

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

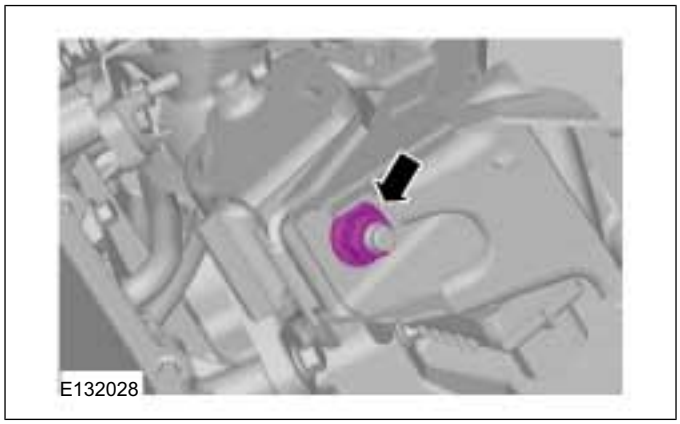
2. Special Tool(s): 303-122



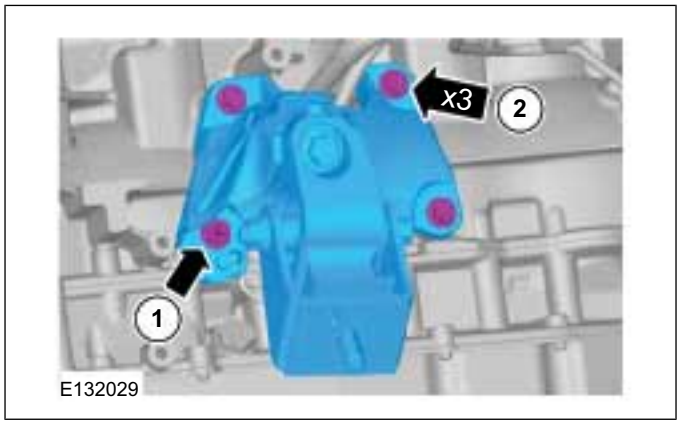
3.



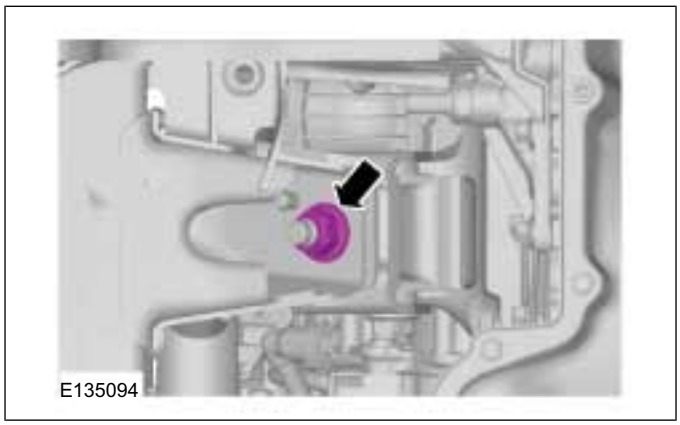
4. **NOTE:** Hand tighten the nut at this stage.



5. **NOTE:** Hand tighten the nuts at this stage.

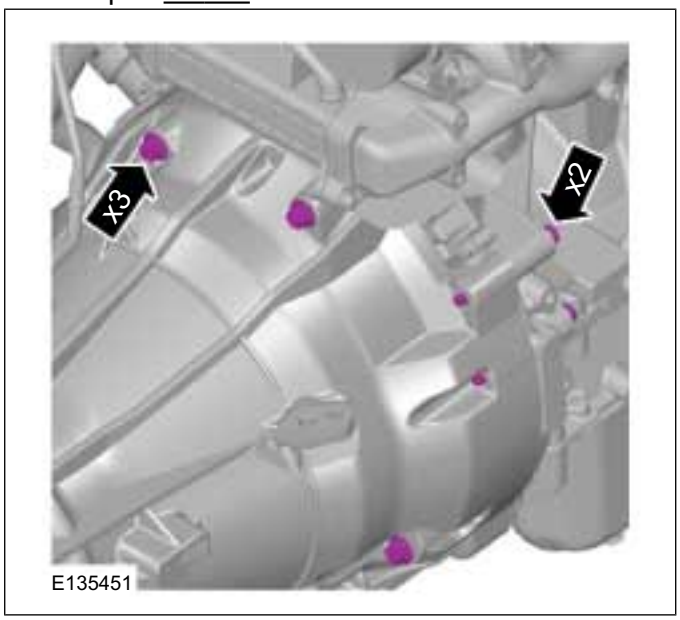


6. **NOTE:** Hand tighten the nut at this stage.

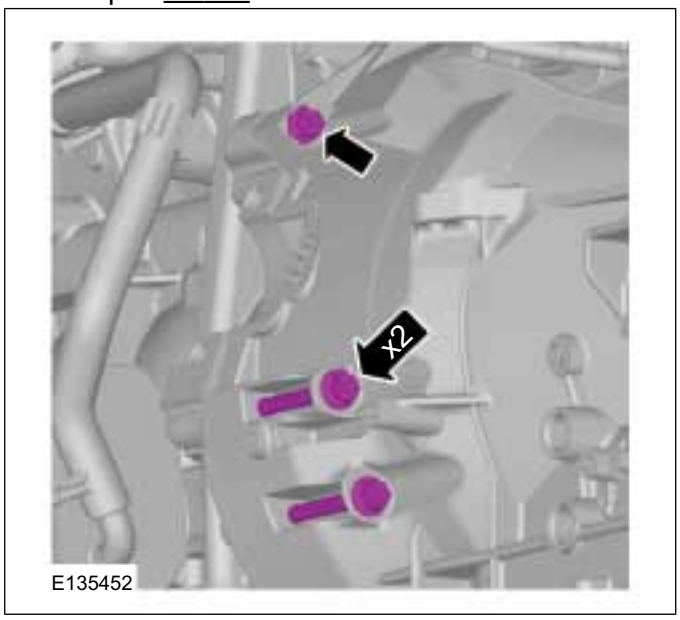


INSTALLATION

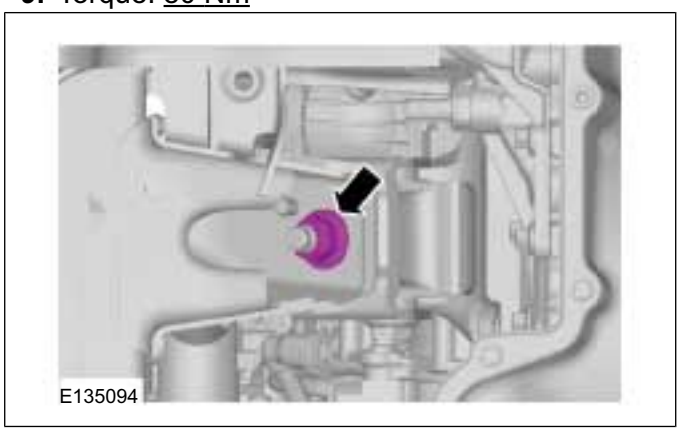
7. Initially hand tighten the fasteners.
Torque: 48 Nm



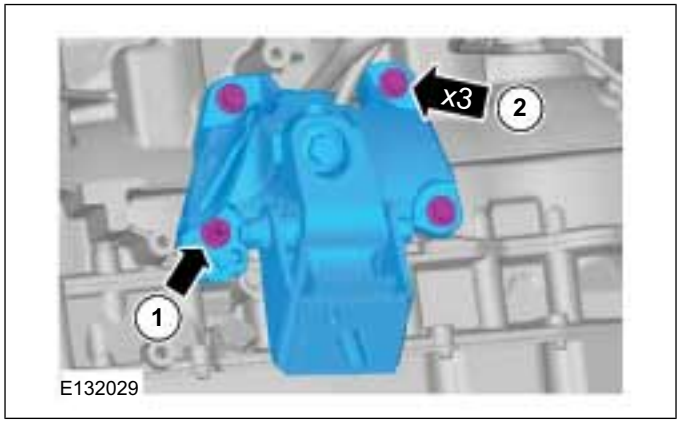
8. Initially hand tighten the fasteners.
Torque: 48 Nm



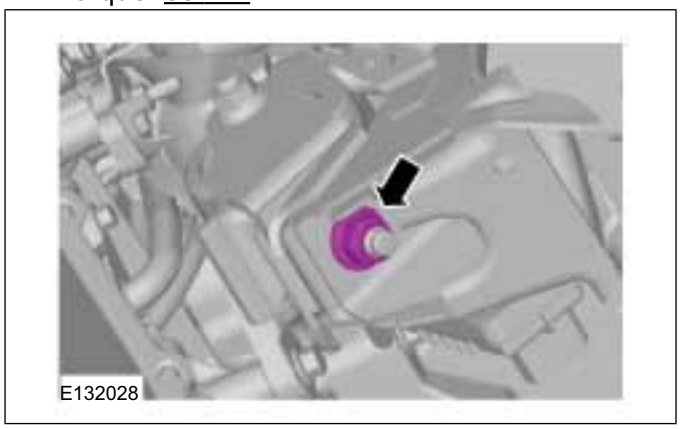
9. Torque: 80 Nm



10. 1. Torque: 48 Nm
2. Torque: 48 Nm



11. Torque: 80 Nm

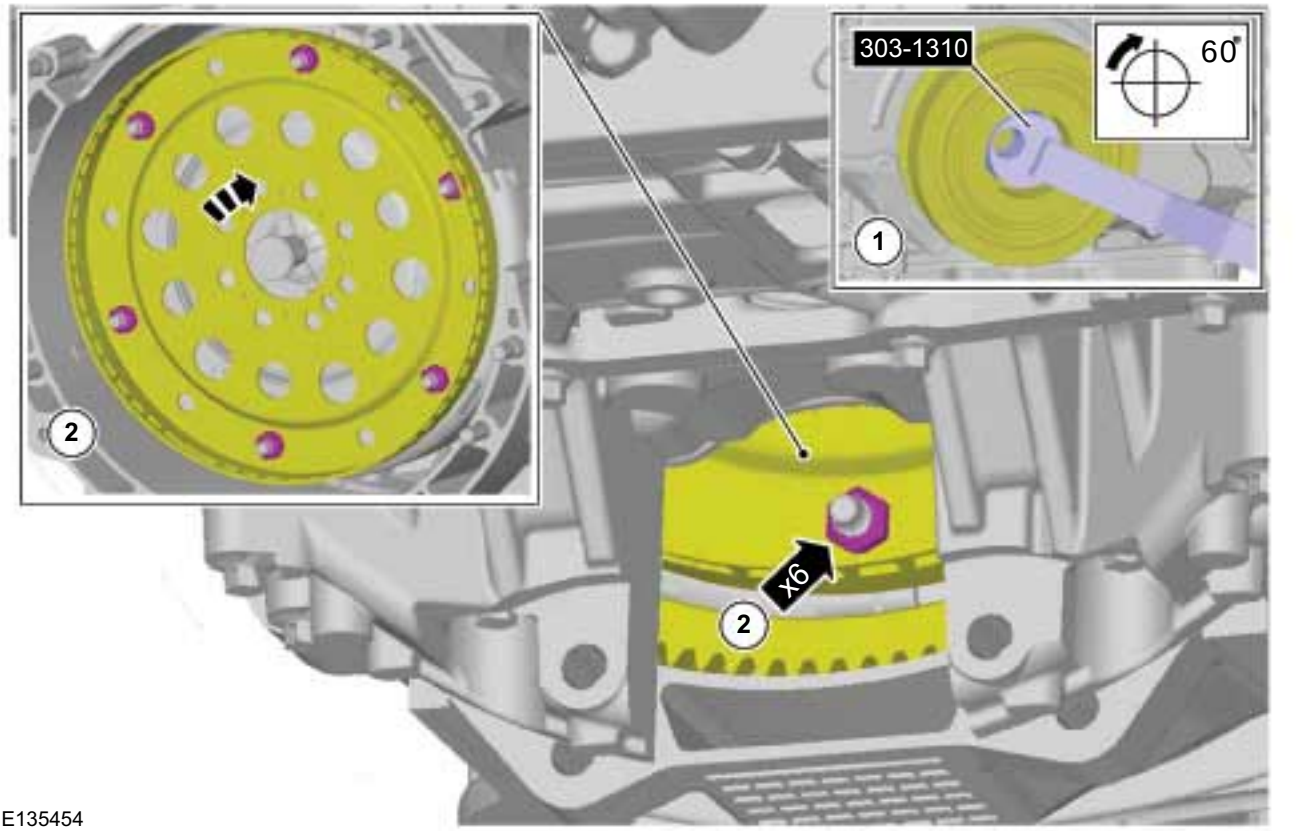


12. 1. Remove the Special Tool(s): 303-122

INSTALLATION

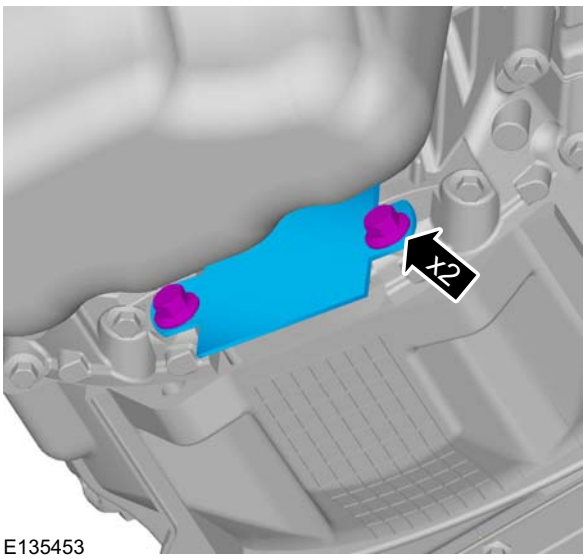
13. Torque: 13 Nm

14. Torque: 40 Nm

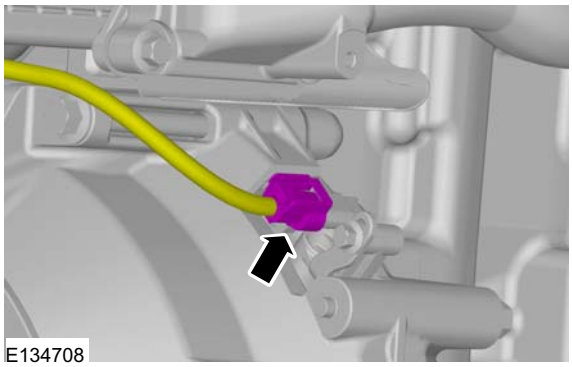


INSTALLATION

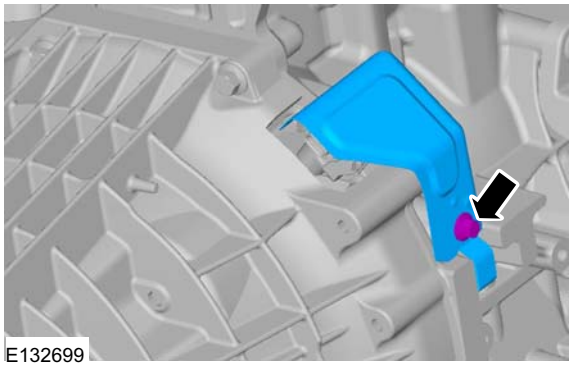
15. Torque: 22 Nm



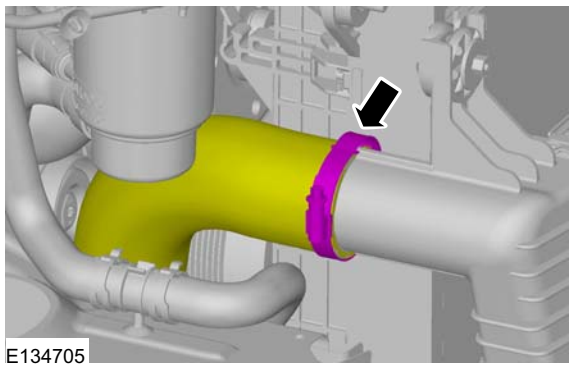
16.



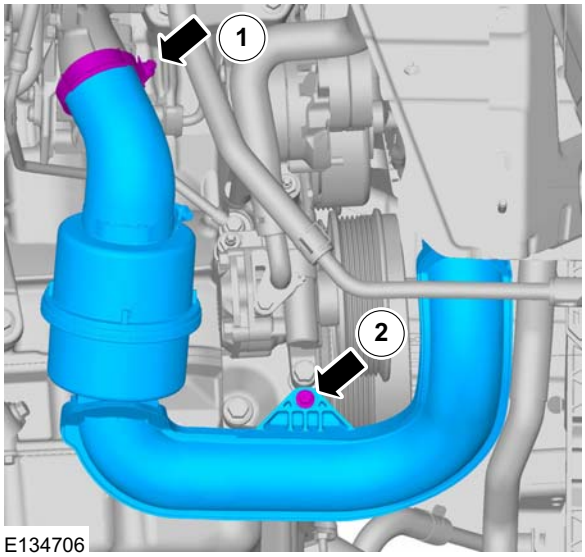
17. Torque: 12 Nm



18.



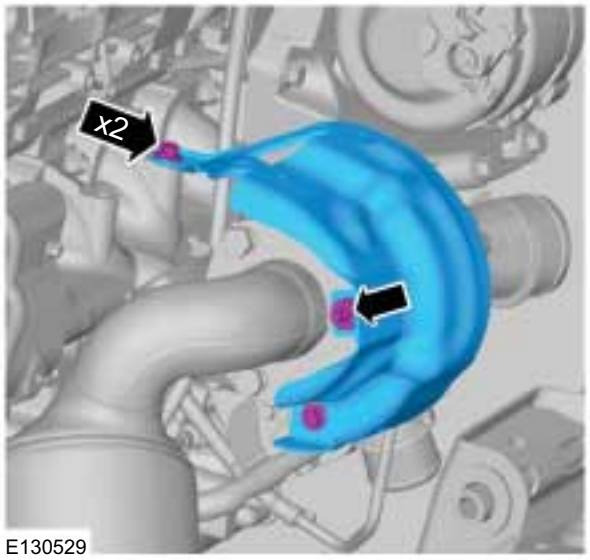
19. Torque: 10 Nm



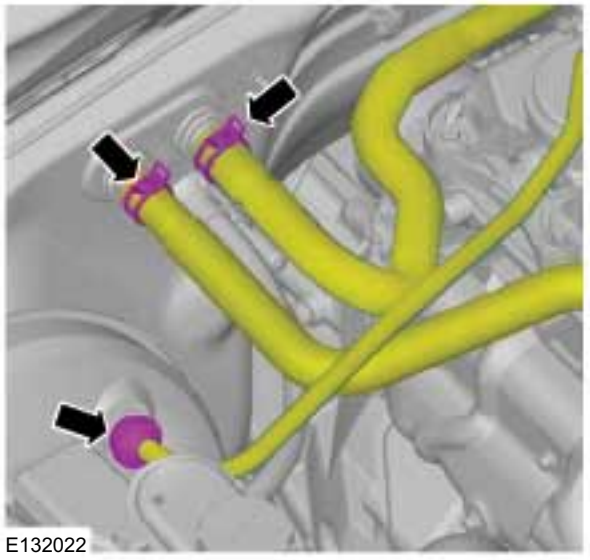
INSTALLATION

20. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

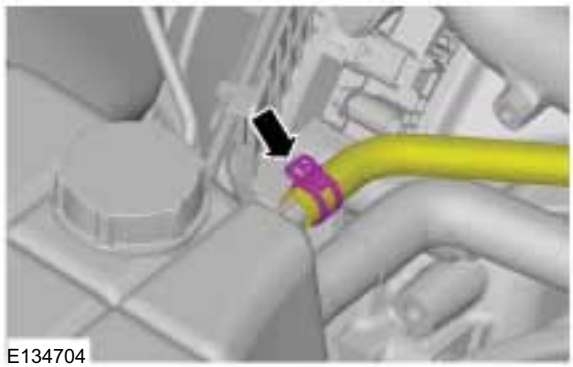
21. Torque: 22 Nm



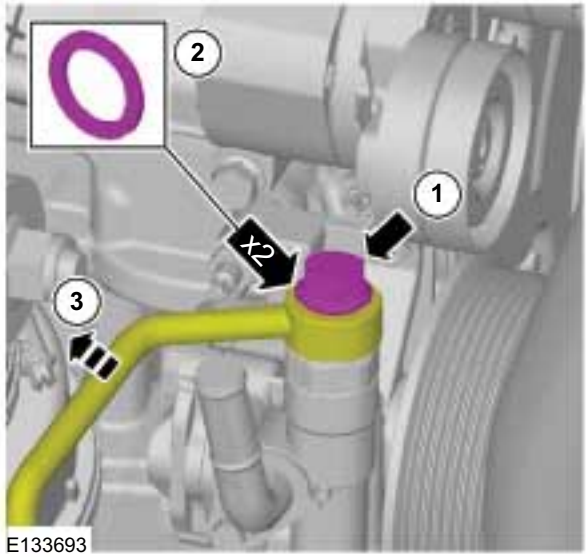
22.



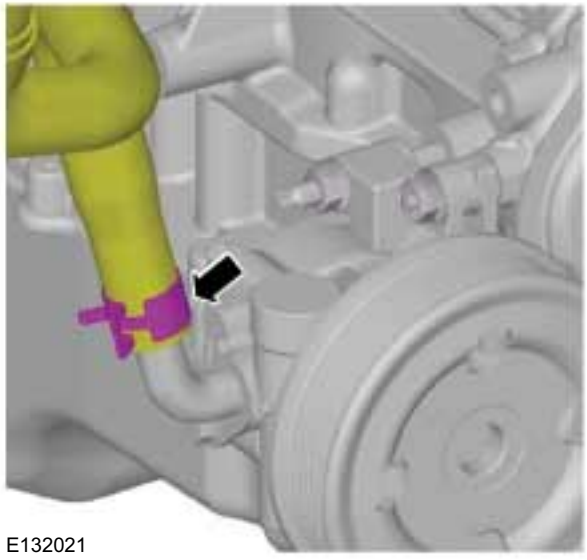
23.



24. Torque: 35 Nm

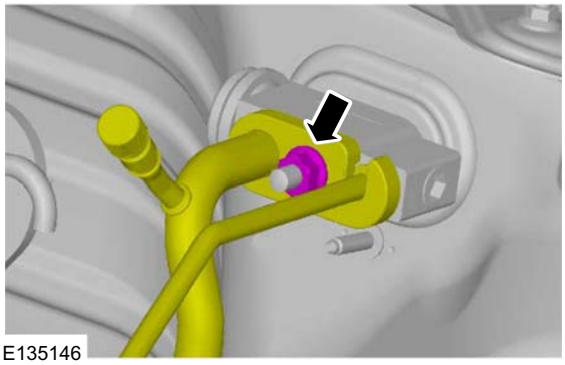


25.



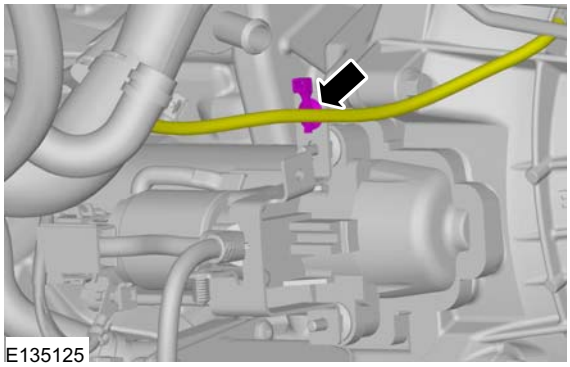
INSTALLATION

26. Torque: 22 Nm


E135146

27. Refer to: Starter Motor - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-06 Starting System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

28.


E135125

29. Refer to: Transmission Fluid Cooler (307-02 Transmission/Transaxle Cooling, Removal and Installation).

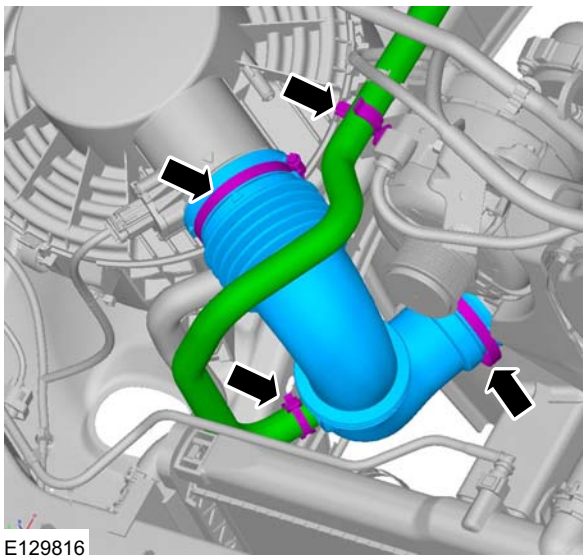
30. Refer to: Condenser - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (412-01 Climate Control, Removal and Installation).

31. Refer to: Radiator (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

32. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

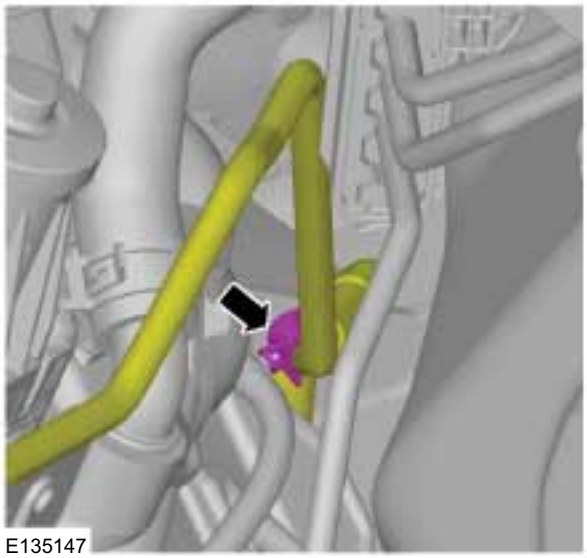
33. Refer to: Air Cleaner - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

34.

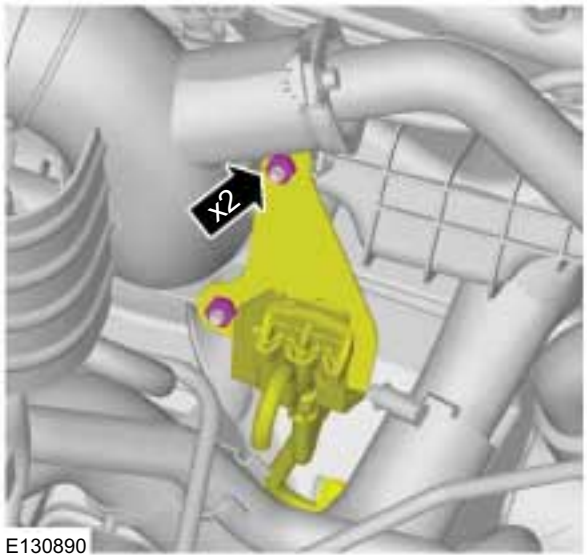

E129816

INSTALLATION

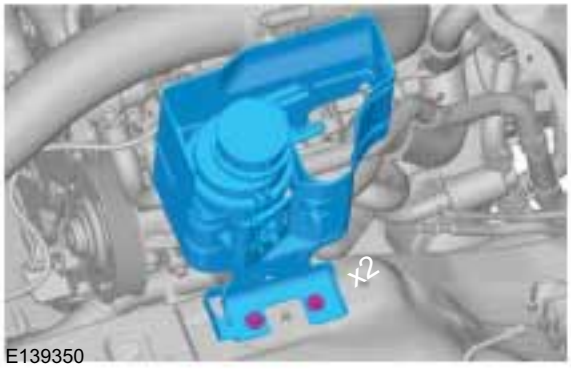
35.



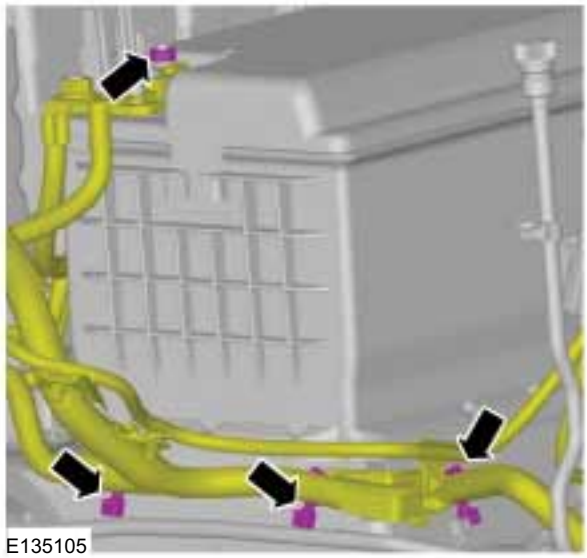
36. Torque: 10 Nm



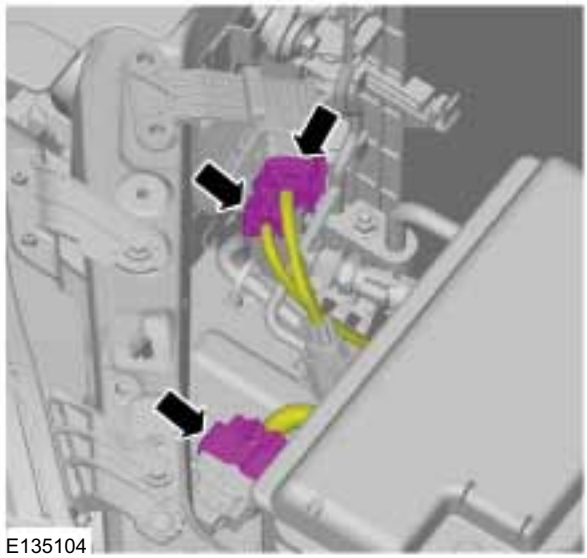
37. Torque: 18 Nm



38. Torque: 5 Nm

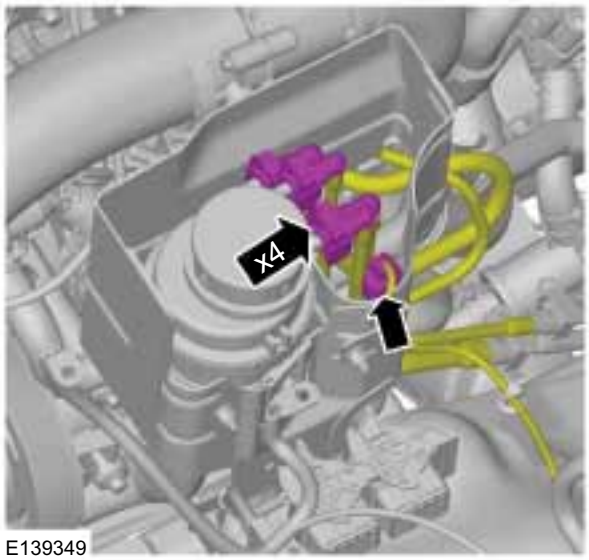


39.



INSTALLATION

40.



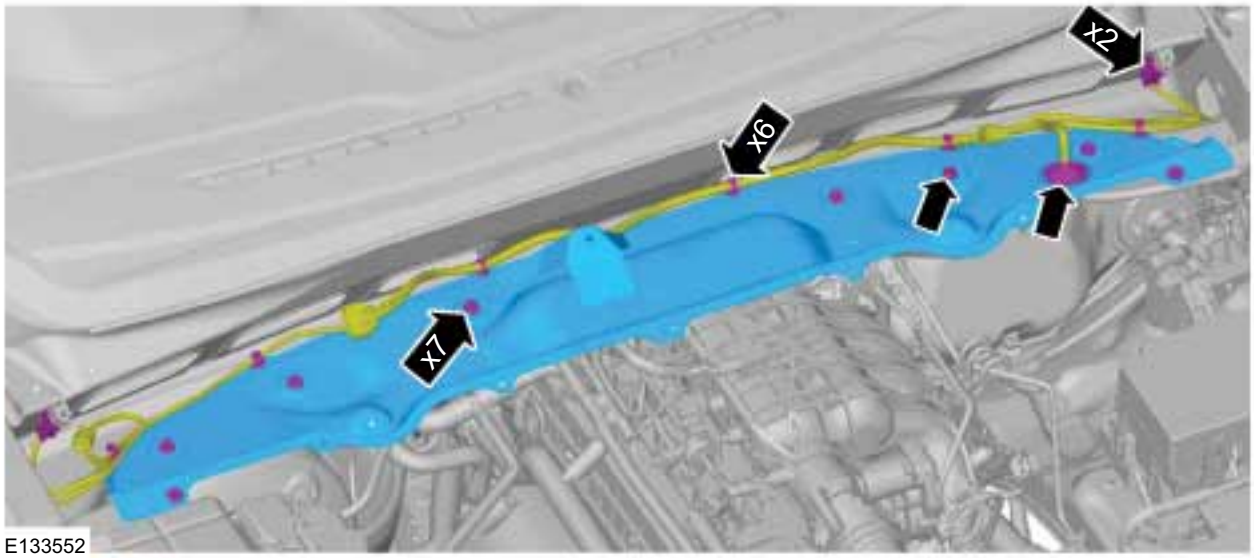
E139349

41. Refer to: Powertrain Control Module (PCM) (303-14 Electronic Engine Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

42. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

43. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

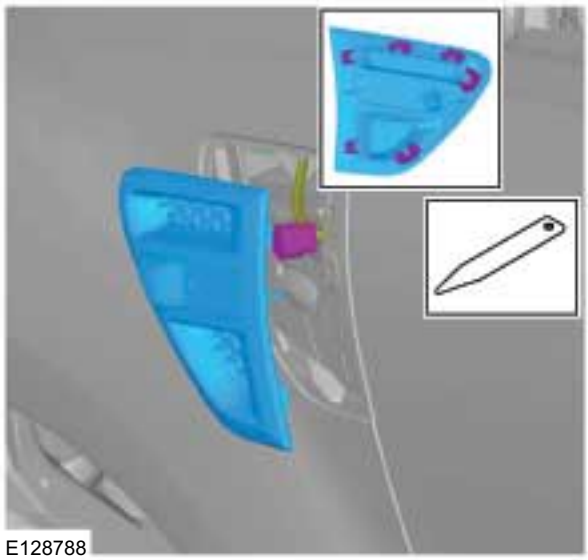
44. Torque: 10 Nm



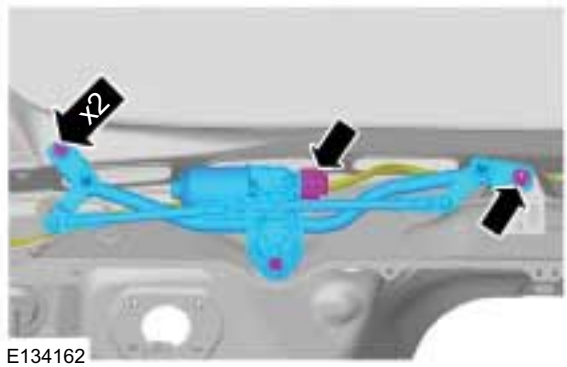
E133552

INSTALLATION

45. On both sides.


E128788

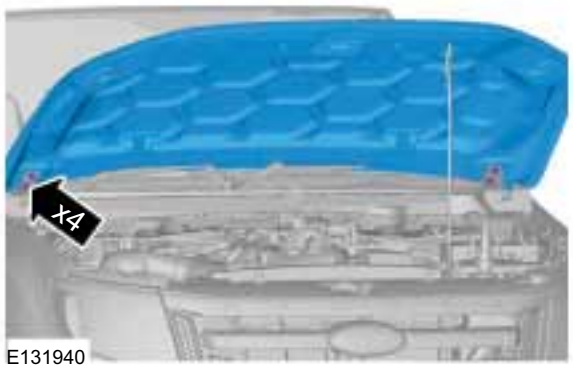
46. Torque: 10 Nm



E134162

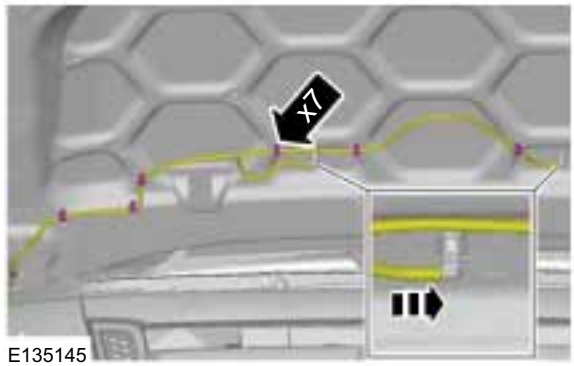
47. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

48. Torque: 25 Nm



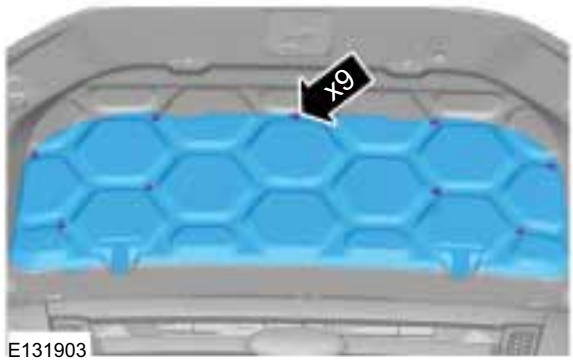
E131940

49.



E135145

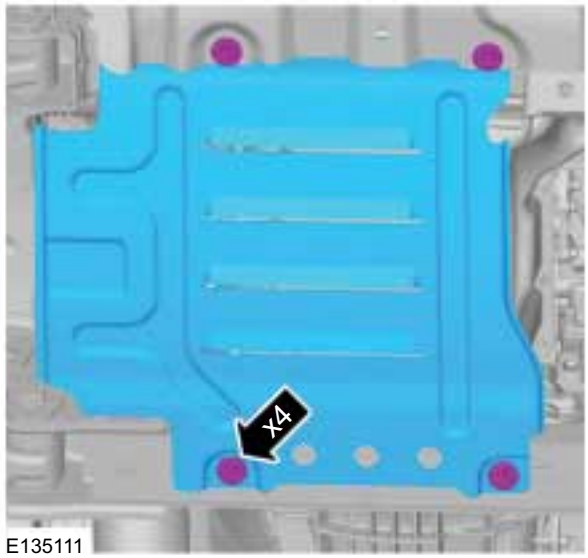
50.



E131903

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

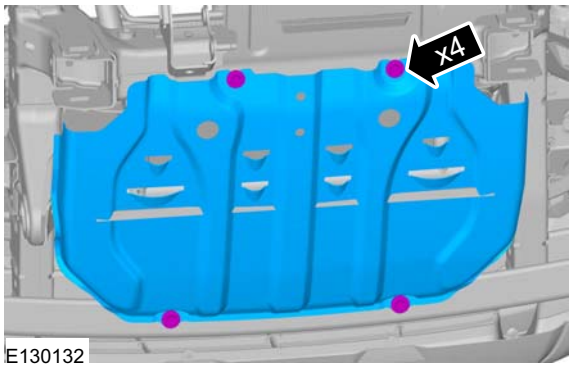
52. Torque: 30 Nm



E135111

INSTALLATION

53. Torque: 20 Nm



54. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

55. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

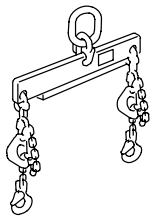
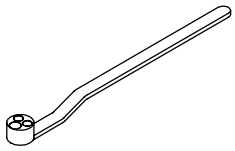
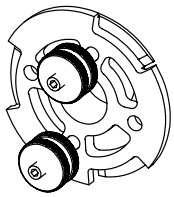
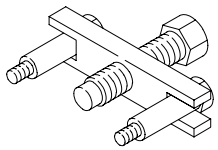
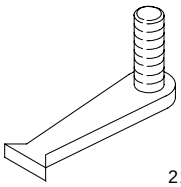
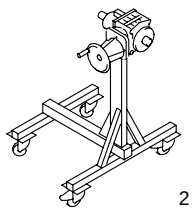
56. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

INSTALLATION

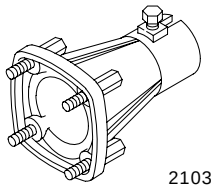
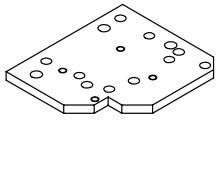
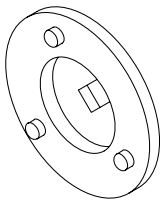
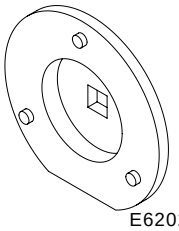
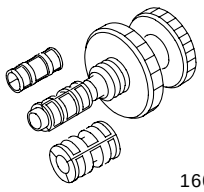
Engine Accessories(21 139 4)

Installation

Special Tool(s) / General Equipment

 21068A	303-122 Lifting Bracket, Engine
 E87614	303-1310 Holding Wrench, Crankshaft
 E75376	303-1317 Locking Tool, Fuel Injection Pump Sprocket
 21132	303-249 Remover, Crankshaft Timing Pulley
 21135	303-254 Locking Tool, Flywheel
 21187	303-435 Mounting Stand

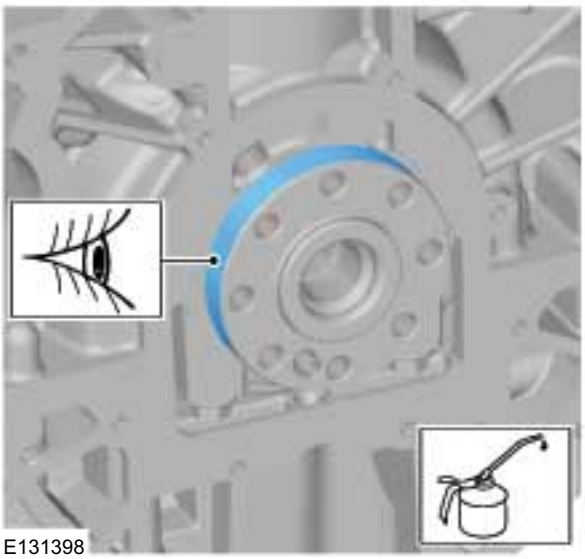
Special Tool(s) / General Equipment

 21031B	303-435-06 Mounting Bracket for 303-435
 E68386	303-435-11B Mounting Plate for 303-435-06
 303679	303-679 Remover/Installer, Engine Front Cover Inspection Plate
 E62024	303-679A Remover/Installer, Engine Front Cover Inspection Plate
 16067	308-204 Aligner, Clutch Disc
1/2 Inch Square Drive Breaker Bar	
Dowel with a Diameter of 6 mm	

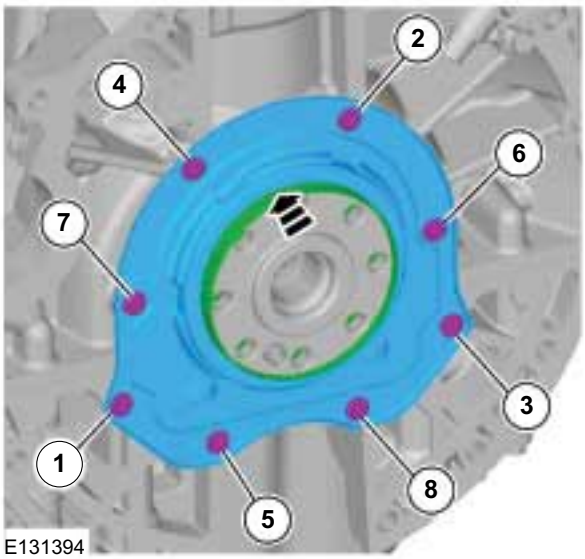
Materials	
Name	**Specification**
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

INSTALLATION

1.

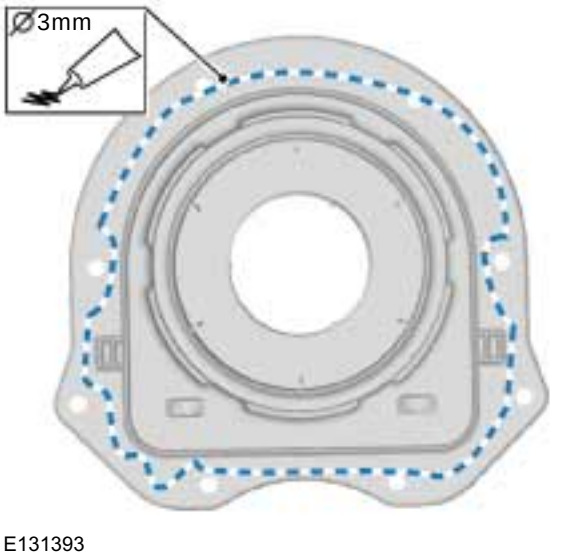


Initially hand tighten the fasteners.



2. **NOTE:** Install the new crankshaft rear seal carrier within five minutes of applying the recommended sealant.

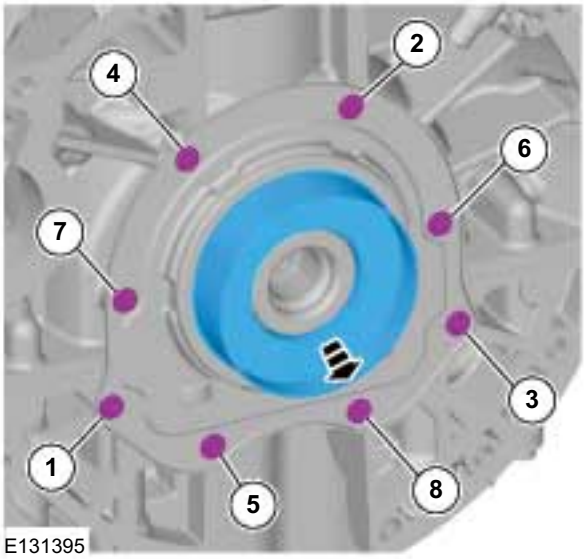
   Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



3. ⚠ **CAUTION: A new crankshaft rear seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft rear seal is fully installed. Failure to follow this instruction may result in damage to the vehicle.**

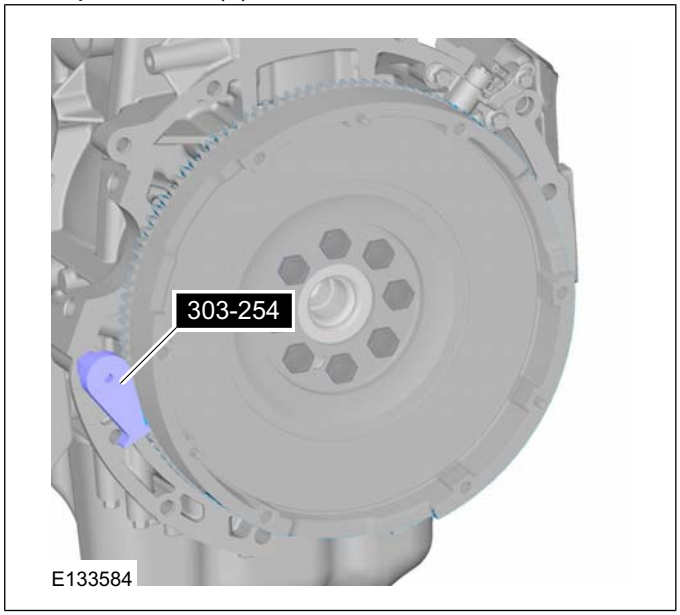
4. **NOTE:** New crankshaft rear seal carriers are supplied with an alignment sleeve which must be removed after installation.

   Torque: 20 Nm



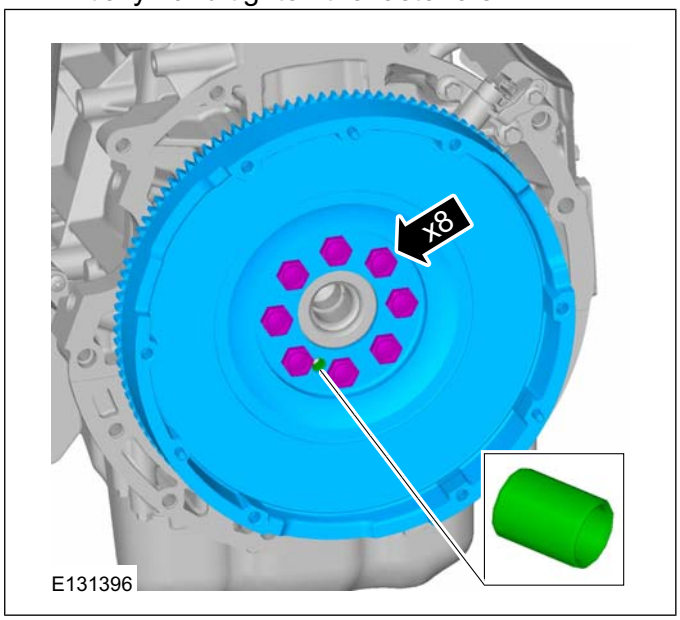
INSTALLATION

5. Special Tool(s): 303-254

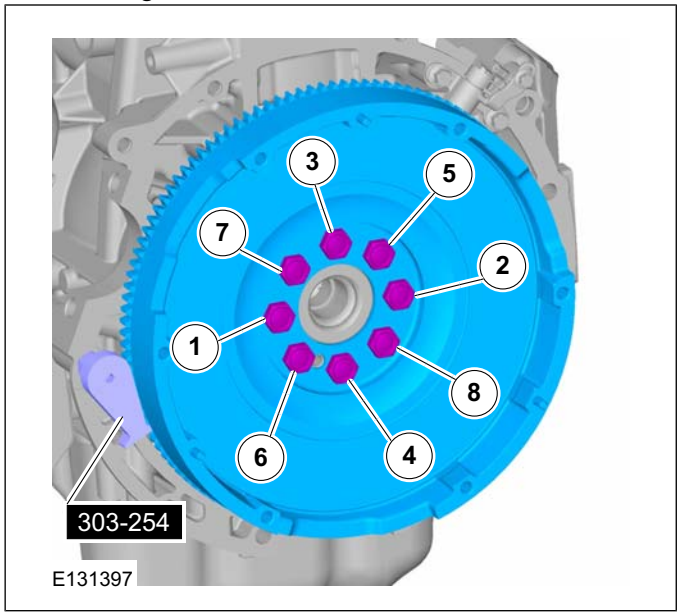


6. **NOTE:** Make sure that the flywheel is in full contact with the crankshaft flange before installing the flywheel bolts.

   Initially hand tighten the fasteners.

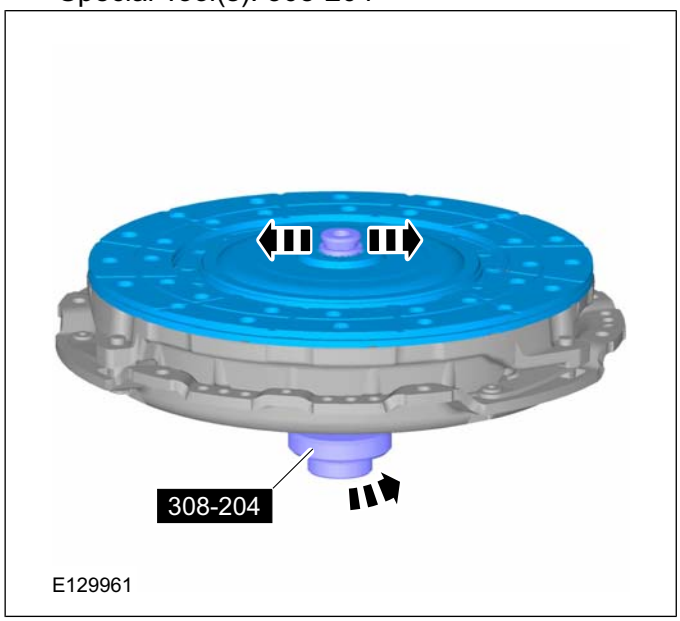


7. Special Tool(s): 303-254
   Torque:
   - Stage 1: 15 Nm
   - Stage 2: 30 Nm
   - Stage 3: 75 Nm



8. **NOTE:** The cone on the special tool must only be tightened finger tight to prevent damage to the clutch disc.

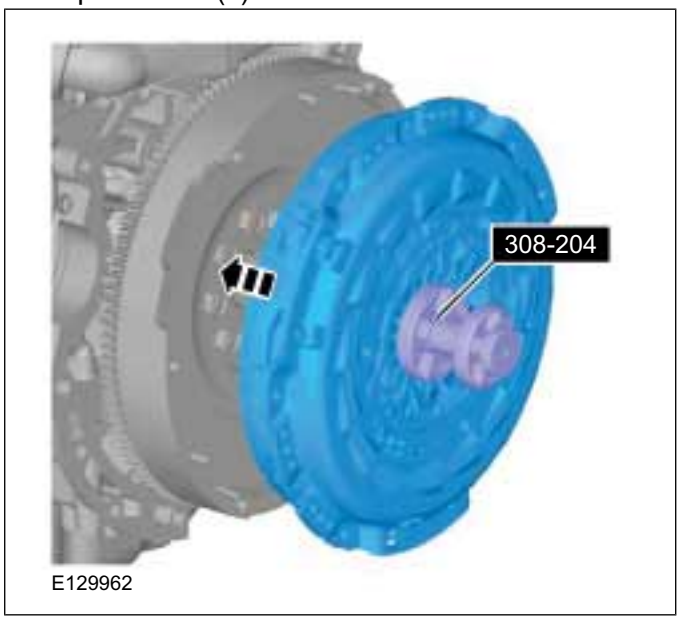
   Special Tool(s): 308-204



INSTALLATION

9. **NOTE:** Only tighten the bolt finger tight at this stage.

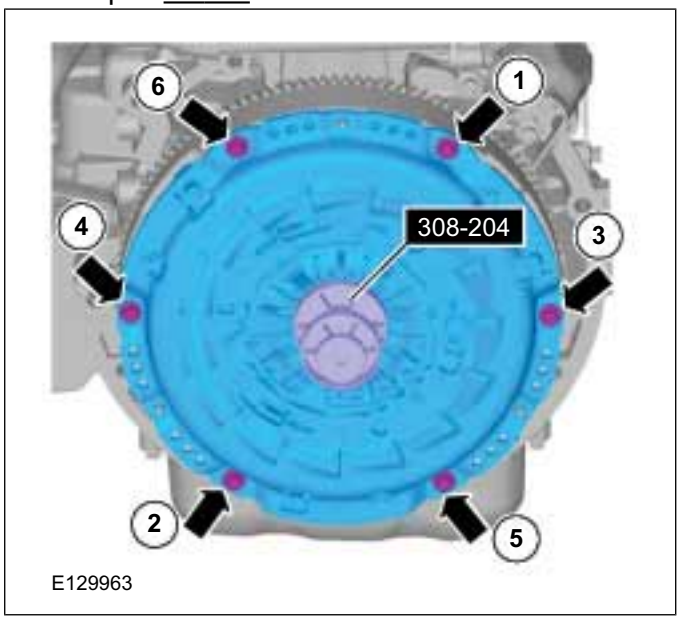
   Special Tool(s): 308-204



E129962

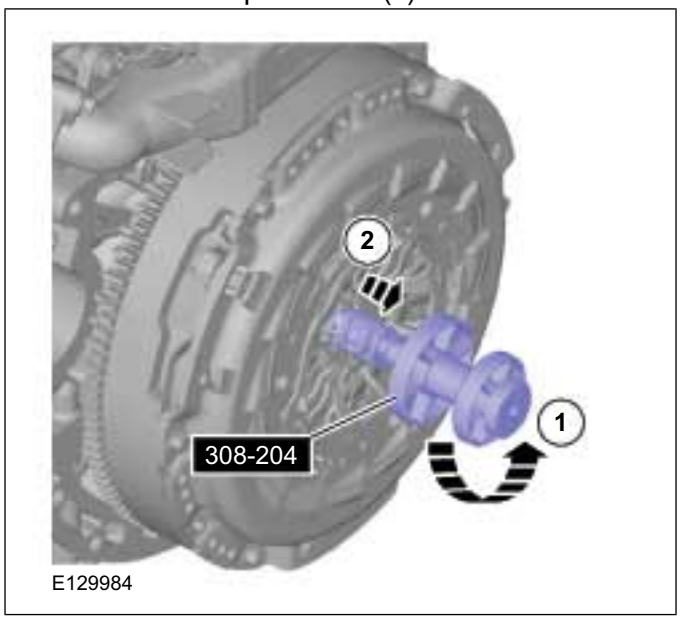
10. ⚠ **CAUTION: Tighten the clutch pressure plate retaining bolts by two turns at a time in the sequence shown.**

    Special Tool(s): 308-204
    Torque: 45 Nm



E129963

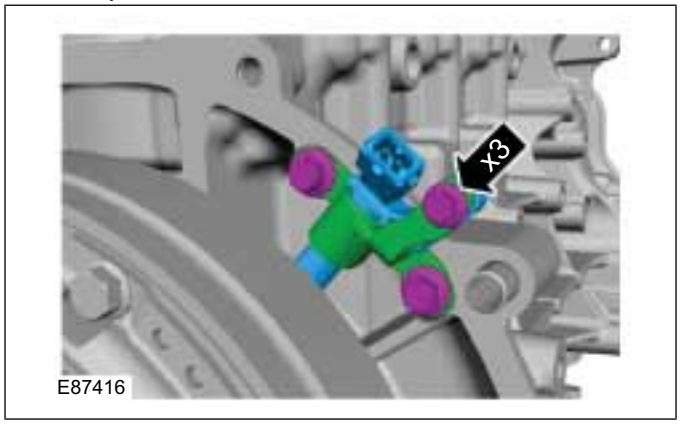
11. Remove the Special Tool(s): 308-204



E129984

12. **NOTE:** Make sure that a new component is installed.

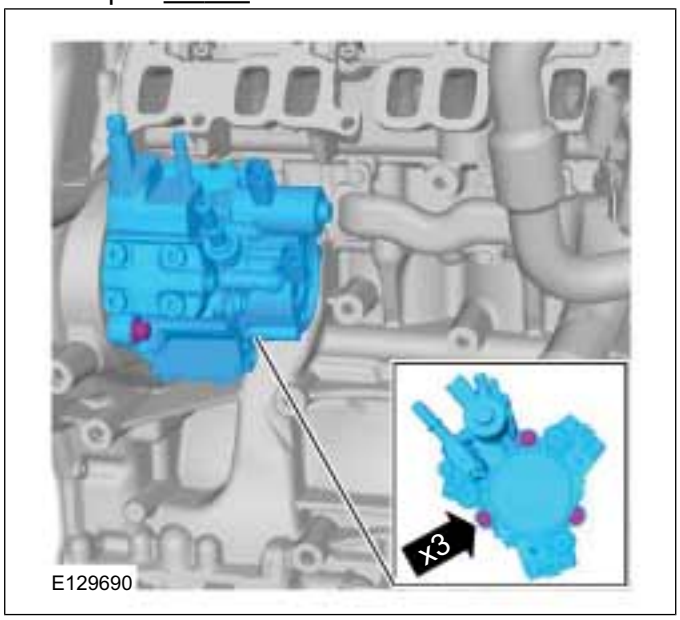
    Torque: 7 Nm



E87416

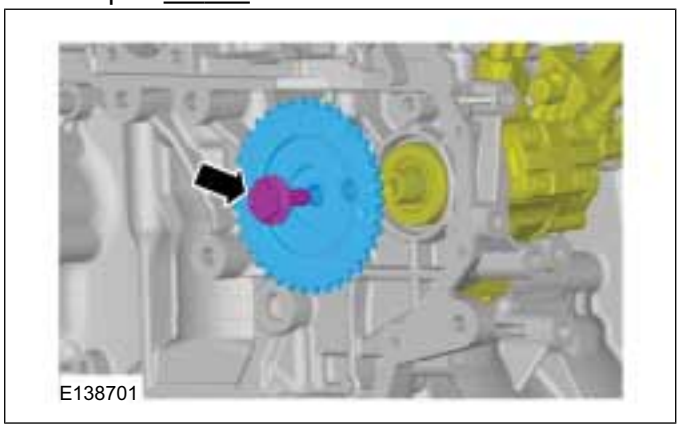
INSTALLATION

13. Torque: 23 Nm

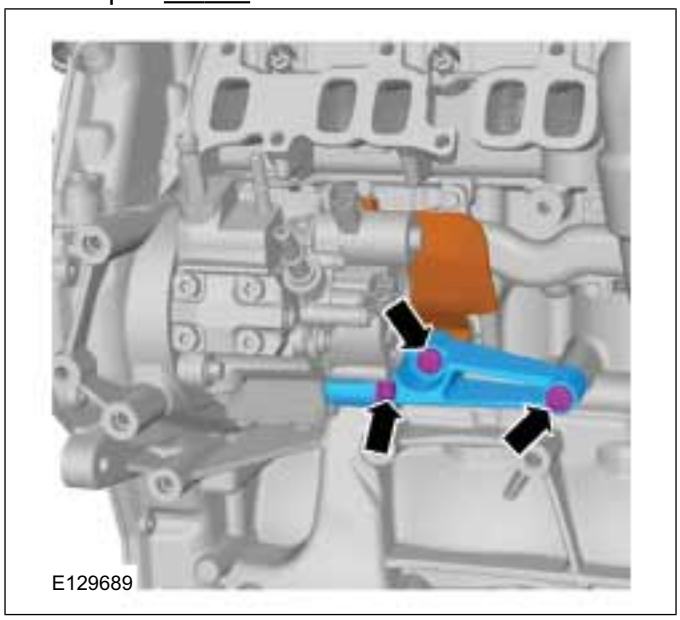


14. NOTE: Make sure that a new component is installed.

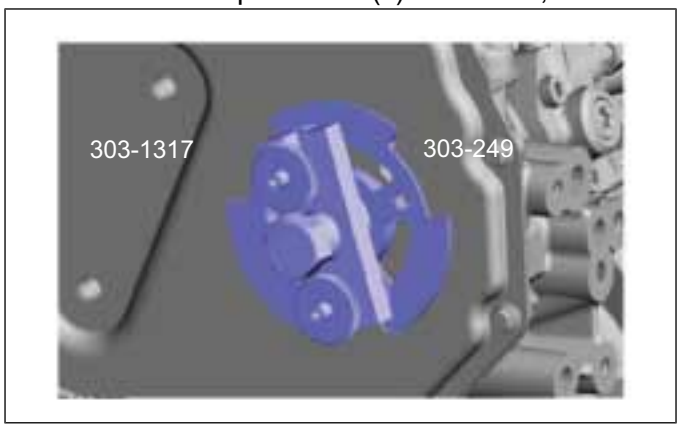
Torque: 45 Nm



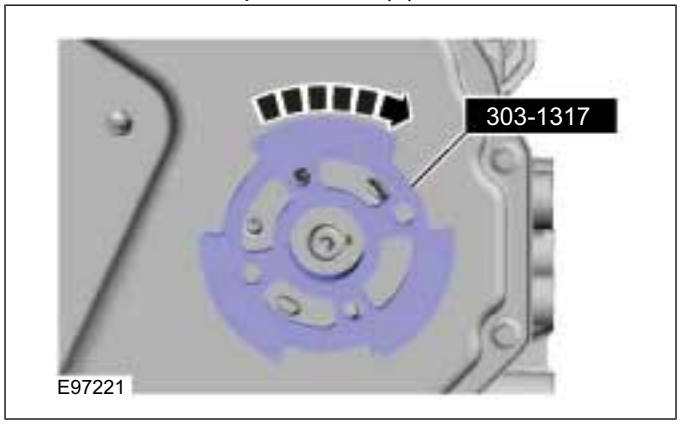
15. Torque: 22 Nm



16. Remove the Special Tool(s): 303-1317, 303-249

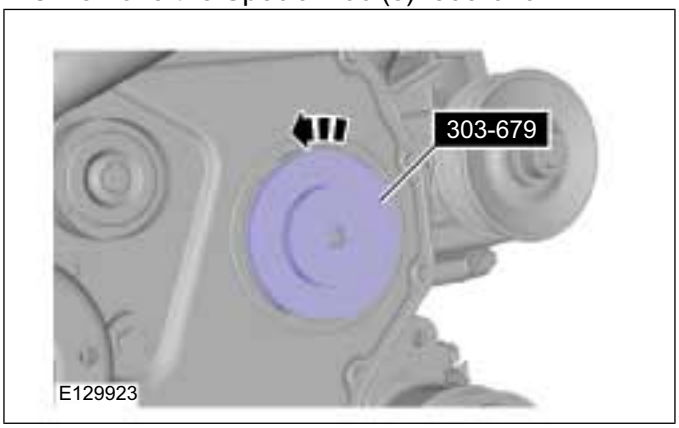


17. Remove the Special Tool(s): 303-1317

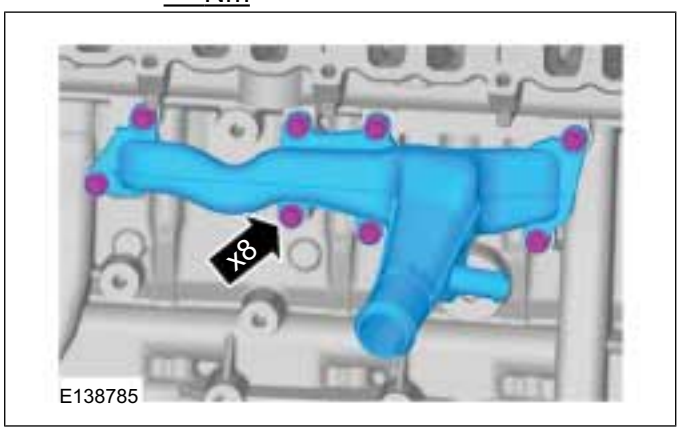


INSTALLATION

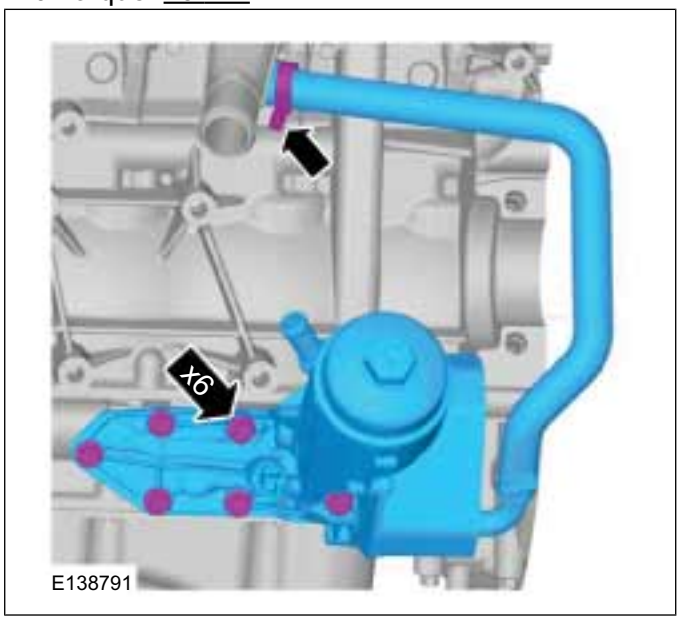
18. Remove the Special Tool(s): 303-679



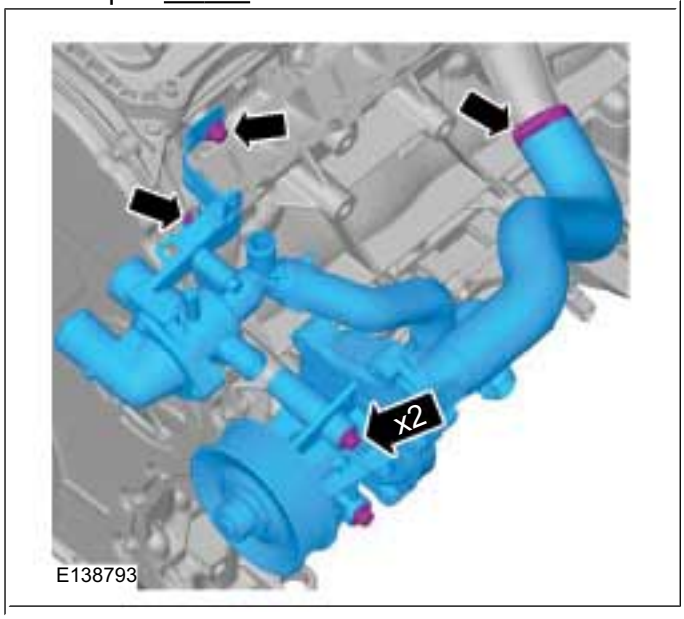
19. Torque: 12 Nm



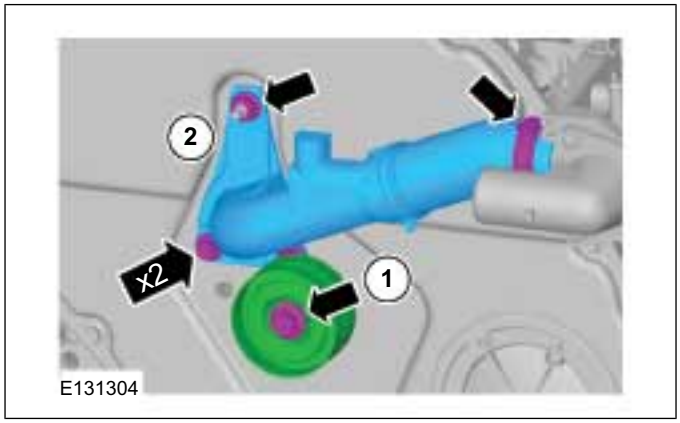
20. Torque: 23 Nm



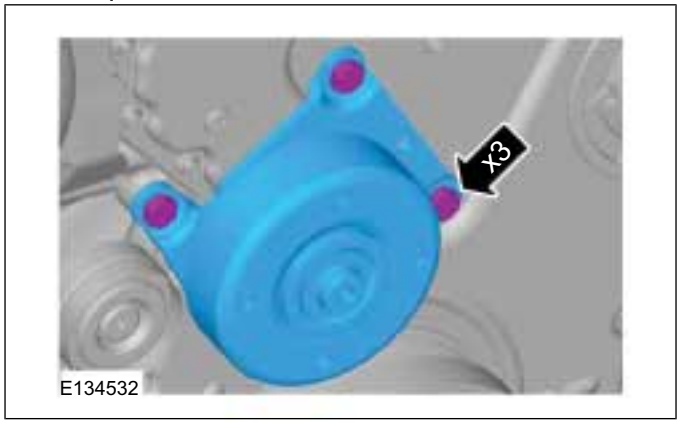
21. Torque: 23 Nm



22. 1. Torque: 48 Nm
2. Torque: 23 Nm

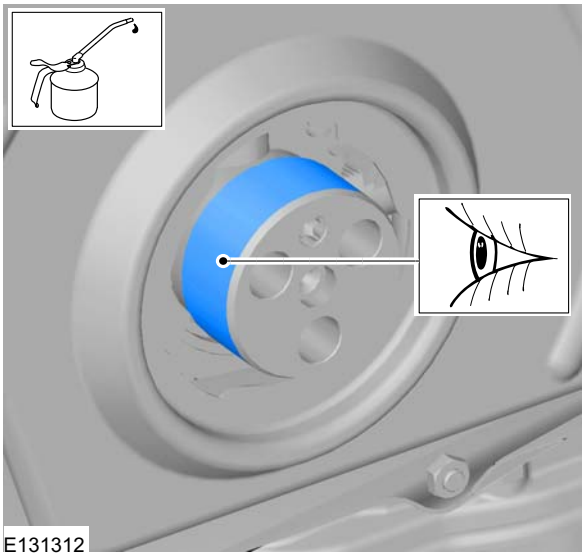


23. Torque: 48 Nm



INSTALLATION

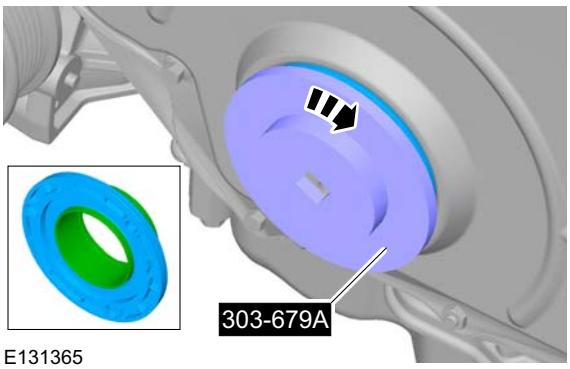
24. **NOTE:** Make sure that the mounting face is clean and lubricated.


E131312

25. **CAUTION: Rotate the seal assembly until it locks. Failure to follow this instruction may result in damage to the seal assembly.**

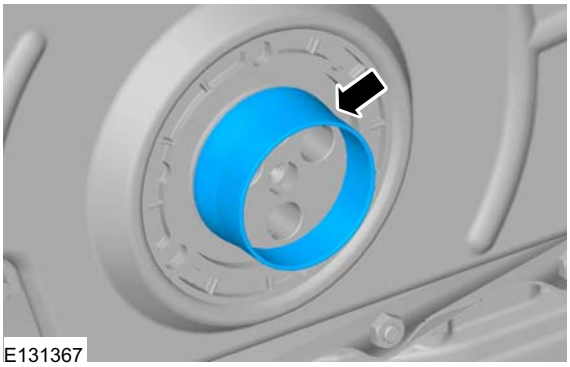
NOTE: A new crankshaft front seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft rear seal is fully installed.

Special Tool(s): 303-679A



E131365

26. Remove the alignment sleeve after the seal is fully installed.

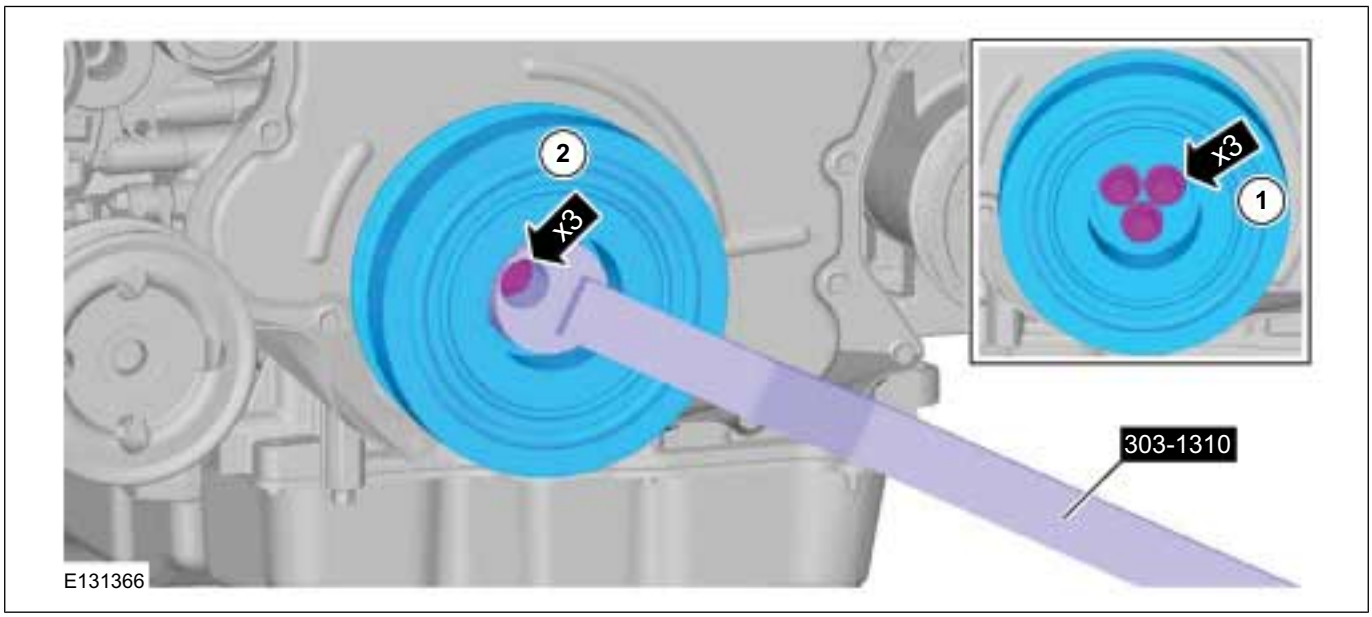

E131367

27. **CAUTION: Crankshaft pulley retaining bolts must only be used three times.**

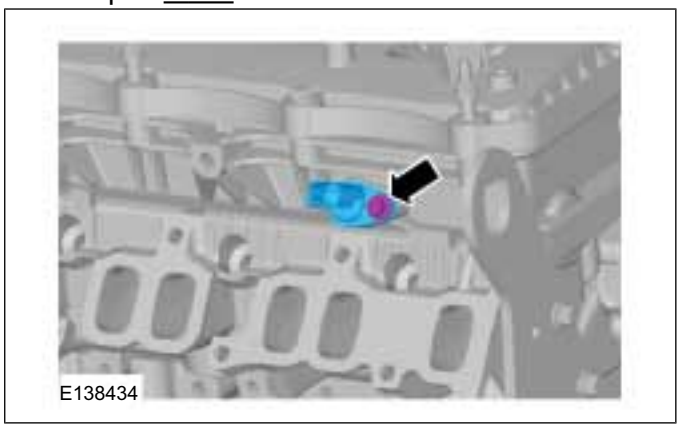
NOTE: Initially hand tighten the fasteners.

Special Tool(s): 303-1310
Torque:
- Stage 1: 45 Nm
- Stage 2: 120°

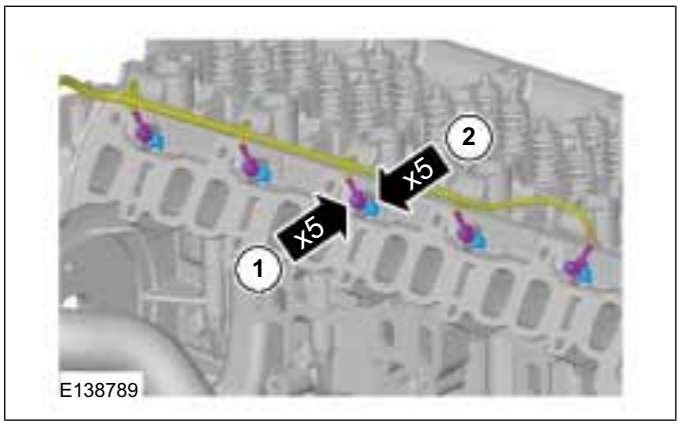
INSTALLATION



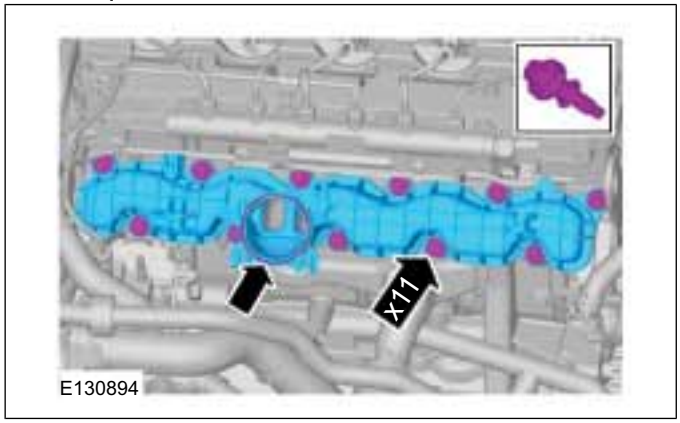
28. Torque: 9 Nm



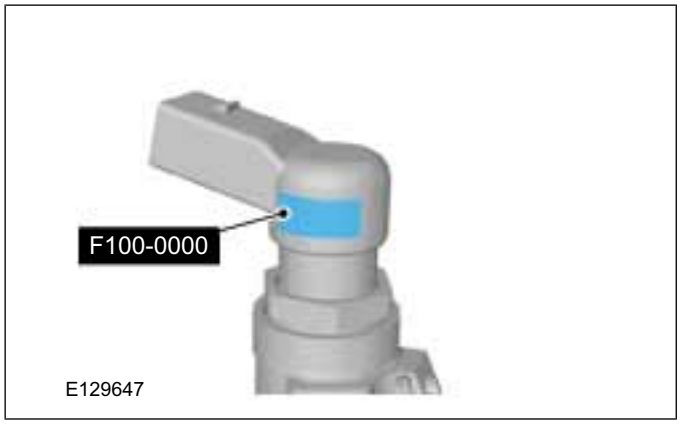
29.



30. Torque: 15 Nm



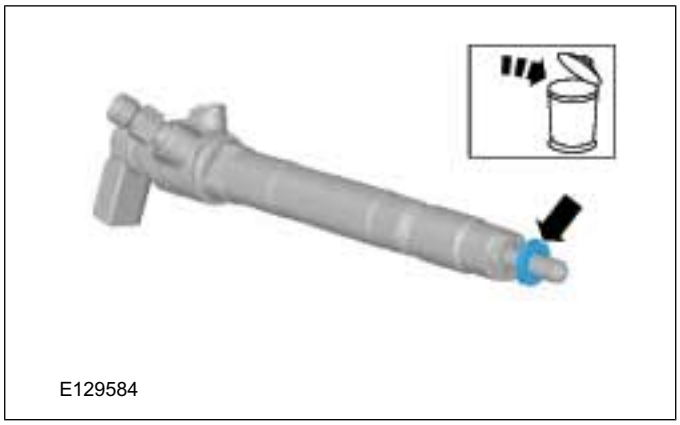
31. Record the new fuel injector correction factor code.



32. NOTE: Using a socket (or similar), press the new fuel injector copper seals onto the fuel

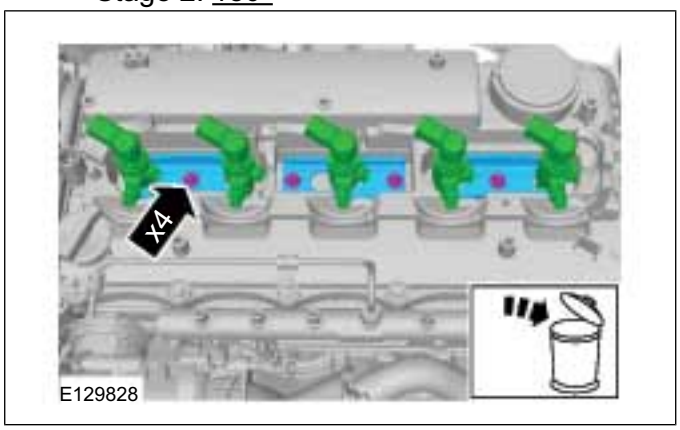
INSTALLATION

injectors making sure that the copper seals are pushed fully home to prevent uneven clamping.

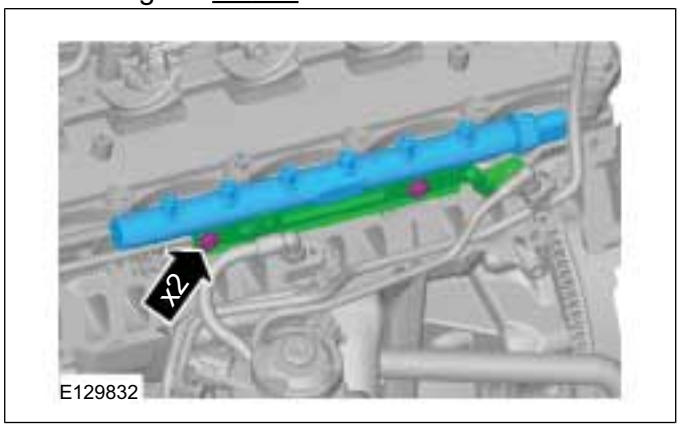


33. **CAUTION: Make sure that new bolts are installed.**

Torque:
- Stage 1: 5 Nm
- Stage 2: 180°



34. Torque:
- Stage 1: 7 Nm
- Stage 2: 20 Nm



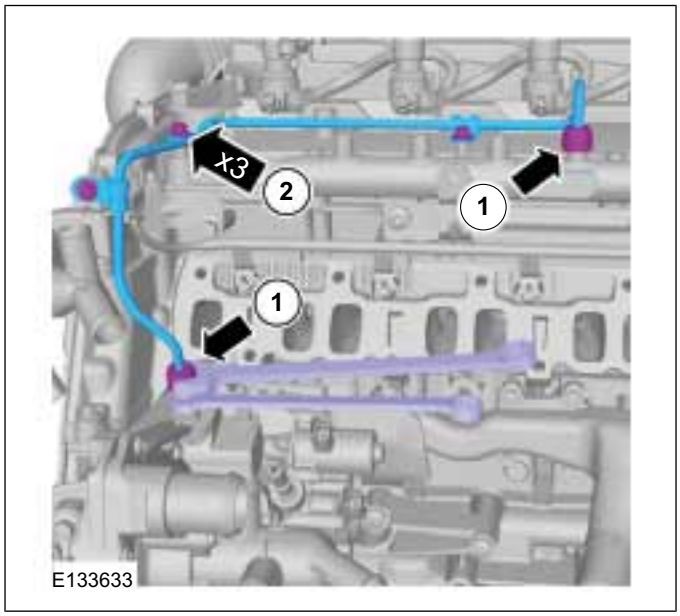
35. **CAUTIONS:**

Make sure that the fuel line remains in contact at both ends until both unions nuts have been unscrewed and the area around the joints thoroughly cleaned.

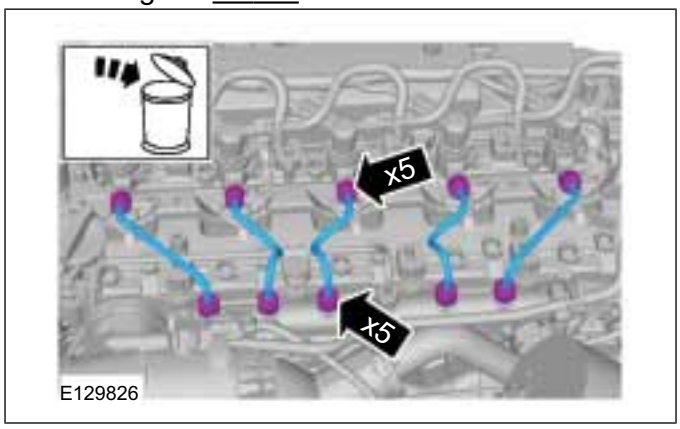
Make sure that all openings are sealed. Use new blanking caps.

NOTE: Vacuum foreign material from the high-pressure fuel supply line, the fuel pump and the fuel rail.

1. Torque:
   - Stage 1: 10 Nm
   - Stage 2: 35 Nm
2. Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).
   Torque: 12 Nm

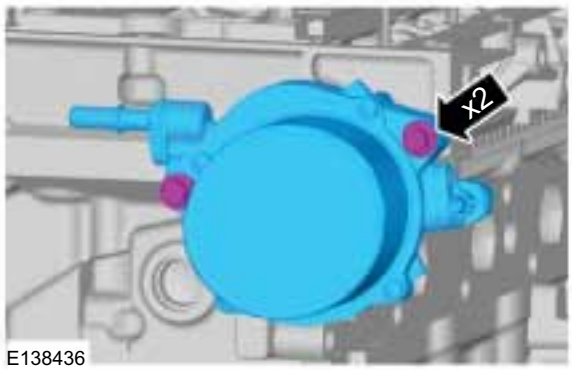


36. Torque:
- Stage 1: 20 Nm
- Stage 2: 25 Nm

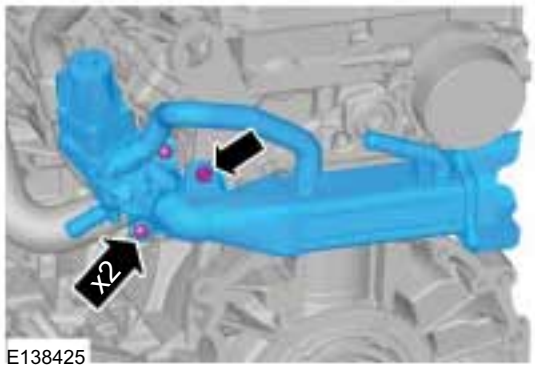


INSTALLATION

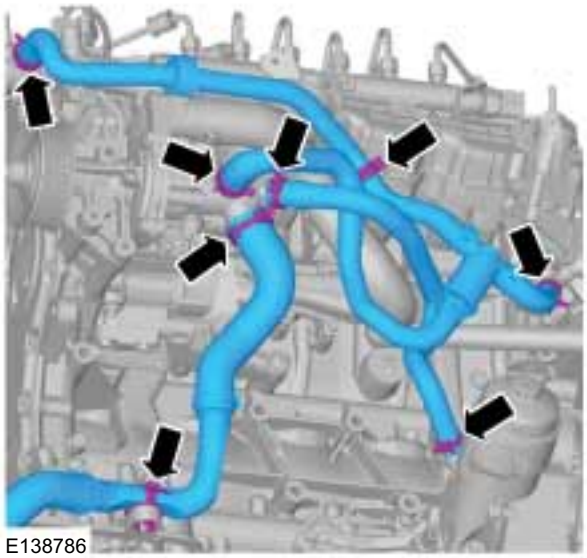
37. Torque: 22 Nm



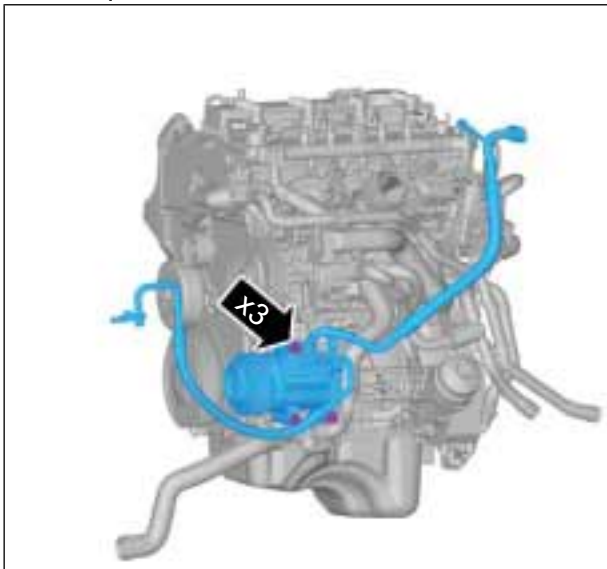
38. Torque: 12 Nm



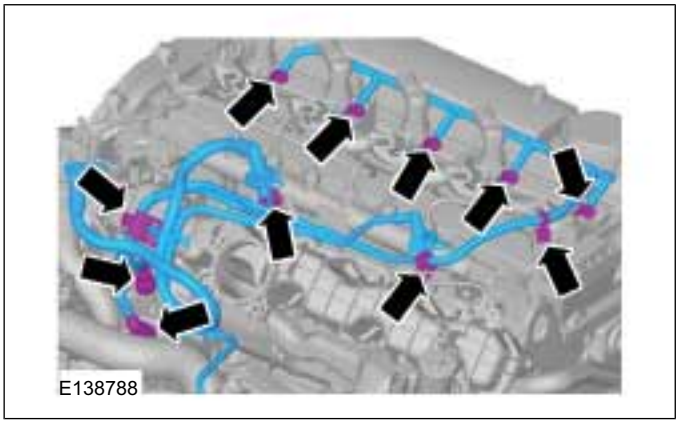
39.



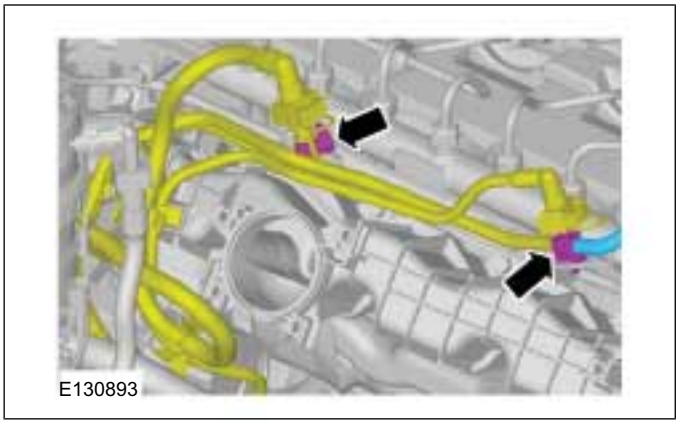
40. Torque: 25 Nm



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



42.



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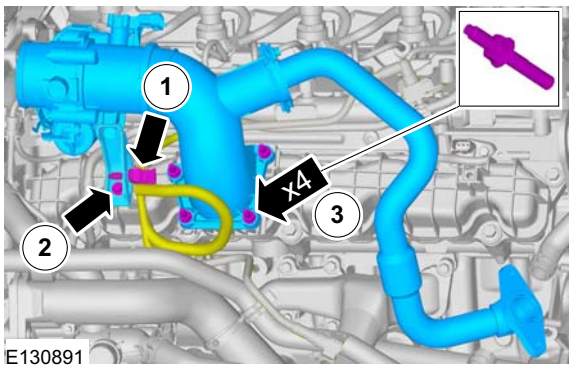
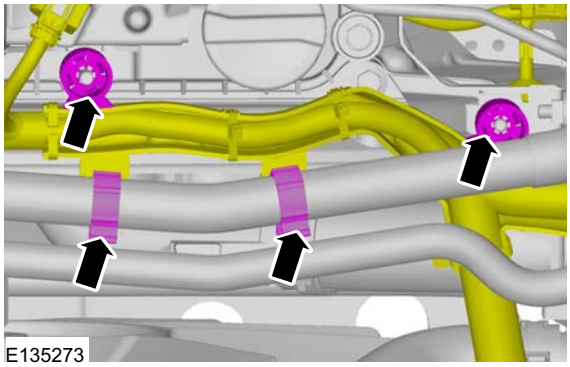
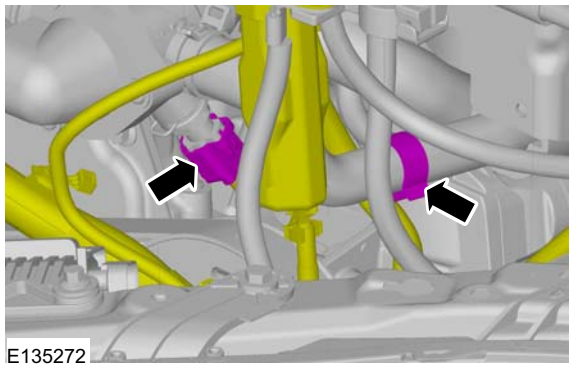
43. 3. Torque: 25 Nm



44.

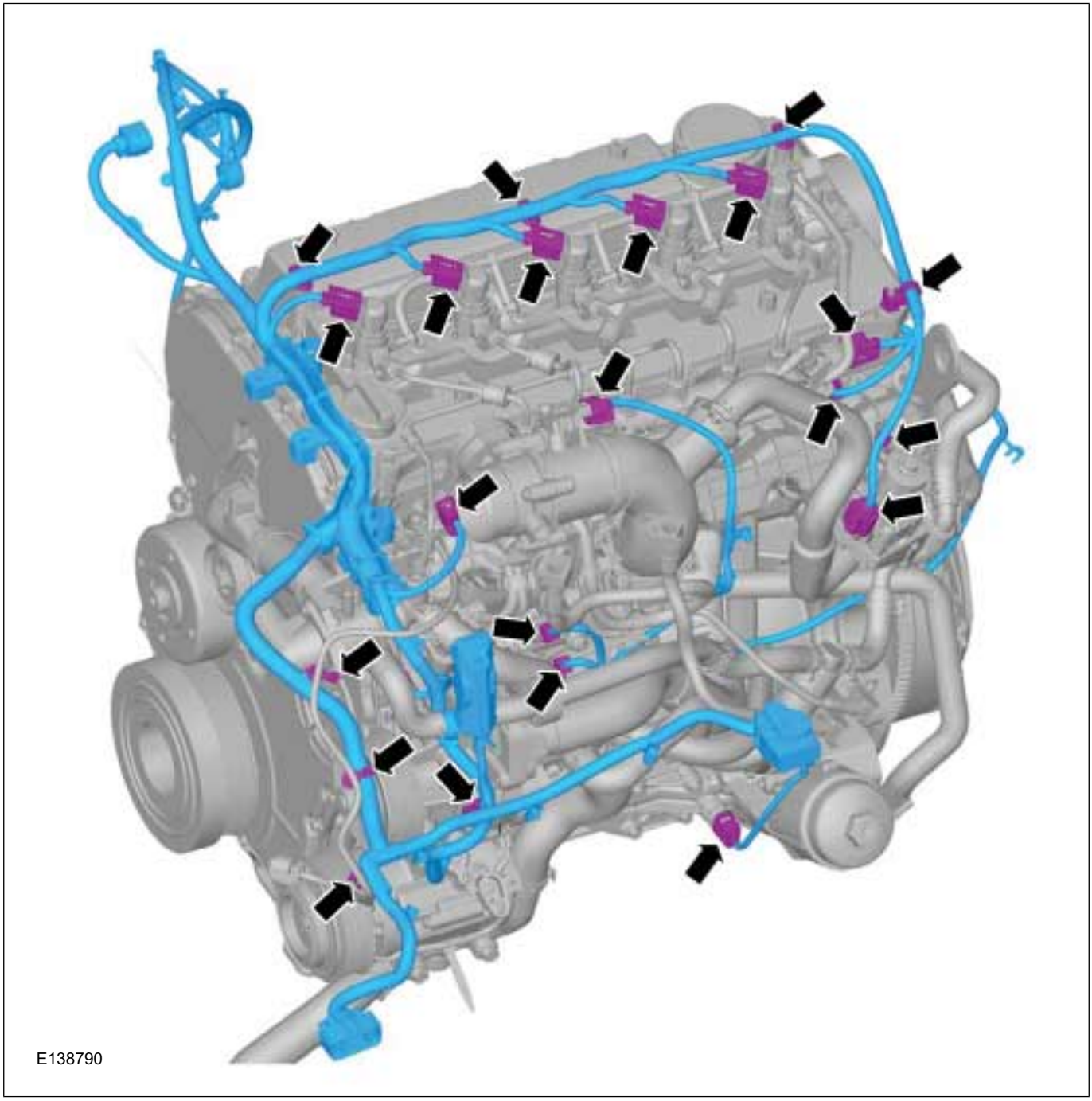


45.



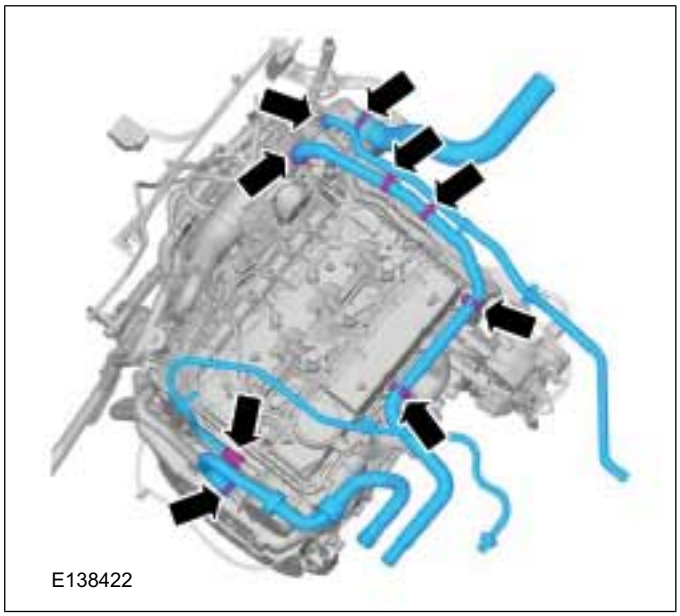
46.

INSTALLATION



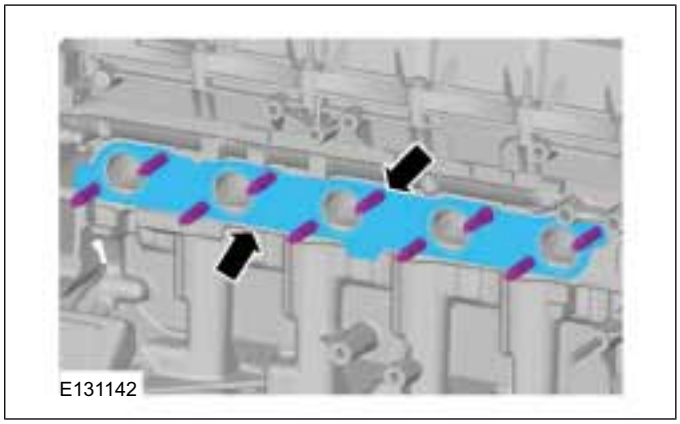
INSTALLATION

47.

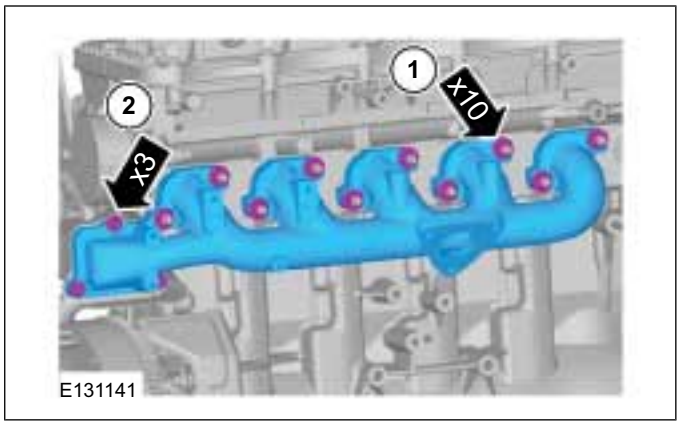


48. **NOTE:** The gasket is to be reused unless damaged.

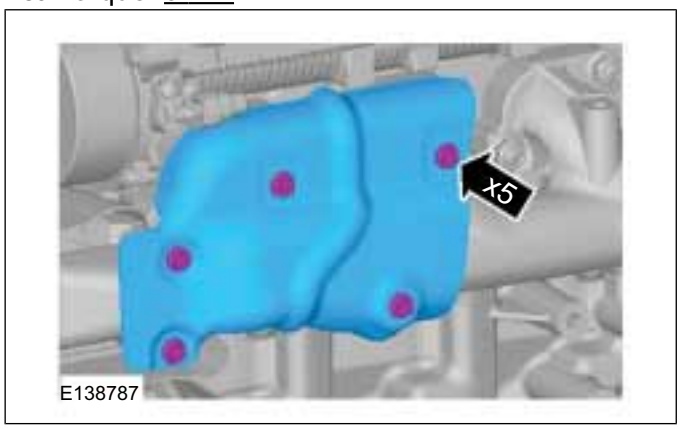
NOTE: The studs are to be reused unless damaged.



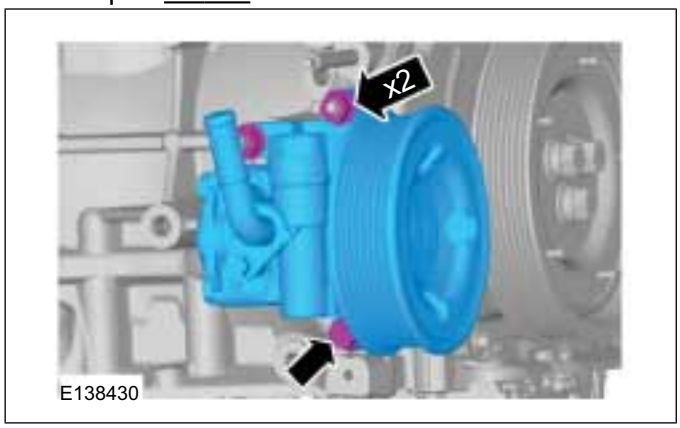
49. 1. Torque: 40 Nm
2. Torque: 23 Nm



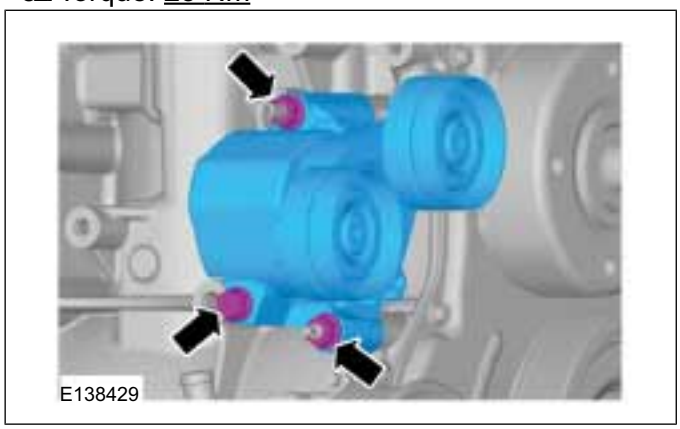
50. Torque: 9 Nm



51. Torque: 20 Nm



52. Torque: 25 Nm



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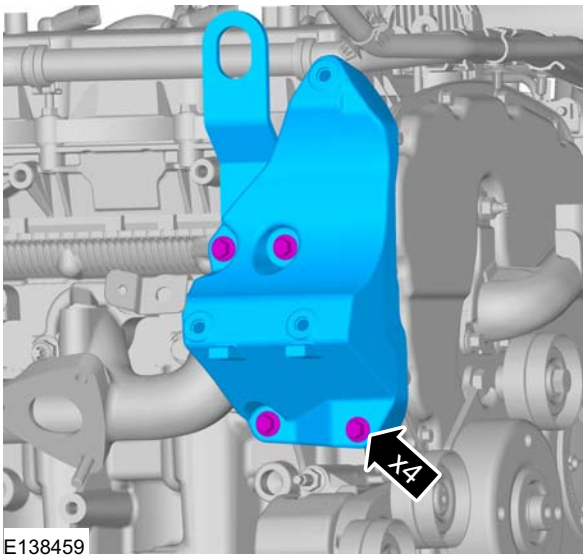
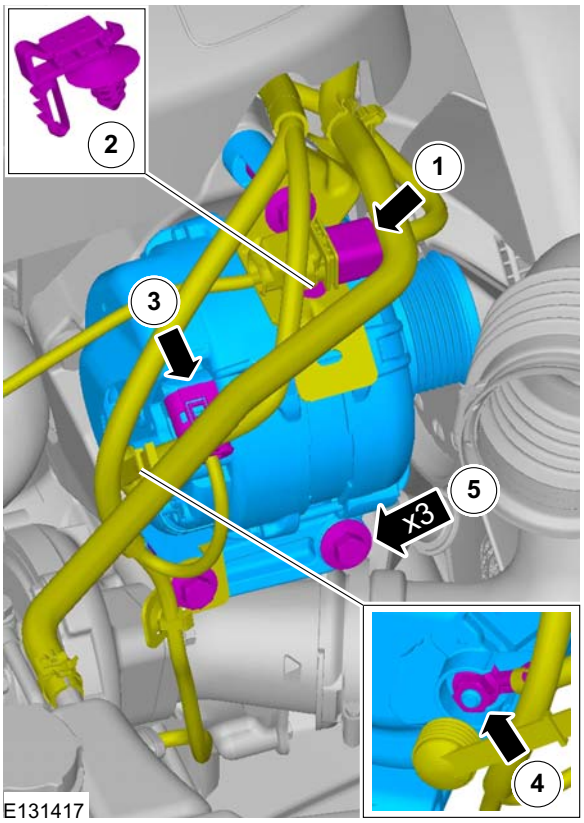
53. Torque: 25 Nm



54. ⚠ **CAUTION: Take extra care not to damage the wiring harnesses.**
    4. Torque: 15 Nm
    5. Torque: 48 Nm



55. General Equipment: 1/2 Inch Square Drive Breaker Bar
    General Equipment: Dowel with a Diameter of 6 mm

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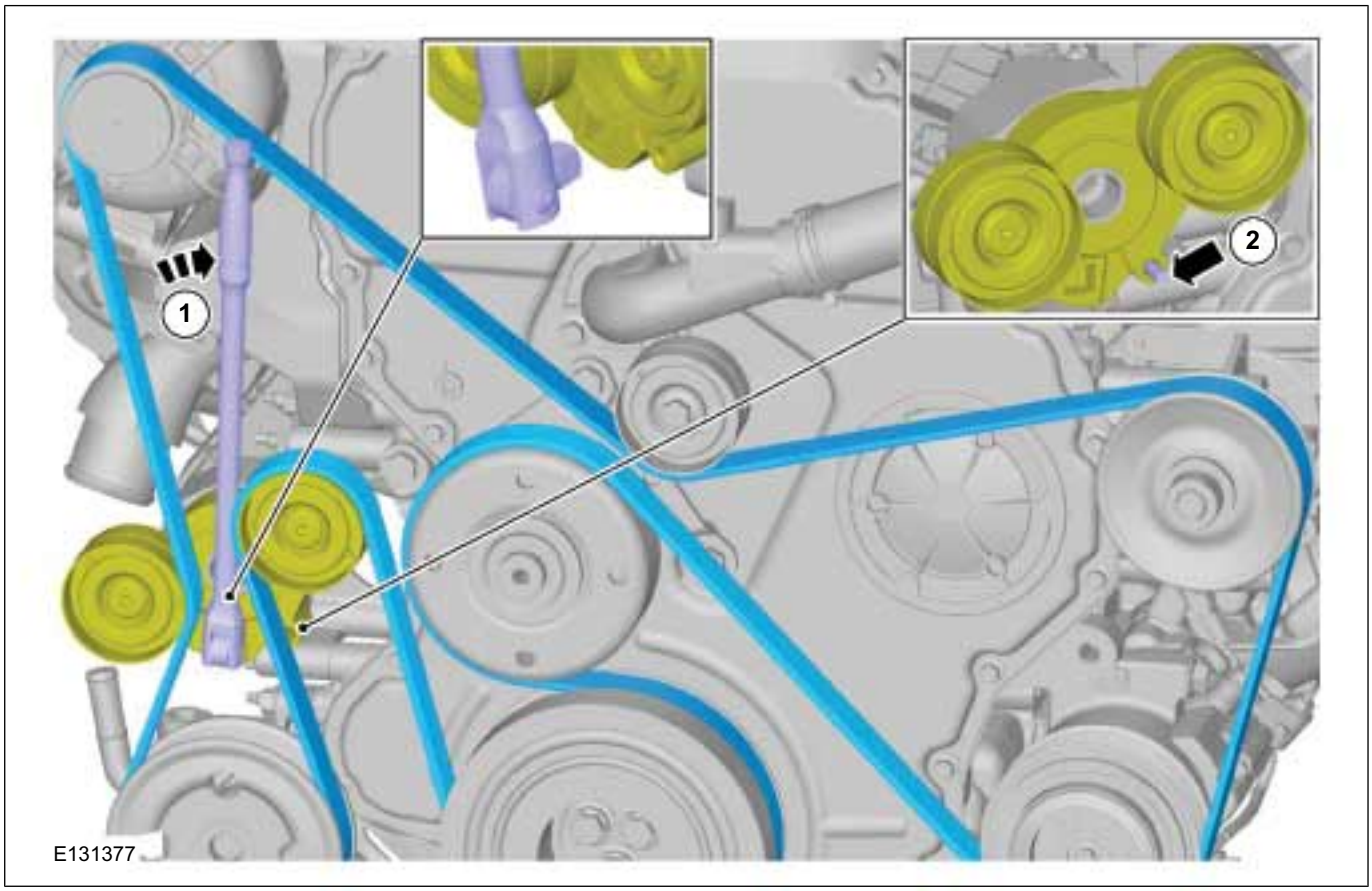
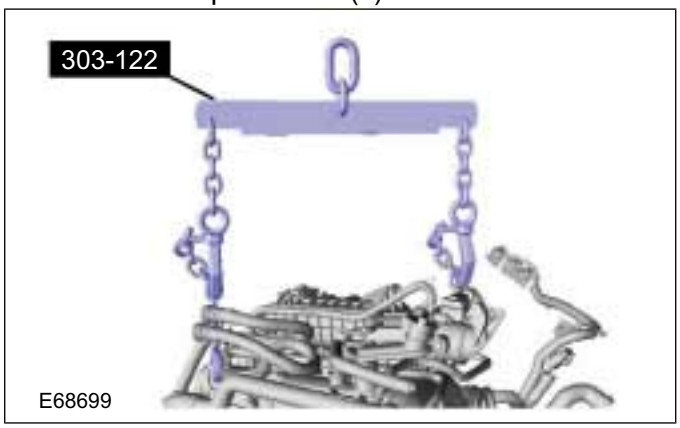
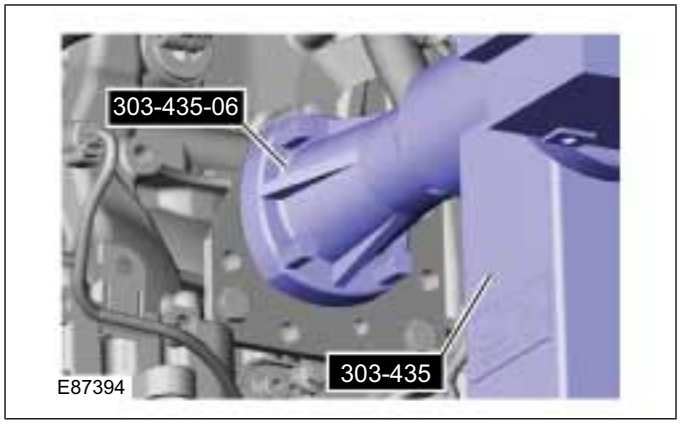


56. Install the Special Tool(s): 303-122



57. Remove the Special Tool(s): 303-435-06, 303-435



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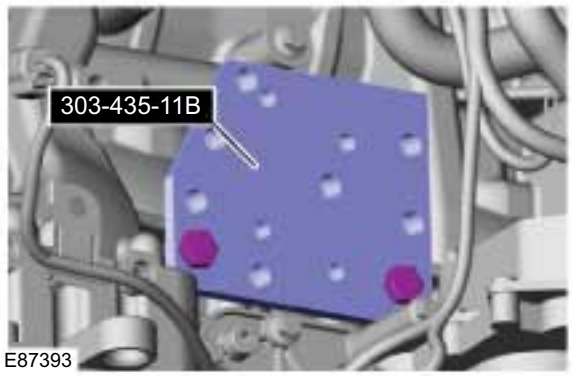
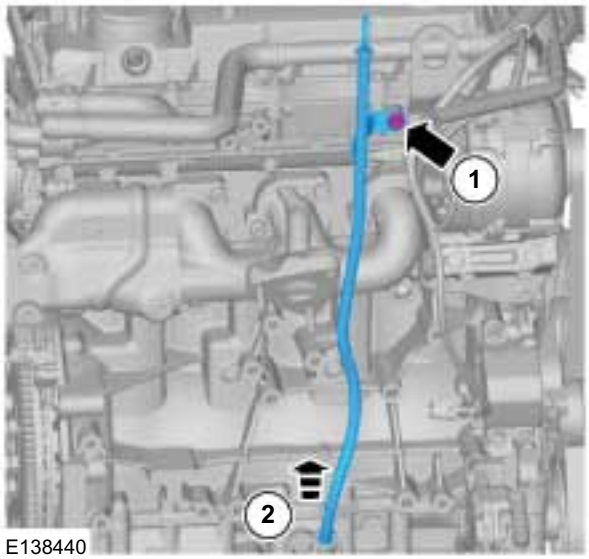
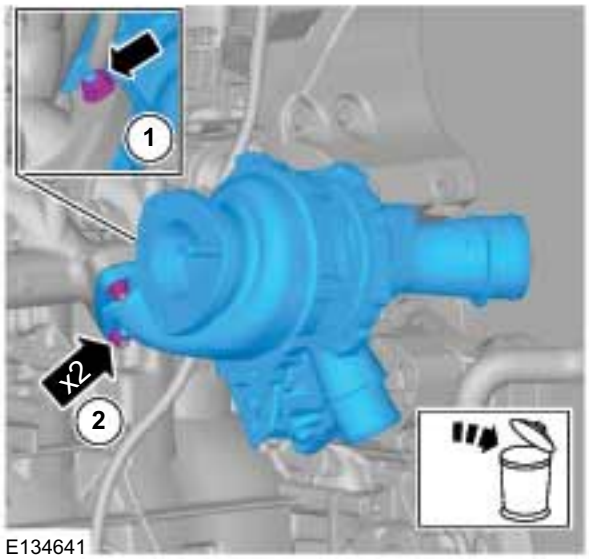
58. Remove the Special Tool(s): 303-435-11B



59. Torque: 9 Nm



60. Torque: 23 Nm



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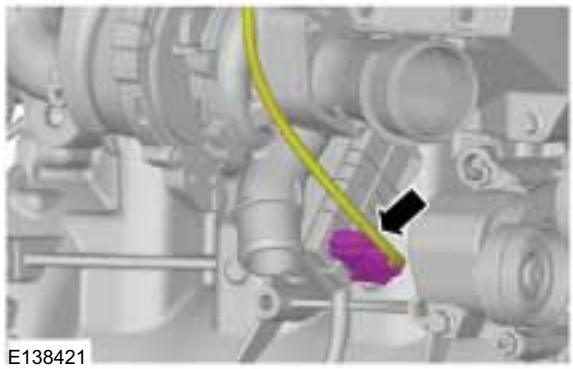
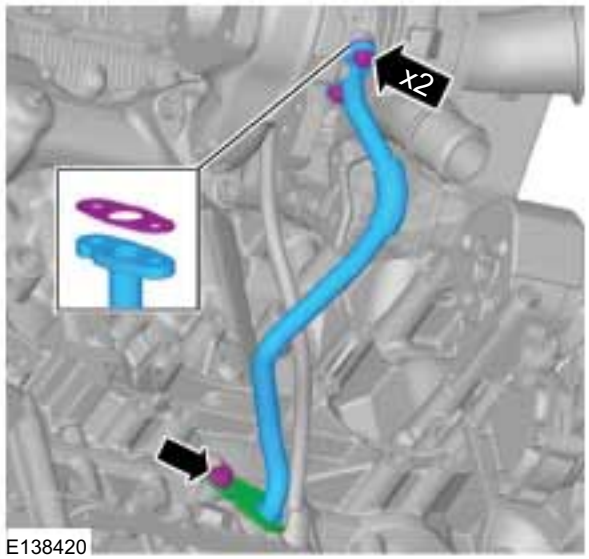
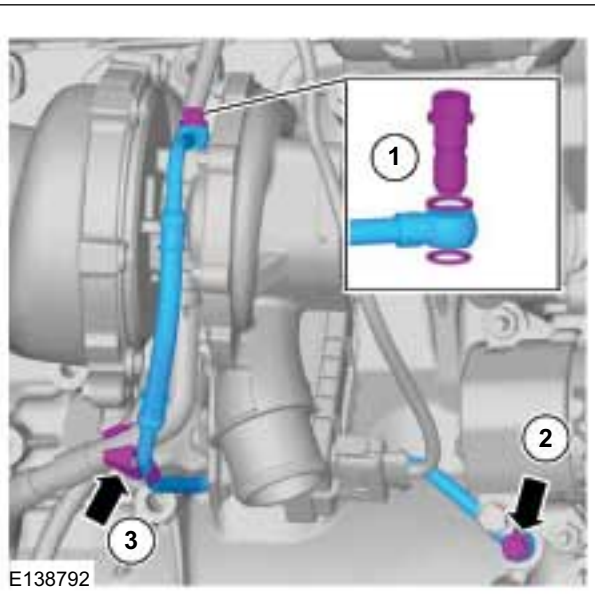


62. Torque: 10 Nm



63. 1. Torque: 35 Nm
2. Torque: 32 Nm



SECTION 303-03A Engine Cooling — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

SPECIFICATIONS

Antifreeze Specifications

Description	Specification
Motorcraft Super Plus 2000	WSS-M97B44-D
Specific gravity (providing no other additive is in the coolant)	1.068 at +15°C
Approximate percentage of antifreeze (by volume)	50%
Coolant remains fluid to	-30°C (-22°F)
Coolant solidifies at	-35°C (-31°F)

Cooling System Capacities — Vehicles with 2.2L Diesel Engine

Description	Liters
Vehicles with front heater only	11.5

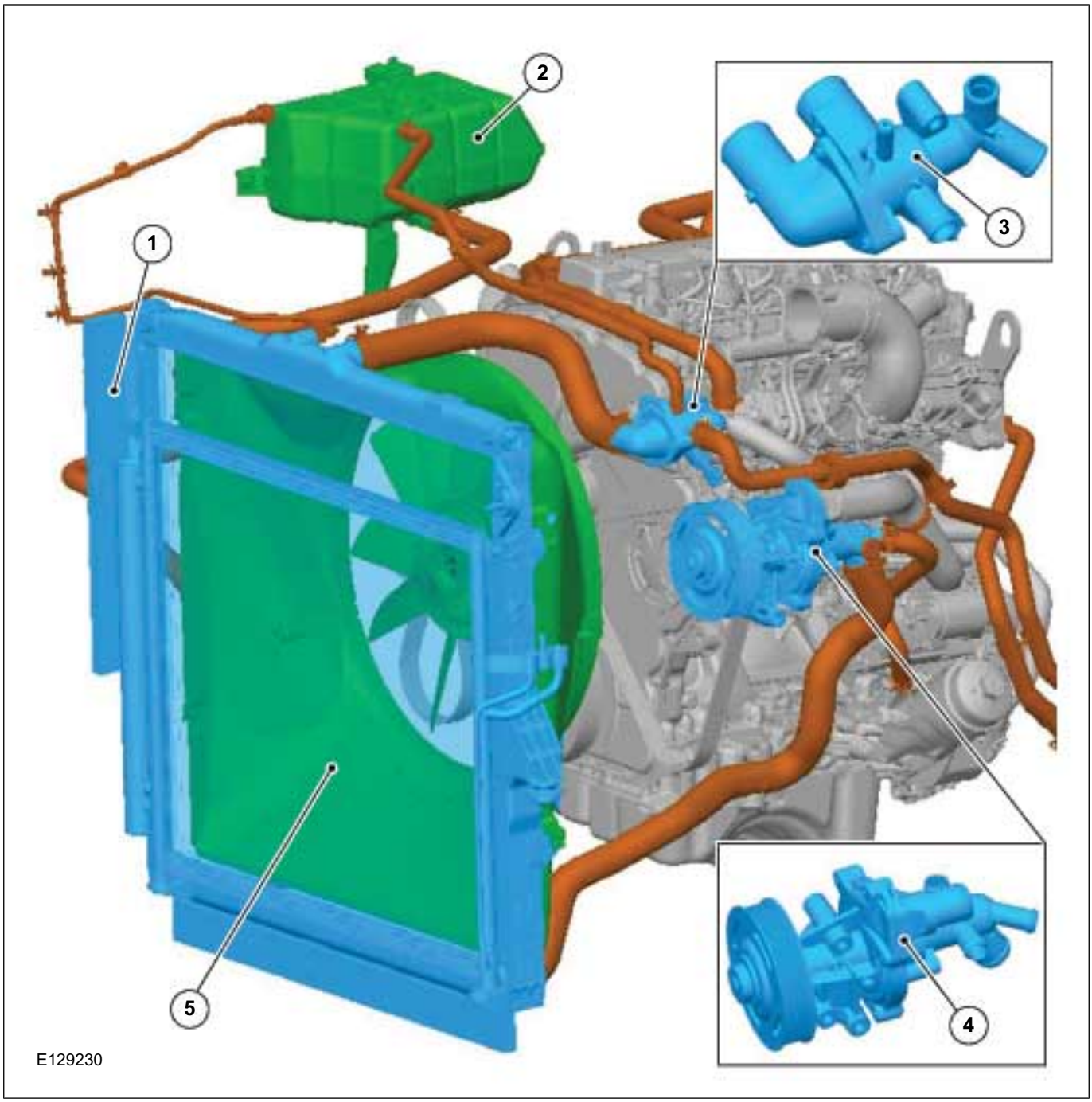
Cooling System Pressure Specification

Description	Pressure kPa (psi)
Radiator pressure test	138 (20)
Coolant expansion tank cap release pressure	135-155 (19-22)

DESCRIPTION AND OPERATION

Engine Cooling

Vehicles with 2.2L Duratorq-TDCi (Puma) diesel engine



Item	Description
1	Radiator
2	Coolant expansion tank
3	Thermostat housing

Item	Description
4	Coolant pump
5	Cooling fan motor and shroud

CAUTION: If the coolant concentration is insufficient, low temperature protection and corrosion resistance will be inadequate.

DESCRIPTION AND OPERATION

NOTE: Providing the coolant has not been contaminated with other fluids or foreign material, the robust corrosion resistance properties of this coolant means that it can be reused after changing an aluminium cooling system component. The concentration should always be checked and maintained within specification.

Coolant concentration should be checked through the neck of the coolant expansion tank with a hydrometer. The acceptable range of specific gravity (sg) must be maintained.

The coolant used is an orange colored Motorcraft Super Plus 2000 engine coolant. This is a non silicated organic acid technology (OAT) coolant that must not be mixed with other coolant types. For cooling system top up, only use coolant which meets the correct specification.

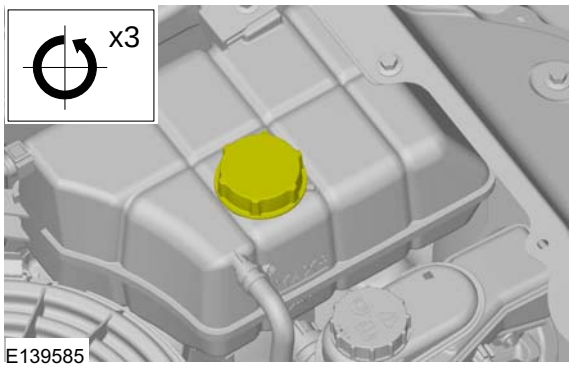
GENERAL PROCEDURES

Cooling System Draining, Filling and Bleeding — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma(24 122 0)

Draining

WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

1. Release the cooling system pressure by slowly turning the coolant expansion tank cap between 2 and 3 turns.



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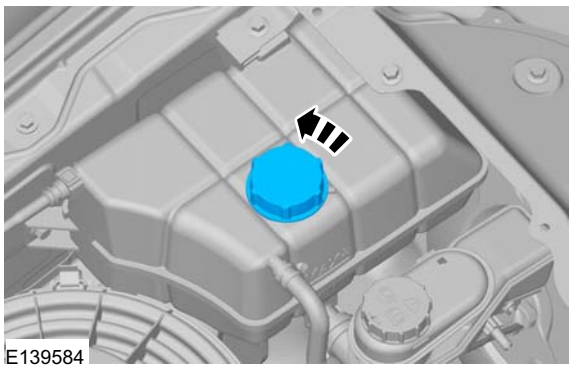
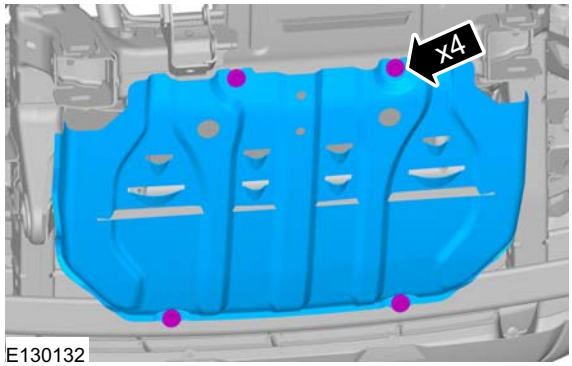
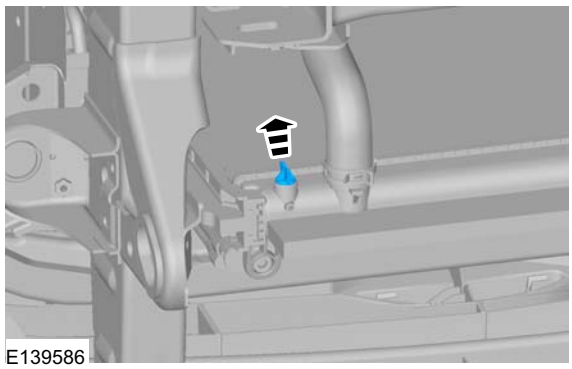


3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

4.



5. Remove the radiator drain plug and drain the coolant.



6. Install the radiator drain plug.

7. Lower the vehicle.

Filling

1. Refill the coolant to the expansion tank to maximum line (+15mm).

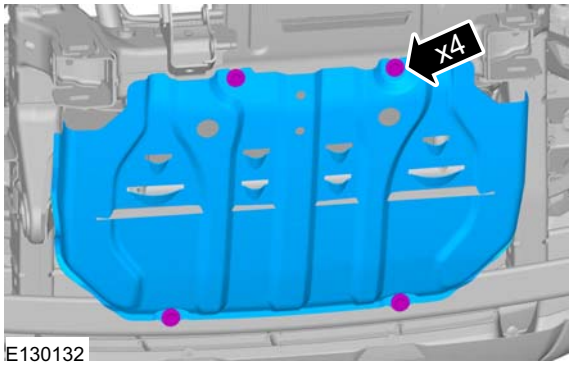
Bleeding

CAUTION: The fluid level must remain between the MAX and MIN marks.

1. Run the engine for 5 minutes at idle rpm.

GENERAL PROCEDURES

2. Install the coolant expansion tank cap.
3. Run the engine speed to 2500 RPM and maintain it for approximately 15 minutes.
4. Run the engine for 5minutes at idle rpm.
5. Switch the engine off.
6. Check the cooling system for leaks.
7. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
8. Torque: 30 Nm



9. Lower the vehicle.
10. Allow the engine to cool and maintain close to room temperature.
11. Fill the coolant to the expansion tank max fill line, if required.

REMOVAL AND INSTALLATION

Thermostat(24 454 0)

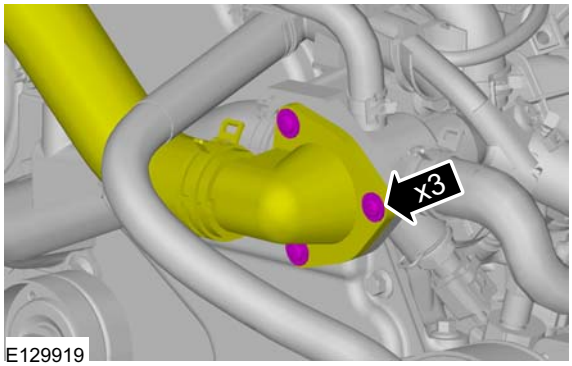
Removal

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

1. Drain the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

2. Torque: 10 Nm



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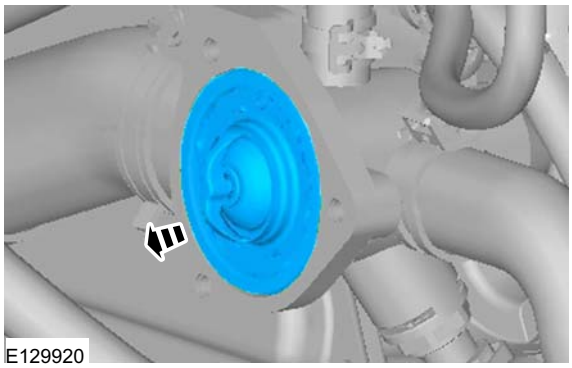


Installation

1. **NOTE:** Inspect the thermostat housing cover O-ring seal. Install a new O-ring seal if necessary.

   To install, reverse the removal procedure.

2. Bleed the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

REMOVAL AND INSTALLATION

Thermostat Housing(24 001 0)

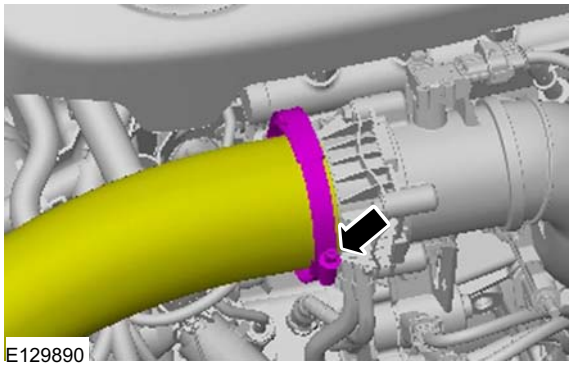
Removal

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

1. Drain the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

2.



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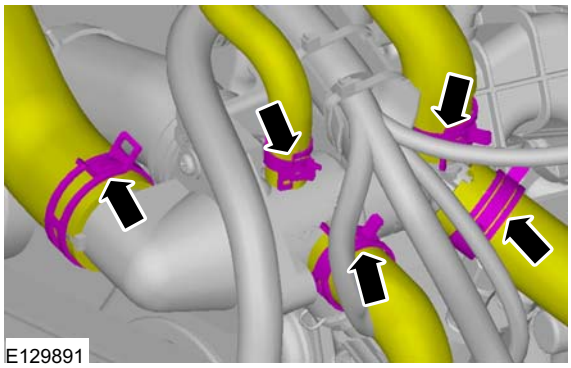
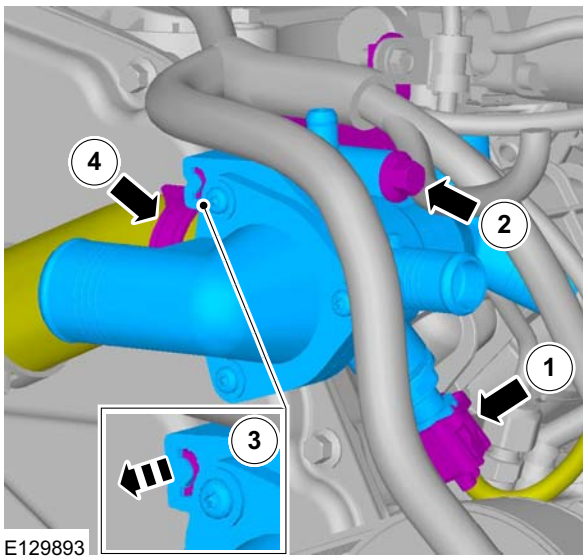


4. Torque: 23 Nm



Installation

1. To install, reverse the removal procedure.
2. Bleed the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

REMOVAL AND INSTALLATION

Coolant Pump(24 404 0)

Removal

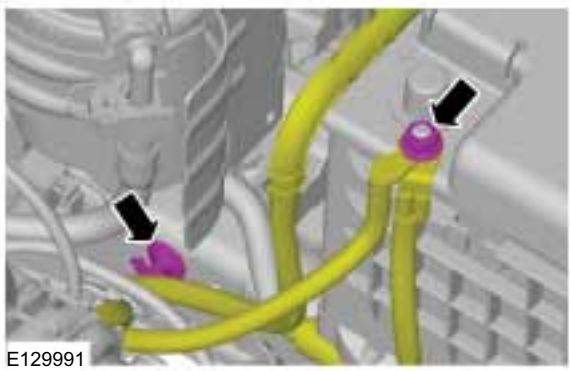
NOTE: Removal steps in this procedure may contain installation details.

1. Drain the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).

2. Refer to: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

3. Torque: 14 Nm



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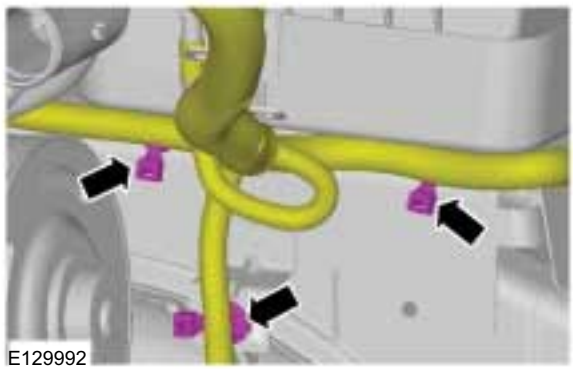

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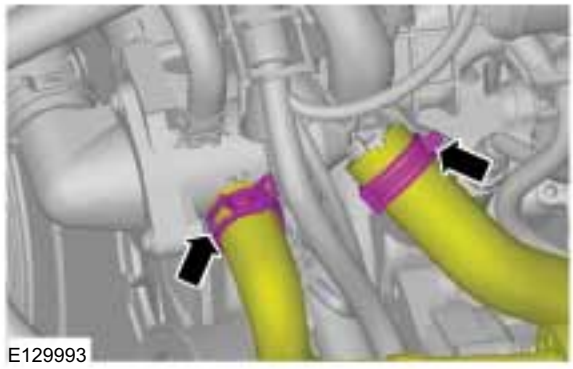
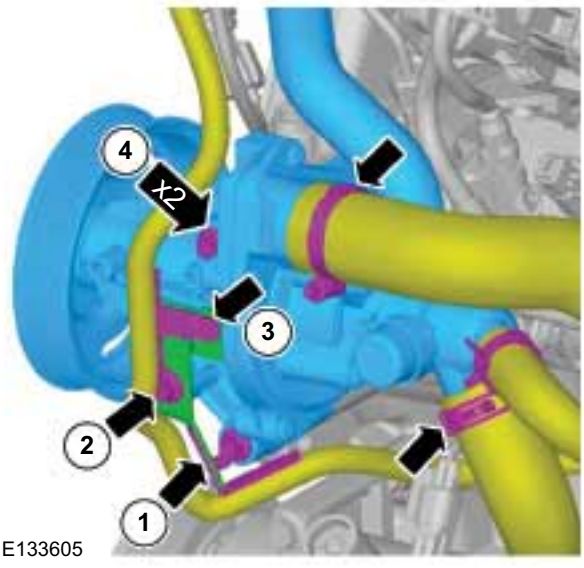
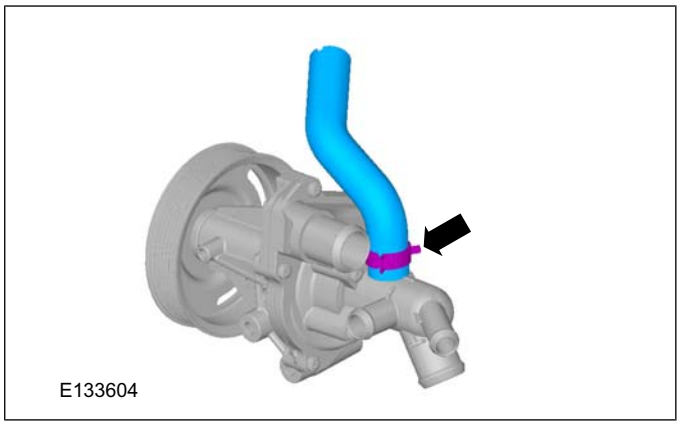


6. 2. Torque: 23 Nm
   4. Torque: 23 Nm



REMOVAL AND INSTALLATION

7. **NOTE:** Use care when cleaning the water pump gasket mating surfaces. Gouges in the aluminum could form leak paths.


E133604

Installation

1. To install, reverse the removal procedure.
2. Bleed the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).

REMOVAL AND INSTALLATION

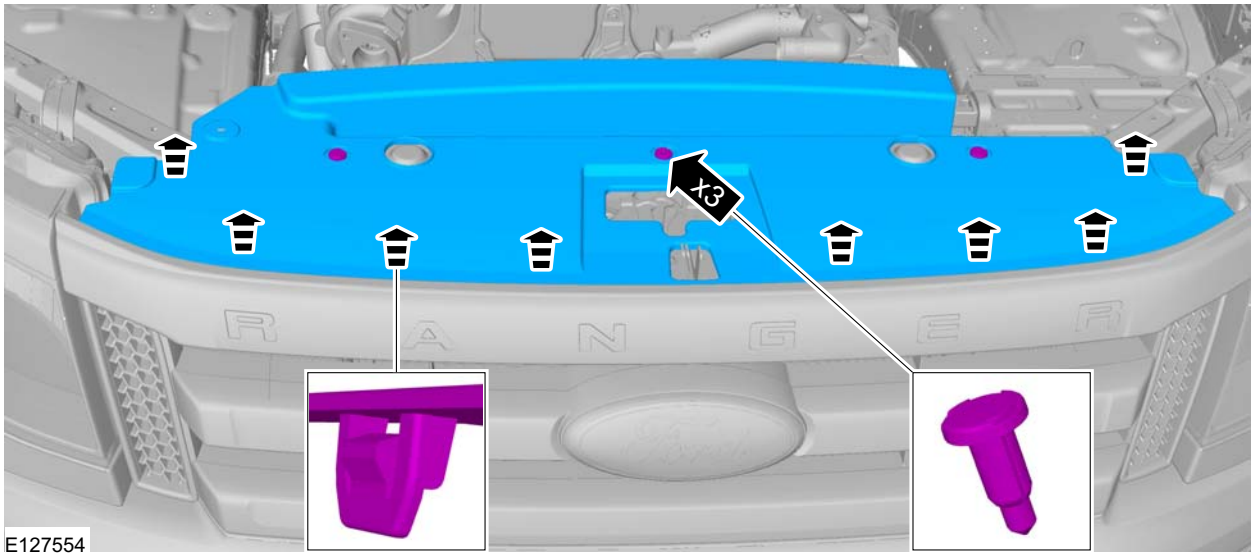
Radiator(24 254 0)

Removal

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

1. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

2.



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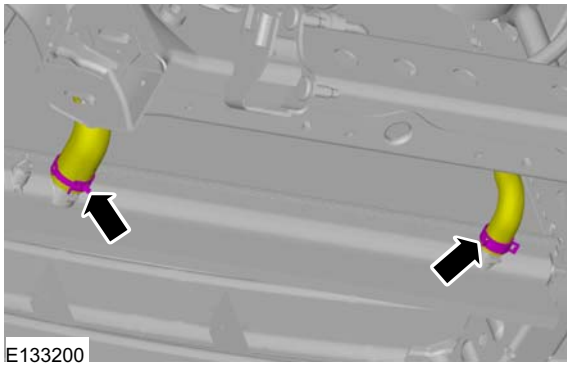
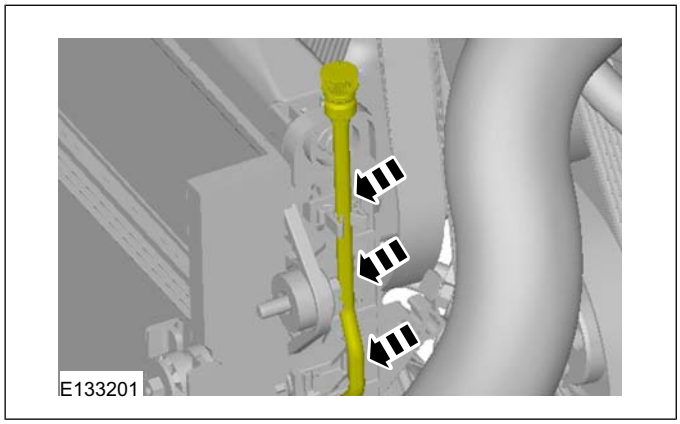
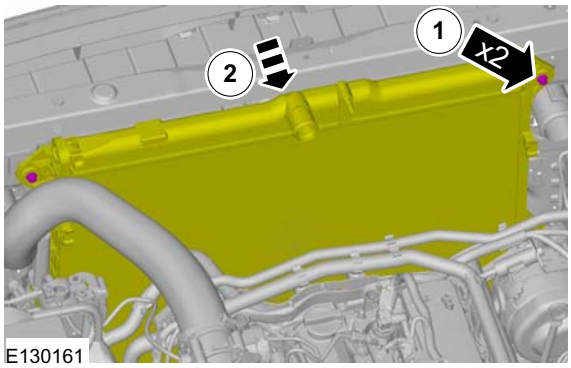


4. **NOTE:** Take extra care not to damage the A/C refrigerant filling pipe.

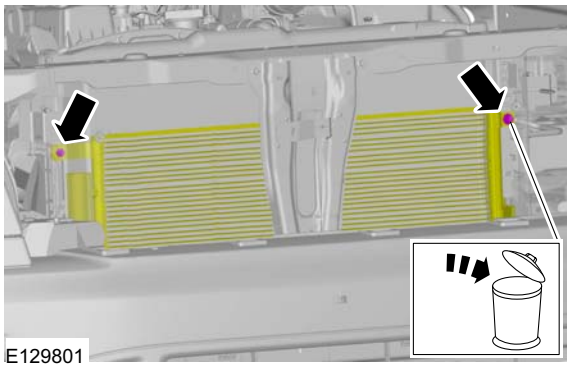


REMOVAL AND INSTALLATION

5. Torque: 20 Nm

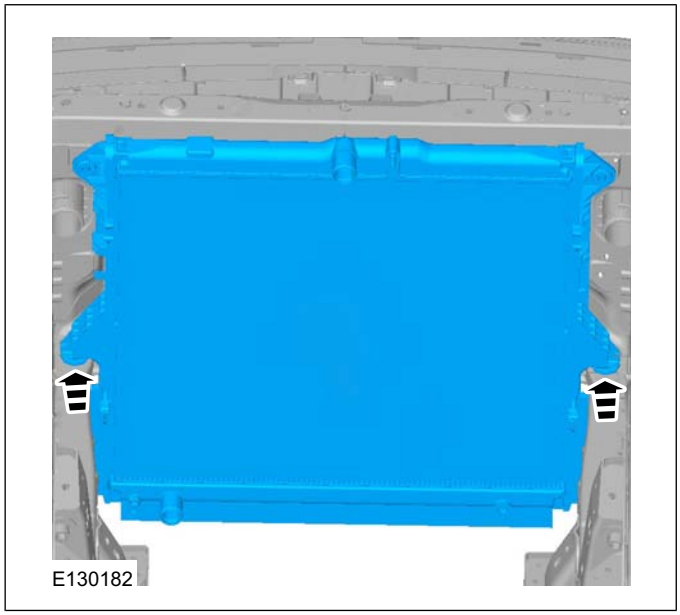


6. Lift the A/C condenser off the supports and move the A/C condenser toward the front of the vehicle and securely strap the A/C condenser on the grill support.
   Torque: 7 Nm



7. **NOTE:** Radiator insulators are to be reused unless damaged.

NOTE: Take extra care not to damage the radiator during removal.



Installation

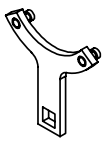
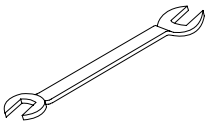
1. **NOTE:** Make sure that no components catch when installing the radiator.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Cooling Fan Motor and Shroud(24 222 0)

Special Tool(s)

 E62783	303-1196 Holding Wrench, Pulley
 24002	303-378 Wrench, Fan Hub

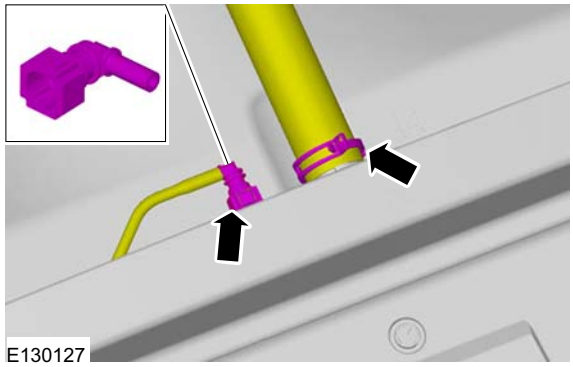
Removal

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

1. Drain the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

2.



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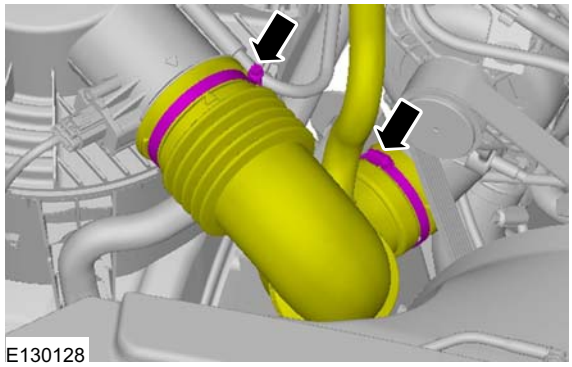

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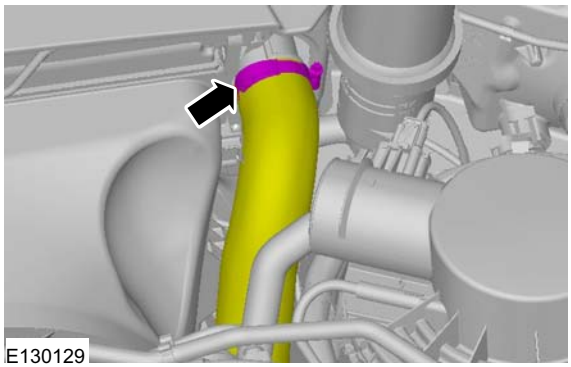

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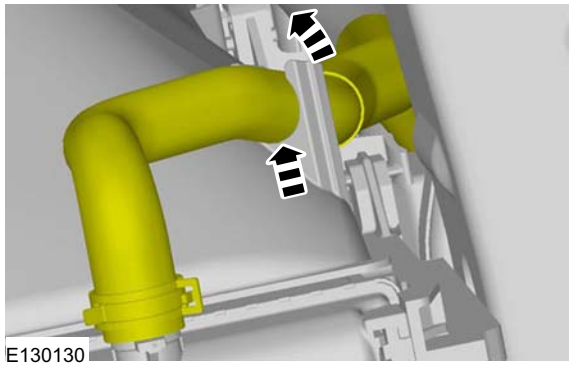
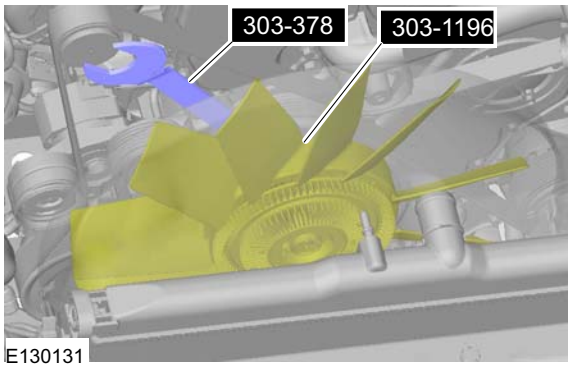
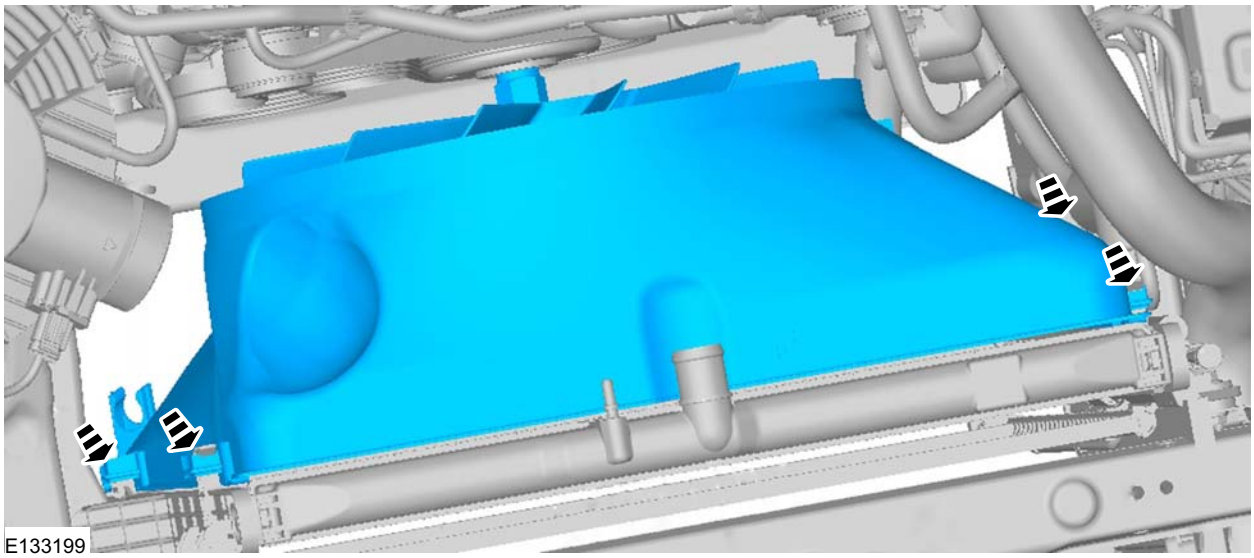


REMOVAL AND INSTALLATION

6. Special Tool(s): 303-378, 303-1196
   Torque: 105 Nm



7. Remove the fan and position it inside the shroud. Lift the fan and shroud together and remove from the vehicle.



Installation

1. To install, reverse the removal procedure.
2. Bleed the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

REMOVAL AND INSTALLATION

Coolant Outlet Connector

Removal

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

1. Drain the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).

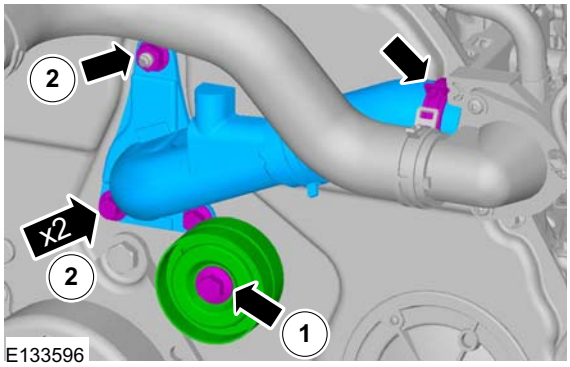
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

3. Refer to: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

4. **NOTE:** Make sure that these components are installed to the noted removal position.

   NOTE: The gasket is to be reused unless damaged.

   1. Torque: 23 Nm
   2. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

2. Bleed the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).

SECTION 303-03B Engine Cooling — 3.2L Duratorq-TDCi (148kW/200PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

SPECIFICATIONS

Antifreeze Specifications

Description	Specification
Motorcraft Super Plus 2000	WSS-M97B44-D
Specific gravity (providing no other additive is in the coolant)	1.068 at +15°C
Approximate percentage of antifreeze (by volume)	50%
Coolant remains fluid to	-30°C (-22°F)
Coolant solidifies at	-35°C (-31°F)

Cooling System Capacities — Vehicles with 3.2L Diesel Engine

Description	Liters
Vehicles with front heater only	12.9

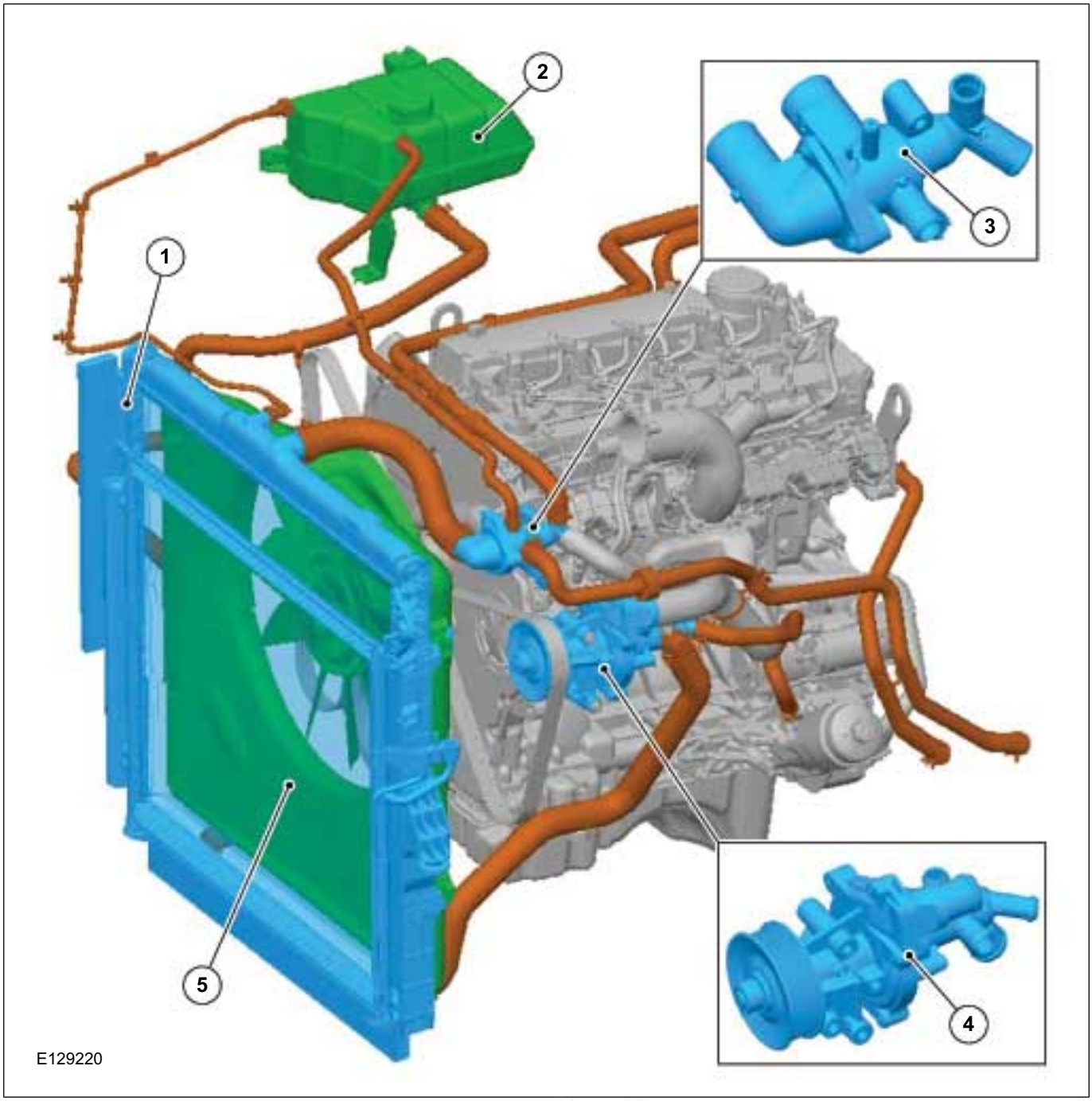
Cooling System Pressure Specification

Description	Pressure kPa (psi)
Radiator pressure test	138 (20)
Coolant expansion tank cap release pressure	135-155 (19-22)

DESCRIPTION AND OPERATION

Engine Cooling

Vehicles with 3.2L Duratorq-TDCi (Puma) diesel engine



Item	Description
1	Radiator
2	Coolant expansion tank
3	Thermostat housing

Item	Description
4	Coolant pump
5	Cooling fan motor and shroud

CAUTION: If the coolant concentration is insufficient, low temperature protection and corrosion resistance will be inadequate.

DESCRIPTION AND OPERATION

NOTE: Providing the coolant has not been contaminated with other fluids or foreign material, the robust corrosion resistance properties of this coolant means that it can be reused after changing an aluminium cooling system component. The concentration should always be checked and maintained within specification.

Coolant concentration should be checked through the neck of the coolant expansion tank with a hydrometer. The acceptable range of specific gravity (sg) must be maintained.

The coolant used is an orange colored Motorcraft Super Plus 2000 engine coolant. This is a non silicated organic acid technology (OAT) coolant that must not be mixed with other coolant types. For cooling system top up, only use coolant which meets the correct specification.

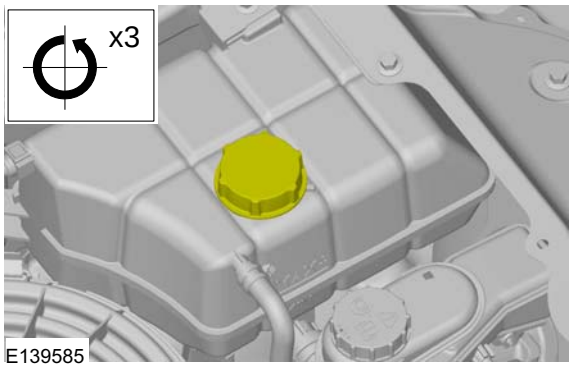
GENERAL PROCEDURES

Cooling System Draining, Filling and Bleeding — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma(24 122 0)

Draining

WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

1. Release the cooling system pressure by slowly turning the coolant expansion tank cap between 2 and 3 turns.



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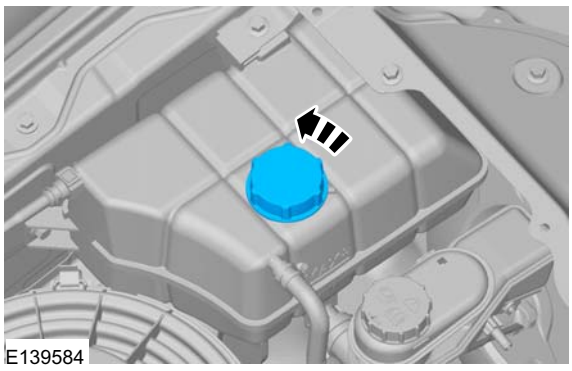
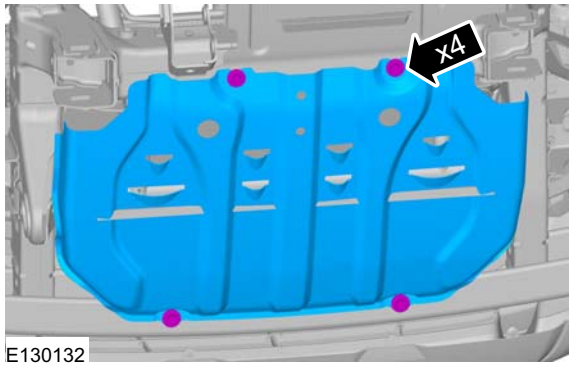
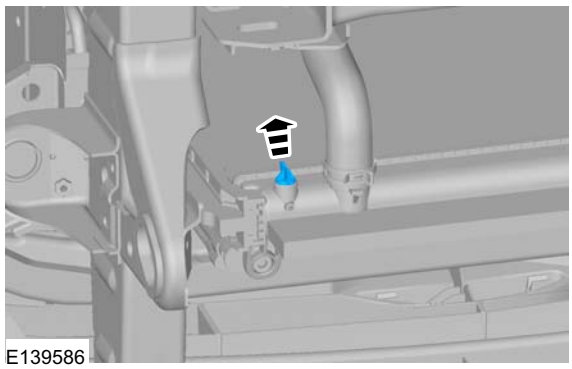


3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

4.



5. Remove the radiator drain plug and drain the coolant.



6. Install the radiator drain plug.

7. Lower the vehicle.

Filling

1. Refill the coolant to the expansion tank to maximum line (+15mm).

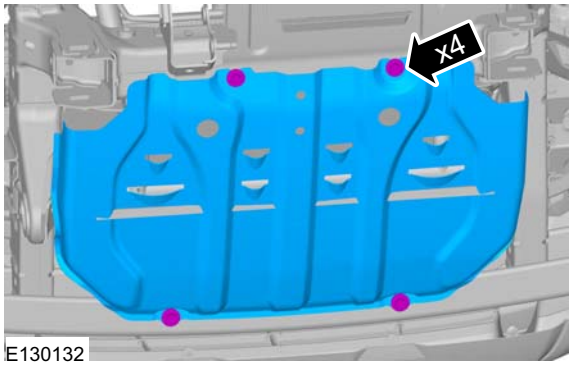
Bleeding

CAUTION: The fluid level must remain between the MAX and MIN marks.

1. Run the engine for 5 minutes at idle rpm.

GENERAL PROCEDURES

2. Install the coolant expansion tank cap.
3. Run the engine speed to 2500 RPM and maintain it for approximately 15 minutes.
4. Run the engine for 5minutes at idle rpm.
5. Switch the engine off.
6. Check the cooling system for leaks.
7. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
8. Torque: 30 Nm



9. Lower the vehicle.
10. Allow the engine to cool and maintain close to room temperature.
11. Fill the coolant to the expansion tank max fill line, if required.

REMOVAL AND INSTALLATION

Thermostat(24 454 0)

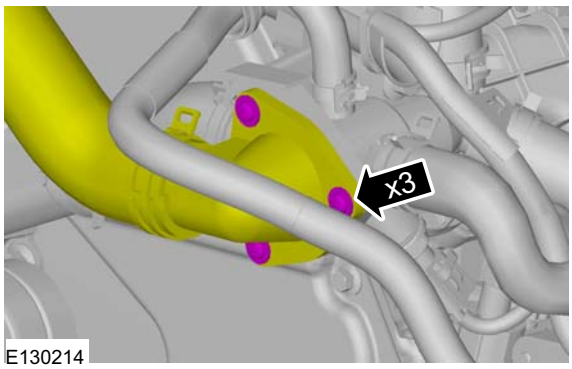
Removal

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

1. Drain the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

2. Torque: 10 Nm



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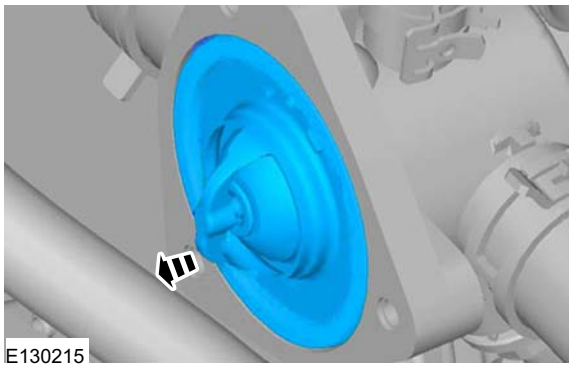


Installation

1. **NOTE:** Inspect the thermostat housing cover O-ring seal. Install a new O-ring seal if necessary.

   To install, reverse the removal procedure.

2. Bleed the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

REMOVAL AND INSTALLATION

Thermostat Housing(24 001 0)

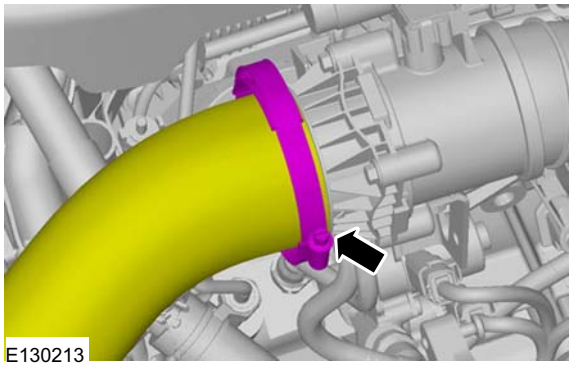
Removal

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

1. Drain the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

2.



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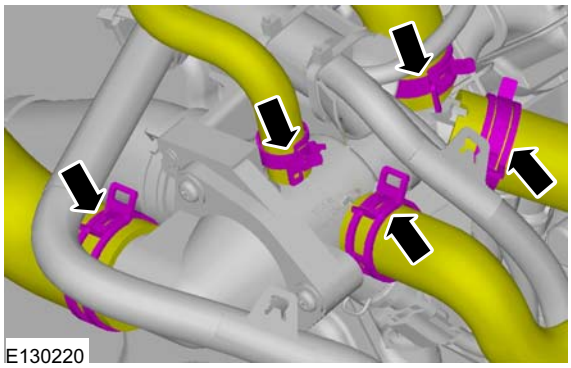
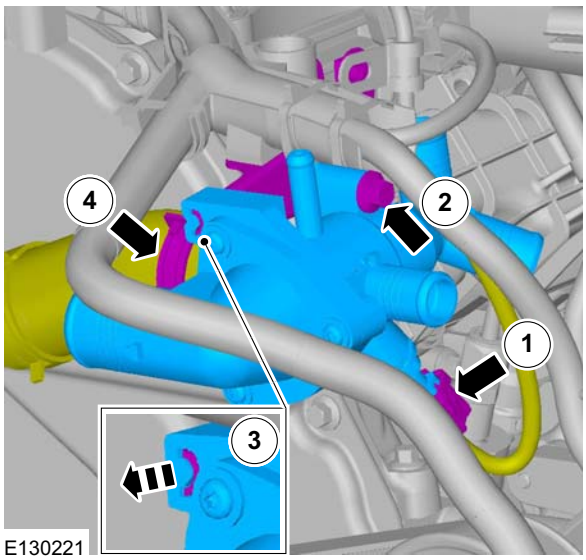


4. Torque: 23 Nm



Installation

1. To install, reverse the removal procedure.
2. Bleed the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

REMOVAL AND INSTALLATION

Coolant Pump(24 404 0)

Removal

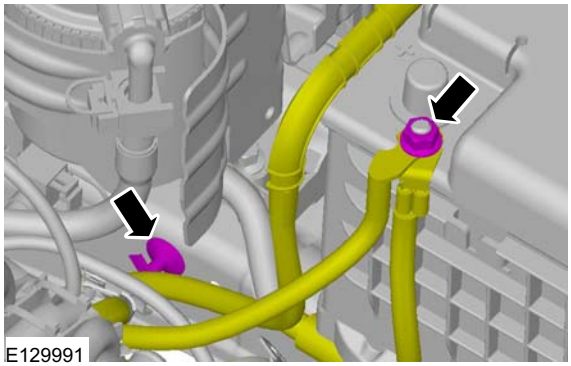
NOTE: Removal steps in this procedure may contain installation details.

1. Drain the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).

2. Refer to: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

3. Torque: 14 Nm



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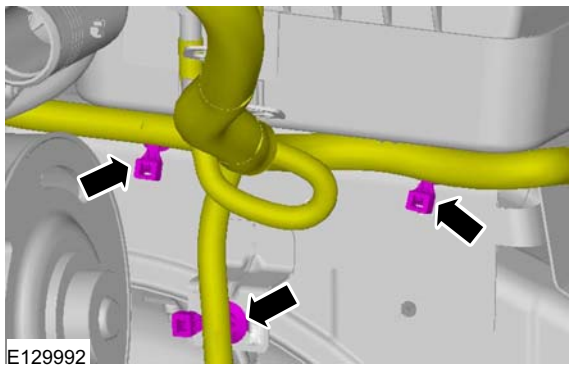

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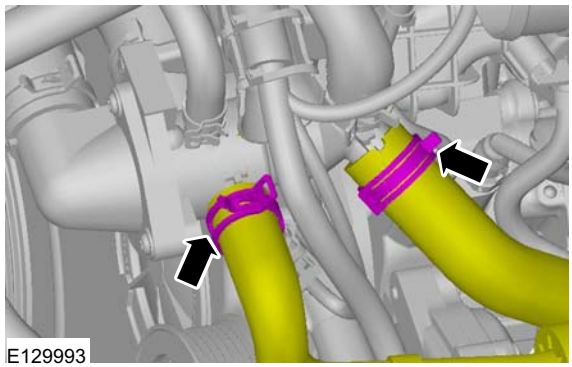
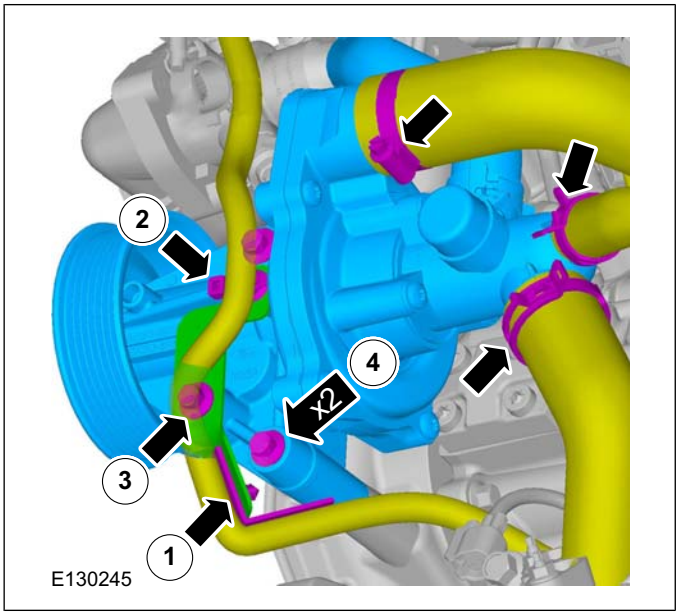
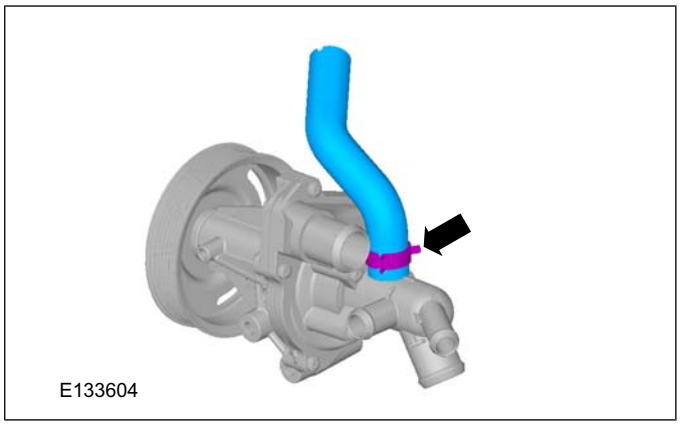


6. 3. Torque: 23 Nm
   4. Torque: 23 Nm



REMOVAL AND INSTALLATION

7. **NOTE:** Use care when cleaning the water pump gasket mating surfaces. Gouges in the aluminum could form leak paths.


E133604

Installation

1. To install, reverse the removal procedure.
2. Bleed the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).

REMOVAL AND INSTALLATION

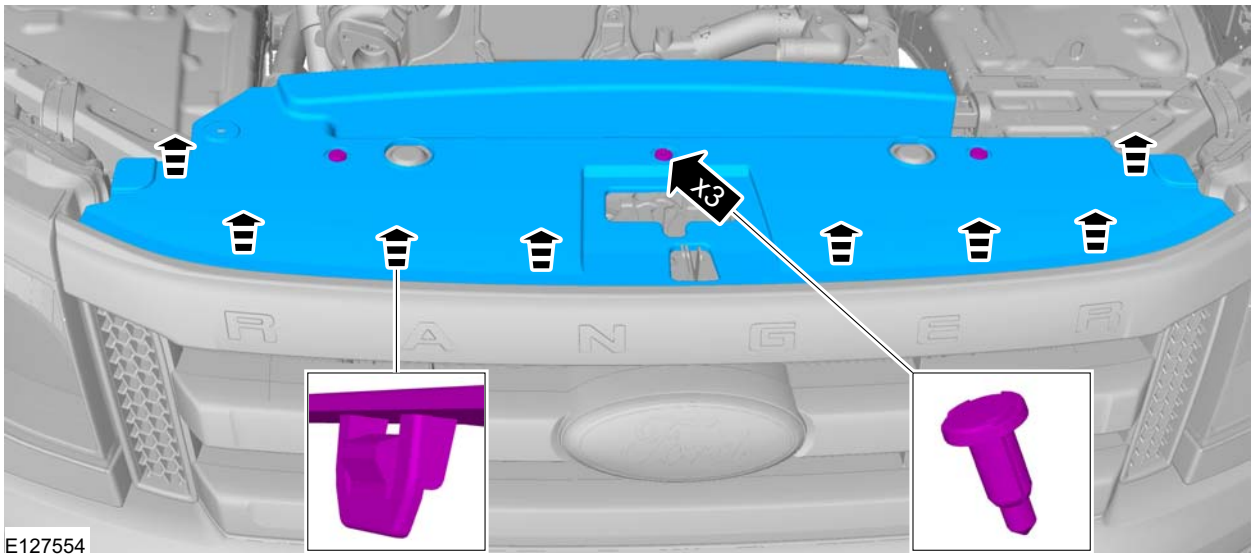
Radiator(24 254 0)

Removal

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

1. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

2.



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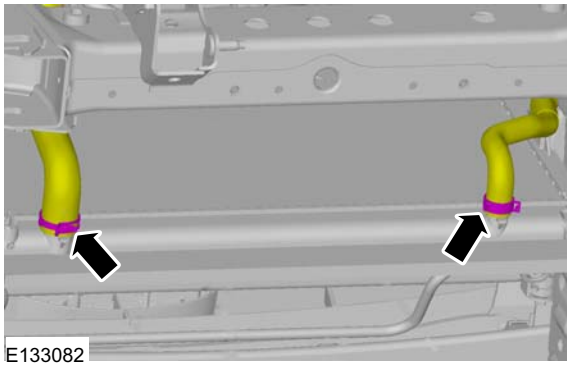
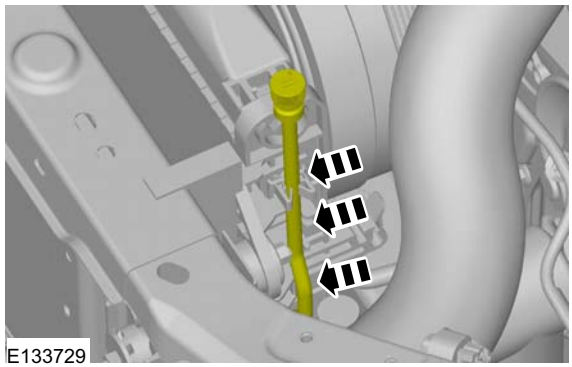
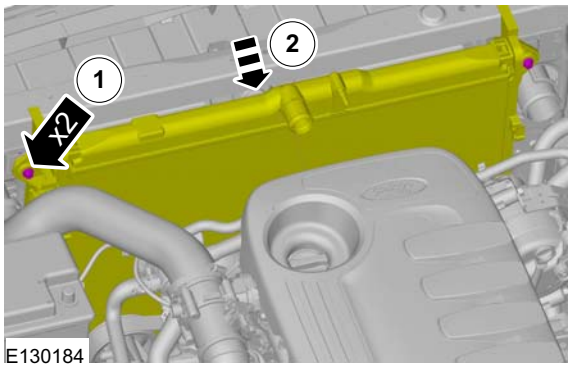


4. **NOTE:** Take extra care not to damage the A/C refrigerant filling pipe.

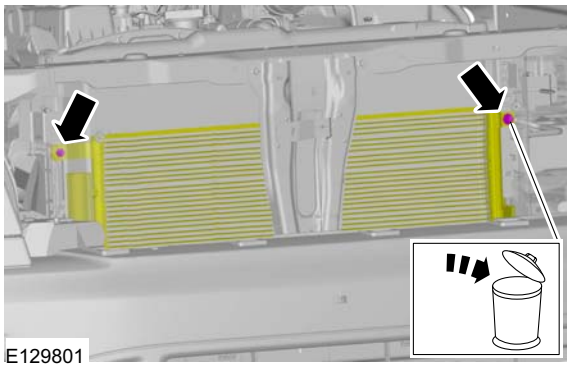


REMOVAL AND INSTALLATION

5. Torque: 20 Nm

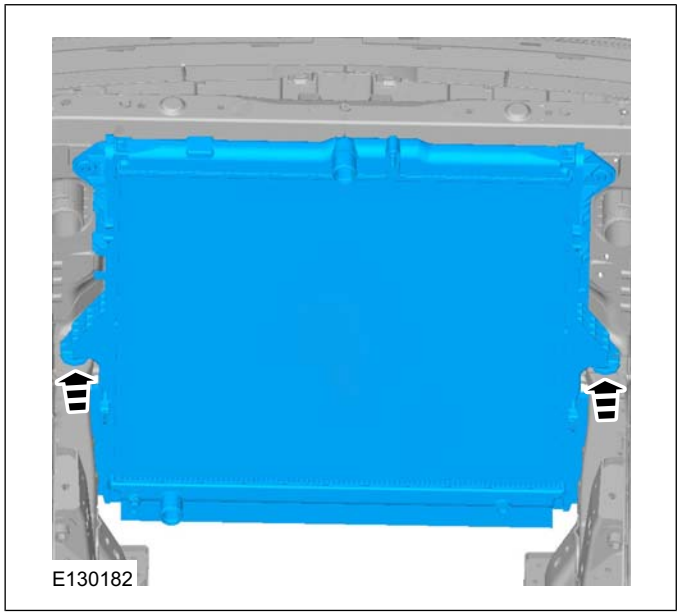


6. Lift the A/C condenser off the supports and move the A/C condenser toward the front of the vehicle and securely strap the A/C condenser on the grill support.
   Torque: 7 Nm



7. **NOTE:** Radiator insulators are to be reused unless damaged.

NOTE: Take extra care not to damage the radiator during removal.



Installation

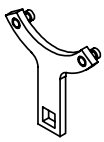
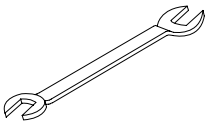
1. **NOTE:** Make sure that no components catch when installing the radiator.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Cooling Fan Motor and Shroud(24 222 0)

Special Tool(s)

 E62783	303-1196 Holding Wrench, Pulley
 24002	303-378 Wrench, Fan Hub

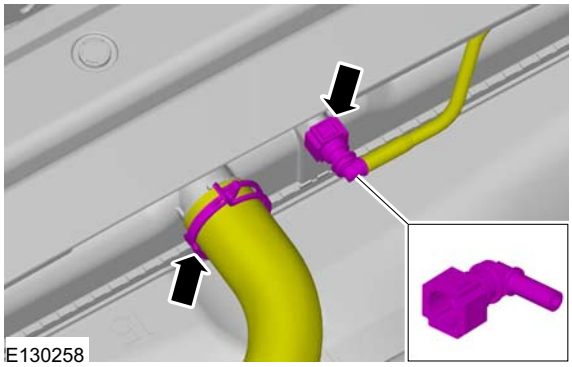
Removal

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

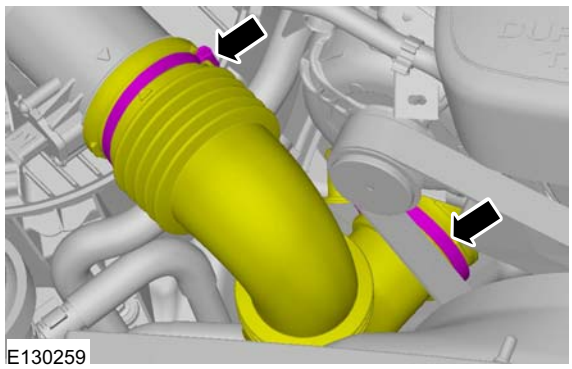
1. Drain the cooling system.

Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

2.



3.



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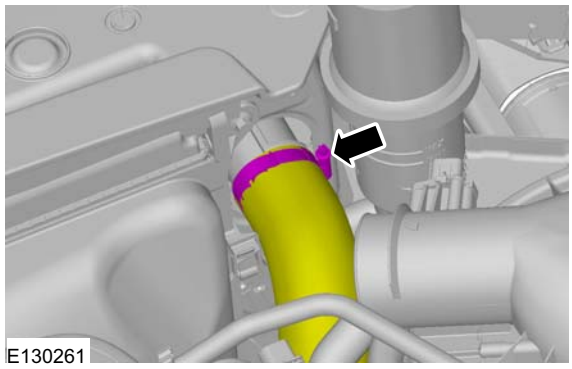
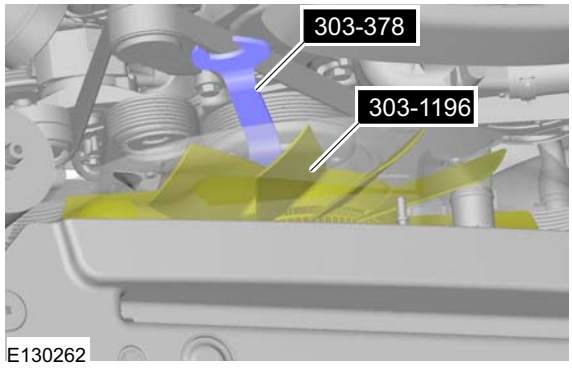
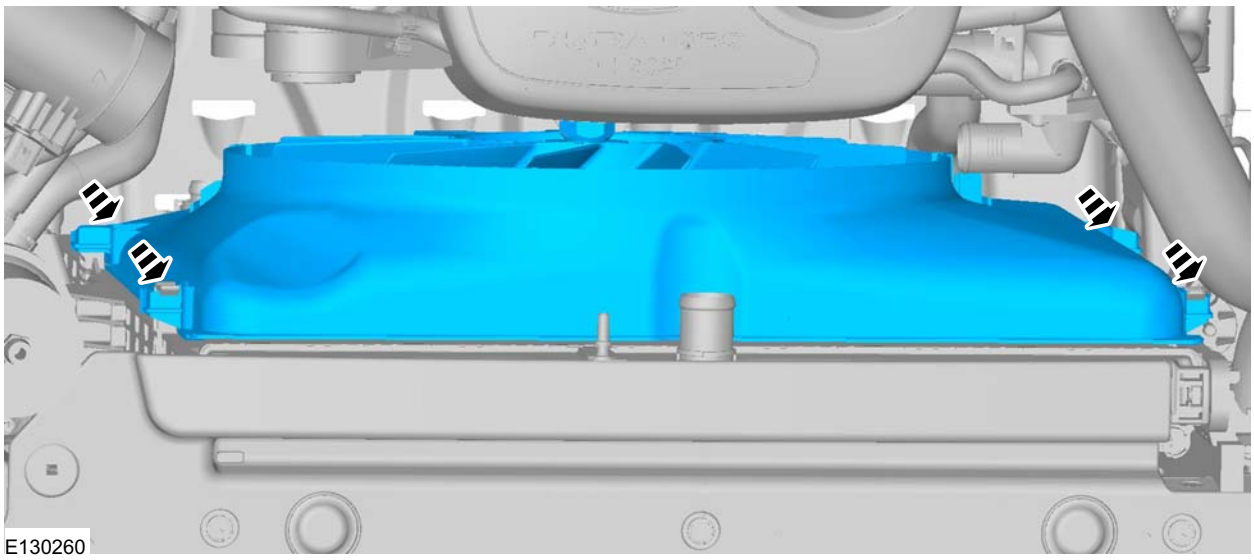


5. Special Tool(s): 303-378, 303-1196
Torque: 105 Nm



6. Remove the fan and position it inside the shroud. Lift the fan and shroud together and remove from the vehicle.

REMOVAL AND INSTALLATION



Installation

1. To install, reverse the removal procedure.
2. Bleed the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

REMOVAL AND INSTALLATION

Coolant Outlet Connector

Removal

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

1. Drain the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).

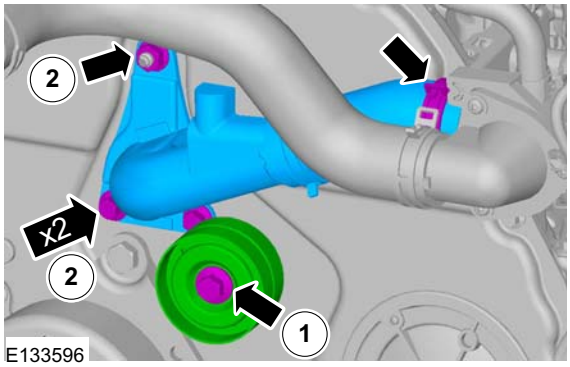
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

3. Refer to: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

4. **NOTE:** Make sure that these components are installed to the noted removal position.

   NOTE: The gasket is to be reused unless damaged.

   1. Torque: 23 Nm
   2. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

2. Bleed the cooling system.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).

SECTION 303-03C Engine Cooling

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

SPECIFICATIONS

Lubricants, Fluids, Sealers and Adhesives

Item	Specification
Motorcraft Super Plus Antifreeze	WSS-M97B44–D

Antifreeze

Specific Gravity (providing no other additive is in coolant)	Approximate percentage of Anti-Freeze (by volume)	Remains Fluid to	Solidifies at
1.068 at +15°C	50%	–30°C (–22°F)	–35°C (–31°F)

Cooling System Refill Capacity - Vehicles with 2.5L Duratec-HE (MI4) engine

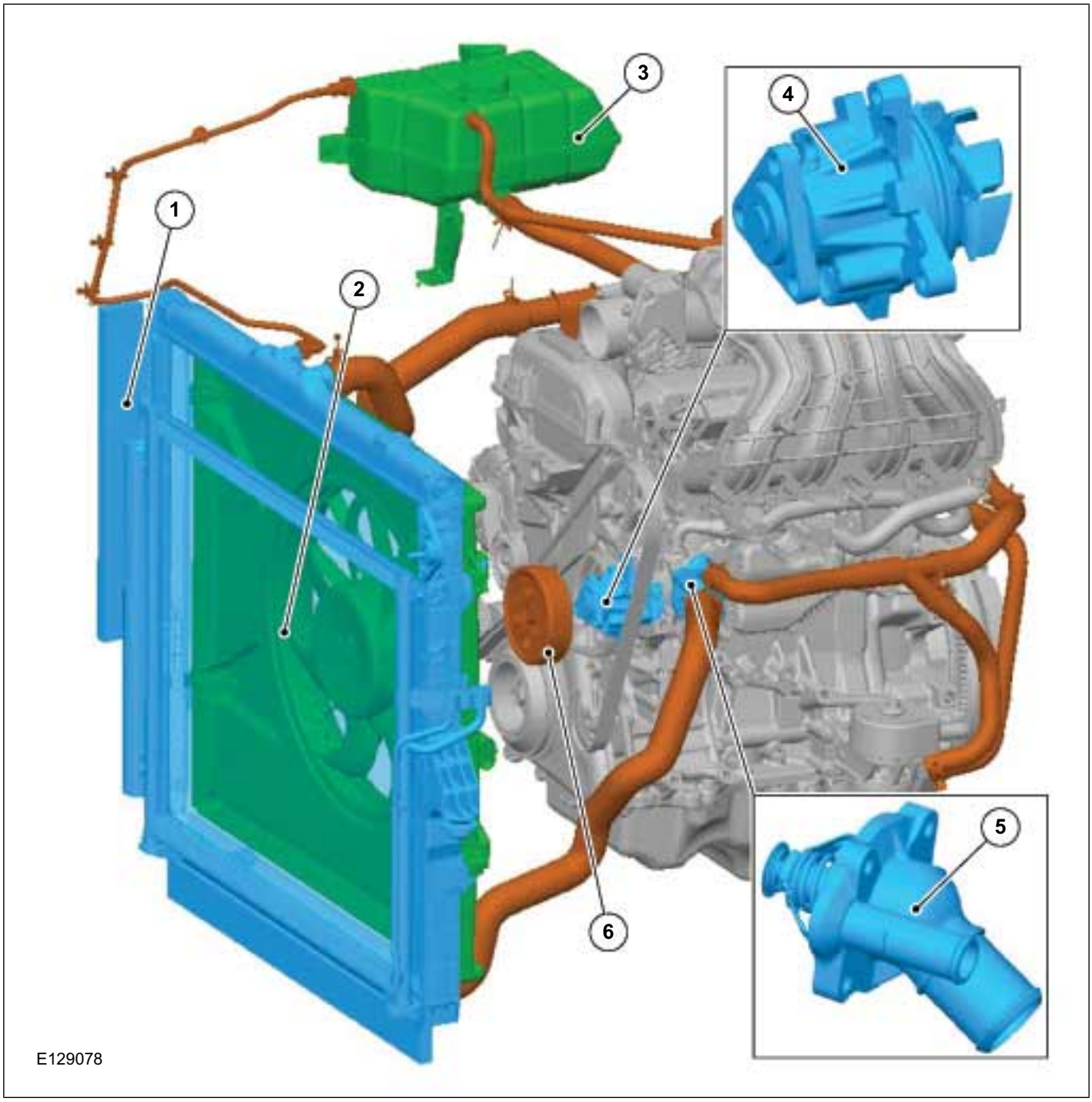
Description	Liters
Cooling system and heater	11.0

Cooling System Pressure Specification

Description	Pressure kpa (psi)
Radiator pressure test	138 (20)
Coolant expansion tank cap release pressure	135 to 155 (19 to 22)

DESCRIPTION AND OPERATION

Engine Cooling



Item	Description
1	Radiator
2	Cooling fan motor and shroud
3	Coolant expansion tank
4	Coolant pump
5	Thermostat
6	Coolant pump pulley

CAUTION: If the coolant concentration is insufficient, low temperature protection and corrosion resistance will be impaired.

NOTE: Providing the coolant has not been contaminated with other fluids or foreign material, the robust corrosion resistance properties of this coolant means that it can be reused after changing an aluminum cooling system component. The concentration should always be checked and maintained within the specification.

DESCRIPTION AND OPERATION

Coolant concentration should be checked through the neck of the coolant expansion tank with a hydrometer. The acceptable range of specific gravity (sg) must be maintained.

The coolant used is an orange colored Motorcraft Super Plus 2000 engine coolant. This is a non silicated organic acid technology (OAT) coolant that must not be mixed with other coolant types. For cooling system top up, only use coolant which meets the correct specification.

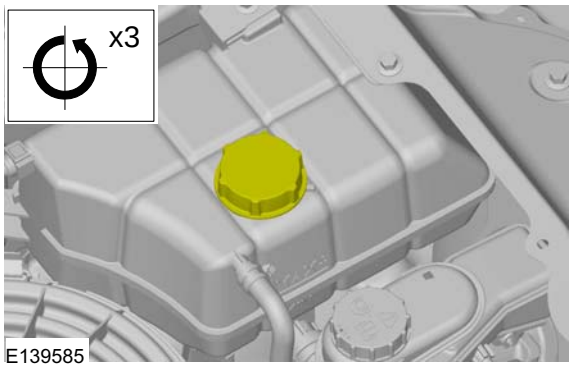
GENERAL PROCEDURES

Cooling System Draining, Filling and Bleeding(24 122 0)

Draining

WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

1. Release the cooling system pressure by slowly turning the coolant expansion tank cap between 2 and 3 turns.



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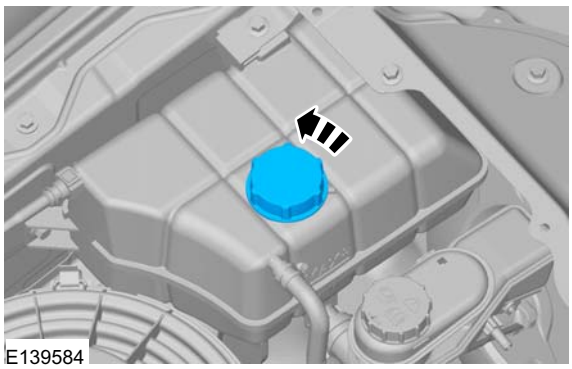
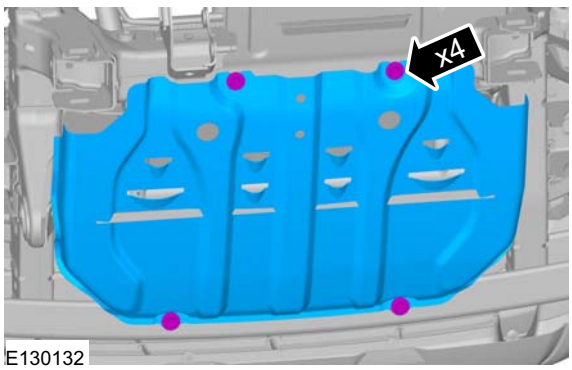
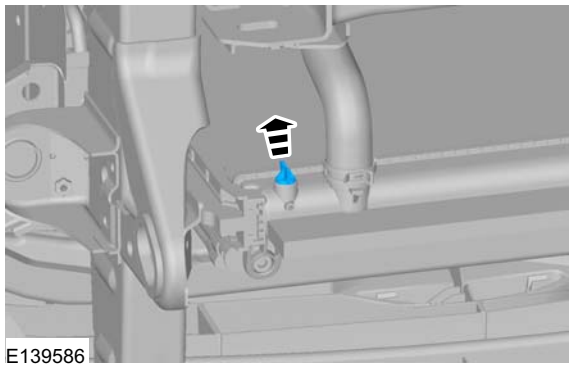


3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

4.



5. Remove the radiator drain plug and drain the coolant.



6. Install the radiator drain plug.
7. Lower the vehicle.

Filling

1. Refill the coolant to the expansion tank to maximum line (+15mm).

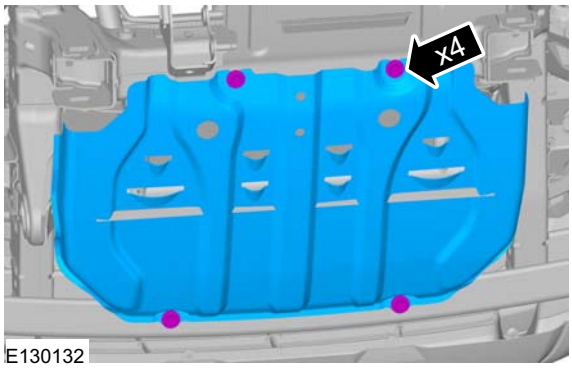
Bleeding

CAUTION: The fluid level must remain between the MAX and MIN marks.

1. Run the engine for 5 minutes at idle rpm.
2. Install the coolant expansion tank cap.
3. Run the engine speed to 2500 RPM and maintain it for approximately 15 minutes.
4. Run the engine for 5minutes at idle rpm.
5. Switch the engine off.
6. Check the cooling system for leaks.

GENERAL PROCEDURES

7. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
8. Torque: 30 Nm



9. Lower the vehicle.
10. Allow the engine to cool and maintain close to room temperature.
11. Fill the coolant to the expansion tank max fill line, if required.

GENERAL PROCEDURES

Cooling System Draining and Vacuum Filling

General Equipment

Cooling System Vacuum Tester and Refiller
Fluid Container

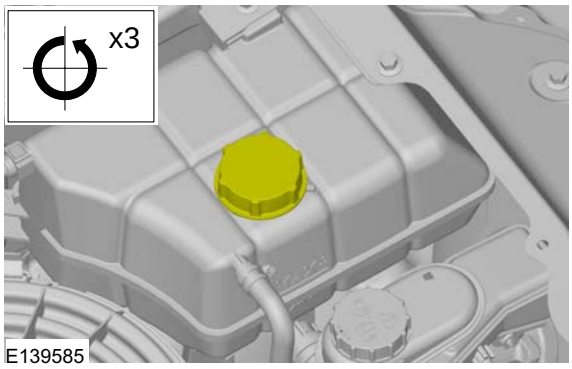
Draining

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.

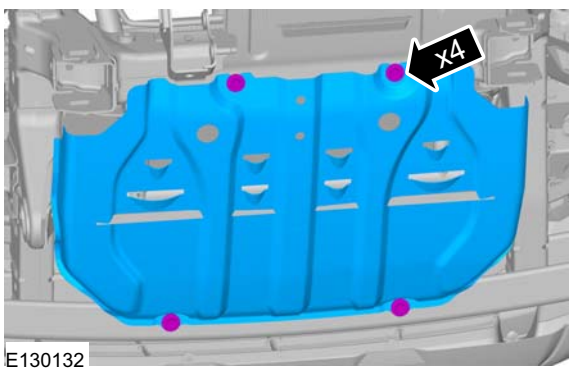
1. Refer to: Engine Cooling System Health and Safety Precautions (100-00 General Information, Description and Operation).

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.

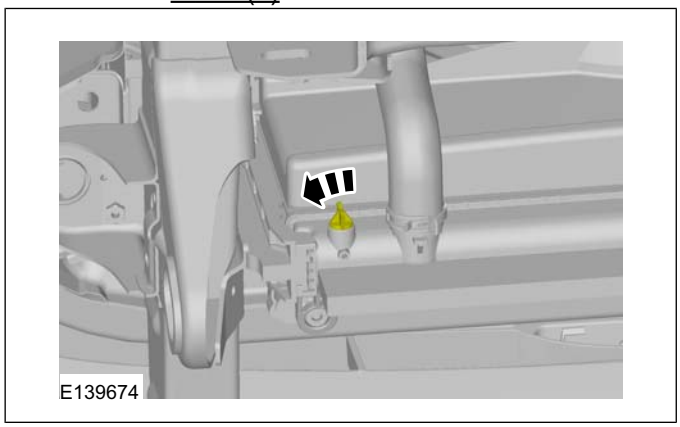


5.

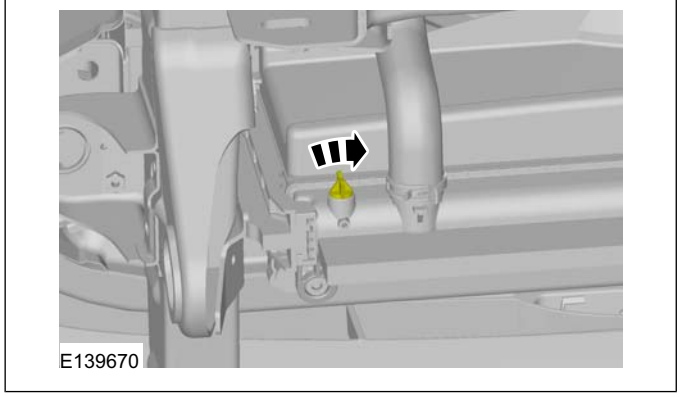
WARNING: Be prepared to collect escaping fluid.

Use a suitable coolant hose to drain the coolant.

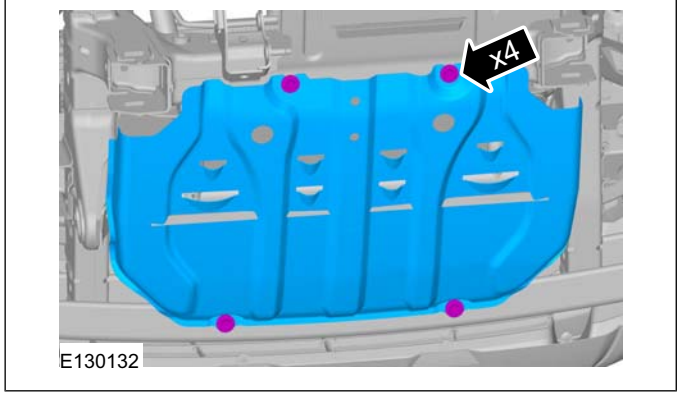
General Equipment: Fluid Container
Loosen: 4 turn(s)



6. Install the radiator drain plug.



7. Torque: 30 Nm

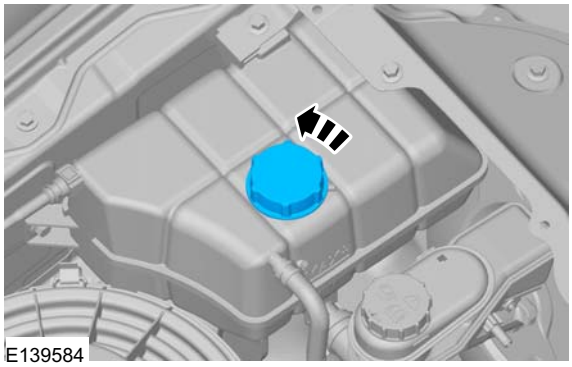


GENERAL PROCEDURES

Evacuating and Filling

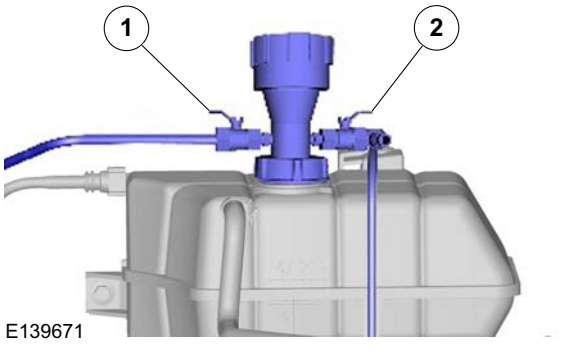
1. • If the cooling system was completely drained, fill the fluid container with the full cooling system fill capacity plus 0.5L of additional coolant.
   • If the cooling system was partially drained, fill the fluid container with the removed and spilled amount of coolant plus 1.0L of additional coolant. When in doubt always use the full cooling system fill capacity plus 0.5L of additional coolant.

2. Remove the coolant expansion tank cap.

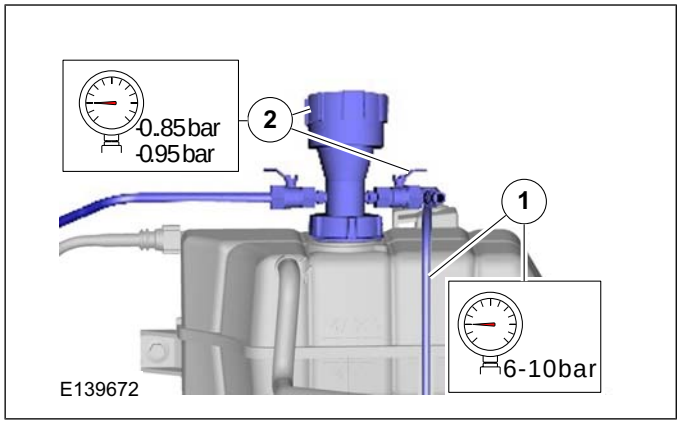


3. 1. Close the valve, install the coolant hose and place it into the fluid container.

   General Equipment: Cooling System Vacuum Tester and Refiller
   2. Close the valve and connect the compressed air hose.

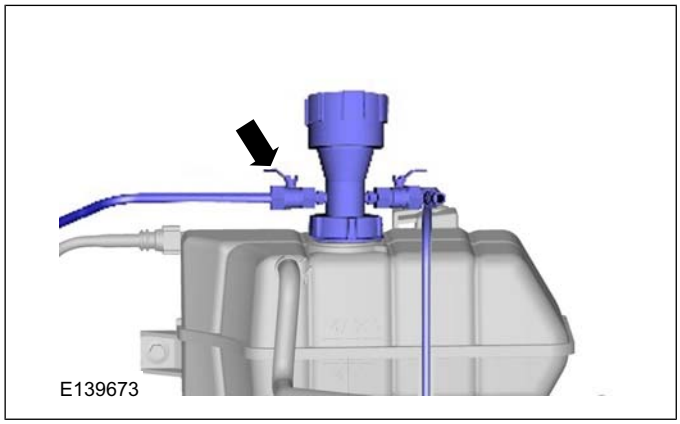


4. 1. General Equipment: Cooling System Vacuum Tester and Refiller
   2. Open the valve until the specificied vacuum is achieved.

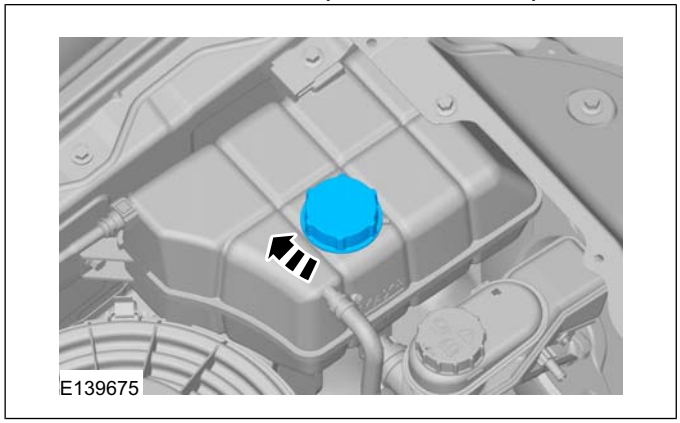


5. • Open the valve until the coolant reservoir fluid level is at the MAX mark.

   General Equipment: Cooling System Vacuum Tester and Refiller
   • 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. Install the coolant expansion tank cap.



REMOVAL AND INSTALLATION

Thermostat(24 454 0)

Removal

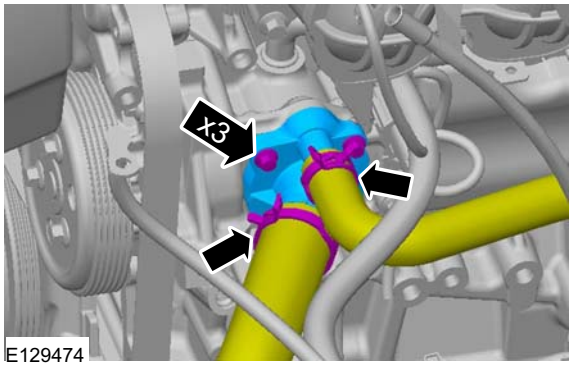
NOTE: Removal steps in this procedure may contain installation details.

1. Drain the cooling system.

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

2. **NOTE:** The gasket is to be reused unless damaged.

   Torque: 10 Nm



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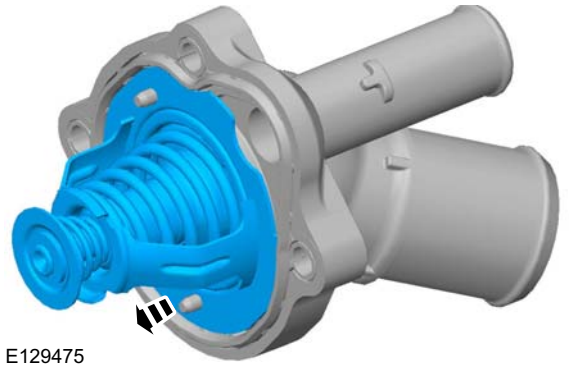


Installation

1. To install, reverse the removal procedure.
2. Bleed the cooling system.

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

REMOVAL AND INSTALLATION

Coolant Pump(24 404 0)

Removal

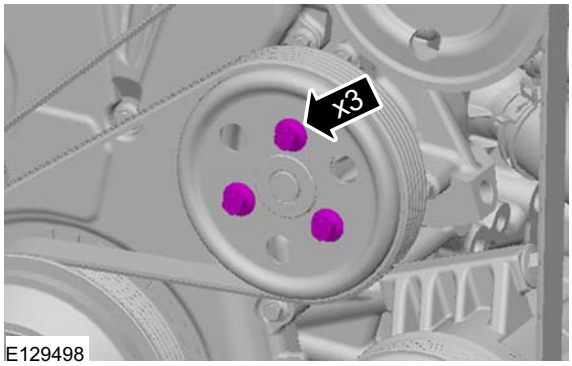
NOTE: Removal steps in this procedure may contain installation details.

1. Drain the cooling system.

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

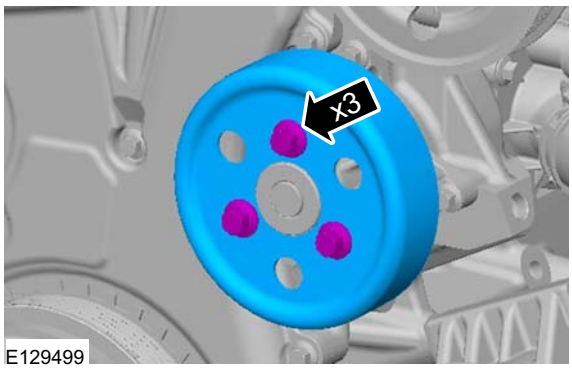
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

3. Loosen: 3 turn(s)



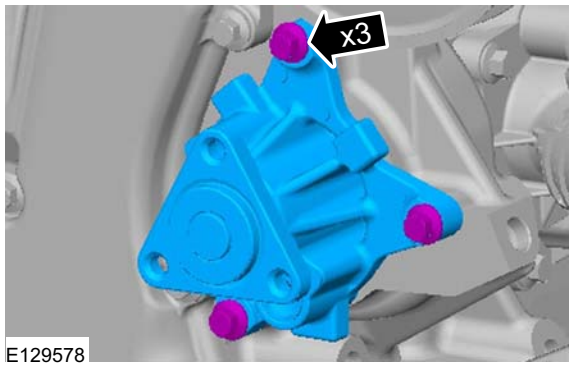
4. Refer to: Accessory Drive Belt (303-05 Accessory Drive - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

5. Torque: 20 Nm



6. **NOTE:** Make sure that the mating faces are clean and free of foreign material.

   Torque: 10 Nm



Installation

1. **NOTE:** Install all the bolts finger tight before final tightening.

   To install, reverse the removal procedure.

2. Bleed the cooling system.

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

REMOVAL AND INSTALLATION

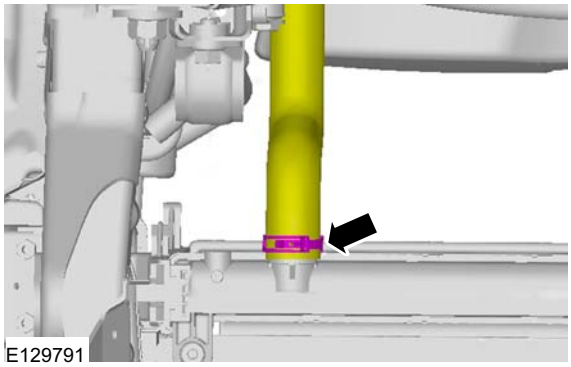
Radiator(24 254 0)

Removal

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

1. Refer to: Cooling Fan Motor and Shroud (303-03 Engine Cooling, Removal and Installation).

2.



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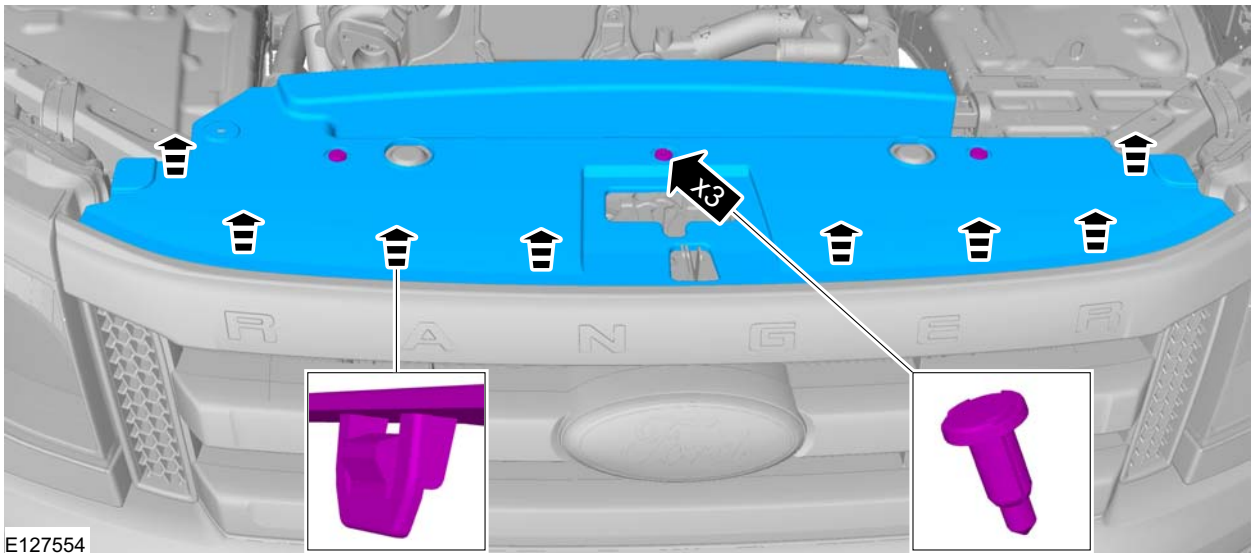
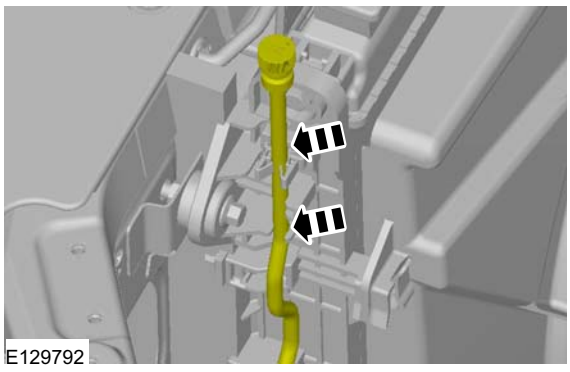
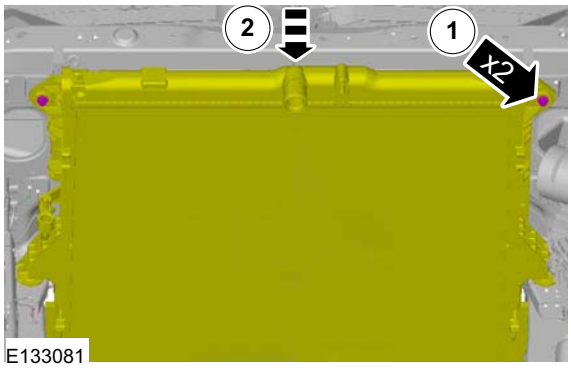


4. **NOTE:** Take extra care not to damage the A/C refrigerant filling pipe.



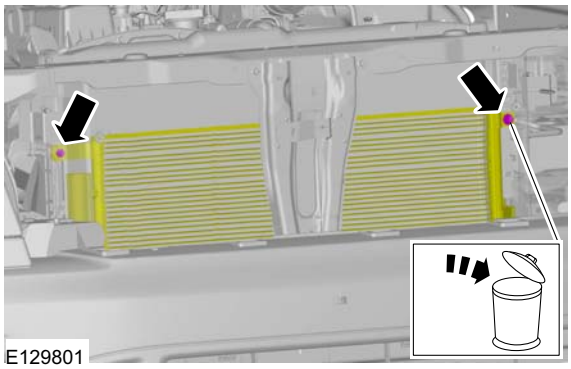
5. **NOTE:** Take extra care not to bend the radiator.

Torque: 20 Nm



REMOVAL AND INSTALLATION

6. Lift the A/C condenser off the supports and move the A/C condenser toward the front of the vehicle and securely strap the A/C condenser on the grill support.
   Torque: 7 Nm



7. **NOTE:** Radiator insulators are to be reused unless damaged.

   NOTE: Take extra care not to damage the radiator during removal.

Installation

1. **NOTE:** Make sure that no components catch when installing the radiator.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Cooling Fan Motor and Shroud(24 222 0)

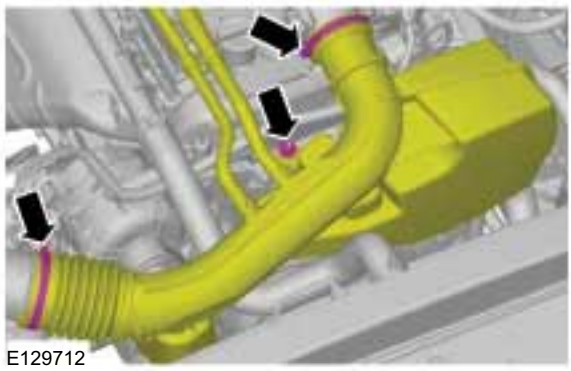
Removal

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

1. Drain the cooling system.

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

2. Torque: 11 Nm


E129712

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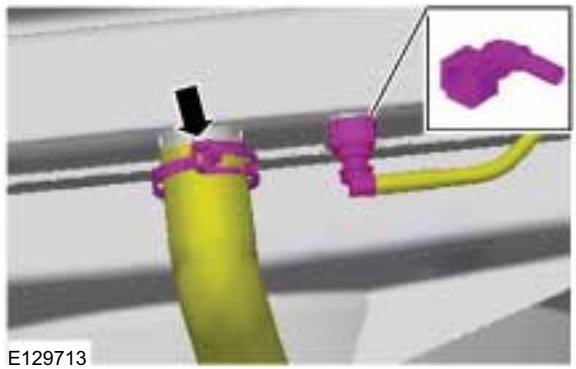
E129713

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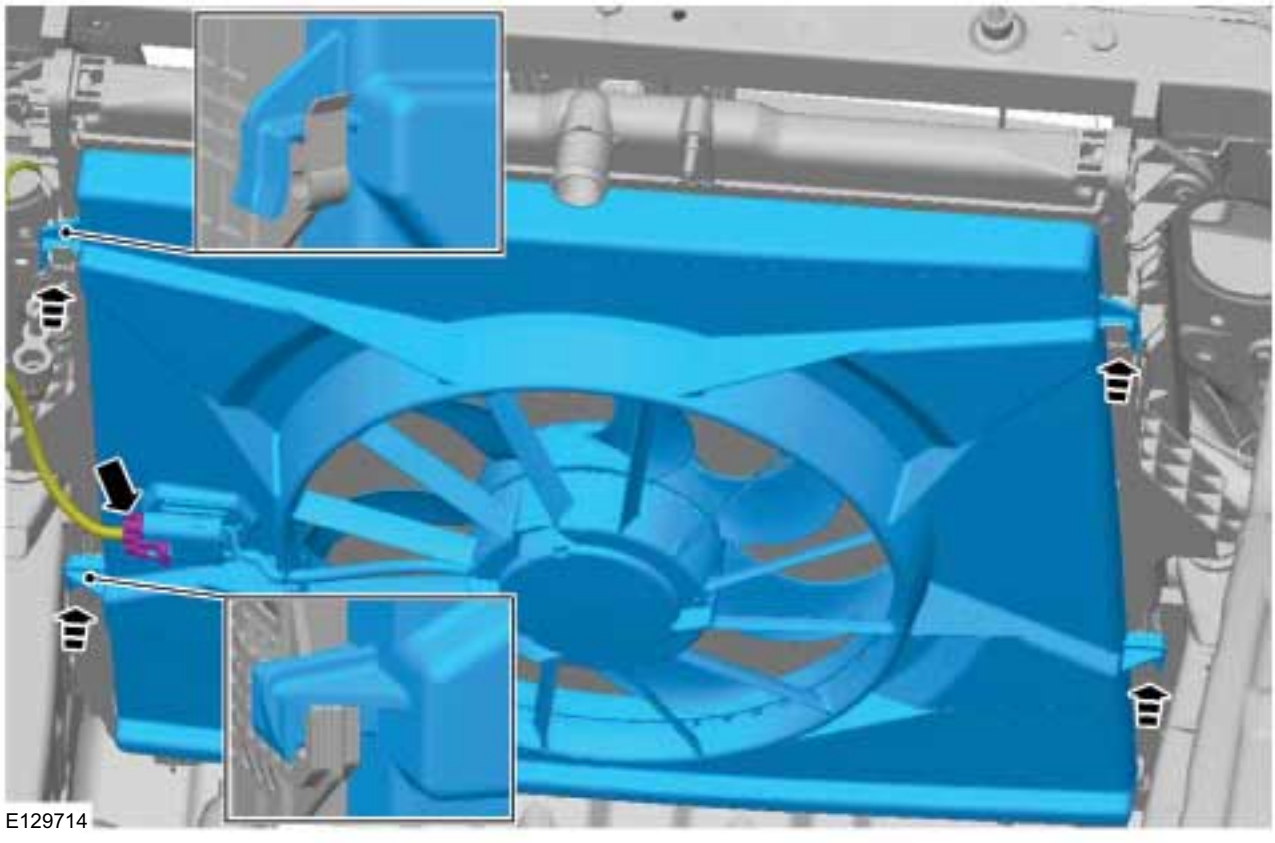

E129714

REMOVAL AND INSTALLATION

Installation

1. To install, reverse the removal procedure.
2. Bleed the cooling system.

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

REMOVAL AND INSTALLATION

Coolant Outlet Connector

Removal

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

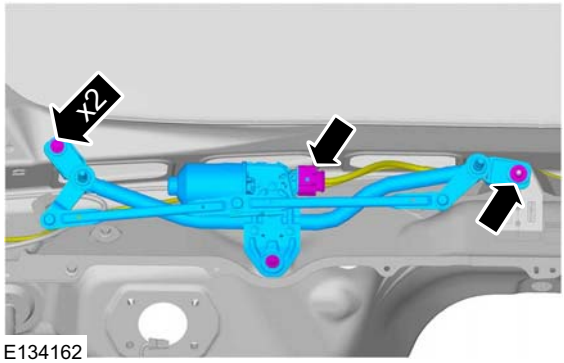
1. Drain the cooling system.

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

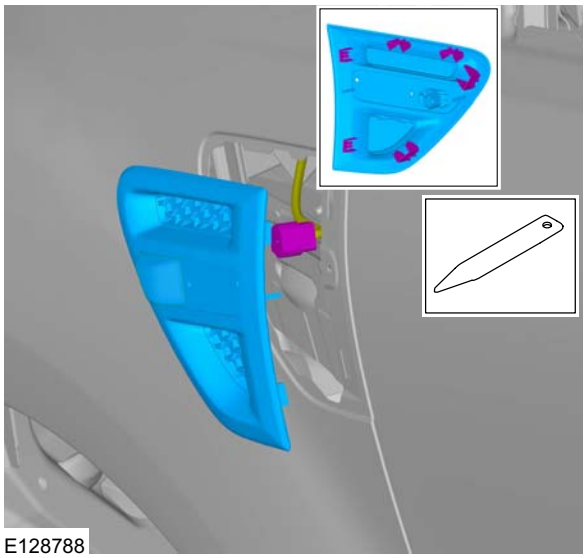
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

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

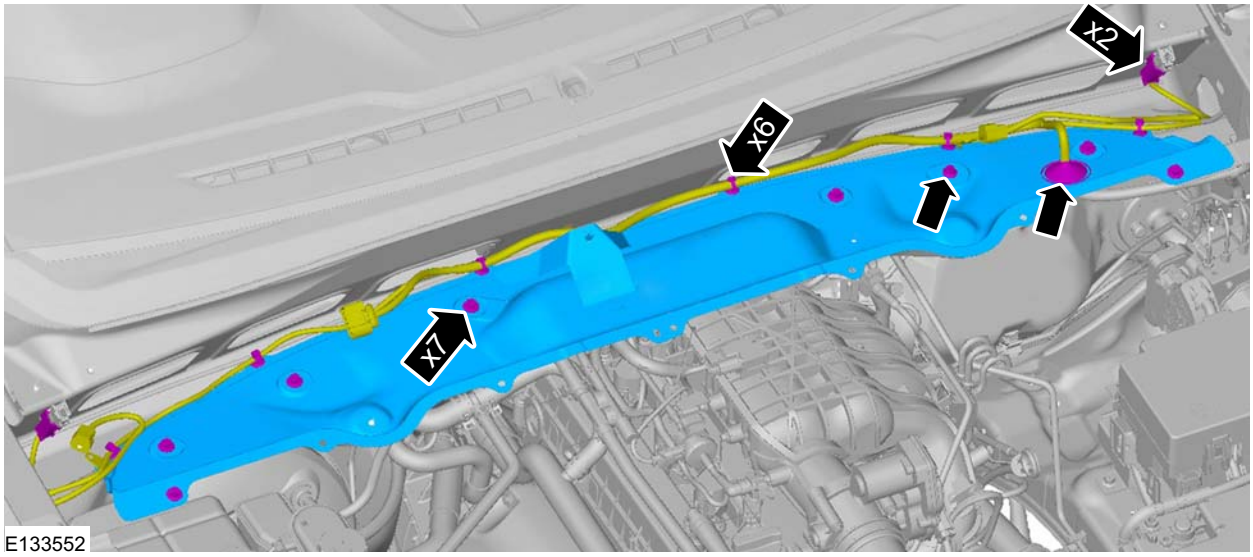
4. Torque: 11 Nm



5. on both sides.

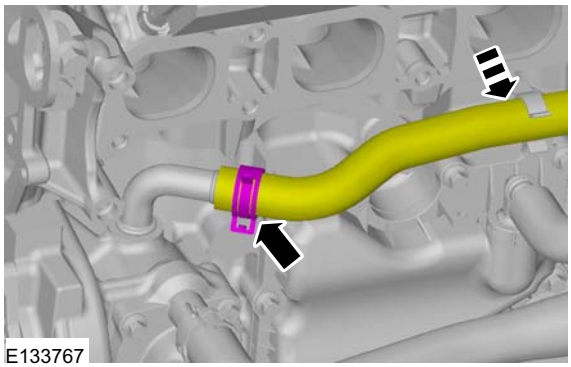


6. Torque: 14 Nm



REMOVAL AND INSTALLATION

7.



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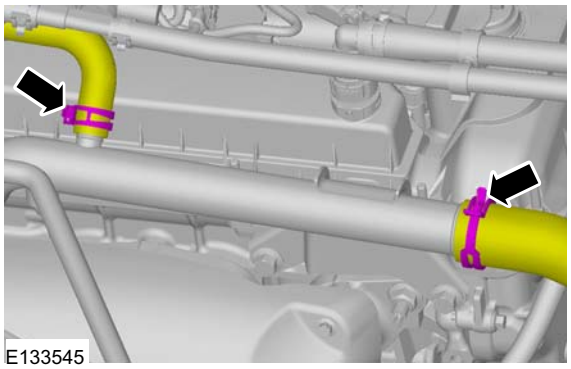
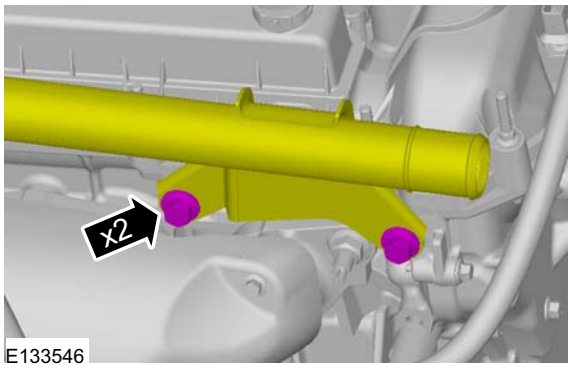


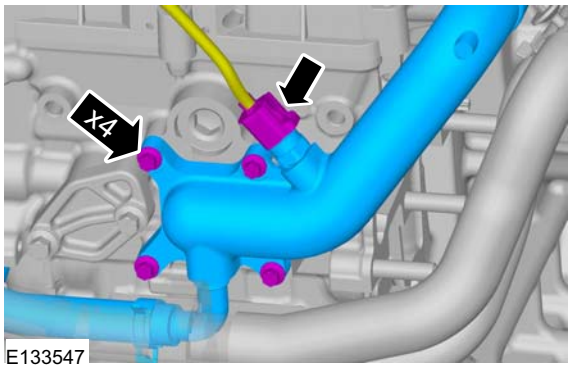
9. Torque: 48 Nm



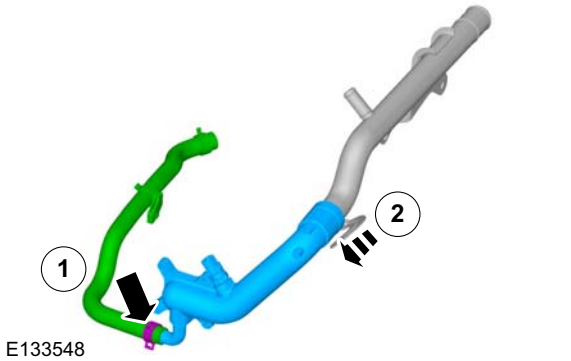
10. NOTE: Make sure that these components are installed to the noted removal position.

NOTE: The gasket is to be reused unless damaged.

Torque: 10 Nm

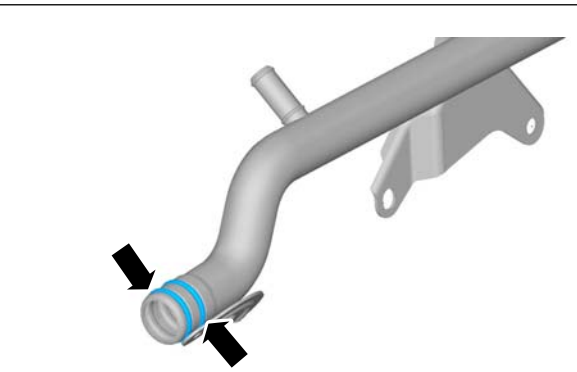


11.



12. NOTE: Make sure that the mating faces are clean and free of foreign material.

NOTE: The O-ring seal is to be reused unless damaged.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

2. Bleed the cooling system.

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

SECTION 303-04A Fuel Charging and Controls — 2.5L

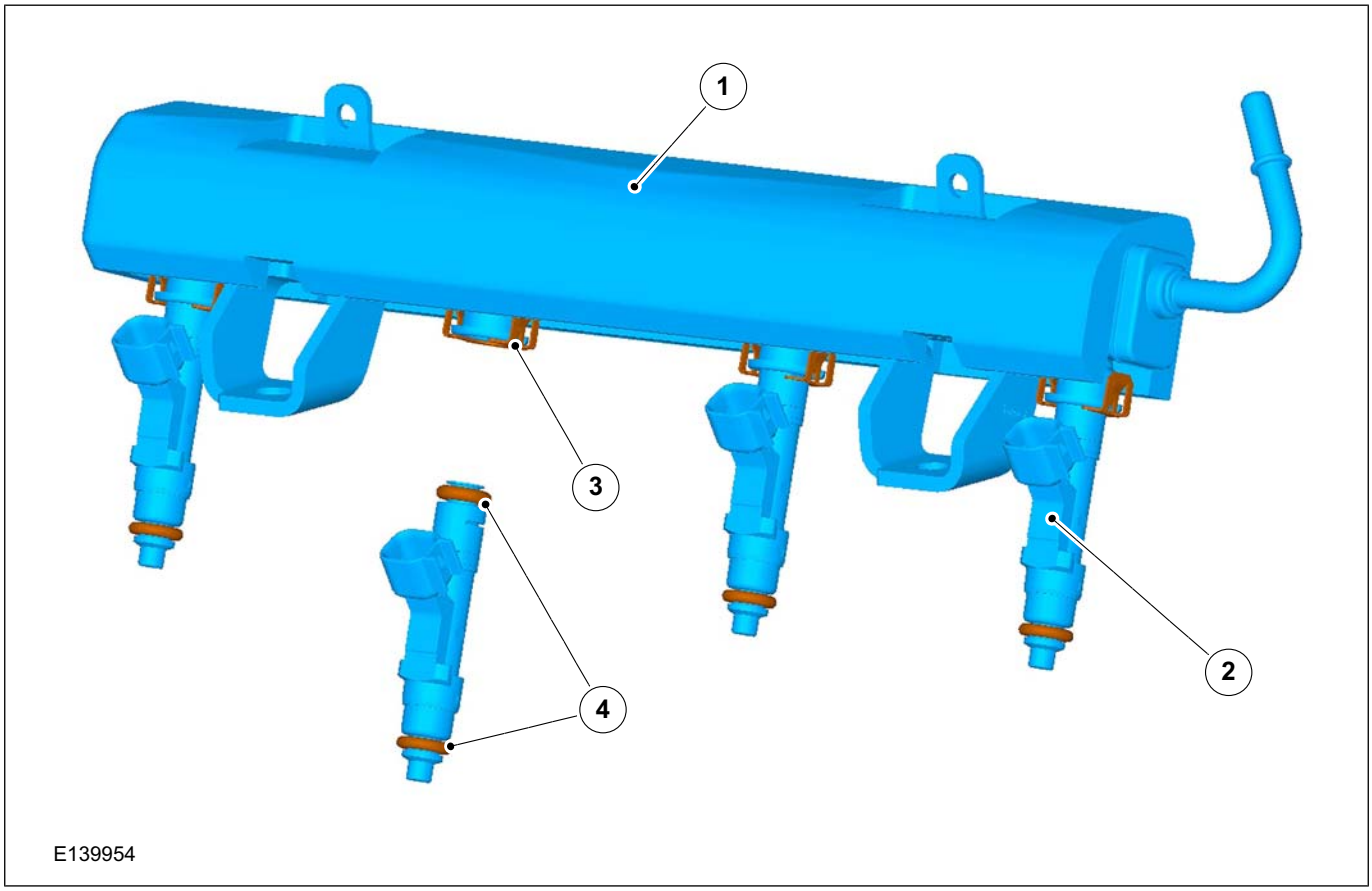
Duratec-HE (122kW/165PS) - MI4

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Fuel Charging and Controls

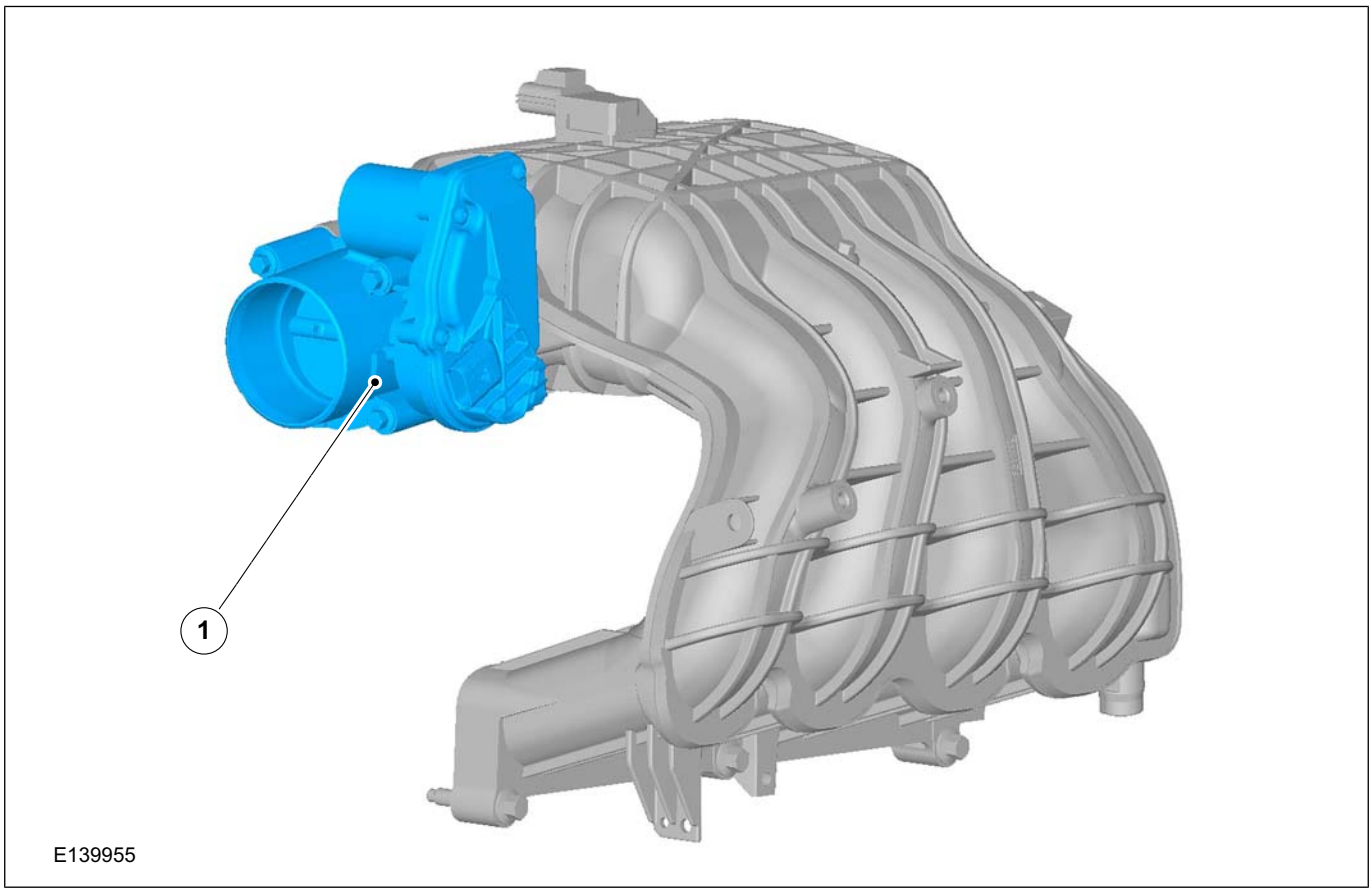


E139954

Item	Part Number	Description
1		Fuel rail
2		Fuel injector

Item	Part Number	Description
3		Fuel injector retaining clip
4	-	Fuel injector O-ring seals

DESCRIPTION AND OPERATION



Item	Description
1	Throttle body

Throttle Body

The throttle plate position is controlled by a signal from the powertrain control module (PCM) which receives an input from the accelerator pedal position (APP) sensor. The system is fully electronic and does not use any cables. The signal from the PCM is used to control a DC motor within the throttle body which is connected to the throttle plate through gears. The throttle body also gives inputs back to the PCM. This information allows the PCM to compensate for factors such as carbon build up within the throttle body and throttle body wear. The throttle body also provides information to the PCM to enable the flagging of a diagnostic trouble code (DTC).

REMOVAL AND INSTALLATION

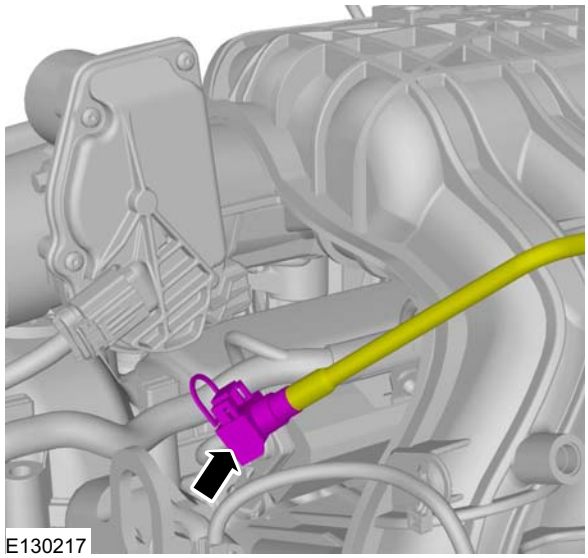
Fuel Rail

Materials	
Name	**Specification**
Engine Oil - 5W-30	WSS-M2C913-C

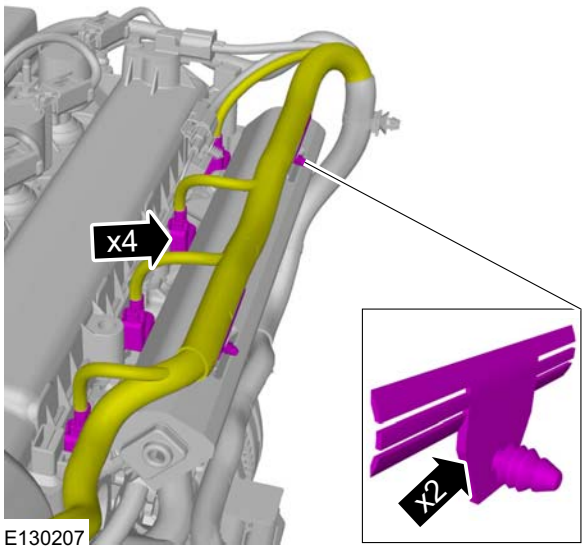
Removal

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

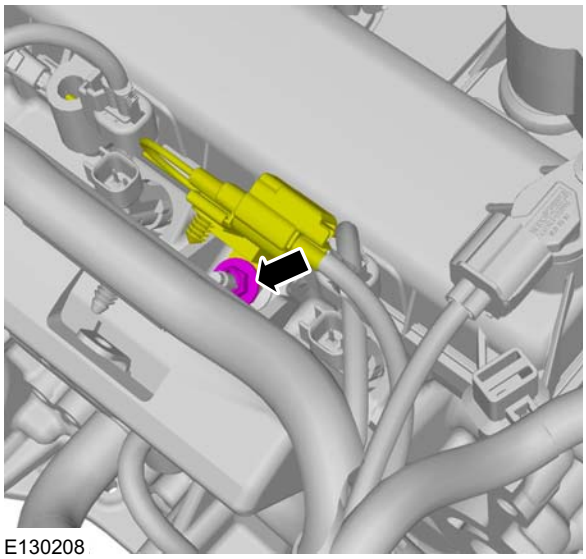
1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Fuel System Pressure Release (310-00 Fuel System - General Information - 2.5L Duratec-HE (122kW/165PS) - MI4, General Procedures).
3. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
4.



5. Refer to: Intake Manifold (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
6.

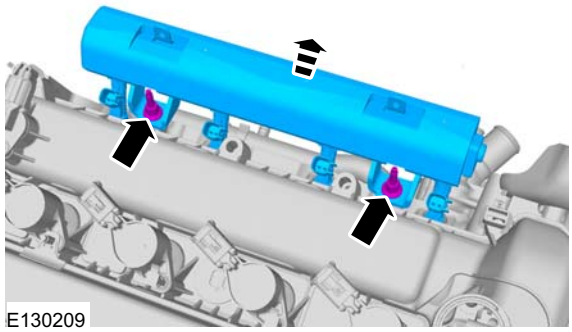


7. Torque: 10 Nm

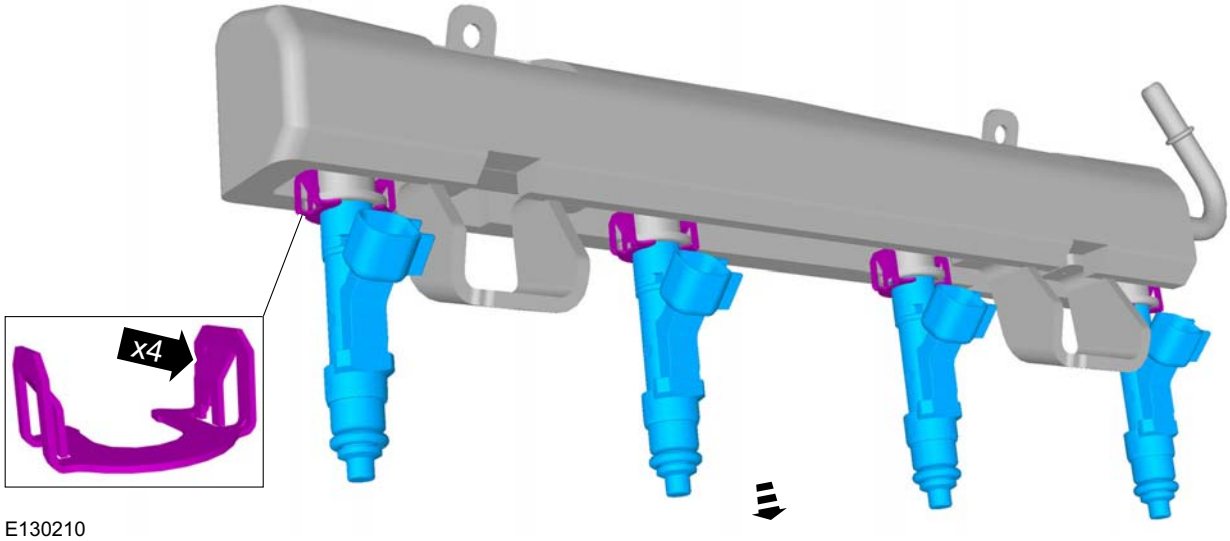


REMOVAL AND INSTALLATION

8. Torque: 23 Nm


E130209

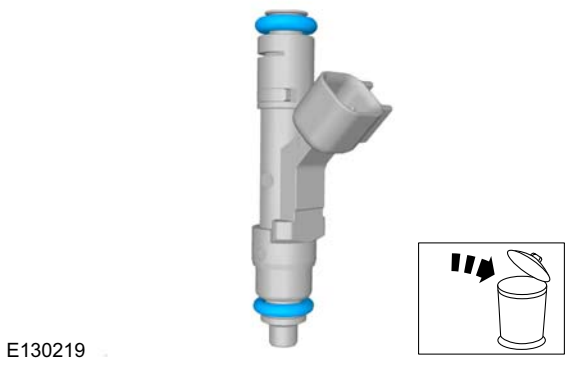
9.



E130210

10. ⚠ **CAUTION: Only use the specified material to lubricate the seals.**

Material: Engine Oil - 5W-30 (WSS-M2C913-C) engine oil


E130219

Installation

1. To install, reverse the removal procedure.

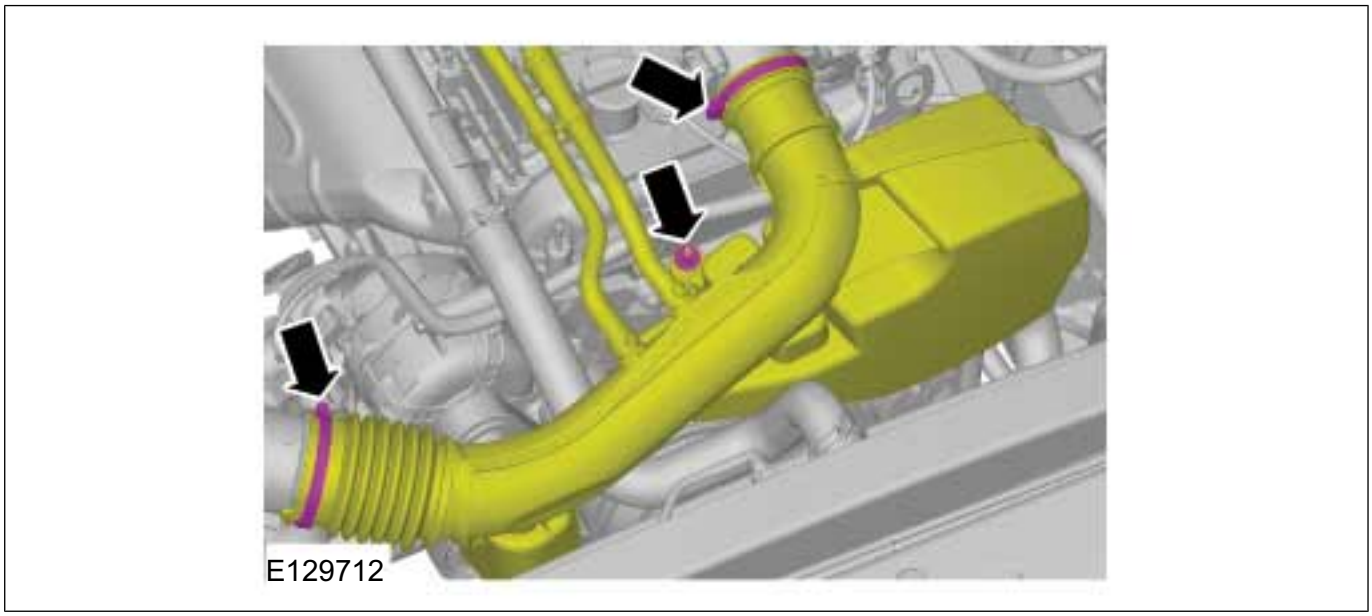
REMOVAL AND INSTALLATION

Throttle Body(23 198 0)

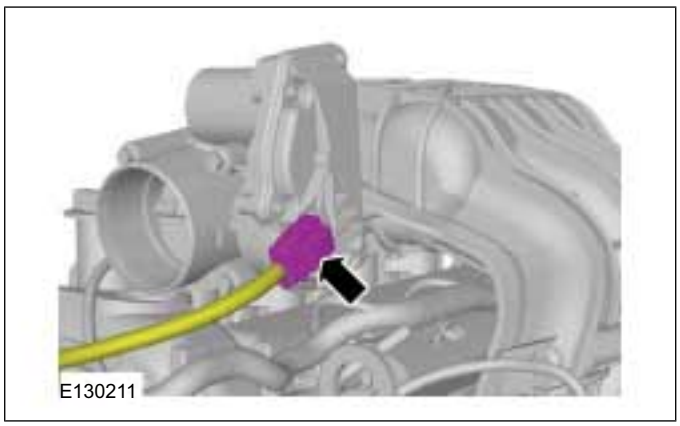
Removal

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

1.

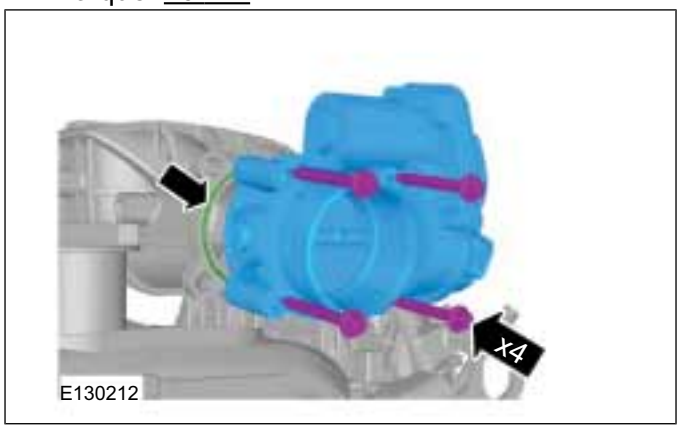


2.



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 during the initialization.

   Turn the ignition key to position II and wait for one minute to initialize the throttle body.
3. Turn the ignition key to the OFF position.

SECTION 303-04B Fuel Charging and Controls — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

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DESCRIPTION AND OPERATION

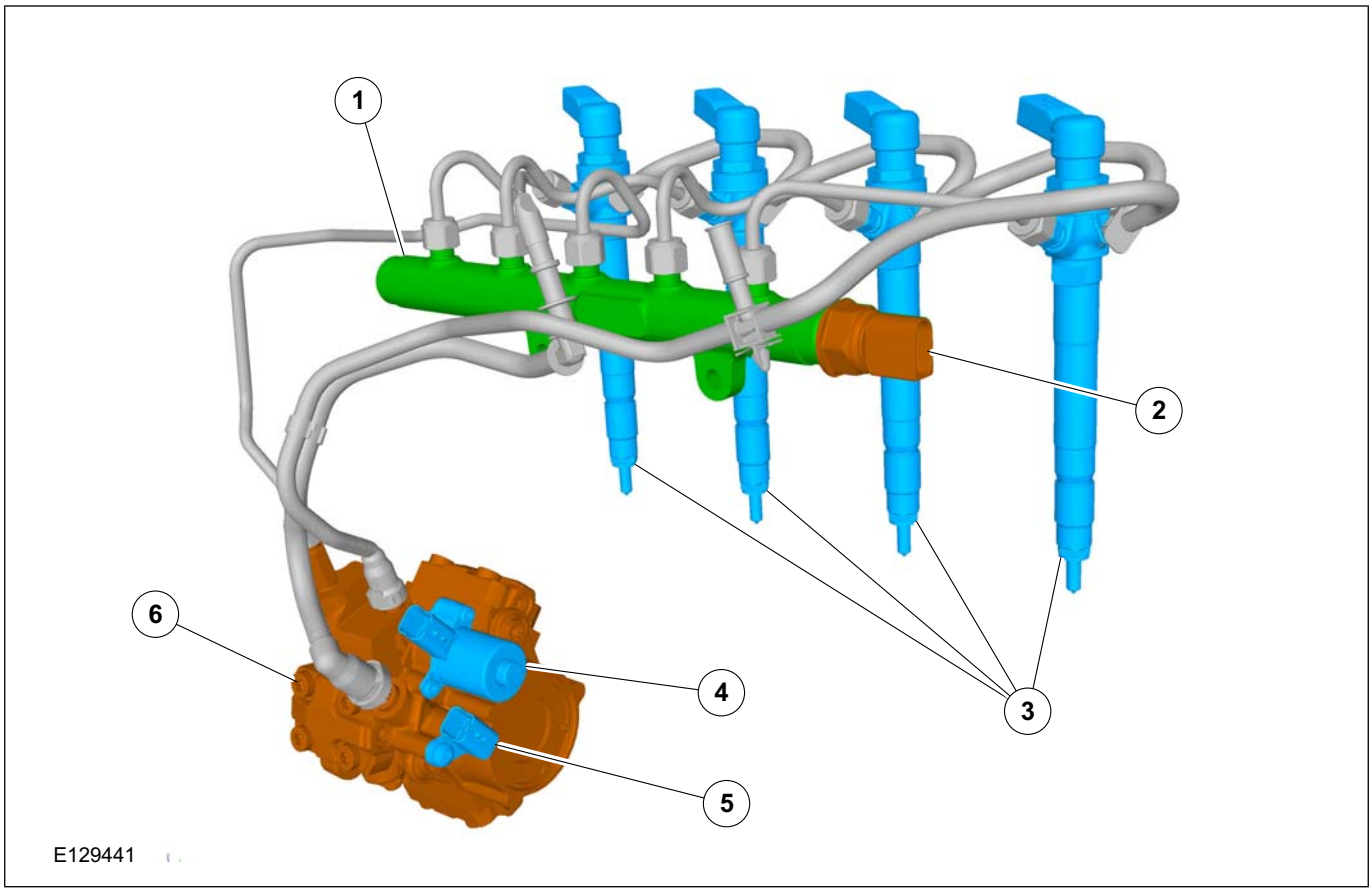
GENERAL PROCEDURES

REMOVAL AND INSTALLATION

DESCRIPTION AND OPERATION

Fuel Charging and Controls

Overview



Item	Description
1	Fuel rail
2	Fuel rail pressure (FRP) sensor
3	Fuel Injector(s)
4	Fuel metering valve
5	Fuel temperature sensor
6	Fuel pump

General

A Denso common rail fuel injection system is used on the 2.2L Duratorq-TDCi (Puma) diesel engine.

Within the fuel pump there is an integral fuel transfer pump which draws the fuel from the fuel tank to the fuel pump.

A fuel metering valve is located in the supply port to the high-pressure chamber of the fuel pump. The fuel metering valve varies the quantity of fuel supplied to the fuel rail and fuel injector(s), in relation to the driving conditions.

The fuel is supplied at high-pressure to the fuel rail and to the fuel injectors ready for injection. Depending on engine operating conditions, the fuel injection pressure varies between 230 bar and 1600 bar.

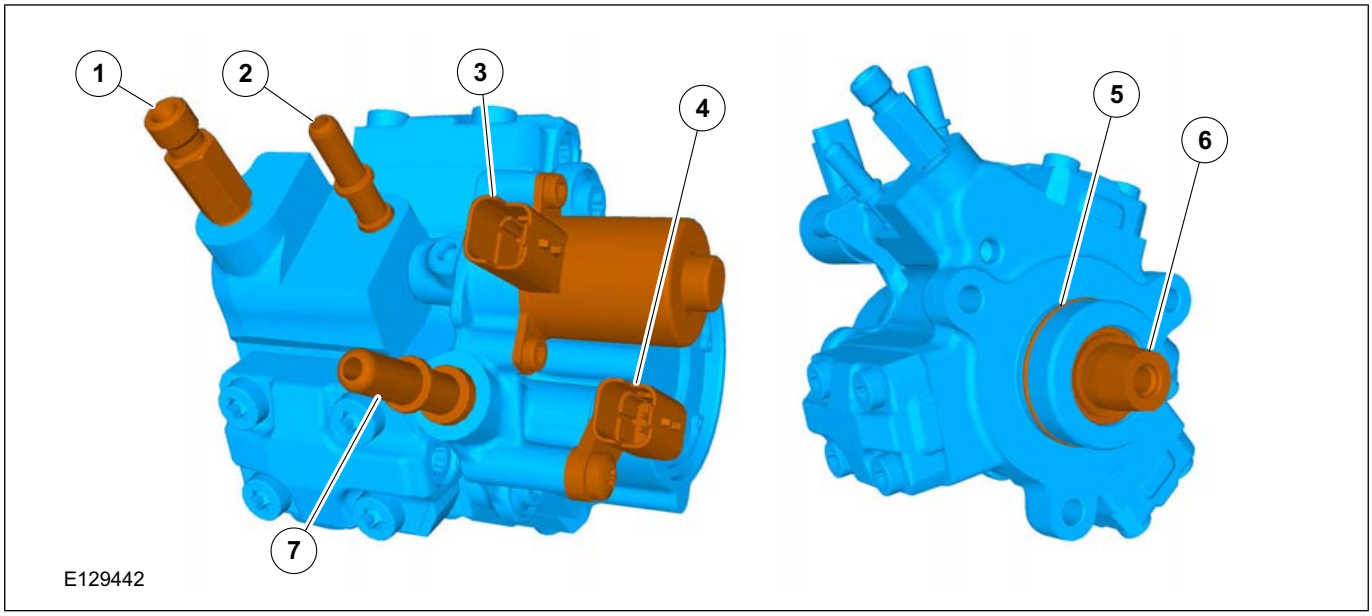
Fuel system pressure is measured using an FRP sensor located in the fuel rail. The FRP sensor converts the fuel system pressure into a voltage signal. This voltage signal acts as an input signal to the powertrain control module (PCM) for calculation of the fuel injection quantity.

The power train control module (PCM) calculates the time of fuel injection and the fuel injection quantity depending on various input variables. The specified quantity of fuel is injected into the respective combustion chamber through the solenoid actuated fuel injector(s). In doing so, a pre-injection and a main injection occur each time.

The excess fuel is returned to the fuel tank through the fuel return line.

DESCRIPTION AND OPERATION

Fuel pump



Item	Description
1	Fuel pump high-pressure outlet union
2	Fuel pump fuel return union
3	Fuel metering valve
4	Fuel temperature sensor
5	Fuel pump O-ring seal
6	Fuel pump input drive
7	Fuel pump fuel supply union

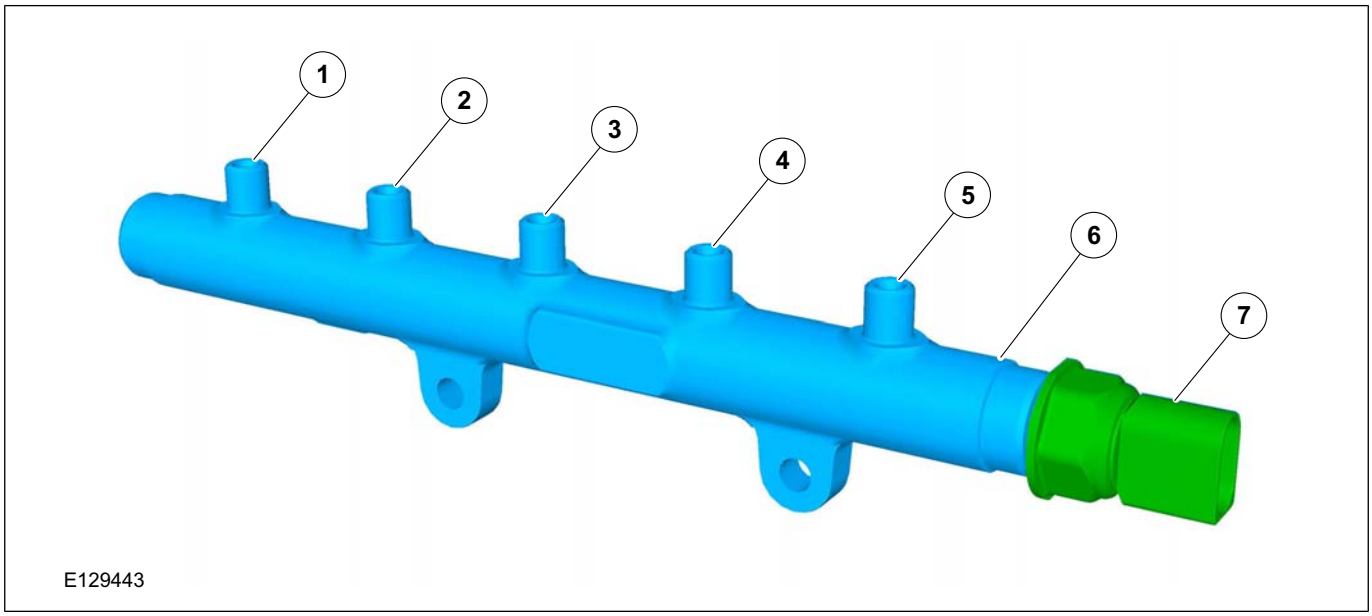
The fuel pump is driven directly by the intake camshaft and is located at the rear of the cylinder head.

The fuel pump has three pump elements, each offset from each other by 120 degrees.

The fuel transfer pump is incorporated into the fuel pump and is located on the drive flange. The fuel transfer pump is a cycloid type pump.

The fuel metering valve is actuated by the PCM using pulse width modulation.

Fuel rail



DESCRIPTION AND OPERATION

Item	Description
1	Fuel rail to fuel injector number 1 high-pressure fuel supply line union
2	Fuel rail to fuel injector number 2 high-pressure fuel supply line union
3	Fuel pump to fuel rail high-pressure fuel supply line union
4	Fuel rail to fuel injector number 3 high-pressure fuel supply line union
5	Fuel rail to fuel injector number 4 high-pressure fuel supply line union
6	Fuel rail
7	FRP sensor

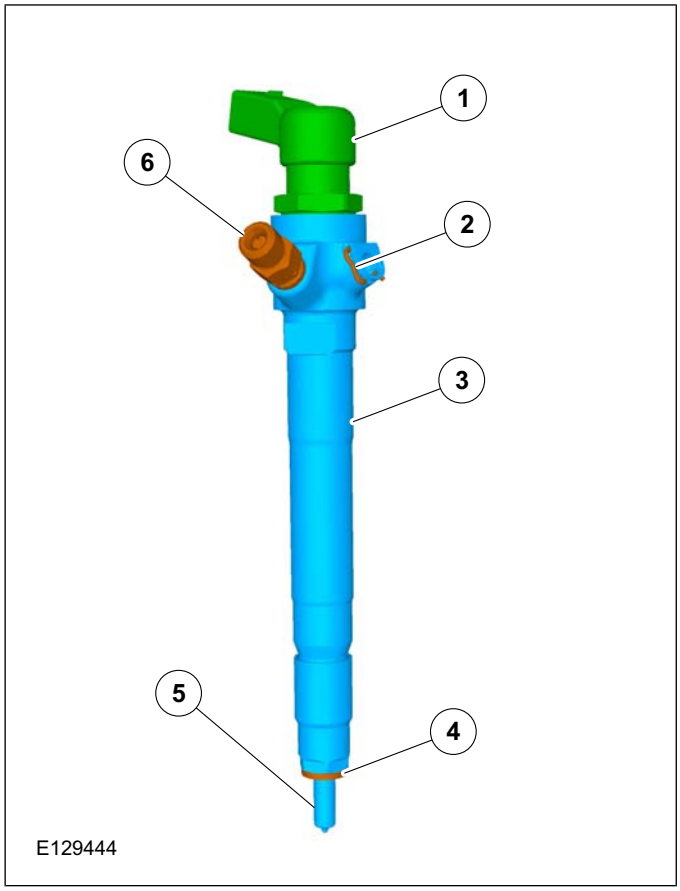
CAUTION: The FRP sensor must not be detached or removed from the fuel rail.

The fuel rail is made from forged steel and is retained by a support bracket located on the camshaft carrier .

The fuel is delivered by one high-pressure fuel supply line from the fuel pump to the fuel rail.

From the fuel rail, the fuel travels through high-pressure fuel supply line(s) to the fuel injector(s).

Fuel injectors



Item	Description
1	Fuel injector electrical connector
2	Fuel injector fuel return line clip
3	Fuel injector
4	Fuel injector sealing washer
5	Fuel injector nozzle
6	Fuel injector high-pressure fuel supply line union

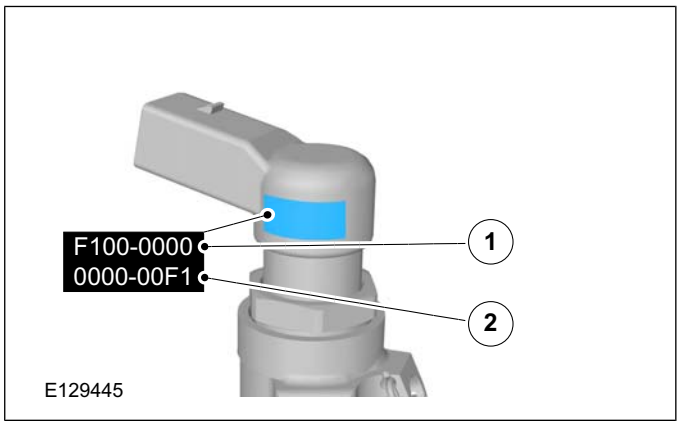
The fuel injector(s) are located centrally on the cylinder head upper section and are attached by means of retaining clamps.

The fuel injector(s) are sealed from the combustion chamber by means of a copper sealing washer located between the fuel injector and the cylinder head. A new sealing washer must always be installed when carrying out installation work.

The fuel injectors are controlled directly by the PCM.

The fuel return line(s) are attached to the top of the fuel injector and are connected in series.

DESCRIPTION AND OPERATION



Item	Description
1	Eight digit injector correction factor (example only shown)
2	Eight digit serial code (For manufacturer use only)

When installing new fuel injectors, the injector correction factor from the new fuel injector(s) must be recorded and uploaded using the Worldwide Diagnostic System (WDS).

GENERAL PROCEDURES

Fuel Injection Component Cleaning

General Equipment

Pneumatic vacuum gun

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 mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

Do not carry out any repairs to the fuel injection system with the engine running. The fuel pressure within the system can be as high as 1600 bar. Failure to follow this instruction may result in personal injury.

Eye protection must be worn at all times when working on or near any fuel related components. Failure to follow this instruction may result in personal injury.

CAUTIONS:

Make sure that the workshop area in which the vehicle is being worked on is as clean and dust-free as possible. Areas in which work on clutches, brakes or where welding or machining are carried out are not suitable in view of the risk of contamination to the fuel system.

Make sure that clean non-plated tools are used. Clean tools using a new brush that will not lose its bristles and fresh suitable evaporative cleaning agent, prior to starting work on the vehicle.

Use a steel topped workbench and cover it with clean, lint-free non-flocking material.

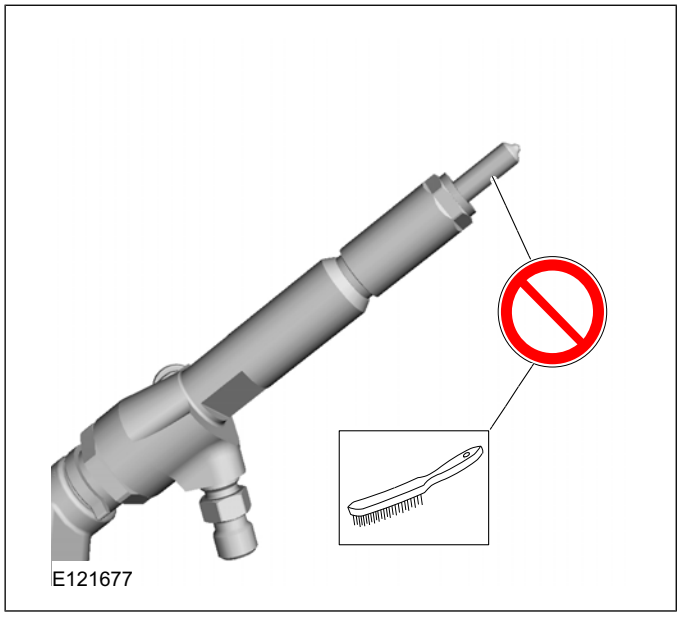
Make sure that all parts removed from the vehicle are placed on the lint-free non-flocking material.

Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.

Make sure that any protective gloves worn are new and are of the non-powdered latex type.

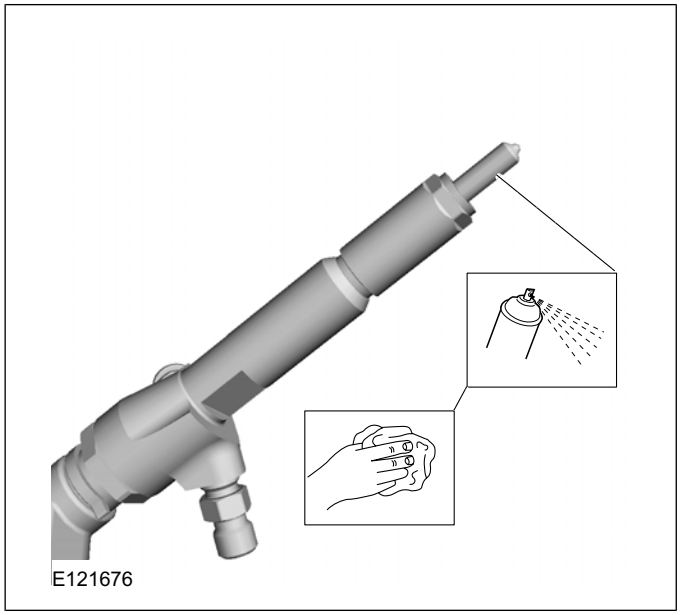
Before using the suitable evaporative cleaning agent, protect all electrical components and connectors with lint-free non-flocking material.

1. **For additional information, refer to: Solvents, Sealants and Adhesives (100-00 General Information, Description and Operation) / Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).**
2.


E121677

CAUTION: Use lint free cloth.

3. **Using Brake Cleaner: 3U7J-2C410-AA**


E121676

GENERAL PROCEDURES

4. Using a new brush that will not lose its bristles, brush a suitable evaporative cleaning agent onto the components being removed and onto the surrounding area.
5. Using the pneumatic vacuum gun, remove all traces of evaporative cleaning agent and foreign material.
6. Dispose of any unused evaporative cleaning agent and the brush after completing the repair.

REMOVAL AND INSTALLATION

Fuel Injectors

General Equipment

Ford Diagnostic Equipment

General Equipment

Long Nose Pliers

Removal

1. **WARNINGS:**

   Make sure that the engine is switched off.

   Make sure that the fuel pressure has dropped to zero and that the fuel temperature is at ambient temperature.

   Wait for a minimum of 1 minute after the engine has stopped before commencing any repair to the fuel injection system.

   CAUTIONS:

   Fuel injectors must not be dismantled or the nozzles cleaned, not even with ultrasonic equipment. Install new fuel injectors if necessary.

   Fuel injectors sharing a common fuel injector clamp must be removed in pairs.

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

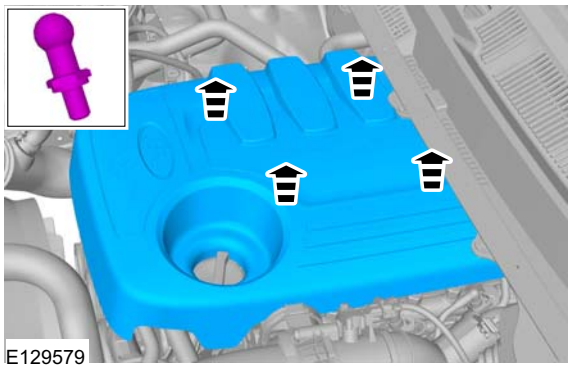
   Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Within the datalogger function of WDS, check that the fuel pressure has dropped to zero and that the fuel temperature has either reached ambient temperature or is below 30ºC whichever is the greater.

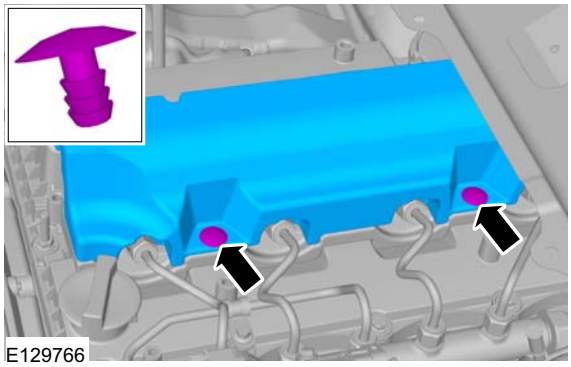
   General Equipment: Ford Diagnostic Equipment

3. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

4.



5.

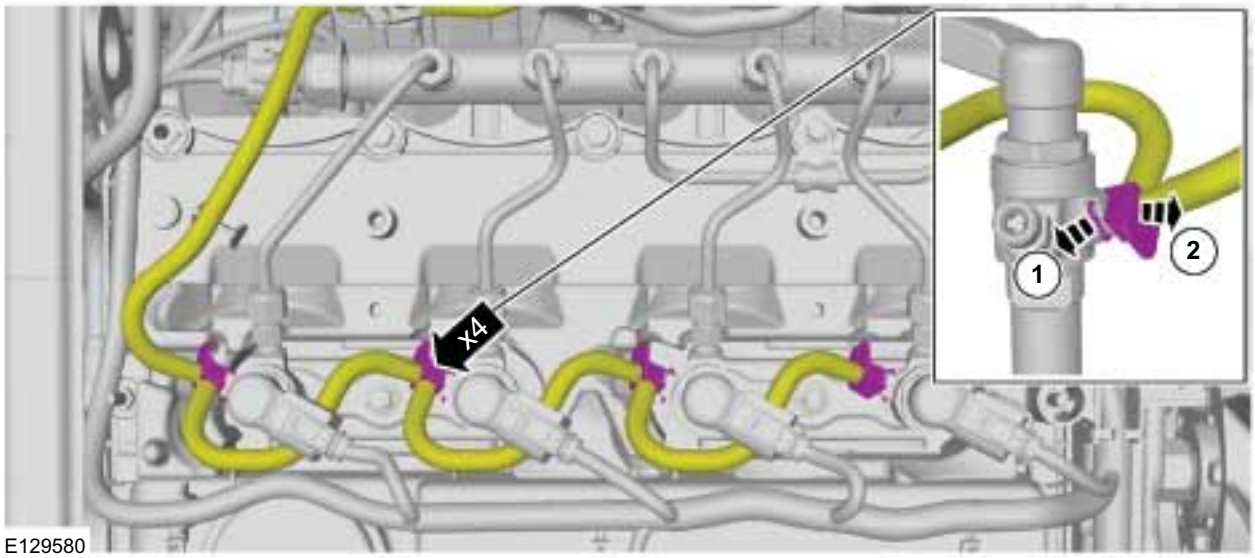


6. **CAUTION: Make sure that all openings are sealed. Use new blanking caps.**

   Vacuum foreign material from the fuel injector and fuel return lines.

   Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

REMOVAL AND INSTALLATION



7. CAUTIONS:

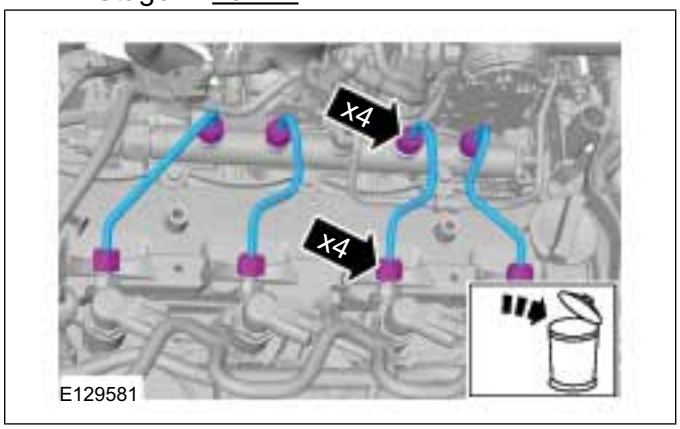
Make sure that the fuel line remains in contact at both ends until both unions nuts have been unscrewed and the area around the joints thoroughly cleaned.

Make sure that all openings are sealed. Use new blanking caps.

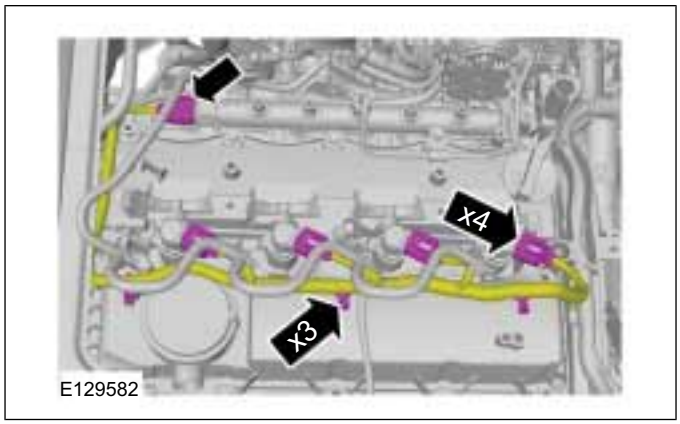
Vacuum foreign material from the high-pressure fuel supply line, the fuel injector and the fuel rail.

Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

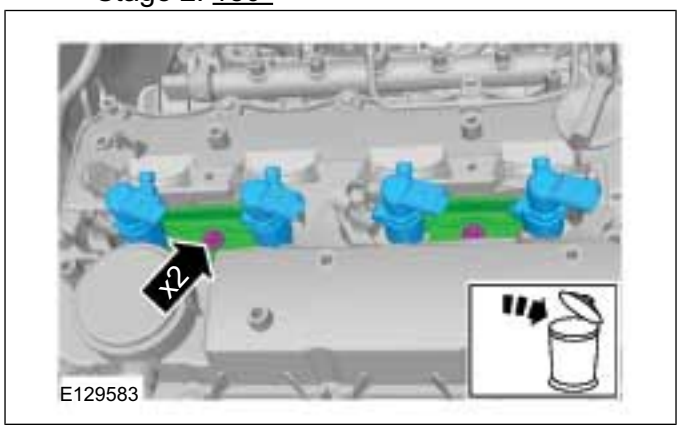
Torque:
- Stage 1: 22 Nm
- Stage 2: 25 Nm



8.

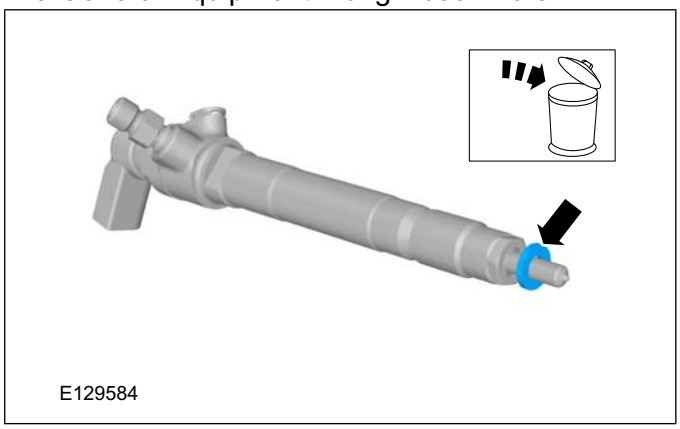


9. Torque:
- Stage 1: 5 Nm
- Stage 2: 180°



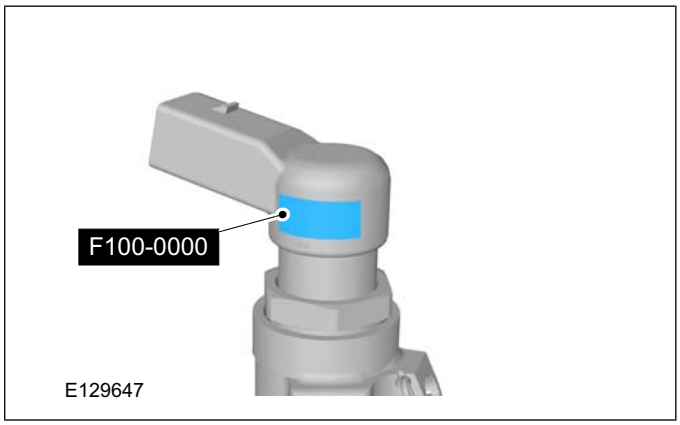
REMOVAL AND INSTALLATION

10. General Equipment: Long Nose Pliers



Installation

1. To install, reverse the removal procedure.
2. Record the new fuel injector correction factor code.



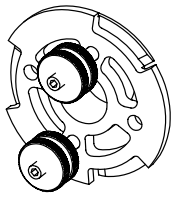
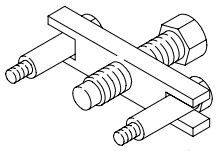
3. Input the new Injector Correction Factors using the following WDS menu options:
   ToolBox/Powertrain/Service Functions

   General Equipment: Ford Diagnostic Equipment

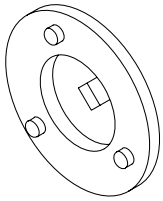
REMOVAL AND INSTALLATION

Fuel Pump

Special Tool(s) / General Equipment

 E75376	303-1317 Locking Tool, Fuel Injection Pump Sprocket
 21132	303-249 Remover, Crankshaft Timing Pulley

Special Tool(s) / General Equipment

	303-679 Remover/Installer, Engine Front Cover Inspection Plate
Ford Diagnostic Equipment	

Removal

1. **WARNINGS:**

   Make sure that the engine is switched off.

   Make sure that the fuel pressure has dropped to zero and that the fuel temperature is at ambient temperature.

   Wait for a minimum of 1 minute after the engine has stopped before commencing any repair to the fuel injection system.

   NOTE: Vacuum any foreign material from the fuel pump and fuel rail unions before sealing the unions with blanking caps.

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

   Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Within the datalogger function, check that the fuel pressure has dropped to zero and that the fuel temperature has either reached ambient temperature or is below 30ºC whichever is the greater.

   General Equipment: Ford Diagnostic Equipment

REMOVAL AND INSTALLATION

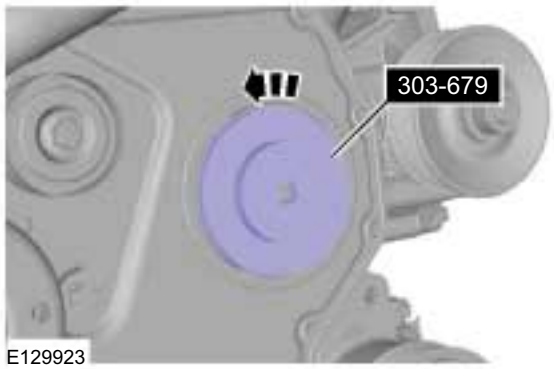
3. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

4. Refer to: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

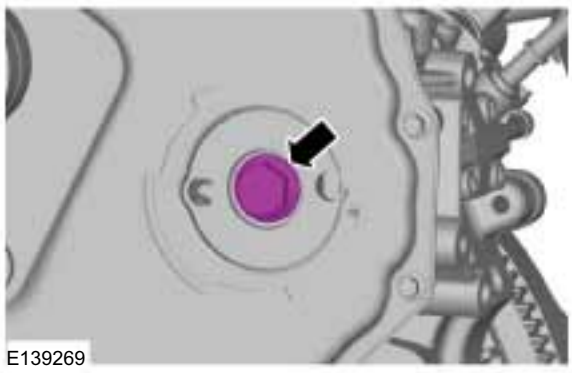
5. Refer to: Intake Manifold (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

6. Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

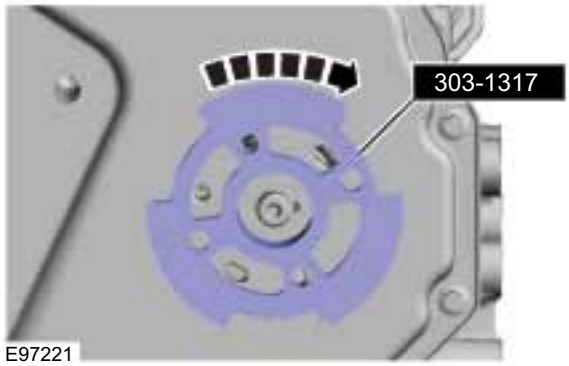
7. Special Tool(s): 303-679



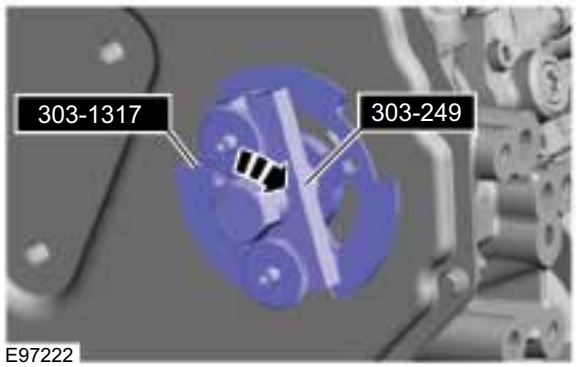
8. Torque: 64 Nm



9. Install the Special Tool(s): 303-1317



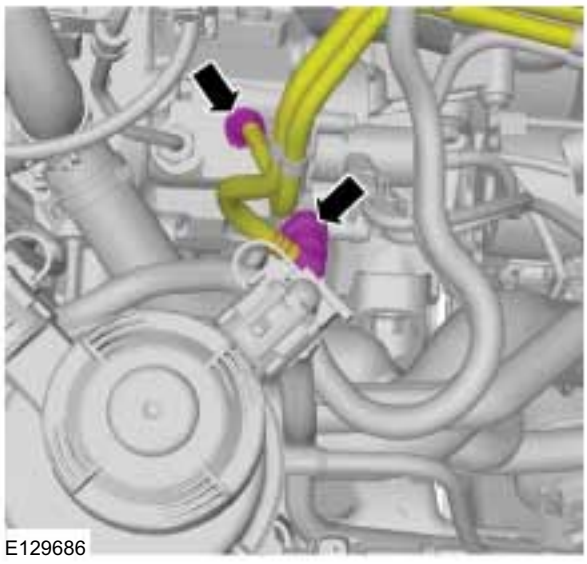
10. Special Tool(s): 303-249



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

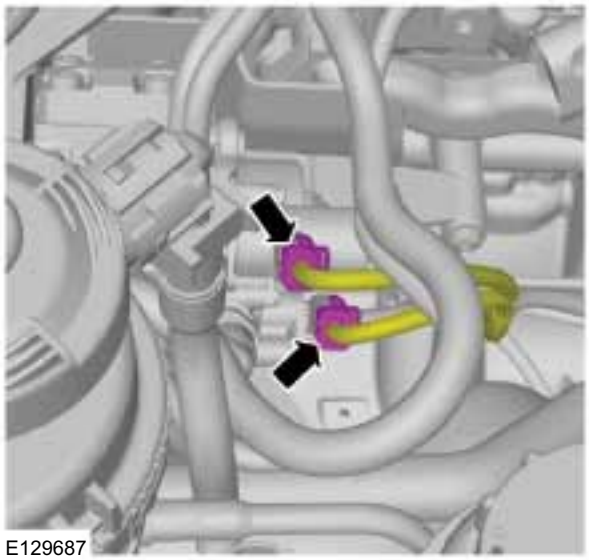
Vacuum foreign material from the low-pressure fuel supply line and fuel return line.

Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).



REMOVAL AND INSTALLATION

12.


E129687

13. CAUTIONS:

Make sure that the fuel line remains in contact at both ends until both unions nuts have been unscrewed and the area around the joints thoroughly cleaned.

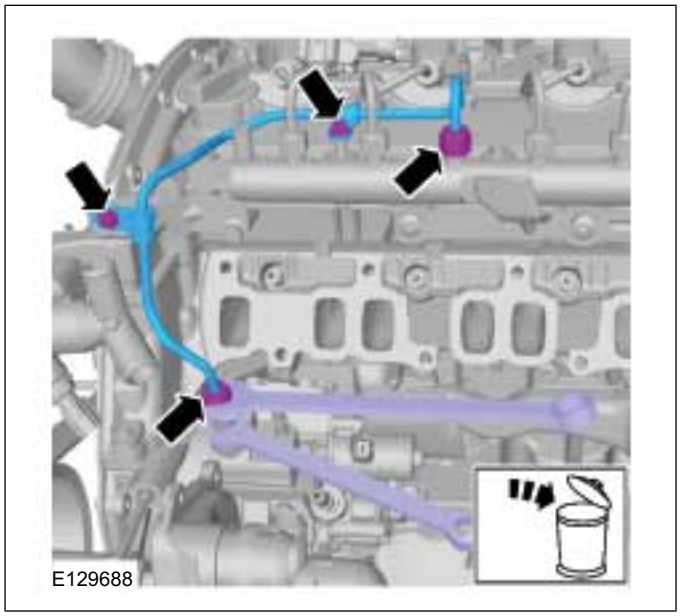
Make sure that all openings are sealed. Use new blanking caps.

Vacuum foreign material from the high-pressure fuel supply line, the fuel pump and the fuel rail.

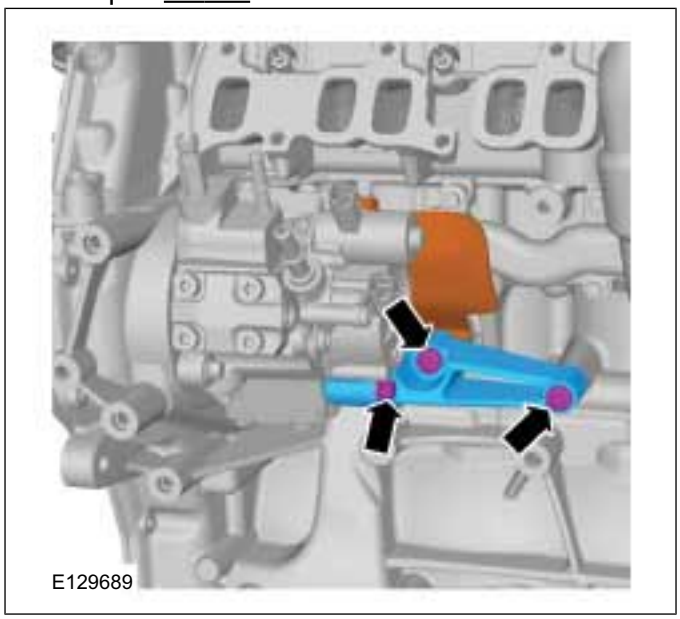
Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

Torque:

- Fuel rail high-pressure fuel supply line unions
  - Stage 1: 5 Nm
  - Stage 2: 35 Nm
- Fuel rail high-pressure fuel supply line bracket bolt 10 Nm

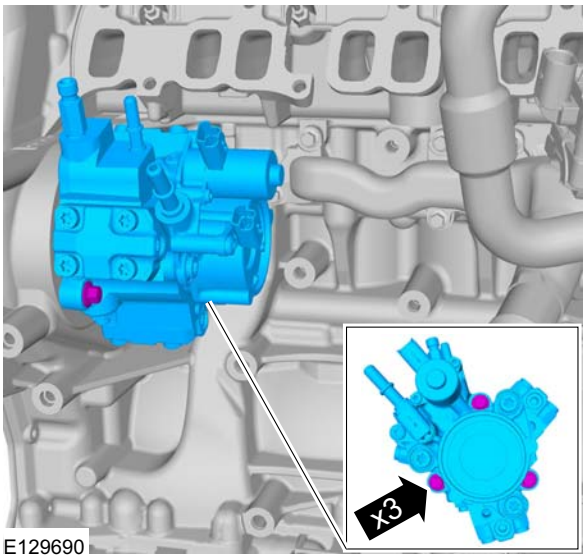

E129688

14. Torque: 23 Nm


E129689

REMOVAL AND INSTALLATION

15. Torque: 23 Nm



Installation

1. To install, reverse the removal procedure.
2. Carry out a Fuel System Leak Test using the following menu options:
   ToolBox/Powertrain/Service Functions

   General Equipment: Ford Diagnostic Equipment
3. Carry out a Pump Learn procedure using the following menu options:
   ToolBox/Powertrain/Service Functions

   General Equipment: Ford Diagnostic Equipment
4. Carry out the Pilot Correction Learn procedure using the following menu options:
   ToolBox/Powertrain/Service Functions

   General Equipment: Ford Diagnostic Equipment

REMOVAL AND INSTALLATION

Fuel Rail

General Equipment

Ford Diagnostic Equipment

Removal

1. **WARNINGS:**

   Make sure that the engine is switched off.

   Make sure that the fuel pressure has dropped to zero and that the fuel temperature is at ambient temperature.

   Wait at least 1 minute after the engine has stopped before commencing any repair to the fuel injection system.

   CAUTION: Always carry out the cleaning process before carrying out any repairs to the fuel injection system components.

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

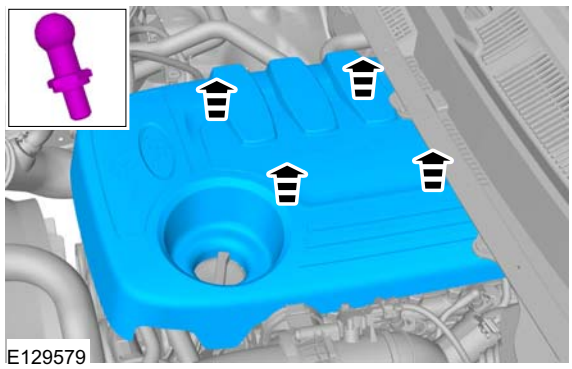
2. Within the datalogger function of WDS, check that the fuel pressure has dropped to zero and that the fuel temperature has either reached ambient temperature or is below 30ºC whichever is the greater.

   General Equipment: Ford Diagnostic Equipment

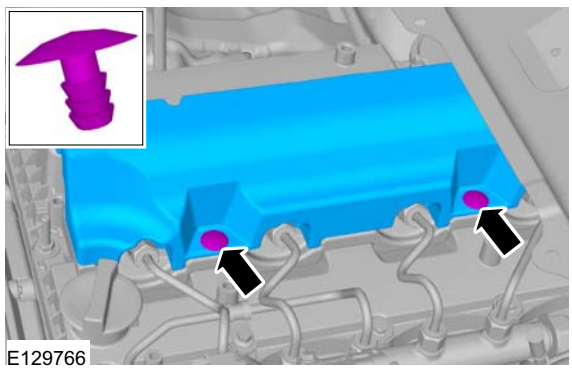
3. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

4. Refer to: Air Cleaner - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

5.



6.



7. **CAUTIONS:**

   Make sure that the fuel line remains in contact at both ends until both unions

REMOVAL AND INSTALLATION

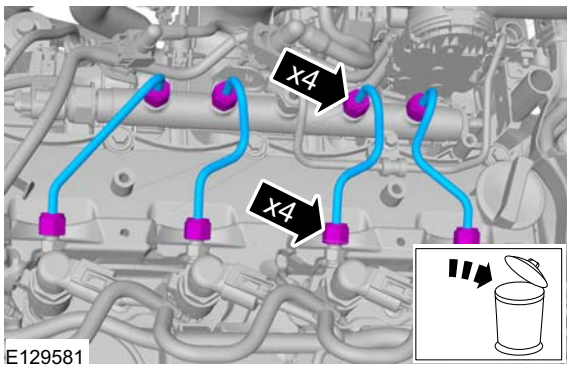
nuts have been unscrewed and the area around the joints thoroughly cleaned.

Make sure that all openings are sealed. Use new blanking caps.

Vacuum foreign material from the high-pressure fuel supply line, the fuel injector and the fuel rail.

Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

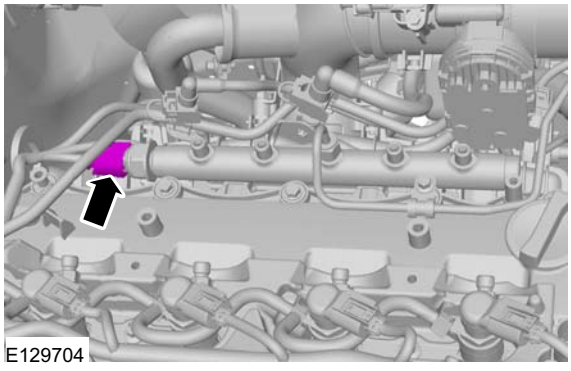
Torque:
- Stage 1: 22 Nm
- Stage 2: 25 Nm



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

Vacuum foreign material from the fuel rail fuel return line quick release coupling.

Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).



9. Refer to: Intake Manifold (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

10. **CAUTIONS:**

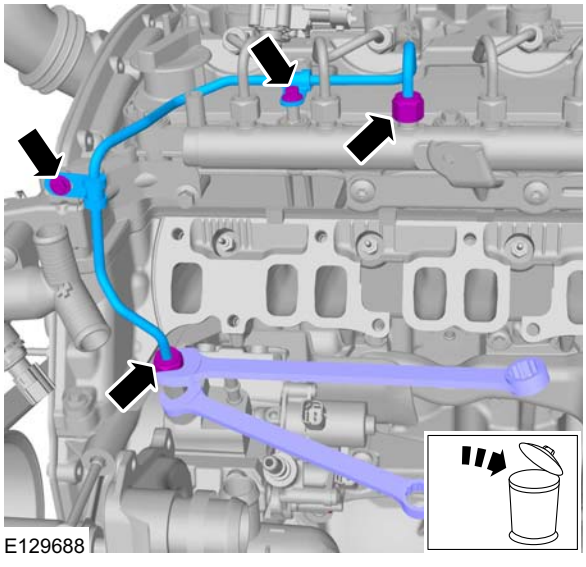
Make sure that the fuel line remains in contact at both ends until both unions nuts have been unscrewed and the area around the joints thoroughly cleaned.

Make sure that all openings are sealed. Use new blanking caps.

Vacuum foreign material from the high-pressure fuel supply line, the fuel pump and the fuel rail.

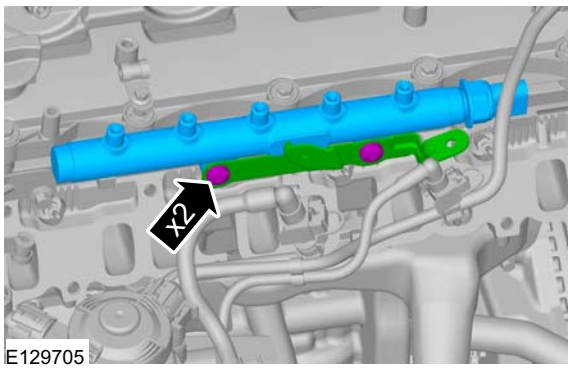
Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

Torque:
- Fuel rail high-pressure fuel supply line unions
  - Stage 1: 5 Nm
  - Stage 2: 35 Nm
- Fuel rail high-pressure fuel supply line bracket bolt 10 Nm



REMOVAL AND INSTALLATION

11. Fuel rail bolts
Torque:
- Stage 1: 6 Nm
- Stage 2: 23 Nm



Installation

1. To install, reverse the removal procedure.
2. Carry out a Fuel System Leak Test using the following WDS menu options:
ToolBox/Powertrain/Service Functions

   General Equipment: Ford Diagnostic Equipment

SECTION 303-04C Fuel Charging and Controls — 3.2L

Duratorq-TDCi (148kW/200PS) - Puma

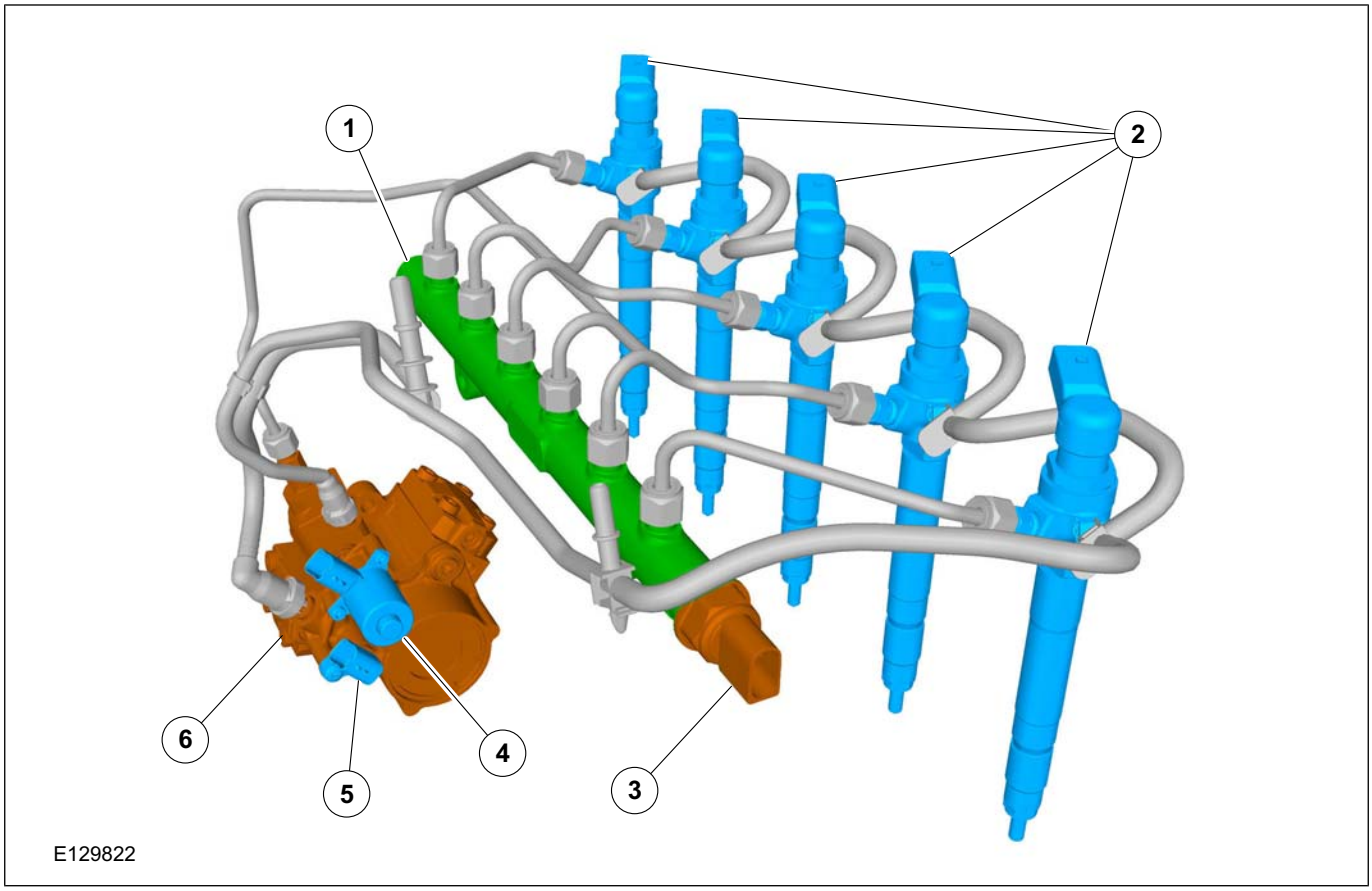
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Fuel Charging and Controls

Overview



Item	Description
1	Fuel rail
2	Fuel injector(s)
3	Fuel pressure (FRP) sensor
4	Fuel metering valve
5	Fuel temperature sensor
6	Fuel pump

General

A common rail fuel injection system is used on the 3.2L Duratorq-TDCi (Puma) diesel engine.

Within the fuel pump there is an integral fuel transfer pump which draws the fuel from the fuel tank to the fuel pump.

A fuel metering valve is located in the supply port to the high-pressure chamber of the fuel pump. The fuel metering valve varies the quantity of fuel supplied to the fuel rail and fuel injector(s), in relation to the driving conditions.

The fuel is supplied at high-pressure to the fuel rail and to the fuel injectors ready for injection. Depending on engine operating conditions, the fuel injection pressure varies between 230 bar and 1600 bar.

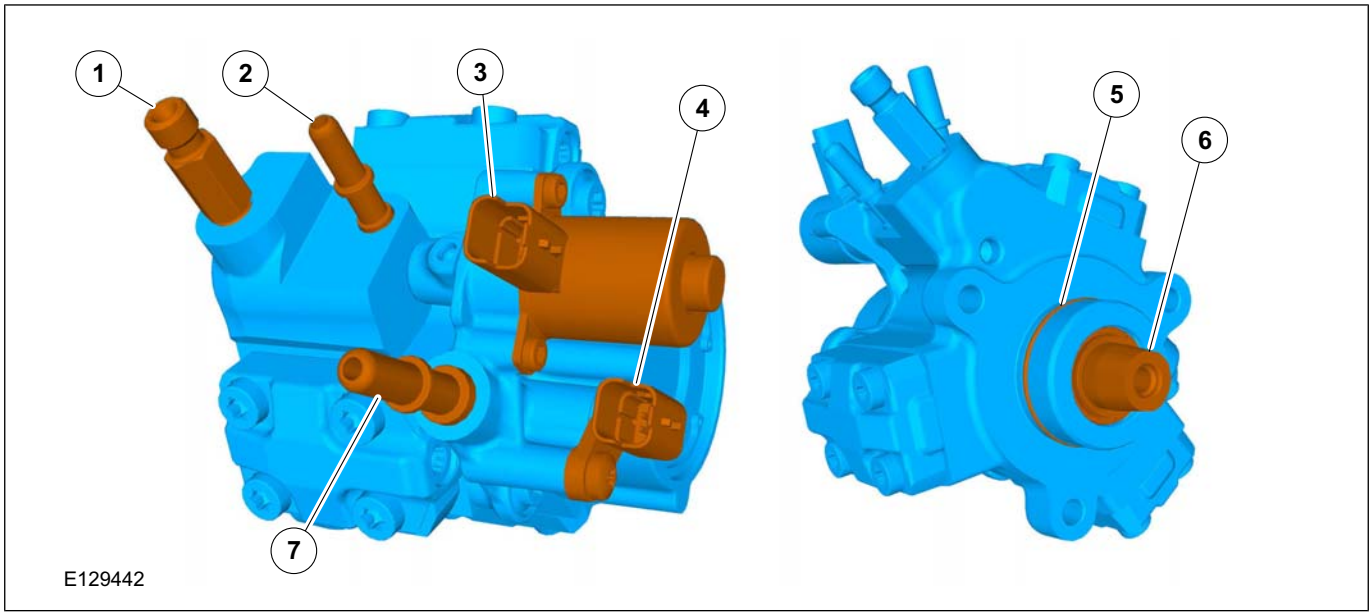
Fuel system pressure is measured using an FRP sensor located in the fuel rail. The FRP sensor converts the fuel system pressure into a voltage signal. This voltage signal acts as an input signal to the powertrain control module (PCM) for calculation of the fuel injection quantity.

The power train control module (PCM) calculates the time of fuel injection and the fuel injection quantity depending on various input variables. The specified quantity of fuel is injected into the respective combustion chamber through the solenoid actuated fuel injector(s). In doing so, a pre-injection and a main injection occur each time.

The excess fuel is returned to the fuel tank through the fuel return line.

DESCRIPTION AND OPERATION

Fuel pump



Item	Description
1	Fuel pump high-pressure outlet union
2	Fuel pump fuel return union
3	Fuel metering valve
4	Fuel temperature sensor
5	Fuel pump O-ring seal
6	Fuel pump input drive
7	Fuel pump fuel supply union

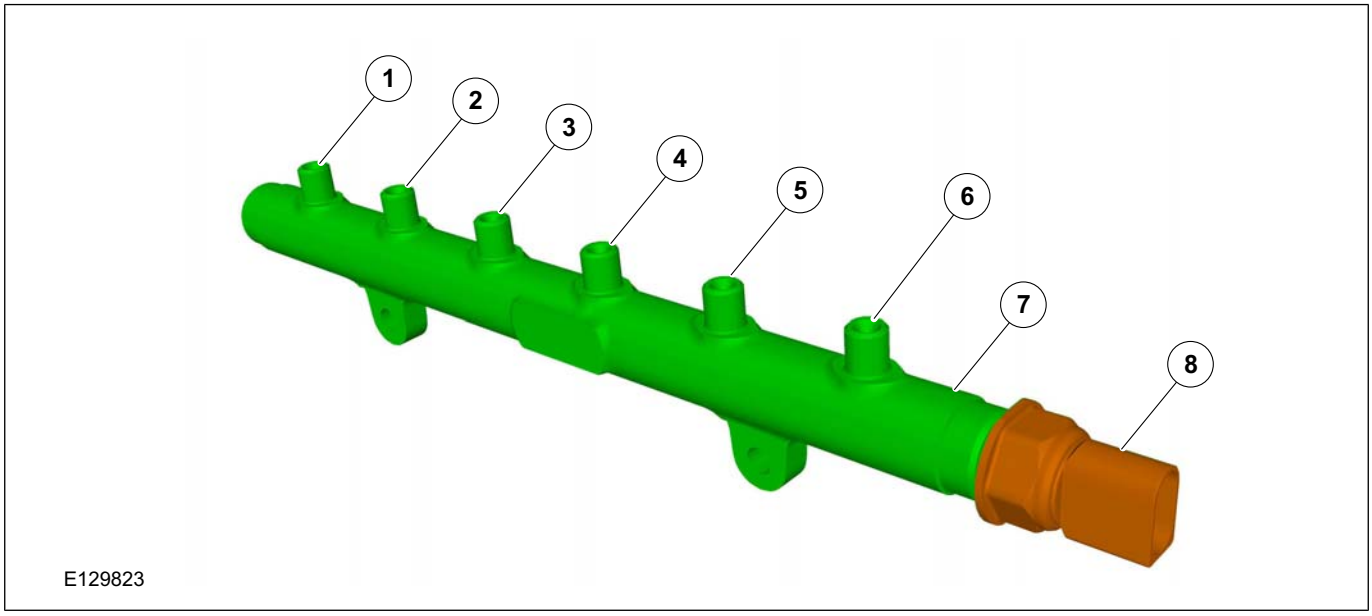
The fuel pump is driven directly by the timing belt.

The fuel pump has three pump elements, each offset from each other by 120 degrees.

The fuel transfer pump is incorporated into the fuel pump and is located on the drive flange. The fuel transfer pump is a cycloid type pump.

The fuel metering valve is actuated by the PCM using pulse width modulation.

Fuel rail



DESCRIPTION AND OPERATION

Item	Description
1	Fuel rail to fuel injector number 1 high-pressure fuel supply line union
2	Fuel rail to fuel injector number 2 high-pressure fuel supply line union
3	Fuel rail to fuel injector number 3 high-pressure fuel supply line union
4	Fuel pump to fuel rail high-pressure fuel supply line union
5	Fuel rail to fuel injector number 4 high-pressure fuel supply line union
6	Fuel rail to fuel injector number 5 high-pressure fuel supply line union
7	Fuel rail
8	FRP sensor

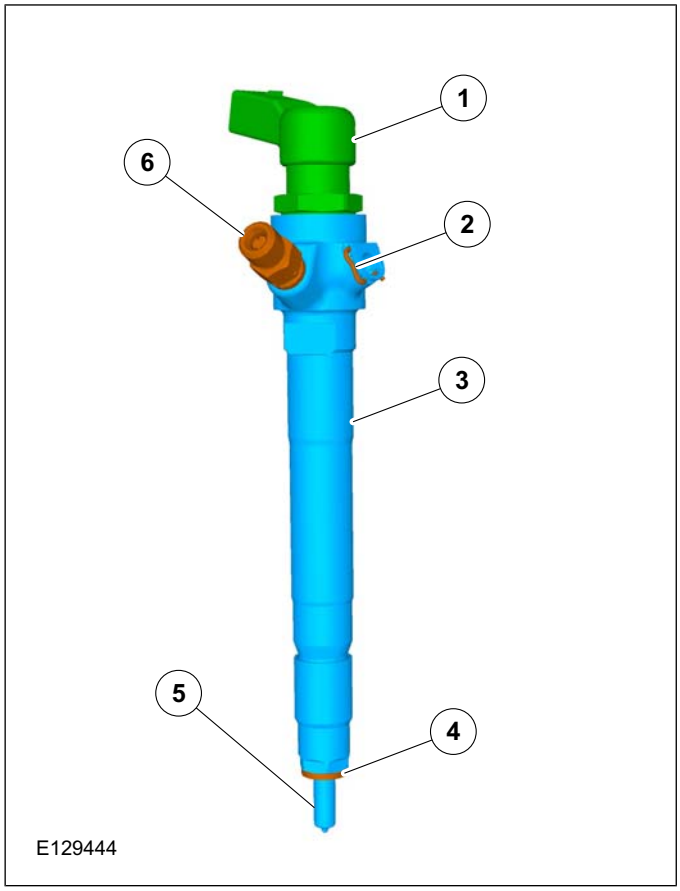
CAUTION: The FRP sensor must not be detached or removed from the fuel rail.

The fuel rail is made from forged steel and is retained by a support bracket located on the camshaft carrier.

The fuel is delivered by one high-pressure fuel supply line from the fuel pump to the fuel rail.

From the fuel rail, the fuel travels through the high-pressure fuel supply line(s) to the fuel injector(s).

Fuel injectors



Item	Description
1	Fuel injector electrical connector
2	Fuel injector fuel return line clip
3	Fuel injector
4	Fuel injector sealing washer
5	Fuel injector nozzle
6	Fuel injector high-pressure fuel supply line union

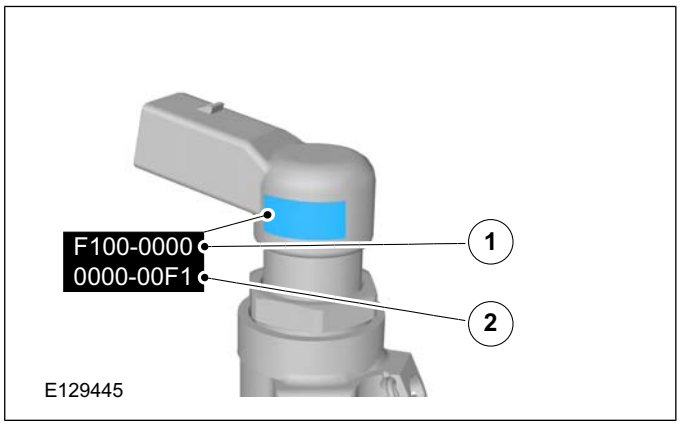
The fuel injector(s) are located centrally on the cylinder head upper section and are attached by means of retaining clamps.

The fuel injector(s) are sealed from the combustion chamber by means of a copper sealing washer located between the fuel injector and the cylinder head. A new sealing washer must always be installed when carrying out installation work.

The fuel injectors are controlled directly by the PCM.

The fuel return line(s) are attached to the top of the fuel injector and are connected in series.

DESCRIPTION AND OPERATION



Item	Description
1	Eight digit injector correction factor (example only shown)
2	Eight digit serial code (For manufacturer use only)

When installing new fuel injectors, the injector correction factor from the new fuel injector(s) must be recorded and uploaded using the Worldwide Diagnostic System (WDS).

GENERAL PROCEDURES

Fuel Injection Component Cleaning

General Equipment

Pneumatic vacuum gun

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 mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

Do not carry out any repairs to the fuel injection system with the engine running. The fuel pressure within the system can be as high as 1600 bar. Failure to follow this instruction may result in personal injury.

Eye protection must be worn at all times when working on or near any fuel related components. Failure to follow this instruction may result in personal injury.

CAUTIONS:

Make sure that the workshop area in which the vehicle is being worked on is as clean and dust-free as possible. Areas in which work on clutches, brakes or where welding or machining are carried out are not suitable in view of the risk of contamination to the fuel system.

Make sure that clean non-plated tools are used. Clean tools using a new brush that will not lose its bristles and fresh suitable evaporative cleaning agent, prior to starting work on the vehicle.

Use a steel topped workbench and cover it with clean, lint-free non-flocking material.

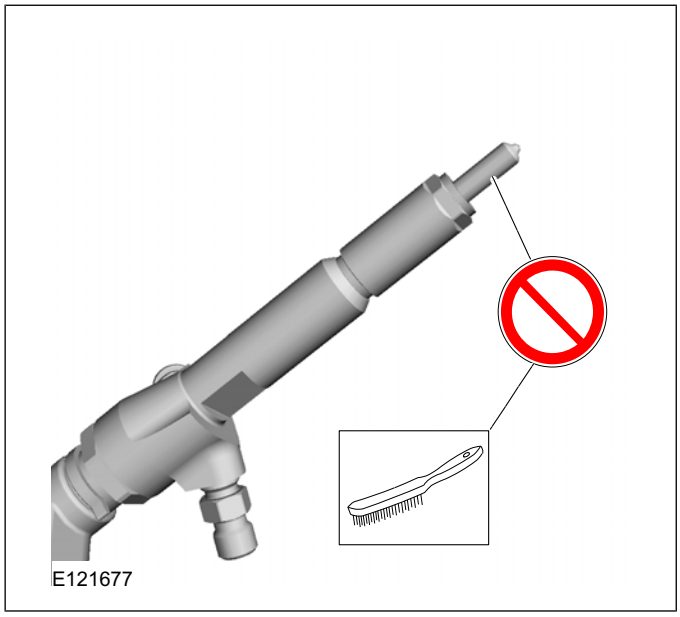
Make sure that all parts removed from the vehicle are placed on the lint-free non-flocking material.

Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.

Make sure that any protective gloves worn are new and are of the non-powdered latex type.

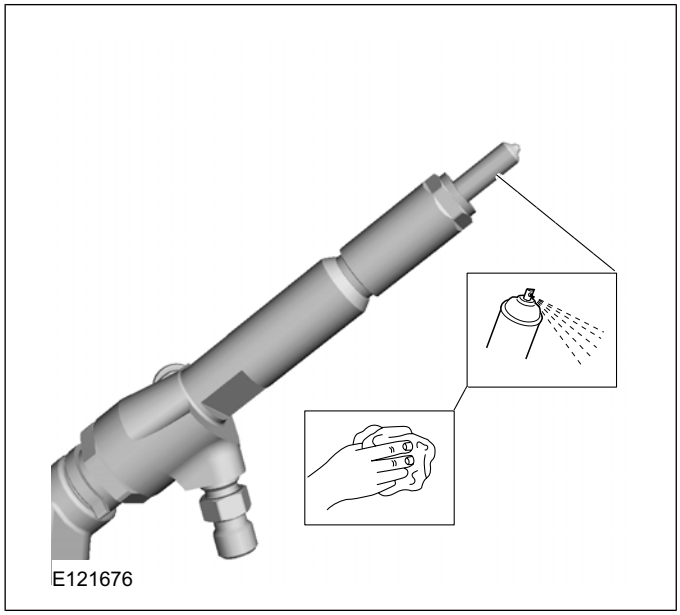
Before using the suitable evaporative cleaning agent, protect all electrical components and connectors with lint-free non-flocking material.

1. **For additional information, refer to: Solvents, Sealants and Adhesives (100-00 General Information, Description and Operation) / Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).**
2.


E121677

CAUTION: Use lint free cloth.

3. **Using Brake Cleaner: 3U7J-2C410-AA**


E121676

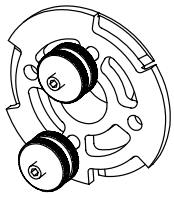
GENERAL PROCEDURES

4. Using a new brush that will not lose its bristles, brush a suitable evaporative cleaning agent onto the components being removed and onto the surrounding area.
5. Using the pneumatic vacuum gun, remove all traces of evaporative cleaning agent and foreign material.
6. Dispose of any unused evaporative cleaning agent and the brush after completing the repair.

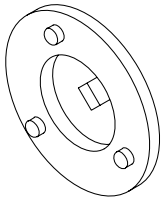
REMOVAL AND INSTALLATION

Fuel Pump

Special Tool(s) / General Equipment

 E75376	303-1317 Locking Tool, Fuel Injection Pump Sprocket

Special Tool(s) / General Equipment

 303679	303-679 Remover/Installer, Engine Front Cover Inspection Plate
Ford approved diagnostic tool	
Ford Diagnostic Equipment	

Removal

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

WARNINGS:

Make sure that the engine is switched off.

Wait for a minimum of 1 minute after the engine has stopped before commencing any repair to the fuel injection system.

Make sure that the fuel pressure has dropped to zero and that the fuel temperature is at ambient temperature.

CAUTION: Extreme cleanliness must be exercised when handling these components.

REMOVAL AND INSTALLATION

2. General Equipment: Ford Diagnostic Equipment

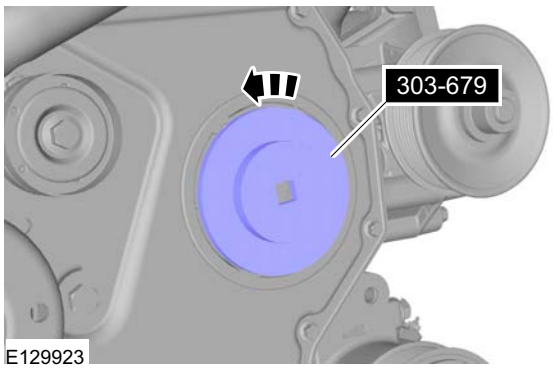
3. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

4. Refer to: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

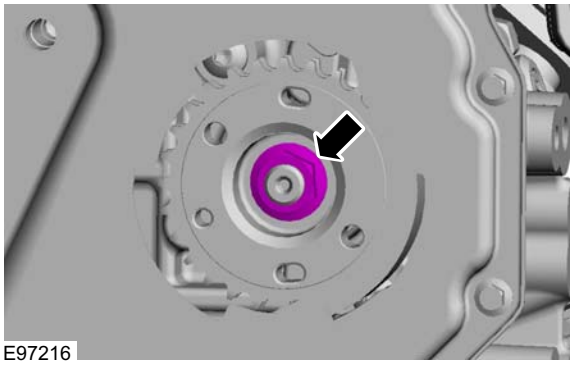
5. Refer to: Intake Manifold (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

6. Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

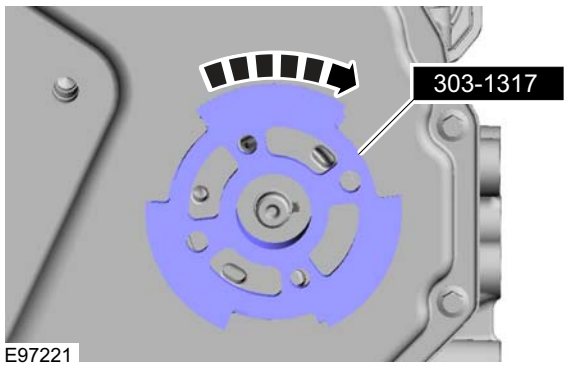
7. Special Tool(s): 303-679



8. Torque: 64 Nm



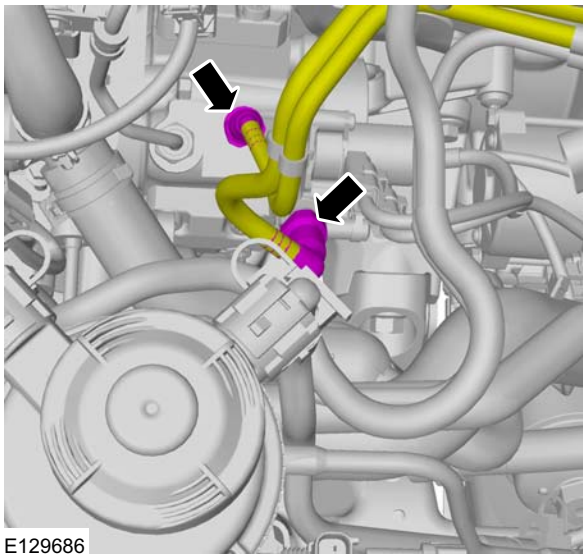
9. Install the Special Tool(s): 303-1317



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

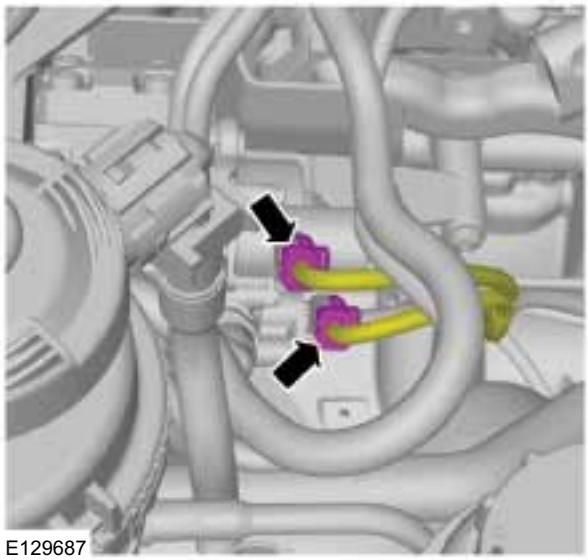
Vacuum foreign material from the low-pressure fuel supply line and fuel return line.

Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).



REMOVAL AND INSTALLATION

11.


E129687

12. CAUTIONS:

Make sure that the fuel line remains in contact at both ends until both unions nuts have been unscrewed and the area around the joints thoroughly cleaned.

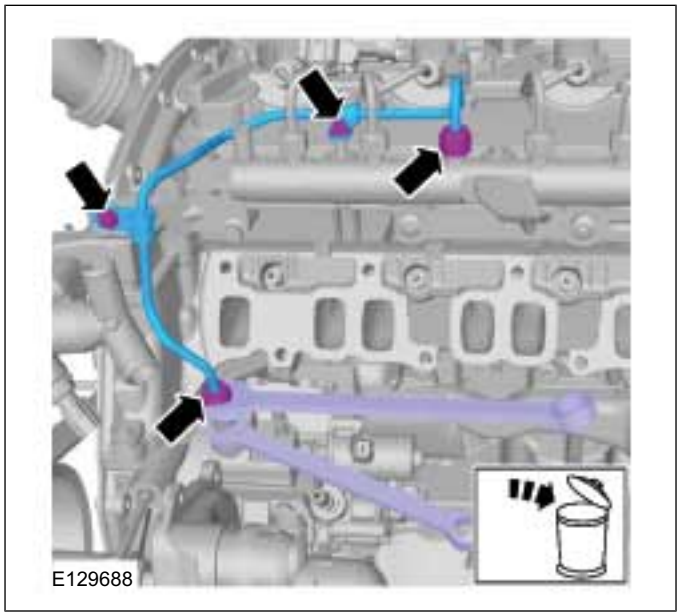
Make sure that all openings are sealed. Use new blanking caps.

Vacuum foreign material from the high-pressure fuel supply line, the fuel pump and the fuel rail.

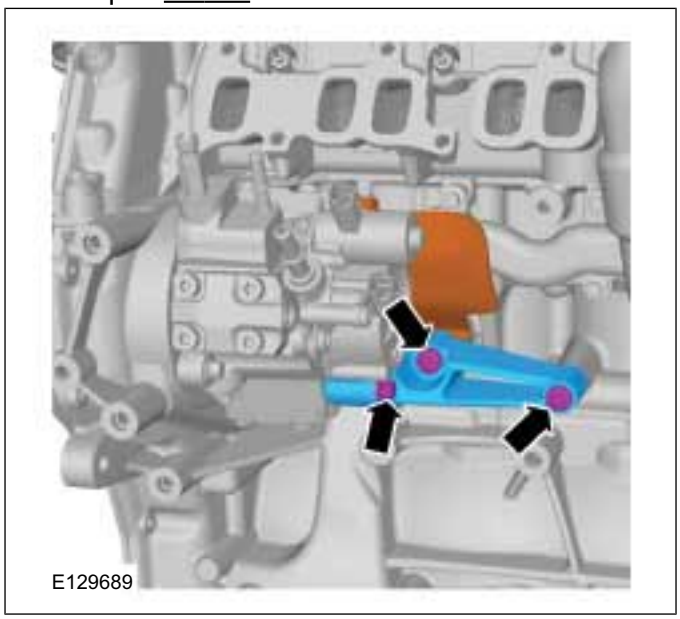
Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

Torque:

- Fuel rail high-pressure fuel supply line unions
  - Stage 1: 5 Nm
  - Stage 2: 35 Nm
- Fuel rail high-pressure fuel supply line bracket bolt 10 Nm

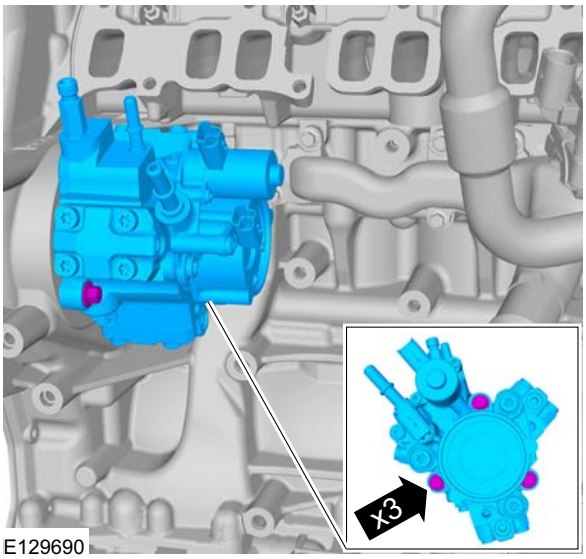

E129688

13. Torque: 23 Nm


E129689

REMOVAL AND INSTALLATION

14. Torque: 23 Nm



Installation

1. To install, reverse the removal procedure.
2. Carry out a Fuel System Leak Test using the following menu options:
   ToolBox/Powertrain/Service Functions

   General Equipment: Ford approved diagnostic tool
3. Carry out a Pump Learn procedure using the following menu options:
   ToolBox/Powertrain/Service Functions

   General Equipment: Ford approved diagnostic tool
4. Carry out the Pilot Correction Learn procedure using the following menu options:
   ToolBox/Powertrain/Service Functions

   General Equipment: Ford approved diagnostic tool

REMOVAL AND INSTALLATION

Fuel Rail

General Equipment

Ford Diagnostic Equipment

Removal

1. **WARNINGS:**

   Make sure that the engine is switched off.

   Make sure that the fuel pressure has dropped to zero and that the fuel temperature is at ambient temperature.

   Wait at least 1 minute after the engine has stopped before commencing any repair to the fuel injection system.

   CAUTION: Always carry out the cleaning process before carrying out any repairs to the fuel injection system components.

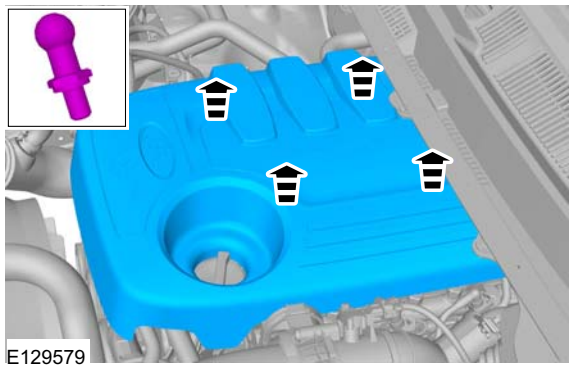
   NOTE: Removal steps in this procedure may contain installation details.

2. Within the datalogger function, check that the fuel pressure has dropped to zero and that the fuel temperature has either reached ambient temperature or is below 30ºC whichever is the greater.

   General Equipment: Ford Diagnostic Equipment

3. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

4.



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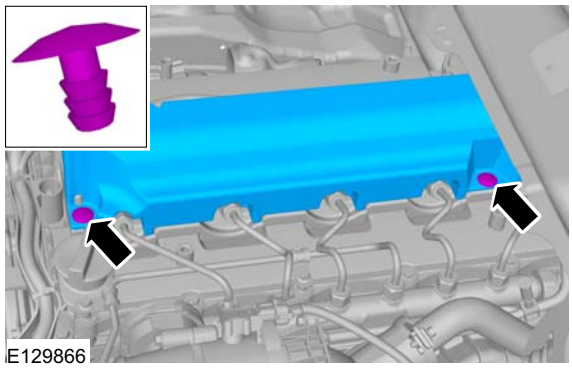


6. **CAUTIONS:**

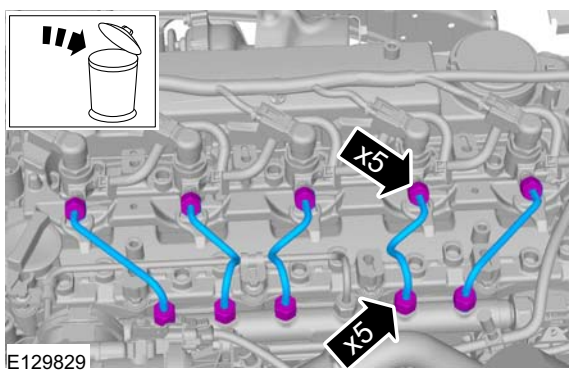
   Make sure that the fuel line remains in contact at both ends until both unions nuts have been unscrewed and the area around the joints thoroughly cleaned.

   Make sure that all openings are sealed. Use new blanking caps.

   Vacuum foreign material from the high-pressure fuel supply line, the fuel injector and the fuel rail.

   Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

   Torque:
   - Stage 1: 22 Nm
   - Stage 2: 25 Nm

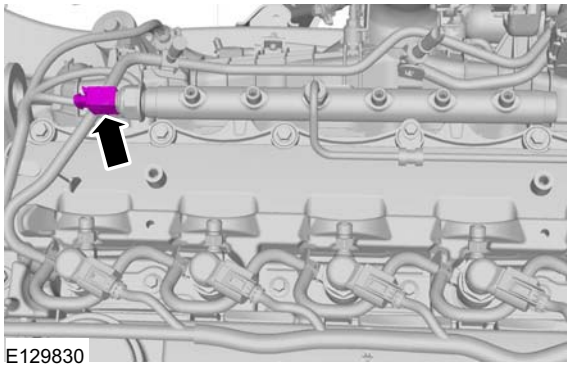


7. **CAUTION: Make sure that all openings are sealed. Use new blanking caps.**

REMOVAL AND INSTALLATION

Vacuum foreign material from the fuel rail fuel return line quick release coupling.

Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).


E129830

8. Refer to: Intake Manifold (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

9. **CAUTIONS:**

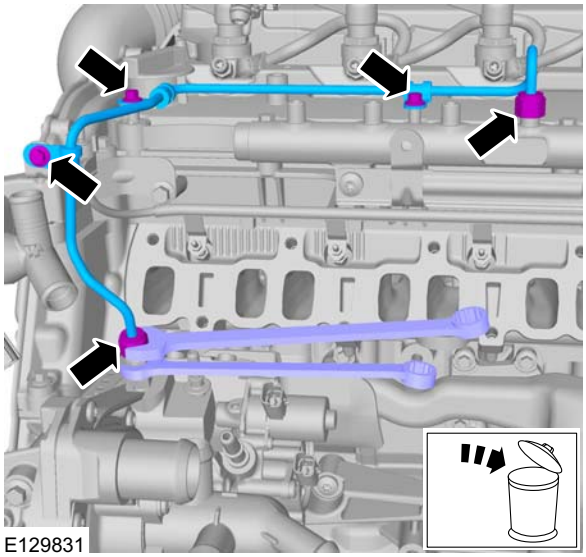
Make sure that the fuel line remains in contact at both ends until both unions nuts have been unscrewed and the area around the joints thoroughly cleaned.

Make sure that all openings are sealed. Use new blanking caps.

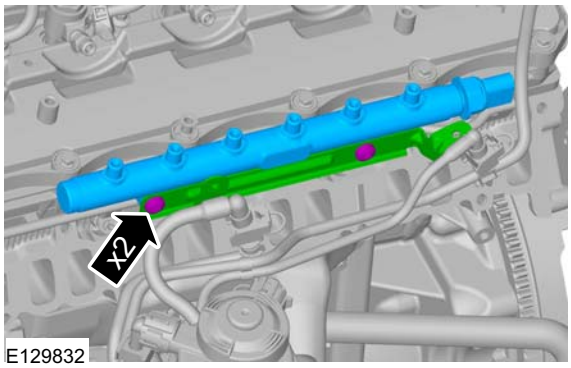
Vacuum foreign material from the high-pressure fuel supply line, the fuel pump and the fuel rail.

Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

Torque:
- Fuel rail high-pressure fuel supply line unions
  - Stage 1: 5 Nm
  - Stage 2: 35 Nm
- Fuel rail high-pressure fuel supply line bracket bolt 10 Nm


E129831

10. Fuel rail bolts
Torque:
- Stage 1: 6 Nm
- Stage 2: 23 Nm


E129832

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Fuel Injectors

General Equipment

Ford Diagnostic Equipment

General Equipment

Long Nose Pliers

Removal

1. **WARNINGS:**

   Make sure that the engine is switched off.

   Make sure that the fuel pressure has dropped to zero and that the fuel temperature is at ambient temperature.

   Wait for a minimum of 1 minute after the engine has stopped before commencing any repair to the fuel injection system.

   CAUTIONS:

   Fuel injectors must not be dismantled or the nozzles cleaned, not even with ultrasonic equipment. Install new fuel injectors if necessary.

   Fuel injectors sharing a common fuel injector clamp must be removed in pairs.

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

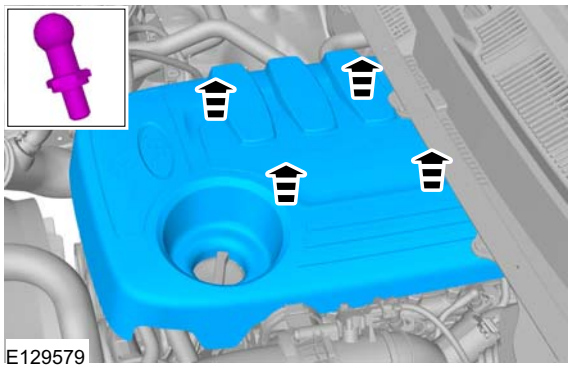
   Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Within the datalogger function of WDS, check that the fuel pressure has dropped to zero and that the fuel temperature has either reached ambient temperature or is below 30ºC whichever is the greater.

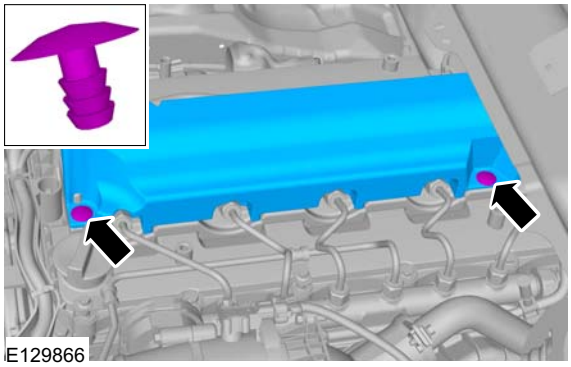
   General Equipment: Ford Diagnostic Equipment

3. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

4.



5.

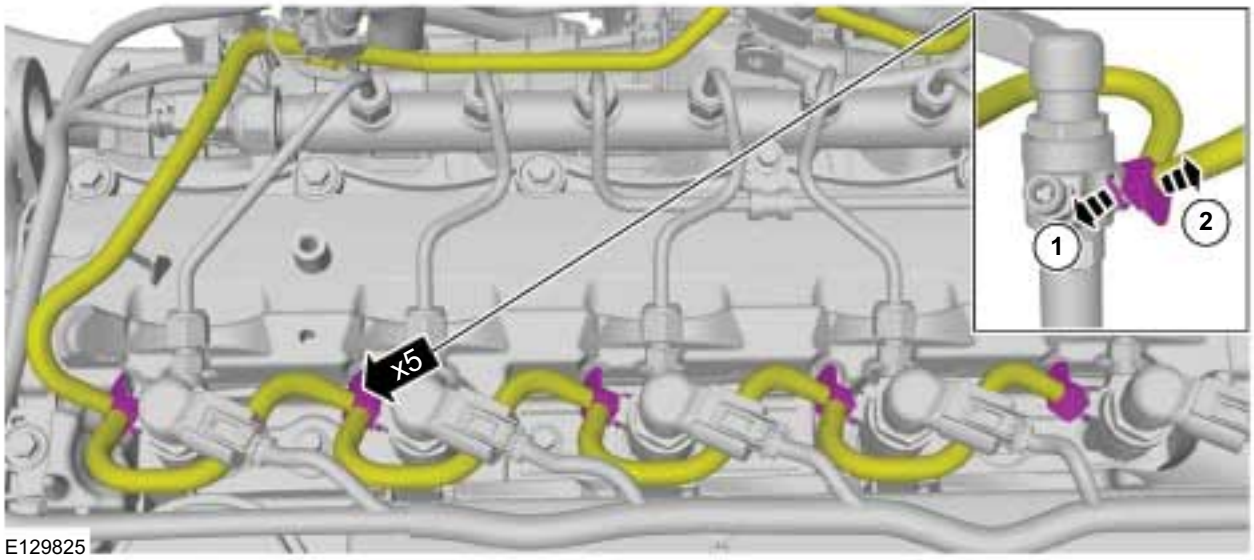


6. **CAUTION: Make sure that all openings are sealed. Use new blanking caps.**

   Vacuum foreign material from the fuel injector and fuel return lines.

   Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

REMOVAL AND INSTALLATION



7. CAUTIONS:

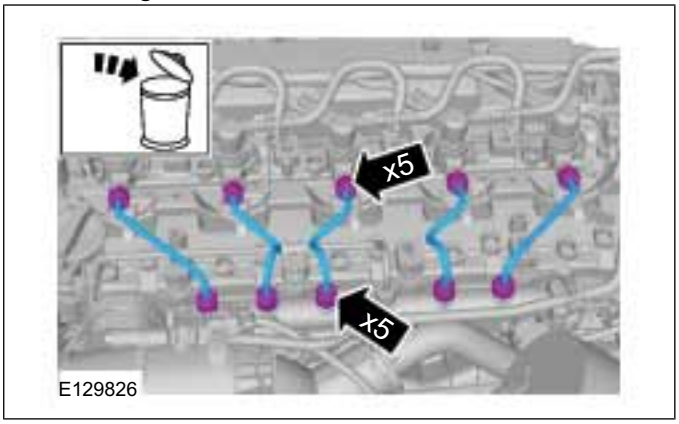
Make sure that the fuel line remains in contact at both ends until both unions nuts have been unscrewed and the area around the joints thoroughly cleaned.

Make sure that all openings are sealed. Use new blanking caps.

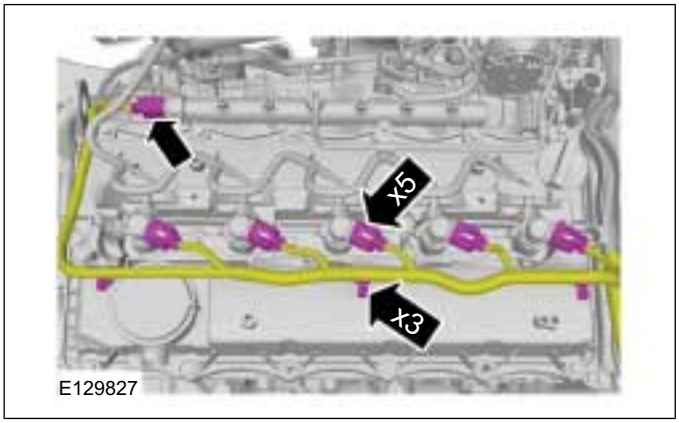
Vacuum foreign material from the high-pressure fuel supply line, the fuel injector and the fuel rail.

Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

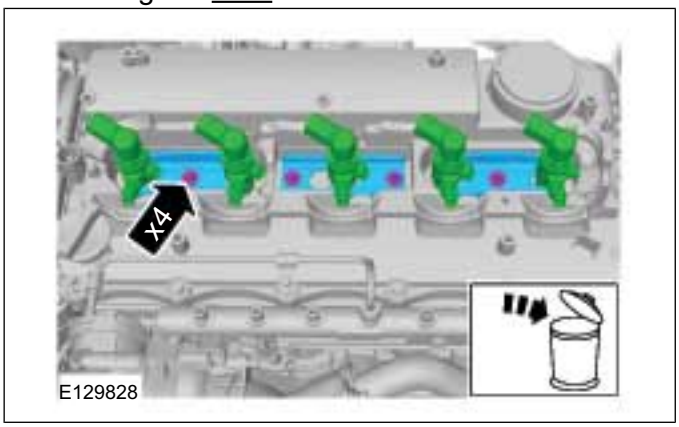
Torque:
- Stage 1: 22 Nm
- Stage 2: 25 Nm



8.

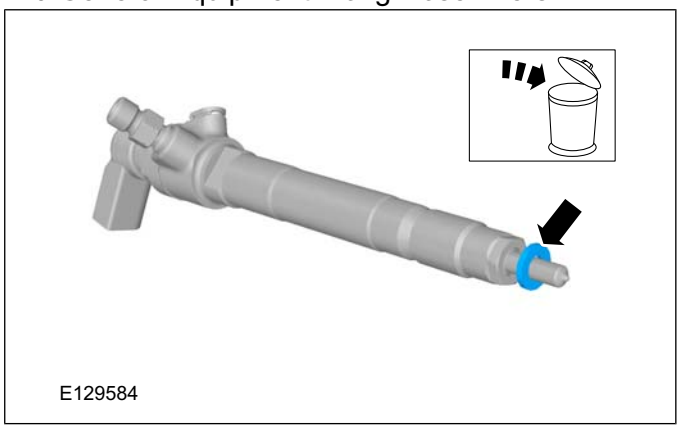


9. Torque:
- Stage 1: 5 Nm
- Stage 2: 180°



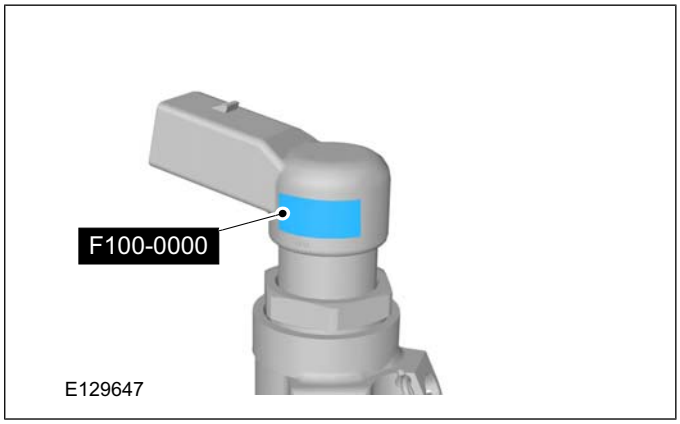
REMOVAL AND INSTALLATION

10. General Equipment: Long Nose Pliers



Installation

1. To install, reverse the removal procedure.
2. Record the new fuel injector correction factor code.



3. Input the new Injector Correction Factors using the following WDS menu options: ToolBox/Powertrain/Service Functions

   General Equipment: Ford Diagnostic Equipment

SECTION 303-04D Fuel Charging and Controls - Turbocharger

VEHICLE APPLICATION: 2011.50 Ranger

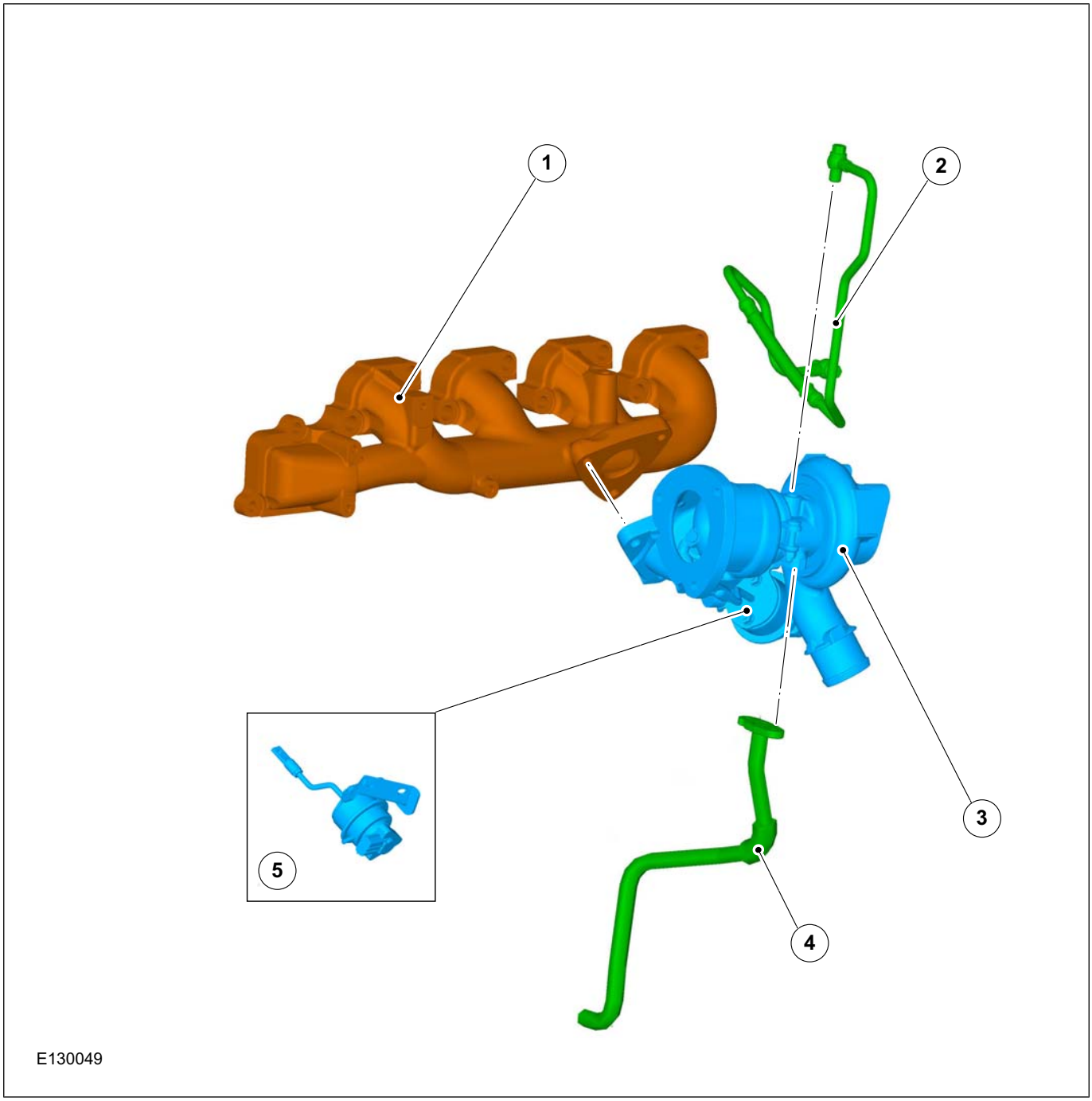
CONTENTS PAGE

DESCRIPTION AND OPERATION

Turbocharger

2.2L Duratorq-TDCi (Puma) diesel engine

Vehicles with 2.2L Duratorq-TDCi (Puma) (125 PS/120 PS) diesel engine

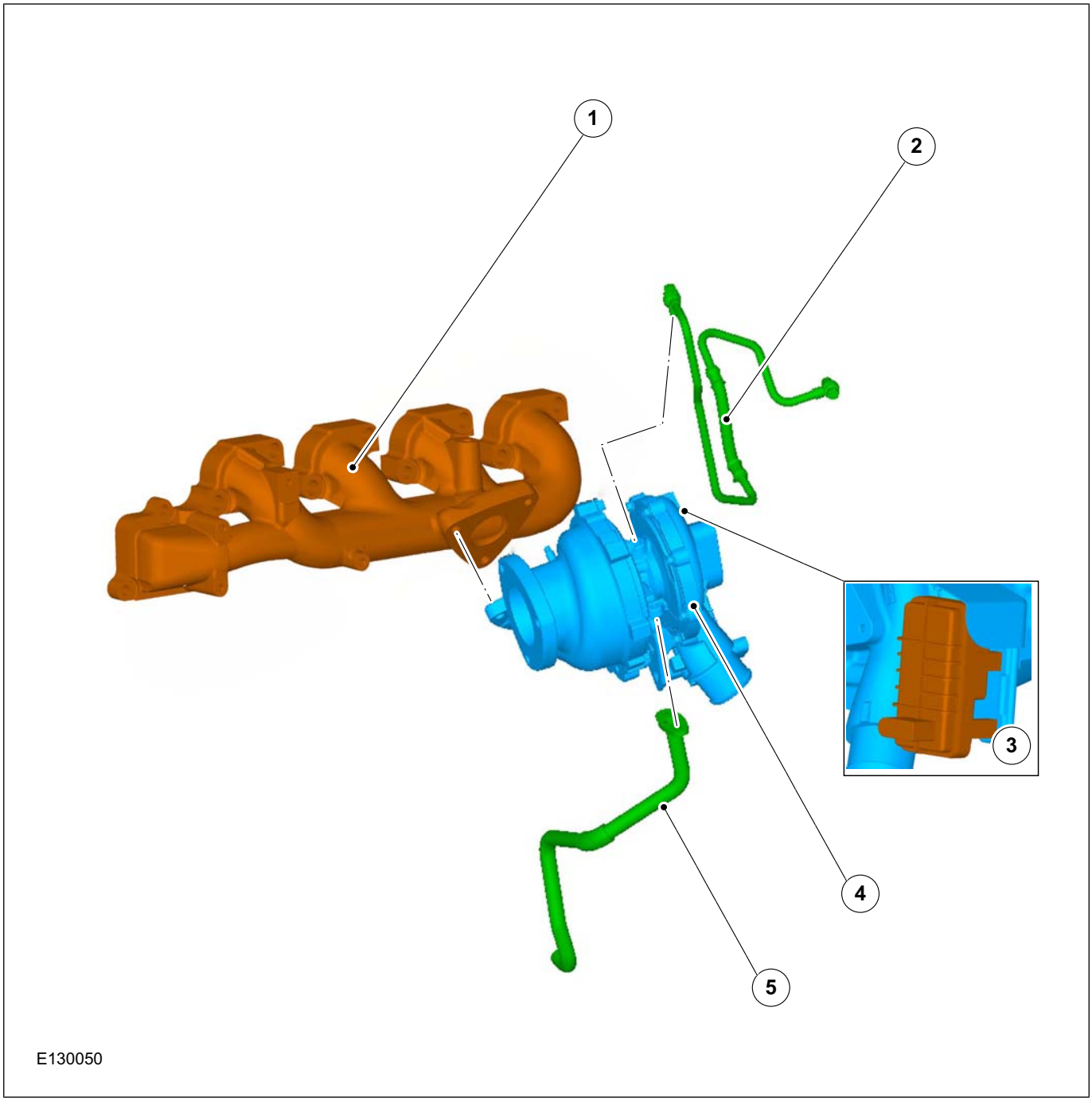


Item	Description
1	Exhaust manifold
2	Oil supply tube

Item	Description
3	Turbocharger
4	Oil drain tube
5	Actuator

DESCRIPTION AND OPERATION

Vehicles with 2.2L Duratorq-TDCi (Puma) (150 PS) diesel engine



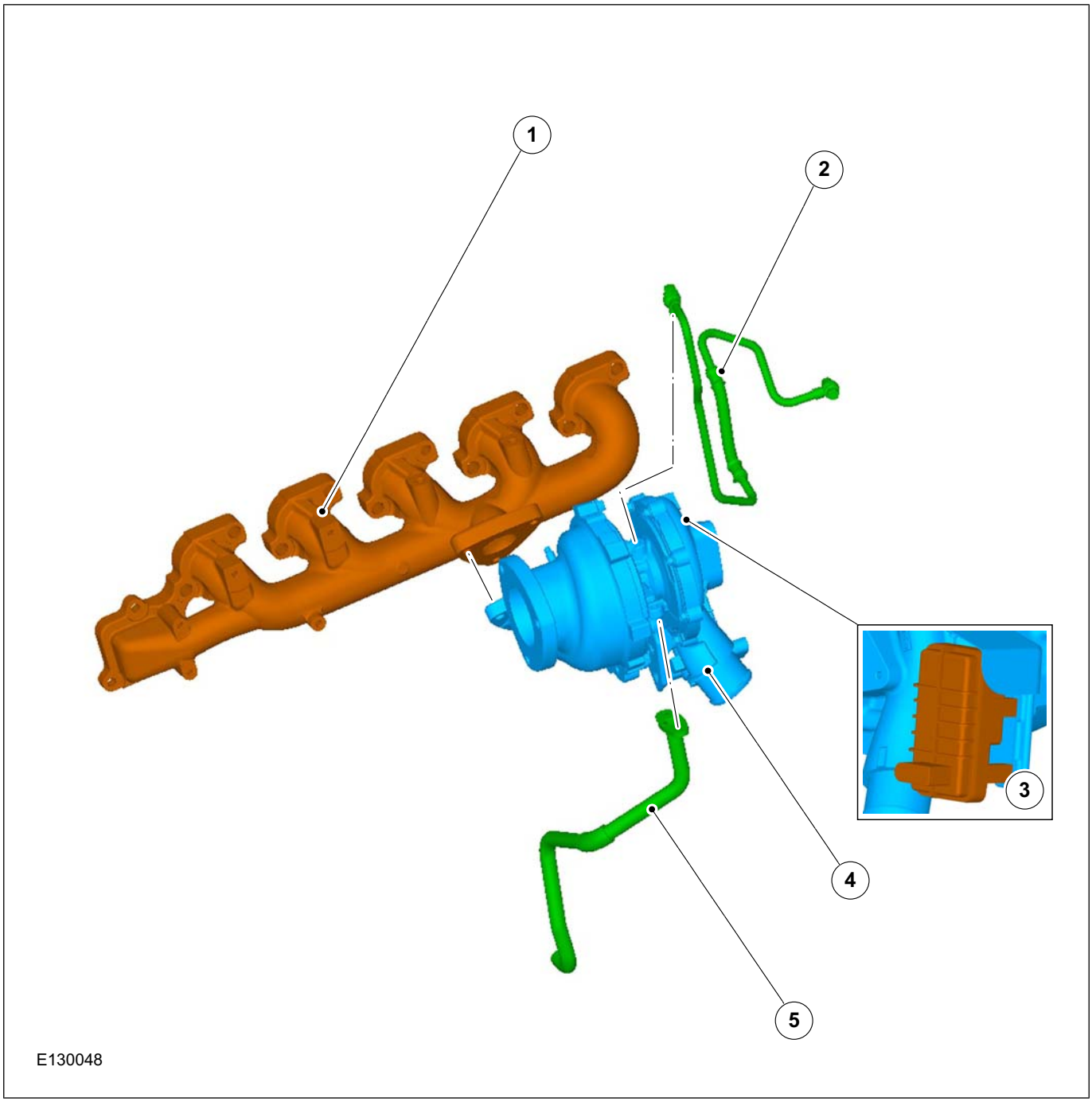
Item	Description
1	Exhaust manifold
2	Oil supply tube

Item	Description
3	Electronic turbocharger guide vane adjuster
4	Turbocharger
5	Oil drain tube

DESCRIPTION AND OPERATION

3.2 L Duratorq-TDCi (Puma) diesel engine

Vehicles with 3.2L Duratorq-TDCi (Puma) (200 PS) diesel engine



Item	Description
1	Exhaust manifold
2	Oil supply tube
3	Electronic turbocharger guide vane adjuster

Item	Description
4	Turbocharger
5	Oil drain tube

REMOVAL AND INSTALLATION

Turbocharger — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, LHD 4WD/LHD RWD(23 612 0)

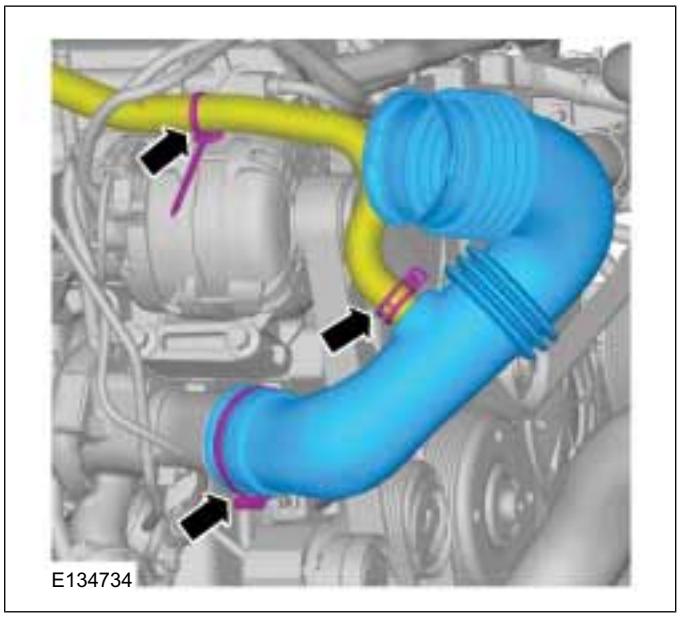
Removal

WARNING: When the engine and exhaust system are hot, they can cause severe burns or injury. Turn off the engine and wait until they are cool before removing the exhaust system.

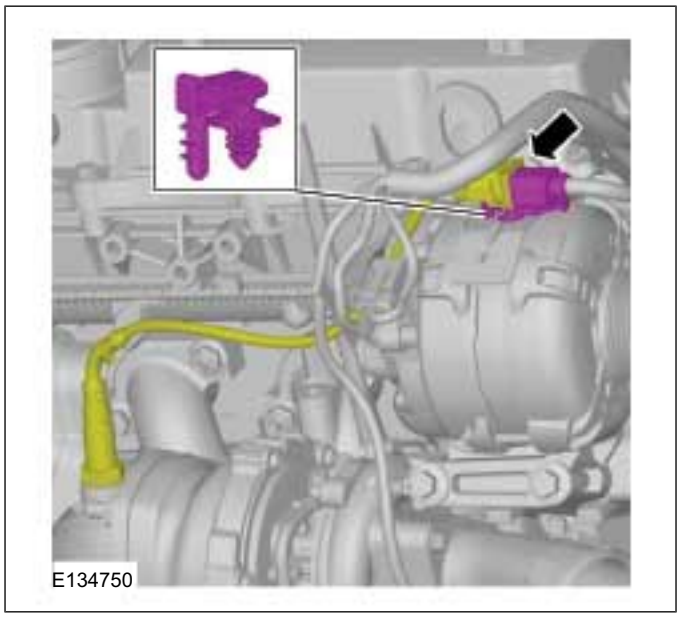
NOTE: Removal steps in this procedure may contain installation details.

All vehicles

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Air Cleaner - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
3.



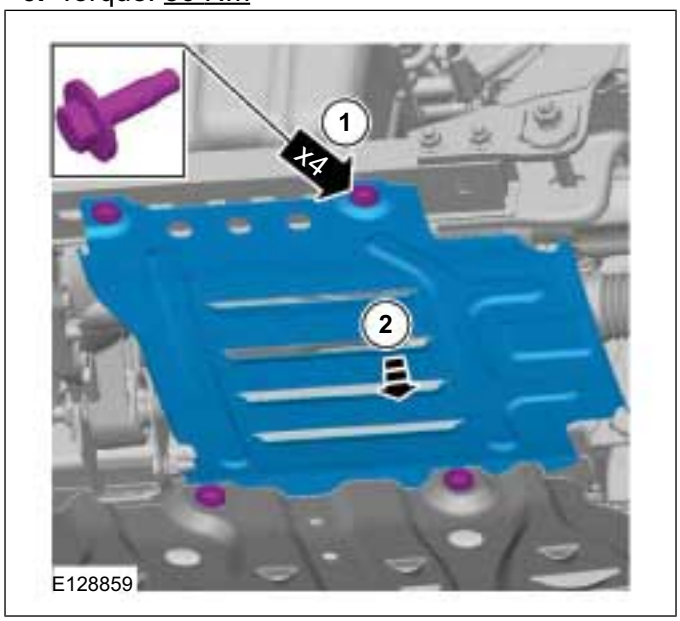
4.



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

4x4

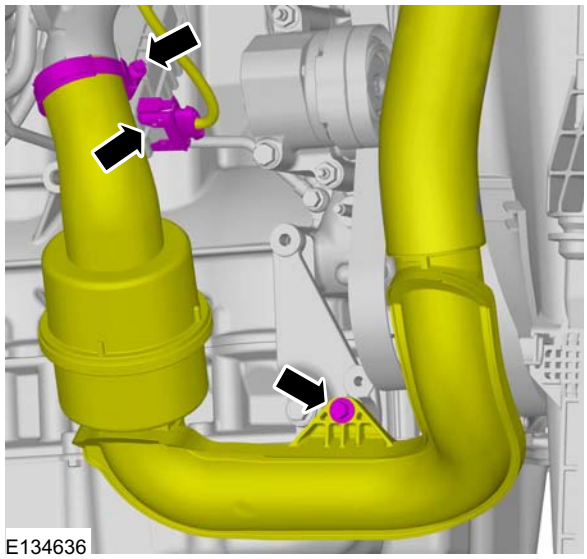
6. Torque: 30 Nm



REMOVAL AND INSTALLATION

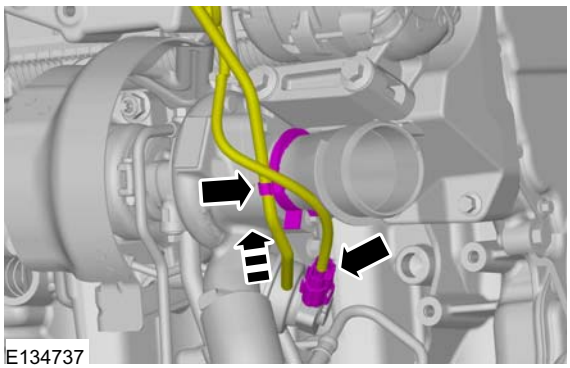
All vehicles

7. Torque: 10 Nm

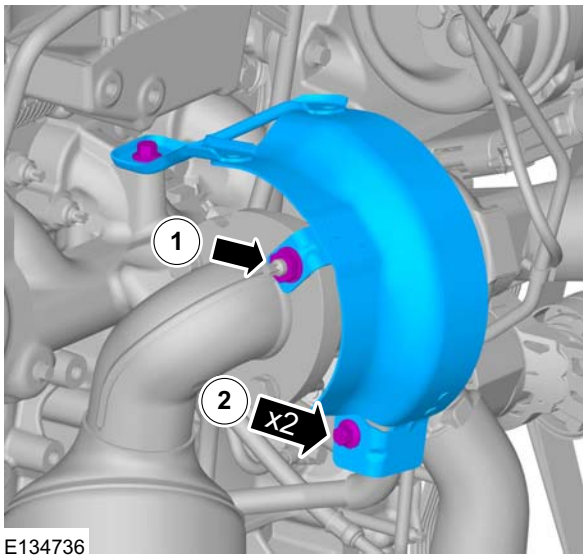


Vehicles with fixed vane turbocharger

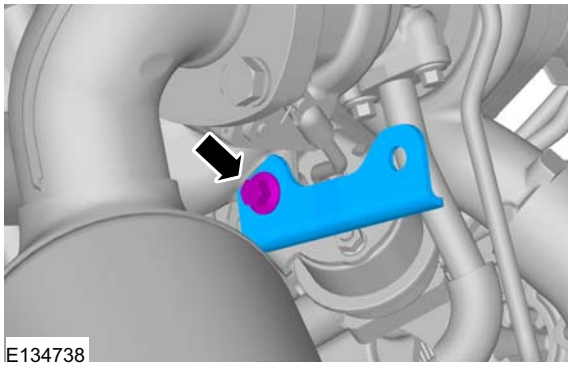
8.



9. 1. Torque: 47 Nm
2. Torque: 22 Nm



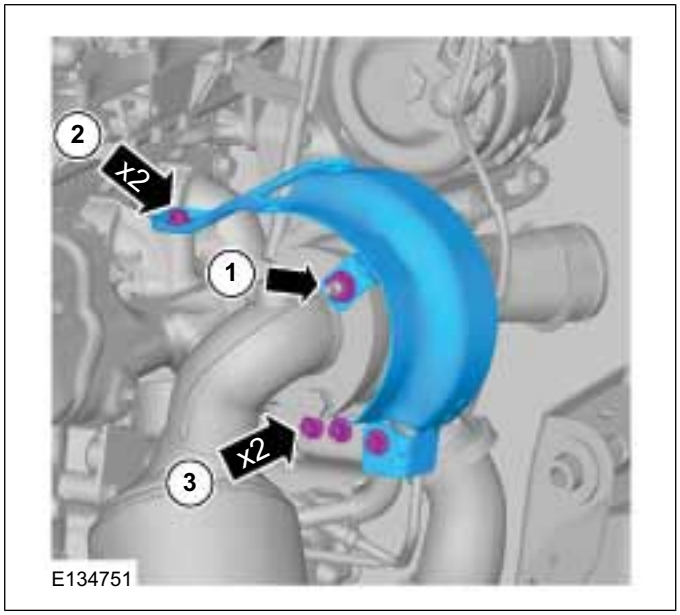
10. Torque: 22 Nm



REMOVAL AND INSTALLATION

All vehicles

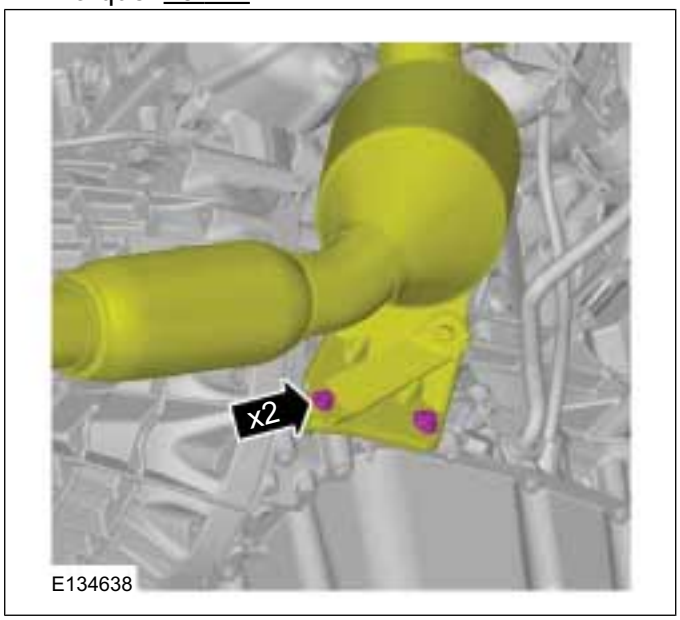
11. 1. Torque: 47 Nm
2. Torque: 22 Nm
3. Torque: 22 Nm



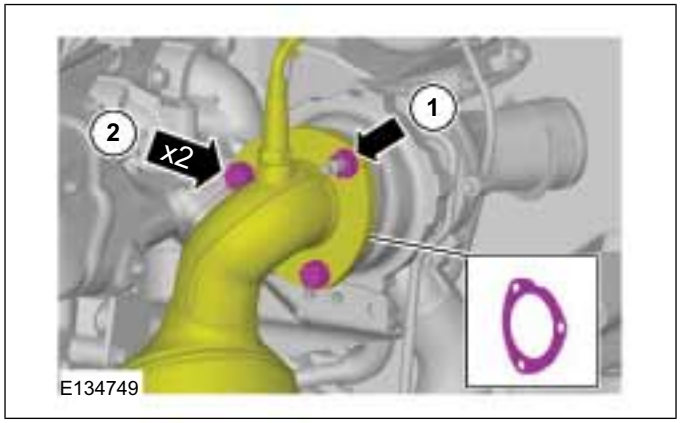
12. **CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.**

NOTE: Securely strap the exhaust flexible pipe to the frame.

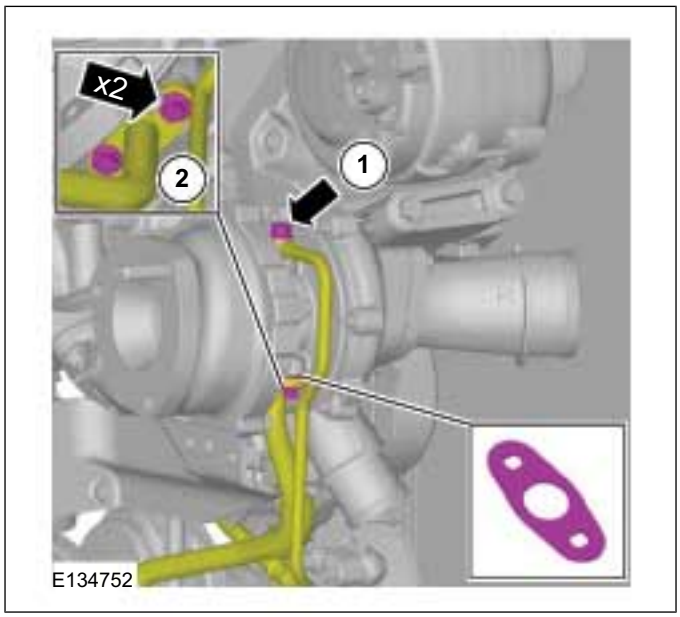
Torque: 25 Nm



13. 1. Torque: 47 Nm
2. Torque: 47 Nm



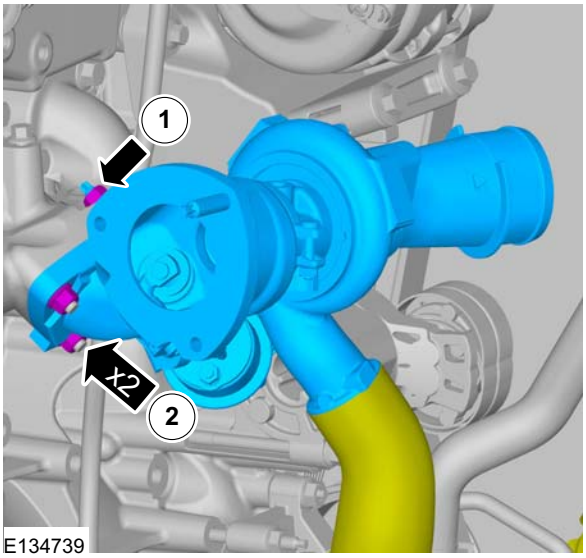
14. 1. Torque: 35 Nm
2. Torque: 10 Nm



REMOVAL AND INSTALLATION

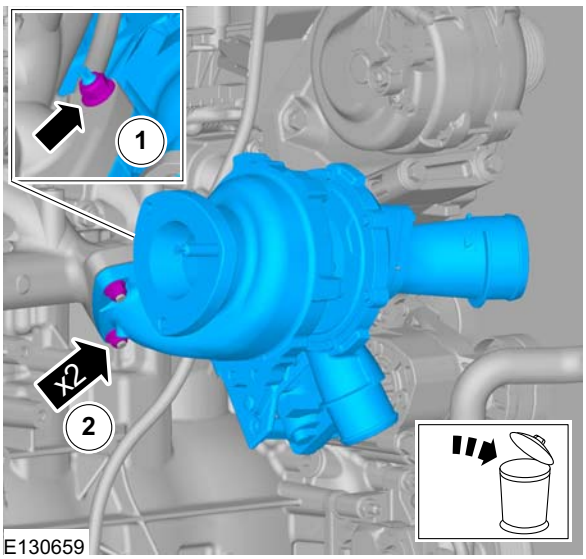
Vehicles with fixed vane turbocharger

15. 1. Torque: 23 Nm
2. Torque: 23 Nm

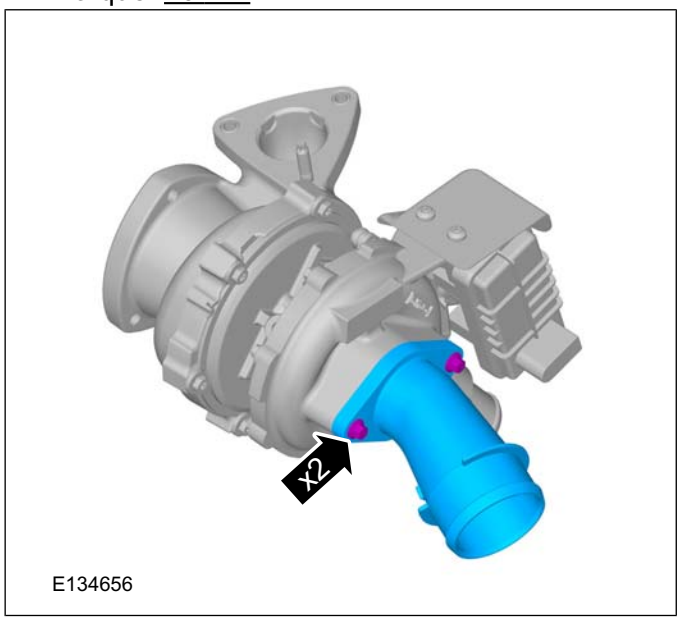


All vehicles

16. 1. Torque: 23 Nm
2. Torque: 23 Nm



17. Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Turbocharger — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, RHD 4WD/RHD RWD(23 612 0)

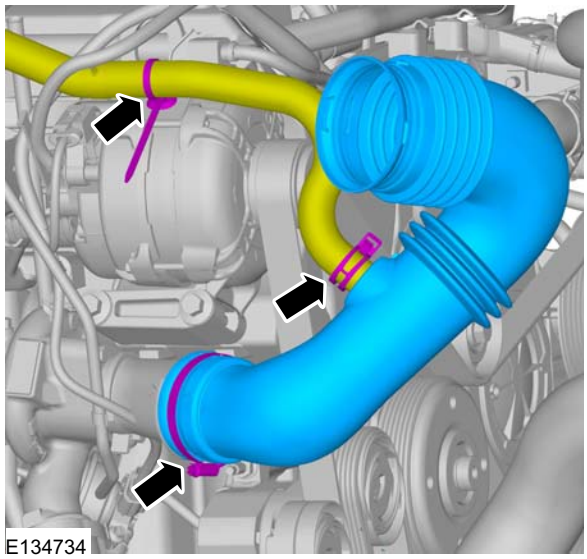
Removal

WARNING: When the engine and exhaust system are hot, they can cause severe burns or injury. Turn off the engine and wait until they are cool before removing the exhaust system.

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

All vehicles

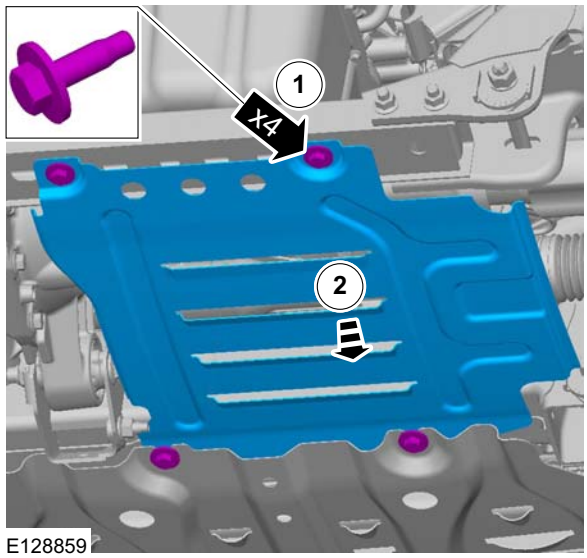
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Air Cleaner - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
3.


E134734

4. Refer to: Generator - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (414-02 Generator and Regulator, Removal and Installation).
5. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

4x4

6. Torque: 30 Nm

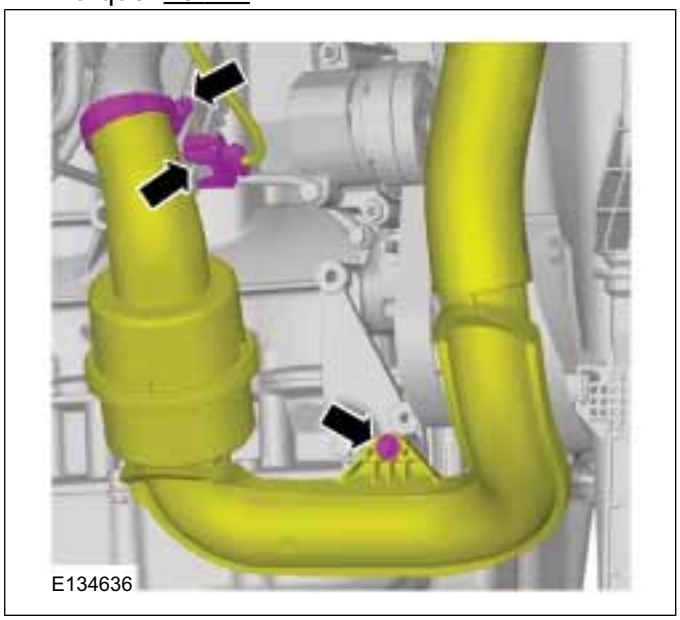


E128859

REMOVAL AND INSTALLATION

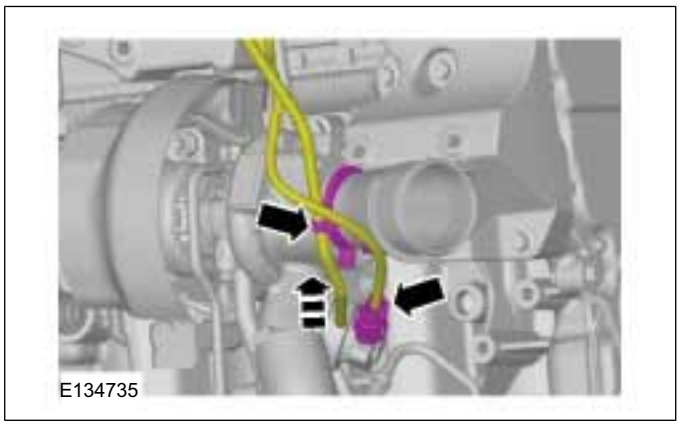
All vehicles

7. Torque: 10 Nm

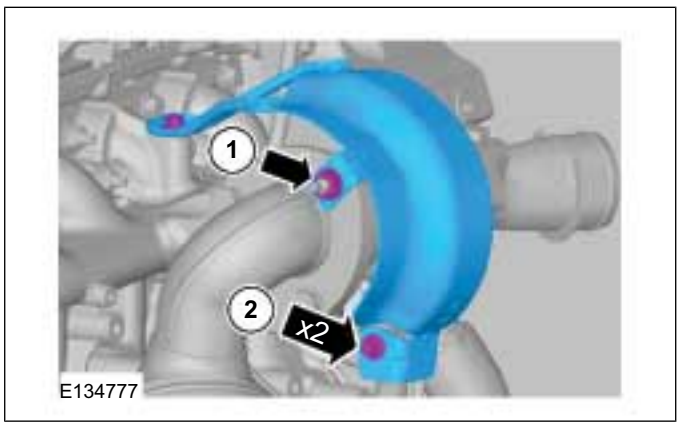


Vehicles with fixed vane turbocharger

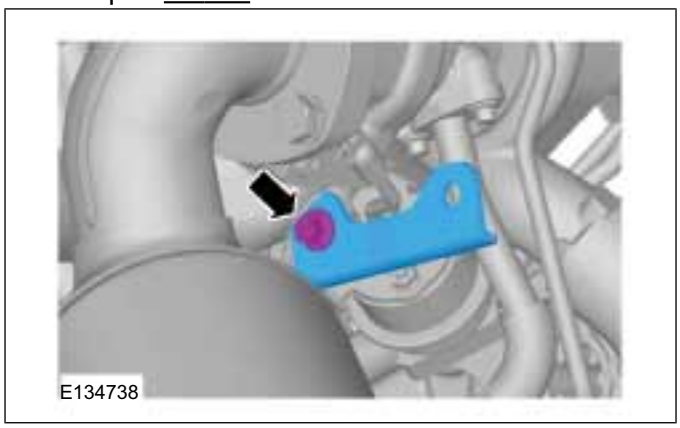
8.



9. 1. Torque: 47 Nm
2. Torque: 22 Nm

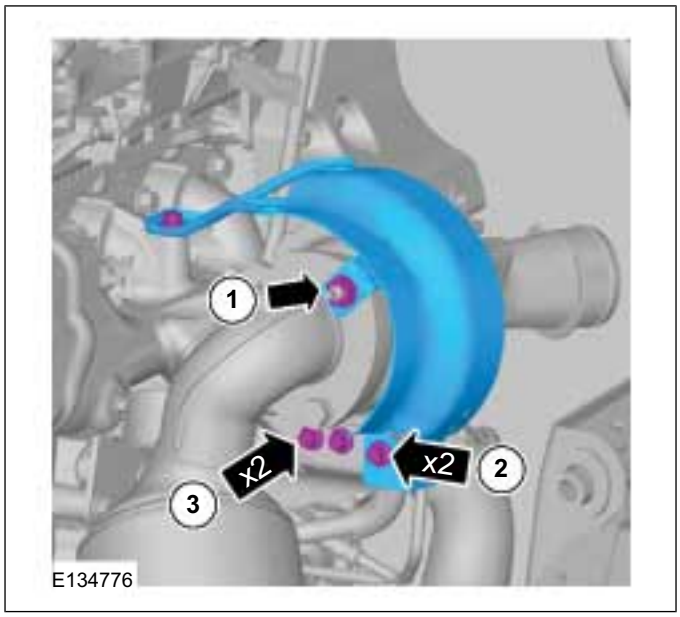


10. Torque: 22 Nm



All vehicles

11. 1. Torque: 47 Nm
2. Torque: 22 Nm
3. Torque: 22 Nm

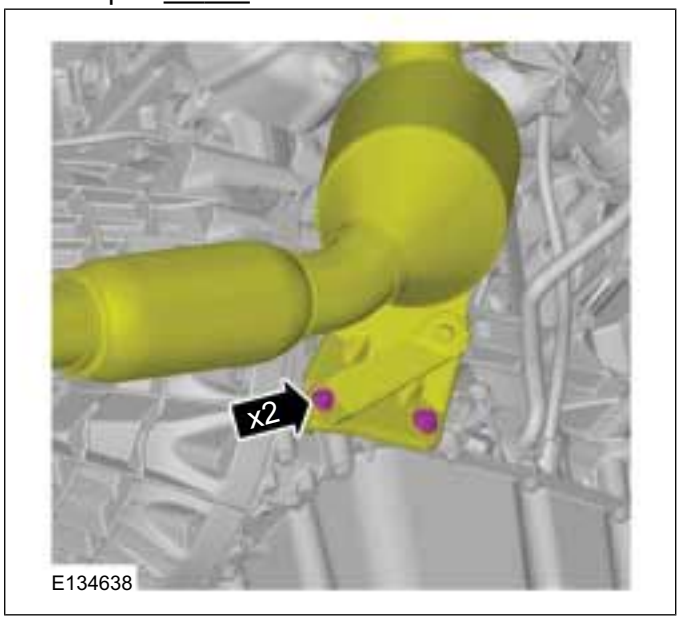


12. ⚠ **CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.**

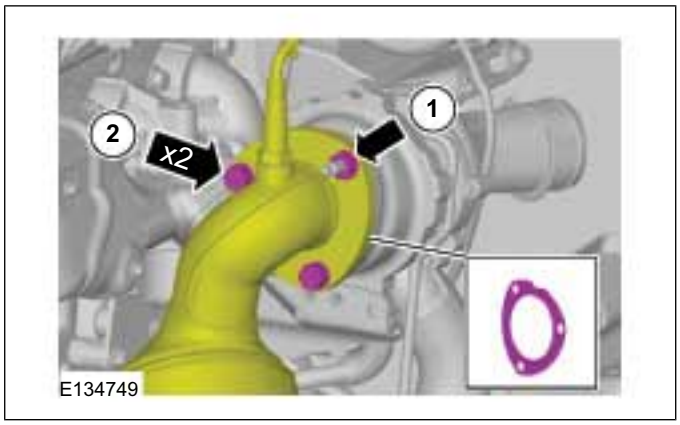
REMOVAL AND INSTALLATION

NOTE: Securely strap the exhaust flexible pipe to the frame.

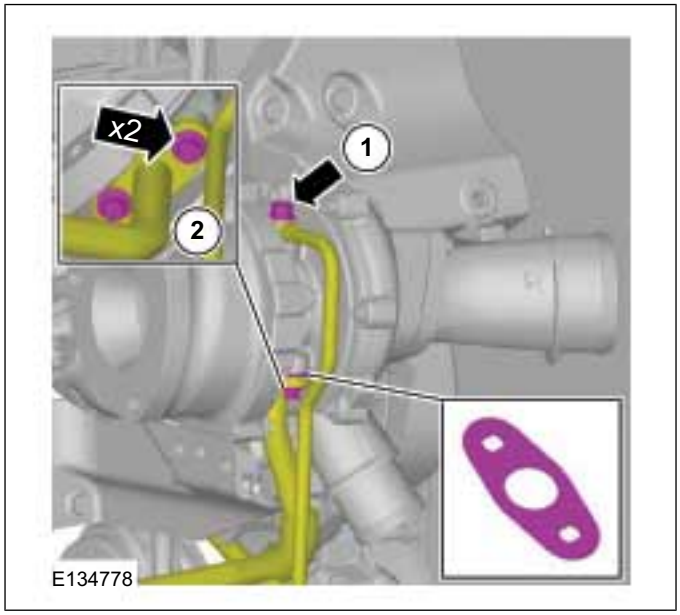
Torque: 25 Nm



13. 1. Torque: 47 Nm
    2. Torque: 47 Nm

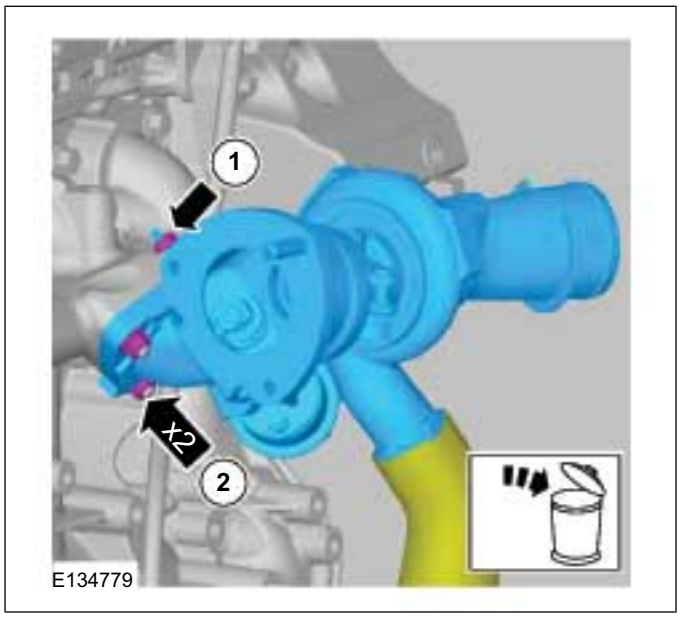


14. 1. Torque: 35 Nm
    2. Torque: 10 Nm



Vehicles with fixed vane turbocharger

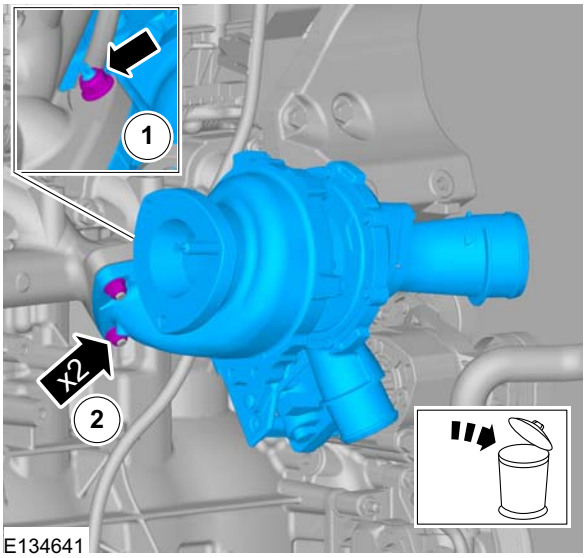
15. 1. Torque: 23 Nm
    2. Torque: 23 Nm



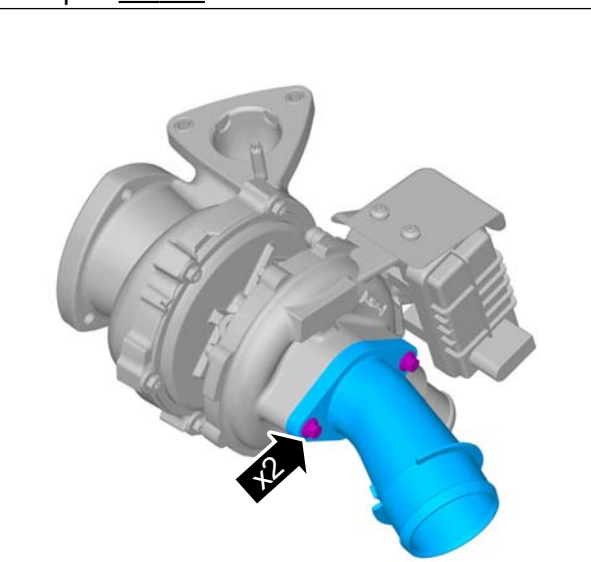
REMOVAL AND INSTALLATION

All vehicles

16. 1. Torque: 23 Nm
2. Torque: 23 Nm



17. Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Turbocharger — 3.2L Duratorq-TDCi (148kW/200PS) - Puma, LHD 4WD/LHD RWD(23 612 0)

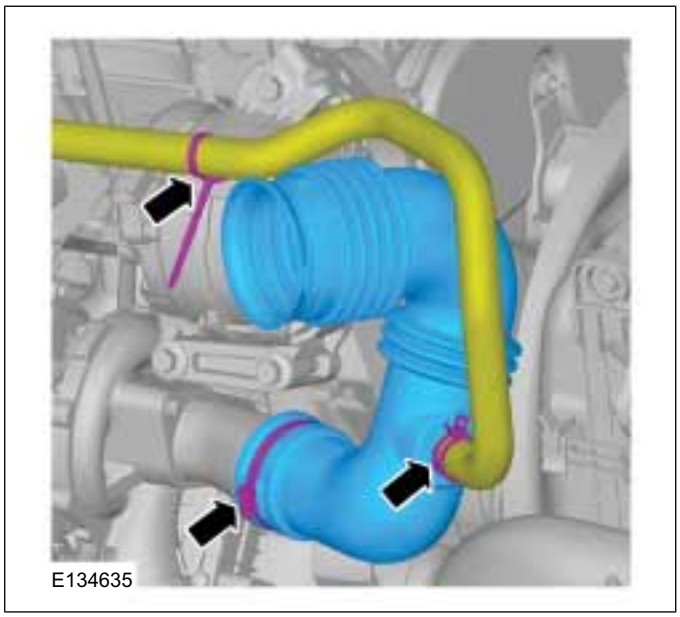
Removal

WARNING: When the engine and exhaust system are hot, they can cause severe burns or injury. Turn off the engine and wait until they are cool before removing the exhaust system.

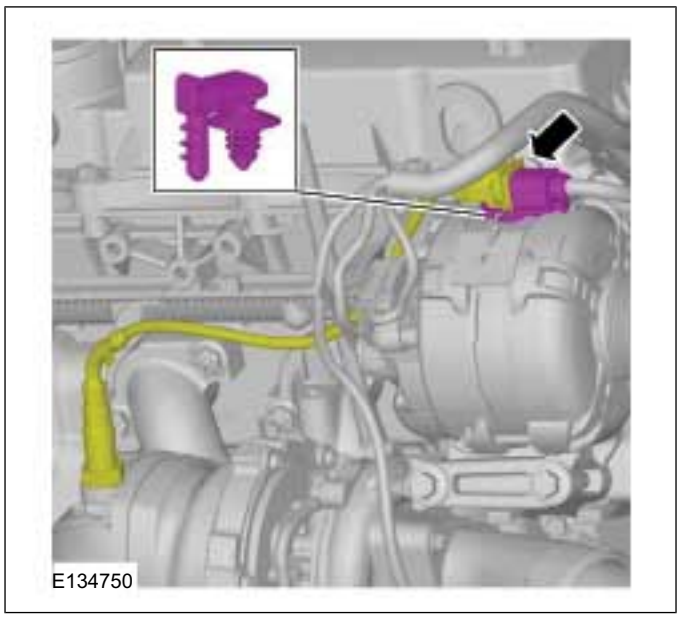
NOTE: Removal steps in this procedure may contain installation details.

All vehicles

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Air Cleaner - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
3.

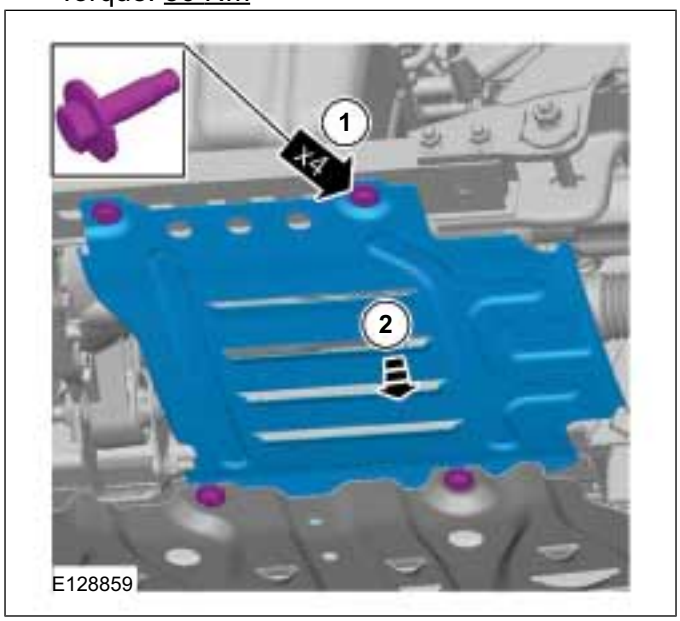


4.



4x4

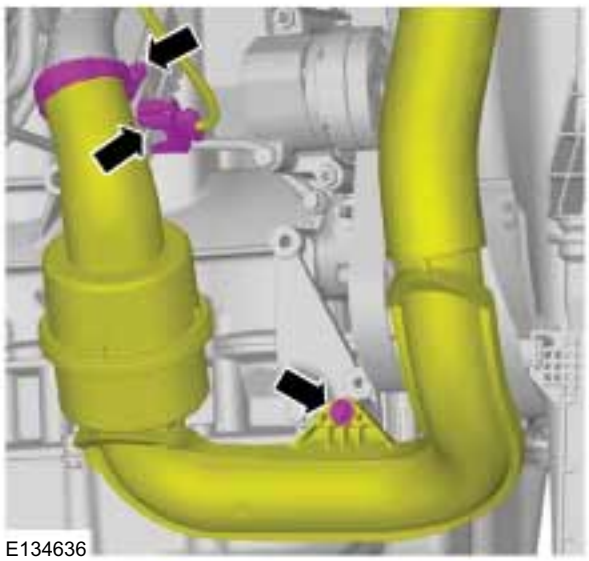
5. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
   Torque: 30 Nm



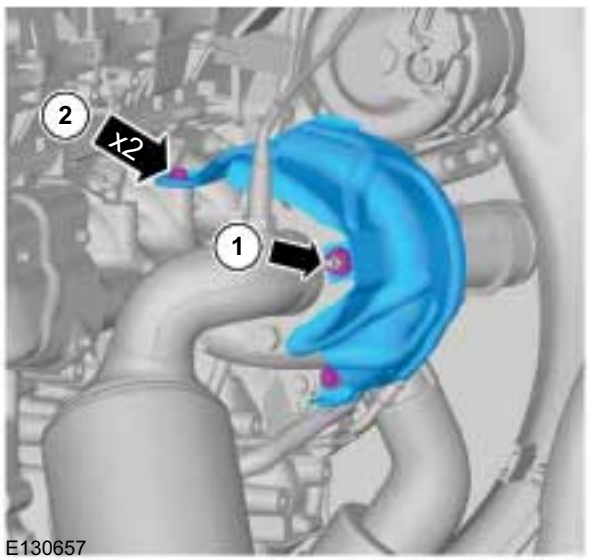
REMOVAL AND INSTALLATION

All vehicles

6. Torque: 10 Nm



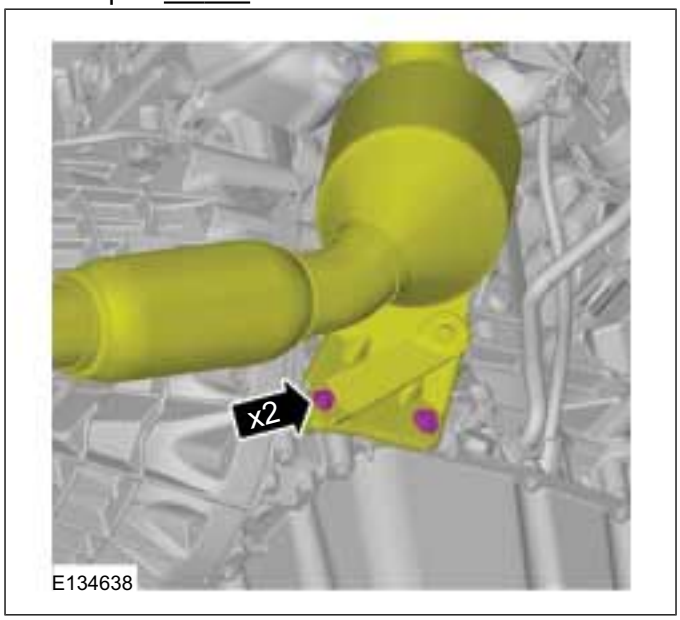
7. 1. Torque: 47 Nm
2. Torque: 22 Nm



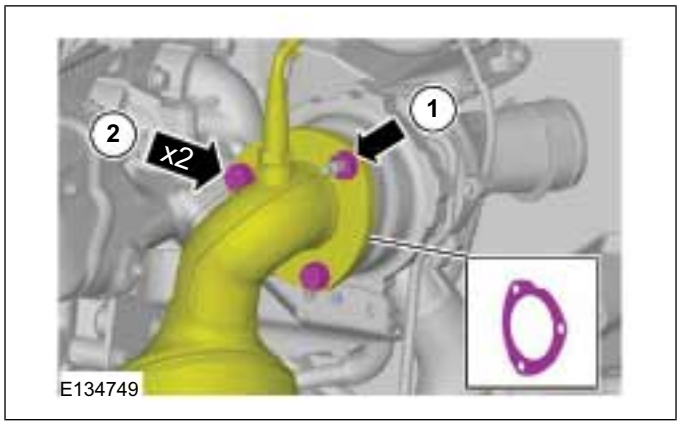
8. **CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.**

NOTE: Securely strap the exhaust flexible pipe to the frame.

Torque: 25 Nm

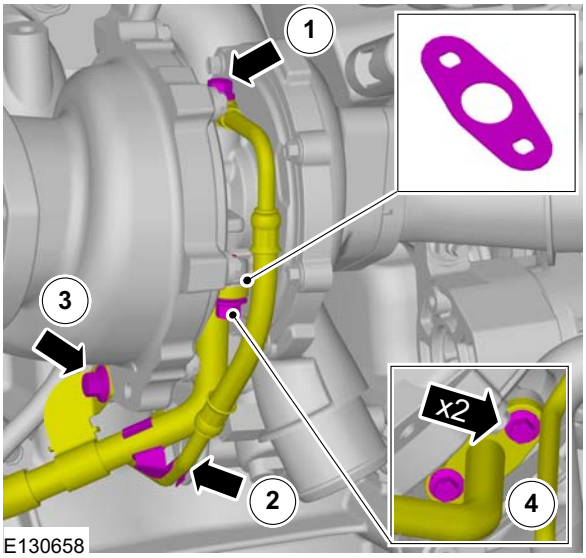


9. 1. Torque: 47 Nm
2. Torque: 47 Nm

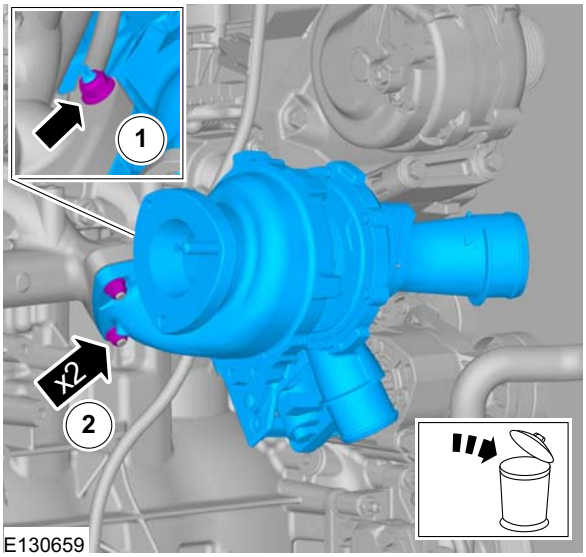


REMOVAL AND INSTALLATION

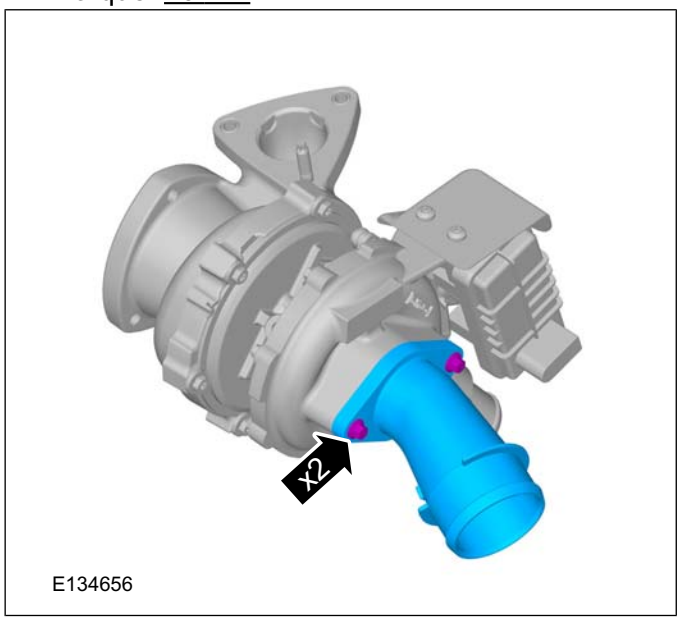
10. 1. Torque: 35 Nm
3. Torque: 22 Nm
4. Torque: 10 Nm



11. 1. Torque: 23 Nm
2. Torque: 23 Nm



12. Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Turbocharger — 3.2L Duratorq-TDCi (148kW/200PS) - Puma, RHD 4WD/RHD RWD(23 612 0)

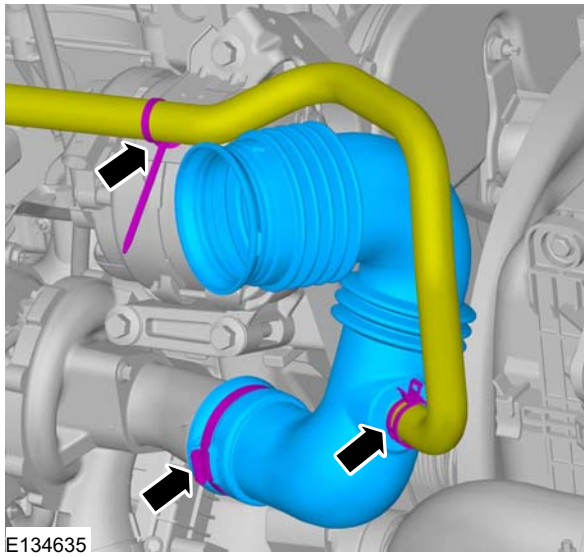
Removal

WARNING: When the engine and exhaust system are hot, they can cause severe burns or injury. Turn off the engine and wait until they are cool before removing the exhaust system.

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

All vehicles

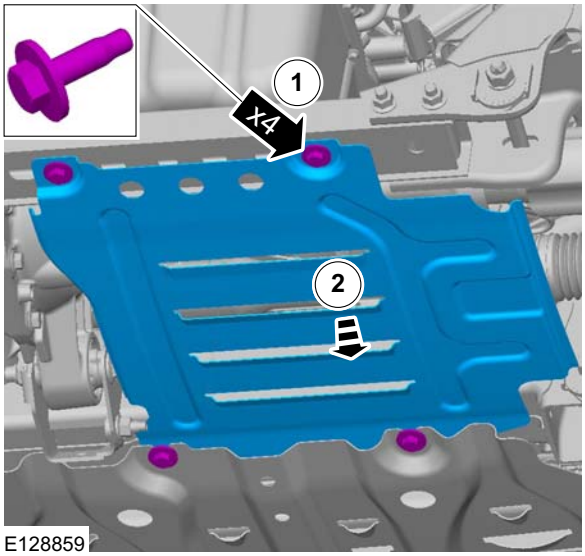
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Air Cleaner - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
3.


E134635

4. Refer to: Generator - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (414-02 Generator and Regulator, Removal and Installation).
5. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

4x4

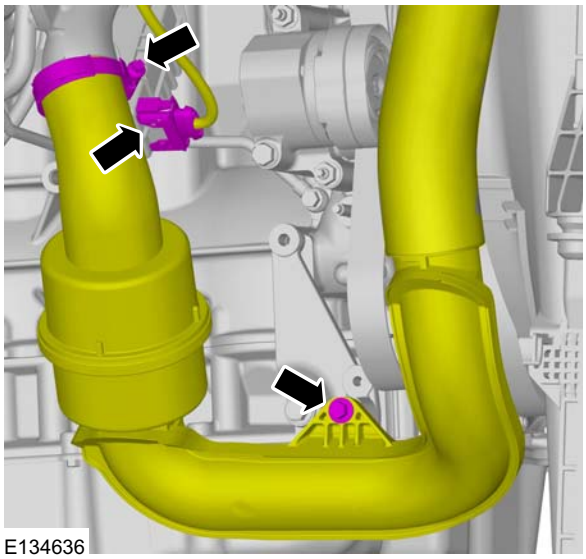
6. Torque: 30 Nm



E128859

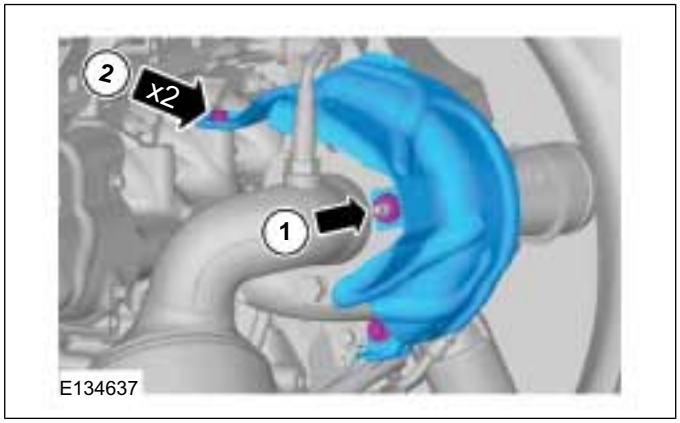
All vehicles

7. Torque: 10 Nm


E134636

REMOVAL AND INSTALLATION

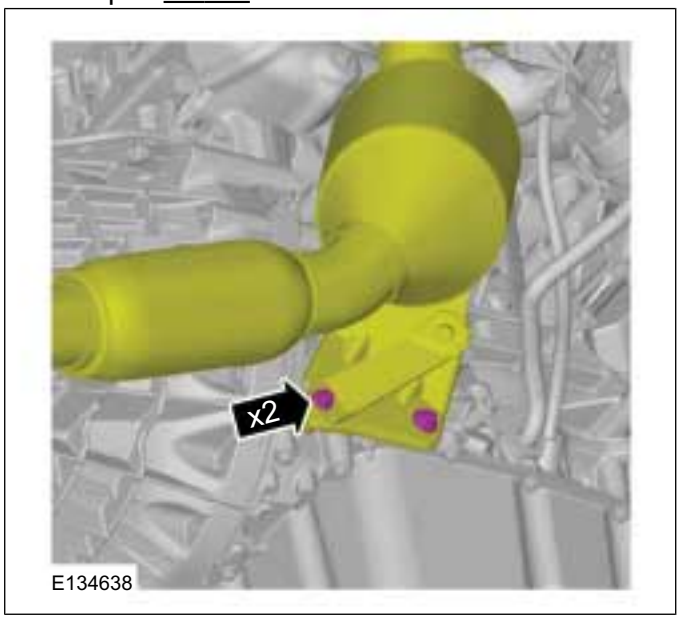
8. 1. Torque: 47 Nm
2. Torque: 22 Nm



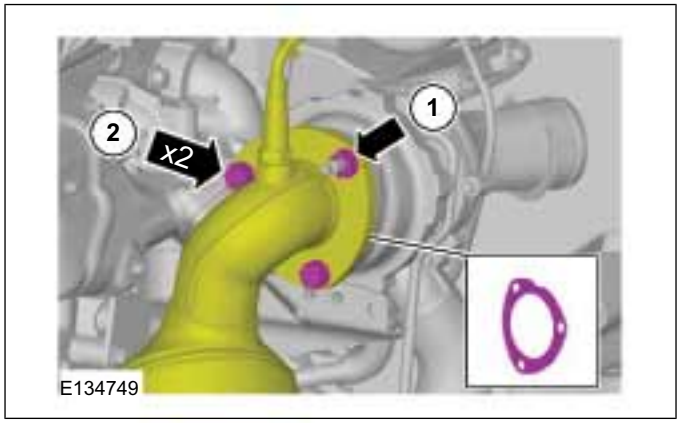
9. **CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.**

NOTE: Securely strap the exhaust flexible pipe to the frame.

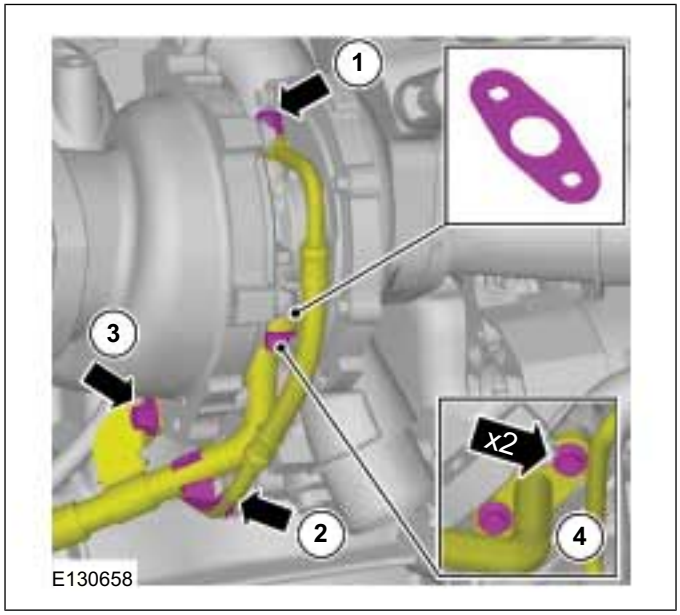
Torque: 25 Nm



10. 1. Torque: 47 Nm
2. Torque: 47 Nm

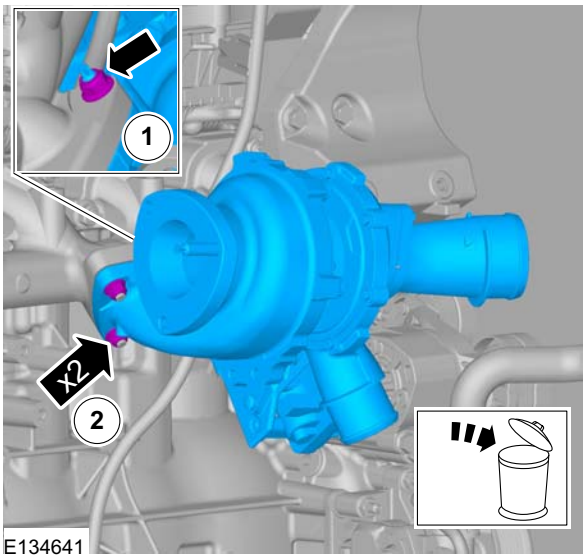


11. 1. Torque: 35 Nm
3. Torque: 22 Nm
4. Torque: 10 Nm

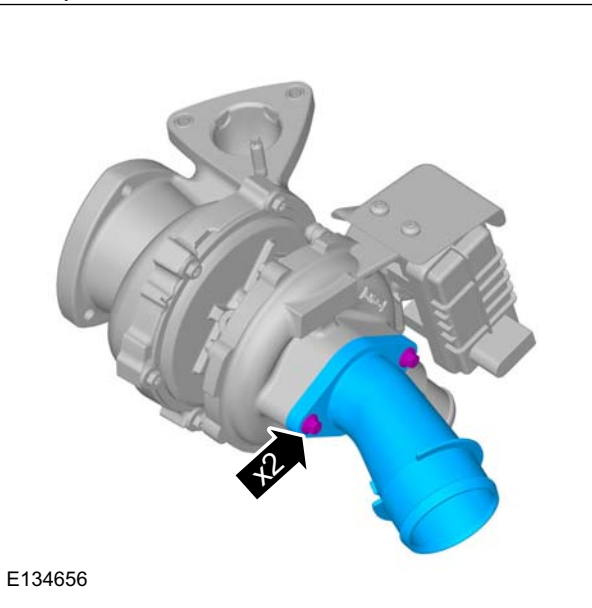


REMOVAL AND INSTALLATION

12. 1. Torque: 23 Nm
2. Torque: 23 Nm



13. Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 303-05A Accessory Drive — 2.5L Duratec-HE (122kW/165PS) - MI4

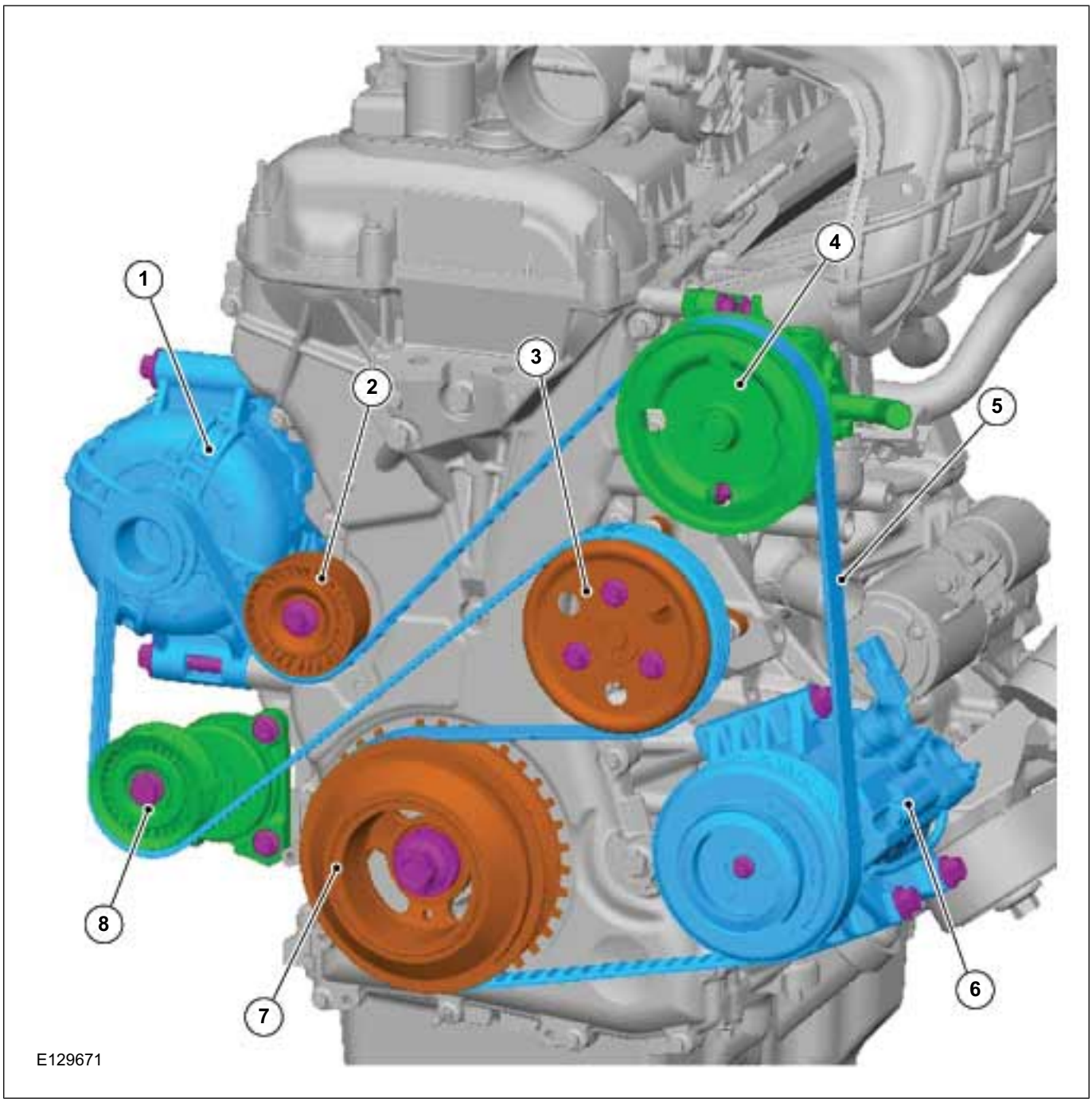
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Accessory Drive

Vehicles with air conditioning

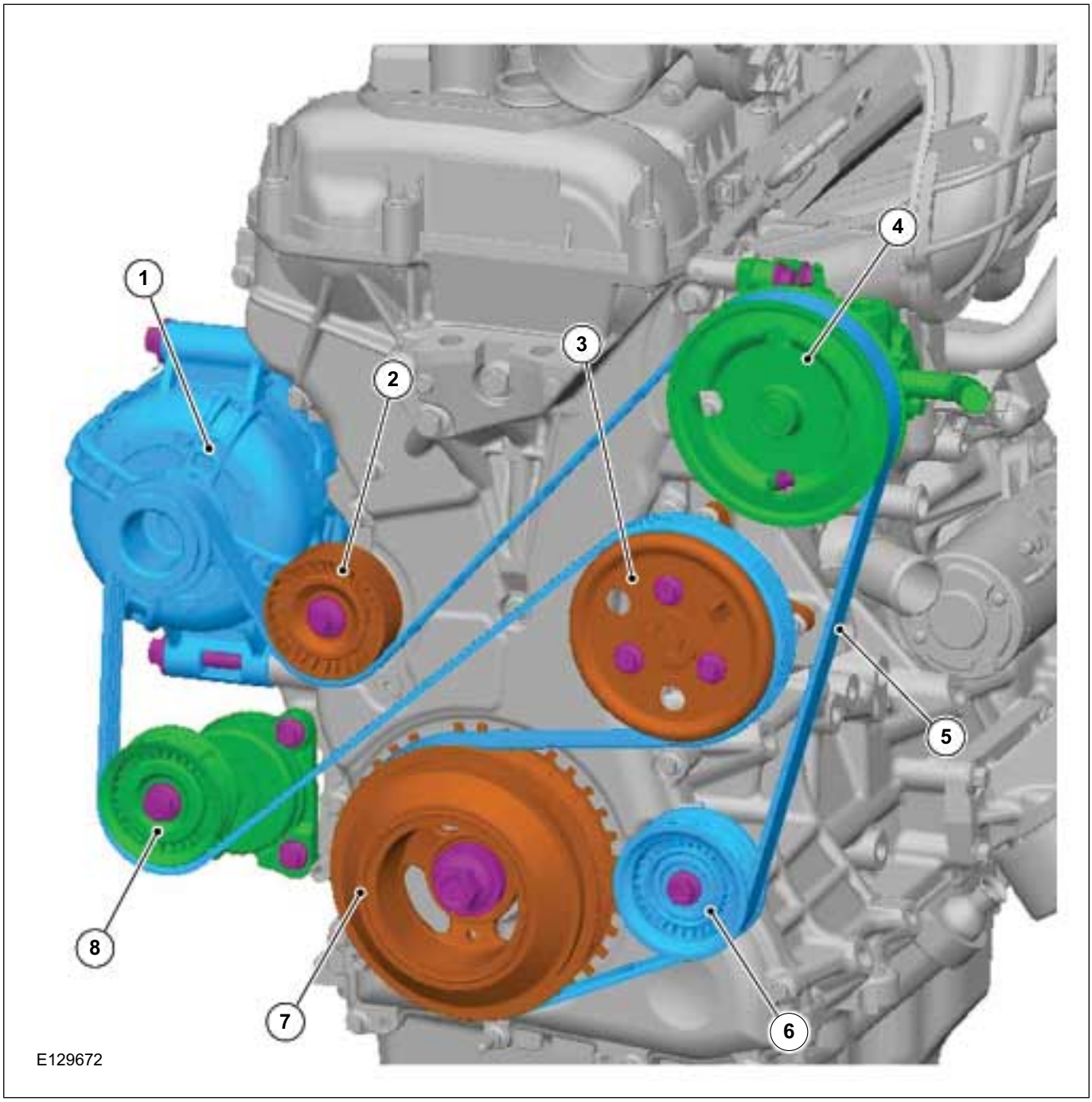


Item	Description
1	Alternator
2	Accessory drive belt idler pulley
3	Coolant pump pulley
4	Power steering pump pulley

Item	Description
5	Accessory drive belt
6	Air conditioning (A/C) compressor
7	Crankshaft pulley
8	Accessory drive belt tensioner pulley

DESCRIPTION AND OPERATION

Vehicles without air conditioning



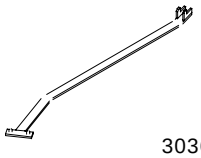
Item	Description
1	Alternator
2	Accessory drive belt idler pulley
3	Coolant pump pulley
4	Power steering pump pulley
5	Accessory drive belt
6	Accessory drive belt idler pulley

Item	Description
7	Crankshaft pulley
8	Accessory drive belt tensioner pulley

REMOVAL AND INSTALLATION

Accessory Drive Belt(21 567 0)

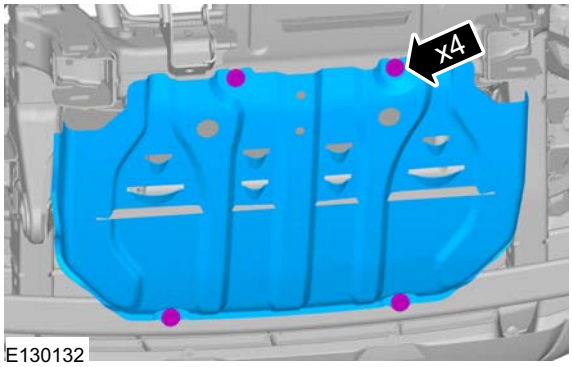
Special Tool(s)

 303676	303-676 Release Tool, Belt Tensioner

Removal

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

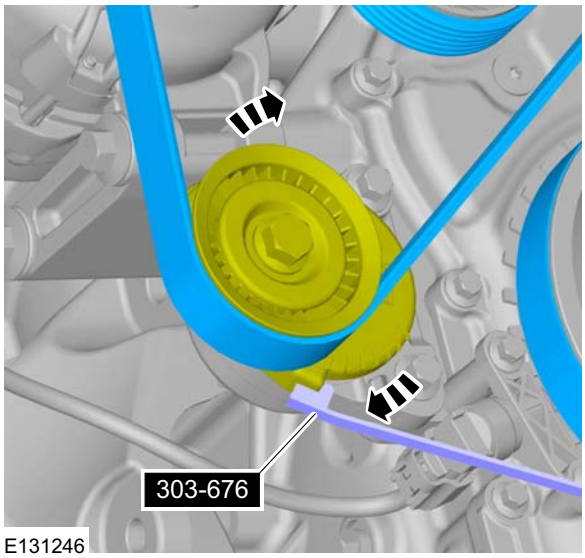
1. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
2. Torque: 30 Nm



E130132

3. Rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt.

   Remove the Special Tool(s): 303-676



E131246

Installation

1. To install, reverse the removal procedure.

   Refer to: Accessory Drive (303-05 Accessory Drive - 2.5L Duratec-HE (122kW/165PS) - MI4, Description and Operation).

REMOVAL AND INSTALLATION

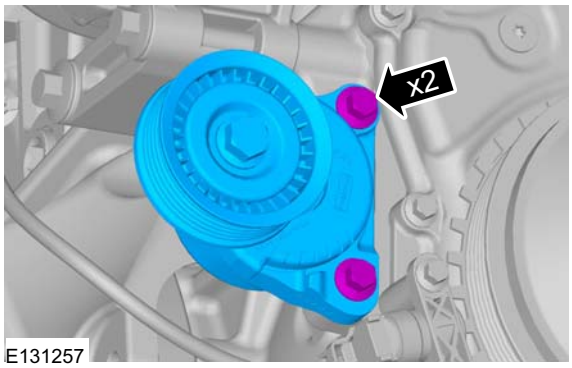
Accessory Drive Belt Tensioner(21 569 0)

Removal

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

1. Refer to: Accessory Drive Belt (303-05 Accessory Drive - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
2. **NOTE:** The accessory drive belt tensioner must be replaced as a complete unit.

   Torque: 25 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 303-05B Accessory Drive — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

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DESCRIPTION AND OPERATION

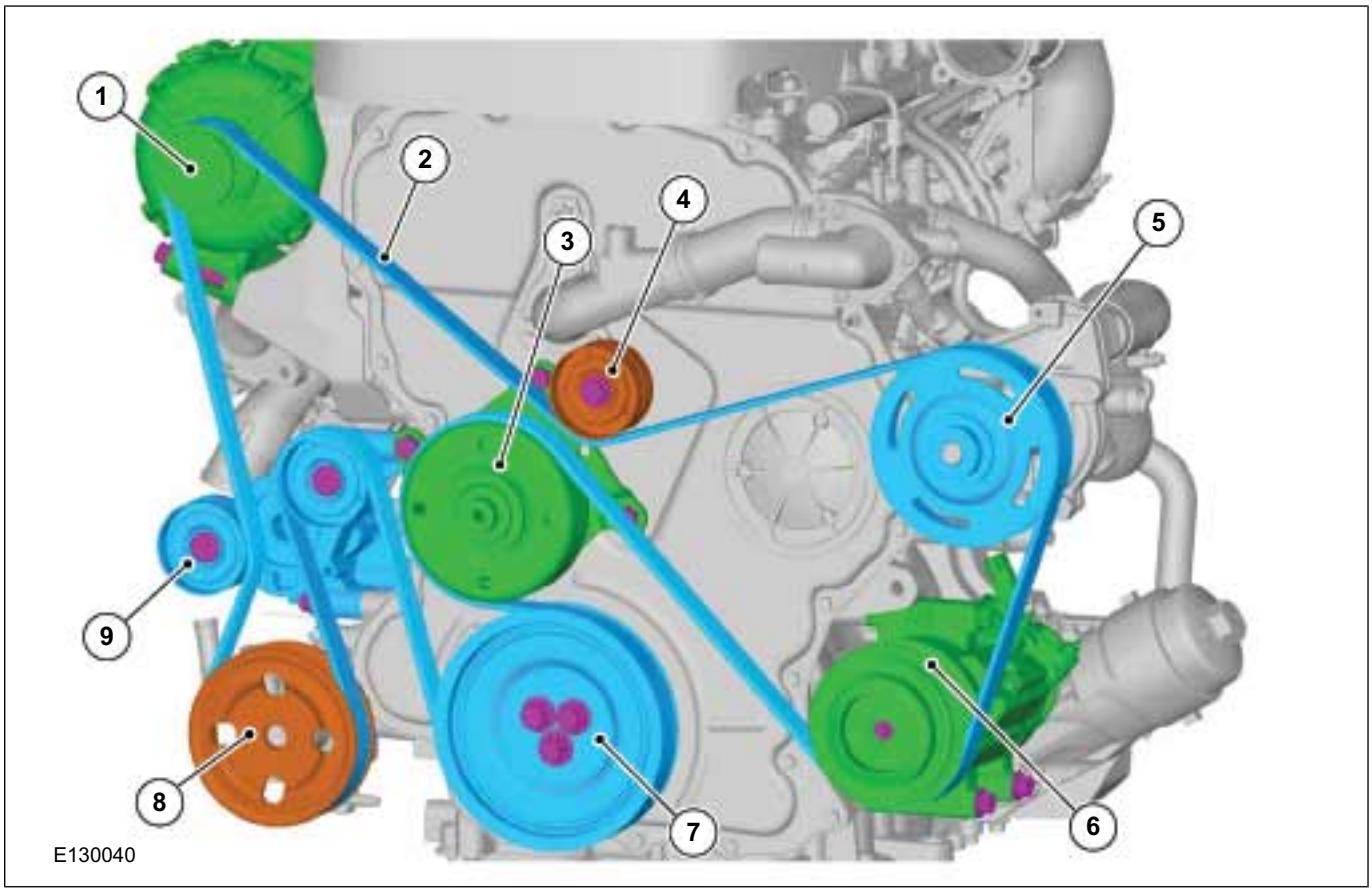
REMOVAL AND INSTALLATION

DESCRIPTION AND OPERATION

Accessory Drive

Vehicles with 2.2L Duratorq-TDCi (Puma) diesel engine

Vehicles with air conditioning

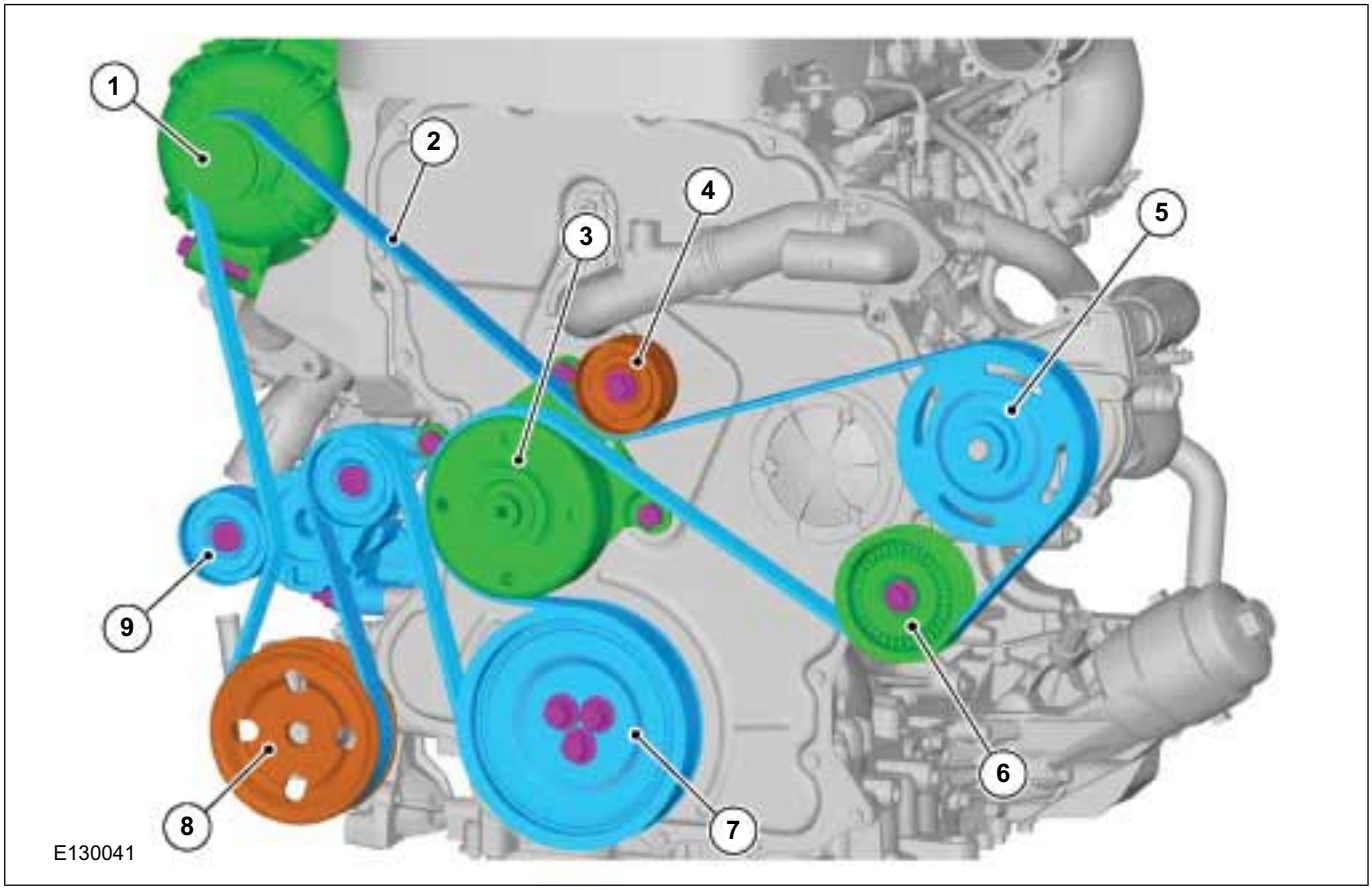


Item	Description
1	Alternator
2	Accessory drive belt
3	Cooling fan pulley
4	Accessory drive belt idler pulley

Item	Description
5	Coolant pump pulley
6	Air conditioning (A/C) compressor
7	Crankshaft pulley
8	Power steering pump pulley
9	Accessory drive belt tensioner pulley

DESCRIPTION AND OPERATION

Vehicles without air conditioning



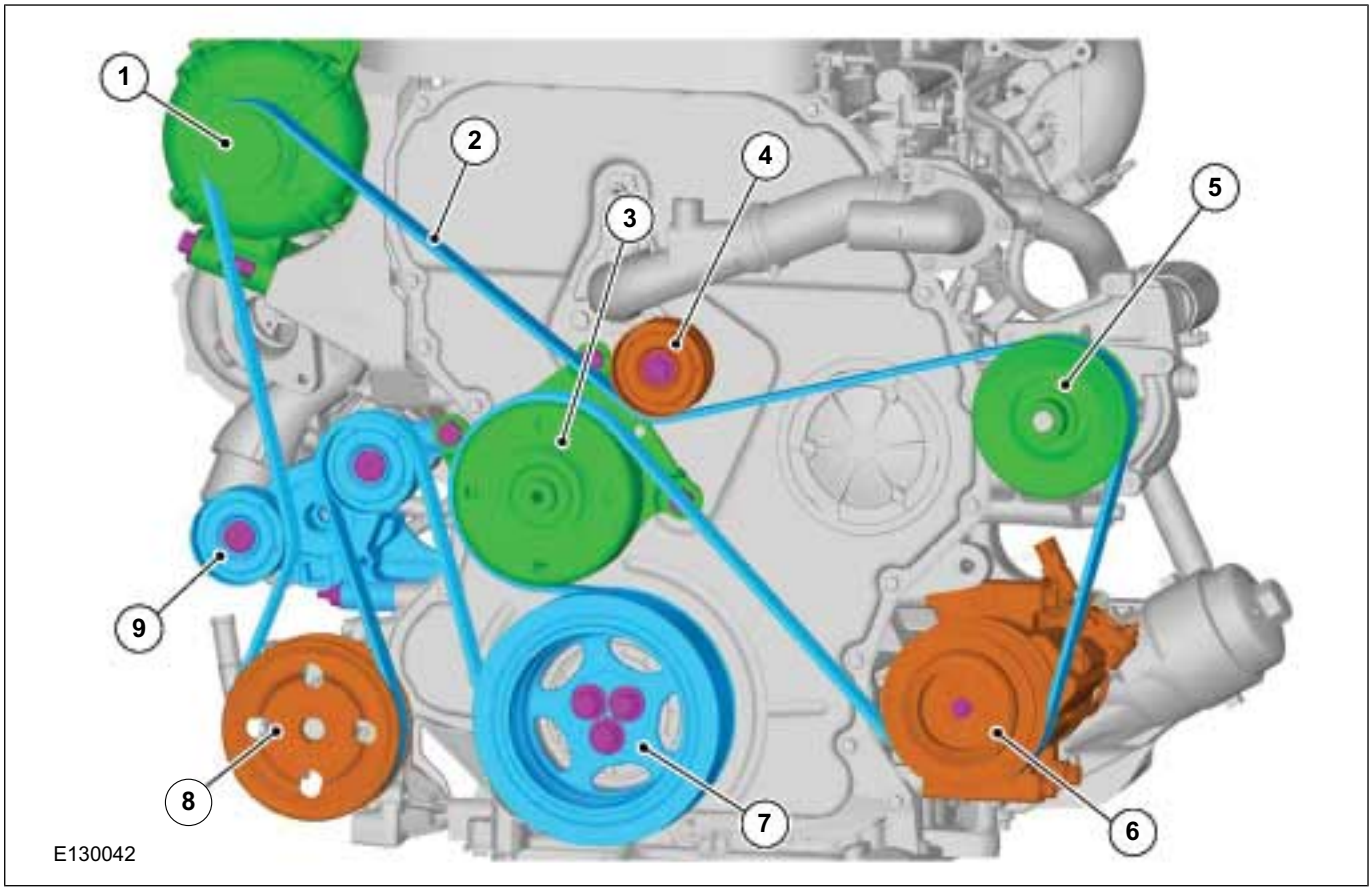
Item	Description
1	Alternator
2	Accessory drive belt
3	Cooling fan pulley
4	Accessory drive belt idler pulley

Item	Description
5	Coolant pump pulley
6	Accessory drive belt idler pulley
7	Crankshaft pulley
8	Power steering pump pulley
9	Accessory drive belt tensioner pulley

DESCRIPTION AND OPERATION

Vehicles with 3.2L Duratorq-TDCi (Puma) diesel engine

Vehicles with air conditioning

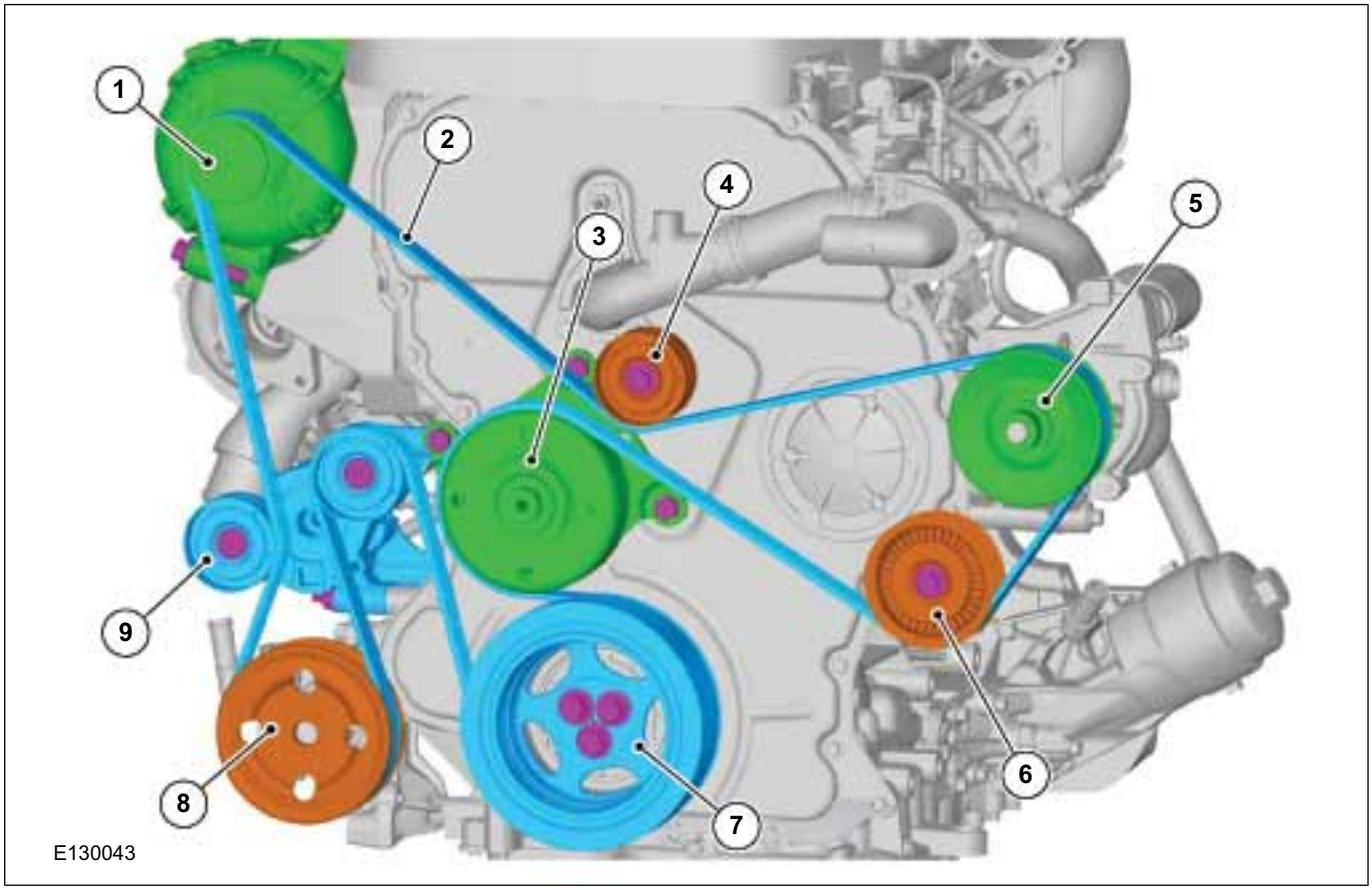


Item	Description
1	Alternator
2	Accessory drive belt
3	Cooling fan pulley
4	Accessory drive belt idler pulley

Item	Description
5	Coolant pump pulley
6	Air conditioning (A/C) compressor
7	Crankshaft pulley
8	Power steering pump pulley
9	Accessory drive belt tensioner pulley

DESCRIPTION AND OPERATION

Vehicles without air conditioning



Item	Description
1	Alternator
2	Accessory drive belt
3	Cooling fan pulley
4	Accessory drive belt idler pulley
5	Coolant pump pulley
6	Accessory drive belt idler pulley
7	Crankshaft pulley
8	Power steering pump pulley
9	Accessory drive belt tensioner pulley

REMOVAL AND INSTALLATION

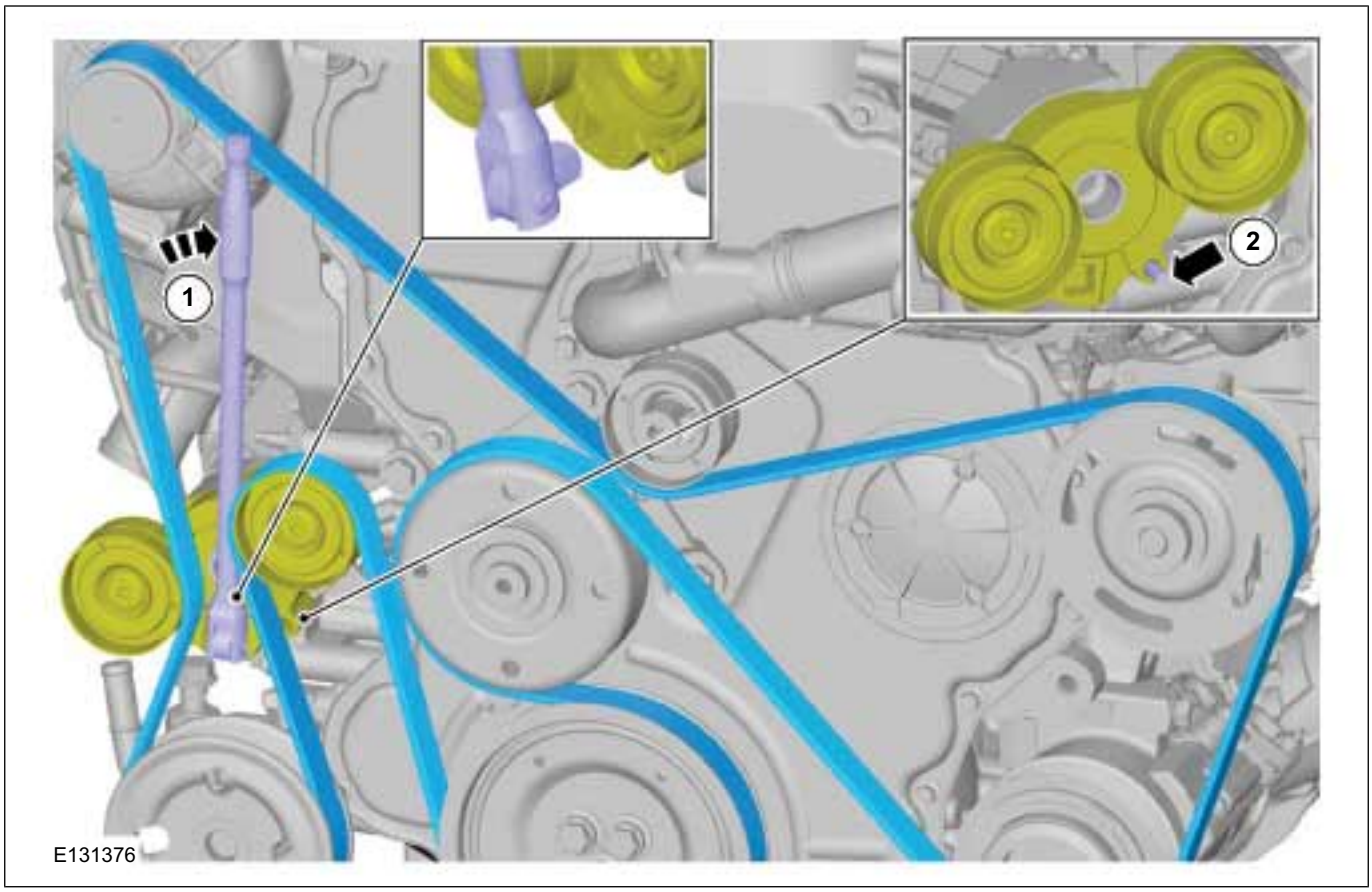
Accessory Drive Belt — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma(21 567 0)

General Equipment

1/2 Inch Square Drive Breaker Bar
Dowel with a Diameter of 6 mm

Removal

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



Vehicles with 2.2L diesel engine

1. 1. Rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt.

   General Equipment: 1/2 Inch Square Drive Breaker Bar

2. General Equipment: Dowel with a Diameter of 6 mm

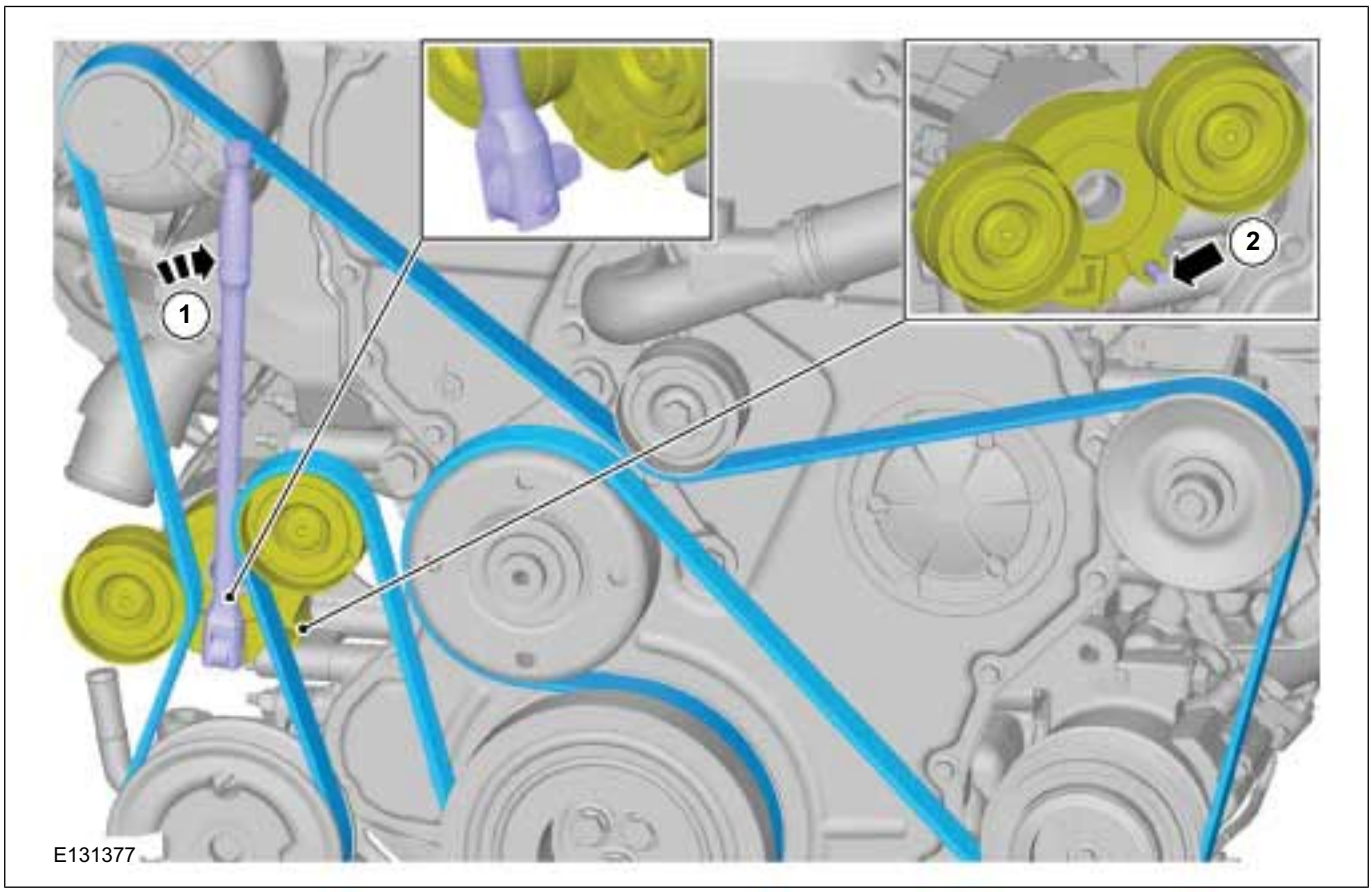
Vehicles with 3.2L diesel engine

2. 1. Rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt.

   General Equipment: 1/2 Inch Square Drive Breaker Bar

2. General Equipment: Dowel with a Diameter of 6 mm

REMOVAL AND INSTALLATION



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

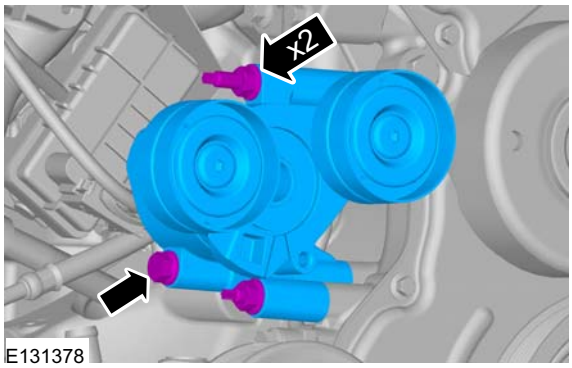
Accessory Drive Belt Tensioner — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma(21 569 0)

Removal

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

1. Refer to: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
2. **NOTE:** The accessory drive belt tensioner must be replaced as a complete unit.

   Torque: 25 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 303-06A Starting System — 2.5L Duratec-HE (122kW/165PS) - MI4

VEHICLE APPLICATION: 2011.50 Ranger

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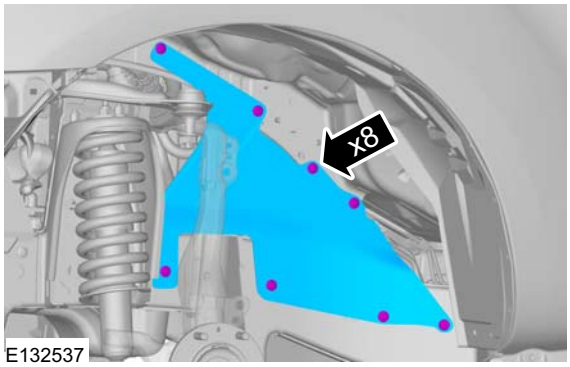
REMOVAL AND INSTALLATION

Starter Motor(26 204 0)

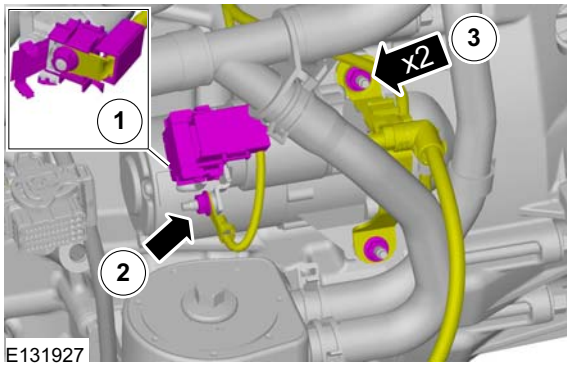
Removal

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

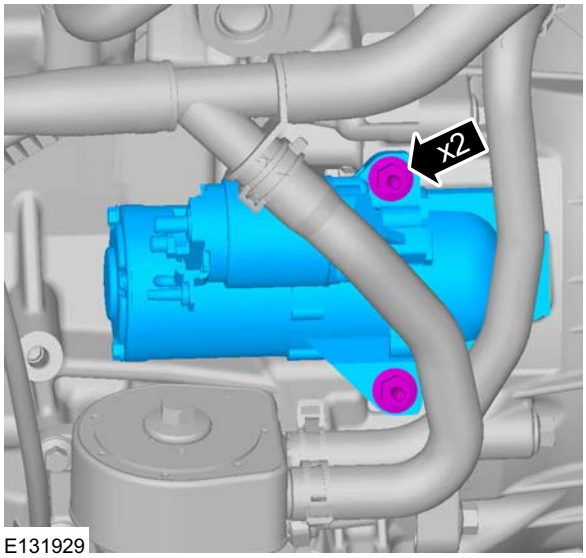
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove Front LH wheel only.

   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. 

5. 1. Torque: 10 Nm
   2. Torque: 10 Nm
   3. Torque: 10 Nm



6. Torque: 35 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 303-06B Starting System — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

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REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

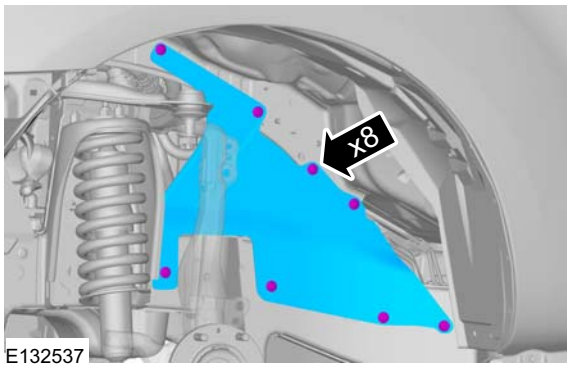
Starter Motor — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma(26 204 0)

Removal

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

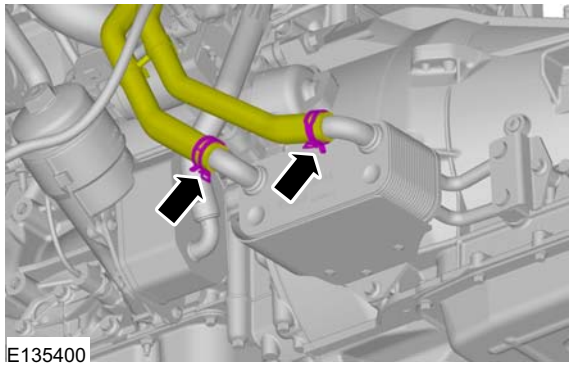
All vehicles

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove Front LH wheel only.

   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. 

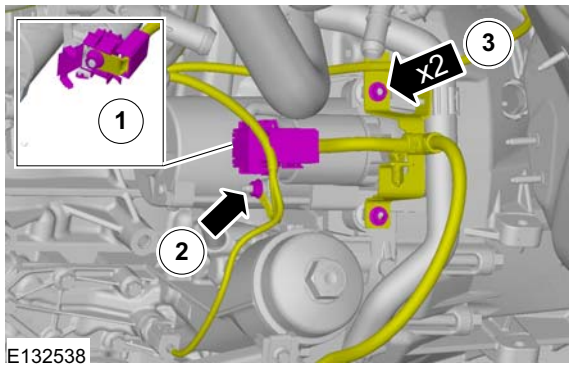
E132537

Vehicles with automatic transmission

5. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).
6. 
E135400

All vehicles

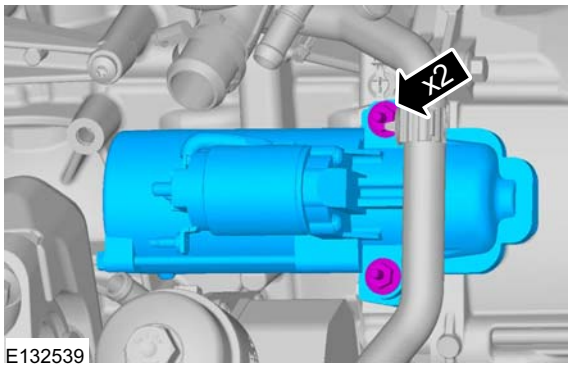
7. 1. Torque: 10 Nm
   2. Torque: 10 Nm
   3. Torque: 10 Nm



E132538

REMOVAL AND INSTALLATION

8. Torque: 35 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Starter Motor — 3.2L Duratorq-TDCi (148kW/200PS) - Puma(26 204 0)

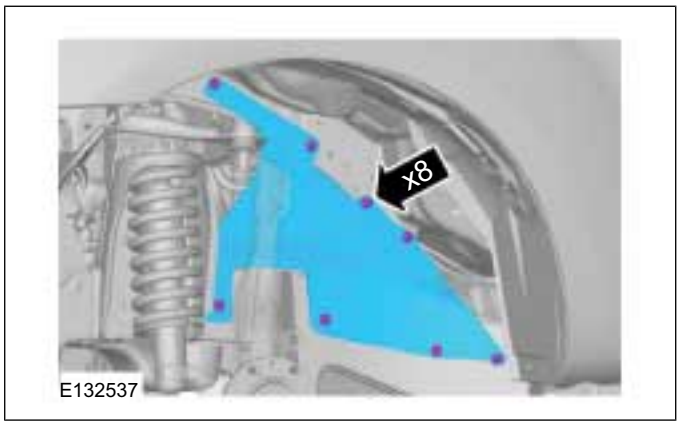
Removal

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

All vehicles

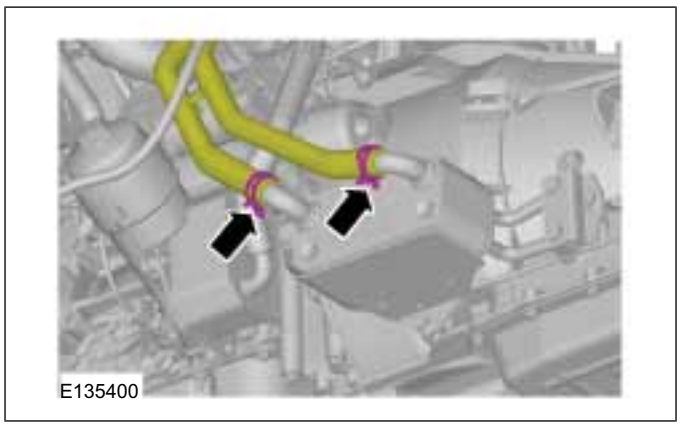
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove Front LH Wheel only.

   Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4.



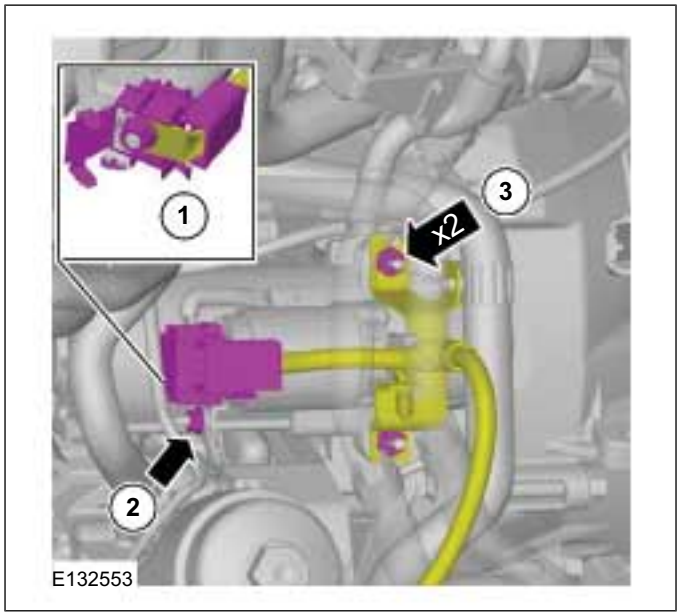
Vehicles with automatic transmission

5. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).
6.



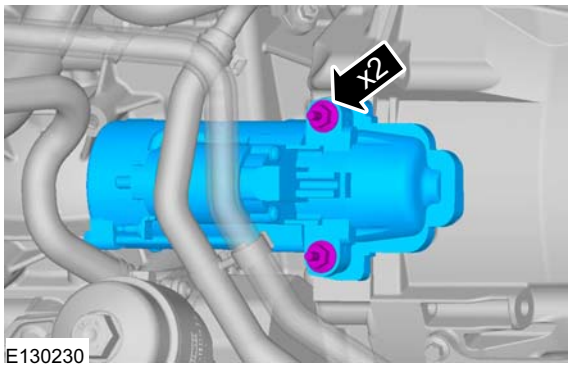
All vehicles

7. 1. Torque: 10 Nm
   2. Torque: 10 Nm
   3. Torque: 10 Nm



REMOVAL AND INSTALLATION

8. Torque: 35 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 303-07A Engine Ignition — 2.5L Duratec-HE (122kW/165PS) - MI4

VEHICLE APPLICATION: 2011.50 Ranger

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SPECIFICATIONS

Torque Specifications

Item	Nm	lb-ft	lb-in
Ignition coil-on-plug retaining bolt(s)	8	-	71
Spark plug(s)	12	-	106

Item	mm
Spark plug gap	1,3

SECTION 303-07B Glow Plug System — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma

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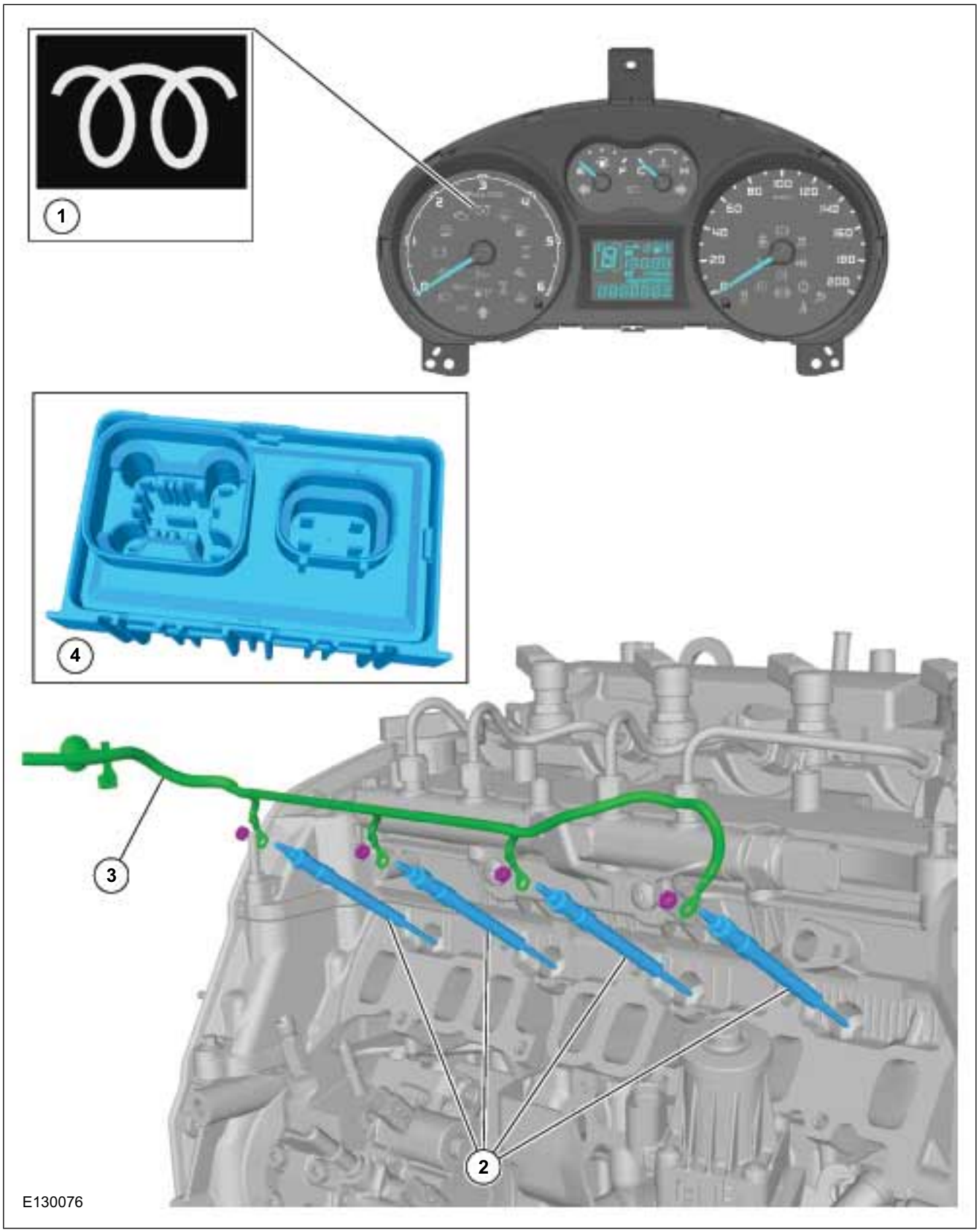
SPECIFICATIONS

Torque Specifications

Description	Nm	lb-ft	lb-in
Glow plug electrical connector retaining nut	2	-	18
Main wiring harness to glow plug wiring harness nut	4	-	35
Glow plug terminal block retaining screw	5	-	44
Intake manifold retaining bolts	16	12	-
Glow plug	12	9	-

DESCRIPTION AND OPERATION

Glow Plug System



DESCRIPTION AND OPERATION

Item	Part Number	Description
1		Glow plug indicator lamp
2		Glow plug(s)
3		Glow plug wire
4		Glow plug relay

Glow Plugs

The glow plugs are located in the side of the cylinder head and aid engine starting and efficiency. The glow plugs and the glow plug indicator lamp are controlled by the powertrain control module (PCM).

The glow plugs preheat the combustion chambers, which aids cold starting. During the preheat stage, the PCM receives an engine temperature signal from the cylinder head temperature (CHT) sensor and this determines the preheat time. The lower the temperature, the longer the preheat time. There is a maximum preheat time of 8 seconds at -20°C or lower. At temperatures above 80°C there is no preheat phase.

Once the engine has started, the glow plugs enter an after-glow phase. The after-glow phase helps to improve idling and reduce hydrocarbon emissions through more efficient combustion just after starting. The after-glow phase only operates at engine speeds below 2500 RPM, above that, the after-glow phase is interrupted to increase the durability of the glow plugs. There is a maximum after-glow time of 30 seconds at -20°C or lower. At temperatures above 50°C there is no after-glow phase.

DIAGNOSIS AND TESTING

Glow Plug System

Inspection and Verification

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

Visual Inspection Chart

Electrical
– Fuse(s) – Relay – Wiring harness – Electrical connector(s) – Glow plug(s) – Glow plug wire – Powertrain control module (PCM)

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 WDS to diagnose the system.

REMOVAL AND INSTALLATION

Glow Plugs(23 777 0)

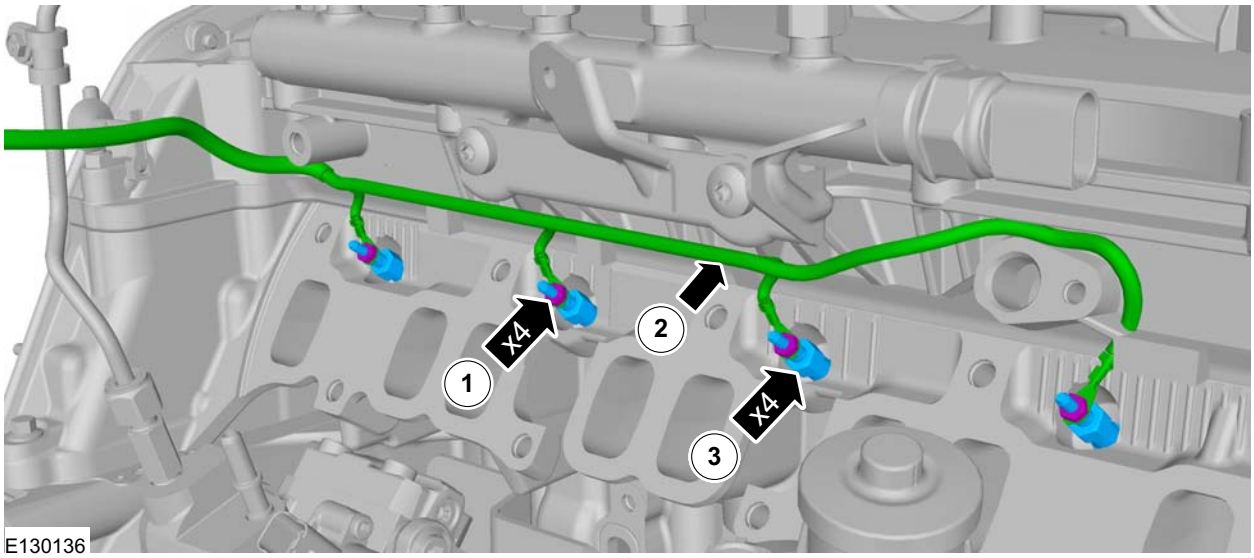
Removal

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

1. Refer to: Intake Manifold (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

CAUTION: Make sure that all openings are sealed.

2. Torque:
   - Glow plug wire retainer 8 Nm
   - Glow plug 13 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 303-07C Glow Plug System — 3.2L Duratorq-TDCi (148kW/200PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

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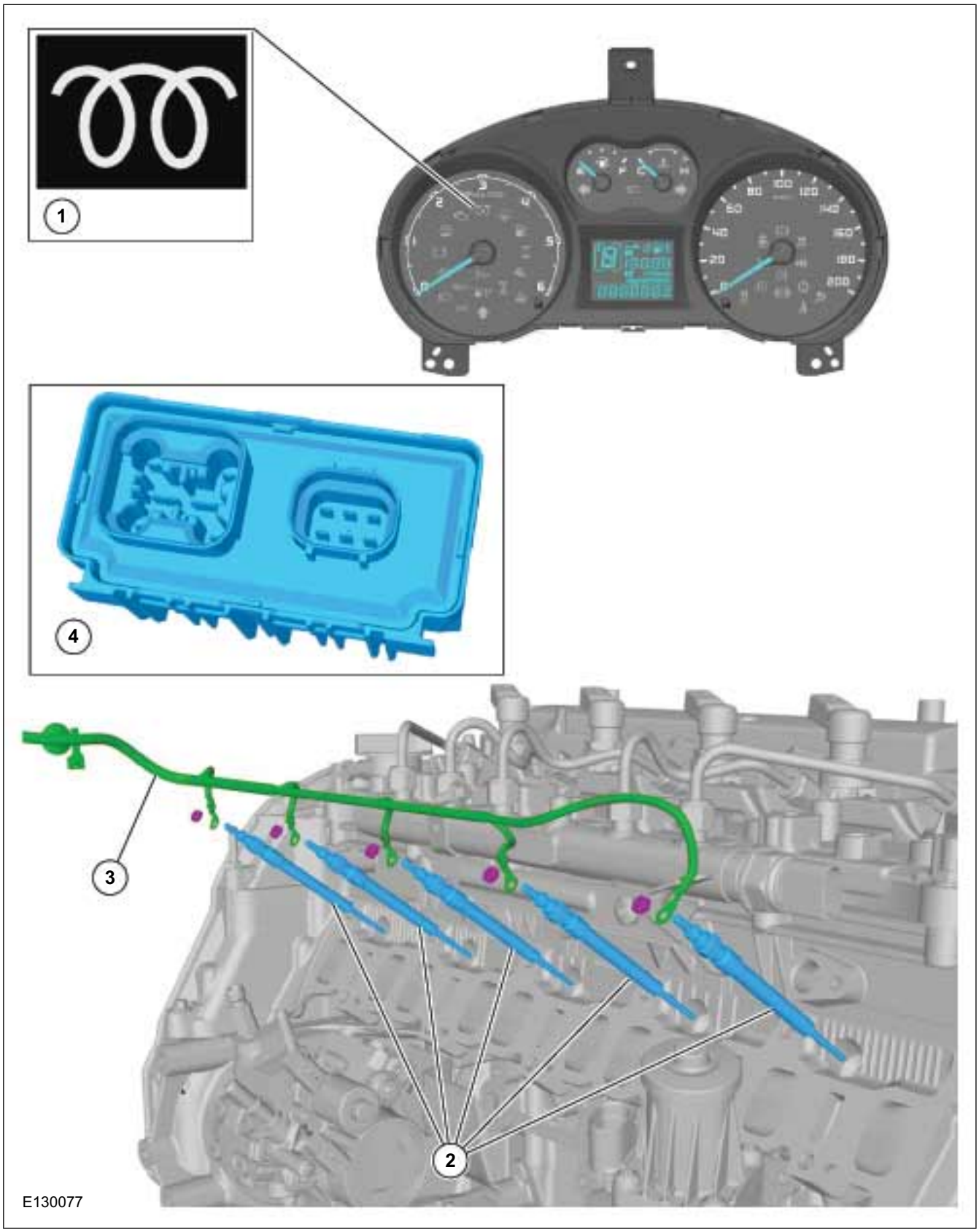
DESCRIPTION AND OPERATION

Glow Plug System



DESCRIPTION AND OPERATION

Item	Part Number	Description
1		Glow plug indicator lamp
2		Glow plug(s)
3		Glow plug wire
4		Glow plug relay

Glow Plugs

The glow plugs are located in the side of the cylinder head and aid engine starting and efficiency. The glow plugs and the glow plug indicator lamp are controlled by the powertrain control module (PCM).

The glow plugs preheat the combustion chambers, which aids cold starting. During the preheat stage, the PCM receives an engine temperature signal from the cylinder head temperature (CHT) sensor and this determines the preheat time. The lower the temperature, the longer the preheat time. There is a maximum preheat time of 8 seconds at -20°C or lower. At temperatures above 80°C there is no preheat phase.

Once the engine has started, the glow plugs enter an after-glow phase. The after-glow phase helps to improve idling and reduce hydrocarbon emissions through more efficient combustion just after starting. The after-glow phase only operates at engine speeds below 2500 RPM, above that, the after-glow phase is interrupted to increase the durability of the glow plugs. There is a maximum after-glow time of 30 seconds at -20°C or lower. At temperatures above 50°C there is no after-glow phase.

DIAGNOSIS AND TESTING

Glow Plug System

Inspection and Verification

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

Visual Inspection Chart

Electrical
– Fuse(s) – Relay – Wiring harness – Electrical connector(s) – Glow plug(s) – Glow plug wire – Powertrain control module (PCM)

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 WDS to diagnose the system.

REMOVAL AND INSTALLATION

Glow Plugs(23 777 0)

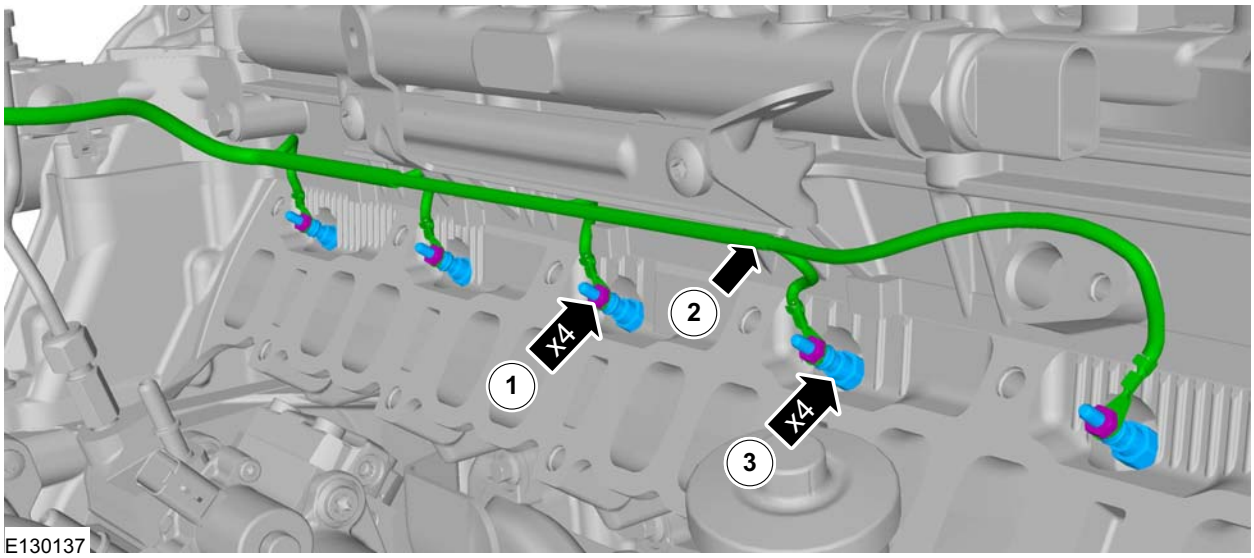
Removal

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

1. Refer to: Intake Manifold (303-01 Engine - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

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

2. Torque:
   - Glow plug wire retainer 8 Nm
   - Glow plug 13 Nm



Installation

1. To install, reverse the removal procedure

SECTION 303-08A Engine Emission Control — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma

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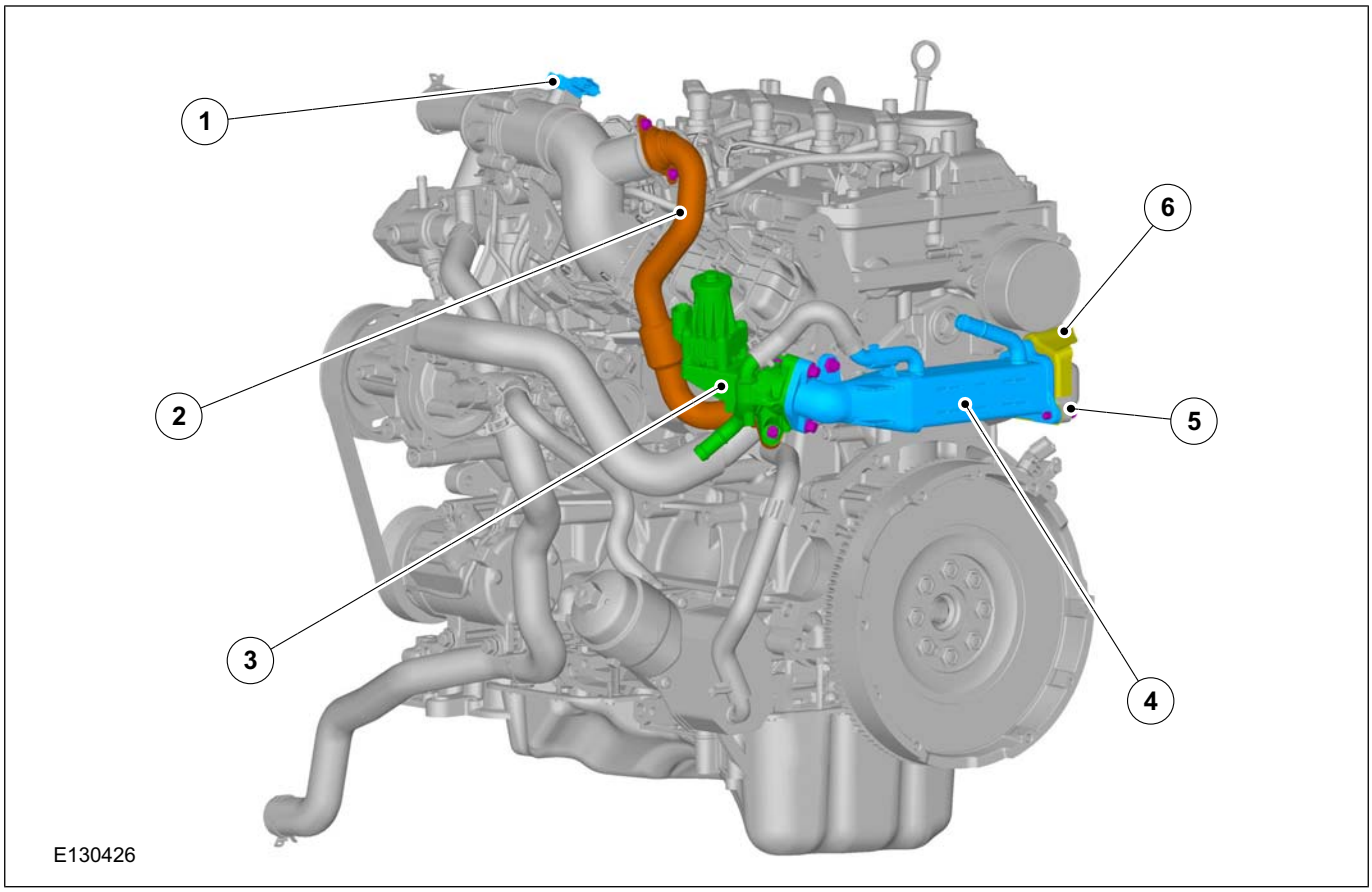
DESCRIPTION AND OPERATION

REMOVAL AND INSTALLATION

DESCRIPTION AND OPERATION

Engine Emission Control

Vehicles with 2.2L Duratorq-TDCi (Puma) diesel engine

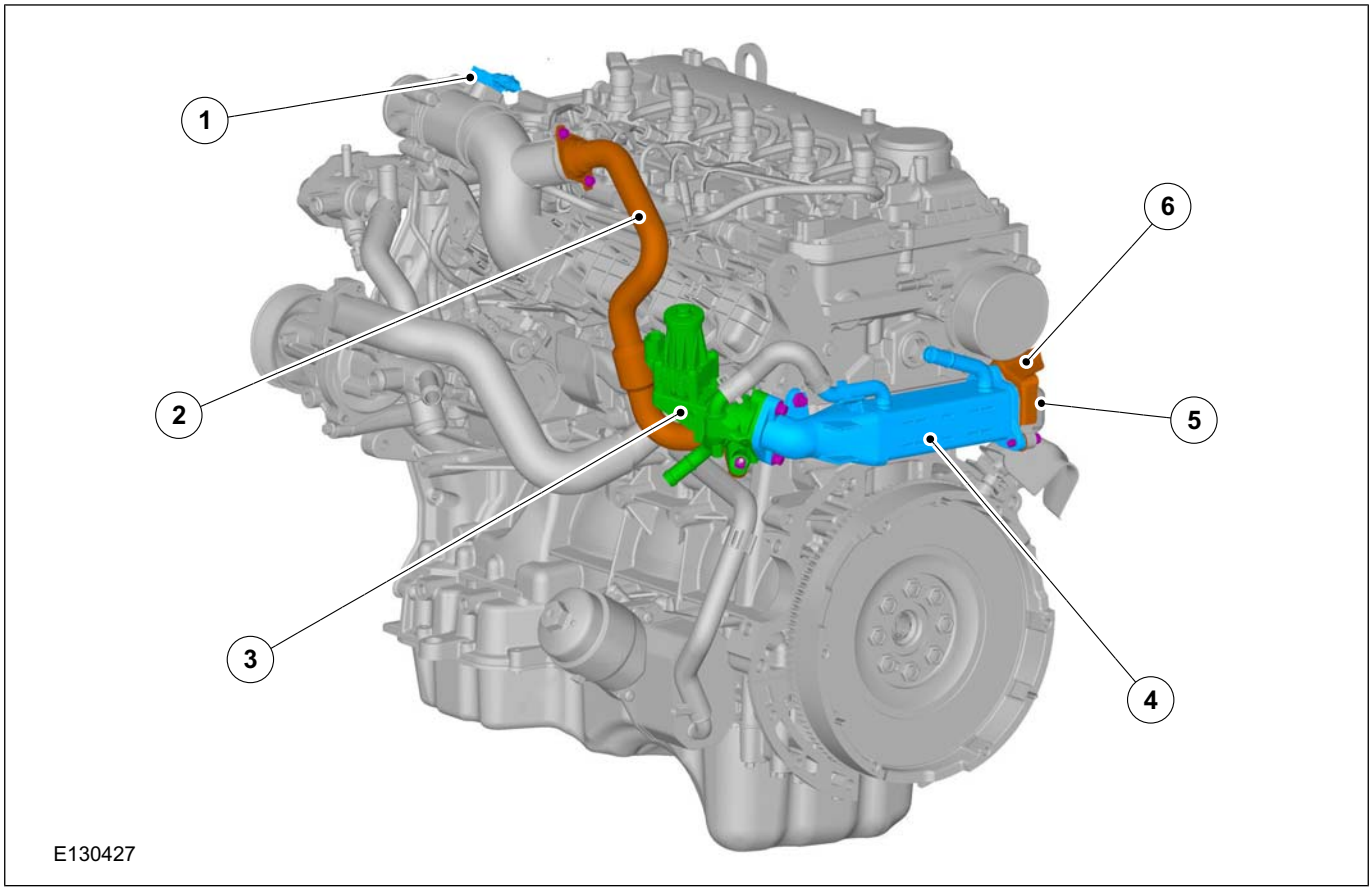


Item	Description
1	Intake air temperature (IAT) sensor
2	Exhaust gas recirculation (EGR) valve outlet tube
3	EGR valve

Item	Description
4	EGR cooler
5	Exhaust manifold
6	Heat shield

DESCRIPTION AND OPERATION

Vehicles with 3.2L Duratorq-TDCi (Puma) diesel engine



Item	Description
1	Intake air temperature (IAT) sensor
2	Exhaust gas recirculation (EGR) valve outlet tube
3	EGR valve
4	EGR cooler
5	Exhaust manifold
6	Heat shield

REMOVAL AND INSTALLATION

Exhaust Gas Recirculation (EGR) Valve — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma(23 312 0)

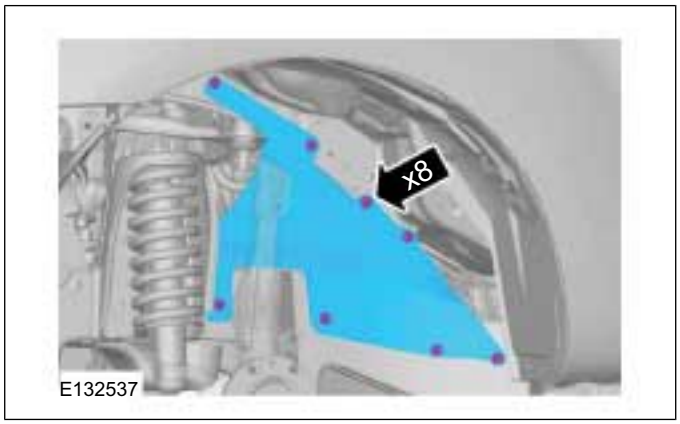
General Equipment

Hose Clamp Remover/Installer

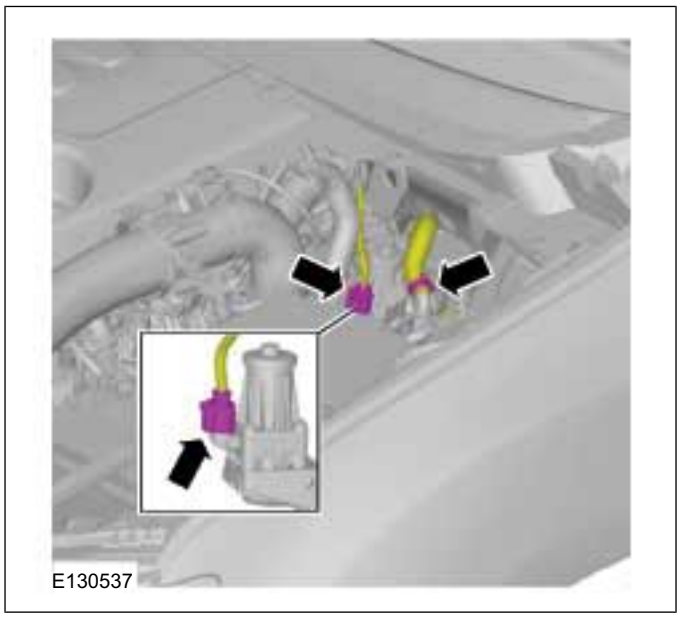
Removal

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

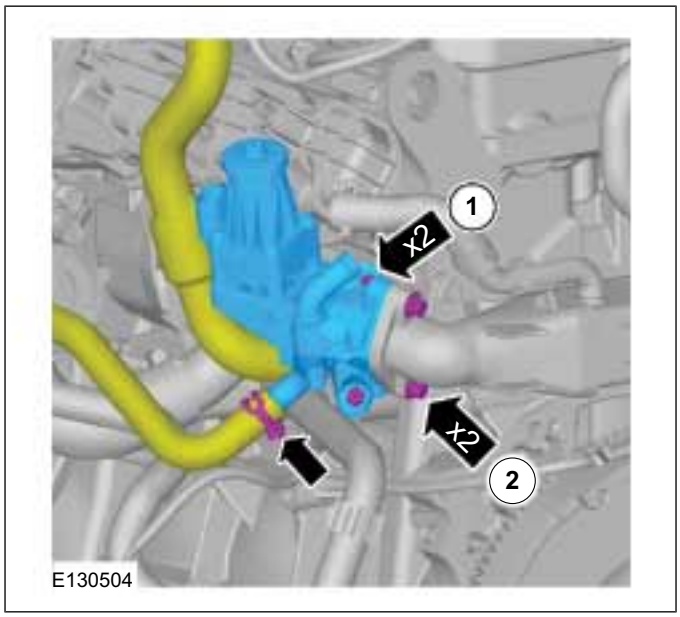
1. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).
2. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
5.



6. General Equipment: Hose Clamp Remover/Installer



7. 1. Torque: 10 Nm
   2. Torque: 24 Nm



Installation

NOTE: Install all the bolts finger tight before final tightening.

NOTE: Make sure that new gaskets are installed.

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Exhaust Gas Recirculation (EGR) Valve — 3.2L Duratorq-TDCi (148kW/200PS) - Puma(23 312 0)

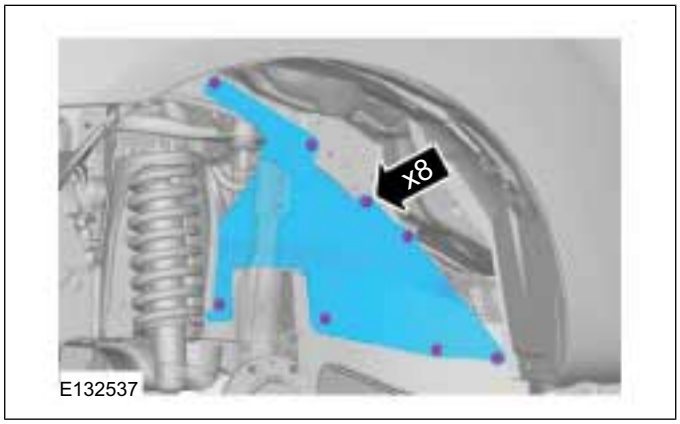
General Equipment

Hose Clamp Remover/Installer

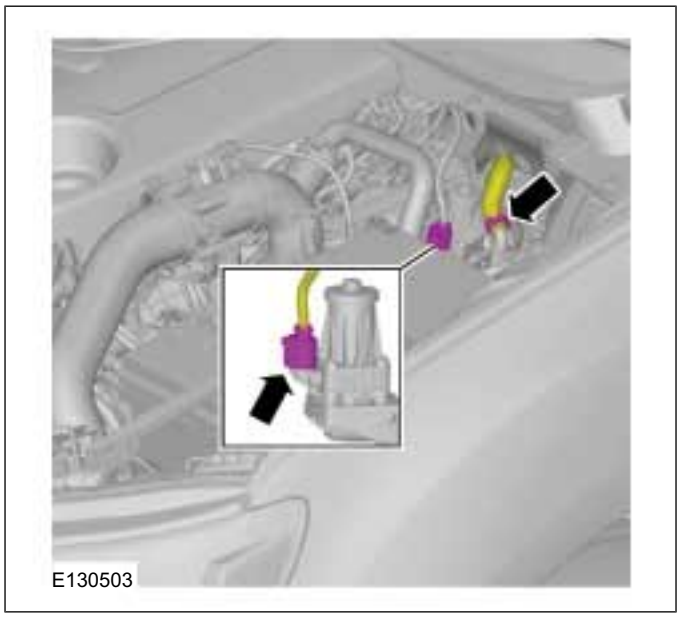
Removal

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

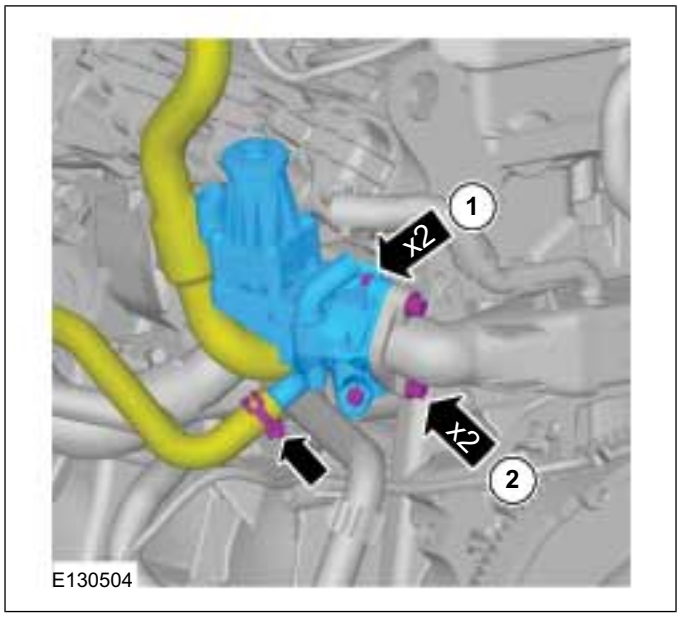
1. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).
2. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
5.



6. General Equipment: Hose Clamp Remover/Installer



7. 1. Torque: 10 Nm
   2. Torque: 24 Nm



Installation

NOTE: Install all the bolts finger tight before final tightening.

NOTE: Make sure that new gaskets are installed.

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Cooled Exhaust Gas Recirculation (EGR) Valve — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma

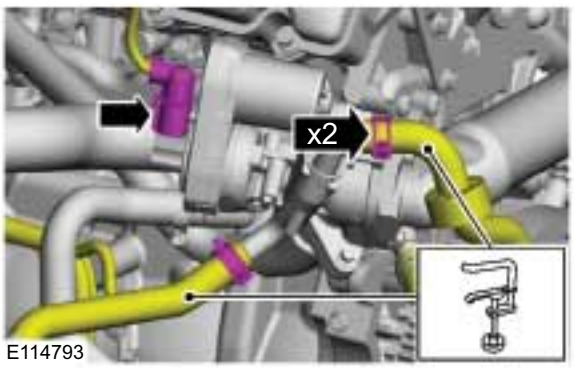
General Equipment
Hose Clamp(s)

General Equipment
Hose Clamp Remover/Installer

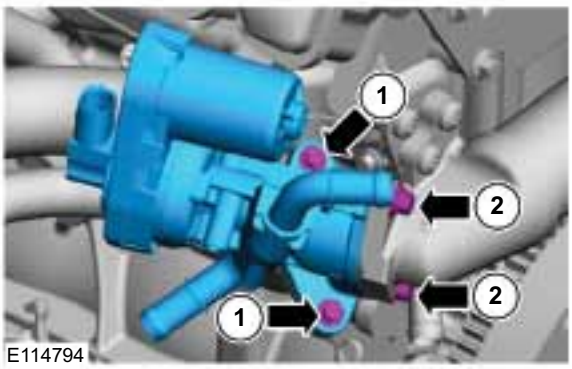
Removal

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

1. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
2. General Equipment: Hose Clamp Remover/Installer
   General Equipment: Hose Clamp(s)



3. Torque:
   - 1: 10 Nm
   - 2: 24 Nm



To install, reverse the removal procedure.

2. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).
   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

Installation

1. **NOTE:** Install all the bolts finger tight before final tightening.

REMOVAL AND INSTALLATION

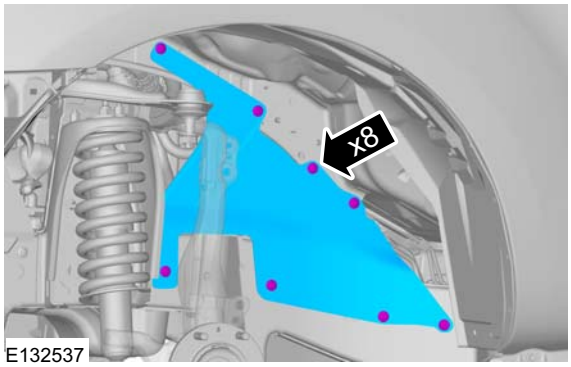
Exhaust Gas Recirculation (EGR) Cooler — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma(23 299 0)

General Equipment

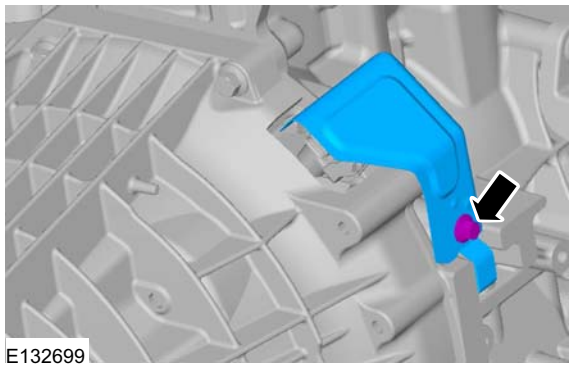
Hose Clamp Remover/Installer

Removal

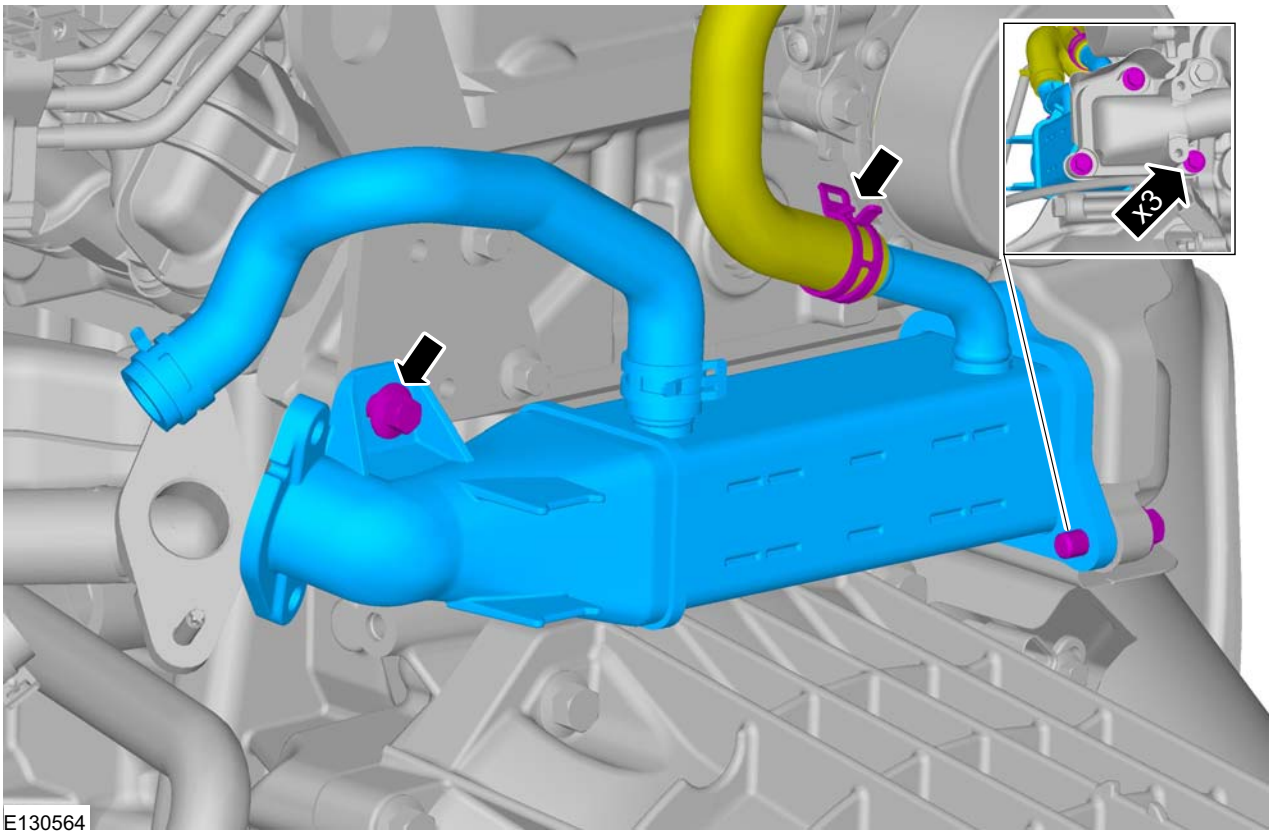
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
5. 

E132537
6. Refer to: Exhaust Gas Recirculation (EGR) Valve - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-08 Engine Emission Control - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
7. Torque: 22 Nm


E132699
8. General Equipment: Hose Clamp Remover/Installer
   Torque: 23 Nm

REMOVAL AND INSTALLATION



Installation

1. **NOTE:** Make sure that new gaskets are installed.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

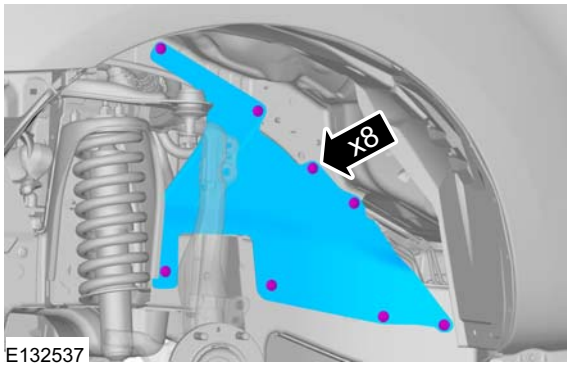
Exhaust Gas Recirculation (EGR) Cooler — 3.2L Duratorq-TDCi (148kW/200PS) - Puma(23 299 0)

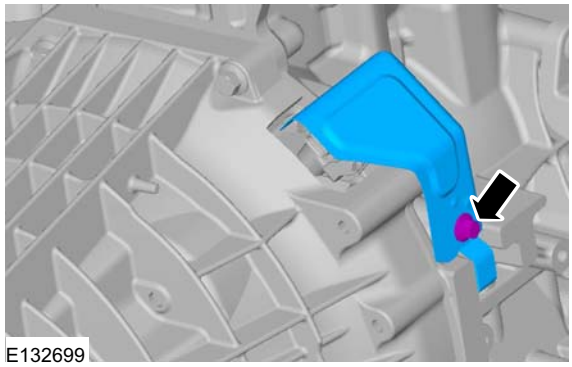
General Equipment

Hose Clamp Remover/Installer

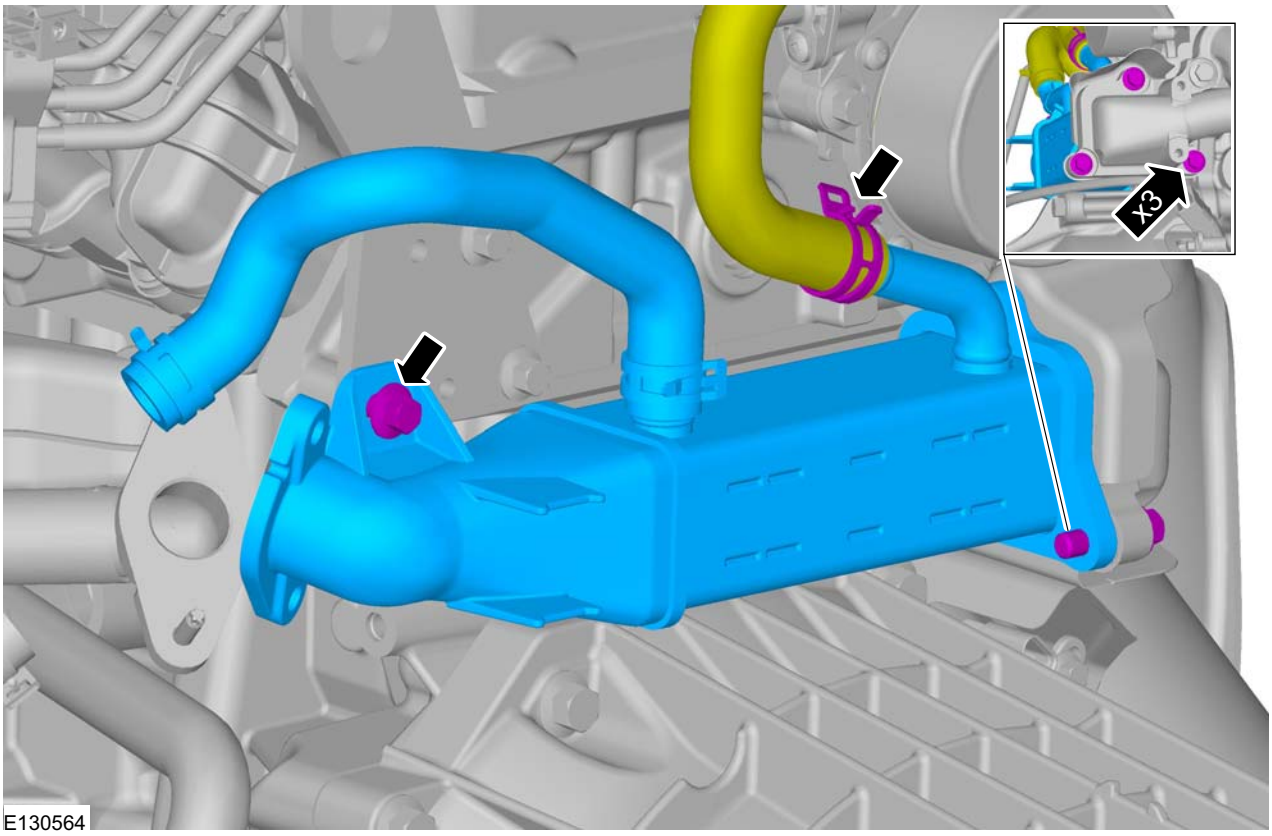
Removal

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, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
5. 

E132537
6. Refer to: Exhaust Gas Recirculation (EGR) Valve - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-08 Engine Emission Control - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
7. Torque: 22 Nm

E132699
8. General Equipment: Hose Clamp Remover/Installer
   Torque: 23 Nm

REMOVAL AND INSTALLATION



Installation

1. **NOTE:** Make sure that new gaskets are installed.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

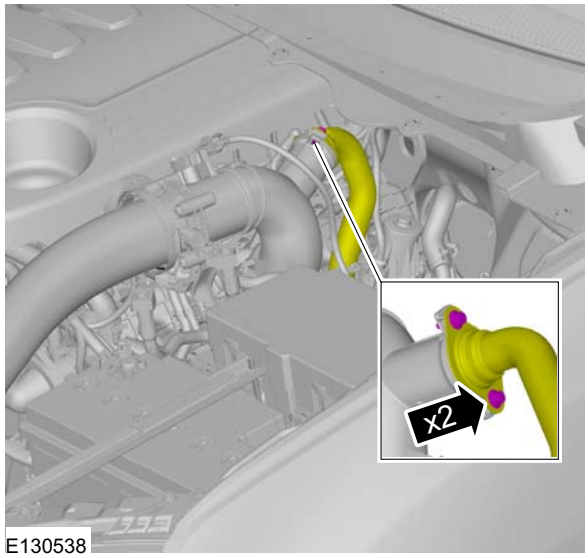
Exhaust Gas Recirculation (EGR) Valve Outlet Tube — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma(23 301 0)

Removal

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

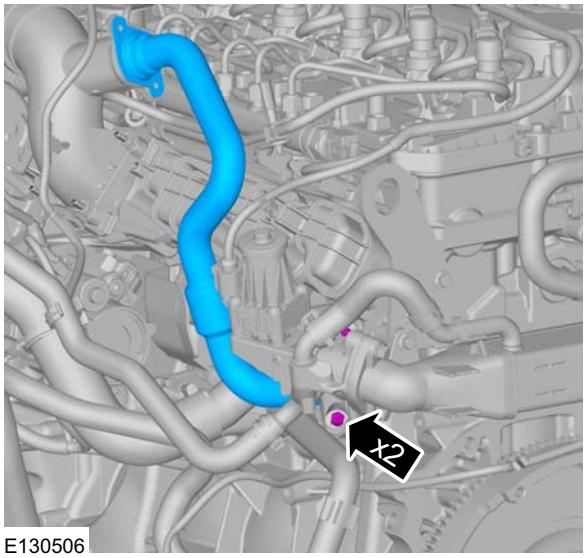
1. **NOTE:** The O-ring is to be reused unless damaged.

   Torque: 10 Nm



2. **NOTE:** Make sure that new gaskets are installed.

   Torque: 10 Nm



Installation

NOTE: Install all the bolts finger tight before final tightening.

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

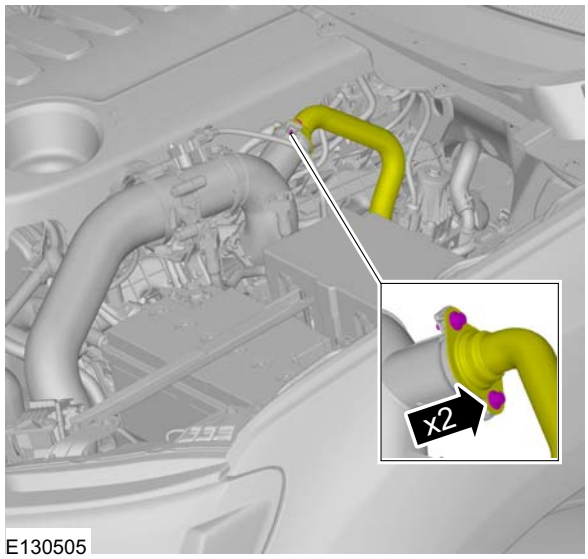
Exhaust Gas Recirculation (EGR) Valve Outlet Tube — 3.2L Duratorq-TDCi (148kW/200PS) - Puma(23 301 0)

Removal

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

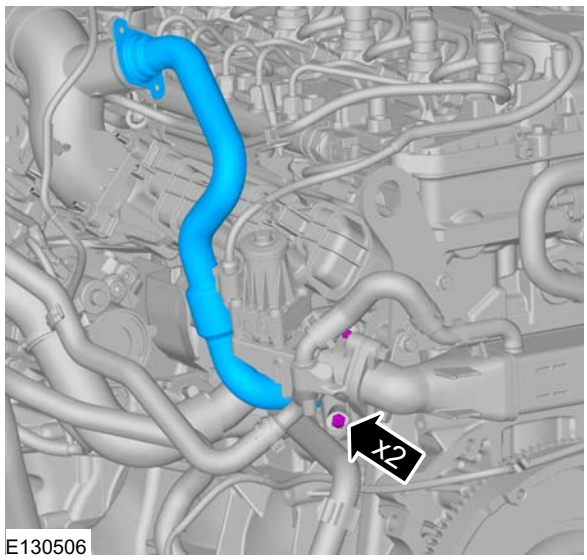
1. **NOTE:** The O-ring is to be reused unless damaged.

   Torque: 10 Nm



2. **NOTE:** Make sure that new gaskets are installed.

   Torque: 10 Nm



Installation

NOTE: Install all the bolts finger tight before final tightening.

1. To install, reverse the removal procedure.

SECTION 303-08B Engine Emission Control

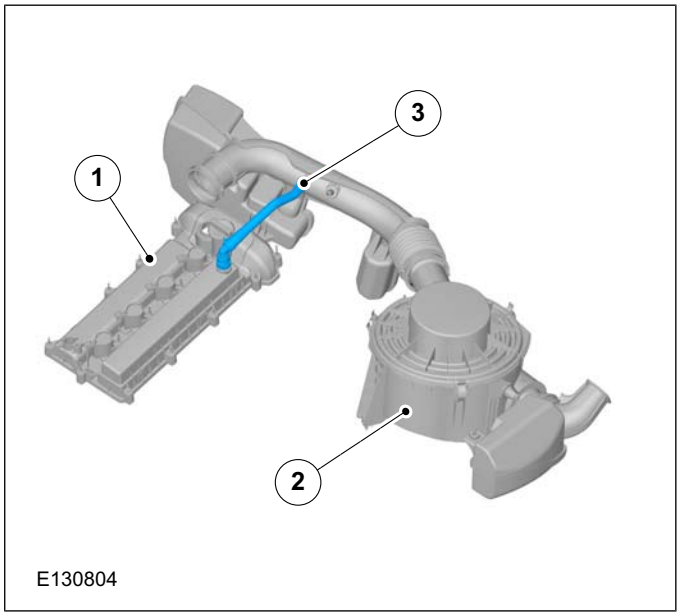
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

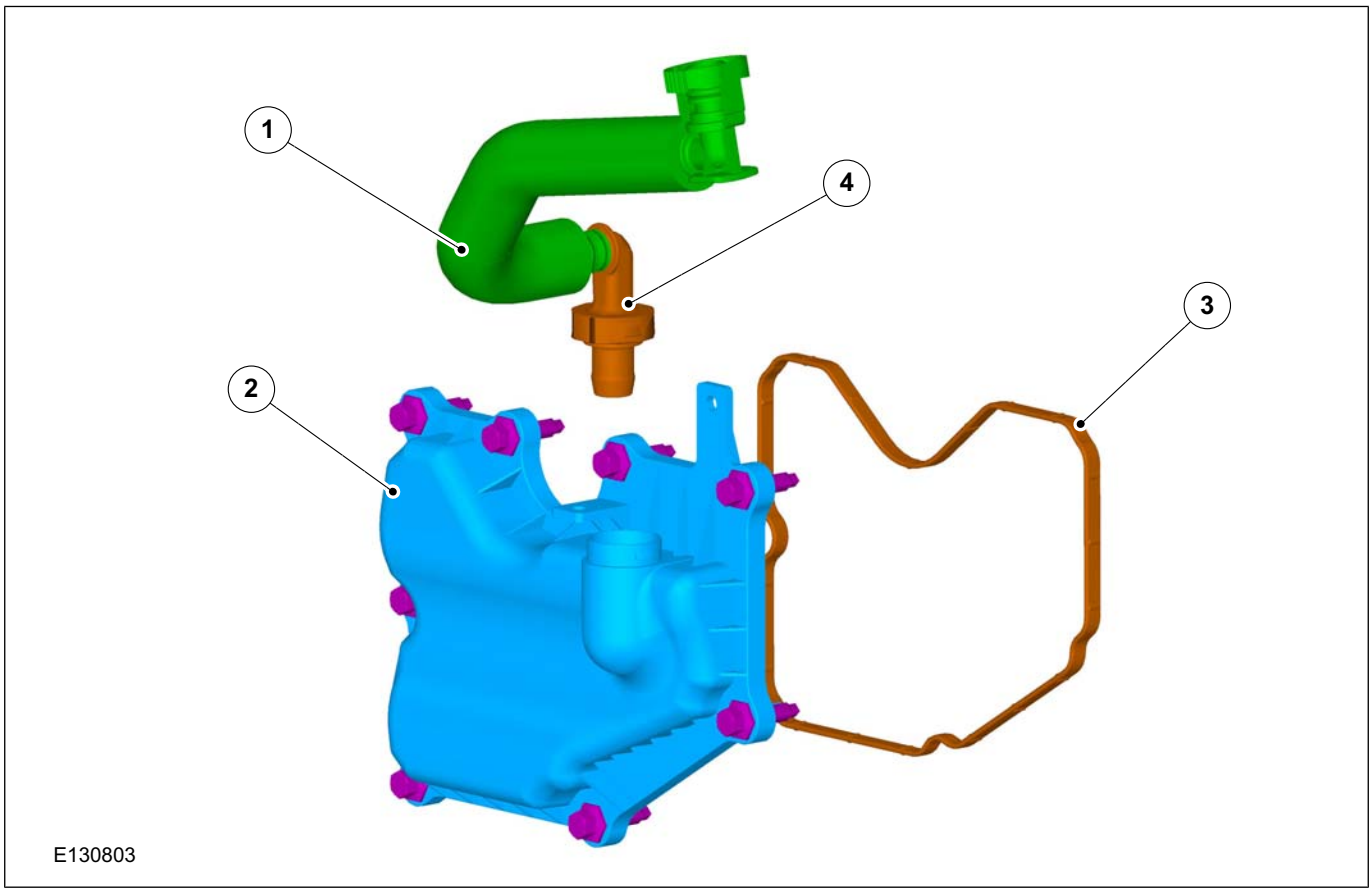
Engine Emission Control

Vehicles with 2.5L Duratec-HE engine



Item	Description
1	Valve cover
2	Air cleaner assembly
3	Valve cover to air cleaner outlet pipe positive crankcase ventilation (PCV) hose

DESCRIPTION AND OPERATION



Item	Description
1	PCV valve to intake manifold PCV hose
2	Crankcase vent oil separator
3	Crankcase vent oil separator gasket
4	PCV valve

PCV System

The PCV system consists of a valve mounted in the crankcase vent oil separator (attached to the cylinder block) and two hoses. One PCV hose connects the PCV valve to the intake manifold, the other PCV hose connects the valve cover to the air cleaner outlet pipe.

Under idle and part throttle conditions, the crankcase vapor flows from the crankcase vent oil separator to the intake manifold and into the combustion chambers where the vapor is burnt during combustion.

Under full throttle conditions, the crankcase vapor flows from the valve cover into the air cleaner outlet pipe through the PCV hose.

REMOVAL AND INSTALLATION

Crankcase Vent Oil Separator — 2.5L Duratec-HE (122kW/165PS) - MI4

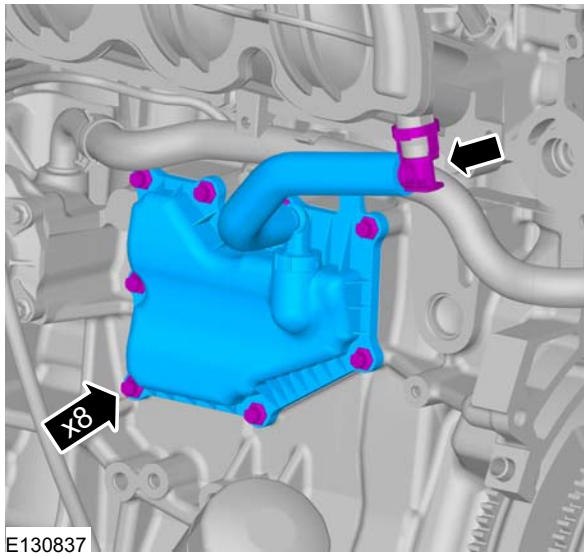
Removal

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

1. **NOTE:** The gasket is to be reused unless damaged.

   NOTE: Make sure that the mating faces are clean and free of foreign material.

   Torque: 11 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 303-12A Intake Air Distribution and Filtering

— 2.5L Duratec-HE (122kW/165PS) - MI4

VEHICLE APPLICATION: 2011.50 Ranger

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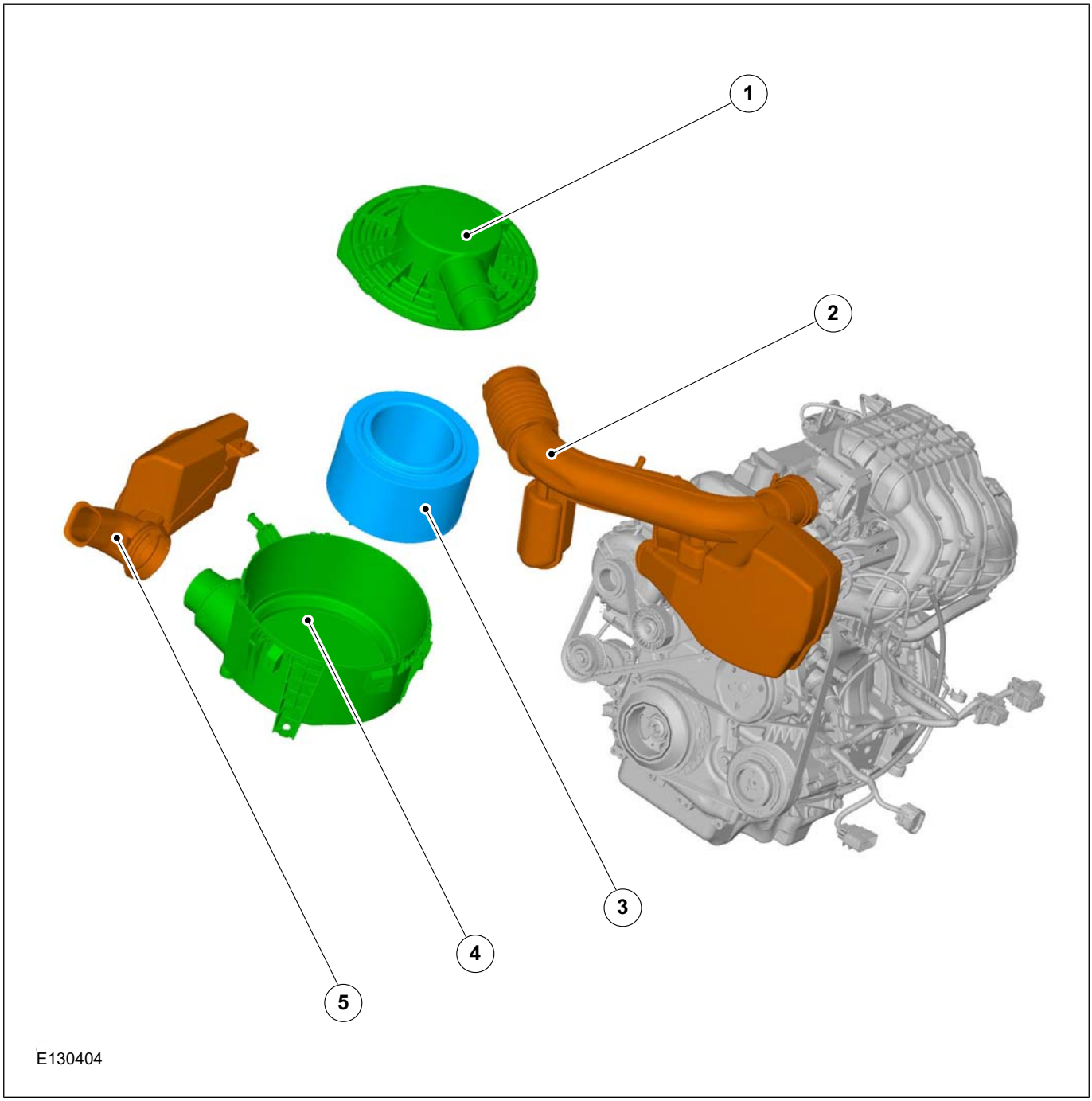
DESCRIPTION AND OPERATION

Intake Air Distribution and Filtering



Item	Description
1.	Air cleaner housing cover
2.	Air cleaner outlet pipe
3.	Air cleaner element
4.	Air cleaner housing
5.	Air cleaner intake pipe

REMOVAL AND INSTALLATION

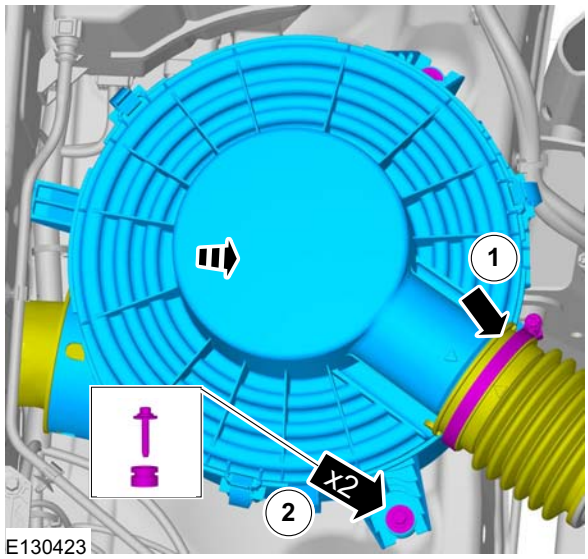
Air Cleaner(23 174 0)

Removal

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

NOTE: Make sure that crankcase ventilation tube and Brake vaccum pump hose are not disturbed.

1. Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 303-12B Intake Air Distribution and Filtering

— 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

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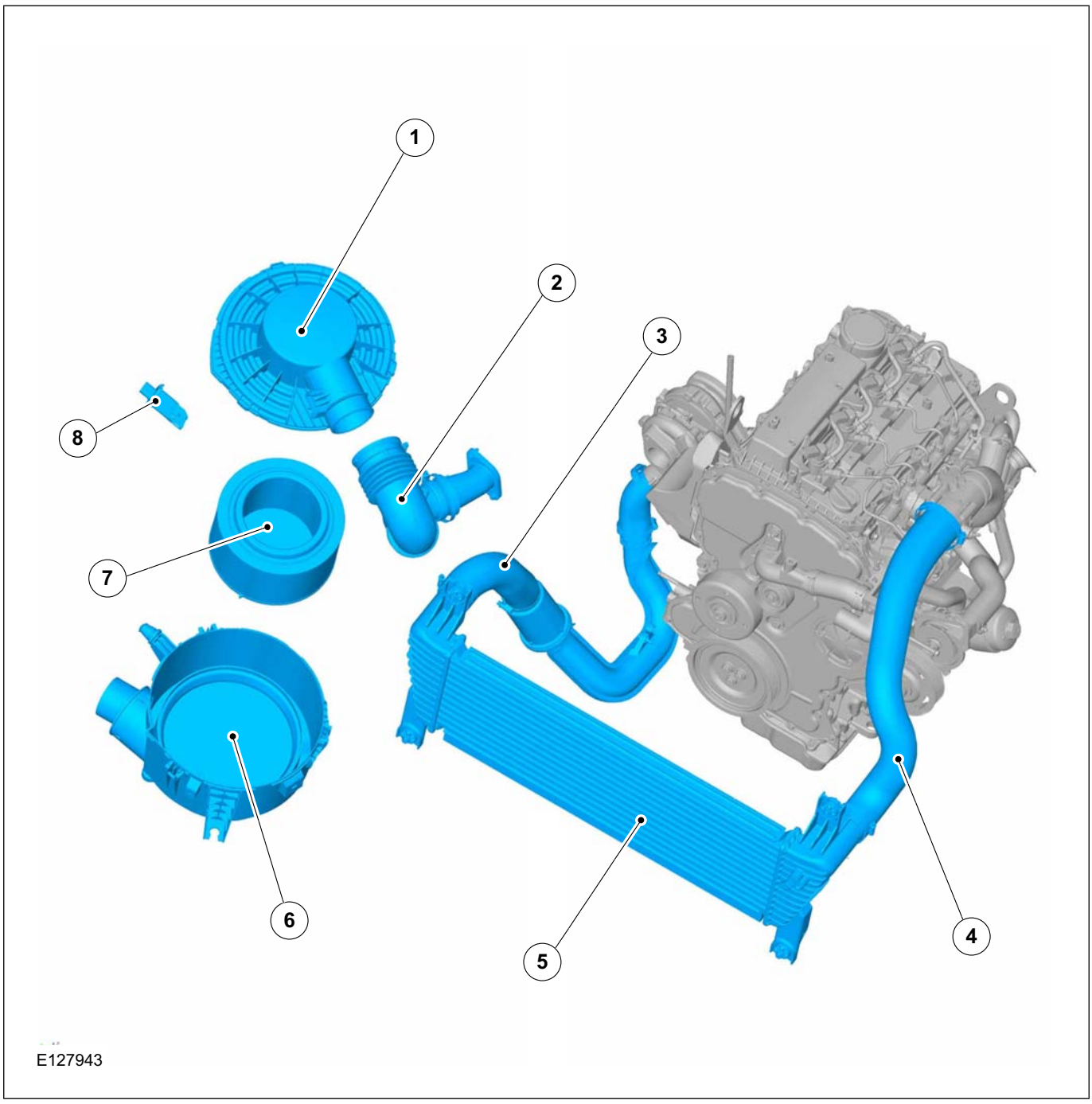
DESCRIPTION AND OPERATION

Intake Air Distribution and Filtering

Vehicles with 2.2L Duratorq-TDCi (Puma) diesel engine

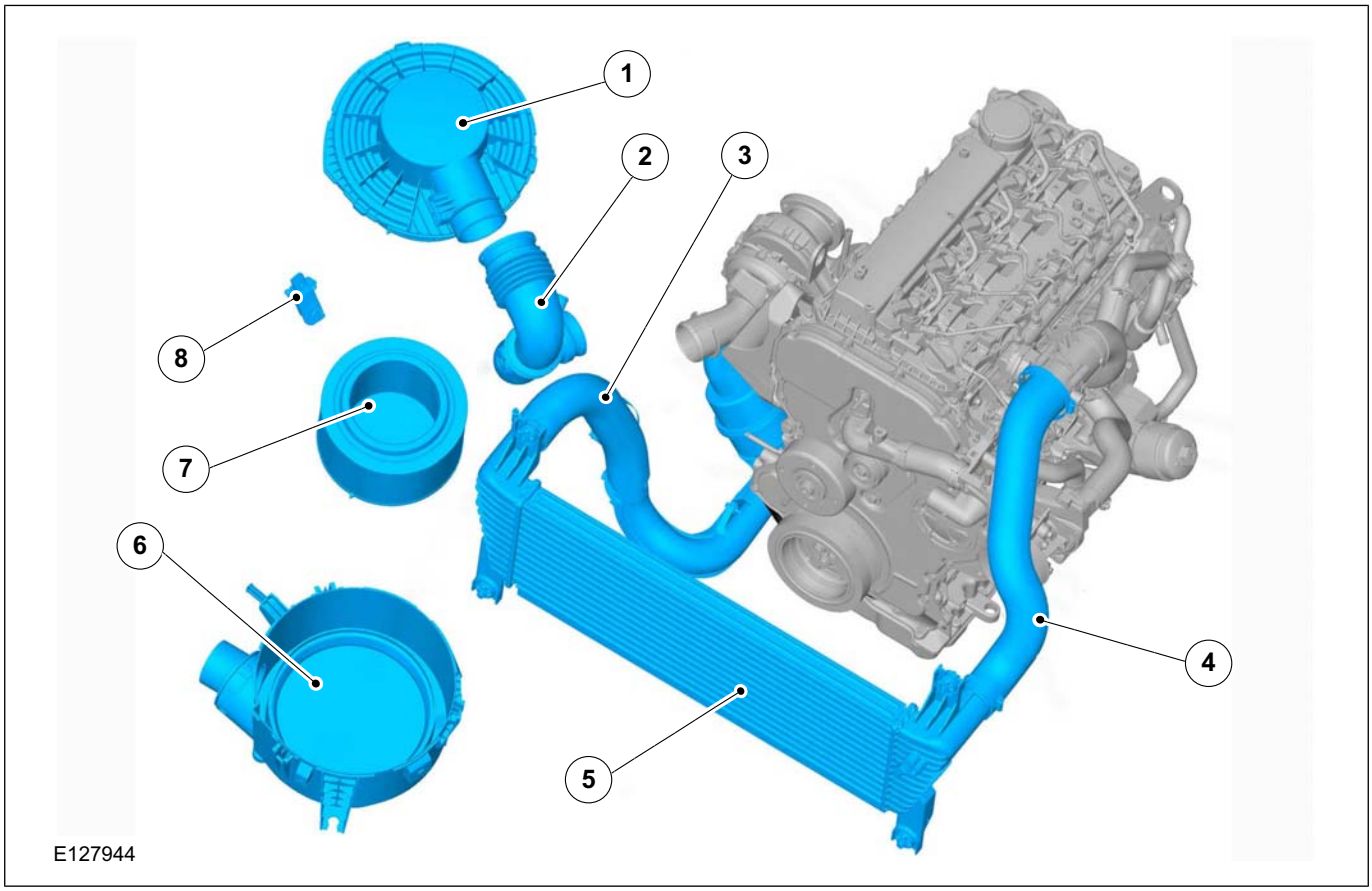


Item	Description
1	Air cleaner housing cover
2	Air cleaner outlet pipe
3	Charge air cooler intake pipe
4	Charge air cooler outlet pipe

Item	Description
5	Charge air cooler
6	Air cleaner housing
7	Air cleaner element
8	Mass air flow (MAF) sensor

DESCRIPTION AND OPERATION

Vehicles with 3.2 L Duratorq-TDCi (Puma) diesel engine



Item	Description
1	Air cleaner housing cover
2	Air cleaner outlet pipe
3	Charge air cooler intake pipe
4	Charge air cooler outlet pipe
5	Charge air cooler
6	Air cleaner housing
7	Air cleaner element
8	Mass air flow (MAF) sensor

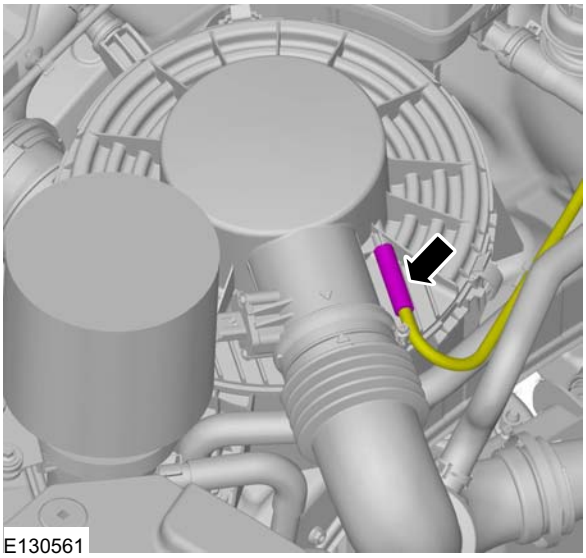
REMOVAL AND INSTALLATION

Air Cleaner — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma(23 174 0)

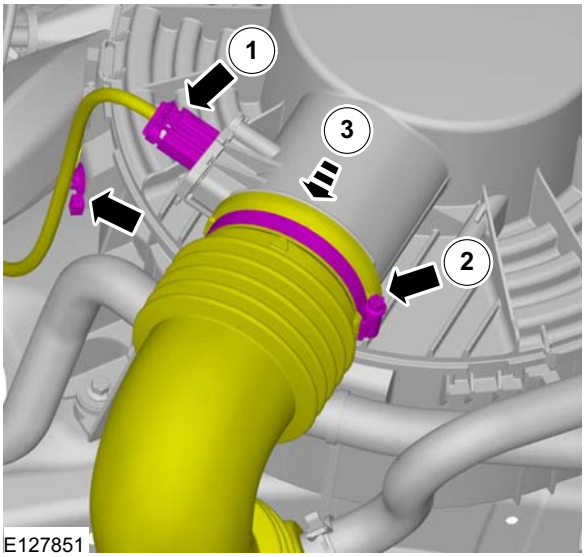
Removal

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

1. **NOTE:** This step is applicable for FGT engines only.

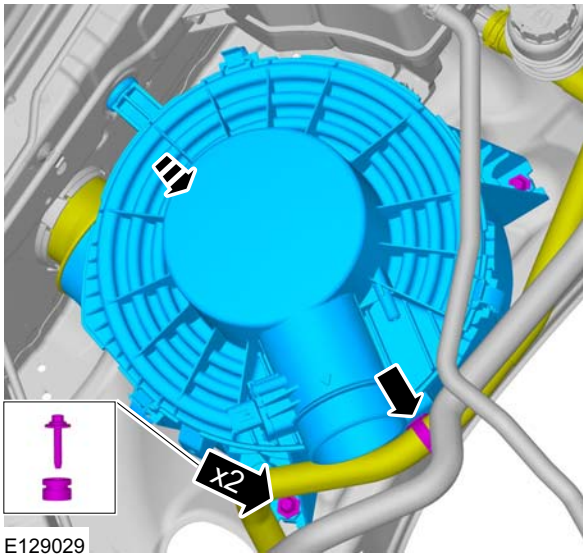

E130561

2. **NOTE:** Make sure that the positive crankcase ventilation (PCV) hose and the turbocharger intake pipe are not disturbed.



E127851

3. Torque: 10 Nm



E129029

Installation

1. To install, reverse the removal procedure.

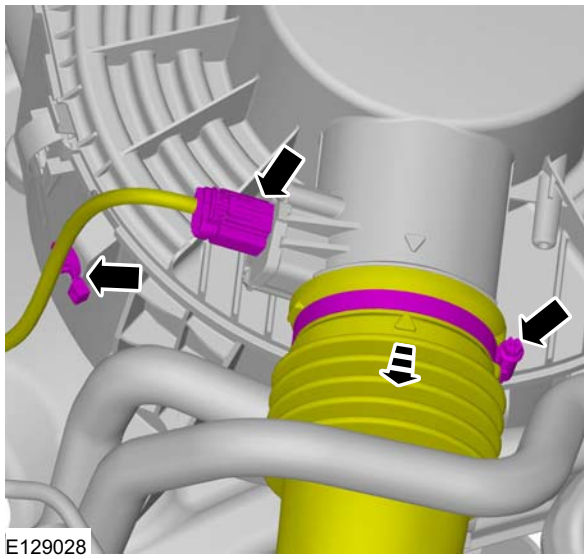
REMOVAL AND INSTALLATION

Air Cleaner — 3.2L Duratorq-TDCi (148kW/200PS) - Puma(23 174 0)

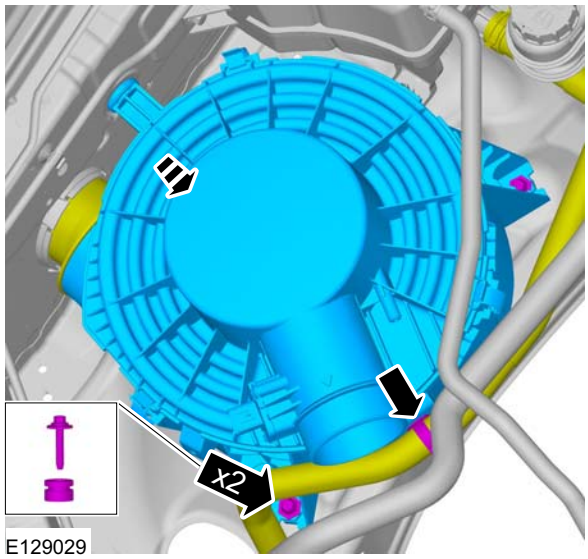
Removal

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

1. **NOTE:** Make sure that the positive crankcase ventilation (PCV) hose and the turbocharger intake pipe are not disturbed.


E129028

2. Torque: 10 Nm



E129029

Installation

1. To install, reverse the removal procedure.

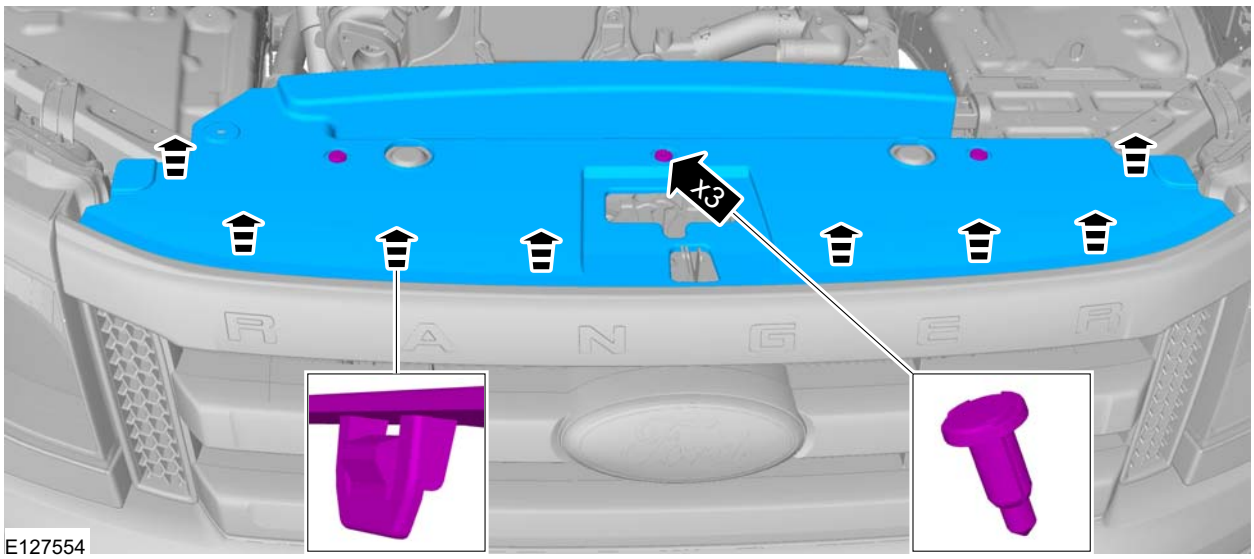
REMOVAL AND INSTALLATION

Charge Air Cooler(23 620 0)

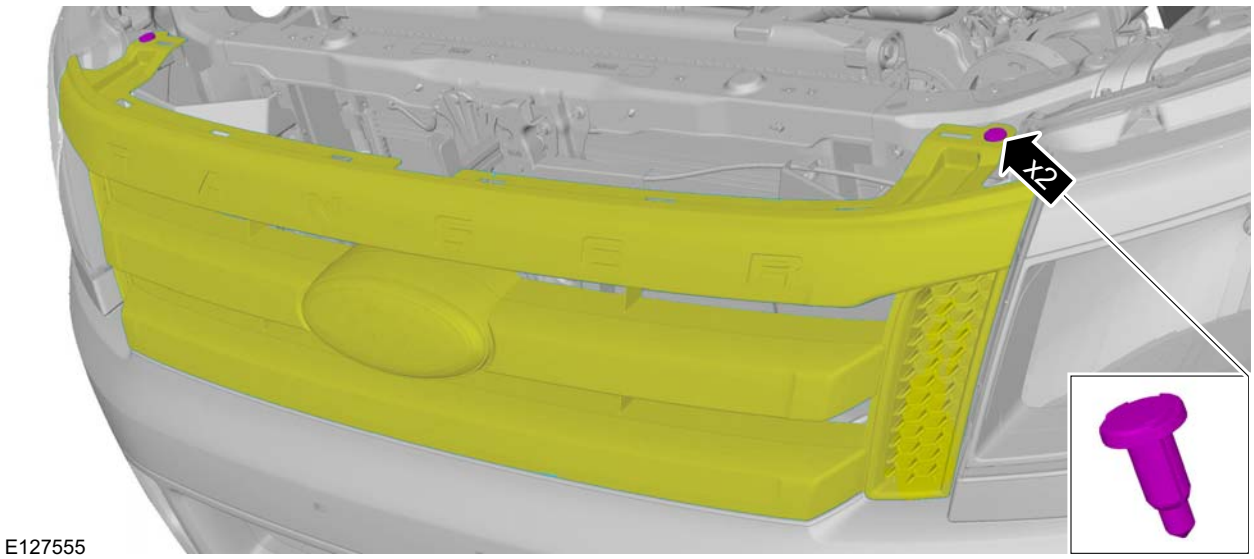
1.

Removal

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

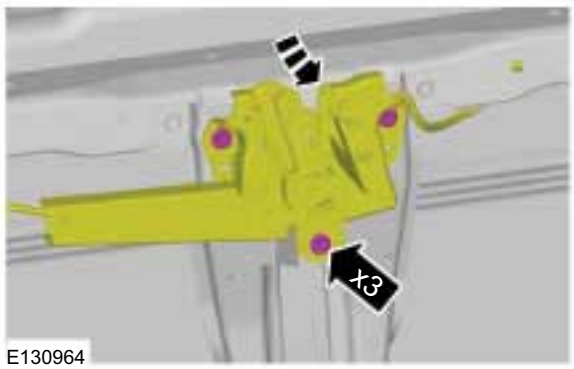


2.

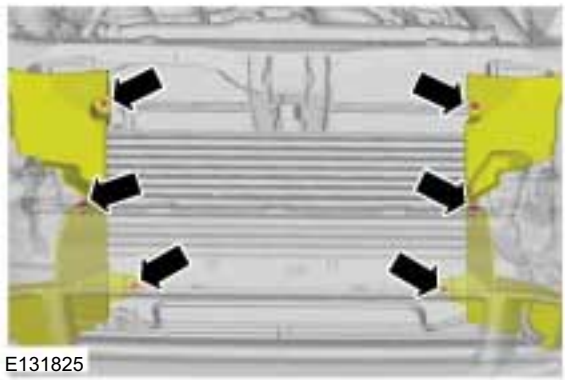


REMOVAL AND INSTALLATION

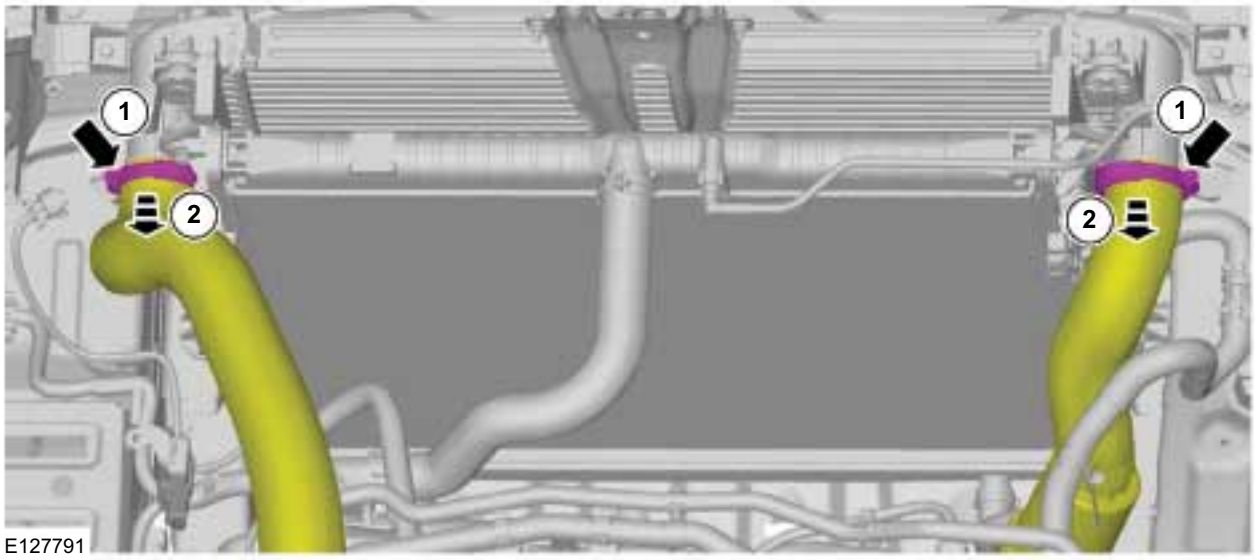
3. Torque: 10 Nm



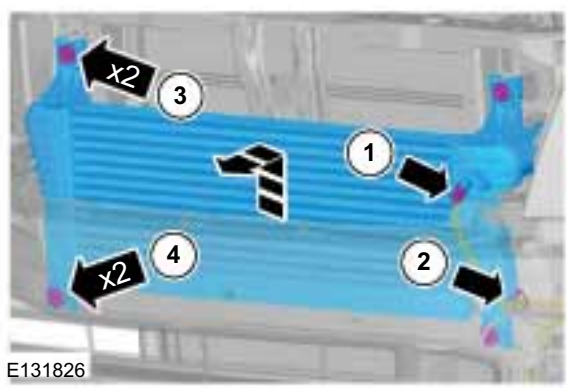
4. Torque: 10 Nm



5. ⚠ **CAUTION: Make sure that the inside of the pipe ends are clean and free of oil residue.**



6. 3. Torque: 10 Nm
4. Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.

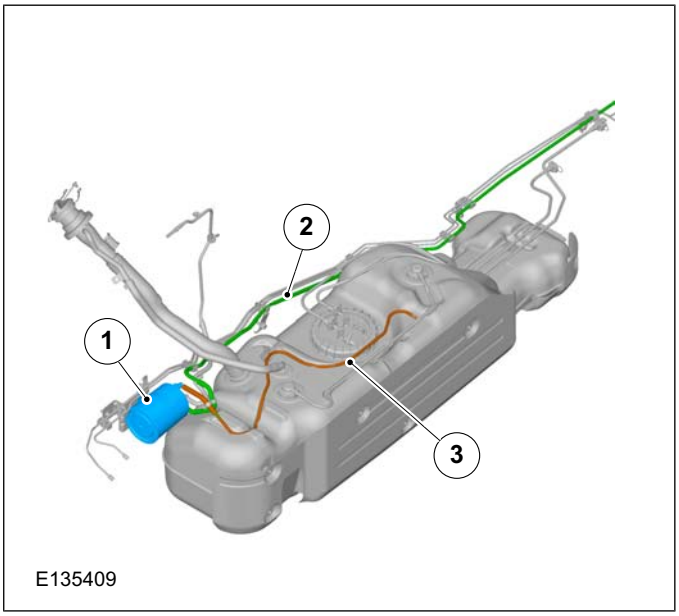
SECTION 303-13 Evaporative Emissions

VEHICLE APPLICATION: 2011.50 Ranger

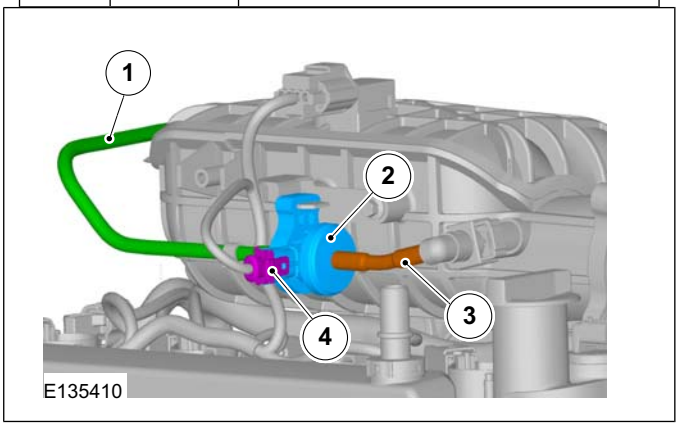
CONTENTS PAGE

DESCRIPTION AND OPERATION

Evaporative Emissions



Item	Part Number	Description
1		Evaporative emission canister
2		Evaporative emission canister to evaporative emission canister purge valve vapor line
3	-	Fuel tank vent to evaporative emission canister line



Item	Description
1	Evaporative emission canister to evaporative emission canister purge valve vapor line
2	Evaporative emission canister purge valve
3	Evaporative emission canister purge valve to intake manifold vapor line
4	Evaporative emission canister purge valve electrical connector

REMOVAL AND INSTALLATION

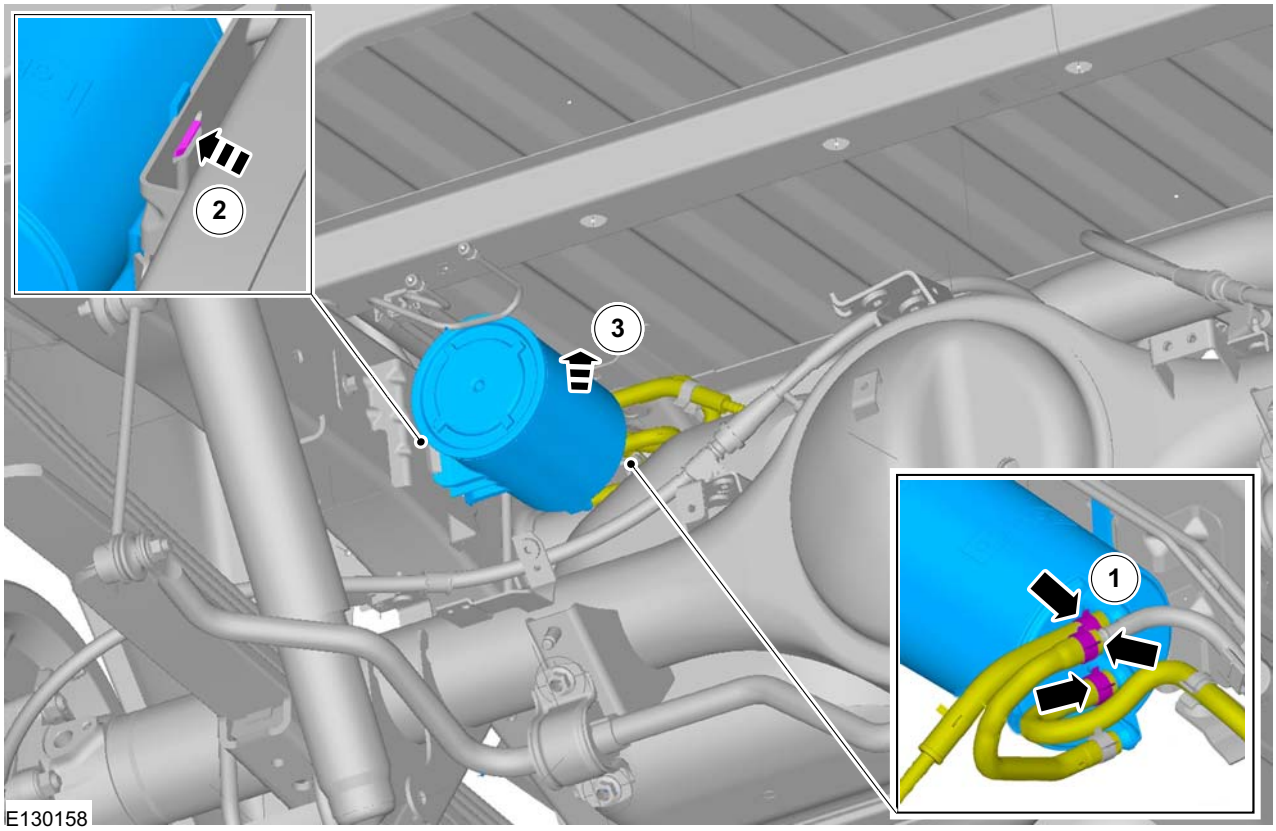
Evaporative Emission Canister(29 250 0)

Removal

CAUTION: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

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).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. **WARNING: Be prepared to collect escaping fluids.**



Installation

1. To install, reverse the removal procedure.

SECTION 303-14A Electronic Engine Controls — 2.5L

Duratec-HE (122kW/165PS) - MI4

VEHICLE APPLICATION: 2011.50 Ranger

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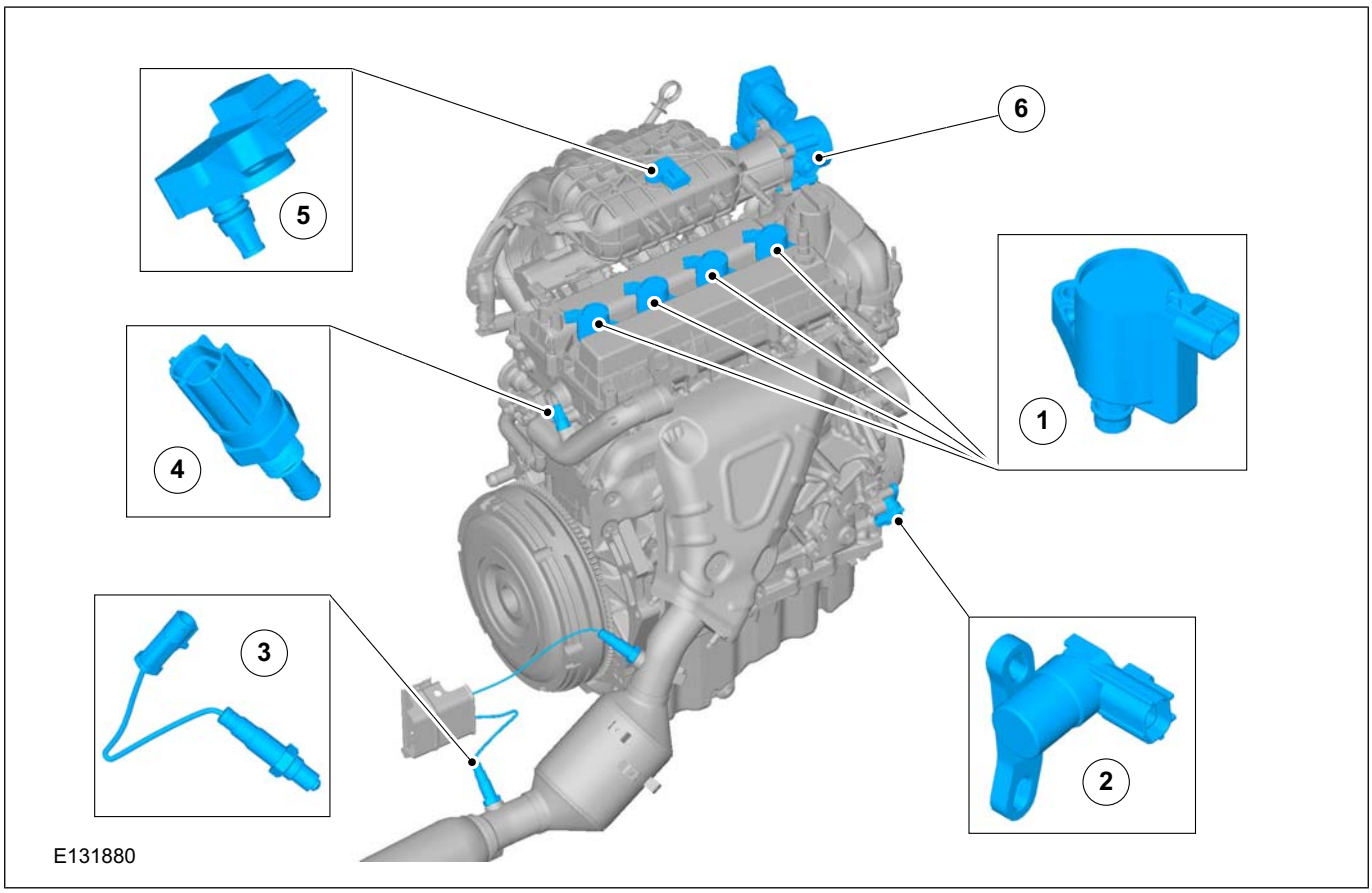
DESCRIPTION AND OPERATION

REMOVAL AND INSTALLATION

DESCRIPTION AND OPERATION

Electronic Engine Controls

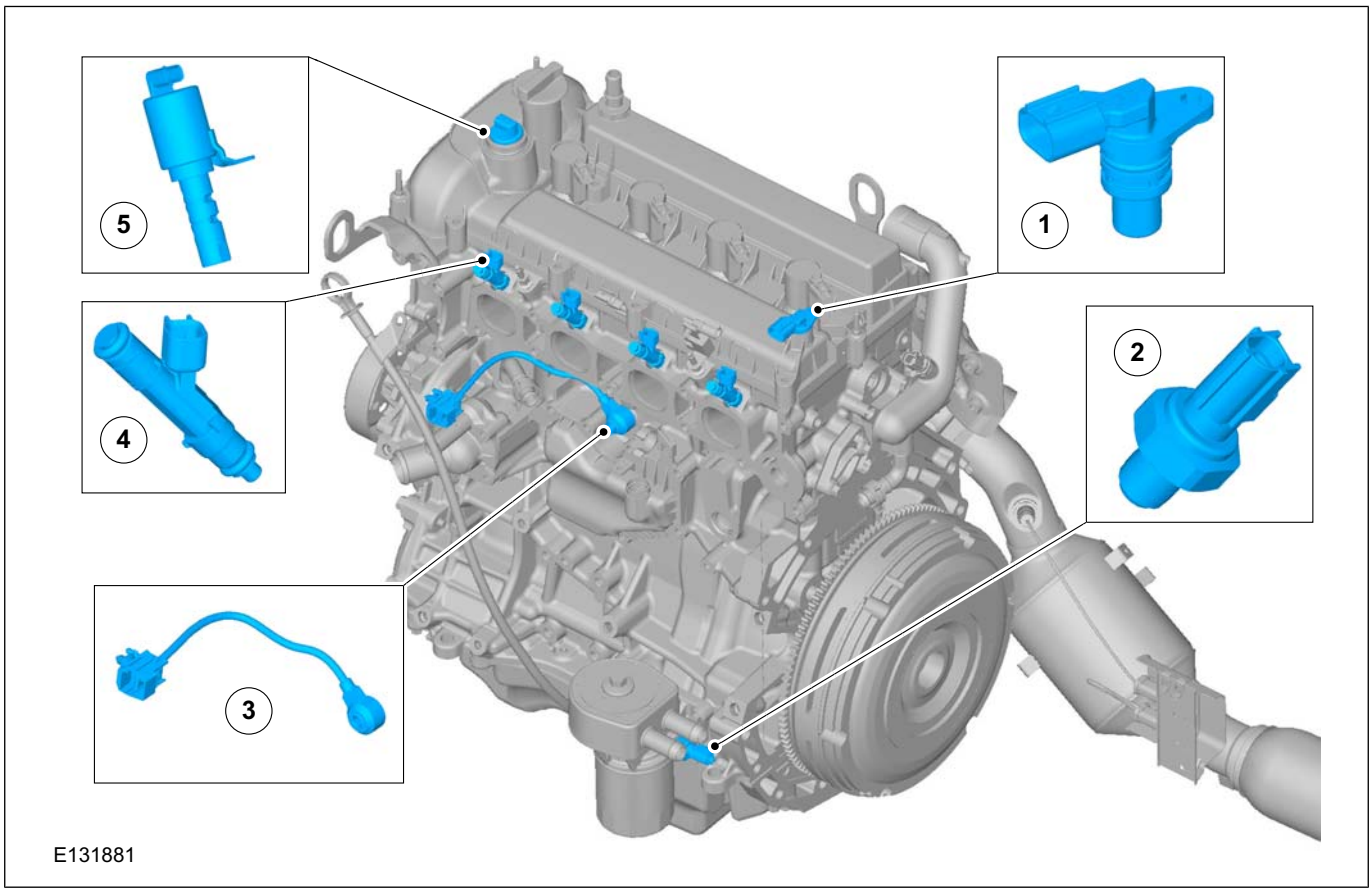
Electronic Engine Control Location



Item	Description
1	Ignition coils
2	Crankshaft position (CKP) sensor
3	Heated oxygen (HO2S) sensor

Item	Description
4	Engine coolant temperature (ECT) sensor
5	Manifold absolute pressure and temperature (MAPT) sensor
6	Electronic throttle body

DESCRIPTION AND OPERATION

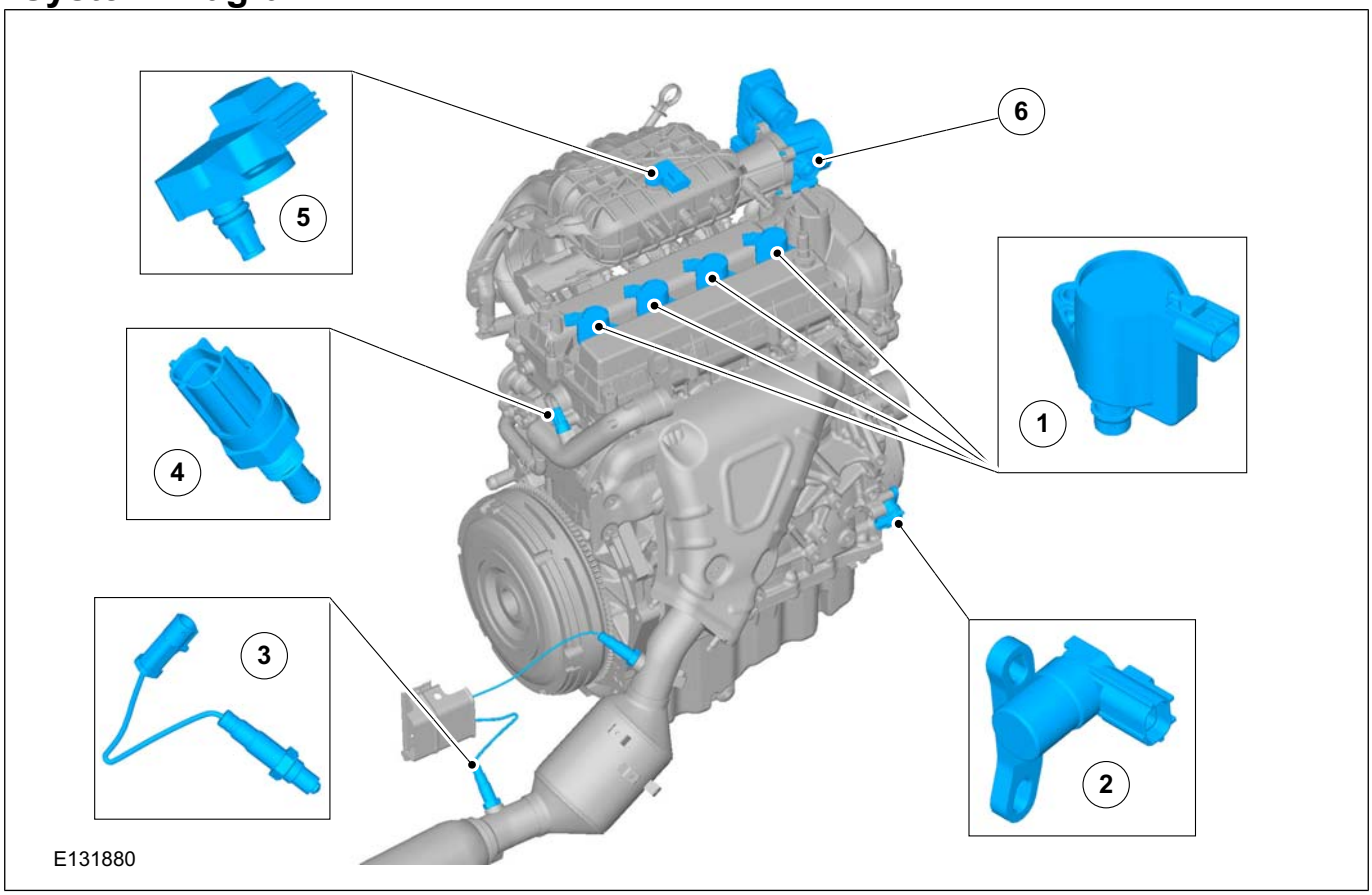


Item	Description
1	Camshaft position (CMP) sensor
2	Engine oil pressure (EOP) sensor
3	Knock (KS) sensor
4	Injectors
5	Variable camshaft timing (VCT) oil control solenoid

DESCRIPTION AND OPERATION

Electronic Engine Controls – System Operation and Component Description

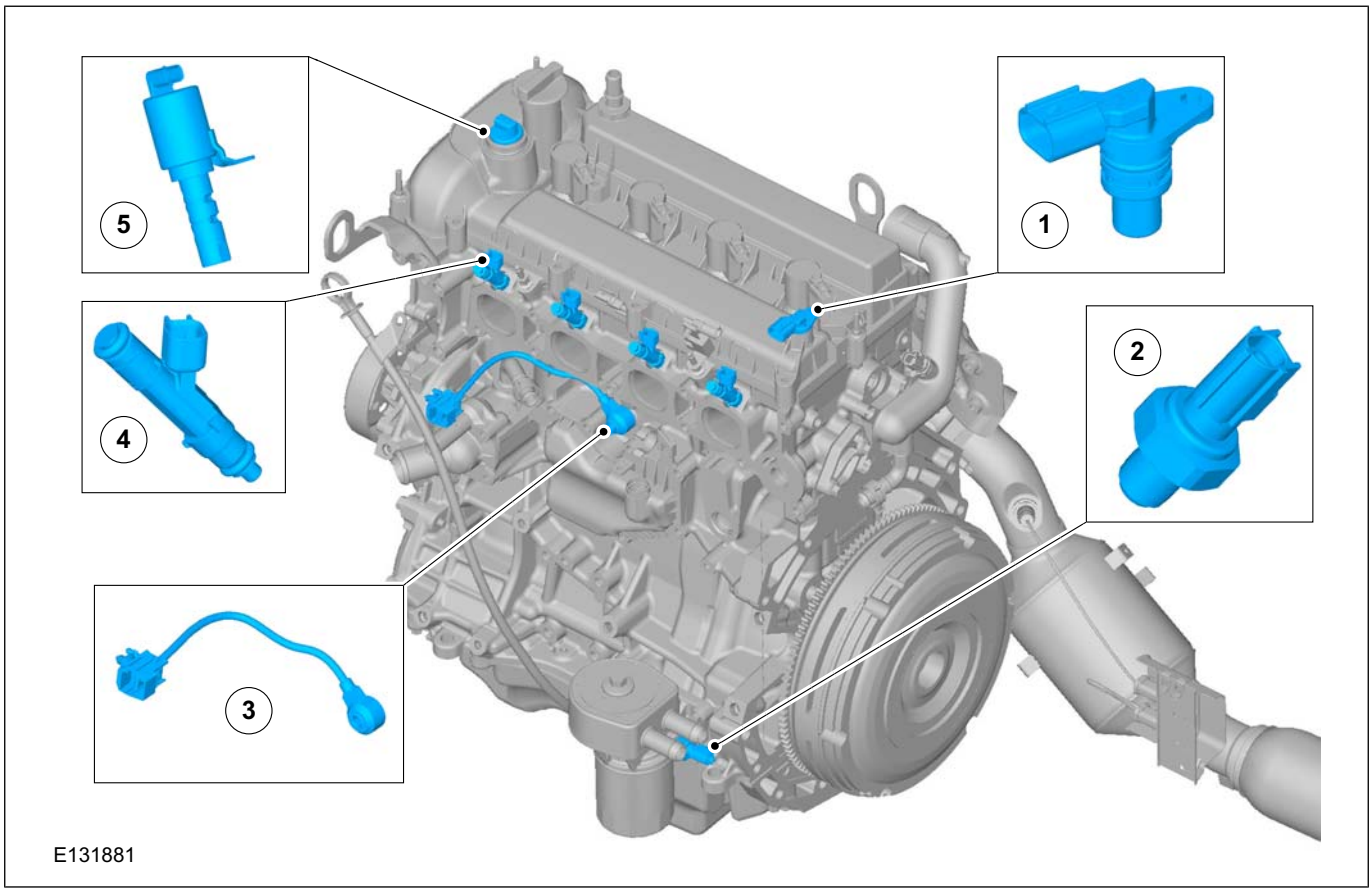
System Diagram



Item	Description
1	Ignition coil
2	Crankshaft position (CKP) sensor
3	Heated oxygen (HO2S) sensor

Item	Description
4	Engine coolant temperature (ECT) sensor
5	Manifold absolute pressure and temperature (MAPT) sensor
6	Electronic throttle body

DESCRIPTION AND OPERATION

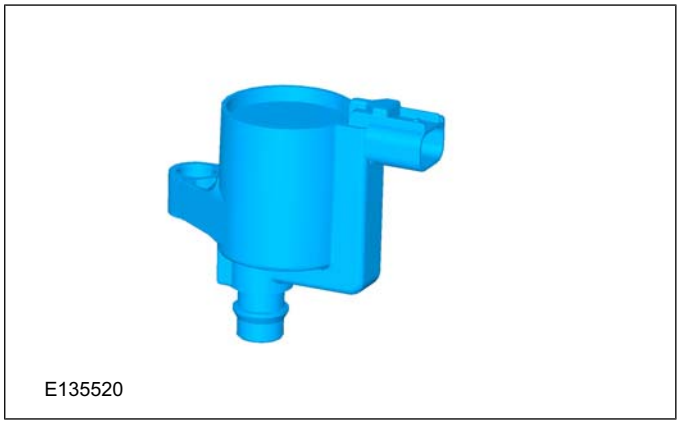


Item	Description
1	Camshaft position (CMP) sensor
2	Engine oil pressure (EOP) sensor
3	Knock (KS) sensor

Item	Description
4	Injectors
5	Variable camshaft timing (VCT) oil control solenoid

System Operation

Ignition Coil



The electronic ignition system is a fully electronic, distributor less ignition system with no moving parts on the high-voltage side

The electronic ignition system is integrated into the PCM.

With an electronic ignition system, high-voltage distribution to the individual cylinders is realized via special double spark coils. The signal from the CKP sensor forms the basis for ignition timing calculations. From an ignition map, the PCM determines the optimum closing time and current rise of the primary current circuit of the ignition coil with switching carried out via end-stages in the PCM. The ignition timing is determined by the PCM on the basis of the engine operating conditions. Once the ignition timing is determined, the PCM interrupts the current supply to the ignition coil

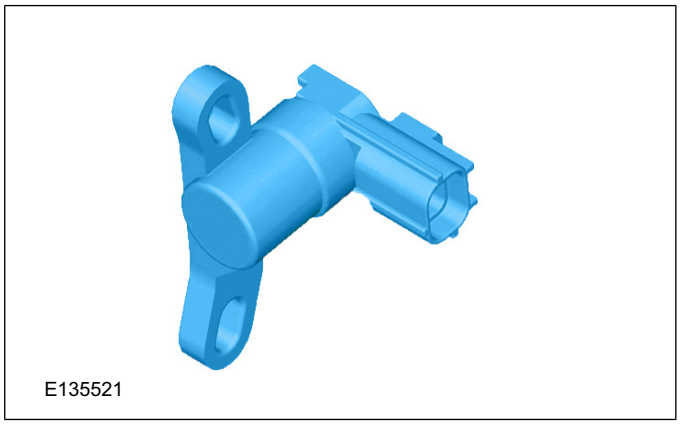
DESCRIPTION AND OPERATION

primary circuit, thereby producing an ignition spark which passes to the cylinder via the spark plug.

The spark plugs are activated in pairs (cylinders 1 and 4, and cylinders 2 and 3) and send a strong main spark to the cylinder in the compression cycle and a weak secondary spark to the cylinder in the exhaust cycle. The main spark is generated automatically in the cylinder that is in the compression cycle, because a higher resistance exists between the electrodes on account of the high compression.

On one spark plug a spark jumps across from the center electrode to the earth electrode and on the other spark plug from the earth electrode to the center electrode.

Crankshaft Position (CKP) Sensor


E135521

The CKP sensor is an inductive sensor that allows the ECM to determine the angular position of the crankshaft and the engine speed.

The CKP sensor is installed in the rear left side of the sump body, in line with the engine drive plate. The sensor is secured with a single screw and sealed with an O-ring. A two pin electrical connector provides the interface with the engine harness.

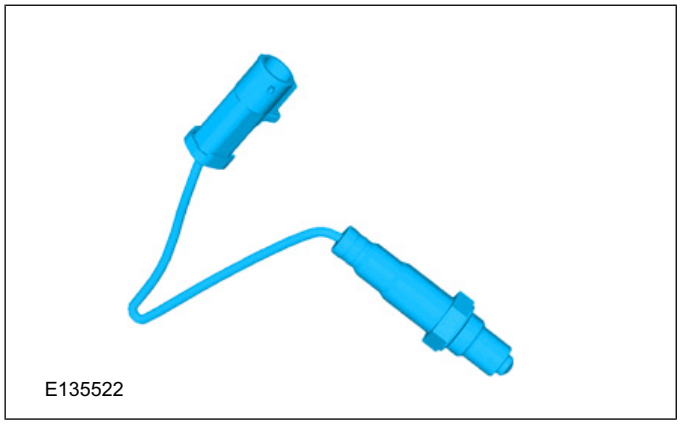
The head of the CKP sensor faces a reluctor ring pressed into the outer circumference of the engine drive plate. The reluctor ring has a 60 minus 2 tooth pattern. There are 58 teeth at 6° intervals, with two teeth removed to provide a reference point with a centerline that is 21° BTDC (before top dead center) on cylinder 1 of bank A.

If the CKP sensor fails, the ECM:

Uses signals from the CMP sensors to determine the angular position of the crankshaft and the engine speed

Adopts a limp home mode where engine speed is limited to a maximum of 3000 rev/min. With a failed CKP sensor, engine starts will require a long crank time while the ECM determines the angular position of the crankshaft.

Heated oxygen (HO2S) senso


E135522

The heated oxygen sensors allow the ECM to measure the oxygen content of the exhaust gases, for closed loop control of the fuel:air mixture and for catalytic converter monitoring.

An upstream heated oxygen sensor is installed in the outlet of each exhaust manifold, which enables independent control of the fuel:air mixture for each cylinder bank. A downstream heated oxygen sensor is installed in each catalytic converter, which enables the performance of the catalytic converters to be optimized and monitored

Oxygen sensors need to operate at high temperatures in order to function correctly. To achieve the high temperatures required, the sensors are fitted with heater elements that are controlled by a PWM (pulse width modulation) signal from the ECM. The heater elements are operated after each engine start, once it has been calculated that there is no moisture in the exhaust (between 0 and 2 minutes delay), and also during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperature. The PWM duty cycle is carefully controlled to prevent thermal shock to cold sensors. A non-functioning heater delays the sensor's readiness for closed loop control and increases emissions.

The upstream heated oxygen sensors produce a constant voltage, with a variable current that is proportional to the lambda ratio. The downstream heated oxygen sensors produce an output voltage dependant on the ratio of the exhaust gas oxygen to the ambient oxygen.

DESCRIPTION AND OPERATION

The heated oxygen sensors age with mileage, increasing their response time to switch from rich to lean and lean to rich. This increase in response time influences the ECM closed loop control and leads to progressively increased emissions. Measuring the period of rich to lean and lean to rich switching monitors the response rate of the upstream sensors.

Diagnosis of electrical faults is continually monitored in both the upstream and downstream sensors. This is achieved by checking the signal against maximum and minimum threshold, for open and short circuit conditions.

If a heated oxygen sensor fails:

The ECM defaults to open loop fueling for the related cylinder bank

The CO (carbon monoxide) and emissions content of the exhaust gases may increase

The exhaust may smell of rotten eggs (hydrogen sulphide).

With a failed heated oxygen sensor, the engine will suffer from reduced refinement and performance.

Engine coolant temperature (ECT) sensor


E135523

The ECT sensors are NTC (negative temperature coefficient) thermostats that allow the ECM to monitor the engine coolant temperature.

There are two identical ECT sensors installed, which are identified as ECT 1 and ECT 2. Each sensor is secured with a twist-lock and latch mechanism, and is sealed with an O-ring. A two pin electrical connector provides the interface between the sensor and the engine harness

ECT 1

ECT 1 is installed in the heater manifold, at the rear of the RH (right-hand) cylinder head. The input from this sensor is used in calibration tables and by other systems.

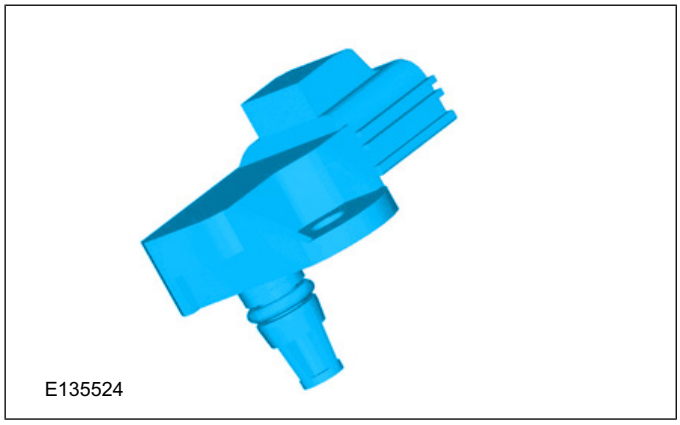
If there is an ECT 1 fault, the ECM adopts an estimated coolant temperature. On the second consecutive trip with an ECT 1 fault, the ECM illuminates the MIL (malfunction indicator lamp).

ECT 2

ECT 2 is installed in the lower hose connector which attaches to the bottom of the thermostat. The input from this sensor is used for OBD (on-board diagnostic) 2 diagnostics and, in conjunction with the input from ECT 1, to confirm that the thermostat is functional.

If there is an ECT 2 fault, the ECM illuminates the MIL on the second consecutive trip.

Manifold absolute pressure and Temperature (MAPT) sensor


E135524

In the MAPT sensor housing are located a piezo-pressure sensor element (MAP (manifold absolute pressure) sensor) and the electronic circuits for signal amplification and temperature compensation. The IAT sensor element is an NTC (negative temperature coefficient) resistor. A special coating process renders the MAP and IAT sensor elements resistant to damp and humidity in the intake pipe. The MAPT sensor receives a reference voltage of 5 Volts from the PCM. The output signal from the MAP sensor element is an analogue voltage signal which changes proportionately to the absolute pressure in the intake manifold. A high absolute pressure in the intake manifold (throttle valve wide open) means a high voltage, and a low absolute pressure in the intake manifold (throttle valve closed) means a low voltage. With ignition on and wide-open throttle the MAP sensor measures the BARO (barometric pressure). The resulting value is stored in the Keep Alive Memory and serves as a reference pressure

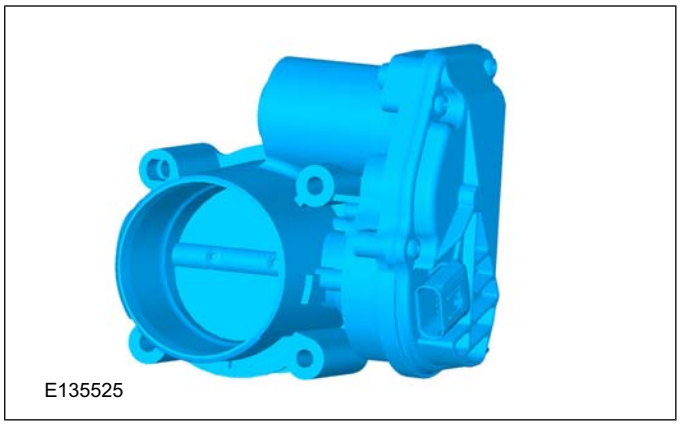
DESCRIPTION AND OPERATION

for the prevailing manifold absolute pressure at the various load states.

The IAT sensor element also sends an analog voltage signal to the PCM. The temperature range (falling temperature characteristic) of the IAT sensor is from -40 ºC (nominal resistance approx. 48 kOhms) to 130 ºC (nominal resistance approx. 85 Ohms). At an intake air temperature of 20ºC, the nominal resistance is 2.5 kOhm +/- 5%. The analog voltage signals are digitized in the analog-to-digital converter and transmitted to the microprocessor as numerical values (counts).

Use of the MAPT signal:

Electronic Throttle


E135525

The ECM uses the electronic throttle to help regulate engine torque.

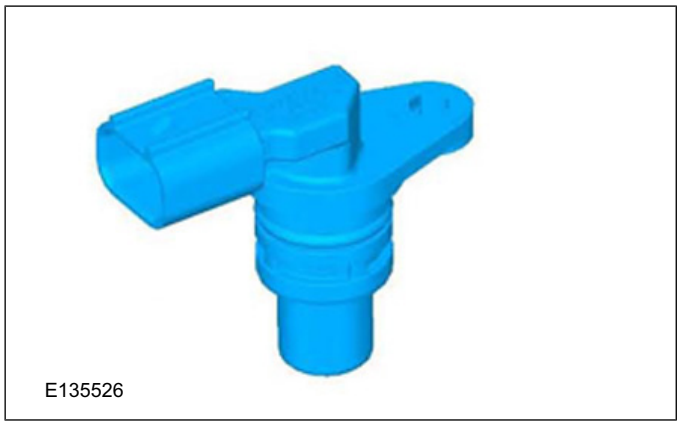
The electronic throttle is attached to the intake manifold. For additional information, refer to: Intake Air Distribution and Filtering (303-12 Intake Air Distribution and Filtering - 5.0L NA V8 - AJ133, Description and Operation).

The throttle plate is operated by an electric DC (direct current) motor integrated into the throttle body. The ECM uses a PWM signal to control the DC motor. The ECM compares the APP sensor inputs against an electronic request or value to determine the required position of the throttle plate. The ECM and electronic throttle are also required to:

- Monitor requests for cruise control operation
- Automatically operate the electronic throttle for accurate cruise control
- Perform all dynamic stability control engine interventions
- Monitor and carry out maximum engine speed and road speed cut outs
- Provide different engine maps for the ride and handling optimization system.

A software strategy within the ECM calibrates the position of the throttle plate at the beginning of each ignition cycle. When the ignition is turned on, the ECM performs a self test and calibration routine by fully closing the throttle plate and then opening it again. This tests the default position springs and allows the ECM to learn the fully closed position.

Camshaft position (CMP) sensor


E135526

A sensor is installed for the intake camshaft. The CMP sensor is used by the PCM for cylinder number one recognition so that the injection sequence can be determined.

Based on the calculated camshaft position and information about the crankshaft position, the PCM is able to determine the correct ignition timing and the correct injection timing for each individual cylinder. Also it can accurately identify a cylinder that is showing a tendency to knocking combustion

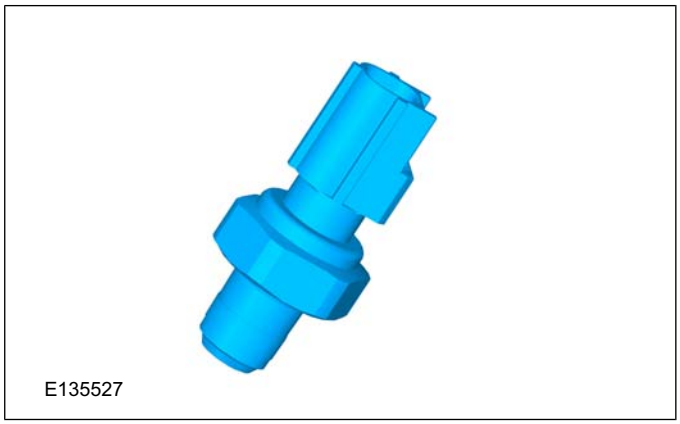
The CMP sensor is realized as a Hall effect sensor and is provided by the PCM with a 5 volt supply. The Hall effect sensor emits a signal when the pulse segments incorporated into the sensor wheel rotate past the tip of the sensor. Thanks to the composition of the pulse segments, and combined with the signals from the CKP sensor, the PCM is able to calculate the position of the individual camshafts at any time. If an increase occurs in the area of the sensor, the PCM receives a 'low' signal with a maximum voltage of 0.5V. If a gap occurs in the area of the sensor, a 'high' signal is sent to the PCM. In this case the voltage is approx. 4.5V.

If the CMP sensor fails, the fault is stored in the fault memory of the PCM and knock control is deactivated.

DESCRIPTION AND OPERATION

On vehicles without a CMP sensor, cylinder no. 1 is recognized using the different current rises of the two sparked cylinders 1 and 3.

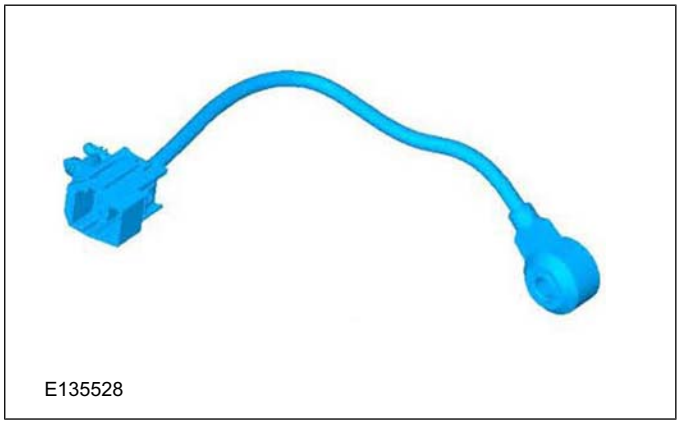
Engine oil pressure (EOP) sensor


E135527

The EOP switch detects the oil pressure. When a defined engine oil pressure is reached, the EOP switch opens.

This information is transmitted via the CAN bus to the instrument cluster where the EOP warning lamp is switched on or off accordingly.

Knock (KS) sensor


E135528

The knock sensors are piezo-ceramic sensors that allow the ECM to employ active knock control and prevent engine damage from pre-ignition or detonation.

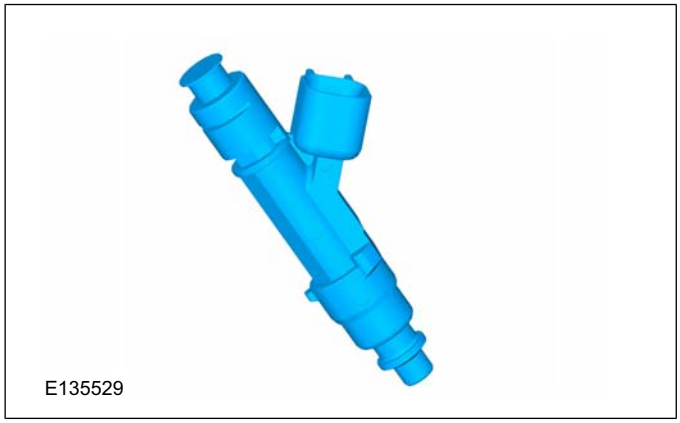
Two knock sensors are installed on the inboard side of each cylinder head, one mid-way between cylinders 1 and 2, and one mid-way between cylinders 3 and 4. Each knock sensor is secured with a single screw. On each knock sensor, a two pin electrical connector provides the interface with the engine harness.

The ECM compares the signals from the knock sensors with mapped values stored in memory to determine when detonation occurs on individual cylinders. When detonation is detected, the ECM retards the ignition timing on that cylinder for a number of engine cycles, then gradually returns it to the original setting.

The ECM cancels closed loop control of the ignition system if the signal received from a knock sensor becomes implausible. In these circumstances the ECM defaults to base mapping for the ignition timing. This ensures the engine will not become damaged if low quality fuel is used. The MIL will not illuminate, although the driver may notice that the engine 'pinks' in some driving conditions and displays a drop in performance and smoothness.

The ECM calculates the default value if one sensor fails on each bank of cylinders.

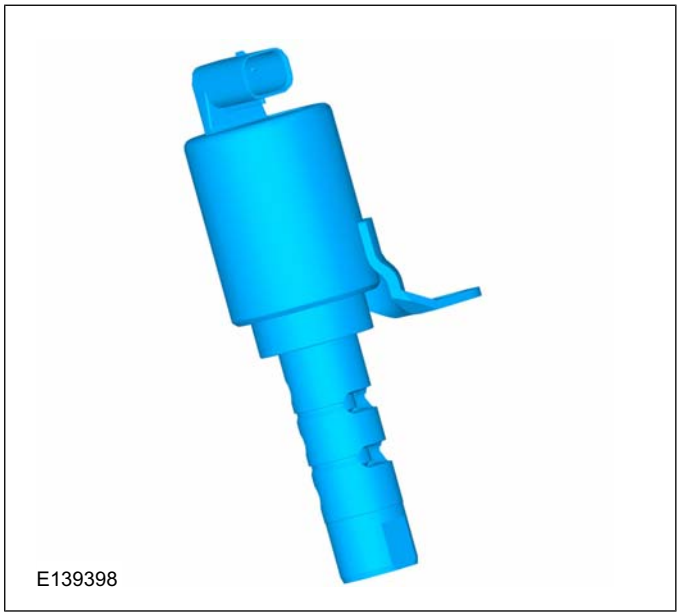
Injectors


E135529

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 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.

DESCRIPTION AND OPERATION

Variable camshaft timing (VCT) oil control solenoid



The VCT oil control solenoid is an electrically controlled hydraulic valve that directs engine oil to the variable camshaft. Once the PCM transmits a signal, the solenoid moves a valve spool, directing oil into the camshaft phaser cavity. This action changes valve timing by either inducing an advance or retard condition. The camshaft is, thereby repositioned in relation to crankshaft timing and allows for optimum engine performance and lower emissions.

DESCRIPTION AND OPERATION

Electronic Engine Controls — Vehicles With: Ethanol Capability

As a general rule, engine management works according to the same principles as for petrol operation. The PCM (powertrain control module), the sensors and the actuators are the same for petrol and for ethanol operation E100. For vehicles operated with ethanol, however, a fuel type determination and adaptation function is activated. This determines the fuel composition and adapts the control mode accordingly.

Fuel type determination

The mixture of fuel in the tank can vary from an ethanol share of 0% to 100%. This ethanol share is important for the engine management, as it has a strong influence on the engine running characteristics and the exhaust gas emissions. To determine the ethanol share in the fuel, the HO2S (heated oxygen sensor) and the fuel level sensor are used.

Adaptation for ethanol operation

The optimal fuel-air mixture for ethanol fuel E100 is 9.7 kg air per 1 kg E100. For petrol, the optimal fuel-air mixture is 14.5 kg air per 1 kg petrol. Ethanol operation therefore requires a richer mixture. To achieve this, injectors with a higher flow rate are used. In addition, the ignition time is "advanced", as the speed of transmission of the flame front of ethanol fuel E100 is lower.

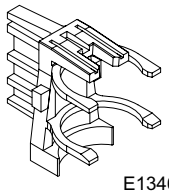
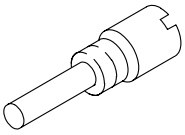
The requirements for petrol and ethanol operation are very different, which is why special characteristics maps have been saved in the PCM for both fuel types.

Errors during fuel type determination and adaptation can have a significant influence on fuel consumption and the engine running characteristics. If a leak upstream of the HO2S causes the engine management to change the control mode to ethanol operation, the spark plugs may fail due to an excessive fuel supply and the engine will not run satisfactorily in the cold state. If the engine management switches to petrol during ethanol operation, the engine will run irregularly or will not start.

REMOVAL AND INSTALLATION

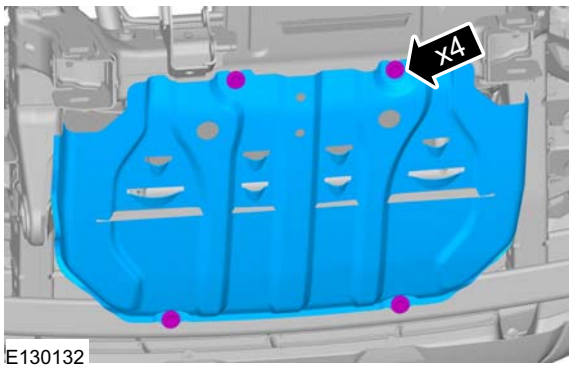
Crankshaft Position (CKP) Sensor(29 230 0)

Special Tool(s)

 E134676	303-1417 Tool, Crank Sensor Alignment
 PZ21210	303-507 Timing Peg, Crankshaft TDC

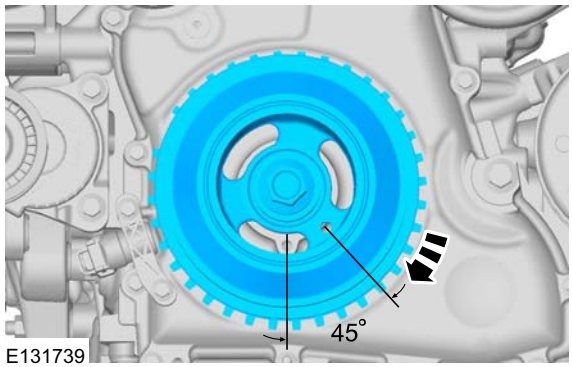
Removal

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

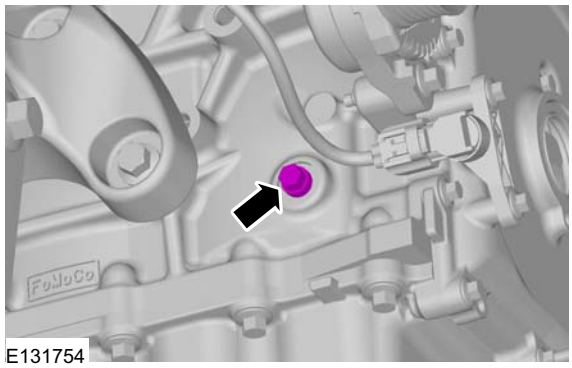
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. 

E130132
4. **WARNING: Only rotate the crankshaft clockwise.**

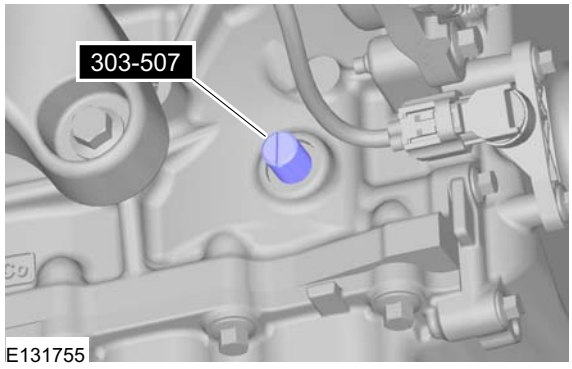
Turn the crankshaft until no. 1 piston is at about 45° before TDC.



E131739

5. 
E131754

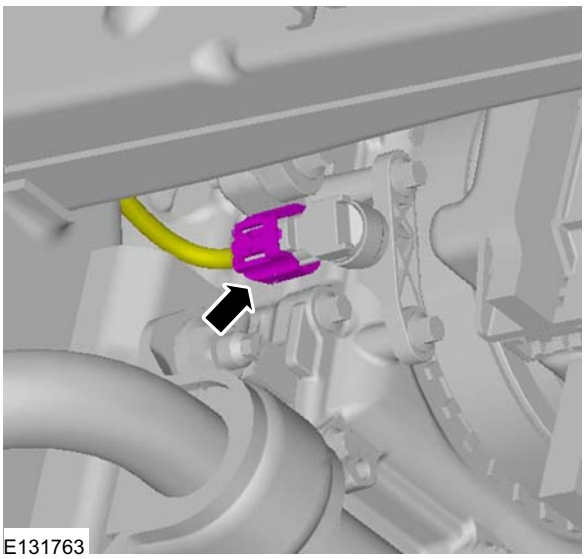
6. Special Tool(s): 303-507



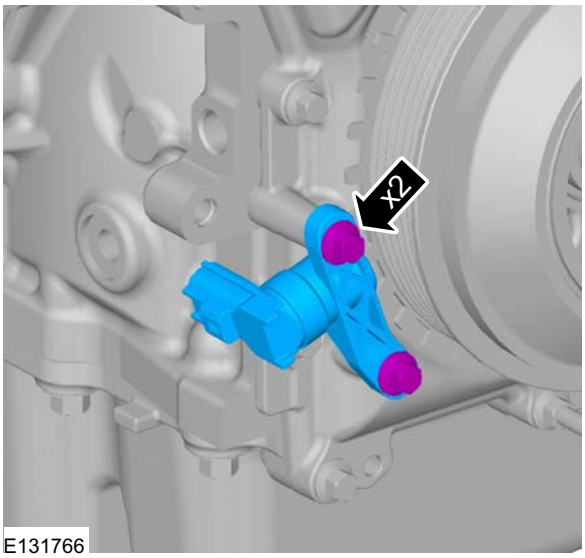
E131755

REMOVAL AND INSTALLATION

7.


E131763

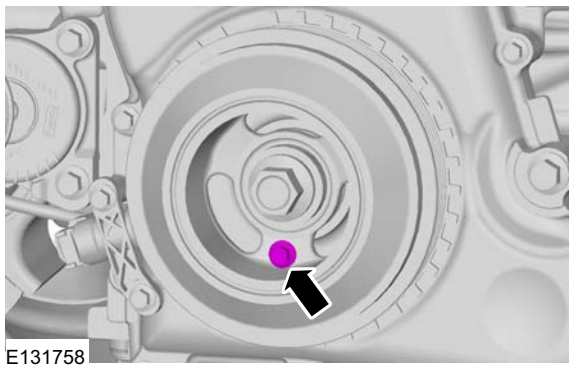
8.



E131766

Installation

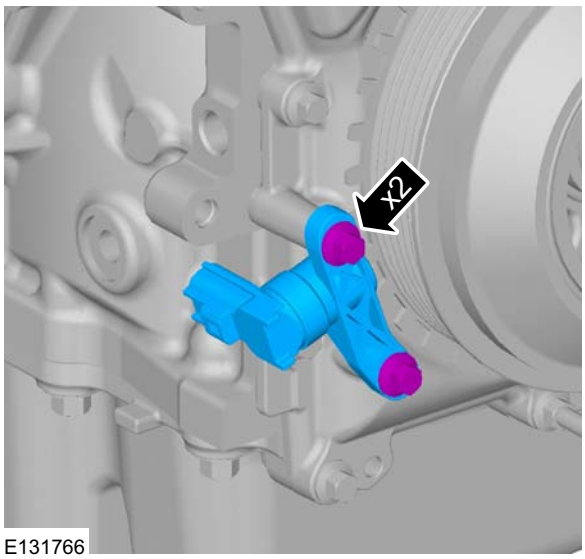
1. Install the bolt M6 x 18 mm.


E131758

2. Special Tool(s): 303-1417

E135214

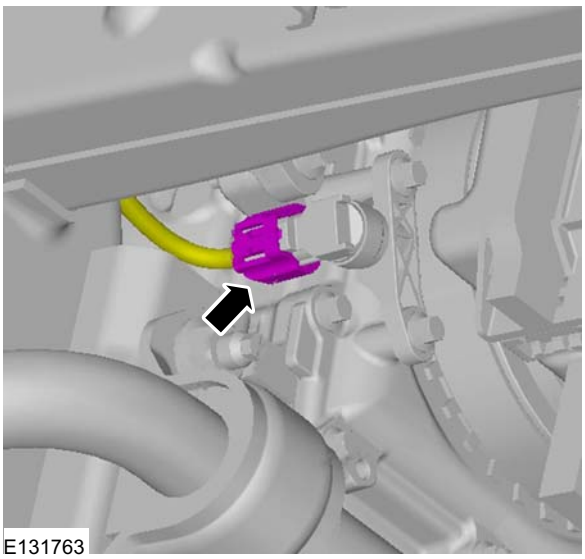
3. Torque: 7 Nm



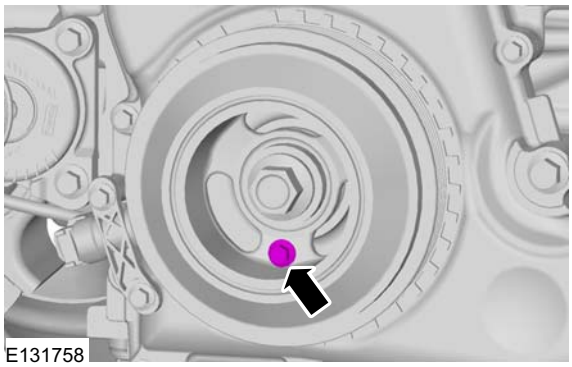
E131766

REMOVAL AND INSTALLATION

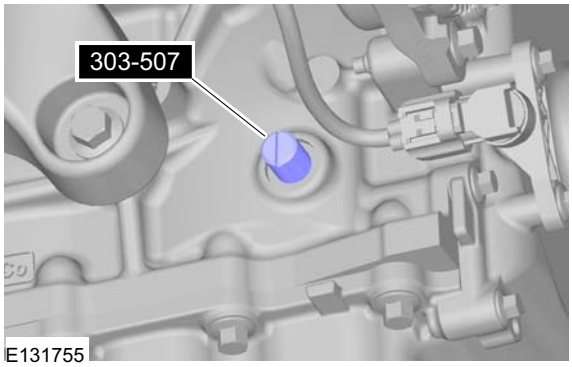
4.



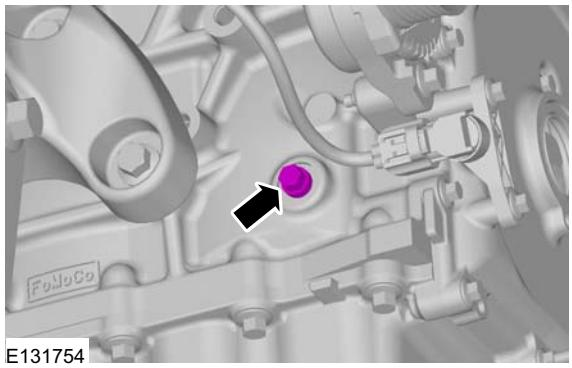
5. Remove the bolt M6 x 18 mm.



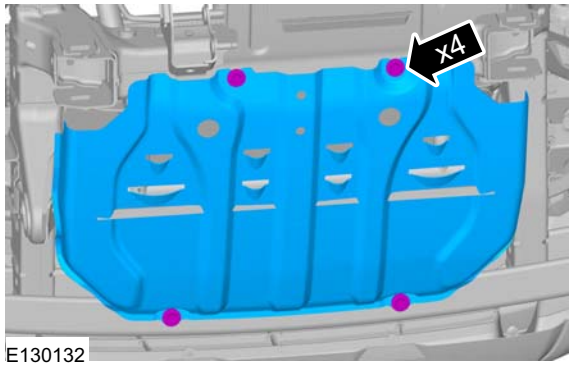
6. Remove the Special Tool(s): 303-507



7. Torque: 20 Nm



8. Torque: 30 Nm



REMOVAL AND INSTALLATION

Powertrain Control Module (PCM)(29 200 0)

General Equipment

Ford Diagnostic Equipment

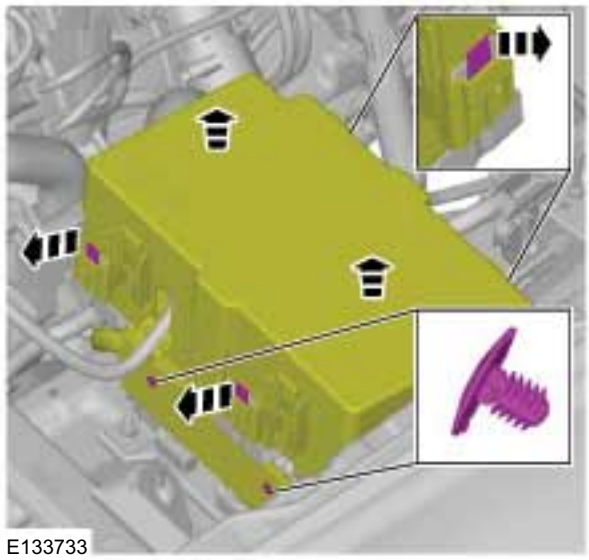
Removal

CAUTION: If a new PCM is to be installed, upload the PCM configuration information using the Programmable Modules Installation Routine, prior to commencing the removal of the PCM.

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

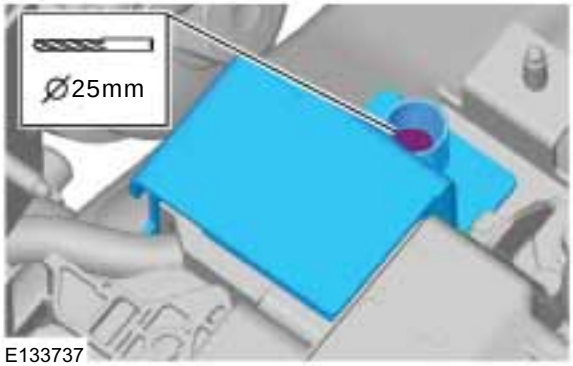
All vehicles

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).
3. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).
4.


E133733

Vehicles with PCM security shield

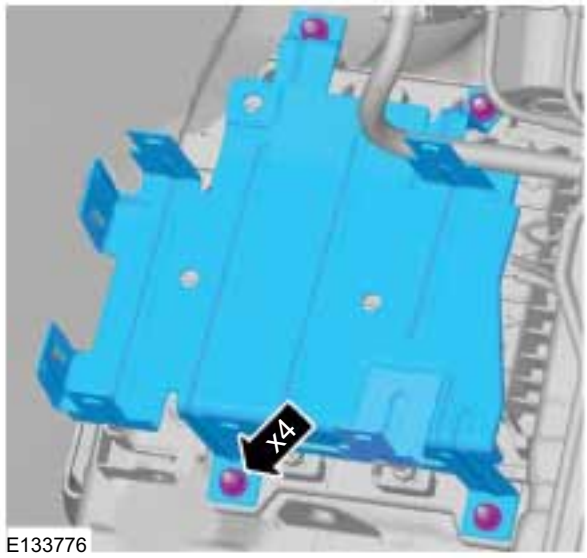
5. Torque: 15 Nm



E133737

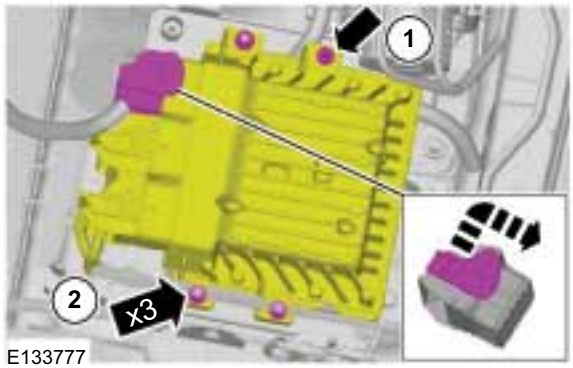
All vehicles

6. Torque: 11 Nm



E133776

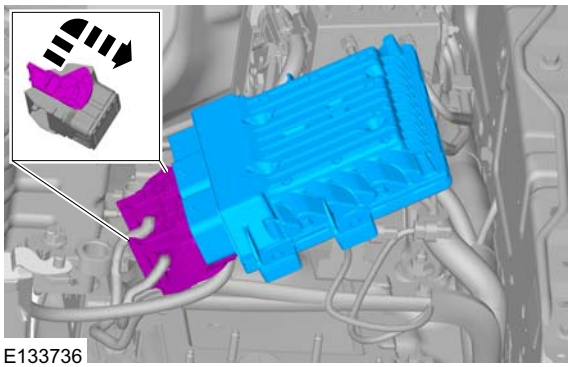
7. 1. Torque: 10 Nm
   2. Torque: 11 Nm



E133777

REMOVAL AND INSTALLATION

8.


E133736

Installation

1. To install, reverse the removal procedure.
2. Carry out the Injector Correction Factors procedure using the following menu options: ToolBox/Powertrain/Service Functions.

   General Equipment: Ford Diagnostic Equipment
3. Carry out the Oil Quality History function using the following menu options: ToolBox/Powertrain/Service Functions.

   General Equipment: Ford Diagnostic Equipment
4. Carry out the Stored Speed Limit function using the following menu options: ToolBox/Powertrain/Service Functions.

   General Equipment: Ford Diagnostic Equipment
5. Carry out the Pump Learn procedure using the following menu options: ToolBox/Powertrain/Service Functions.

   General Equipment: Ford Diagnostic Equipment
6. Carry out the Pilot Correction Learn procedure using the following menu options: ToolBox/Powertrain/Service Functions.

   General Equipment: Ford Diagnostic Equipment
7. Change the engine oil and the oil filter.
8. Carry out the oil reset procedure.

REMOVAL AND INSTALLATION

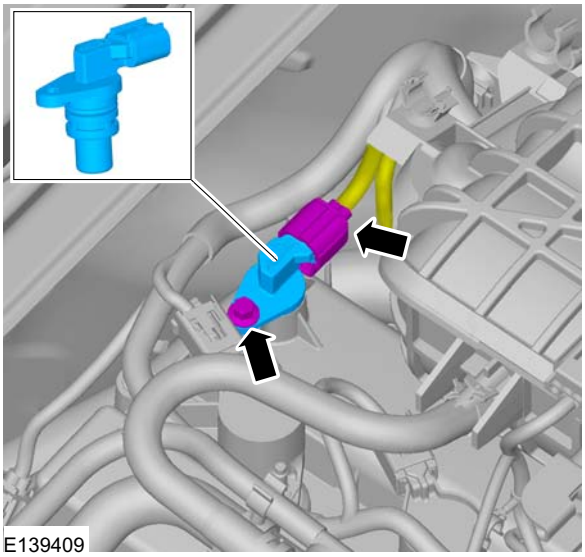
Camshaft Position (CMP) Sensor(29 232 0)

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. **NOTE:** Lubricate the O-ring seal with clean engine oil.

   Torque: 7 Nm


E139409

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Engine Coolant Temperature (ECT) Sensor(21 190 0)

Removal

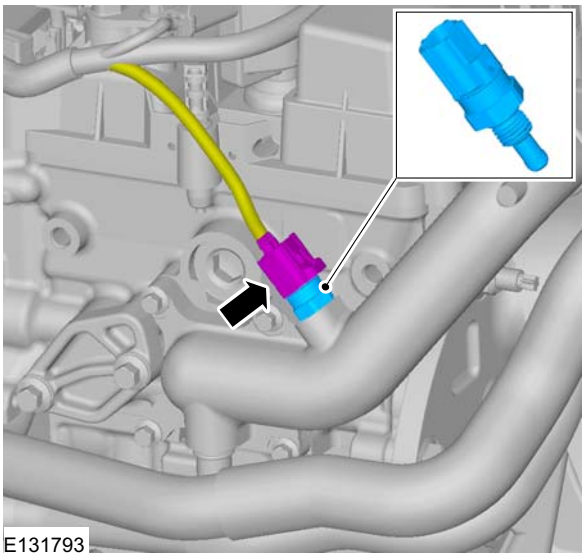
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

NOTE: The sensor is located at the rear of the cylinder head.

2. **NOTE:** Lubricate the O-ring seal with clean engine oil.

   Torque: 30 Nm



Installation

1. To install, reverse the removal procedure.

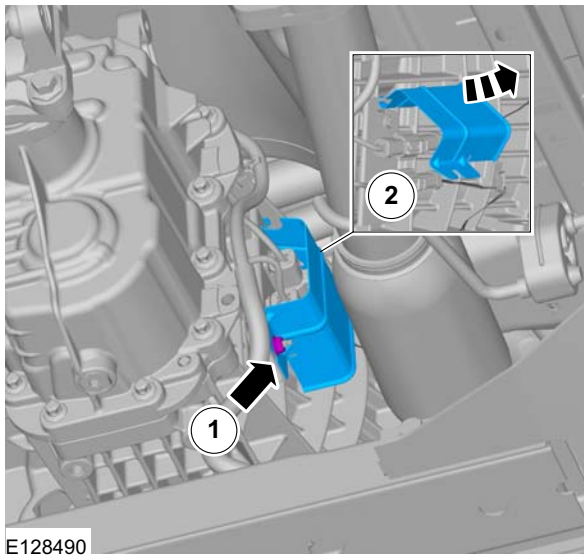
REMOVAL AND INSTALLATION

Heated Oxygen Sensor (HO2S)(29 220 0)

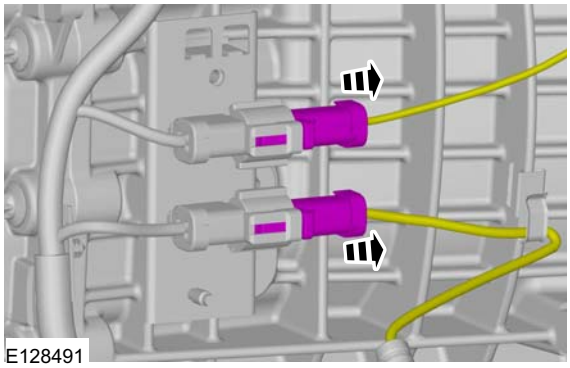
Removal

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

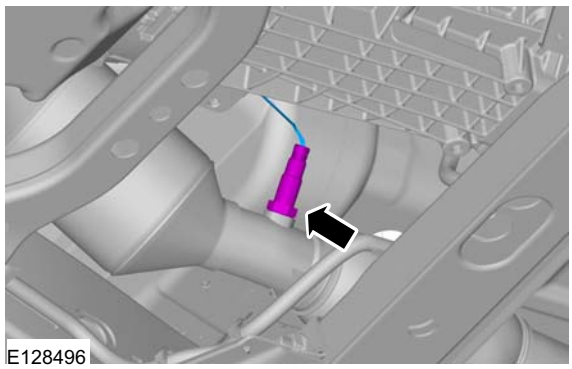
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Torque: 18 Nm



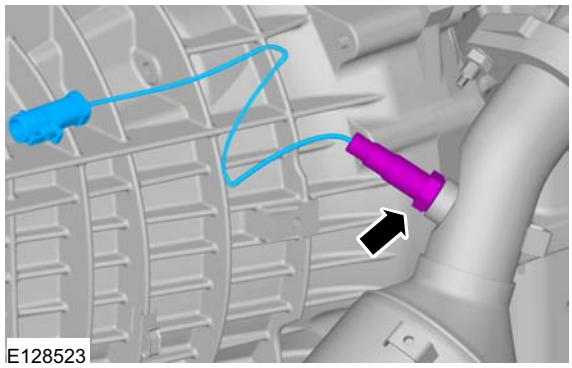
4.



5. Torque: 48 Nm



6. Torque: 48 Nm



Installation

1. **NOTE:** A new component may be supplied with a longer cable than the one removed. Make sure that the cable is routed and secured in such a way that it cannot be damaged and cause a noise, vibration or harshness (NVH) concern.

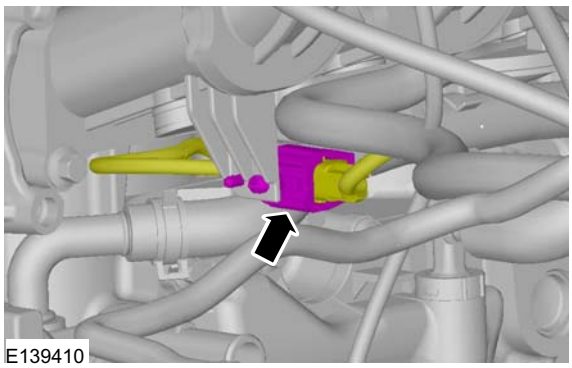
   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Knock Sensor (KS)(29 222 0)

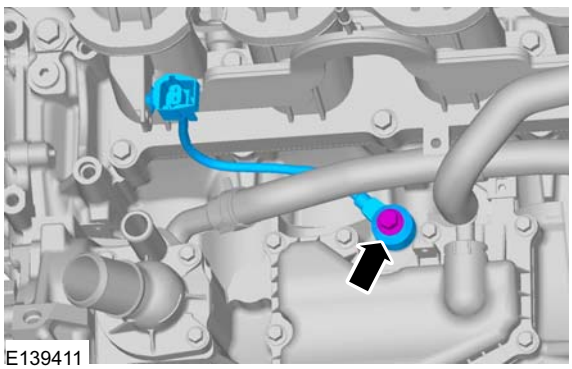
Removal

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

4. **NOTE:** Make sure that the mating faces are clean and free of foreign material.

   Torque: 20 Nm



Installation

1. To install, reverse the removal procedure.

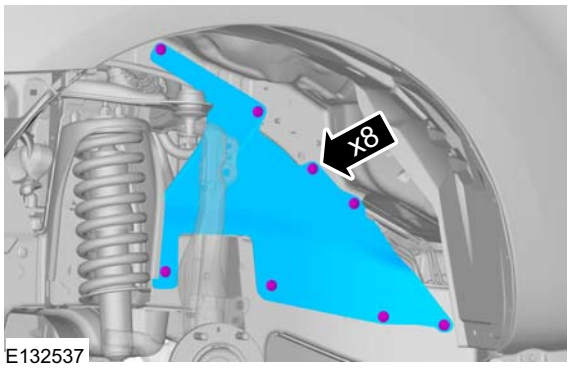
REMOVAL AND INSTALLATION

Engine Oil Pressure (EOP) Sensor

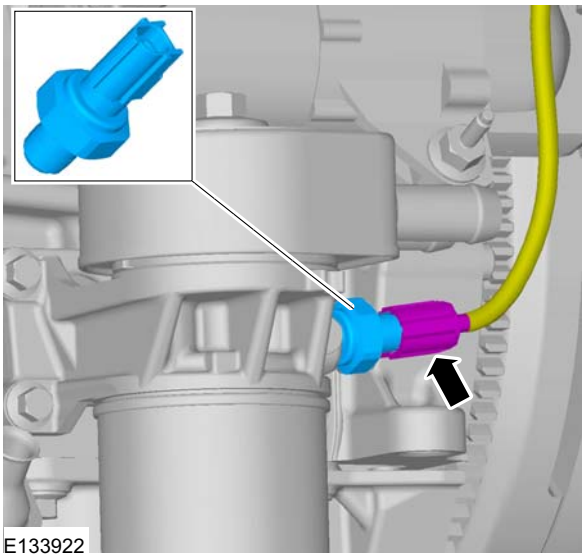
Removal

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. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4.



5. Torque: 30 Nm



Installation

1. To install, reverse the removal procedure.

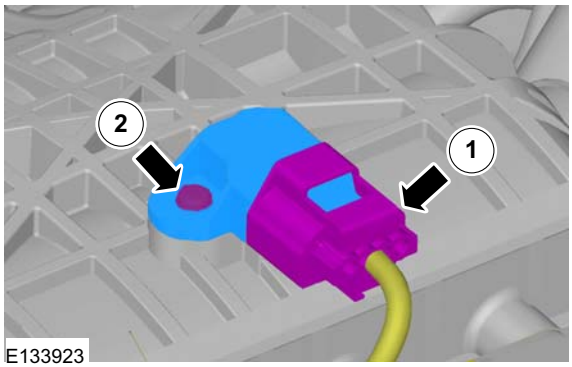
REMOVAL AND INSTALLATION

Manifold Absolute Pressure (MAP) Sensor(29 224 0)

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. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Torque: 3 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 303-14B Electronic Engine Controls — 2.2L

Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

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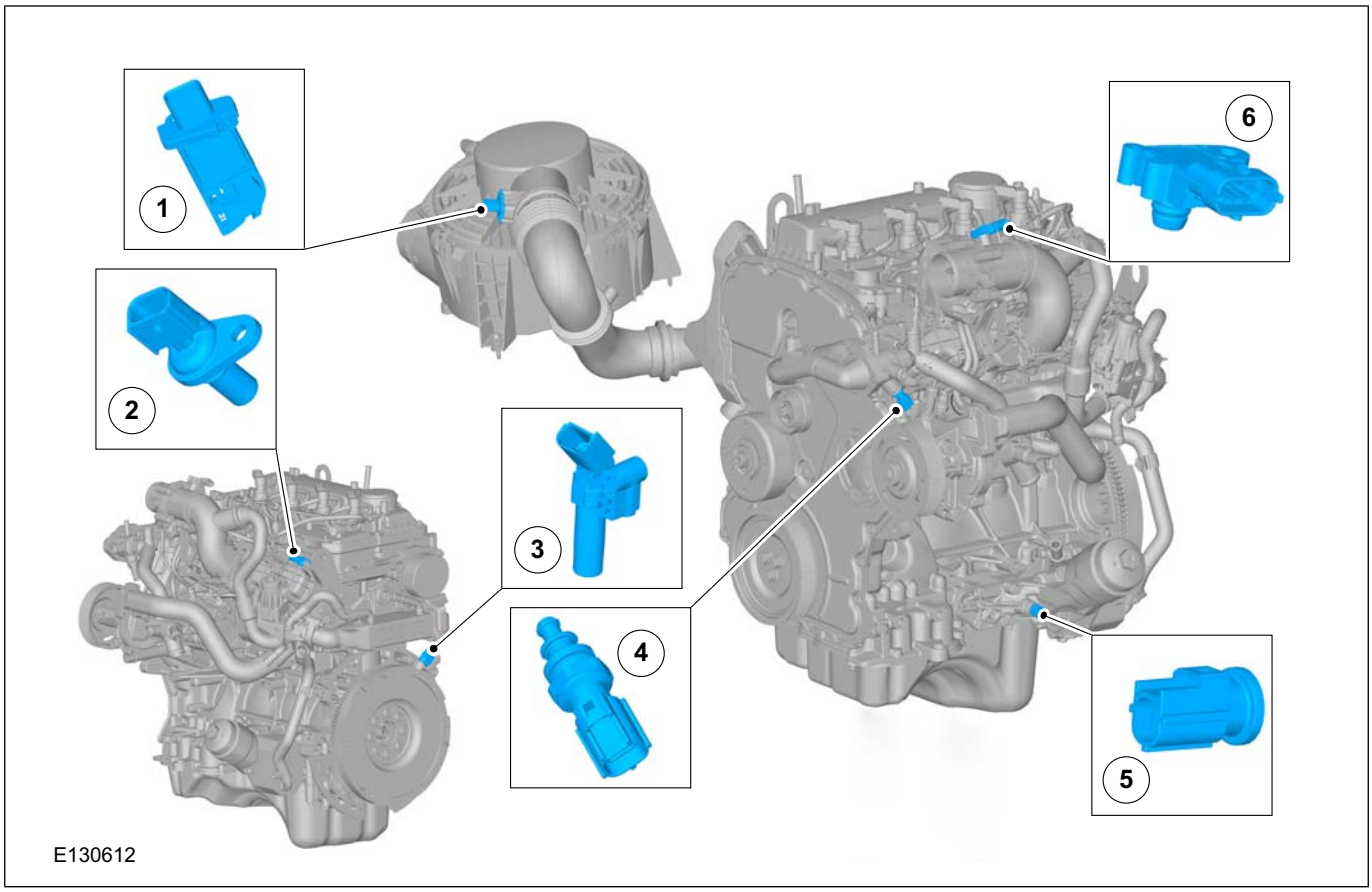
DESCRIPTION AND OPERATION

Electronic Engine Controls

Vehicles with 2.2L Duratorq-TDCi (Puma) diesel engine

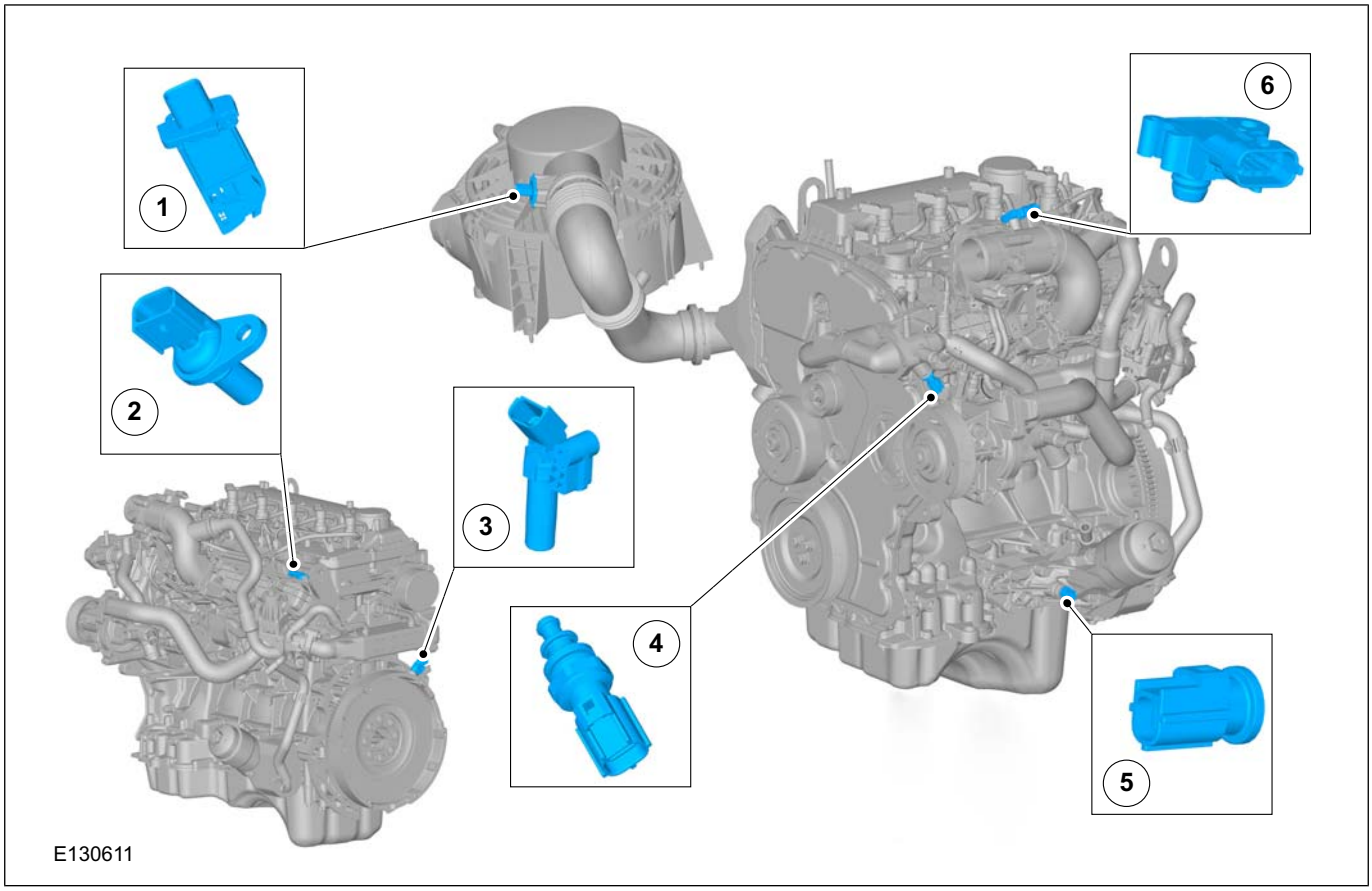


Item	Description
1	Mass air flow (MAF)
2	Camshaft position (CMP) sensor
3	Crankshaft position (CKP) sensor

Item	Description
4	Engine coolant temprature (ECT) sensor
5	Engine oil pressure sensor
6	Manifold absolute pressure and temperature (MAPT) sensor

DESCRIPTION AND OPERATION

Vehicles with 3.2L Duratorq-TDCi (Puma) diesel engine



Item	Description
1	Mass air flow (MAF) sensor
2	Camshaft position (CMP) sensor
3	Crankshaft position (CKP) sensor
4	Engine coolant temprature (ECT) sensor
5	Engine oil pressure sensor
6	Manifold absolute pressure and temperature (MAPT) sensor

DESCRIPTION AND OPERATION

Electronic Engine Controls – System Operation and Component Description

Information not available at this time.

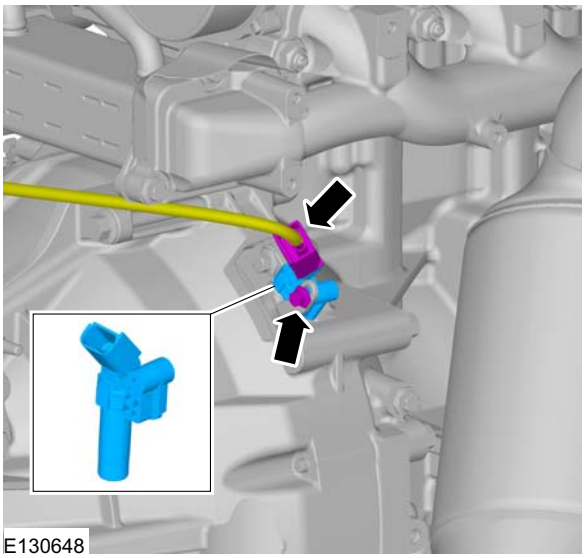
REMOVAL AND INSTALLATION

Crankshaft Position (CKP) Sensor — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma(29 230 0)

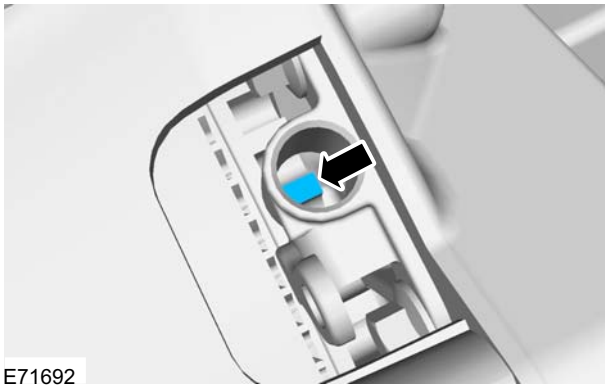
Removal

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: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Torque: 7 Nm


E130648

Rotate the crankshaft until a flywheel tooth is visible through the CKP sensor housing.


E71692

2. **CAUTION: The tip of the sensor must rest on a flywheel tooth.**

   NOTE: Make sure that a new component is installed.

   To install, reverse the removal procedure.

Installation

1. **CAUTION: Only rotate the crankshaft clockwise.**

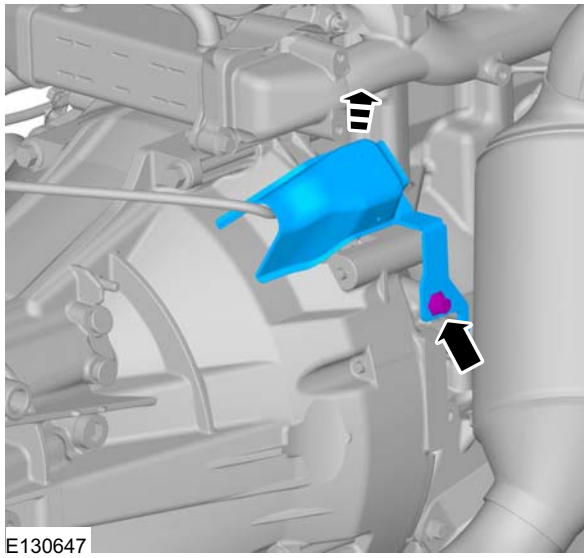
REMOVAL AND INSTALLATION

Crankshaft Position (CKP) Sensor — 3.2L Duratorq-TDCi (148kW/200PS) - Puma(29 230 0)

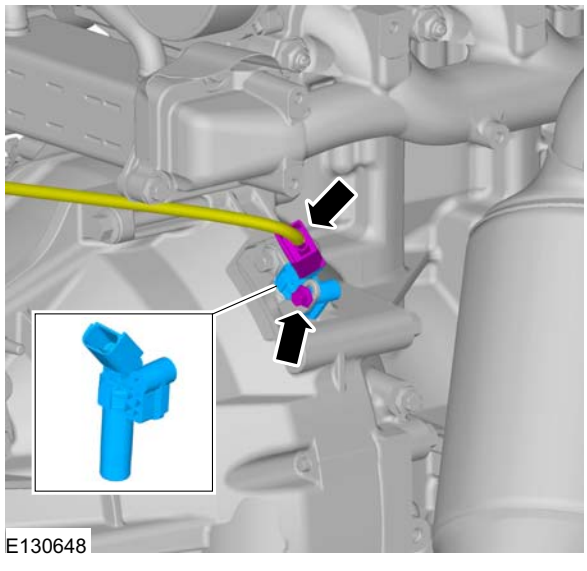
Removal

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: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Torque: 25 Nm



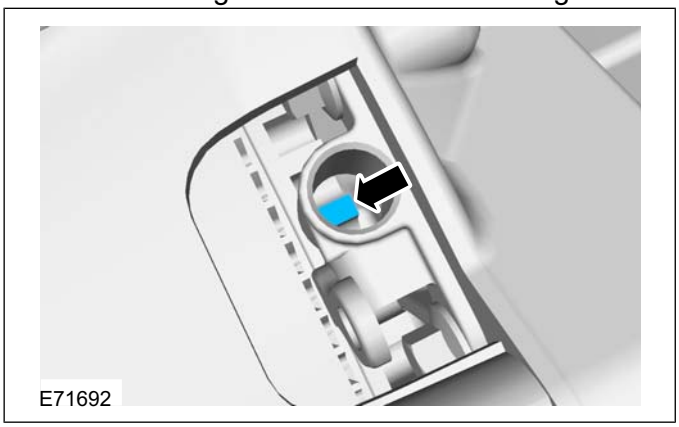
4. Torque: 7 Nm



Installation

1. **CAUTION: Only rotate the crankshaft clockwise.**

   Rotate the crankshaft until a flywheel tooth is visible through the CKP sensor housing.



2. **CAUTION: The tip of the sensor must rest on a flywheel tooth.**

   NOTE: Make sure that a new component is installed.

   To install, reverse the removal procedure.

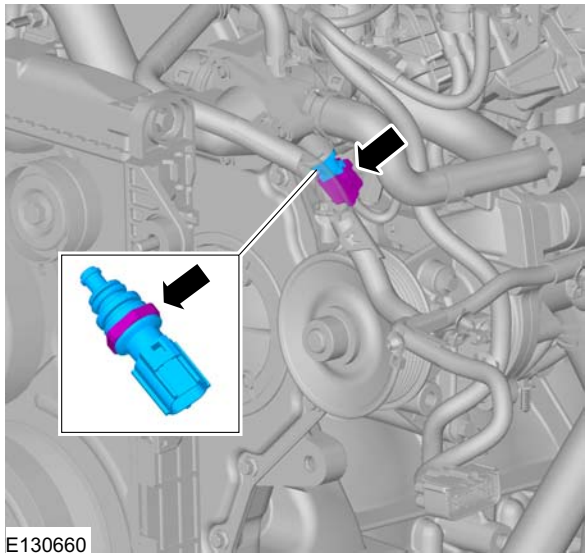
REMOVAL AND INSTALLATION

Engine Coolant Temperature (ECT) Sensor(21 190 0)

Removal

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

1. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Torque: 24 Nm


E130660

Installation

1. To install, reverse the removal procedure.

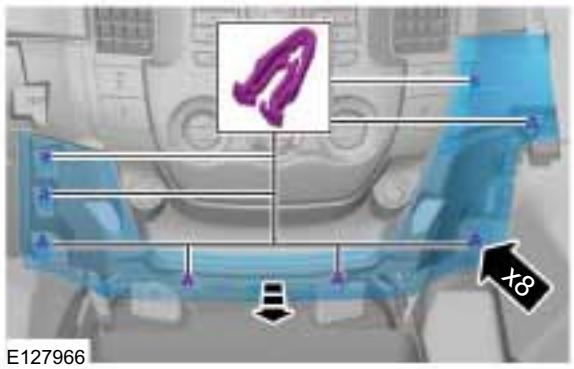
REMOVAL AND INSTALLATION

Brake Pedal Position (BPP) Switch(33 502 0)

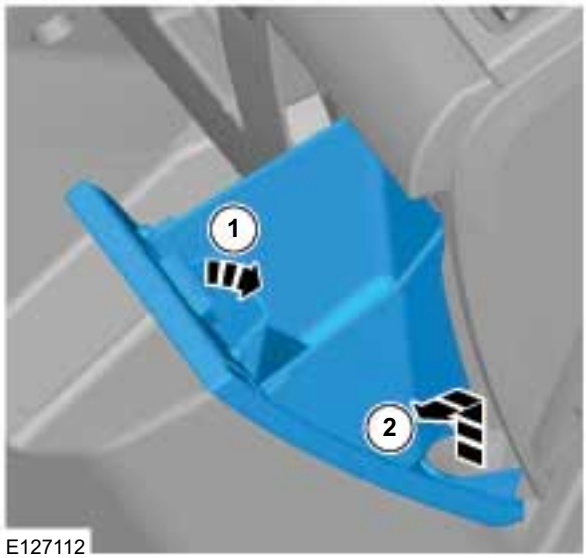
Removal

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

1.



2.



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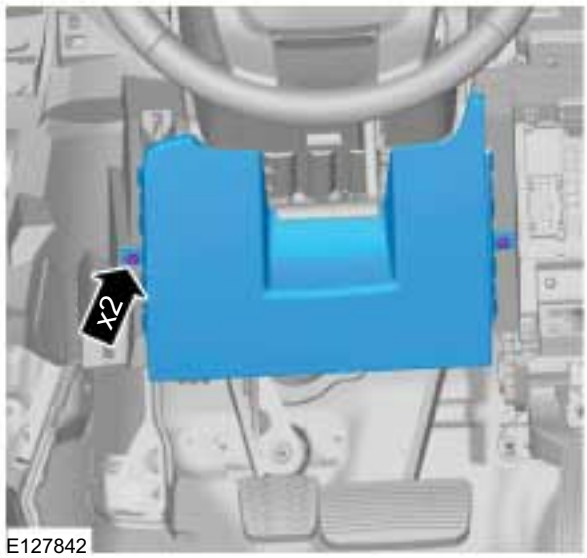
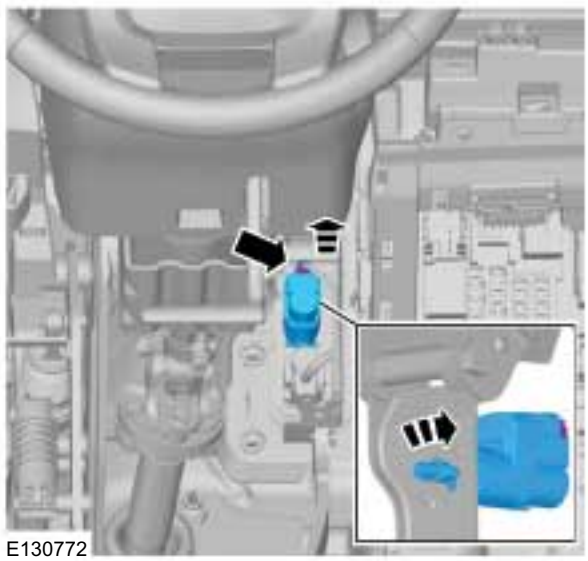


4. NOTE: Only if equipped with driver lower air bag module.

Refer to: Driver Lower Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation).

5.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Powertrain Control Module (PCM)(29 200 0)

General Equipment

Ford Diagnostic Equipment

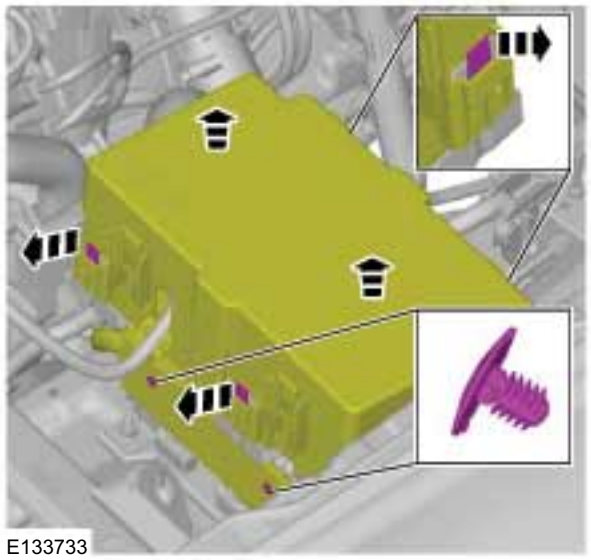
Removal

⚠ **CAUTION: If a new PCM is to be installed, upload the PCM configuration information using the Programmable Modules Installation Routine, prior to commencing the removal of the PCM.**

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

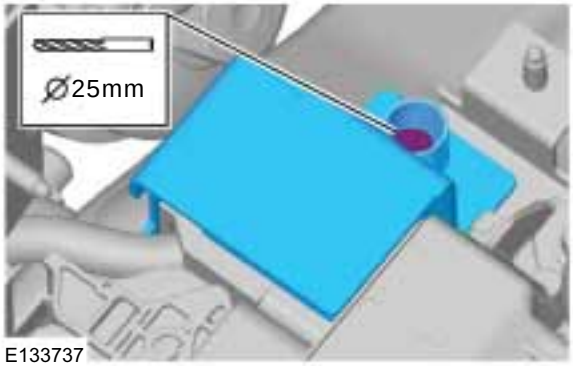
All vehicles

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).
3. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).
4.


E133733

Vehicles with PCM security shield

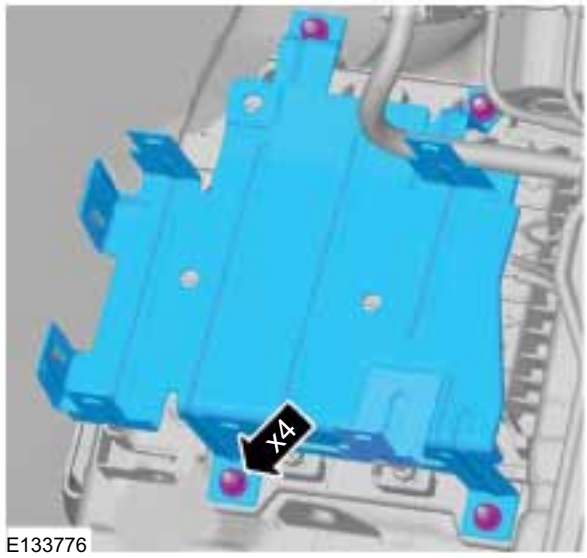
5. Torque: 15 Nm



E133737

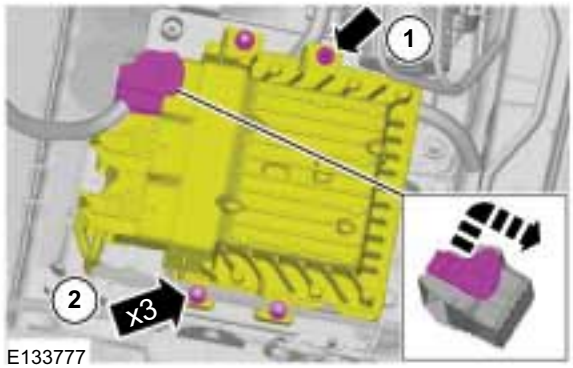
All vehicles

6. Torque: 11 Nm



E133776

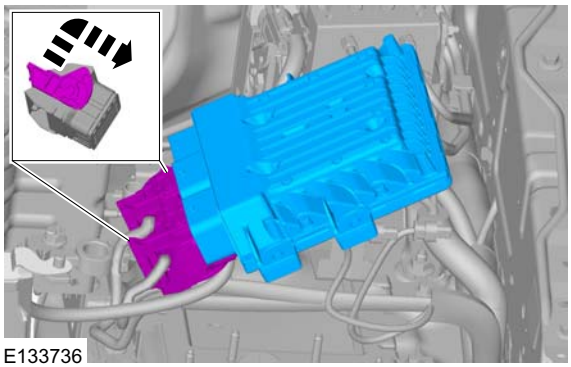
7. 1. Torque: 10 Nm
   2. Torque: 11 Nm



E133777

REMOVAL AND INSTALLATION

8.


E133736

Installation

1. To install, reverse the removal procedure.
2. Carry out the Injector Correction Factors procedure using the following menu options: ToolBox/Powertrain/Service Functions.

   General Equipment: Ford Diagnostic Equipment
3. Carry out the Oil Quality History function using the following menu options: ToolBox/Powertrain/Service Functions.

   General Equipment: Ford Diagnostic Equipment
4. Carry out the Stored Speed Limit function using the following menu options: ToolBox/Powertrain/Service Functions.

   General Equipment: Ford Diagnostic Equipment
5. Carry out the Pump Learn procedure using the following menu options: ToolBox/Powertrain/Service Functions.

   General Equipment: Ford Diagnostic Equipment
6. Carry out the Pilot Correction Learn procedure using the following menu options: ToolBox/Powertrain/Service Functions.

   General Equipment: Ford Diagnostic Equipment
7. Change the engine oil and the oil filter.
8. Carry out the oil reset procedure.

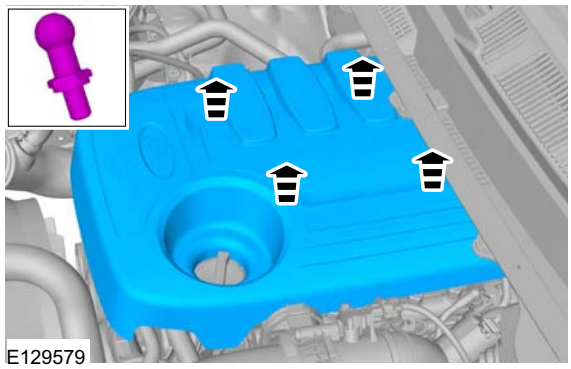
REMOVAL AND INSTALLATION

Camshaft Position (CMP) Sensor — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma(29 232 0)

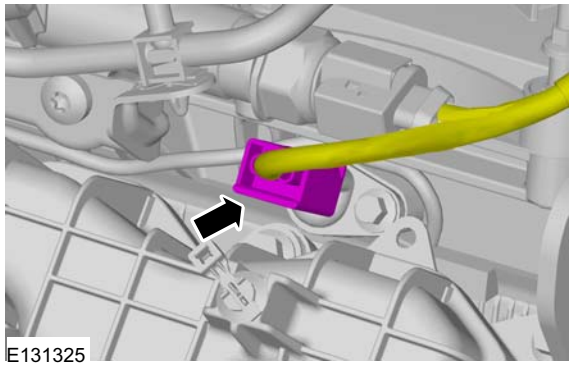
Removal

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

1.



2.



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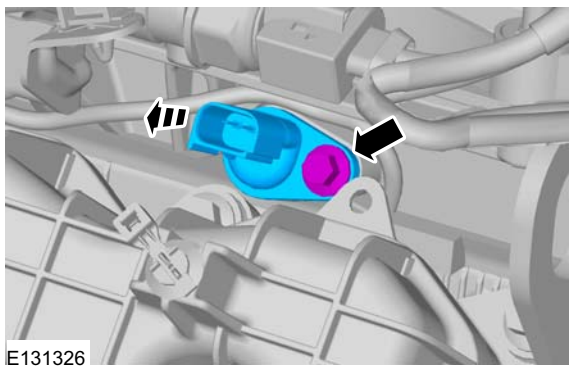


Installation

1. To install, reverse the removal procedure.

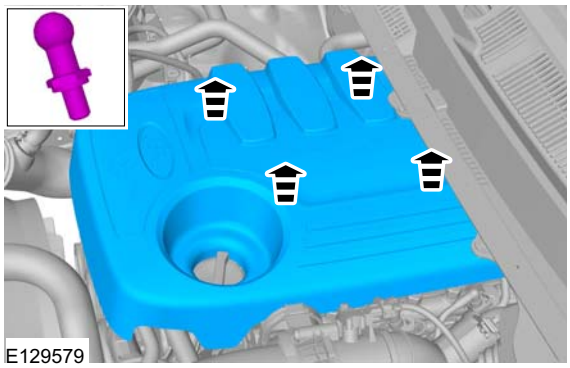
REMOVAL AND INSTALLATION

Camshaft Position (CMP) Sensor — 3.2L Duratorq-TDCi (148kW/200PS) - Puma(29 232 0)

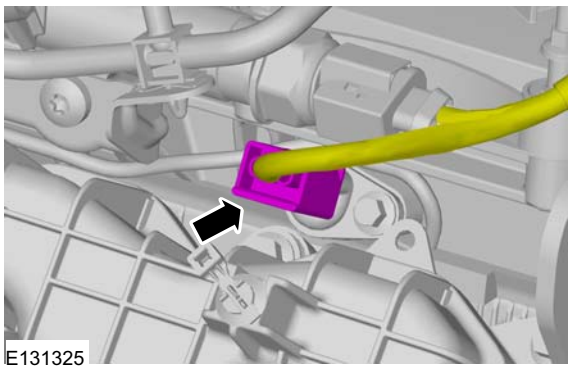
Removal

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

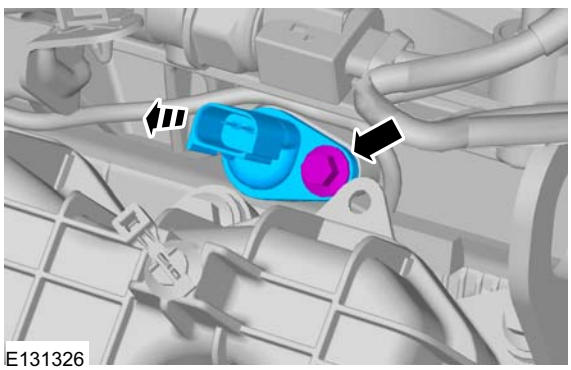
1.



2.



3.



Installation

1. To install, reverse the removal procedure.

SECTION 307-01 Automatic Transmission/Transaxle

— Vehicles With: 6-Speed Automatic Transaxle - 6R80

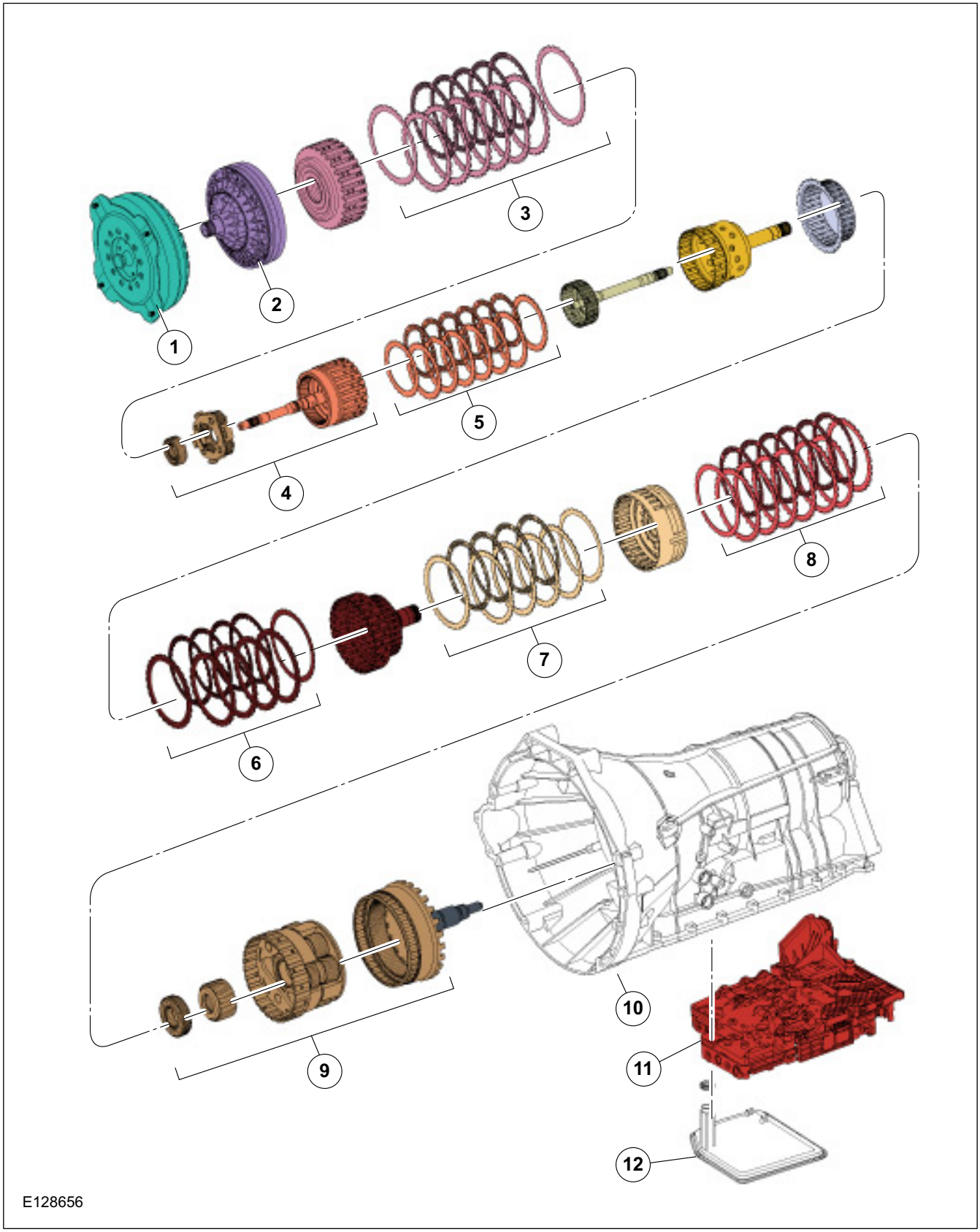
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Transmission Description – Component Location

Major Components of 6R80 Transmission



DESCRIPTION AND OPERATION

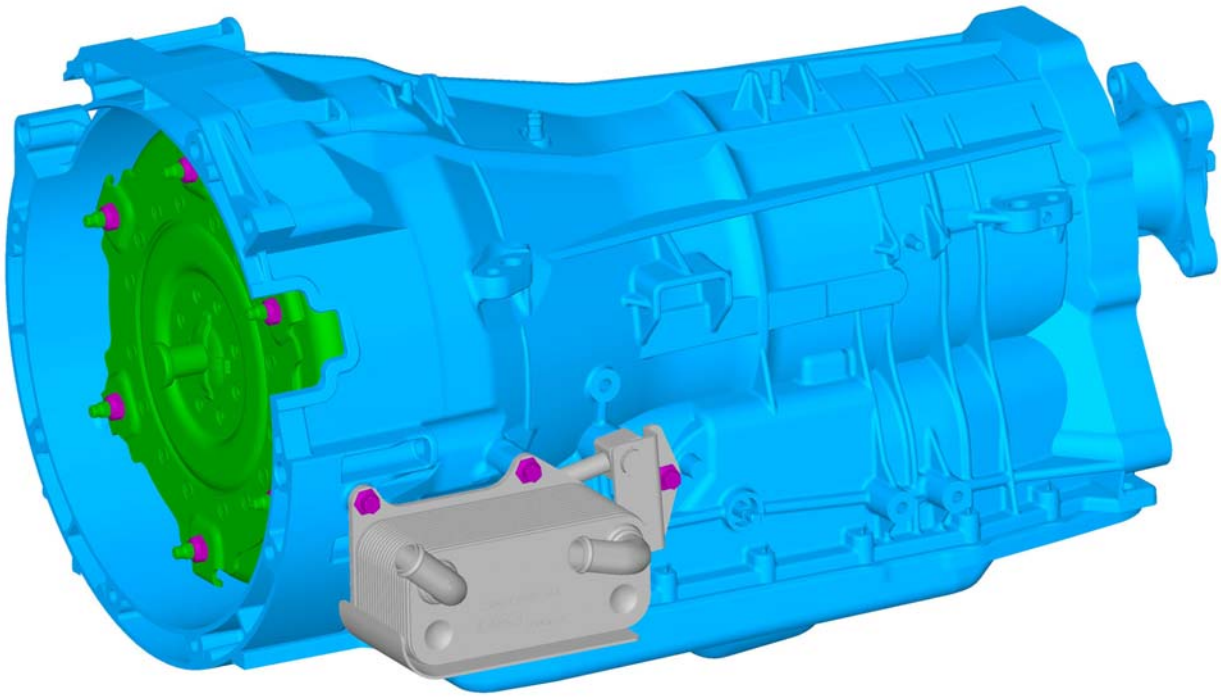
Item	Description
1	Torque converter
2	Front pump assembly
3	Forward clutch (A) (quantity model dependant)
4	Front planetary gearset
5	Overdrive (O/D) clutch (E)
6	Direct clutch (B) (quantity model dependant)

Item	Description
7	Intermediate clutch (C) (quantity model dependant)
8	Low/reverse clutch (D)
9	Rear planetary gearset
10	Transmission case
11	Main control assembly
12	Transmission fluid filter

DESCRIPTION AND OPERATION

Transmission Description – Overview

6R80 Transmission



E128660

This transmission has an internal thermal bypass valve contained within the case.

This transmission uses planetary gears with hydraulic electronic controls. The Transmission Control Module (TCM) and the main control valve body units form a composite element that is installed as a single unit inside the automatic transmission.

This transmission has the following features:

- Six forward speeds
- Torque converter with an integral converter clutch
- Electronic shift and pressure controls
- Single planetary gear set
- Double planetary gear set
- Two fixed multi-disc clutches
- Three multi-plate clutches

All hydraulic functions are directed by electronic solenoids to control the following:

- Engagement feel
- Shift feel
- Shift scheduling
- Modulated Torque Converter Clutch (TCC) applications

This transmission has a mechatronic unit which contains:

- Transmission Control Module (TCM)
- Turbine Shaft Speed (TSS) sensor
- Output Shaft Speed (OSS) sensor
- An internal P, R, N, D selector shaft position sensor
- Transmission Fluid Temperature (TFT) sensor

Engine power reaches the transmission by a torque converter with an integral clutch. The 6 forward gears and one reverse gear are obtained from 2 planetary gearsets.

This automatic transmission is a 6-speed electronically controlled transmission comprising the basic elements, main control valve body unit,

DESCRIPTION AND OPERATION

torque converter, 1 solenoid valve and 6 pressure regulators. Gear selection is achieved by the control of automatic transmission fluid flow to operate various internal clutches. The TCM operates the electrical components and provides for the control of gear selection shift pressure, which increases refinement and torque converter slip.

In the event of a system fault, the TCM also provides for Failure Mode Effect Management to maintain maximum functional operation of the transmission with a minimum reduction in driver, passenger or vehicle safety. In the event of a total loss of control or electrical power, the basic transmission functions P, R, N and D are retained. Also 3rd or 5th gear is retained by the hydraulic system. The gear retained is dependent upon the gear selected at the time of the failure.

Major Components

This transmission has the following major components:

- Transmission case with integral torque converter housing and extension housing
- Torque converter
- Fluid pump
- Three drive clutches:
  - Forward clutch (A)
  - Direct clutch (B)
  - Overdrive (O/D) clutch (E)
- Two brake clutches:
  - Intermediate clutch (C)
  - Low/reverse clutch (D)
- Two planetary gearsets:
  - Front single planetary gearset (1 sun gear, 1 carrier, 1 ring gear)
  - Rear Ravigenaux planetary gearset (2 sun gears, 1 carrier with 2 sets of pinion gears and 1 ring gear)
- Main control (mechatronic assembly):
  - Upper valve body
  - Lower valve body
  - Transmission Control Module (TCM)
  - Transmission Range (TR) sensor
  - Turbine Shaft Speed (TSS) sensor
  - Output Shaft Speed (OSS) sensor

NOTE: Friction and steel plate quantity will vary based on engine displacement. Refer to the Clutch Plate Quantity Chart in the Specifications portion of this section.

In addition to the torque converter, the other shift elements are:

- three rotating multi-plate clutches: forward (A), direct (B) and overdrive (E).
- two fixed multi-disc brakes: intermediate (C) and low/reverse (D).

All gear shifts from 1st to 6th or from 6th to 1st are power-on overlapping shifts. That is, during the shift, one of the clutches must continue to transmit the drive at lower main pressure until the other clutch is able to accept the input torque.

The shift elements, clutches or brakes are engaged hydraulically. The transmission fluid pressure builds up between the cylinder and the piston, pressing the clutches together.

The purpose of these shift elements is to carry out in-load shifts with no interruption to traction.

Multi-plate clutches; forward, direct and overdrive, supply power from the engine to the planetary geartrain. Multi-disc brakes, intermediate and low/reverse, press against the transmission housing in order to achieve a torque reaction effect.

Multi-Plate Clutch

Clutches; O/D (E), forward (A) and direct (B) are balanced in terms of dynamic pressure. That is, their pistons are exposed to the transmission fluid flow on both sides, in order to prevent pressure buildup in the clutch as speed increases. This equalization process is achieved by a baffle plate and pressure-free transmission fluid supply by a lubricating passage, through which the space between piston and baffle plate is filled with transmission fluid.

The advantages of this dynamic pressure equalization are:

- Reliable clutch engagement and release in all speed ranges.
- Improved shift refinement.

Shift Overlap Control

The electro-hydraulic shift action is obtained by means of various valves in the TCM and main control valve body, actuated by pressure regulators. They engage or disengage the relevant clutches or brakes at the correct moments.

DESCRIPTION AND OPERATION

Hydraulic Systems

Fluid Pump

The torque converter is supported in the fluid pump by a needle roller bearing. The fluid pump is driven directly from the engine by the torque converter shell and supplies transmission fluid to the transmission and the hydraulic control unit.

The fluid pump draws in transmission fluid through a transmission fluid filter and delivers it at high pressure to the main pressure valve in the main control valve body unit. The valve adjusts the pressure and returns excess transmission fluid to the transmission fluid pan.

Fluid Filter

All transmission fluid that is picked up from the transmission fluid pan passes through the transmission fluid filter. The transmission fluid filter and its accompanying seal are part of the transmission fluid path from the pan to the transmission fluid pump.

Single Planetary Gearset

The single planetary gear O/D carrier is driven by the input shaft. The single planetary gear set consists of the following components:

- One sun gear
- Four planetary gears meshing with the sun gear
- One planetary carrier
- One ring gear

Ravigenaux Planetary Gearset

The Ravigenaux planetary gearset is splined to the output shaft and consists of the following components:

- Two sun gears of different sizes
- Three short planetary gear pinions meshing with the sun gears
- Three long planetary gear pinions meshing with the sun gears
- One planetary carrier
- One ring gear

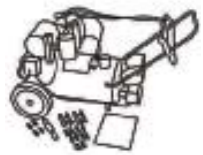
Output Shaft

The output shaft provides torque to the driveshaft and rear axle assembly. It is driven by the ring gear of the planetary gearset.

GENERAL PROCEDURES

Transmission Fluid Cooler - Backflushing and Cleaning

Special Tool(s)

 E128862	Transmission Heated Cooler Line Flusher 222-00007, 222-00004

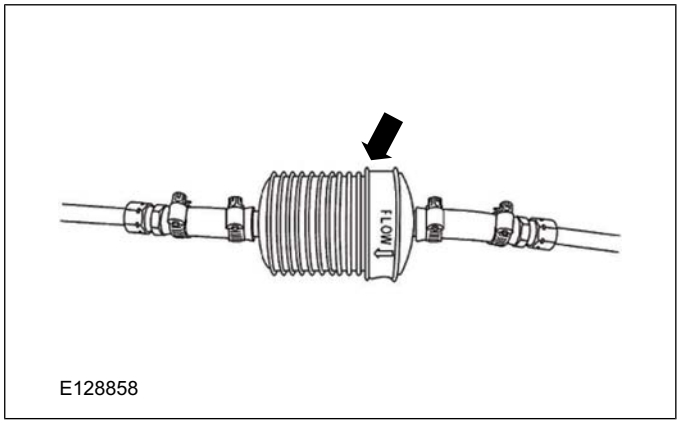
WARNING: Use transmission fluid specified for this transmission. Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products could cause internal transmission components to fail; this will affect the operation of the transmission.

NOTE: Transmission fluid cooler backflushing and cleaning will be performed using the Transmission Heated Cooler Line Flusher or equivalent. Follow the manufacturer's instructions included with the machine. Test the equipment to make sure that a vigorous fluid flow is present before proceeding.

NOTE: If the Transmission Heated Cooler Line Flusher or equivalent is not available, install a new transmission fluid cooler and/or an auxiliary transmission fluid cooler will be required.

NOTE: If the vehicle is equipped with an in-line transmission fluid filter, remove and discard the in-line filter.

1. **Check and top off the fluid level of the cooler line flusher with transmission fluid.**
2. **Allow the transmission fluid in the cooler line flusher 15-30 minutes to heat up to 60°C (140°F) before using.**
3. **If equipped, remove and discard the in-line transmission fluid filter.**



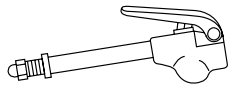
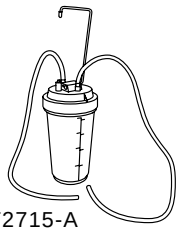
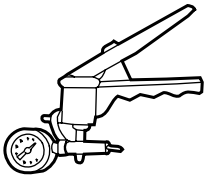
E128858

4. **Install the line adapters into the transmission fluid cooler tubes.**
5. **Attach the cooler line flusher red line to the transmission fluid cooler pressure tube quick connect fitting.**
6. **Attach the cooler line flusher blue line to the transmission fluid cooler return tube quick connect fitting.**
7. **Follow the equipment instructions to purge the transmission fluid cooler tubes and cooler prior to starting the flushing procedure.**
8. **Allow the transmission fluid cooling system to backflush for 10-15 minutes, then flush the transmission fluid cooler in a normal flow direction for an additional 10-15 minutes.**

GENERAL PROCEDURES

Transmission Fluid Drain and Refill

Special Tool(s)

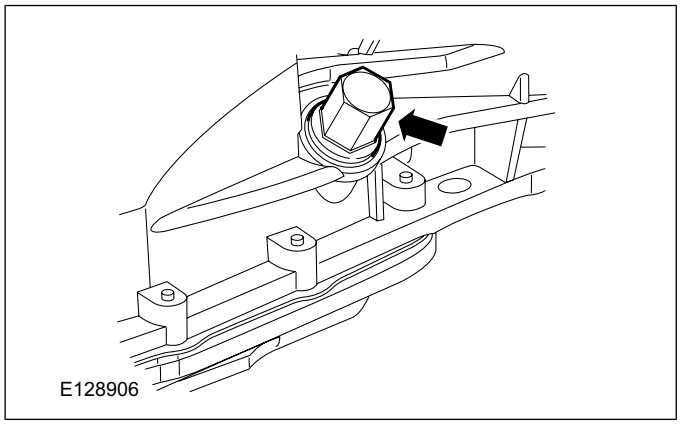
 ST2467-A	Rubber Tip Air Nozzle 100-D009 (D93L-7000-A)
 ST2715-A	Fluid Transporter/Evacuator/Injector 307-D465
 E129427	Adapter, Fluid Level and Fill Plug 307-437
 ST1269-A	Vacuum Pump Kit 416-D002 (D95L-7559-A) Integrated Diagnostic System (IDS) Vehicle Communication Module, with appropriate adapters or equivalent diagnostic tool

Materials	
Name	**Specification**
Transmission Fluid	MERCON®V

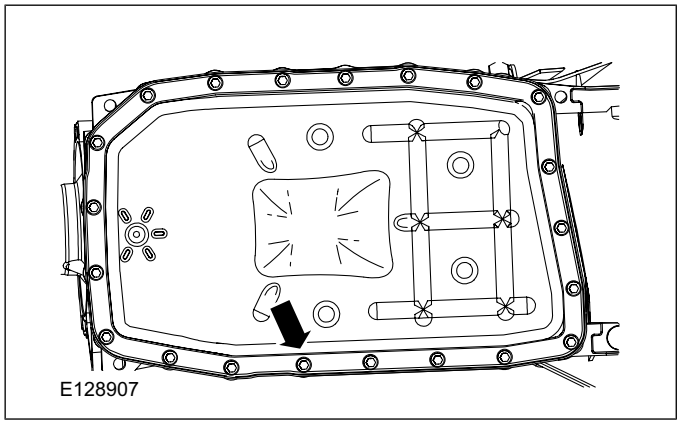
Drain

1. **With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02.**
2. **NOTE: Some transmission fluid leakage may occur when removing the transmission fluid fill plug.**

   Remove the transmission fluid fill plug fluid level indicator assembly located on the passenger side front portion of the transmission case. Removal of the transmission fluid fill plug will relieve any vacuum that might have built up in the transmission. This will aid in allowing the transmission fluid pan to be easily removed when the bolts are removed.

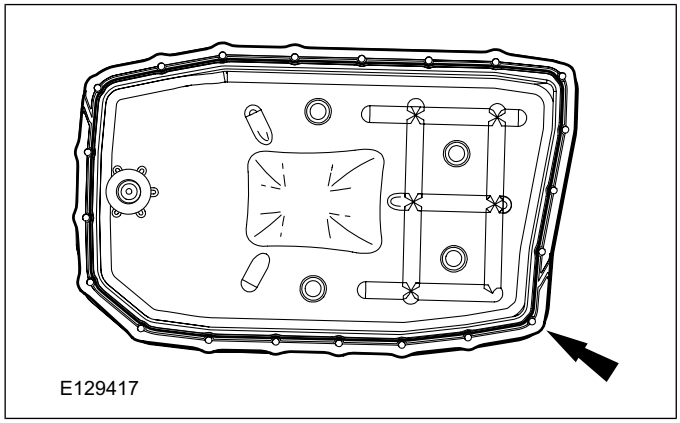

E128906

3. **Remove the transmission fluid pan and allow the transmission fluid to drain.**


E128907

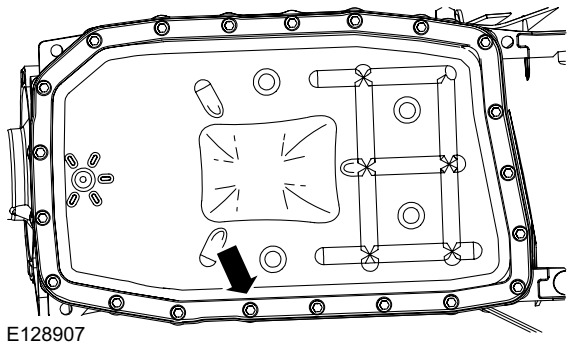
4. **NOTE: The transmission fluid pan gasket can be reused if not damaged.**

   Install a new transmission fluid pan gasket, if required.


E129417

GENERAL PROCEDURES

5. **Install the transmission fluid pan and tighten the bolts in a crisscross pattern.**
   - Tighten to 12NM


E128907

Refill

WARNING: The transmission fluid fill plug is located near the exhaust system. The exhaust will be extremely hot during this procedure.

CAUTIONS:

This procedure contains the air purge steps required to purge air from the transmission fluid cooling system. This procedure is NOT intended for use with the Transmission Fluid Level Check.

The vehicle should not be driven if the transmission fluid level is low as internal failure could result.

The use of any other transmission fluid than specified can result in the transmission failing to operate in a normal manner or transmission failure.

NOTE: If the transmission starts to slip, shifts slowly or shows signs of transmission fluid leaking, the transmission fluid level should be checked.

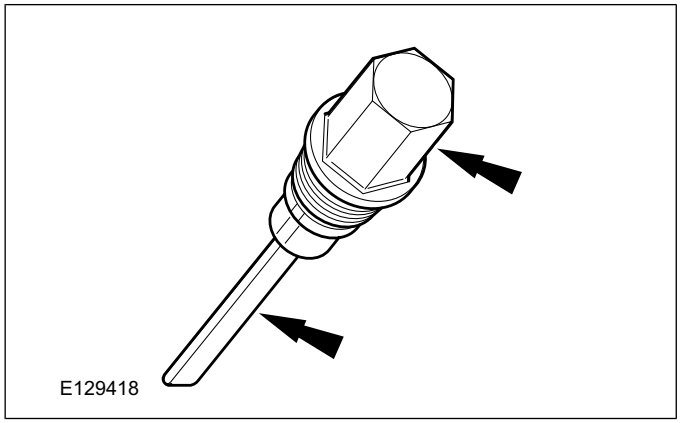
NOTE: Here is an overview of the Transmission Fluid Drain and Refill procedure.

1. **NOTE: The transmission will need 3.3L (3.5 qt) of transmission fluid added to the transmission as an initial fill if: th•e transmission has been overhauled. a• new mechatronic assembly has been installed. th•e transmission fluid pan or transmission fluid filter have been removed.**

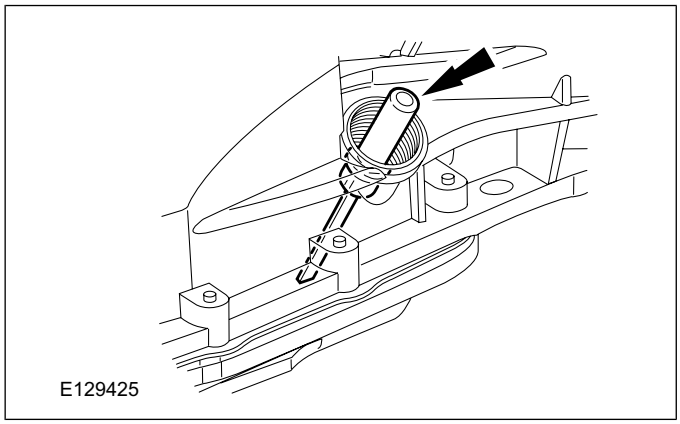
   Using the Transmission Fluid Fill Tube, add 3.3L (3.5 qt) of transmission fluid to the transmission through the transmission fluid fill hole. For additional information, refer to Adding Additional Transmission Fluid in this procedure.transmission fluid

2. **Check the transmission fluid level cold.**
   - The vehicle is safe to drive if the transmission fluid is in the cold level range 32°C-43°C (90°F-110°F).
   - Using the scan tool and with the engine running, place the selector lever in each gear position and hold approximately 5 seconds. Place the selector lever in PARK, with the engine at idle (600-750 rpm).

3. **Separate the transmission fluid level indicator from the transmission fluid fill plug.**

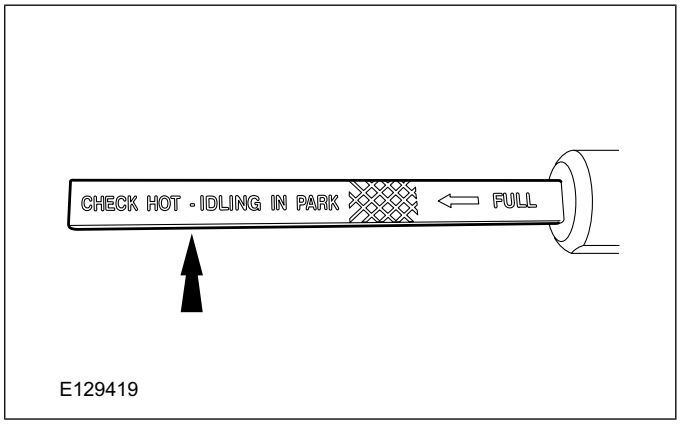

E129418

4. **Wipe the transmission fluid level indicator clean. Reinstall the transmission fluid level indicator only back into the transmission fluid fill plug hole to check the transmission fluid level. Repeat this until a consistent reading is established.**


E129425

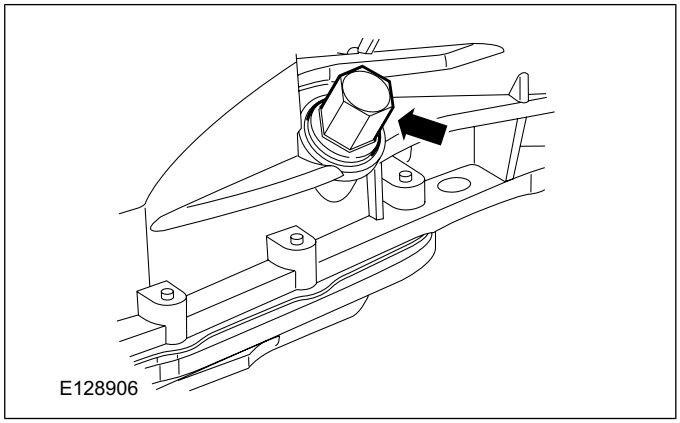
GENERAL PROCEDURES

5. **Add transmission fluid to the cold level location as shown in the illustration.**



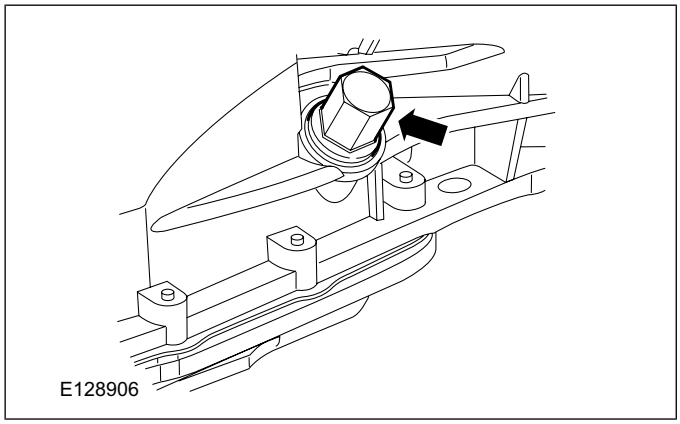
E129419

6. **Install the transmission fluid fill plug.**
   - Tighten to 35 Nm

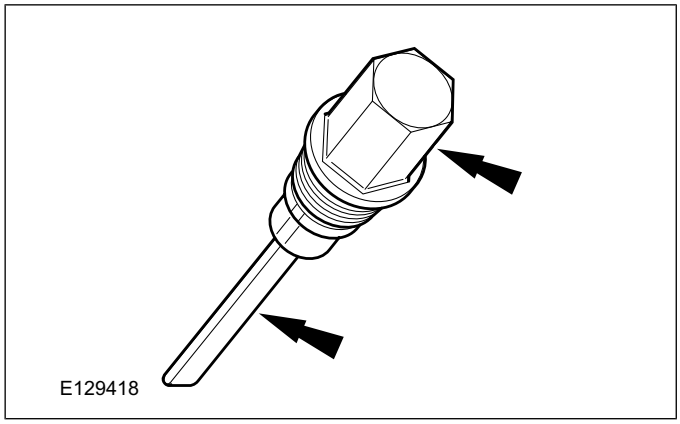

E128906

7. **While driving the vehicle, use the scan tool to verify that the TFT has reached a temperature of 88°C (190°F). This will circulate the transmission fluid through the torque converter and the transmission fluid cooling system, eliminating any trapped air in the transmission fluid cooling system.**
   - With the engine idling (600-750 rpm) in PARK, verify that the TFT is between 80ºC-85ºC (176ºF-185ºF).

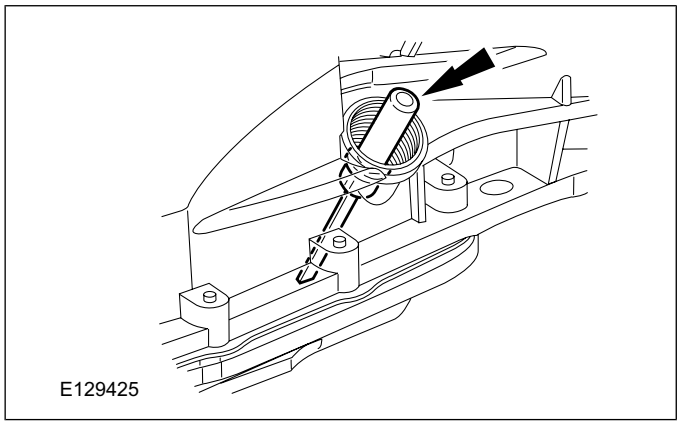
8. **Remove the transmission fluid fill plug transmission fluid level indicator assembly located on the passenger side front portion of the transmission case.**


E128906

9. **Separate the transmission fluid level indicator from the transmission fluid fill plug.**


E129418

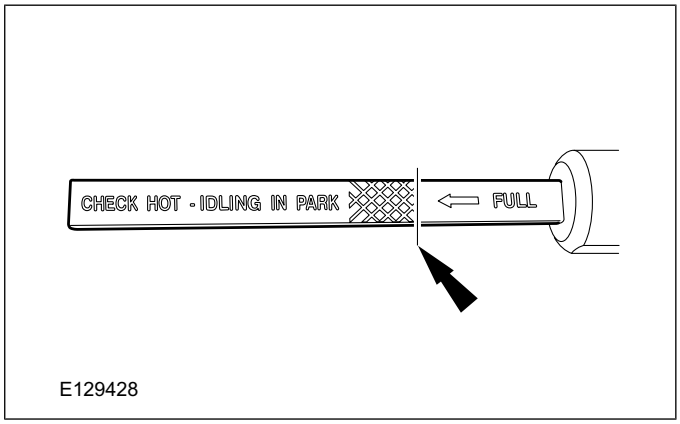
10. **Wipe the transmission fluid level indicator clean. Reinstall the transmission fluid level indicator only back into the transmission fluid fill plug hole to check the transmission fluid level. Repeat this until a consistent reading is established.**


E129425

11. **Using the scan tool verify that the TFT is between 80ºC-85ºC (176ºF-185ºF). The**

GENERAL PROCEDURES

transmission fluid level must be at the upper level of the crosshatch mark.



12. **NOTE: If the transmission fluid is not at the correct level, follow the steps for Adding Additional Transmission Fluid or Removing Transmission Fluid in this procedure.**

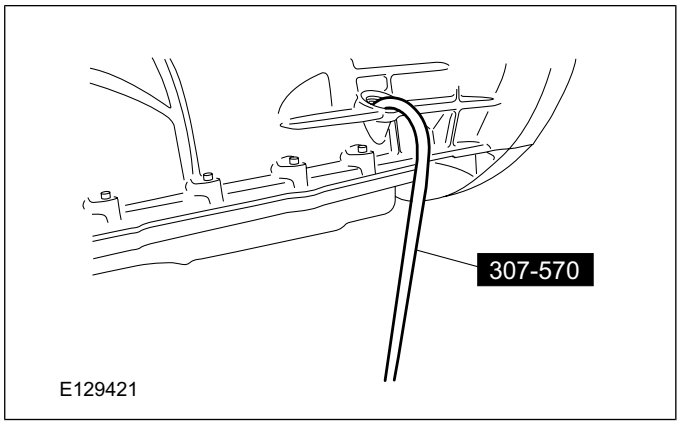
    Install the transmission fluid fill plug.

    - Tighten to 35 Nm

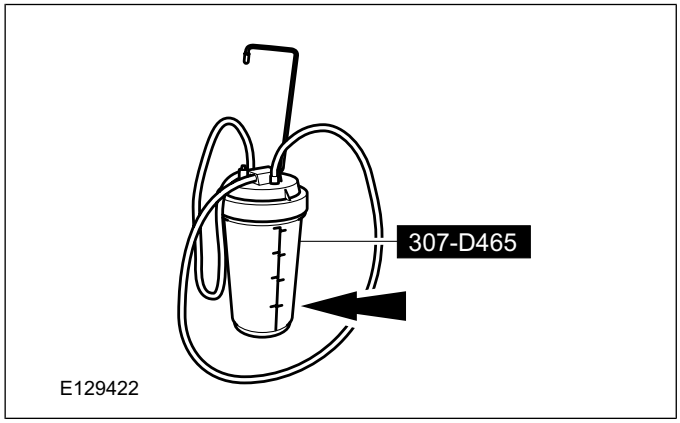
Adding additional transmission fluid

1. **NOTE: To get an accurate transmission fluid level reading the engine should be idling (600-750 rpm) in PARK.**

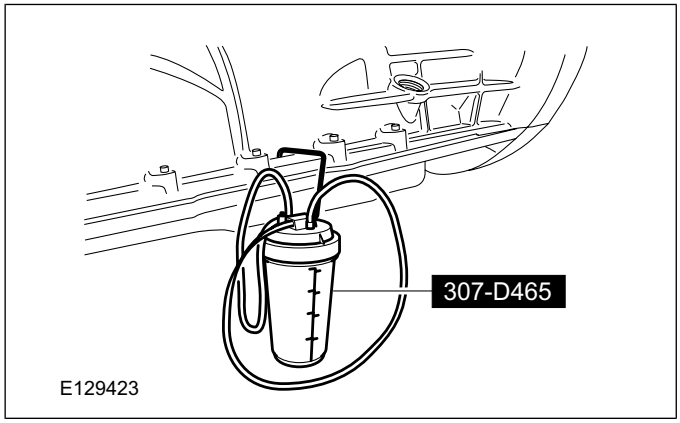
   Install the Transmission Fluid Fill Tube into the transmission fluid fill hole.



2. **Fill the Transporter Fluid Evacuator/Injector with approximately 0.47L (1 pt) of transmission fluid.**

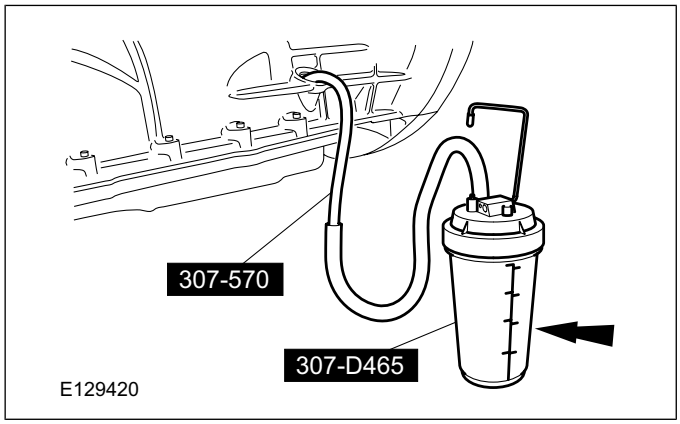


3. **Hang the Transporter Fluid Evacuator/Injector under the vehicle, upright and close to the transmission.**



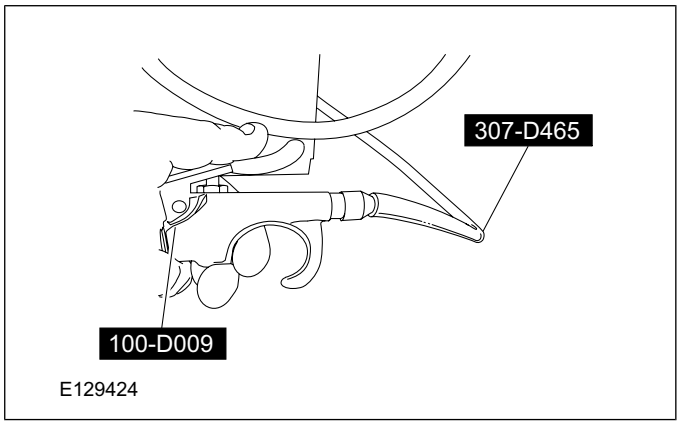
4. **Connect the Transporter Fluid Evacuator/Injector and Transmission Fluid Fill Tube.**

   - Connect the open end of the fluid hose from the Transporter Fluid Evacuator/Injector onto the Transmission Fluid Fill Tube from the transmission case.



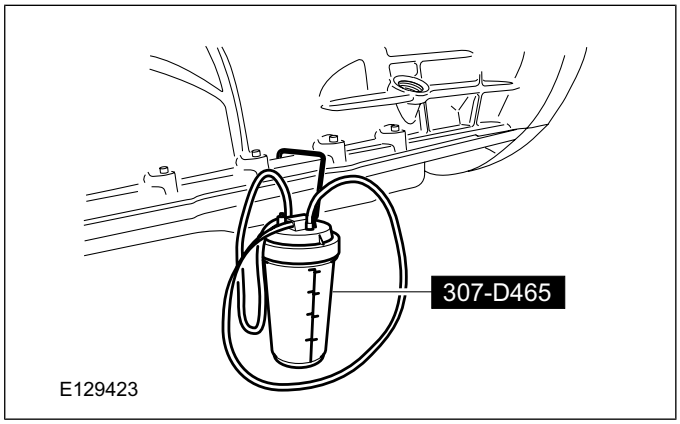
GENERAL PROCEDURES

5. **Use a Rubber Tip Air Nozzle to apply a maximum of 206.85 kPa (30 psi) to the open end of the vacuum/ pressure hose from the Transporter Fluid Evacuator/ Injector. Transmission fluid will immediately start flowing out of the Transporter Fluid Evacuator/Injector into the transmission.**

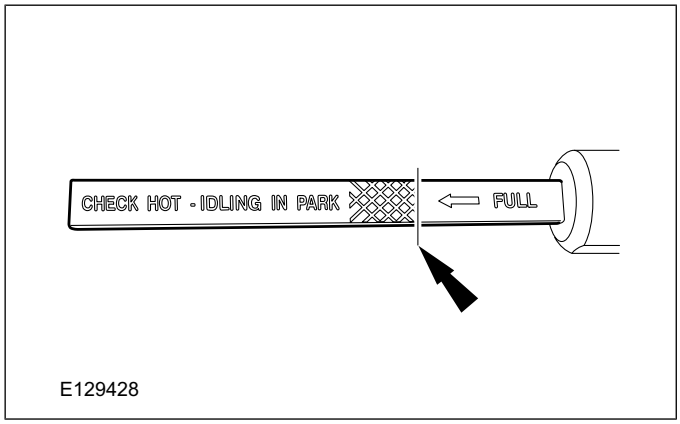


6. **NOTE: Do not overfill the transmission. The transmission fluid level must be at the upper level of the crosshatch mark.**

   Reinstall the transmission fluid level indicator only back into the transmission fluid fill plug hole to check the transmission fluid level. Repeat this until a consistent reading is established.



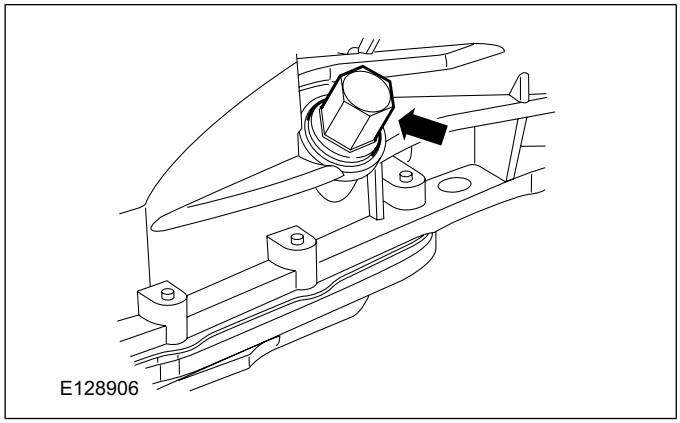
7. **Using the scan tool, verify that the TFT is between 80ºC-85ºC (176ºF-185ºF). The transmission fluid level must be at the upper level of the crosshatch mark.**



8. **NOTE: If the transmission fluid is over full, follow the steps for Removing Transmission Fluid in this procedure.**

   Install the transmission fluid fill plug.

   - Tighten to 35 Nm



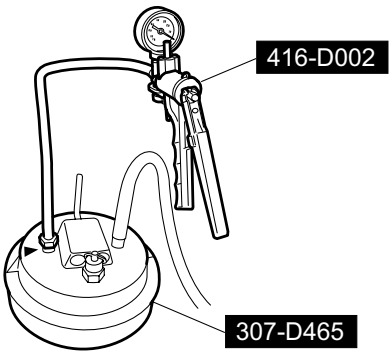
Removing transmission fluid

NOTE: To get an accurate transmission fluid level reading the engine should be idling (600-750 rpm) in PARK.

1. **If the transmission is overfilled, transmission fluid must be removed to the correct level. Use the Transporter Fluid Evacuator/Injector**

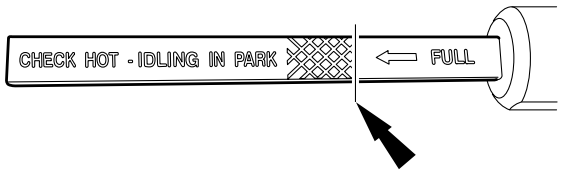
GENERAL PROCEDURES

and the Vacuum Pump Kit to extract any excessive transmission fluid.



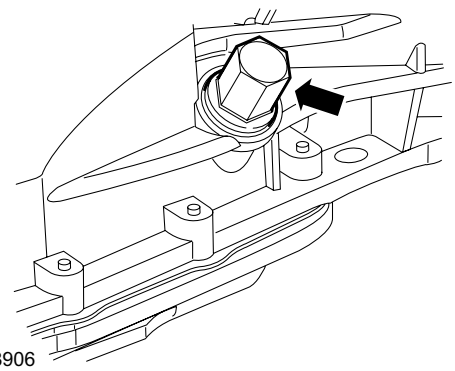
E129426

2. **Using the scan tool, verify that the TFT is between 80ºC-85ºC (176ºF-185ºF). The transmission fluid level must be at the upper level of the crosshatch mark. Reinstall the transmission fluid level indicator only back into the transmission fluid fill plug hole to check the transmission fluid level. Repeat this until a consistent reading is established.**



E129428

3. **Install the transmission fluid fill plug.**
   - Tighten to 35 Nm


E128906

GENERAL PROCEDURES

Transmission Fluid Level Check

WARNING: The vehicle should not be driven if the transmission fluid level is low as internal failure could result.

CAUTION: The transmission fluid fill plug is located near the exhaust system. The exhaust will be extremely hot during this procedure.

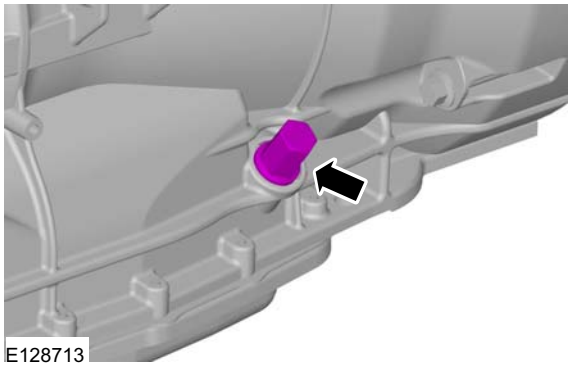
NOTE: If the vehicle has been operated for an extended period at high highway speeds, in city traffic, during hot weather or while pulling a trailer, the transmission fluid must cool down to obtain an accurate reading.

NOTE: If the transmission starts to slip, shifts slowly or shows signs of transmission fluid leaking, the transmission fluid level should be checked.

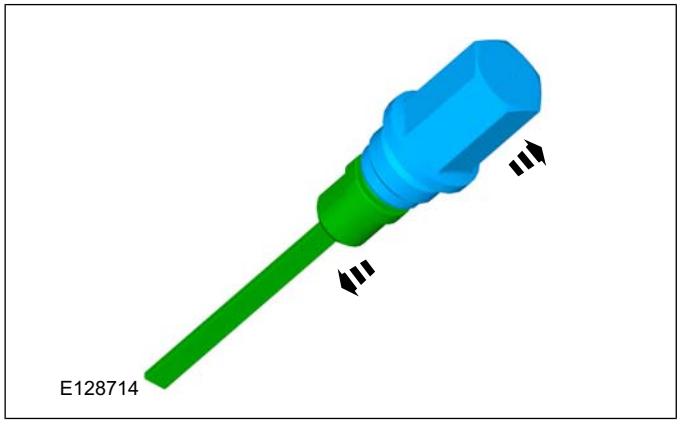
NOTE: Do not overfill the transmission. The transmission fluid level must be at the upper level of the crosshatch mark.

NOTE: If the installation of a new transmission fluid cooler or transmission fluid cooler tubes has been carried out, the vehicle must be driven to get the transmission fluid to a temperature of 88ºC (190ºF) in order to purge the air from the transmission fluid cooling system.

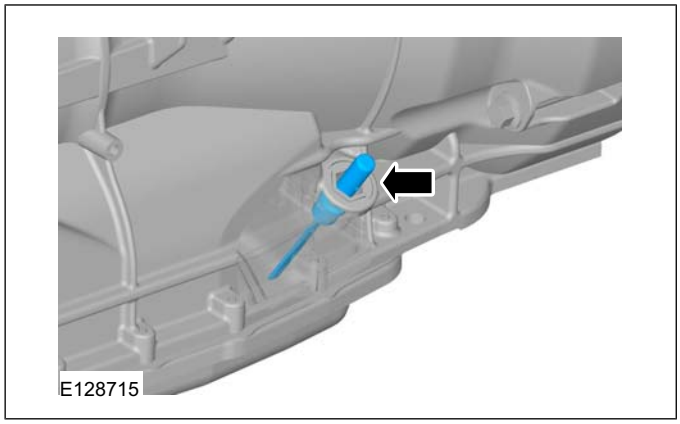
1. **With the engine running, place the transmission selector lever in each gear position and hold approximately 5 seconds. Place the transmission selector lever in PARK.**
2. **With the engine idling (600-750 rpm) in PARK, position it on a hoist. For additional information, refer to Section 100-02.**
3.


E128713

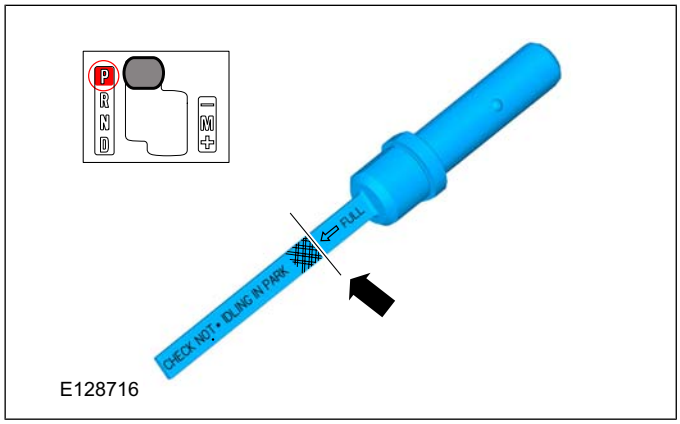
4.


E128714

5.


E128715

6.

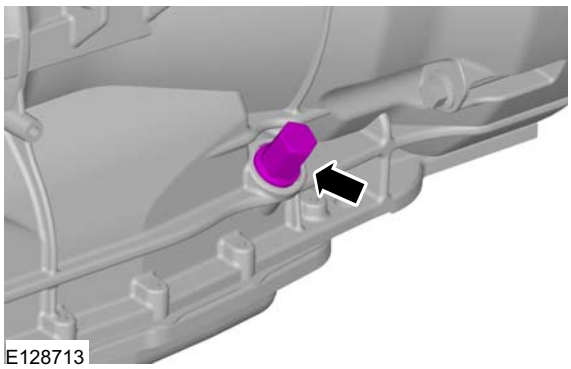


E128716

7. **NOTE: If the transmission fluid is not at the correct level, follow the steps for Adding Additional Transmission Fluid or Removing Transmission Fluid. For additional information, refer to Transmission Fluid Drain and Refill in this section**

GENERAL PROCEDURES

Tighten to 35 Nm (26 lb-ft).

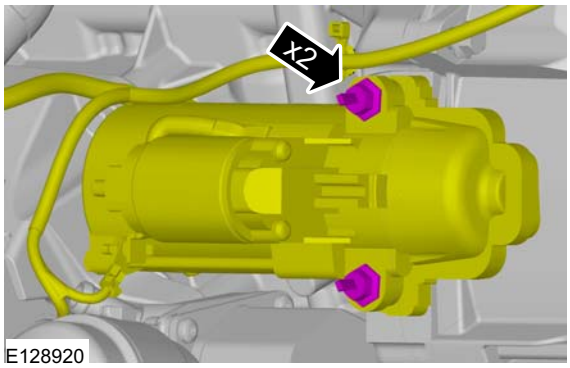

E128713

REMOVAL

Transmission — 2WD

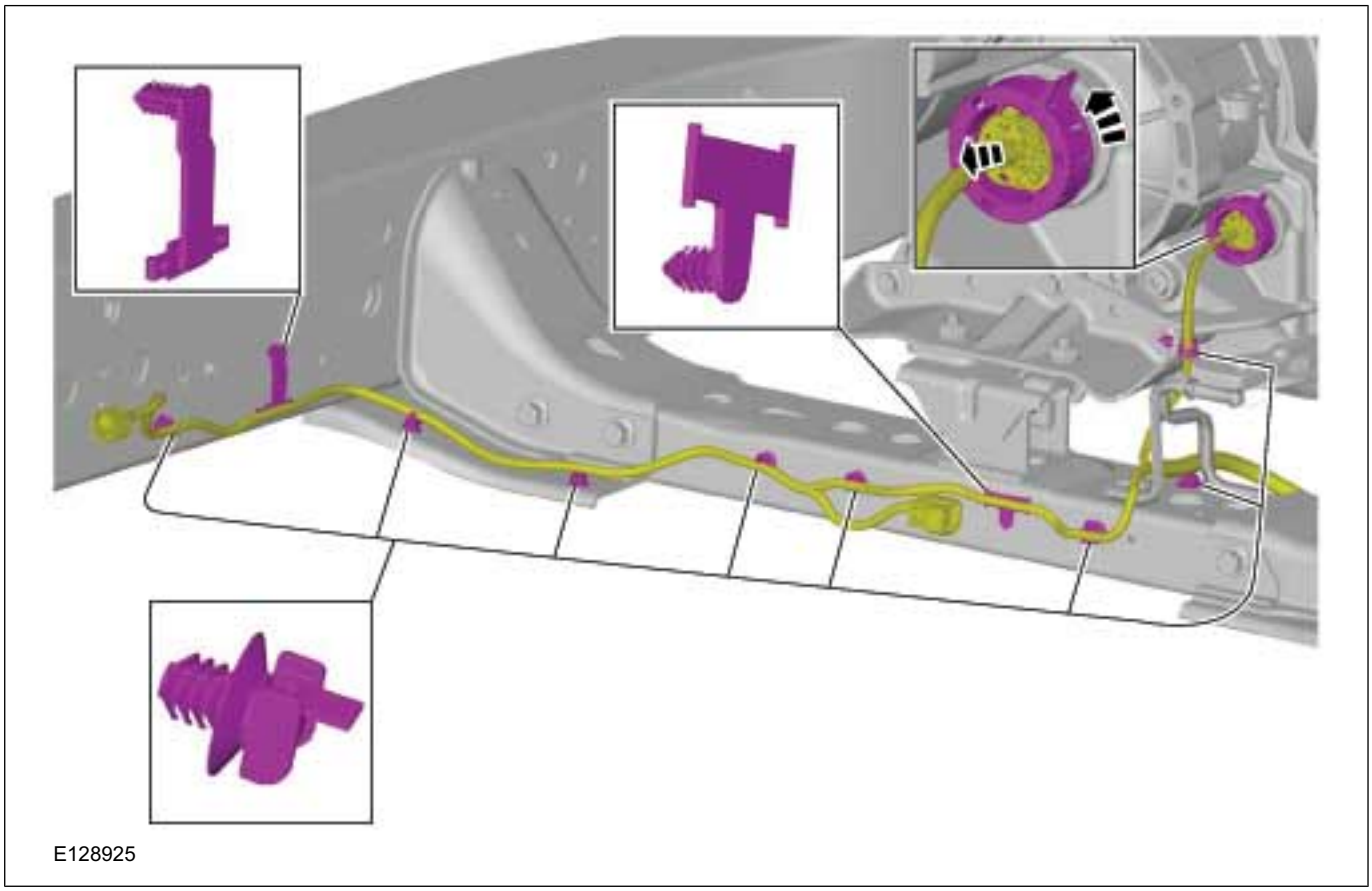
Removal

1. Refer to: Driveshaft - 2WD (205-01 Driveshaft, Removal and Installation).
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
4. Refer to: Transmission Fluid Drain and Refill (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, General Procedures).
5. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).
6. Torque: 21 Nm

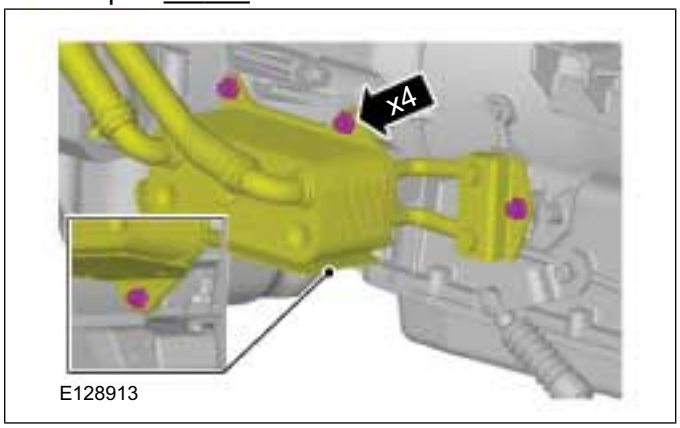


7.

REMOVAL


E128925

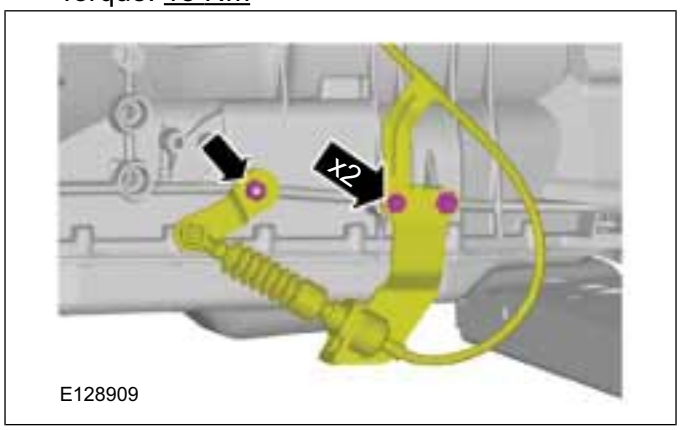
8. Torque: 19 Nm



E128913

9. **WARNING: To prevent selector lever cable damage, do not apply force to the selector lever cable between the manual control lever and the selector lever cable bracket.**

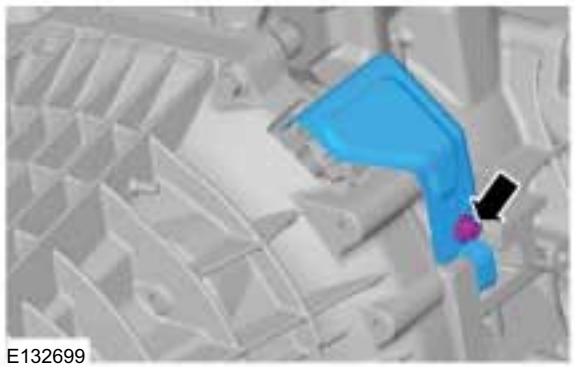
Torque: 15 Nm



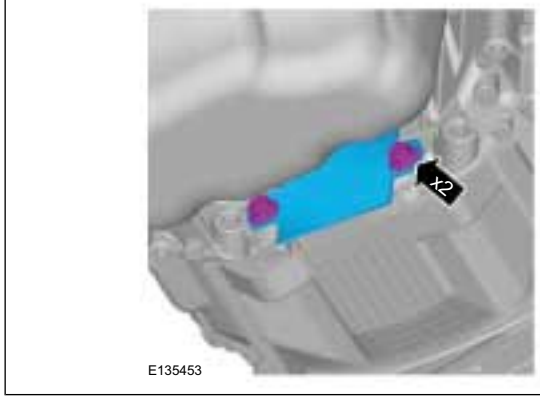
E128909

REMOVAL

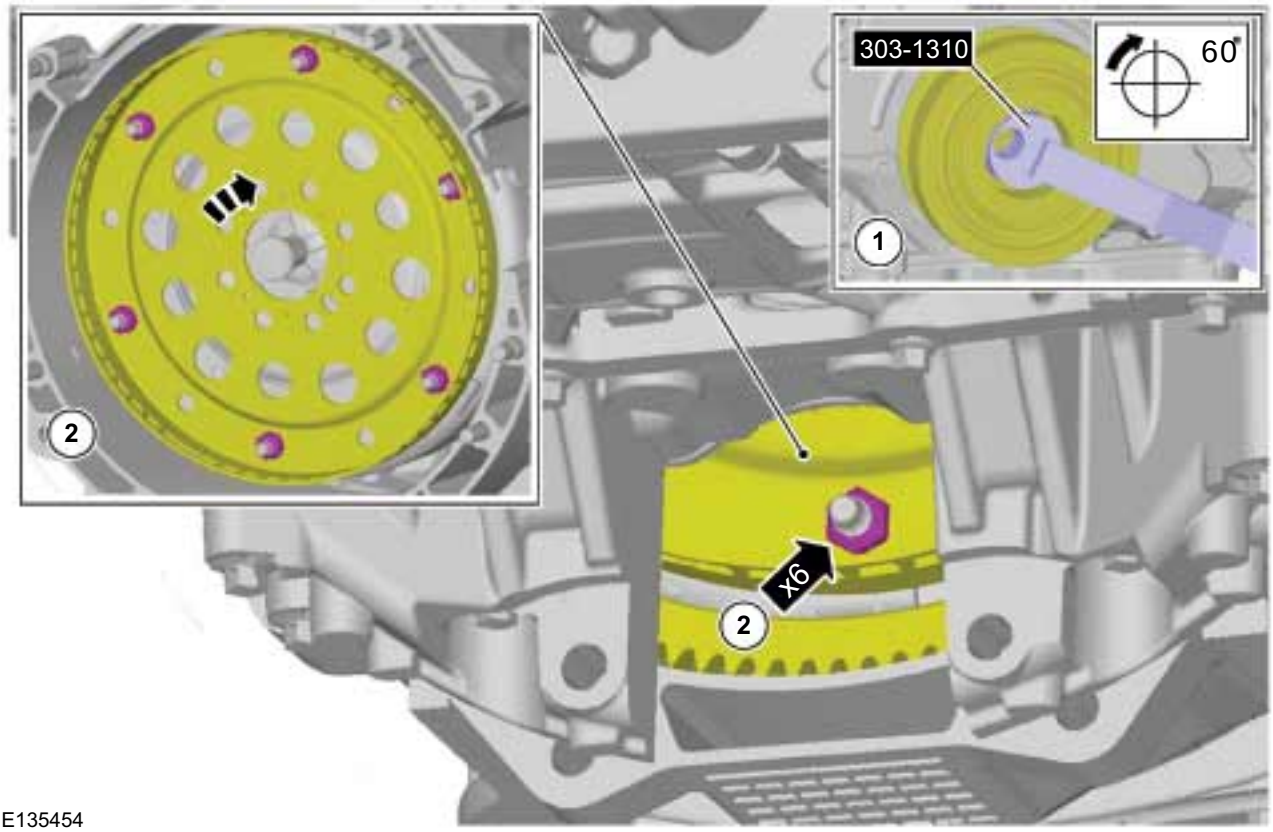
10. Torque: 22 Nm



11. Torque: 21 Nm



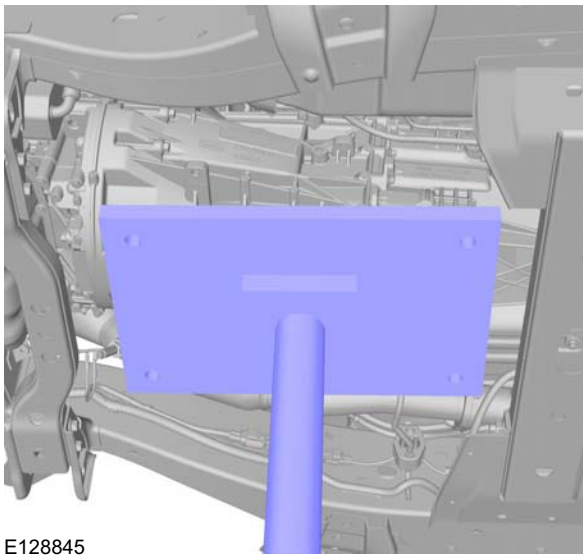
12. Torque: 29 Nm



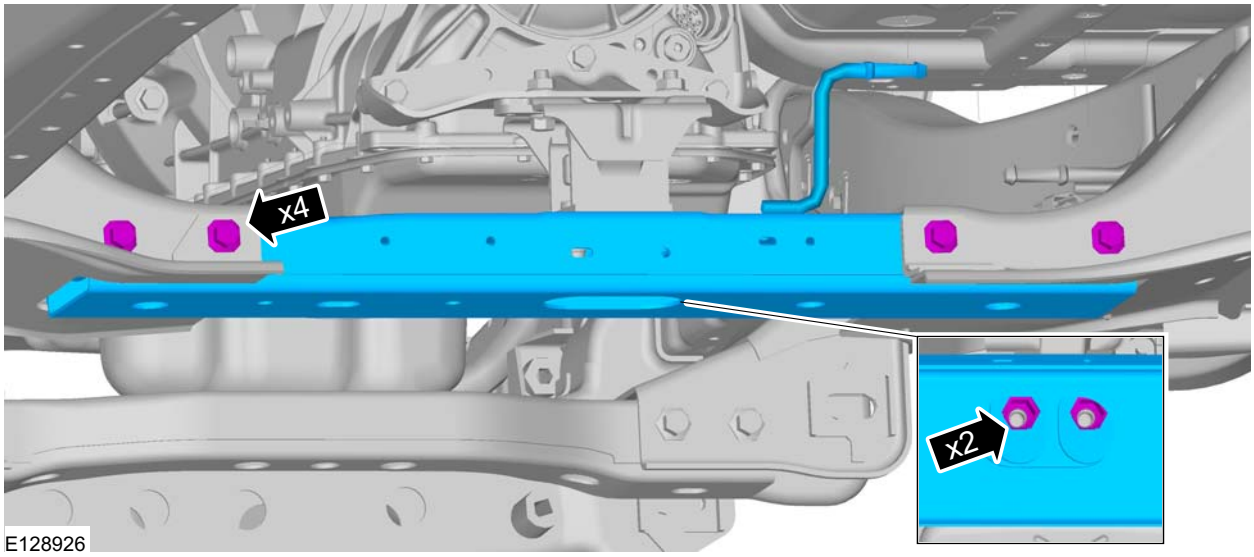
13. NOTE: Make sure that the transmission jack makes contact on the outer ribs of the fluid pan.

REMOVAL

NOTE: Make sure that the transmission is securely fastened to the transmission jack.


E128845

14. Torque: 45 Nm



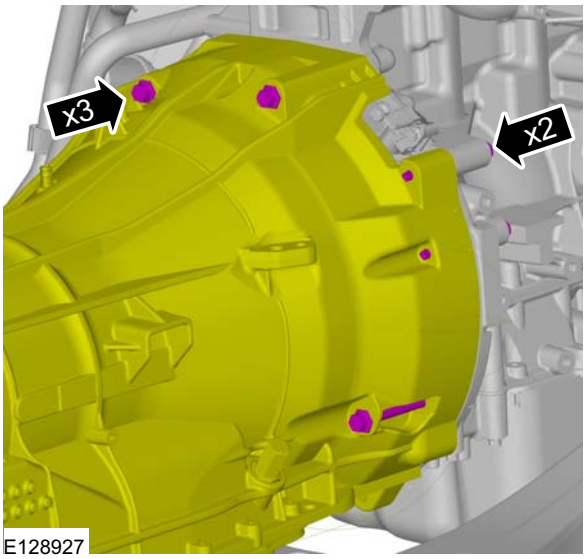
E128926

15. **NOTE:** The top 2 transmission-to-engine bolts need to be removed prior to removing the remaining bolts.

REMOVAL

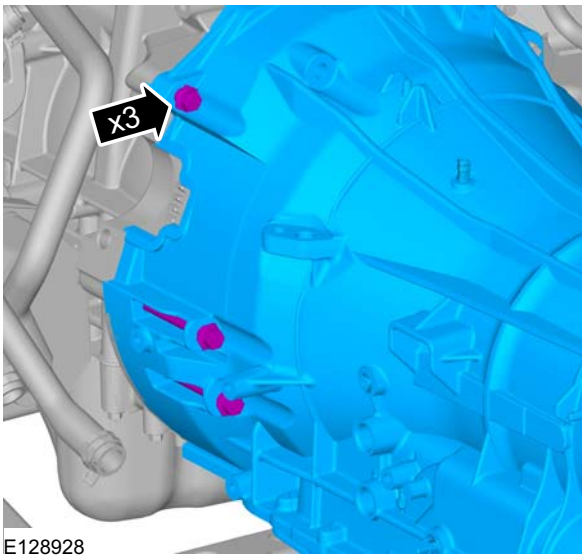
NOTE: The top left bolt secures the fuel line bracket to the transmission case.

Torque: 40 Nm

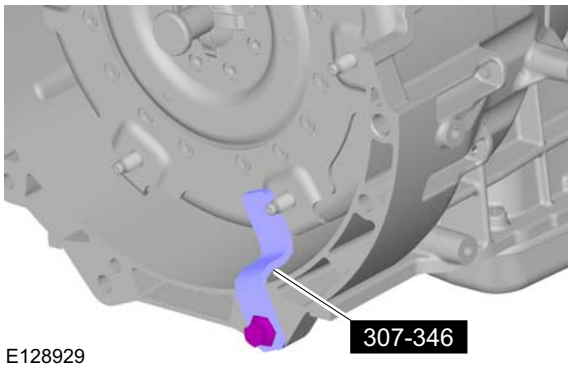


16. **NOTE:** The top left bolt secures the fuel line bracket to the transmission case.

    Torque: 40 Nm



17. Slide the transmission back far enough to install the Torque Converter Retainer.



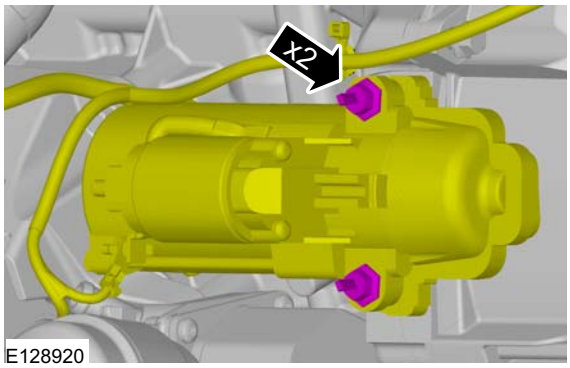
18. If the transmission is being disassembled to install new parts, or if a new or remanufactured transmission is being installed, the transmission fluid cooler, the auxiliary transmission fluid cooler (if equipped) and the transmission fluid cooler tubes must be cleaned and backflushed to keep contaminants from entering the transmission. For additional information, refer to Transmission Fluid Cooler Backflushing and Cleaning in this section.

REMOVAL

Transmission — 4WD

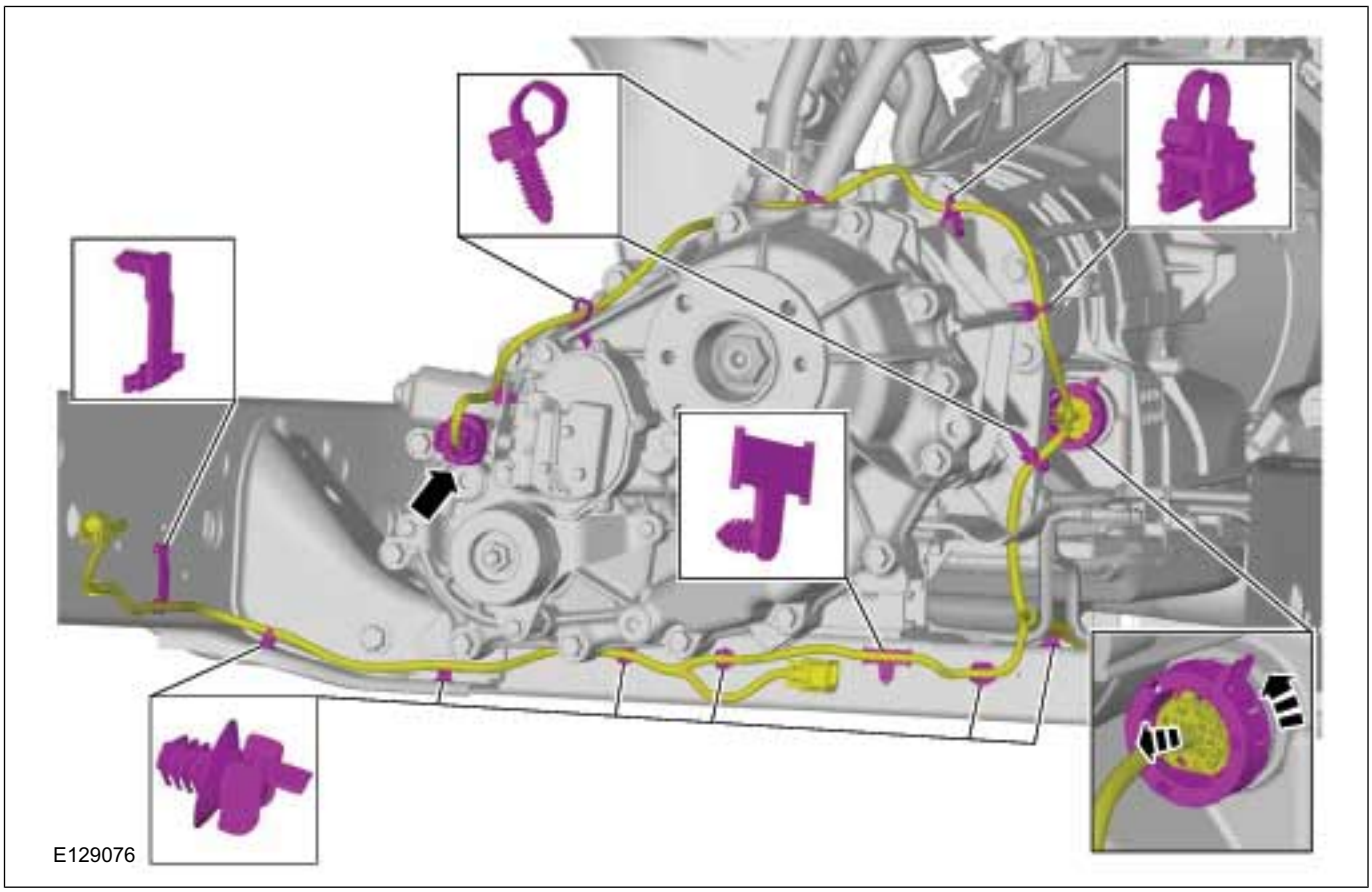
Removal

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).
4. Refer to: Transmission Fluid Drain and Refill (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, General Procedures).
5. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).
6. Torque: 21 Nm

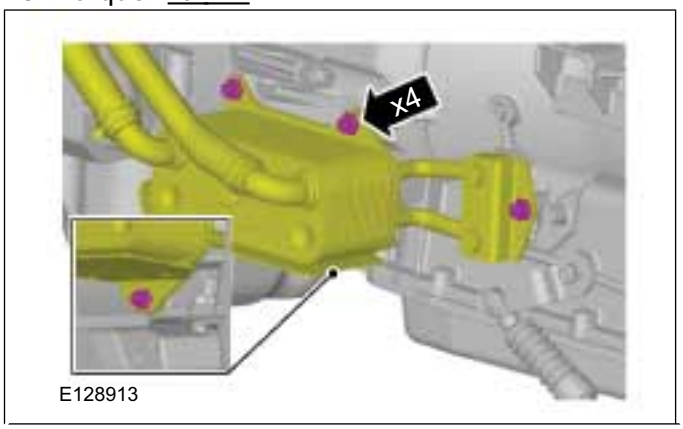


7.

REMOVAL

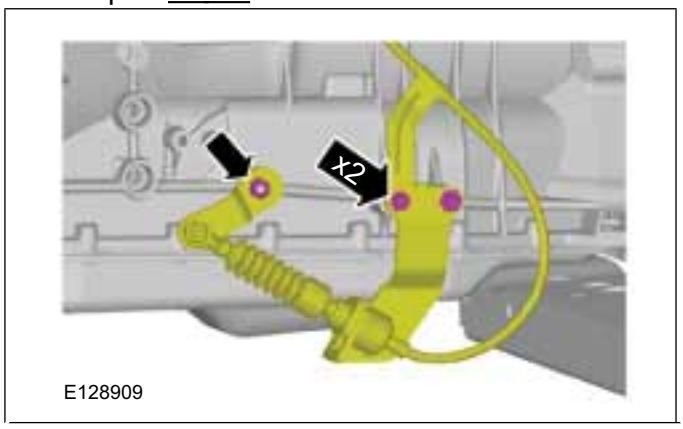


8. Torque: 19 Nm



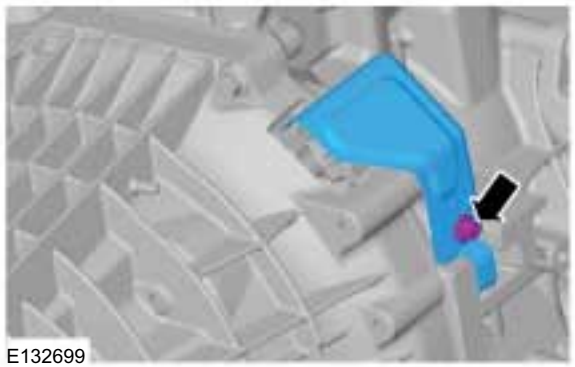
9. **WARNING: To prevent selector lever cable damage, do not apply force to the selector lever cable between the manual control lever and the selector lever cable bracket.**

Torque: 15 Nm

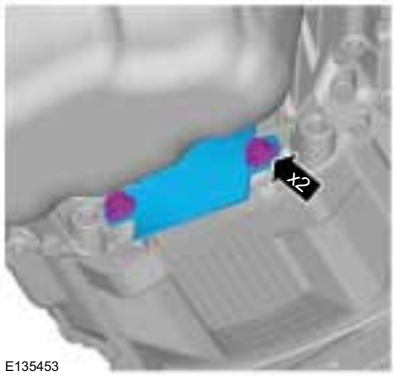


REMOVAL

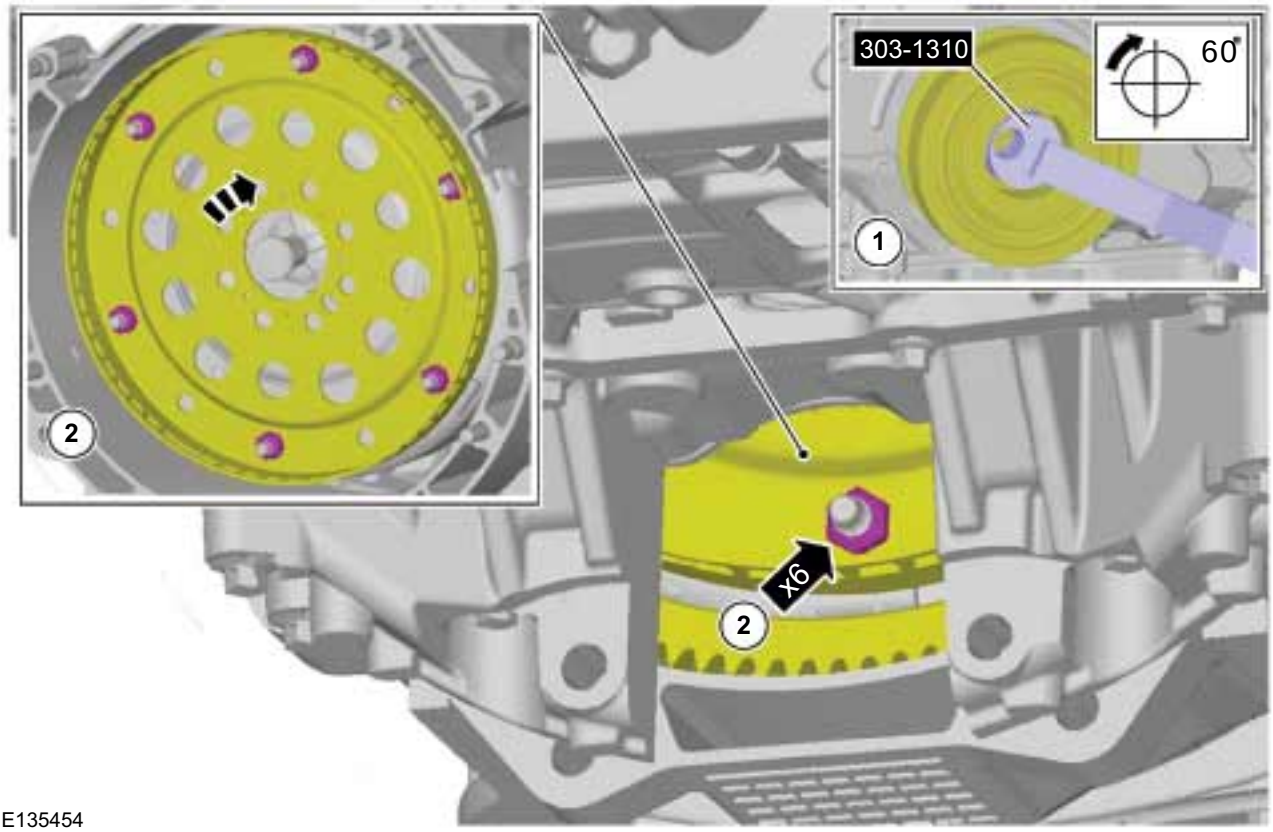
10. Torque: 22 Nm



11. Torque: 21 Nm



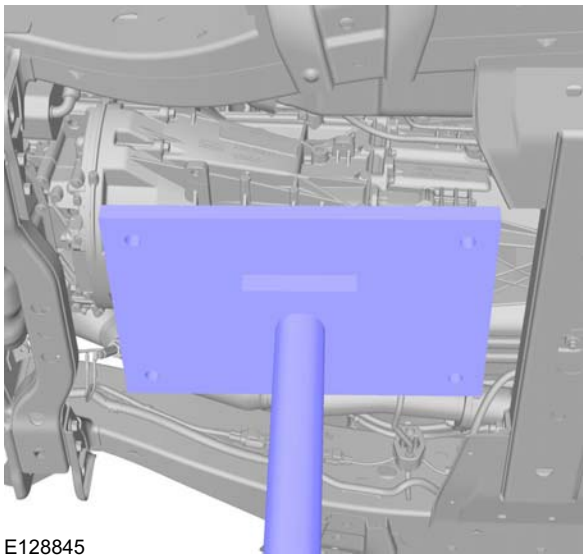
12. Torque: 29 Nm



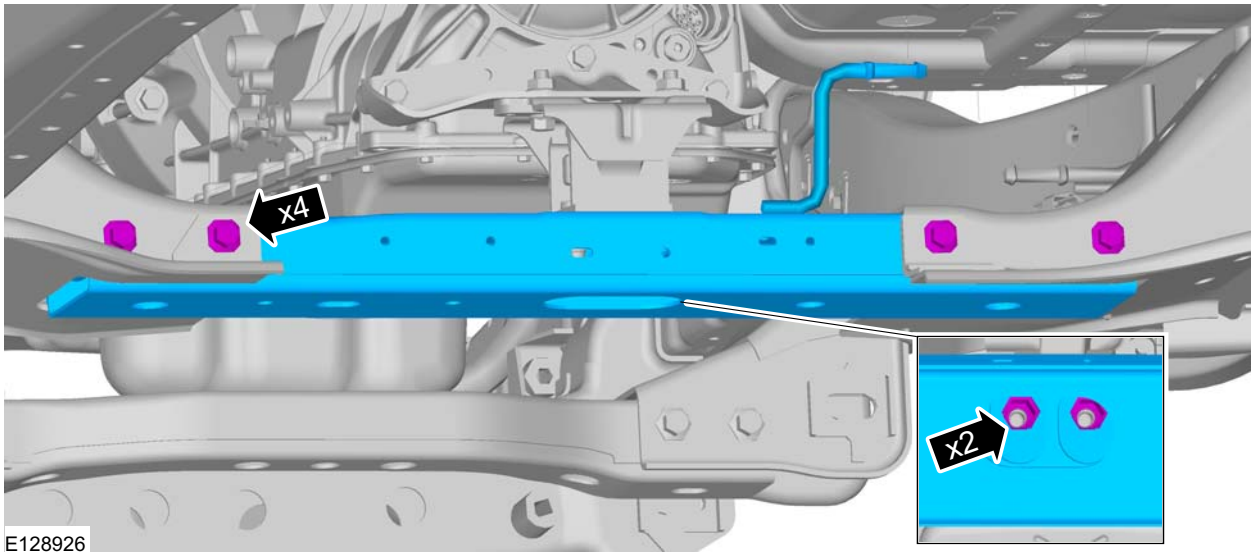
13. NOTE: Make sure that the transmission jack makes contact on the outer ribs of the fluid pan.

REMOVAL

NOTE: Make sure that the transmission is securely fastened to the transmission jack.


E128845

14. Torque: 45 Nm



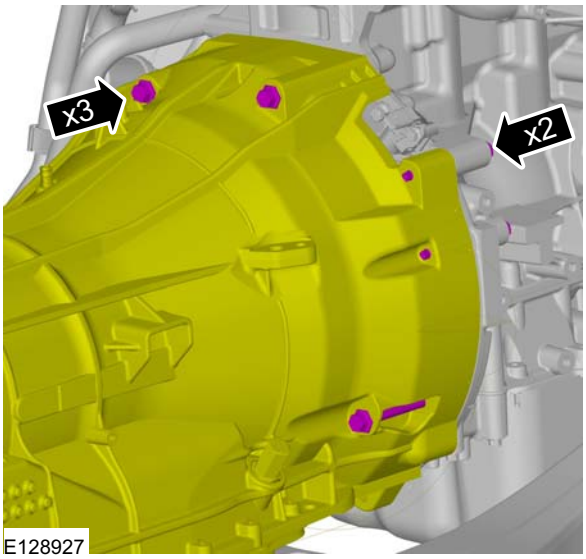
E128926

15. **NOTE:** The top 2 transmission-to-engine bolts need to be removed prior to removing the remaining bolts.

REMOVAL

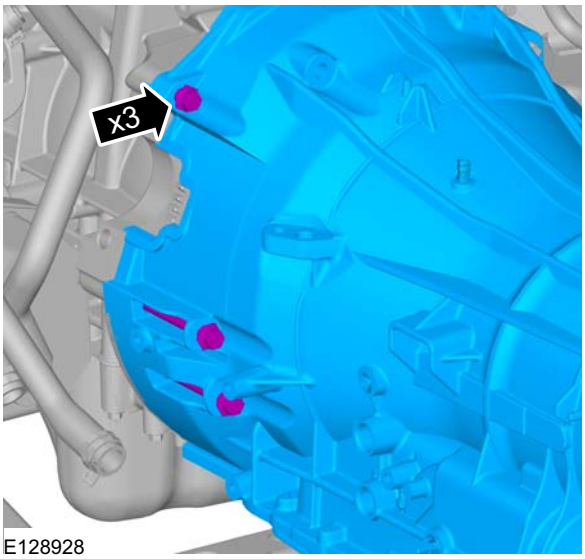
NOTE: The top left bolt secures the fuel line bracket to the transmission case.

Torque: 40 Nm

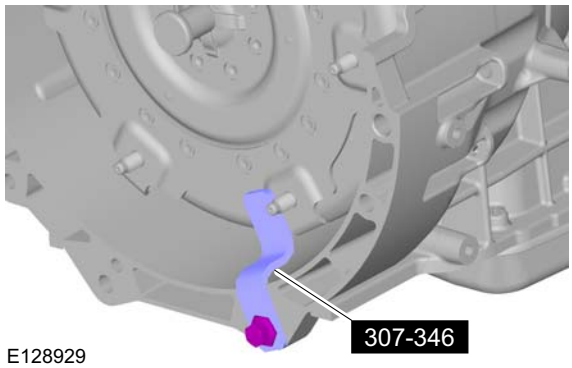


16. **NOTE:** The top left bolt secures the fuel line bracket to the transmission case.

Torque: 40 Nm



17. Slide the transmission back far enough to install the Torque Converter Retainer.



18. If the transmission is being disassembled to install new parts, or if a new or remanufactured transmission is being installed, the transmission fluid cooler, the auxiliary transmission fluid cooler (if equipped) and the transmission fluid cooler tubes must be cleaned and backflushed to keep contaminants from entering the transmission. For additional information, refer to Transmission Fluid Cooler Backflushing and Cleaning in this section.

INSTALLATION

Transmission — 2WD

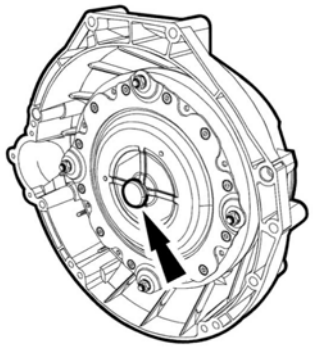
Installation

Materials	
Name	**Specification**
Automatic Transmission Oil C-ML5	WSS-M2C938-A / 7U7J-M2C938-AA
Contact Grease	WSB-M1C239-A / YS5J-M1C239-AA

1. **CAUTION: Prior to installation of the transmission, the torque converter pilot hub must be lubricated with multipurpose grease or damage to the torque converter or the engine crankshaft can occur.**

   Lubricate the torque converter pilot hub with multipurpose grease.

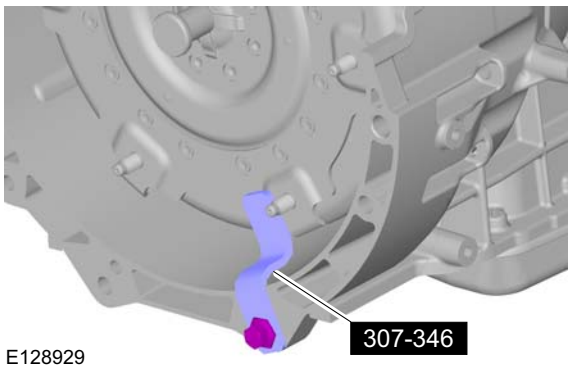
   Material: Contact Grease (WSB-M1C239-A / YS5J-M1C239-AA) grease



E129224

2. **CAUTION: Prior to installation of the transmission, the torque converter pilot hub must be lubricated with multipurpose grease or damage to the torque converter or the engine crankshaft can occur.**

   Remove the Torque Converter Retainer.



E128929

3. **CAUTION: The converter housing is piloted into position by dowels in the rear of the engine block. The torque converter must rest squarely against the flexplate. This indicates that the converter pilot is not binding in the engine crankshaft.**

   NOTE: Make sure that the transmission jack makes contact on the outer ribs of the transmission fluid pan.

   NOTE: Make sure that the transmission is securely fastened to the transmission jack.

   Position and secure the transmission on the high-lift transmission jack. Raise and position the transmission into the vehicle.

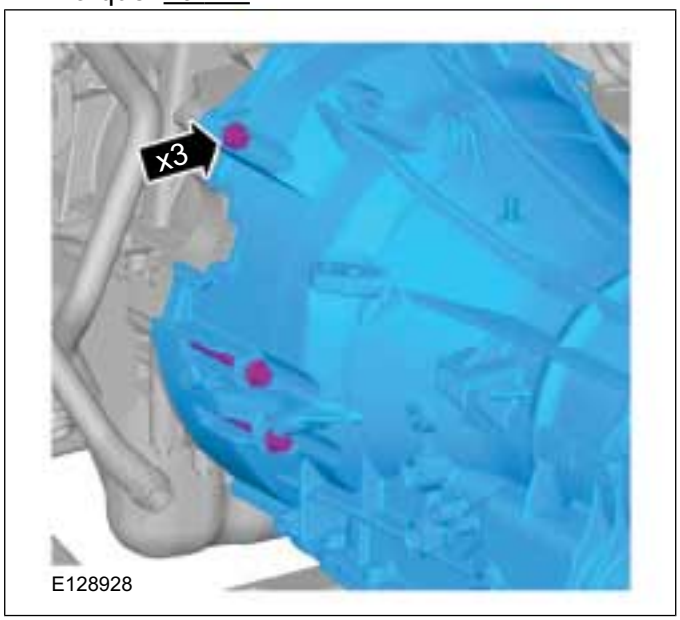
4. **NOTE:** Make sure the torque converter is fully seated in the transmission before aligning the transmission to the engine.

   With the transmission in a horizontal position, move it toward the engine. Align the orange balancing marks between the torque converter studs and the flexplate bolt holes.

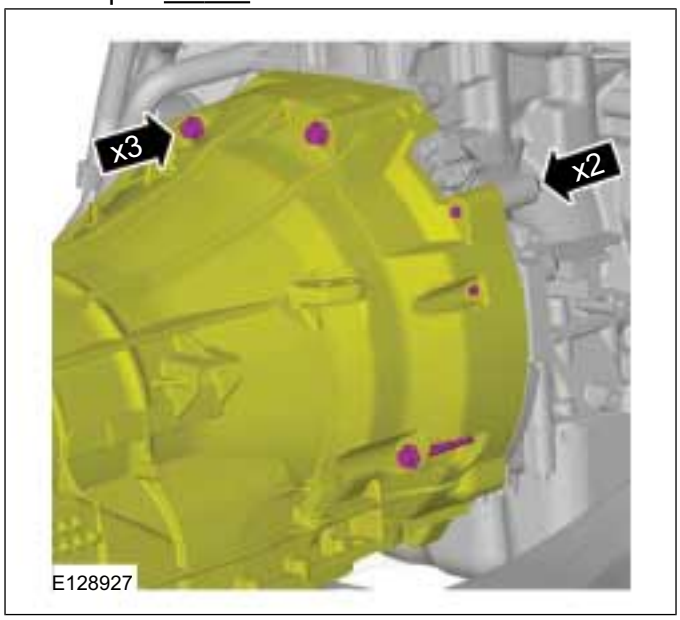
INSTALLATION

5. **NOTE:** LH shown, RH similar.

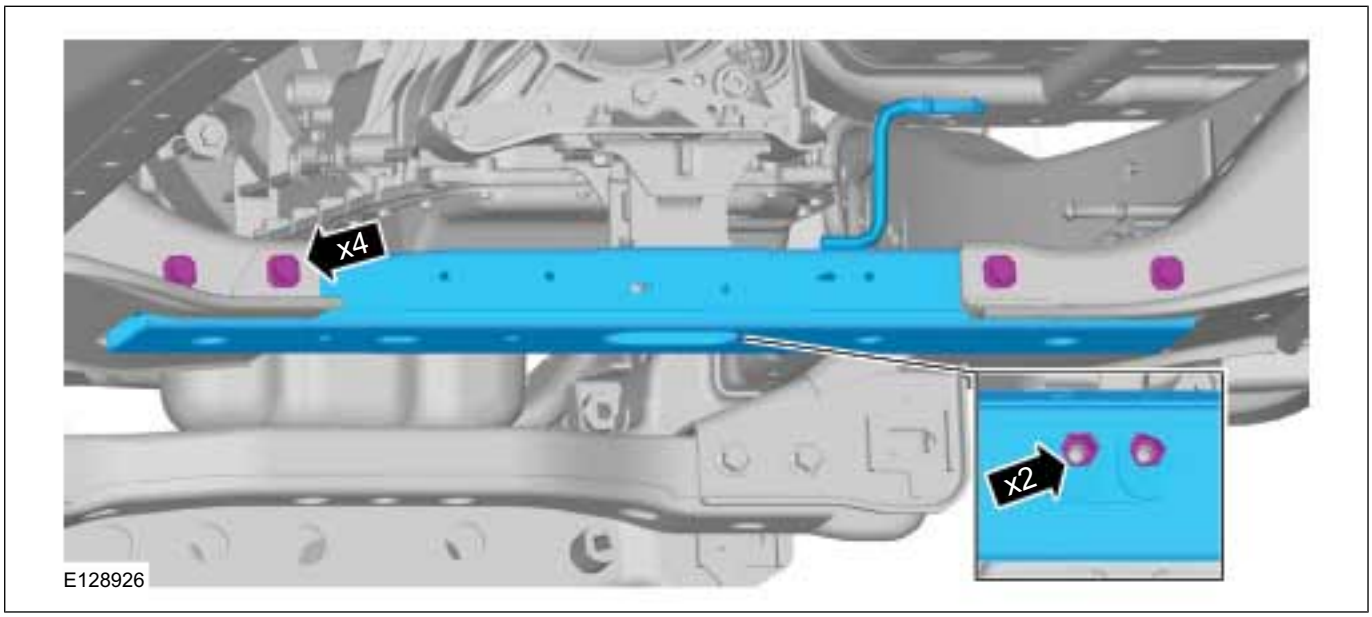
   Torque: 49 Nm



6. Torque: 49 Nm

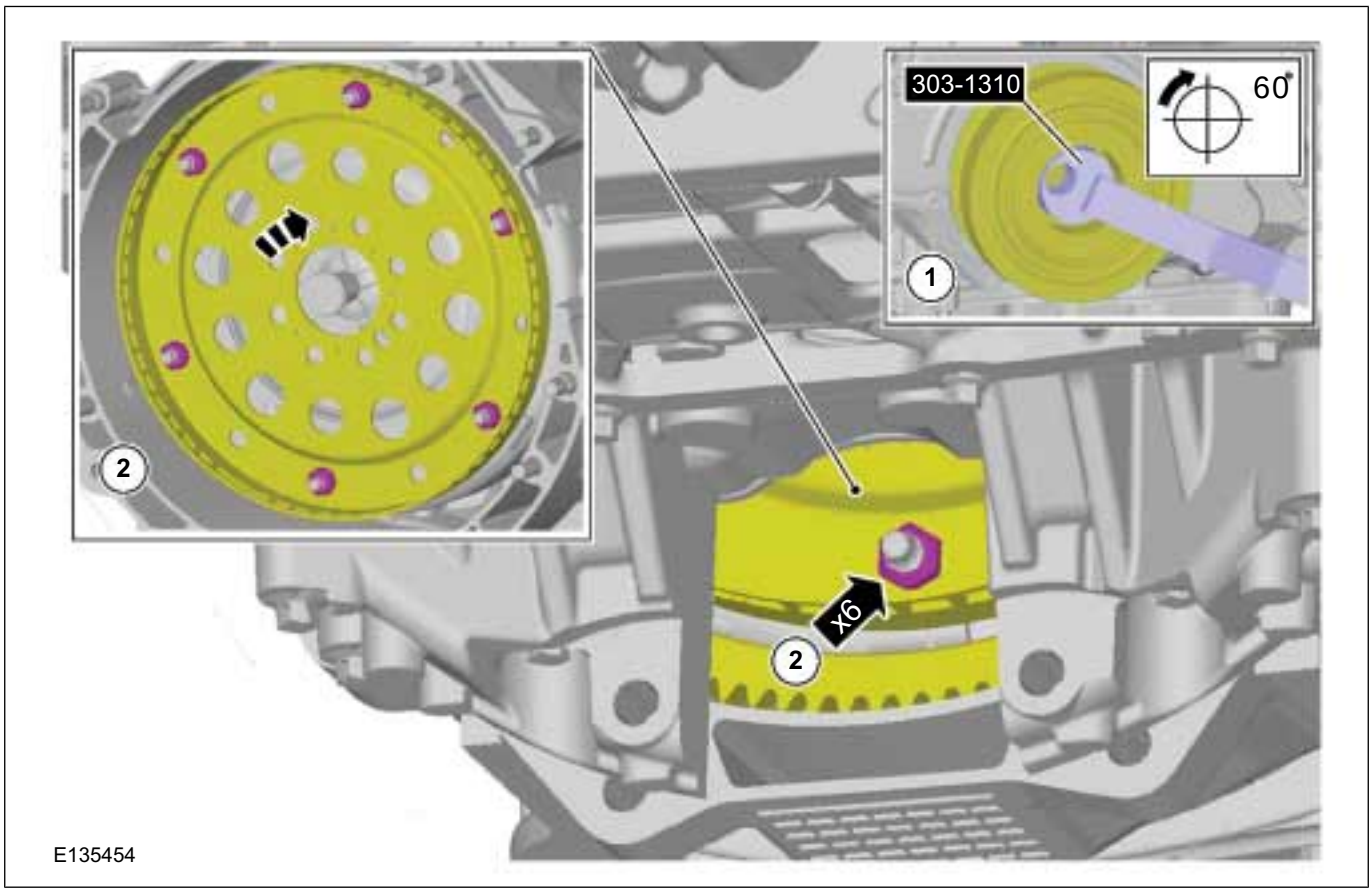


7. Torque: 45 Nm

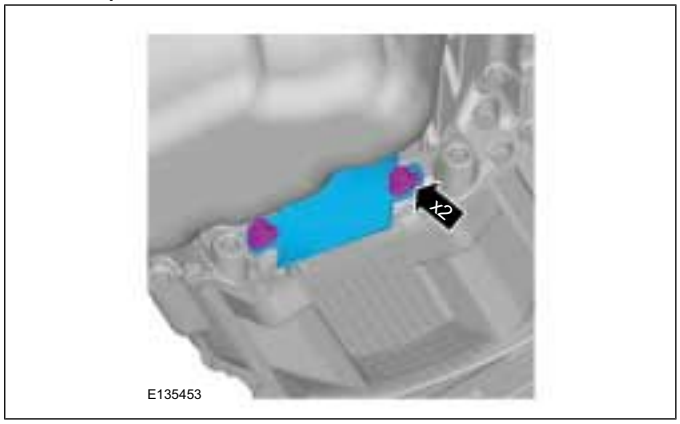


8. Torque: 49 Nm

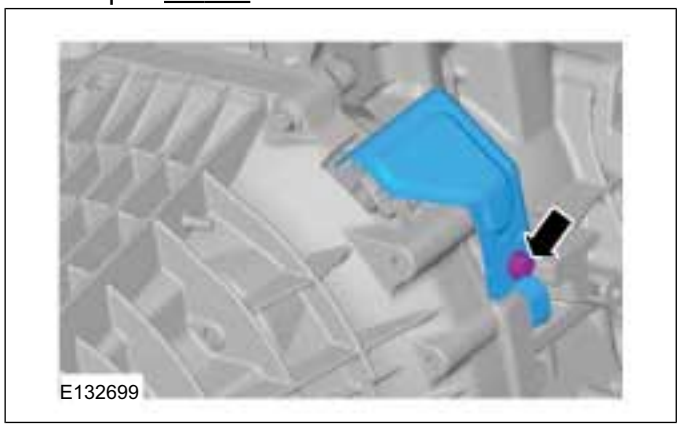
INSTALLATION



9. Torque: 49 Nm



10. Torque: 18 Nm

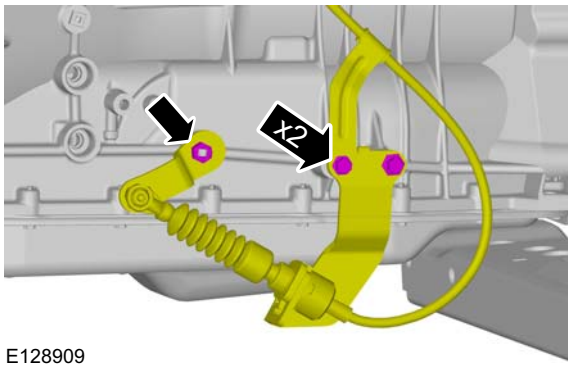


11. **WARNING: To prevent selector lever cable damage, do not apply force to the selector lever cable between the manual**

INSTALLATION

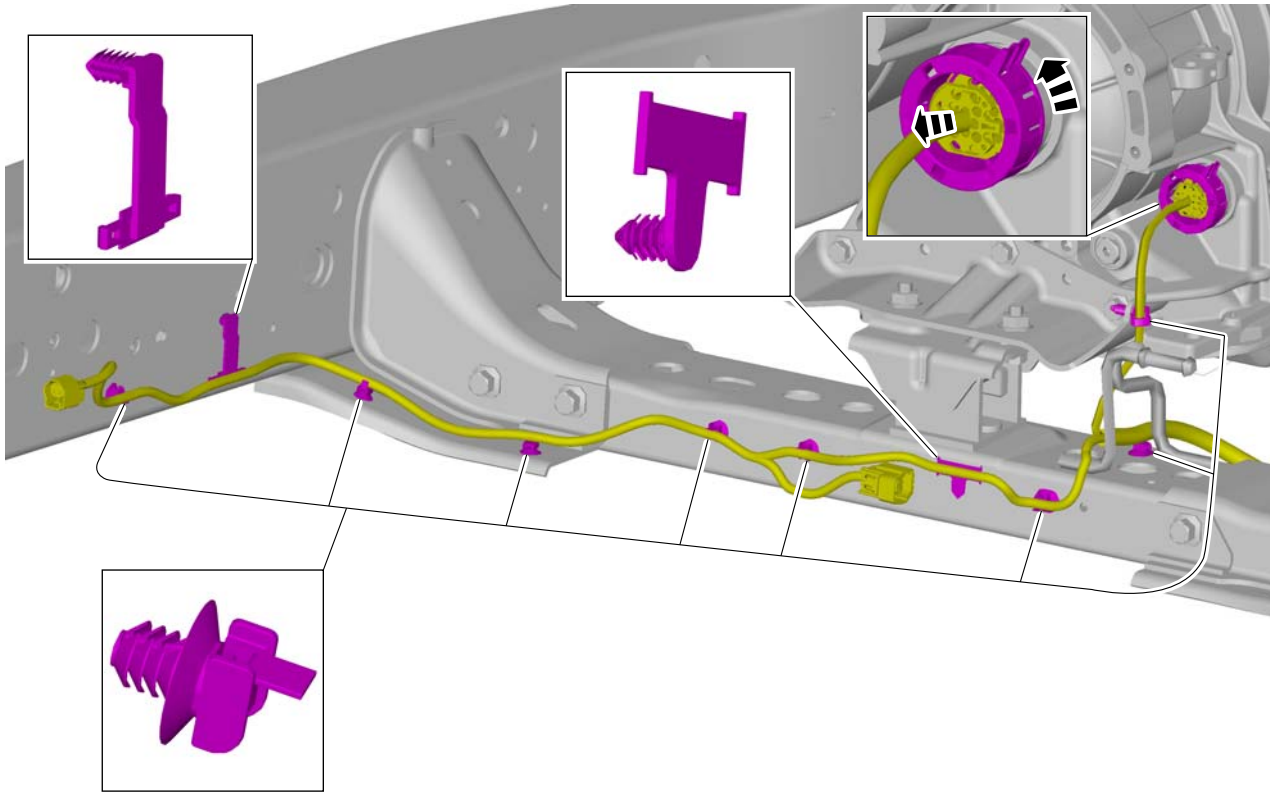
control lever and the selector lever cable bracket.

Torque: 25 Nm



E128909

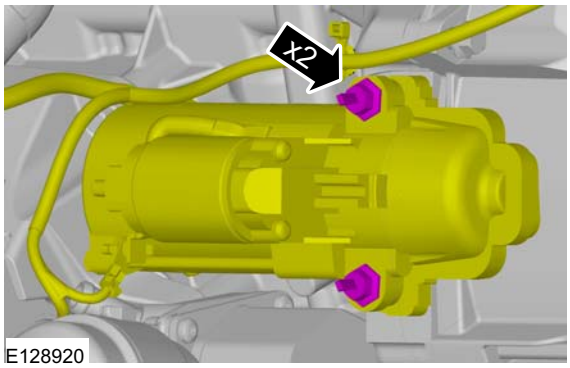
12



E128925

INSTALLATION

13. Torque: 26 Nm

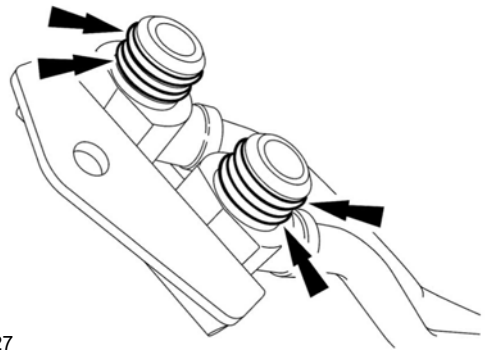


E128920

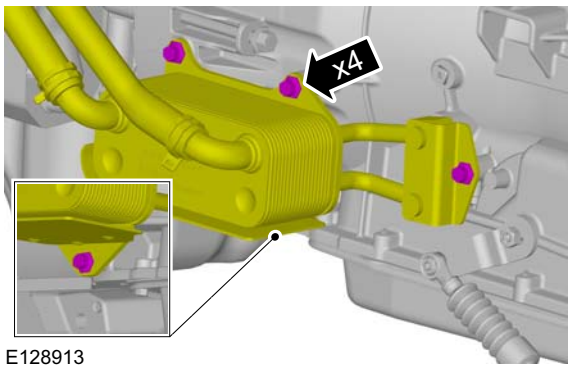
14. **NOTE:** Inspect the case to make sure that the old transmission fluid cooler tube O-rings are not stuck in the case.

    NOTE: Install new transmission fluid cooler tube O-rings on the ends of the transmission fluid cooler tubes prior to installing.

    Install new transmission fluid cooler tube O-rings on the transmission fluid cooler tubes.


E129227

15. Install the transmission fluid cooler tube bracket bolt.
    Torque: 26 Nm



E128913

16. Refer to: Driveshaft - 2WD (205-01 Driveshaft, Removal and Installation).

17. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

18. Refer to: Selector Lever Cable Adjustment (307-05 Automatic Transmission/Transaxle External Controls, General Procedures).

19. Program the Transmission Control Module (TCM) with the latest calibration.

20. Refer to: Transmission Fluid Drain and Refill (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, General Procedures).
    Material: Automatic Transmission Oil C-ML5 (WSS-M2C938-A / 7U7J-M2C938-AA) transmission fluid

INSTALLATION

Transmission — 4WD

Installation

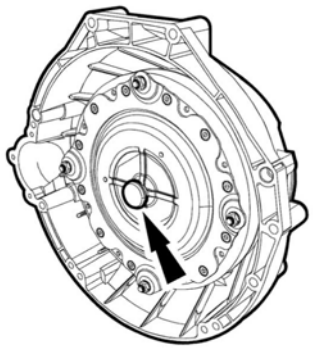
Materials	
Name	**Specification**
Contact Grease	WSB-M1C239-A / YS5J-M1C239-AA

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

2. **CAUTION: Prior to installation of the transmission, the torque converter pilot hub must be lubricated with multipurpose grease or damage to the torque converter or the engine crankshaft can occur.**

   Lubricate the torque converter pilot hub with multipurpose grease.

   Material: Contact Grease (WSB-M1C239-A / YS5J-M1C239-AA) grease

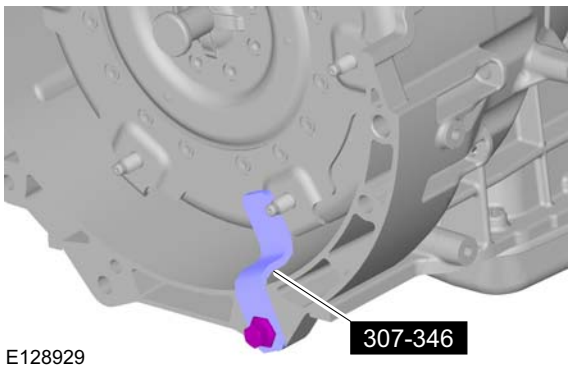

E129224

3. **CAUTION: The converter housing is piloted into position by dowels in the rear of the engine block. The torque converter must rest squarely against the flexplate. This indicates that the converter pilot is not binding in the engine crankshaft.**

   NOTE: Make sure that the transmission jack makes contact on the outer ribs of the transmission fluid pan.

   NOTE: Make sure that the transmission is securely fastened to the transmission jack.

   Position and secure the transmission on the high-lift transmission jack. Raise and position the transmission into the vehicle.

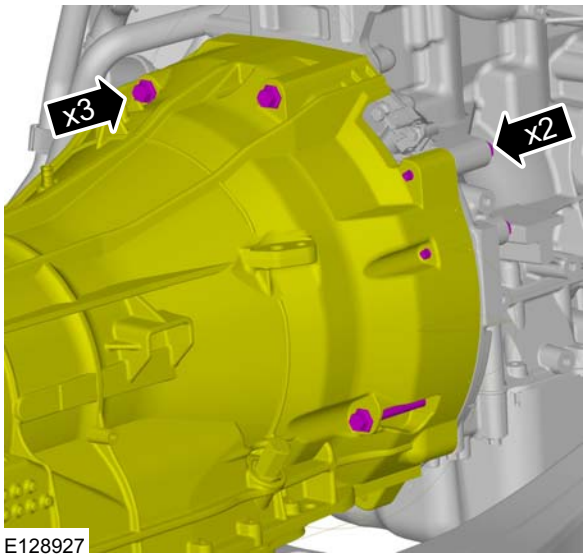


E128929

4. **NOTE:** The top 2 transmission-to-engine bolts need to be removed prior to removing the remaining bolts.

   NOTE: The top left bolt secures the fuel line bracket to the transmission case.

   Torque: 49 Nm



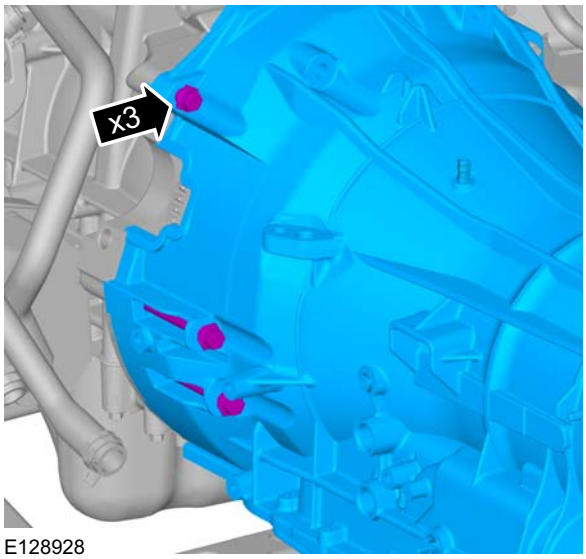
E128927

5. **NOTE:** The top 2 transmission-to-engine bolts need to be removed prior to removing the remaining bolts.

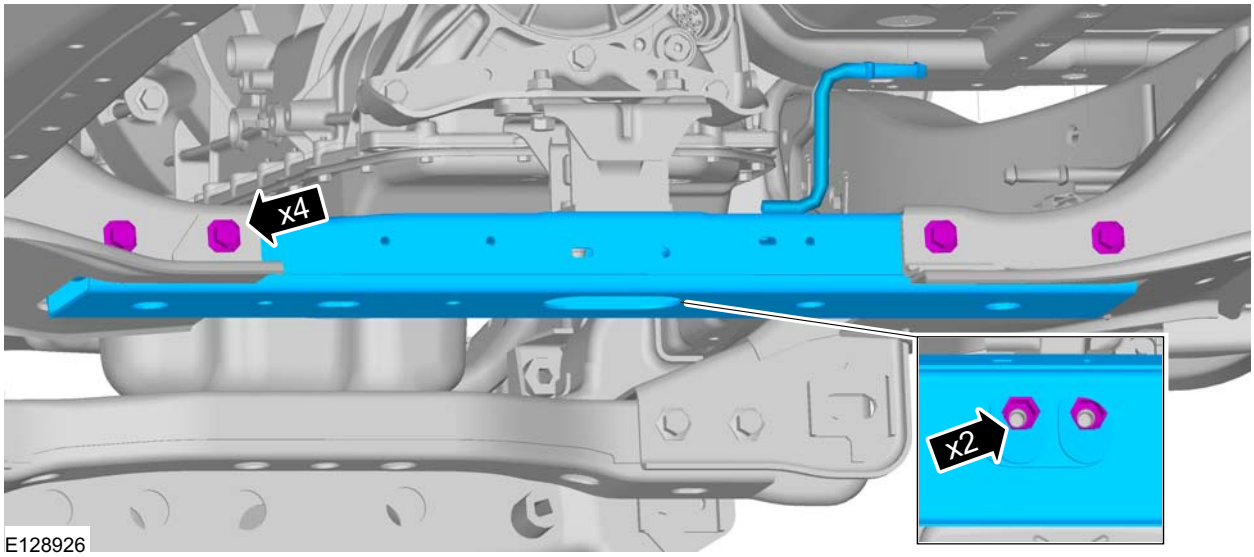
INSTALLATION

NOTE: The top left bolt secures the fuel line bracket to the transmission case.

Torque: 49 Nm

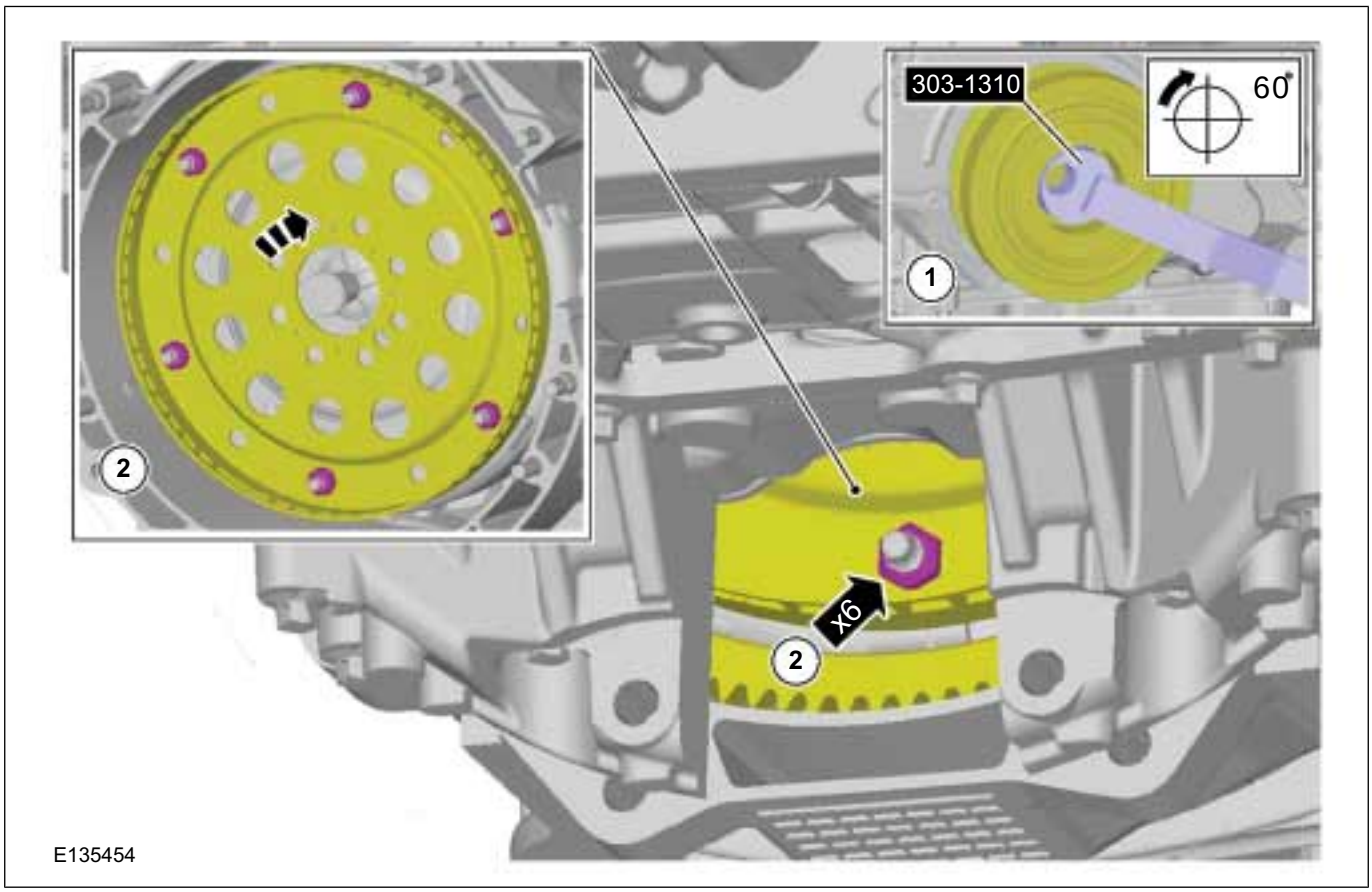


6. Torque: 45 Nm

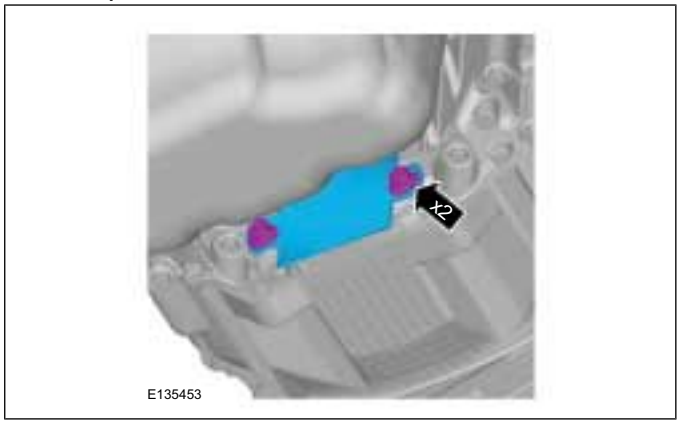


7. Torque: 49 Nm

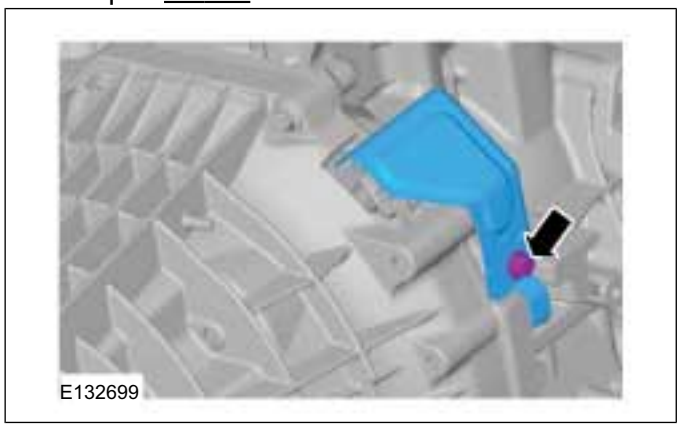
INSTALLATION



8. Torque: 49 Nm



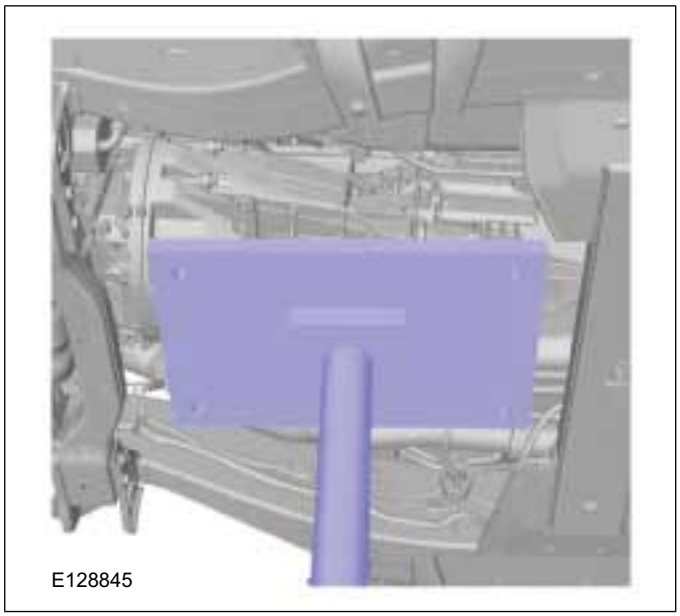
9. Torque: 18 Nm



10. **NOTE:** Make sure that the transmission jack makes contact on the outer ribs of the fluid pan.

INSTALLATION

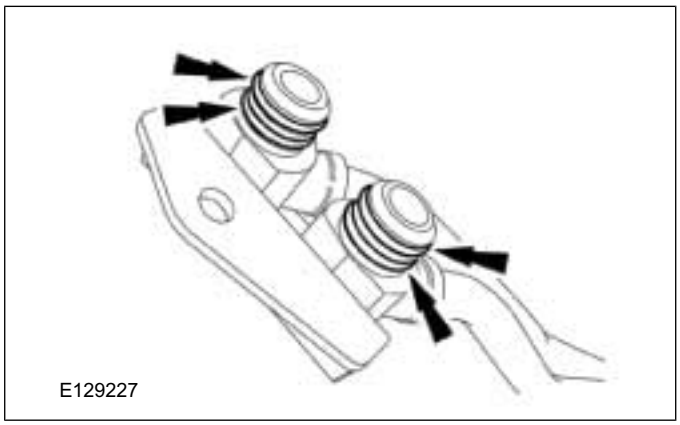
NOTE: Make sure that the transmission is securely fastened to the transmission jack.


E128845

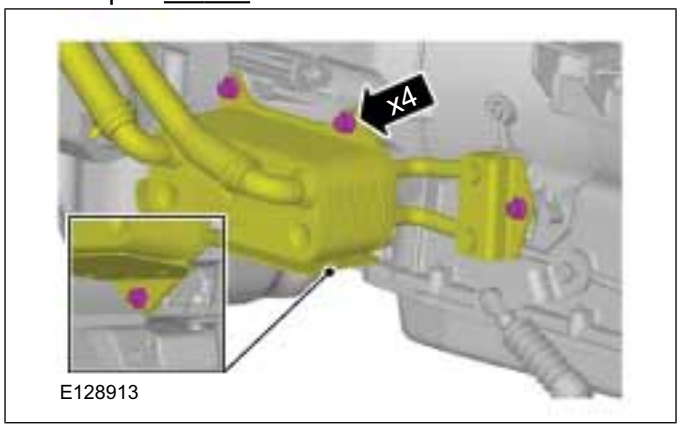
11. **NOTE:** Inspect the case to make sure that the old transmission fluid cooler tube O-rings are not stuck in the case.

    NOTE: Install new transmission fluid cooler tube O-rings on the ends of the transmission fluid cooler tubes prior to installing.

    Install new transmission fluid cooler tube O-rings on the transmission fluid cooler tubes.


E129227

12. Torque: 26 Nm

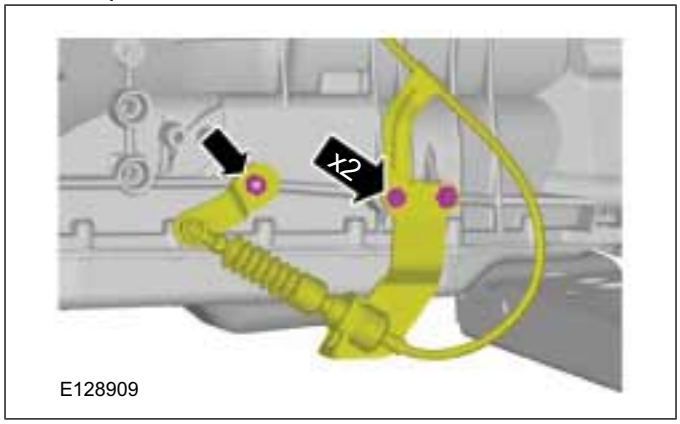


E128913

13. **WARNING: To prevent selector lever cable damage, do not apply force to the selector lever cable between the manual control lever and the selector lever cable bracket.**

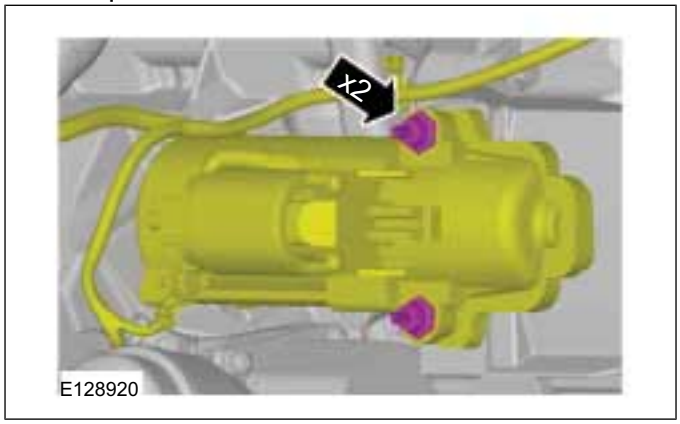
    NOTE: When installing the selector lever cable end, make sure that the selector lever cable end is correctly installed onto the manual control lever. Pull back on the selector lever cable end to make sure that the selector lever cable end is securely installed onto the manual control lever.

    Torque: 26 Nm



E128909

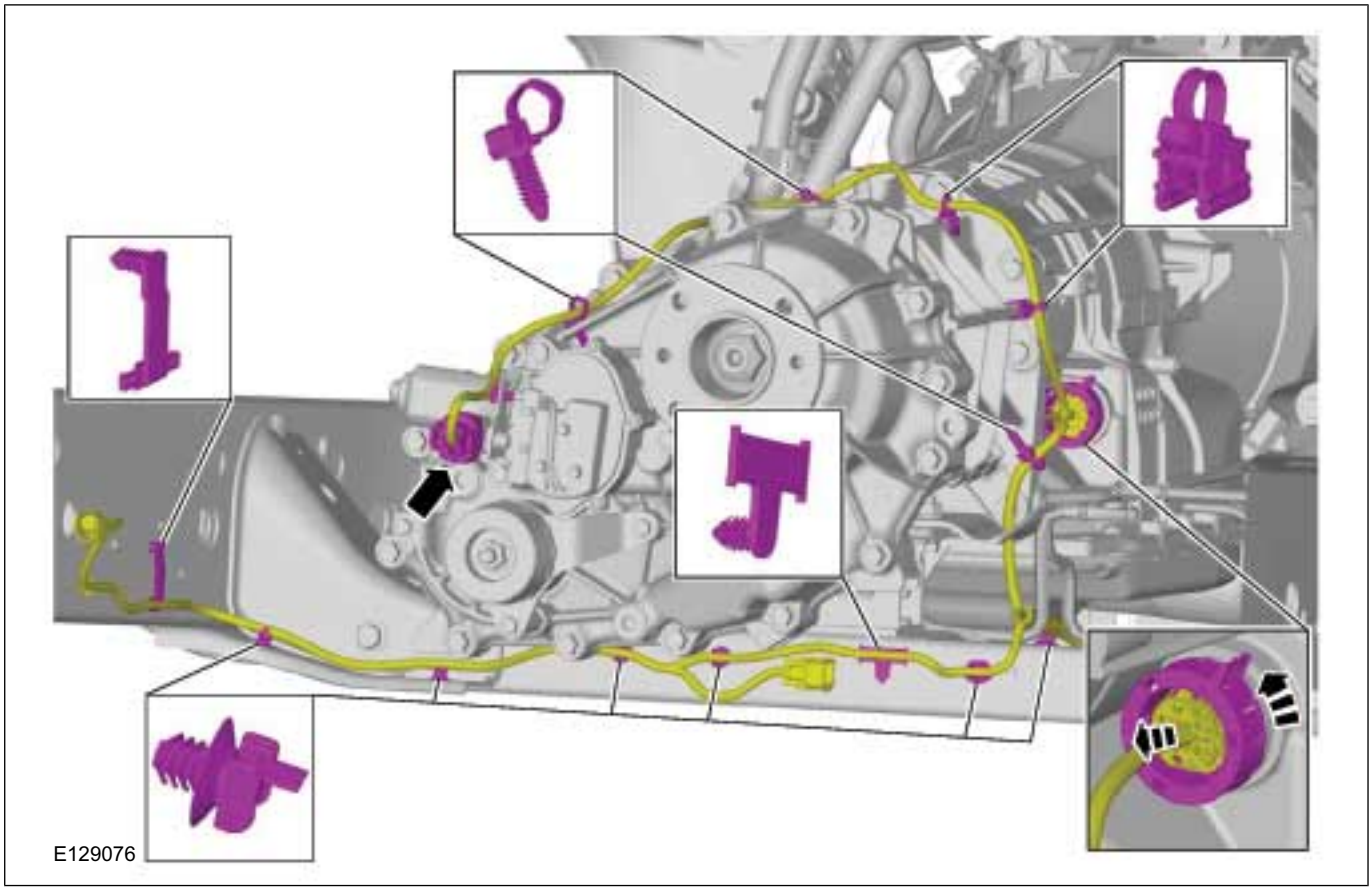
14. Torque: 26 Nm



E128920

INSTALLATION

15.



16. Refer to: Selector Lever Cable Adjustment (307-05 Automatic Transmission/Transaxle External Controls, General Procedures).

17. Program the Transmission Control Module (TCM (transmission control module)) with the latest calibration.

18. Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).

19. Refer to: Transmission Fluid Drain and Refill (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, General Procedures).

20. Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).

21. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

SECTION 307-02 Transmission/Transaxle Cooling

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

Transmission Fluid Cooler

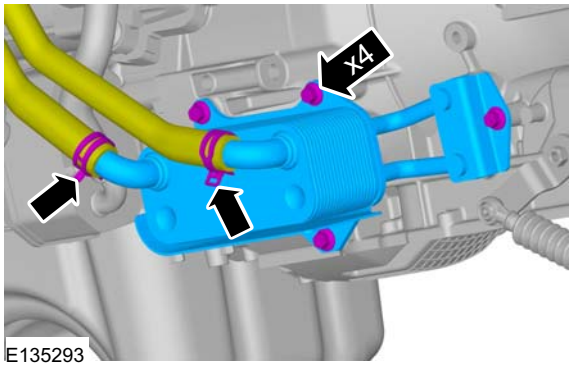
Removal

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

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

   Refer to: Transmission Fluid Drain and Refill (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, General Procedures).
3. Torque: 15 Nm



Installation

1. To install, reverse the removal procedure.

   Refer to: Cooling System Draining, Filling and Bleeding - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-03 Engine Cooling - 3.2L Duratorq-TDCi (148kW/200PS) - Puma, General Procedures).

   Refer to: Transmission Fluid Drain and Refill (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, General Procedures).

SECTION 307-05 Automatic Transmission/Transaxle External Controls

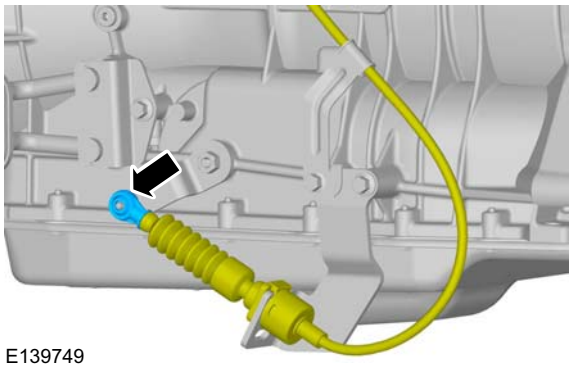
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

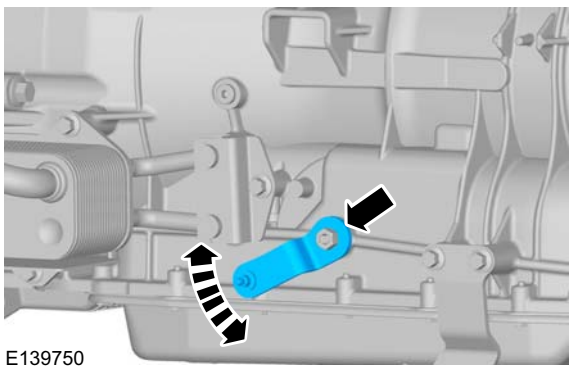
GENERAL PROCEDURES

Selector Lever Cable Adjustment

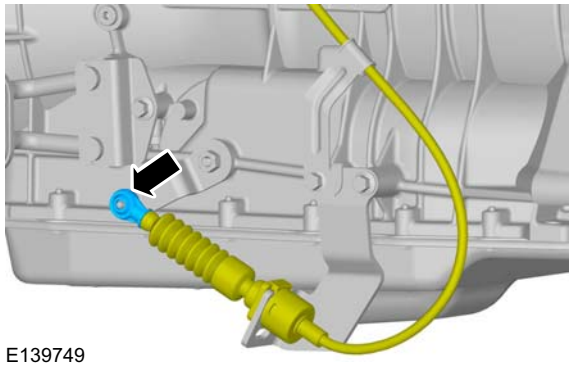
Adjustment

1. Shift the selector lever to the "D" (DRIVE) position.
2. Refer to: Jacking (100-02 Jacking and Lifting, Description and Operation).
   Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. 

4. Rotate the selector lever clockwise until the travel stops. Then rotate the manual lever counterclockwise 3 detents, this should be the (D) position.



5. **NOTE:** NOTE: Ensure that the selector lever cable adjustment mechanism is locked.



6. Refer to: Jacking (100-02 Jacking and Lifting, Description and Operation).
   Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
7. Start the engine and move the selector lever through all the gear positions. Wait until each gear engages when moving through the gear positions.
8. Check that the selector lever position indicator corresponds to the position of the selector lever, repeat the adjustment procedure if necessary.
9. Move the selector lever into the "P" (PARK) position and switch off the engine.

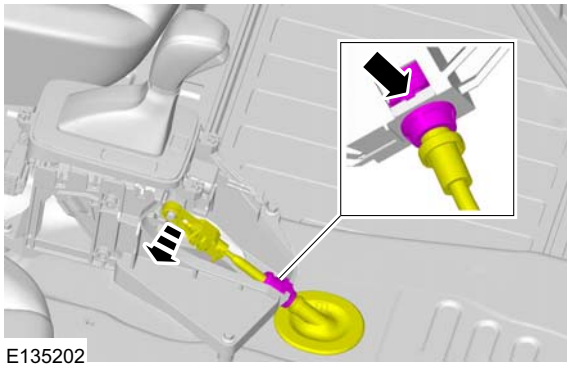
REMOVAL AND INSTALLATION

Selector Lever Assembly

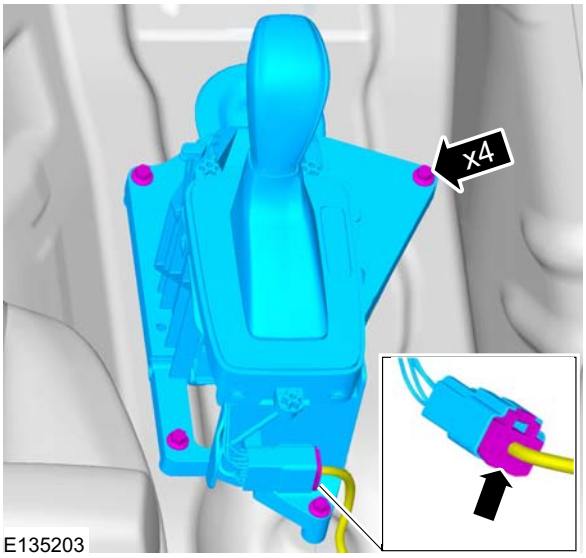
Removal

1. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
   Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

2.



3. Torque: 15 Nm



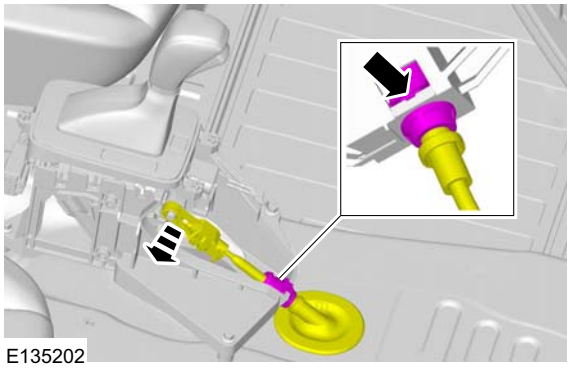
Installation

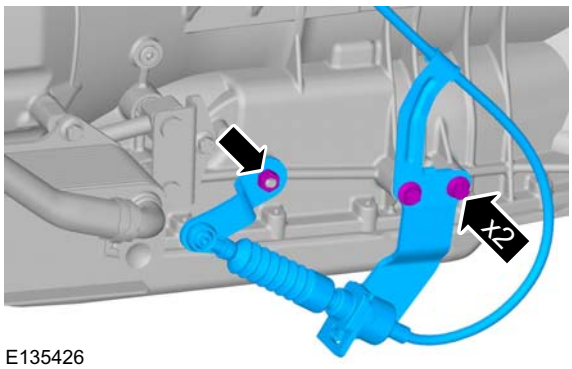
1. To Install, Reverse the removal procedure.

REMOVAL AND INSTALLATION

Selector Lever Cable

Removal

1. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
   Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).
2. 

3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Torque: 25 Nm


Installation

1. To install, reverse the removal procedure.
2. Refer to: Selector Lever Cable Adjustment (307-05 Automatic Transmission/Transaxle External Controls, General Procedures).

SECTION 308-00 Manual Transmission/Transaxle and Clutch - General Information

VEHICLE APPLICATION: 2011.50 Ranger

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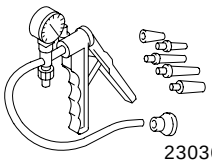
GENERAL PROCEDURES

GENERAL PROCEDURES

Clutch System Bleeding — Vehicles With: MT-75(16 843 0)

Special Tool(s)

 23036A	Vacuum Pump Kit 416-D001 (23-036 A)

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with the eyes. Wash hands thoroughly after handling. If brake fluid contacts the eyes, flush the eyes for 15 minutes with cold running water. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately. Failure to follow these instructions may result in personal injury.

CAUTION: If brake fluid is spilt on the paintwork, the affected area must be immediately washed down with cold water.

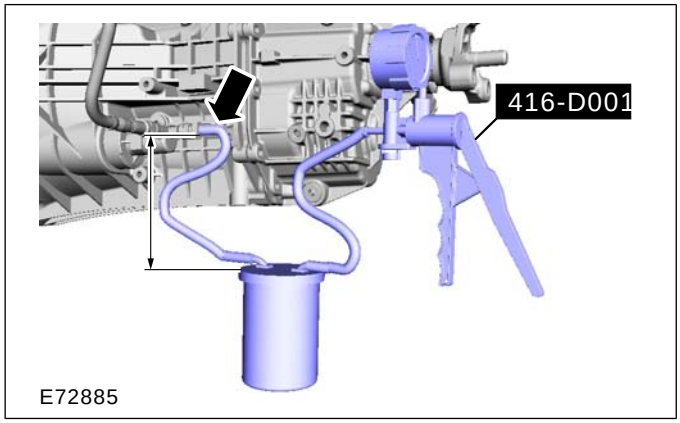
NOTE: If proprietary brake bleeding equipment is available, this can be used to bleed the clutch system, following the method below. The maximum pressure must not exceed 1.5 bar.

NOTE: The clutch control system is self-venting. The components are arranged in such a way that small amounts of air trapped in the system are removed automatically during clutch operation.

1. **Drain the brake fluid reservoir.**
2. **Raise and support the vehicle.**

   For additional information, refer to: Jacking (100-02 Jacking and Lifting, Description and Operation) / Lifting (100-02 Jacking and Lifting, Description and Operation).
3. **Fill the reservoir of the special tool with approximately 100 ml of new brake fluid.**
4. **NOTE: Make sure that the special tool reservoir is positioned lower than the bleed nipple.**

   Install the special tool.

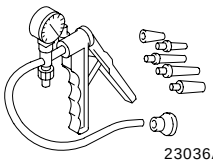


5. **Open the bleed nipple.**
6. **Using the special tool, bleed the clutch system.**
   - Pump approximately 80 ml of brake fluid into the clutch system.
7. **Close the bleed nipple.**
8. **Remove the special tool.**
9. **Lower the vehicle.**
10. **In order to remove any small amounts of trapped air remaining in the system, operate the clutch pedal several times (maximum five times), using the full clutch pedal travel.**
11. **Check the fluid level in the brake fluid reservoir and top up to the MAX mark with brake fluid if necessary.**
12. **Test the clutch control system for normal operation.**
    - Start the engine, depress the clutch pedal, wait two seconds, then carefully engage reverse gear. If there are any abnormal noises, or reverse gear is difficult to engage, repeat the clutch system bleeding procedure.

GENERAL PROCEDURES

Clutch System Bleeding — Vehicles With: MT82(16 843 0)

Special Tool(s)

 23036A	Vacuum Pump Kit 416-D001 (23-036 A)

General Equipment

Syringe

Materials	
Name	**Specification**
Super DOT 4 brake fluid	ESD-M6C57-A / WSSM6C57- A2

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with the eyes. Wash hands thoroughly after handling. If brake fluid contacts the eyes, flush the eyes for 15 minutes with cold running water. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately. Failure to follow these instructions may result in personal injury.

CAUTION: If brake fluid is spilt on the paintwork, the affected area must be immediately washed down with cold water.

NOTE: If proprietary brake bleeding equipment is available, this can be used to bleed the clutch system, following the method below. The maximum pressure must not exceed 1.5 bar.

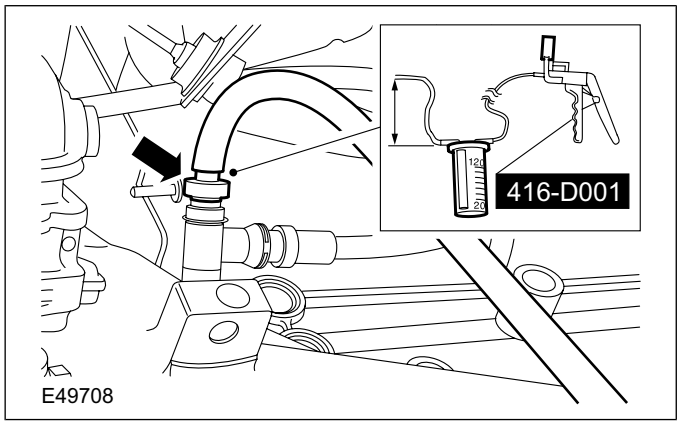
NOTE: The clutch control system is self-venting. The components are arranged in such a way that small amounts of air trapped in the system are removed automatically during clutch operation.

1. **Drain the brake fluid reservoir.**
2. **Raise and support the vehicle.**

   For additional information, refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. **Remove the clutch slave cylinder bleed nipple dust cap.**
4. **NOTE: Make sure that the special tool reservoir is positioned lower than the bleed nipple.**

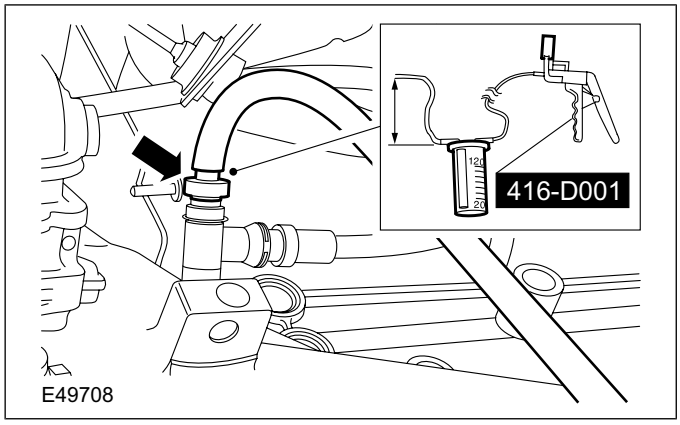
   Install the special tool.

   - Fill the reservoir of the special tool with approximately 100 ml of new Super DOT 4 brake fluid.
   - Connect the reservoir hose to the clutch slave cylinder bleed nipple.



5. **Using the special tool, bleed the clutch system.**

   - Pump approximately 80 ml of the Super DOT 4 brake fluid into the clutch system.
6. **Close the bleed nipple.**
7. **Remove the special tool.**



8. **In order to remove any small amounts of trapped air remaining in the system, operate the clutch pedal several times (maximum five times), using the full clutch pedal travel.**
9. **Lower the vehicle.**

GENERAL PROCEDURES

10. **Check the fluid level in the brake fluid reservoir and top up to the MAX mark with brake fluid if necessary.**
11. **Test the clutch control system for normal operation.**
    - Start the engine, depress the clutch pedal, wait two seconds, then carefully engage reverse gear. If there are any abnormal noises, or reverse gear is difficult to engage, repeat the clutch system bleeding procedure.
12. **CAUTION: The brake fluid reservoir cap must not become contaminated.**

    Install the brake fluid reservoir cap.

SECTION 308-01A Clutch — Vehicles With: 5-Speed Manual Transmission - MT75

VEHICLE APPLICATION: 2011.50 Ranger

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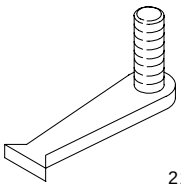
REMOVAL AND INSTALLATION

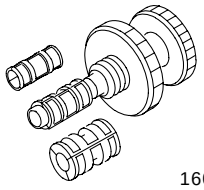
REMOVAL AND INSTALLATION

Clutch Disc and Pressure Plate

Special Tool(s)

 21135	303-254 Locking Tool, Flywheel

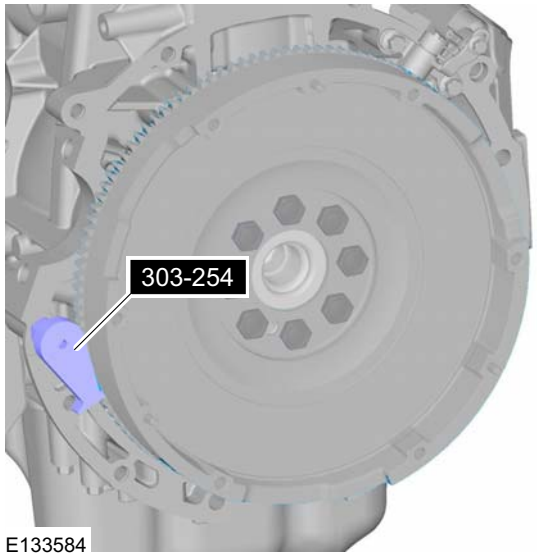
Special Tool(s)

 16067	308-204 Aligner, Clutch Disc

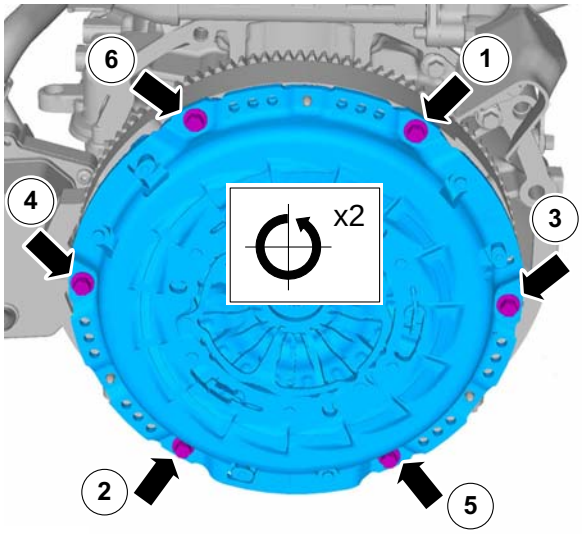
Removal

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. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Transmission - 2WD (308-03 Manual Transmission/Transaxle - Vehicles With: 5-Speed Manual Transmission - MT75, Removal).
   Refer to: Transmission - 4WD (308-03 Manual Transmission/Transaxle - Vehicles With: 5-Speed Manual Transmission - MT75, Removal).
4. Special Tool(s): 303-254



5. **CAUTION: Loosen the clutch pressure plate retaining bolts by two turns at a time in the sequence shown.**

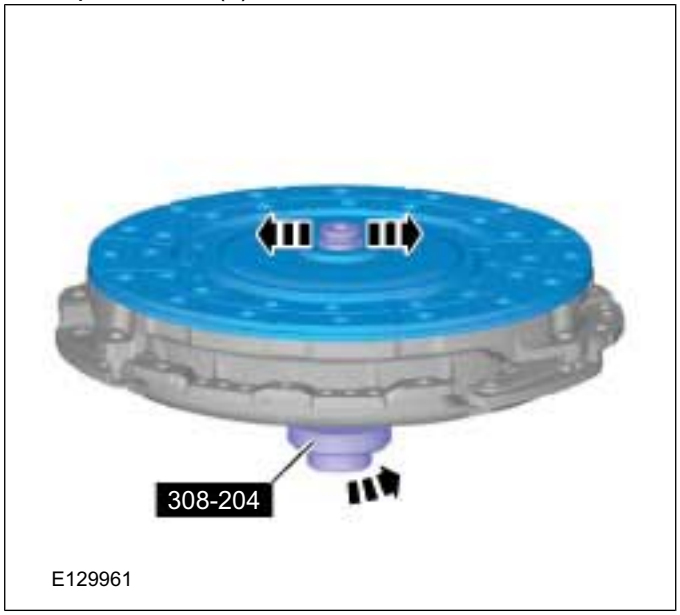


REMOVAL AND INSTALLATION

Installation

1. Using the special tool, centralize the clutch disc on the pressure plate.

   Special Tool(s): 308-204



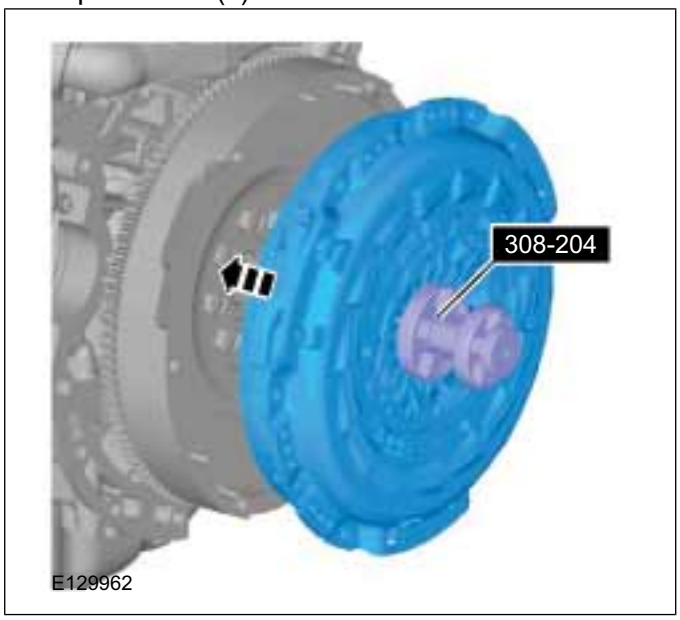
2. **NOTE:** Check the pilot bearing for damage. If damaged, install a new pilot bearing.

   NOTE: Do not apply grease to a newly installed pilot bearing.

   Refer to: Pilot Bearing - 2.5L Duratec-HE (122kW/165PS) - MI4 (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).

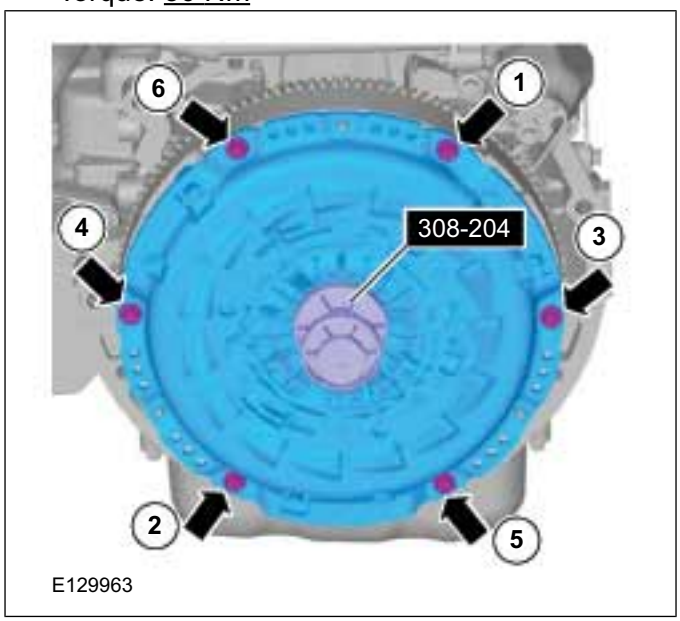
3. **NOTE:** Hand tighten the bolts at this stage.

   Special Tool(s): 308-204

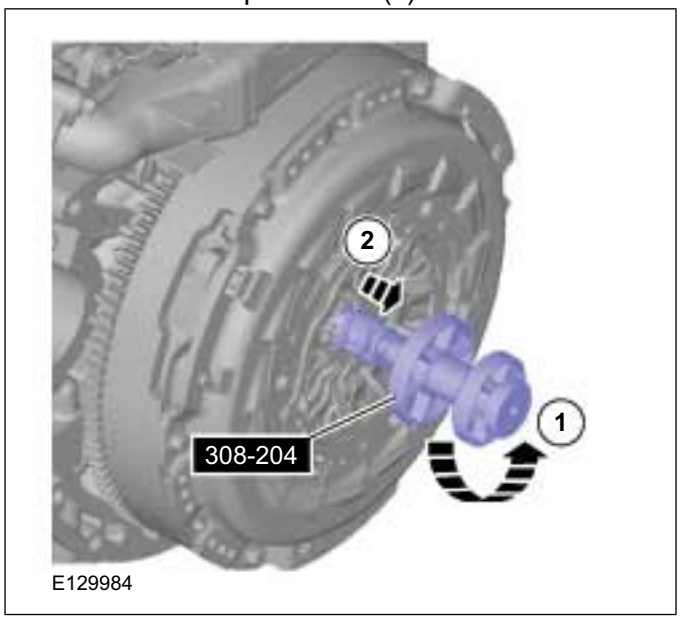


4. **CAUTION: Tighten the clutch pressure plate retaining bolts in the sequence shown to the specified torque.**

   Special Tool(s): 308-204
   Torque: 30 Nm

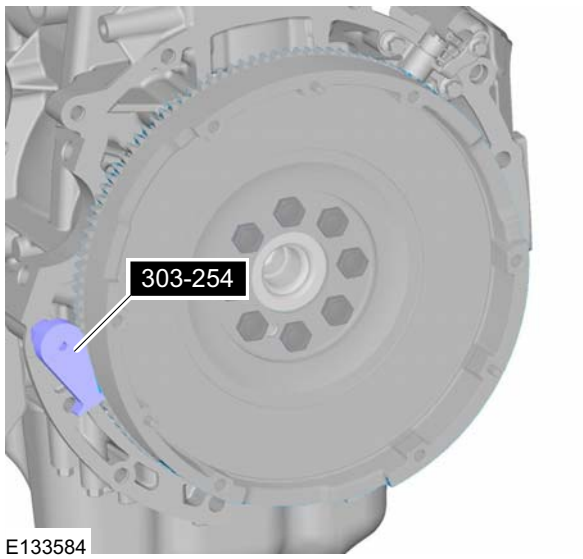


5. Remove the Special Tool(s): 308-204



REMOVAL AND INSTALLATION

6. Remove the Special Tool(s): 303-254

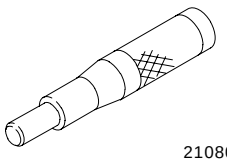


7. Refer to: Transmission - 2WD (308-03 Manual Transmission/Transaxle - Vehicles With: 5-Speed Manual Transmission - MT75, Installation).
   Refer to: Transmission - 4WD (308-03 Manual Transmission/Transaxle - Vehicles With: 5-Speed Manual Transmission - MT75, Installation).

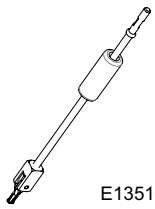
REMOVAL AND INSTALLATION

Pilot Bearing — 2.5L Duratec-HE (122kW/165PS) - MI4

Special Tool(s)

 21080	303-132 Installer/Aligner, Pilot Bearing/Clutch Plate

Special Tool(s)

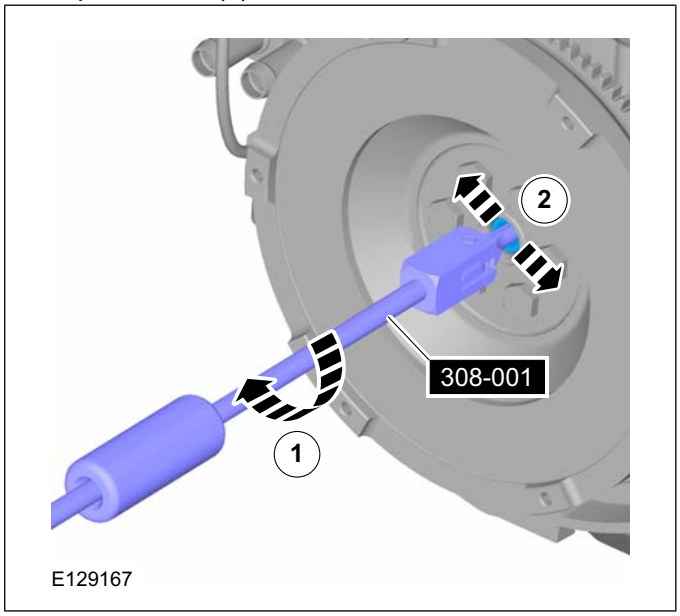
 E135106	308-001 Remover Pilot Bearing

Removal

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

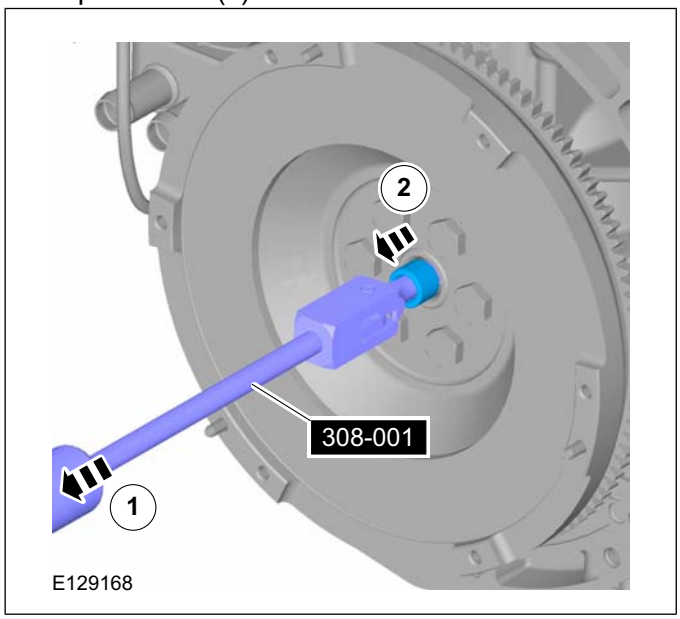
1. Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).

2. Special Tool(s): 308-001



E129167

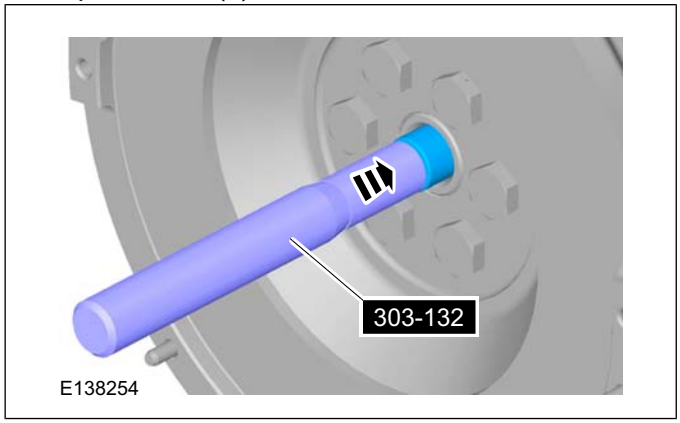
3. Special Tool(s): 308-001



E129168

Installation

1. Special Tool(s): 303-132

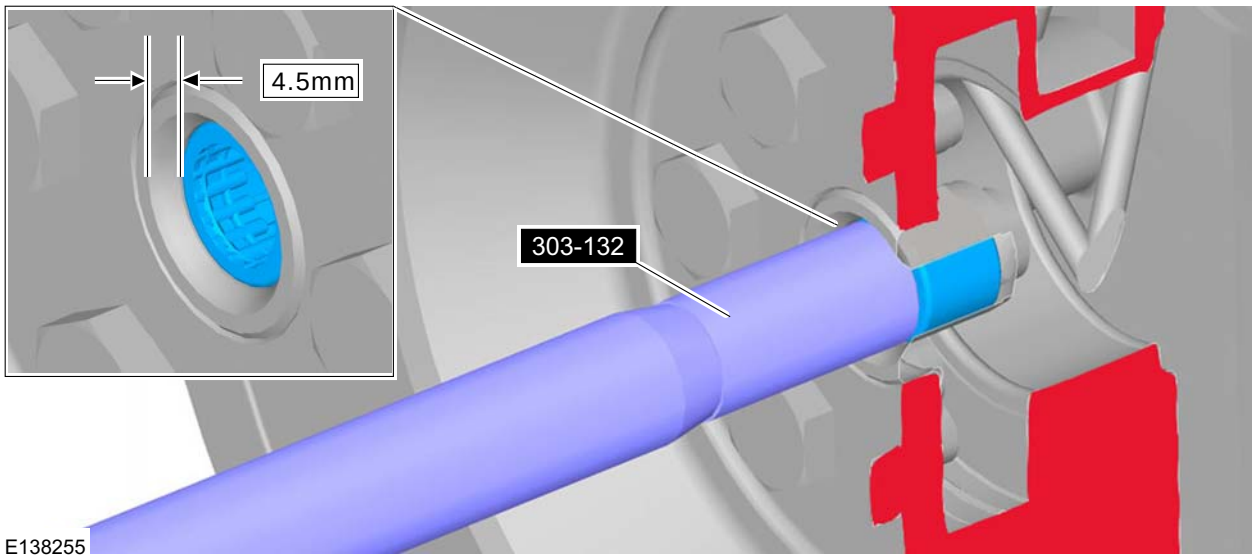


E138254

2. **CAUTION: Make sure that the pilot bearing is correctly installed.**

   Special Tool(s): 303-132

REMOVAL AND INSTALLATION

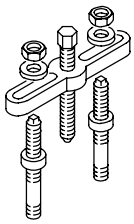


3. Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).

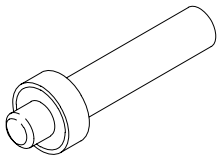
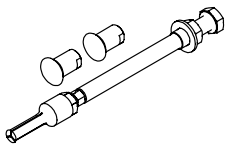
REMOVAL AND INSTALLATION

Pilot Bearing — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma

Special Tool(s)

	205-311 Remover, Bearing/Gear

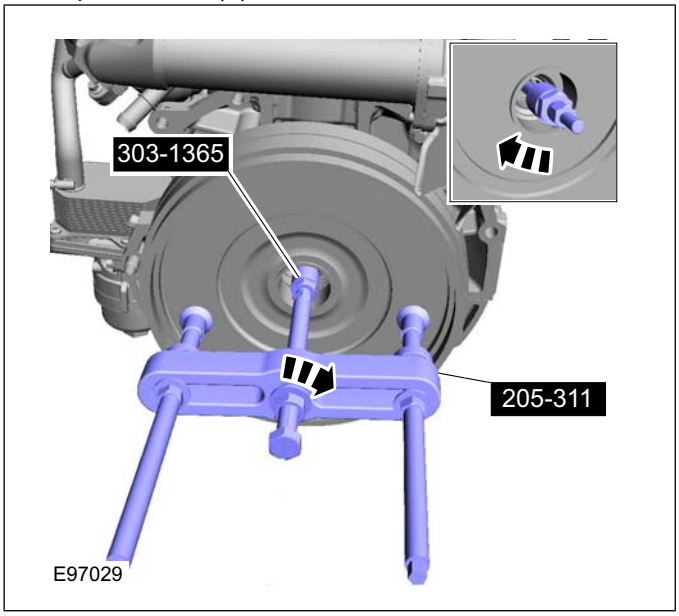
Special Tool(s)

	303-090 Installer, Crankshaft Pilot Bearing
 E92318	303-1365 Remover, Crankshaft Pilot Bearing

Removal

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

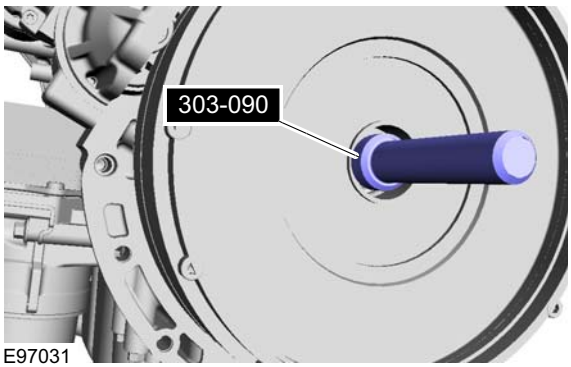
1. Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 6-Speed Manual Transmission - MT82, Removal and Installation).
   Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).
2. Special Tool(s): 205-311, 303-1365



REMOVAL AND INSTALLATION

Installation

1. Special Tool(s): 303-090



2. Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 6-Speed Manual Transmission - MT82, Removal and Installation).
   Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).

SECTION 308-01B Clutch — Vehicles With: 6-Speed Manual Transmission - MT82

VEHICLE APPLICATION: 2011.50 Ranger

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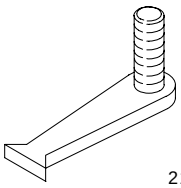
REMOVAL AND INSTALLATION

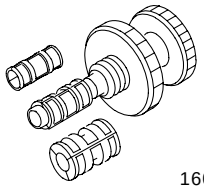
REMOVAL AND INSTALLATION

Clutch Disc and Pressure Plate

Special Tool(s)

 21135	303-254 Locking Tool, Flywheel

Special Tool(s)

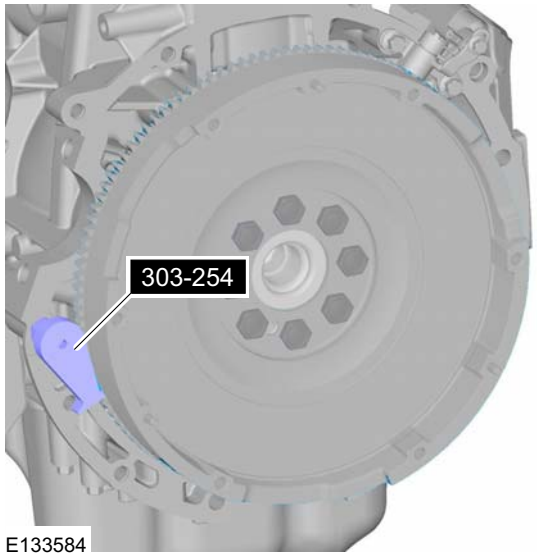
 16067	308-204 Aligner, Clutch Disc

Removal

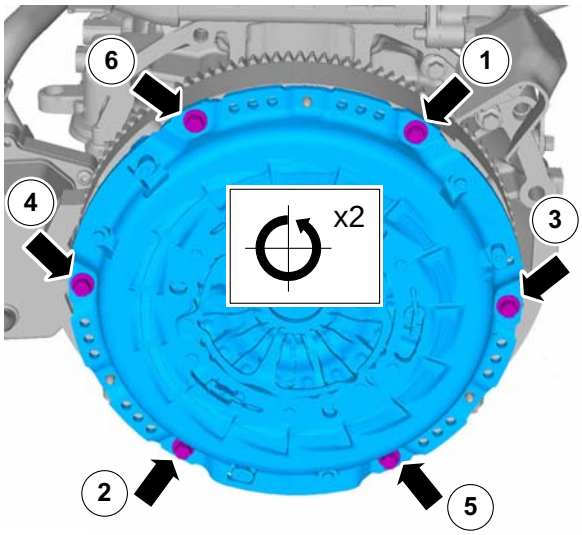
NOTE: Removal steps in this procedure may contain installation details.

REMOVAL AND INSTALLATION

1. Refer to: 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: Transmission - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, 2WD (308-03 Manual Transmission/Transaxle - Vehicles With: 6-Speed Manual Transmission - MT82, Removal).
   Refer to: Transmission - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, 4WD (308-03 Manual Transmission/Transaxle - Vehicles With: 6-Speed Manual Transmission - MT82, Removal).
4. Special Tool(s): 303-254



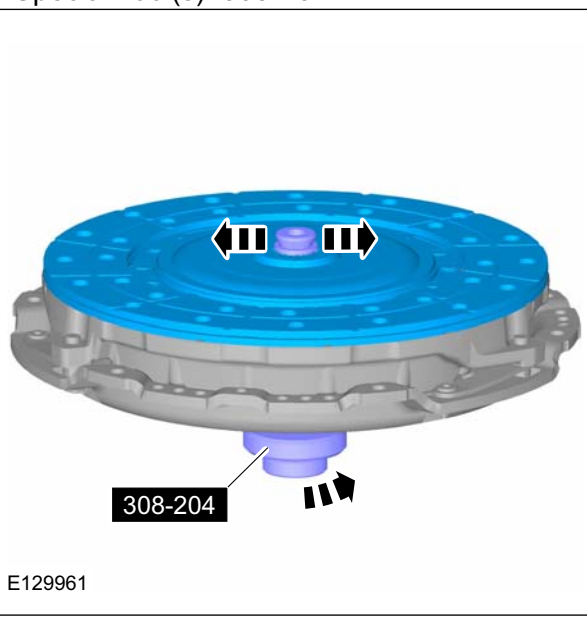
5. **CAUTION: Loosen the clutch pressure plate retaining bolts by two turns at a time in the sequence shown.**



Installation

1. Using the special tool, centralize the clutch disc on the pressure plate.

   Special Tool(s): 308-204



2. **NOTE:** Check the pilot bearing for damage. If damaged, install a new pilot bearing.

   NOTE: Do not apply grease to a newly installed pilot bearing.

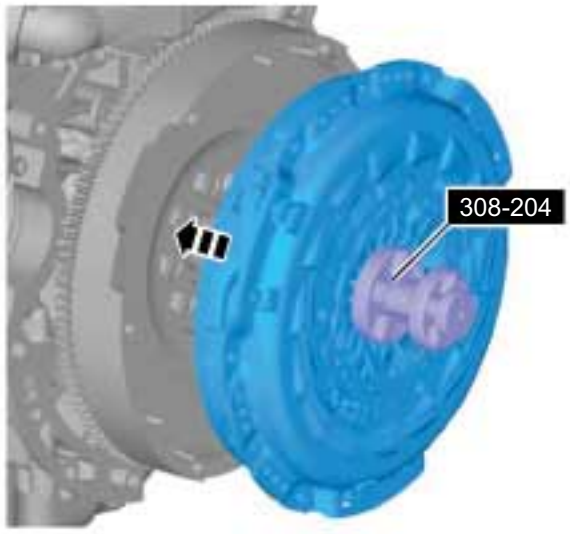
   Refer to: Pilot Bearing - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi

REMOVAL AND INSTALLATION

(110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).

3. **NOTE:** Hand tighten the bolts at this stage.

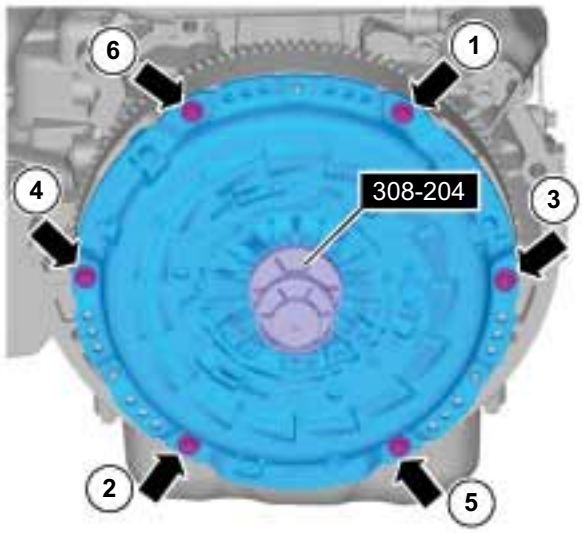
   Special Tool(s): 308-204



E129962

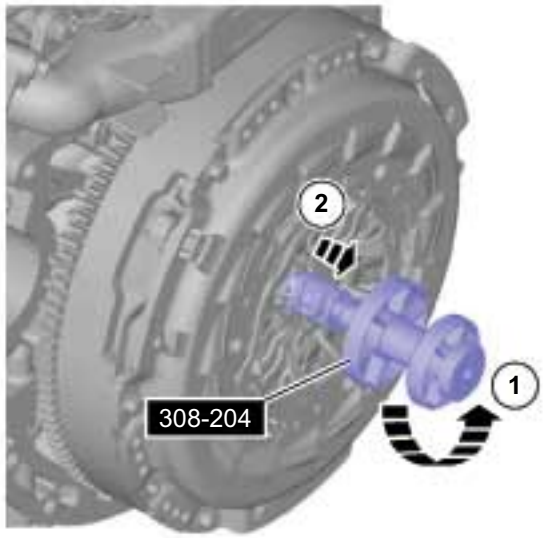
4. ⚠ **CAUTION: Tighten the clutch pressure plate retaining bolts in the sequence shown to the specified torque.**

   Special Tool(s): 308-204
   Torque: 30 Nm



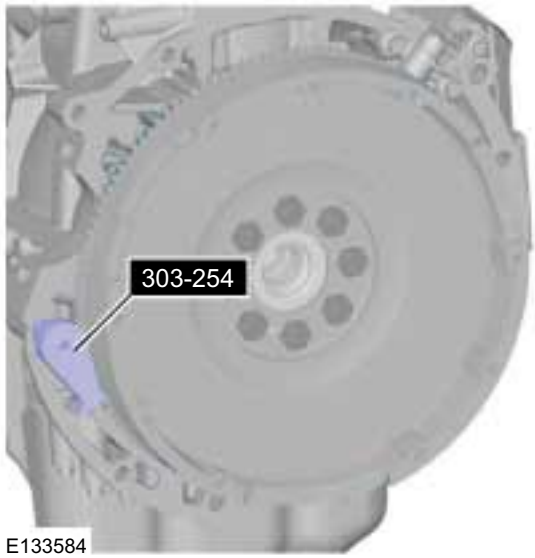
E129963

5. Remove the Special Tool(s): 308-204



E129984

6. Remove the Special Tool(s): 303-254



E133584

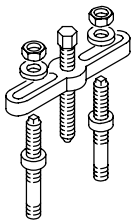
REMOVAL AND INSTALLATION

7. Refer to: Transmission - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, 2WD (308-03 Manual Transmission/Transaxle - Vehicles With: 6-Speed Manual Transmission - MT82, Installation).
   Refer to: Transmission - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, 4WD (308-03 Manual Transmission/Transaxle - Vehicles With: 6-Speed Manual Transmission - MT82, Installation).

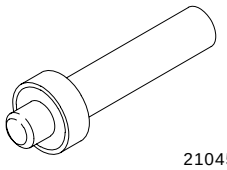
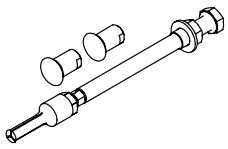
REMOVAL AND INSTALLATION

Pilot Bearing — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma

Special Tool(s)

 15092	205-311 Remover, Bearing/Gear

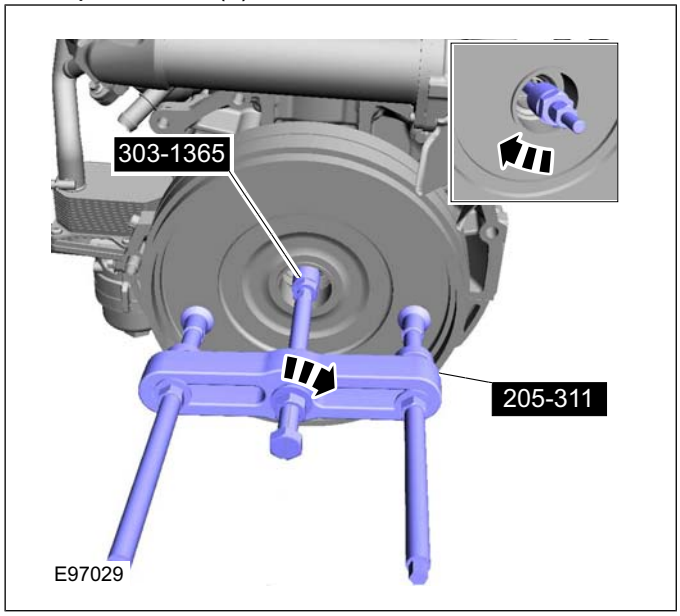
Special Tool(s)

 21045	303-090 Installer, Crankshaft Pilot Bearing
 E92318	303-1365 Remover, Crankshaft Pilot Bearing

Removal

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

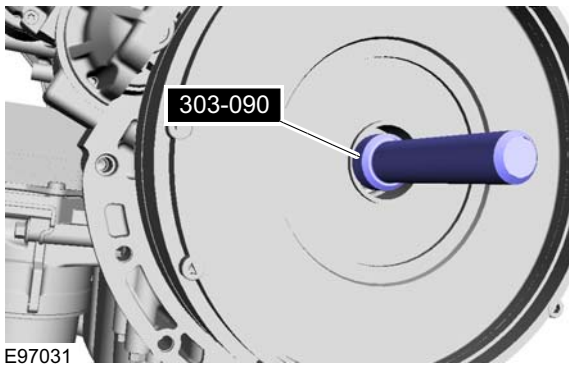
1. Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 6-Speed Manual Transmission - MT82, Removal and Installation).
   Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).
2. Special Tool(s): 205-311, 303-1365



REMOVAL AND INSTALLATION

Installation

1. Special Tool(s): 303-090



2. Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 6-Speed Manual Transmission - MT82, Removal and Installation).
   Refer to: Clutch Disc and Pressure Plate (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).

SECTION 308-02A Clutch Controls — Vehicles With: 5-Speed Manual Transmission - MT75

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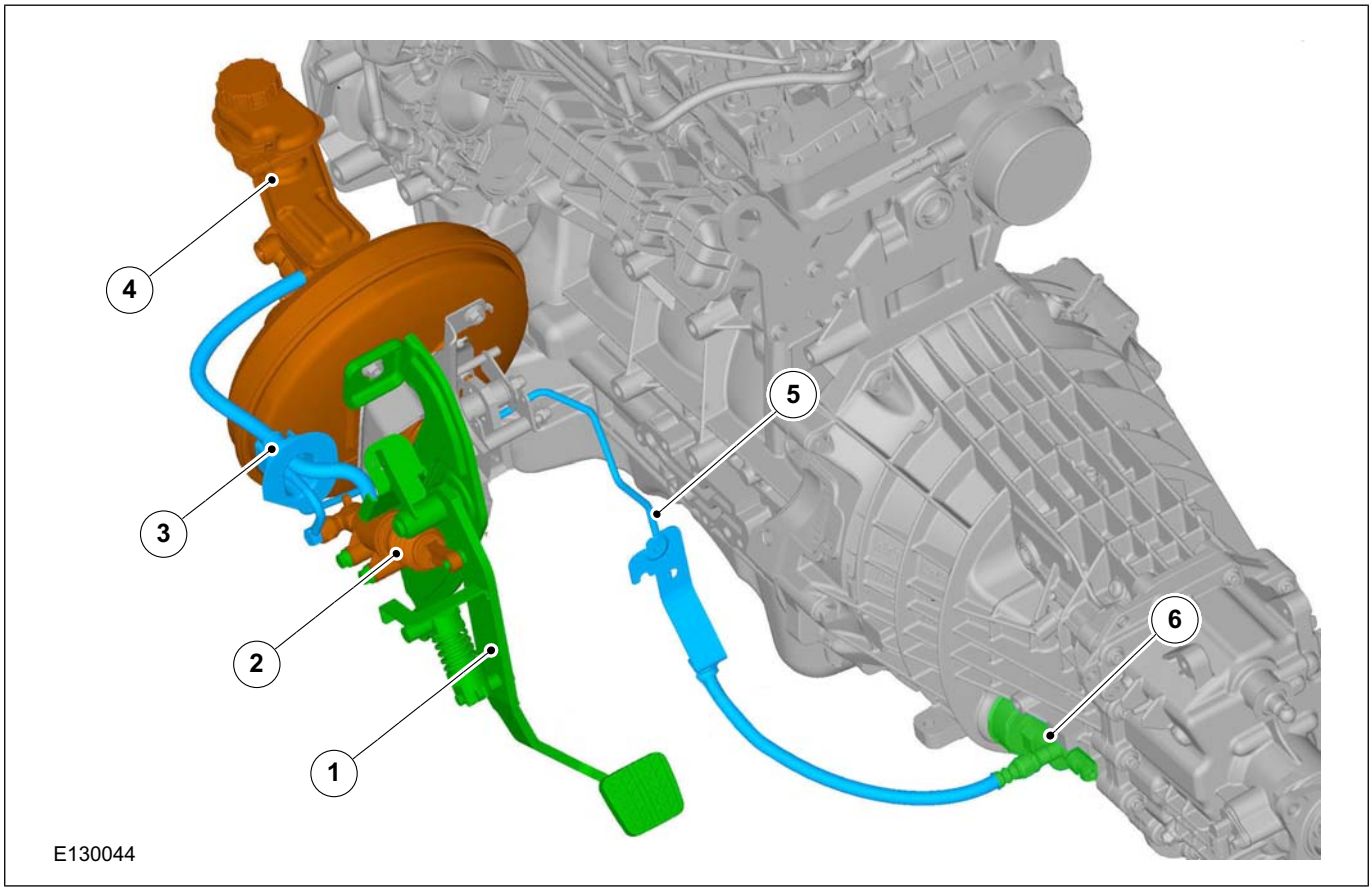
DESCRIPTION AND OPERATION

Clutch Controls



Item	Part Number	Description
1		Clutch pedal
2		Clutch master cylinder
3		Master cylinder fluid tube
4		Hydraulic fluid reservior
5		Slave cylinder fluid tube
6		Clutch slave cylinder

REMOVAL AND INSTALLATION

Clutch Master Cylinder

Removal

CAUTION: If brake fluid is spilt on the paintwork, the affected area must be immediately washed down with cold water.

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

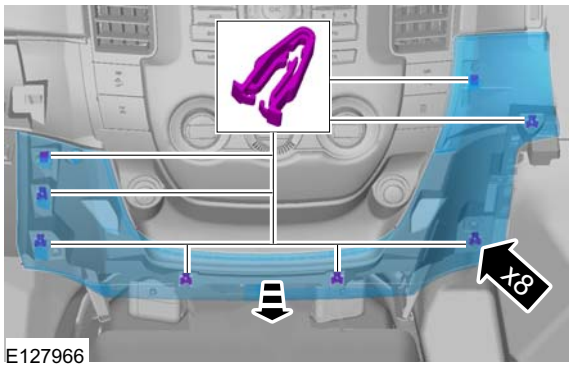
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

Vehicles with driver lower air bag

3. Refer to: Driver Lower Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation).

Vehicles without driver lower air bag

4.



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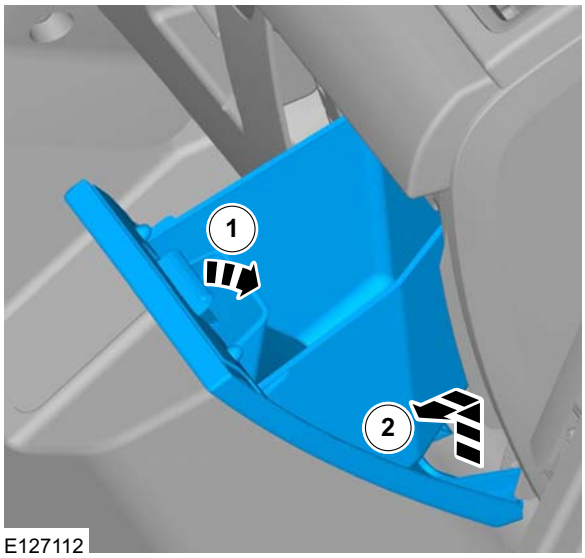
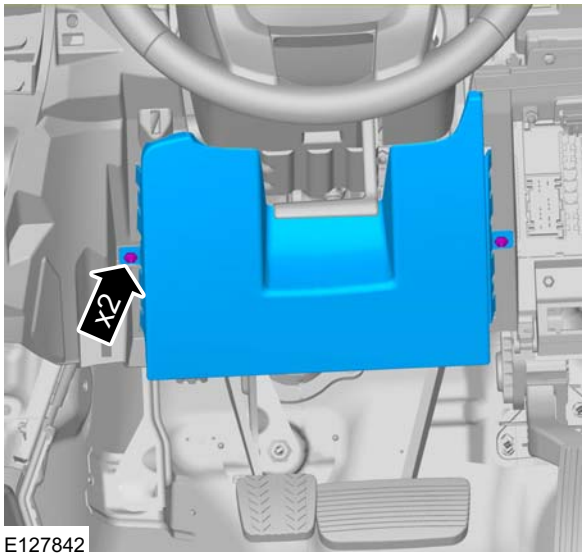
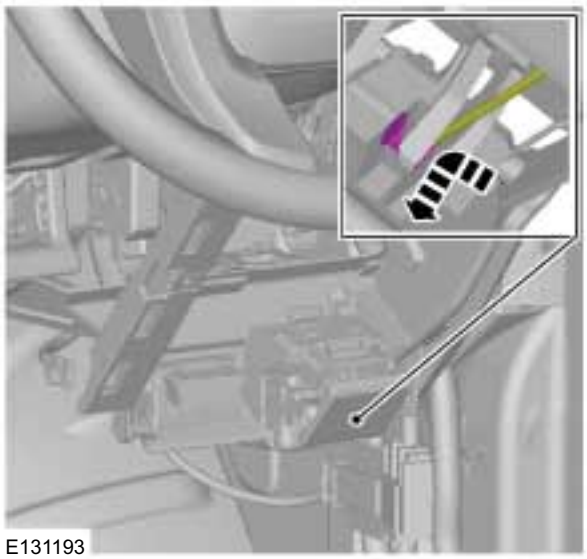


6. Torque: 2 Nm



REMOVAL AND INSTALLATION

7.



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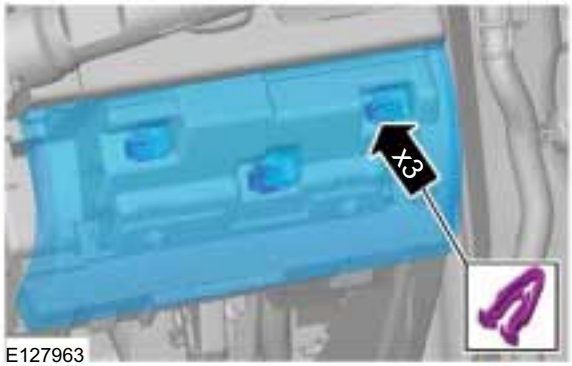
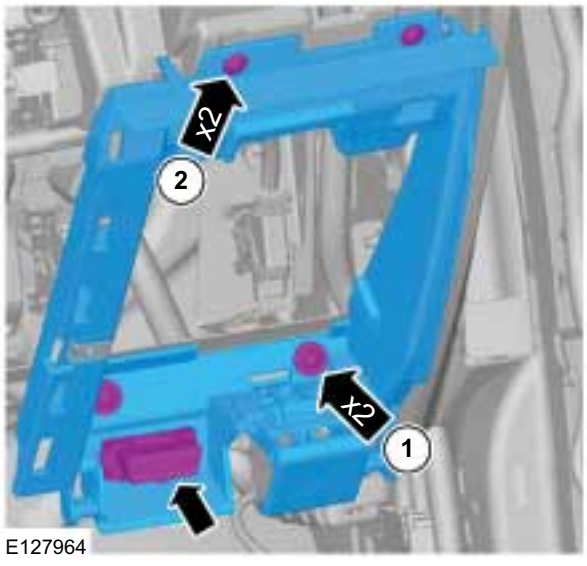
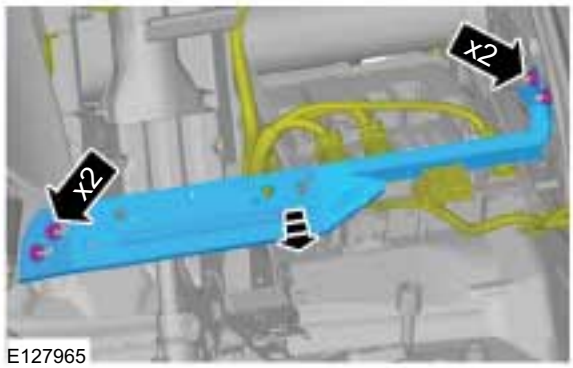


9. 1. Torque: 3 Nm
2. Torque: 2 Nm



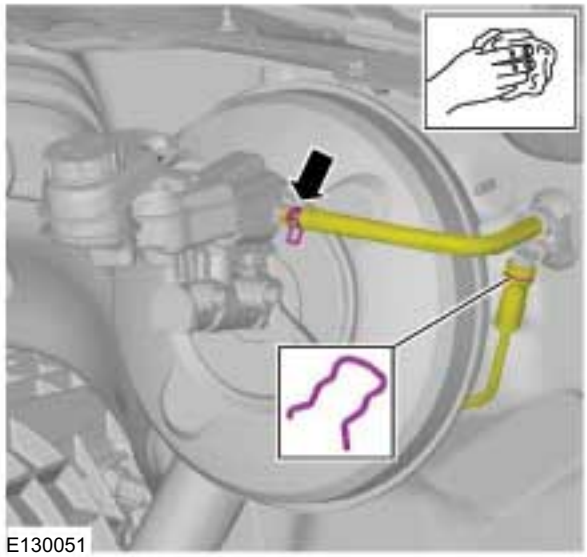
10. Torque: 10 Nm



Left-hand drive vehicles

11. **WARNING: Be prepared to collect escaping fluids.**

NOTE: Cap the clutch master cylinder supply hose to prevent fluid loss or dirt ingress.

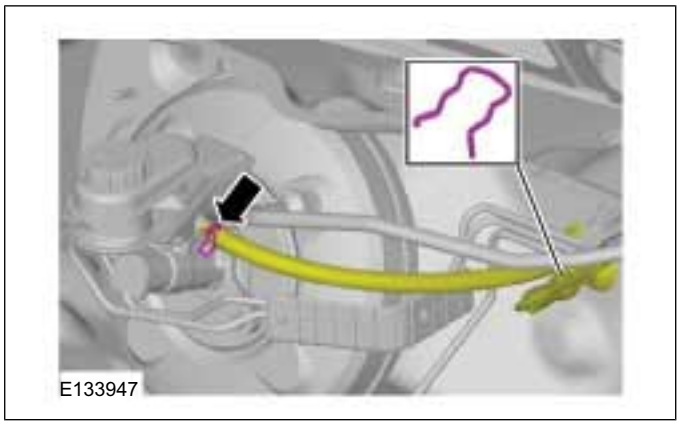


Right-hand drive vehicles

12. **WARNING: Be prepared to collect escaping fluids.**

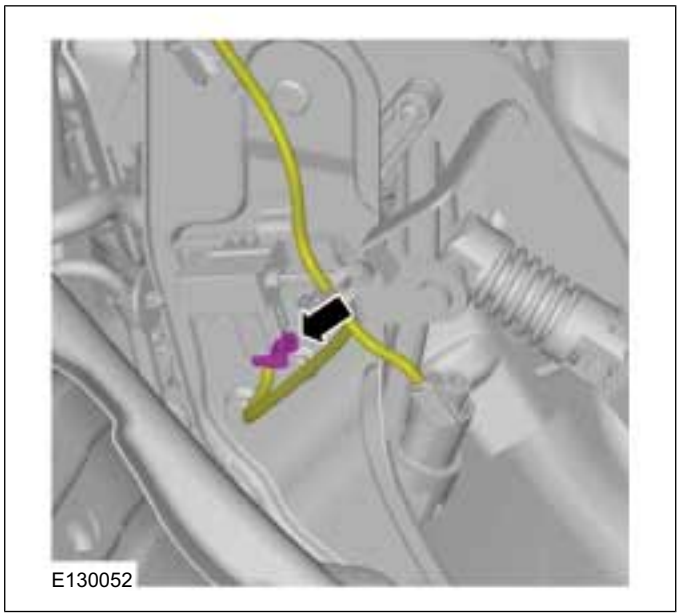
REMOVAL AND INSTALLATION

NOTE: Cap the clutch master cylinder supply hose to prevent fluid loss or dirt ingress.



All vehicles

13.



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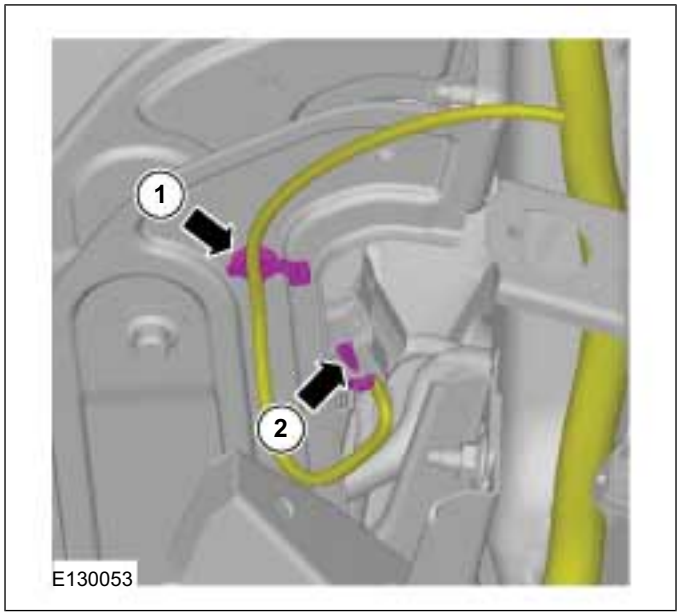
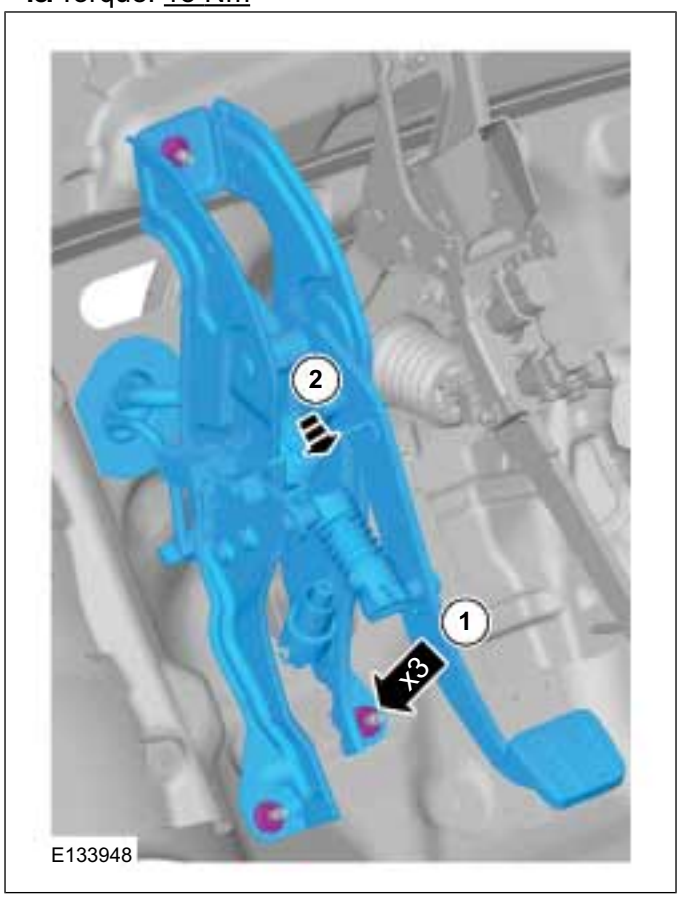
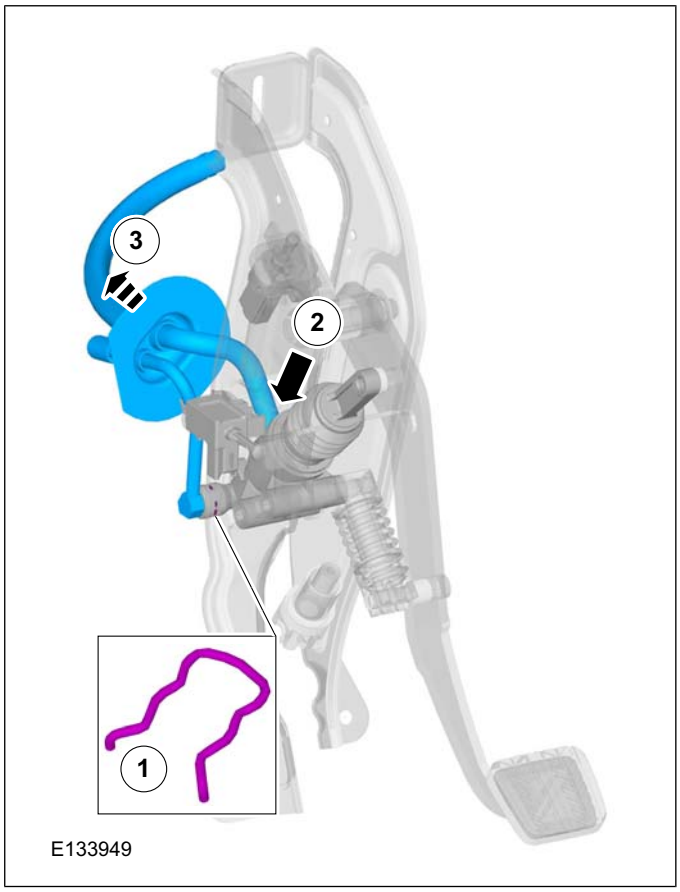


15. Torque: 15 Nm

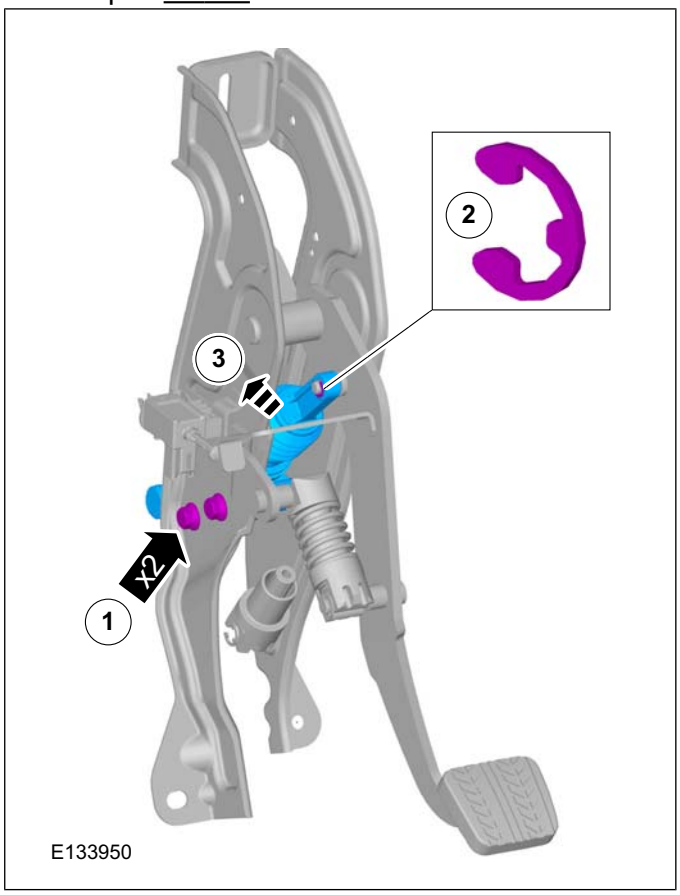


REMOVAL AND INSTALLATION

16.



17. Torque: 20 Nm



Installation

1. To install, reverse the removal procedure.
2. Refer to: Clutch System Bleeding - Vehicles With: MT-75 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).
   Refer to: Clutch System Bleeding - Vehicles With: MT82 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).

REMOVAL AND INSTALLATION

Clutch Slave Cylinder

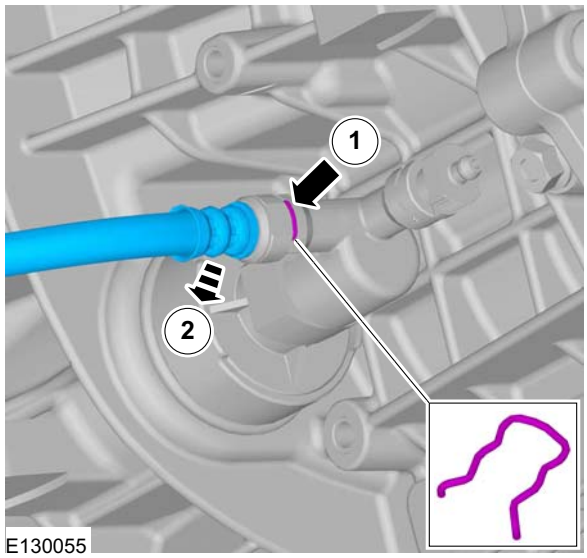
Removal

CAUTION: If the fluid is spilled on the paintwork, the affected area must be immediately washed down with cold water.

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

1. Refer to: Clutch System Bleeding - Vehicles With: MT-75 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).

2.



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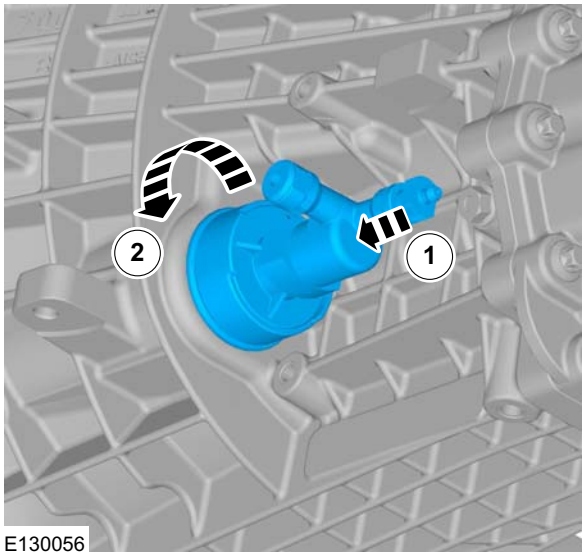
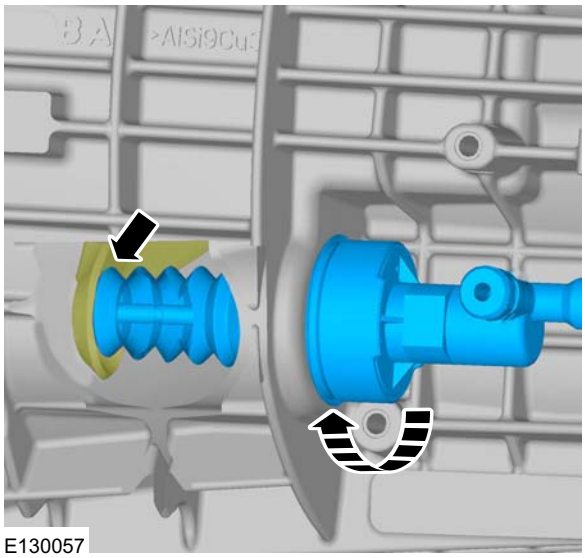


Installation

1. To install, reverse the removal procedure.
2. **CAUTION: Make sure that the clutch slave cylinder actuating rod is correctly engaged with the clutch release lever.**



REMOVAL AND INSTALLATION

3. Refer to: Clutch System Bleeding - Vehicles With: MT-75 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).

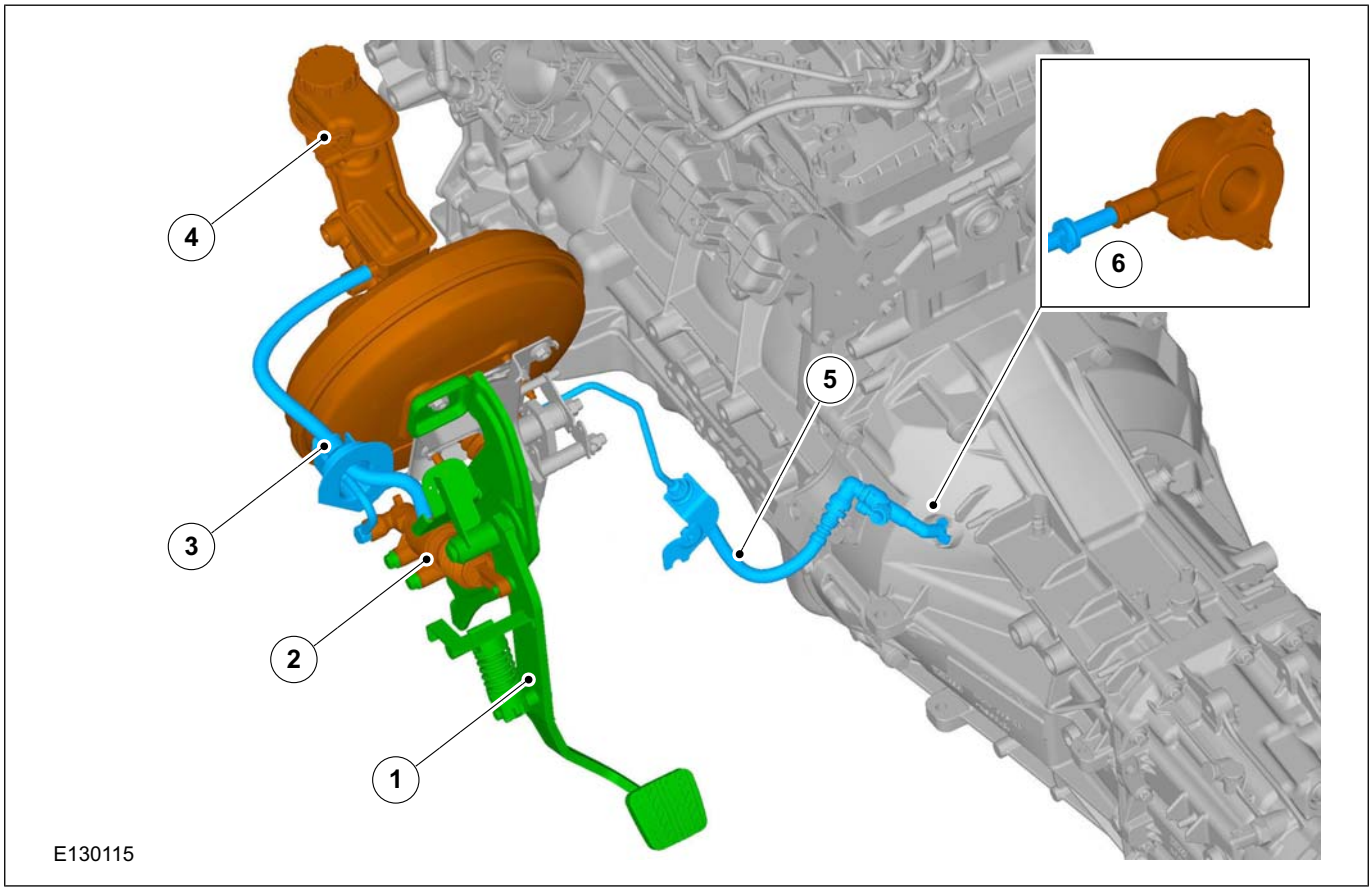
SECTION 308-02B Clutch Controls — Vehicles With: 6-Speed Manual Transmission - MT82

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Clutch Controls – Component Location



Item	Description
1	Clutch pedal
2	Clutch master cylinder
3	Master cylinder fluid tube

Item	Description
4	Hydraulic fluid reservior
5	Slave cylinder fluid tube
6	Clutch slave cylinder

REMOVAL AND INSTALLATION

Clutch Master Cylinder

Removal

CAUTION: If brake fluid is spilt on the paintwork, the affected area must be immediately washed down with cold water.

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

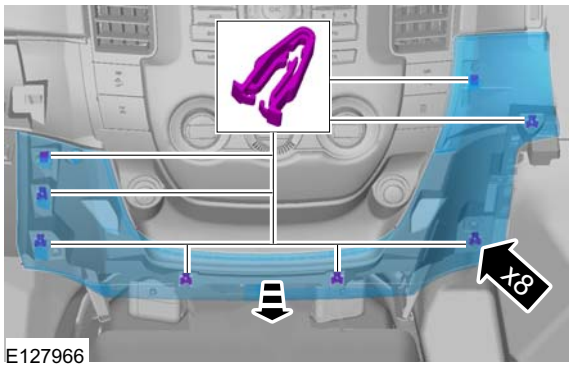
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

Vehicles with driver lower air bag

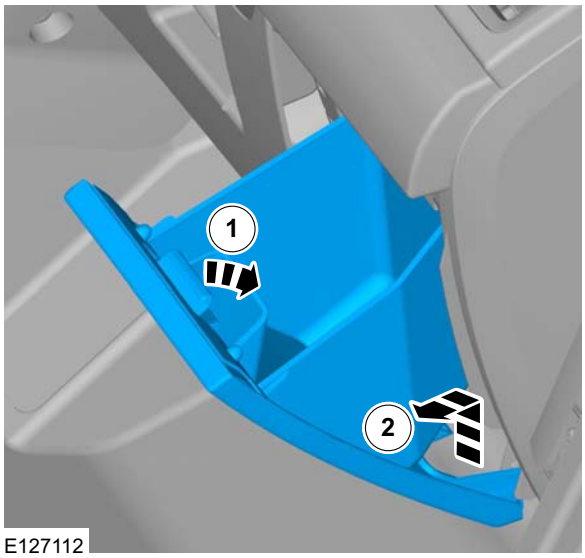
3. Refer to: Driver Lower Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation).

Vehicles without driver lower air bag

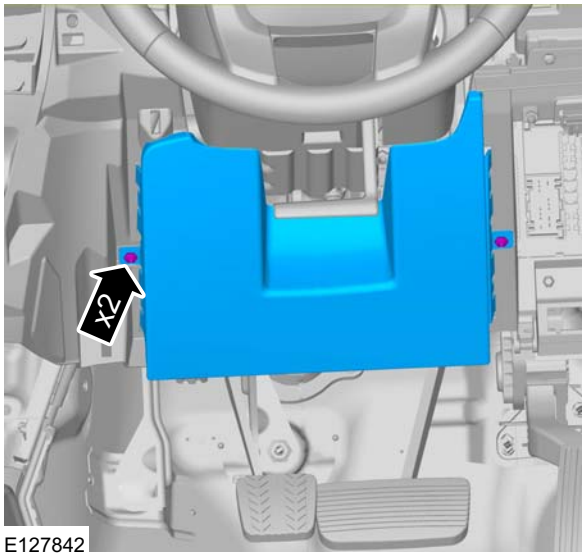
4.



5.

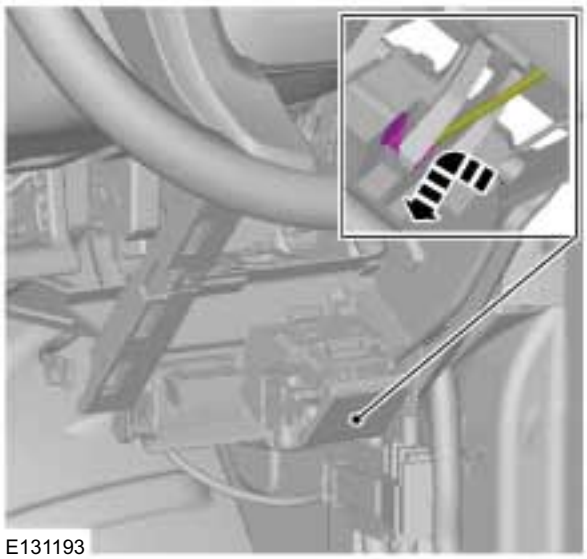


6. Torque: 2 Nm

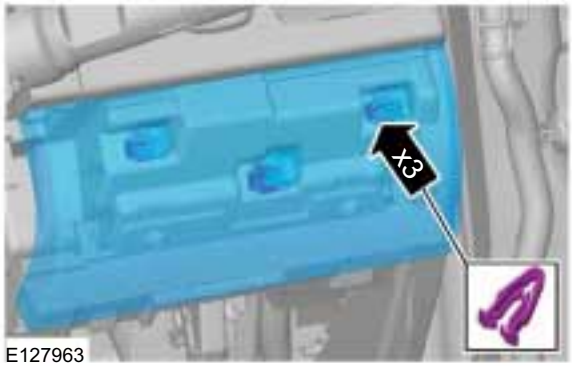


REMOVAL AND INSTALLATION

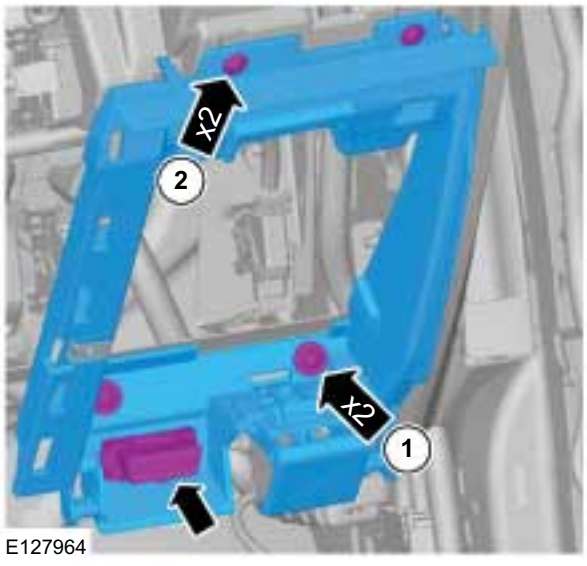
7.



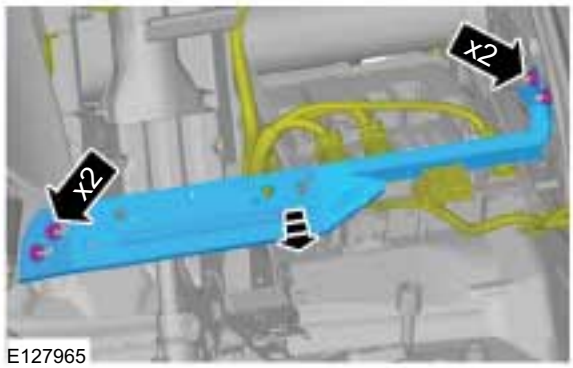
8.



9. 1. Torque: 3 Nm
2. Torque: 2 Nm



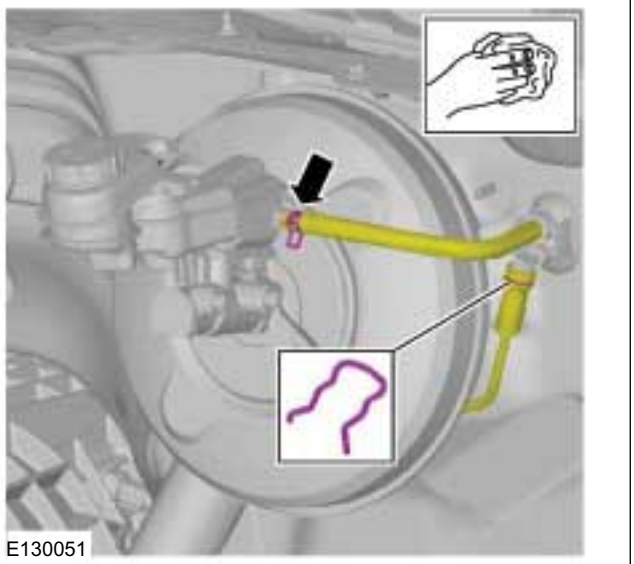
10. Torque: 10 Nm



Left-hand drive vehicles

11. **WARNING: Be prepared to collect escaping fluids.**

NOTE: Cap the clutch master cylinder supply hose to prevent fluid loss or dirt ingress.

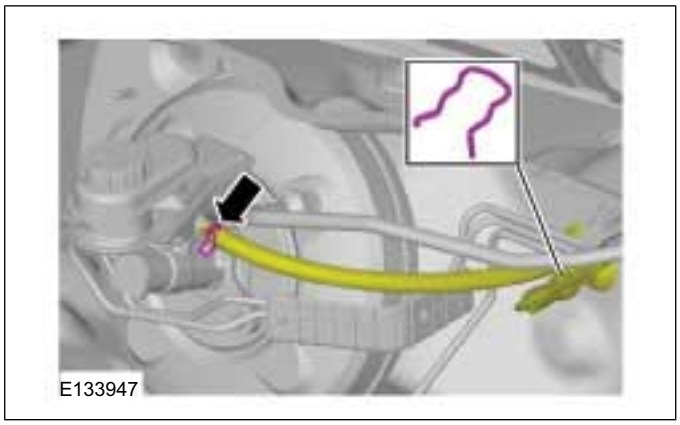


Right-hand drive vehicles

12. **WARNING: Be prepared to collect escaping fluids.**

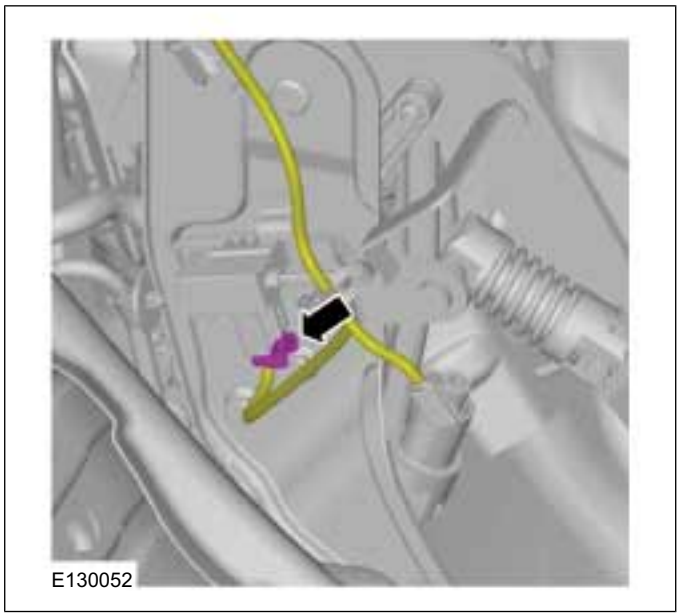
REMOVAL AND INSTALLATION

NOTE: Cap the clutch master cylinder supply hose to prevent fluid loss or dirt ingress.



All vehicles

13.



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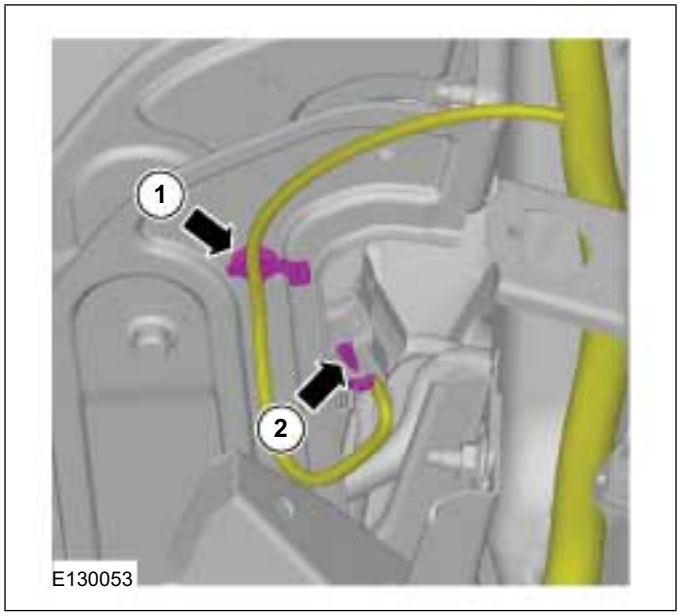
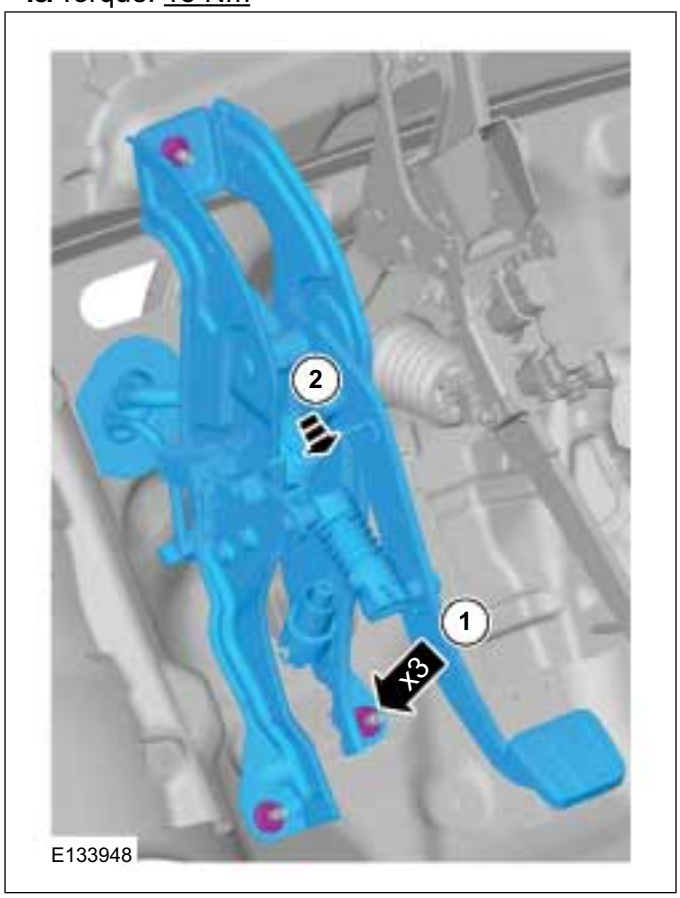
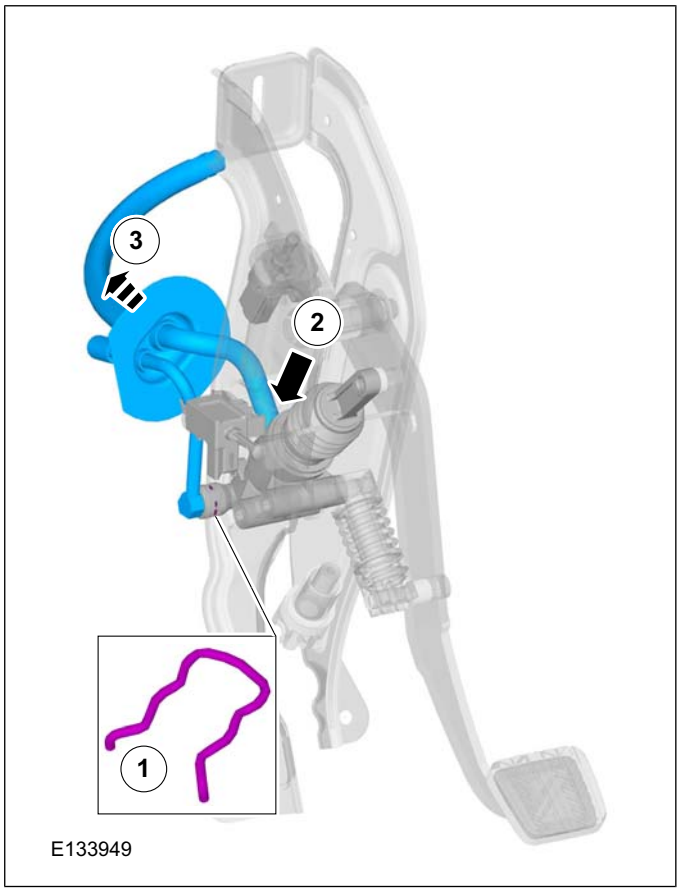


15. Torque: 15 Nm

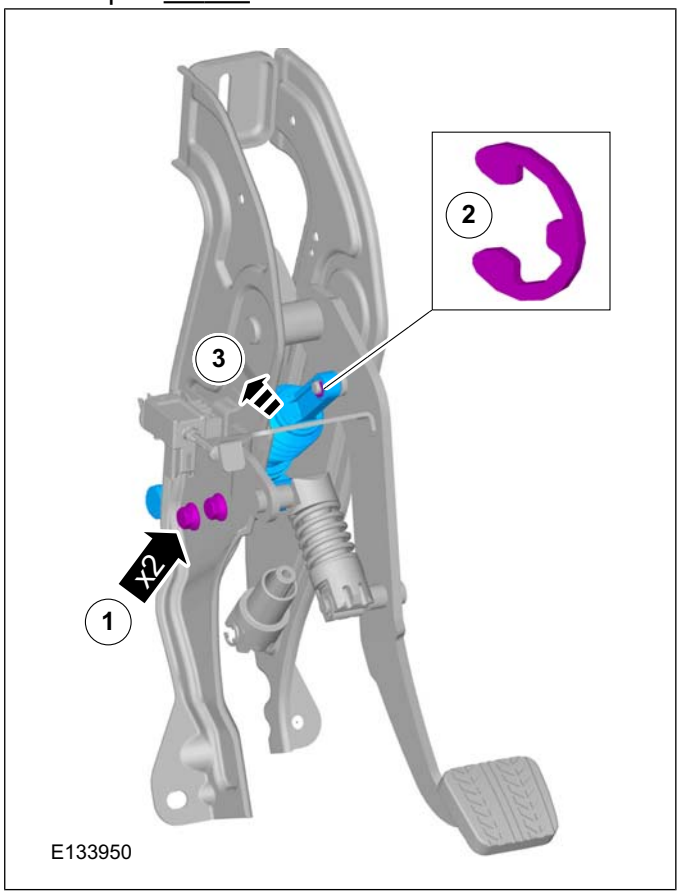


REMOVAL AND INSTALLATION

16.



17. Torque: 20 Nm



Installation

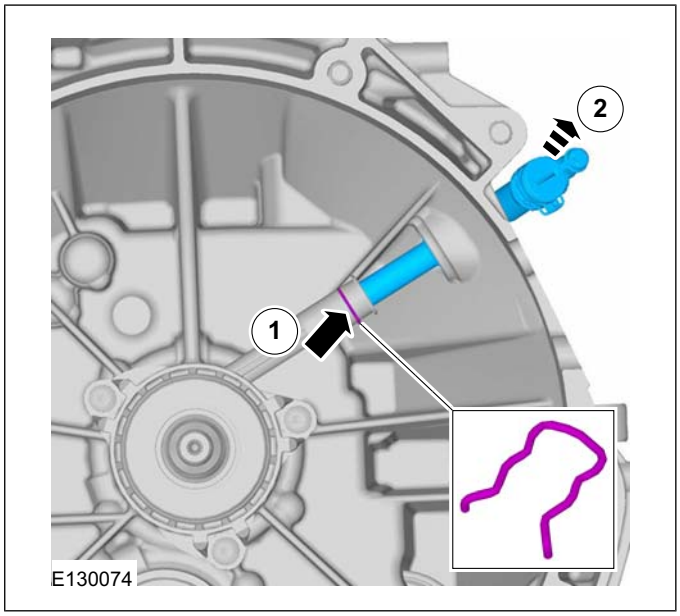
1. To install, reverse the removal procedure.
2. Refer to: Clutch System Bleeding - Vehicles With: MT-75 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).
   Refer to: Clutch System Bleeding - Vehicles With: MT82 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).

REMOVAL AND INSTALLATION

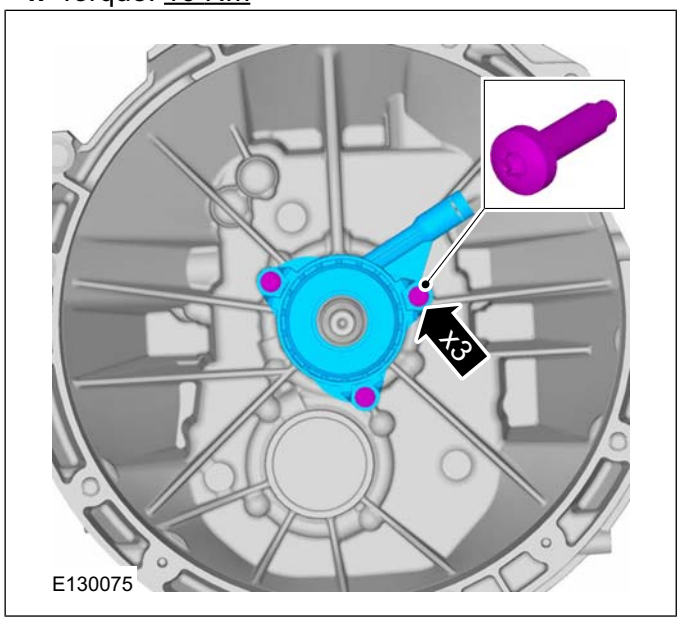
Clutch Slave Cylinder

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. Refer to: Transmission - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, 2WD (308-03 Manual Transmission/Transaxle - Vehicles With: 6-Speed Manual Transmission - MT82, Removal).
   Refer to: Transmission - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, 4WD (308-03 Manual Transmission/Transaxle - Vehicles With: 6-Speed Manual Transmission - MT82, Removal).
3. 

4. Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.
2. Refer to: Clutch System Bleeding - Vehicles With: MT82 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).

SECTION 308-03A Manual Transmission/Transaxle —

Vehicles With: 5-Speed Manual Transmission - MT75

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

SPECIFICATIONS

Lubricants, Fluids, Sealers and Adhesives

Item	Specification
Manual transmission fluid	WSD-M2C200-C
Sealant	WSK-M2G348-A8 / WSS-M2G348-A10
Grease	ESD-M1C220-A
Thread-locking compound	SDM-4G9107-A

Capacities

	Litres
MT75 transmission	1.7

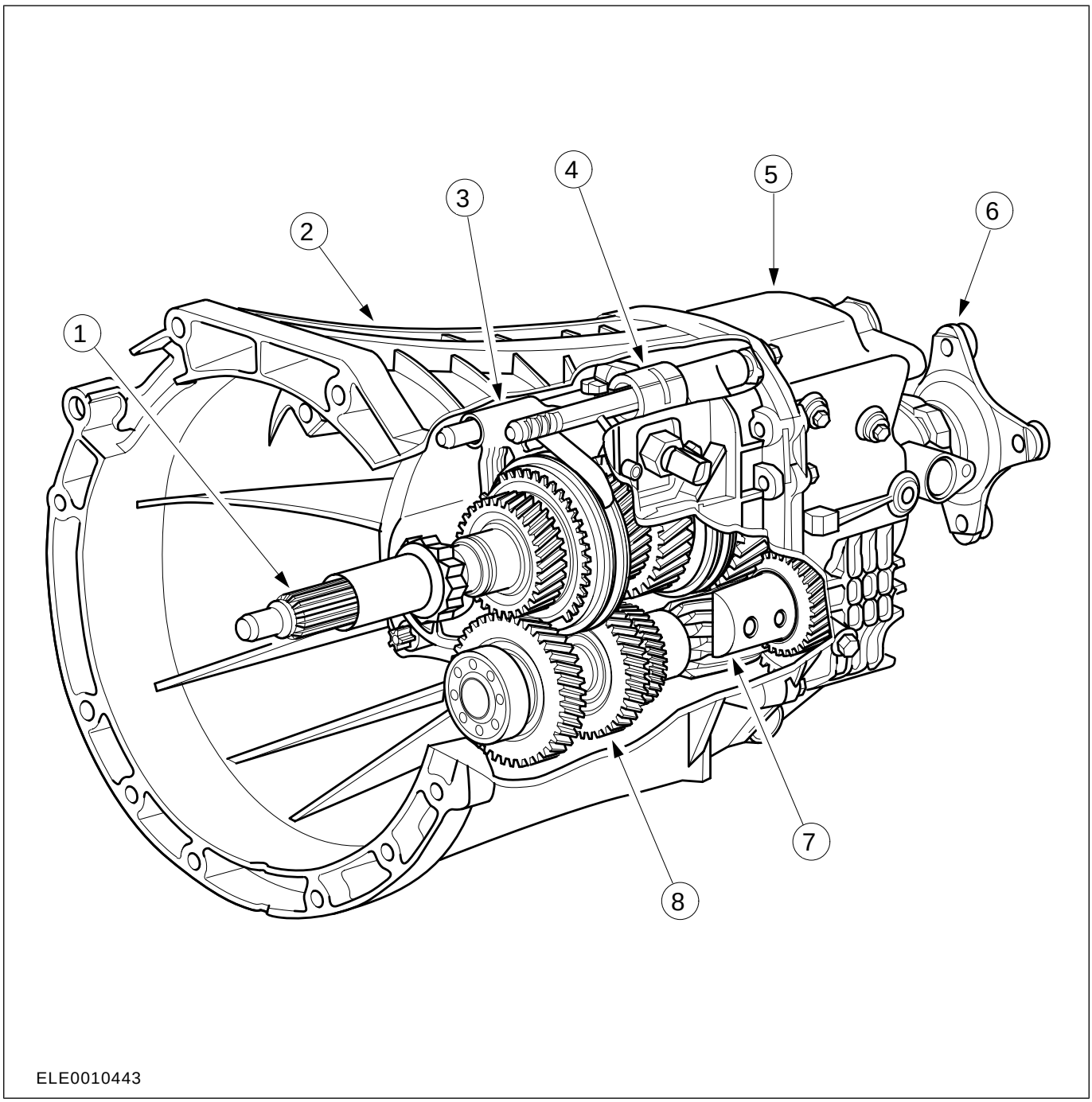
Torque Specifications

Description	Nm	lb-ft	lb-in
Selector gate retaining bolts	10	-	89
Transmission retaining bolts	50	37	-
Reversing lamp switch	20	15	-
Transmission output shaft flange retaining nut	200	148	-
Oil drain plug	50	37	-
Oil fill plug	35	26	-
Vehicle speed sensor (VSS)	10	-	89

DESCRIPTION AND OPERATION

Manual Transmission

Transmission Overview



ELE0010443

Item	Part Number	Description
1		Mainshaft — Input shaft/Output shaft
2		Transmission front case
3		Shifter fork third/fourth gear
4		Selector shaft

Item	Part Number	Description
5		Transmission rear case
6		Output drive flange
7		Reverse gear idler
8		Counter shaft

DESCRIPTION AND OPERATION

The MT - 75 manual transmission is a ” three - shaft transmission".

MT - 75 means:

– M: Manual.
– T: Transmission
– 75: Distance between main shaft and counter shaft in mm.

The aluminum transmission housing consists of two closed sections. The reinforcing ribs on the transmission housing have been revised to reduce noise and vibration.

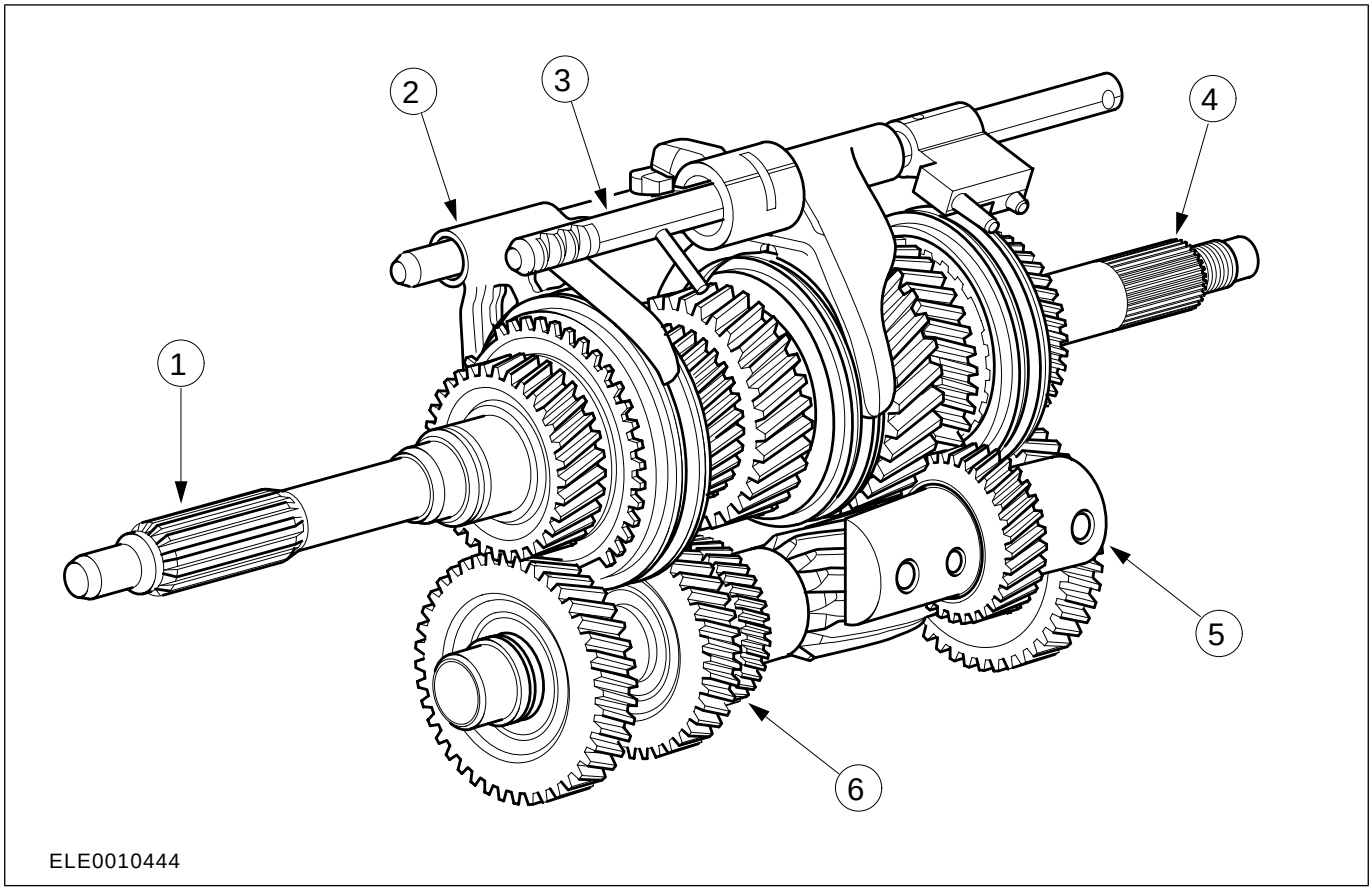
With the ” three - shaft transmission", all the gears are in permanent mesh. In each gear the required transmission ratio is achieved by means of a pair of gears.

When the reverse gear is selected, the direction of the output shaft is changed by an idler gear.

The input and output shafts turn on taper roller bearings.

All the gears, including reverse, are bevel - cut, synchronized and turn on needle roller bearings.

Mainshaft and Counter Shaft



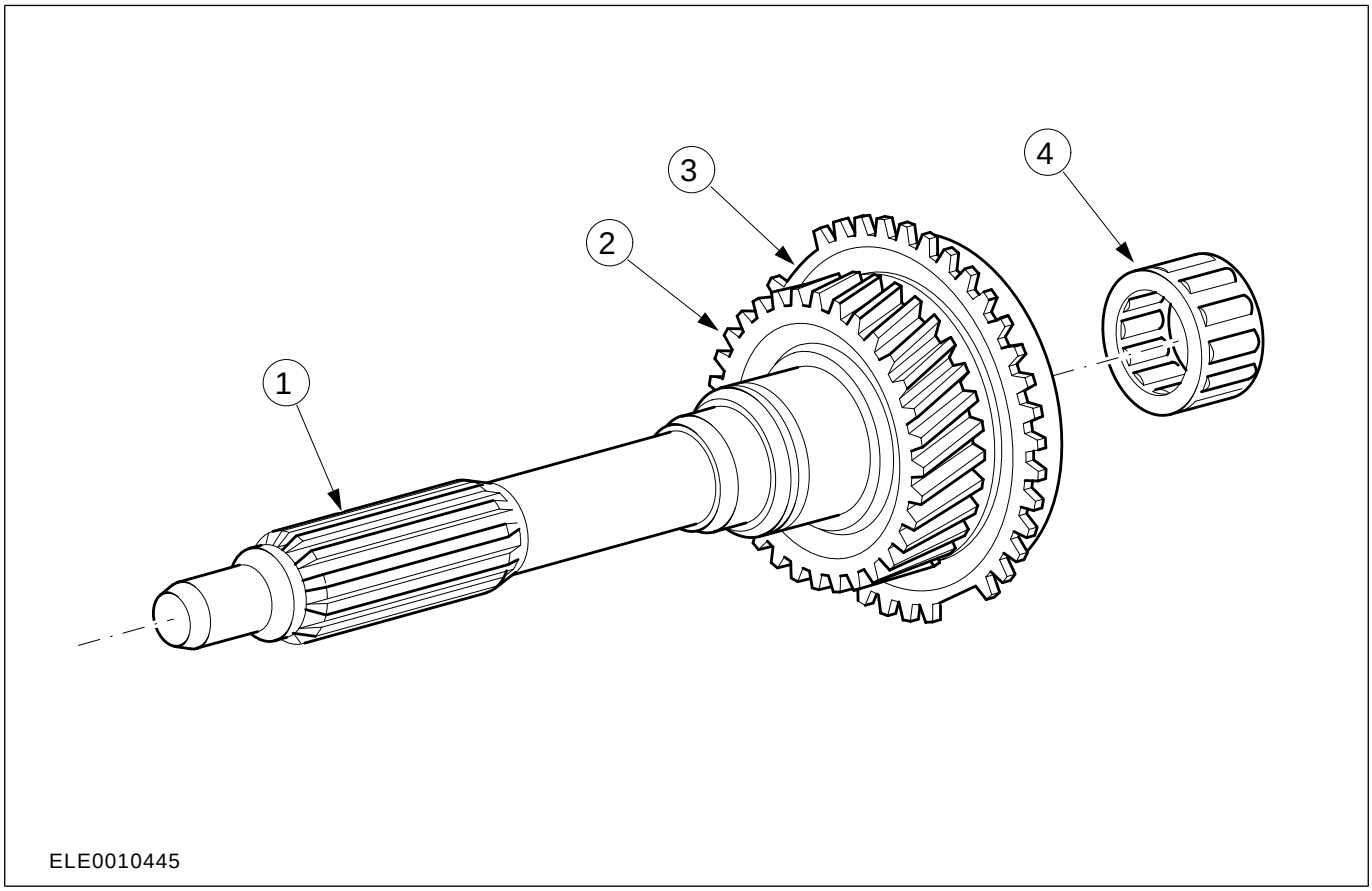
ELE0010444

Item	Part Number	Description
1		Input shaft
2		Selector fork third/fourth gear
3		Selector fork fifth/reverse gear

Item	Part Number	Description
4		Output shaft
5		Reverse gear idler
6		Counter shaft

DESCRIPTION AND OPERATION

Input shaft



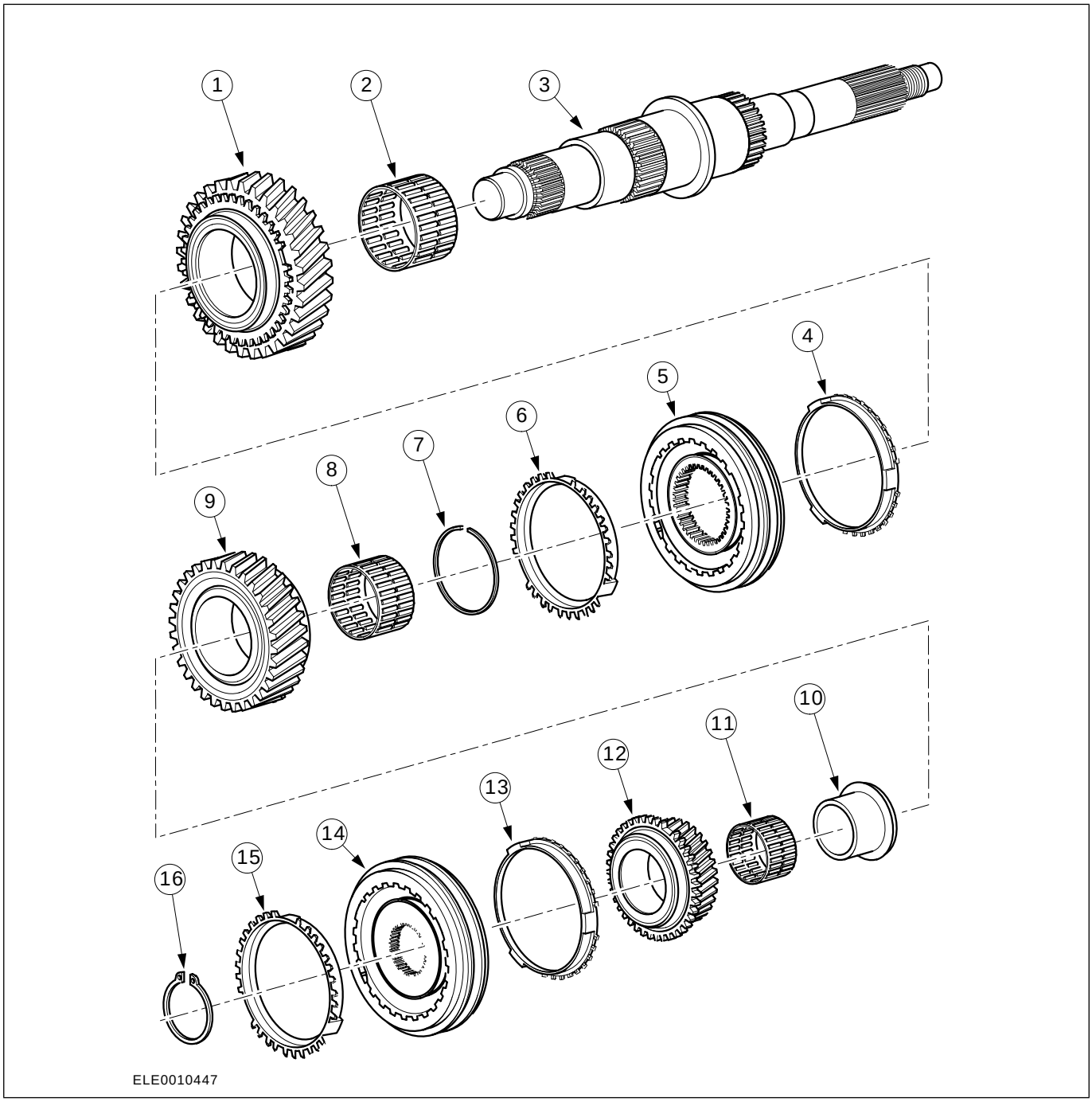
ELE0010445

Item	Part Number	Description
1		Input shaft
2		Driving gear for counter shaft

Item	Part Number	Description
3		Fourth gear synchronizer teeth
4		Output shaft locating bearing

DESCRIPTION AND OPERATION

Mainshaft (left - hand side shown)



Item	Part Number	Description
1		Output shaft
2		Needle roller bearing
3		Gear wheel first gear
4		Synchronizer ring first gear
5		Synchronizer clutch first/second gear
6		Synchronizer ring second gear

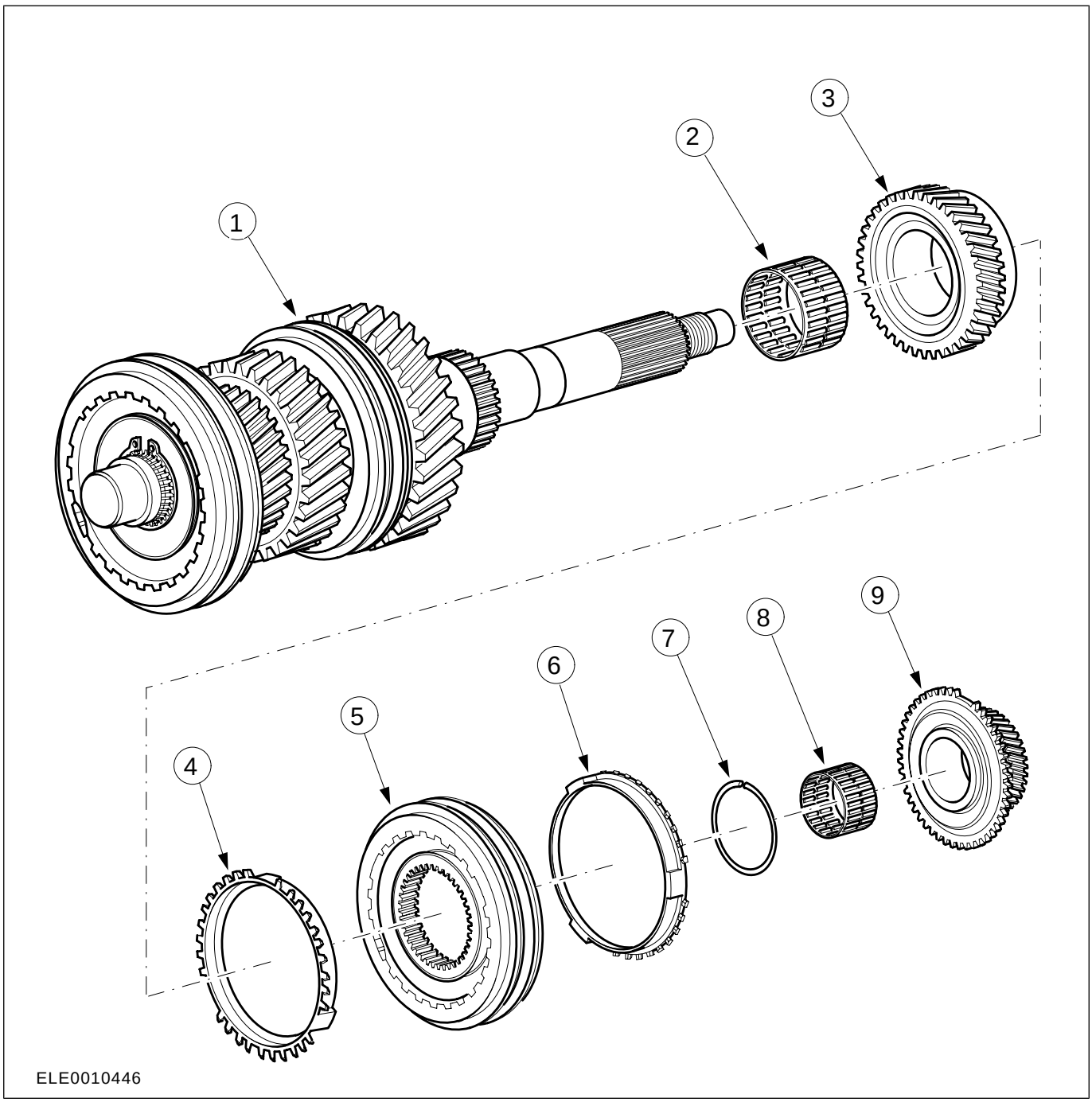
Item	Part Number	Description
7		Snap ring
8		Needle roller bearing
9		Gear wheel second gear
10		Inner race third gear needle roller bearing
11		Neeedle roller bearing
12		Gear wheel third gear

DESCRIPTION AND OPERATION

Item	Part Number	Description
13		Synchronizer ring third gear
14		Synchronizer clutch third/fourth gear

Item	Part Number	Description
15		Synchronizer ring fourth gear
16		Snap ring

Mainshaft (right - hand side shown)



Item	Part Number	Description
1		Output shaft
2		Needle roller bearing

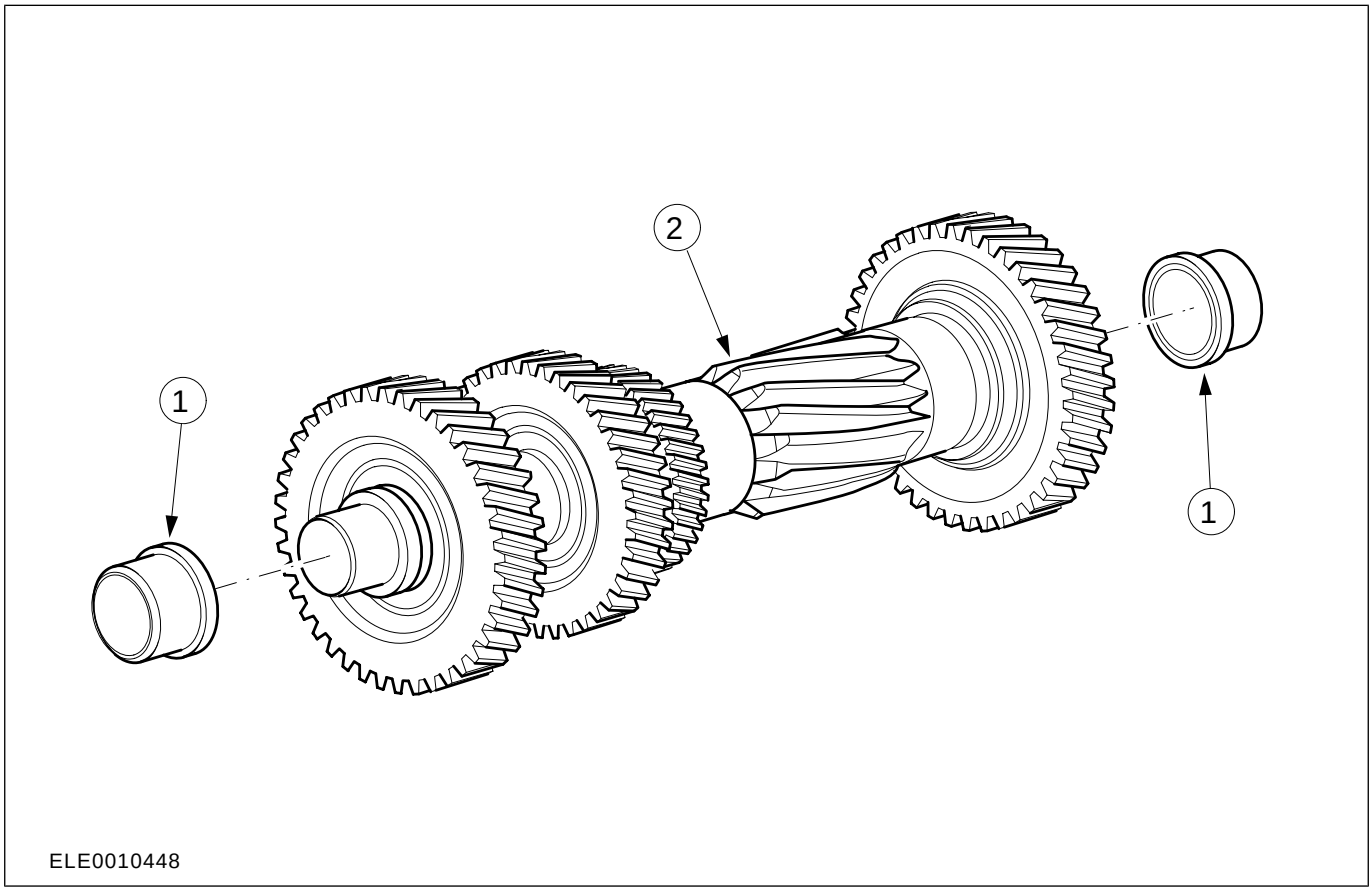
Item	Part Number	Description
3		Reverse gear wheel
4		Synchronizer ring reverse gear

DESCRIPTION AND OPERATION

Item	Part Number	Description
5		Synchronizer clutch fifth/reverse gear
6		Synchronizer ring fifth gear
7		Snap ring

Item	Part Number	Description
8		Needle roller bearing
9		Gear wheel fifth gear
10		Taper roller bearing

Countershaft

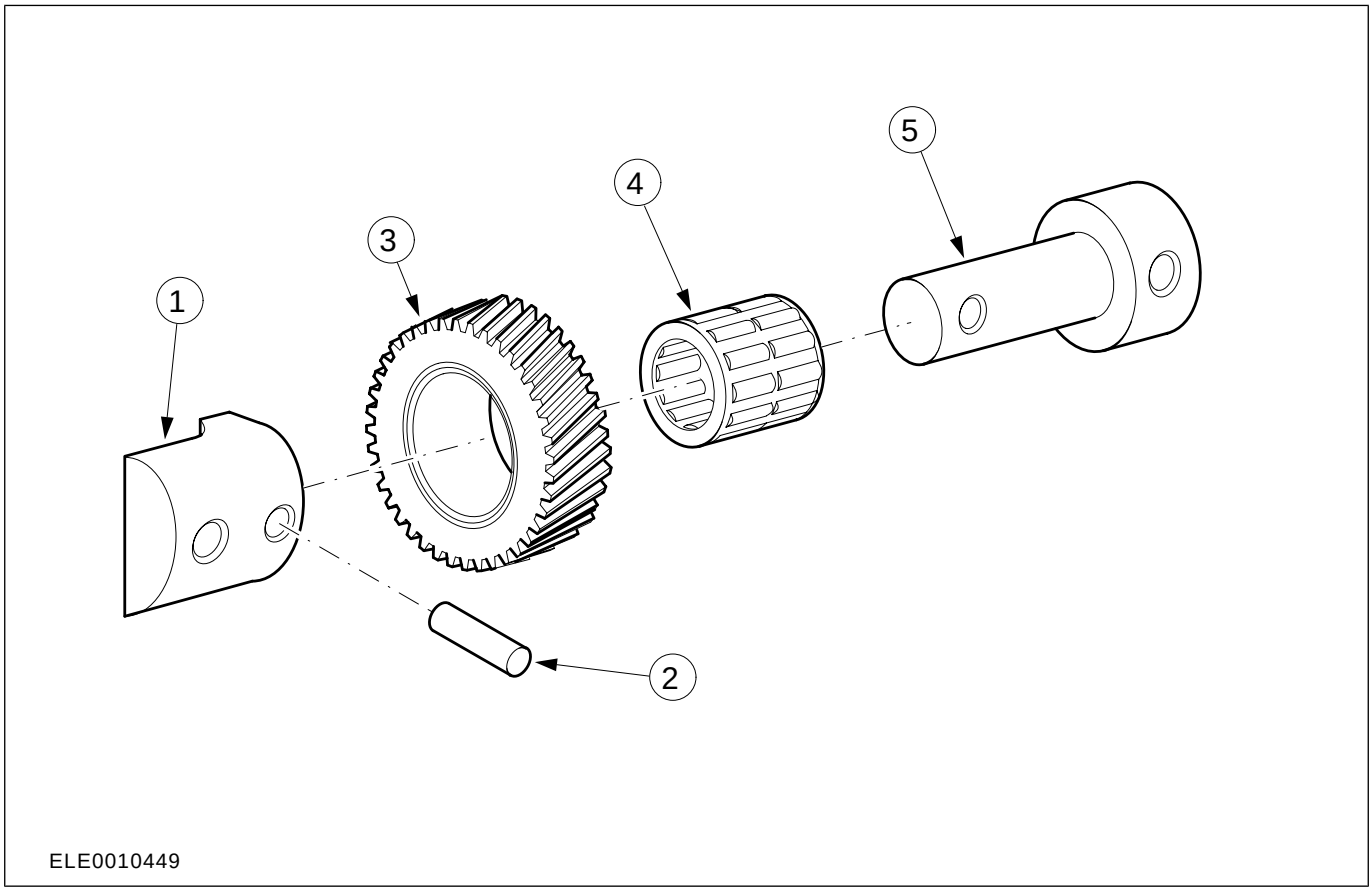


ELE0010448

Item	Part Number	Description
1		Inner race
2		Countershaft

DESCRIPTION AND OPERATION

Reverse gear idler



ELE0010449

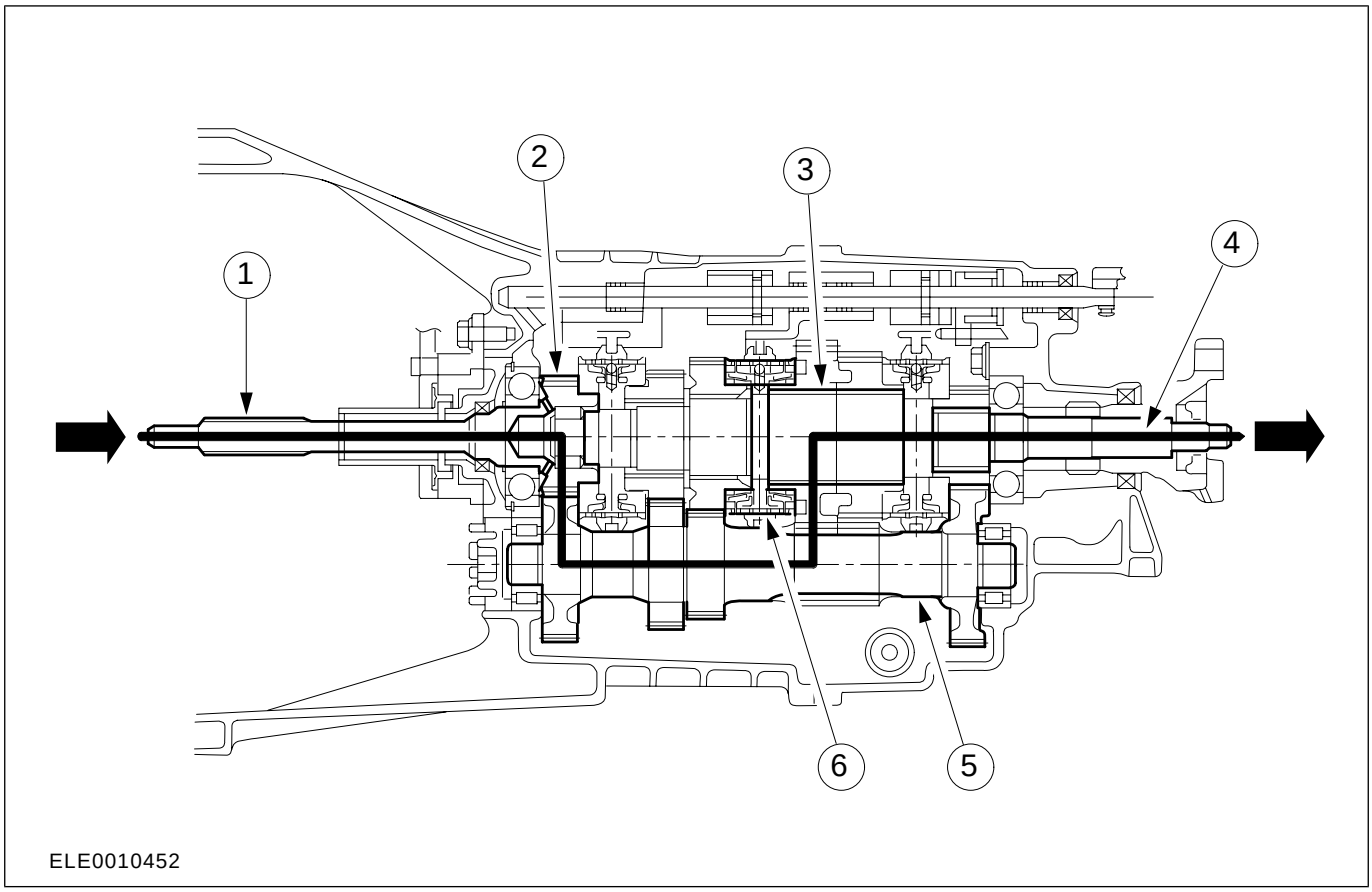
Item	Part Number	Description
1		Reverse gear idler shaft mounting
2		Roll pin

Item	Part Number	Description
3		Reverse gear idler
4		Needle roller bearing
5		Reverse gear idler shaft

DESCRIPTION AND OPERATION

Power Flow

First gear



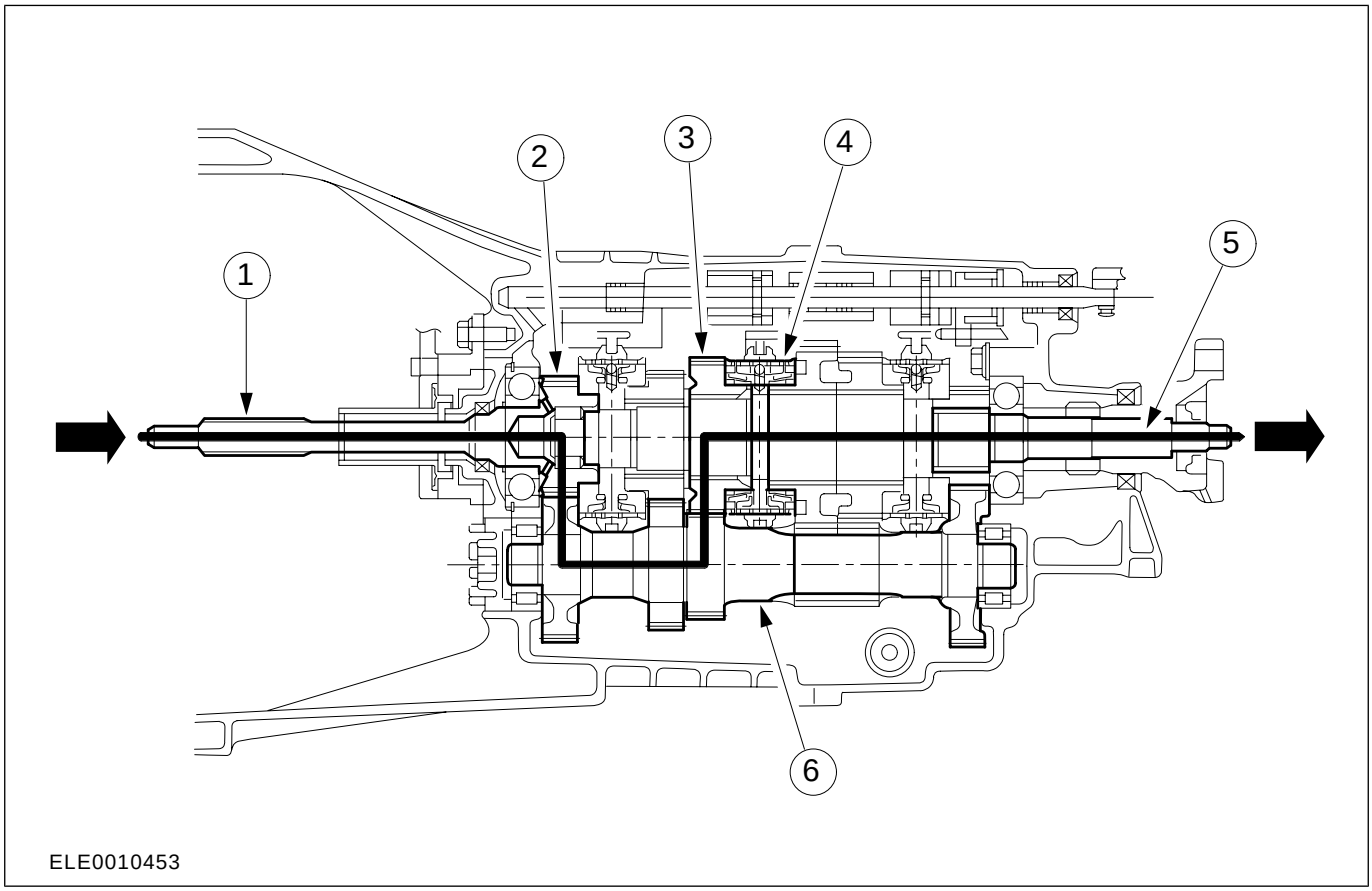
ELE0010452

Item	Part Number	Description
1		Input shaft
2		Driving gear for countershaft
3		Gear wheel fist gear

Item	Part Number	Description
4		Output shaft
5		Counter shaft
6		Synchonizer clutch first/second gear

DESCRIPTION AND OPERATION

Second gear



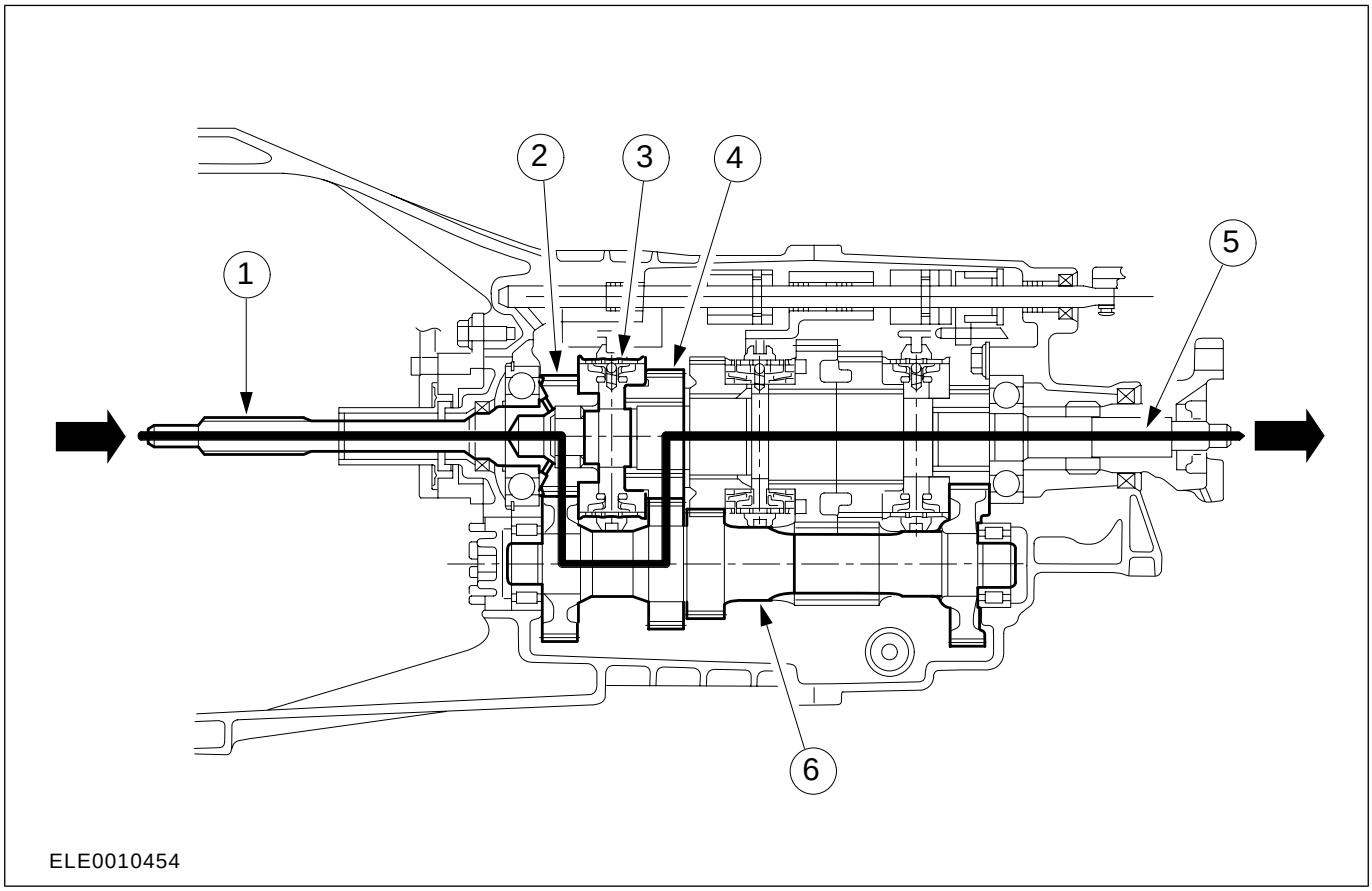
ELE0010453

Item	Part Number	Description
1		Input shaft
2		Driving gear for countershaft
3		Gear wheel second gear

Item	Part Number	Description
4		Synchonizer clutch first/second gear
5		Output shaft
6		Counter shaft

DESCRIPTION AND OPERATION

Third gear



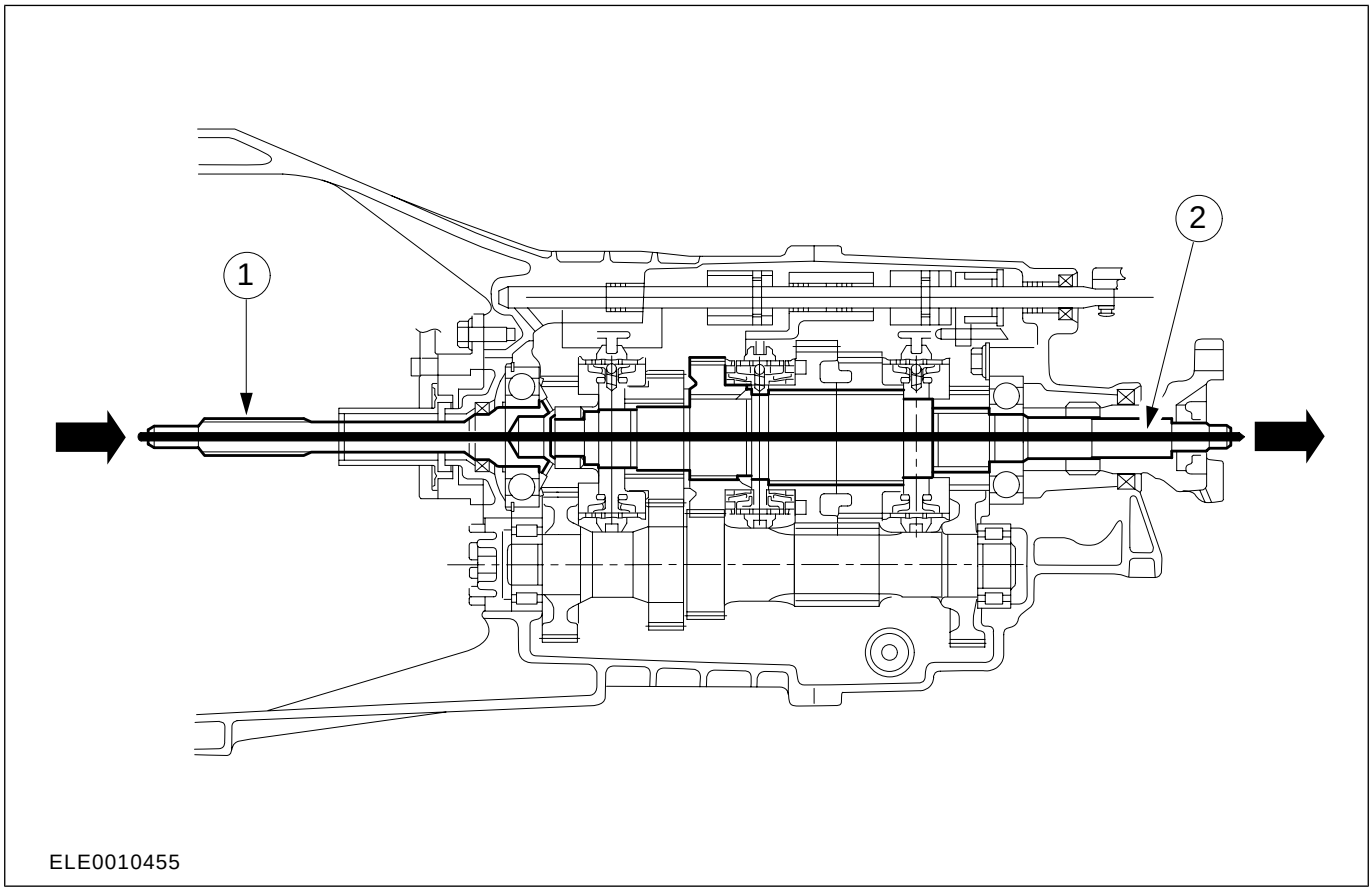
ELE0010454

Item	Part Number	Description
1		Input shaft
2		Driving gear for countershaft
3		Synchronizer clutch first/second gear

Item	Part Number	Description
4		Gear wheel second gear
5		Output shaft
6		Counter shaft

DESCRIPTION AND OPERATION

Fourth gear

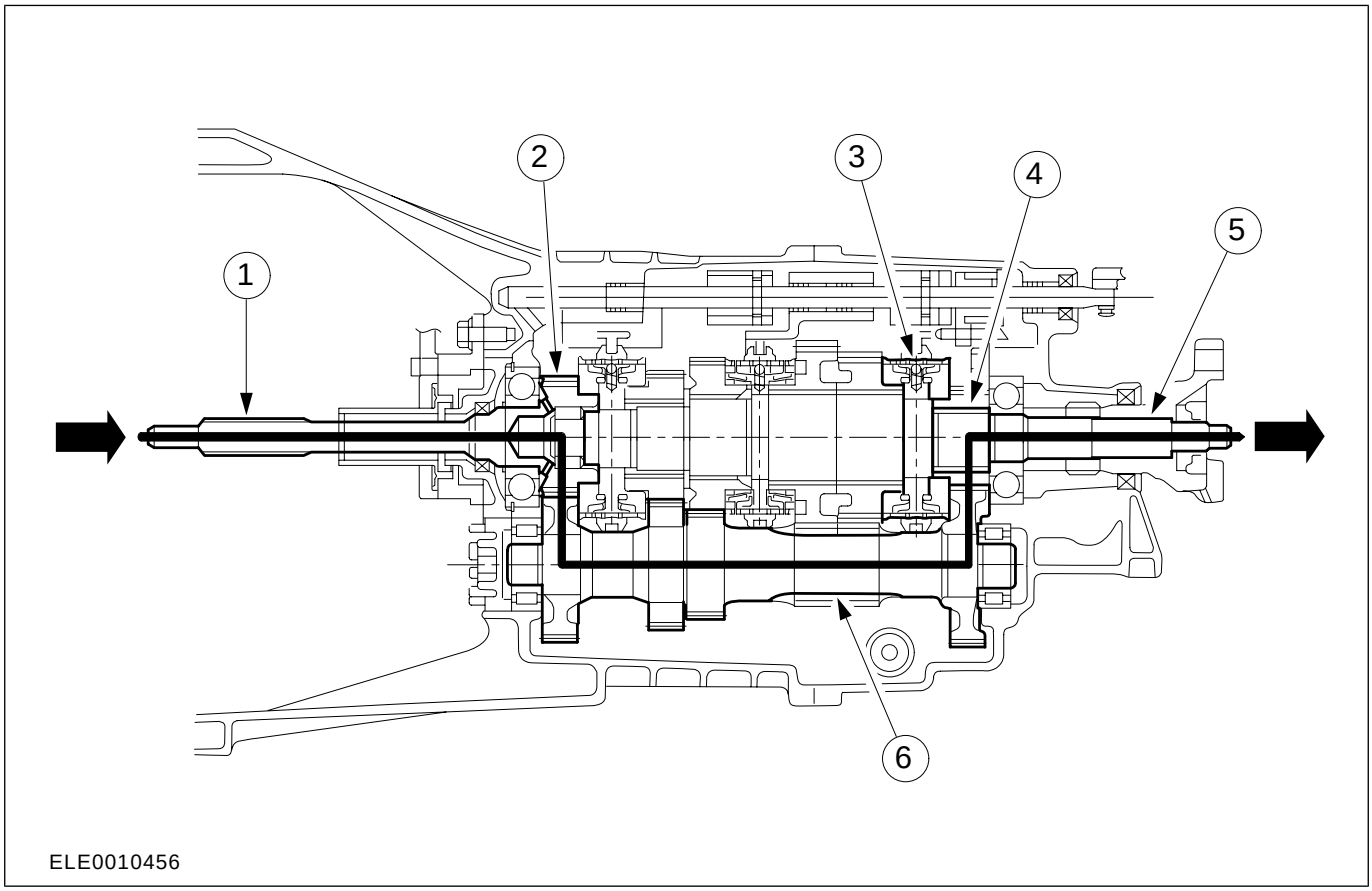


ELE0010455

Item	Part Number	Description
1		Input shaft
2		Output shaft

DESCRIPTION AND OPERATION

Fifth gear



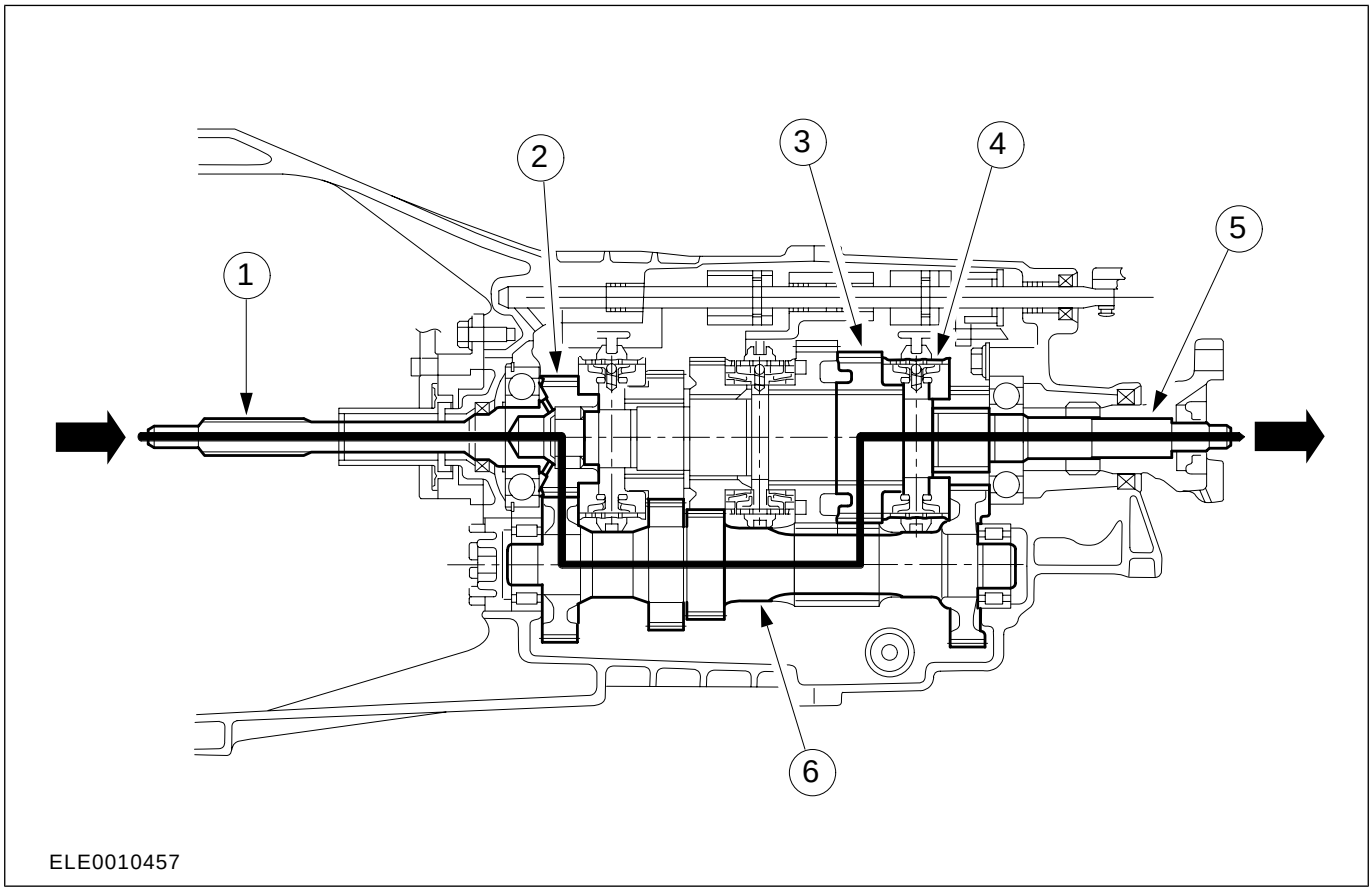
ELE0010456

Item	Part Number	Description
1		Input shaft
2		Driving gear for countershaft
3		Synchronizer clutch fifth/reverse gear

Item	Part Number	Description
4		Gerar wheel fifth gear
5		Output shaft
6		Counter shaft

DESCRIPTION AND OPERATION

Reverse gear



ELE0010457

Item	Part Number	Description
1		Input shaft
2		Driving gear for countershaft
3		Gear wheel reverse gear
4		Synchronizer clutch fifth/reverse gear
5		Output shaft
6		Input shaft

GENERAL PROCEDURES

Transmission Draining and Filling

1. Information not available at this time.

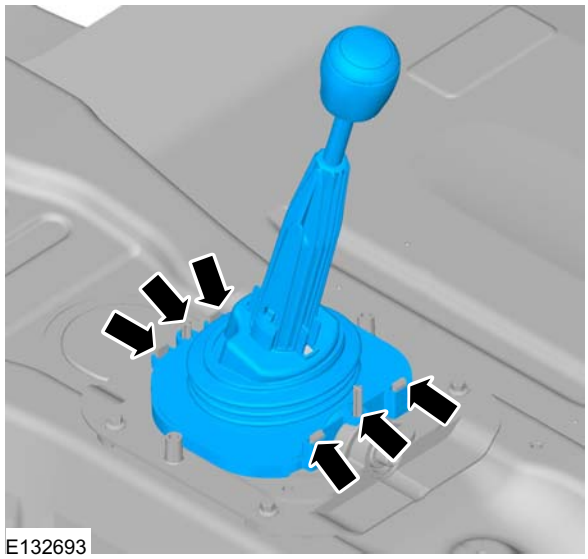
REMOVAL

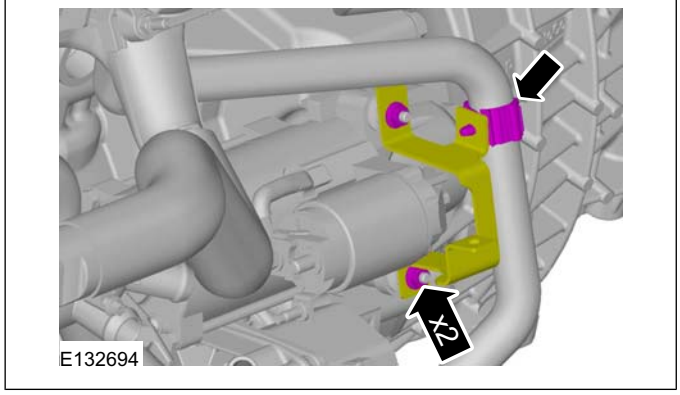
Transmission — 2WD

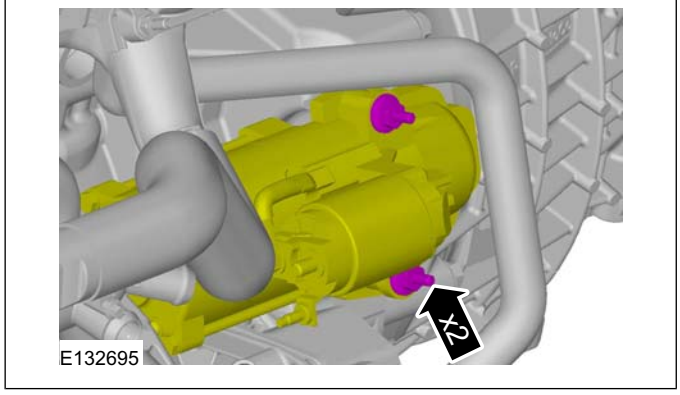
Removal

General Equipment

Transmission Jack

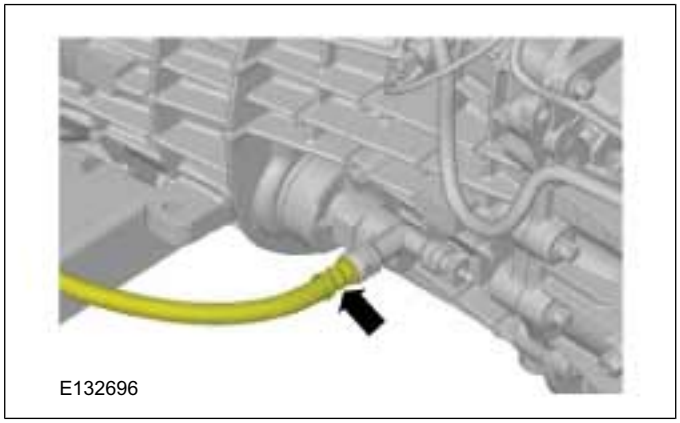
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
   Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).
3. 

4. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
5. Refer to: Jacking (100-02 Jacking and Lifting, Description and Operation).
   Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
6. Refer to: Driveshaft - 2WD (205-01 Driveshaft, Removal and Installation).
7. 

8. 

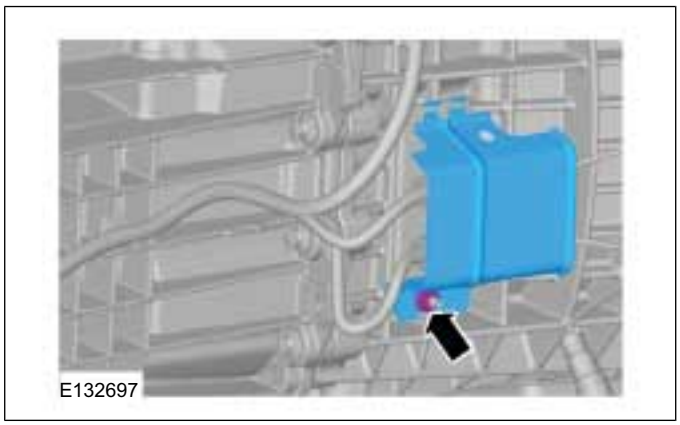
REMOVAL

9. **NOTE:** Cap the fluid line



Vehicles with 2.5L engine

10.



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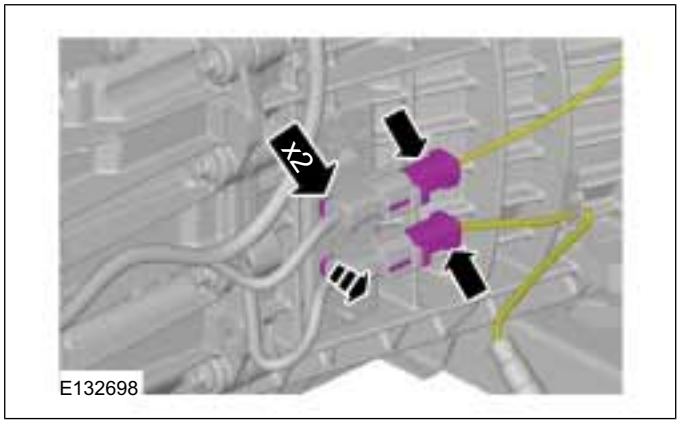

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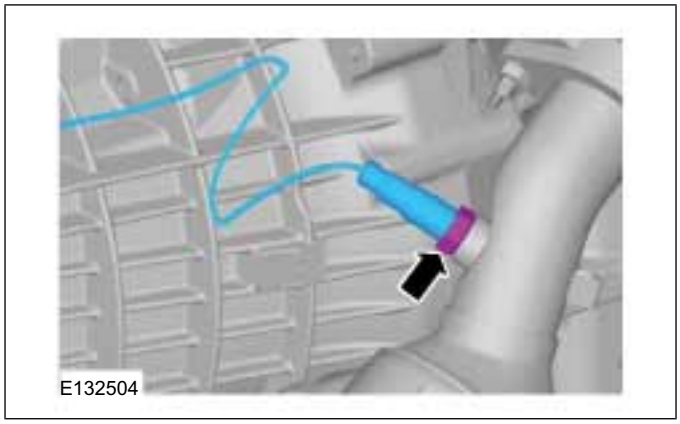
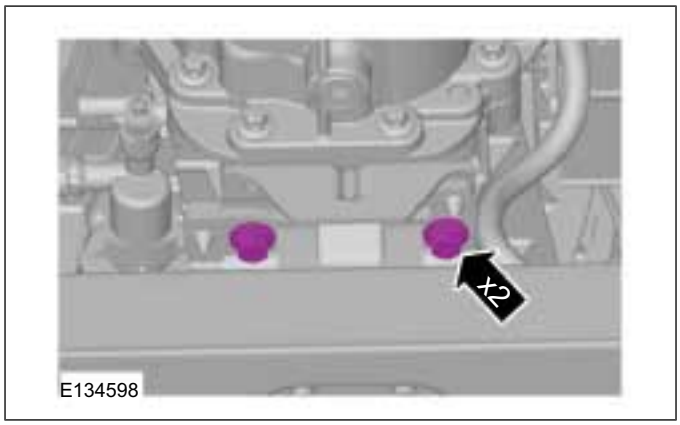


All vehicles

13.

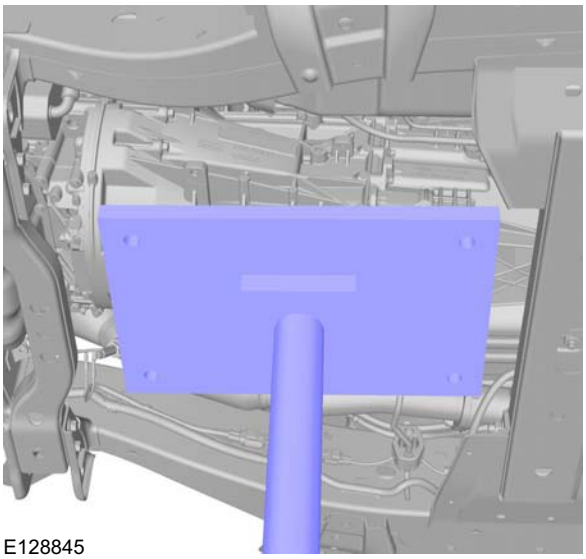
14.



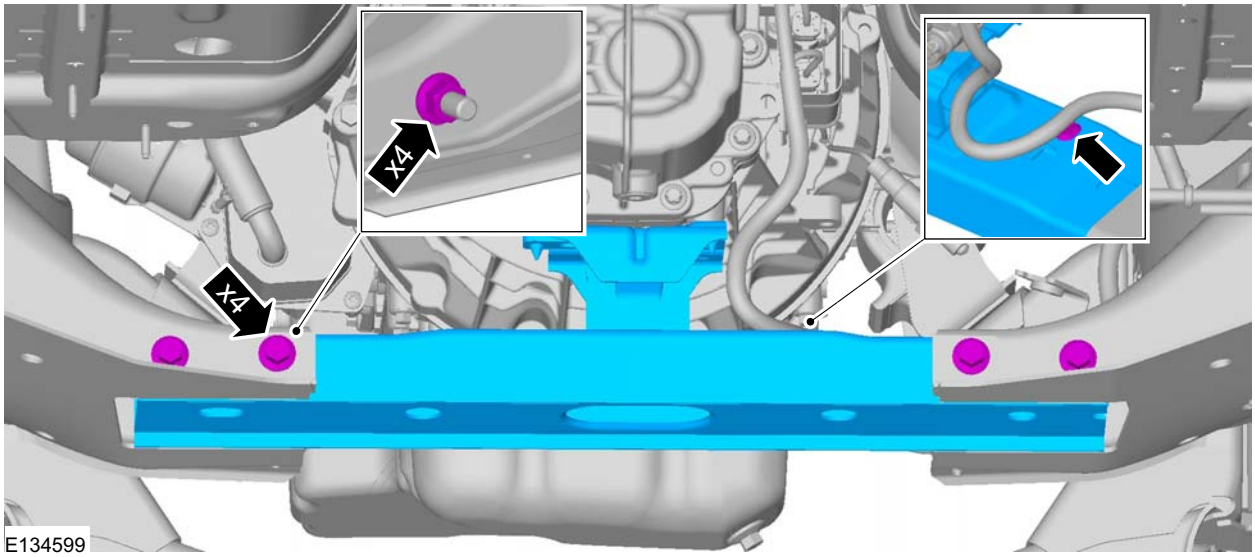
REMOVAL

15. General Equipment: Transmission Jack

16.



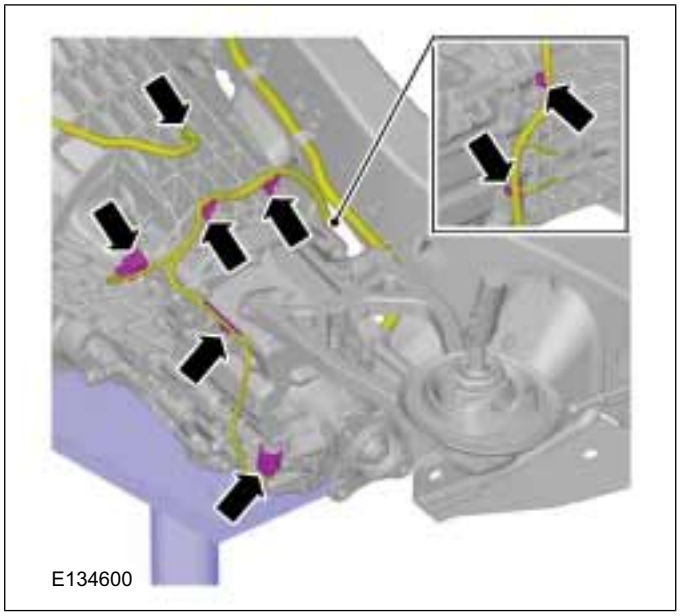
E128845



E134599

REMOVAL

17.



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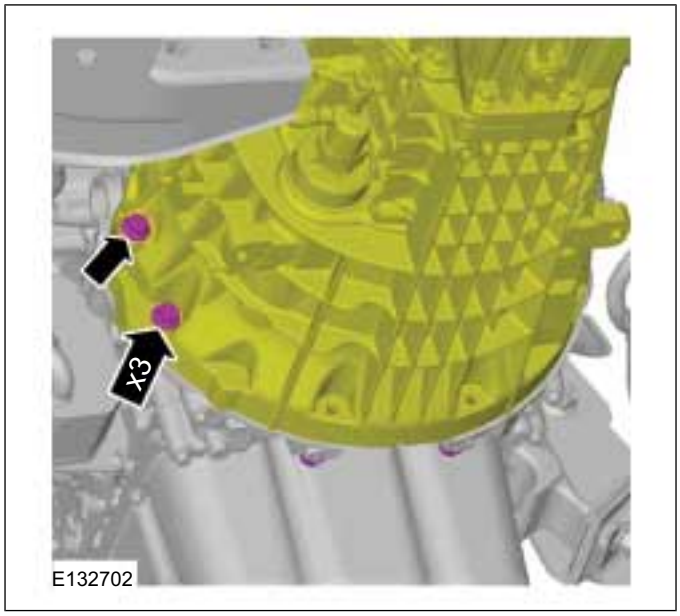

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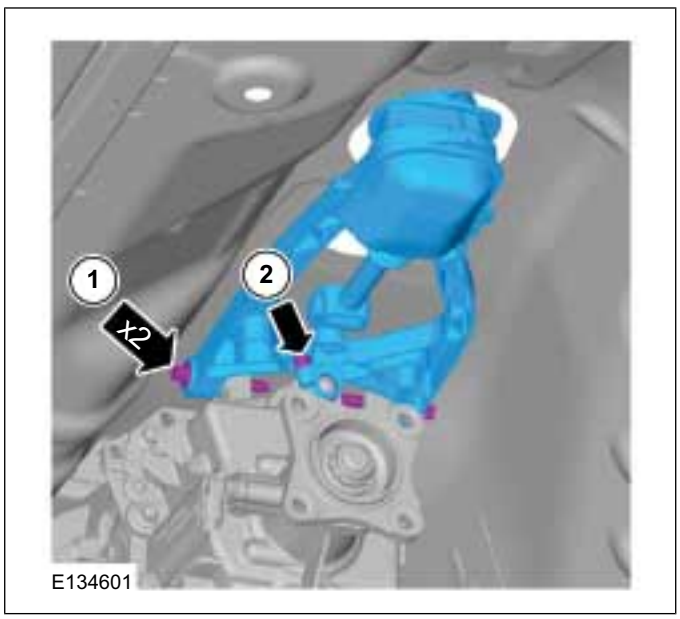

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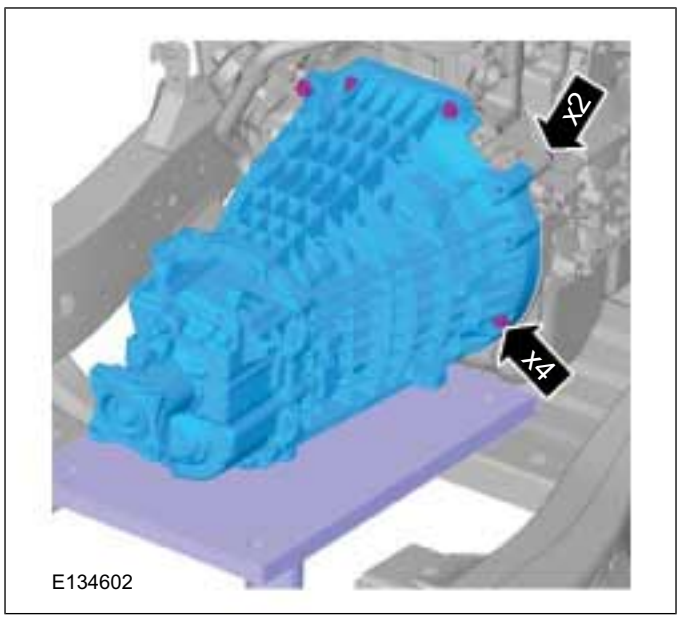


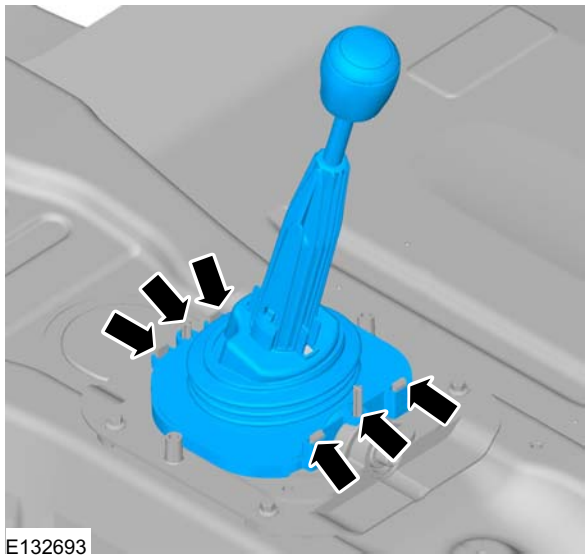
REMOVAL

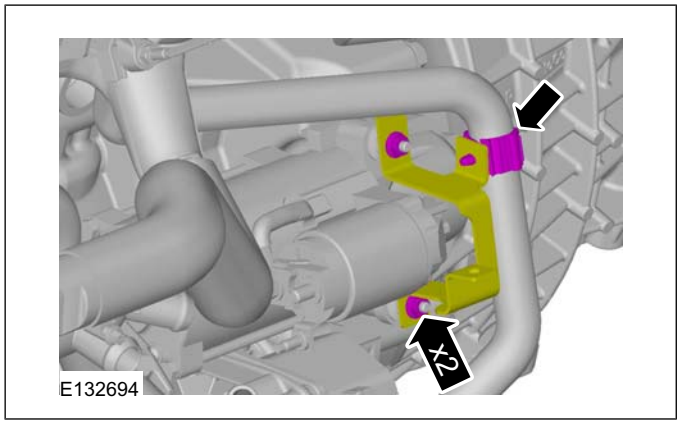
Transmission — 4WD

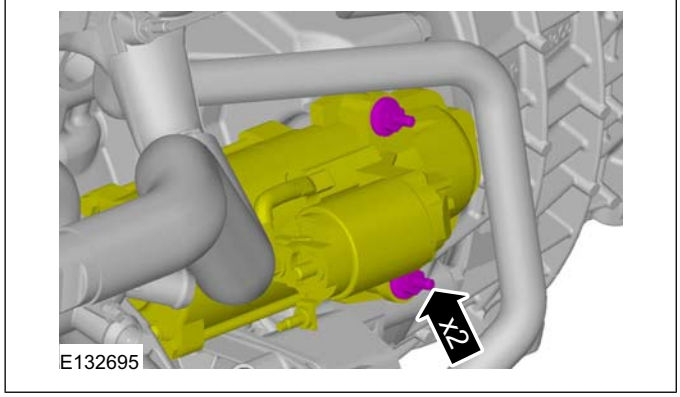
Removal

General Equipment

Transmission Jack

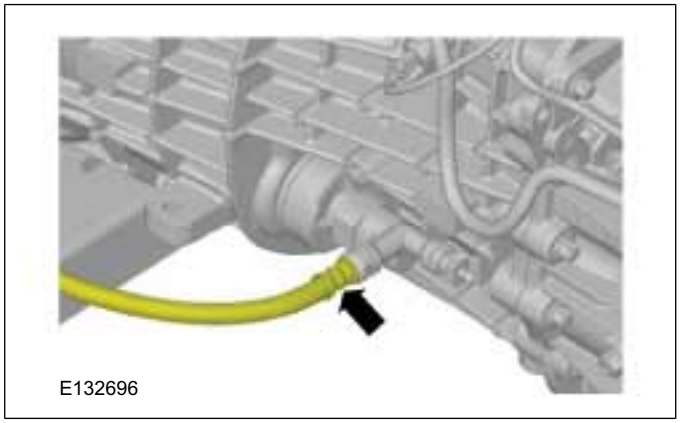
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
   Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).
3. 

4. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
5. Refer to: Jacking (100-02 Jacking and Lifting, Description and Operation).
   Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
6. Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).
   Refer to: Front Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).
7. 

8. 

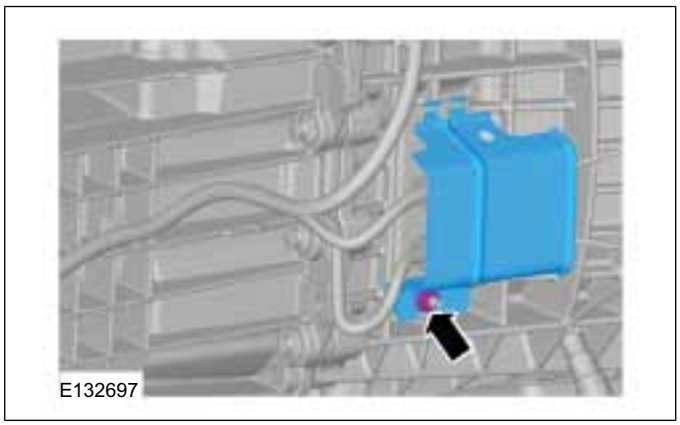
REMOVAL

9. **NOTE:** Cap the fluid line



Vehicles with 2.5L engine

10.



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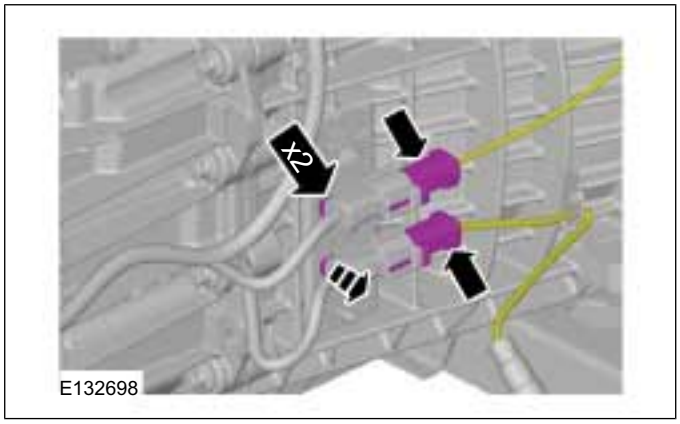

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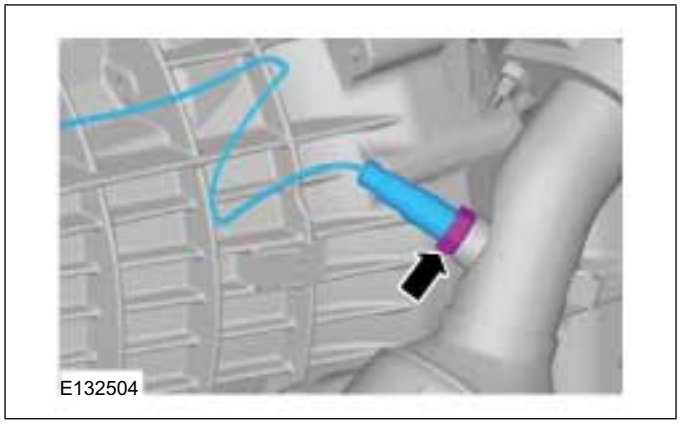
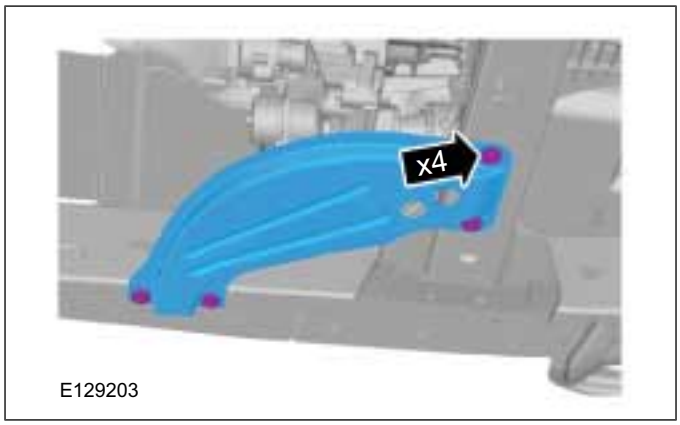


All vehicles

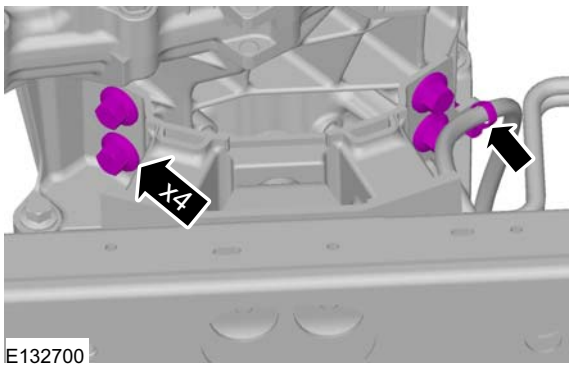
13.

14.

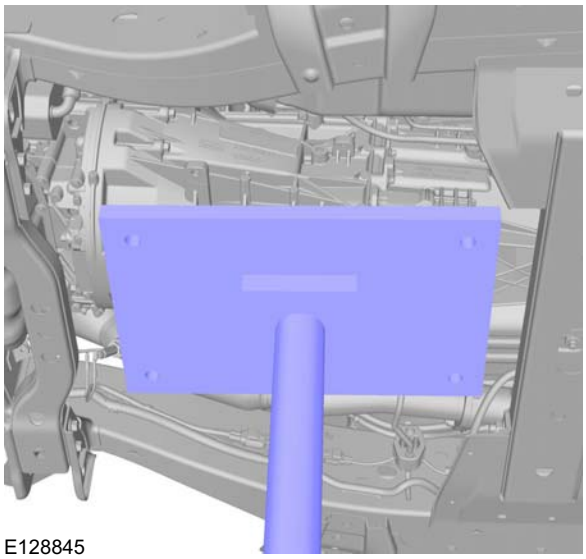


REMOVAL

15.



16. General Equipment: Transmission Jack



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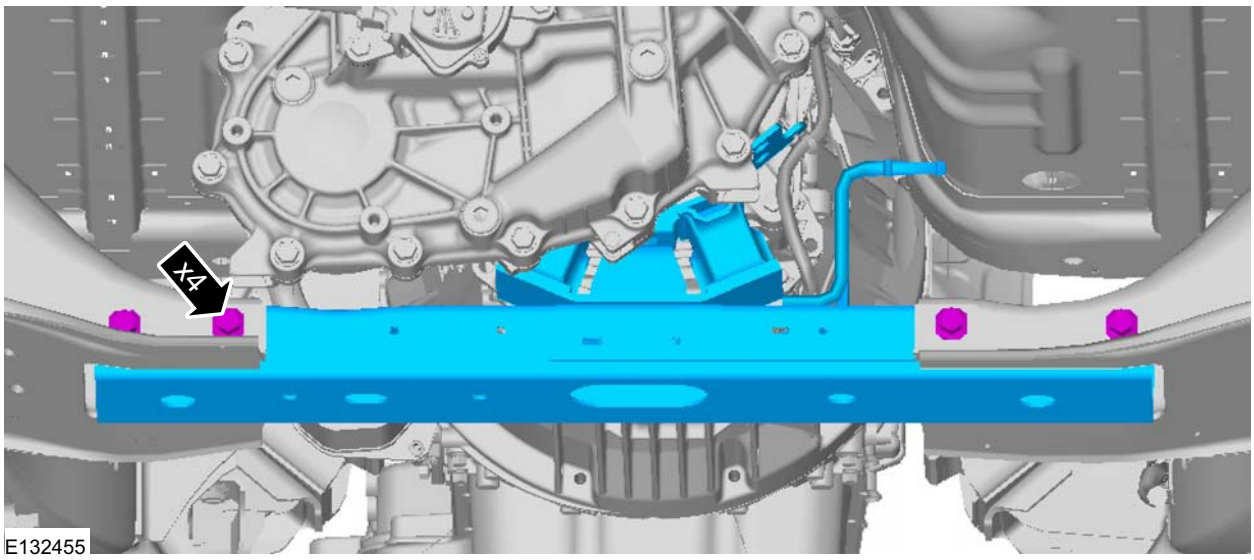
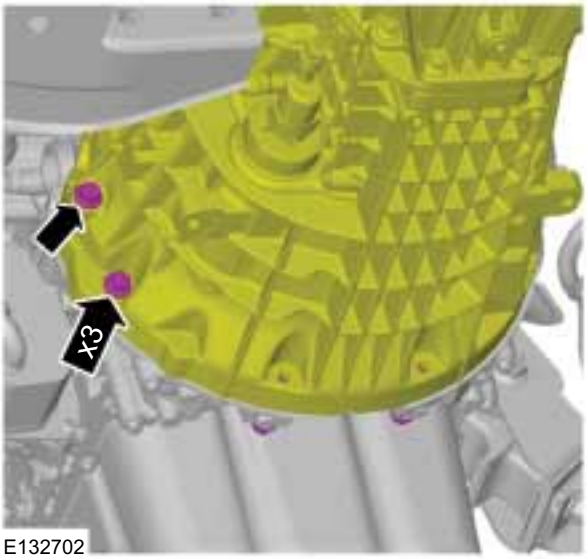


REMOVAL

18.



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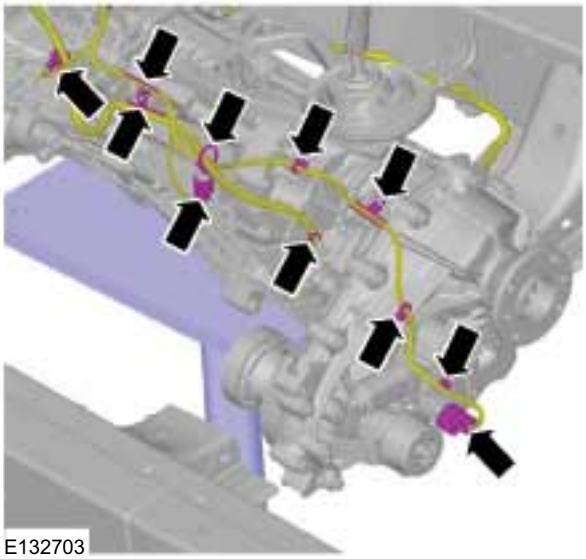

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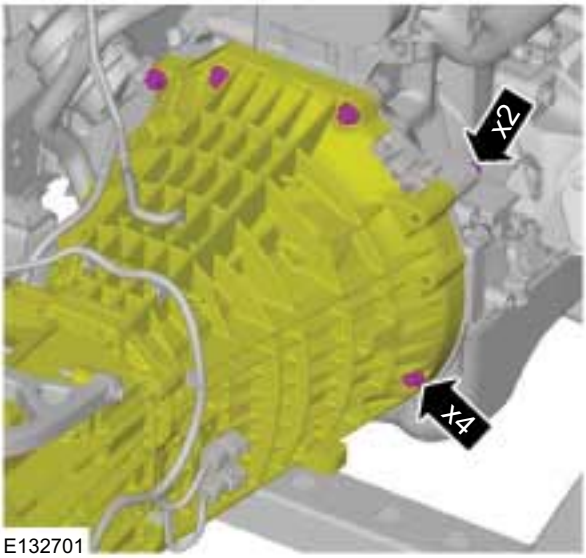

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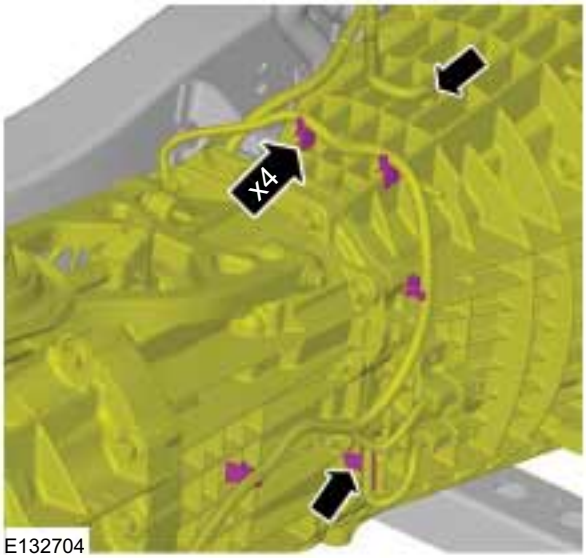
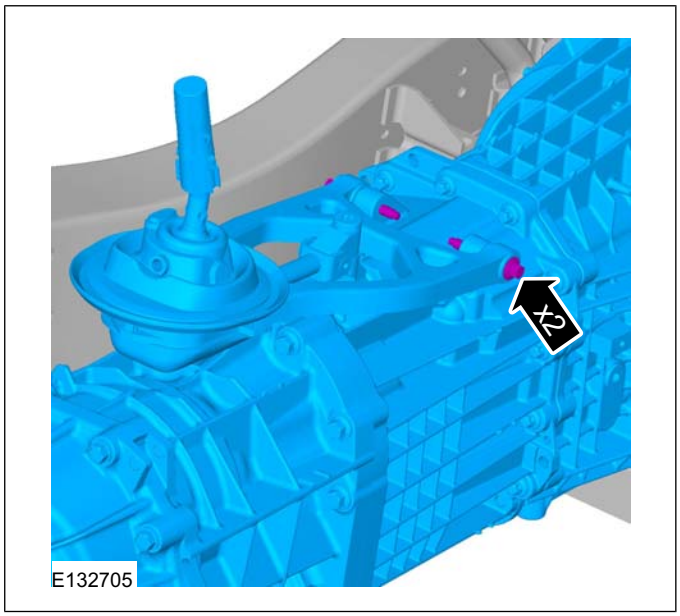


REMOVAL

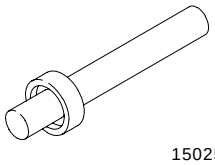
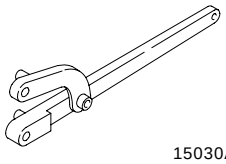
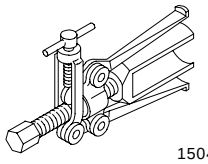
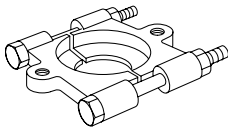
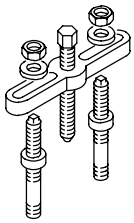
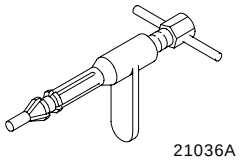
22.



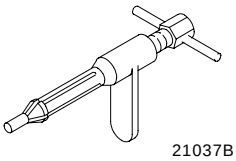
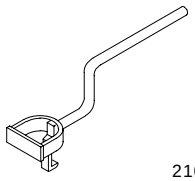
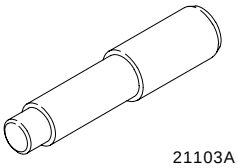
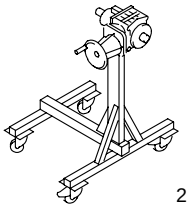
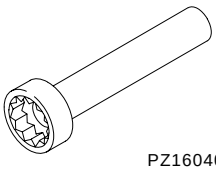
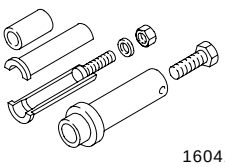
DISASSEMBLY

Transmission

Special Tool(s)

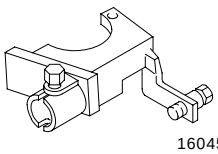
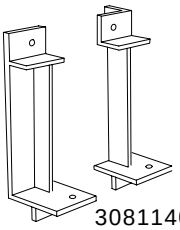
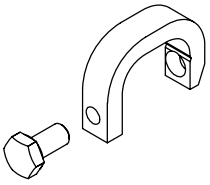
 15025A	Installer, Differential Bearing 205-062 (15-025A)
 15030A	Flange Holding Wrench, Universal 205-072 (15-030A)
 15048	Remover, Drive Pinion Oil Seal 205-078 (15-048)
 T115091	Remover, Bearing/Gear 205-310 (15-091)
 15092	Remover, Crankshaft Pilot Bearing 303-078 (21-036A)
 21036A	

Special Tool(s)

 21037B	Remover, Crankshaft Pilot Bearing 303-079 (21-037B)
 21051	Remover, Oil Seal 303-112 (21-051)
 21103A	Aligner, Clutch Plate 303-173 (21-103A)
 21187	Mounting Stand 303-435 (21-187)
 PZ16040A	Socket, Guide Sleeve 308-109 (16-040A)
 16041	Remover/Installer, Front Housing 308-110 (16-041)

DISASSEMBLY

Special Tool(s)

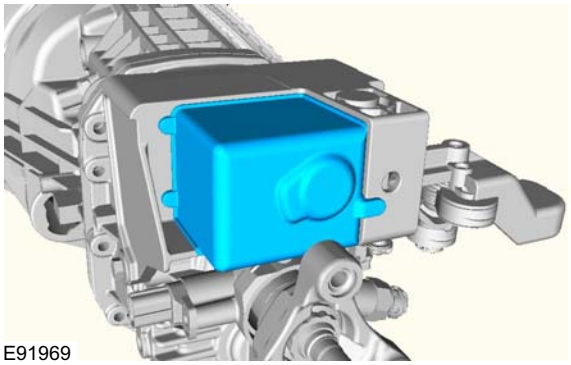
 16045	Mounting Bracket for 303-435 308-114 (16-045)
 30811401	Mounting Brackets for 308-114 308-114-01 (16-045-01)
 E77040	Remover, Slider 308-652

Disassembly

All vehicles

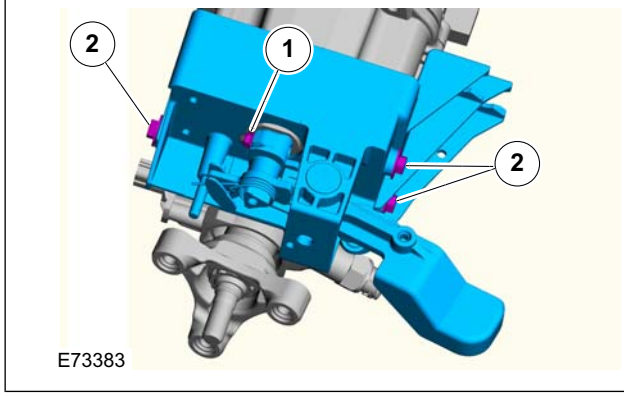
NOTE: All the bearings are paired and must not be mixed.

1. Remove the external gearshift control cover.


E91969

2. Detach the external gearshift control assembly.

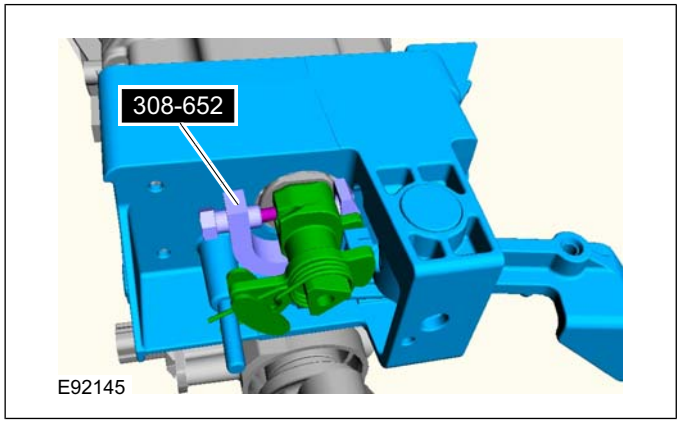
1. Remove the nut.
2. Remove the bolts.



E73383

3. Using the special tool, detach the shifter shaft connector.

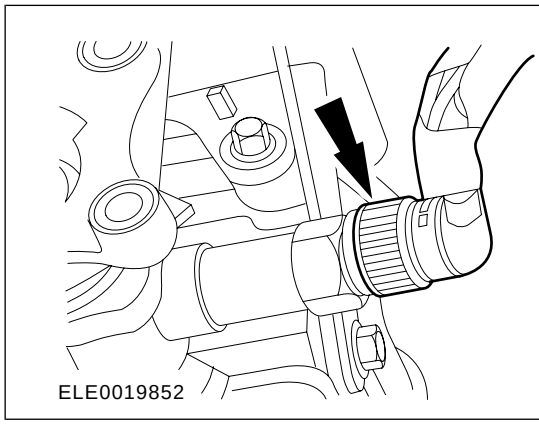
- Remove the external gearshift control assembly.



E92145

Vehicles with tachograph

4. Remove the tachograph sensor.


ELE0019852

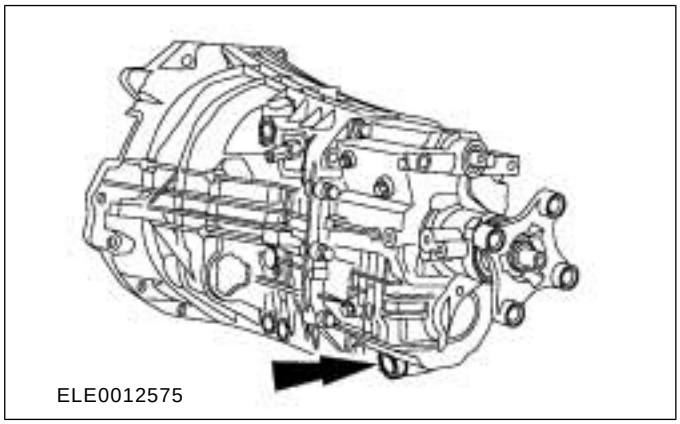
All vehicles

5. Drain the transmission.

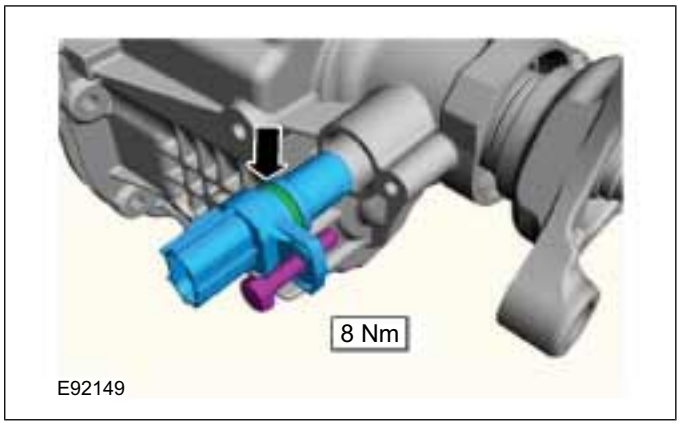
- Remove the drain plug.

DISASSEMBLY

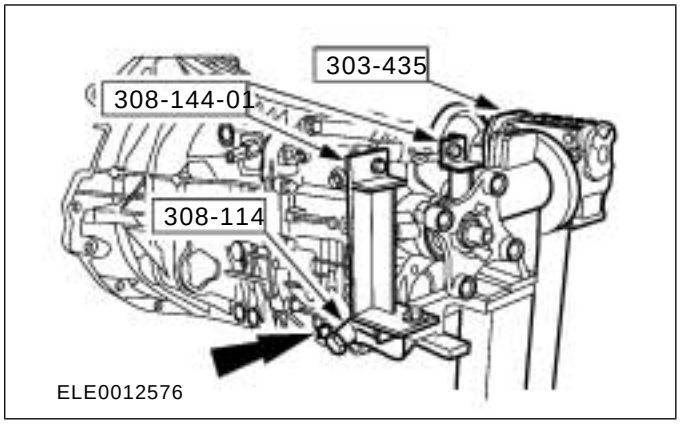
- Allow the oil to drain into a suitable container.



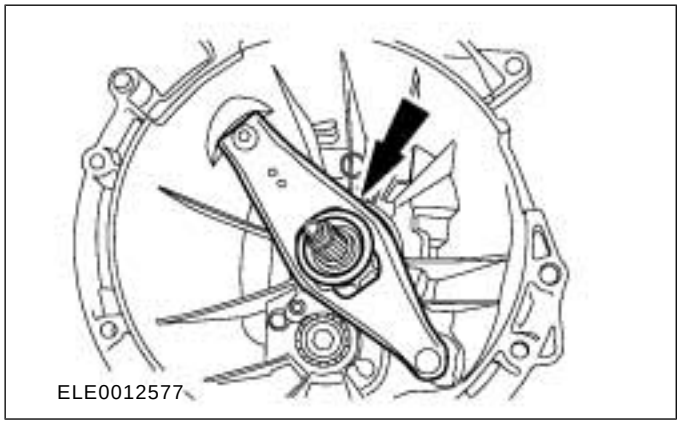
6. **Remove the vehicle speed sensor (VSS).**



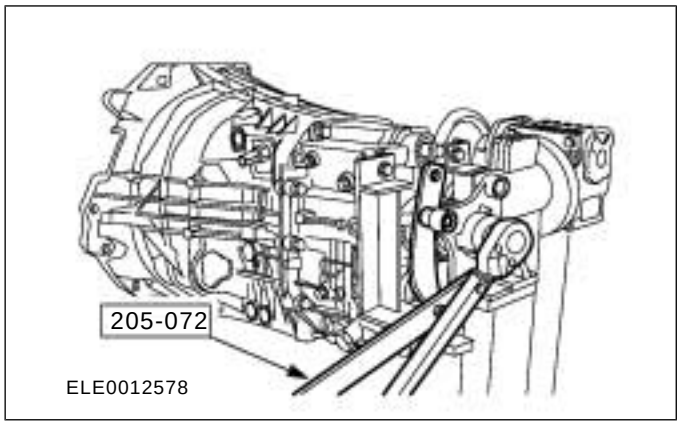
7. **Mount the transmission on the mounting stand.**
   - Remove the transmission housing retaining bolt.



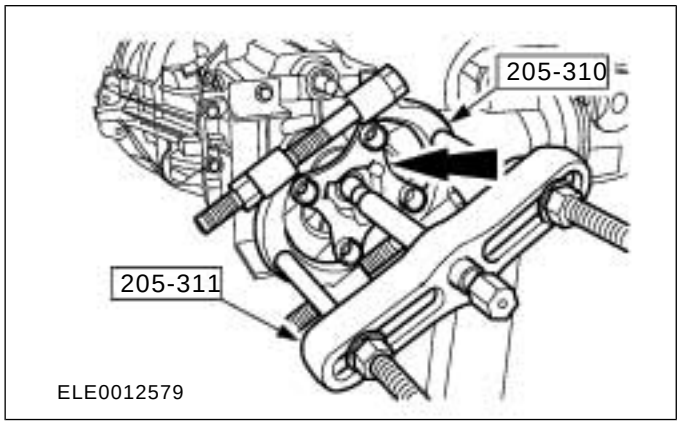
8. **Remove the clutch release bearing and the clutch release lever.**



9. **Using the special tool, remove the output shaft flange retaining nut.**
   - Discard the nut.

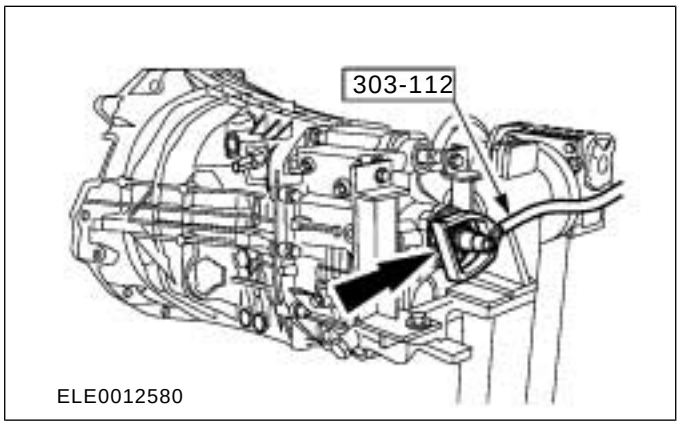


10. **Using the special tools, remove the output shaft flange.**
    - Remove the splash shield.

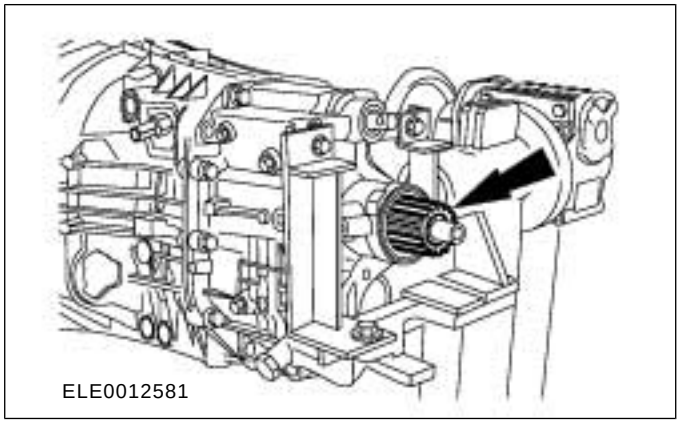


DISASSEMBLY

11. Using the special tool, remove the output shaft oil seal.

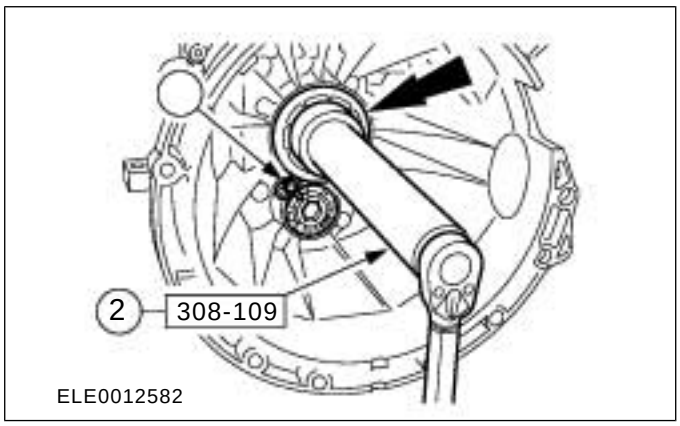


12. Remove the VSS ring.



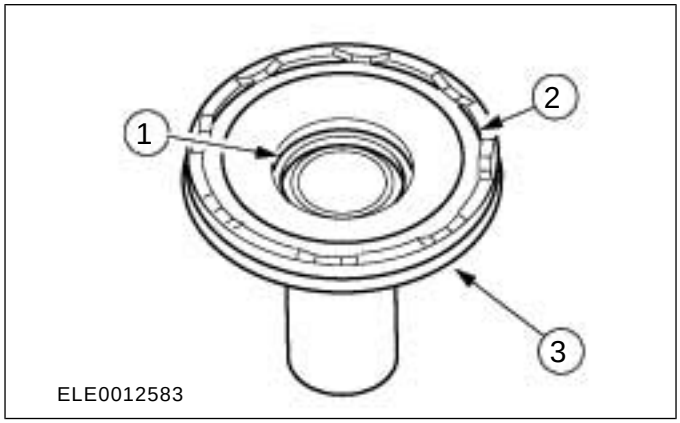
13. Using the special tool, remove the input shaft guide sleeve.

1. Remove the bearing retainer locking plate.
2. Install the special tool and remove the guide sleeve.



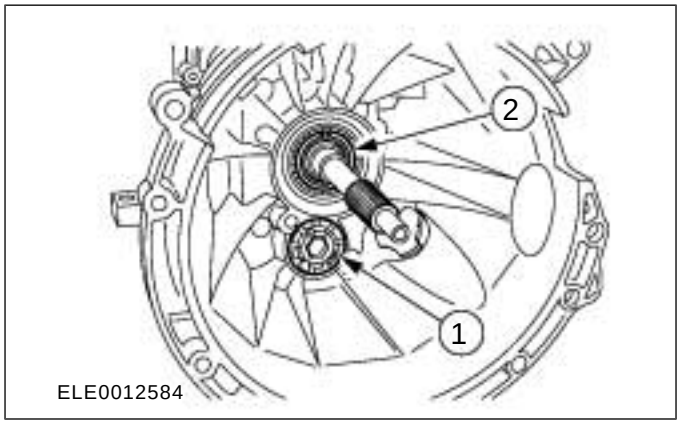
14. Disassemble the input shaft guide sleeve.

1. Remove the oil seal.
2. Remove the thrust washer.
3. Remove the O-ring seal.

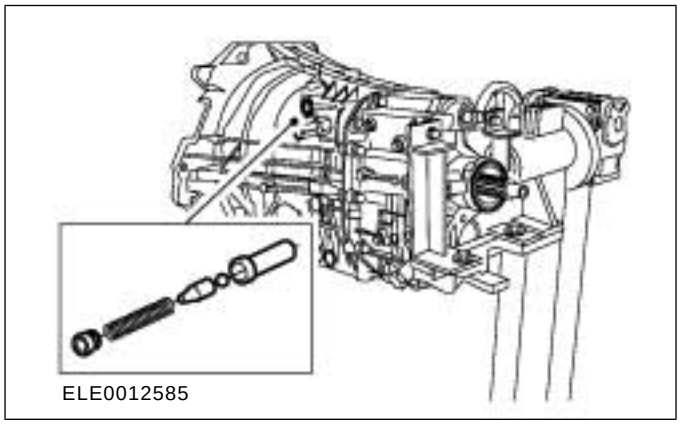


15. Remove the countershaft bearing.

1. Remove the bearing retainer.
2. Remove the circlip.

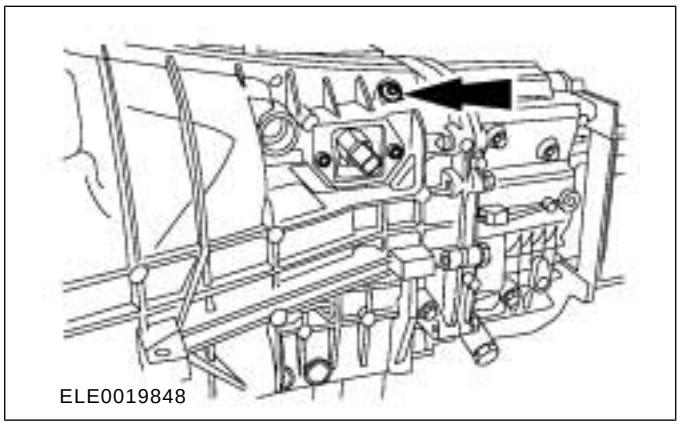


16. Remove the selector interlock mechanism.

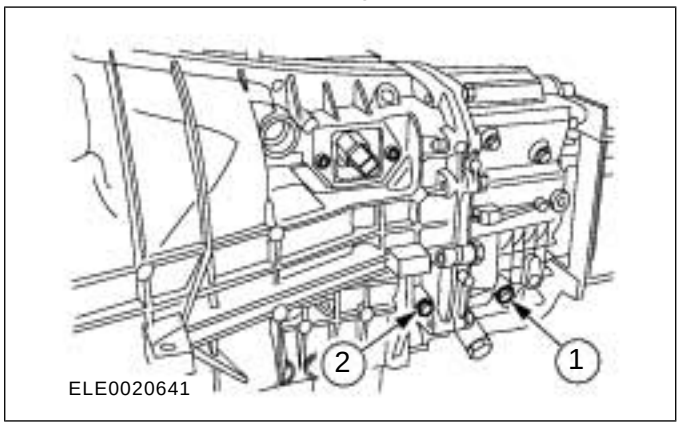


DISASSEMBLY

17. **Remove the selector shaft locking plate bolt.**

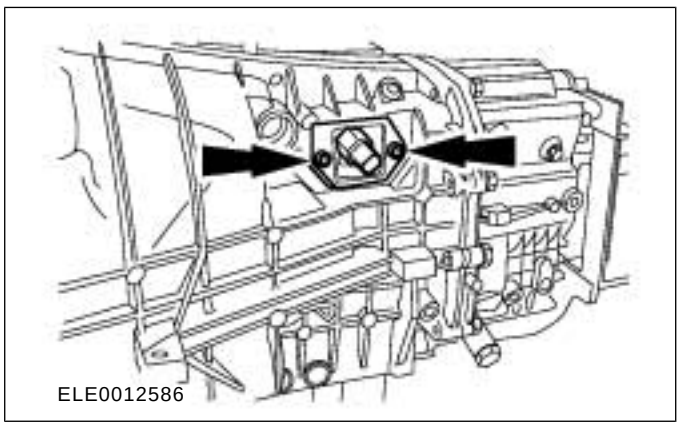

ELE0019848

18. **Loosen and remove the reverse gear idler shaft retaining bolts.**
    1. Loosen the retaining bolt.
    2. Remove the retaining bolt.

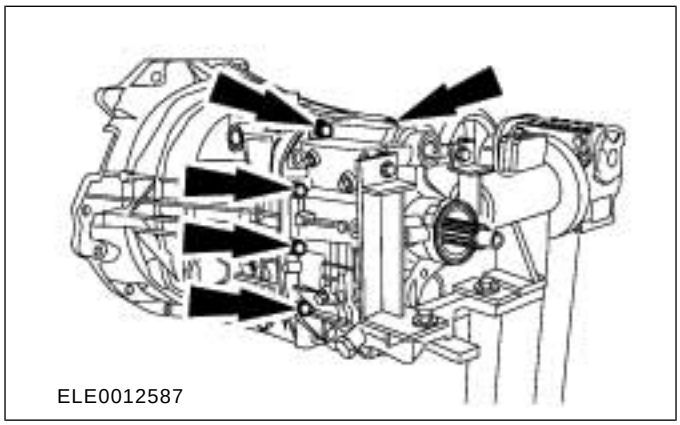


ELE0020641

19. **Remove the reversing lamp switch.**


ELE0012586

20. **Remove the transmission housing retaining bolts (nine bolts).**

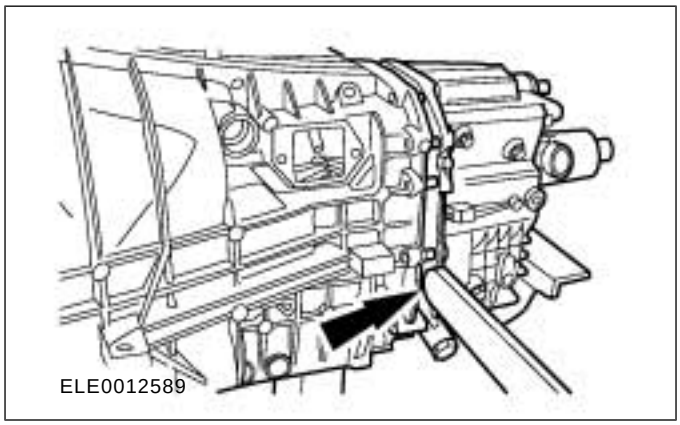

ELE0012587

21. **CAUTIONS:**

⚠ Do not remove the housing locating dowels.

⚠ Only apply leverage to the reinforcement ribs.

Using a suitable lever, separate the two halves of the transmission housing.

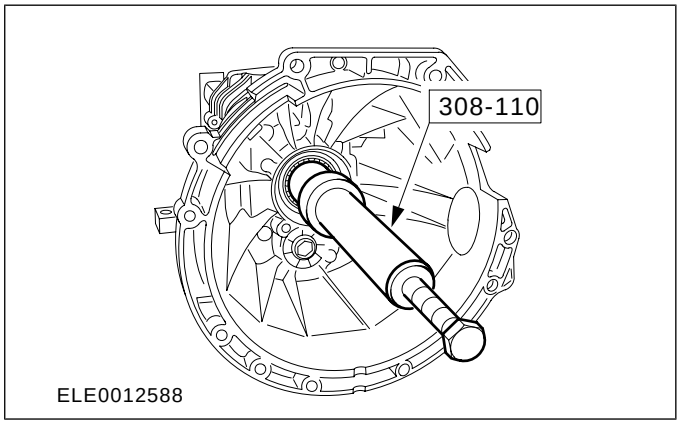

ELE0012589

22. **⚠ CAUTION: Do not apply excessive pressure to the input shaft. This may cause damage to the fourth gear synchronizer ring.**

NOTE: Hold the special tool with a drift.

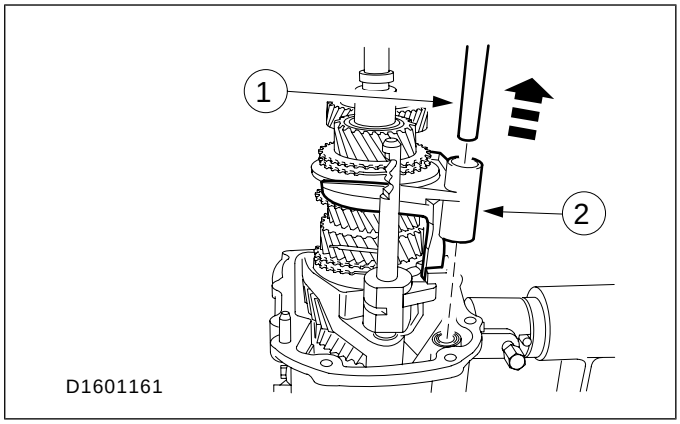
DISASSEMBLY

Using the special tool, remove the transmission front housing.

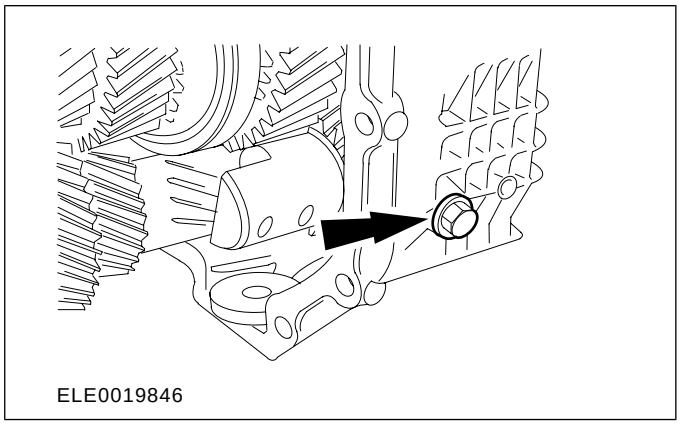


23. Remove the third and fourth gear selector fork.

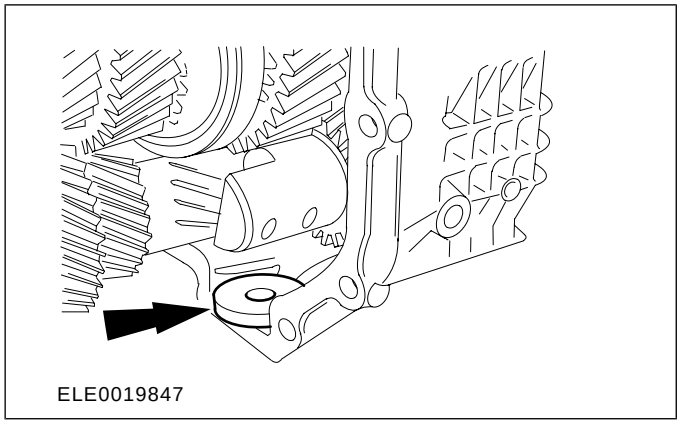
1. Remove the auxiliary selector shaft.
2. Remove the selector fork.



24. Remove the reverse gear idler shaft rear retaining bolt.



25. Remove the magnetic disc.



26. Remove the transmission from the mounting stand.

27. CAUTIONS:

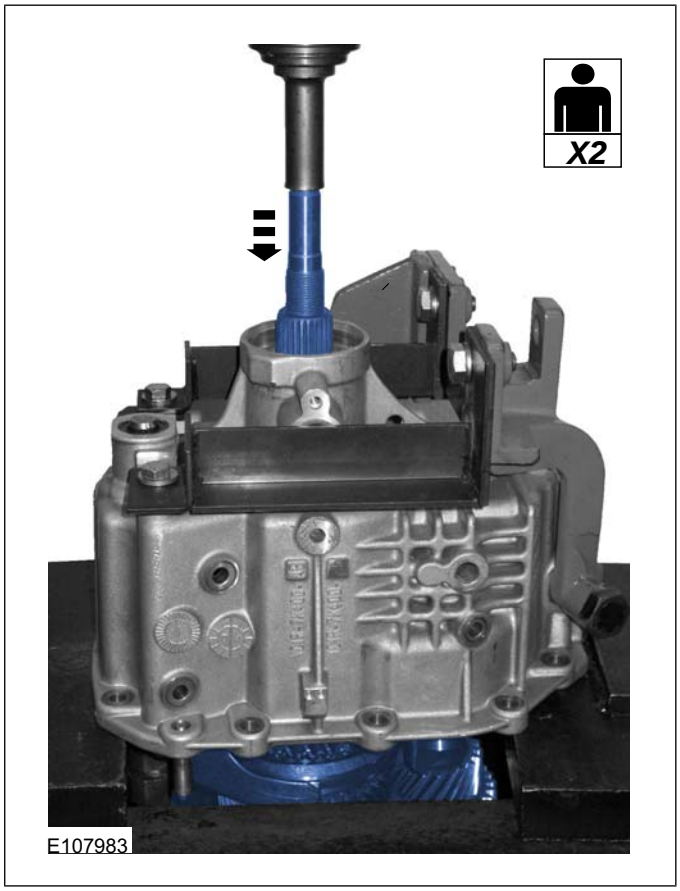
⚠ Move the main selector shaft to the NEUTRAL position. Failure to follow this instruction may result in damage to the shift finger.

⚠Make sure that no component falls off during removal.

Using a hydraulic press and press out the output shaft. Avoid the output shaft, input

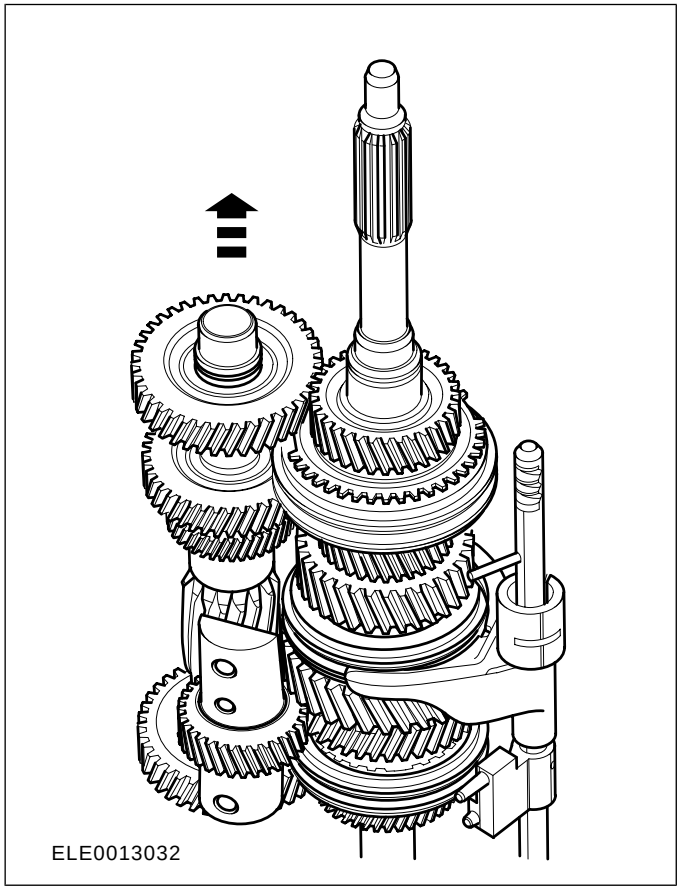
DISASSEMBLY

shaft, reverse gear and selector mechanism from falling down.

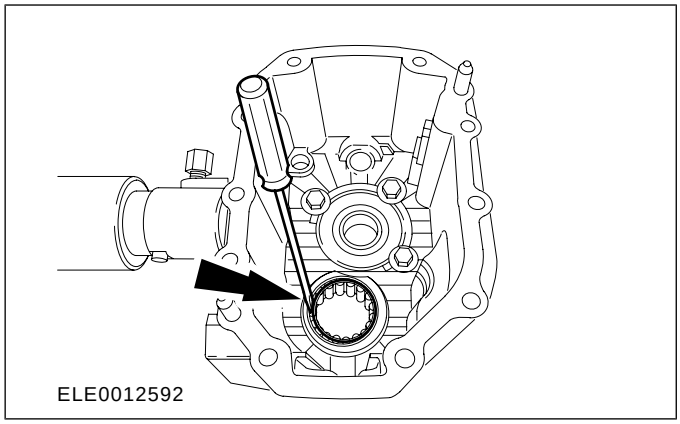


28. Mount the transmission on the mounting stand.

29. Remove the mainshaft and countershaft assembly, the main selector shaft and the selector fork.

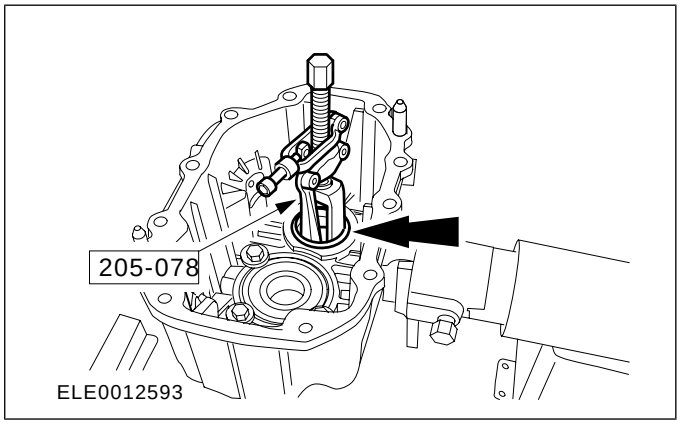


30. Remove the countershaft rear bearing rollers.



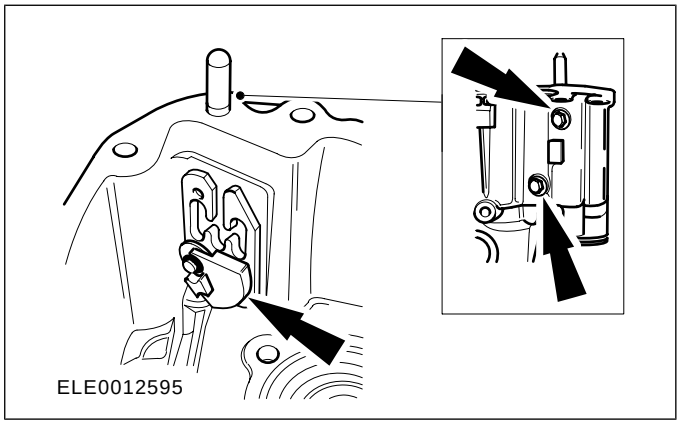
DISASSEMBLY

31. Using the special tool, remove the countershaft rear bearing.

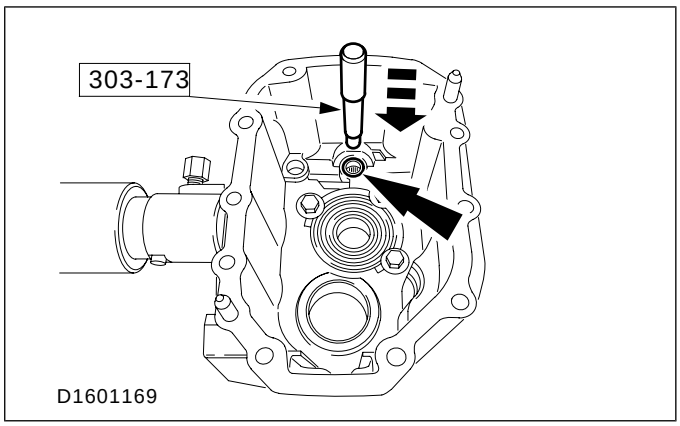


32. NOTE: Only remove the selector gate if it is damaged.

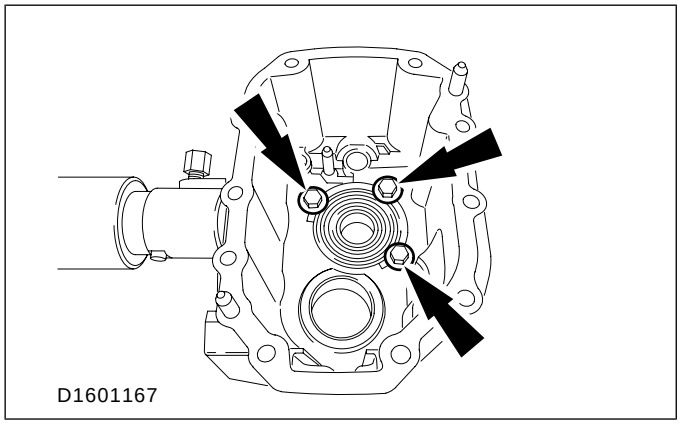
Remove the selector gate.



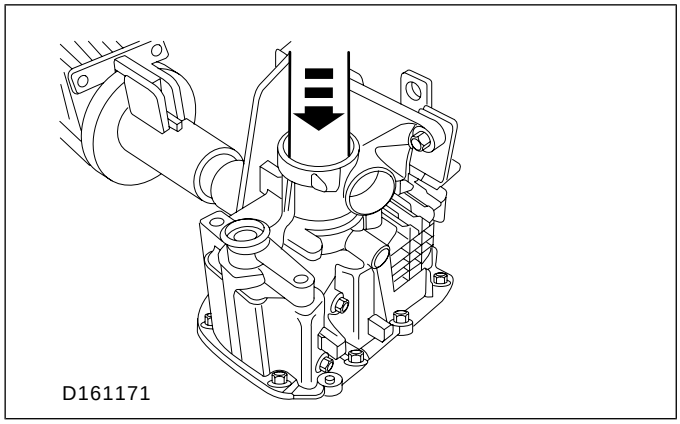
33. Using the special tool, remove the main selector shaft bearing and oil seal.



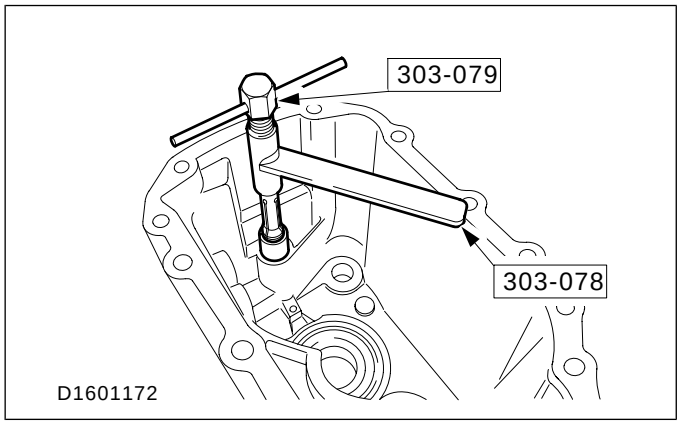
34. Remove the output shaft bearing retaining bolts.



35. Using a length of suitable tube, remove the output shaft bearing.

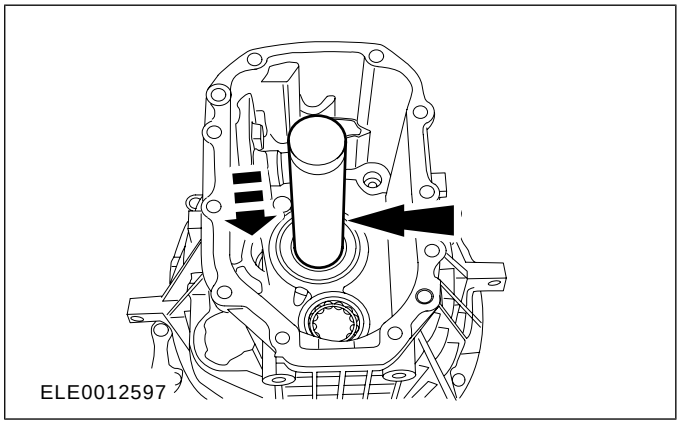


36. Using the special tools and a 63 mm spacer, remove the main selector shaft bearing.



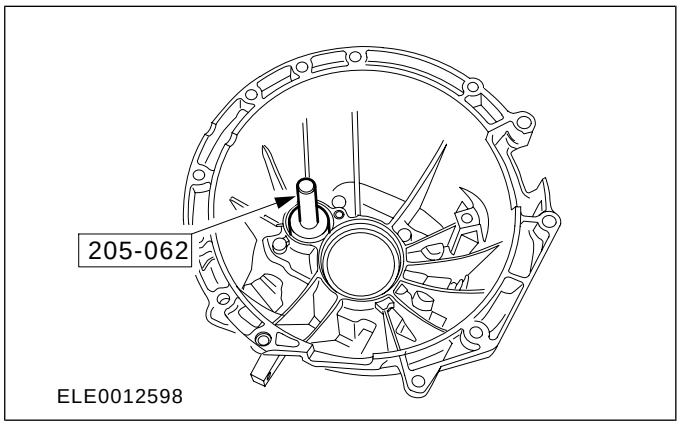
DISASSEMBLY

37. Using a length of suitable tube, remove the input shaft bearing.



38. ⚠CAUTION: Do not damage the thread in the transmission housing.

Using the special tool, remove the countershaft front bearing.



DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

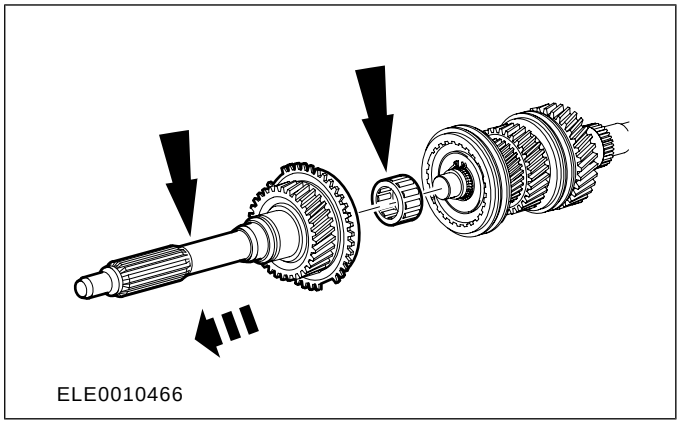
Input Shaft

Disassembly

1. **CAUTION: Handle the synchronizer ring and synchronizer cone with care.**

   Remove the input shaft with the fourth gear synchronizer ring from the output shaft.

   - Remove the output shaft locating bearing.



ELE0010466

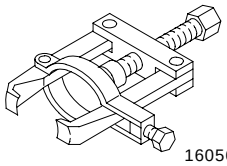
Assembly

1. **Carefully clean and check all parts and assemble the parts in reverse order.**

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Output Shaft

Special Tool(s)

 16056	Remover, Mainshaft Needle Bearing Sleeve 308 - 191 (16 - 056)

General Equipment

Hot air gun

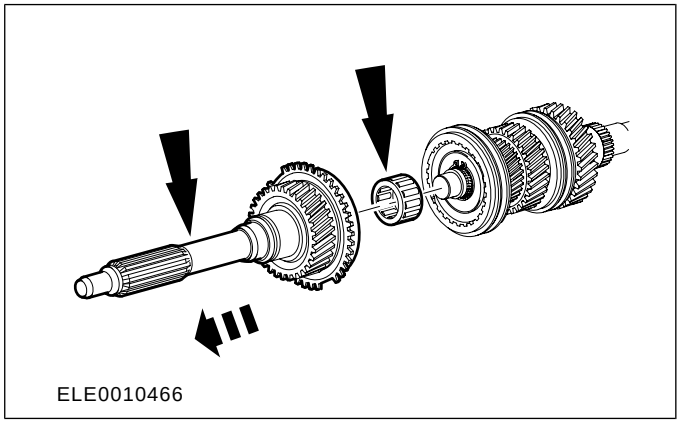
Materials	
Name	**Specification**
Manual transmission fluid	WSD - M2C200 - C

Disassembly

1. CAUTION: Mark the position of the synchronizer rings in relation to the synchronizer units to aid installation.

Remove the input shaft and fourth gear synchronizer ring from the output shaft.

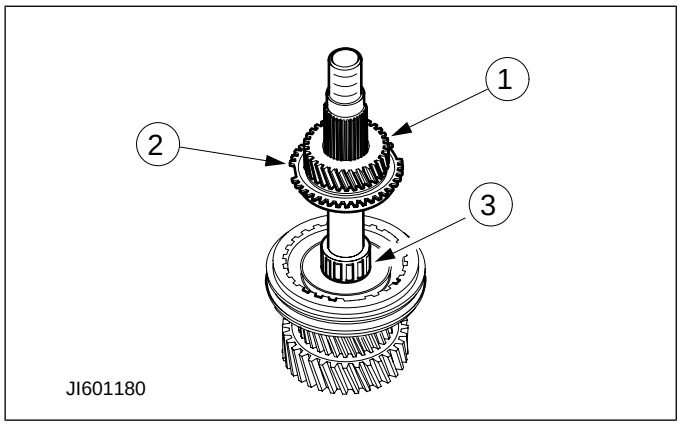
- Remove the output shaft locating bearing.



2. Remove the fifth gear wheel and synchronizer ring from the output shaft.

1. Remove the gear wheel.
2. Remove the gear synchronizer ring.

3. Remove the needle roller bearing.



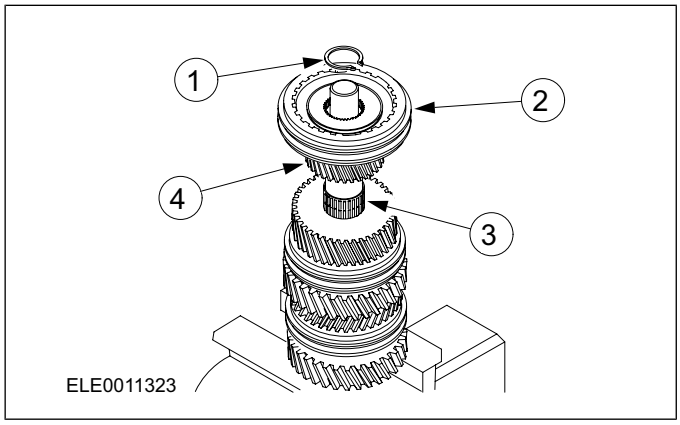
3. WARNING: Do not allow the synchronizers to fall apart. Failure to follow these instructions may result in personal injury.

CAUTION: Use soft jaws for all operations in a vise.

NOTE: Clamp the output shaft in a vise with the output end.

Remove the third/fourth gear synchronizer unit together with the third gear wheel.

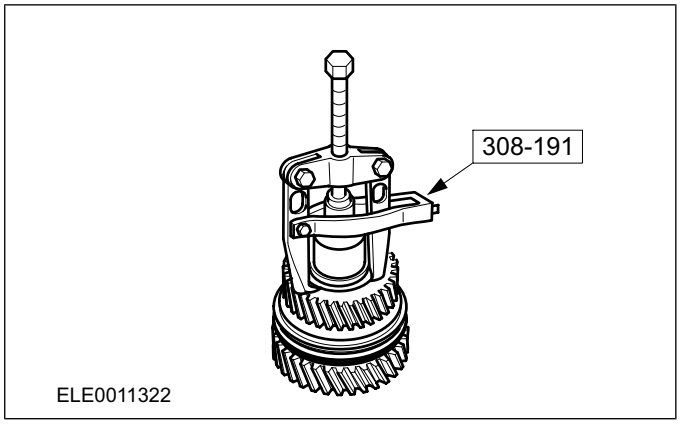
1. Remove the circlip.
2. Third/fourth gear synchronizer.
3. Needle roller bearing.
4. Third gear wheel.



4. Using the special tool, remove the third gear bearing ring.

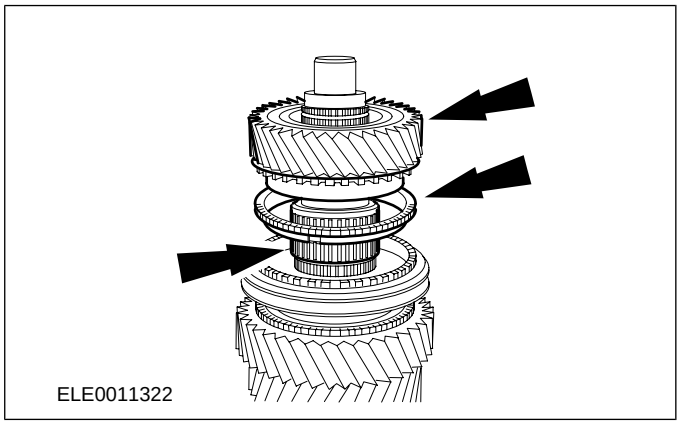
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

- Locate the special tool in the recesses off the bearing ring.



5. **NOTE: Mark the position of the second gear wheel in relation to the synchronizer ring to aid installation.**

   Remove the second gear wheel, the needle roller bearing and synchronizer ring.

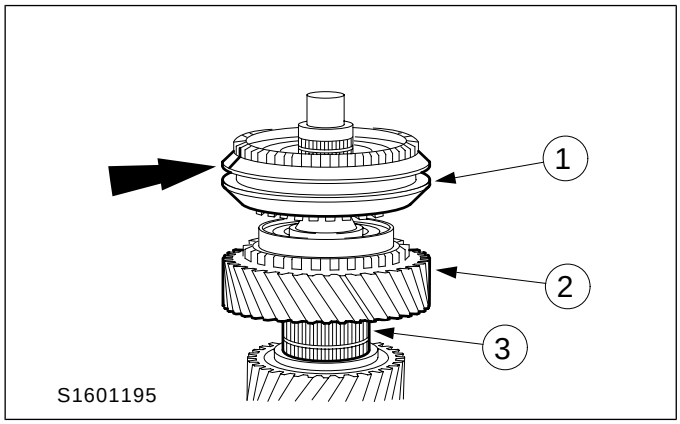


6. **NOTE: Mark the position of the shift ring in relation to the first gear wheel to aid installation.. Components are paired.**

NOTE: Remove the circlip.

Remove the first/second gear synchronizer and the first gear wheel.

1. First/second gear synchronizer.
2. First gear wheel.
3. Needle roller bearing.



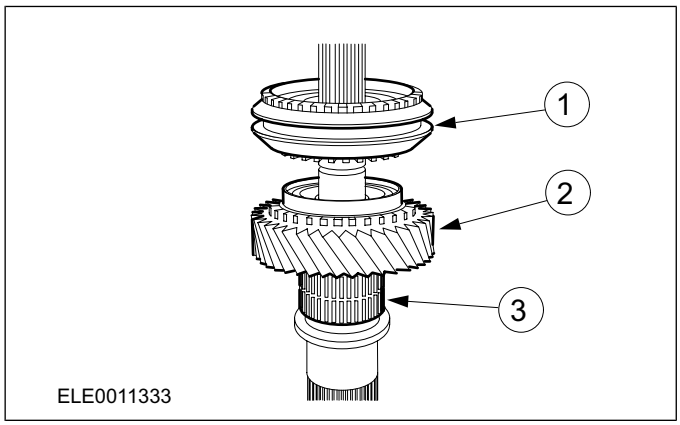
7. **NOTE: Mark the position of the shift ring in relation to the reverse gear wheel to aid installation. Components are paired.**

NOTE: Clamp the output shaft the other way round in the vise.

NOTE: Remove the circlip.

Remove the fifth/reverse gear synchronizer, the reverse gear wheel and needle roller bearing.

1. Fifth/reverse gear synchronizer.
2. Reverse gear wheel.
3. Needle roller bearing.



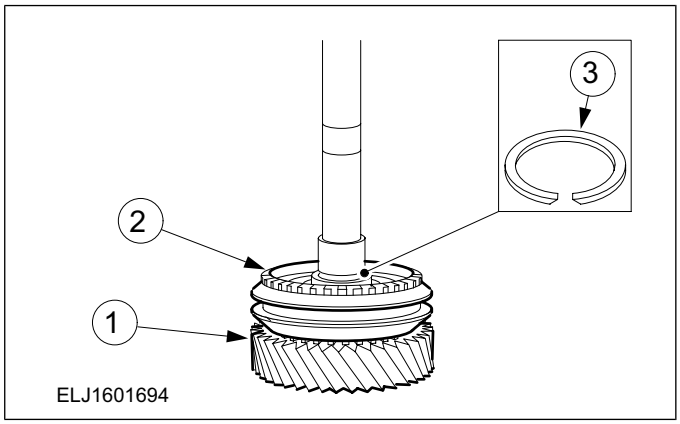
Assembly

1. **Carefully clean and check all sliding parts and lubricate the synchronizer rings with Manual transmission fluid before assembly.**
2. **Install the needle roller bearing, reverse gear wheel and synchronizer unit.**

   1. Install the reverse gear wheel.
   2. Install the synchronizer.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

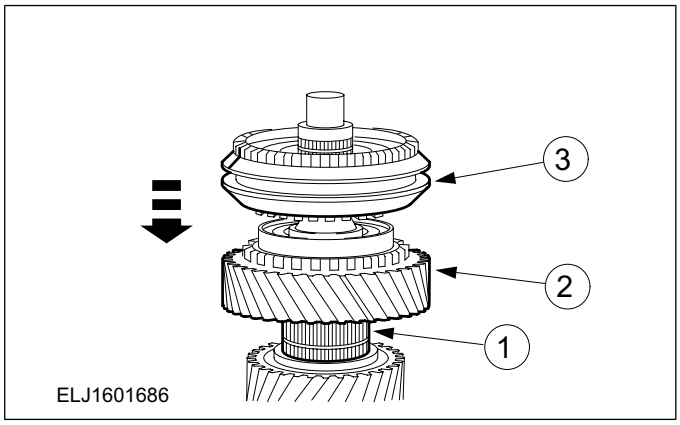
3. Install the snap ring.



3. Install the first/second gear synchronizer unit.

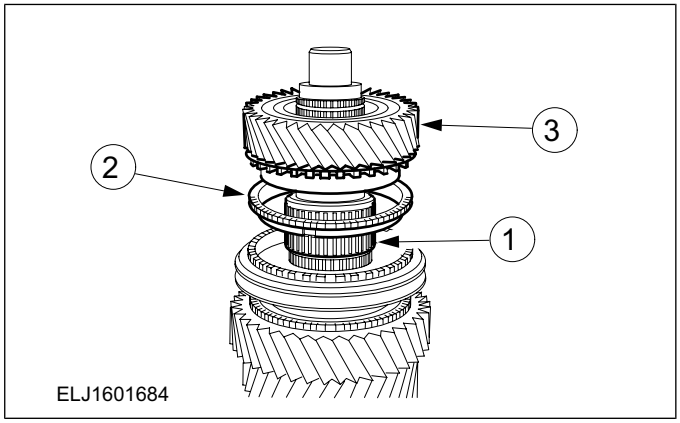
1. Install the needle roller bearing.
2. Install the gear wheel.
3. Install the synchronizer unit.

- Install the circlip.



4. Install the synchronizer ring, needle roller bearing and second gear wheel.

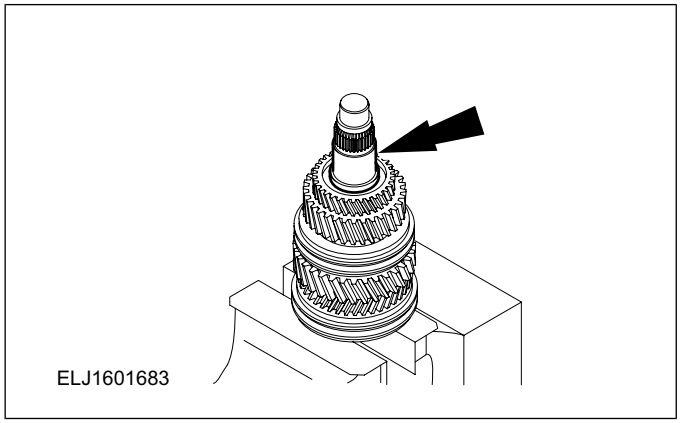
1. Install the needle roller bearing.
2. Install the synchronizer ring.
3. Install the gear wheel.



5. NOTE: Slide the inner bearing ring onto the output shaft as far as the shoulder.

NOTE: Install a new inner bearing ring and needle bearing.

Using a hot air gun heat the inner bearing ring to approximately 100 ° C and install it.

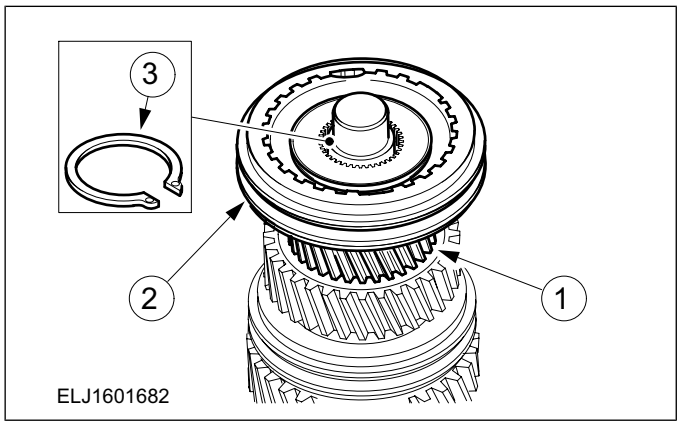


6. NOTE: Install the synchronizer with the small collar upwards.

NOTE: Install the needle roller bearing.

Install the third/fourth gear synchronizer.

1. Install the gear wheel.
2. Install the synchronizer.
3. Install the circlip.

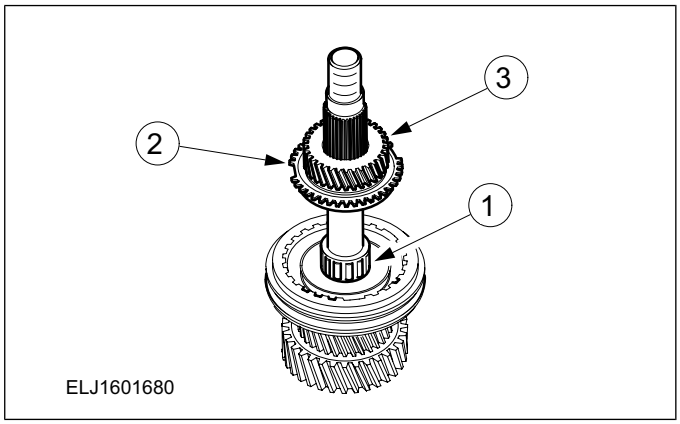


7. Install the fifth gear wheel.

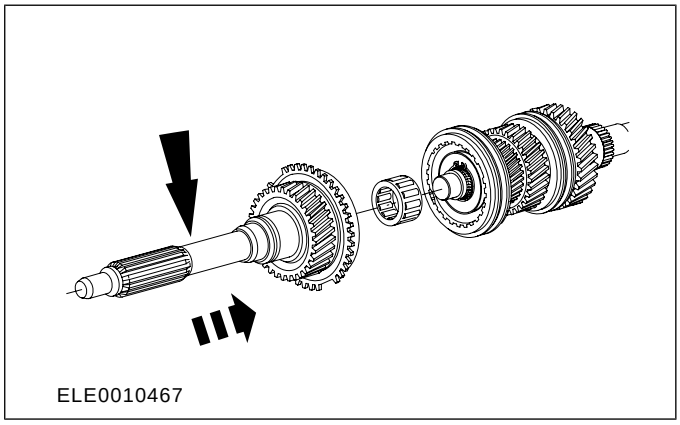
1. Install the needle roller bearing.
2. Install the synchronizer ring.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

3. Install the gear wheel.



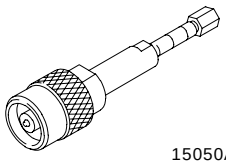
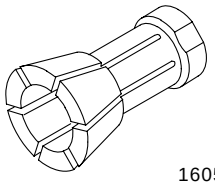
8. Install the output shaft locating bearing, synchronizer ring and the input shaft.



DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Countershaft

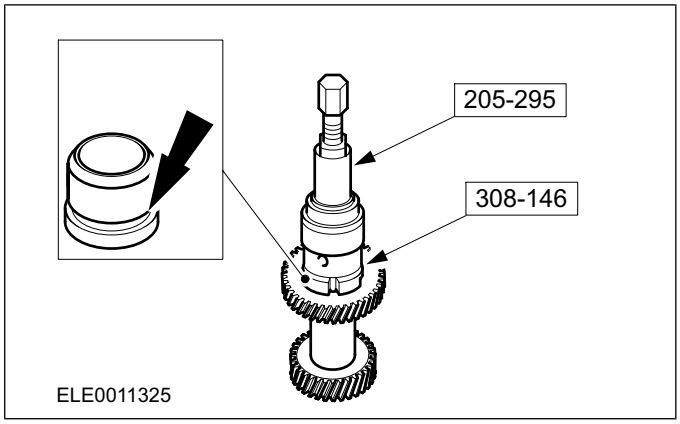
Special Tool(s)

 15050A	Remover, Bearing (Main Tool) 205-295 (15-050A)
 16050	Collet for 205-295 308-146 (16-050)

Disassembly

1. **NOTE: Insert the special tool in the annular groove provided in the ring.**

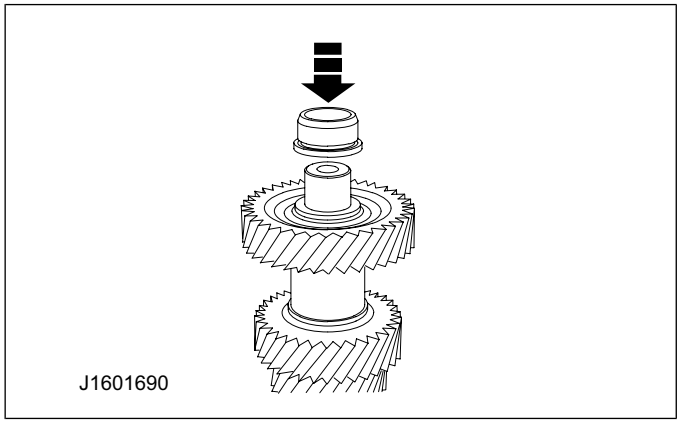
   Using the special tools, pull the bearing rings off the countershaft.



Assembly

1. **Install the bearing rings.**

- Heat the bearing rings to approximately 100°C and slide on.



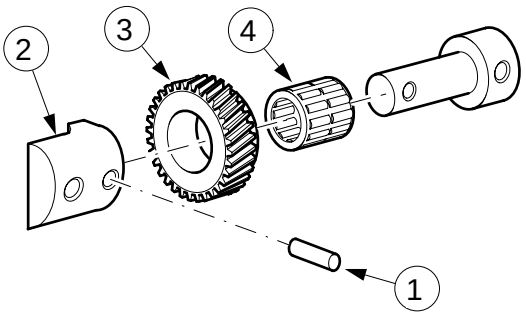
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Reverse Idler Gear

Disassembly

1. Disassemble the reverse gear idler shaft.

1. Drive out the roll pin.
2. Remove the bearing housing.
3. Remove the reverse idler gear.
4. Remove the needle roller bearing.



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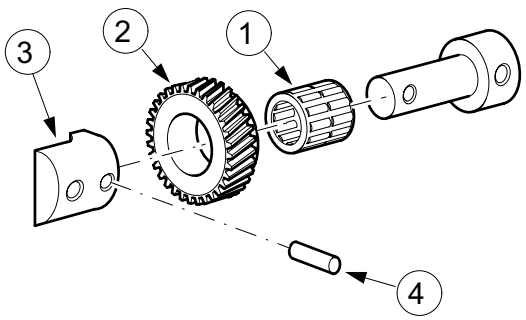
Assembly

1. NOTE: Do not install the bearing housing twisted. The threaded holes must line up with one another.

Assemble the reverse gear idler shaft.

1. Install the needle roller bearing.
2. Install the reverse idler gear.
3. Install the bearing housing.
4. Drive in the roll pin.



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DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Synchronizers

Materials	
Name	**Specification**
Manual transmission fluid	WSD-M2C200-C

Disassembly

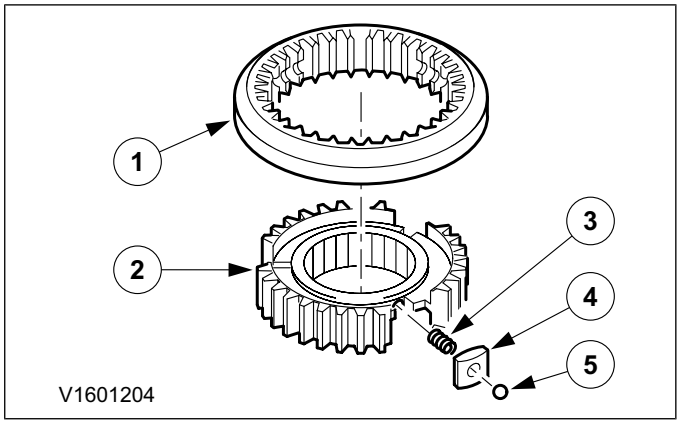
1. CAUTIONS:

Take care when pulling the selector ring off the synchronizer hub. The detent balls are spring-loaded.

Mark the synchronizers to the synchronizer hubs in relation to the selector rings.

Disassemble the synchronizer.

1. Selector ring.
2. Synchronizer hub.
3. Compression spring.
4. Blocker bar.
5. Detent ball.

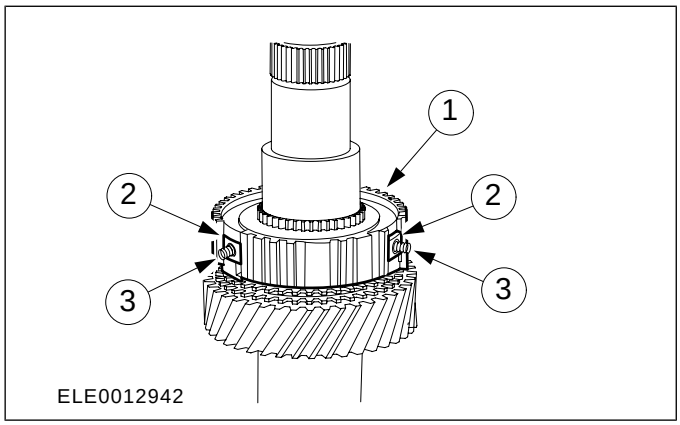


Assembly

1. NOTE: Carefully clean and check all sliding parts and lubricate them with Manuel transmission fluid before assembly.

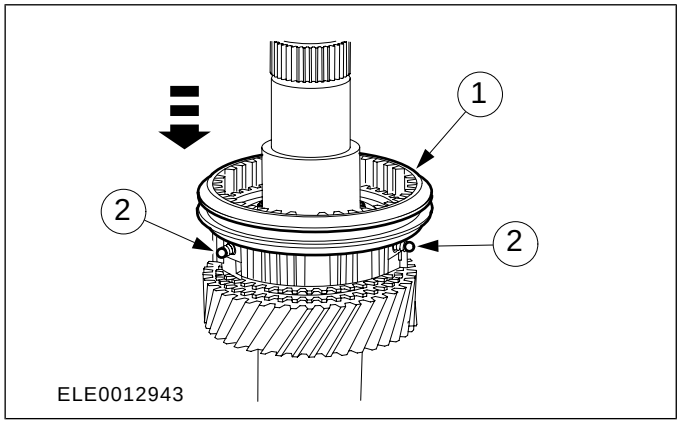
Assemble the inner synchronizer.

1. Synchronizer inner ring.
2. Blocker bars.
3. Compression springs.



2. Assemble the outer synchronizer.

1. Synchronizer outer ring.
2. Detent balls.



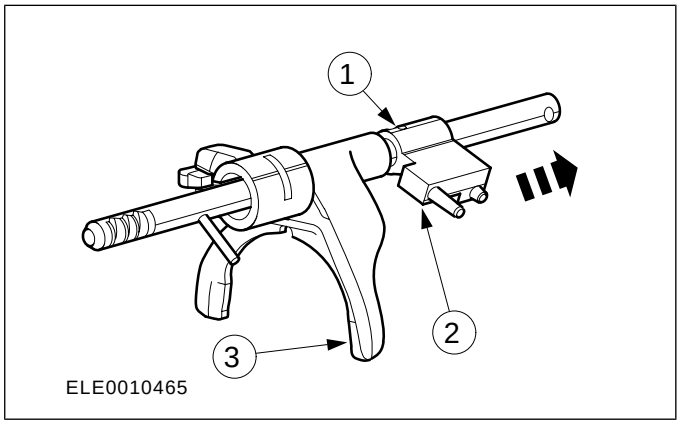
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Gearshift Control Shaft

Disassembly

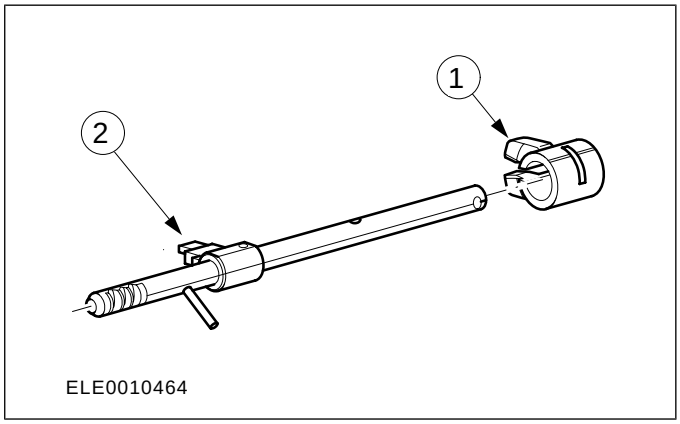
1. Disassemble the gearshift control shaft.

1. Remove the roll pin.
2. Remove the shift finger.
3. Remove the selector fork.



2. Disassemble the gearshift control shaft (continued)

1. Remove the locking sleeve.
2. Remove the roll pin and the selector finger.



Assembly

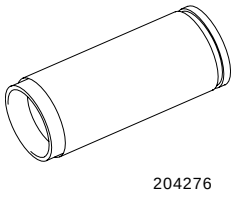
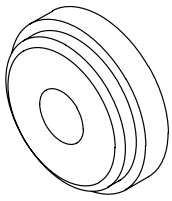
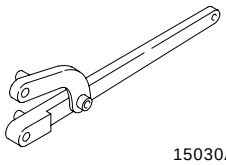
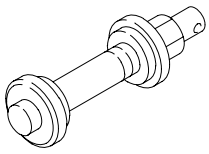
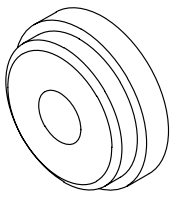
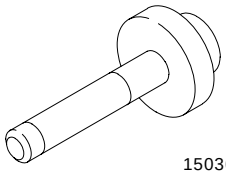
1. NOTE: Make sure that the roll pins do not protrude.

To assemble, reverse the disassembly procedure.

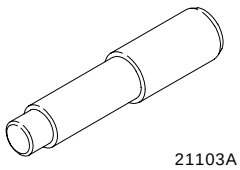
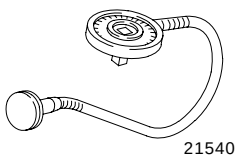
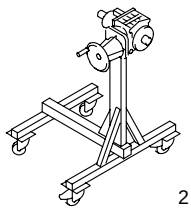
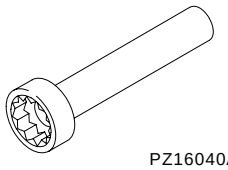
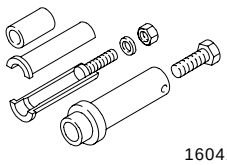
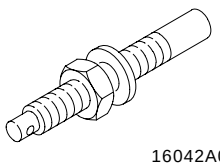
ASSEMBLY

Transmission

Special Tool(s)

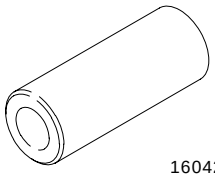
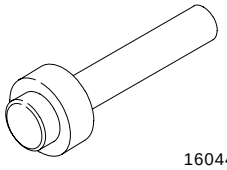
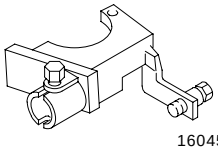
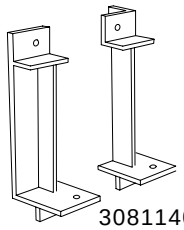
 204276	Installer, Wear Sleeve Stub Axle 204-276 (14-055)
 15068	Adapter for 205-066 205-066-04 (15-068)
 15030A	Flange Holding Wrench, Universal 205-072 (15-030A)
 15035	Installer, Differential Bearing Cone 205-074 (15-035)
 15064	Adapter for 205-074 205-074-01 (15-064)
 15036	Installer, Rear Hub Oil Seal 205-075 (15-036)

Special Tool(s)

 21103A	Aligner, Clutch Plate 303-173 (21-103A)
 21540	Angle Gauge, Bolt Tightening 303-174 (21-540)
 21187	Mounting Stand 303-435 (21-187)
 PZ16040A	Socket, Guide Sleeve 308-109 (16-040A)
 16041	Remover/Installer, Front Housing 308-110 (16-041)
 16042A01	Threaded Spindle 308-111 (16-042A-01)

ASSEMBLY

Special Tool(s)

 16042A	Adapter for 308-111 308-111-01 (16-042A)
 16044	Installer, Input Shaft Seal 308-113 (16-044)
 16045	Mounting Bracket for 303-435 308-114 (16-045)
 30811401	Mounting Brackets for 308-114 308-114-01 (16-045-01)

General Equipment

17 mm socket

Materials	
Name	**Specification**
Manual transmission fluid	WSD-M2C200-C
Sealant	WSS-M2G348-A10
Sealant	ESK-M4G242-A
Sealant - Loctite 518	WSK-M2G348-A5
Grease	ESD-M2C220-A

Assembly

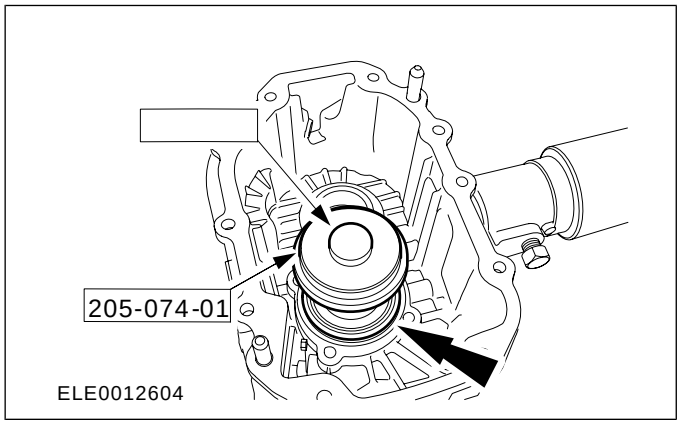
All vehicles

1. **NOTE: Lubricate all moving parts with manual transmission fluid during assembly.**

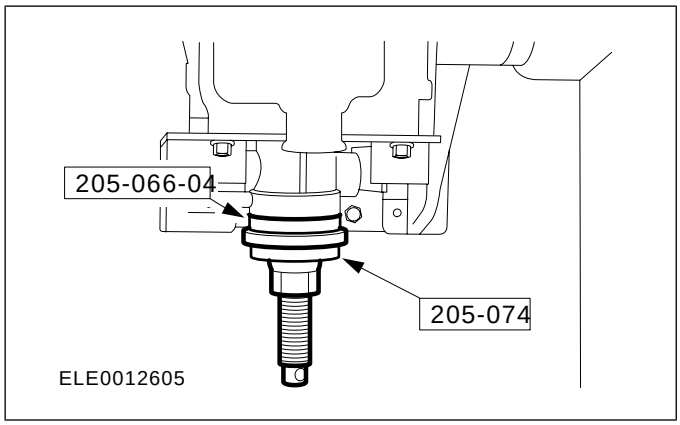
NOTE: Clean and check all parts for wear and damage. Install new parts as necessary.

NOTE: When installing a new transmission rear housing, install the locating studs with a 24 ± 0.5 mm protrusion.

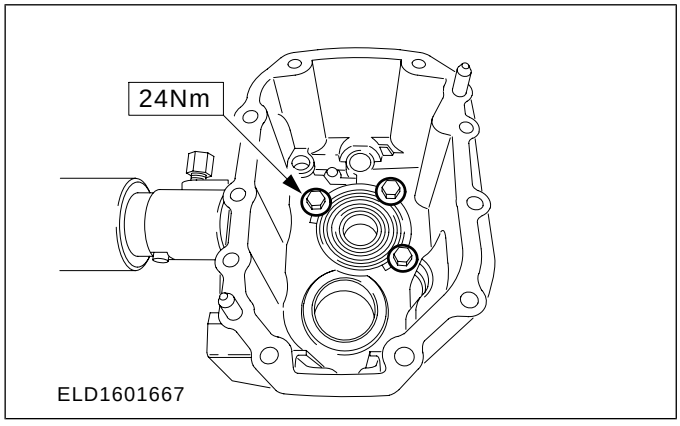
Using the special tools, install the output shaft bearing.



2. **Using the special tools, install the output shaft bearing.**

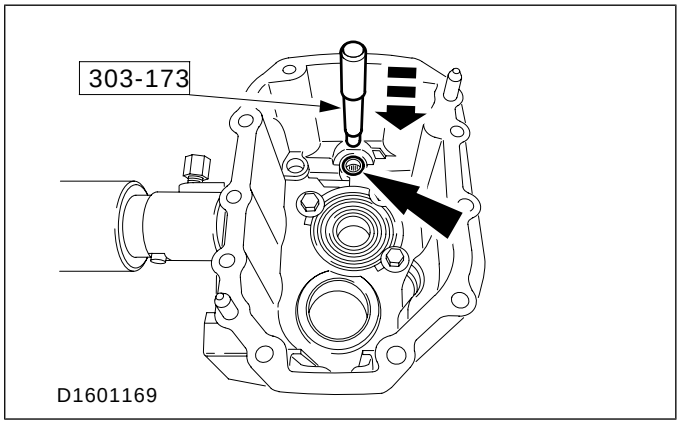


3. **Install the output shaft bearing retaining bolts.**

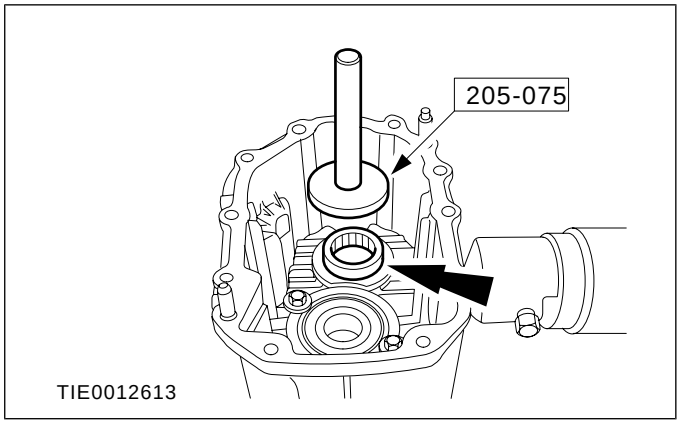


ASSEMBLY

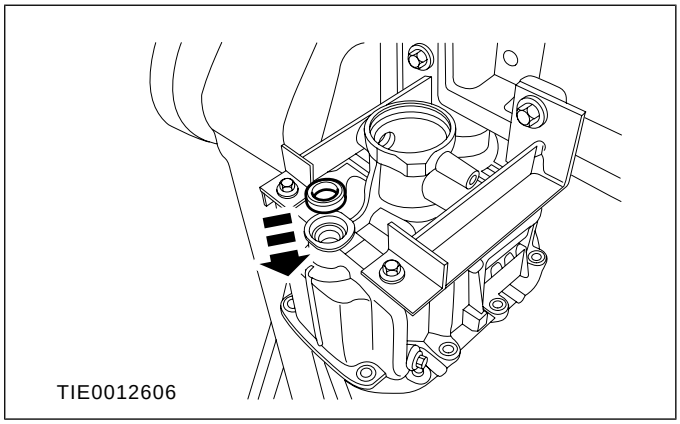
4. Using the special tool, install the main selector shaft bearing.



5. Using the special tool, install the countershaft rear bearing.

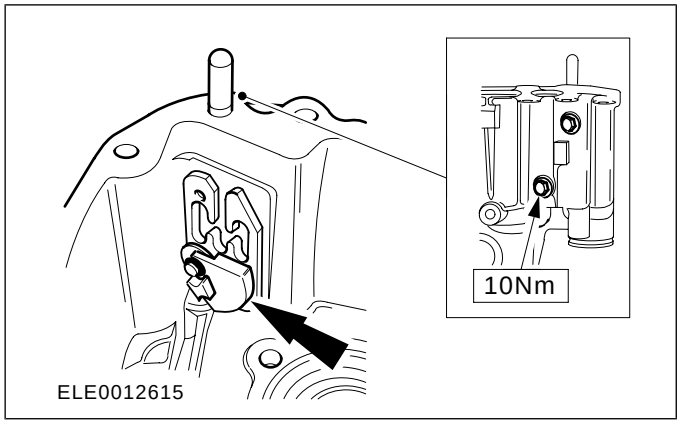


6. Coat the lip of the main selector shaft oil seal with grease.
7. Using a 17 mm socket, install the main selector shaft oil seal.



8. NOTE: Install new selector gate retaining bolts.

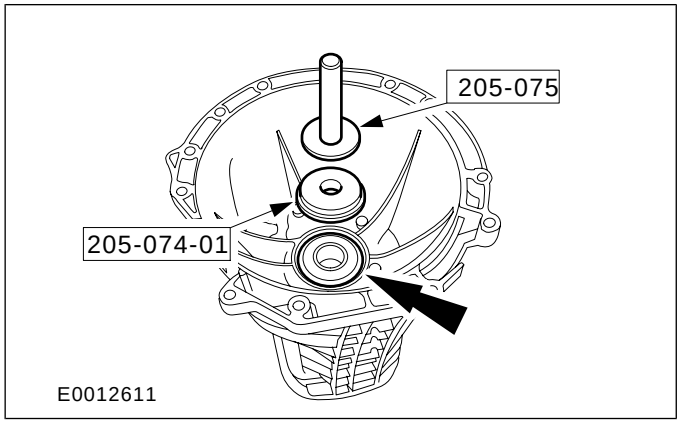
   Install the selector gate.



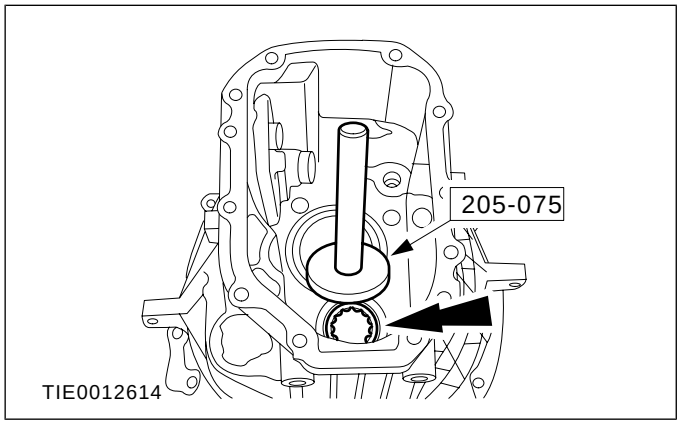
9. NOTE: Install a new input shaft bearing snap ring.

   Using the special tools, install the input shaft bearing.

   - Install the snap ring in the annular groove of the bearing.

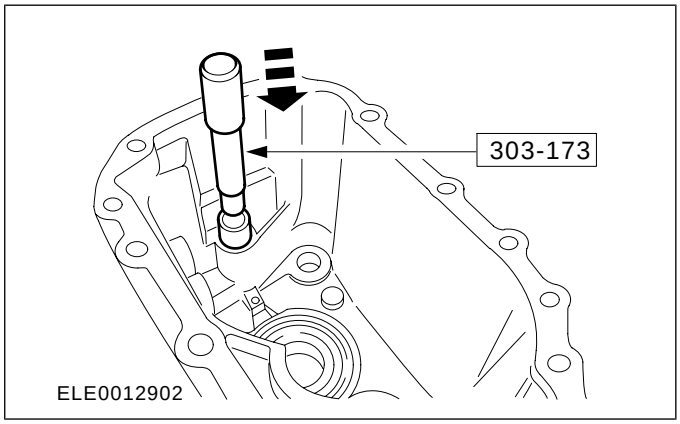


10. Using the special tool, install the countershaft front bearing.

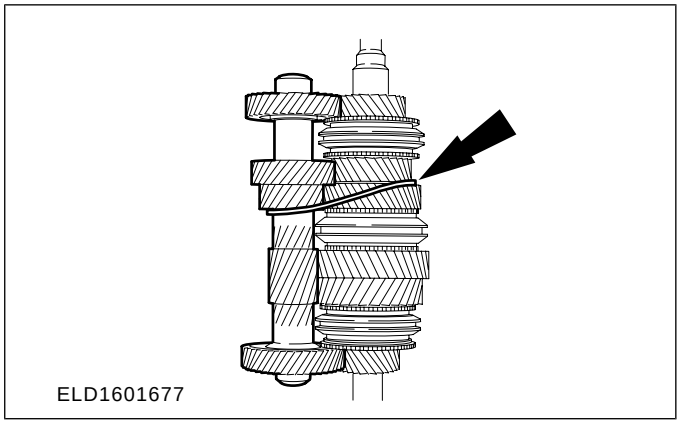


ASSEMBLY

11. Using the special tool, install the main selector shaft bearing.

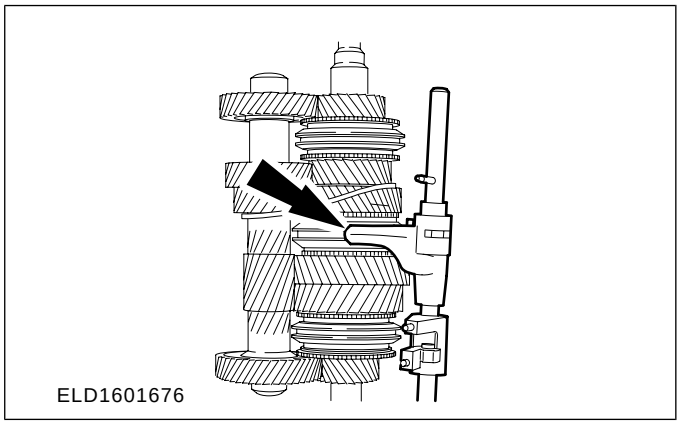


12. Assemble the countershaft to the output shaft and secure it with a cable tie.



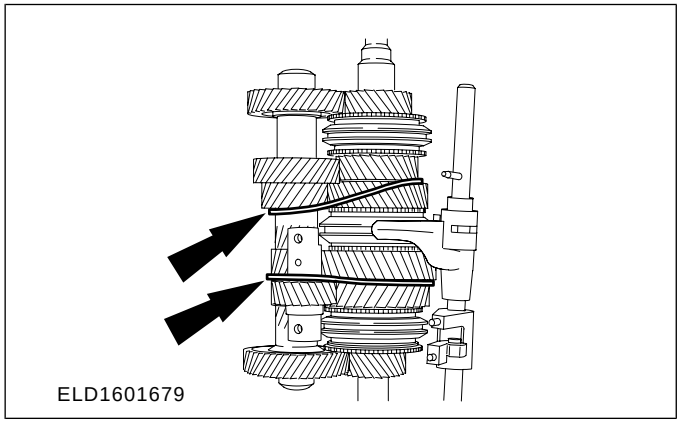
13. NOTE: The first and second gear selector fork must engage in the middle of the first and second gear synchronizer unit.

Assemble the main selector shaft to the countershaft and output shaft assembly.



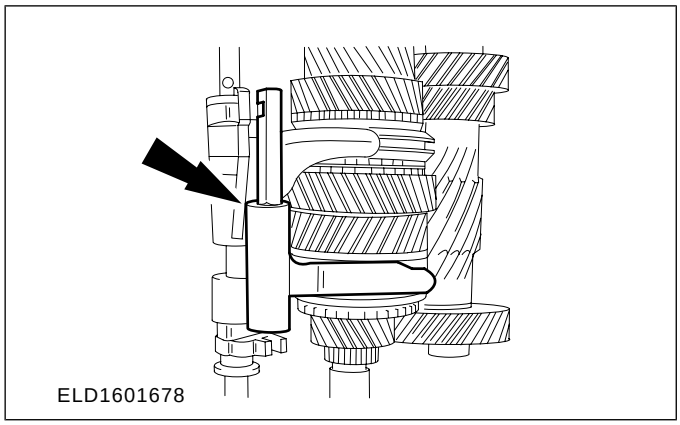
14. NOTE: Make sure that the flat end of the reverse gear idler shaft is facing upwards.

Assemble the reverse gear idler to the countershaft and output shaft assembly and secure it with cable ties.



15. NOTE: Make sure that the outtrigger of the selector fork is facing upwards.

Attach the fifth and reverse gear selector fork to the lower synchronizer unit.



16. NOTE: During installation, guide the main selector shaft into the bearing and selector gate correctly.

NOTE: Make sure that there is no touch condition between the countershaft and the synchronizer ring.

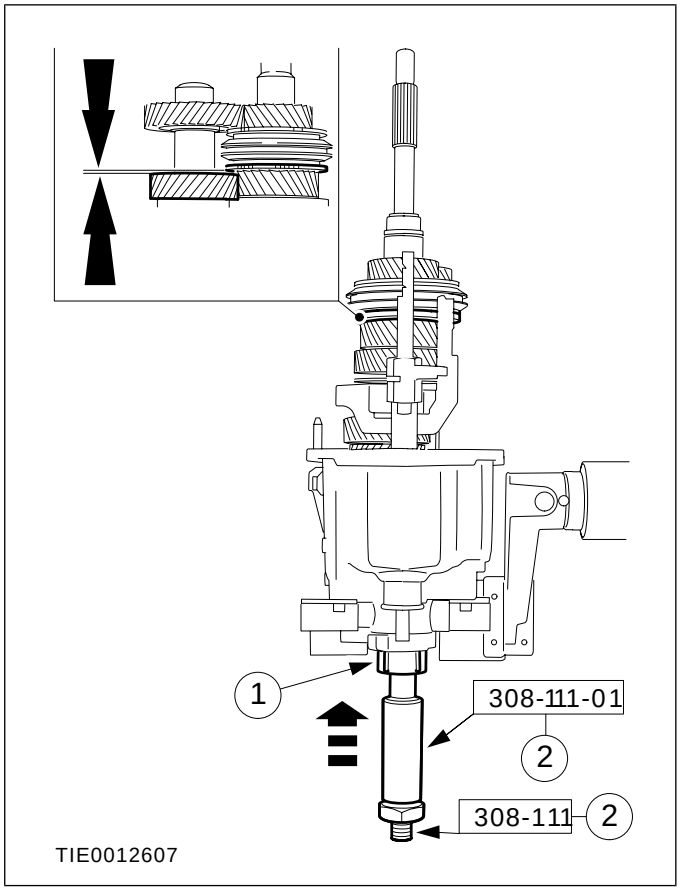
NOTE: Make sure that the inside splines of the sensor ring are facing to the output shaft flange.

Using the special tools, install the countershaft and output shaft assembly.

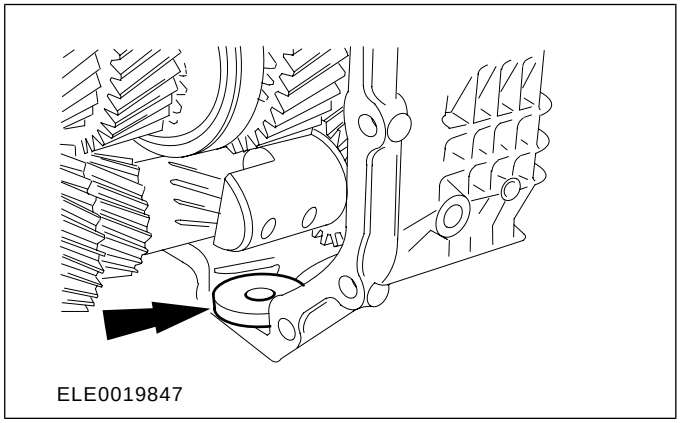
1. Install the vehicle speed sensor (VSS) ring.

ASSEMBLY

2. Use the special tools to guide the countershaft into the rear bearing.

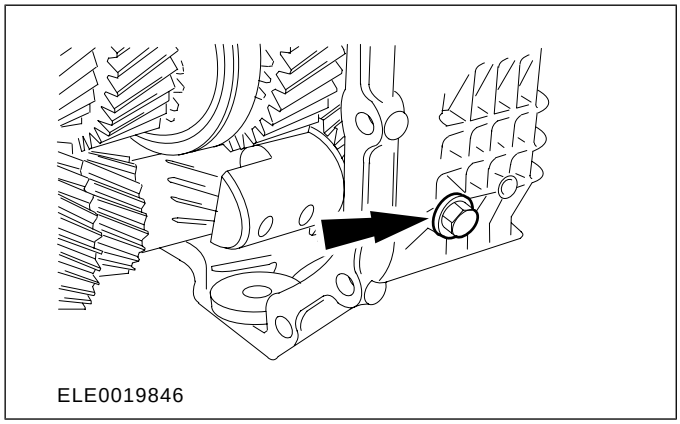


17. Remove the VSS ring.
18. Install the magnetic disc.



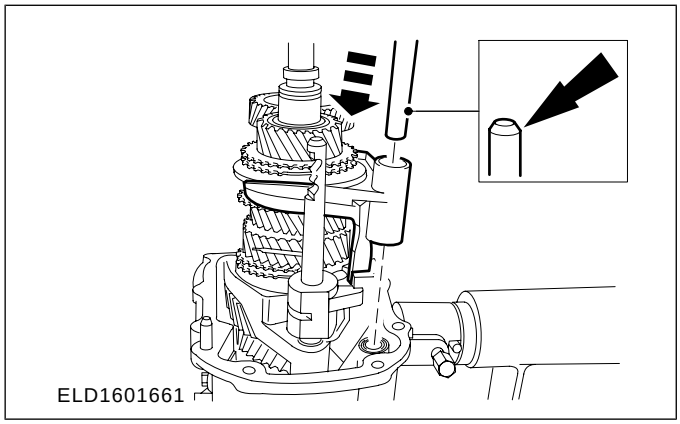
19. NOTE: Do not fully tighten the reverse gear idler shaft rear retaining bolt at this stage.

Install the reverse gear idler shaft rear retaining bolt.



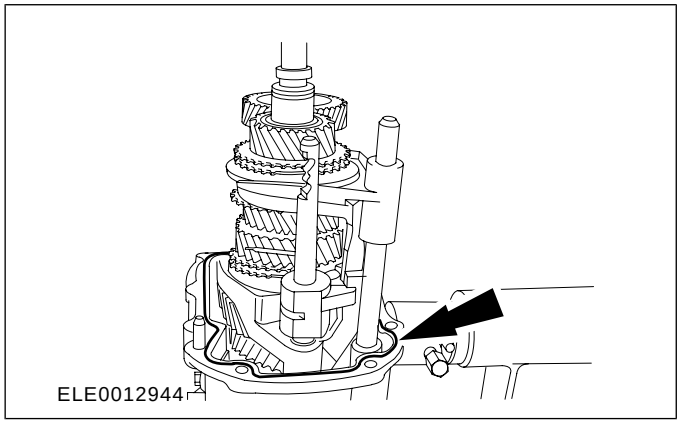
20. Remove the cable ties from the countershaft and output shaft assembly.
21. NOTE: Make sure that the chamfered end of the selector shaft is facing upwards.

Install the third and fourth gear selector fork and the auxiliary selector shaft.



22. ⚠CAUTION: Install the transmission front housing within 15 minutes of applying the sealant.

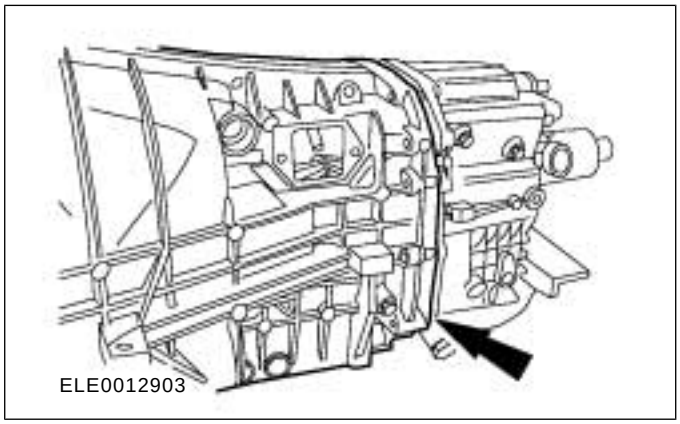
Apply sealantto the mating surface of the transmission rear housing.



ASSEMBLY

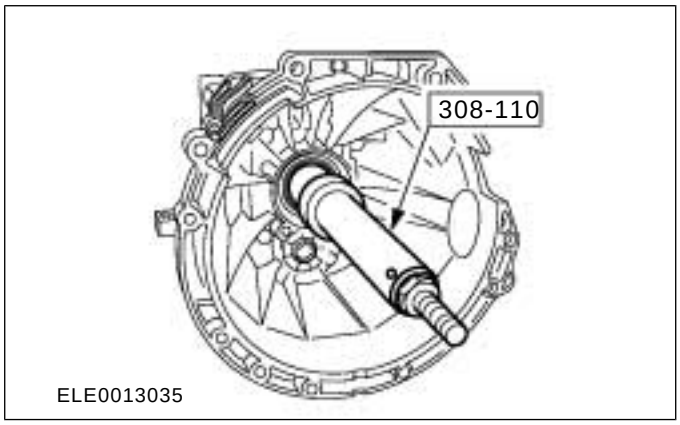
23. **CAUTION: Install the transmission front housing carefully. Failure to follow this instruction may result in damage to the fourth gear synchronizer ring.**

Assemble the transmission front housing to the transmission rear housing.


ELE0012903

24. **NOTE: During installation, guide the countershaft carefully into the bearing.**

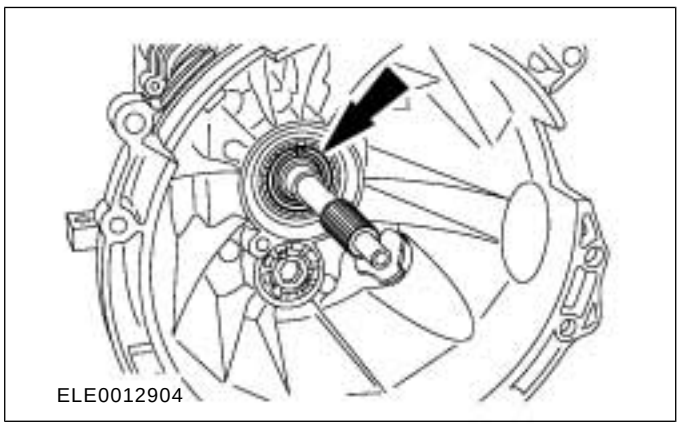
Using the special tool, install the transmission front housing.



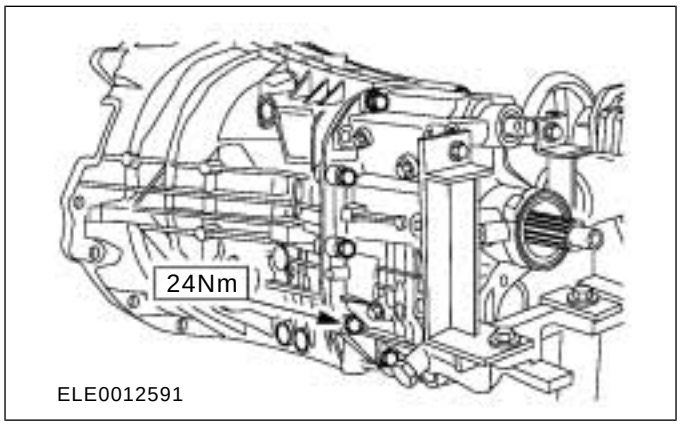
ELE0013035

25. **NOTE: Install a new input shaft circlip.**

Install the input shaft circlip.


ELE0012904

26. **Install the transmission housing retaining bolts.**

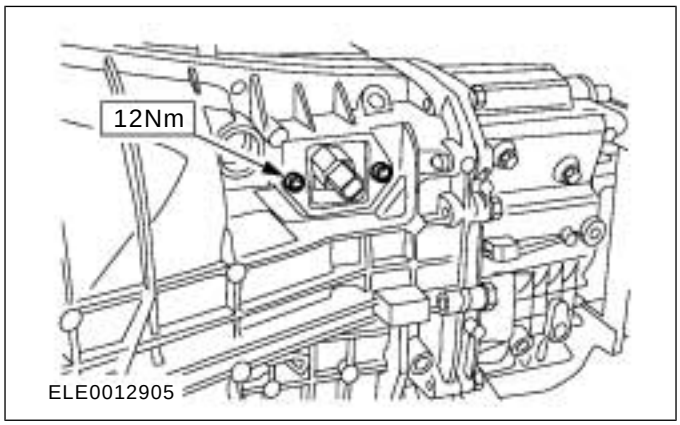


ELE0012591

27. **CAUTION: Check the reversing lamp switch gasket. If the gasket is loose or damaged, discard the reversing lamp switch.**

NOTE: Install new reversing lamp switch retaining bolts.

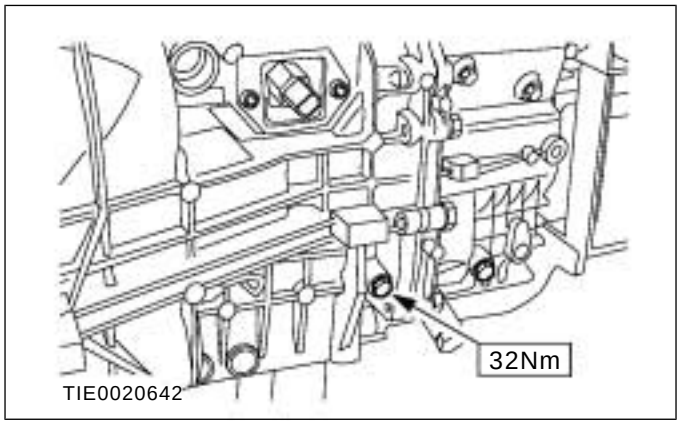
Install the reversing lamp switch.



ELE0012905

28. **Install the reverse gear idler shaft front retaining bolt**

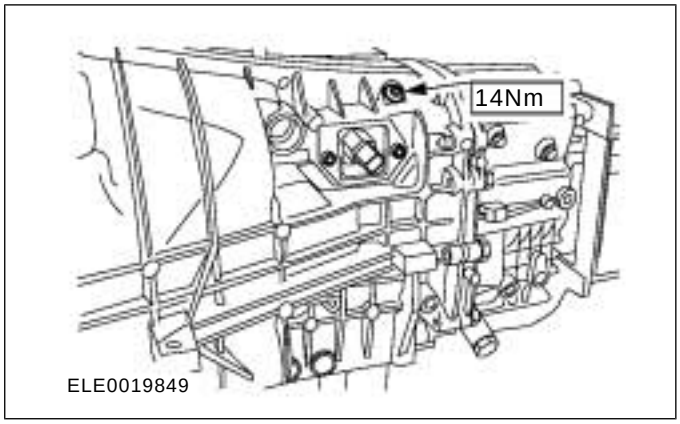
- Tighten the reverse gear idler shaft retaining bolts.



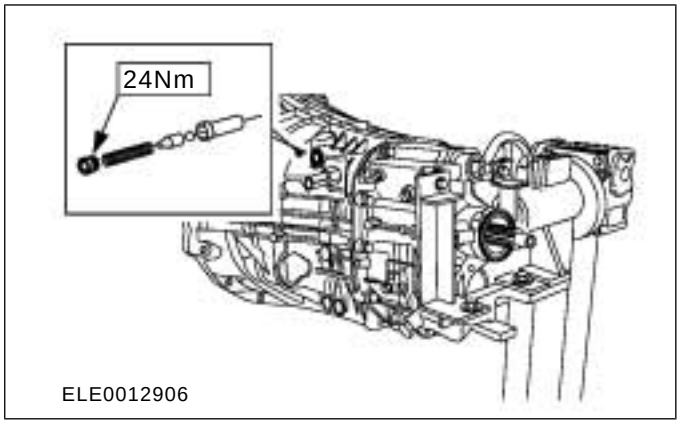
TIE0020642

ASSEMBLY

29. Install the selector shaft locking plate bolt.

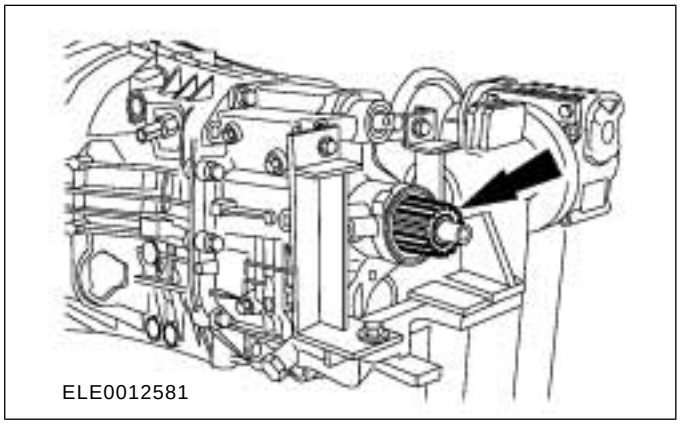


30. Apply sealant to the selector interlock mechanism retaining plug.
31. Install the selector interlock mechanism.

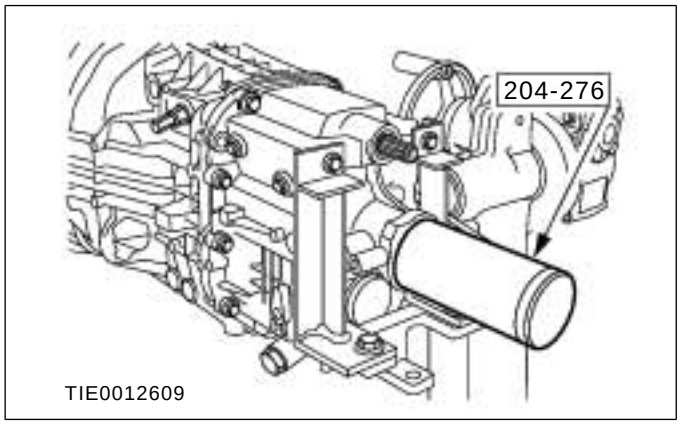


32. NOTE: Make sure that the inside splines of the sensor ring are facing the output shaft flange.

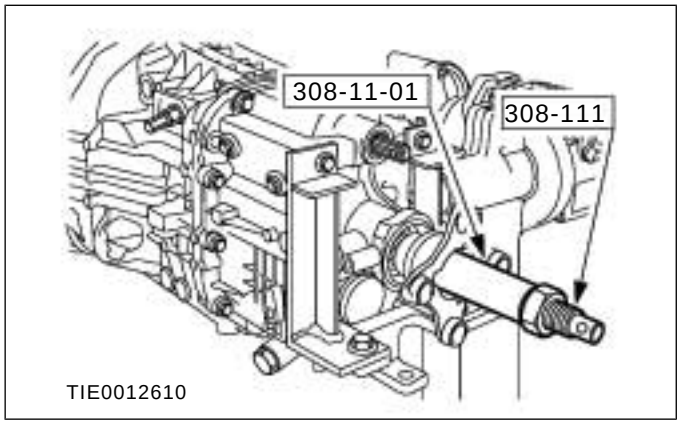
Install the VSS ring.



33. Coat the lip of the output shaft oil seal with grease.
34. Using the special tool, install the output shaft oil seal.
- Install the splash shield.



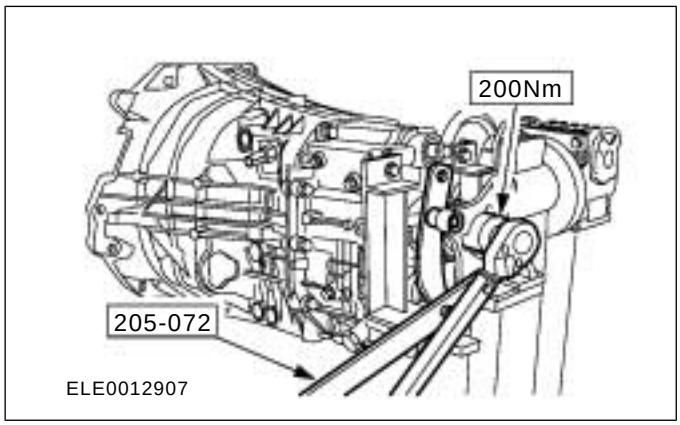
35. Using the special tools, install the output shaft flange.
- Hold the spindle with a drift.



36. NOTE: Install a new output shaft flange retaining nut.

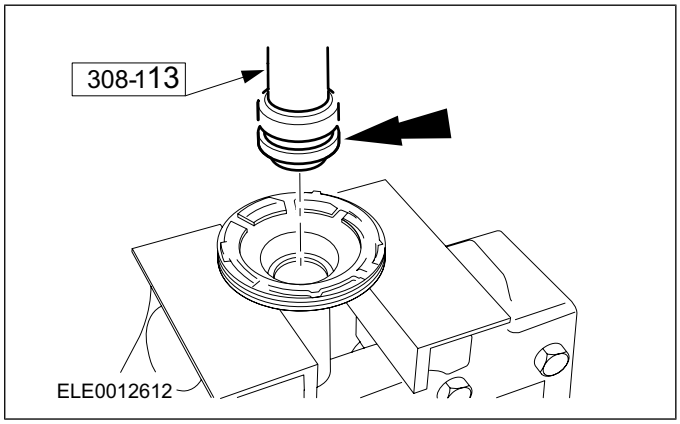
Coat the threads and the mating surface of the output shaft retaining nut with sealant.

37. Using the special tool, install the output shaft flange retaining nut.

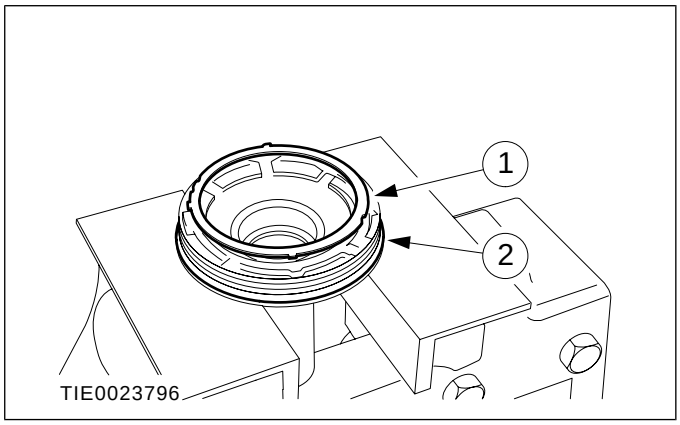


ASSEMBLY

38. **Using the special tool, install the input shaft guide sleeve oil seal.**

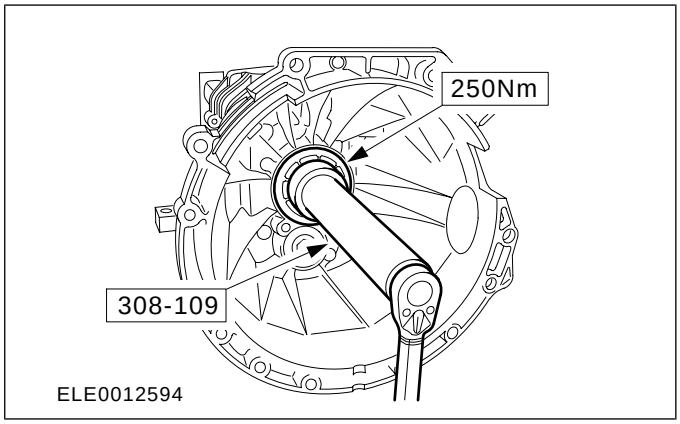


39. **Assemble the input shaft guide sleeve.**
    1. Install the thrust washer.
    2. Install the O-ring seal.



40. **Coat the threads of the input shaft guide sleeve and the O-ring seal with grease**

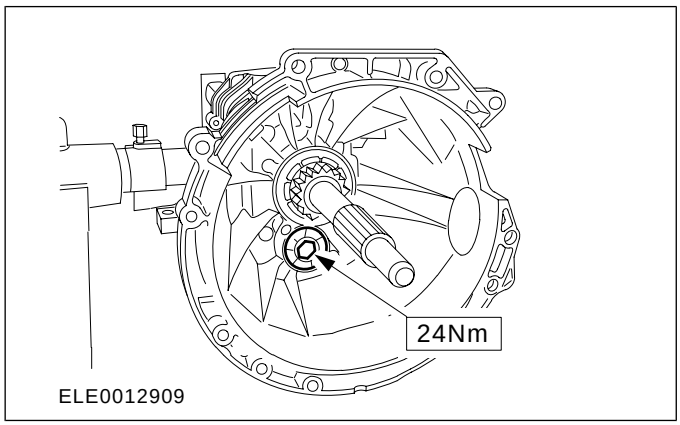
41. **Using the special tool, install the input shaft guide sleeve.**



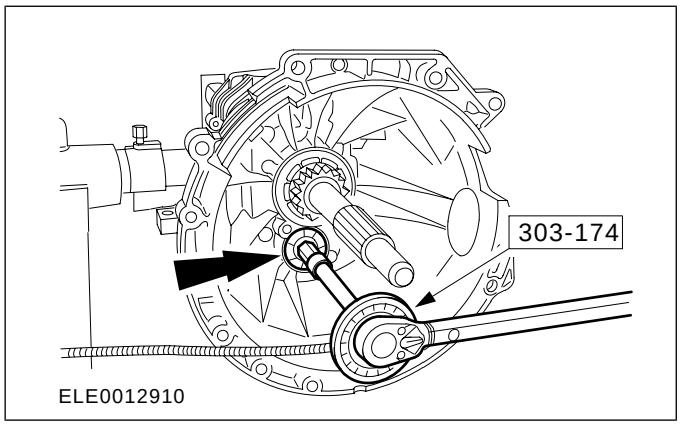
42. **Coat the threads of the countershaft bearing retainer and the O-ring seal with grease.**

43. **NOTE: Install a new countershaft bearing retainer O-ring seal.**

    Install the countershaft bearing retainer.



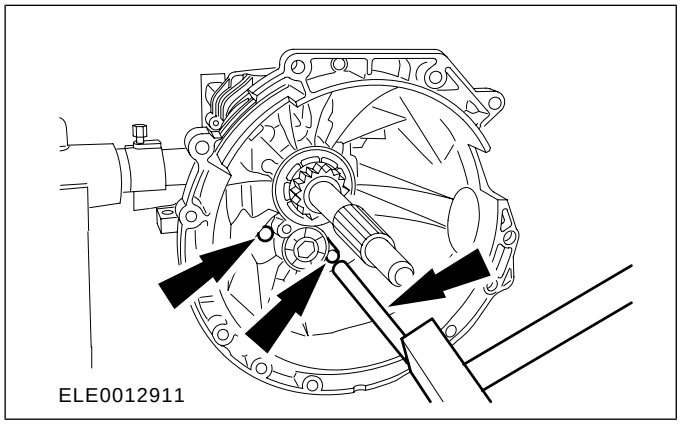
44. **Using the special tool, loosen the bearing retainer by 80 degrees.**



45. **NOTE: Rotate the transmission housing downwards at least 45 degrees.**

    Adjust the countershaft.

    - Using a suitable brass drift and a soft faced hammer, strike two blows on each of the bosses. This will seat the countershaft front bearing against the bearing retainer.

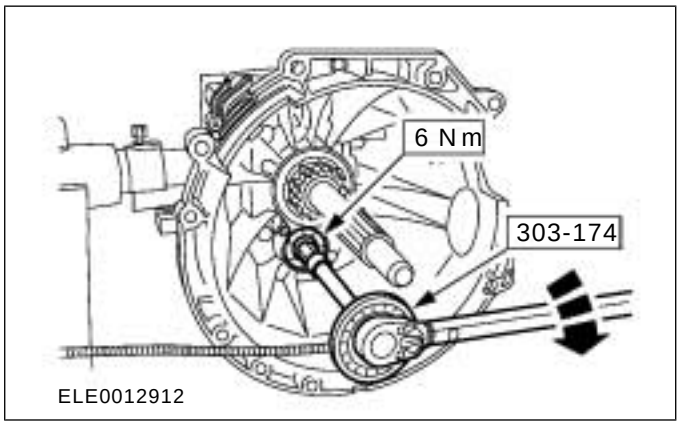


ASSEMBLY

46. ⚠CAUTION: The indicated torque must be achieved.

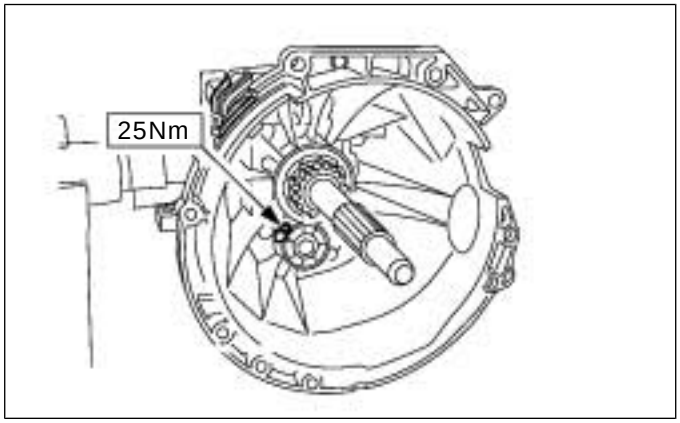
Using the special tool, tighten the bearing retainer 20 degrees.

- If the indicated torque is not achieved, repeat the previous two steps.

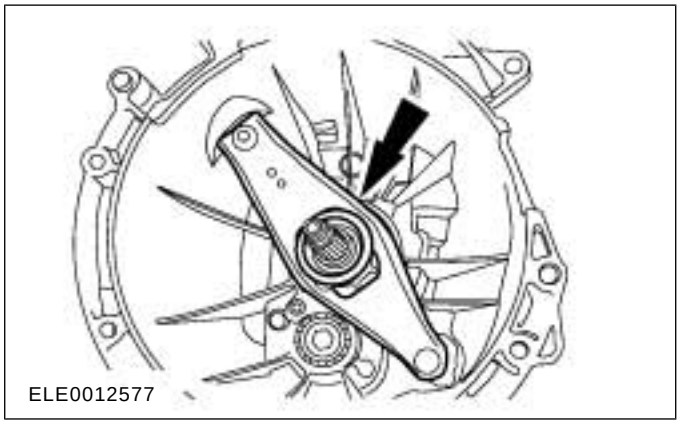


47. NOTE: Install a new countershaft bearing retainer locking plate bolt.

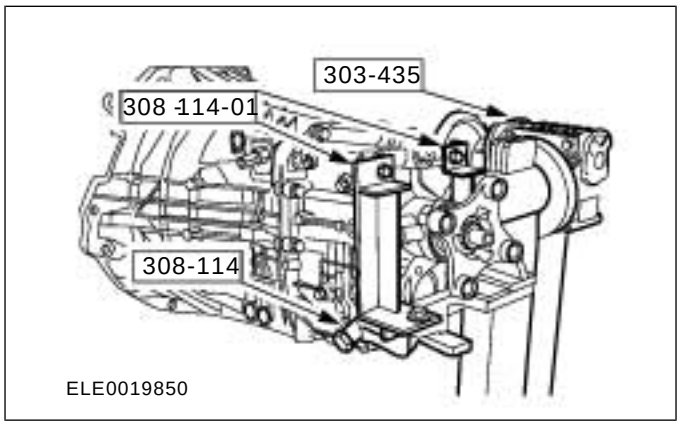
Install the countershaft bearing retainer locking plate.



48. Install the clutch release bearing and the clutch release lever.

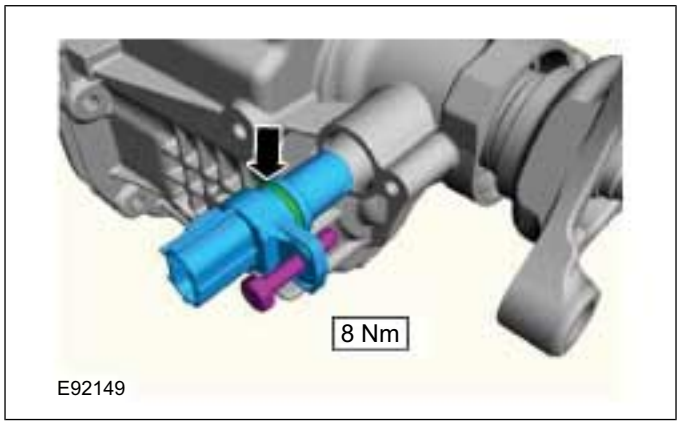


49. Remove the transmission from the mounting stand.

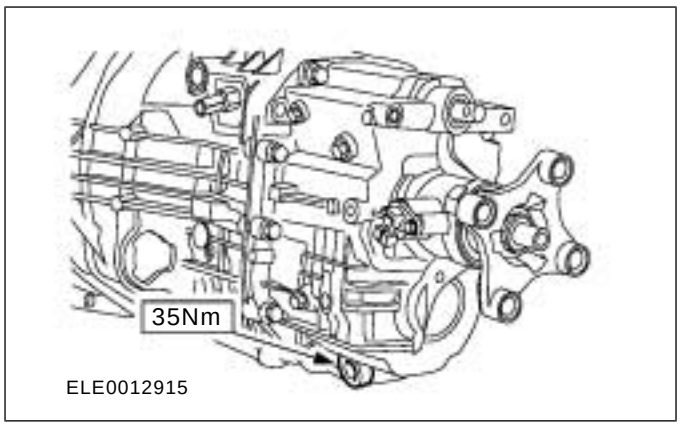


50. Install the vehicle speed sensor.

- Coat the VSS O-ring seal with grease



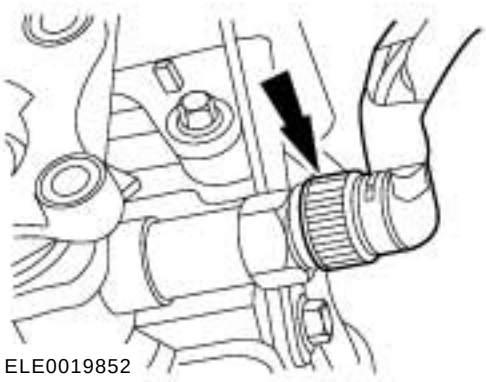
51. Install the drain plug.



ASSEMBLY

Vehicles with tachograph

52. Install the tachograph sensor.


ELE0019852

All vehicles

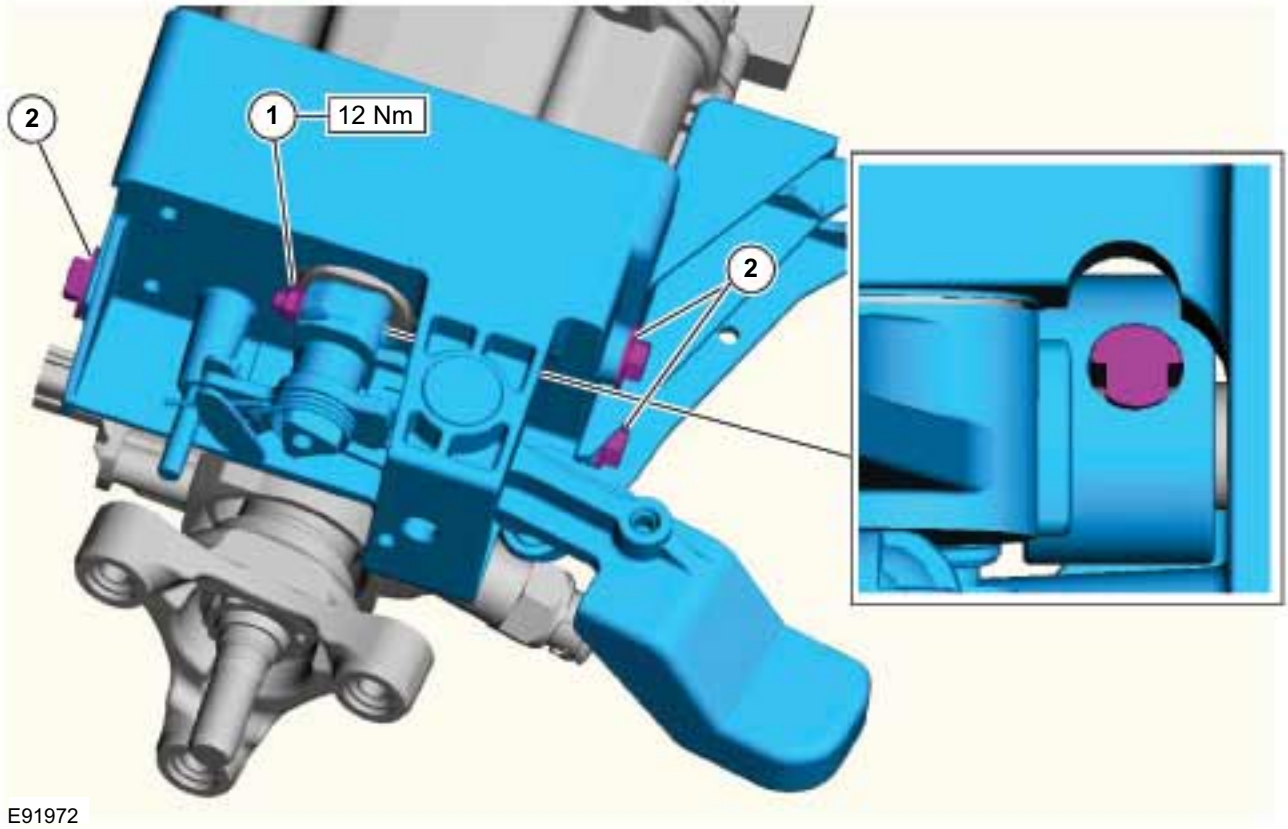
53. Install the external gearshift control assembly.

- Make sure that one of the flat sides of the output shaft flange is upper most.

1. Install the bolt and nut.

NOTE: Only tighten the bolts finger tight at this stage.

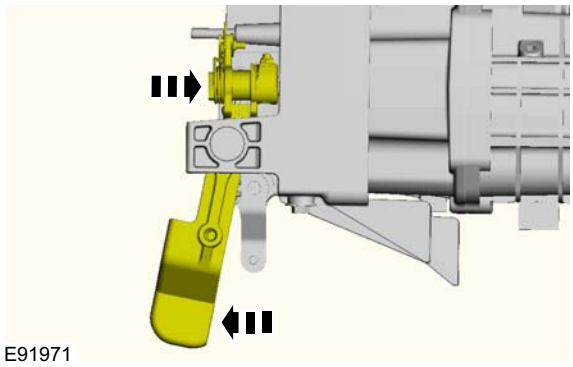
2. Install the bolts.



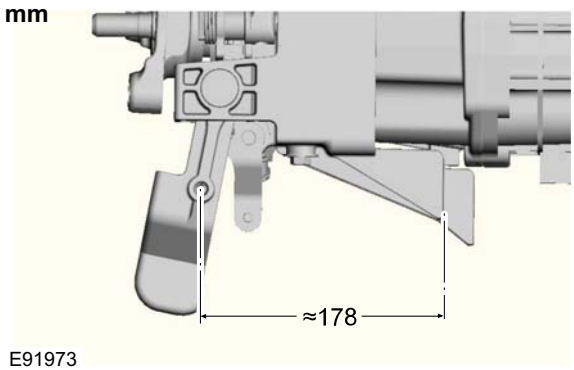
E91972

ASSEMBLY

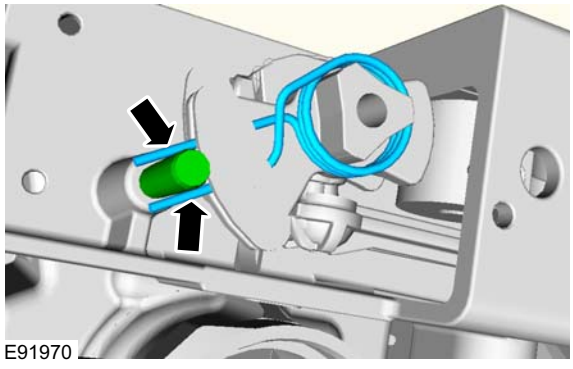
54. Shift the transmission into 4th gear.



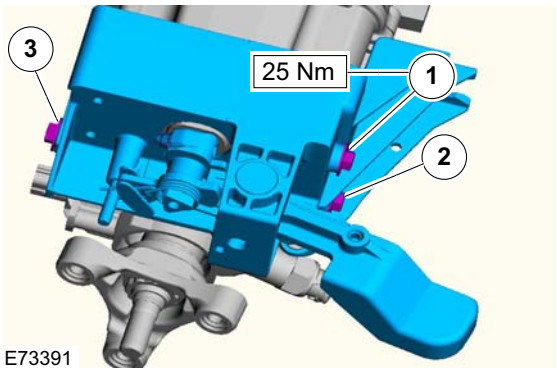
55. Move the external gearshift control assembly, to achive the dimension shown.



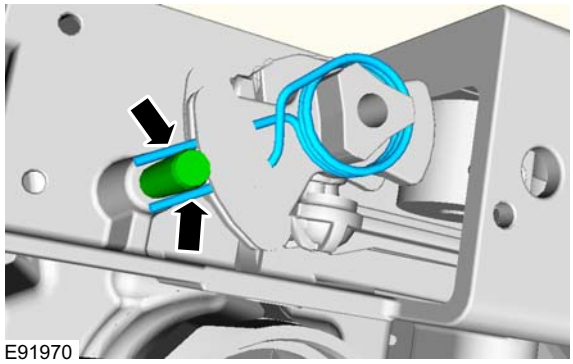
56. Make sure that the spring touches the pin on both sides.



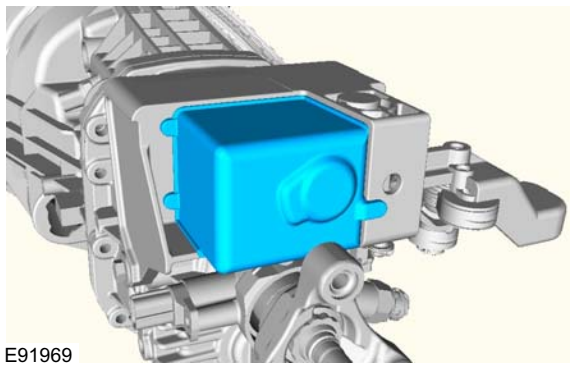
57. Tighten the external gearshift control assembly bolts in the sequence shown.



58. Make sure that the spring touches the pin on both sides in 4th gear, neutral and 3rd gear position. If not, loosen the external gearshift control assembly bolts and repeat the previous four steps.



59. Install the external gearshift control cover.



60. Fill the transmission with manual transmission fluid .

    For additional information, refer to: Transmission Draining and Filling (308-03

ASSEMBLY

Manual Transmission/Transaxle - Vehicles With: MT-75, General Procedures).

INSTALLATION

Transmission — 2WD

Installation

General Equipment

Transmission Jack

1. Check the pilot bearing for damage. If damaged, install a new pilot bearing.

   Refer to: Pilot Bearing - 2.5L Duratec-HE (122kW/165PS) - MI4 (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).

2. **NOTE:** Do not apply grease to a newly installed pilot bearing.

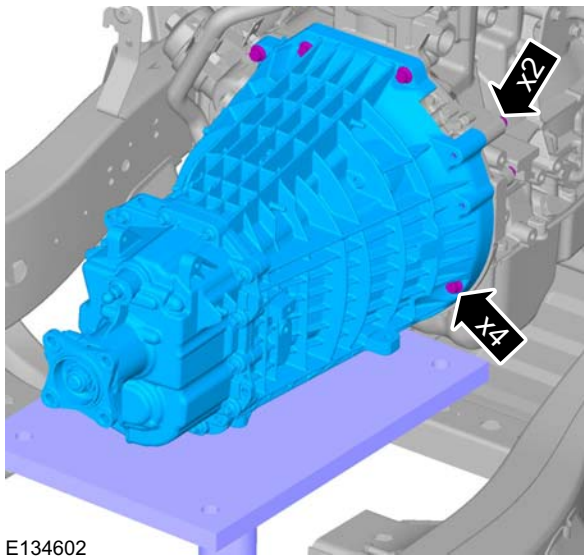
   Apply approximately one gram of grease to the pilot bearing.

3. Apply a thin film of grease to the input shaft guide sleeve.

4. Shift the transmission into third gear.

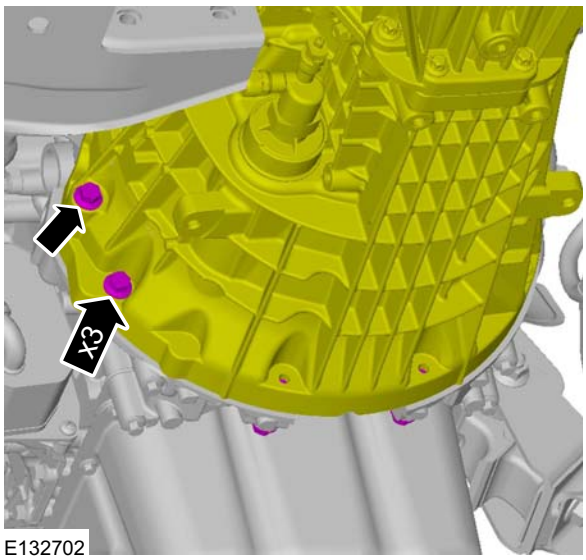
All vehicles

5. General Equipment: Transmission Jack
   Torque: 48 Nm



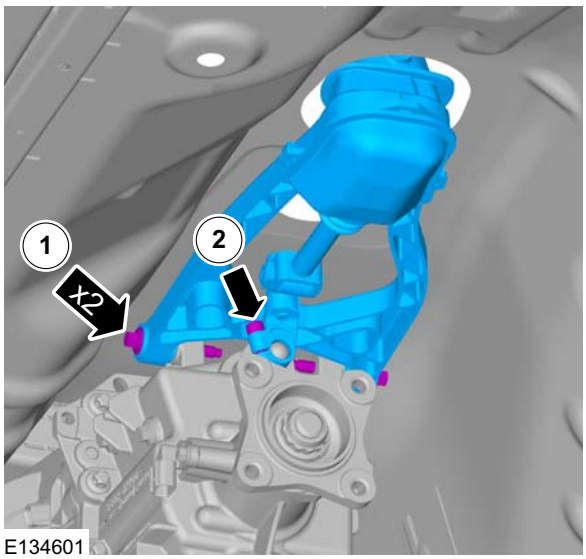
E134602

6. Torque: 48 Nm



E132702

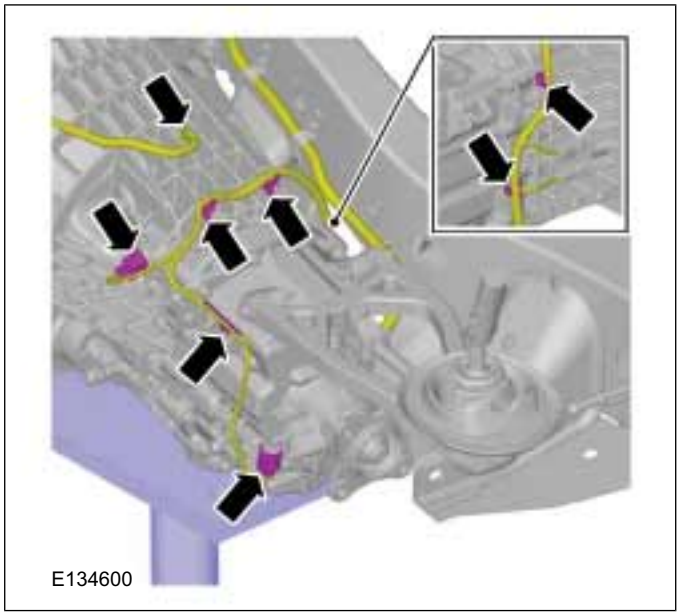
7. 1. Torque: 25 Nm
   2. Torque: 40 Nm



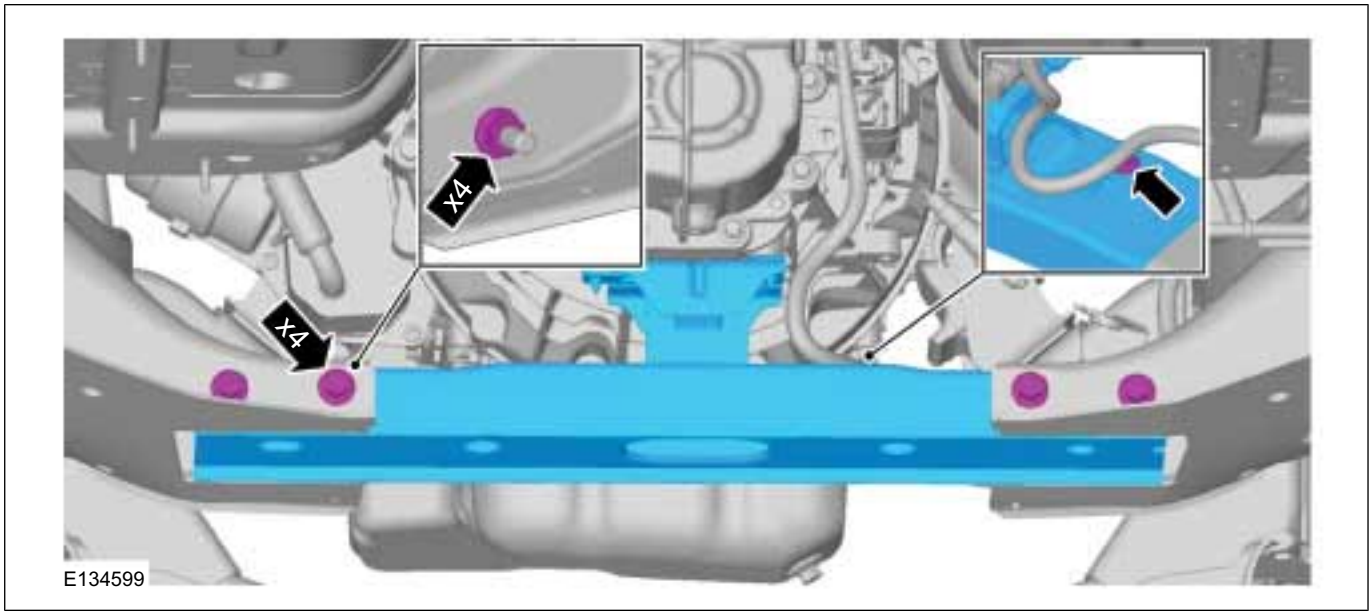
E134601

INSTALLATION

8.

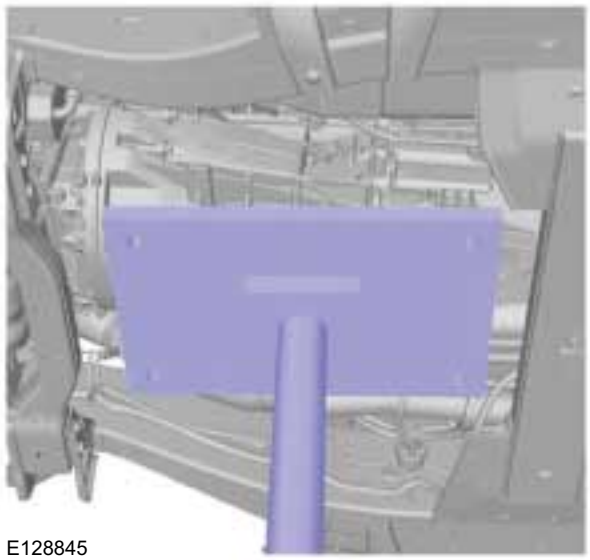


9. Torque: 90 Nm

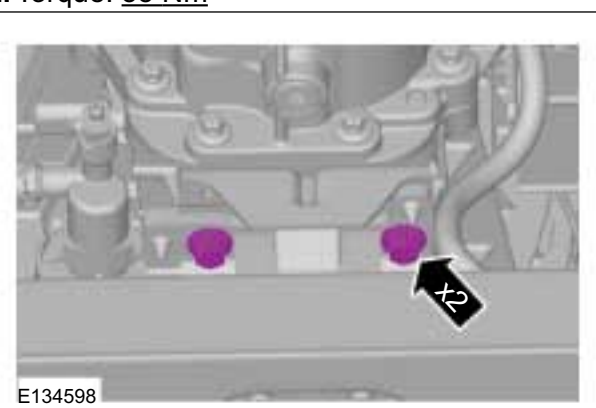


INSTALLATION

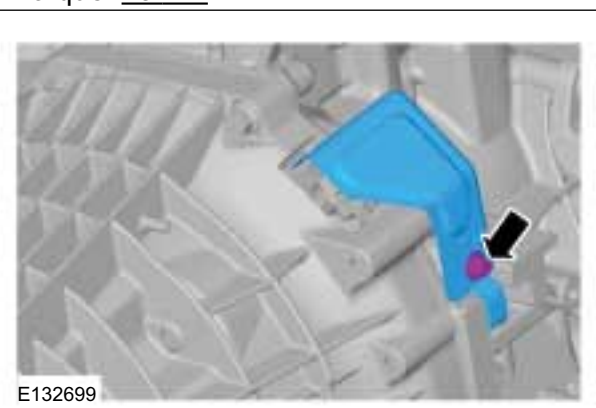
10. Lower the transmission jack.



11. Torque: 55 Nm

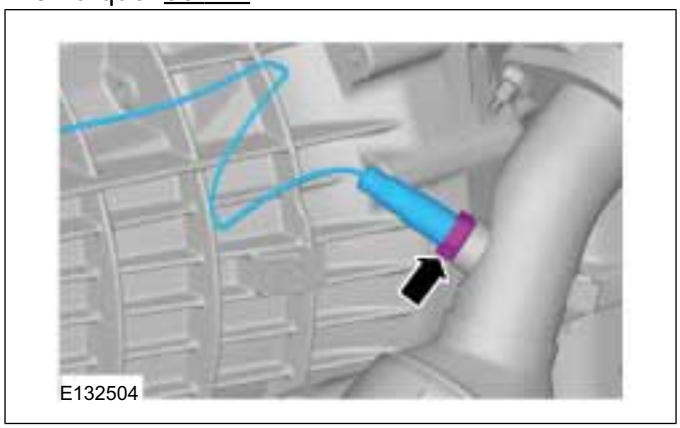


12. Torque: 25 Nm

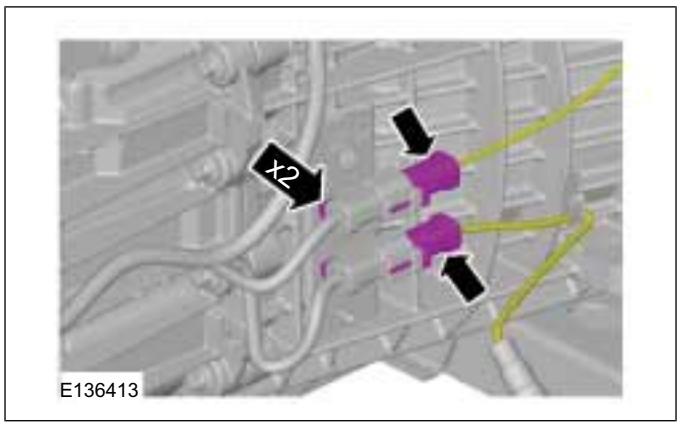


Vehicles with 2.5L engine

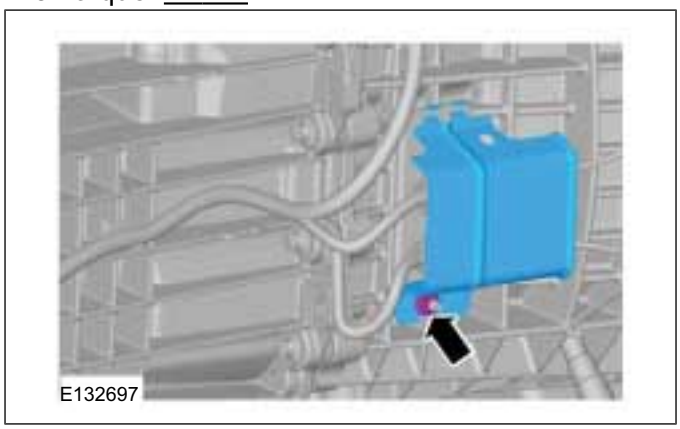
13. Torque: 50 Nm



14.



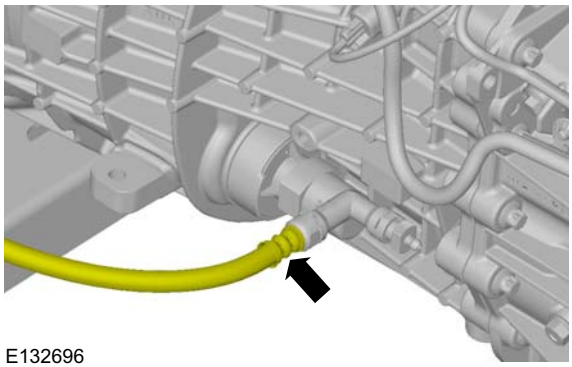
15. Torque: 11 Nm



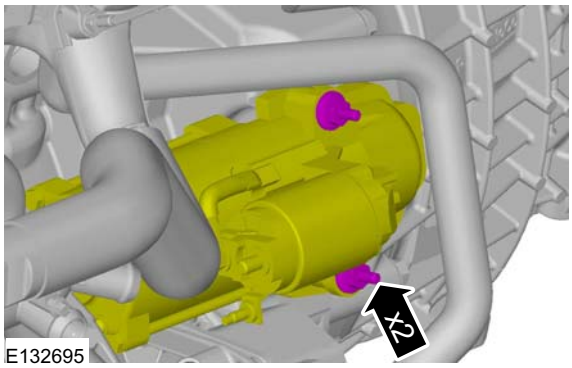
INSTALLATION

All vehicles

16. **NOTE:** Uncap the fluid line.

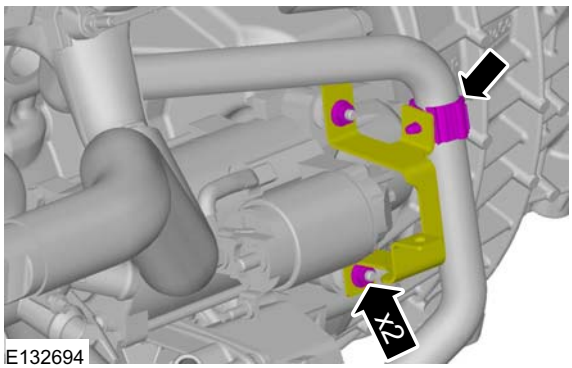

E132696

17. Torque: 35 Nm



E132695

18. Torque: 35 Nm



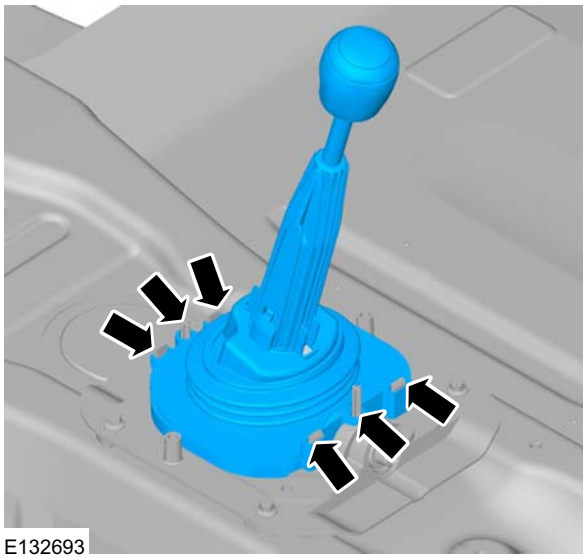
E132694

19. Refer to: Driveshaft - 2WD (205-01 Driveshaft, Removal and Installation).

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

21. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

22.


E132693

23. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

24. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

INSTALLATION

Transmission — 4WD

Installation

1. Check the pilot bearing for damage. If damaged, install a new pilot bearing.

   Refer to: Pilot Bearing - 2.5L Duratec-HE (122kW/165PS) - MI4 (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).

2. **NOTE:** Do not apply grease to a newly installed pilot bearing.

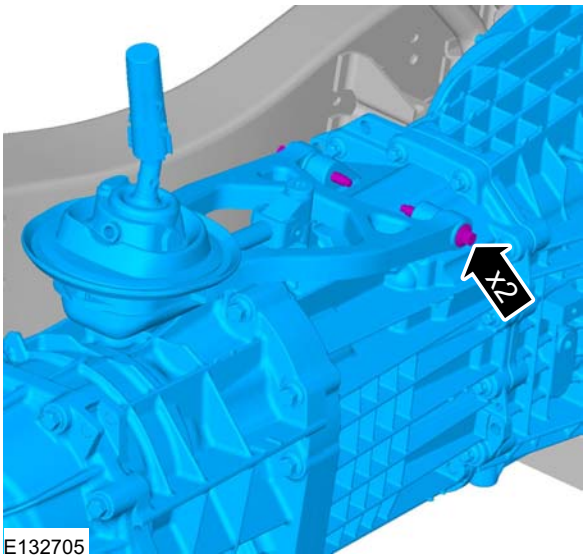
   Apply approximately one gram of grease to the pilot bearing.

3. Apply a thin film of grease to the input shaft guide sleeve.

4. Shift the transmission into third gear.

All vehicles

5. Torque: 25 Nm



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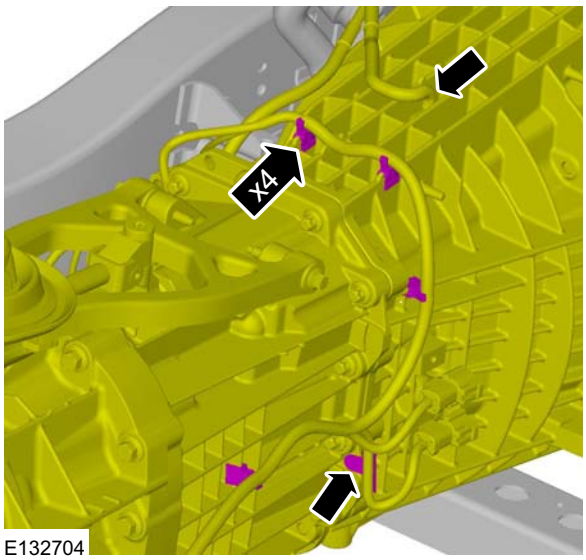

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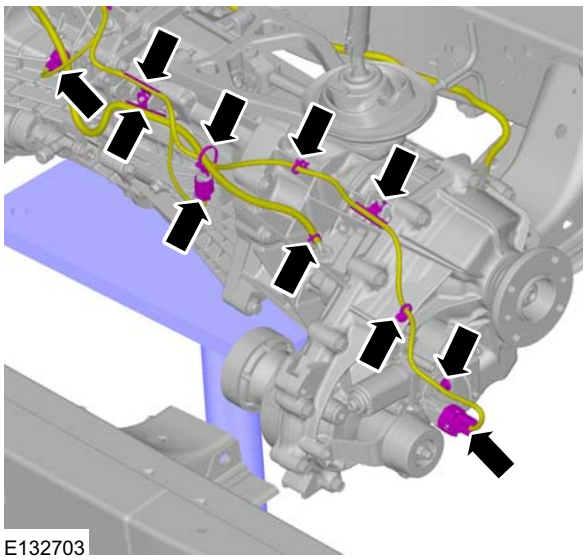
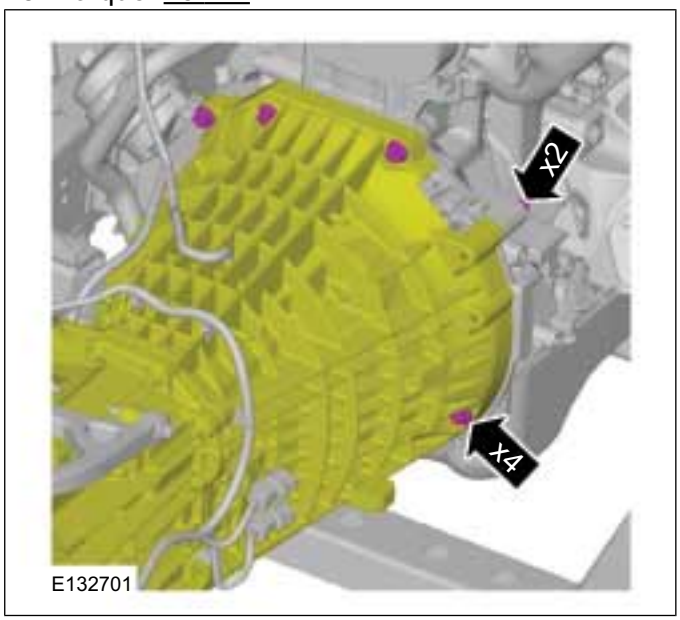
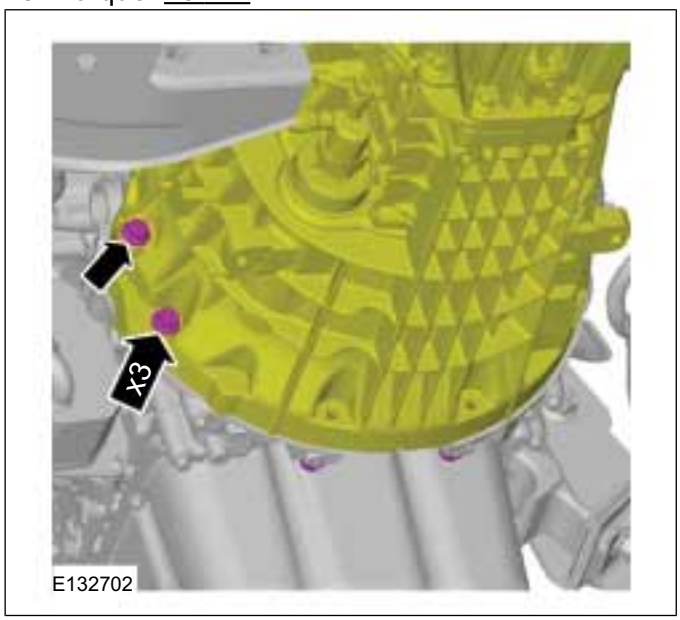


INSTALLATION

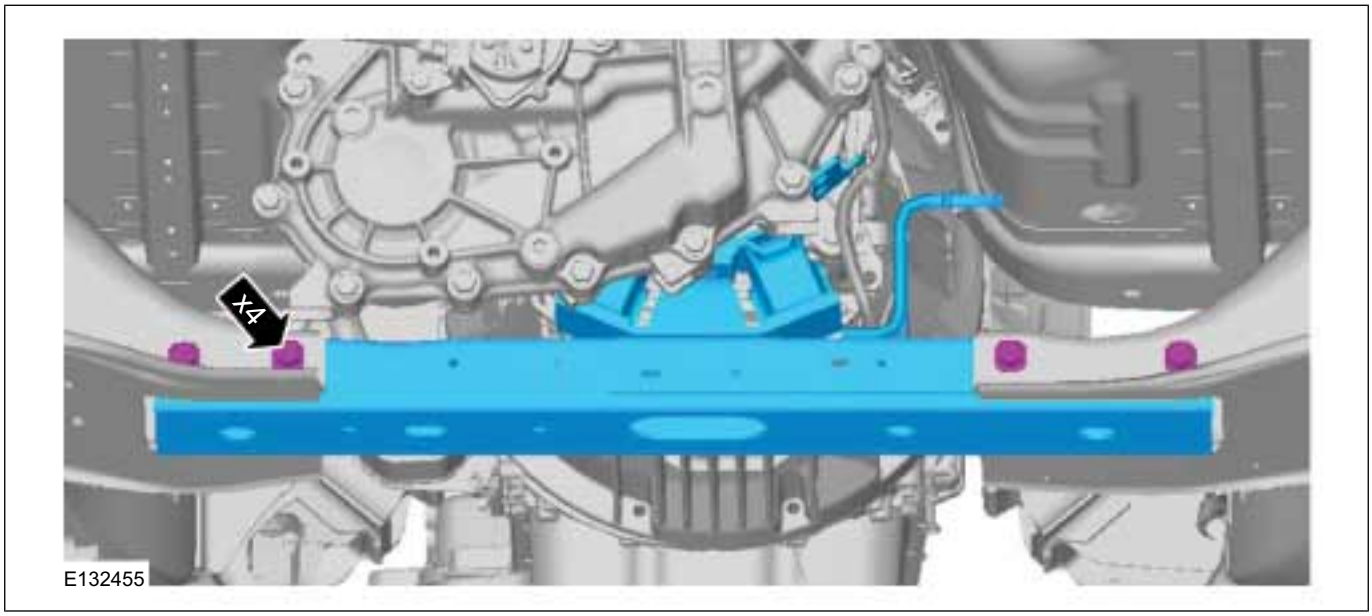
8. Torque: 48 Nm



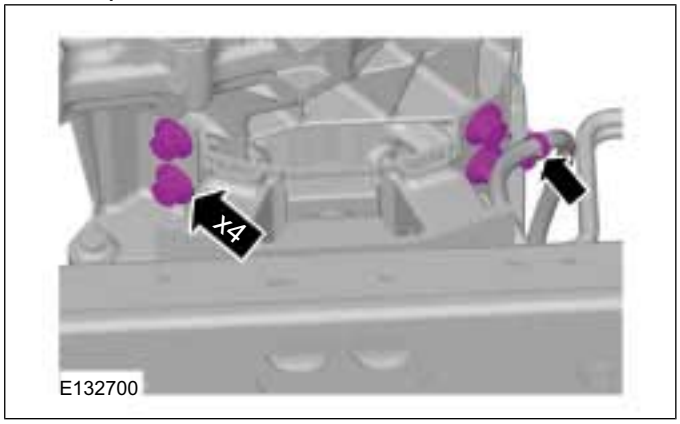
9. Torque: 48 Nm



10. Torque: 90 Nm

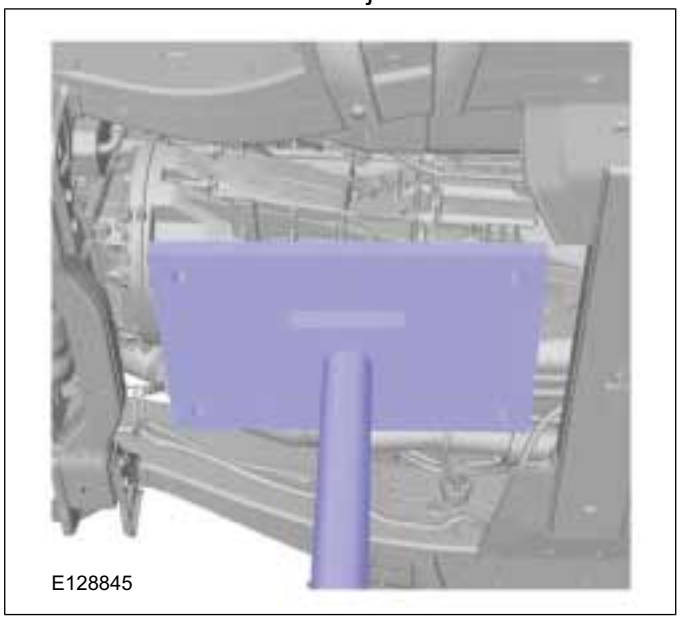


11. Torque: 90 Nm

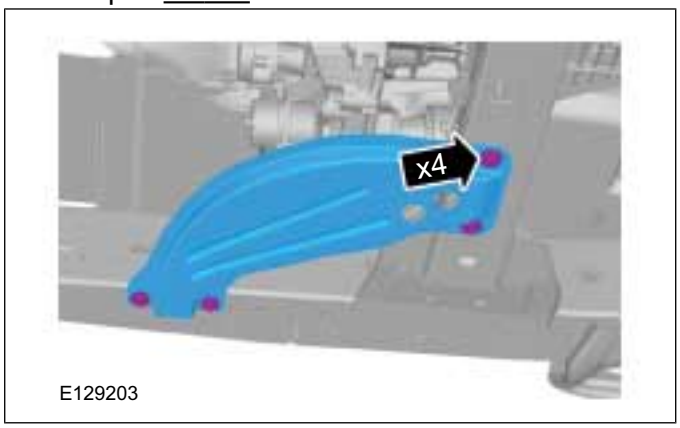


INSTALLATION

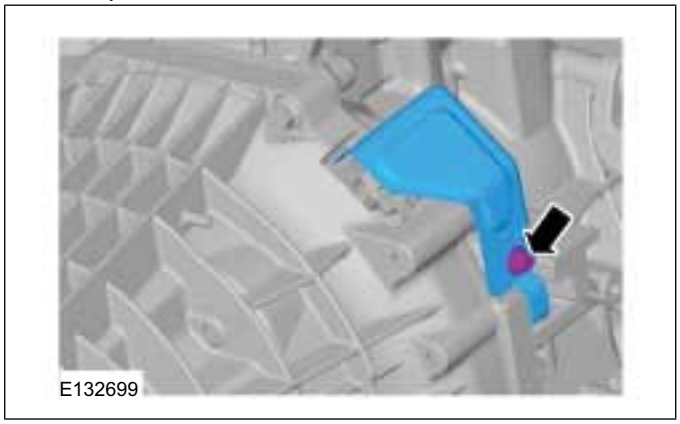
12. Lower the transmission jack.



13. Torque: 48 Nm

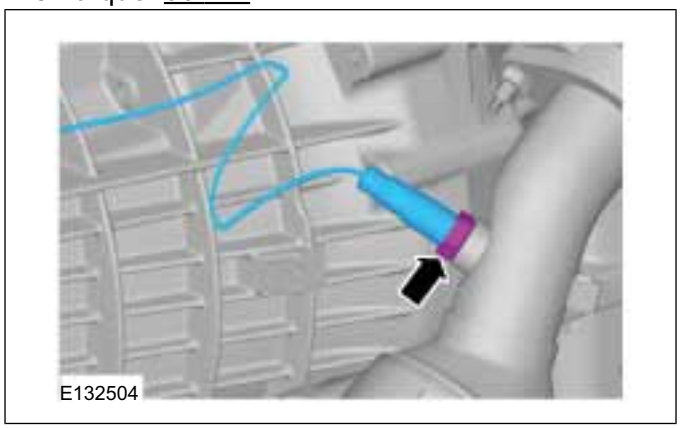


14. Torque: 25 Nm



Vehicles with 2.5L engine

15. Torque: 50 Nm



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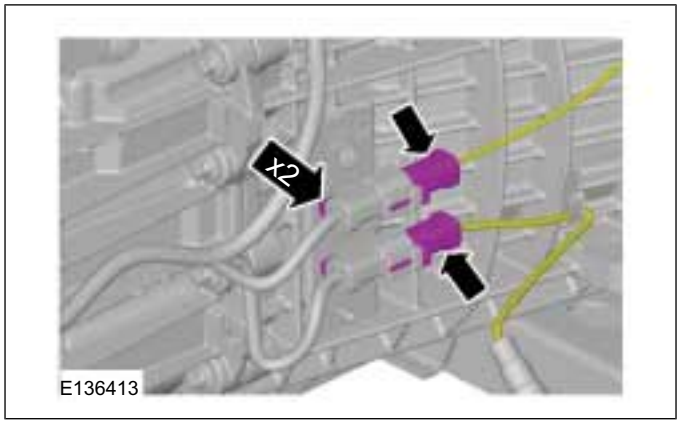
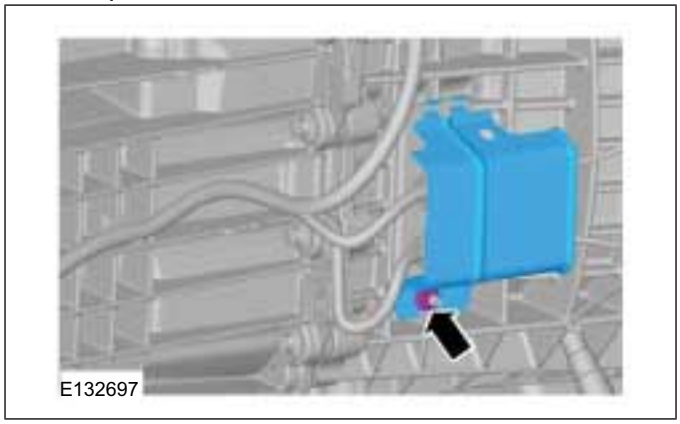


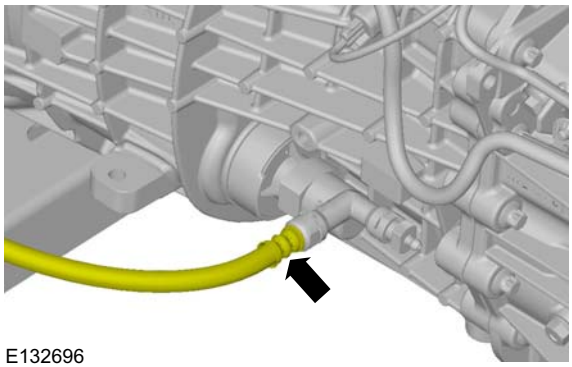
17. Torque: 11 Nm



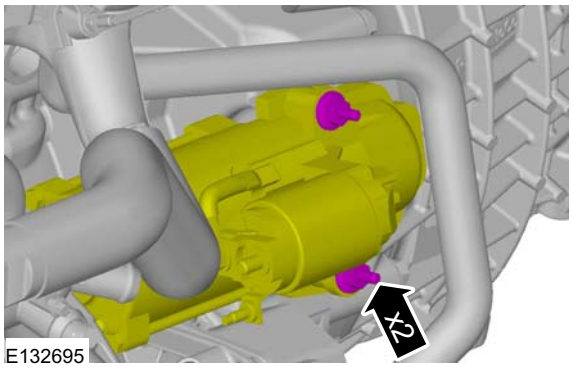
INSTALLATION

All vehicles

18. **NOTE:** Uncap the fluid line.

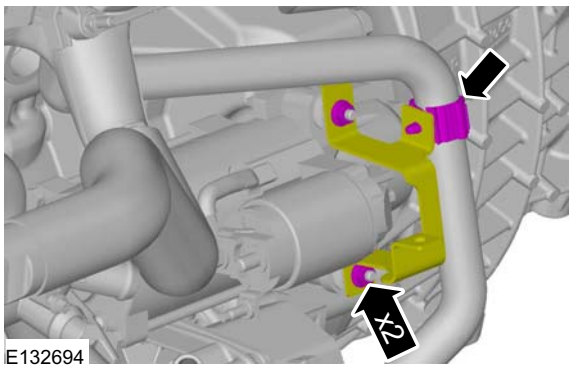

E132696

19. Torque: 35 Nm



E132695

20. Torque: 35 Nm



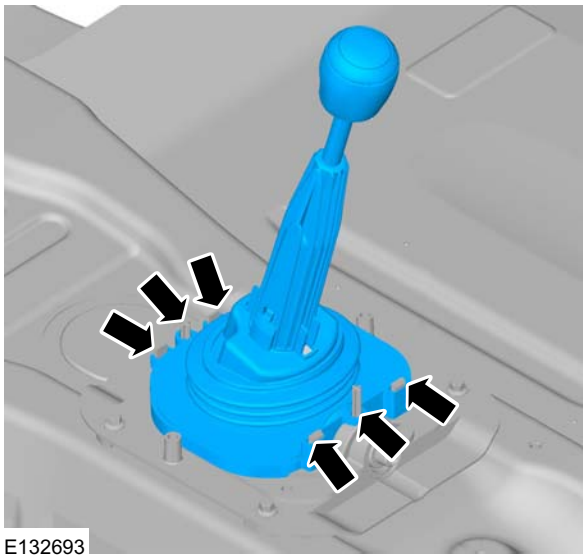
E132694

21. Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).
Refer to: Front Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).

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

23. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

24.


E132693

25. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

26. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

SECTION 308-03B Manual Transmission/Transaxle —

Vehicles With: 6-Speed Manual Transmission - MT82

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

PAGE 1 OF 2

PAGE 2 OF 2

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

ASSEMBLY

INSTALLATION

SPECIFICATIONS

Lubricants, Fluids, Sealers and Adhesives

Item	Specification
Manual transmission fluid	WSD-M2C200-D2
Thread locking compound	WSK-M2G349-A7
Sealant	WSS-M2G348-A10
Grease	ESD-M1C220-A

Capacities

	Litres
MT82 transmission - Service fill	2.6
MT82 transmission - Add-on for initial fill or if transmission has been disassembled and assembled in the workshop	0.1

Torque Specifications

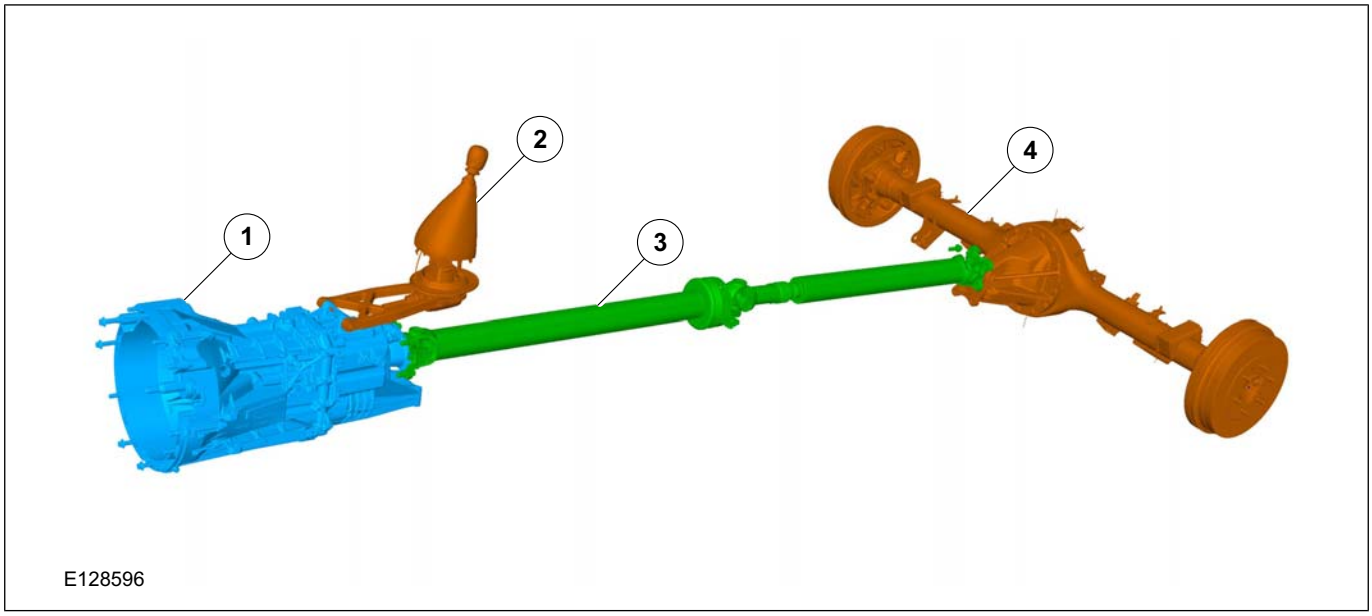
Description	Nm	lb-ft	lb-in
Transmission retaining bolts	50	37	-
Reversing lamp switch	20	15	-
Transmission output shaft flange retaining nut	200	148	-
Oil drain plug	50	37	-
Oil fill plug	35	26	-
Vehicle speed sensor (VSS)	10	-	89

DESCRIPTION AND OPERATION

Manual Transmission – Overview

Component Location

4x2

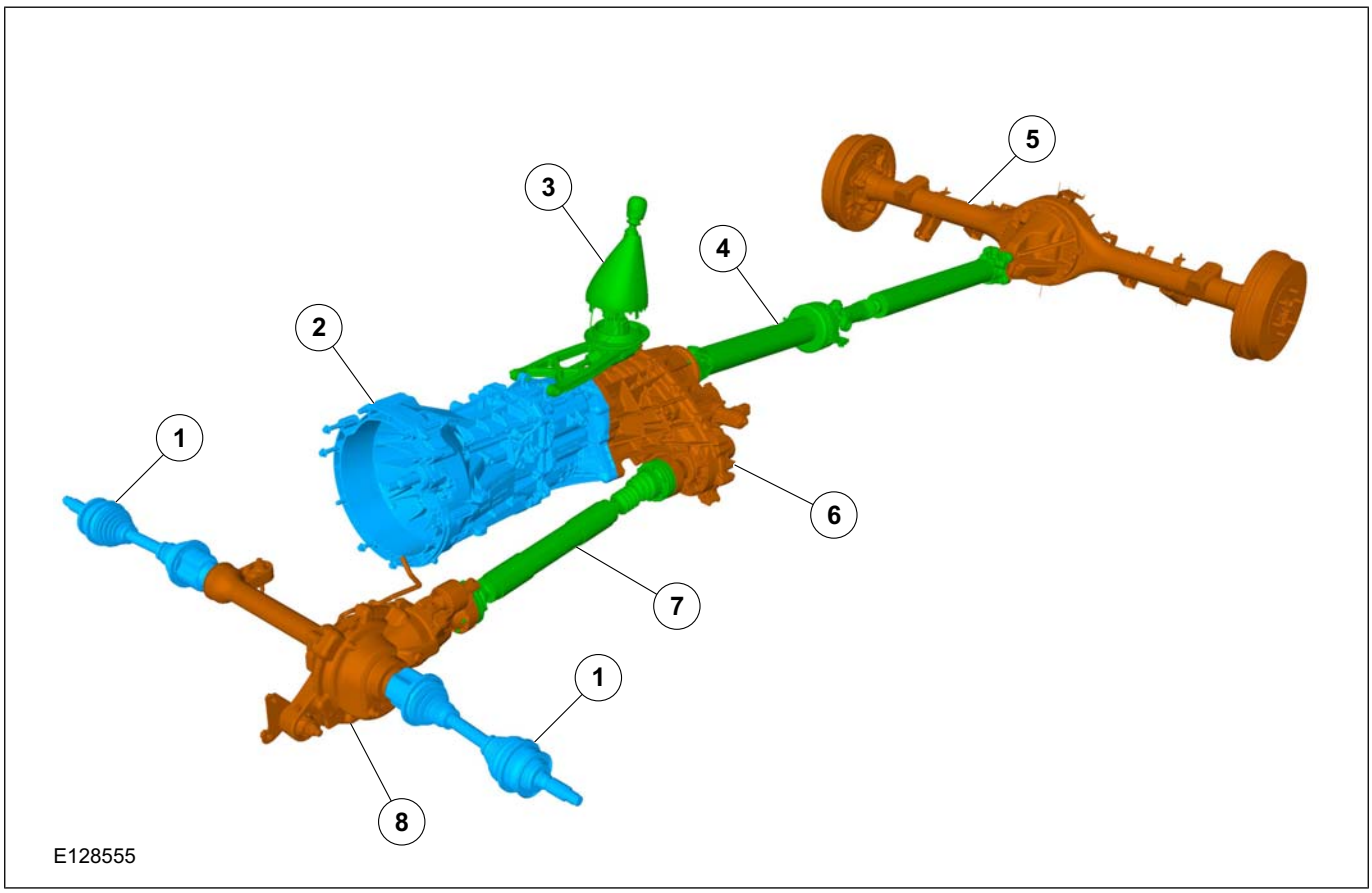


Item	Description
1	MT82 4x2
2	Manual gear change lever

Item	Description
3	Rear propeller shaft
4	Rear drive axle

DESCRIPTION AND OPERATION

4x4



Item	Description
1	Front half shafts
2	MT82 4x4
3	Manual gear change lever
4	Rear propeller shaft

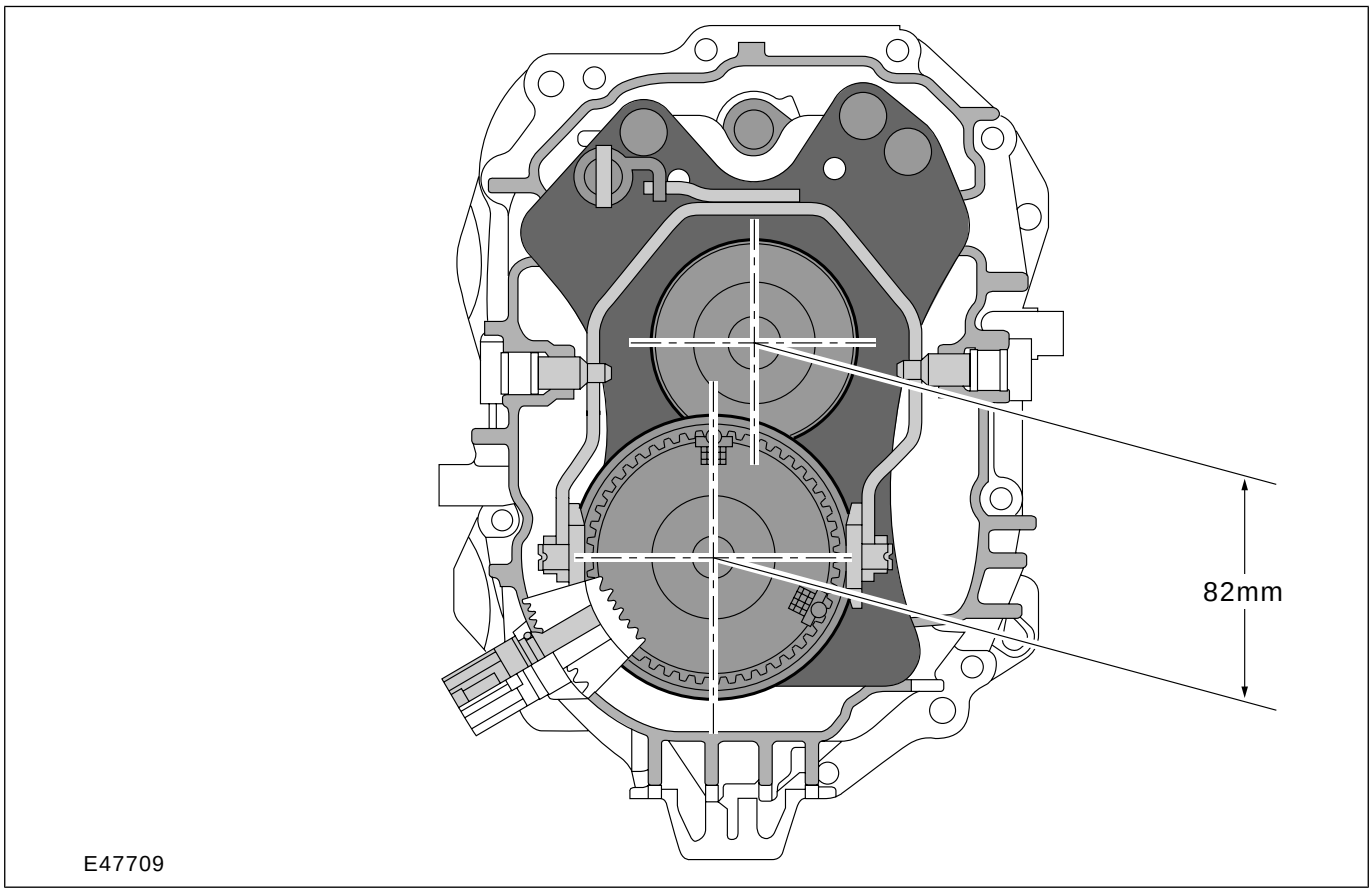
Item	Description
5	Rear drive axle
6	Transfer case
7	Front propeller shaft
8	Front differential assembly

Overview

The name of the 6-speed manual transaxle MT82 is derived from the distance between the two shafts in the transaxle:

- M stands for Manual
- T stands for Transaxle
- 82 is the distance between the two shafts in mm

DESCRIPTION AND OPERATION



Transaxles are designed for a torque of max. 480 Nm.

In order to ensure secure mounting of the selector rods, these are passed through a centre bearing mounting plate. The centre bearing mounting plate is in turn bolted to the housing.

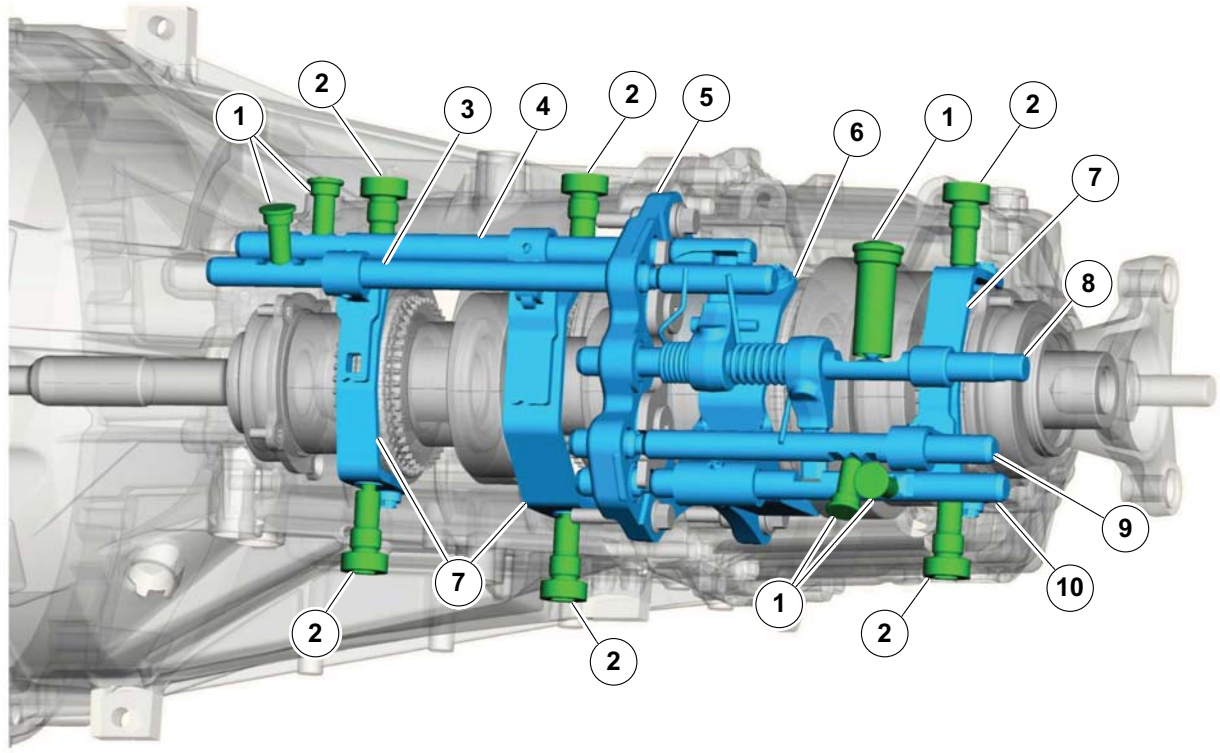
All gear selector forks and shift forks are made of forged steel.

The sliding elements of the selector forks are made of a plastic material that exhibits high resistance to wear.

The main selector shaft is mounted in the center bearing mounting plate.

Internal gearshift mechanism

DESCRIPTION AND OPERATION



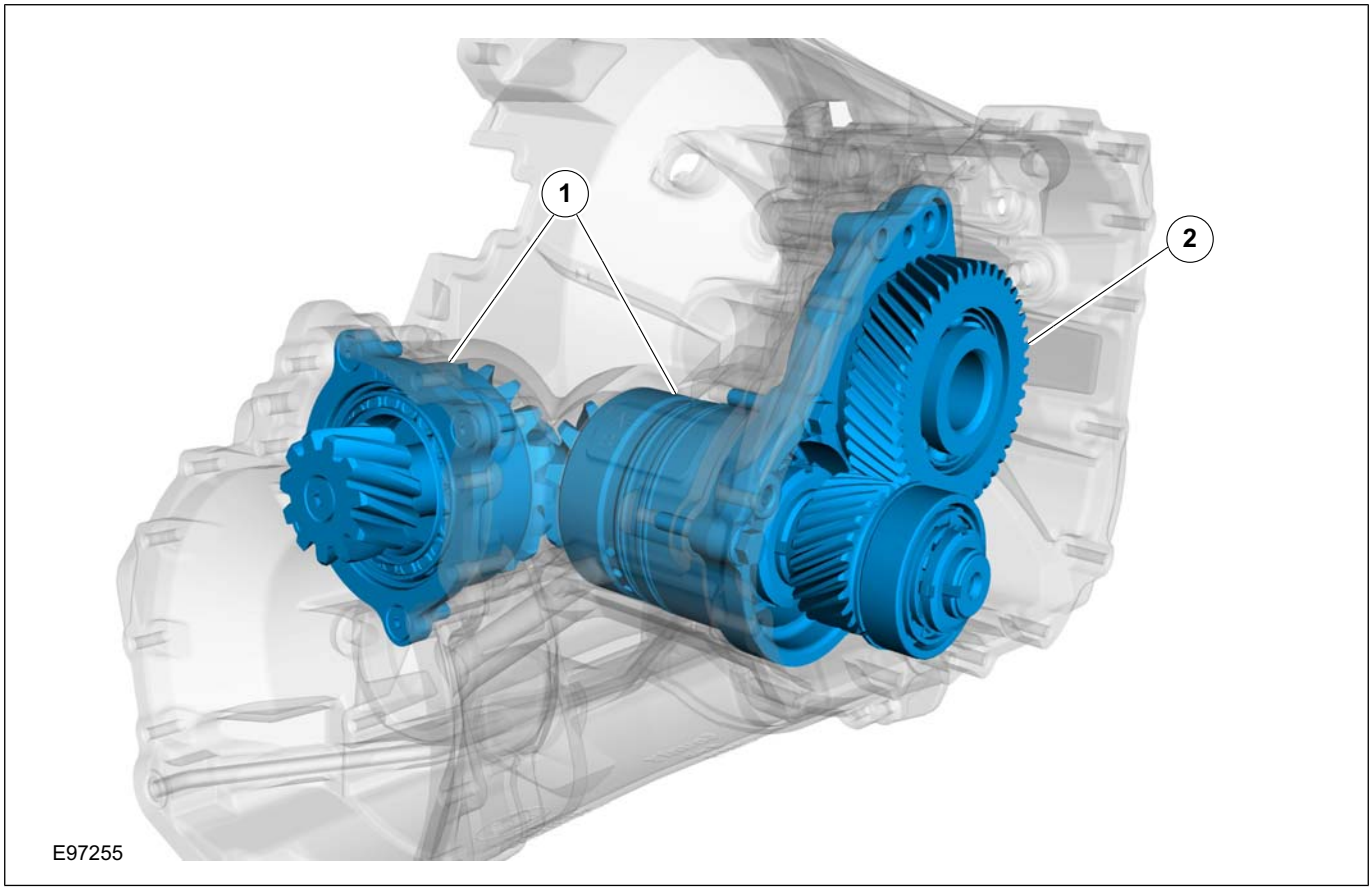
E104867

Item	Description
1	Selector rod detent
2	Shift fork bolt
3	1st/2nd gear selector rod
4	Reverse gear selector rod
5	Center bearing mounting plate

Item	Description
6	1st/2nd gear selector fork
7	Shift fork
8	Main shift rod
9	5th/6th gear selector rod
10	3rd/4th gear selector rod

DESCRIPTION AND OPERATION

Internal gears - Transfer case

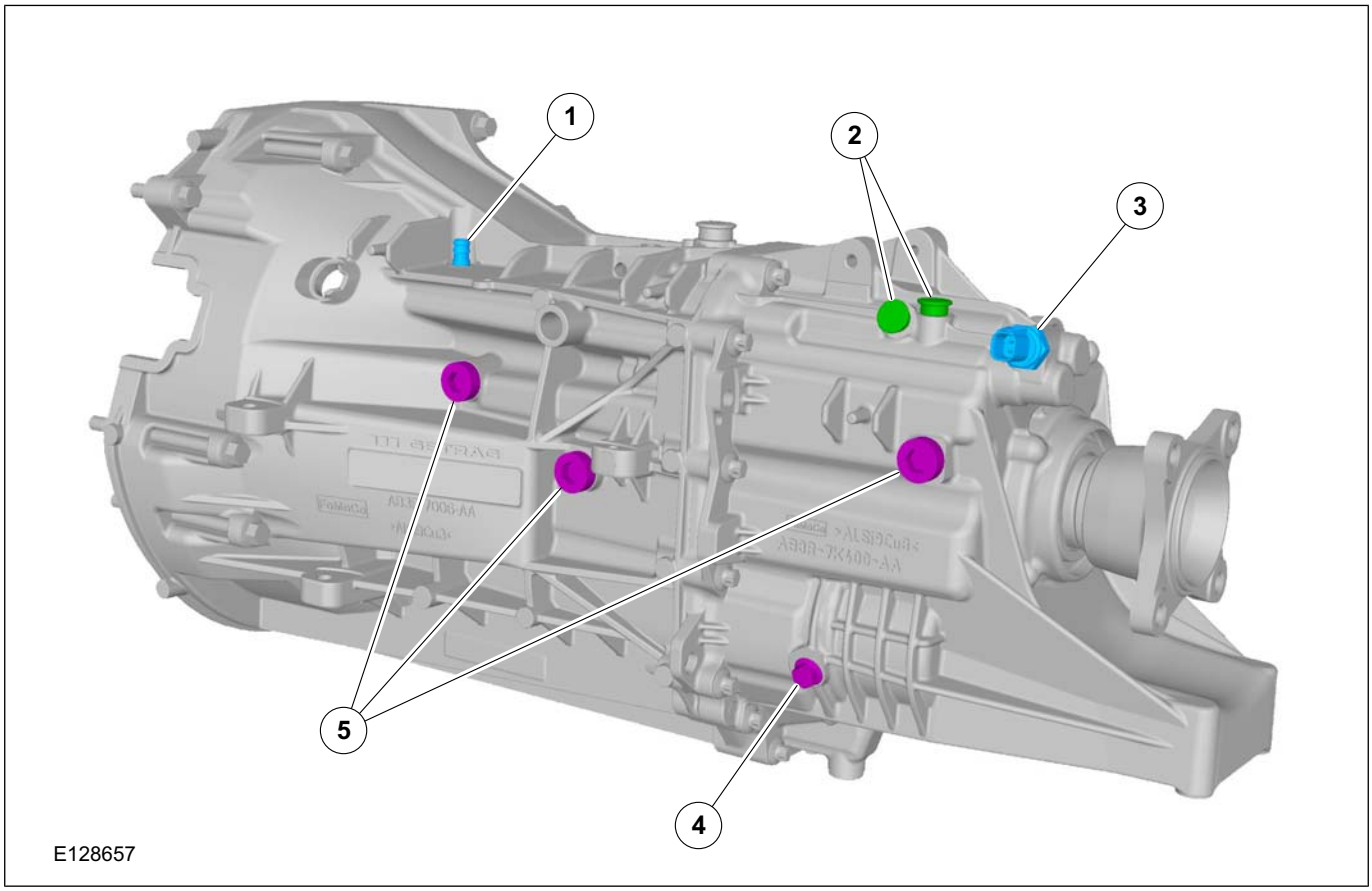


Item	Description
1	Right-angle drive
2	Idle gear

(4x2)

DESCRIPTION AND OPERATION

Side view - left-hand side



Item	Description
1	Transaxle breather
2	Selector rod detents

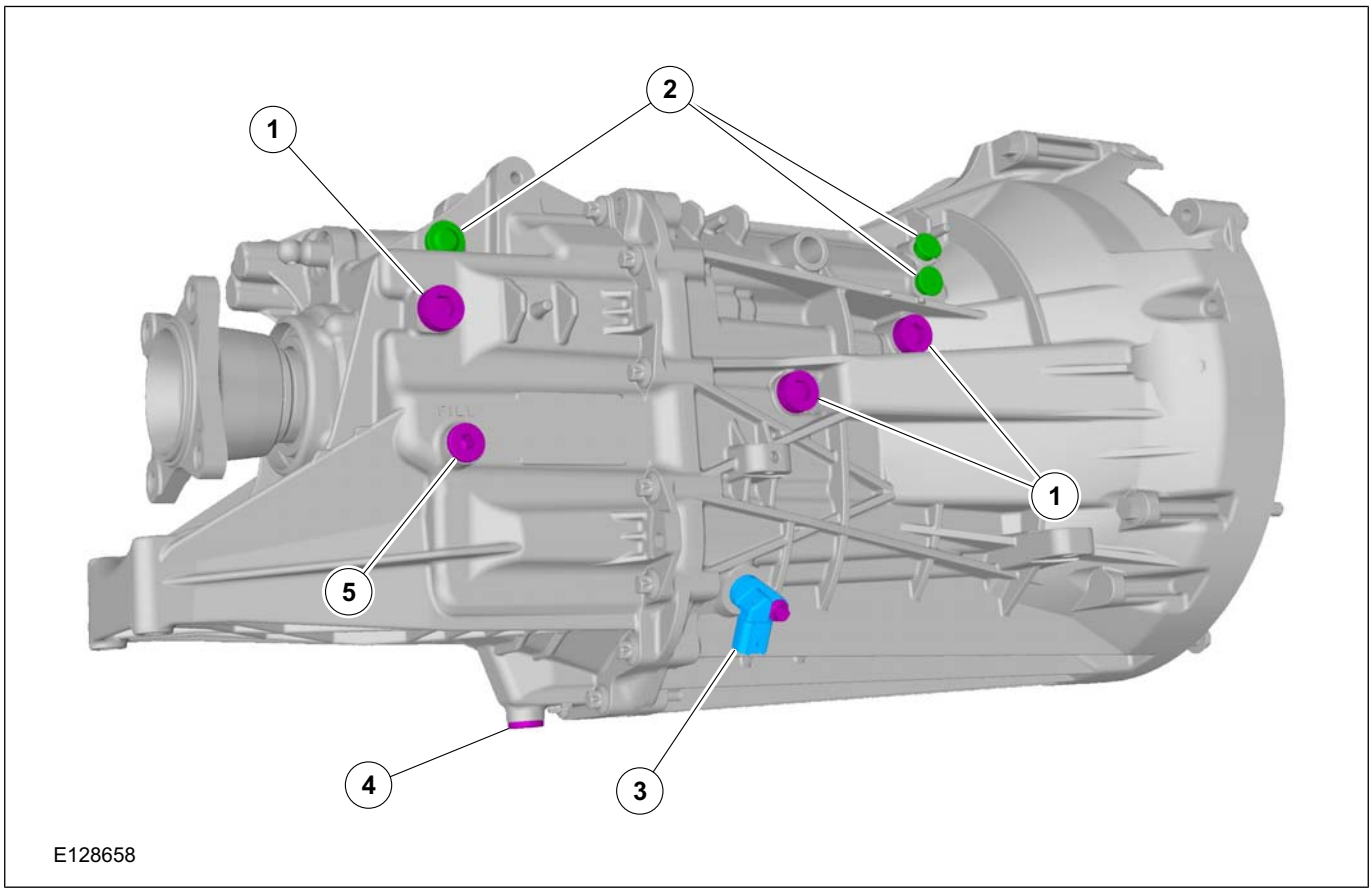
Item	Description
3	Reverse switch
4	Reverse gear mounting retaining bolt
5	Shift fork bolts

The reverse idler gear shaft is attached to the housing using the reverse gear mounting retaining bolt (4). This should not be mixed up with any other bolt on the transaxle.

NOTE: The reverse gear mounting retaining bolt should only be removed to dismantle the transaxle.

Side view - right-hand side

DESCRIPTION AND OPERATION



Item	Description
1	Shift fork bolts
2	Selector rod detents

Item	Description
3	Vehicle speed sensor
4	Oil drain plug
5	Oil filler plug / oil level check

The transmission oil in the MT82 6-speed transaxle does not need to be changed in service. Only before repair work on the transaxle should the transmission oil be drained by removing the oil drain plug (4).

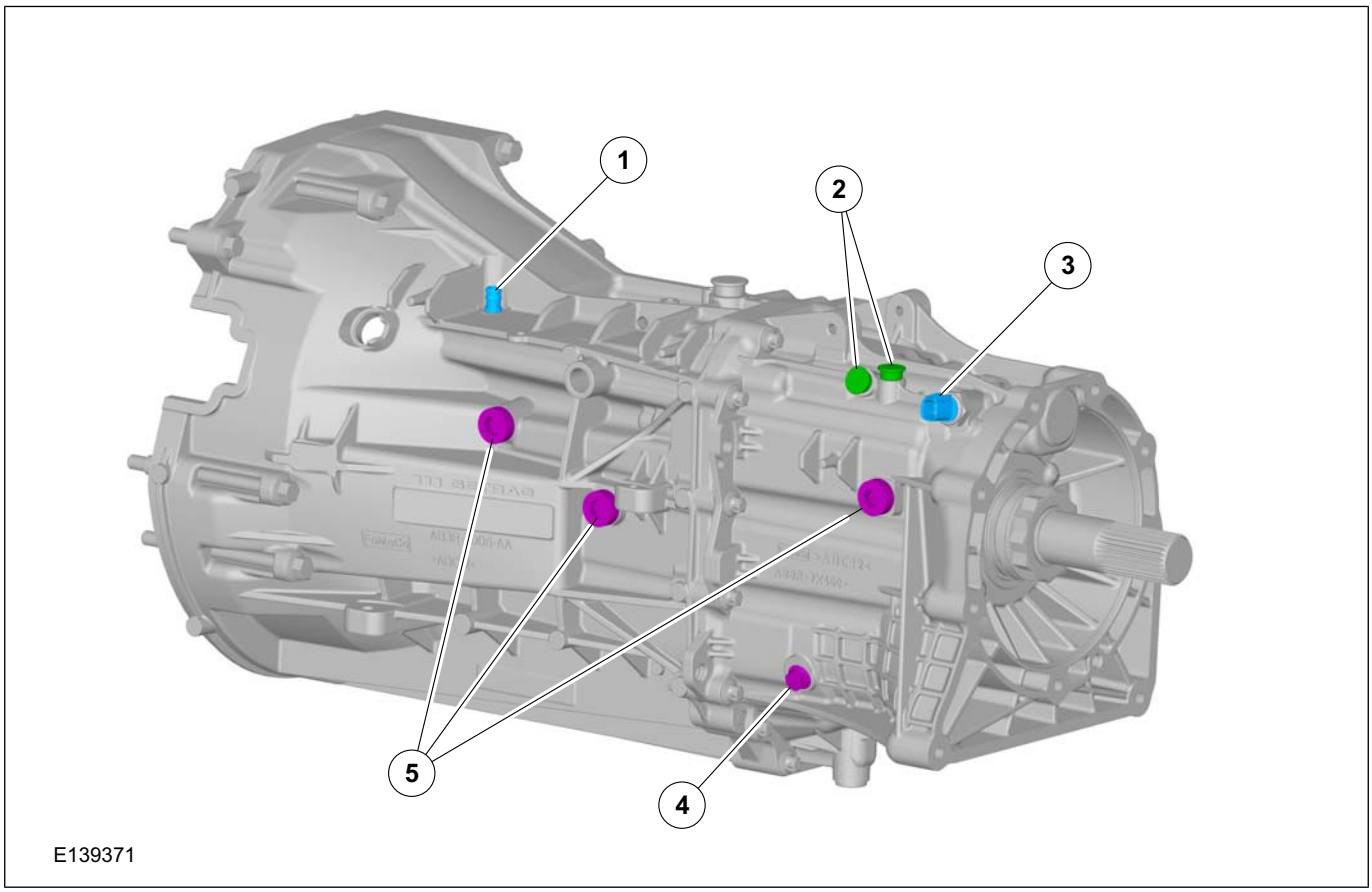
NOTE: The shift fork bolts (1) must only be removed during repair.

The oil filler plug (5) also allows the oil level to be checked.

4x4

Side view - left-hand side

DESCRIPTION AND OPERATION

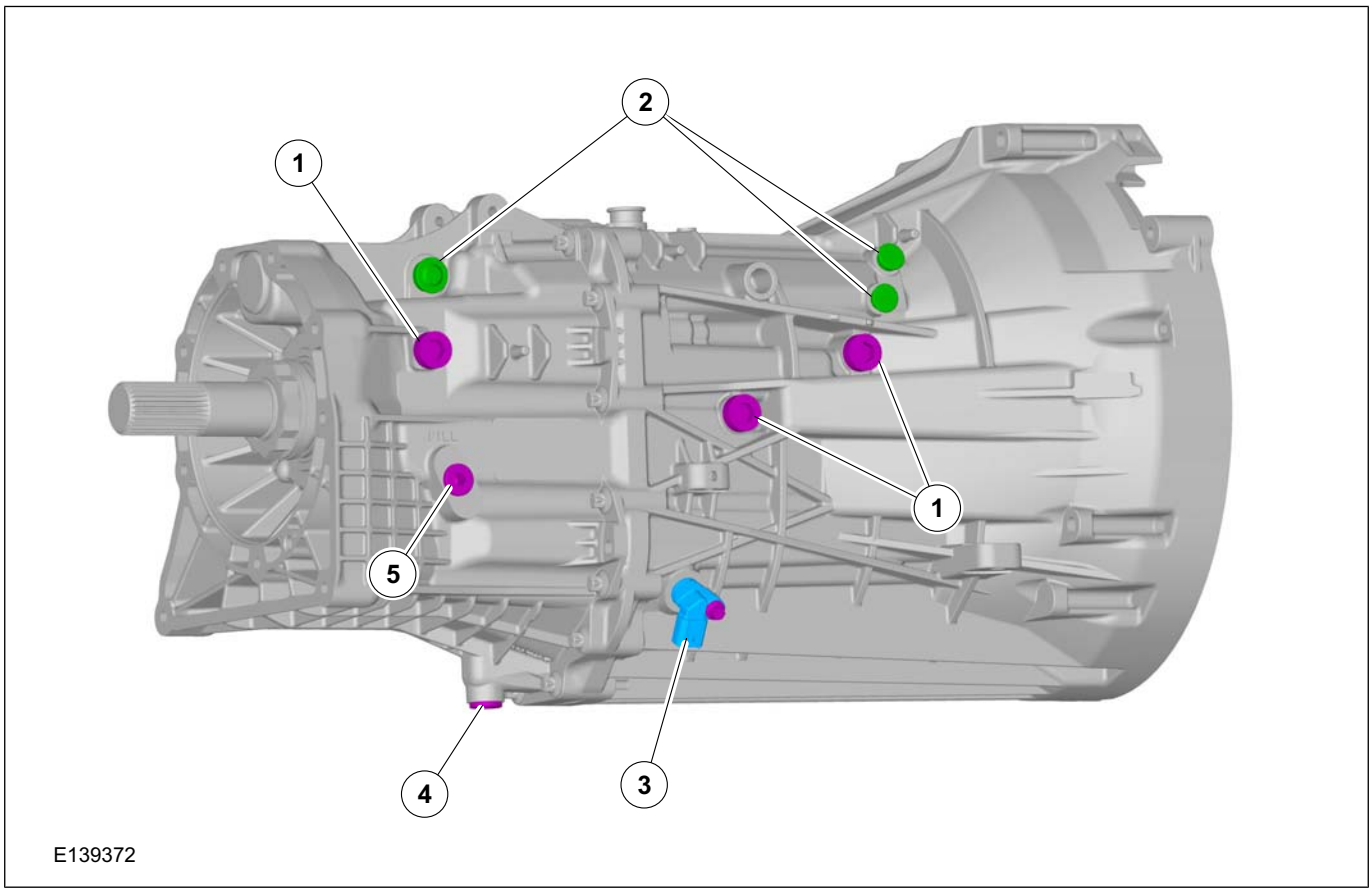


Item	Description
1	Transaxle breather
2	Selector rod detents

Item	Description
3	Reverse switch
4	Reverse gear mounting retaining bolt
5	Shift fork bolts

Side view - right-hand side

DESCRIPTION AND OPERATION



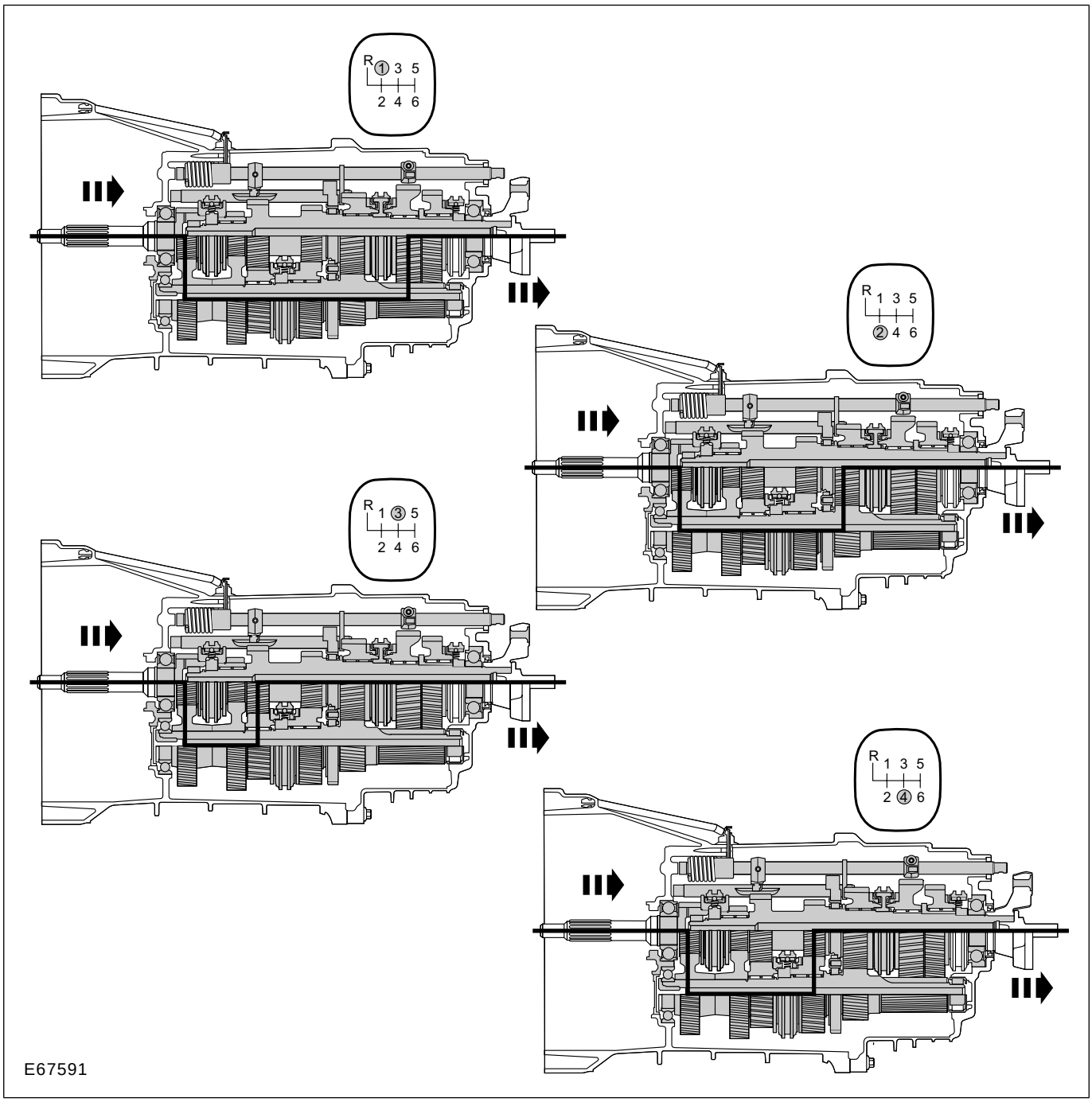
E139372

Item	Description
1	Shift fork bolts
2	Selector rod detents

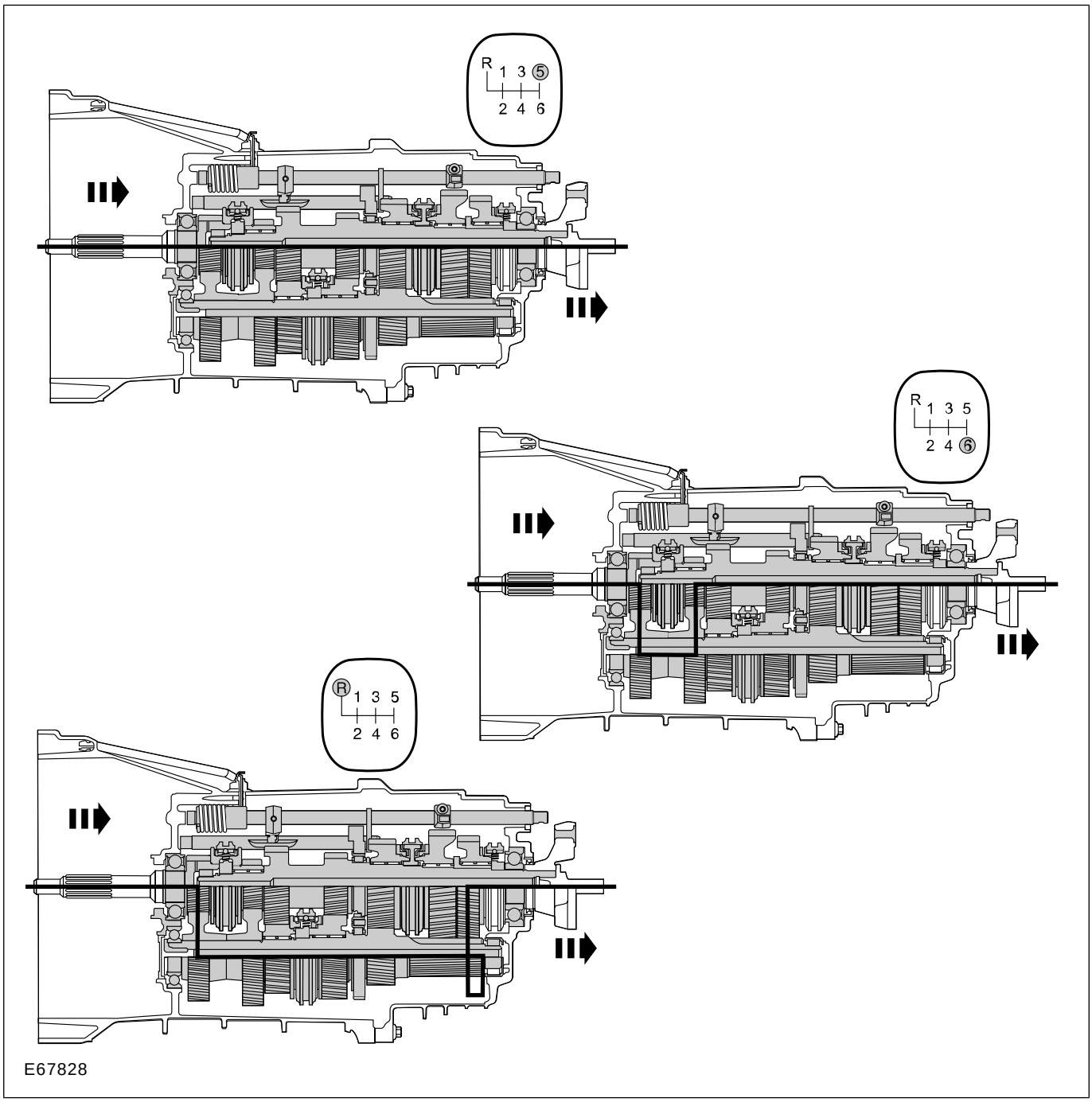
Item	Description
3	Vehicle speed sensor
4	Oil drain plug
5	Oil filler plug / oil level check

Torque path

DESCRIPTION AND OPERATION



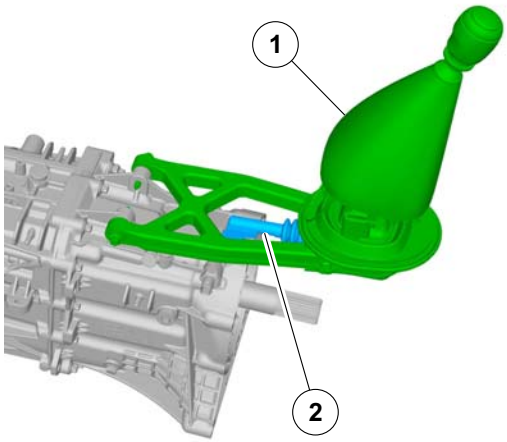
DESCRIPTION AND OPERATION



E67828

DESCRIPTION AND OPERATION

External gearshift mechanism



E128659

Item	Description
1	Selector lever
2	Gear shift rod

DIAGNOSIS AND TESTING

Manual Transmission

REFER to Section 308-00 [Manual Transmission/Transaxle and Clutch - General Information].

GENERAL PROCEDURES

Transmission Draining and Filling

Materials	
Name	**Specification**
Transmission Oil 75W FE	WSS-M2C200-D2 / 7U7J-M2C200-BA

1. Raise and support the vehicle.

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

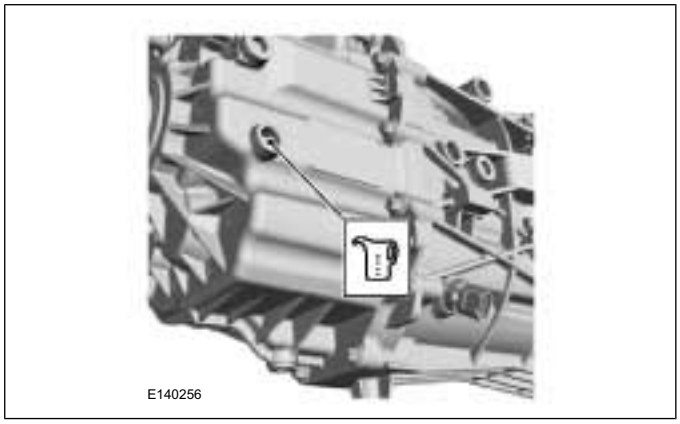
2. **WARNING: Be prepared to collect escaping fluid.**

   Torque: 50 Nm

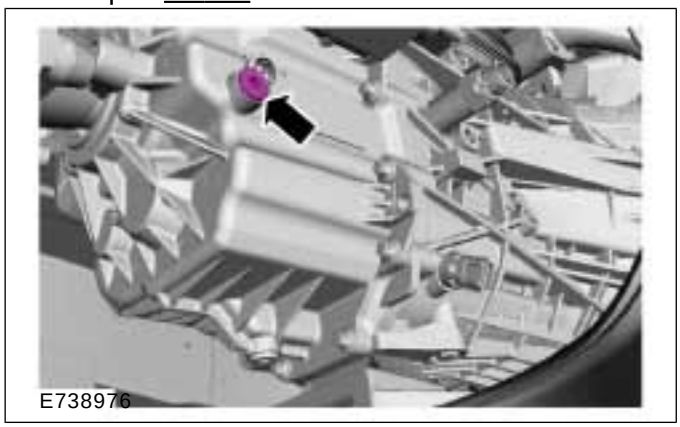
3. **NOTE:** Add additional 0.1L Transmission Fluid to the initial fill amount, if transmission has been disassembled and assembled in your workshop.

   Fill with 2.6L Transmission fluid.

   Material: Transmission Oil 75W FE (WSS-M2C200-D2 / 7U7J-M2C200-BA) transmission fluid



4. Torque: 35 Nm



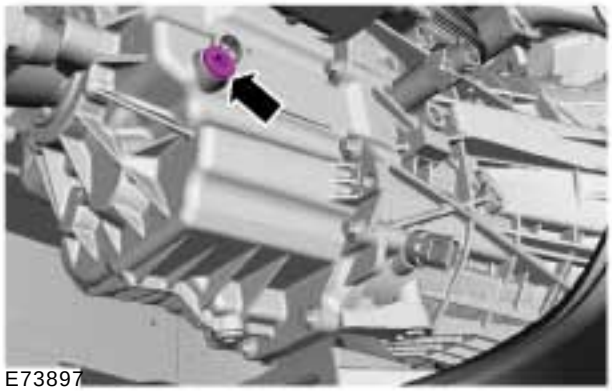
GENERAL PROCEDURES

Transmission Fluid Level Check

Materials	
Name	**Specification**
Transmission Oil 75W FE	WSS-M2C200-D2 / 7U7J-M2C200-BA

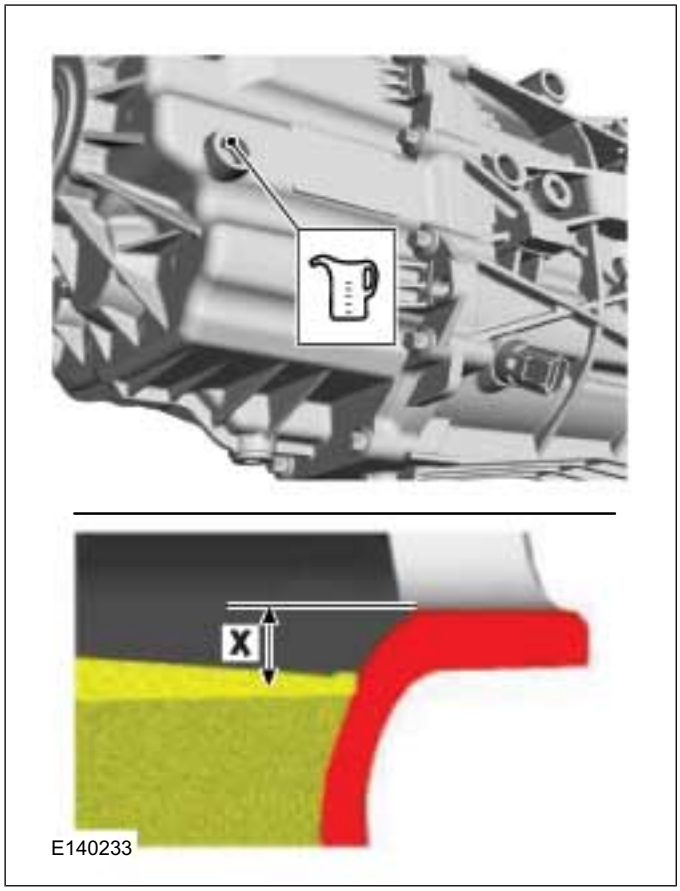
1. Check the component for leaks.
2. Transmission Fluid Level Check should only be carried out if an oil leak was identified.

   Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
3. **NOTE:** Make sure that the vehicle is standing on a level surface.

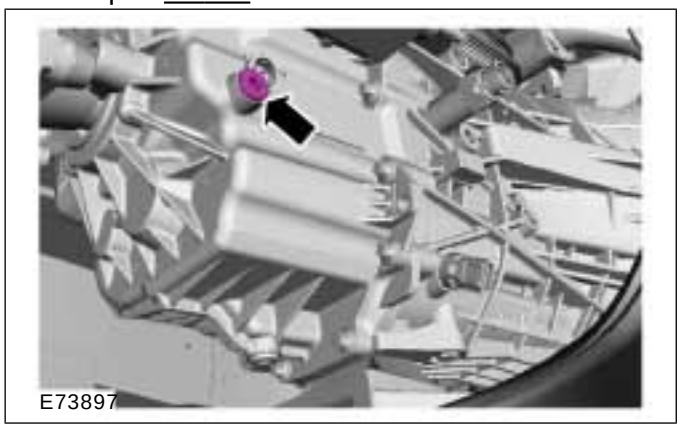
   Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. 

5. **X:**0 - 3 mm

   Material: Transmission Oil 75W FE (WSS-M2C200-D2 / 7U7J-M2C200-BA) transmission fluid



6. Torque: 35 Nm



REMOVAL AND INSTALLATION

Input Shaft Seal

1. Information not available at this time.

REMOVAL AND INSTALLATION

Output Shaft Seal

2. Information not available at this time.

REMOVAL

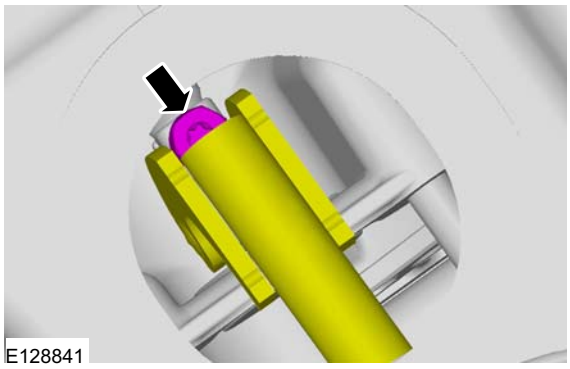
Transmission — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, 2WD

Removal

General Equipment

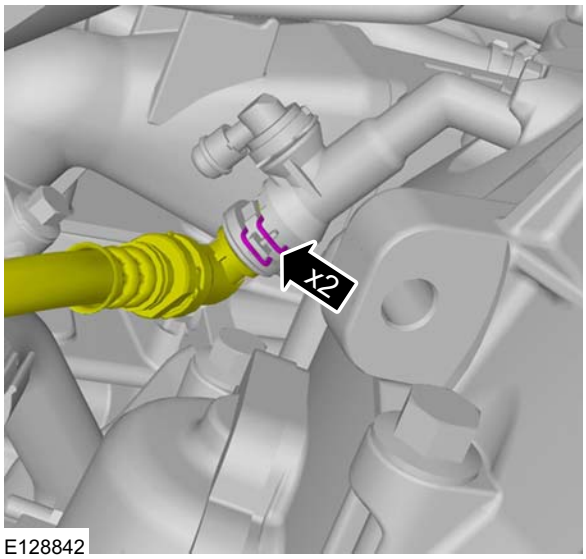
Transmission Jack

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
   Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).
3. Torque: 40 Nm


E128841

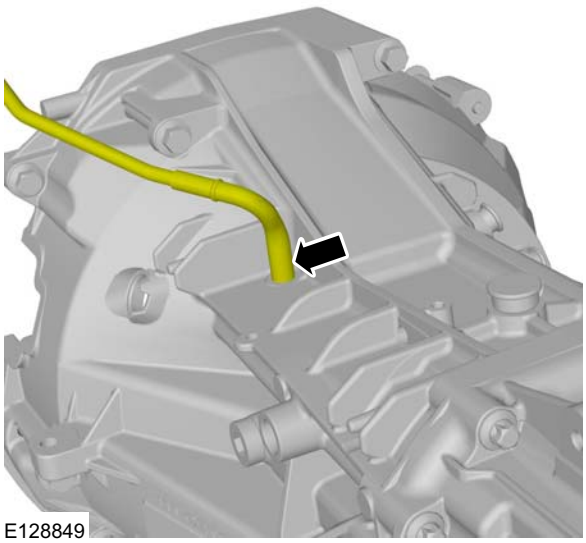
4. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
5. Refer to: Driveshaft - 2WD (205-01 Driveshaft, Removal and Installation).
6. ⚠ **CAUTION: Cap the clutch slave cylinder supply line to prevent fluid loss or dirt ingress.**

NOTE: If the clutch fluid comes into contact with the painted area, rinse off the affected areas with cold water without delay.



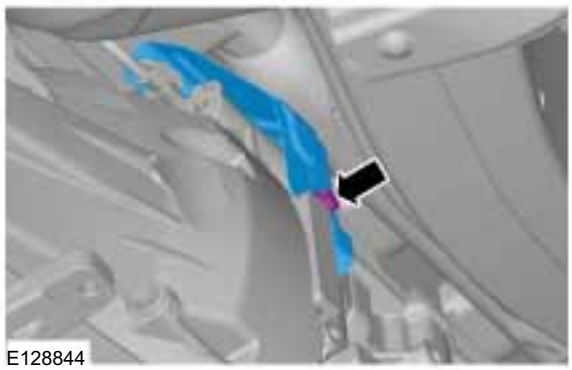
E128842

7.

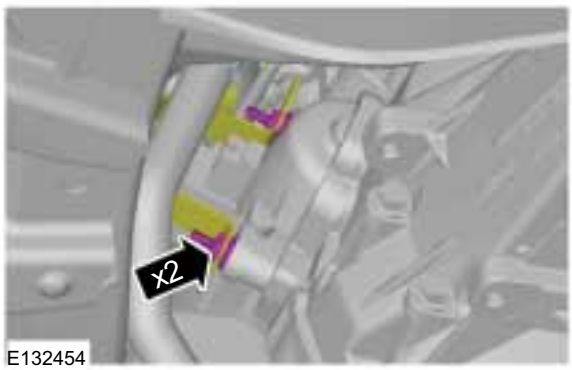

E128849

REMOVAL

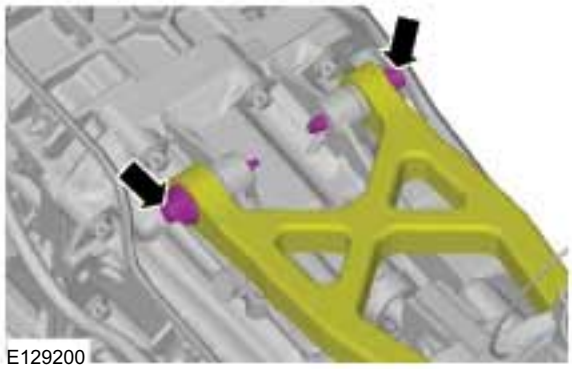
8. Torque: 25 Nm



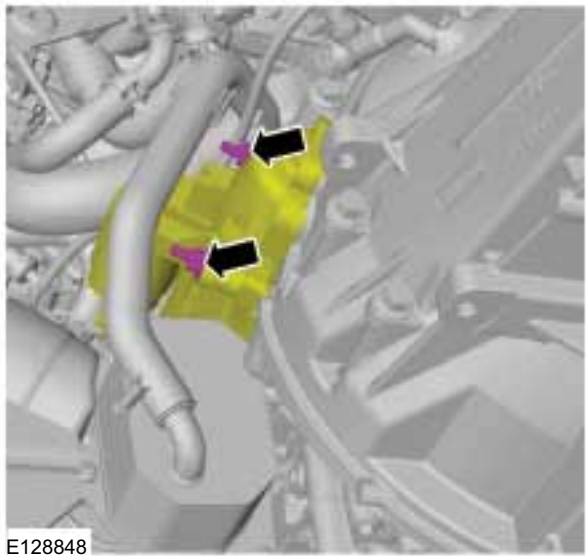
10. Torque: 35 Nm



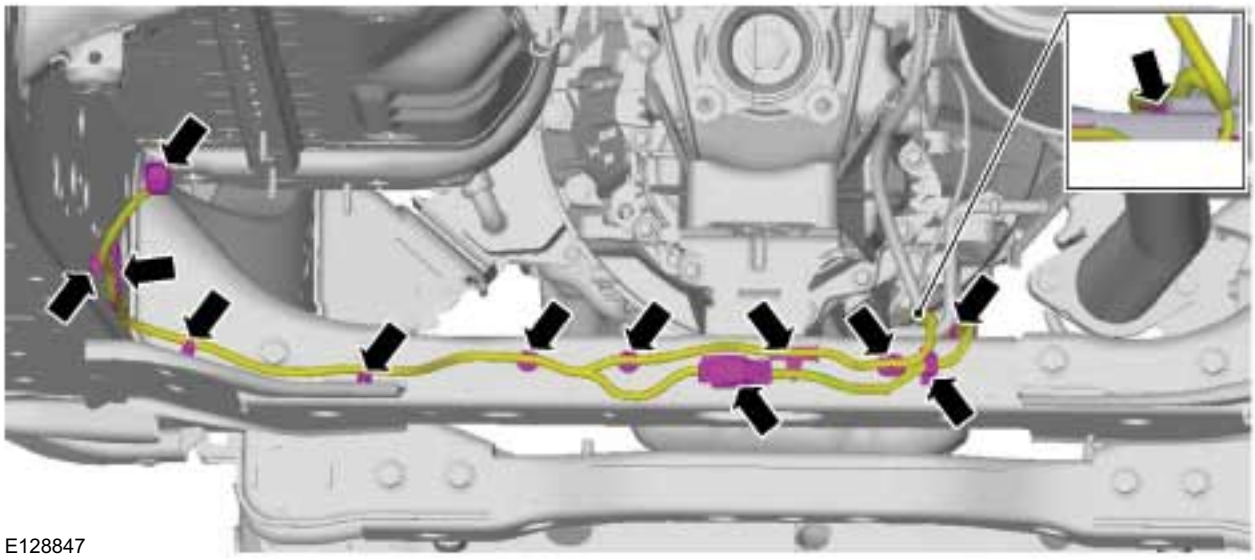
9. Torque: 25 Nm



11. Torque: 35 Nm

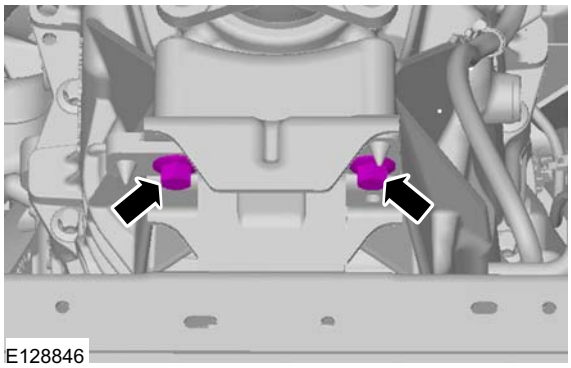


12.

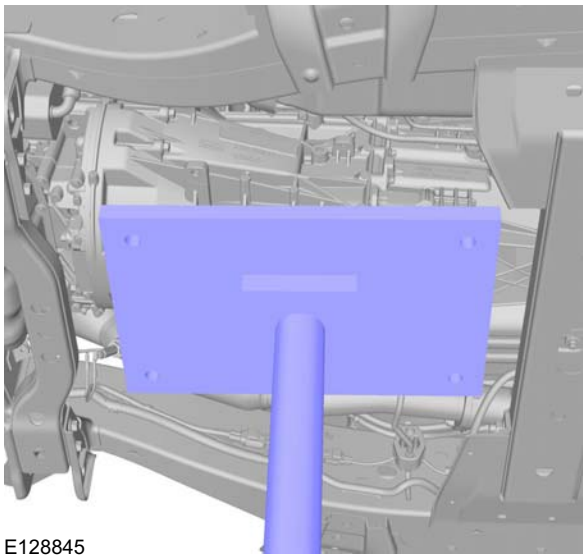


REMOVAL

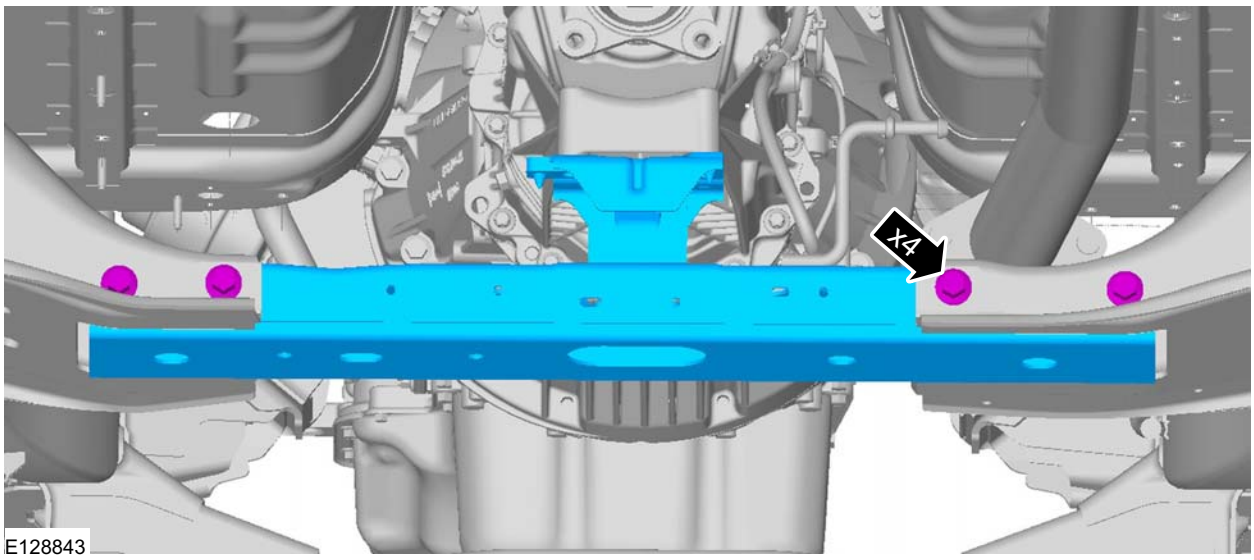
13. Torque: 95 Nm



14. General Equipment: Transmission Jack

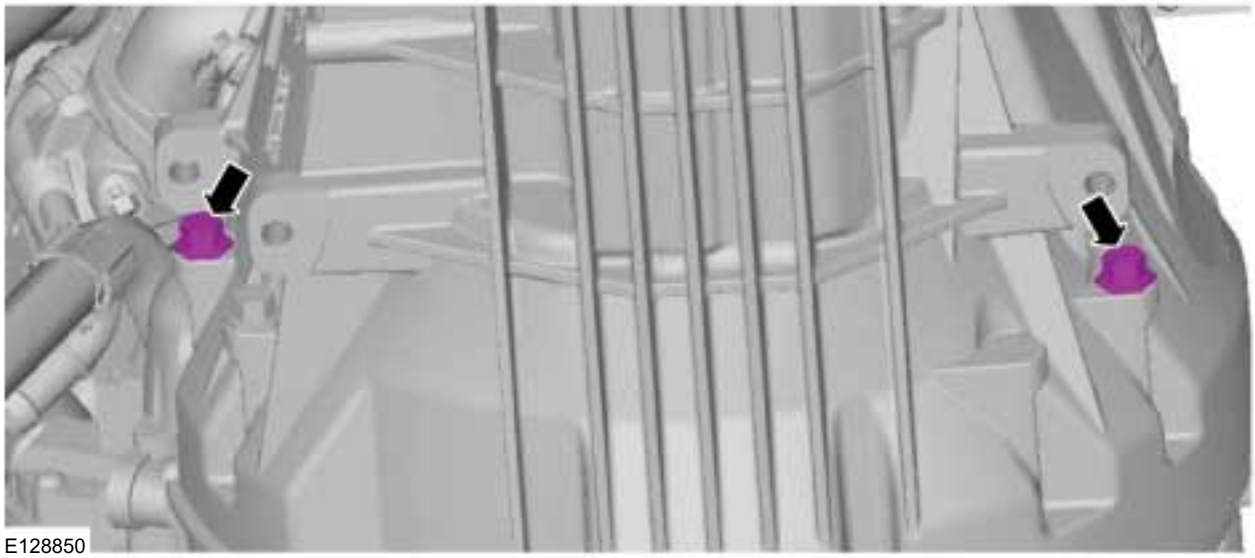


15. Torque: 90 Nm

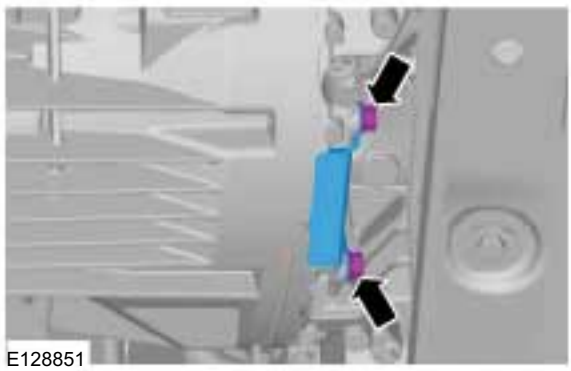


16. Torque: 50 Nm

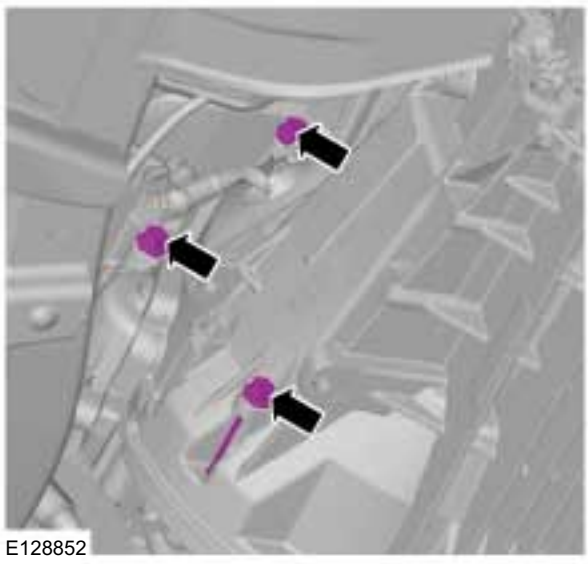
REMOVAL


E128850

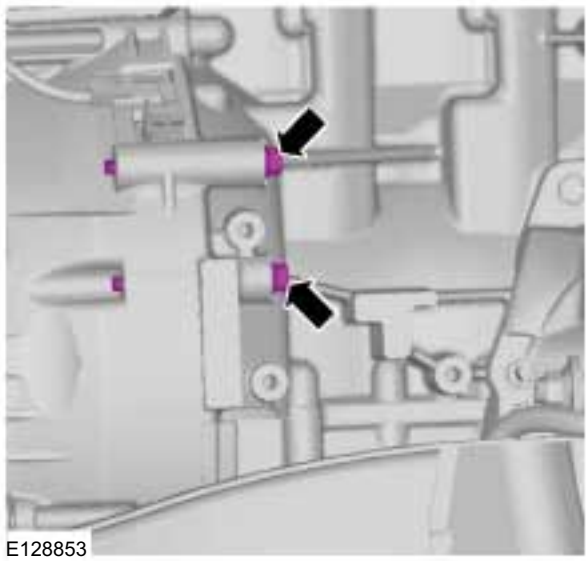
17. Torque: 50 Nm


E128851

18. Torque: 50 Nm


E128852

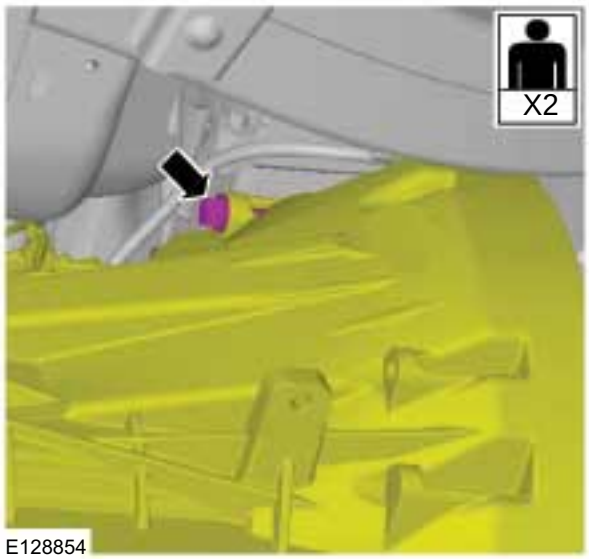
19. Torque: 50 Nm


E128853

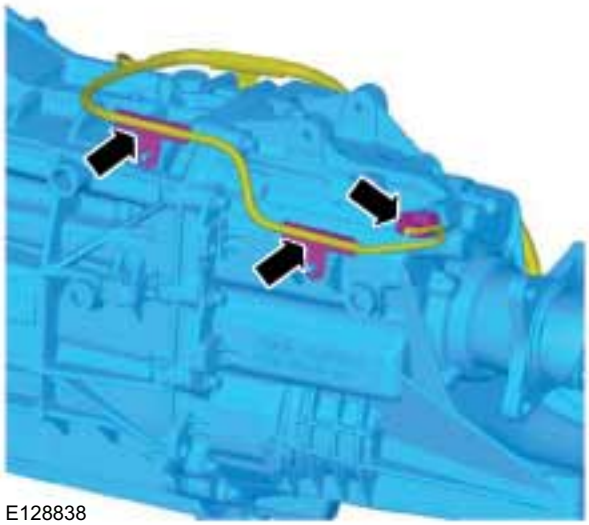
REMOVAL

20. **CAUTION: Do not tilt the transmission during removal. This may cause damage to the pilot bearing.**

Torque: 50 Nm

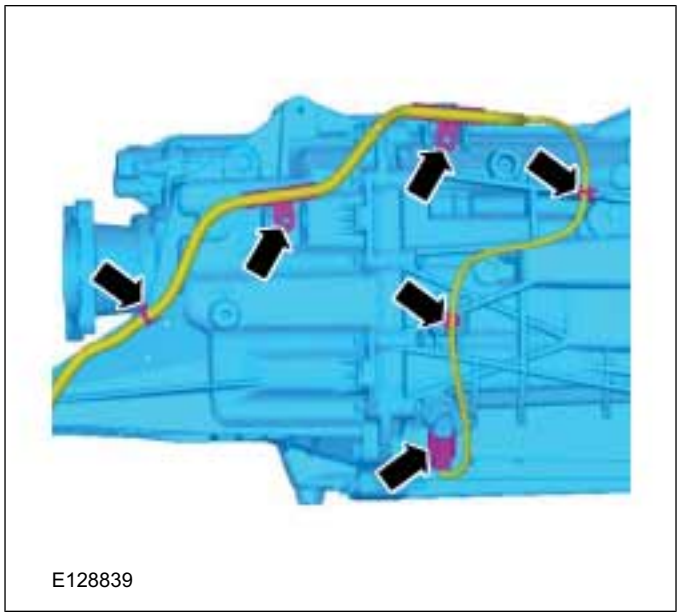


21.



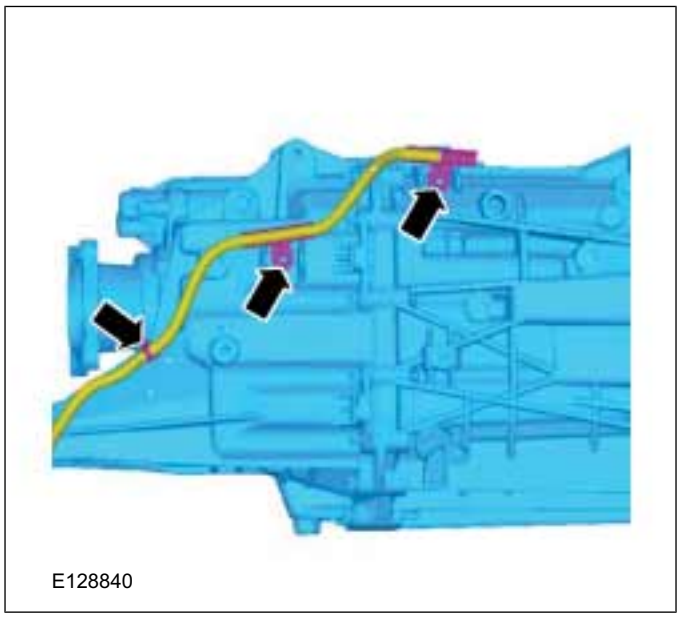
Vehicles with speed control

22.



Vehicles without speed control

23.



REMOVAL

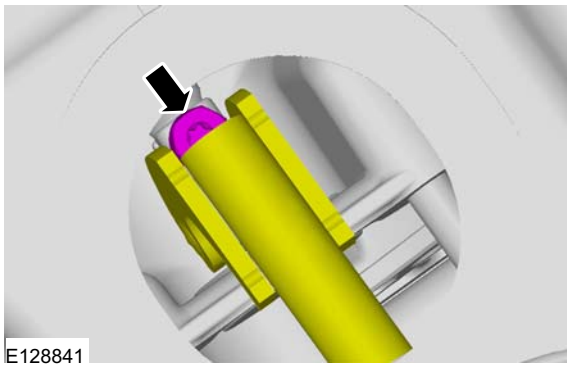
Transmission — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, 4WD

Removal

General Equipment

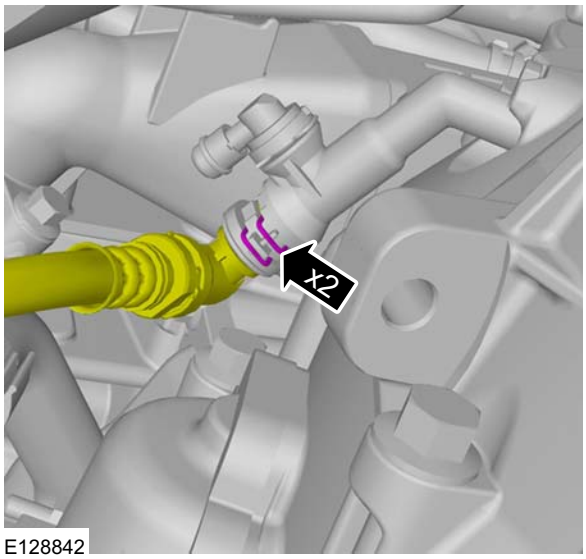
Transmission Jack

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
   Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).
3. Torque: 40 Nm


E128841

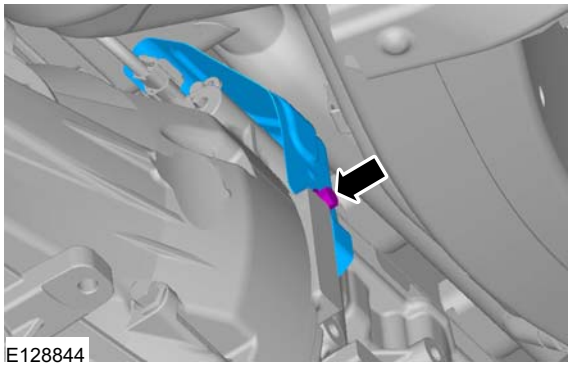
4. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
5. Refer to: Front Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).
   Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).
6. **CAUTION: Cap the clutch slave cylinder supply line to prevent fluid loss or dirt ingress.**

NOTE: If the clutch fluid comes into contact with the painted area, rinse off the affected areas with cold water without delay.



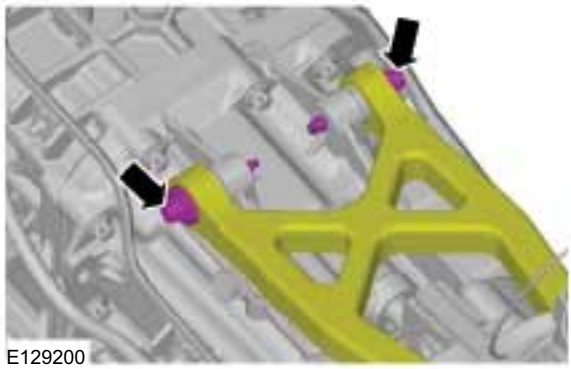
E128842

7. Torque: 25 Nm

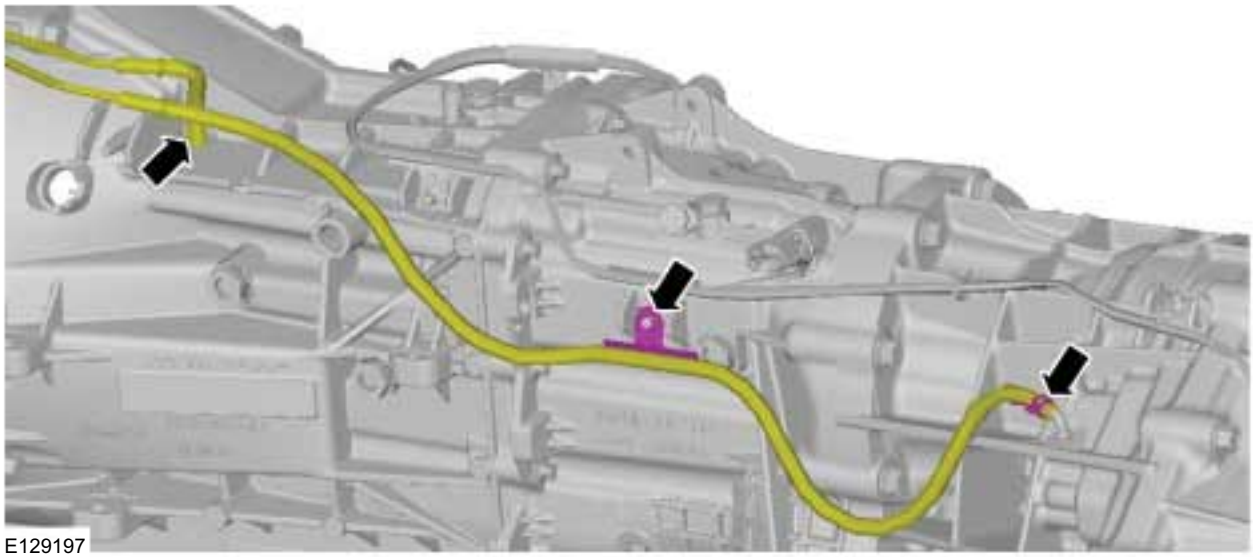

E128844

REMOVAL

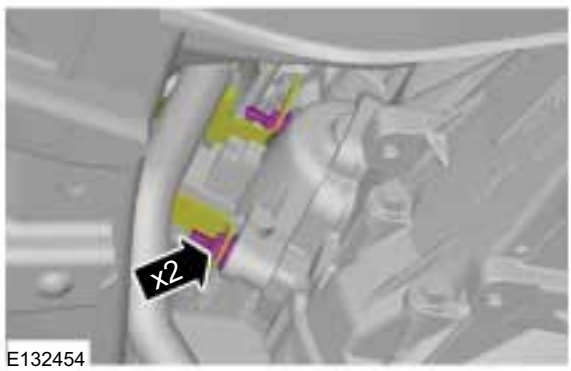
8. Torque: 25 Nm



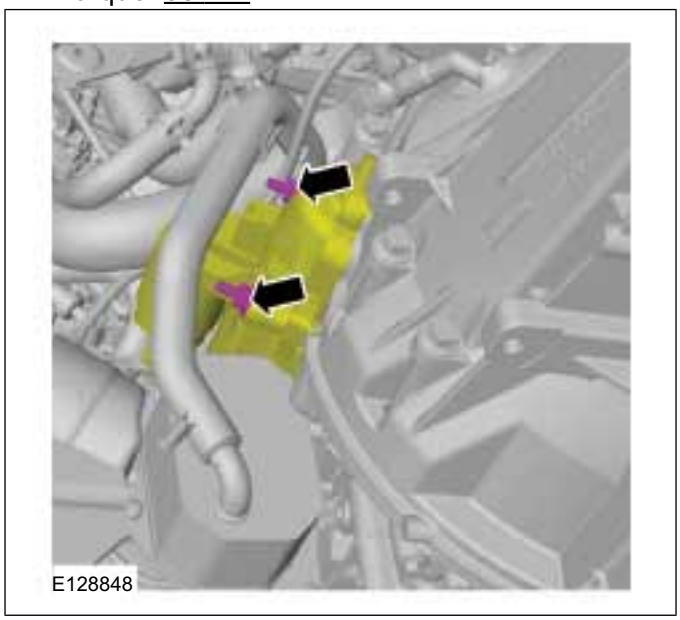
9.



10. Torque: 35 Nm



11. Torque: 35 Nm

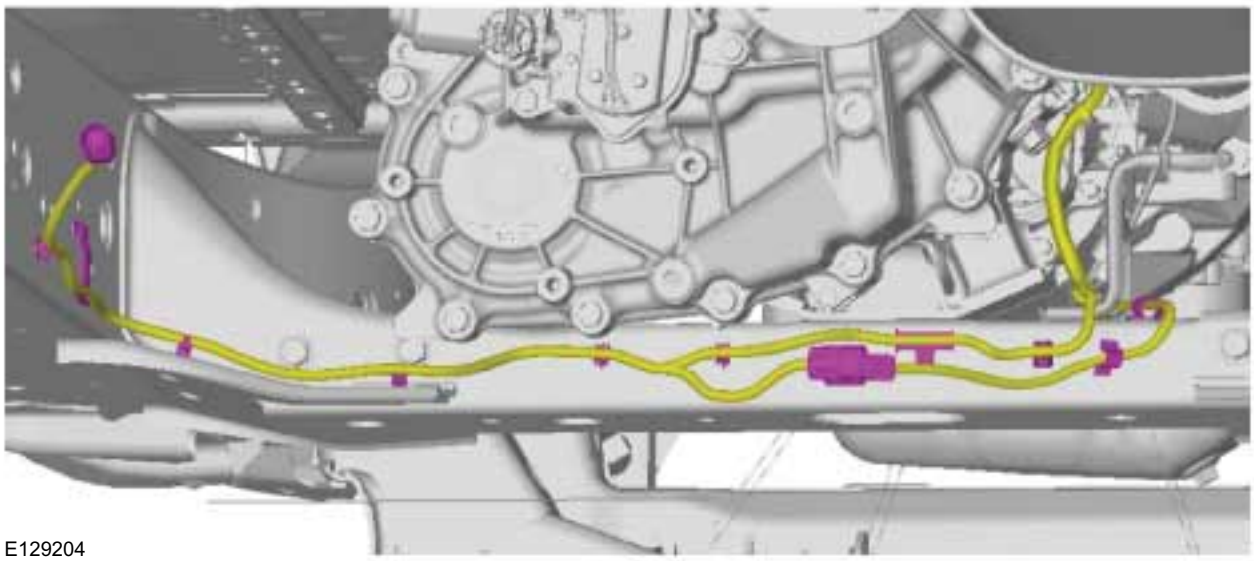


REMOVAL

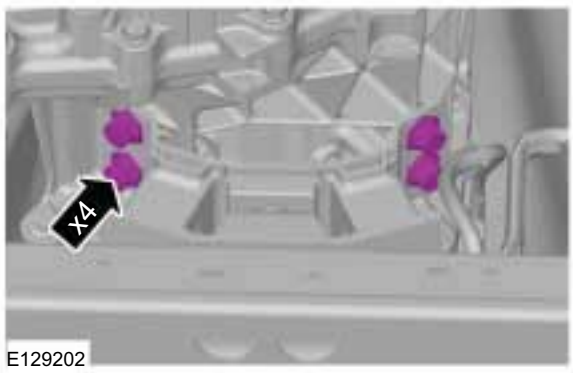
12.

E129203

13.

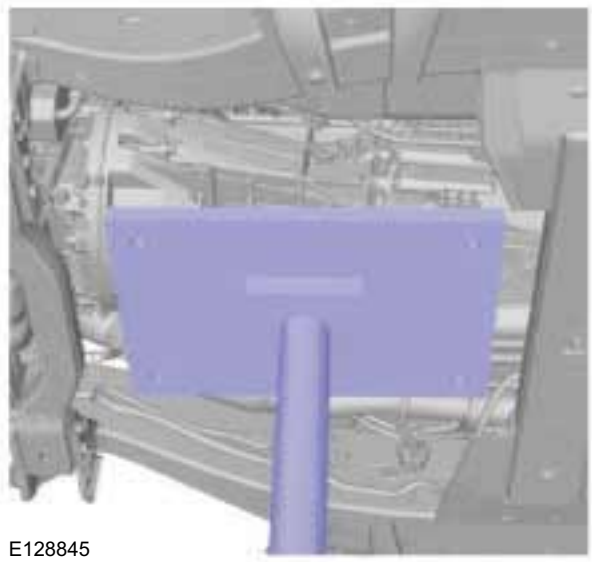

E129204

14. Torque: 95 Nm



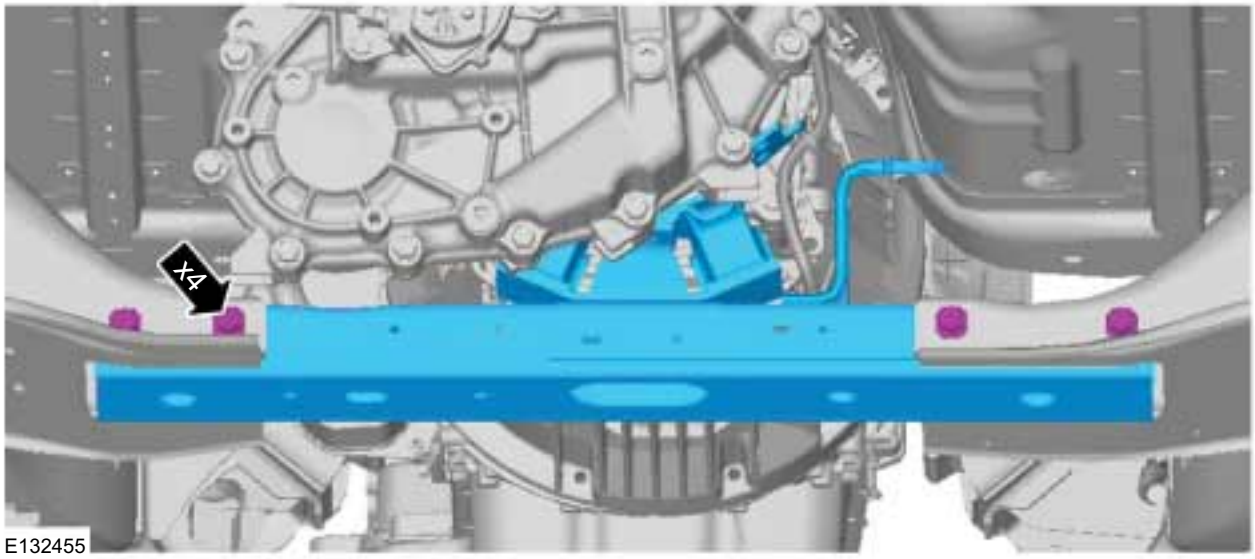
E129202

15. General Equipment: Transmission Jack

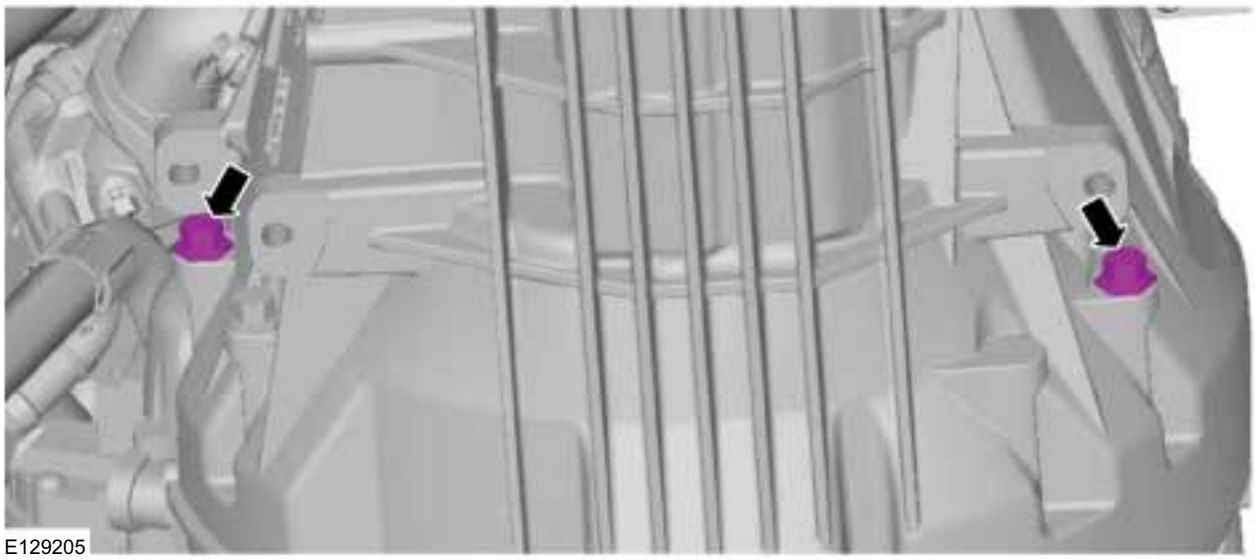

E128845

16. Torque: 90 Nm

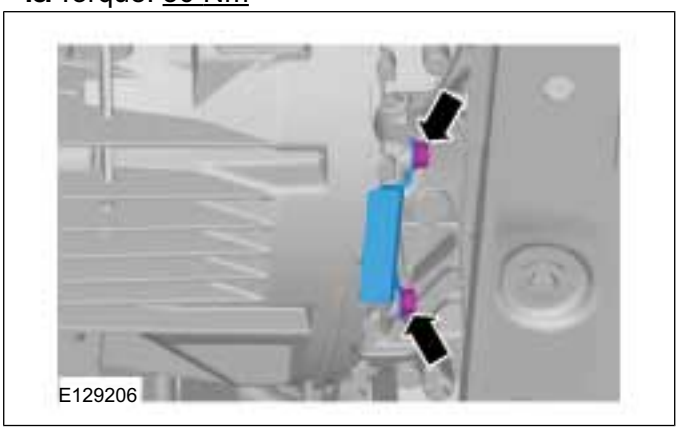
REMOVAL



17. Torque: 50 Nm

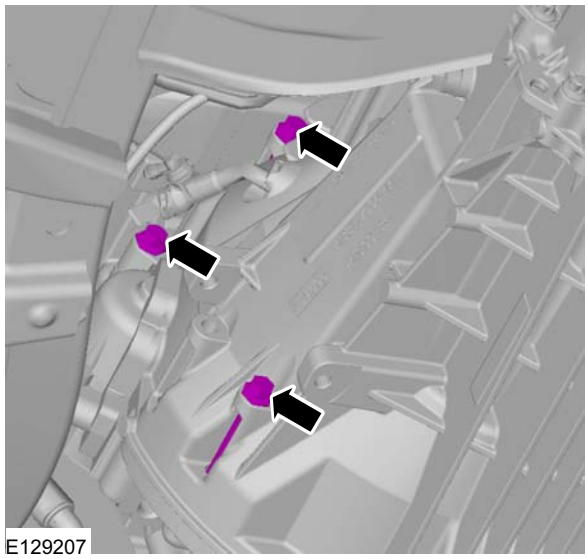


18. Torque: 50 Nm

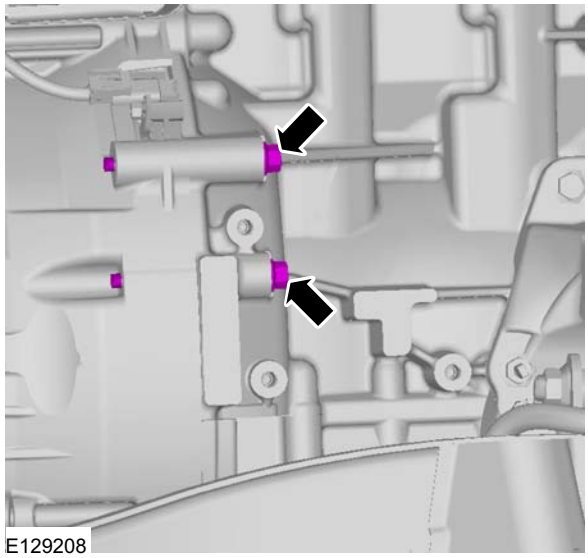


REMOVAL

19. Torque: 50 Nm

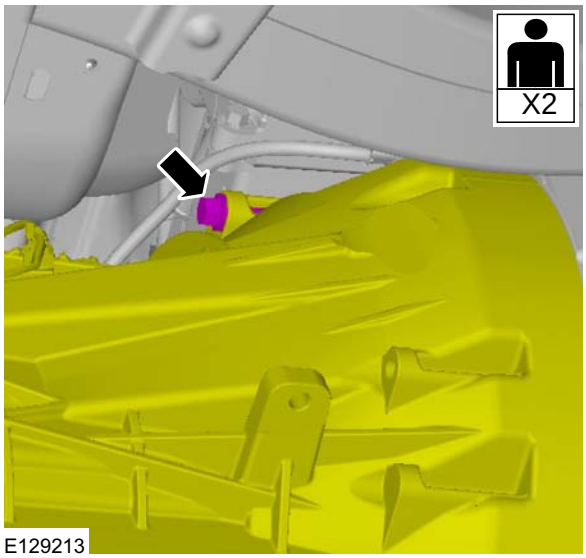


20. Torque: 50 Nm

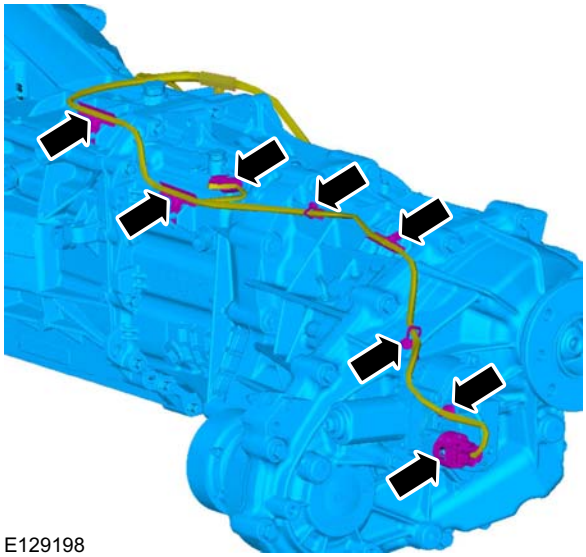


21. **CAUTION: Do not tilt the transmission during removal. This may cause damage to the pilot bearing.**

Torque: 50 Nm



22.



REMOVAL

Vehicles with speed control

23.

Vehicles without speed control

24.

DISASSEMBLY

Transmission

Disassembly

3. Information not available at this time.

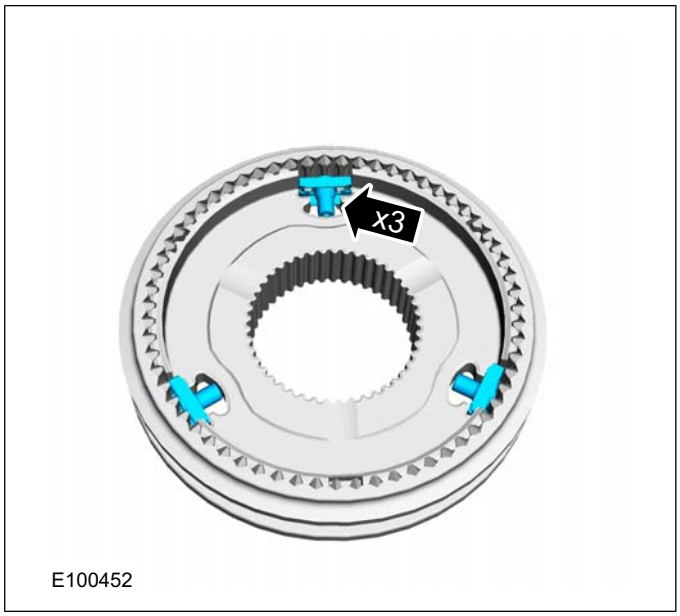
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Synchronizers

Materials	
Name	**Specification**
Grease K-HT	ESD-M1C220-A / A88SX1C220AA

Disassembly

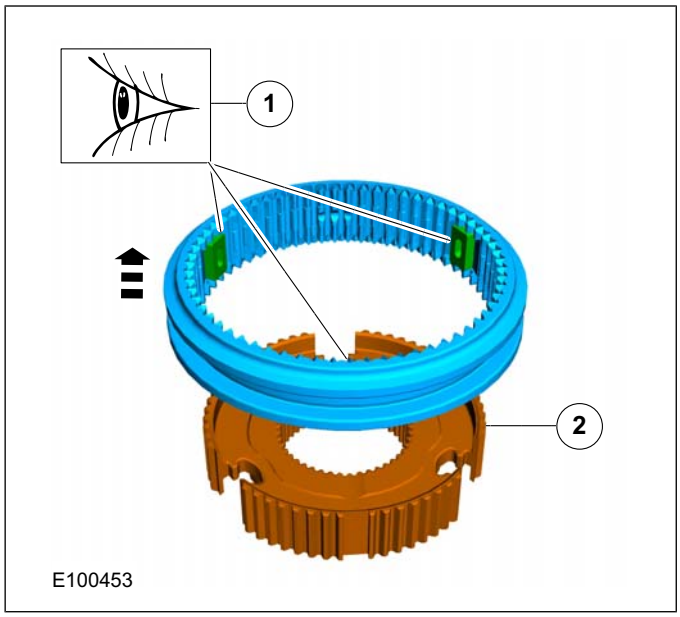
1.



2. NOTE: Note the position of each component before removal.

NOTE: Make sure that no component falls off during removal.

1. 3rd/4th gear only



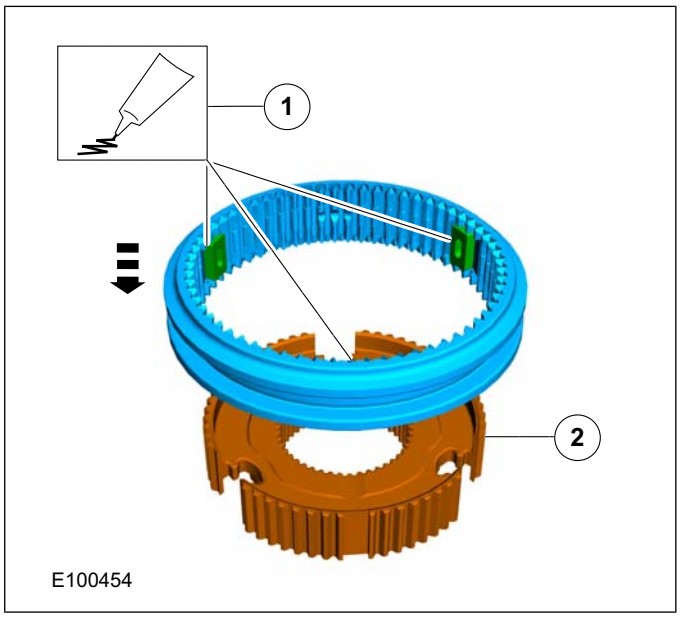
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Assembly

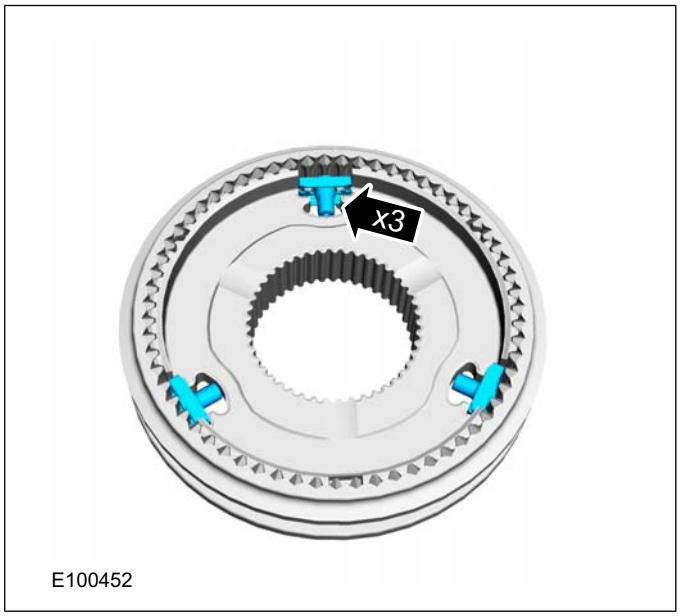
3. **NOTE:** Make sure that these components are installed to the noted removal position.

   1. 3rd/4th gear only

      Material: Grease K-HT (ESD-M1C220-A / A88SX1C220AA) grease



4.



ASSEMBLY

Transmission

Assembly

4. Information not available at this time.

INSTALLATION

Transmission — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, 2WD

Installation

General Equipment

Transmission Jack

1. Check the pilot bearing for damage. If damaged, install a new pilot bearing.

   Refer to: Pilot Bearing - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (308-01 Clutch - Vehicles With: 6-Speed Manual Transmission - MT82, Removal and Installation).

2. **NOTE:** Do not apply grease to a newly installed pilot bearing.

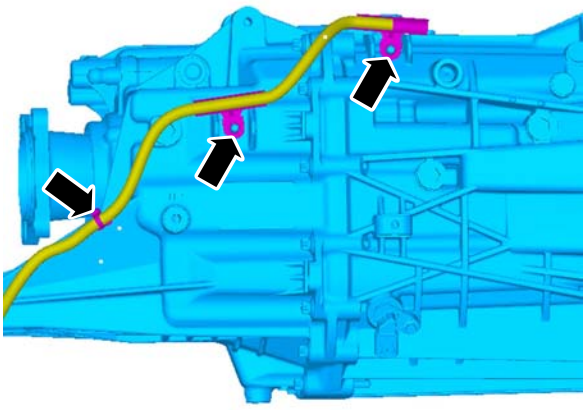
   Apply approximately one gram of grease to the pilot bearing.

3. Apply a thin film of grease to the input shaft guide sleeve.

4. Shift the transmission into third gear.

Vehicles without speed control

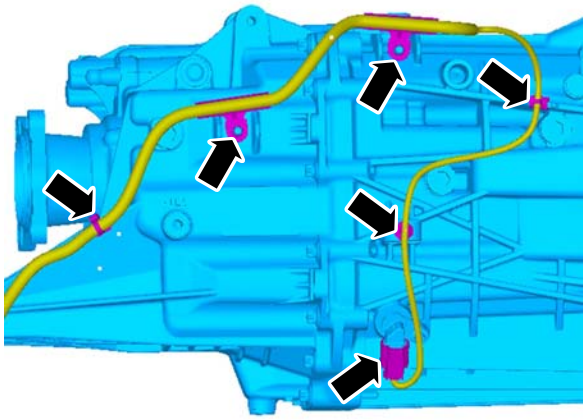
5.



E128840

Vehicles with speed control

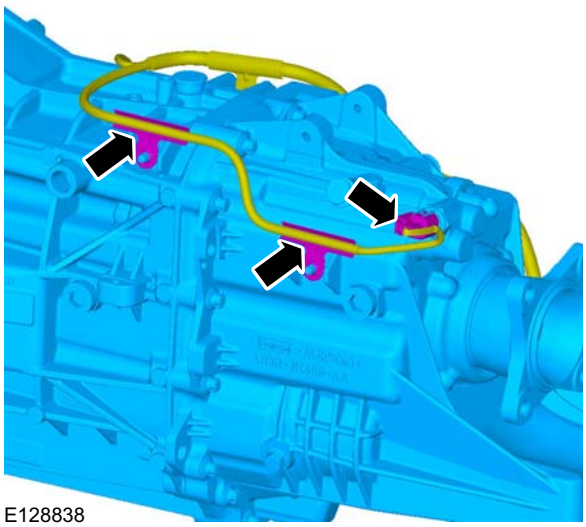
6.



E128839

All vehicles

7.

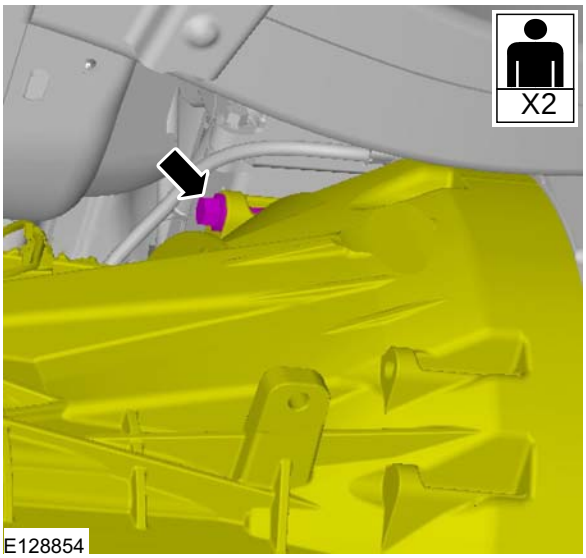


E128838

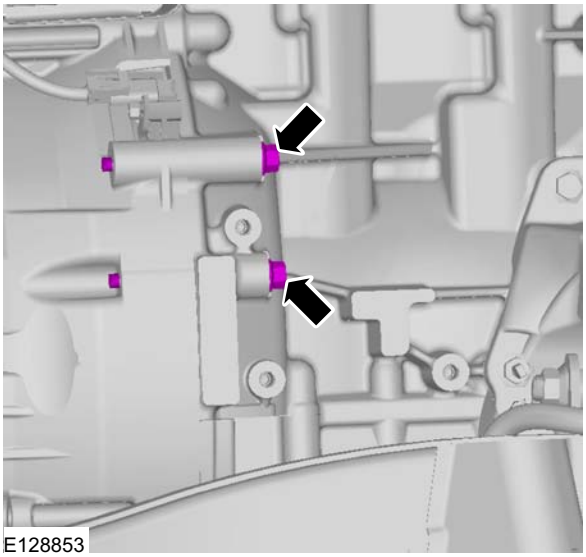
INSTALLATION

8. ⚠ **CAUTION: Do not tilt the transmission during removal. This may cause damage to the pilot bearing.**

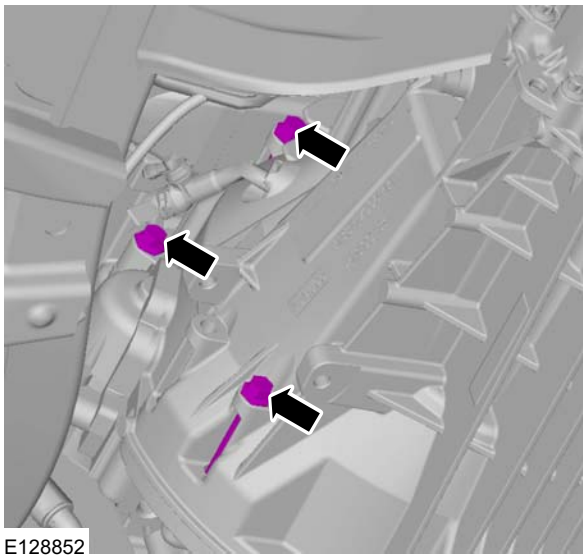
Torque: 50 Nm



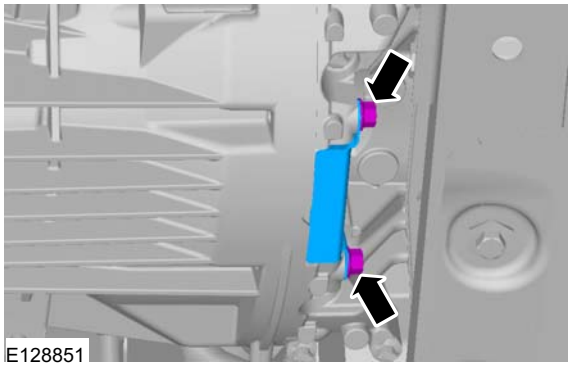
9. Torque: 50 Nm



10. Torque: 50 Nm

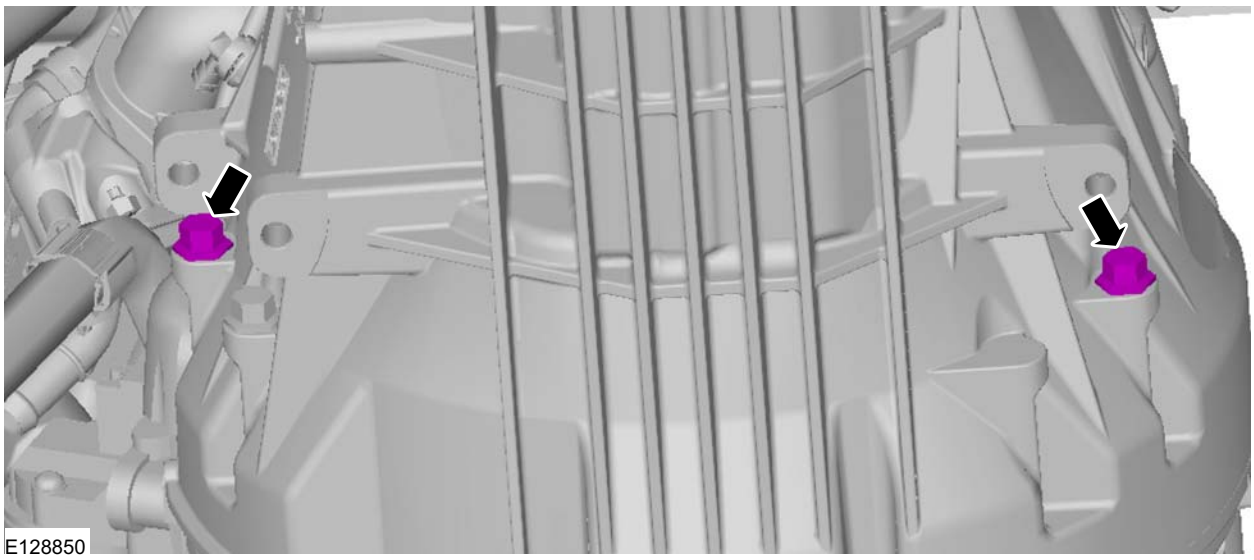


11. Torque: 50 Nm

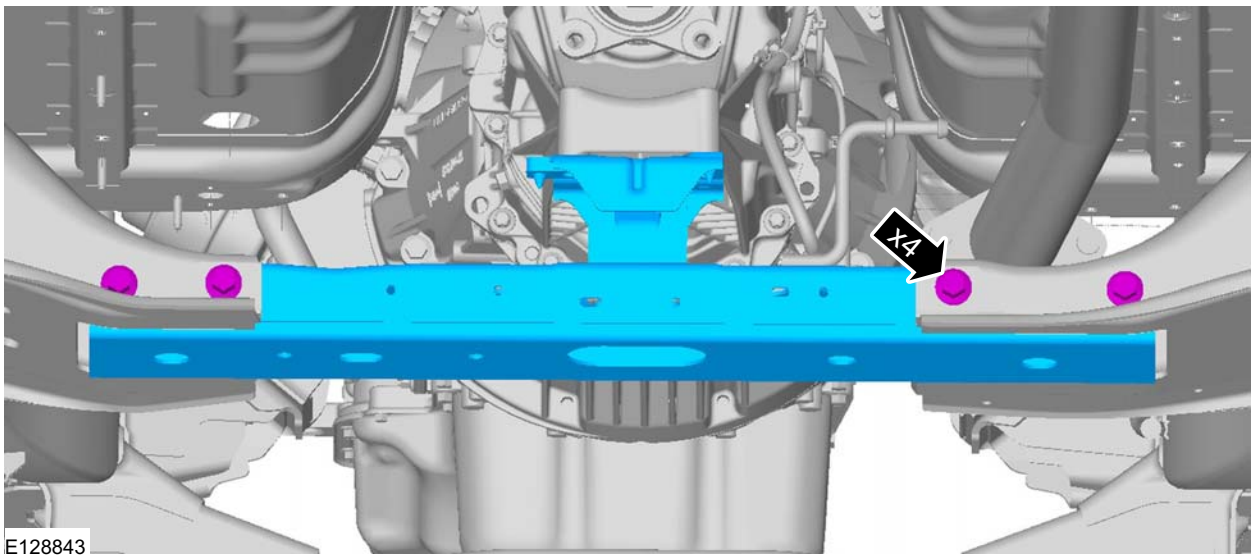


12. Torque: 50 Nm

INSTALLATION

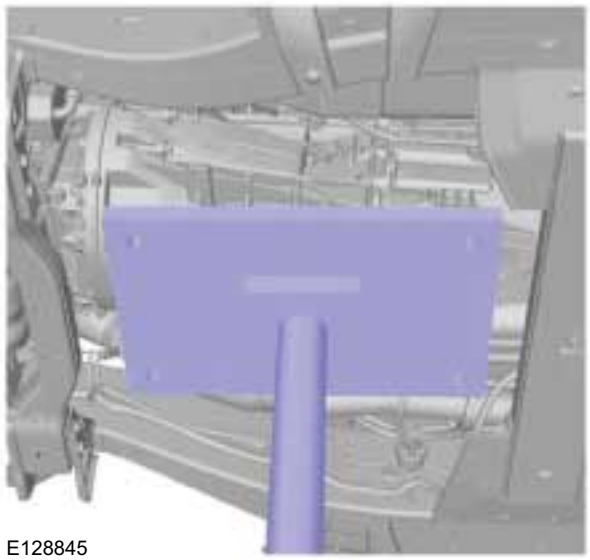


13. Torque: 90 Nm

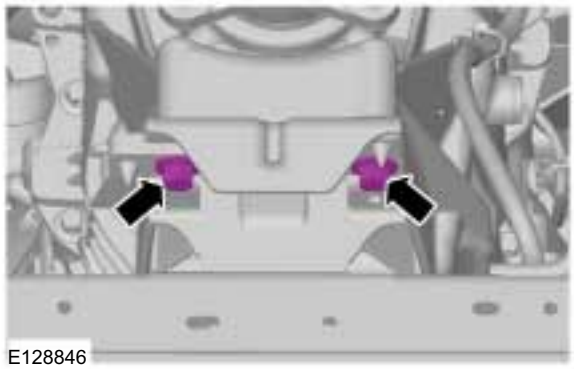


INSTALLATION

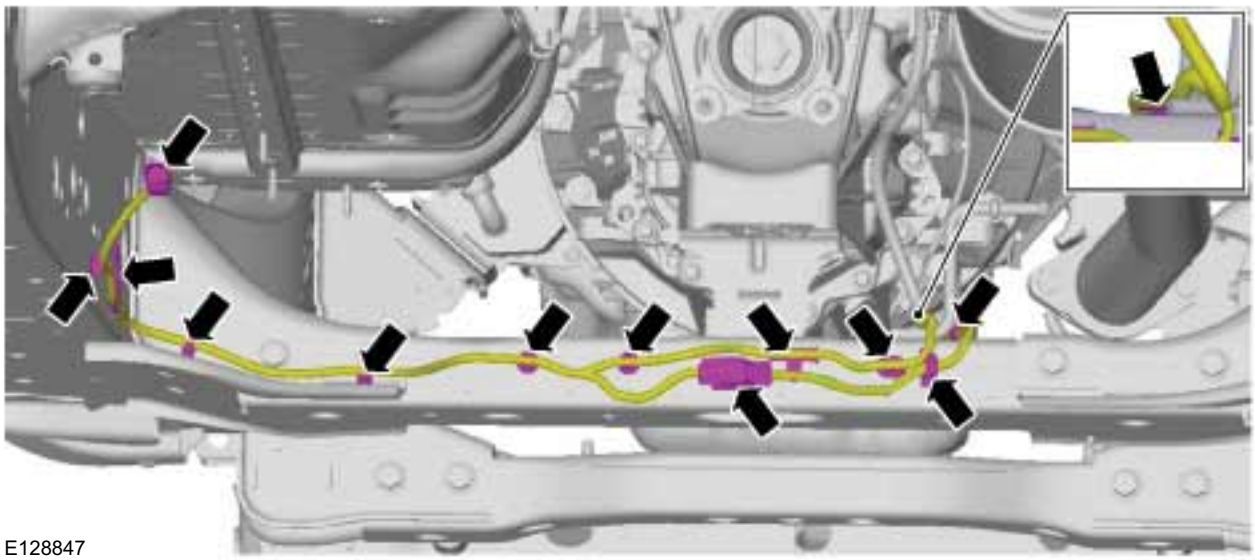
14. General Equipment: Transmission Jack


E128845

15. Torque: 95 Nm

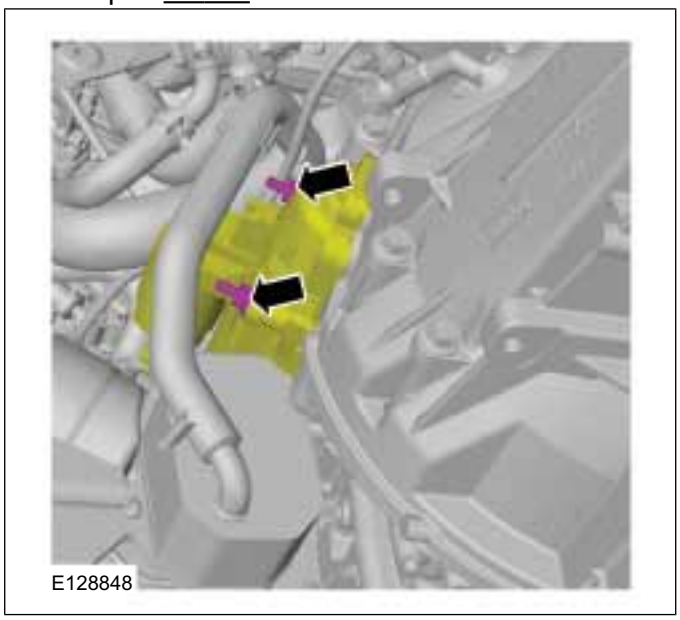

E128846

16. Torque: 50 Nm

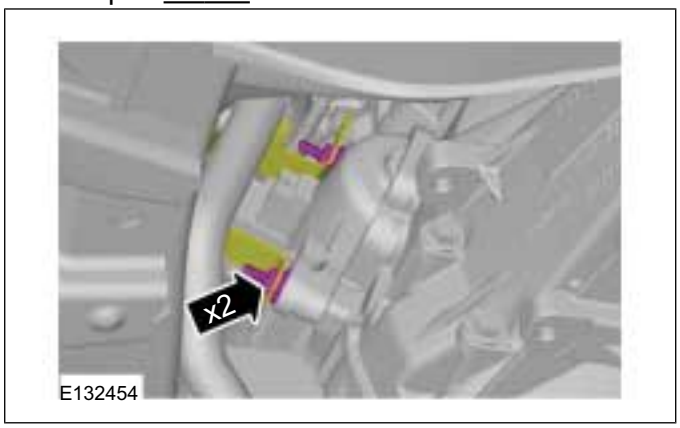

E128847

INSTALLATION

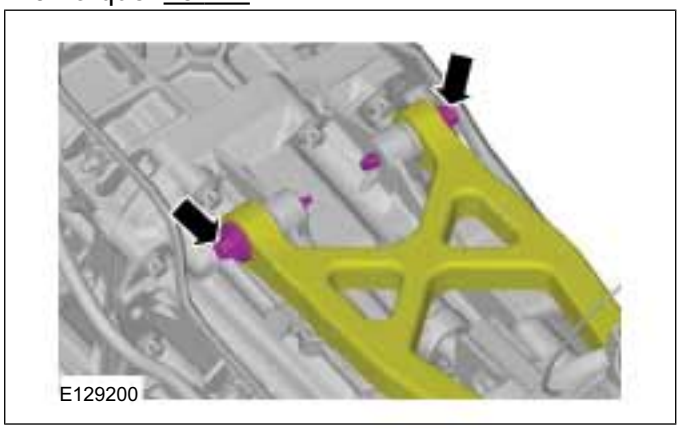
17. Torque: 35 Nm



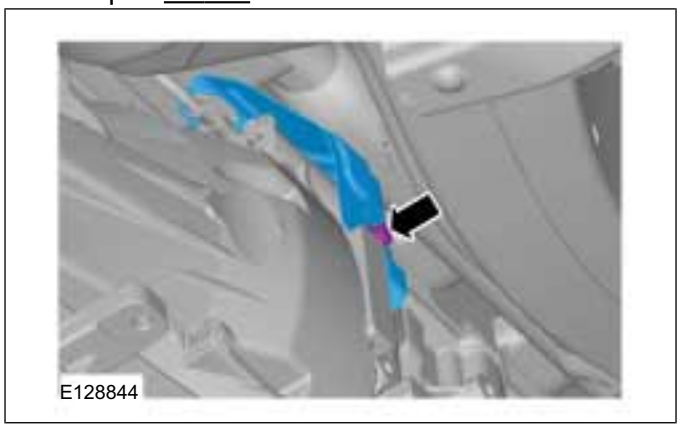
18. Torque: 35 Nm



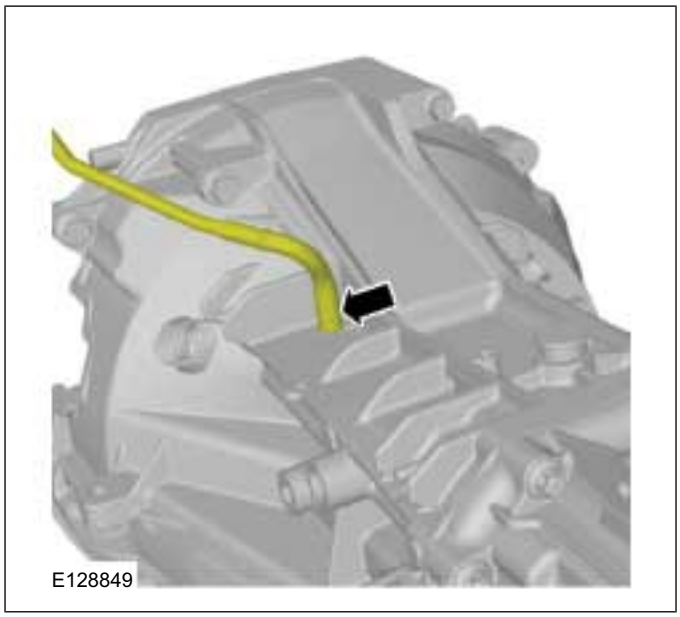
19. Torque: 25 Nm



20. Torque: 25 Nm

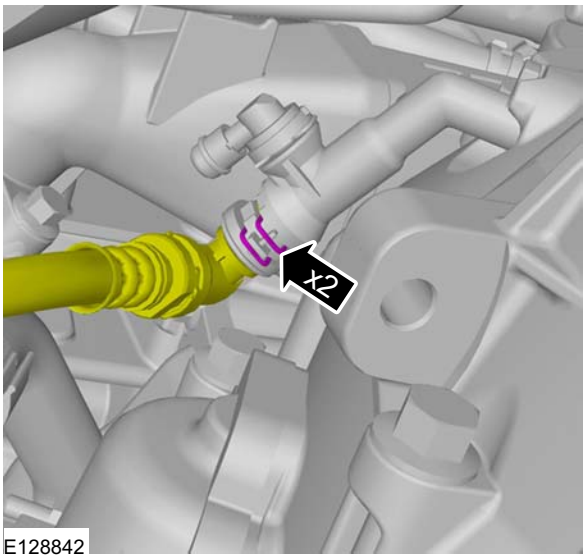


21.



INSTALLATION

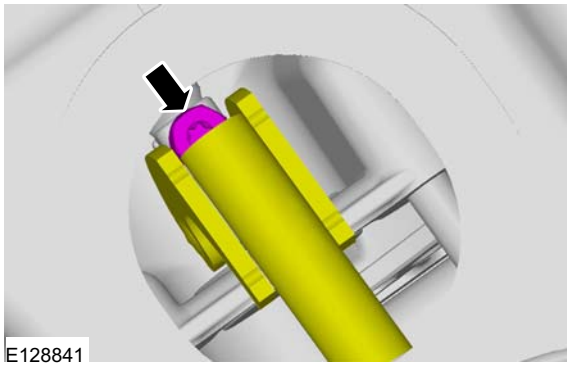
22. **NOTE:** If the clutch fluid comes into contact with the painted area, rinse off the affected areas with cold water without delay.



23. Refer to: Driveshaft - 2WD (205-01 Driveshaft, Removal and Installation).

24. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

25. Torque: 40 Nm



26. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

27. Refer to: Clutch System Bleeding - Vehicles With: MT82 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).

28. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

INSTALLATION

Transmission — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, 4WD

Installation

General Equipment

Transmission Jack

1. Check the pilot bearing for damage. If damaged, install a new pilot bearing.

   Refer to: Pilot Bearing - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (308-01 Clutch - Vehicles With: 6-Speed Manual Transmission - MT82, Removal and Installation).

2. **NOTE:** Do not apply grease to a newly installed pilot bearing.

   Apply approximately one gram of grease to the pilot bearing.

3. Apply a thin film of grease to the input shaft guide sleeve.

4. Shift the transmission into third gear.

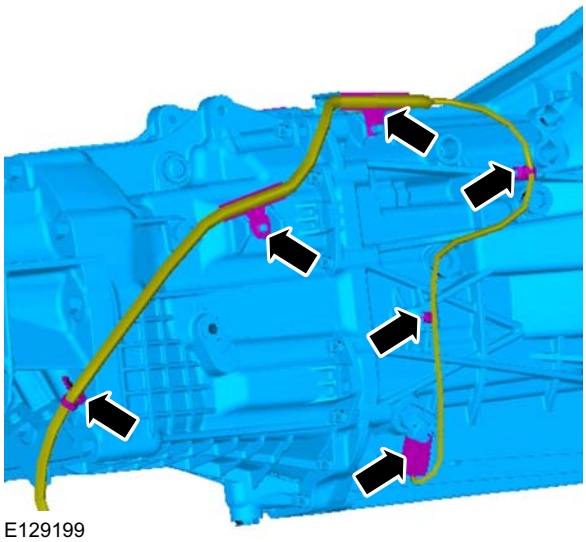
Vehicles without speed control

5.


E129201

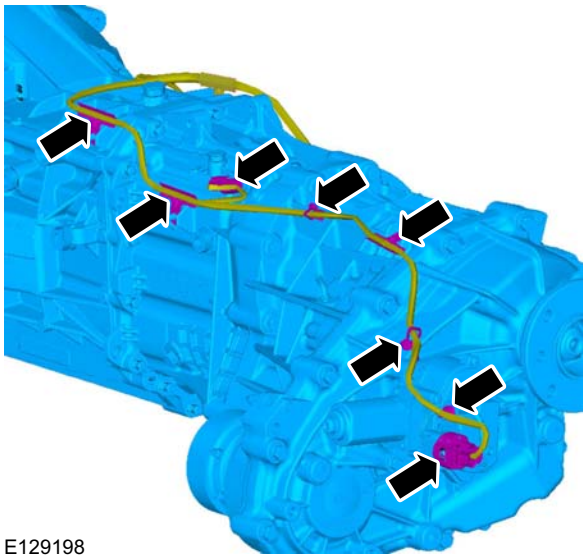
Vehicles with speed control

6.


E129199

All vehicles

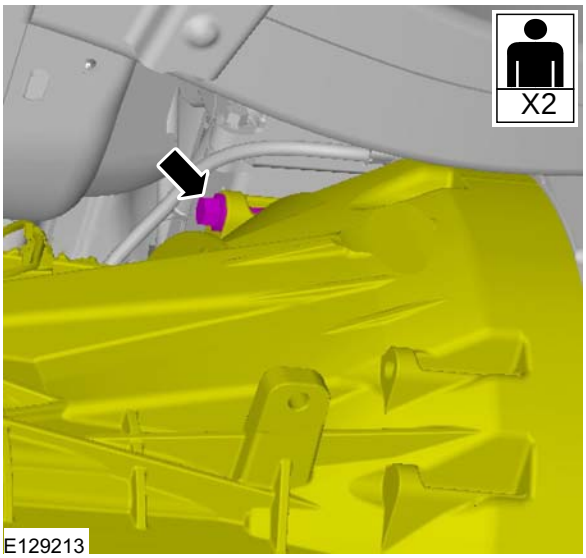
7.


E129198

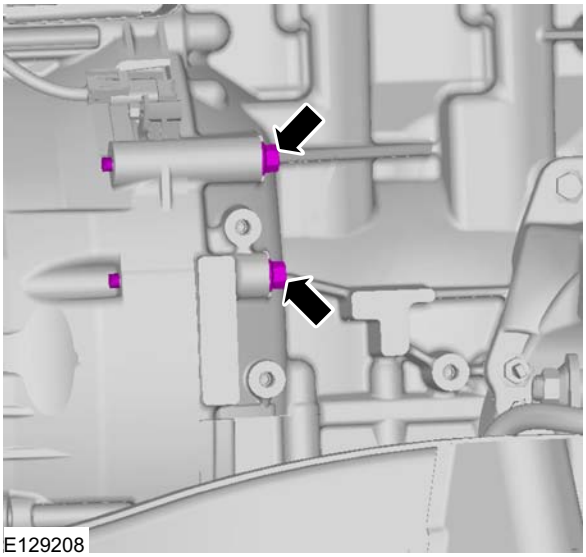
INSTALLATION

8. ⚠ **CAUTION: Do not tilt the transmission during installation. This may cause damage to the pilot bearing.**

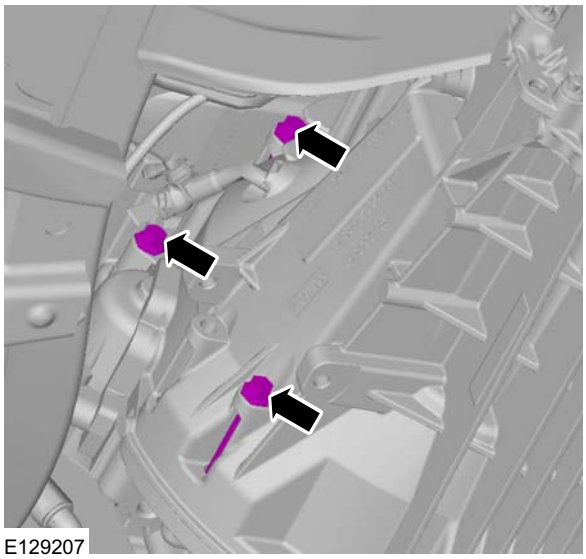
Torque: 50 Nm



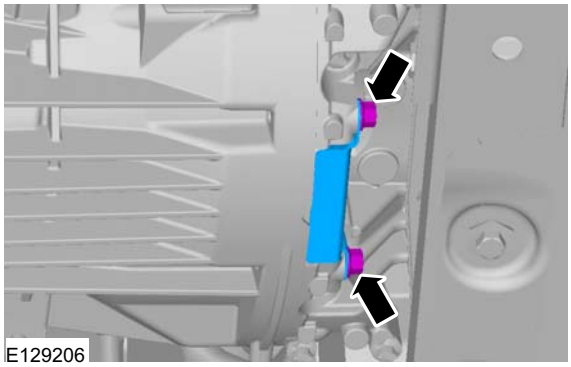
9. Torque: 50 Nm



10. Torque: 50 Nm

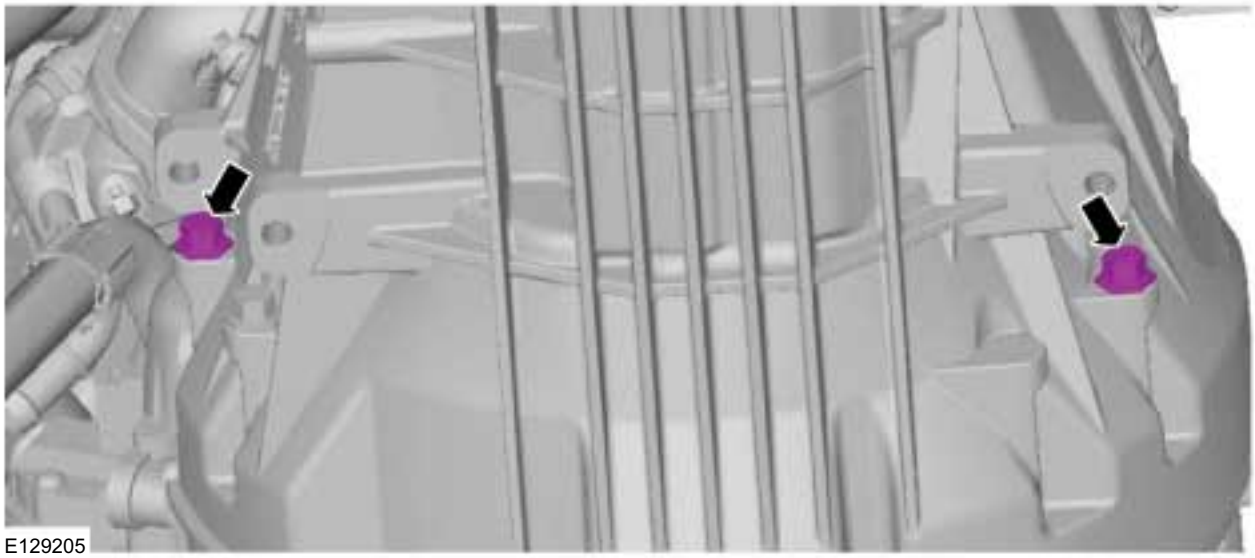


11. Torque: 50 Nm

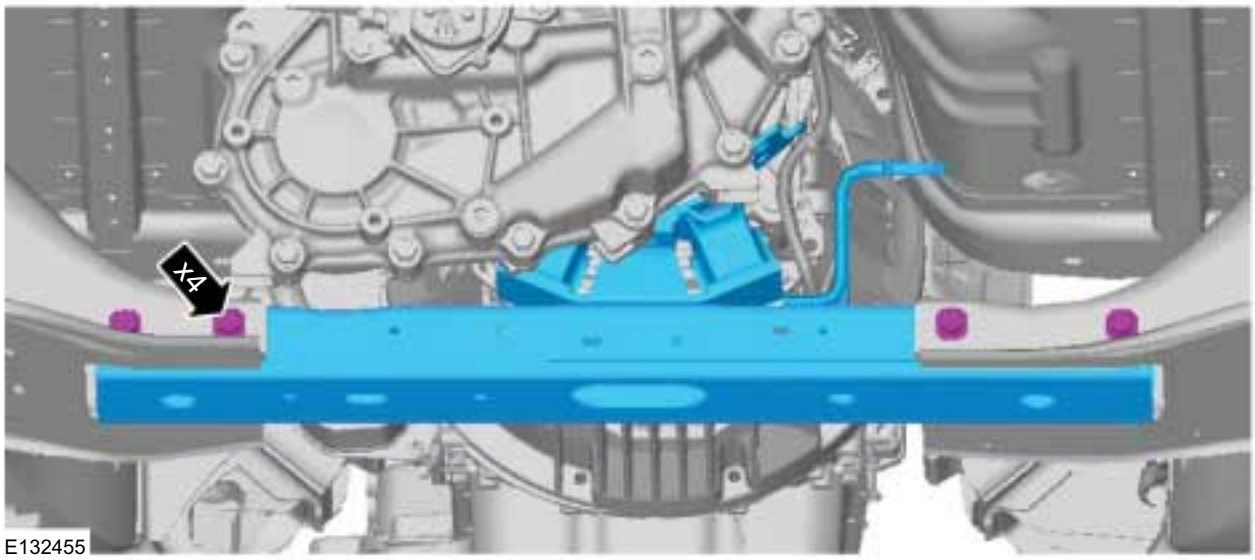


12. Torque: 50 Nm

INSTALLATION


E129205

13. Torque: 90 Nm



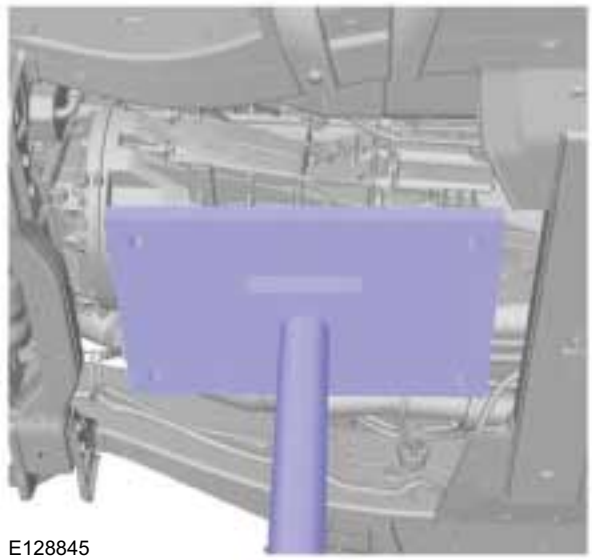
E132455

14. Torque: 95 Nm

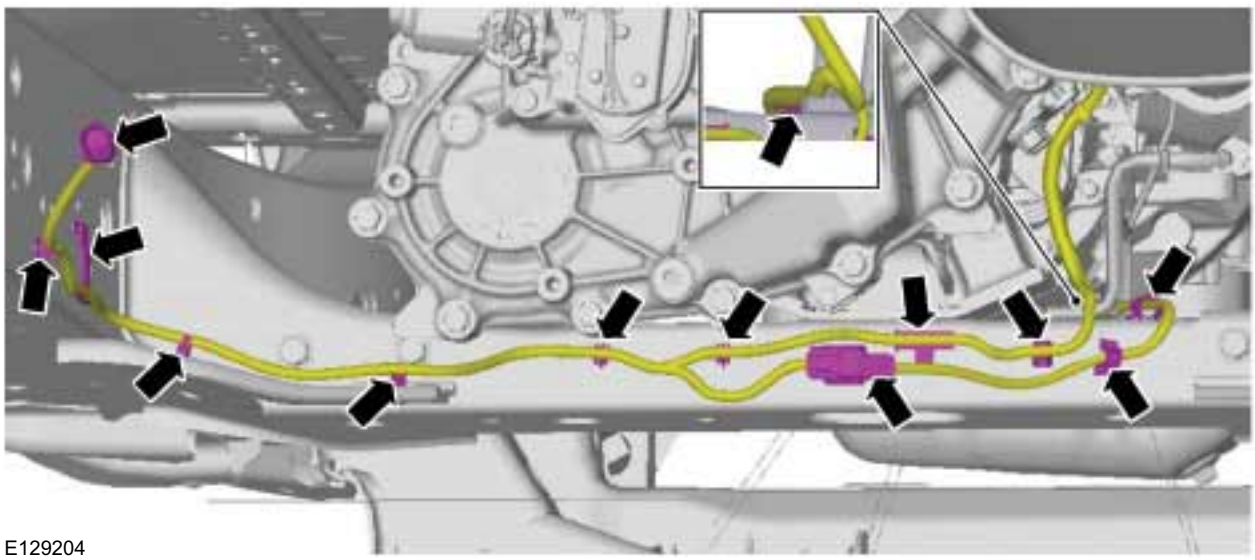
E129202

INSTALLATION

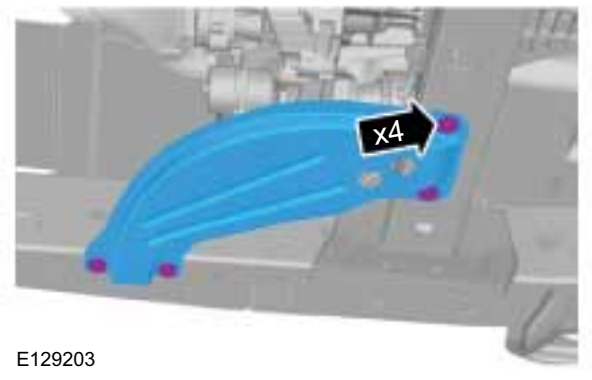
15. General Equipment: Transmission Jack


E128845

16.


E129204

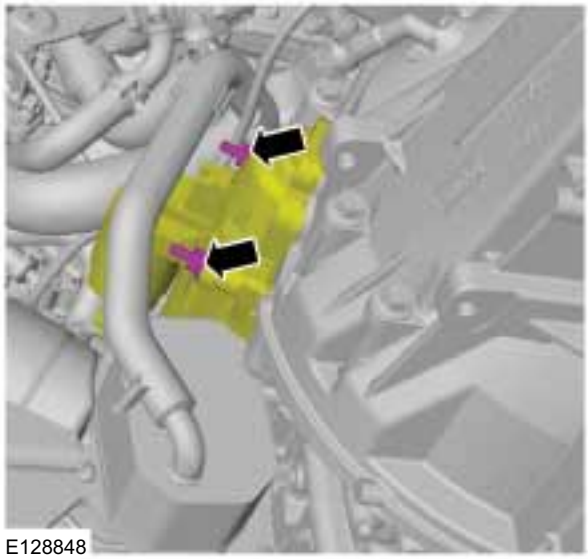
17. Torque: 50 Nm



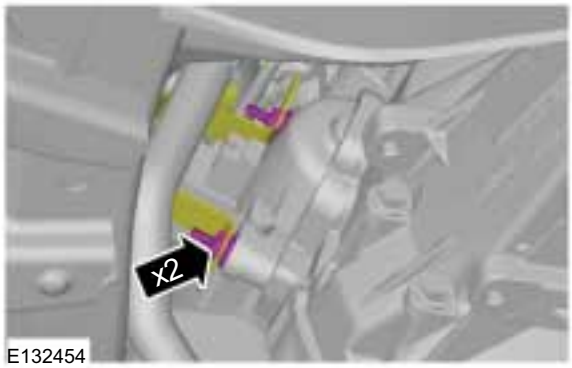
E129203

INSTALLATION

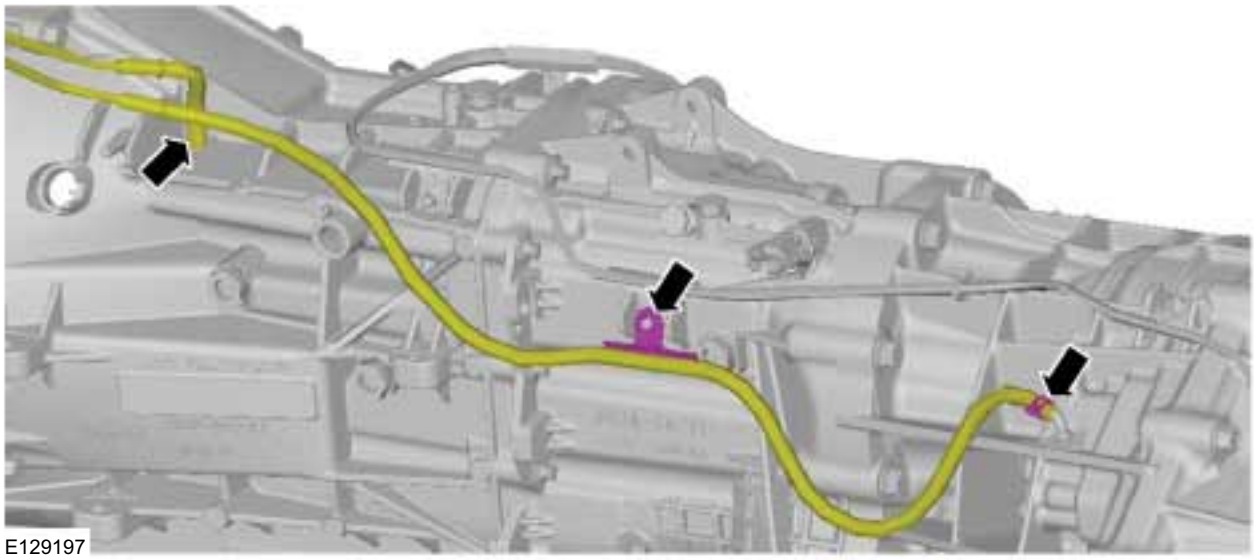
18. Torque: 35 Nm



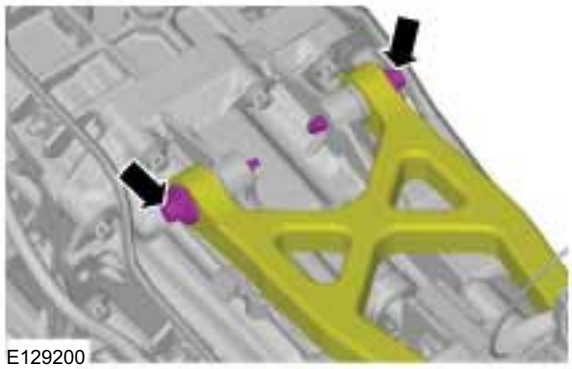
19. Torque: 35 Nm



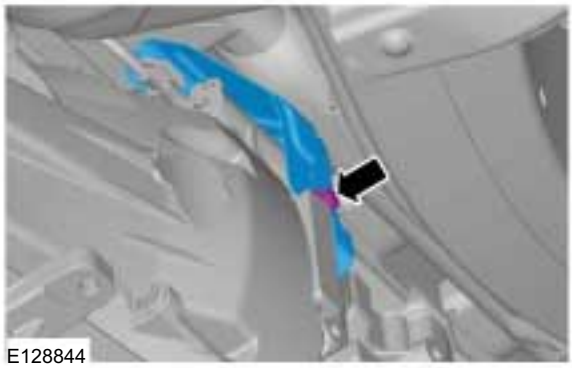
20.



21. Torque: 25 Nm

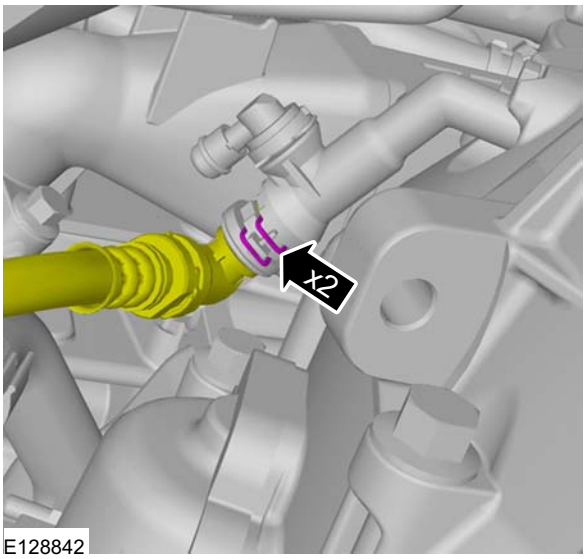


22. Torque: 25 Nm



INSTALLATION

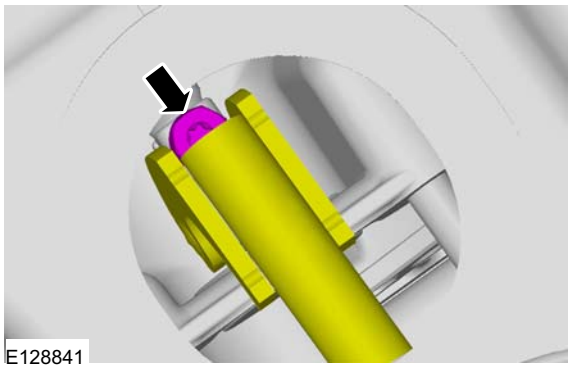
23. **NOTE:** If the clutch fluid comes into contact with the painted area, rinse off the affected areas with cold water without delay.



24. Refer to: Front Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).
Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).

25. Refer to: Catalytic Converter (309-00 Exhaust System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

26. Torque: 40 Nm



27. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

28. Refer to: Clutch System Bleeding - Vehicles With: MT82 (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).

29. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

SECTION 308-06A Manual Transmission/Transaxle External Controls — Vehicles With: MT-75

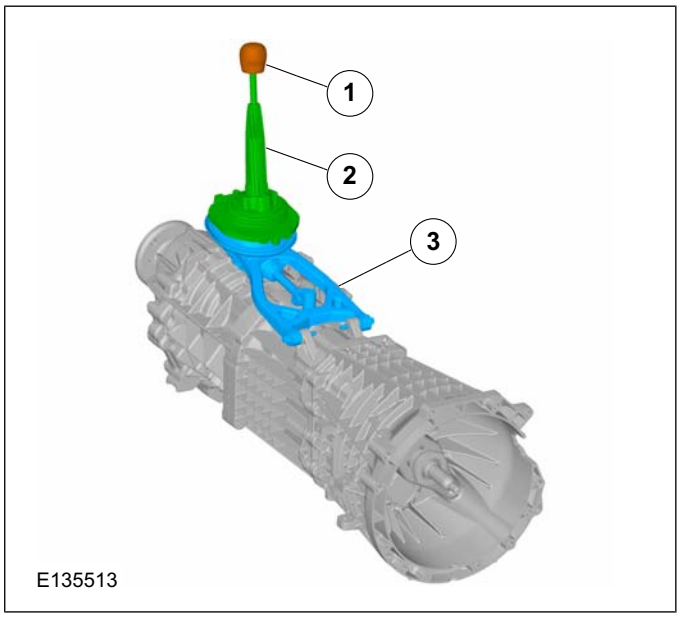
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

External Controls

External Controls



Item	Description
1	Gearshift lever knob
2	Gearshift lever
3	Selector mechanism

REMOVAL AND INSTALLATION

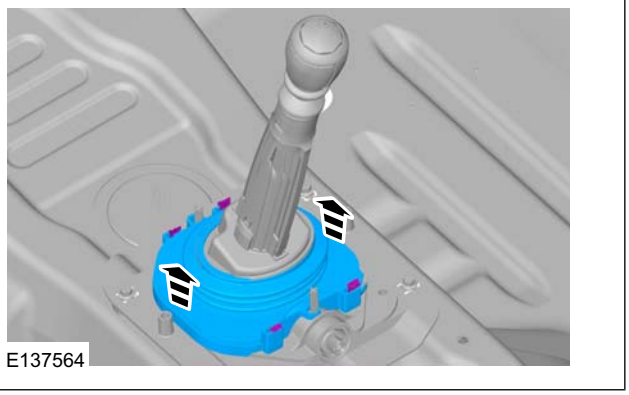
Gearshift Lever

Removal

All vehicles

1. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
   Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

2.



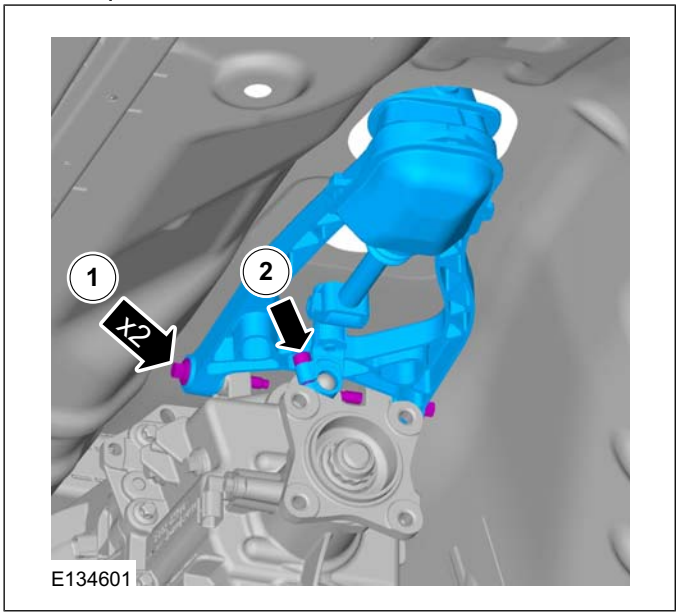
3. Torque: 28 Nm

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

4x2

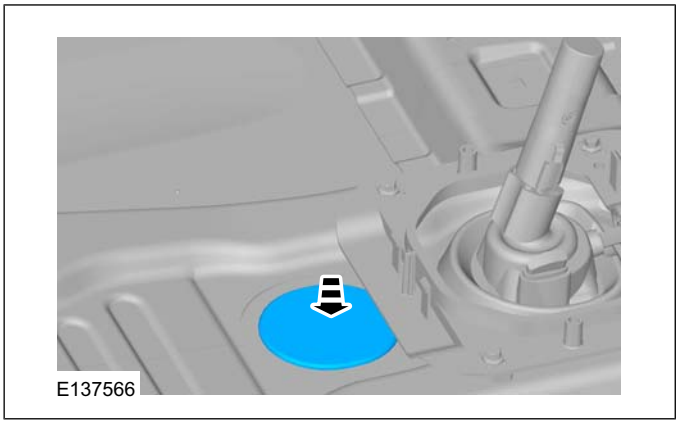
5. Refer to: Driveshaft - 2WD (205-01 Driveshaft, Removal and Installation).

6. Torque: 26 Nm



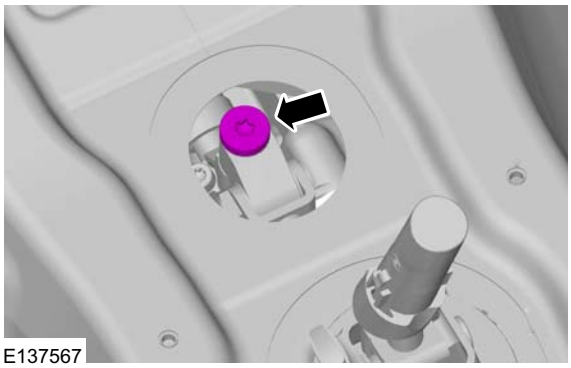
4x4

7.



REMOVAL AND INSTALLATION

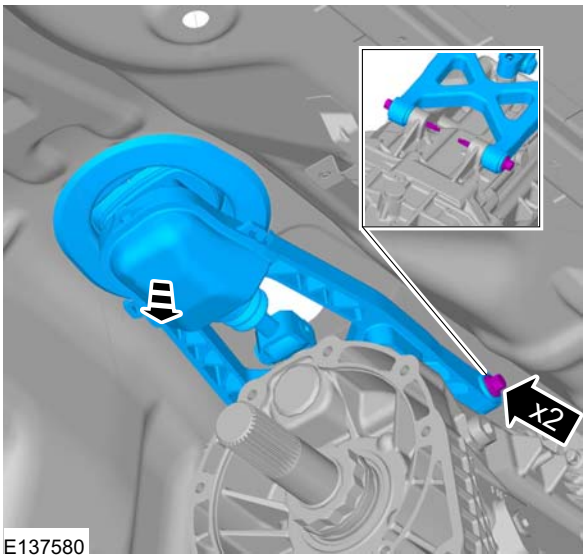
8. Torque: 31 Nm



9. Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).

10. Refer to: Transfer Case (308-07 Transfer Case - Vehicles With: 5-Speed Manual Transmission - MT75/6-Speed Manual Transmission - MT82, Removal).

11. Torque: 26 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 308-06B Manual Transmission/Transaxle External Controls — Vehicles With: MT82

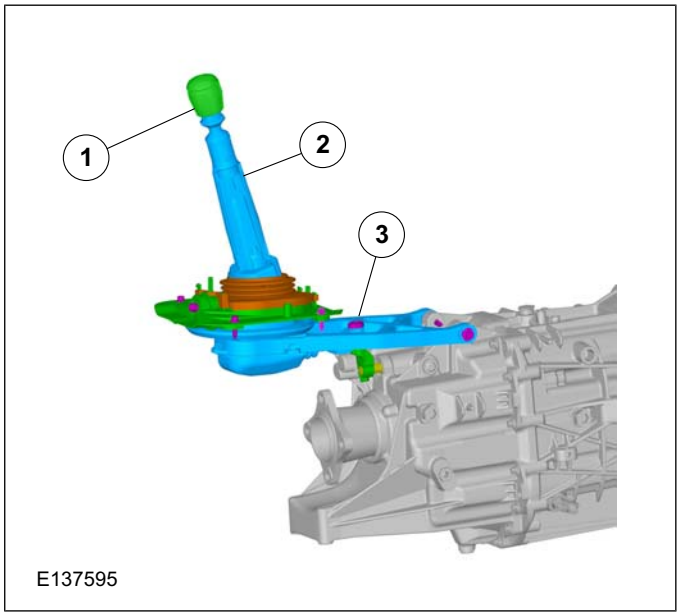
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

External Controls

External Controls



E137595

Item	Description
1	Gearshift lever knob
2	Gearshift lever
3	Selector mechanism

REMOVAL AND INSTALLATION

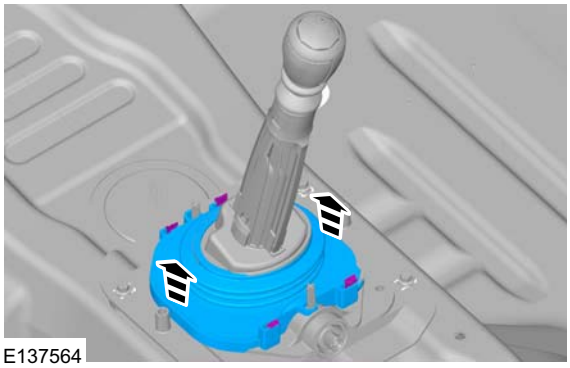
Gearshift Lever

Removal

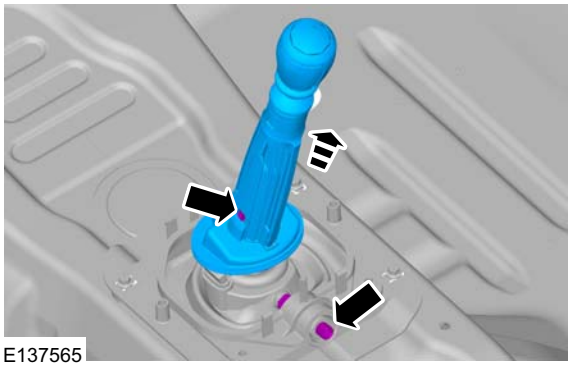
All vehicles

1. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
   Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

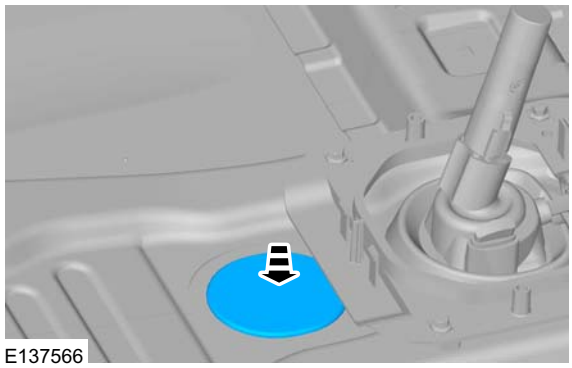
2.


E137564

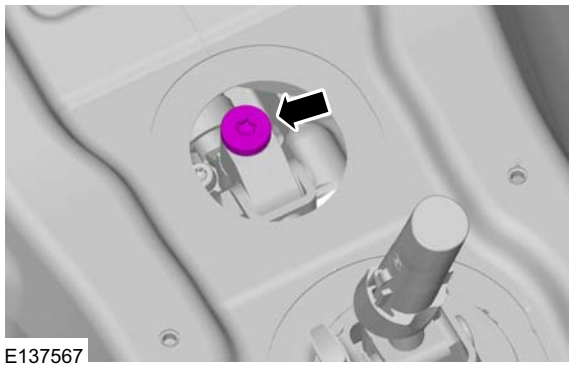
3. Torque: 28 Nm


E137565

4.


E137566

5. Torque: 31 Nm


E137567

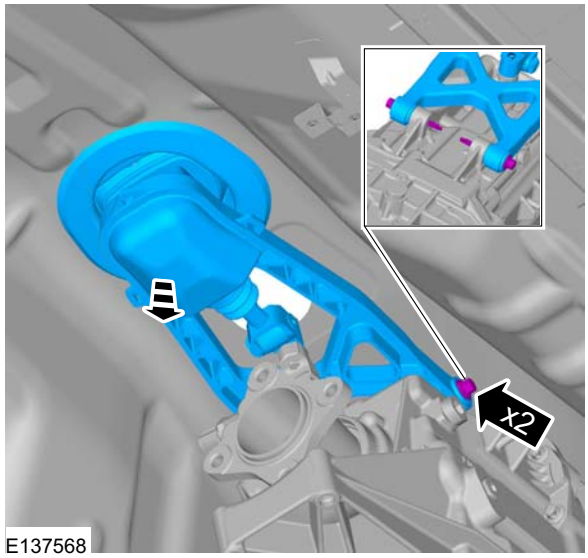
REMOVAL AND INSTALLATION

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

4x2

7. Refer to: Driveshaft - 2WD (205-01 Driveshaft, Removal and Installation).

8. Torque: 26 Nm

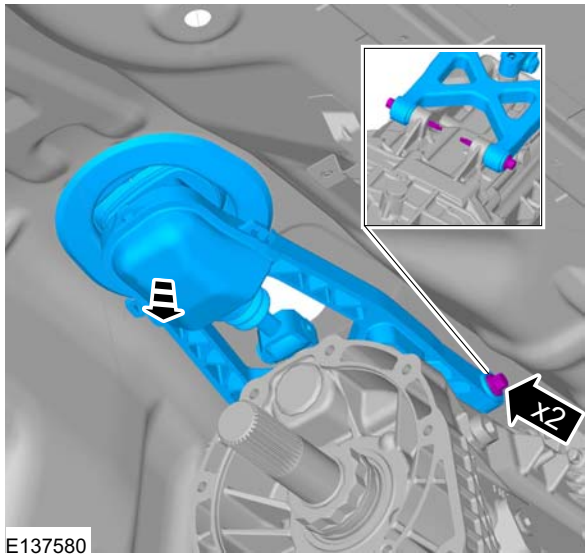


4x4

9. Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).

10. Refer to: Transfer Case (308-07 Transfer Case - Vehicles With: 5-Speed Manual Transmission - MT75/6-Speed Manual Transmission - MT82, Removal).

11. Torque: 26 Nm



Installation

1. To install, reverse the removal procedure.

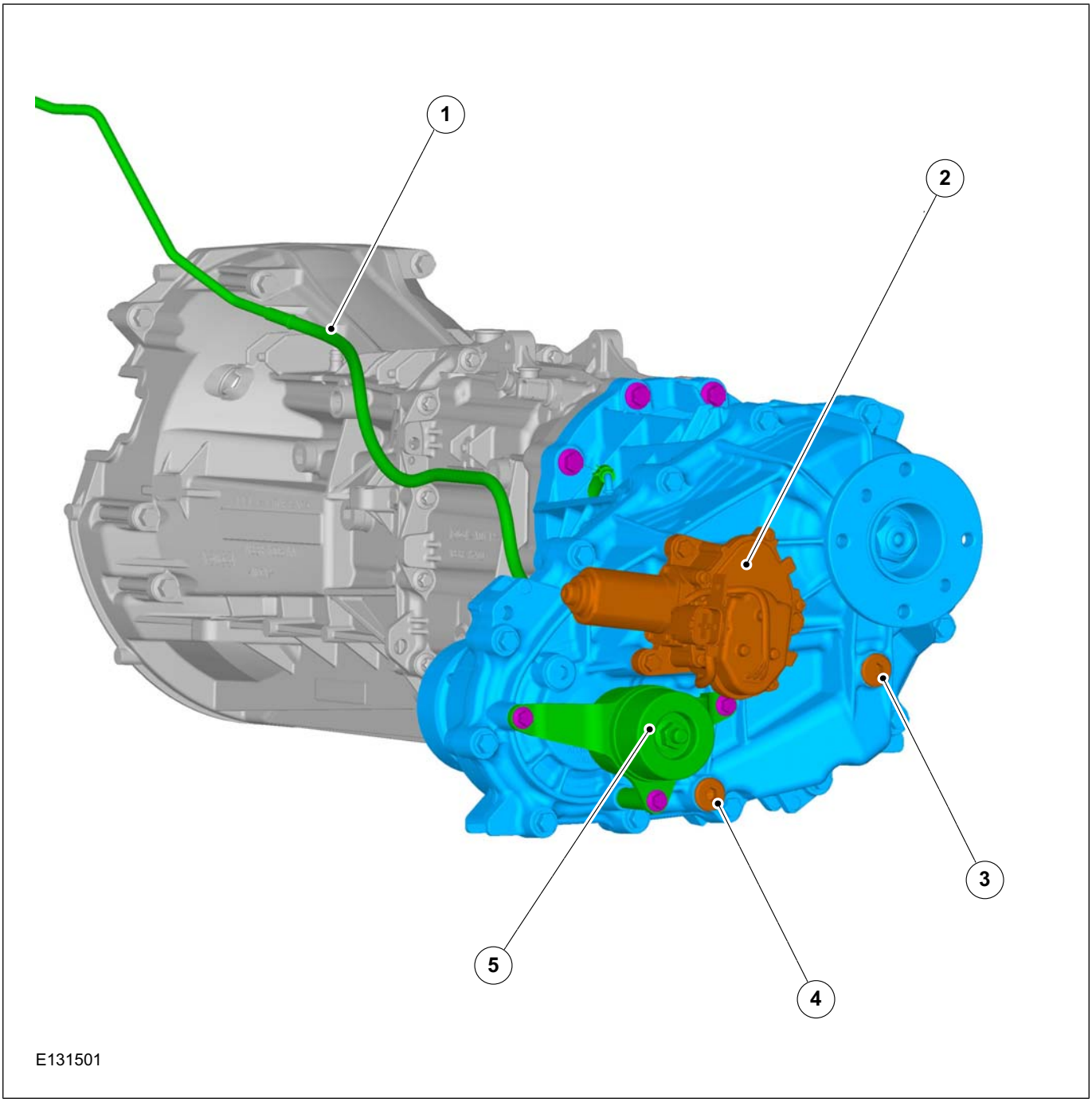
SECTION 308-07A Transfer Case — Vehicles With: 5-Speed Manual Transmission - MT75/6-Speed Manual Transmission - MT82

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Transfer Case

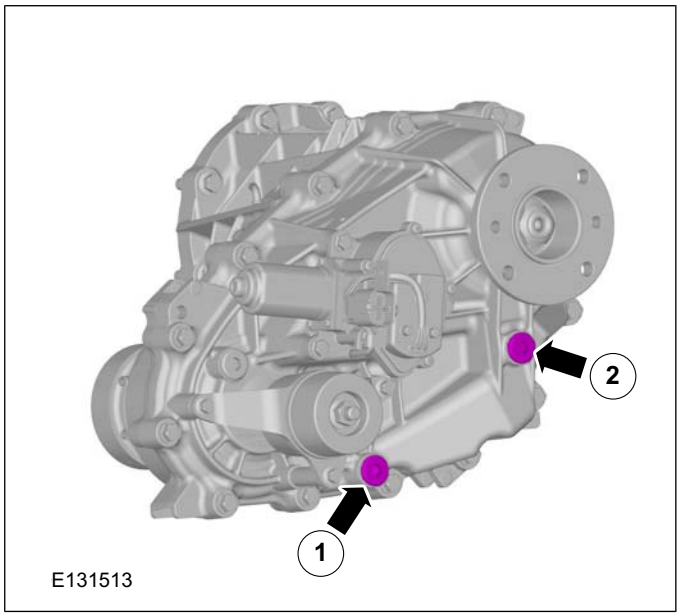


Item	Description
1	Breather tube
2	Motor
3	Oil filler plug
4	Drain plug
5	Damper

GENERAL PROCEDURES

Transfer Case Draining and Filling

1.



2. Remove the drain plug and the seal.

- Drain the oil into a suitable container.
- Tighten the drain plug with a new seal.
- Tightening torque 19-30 Nm.

3. Remove the filler plug and seal and add the specified amount and type of oil through the filler plug hole until the level reaches the bottom of the filler plug hole.

- Transfer oil type: Mercon® Multi-purpose AFT XT-2-QDXCapacity (approximate quantity): 1.85 L {1.95 US qt, 1.63 lmp qt}.
- Tighten the filler plug with a new seal.
- Tightening torque 19-30 Nm.

REMOVAL

Transfer Case

Removal

General Equipment

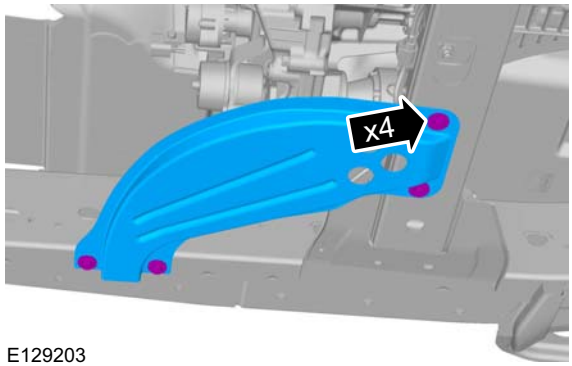
Transmission Jack

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

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

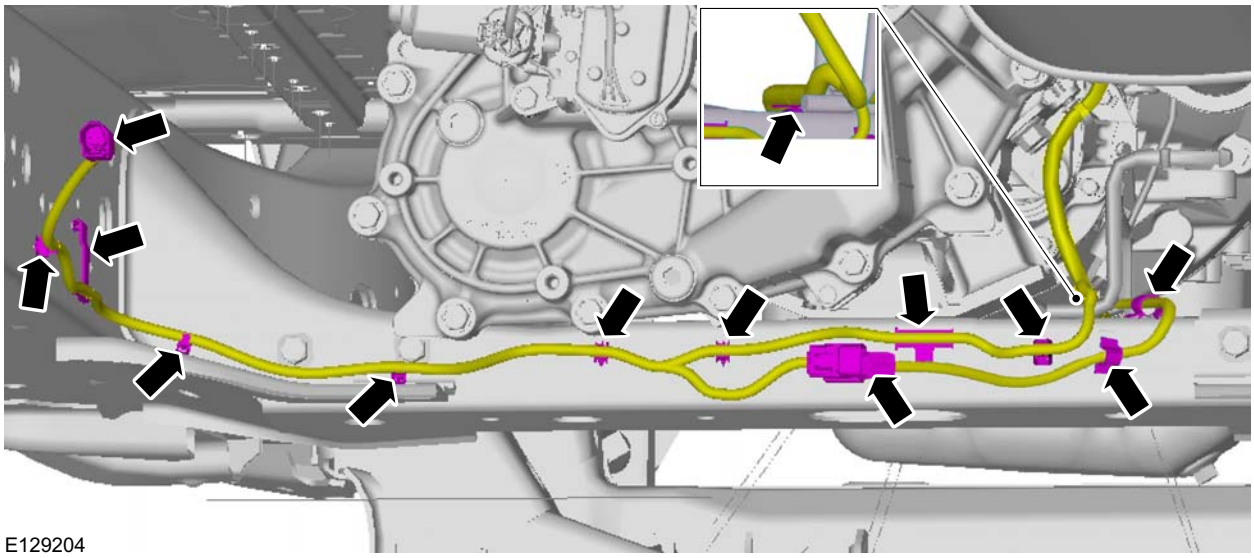
3. Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).
   Refer to: Front Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).

4.



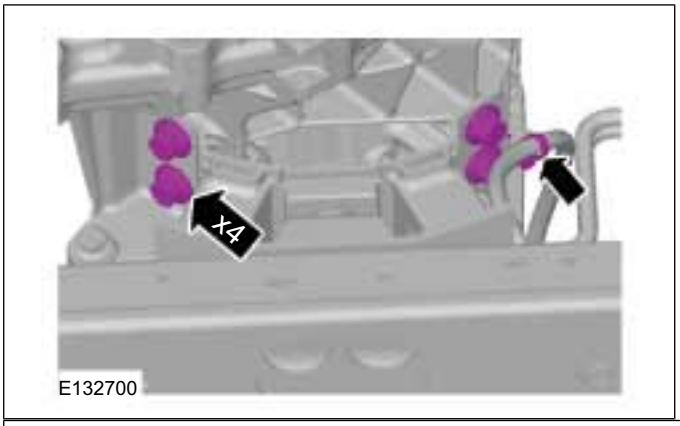
E129203

5.


E129204

REMOVAL

6.



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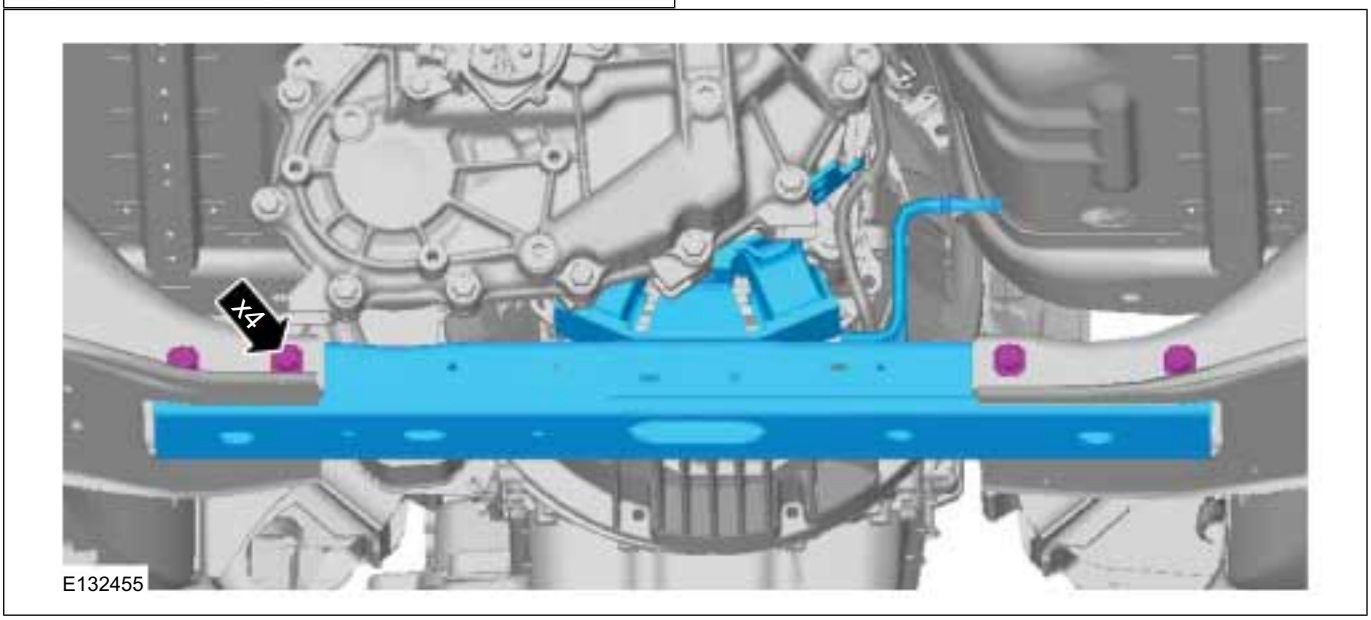
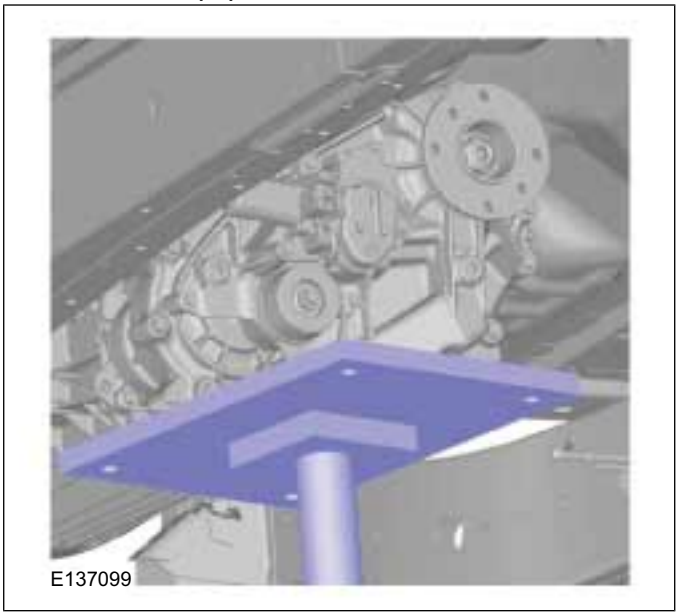


8. General Equipment: Transmission Jack



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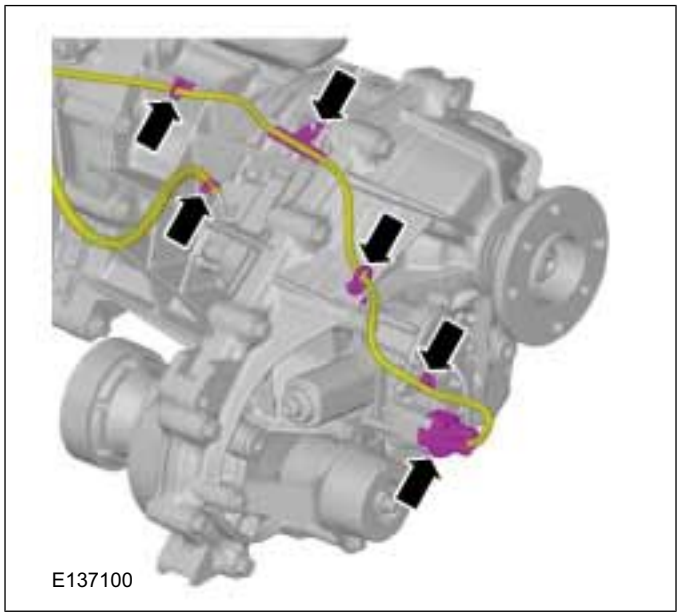
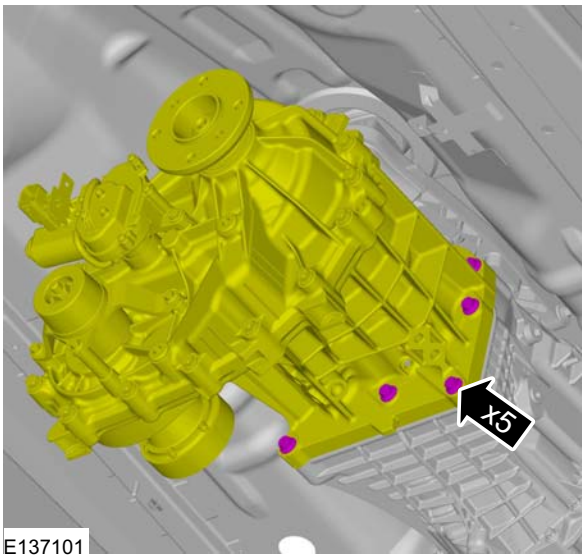


REMOVAL

10.



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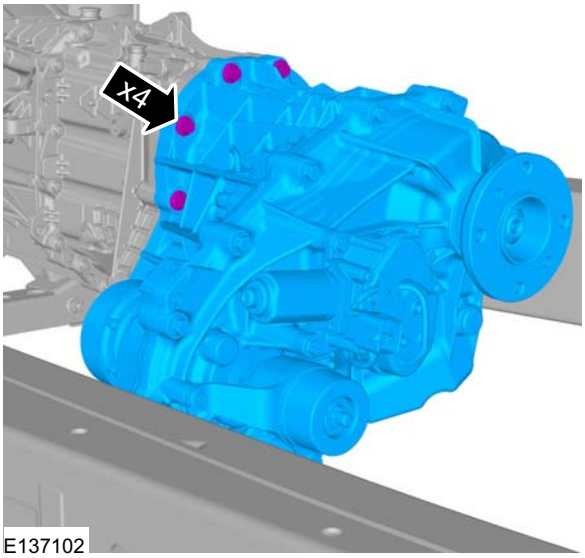


DISASSEMBLY AND ASSEMBLY

Transfer Case

4. Information not available at this time.

INSTALLATION

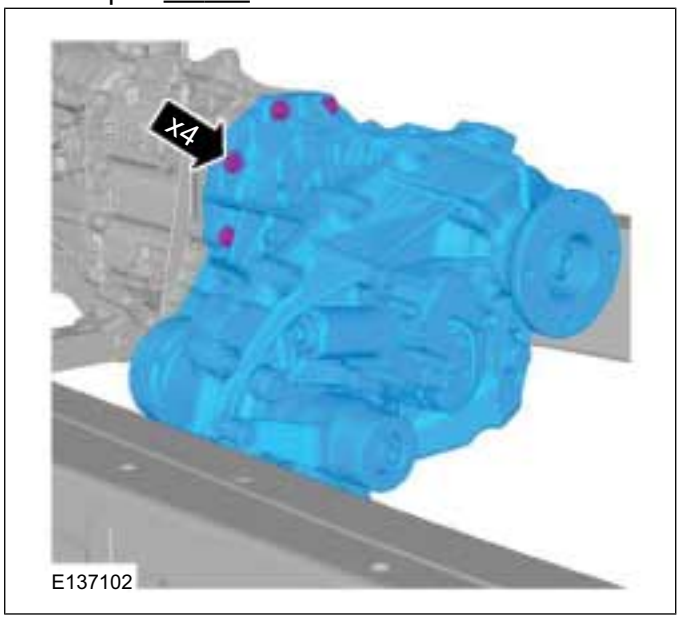
Transfer Case

Installation

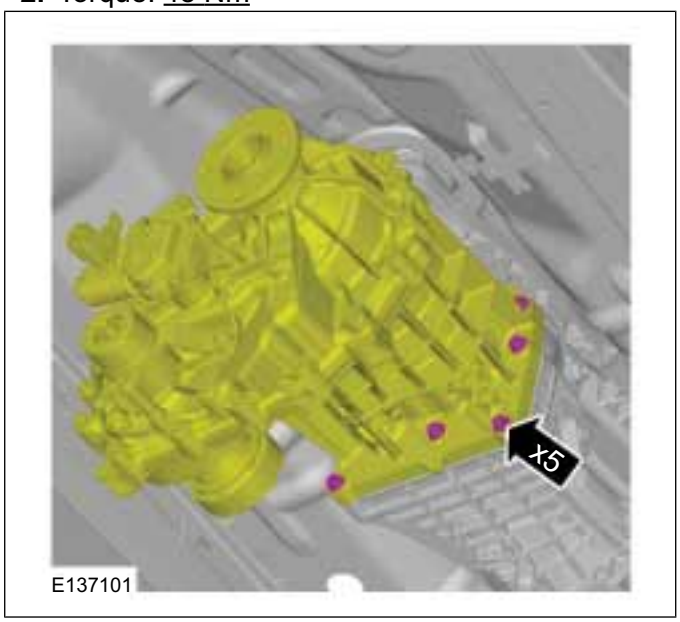
General Equipment

Transmission Jack

1. Torque: 48 Nm



2. Torque: 48 Nm



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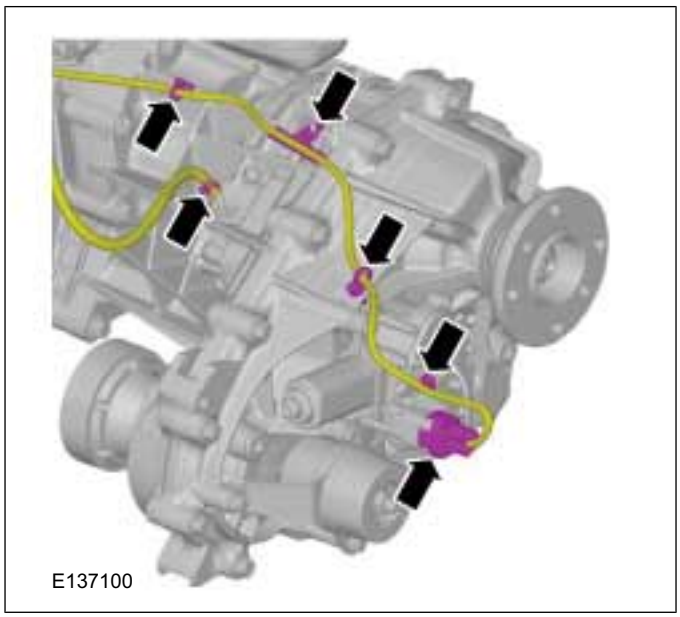
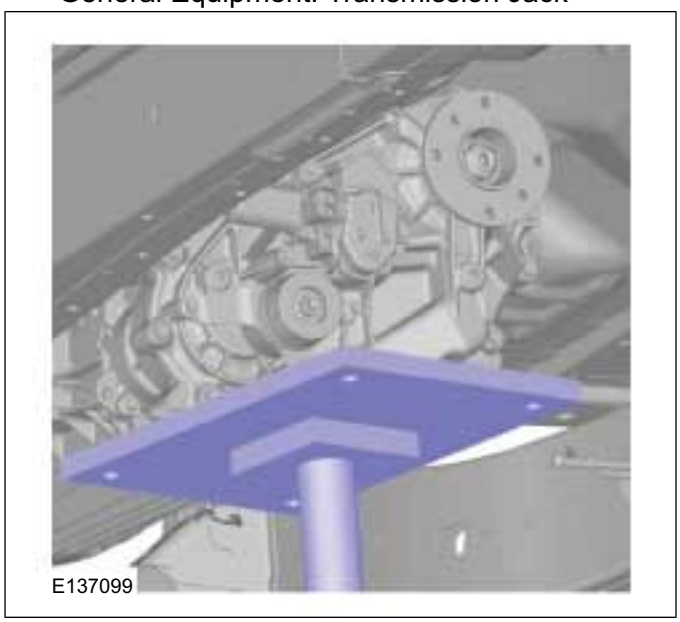


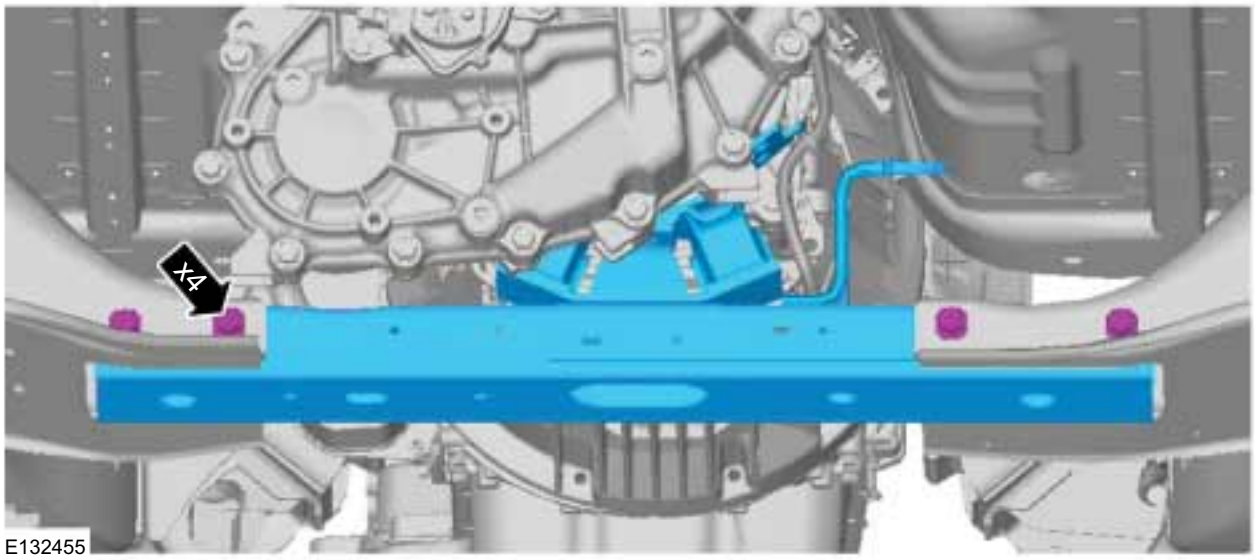
4. Lower the transmission jack.

General Equipment: Transmission Jack



5. Torque: 90 Nm

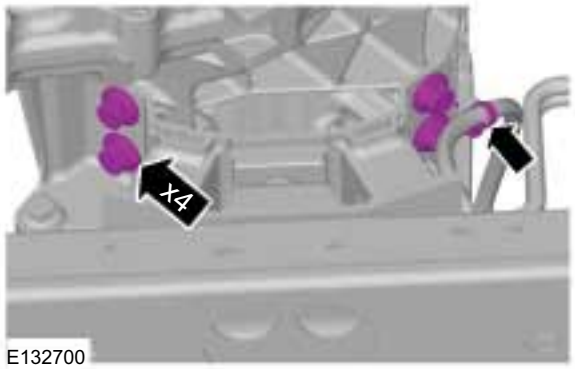
INSTALLATION



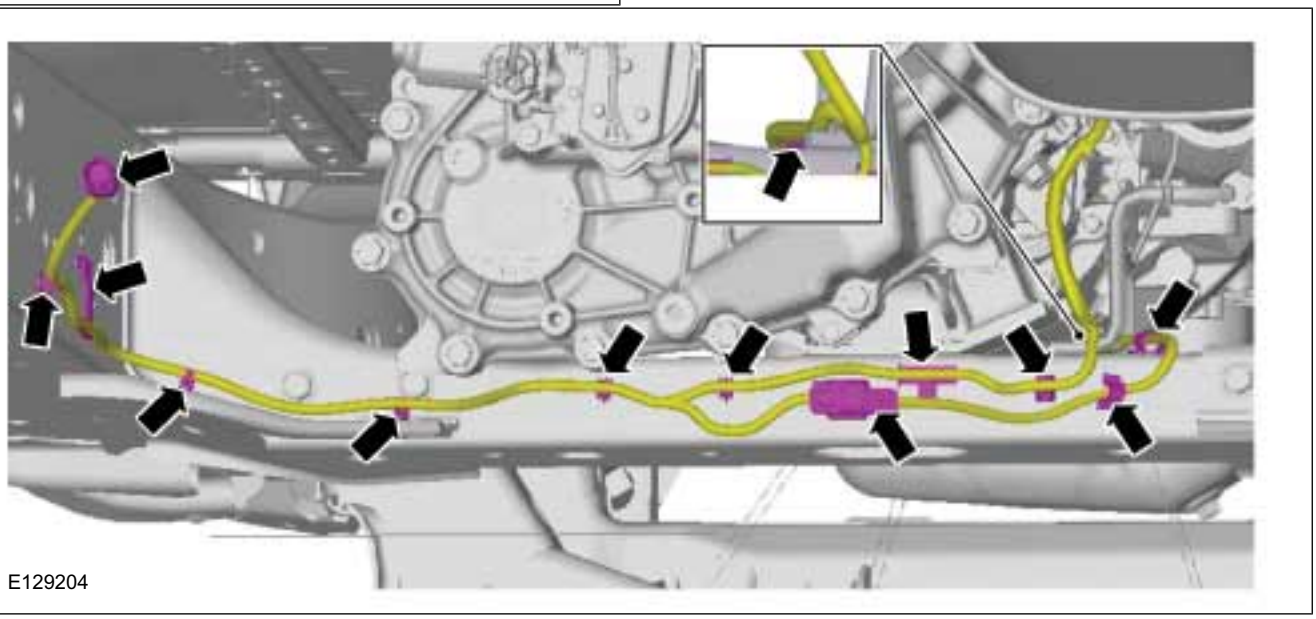
E132455

6. Torque: 90 Nm

7.

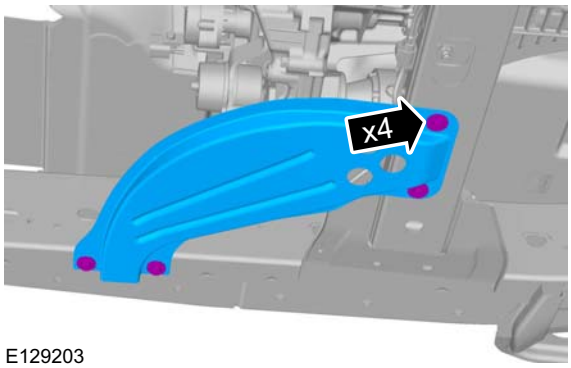


E132700


E129204

INSTALLATION

8. Torque: 48 Nm



E129203

9. Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).
   Refer to: Front Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).

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

11. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

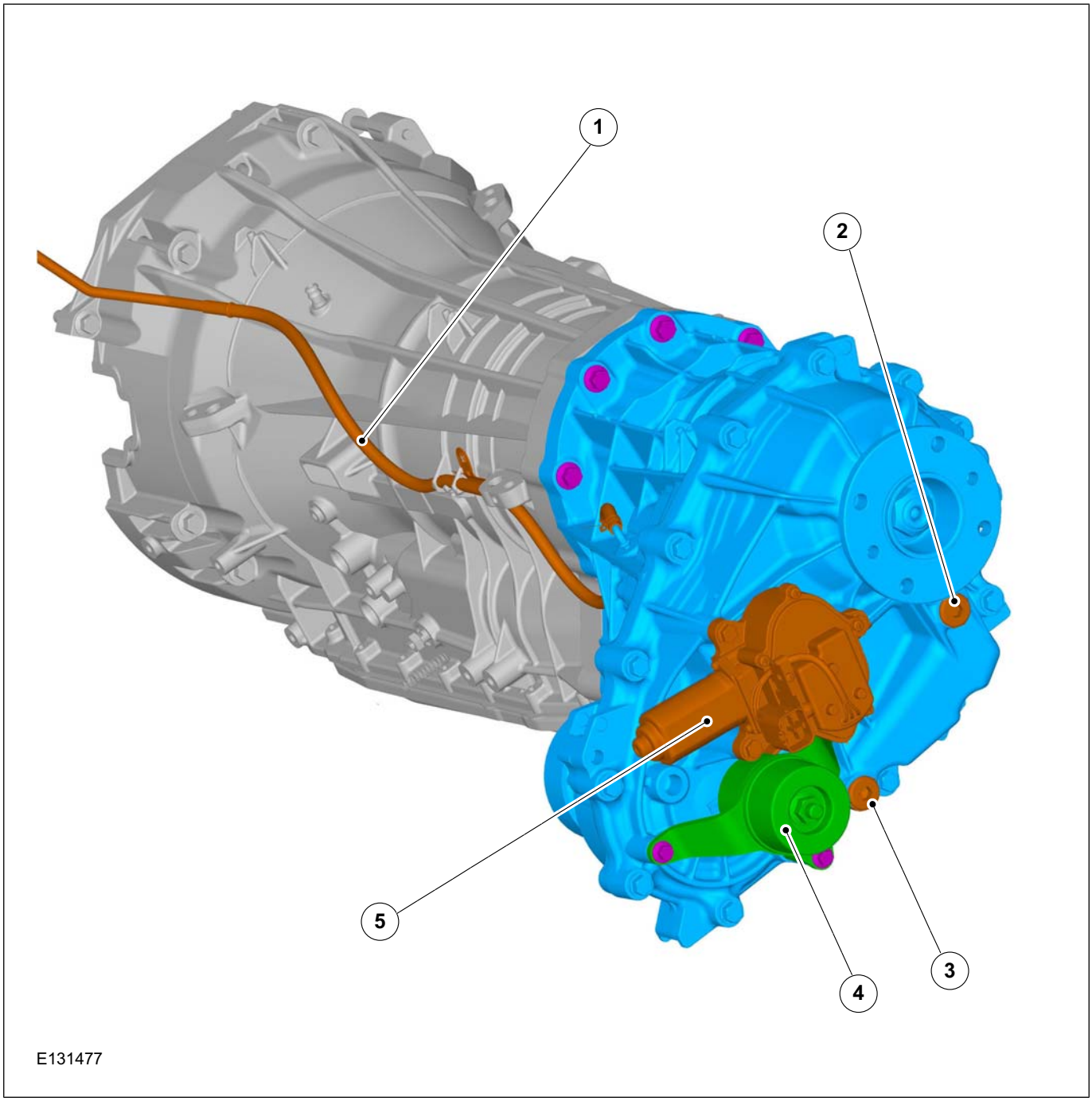
SECTION 308-07B Transfer Case — Vehicles With: 6-Speed Automatic Transaxle - 6R80

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Transfer Case



Item	Description
1	Breather tube
2	Oil filler plug
3	Drain plug
4	Damper
5	Motor

GENERAL PROCEDURES

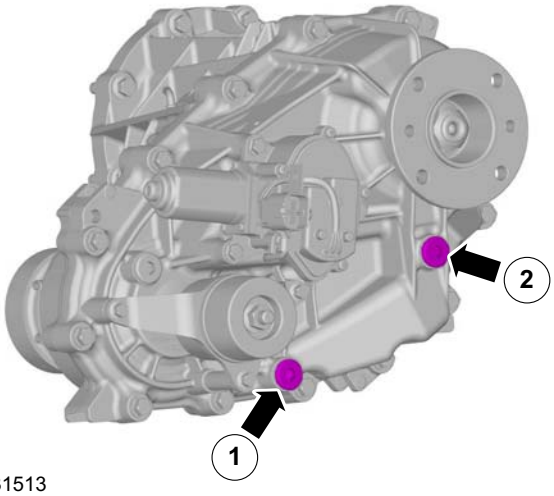
Transfer Case Draining and Filling

Materials	
Name	**Specification**
Transmission Fluid	MERCON® V

1. **CAUTION: Do not use an impact wrench when removing the filler plug or drain plug. It may damage the transfer case.**

   Remove the drain plug and the seal.

   - Drain the oil into a suitable container.
   - Tighten the drain plug with a new seal.
   - Tightening torque 19-30 Nm.



2. **CAUTION: Incorrect fluid fill can result in transfer case failure.**

   Remove the filler plug and seal and add the specified amount and type of oil through the filler plug hole until the level reaches the bottom of the filler plug hole.

   - Transfer oil type: Mercon® Multi-purpose AFT XT-2-QDXCapacity (approximate quantity): 1.2 L {1.3 US qt, 1.1 Imp qt}.
   - Tighten the filler plug with a new seal.
   - Tightening torque 19-30 Nm.

REMOVAL

Transfer Case

Removal

General Equipment

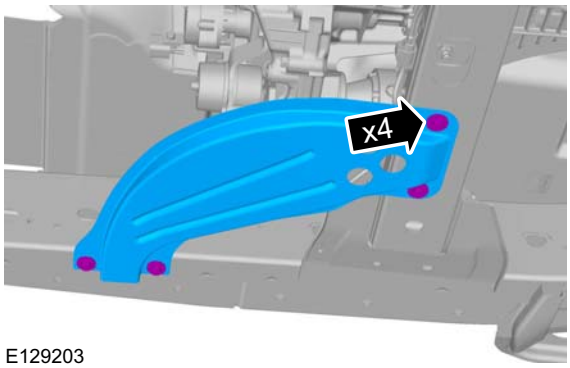
Transmission Jack

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

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

3. Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).
   Refer to: Front Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).

4.



E129203

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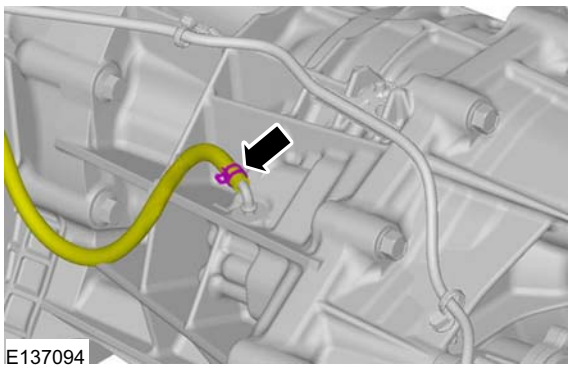
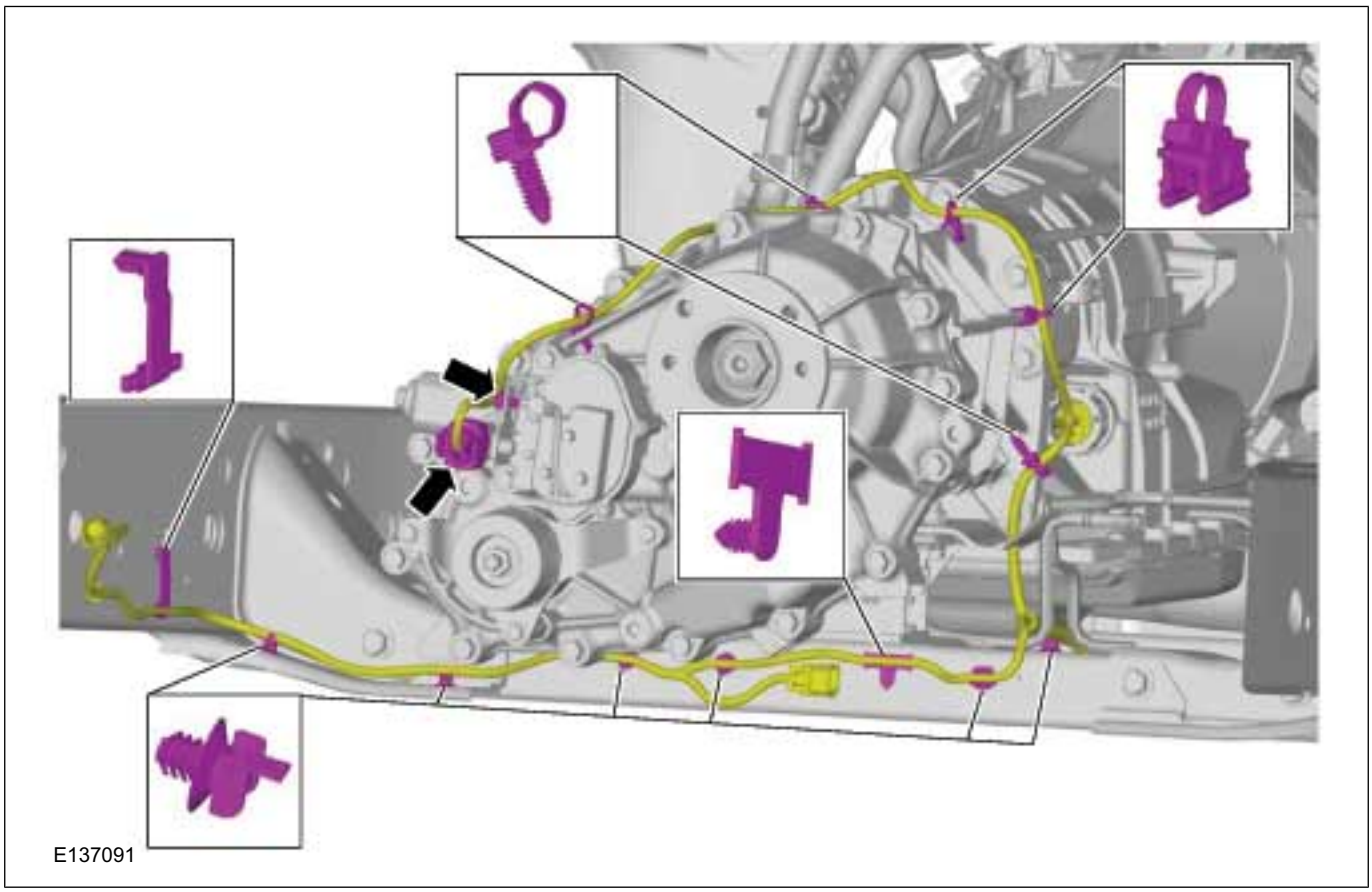

E137094

6.

REMOVAL



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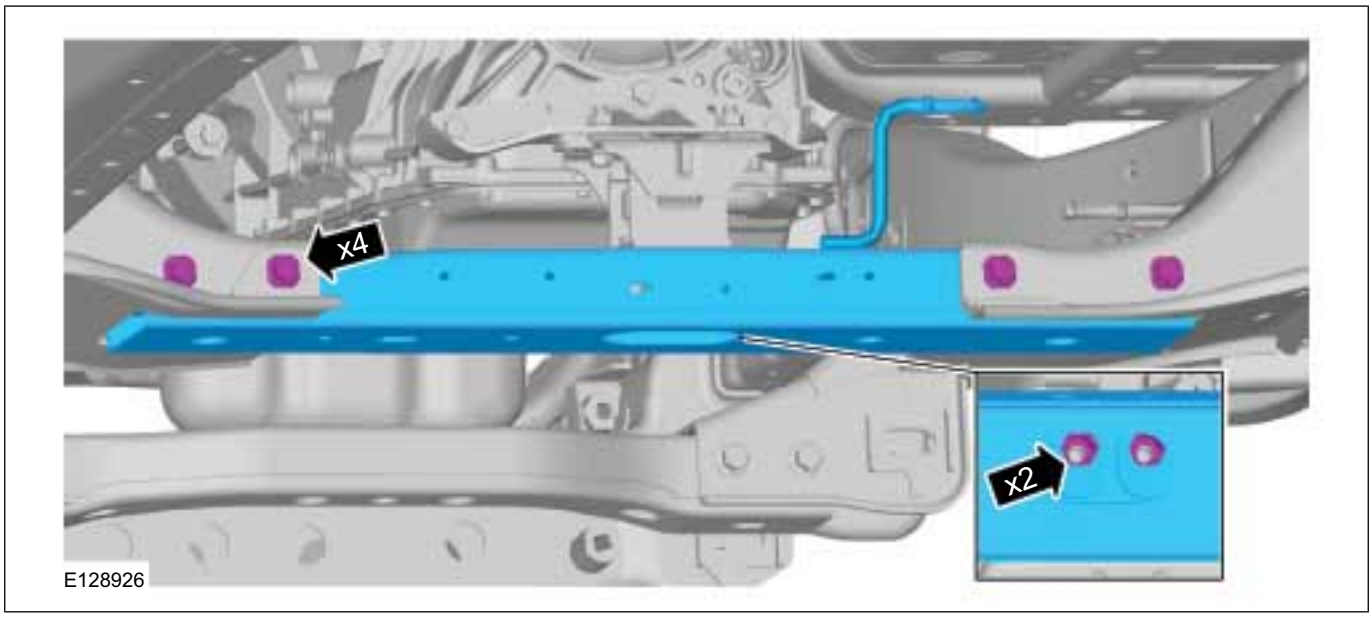
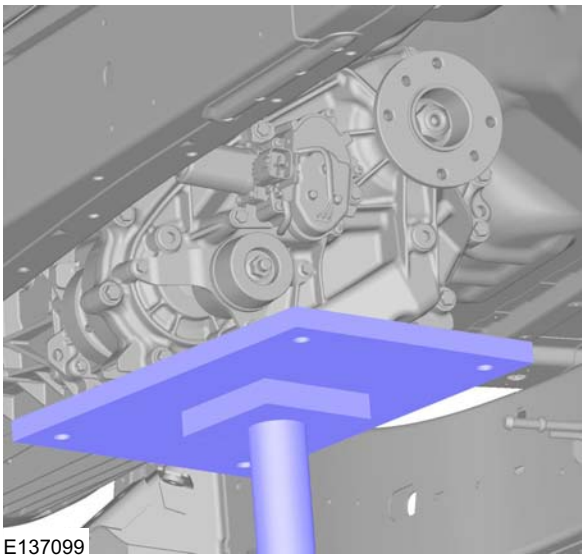


REMOVAL

8. General Equipment: Transmission Jack


E137099

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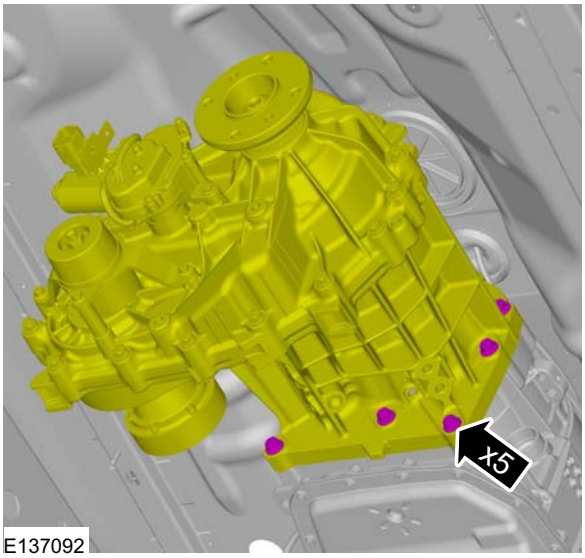

E137092

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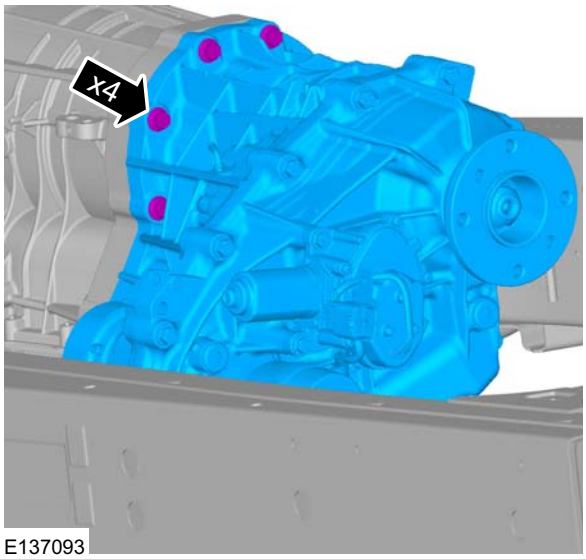


E137093

INSTALLATION

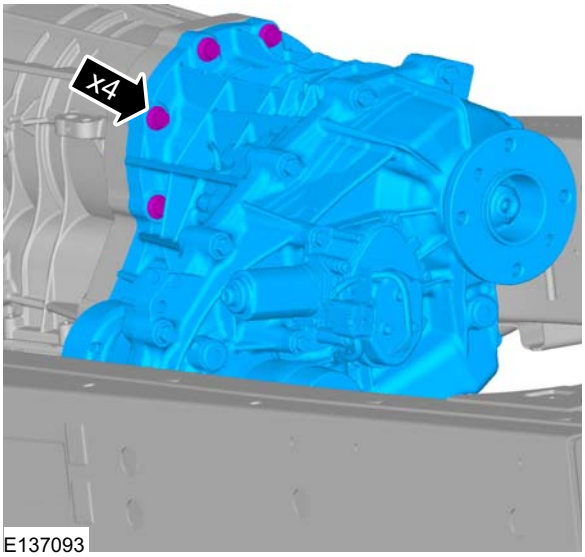
Transfer Case

Installation

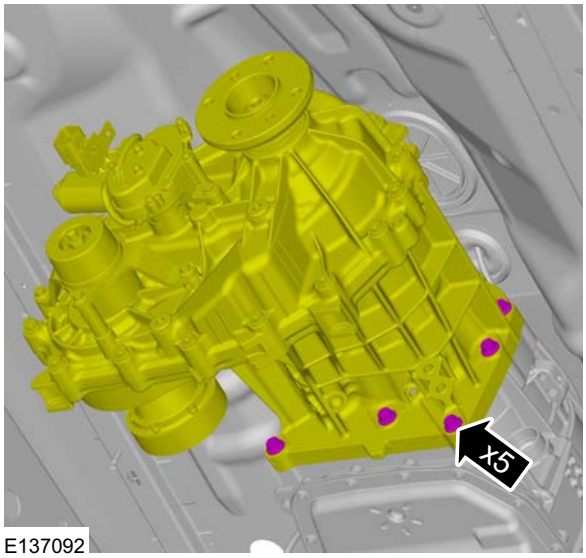
General Equipment

Transmission Jack

1. Torque: 48 Nm

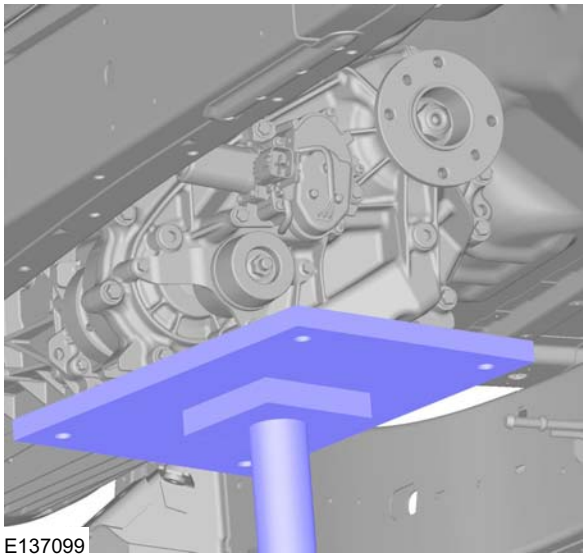


2. Torque: 48 Nm



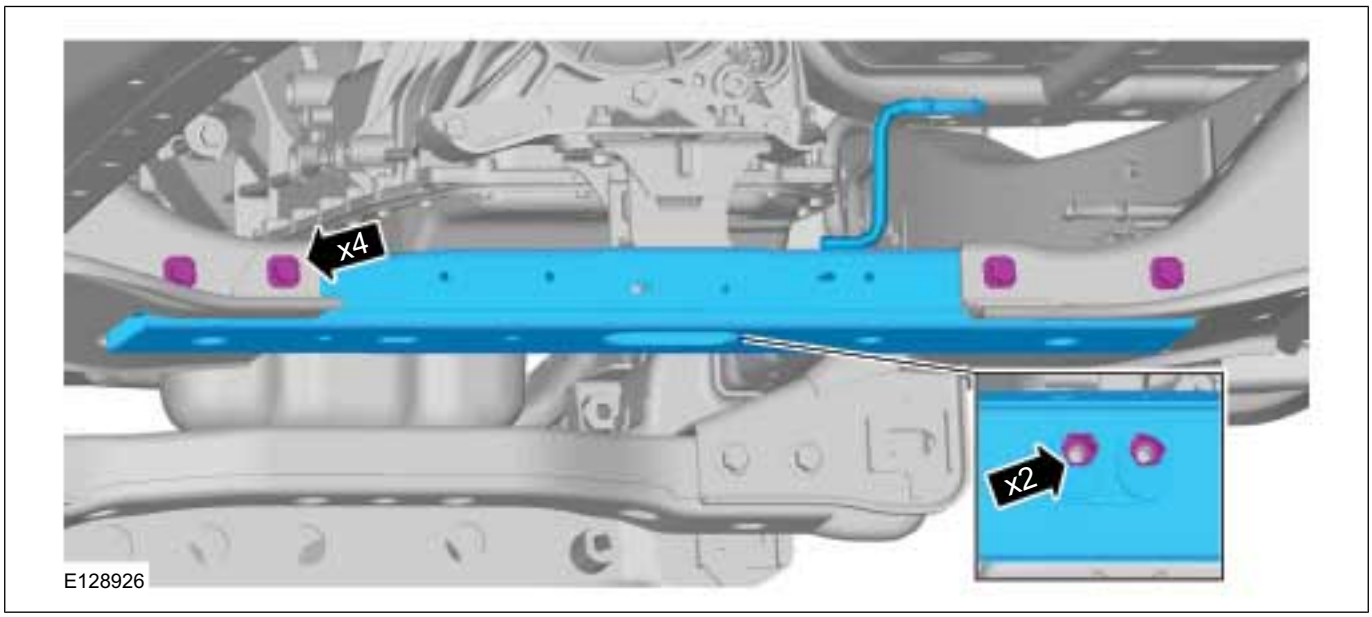
3. Lower the transmission jack.

General Equipment: Transmission Jack



4. Torque: 90 Nm

INSTALLATION



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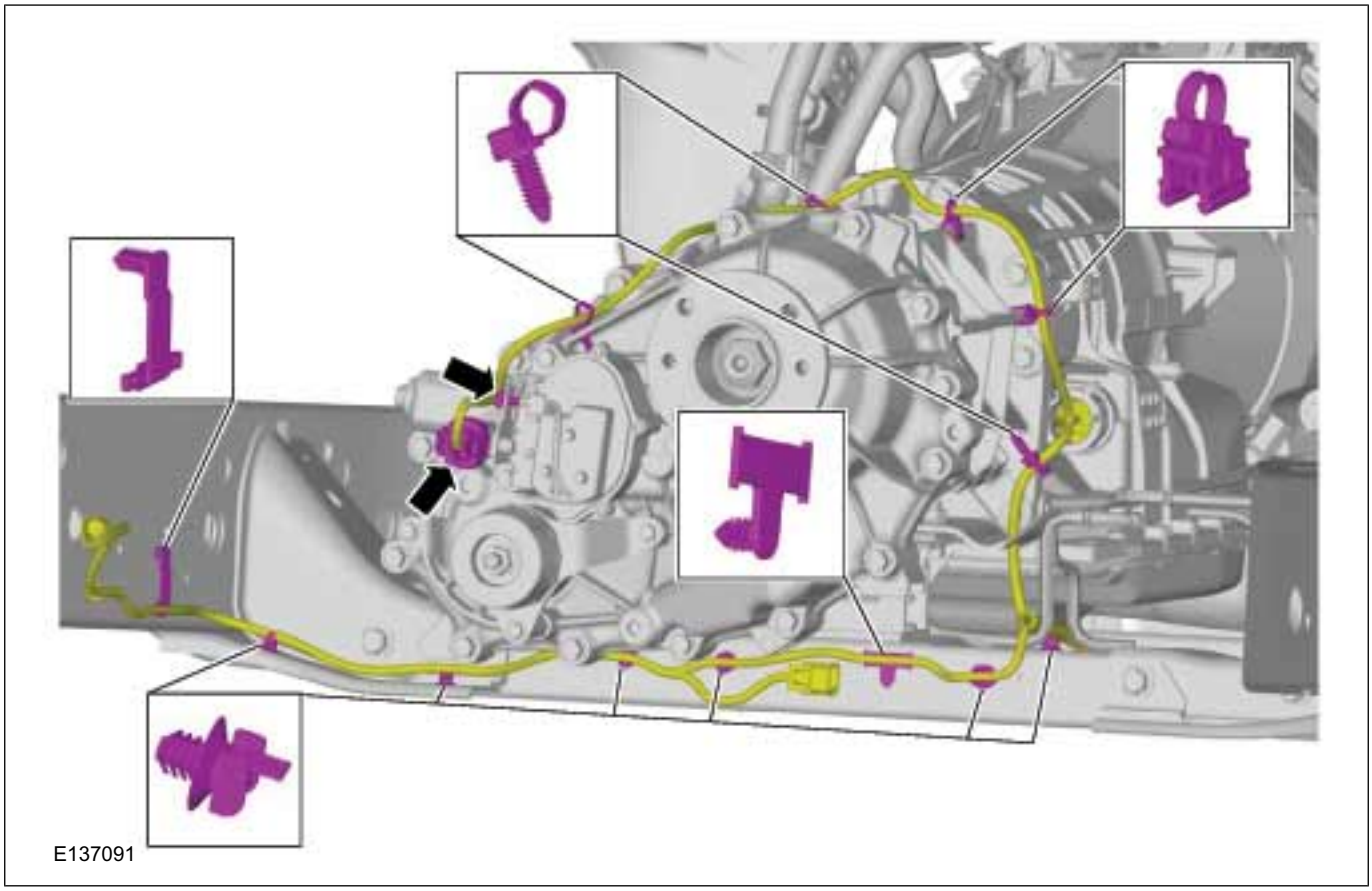
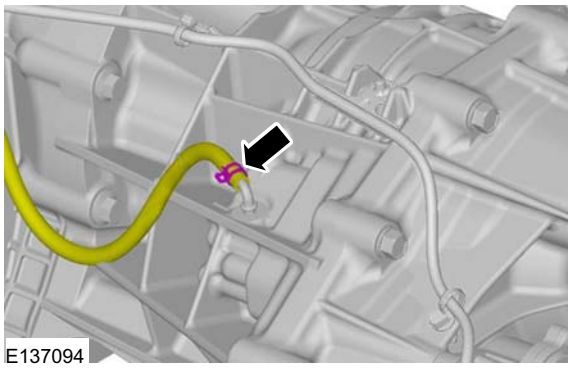
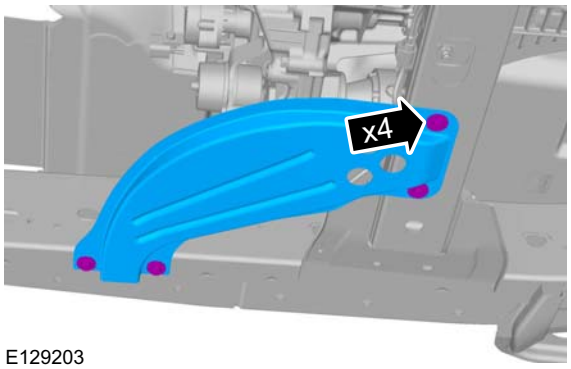


INSTALLATION

6.



7. Torque: 48 Nm



8. Refer to: Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).
Refer to: Front Driveshaft - 4WD (205-01 Driveshaft, Removal and Installation).

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

10. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

SECTION 309-00A Exhaust System — 2.5L Duratec-HE (122kW/165PS) - MI4

VEHICLE APPLICATION: 2011.50 Ranger

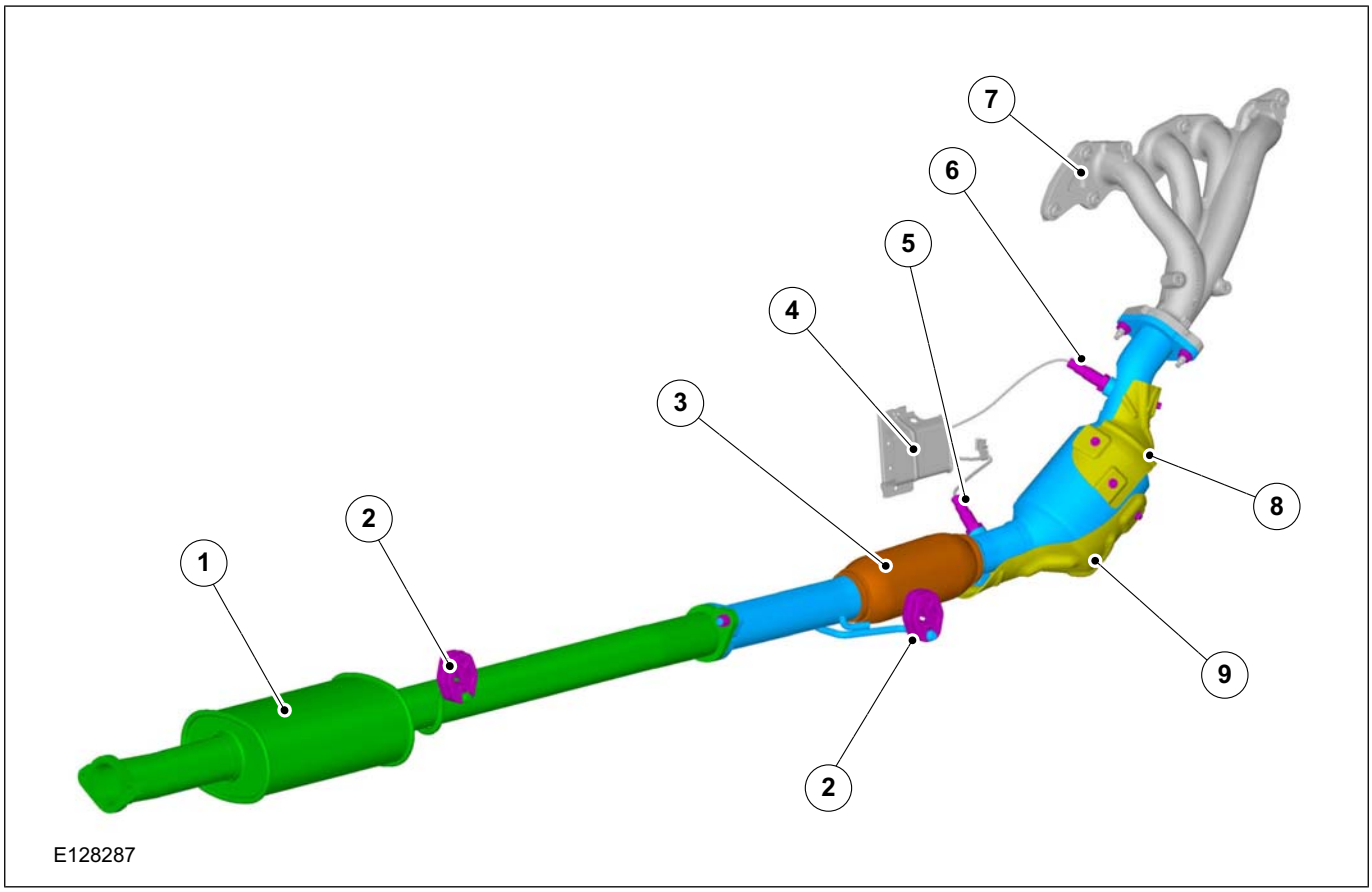
CONTENTS PAGE

DESCRIPTION AND OPERATION

Exhaust System

Exhaust flexible pipes are very fragile and must not be subjected to any load. They must be secured against twisting and bending during any work on the exhaust system.

2.5L E100

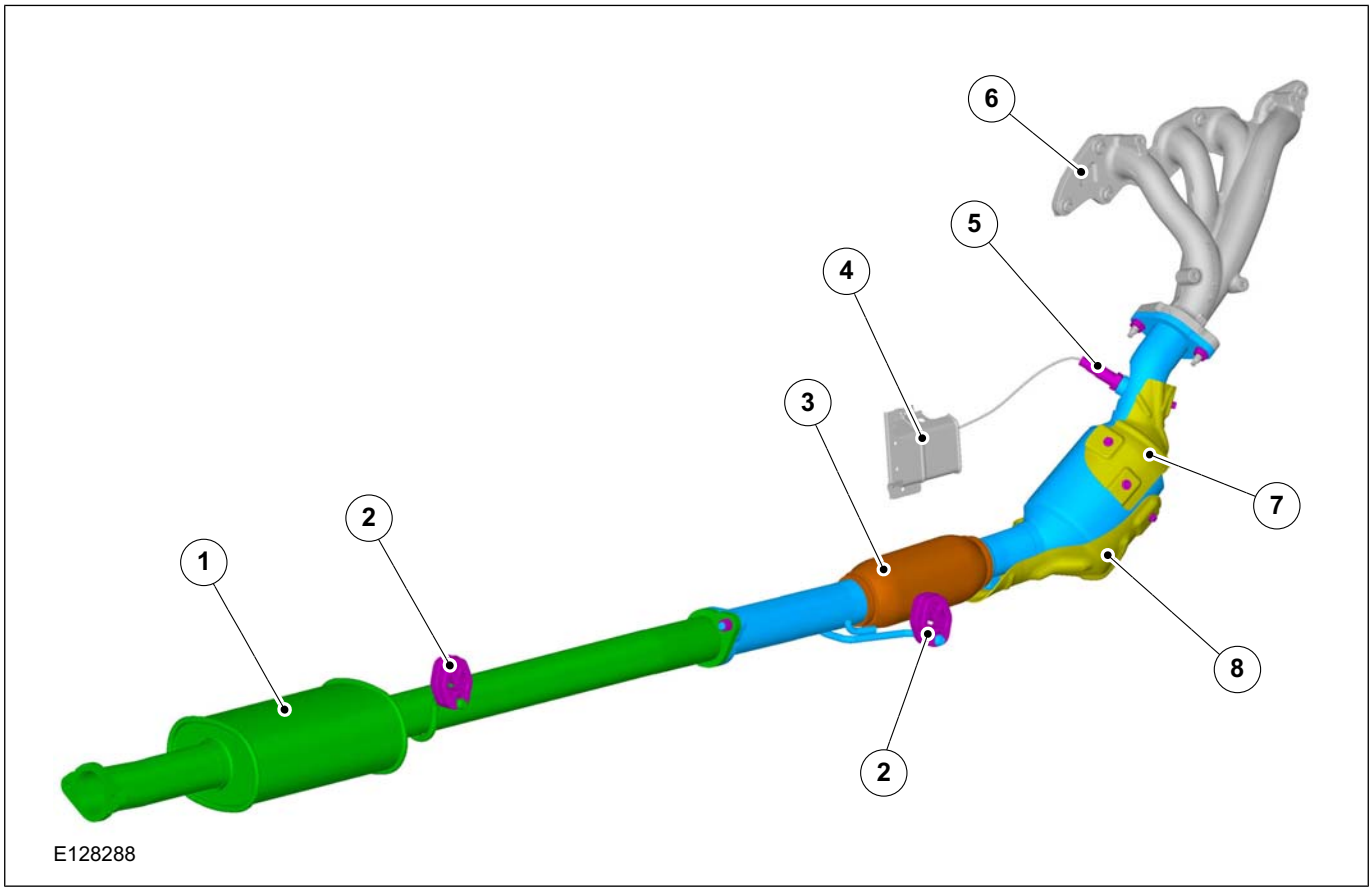


Item	Description
1	Intermidiate muffler
2	Exhaust hanger insulator
3	Exhaust flexible pipe
4	Heatsheild

Item	Description
5	Catalyst monitor sensor
6	Heated oxygen Sensor
7	Exhaust manifold
8	Heatsheild
9	Heatsheild

DESCRIPTION AND OPERATION

2.5L

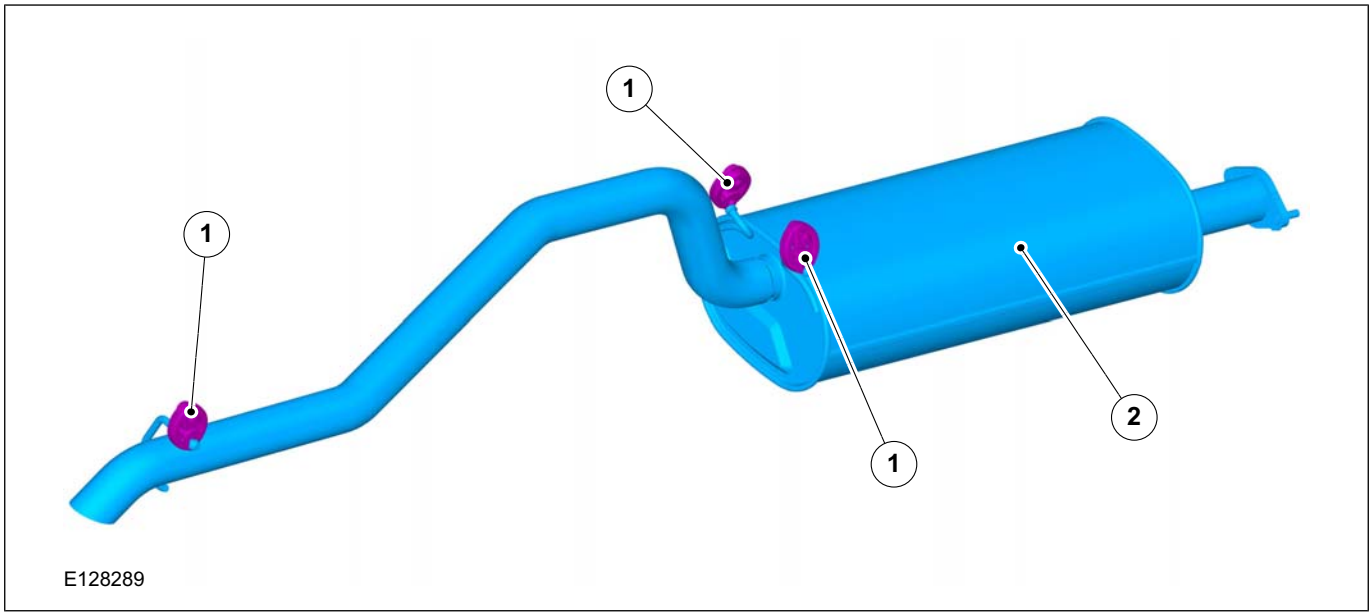


E128288

Item	Description
1	Intermidiate muffler
2	Exhaust hanger insulator
3	Exhaust flexible pipe
4	Heatsheild

Item	Description
5	Heated oxygen sensor
6	Exhaust manifold
7	Heatsheild
8	Heatsheild

All Vehicles



E128289

DESCRIPTION AND OPERATION

Item	Description
1	Exhaust hanger insulator
2	Rear muffler

REMOVAL AND INSTALLATION

Catalytic Converter

Removal

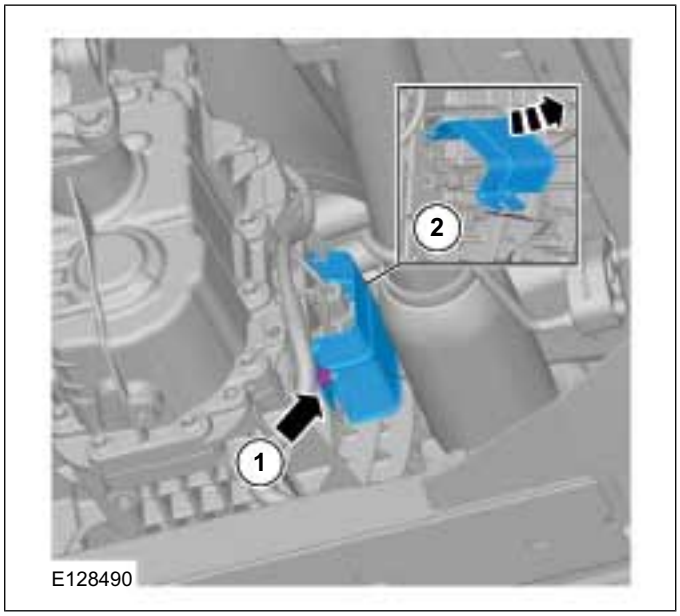
WARNING: When the engine and exhaust system are hot, they can cause severe burns or injury. Turn off the engine and wait until they are cool before removing the exhaust system.

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

All vehicles

3. 1. Torque: 28 Nm



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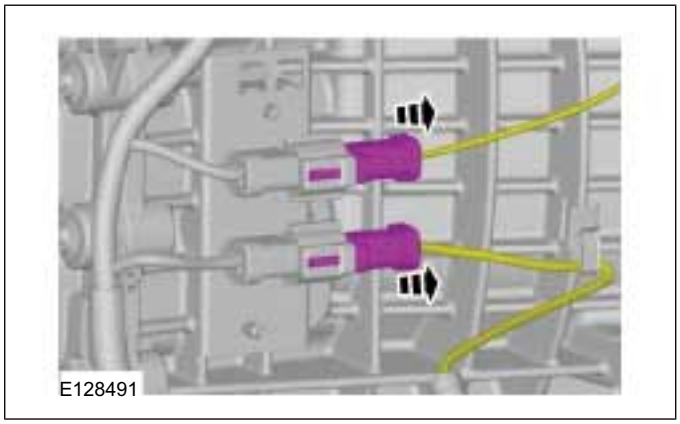
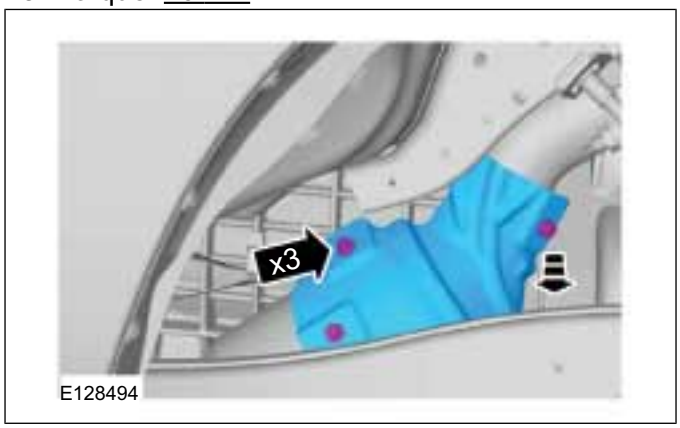
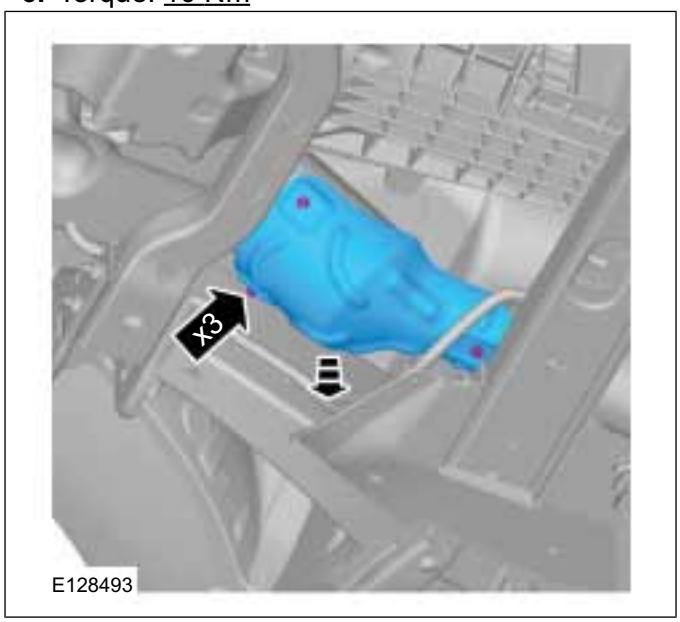


5. Torque: 10 Nm

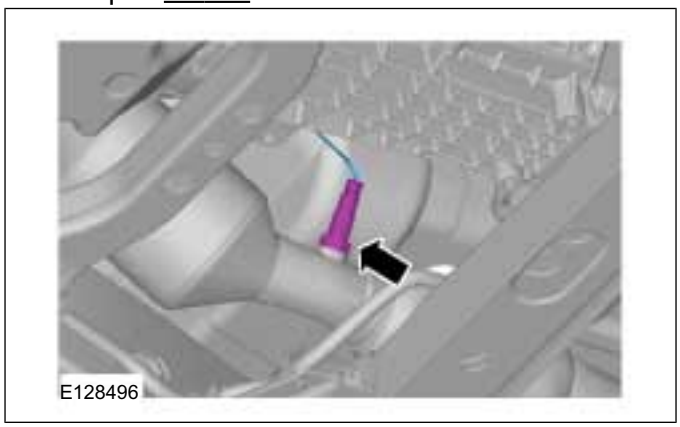


4x4

6. Torque: 10 Nm



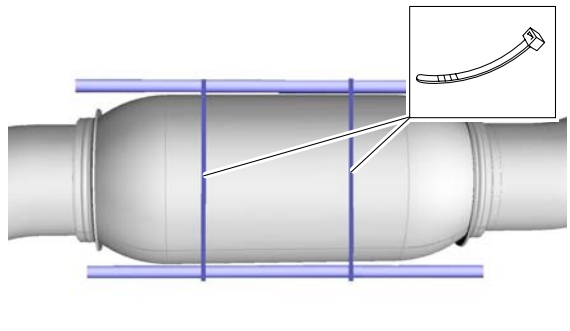
7. Torque: 48 Nm



REMOVAL AND INSTALLATION

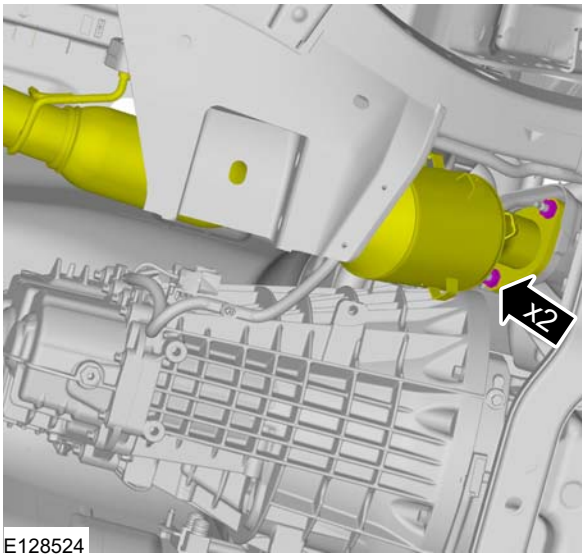
All vehicles

8. **CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.**


E98634

9. **CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.**

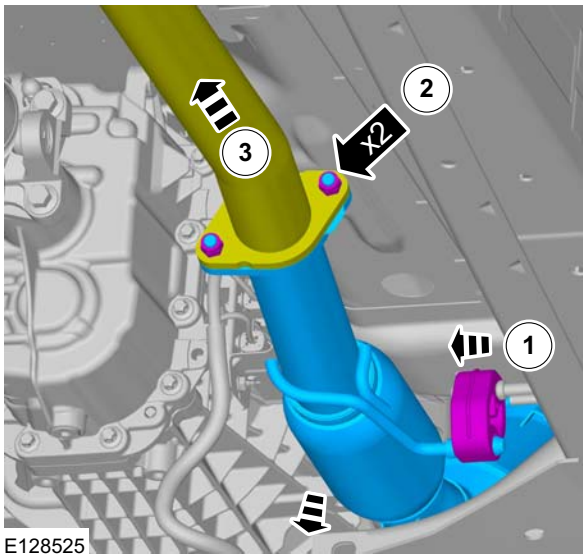
Torque: 48 Nm



E128524

10. **CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.**

Torque: 48 Nm



E128525

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

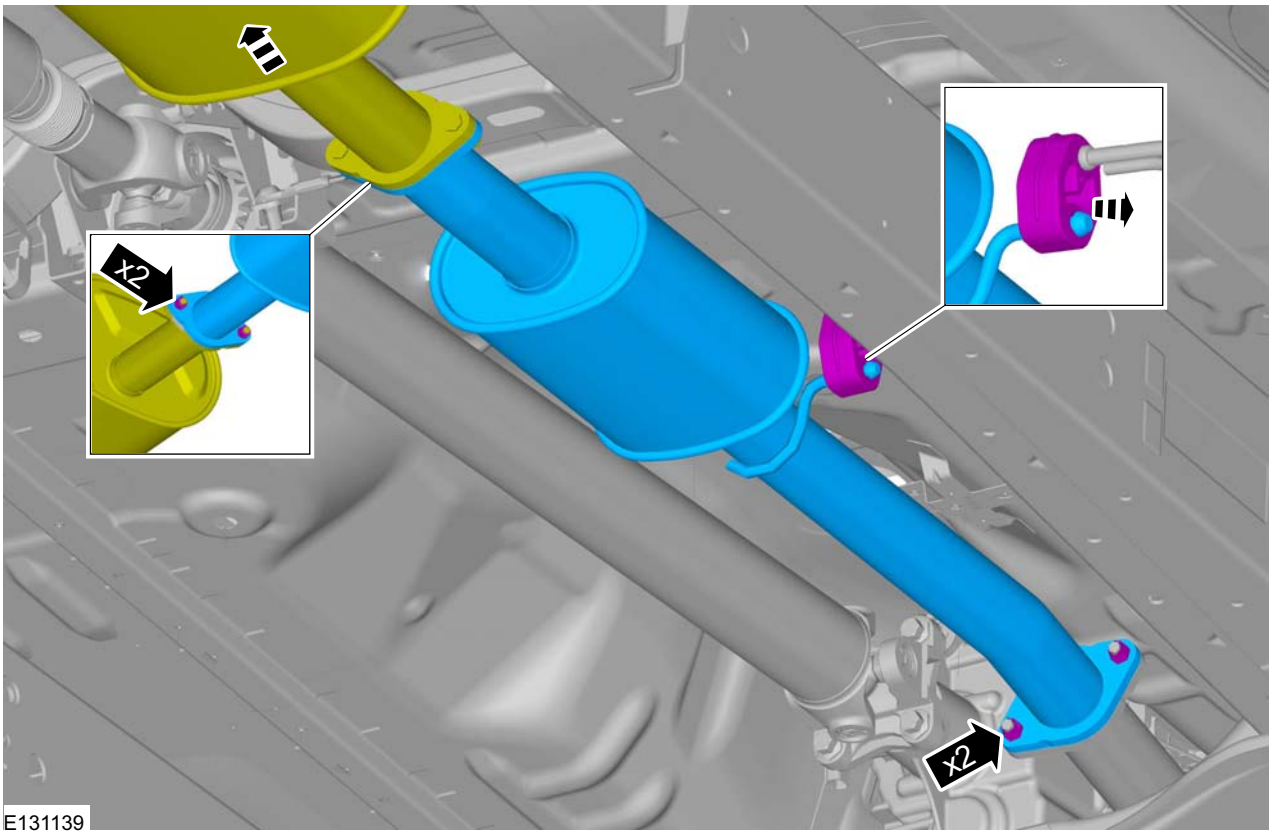
Front Muffler

Removal

WARNING: When the engine and exhaust system are hot, they can cause severe burns or injury. Turn off the engine and wait until they are cool before removing the exhaust system.

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. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

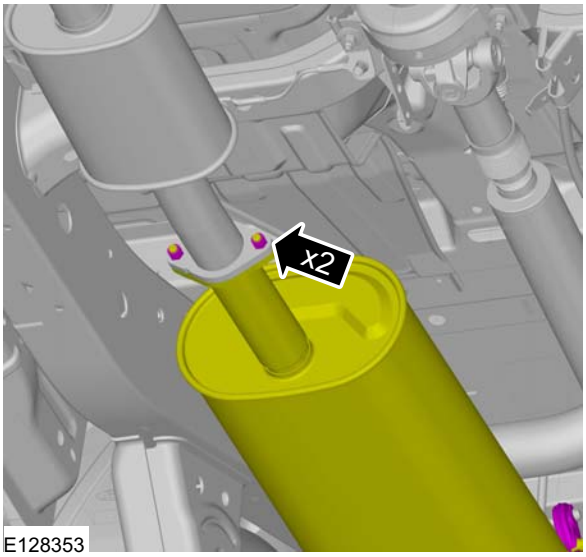
Rear Muffler

Removal

WARNING: When the engine and exhaust system are hot, they can cause severe burns or injury. Turn off the engine and wait until they are cool before removing the exhaust system.

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. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Torque: 48 Nm



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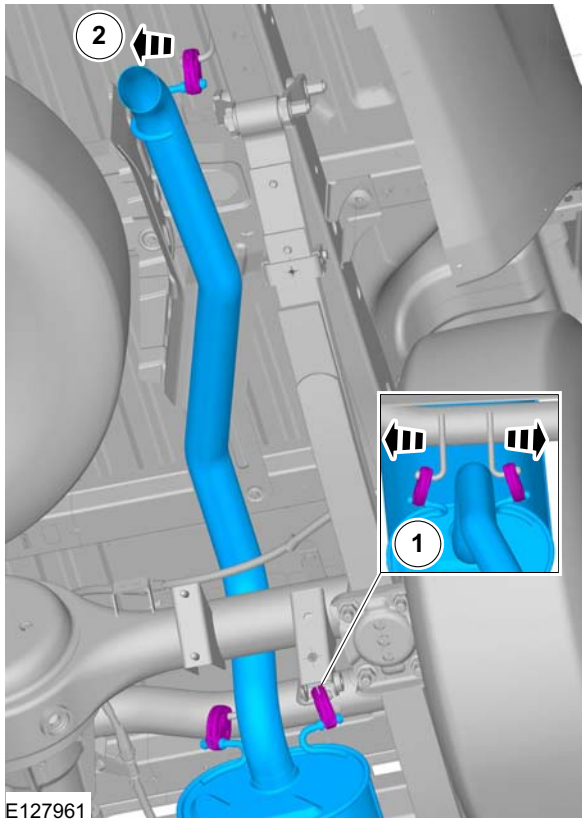
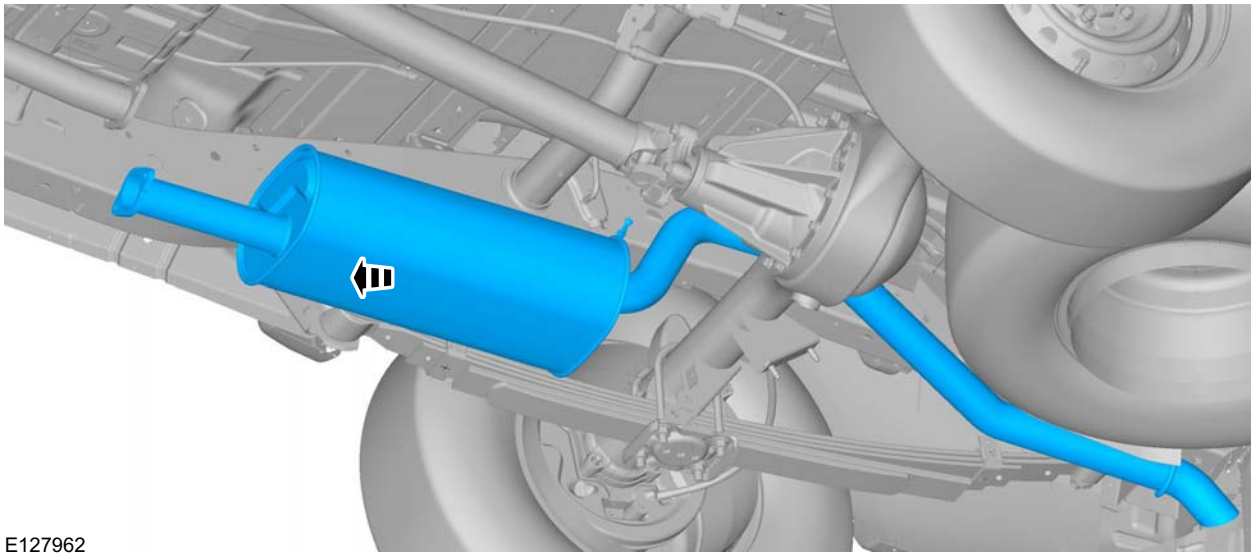


5.

REMOVAL AND INSTALLATION


E127962

Installation

1. To install, reverse the removal procedure.

SECTION 309-00B Exhaust System — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

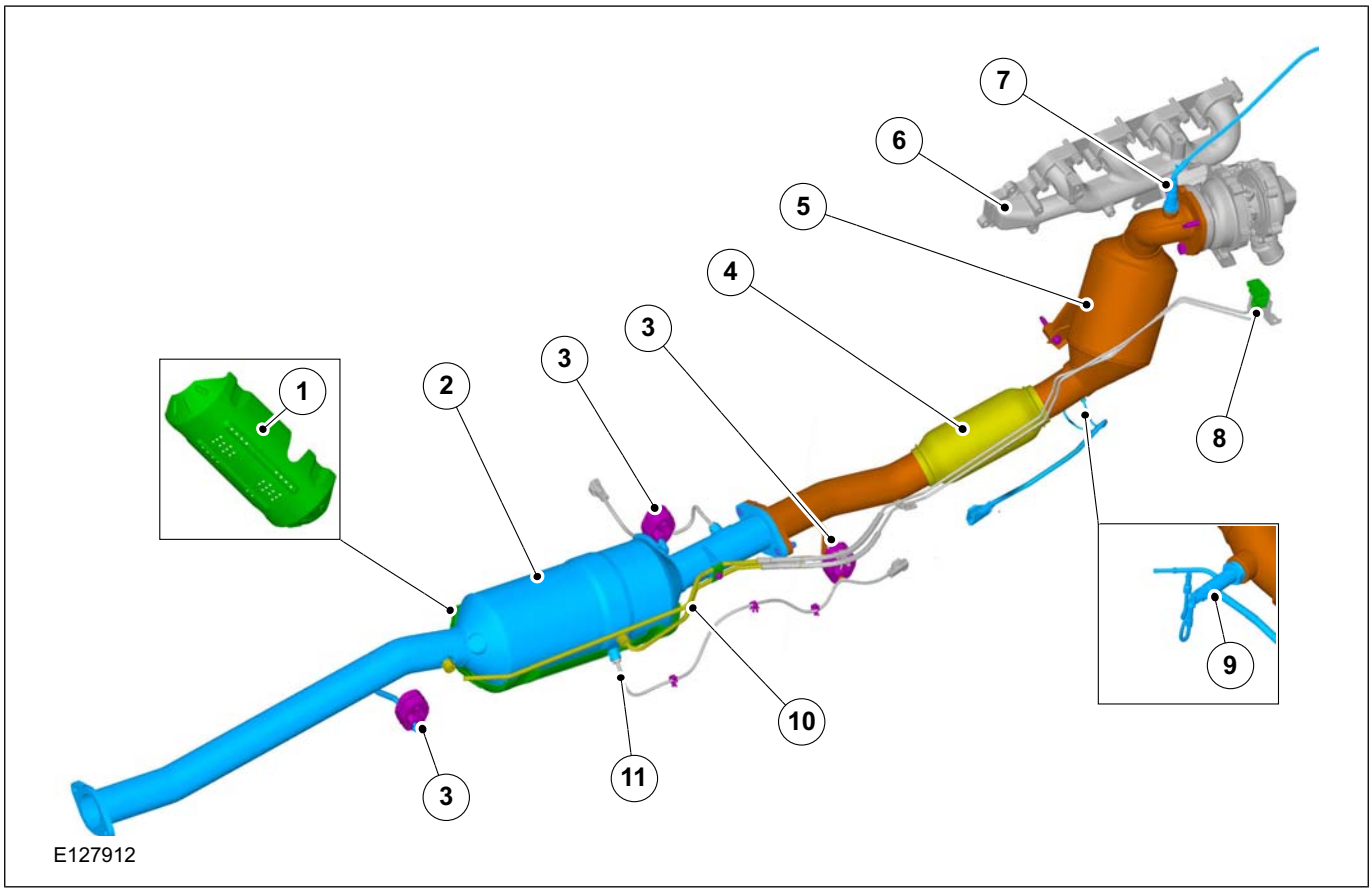
CONTENTS PAGE

DESCRIPTION AND OPERATION

Exhaust System – Component Location

NOTE: Exhaust flexible pipes are very fragile and must not be subjected to any load. They must be secured against twisting and bending during any work on the exhaust system.

Vehicles with diesel particulate filter & catalytic convertor



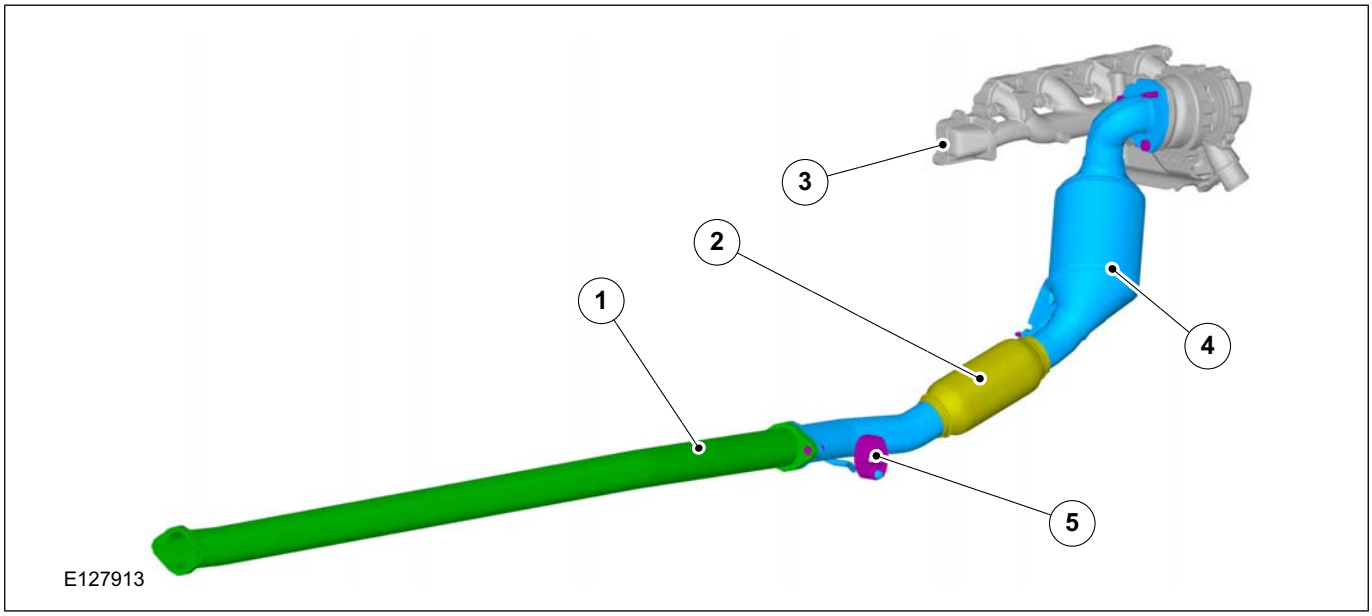
E127912

Item	Description
1	DPF Heat shield
2	DPF
3	Exhaust hanger insulator
4	Exhaust flexible pipe
5	Catalytic converter

Item	Description
6	Exhaust manifold
7	Temprature sensor
8	Pressure differential sensor
9	Fuel vapourizer
10	Pressure differential sensor lines
11	Temprature sensor

DESCRIPTION AND OPERATION

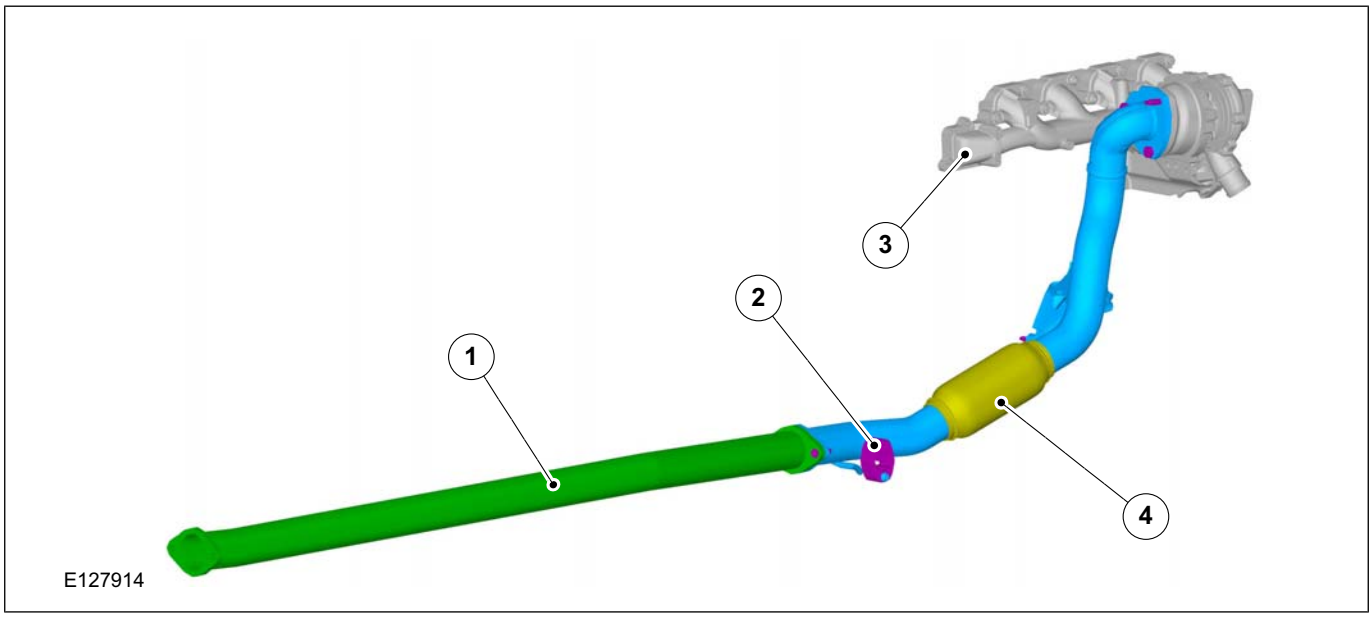
Vehicles with catalytic convertor



Item	Description
1	Exhaust link pipe
2	Exhaust flexible pipe

Item	Description
3	Exhaust manifold
4	Catalytic converter
5	Exhaust hanger insulator

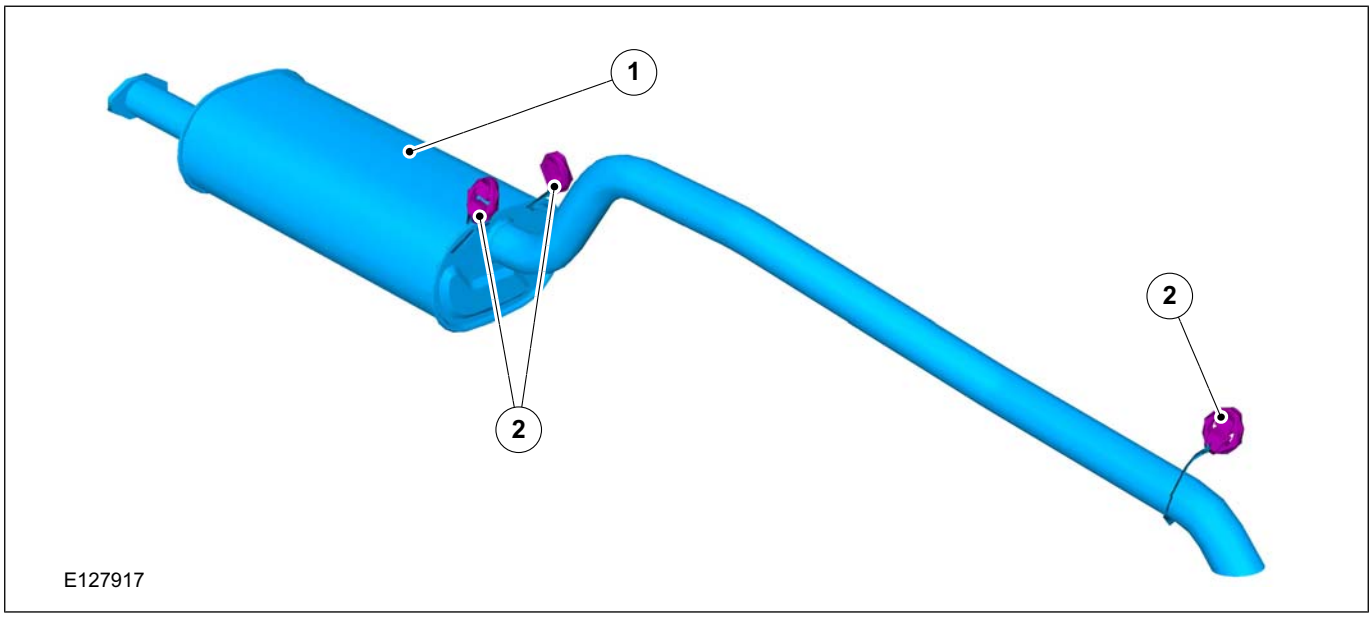
Vehicles without diesel particulate filter & catalytic convertor



Item	Description
1	Exhaust link pipe
2	Exhaust hanger insulator

Item	Description
3	Exhaust manifold
4	Exhaust flexible pipe

DESCRIPTION AND OPERATION



Item	Description
1	Rear muffler
2	Exhaust hanger insulator

REMOVAL AND INSTALLATION

Catalytic Converter

Removal

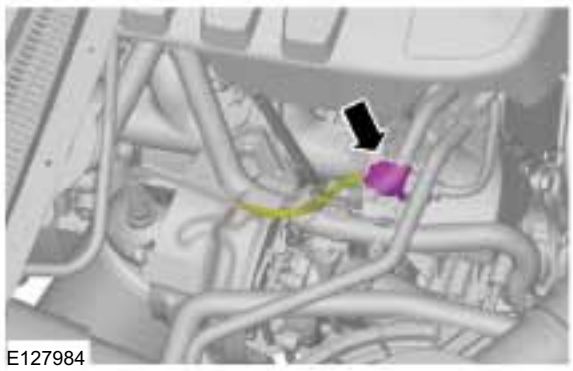
WARNING: When the engine and exhaust system are hot, they can cause severe burns or injury. Turn off the engine and wait until they are cool before removing the exhaust system.

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

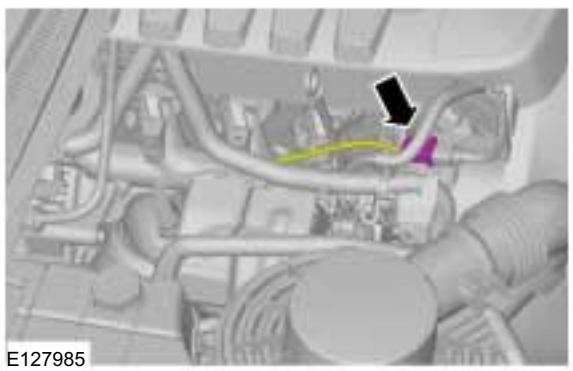
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).

Vehicles with diesel particulate filter (DPF)

2. **NOTE:** Vehicles with 2.2L diesel engine only.

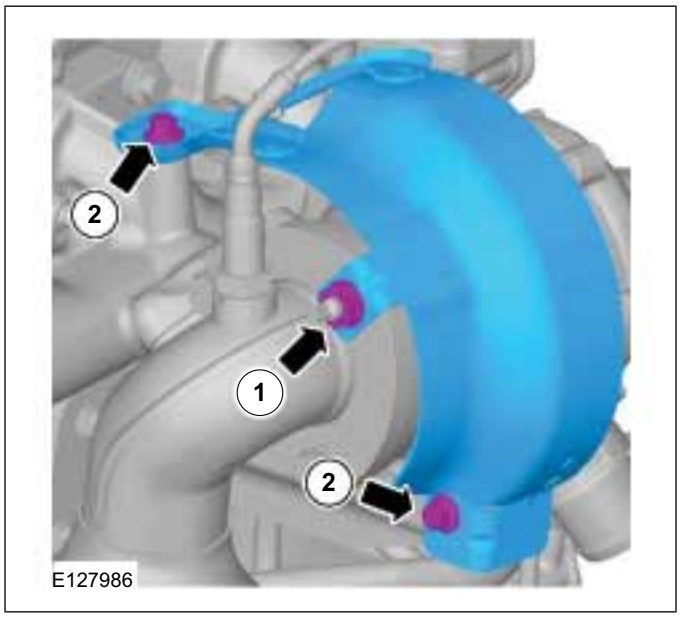

E127984

3. **NOTE:** Vehicles with 3.2L diesel engine only.


E127985

Vehicles with 2.2L diesel engine

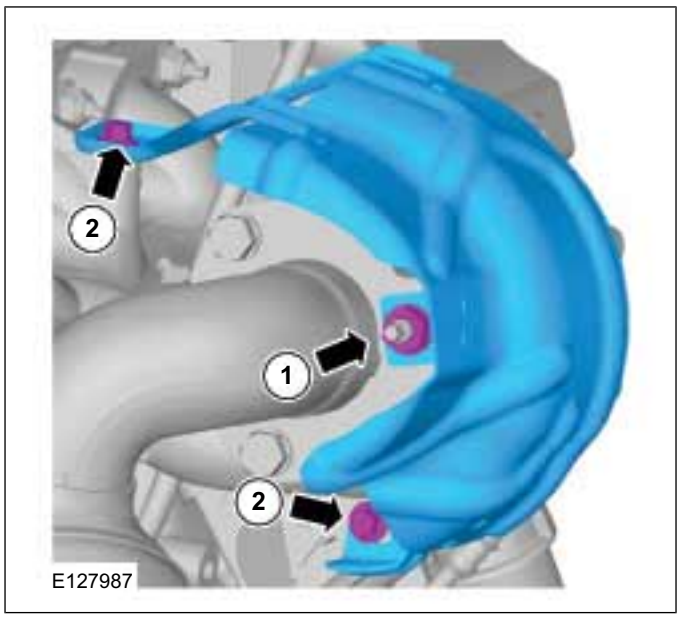
4. 1. Torque: 47 Nm
   2. Torque: 23 Nm



E127986

Vehicles with 3.2L diesel engine

5. 1. Torque: 47 Nm
   2. Torque: 23 Nm

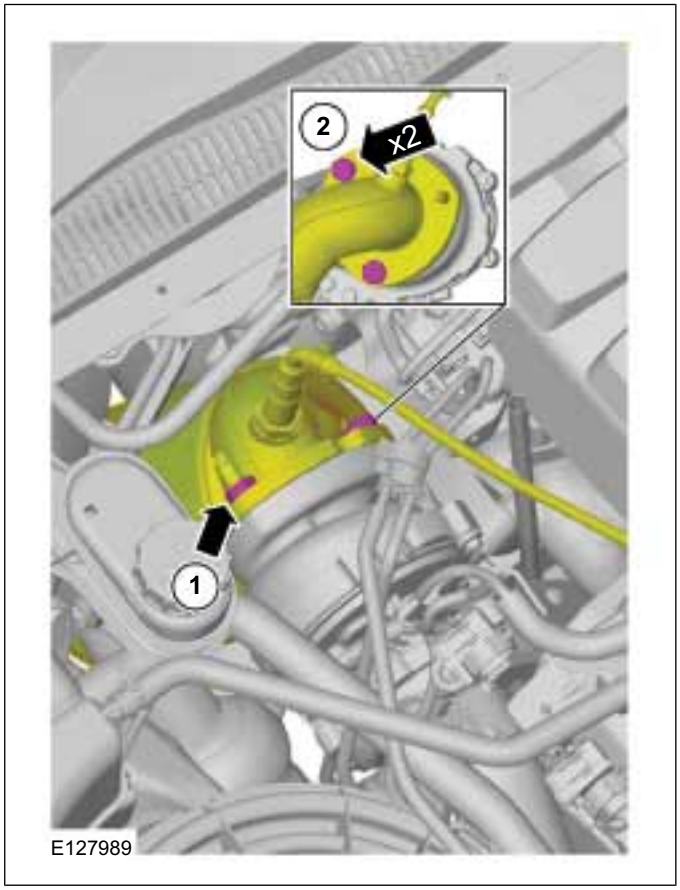


E127987

REMOVAL AND INSTALLATION

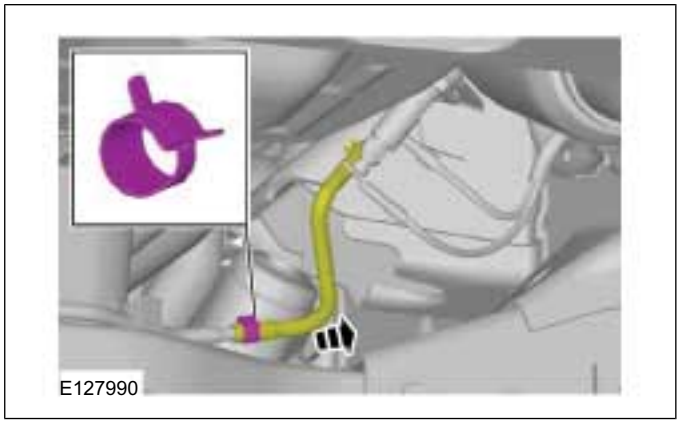
Vehicles with diesel particulate filter (DPF)

6. 1. Torque: 47 Nm
2. Torque: 47 Nm

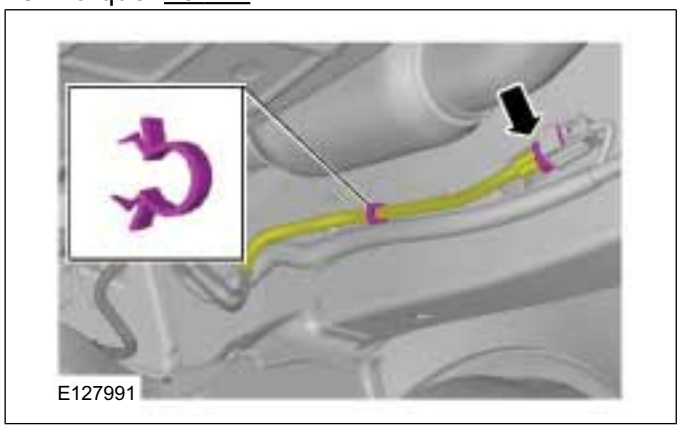


7. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

8.

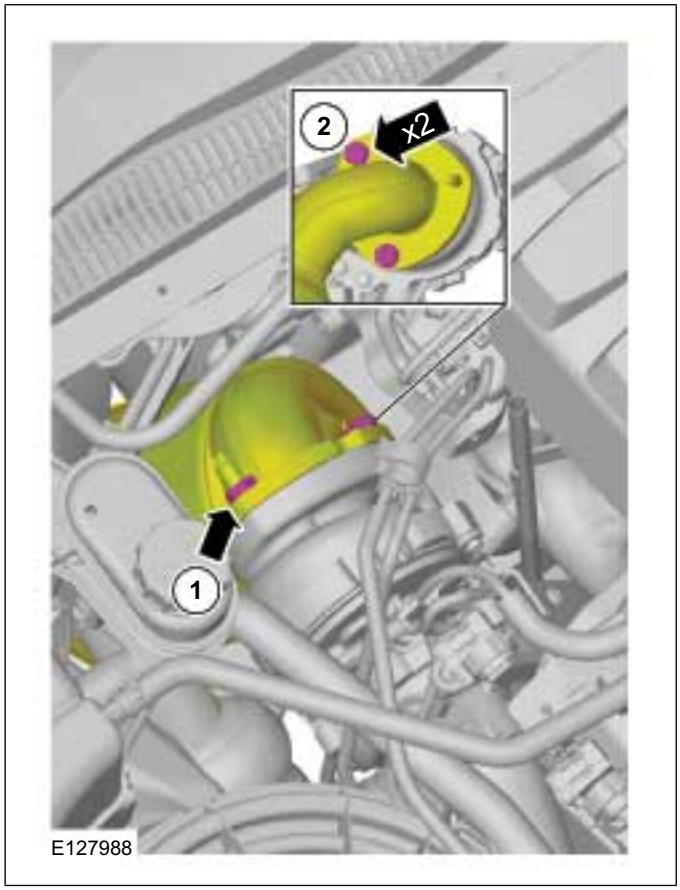


9. Torque: 48 Nm



Vehicles without diesel particulate filter (DPF)

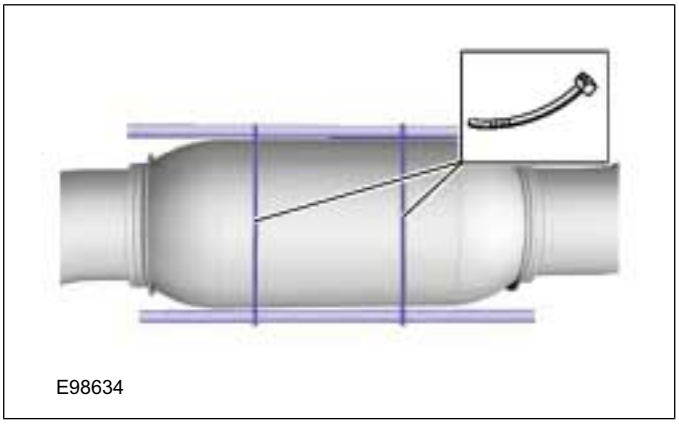
10. 1. Torque: 47 Nm
2. Torque: 47 Nm



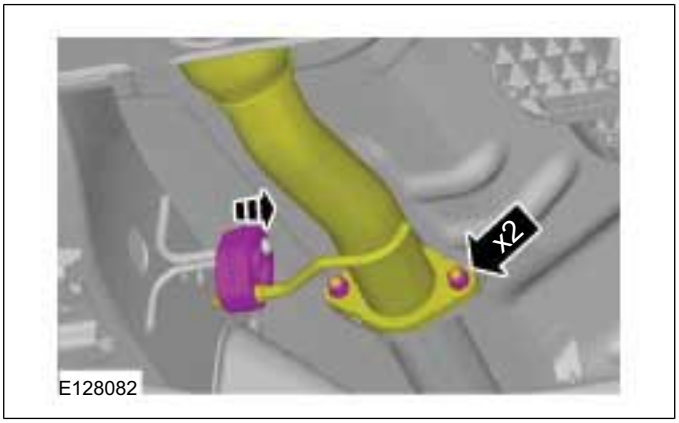
REMOVAL AND INSTALLATION

All vehicles

11. ⚠ **CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.**



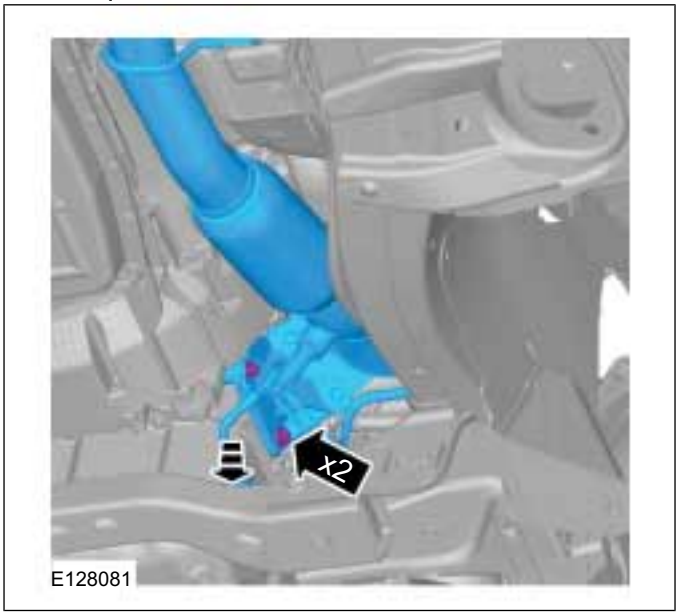
12. 1. Torque: 48 Nm



Vehicles with diesel particulate filter (DPF)

13. ⚠ **CAUTION: Make sure that the exhaust flexible pipe is not forcibly bent.**

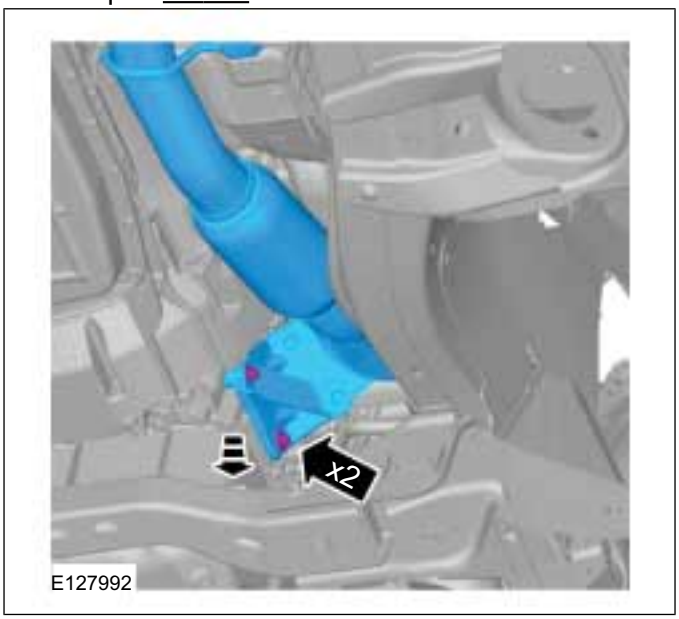
Torque: 25 Nm



Vehicles without diesel particulate filter (DPF)

14. ⚠ **CAUTION: Make sure that the exhaust flexible pipe is not forcibly bent.**

Torque: 25 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

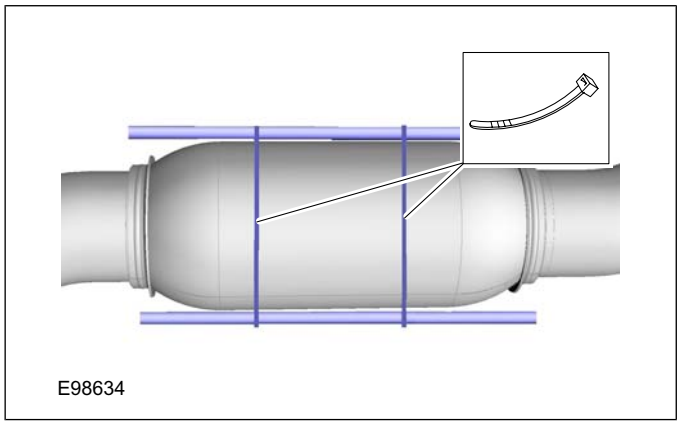
Diesel Particulate Filter (DPF)

Removal

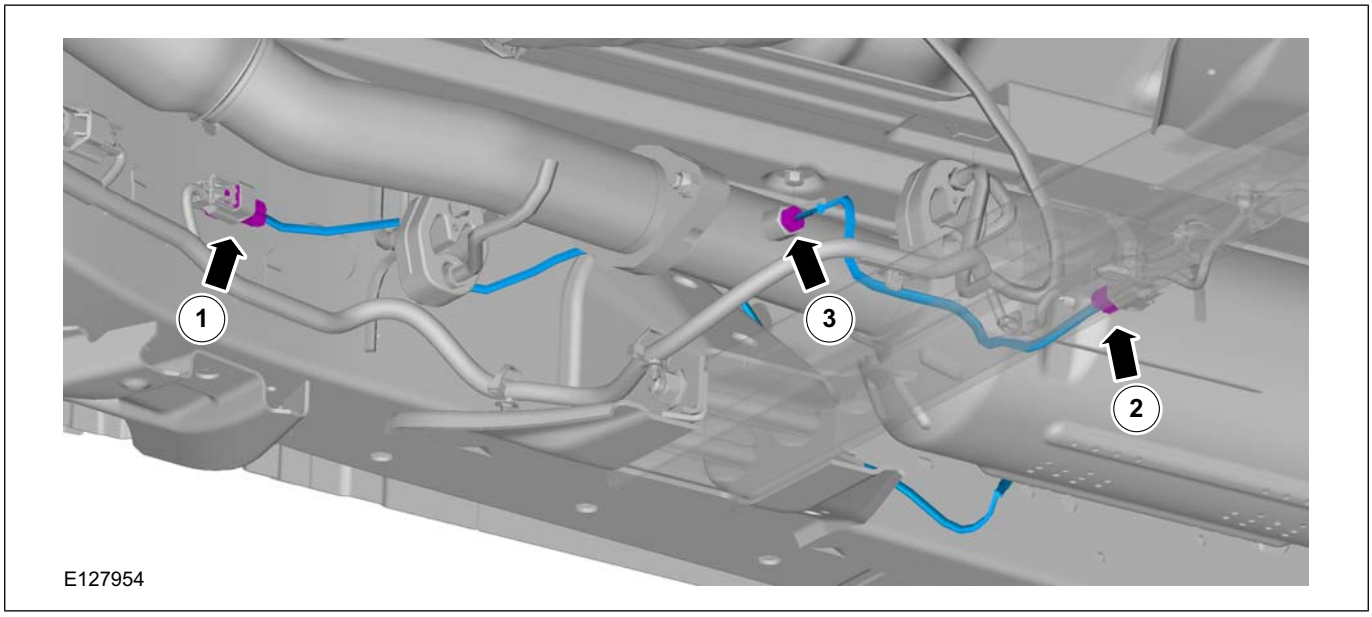
WARNING: When the engine and exhaust system are hot, they can cause severe burns or injury. Turn off the engine and wait until they are cool before removing the exhaust system.

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

1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. **CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.**

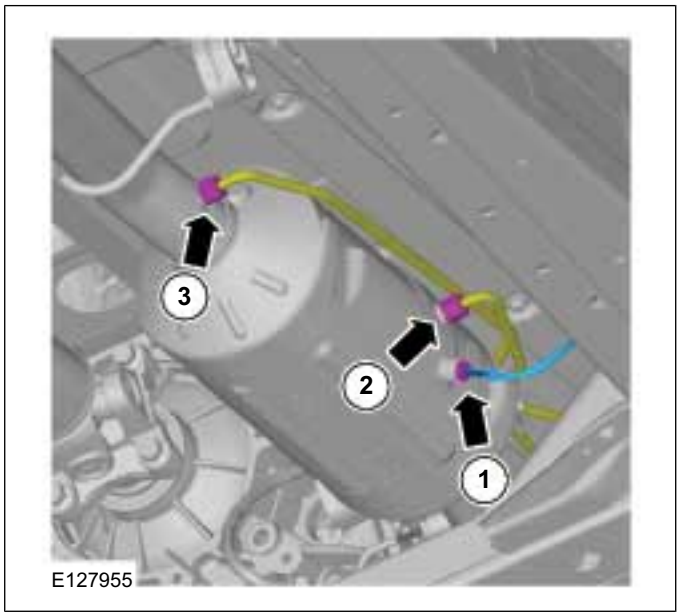


4. Torque: 40 Nm

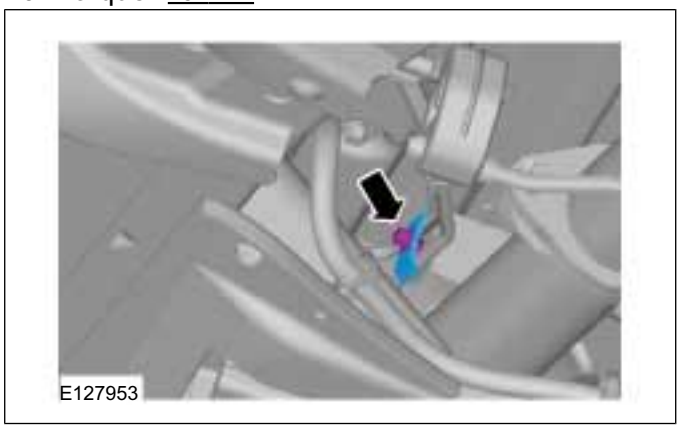


REMOVAL AND INSTALLATION

5. 1. Torque: 40 Nm
2. Torque: 40 Nm
3. Torque: 40 Nm

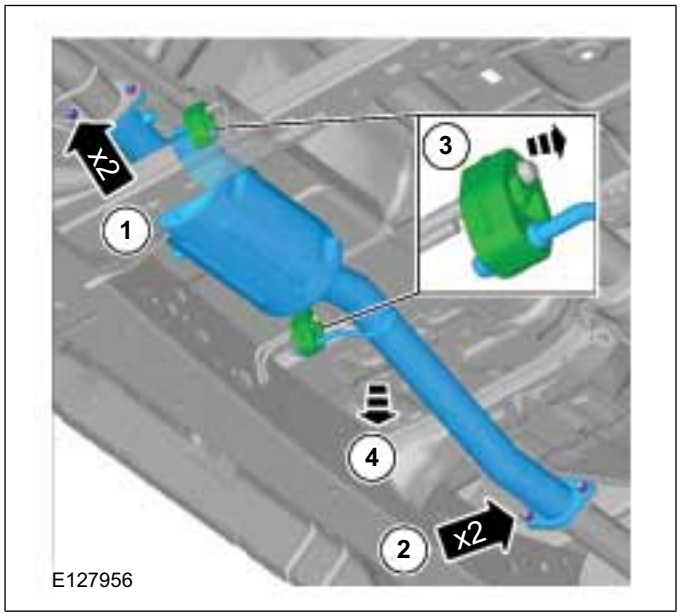


6. Torque: 40 Nm



7. NOTE: Discard the gaskets at both the ends.

1. Torque: 47 Nm
2. Torque: 47 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Exhaust Flexible Pipe

Removal

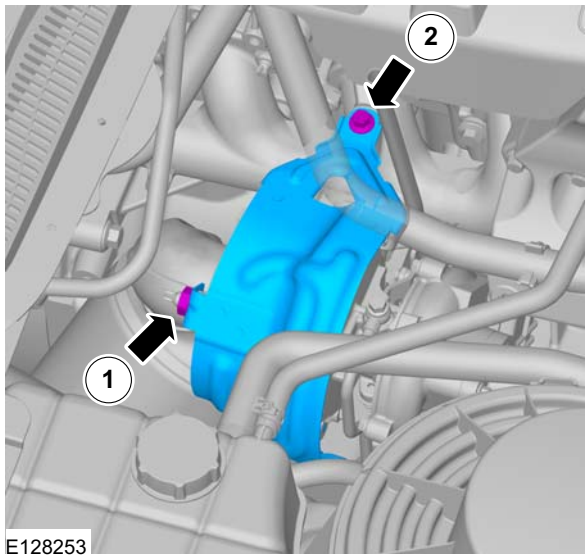
WARNING: When the engine and exhaust system are hot, they can cause severe burns or injury. Turn off the engine and wait until they are cool before removing the exhaust system.

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

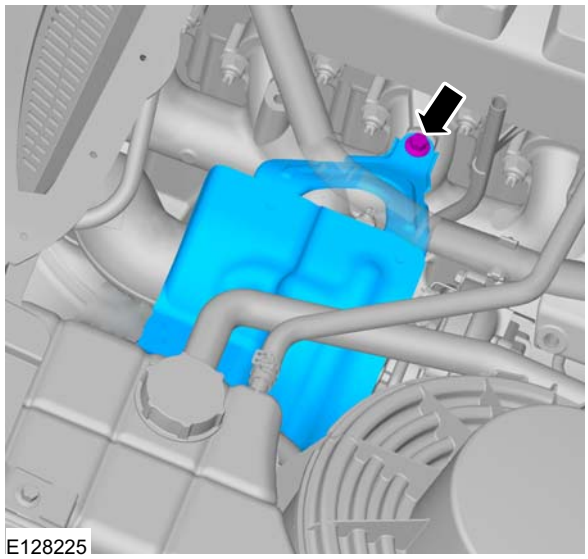
Vehicles with 2.2L diesel engine

3. 1. Torque: 24 Nm
   2. Torque: 24 Nm



Vehicles with 3.2L diesel engine

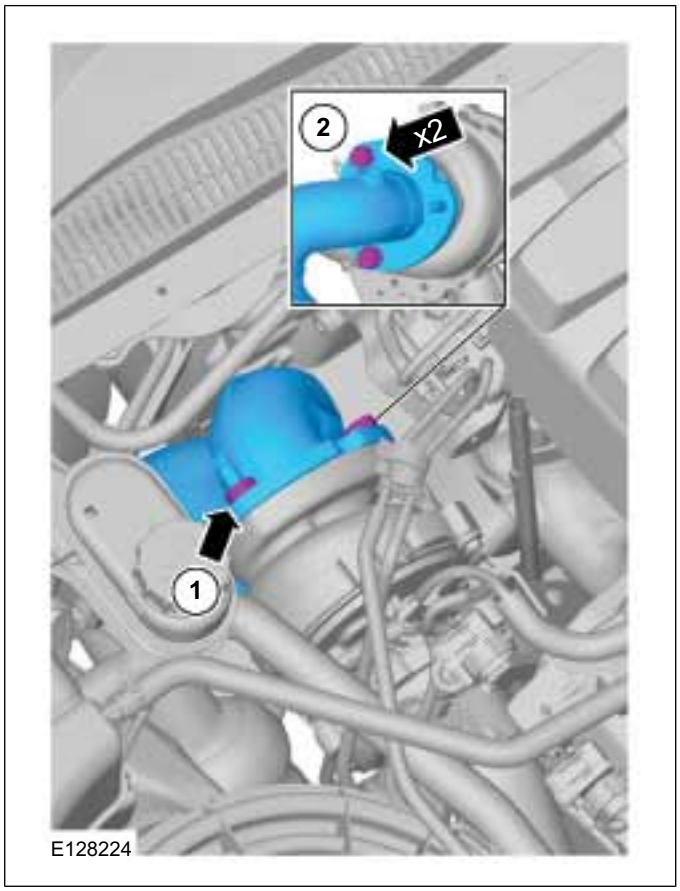
4. Torque: 24 Nm



REMOVAL AND INSTALLATION

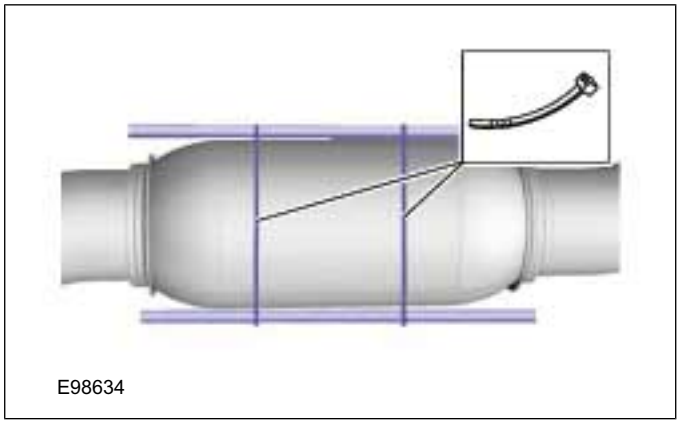
All vehicles

5. 1. Torque: 48 Nm
2. Torque: 48 Nm

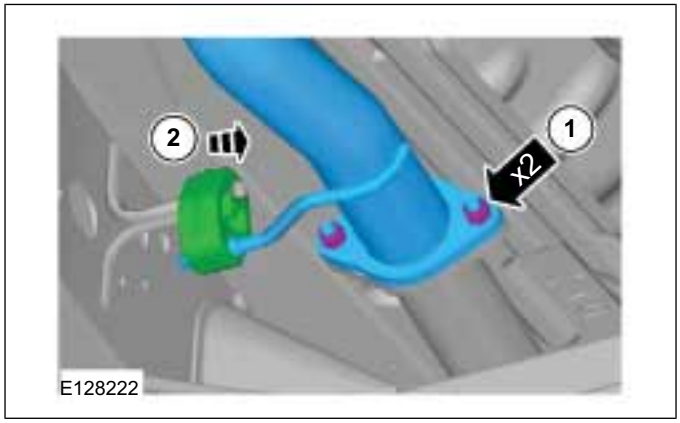


E128224

6. ⚠ **CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.**


E98634

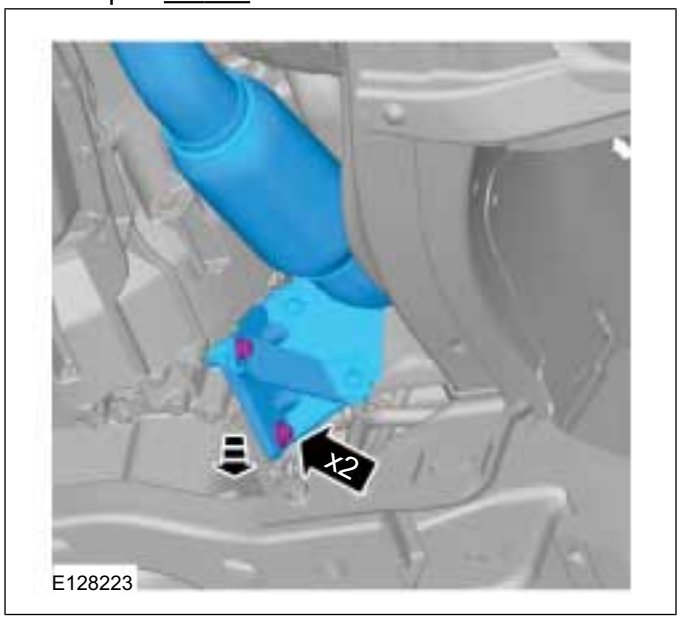
7. 1. Torque: 48 Nm



E128222

8. ⚠ **CAUTION: Make sure that the exhaust flexible pipe is not forcibly bent.**

Torque: 25 Nm



E128223

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

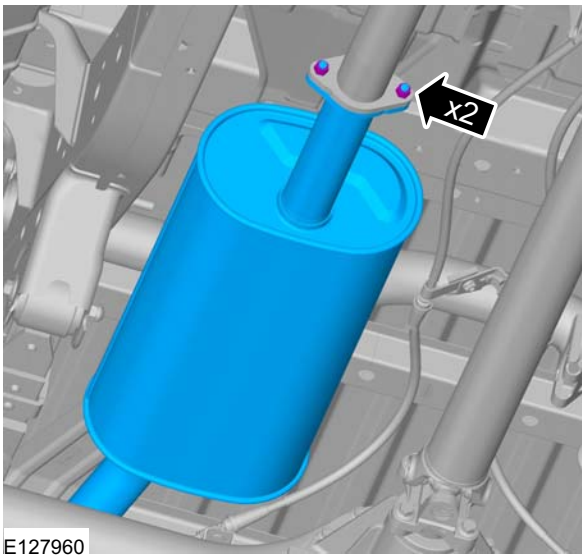
Rear Muffler

Removal

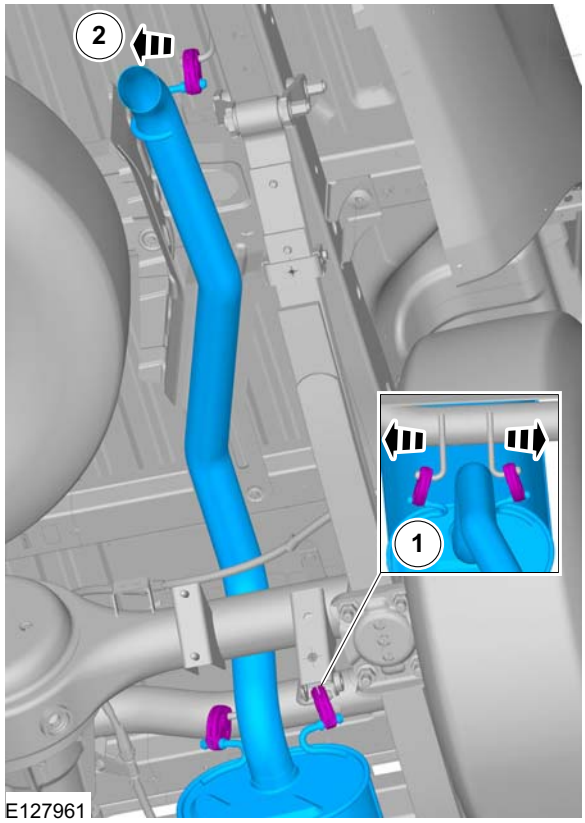
WARNING: When the engine and exhaust system are hot, they can cause severe burns or injury. Turn off the engine and wait until they are cool before removing the exhaust system.

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. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Torque: 48 Nm

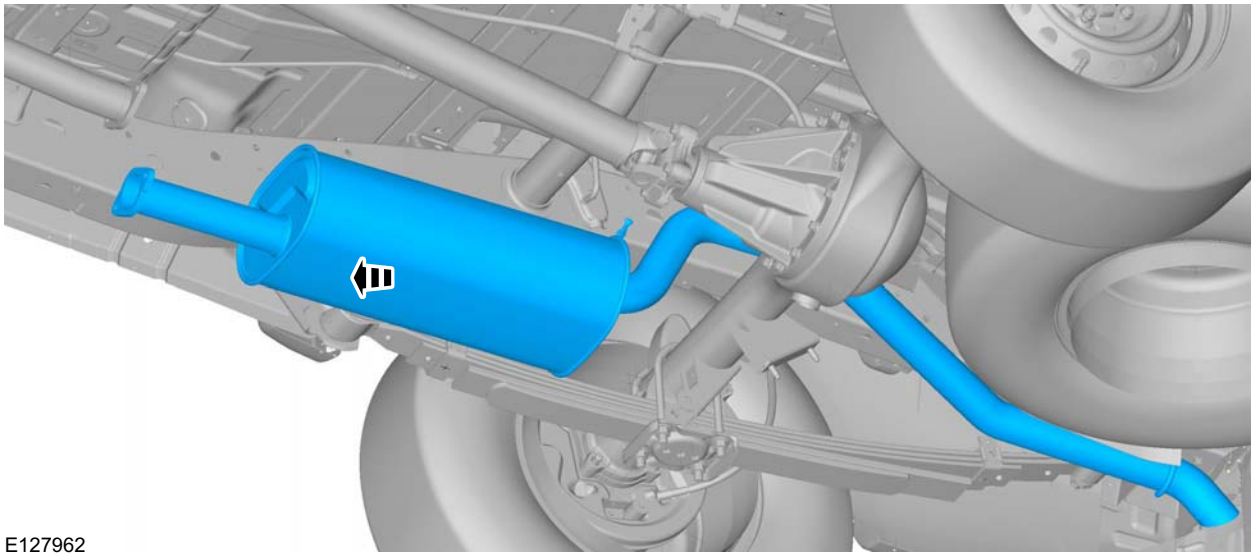


4.



5.

REMOVAL AND INSTALLATION


E127962

Installation

1. To install, reverse the removal procedure.

SECTION 310-00A Fuel System - General Information

— 2.5L Duratec-HE (122kW/165PS) - MI4

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

GENERAL PROCEDURES

GENERAL PROCEDURES

Fuel System Pressure Release

Activation

WARNINGS:

Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

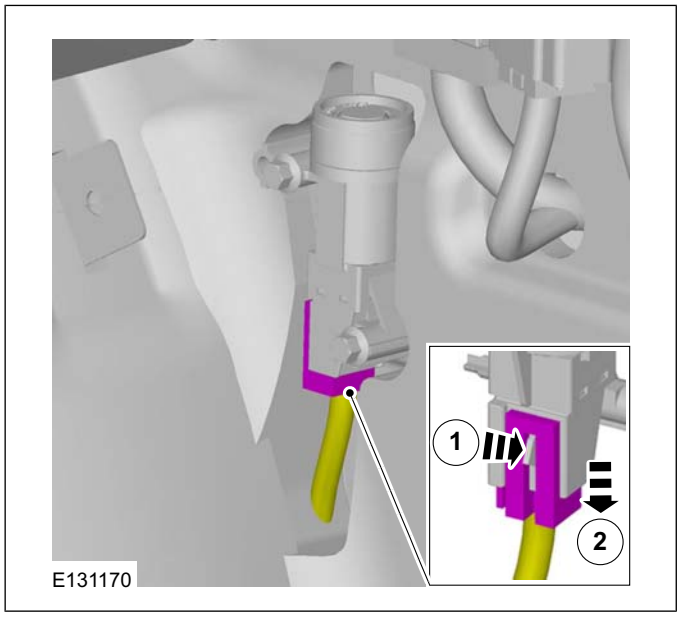
2. **NOTE:** The front passenger door frame scuff plate is retained only by internal metal clips.

   NOTE: The front passenger door side interior kick panel is retained only by internal metal clips.

   NOTE: It may be necessary to reposition the lower end of the door jam weatherstripping to remove the front passenger door side interior kick panel.

   Refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Disconnect the Inertia Fuel Shutoff (IFS) switch electrical connector.



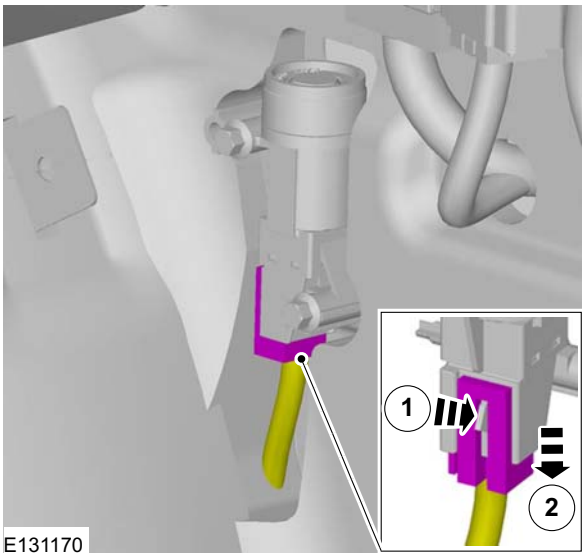
4. Start and run the engine at idle speed until the engine stops.

5. After the engine stalls, crank the engine for approximately 5 seconds to make sure the fuel rail pressure has been released.

6. Turn the ignition switch to the OFF position.

GENERAL PROCEDURES

7. When the fuel system service is complete, reconnect the Inertia Fuel Shutoff (IFS) switch electrical connector.



8. **NOTE:** It may take more than one key cycle to pressurize the fuel system.

   Cycle the ignition key and wait 3 seconds to pressurize the fuel system. Check for leaks before starting the engine.

9. Start the vehicle and check the fuel system for leaks.

10. **NOTE:** The front passenger door frame scuff plate is retained only by internal metal clips.

    NOTE: The front passenger door side interior kick panel is retained only by internal metal clips.

    NOTE: It may be necessary to reposition the lower end of the door jam weatherstripping to remove the front passenger door side interior kick panel.

    Install the front passenger side interior kick panel and the front passenger door frame scuff plate.

    Refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

GENERAL PROCEDURES

Fuel Tank Draining

Check

WARNINGS:

Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

Remove the fuel filler cap slowly. The fuel system may be under pressure. If the fuel filler cap is venting vapor or if you hear a hissing sound, wait until it stops before completely removing the fuel filler cap. Otherwise, fuel may spray out. Failure to follow these instructions may result in serious personal injury.

Be prepared to collect escaping fluid.

11. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

12. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

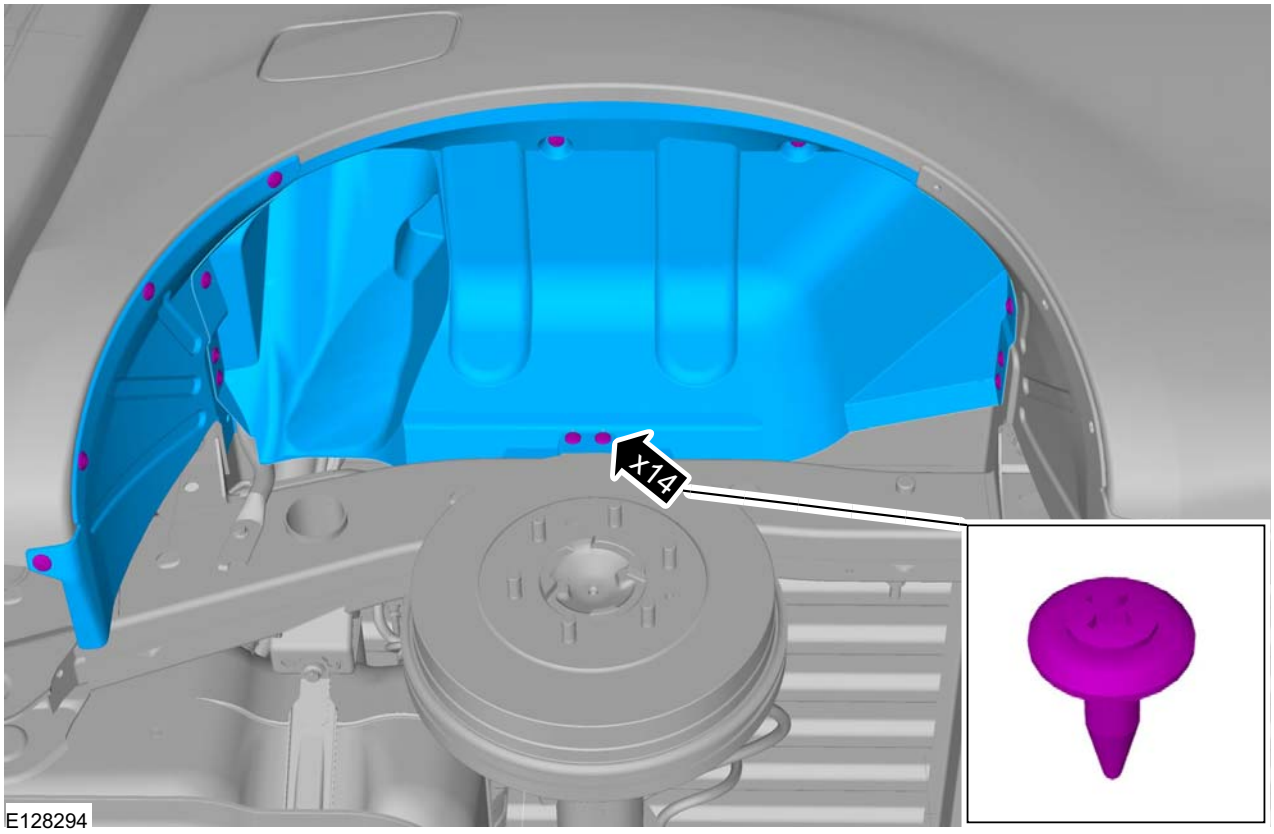
13. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

14. Remove the left-hand rear wheel and tire.

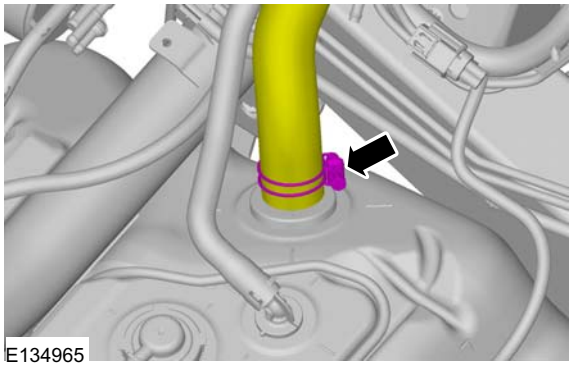
Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

15.

GENERAL PROCEDURES

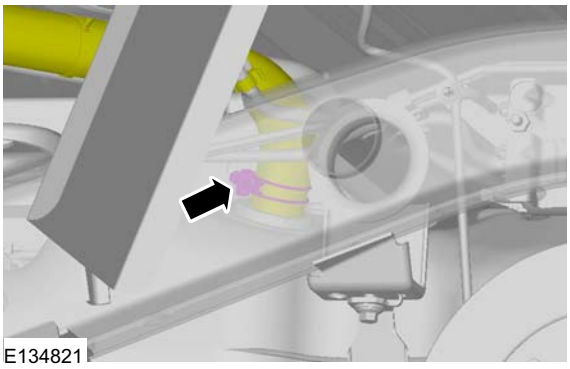


16. **NOTE:** Make sure that the clamp is installed to the same orientation as when removed.



Single cab

17. **NOTE:** Make sure that the clamp is installed to the same orientation as when removed.

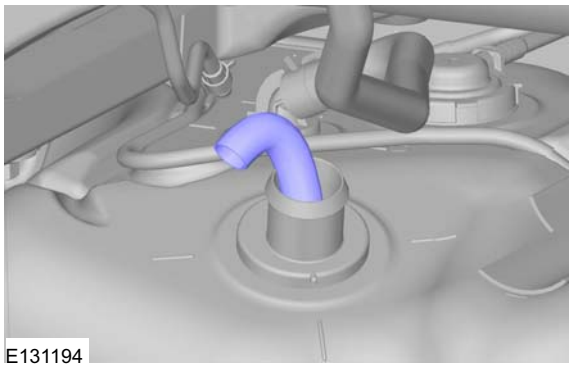


All vehicles

18. **NOTE:** Secure the hose opening above the fuel level.

GENERAL PROCEDURES

Insert the fuel tank drain Hose into the fuel tank.


E131194

19. **NOTE:** Follow the operating instructions supplied by the equipment manufacturer.

    Attach the fuel tank drain hose to the 30 gallon gasoline hand pump storage tanker and siphon the fuel from the fuel tank.

GENERAL PROCEDURES

Spring Lock Couplings

Activation

WARNINGS:

Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

Remove the fuel filler cap slowly. The fuel system may be under pressure. If the fuel filler cap is venting vapor or if you hear a hissing sound, wait until it stops before completely removing the fuel filler cap. Otherwise, fuel may spray out. Failure to follow these instructions may result in serious personal injury.

NOTE: 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 or component damage may occur. Always install blanking plugs to any open orifices or tubes.

NOTE: When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip may occur. Apply clean engine oil to the end of the tube before inserting the tube into the connector.

NOTE: Fuel supply line connectors are color coded white. Fuel return line connectors are color coded red.

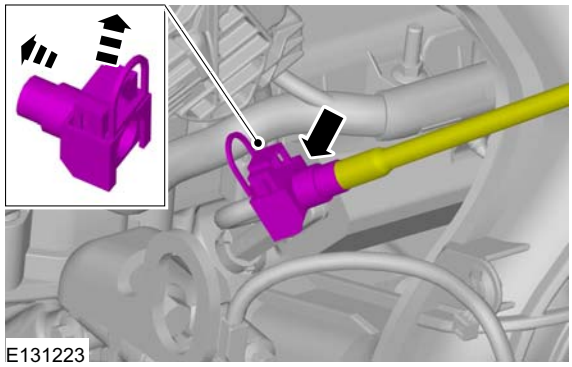
20. Refer to: Fuel System Pressure Release (310-00 Fuel System - General Information - 2.5L Duratec-HE (122kW/165PS) - MI4, General Procedures).

21. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

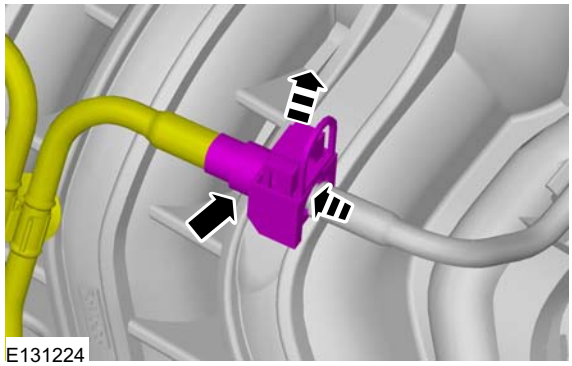
22. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

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

24. If equipped, remove the fuel tube safety clip.

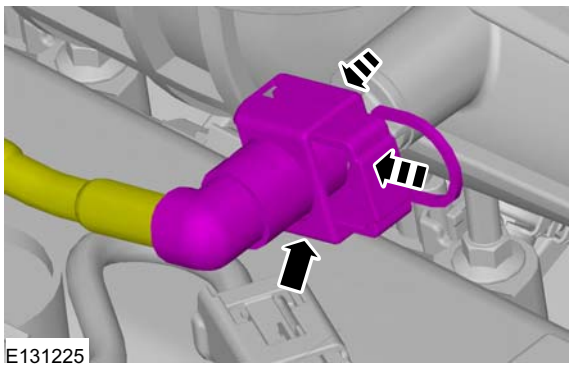

E131223

25.


E131224

GENERAL PROCEDURES

26.



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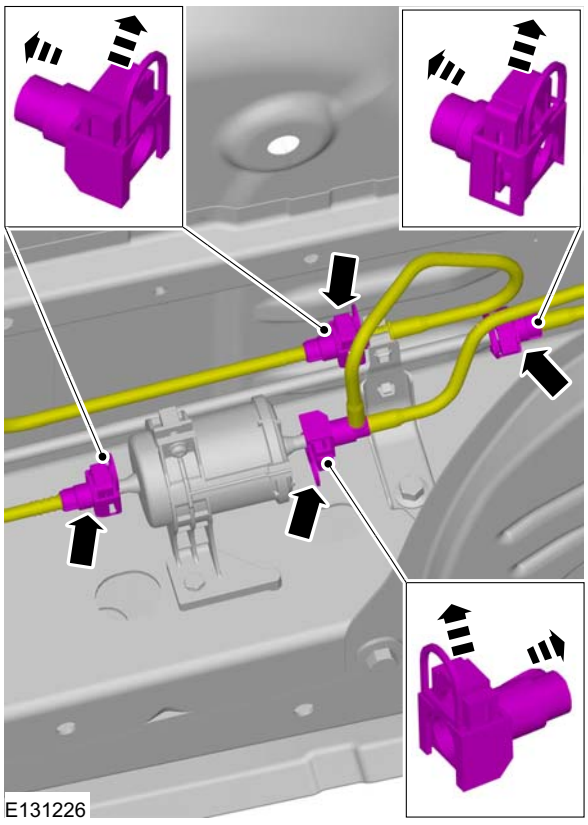


SECTION 310-00B Fuel System - General Information

— 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

GENERAL PROCEDURES

Diesel Filter Water Drain-Off

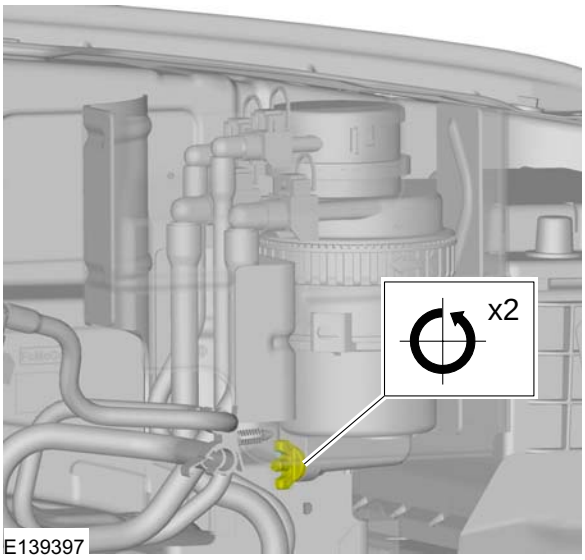
WARNINGS:

Fuel vapor is hazardous. It can easily ignite, causing serious injury and damage. Always keep sparks and flames away from fuel.

A person charged with static electricity could cause a fire or explosion, resulting in death or serious injury. Before performing work on the fuel system, discharge static electricity by touching the vehicle body.

Avoid fuel line spills and leaks by completing the following procedure.

1. For additional information, refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. For additional information, refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Remove the fuel-filler cap and release the pressure in the fuel tank.
4.



5. After all the water has been drained, tighten the drain plug.
6. Reconnect the negative battery cable.
7. **WARNING: If fuel does not pass through the fuel filter, foreign material may have penetrated in the supply pump, and this may cause a malfunction resulting in damage to the fuel injection pump.**

CAUTION: Continuously cranking the engine for over 30 s can damage the battery and the starter.

Complete the fuel line air bleeding.

SECTION 310-01A Fuel Tank and Lines

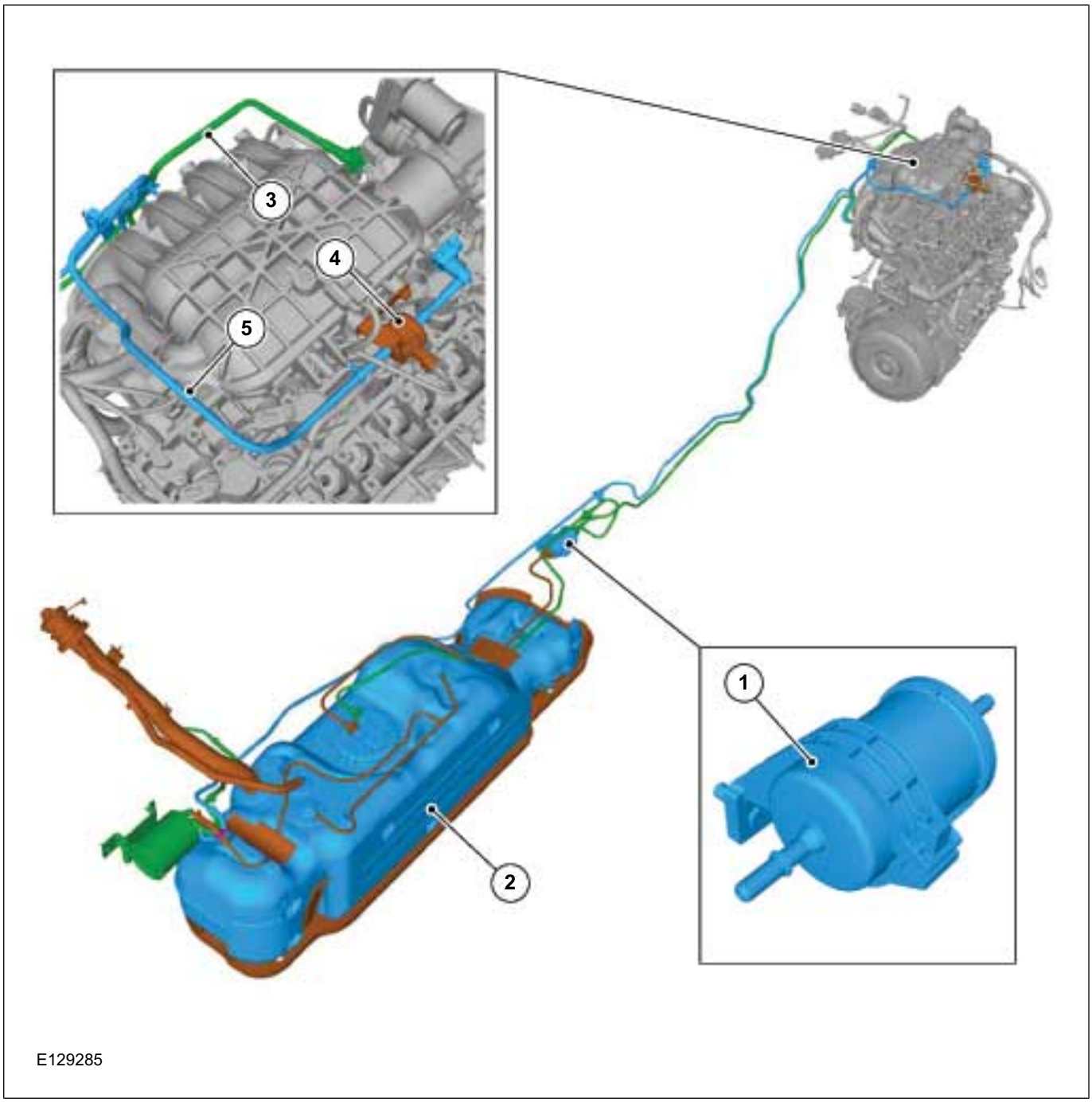
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Fuel Tank and Lines

Vehicles with petrol engine



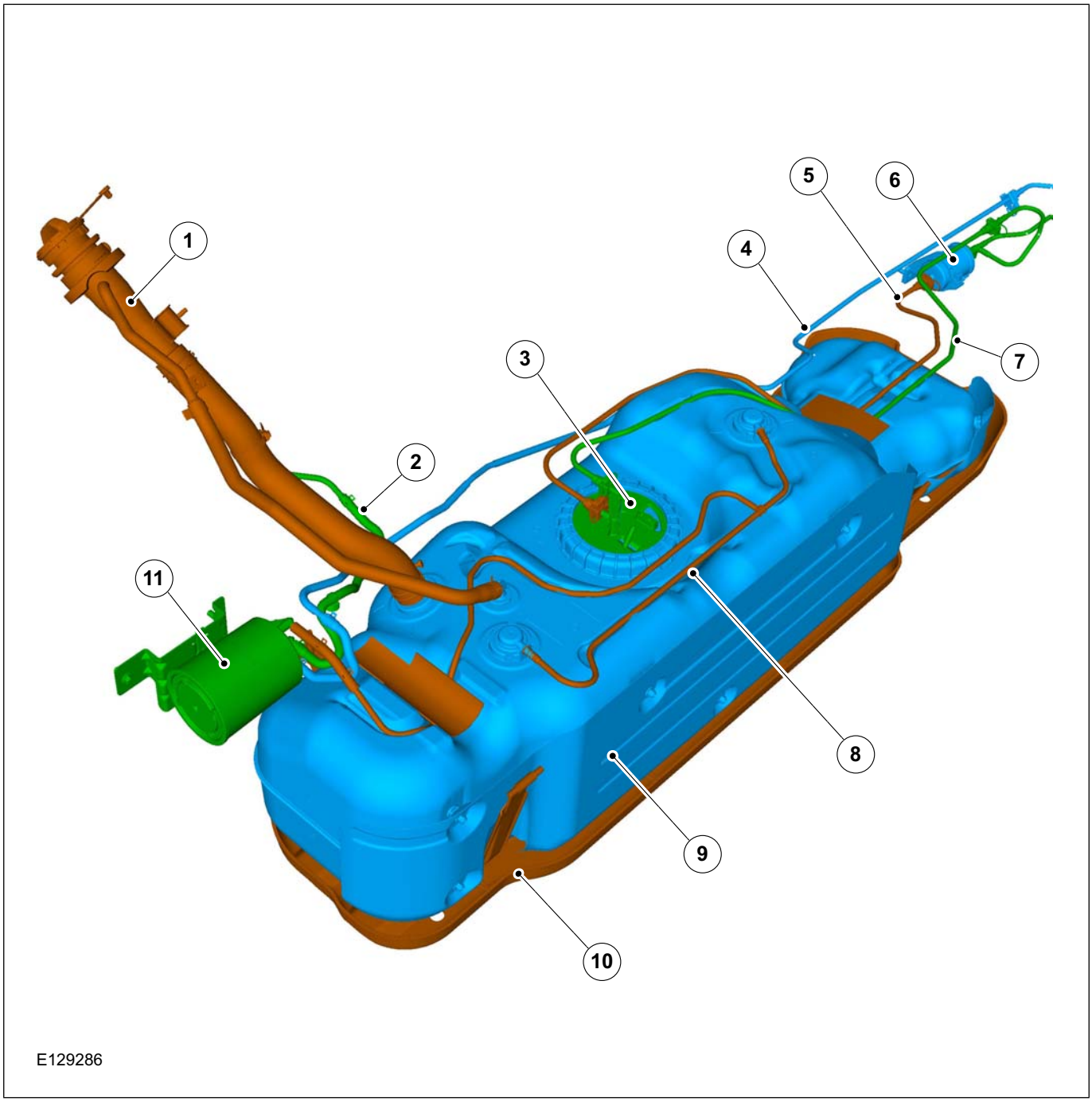
Item	Description
1	Fuel filter
2	Fuel tank
3	Supply line to injection rail

Item	Description
4	Vapor emission valve
5	Vapor return line to canister

Fuel is stored in the fuel tank and delivered to the fuel injectors by means of a submersed fuel pump through an inline fuel filter.

DESCRIPTION AND OPERATION

Fuel tank and lines

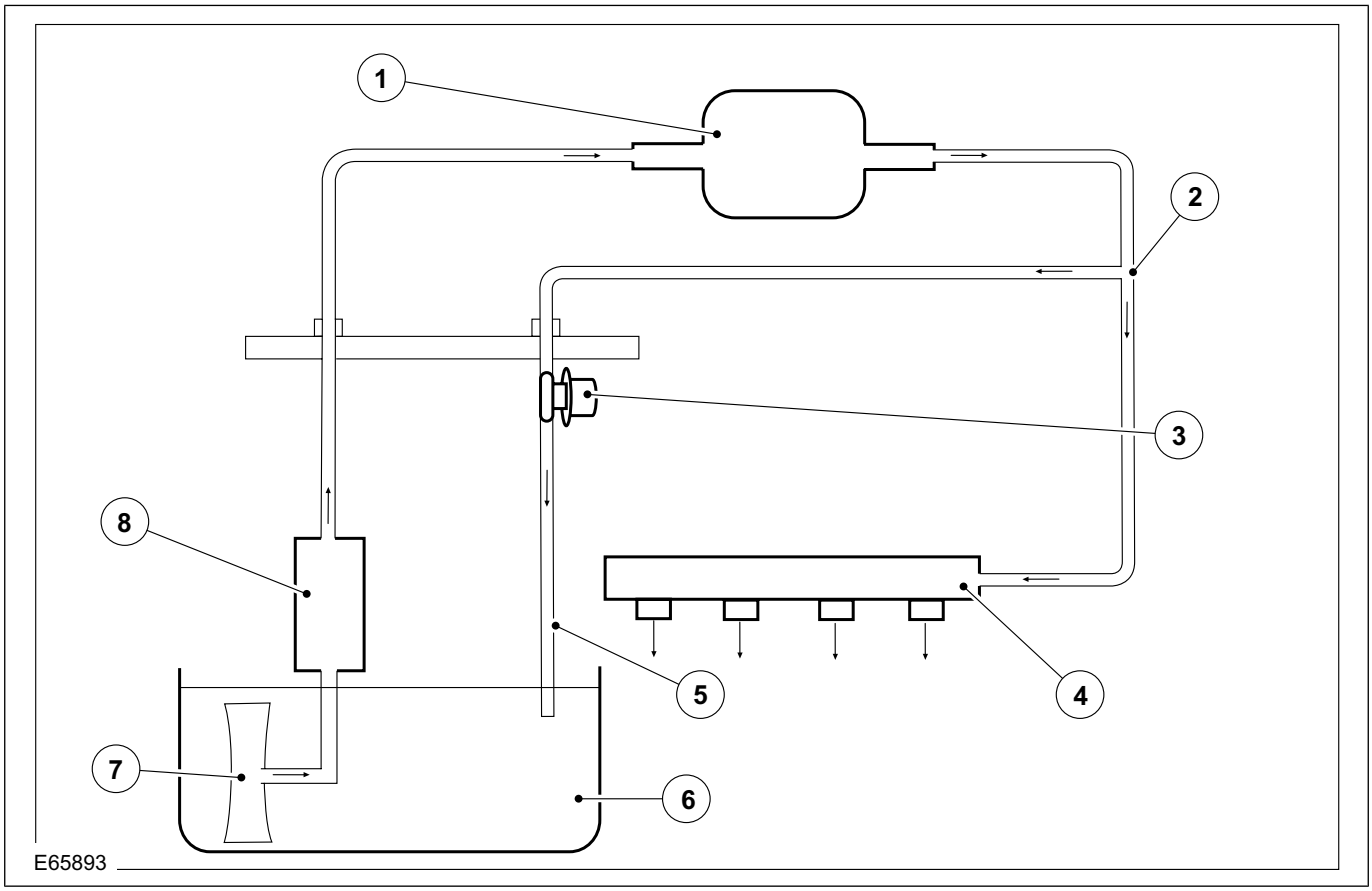


Item	Description
1	Fuel tank filler pipe
2	Vapor line between atmosphere and canister
3	Fuel level sensor
4	Vapor return line to canister
5	Supply line from fuel tank to fuel filter

Item	Description
6	Fuel filter
7	Return line from fuel filter to fuel tank
8	Fuel tank vent valve to evaporative emission canister fuel vapor line
9	Fuel tank
10	Tank protector
11	Canister

DESCRIPTION AND OPERATION

Fuel return system



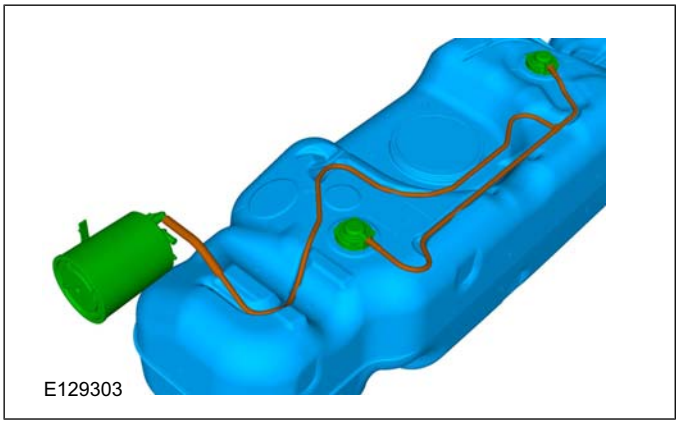
Item	Description
1	Fuel filter
2	Fuel line fuel return T-piece
3	Fuel pressure regulator
4	Fuel rail
5	Fuel return line
6	Fuel tank
7	Fuel jet pump
8	Fuel pump

The fuel pressure at the fuel injectors is controlled by a fuel pressure regulator mounted in the fuel return system.

Fuel is pumped from the fuel tank, to the fuel filter. From the fuel filter, fuel is delivered to the fuel rail. A T-piece is fitted into the fuel injector fuel supply line above the fuel tank. This T-piece acts as the fuel return line and has a fuel pressure regulator fitted in the circuit.

By allowing excess fuel pressure to return to the fuel tank, a constant pressure can be maintained at the fuel injectors.

Fuel tank vent valves



Unlike the fuel tank on vehicles with diesel engine, the fuel vapor is not permitted to vent to atmosphere. Instead the fuel vapor is collected in the evaporative emission canister until the correct driving conditions permit the fuel vapor to be burnt in the engine combustion chambers. This reduces the overall emissions from the vehicle.

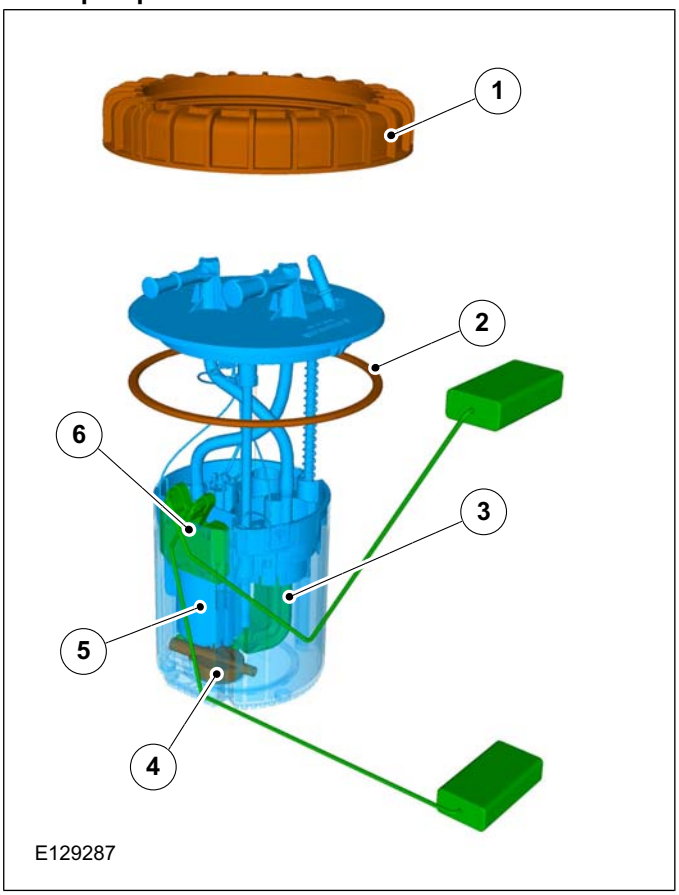
If the fuel tank becomes inverted, the fuel tank vent valves close preventing the evaporative emission canister being filled with fuel.

If the fuel tank vent valves, fuel vapor lines or the evaporative emission canister become restricted,

DESCRIPTION AND OPERATION

vehicle performance will become impaired. The inability of the fuel tank to substitute the fuel demanded by the fuel pump with air, will create a negative pressure in the fuel tank which could result in deformation of the fuel tank.

Fuel pump and sender Unit



Item	Description
1	Fuel pump and sender unit locking ring
2	Fuel pump and sender unit sealing ring
3	Sock filter
4	Fuel jet pump
5	Fuel pump
6	Fuel level sensor resistor card

The fuel pump and sender are a combined unit and cannot be serviced separately.

The fuel pump and sender unit is located in the top of the fuel tank and is retained by a fuel pump and sender unit locking ring and seal.

The fuel pump and sender consists of a mechanical float attached to a variable resistor card by means of a rigid wire lever. The resistor card has two electrical elements. One element is solid and one element is a variable resistor. The resistance value created by the resistor card is sent to the central junction box (CJB) through a hard wired circuit. The CJB distributes the information from the fuel pump and sender to the instrument cluster and the powertrain control module (PCM) using the controller area network (CAN) circuits.

The fuel pump and sender resistor card can be susceptible to contaminated fuel, which can affect electrical continuity. This condition is normally temporary and self-rectifying. If the fuel pump and sender has been removed, moving the rigid wire lever from empty to full a minimum of 10 times will normally be as effective as installing a new fuel pump and sender. The most common symptom of contamination occurs after refuelling where the electrical contact moves to an area of the resistor card which has not been used for several days. This results in a very slow movement of the fuel gauge pointer from empty to full over approximately 15 minutes. In more extreme cases where the resistor card resistance is continuously outside the permitted range for more than 33 seconds, a DTC will be set in the CJB and the fuel gauge pointer will fall to its key-off position. In all cases where the fuel pump and sender is suspected of being inoperative, worn or damaged, the ford diagnostic system (FDS) diagnostic procedures must be followed before any parts are dismantled.

The fuel pump supplies fuel to the fuel charging system at a constant regulated pressure. The fuel pressure is controlled by the fuel pressure regulator, built into the fuel pump fuel return circuit.

The fuel pump and sender also incorporates a fuel jet pump. The return fuel from the fuel charging system is passed through a venturi in the jet pump which causes a pressure drop across an open orifice. This draws in fuel through the base of the unit which then passes through the sock filter to the fuel pump.

REMOVAL AND INSTALLATION

Fuel Tank

General Equipment

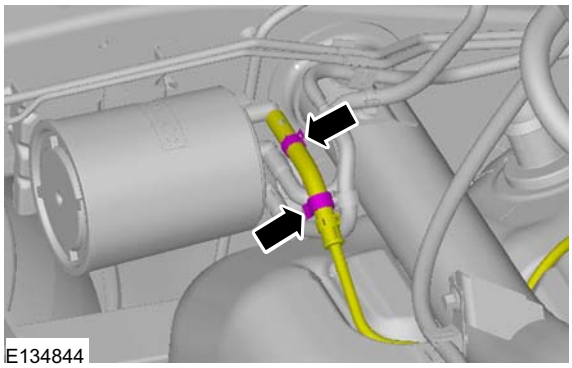
Transmission Jack

Removal

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

1. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information - 2.5L Duratec-HE (122kW/165PS) - MI4, General Procedures).

2.



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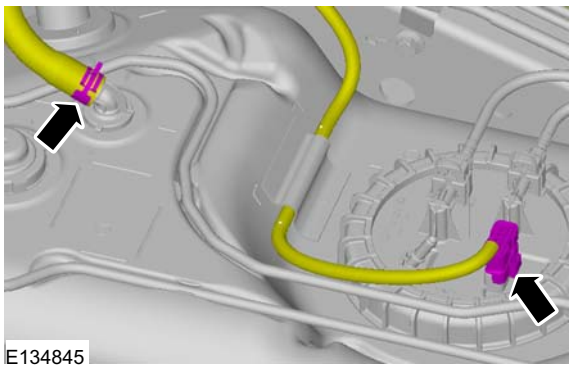
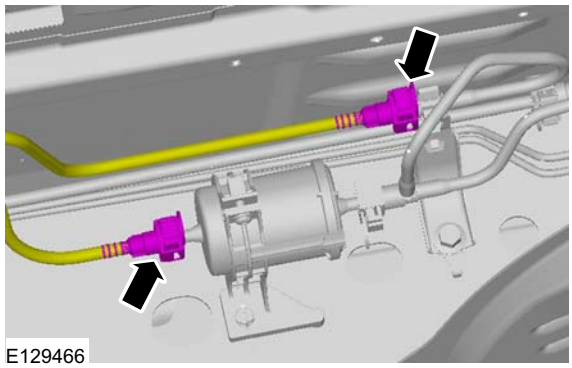
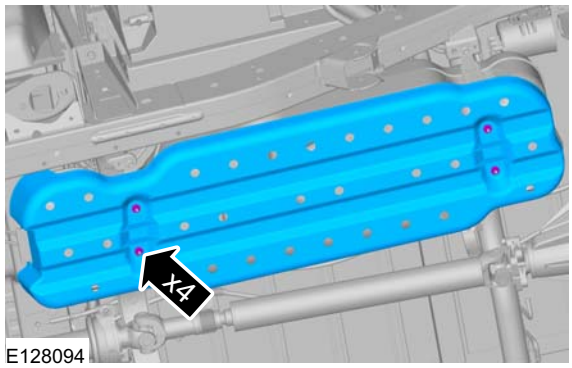


4. **WARNING: Fuel may still be present in the fuel tank after draining.**



4x4

5. Torque: 15 Nm

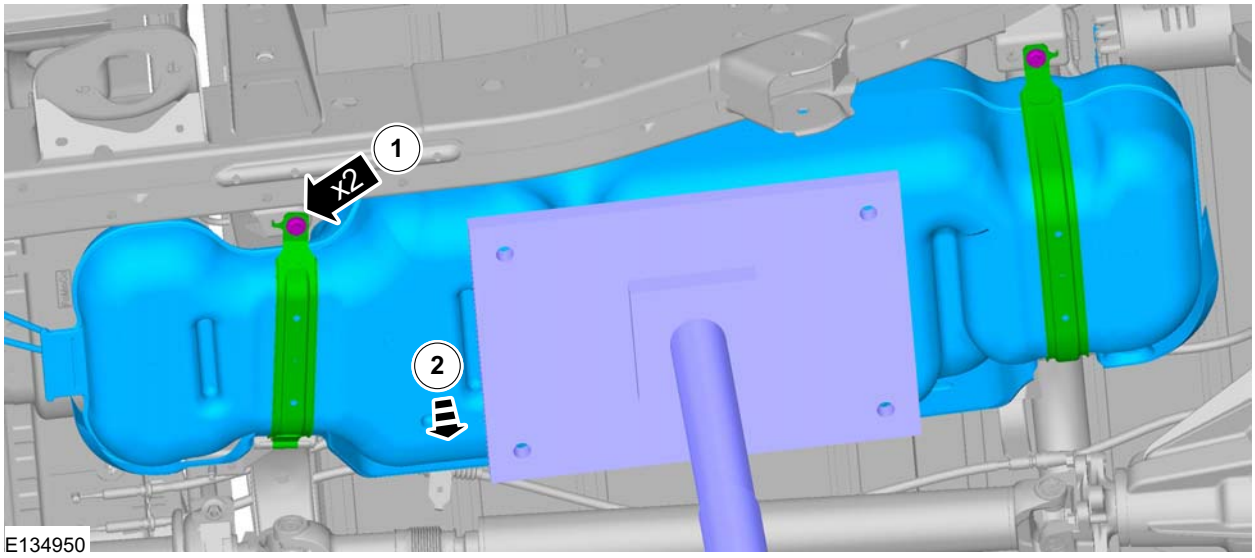


All vehicles

6. **NOTE:** Move the fuel tank to a designated safe area and slowly release the remaining fuel pressure.

   General Equipment: Transmission Jack
   Torque: 48 Nm

REMOVAL AND INSTALLATION



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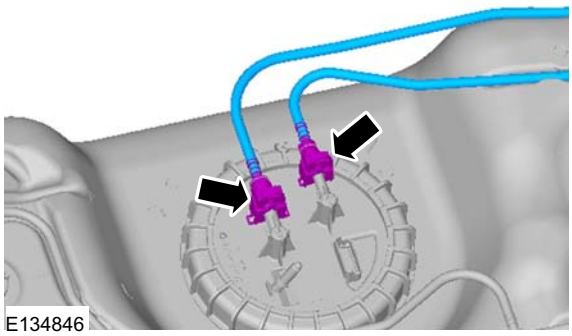


Installation

1. **CAUTION: If the fuel tank has been filled with the wrong type of fuel, the engine must not be started before the fuel system is cleaned.**

   NOTE: Fill the fuel tank with petrol fuel.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Fuel Tank Filler Pipe

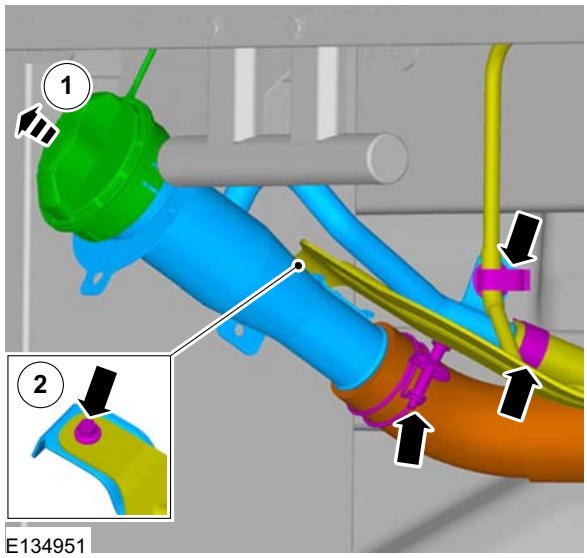
Removal

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

1. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information - 2.5L Duratec-HE (122kW/165PS) - MI4, General Procedures).

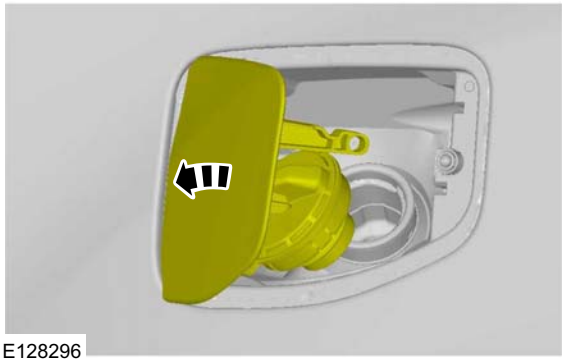
Single cab

2. 2. Torque: 11 Nm

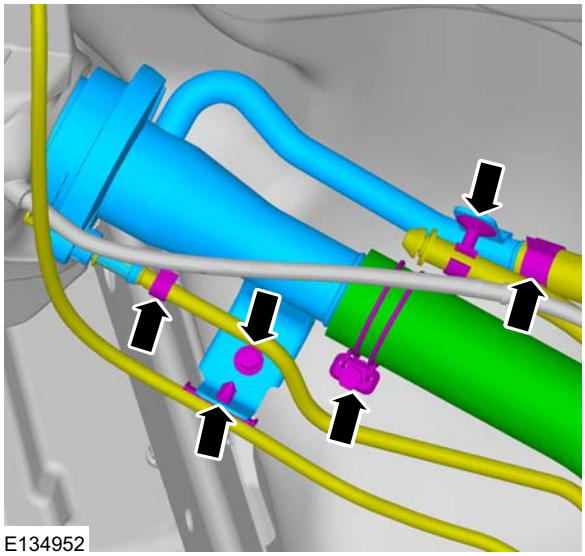


All vehicles

3.



4. Torque: 11 Nm



Installation

1. To install, reverse the removal procedure.

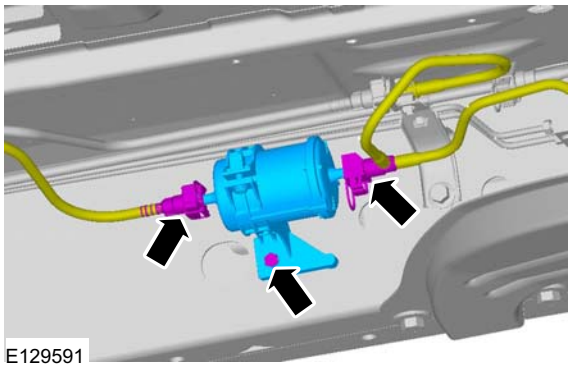
REMOVAL AND INSTALLATION

Fuel Filter

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: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Torque: 25 Nm



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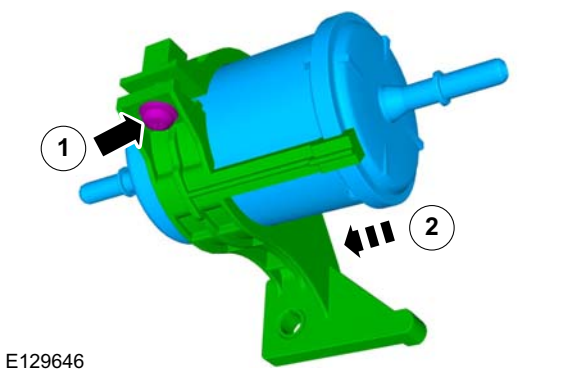


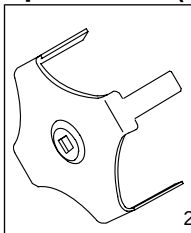
Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Fuel Pump and Sender Unit

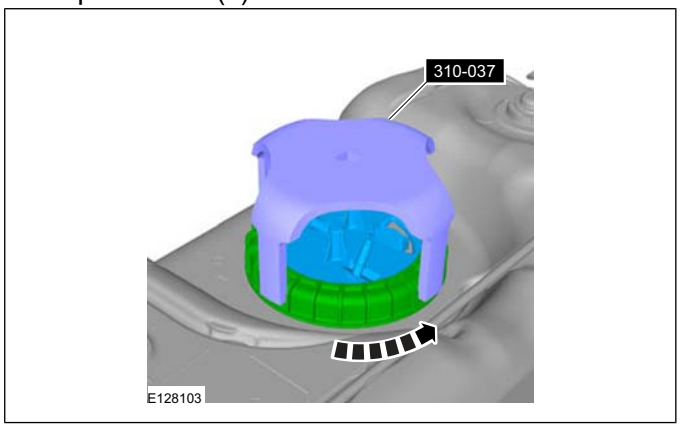
Special Tool(s)

 23042	310-037 Remover/Installer, Fuel Tank Sender Unit

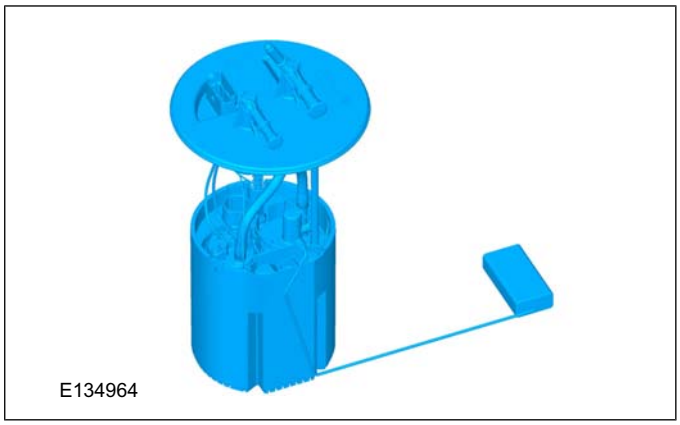
Removal

1. Refer to: Fuel Tank (310-01 Fuel Tank and Lines, Removal and Installation).
2. **CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.**

   Special Tool(s): 310-037



3.

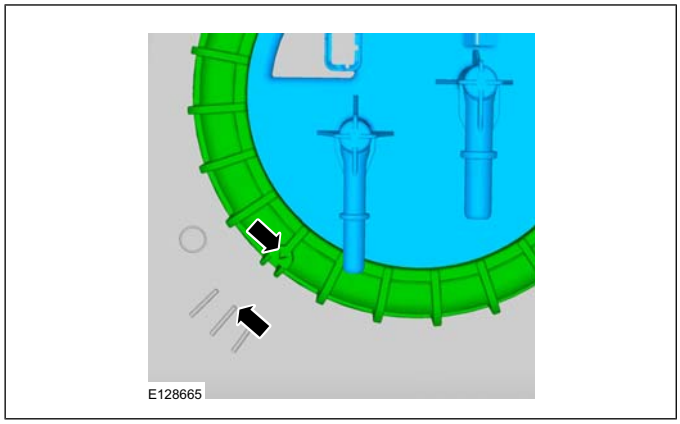


Installation

1. **CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.**

NOTE: Make sure that the seal is correctly located.

NOTE: Make sure that the installation marks are aligned.



2. To install, reverse the removal procedure.

SECTION 310-01B Fuel Tank and Lines — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma

VEHICLE APPLICATION: 2011.50 Ranger

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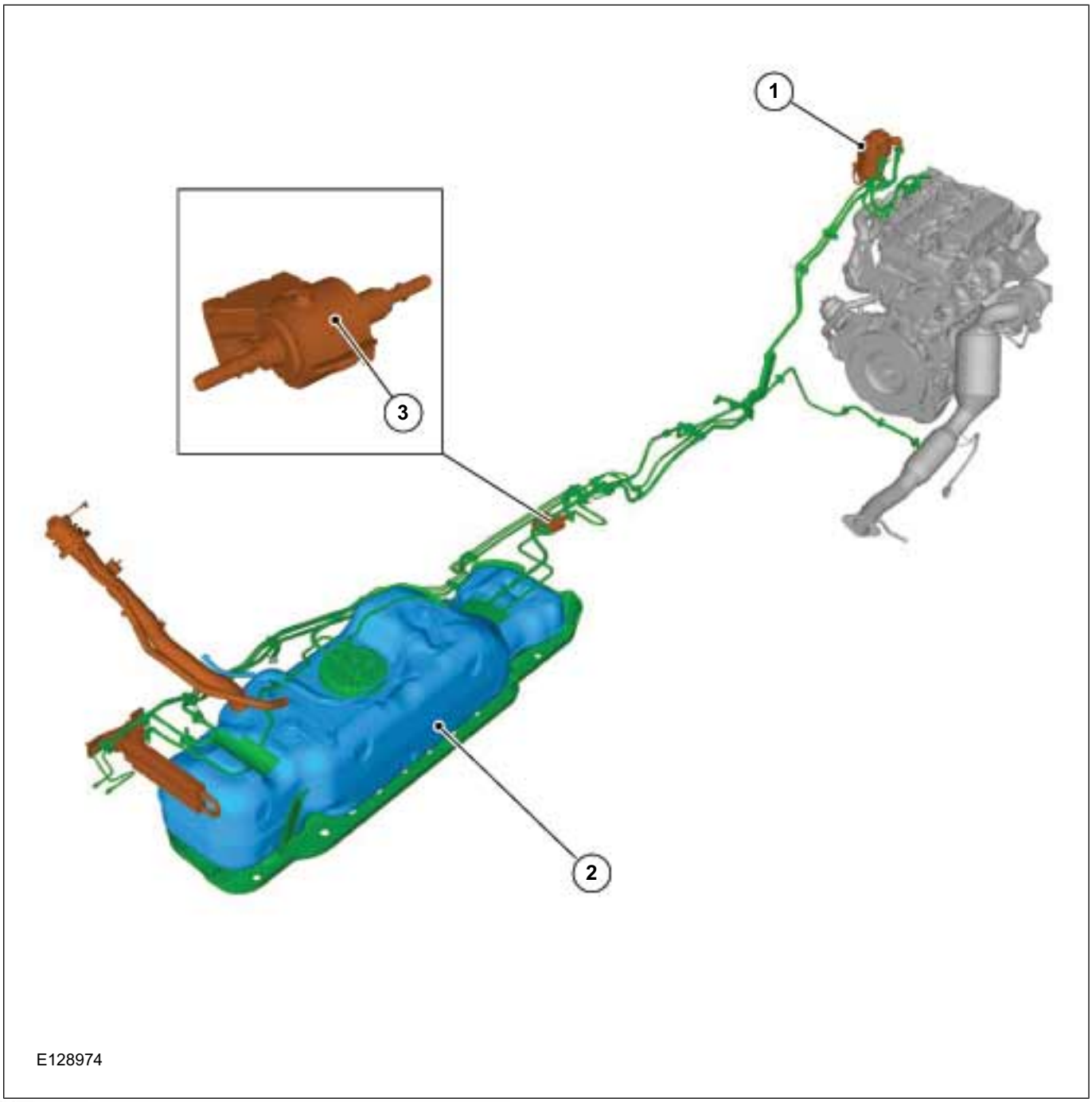
DESCRIPTION AND OPERATION

Fuel Tank and Lines

Vehicles with diesel engine

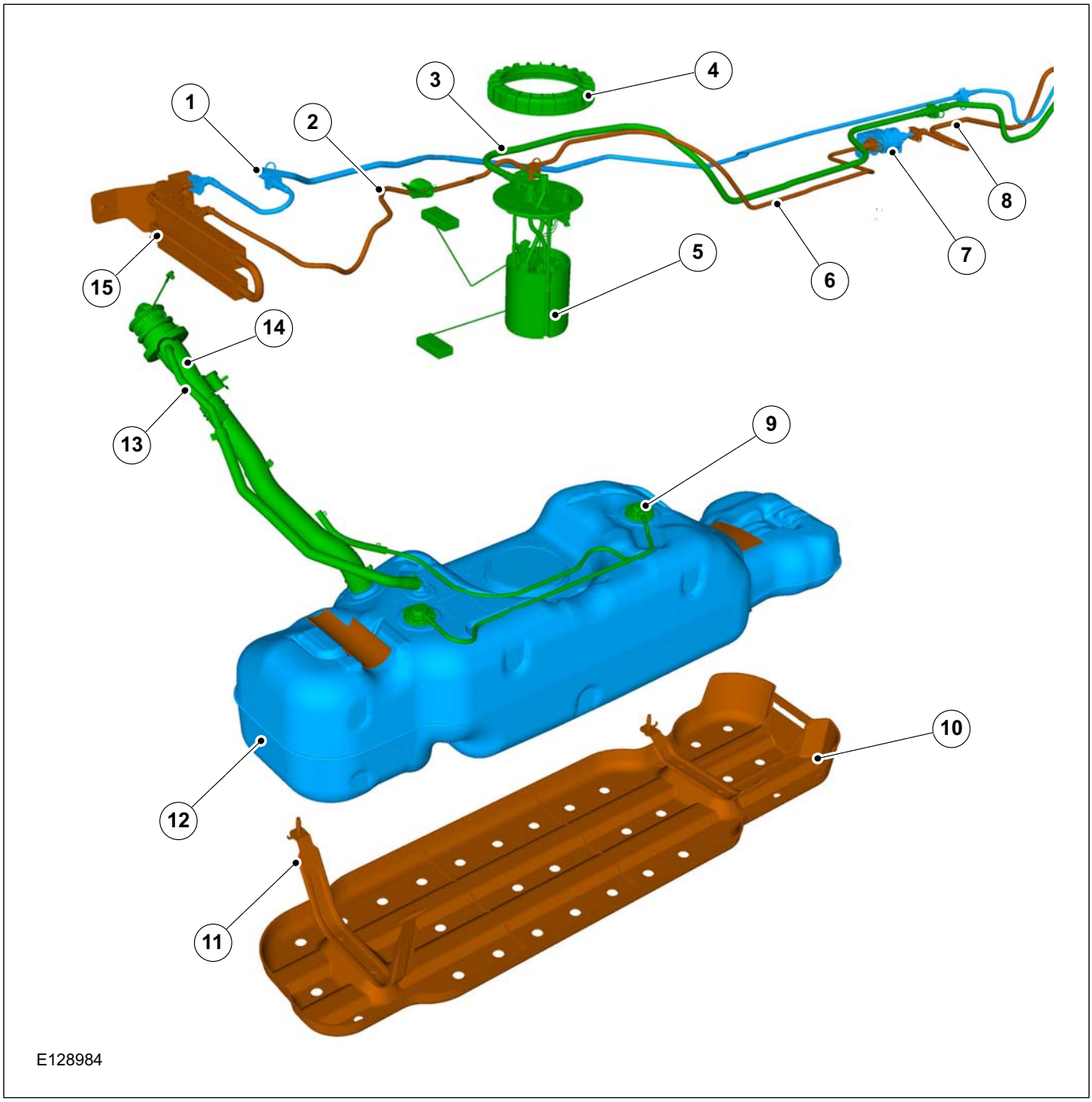


E128974

Item	Description
1	Fuel filter
2	Fuel tank
3	Primary fuel filter

DESCRIPTION AND OPERATION

Fuel tank supply and return lines



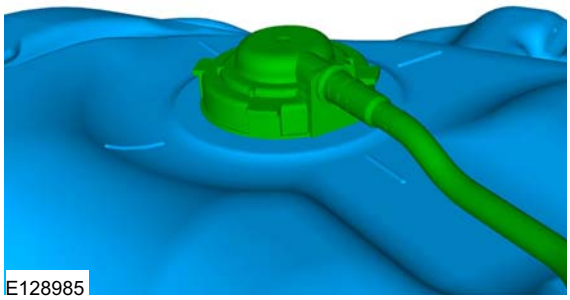
Item	Description
1	Return line from fuel filter to fuel cooler
2	Return line fuel cooler to fuel tank
3	Supply line fuel tank to fuel filter
4	Fuel level sensor locking ring
5	Fuel level sensor
6	Pipe connecting primary fuel filter to fuel tank

Item	Description
7	Primary fuel filter
8	Return line from vapouriser to primary fuel filter
9	Fuel tank vent valve(s)
10	Tank protector
11	Fuel tank support straps
12	Fuel tank

DESCRIPTION AND OPERATION

Item	Description
13	Breather pipe
14	Fuel tank filler pipe
15	Fuel cooler

Fuel tank vent valves

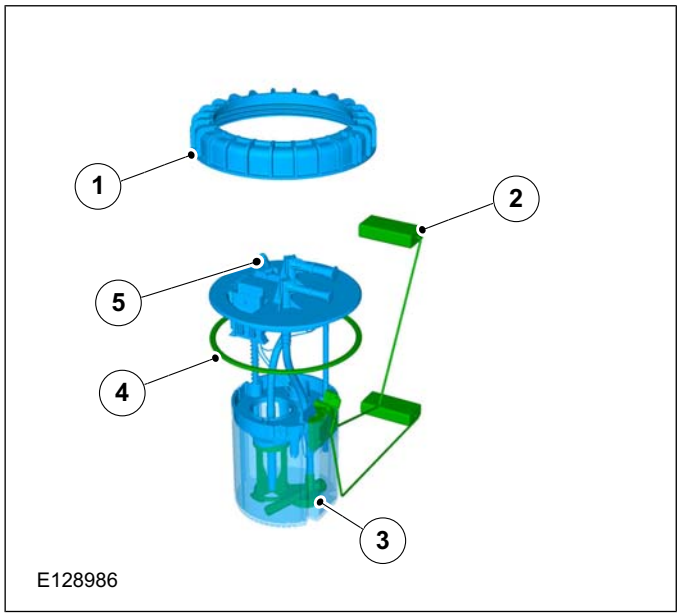


Fuel tank ventilation is achieved by two fuel tank vent valves. The fuel tank vent valves are integral to the fuel tank and will prevent fuel loss from the fuel tank if the vehicle becomes inverted.

Under normal working conditions, the pressure within the fuel tank is controlled by allowing the fuel vapor to vent through the fuel tank vent valves to atmosphere. If the fuel tank becomes inverted, the fuel tank vent valves close preventing fuel being lost from the fuel tank.

If the fuel tank vent valves or the fuel vapor lines connected to the vent valves become restricted, vehicle performance will become impaired. The inability of the fuel tank to substitute the fuel demanded by the fuel charging system with air, will create a negative pressure in the fuel tank which will result in reduced fuel flow to the fuel pump.

Fuel Level sensor



Item	Description
1	Fuel level sensor locking ring
2	Fuel level sensor resistor card
3	Fuel jet pump and filter
4	Fuel level sensor sealing ring
5	Fuel fired booster heater fuel pickup connector

The fuel level sensor is located in the top of the fuel tank and is retained by a fuel level sensor locking ring and seal.

The fuel level sensor consists of a mechanical float attached to a variable resistor card by means of a rigid wire lever. The resistor card has two electrical elements. One element is solid and one element is a variable resistor. The resistance value created by the resistor card is sent to the central junction box (CJB) through a hard wired circuit. The CJB distributes the information from the fuel level sensor to the instrument cluster and the powertrain control module (PCM) using the controller area network (CAN) circuits.

The fuel level sensor resistor card can be susceptible to contaminated fuel, which can affect electrical continuity. This condition is normally temporary and self-rectifying. If the fuel level sensor has been removed, moving the rigid wire lever from empty to full a minimum of 10 times will normally be as effective as installing a new fuel level sensor. The most common symptom of contamination occurs after refuelling where the electrical contact moves to an area of the resistor card which has not been used for several days. This results in a

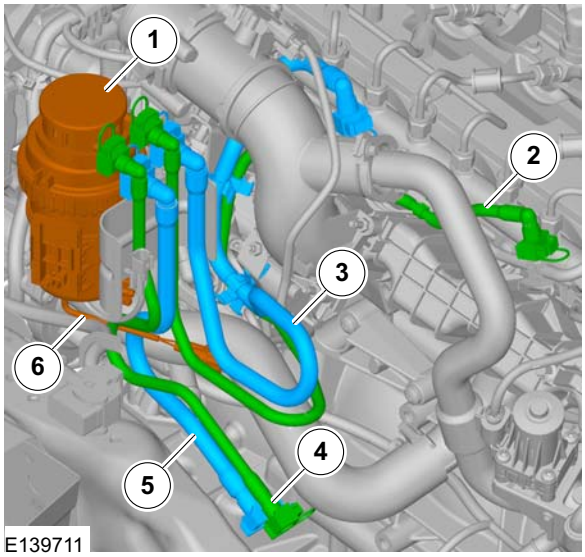
DESCRIPTION AND OPERATION

very slow movement of the fuel gauge pointer from empty to full over approximately 15 minutes. In more extreme cases where the resistor card resistance is continuously outside the permitted range for more than 33 seconds, a DTC will be set in the CJB and the fuel gauge pointer will fall to its key-off position. In all cases where the fuel level sensor is suspected of being inoperative, worn or damaged, the Worldwide Diagnostic System (WDS) diagnostic procedures must be followed before any parts are dismantled.

The base of the fuel level sensor is a chamber that sits in the swirl bowl at the bottom of the fuel tank. Built into the chamber is a filter element.

The fuel level sensor also incorporates a fuel jet pump. The return fuel from the fuel charging system is passed through a venturi in the jet pump which causes a pressure drop across an open orifice. This draws in fuel through the base of the unit which then passes through the fuel supply tube.

Fuel Filter



Item	Description
1	Fuel filter
2	Supply line fuel filter to engine
3	Return line from Engine to Filter
4	Return line fuel filter to fuel cooler
5	Supply line from tank to fuel filter
6	Water-in fuel sensor

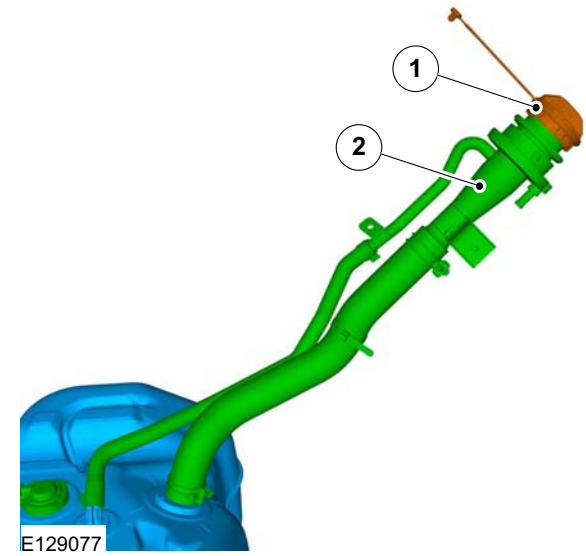
Fuel is delivered through the fuel supply lines to the fuel filter. The fuel filter cleans the fuel of water and contaminants. Unused fuel is returned to the fuel tank through the fuel cooler return line.

The fuel filter is also equipped with a water-in-fuel sensor which measures the amount of water which has collected in the fuel filter element.

Fuel Tank

The fuel tank is of a plastic construction and has the capacity to hold 80 liters of fuel. The fuel tank is secured to the vehicle by two metal support straps bolted to the underside of the vehicle.

Fuel filler



Item	Description
1	Filler cap
2	Fuel tank filler pipe

The fuel tank filler pipe incorporates a fuel tank vent pipe. The fuel tank vent pipe is connected to the top of the fuel tank and exits just below the top of the fuel tank filler pipe. The fuel tank vent pipe allows the displaced air above the fuel in the fuel tank to escape without pushing the fuel entering the fuel tank during refill back up the fuel tank filler pipe.

This vehicle uses a lockable fuel filler cap.

The fuel filler cap is sealed to the fuel filler neck. This is to prevent the escape of fuel vapor during normal operation and to prevent fuel loss in the event of a vehicle accident.

REMOVAL AND INSTALLATION

Fuel Tank

General Equipment

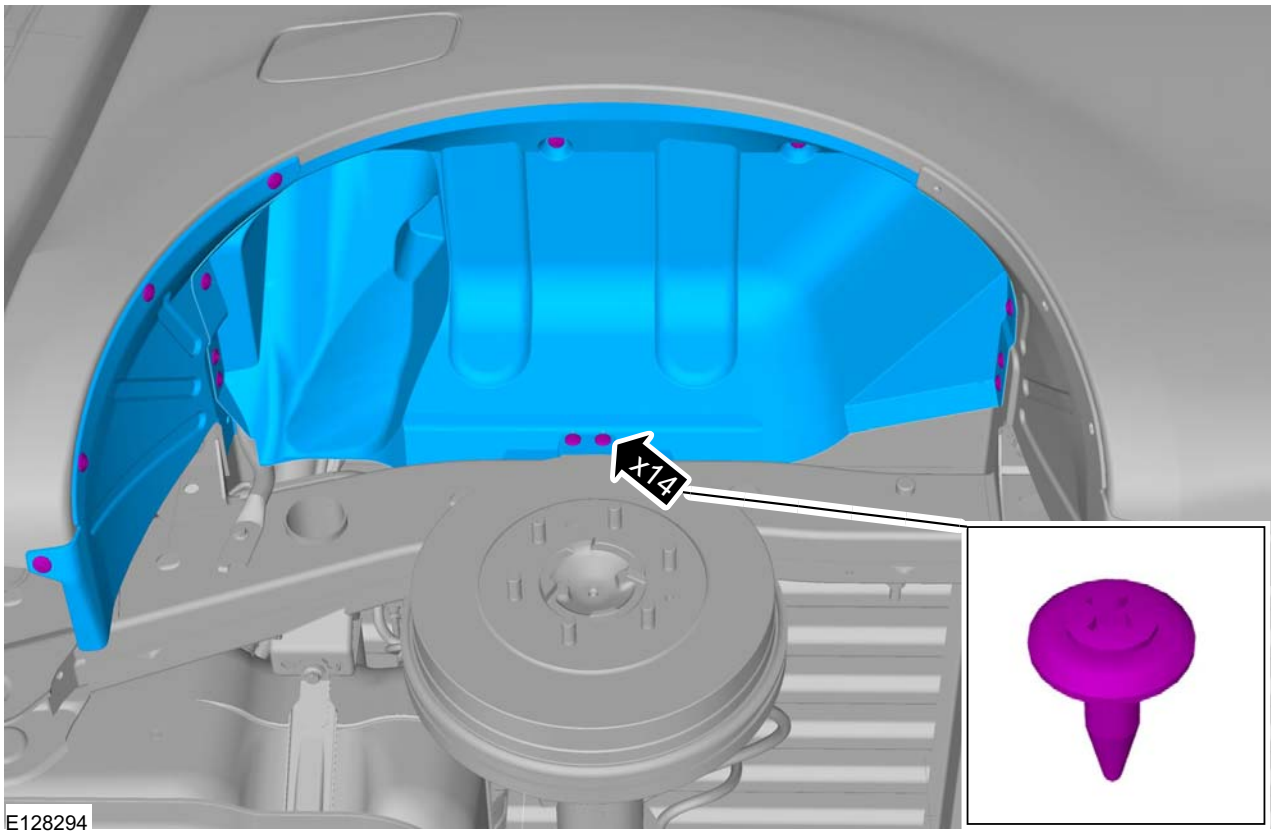
Transmission Jack

Removal

WARNING: Make sure that the fuel pressure has dropped to zero and that the fuel temperature is at ambient air temperature.

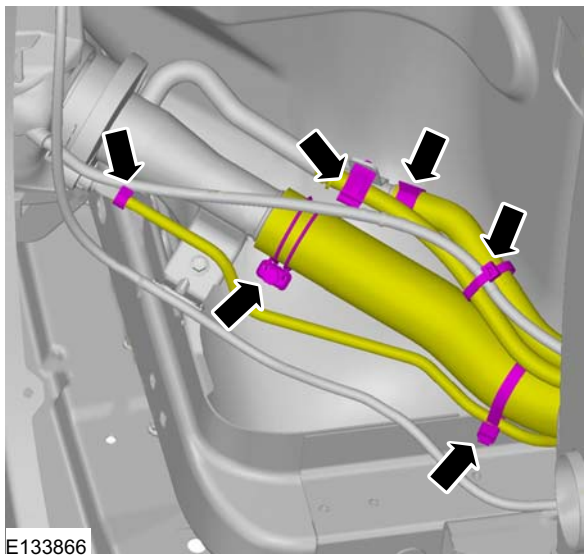
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Drain the fuel into a suitable container.
4.



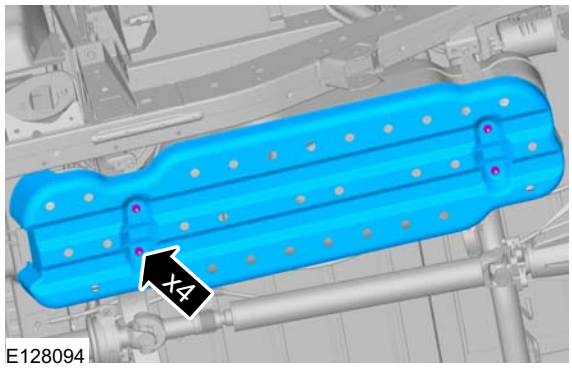
REMOVAL AND INSTALLATION

5.



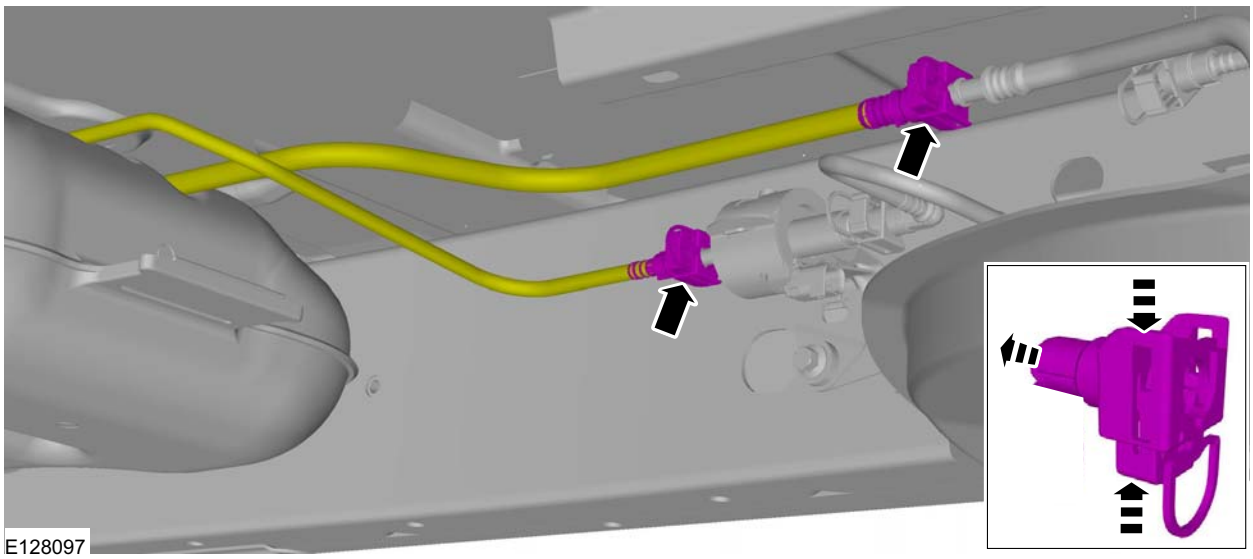
Double cab

6. Torque: 10 Nm



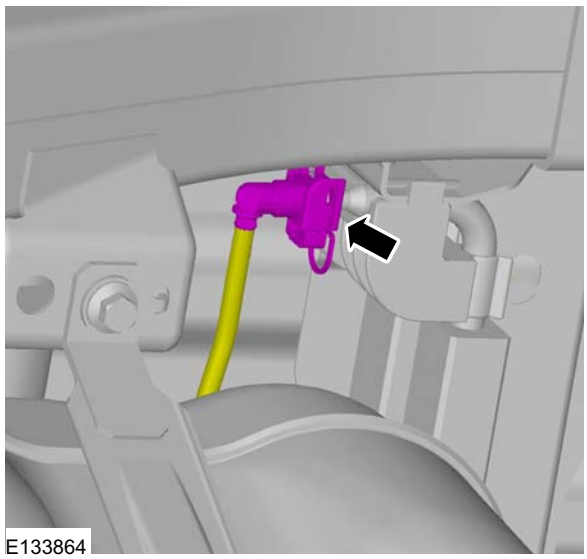
All vehicles

7. **WARNING: Fuel may still be present in the fuel tank after draining.**

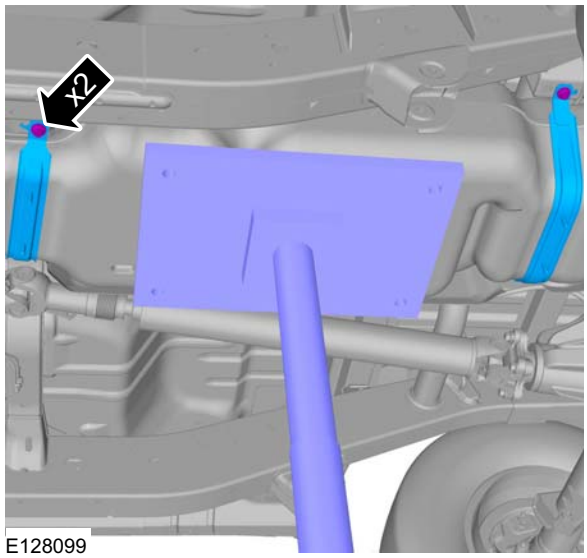


REMOVAL AND INSTALLATION

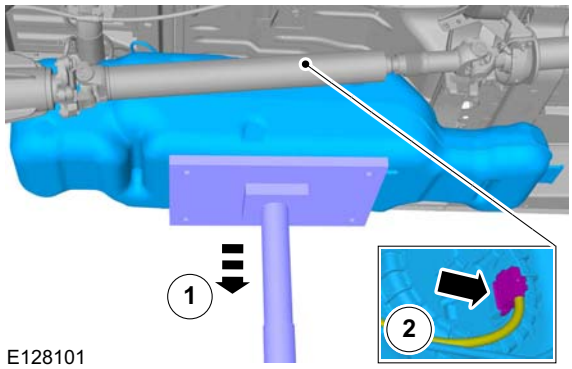
8.



9. General Equipment: Transmission Jack
   Torque: 50 Nm



10. **NOTE:** Move the fuel tank to a designated safe area and slowly release the remaining fuel pressure.



Installation

1. **CAUTION: If the fuel tank has been filled with the wrong type of fuel, the engine must not be started before the fuel system is cleaned.**

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

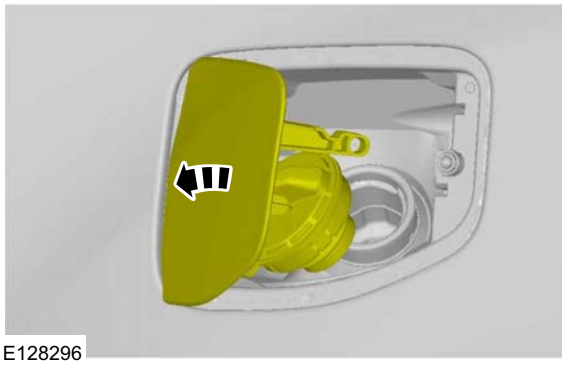
Fuel Tank Filler Pipe

Removal

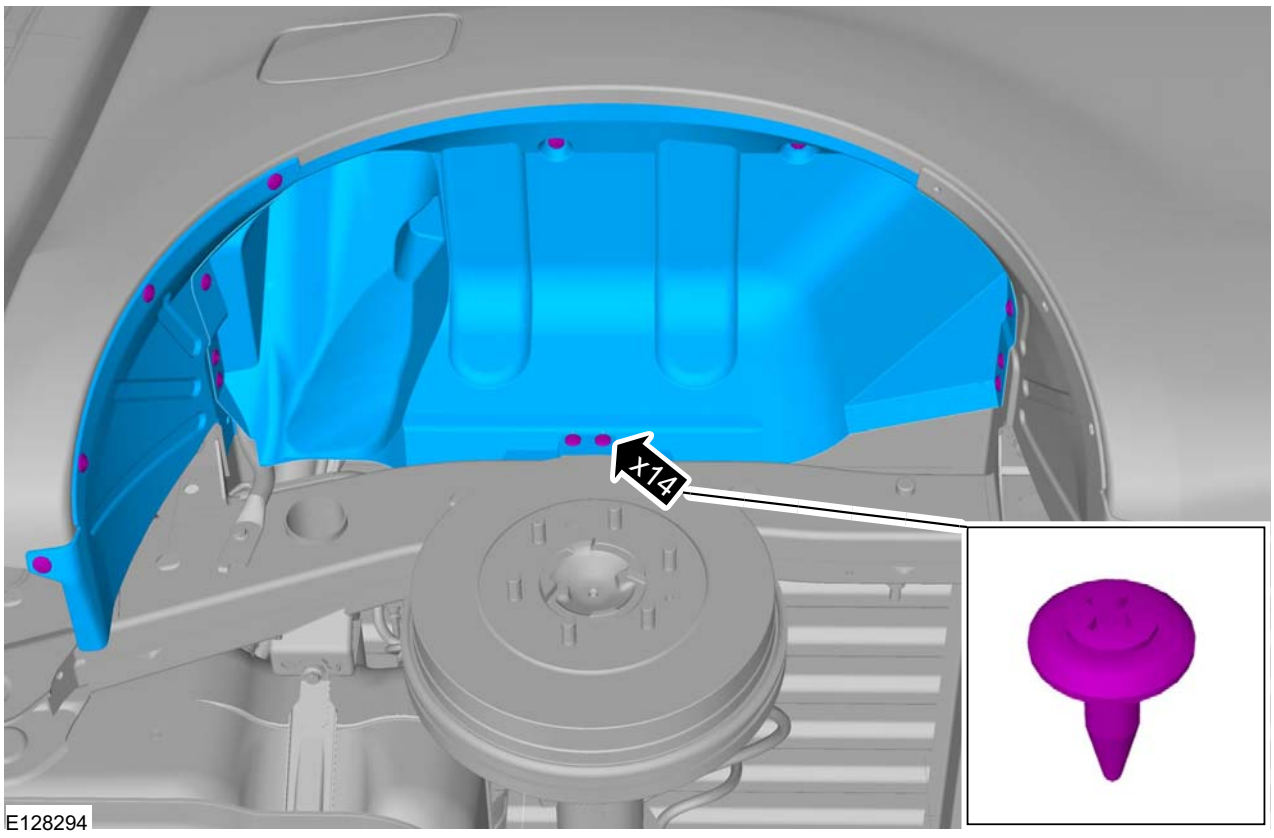
WARNING: Wait for a minimum of 1 minute after the engine has stopped before carrying out any repair to the fuel system.

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

1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
2.

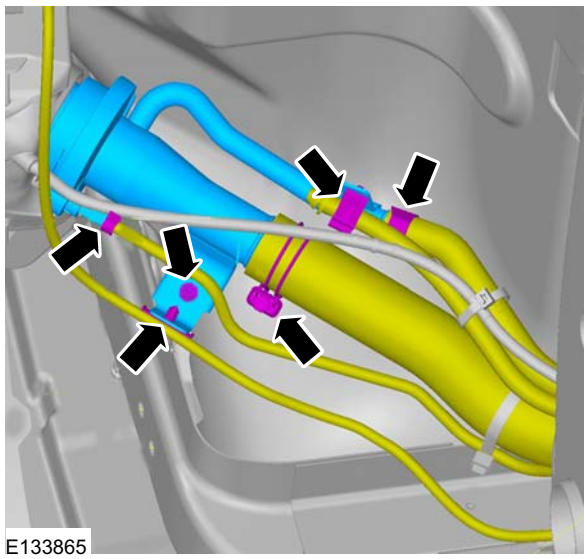


3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4.



REMOVAL AND INSTALLATION

5. Torque: 11 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

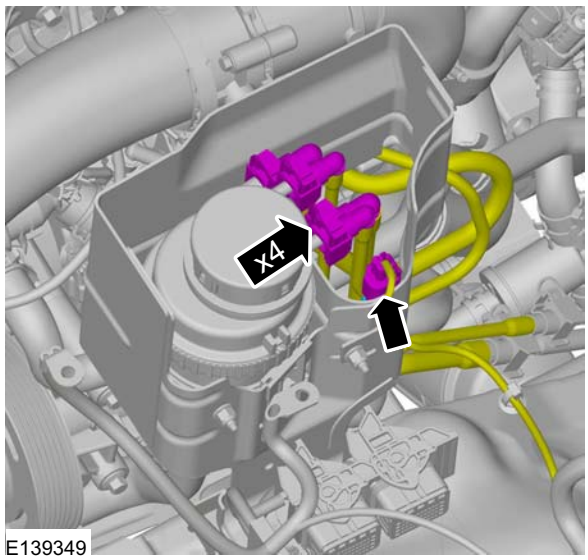
Fuel Filter

Removal

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

1. Refer to: Diesel Fuel System 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: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, General Procedures).

4.



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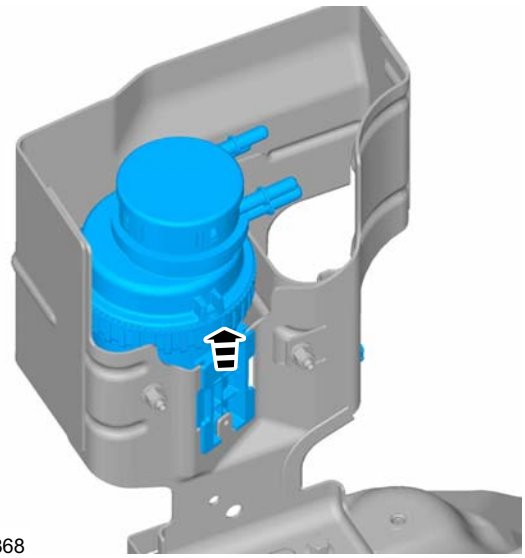


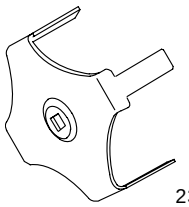
Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Fuel Level Sender

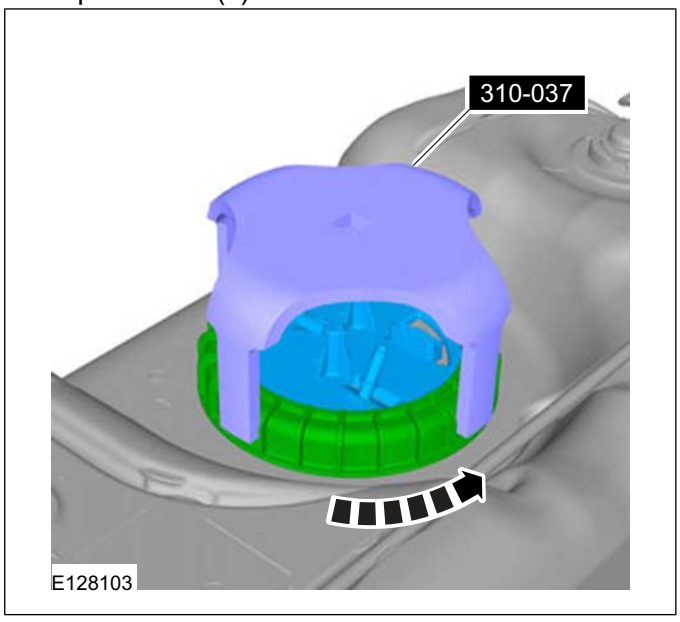
Special Tool(s)

 23042	310-037 Remover/Installer, Fuel Tank Sender Unit

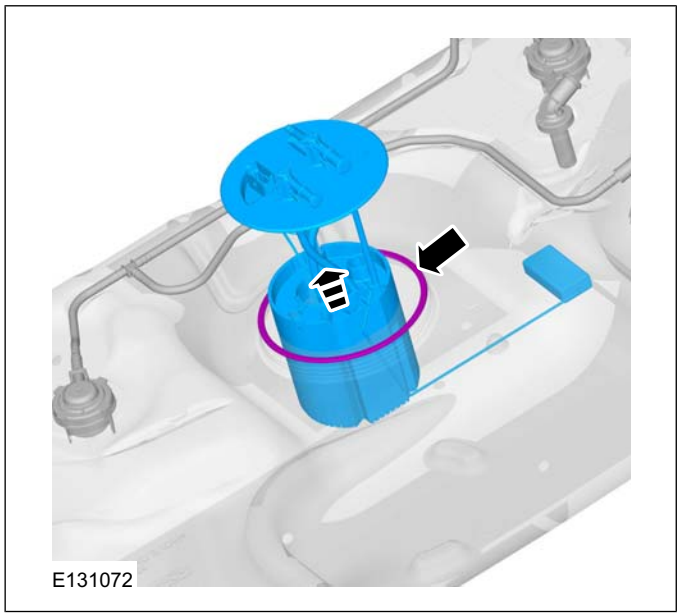
Removal

1. Refer to: Fuel Tank (310-01 Fuel Tank and Lines - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
2. **CAUTION: Take extra care not to damage the fuel tank level sensor float and arm .**

   Special Tool(s): 310-037

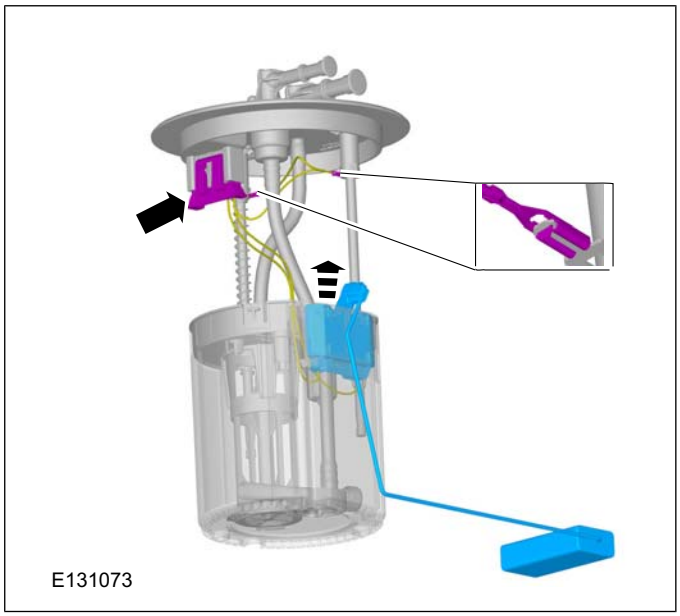


3. **CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.**



REMOVAL AND INSTALLATION

4.

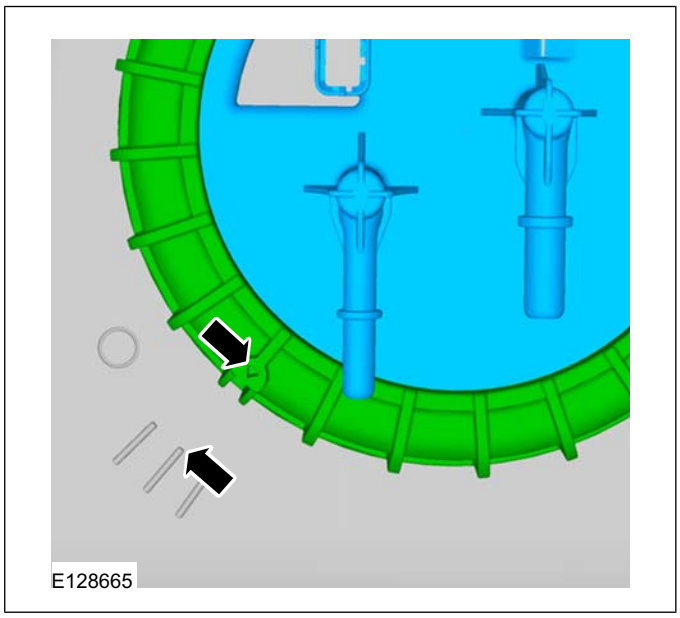


Installation

1. To install, reverse the removal procedure.
2. **CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.**

   NOTE: Make sure that the seal is correctly located.

   NOTE: Make sure that the installation marks are aligned.



SECTION 310-02 Acceleration Control

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

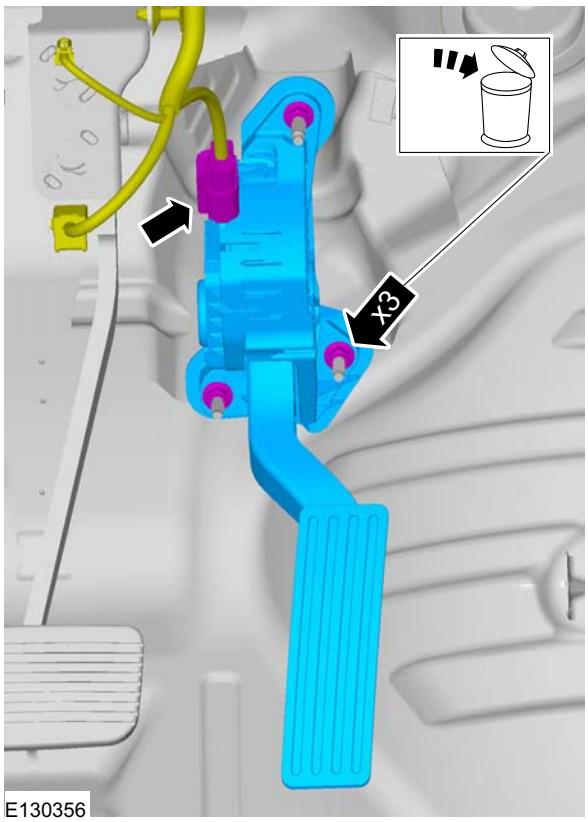
Accelerator Pedal

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).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

2. Torque: 11 Nm



Installation

1. To install, reverse the removal procedure.

GROUP

4

Electrical

SECTION TITLE PAGE

SECTION 412-00 Climate Control System - General Information

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

SPECIFICATIONS

Lubricants, Fluids, Sealers and Adhesives

	Specifications
Refrigerant R134a	WSH-M17B19-A
Refrigerant oil	WSH-M1C231-B

Refrigerant Capacities (When Charging)

	Grams
Air Conditioning	650 ± 10

Refrigerant Oil Capacities (When Charging)

	Milliliters
Air Conditioning	150

Addition of Refrigerant Oil (When a new compressor is installed)

	Milliliters
Air conditioning compressor if the amount of refrigerant oil taken from the faulty compressor is 50 to 90 ml	Drain 70 from new compressor.
Air conditioning compressor if the amount of refrigerant oil taken from the faulty compressor is 91 to 120 ml	Drain 40 from new compressor.
Air conditioning compressor if the amount of refrigerant oil taken from the faulty compressor is more than 121 to 150 ml	Drain 0 from new compressor.

Addition of Refrigerant Oil (When new components are installed)

	Milliliters
Condenser	add 80.
Evaporator	add 40.
Every time refrigerant is evacuated.	as taken from the system
When all new components are installed (including compressor).	add 0.
When A/C system is flushed.	150

Clutch air gap

	mm
Compressor clutch air gap	0,35 - 0,65

Torque Specifications

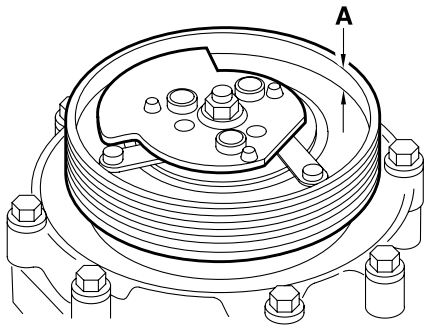
Item	Nm	lb-ft	lb-in
Compressor drive plate retaining bolt	13	10	–

GENERAL PROCEDURES

Air Conditioning (A/C) Clutch Air Gap Adjustment

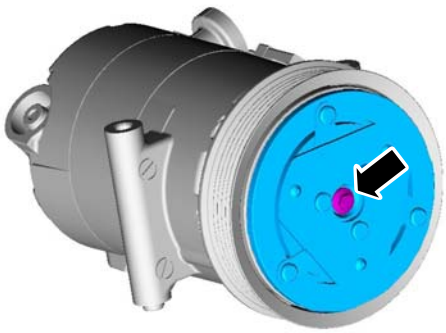
1. Check the gap A (measure the difference between the engaged and disengaged positions of the air conditioning clutch) at 60° intervals around the circumference of the pulley. Operate the air conditioning clutch several times with the aid of a 5 A fused cable. Refer to the relevant wiring diagram for the correct electrical connection.

   Refer to: Specifications (412-00 Climate Control System - General Information, Specifications).



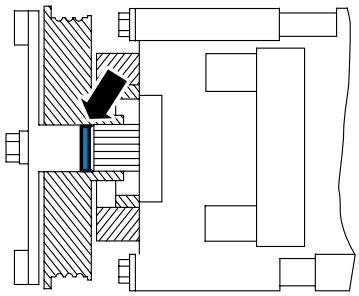
E92144

2.



E68442

3. If necessary correct the gap A using spacer washers.



E68470

4. Refer to: Specifications (412-00 Climate Control System - General Information, Specifications).

E68442

5. Check the gap A as described in step 1. If necessary, repeat steps 2-5.

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

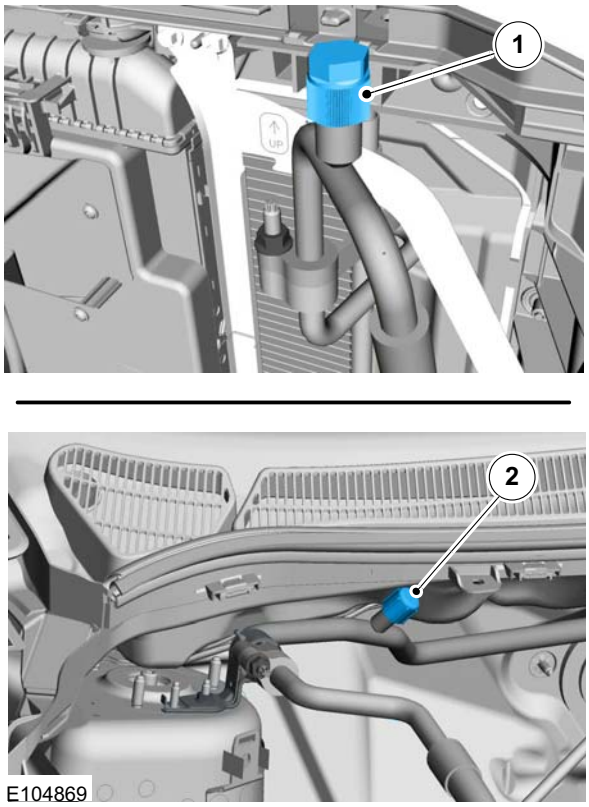
1. Refer to: Air Conditioning (A/C) System Health and Safety Precautions (100-00 General Information, Description and Operation).

2. **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.**

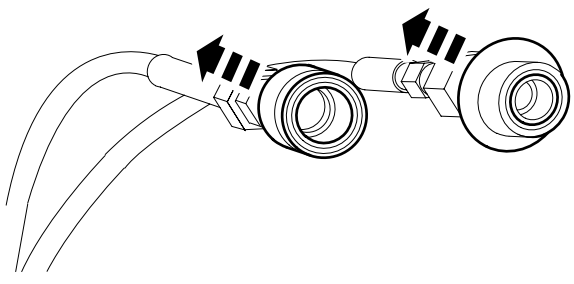
   Unscrew and remove the protective caps from the A/C charging connections.

   General Equipment: Air Conditioning Service Unit
   General Equipment: Refrigerant Identification Equipment

3. 1. Low-pressure connection
   2. High-pressure connection



4. Connect the service unit lines to the filling connection of the air conditioning system.



5. Drain the air conditioning system via the low-pressure port in accordance with the service unit manufacturer instructions.

6. **CAUTION: Make sure that the specified amount of refrigerant oil is added.**

   NOTE: This step is only required when installing a new component.

GENERAL PROCEDURES

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).

7. Evacuate the air conditioning system in accordance with the service unit manufacturer instructions.

8. **NOTE:** The system is leak-tight if the pressure increase does not exceed 20 mbar.

   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.

9. **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

10. 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).

11. Fill the air conditioning system with liquid through the high-pressure connection.

    Refer to: Specifications (412-00 Climate Control System - General Information, Specifications).

12. 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).

13. Fill the air conditioning system with gas through the low-pressure connection.

    Refer to: Specifications (412-00 Climate Control System - General Information, Specifications).

14. 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.

15. Disconnect the service unit.

16. 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.

17. Install all components in reverse order.

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

Leak detection

4. Refer to: Air Conditioning (A/C) System Health and Safety Precautions (100-00 General Information, Description and Operation).

5. **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 cigarette smoke and 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.

6. For the leak test, close the manual valves on the gauge set.

7. If little or no pressure is indicated, charge the system with approx. 300g of refrigerant.

   Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

8. **WARNING: Make sure that the surface is clean and free of foreign material.**

   NOTE: Make sure that the leak detector is calibrated and set in accordance with the operating instructions.

   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.

9. **CAUTION: Do not let the detector sensing tip contact any substance as this could cause a false reading and may damage the sensor.**

   Position the sensor about 5mm from the point to be checked. Circle each fitting completely.

10. If a leak is detected, repeat the leak detection process after blowing away the chemical detected with compressed air.

11. If a leak is detected again, extract the refrigerant under suction.

    Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

GENERAL PROCEDURES

Fluorescent Dye Leak Detection

General Equipment

UV Leak Detector

Leak detection

CAUTION: Make sure that the vehicle is in a low sunlight area before performing any actions.

12. Refer to: Air Conditioning (A/C) System Health and Safety Precautions (100-00 General Information, Description and Operation).
13. **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
14. After the leak is found and rectified, remove any traces of dye with a general purpose solvent.
15. 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: 2011.50 Ranger

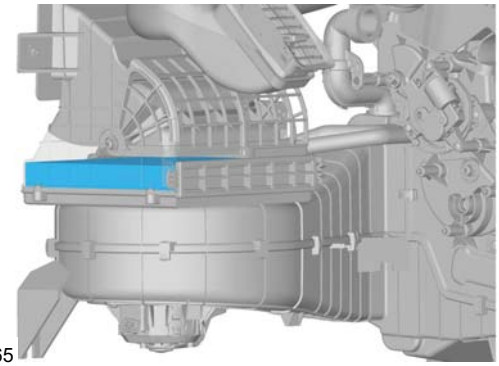
CONTENTS PAGE

DESCRIPTION AND OPERATION

REMOVAL AND INSTALLATION

DESCRIPTION AND OPERATION

Air Distribution and Filtering

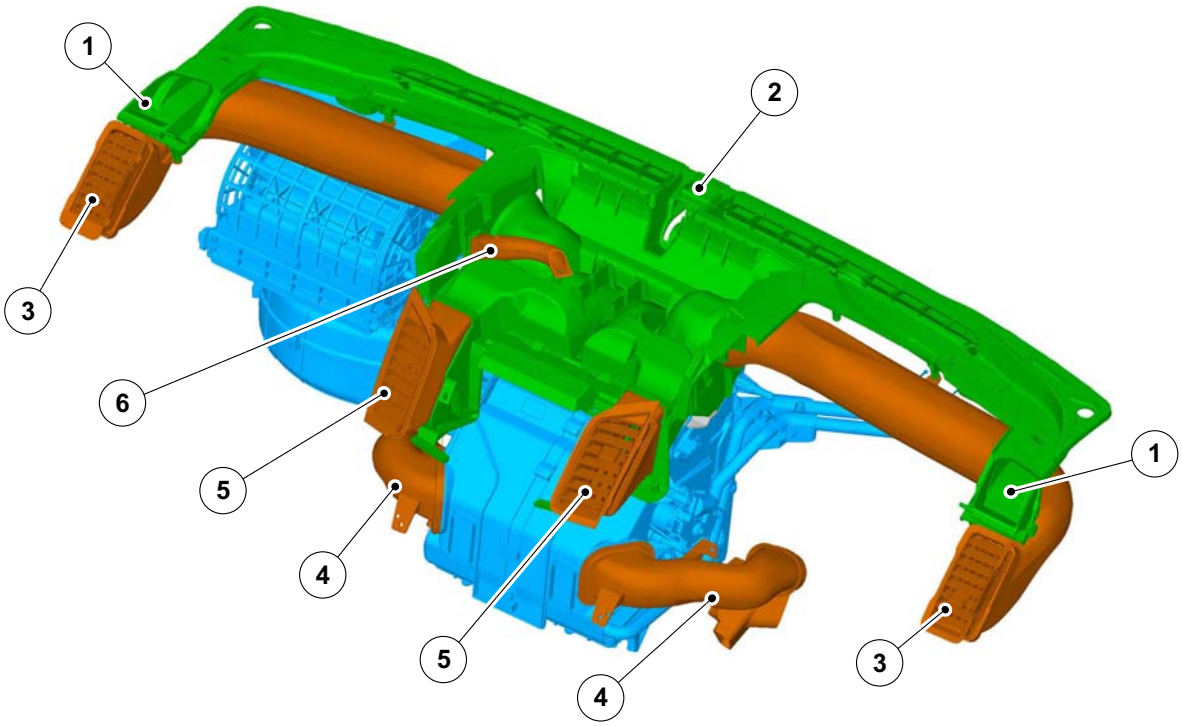

E129565

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.

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 off when the filter is changed. The service pollen filter is flexible and can be pushed together during installation or removal.

Air distribution, instrument cluster



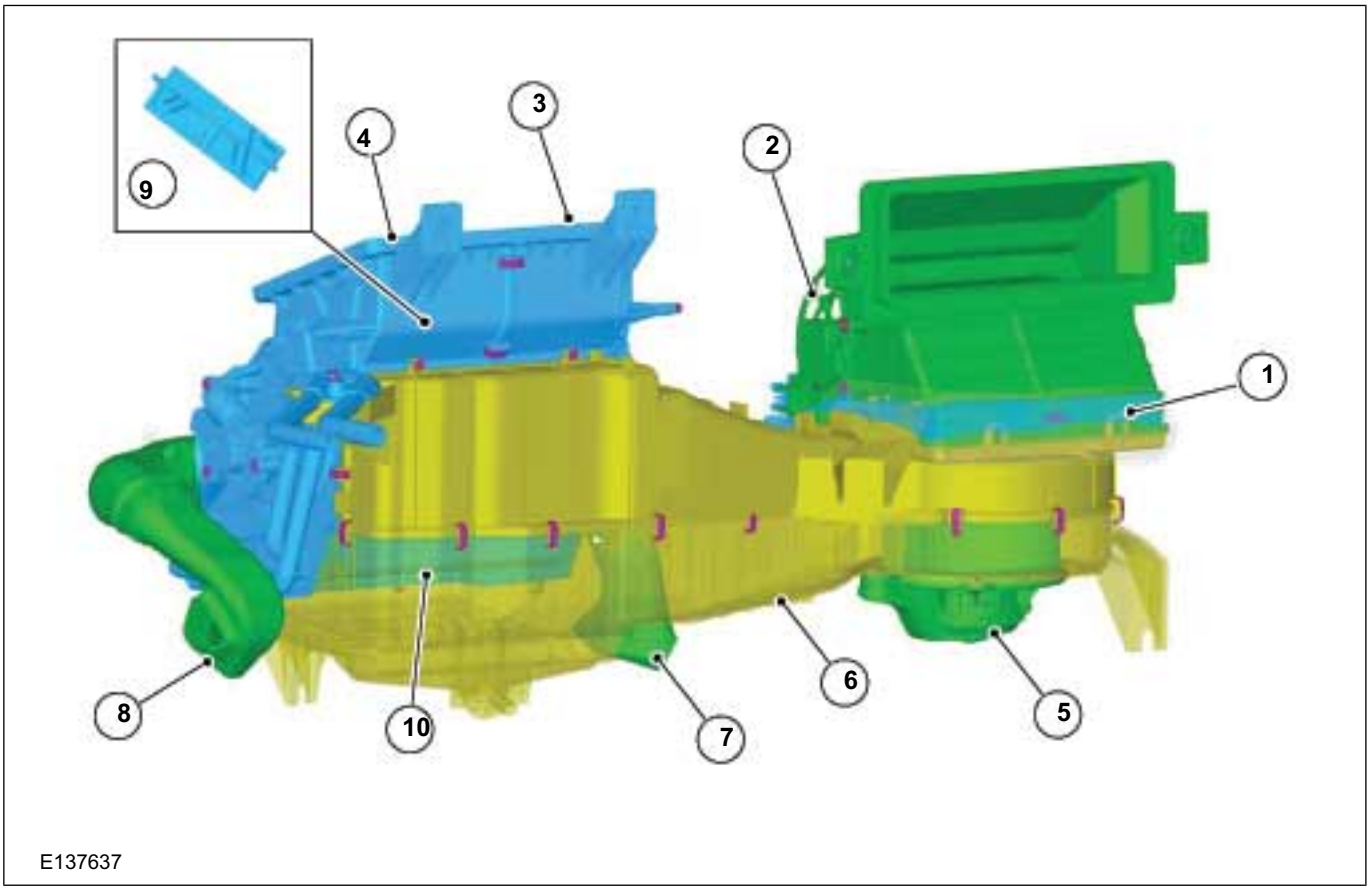
E129564

Item	Description
1	Air passages - side window defroster vents
2	Air passages – defroster vents
3	Air passages - side vents (adjustable)
4	Air ducts, front footwell
5	Center duct vent
6	Air Duct - Navigation Display (if fitted)

DESCRIPTION AND OPERATION

Heating and Ventilation

Overview of the climate control housing



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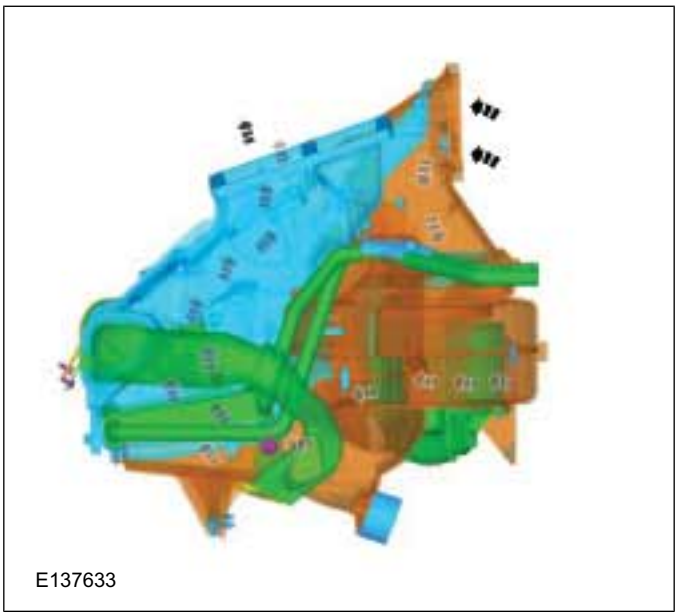
Item	Description
1	Pollen filter
2	Air inlet flap
3	Air Center vent
4	Air Defroster vent
5	Blower motor
6	Evaporator case
7	side foot well
8	Rear foot well
9	Air flip door
10	Heat exchanger

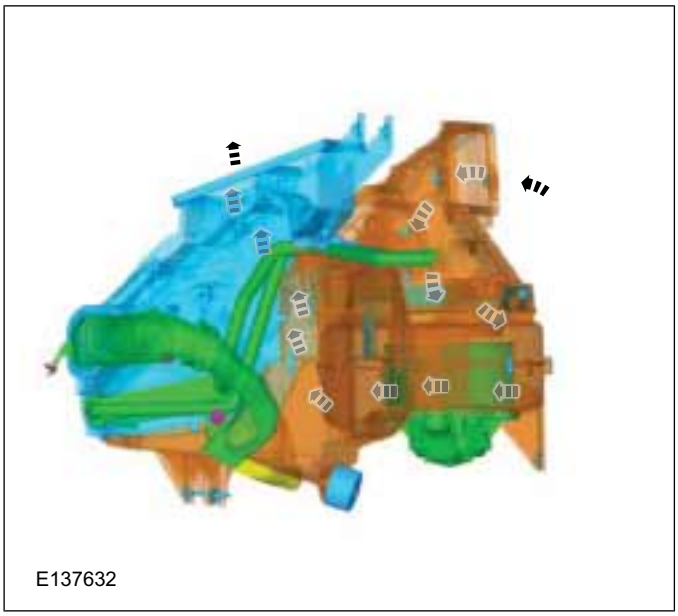
Air flow - defroster vent-Warm air



E137633

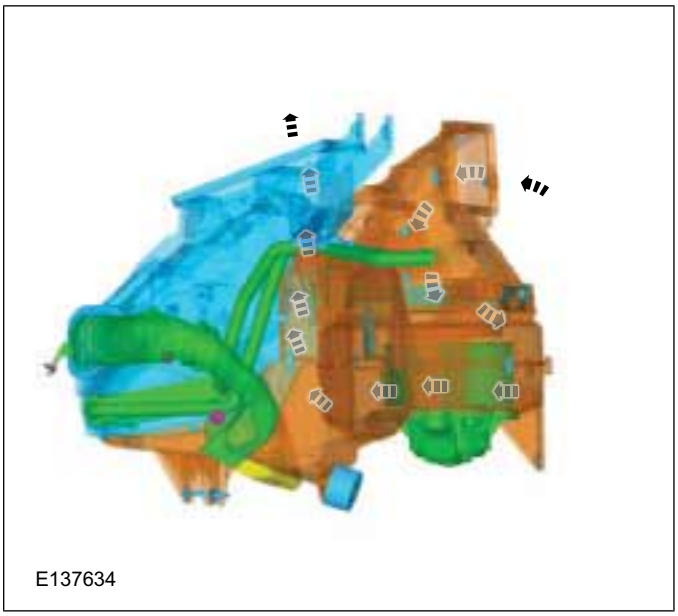
DESCRIPTION AND OPERATION

Air flow - defroster vent-Cold air



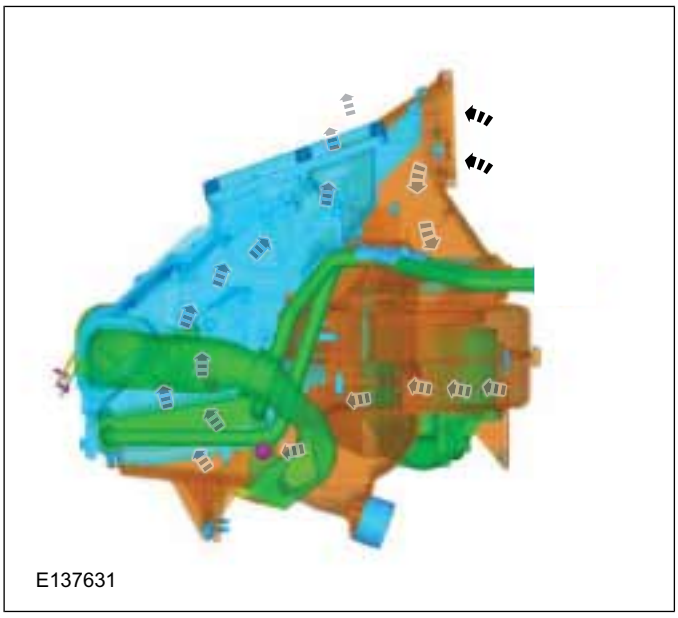
E137632

Air flow - center vent-Cold air



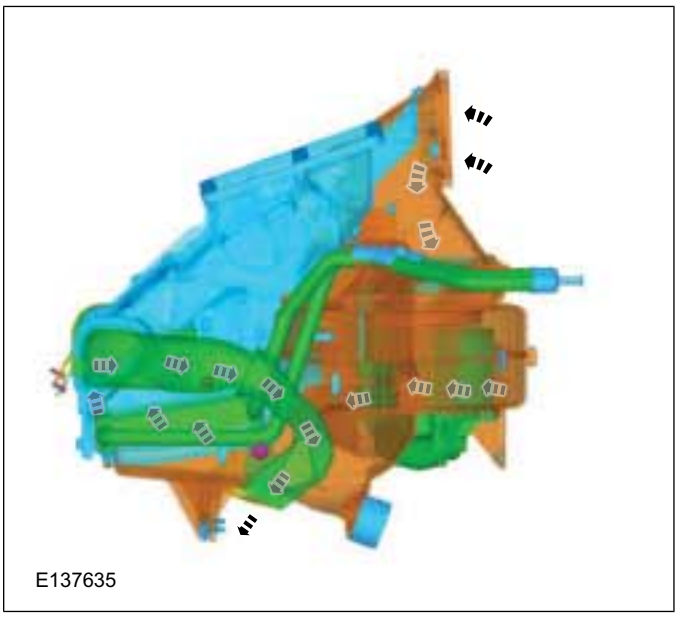
E137634

Air flow - center vent-warm air



E137631

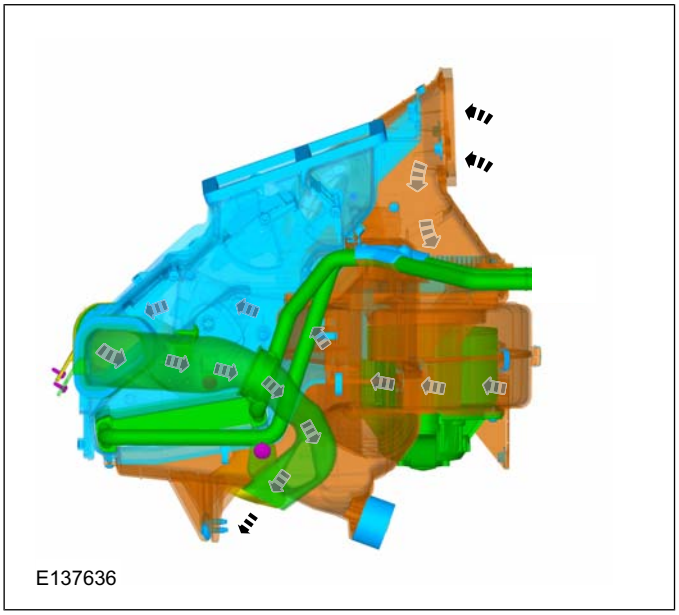
Air flow - foot well-Warm air



E137635

DESCRIPTION AND OPERATION

Air flow - foot well-Cold air



DESCRIPTION AND OPERATION

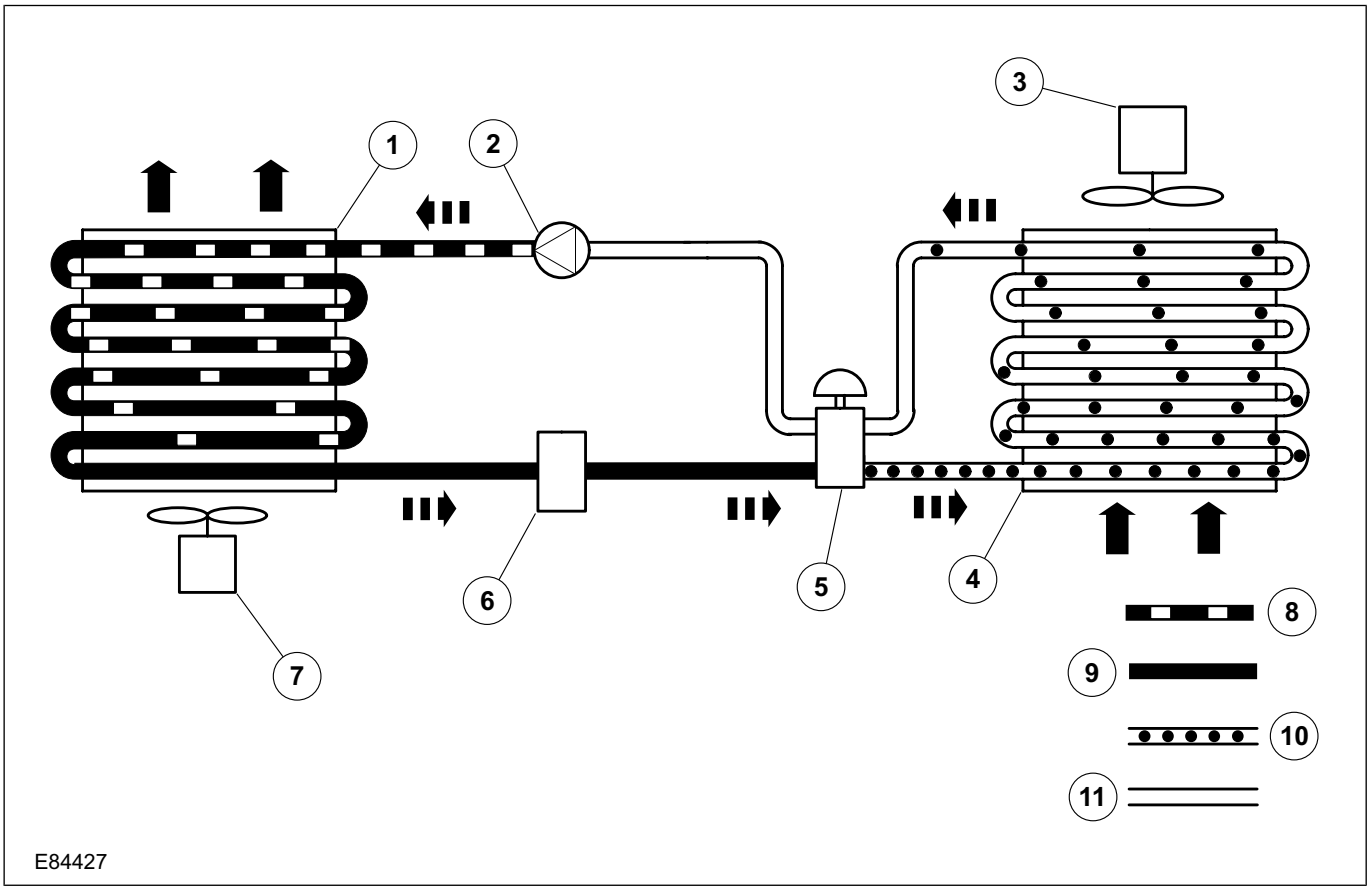
Air Conditioning

The air conditioning system is controlled by an thermostatic expansion valve. R134a refrigerant is used.

Two options are available:

- Manual climate control
- Air conditioning system with automatic temperature control (DEATC)

In order to prevent icing of the evaporator, the vehicles are equipped with a temperature sensor on the evaporator. The sensor measures the surface temperature of the cooling fins on the evaporator. If the measured temperature drops below a temperature of approx. +2 °C then the compressor clutch is deactivated. If the temperature increases above +4 °C the compressor is switched back on again. On systems with manual temperature control, the sensor signal is sent via the body control module (BCM) and the CAN bus to the powertrain control module (PCM), which then switches the compressor clutch on and off. On systems with automatic temperature control (DEATC) the sensor signal is first sent to the air conditioning module and then via the CAN bus to the PCM, which then switches the compressor clutch on and off.



E84427

Item	Description
1	Condenser
2	A/C compressor
3	Blower motor
4	Evaporator
5	Expansion valve
6	Refrigerant drier
7	Cooling fan

Item	Description
8	High pressure (gaseous and hot)
9	High - pressure (liquid and warm)
10	Low - pressure (liquid and cool)
11	Low-pressure (gaseous and cool)

Function

The refrigerant compressor (2) which is driven by the engine sucks in the gaseous refrigerant from the evaporator (5) and compresses it. The

DESCRIPTION AND OPERATION

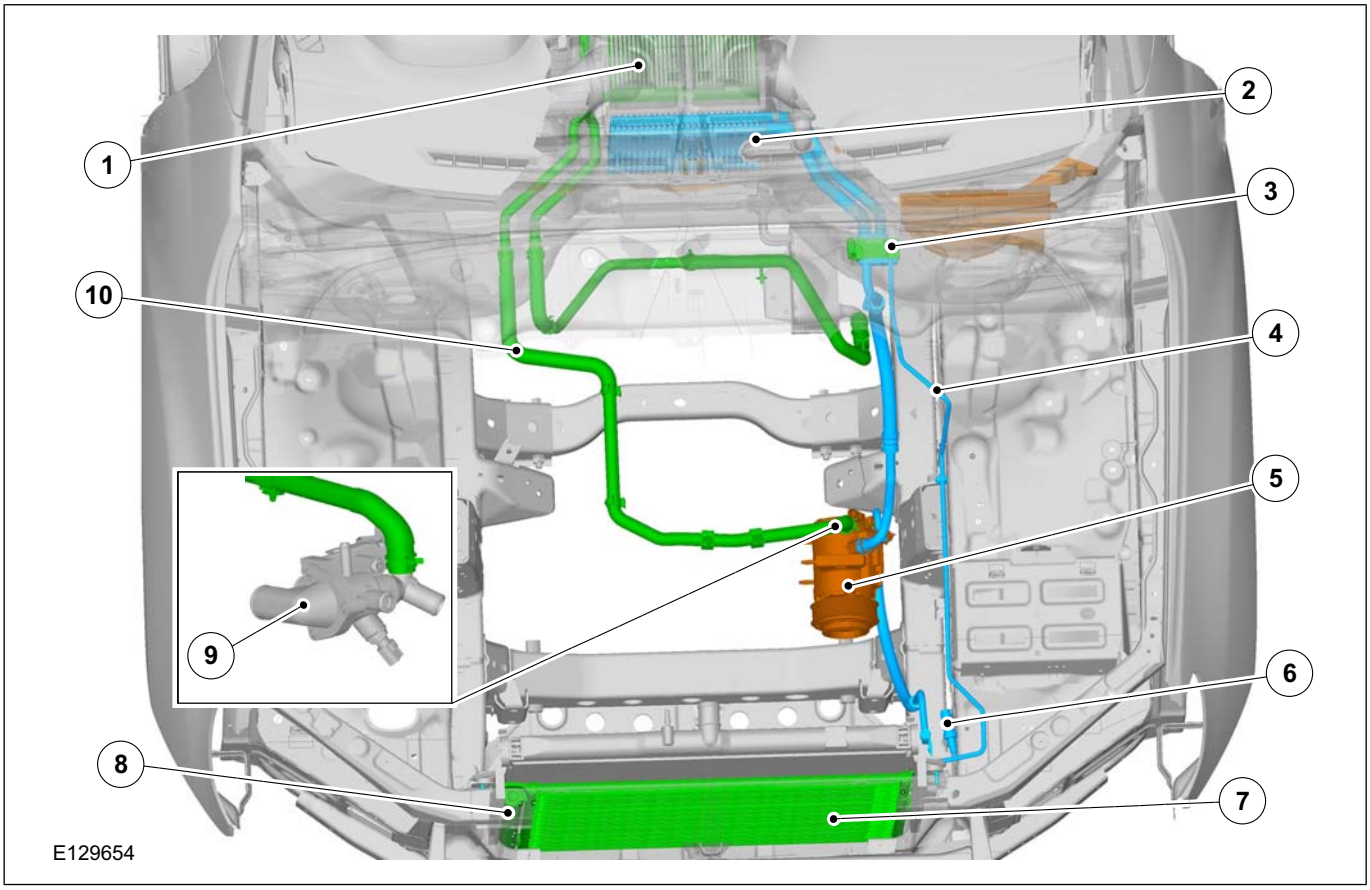
temperature of the refrigerant rises to a value between 70 °C and 110 °C. It passes to the condenser (1) under high pressure. At this point heat is drawn from the refrigerant by the air being forced past the cooling fins. Because of this heat loss, the refrigerant liquefies and leaves the condenser.

The refrigerant then passes under high pressure to the refrigerant drier (8). This serves as a storage medium and filters out any moisture contained in the refrigerant.

The expansion valve (6) regulates the quantity of refrigerant injected into the evaporator (5) as a function of the pressure and temperature in the evaporator. The liquid refrigerant is vaporized in the evaporator. This causes heat to be extracted from the air coming into the vehicle. The air therefore cools down and the moisture it contained is given up at the evaporator core.

The gaseous flow of refrigerant which comes out from the evaporator at low pressure enters the expansion valve at the upper opening, from where it is sucked in by the refrigerant compressor.

The A/C pressure converter sensor sends an analog signal to the PCM. After evaluating the different input signals, the PCM sends a control signal to the A/C clutch relay, which engages and disengages the compressor clutch. The PCM input signals come from the blower motor switch via the evaporator temperature sensor (vehicles with manual temperature control), via the A/C module (vehicles with automatic temperature control), the A/C pressure converter sensor and the PCM.

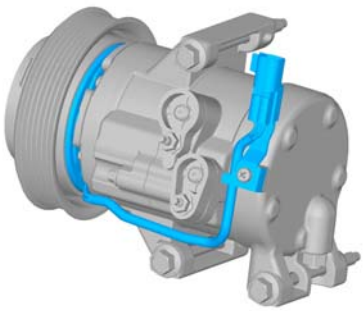


Item	Description
1	Heater core
2	Evaporator
3	Expansion valve
4	A/C lines
5	A/C compressor
6	Condenser

Item	Description
7	Refrigerant drier
8	Coolant Pump
9	Heater lines

DESCRIPTION AND OPERATION

Electronic refrigerant compressor control valve



E129655

A refrigerant compressor with electronic control valve is used. The control valve regulates the delivery rate of the refrigerant compressor according to the request received from the A/C module.

DESCRIPTION AND OPERATION

Control Components

Control assembly, climate control - vehicles with manual temperature control

In vehicles with manual temperature control, the heating and A/C (air conditioning) are operated using three rotary switches. The air distribution flap and the temperature control flap are electrically actuated and controlled via potentiometer switches on the control head.

In addition, the operating switch for recirculated air, heated front screen, heated rear screen and the on/off switch for the air conditioning are located on the control assembly.

Vehicles with manual temperature control have a control assembly with the following functions:

Button operated functions include:

- Switching the air conditioning system on and off
- Switching the windshield defrost function on and off
- Recirculated air control
- Switching the heated rear screen on and off

Dial adjustments include:

- Temperature adjustment
- Air distribution
- Blower Control
- A/C max (used to cool the interior quickly)

Control assembly, climate control - vehicles with automatic temperature control

Vehicles with automatic temperature control have a control assembly with the following functions:

Button operated functions include:

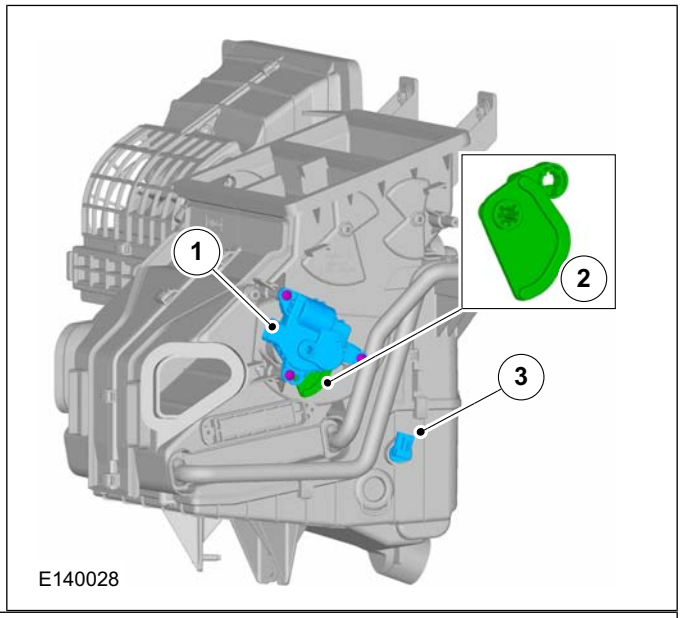
- Switching the air conditioning system on and off
- Air distribution
- Switching the max defrost function on and off
- Switching automatic climate control on and off
- Recirculated air control
- Switching the front and rear demist function on and off

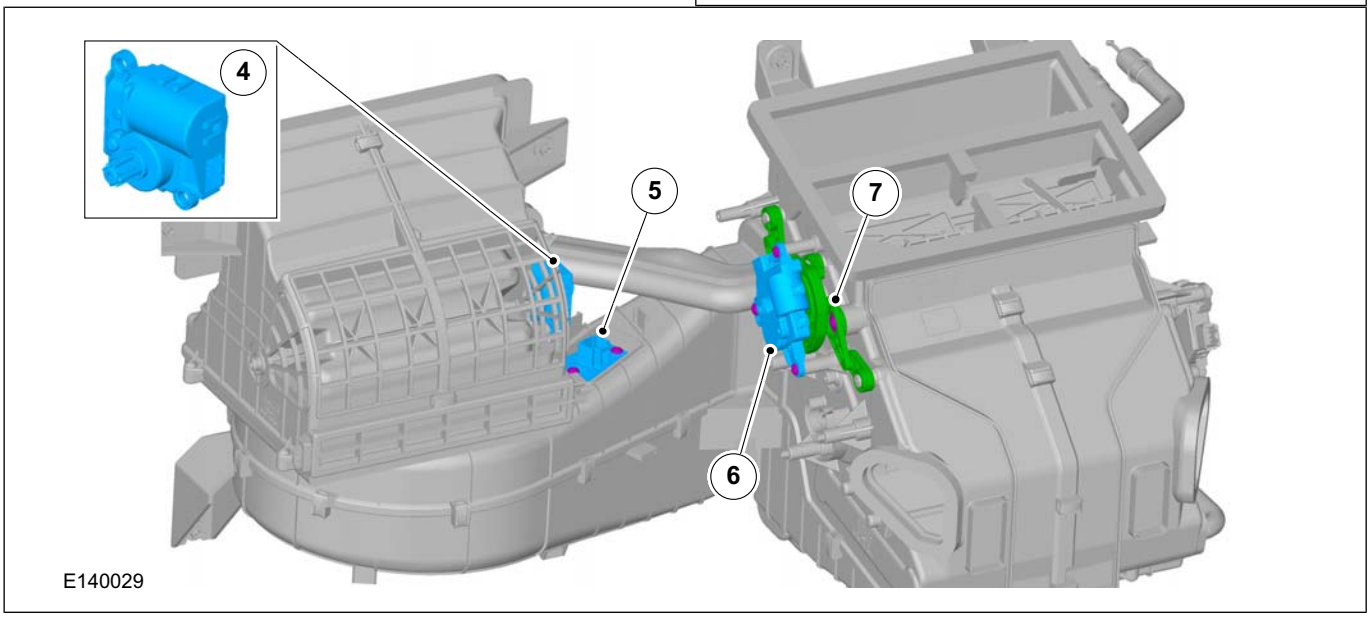
Dial adjustments include:

- Dual zone or mono zone temperature adjustment (between driver and passenger side)
- Switching the automatic climate control on and off
- Blower control

DESCRIPTION AND OPERATION

Overview of the climate control housing - vehicles with manual temperature control

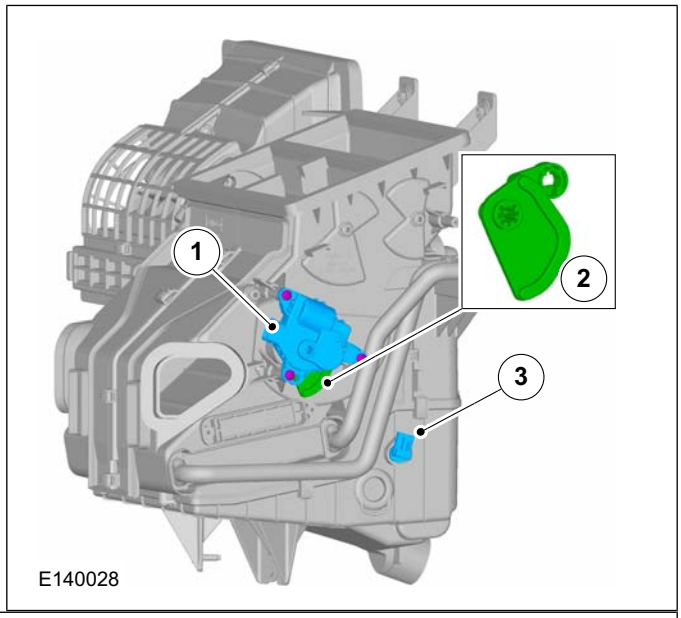


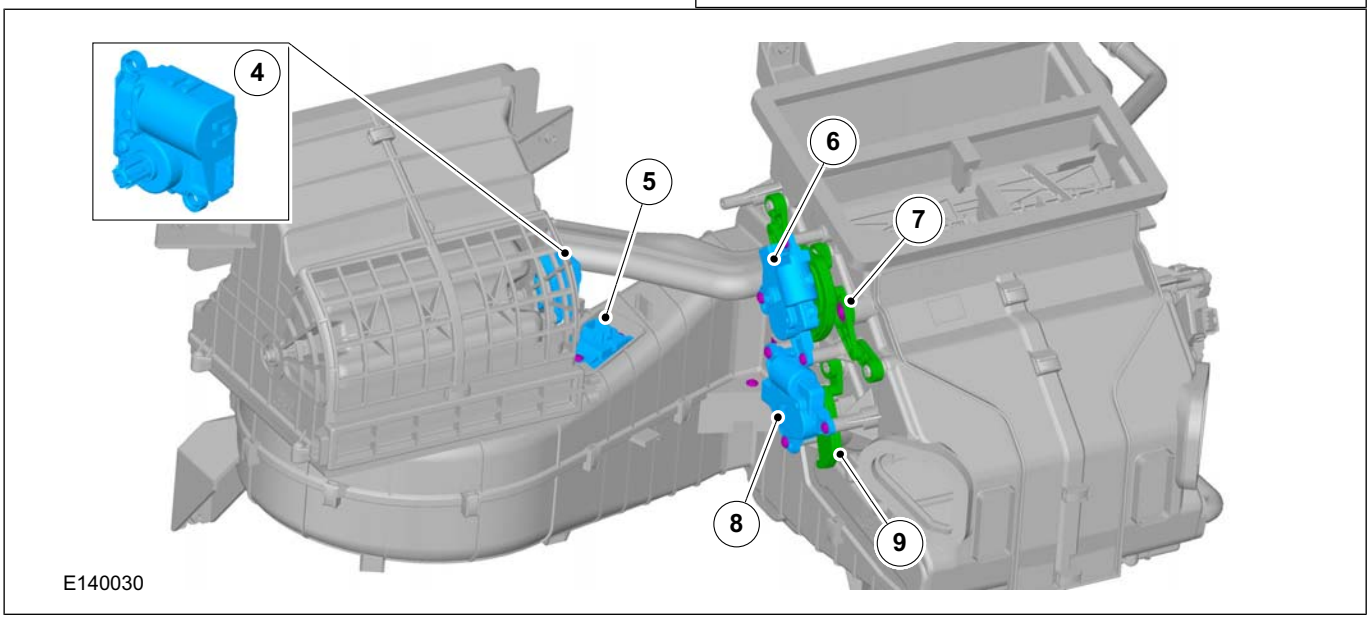


Item	Description
1	Actuator - temperature flap
2	Lever - temperature control
3	Temperature sensor - evaporator
4	Actuator - air intake flap
5	Blower motor speed controller
6	Actuator - air distribution flap
7	Cam - air distribution control

DESCRIPTION AND OPERATION

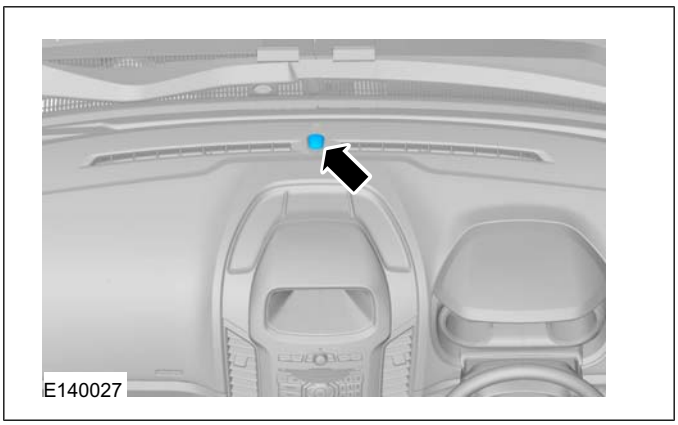
Overview of the climate control housing - vehicles with automatic temperature control





Item	Description
1	Actuator - right-hand temperature flap
2	Lever - right-hand temperature control
3	Temperature sensor - evaporator
4	Actuator - air intake flap
5	Blower motor speed controller
6	Actuator - air distribution flap
7	Cam - air distribution control
8	Actuator - left-hand temperature control
9	Lever - left-hand temperature control

Sun load sensor/interior temperature sensor - vehicles with automatic temperature control



On vehicles with automatic temperature control, the sun load sensor measures the intensity of the sunlight reaching the vehicle and passes the values

DESCRIPTION AND OPERATION

on to the A/C module. Additionally, the integrated in-car temperature sensor provides the A/C module with variable feedback from the cabin. The A/C module then ensures that the cabin temperature is regulated to customer comfort.

REMOVAL AND INSTALLATION

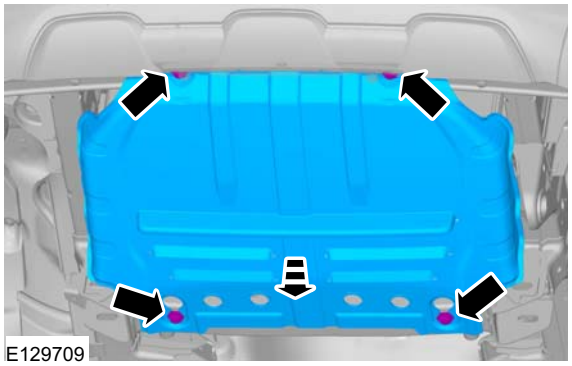
Air Conditioning (A/C) Compressor — 2.5L Duratec-HE (122kW/165PS) - MI4(34 626 4)

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

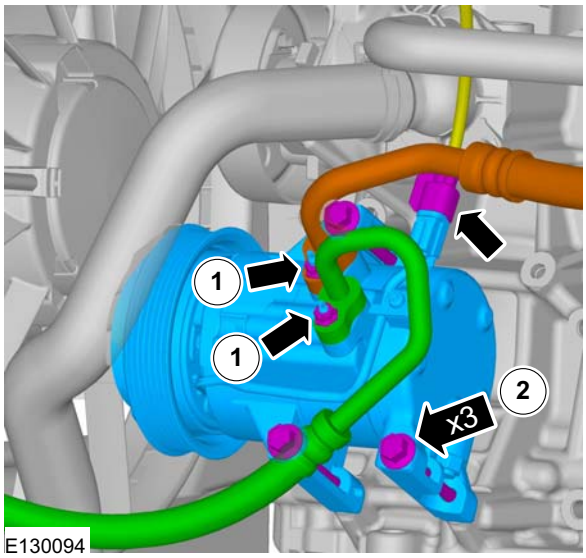
Removal

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: Accessory Drive Belt (303-05 Accessory Drive - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Torque: 15 Nm


E129709

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



E130094

Installation

1. Coat the O-rings on the refrigerant lines.

   Material: Compressor Oil - Air Conditioning (WSH-M1C231-B / 6U7J-M1C231-AA) refrigerant oil
2. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

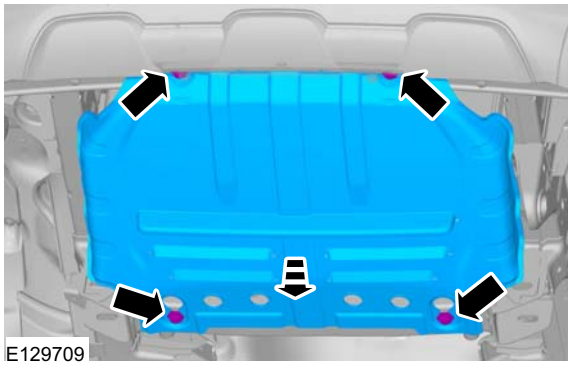
Air Conditioning (A/C) Compressor — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma(34 626 4)

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

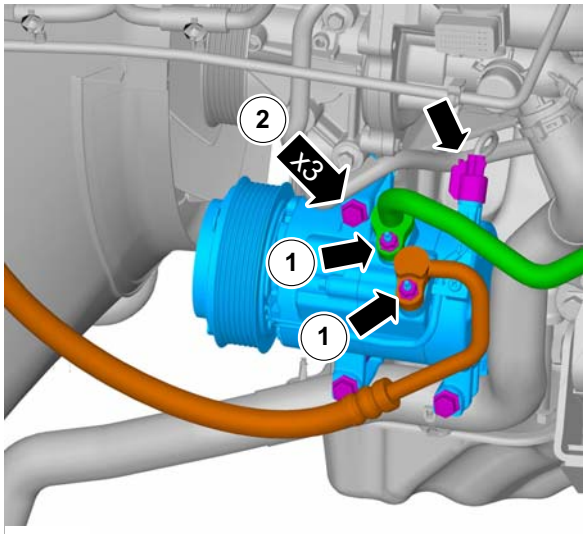
Removal

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: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Torque: 15 Nm


E129709

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



E130065

Installation

1. Coat the O-rings on the refrigerant lines.

   Material: Compressor Oil - Air Conditioning (WSH-M1C231-B / 6U7J-M1C231-AA) refrigerant oil
2. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

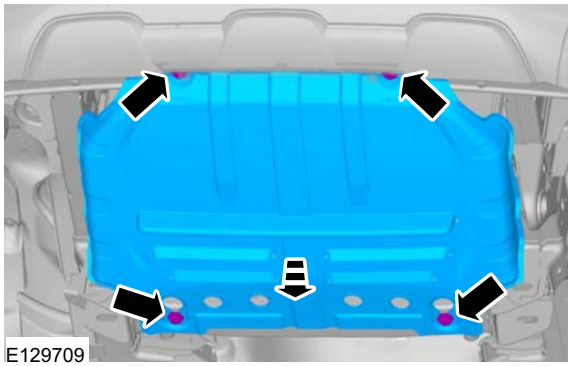
Air Conditioning (A/C) Compressor — 3.2L Duratorq-TDCi (148kW/200PS) - Puma(34 626 4)

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

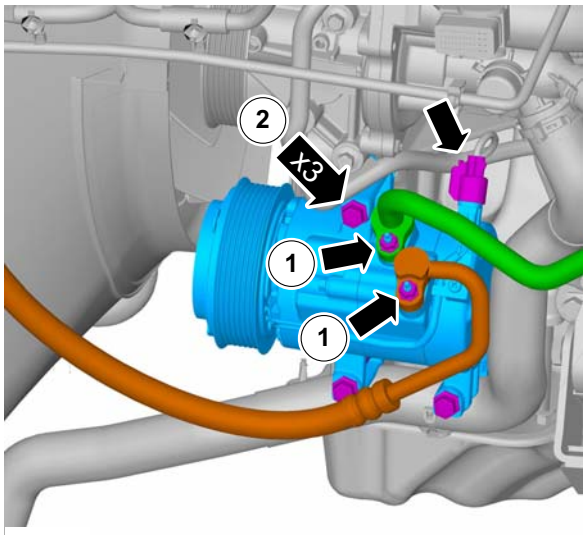
Removal

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: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Torque: 15 Nm


E129709

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



E130065

Installation

1. Coat the O-rings on the refrigerant lines.

   Material: Compressor Oil - Air Conditioning (WSH-M1C231-B / 6U7J-M1C231-AA) refrigerant oil
2. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Air Conditioning (A/C) Pressure Sensor

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

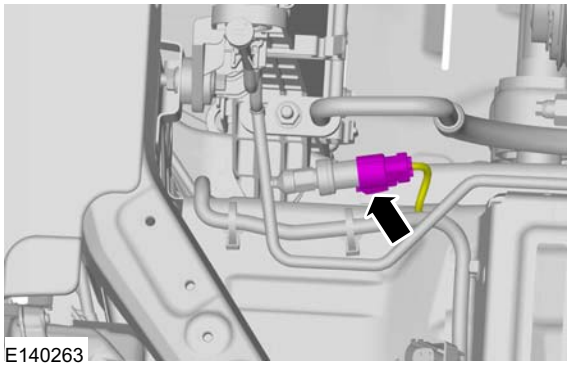
Removal

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

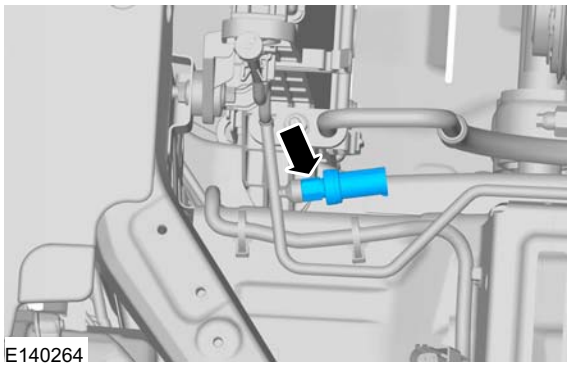
1. Refer to: Air Conditioning (A/C) System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

Vehicles with automatic transmission

3.

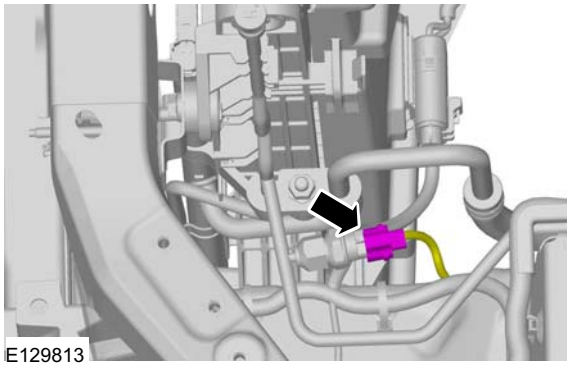


4. Torque: 8 Nm

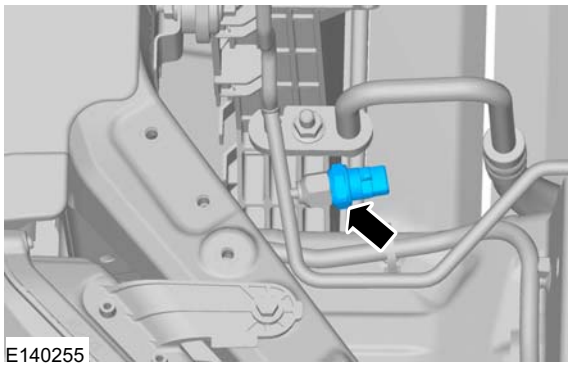


Vehicles with manual transmission

5.



6. Torque: 8 Nm



Installation

1. Coat the O-rings on the refrigerant lines.

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

2. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

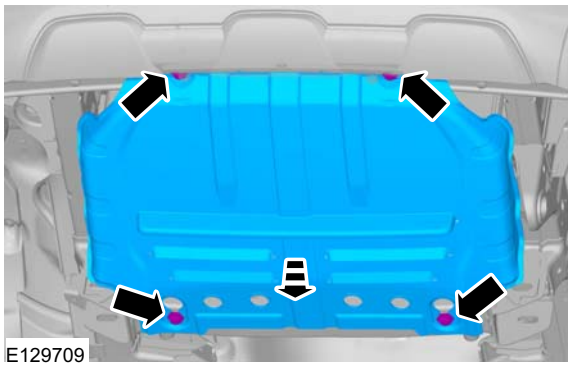
Condenser — 2.5L Duratec-HE (122kW/165PS) - MI4

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

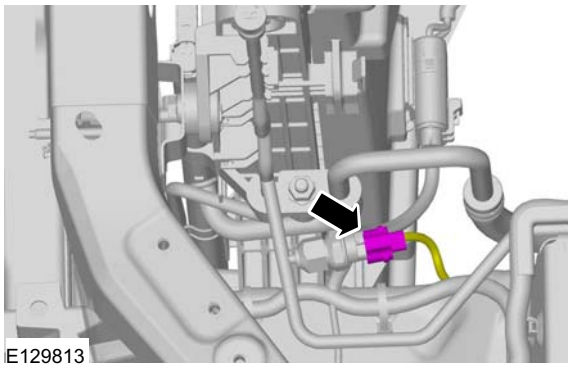
Removal

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. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).
3. Refer to: Radiator Grille (501-08 Exterior Trim and Ornamentation, Removal and Installation).
4. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
5. Torque: 45 Nm

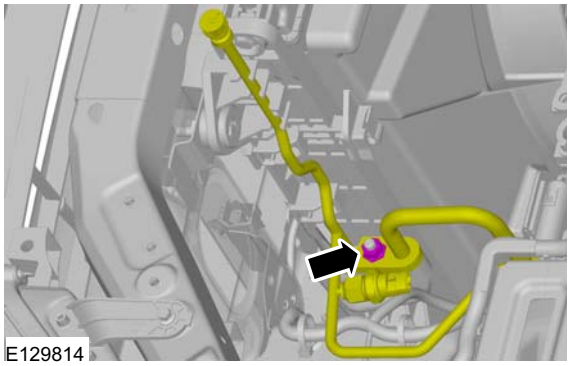


6.



7. **CAUTION: All openings must be closed.**

Torque: 45 Nm



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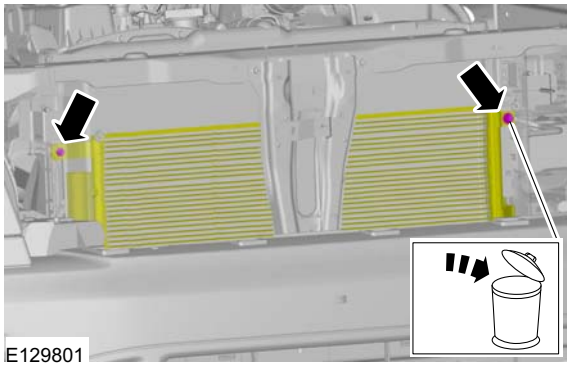

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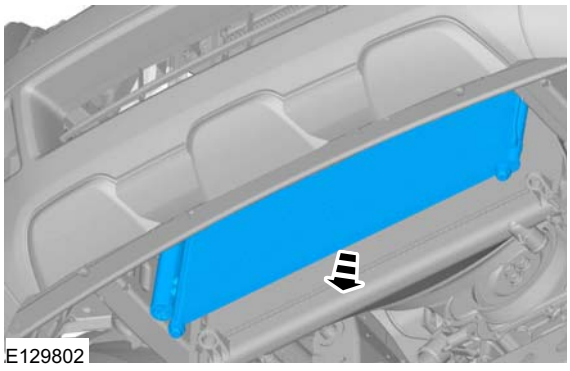


REMOVAL AND INSTALLATION

Installation

1. Coat the O-rings on the refrigerant lines.

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

2. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

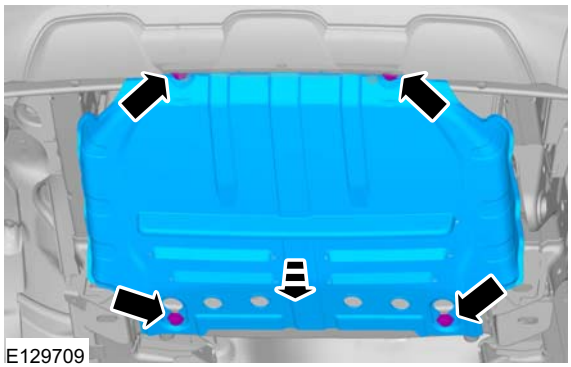
Condenser — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma

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

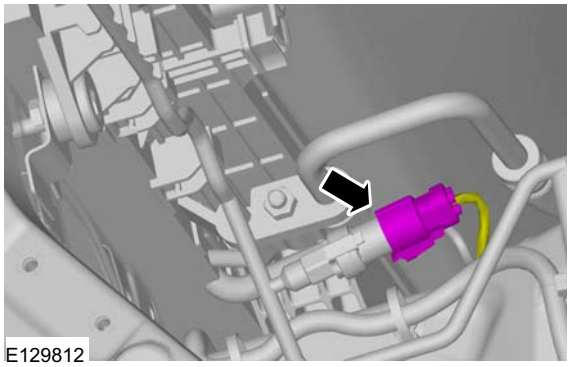
Removal

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. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).
3. Refer to: Radiator Grille (501-08 Exterior Trim and Ornamentation, Removal and Installation).
4. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
5. Torque: 15 Nm

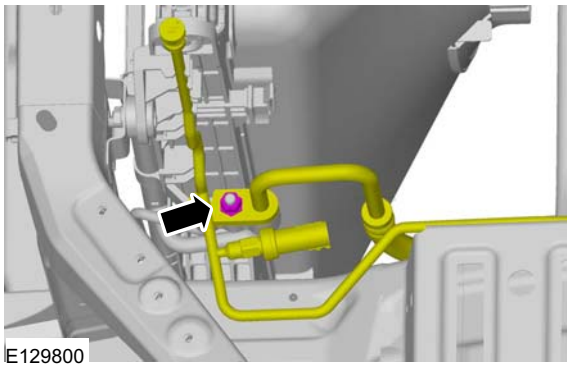

E129709

6.


E129812

7. **CAUTION: All openings must be closed.**

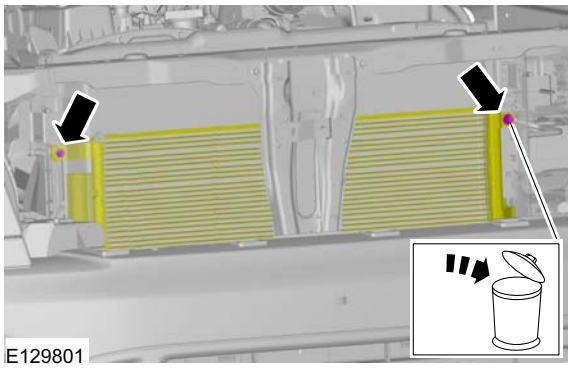
   Torque: 22 Nm


E129800

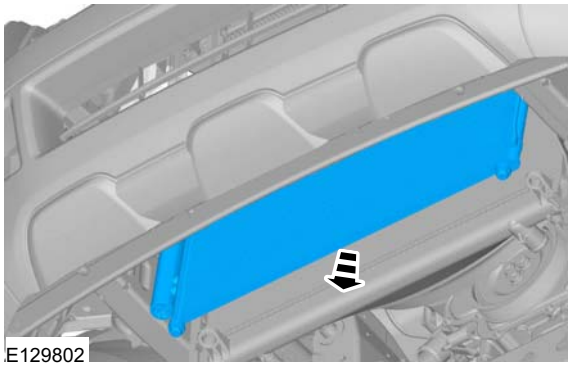
REMOVAL AND INSTALLATION

8. Refer to: Charge Air Cooler (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

9.



10.



Installation

1. Coat the O-rings on the refrigerant lines.

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

2. To install, reverse the removal procedure.

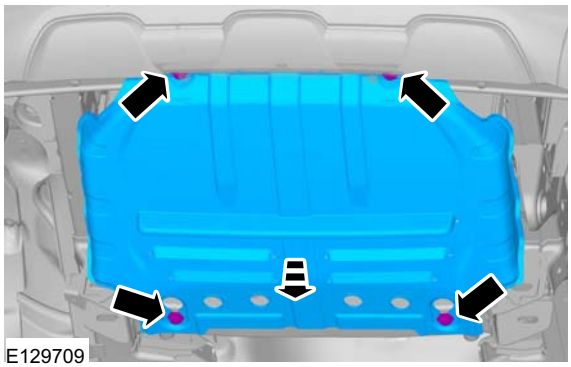
REMOVAL AND INSTALLATION

Receiver Drier

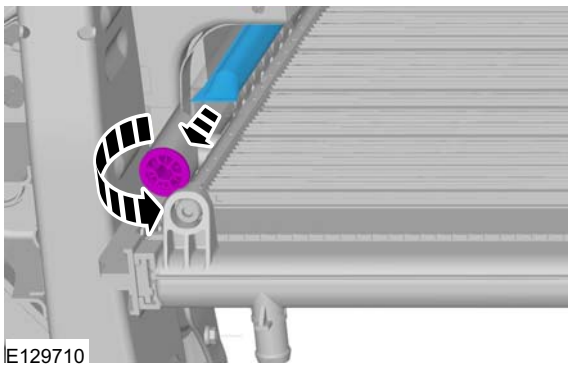
Removal

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: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Torque: 15 Nm


E129709

4.


E129710

Installation

1. To install, reverse the removal procedure.

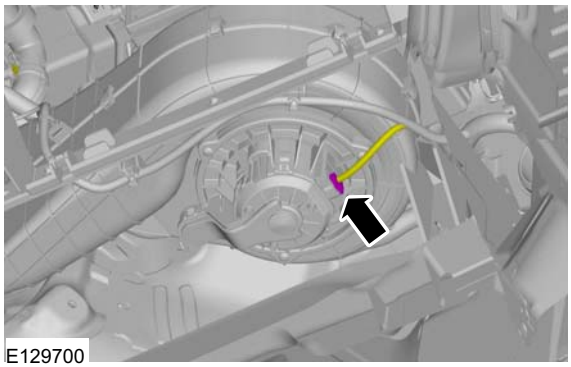
REMOVAL AND INSTALLATION

Blower Motor — LHD 4WD/LHD RWD(34 374 0)

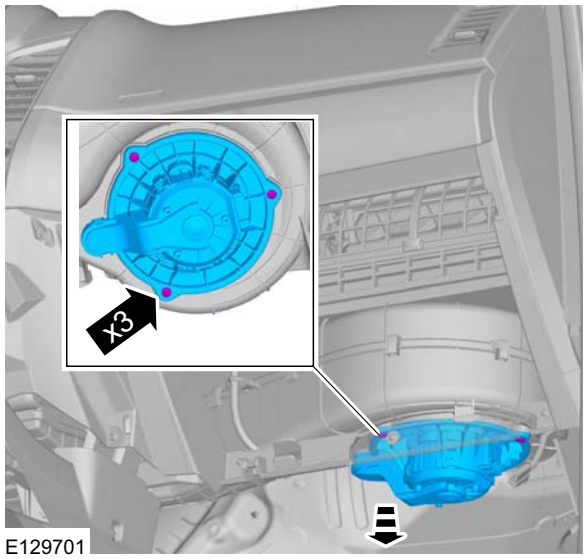
Removal

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: Glove Compartment (501-12 Instrument Panel and Console, Removal and Installation).
3.


E129700

4. **CAUTION: Do not put the blower motor down on the blower motor fan wheel.**



E129701

Installation

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

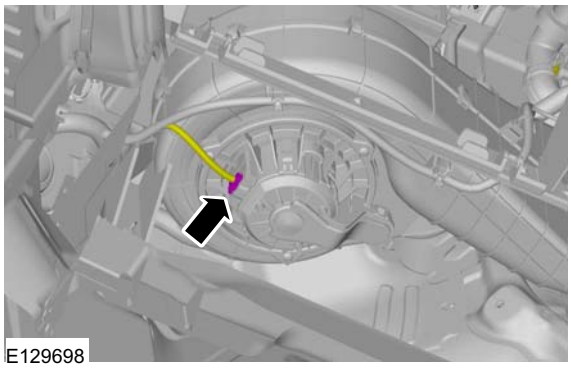
To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

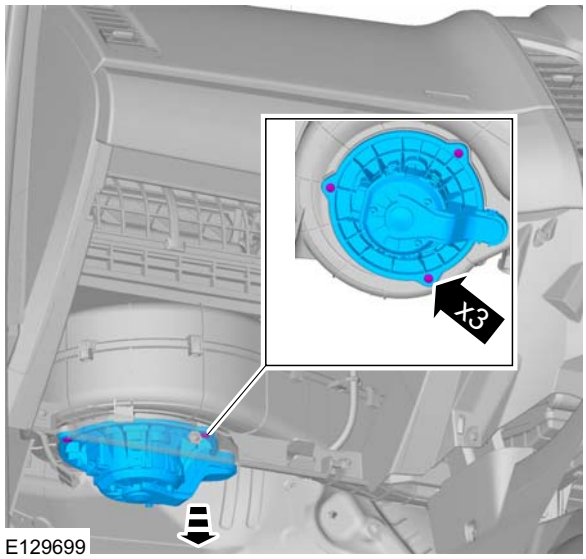
Blower Motor — RHD 4WD/RHD RWD(34 374 0)

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: Glove Compartment (501-12 Instrument Panel and Console, Removal and Installation).
3. 

4. **CAUTION: Do not put the blower motor down on the blower motor fan wheel.**



Installation

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

To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

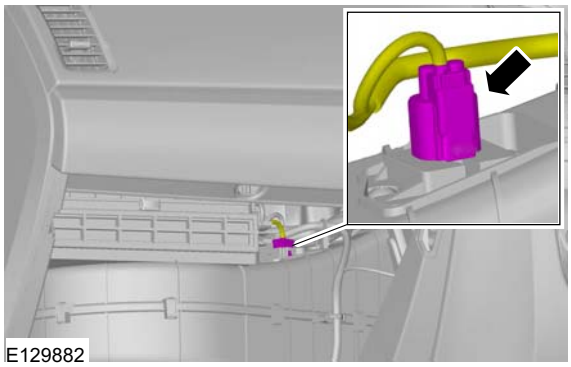
Blower Motor Resistor(34 382 0)

Removal

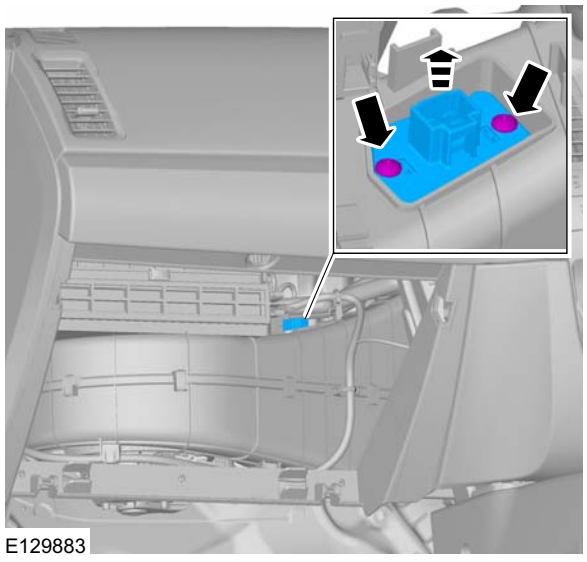
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Glove Compartment (501-12 Instrument Panel and Console, Removal and Installation).

2.



3. Torque: 15 Nm



Installation

1. To install, reverse the removal procedure.

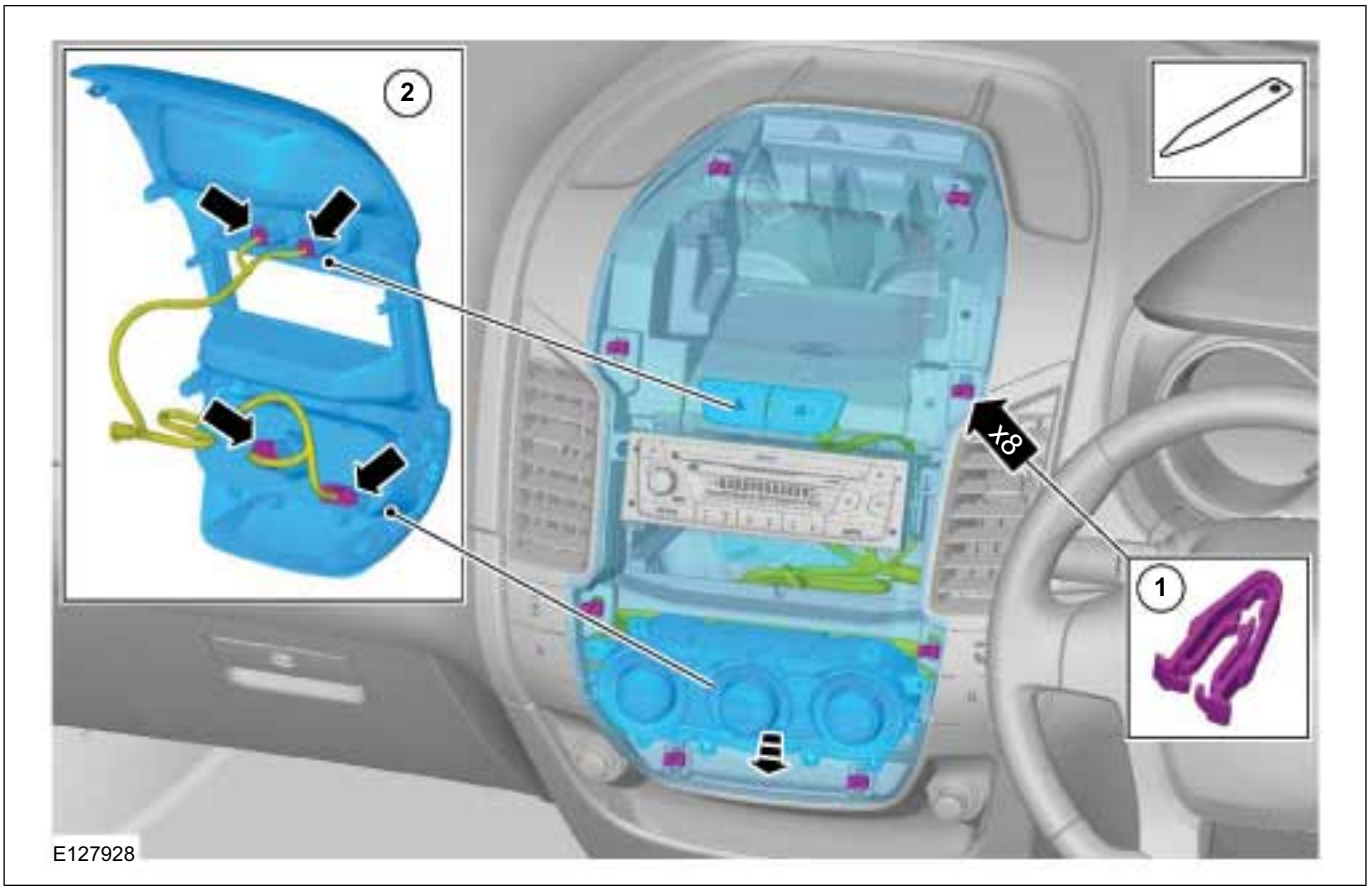
REMOVAL AND INSTALLATION

Climate Control Module

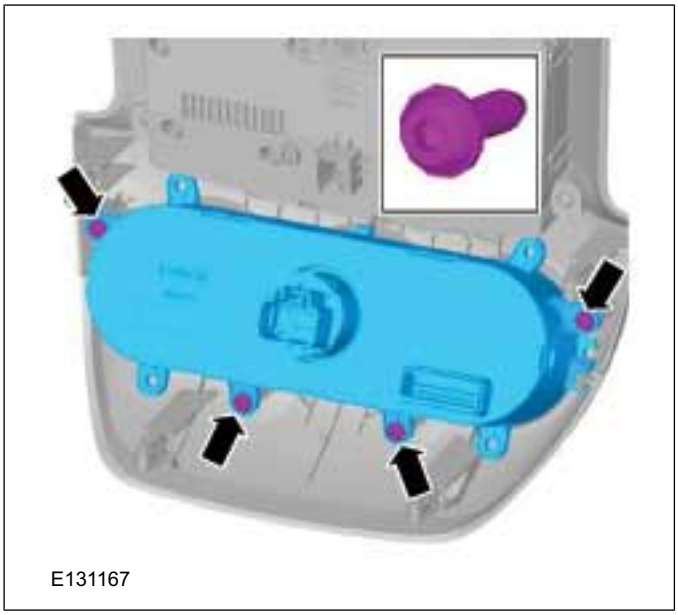
Removal

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

1.



2.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

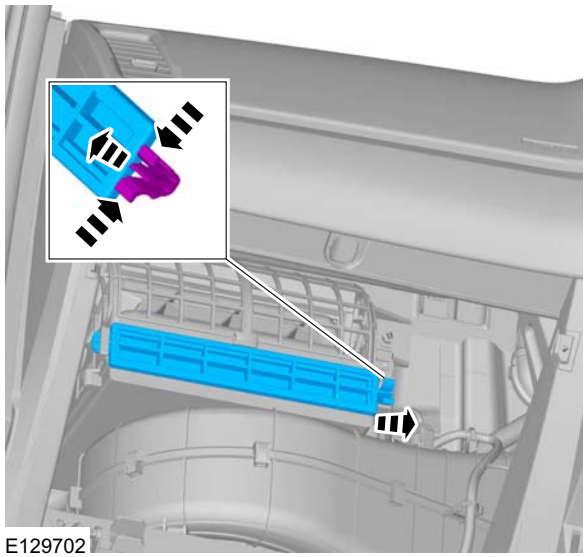
Pollen Filter

Removal

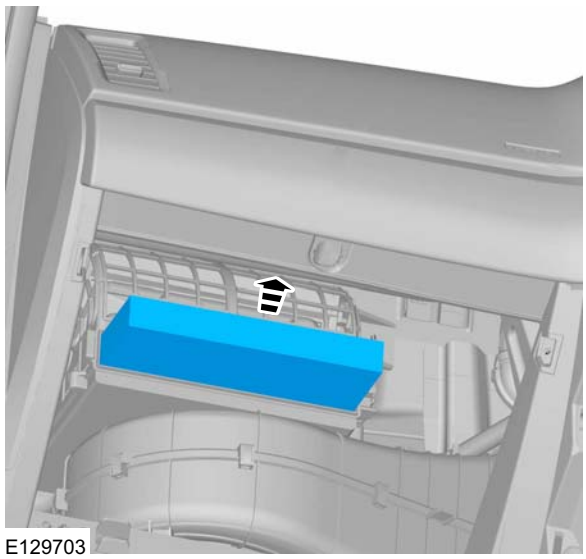
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Glove Compartment (501-12 Instrument Panel and Console, Removal and Installation).

2.


E129702

3.


E129703

Installation

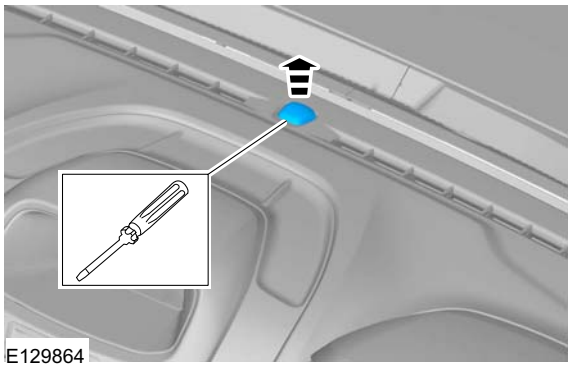
1. To install, reverse the removal procedure.

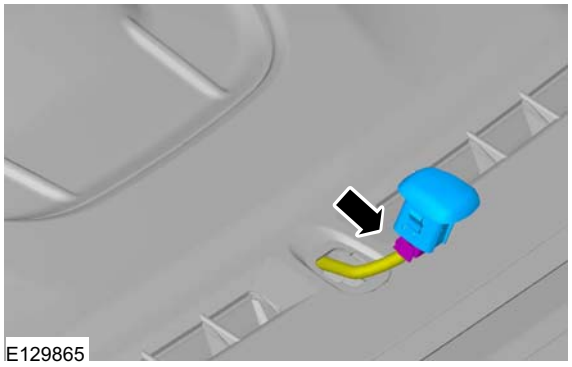
REMOVAL AND INSTALLATION

Sunload Sensor(34 665 0)

Removal

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

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. 

4. 

Installation

1. To install, reverse the removal procedure.

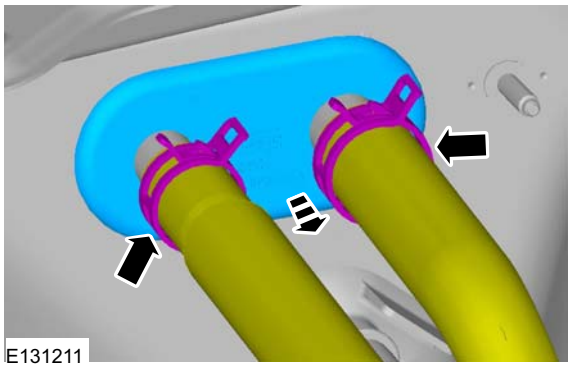
REMOVAL AND INSTALLATION

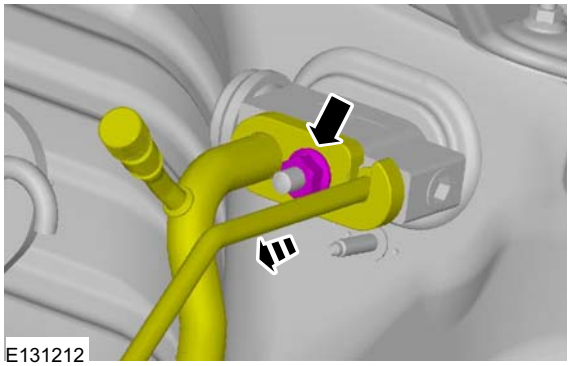
Heater Core and Evaporator Core Housing

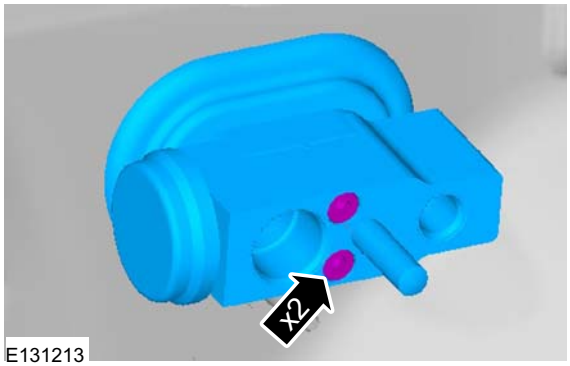
Materials	
Name	**Specification**
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

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: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Instrument Panel - RHD 4WD/RHD RWD (501-12 Instrument Panel and Console, Removal and Installation).
4. 

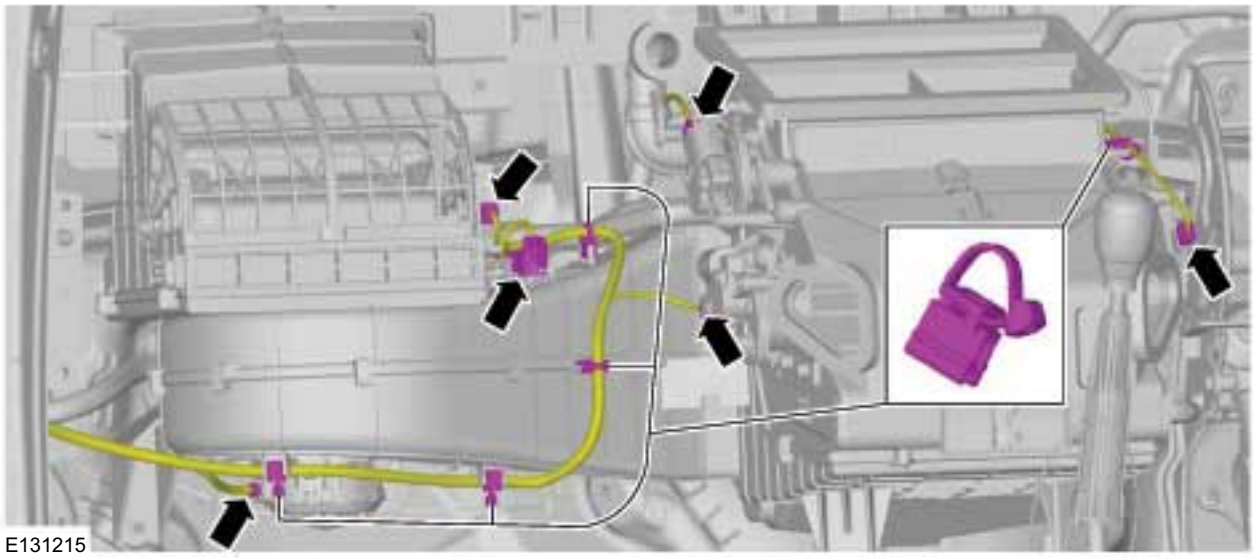
5. Torque: 24 Nm


6. 

Vehicles with electronic automatic temperature control (EATC)

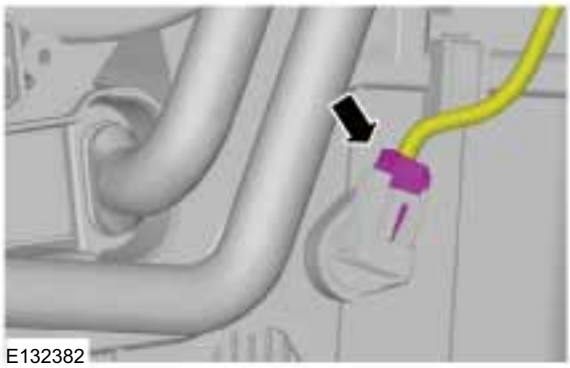
7.

REMOVAL AND INSTALLATION

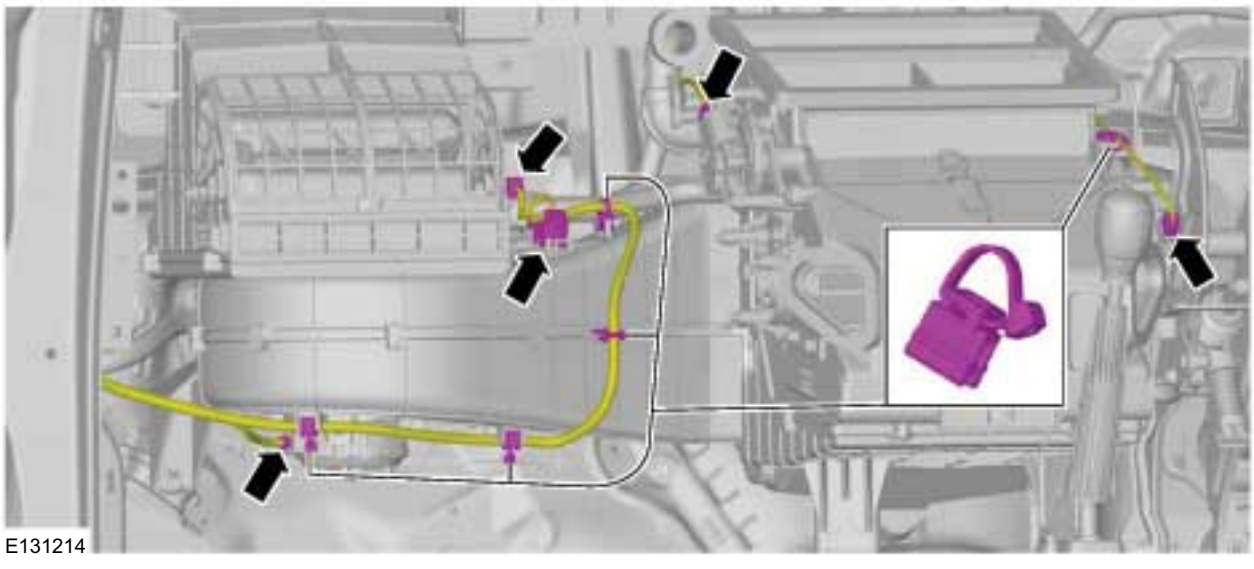

E131215

Vehicles with manual temperature control

8.


E132382

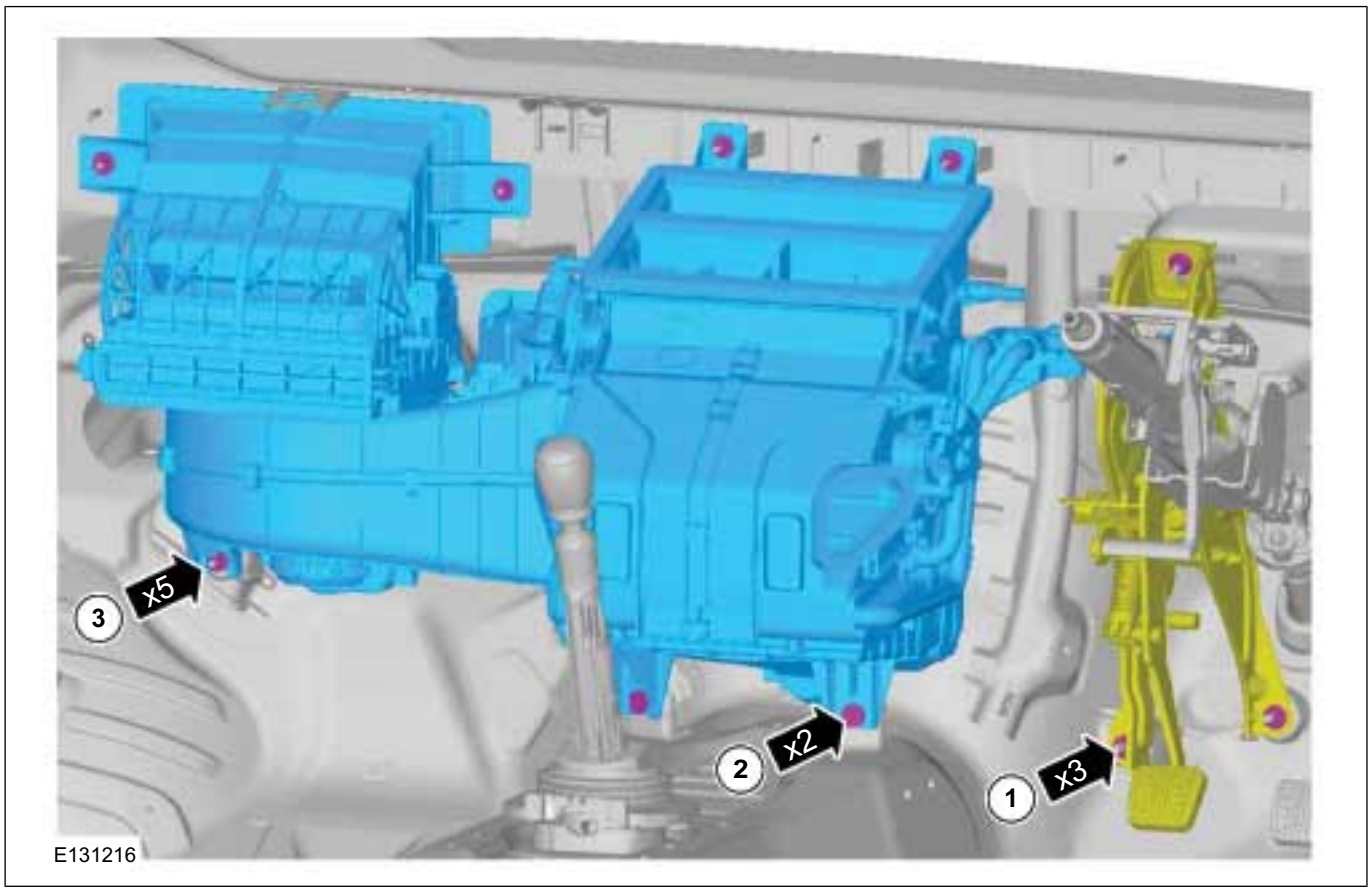
9.


E131214

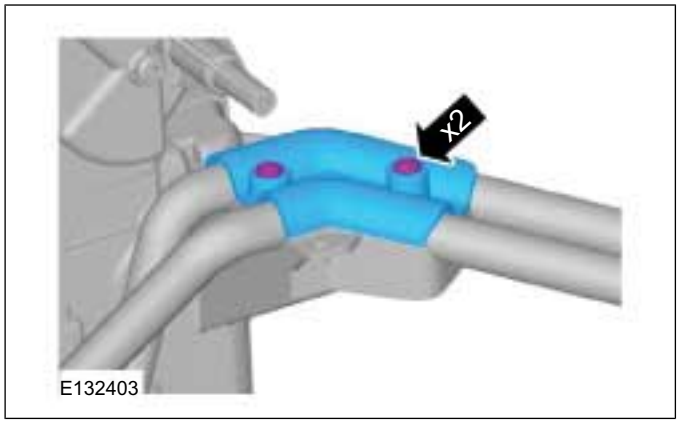
All vehicles

10. 1. Torque: 15 Nm
2. Torque: 7 Nm

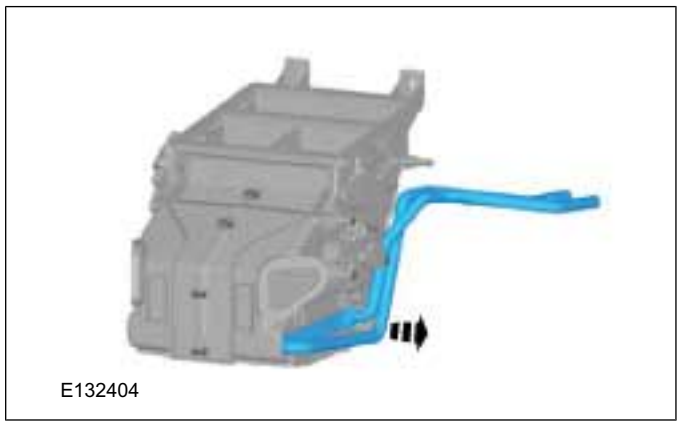
REMOVAL AND INSTALLATION



11.



12.



Installation

1. Coat the O-rings on the refrigerant lines.

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

2. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Evaporator

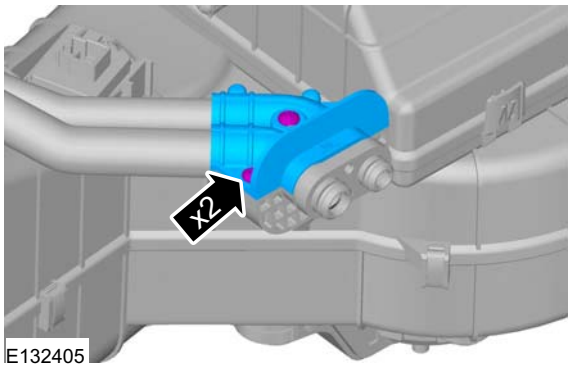
Materials	
Name	**Specification**
Compressor Oil - Air Conditioning	WSH-M1C231-B / 6U7J-M1C231-AA

Removal

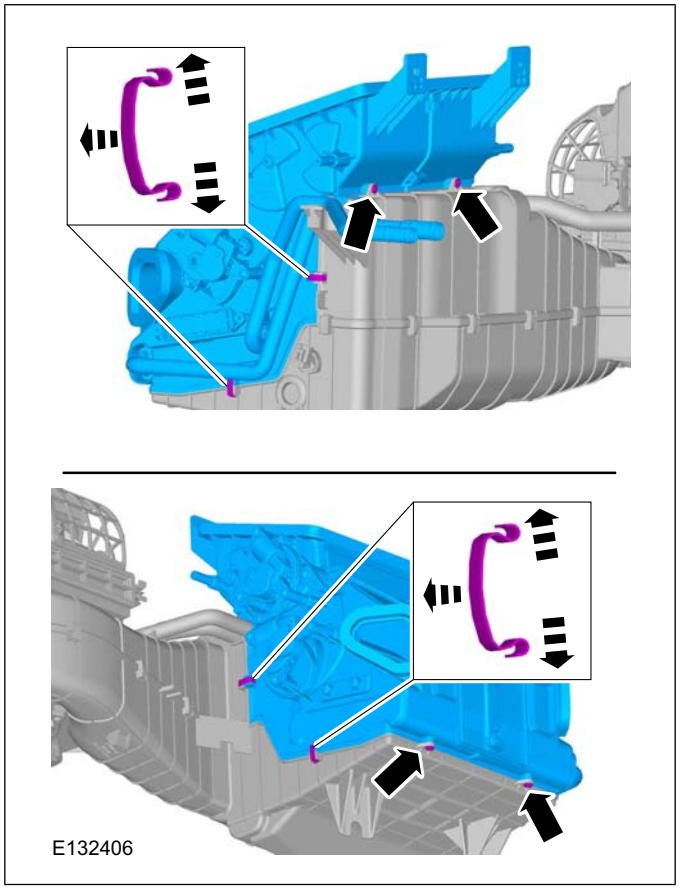
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Heater Core and Evaporator Core Housing (412-01 Climate Control, Removal and Installation).

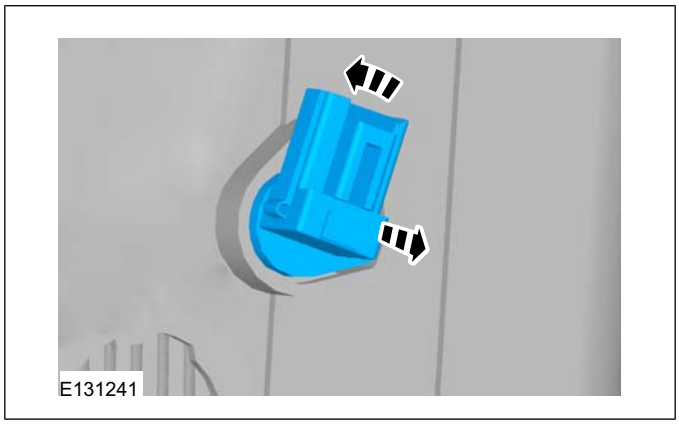
2.



3.

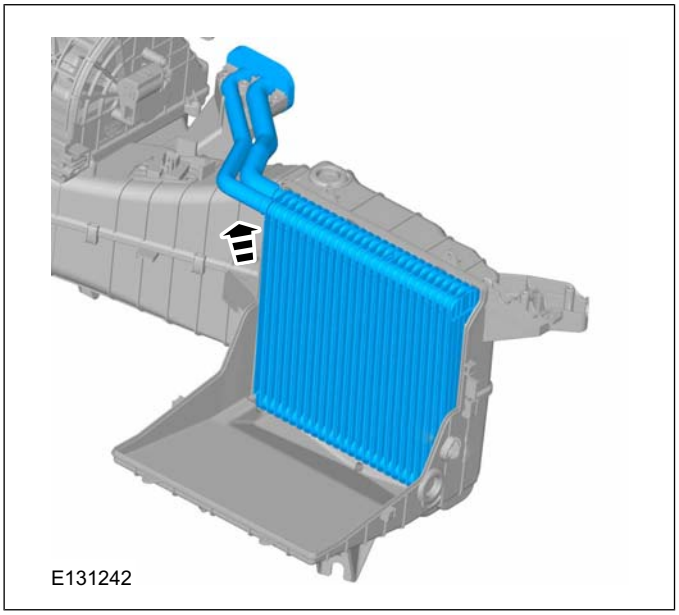


4. **NOTE:** Vehicles with electronic automatic temprature control only



REMOVAL AND INSTALLATION

5.



Installation

1. Coat the O-rings on the refrigerant lines.

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

2. To install, reverse the removal procedure.

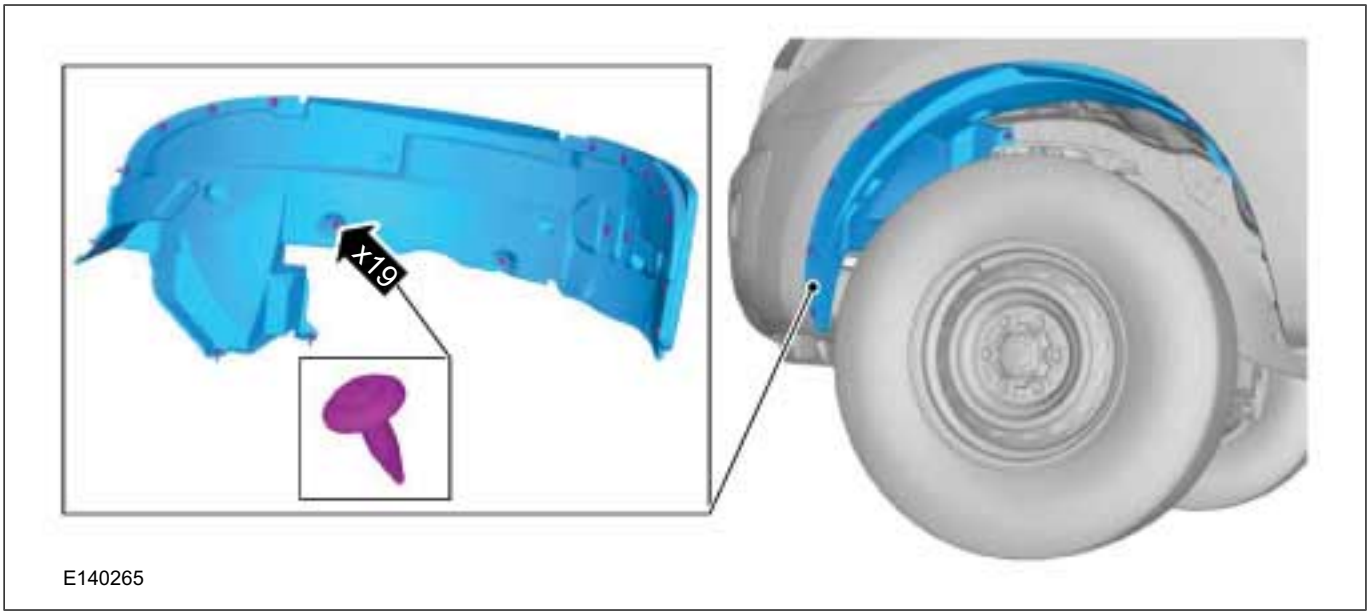
REMOVAL AND INSTALLATION

Ambient Air Temperature Sensor(34 676 0)

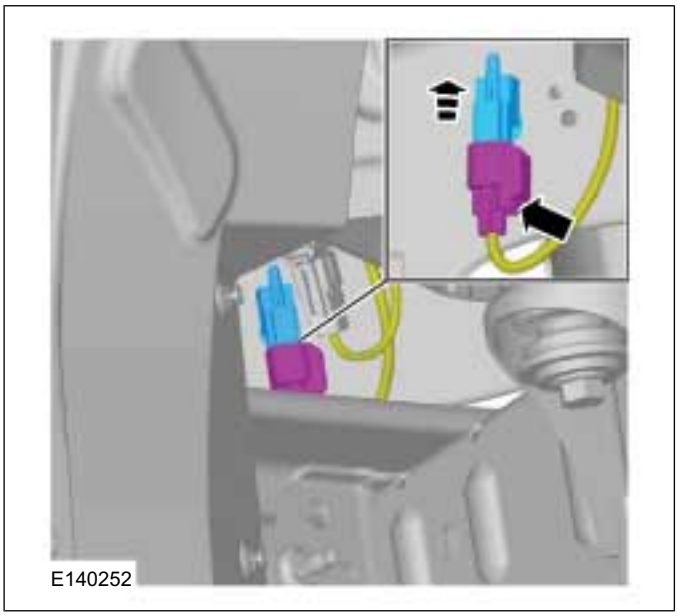
Removal

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



4.



Installation

1. To install, reverse the removal procedure.

SECTION 413-01 Instrument Cluster

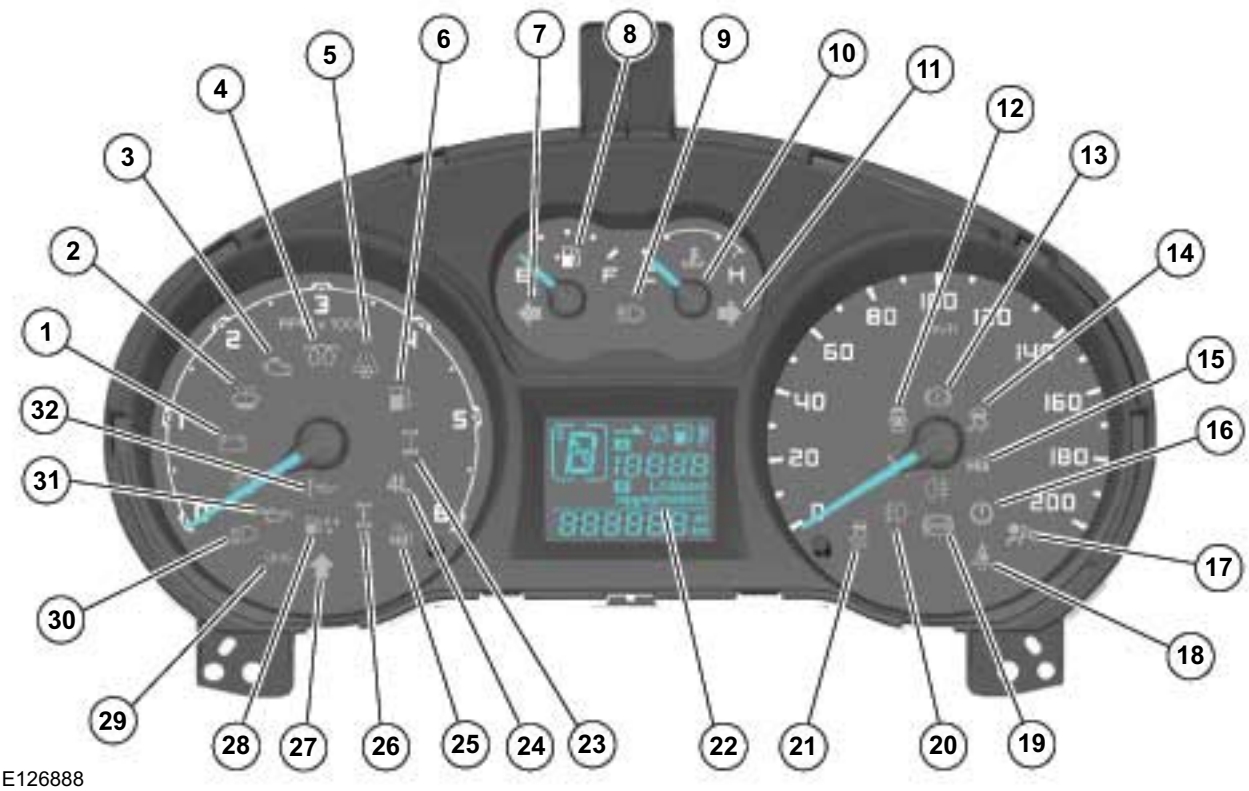
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Instrument Cluster

Vehicles with Diesel Engine



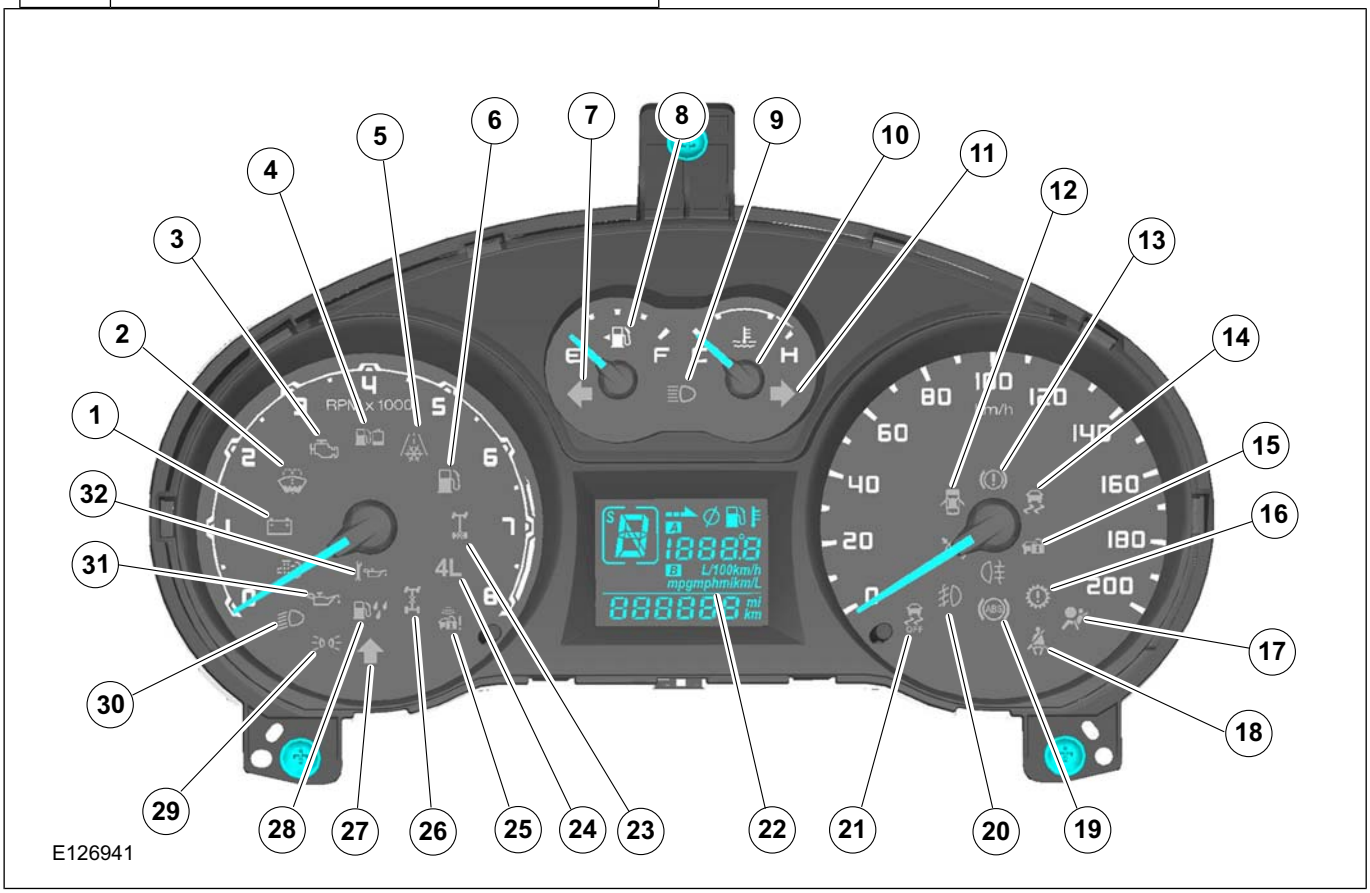
Item	Description
1	Charging system indicator
2	Washer fluid level indicator
3	Malfunction indicator lamp (MIL)
4	Glow plug indicator
5	Ice warning indicator
6	Low fuel level indicator
7	Left hand turn signal indicator
8	Fuel gauge
9	High beam indicator
10	Engine coolant temperature gauge
11	Right hand turn signal indicator
12	Door open indicator
13	Braking system indicator
14	Stability assist ON indicator
15	Vehicle immobiliser indicator

Item	Description
16	Powertrain warning indicator
17	Air bag warning indicator
18	Seat belt indicator
19	Anti lock braking system (ABS) warning indicator
20	Front fog lamp indicator
21	Stability assist OFF indicator
22	Message center
23	Two wheel drive indicator
24	Four wheel drive low ratio indicator
25	Anti theft indicator
26	Four wheel drive indicator
27	Gear shift indicator lamp
28	Water in fuel indicator
29	Head lamp indicator
30	Low beam indicator

DESCRIPTION AND OPERATION

Item	Description
31	Low engine oil pressure warning indicator
32	Engine oil change indicator

Vehicles with Petrol Engine



Item	Description
1	Charging system indicator
2	Washer fluid level indicator
3	Malfunction indicator lamp (MIL)
4	Fuel fired booster indicator
5	Ice warning indicator
6	Low fuel level indicator
7	Left hand turn signal indicator
8	Fuel gauge
9	High beam indicator
10	Engine coolant temperature gauge
11	Right hand turn signal indicator
12	Door open indicator
13	Braking system indicator
14	Stability assist ON indicator
15	Vehicle immobiliser indicator

Item	Description
16	Powertrain warning indicator
17	Air bag warning indicator
18	Seat belt indicator
19	Anti lock braking system (ABS) warning indicator
20	Front fog lamp indicator
21	Stability assist OFF indicator
22	Message center
23	Two wheel drive indicator
24	Four wheel drive low ratio indicator
25	Anti theft indicator
26	Four wheel drive indicator
27	Gear shift indicator lamp
28	Water in fuel indicator
29	Head lamp indicator

DESCRIPTION AND OPERATION

Item	Description
30	Low beam indicator
31	Low engine oil pressure warning indicator
32	Engine oil change indicator

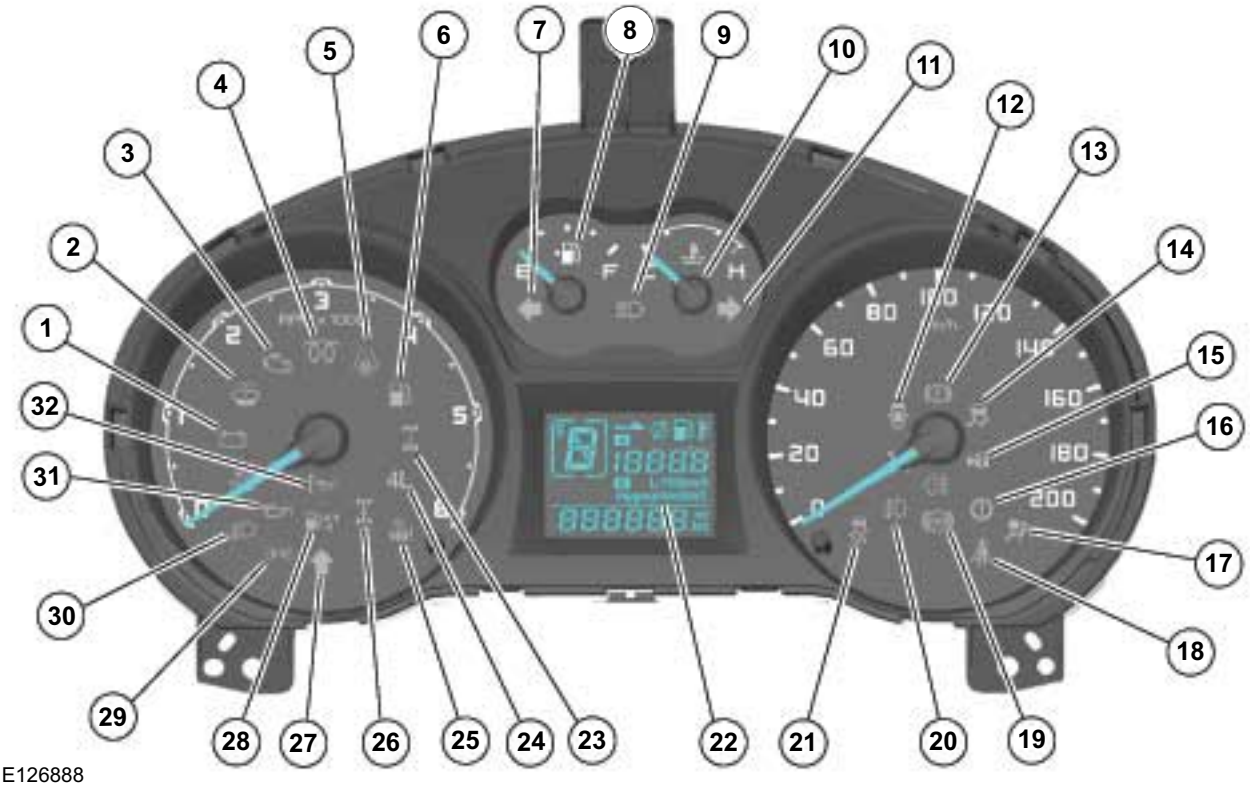
Service instructions

If the instrument cluster is replaced, the data of the central module configuration must be copied using IDS (Integrated Diagnostic System) from BCM to the new instrument cluster. In addition, all vehicle keys must be relearned. At least two vehicle keys are needed for relearning.

DESCRIPTION AND OPERATION

Instrument Cluster – System Operation and Component Description

System Diagram



Item	Description
1	Charging system indicator
2	Washer fluid level indicator
3	MIL (malfunction indicator lamp)
4	Glow plug indicator
5	Ice warning indicator
6	Low fuel level indicator
7	Left hand turn signal indicator
8	Fuel gauge
9	High beam indicator
10	Engine coolant temperature gauge
11	Right hand turn signal indicator
12	Door open indicator
13	Braking system indicator
14	Stability assist ON indicator

Item	Description
15	Vehicle immobilize indicator
16	Powertrain warning indicator
17	Air bag warning indicator
18	Seat belt indicator
19	Anti lock braking system (ABS) warning indicator
20	Front fog lamp indicator
21	Stability assist OFF indicator
22	Message center
23	Two wheel drive indicator
24	Four wheel drive low ratio indicator
25	Anti theft indicator
26	Four wheel drive indicator
27	Gear shift indicator lamp

DESCRIPTION AND OPERATION

Item	Description
28	Water in fuel indicator
29	Head lamp indicator
30	Low beam indicator

Item	Description
31	Engine oil pressure
32	Engine oil change indicator

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 (liquid crystal display) 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 BCM 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 traveled 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 (Electronically Erasable Programmable Read Only Memory) area. This area of memory is 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.

Component Description

Turn Signal Indicators

The turn signal indicators are controlled by the PJB (Passenger Junction Box) on receipt of medium speed CAN bus signals from the instrument cluster.

The instrument cluster outputs a voltage to the turn signal indicator switch. The switch contains resistors of different values. When the switch is operated in either the LH or RH direction, the voltage is passed to a ground connection in the instrument cluster which detects the reduced voltage supplied via the resistors. When the turn signal indicator switch is operated in the LH or RH direction, the instrument cluster detects the ground voltage and determines whether a LH or RH selection is made.

The instrument cluster transmits a medium speed CAN message to the PJB for operation of the applicable turn signal indicators. The message can contain a number of states for each possible switch position and also an out of range low and high state for circuit faults and an initial value for the switch neutral position. The turn signal indicators are not subject to the 3 second indicator check when the ignition is switched on.

The hazard warning indicators are controlled by the PJB on receipt of a completed ground path from the hazard warning indicator switch. The PJB outputs a medium speed CAN message to the instrument cluster which operates both the LH and RH turn signal indicators simultaneously. The hazard warning indicators can operate with the ignition switched off, therefore the CAN message

DESCRIPTION AND OPERATION

from the PJB will also carry a 'wake-up' message for the instrument cluster.

Brake Warning Indicator

The indicator is controlled by high speed CAN messages from the ABS module and the parking brake control module. If it illuminates when you are driving, check that the parking brake is not engaged. If the parking brake is not engaged, this indicates a malfunction. Have the system checked by a properly trained technician immediately.

If a condition exists where the parking brake cannot be applied, the parking brake control module issues a CAN message to the instrument cluster which flashes the warning lamp on and off and is accompanied with a message 'CANNOT APPLY PARK BRAKE'. If a fault occurs in the parking brake system, the parking brake control module issues a CAN message to the instrument cluster which illuminates the warning indicator and displays the message 'PARK BRAKE FAULT' in the message center.

Water-in-fuel indicator

The water-in-fuel indicator lamp will come on if there is excess water in the fuel filter.

Anti-lock Braking System (ABS) Warning Indicator

The ABS warning indicator is controlled by the ABS module. If a fault in the ABS system is detected by the ABS module, the module issues a high speed CAN message to the instrument cluster to illuminate the ABS warning indicator and display the message 'ABS FAULT' in the instrument cluster. If it illuminates when you are driving, this indicates a malfunction. You will continue to have normal braking (without ABS). Have the system checked by a properly trained technician as soon as possible.

Engine Malfunction Indicator Lamp (MIL)

The MIL warning indicator is controlled by the ECM and illuminated by the instrument cluster on receipt of a message on the high speed CAN bus from the ECM. If either lamp illuminates when the engine is running, this indicates a fault. The engine will continue to run but it may have limited power. If it flashes when you are driving, reduce the speed of your vehicle immediately. If it continues to flash, avoid heavy acceleration or deceleration.

If both lamps illuminate together, stop your vehicle as soon as it is safe to do so (continued use may cause reduced power and cause the engine to stop). Turn the ignition off and attempt to restart the engine. If the engine restarts have the system checked by a properly trained technician immediately. If the engine does not restart the vehicle must be checked before continuing your journey.

Airbag Warning Indicator

The airbag warning indicator is controlled by the instrument cluster. If it illuminates while driving, this indicates a malfunction. The indicator remains illuminated after the 3 second period has expired until the instrument cluster receives a turn off message on the high speed CAN bus from the RCM (restraints control module).

Front Fog Lamp Indicator

The green colored front fog lamp indicator is controlled by the PJB and illuminated by the instrument cluster on receipt of a front fog lamp on message on the medium speed CAN bus from the PJB. The front fog lamp indicator will come on when you switch the front fog lamps on.

Stability control (ESP) warning lamp

The ESP supports stability when the vehicle starts to slide away from your intended path. This is performed by braking individual wheels and reducing engine torque as needed.

The system also provides an enhanced traction control function by reducing engine torque and braking if the wheels spin when you accelerate. This improves your ability to pull away on slippery roads or loose surfaces, and improves comfort by limiting wheel spin in hairpin bends.

Emergency brake assist will detect when you brake heavily by measuring the rate at which you press the brake pedal. It will provide maximum braking efficiency as long as you press the pedal. Emergency brake assist can reduce stopping distances in critical situations.

DESCRIPTION AND OPERATION

Safety Belt Warning Indicator

The safety belt warning indicator operates for both the driver and passenger safety belts. The warning indicator is controlled by the RCM and illuminated by the instrument cluster on receipt of high speed CAN bus messages. The safety belt warning indicator is not subject to the 6 second indicator check when the ignition is switched on.

The safety belt warning indicator is subject to a timer. The warning indicator is activated when the following conditions exist:

• The seat belt warning lamp will be illuminated for 6 seconds when the ignition is turned on to remind the driver to fasten the seatbelt.

• The seat belt warning lamp will be illuminated for 6 seconds when the ignition is turned on and if the drivers seat belt is not buckled.

• The seat belt reminder warning lamp illuminates and an audible warning will sound if the driver or front passenger seat belt has not been fastened and the vehicle exceeds a relatively low speed. It will also illuminate if either of the seat belt is unfastened when the vehicle is moving. The audible warning will go off after five minutes but the seat belt reminder warning lamp will remain on until the seat belt is fastened.

Side Lamp Indicator

The instrument cluster controls the orange colored side lamp indicator on receipt of a side lamp status message on the medium speed CAN bus from the PJB and the auxiliary junction box. Selections using this switch are detected by the cluster which requests the side or headlamp operation via a message to the PJB and the PJB. The PJB and the RJB responds with a side lamp active message and the cluster illuminates the side lamp indicator. The side lamp indicator is not subject to the 3 second indicator check when the ignition is switched on.

High Beam Indicator

The instrument cluster controls the blue colored high beam indicator on receipt of a high beam status message on the medium speed CAN bus from the PJB. High beam or flash selections using this switch are detected by the cluster which requests the light operation via a CAN message to the PJB. The PJB responds with a high beam active message and the cluster illuminates the high beam indicator. The high beam indicator is not subject to the 3 second indicator check when the ignition is switched on.

Rear Fog Lamp Indicator

The amber colored rear fog lamp indicator is controlled by the auxiliary junction box and illuminated by the instrument cluster on receipt of a rear fog lamp on . The rear fog lamp indicator lamp will come on when you switch the rear fog lamps on. The rear fog lamp indicator is not subject to the 3 second indicator check when the ignition is switched on. You cannot switch the rear fog lamps on unless you have switched the headlamps and front fog lamp on.

Speedo meter

The speedometer is driven by high speed CAN signals transmitted by the ABS module. The wheel speeds are measured by sensors reading the rotational speed of the rear wheels from toothed targets on the hubs. An average of the two wheel speeds are passed from the sensors to the ABS module in the form of pulsed signals. The ABS module converts these signals into a speed output on the high speed CAN to the instrument cluster. The same speed outputs from the wheel speed sensors are also used to calculate the distance the vehicle has traveled.

Tacho meter

The tachometer is driven by an engine speed signal transmitted on the high speed CAN from the ECM. The signal is derived from the CKP (crankshaft position) sensor. The signal is received by the instrument cluster microprocessor and the output from the microprocessor drives the tachometer.

Fuel gauge

The fuel gage is controlled by CAN messages from the RJB. The RJB reads the values output by the fuel level sensors every 131 ms and transmits a fuel tank contents value, corrected for battery voltage, in a CAN message to the instrument cluster. A fuel pump symbol is displayed to the left of the linear gage. Above the linear fuel gage, is a LCD (liquid crystal display) area which displays

DESCRIPTION AND OPERATION

odometer and trip readouts. When a trip computer function is selected, these are replaced by a trip computer display for the trip function selected.

Liquid crystal display

In liquid crystal display which is located in instrument cluster displays a linear fuel gage, odometer, trip distance and trip computer readouts. The trip distance and trip computer information is derived from information supplied on the high speed CAN bus to the instrument cluster from the ABS module and the ECM.

The area above the message center displays the transmission gear position information and speed control related information. The transmission information is supplied on the high speed CAN bus from the TCM (transmission control module).

Gear shift indicator lamp

The gear selector module transmits a CAN message to the instrument cluster for gear selector lever position. The module also outputs a 'not in park' signal to the instrument cluster. It will illuminate to inform you that shifting to a higher gear may give better fuel economy and lower CO2 emissions.

REMOVAL AND INSTALLATION

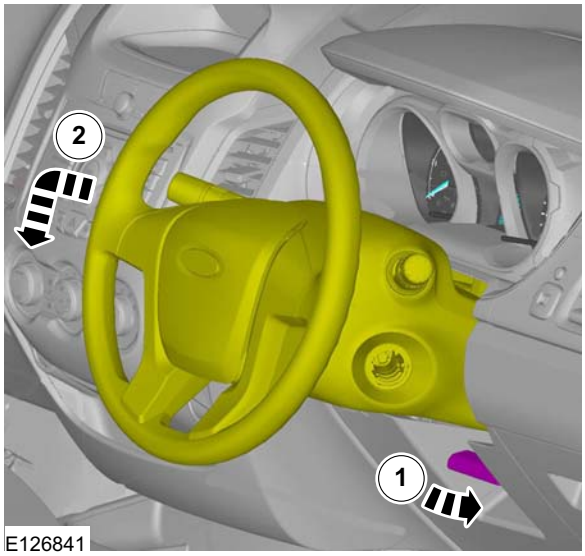
Instrument Cluster

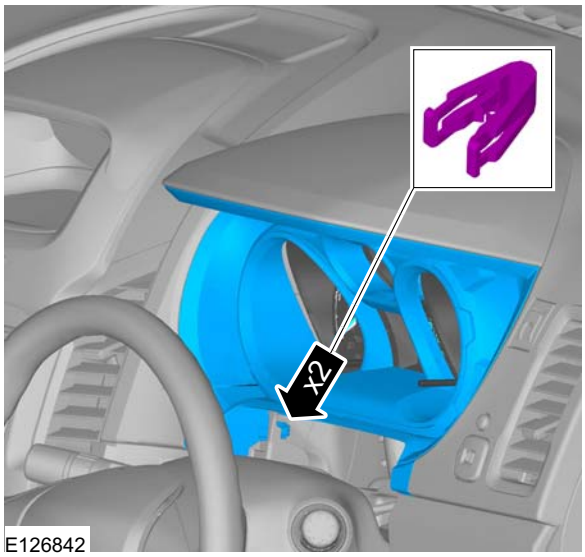
General Equipment

Ford Diagnostic Equipment

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. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. 

4. 

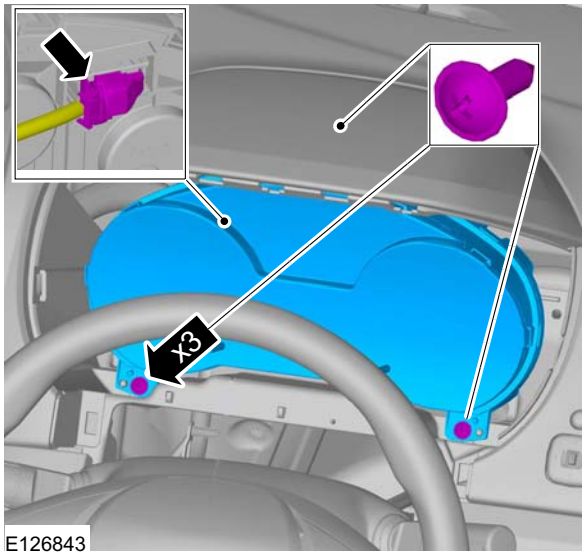
5. **NOTE:** This step is only necessary when installing a new component.

   Download the instrument cluster configuration information to the newly installed instrument cluster using the programmable modules installation routine.
6. **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.

REMOVAL AND INSTALLATION

7. Torque: 2 Nm



Installation

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

   Configure the PATS system using the programmable modules installation routine.

SECTION 413-06 Horn

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

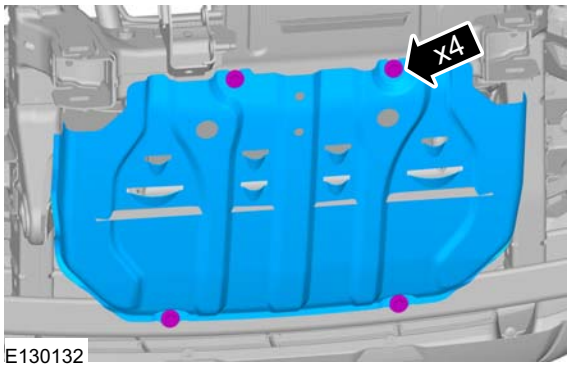
REMOVAL AND INSTALLATION

Horn

Removal

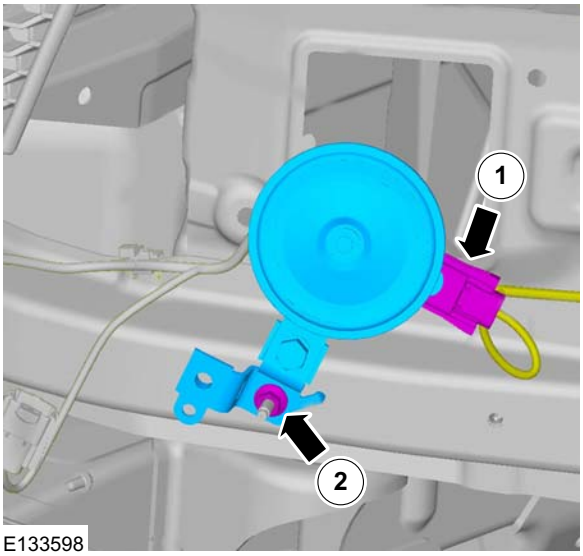
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Torque: 30 Nm



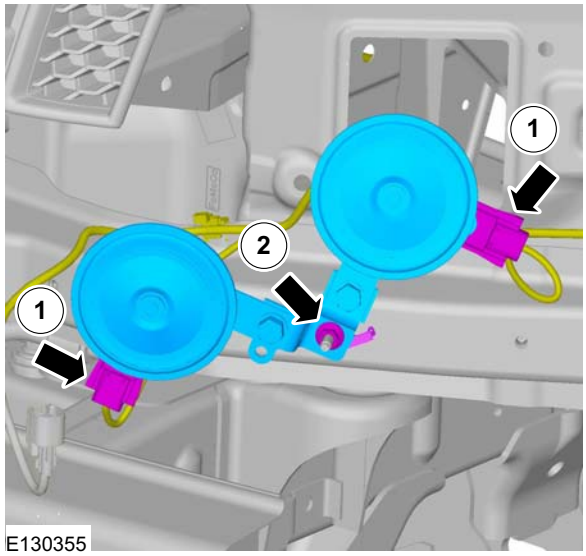
E130132

5. Single horn.
   Torque: 11 Nm



E133598

6. Dual horn.
   Torque: 11 Nm



E130355

Installation

1. To install, reverse the removal procedure.

SECTION 413-09 Warning Devices

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

GENERAL PROCEDURES

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 OFF 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.

NOTE: The belt minder can be turned off independently for the driver and the front passenger by performing the following procedure.

1. **Unbuckle** the driver's safety belt.
2. **Unbuckle** the front passenger's safety belt.
3. Turn the ignition switch to the ON position (do not start the engine).
4. **Wait until the safety belt warning indicator turns off.**
5. **NOTE:** This step must be completed within 30 seconds or the procedure must be repeated.

   Buckle then unbuckle the safety belt four times, ending with the safety belt unbuckled. Release the red unbuckle switch **completely** every cycle.
6. The safety belt warning indicator flashes momentarily to confirm the belt minder status change.
7. Turn the ignition switch to the OFF position. The deactivation/activation procedure is now complete.

SECTION 413-13 Parking Aid

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

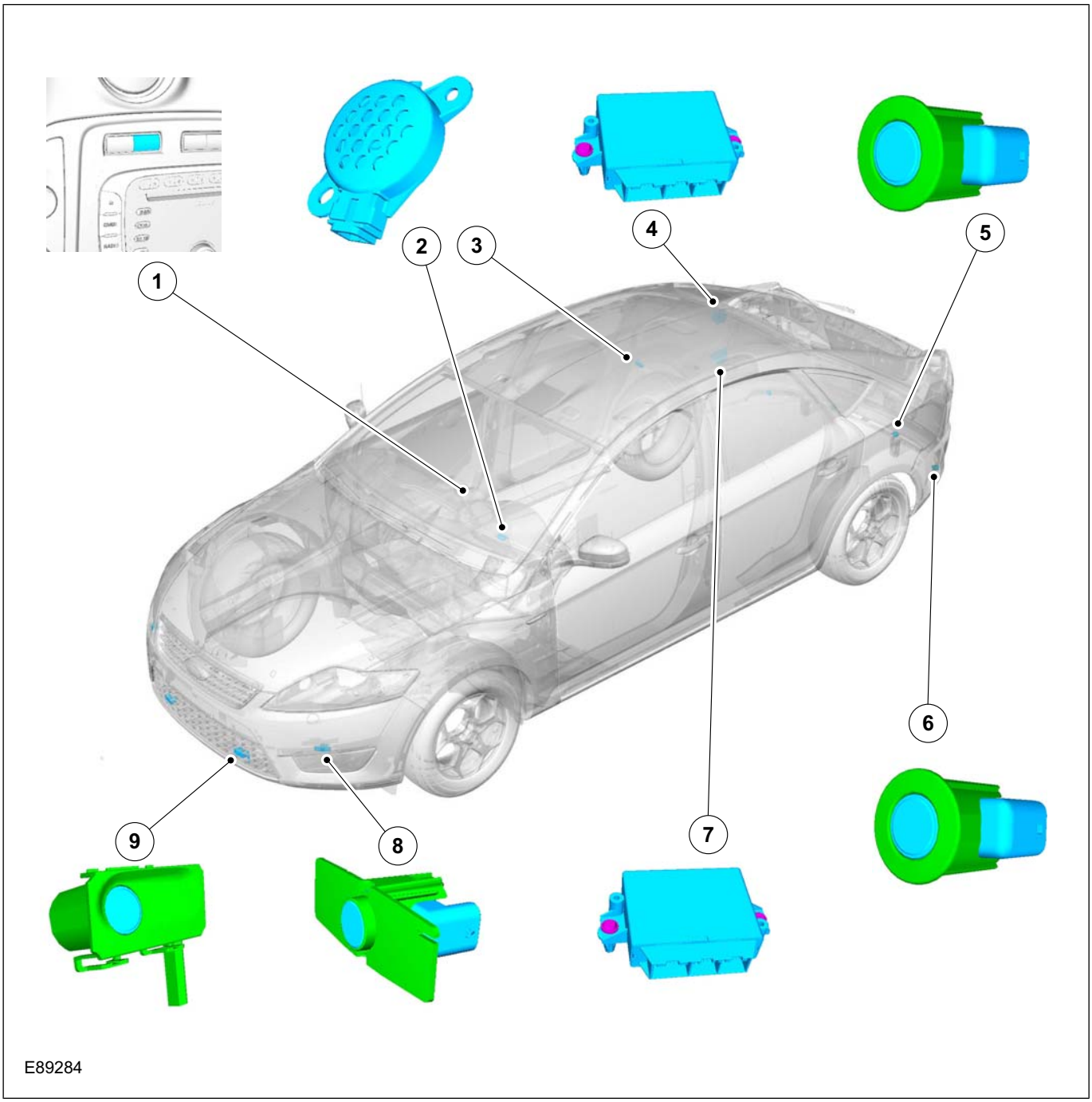
REMOVAL AND INSTALLATION

DESCRIPTION AND OPERATION

Parking Aid

Component location

4-Door and 5-Door



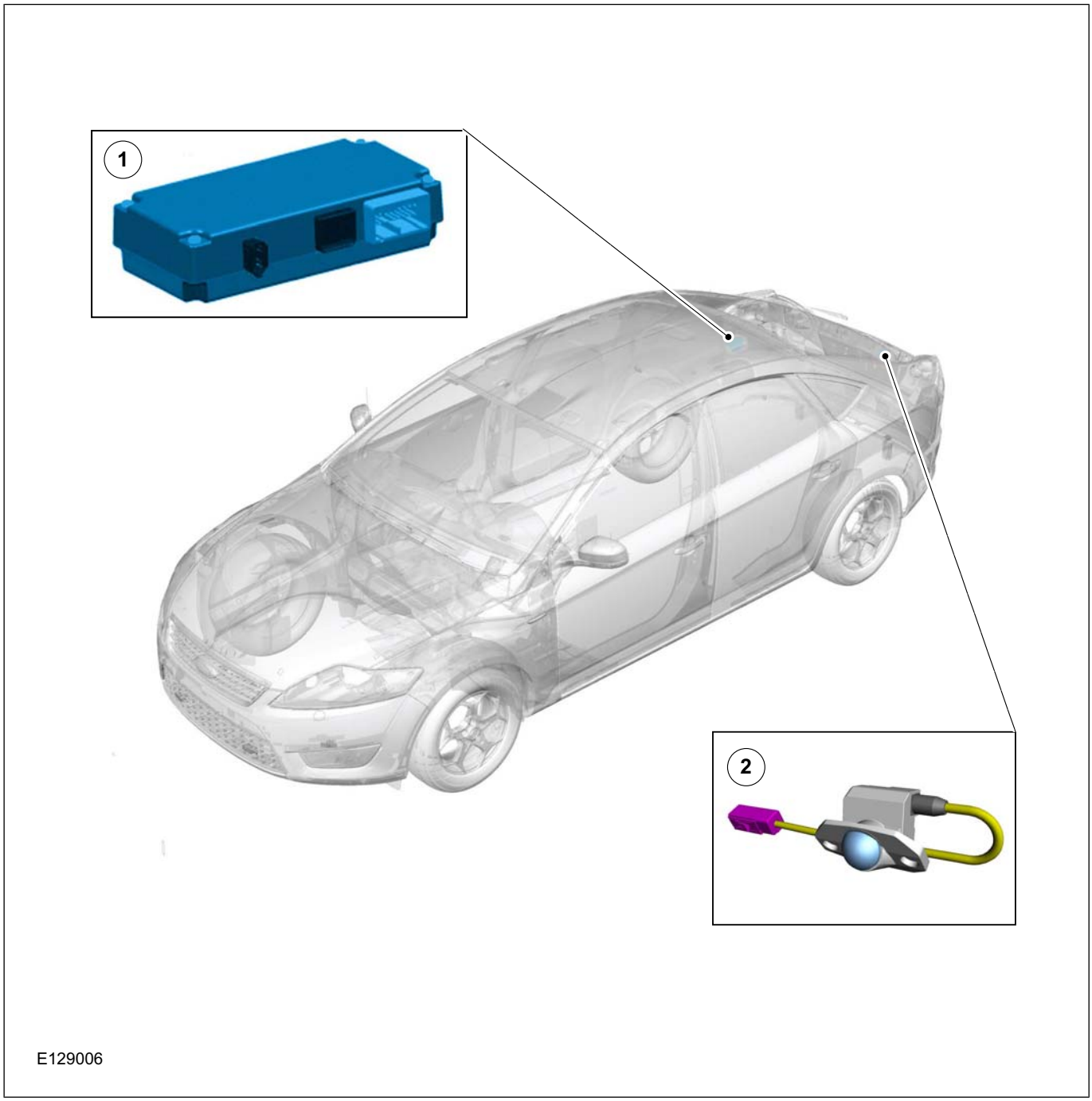
Item	Description
1	Parking aid switch (with light emitting diode (LED)).
2	Front parking aid speaker.
3	Rear parking aid speaker.

Item	Description
4	Parking aid module (4-door).
5	Rear inner parking aid sensor and holder.
6	Rear outer parking aid sensor and holder.
7	Parking aid module (5-door).

DESCRIPTION AND OPERATION

Item	Description
8	Front outer parking aid sensor and holder.
5-Door	with parking aid camera

Item	Description
9	Front inner parking aid sensor and holder.

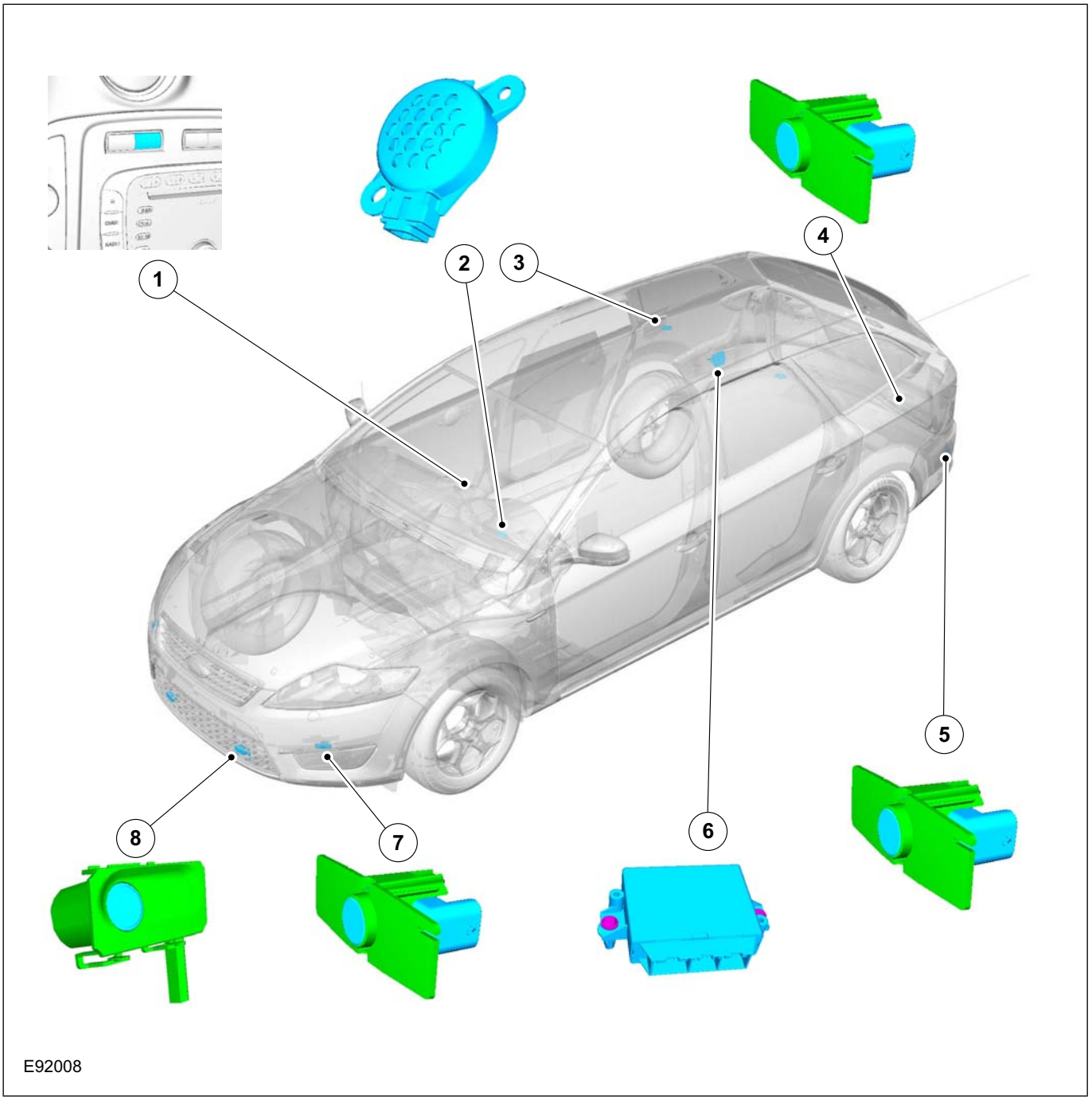


E129006

Item	Description
1	Parking aid camera module.
2	Parking aid camera.

DESCRIPTION AND OPERATION

Wagon

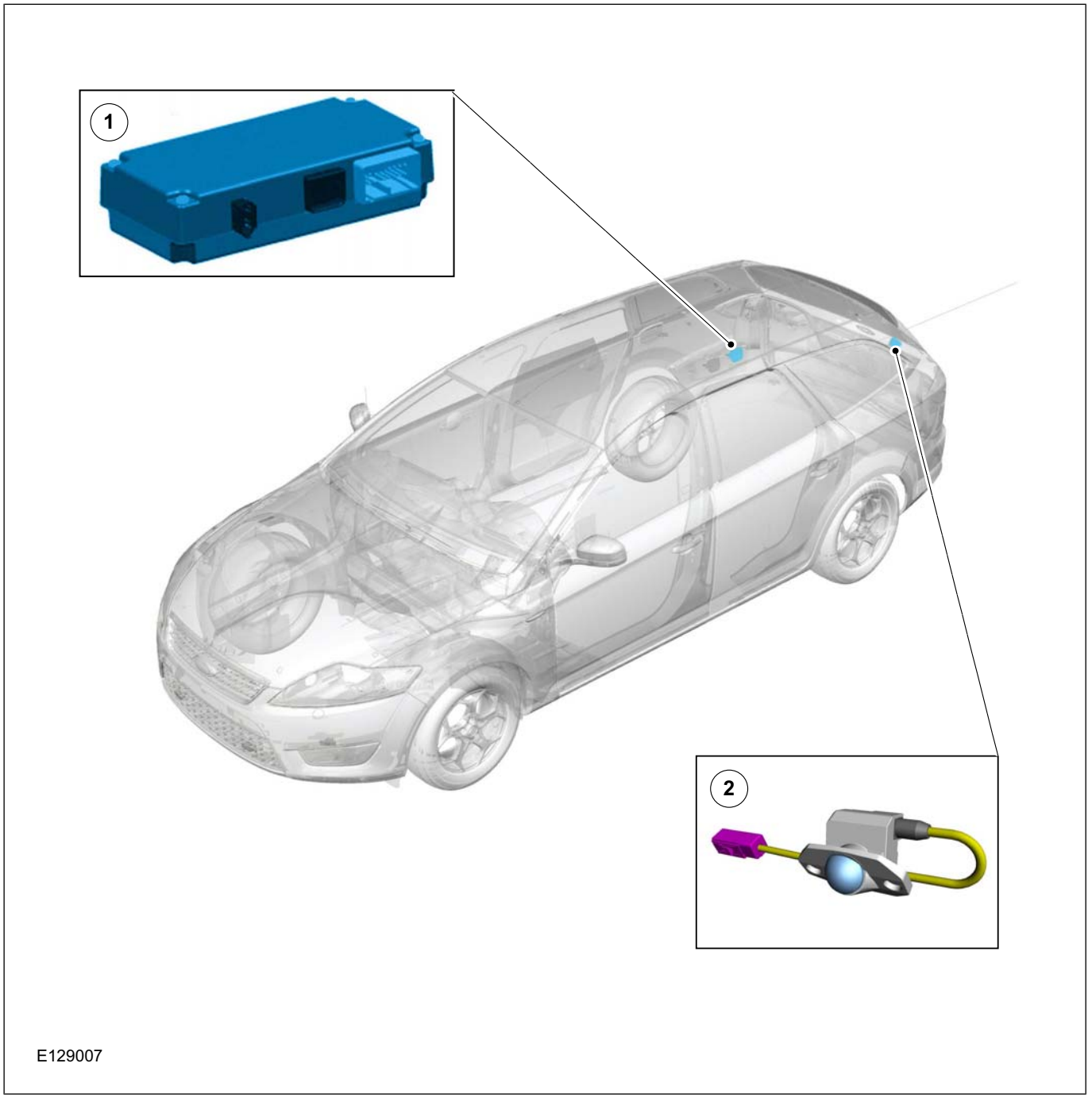


Item	Description
1	Parking aid switch (with light emitting diode (LED)).
2	Front parking aid speaker.
3	Rear parking aid speaker.
4	Rear inner parking aid sensor and holder.

Item	Description
5	Rear outer parking aid sensor and holder.
6	Parking aid module.
7	Front outer parking aid sensor and holder.
8	Front inner parking aid sensor and holder.

DESCRIPTION AND OPERATION

Wagon with parking aid camera



Item	Description
1	Parking aid camera module.
2	Parking aid camera.

Description and operation

Only one level of parking aid is installed to the vehicle, a front and rear system.

The parking aid provides an audible warning to the driver when any obstacles are in the path of the vehicle during forward or reverse parking manoeuvres. The system consists of four ultrasonic parking aid sensors and holders in each bumper, a parking aid module, parking aid speaker(s) and a parking aid switch.

At low speeds, the parking aid module uses the parking aid sensors to monitor the area around the front and rear bumpers. If an object is detected within a monitored area, the parking aid module outputs a warning tone using the parking aid speakers. Objects very close to the ground may

DESCRIPTION AND OPERATION

not be detected, but because of their low height will not cause damage to the vehicle.

The parking aid module communicates through discrete signals with the parking aid speakers. The parking aid speakers output the applicable warning tones when an object is detected. The medium speed controller area network (CAN) bus is used to collect vehicle data from other vehicle systems.

When the parking aid module activates the system, the parking aid switch LED is illuminated. The parking aid module processes signals received from the parking aid sensor(s) to determine if there is an object within the detection range of the parking aid sensor(s).

In the combined mode, the parking aid sensor(s) 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 analogue signal to a digital signal by the parking aid sensor. The digital signal is passed to the parking aid module and compared with pre-programmed data stored in an EEPROM within the parking aid module. The parking aid module receives this data through the signal line from the parking aid sensor and calculates the distance from the object using the elapsed time between the transmitted and received impulse.

In receiver mode, the parking aid sensor receives impulses that were emitted by adjacent parking aid sensors. The parking aid module uses this information to determine the distance of the object.

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, after the initial detection of an object, there is no decrease in distance between the object and the vehicle, the audible warning tones remain constant if the object is detected by a inner parking aid sensor or stops after 3 seconds if the object is detected by an outer parking aid sensor.

The parking aid module continues to monitor the distance and will resume the warning tones if a decrease in distance is detected.

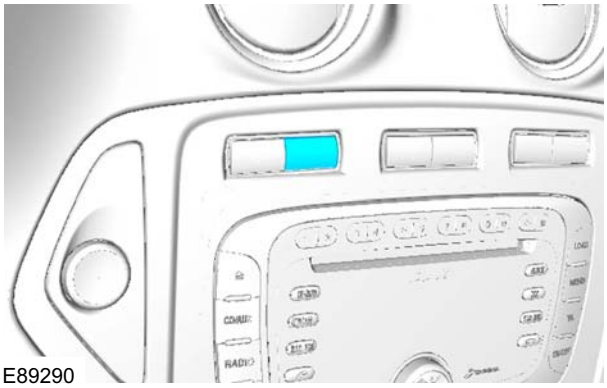
The parking aid is activated when the driver presses the parking aid switch and the vehicle speed is below 16 km/h (10 mph) or selects reverse gear.

Front and rear parking aid sensors are activated and deactivated together.

On vehicles with automatic transmission, the parking aid is always inactive in the PARK position.

The parking aid can detect when a trailer is connected to the vehicle by a message output on the medium speed 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.

Parking aid switch


E89290

The parking aid switch is located in the instrument panel, above the audio unit or navigation system display module. The parking aid switch is equipped with an integral LED.

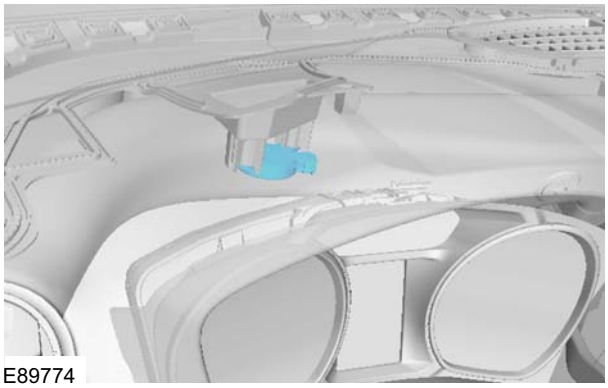
The parking aid switch is a non-latching push switch which allows the driver to select the parking aid on or off. When pressed, the parking aid switch momentarily connects a ground to the parking aid module. The LED indicates when the parking aid is active. The LED is controlled by the parking aid module.

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 concern exists in the parking aid, the LED flashes for 3 seconds when the reverse gear is selected or the driver selects the parking aid sensors on, using the parking aid switch.

DESCRIPTION AND OPERATION

Front parking aid speaker


E89774

The front parking aid speaker is located within the instrument panel behind the instrument cluster.

For additional information, refer to: Front Parking Aid Speaker (413-13 Parking Aid, Removal and Installation).

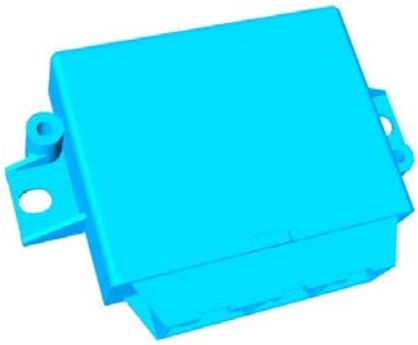
Rear parking aid speaker


E89773

The rear parking aid speaker is used to indicate failure modes within 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.

For additional information, refer to: Rear Parking Aid Speaker - 4-Door (413-13 Parking Aid, Removal and Installation).

Parking aid module


E89772

The parking aid module has three connectors which provide for power, ground and CAN bus connections, front and rear parking aid sensors, parking aid switch, LED and parking aid speakers.

The medium speed CAN bus connections provide for the receipt of the following information from other systems:

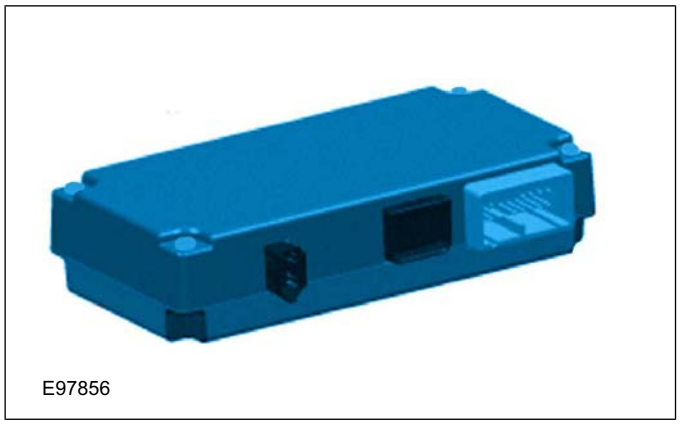
- ABS (anti-lock brake system) module - Road speed signal
- Generic electronic module (GEM) - Reverse gear engaged signal, vehicle configuration parameters, carmode and powermode
- Electronic parking brake (EPB)
- Transmission control unit - Gear selector position (automatic transmission)
- Trailer module - Trailer connection status

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 is made aware of any concern condition by the parking aid switch LED flashing and a continuous high pitch warning tone being emitted for 3 seconds when the parking aid is activated, in place of the normal short tones when the parking aid is functioning normally. DTCs can be read using the Ford approved diagnostic tool through the data link connector (DLC).

For additional information, refer to: Parking Aid Module (413-13 Parking Aid, Removal and Installation).

DESCRIPTION AND OPERATION

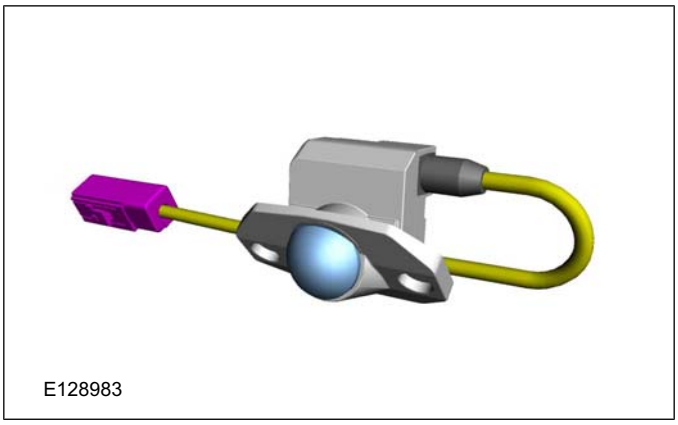
Parking aid camera module


E97856

The data from the optional parking aid is sent to the module via the Mid Speed CAN data bus. The module is connected to the navigation device via a video-in/out cable.

It is necessary to programme the module withIDS (Integrated Diagnostic System) after changing it.

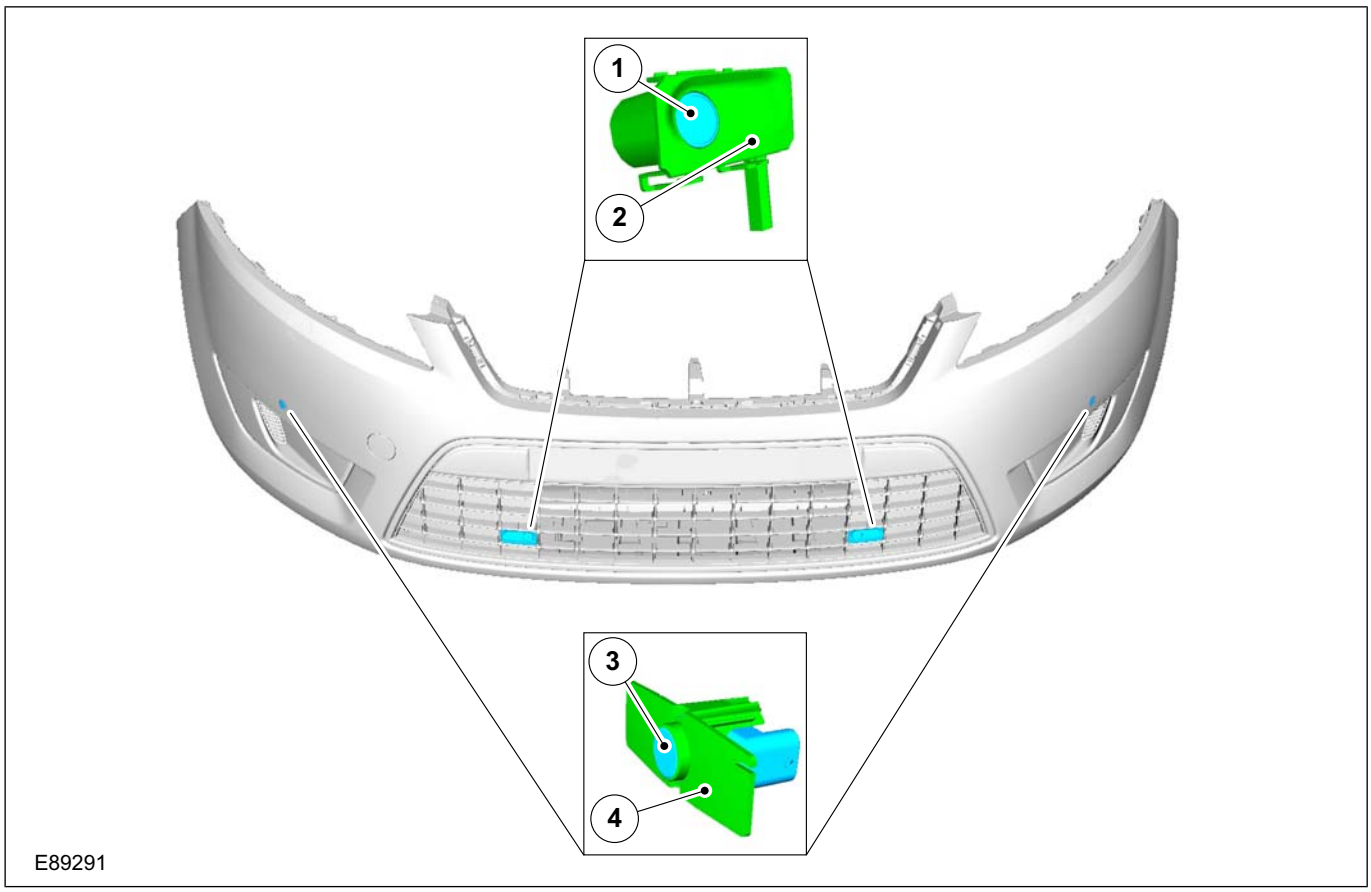
Parking Aid Camera


E128983

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.

It is not necessary to programme the camera after changing it.

Front parking aid sensors



E89291

DESCRIPTION AND OPERATION

Item	Description
1	Front inner parking aid sensor(s).
2	Front inner parking aid sensor holder(s).
3	Front outer parking aid sensor(s).
4	Front outer parking aid sensor holder(s).

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 front bumper.

For additional information, refer to: Front Parking Aid Sensor (413-13 Parking Aid, Removal and Installation).

Each parking aid sensor has a three pin connector which connects with the front bumper wiring harness, which 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.

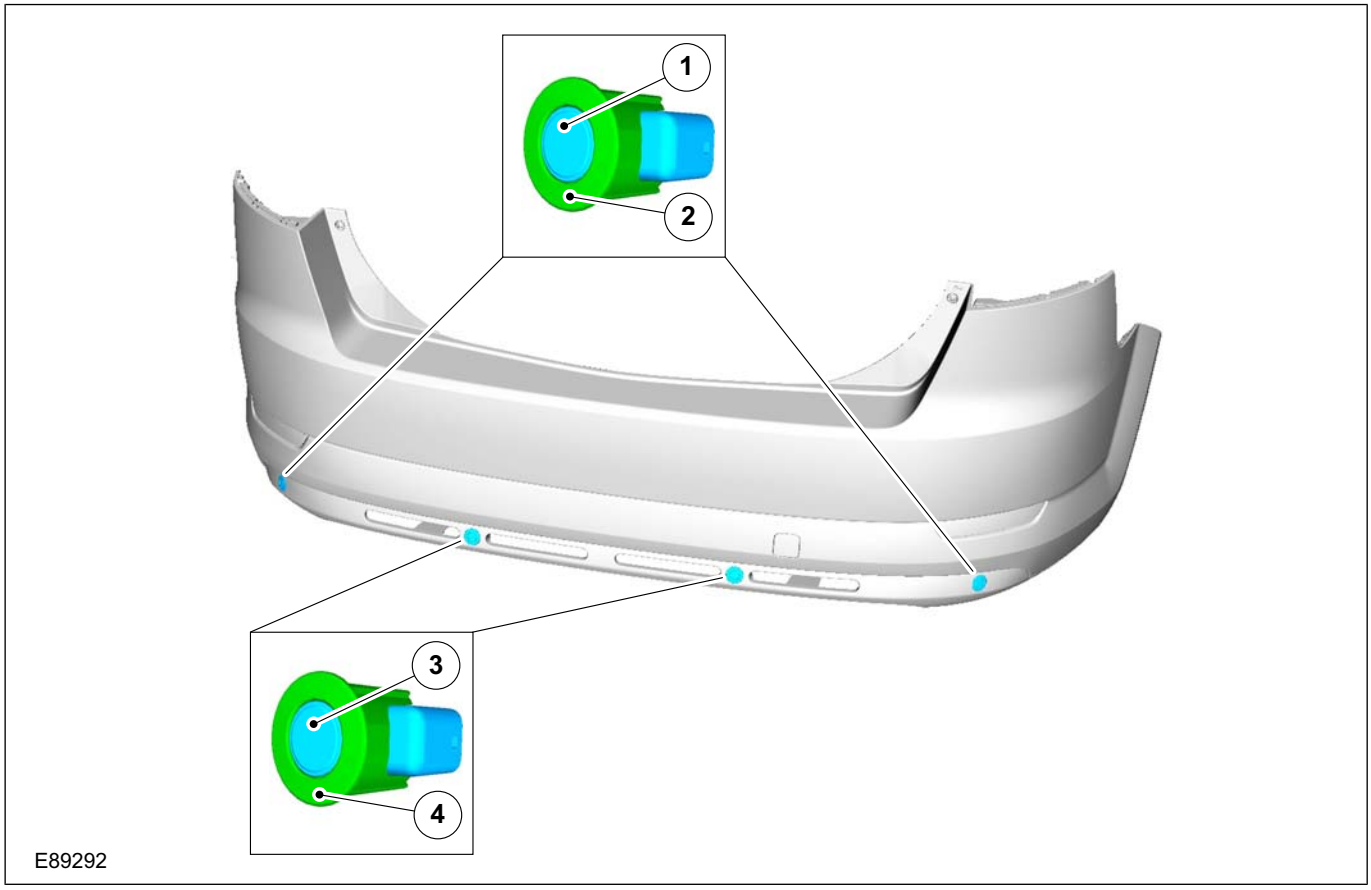
Each parking aid sensor consists of the following:

- a plastic housing
- an aluminium membrane which contains a piezo electric disc
- a separate decoupling ring (which must be removed before the parking aid sensors are painted and re-assembled afterwards)
- a printed circuit board assembly

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.

Rear parking aid sensors

4-Door and 5-Door

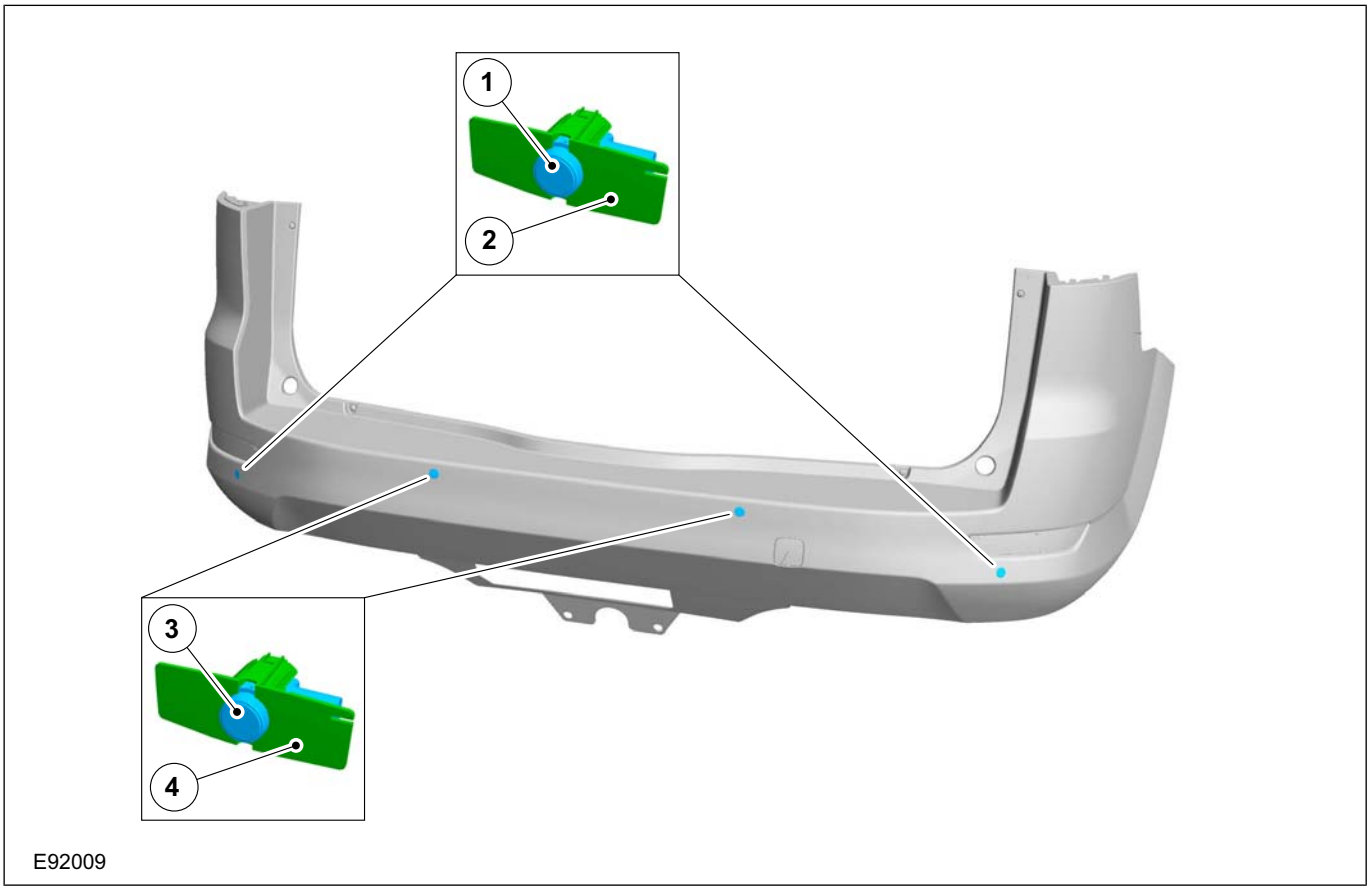


Item	Description
1	Rear outer parking aid sensor(s).
2	Rear outer parking aid sensor holder(s).

Item	Description
3	Rear inner parking aid sensor(s).
4	Rear inner parking aid sensor holder(s).

DESCRIPTION AND OPERATION

Wagon



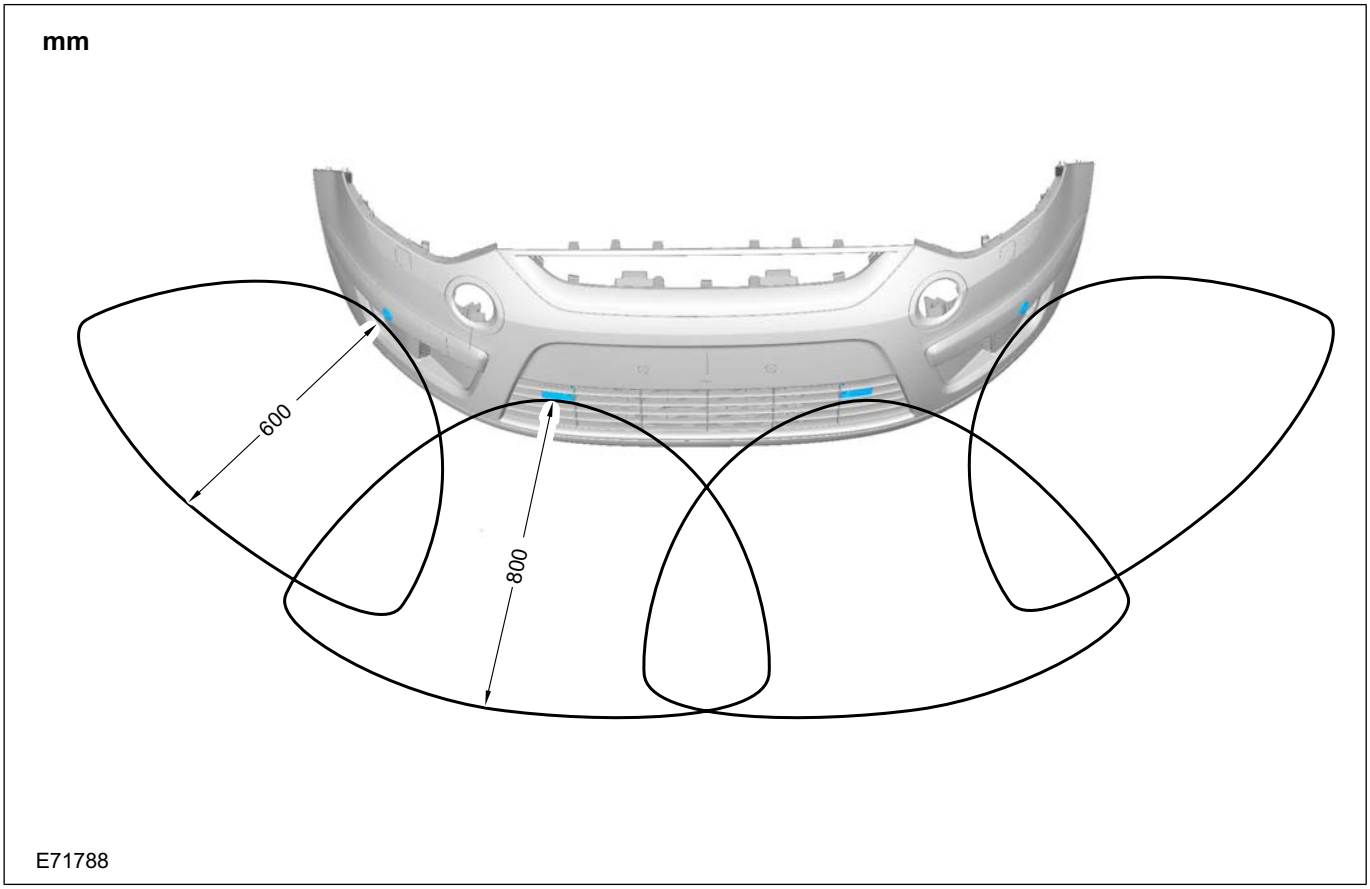
Item	Description
1	Rear outer parking aid sensor(s).
2	Rear outer parking aid sensor holder(s).
3	Rear inner parking aid sensor(s).
4	Rear inner parking aid sensor holder(s).

Design and function principles of the rear parking aid sensors are the same as on the front parking aid sensors.

DESCRIPTION AND OPERATION

Distance calculation

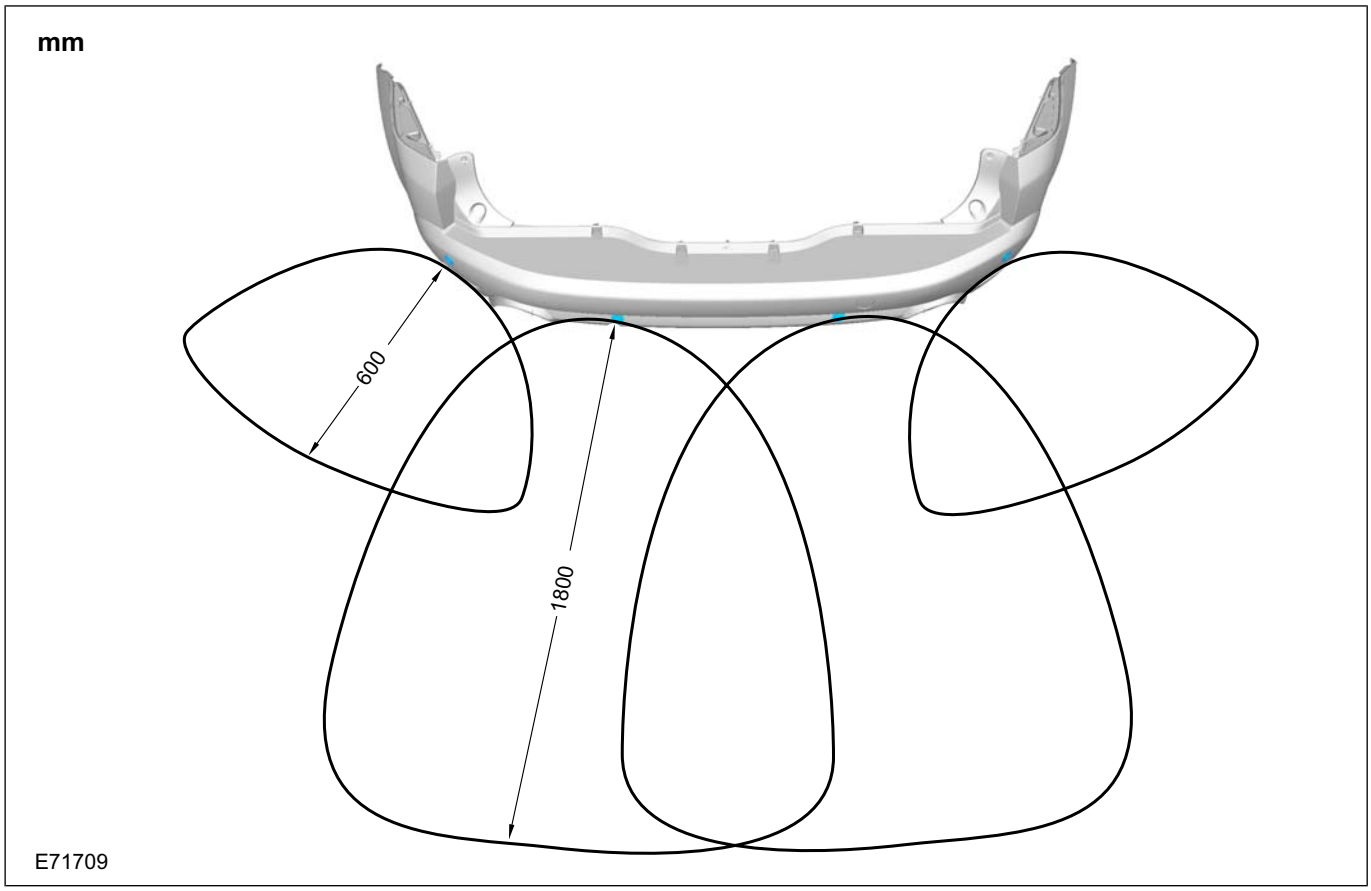
Front parking aid sensors



The maximum detection range for the front parking aid sensors is 800 mm (31 inches) for the central parking aid sensors and 600 mm (23.5 inches) for the corner parking aid sensors.

DESCRIPTION AND OPERATION

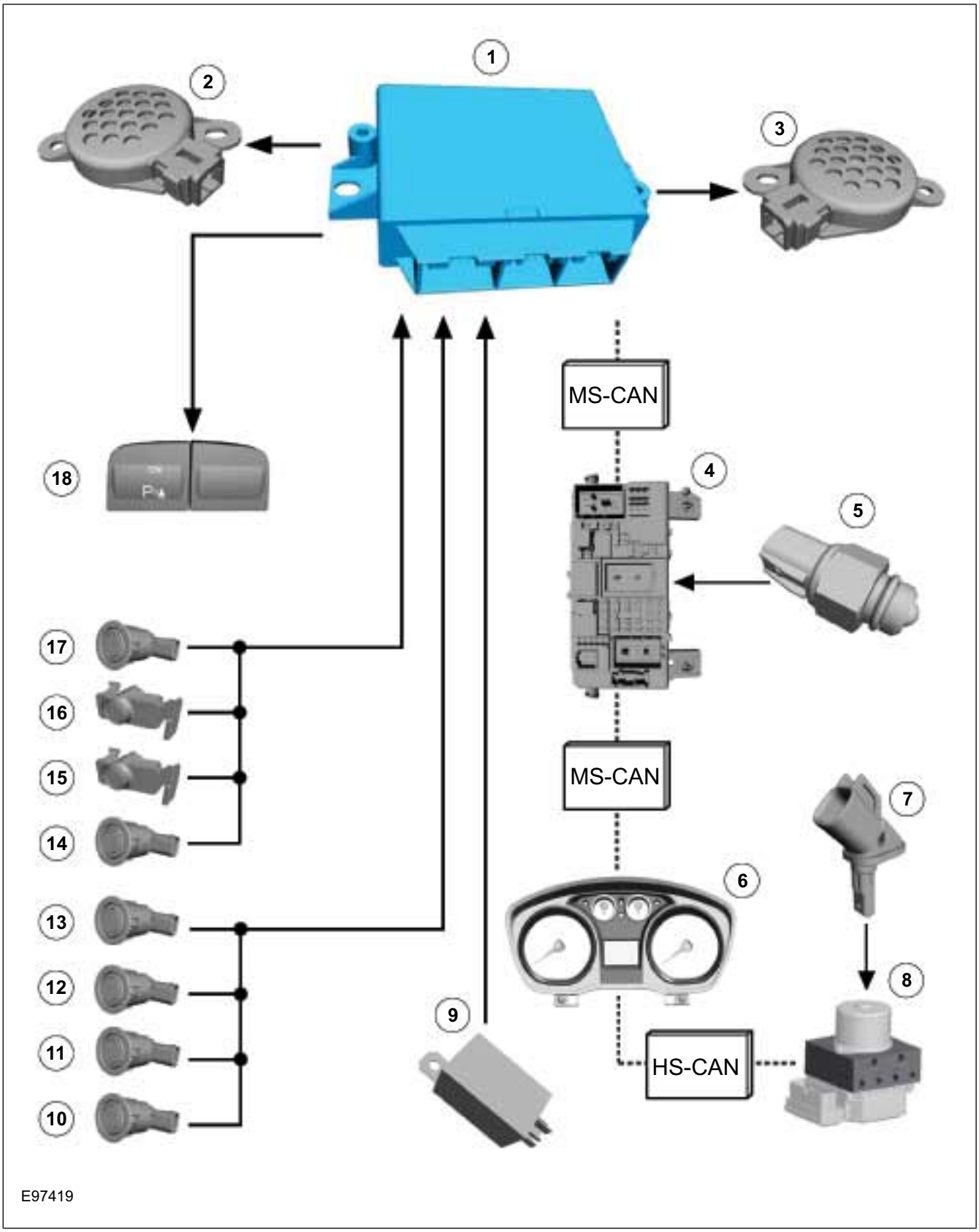
Rear parking aid sensors



The maximum detection range for the rear parking aid sensors is 1800 mm (70 inches) for the central parking aid sensors and 600 mm (23.5 inches) for the corner parking aid sensors.

DESCRIPTION AND OPERATION

Vehicles with front and rear parking aid



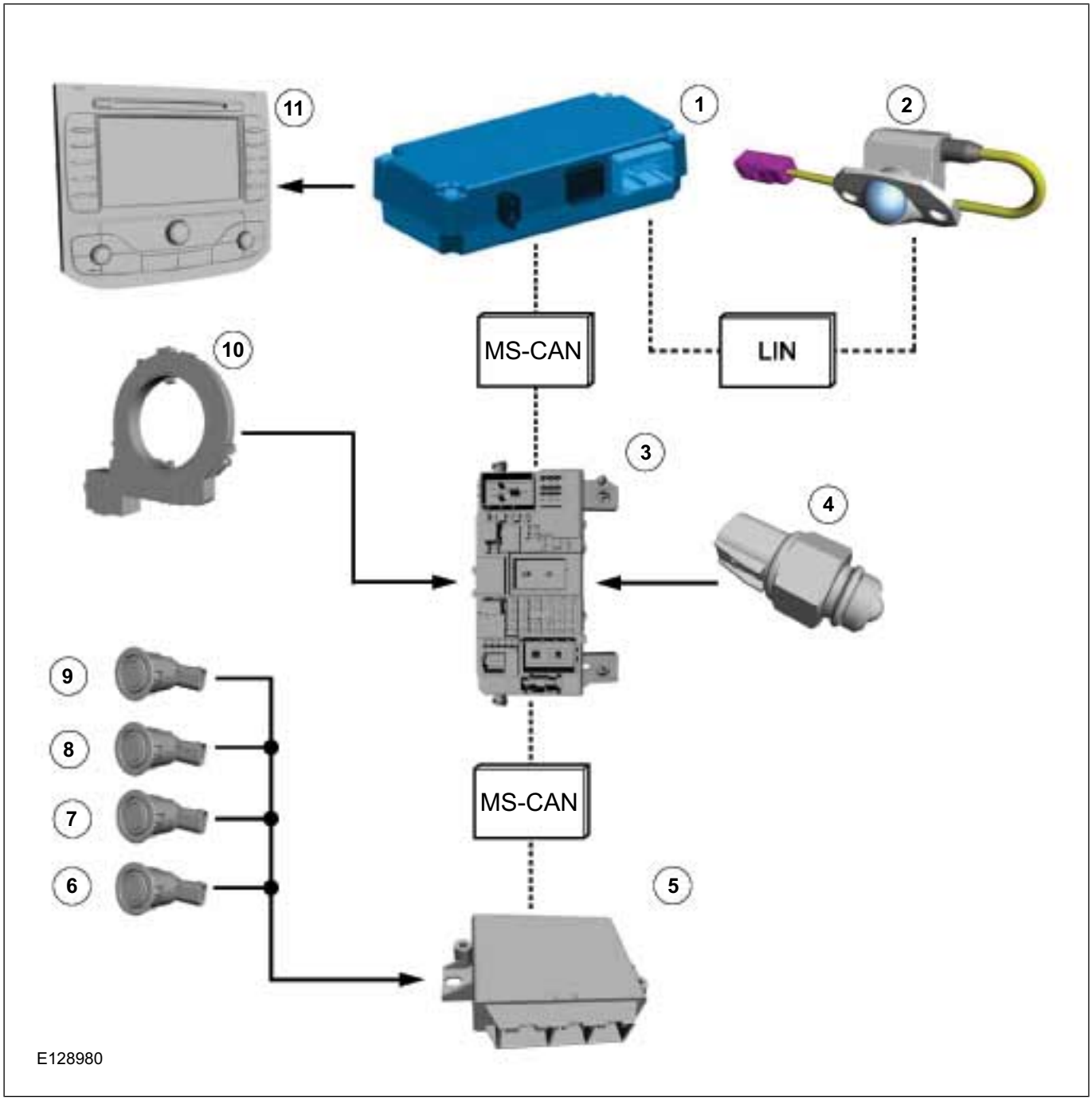
DESCRIPTION AND OPERATION

Item	Description
1	Parking aid module.
2	Front parking aid speaker.
3	Rear parking aid speaker.
4	Generic Electronic Module (GEM).
5	Reverse gear switch.
6	Instrument cluster.
7	ABS sensor assembly.
8	ABS.
9	Trailer relay.

Item	Description
10	Rear parking aid sensor.
11	Rear parking aid sensor.
12	Rear parking aid sensor.
13	Rear parking aid sensor.
14	Front parking aid sensor.
15	Front parking aid sensor.
16	Front parking aid sensor.
17	Front parking aid sensor.
18	Parking aid switch (with light emitting diode (LED)).

DESCRIPTION AND OPERATION

Vehicles with parking aid camera



Item	Description
1	Parking aid camera module.
2	Parking Aid Camera.
3	Generic Electronic Module (GEM).
4	Reverse gear switch.
5	Parking aid module.
6	Rear parking aid sensor.
7	Rear parking aid sensor.

Item	Description
8	Rear parking aid sensor.
9	Rear parking aid sensor.
10	steering angle sensor.
11	Navigation device.

DESCRIPTION AND OPERATION

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.

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.

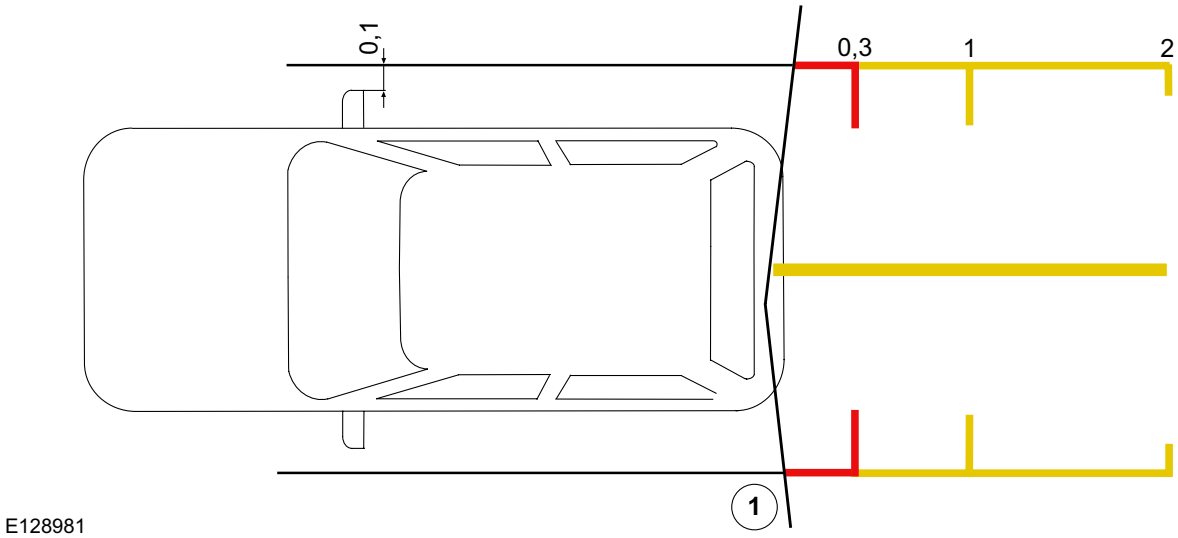
For vehicles with a navigation system, the parking aid camera can be ordered as an optional extra. The system essentially consists of a camera with a wide angle lens, a control unit and a wiring harness which is not integrated in the vehicle wiring harness.

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

DESCRIPTION AND OPERATION

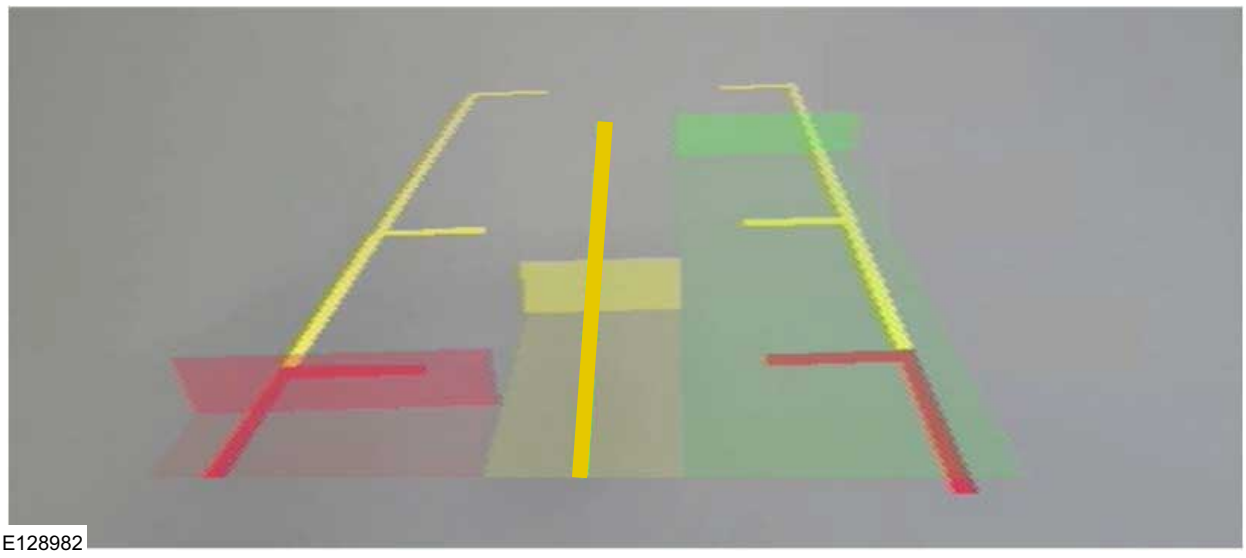
screen help the driver to find out about the steering angle, vehicle width, cornering and driving straight ahead. The system generates these guides using:

- 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.



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).

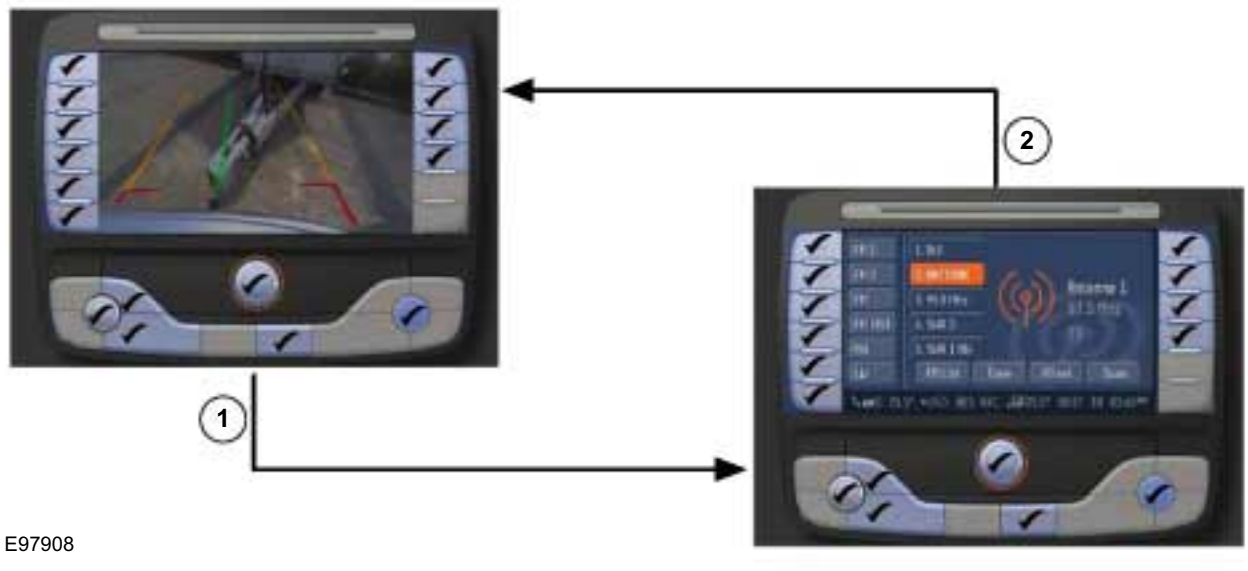
DESCRIPTION AND OPERATION

E97906


E97909

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.



E97908

REMOVAL AND INSTALLATION

Parking Aid Module

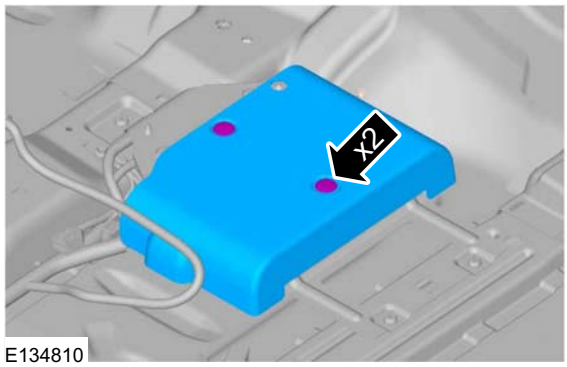
Removal

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

1. Passenger side.

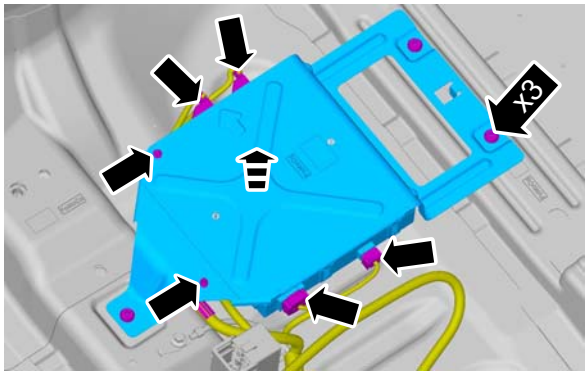
   Refer to: Front Seat (501-10 Seating, Removal and Installation).

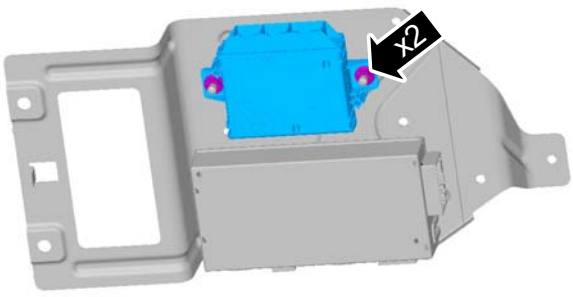
2.



E134810

3. Torque: 10 Nm





E134811

Installation

1. To install, reverse the removal procedure.

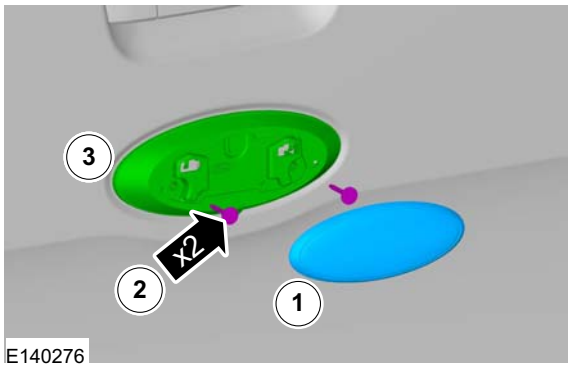
REMOVAL AND INSTALLATION

Parking Aid Camera

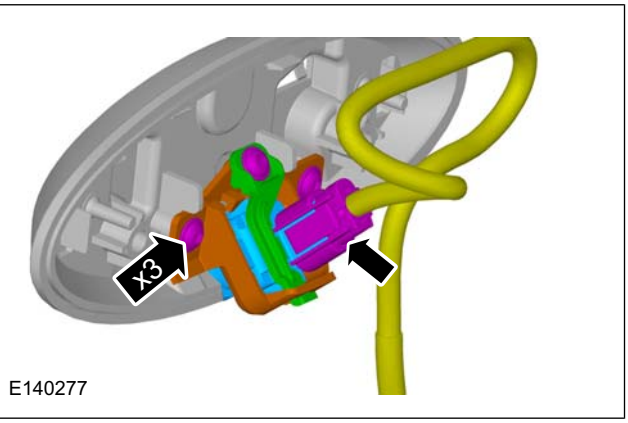
Removal

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

1.



2.



Installation

1. To install, reverse the removal procedure.

SECTION 414-00 Charging System - General Information

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

GENERAL PROCEDURES

Battery Charging(31 003 0)

General Equipment

Midtronics GR-590 Battery Management Center
Battery Charger

WARNINGS:

Always observe the battery charger equipment manufacturer's instructions.

Do not jump/slave start using a battery charging system from another vehicle.

Do not overfill a battery as this can cause acid leakage that will result in damage to the vehicle and possible personal injury.

CAUTIONS:

Do not rely on the generator to recharge a discharged battery. It would take in excess of eight hours of continuous driving with no additional loads placed on the charging system.

Make sure that the battery electrolyte reaches the indicated maximum mark.

Connect the battery charger cables to the battery before switching the battery charger on.

Switch the battery charger off before disconnecting the battery charger cables from the battery.

NOTE: Ford batteries generally require no maintenance however, in certain conditions, it is possible for the electrolyte in a battery to fall below the minimum level.

NOTE: The use of the Midtronics GR-590 Battery Management Center, which has been specifically designed for use on silver calcium type batteries is recommended. Once connected to the battery, the battery charger detects the state of battery charge and then applies the appropriate charge rate and duration. When the battery is fully charged, the battery charger switches to stand-by, keeping the battery in a fully charged state preventing excessive gassing and overcharging. The Midtronics GR-590 Battery Management Center also incorporates a software program that has the capability to assist in the recovery of deeply discharged (sulphated) batteries.

NOTE: Charging methods and types of battery chargers vary widely. Whichever method is utilized it must be carried out carefully to avoid damage to the battery and possible personal injury. Specific instructions accompanying each battery charger and must be followed exactly. Safeguards provided by the equipment manufacturer should not be disregarded by the operator.

NOTE: A battery which has been stored in a highly discharged state may be slow to accept a charge at first. In such cases the initial charging rate may be so low that the ammeter on some battery testers will not show any indication of charge for 5 to 10 minutes.

NOTE: Automatic battery chargers are also protected against reverse polarity connection and require no adjustment or monitoring.

NOTE: Slow-charging will readily restore a battery to a full state of charge and, since the charging current is relatively low, the possibility of overcharging a battery are minimized. The charge rate used should be approximately equal to 5% of the reserve capacity of the battery being charged (approximately three to six Amps depending on battery size). The charging current should be adjusted 10 minutes after initial setting and again after 1 hour before being left to charge the battery for between 8 and 12 hours.

NOTE: A constant voltage battery charger will charge a battery at a set maximum voltage. The voltage used depends upon the design and condition of the battery charger and the age and temperature of the battery. This type of battery charger initially charges at a high rate of current that reduces as battery voltage is restored. When using a constant voltage battery charger, the charging current should be recorded after five minutes and the battery charger switched off when the charging current falls to one–third of the recorded value, or after eight hours whichever occurs first.

NOTE: Multiple battery chargers are designed to charge a number of batteries, simultaneously. Of the two different types of multiple battery chargers available, only those that charge batteries in series should be used and it is important that batteries are of the same or very similar ratings and voltages. Multiple battery chargers that charge batteries in parallel are not recommended.

NOTE: The use of a fast (boost) battery charger is not recommended as it can cause damage to a battery. Fast charging will only restore a battery to a state of charge that will enable it to carry out it's critical function of cranking the engine. Fast

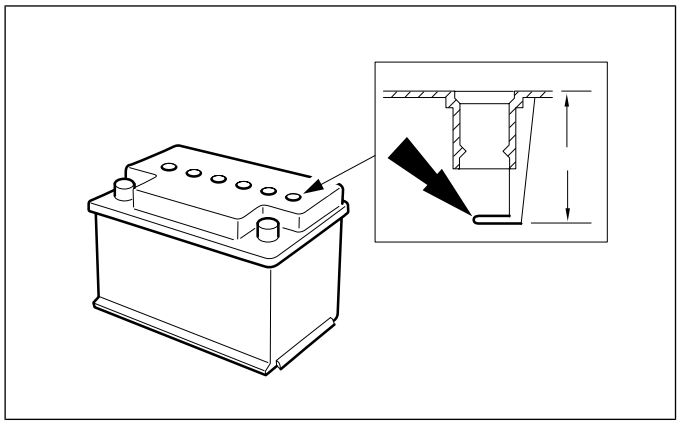
GENERAL PROCEDURES

charging will not restore a battery to a full state of charge and must therefore be followed by a period of slow charging. Excessively fast charging can cause damage to a battery. For this reason, charging times must be carefully controlled. Fast battery chargers vary widely in design so it is very important to strictly adhere to the equipment manufacturer's instructions. A charge of 30 amps for up to 30 minutes is the most common fast charging application. If the battery is very discharged and requires additional restoration, an additional charge of 20 amps for a period up to one and a half hours should be applied. Fast charging for a period in excess of two hours significantly increases the risk of causing damage to the battery.

NOTE: When connecting and disconnecting the battery from the vehicle, make sure that the battery ground cable is disconnected first and connected last and that all electrical items are switched off. Record the audio unit keycode and preset radio frequencies before disconnecting the battery.

1. **Remove the battery (Focus C-MAX 2003.75, Focus 2004.75, S-MAX/Galaxy 2006.50, Mondeo 2007.50 only).**
2. **Disconnect the battery ground cable (All, except the vehicles mentioned in the previous step).**
3. **NOTE: The maximum battery electrolyte level is approximately 40 mm below the very top of the battery casing. This corresponds to a point just below the lower rim of the battery casing.**

   Check that the battery electrolyte reaches the indicated maximum level. Top up with distilled/de-ionized water, as necessary.



4. **Connect the positive red clamp from the battery charger to the positive battery terminal.**
5. **Connect the negative black clamp from the battery charger to the negative battery terminal.**
6. **Connect the AC power cable to the mains outlet and switch on.**
7. **Follow the instructions supplied with the battery charger to charge the battery.**
8. **To disconnect the battery charger, reverse the connection procedure.**

SECTION 414-01 Battery, Mounting and Cables

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

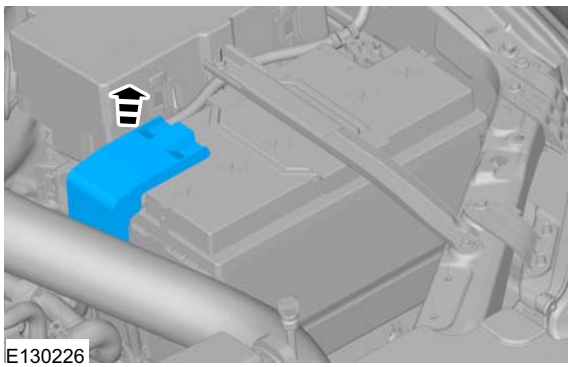
GENERAL PROCEDURES

Battery Disconnect and Connect

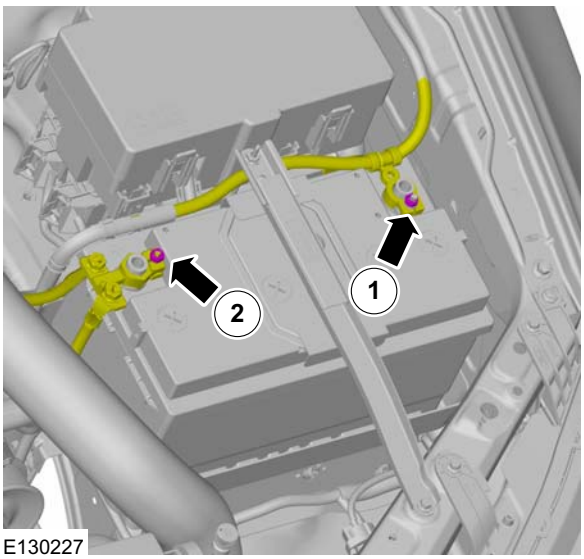
Activation

1. Obtain and record the audio unit keycode and preset radio frequencies.

2.


E130226

3. Torque: 27 Nm



E130227

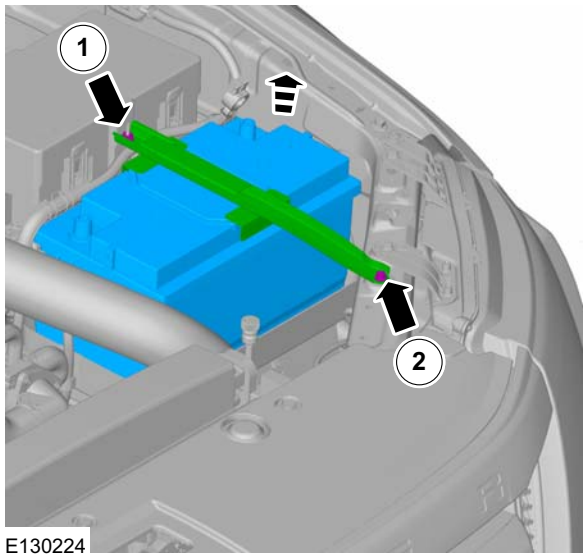
REMOVAL AND INSTALLATION

Battery

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. 2. Torque: 11 Nm



Installation

1. To install, reverse the removal procedure.

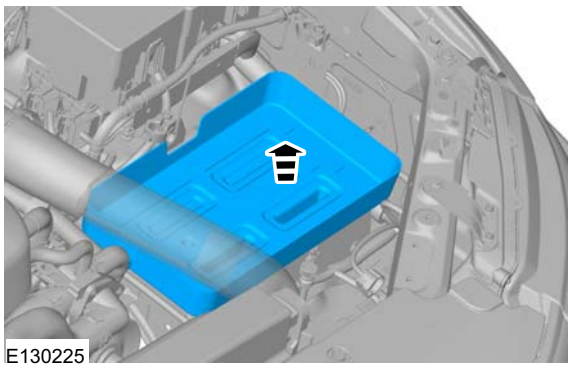
REMOVAL AND INSTALLATION

Battery Tray

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: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).
3.


E130225

Installation

1. To install, reverse the removal procedure.

SECTION 414-02 Generator and Regulator

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

Generator — 2.5L Duratec-HE (122kW/165PS) - MI4(31 414 0)

Removal

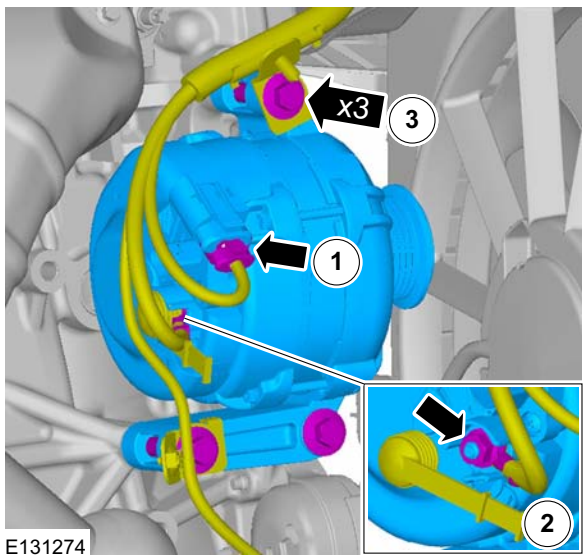
NOTE: Removal steps in this procedure may contain installation details.

1. **WARNING: When the battery cables are connected, touching the vehicle body with generator terminal B will generate sparks. This can cause personal injury, fire, and damage to the electrical components. Always disconnect the battery negative cable before performing the following operation.**

   CAUTION: Do not allow any metal object to come in contact with the generator housing and internal diode cooling fins. A short circuit may result and burn out the diodes.

   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

2. Refer to: Accessory Drive Belt (303-05 Accessory Drive - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
3. **CAUTION: Take extra care not to damage the wiring harnesses.**
   2. Torque: 15 Nm
   3. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Generator — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma(31 414 0)

Removal

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

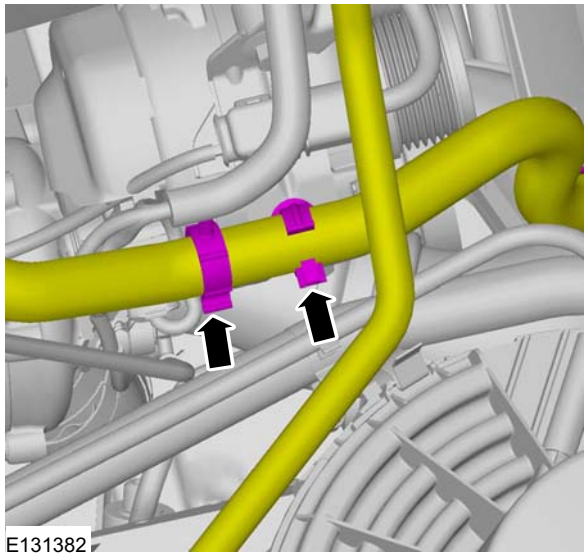
1. **WARNING: When the battery cables are connected, touching the vehicle body with generator terminal B will generate sparks. This can cause personal injury, fire, and damage to the electrical components. Always disconnect the battery negative cable before performing the following operation.**

   CAUTION: Do not allow any metal object to come in contact with the generator housing and internal diode cooling fins. A short circuit may result and burn out the diodes.

   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

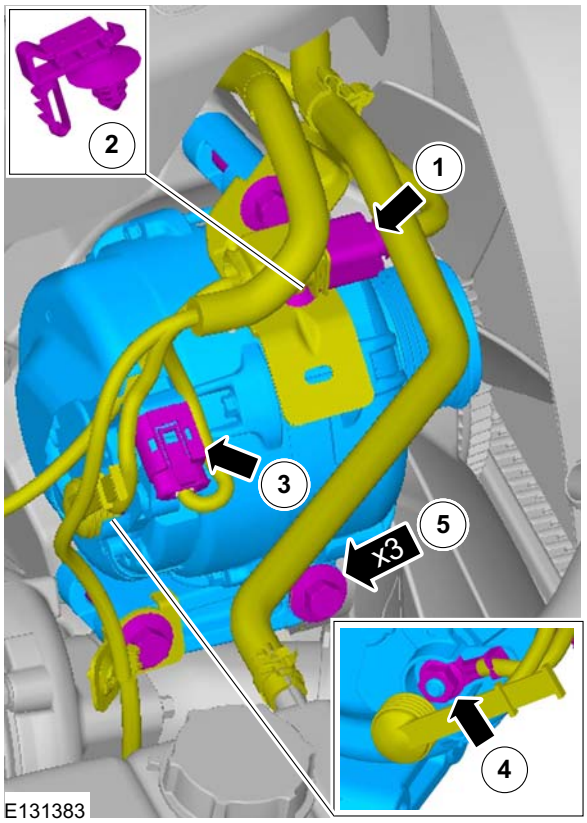
2. Refer to: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

3.



REMOVAL AND INSTALLATION

4. ⚠ **CAUTION: Take extra care not to damage the wiring harnesses.**
   4. Torque: 15 Nm
   5. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Generator — 3.2L Duratorq-TDCi (148kW/200PS) - Puma(31 414 0)

Removal

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

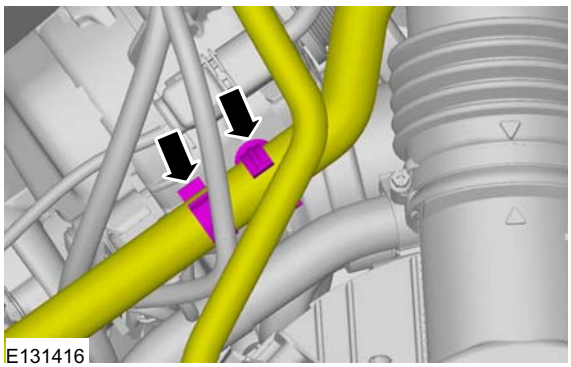
1. **WARNING: When the battery cables are connected, touching the vehicle body with generator terminal B will generate sparks. This can cause personal injury, fire, and damage to the electrical components. Always disconnect the battery negative cable before performing the following operation.**

   CAUTION: Do not allow any metal object to come in contact with the generator housing and internal diode cooling fins. A short circuit may result and burn out the diodes.

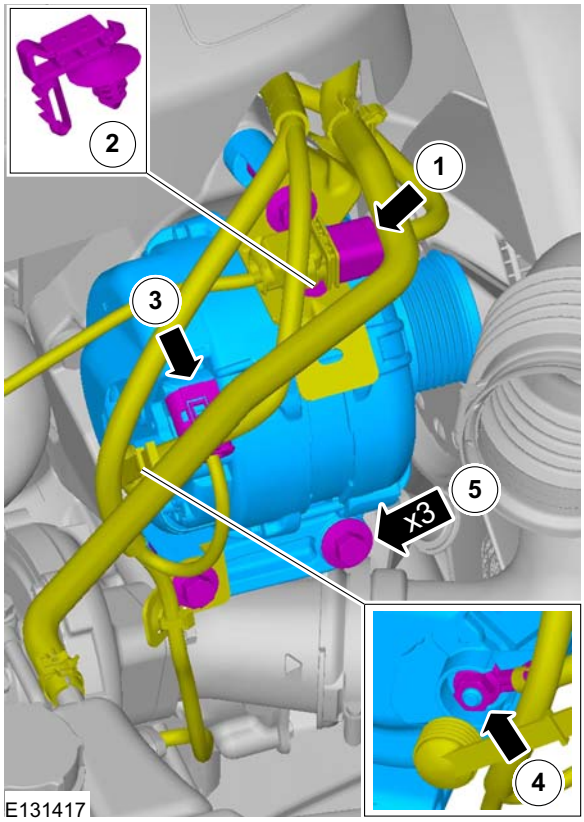
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

2. Refer to: Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-05 Accessory Drive - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).

3.



4. **CAUTION: Take extra care not to damage the wiring harnesses.**
   4. Torque: 15 Nm
   5. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 415-00 Information and Entertainment System - General Information

VEHICLE APPLICATION: 2011.50 Ranger

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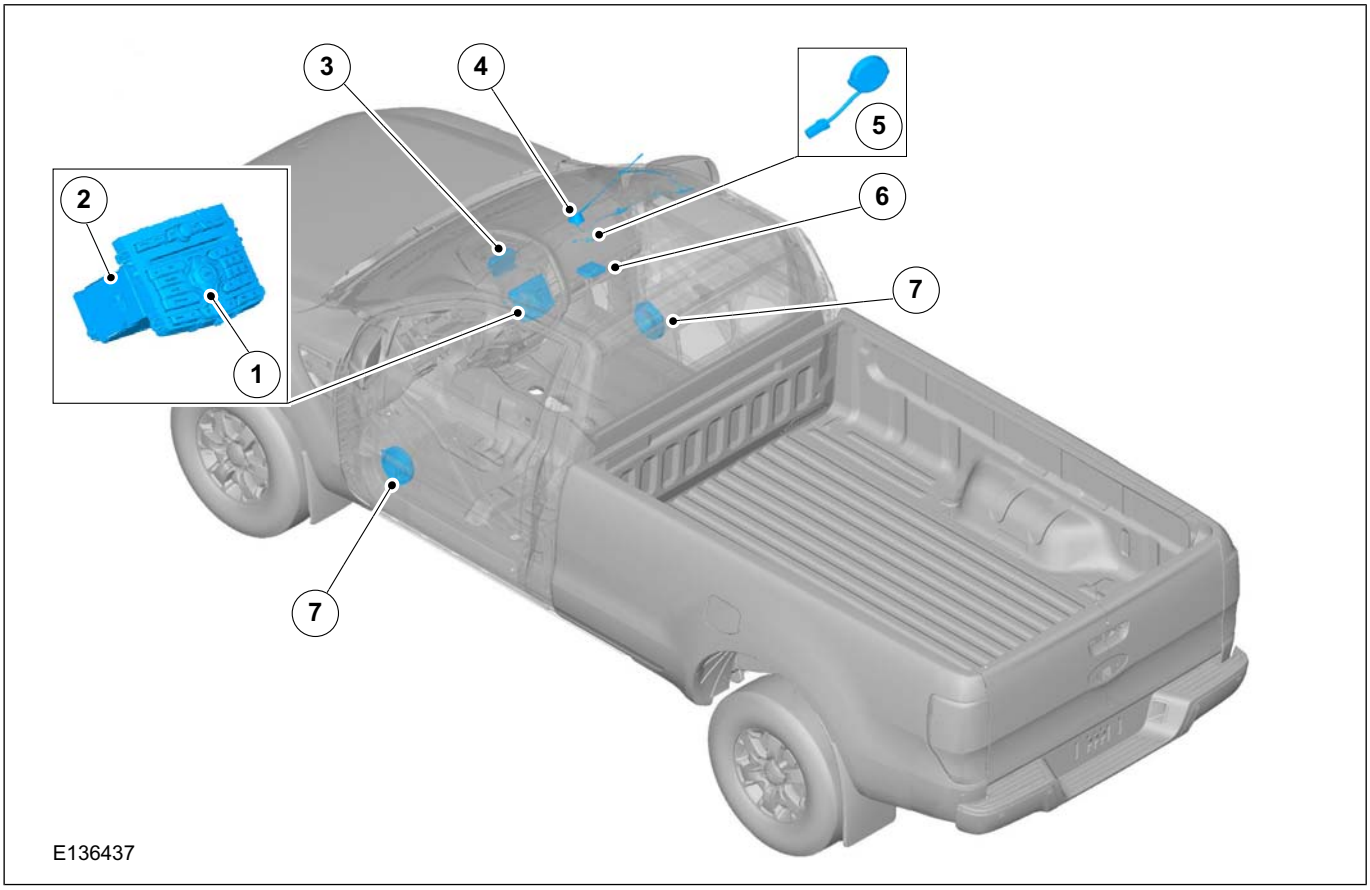
DESCRIPTION AND OPERATION

DESCRIPTION AND OPERATION

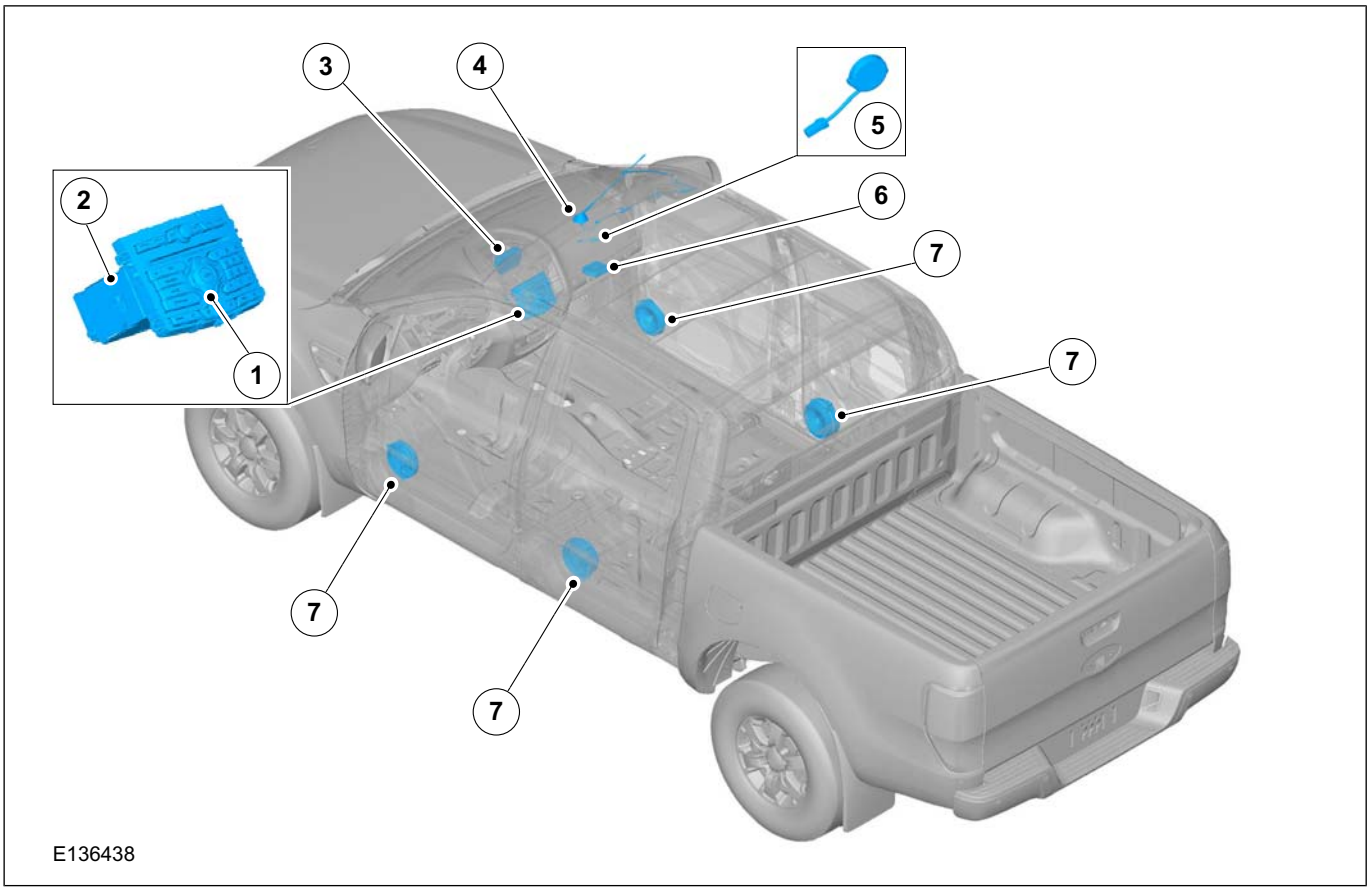
Information and Entertainment System

SINGLE CAB



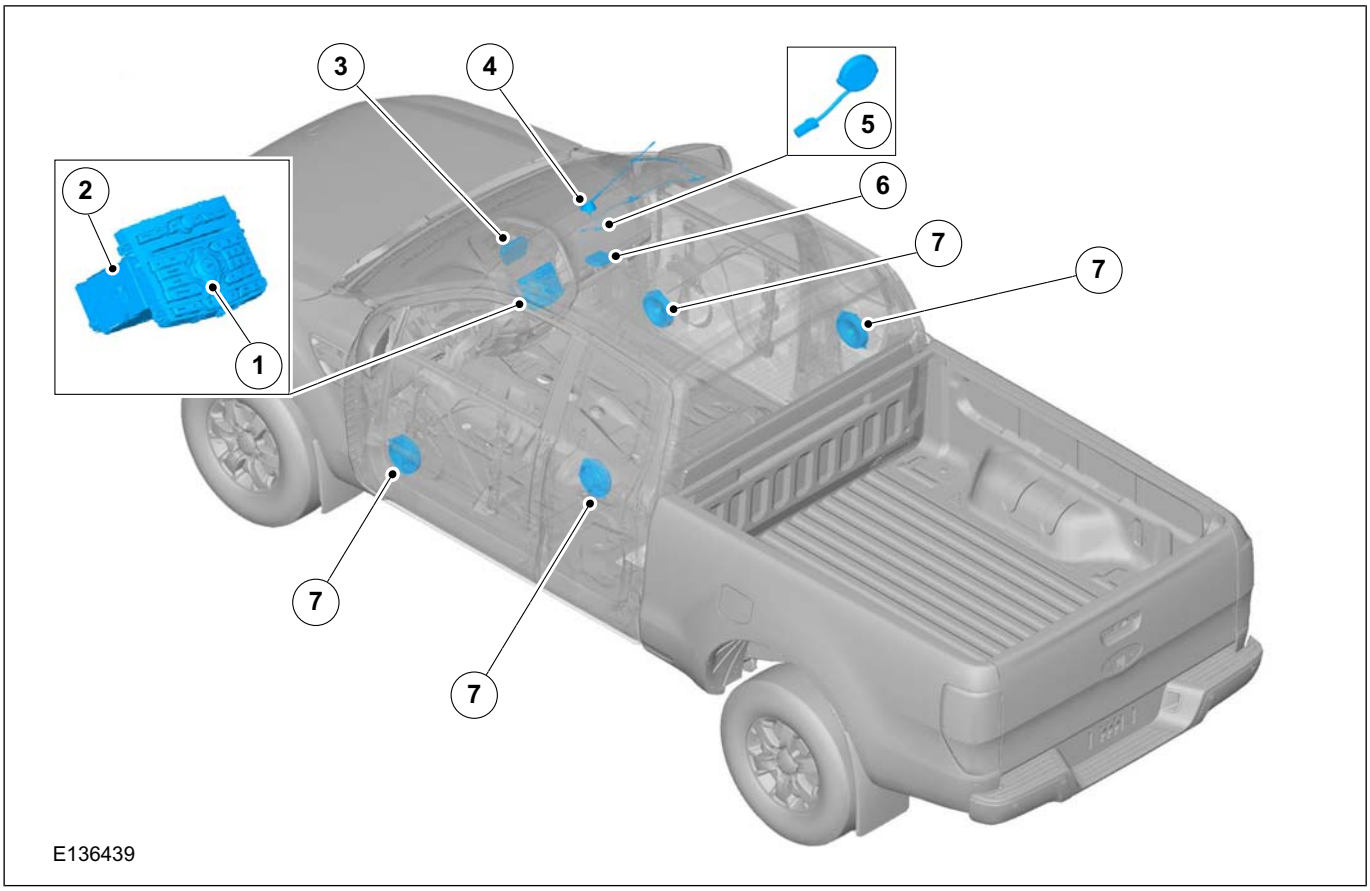
DESCRIPTION AND OPERATION

DOUBLE CAB



DESCRIPTION AND OPERATION

STRETCH CAB



Item	Description
1	Audio Switch pack
2	Audio Unit
3	Display Screen
4	Radio Antenna
5	Microphone
6	Bluetooth
7	Speaker

SECTION 415-01 Information and Entertainment System

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

Audio Unit

Removal

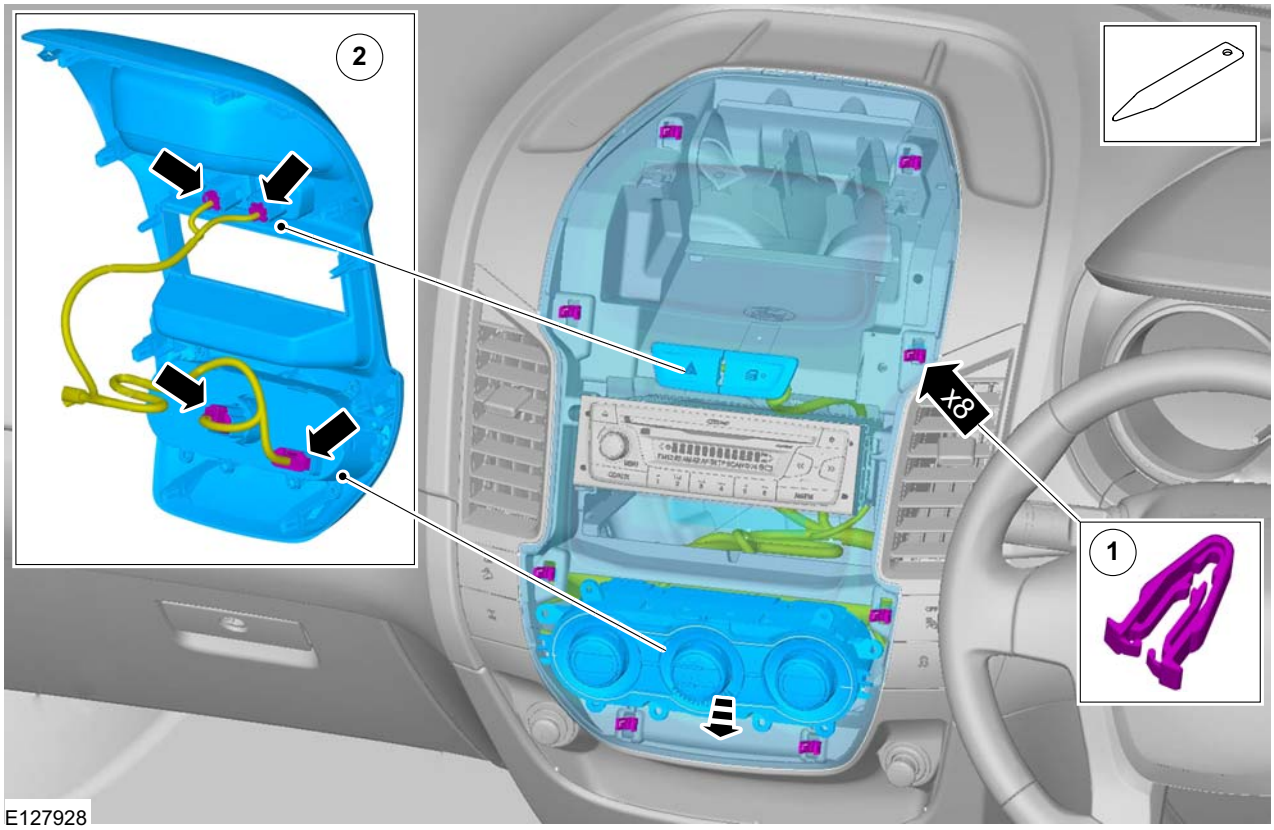
WARNING: The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

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).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

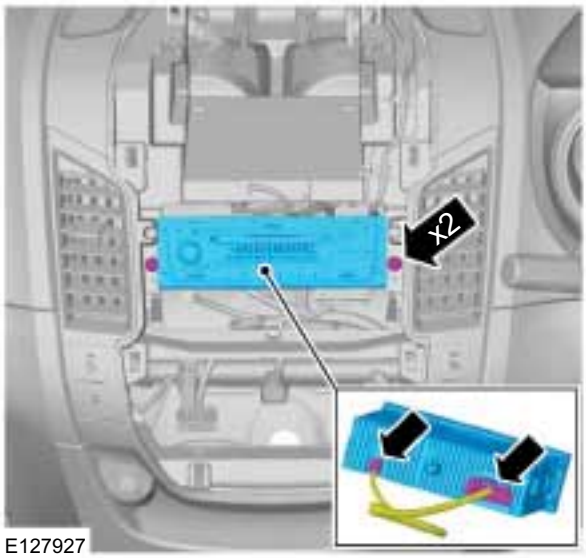
Vehicles with single DIN Standard audio unit

2.



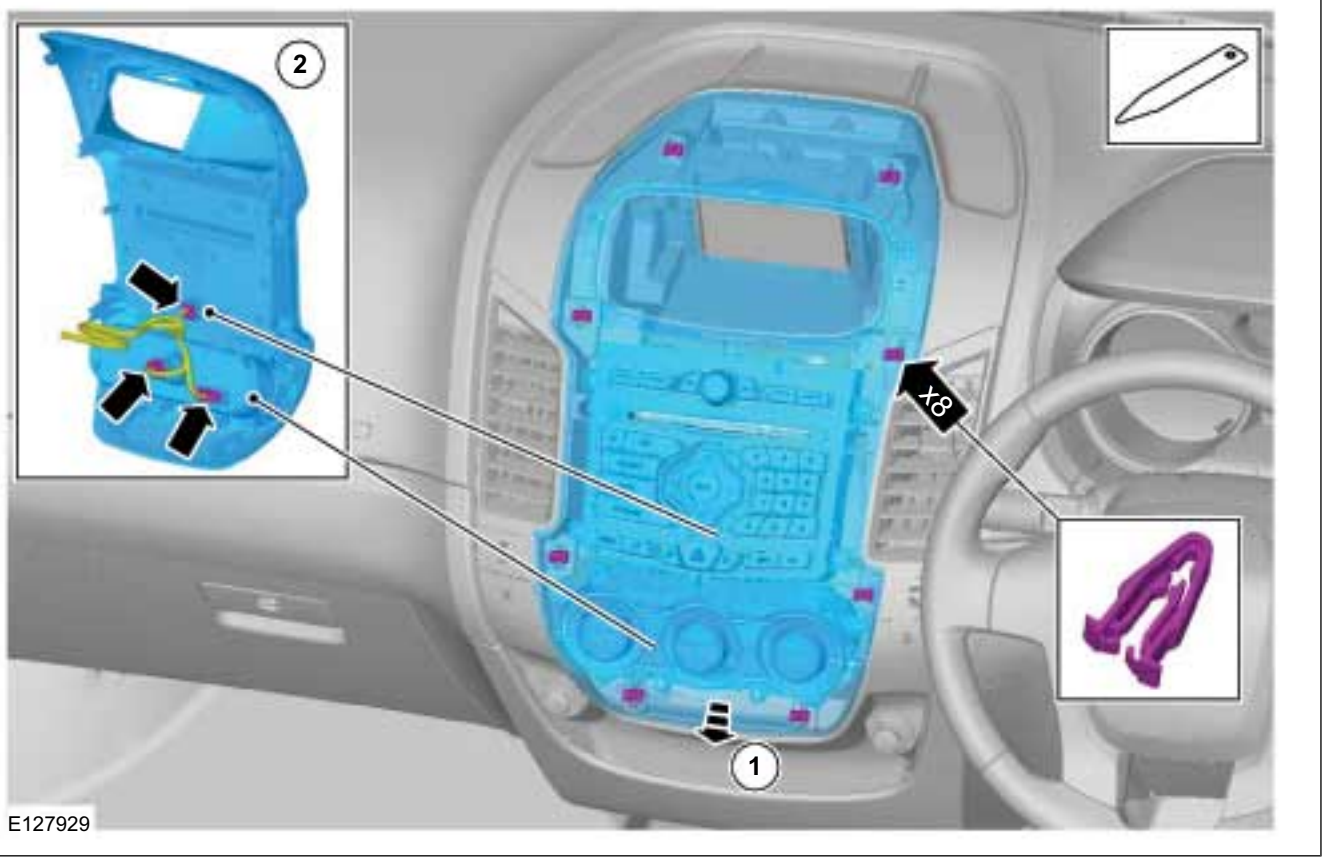
REMOVAL AND INSTALLATION

3. Torque: 3 Nm



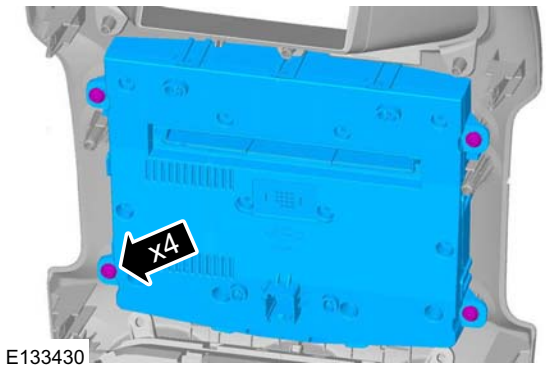
Vehicles with double DIN Standard audio unit

4.

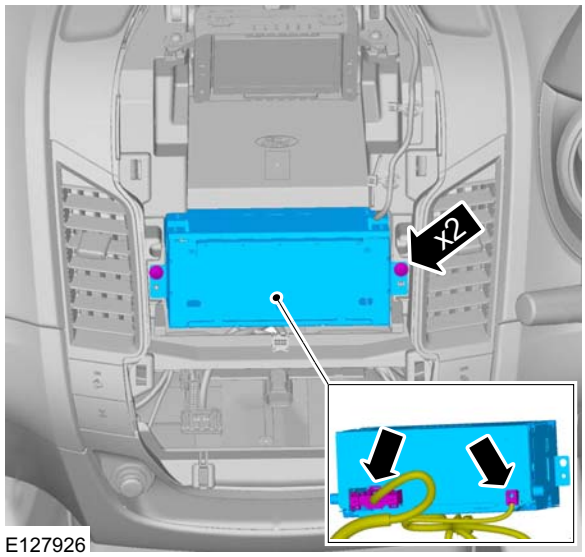


REMOVAL AND INSTALLATION

5. Torque: 2 Nm



6. Torque: 3 Nm



Installation

1. To install, reverse the removal procedure.

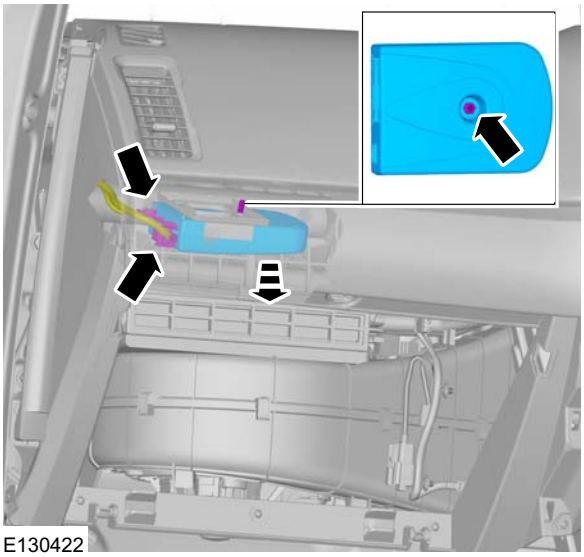
REMOVAL AND INSTALLATION

Bluetooth Module(33 635 0)

Removal

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

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



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Audio Unit Antenna

Removal

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

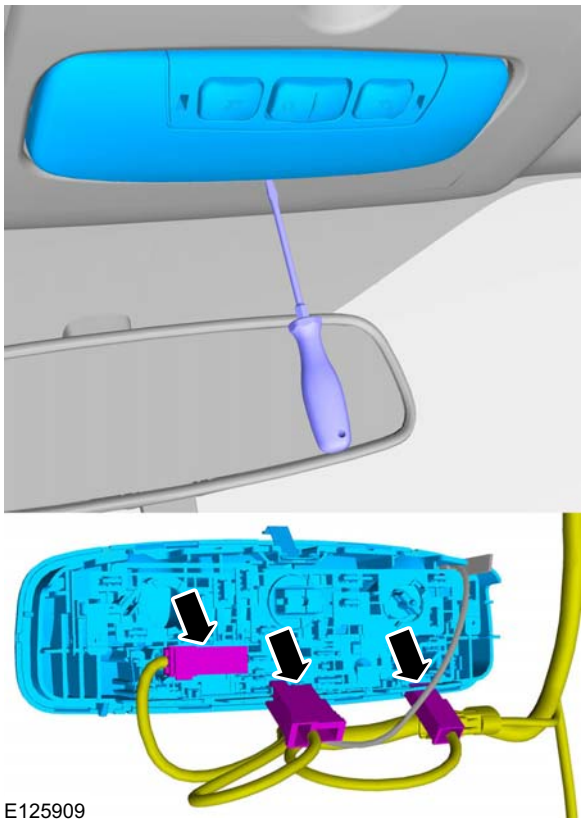
1. On both sides.

   Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

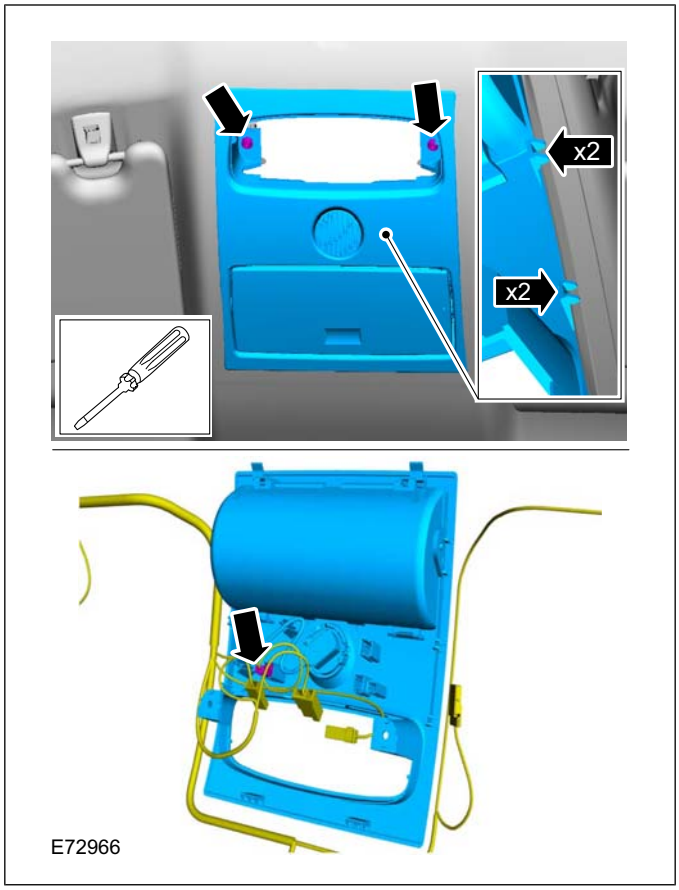
2. On both sides.

   Refer to: C-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: C-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.

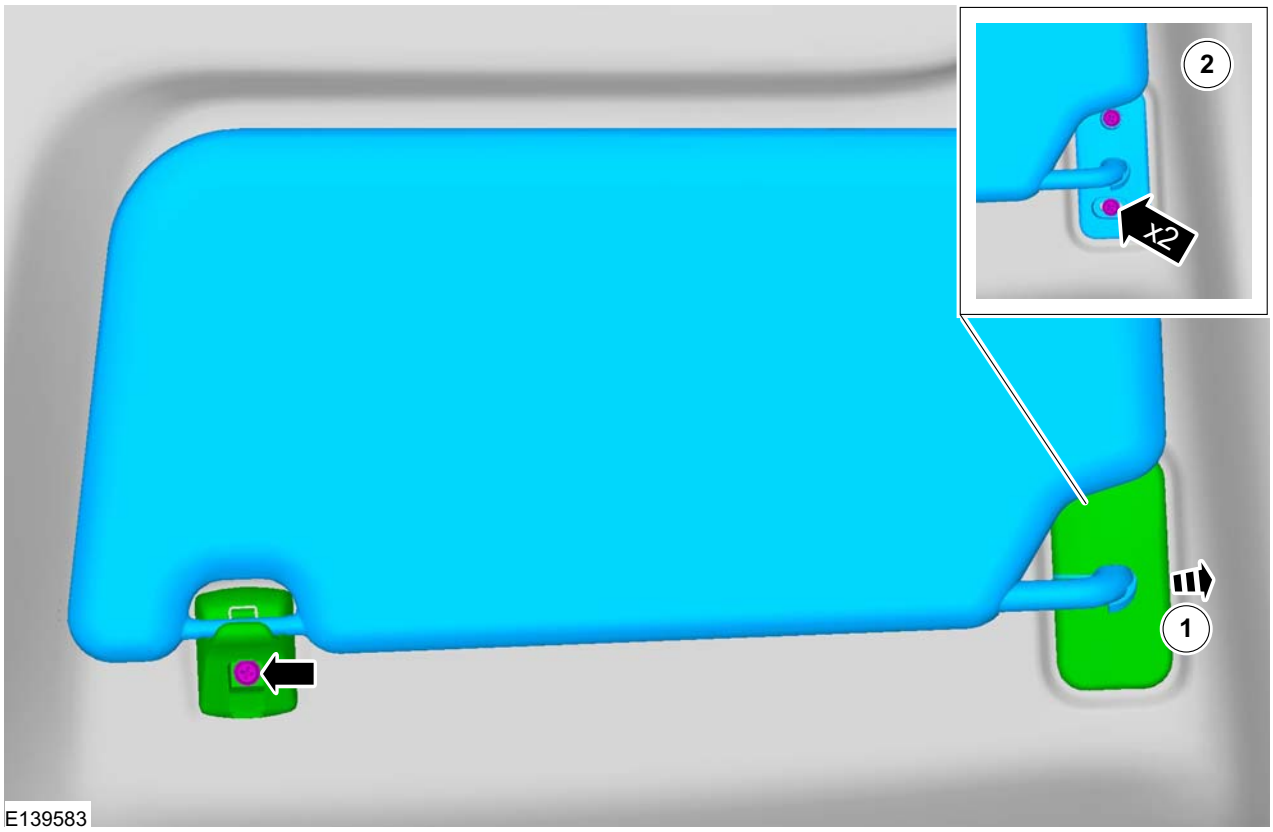


4. **NOTE:** This step is not necessary when installing a new component.

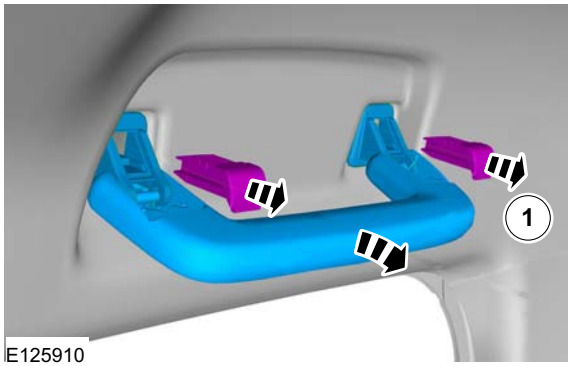


5. On both sides.

REMOVAL AND INSTALLATION



6.



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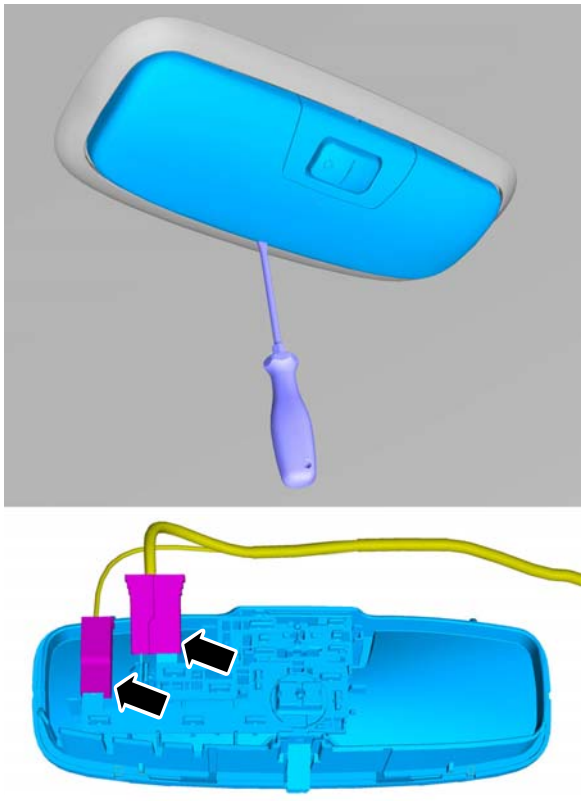
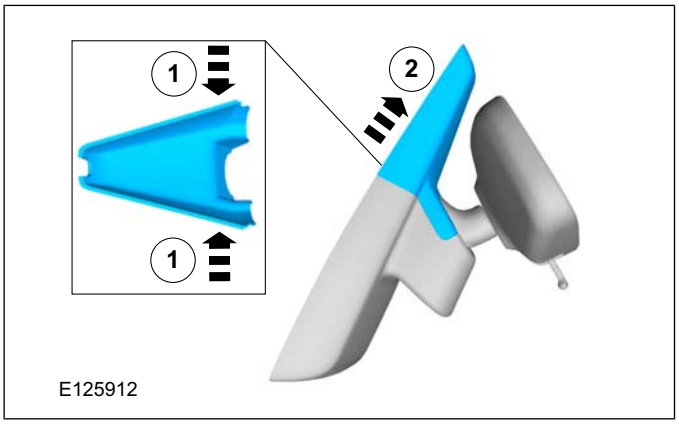


REMOVAL AND INSTALLATION

Vehicles with autolamps and rain sensor

8.



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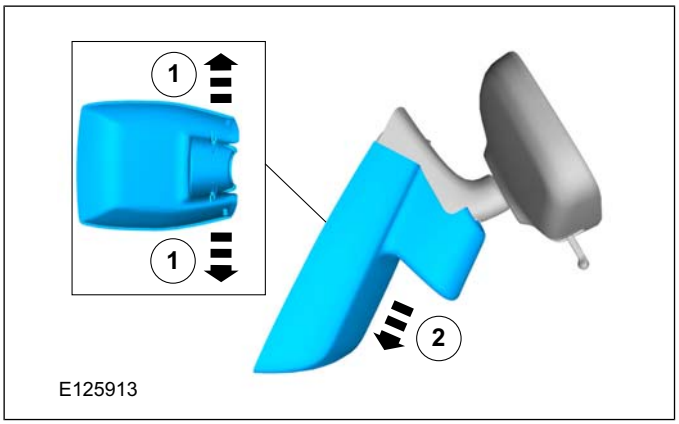

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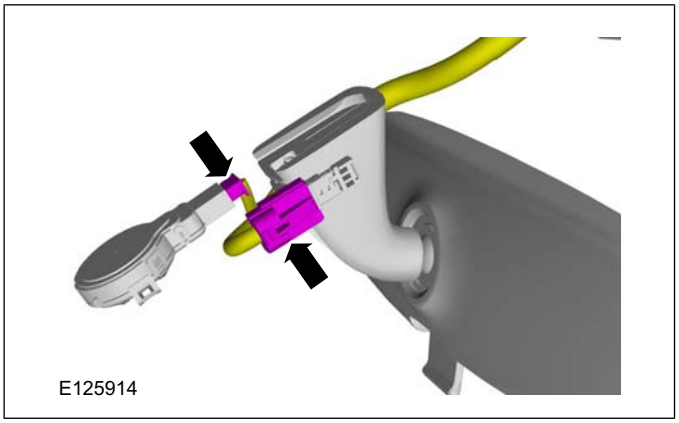
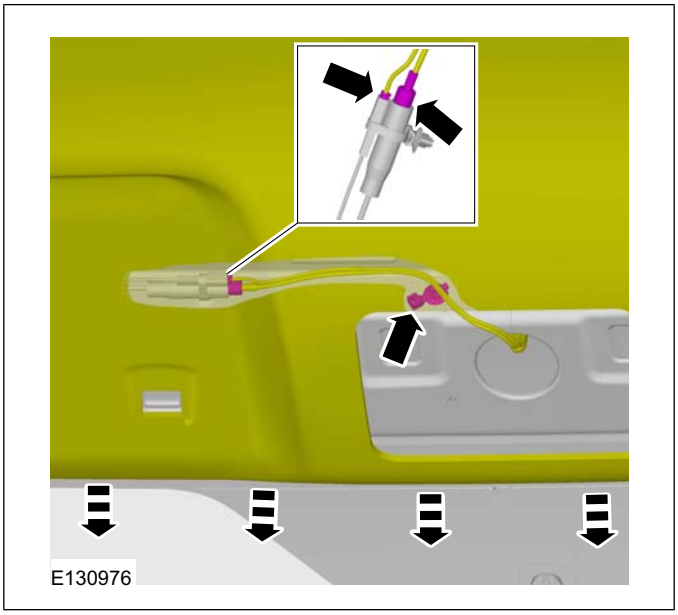


All vehicles

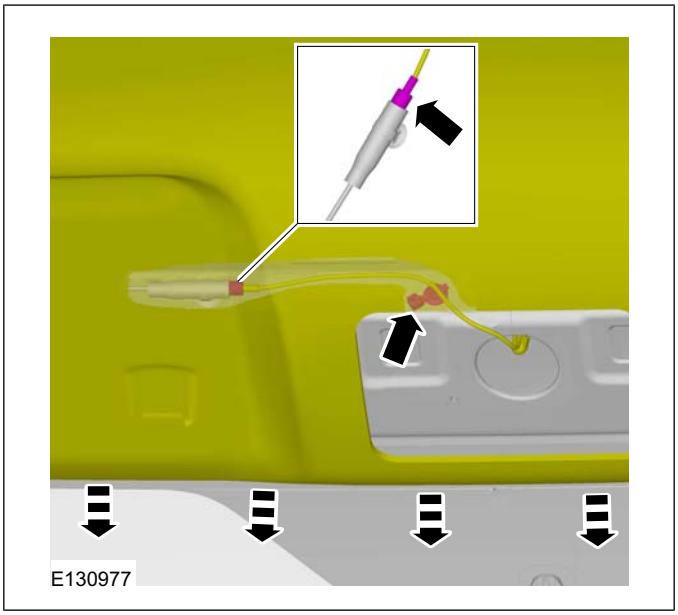
11. ⚠ **CAUTION: Take extra care not to crease the headliner.**

NOTE: Make a note of the routing of the antenna cable.



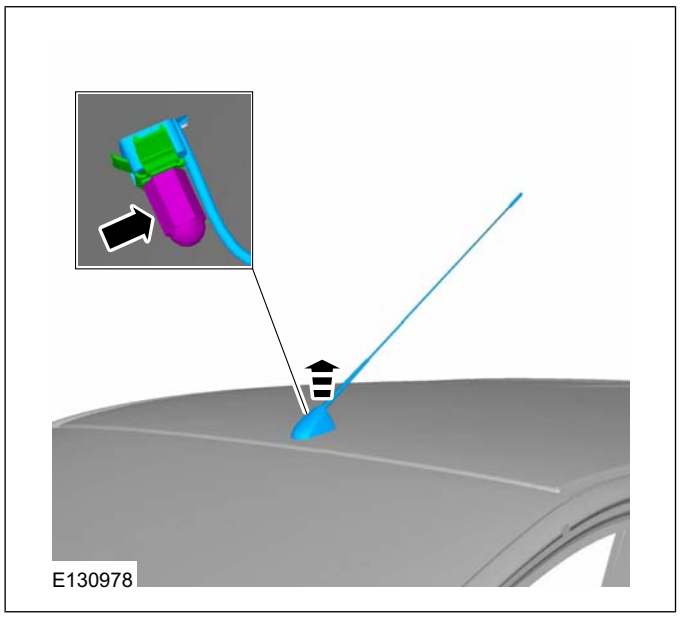
12. ⚠ **CAUTION: Take extra care not to crease the headliner.**

NOTE: Make a note of the routing of the antenna cable.



REMOVAL AND INSTALLATION

13.



Installation

1. **NOTE:** The antenna cable must be installed to the same routing as when removed.

   To install, reverse the removal procedure.

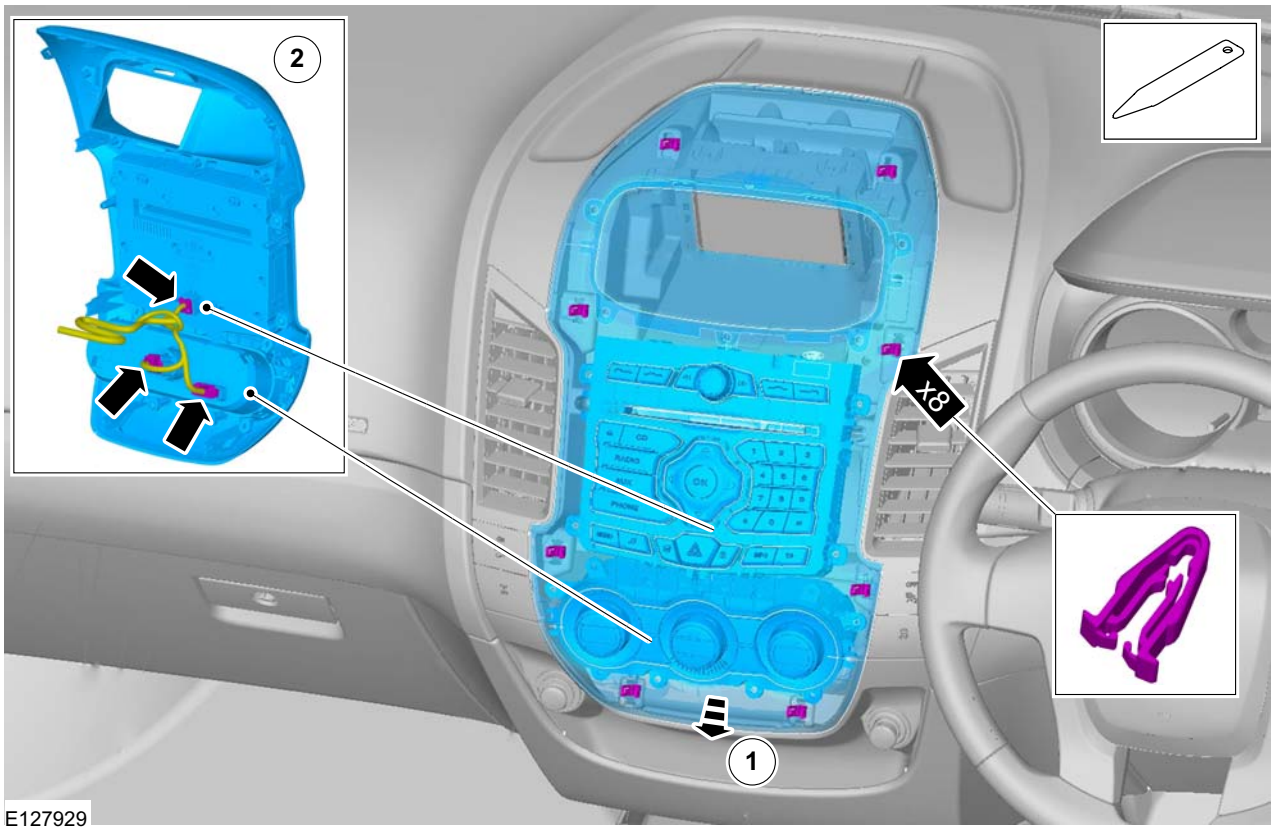
REMOVAL AND INSTALLATION

Information and Entertainment Display Unit

Removal

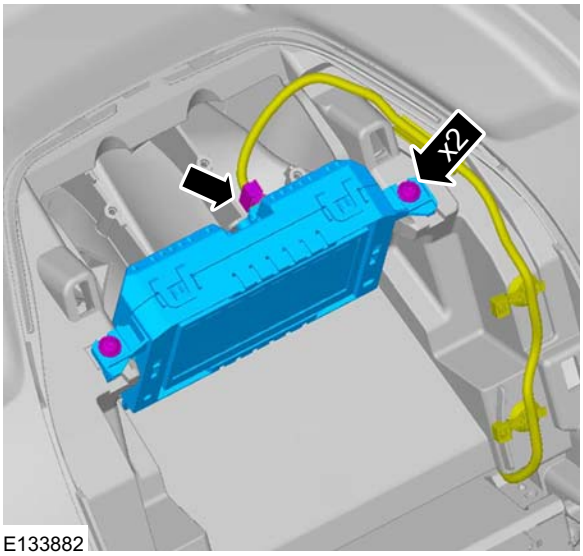
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3.



REMOVAL AND INSTALLATION

4.



Installation

1. To install, reverse the removal procedure.

SECTION 417-01 Exterior Lighting

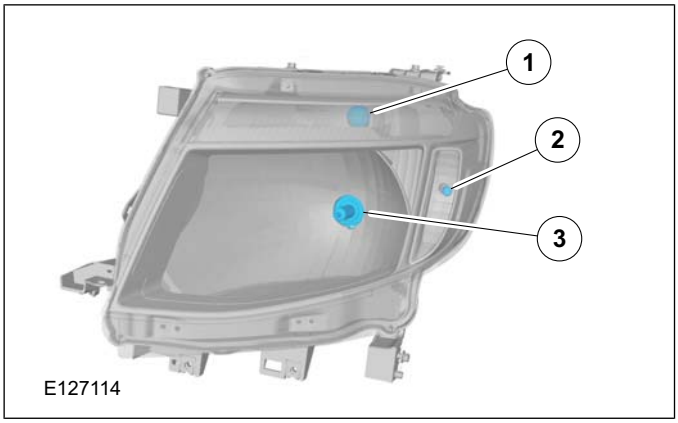
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Exterior Lighting

Front headlamps

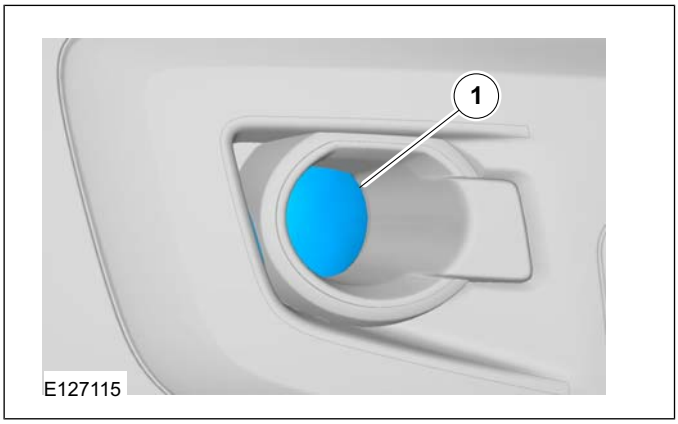


Item	Description
1	Direction indicator bulb
2	Parking / day time running lamp bulb
3	Headlamp bulb

The headlamps form a unit with the front turn signal lamps and the side lamps. They are made entirely of plastic and can only be replaced as a whole unit.

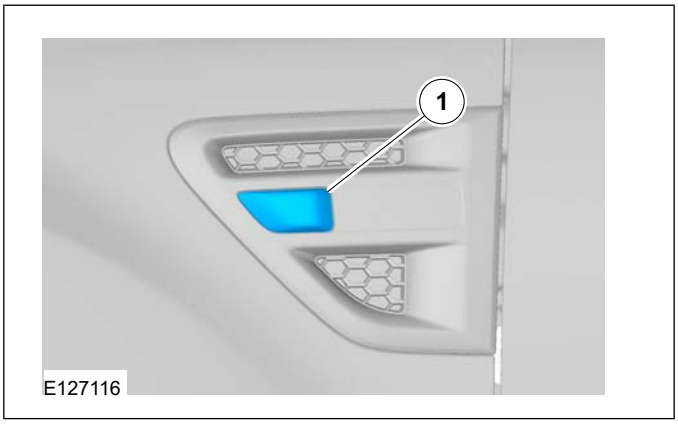
H4 bulbs with a power rating of 55W / 60W are used in the headlamps.

Front fog lamps

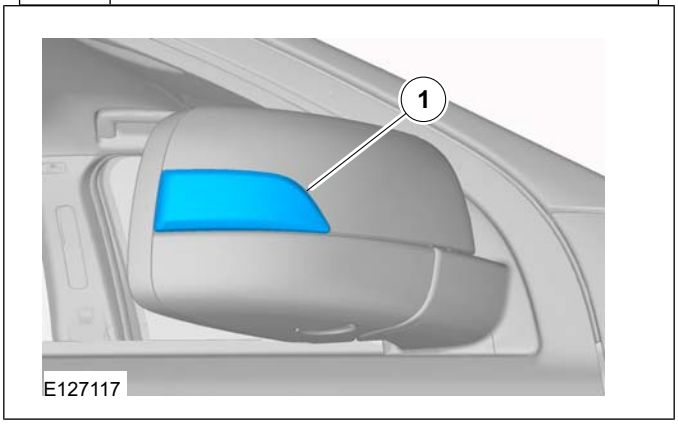


Item	Description
1	Front fog lamp bulb

Side repeater / turn signal lamps



Item	Description
1	Side repeater lamp



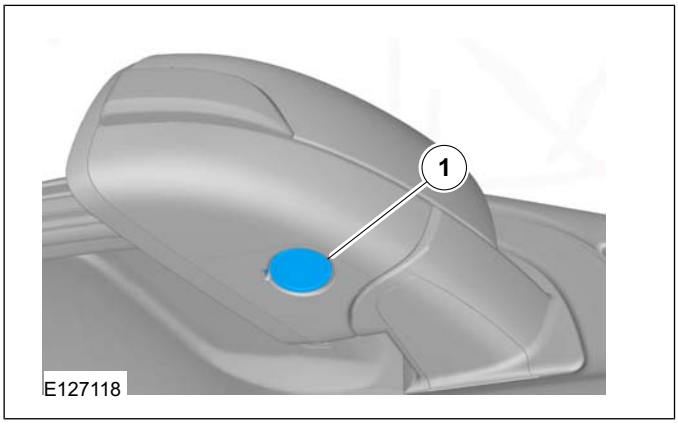
Item	Description
1	Direction indicator lamp

The direction indicator lamps are used to indicate a turn signal and for the hazard warning lights. They use a PY21W bulb colored yellow.

The sound generator for the acoustic turn signal check is integrated in the instrument cluster.

DESCRIPTION AND OPERATION

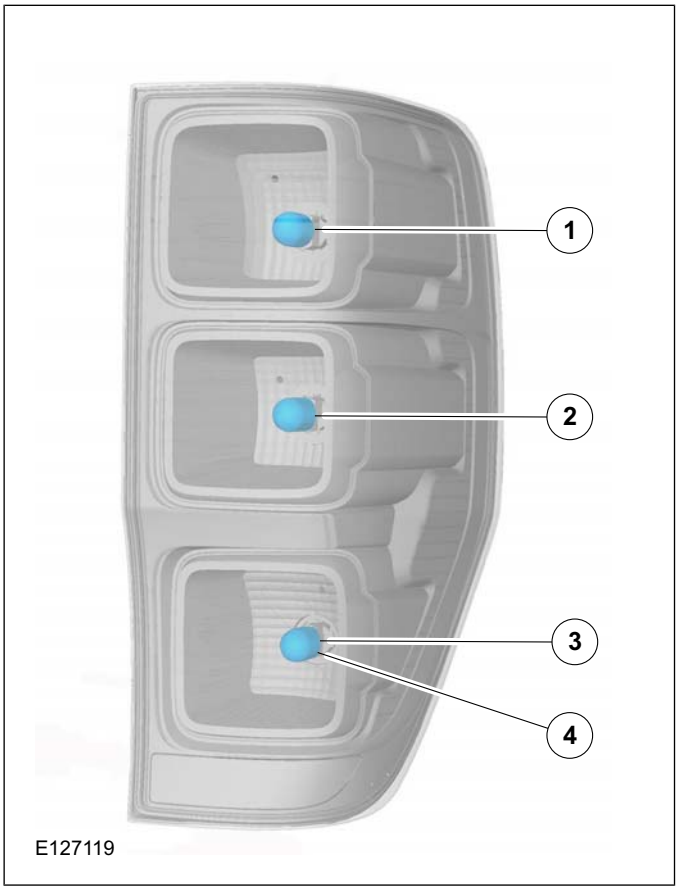
Puddle lamps



Item	Description
1	Puddle lamp

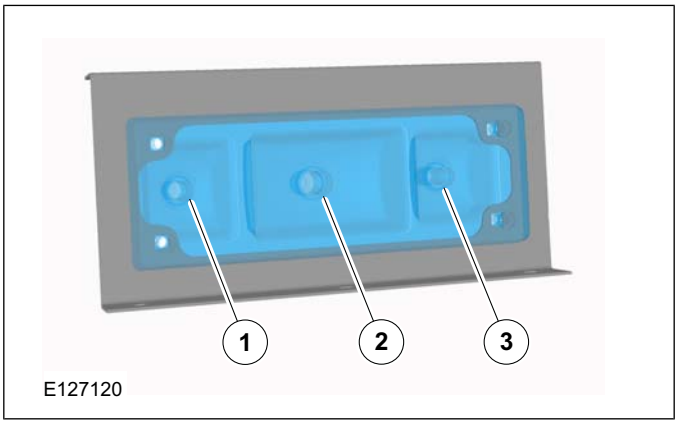
This illuminates the area where a passenger is going to step when the door is opened.

Rear combination lamps



Item	Description
1	Side and brake lamp bulb
2	Direction indicator bulb
3	Reverse lamp bulb
4	Fog lamp bulb (Right for RHD)

Rear combination lamps (Chassis cab)



Item	Description
1	Direction indicator bulb
2	Side and brake lamp bulb
3	Reverse lamp bulb

The rear lamp clusters incorporate all rearward facing lights with exception of the license plate lamp and the additional high-mounted stoplamp.

The rear lamps can only be replaced as a complete unit.

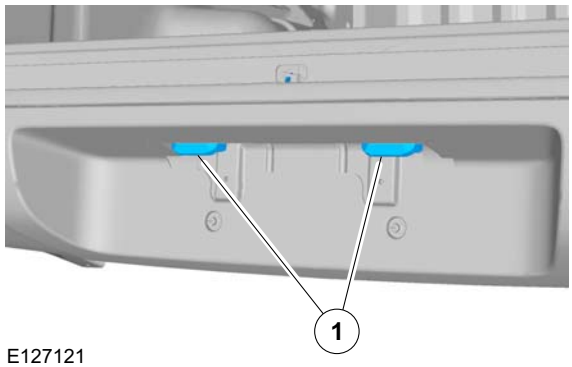
The turn signal lamps are equipped with P21W bulbs.

Side and brake lamp bulbs are illuminated when the driver applies the brake.

The reversing lamps (21W bulb) are used to illuminate the road when reversing the vehicle. The rear fog lamp is illuminated when the front fog lamp switch is activated.

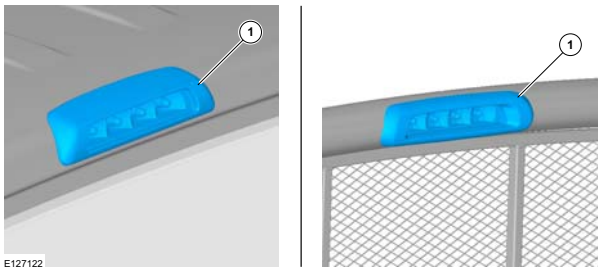
DESCRIPTION AND OPERATION

License plate lamp



Item	Description
1	License plate lamp

Center high mounted stop lamp



Item	Description
1	Center high mounted stop lamp

Four W5W glass base bulbs are used.

The stoplamps (21/W5W bulb) are switched on by the stoplamp switch on the brake pedal as soon as the brake pedal is depressed.

GENERAL PROCEDURES

Headlamp Adjustment

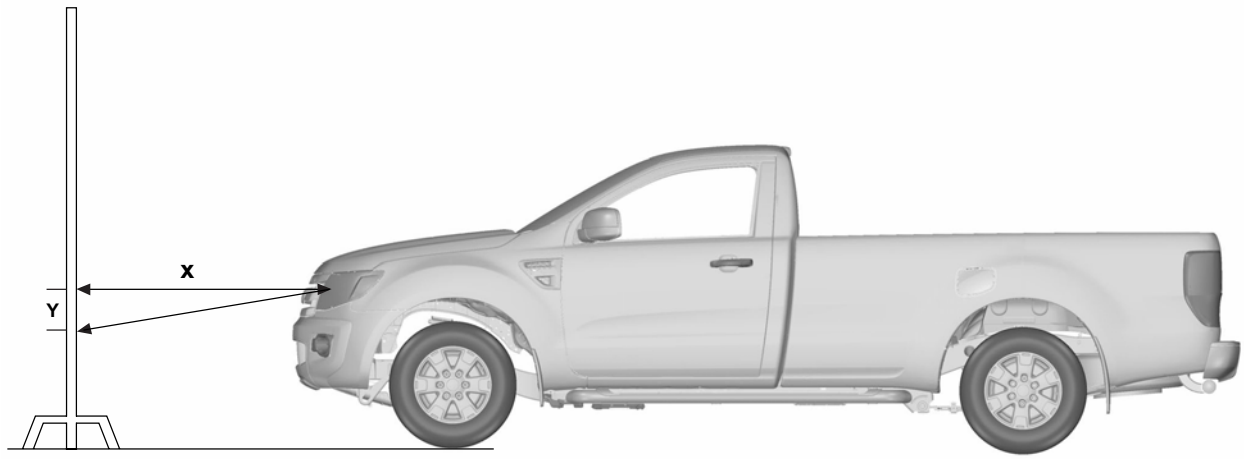
General Equipment

Headlamp Beam Setter

Activation

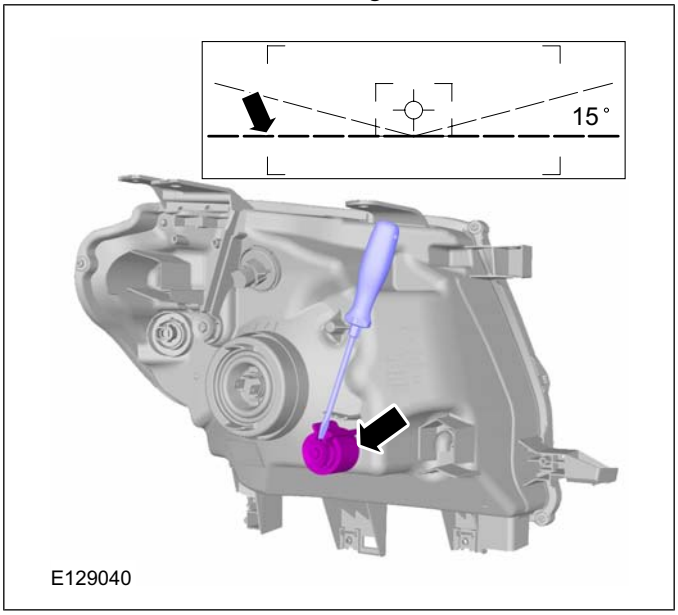
1. Adjust the tire pressure to the specification.
2. Position the unloaded vehicle on a flat, level surface.
3. Seat one person in the driver's seat.
4. Position the vehicle straight ahead and perpendicular to the white screen.
5. Repeatedly operate the headlamp leveling switch and then set it to "0".
6. Set the measuring screen of the beam setting equipment to the correct headlamp adjustment setting.

   General Equipment: Headlamp Beam Setter
7. **X:** 3 m [9.8 ft], **Y:** 1.2°, **Z:** 36 mm [1.4 inch].



E136737

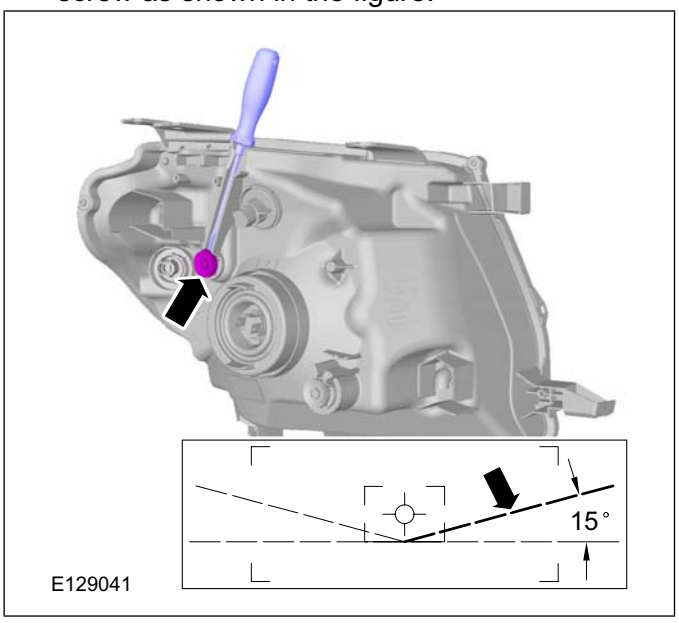
8. Place an object in front of the headlight not being adjusted to block its light beam.
9. Start the engine so that the battery remains charged.
10. Turn on the headlamp.
11. Adjust the headlight by loosening the adjusting screw as shown in the figure.



E129040

GENERAL PROCEDURES

12. Adjust the headlight by loosening the adjusting screw as shown in the figure.

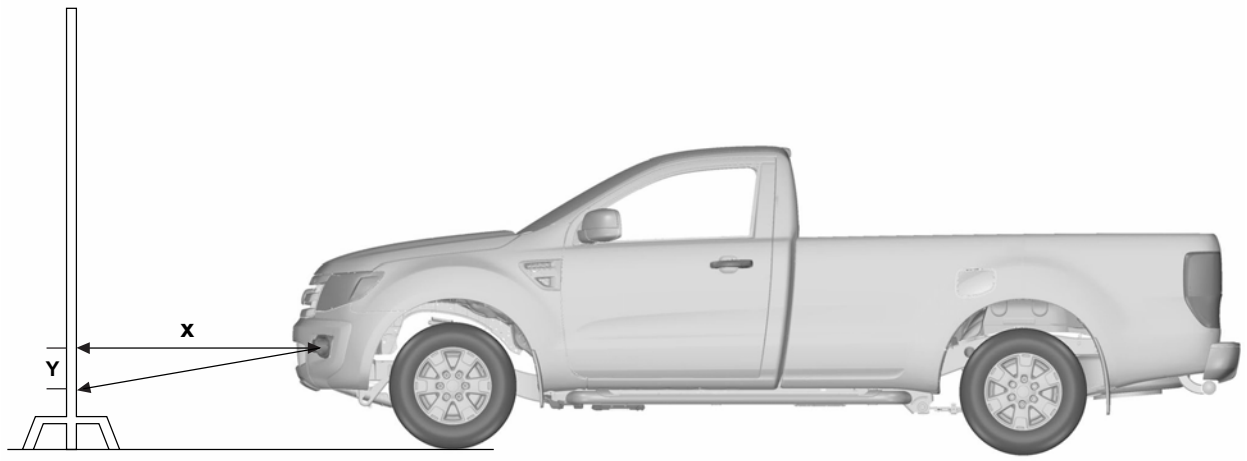


GENERAL PROCEDURES

Front Fog Lamp Adjustment

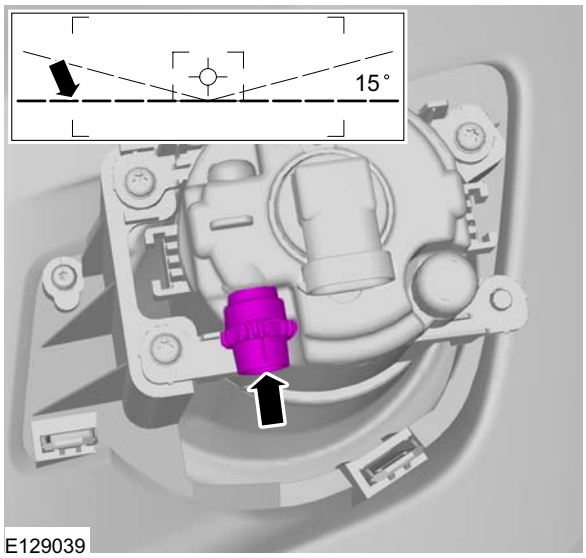
Activation

13. Make an adjustment screen using double-weight, white paper.
14. Adjust the tire pressure to the specification.
15. Position the unloaded vehicle on a flat, level surface.
16. Seat one person in the driver's seat.
17. **X:** 3 m [9.8 ft], **Y:** 2.0°, **Z:** 60 mm [2.4 inch].



E136738

18. Place an object in front of the fog light not being adjusted to block its light beam.
19. Start the engine so that the battery remains charged.
20. Turn the front fog lights on.
21. Adjust the fog lamp so that the cut-off line touches the horizontal line.



E129039

GENERAL PROCEDURES

Headlamp Masking

Activation

22. Print out the corresponding templates at the end of this operation.

23. Measure dimension X on the printout of the template.

24. Calculate the enlargement/reduction factor Y for the photocopier using the following formula: Y=Z÷X×100.

25.
- X = measurement on the printout of the template in mm.
- Y = enlargement/reduction factor in %.
- Z = original dimension in mm = 100.

26. Enlarge/reduce the printout with a photocopier by the calculated percentage.

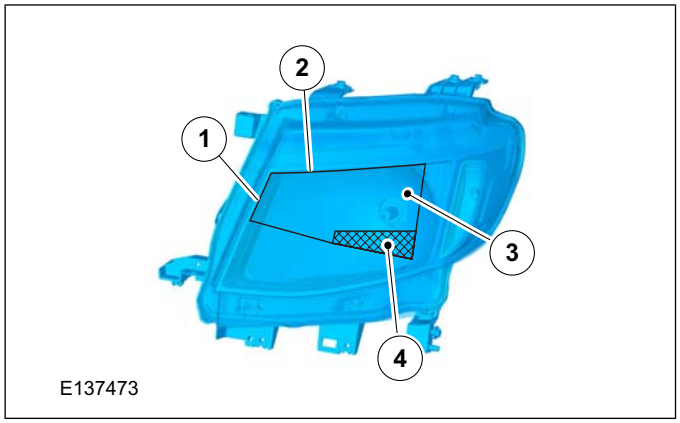
27. Compare dimension X on the photocopy with the original dimension.

28. Cut out the prepared template for the headlamp.

Left-hand drive vehicles

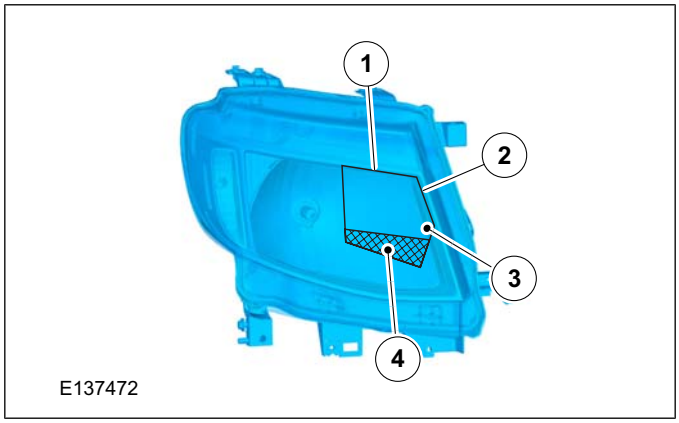
29. Align the template on the lens of the headlamp.

30.
1. Inner alignment edge of the headlamp lens.
2. Upper alignment edge of the headlamp lens.
3. Alignment aid.
4. Template.



31. Align the template on the lens of the headlamp.

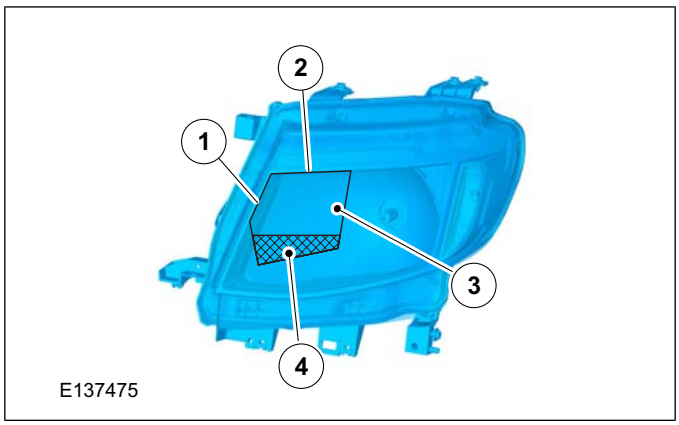
32.
1. Upper alignment edge of the headlamp lens.
2. Inner alignment edge of the headlamp lens.
3. Alignment aid.
4. Template.



Right-hand drive vehicles

33. Align the template on the lens of the headlamp.

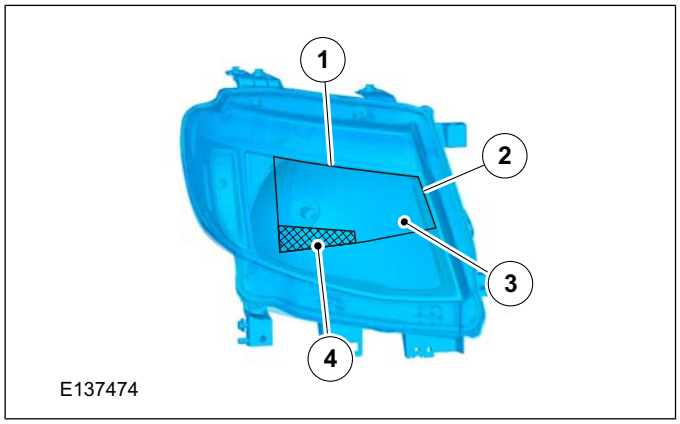
34.
1. Inner alignment edge of the headlamp lens.
2. Upper alignment edge of the headlamp lens.
3. Alignment aid.
4. Template.



35. Align the template on the lens of the headlamp.

GENERAL PROCEDURES

36. 1. Upper alignment edge of the headlamp lens.
    2. Inner alignment edge of the headlamp lens.
    3. Alignment aid.
    4. Template.



All vehicles

37. **CAUTION: Take extra care not to scratch the headlamp lens.**
    Copy the outline of the template with a white board marker onto the headlamp lens.

38. Remove the template.

39. Copy the outline of the template on to the black adhesive tape.

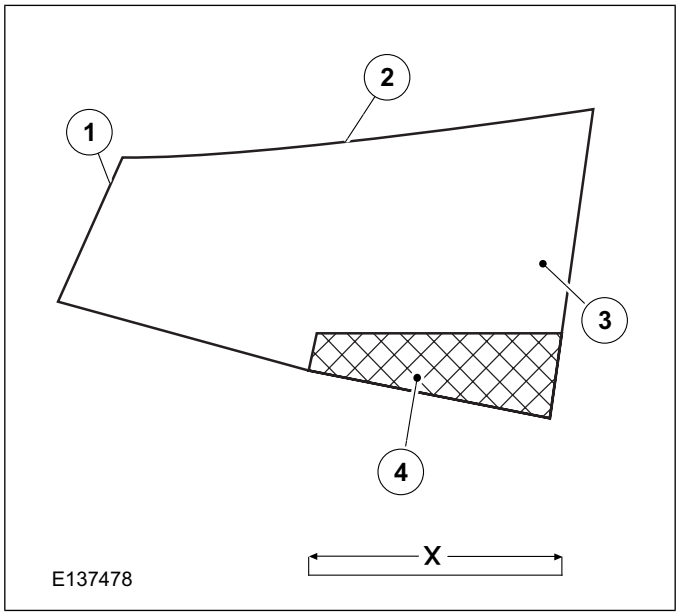
40. Cut out the shape of the template from the black adhesive tape.

41. Use the pre-marked outline of the template drawn on the head lamp lens as the final position of the template, and stick template into this position.

42. Repeat steps 16 to 20 for the other head lamp.

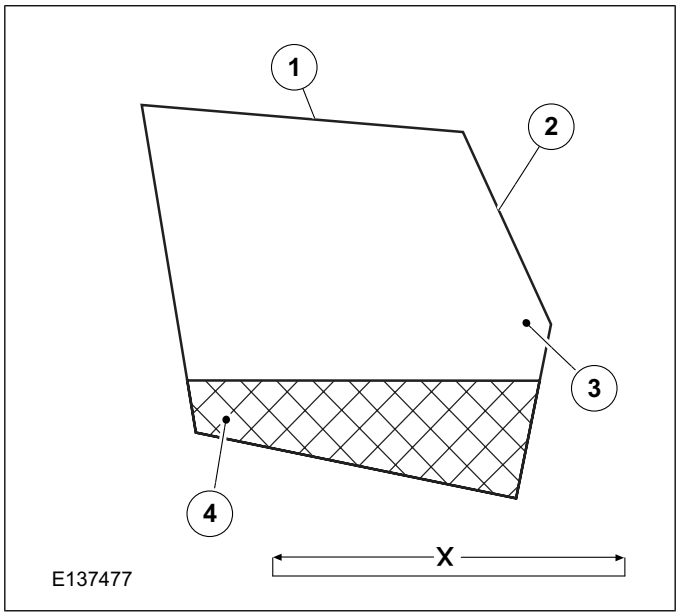
43. Template for LHD vehicles, left-hand headlamp.

44. 1. Inner alignment edge of the headlamp lens.
    2. Upper alignment edge of the headlamp lens.
    3. Alignment aid.
    4. Template.



45. Template for LHD vehicles, right-hand headlamp.

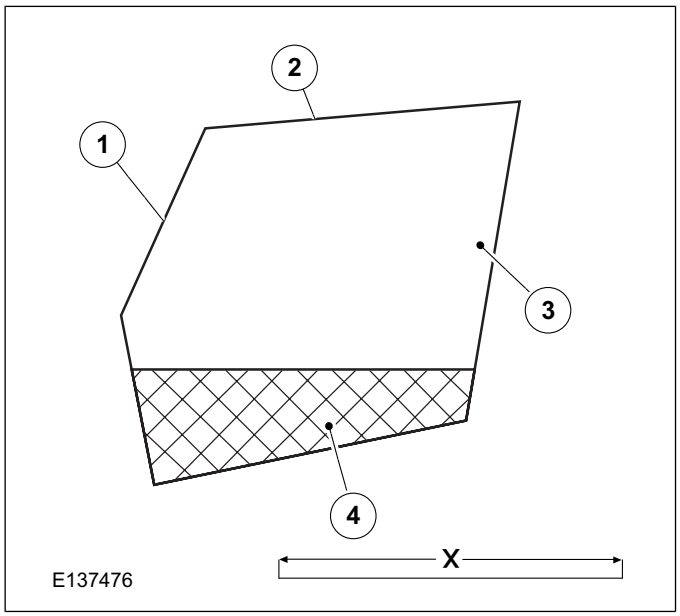
46. 1. Upper alignment edge of the headlamp lens.
    2. Inner alignment edge of the headlamp lens.
    3. Alignment aid.
    4. Template.



47. Template for RHD vehicles, left-hand headlamp.

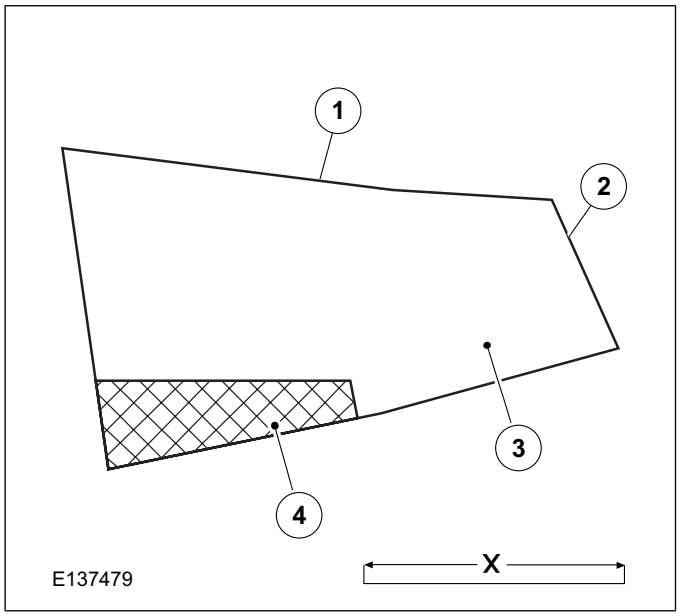
GENERAL PROCEDURES

48. 1. Inner alignment edge of the headlamp lens.
    2. Upper alignment edge of the headlamp lens.
    3. Alignment aid.
    4. Template.



49. Template for RHD vehicles, right-hand headlamp.

50. 1. Upper alignment edge of the headlamp lens.
    2. Inner alignment edge of the headlamp lens.
    3. Alignment aid.
    4. Template.

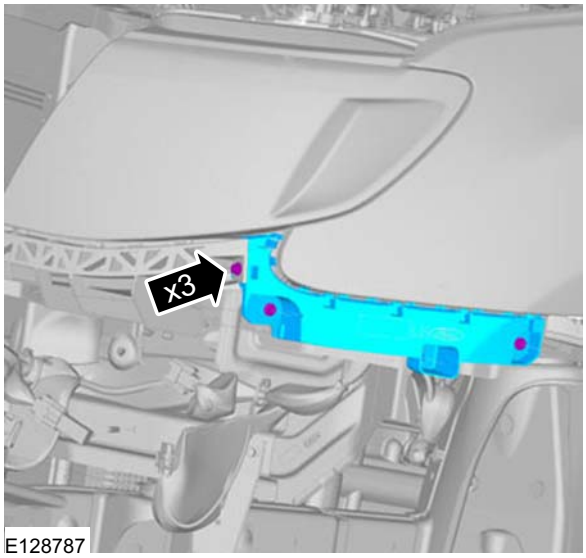


REMOVAL AND INSTALLATION

Headlamp Assembly

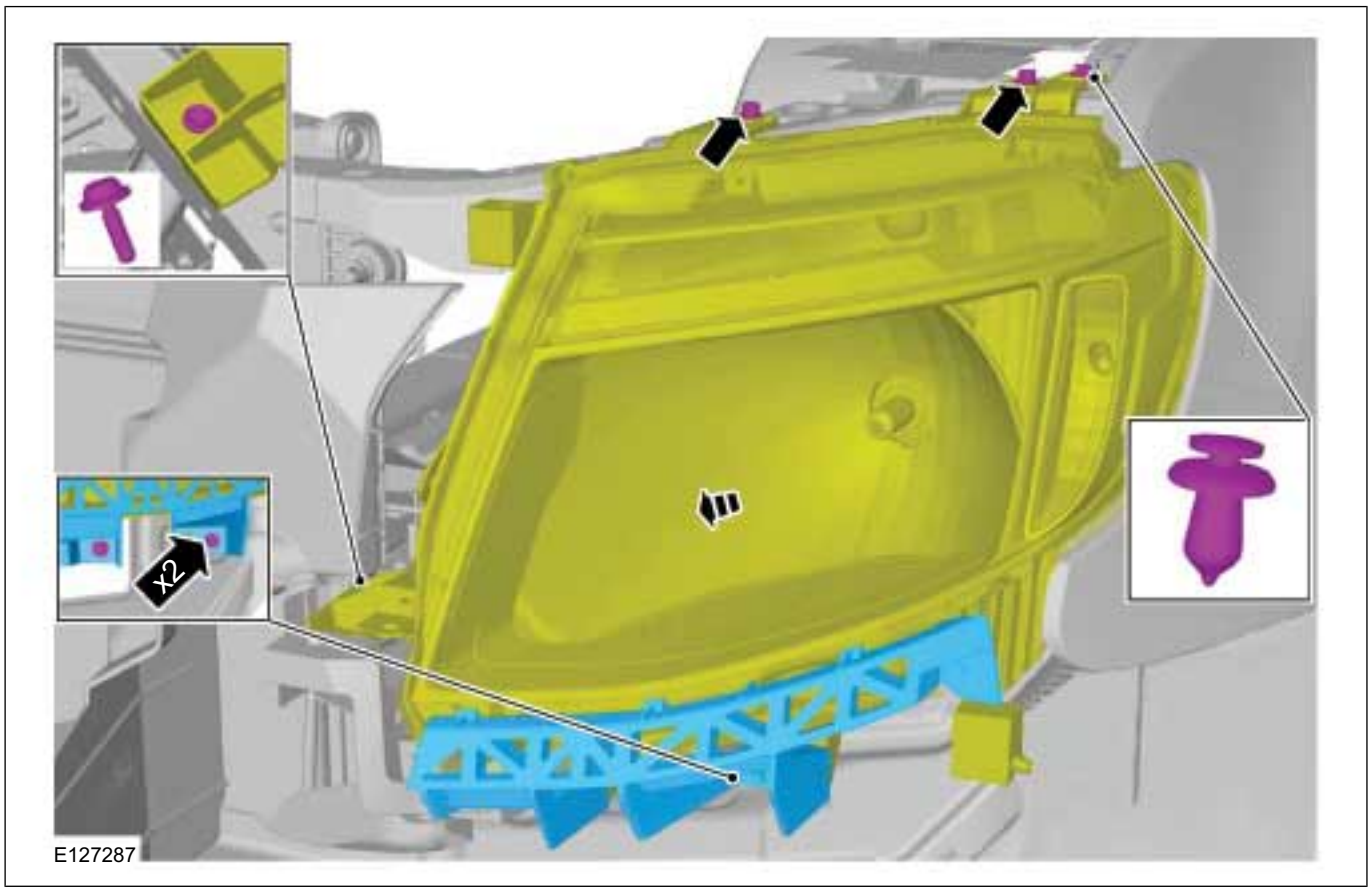
Removal

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: Front Bumper Cover (501-19 Bumpers, Removal and Installation).
3. 

4.

REMOVAL AND INSTALLATION



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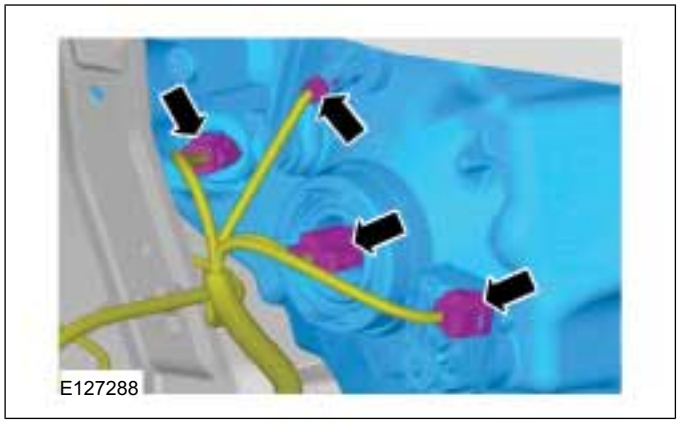


Installation

1. To install, reverse the removal procedure.
2. Refer to: Headlamp Adjustment (417-01 Exterior Lighting, General Procedures).

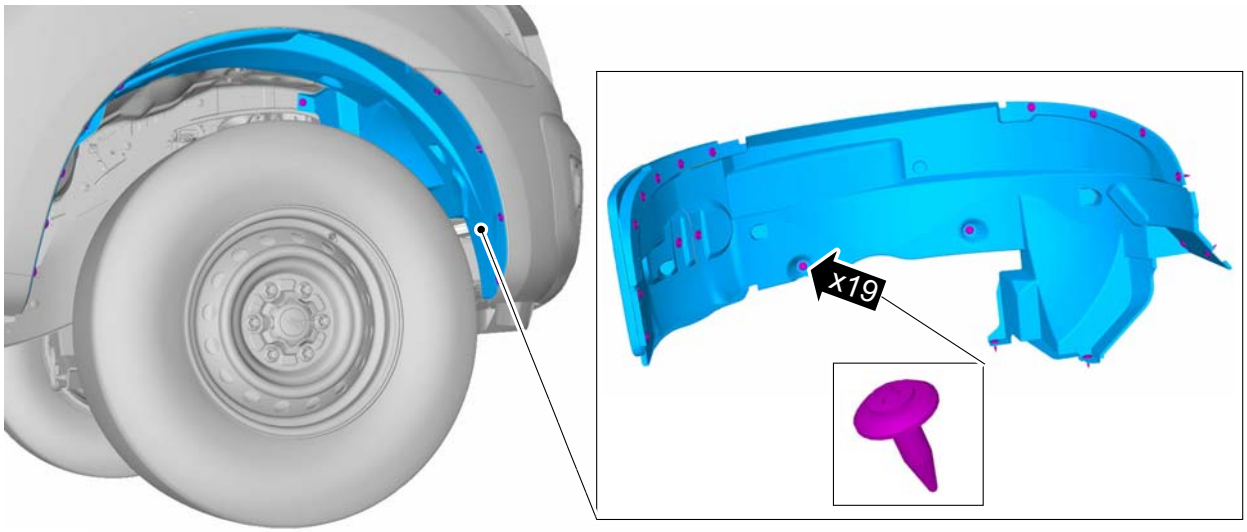
REMOVAL AND INSTALLATION

Front Fog Lamp

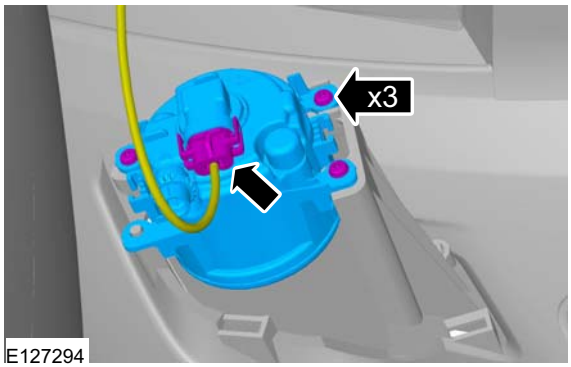
Removal

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



4.



Installation

1. To install, reverse the removal procedure.
2. Refer to: Front Fog Lamp Adjustment (417-01 Exterior Lighting, General Procedures).

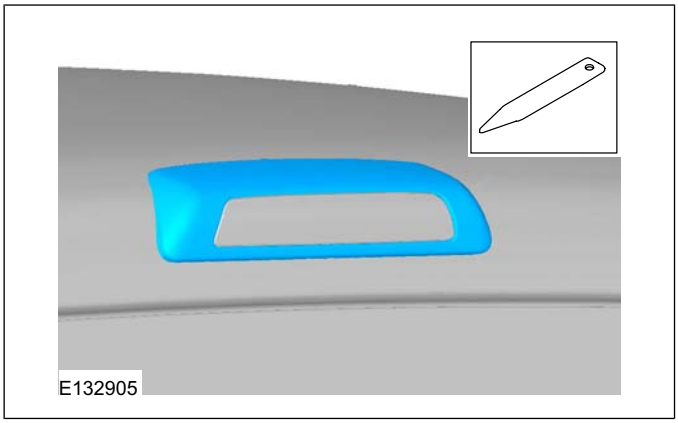
REMOVAL AND INSTALLATION

High Mounted Stoplamp

Removal

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

1.



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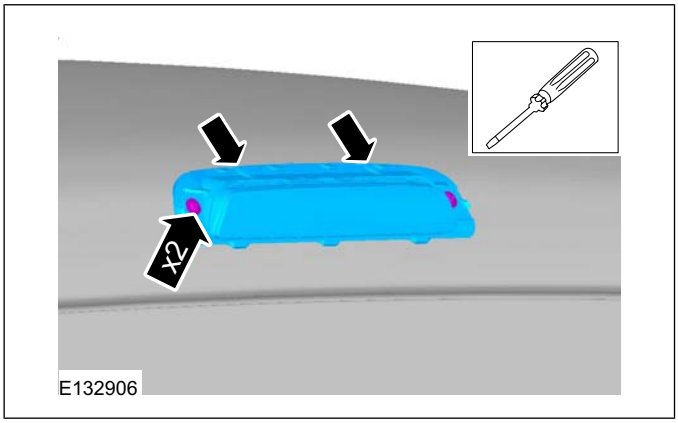

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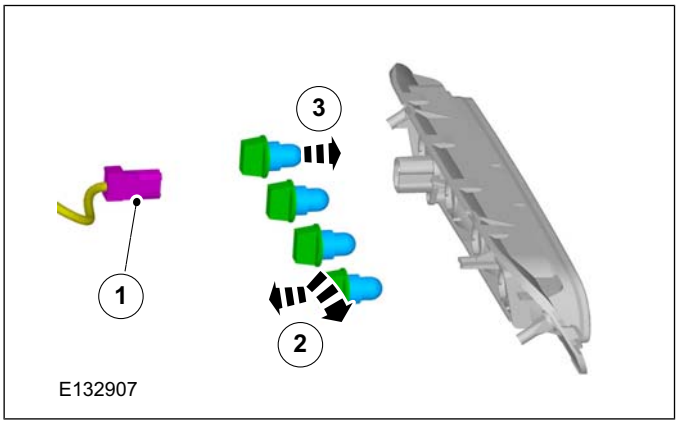
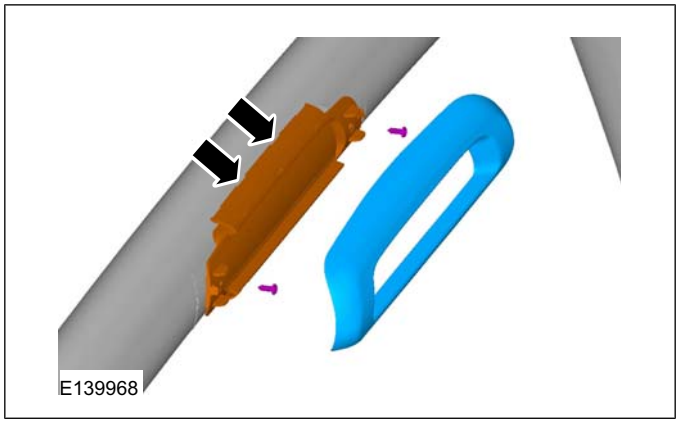


NOTE: Following steps are applicable to the vehicles fitted with tubular sports bar.

4.



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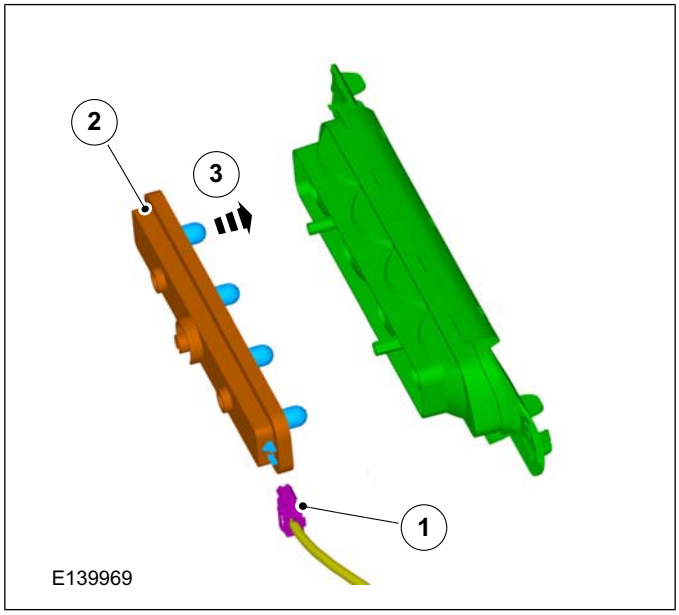


Installation

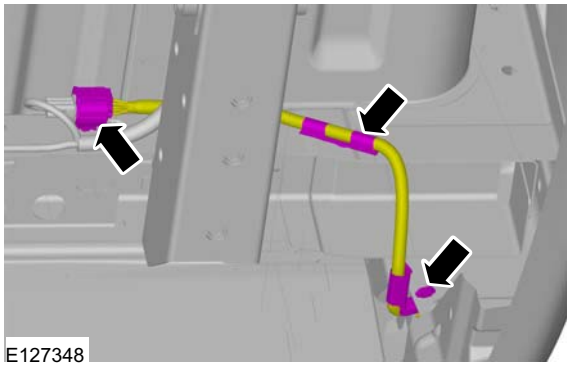
1. To install, reverse the removal procedure.

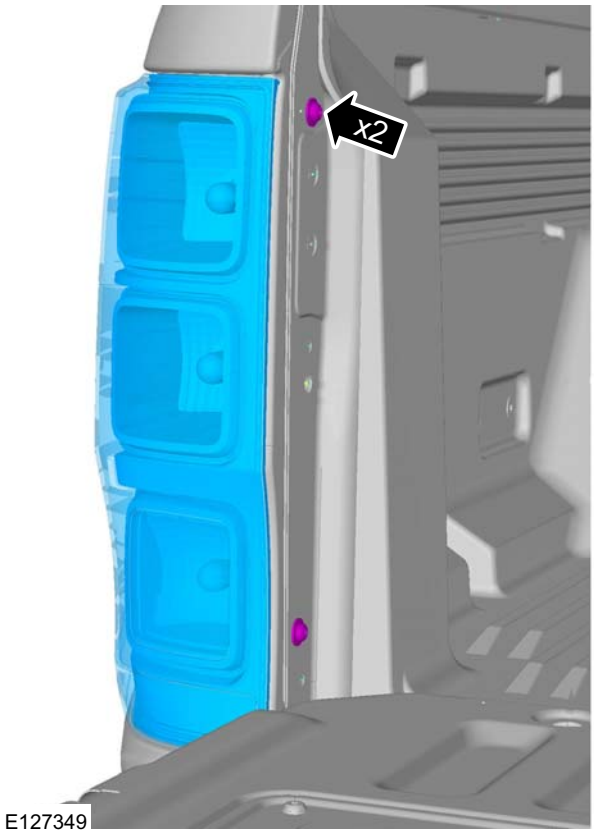
REMOVAL AND INSTALLATION

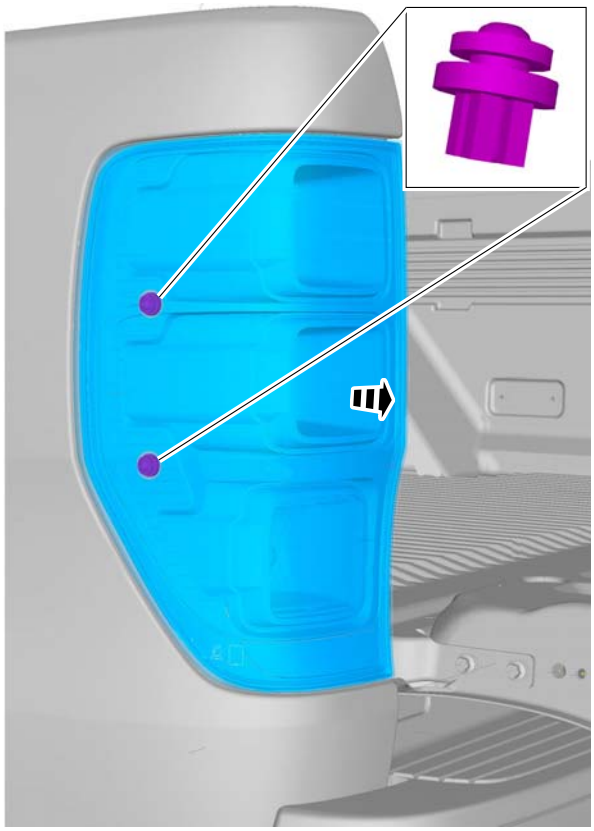
Rear Lamp Assembly

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

4. 



REMOVAL AND INSTALLATION

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

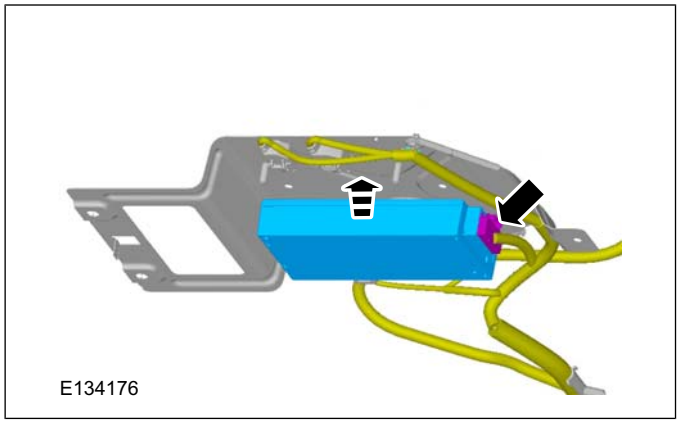
Trailer Module

Removal

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

1. Refer to: Parking Aid Module (413-13 Parking Aid, Removal and Installation).

2.



Installation

1. To install, reverse the removal procedure.

SECTION 417-02 Interior Lighting

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

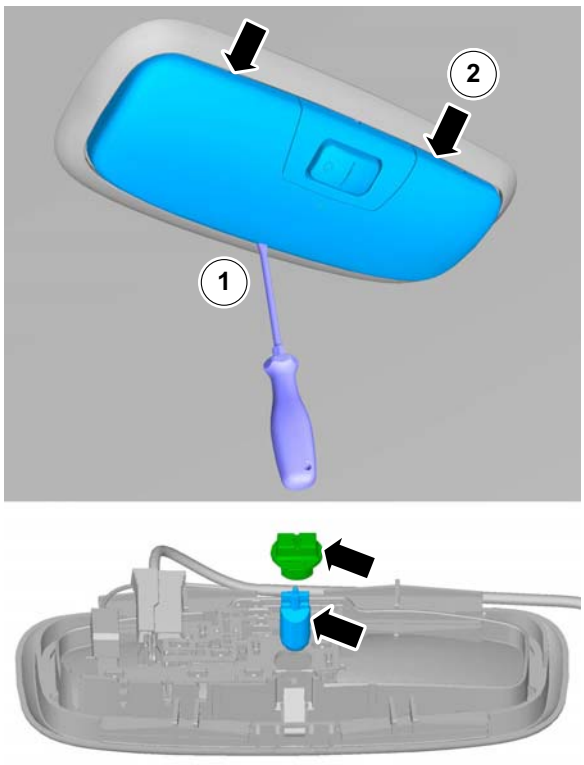
REMOVAL AND INSTALLATION

Center Interior Lamp

Removal

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

1.



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Installation

1. To install, reverse the removal procedure.

SECTION 417-04 Daytime Running Lamps (DRL)

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Daytime Running Lamps (DRL)

In areas in which daytime running lamps (DRL) are required by law, the body control module (BCM) switches on the DRL when the ignition is switched on.

The configuration in the BCM can be changed using the Integrated Diagnostic System (IDS). This makes aftermarket configuration of vehicles fitted with DRL possible (e.g. on customer request or in response to changes in the law).

Vehicles with DRL can be combined with autolamps.

SECTION 418-00 Module Communications Network

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

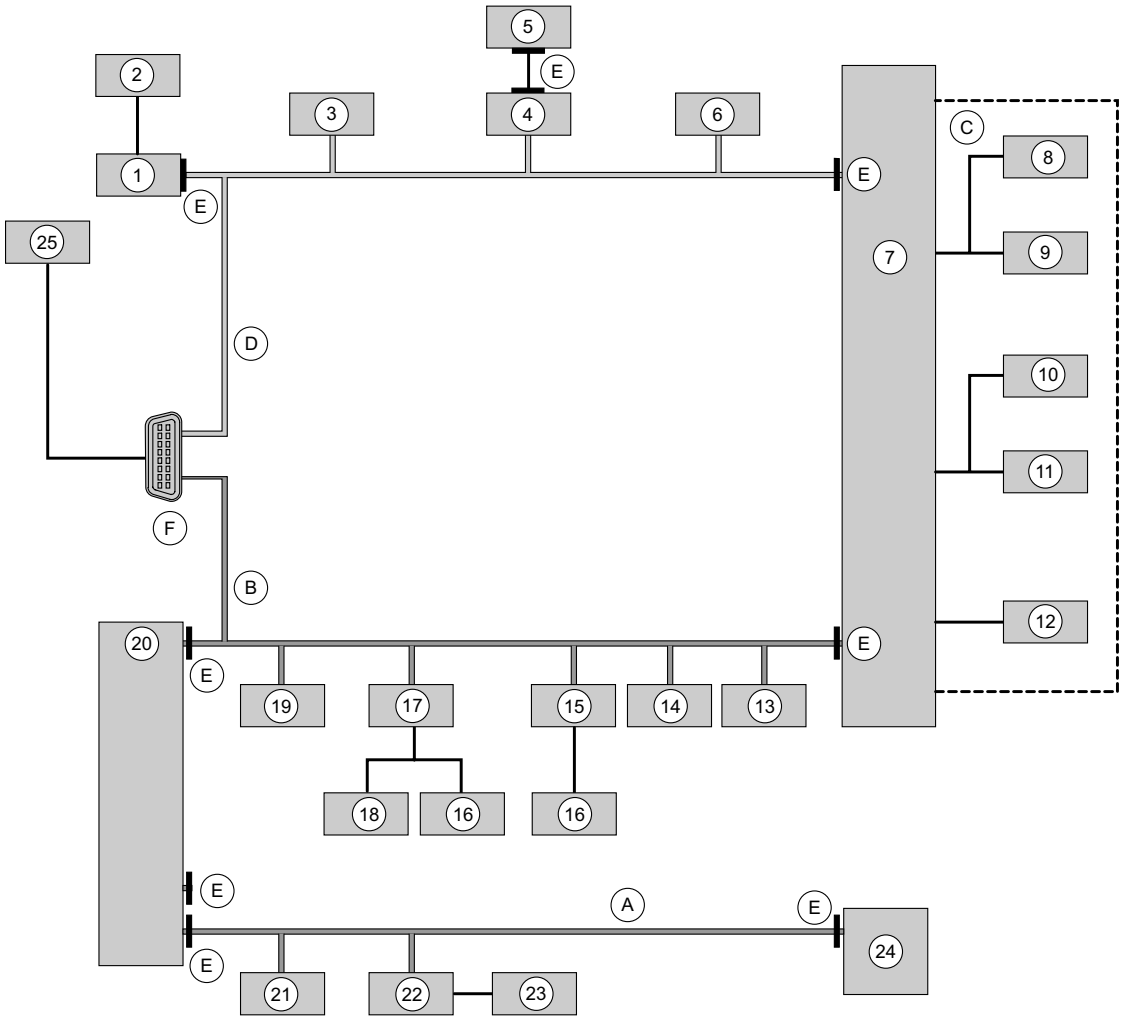
DESCRIPTION AND OPERATION

Communications Network – Component Location

Information not available at this time.

DESCRIPTION AND OPERATION

Communications Network – Overview



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Item	Description
A	HS CAN bus (Infotainment)
B	MS CAN bus (Body side)
C	LIN bus (directly to the BCM)
D	HS CAN bus (Powertrain side)
E	Terminating resistors
F	DLC

Item	Description
1	Powertrain control module (PCM)
2	Alternator
3	Transmission control module
4	ABS module or ESP module
5	Steering angle sensor module
6	Restraints control module

DESCRIPTION AND OPERATION

Item	Description
7	Body control module (BCM)
8	Battery monitoring system
9	Rain sensor
10	Battery backed sounder
11	Interior motion sensor
12	Electric booster heater
13	Trailer module
14	Parking assist control module
15	Passenger front door module
16	Rear door module

Item	Description
17	Driver front door module
18	Multi-power window switch pack
19	Dual zone electronic temperature control
20	Instrument panel cluster
21	Bluetooth/Voice control
22	Multifunction display/Navigation multifunction display
23	Integrated control panel
24	Audio head unit
25	Tracking and blocking module

Network components

Dependent on the vehicle accessories version, two data bus systems are used:

- Controller Area Network (CAN) bus
- Local Interconnect Network (LIN) bus

Due to the increased number of modules and the resulting continued increase in data transfer, three different CAN bus systems are used. Essentially, they only differ in terms of their data transmission rates and application areas. In order to be able to distinguish between the individual CAN bus systems, the CAN bus system with the higher data transfer rate is referred to as the high-speed (HS) CAN bus, the CAN bus system(s) with the lower data transfer rate as the mid-speed (MS) CAN bus or multimedia (MM) CAN bus. The latter operate at a slower speed and are used primarily for communications in comfort electronics. Two interfaces (gateways) are used in order to exchange data between the HS CAN bus, MS CAN bus and the MM CAN bus. These provide the connection between the three CAN databus systems and are installed in the BCM and in the electronic instrument cluster.

The number of modules which are connected to the three databus systems depends on the equipment level of the vehicle.

Controller area network (CAN)

General

In the past, a separate cable was needed for every command and every message. The use of networks has enabled an increase in functionality without additional cables.

The demand for greater functionality in vehicles, both due to legal requirements and in order to meet customer demands, results in increasing complexity of vehicle systems.

The Controller Area Network (CAN) was developed as part of the effort to achieve greater flexibility of the electrical systems. It allows a large number of different control commands and messages to be sent and received on the same cable system.

The number of control commands and messages which can be processed by a network depends on factors like the data transfer rate and the length of the messages. The SMAX/Galaxy network, which is based on a Controller Area Network (CAN), is capable of transferring over 500 different signals and approx. 100 messages. These messages are also described as transmission blocks and may contain several signals.

Advantages of a network

Easy integration of additional functions and accessories

As the control modules in the network are already connected to each other and can easily accept further information, only the following steps are necessary:

DESCRIPTION AND OPERATION

- Connection of the sensors to the nearest control module
- Connection of the component which is to be actuated to the nearest control module
- Software-based adaptation of the module configuration

This means that the overall length of cabling and the number of components in a vehicle are reduced compared to before.

One example of this is the integration of the speed control system.

Before the introduction of the network, control modules, switches, vacuum pumps, vacuum servos, hoses and wiring harnesses were needed for this system.

Following introduction of the network, only one switch and the software for adaptation of the vehicle configuration are required.

Easier to introduce logical functions

The term "logical functions" is used to describe the concept whereby certain events trigger certain responses. For example, the system is programmed in such a way that if a tail lamp fails a message is sent via the Controller Area Network (CAN) to the electronic instrument cluster to warn the driver.

A logical function can be introduced by merely reprogramming the affected control modules. In the above case this would be the body control module (BCM) and the electronic instrument cluster. The number of components and cables remains the same.

Simple adaptation of systems to customer demands and market requirements

Vehicle functions can be adapted to customer demands and market requirements, e.g. in the case of the rear fog lamps. In some countries two rear fog lamps are used, whereas in other countries only one fog lamp is used on the driver's side. In the past it was necessary to stock different spare parts for different markets. Now a single part is sufficient to cover all markets - it just needs to be programmed for the specific market.

Use of similar basic systems for entire series

Similar networks (hardware) can be used for a wide variety of different vehicles.

The vehicles only differ in terms of:

- The individual components (modules, sensors, actuated components etc.) which are connected to the system.
- The task(s) of the components.
- The definition of the components as standard/optional/accessories.
- The configuration/programming of the system.

The layout of the network.

General

The network is made up of a range of control modules (these are also referred to as nodes) which are connected to each other via two communication cables. Each module has its own voltage supply and ground connection and receives messages and control commands via both communication cables.

In the event of a break in the circuit, the modules beyond the break cannot communicate with other parts of the network.

Network areas with high and low data transfer rates

The network consists of two parts. The area with the higher data transfer rate (HS CAN bus) transmits signals and messages between the body control module (BCM) and control modules which are mostly located in the engine compartment. The area with the lower data transfer rate (MS/MM CAN bus) transmits signals and messages between the body control module (BCM) and the control modules in the passenger compartment and in the luggage compartment.

The body control module (BCM) represents the interface between the two areas and converts the data transfer rate up or down to allow the two areas of the network to communicate with each other.

Data transfer rates

The Controller Area Network (CAN) uses two data transfer rates.

- The HS/MM CAN bus (high data transfer rate) transfers data at a rate of 500 kBit/s.
- The MS CAN bus (low data transfer rate) transfers data at a rate of 125 kBit/s. 1 kBit/s = 1024 Bit per second (1 Byte = 8 Bit).

DESCRIPTION AND OPERATION

Terminating resistor

In order to avoid reflections and interferences in the CAN bus network, a terminating resistor is provided for bridging purposes at both ends of the CAN. Each terminating resistor has a resistance value of 120 Ohm.

- For the HS CAN bus, the terminating resistors are located in the body control module (BCM) and in the powertrain control module (PCM).
- For the MS/MM CAN bus, the terminating resistors are located in the body control module (BCM) and in the electronic instrument cluster.

The two resistors are connected in parallel. The resistance values are as follows:

- When the CAN bus is intact, the resistance is approx. 60 Ohm in both areas of the network.
- In the event of a short circuit between the communication lines the resistance is approx. 0 Ohm.

Controller Area Network (CAN) Standard

General

The CAN bus is a standardized system for multiplex communication. This means that multiple control modules can use the same wires for communication without causing interference between the different signals.

The Controller Area Network (CAN) Standard specifies the following:

- The use of two wires (CAN H and CAN L)
- The voltage amplitudes
- The structure of the messages
- The way in which transmission faults are handled

The lines CAN H and CAN L

The lines CAN H and CAN L must not be confused with the different data transfer rates HS CAN bus and HS CAN bus. The lines CAN H and CAN L are the paths on which signals are transmitted within the multiplex communication system.

Communications take place at different voltages via two separate wires which are twisted in pairs. As a result, the network is less susceptible to interference.

The same message is put out at the same time on both wires with different voltages.

- Binary signal 0 = 2.5V on CAN H and on CAN L
- Binary signal 1 = 4V on CAN H and 1V on CAN L

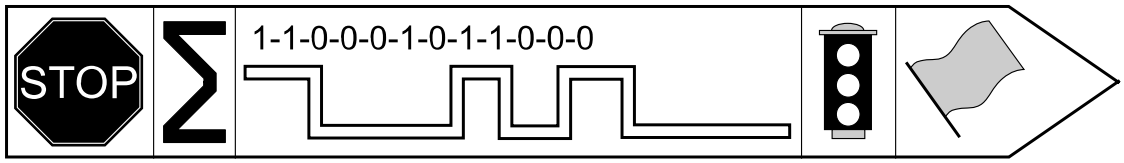
The average potential difference between CAN L and ground is approx. 2.3V, or approx. 2.8V between CAN H and ground.

These measured values refer to "normal" communications in the Controller Area Network (CAN), i.e. cases in which no faults have occurred which would cause the modules to send out error messages.

NOTE: Certain modules, such as the restraints control module (the module for the SRS system) and the ABS module or ESP module communicate with their relevant sensors via a so-called internal CAN bus. The internal CAN bus systems have nothing to do with the communications on the general CAN bus. Instead, they are only used for the purpose of transmitting data between sensors and associated modules.

DESCRIPTION AND OPERATION

Messages in the Controller Area Network (CAN)



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A message comprises the following parts:

- An identifier which indicates the identity and priority of the message
- Information data (value, information etc.)
- A check sum which is used to check whether the message is received in full
- And end signal which signals the end of the message

A complete CAN message is referred to as a signal frame.

Priority

Conflicts may arise in a network if several control modules try to send messages at the same time as each other. This could for example be the case if the driver applied the brakes while the front passenger adjusted the A/C settings and a rear passenger operated the electric rear window regulators. The messages need to be prioritized so that safe operation can be ensured. In addition, any delays arising as a result of the prioritization process must be kept within limits so that the customer preferably does not notice them at all.

In order to avoid conflicts and delays and to ensure perfect operation of the systems, a fixed ranking order applies to the messages.

The priority of a message is defined by the number of zeros at the start of the message; the more zeros, the higher the priority.

Prioritization takes place as follows:

- If the network is available, all modules waiting to send a message deliver the first bit of their message.
- All modules register the signals sent out on the network.
- If a zero is sent out by a module then the modules which sent out a "1" wait until the network is available again.
- The modules with a zero then send the second bit of their message.
- If a zero is sent out by a module as its second bit then the modules with a "1" wait until the network is available again. This process is repeated.

The message with the highest priority, i.e. the message with the largest number of zeros at the start, is sent first.

The end of a message is made up of seven zeros. It shows the modules that the network is free again and that messages can be sent out again according to their priority.

Two message types

Two types of message are sent in the system:

DESCRIPTION AND OPERATION

- Periodic signal frames are sent regularly to indicate the current status of a parameter. They are used for types of information which change frequently, e.g. vehicle speed signals.
- Event-related signal frames are only sent if certain conditions are met. They are used for types of information which occur more rarely, e.g. the opening or closing of a window.

The messages may also incorporate an update bit which shows how "new" the message is.

The system always assumes that the messages reach the intended recipient, so no receipt acknowledgement signals are sent out. Replies are only sent in response to direct queries from other modules.

However, a receiver module also knows how often it should receive a particular status message. If the message is not received then the receiver module can launch an emergency running program and/or set a trouble code (DTC).

Compatibility

The modules must all speak the same language and be compatible with each other. As a result, a standardized communication protocol is used.

The language of the modules is contained in the signal configuration. If the signal configuration of a module does not match the configuration of the other modules than the module cannot communicate with them. This means that all modules must have a compatible signal configuration.

In order to check this, the body control module (BCM) sends out an identification number for its signal configuration via the Controller Area Network (CAN). The other modules compare this number to their own number. If the identification does not match then the module stores a trouble code (DTC). The signal configuration is changed occasionally, so that new messages are added and old ones are removed.

Configurations

The following information is downloaded when a system is configured:

- Type of control modules contained (e.g. body control module (BCM)) - task assignments for the individual modules (e.g. this is the module for the driver's door))
- Functions contained (e.g. alarm function on or off)
- Connected components (e.g. whether or not the inclination sensor is relevant for the alarm function)
- Output an input messages for each module
- Storage locations for various data

The configuration needs to be adapted for any accessories which are installed and needs to be downloaded again if a module is replaced. The diagnostic unit is used for adaptation and downloading.

NOTE: Two vehicles which otherwise appear identical may behave differently if they have different configurations. Parameters may have been changed by the customer or by the workshop.

Error management in the Controller Area Network (CAN)

General

The Controller Area Network (CAN) is monitored by the body control module (BCM). If the BCM detects a fault in the CAN bus then a trouble code (DTC) is stored in the BCM. There are different types of DTC according to the fault type:

- No communications from the module
- Faulty communications

No communications from the module

The body control module (BCM) knows which modules are in the Controller Area Network (CAN) and checks whether all modules are communicating. If a module is not communicating a trouble code (DTC) is set in the BCM. There is a trouble code (DTC) for every module.

Faulty communications

If the Controller Area Network (CAN) is in operation then the body control module (BCM) continuously monitors the flow of information in the network. If the BCM determines that, for some reason, the communications in the CAN bus are interrupted, it can set a trouble code (DTC). The BCM has trouble codes for all parts of the CAN bus (one each for the HS CAN bus and the MS/MM CAN bus).

DESCRIPTION AND OPERATION

With the exception of the BCM, which only knows one type of DTC, each module uses two types of DTC in relation to communication faults. These are:

- Faulty messages
- Faulty configuration

As the BCM is the main module in the network, it does not have a DTC for faulty configuration.

Faulty messages

The control modules continuously monitor the flow of information in the Controller Area Network (CAN). If a module receives a message it cannot interpret it sends a fault message via the CAN bus. The modules also have function which allows them to detect any faulty messages they generate themselves. This prevents interference on the CAN bus. If there is a lot of interference in the network then any modules which cannot communicate properly can switch themselves off. This status is referred to as "databus OFF" - the module can no longer send or receive information.

To prevent the vehicle from coming to a sudden standstill or suffering a total loss of particular functions if a fault occurs in the CAN bus, certain modules have an emergency running mode. This means that modules which are required for driving or for safety aspects (e.g. the powertrain control module (PCM) or the transmission control module (TCM)) can maintain a restricted functionality on the basis of predefined or estimated data. For example, if communications to the transmission control module (TCM) are interrupted then the transmission will use a preselected gear which will enable the customer to at least drive to the nearest workshop.

A module remains in "databus OFF" mode until the power supply to the module is switched off, or a module determines that the "databus OFF" condition no longer exists. If the power supply is reconnected the module attempts to re-establish communications.

Faulty configuration

The body control module (BCM) transmits its configuration ID within the messages it sends out to other modules. To enable the modules in the Controller Area Network (CAN) to communicate with each other they must have the same configuration ID, as modules only look at messages carrying their own configuration ID. If the signal configuration of a module does not match the signal configuration of the BCM then a trouble code (DTC) is stored in the module with the faulty configuration.

NOTE: A module will save a trouble code (DTC) if it does not receive any messages from the engine control module (ECM). This also applies if there are any software errors in the module. If the circuit in the Controller Area Network (CAN) is interrupted then certain modules will also not receive any messages from the ECM.

NOTE: A module will save a trouble code (DTC) if it does not receive any messages from the body control module (BCM). This also applies if there are any software errors in the module. If the circuit in the Controller Area Network (CAN) is interrupted then certain modules will also not receive any messages from the BCM.

Local Interconnect Network (LIN)

The Local Interconnect Network (LIN) bus is a standard which has been developed for cost-effective communications between intelligent sensors and actuators in motor vehicles. LIN is used wherever the bandwidth and versatility of CAN is not required.

The LIN specification comprises the LIN protocol, a standard format for describing a complete LIN network and the interface between a LIN network and the application.

A LIN network is made up of a LIN master and one or more LIN slaves.

The LIN network 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) when requested to do so by the LIN master.

LIN is a single-wire bus, i.e. the data are transmitted across a single-stranded cable. 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

DESCRIPTION AND OPERATION

data transmission. No terminating resistors are used in the LIN network.

SECTION 418-01 Module Configuration

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

DESCRIPTION AND OPERATION

Module Configuration – Overview

Central module configuration

Previously, the modules in the vehicle have been configured with the aid of the diagnostic unit and the "Module Programming" function (Inhale/Exhale). Here, the actual status of each module is read into the diagnostic unit and then transferred into the new module.

In this vehicle, a new form of module configuration is used, known as "central module configuration".

Here, all the required configuration parameters are stored in the BCM (body control module) at the factory, and from there they are transmitted to the individual modules via the CAN (controller area network).

The diagnostic unit is equipped with a new routine for performing the central module configuration which is used to replace or subsequently change configuration data. Instead of reading the data into the diagnostic unit as was done in the past, they are transferred directly to the relevant module by the BCM. The diagnostic unit is only needed for starting and monitoring the process.

For security reasons, all the configuration data of the BCM is also stored in the instrument cluster. This means that if the BCM is replaced, the required configuration data can be read out from the instrument cluster using the diagnostic unit and transferred to the new BCM.

All modules independently check configuration data for consistency, and store a DTC (diagnostic trouble code) in the event of a fault.

In the event of a fault the functionality of a particular module may be restricted.

When installing a new BCM, it is necessary to reprogram the keys for the radio remote control and for PATS (passive anti-theft system). The procedure here remains the same.

SECTION 418-02 Wiring Harnesses

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

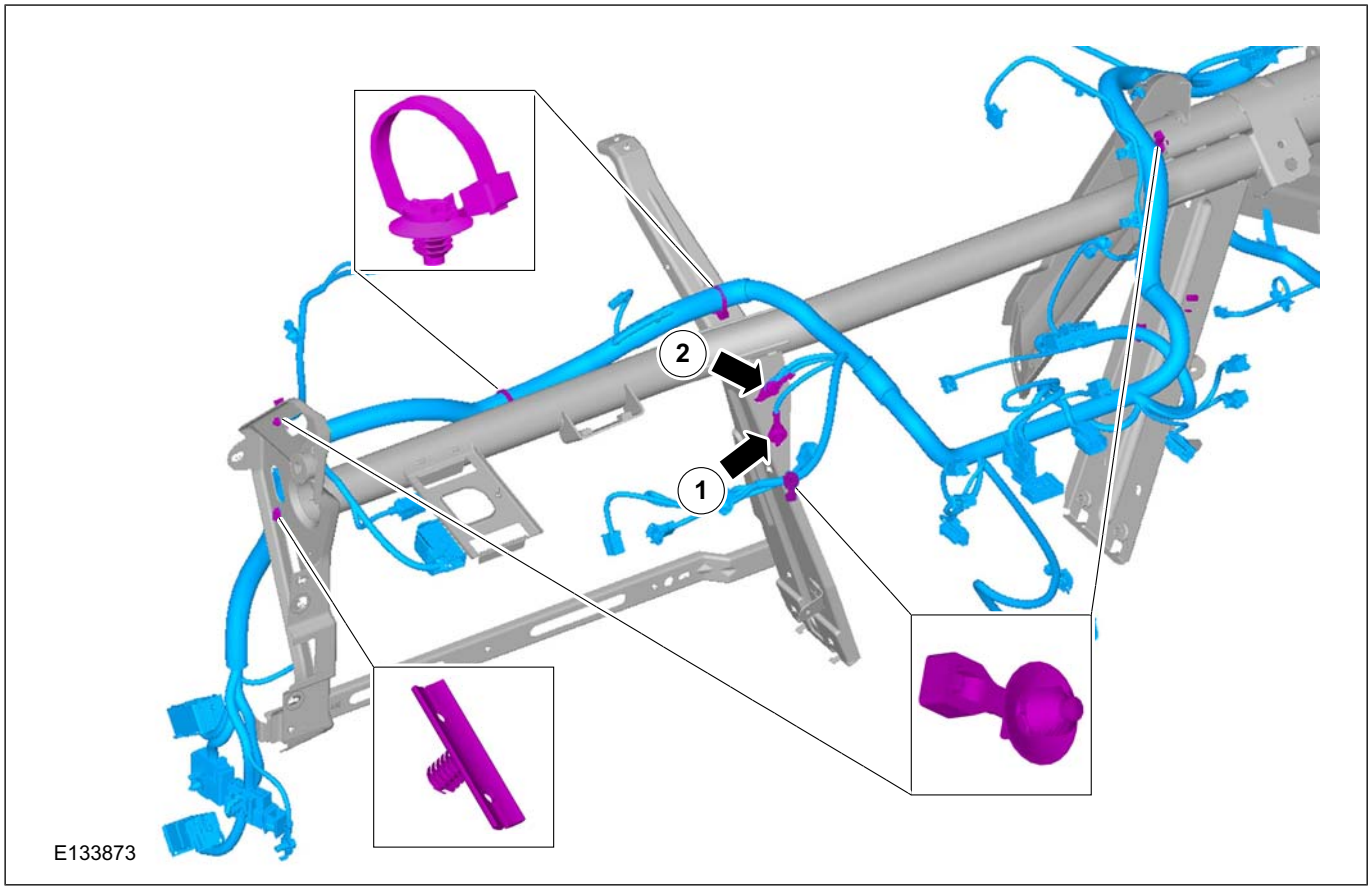
Instrument Panel Wiring Harness

Removal

WARNING: Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

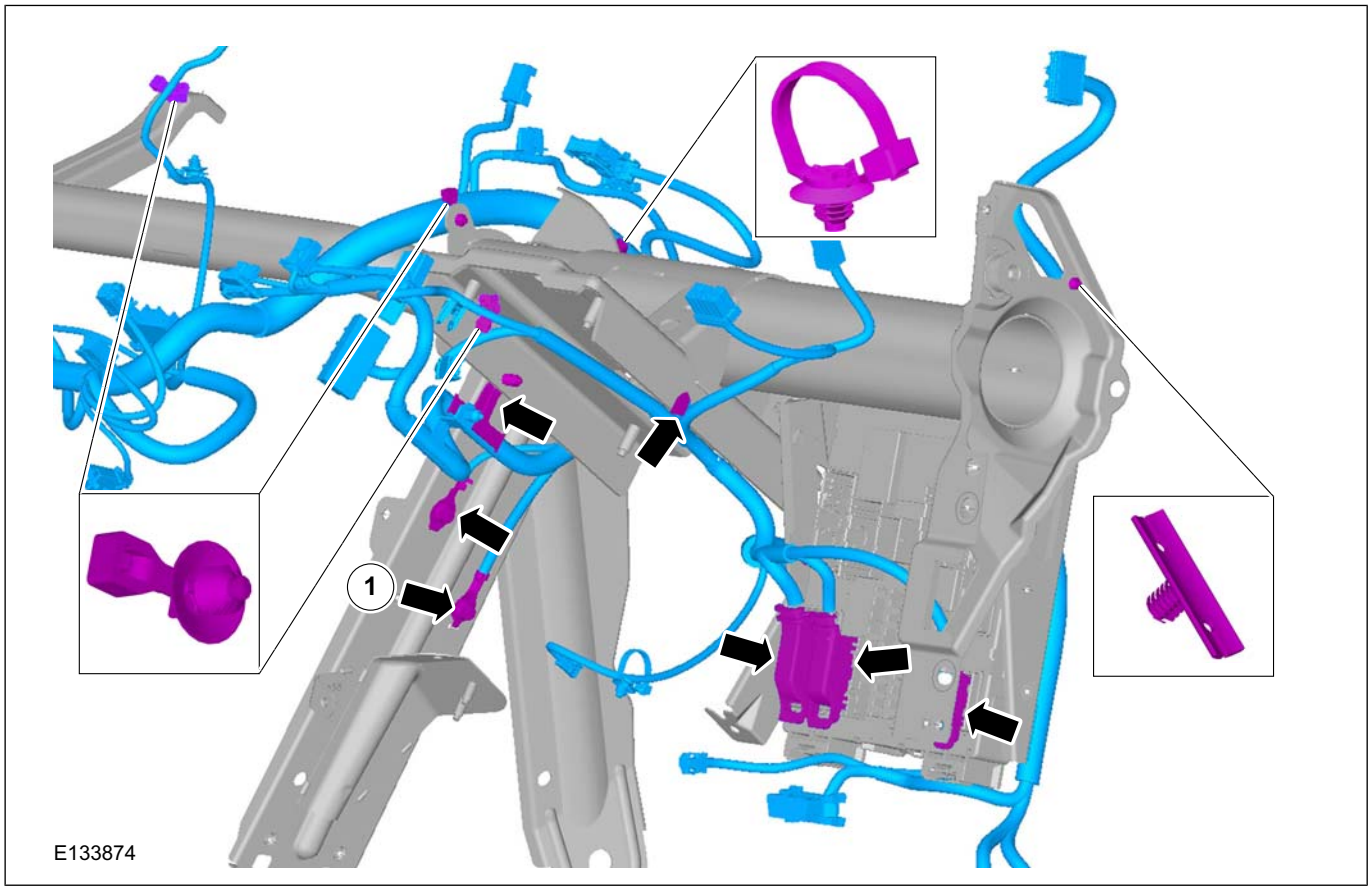
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Instrument Panel - RHD 4WD/RHD RWD (501-12 Instrument Panel and Console, Removal and Installation).
3. Refer to: Instrument Panel (501-12 Instrument Panel and Console, Disassembly and Assembly).
4. 1. Torque: 11 Nm
   2. Torque: 11 Nm



5. 1. Torque: 11 Nm

REMOVAL AND INSTALLATION



Installation

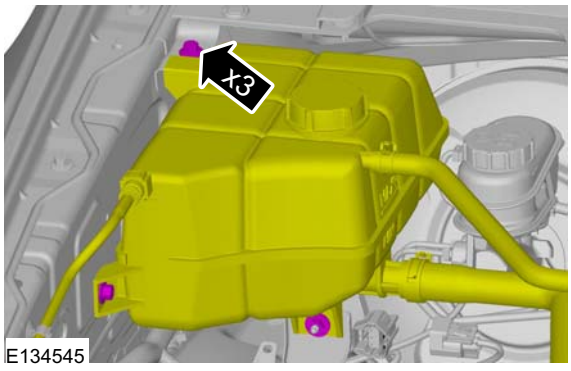
1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Passenger Compartment Wiring Harness

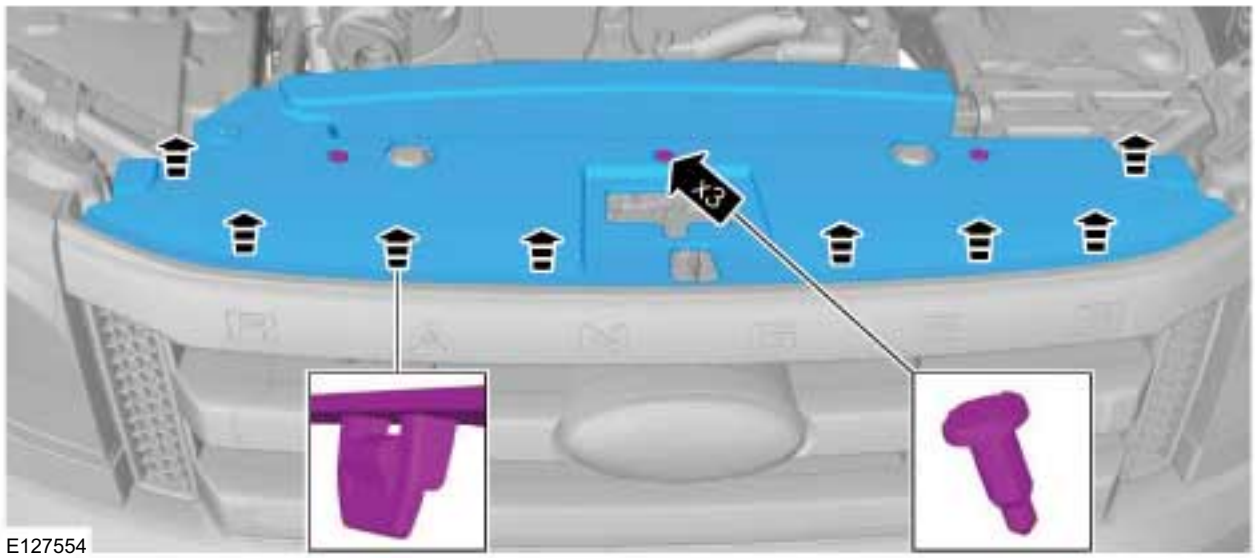
Removal

1. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).
2. Refer to: Instrument Panel - LHD 4WD/LHD RWD (501-12 Instrument Panel and Console, Removal and Installation).
   Refer to: Instrument Panel - RHD 4WD/RHD RWD (501-12 Instrument Panel and Console, Removal and Installation).
3. Refer to: Heater Core and Evaporator Core Housing (412-01 Climate Control, Removal and Installation).
4. Refer to: Air Cleaner - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
   Refer to: Air Cleaner - 3.2L Duratorq-TDCi (148kW/200PS) - Puma (303-12 Intake Air Distribution and Filtering - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma, Removal and Installation).
   Refer to: Air Cleaner (303-12 Intake Air Distribution and Filtering - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
5.



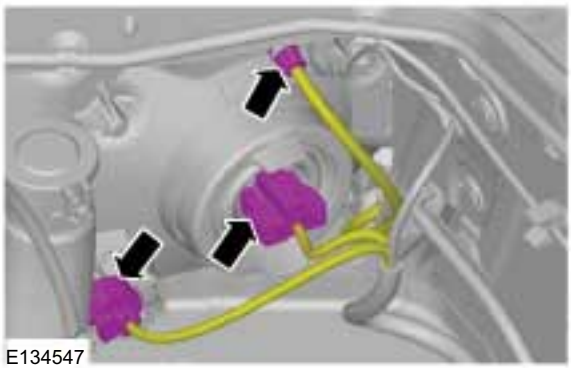
6.

REMOVAL AND INSTALLATION

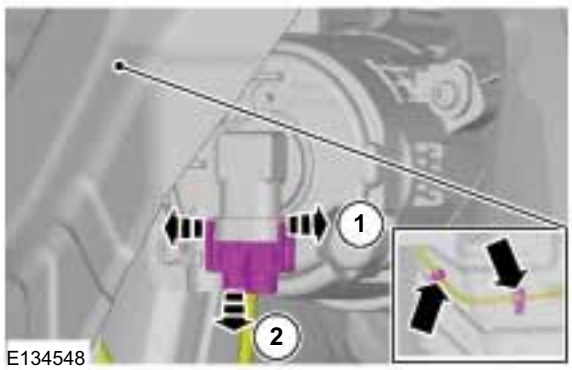


7.

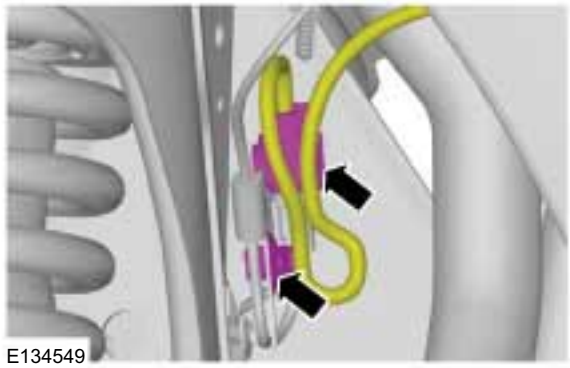
8. On both the sides.



9. On both the sides.

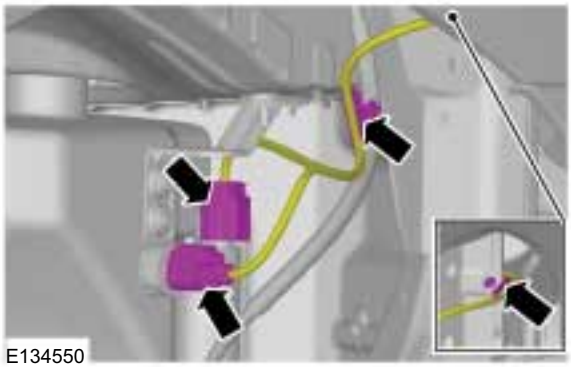


10. On both the sides.

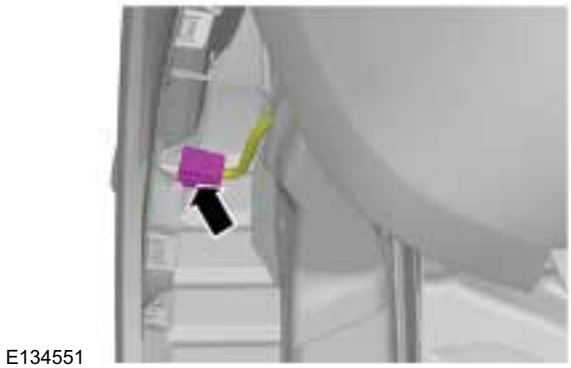


REMOVAL AND INSTALLATION

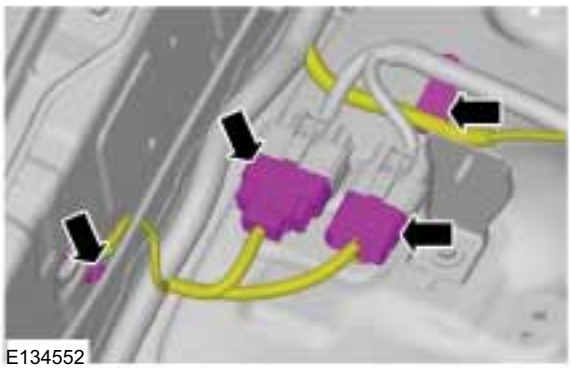
11.



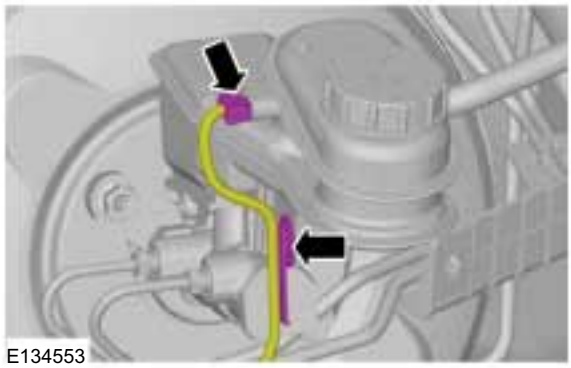
12.



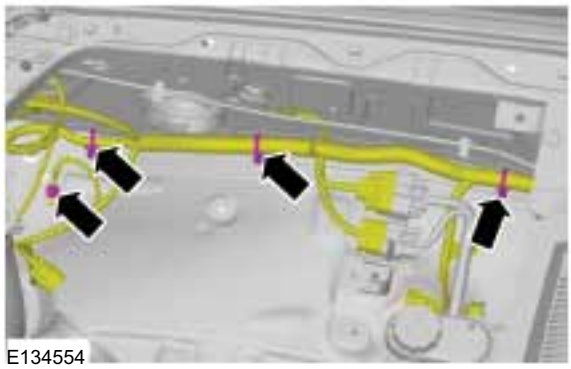
13. Torque: 10 Nm



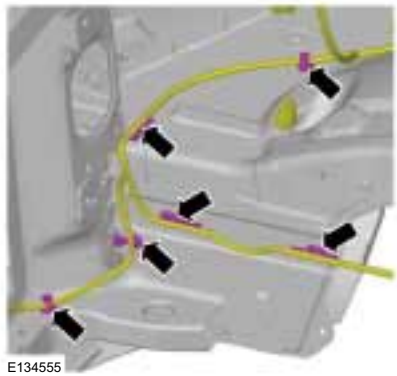
14.



15. Torque: 10 Nm

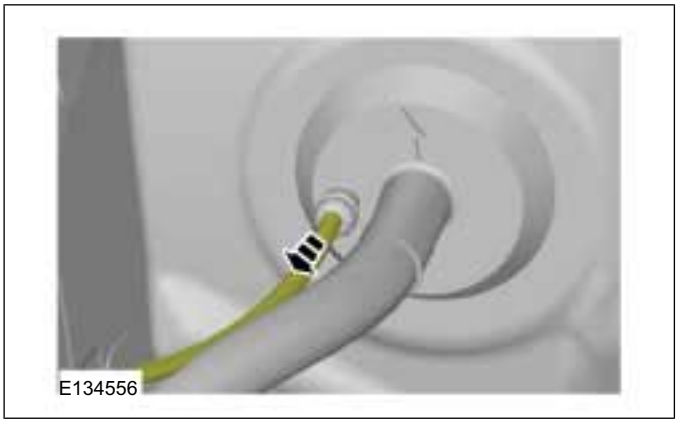


16.



REMOVAL AND INSTALLATION

17.



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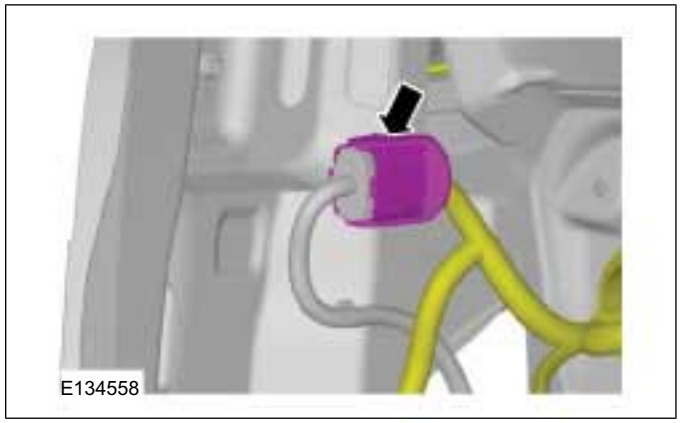
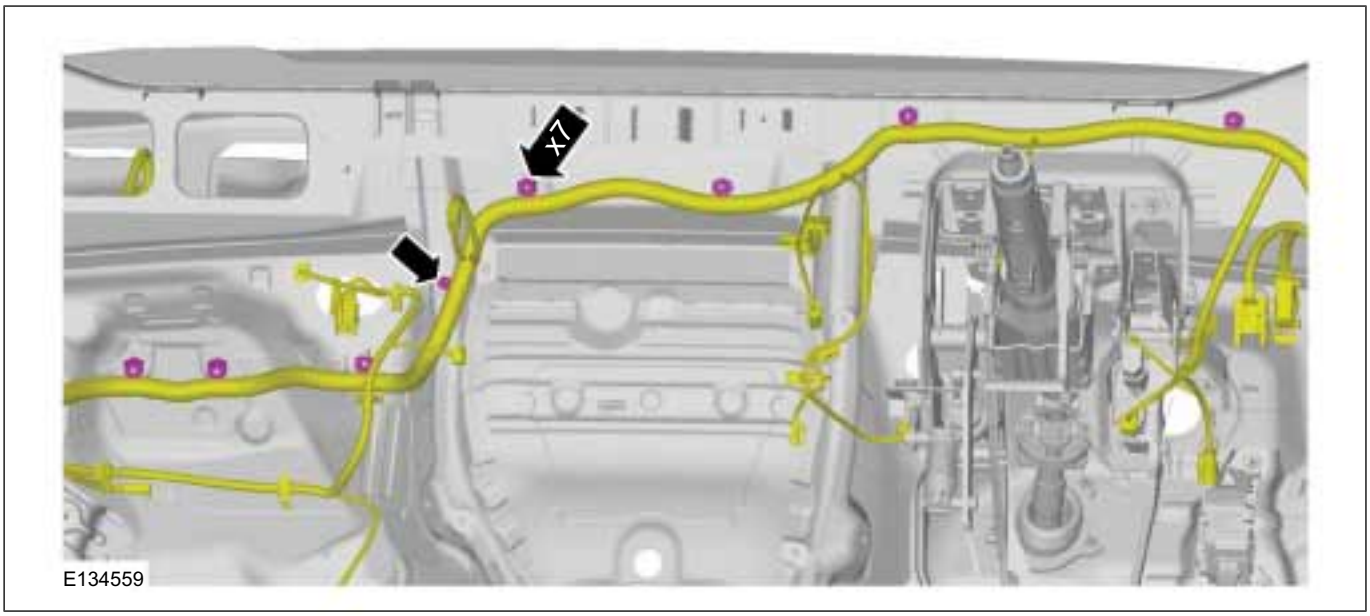


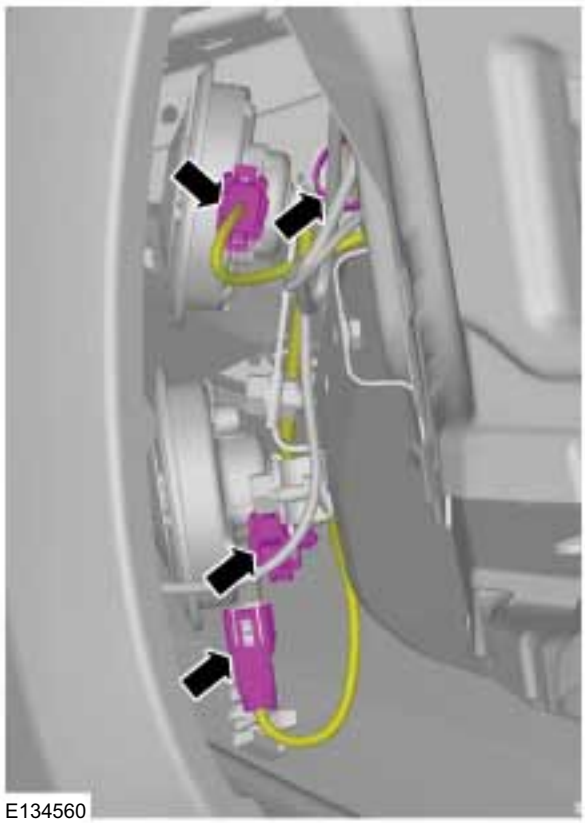
18.

20.

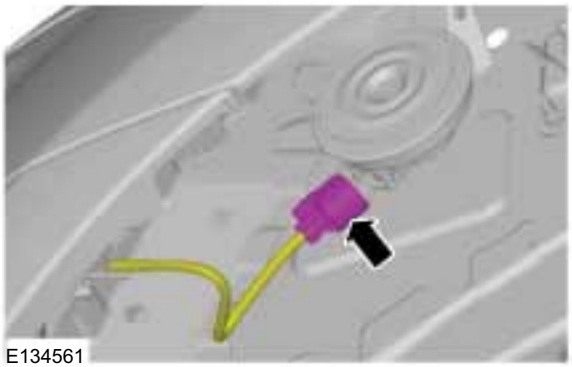


REMOVAL AND INSTALLATION

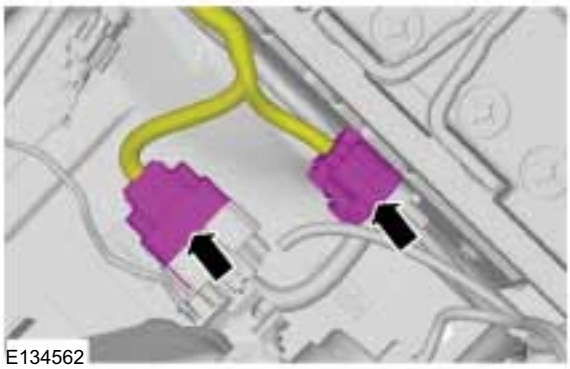
21.



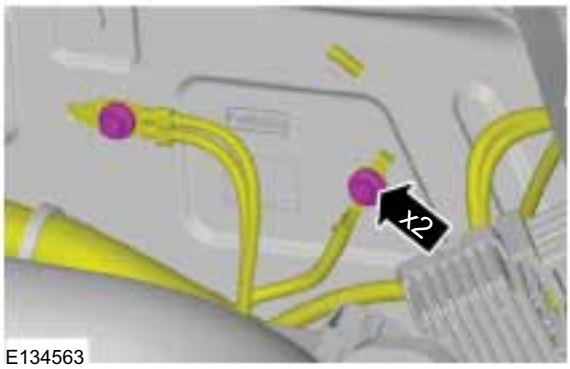
22.



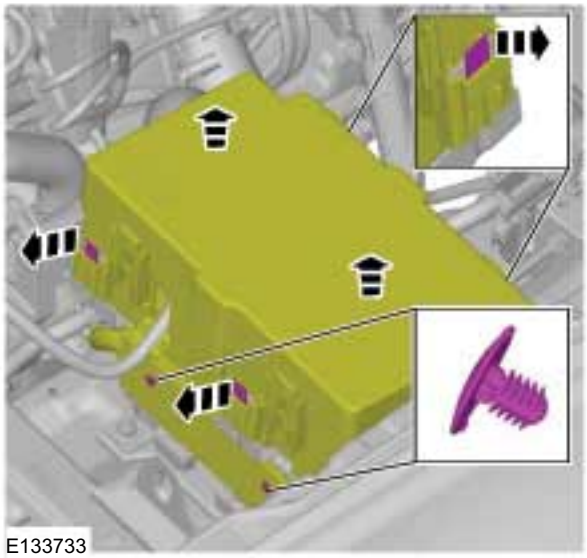
23.



24. Torque: 10 Nm

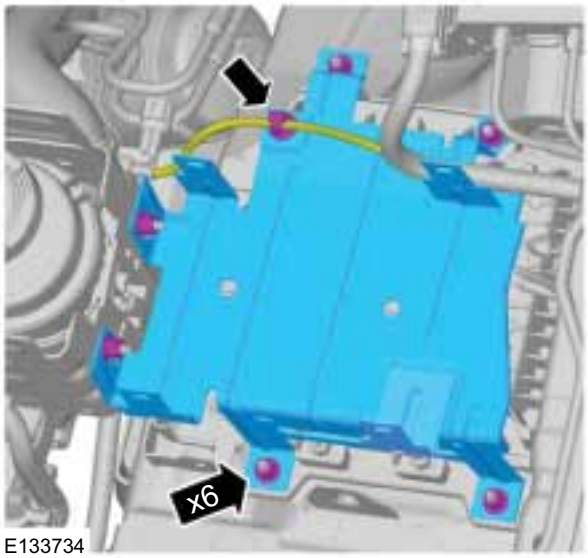


25.

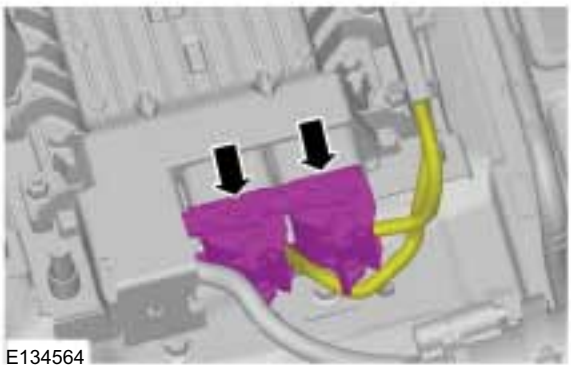


REMOVAL AND INSTALLATION

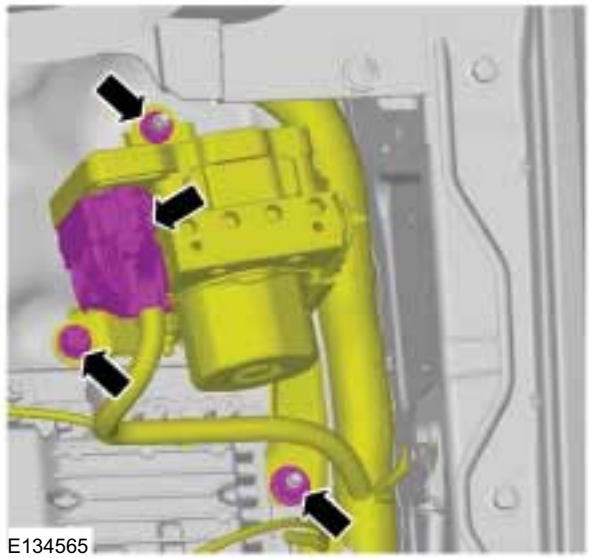
26. Torque: 10 Nm



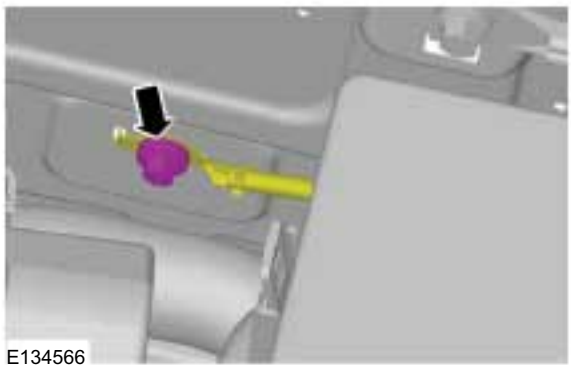
27.



28. Torque: 13 Nm

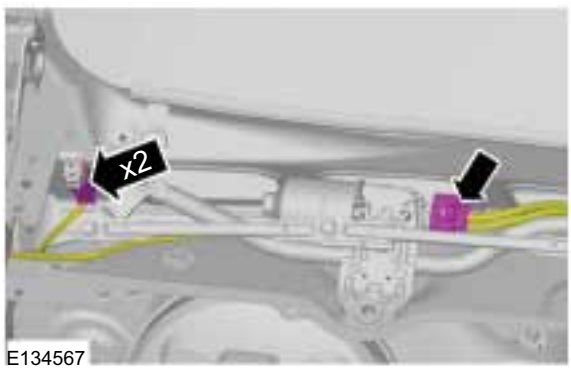


29. Torque: 10 Nm



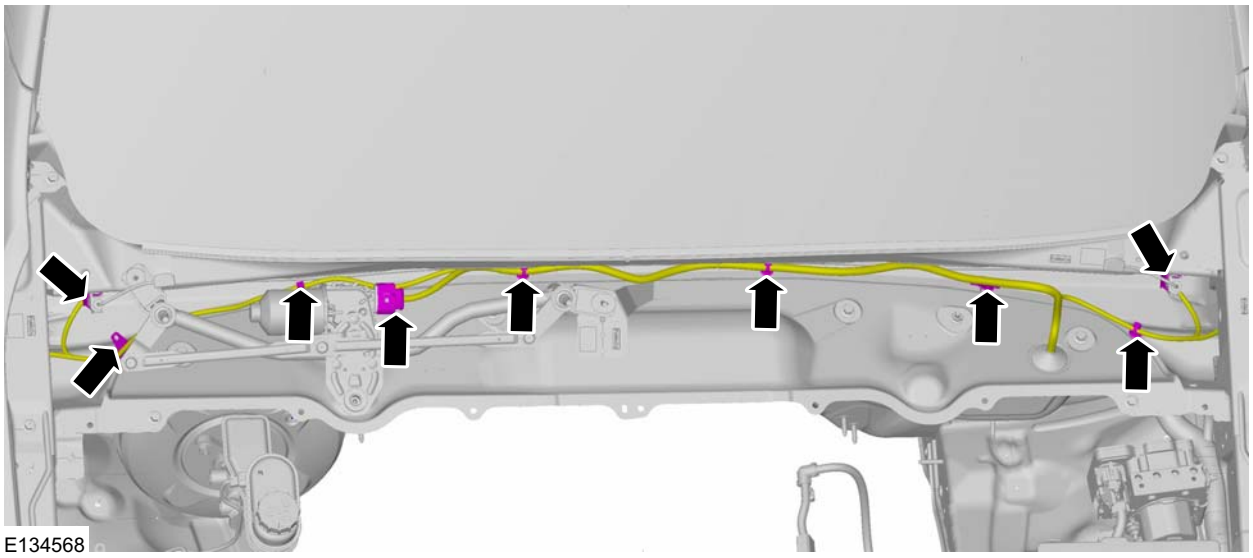
30. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

31.

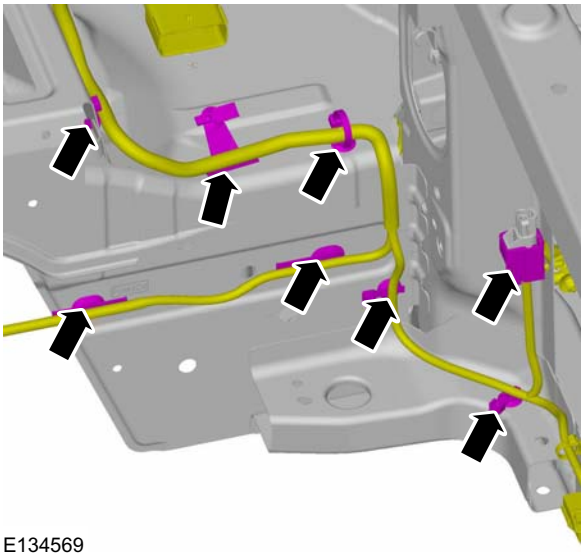


32.

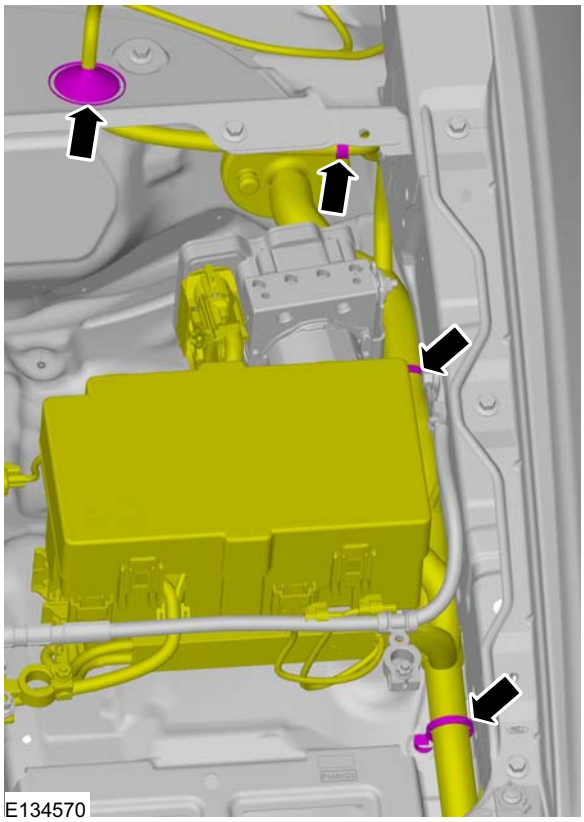
REMOVAL AND INSTALLATION


E134568

33.

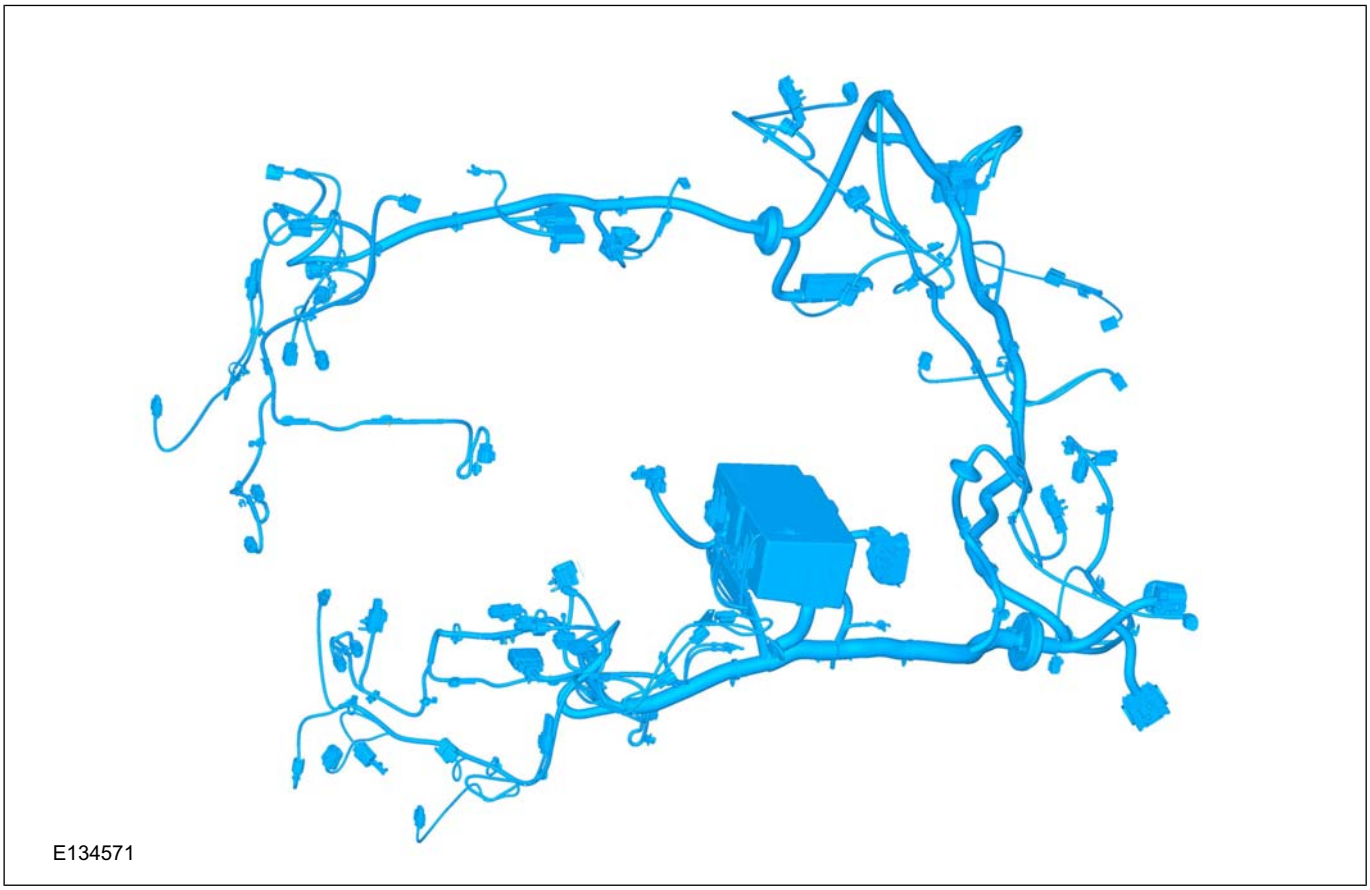

E134569

34.


E134570

35.

REMOVAL AND INSTALLATION



REMOVAL AND INSTALLATION

36. Refer to: Front Bench Seat (501-10 Seating, Removal and Installation).
Refer to: Front Seat (501-10 Seating, Removal and Installation).

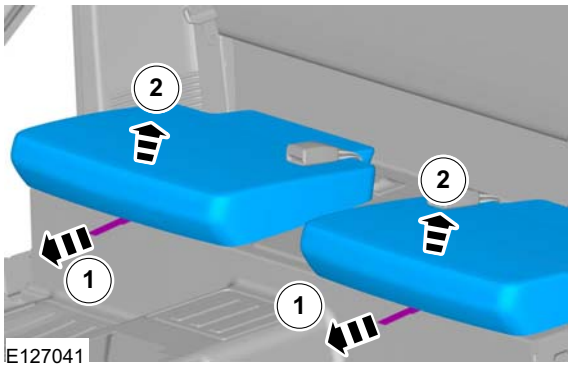
37. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).
Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

38. Refer to: Headliner (501-05 Interior Trim and Ornamentation, Removal and Installation).

39. Refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

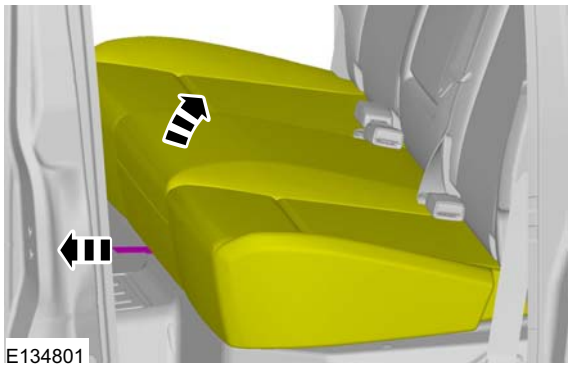
Stretch cab

40.

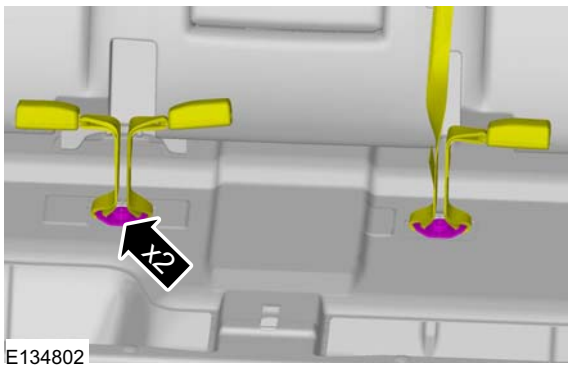


Double cab

41.



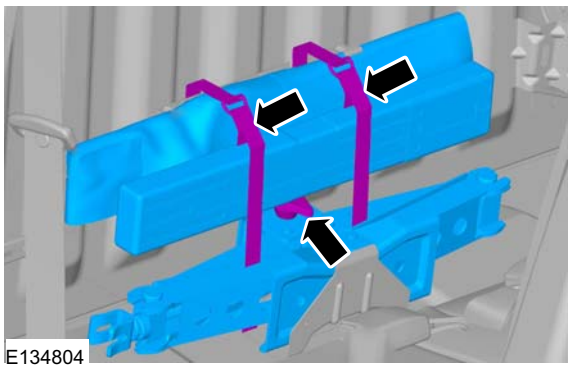
42.



43.

Single cab oder Double cab

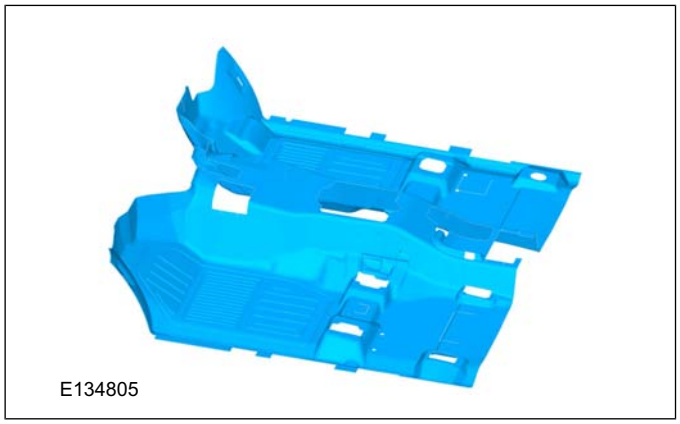
44.



REMOVAL AND INSTALLATION

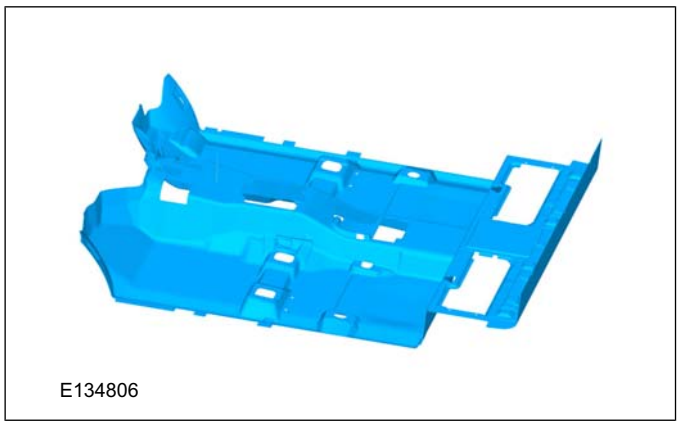
Single cab

45.



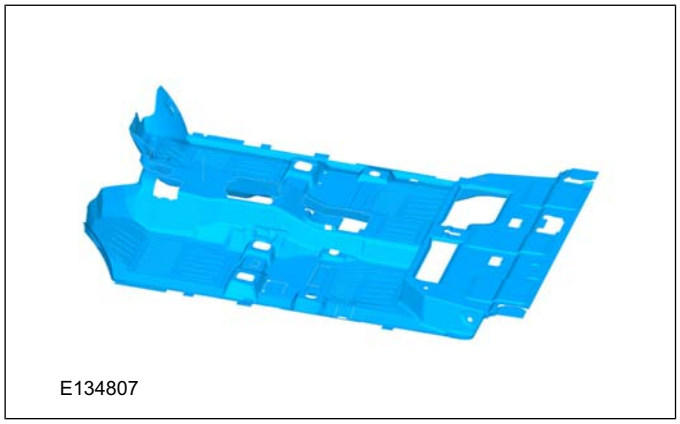
Stretch cab

46.



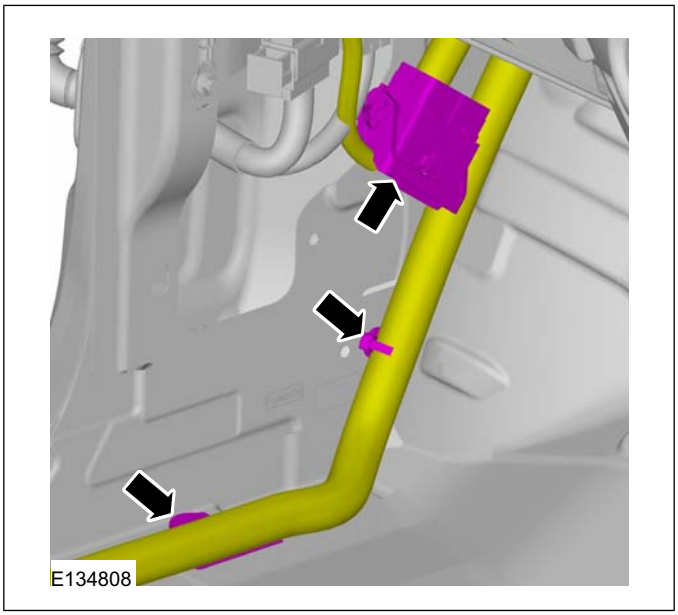
Double cab

47.



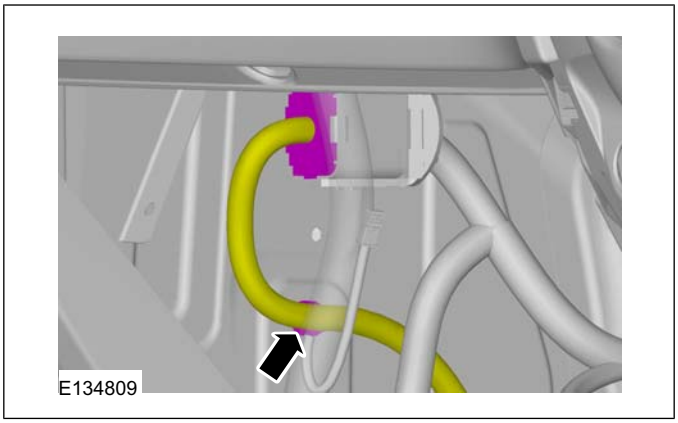
All vehicles

48.

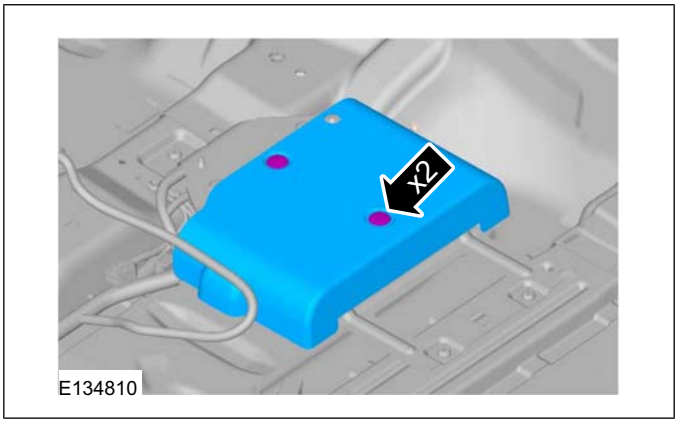


49. Refer to: Glove Compartment - Removal (501-12 Instrument Panel and Console, Removal and Installation).

50.

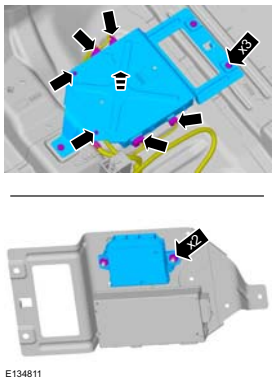


51.

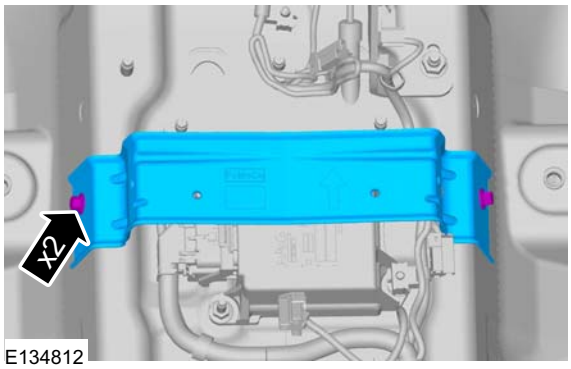


REMOVAL AND INSTALLATION

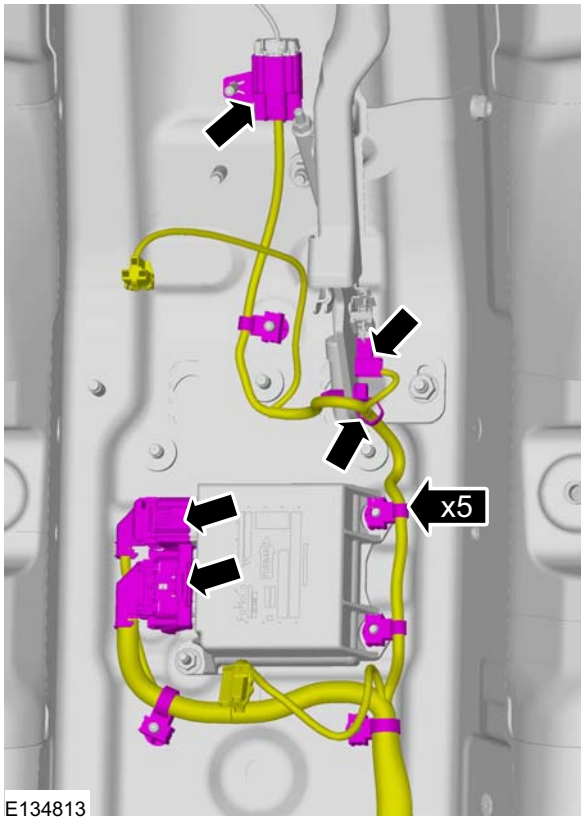
52. Torque: 10 Nm



53. Torque: 10 Nm

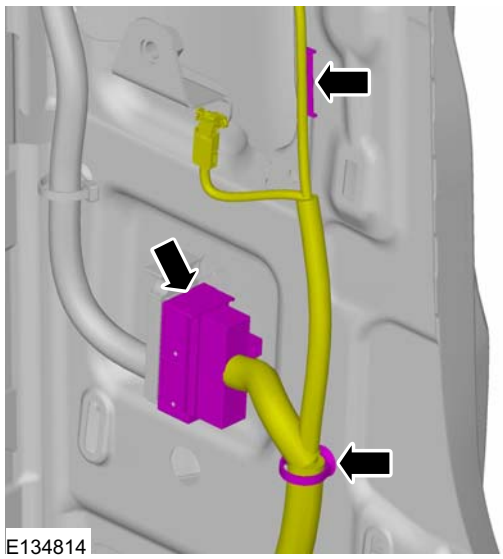


54.



Single cab

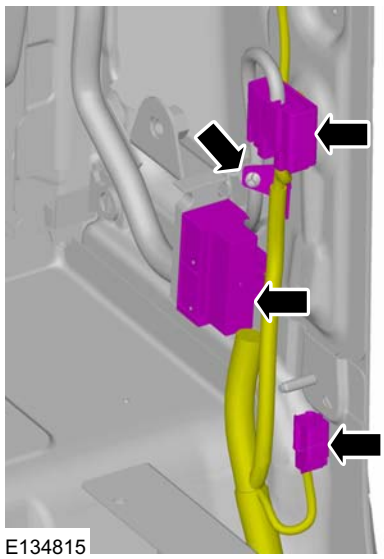
55.



REMOVAL AND INSTALLATION

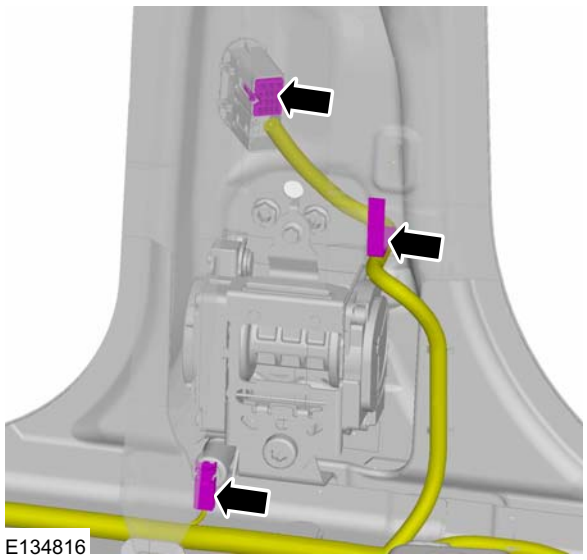
Stretch cab

56.

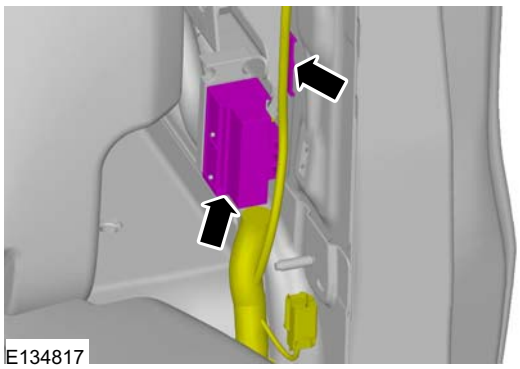


Double cab

57.

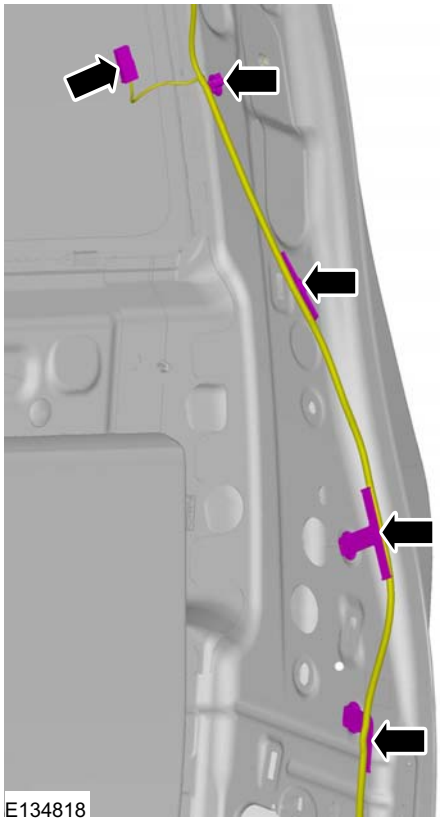


58.



All vehicles

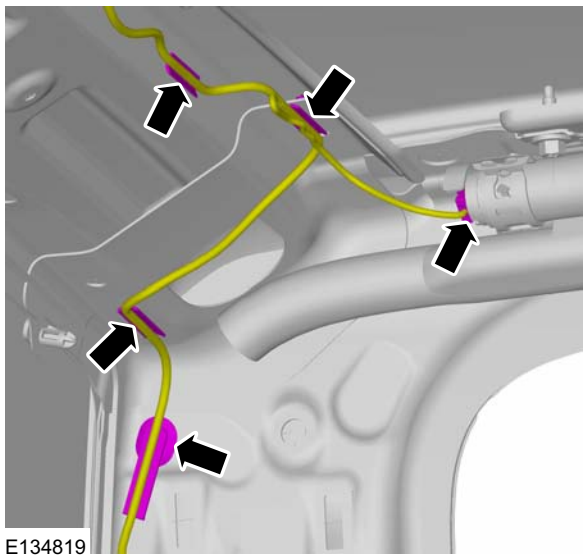
59.



REMOVAL AND INSTALLATION

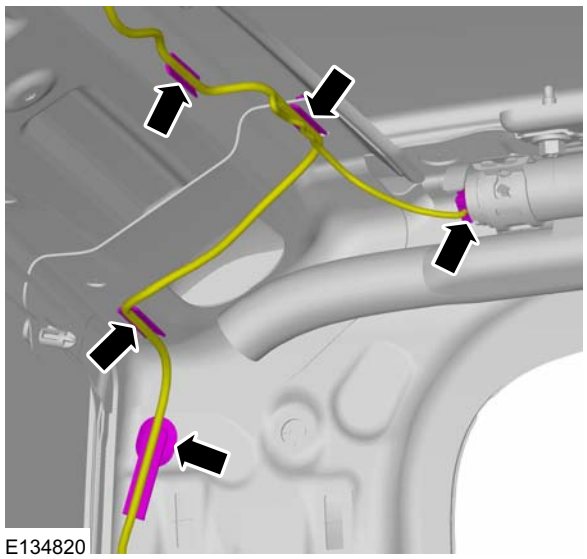
Single cab

60.



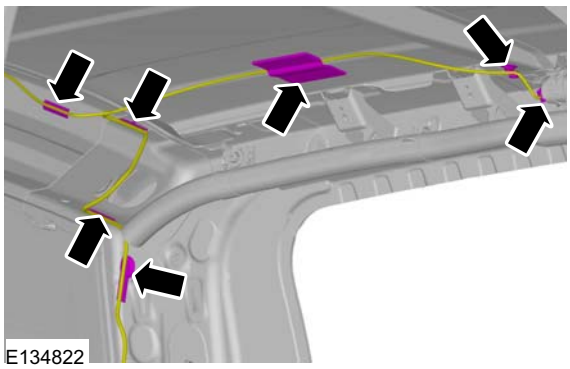
Stretch cab

61.



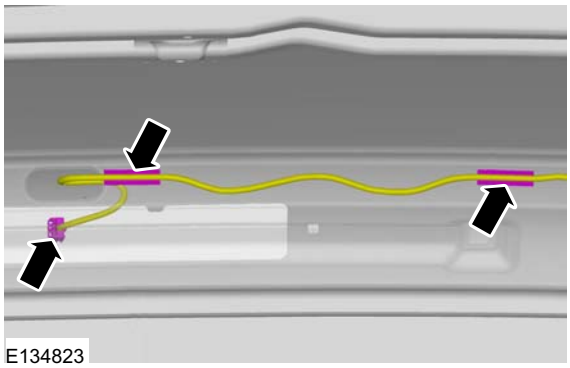
Double cab

62.



All vehicles

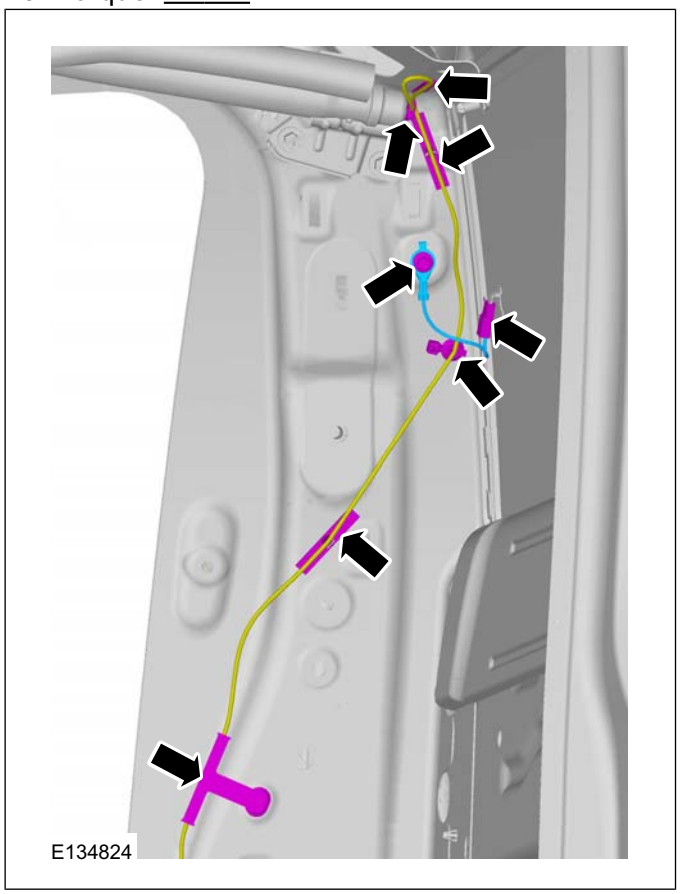
63.



REMOVAL AND INSTALLATION

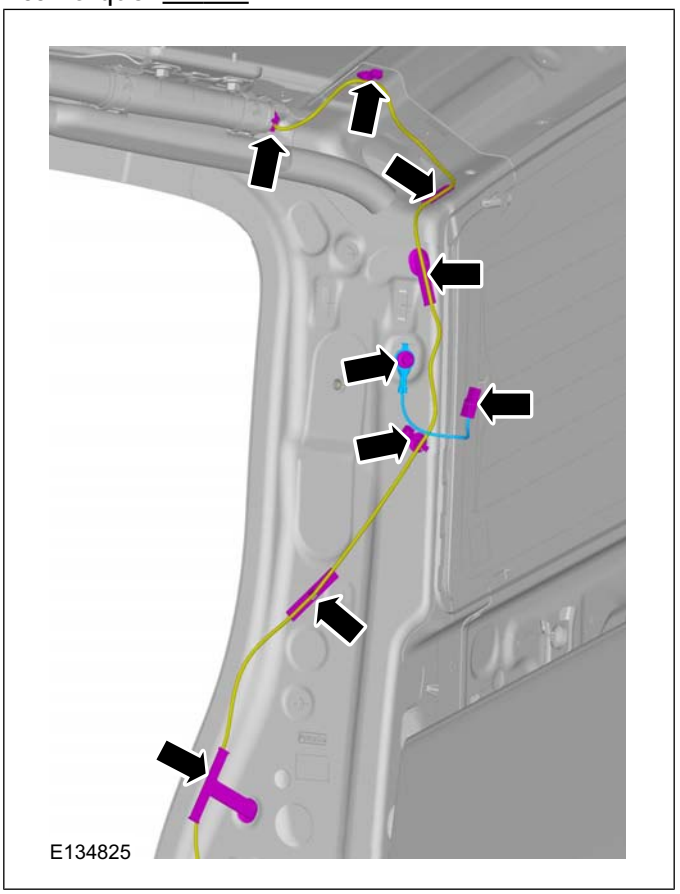
Single cab

64. Torque: 12 Nm

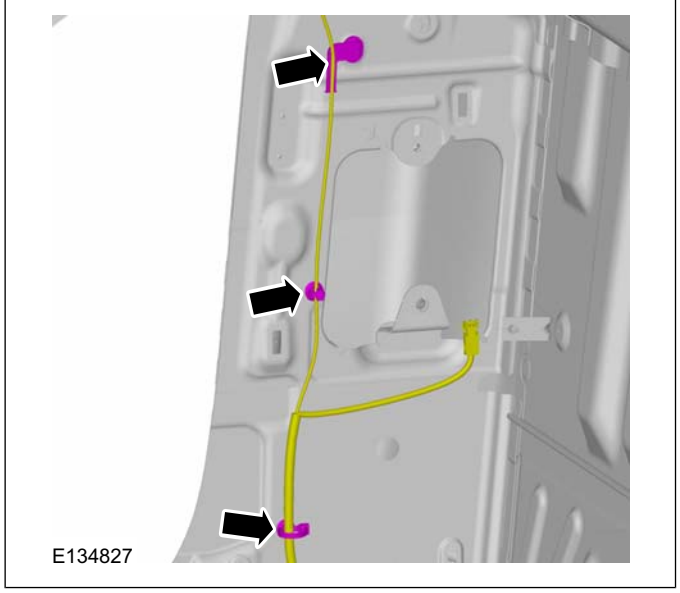


Stretch cab

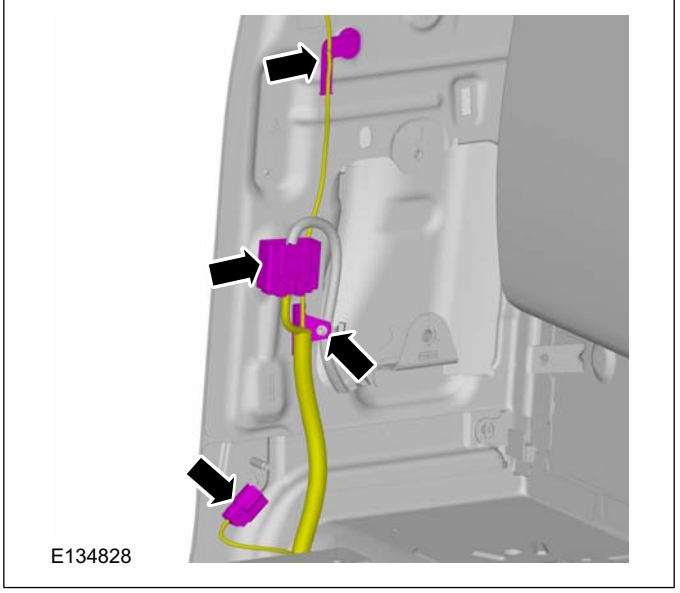
66. Torque: 12 Nm



65.



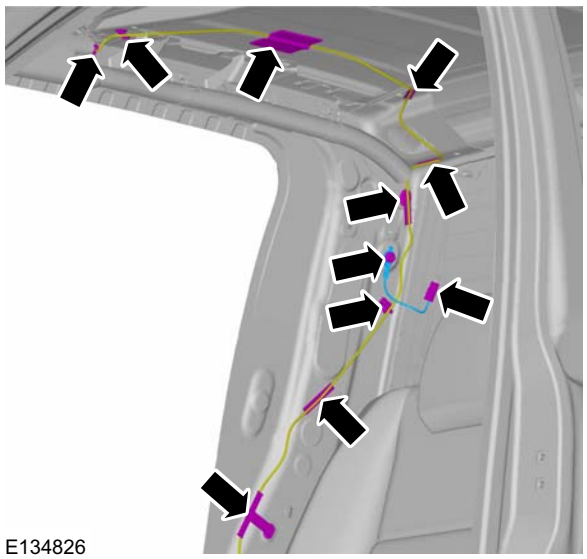
67.



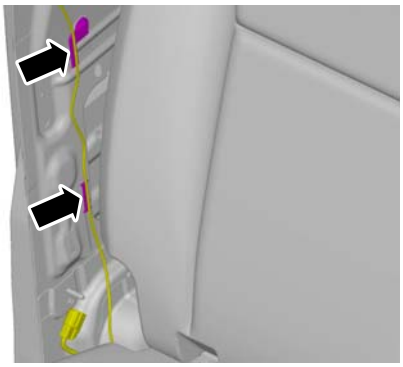
REMOVAL AND INSTALLATION

Double cab

68. Torque: 12 Nm

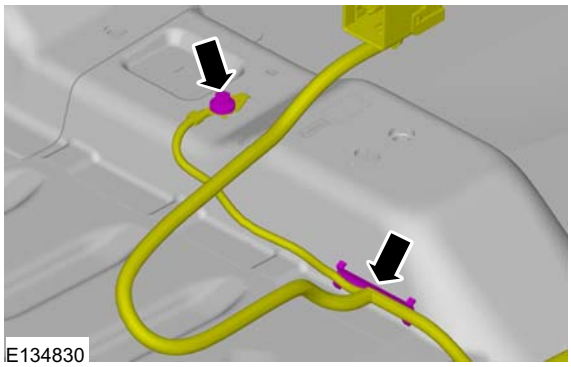


69.

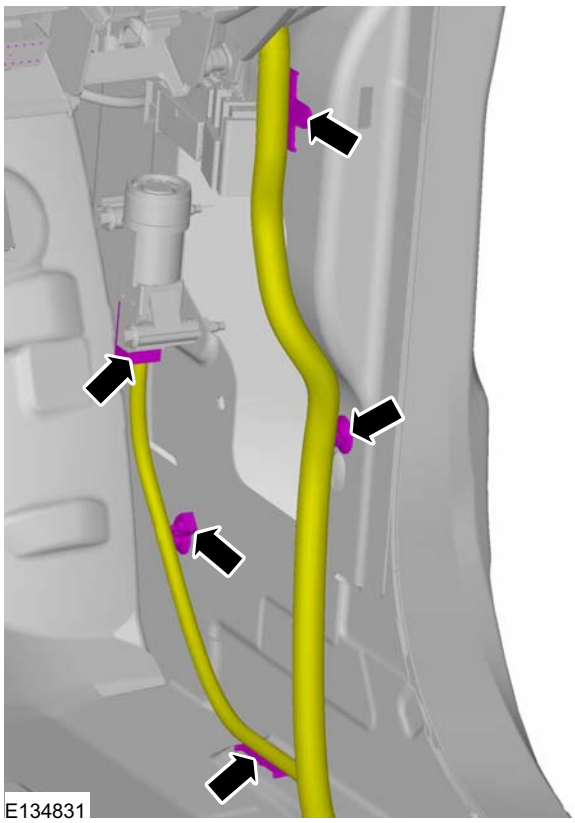


All vehicles

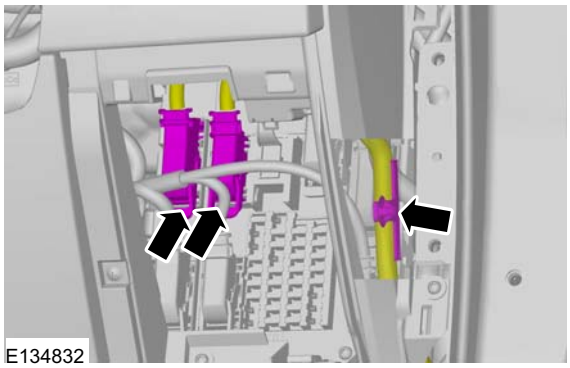
70. Torque: 12 Nm



71.



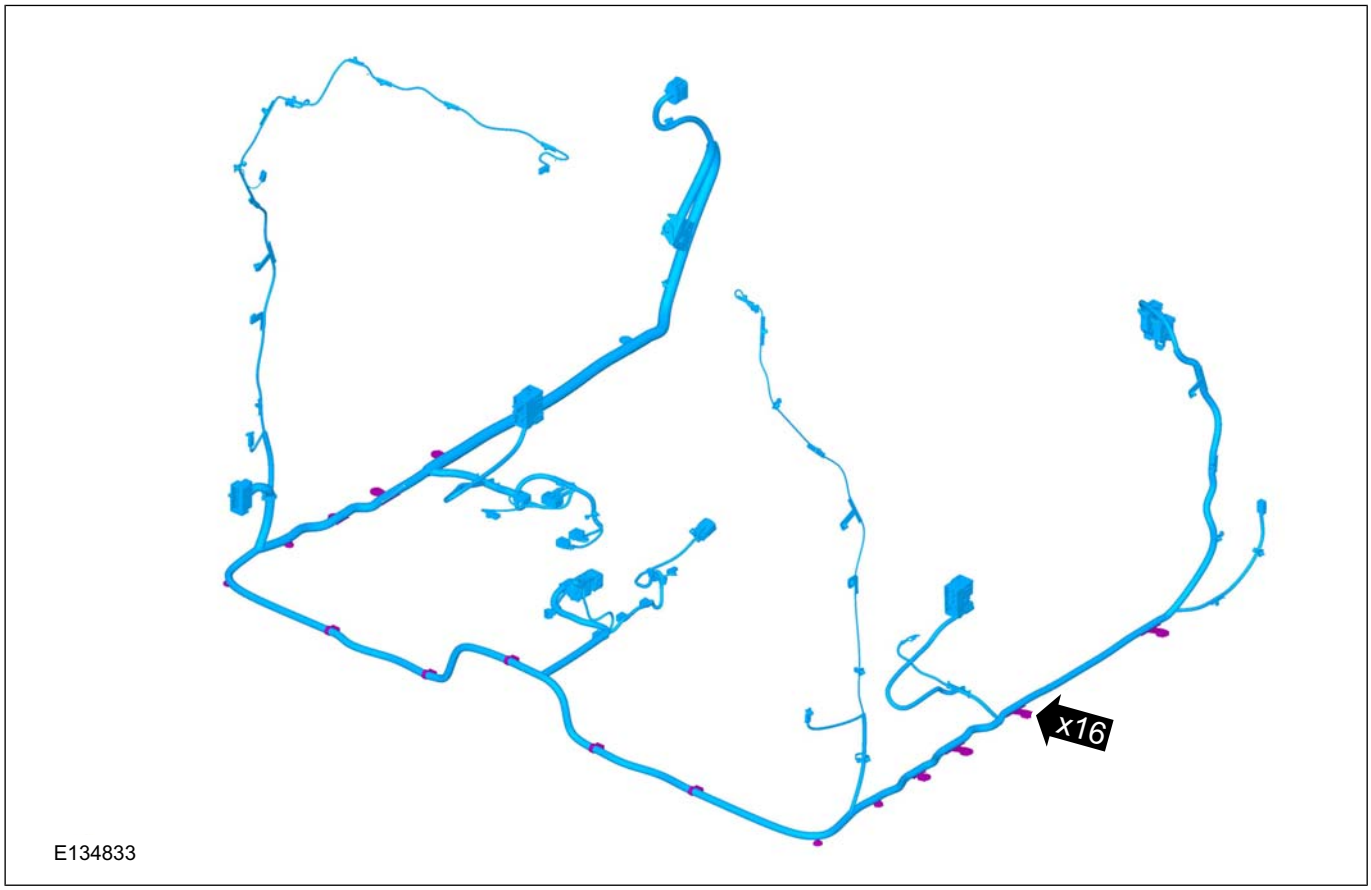
72.



Single cab

73.

REMOVAL AND INSTALLATION



Stretch cab

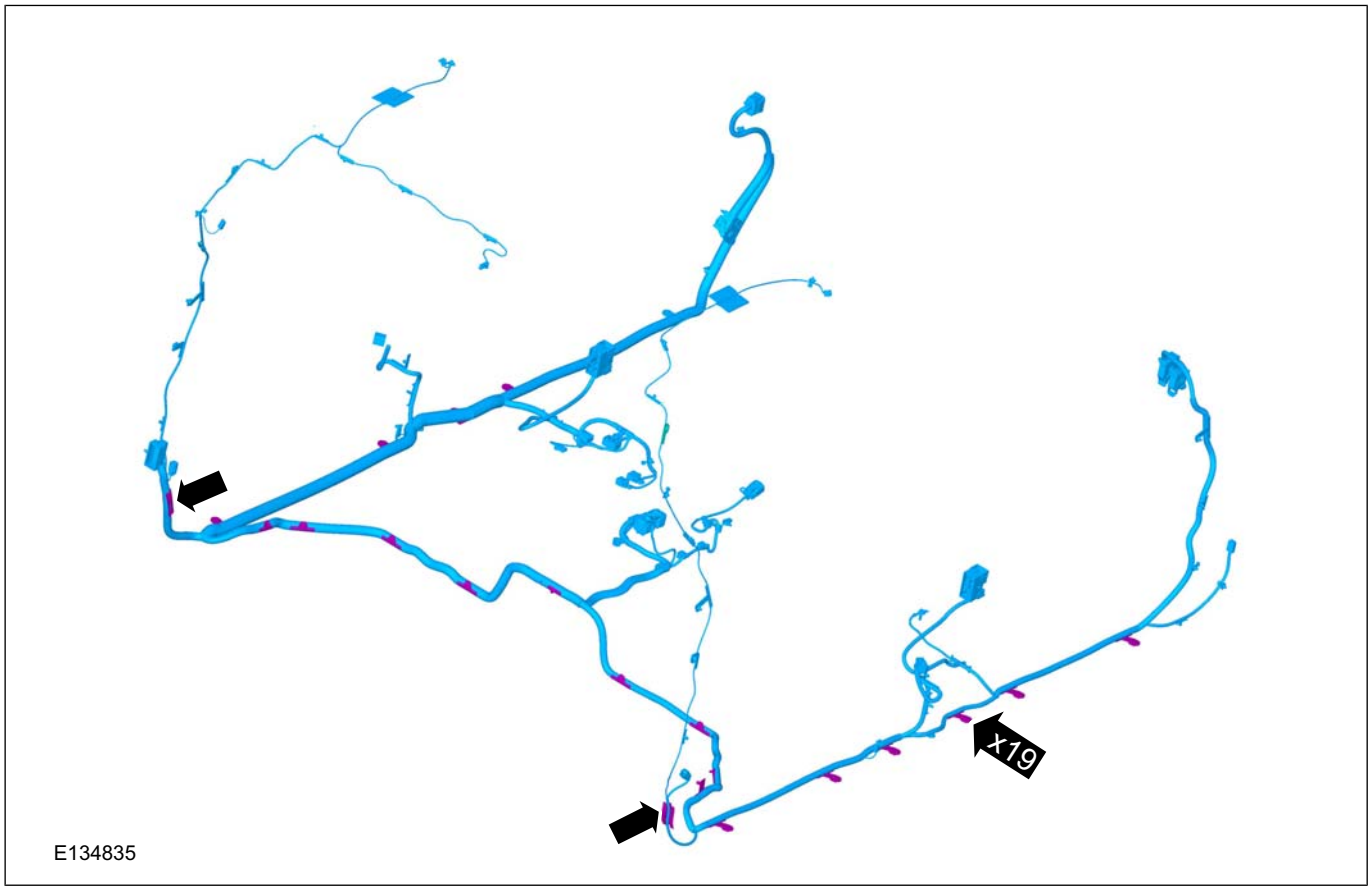
74.

REMOVAL AND INSTALLATION

Double cab

75.

REMOVAL AND INSTALLATION



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

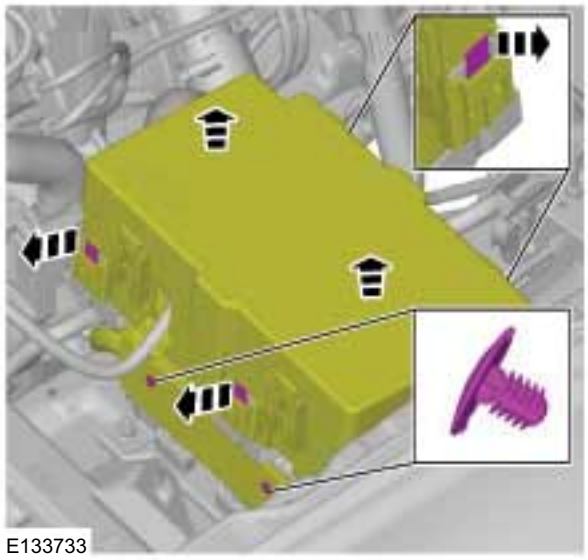
Engine Wiring Harness — 2.5L Duratec-HE (122kW/165PS) - MI4

Removal

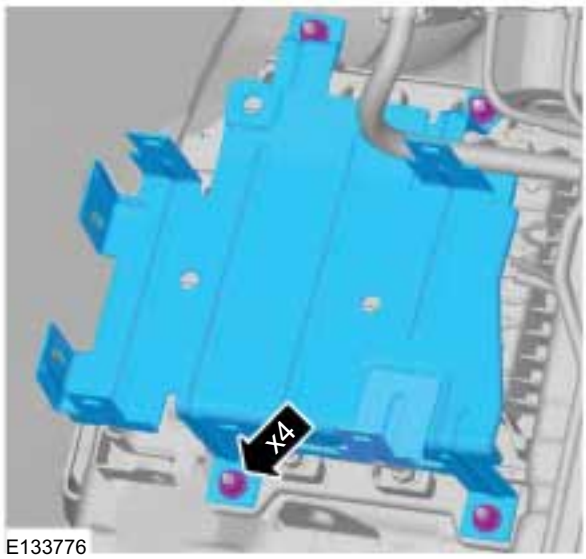
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

2.

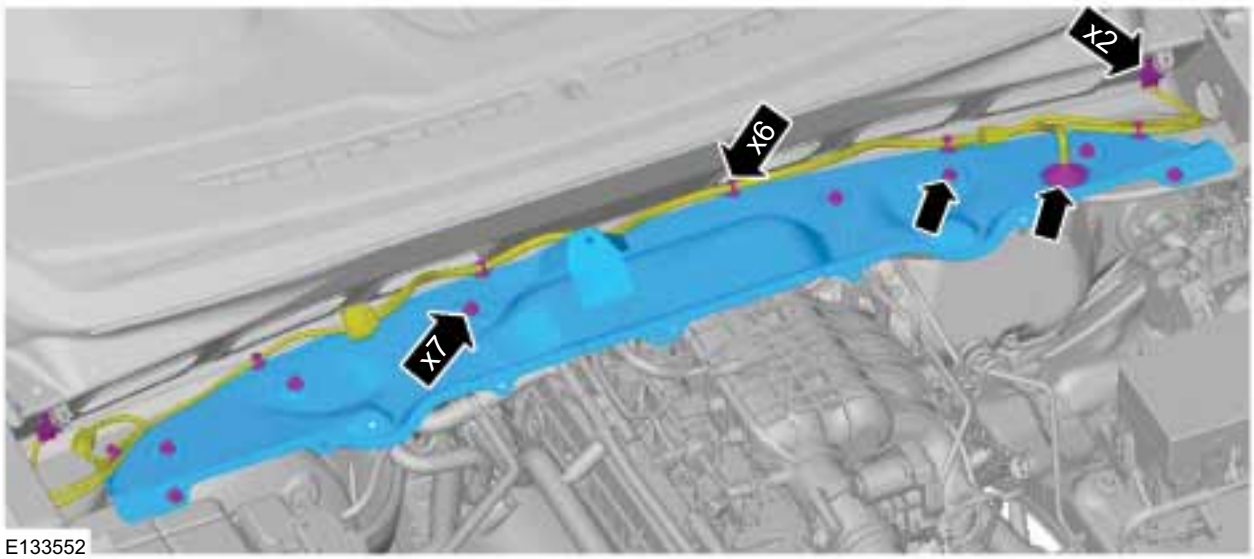


3. Torque: 10 Nm



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

5. Torque: 10 Nm



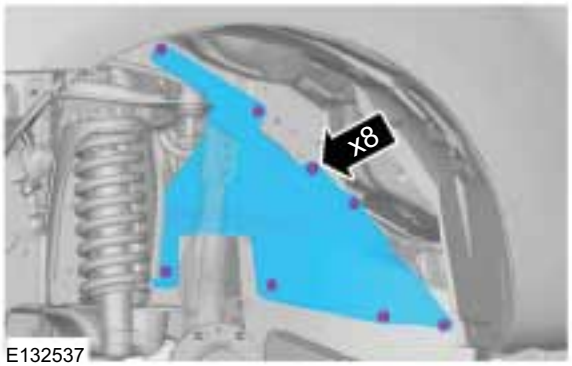
REMOVAL AND INSTALLATION

6. Refer to: Intake Manifold (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

7.

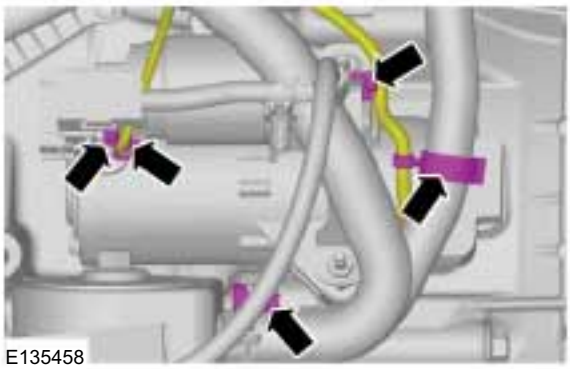

E135457

8.



E132537

9.


E135458

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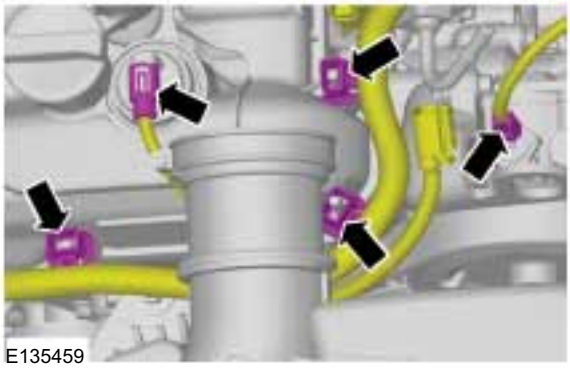
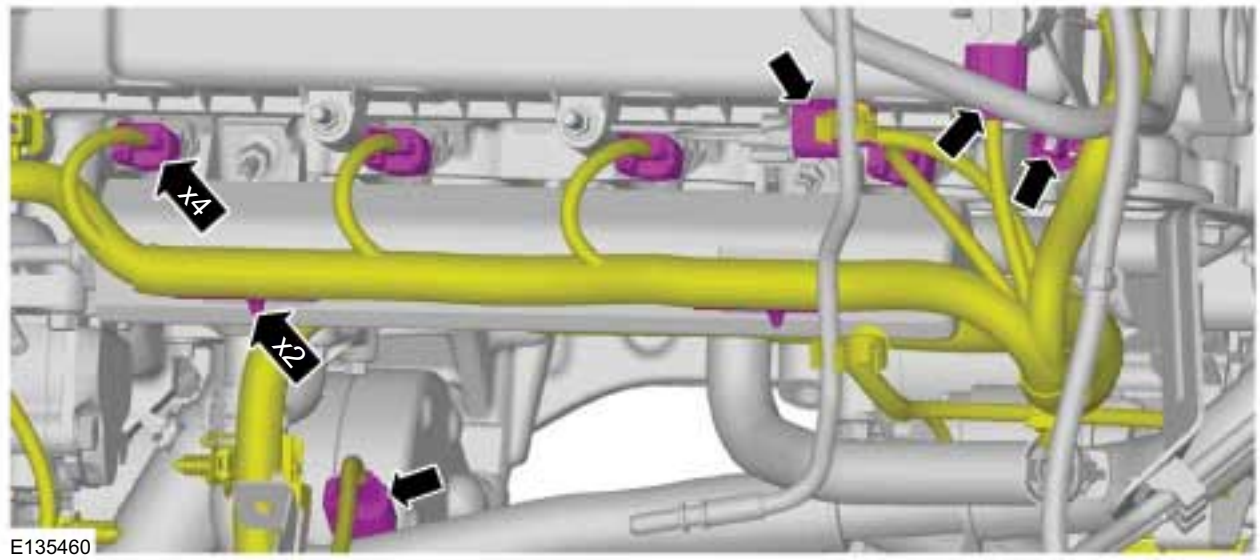

E135459

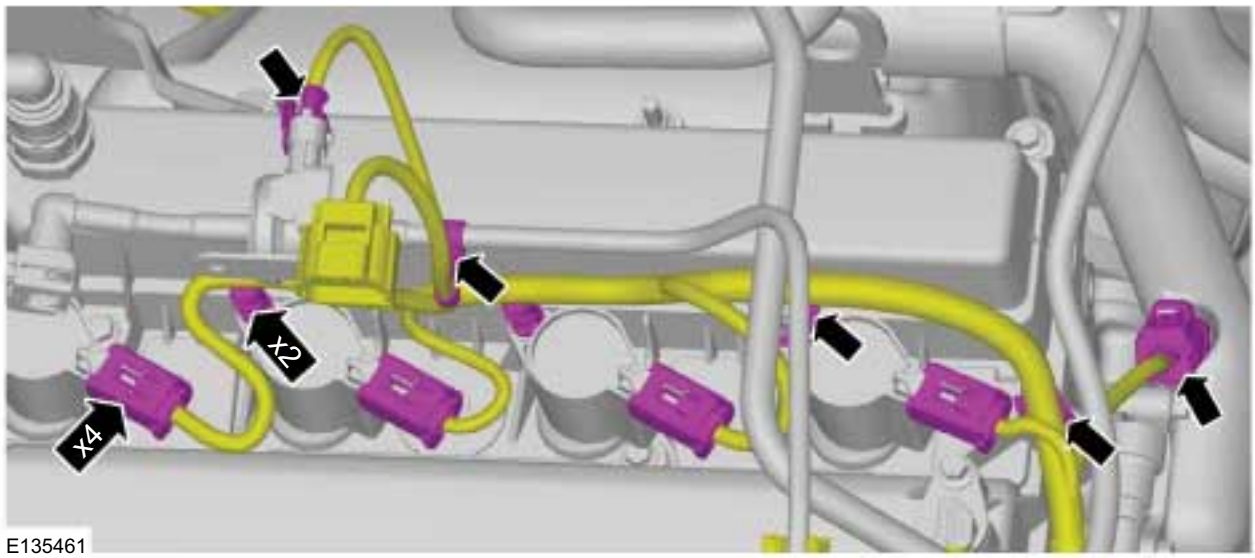
11.



E135460

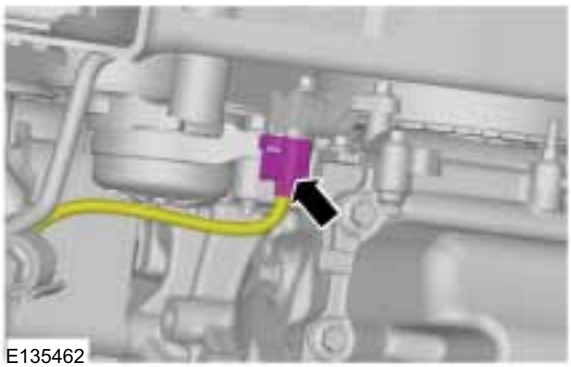
12.

REMOVAL AND INSTALLATION



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

14.



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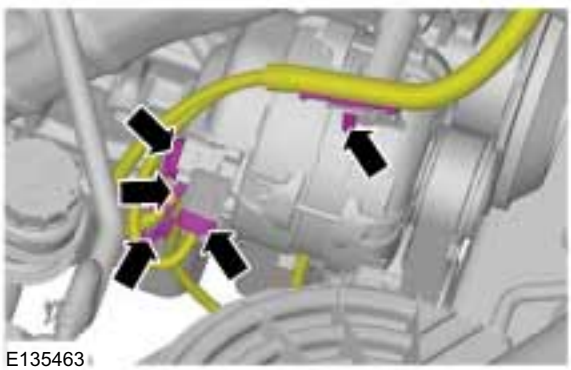
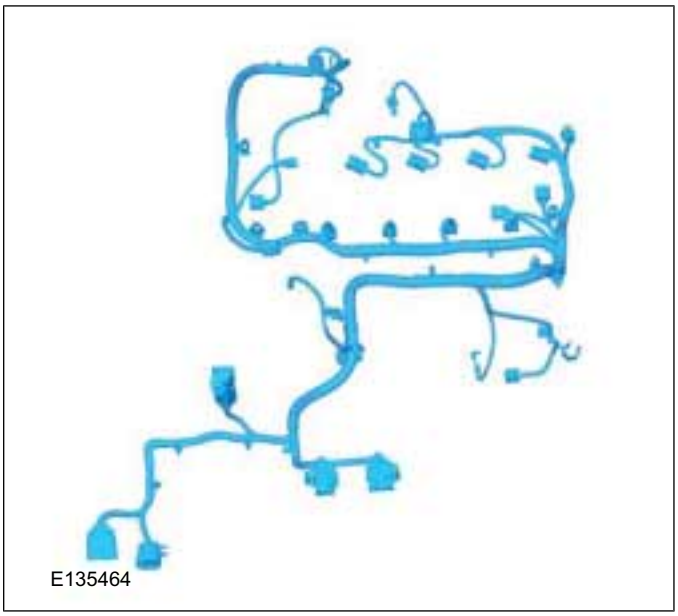


16.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

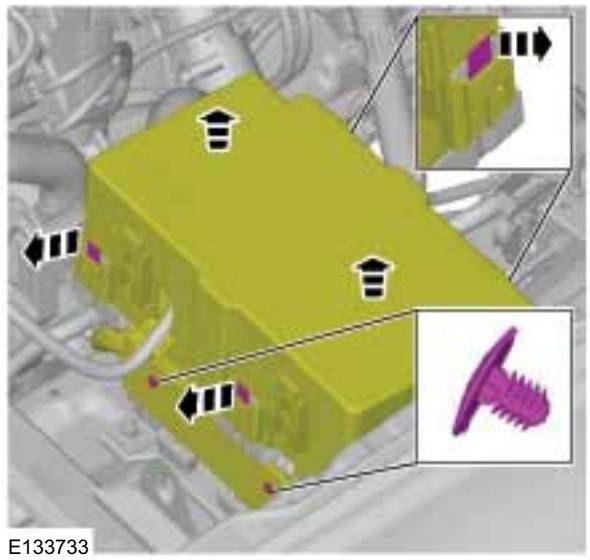
Engine Wiring Harness — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma

Removal

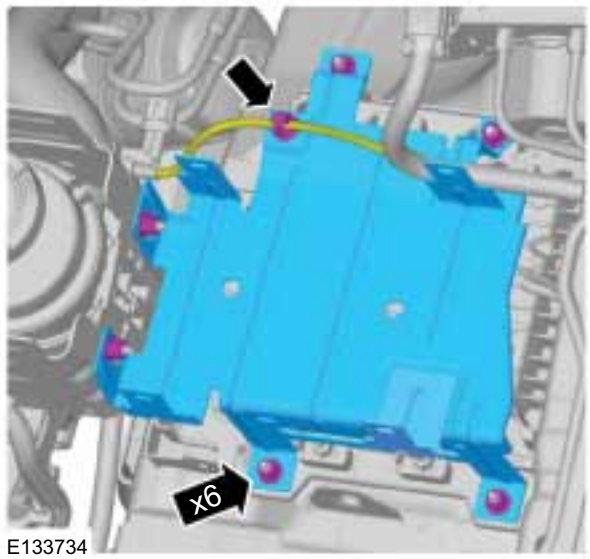
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

2.

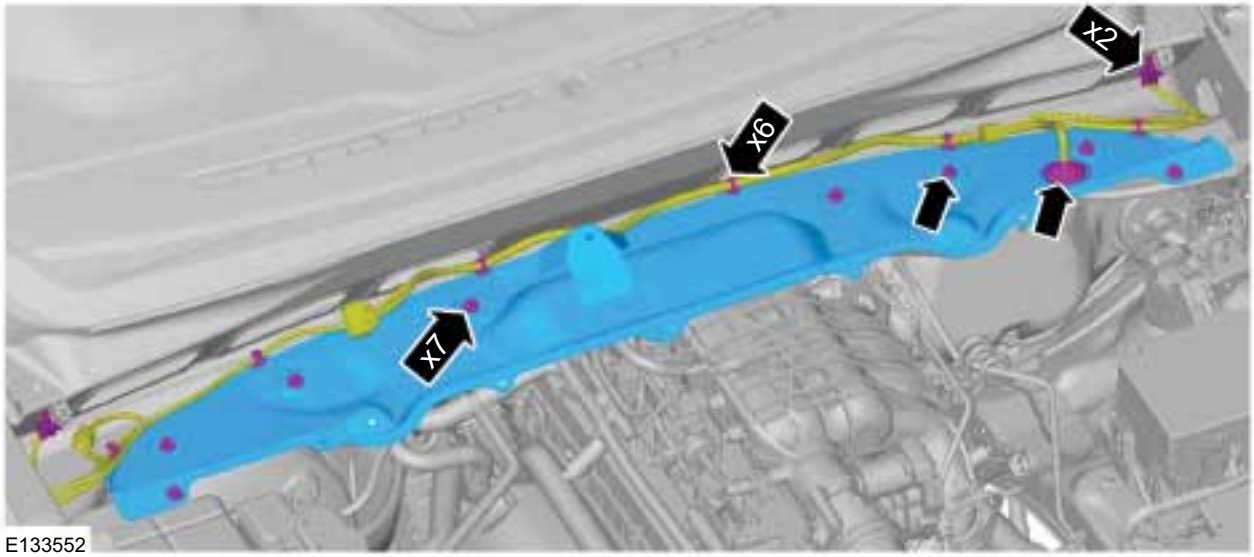


3. Torque: 10 Nm



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

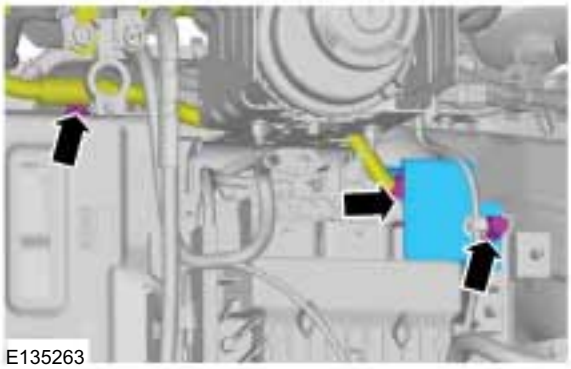
5. Torque: 10 Nm



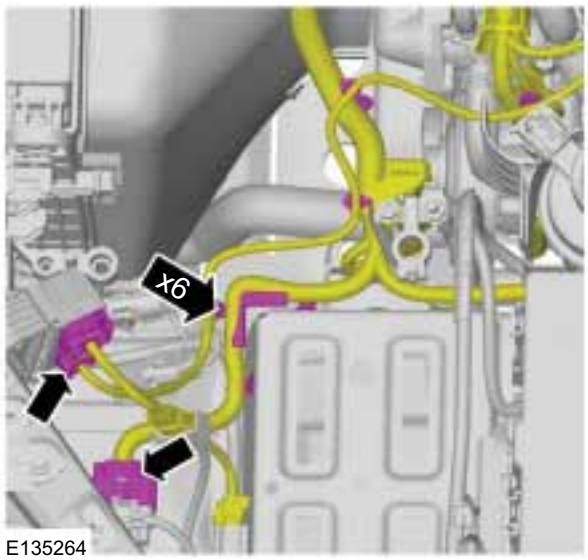
REMOVAL AND INSTALLATION

6. Refer to: Intake Manifold (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

7.

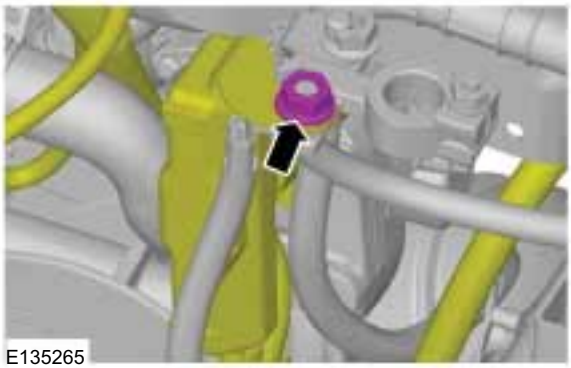

E135263

8.



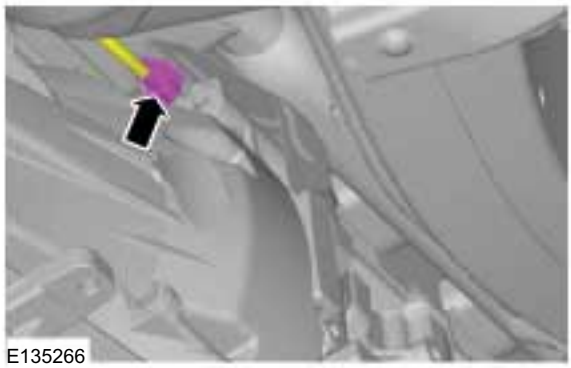
E135264

9. Torque: 13 Nm


E135265

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

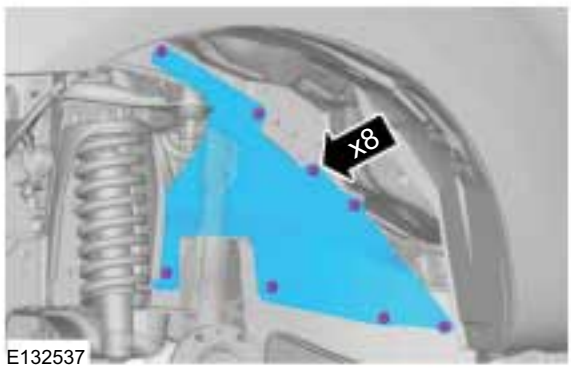
11.


E135266

12.


E135267

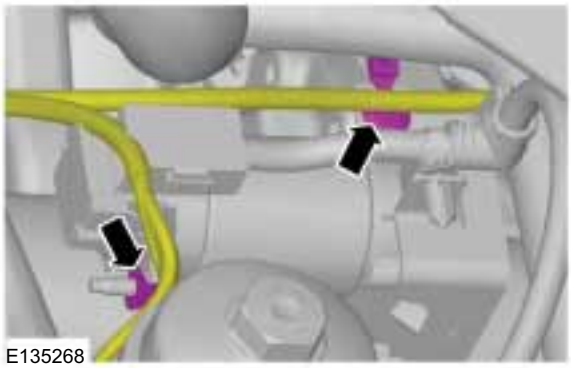
13.



E132537

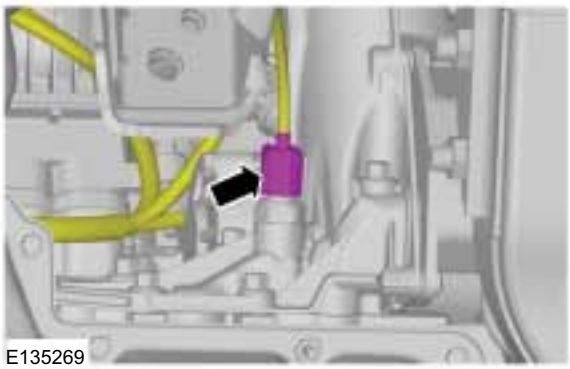
REMOVAL AND INSTALLATION

14.



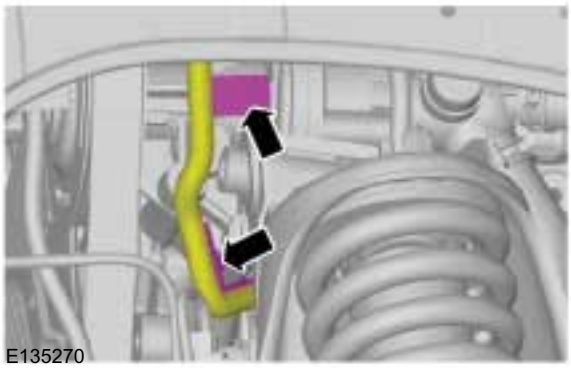
Vehicles with automated gearshift

15.



All vehicles

16.



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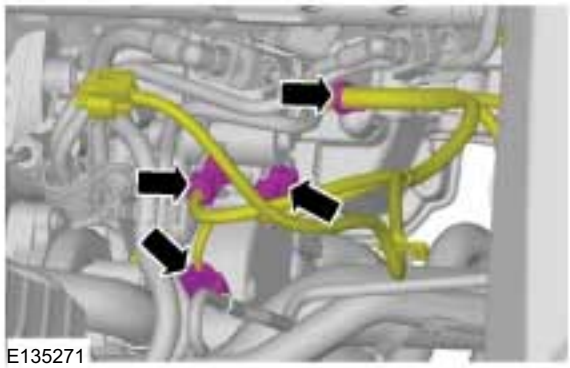
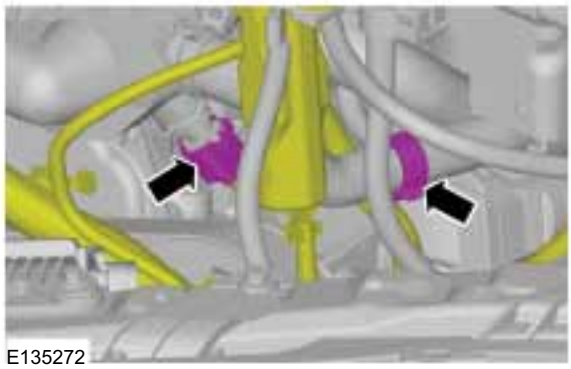
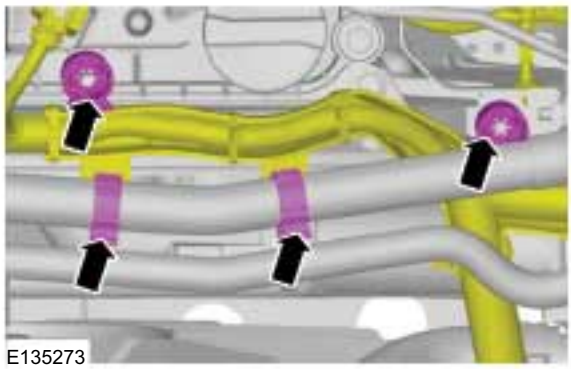


18.

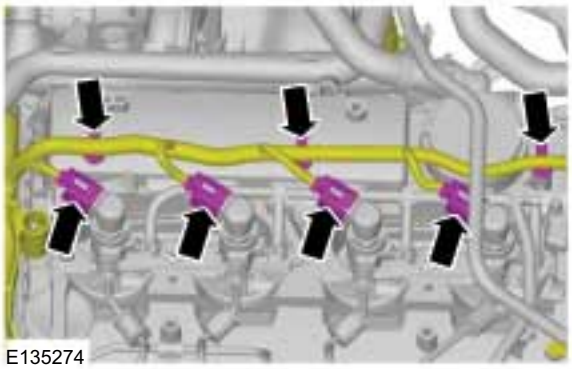


19.

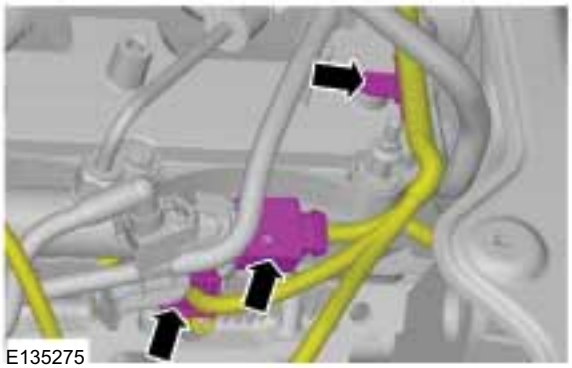


REMOVAL AND INSTALLATION

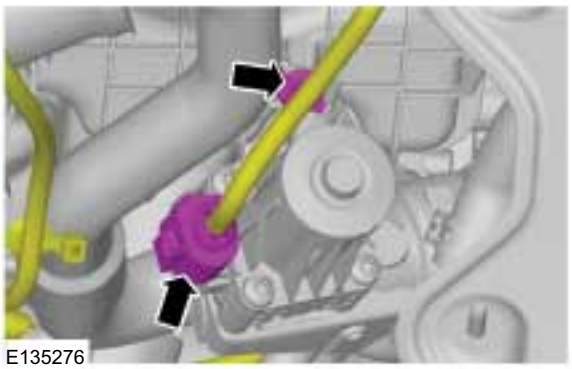
20.



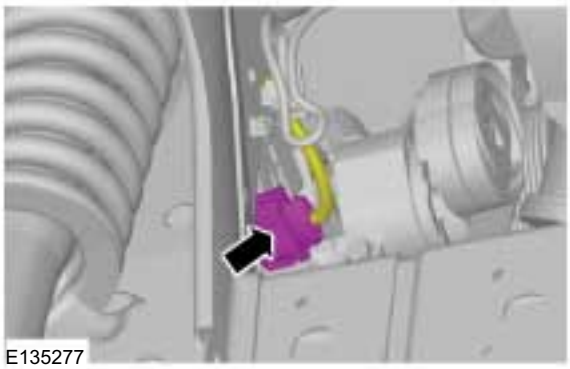
21.



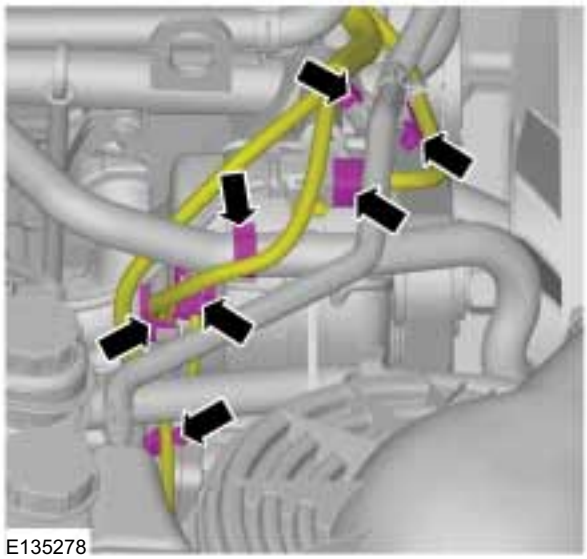
22.



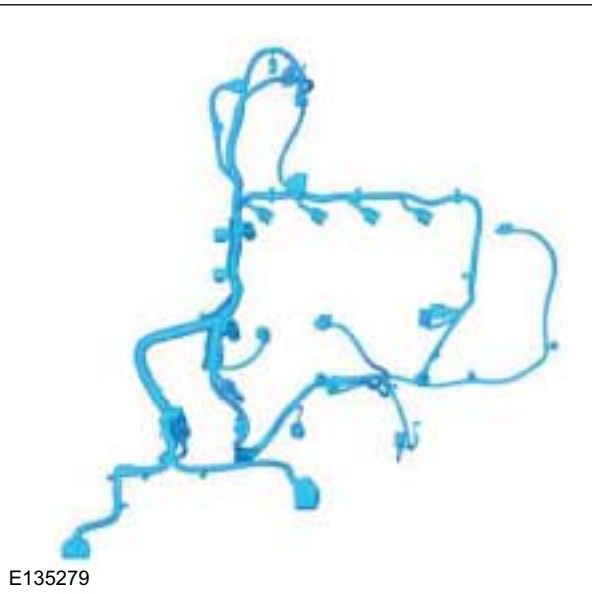
23.



24.

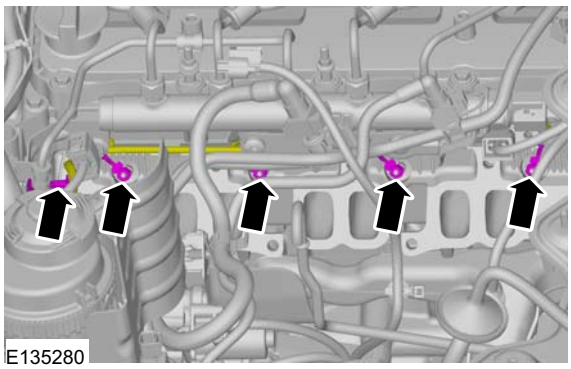


25.



REMOVAL AND INSTALLATION

26.



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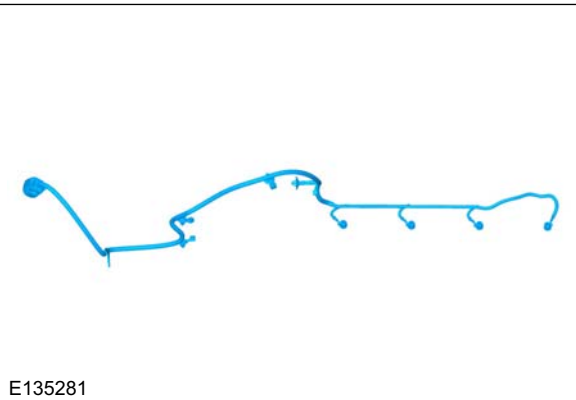


Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

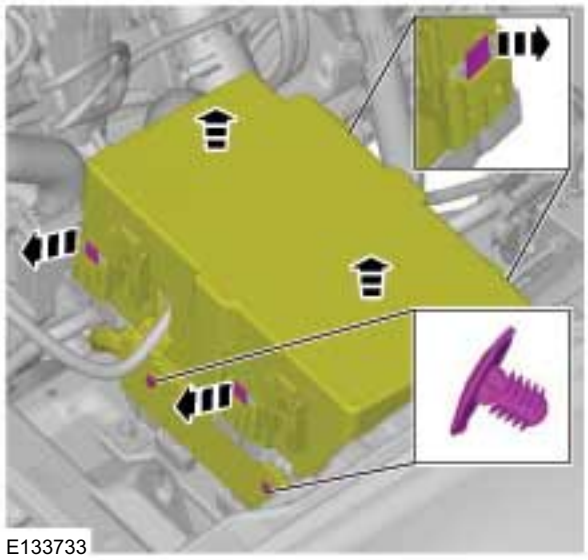
Engine Wiring Harness — 3.2L Duratorq-TDCi (148kW/200PS) - Puma

Removal

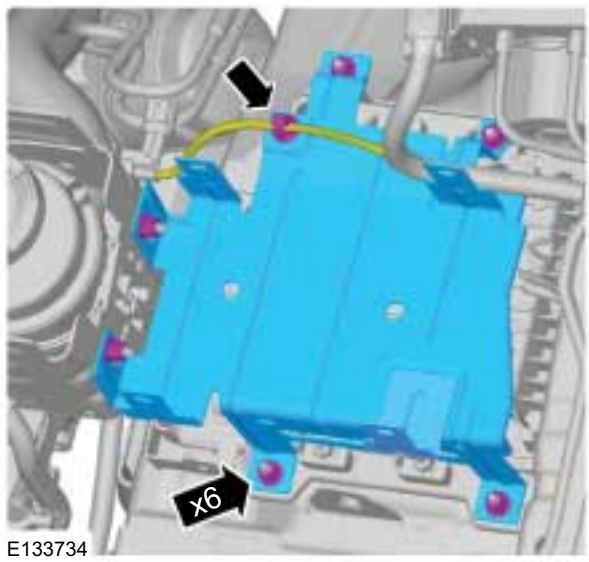
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Tray (414-01 Battery, Mounting and Cables, Removal and Installation).

2.

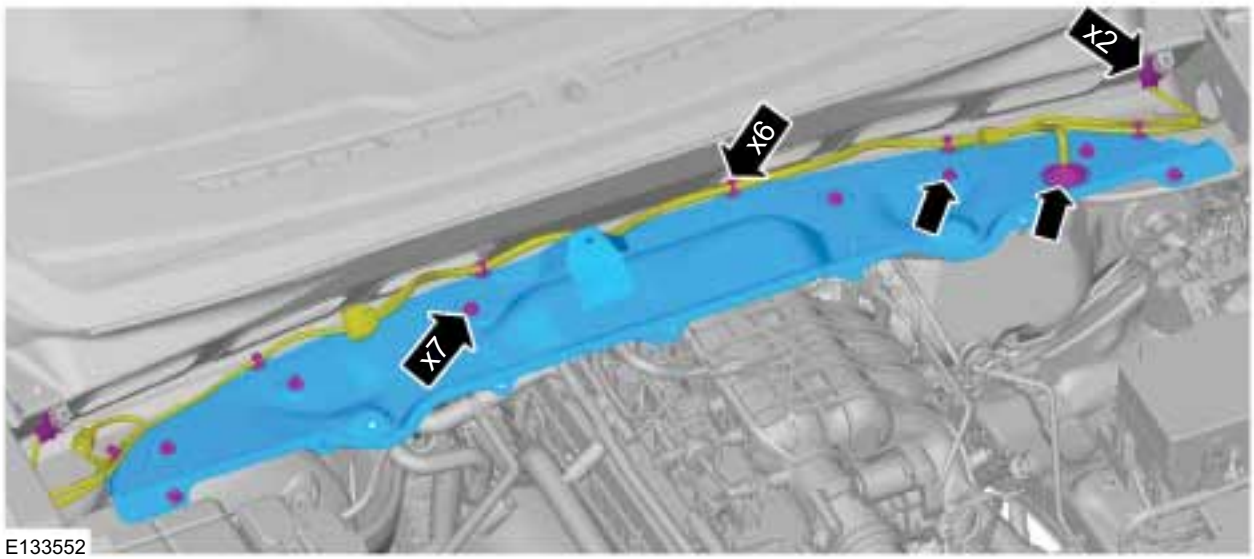


3. Torque: 10 Nm



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

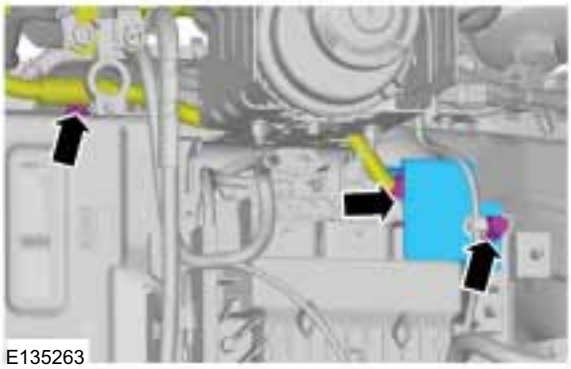
5. Torque: 10 Nm



REMOVAL AND INSTALLATION

6. Refer to: Intake Manifold (303-01 Engine - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, Removal and Installation).

7.


E135263

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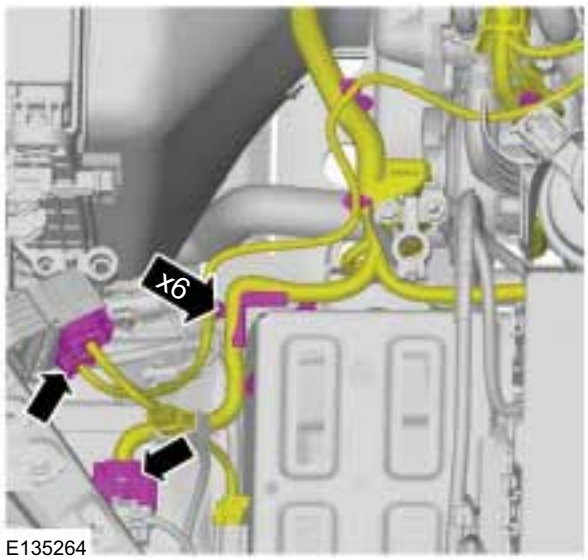
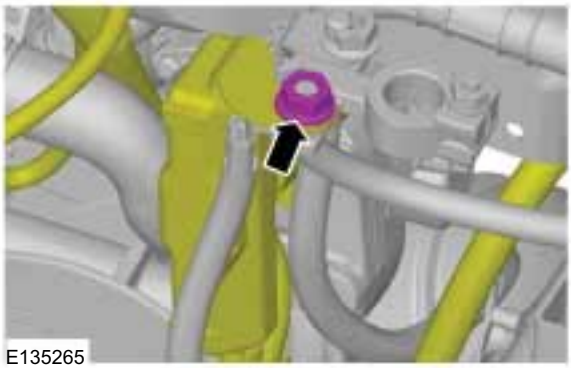


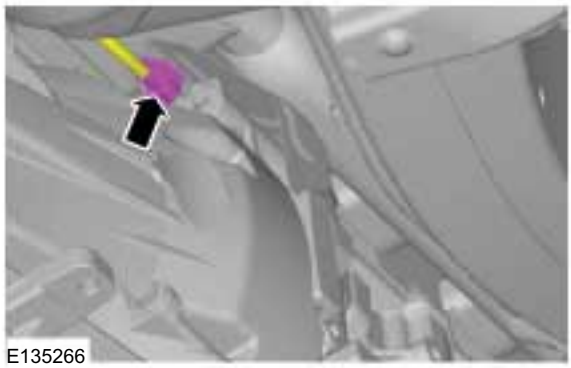
E135264

9. Torque: 13 Nm


E135265

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

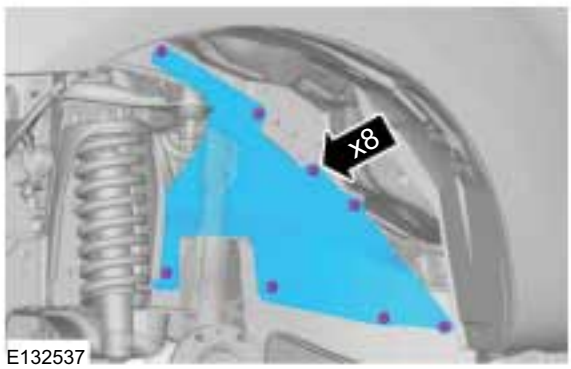
11.


E135266

12.


E135267

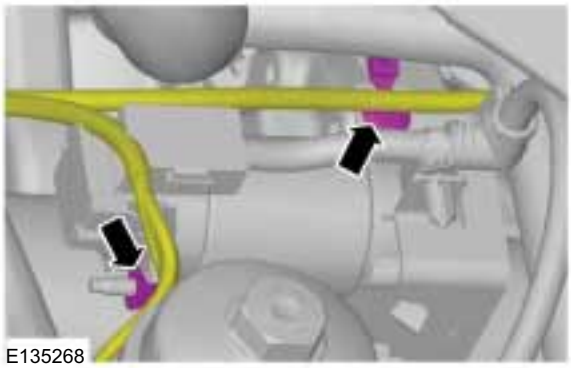
13.



E132537

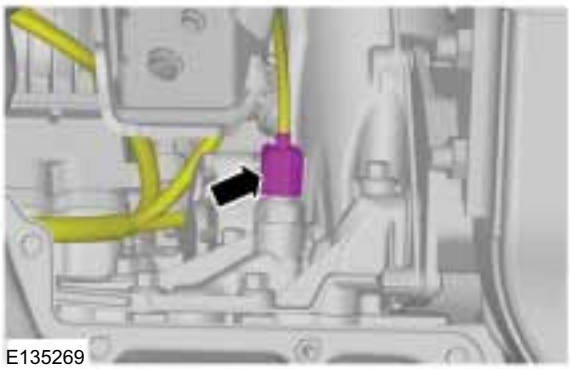
REMOVAL AND INSTALLATION

14.



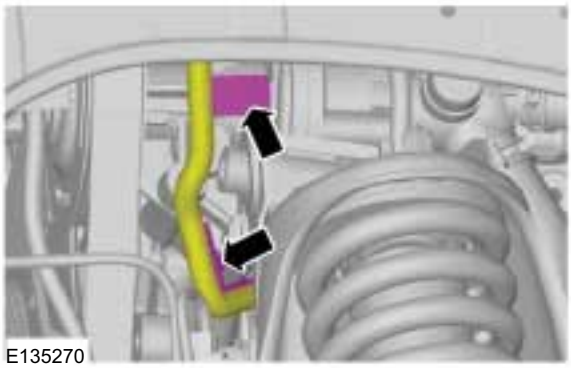
Vehicles with automated gearshift

15.

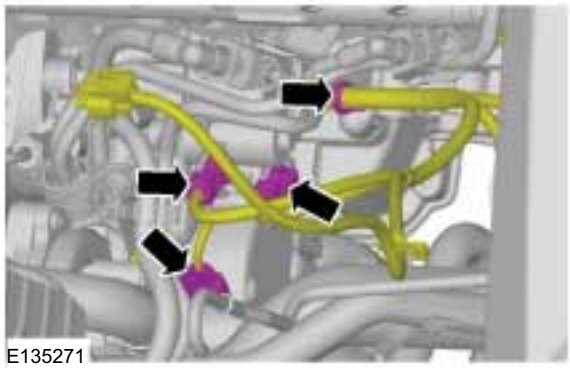


All vehicles

16.



17.



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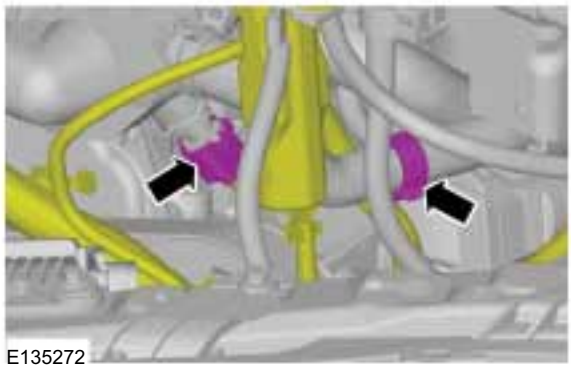

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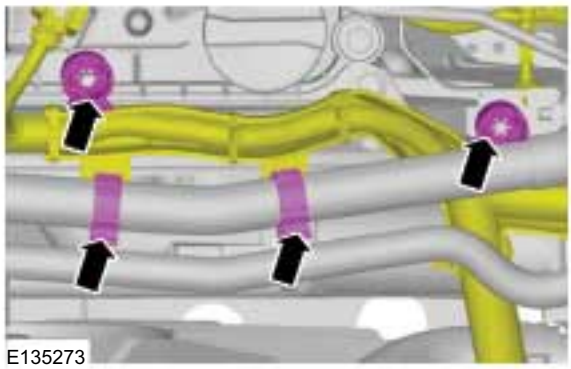
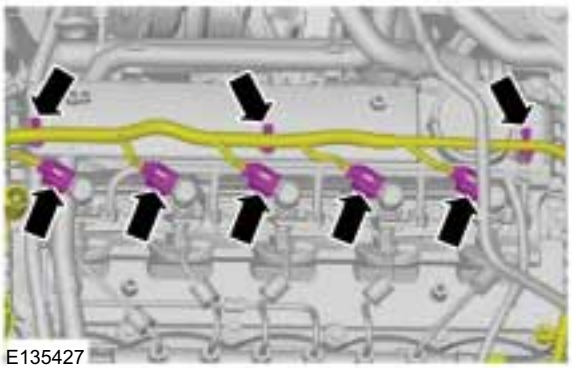


REMOVAL AND INSTALLATION

20.


E135427

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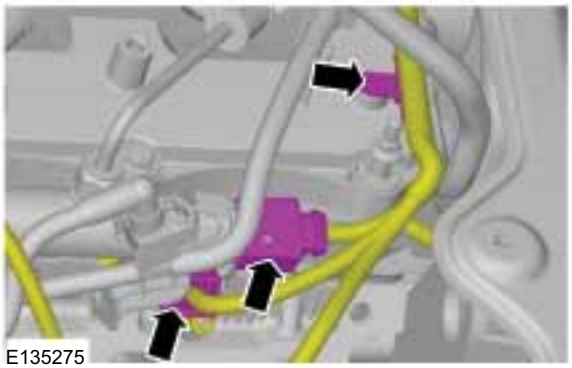
E135275

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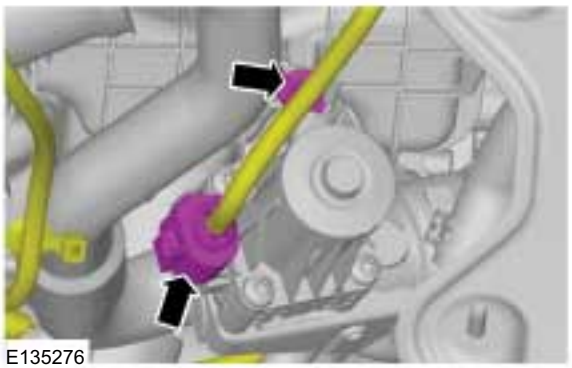
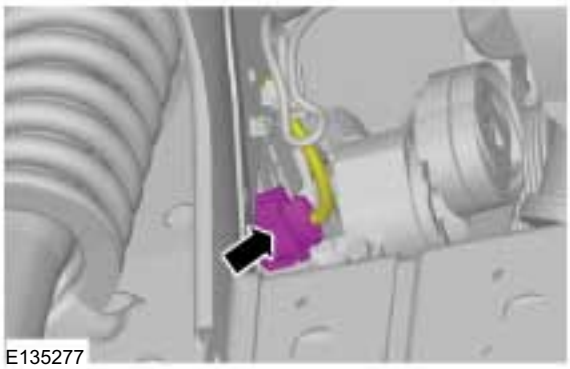

E135276

23.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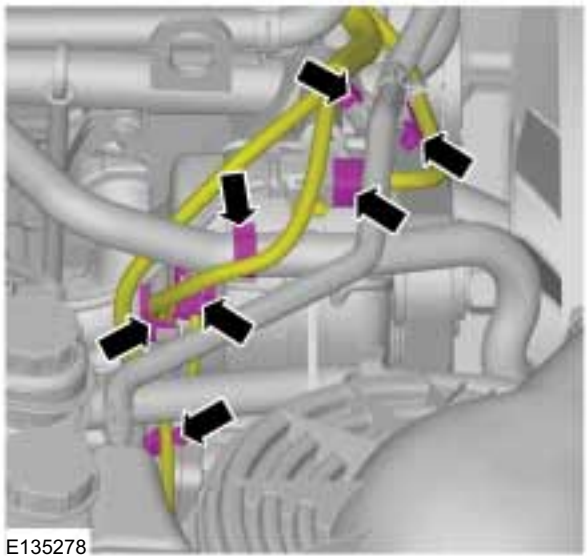
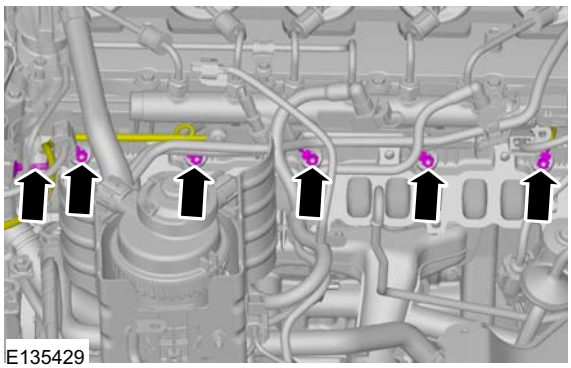

E135278

25.

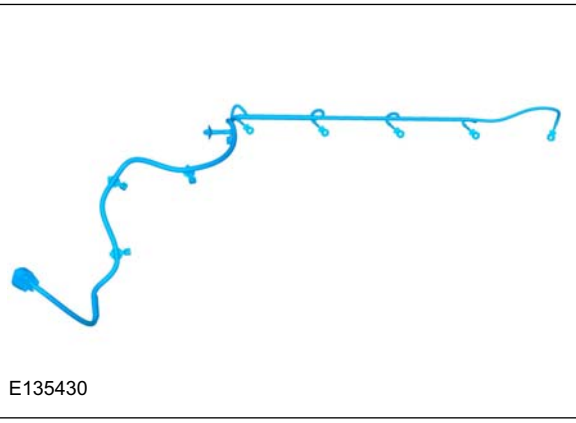
E135428

REMOVAL AND INSTALLATION

26.



27.



Installation

1. To install, reverse the removal procedure.

SECTION 419-01A Anti-Theft - Active

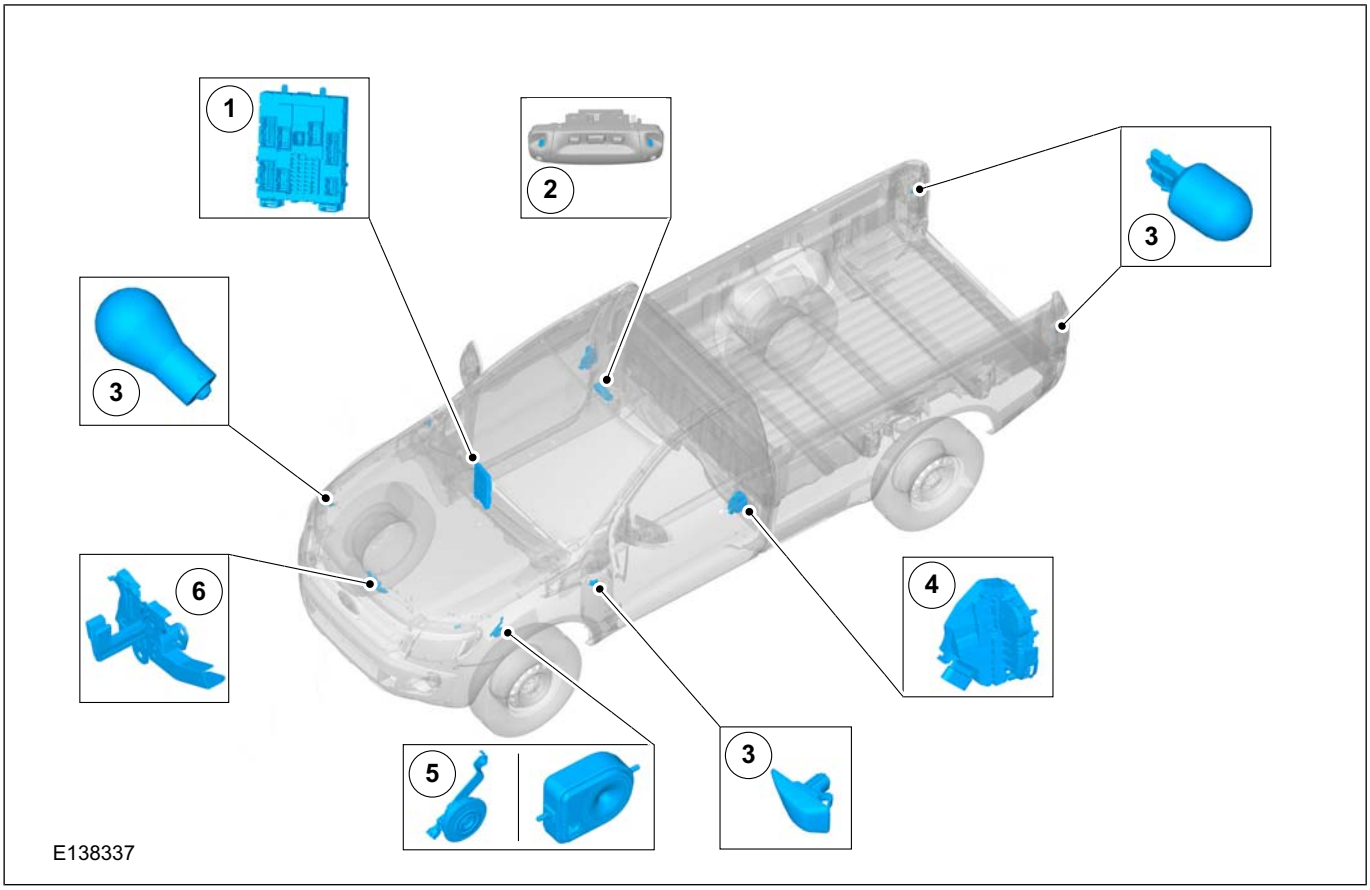
VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

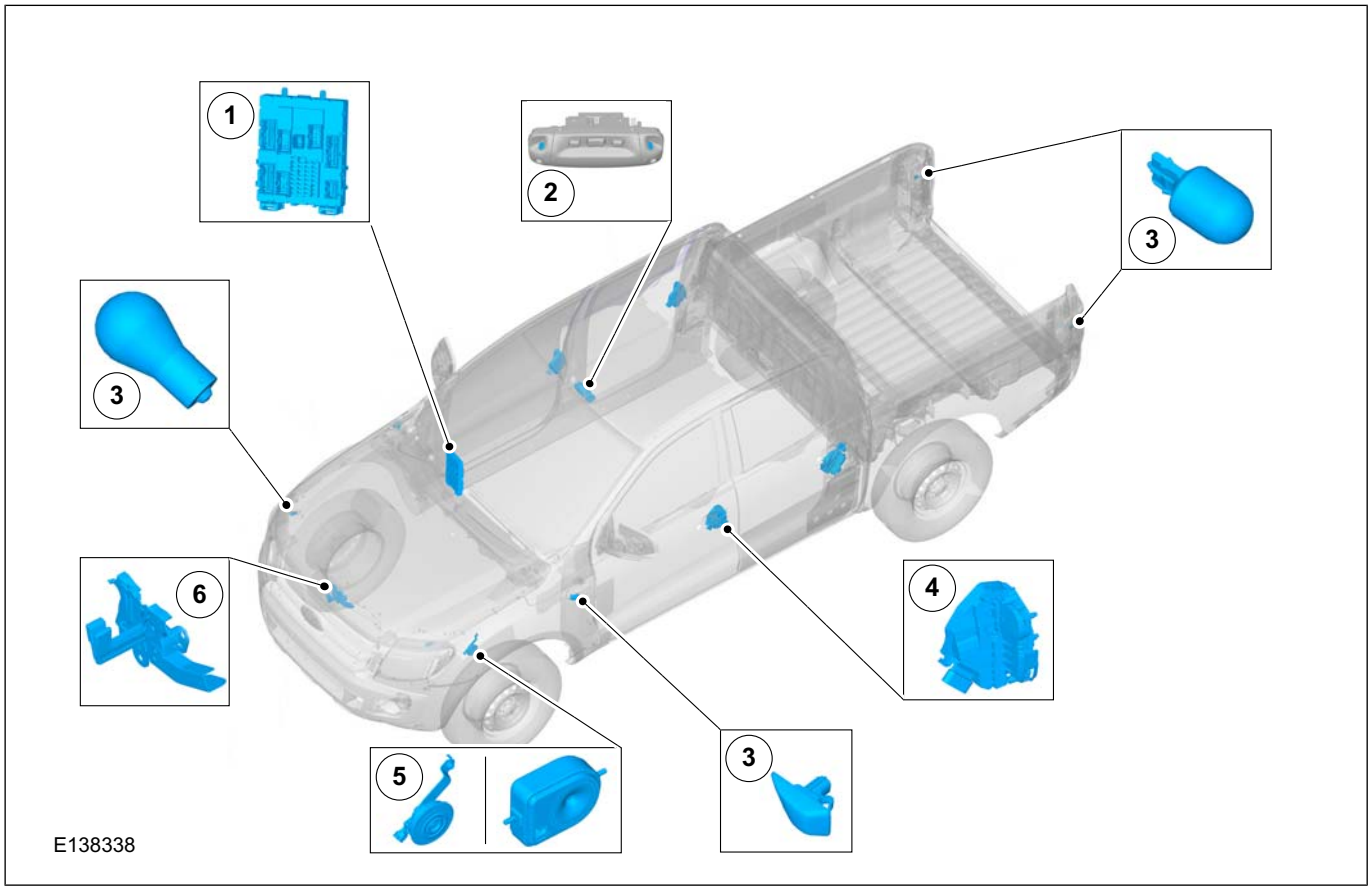
Anti-Theft - Active

Single cab



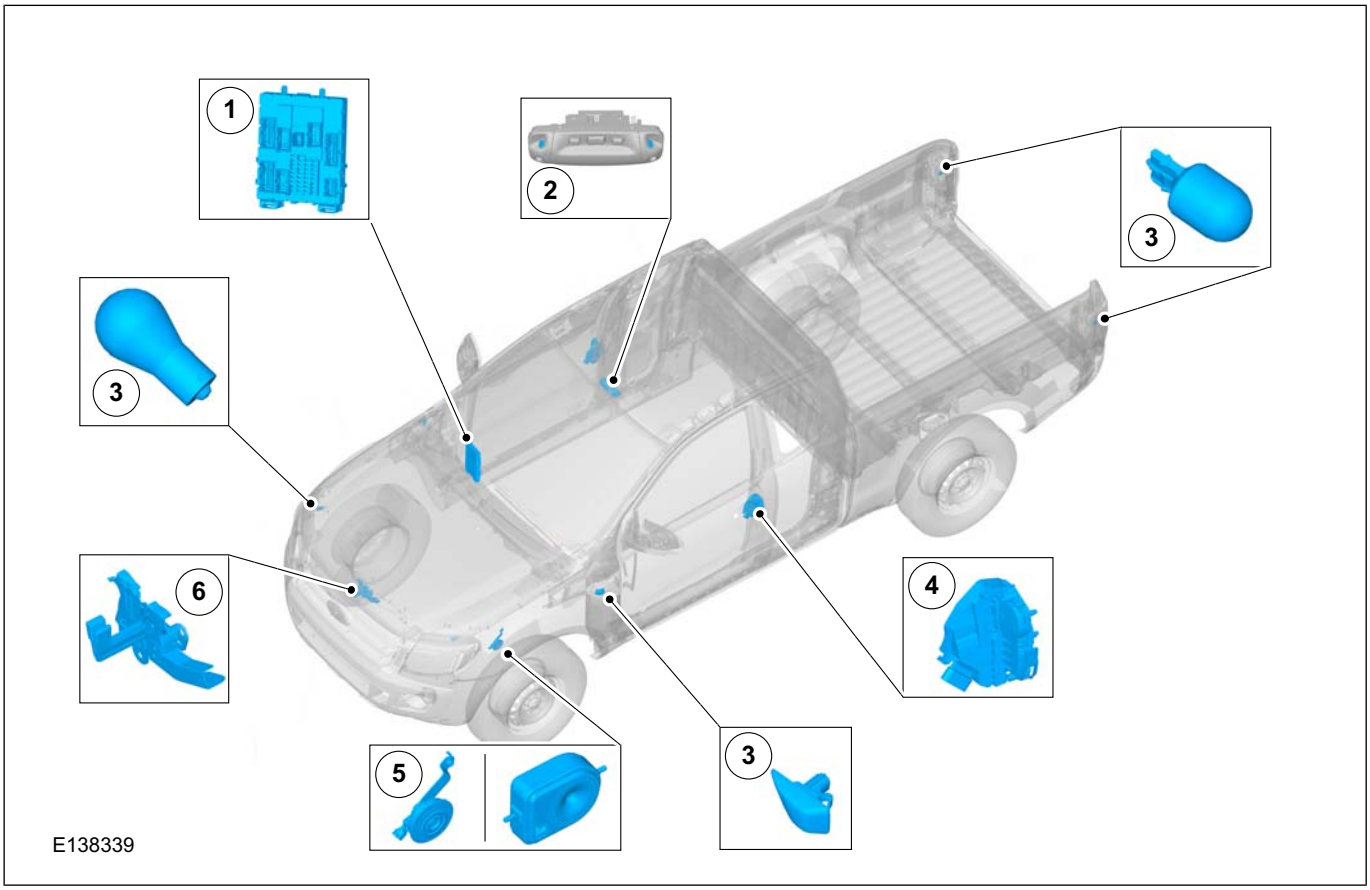
DESCRIPTION AND OPERATION

Double cab



DESCRIPTION AND OPERATION

Stretch cab



Item	Description
1	Body control module
2	Intrusion sensor(s)
3	Direction indicator(s)
4	Door latch(s)
5	Anti-theft alarm horn
6	Hood latch

System operation

Operation

Two anti-theft alarm systems are available, depending on the market and model version:

- Perimeter and interior monitoring.
- Perimeter fitted with battery back-up sounder and interior monitoring

NOTE: If a window is not closed, there is the risk that a false alarm may be triggered on vehicles with interior monitoring.

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 flashers, whilst the acoustic warning is performed via the anti-theft alarm system horn (with or without battery back-up sounder).

The anti-theft alarm system is activated after the vehicle is locked, provided the hood and all the doors are fully closed.

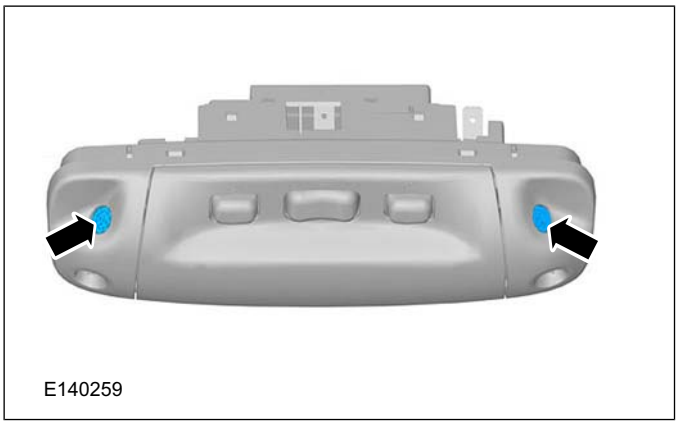
If the hood or one of the doors is not completely closed, it can be opened without the alarm being triggered since the system is not activated for this entry point.

The anti-theft alarm system can be switched off by unlocking the vehicle using the remote controls or by unlocking the door with the key and inserting the correctly coded key into the ignition switch within 12 seconds.

DESCRIPTION AND OPERATION

Component description

Intrusion sensors



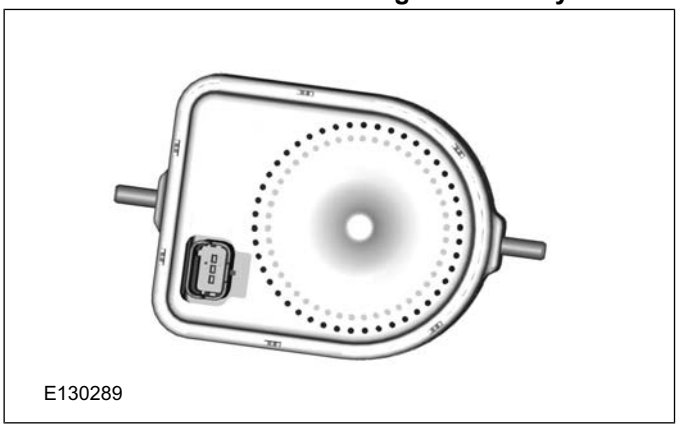
E140259

The interior monitoring is an additional security system that triggers the alarm if any movement inside the locked vehicle is detected.

The transceivers work ultrasonically. The transmitter sends at a specific frequency into the monitoring area. The receiver receives the corresponding echo signal. Here, the signals are converted into digital values and the previously sent values are compared with the signals received. If there are significant differences between the two, a trigger signal is sent to the BCM.

As the period during which no movement is detected increases, so the sensitivity of the sensors increases.

Anti-theft alarm horn with integrated battery



E130289

This horn has its own voltage supply from an integrated battery.

This ensures that the alarm horn will still be powered even if the vehicle battery has been disconnected.

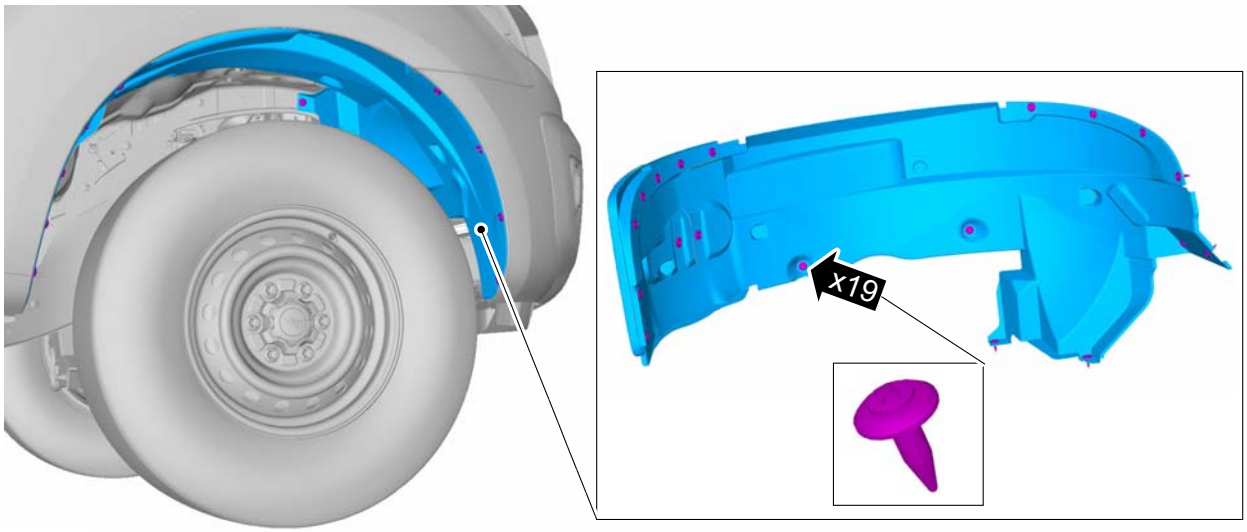
REMOVAL AND INSTALLATION

Anti-Theft Alarm Horn

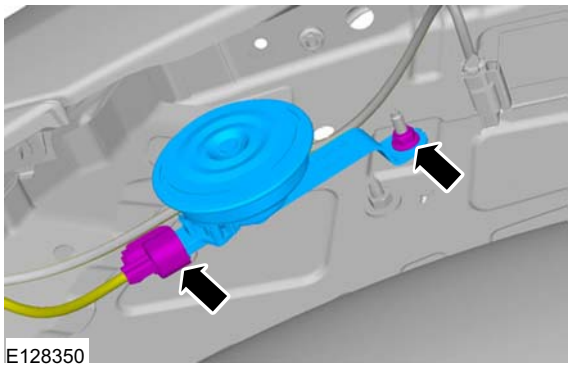
Removal

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



4. Torque: 8 Nm



Installation

1. To install, reverse the removal procedure.

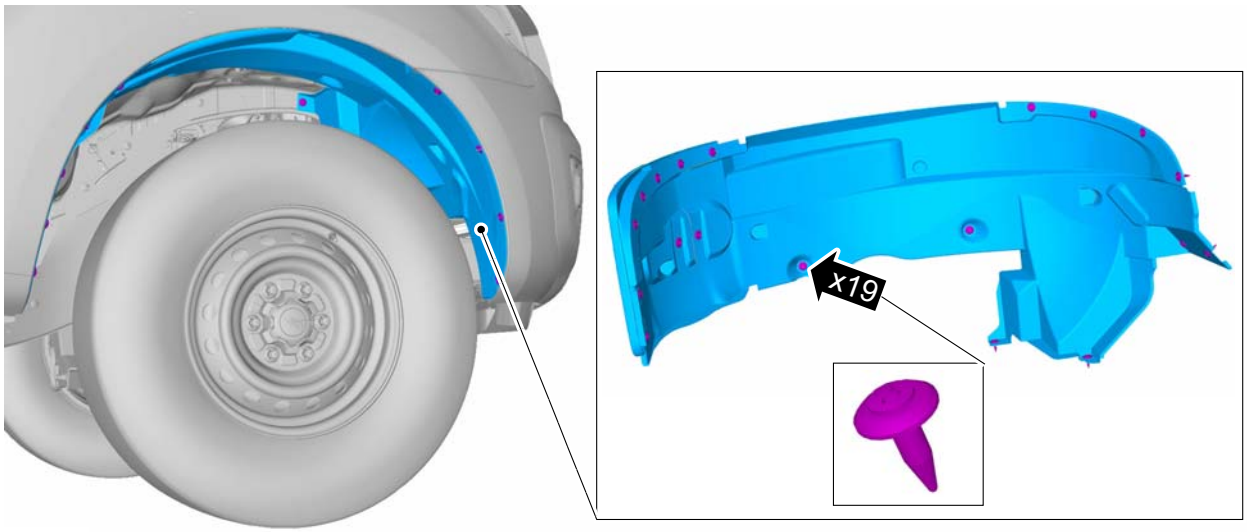
REMOVAL AND INSTALLATION

Anti-Theft Alarm Horn with Integral Battery

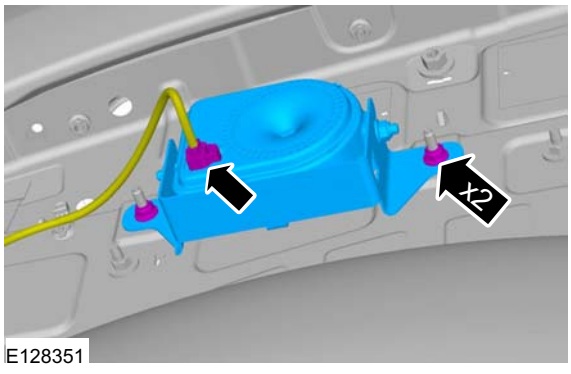
Removal

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



4. Torque: 8 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

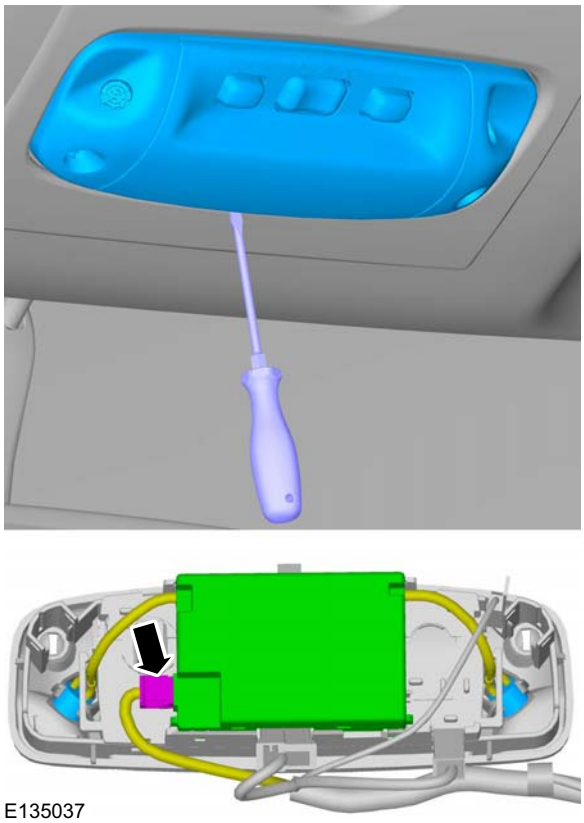
Intrusion Sensor

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.



E135037

Installation

1. To install, reverse the removal procedure.

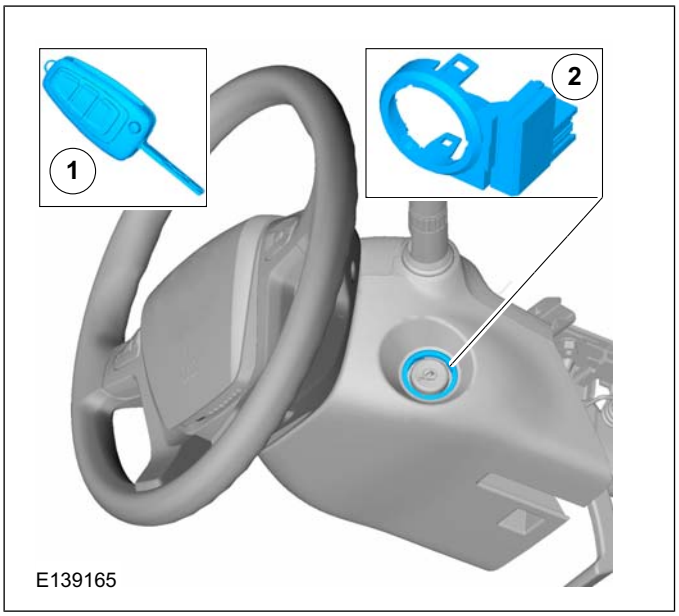
SECTION 419-01B Anti-Theft - Passive

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Anti-Theft - Passive



Item	Description
1	Passive anti-theft (PATS) transponder
2	PATS transceiver

PATS

The PATS is a passive system designed to increase the anti-theft security of the vehicle.

The driver does not need to actively do anything to protect the vehicle. The PATS is activated automatically after the ignition is switched off.

The PATS system uses specially encoded keys. If a valid key is inserted into the ignition lock cylinder and turned to position II, the code from the PATS transponder is received by the PATS transceiver. The code is then sent to the passenger junction box (PJB) which checks that a correct key has been inserted and communicates with the powertrain control module (PCM) to enable the engine to start.

If the code received by the PATS transceiver does not agree with any of the codes programmed to the vehicle, or if errors occur in the PATS, the engine cannot be started.

To indicate a concern in the PATS, the Vehicle immobiliser indicator glow in the instrument cluster.

GENERAL PROCEDURES

Anti-Theft Security Access

General Equipment

Ford Diagnostic Equipment

NOTE: This procedure requires access to the Global Secure Vehicle Information System (GSEVIN) database in order to obtain the coded security access.

1. From the diagnostic tool menu Select: Body/Security/PATS Functions. Follow the instructions on the screen.

   General Equipment: Ford Diagnostic Equipment

2. • When installing a new passenger junction box (PJB), the following sequence must be completed:
   • 1. Ignition Key Programming.
   • 2. Module Initialization.
3. • When installing a new powertrain control module (PCM) the following must be completed:
   • 1. Module Initialization.

GENERAL PROCEDURES

Key and Remote Transmitter Programming Using Diagnostic Equipment

General Equipment

Ford Diagnostic Equipment

NOTE: This procedure requires access to the Global Secure Vehicle Information System (GSEVIN) database in order to obtain the coded security access.

NOTE: This procedure will not erase programmed ignition keys from the passive anti-theft system (PATS).

NOTE: A maximum of 8 ignition keys can be programmed to a vehicle equipped with a passive anti-theft system (PATS).

1. From the diagnostic tool menu Select: Body/Security/PATS Functions. Follow the instructions on the screen.

   General Equipment: Ford Diagnostic Equipment

2. From the diagnostic tool menu Select: Ignition Key Programming. Follow the instructions on the screen.

GENERAL PROCEDURES

Erasing All Key Codes Using Diagnostic Equipment

General Equipment

Worldwide Diagnostic System (WDS) (418-F224)

NOTE: This procedure is used when a customer needs ignition keys programmed into the system. This procedure is also useful when programmed ignition key(s) have been lost or when the ignition lock cylinder has been replaced or when it is necessary to erase a key(s) from the passive anti-theft alarm system (PATS) memory.

NOTE: During this procedure it will be necessary to utilize the Anti-Theft System (PATS) Security Access Procedure. PATS security access must be granted to erase or program ignition keys. The anti-theft security access procedure requires access to the GSEVIN database in order to obtain the coded security access.

NOTE: This procedure will erase all programmed ignition keys from the passive anti-theft alarm system (PATS) memory and the engine will not start until two keys have been reprogrammed to the system.

For additional information, refer to Key Programming Using Diagnostic Equipment - in this section.

NOTE: Two PATS encoded keys with the correct mechanical cut must be available to carry out this procedure. One or both of them may be the original keys.

NOTE: If the remaining keys are with the customer and are not available with the vehicle, instruct the customer that the remaining keys are no longer valid to start the vehicle. If the customer wants to have these keys to be valid for the vehicle, the keys must be programmed using WDS.

For additional information, refer to Key Programming Using Diagnostic Equipment - in this section.

1. **Turn the ignition lock cylinder from the 0 position to the II position.**
2. **From the diagnostic tool menu Select: Body/Security/PATS Functions from the menu. Follow the instructions on the screen.**
3. **From the diagnostic tool menu Select: Ignition Key Erase. Follow the instructions on the screen.**
4. **From the diagnostic tool menu Select: Ignition Key Programming. Follow the instructions on the screen.**

GENERAL PROCEDURES

Key Programming Using Two Programmed Keys(33 005 0)

NOTE: A maximum of 8 ignition keys can be programmed to a vehicle equipped with a passive anti-theft system (PATS).

1. **NOTE: This procedure works only if 2 or more programmed keys are available.**

   For additional information, refer to: Key and Remote Transmitter Programming Using Diagnostic Equipment (419-01 Anti-Theft - Passive, General Procedures).

2. **NOTE: This procedure only works if the customer spare key programming is enabled.**

   For additional information, refer to: Key and Remote Transmitter Programming Using Diagnostic Equipment (419-01 Anti-Theft - Passive, General Procedures).

3. **Insert the first programmed passive anti-theft system (PATS) key into the ignition and turn the key from the OFF position to the ON position (maintain the key in the ON position for approximately 3 seconds).**
4. **Turn the first key to the OFF position and remove the key from the ignition.**
5. **Within 10 seconds of turning the key to the OFF position, insert a second programmed passive anti-theft system (PATS) key into the ignition and turn the key from the OFF position to the ON position (maintain the key in the ON position for approximately 3 seconds).**
6. **Turn the second key to the OFF position and remove the key from the ignition.**
7. **Within 10 seconds of turning the second key to the OFF position, insert the new, unprogrammed passive anti-theft system (PATS) key into the ignition and turn the key from the OFF position to the ON position (maintain the key in the ON position for approximately 6 seconds).**
8. **Turn the new key to the OFF position and remove the key from the ignition.**
9. **If it is desired to program additional keys, repeat steps 3 - 9 for each additional key.**

REMOVAL AND INSTALLATION

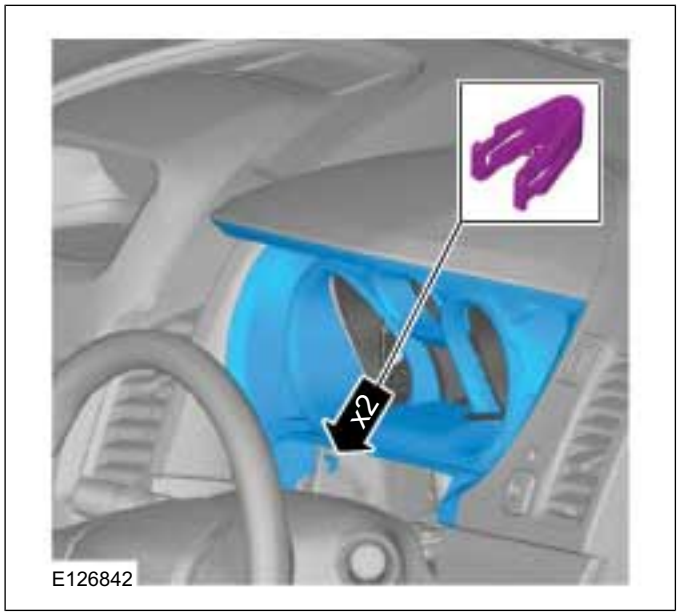
Passive Anti-Theft System (PATS) Transceiver

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.



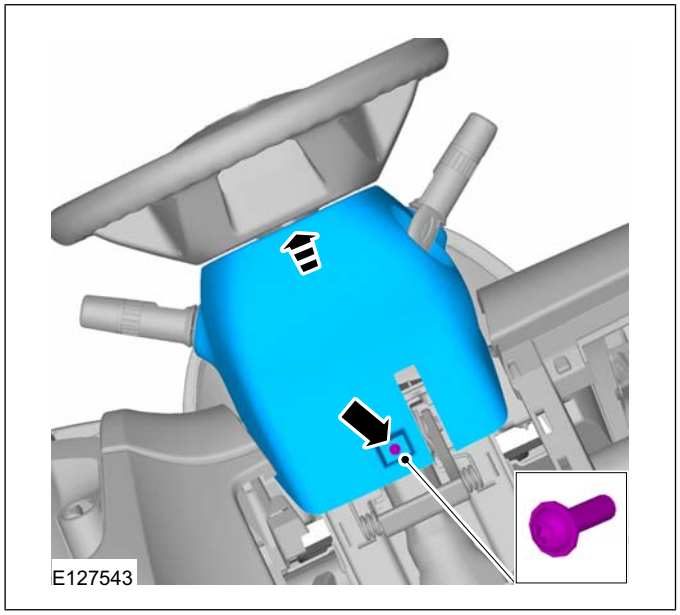
3.

4.

5.

REMOVAL AND INSTALLATION

6.



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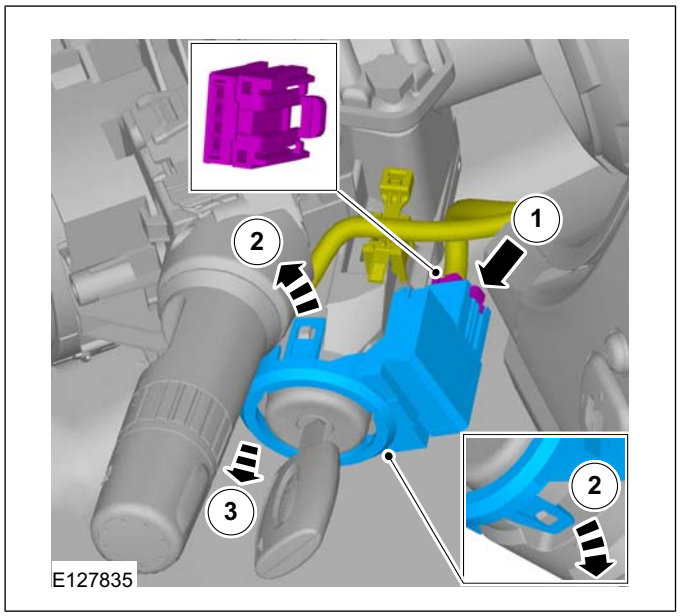


Installation

1. To install, reverse the removal procedure.

SECTION 419-10 Multifunction Electronic Modules

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

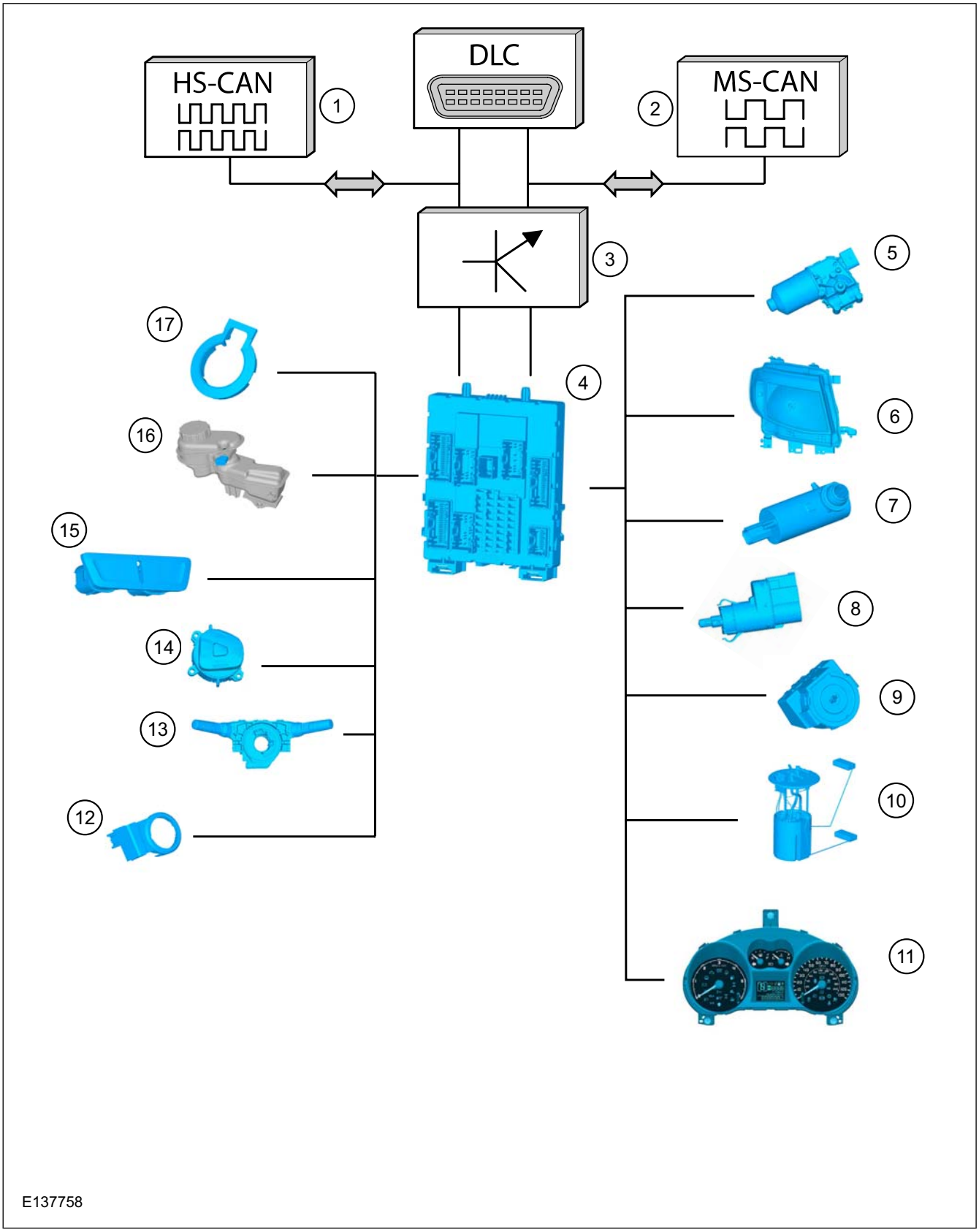
DESCRIPTION AND OPERATION

REMOVAL AND INSTALLATION

DESCRIPTION AND OPERATION

Module Controlled Functions

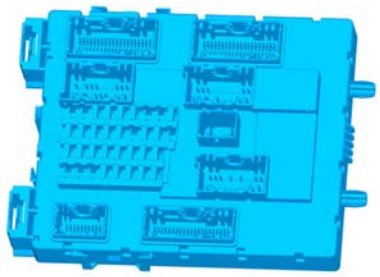
Overview



DESCRIPTION AND OPERATION

Item	Description
1	HS CAN bus
2	MS CAN bus
3	Gateway (BCM)
4	BCM
5	Front window wiper motors
6	Headlamp
7	Window washer pump
8	Stoplamp switch
9	Ignition lock
10	Fuel level sensor
11	Instrument cluster
12	PATS transceiver (vehicles without keyless vehicle module only)
13	Multifunction switch
14	Speed control switch
15	Hazard flasher switch
16	Brake fluid level switch
17	Light/rain sensor

Body control module (BCM)



E139764

The body control module is installed on the driver's side of the vehicle underneath the dash panel.

It replaces separate components such as the central locking module, the timer relay and the fuse box in the passenger compartment.

It consists of a power distribution section (including fuses and relays) and an electronic control module, which controls the operation of most of the vehicle's electronic systems.

New vehicles are supplied with different versions of the BCM (depending on the equipment specification of the vehicle). When installing a replacement BCM it needs to be configured for the specific vehicle.

The following functions are controlled or executed by the BCM if the battery voltage is between 9 and 16 V.

- Battery saving function
- Current distribution
- Exterior lighting
- Interior lighting
- Wiper system
- Washer fluid level indicator
- Window heating (heated windshield, heated rear window, heated exterior mirrors)
- Speed control system (reads the speed control switches and transmits signals on the CAN bus)
- Locking / Unlocking
- Anti-theft
- Air conditioning controls (partial)
- Handbrake (it monitors the switch and transmits the signal on the CAN bus)
- Monitoring of the brake fluid level.
- Electric fuel pump (mechanical fuel pump on diesel engines is not BCM controlled)
- Fuel level indicator
- Battery charging (smart charge, partially)
- Electric booster heater
- Brake pedal position (BPP) switch.
- Communications via the high speed CAN bus (HS-CAN) and mid-speed CAN bus (MS-CAN)
- Main module in the LIN bus system
- PATS (interface for transceiver)
- BTSI (brake transmission shift interlock)
- Central module configuration
- Power management (vehicle mode)

The BCM can be diagnosed via the diagnostic tool. Furthermore, an integrated service mode enables testing of the input and output signals without the need for further tools.

Emergency function

The BCM is equipped with restricted emergency running functions on all vehicles.

A monitoring function within the BCM is sent a control signal at regular intervals by the

microcontroller. If this control signal is not sent, the BCM goes into emergency running mode after a specified time.

In this case, vehicle electrical functions will be restricted to the following:

- Stop light will function normally.
- Horn will function normally.
- Dipped beam and position lamps will be switched on permanently, irrespective of light switch position.
- Windscreen wipers will perform continuous wiping at normal wipe speed, irrespective of wiper switch position.

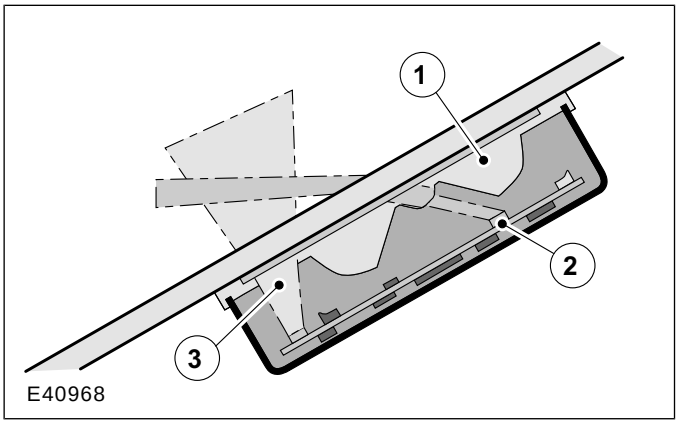
The emergency running mode is switched off when the ignition is switched to "0". When the ignition is switched on again, the BCM will try to recover. If recovery fails, the vehicle cannot be started.

Light switch

If the ignition lock is in position "0" for more than 3 minutes then the front fog lamps, rear fog lamp and the main beam headlamps are deactivated when the ignition is next switched on (if they were previously activated).

Combined rain sensor/light sensor

The combined rain sensor/light sensor is attached to the windshield, near the interior rear view mirror.



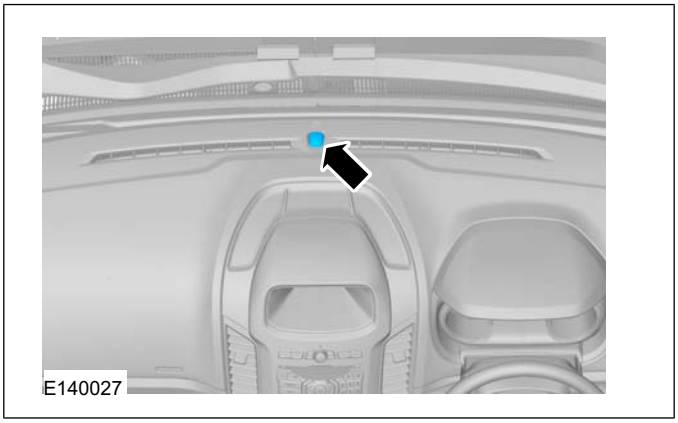
Item	Description
1	Lens
2	Front light sensor
3	Ambient light sensor

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.

Sunload Sensor



The sunload sensor is positioned centrally on the dashboard.

The sunload sensor measures the intensity of the sunlight reaching the vehicle.

Automatic headlamps

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 switch in the "II" or "III" position
- Light switch in the "AUTO" position
- Detected ambient light conditions below a stored threshold value

They are switched on or off by the BCM depending on the input signals of the combined rain sensor/light sensor(s).

If both the ambient light sensor and the front light sensor simultaneously detect a sudden reduction in light intensity then algorithm-based calculations are performed to determine that the vehicle has entered a tunnel, multi-storey car park or a long underpass.

In this type of case a request to switch on the exterior lights and the display lamps in the instrument cluster is transmitted to the BCM.

If the vehicle is suddenly thrown into the shade 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.

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 and the light switch is in the "AUTO" 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 set to the above values at the factory, and can be changed in the central module configuration by a Ford dealer.

Interior lighting

Depending on the vehicle specification, the interior lighting which is controlled by the BCM may include:

- Left and right-hand footwell lamps
- Front and rear dome lamps (in "door contact" switch position)

Depending upon vehicle specification, the interior lamps which can be switched by the operator include:

- Front and rear dome lamps (in "On" switch position)
- Map lights
- Glove compartment lamp

The BCM-controlled interior lighting is switched on with dimmed brightness 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 BCM-controlled interior lighting is switched off if 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 duration of the dimmer function is 1.7 seconds in both the switch-on and switch-off phases.

The dimmer function is not used if the interior lighting is switched off by the battery saving function after 30 minutes.

Heated windscreen

The heated windshield is switched on by the BCM 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 climate control has been activated, the ignition switch is in position "II" and the charge warning lamp is switched off.

The heated windshield is switched off by the BCM under the following conditions:

- More than 4 minutes have elapsed since the switch for the heated windshield was operated.
- The engine is switched off.
- The "Defrost" function is deactivated or the switch for the heated windshield is pressed again while the heated windshield is still switched on.
- The charging system warning indicator 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 windshield by pressing the switch, are ignored at this time.

If the battery voltage returns to the normal range then the disabling of the heated windshield is cancelled - the heated windhsield is then in a switched-off state.

DESCRIPTION AND OPERATION

Heated rear window and heated external mirrors

The heated rear window and the heated exterior mirrors are switched on by the BCM under the following conditions:

- The heated rear window switch is operated, the ignition switch is in position "II" and the charge warning lamp is switched off.
- The "Defrost" function of the climate control has been activated, the ignition switch is in position "II" and the charge warning lamp is switched off.

The heated rear window and the heated exterior mirrors are switched off by the BCM under the following conditions:

- More than 4 minutes have elapsed since the switch for the heated rear window was operated.
- The engine is switched off.
- While the heated rear window is switched on, the switch for the heated rear window is pressed or the "Defrost" function of the climate control is deactivated.
- 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.

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.

Windshield wash/wipe system

The windshield wiper system is equipped with just one wiper motor, and this motor is connected to the BCM via a simple cable connection.

The windshield wash/wipe system will only operate if the ignition switch is in the position "I" or "II".

Four wipe functions are available: "Single Wipe", "Speed 1", "Speed 2" and "Intermittent Wipe" or "Automatic Wipe" (depending on the specification of the vehicle)".

In "Speed 1" or "Speed 2" mode, the wipers are operating continuously at either normal speed or fast speed.

When the intermittent wipe mode is switched on the windshield wipers operate at normal speed with the following wiper delays:

- Wiper delay 1: 1 second
- Wiper delay 2: 3.5 seconds
- Wiper delay 3: 6 seconds
- Wiper delay 4: 9.5 seconds
- Wiper delay 5: 15.5 seconds
- Wiper delay 6: 22 seconds

In the event of a failure, the default time for the wiper delay is 3.5 seconds.

When the windshield washer switch is operated washer fluid is sprayed onto the windshield. After a short delay designed to protect the wiper blades the wipers perform 2 or 3 wipes at low speed.

If when the windshield washer switch is activated the windshield wipers are switched off, a single wipe is performed 4 seconds after the wipers have returned to the home position after performing the 2 or 3 wipes.

If the wipers are set to intermittent wipe and the window washer switch is actuated, the wipes are only performed if no further wipe request has been selected via a shorter delay time within the 4-second delay time.

The post wipe function on the windshield ensures that any water remaining on the windshield after washing is wiped away. It is only required if the wipers are switched off or they are set to intermittent mode.

Rain sensor

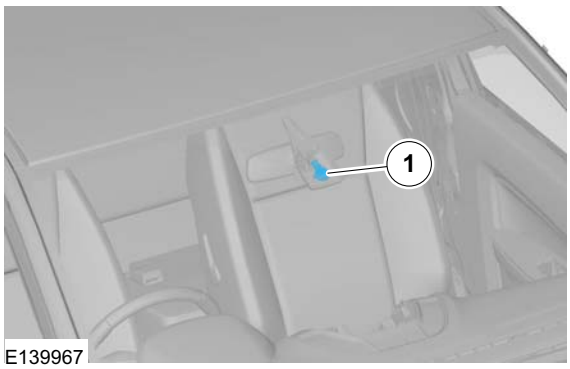
The automatic windshield wipers must be switched off before the vehicle is driven into a car wash.

If the windshield is iced up, the wipers may only be activated by the rain sensor after the windshield has been completely defrosted.

The rain sensor is an optical measuring instrument. Contamination such as oil, grease, dust or faulty wiper blades will prevent the system from working properly. Before switching on the automatic windshield wipers, the windshield must be clean in the area of the rain sensor.

The rain sensor is built into a housing which is mounted behind the rear view mirror on the windshield.

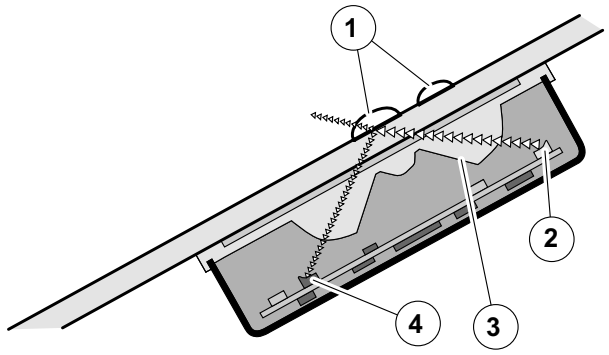
DESCRIPTION AND OPERATION



The rain sensor (1) consists of an opto-electronic measuring and evaluation circuit. The sensor can calculate the amount of precipitation falling on the windshield and request that the windshield wipers are switched on.

On the basis of the information provided by the rain sensor, the windshield wipers are then set to the required wipe speed by the generic electronic module (BCM).

Mode of operation of the rain sensor



Item	Description
1	Raindrop
2	LED
3	Lens
4	Photodiode

The rain sensor consists of three optical components:

- an LED
- a photodiode
- a lens

The photodiode emits an infrared light beam of known intensity; the emitted light exits through the lens and is 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 the automatic calibration process.

Subsequent deviations from this value cause the windshield wipers to be switched on.

If rain lands on the windshield then the light reflected by the windshield has a lower intensity. This loss of intensity is registered by the photodiode and, proportionally to the loss of intensity, the module switches on the windshield wipers with the required wipe speed (in intermittent or continuous mode).

When the automatic wipe function is switched on (wiper lever to intermittent position) the wipers are only activated automatically if the rain sensor registers water on the windshield.

It is not necessary to calibrate the rain sensor, as this has already been done at the factory.

The sensitivity of the rain sensor can be changed by adjusting the control resistor for the intermittent mode of the windshield wipers.

- Adjusting ring position - wide symbol: High sensitivity
  - The wipers wipe even if only a small amount of water has been measured on the windshield.
- Adjusting ring position - narrow symbol: Low sensitivity
  - The wipers only wipe if a large amount of water has been measured on the windshield.

Central door locking

Locking/unlocking – central locking

The central locking system locks all doors, so that none of these can be opened from the outside of the vehicle. The door lock motors are directly activated by the BCM.

DESCRIPTION AND OPERATION

The central locking is actuated if one of the following conditions is satisfied:

- A key is inserted into one of the door locks and turned to the "locking" position.
- The locking button on the remote control is pressed once.
- The lock/unlock button is pressed inside the vehicle.

If one of the doors is not properly closed when the central locking function is performed then all doors are locked and unlocked again.

The turn signal lamps will show one short flash when the vehicle has been successfully centrally locked.

Locking/unlocking – double locking

The double locking system locks all doors so that they cannot be opened from outside the vehicle. In addition to the central locking function, the double locking system also disconnects the door opening levers from the locking mechanism. This means that the doors can no longer be opened from inside the vehicle.

The double locking mechanism only works when the ignition key is not in the ignition lock.

The double locking is activated if one of the following conditions is satisfied:

- A key is inserted into a door lock and turned to the "locking" position twice within 3 seconds.
- The locking button on the remote control is pressed twice within the space of 3 seconds (if the vehicle is configured for activation of the double locking upon a double press of the locking button on the remote control).

If the ignition key has been turned to position "I" then the vehicle is centrally locked but not double-locked.

If on a double-locked vehicle the corresponding ignition key is inserted into the ignition, the system switches over from double locking to central locking.

The turn signal lamps will show two short flashes to confirm when the vehicle has been double locked.

Locking/unlocking – central unlocking

The central unlocking system unlocks all of the doors on the vehicle including the liftgate.

The central locking is actuated if one of the following conditions is satisfied:

- The door lock is turned to the unlocking position.
- The release button on the radio remote control is pressed once (provided that the vehicle is not configured to unlock the driver's door only).
- The release button on the radio remote control is pressed twice within 3 seconds.
- The door opening lever on a front door is pulled to the unlocking position on a centrally locked vehicle (provided the vehicle is not double locked).
- The lock/unlock button is pressed inside the vehicle, whilst a key is in the ignition or up to 10 seconds after a key has been removed from the ignition.

If the vehicle has been configured for unlocking via the driver's door lock and the "unlocking" button on the remote control is only pressed once, then just the driver's door is unlocked.

If the "unlocking" button on the remote control is then pressed again within 3 seconds the remaining doors are unlocked via the central unlocking function.

If the vehicle was double locked beforehand, then the other doors are centrally locked, whereas the driver's door is unlocked.

Unlocking of the vehicle with the ignition switched off, is confirmed by one long flash of the turn signal lamps.

Locking/unlocking - automatic re-locking function

The automatic re-locking function returns the locking system of the vehicle to its last status if it was centrally locked or double locked and the following conditions are satisfied:

- The vehicle is unlocked via remote control.
- A door has not been opened within 45 seconds.
- The ignition is not switched on.

This feature may be turned off at the Ford dealer.

DESCRIPTION AND OPERATION

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.

When the Smart Charge system is active, a slight variation in blower fan speed may be noticed.

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 BCM.

Electrical consumers are switched off due to low voltage when the BCM 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 BCM 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 and heated windscreen
- Heated rear window

If the battery voltage rises back above the lower threshold then the BCM 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 BCM 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 BCM automatically activates the following consumers - in this order and with a gap of 5 seconds between each:

- Heated rear window
- Heated exterior mirrors and heated windscreen
- Electric booster heater (vehicles with diesel engines)

If the battery voltage drops back below the threshold then the BCM 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.

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 transmitted by the BCM on the MS CAN/HS CAN bus.

The ignition overload protection relay is located in the battery junction box, and is activated by the BCM when the ignition switch is in position III.

The activated ignition overload protection then switches off the following electrical consumers:

- Exterior lighting
- Windscreen/rear window wash/wipe systems
- Backup lamps

Electric window regulators

The ignition key must be in position "II" before the electric window regulators can be operated. The electric window regulator open or close the door windows when the switch is moved to the corresponding position.

The movement of the window glass stops when the window regulator button is released or when the ignition key is moved from position "II" to position "I", "III" or "0".

The driver door window can only be operated via the driver door switch; the other windows can be opened and closed via the driver door switch panel or the relevant door switch.

If the window on the front passenger's door is operated via the switch on the switch panel in the driver's door, then the driver's door module

receives the cable-transmitted signal from the switch and forwards it on the CAN bus to the door module of the front passenger's door, which then moves the window glass to the corresponding position.

The rear doors are each connected via a LIN bus to the door modules of the front doors.

The disabling switch in the switch panel on the driver's door can be used to disable the window regulator switches in the rear doors.

Speed control

The BCM acts as the provider of the signals of the speed control system. The signals which come from the switch unit in the steering wheel are converted to CAN and sent on to the PCM via the HS CAN bus.

The PCM then adjusts the power output of the engine to maintain the selected vehicle speed.

Brake fluid level

If the brake fluid level is normal the brake fluid level switch is closed and sends a ground signal via cable to the BCM.

If the brake fluid level is below the threshold and the level switch opens for more than two seconds then the BCM generates a CAN signal which it sends to the instrument cluster.

Power management

The power management system offers various modes which can be used in different situations to ensure an effective power supply to individual modules.

The power management function is integrated in the BCM.

Four different vehicle modes are used depending on the operating status of the vehicle:

Factory mode:

- Factory mode is activated while the vehicle is in production. In this mode, power supply is reduced to a minimum by switching off relays. Once the vehicle leaves the factory the factory mode is deactivated, and transport mode is activated instead.

Transport mode:

- Transport mode is activated while the vehicle is en route from the factory to the dealer. In this mode, the vehicle can be driven without any adverse effects on vehicle safety.
- Individual modules and electrical systems (e.g. anti-theft alarm system, clock and remote control) are deactivated.
- This ensures that the battery is sufficiently charged when the vehicle is handed over to the customer.

If the engine is started while the vehicle is in transport mode then the transport mode is temporarily suspended. It is reactivated once the ignition is switched off.

Transport mode must be deactivated by the **dealer**. To do this, the dealer needs to press the brake five times and operate the hazard warning lights switch twice within the space of 10 seconds.

When the transport mode is deactivated the BCM automatically changes into normal mode.

Normal mode:

- The full functionality of all electrical systems is available in normal mode.

Crash mode:

- Crash mode is activated as soon as the restraints control module (RCM) registers a sufficiently severe vehicle impact.
- The vehicle is then centrally unlocked if it was locked at the time of the crash.
- In addition the hazard warning lights are activated.
- Crash mode is deactivated if the ignition key is turned to position "0" and then back to position "II" after at least 500 ms. The hazard warning switch needs to be operated to deactivate the hazard warning lights.

Immobiliser

The PATS function is integrated in the BCM. Correspondingly, the send/receive unit is directly connected to the BCM (previously it was connected to the powertrain control module (PCM)).

After reading in the key code (in ignition lock position "0", "I" or "II"), a corresponding message is placed by the BCM on the HS CAN databus for the PCM.

DESCRIPTION AND OPERATION

Depending on the outcome of this query and the status of the key, the PCM then issues the start enable.

Central module configuration

The modules in the vehicle were previously configured with the aid of the diagnostic unit and the "Module Programming" (inhale/exhale) function. Here, the actual status of each module is read into the diagnostic unit and then saved in the new module.

Ranger vehicles utilize a new form of module configuration called "central module configuration".

Here, all of the necessary configuration parameters are stored in the BCM at the factory, and from there they are transmitted via the CAN bus network to the individual modules.

The diagnostic unit is equipped with a new routine for performing the central module configuration which is used to replace or subsequently change configuration data. Instead of reading the data into the diagnostic unit as was done in the past, they are transmitted by the BCM to the relevant module. The diagnostic unit is only used to initiate and monitor the process.

For safety reasons all configuration data which are stored in the BCM are also stored in parallel in the instrument cluster. If the BCM then needs to be replaced, this means that the required configuration data can be read out from the instrument cluster with the aid of the diagnostic unit and then transferred to the new BCM.

The BCM checks the configuration data for consistency and stores DTCs in the event of any faults (diagnostic unit trouble codes).

In the event of a fault the functionality of a particular module may be restricted.

When the BCM is replaced it is necessary to re-learn the keys for the remote control and for the PATS system. The procedure for doing this is the same as on the current vehicles.

VIN identification

During the VIN identification, the VIN is saved in individual modules at the factory.

As soon as a module is identified when the ignition is switched on (even after the battery has been disconnected), it can be operated without further inputs.

If no VIN or an invalid VIN is read in from a module then this is stored in a memory. Subsequently the functionality of the module may be restricted depending on its use.

Climate control

Evaporator temperature

On vehicles with air conditioning the evaporator temperature is measured via the evaporator temperature sensor, located in climate the climate controls. The temperature is then communicated to the BCM.

If a temperature below +2.9 °C is determined then the BCM sends a signal to the PCM via the HS CAN bus which then shuts off the air conditioning clutch. If the temperature is above +3.9 °C the BCM sends a signal to the PCM and the air conditioning clutch is switched back on again.

Electric booster heater

If the interior temperature is set to "HI" on the heater / air conditioning control assembly or the temperature control switch is set to its highest setting then the climate control module sends an "electric booster heater ON" request signal via the MS CAN bus to the BCM. If a manual air conditioning system is installed, the signal is transmitted via a conventional cable connection.

The BCM controls the electric booster heater according to the available alternator capacity.

In contrast to other Ford vehicles, there is no link to the coolant temperature or the ambient temperature.

The electric booster heater electronics activates depending on a LIN signal generated by the BCM. 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 LIN signal. If the LIN signal equals 10%, the electric booster heater is not activated.

REMOVAL AND INSTALLATION

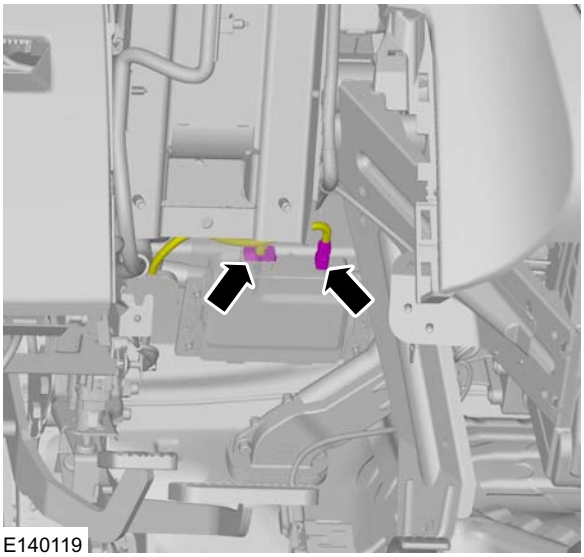
Body Control Module (BCM)

Removal

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

1. Refer to: Steering Column (211-04 Steering Column, Removal and Installation).

2.



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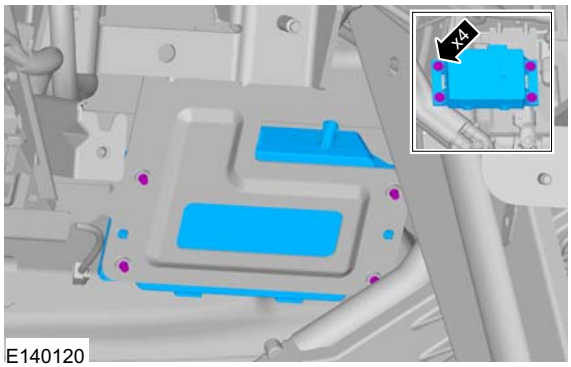


Installation

1. To install, reverse the removal procedure.

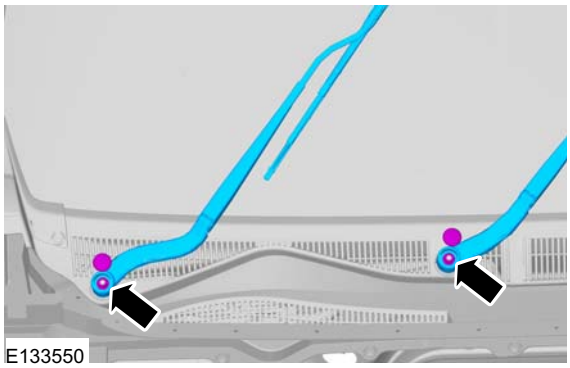
REMOVAL AND INSTALLATION

Cowl Panel Grille

Removal

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

1. Torque: 35 Nm



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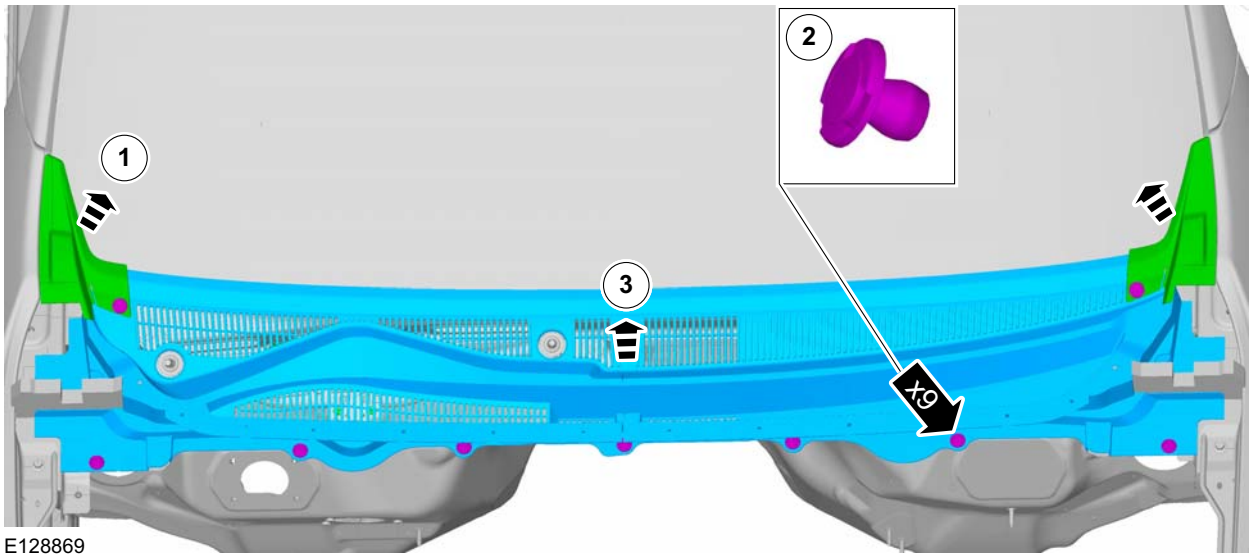


Installation

1. **CAUTION: Make sure that the motor is in the park position.**

To install, reverse the removal procedure.

2. Check the angle of the wiper arms to the windscreen.

Refer to: Windshield Wiper Blade and Pivot Arm Adjustment (501-16 Wipers and Washers, General Procedures).

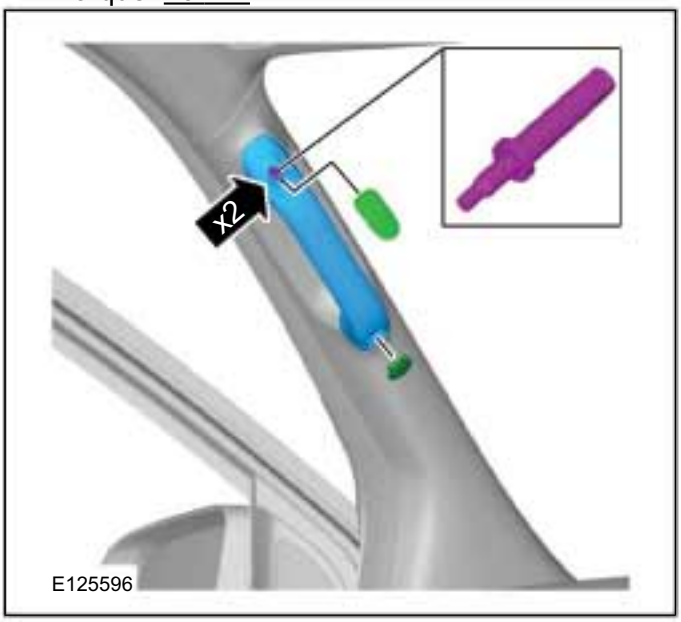
REMOVAL AND INSTALLATION

A-Pillar Trim Panel

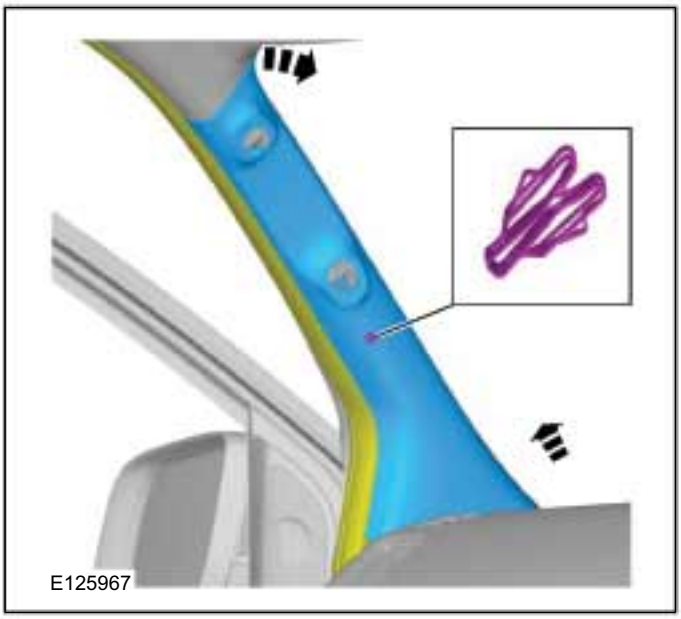
Removal

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

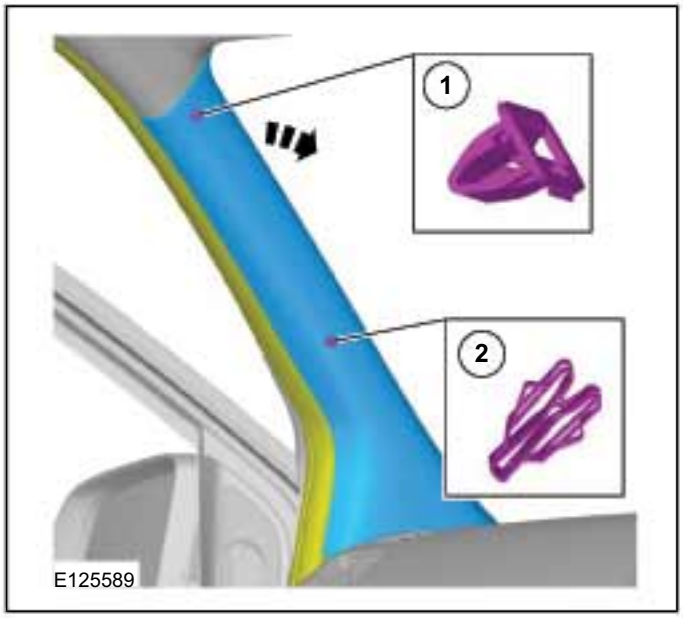
1. Torque: 10 Nm



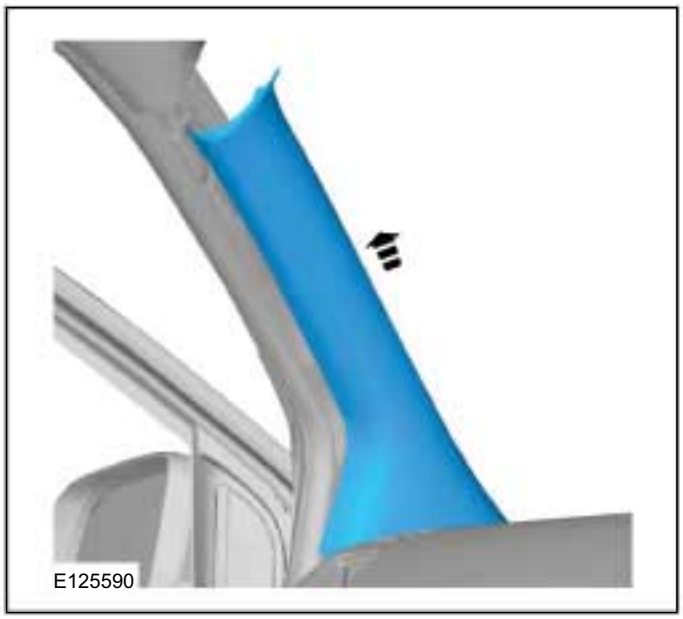
2.



3.



4.



Installation

1. To install, reverse the removal procedure.

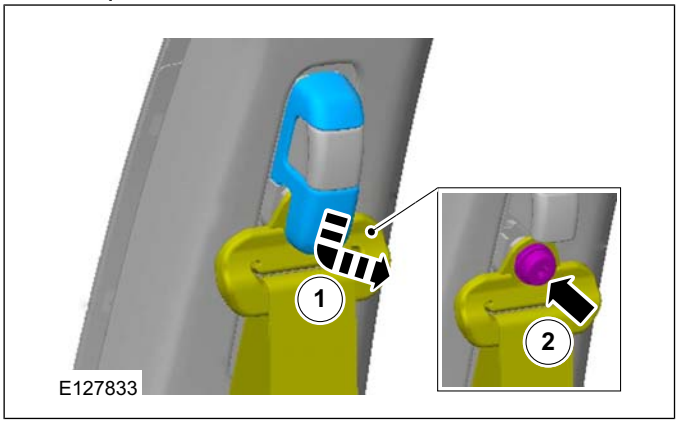
REMOVAL AND INSTALLATION

B-Pillar Upper Trim Panel

Removal

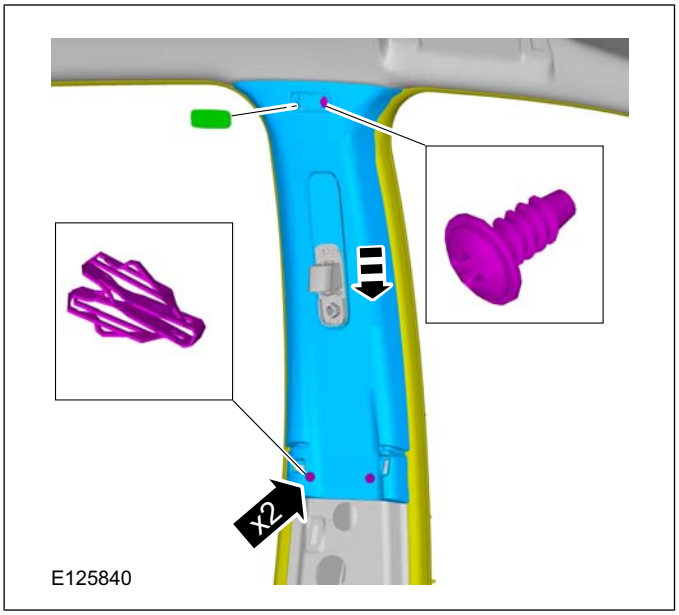
NOTE: Removal steps in this procedure may contain installation details.

1. Torque: 47 Nm



2. Refer to: B-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.



Installation

1. To install, reverse the removal procedure.

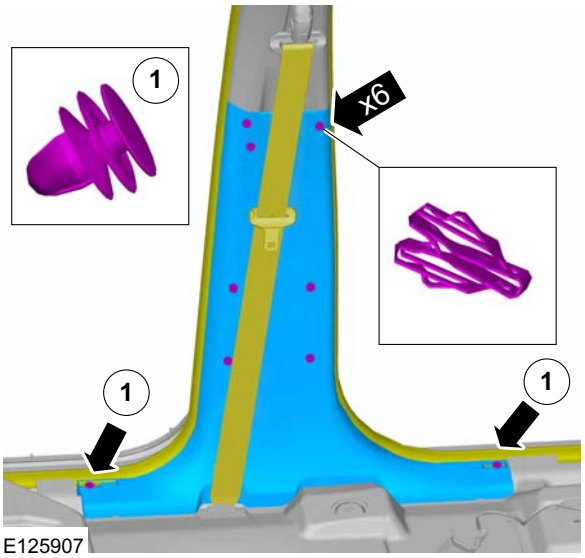
REMOVAL AND INSTALLATION

B-Pillar Lower Trim Panel

Removal

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

1. Refer to: Front Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Refer to: Rear Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

C-Pillar Upper Trim Panel

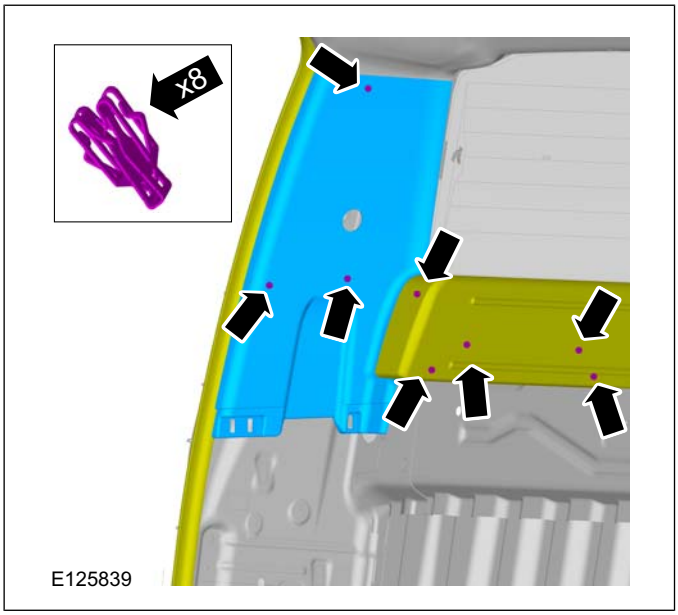
Removal

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

1. Refer to: Rear Safety Belt Retractor (501-20 Safety Belt System, Removal and Installation).
2. Refer to: C-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

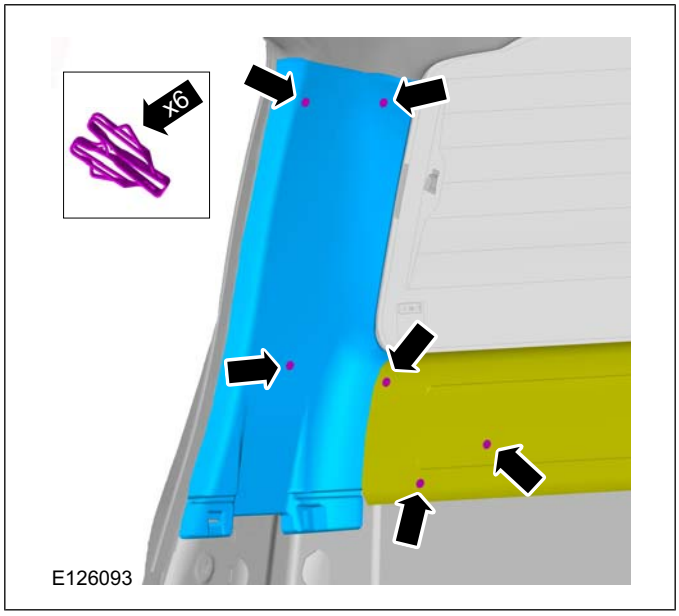
Single cab

3.



Stretch cab

4.



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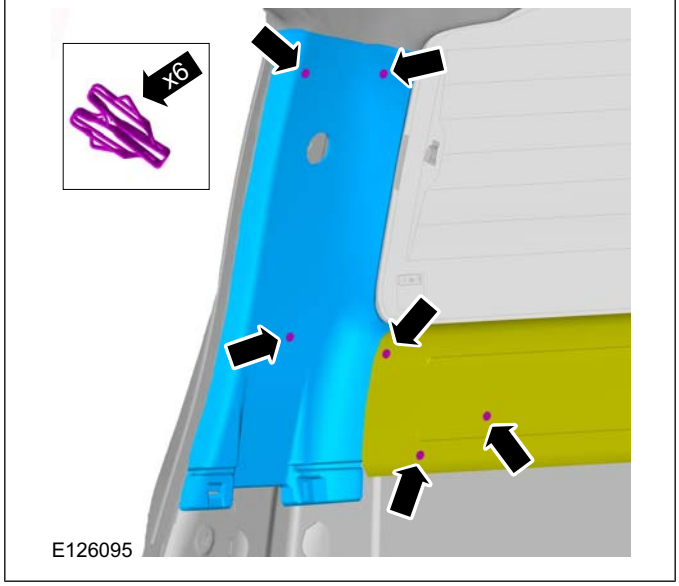
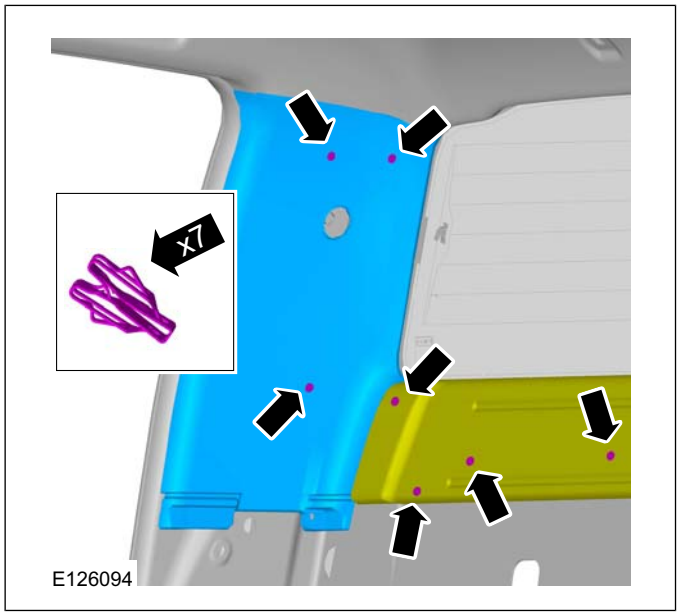


REMOVAL AND INSTALLATION

Double cab

6.



Installation

1. To install, reverse the removal procedure

REMOVAL AND INSTALLATION

C-Pillar Lower Trim Panel

Removal

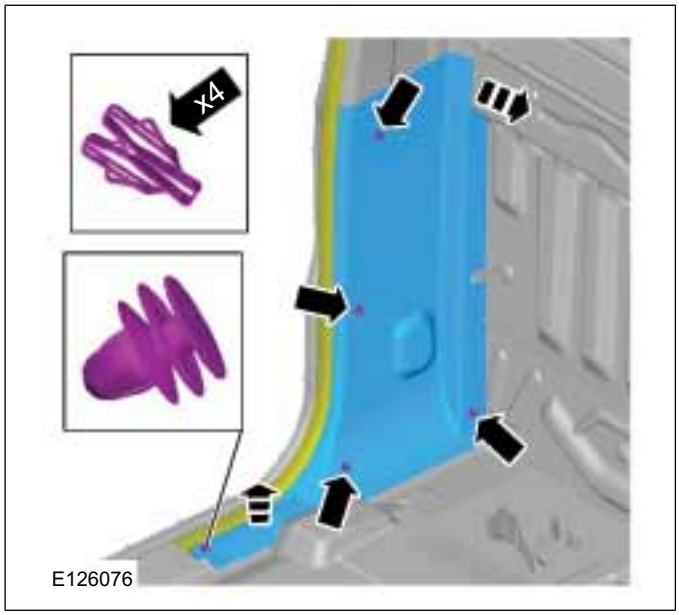
NOTE: Removal steps in this procedure may contain installation details.

Single cab

1. Remove scuff plate

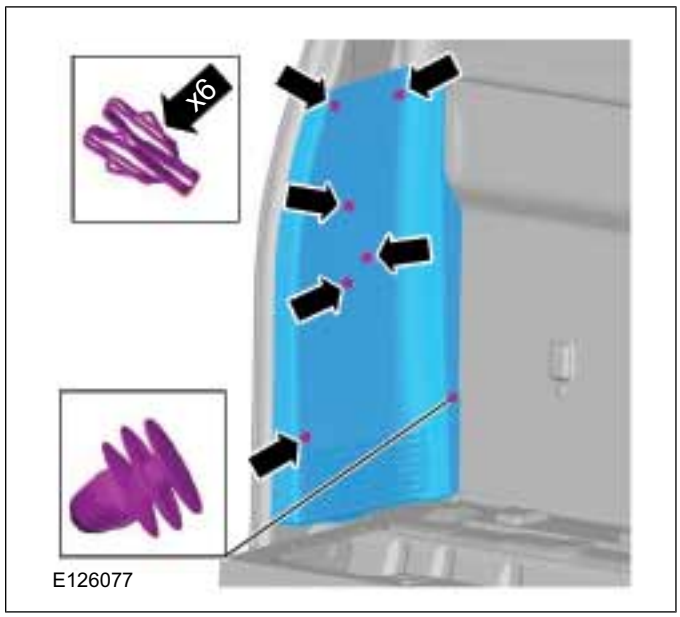
Refer to: Front Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



Stretch cab

3.

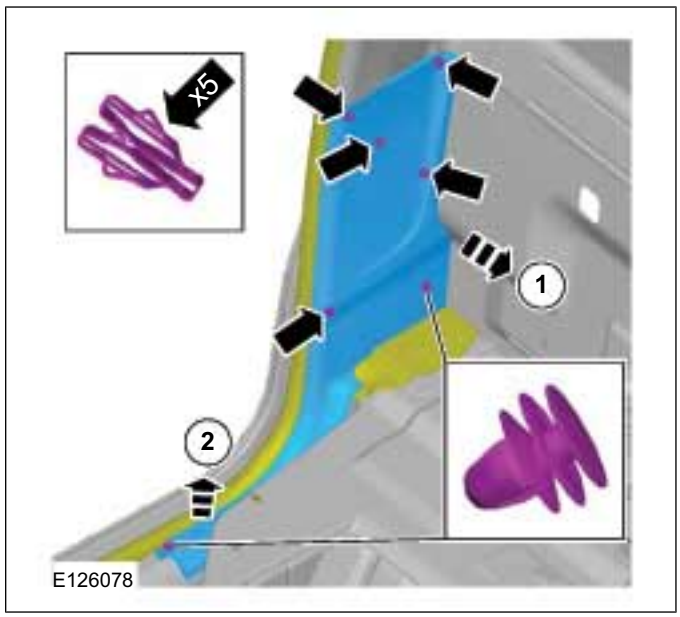


Double cab

4. Remove rear scuff plate

Refer to: Front Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

5.



REMOVAL AND INSTALLATION

Installation

1. To install reverse the removal procedure

REMOVAL AND INSTALLATION

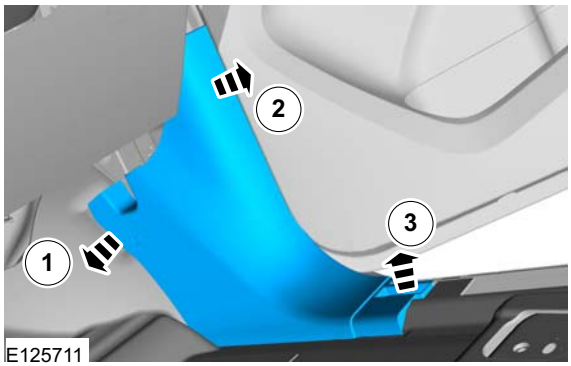
Cowl Side Trim Panel

Removal

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

1. Refer to: Front Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



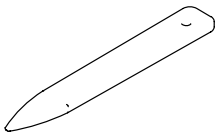
Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Door Trim Panel

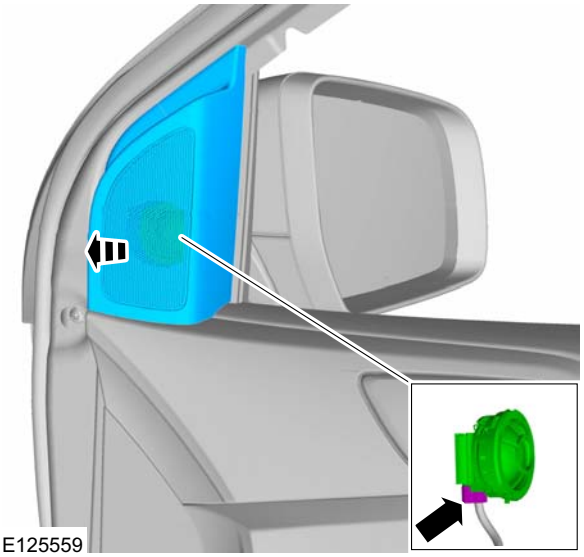
Special Tool(s)

 E84511	501-125 Remover, Grab Handle Cover

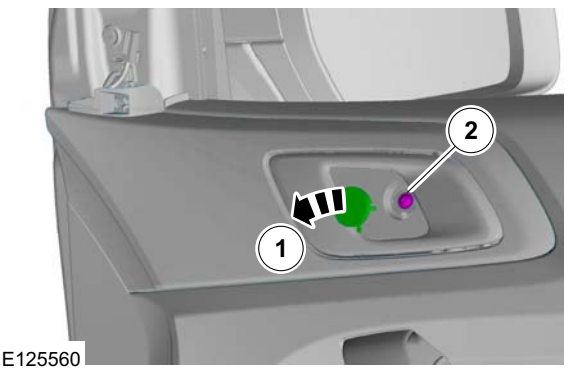
Removal

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

1.

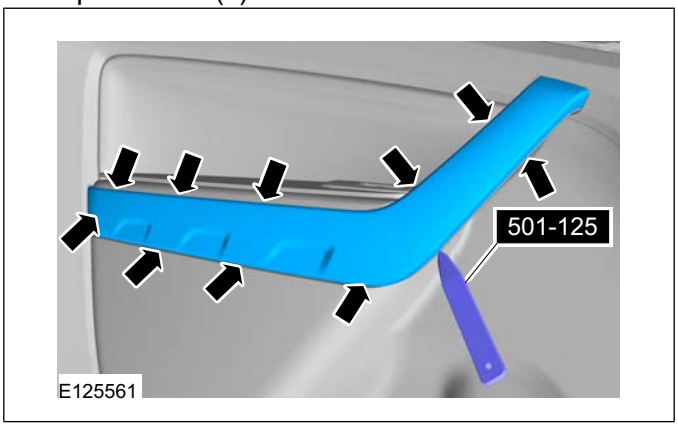


2.

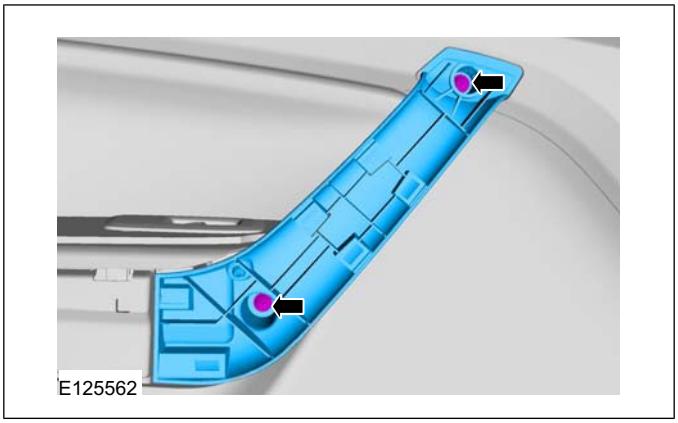


3. **CAUTION: Take extra care not to damage the edges of the component.**

Special Tool(s): 501-125



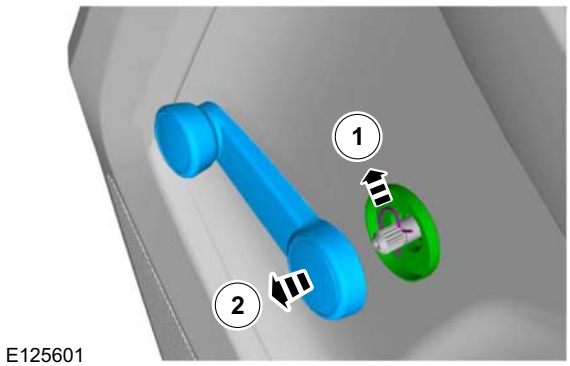
4.



REMOVAL AND INSTALLATION

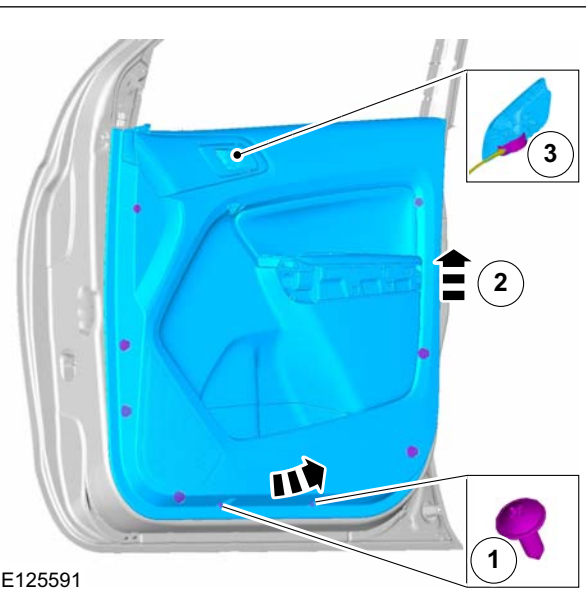
Vehicles with manual windows

5.



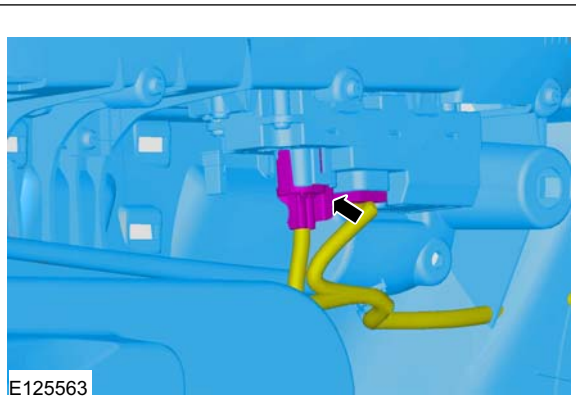
All vehicles

6.



Vehicles with power windows

7.



Installation

1. To install, reverse the removal procedure.

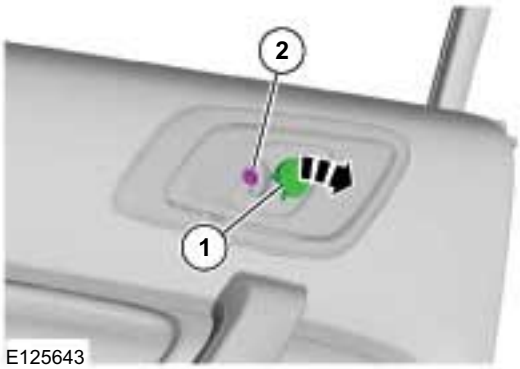
REMOVAL AND INSTALLATION

Rear Door Trim Panel — Double Cab

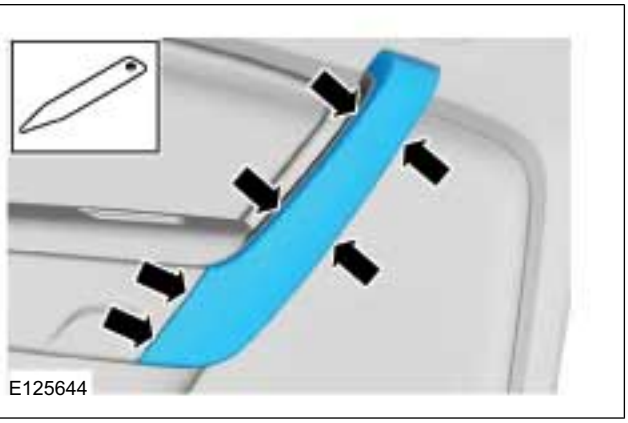
Removal

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

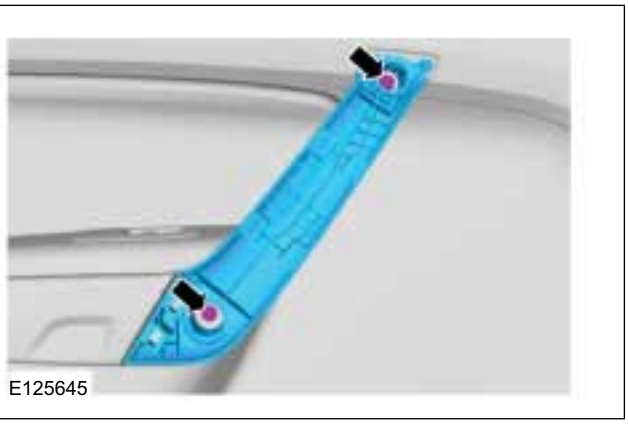
1.



2. ⚠ **CAUTION: Take extra care not to damage the edges of the component.**

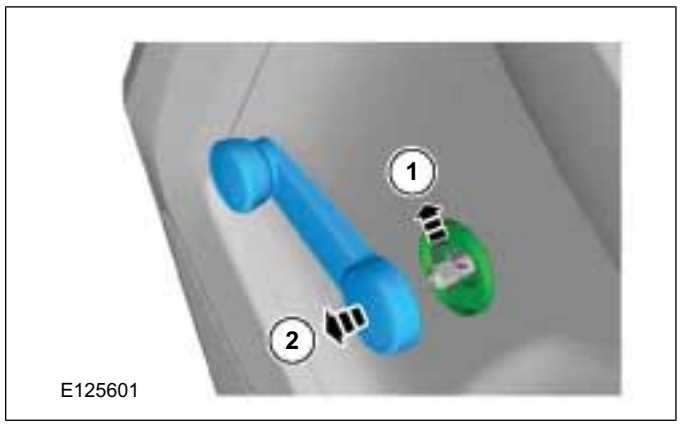


3.



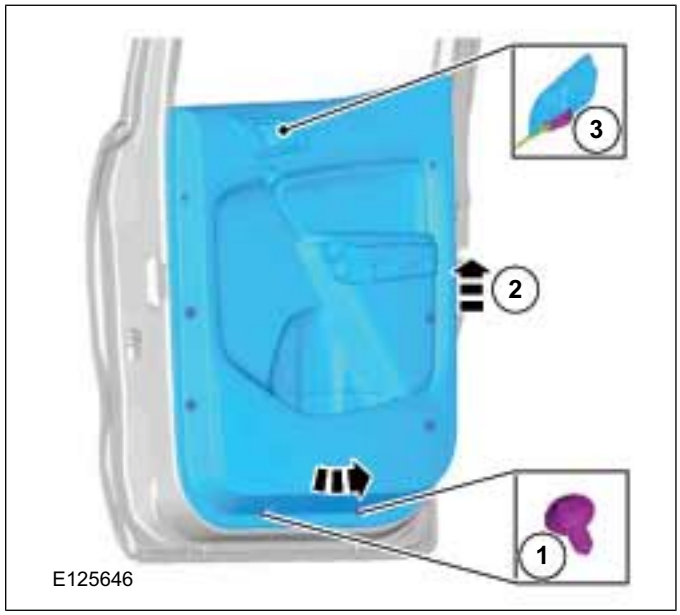
Vehicles with manual windows

4.



All vehicles

5.



REMOVAL AND INSTALLATION

Vehicles with power windows

6.

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

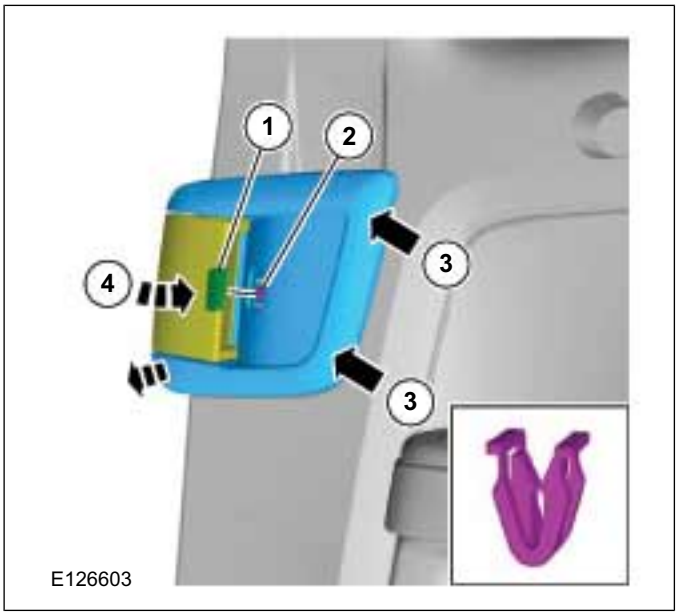
Rear Door Trim Panel — Super Cab

Removal

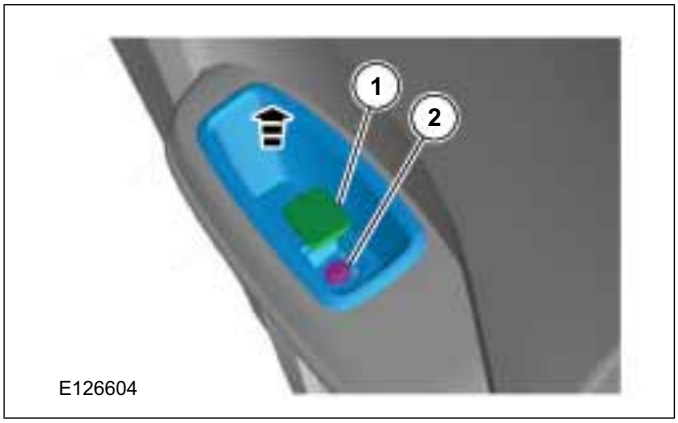
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Front Safety Belt Retractor - Super Cab (501-20 Safety Belt System, Removal and Installation).

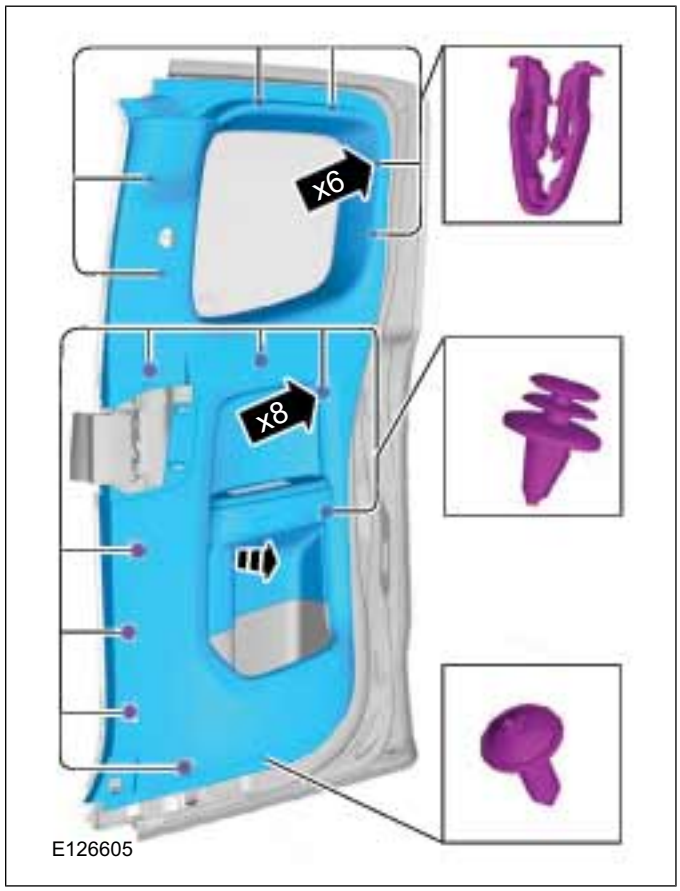
2.



3.



4.



Installation

1. To install, reverse the removal procedure.

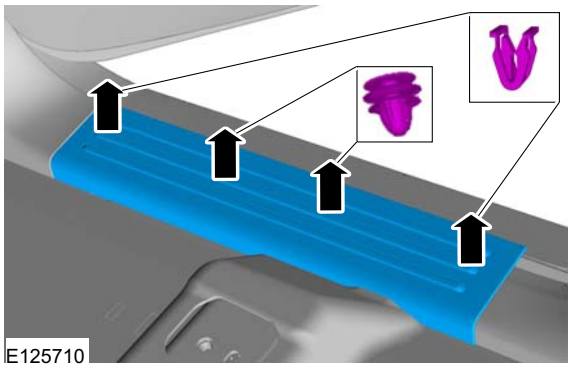
REMOVAL AND INSTALLATION

Front Scuff Plate Trim Panel

Removal

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

1.



Installation

1. To install, reverse the removal procedure.

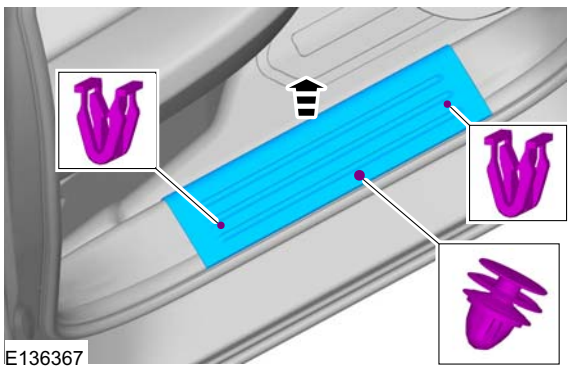
REMOVAL AND INSTALLATION

Rear Scuff Plate Trim Panel

Removal

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

1. **NOTE:** Note the position of each fastener.



Installation

1. **NOTE:** Make sure that the fasteners are installed to the position noted before removal.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Headliner

Removal

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

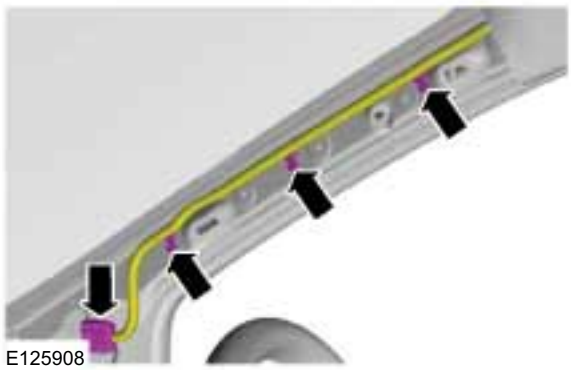
1. On both the sides.

   Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2. On both the sides.


E125920

3.


E125908

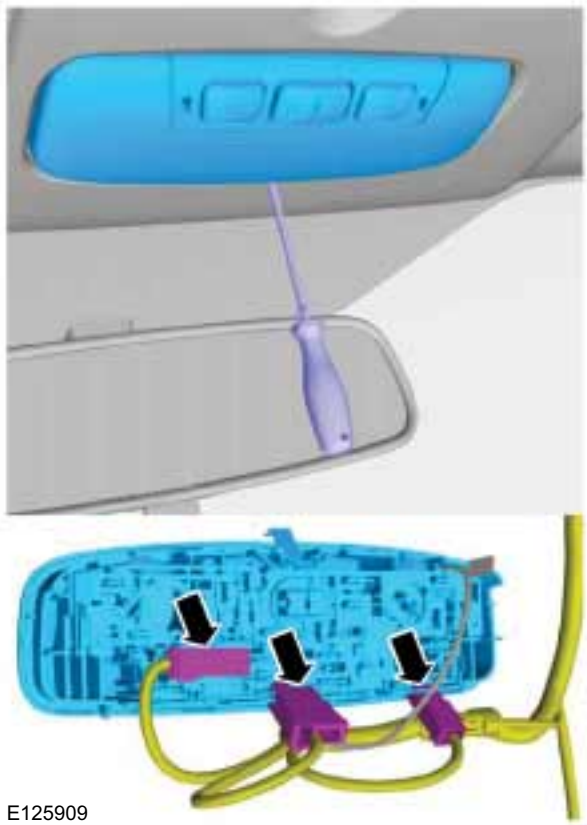
4. On both the sides.

   Refer to: B-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

5. On both the sides.

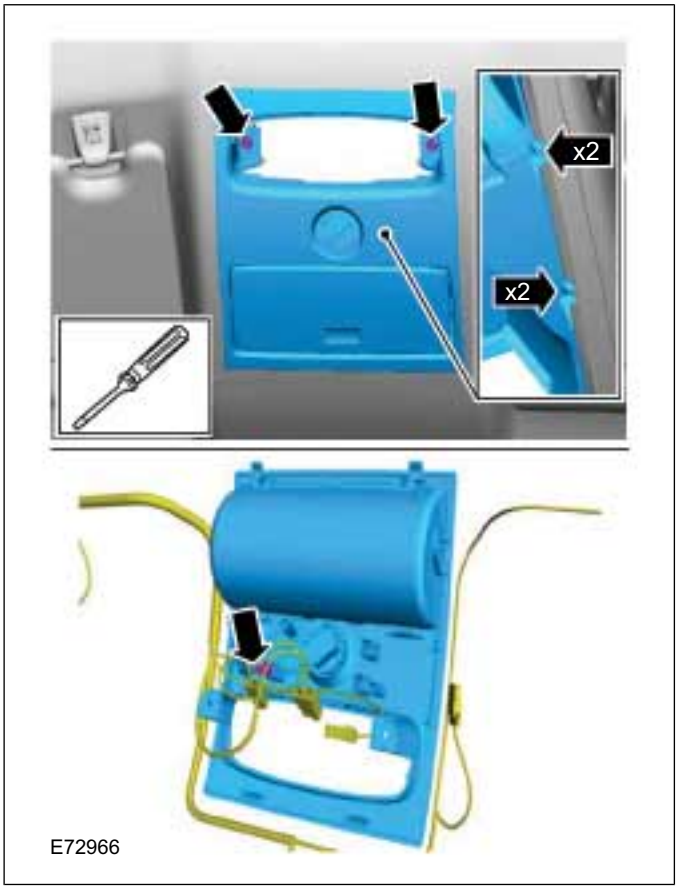
   Refer to: C-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: C-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

6.

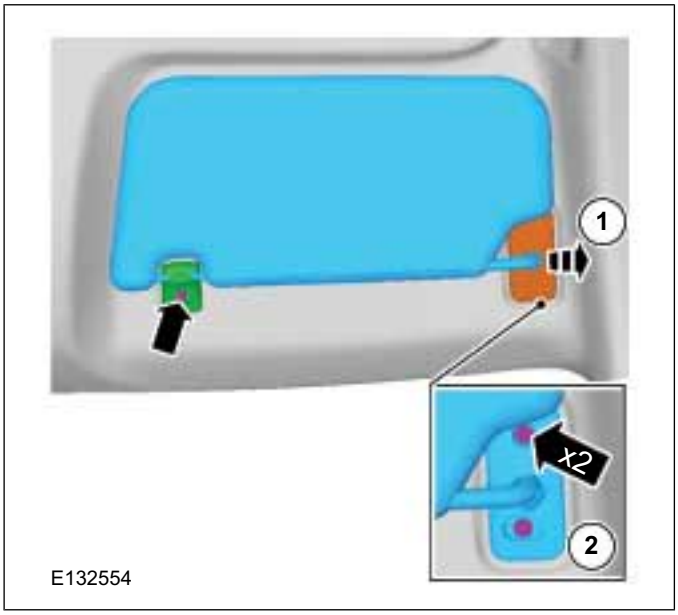

E125909

REMOVAL AND INSTALLATION

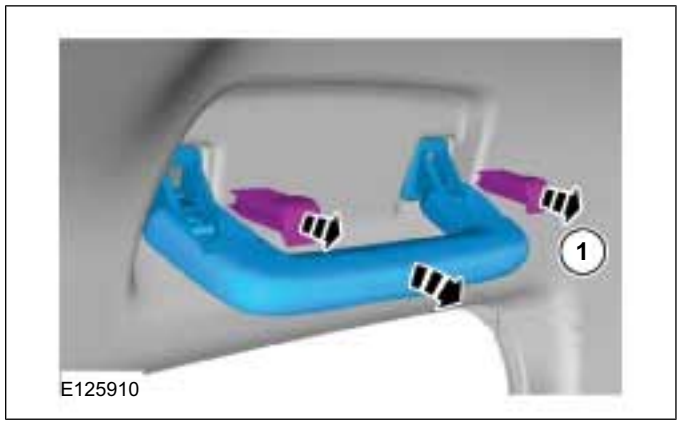
7. **NOTE:** This step is not necessary when installing a new component.



8. On both the sides.

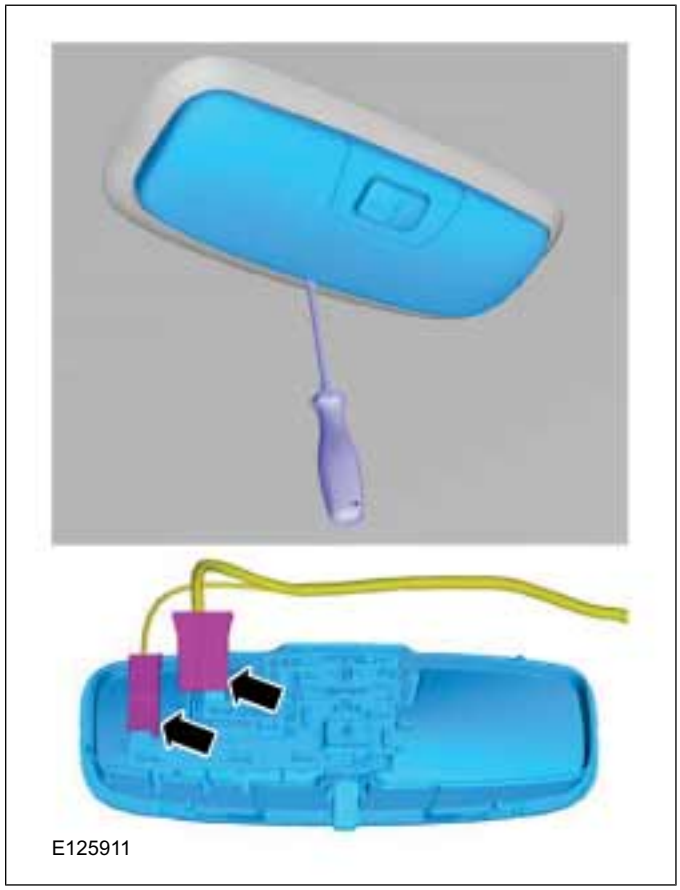


9.



Stretch cab oder Double cab

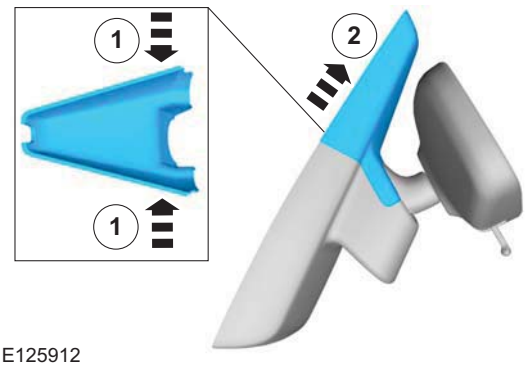
10.



REMOVAL AND INSTALLATION

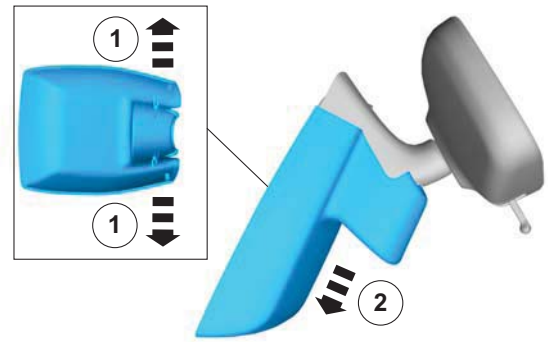
Vehicles with autolamps and rain sensor

11.



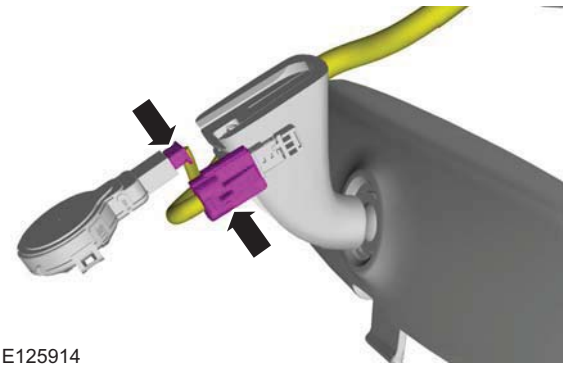
E125912

12.



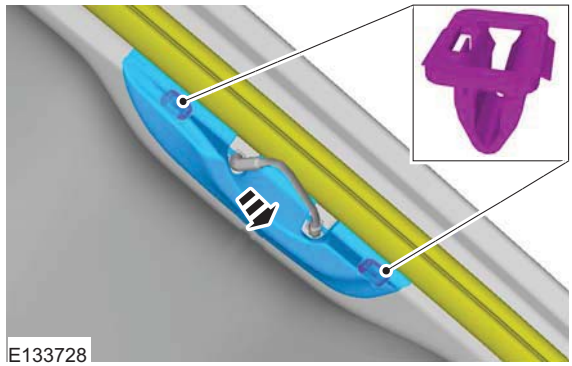
E125913

13.


E125914

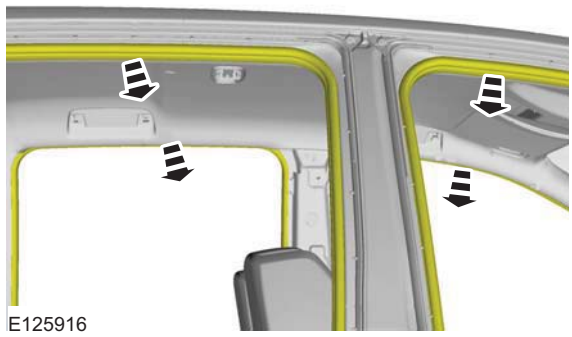
Stretch cab

14.


E133728

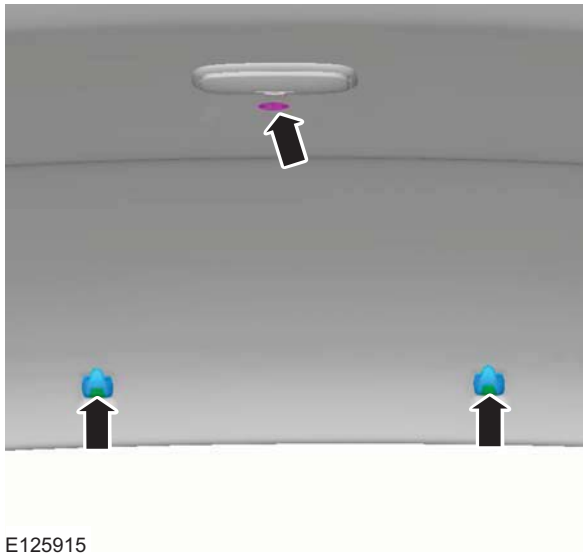
Double cab

15. Support the headliner.


E125916

Stretch cab oder Double cab

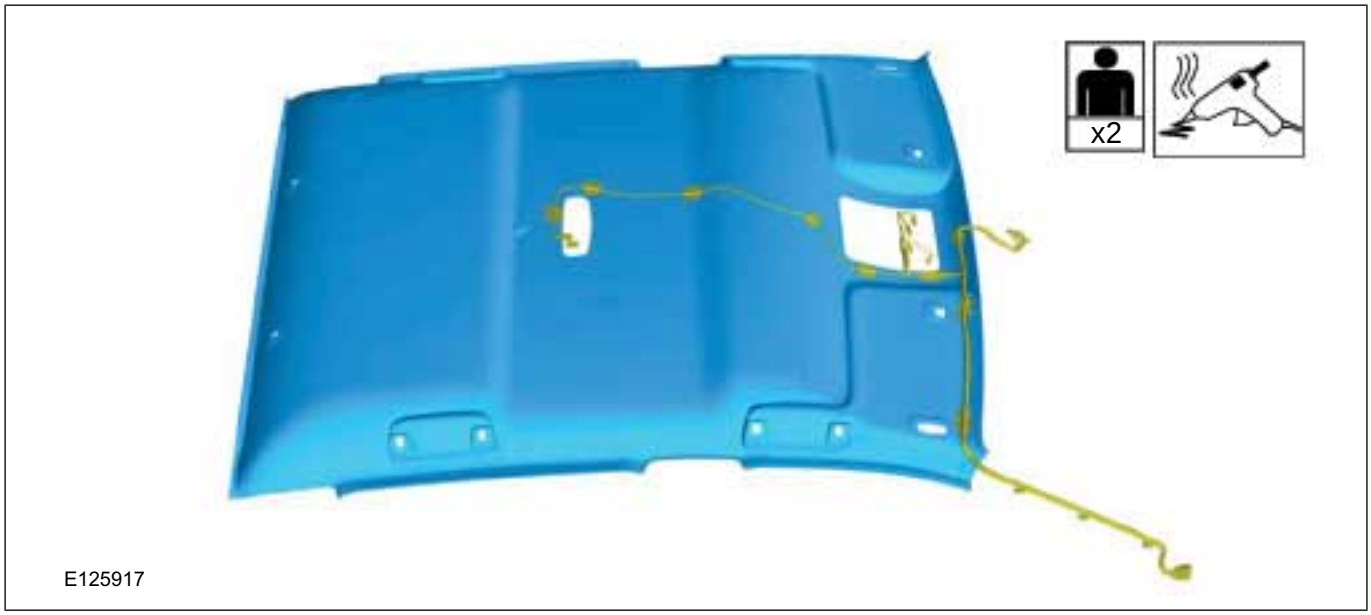
16.


E125915

17. NOTE: Right-hand drive vehicles.

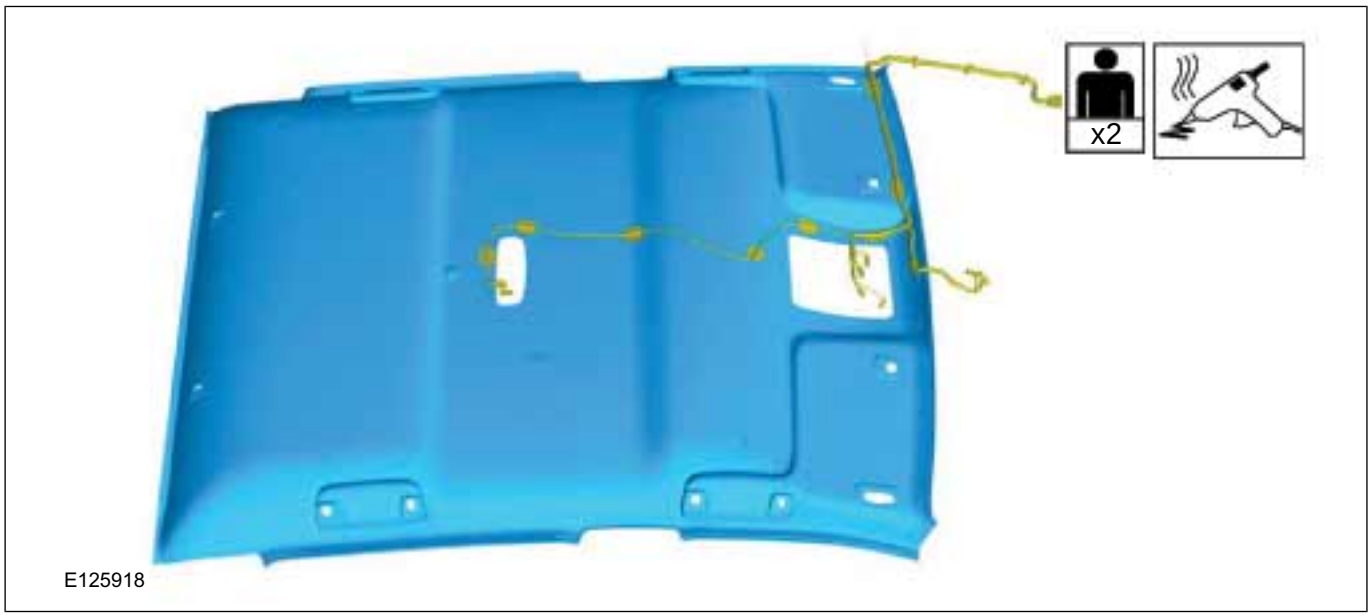
REMOVAL AND INSTALLATION

NOTE: Note the position of each component before removal.



18. **NOTE:** Left-hand drive vehicles.

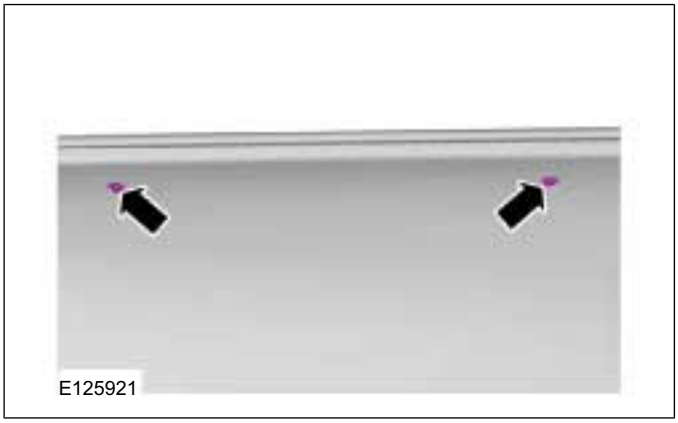
NOTE: Note the position of each component before removal.



REMOVAL AND INSTALLATION

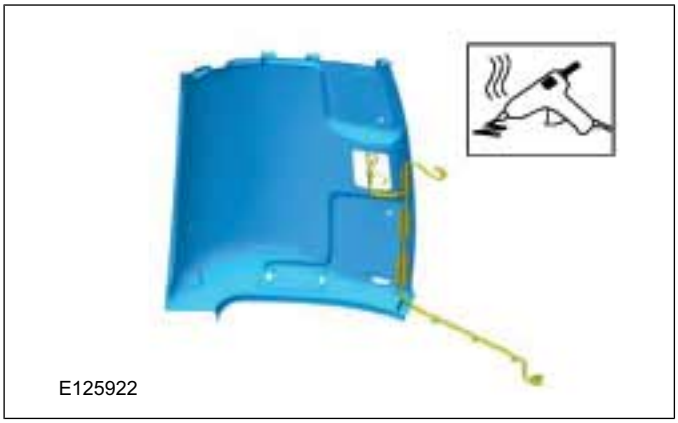
Single cab

19.



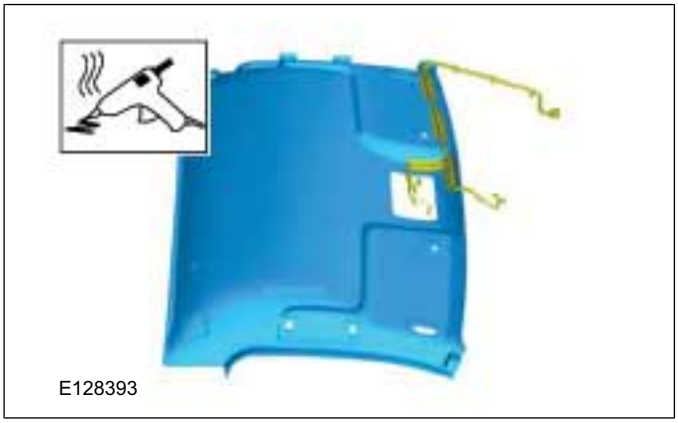
20. NOTE: Right-hand drive vehicles.

NOTE: Note the position of each component before removal.



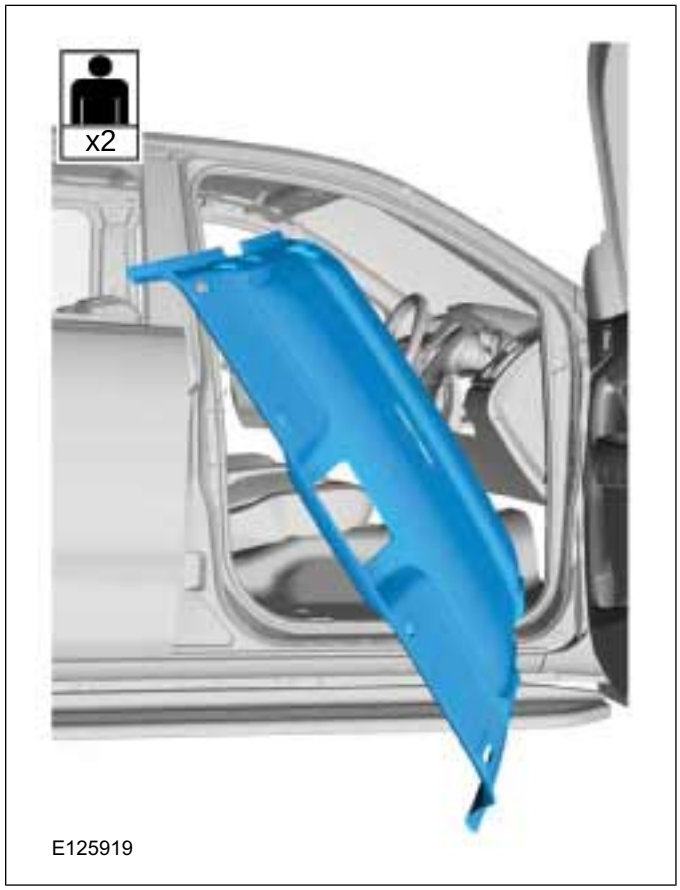
21. NOTE: Left-hand drive vehicles.

NOTE: Note the position of each component before removal.



All vehicles

22. CAUTION: Take extra care not to crease the headliner.



Installation

1. **NOTE:** Make sure that this component is installed to the noted removal position.

   Using a suitable adhesive, bond the roof wiring harness to the headliner.

2. To install, reverse the removal procedure.

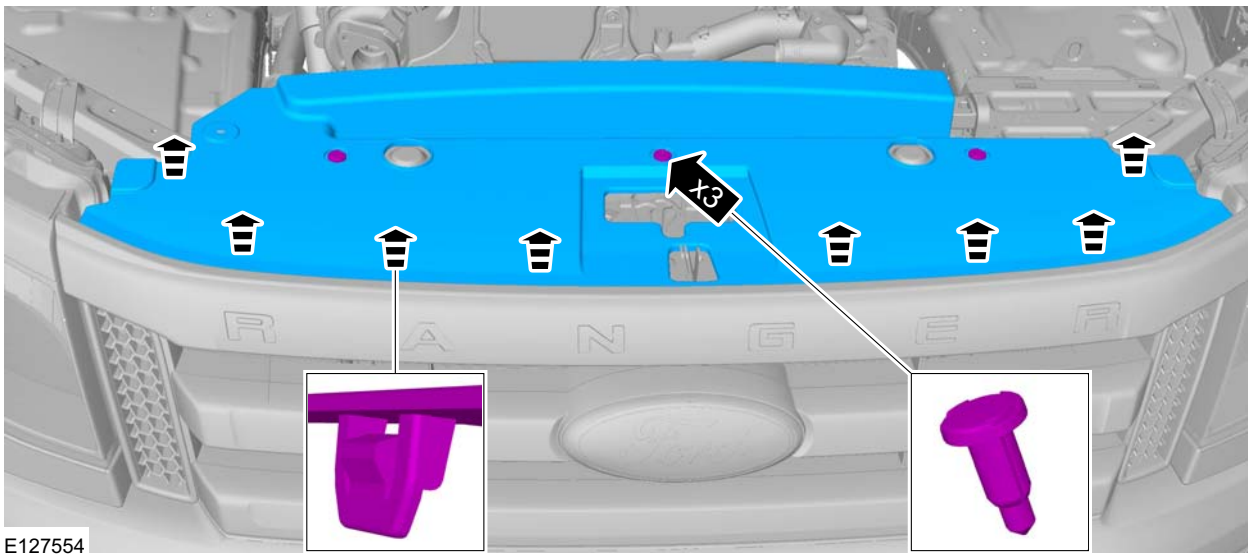
REMOVAL AND INSTALLATION

Radiator Grille

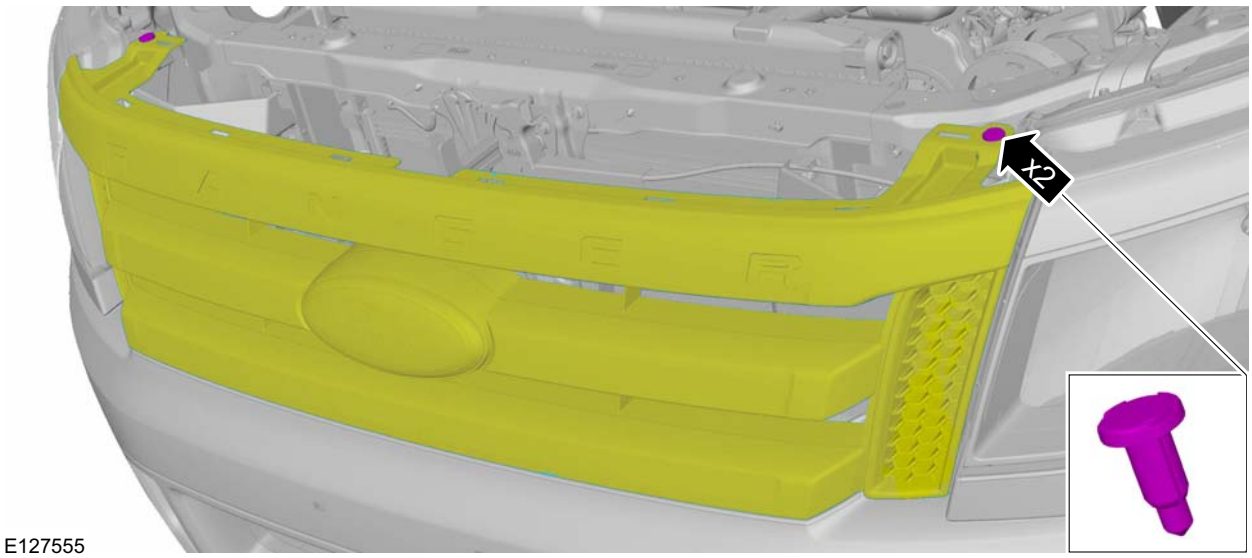
Removal

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

1.

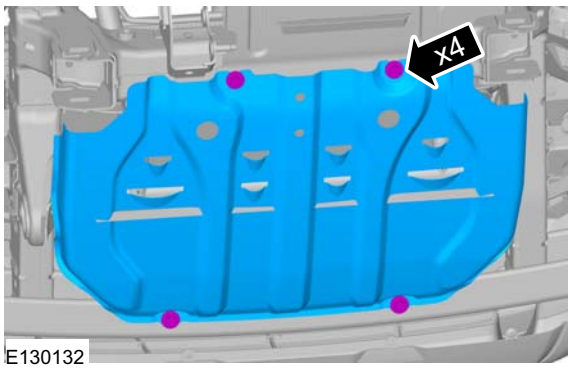


2.

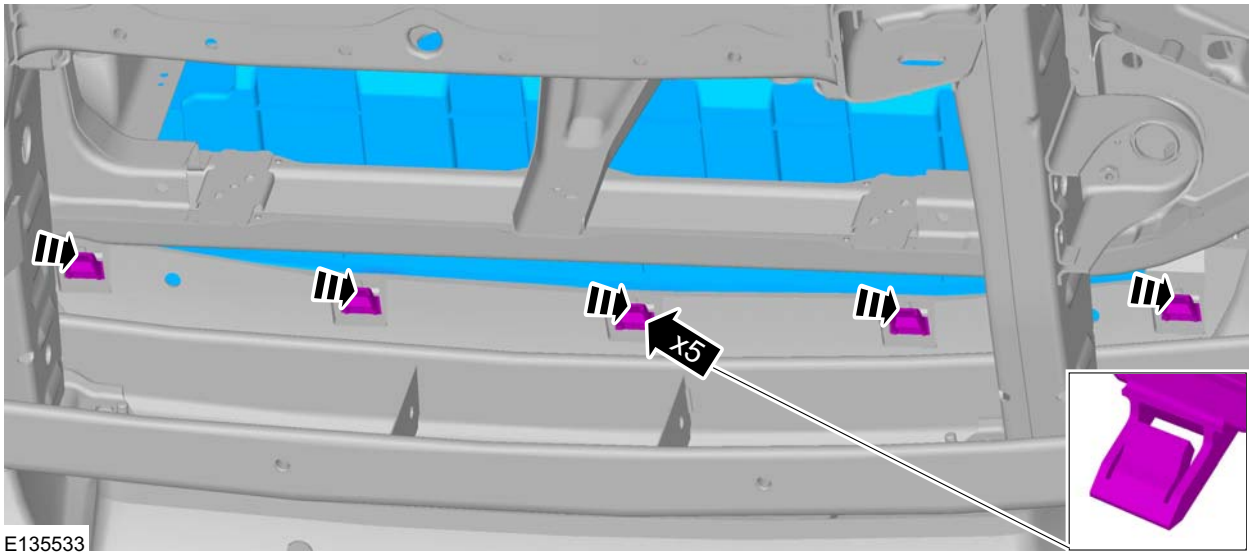


REMOVAL AND INSTALLATION

3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Torque: 30 Nm



5.



Installation

1. To install, reverse the removal procedure.

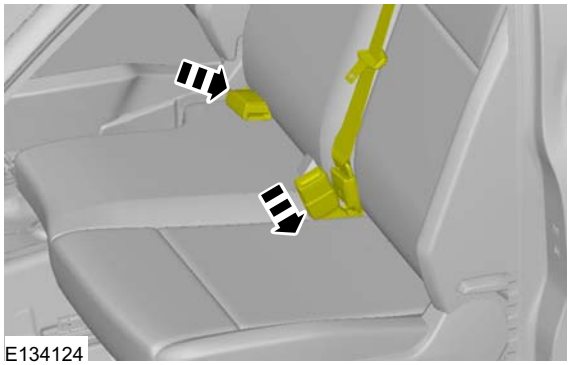
REMOVAL AND INSTALLATION

Front Bench Seat

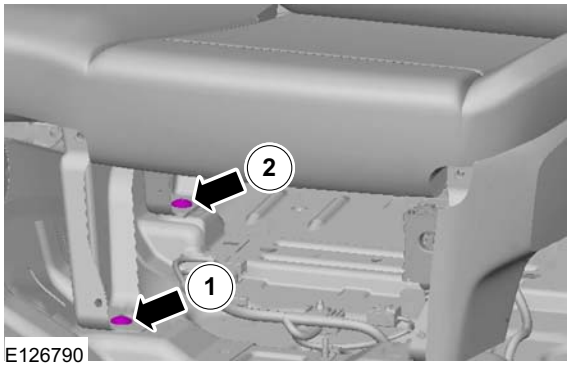
Removal

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

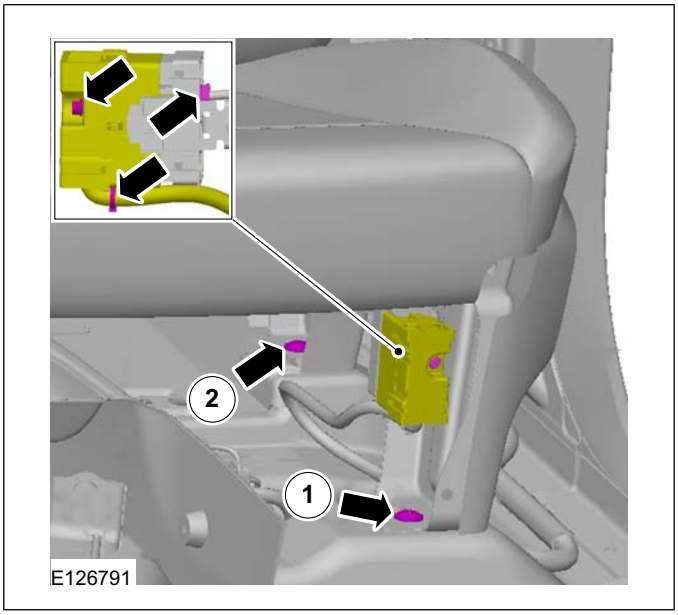
1.



2. 1. Torque: 48 Nm
2. Torque: 30 Nm



3. 1. Torque: 48 Nm
2. Torque: 30 Nm



4.

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Seat(40 100 0; 40 100 4; 40 101 0)

Removal

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

All vehicles

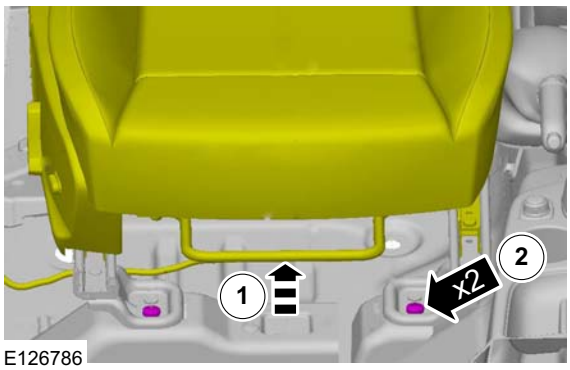
1. **WARNINGS:**

   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.

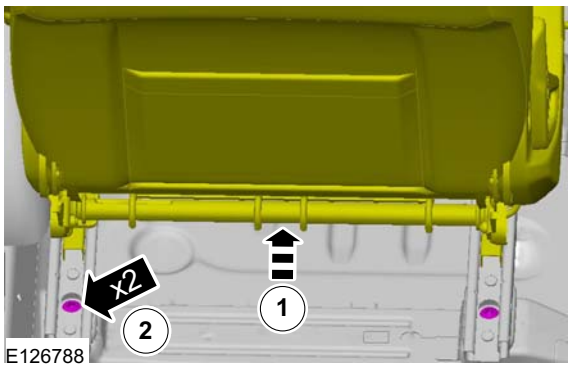
   Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

   Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. 2. Torque: 48 Nm

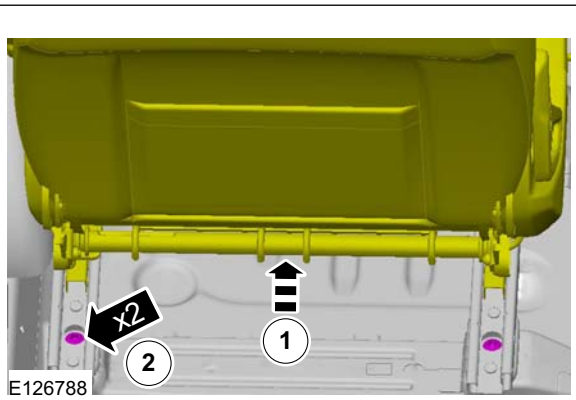


4. 2. Torque: 48 Nm



Single cab

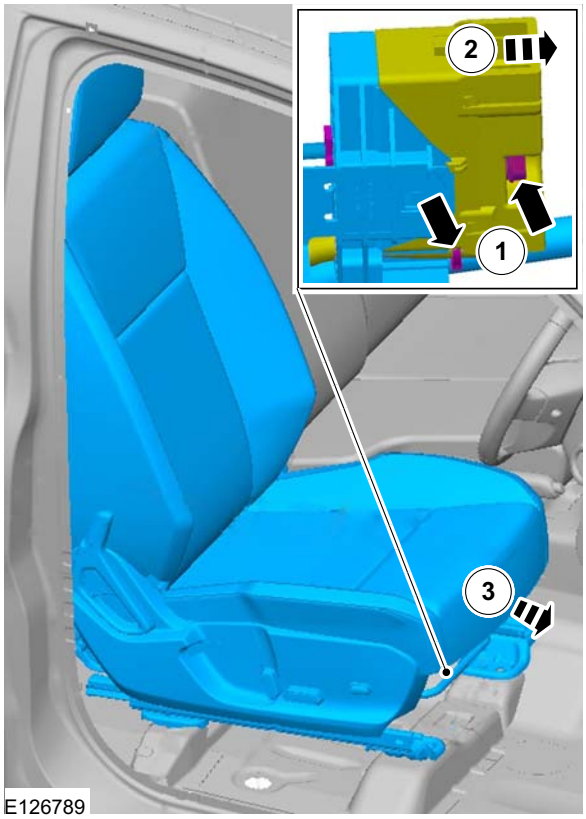
5. 2. Torque: 30 Nm



REMOVAL AND INSTALLATION

All vehicles

6. Disconnect the heated seat and side air bag module electrical connectors (if equipped).

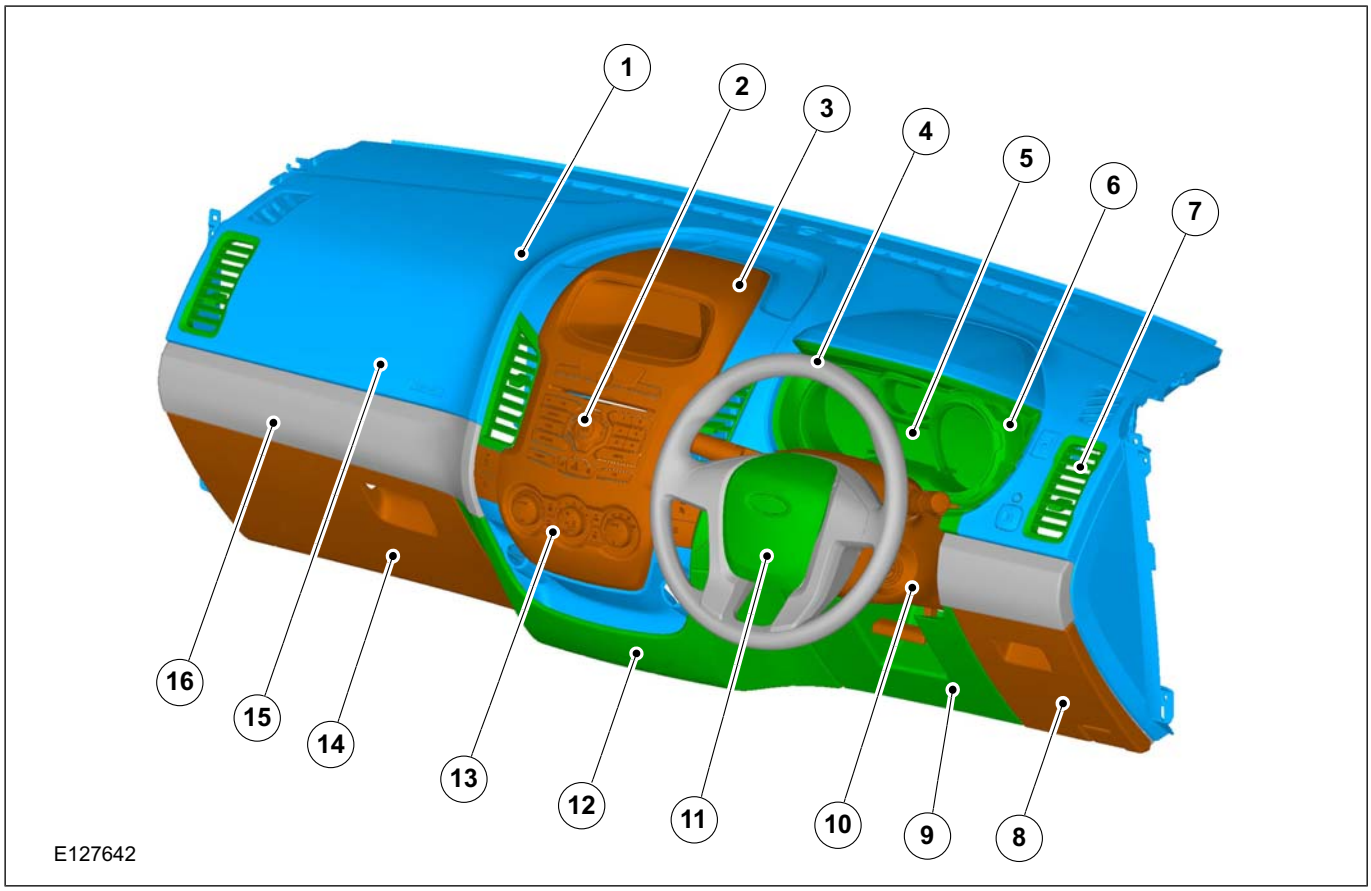


Installation

1. To install, reverse the removal procedure.

DESCRIPTION AND OPERATION

Instrument Panel



Item	Description
1	Instrument panel
2	Audio control
3	Center finishing panel
4	Steering wheel
5	Instrument cluster
6	Instrument cluster bezel
7	Ventilator grille
8	Driver glove compartment
9	Driver lower airbag module
10	Steering column cover
11	Driver air bag module
12	Lower finishing panel
13	Heater / AC control
14	Passenger glove compartment
15	Passenger air bag module
16	Side finishing panel

REMOVAL AND INSTALLATION

Instrument Panel — LHD 4WD/LHD RWD

General Equipment

Ford Diagnostic Equipment

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: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

Single cab

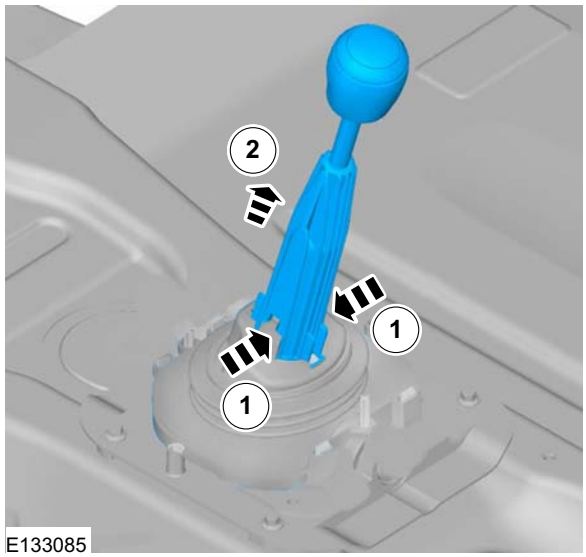
2. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).

Double cab

3. Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

Vehicles with manual transmission

4.



REMOVAL AND INSTALLATION

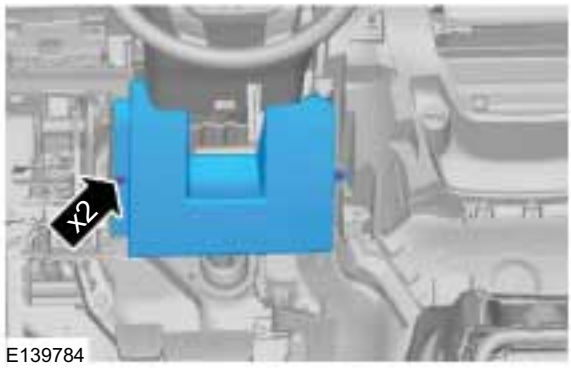
Vehicles with driver lower air bag

5. Refer to: Driver Lower Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation).

Vehicles without driver lower air bag

6.

7.

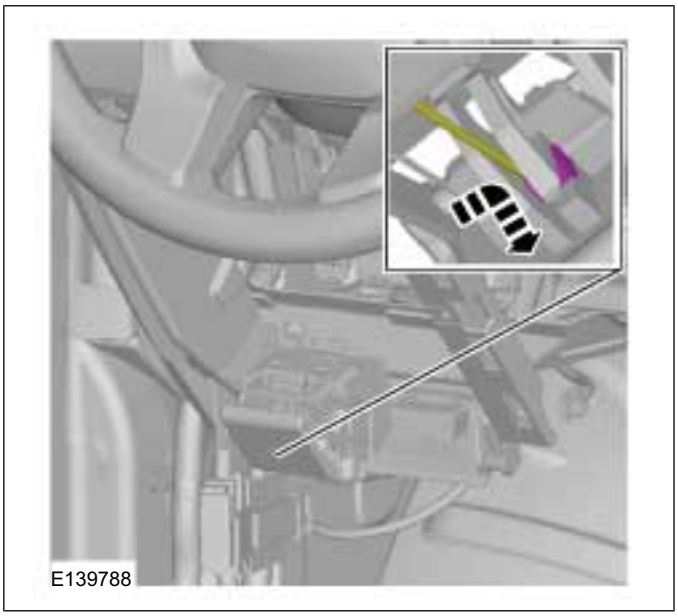


All vehicles

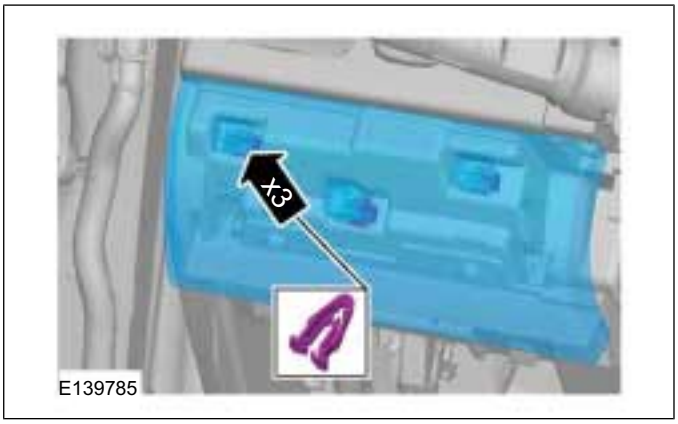
8. Refer to: Glove Compartment (501-12 Instrument Panel and Console, Removal and Installation).

9. Refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

10.

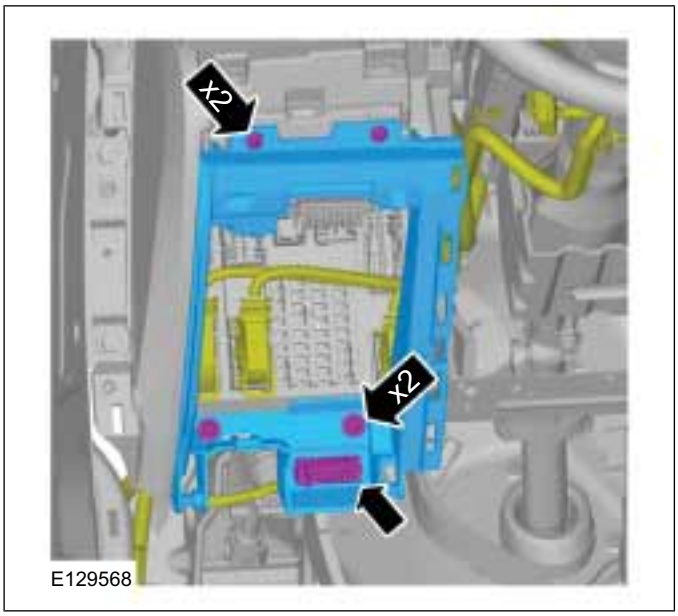


11.

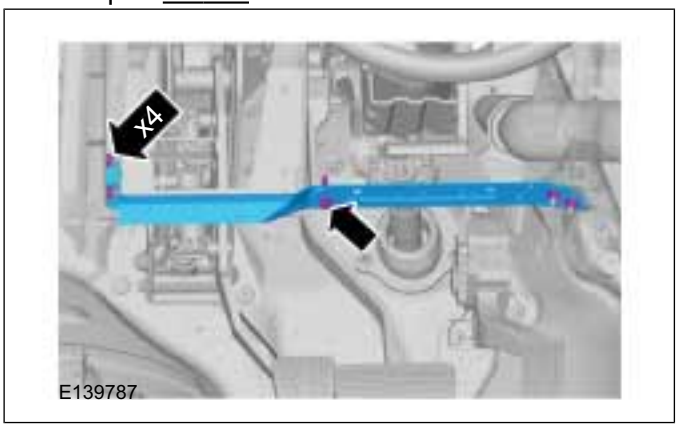


REMOVAL AND INSTALLATION

12.



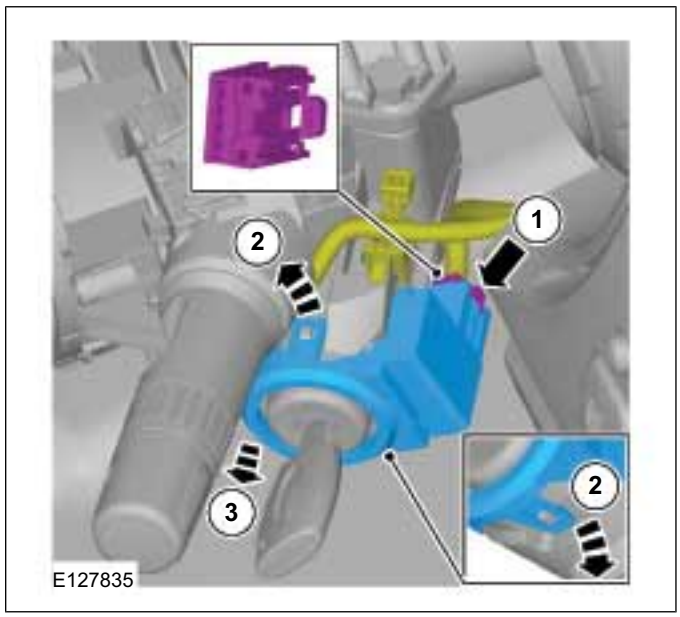
13. Torque: 10 Nm



14. Refer to: Ignition Switch (211-05 Steering Column Switches, Removal and Installation).

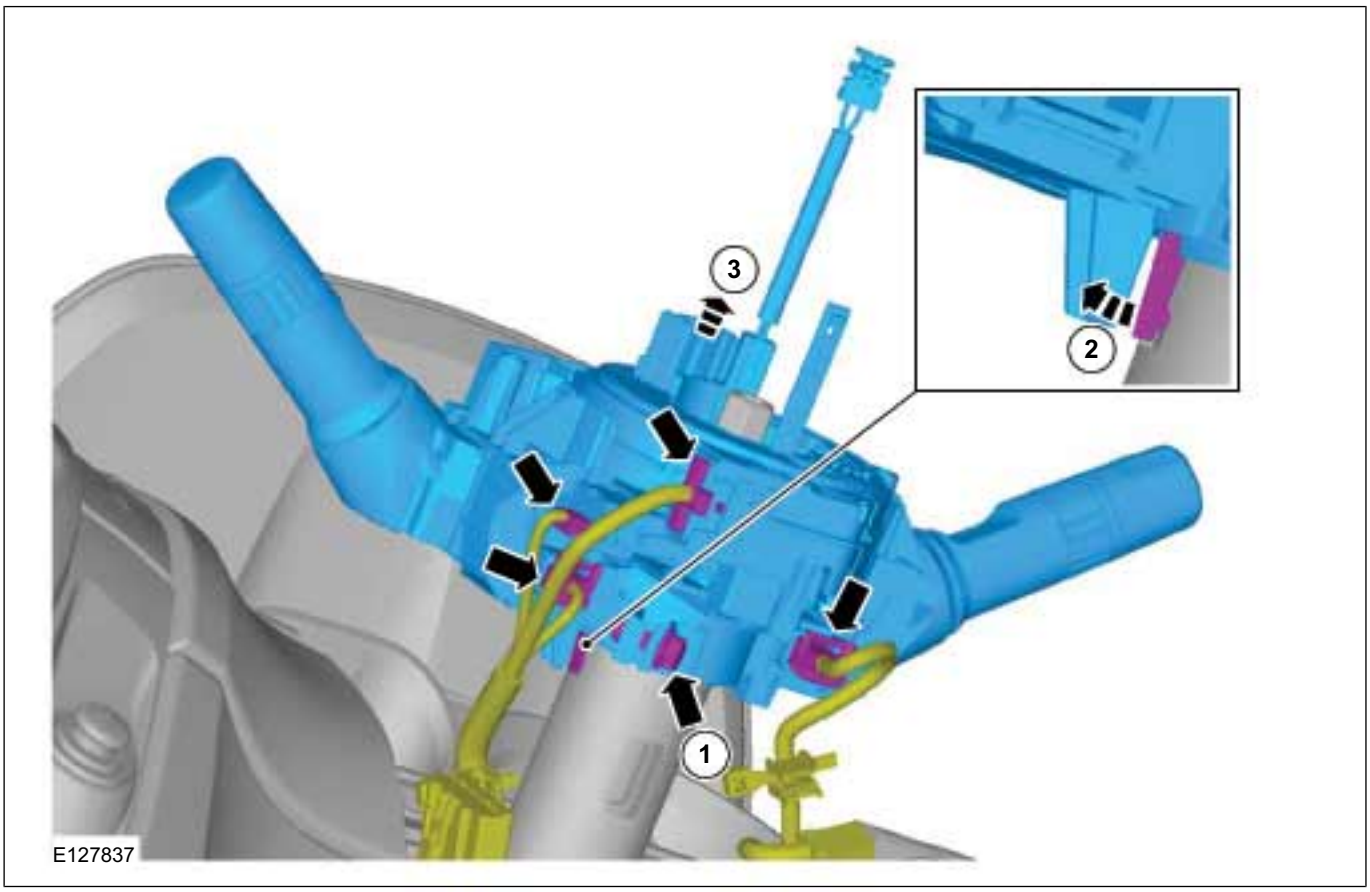
15. Refer to: Steering Wheel (211-04 Steering Column, Removal and Installation).

16.

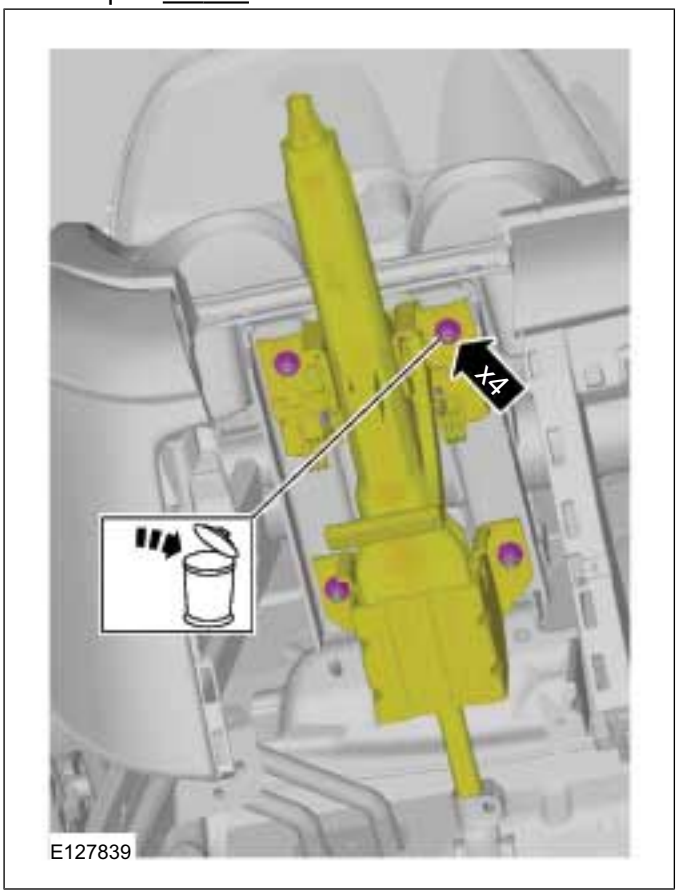


17. 1. Torque: 7 Nm

REMOVAL AND INSTALLATION

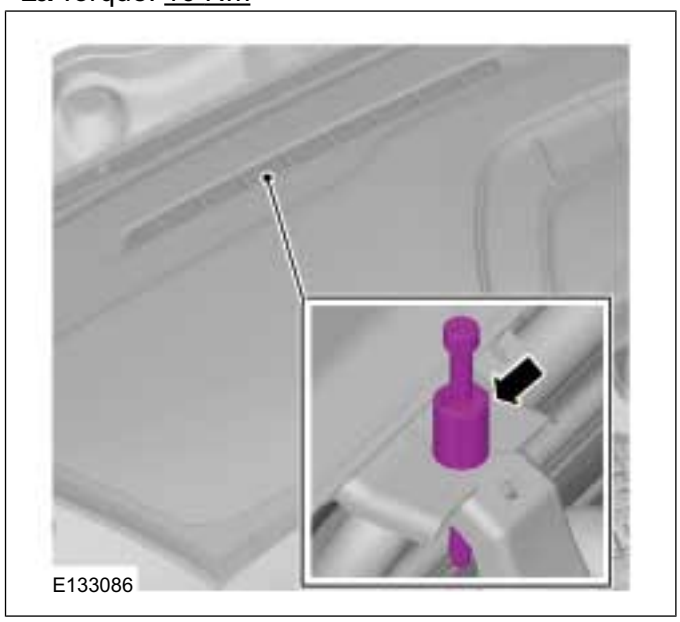


18. Torque: 15 Nm



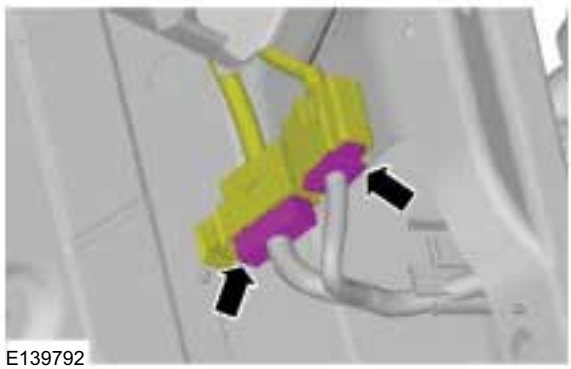
19. Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

20. Torque: 10 Nm



REMOVAL AND INSTALLATION

21.



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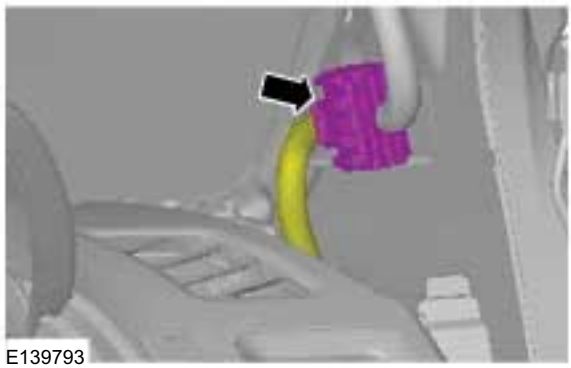
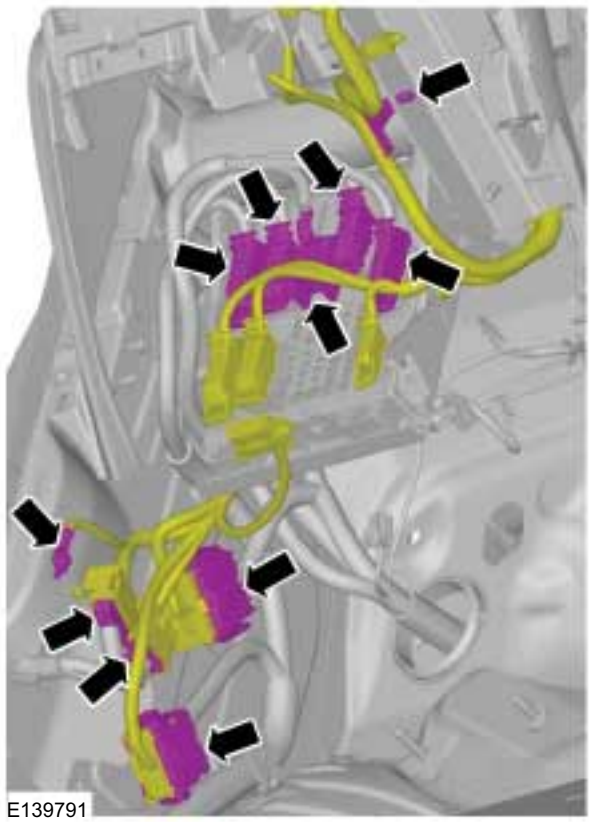


23.



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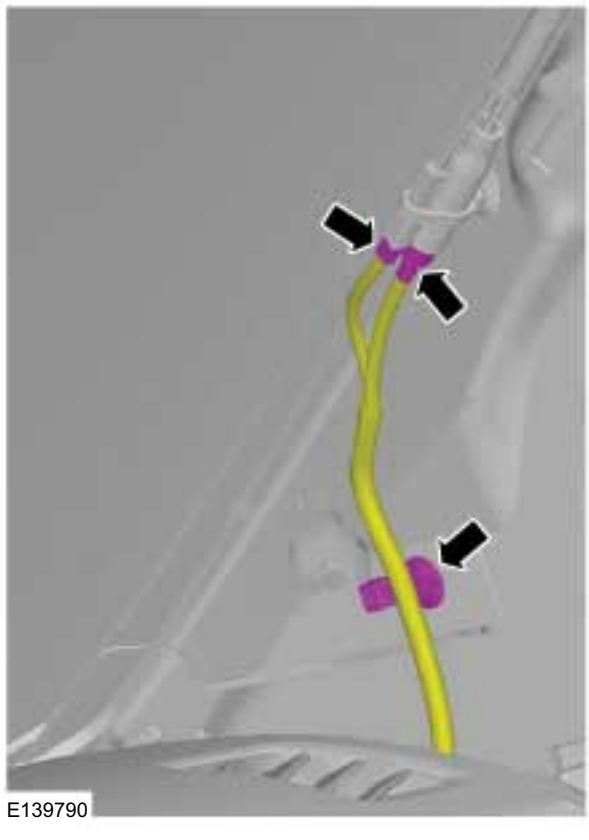
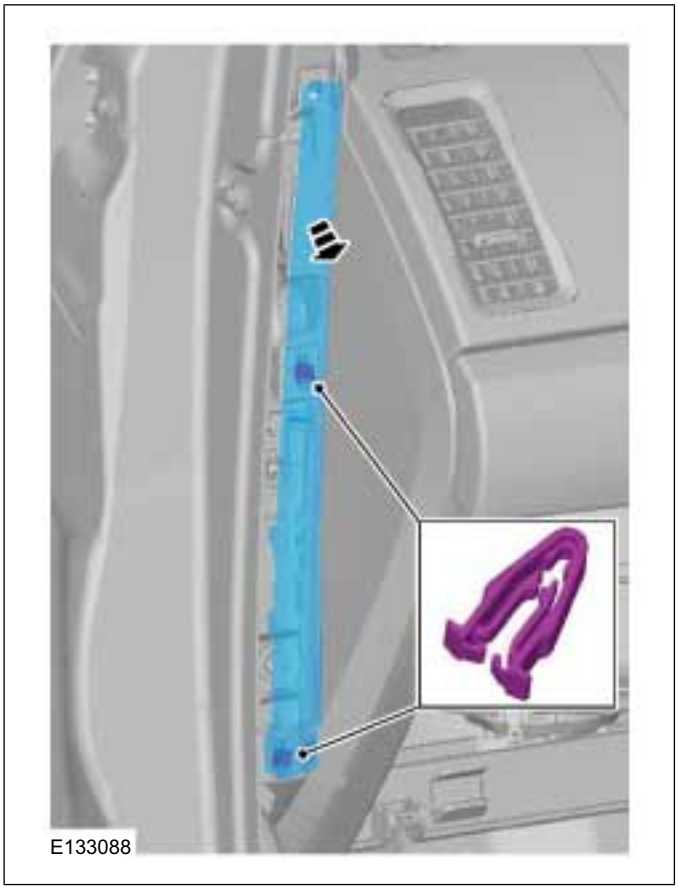
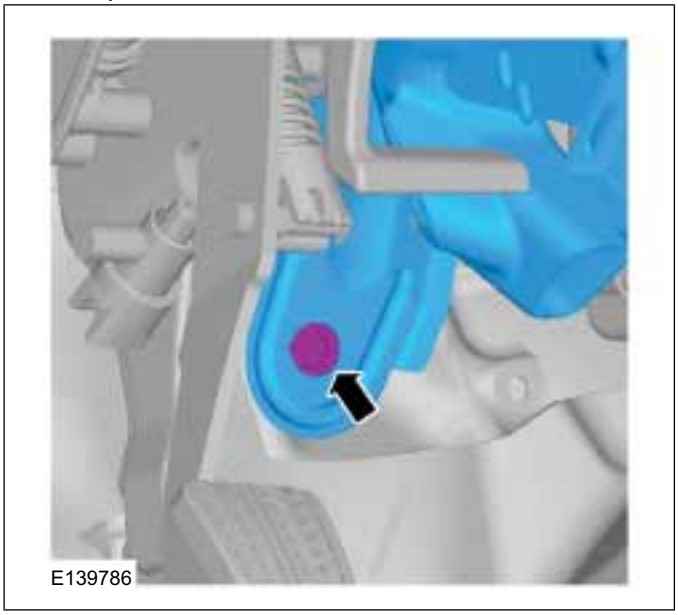


REMOVAL AND INSTALLATION

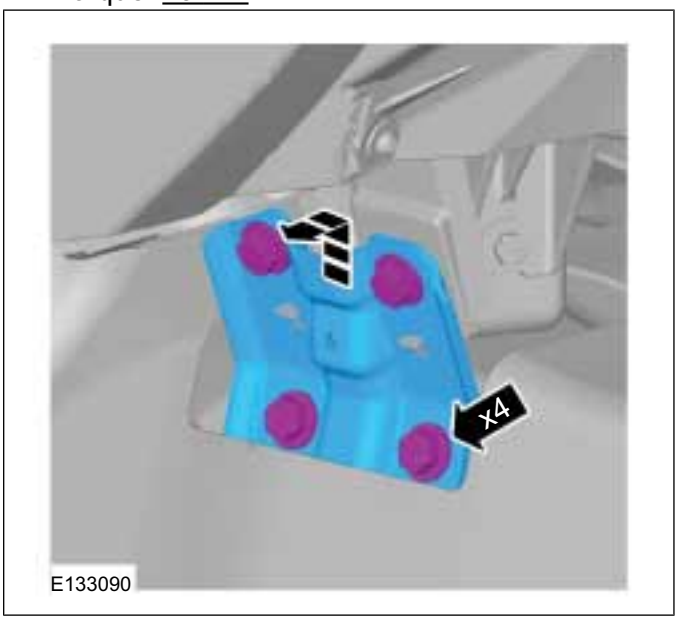
25. On both sides.



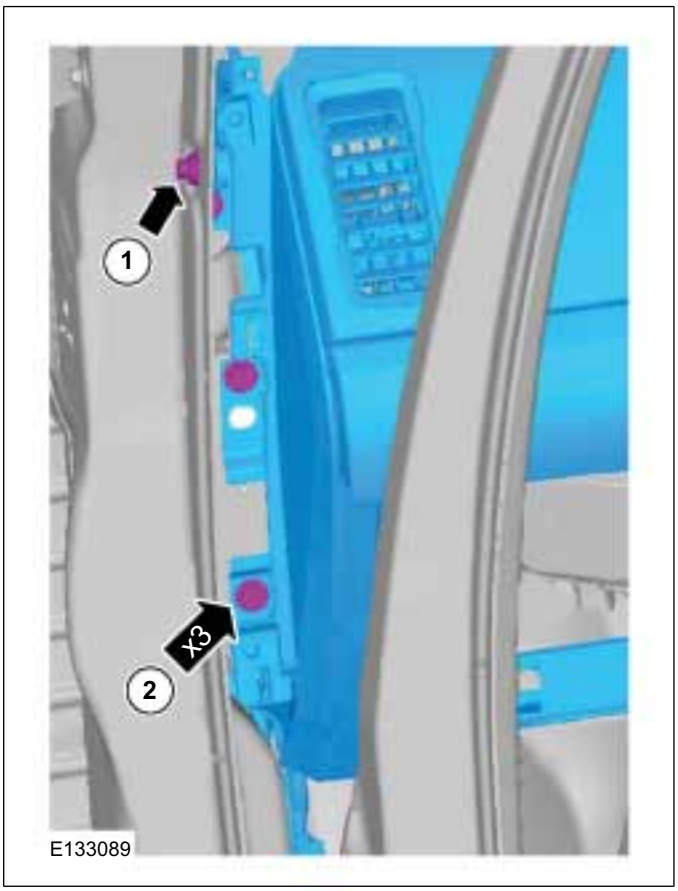
26. Torque: 25 Nm



27. On both sides.
Torque: 25 Nm

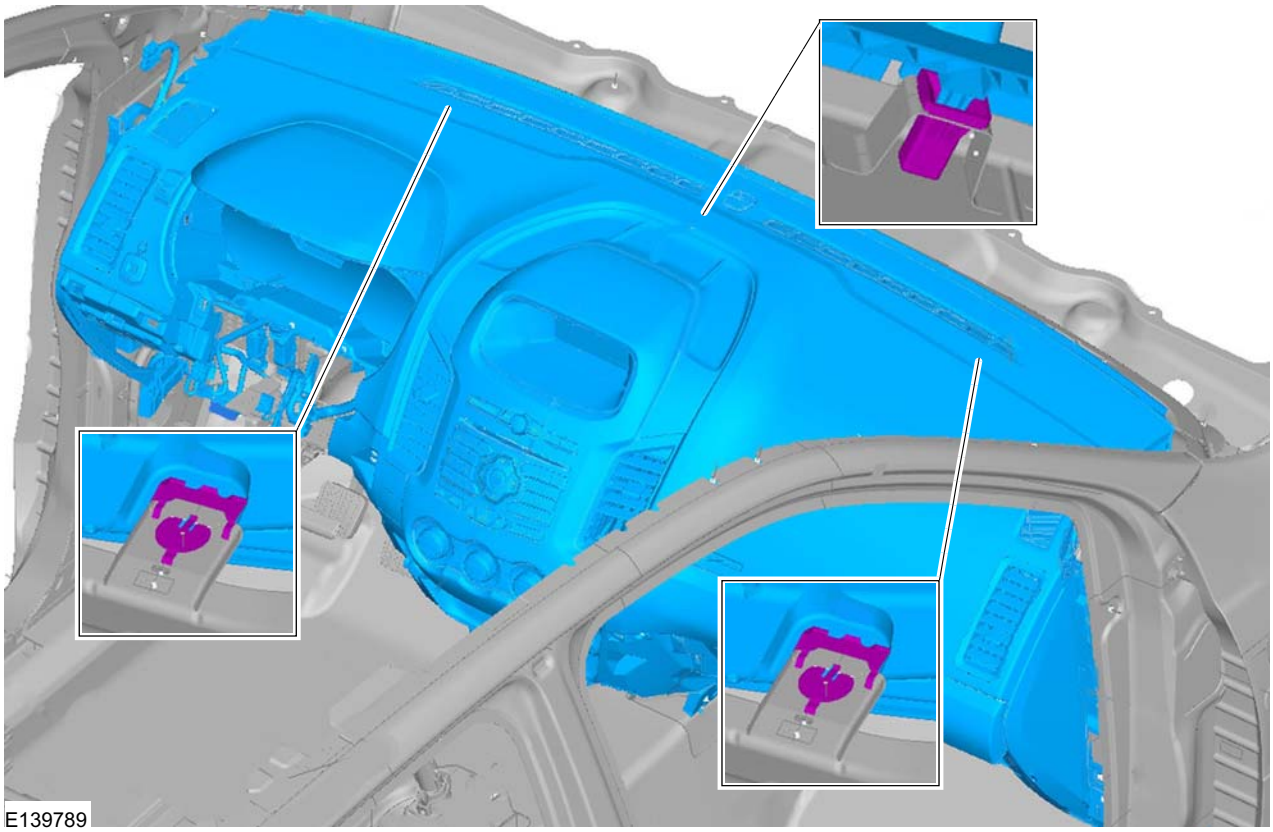


28. 1. On both sides.
Torque: 25 Nm
2. On both sides.
Torque: 25 Nm



29. NOTE: Note the position of the component before removal.

REMOVAL AND INSTALLATION

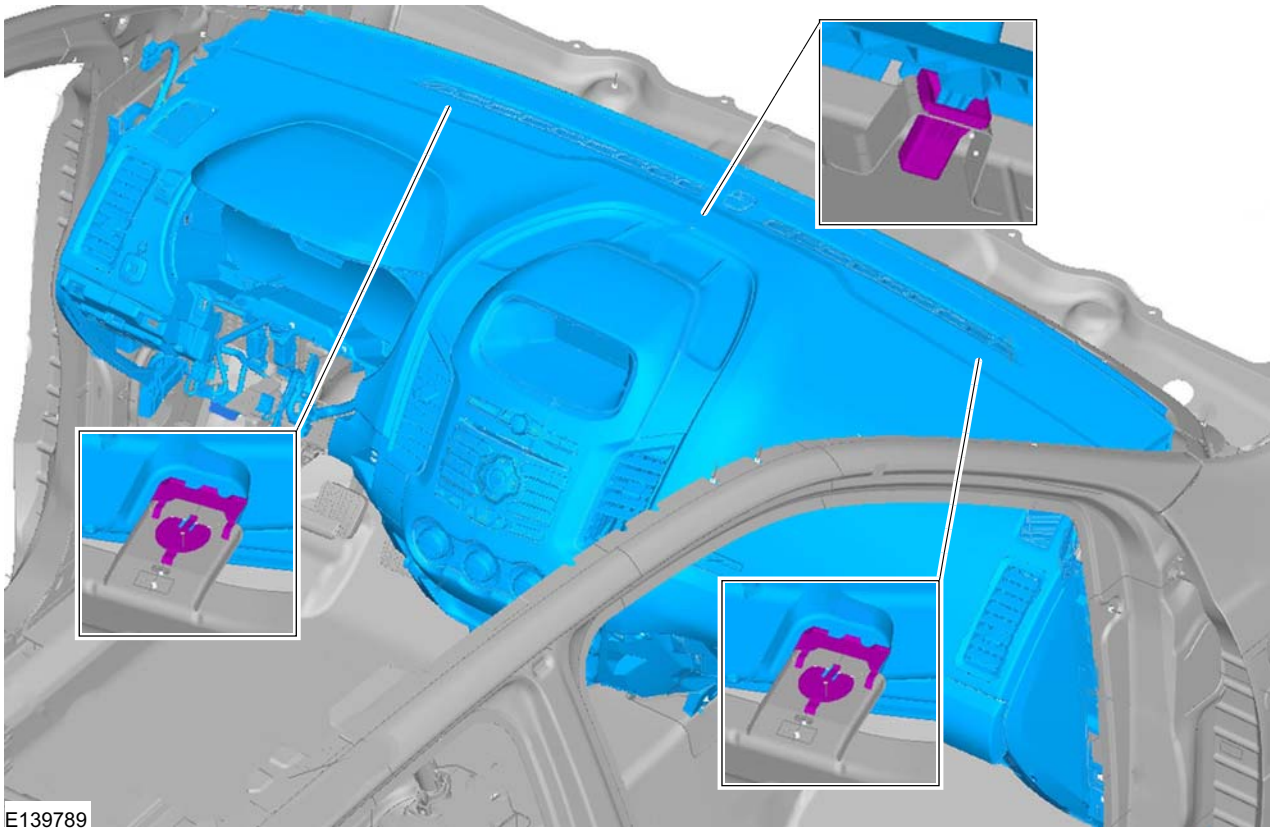


Installation

1. ⚠ **CAUTION: Make sure that the three locking positions are locked correctely.**

NOTE: Make sure that the adjuster is correctely alighned.

REMOVAL AND INSTALLATION



2. To install, reverse the removal procedure.
3. Configure the steering column module.
   General Equipment: Ford Diagnostic Equipment

REMOVAL AND INSTALLATION

Instrument Panel — RHD 4WD/RHD RWD

General Equipment

Ford Diagnostic Equipment

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: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

Single cab

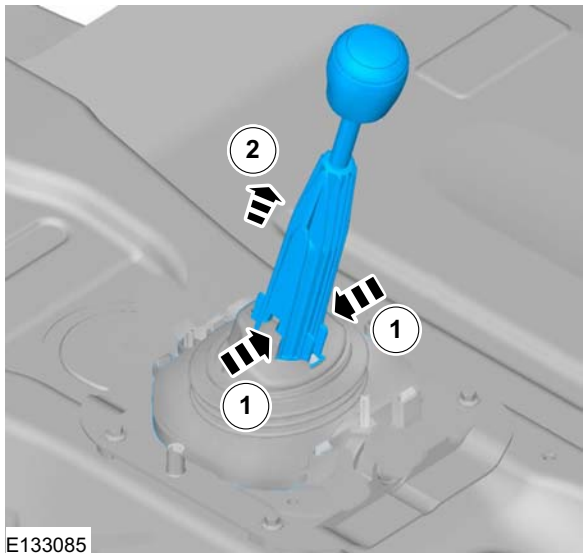
2. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).

Double cab

3. Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

Vehicles with manual transmission

4.



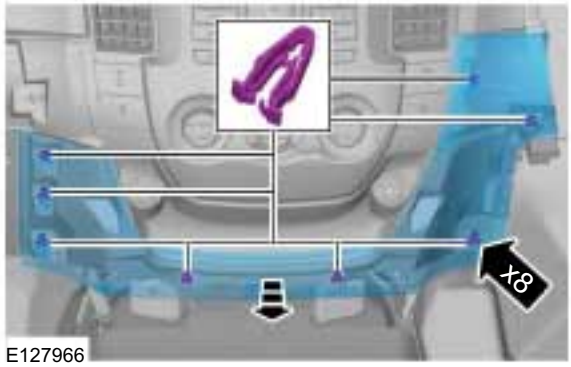
REMOVAL AND INSTALLATION

Vehicles with driver lower air bag

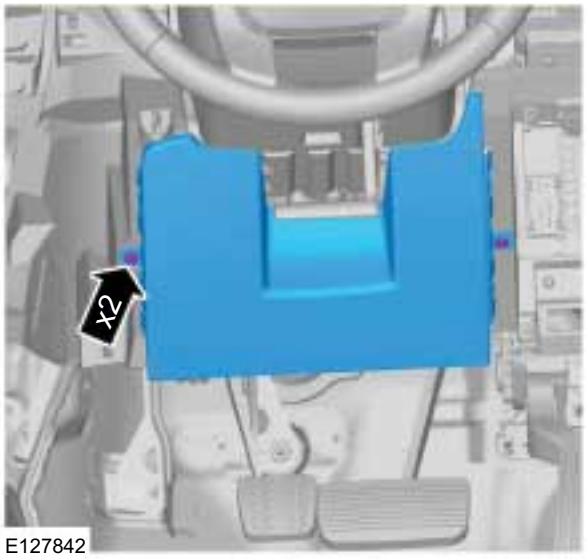
5. Refer to: Driver Lower Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation).

Vehicles without driver lower air bag

6.



7. Torque: 2 Nm

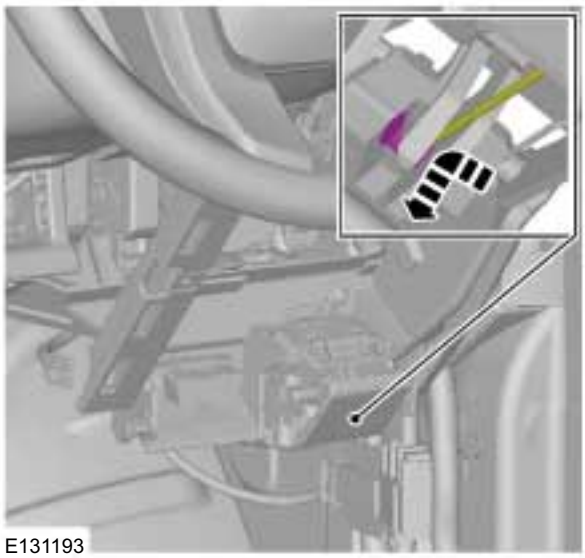


All vehicles

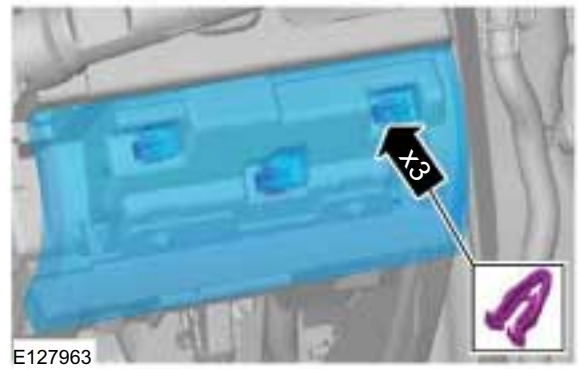
8. Refer to: Glove Compartment (501-12 Instrument Panel and Console, Removal and Installation).

9. Refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

10.

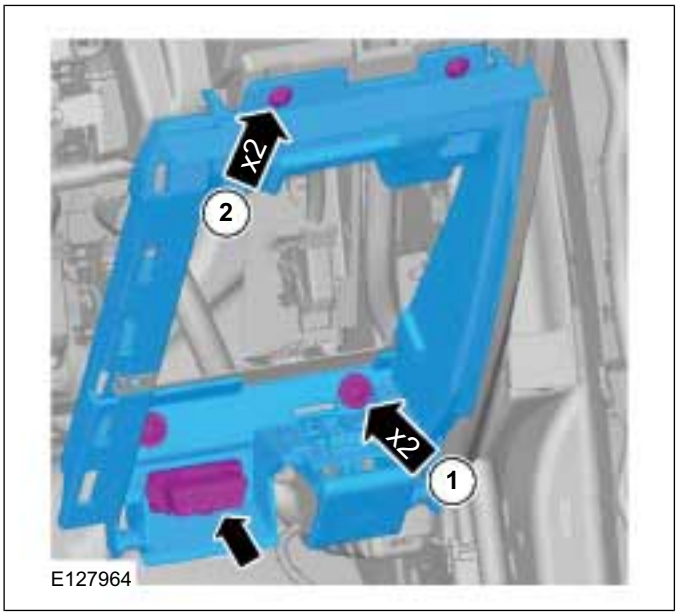


11.

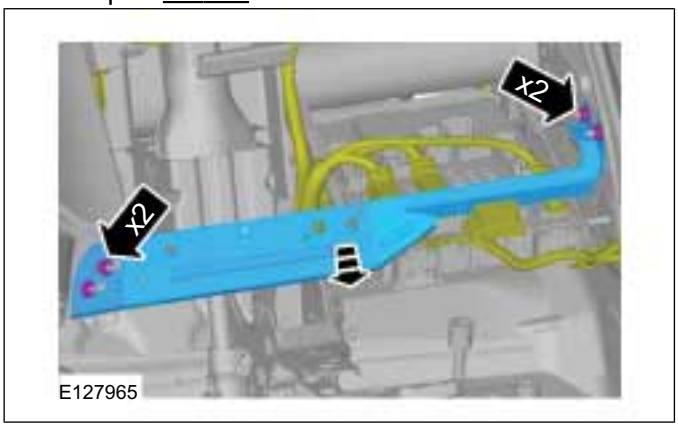


REMOVAL AND INSTALLATION

12. 1. Torque: 3 Nm
2. Torque: 2 Nm



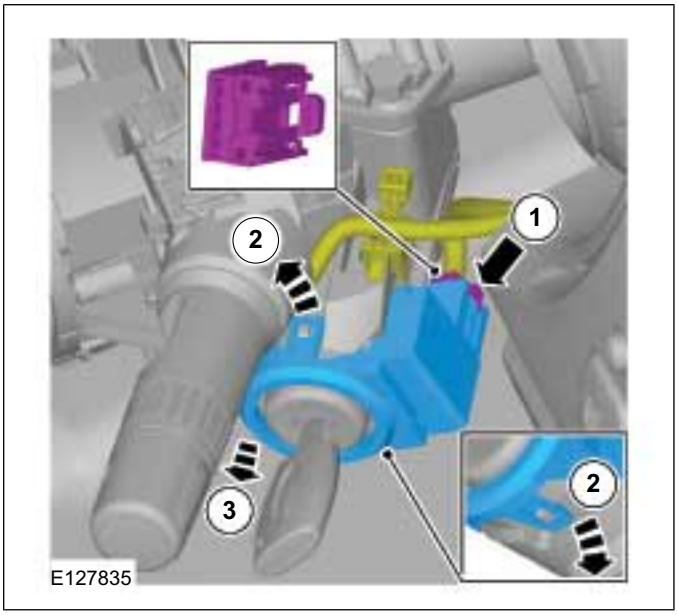
13. Torque: 10 Nm



14. Refer to: Ignition Switch (211-05 Steering Column Switches, Removal and Installation).

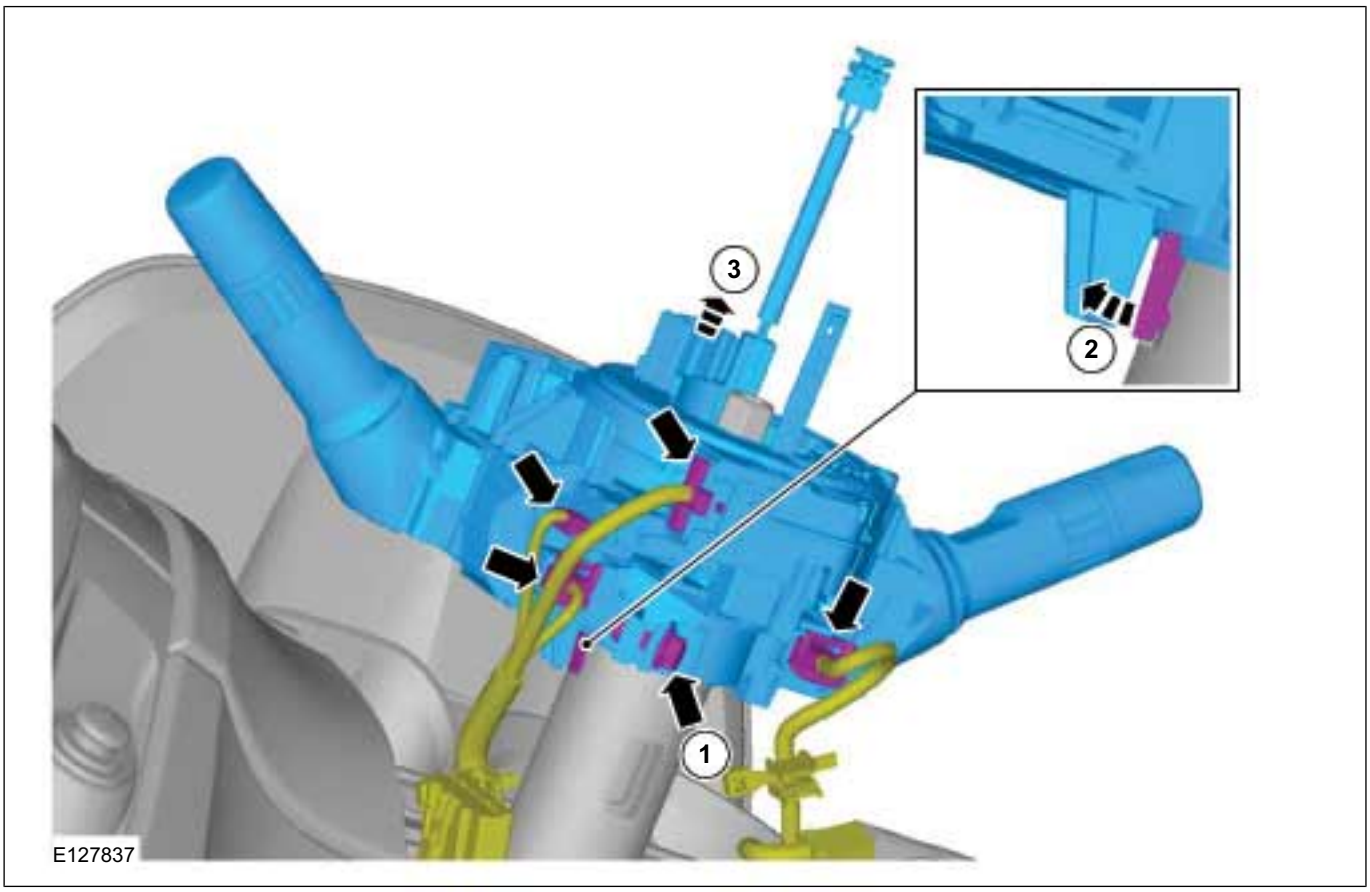
15. Refer to: Steering Wheel (211-04 Steering Column, Removal and Installation).

16.

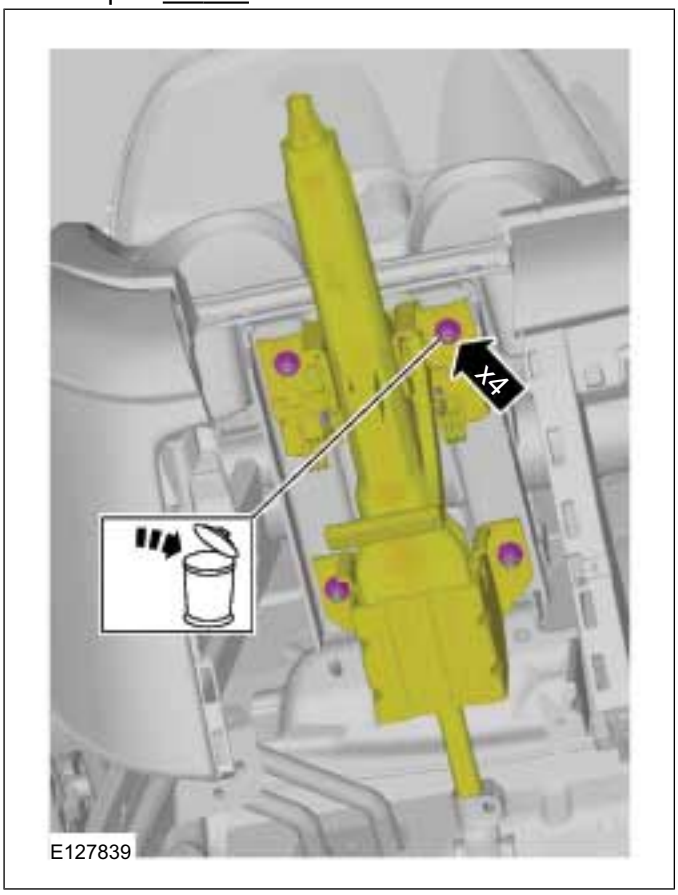


17. Torque: 7 Nm

REMOVAL AND INSTALLATION

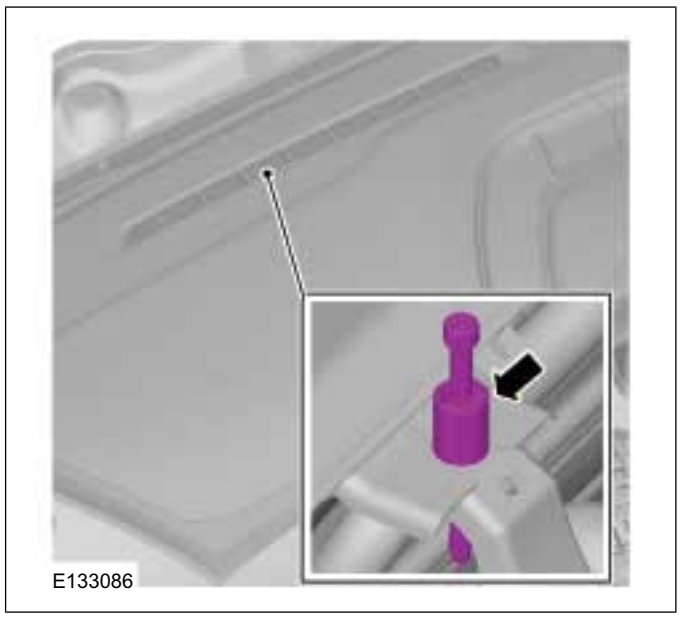


18. Torque: 15 Nm



19. Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

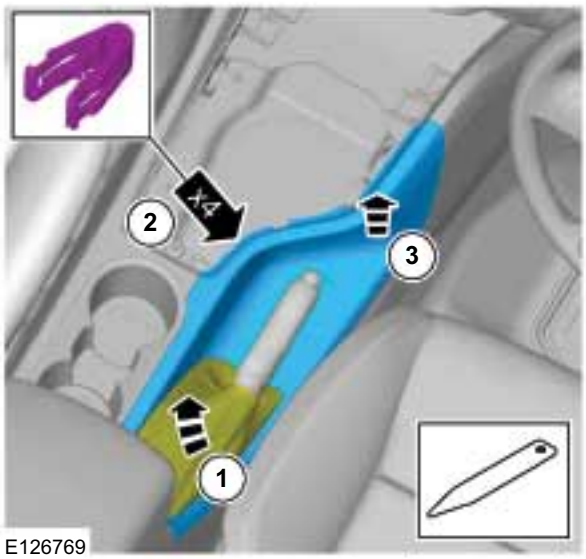
20.



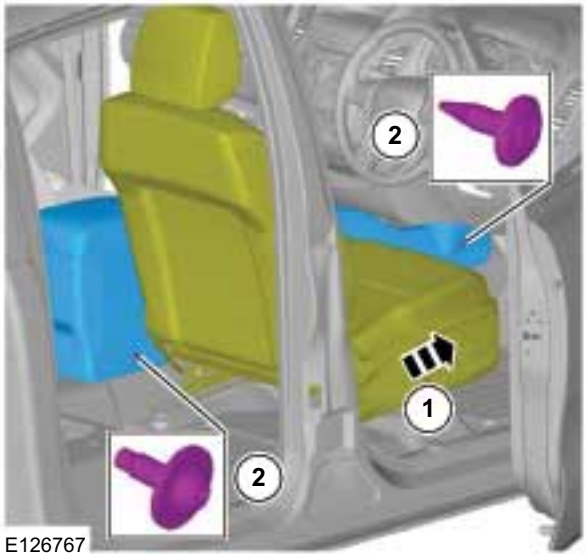
REMOVAL AND INSTALLATION

All vehicles

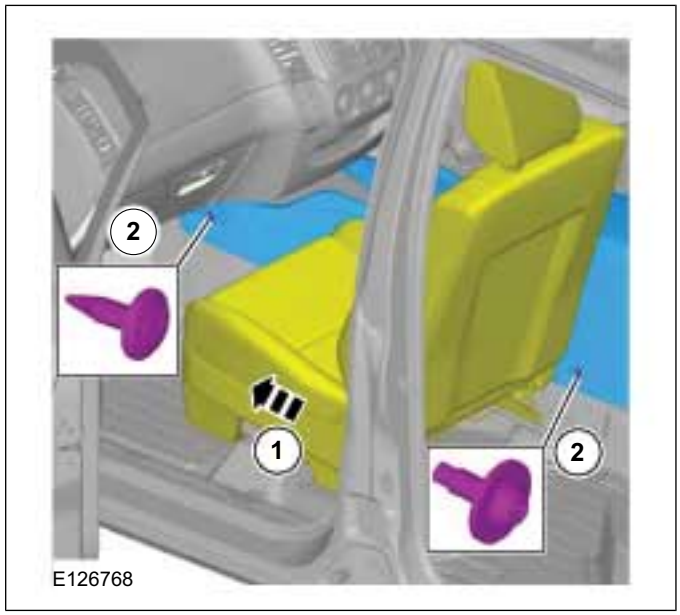
6.



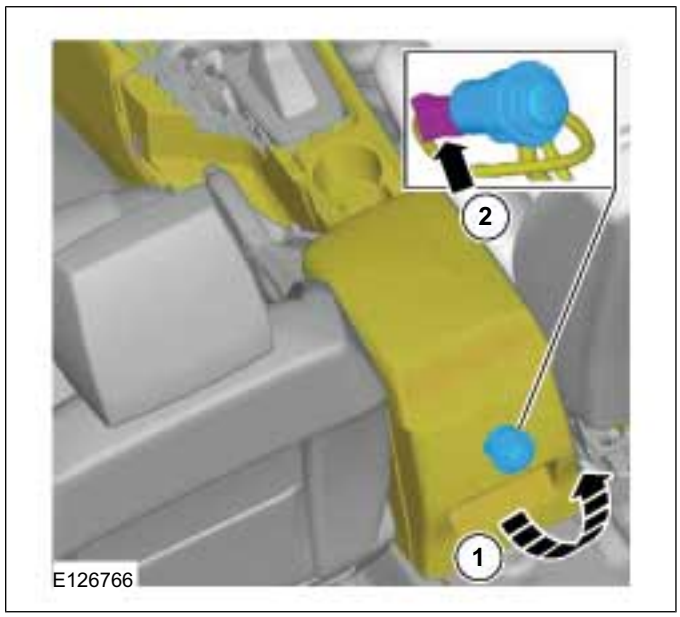
7. 2. Torque: 6 Nm



8. 2. Torque: 6 Nm

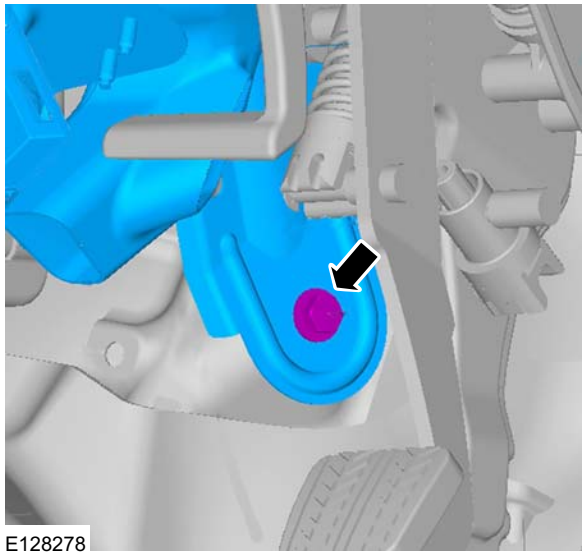


9.

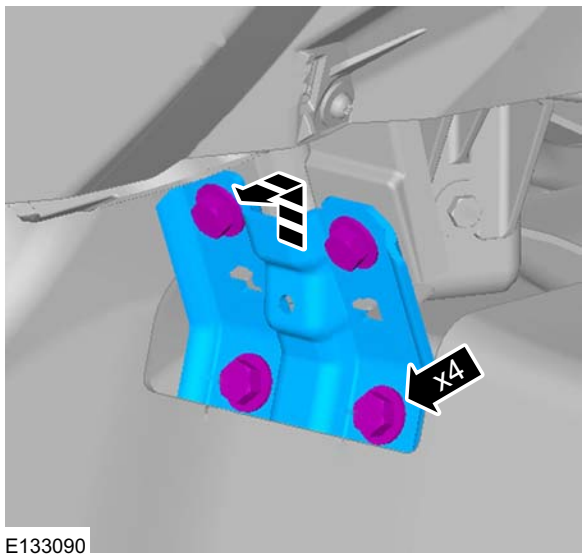


REMOVAL AND INSTALLATION

25. Torque: 25 Nm

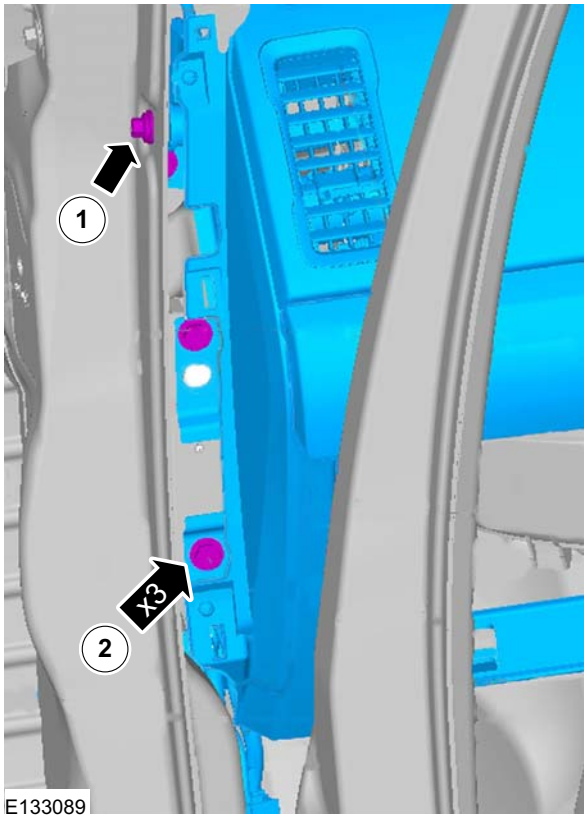

E128278

26. On both sides.
Torque: 25 Nm



E133090

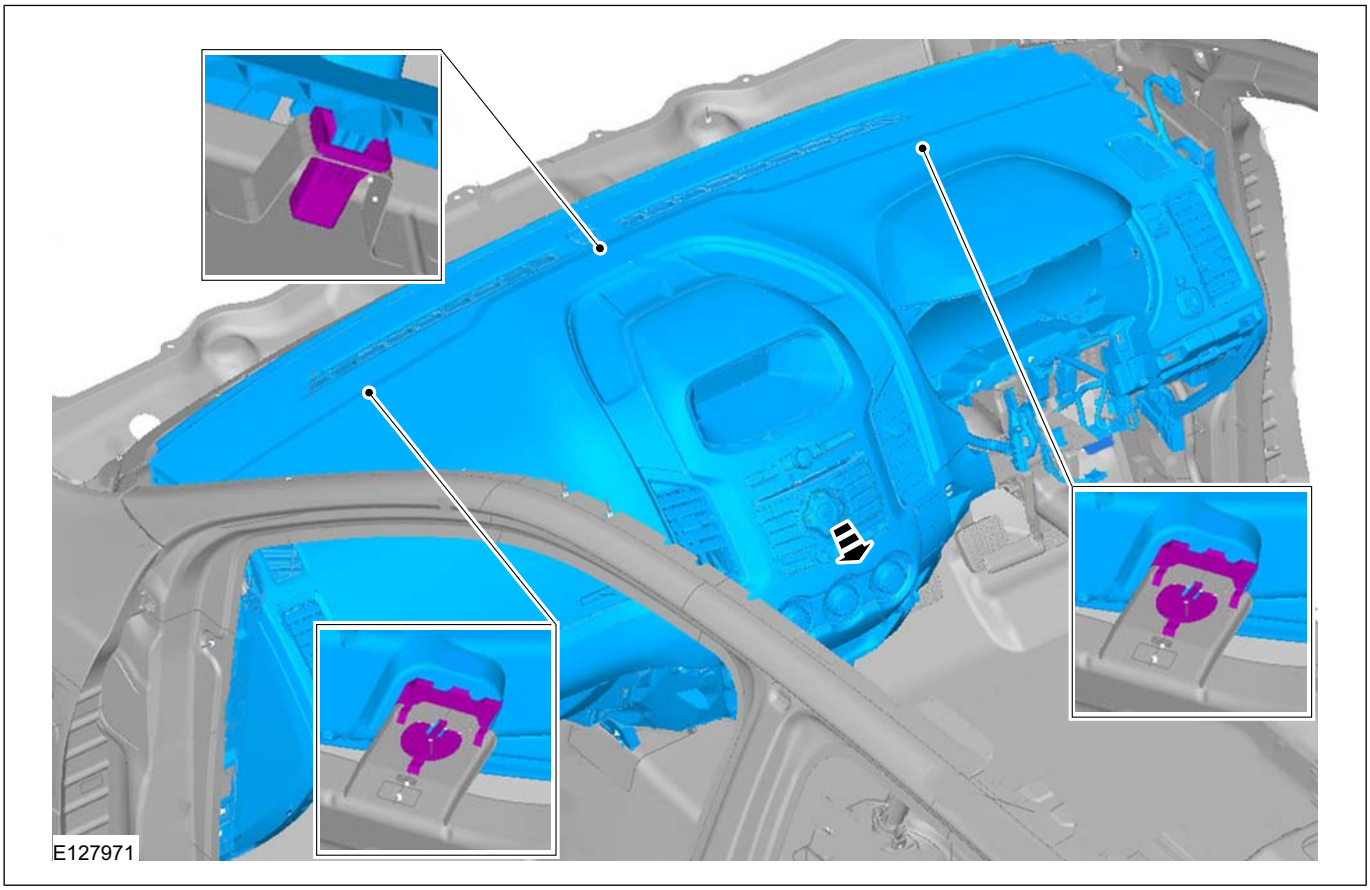
27. 1. On both sides.
Torque: 25 Nm
2. On both sides.
Torque: 25 Nm



E133089

28. NOTE: Note the position of the component before removal.

REMOVAL AND INSTALLATION

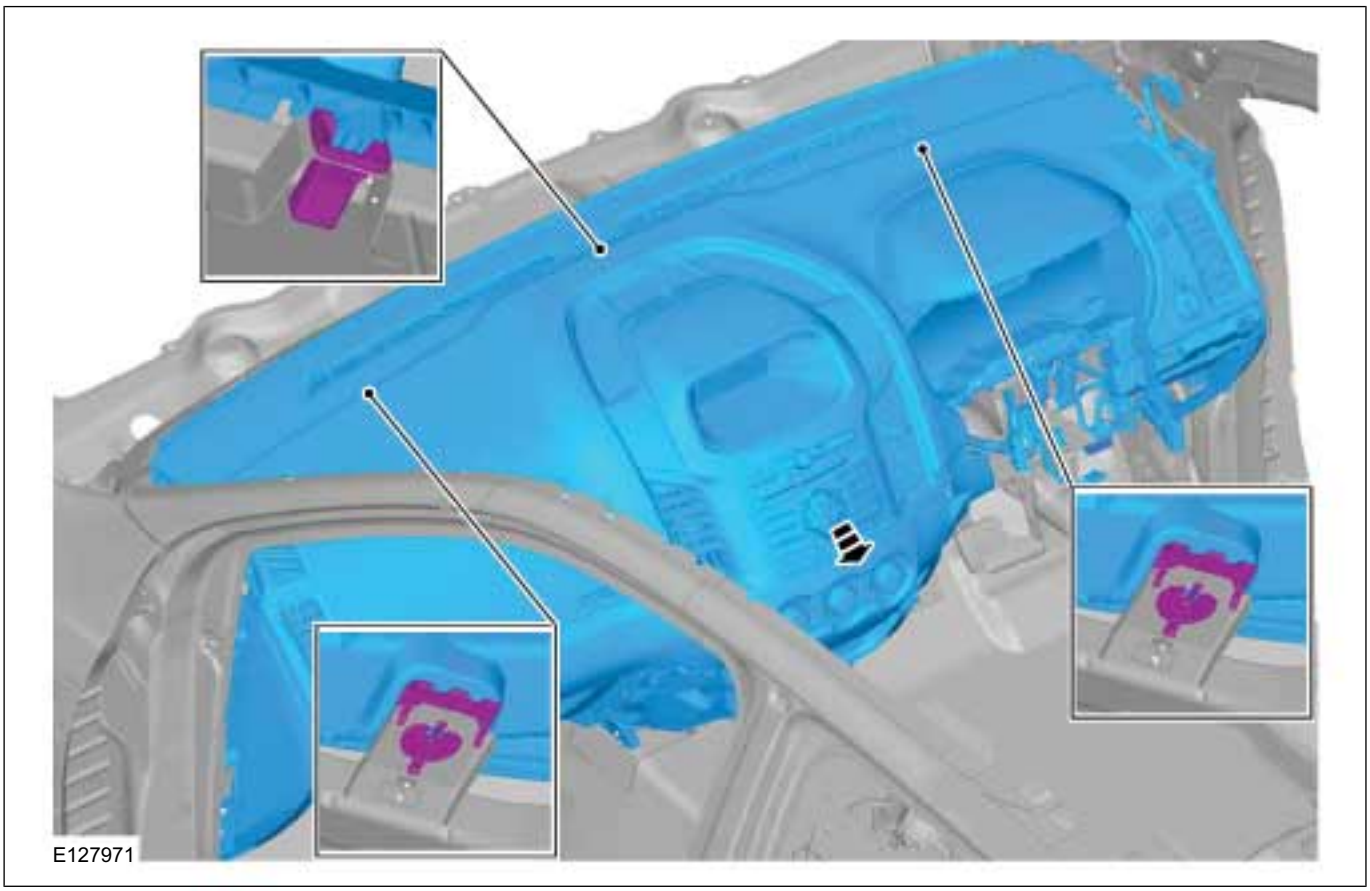


Installation

1. ⚠ **CAUTION: Make sure that the three locking positions are locked correctely.**

NOTE: Make sure that the adjuster is correctely alighned.

REMOVAL AND INSTALLATION



2. To install, reverse the removal procedure.
3. Configure the steering column module.
   General Equipment: Ford Diagnostic Equipment

REMOVAL AND INSTALLATION

Floor Console — Single Cab

Removal

NOTE: Removal steps in this procedure may contain installtion details.

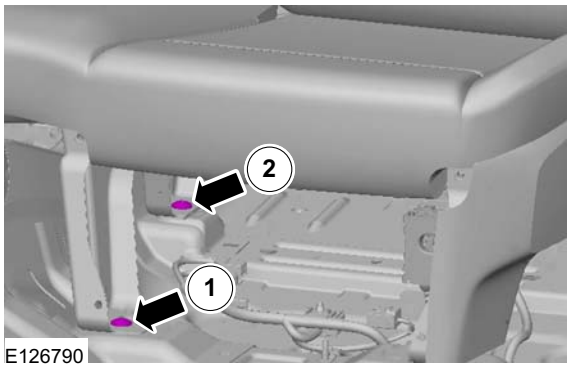
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

Driver and passenger seat

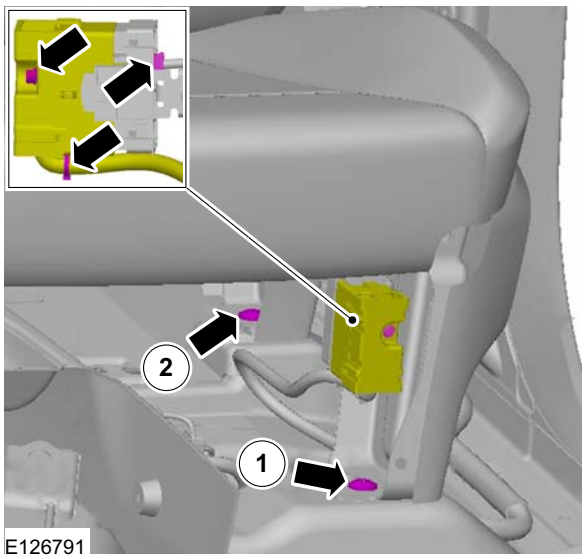
3. Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

Vehicles with front bench seat

4. Torque: 50 Nm



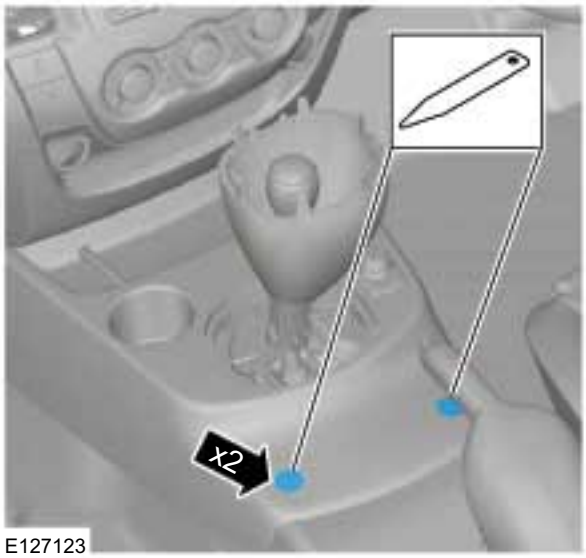
5. Torque: 50 Nm



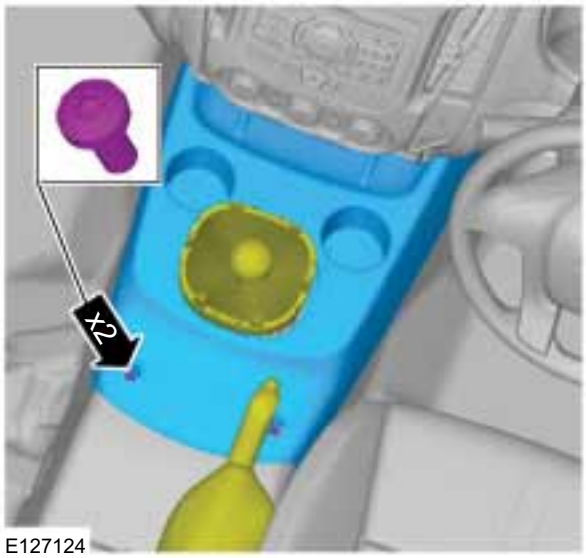
6.

REMOVAL AND INSTALLATION

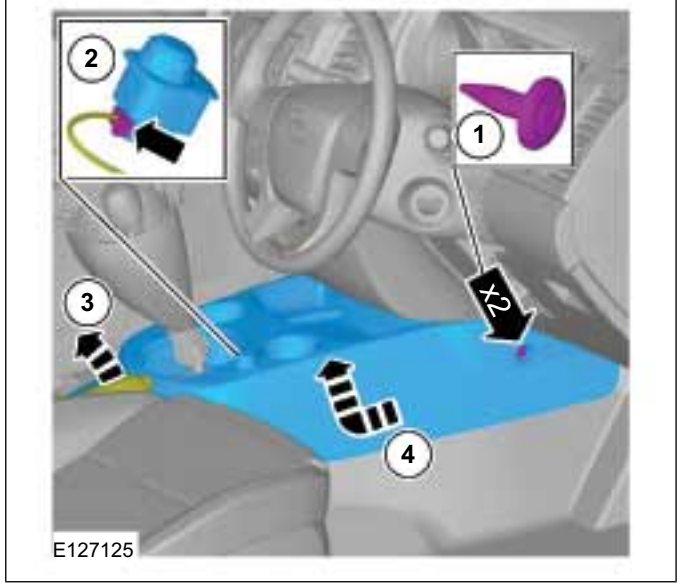
7.



8. Torque: 6 Nm



9.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Floor Console — Double Cab

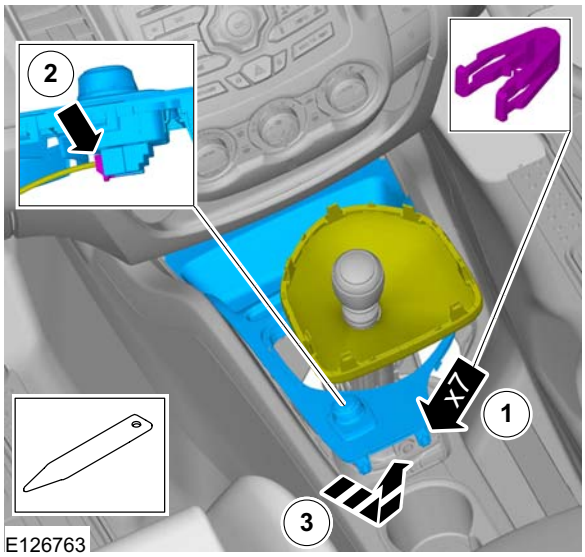
Removal

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. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

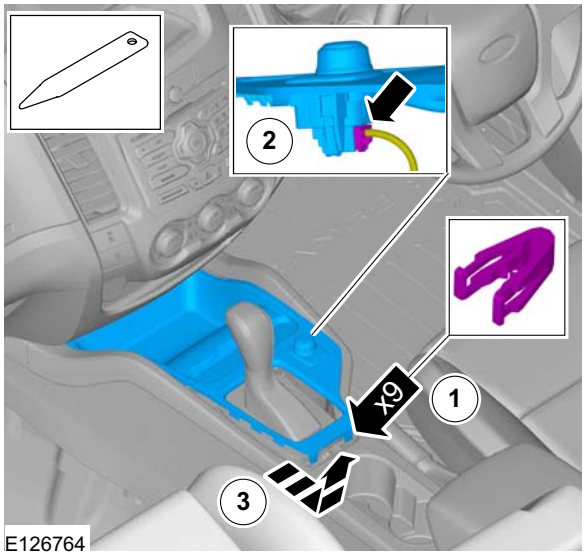
Vehicles with manual transmission

3.

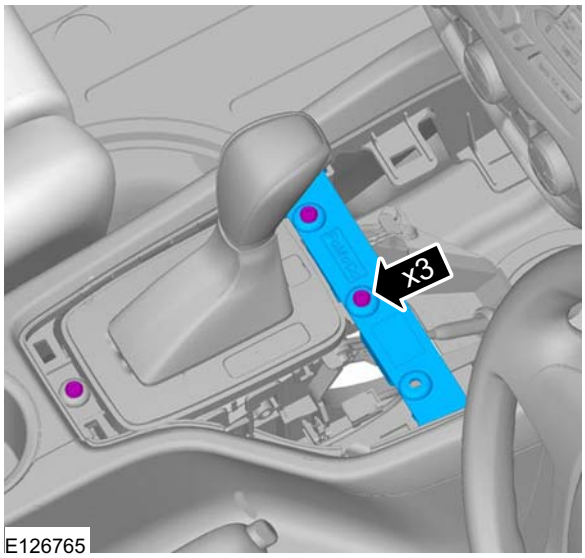


Vehicles with automatic transmission

4.



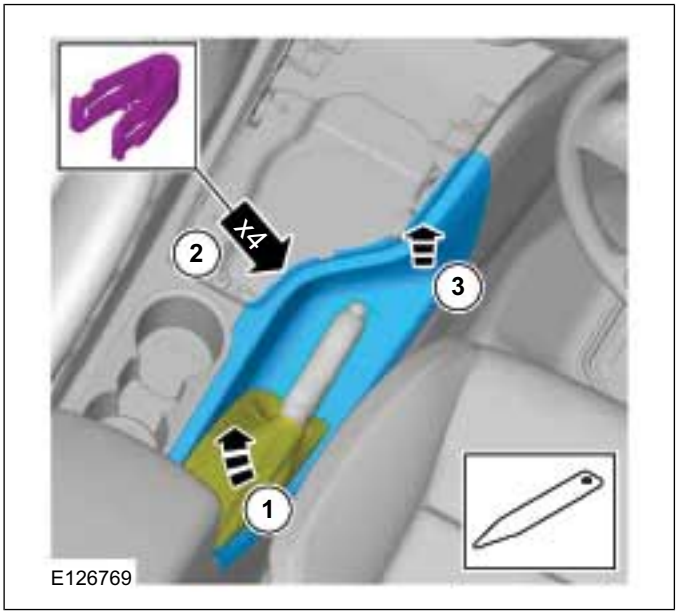
5. Torque: 2 Nm



REMOVAL AND INSTALLATION

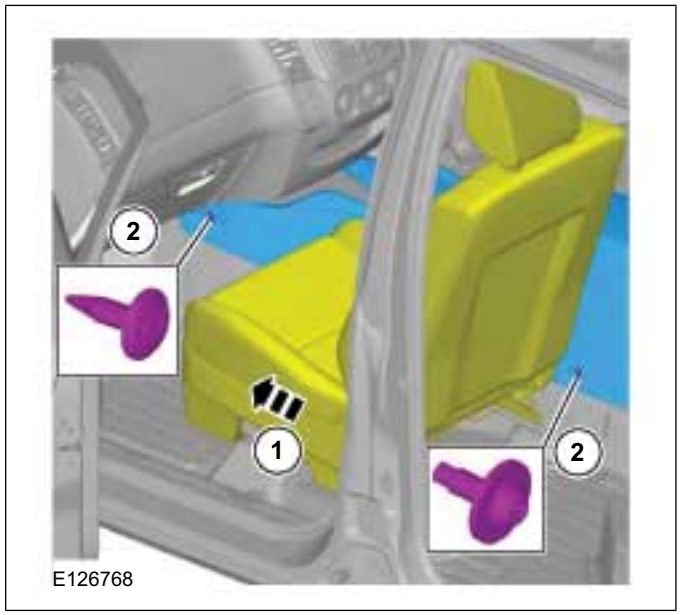
All vehicles

6.

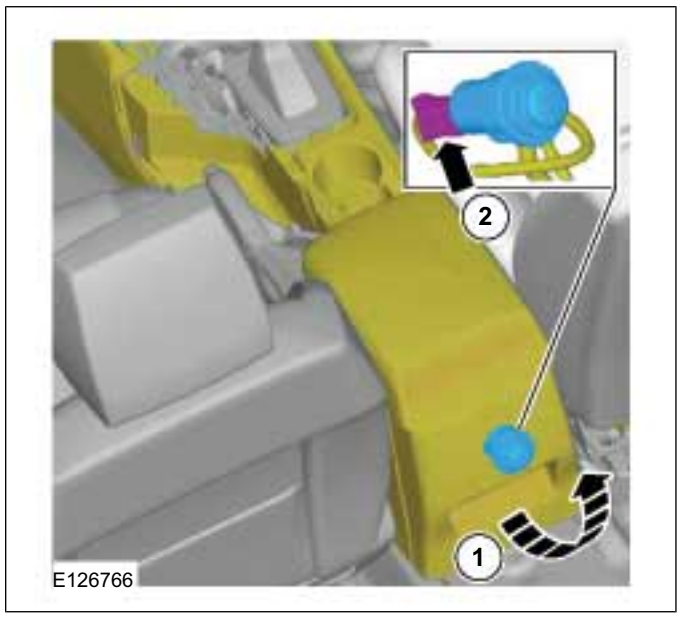


7. 2. Torque: 6 Nm

8. 2. Torque: 6 Nm

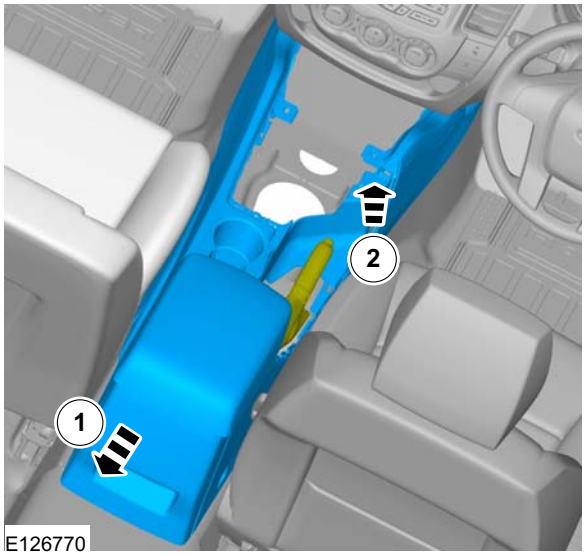


9.



REMOVAL AND INSTALLATION

10.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

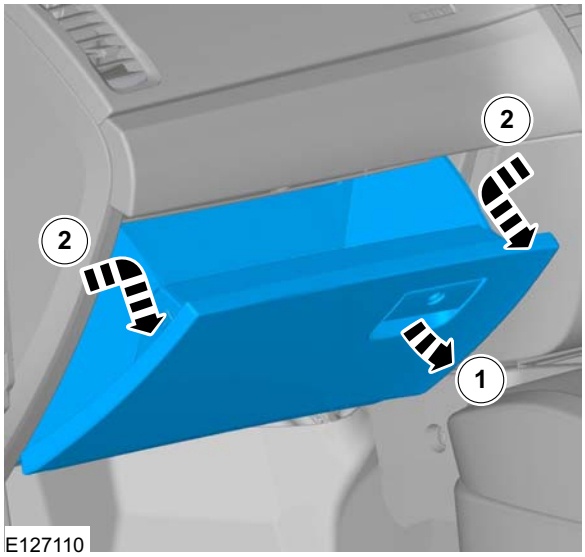
Glove Compartment

Removal

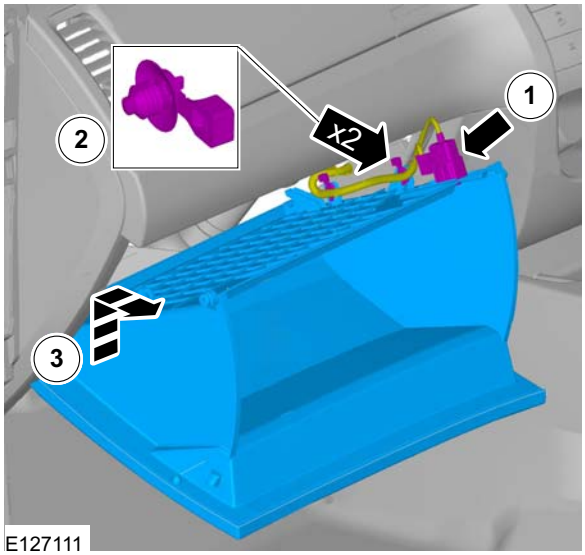
NOTE: Removal steps in this procedure may contain installtion details.

1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

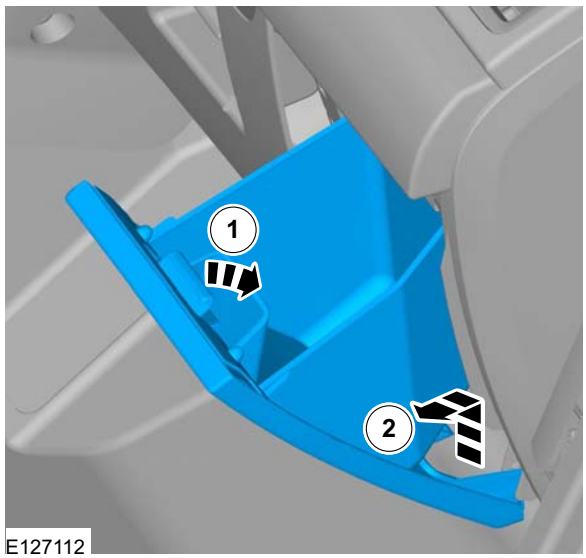
2.



3.



4.



Installation

NOTE: Make sure that the passenger glove box lamp is correctly located.

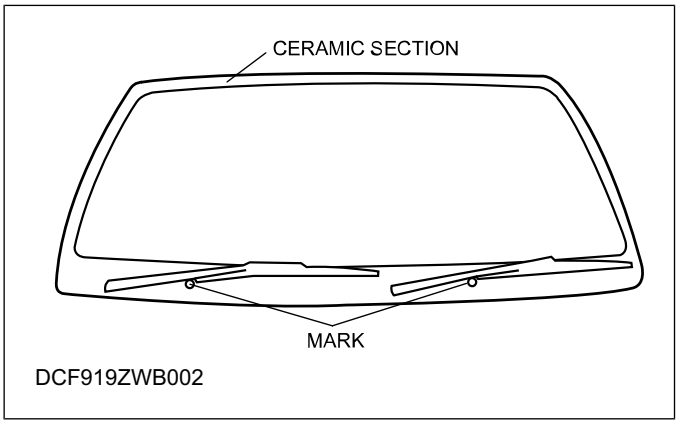
1. To install, reverse the removal procedure.

GENERAL PROCEDURES

Windshield Wiper Blade and Pivot Arm Adjustment

1. **Operate the windshield wipers, and then turn off the windshield wiper motor to set the wipers in the park position.**
2. **NOTE: If the hollowed mark in the ceramic coating cannot be located, measure the distance from the cowl grille end line, and adjust the windshield wiper arm and blade.**

   Slide the serrated connecting part and adjust the windshield wiper arm and blade so that its end is aligned with the hollowed mark in the ceramic coating.



DCF919ZWB002

REMOVAL AND INSTALLATION

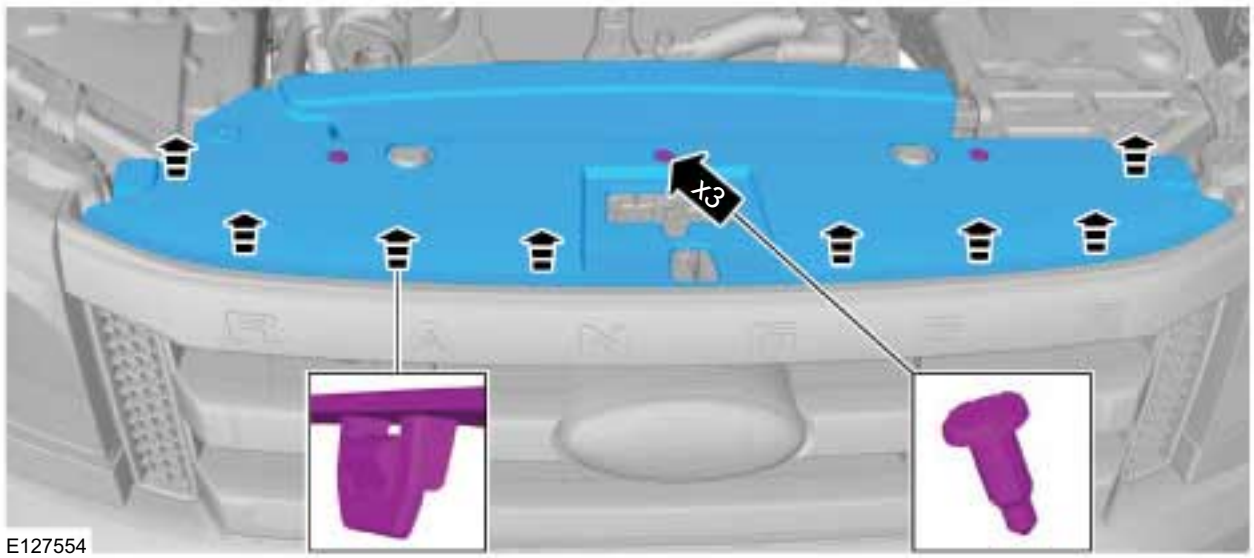
Front Bumper Cover

Removal

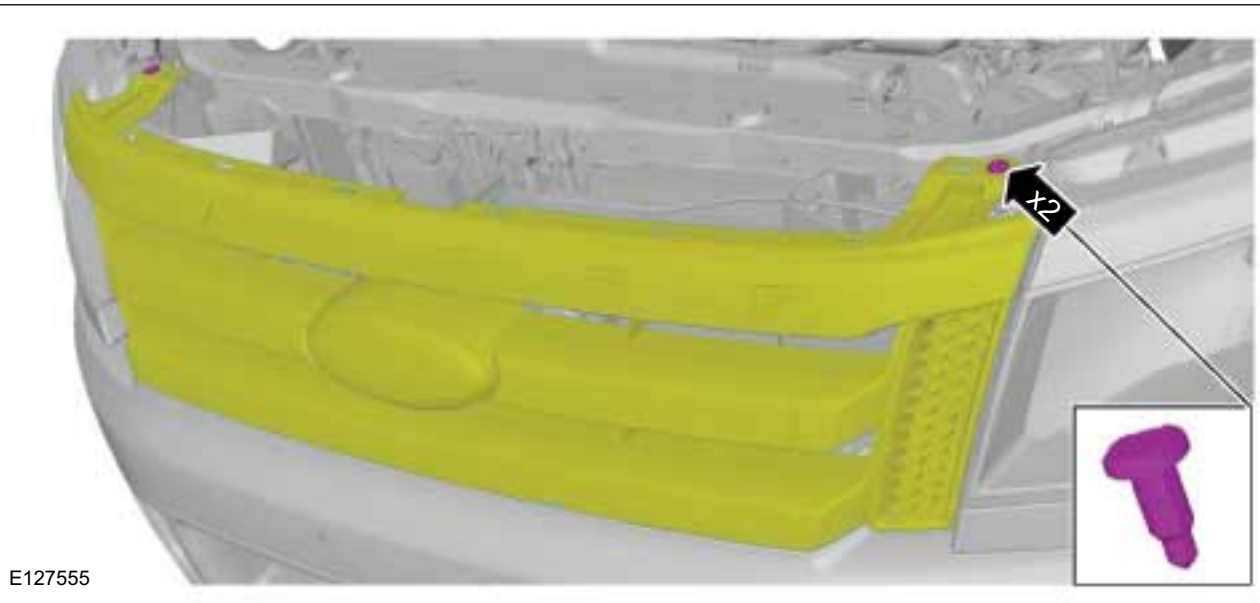
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

2.



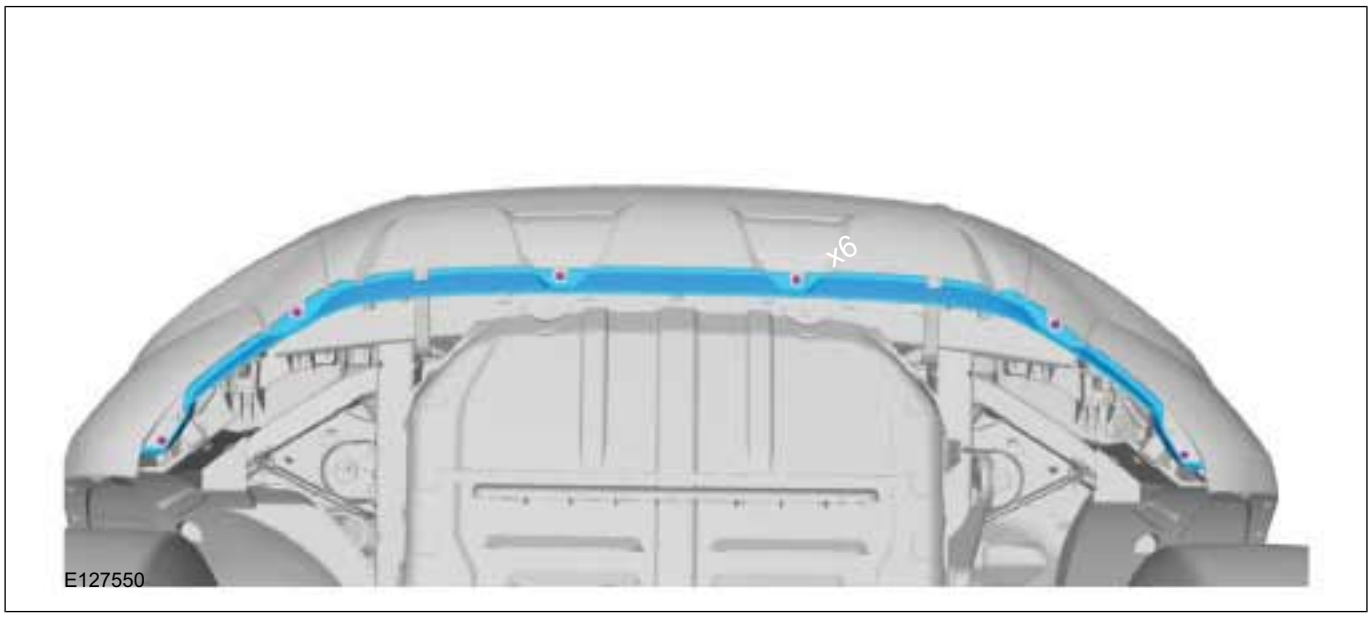
3.



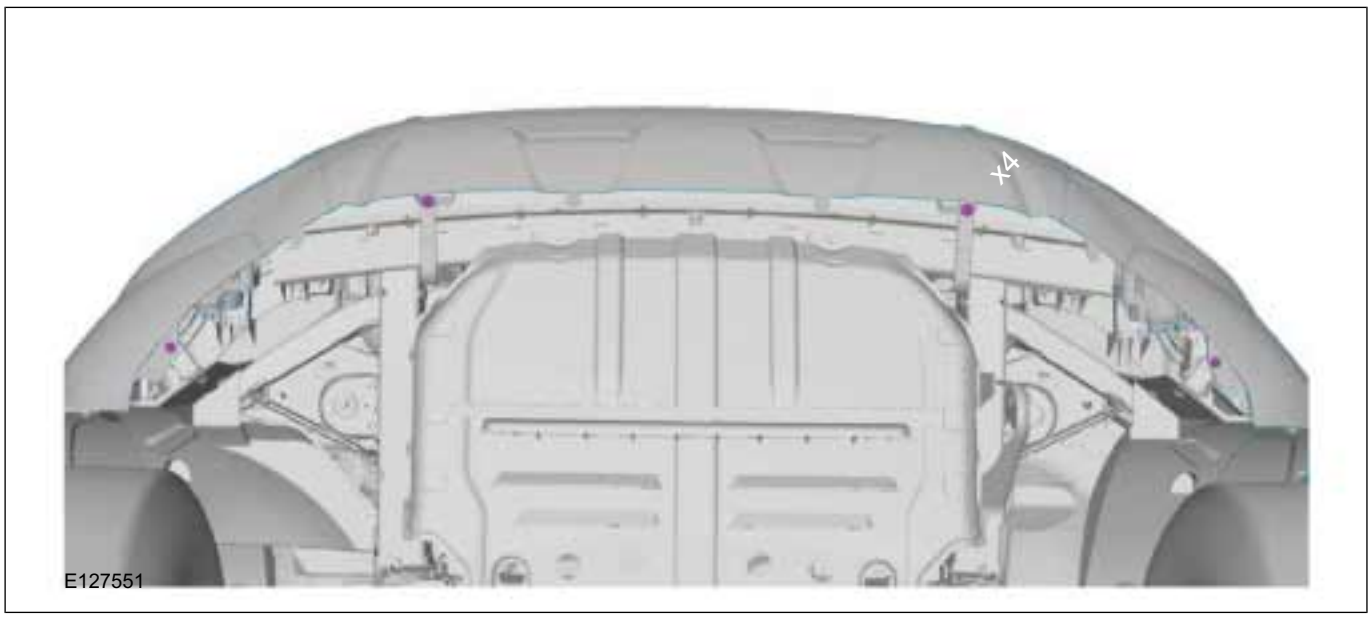
4. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

5.

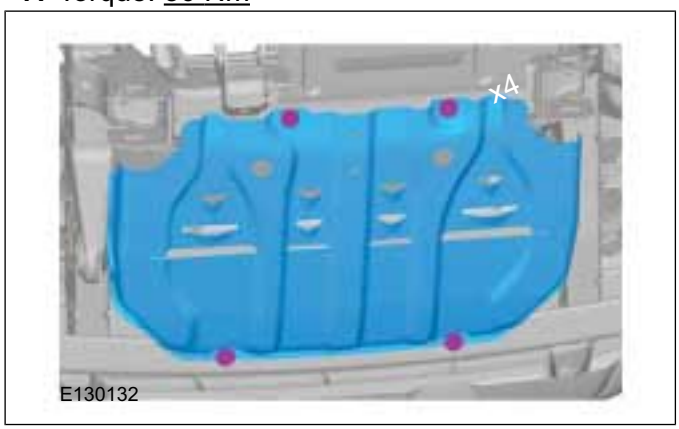
REMOVAL AND INSTALLATION



6.

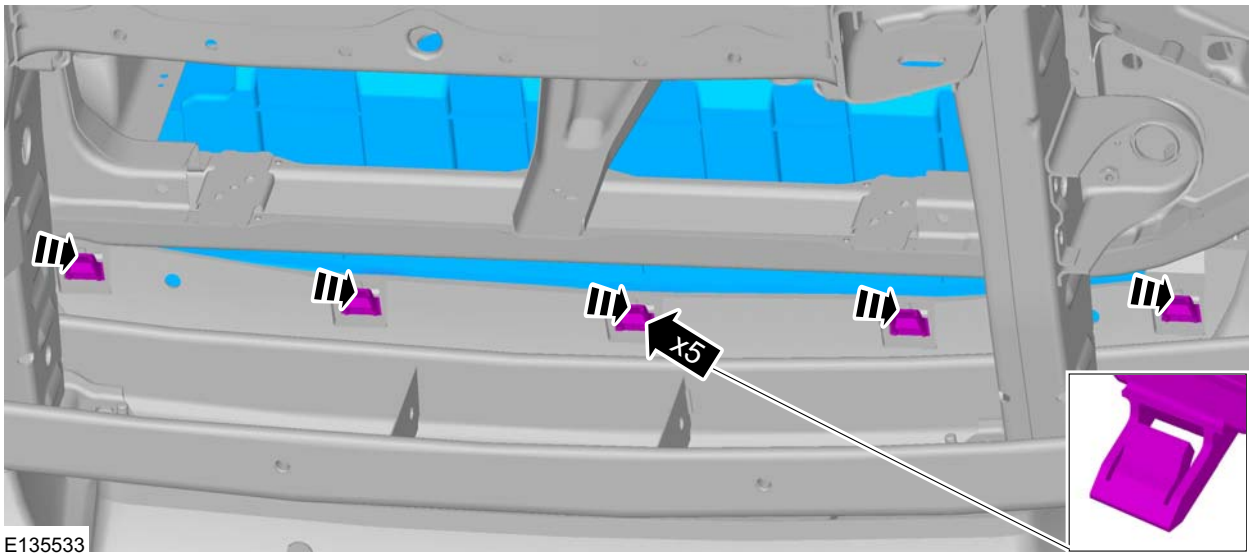


7. Torque: 30 Nm

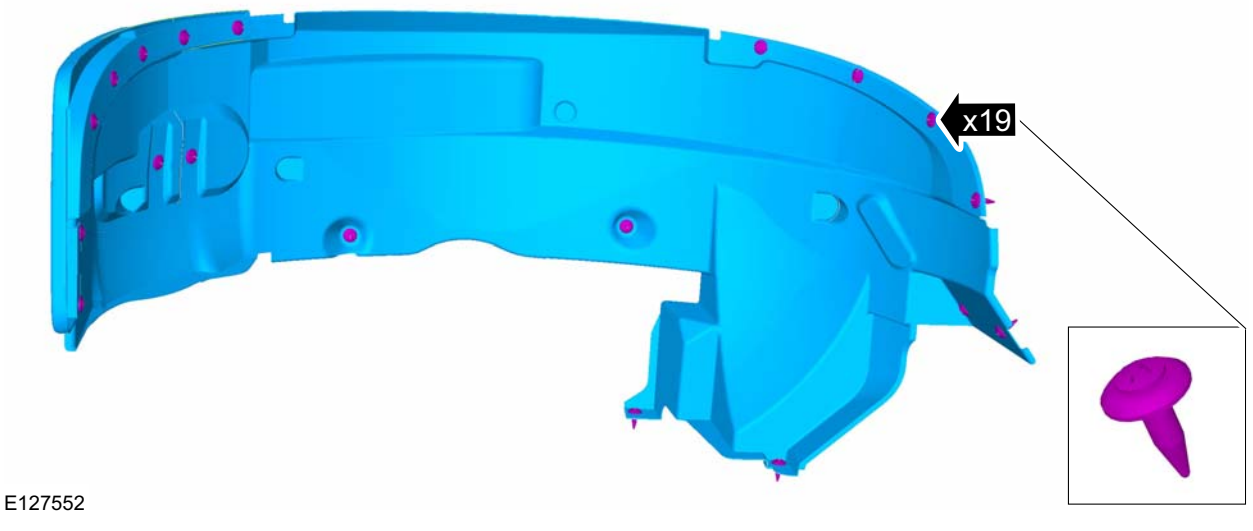


8.

REMOVAL AND INSTALLATION

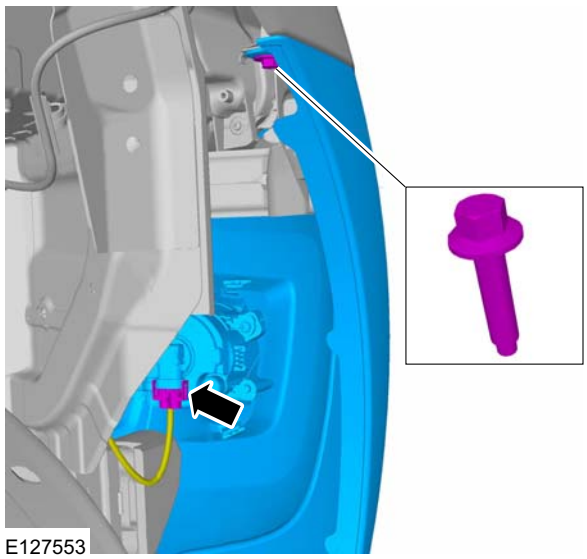


9. On both the sides.

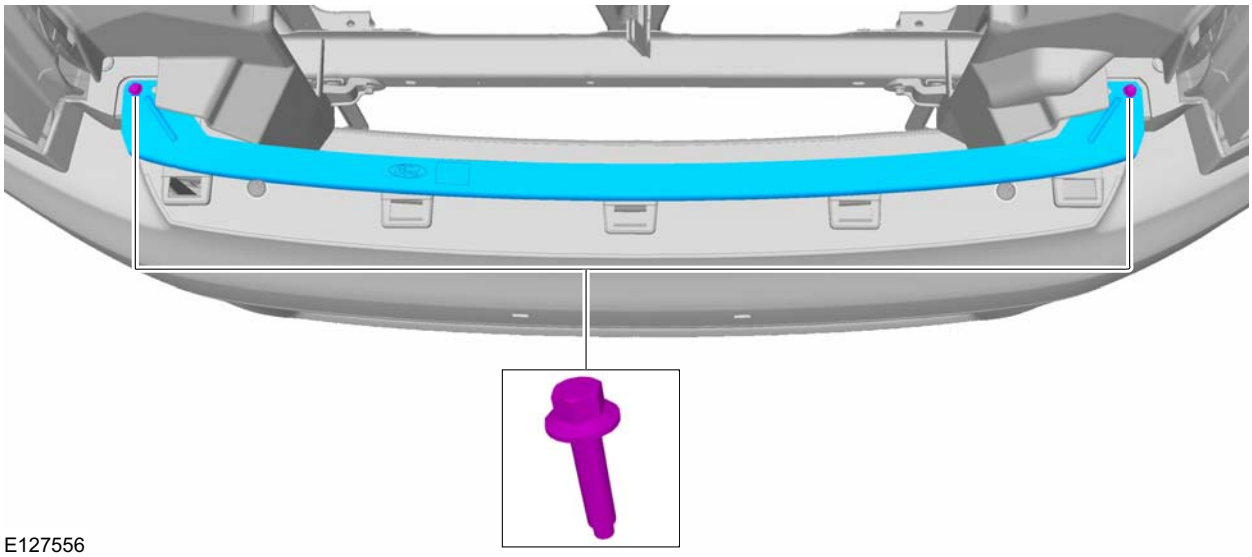


REMOVAL AND INSTALLATION

10. On both the sides.

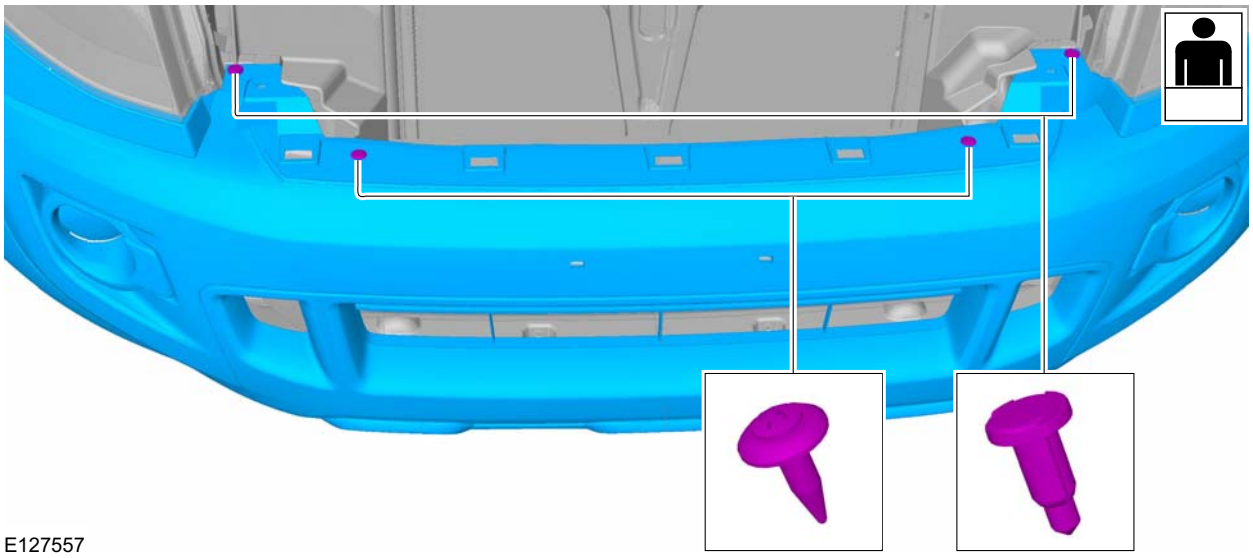

E127553

11. Torque: 10 Nm


E127556

12.

REMOVAL AND INSTALLATION



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Safety Belt Retractor — Super Cab

Removal

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

1. **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.

   Handling the seat belt (pre-tensioner seat belt) improperly can accidentally deploy the pre-tensioner seat belt, which may seriously injure you. Read the service warnings and cautions before handling the seat belt (pre-tensioner seat belt).

   Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

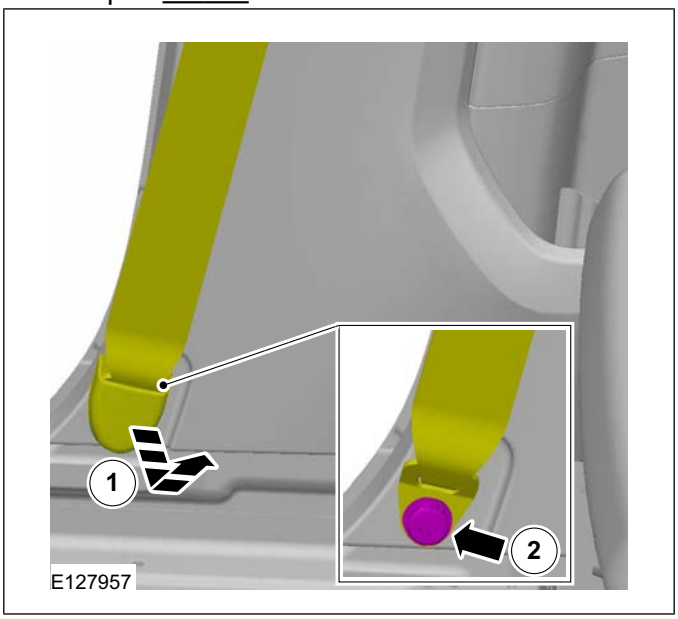
   CAUTION: The ELR (emergency locking retractor) has a spring that will unwind if the retractor cover is removed. The spring cannot be rewound by hand. If this occurs, the ELR will not work properly. Therefore, do not disassemble the retractor.

   Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).

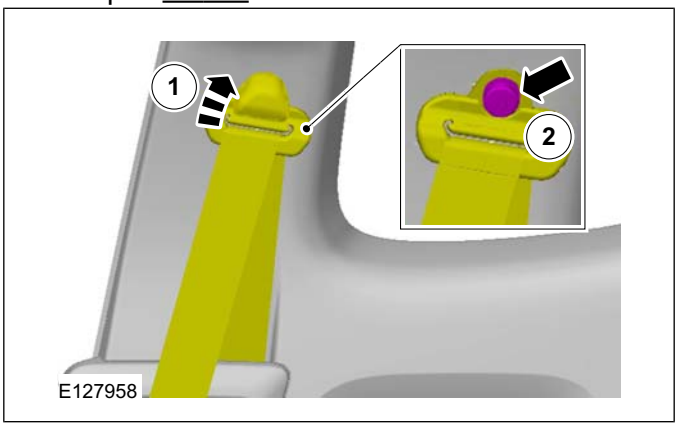
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

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

   Torque: 48 Nm



4. Torque: 48 Nm

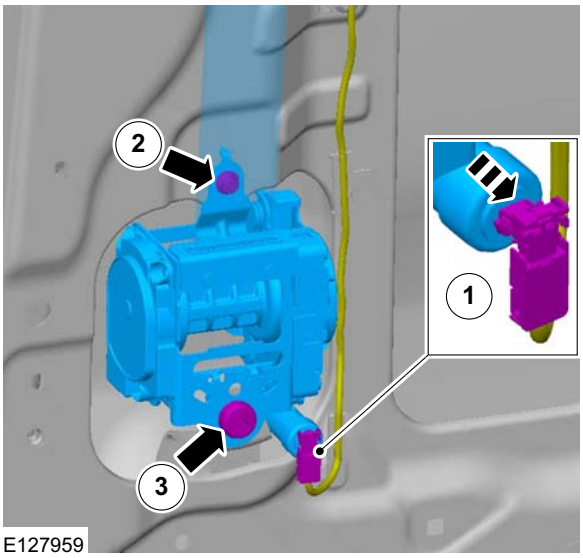


REMOVAL AND INSTALLATION

5. Refer to: Rear Door Trim Panel - Super Cab (501-05 Interior Trim and Ornamentation, Removal and Installation).

6.

7. 2. Torque: 11 Nm
   3. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Rear Safety Belt Retractor

Removal

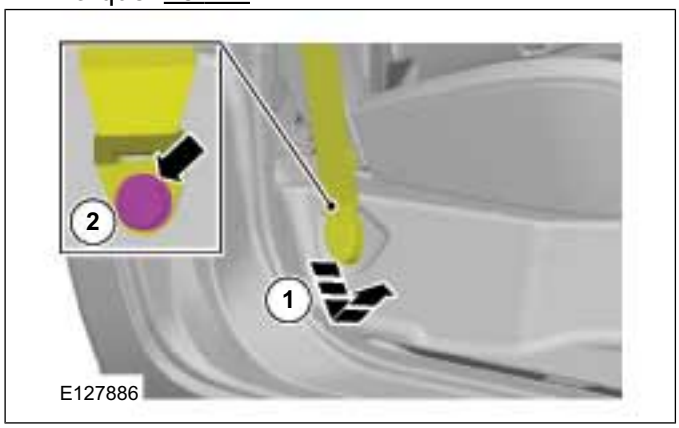
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: C-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

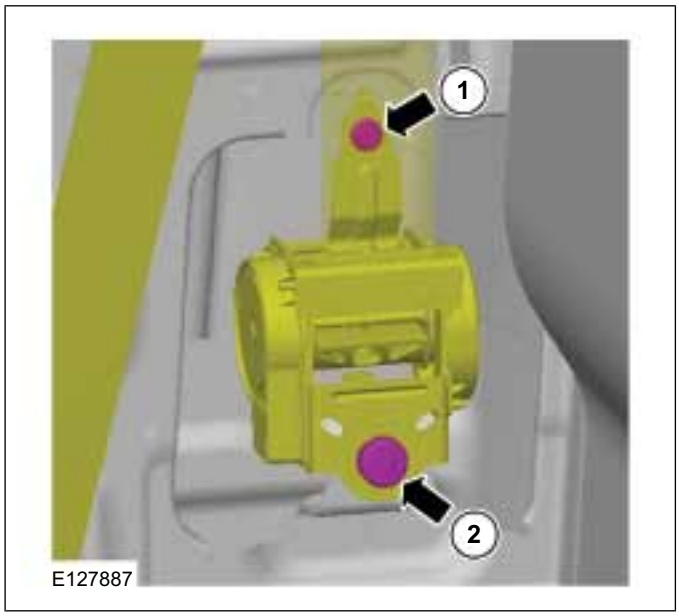
Double cab

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

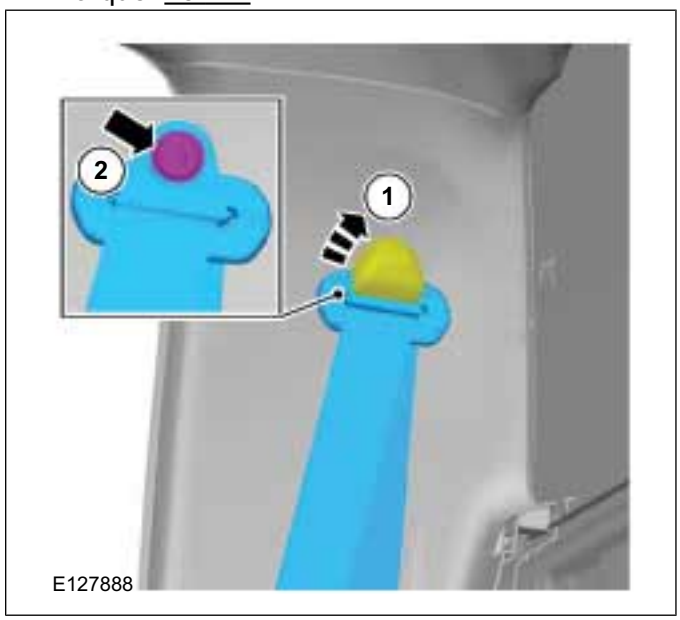
   Torque: 48 Nm



3. 1. Torque: 11 Nm
   2. Torque: 48 Nm

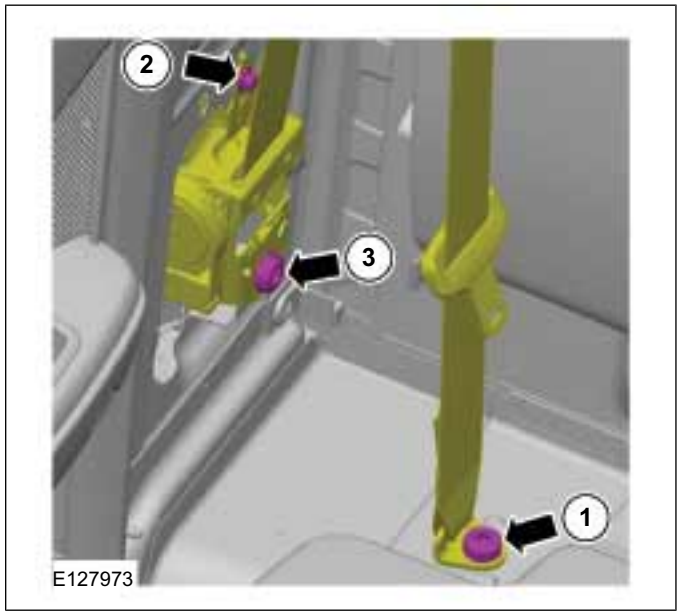


4. Torque: 48 Nm



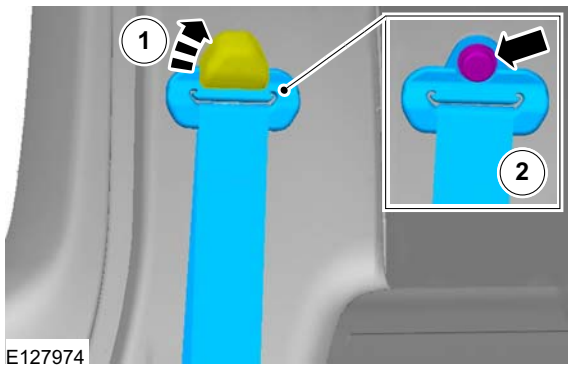
Stretch cab

5. 1. Torque: 48 Nm
   2. Torque: 11 Nm
   3. Torque: 48 Nm



REMOVAL AND INSTALLATION

6. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Driver Air Bag Module

General Equipment

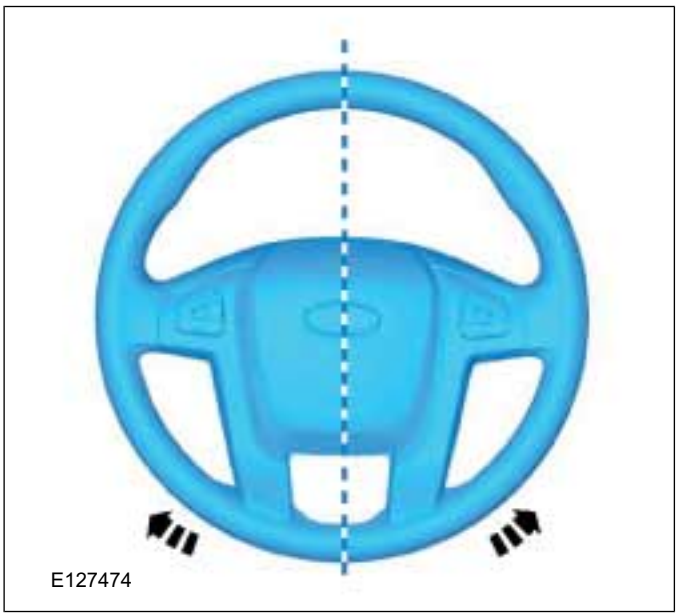
Flat Headed Screw Driver

Removal

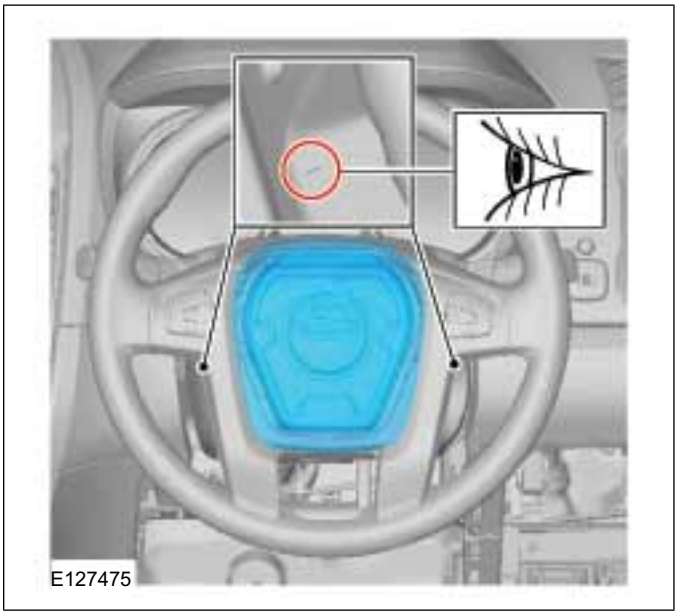
WARNING: The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

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

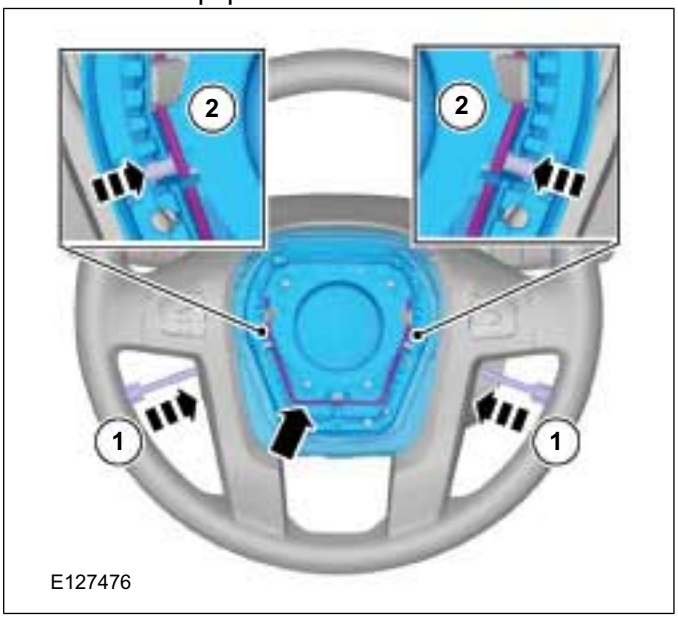
1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. **NOTE:** Make sure that the road wheels are in straight ahead position.



4. Depending on the vehicle variant, steering wheels with a different design for cut marks can be fitted.

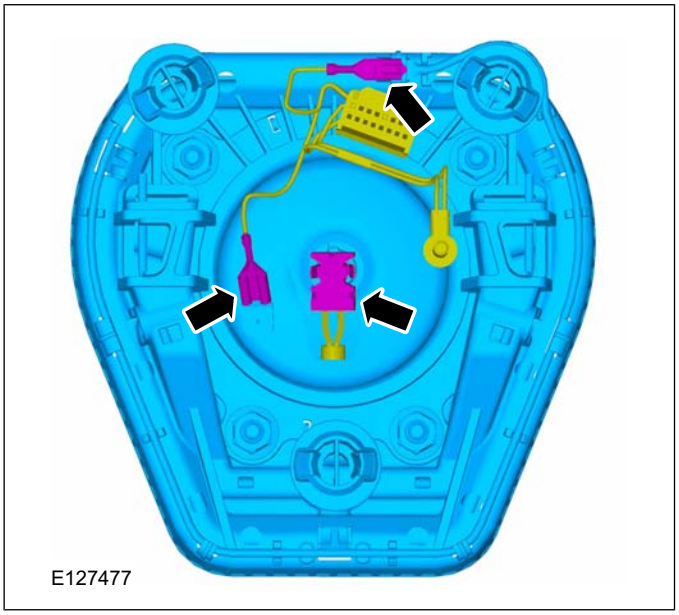


5. General Equipment: Flat Headed Screw Driver



REMOVAL AND INSTALLATION

6.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Driver Lower 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.

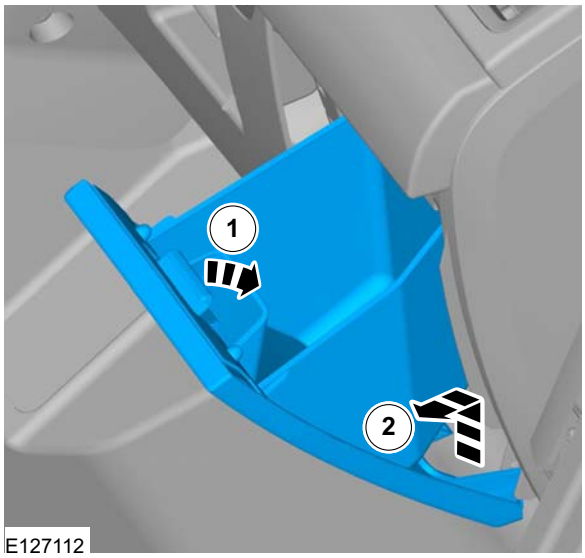
Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

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

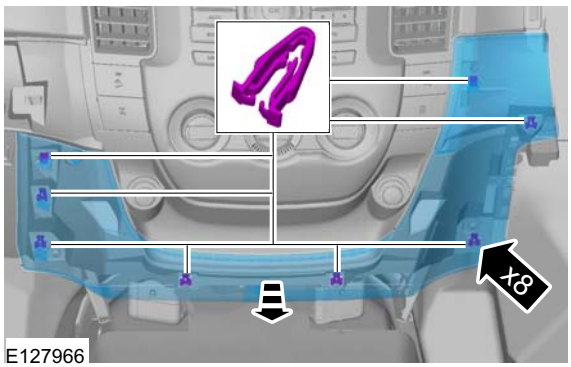
1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

3.

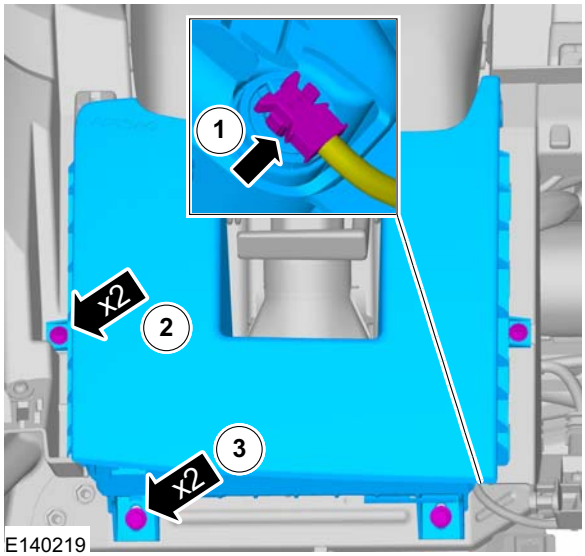


4.



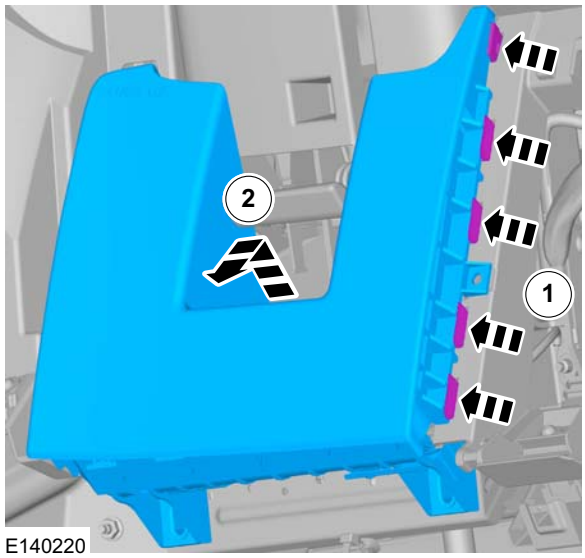
5. **NOTE:** Make sure that the steering column adjustment arm is in normal position.

   3. Torque: 9 Nm



REMOVAL AND INSTALLATION

6. 1. On both sides.



Installation

1. To install, reverse the removal procedure.

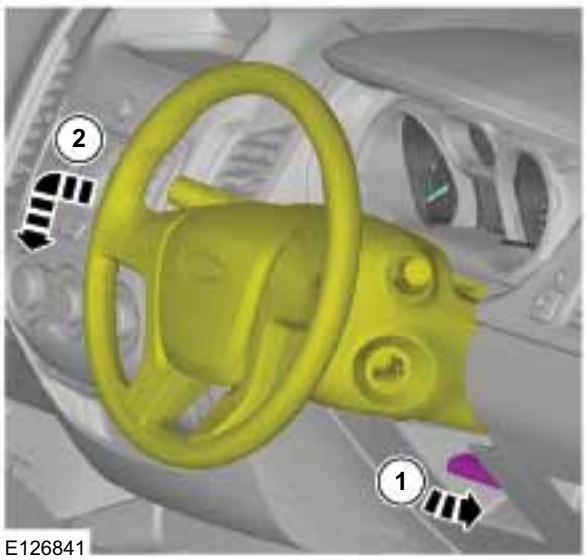
REMOVAL AND INSTALLATION

Clockspring

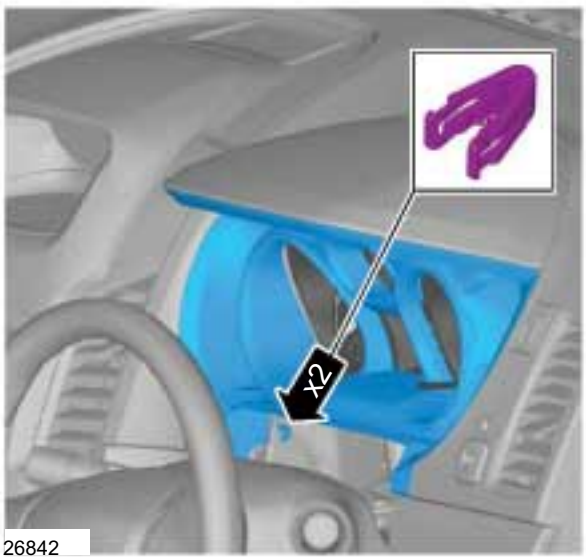
Removal

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

1.



2.



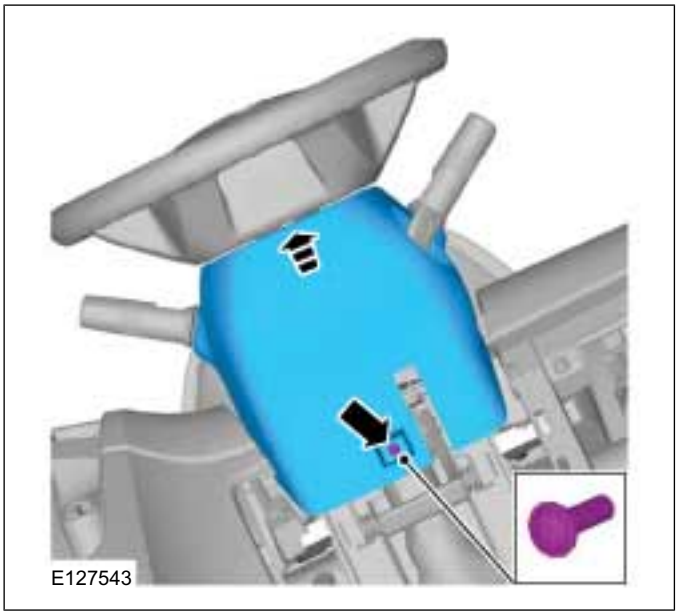
3.

4.

REMOVAL AND INSTALLATION

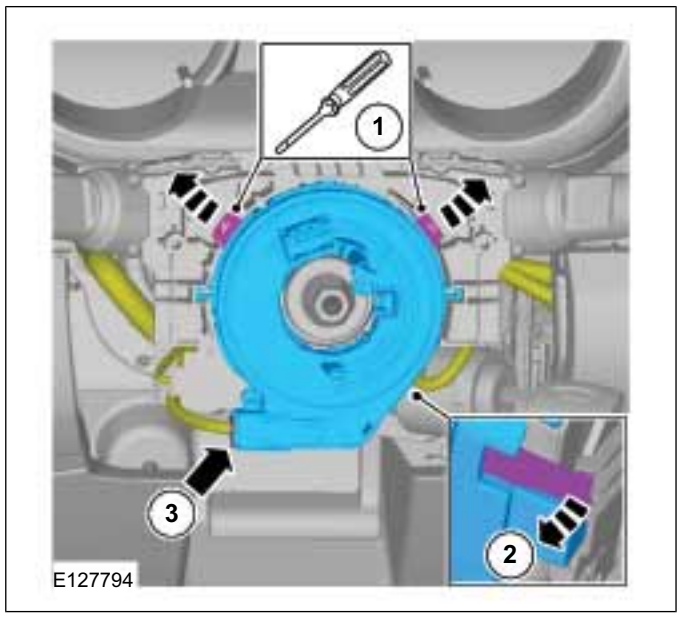
5.

6.



7. Refer to: Steering Wheel (211-04 Steering Column, Removal and Installation).

8.



Installation

1. To install, reverse the removal procedure.

2. Refer to: Clockspring Adjustment (501-20 Supplemental Restraint System, General Procedures).

GENERAL PROCEDURES

Clockspring Adjustment

General Equipment

Adhesive Tape

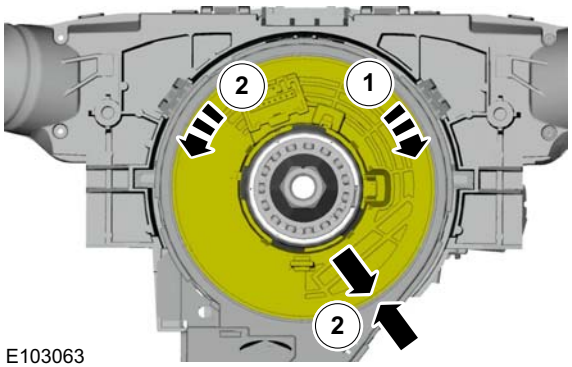
WARNINGS:

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.

NOTE: Make sure that the road wheels are in the straight ahead position.

1. 1. Turn the clockspring in a clockwise direction until a resistance is felt.
2. Turn the clockspring in a counterclockwise direction 2.5 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. **CAUTION: Make sure that the clockspring rotor does not rotate.**

General Equipment: Adhesive Tape