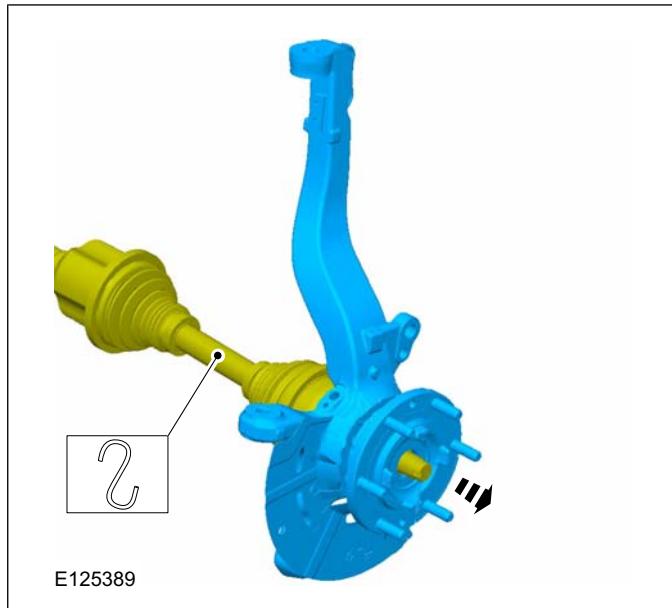


REMOVAL AND INSTALLATION

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.

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

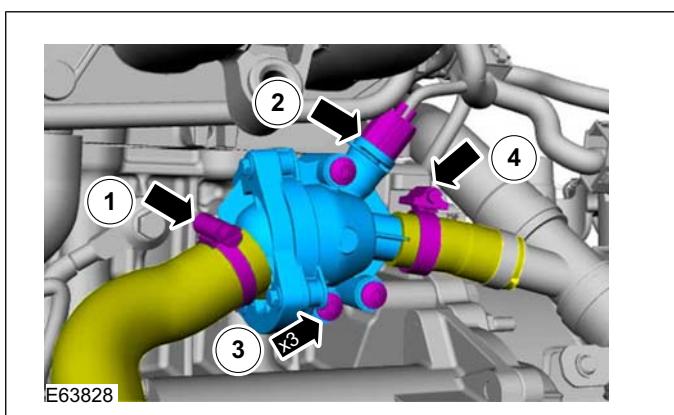
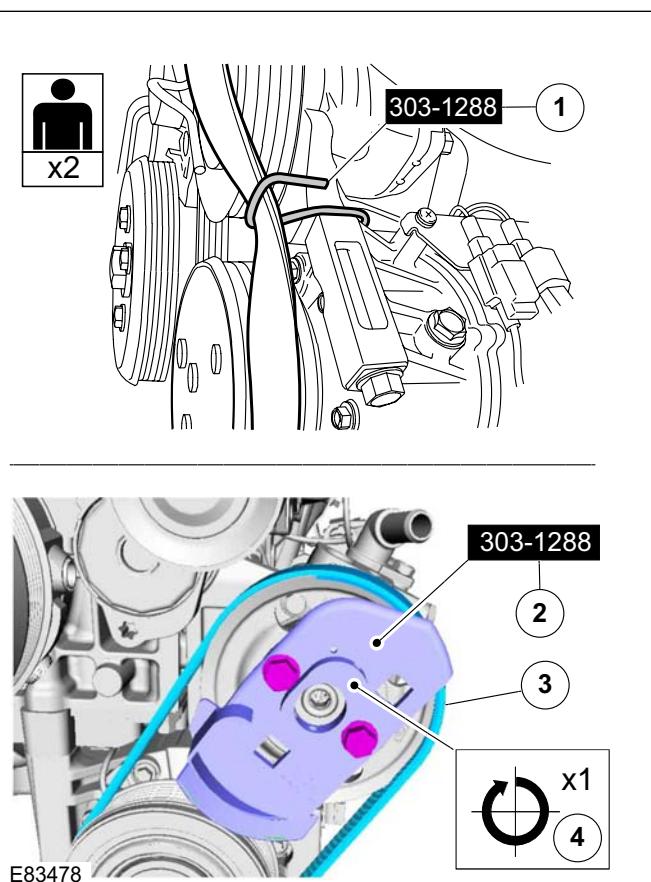
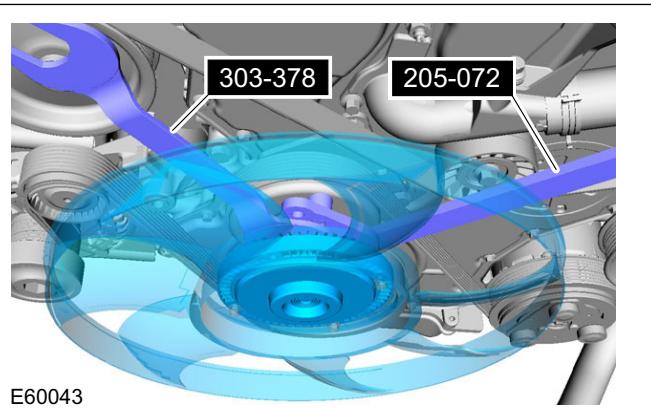
Colors used in the graphic are as follows:

- 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).



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.

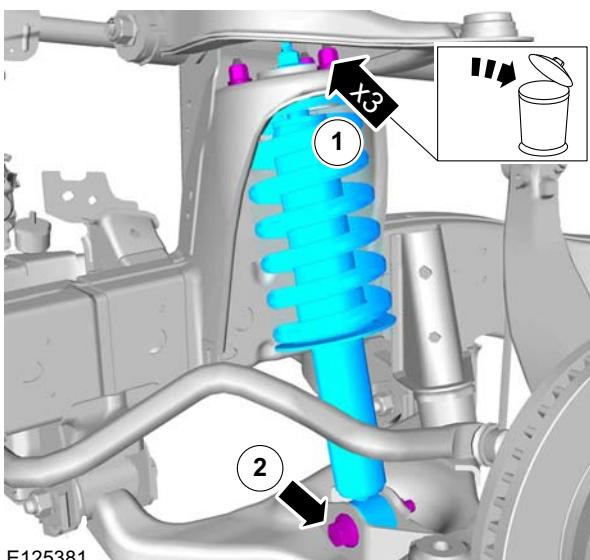
⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser 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.

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

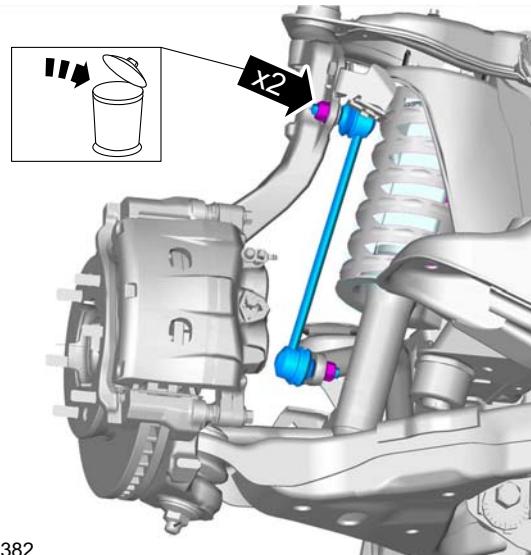
Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

1. Torque: 30 Nm
2. Torque: 250 Nm



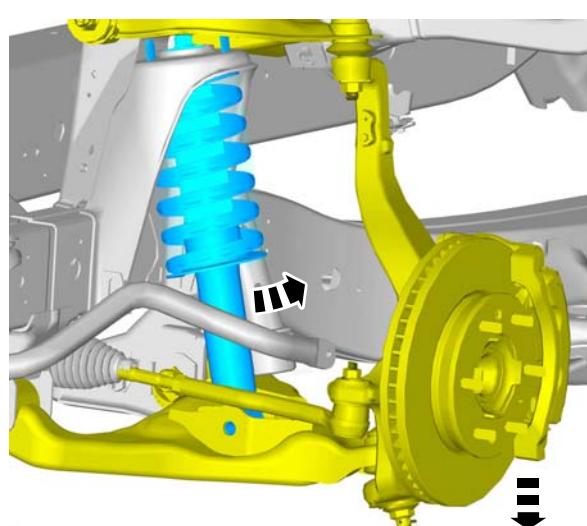
3. Using a suitable jack support the lower control arm near the lower ball joint.

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

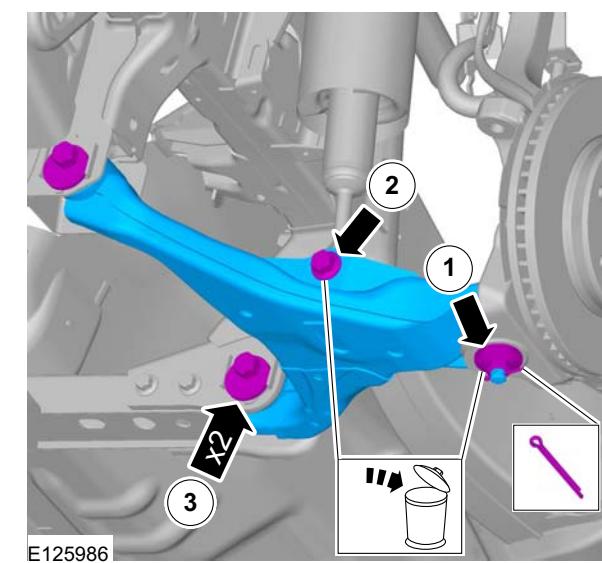
Two Leg Puller

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



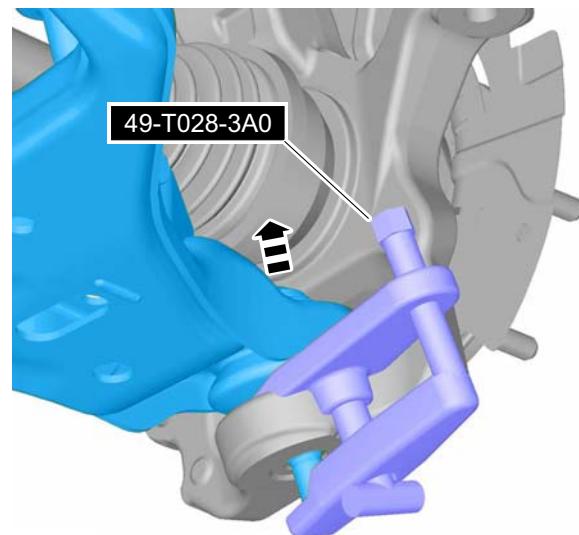
3. CAUTIONS:

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

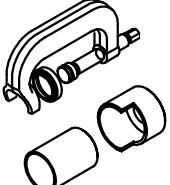
CAUTION: Before tightening any suspension bushing fasteners, use a suitable jack to raise the suspension.

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Upper Arm

Special Tool(s) / General Equipment

	204-288A Remover/Installer, Ball Joint E115081
---	--

Special Tool(s) / General Equipment

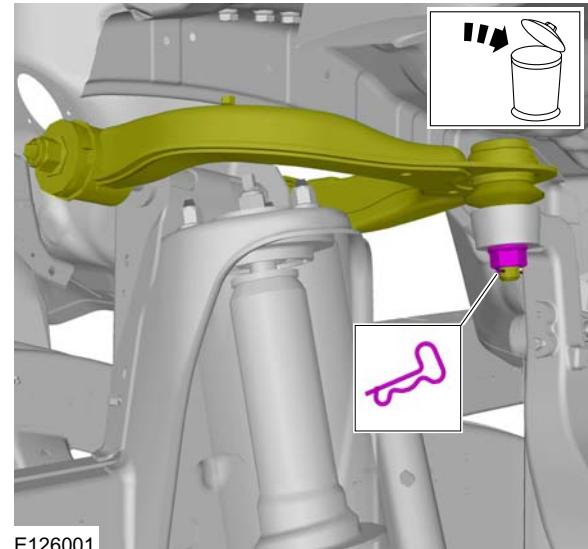
Two Leg Puller

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



4. CAUTIONS:

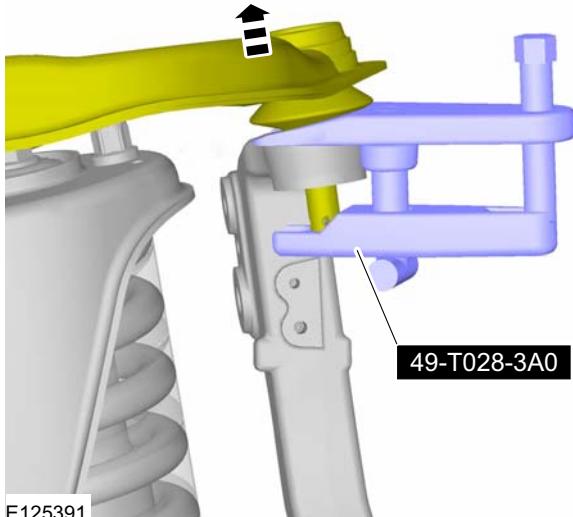
- Do not use a hammer to separate the ball joint from the wheel knuckle or damage to the wheel knuckle can result.**
- Do not damage the ball joint boot while installing the special tool.**

REMOVAL AND INSTALLATION

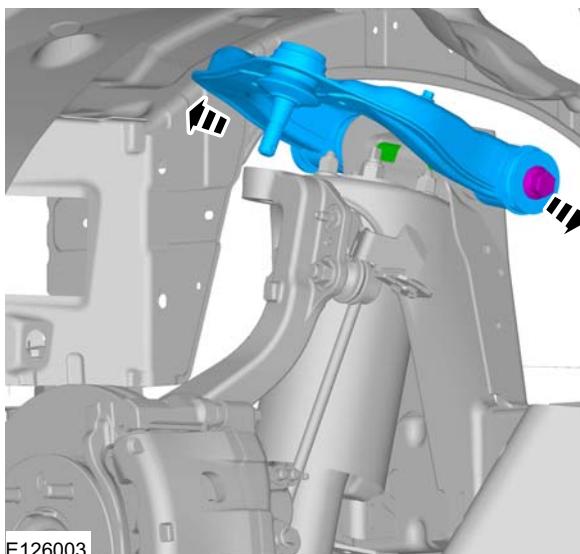
⚠ Make sure that the knuckle assembly is secured with suitable retaining straps.

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: BT50 & Ranger

CONTENTS	PAGE
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DESCRIPTION AND OPERATION

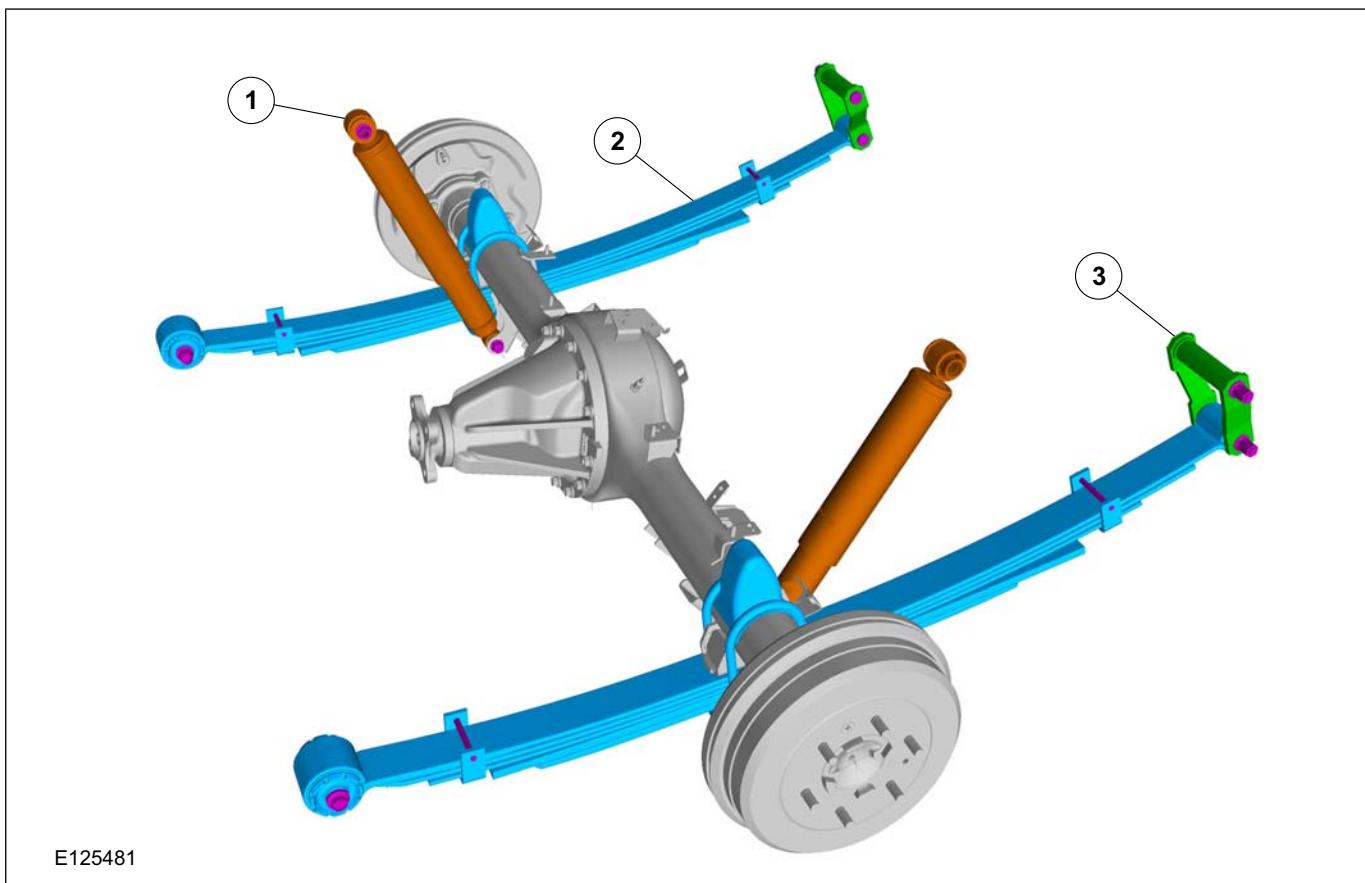
Rear Suspension.....	204-02-2
----------------------	----------

REMOVAL AND INSTALLATION

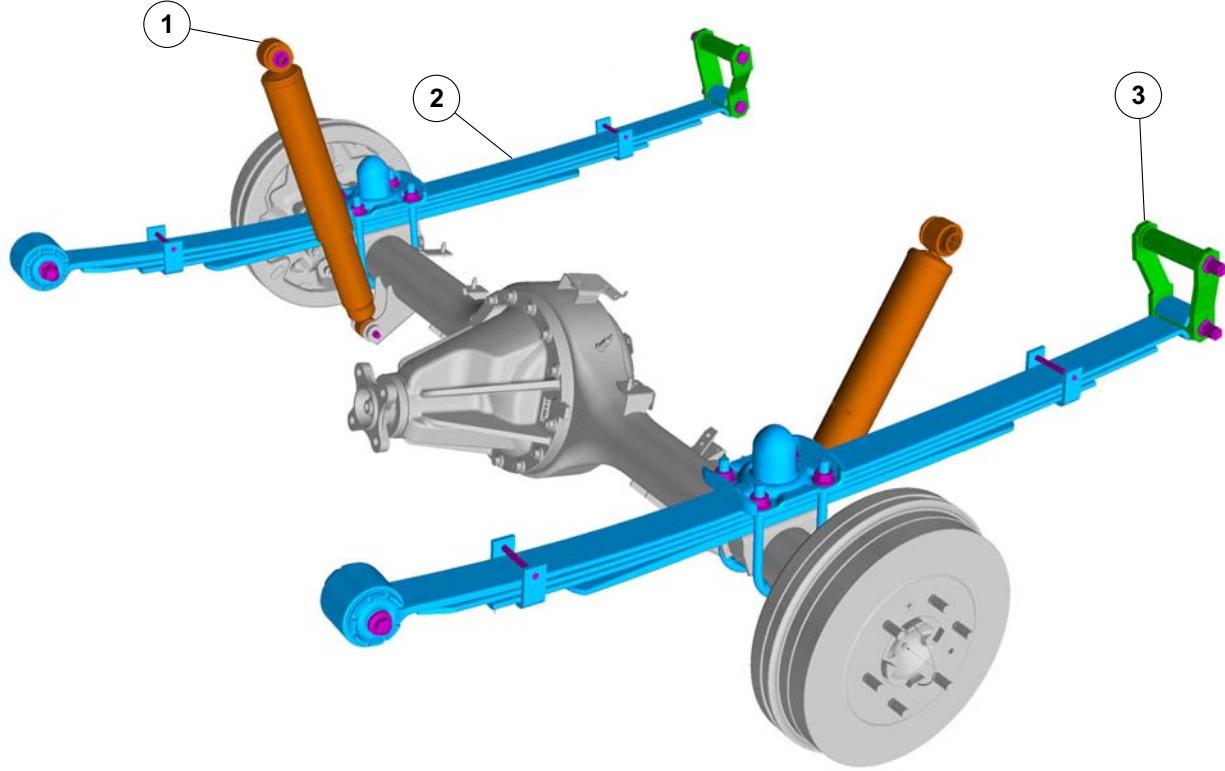
Spring.....	(15 621 0)	204-02-4
Rear Shock Absorber.....	(15 791 0)	204-02-6

DESCRIPTION AND OPERATION**Rear Suspension**

4x2



Item	Description
1	Shock absorber
2	Leaf Spring
3	Shackle Assembly

DESCRIPTION AND OPERATION**Hi-Rider and 4x4**

E125521

Item	Description
1	Shock absorber
2	Leaf Spring
3	Shackle Assembly

REMOVAL AND INSTALLATION

Spring(15 621 0)

4x4

Removal

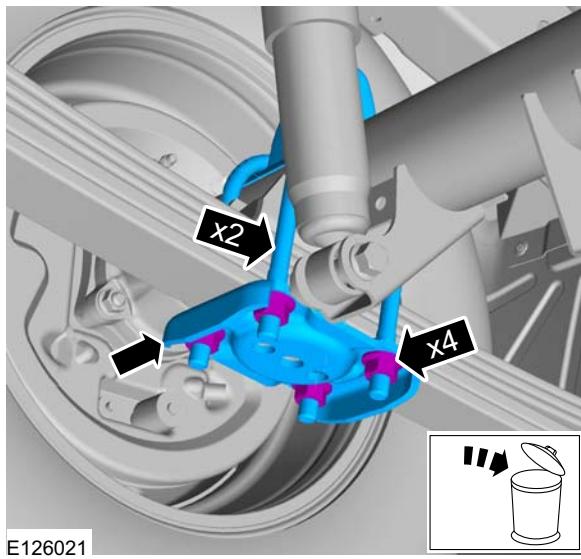
CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser 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.

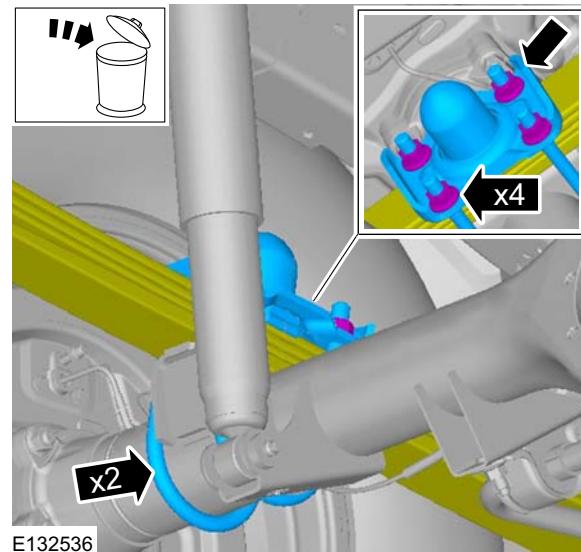
- Refer to: [Lifting](#) (100-02 Jacking and Lifting, Description and Operation).

4x2

- Torque: 120 Nm

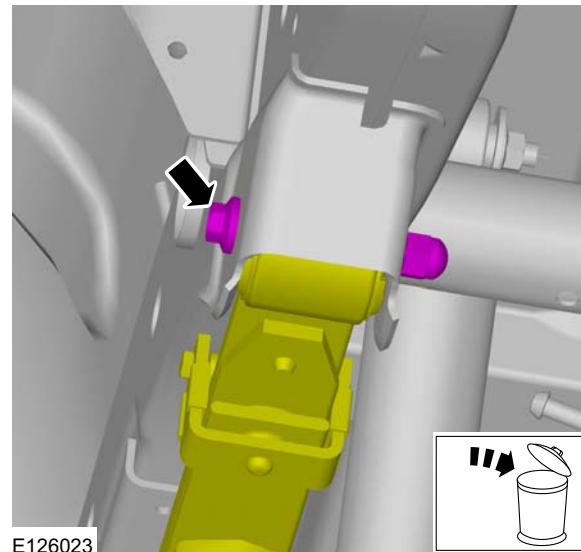


- Torque: 120 Nm



All vehicles

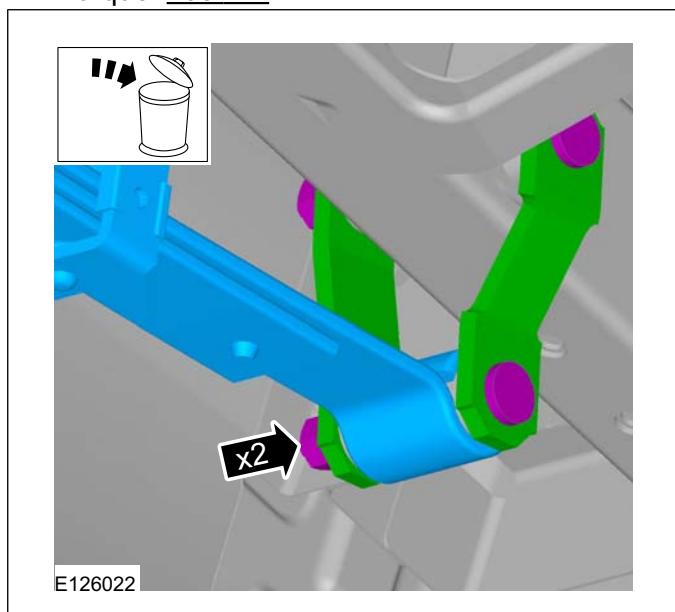
- Torque: 162 Nm



REMOVAL AND INSTALLATION

5. NOTE: Note the position of the bracket.

Torque: 103 Nm

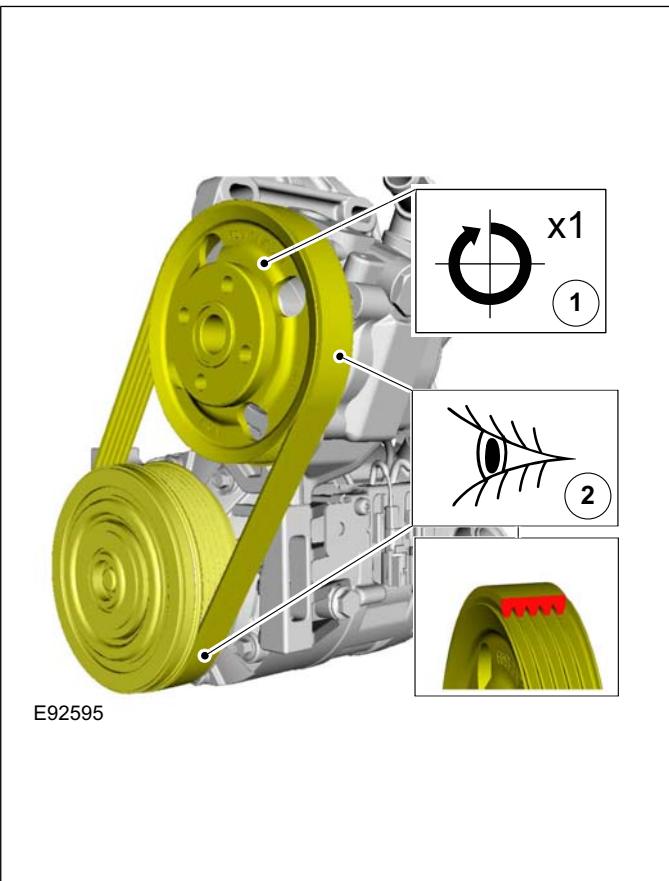


Installation

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

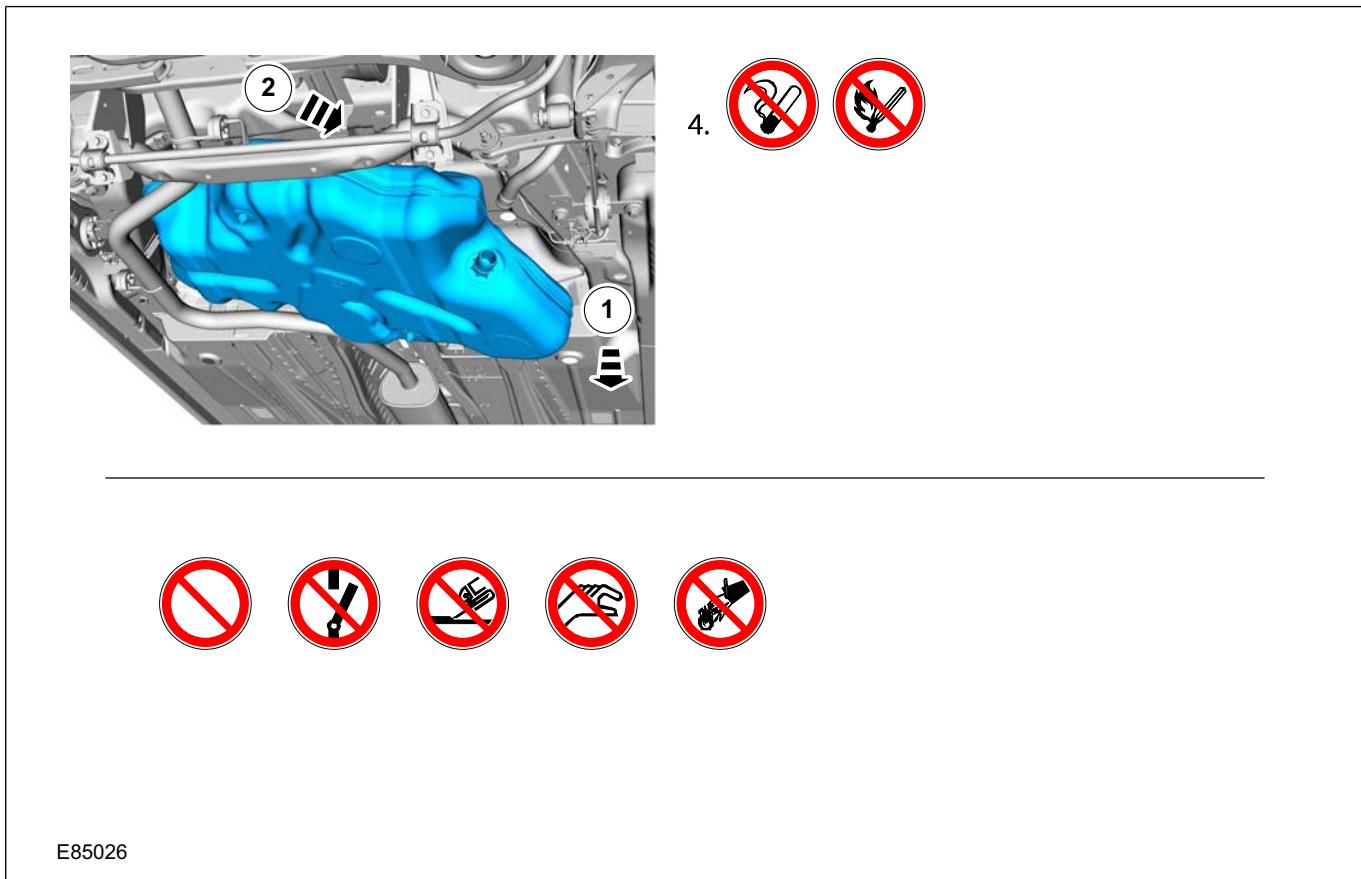
NOTE: Final tightening of the rear suspension components should be carried out when the vehicle weight is on the road wheels.

1. To install, reverse the removal procedure.

DESCRIPTION AND OPERATION**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.



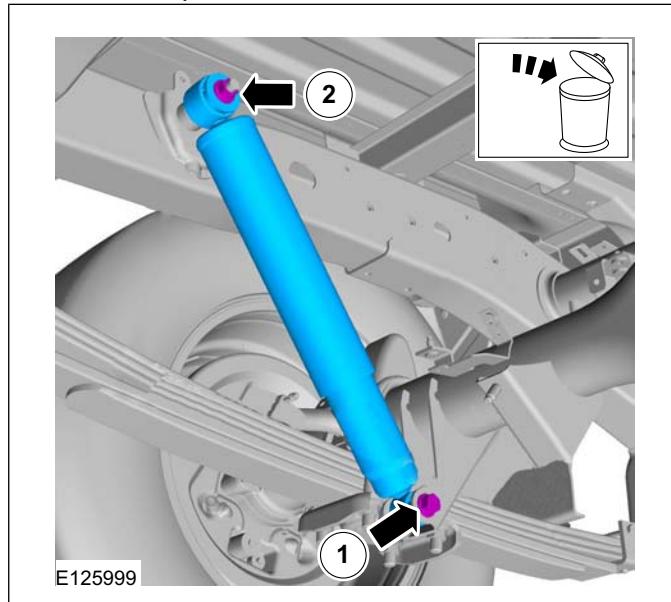
REMOVAL AND INSTALLATION**Rear Shock Absorber(15 791 0)****Removal**

! **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: BT50 & Ranger

CONTENTS	PAGE
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REMOVAL AND INSTALLATION

Wheel and Tire.....	204-04-2
Front Wheel Alignment.....	204-04-5
Rear Wheel Alignment.....	204-04-6

REMOVAL AND INSTALLATION

Wheel and Tire

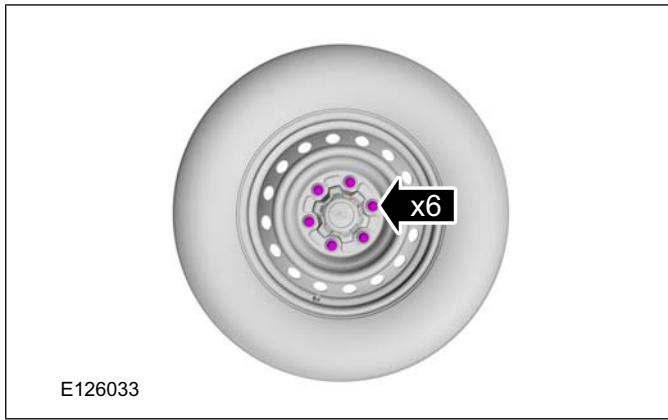
Removal

CAUTIONS:

- ⚠ Do not use heat to loosen a seized wheel nut.**
- ⚠ Do not use power tools on locking wheel nuts.**

1. Loosen

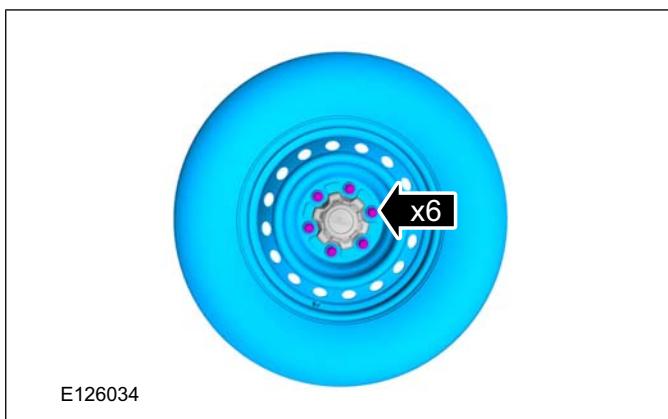
1.



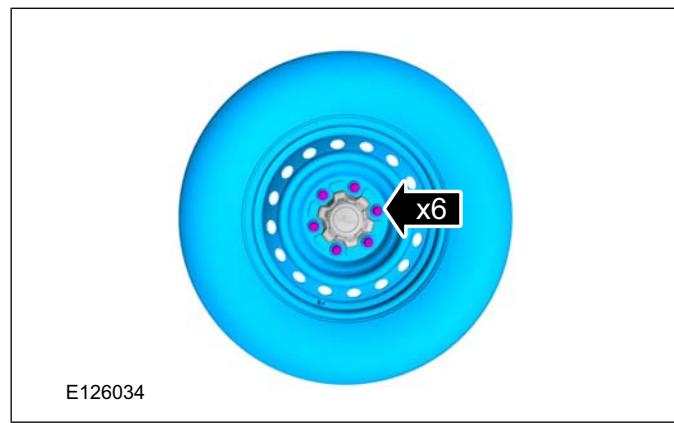
2. For additional information, refer to: **Jacking (100-02 Jacking and Lifting, Description and Operation)**

/ Lifting (100-02 Jacking and Lifting, Description and Operation).

3.



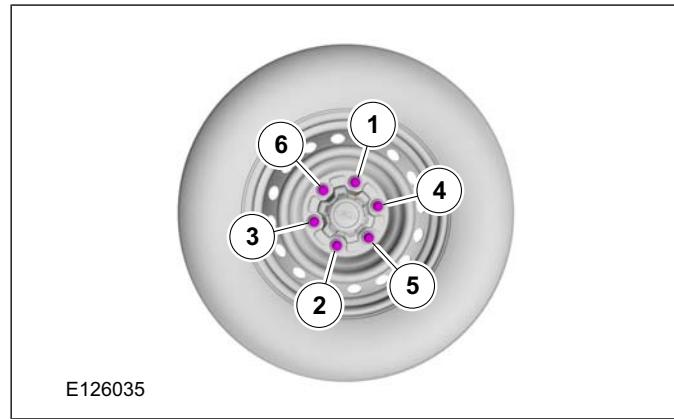
NOTE: Only tighten the nuts finger tight at this stage.



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}.



Installation

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

FRONT WHEEL ALIGNMENT

Front wheel alignment (Unloaded)^{*1} [4x2]

Item	Specifications		
	Except high clearance model		High clearance model
	Regular cab	Freestyle cab, double cab	
Maximum steering angle [Tolerance $\pm 3^\circ$]	Inner	41°24'	38°00'
	Outer	35°30'	33°00'
Total toe-in	Tire [Tolerance $\pm 4 \{0.2\}$] Rim inner [Tolerance $\pm 3 \{0.1\}$]	(mm {in})	0 {0} 0 {0}
		(degree)	0°00'±0°00'
Caster angle ^{*2} (Reference value) [Tolerance $\pm 1^\circ$]		2°53'	3°00' RH: 2°34' LH: 3°04'
Camber angle ^{*2} (Reference value) [Tolerance $\pm 1^\circ$]			0°00'
Steering axis inclination (Reference value)		12°22'	11°06'

Front wheel alignment (Unloaded)^{*1} [4x4]

Item	Specifications		
	Inner	Outer	
Maximum steering angle [Tolerance $\pm 3^\circ$]		38°00'	
		33°00'	
Total toe-in	Tire [Tolerance $\pm 4 \{0.2\}$] Rim inner [Tolerance $\pm 3 \{0.1\}$]	(mm {in})	0 {0} 0 {0}
		(degree)	0°00'±0°00'
Caster angle ^{*2} (Reference value) [Tolerance $\pm 1^\circ$]			RH: 2°34' LH: 3°04'
Camber angle ^{*2} (Reference value) [Tolerance $\pm 1^\circ$]			0°00'
Steering axis inclination (Reference value)			11°06'

*1 : Engine coolant and engine oil are at specified level. Spare tire, jack and tools are in designated position.

*2 : Difference between left and right must not exceed 1°30'.

Steering Angle Adjustment

- Loosen the tie-rod end locknuts.
- Remove the steering gear boot clamp.
- Turn the tie rods.

Standard length L

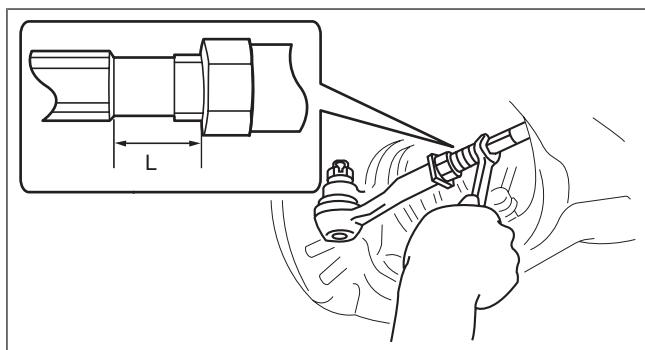
11.1—29.1 mm {0.44—1.14 in}

- Turn the tie rods equally to provide the correct maximum steering angle.
- Tighten the tie-rod end locknuts.

Tightening torque

68—92 N·m {7.0—9.3 kgf·m, 51—67 ft·lbf}

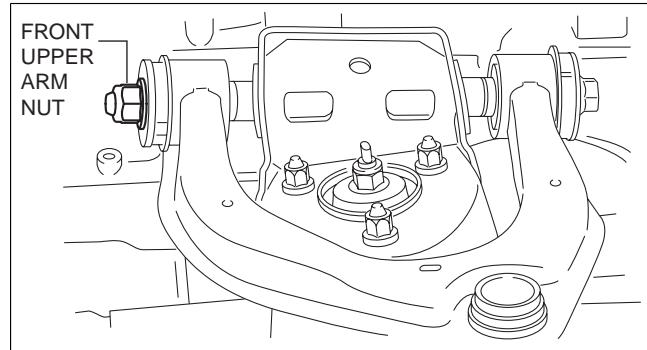
- Verify that the boot is not twisted, and install the boot clamp.
- Adjust the toe-in after adjusting the steering angle.



abs0zw00000589

Camber Adjustment

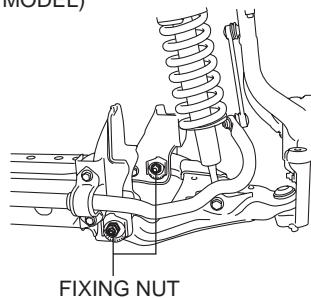
1. Loosen the front upper arm nut.



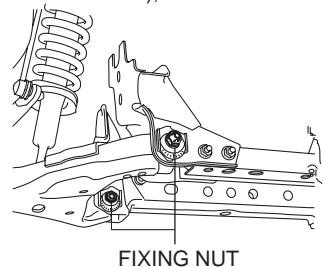
abs0zw00000590

2. Loosen the fixing nut of the adjusting cam bolt (front lower arm).

4x2 (EXCEPT HIGH CLEARANCE MODEL)



4x2 (HIGH CLEARANCE MODEL), 4x4



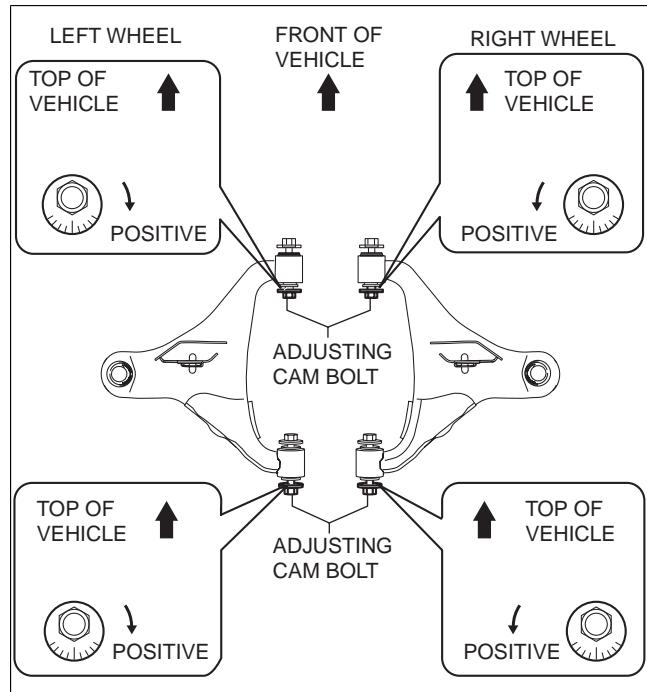
FIXING NUT

abs0zw00001252

3. Rotate the adjusting cam bolt in either direction to adjust the camber.

4x2 (Except high clearance model)

Camber	Left wheel		Right wheel	
	Front cam	Rear cam	Front cam	Rear cam
Positive direction	Clockwise	Clockwise	Counter-clockwise	Counter-clockwise
Negative direction	Counter-clockwise	Counter-clockwise	Clockwise	Clockwise



abs0zw00000592

4x2 (High clearance model), 4x4

Camber	Left wheel		Right wheel	
	Front cam	Rear cam	Front cam	Rear cam
Positive direction	Counter-clockwise	Counter-clockwise	Clockwise	Clockwise
Negative direction	Clockwise	Clockwise	Counter-clockwise	Counter-clockwise

4. Tighten the front upper arm nut.

Tightening torque

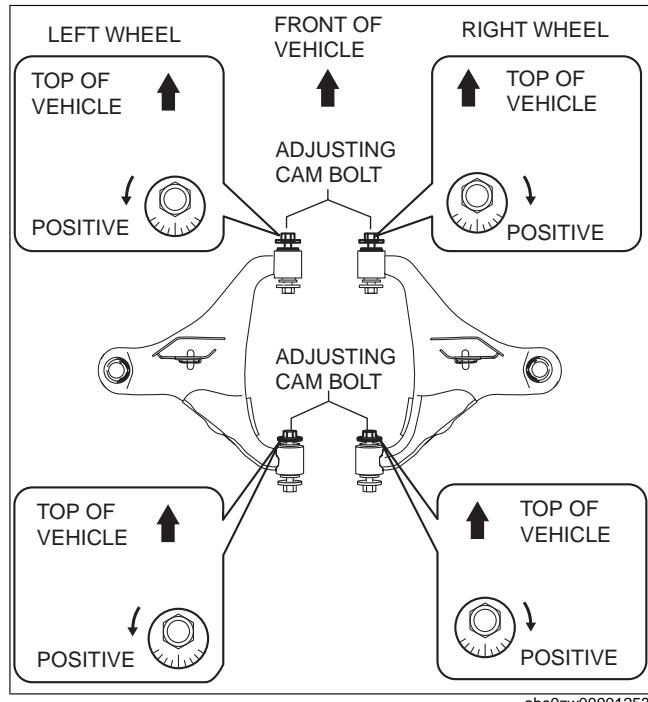
141—189 N·m {15—19 kgf·m, 104—139 ft·lbf}

5. Tighten the the fixing nut of the adjusting cam bolt (front lower arm).

Tightening torque

240—281 N·m {25—28 kgf·m, 178—207 ft·lbf}

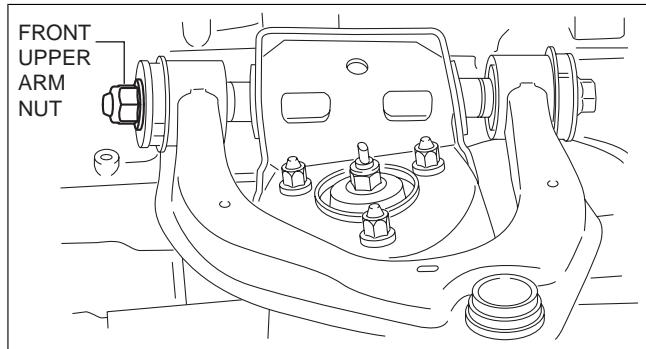
6. Adjust the total toe-in. (See Total Toe-in Adjustment.)



abs0zw00001253

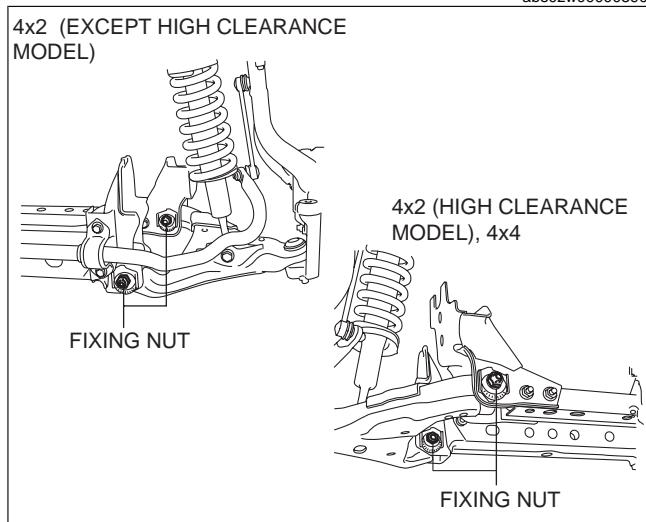
Caster Adjustment

1. Loosen the front upper arm nut.



abs0zw00000590

2. Loosen the fixing nut of the adjusting cam bolt (front lower arm).



abs0zw00001252

3. Rotate the adjusting cam bolt in either direction to adjust the caster.

4x2 (Except high clearance model)

Caster	Left wheel		Right wheel	
	Front cam	Rear cam	Front cam	Rear cam
Increase	Clockwise	Counter-clockwise	Counter-clockwise	Clockwise
Decrease	Counter-clockwise	Clockwise	Clockwise	Counter-clockwise

4x2 (High clearance model), 4x4

Caster	Left wheel		Right wheel	
	Front cam	Rear cam	Front cam	Rear cam
Increase	Counter-clockwise	Clockwise	Clockwise	Counter-clockwise
Decrease	Clockwise	Counter-clockwise	Counter-clockwise	Clockwise

4. Tighten the front upper arm nut.

Tightening torque

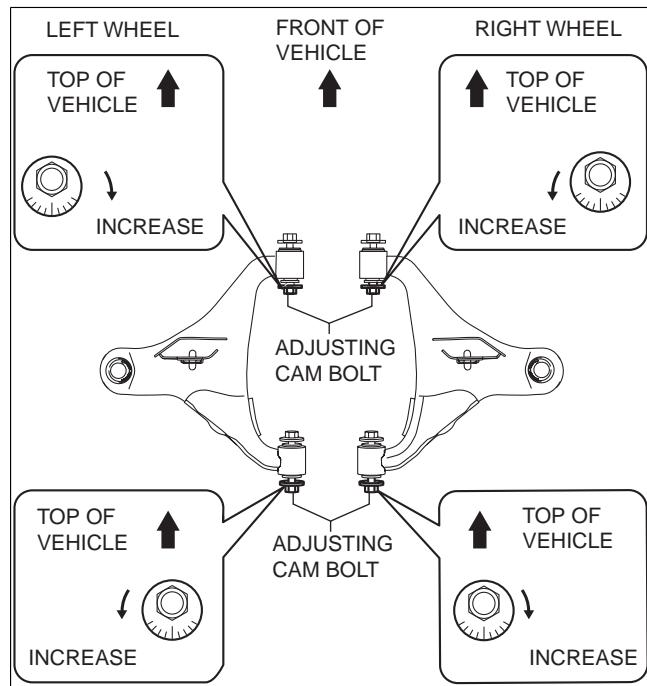
141—189 N·m {15—19 kgf·m, 104—139 ft·lbf}

5. Tighten the the fixing nut of the adjusting cam bolt (front lower arm).

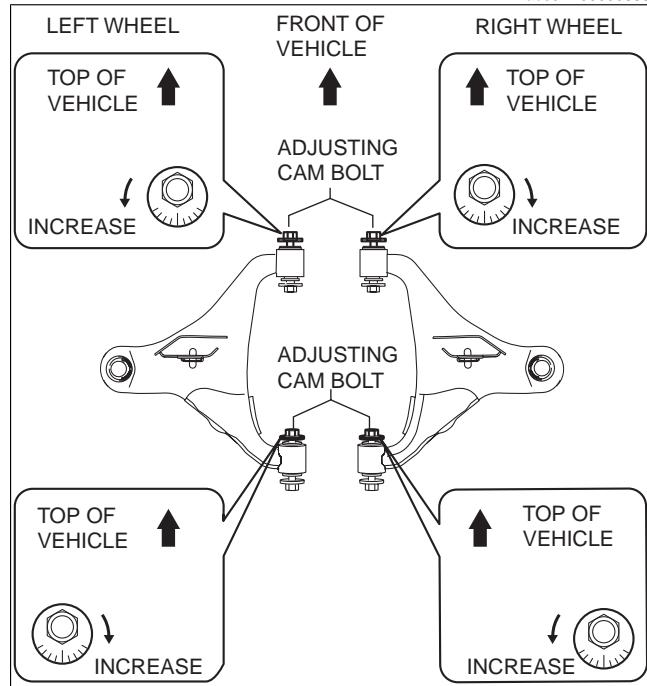
Tightening torque

240—281 N·m {25—28 kgf·m, 178—207 ft·lbf}

6. Adjust the total toe-in. (See Total Toe-in Adjustment.)



abs0zw00000593



abs0zw00001254

Total Toe-in Adjustment

1. Loosen the locknut of the tie-rod end.
2. Remove the rack boot clamp.
3. Adjust the total toe-in by rotating each tie rod (left and right) in the opposite directions by the same amount respectively.

Note

- Toe angle changes by approx. 6 mm {0.2 in} per one rotation of the tie rod for one wheel.
- Each tie rod has a right-hand thread. When increasing the toe-in angle, rotate the right tie rod toward the front of the vehicle and rotate the left tie rod toward the rear of the vehicle by the same amount.

4. Tighten the locknut of the tie-rod end.

Tightening torque
68—92 N·m {7.0—9.3 kgf·m, 51—67 ft·lbf}

5. Verify that the rack boot does not have any twisting and install the rack boot clamp.

REAR WHEEL ALIGNMENT

id021100800300

Rear wheel alignment (Unloaded)*1

Item		Specifications	
Total toe-in (Reference value)	Tire [Tolerance $\pm 4 \{\pm 0.2\}$] Rim inner [Tolerance $\pm 3 \{\pm 0.1\}$]	(mm {in})	0 {0}
			0 {0}
Camber angle*2 (Reference value) [Tolerance $\pm 1^\circ$]		0°00'	

*1 : Engine coolant and engine oil are at specified level. Spare tire, jack and tools are in designated position.

*2 : Difference between left and right must not exceed $1^\circ 30'$.

SECTION 205-01 Driveshaft

VEHICLE APPLICATION: BT50 & Ranger

CONTENTS	PAGE
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DESCRIPTION AND OPERATION

Driveshaft.....	205-01-2
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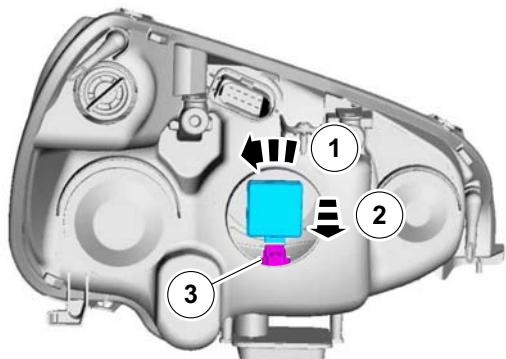
REMOVAL AND INSTALLATION

Driveshaft — 2WD.....	(15 514 0)	205-01-3
Driveshaft — 4WD.....	(15 514 0)	205-01-4
Front Driveshaft — 4WD.....		205-01-5

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.

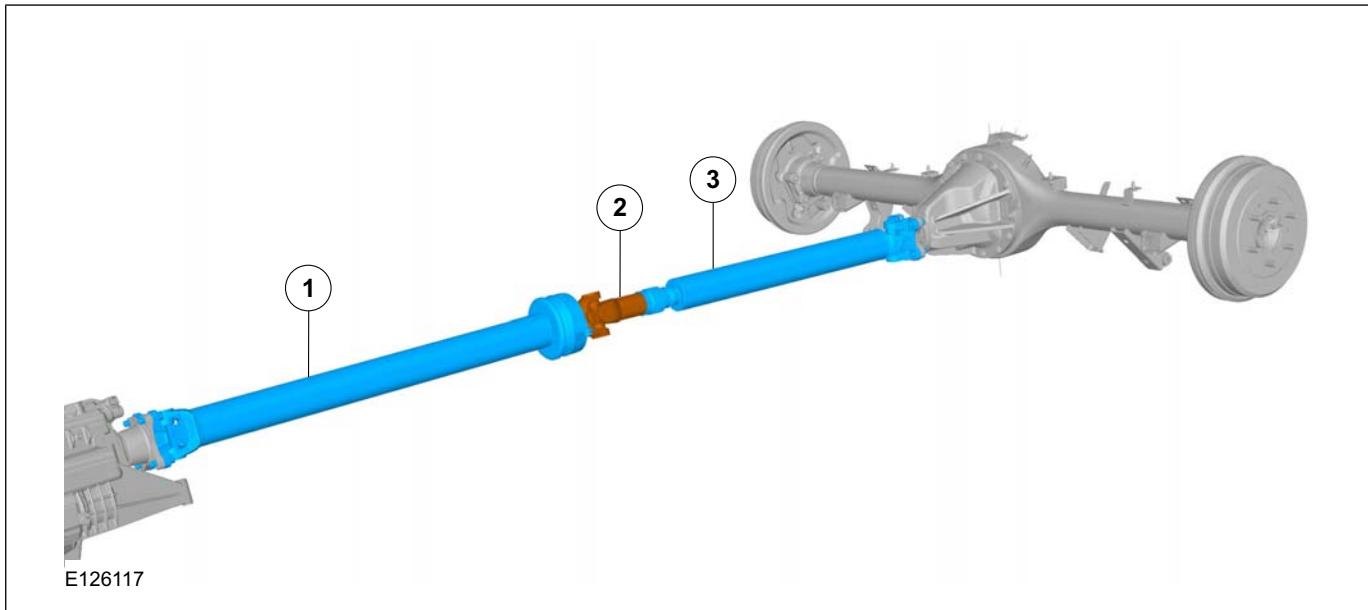


E85027

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

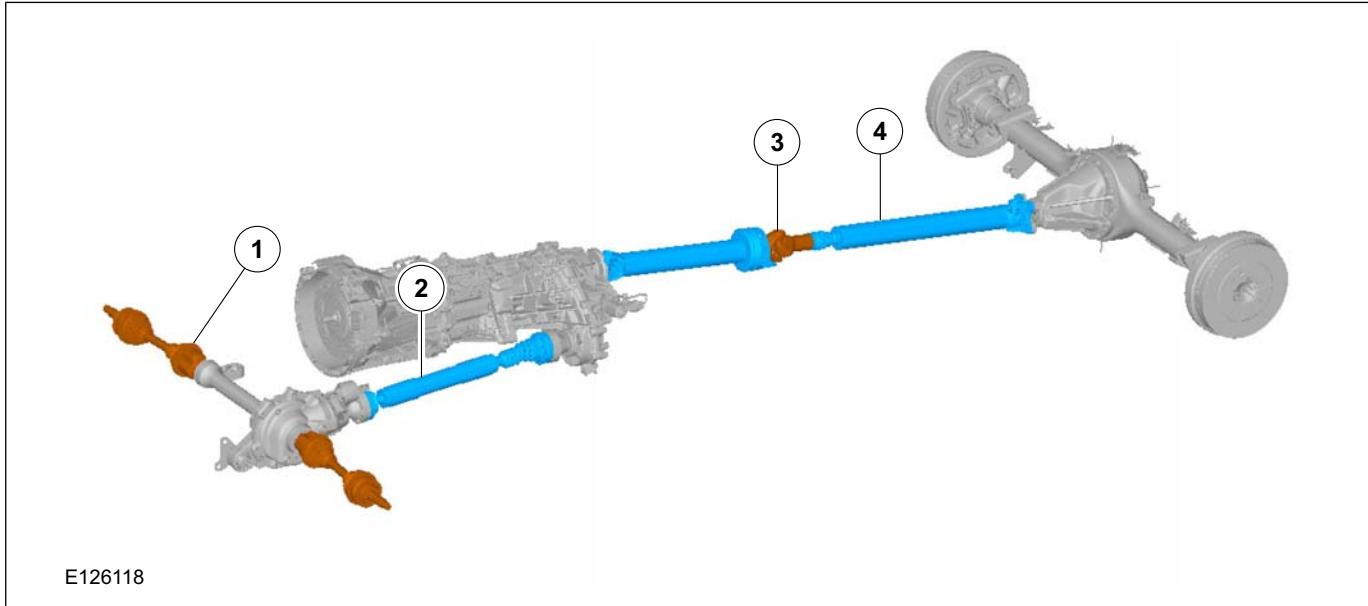
DESCRIPTION AND OPERATION**Driveshaft**

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)

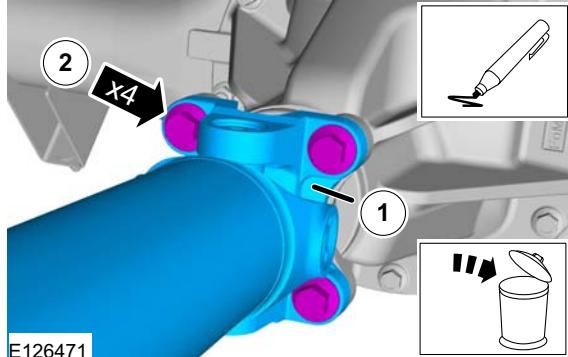
Removal

⚠️ 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.

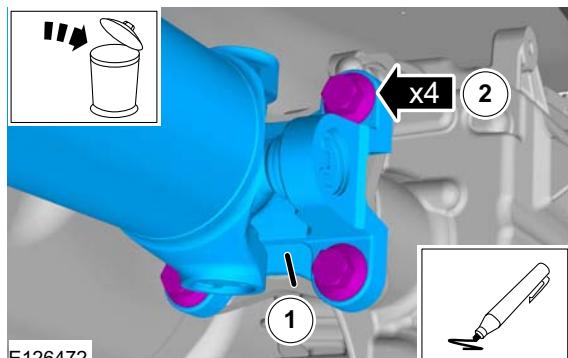
1. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
2. **⚠️ CAUTION:** Do not reuse the bolts, install new bolts or damage to the vehicle may occur.

Torque: 140 Nm

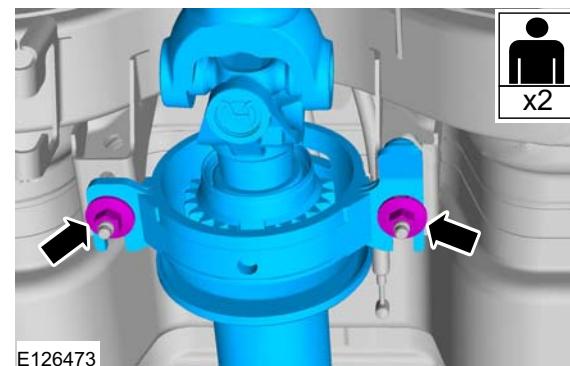


3. **⚠️ CAUTION:** Do not reuse the bolts, install new bolts or damage to the vehicle may occur.

Torque: 140 Nm



4. Torque: 50 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Driveshaft — 4WD(15 514 0)

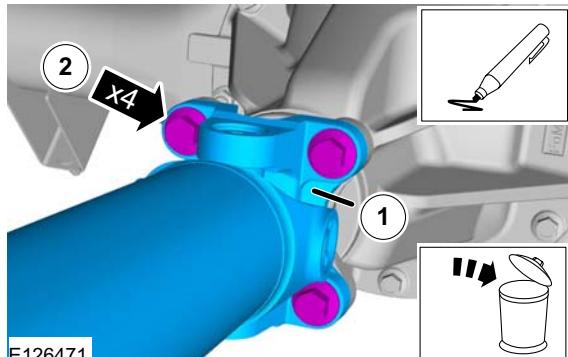
Removal

⚠️ 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.

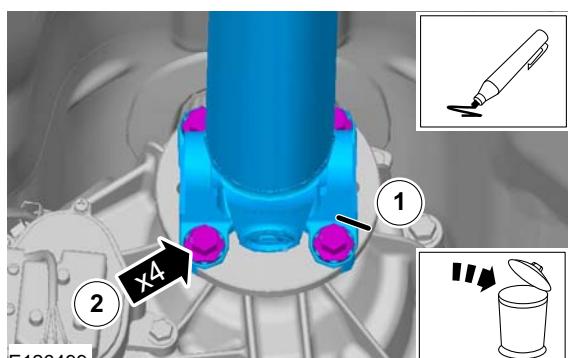
1. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
2. **⚠️ CAUTION:** Do not reuse the bolts, install new bolts or damage to the vehicle may occur.

Torque: 140 Nm

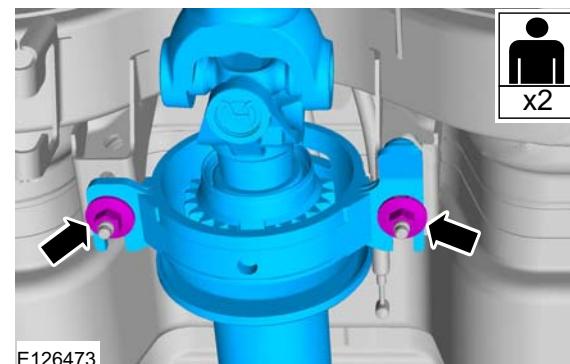


3. **⚠️ CAUTION:** Do not reuse the bolts, install new bolts or damage to the vehicle may occur.

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.**

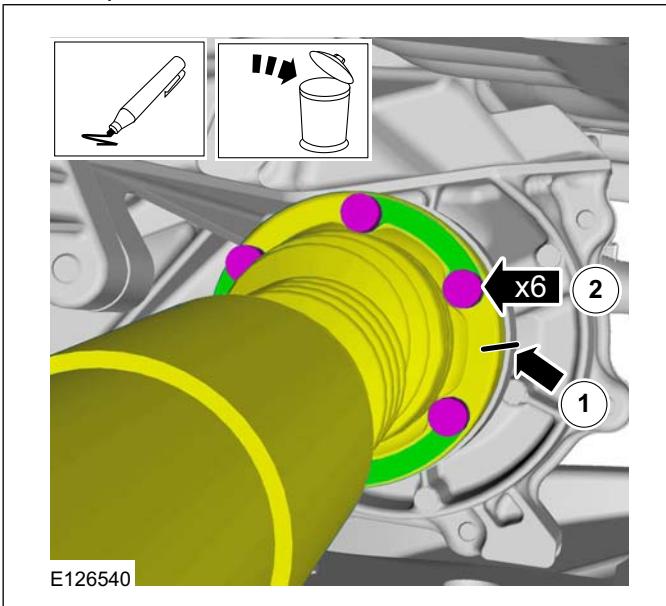
Refer to: [Lifting](#) (100-02 Jacking and Lifting, Description and Operation).

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



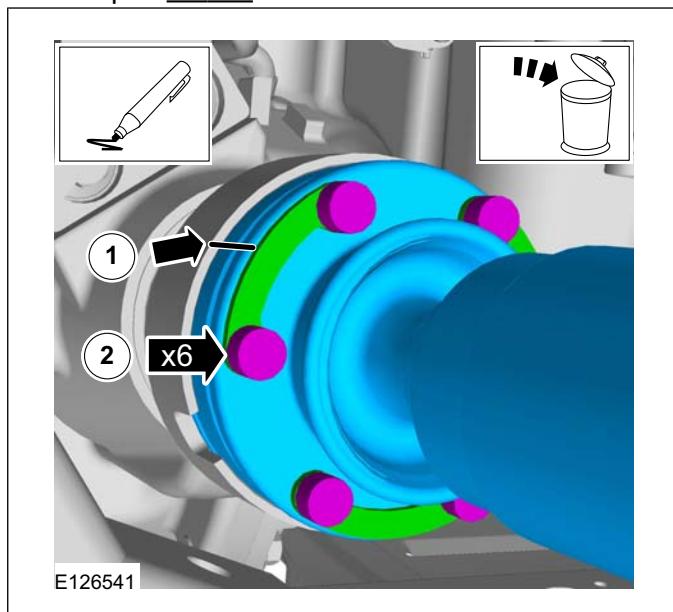
3. CAUTIONS:

- ⚠ 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



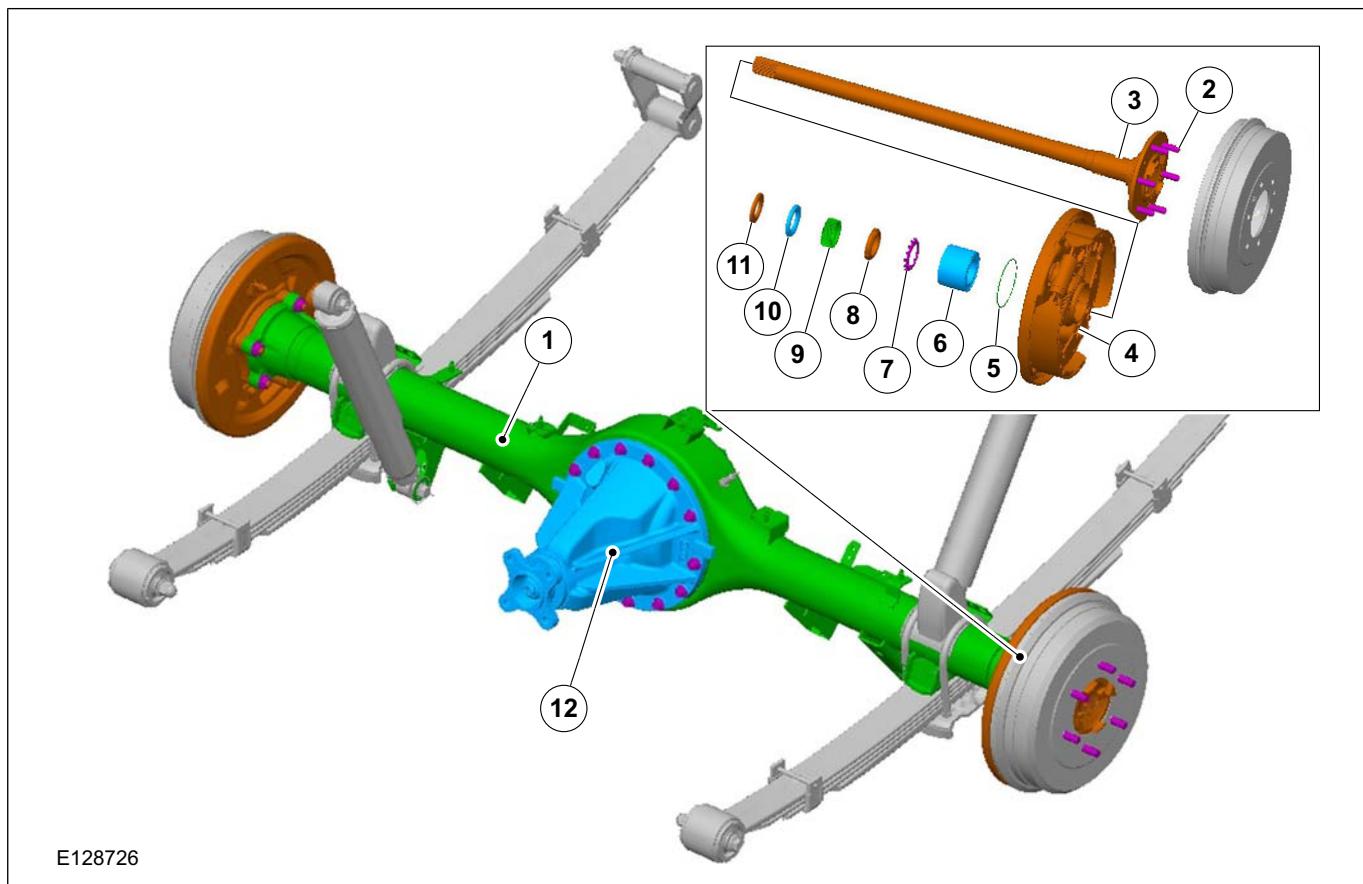
Installation

1. To install, reverse the removal procedure.

SECTION 205-02 Rear Drive Axle/Differential

VEHICLE APPLICATION: BT50 & Ranger

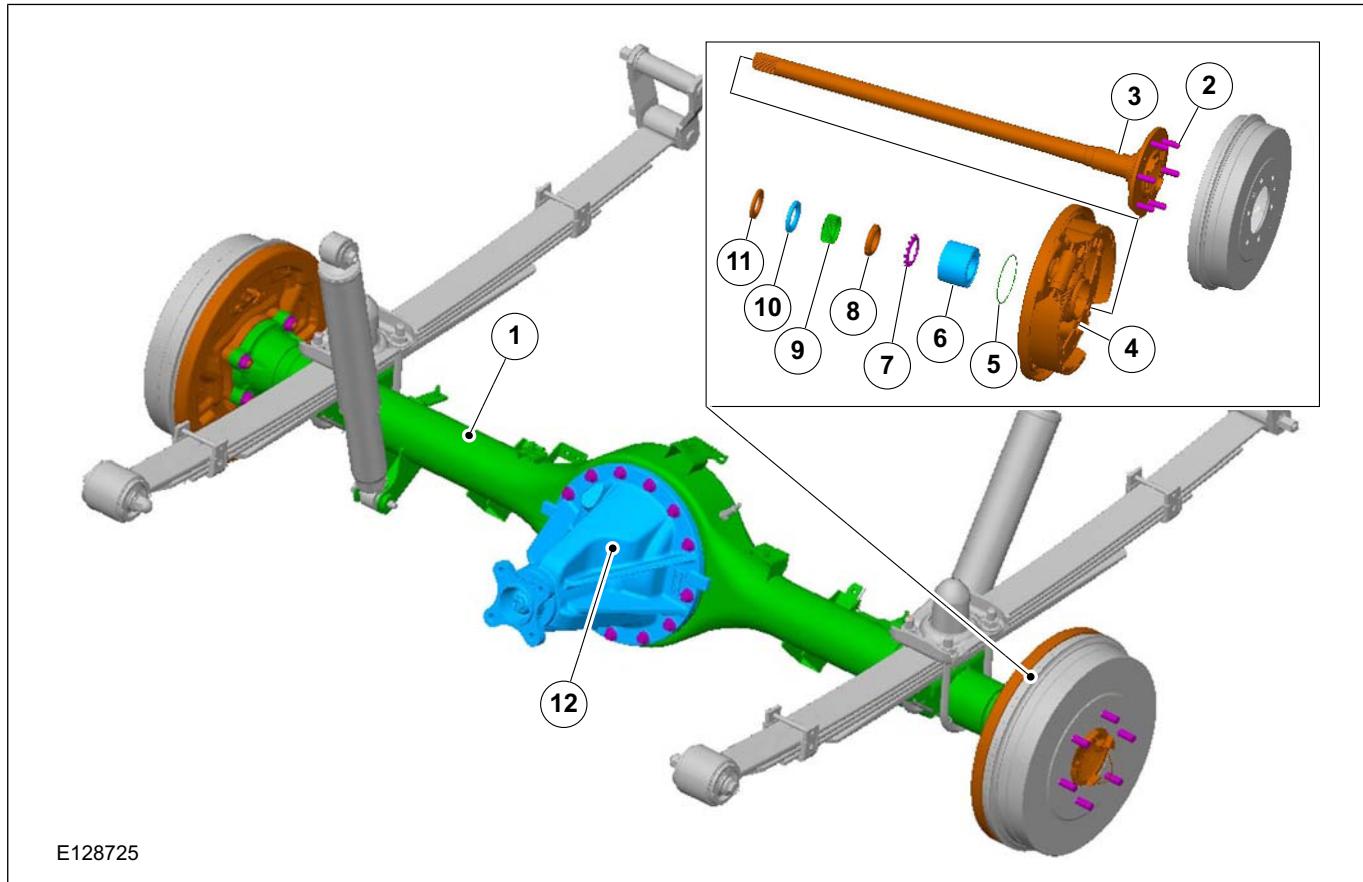
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GENERAL PROCEDURES	
Differential Draining and Filling.....	205-02-4
REMOVAL AND INSTALLATION	
Axle Assembly — 2WD.....	205-02-5
Axle Assembly — 4WD.....	205-02-9
Differential Carrier.....	205-02-12

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

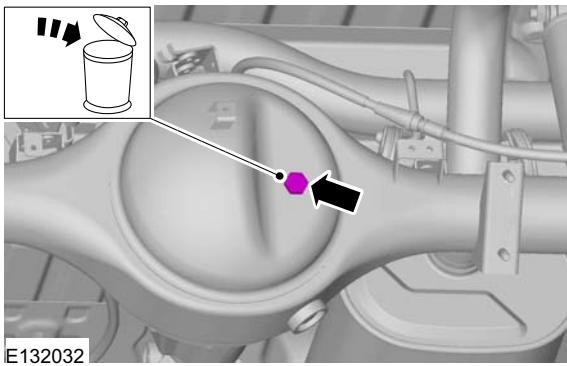
Item	Description
1	Axle housing
2	Wheel stud
3	Axle shaft
4	Brake shoe and wheel cylinder
5	O ring
6	Bearing assembly
7	Lock washer
8	Bearing retainer nut
9	Tone wheel ring
10	Axle shaft guide
11	Oil seal
12	Rear differential

GENERAL PROCEDURES

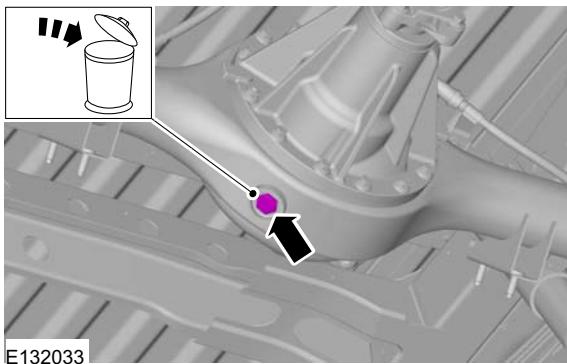
Differential Draining and Filling

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

2. Remove the oil-fill plug.

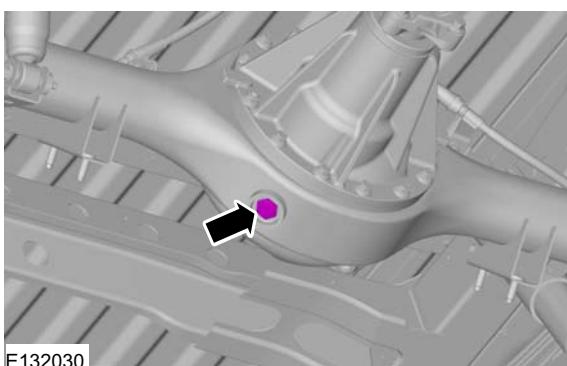


3. Remove the drain plug and drain the oil.



4. Install the drain plug with a new washer and tighten.

- Tightening torque 45 Nm.



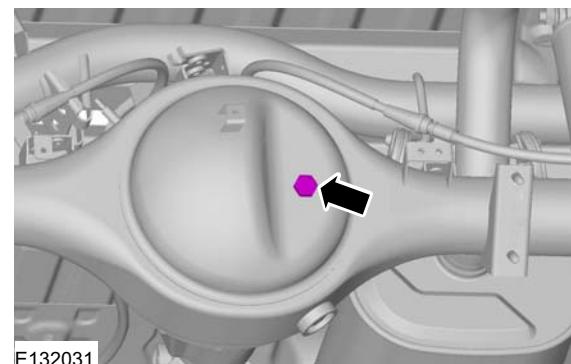
5. Fill up with the specified rear axle oil to the lower edge of the filler hole.

- 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

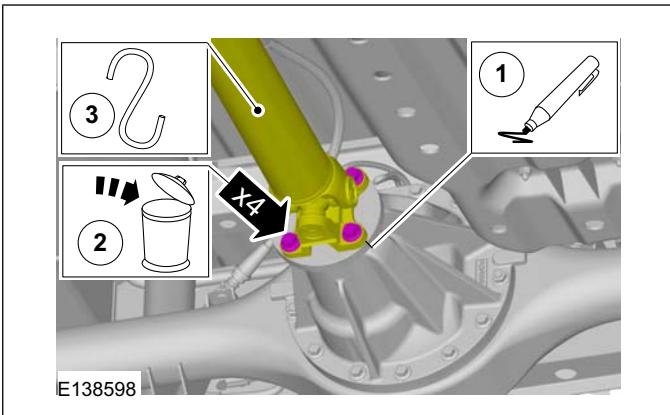
General Equipment

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.

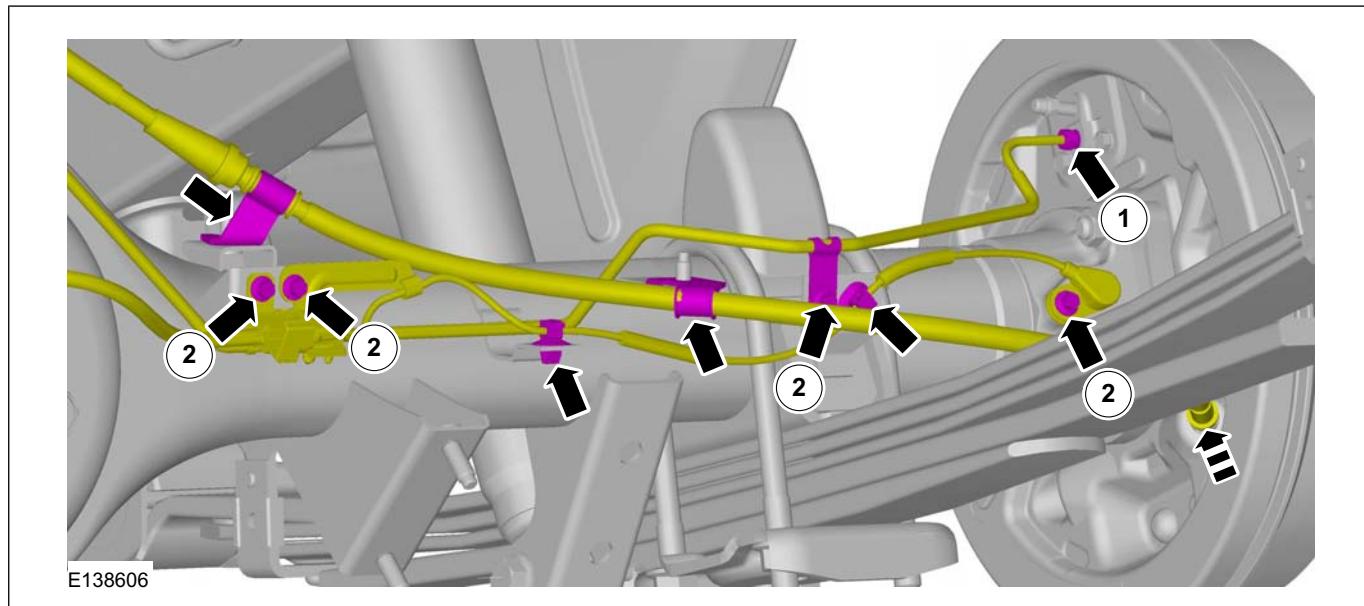
CAUTIONS:

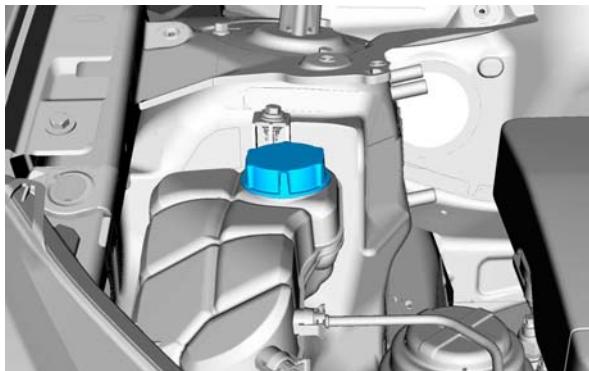
! If the fluid is spilled on the paintwork, the affected area must be immediately washed down with cold water.

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

Torque: 19 Nm

2. Torque: 7 Nm



DESCRIPTION AND OPERATION

E85028

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

REMOVAL AND INSTALLATION

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

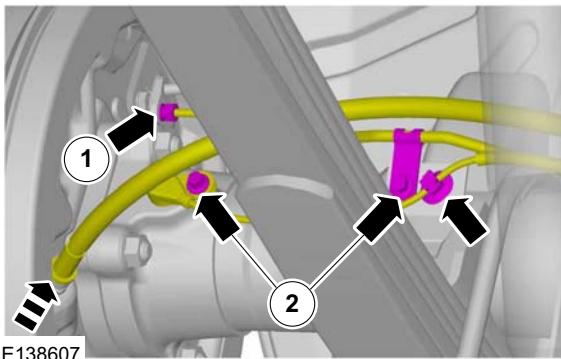
CAUTIONS:

 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

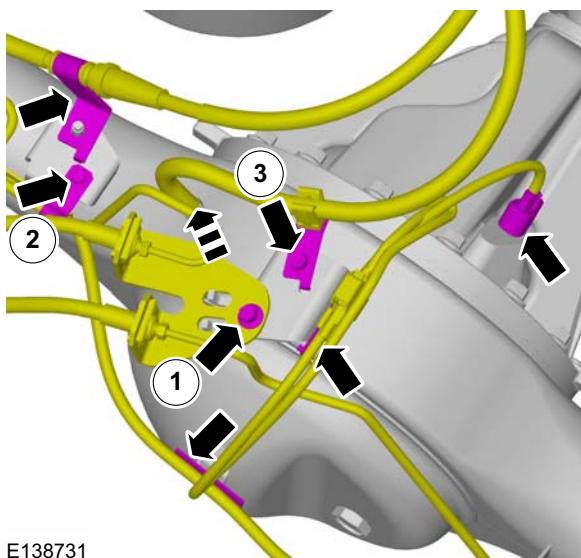
2. Torque: 7 Nm



6. 1. Torque: 14 Nm

2. Torque: 7 Nm

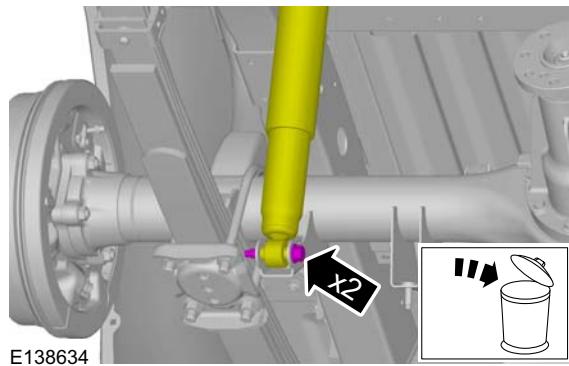
3. Torque: 25 Nm



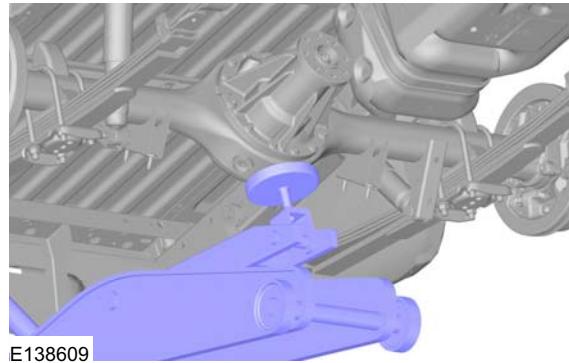
7.  **CAUTION:** Make sure that new bolts are installed.

General Equipment: Trolley Jack

Torque: 48 Nm

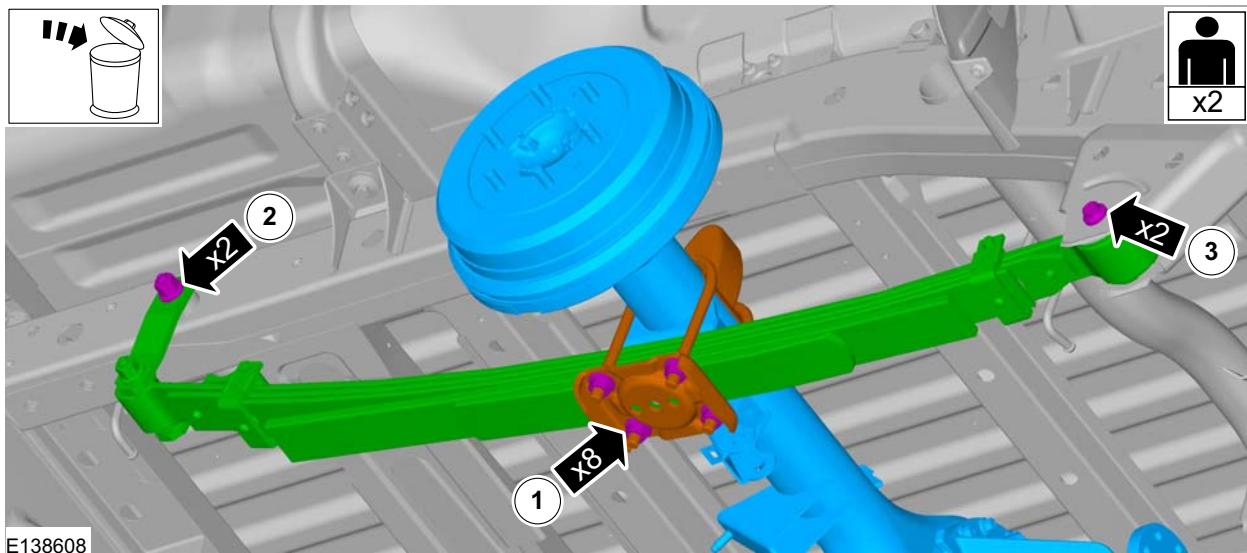


8. General Equipment: Trolley Jack



9. On both sides.

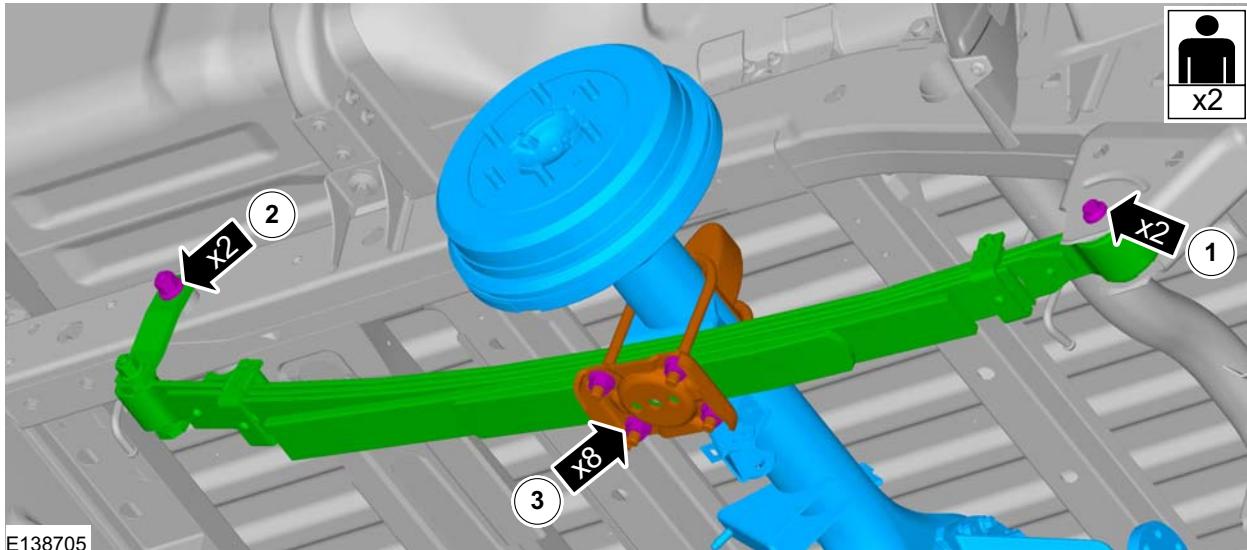
REMOVAL AND INSTALLATION



Installation

On both sides.

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.

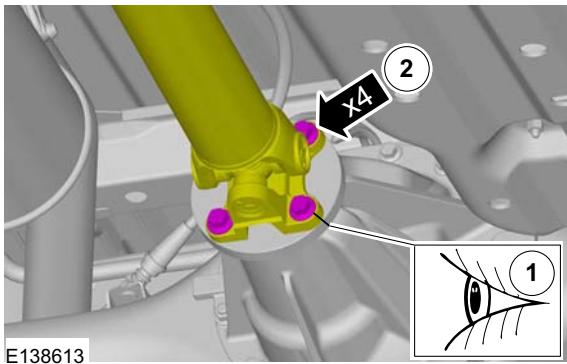


2. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

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

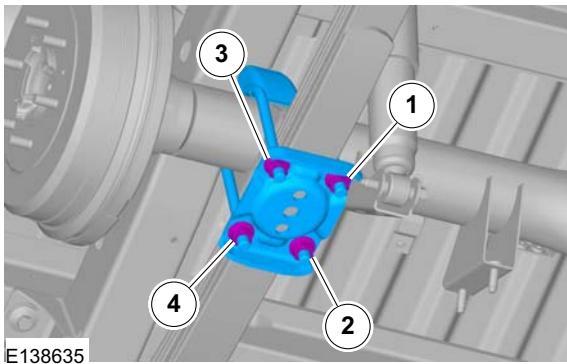
Torque: 135 Nm



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

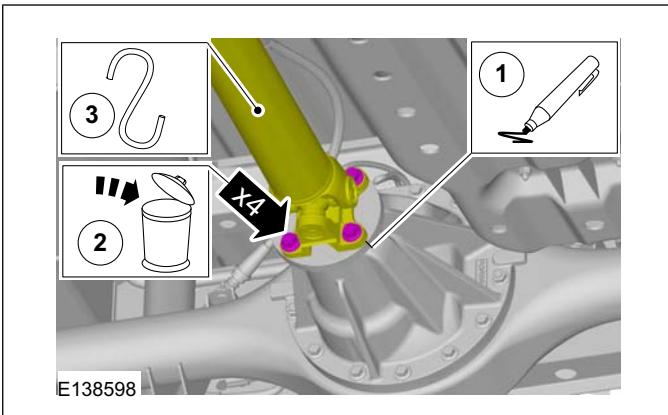
General Equipment

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.

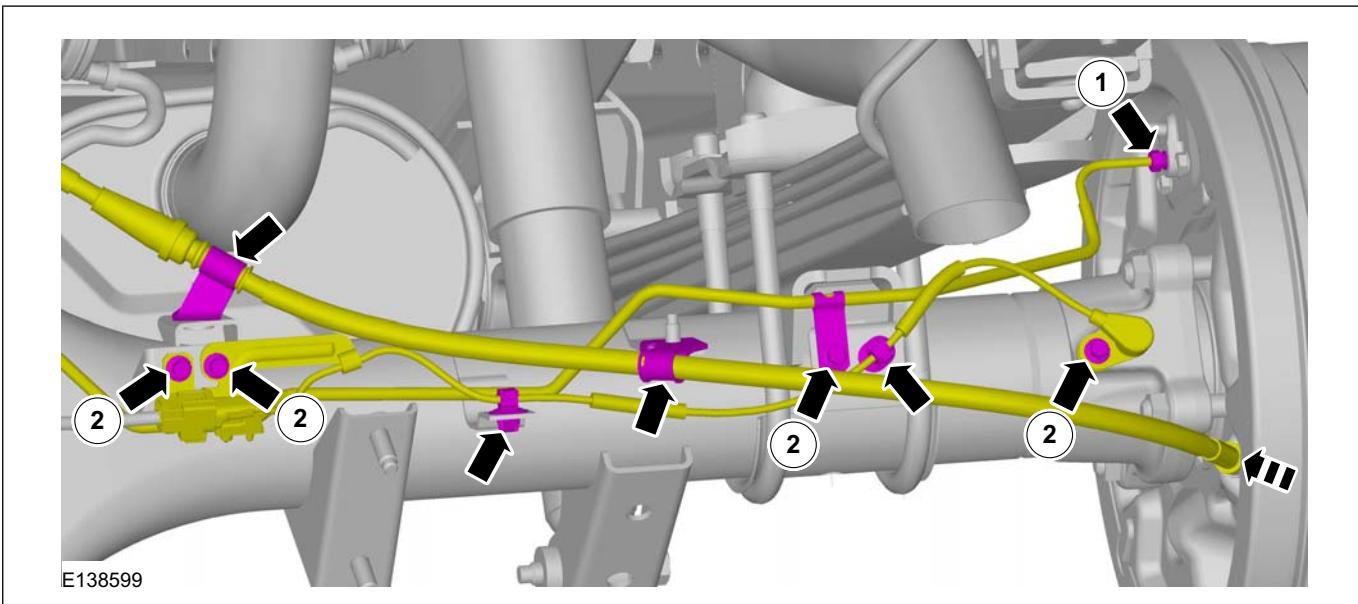
CAUTIONS:

! 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

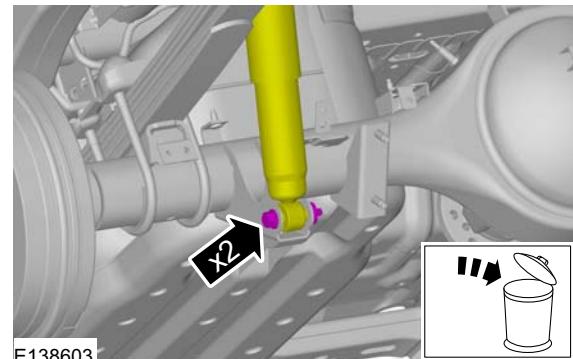
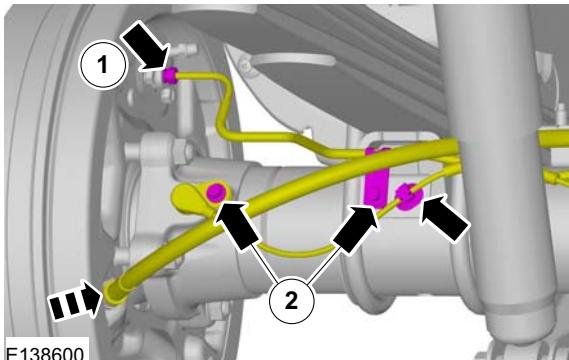
2. Torque: 7 Nm



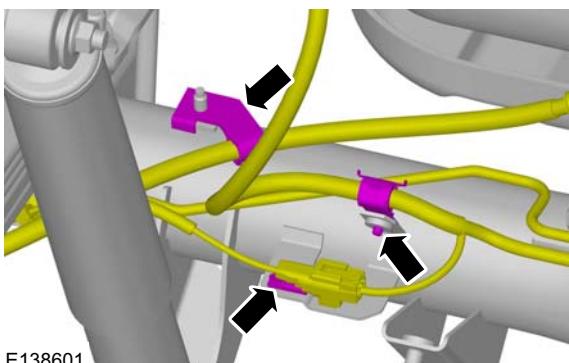
REMOVAL AND INSTALLATION

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

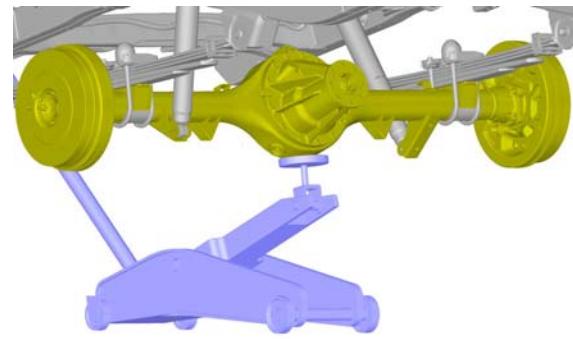
On both sides.
Torque: 48 Nm



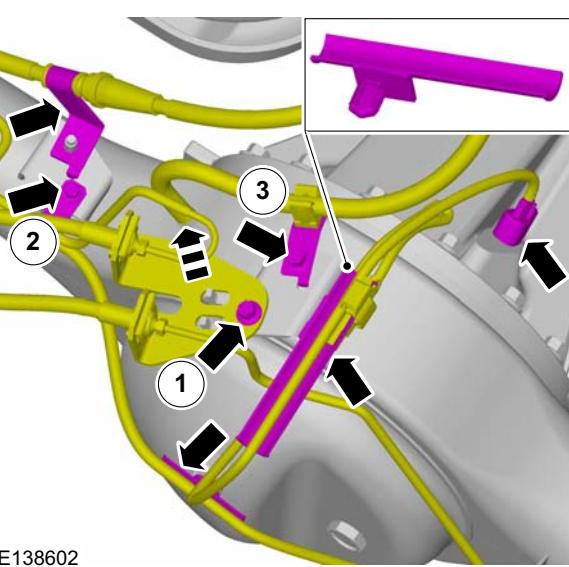
6. Torque: 7 Nm



9. General Equipment: Trolley Jack

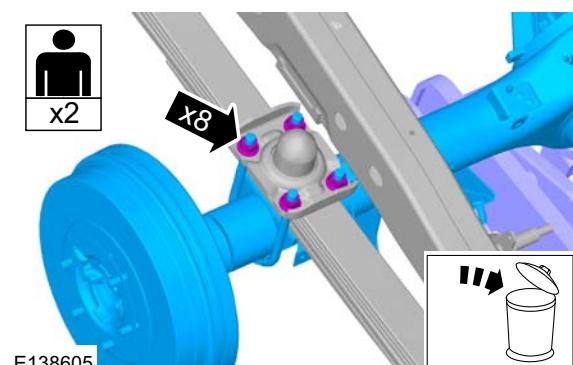


7. 1. Torque: 14 Nm
2. Torque: 7 Nm
3. Torque: 25 Nm



10. On both sides.

General Equipment: Trolley Jack



Installation

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

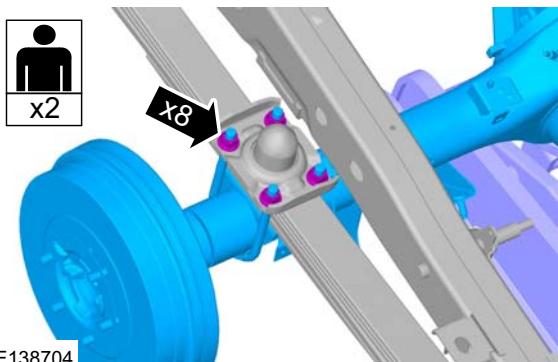
NOTE: Hand tighten the nut at this stage.

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

REMOVAL AND INSTALLATION

On both sides.

General Equipment: Trolley Jack



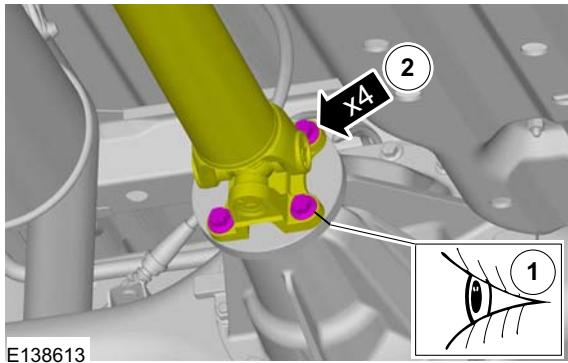
- Refer to: [Brake System Bleeding \(206-00 Brake System - General Information, General Procedures\)](#).

Refer to: [Brake System Pressure Bleeding \(206-00 Brake System - General Information, General Procedures\)](#).

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

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

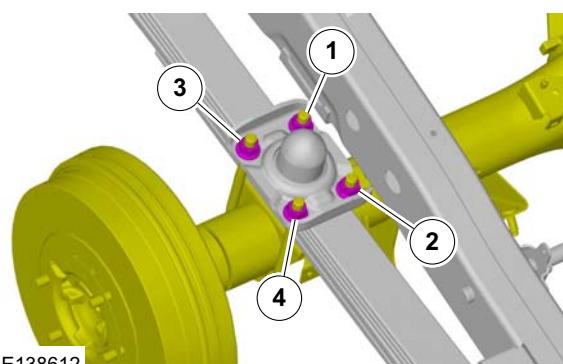
Torque: 135 Nm



- On both sides.

Torque:

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



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 \(205-03 Front Drive Axle/Differential, General Procedures\)](#).

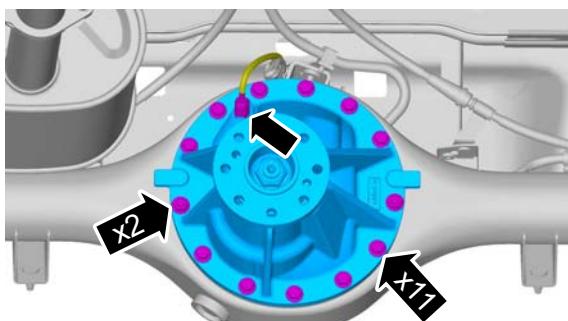
2. NOTE: The driveshaft flange fits tightly on the pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the driveshaft flange from the pinion flange or damage to the component may occur.

Refer to: [Driveshaft - 2WD \(205-01 Driveshaft, Removal and Installation\)](#).

Refer to: [Driveshaft - 4WD \(205-01 Driveshaft, Removal and Installation\)](#).

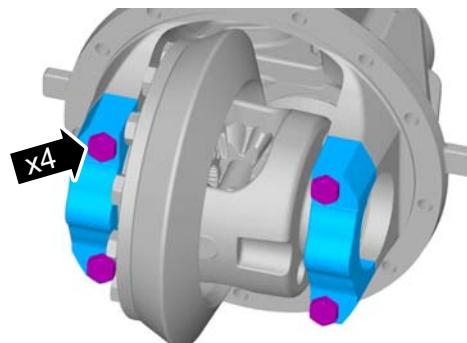
3. Refer to: [Rear Halfshaft \(205-05 Rear Drive Halfshafts, Removal and Installation\)](#).

4. Torque: 60 Nm



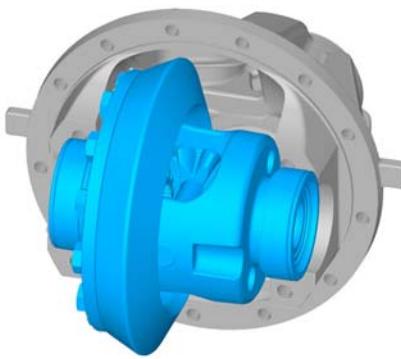
E132048

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: BT50 & Ranger

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DESCRIPTION AND OPERATION

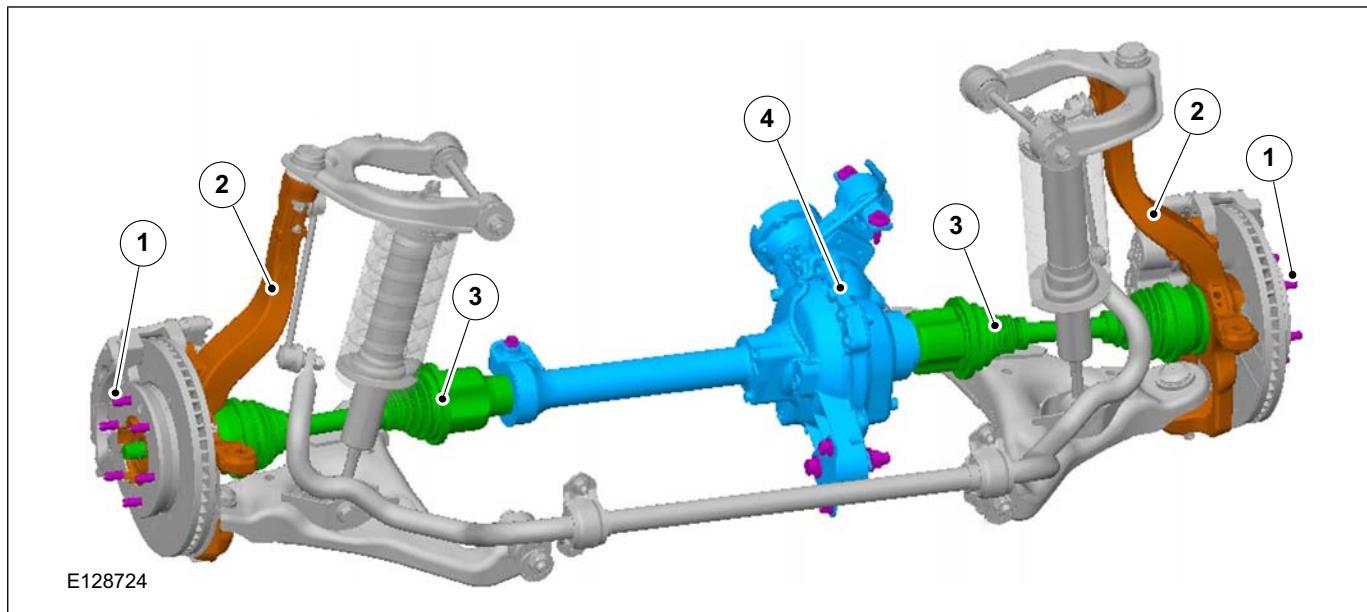
Front Drive Axle and Differential.....	205-03-2
4x4 Hi-rider.....	205-03-2

GENERAL PROCEDURES

Differential Draining and Filling.....	205-03-3
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REMOVAL AND INSTALLATION

Axle Assembly.....	205-03-5
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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

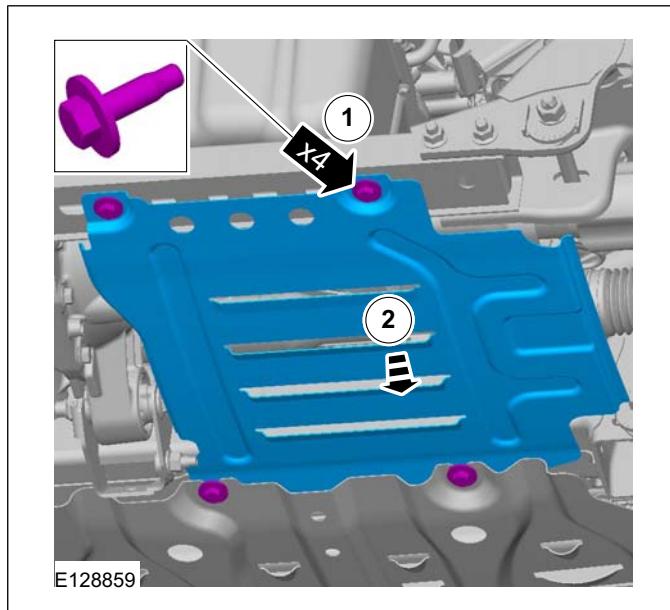
GENERAL PROCEDURES

Differential Draining and Filling

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

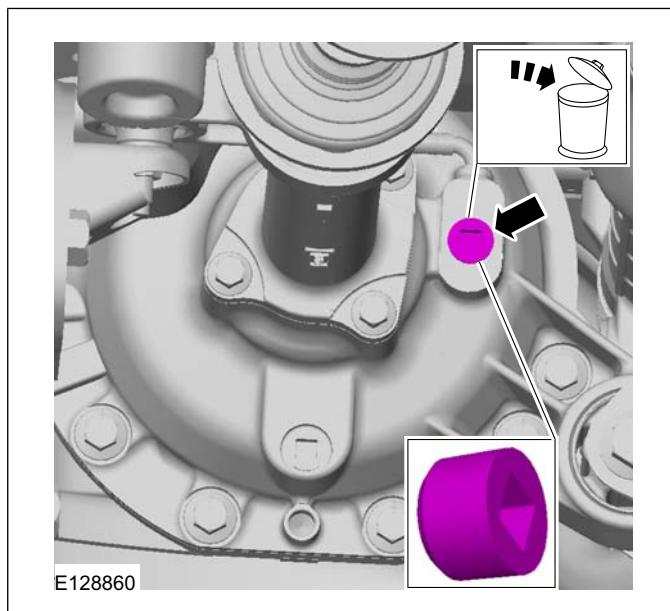
2.

- Tightening torque 30 Nm.

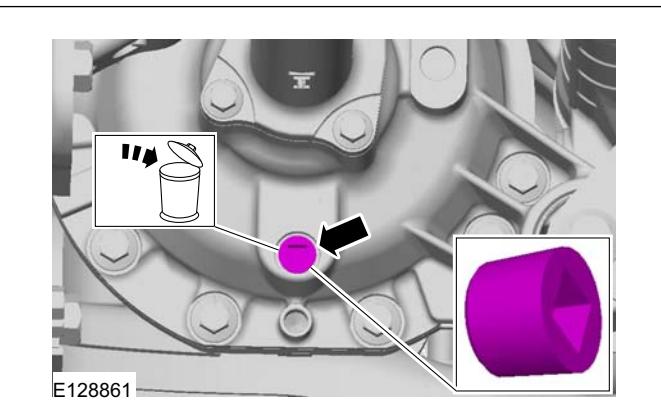


3. Position the vehicle on level ground.

4. Remove the oil-fill plug.

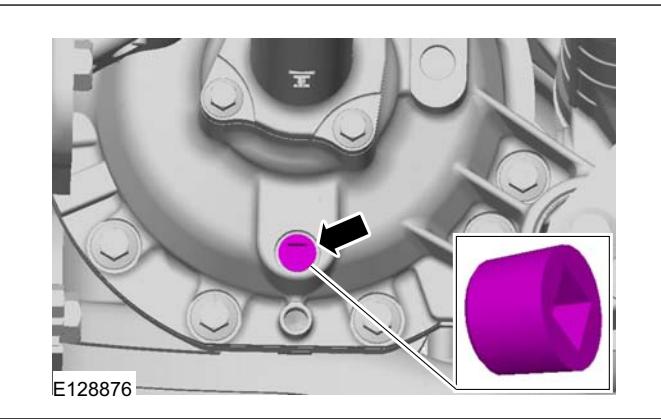


5. Remove the drain plug and drain the oil.



6. Install a new drain plug and tighten.

- Tightening torque 30 Nm.

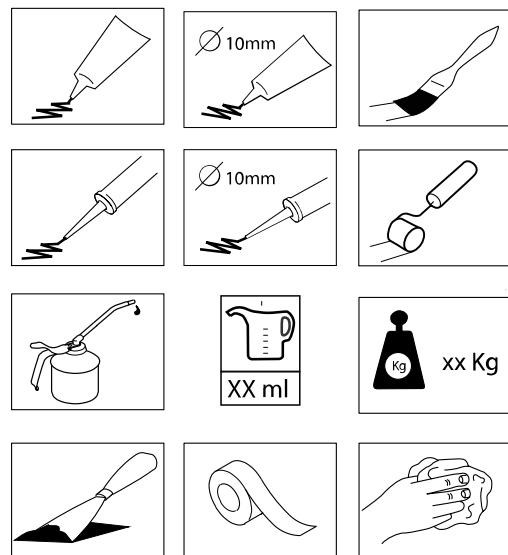


7. Add the specified oil through the oil-fill plug hole.

- Front differential oil spec: WSP-M2C197-A and fill to 1.275L +/-0.10L.

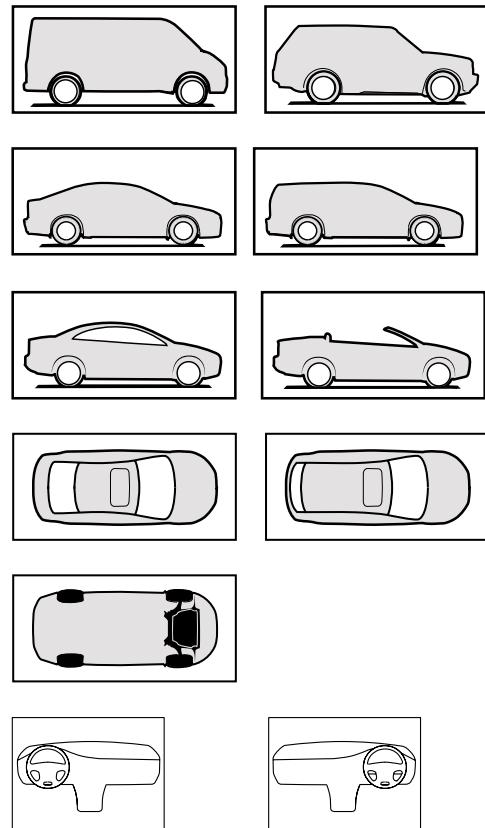
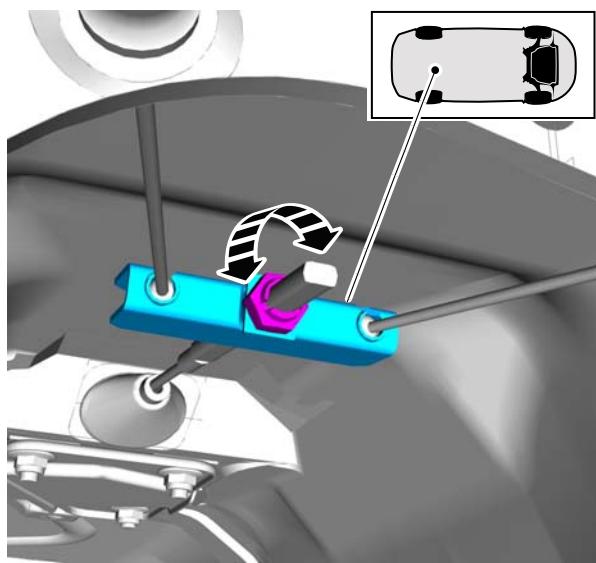
8. After adding the oil, perform the oil level inspection.

9. Install a new oil-fill plug and tighten.

DESCRIPTION AND OPERATION

E84834

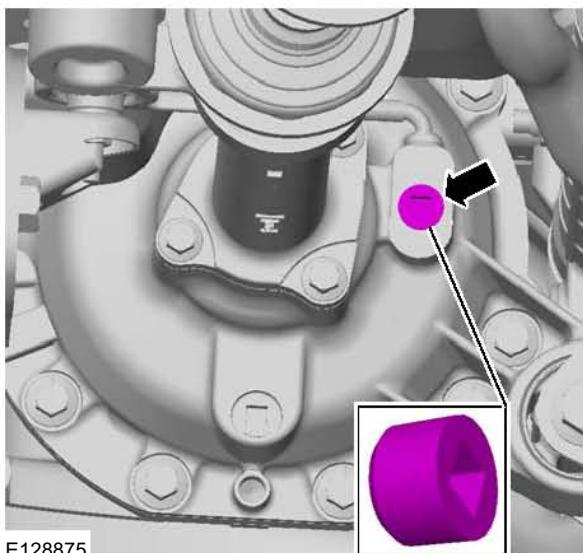
Location symbols are used to show the location of a component or system within the vehicle.



E84835

GENERAL PROCEDURES

- Tightening torque 30 Nm.



REMOVAL AND INSTALLATION

Axle Assembly

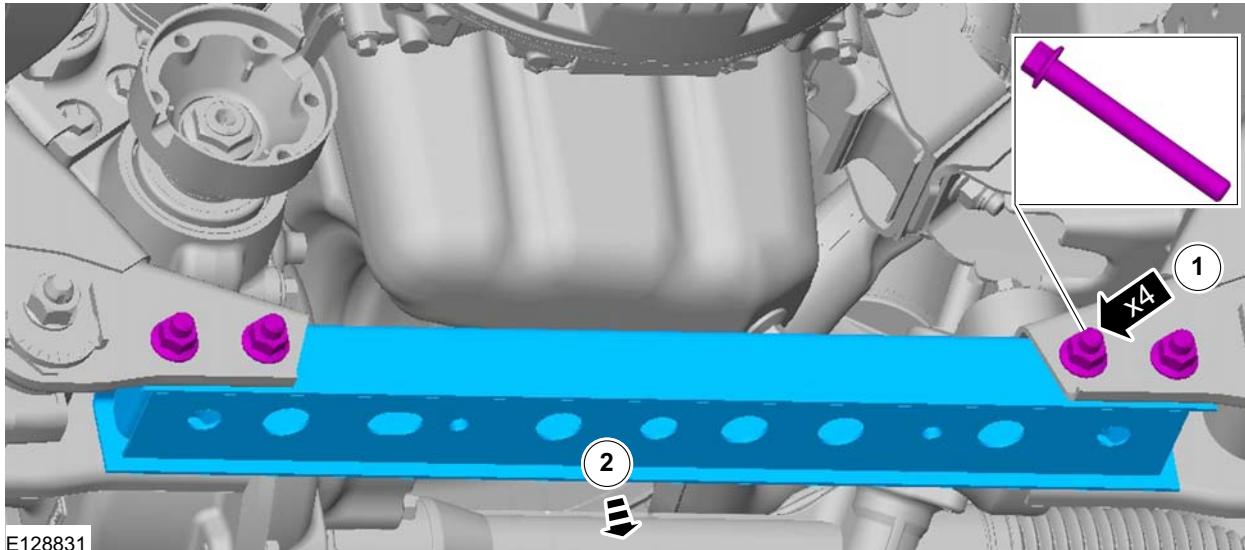
General Equipment

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

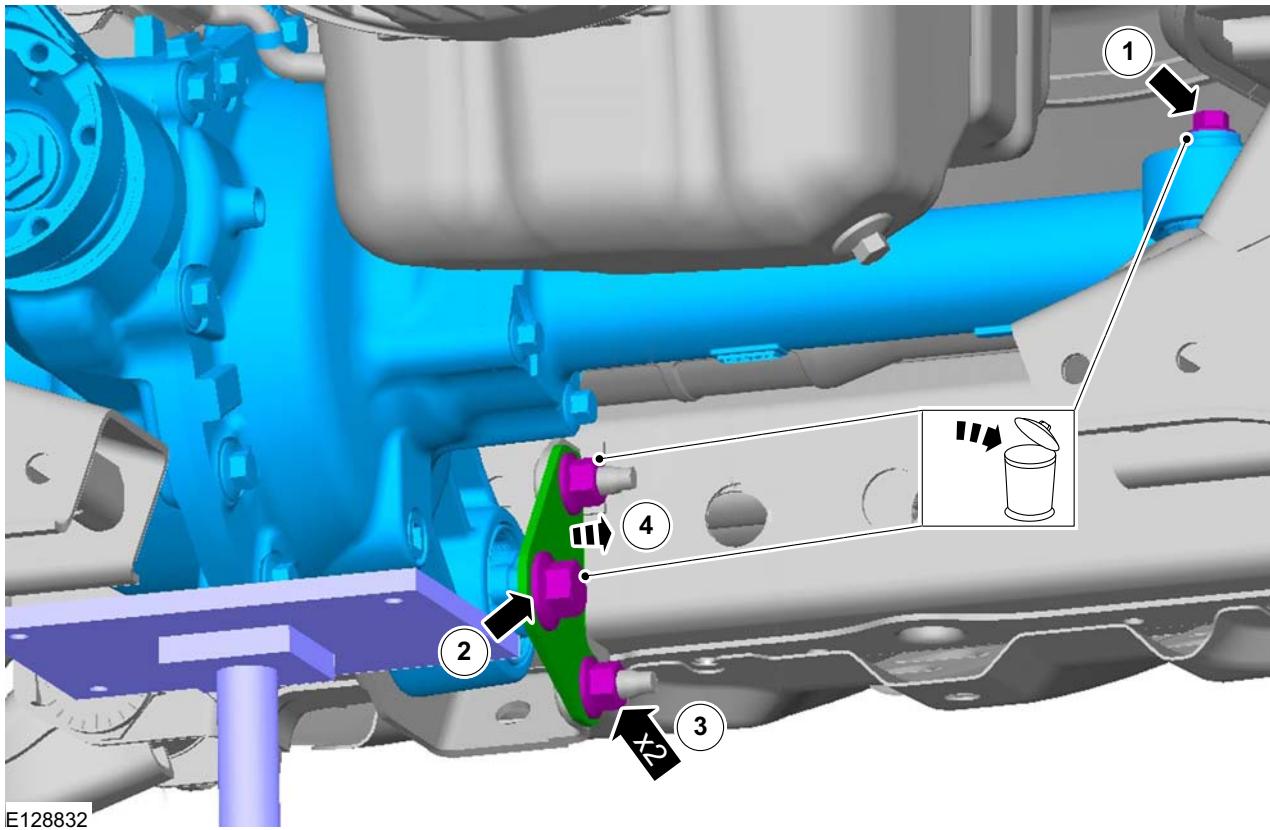


6. **WARNING:** Make sure that a new bolt and nut is installed.

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

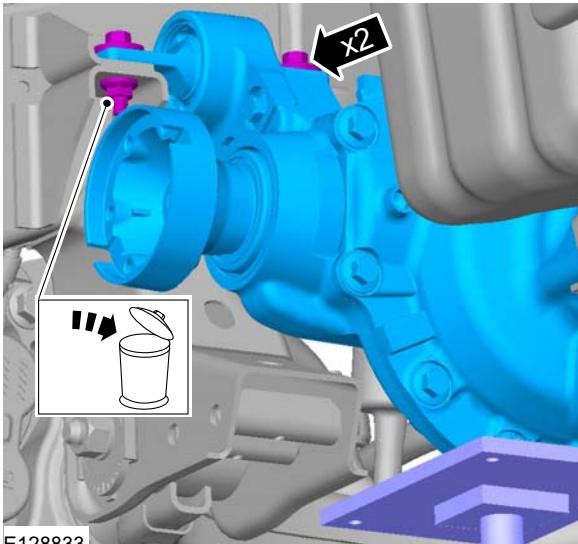
- General Equipment: Transmission Jack
- 1. Torque: 70 Nm
- 2. Torque: 300 Nm
- 3. Torque: 125 Nm

REMOVAL AND INSTALLATION

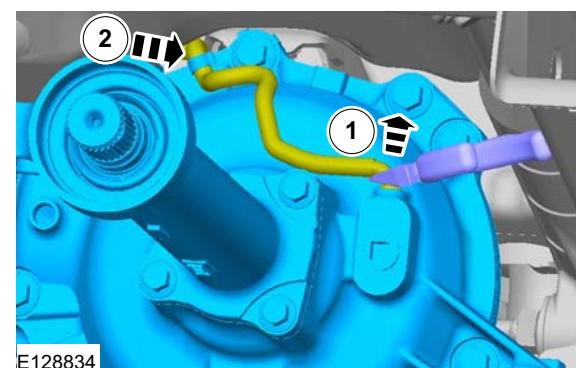


7. **WARNING:** Make sure that a new bolt and nut is installed.

Torque: 48 Nm



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



Installation

- To install, reverse the removal procedure.

SECTION 205-04 Front Drive Halfshafts

VEHICLE APPLICATION: BT50 & Ranger

CONTENTS

PAGE

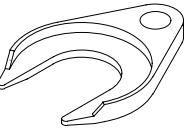
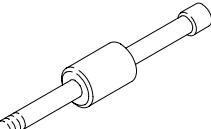
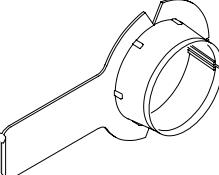
REMOVAL AND INSTALLATION

Front Halfshaft LH.....	(14 320 0)	205-04-2
Front Halfshaft RH.....	(14 321 0)	205-04-4
Inner Constant Velocity (CV) Joint Boot.....	(14 336 0)	205-04-6
Outer Constant Velocity (CV) Joint Boot.....	(14 338 0)	205-04-9

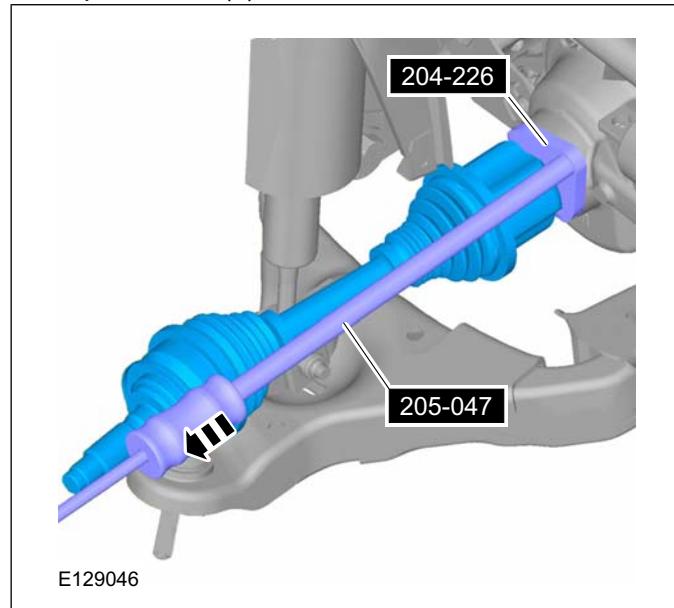
REMOVAL AND INSTALLATION

Front Halfshaft LH(14 320 0)

Special Tool(s)

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

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



Removal

CAUTIONS:

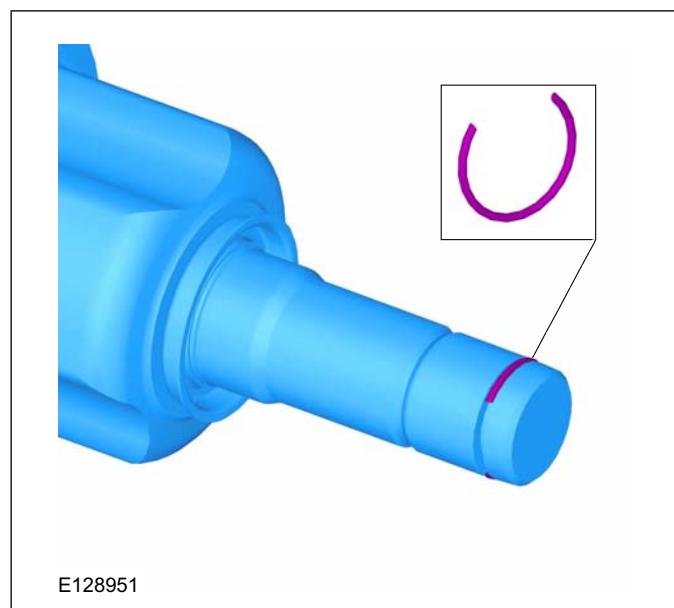
⚠ **Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality 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.

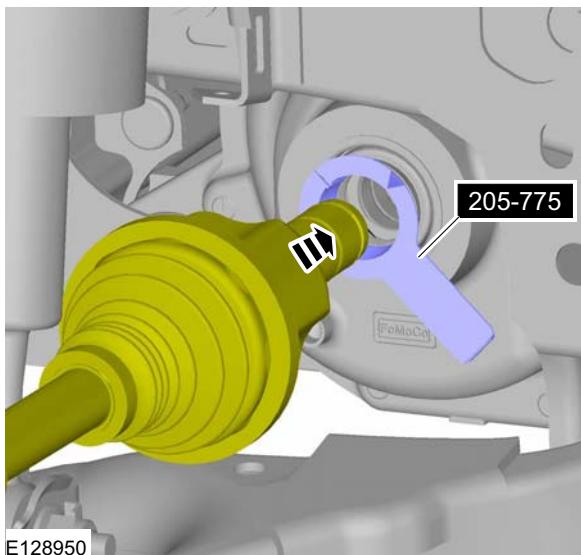
Installation

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



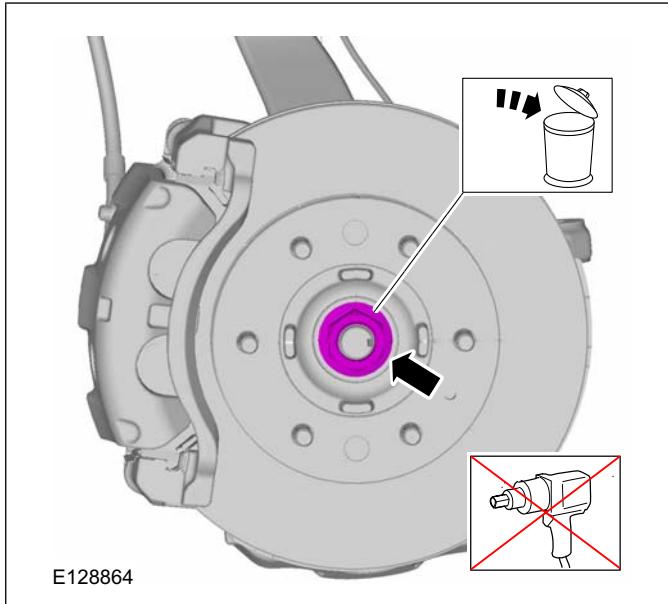
REMOVAL AND INSTALLATION

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:

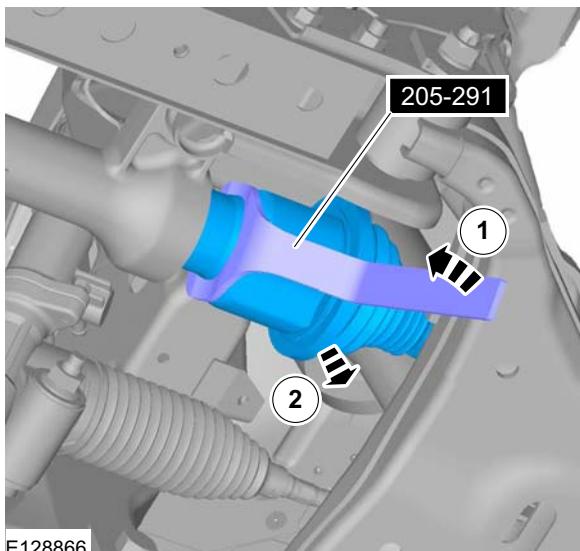
⚠️ Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality 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.

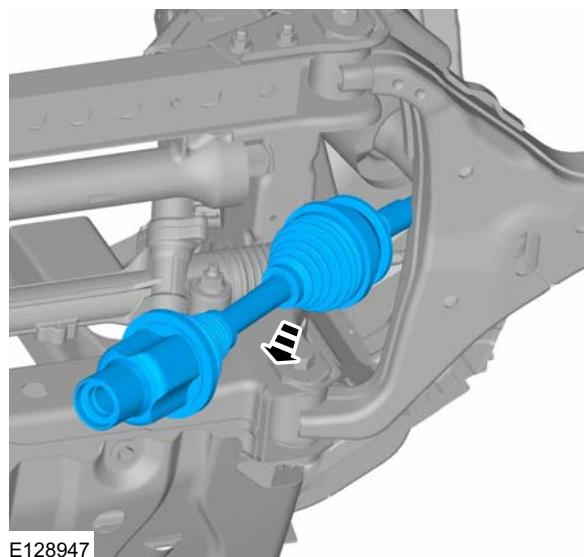
NOTE: Removal steps in this procedure may contain installation details.

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.



4.

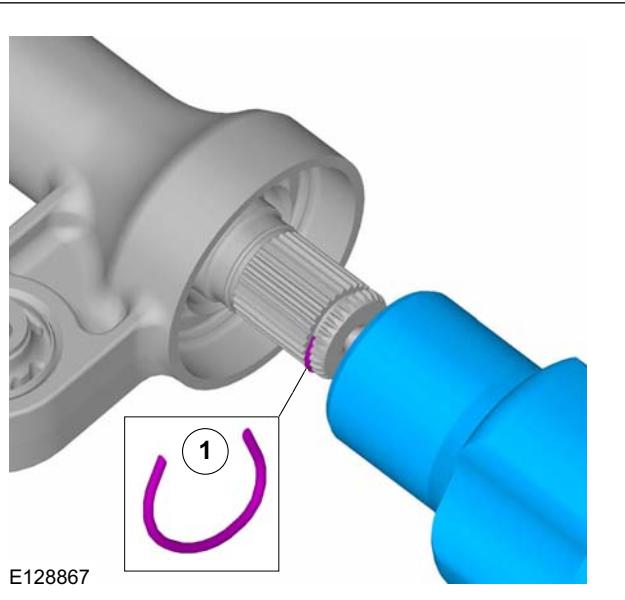


Installation

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.

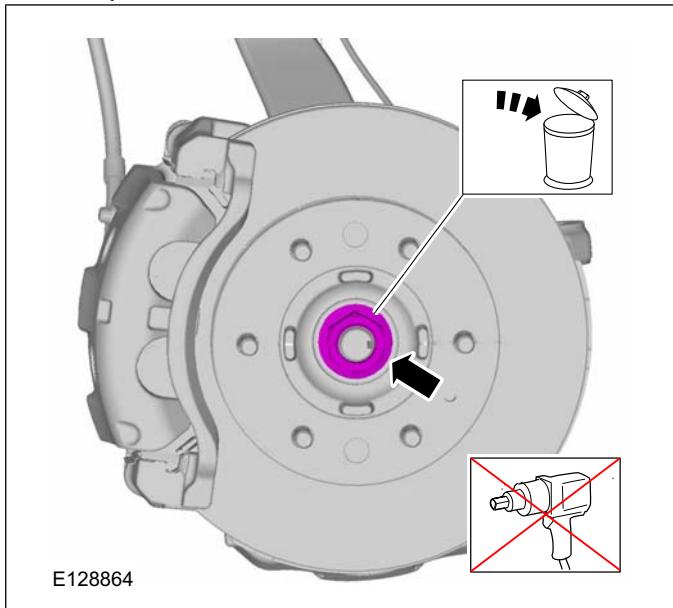
1. Ring retainer.



REMOVAL AND INSTALLATION

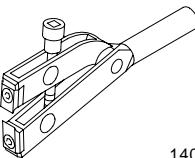
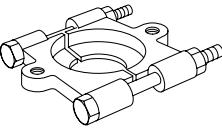
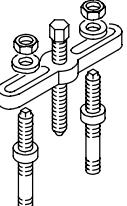
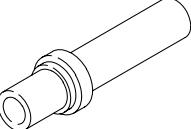
2. **CAUTION:** Make sure that a new halfshaft retaining nut is installed.

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**

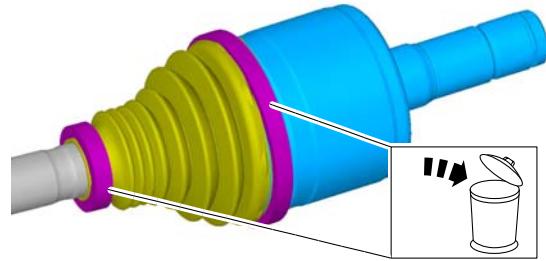
	204-169 Clamping Tool, Boot Retaining Clamp 14044				
	205-310 Remover, Bearing/Gear TI15091				
	205-311 Remover, Bearing/Gear 15092				
	308-046 Installer, Transmission Extension Housing Bushing/Seal 16016				
Vise					
Vise Jaw Protectors					
Materials					
<table border="1"> <thead> <tr> <th>Name</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>Grease FD-R</td> <td>WSS-M1C259-A1 / 3M5J-M1C259-AA</td> </tr> </tbody> </table>		Name	Specification	Grease FD-R	WSS-M1C259-A1 / 3M5J-M1C259-AA
Name	Specification				
Grease FD-R	WSS-M1C259-A1 / 3M5J-M1C259-AA				

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).

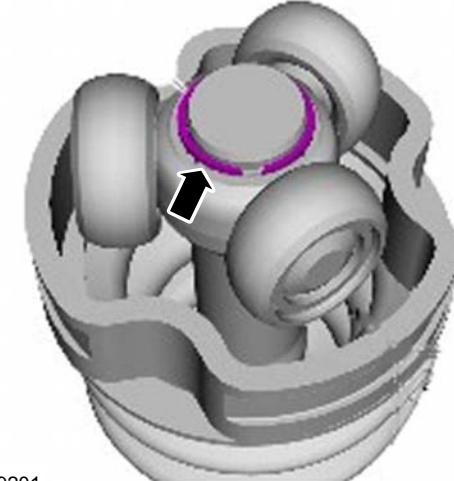
2.  **CAUTION: Use vise jaw protectors.**

General Equipment: Vise

General Equipment: Vise Jaw Protectors



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



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

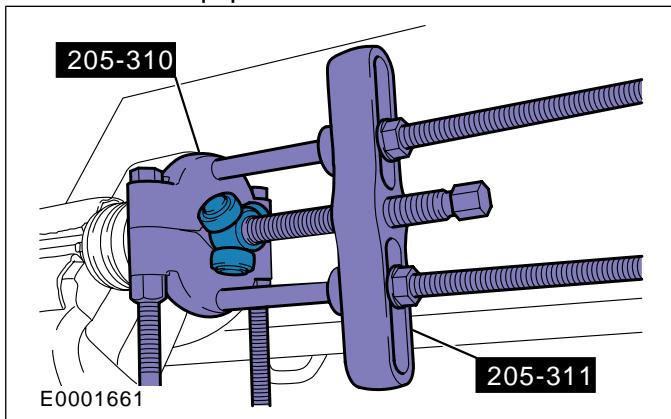
Removal

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

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

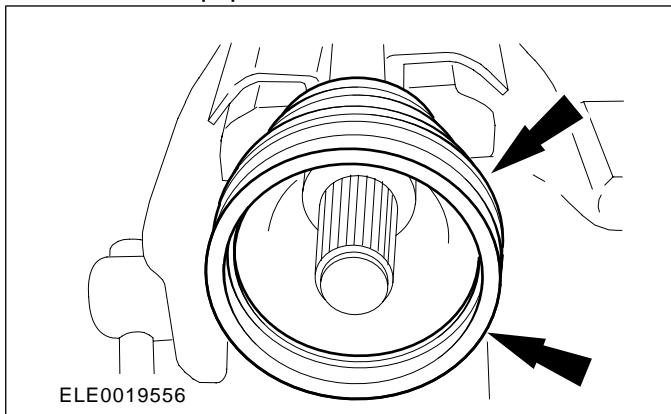


Installation

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

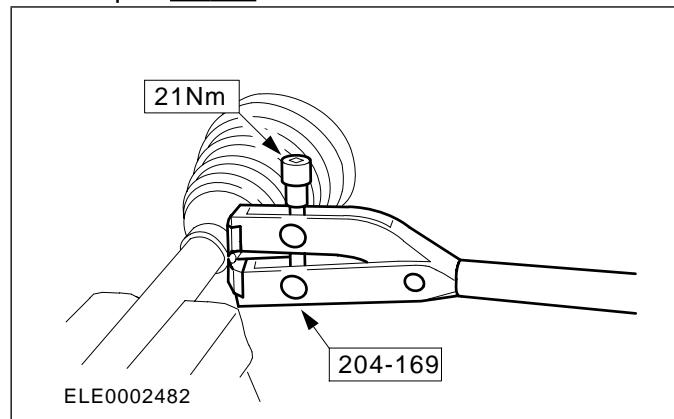
NOTE: Make sure that a new inner constant velocity (CV) joint boot is installed.

General Equipment: Vise
 General Equipment: Vise Jaw Protectors



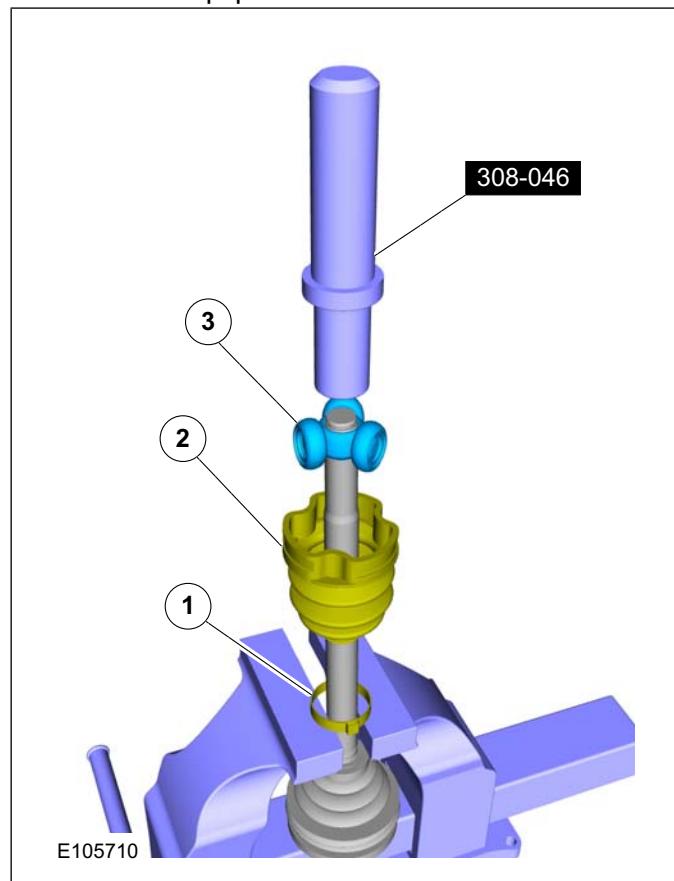
- 2.** **NOTE:** Install a new CV joint boot retaining clamp.

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

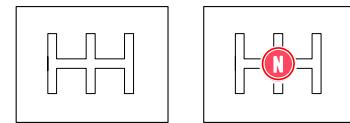
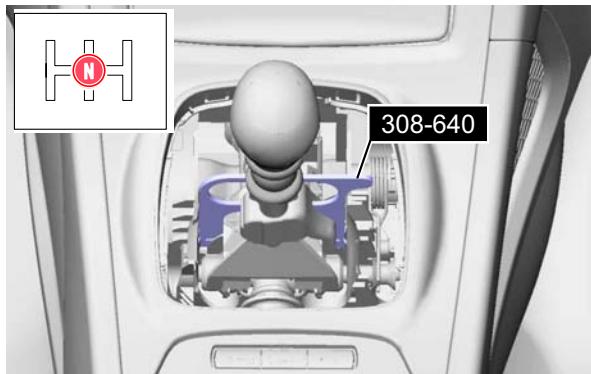


- 4.** **CAUTION:** The total amount of grease in the CV joint must not exceed 160

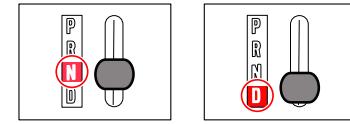
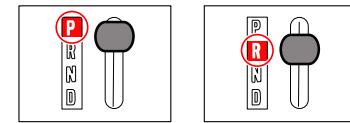
DESCRIPTION AND OPERATION

Gearshift lever or selector lever position symbols are used to show which gearshift lever or selector

lever position is to be set.



1 2 3 4 5 6 R



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 lute arrow. A sequence number is

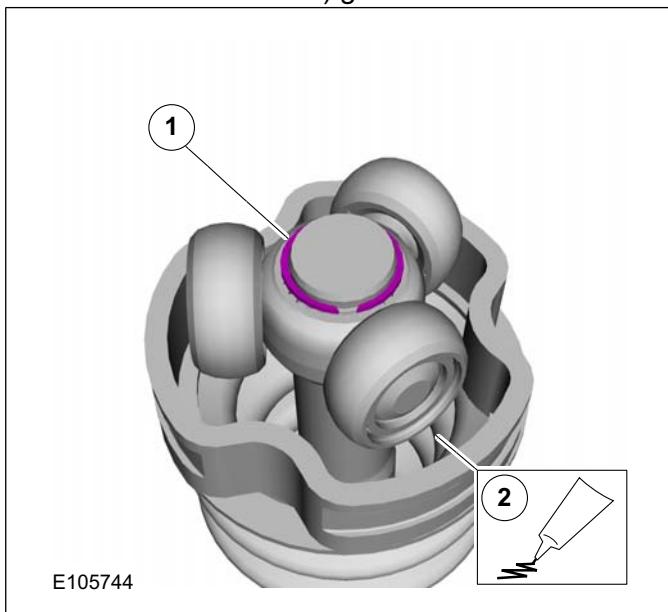
located inside the circle. Numbers inside circles are also used to allocate special information such as tightening torques or chemicals to a particular component.

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



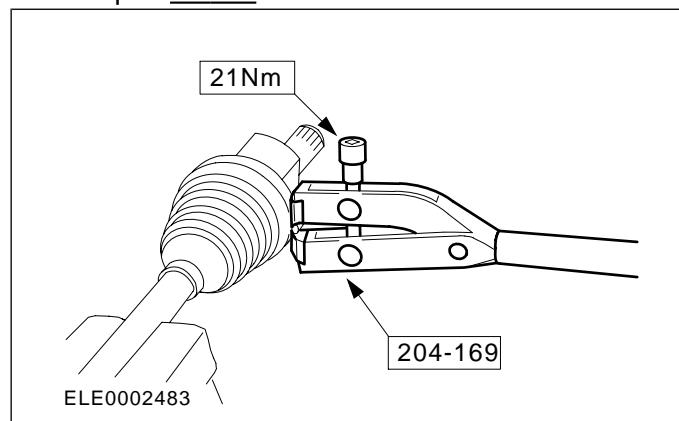
NOTE: Do not move the CV joint housing. Make sure that the CV joint boot is installed at the measured position.

Special Tool(s): 204-169

General Equipment: Vise

General Equipment: Vise Jaw Protectors

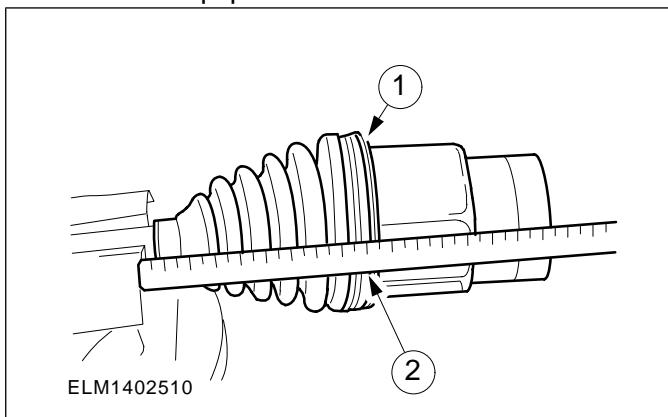
Torque: 21 Nm



- 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



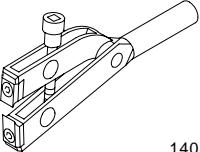
- NOTE:** Install a new CV joint boot retaining clamp.

- 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

	204-169 Clamping Tool, Boot Retaining Clamp 14044
---	--

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.

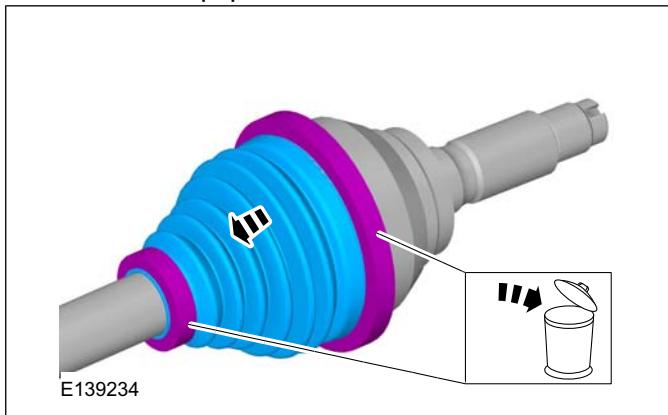
1. Refer to: **Inner Constant Velocity (CV) Joint Boot** (205-04 Front Drive Halfshafts, Removal and Installation).

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

Discard the CV joint boot.

General Equipment: Vise

General Equipment: Vise Jaw Protectors



Installation

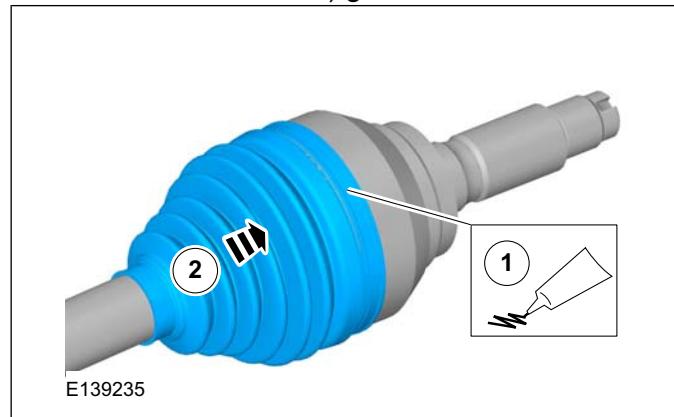
1. **⚠ CAUTION:** The total amount of grease in the CV joint must not exceed 165 grams for 85 PS vehicles and 250 grams for 110/130 PS vehicles.

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



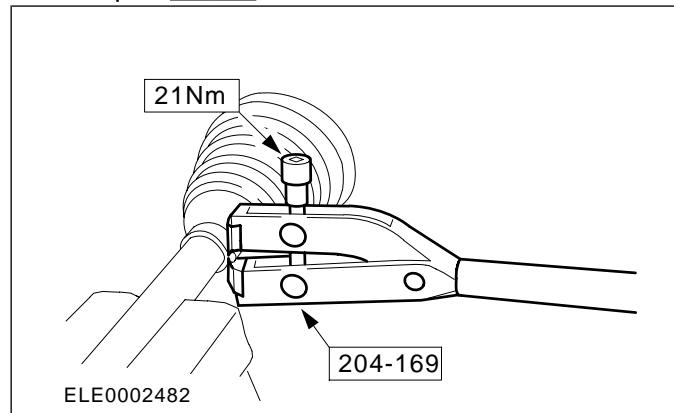
2. **NOTE:** Install a new CV joint boot retaining clamp.

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

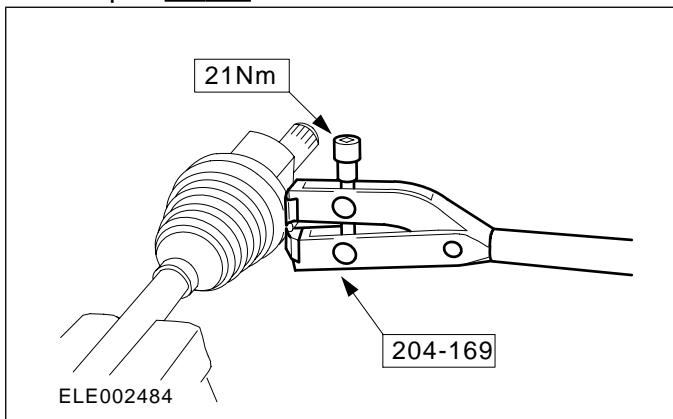
NOTE: Do not move the CV joint housing. Make sure that the CV joint boot is installed at the measured position.

Special Tool(s): 204-169

General Equipment: Vise

General Equipment: Vise Jaw Protectors

Torque: 21 Nm



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

Missing Graphics

url(<http://www.odyssey.ford.com/odyssey/graphicSVGServlet?id=1509205&height=2.987&width=2.987>)

SECTION 205-05 Rear Drive Halfshafts

VEHICLE APPLICATION: BT50 & Ranger

CONTENTS

PAGE

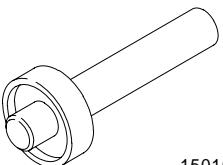
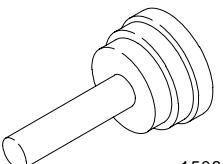
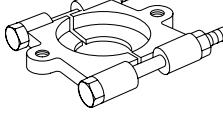
REMOVAL AND INSTALLATION

Rear Halfshaft.....	205-05-2
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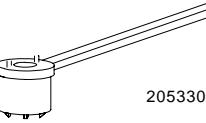
REMOVAL AND INSTALLATION

Rear Halfshaft

Special Tool(s) / General Equipment

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

Special Tool(s) / General Equipment

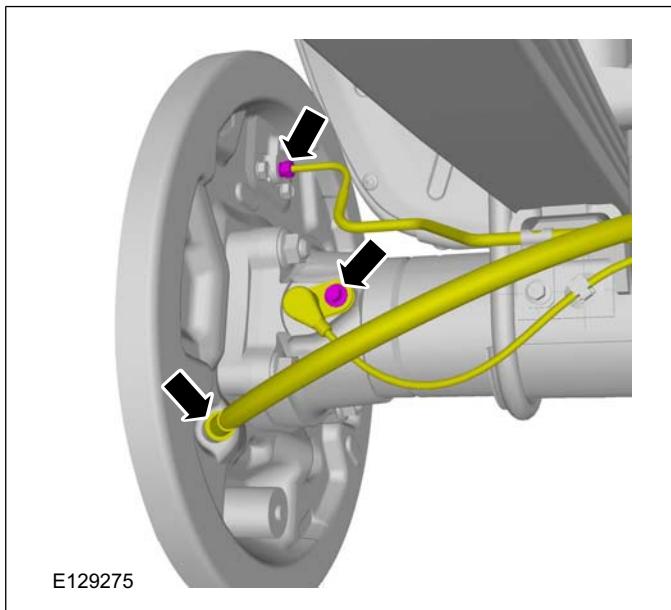
 IMAGE NOT AVAILABLE	205-311-05 Adapter for 205-311
	205-330A Wrench, Axle Shaft Nut 205330A
Hydraulic Press	
Vise	
Materials	
Name	Specification
Contact Grease	WSB-M1C239-A / YS5J-M1C239-AA

Removal

REMOVAL AND INSTALLATION

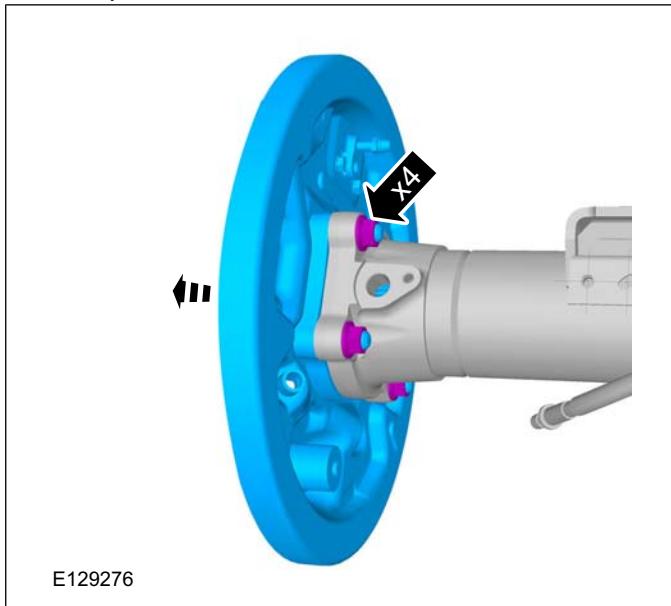
1. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).
3. Refer to: **Wheel Cylinder** (206-02 Drum Brake, Removal and Installation).
Refer to: **Brake Shoes** (206-02 Drum Brake, Removal and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

4.



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

Torque: 108 Nm

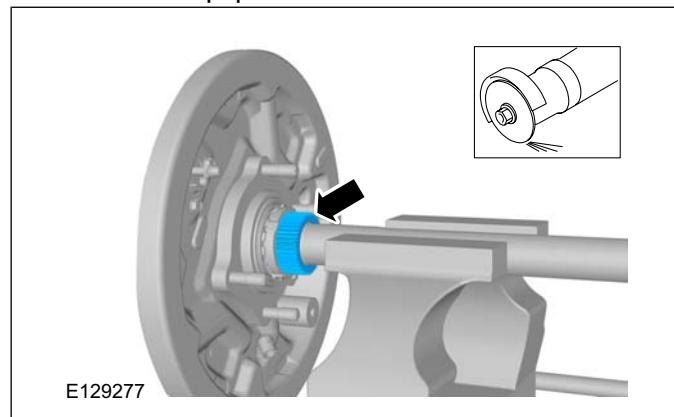


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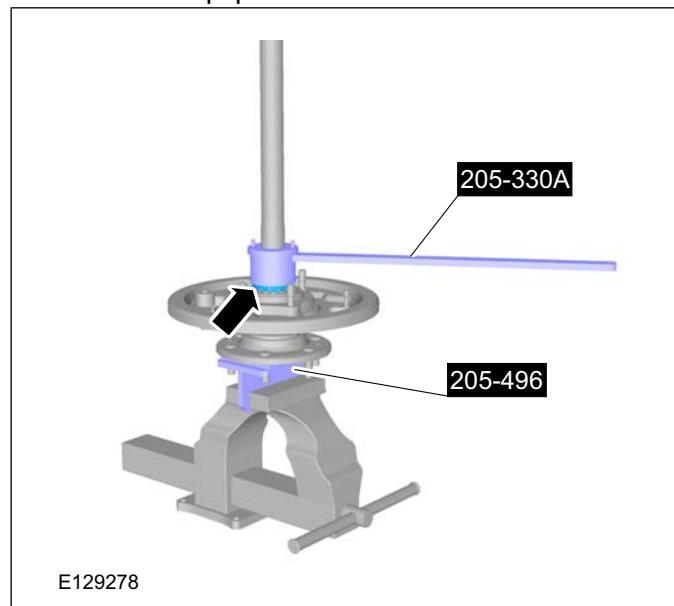


CAUTION: Because the ABS sensor rotor and rear wheel hub edge are almost flush even if the axle shaft is moved as far as it will go, be careful not to damage the rear wheel hub when grinding.

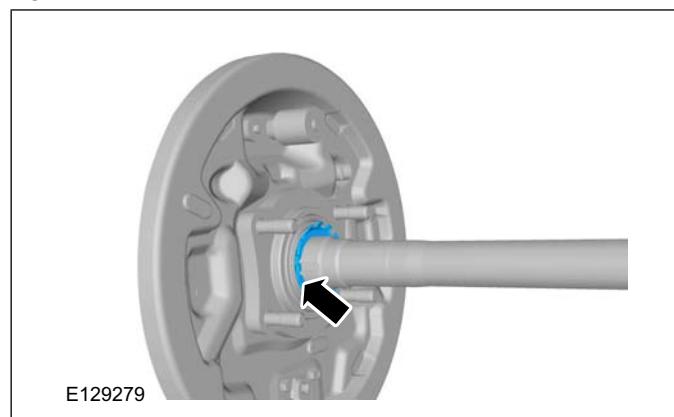
General Equipment: Vise



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

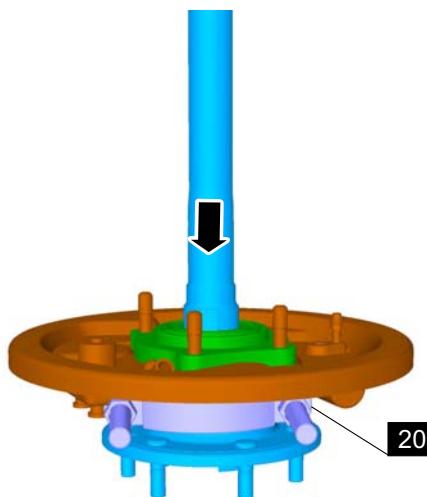


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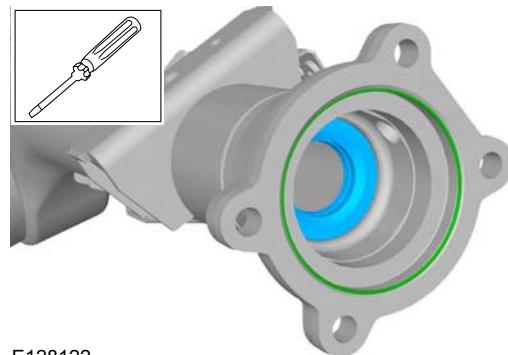


REMOVAL AND INSTALLATION**9. Special Tool(s): 205-310**

General Equipment: Hydraulic Press



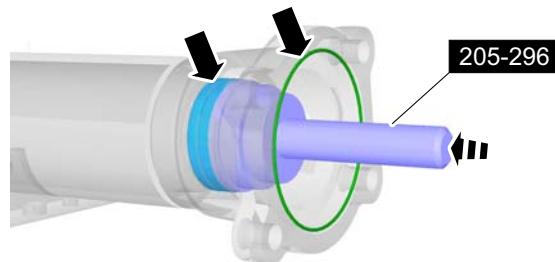
E128118

12

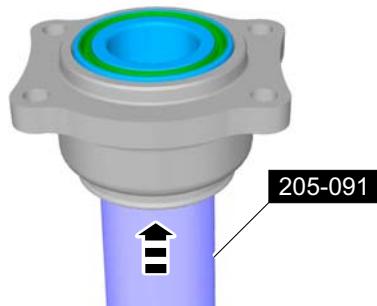
E128122

Installation**1. Special Tool(s): 205-296**

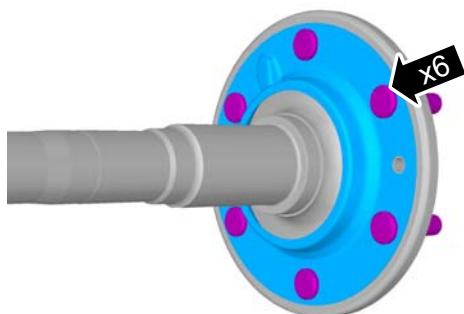
Material: Contact Grease (WSB-M1C239-A / YS5J-M1C239-AA) grease



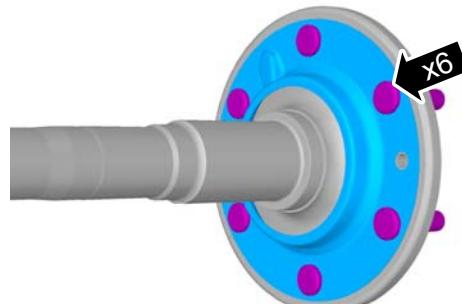
E129248

10. General Equipment: Hydraulic Press

E129280

11.

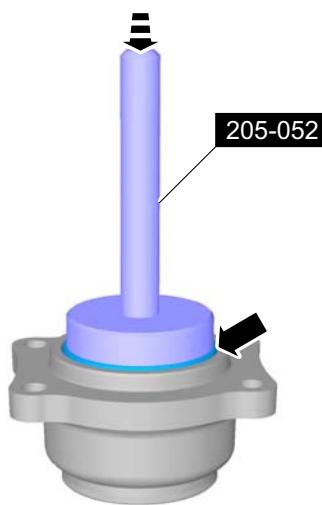
E129291

2.

E129291

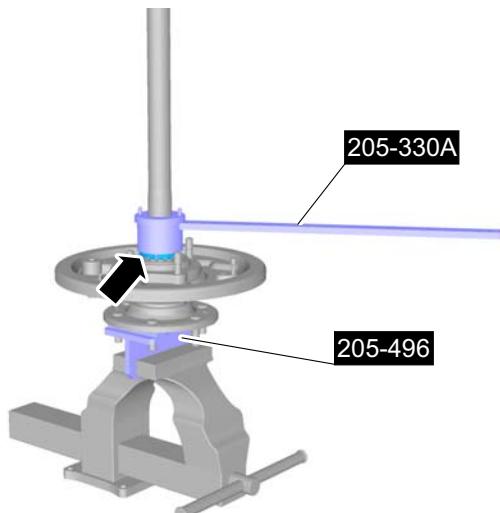
REMOVAL AND INSTALLATION

3. Special Tool(s): 205-052



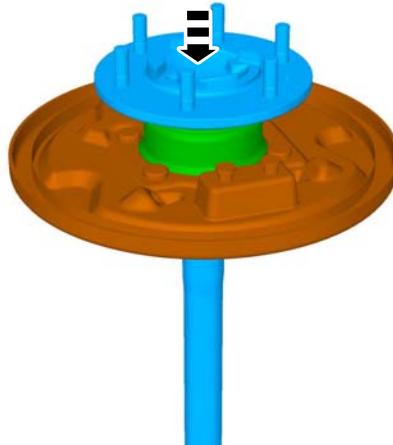
E128971

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



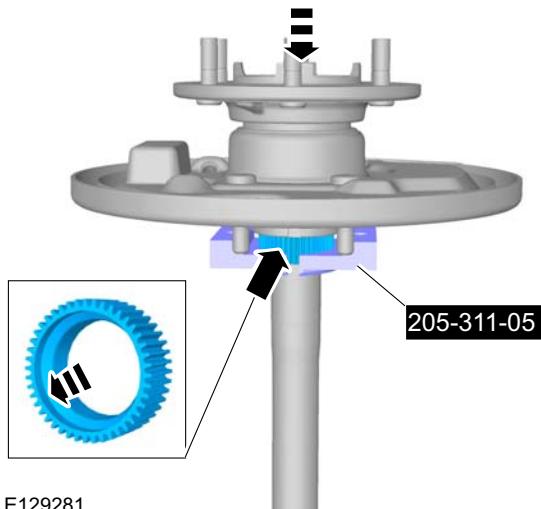
E129278

4. General Equipment: Hydraulic Press



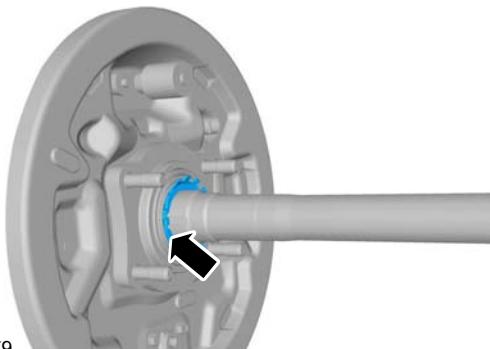
E128972

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



E129281

5.

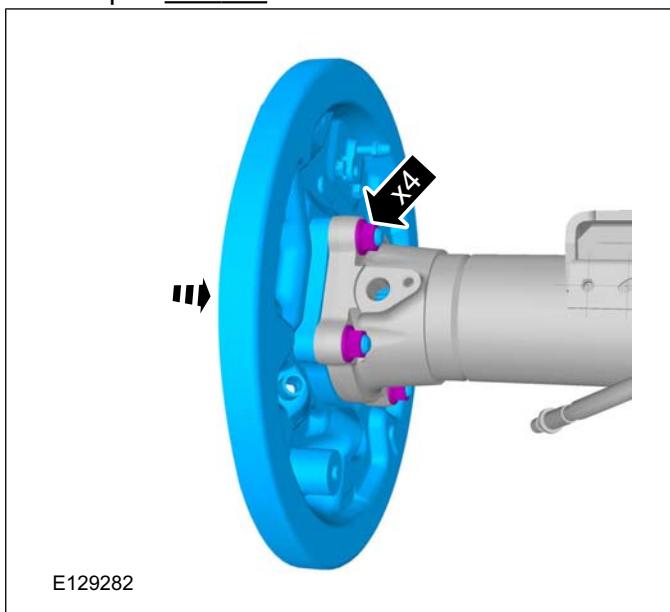


E129279

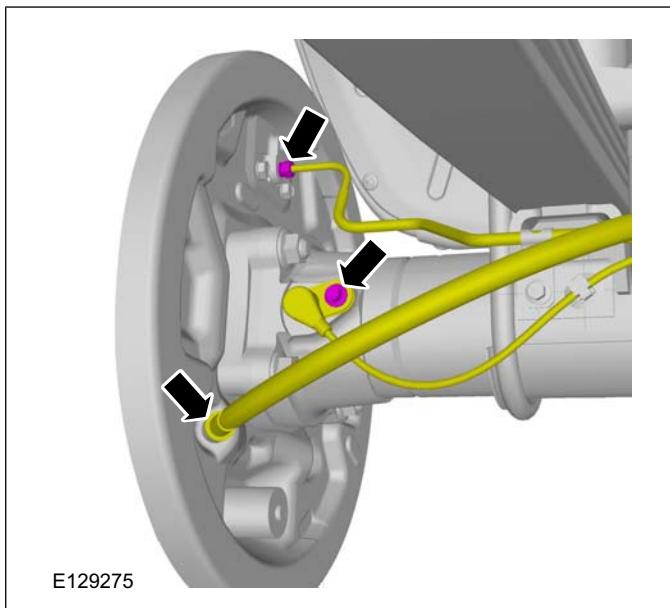
REMOVAL AND INSTALLATION

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

Torque: 108 Nm



9.

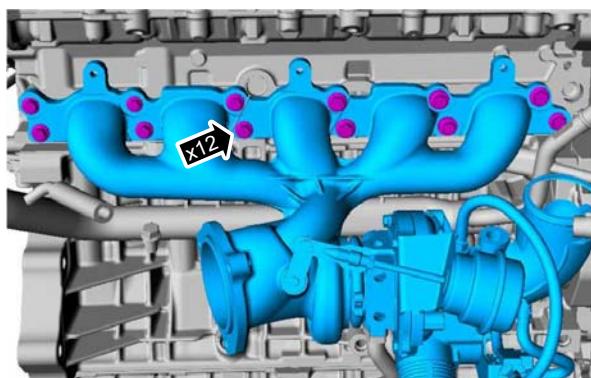
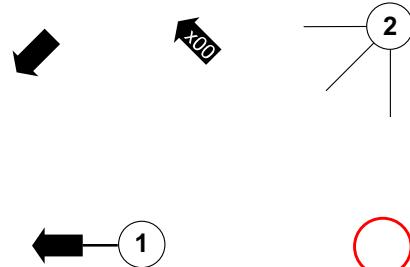
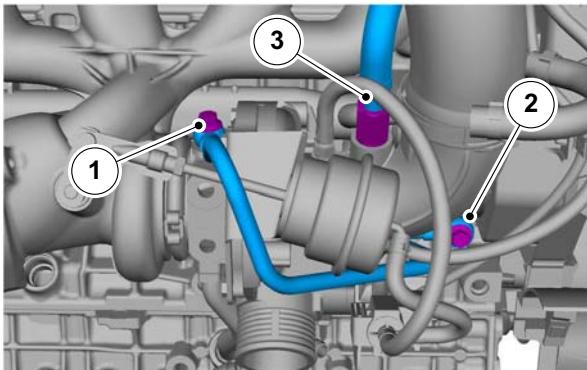


10. Refer to: **Wheel Cylinder** (206-02 Drum Brake, Removal and Installation).

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).

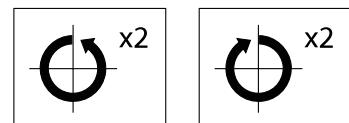
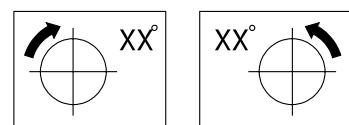
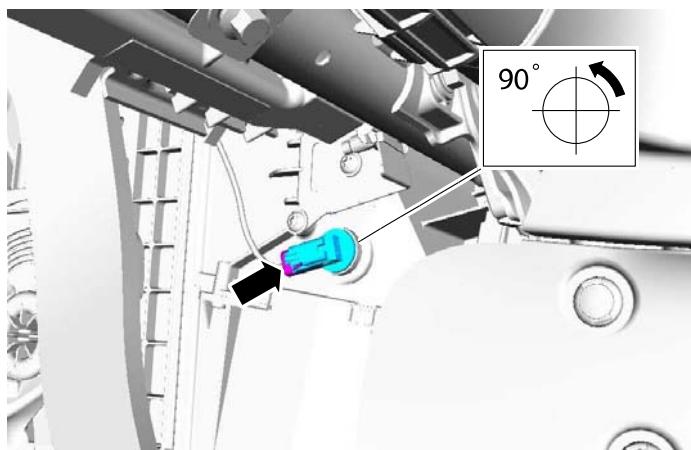
DESCRIPTION AND OPERATION



E84837

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

movements can include specific values inside the symbol if required.



E84838

SECTION 206-00 Brake System - General Information

VEHICLE APPLICATION: BT50 & Ranger

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SPECIFICATIONS

Specifications.....	206-00-2
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GENERAL PROCEDURES

Brake Load Sensor Proportioning Valve Adjustment.....	(12 136 0)	206-00-3
Front Brake Disc Runout Check.....		206-00-4
Brake System Leak Check.....		206-00-6
Brake System Bleeding.....	(12 141 0)	206-00-7
Brake System Pressure Bleeding.....	(12 141 0)	206-00-8

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

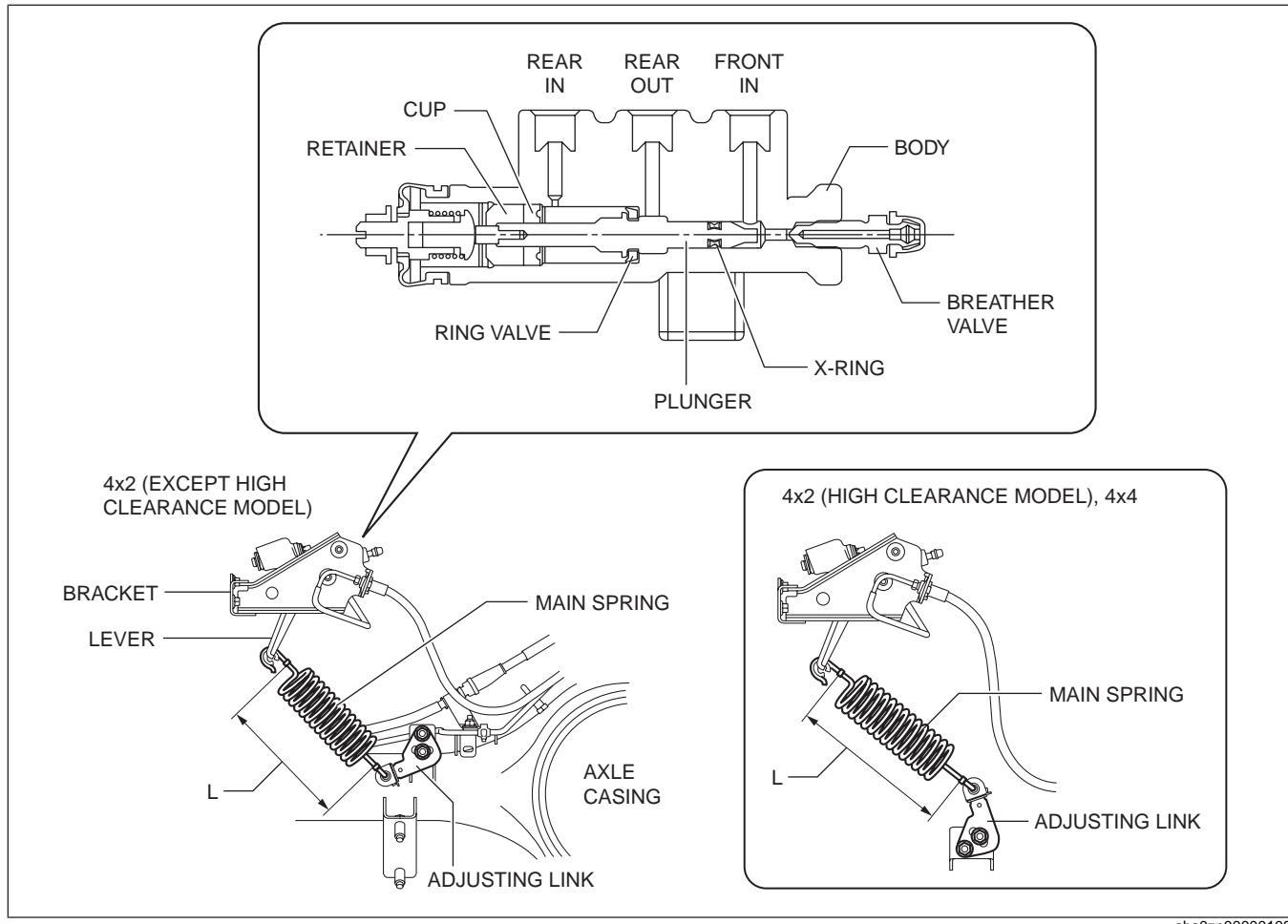
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LOAD SENSING PROPORTIONING VALVE (LSPV)

Purpose/Function

- This valve is used to allocate the braking force to the front and rear wheels as ideally as possible for higher safety when the brakes are applied, it controls the brake fluid pressure to the rear brakes according to the load on the rear axle so that the rear end of the vehicle does not spin due to the locking of the rear wheels in advance of the front wheels.
- This valve also incorporates a bypass passage that prevents pressure reduction so that rear wheels will still have enough braking force to stop the vehicle in the event of a front master cylinder malfunction.

Construction

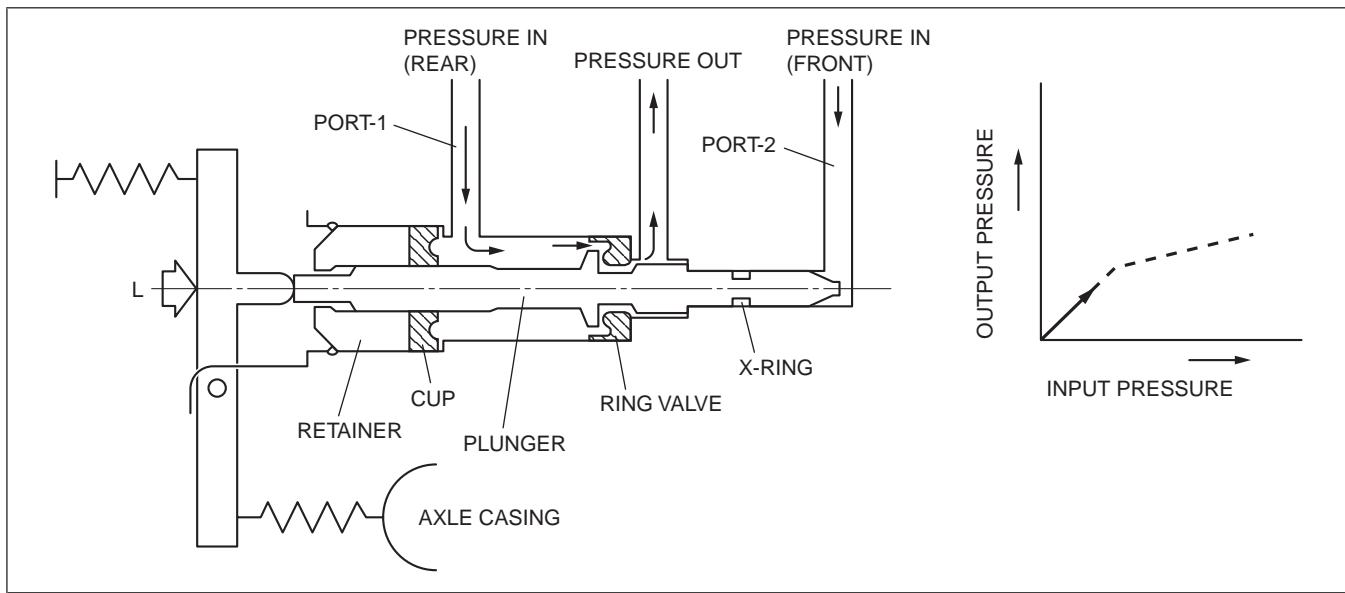


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Operation

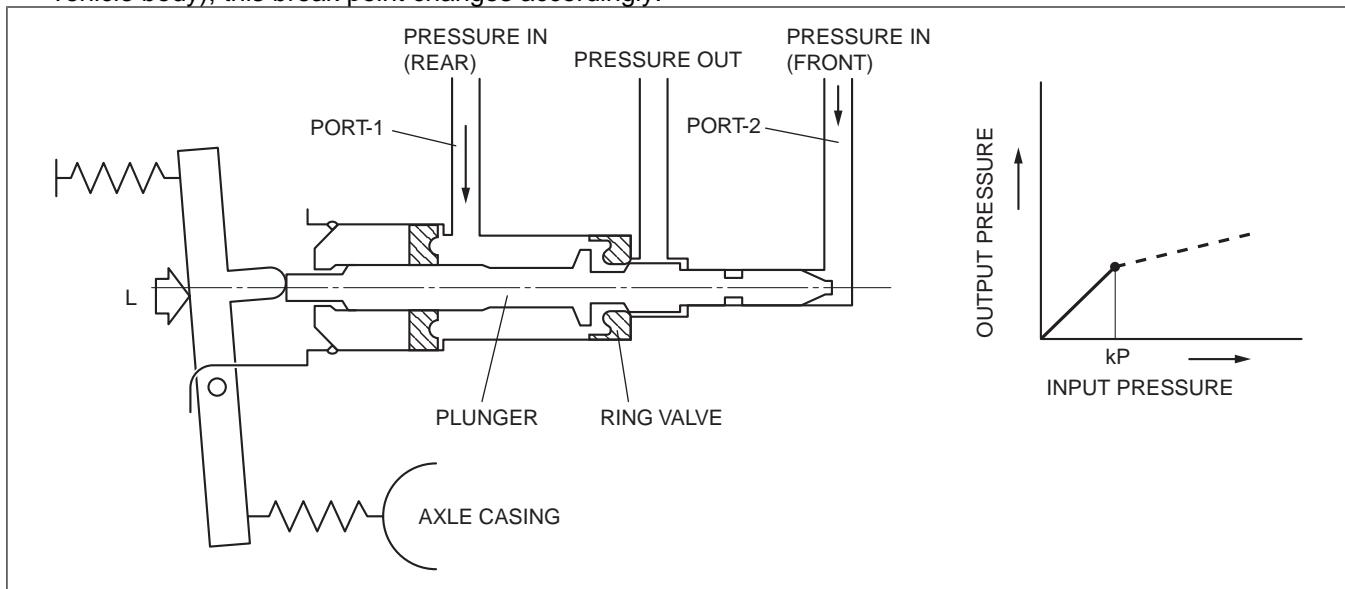
Braking When Vehicle Empty

- The hydraulic pressure generated at the front section of the master cylinder is applied, via input port 1, to the hydraulic-pressure control section of the LSPV.
- The hydraulic pressure generated at the rear section of the master cylinder is applied to the front brakes, and to the bypass section of the LSPV via input port 2. The rear wheel and front wheel hydraulic pressure are separated by the X-ring of the plunger. Since port 1 hydraulic pressure is normally equal to port 2 hydraulic pressure, the plunger is pressed against the cylinder base by L.
- When port 1 hydraulic pressure is applied to the plunger, the plunger tries to move to the left. But, because there is also at the same time force applied in the right direction by the lever link (force L), the plunger is held against the cylinder base. The result is that the hydraulic pressure at the output side is the same as at the input side when force L is higher than the input pressure.



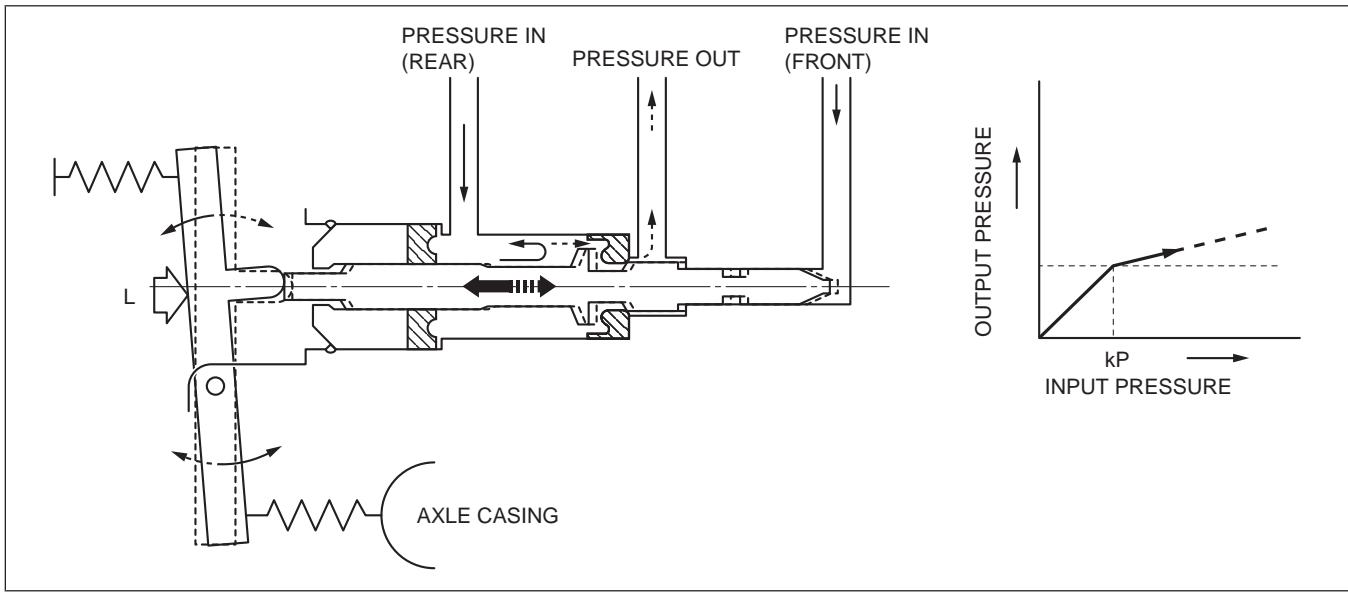
abs0zn00000104

- When the input hydraulic pressure increases further and overcomes force L, the plunger is moved slightly leftward, sealing it against the ring valve. This temporarily separates the input side from the output side. The output pressure at this time is called the break point. If force L from the lever link changes (i.e. lowering of the vehicle body), this break point changes accordingly.



abs0zn00000105

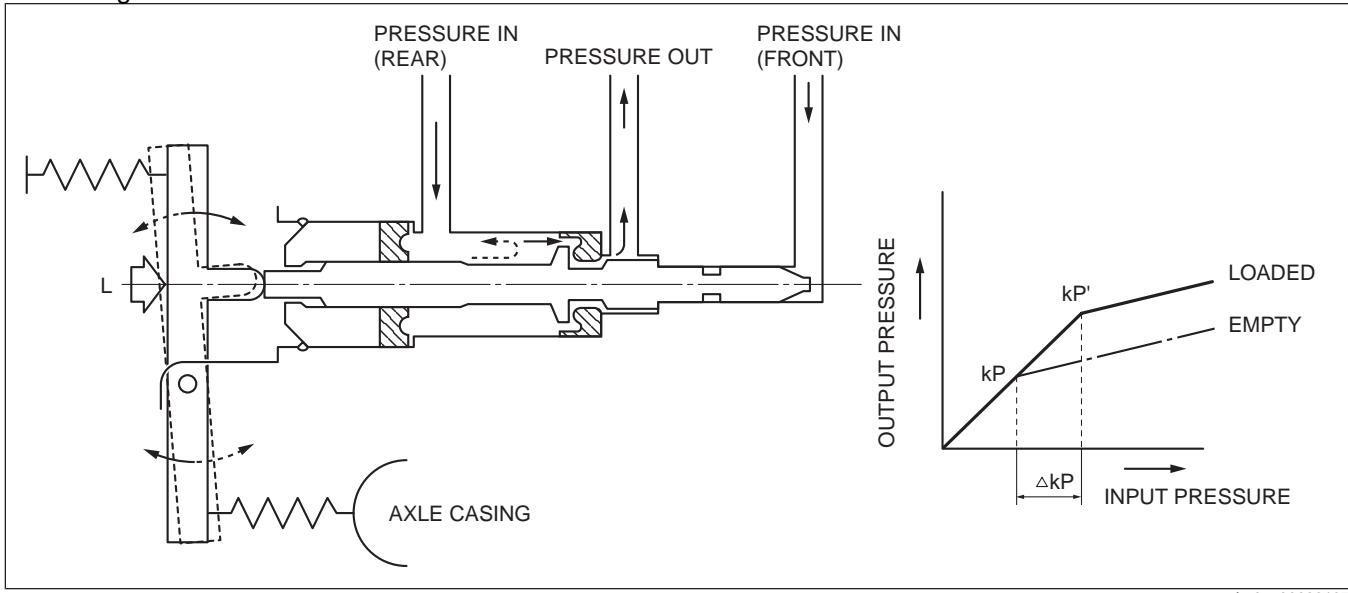
- When the input pressure passes the break point, the plunger is moved back against the cylinder base. The output port is opened, and hydraulic pressure generated at the rear section of the master cylinder is applied to the rear wheel cylinders.
- As the output pressure continues to increase, the plunger is again moved toward the left against the ring valve, thus separating the input and output side again.
- This action is repeated to control the output pressure.



abs0zn00000106

Braking When Vehicle Loaded

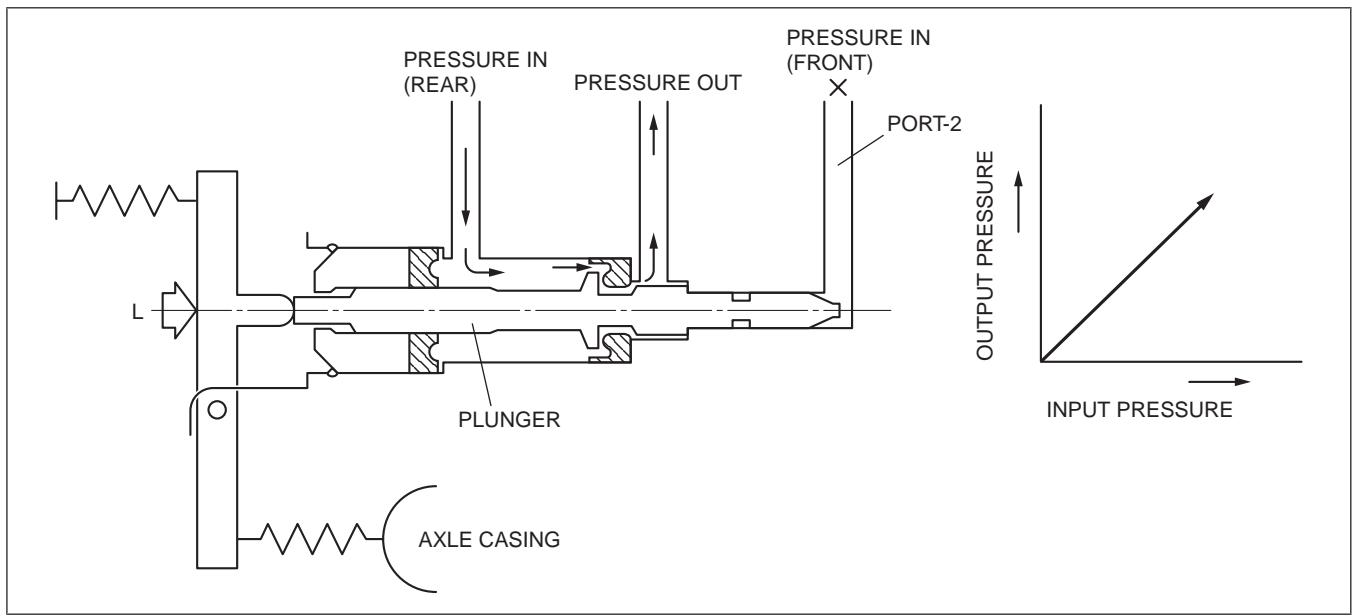
- The vehicle height (from the ground) decreases when cargo is loaded into the vehicle. This causes the force of the spring connected to the axle casing to decrease and the force of the spring on the LSPV to increase force L, increasing the pressure holding the plunger to the right.
- The master cylinder hydraulic pressure (input) needed to cause the plunger to move back to the left also becomes equally higher as a result.
- This causes the break point to be increased and extra braking power is provided in accordance with the weight of cargo loaded.



abs0zn00000107

If Malfunction Of Front Hydraulic System

- If there is a malfunction of the front-brake hydraulic system, the hydraulic pressure from input port 2 becomes zero. The result is that the input pressure presses the plunger to the right, opening the bypass passage.
- The output pressure thus equals the input pressure, and there is no pressure reduction.

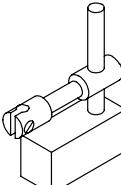
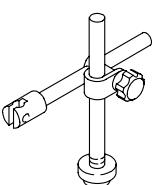


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GENERAL PROCEDURES

Front Brake Disc Runout Check

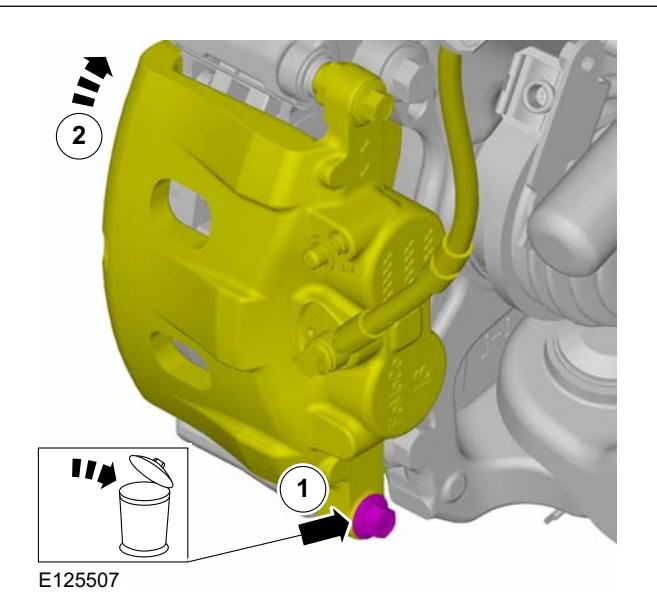
Special Tool(s) / General Equipment

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

Activation

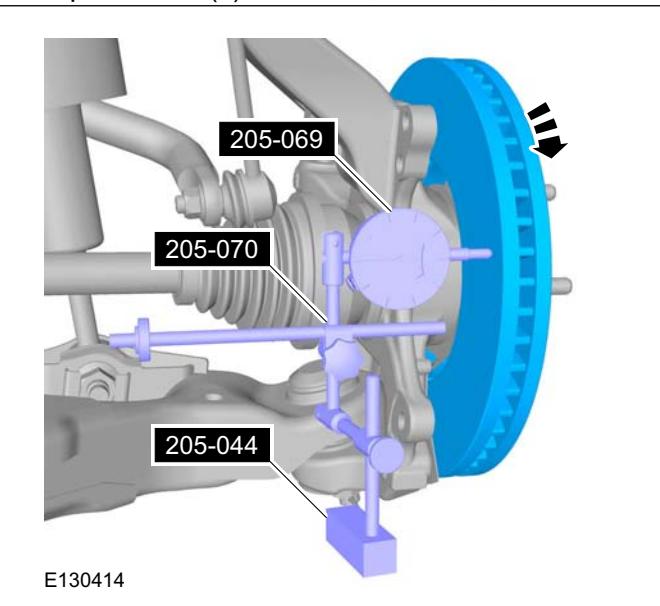
1. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

2.



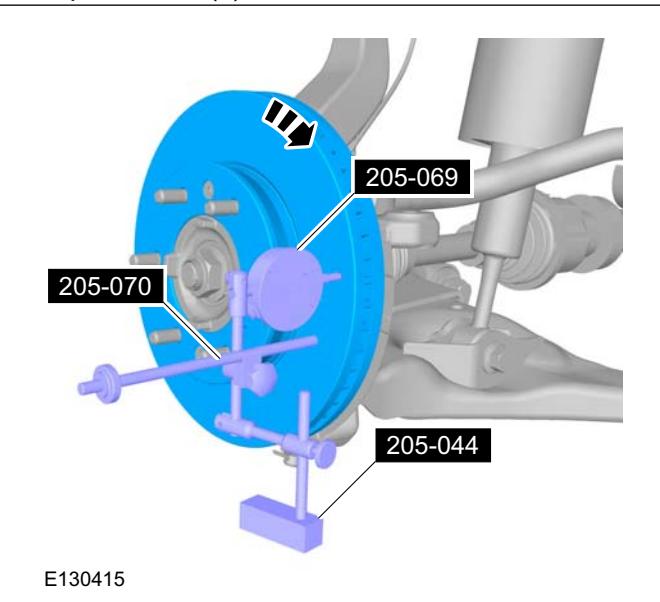
3. **NOTE:** The total dial indicator gauge reading should not exceed specification.

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



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

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



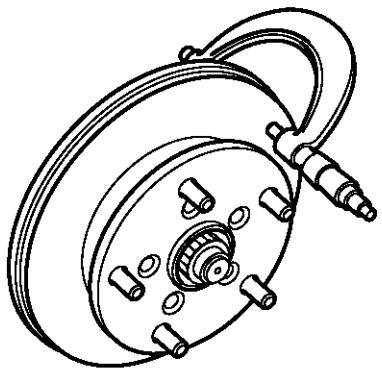
5. **NOTE:** If any of the measurements exceed the run out specification of 0.05 mm or the brake disc thickness variation is more than 0.018 mm, a new brake disc must be installed and the brake disc runout re-checked.

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

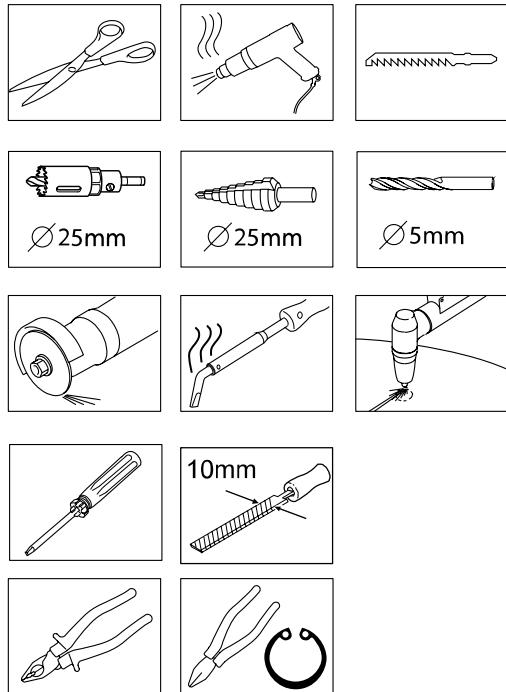
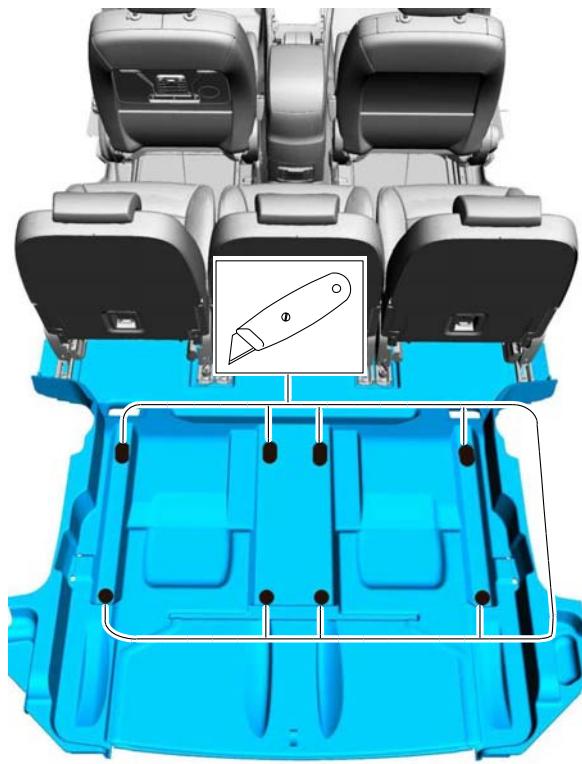
11. **NOTE:** This step is only necessary when changing the brake fluid to remove the used brake fluid from the hydraulic control unit (HCU).

Using WDS, bleed the brake system.

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.

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:BT50 & Ranger

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REMOVAL AND INSTALLATION

Wheel Cylinder.....	206-02-2
Brake Shoes.....	206-02-3

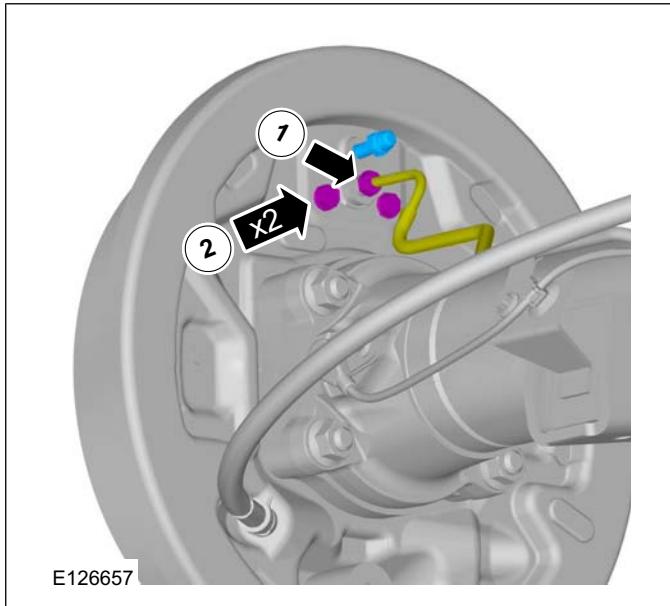
REMOVAL AND INSTALLATION

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



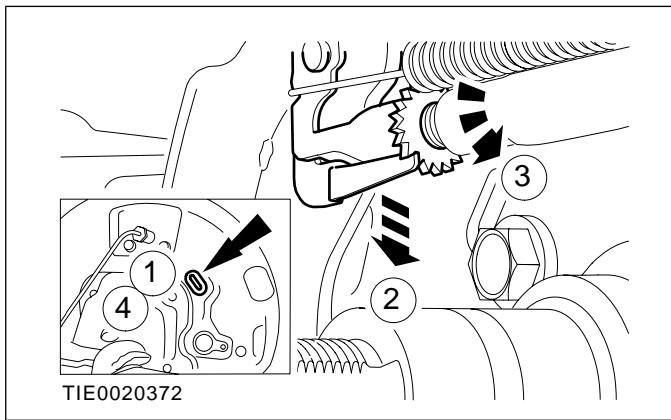
Installation

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**

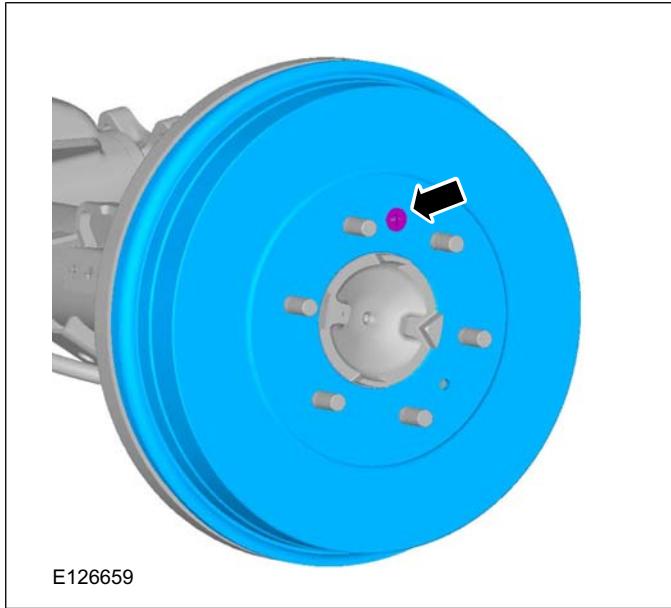
NOTE: Removal steps in this procedure may contain installation details.

1.

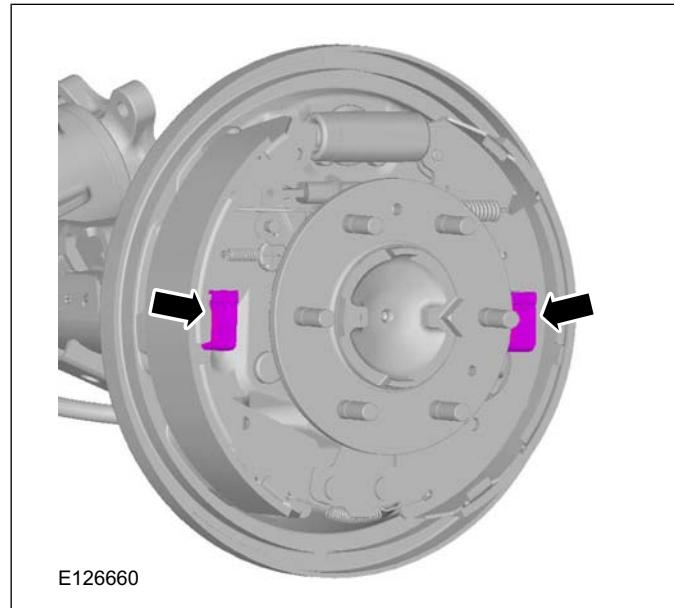


2. Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

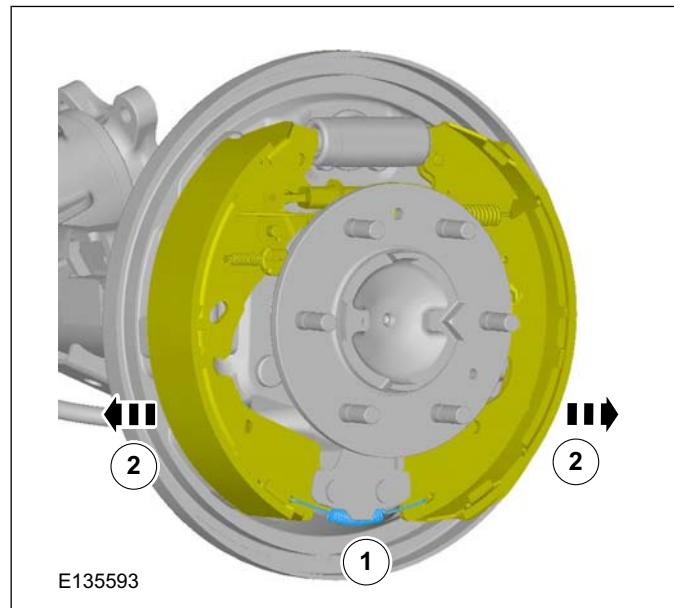
3.



4.



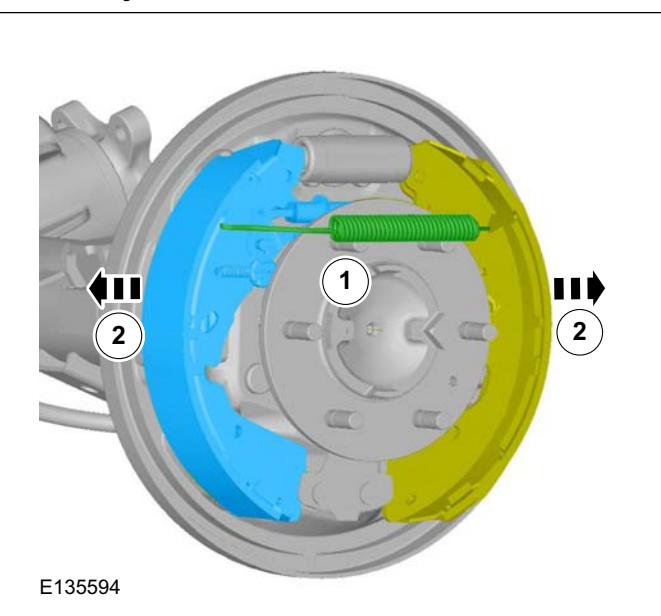
5.



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

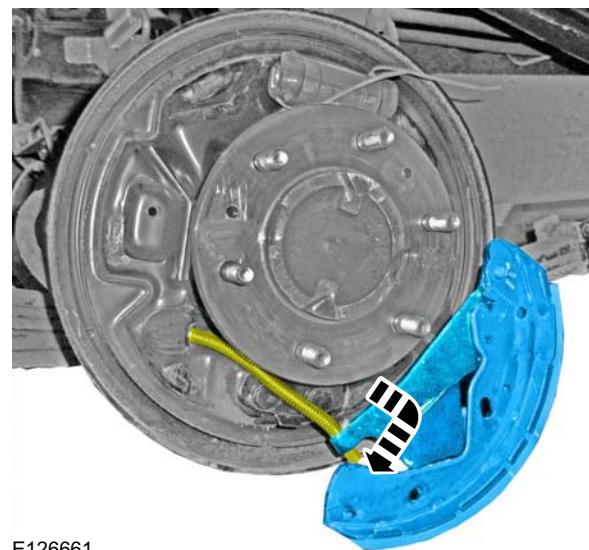
REMOVAL AND INSTALLATION

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



Installation

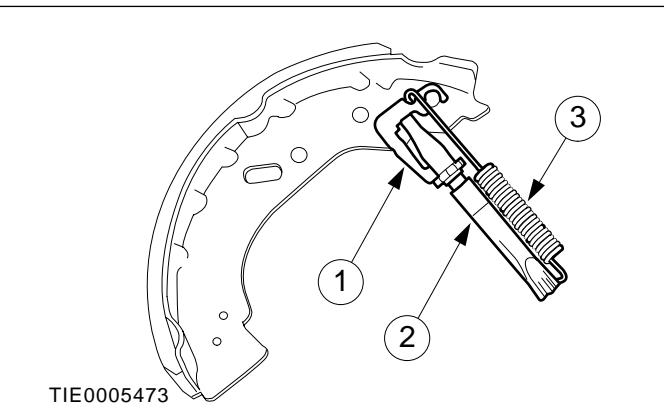
1.



8.

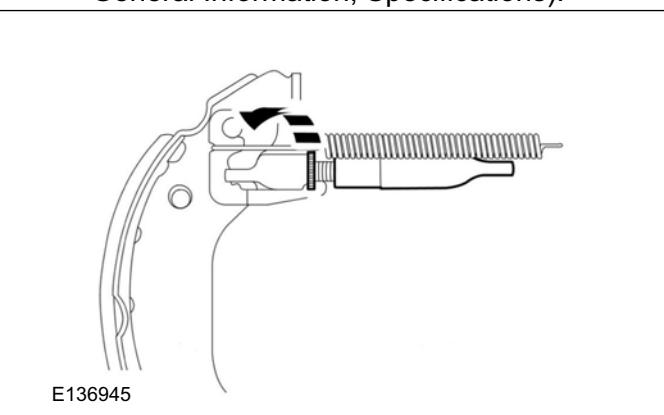


2.



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).



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:BT50 & Ranger

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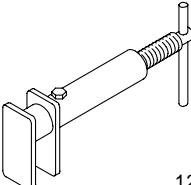
REMOVAL AND INSTALLATION

Brake Pads.....	(12 234 0)	206-03-2
Brake Caliper.....	(12 243 0)	206-03-4
Brake Disc.....	(12 223 0)	206-03-5

REMOVAL AND INSTALLATION

Brake Pads(12 234 0)

Special Tool(s)

	206-005 Retractor, Brake Caliper Piston 12014
---	--

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.

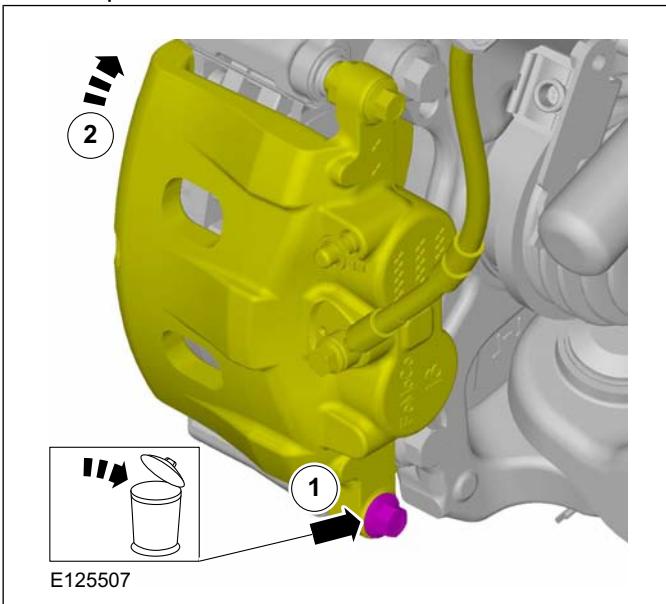
Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).

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

- ⚠ **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

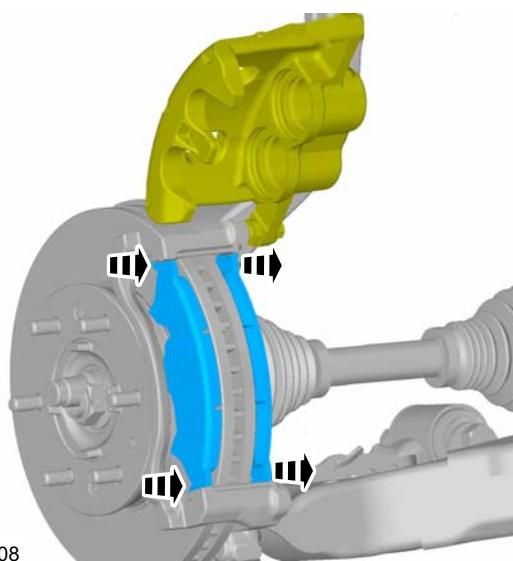


- NOTE: Note the position of the brake pads to aid installation.

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

REMOVAL AND INSTALLATION

Rotate the brake caliper upwards



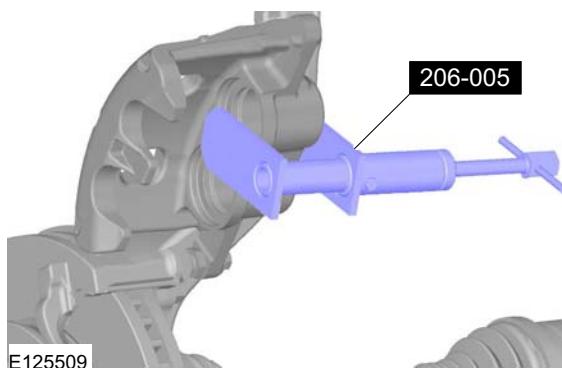
E125508

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



E125509

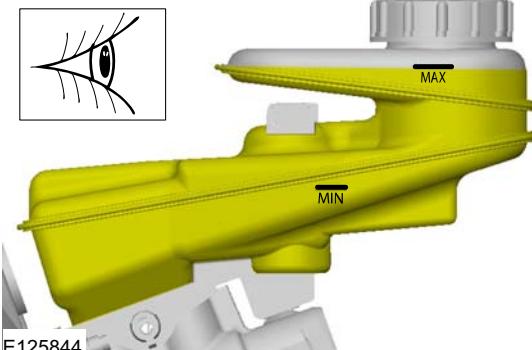
lining material. Do not install contaminated pads.

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



E125844

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**

REMOVAL AND INSTALLATION

Brake Caliper(12 243 0)

Removal

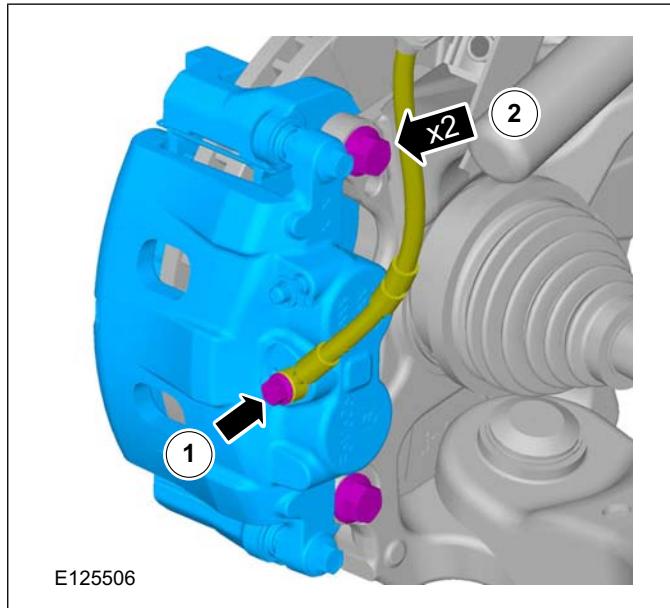
NOTE: Removal steps in this procedure may contain installation details.

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

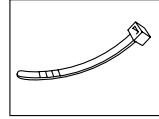
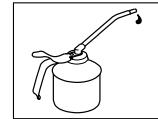
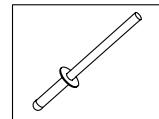
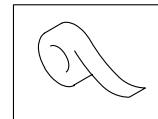
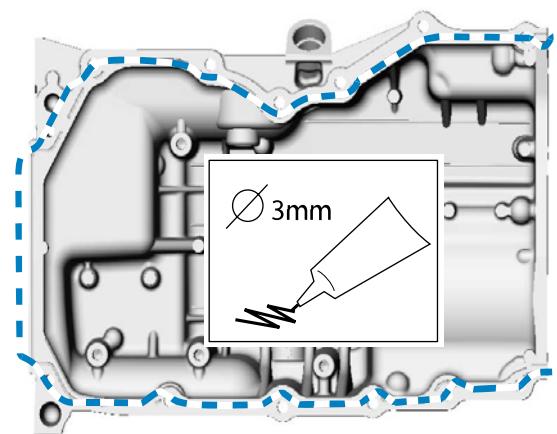


Installation

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).

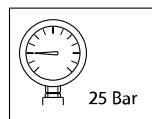
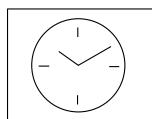
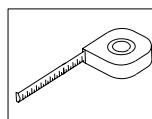
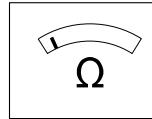
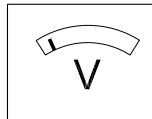
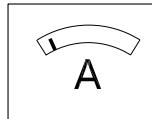
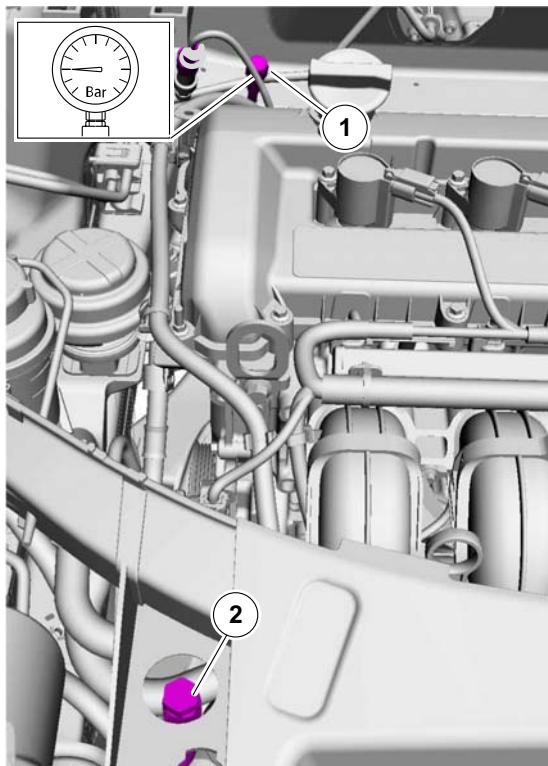
DESCRIPTION AND OPERATION



E84840

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

These symbols can include specific values if required.

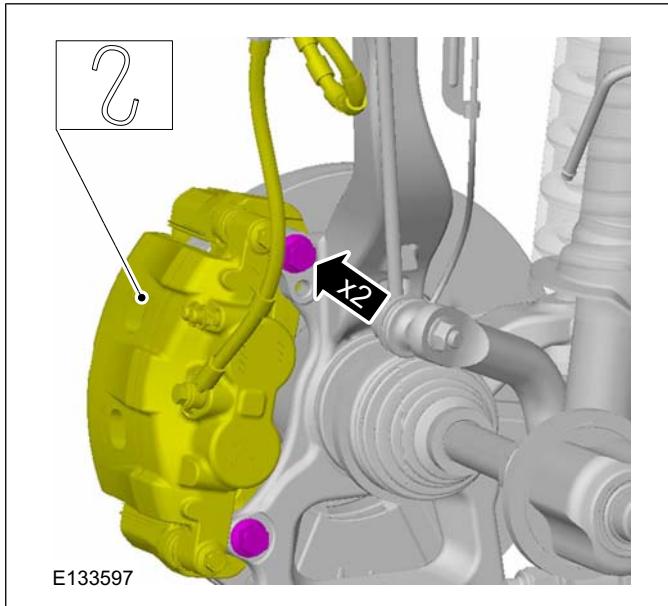


E84841

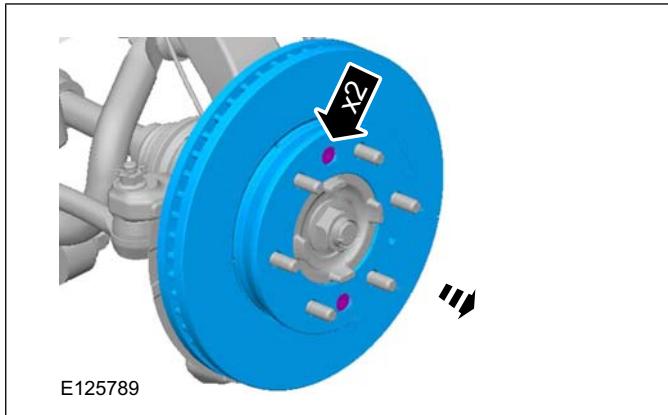
REMOVAL AND INSTALLATION**Brake Disc(12 223 0)****Removal**

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

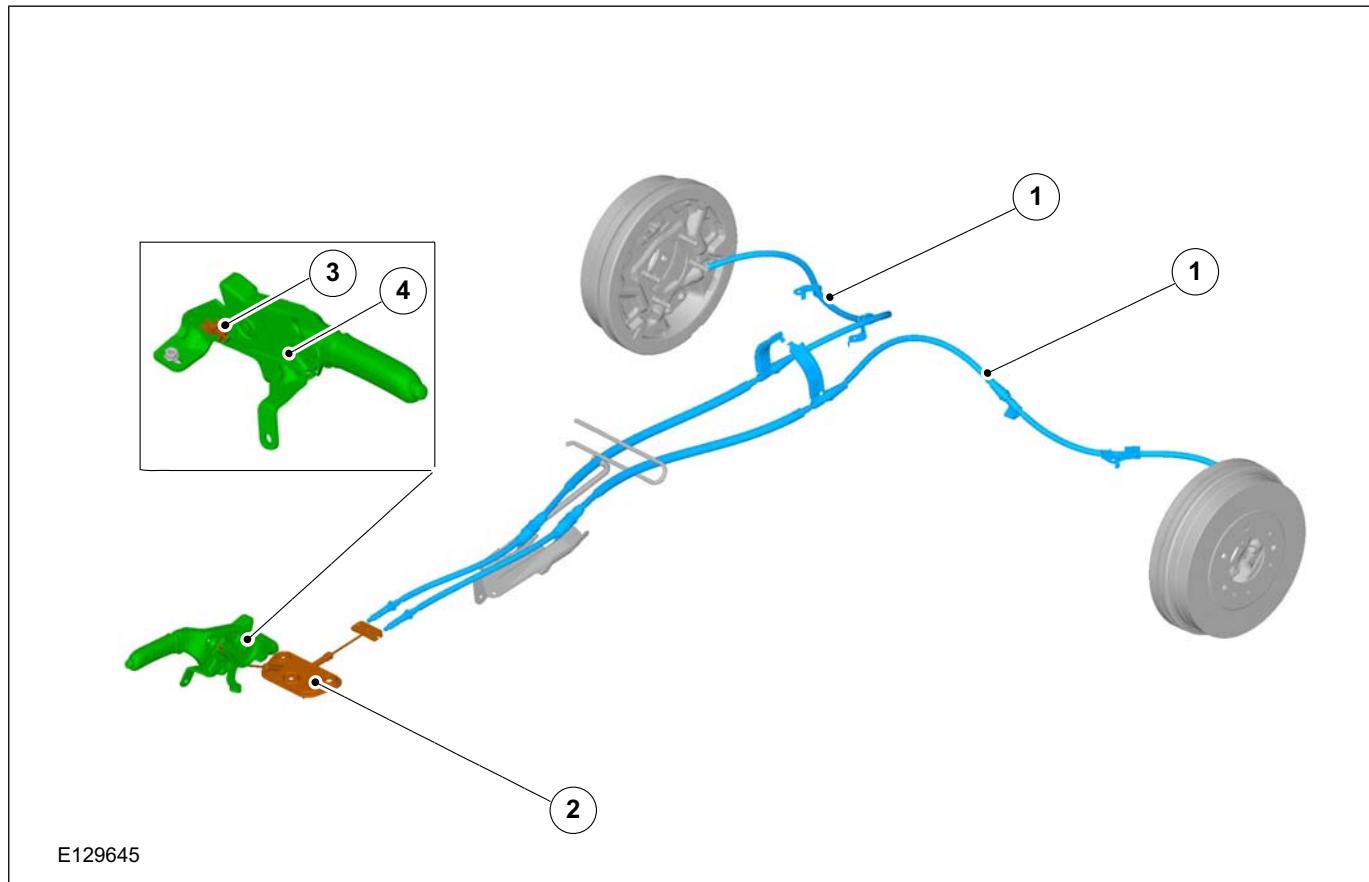
**Installation**

1. To install, reverse the removal procedure.

SECTION 206-05 Parking Brake and Actuation

VEHICLE APPLICATION:BT50 & Ranger

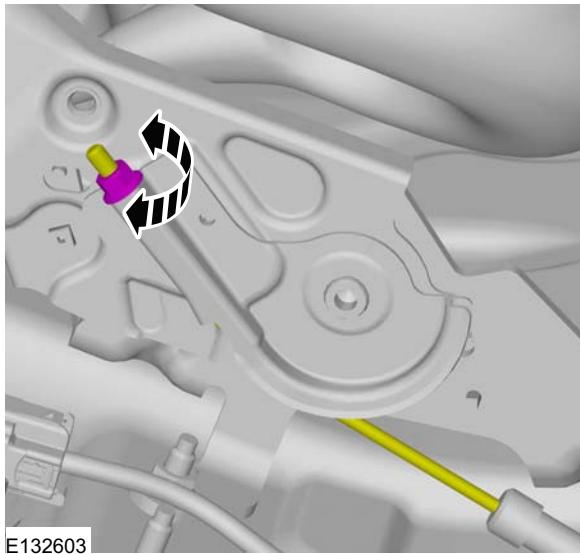
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DESCRIPTION AND OPERATION	
Parking Brake.....	206-05-2
GENERAL PROCEDURES	
Parking Brake Cable Adjustment..... (12 662 0)	206-05-3
REMOVAL AND INSTALLATION	
Parking Brake Control..... (12 664 0)	206-05-4
Parking Brake Front Cable.....	206-05-5
Parking Brake Rear Cables.....	206-05-6

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.

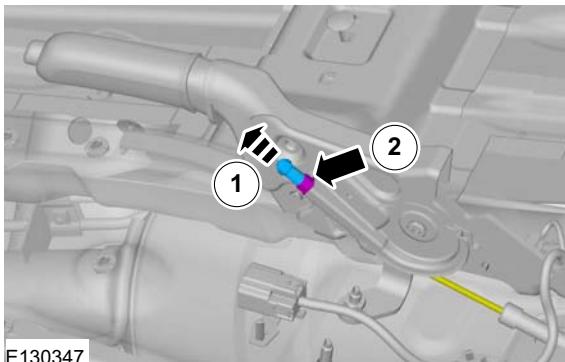


3. After adjustment, pull the parking brake lever one notch and verify that the parking brake warning light illuminates.
4. Verify that the rear brakes do not drag.

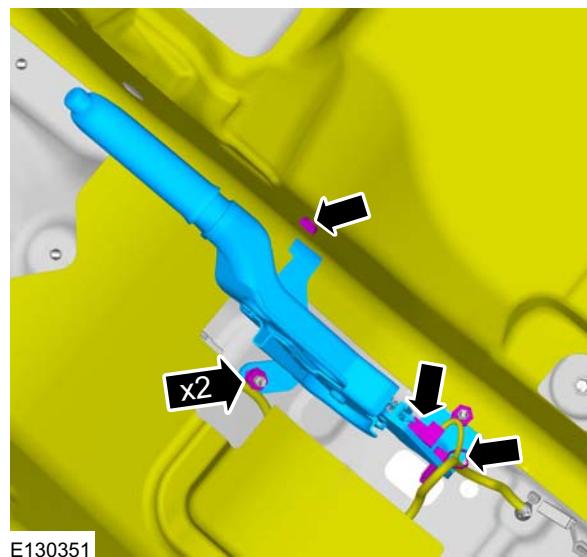
REMOVAL AND INSTALLATION**Parking Brake Control(12 664 0)****Removal**

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

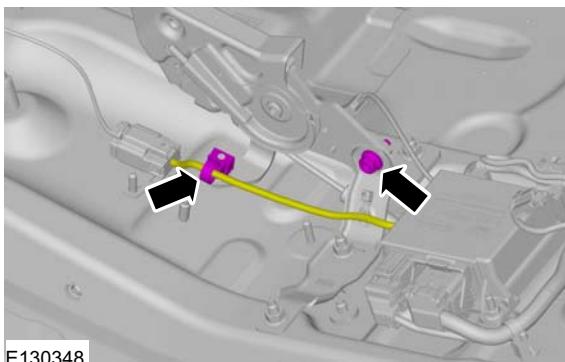
1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Floor Console - Single Cab** (501-12 Instrument Panel and Console, Removal and Installation).
Refer to: **Floor Console - Double Cab** (501-12 Instrument Panel and Console, Removal and Installation).
- 3.



5. Torque: 22 Nm



4. Torque: 22 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

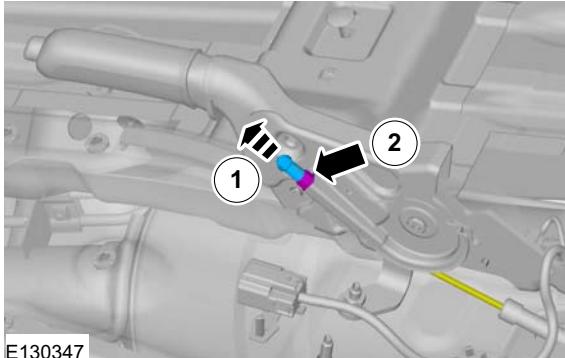
Parking Brake Front Cable

Removal

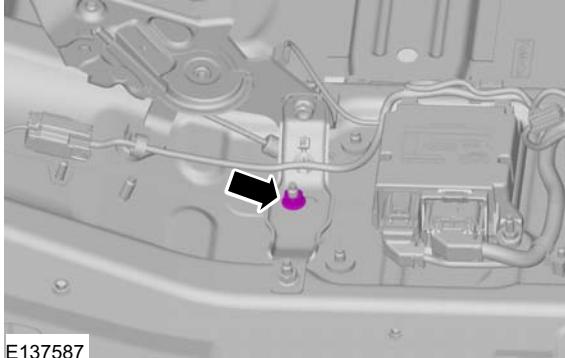
NOTE: Removal steps in this procedure may contain installation details.

- 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.

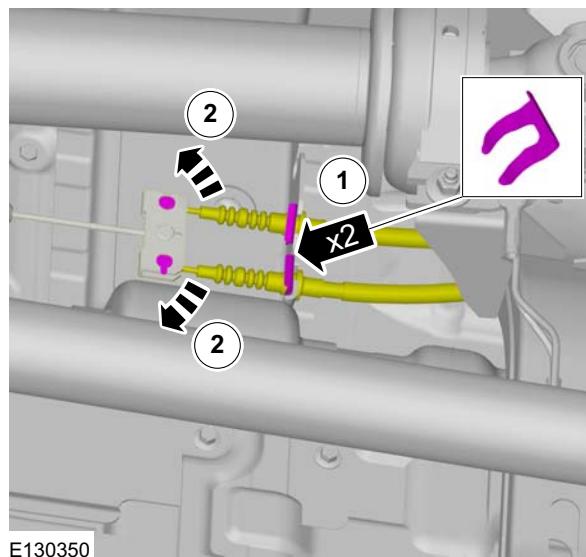


- Torque: 18 Nm

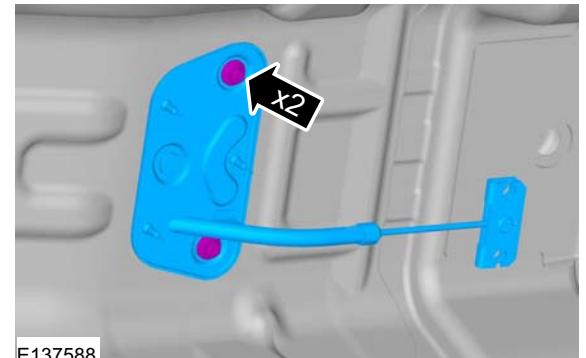


- Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
-

5.



- Torque: 18 Nm



Installation

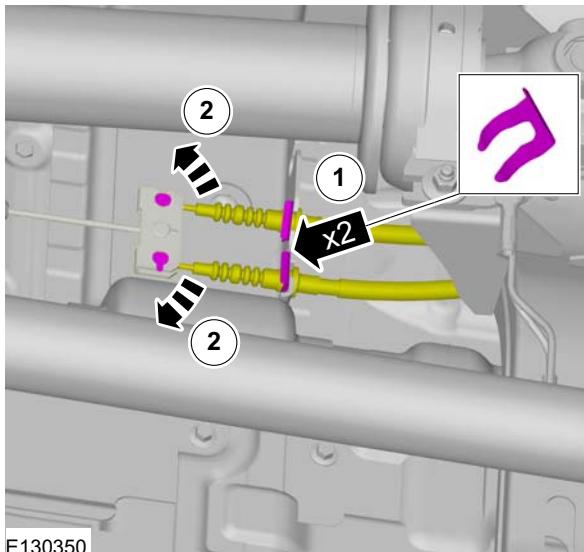
- To install, reverse the removal procedure.
- Refer to: **Parking Brake Cable Adjustment** (206-05 Parking Brake and Actuation, General Procedures).

REMOVAL AND INSTALLATION**Parking Brake Rear Cables****Removal**

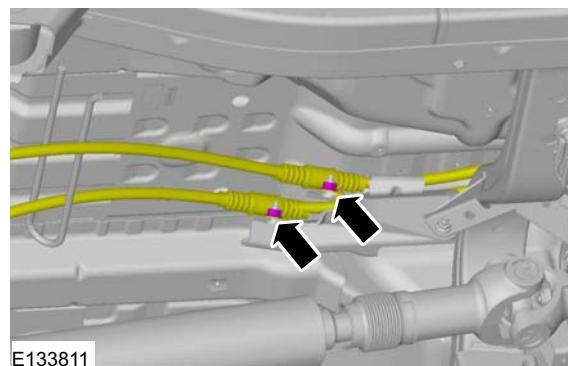
NOTE: Removal steps in this procedure may contain installation details.

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

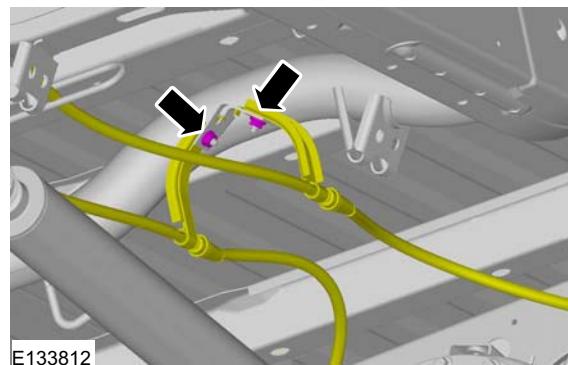
2.



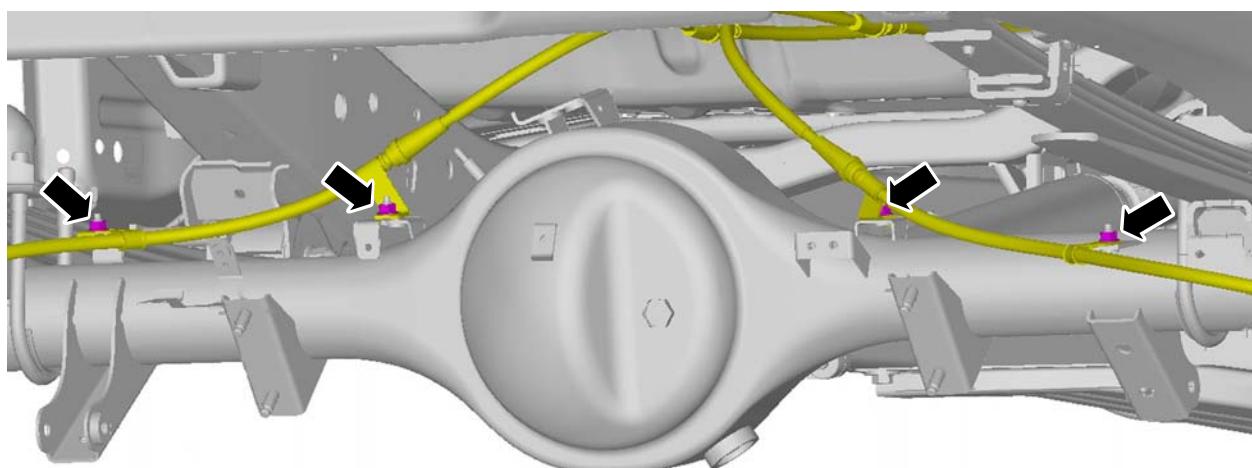
3. Torque: 17 Nm



4. Torque: 17 Nm

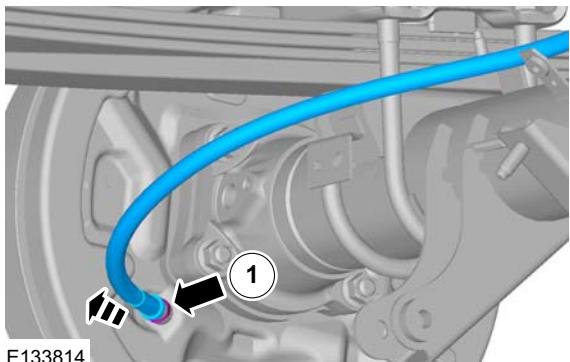


5. Torque: 17 Nm



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:BT50 & Ranger

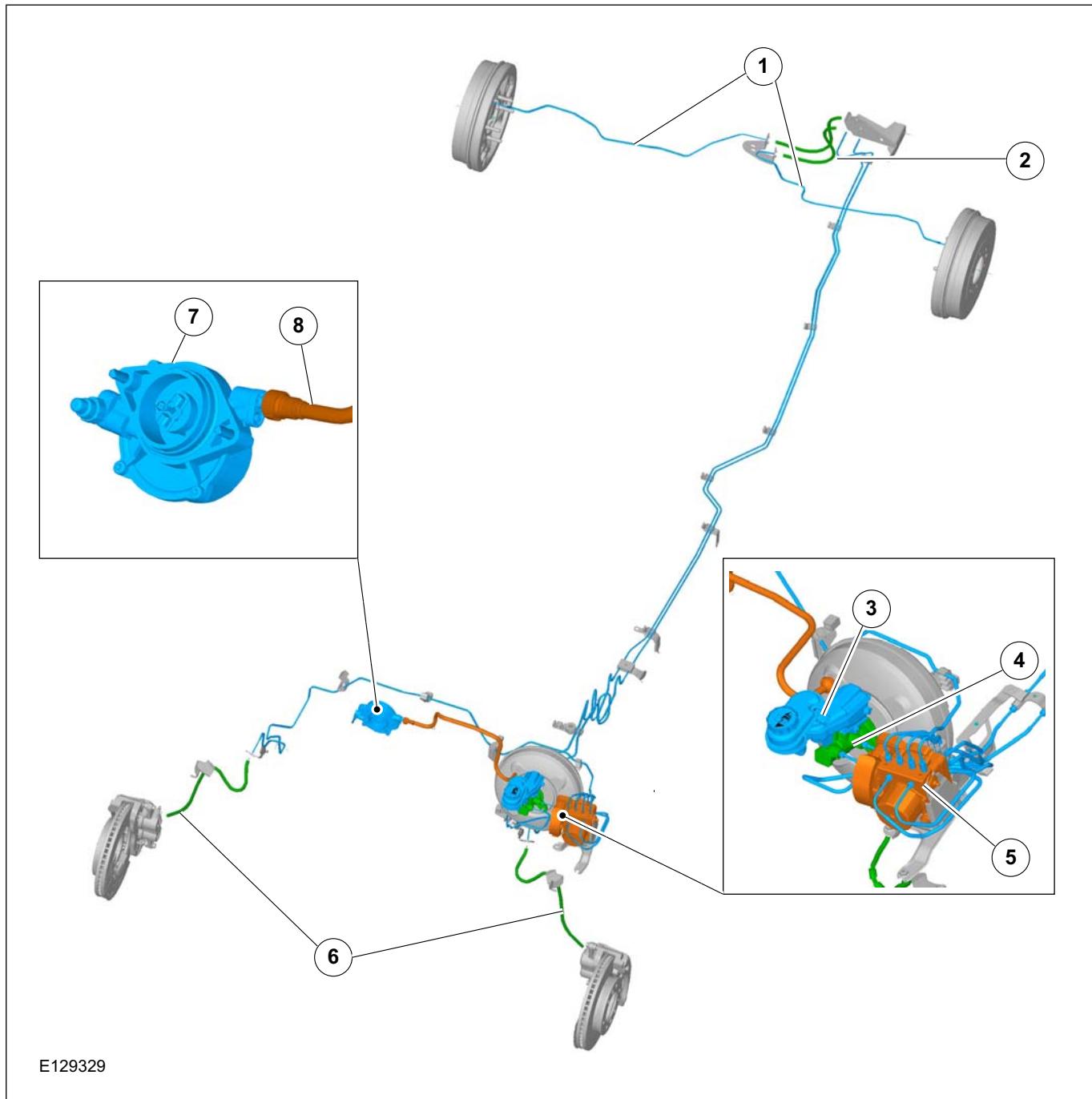
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DESCRIPTION AND OPERATION

Hydraulic Brake Actuation.....	206-06-2
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REMOVAL AND INSTALLATION

Brake Master Cylinder — LHD 4WD/LHD RWD.....	(12 343 0)	206-06-3
Brake Master Cylinder — RHD 4WD/RHD RWD.....	(12 343 0)	206-06-5
Brake Pedal and Bracket.....		206-06-7

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

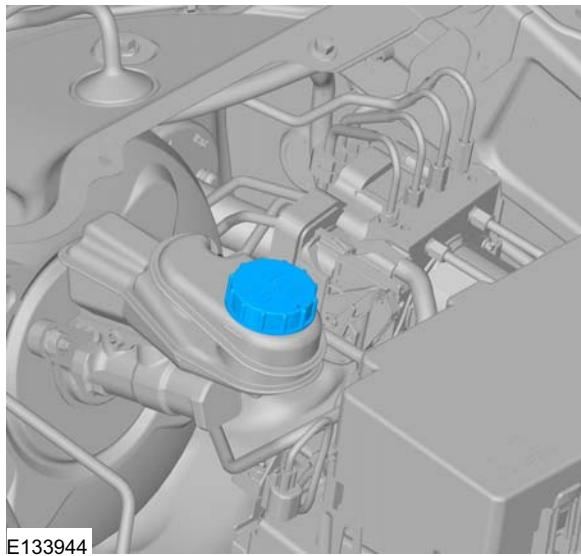
Item	Description
7	Vacuum pump
8	Vacuum hose

REMOVAL AND INSTALLATION**Brake Master Cylinder — LHD 4WD/LHD RWD(12 343 0)****Removal**

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

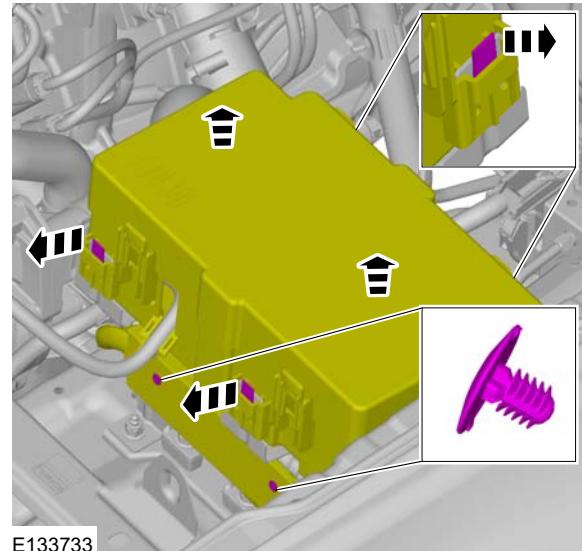
1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).

2.

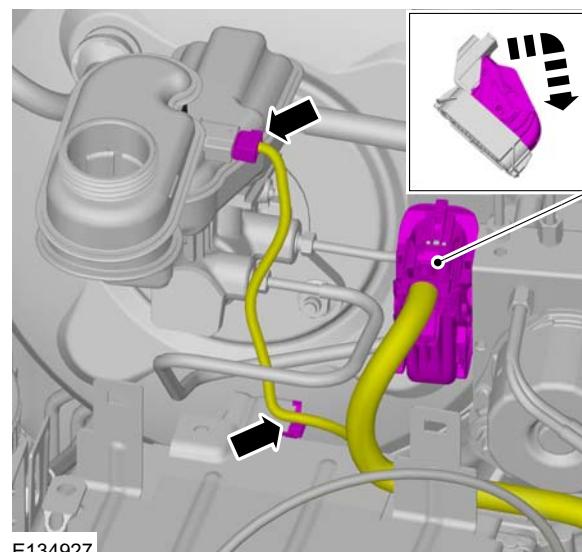


3. 1. Connect one end of a suitable piece of clear plastic pipe to the brake caliper bleed nipple and place the other end into a suitable container.
2. Loosen the bleed nipple.
3. Depress the brake pedal until no more brake fluid comes through the bleed nipple.
4. Tighten the bleed nipple.
5. Repeat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

4.



5.



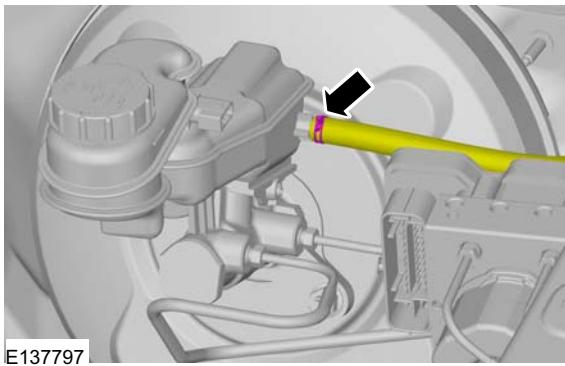
REMOVAL AND INSTALLATION

Vehicles with manual transmission

6.

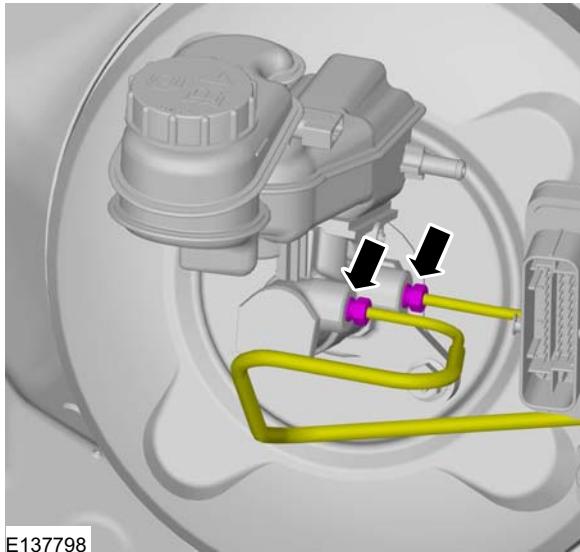


WARNING: Be prepared to collect escaping fluids.



All vehicles

7. Torque: 17 Nm

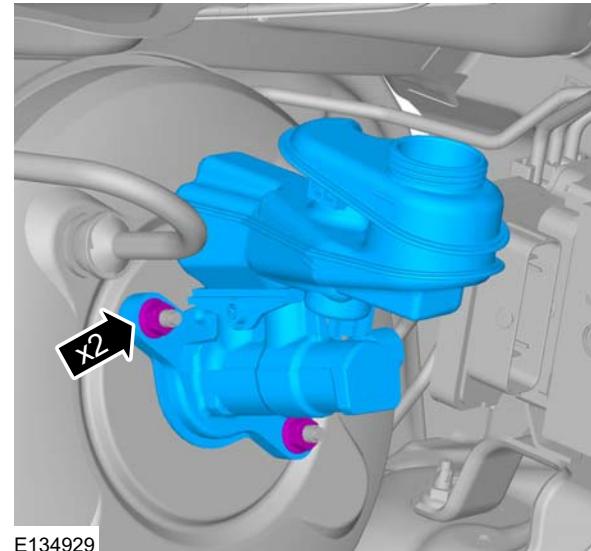


8. CAUTIONS:

- ⚠ 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



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).

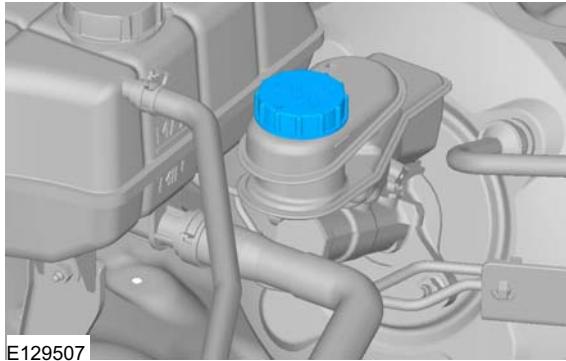
REMOVAL AND INSTALLATION

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

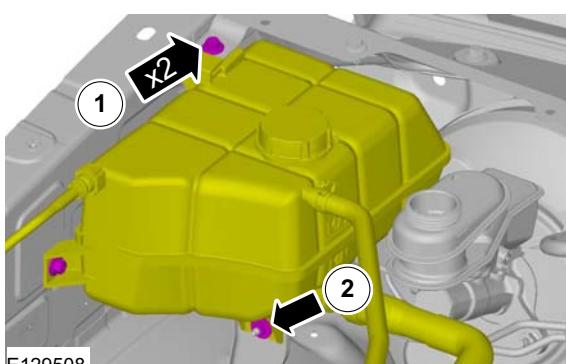
Removal

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

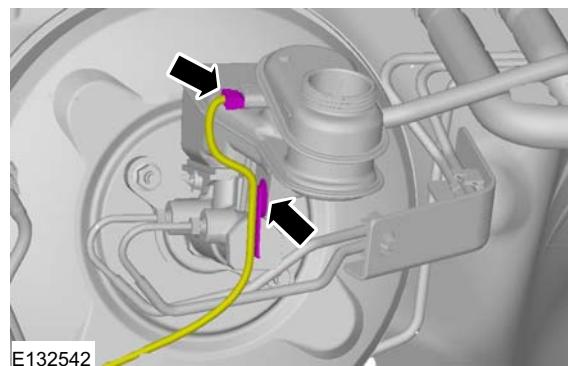
1. Refer to: **Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. 1. Connect one end of a suitable piece of clear plastic pipe to the brake caliper bleed nipple and place the other end into a suitable container.
2. Loosen the bleed nipple.
3. Depress the brake 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.



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



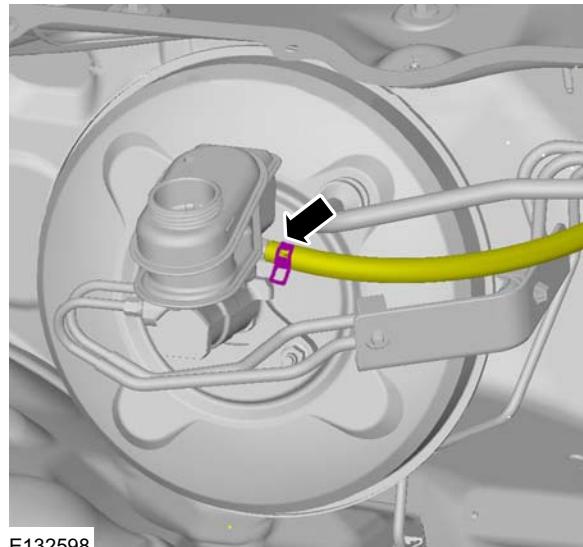
4.



Vehicles with manual transmission



WARNING: Be prepared to collect escaping fluids.



All vehicles



WARNING: Be prepared to collect escaping fluids.

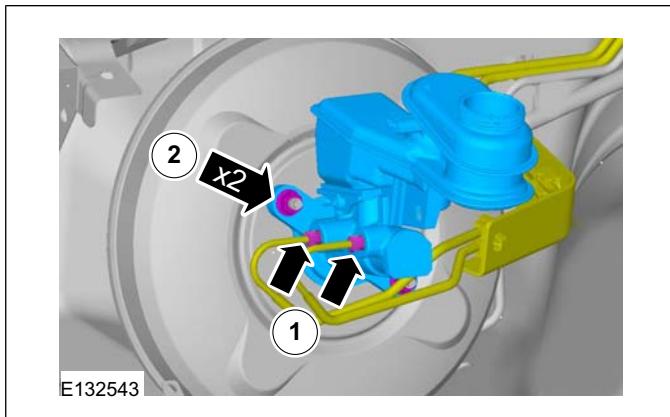
CAUTIONS:

- 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.

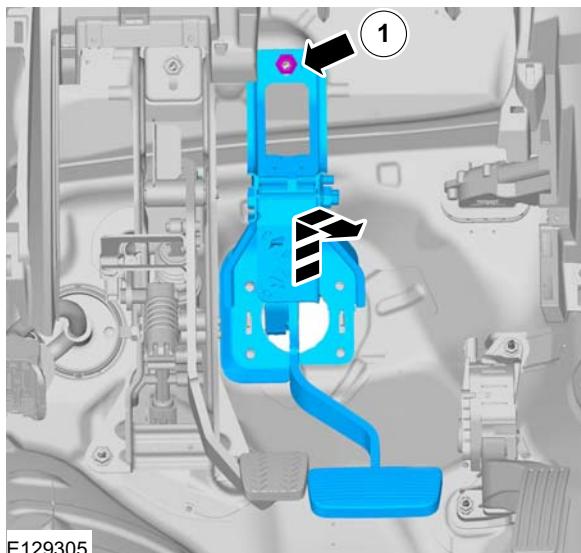
1. Refer to: **Brake Booster - RHD 4WD/RHD RWD** (206-07 Power Brake Actuation, Removal and Installation).

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:BT50 & Ranger

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REMOVAL AND INSTALLATION

Brake Booster — LHD 4WD/LHD RWD.....	(12 451 0)	206-07-2
Brake Booster — RHD 4WD/RHD RWD.....	(12 451 0)	206-07-4
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)	206-07-5
Brake Vacuum Pump — 3.2L Duratorq-TDCi (148kW/200PS) - Puma.....	(12 414 0)	206-07-7

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).

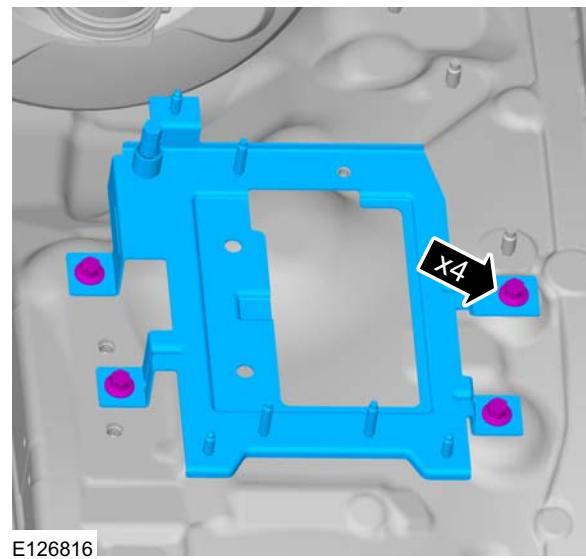
Vehicles with 2.5L engine

3. Torque: 25 Nm



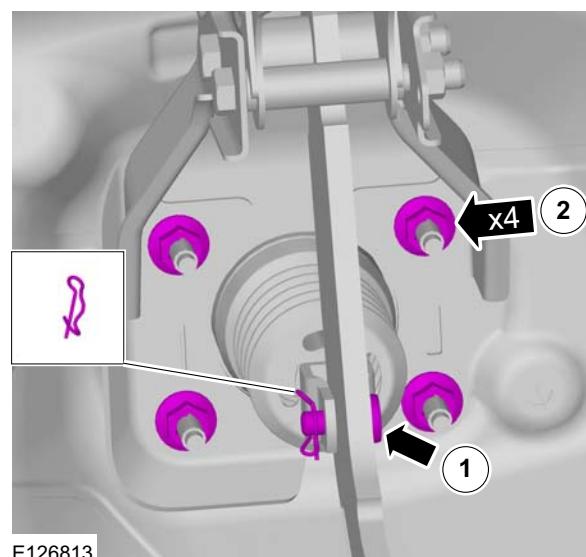
Vehicles with diesel engine

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



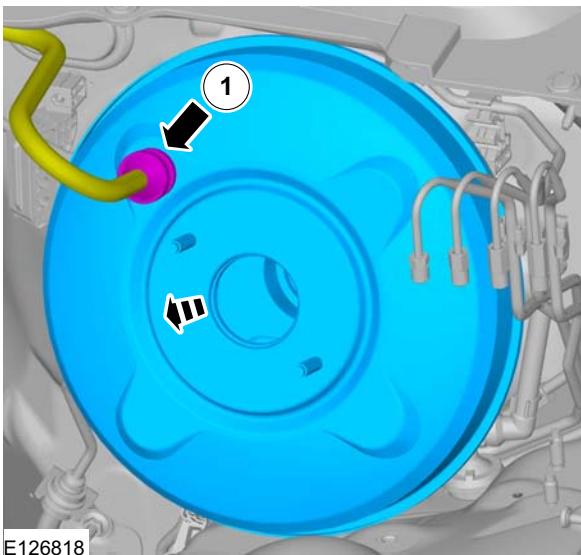
All vehicles

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.

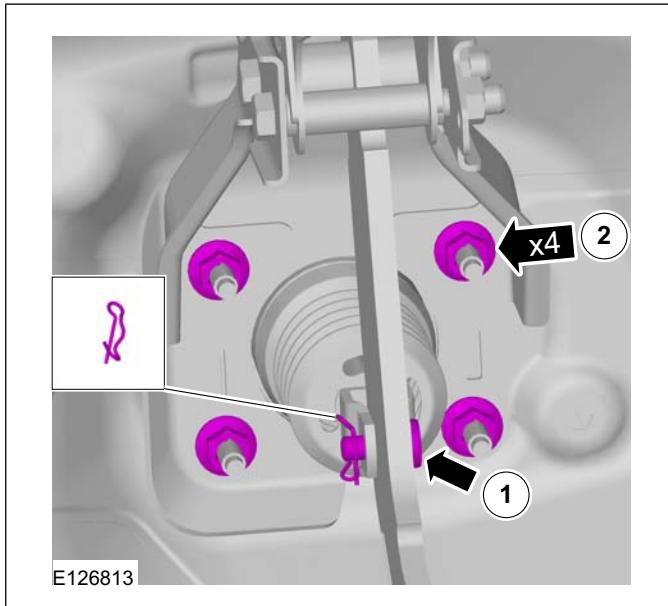
REMOVAL AND INSTALLATION

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

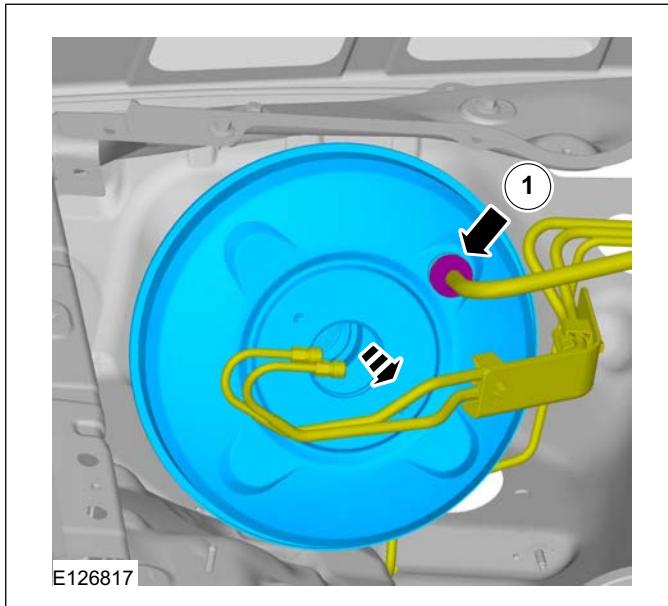


Installation

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

1. To install, reverse the removal procedure.

4.



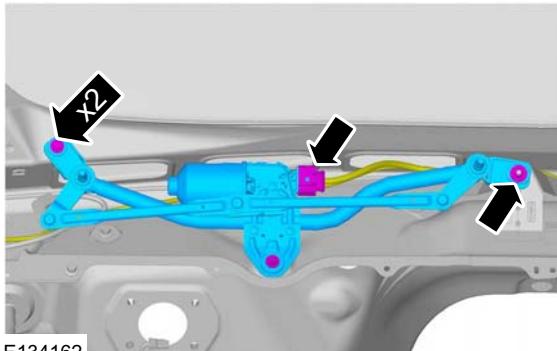
REMOVAL AND INSTALLATION

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)

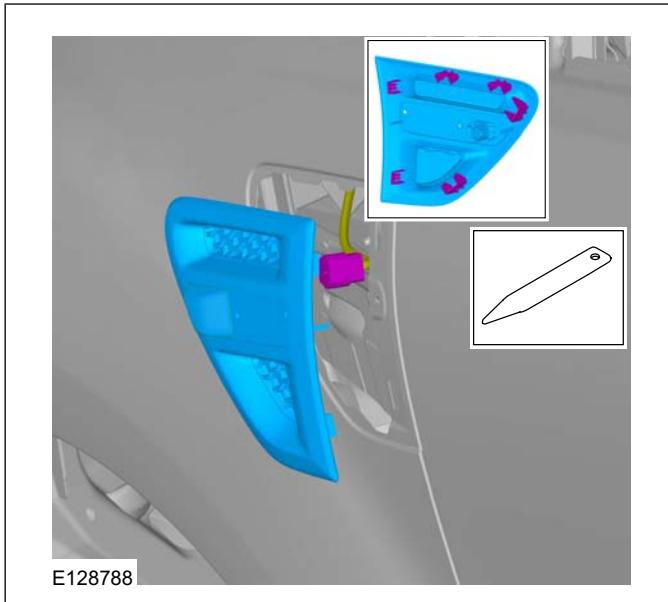
Removal

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

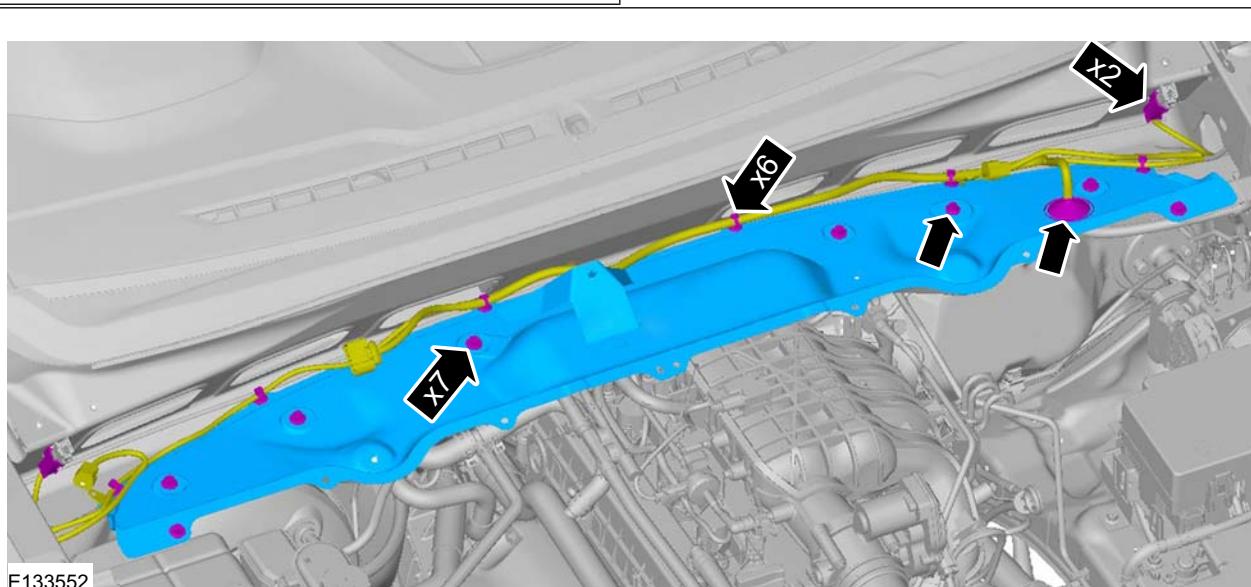
1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
3. Torque: 10 Nm



4. On both sides



5. Torque: 10 Nm

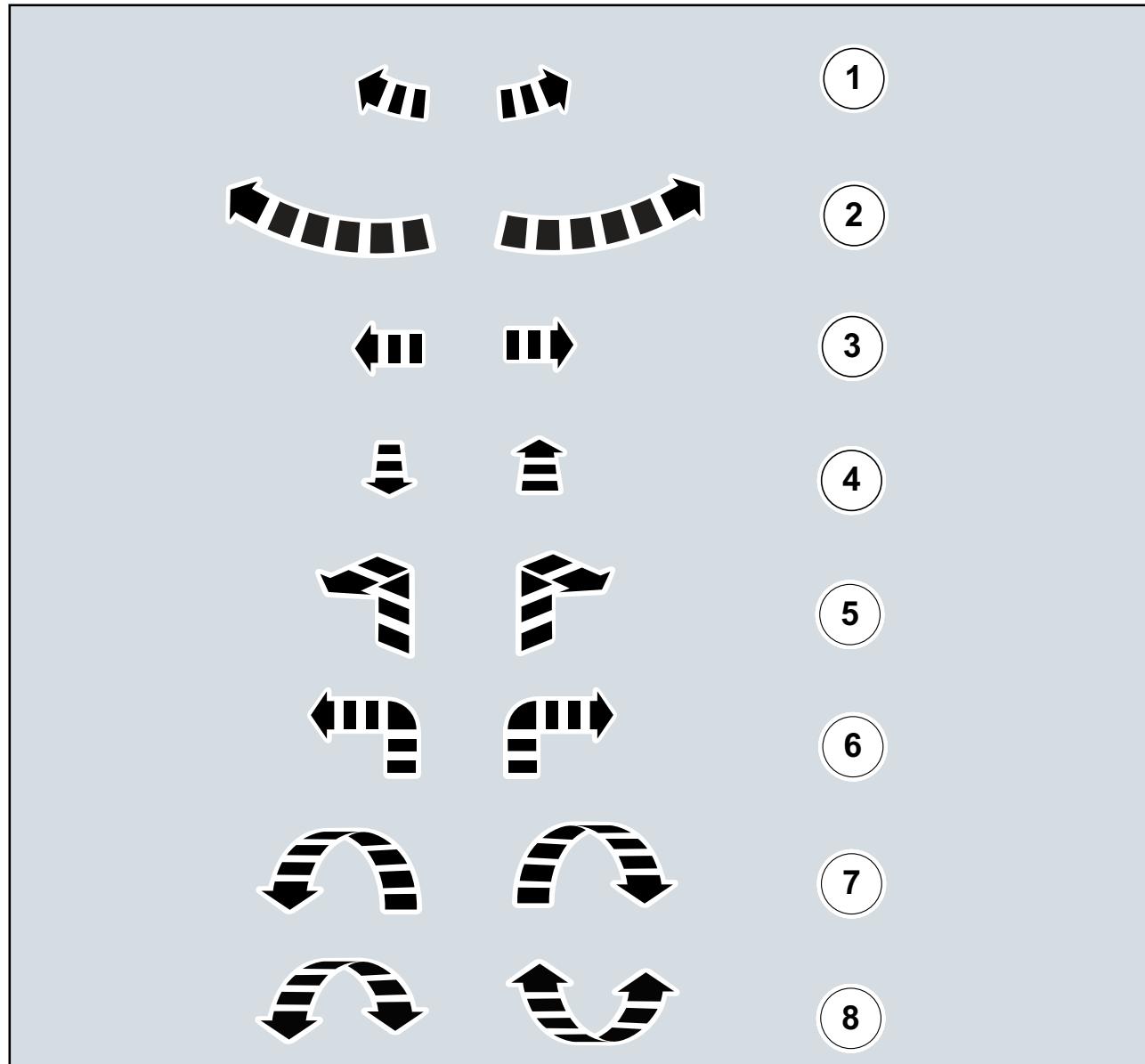


DESCRIPTION AND OPERATION**Symbols Glossary**

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

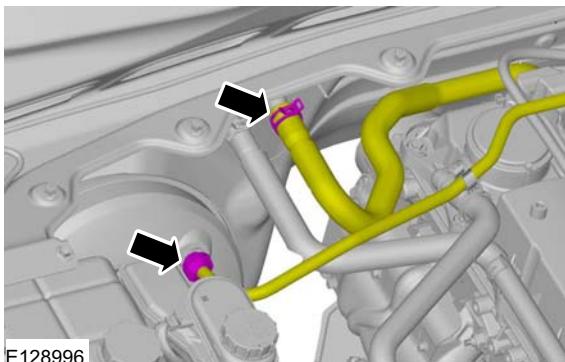
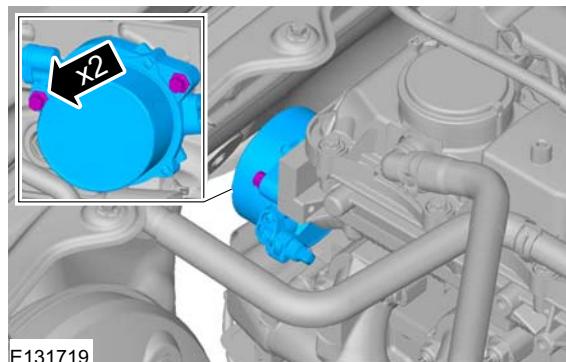
Movement Symbols

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



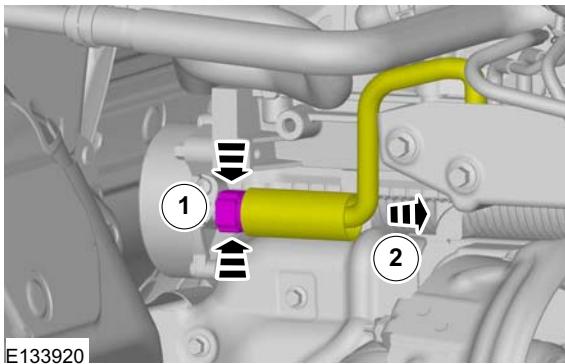
REMOVAL AND INSTALLATION

6.

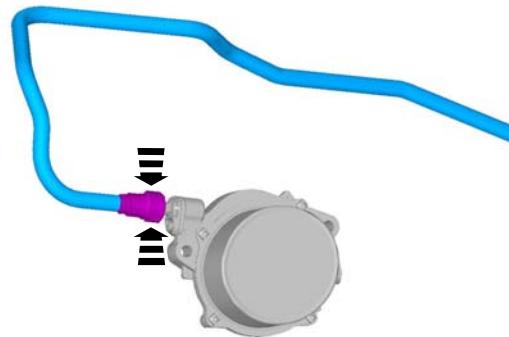
9. Torque: 22 Nm

Vehicles with fixed vane turbocharger

7.

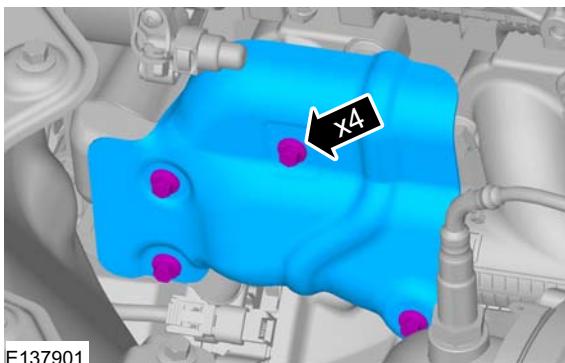


10.



Installation

All vehicles

8. Torque: 9 Nm

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

To install, reverse the removal procedure.

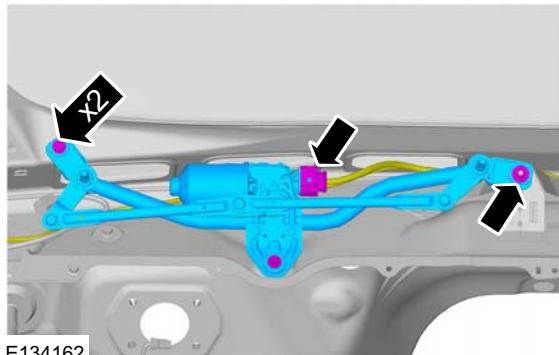
REMOVAL AND INSTALLATION

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

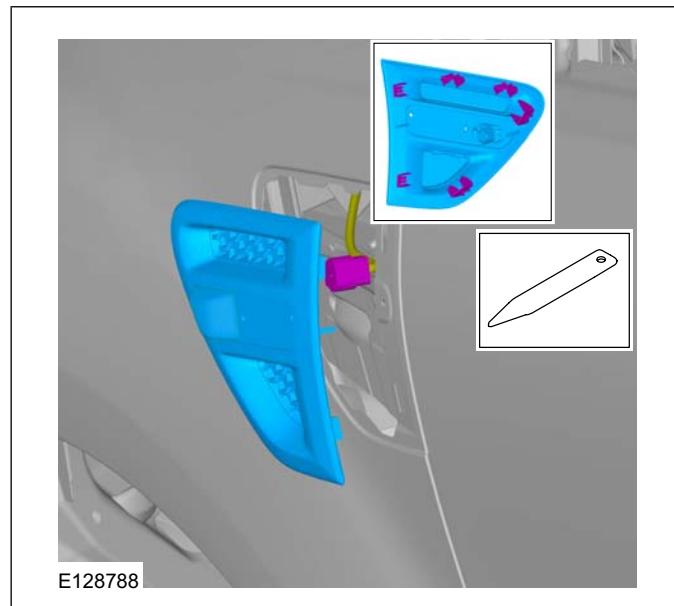
Removal

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

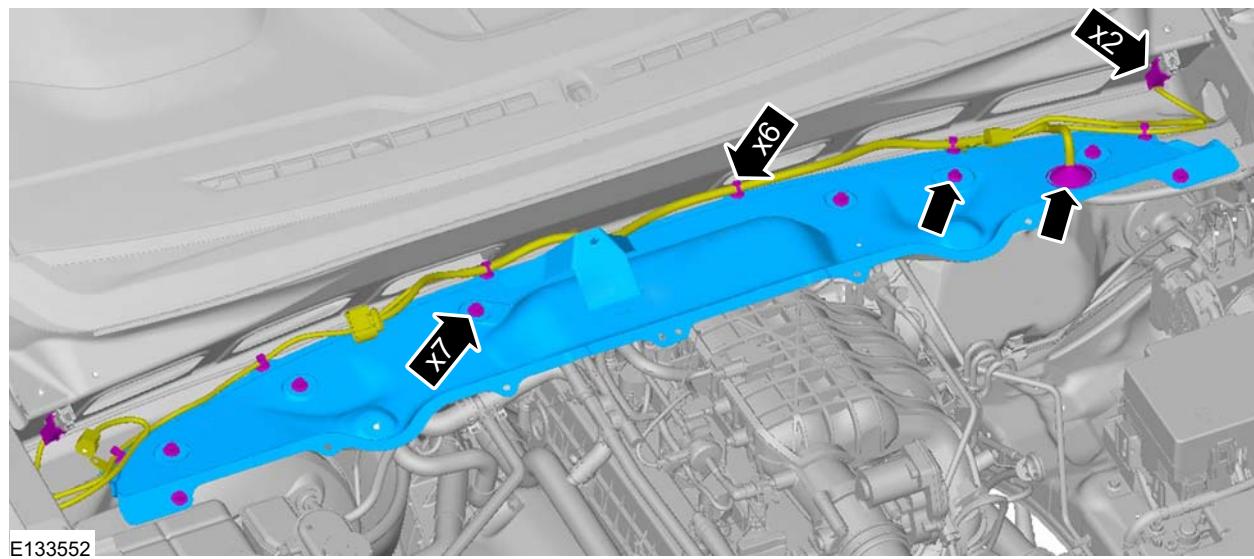
1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).
3. Torque: 10 Nm



4. On both sides

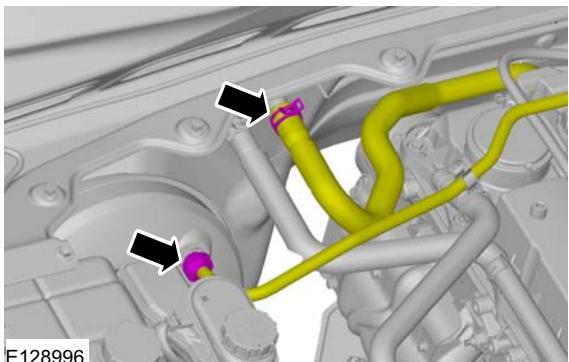


5. Torque: 10 Nm

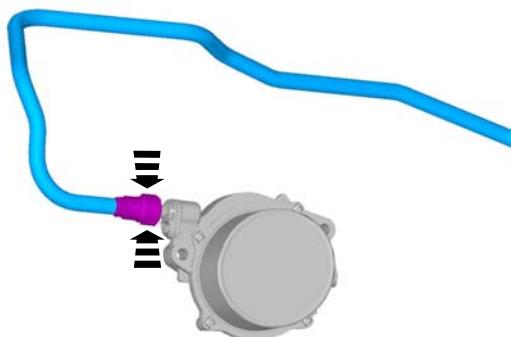
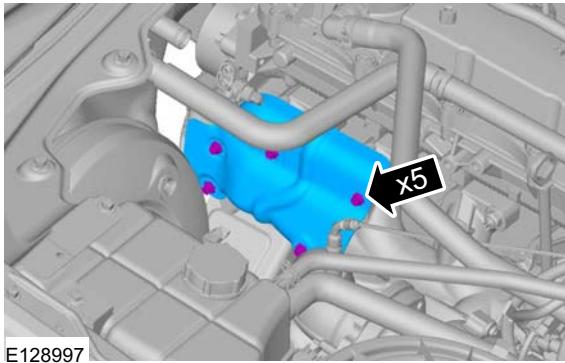


REMOVAL AND INSTALLATION

6.

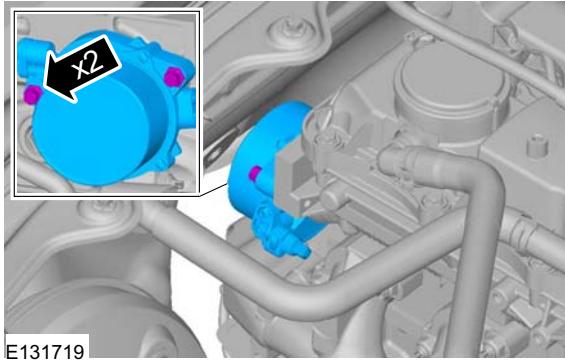


9.

7. Torque: 9 Nm**Installation**

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

To install, reverse the removal procedure.

8. Torque: 22 Nm

SECTION 206-09A Anti-Lock Control

VEHICLE APPLICATION:BT50 & Ranger

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DESCRIPTION AND OPERATION

Anti-Lock Control.....	206-09A-2
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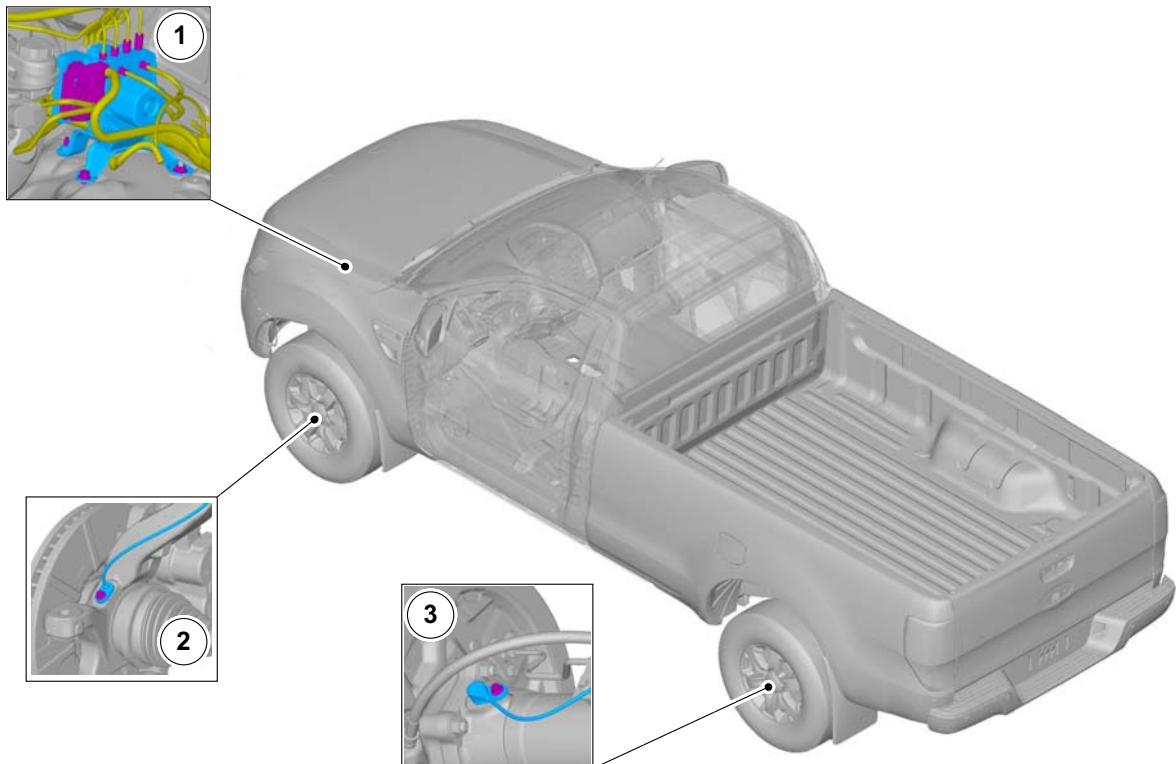
REMOVAL AND INSTALLATION

Hydraulic Control Unit (HCU) — LHD 4WD/LHD RWD.....	206-09A-3
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Hydraulic Control Unit (HCU) — RHD 4WD/RHD RWD.....	206-09A-6
---	-----------

Front Wheel Speed Sensor.....	(12 784 0)	206-09A-8
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Rear Wheel Speed Sensor.....	(12 785 0)	206-09A-9
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DESCRIPTION AND OPERATION**Anti-Lock Control**

E136985

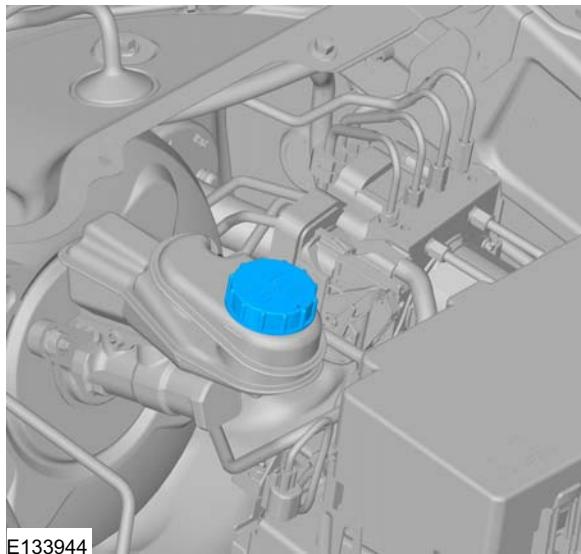
Item	Description
1	Hydraulic Control Unit (HCU)
2	Front Wheel Speed Sensor
3	Rear Wheel Speed Sensor

REMOVAL AND INSTALLATION**Hydraulic Control Unit (HCU) — LHD 4WD/LHD RWD****Removal**

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

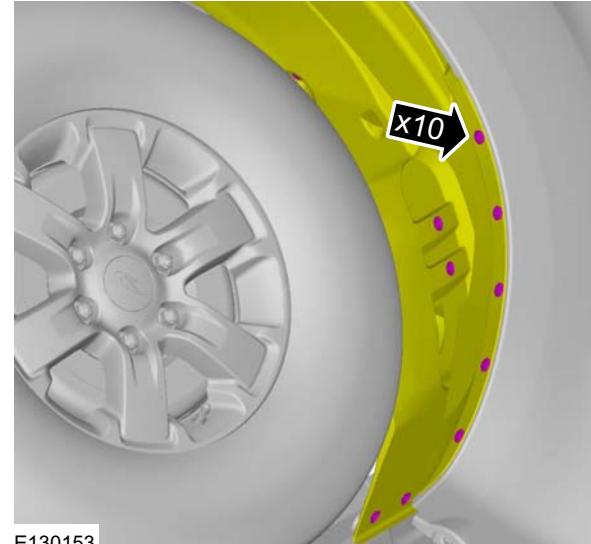
1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).

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.



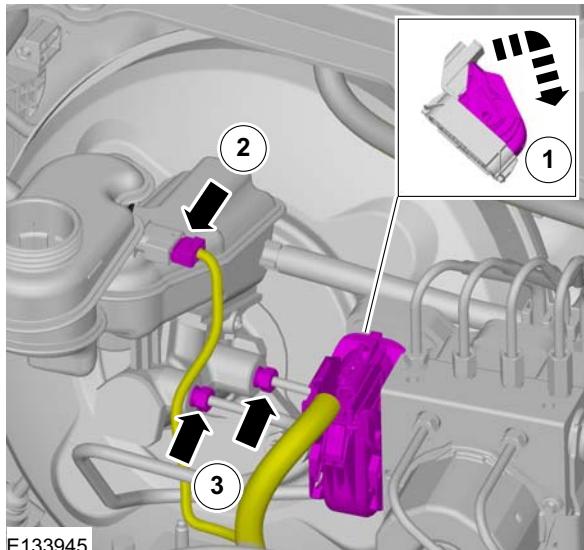
REMOVAL AND INSTALLATION

5. Refer to: **Powertrain Control Module (PCM)**
 (303-14 Electronic Engine Controls - 2.5L
 Duratec-HE (122kW/165PS) - MI4, Removal
 and Installation).

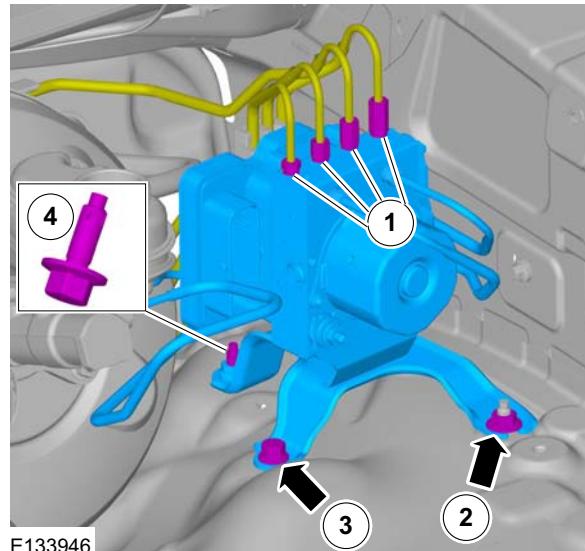
Refer to: **Powertrain Control Module (PCM)**
 (303-14 Electronic Engine Controls - 2.2L
 Duratorq-TDCi (88kW/120PS) - Puma/2.2L
 Duratorq-TDCi (96kW/130PS) - Puma/2.2L
 Duratorq-TDCi (110kW/150PS) - Puma/3.2L
 Duratorq-TDCi (148kW/200PS) - Puma,
 Removal and Installation).

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

3. Torque: 18 Nm

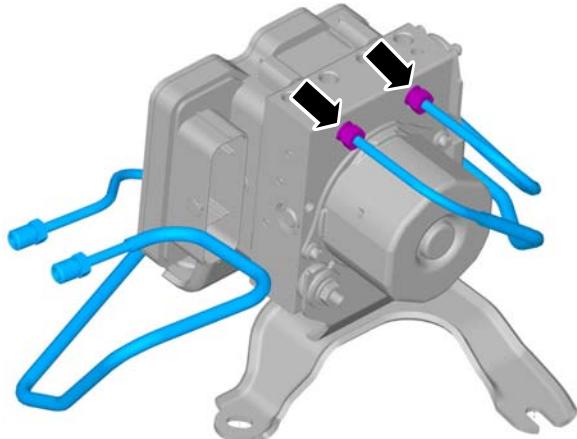


7. 1. Torque: 18 Nm
 2. Torque: 25 Nm
 3. Torque: 25 Nm
 4. Torque: 25 Nm



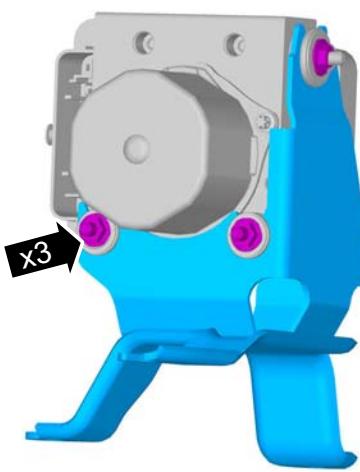
8. **NOTE:** Make sure that all openings are sealed.

Torque: 18 Nm



REMOVAL AND INSTALLATION

9. Torque: 9 Nm



E130156

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).

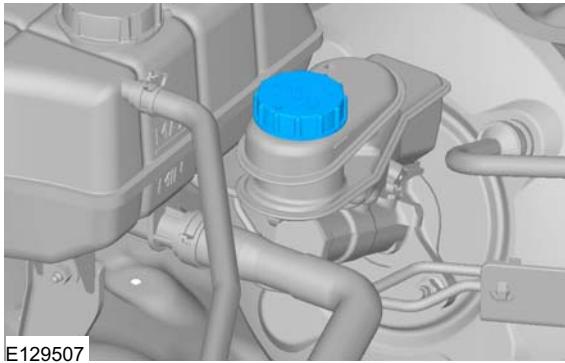
Refer to: **Brake System Pressure Bleeding** (206-00 Brake System - General Information, General Procedures).

REMOVAL AND INSTALLATION**Hydraulic Control Unit (HCU) — RHD 4WD/RHD RWD****Removal**

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

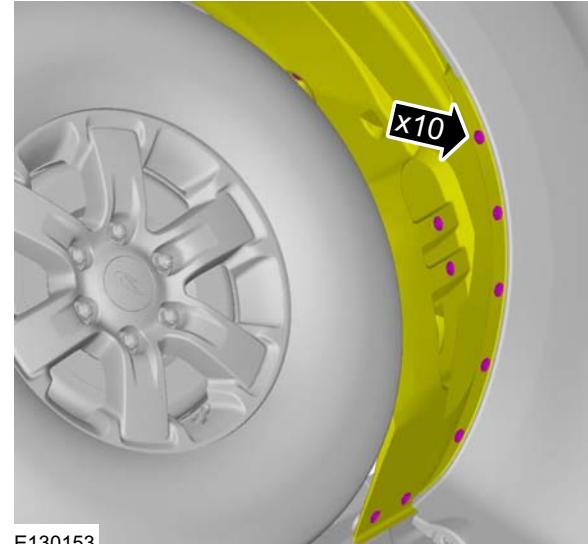
1. Refer to: **Brake System Health and Safety Precautions** (100-00 General Information, Description and Operation).

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.

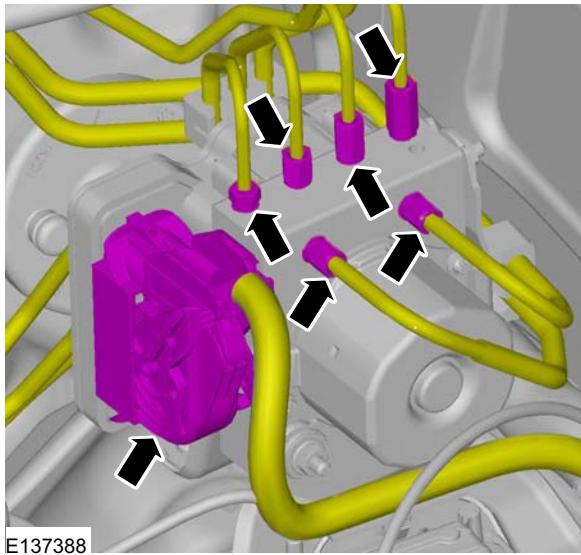
4.



REMOVAL AND INSTALLATION

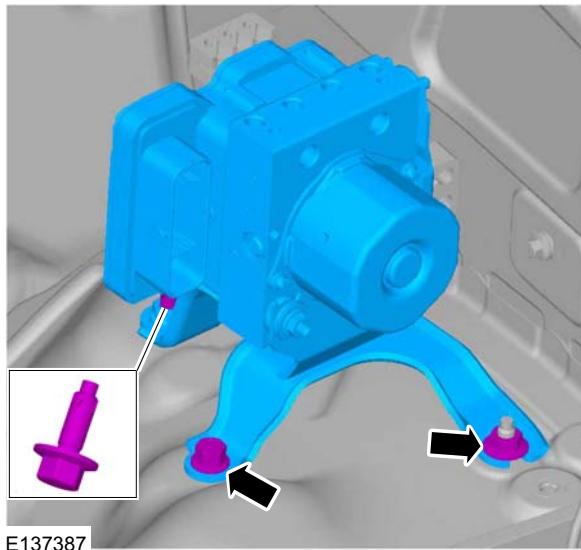
5. **CAUTION:** Make sure that all openings are sealed.

Torque: 18 Nm

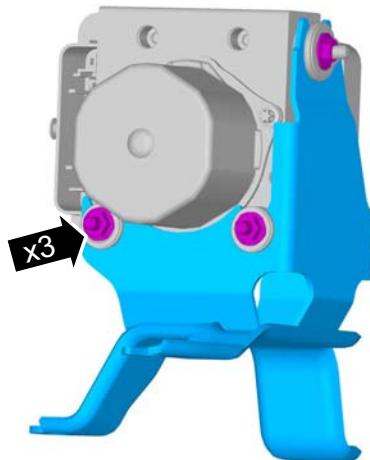


6. **CAUTION:** Make sure that all openings are sealed.

Torque: 25 Nm



7. Torque: 9 Nm



Installation

1. CAUTIONS:

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

CAUTION: 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).

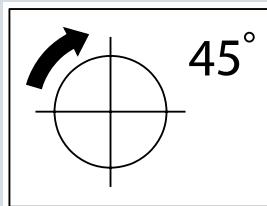
DESCRIPTION AND OPERATION

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

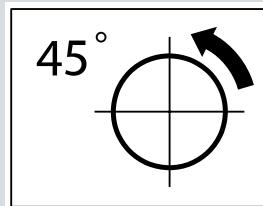
Item	Description
6	2 dimensional component movement
7	3 dimensional component rotation
8	3 dimensional component cycling

Turn Symbols

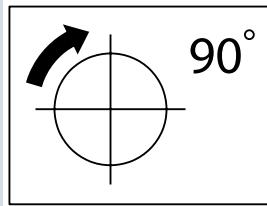
Turn symbols are used to provide further information on the direction or angle of component turns.



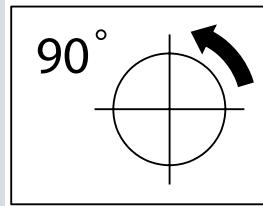
1



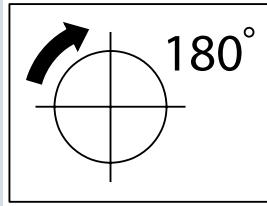
2



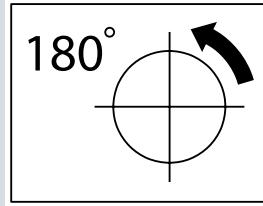
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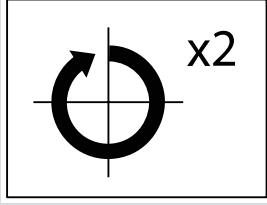
4



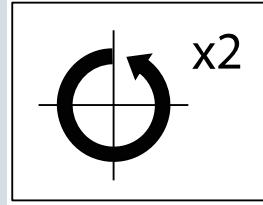
5



6



7



8

REMOVAL AND INSTALLATION

Front Wheel Speed Sensor(12 784 0)

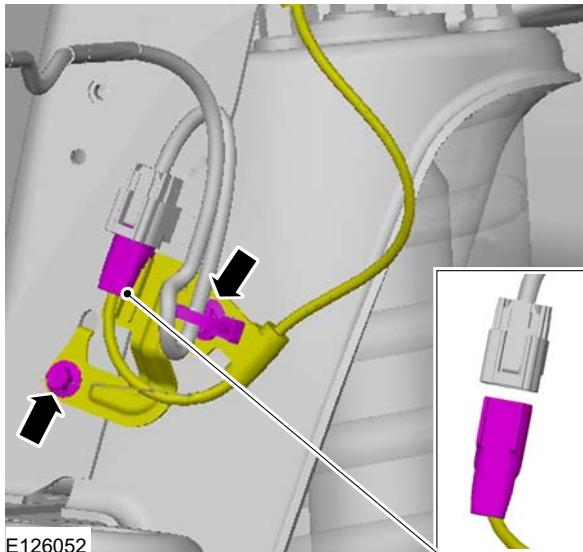
Removal

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).

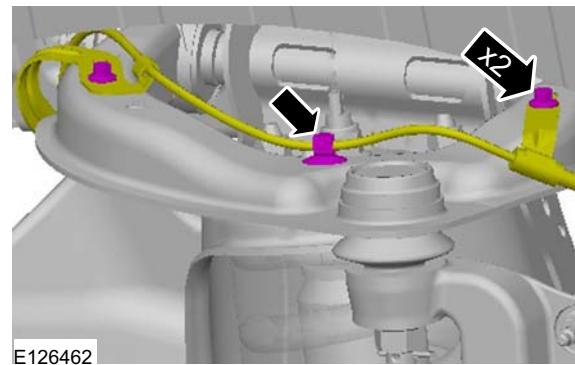
2. **NOTE:** Note the position of the component before removal.

Torque: 7 Nm



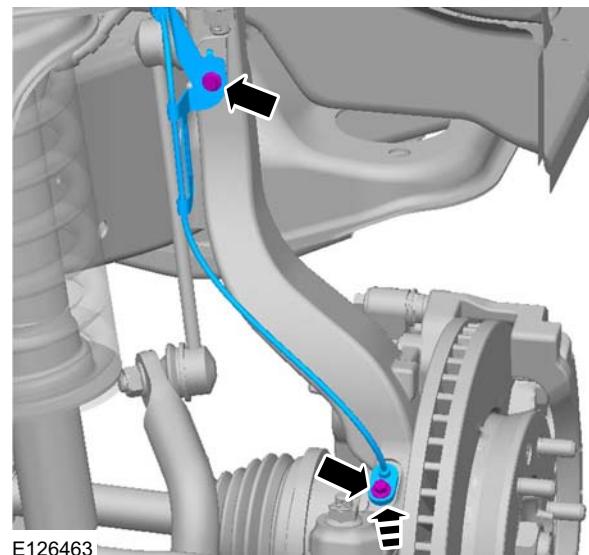
3. **NOTE:** Note the position of the component before removal.

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.

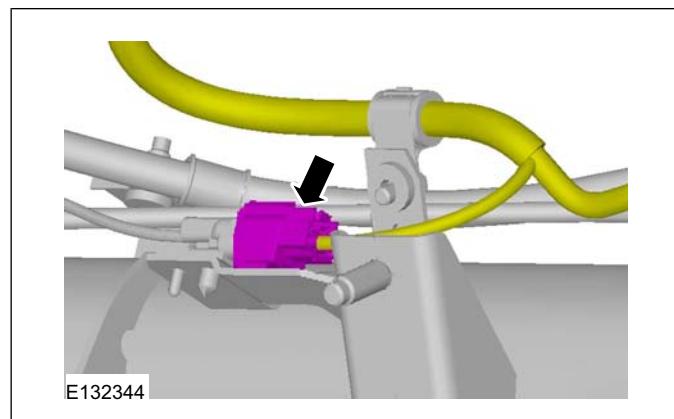
To install, reverse the removal procedure.

REMOVAL AND INSTALLATION**Rear Wheel Speed Sensor(12 785 0)****Removal**

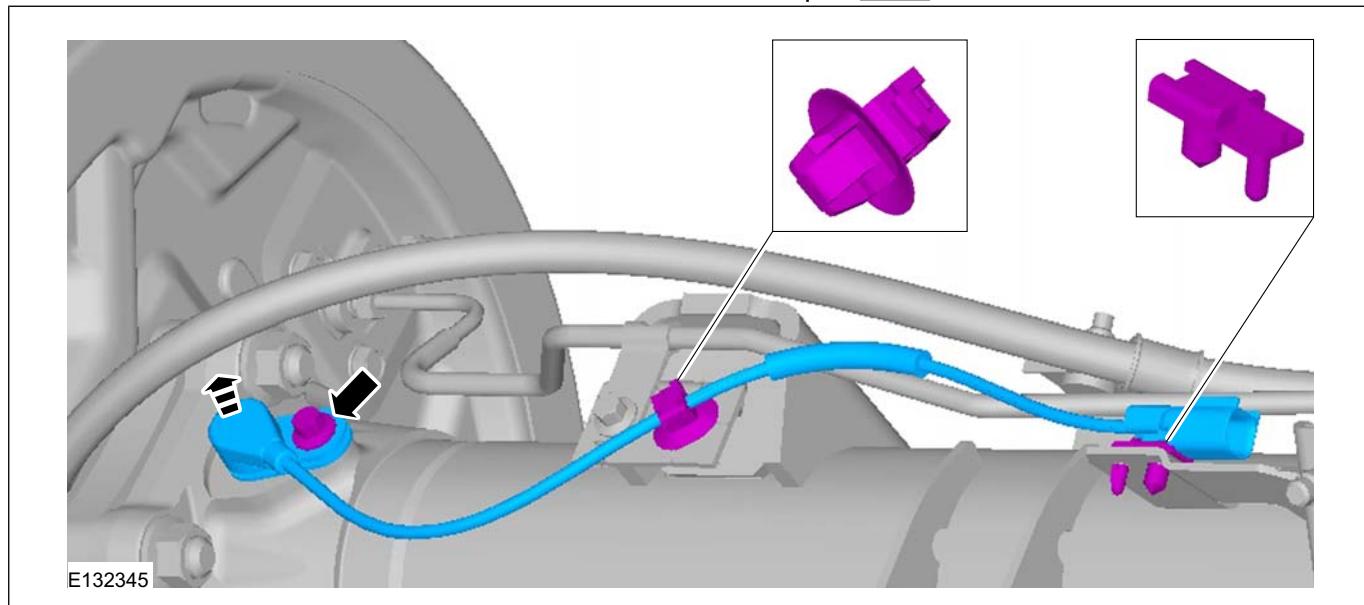
NOTE: Removal steps in this procedure may contain installation details.

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

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DESCRIPTION AND OPERATION

Anti-Lock Control - Traction Control.....	206-09B-2
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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 ELD(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:BT50 & Ranger

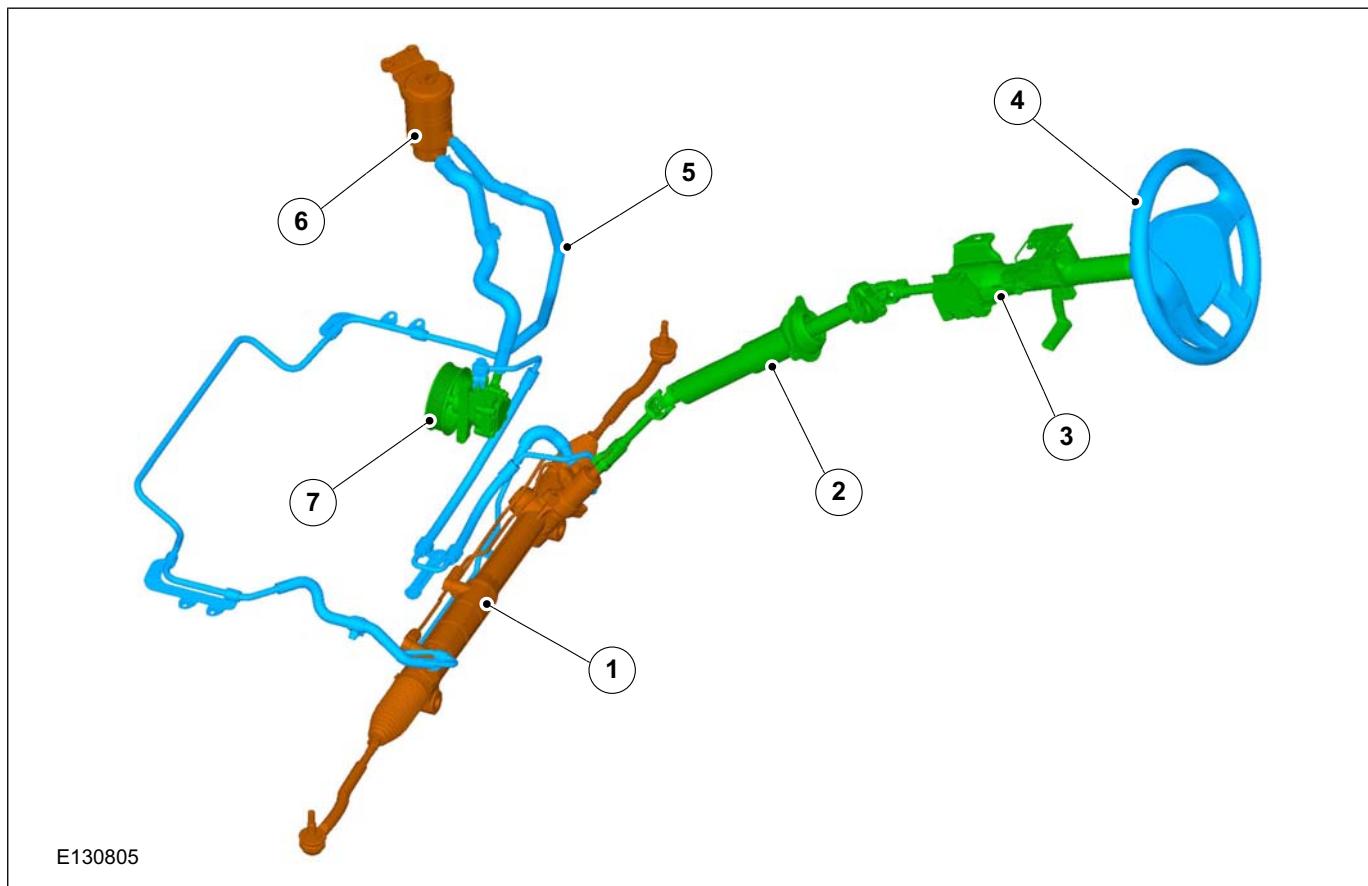
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Steering System.....	211-00-2
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GENERAL PROCEDURES

Power Steering System Flushing.....	211-00-3
Power Steering System Bleeding.....	211-00-5
Power Steering System Filling.....	211-00-7

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

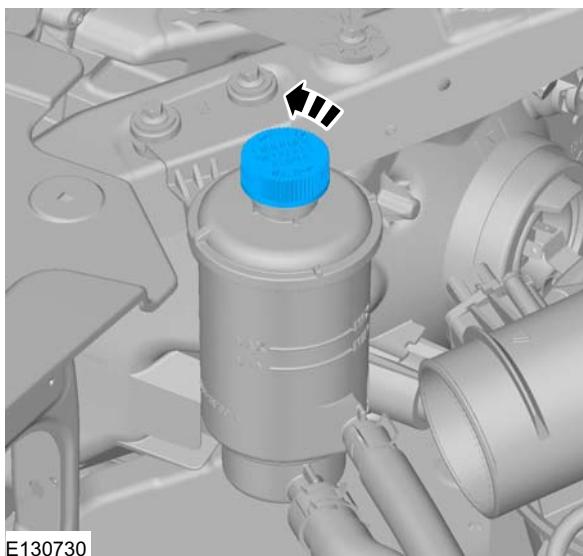
GENERAL PROCEDURES

Power Steering System Flushing

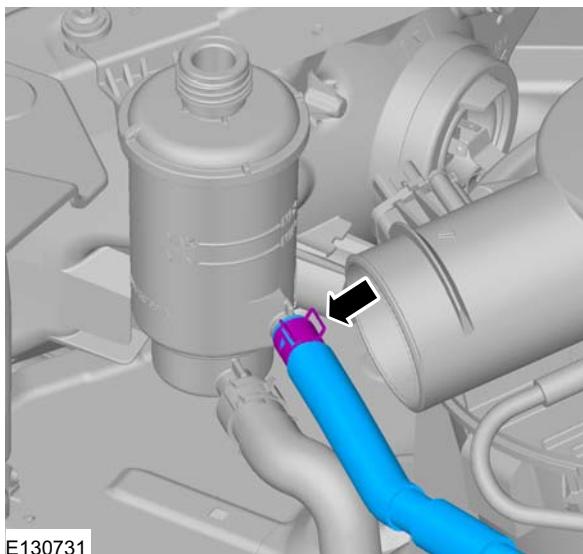
Activation

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.

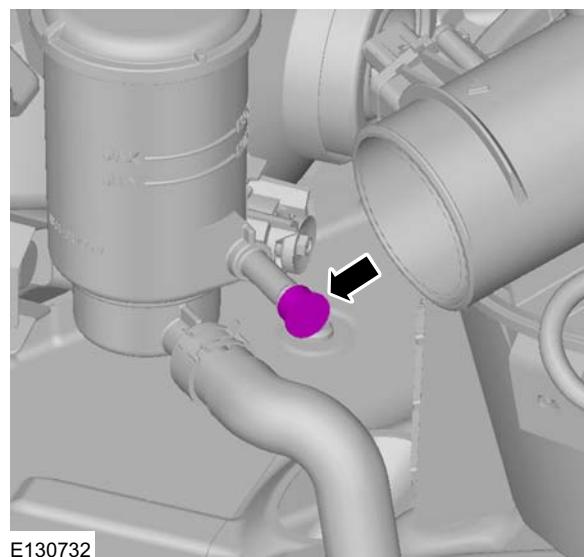
1.



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.



4. Plug the power steering fluid reservoir inlet port.



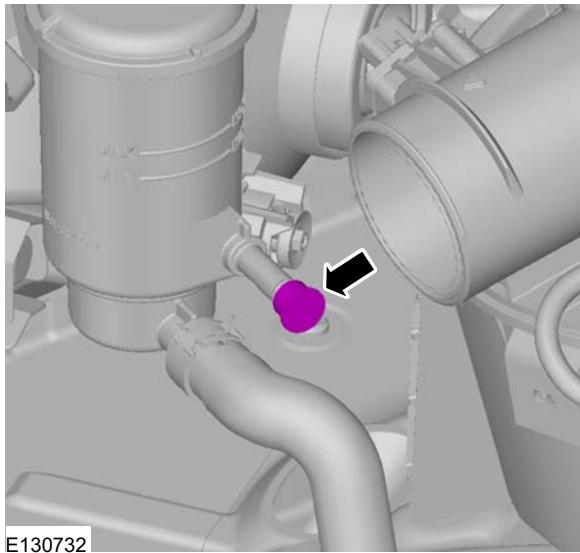
5. Attach an extension hose to the return hose.
6. **NOTE:** Do not reuse the power steering fluid that has been flushed from the power steering system.
Place the open end of the extension hose into a suitable container.
7. If equipped with Hydro-Boost®, apply the brake pedal 4 times.
8. **NOTE:** Do 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.

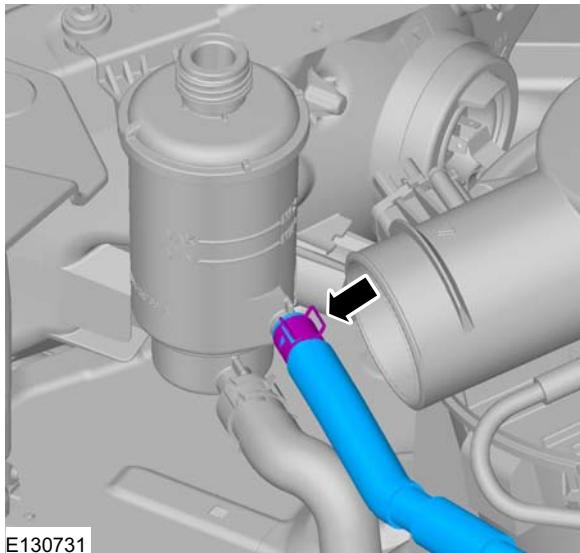
Fill the reservoir as needed with the specified fluid.

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.



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



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.

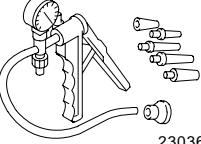
Refer to: **Power Steering System Filling** (211-00 Steering System - General Information, General Procedures).

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

GENERAL PROCEDURES

Power Steering System Bleeding

Special Tool(s)

	416-D001 Hand Vacuum Pump/Pressure Pump 23036A
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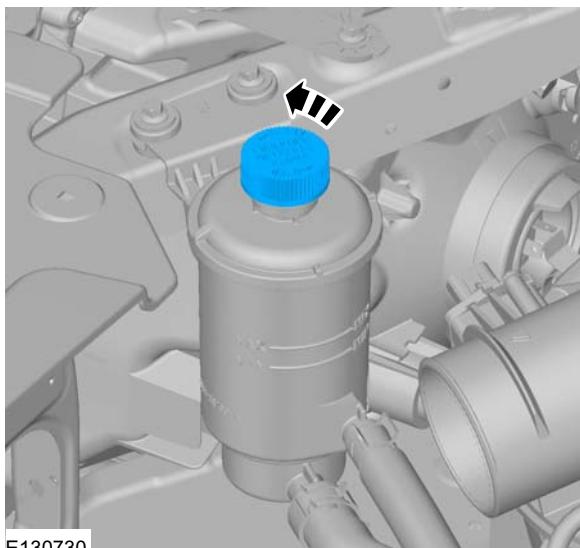
Activation

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.

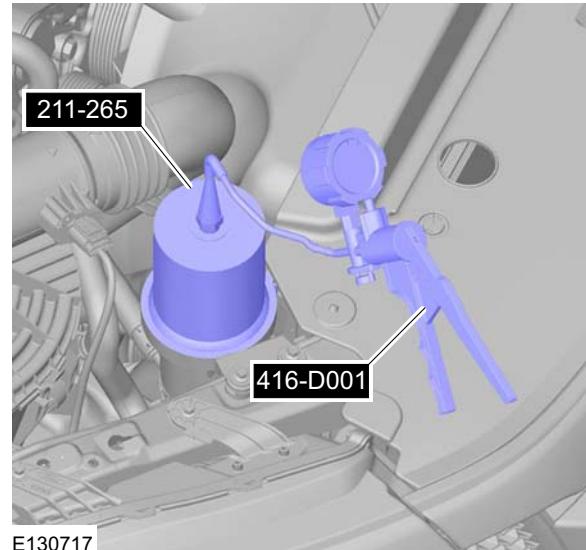
Remove the power steering reservoir cap. Check the fluid.



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



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.

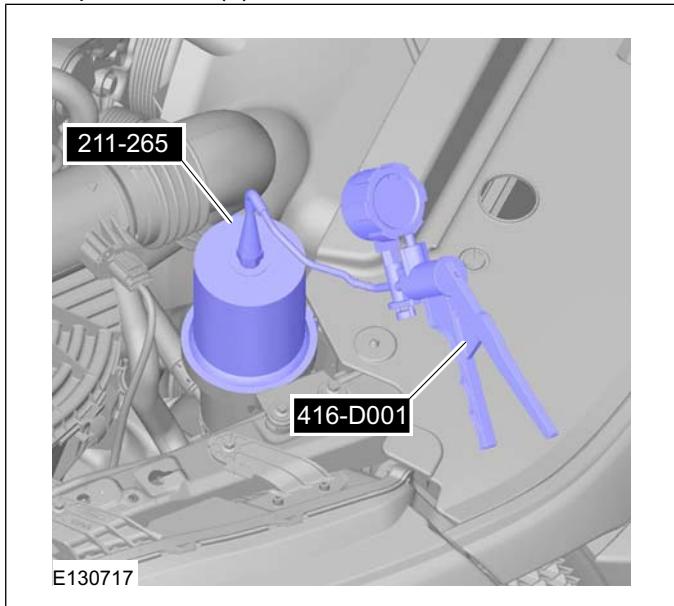
Fill the power steering fluid reservoir to the MAX mark with the appropriate power steering fluid.

27. Start the engine and let it idle.

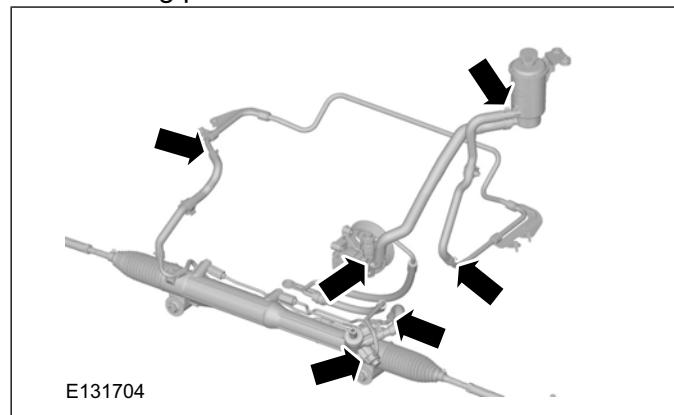
GENERAL PROCEDURES

- 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



noise is apparent, repeat the power steering bleeding procedure.



- 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

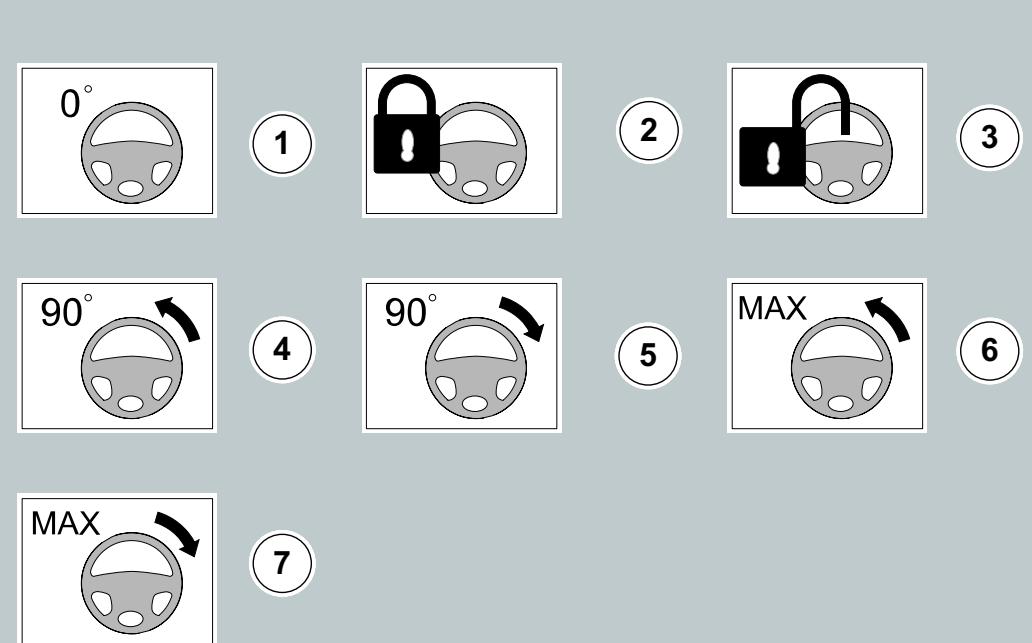
DESCRIPTION AND OPERATION

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

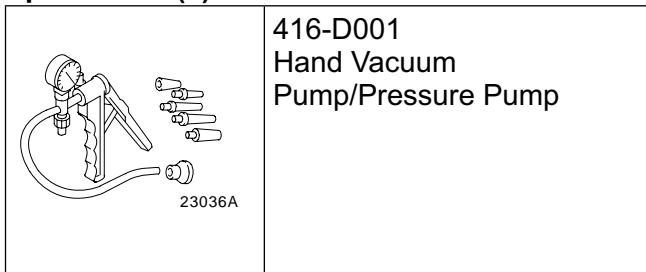
Steering wheel symbols are used to provide further information to a required steering wheel position or steering column lock status.



GENERAL PROCEDURES

Power Steering System Filling

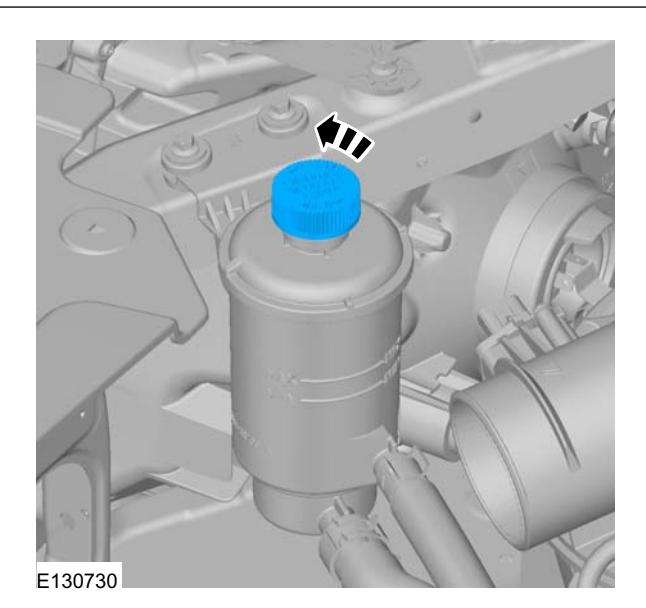
Special Tool(s)



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.



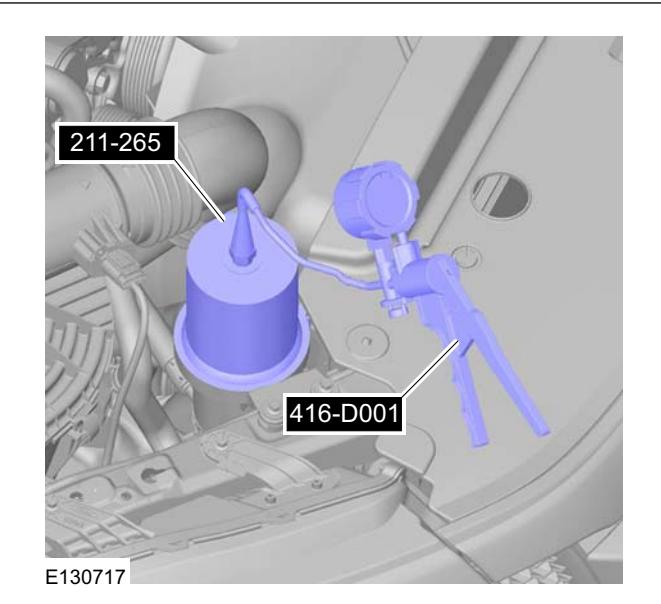
34. NOTE: Make sure that the power steering fluid in the power steering fluid reservoir does not fall below the MIN mark, as air could enter the system.

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



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.

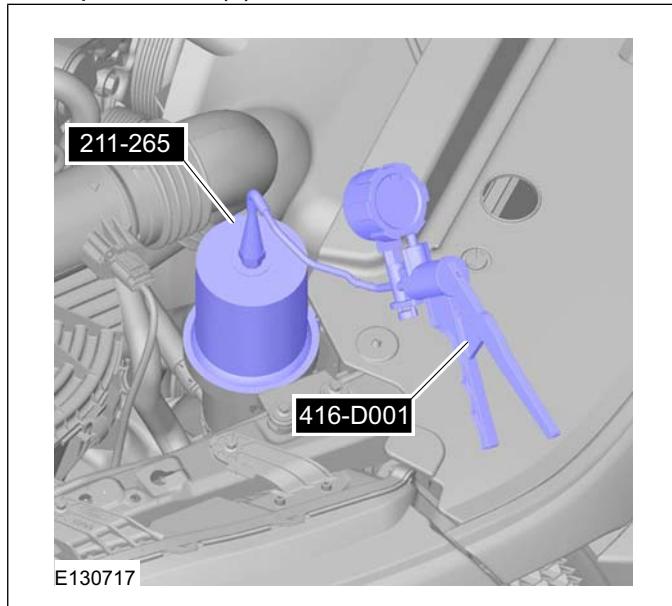
40. NOTE: Do not overfill the reservoir.

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:BT50 & Ranger

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REMOVAL AND INSTALLATION

Power Steering Pump — 2.5L Duratec-HE (122kW/165PS) - MI4.....	(13 434 0)	211-02-2
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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)	211-02-15

REMOVAL AND INSTALLATION

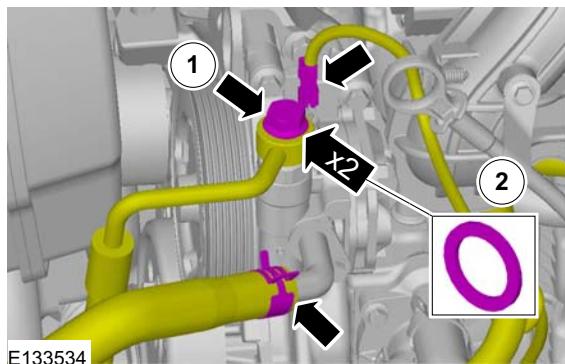
Power Steering Pump — 2.5L Duratec-HE (122kW/165PS) - MI4(13 434 0)

Removal

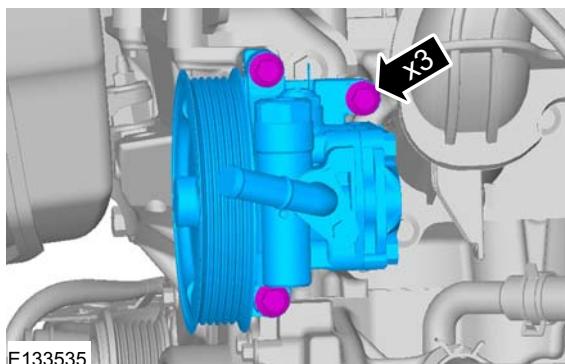
NOTE: Removal steps in this procedure may contain installation details.

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

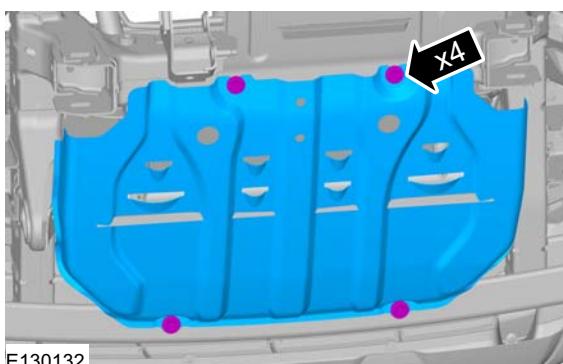
Power Steering Pump — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma(13 434 0)

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.

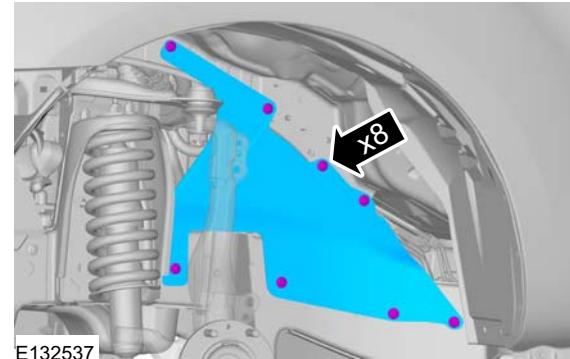
1. Refer to: **Steering System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: **Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L 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.

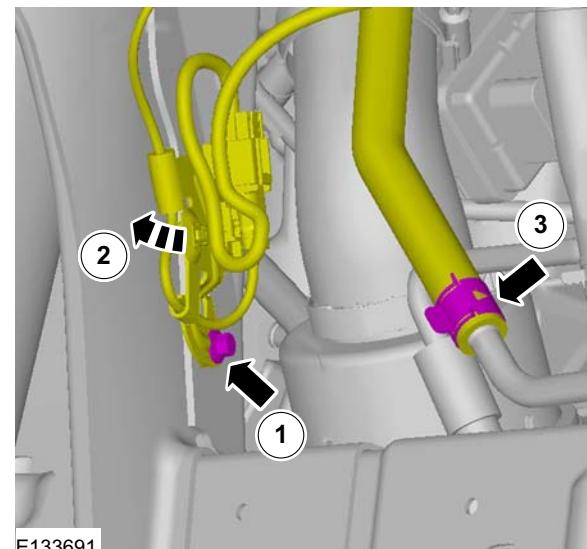
Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

- 7.



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

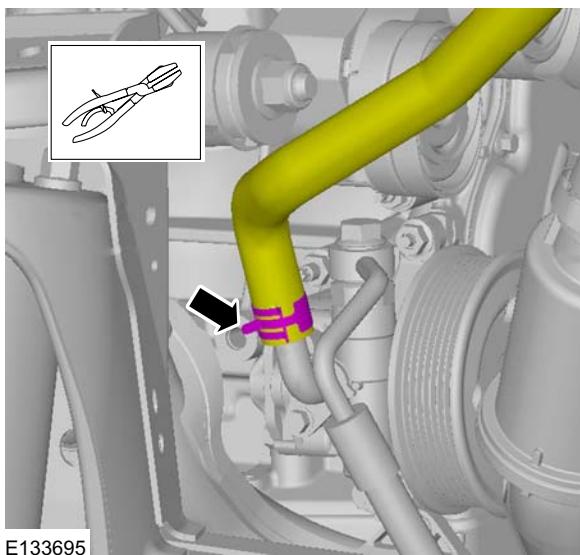
Torque: 7 Nm



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

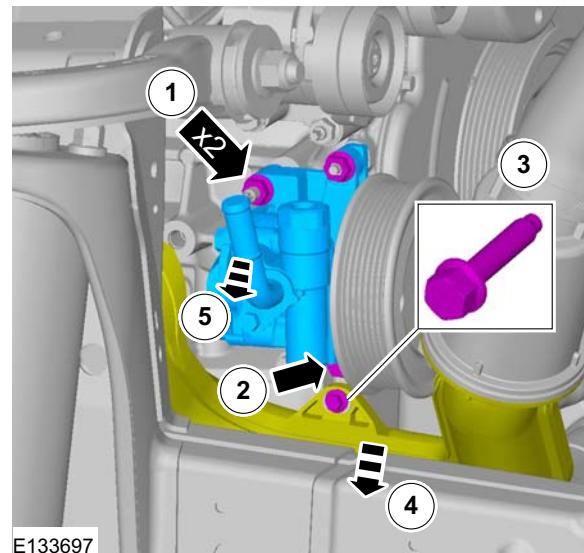
REMOVAL AND INSTALLATION

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



E133695

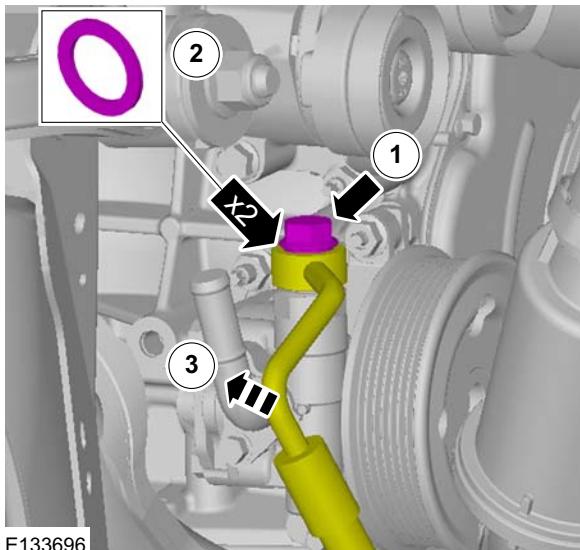
11. 1. Torque: 20 Nm
2. Torque: 20 Nm
3. Torque: 10 Nm



E133697

10. ⚠ CAUTION: Make sure that all openings are sealed with new blanking caps.

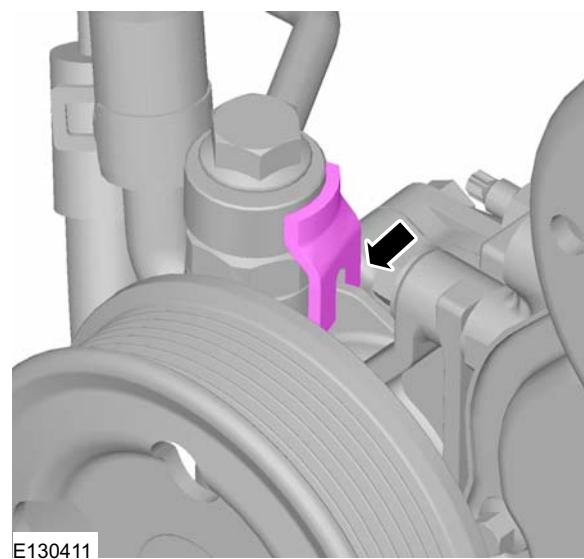
Torque: 35 Nm



E133696

Installation

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



E130411

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

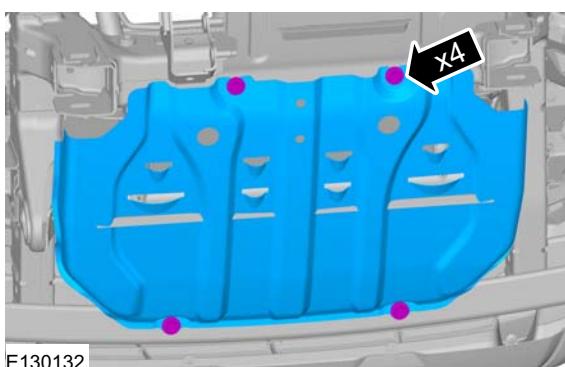
Power Steering Pump — 3.2L Duratorq-TDCi (148kW/200PS) - Puma(13 434 0)

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.

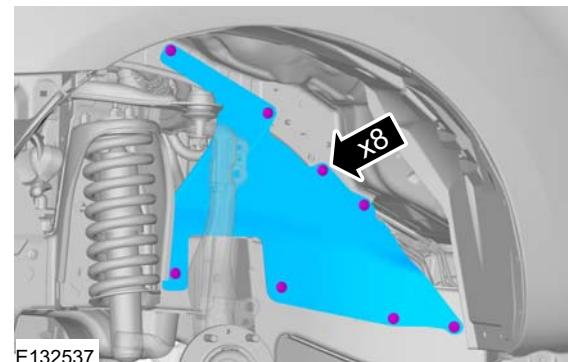
1. Refer to: **Steering System Health and Safety Precautions** (100-00 General Information, Description and Operation).
2. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: **Accessory Drive Belt - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L 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.

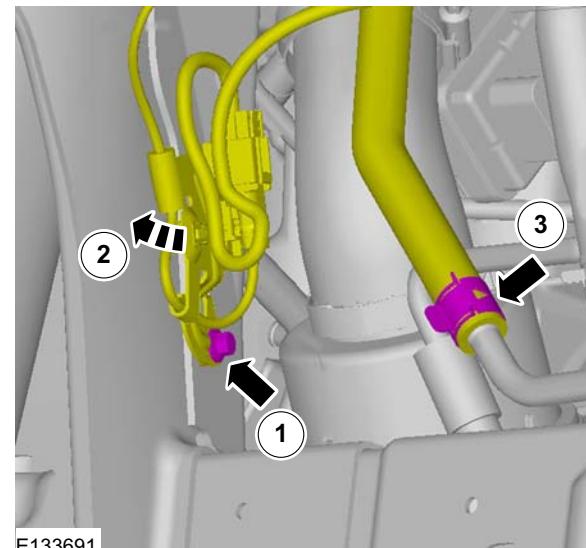
Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

7.



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

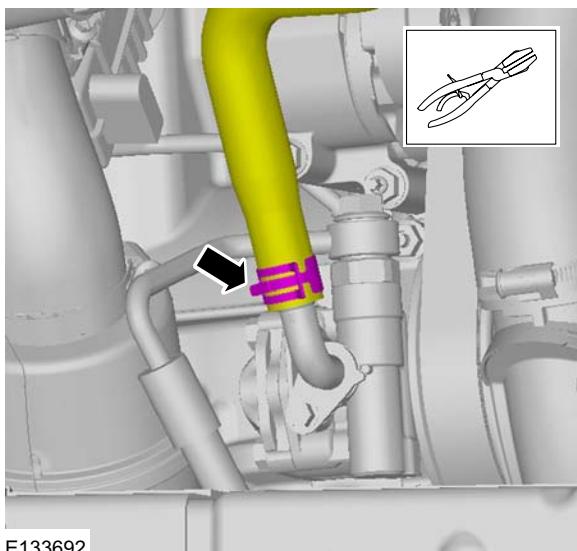
Torque: 7 Nm



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

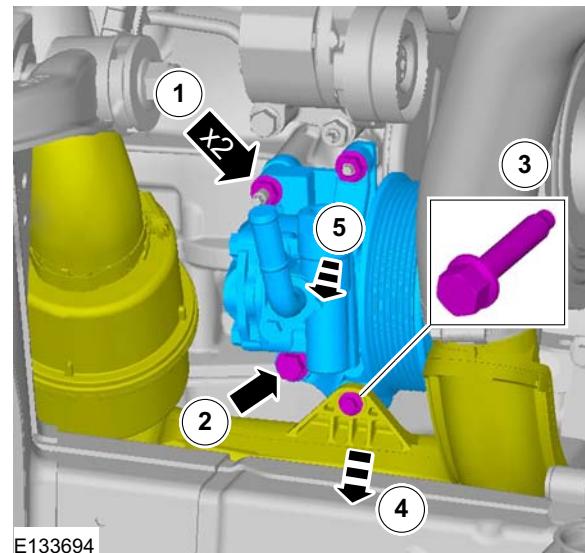
REMOVAL AND INSTALLATION

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



E133692

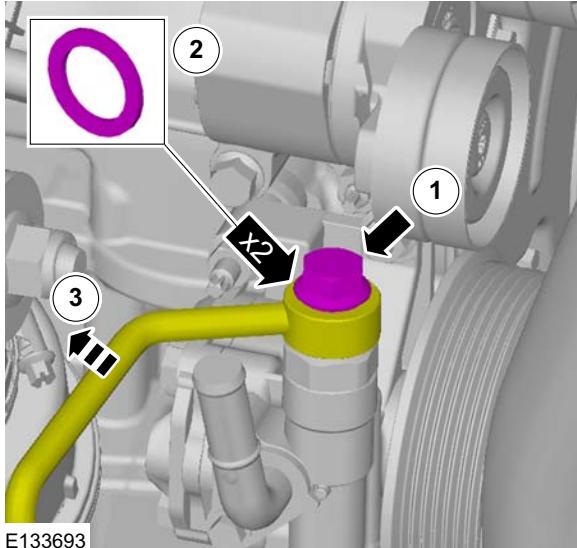
11. 1. Torque: 20 Nm
2. Torque: 20 Nm
3. Torque: 10 Nm



E133694

10. ⚠ CAUTION: Make sure that all openings are sealed with new blanking caps.

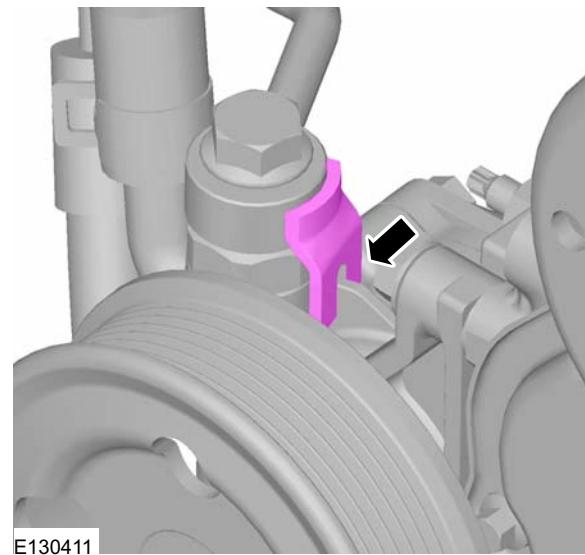
Torque: 35 Nm



E133693

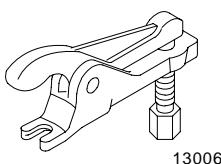
Installation

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



E130411

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

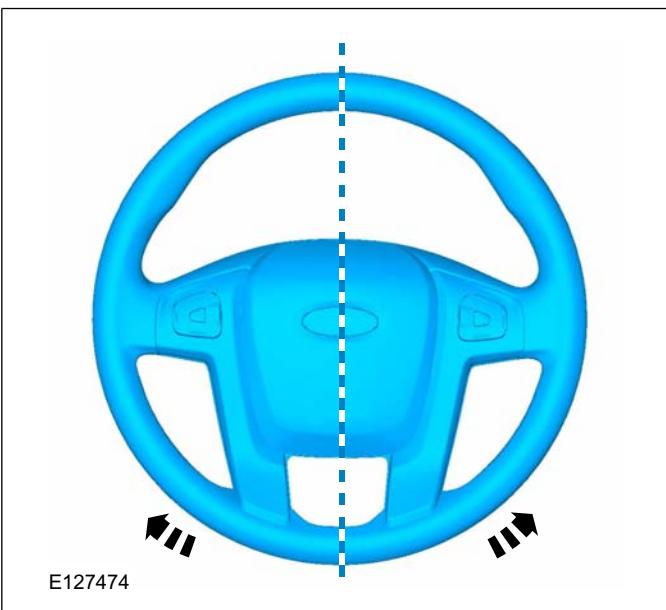
211-020
Separator, Ball Joint

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.

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.



4. Remove both front wheels.

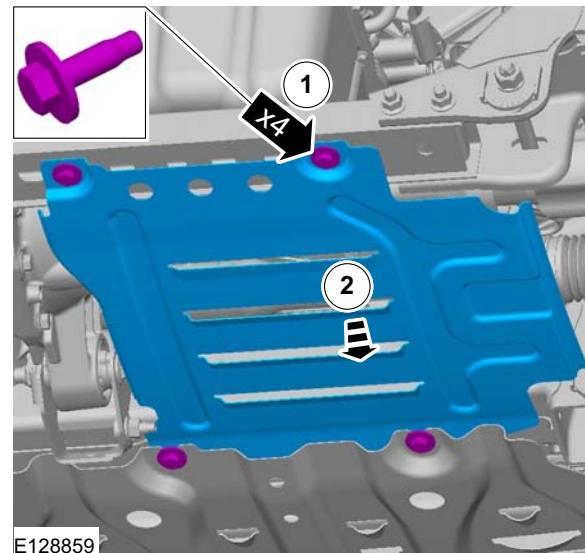
Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

REMOVAL AND INSTALLATION

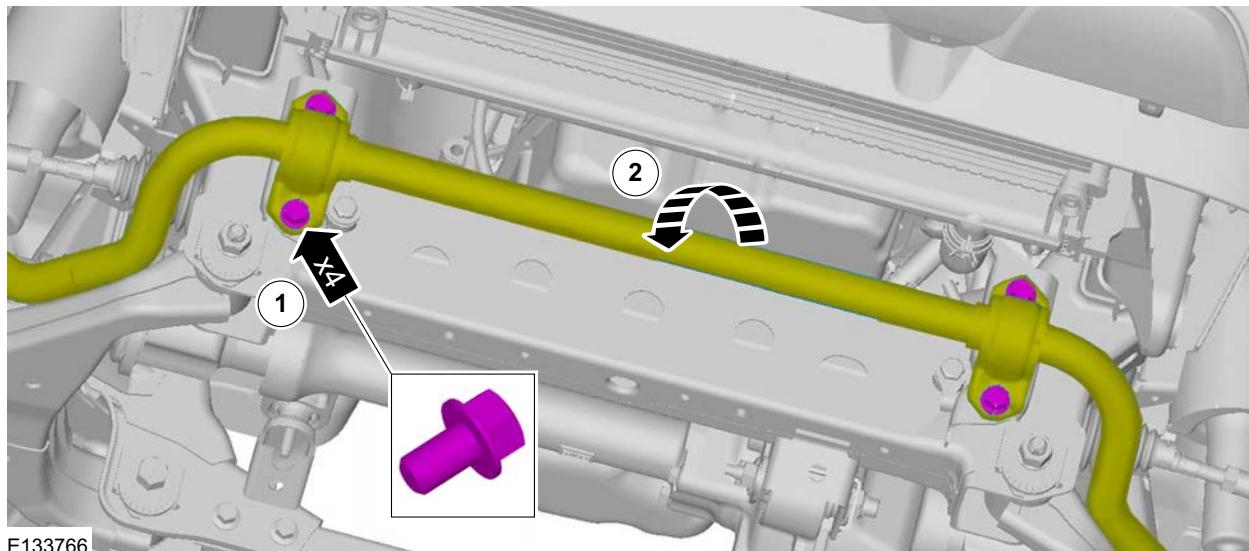
5. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).

4x4

6. Torque: 30 Nm



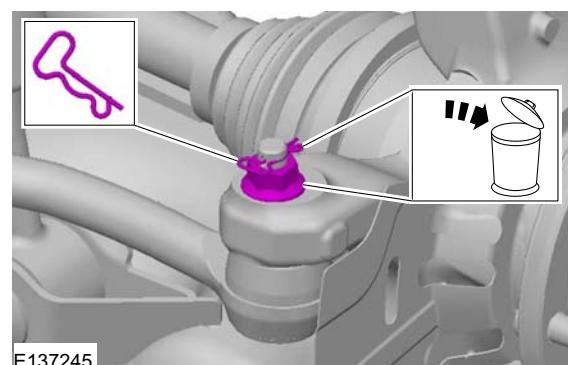
7. Torque: 30 Nm



All vehicles

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

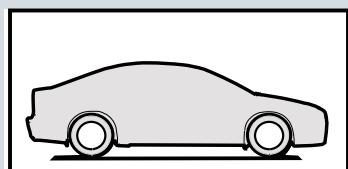
On both sides.
Torque: 63 Nm



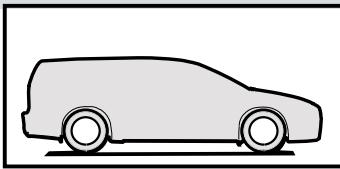
DESCRIPTION AND OPERATION

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

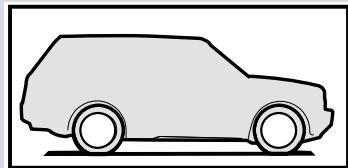
Item	Description
5	Turn the steering wheel to the 90° right position
6	Turn the steering wheel to the left-hand end position
7	Turn the steering wheel to the right-hand end position



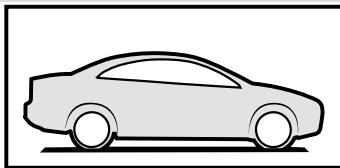
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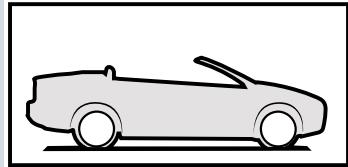
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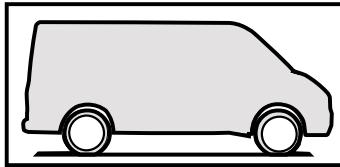
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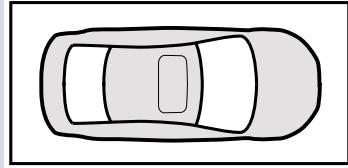
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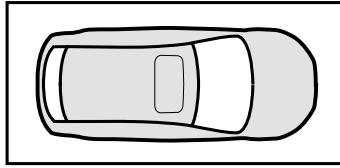
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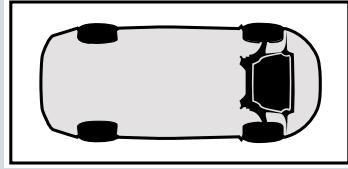
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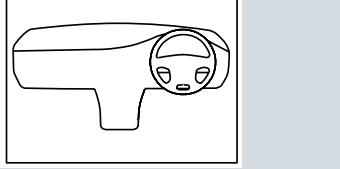
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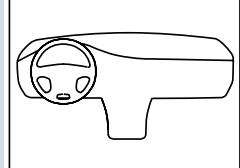
8



9



10



11

E88971

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

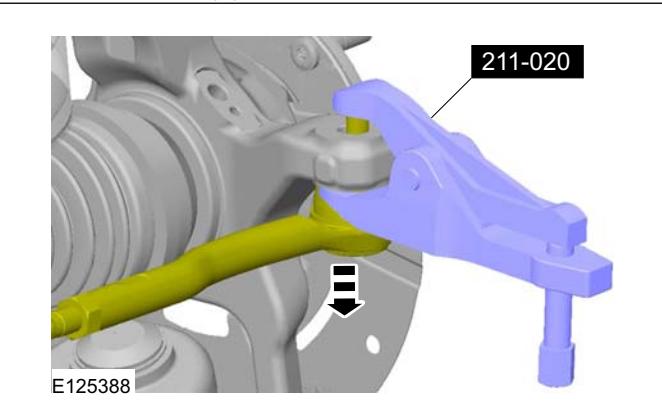
Item	Description
3	Sports utility vehicle body style
4	Coupe body style

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.

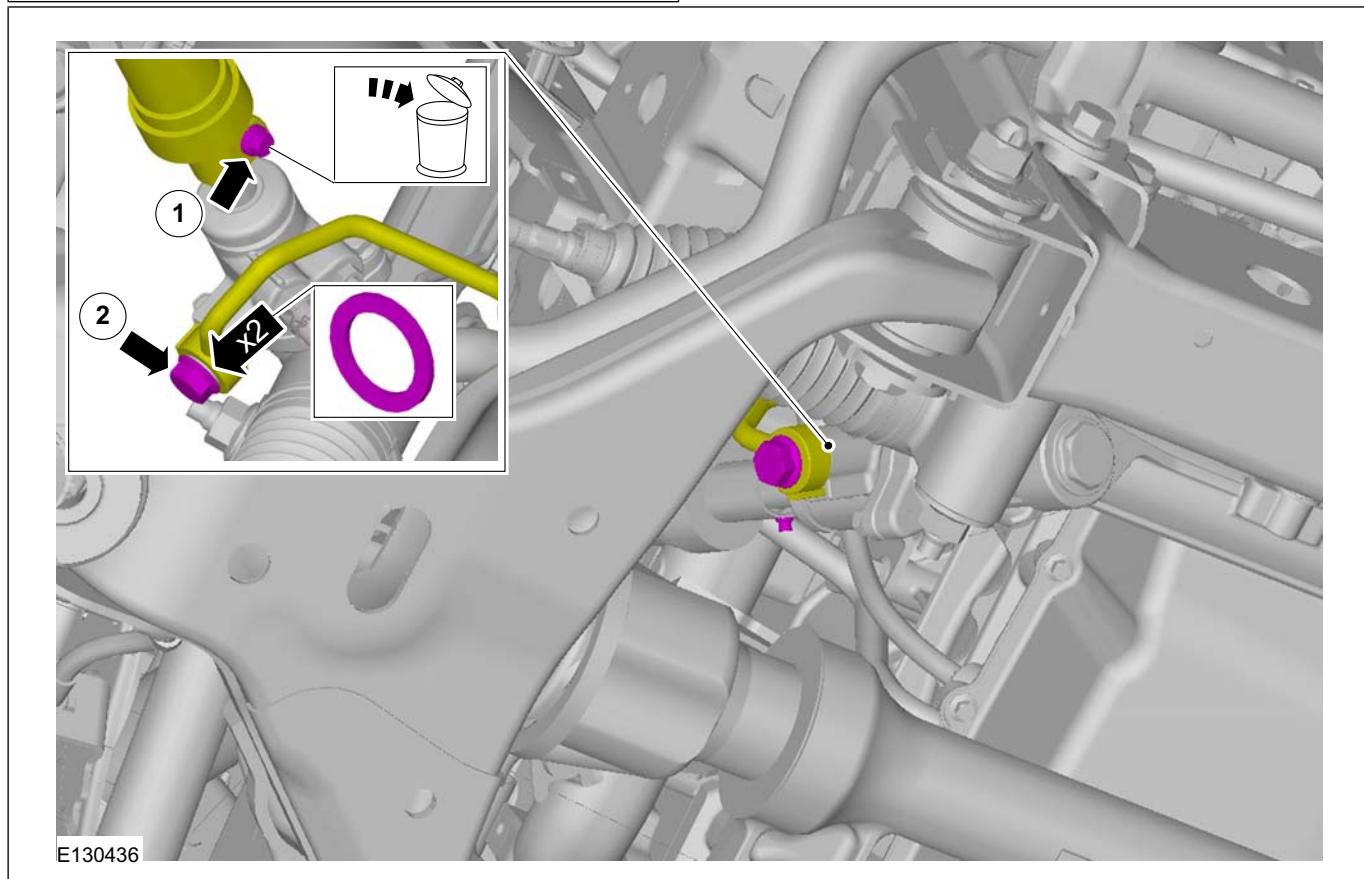
Special Tool(s): 211-020



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

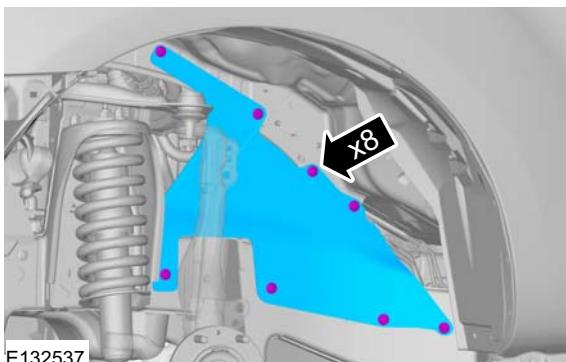
⚠ CAUTION: Cap the power steering line and steering gear body to prevent fluid loss or dirt ingress.

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



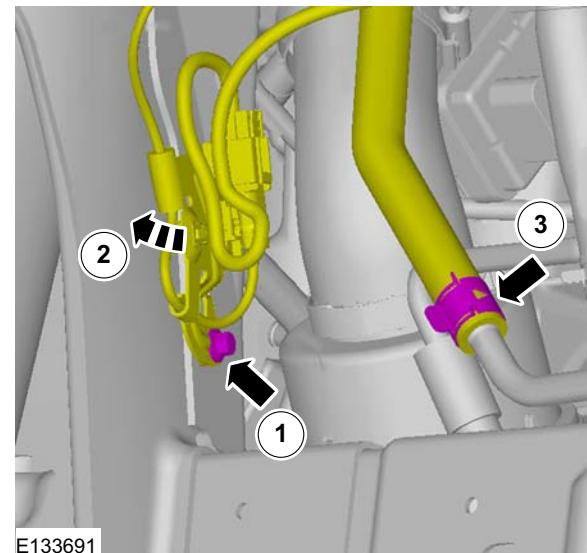
REMOVAL AND INSTALLATION

11.



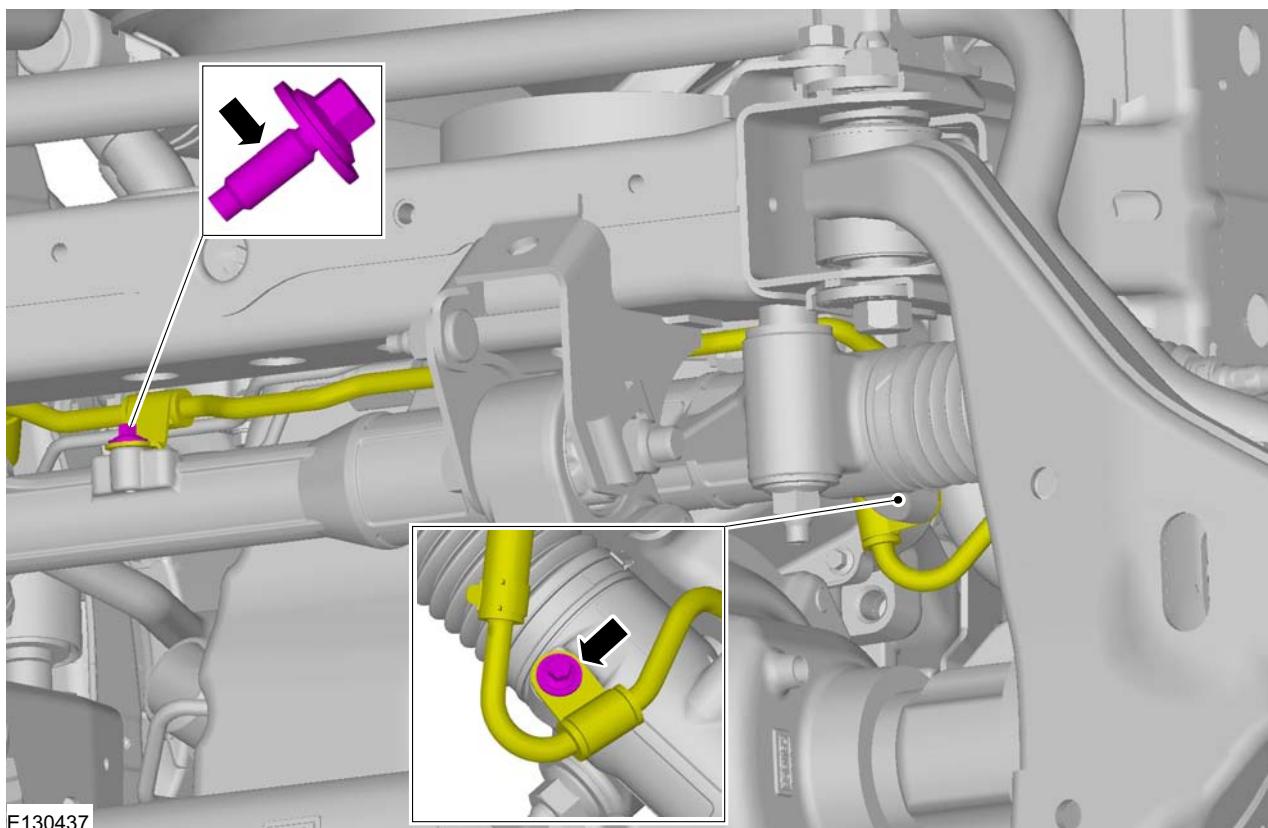
E132537

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

Torque: 7 Nm

E133691

Vehicles with diesel engine

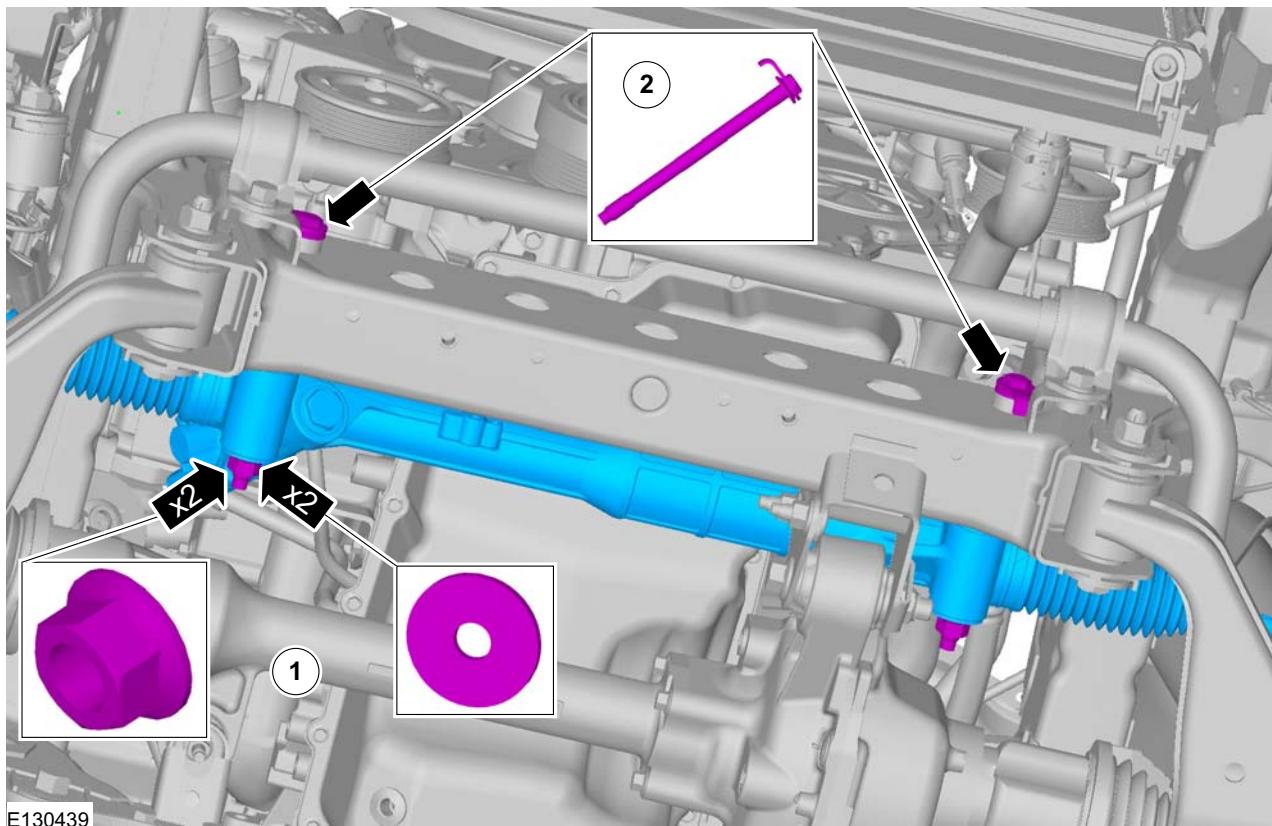
13. Torque: 10 Nm

E130437

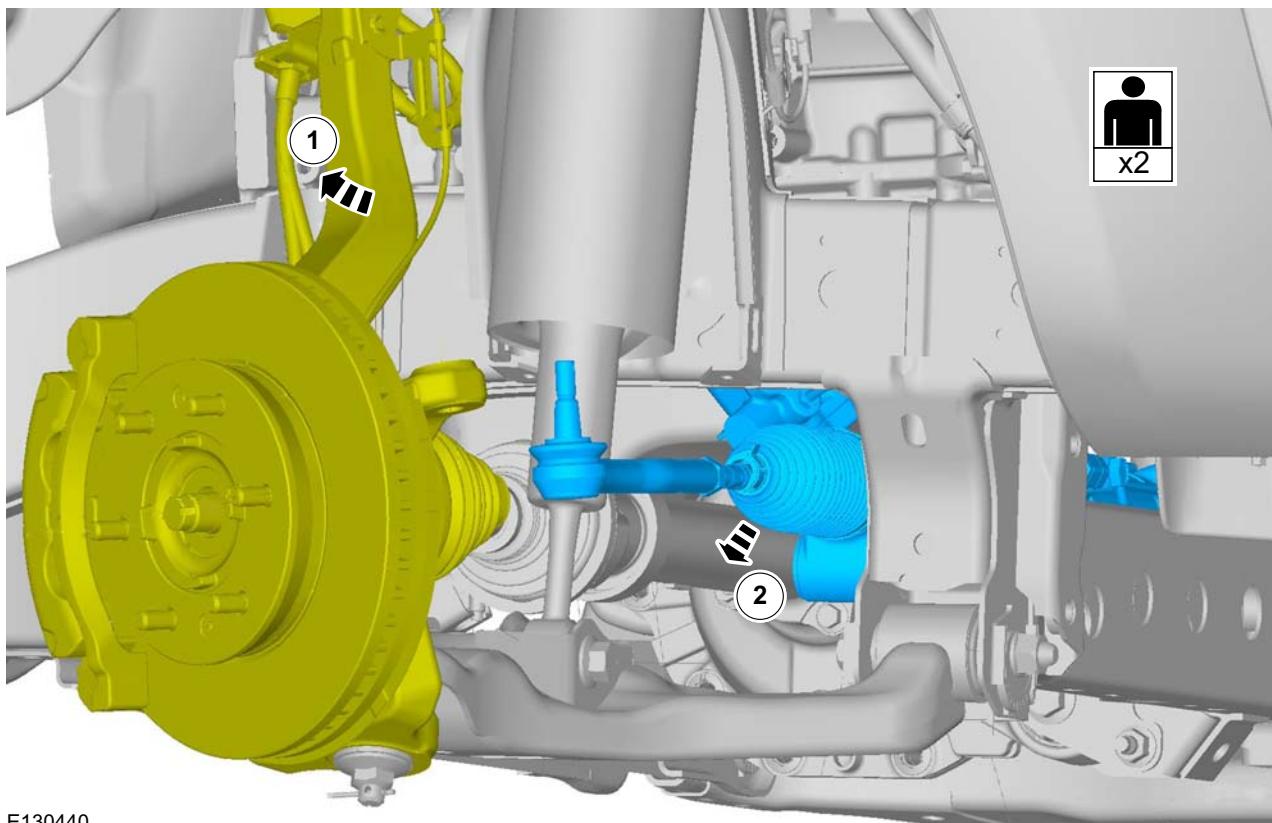
All vehicles

14. Torque: 150 Nm

REMOVAL AND INSTALLATION



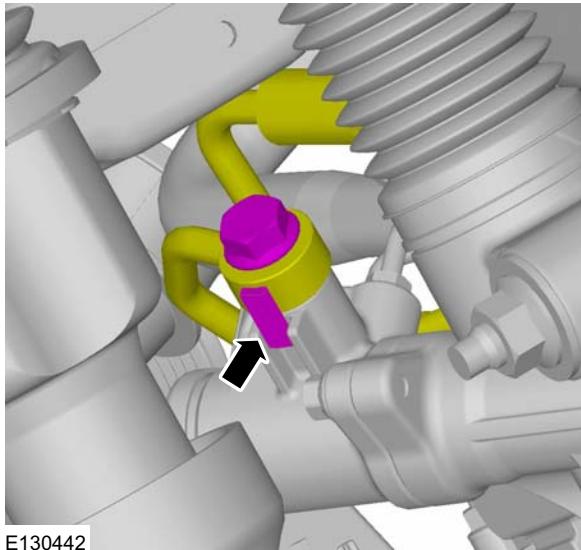
15.



REMOVAL AND INSTALLATION

Installation

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



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

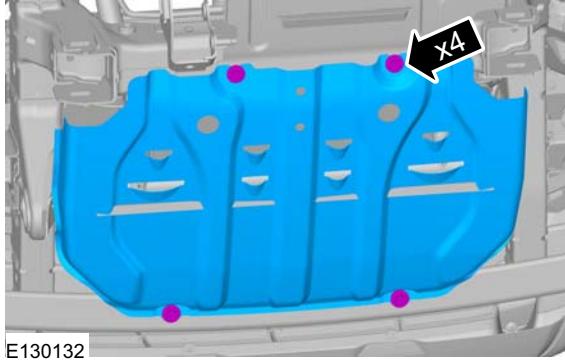
Power Steering Pump to Steering Gear Pressure Line — 2.5L Duratec-HE (122kW/165PS) - MI4(13 440 0; 13 443 0)

Removal

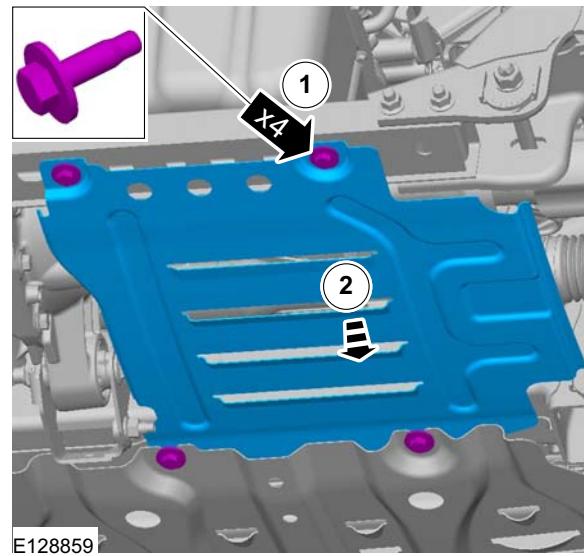
CAUTION: While repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.

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



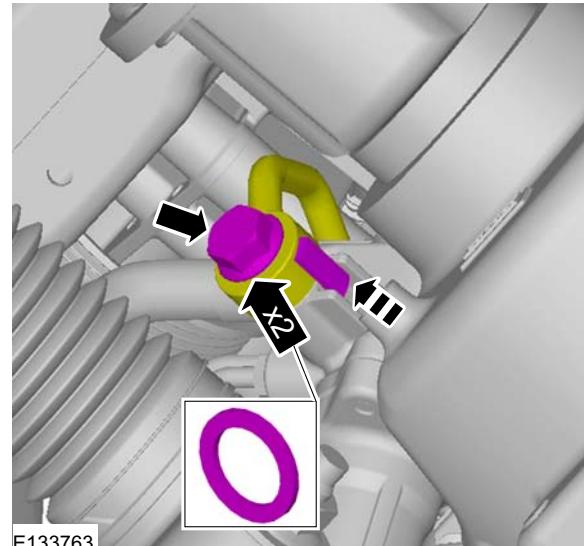
5. Torque: 30 Nm



Left-hand drive vehicles

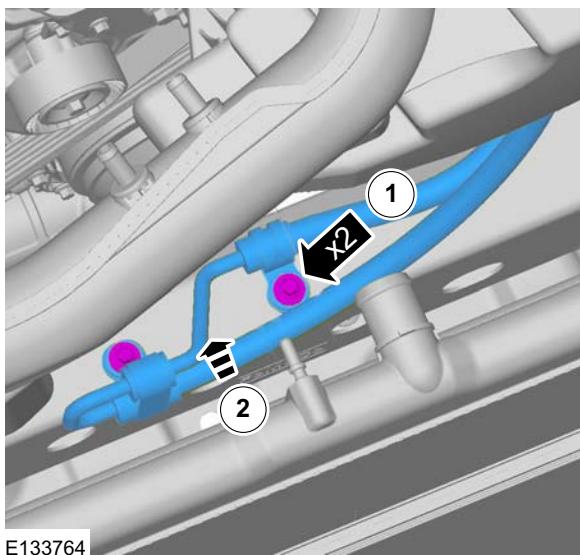
6. **WARNING:** Be prepared to collect escaping fluid.
- CAUTION:** Cap the steering gear body to prevent fluid loss or dirt ingress.

Torque: 35 Nm



REMOVAL AND INSTALLATION

7. Torque: 10 Nm

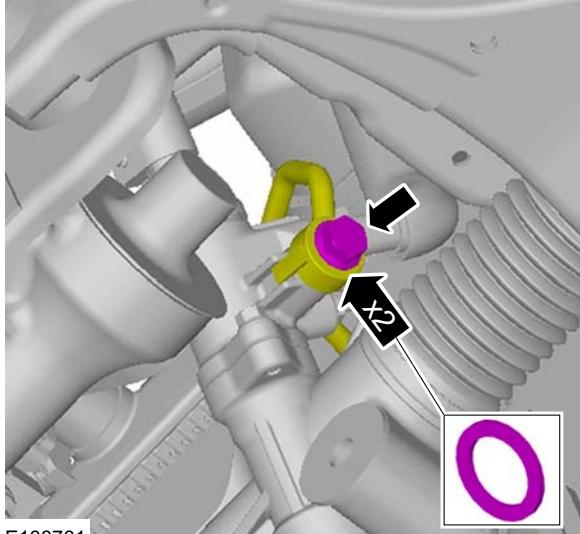


Right-hand drive vehicles

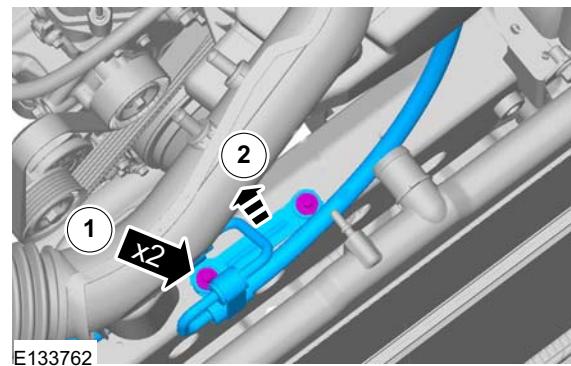
8. **WARNING:** Be prepared to collect escaping fluid.

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

Torque: 35 Nm



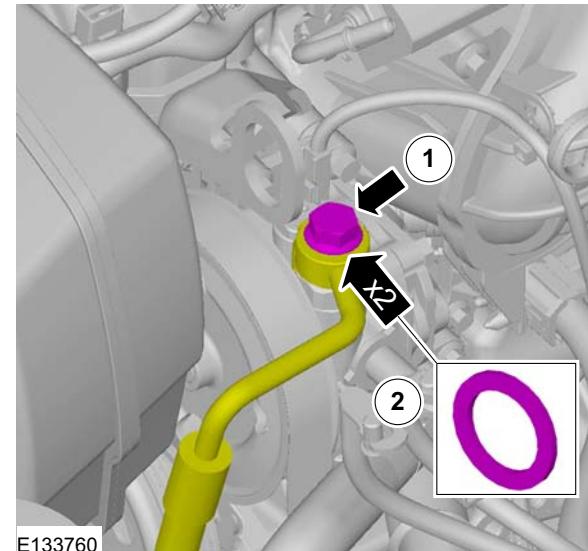
9. Torque: 10 Nm



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

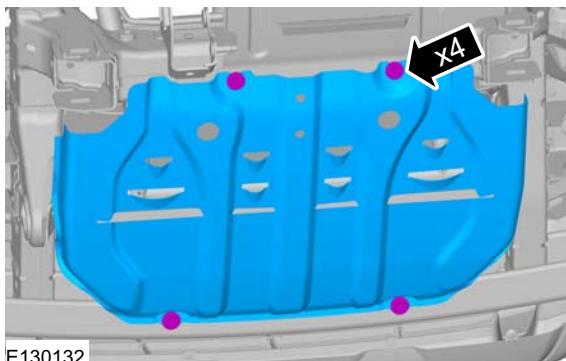
Power Steering Pump to Steering Gear Pressure Line — 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma(13 440 0; 13 443 0)

Removal

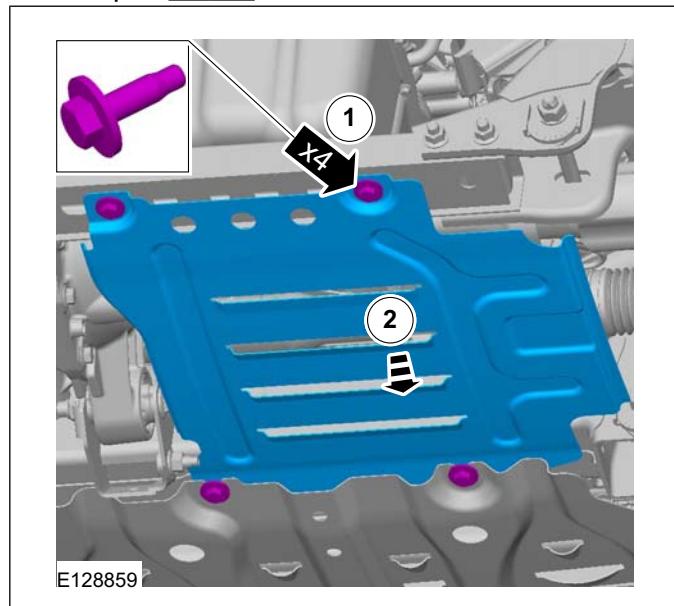
CAUTION: While repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.

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



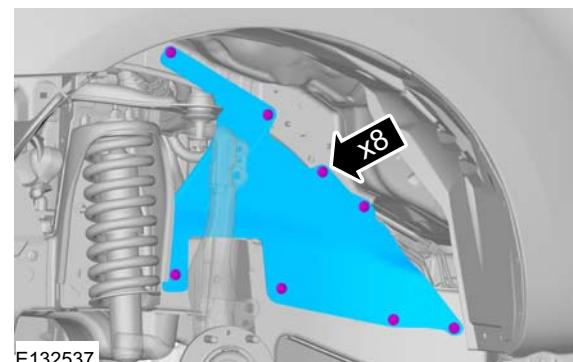
5. Torque: 30 Nm



6. Remove front RH side wheel only.

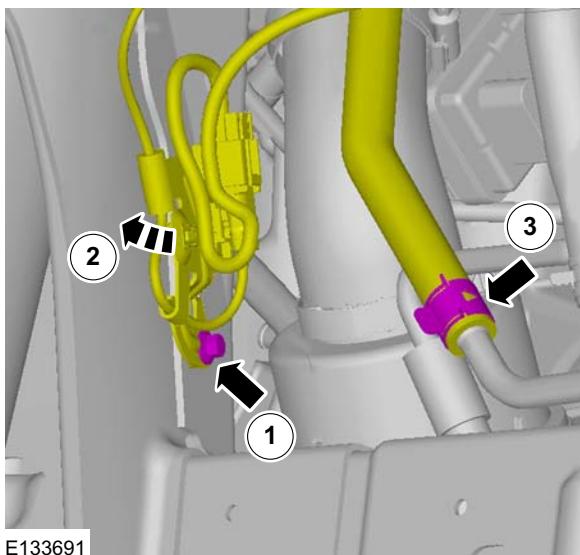
Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

7.



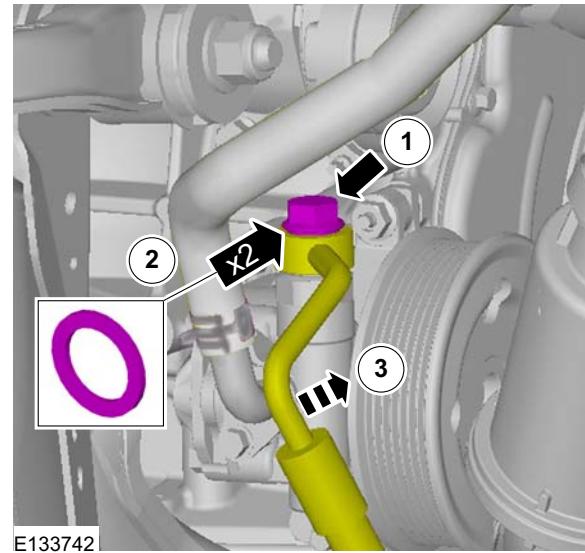
REMOVAL AND INSTALLATION

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

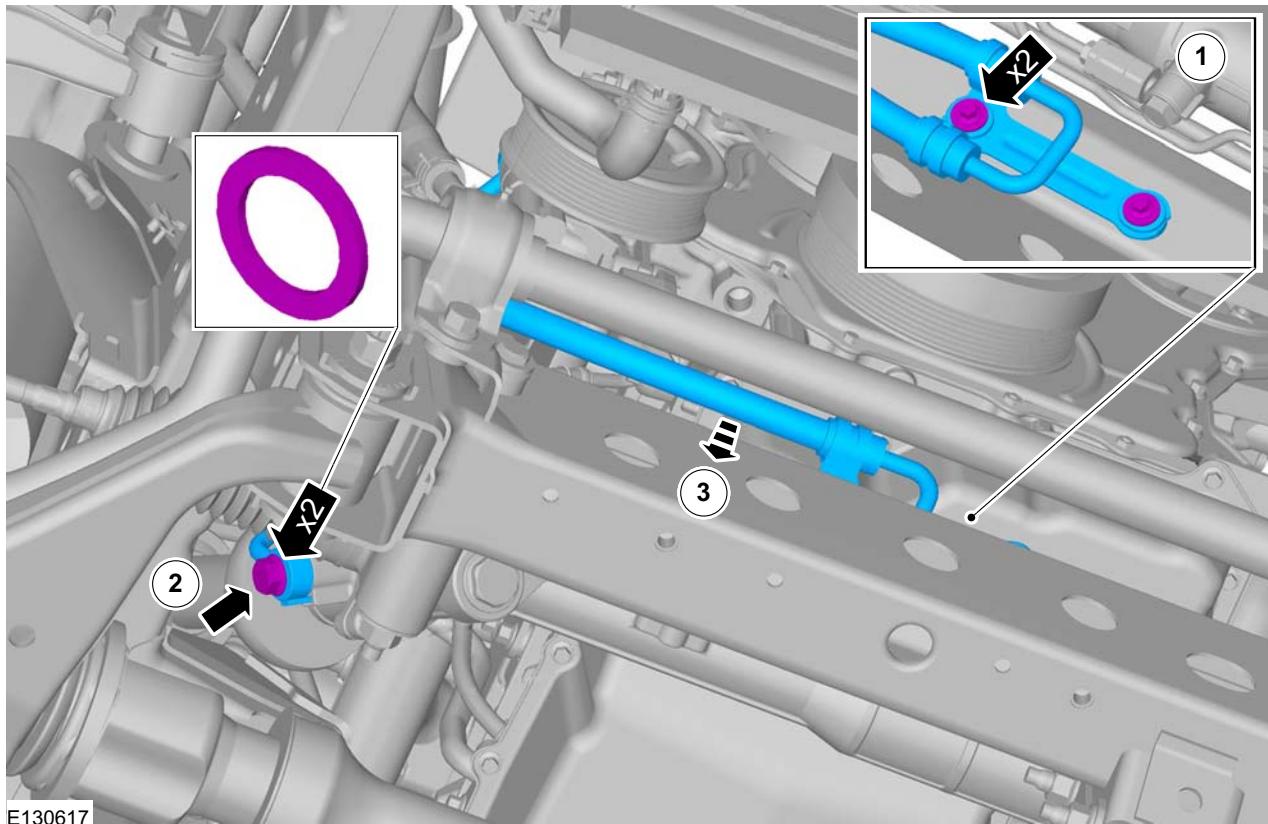
10. WARNING: Be prepared to collect escaping fluid.

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

1. Torque: 10 Nm

2. Torque: 35 Nm

REMOVAL AND INSTALLATION

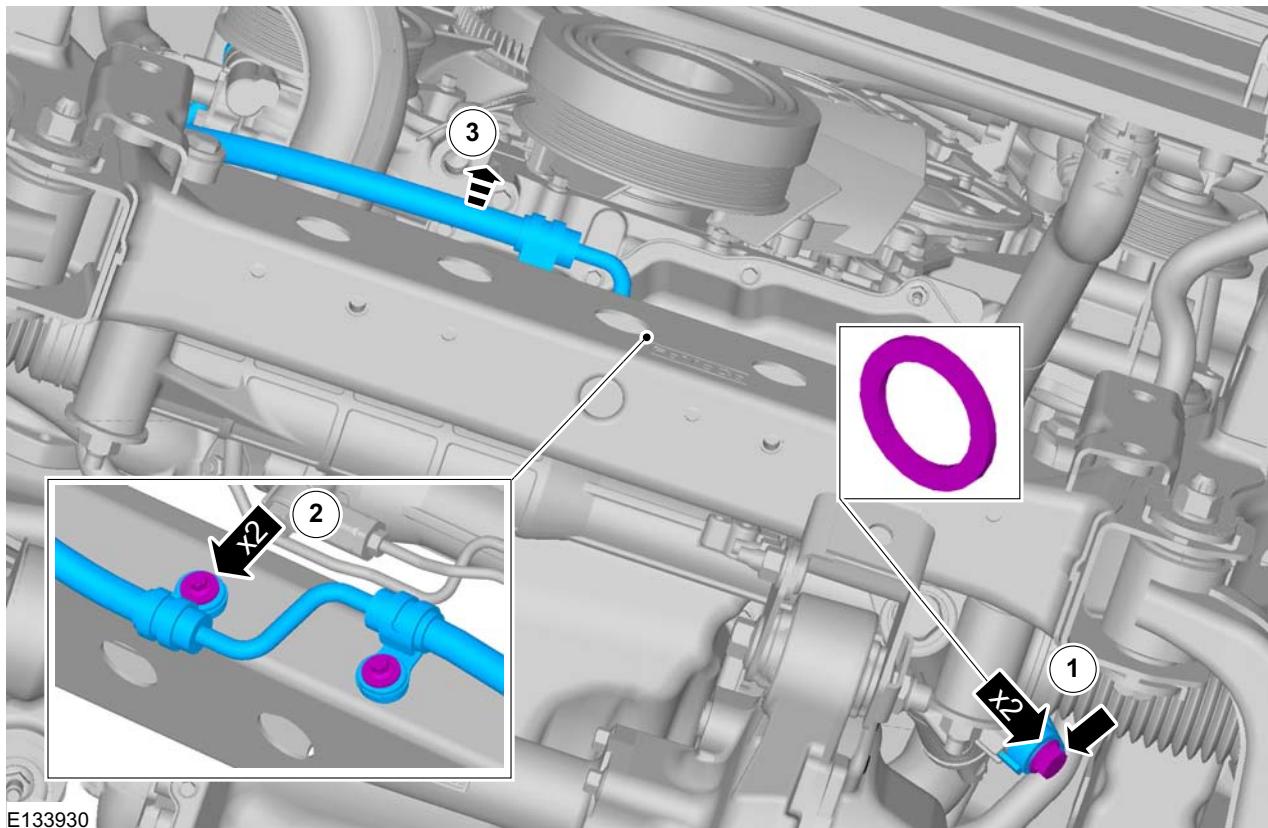


Left-hand drive vehicles

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).

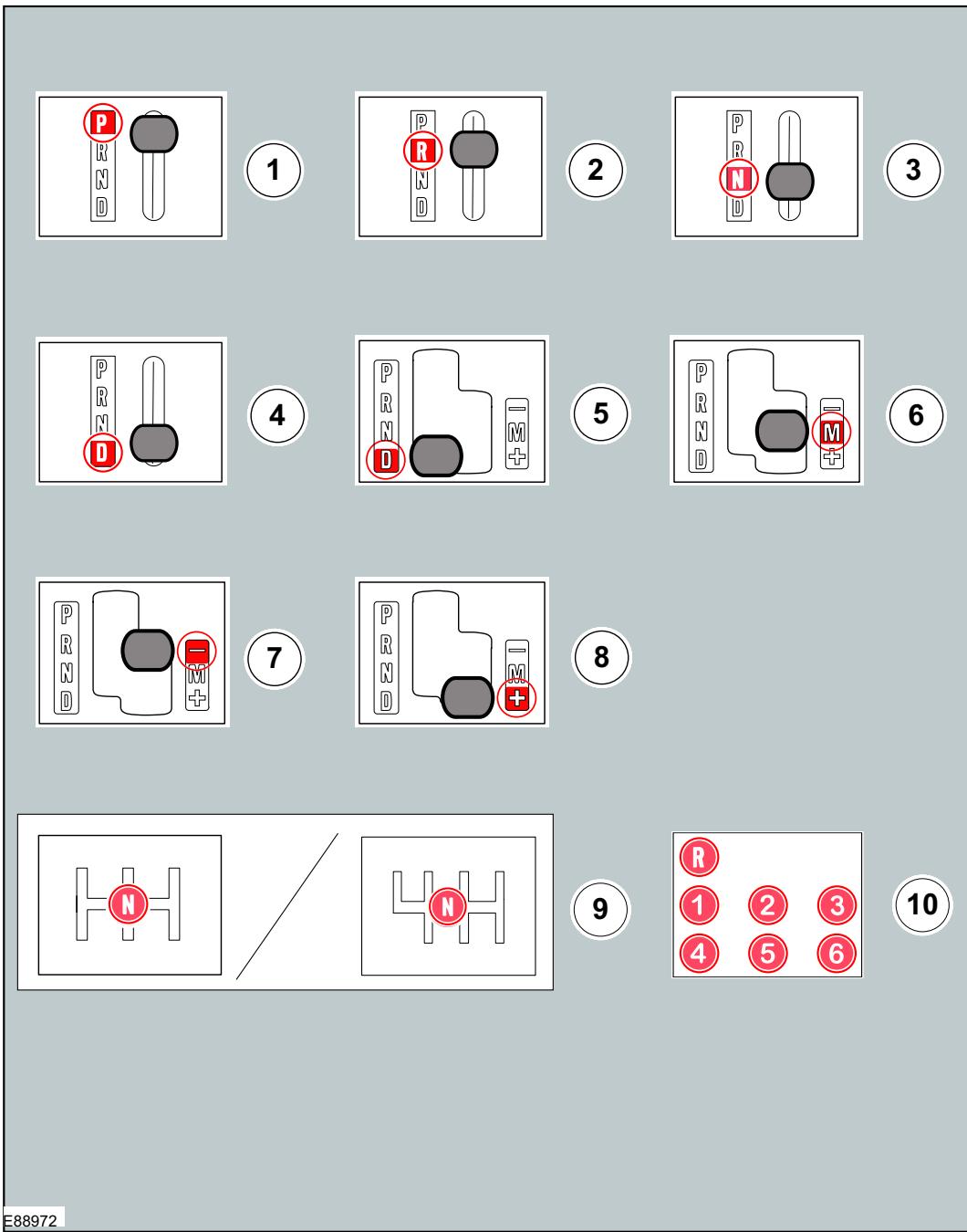
DESCRIPTION AND OPERATION

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.



SECTION 211-03 Steering Linkage

VEHICLE APPLICATION:BT50 & Ranger

CONTENTS

PAGE

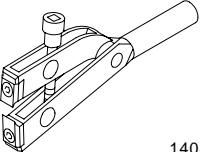
REMOVAL AND INSTALLATION

Tie Rod.....	(13 263 0)	211-03-2
Tie Rod End.....	(13 273 0)	211-03-5

REMOVAL AND INSTALLATION

Tie Rod(13 263 0)

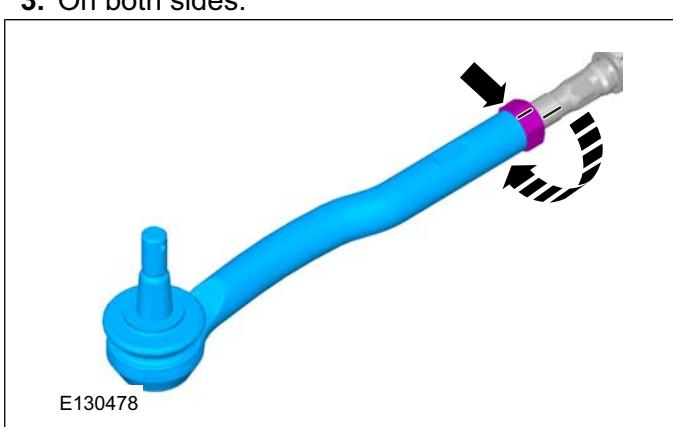
Special Tool(s) / General Equipment

	204-169 Clamping Tool, Boot Retaining Clamp 14044				
Flat Headed Screw Driver					
Vise					
Vise Jaw Protectors					
Materials					
<table border="1"> <thead> <tr> <th>Name</th><th>Specification</th></tr> </thead> <tbody> <tr> <td>Silicone Grease</td><td>ESE-M1C171-A / 2S5J-M1C171-AA</td></tr> </tbody> </table>		Name	Specification	Silicone Grease	ESE-M1C171-A / 2S5J-M1C171-AA
Name	Specification				
Silicone Grease	ESE-M1C171-A / 2S5J-M1C171-AA				

Removal

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

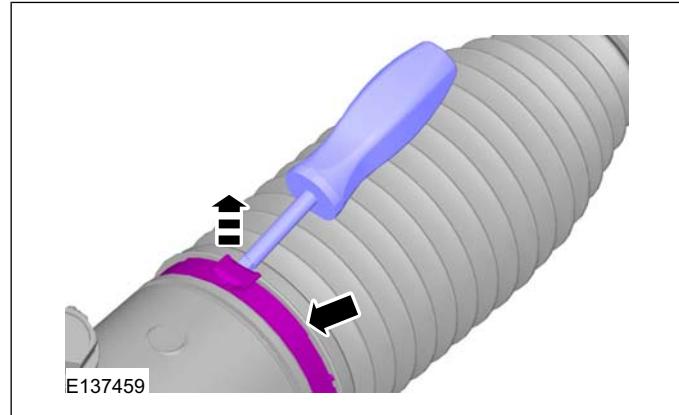
- Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
Refer to: **Steering System Health and Safety Precautions** (100-00 General Information, Description and Operation).
- Refer to: **Steering Gear** (211-02 Power Steering, Removal and Installation).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



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

On both sides.

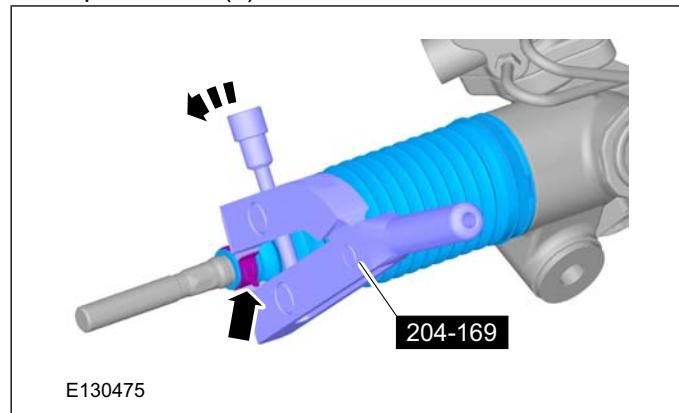
General Equipment: Flat Headed Screw Driver



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

On both sides.

Special Tool(s): 204-169

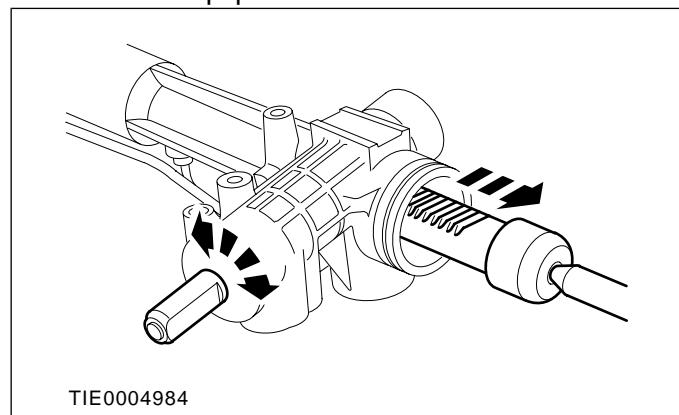


- CAUTION:** Use vise jaw protectors.

Rotate the steering gear pinion to expose the steering rack.

General Equipment: Vise

General Equipment: Vise Jaw Protectors



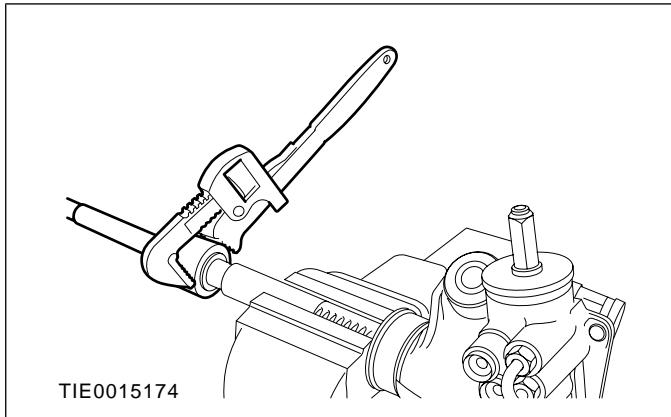
REMOVAL AND INSTALLATION

7. CAUTIONS:

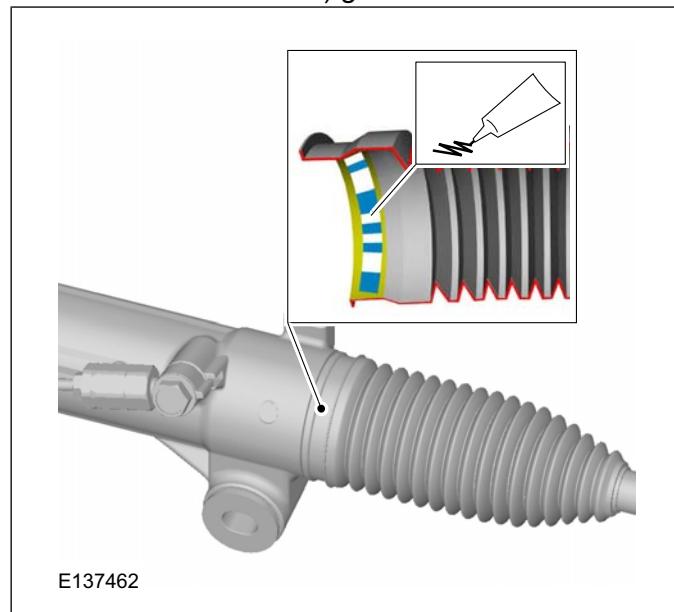
- ⚠ Do not clamp the steering rack on exposed hydraulic sealing surfaces.**
- ⚠ Use vise jaw protectors.**

General Equipment: Vise

General Equipment: Vise Jaw Protectors



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



Installation

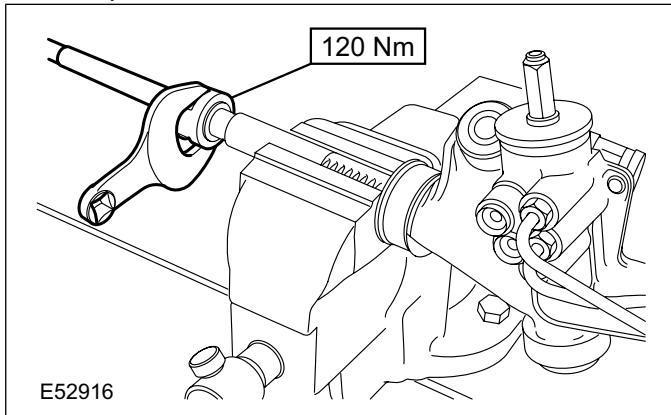
1. To install, reverse the removal procedure.

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

General Equipment: Vise

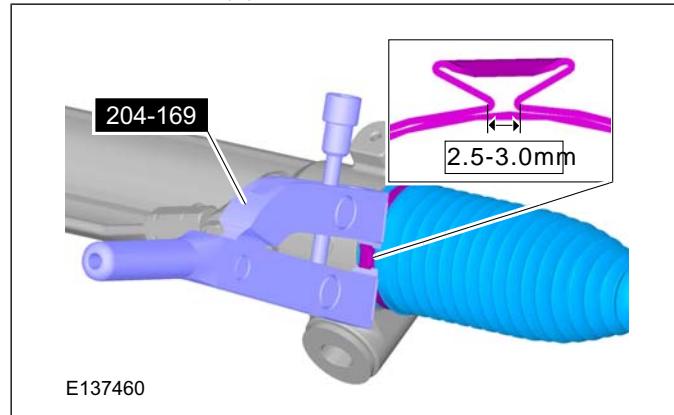
General Equipment: Vise Jaw Protectors

Torque: 120 Nm



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

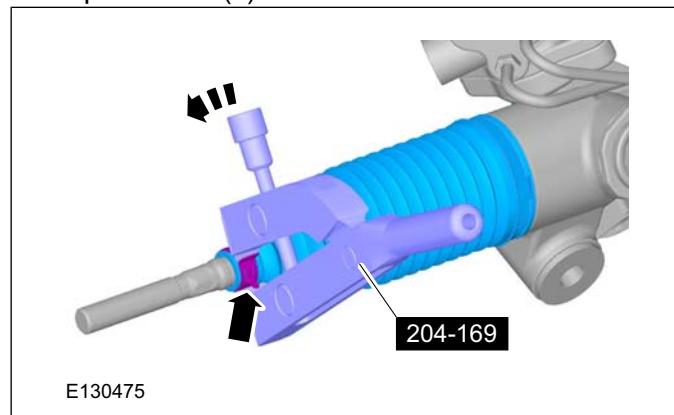
Special Tool(s): 204-169

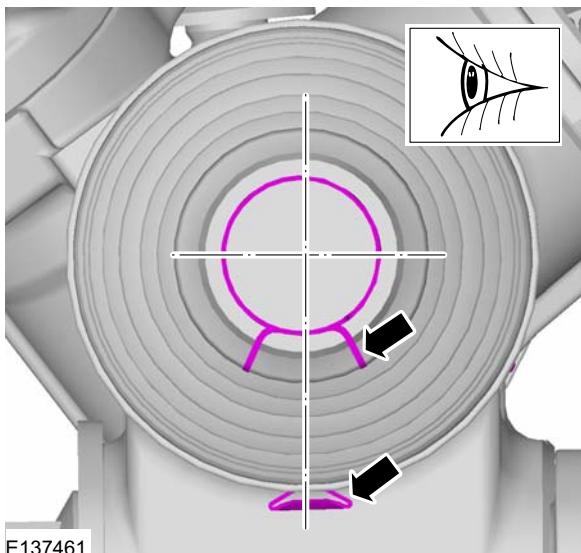


5. **NOTE:** Make sure that a new clamp is installed.

On both sides.

Special Tool(s): 204-169

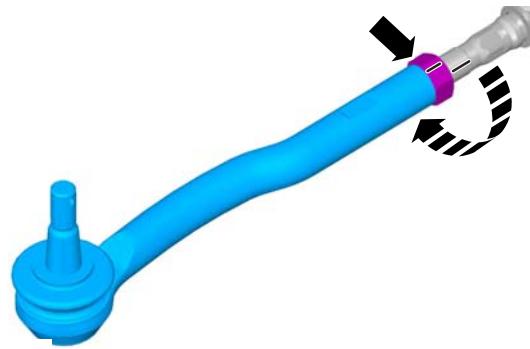


REMOVAL AND INSTALLATION**6.**

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

On both sides.

Torque: 80 Nm

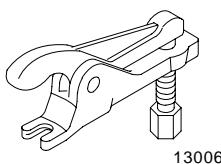


8. Refer to: **Front Toe Adjustment (204-00 Suspension System - General Information, General Procedures).**

REMOVAL AND INSTALLATION

Tie Rod End(13 273 0)

Special Tool(s)



211-020
Separator, Ball Joint

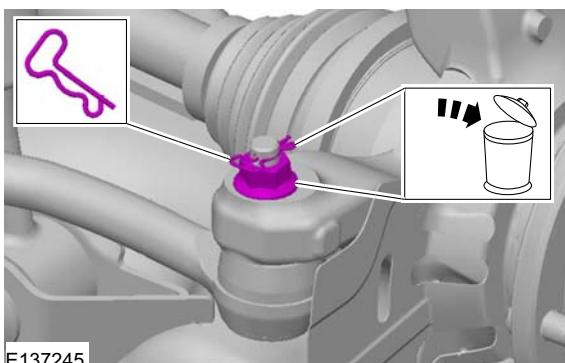
Removal

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.

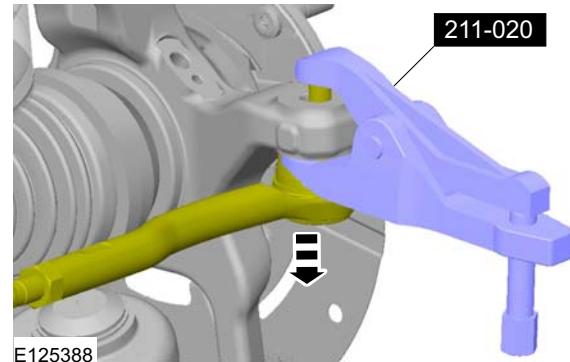
- Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures). Refer to: **Steering System Health and Safety Precautions** (100-00 General Information, Description and Operation).
- Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).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

Torque: 63 Nm



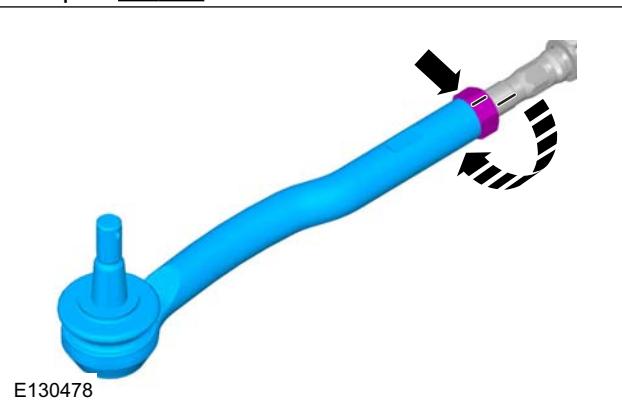
- CAUTION:** Do not use a hammer to separate the tie rod from the wheel knuckle or damage to the wheel knuckle can result.

Special Tool(s): 211-020



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

Torque: 80 Nm



Installation

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

SECTION 211-04 Steering Column

VEHICLE APPLICATION:BT50 & Ranger

CONTENTS	PAGE
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REMOVAL AND INSTALLATION

Steering Wheel.....	(13 524 0)	211-04-2
Steering Column.....	(13 542 0)	211-04-3

REMOVAL AND INSTALLATION

Steering Wheel(13 524 0)

General Equipment

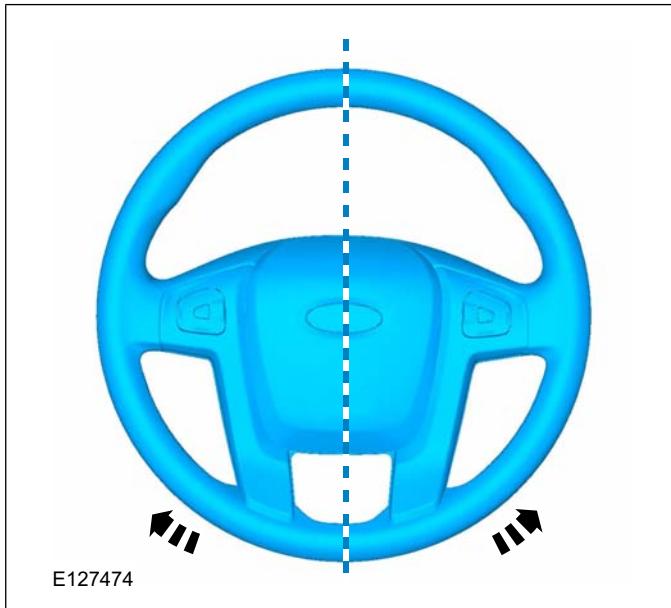
Adhesive Tape

Removal

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

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

1.



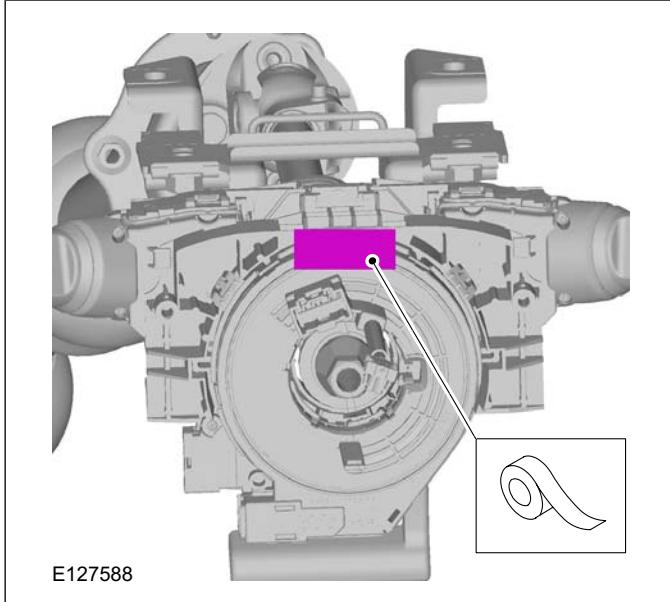
2. Refer to: **Driver Air Bag Module** (501-20 Supplemental Restraint System, Removal and Installation).

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)

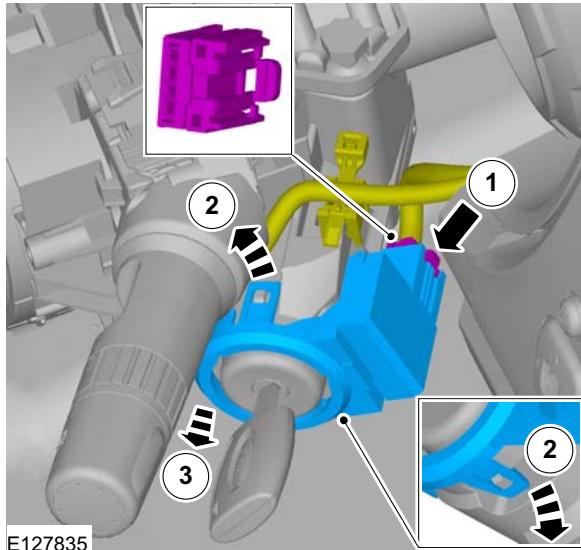
General Equipment

Ford Diagnostic Equipment

Removal

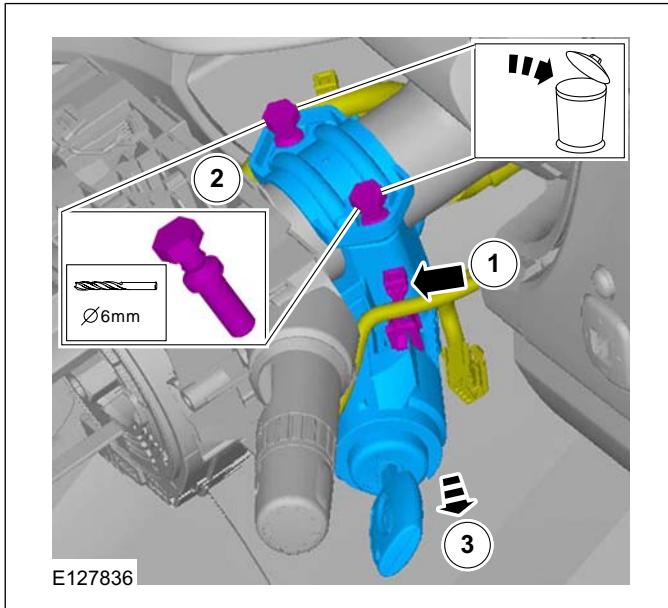
NOTE: Removal steps in this procedure may contain installation details.

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.



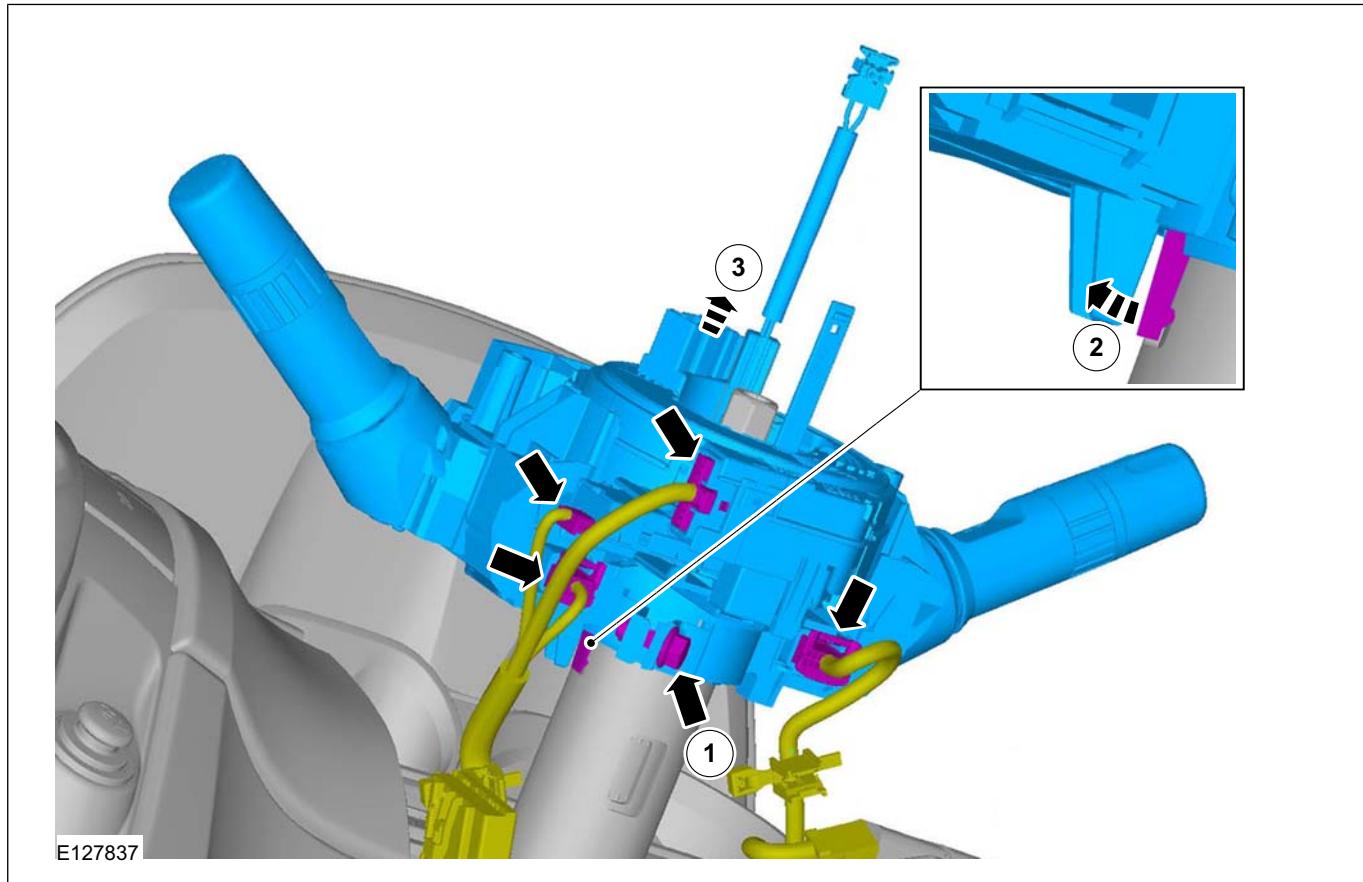
5. **NOTE:** This step is only necessary when installing a new component.

Torque: 25 Nm



6. Torque: 7 Nm

REMOVAL AND INSTALLATION

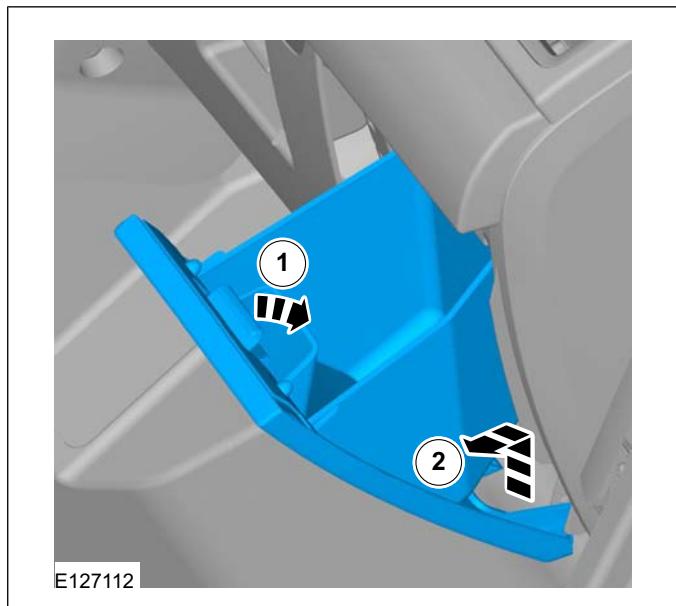


Vehicles with driver lower air bag

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

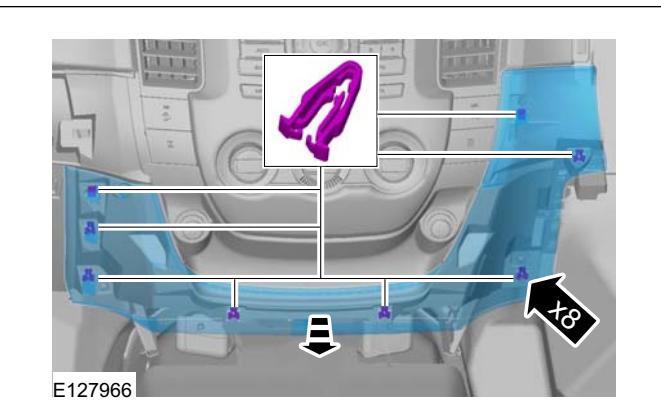
Vehicles without driver lower air bag

8.



E127112

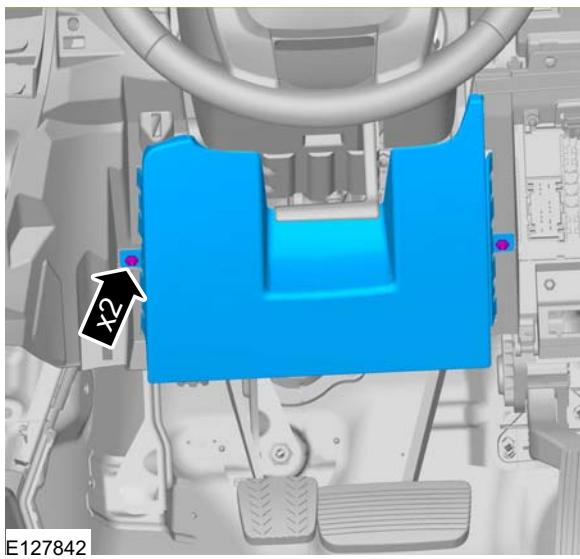
9.



E127966

REMOVAL AND INSTALLATION

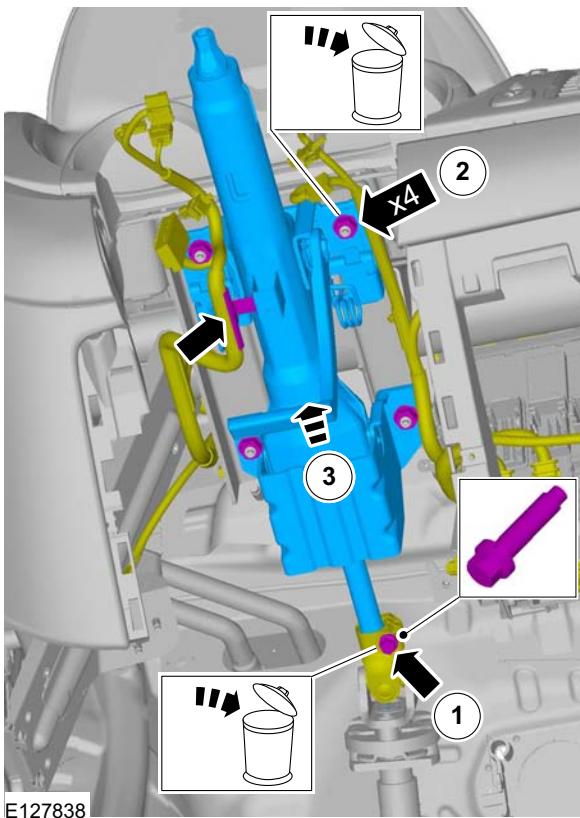
10. Torque: 2.5 Nm



All vehicles

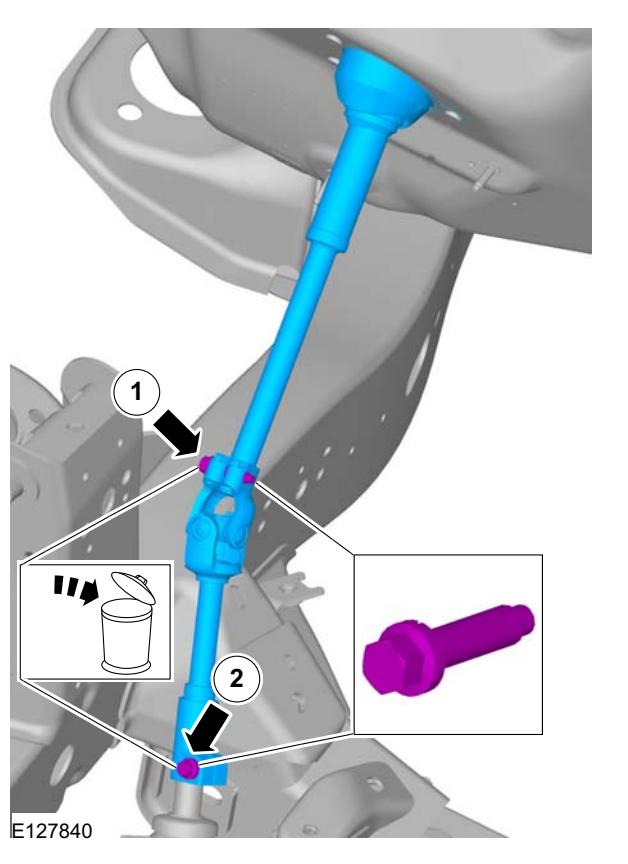
11. NOTE: Make sure that the nuts are not tightened with tilt lever released in position during installation.

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



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

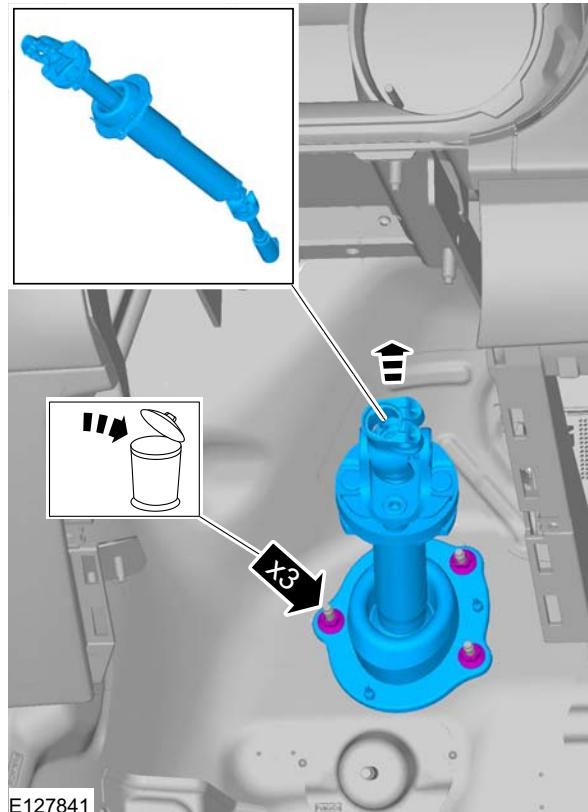
Screwdriver symbols

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

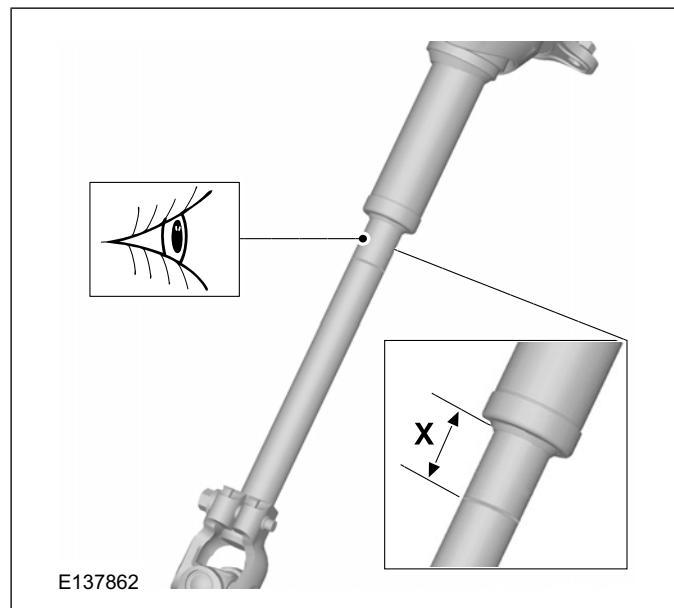
REMOVAL AND INSTALLATION

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
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REMOVAL AND INSTALLATION

Ignition Switch.....	(33 616 0)	211-05-2
Steering Column Multifunction Switch.....	(33 612 0)	211-05-4
Steering Column Multifunction Switch LH.....		211-05-5
Steering Column Multifunction Switch RH.....		211-05-7
Steering Column Lock and Ignition Switch Housing.....		211-05-9

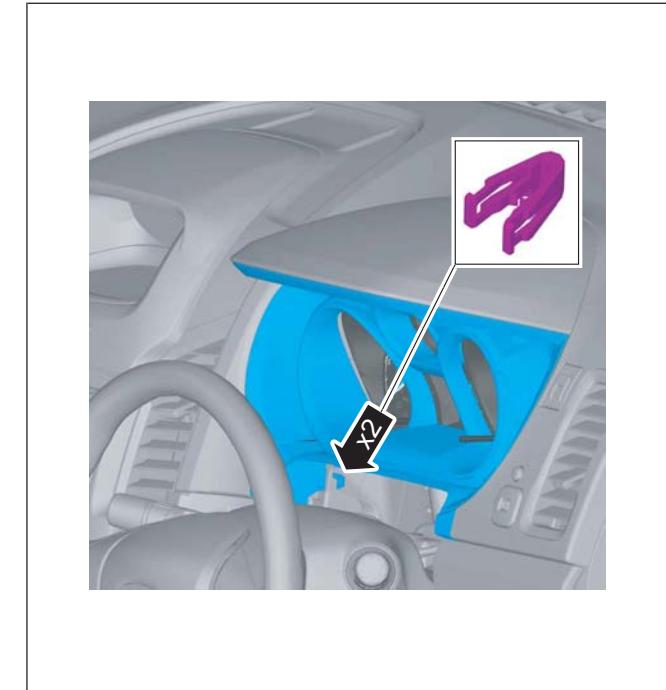
REMOVAL AND INSTALLATION**COIL REMOVAL/INSTALLATION**

id091400812700

Removal**Note**

- Removal steps in this procedure may contain installation details.

1. Refer to: **Battery Disconnect and Connect.**
- 2.



abs0zw00001613

- 3.



abs0zw00001614

REMOVAL AND INSTALLATION

4.



abs0zw00001615

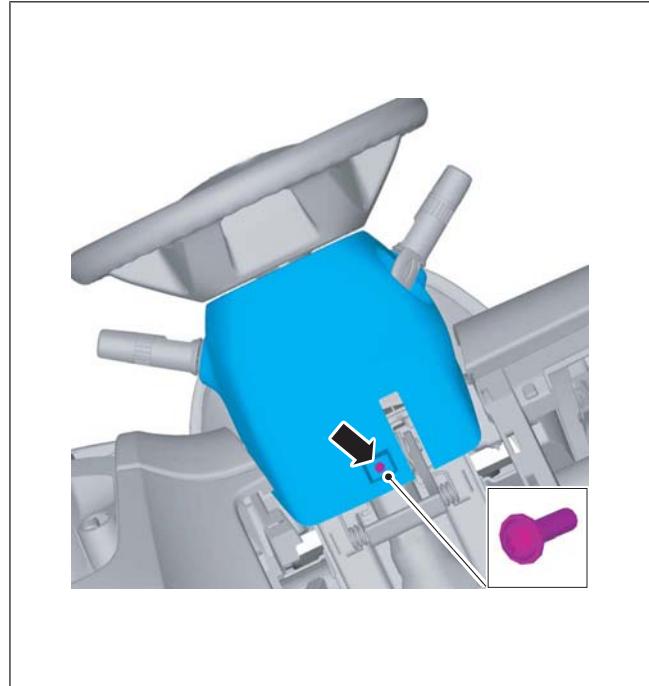
5.



abs0zw00001616

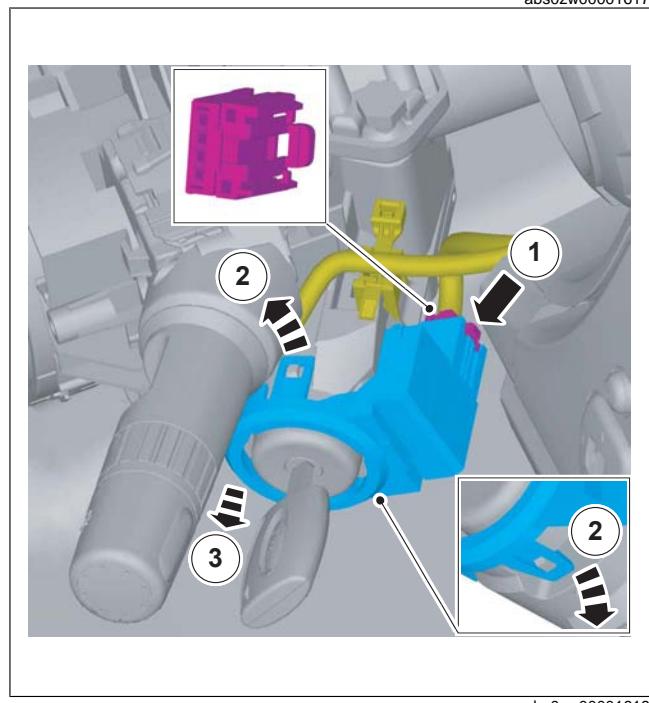
REMOVAL AND INSTALLATION

6.



abs0zw00001617

7.



abs0zw00001618

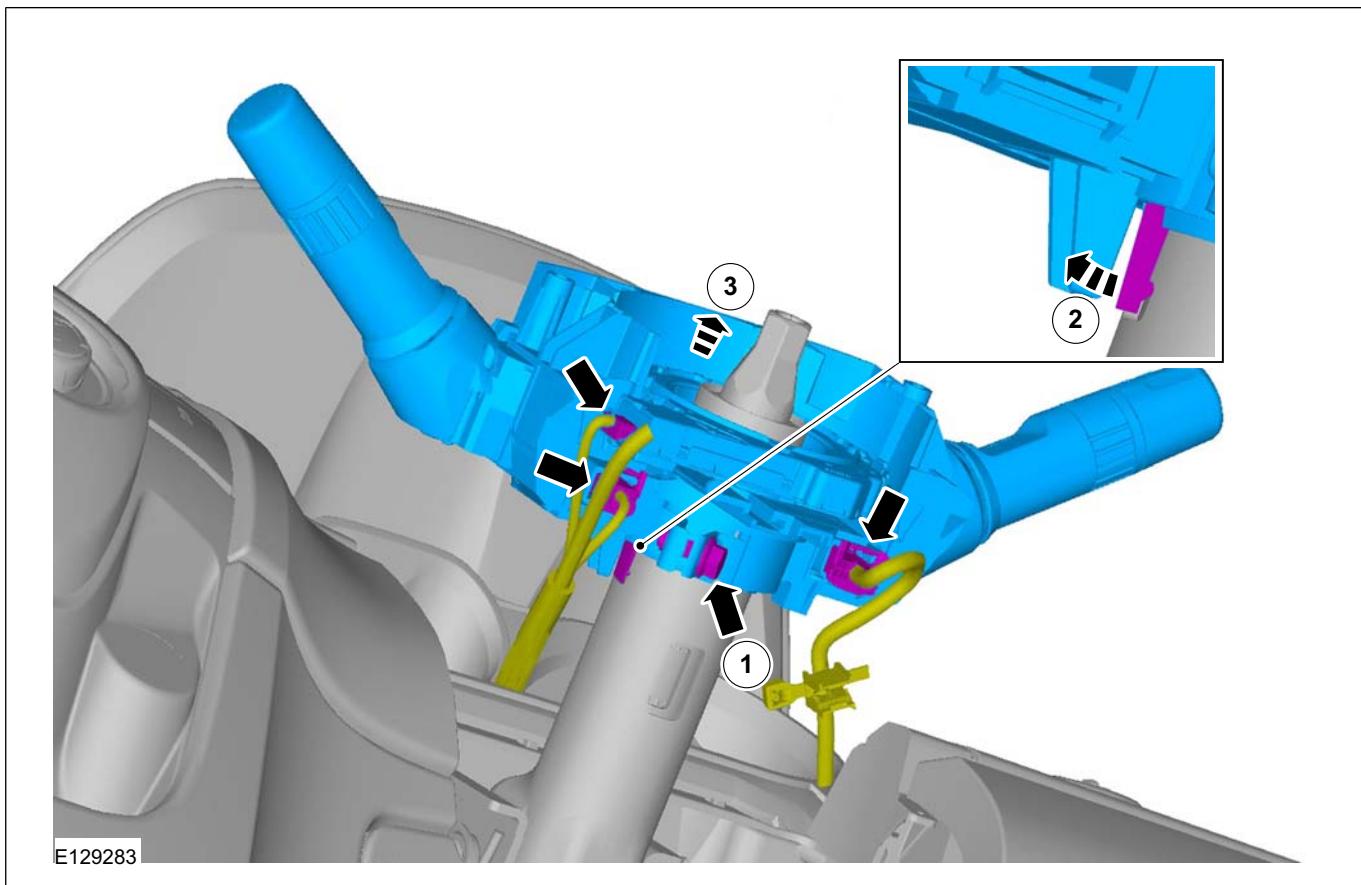
Installation

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**

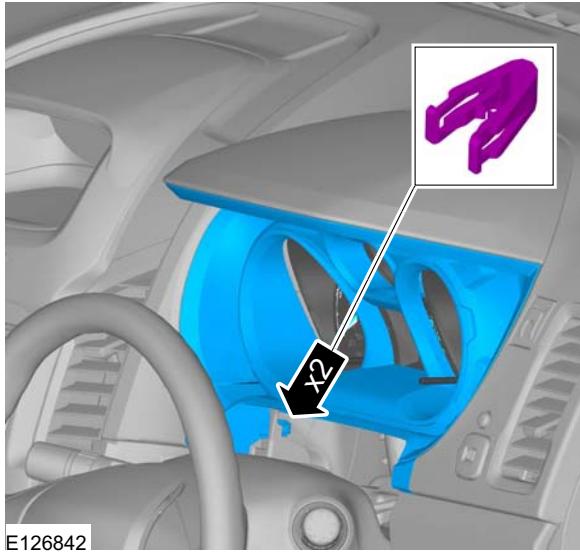
1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION**Steering Column Multifunction Switch LH****Removal**

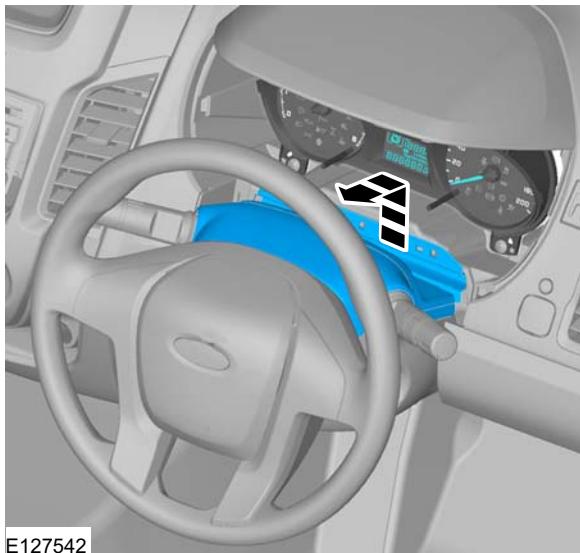
NOTE: Removal steps in this procedure may contain installation details.

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

2.



3.



4. Torque: 1.5 Nm

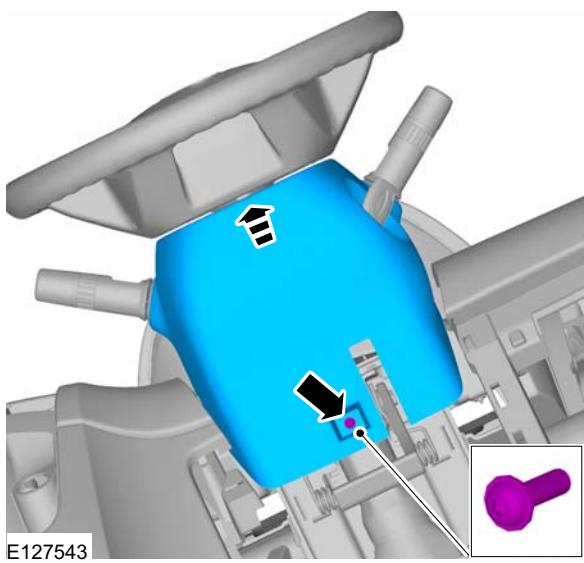


5. Torque: 1.5 Nm

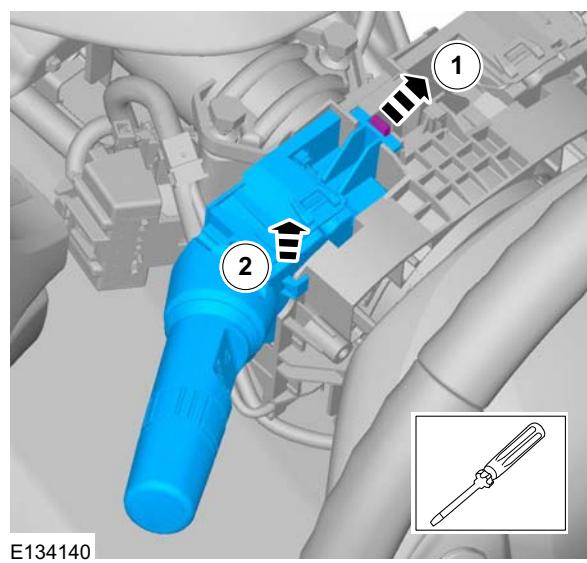


REMOVAL AND INSTALLATION

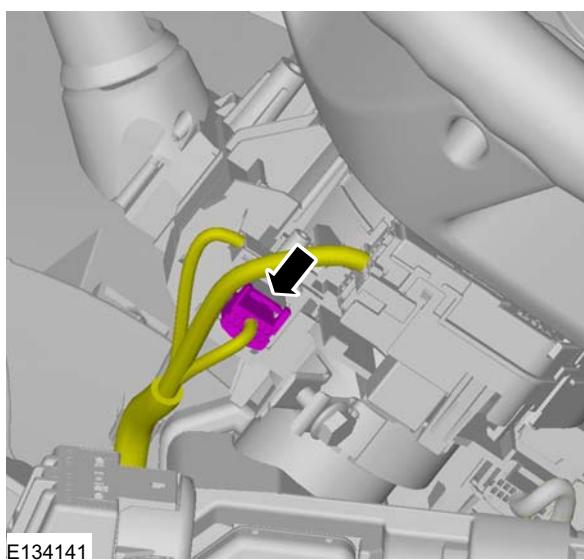
6. Torque: 2.5 Nm



8.



7.

**Installation**

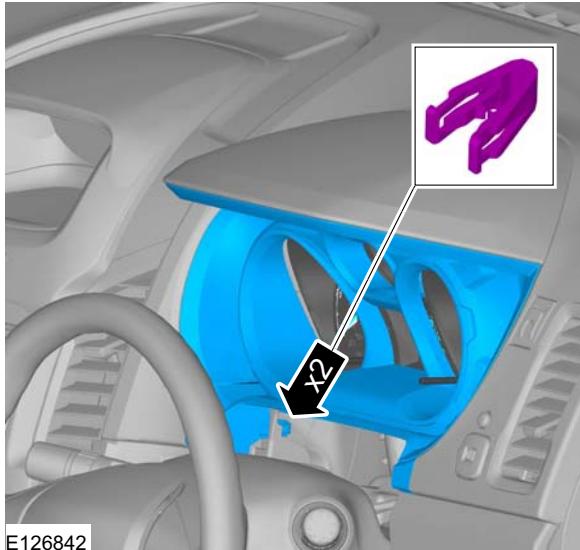
1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION**Steering Column Multifunction Switch RH****Removal**

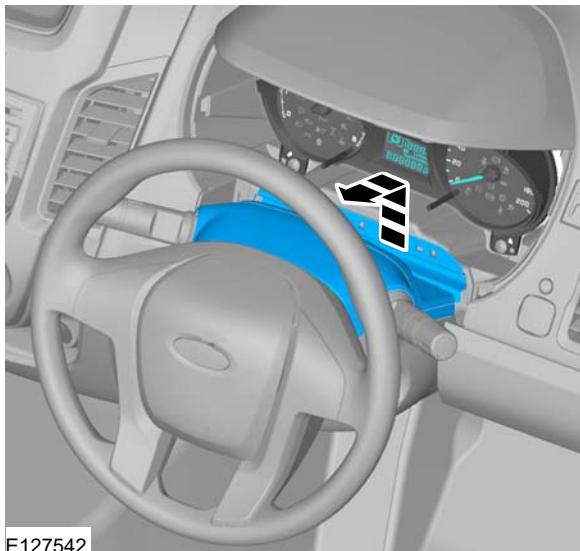
NOTE: Removal steps in this procedure may contain installation details.

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

2.



3.



4. Torque: 1.5 Nm

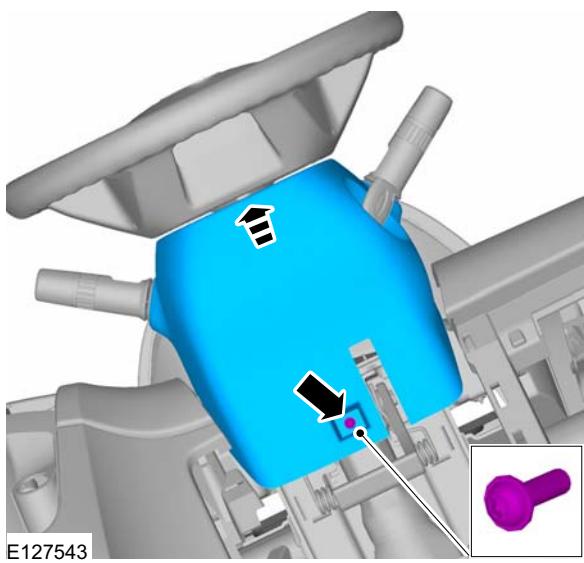


5. Torque: 1.5 Nm

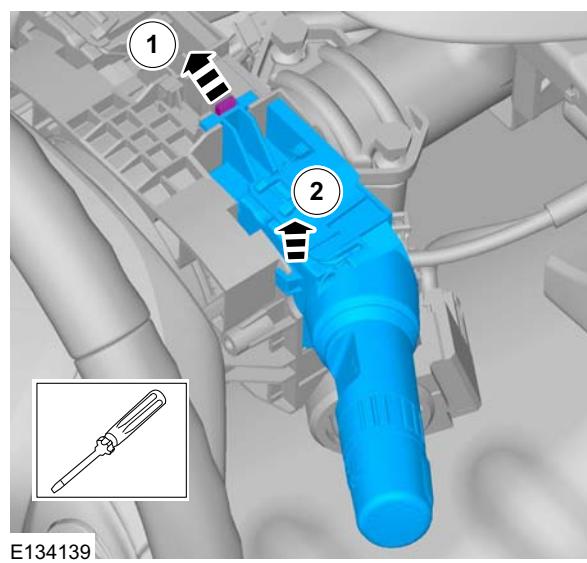


REMOVAL AND INSTALLATION

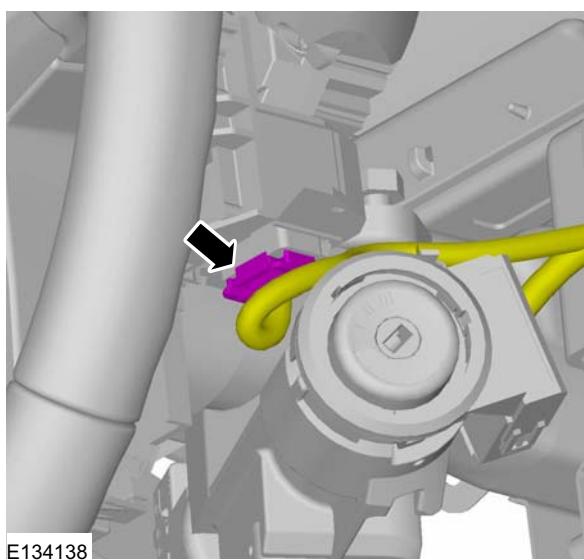
6. Torque: 2.5 Nm



8.

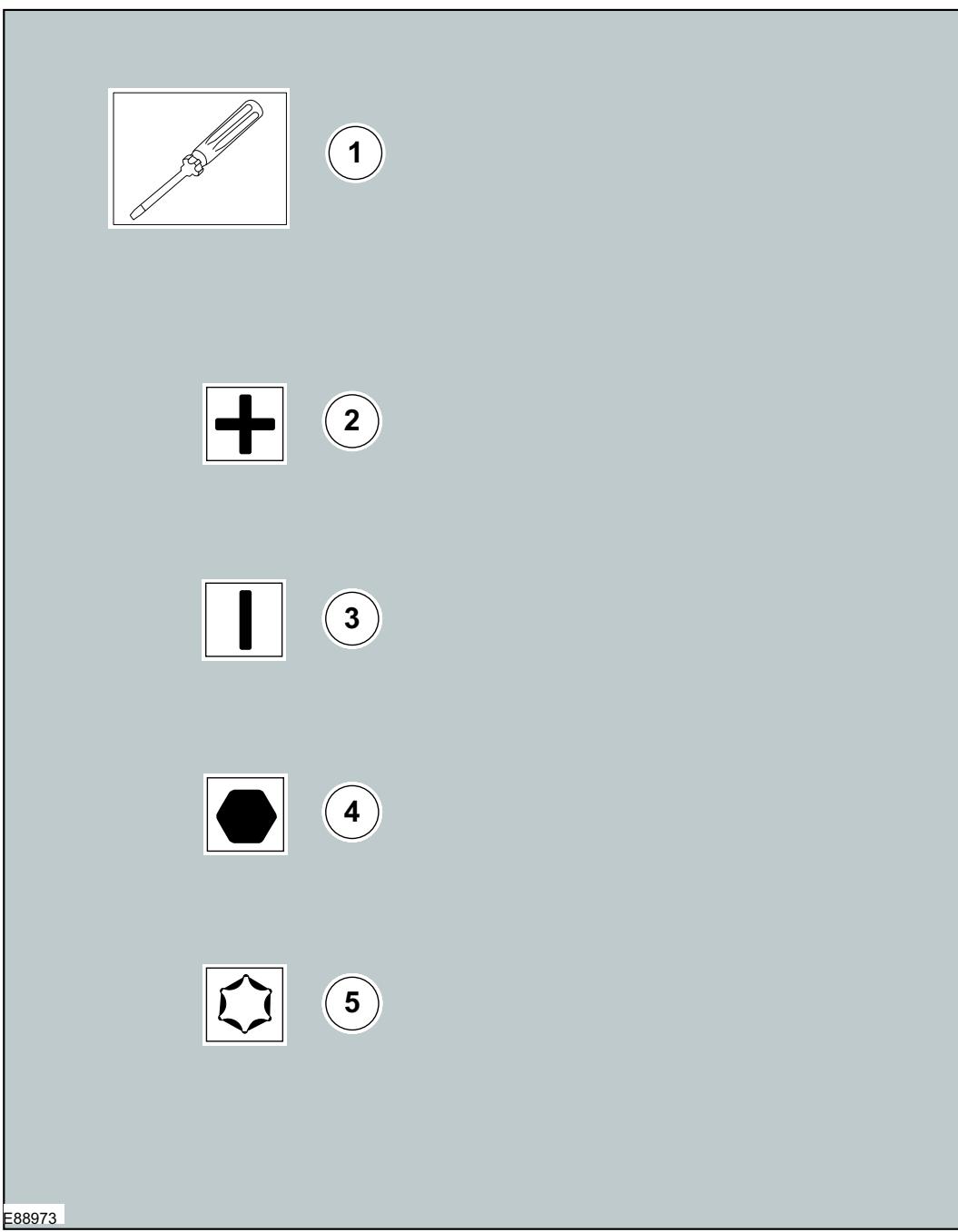


7.

**Installation**

1. To install, reverse the removal procedure.

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.

REMOVAL AND INSTALLATION

Steering Column Lock and Ignition Switch Housing

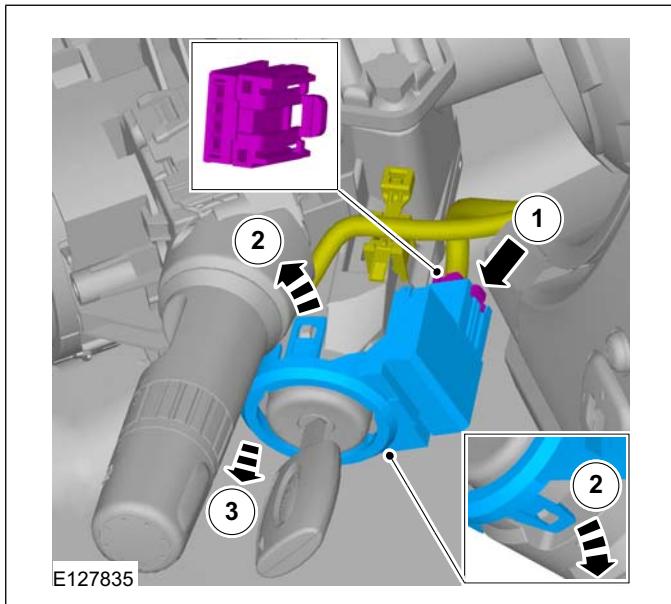
General Equipment

Punch

Removal

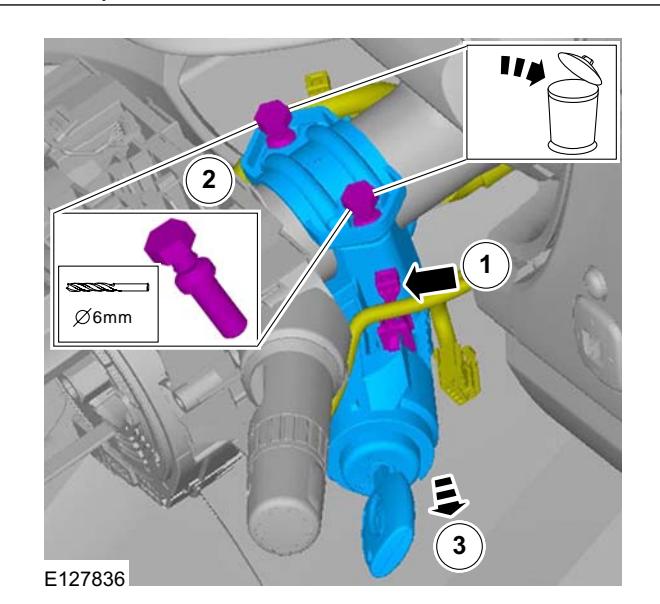
NOTE: Removal steps in this procedure may contain installation details.

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.



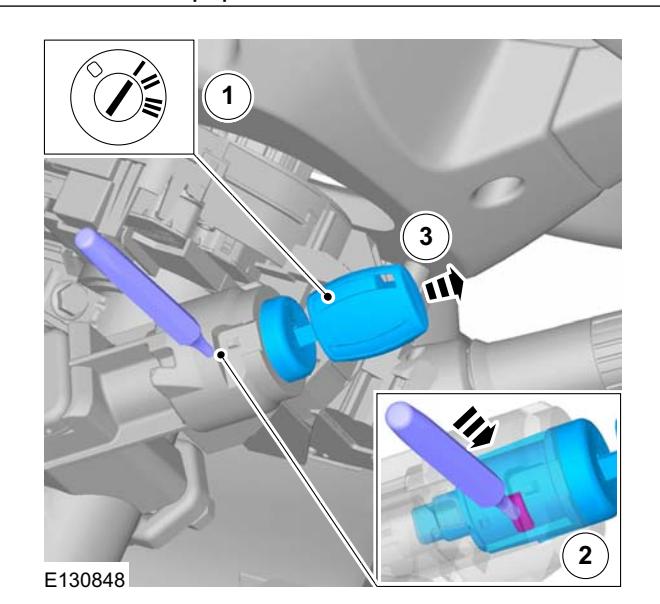
4. NOTE: This step is only necessary when installing a new component.

Torque: 30 Nm



5. Turn the ignition key to position I.

General Equipment: Punch



Installation

1. To install, reverse the removal procedure.

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SECTION 303-00 Engine System - General Information

VEHICLE APPLICATION:BT50 & Ranger

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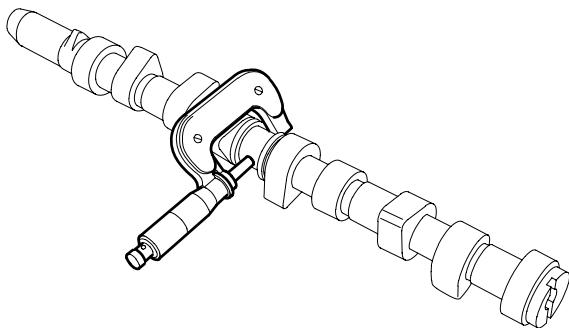
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GENERAL PROCEDURES**Camshaft Bearing Journal Diameter****1. Determine the diameter of the camshaft journals.**

- 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.



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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.

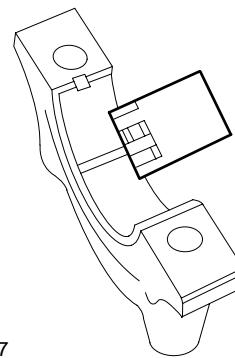
NOTE: Make sure that the camshaft is to specification.

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

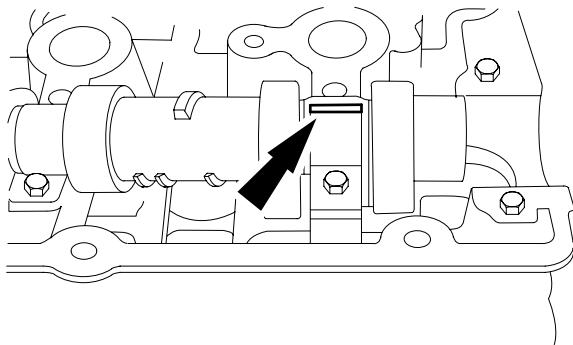
Position on a width of plastigage on the bearing cap.

- 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.

- The value that is read off is the bearing clearance.



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- 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.**

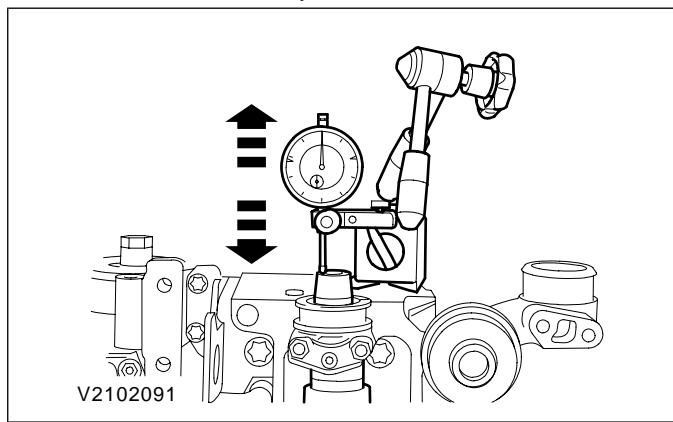
- Compare the width of plastigage with the plastigage scale.

GENERAL PROCEDURES**Camshaft End Play**

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

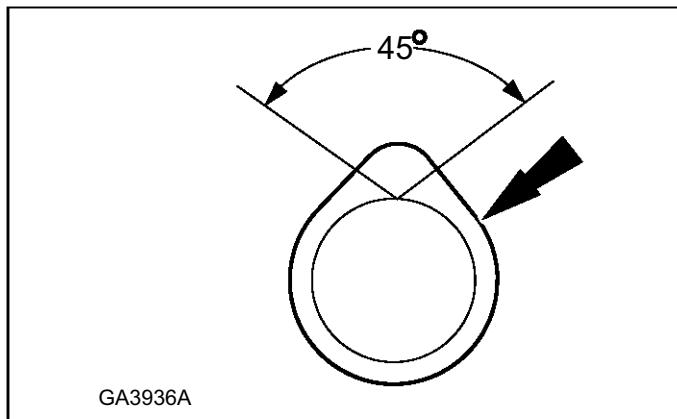
Using a Dial Indicator Gauge, measure the end play.

- 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.



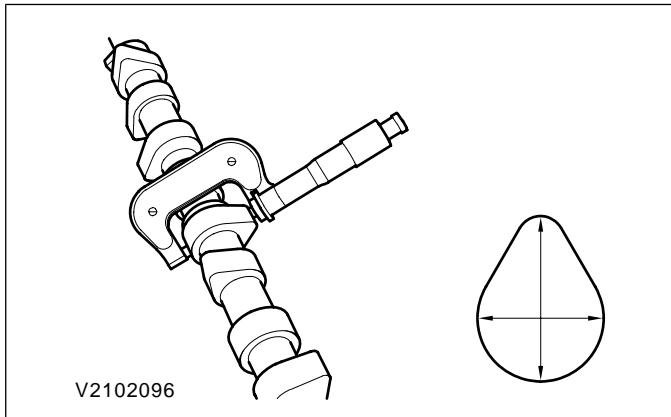
GENERAL PROCEDURES**Camshaft Surface Inspection**

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.**

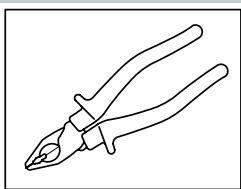
- Using a micrometer measure the cam in two directions.
- The difference between the two measurements is the cam lift.



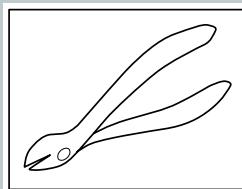
GENERAL PROCEDURES**Crankshaft Main Bearing Journal Clearance**

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

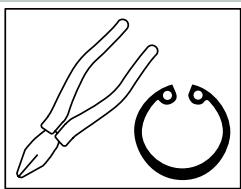
DESCRIPTION AND OPERATION



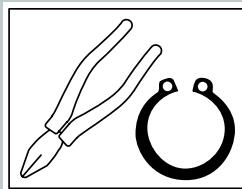
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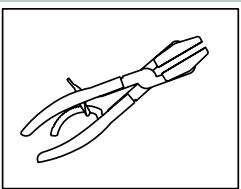
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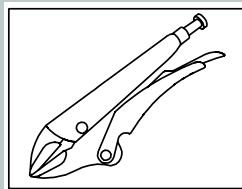
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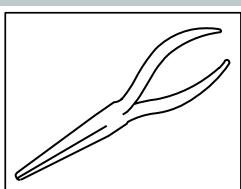
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5



6



7

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Item	Description
1	Combination pliers
2	Side cutter pliers

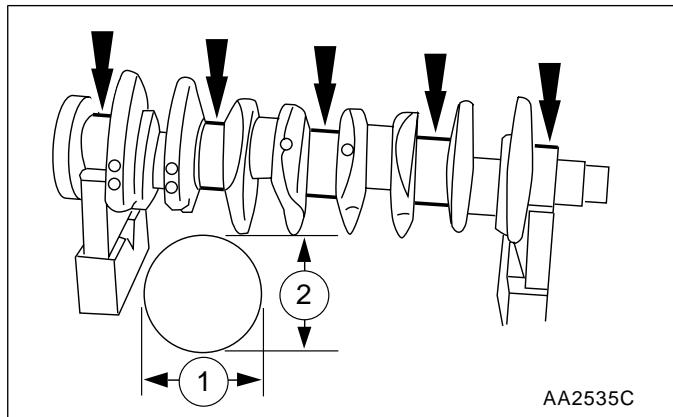
Item	Description
3	Securing ring pliers - inner
4	Securing ring pliers - outer

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.

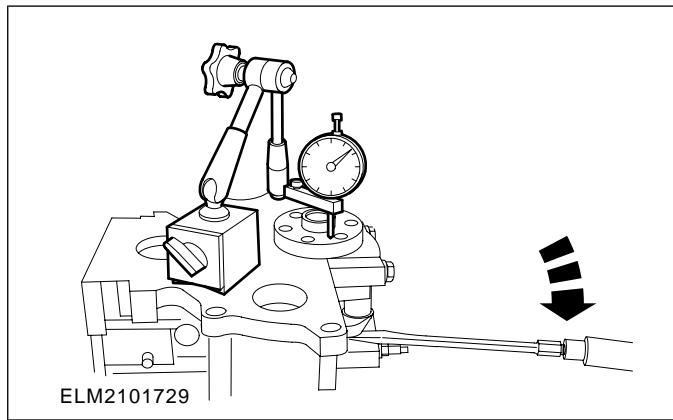


GENERAL PROCEDURES**Crankshaft End Play****General Equipment**

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.

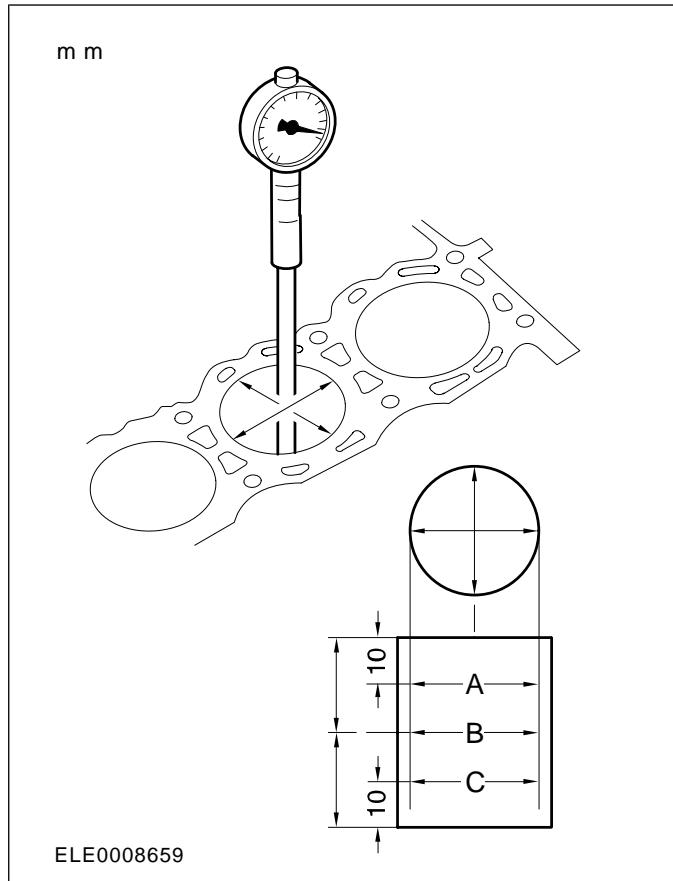


GENERAL PROCEDURES**Cylinder Bore Taper**

- 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 applicable/allowed).

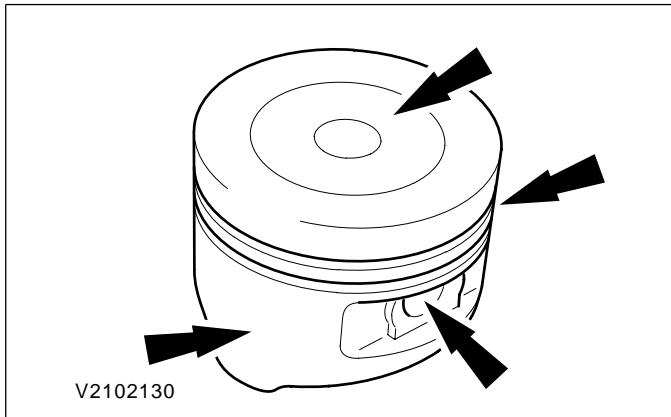


GENERAL PROCEDURES**Piston Inspection**

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.

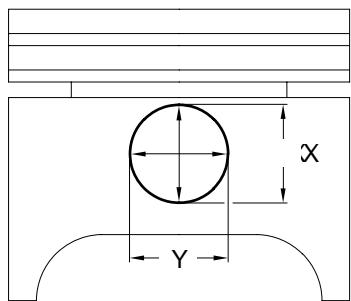


GENERAL PROCEDURES**Piston Pin to Bore Diameter**

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.



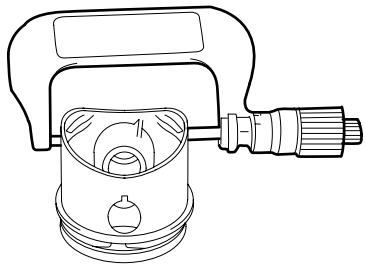
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GENERAL PROCEDURES**Piston Diameter****General Equipment**

Micrometer

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

Using a Micrometer measure the piston diameter.

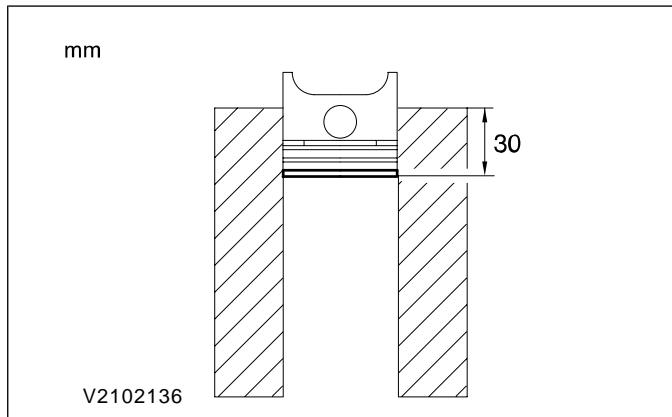


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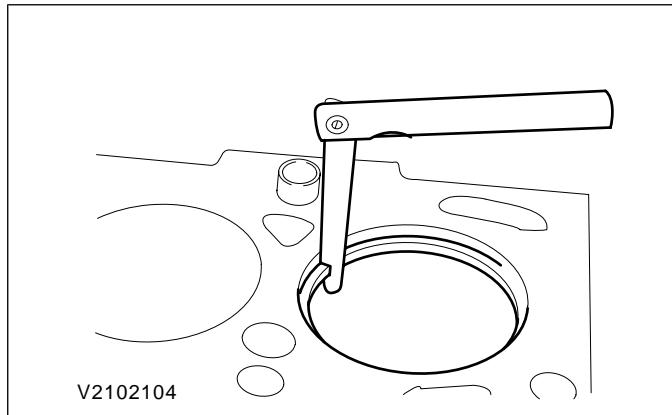
GENERAL PROCEDURES**Piston Ring End Gap**

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.



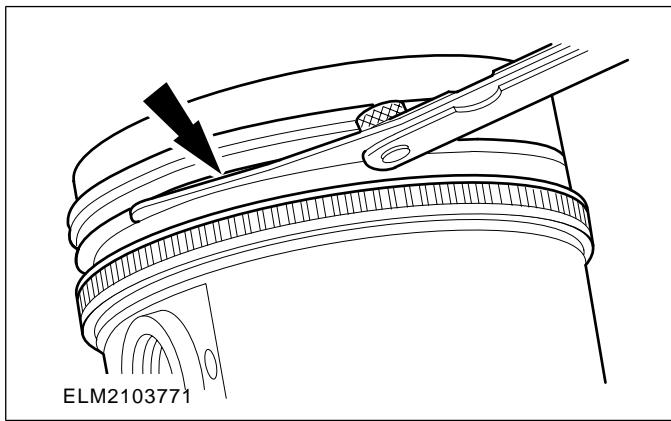
2. Using the Feeler Gauge, measure the piston
ring gap.



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.

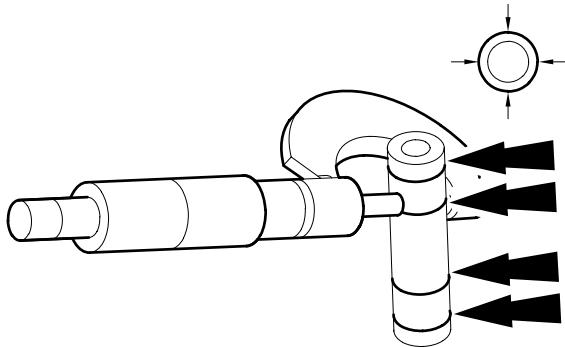


GENERAL PROCEDURES**Piston Pin Diameter**

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

Measure the piston pin diameter.

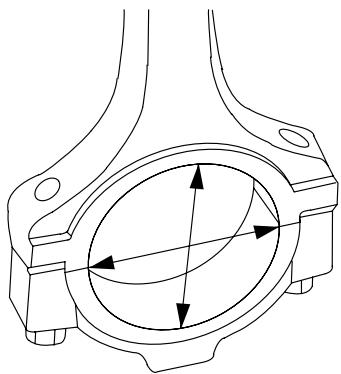
- Measure the diameter in two directions.
- If the values are not to specification, install a new piston and a new piston pin.



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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.



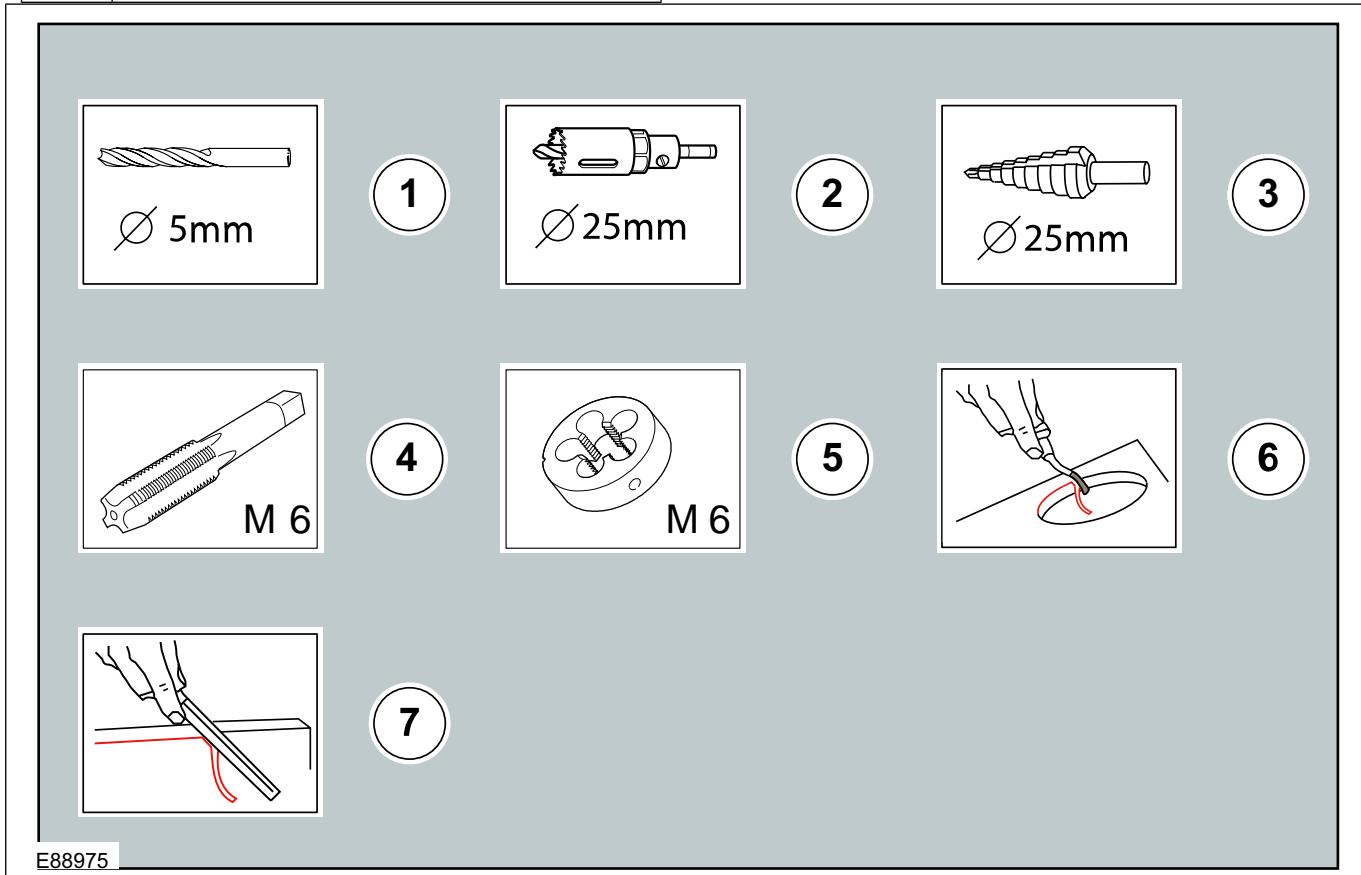
GA3934A

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.



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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

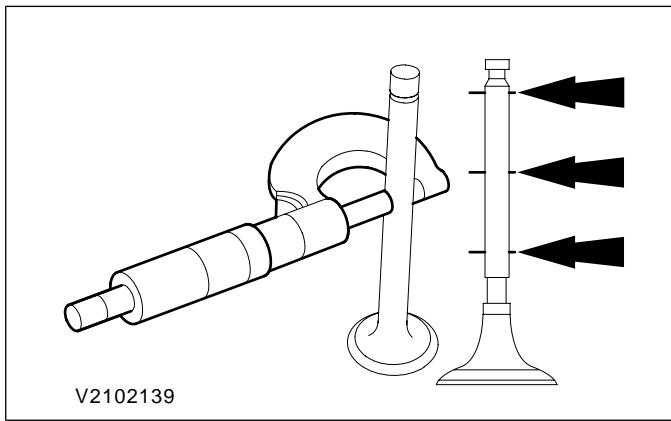
Item	Description
6	Scraper for circular holes
7	Scraper for straight edges

Cutting tool symbols

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

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.

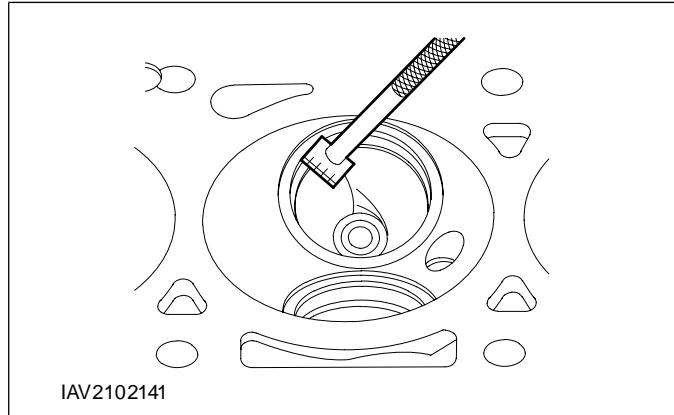


GENERAL PROCEDURES**Valve Seat Inspection****General Equipment**

Valve seat width scale

1. Measure the width of the valve seat.

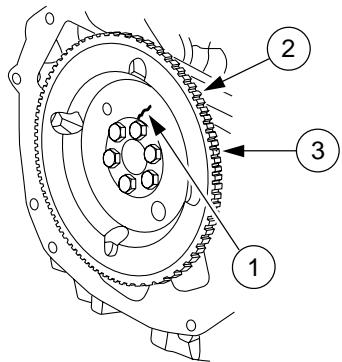
- Measure the valve seat width using the Valve seat width scale.
- If the value is not to specification rework the valve seat.



GENERAL PROCEDURES**Flywheel Inspection**

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

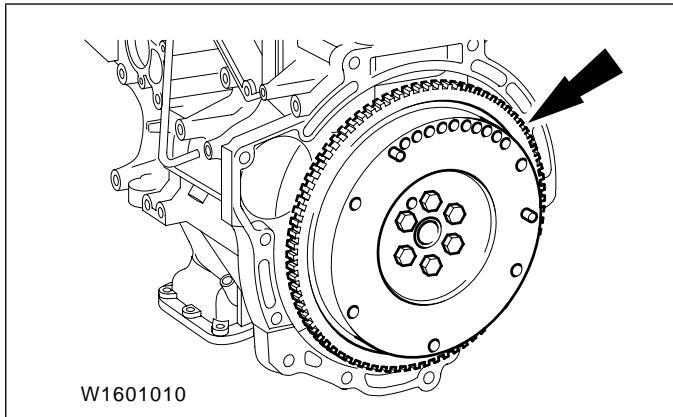
1. Cracks.
2. Worn ring gear teeth.
3. Chipped or cracked ring gear teeth.



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GENERAL PROCEDURES**Flywheel Clutch Surface Inspection****1. Check the flywheel for:**

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



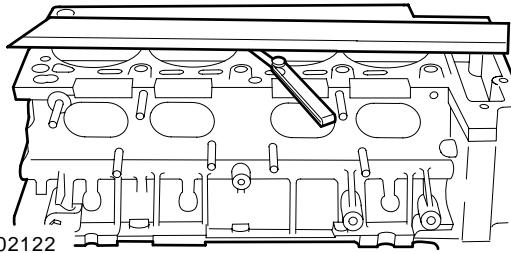
GENERAL PROCEDURES**Cylinder Head Distortion****General Equipment**

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.

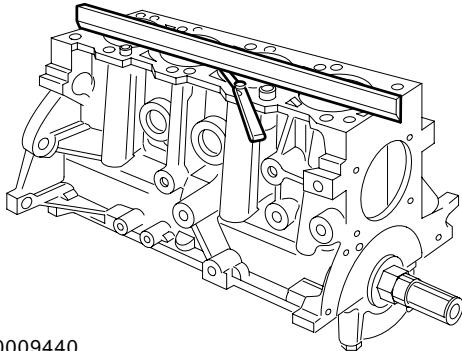


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GENERAL PROCEDURES**Cylinder Block Distortion**

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).



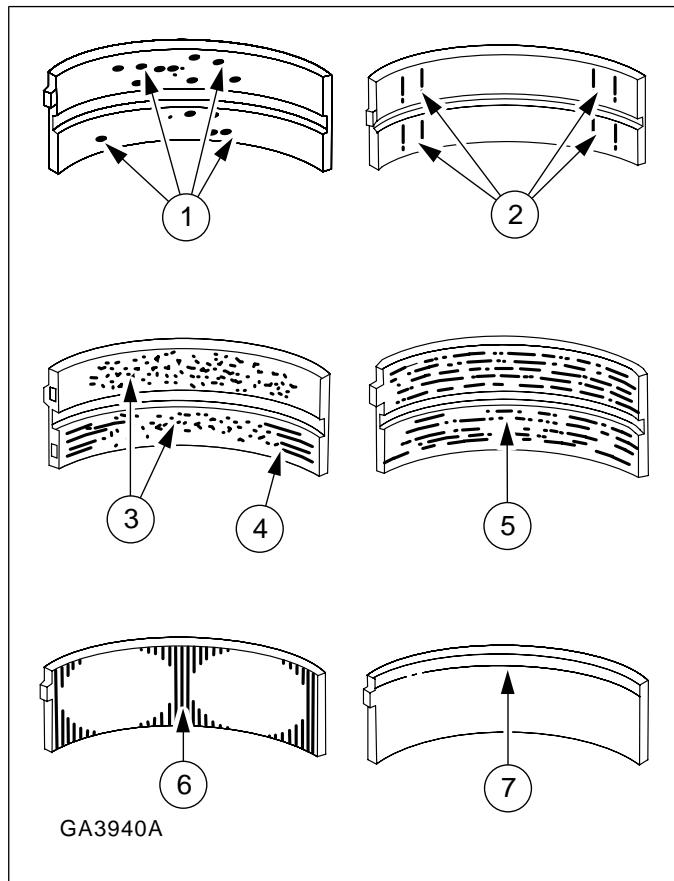
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GENERAL PROCEDURES**Exhaust Manifold Cleaning and Inspection**

- 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: BT50 & Ranger

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Cylinder Head.....	(21 163 0)	303-01A-40
Engine Front Cover.....		303-01A-43
Exhaust Manifold.....	(21 187 0)	303-01A-46
Intake Manifold.....	(21 183 0)	303-01A-48
Timing Chain.....	(21 314 0)	303-01A-51
Oil Pan.....	(21 154 0)	303-01A-53
Oil Pump.....	(21 714 0)	303-01A-56
Valve Cover.....	(21 141 0)	303-01A-57
Valve Stem Seals.....	(21 238 0)	303-01A-60

REMOVAL

Engine — Vehicles With: 5-Speed Manual Transmission - MT75.....	(21 132 0; 21 132 6; 21 132 7)	303-01A-61
Engine Accessories.....	(21 139 4)	303-01A-68

DISASSEMBLY

Engine.....	(21 134 8)	303-01A-75
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PAGE 2 OF 2**DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES**

Cylinder Head..... (21 165 6) 303-01A-83

ASSEMBLY

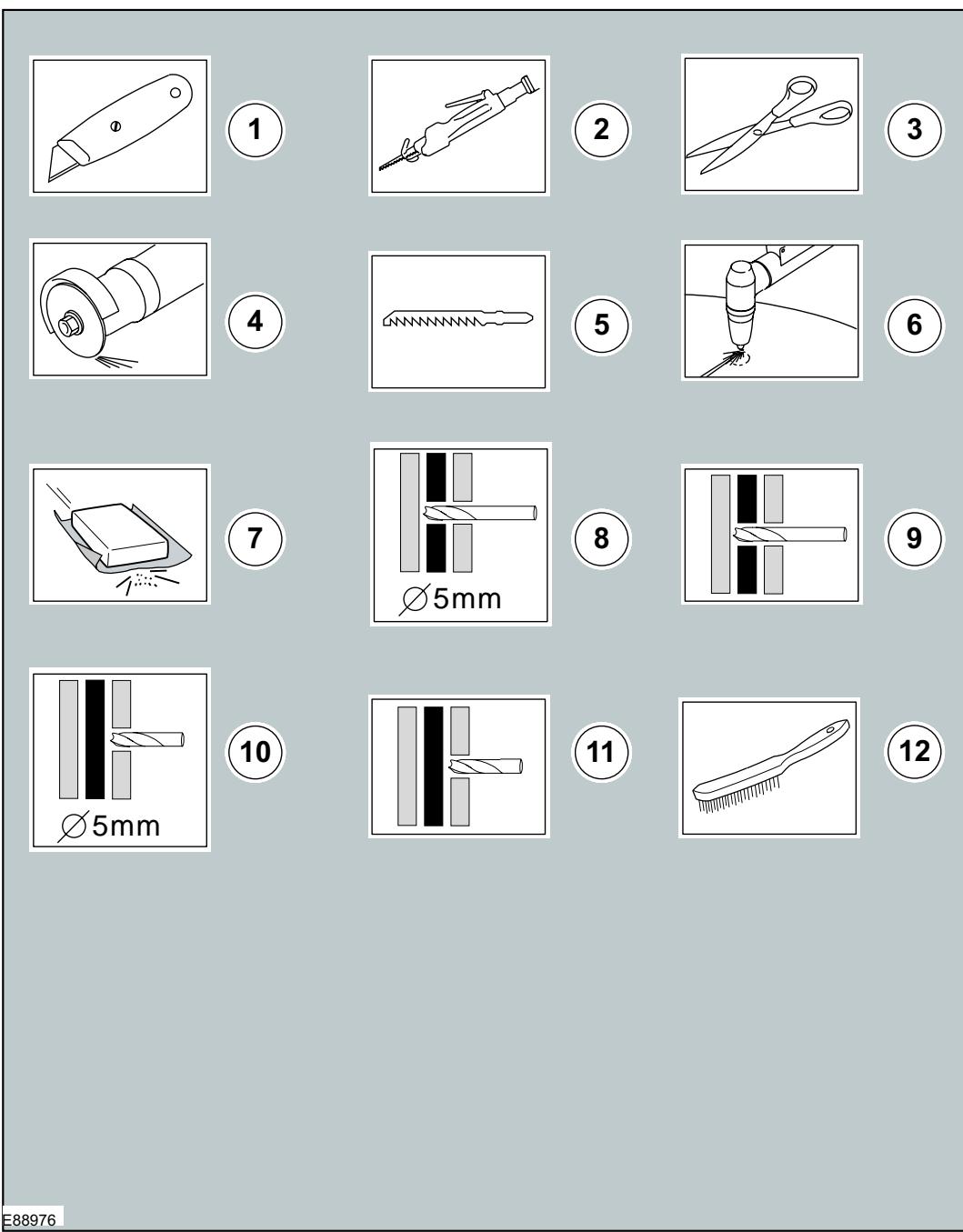
Engine..... (21 134 8) 303-01A-85

INSTALLATIONEngine — Vehicles With: 5-Speed Manual Transmission - MT75..... (21 132 0;
21 132 6;
21 132 7) 303-01A-102

Engine Accessories..... (21 139 4) 303-01A-109

(110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma	303-05B	Transmission/Transaxle Cooling	307-02
Starting System - 2.5L Duratec-HE (122kW/165PS) - MI4	303-06A	Automatic Transmission/Transaxle External Controls	307-05
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	303-06B	Manual Transmission/Transaxle, Clutch and Transfer Case	
Engine Ignition - 2.5L Duratec-HE (122kW/165PS) - MI4	303-07A	Manual Transmission/Transaxle and Clutch - General Information	308-00
Glow Plug System - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma	303-07B	Clutch - Vehicles With: 5-Speed Manual Transmission - MT75	308-01A
Glow Plug System - 3.2L Duratorq-TDCi (148kW/200PS) - Puma	303-07C	Clutch - Vehicles With: 6-Speed Manual Transmission - MT82	308-01B
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	303-08A	Clutch Controls - Vehicles With: 5-Speed Manual Transmission - MT75	308-02A
Engine Emission Control	303-08B	Clutch Controls - Vehicles With: 6-Speed Manual Transmission - MT82	308-02B
Intake Air Distribution and Filtering - 2.5L Duratec-HE (122kW/165PS) - MI4	303-12A	Manual Transmission/Transaxle - Vehicles With: 5-Speed Manual Transmission - MT75	308-03A
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	303-12B	Manual Transmission/Transaxle - Vehicles With: 6-Speed Manual Transmission - MT82	308-03B
Evaporative Emissions	303-13	Manual Transmission/Transaxle External Controls - Vehicles With: MT-75	308-06A
Electronic Engine Controls - 2.5L Duratec-HE (122kW/165PS) - MI4	303-14A	Manual Transmission/Transaxle External Controls - Vehicles With: MT82	308-06B
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	303-14B	Transfer Case - Vehicles With: 5-Speed Manual Transmission - MT75/6-Speed Manual Transmission - MT82	308-07A
Automatic Transmission/Transaxle		Transfer Case - Vehicles With: 6-Speed Automatic Transaxle - 6R80	308-07B
Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80	307-01	Exhaust System	
		Exhaust System - 2.5L Duratec-HE (122kW/165PS) - MI4	309-00A
		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	309-00B
		Fuel System - General Information	
		Fuel System - General Information - 2.5L Duratec-HE (122kW/165PS) - MI4	310-00A
		Fuel System - General Information - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi	

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

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

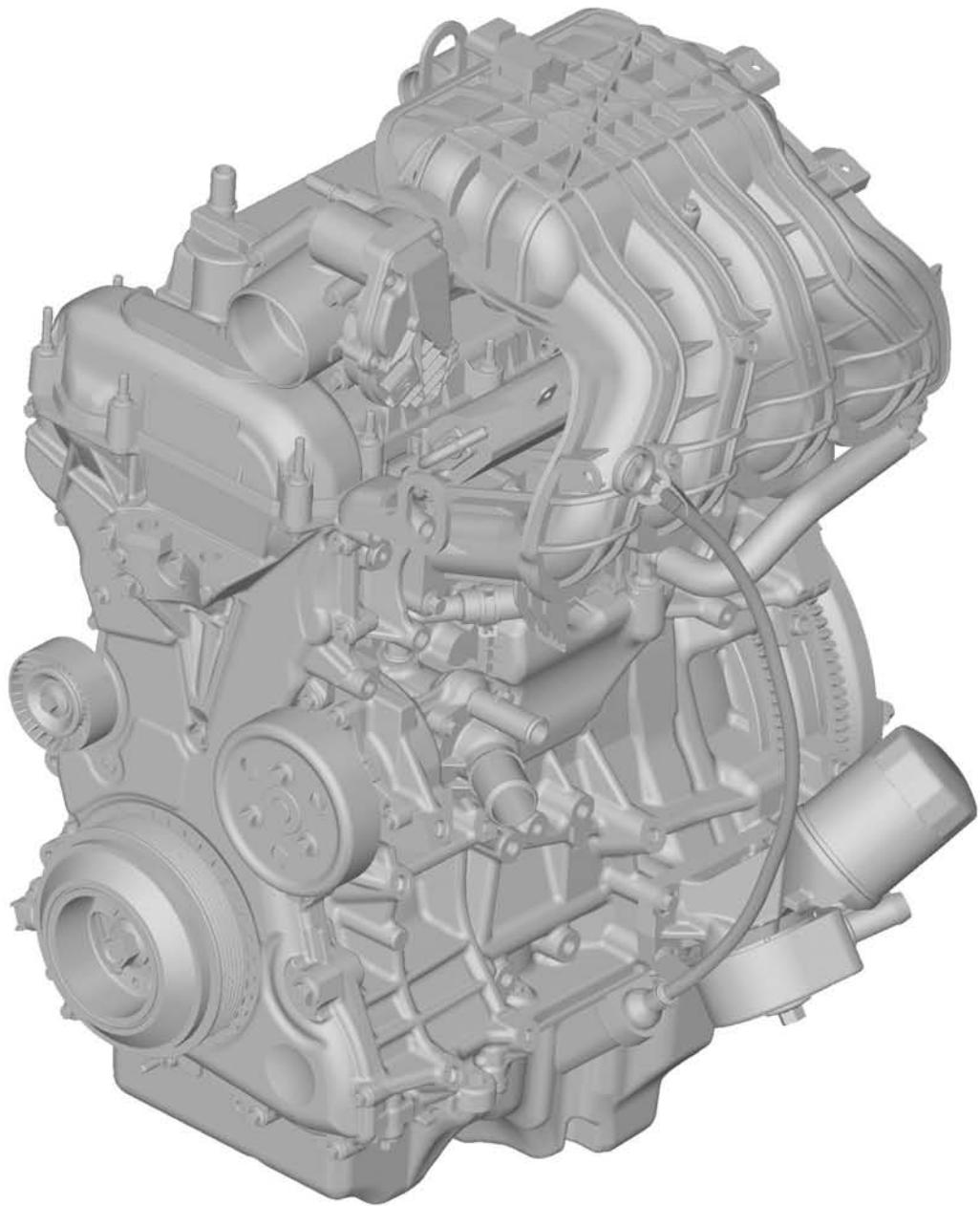
Camshaft

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

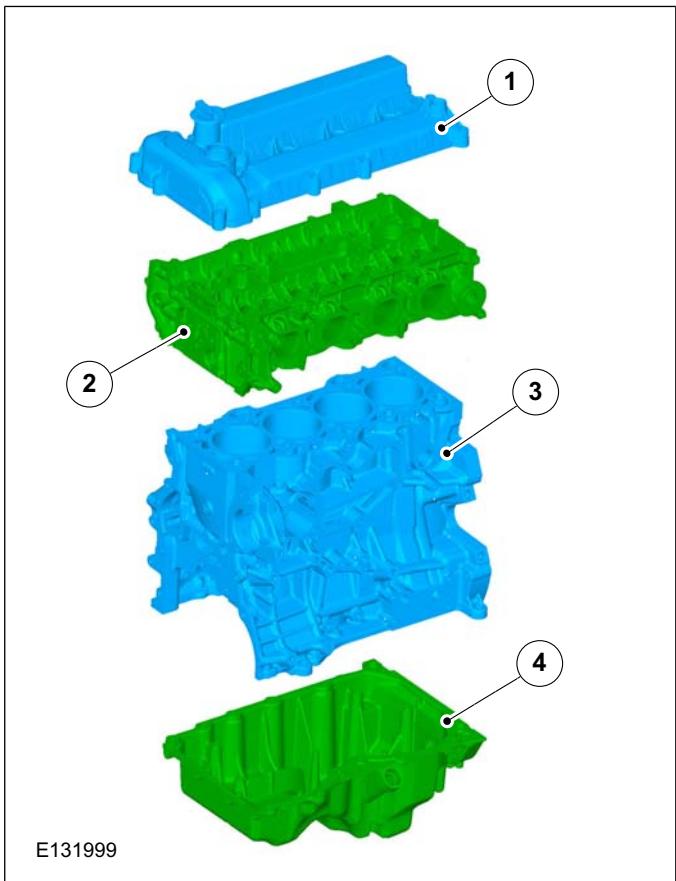
a - No. 3 journal - supported by No. 1 and No. 5 journals.

SPECIFICATIONS**Connecting rod**

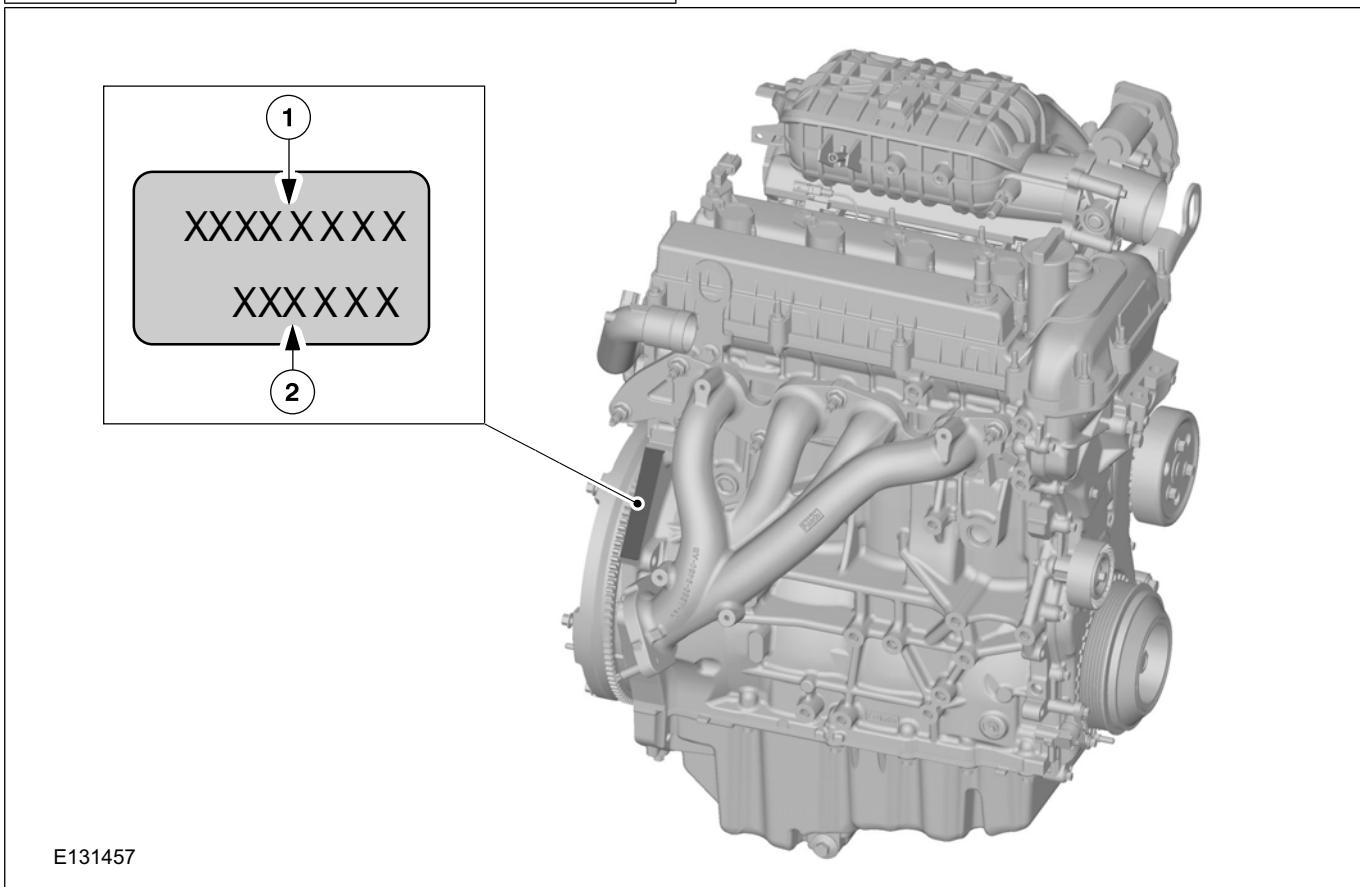
Description	mm
Bearing clearance	0.027 - 0.052 mm
Bearing thickness	1.496 - 1.520 mm
Crank bore diameter	55.023 - 55.047 mm
Pin bore diameter	20.965 - 20.985 mm
Length (center-to-center)	151.8 mm
Side clearance	1.95 - 3.05 mm
Axial clearance	0.14 - 0.36 mm

DESCRIPTION AND OPERATION**Engine – Overview****General View**

E131455

DESCRIPTION AND OPERATION

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

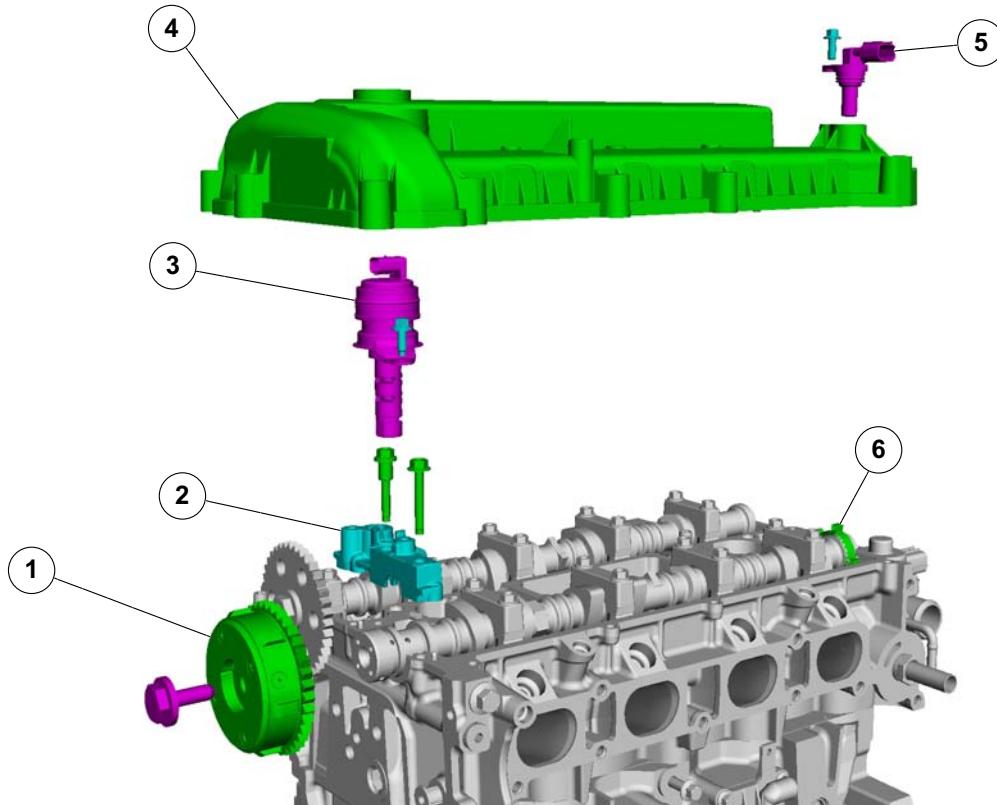


DESCRIPTION AND OPERATION

Item	Description
1	Engine code

Item	Description
2	Engine serial number

Variable camshaft timing (VCT)



E83423

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.

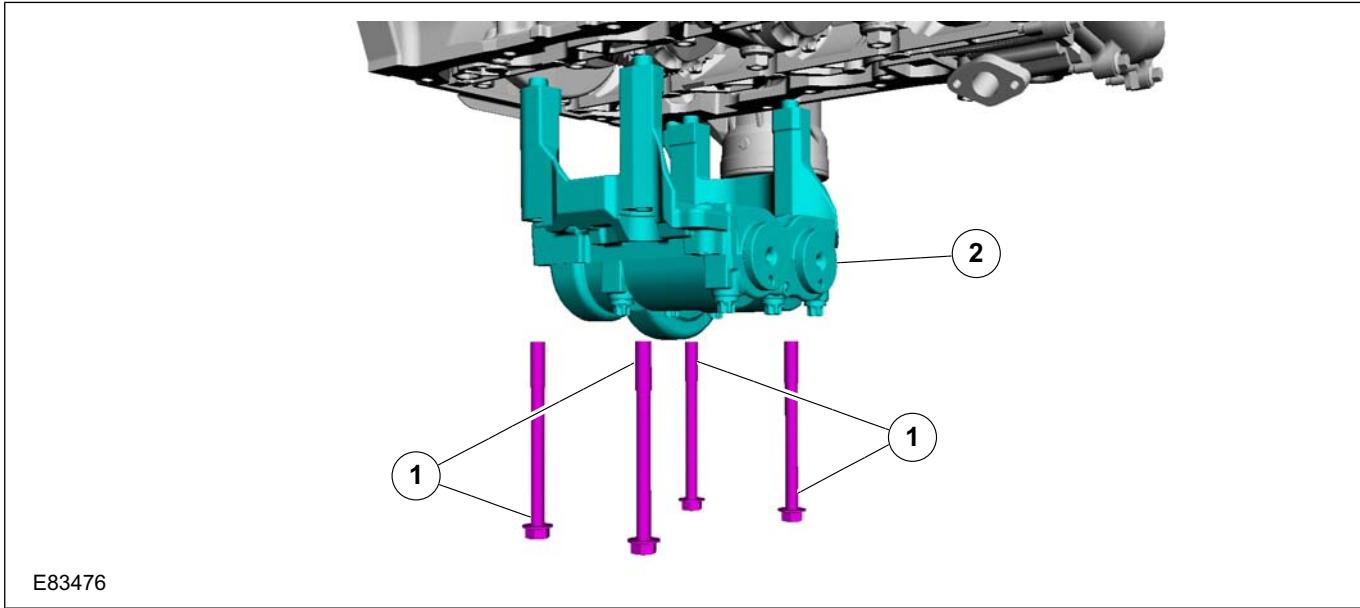
Remember that this special tool must not be used to keep the camshaft from rotating when mounting the camshaft sprocket. They may only be kept from rotating by using the hexagon, which has been specially provided for this purpose.

Advantages of variable camshaft timing (VCT).

- Lower fuel consumption due to improved volumetric efficiency

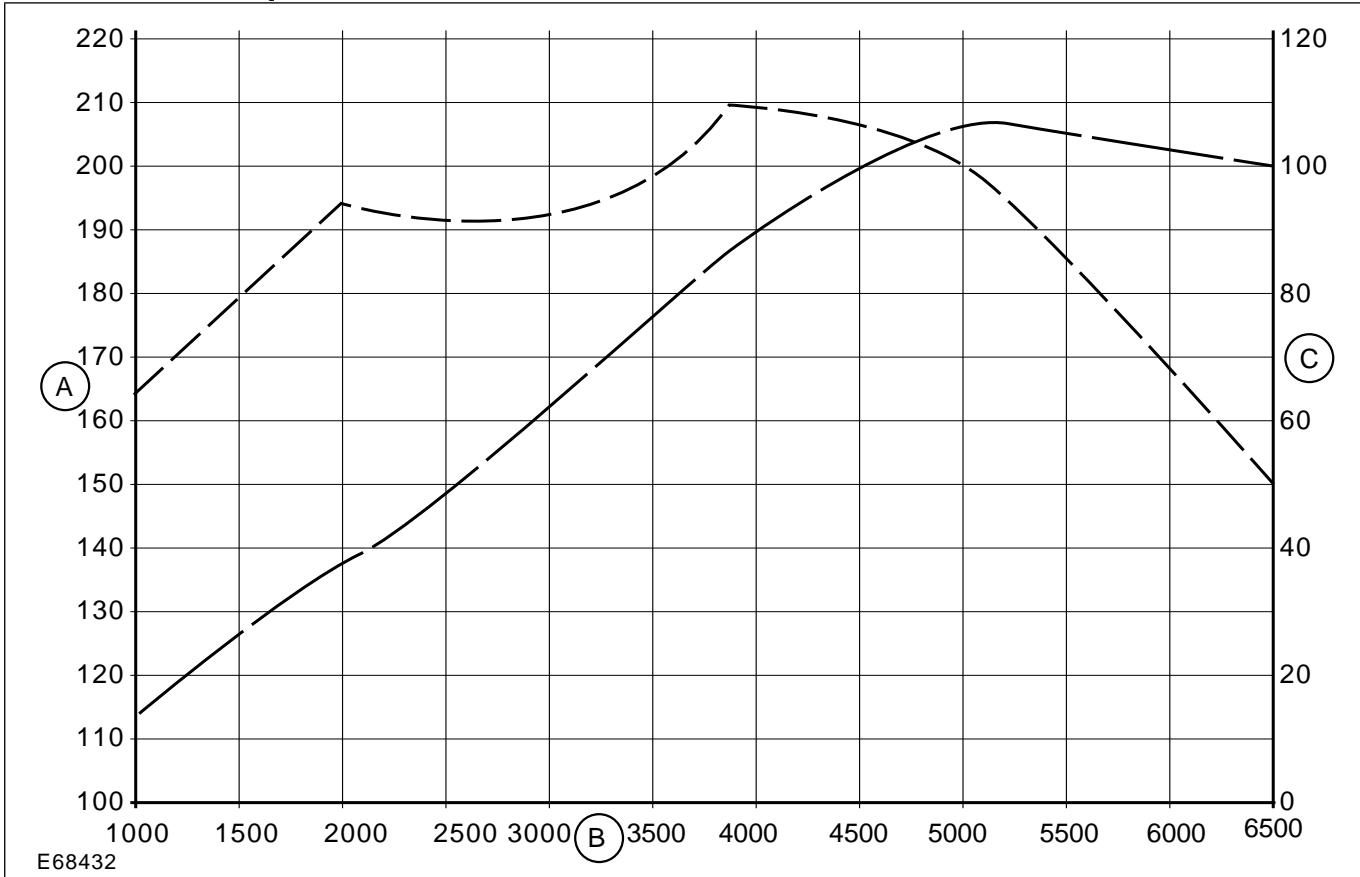
DESCRIPTION AND OPERATION

- 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.

as well as the entire connecting rod, piston and piston ring assembly.

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.

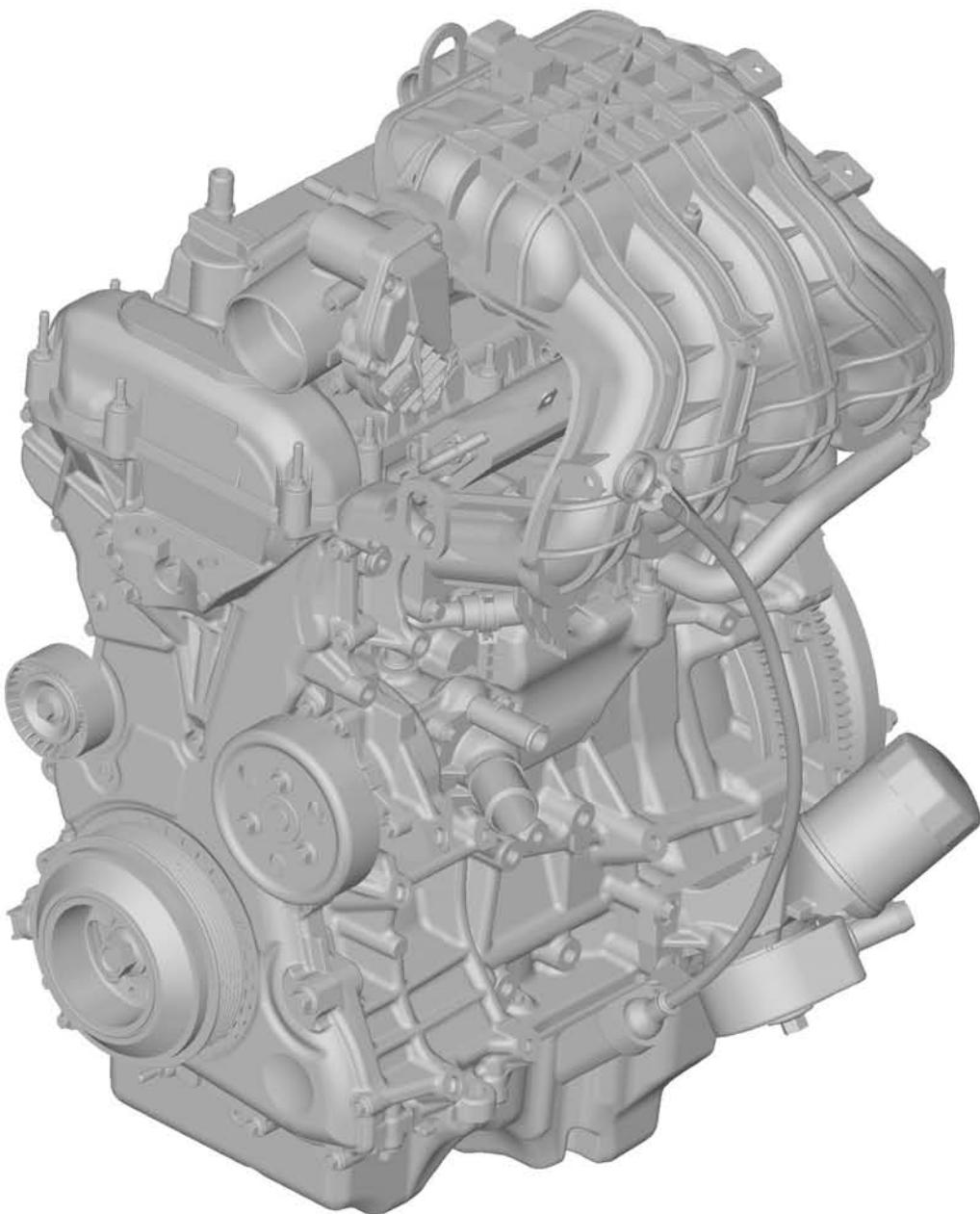
Because of the higher stress involved in gas operation:

- 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

DESCRIPTION AND OPERATION**Engine – Component Location**

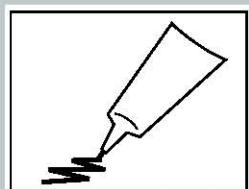
E131455

DESCRIPTION AND OPERATION

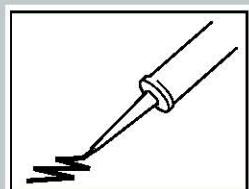
Apply Chemical or load symbols

The apply chemical or load symbols are used to

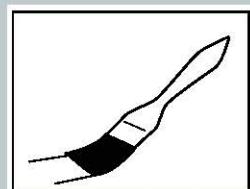
show where to apply which type of chemical or load to carry out a procedure step.



1



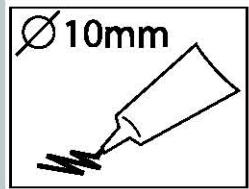
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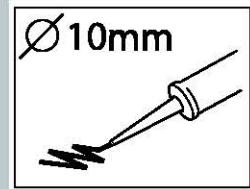
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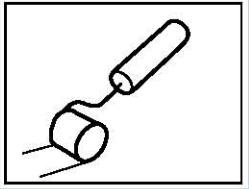
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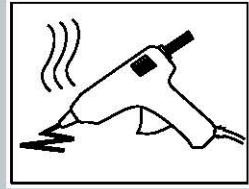
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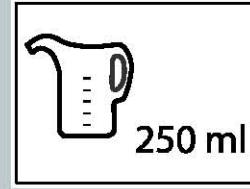
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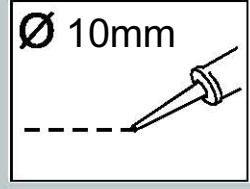
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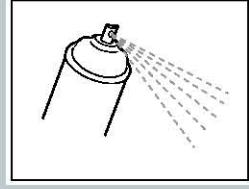
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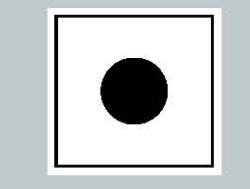
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15



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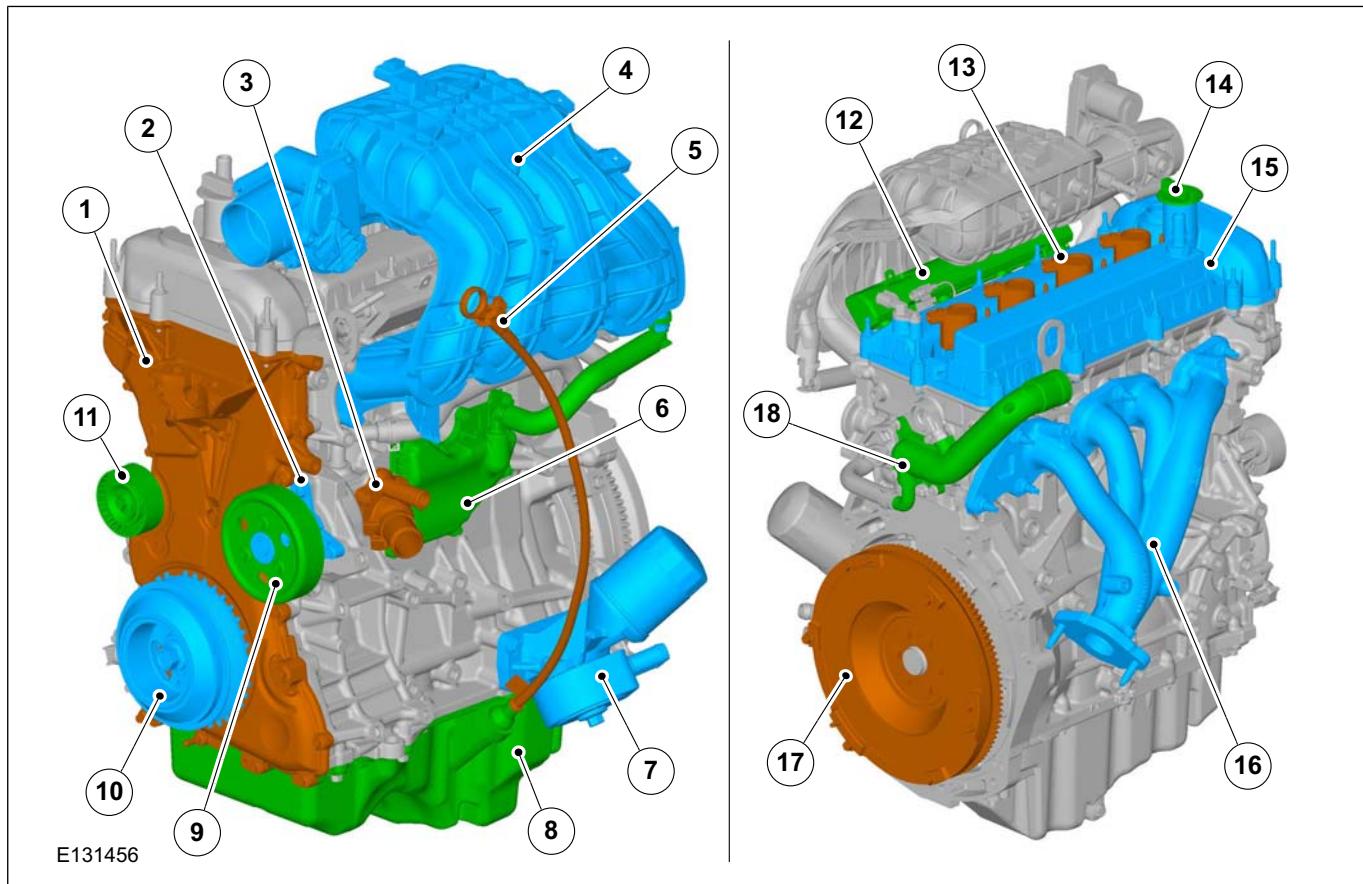


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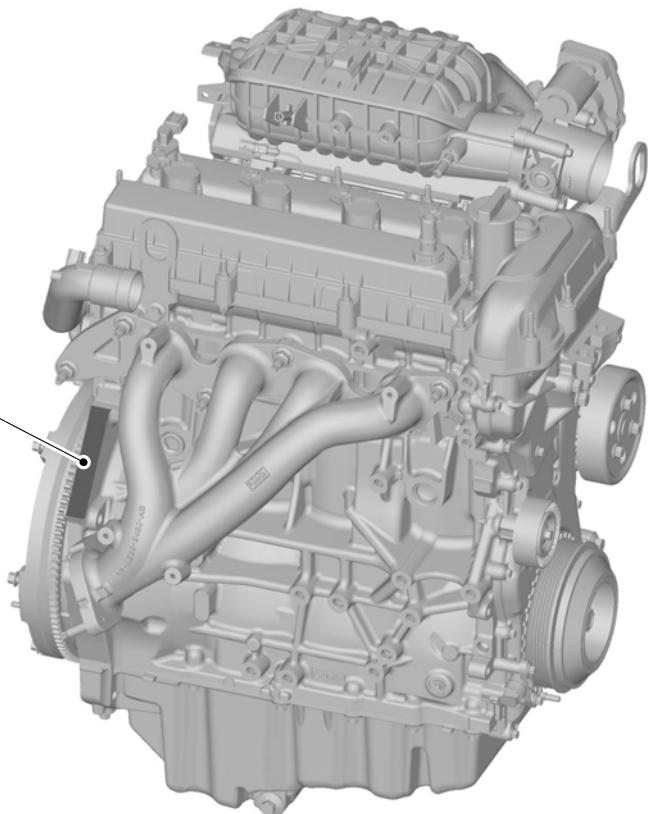
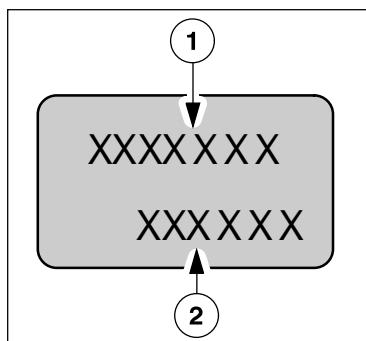
DESCRIPTION AND OPERATION



E131456

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	Crankshaft 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

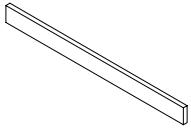
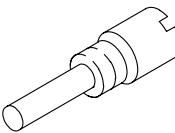
E131457

Item	Description
1	Engine code
2	Engine serial number

GENERAL PROCEDURES

Valve Clearance Adjustment

Special Tool(s) / General Equipment

	303-465 Tool, Camshaft Align Timing E134673
	303-507 Timing Peg, Crankshaft TDC PZ21210
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

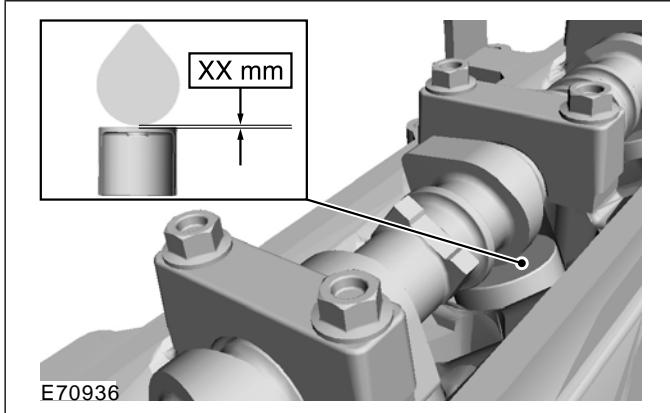
- Refer to: **Accessory Drive Belt** (303-05 Accessory Drive - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
- Refer to: **Valve Cover** (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
- CAUTION: Only rotate the crankshaft clockwise.**

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.

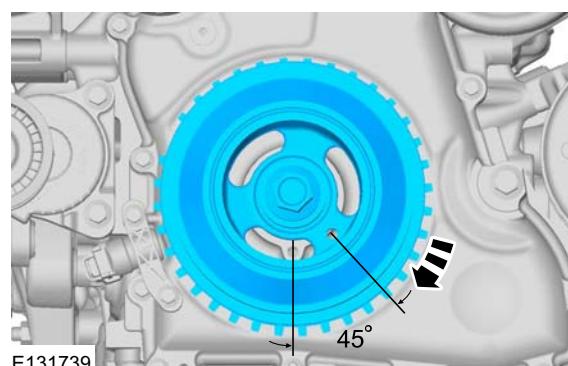
Rotate the crankshaft until the cam pair of the cylinder to be adjusted are pointing upwards.

Using a suitable feeler gauge, measure the valve clearance.



- Make a note of each cylinder number with the corresponding valve clearance.
- Compare the measured valve clearance(s) with the specifications.
- NOTE:** Only carry out the following steps when the valve clearance(s) require adjustment.
- WARNING: Only rotate the crankshaft clockwise.**

Turn the crankshaft until no. 1 piston is at about 45° before TDC.



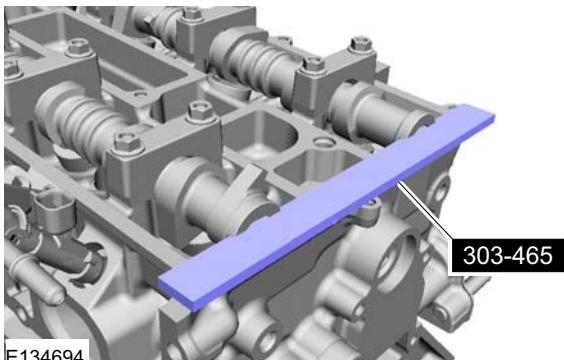
- CAUTION: The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

NOTE: The camshaft timing slots are offset. If the Camshaft Alignment Plate cannot be installed, rotate the crankshaft one complete

GENERAL PROCEDURES

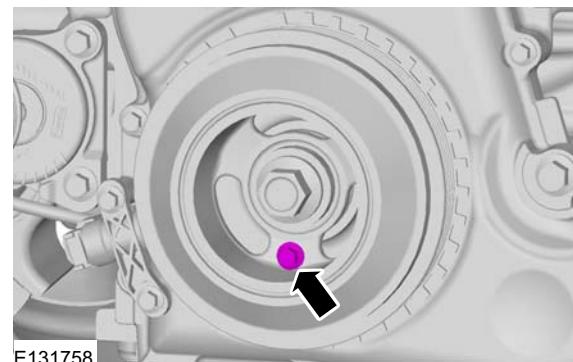
revolution clockwise to correctly position the camshafts.

Special Tool(s): 303-465

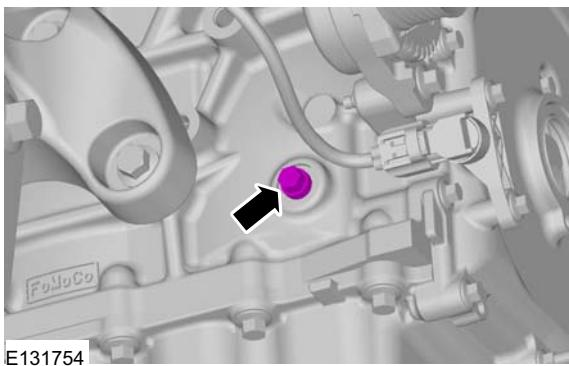


11. NOTE: Only tighten the bolt finger tight at this stage.

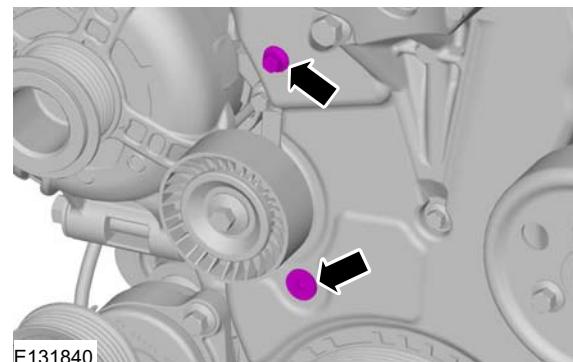
- Bolt M6 x 18 mm



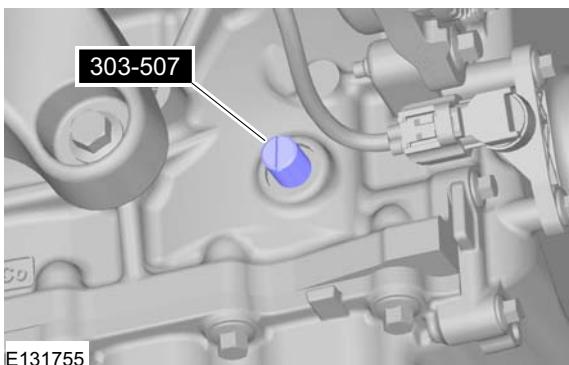
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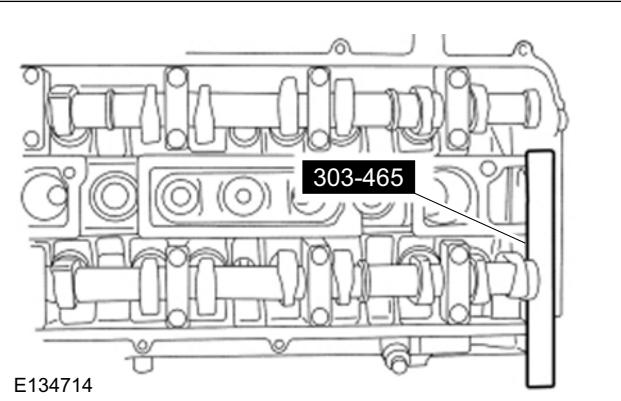


10. Special Tool(s): 303-507



13. Reposition the camshaft alignment plate to the slot on the rear of the intake camshaft only.

Special Tool(s): 303-465



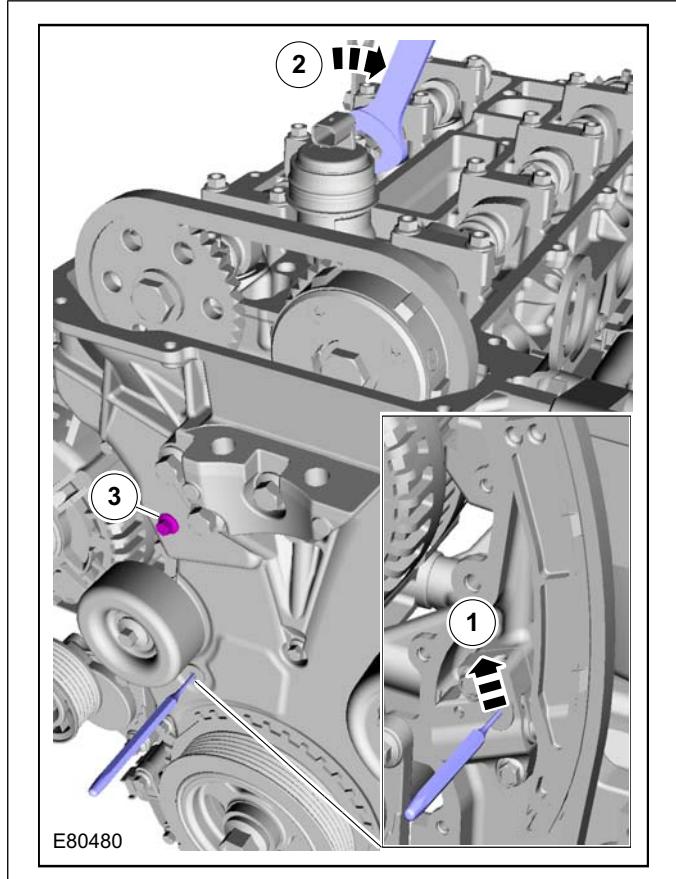
14. CAUTION: Releasing the ratcheting mechanism in the timing chain tensioner allows the plunger to collapse and create slack in the timing chain. Installing an M6 x 30 mm bolt into the upper front cover timing hole will hold the tensioner arm in a retracted position

GENERAL PROCEDURES

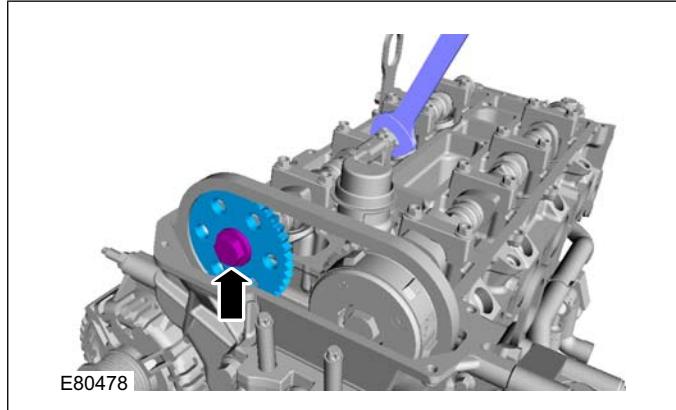
and allow enough slack in the timing chain for removal of the exhaust camshaft gear.

1. NOTE:

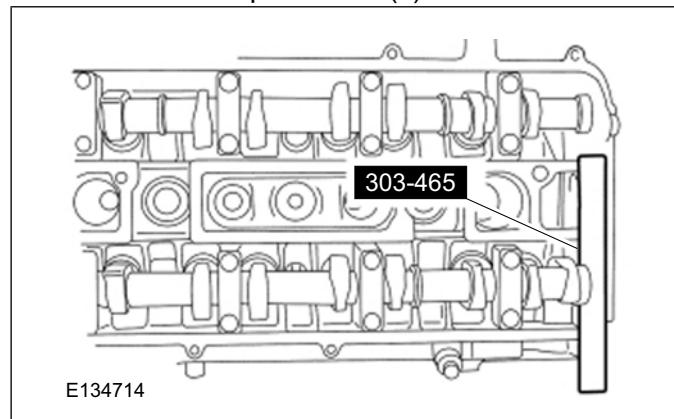
- General Equipment: 2 mm Punch
- 3. Bolt M6 x 25 mm



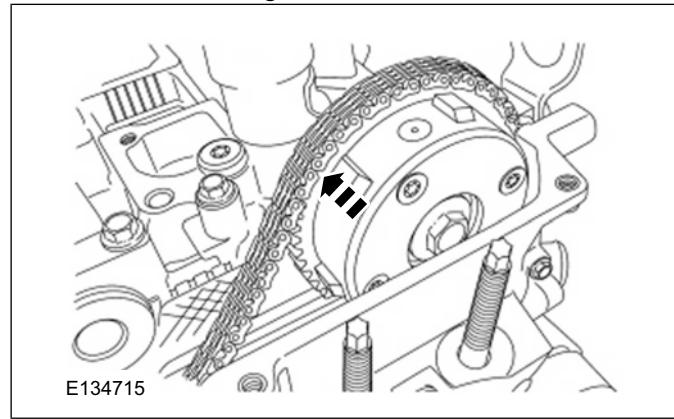
- 15. ! CAUTION: Counterhold the camshaft at the hexagon with a wrench to prevent the camshaft from rotating.**



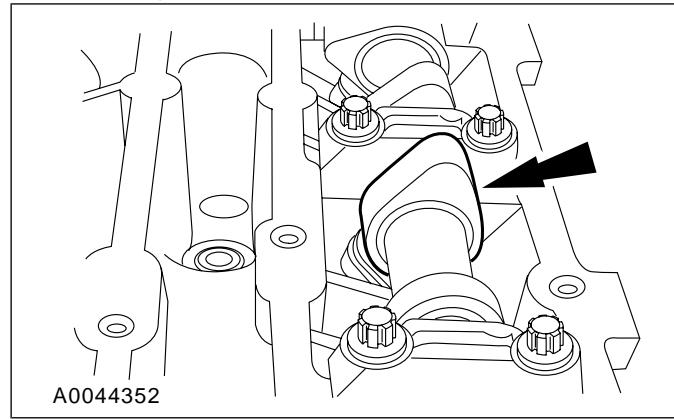
16. Remove the Special Tool(s): 303-465



- 17. Remove the timing chain from the intake camshaft drive gear.**



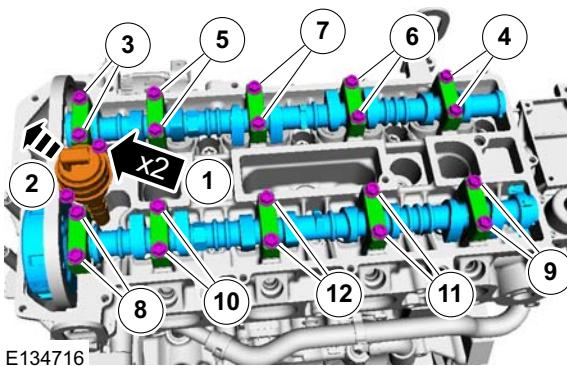
- 18. Mark the position of the camshaft lobes on the No. 1 cylinder for installation reference.**



- 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.



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.

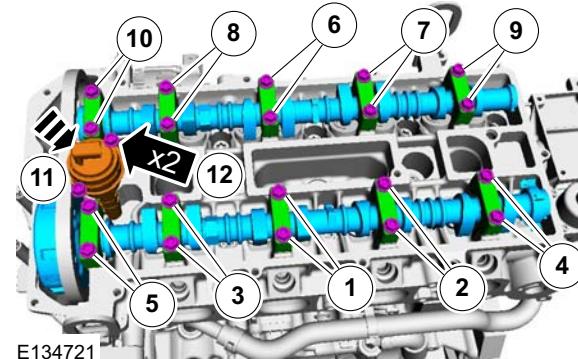
NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil.

Coat the camshaft bearing caps with oil and install the camshafts approximately at valve overlap position cylinder No. 4.

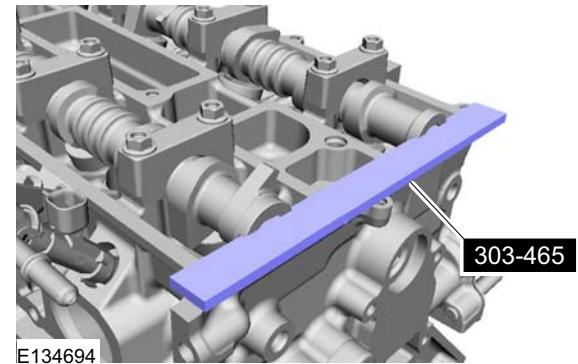
Material: Hypoid Oil 85W-90 (SQ-M2C9002-AA / A72SX-19K261-CA) transmission fluid

Torque:

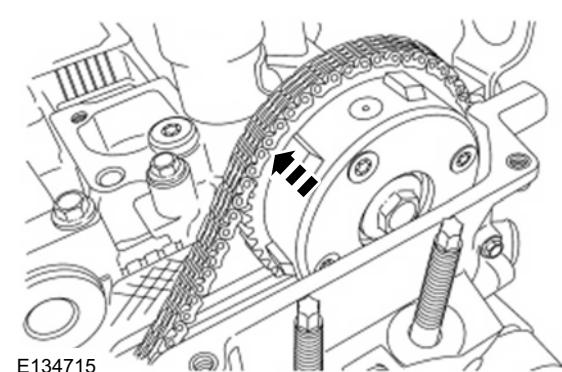
- Stage 1: 7 Nm
- Stage 2: 16 Nm



24. Special Tool(s): 303-465



25. Install the timing chain on the intake camshaft drive gear.

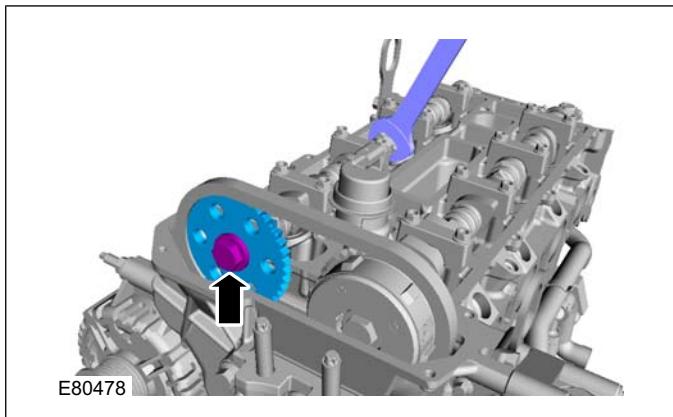


26. **NOTE:** Only tighten the bolt finger tight at this stage.

GENERAL PROCEDURES

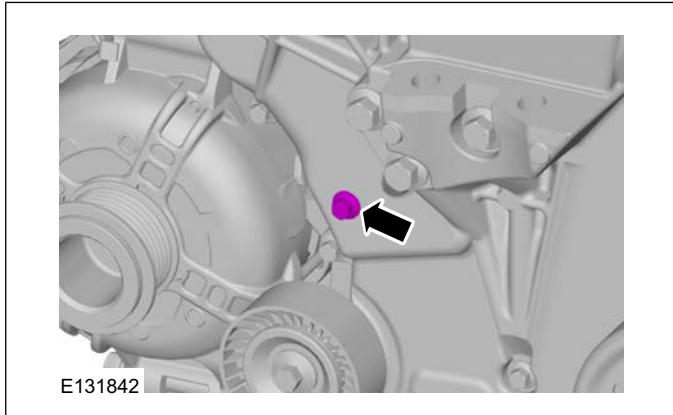
NOTE: Make sure that the camshaft sprockets can rotate on the camshafts.

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.



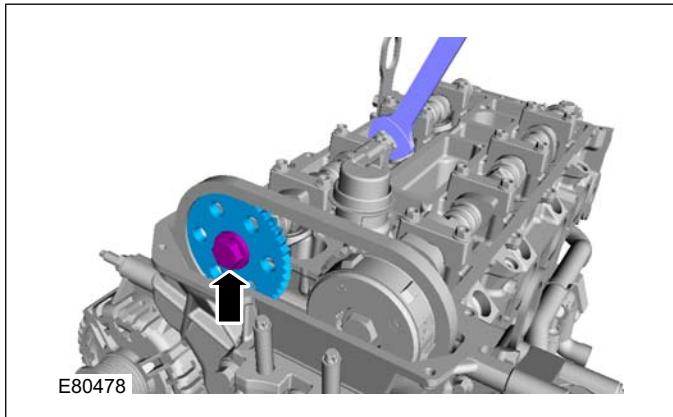
27. NOTE: Releasing the tensioner arm will remove the slack from the timing chain.

Remove the bolt M6 x 30mm.

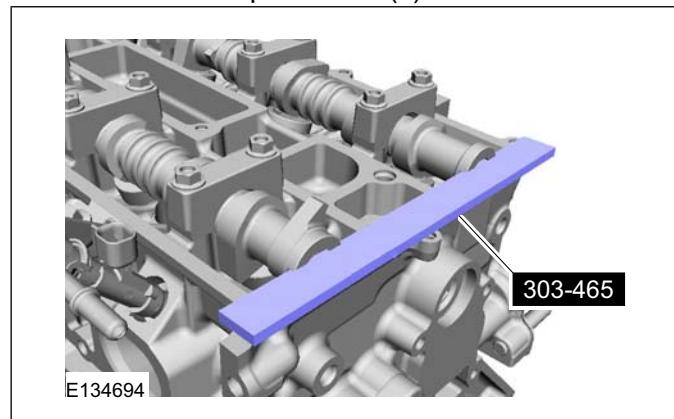


28. ! CAUTION: Counterhold the camshaft at the hexagon with a wrench to prevent the camshaft from rotating.

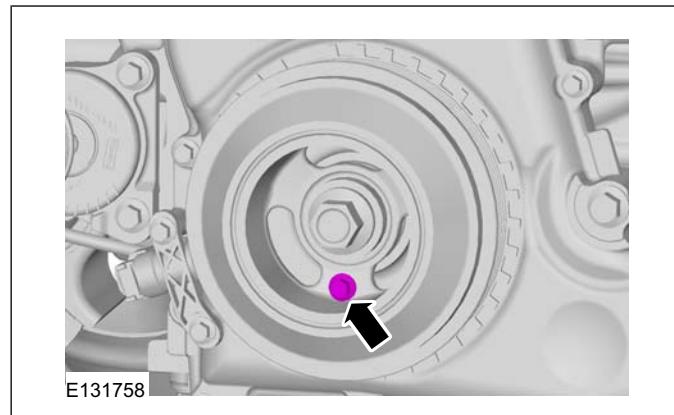
Torque: 72 Nm



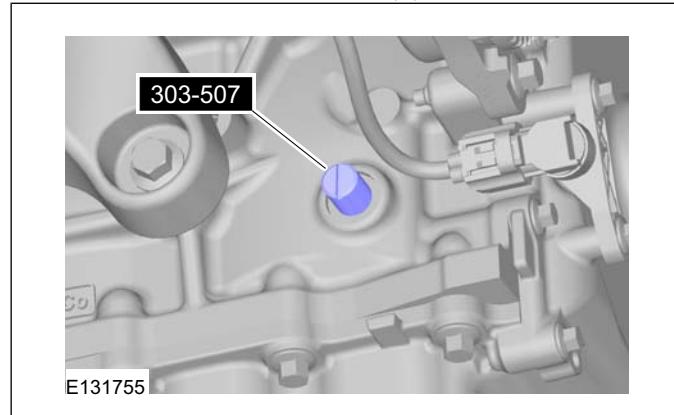
29. Remove the Special Tool(s): 303-465



30. Remove the bolt M6 x 18 mm.

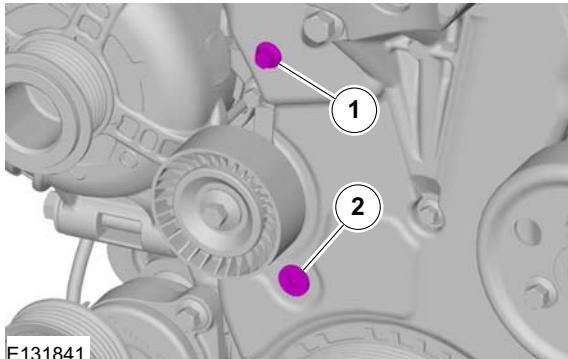


31. Remove the Special Tool(s): 303-507

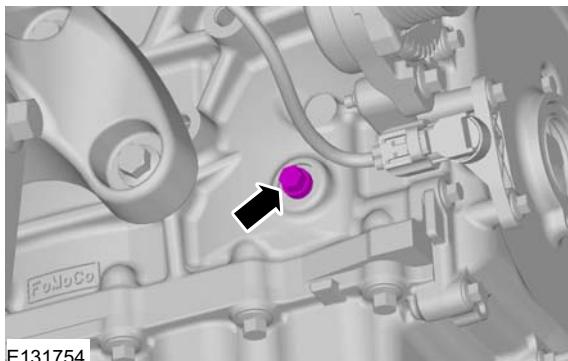


GENERAL PROCEDURES

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.

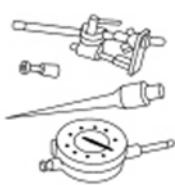
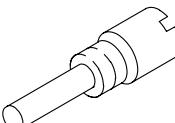
36. Refer to: **Valve Cover** (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

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)

	100-002 Holding Fixture with Dial Indicator Gauge E139373
	303-507 Timing Peg, Crankshaft TDC PZ21210

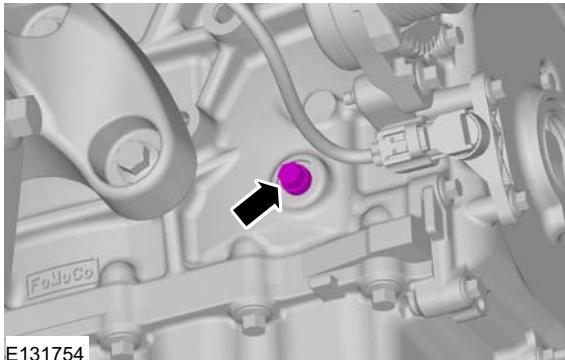
crankshaft TDC timing peg. The engine is now at TDC.

Special Tool(s): 303-507



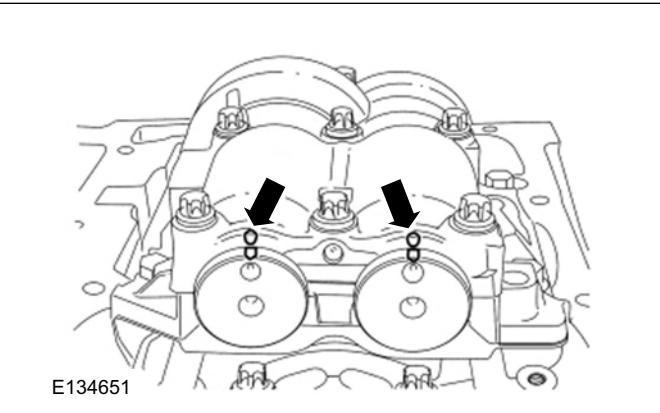
Adjustment

38. Remove the timing peg bolt.



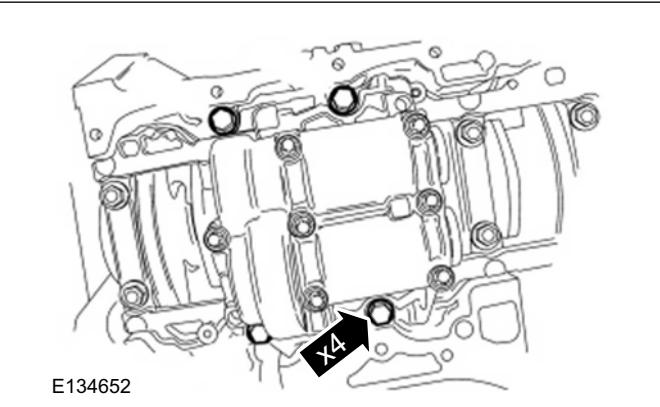
39. Install the crankshaft TDC timing peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the

40. Mark the balancer unit and shafts on the top for reference that the balancer unit is at TDC.



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.



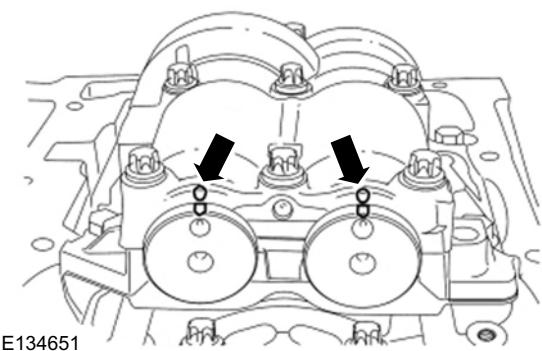
42. Remove the adjustment shims from the seat faces of the balancer unit.

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.

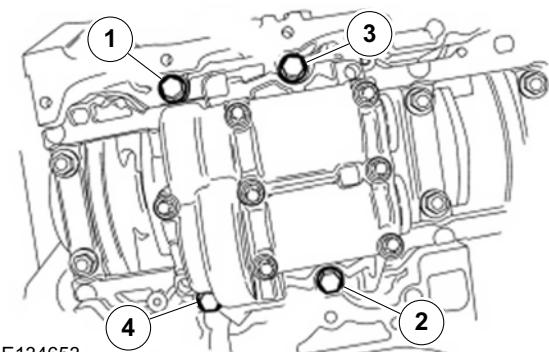
44. With the balancer unit shaft marks at the TDC position, slowly install the balancer unit to the cylinder block to avoid interference between the crankshaft drive gear and the balancer unit driven gear.



45. Install the balancer unit bolts.

Torque:

- Stage 1: 25 Nm
- Stage 2: 50 Nm



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



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



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

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.

GENERAL PROCEDURES

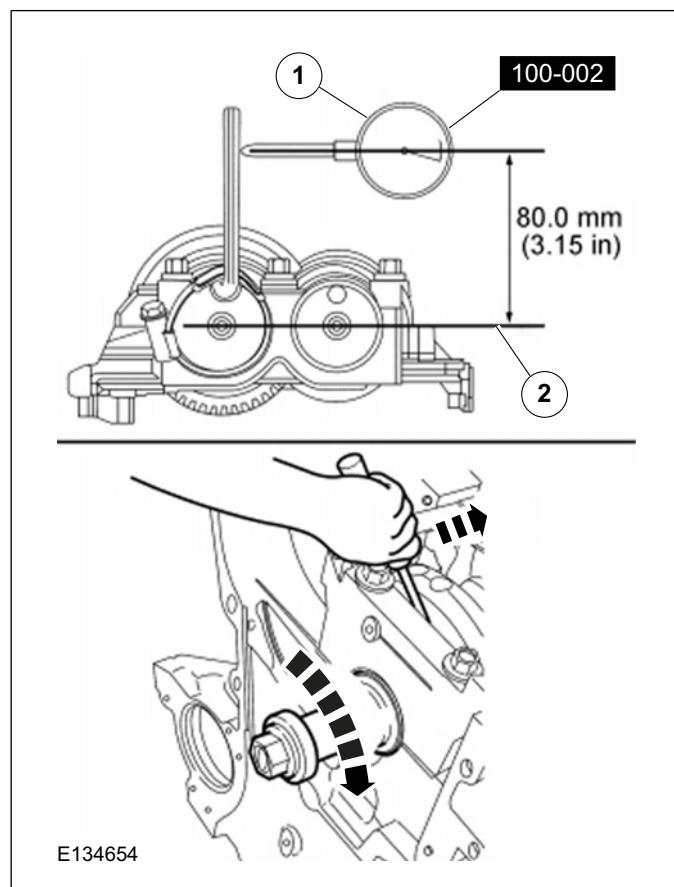
the thrust direction with the screwdriver, using a prying action as shown.

- 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 thickness 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)

Backlash mm (in)	Selection shim (No.)	Shim thickness mm (in)
0.245-0.257 (0.0096-0.0101)	35	1.35 (0.0531)
0.232-0.243 (0.0091-0.0095)	36	1.36 (0.535)
0.218-0.230 (0.0085-0.0090)	37	1.37 (0.539)
0.205-0.216 (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)

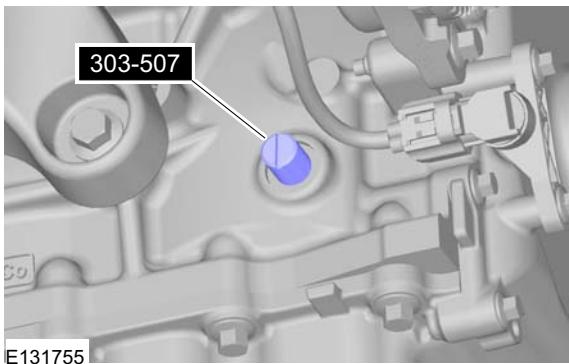
E134655

- 50.** Install the crankshaft TDC timing peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the

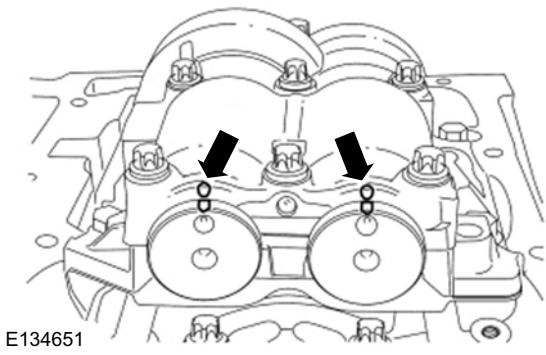
GENERAL PROCEDURES

crankshaft TDC timing peg. The engine is now at TDC.

Special Tool(s): 303-507



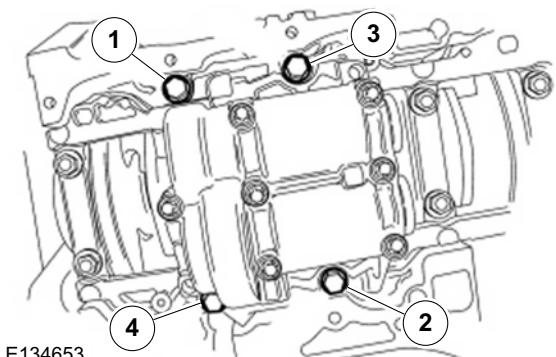
51. With the balancer unit shaft marks in the TDC position, slowly install the balancer unit to the cylinder block to avoid interference between the crankshaft drive gear and the balancer unit driven gear.



52 Install the balancer unit bolts.

Torque:

- Stage 1: 25 Nm
- Stage 2: 50 Nm

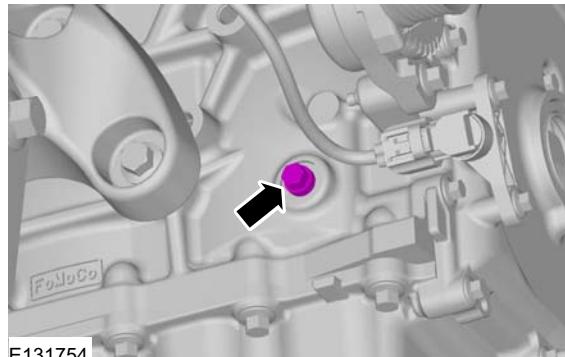


53. Remove the Special Tool(s): 303-507



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.

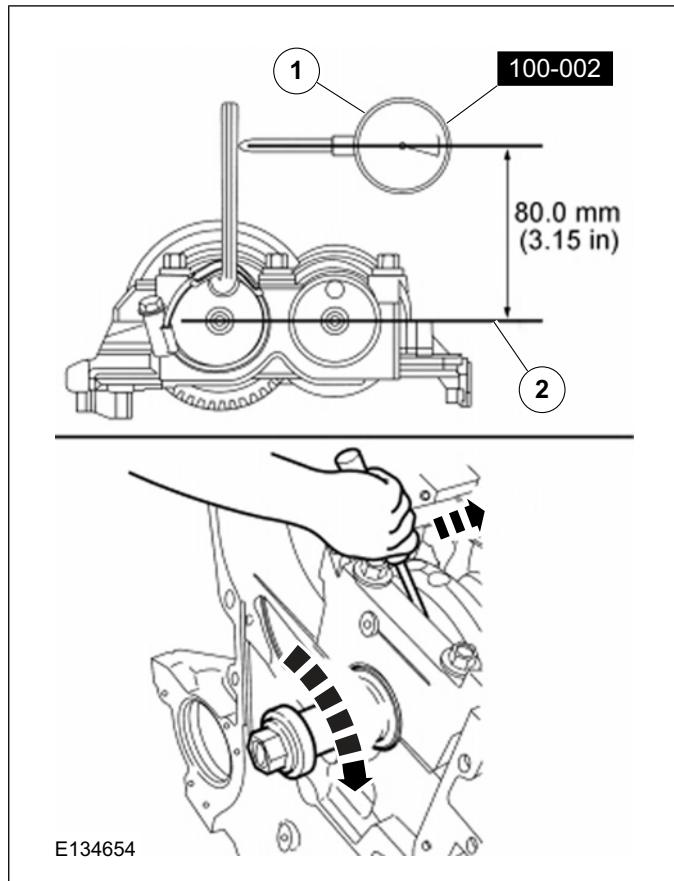
- Position the dial indicator gauge with holding fixture (1) on the allen wrench 80 mm (3.149

GENERAL PROCEDURES

in) above the driven gear shaft center (2) on the balancer unit.

Special Tool(s): 100-002

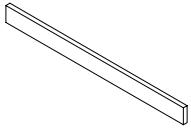
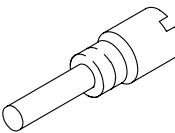
- Rotate the crankshaft clockwise and measure the backlash at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees.
- If the backlash exceeds the specified range of 0.005 to 0.101 mm (0.00019 to 0.0039 in), install a new balancer unit and repeat the procedure.



REMOVAL AND INSTALLATION

Camshafts(21 284 0)

Special Tool(s) / General Equipment

	303-465 Tool, Camshaft Align Timing E134673
	303-507 Timing Peg, Crankshaft TDC PZ21210
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.

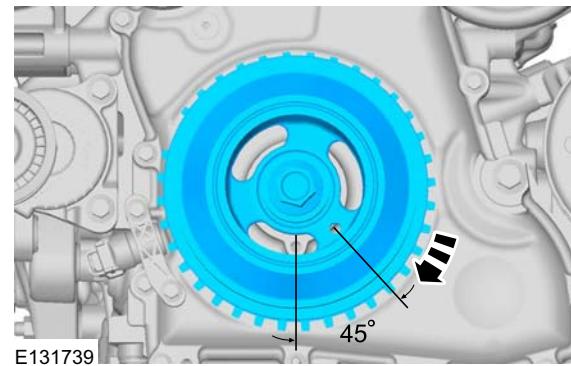
⚠ Do not rotate the camshafts unless instructed to in this procedure. Rotating the camshafts or crankshaft with timing components loosened or removed can

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.**

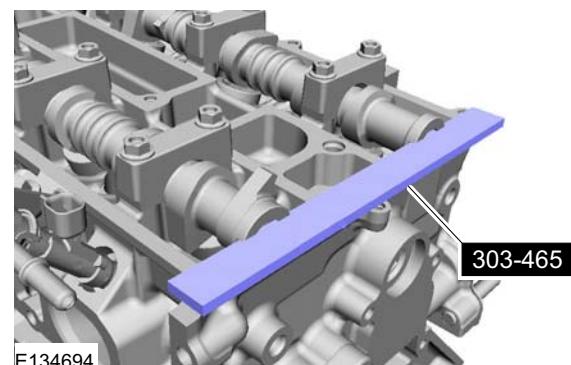
Turn the crankshaft until no. 1 piston is at about 45° before TDC.



4. **⚠ CAUTION: The camshaft alignment plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

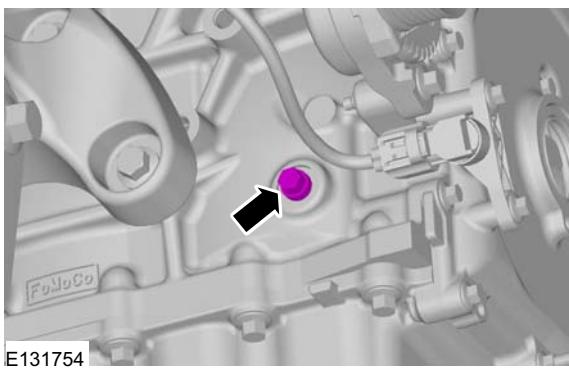
NOTE: The camshaft timing slots are offset. If the camshaft alignment plate cannot be installed, rotate the crankshaft one complete revolution clockwise to correctly position the camshafts.

Special Tool(s): 303-465

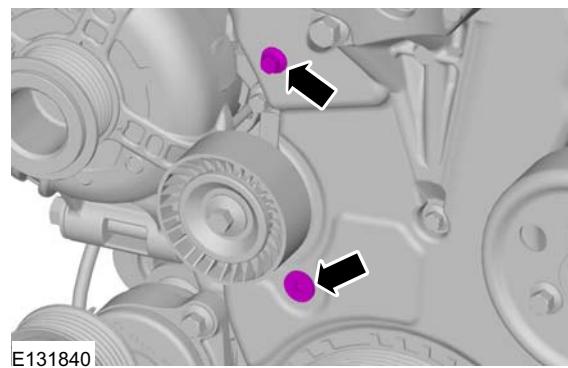


REMOVAL AND INSTALLATION

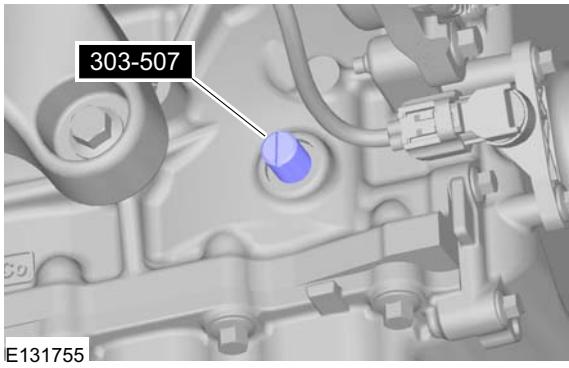
5.



8.

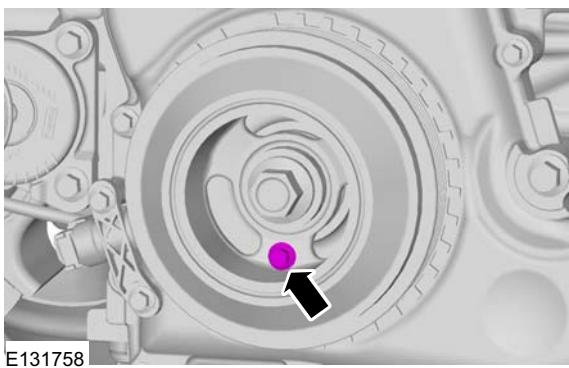


6. Special Tool(s): 303-507



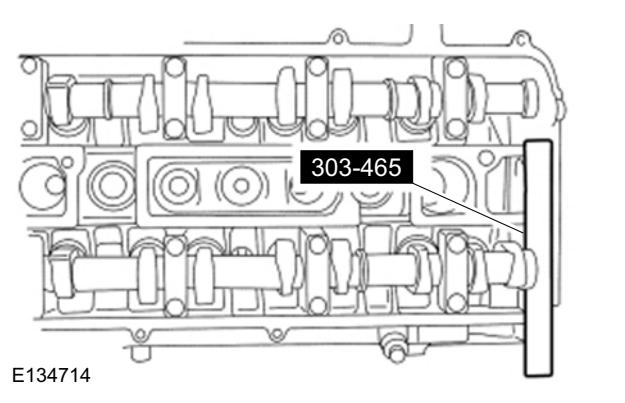
7. NOTE: Only tighten the bolt finger tight at this stage.

- Bolt M6 x 18 mm



9. Reposition the camshaft alignment plate to the slot on the rear of the intake camshaft only.

Special Tool(s): 303-465

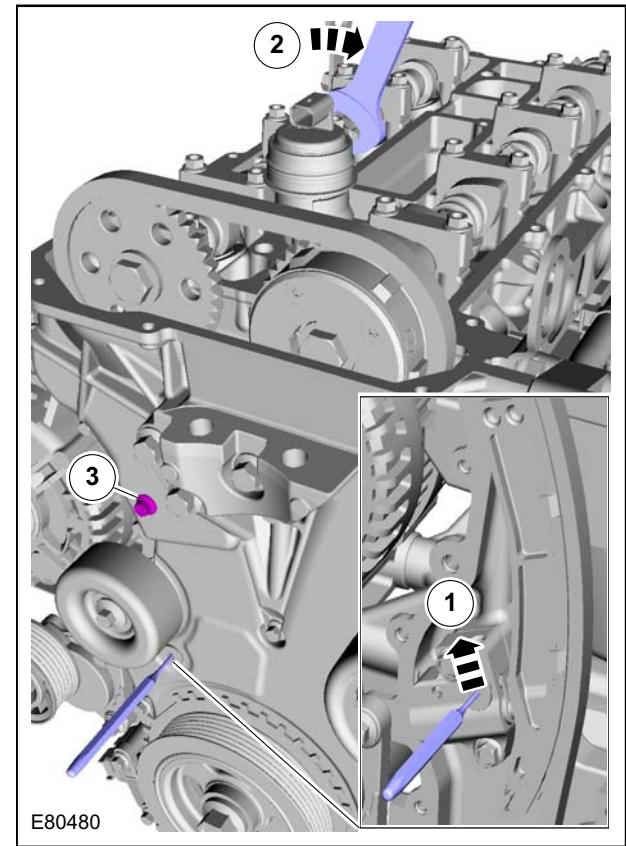


10. **CAUTION:** Releasing the ratcheting mechanism in the timing chain tensioner allows the plunger to collapse and create slack in the timing chain. Installing an M6 x 30 mm bolt into the upper front cover timing hole will hold the tensioner arm in a retracted position and allow enough slack in the timing

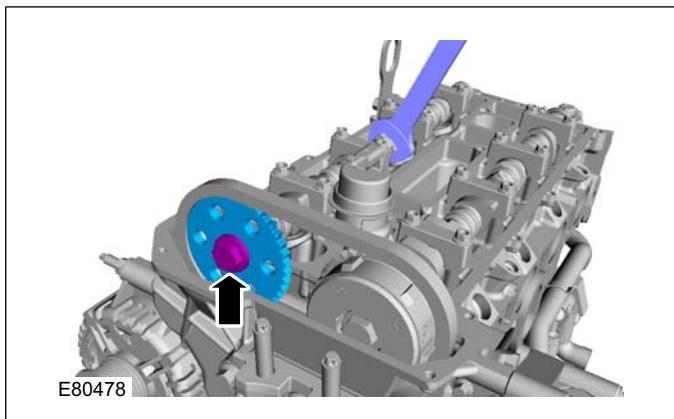
REMOVAL AND INSTALLATION

chain for removal of the exhaust camshaft gear.

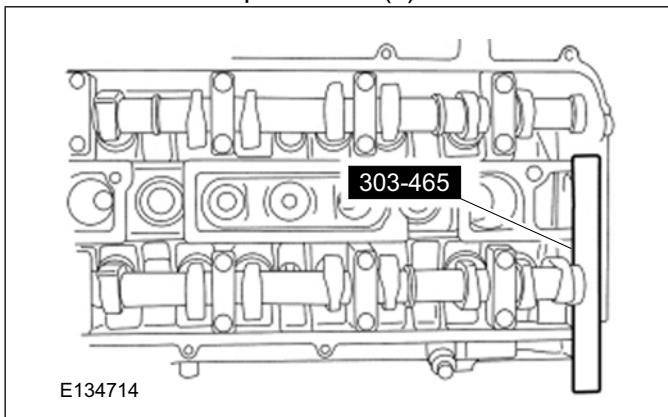
1. General Equipment: 2 mm Punch
3. Bolt M6 x 25 mm



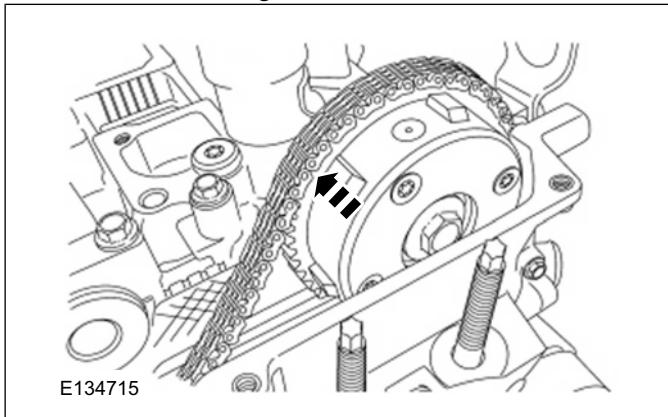
- 11. ! CAUTION: Counterhold the camshaft at the hexagon with a wrench to prevent the camshaft from rotating.**



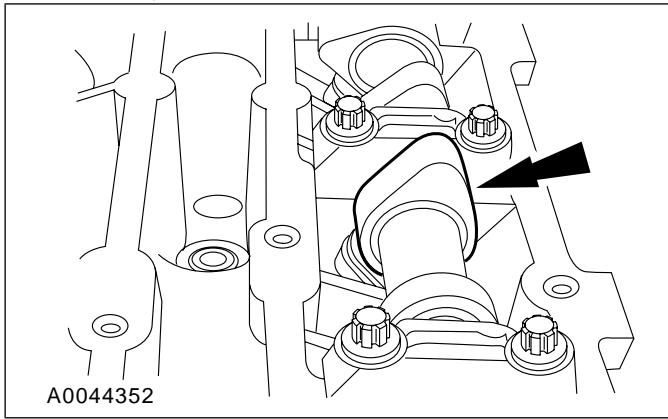
- 12 Remove the Special Tool(s): 303-465**



- 13. Remove the timing chain from the intake camshaft drive gear.**



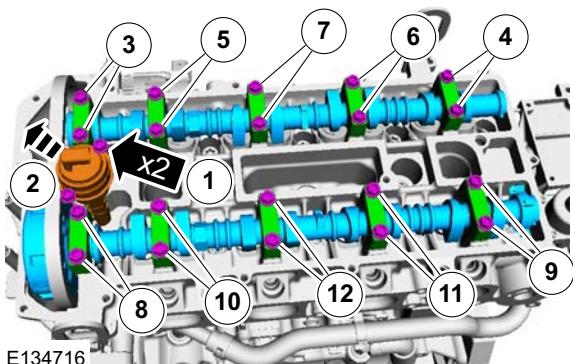
- 14. Mark the position of the camshaft lobes on the No. 1 cylinder for installation reference.**



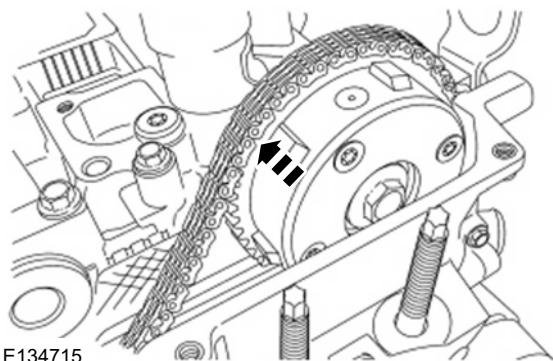
- 15. ! CAUTION: Failure to follow the camshaft loosening procedure can result in damage to the camshafts.**

REMOVAL AND INSTALLATION

NOTE: Mark the location and orientation of each camshaft bearing cap.



3. Install the timing chain on the intake camshaft drive gear.



Installation

1. **CAUTION:** Make sure that the camshafts and camshaft bearing caps are installed in their original locations.

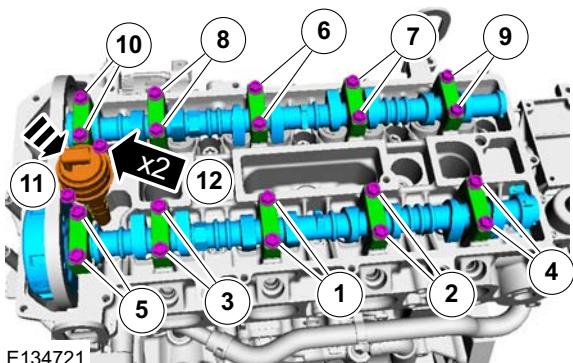
NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil.

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



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

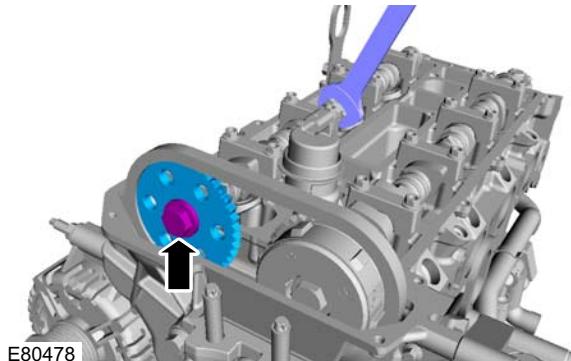
Adjust the valve clearance.

Refer to: **Valve Clearance Adjustment** (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, General Procedures).

4. **NOTE:** Only tighten the bolt finger tight at this stage.

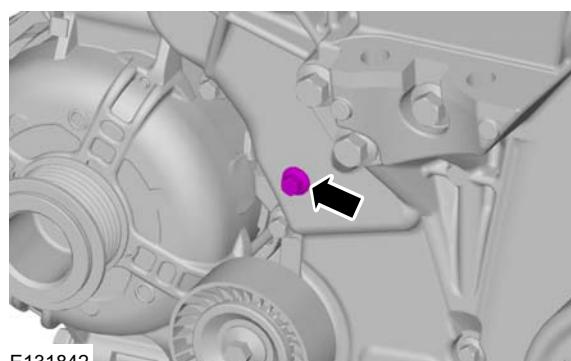
NOTE: Make sure that the camshaft sprockets can rotate on the camshafts.

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.



5. **NOTE:** Releasing the tensioner arm will remove the slack from the timing chain.

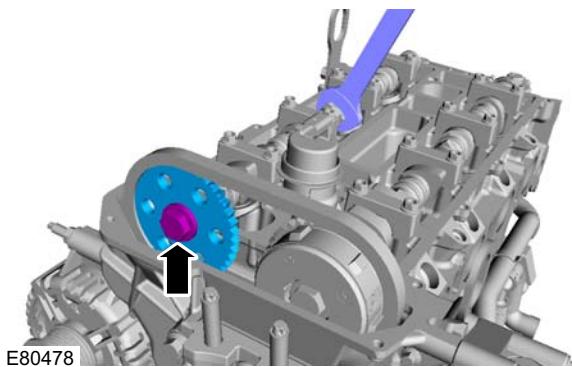
Remove the bolt M6 x 30mm.



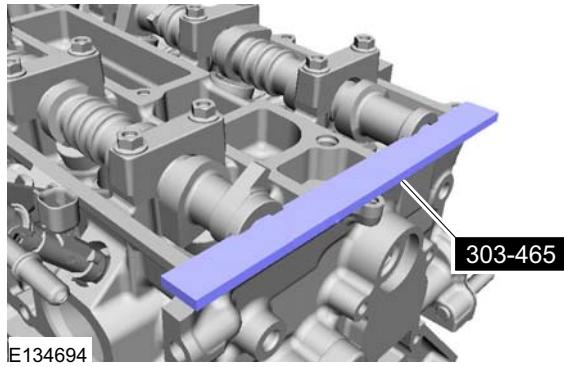
REMOVAL AND INSTALLATION

- 6.** **⚠ CAUTION:** Counterhold the camshaft at the hexagon with a wrench to prevent the camshaft from rotating.

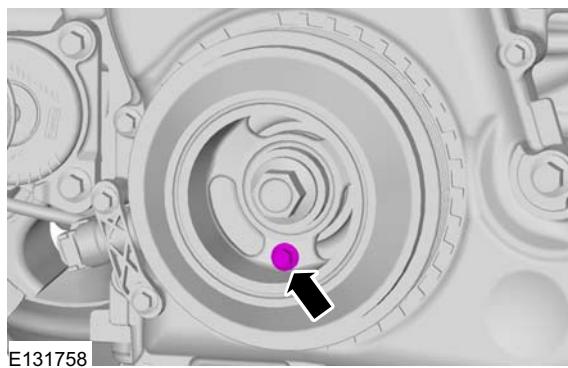
Torque: 72 Nm



- 7.** Remove the Special Tool(s): 303-465



- 8.** Remove the bolt M6 x 18 mm.

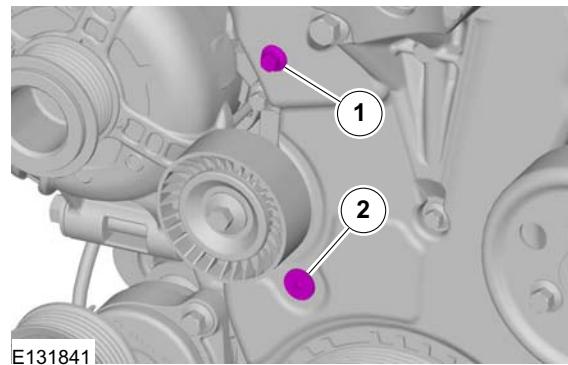


- 9.** Remove the Special Tool(s): 303-507

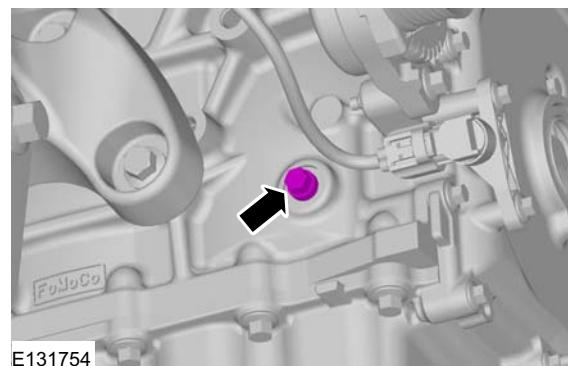


- 10.** • Material: Thread Locking MS
(WSK-M2G349-A7 / 2U7J-M2G349-AA)
adhesive

1. Torque: 10 Nm
2. Torque: 12 Nm



- 11.** Torque: 20 Nm



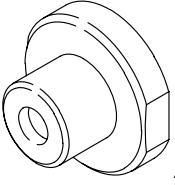
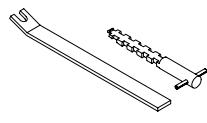
- 12** Refer to: [Valve Cover \(303-01 Engine - 2.5L Duratec-HE \(122kW/165PS\) - MI4, Removal and Installation\).](#)

- 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)

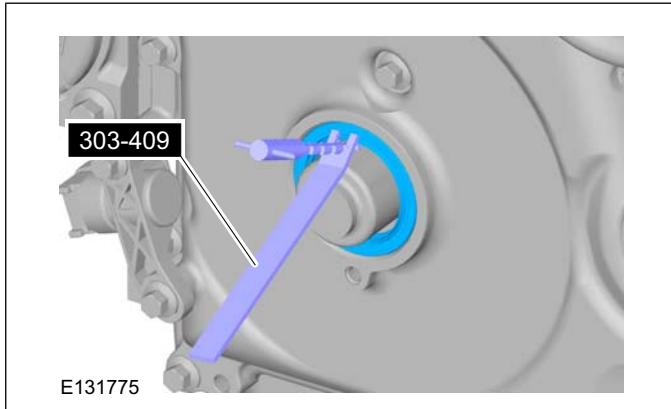
Special Tool(s)

	303-318 Aligner/Installer, Crankshaft Front Seal 21148
	303-409 Remover Crankshaft Seal E134603

Removal

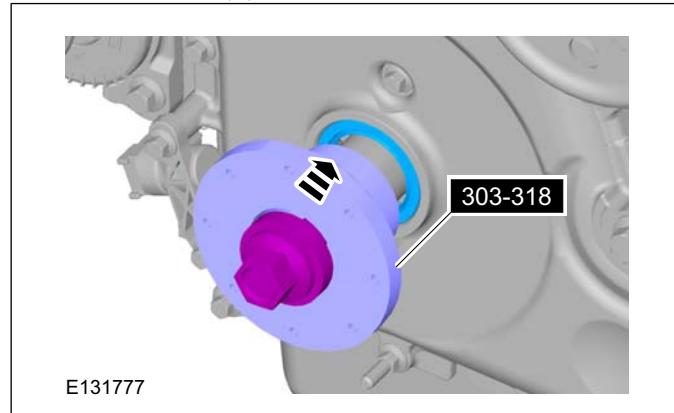
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: **Crankshaft Pulley** (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
2. Special Tool(s): 303-409

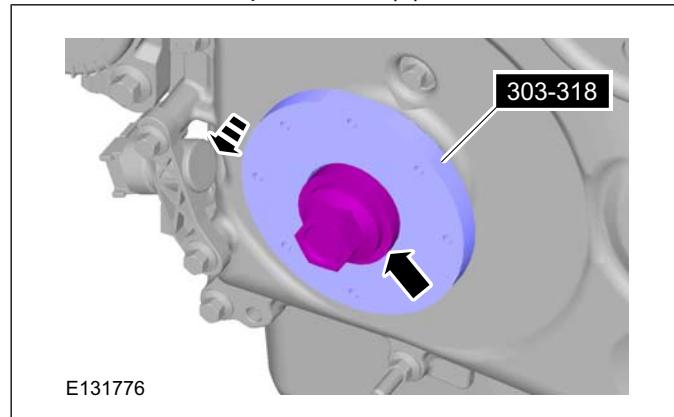


Installation

1. Special Tool(s): 303-318

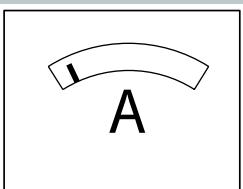


2. Remove the Special Tool(s): 303-318

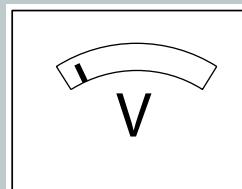


3. To install, reverse the removal procedure.

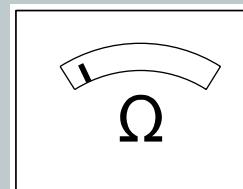
DESCRIPTION AND OPERATION



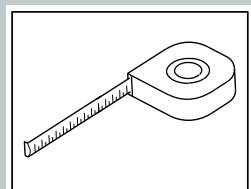
1



2



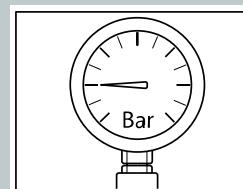
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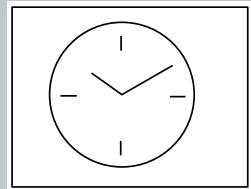
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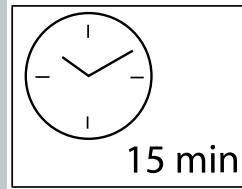
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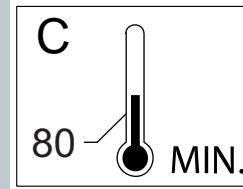
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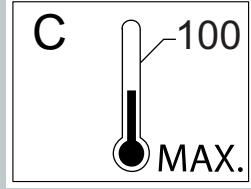
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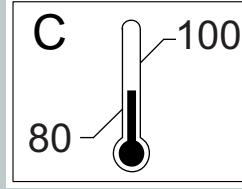
8



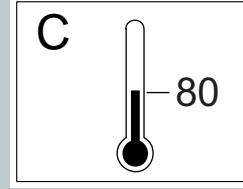
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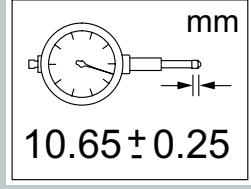
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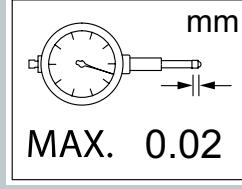
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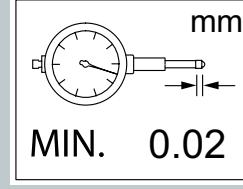
12



13



14

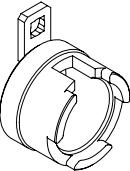
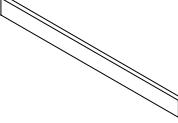
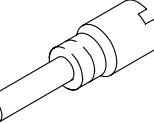


15

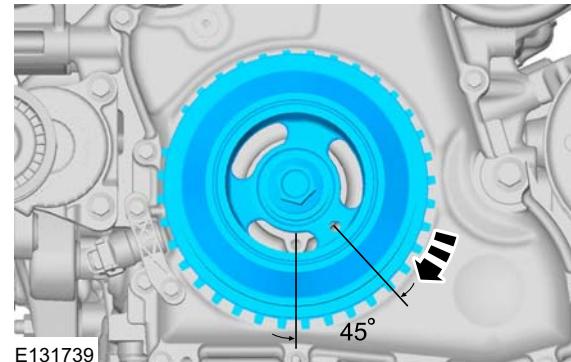
REMOVAL AND INSTALLATION

Crankshaft Pulley(21 572 0)

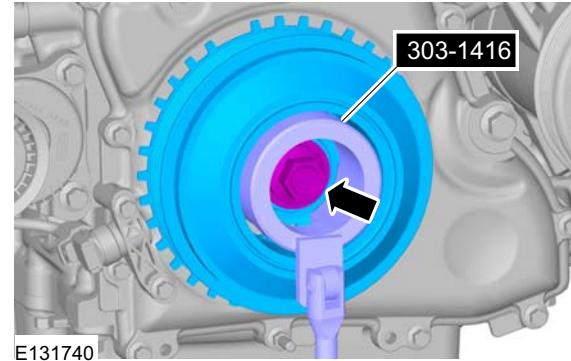
Special Tool(s)

	303-1416 Tool, Crank Damper Holding E134674
	303-465 Tool, Camshaft Align Timing E134673
	303-507 Timing Peg, Crankshaft TDC PZ21210

Turn the crankshaft until no. 1 piston is at about 45° before TDC.



4. Special Tool(s): 303-1416



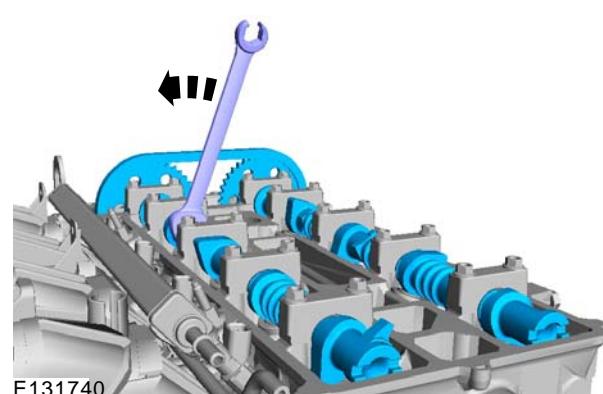
Removal

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.
3. Refer to: **Valve Cover** (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
4. **WARNING:** Only rotate the crankshaft clockwise.

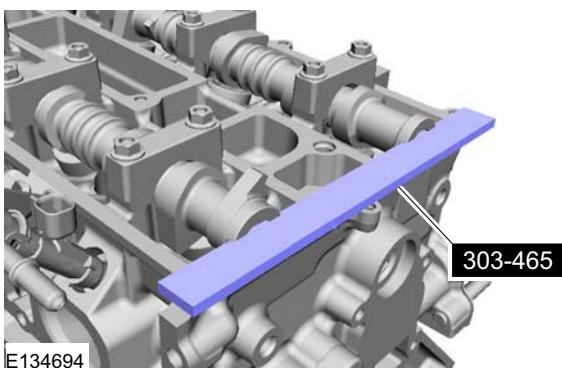
Installation

1. **WARNING:** Only rotate the camshaft clockwise.
- Turn the camshafts to cylinder no. 4 valve overlap position.

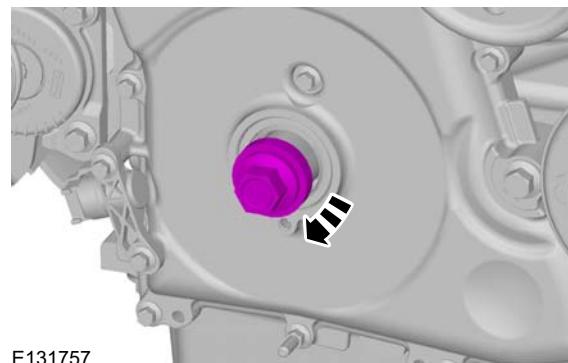


REMOVAL AND INSTALLATION

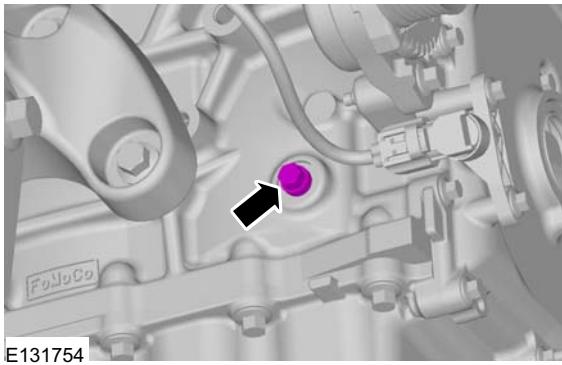
2. Special Tool(s): 303-465



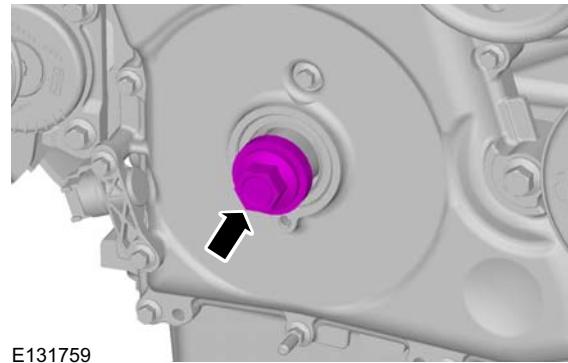
Turn the crankshaft until it stops against the special tool.



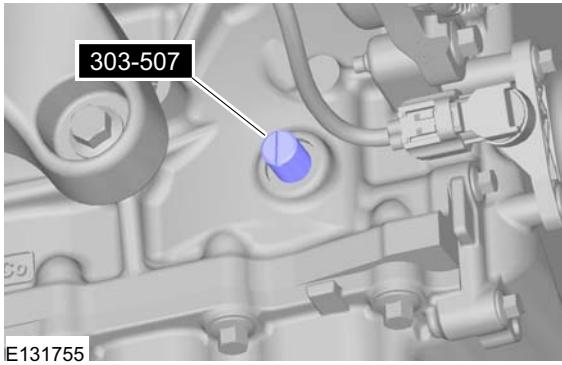
3.



6.

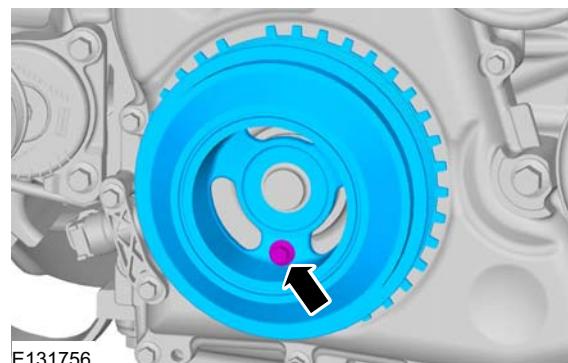


4. Special Tool(s): 303-507



7. NOTE: Only tighten the bolt finger tight at this stage.

- Install the bolt M6 x 18 mm.



5. **WARNING:** Only rotate the crankshaft clockwise.

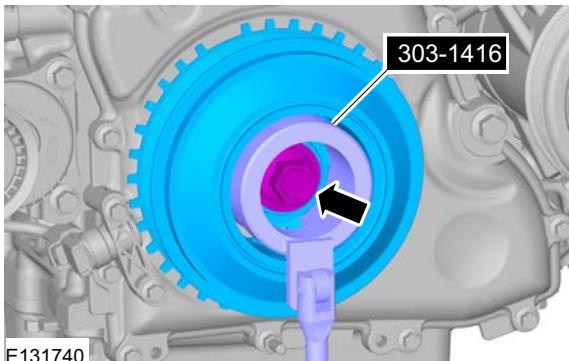
REMOVAL AND INSTALLATION

8.  **CAUTION:** Make sure that a new bolt is installed.

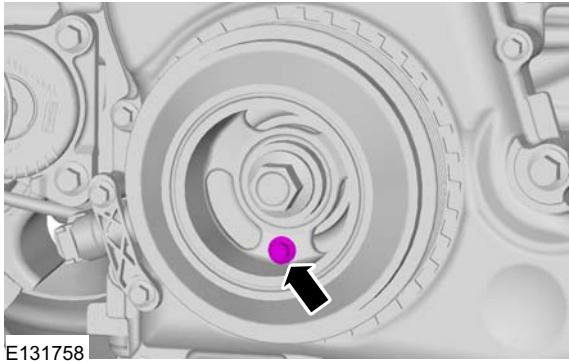
Special Tool(s): 303-1416

Torque:

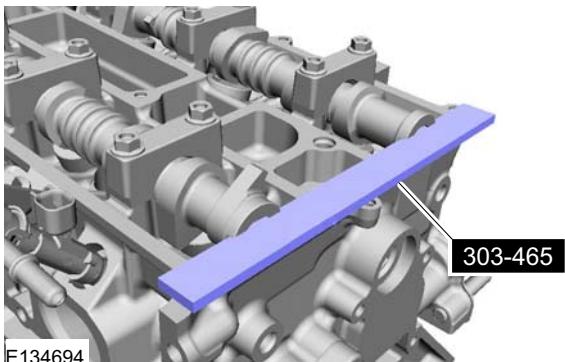
- Stage 1: 100 Nm
- Stage 2: 90°



9. Remove the bolt M6 x 18 mm.



10. Remove the Special Tool(s): 303-465

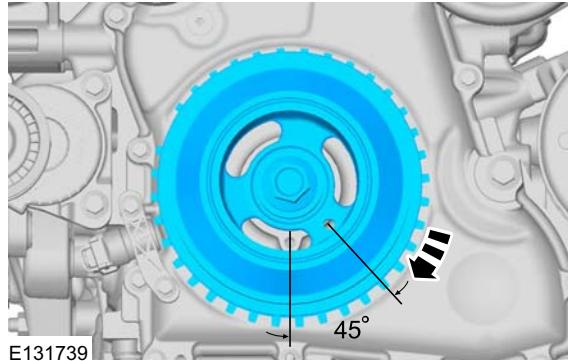


11. Remove the Special Tool(s): 303-507



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.

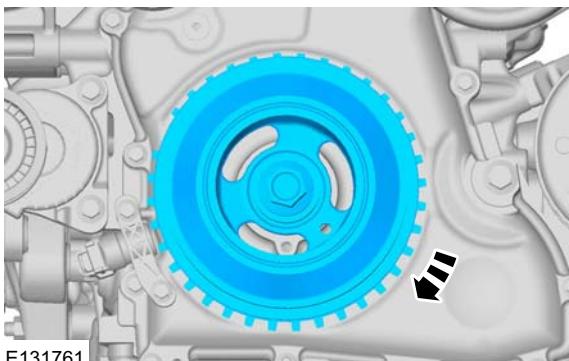
Special Tool(s): 303-507



14.  **WARNING:** Only rotate the crankshaft clockwise.

REMOVAL AND INSTALLATION

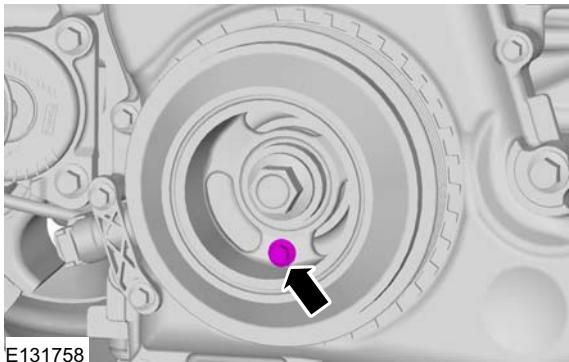
Turn the crankshaft until it stops against the special tool.



15. NOTE: Only tighten the bolt finger tight at this stage.

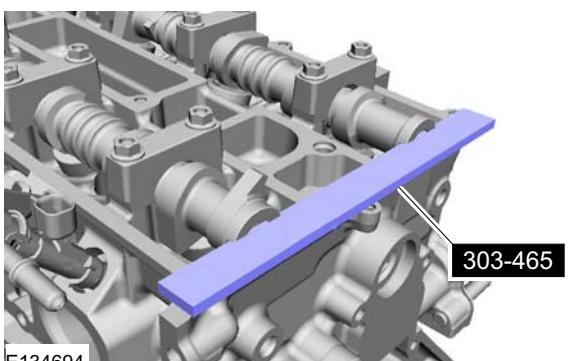
NOTE: The bolt can only be installed if the valve timing is correct.

- Install the bolt M6 x 18 mm.

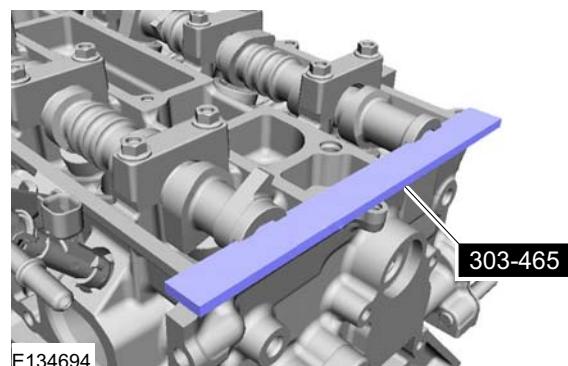


16. NOTE: The special tool may only be installed if the valve timings are correct.

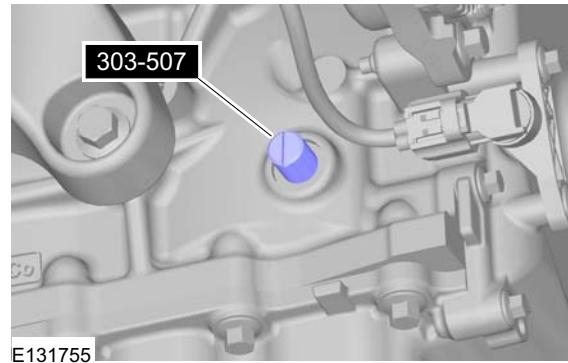
Special Tool(s): 303-465



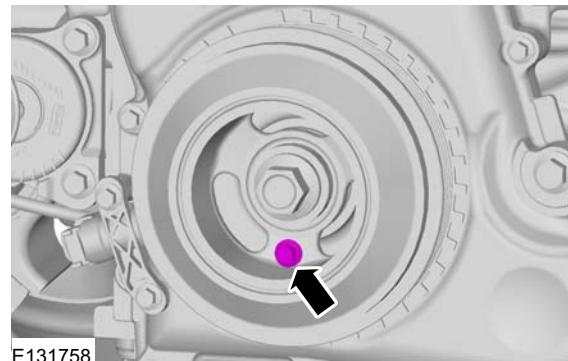
17. Remove the Special Tool(s): 303-465



18. Remove the Special Tool(s): 303-507

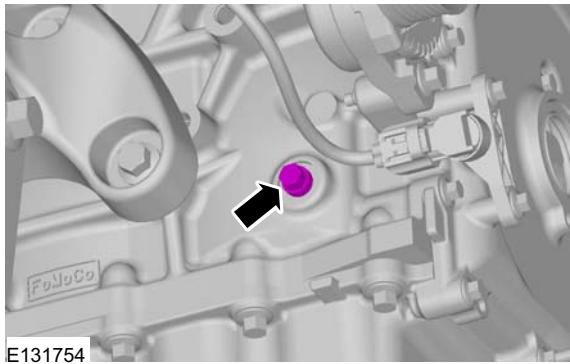


19. Remove the bolt M6 x 18 mm.



REMOVAL AND INSTALLATION

20. Torque: 20 Nm

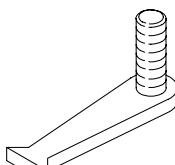
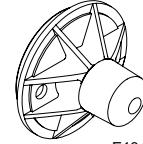


21. To install reverse the removal procedure.

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

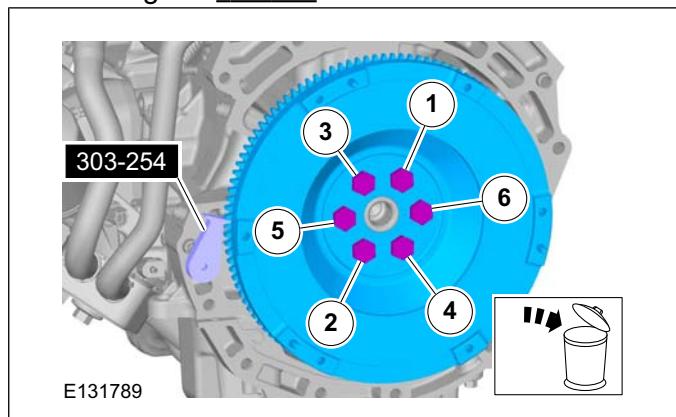
NOTE: Removal steps in this procedure may contain installation details.

- Refer to: **Clutch Disc and Pressure Plate** (308-01 Clutch - Vehicles With: 5-Speed Manual Transmission - MT75, Removal and Installation).
- Discard the flywheel bolts.

Special Tool(s): 303-254

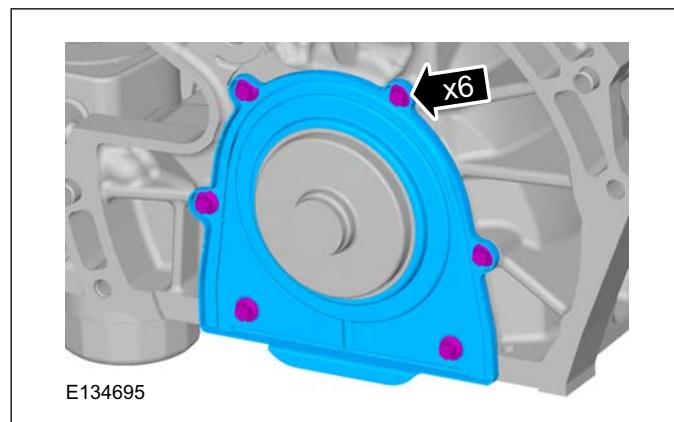
Torque:

- Stage 1: 50 Nm
- Stage 2: 80 Nm
- Stage 3: 112 Nm



- Refer to: **Oil Pan** (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

4.



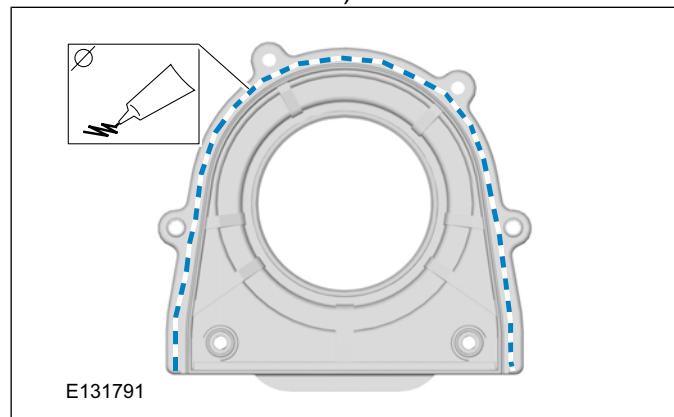
Installation

- 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.

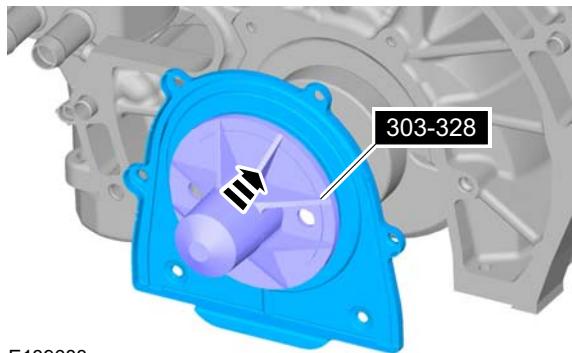
Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



REMOVAL AND INSTALLATION

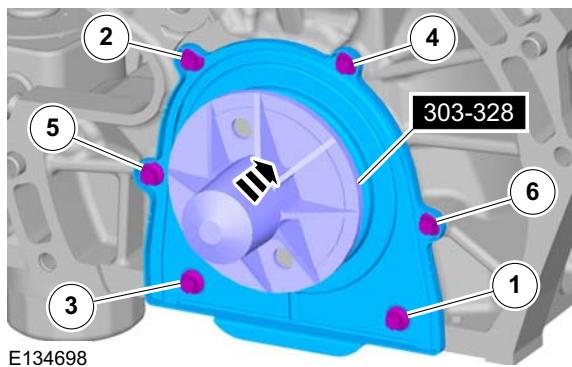
2. Using the crankshaft rear main oil seal installer, position the crankshaft rear oil seal with retainer plate onto the crankshaft.

Special Tool(s): 303-328

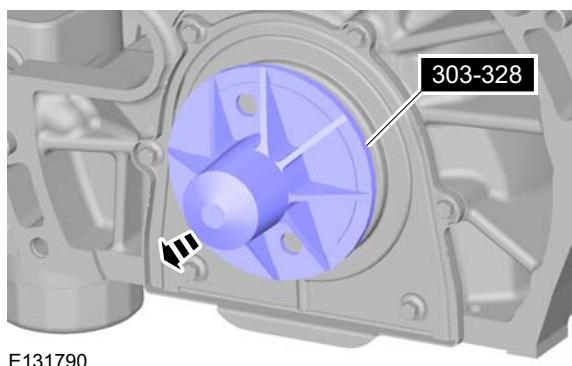


3. Special Tool(s): 303-328

Torque: 10 Nm



4. Remove the Special Tool(s): 303-328



5. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Cylinder Head(21 163 0)

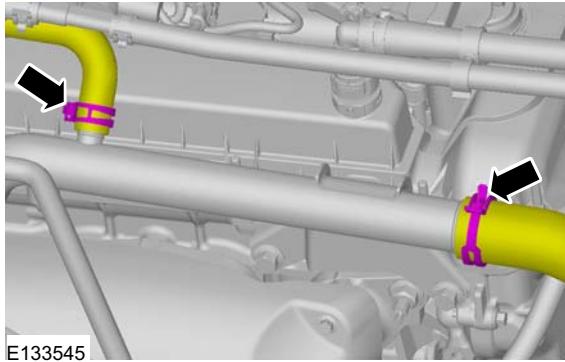
Materials

Name	Specification
Hypoid Oil 85W-90	SQ-M2C9002-AA / A72SX-19K261-CA

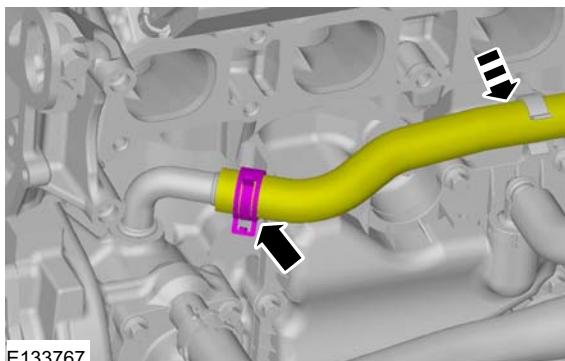
Removal

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

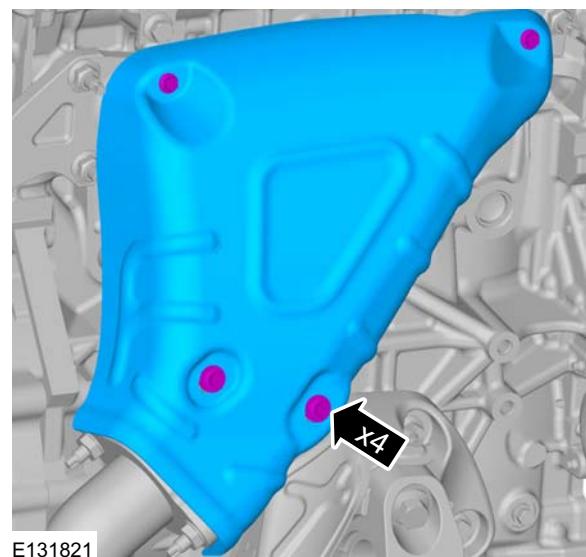
1. Refer to: **Cooling System Draining, Filling and Bleeding** (303-03 Engine Cooling, General Procedures).
2. Refer to: **Timing Chain** (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
- 3.



4.



5. Torque: 10 Nm

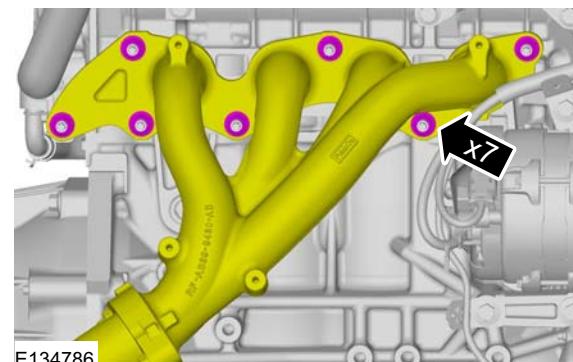


6. CAUTIONS:

- ⚠ Over bending the exhaust flexible pipe may cause damage resulting in failure.**
- ⚠ Make sure that the catalytic converter is supported with suitable retaining straps.**

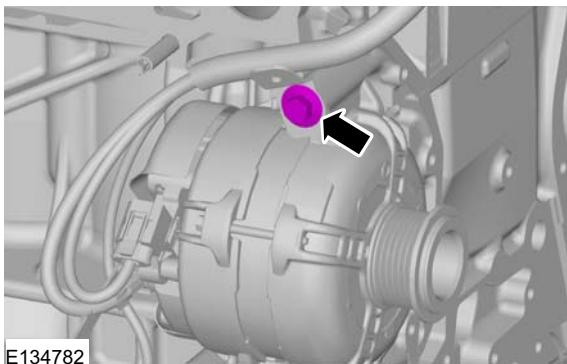
NOTE: The gasket is to be reused unless damaged.

Torque: 48 Nm

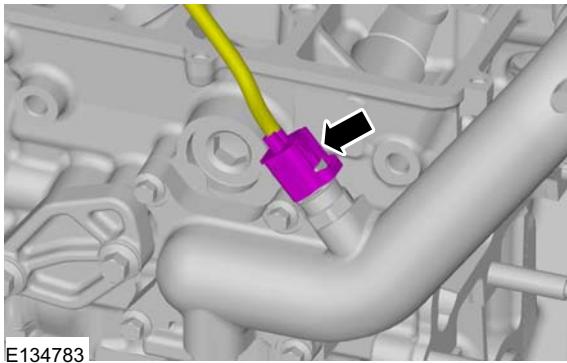


REMOVAL AND INSTALLATION

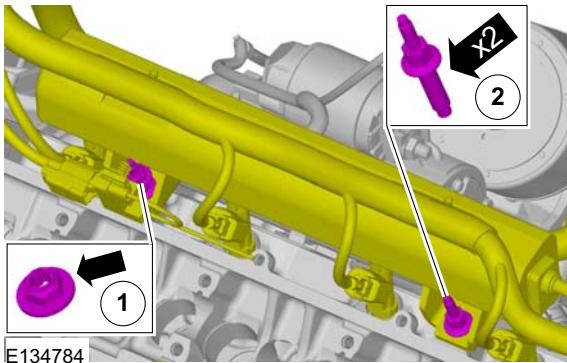
7. Torque: 48 Nm



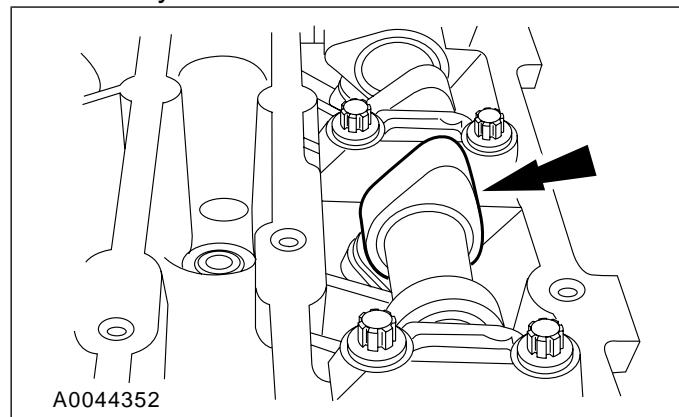
8.



9. Torque: 23 Nm



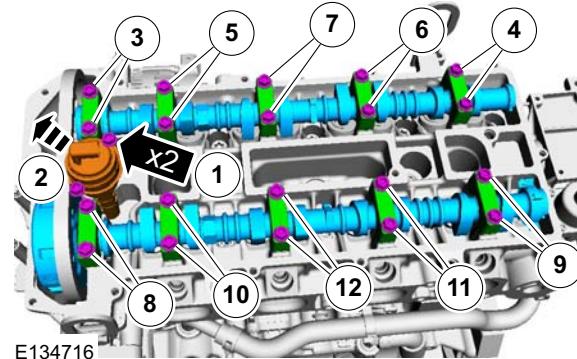
10. Mark the position of the camshaft lobes on the No. 1 cylinder for installation reference.



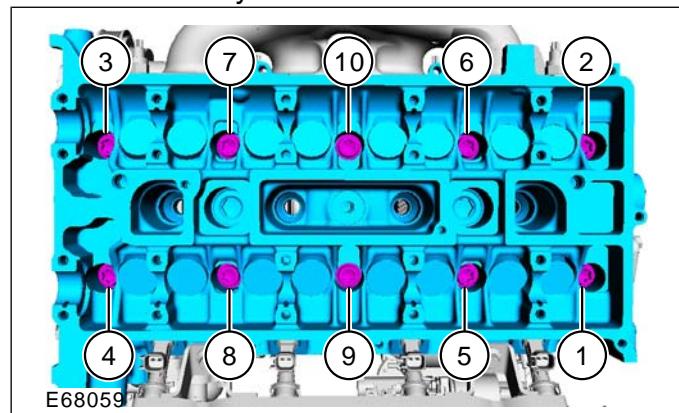
11. CAUTIONS:

- ⚠ 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.



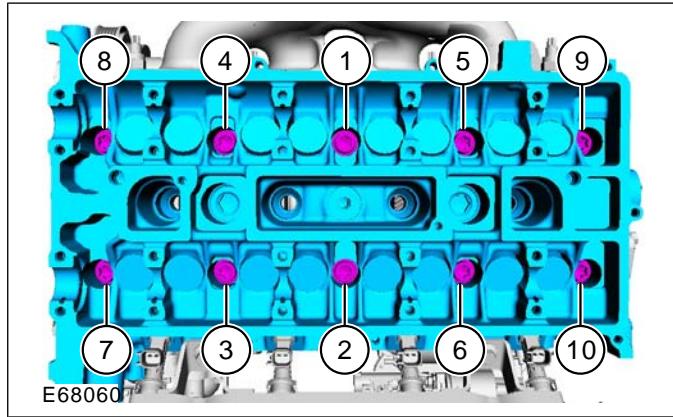
REMOVAL AND INSTALLATION

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°



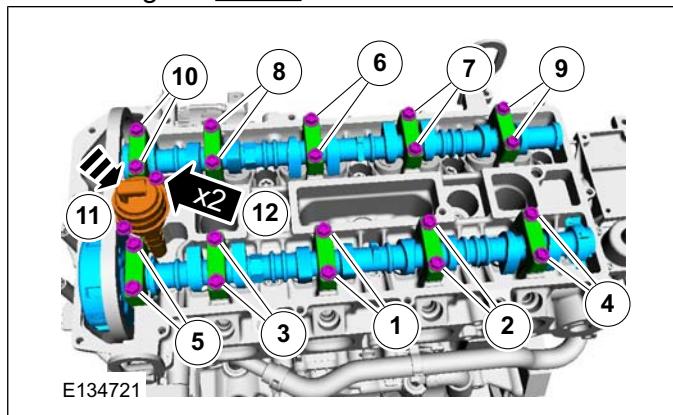
2. ! CAUTION: Make sure that the camshafts and camshaft bearing caps are installed in their original locations.

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.

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

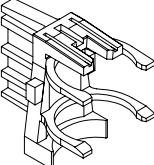
General equipment symbols

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

REMOVAL AND INSTALLATION

Engine Front Cover

Special Tool(s)

	303-1417 Tool, Crank Sensor Alignment
E134676	

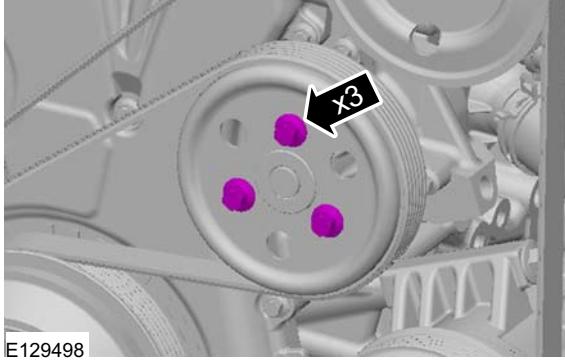
Materials

Name	Specification
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

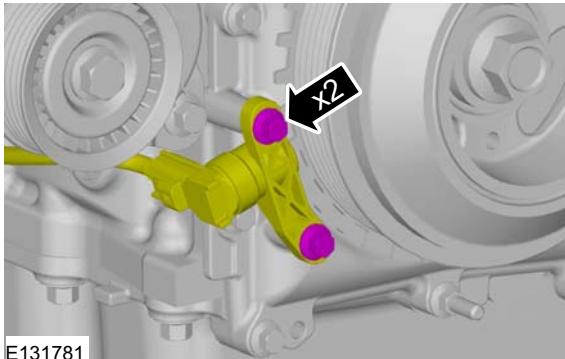
Removal

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

1. Loosen: 3 turn(s)

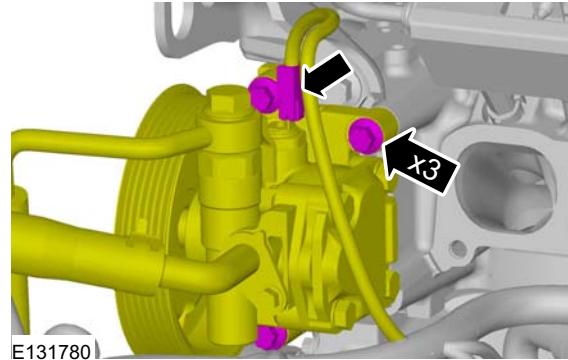


2.



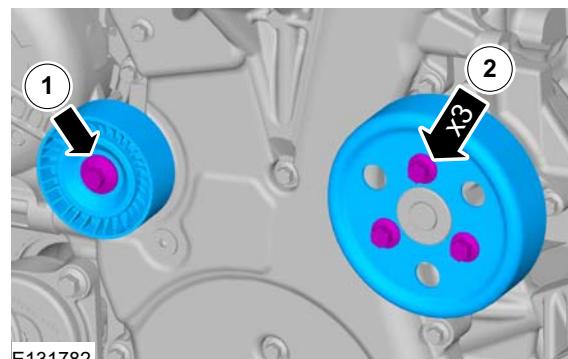
3. Refer to: [Crankshaft Pulley \(303-01 Engine - 2.5L Duratec-HE \(122kW/165PS\) - MI4, Removal and Installation\).](#)

4. Torque: 20 Nm



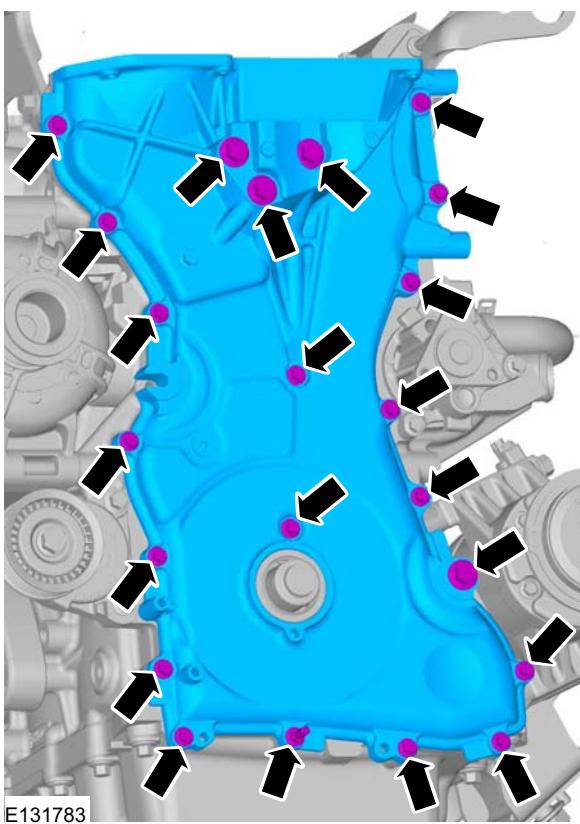
5. 1. Torque: 25 Nm

2. Torque: 20 Nm



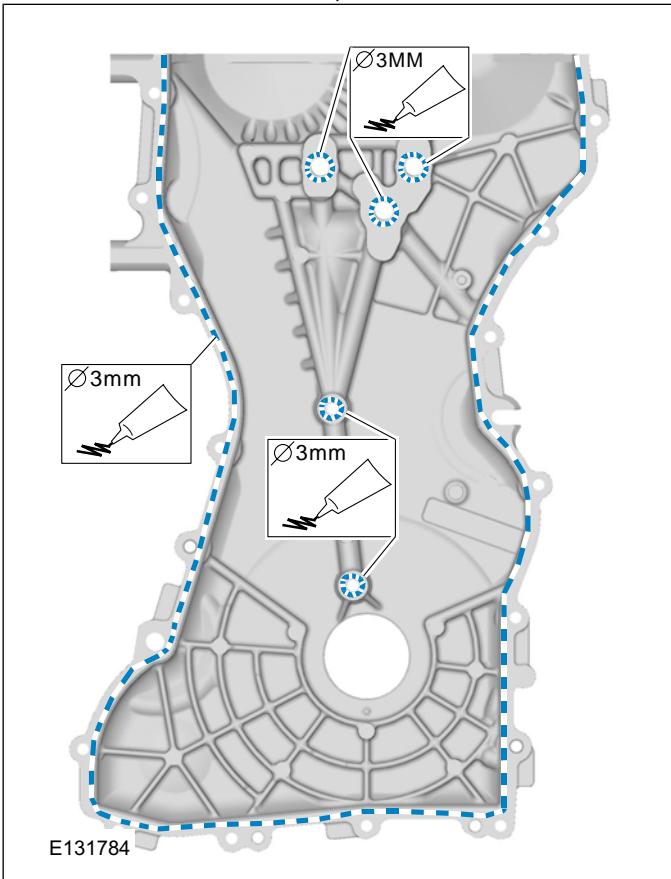
REMOVAL AND INSTALLATION

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.**

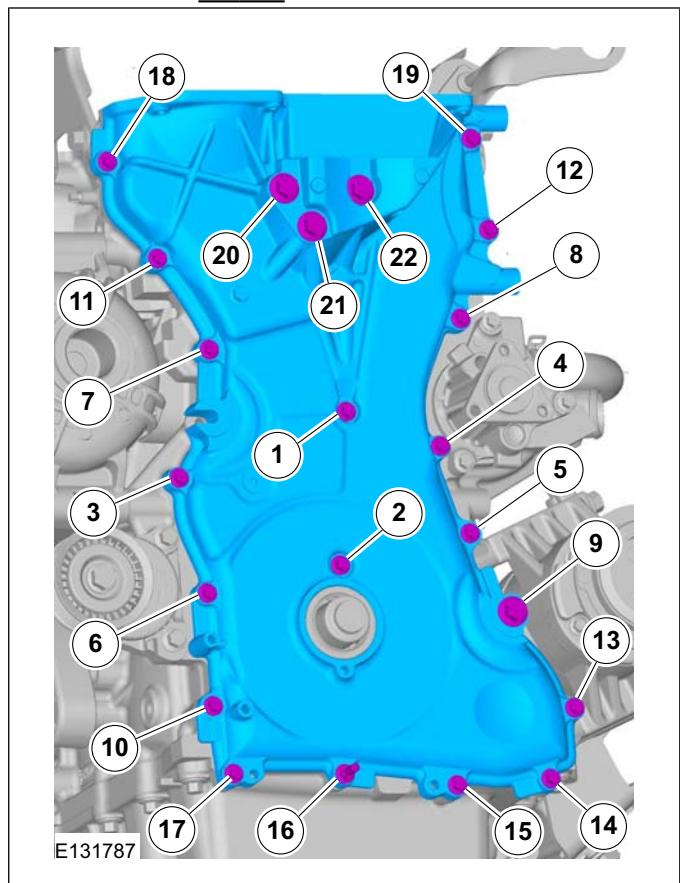
NOTE: Do not damage the mating faces.

NOTE: Mating surface should not have traces of oil to improve the adhesion.

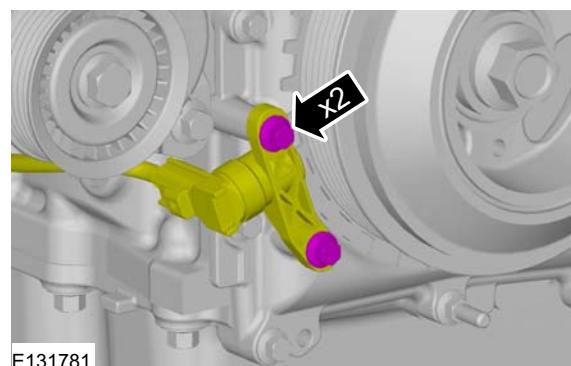
REMOVAL AND INSTALLATION

2. Torque:

- 1 - 8 10 Nm
- 9 48 Nm
- 10 - 19 10 Nm
- 20 - 22 48 Nm



5. Torque: 7 Nm



3. To install, reverse the removal procedure.

4. Special Tool(s): 303-1417



REMOVAL AND INSTALLATION

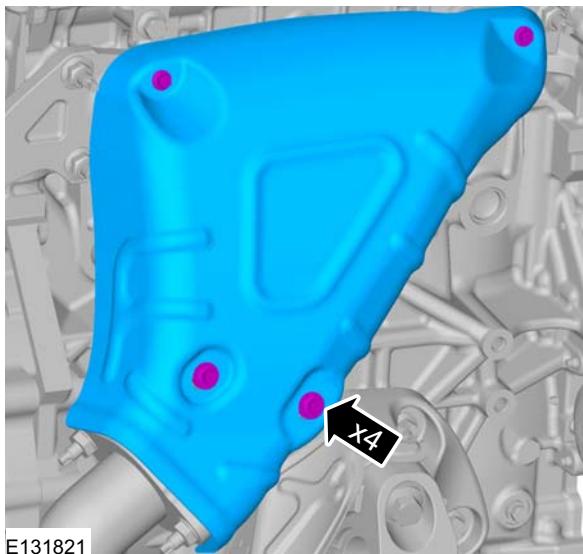
Exhaust Manifold(21 187 0)

Removal

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

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

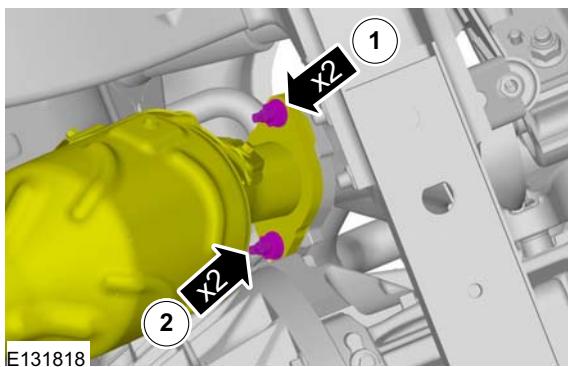
2. Torque: 10 Nm



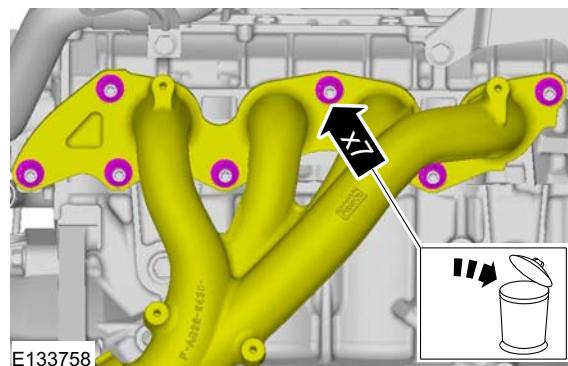
3. **CAUTION:** Over bending the exhaust flexible pipe may cause damage resulting in failure.

NOTE: Securely strap the exhaust flexible pipe to the frame.

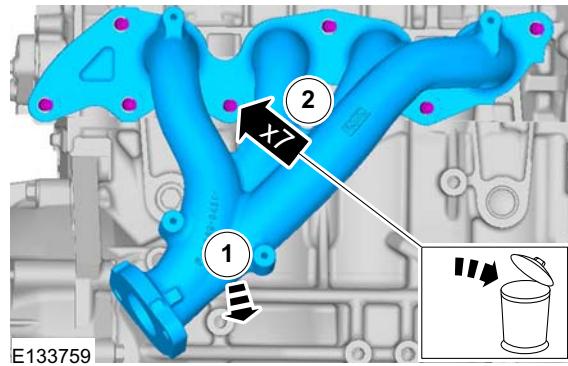
1. Remove the exhaust pipe flange nuts.
Torque: 48 Nm
2. Remove the exhaust pipe flange studs.
Torque: 25 Nm



4.

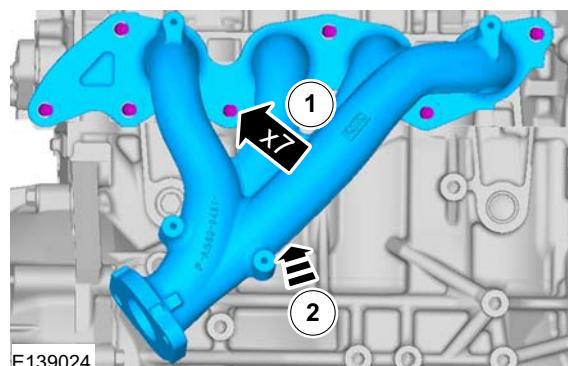


5.



Installation

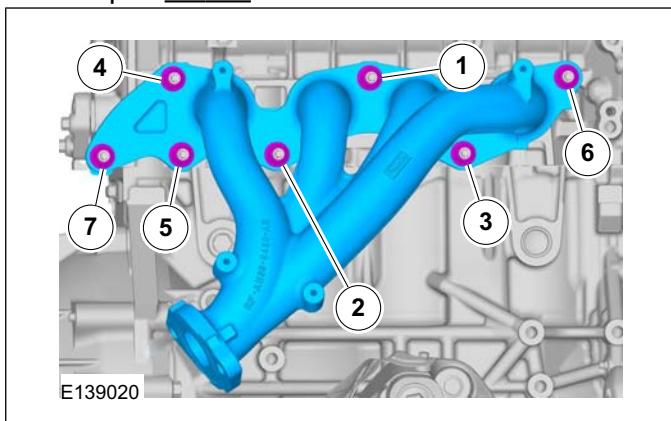
1. Torque: 17 Nm



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

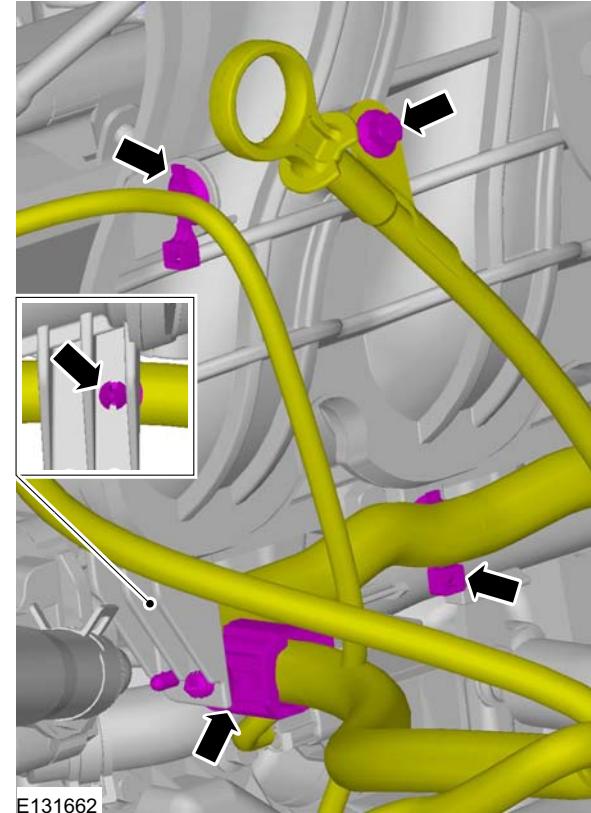
NOTE: Removal steps in this procedure may contain installation details.

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).

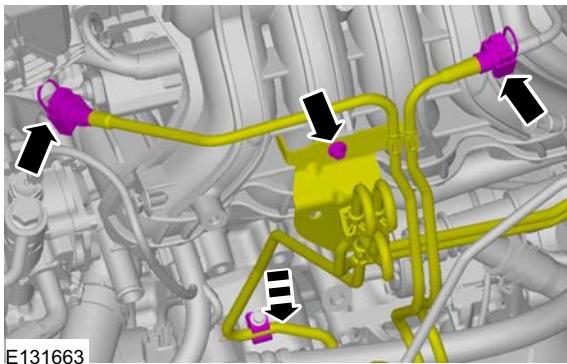
2. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
3. Refer to: **Throttle Body** (303-04 Fuel Charging and Controls - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
4. Refer to: **Fuel System Pressure Release** (310-00 Fuel System - General Information - 2.5L Duratec-HE (122kW/165PS) - MI4, General Procedures).
5. Torque: 10 Nm



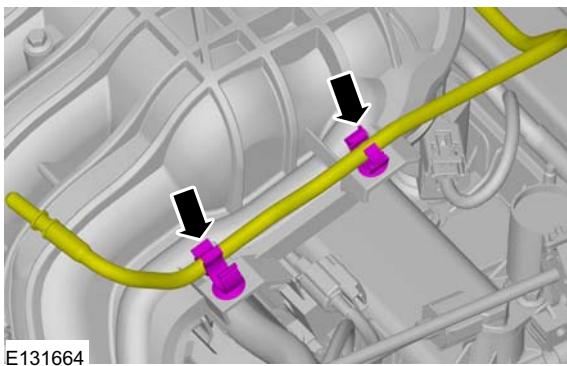
REMOVAL AND INSTALLATION

6. NOTE: Securely strap the fuel and breather tubes.

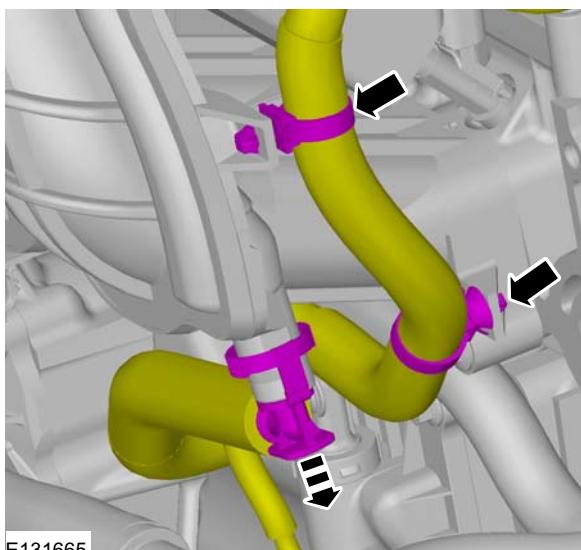
Torque: 8 Nm



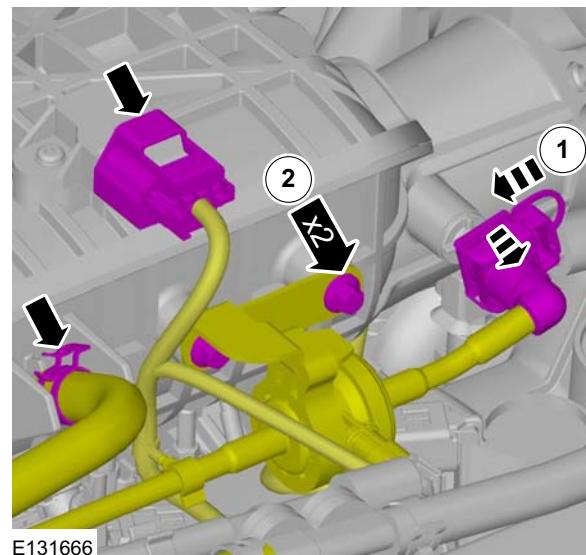
7.



8.

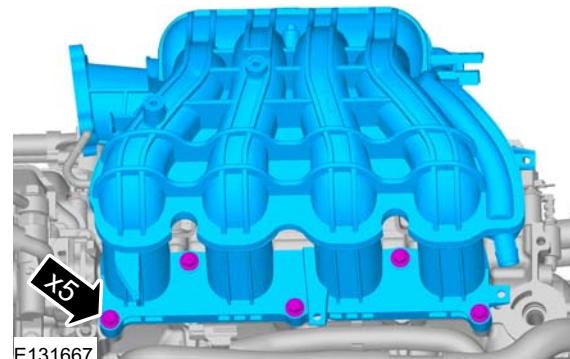


9. Torque: 11 Nm



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)

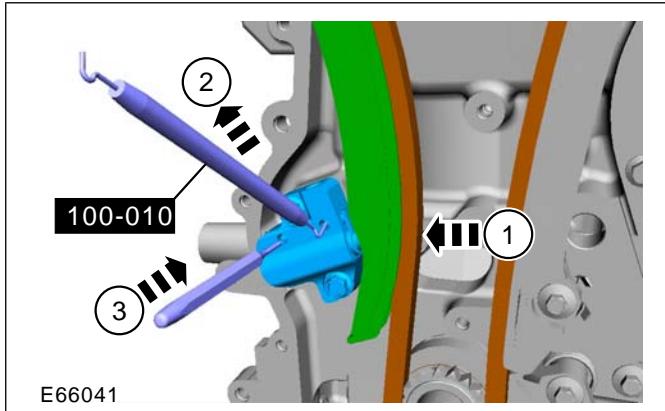
Special Tool(s) / General Equipment

	100-010 Remover, O-Ring Seal 17063
	303-465 Tool, Camshaft Align Timing E134673
2 mm Punch	

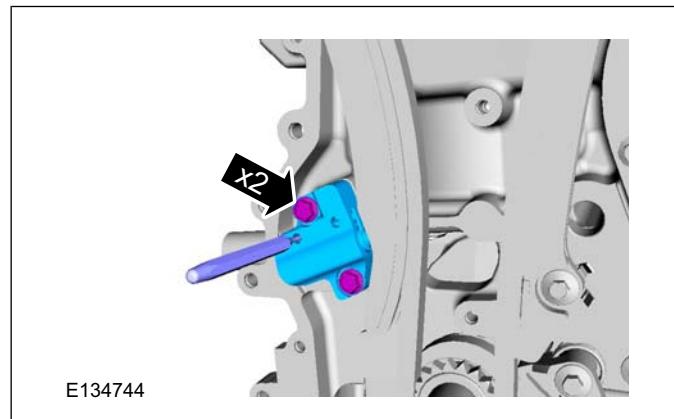
Removal

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

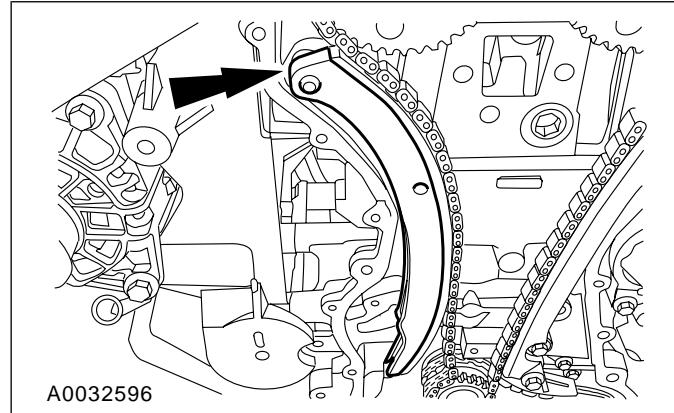
1. Refer to: **Engine Front Cover** (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).
2. Special Tool(s): 100-010
3. General Equipment: 2 mm Punch



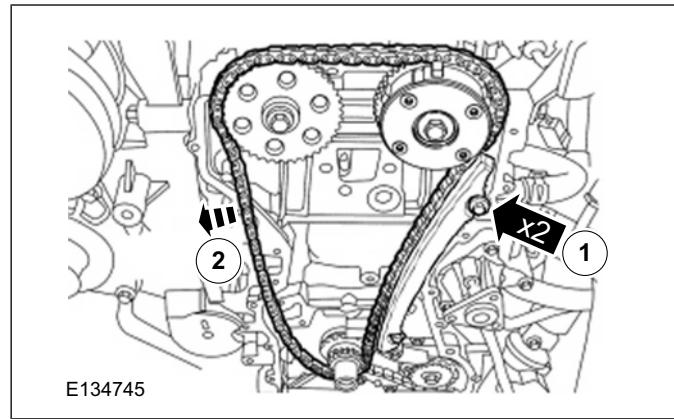
3.



4. Remove the timing chain tensioner arm.



5.



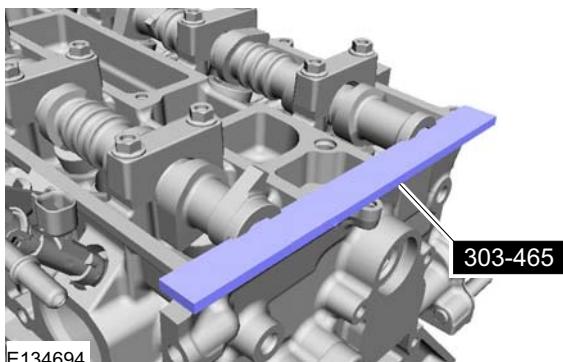
Installation

1. **CAUTION:** Only rotate the camshaft clockwise.

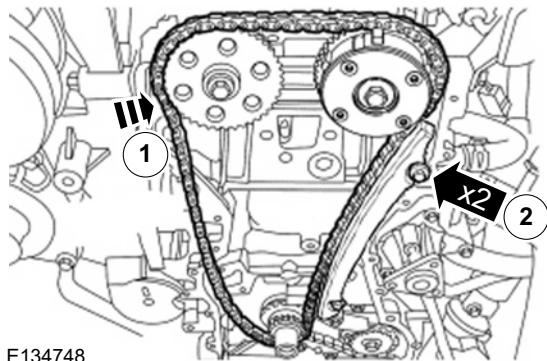
REMOVAL AND INSTALLATION

Turn the camshafts to cylinder no. 4 valve overlap position.

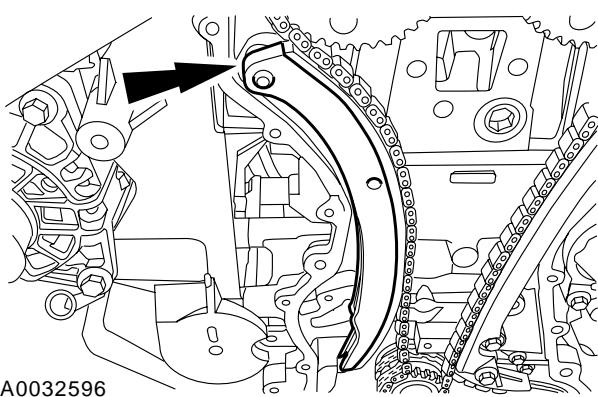
Special Tool(s): 303-465



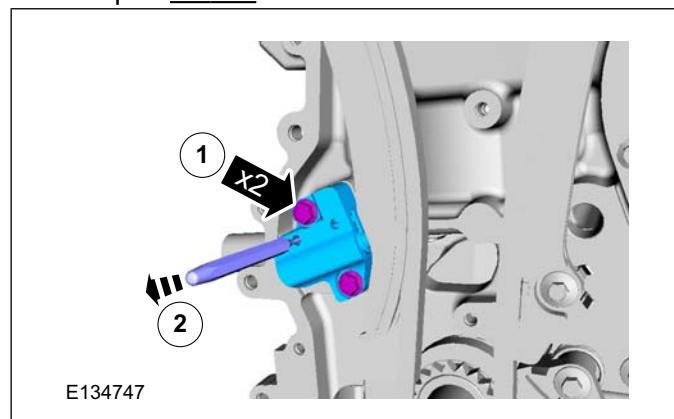
2. Torque: 10 Nm



3.

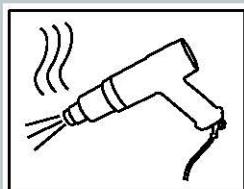


4. Torque: 10 Nm

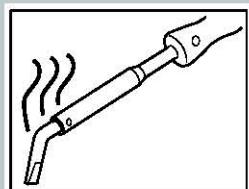


5. Refer to: [Engine Front Cover \(303-01 Engine - 2.5L Duratec-HE \(122kW/165PS\) - MI4, Removal and Installation\).](#)

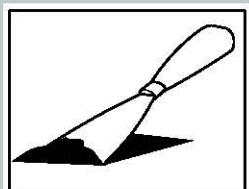
DESCRIPTION AND OPERATION



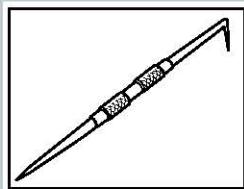
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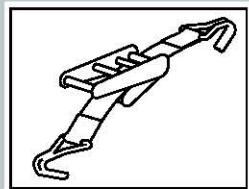
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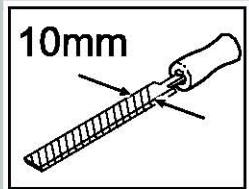
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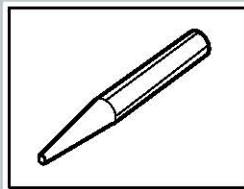
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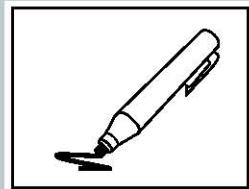
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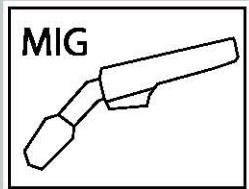
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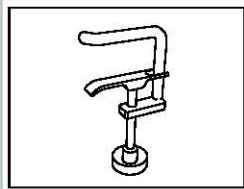
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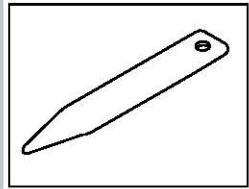
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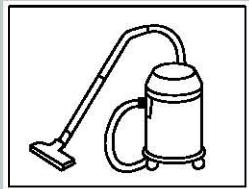
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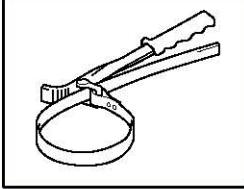
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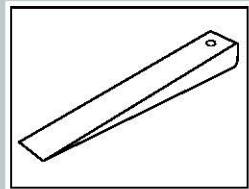
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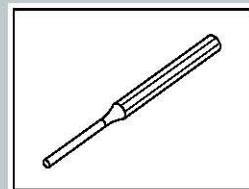
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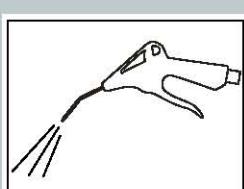
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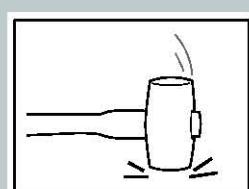
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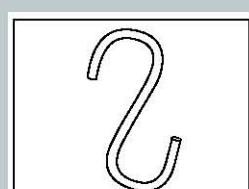
15



16



17



18

E88979

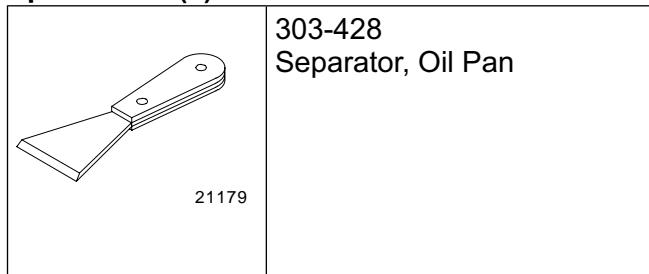
Item	Description
1	Hot air gun
2	Soldering iron

Item	Description
3	Scraper
4	Scriber

REMOVAL AND INSTALLATION

Oil Pan(21 154 0)

Special Tool(s)



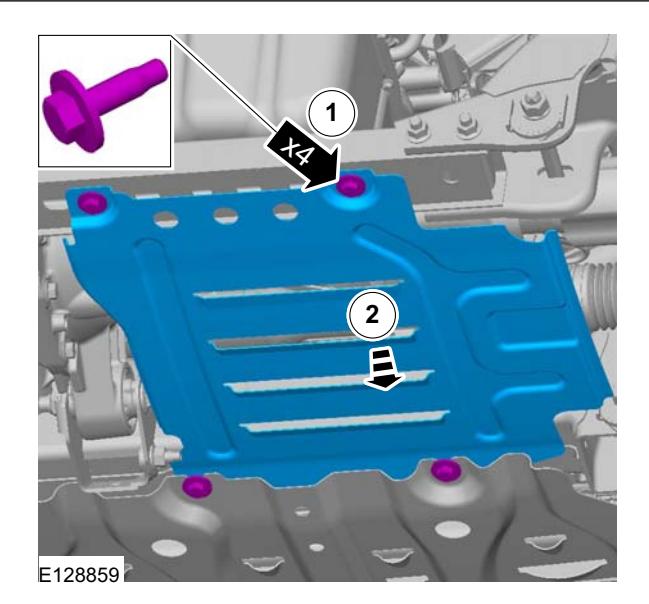
Materials

Name	Specification
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

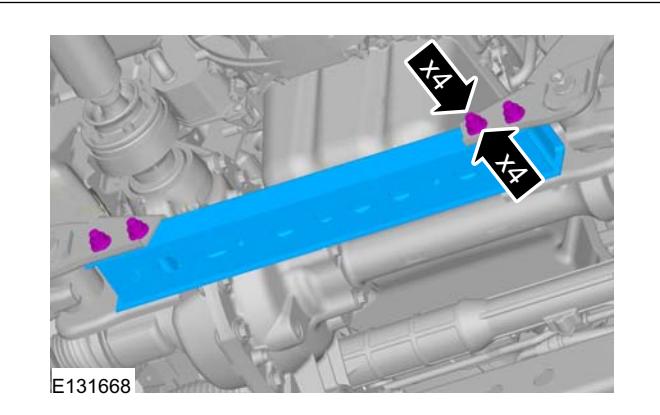
Removal

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



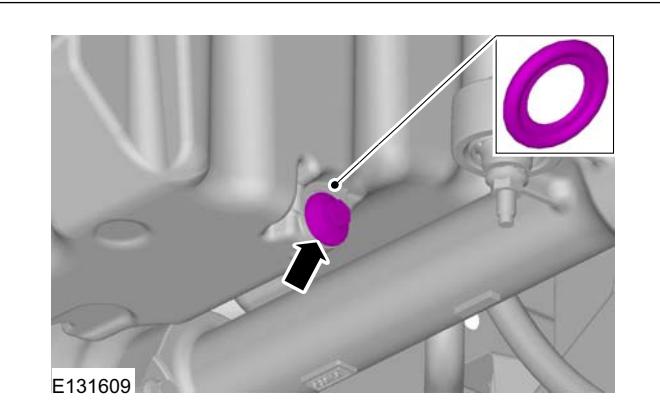
4. Torque: 90 Nm



5. **WARNING:** Be prepared to collect escaping fluids.

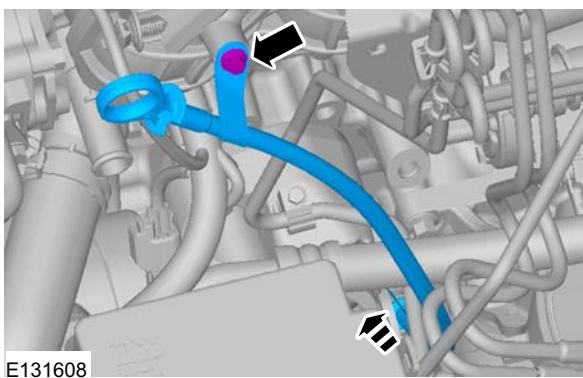
NOTE: The seal is to be reused unless damaged.

Drain the oil into a suitable container.
Torque: 28 Nm



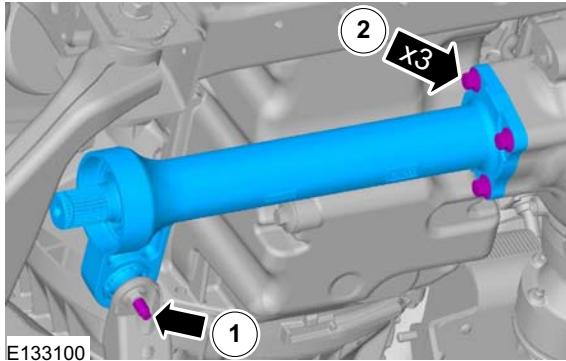
REMOVAL AND INSTALLATION

6. Torque: 10 Nm

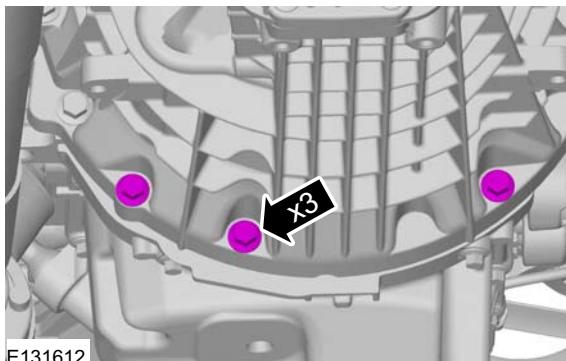


7. Refer to: Front Halfshaft RH (205-04 Front Drive Halfshafts, Removal and Installation).

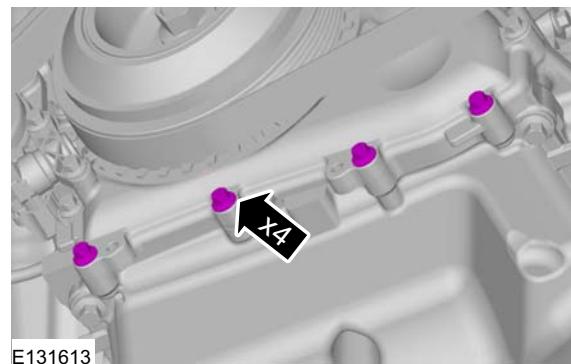
- 8. 1. Torque: 70 Nm**
- 2. Torque: 40 Nm**



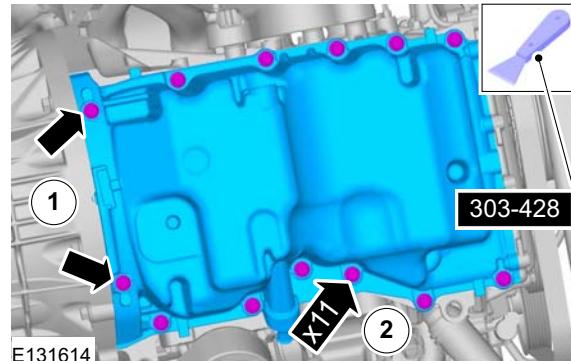
9. Torque: 48 Nm



10. Torque: 10 Nm



11. Special Tool(s): 303-428



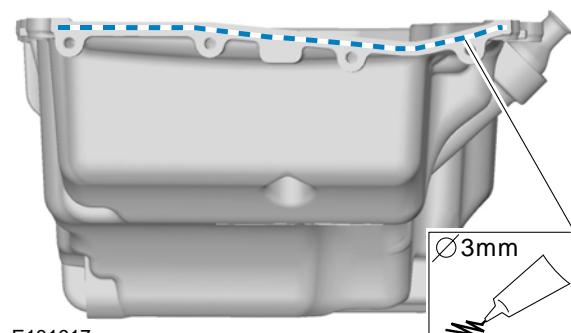
Installation

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



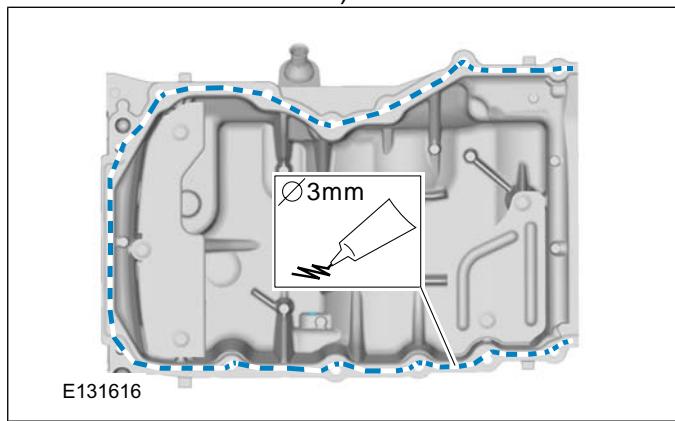
2. CAUTION: Install the oil pan within five minutes of applying the sealer.

REMOVAL AND INSTALLATION

NOTE: Do not damage the mating faces.

NOTE: Mating surface should not have traces of oil to improve the adhesion.

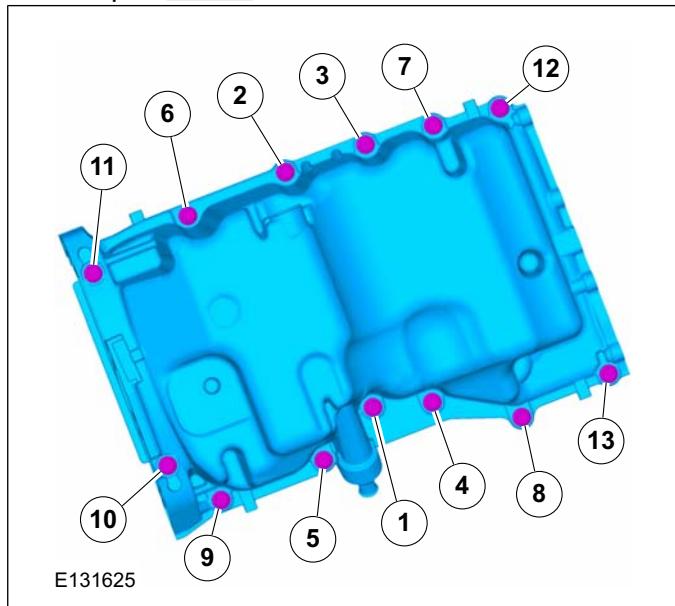
Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



3. To install, reverse the removal procedure.

4. Install the oil pan.

Torque: 25 Nm



5. Fill the oil pan with clean engine oil.

Refer to: **Specifications** (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Specifications).

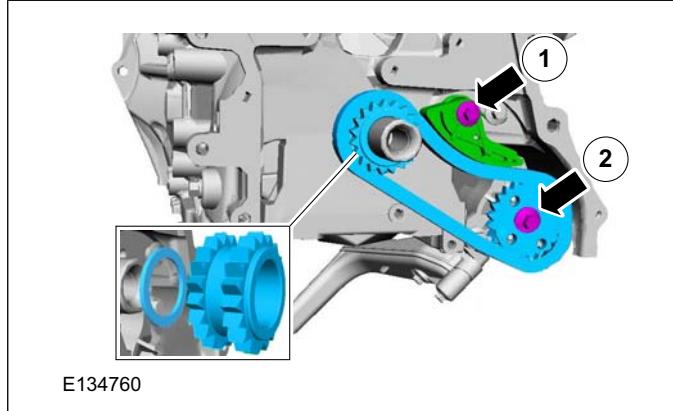
REMOVAL AND INSTALLATION

Oil Pump(21 714 0)

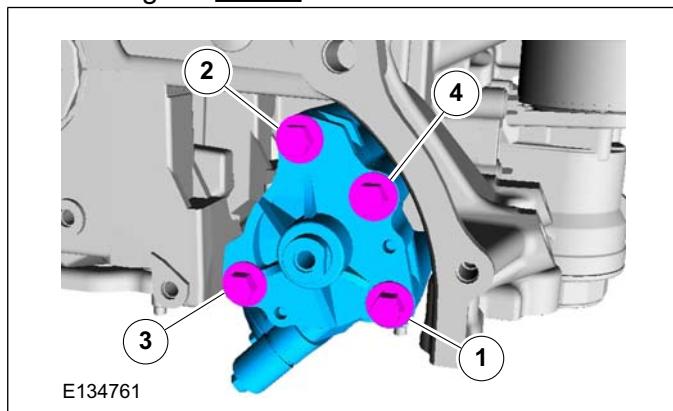
Removal

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



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



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

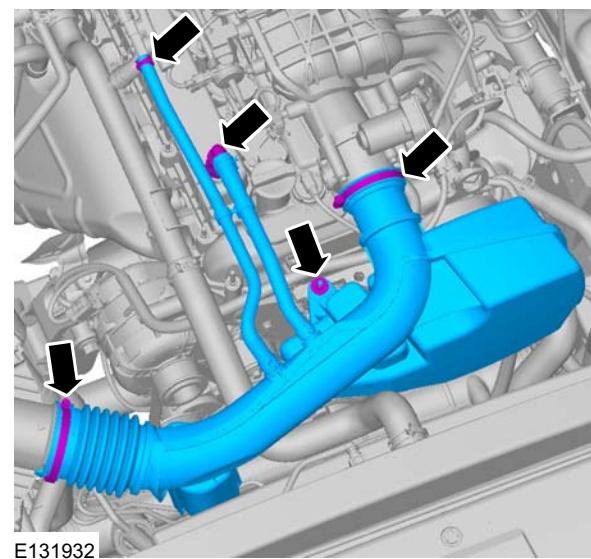
NOTE: Removal steps in this procedure may contain installation details.

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.

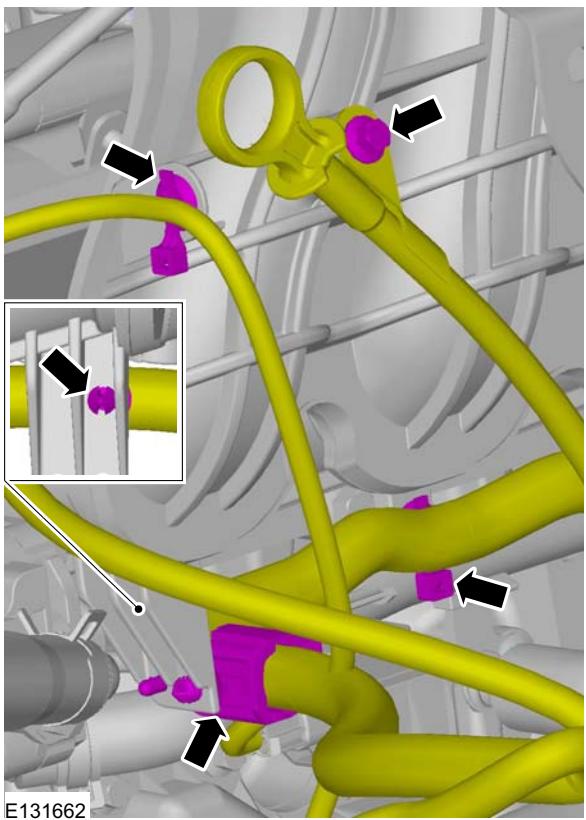
Refer to: [Battery Disconnect and Connect](#)
(414-01 Battery, Mounting and Cables, General Procedures).

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



REMOVAL AND INSTALLATION

5. Torque: 10 Nm



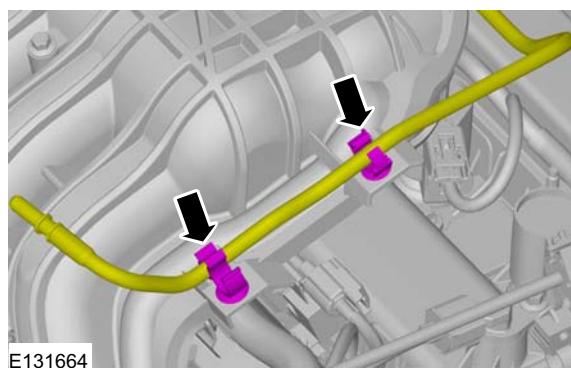
6. NOTE: Securely strap the fuel and breather tubes.

Torque: 8 Nm

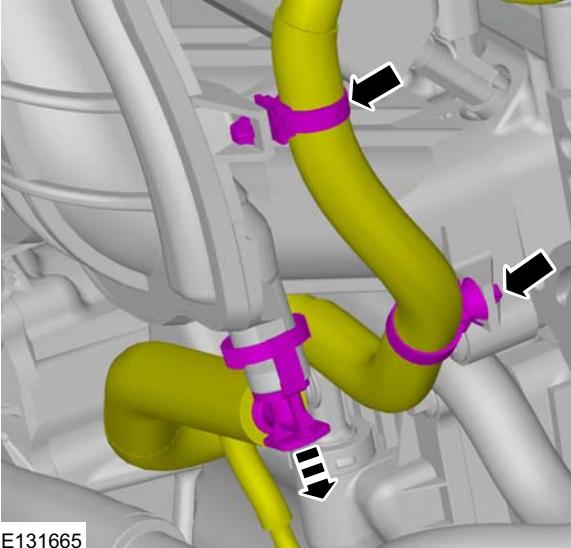


E131663

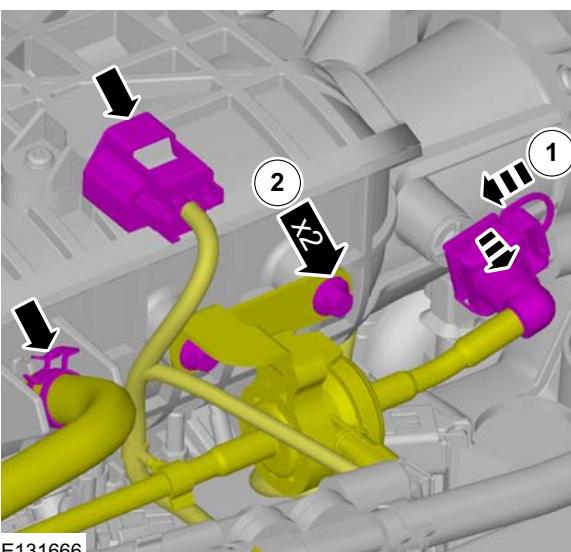
7.



8.

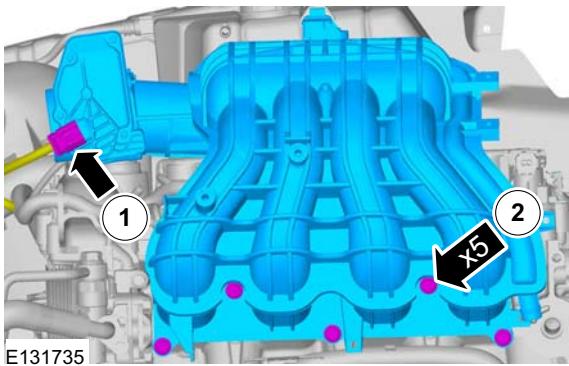


9. Torque: 11 Nm

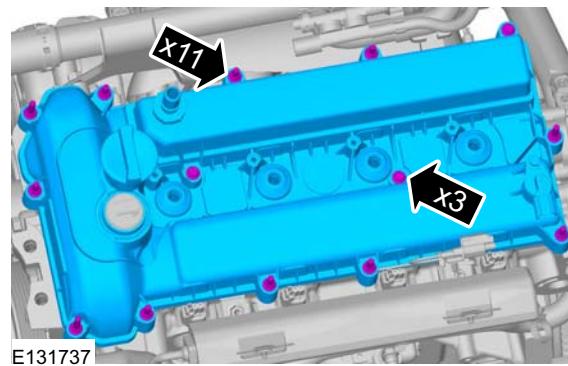


REMOVAL AND INSTALLATION

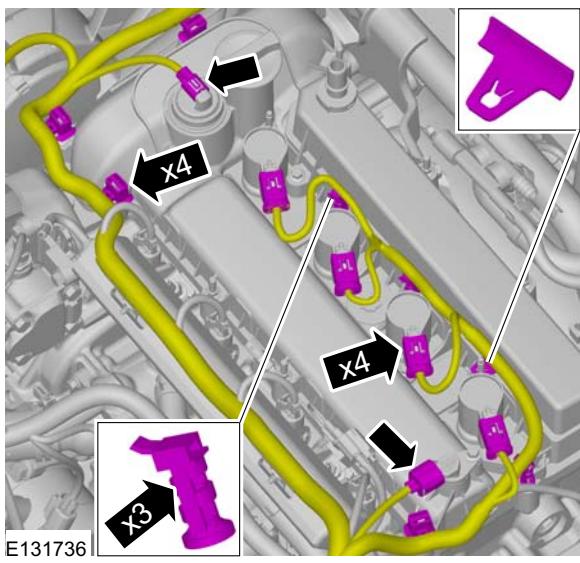
10. Torque: 19 Nm



13.



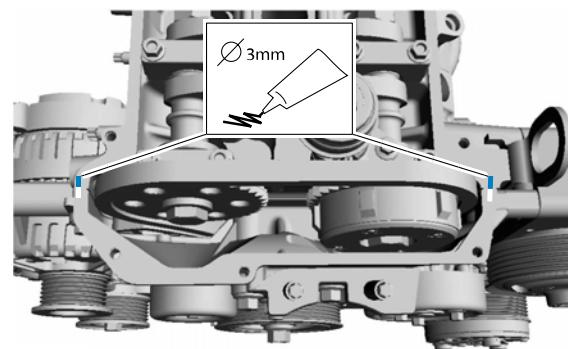
11.



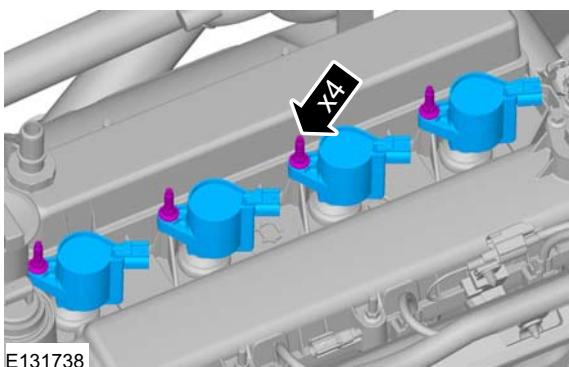
Installation

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

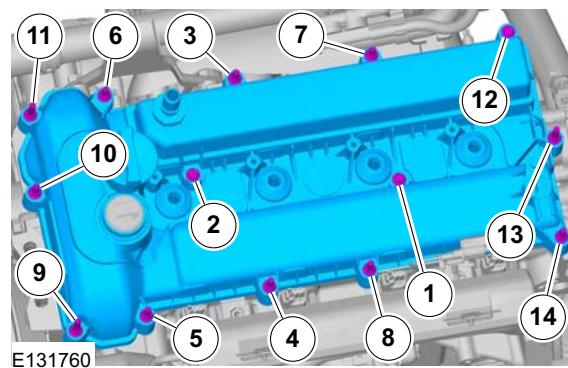


12 Torque: 8 Nm



2. NOTE: The gasket is to be reused unless damaged.

Torque: 10 Nm

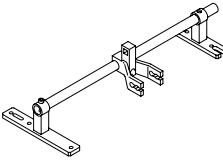
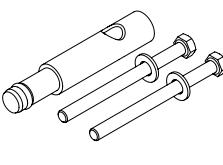
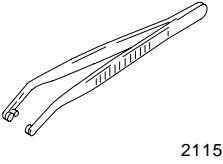
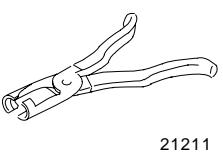


3. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Valve Stem Seals(21 238 0)

Special Tool(s)

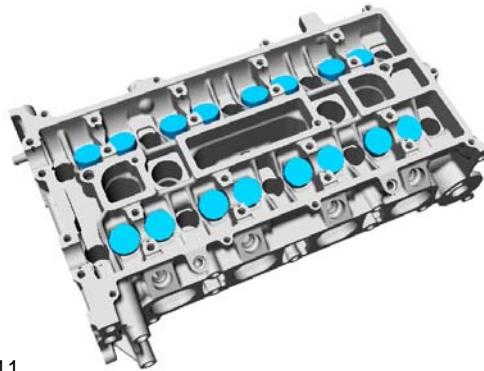
	303-361B Compressor, Valve Spring E62757
	303-361B-06 Adapter for 303-361B E62041
	303-362 Installer, Valve Stem Collets 21156
	303-508 Pliers, Valve Stem Seal 21211

Removal

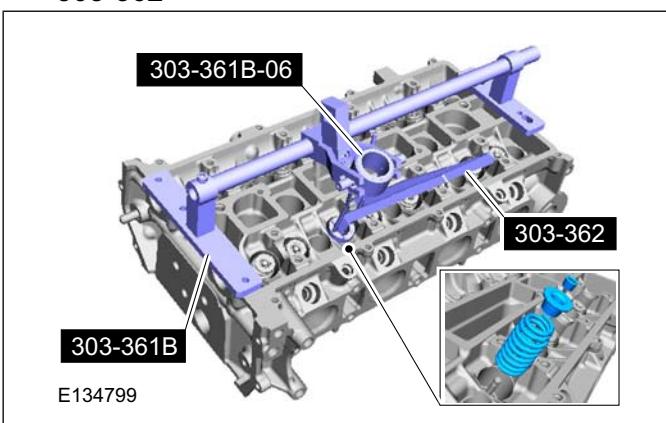
NOTE: Removal steps in this procedure may contain installation details.

- Refer to: **Camshafts** (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

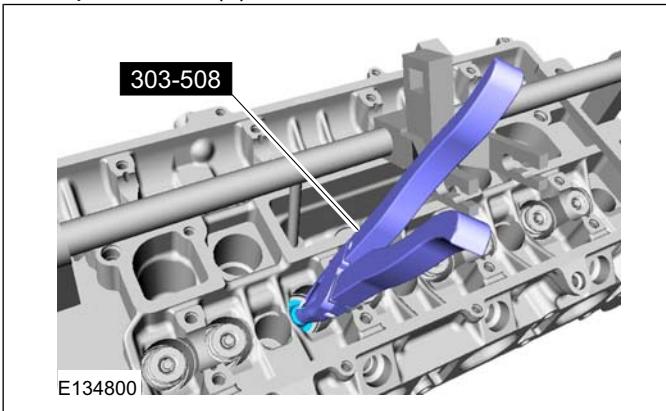
2.



- Special Tool(s): 303-361B, 303-361B-06, 303-362



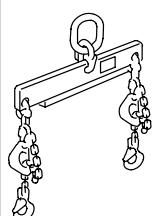
- Special Tool(s): 303-508



Installation

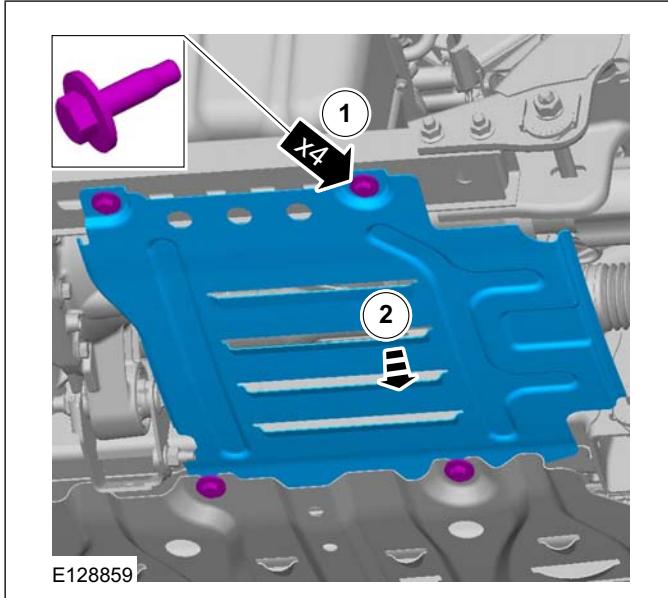
- To install, reverse the removal procedure.

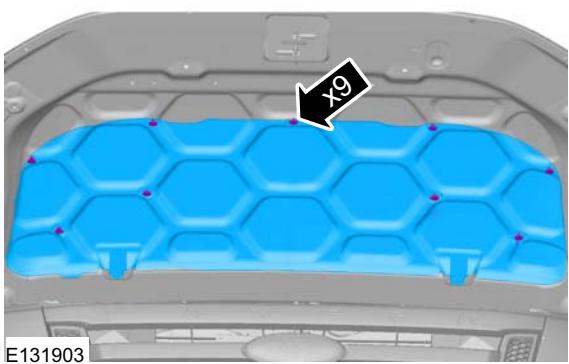
REMOVAL**Engine — Vehicles With: 5-Speed Manual Transmission - MT75(21 132 0; 21 132 6; 21 132 7)****Removal****Special Tool(s) / General Equipment**

	303-122 Lifting Bracket, Engine 21068A
Hydraulic Jib Crane	
Transmission Jack	

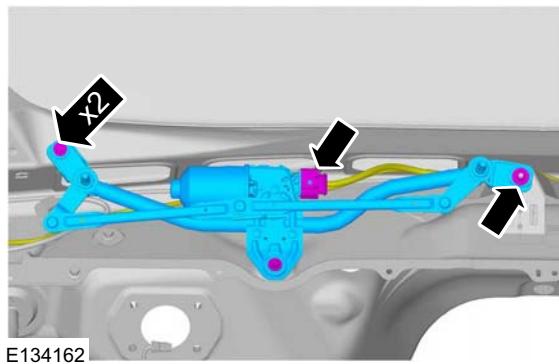
1. Refer to: **Cooling System Draining, Filling and Bleeding** (303-03 Engine Cooling, General Procedures).
2. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: **Lifting** (100-02 Jacking and Lifting, Description and Operation).
4. Refer 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.

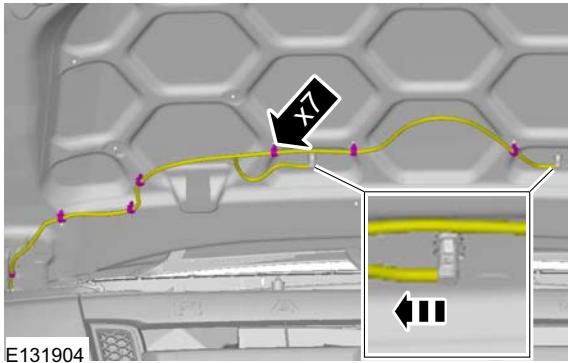


REMOVAL**9.**

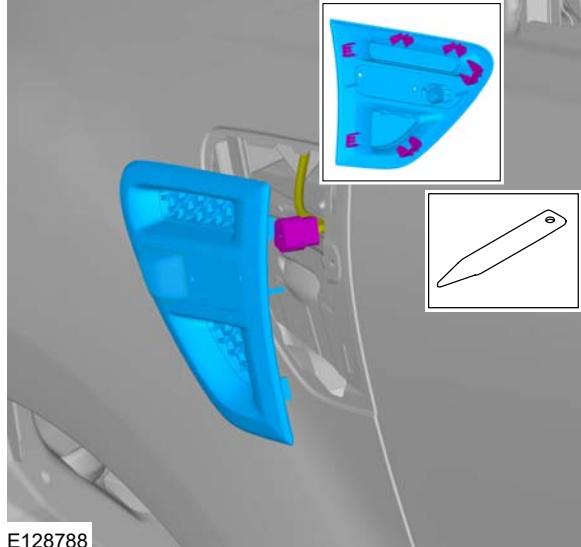
E131903

12 Refer to: **Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).****13.**

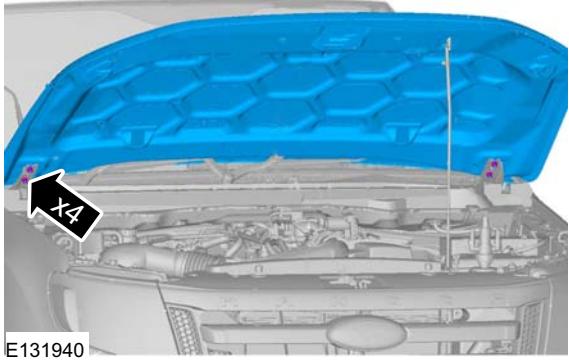
E134162

10.

E131904

14. On both sides.

E128788

11.

E131940

15.

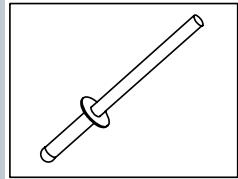
DESCRIPTION AND OPERATION

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

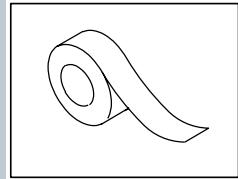
Item	Description
14	Wedge
15	Pin Punch
16	Air blow gun
17	Mallet
18	Relocate and support the component

Material symbols

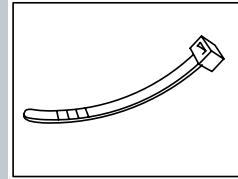
The material symbols are used to show where to use which type of material to carry out a procedure step.



1



2



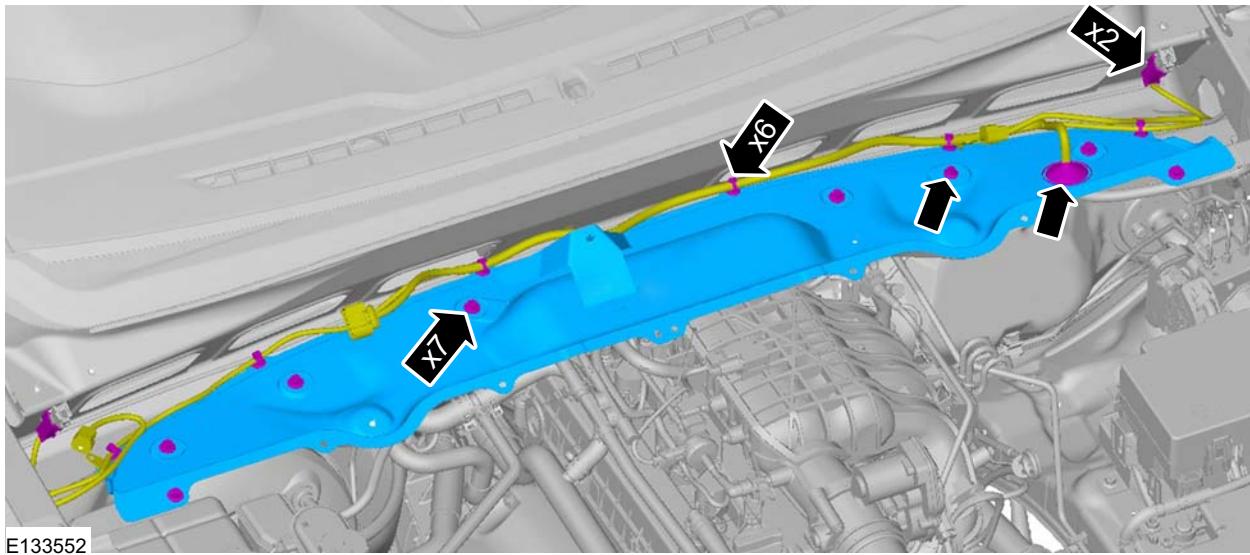
3

E88980

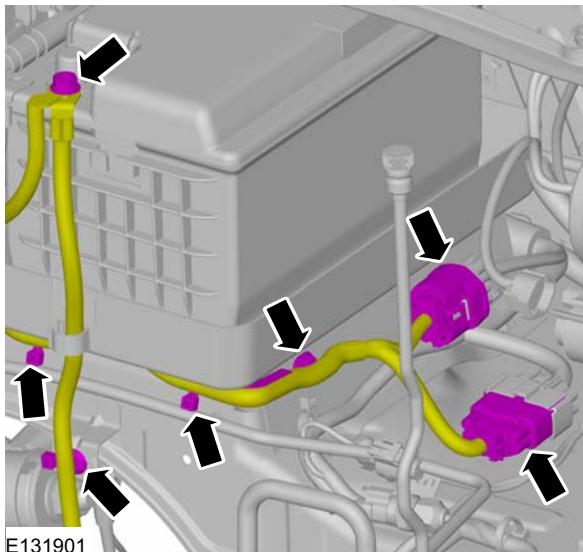
Item	Description
1	Remove/Install the specified blind rivet
2	Apply tape to the specified component/area
3	Remove/Install the specified cable tie

Miscellaneous symbols

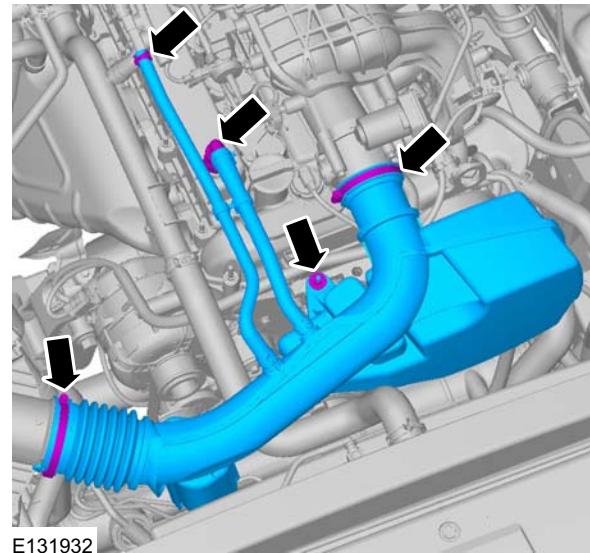
These symbols provide further information that is required to carry out a procedure step.

REMOVAL

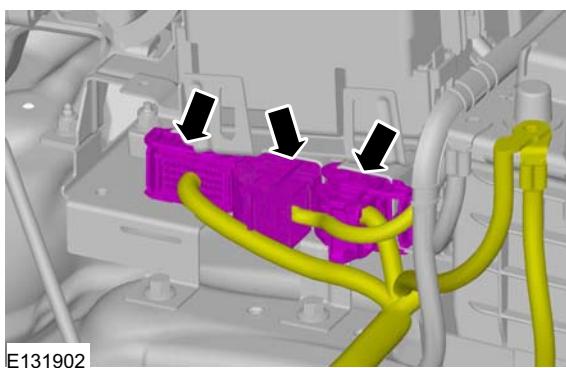
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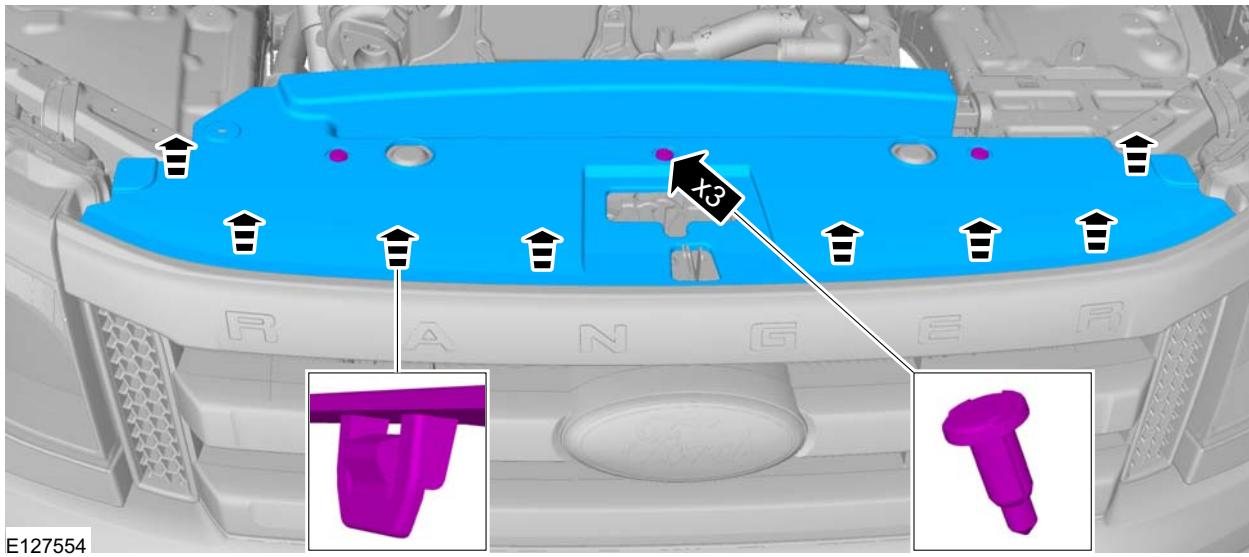
18.



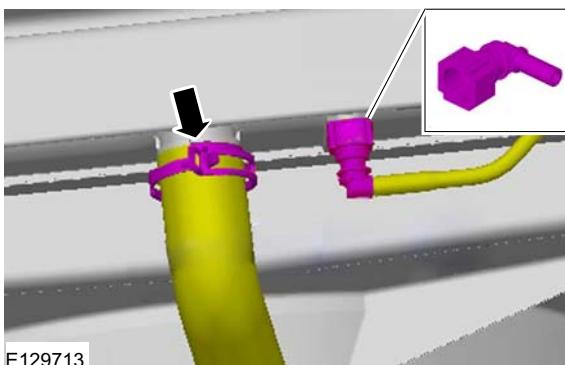
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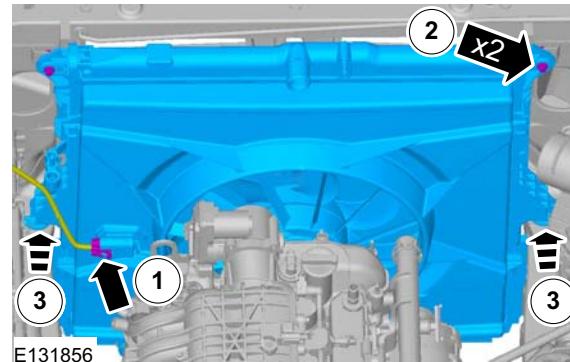
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REMOVAL

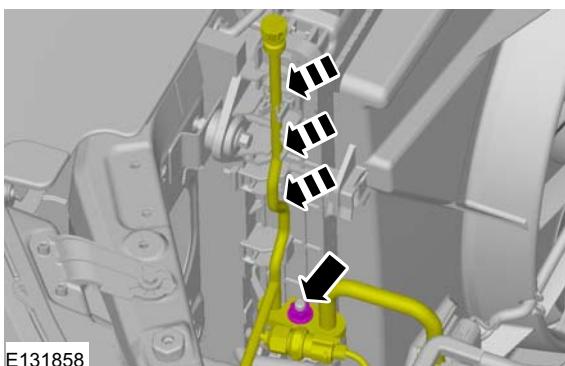
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22

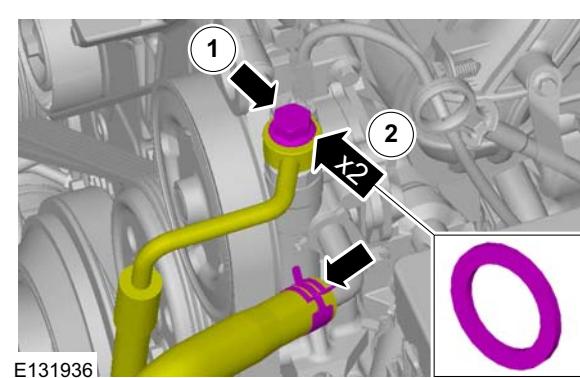


21.



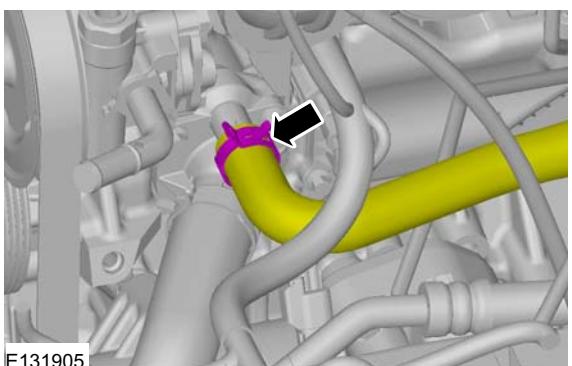
23. ⚠ WARNING: Be prepared to collect escaping fluids.

⚠ CAUTION: Make sure that all openings are sealed.

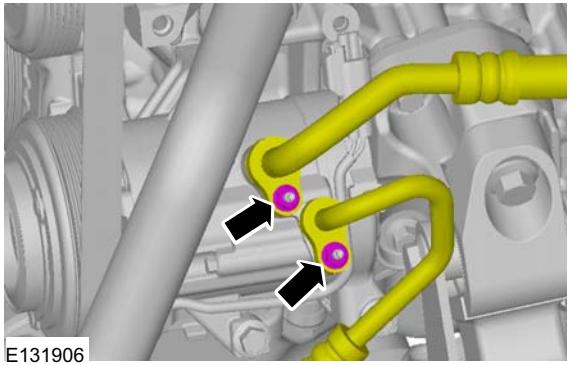


REMOVAL

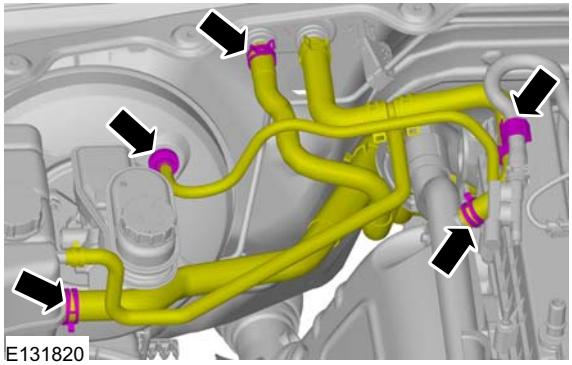
24.



25.



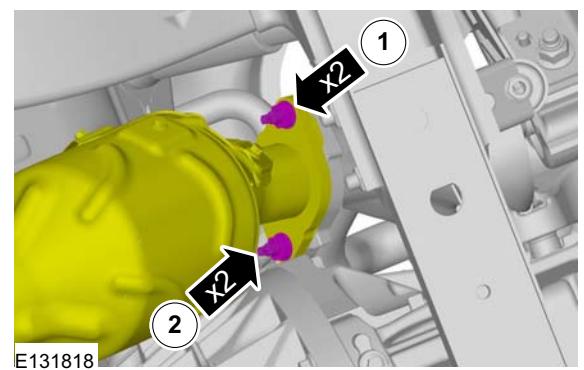
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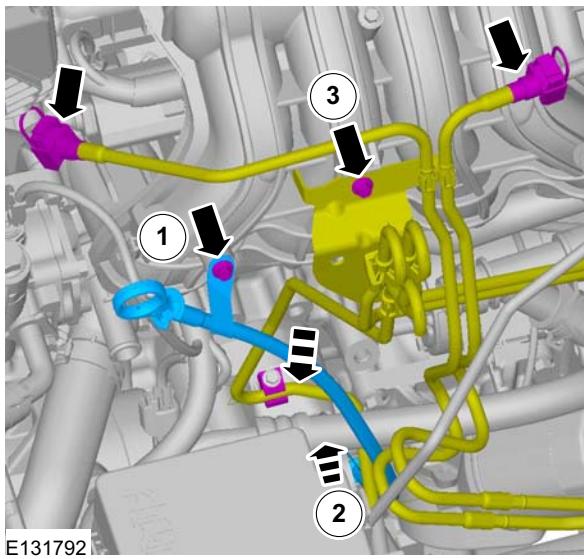


27.

**28. CAUTIONS:**

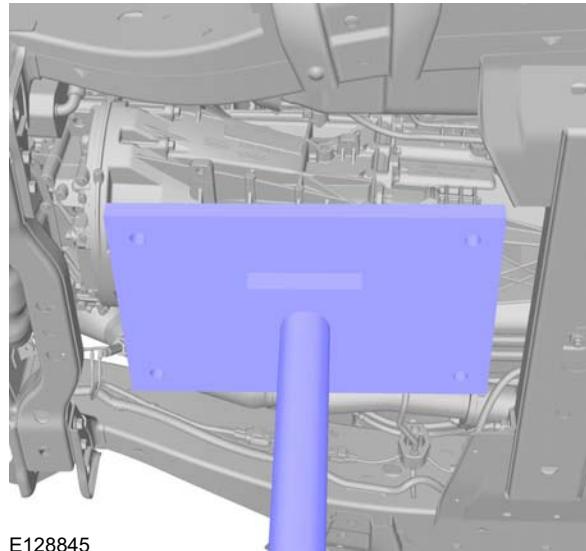
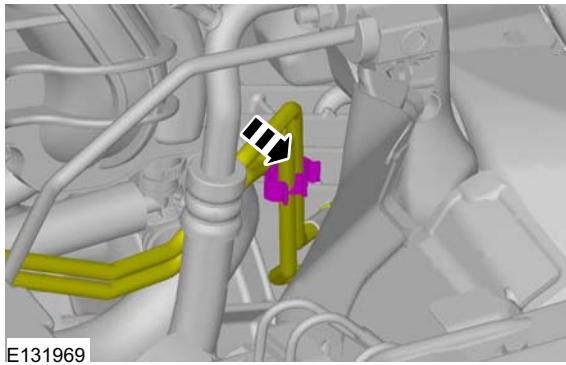
- ⚠ Over bending the exhaust flexible pipe may cause damage resulting in failure.
- ⚠ Make sure that the catalytic converter is supported with suitable retaining straps.



REMOVAL**29.**

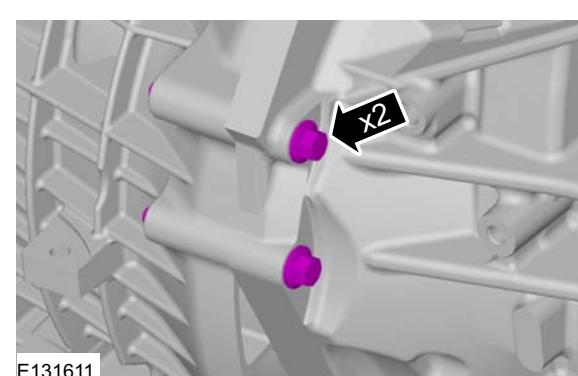
Tie and support the transmission to the chassis with a suitable strap.

General Equipment: Transmission Jack

**30.****32.**

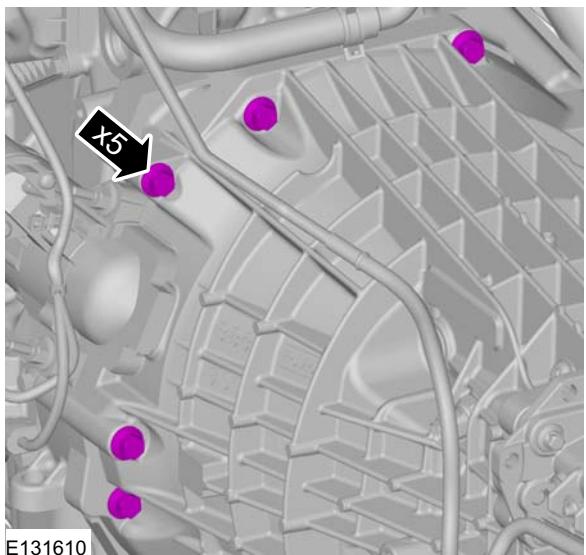
31. **WARNING:** Make sure that transmission assembly is on wooden blocks and secured with suitable retaining straps.

CAUTION: Do not tilt the transmission. This may cause damage to the pilot bearing.

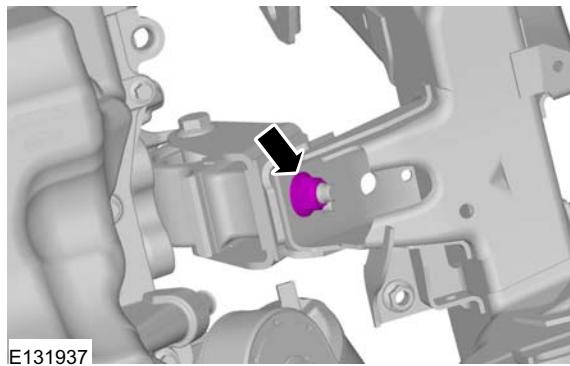
33.

REMOVAL

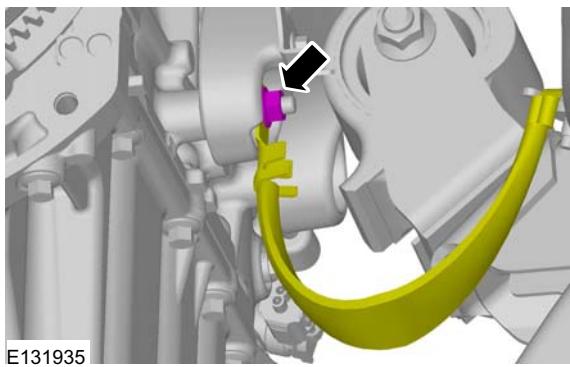
34.



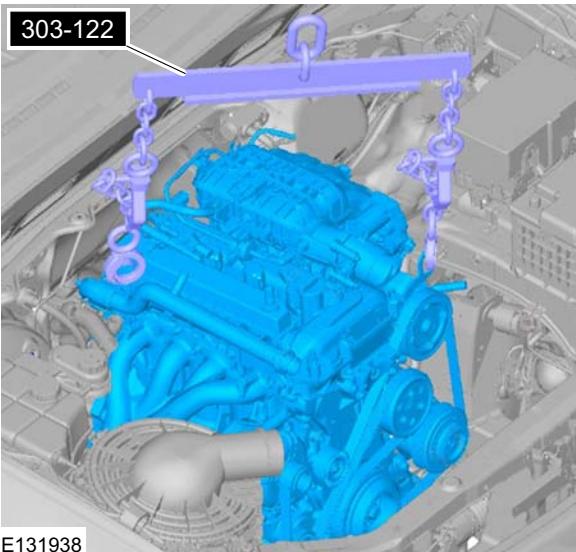
37.



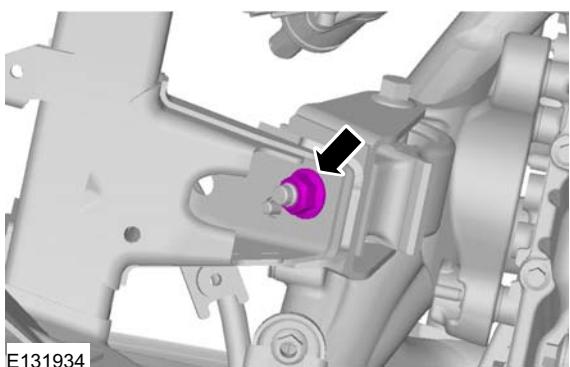
35.



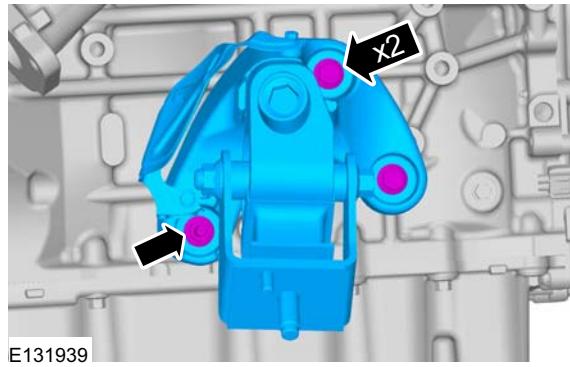
38. Special Tool(s): 303-122
General Equipment: Hydraulic Jib Crane



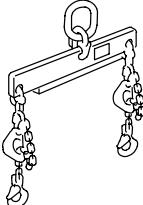
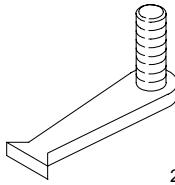
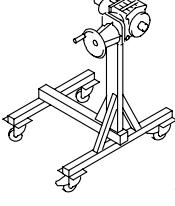
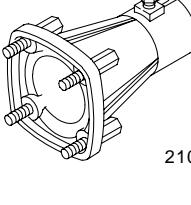
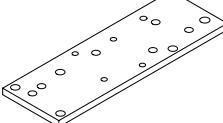
36.



39.

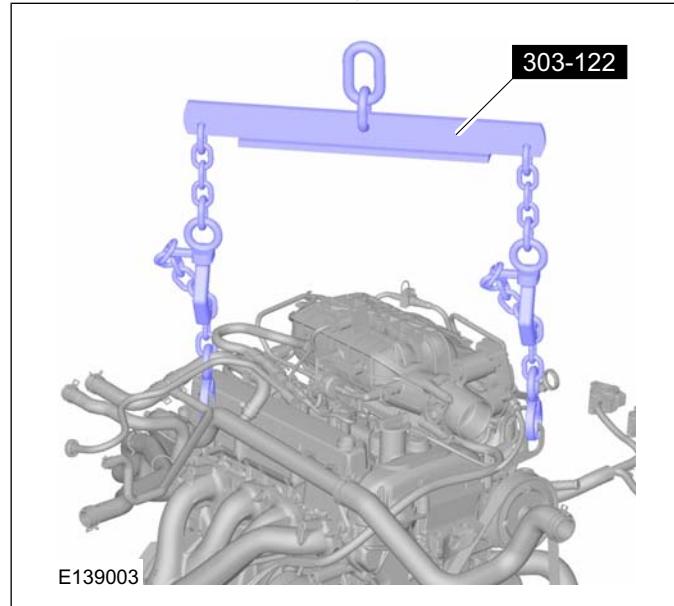


REMOVAL**Engine Accessories(21 139 4)****Removal****Special Tool(s) / General Equipment**

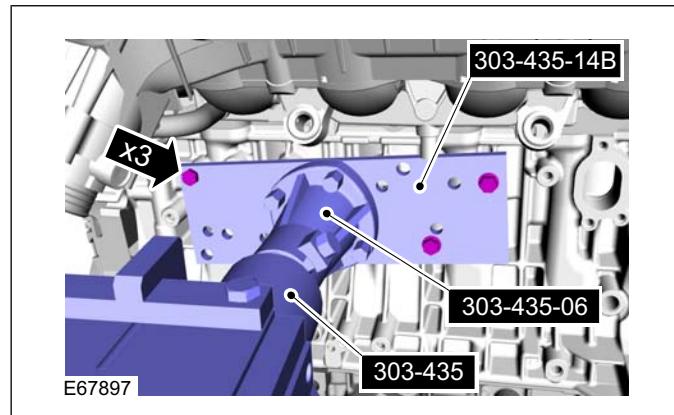
	303-122 Lifting Bracket, Engine 21068A
	303-254 Locking Tool, Flywheel 21135
	303-435 Mounting Stand 21187
	303-435-06 Mounting Bracket for 303-435 21031B
	303-435-14B Mounting Plate for 303-435-06 E62805
	303-676 Release Tool, Belt Tensioner 303676
Hydraulic Jib Crane	

All vehicles

1. Special Tool(s): 303-122
General Equipment: Hydraulic Jib Crane

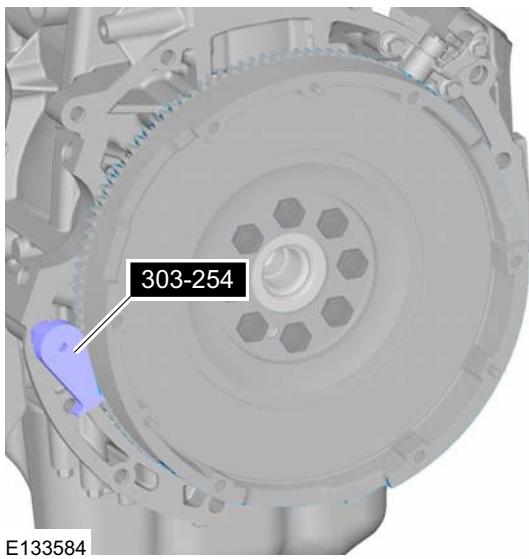


2. Special Tool(s): 303-435, 303-435-06,
303-435-14B

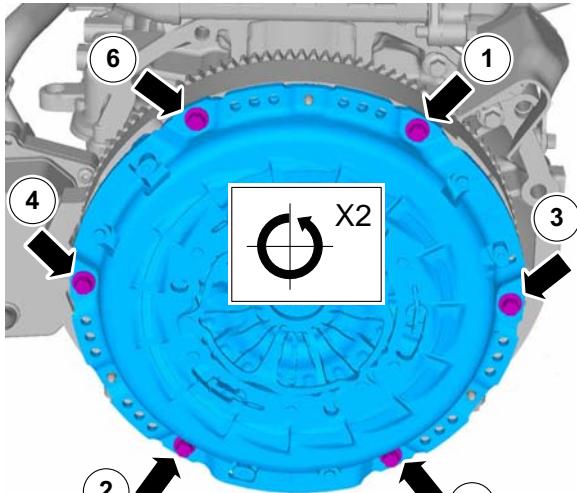


REMOVAL

3. Special Tool(s): 303-254

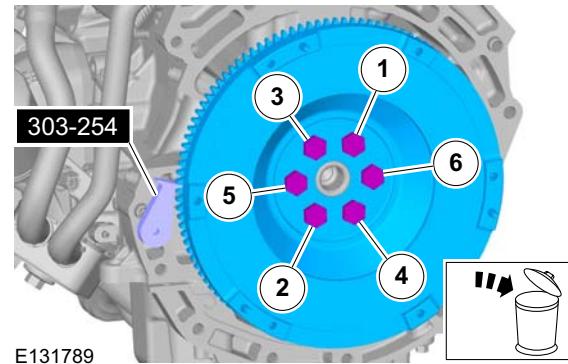


4. **⚠ CAUTION:** Loosen the clutch pressure plate retaining bolts by two turns at a time in the sequence shown.

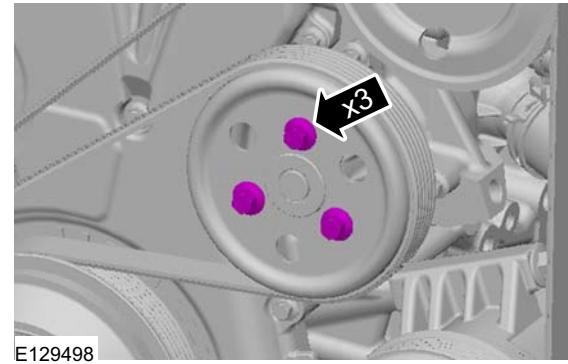


5. Discard the flywheel bolts.

Special Tool(s): 303-254

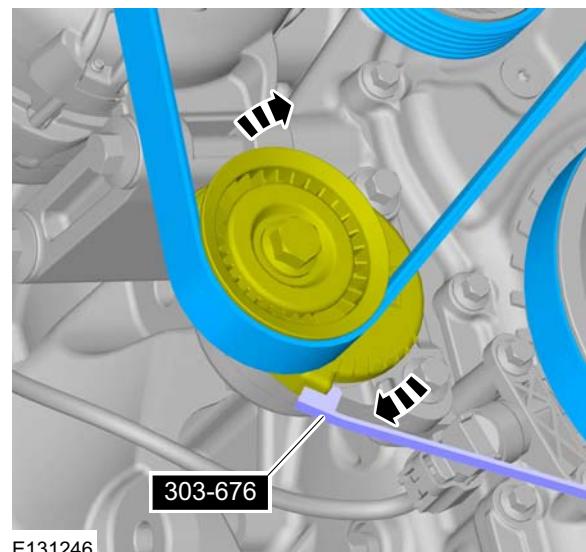


6. Loosen: 3 turn(s)



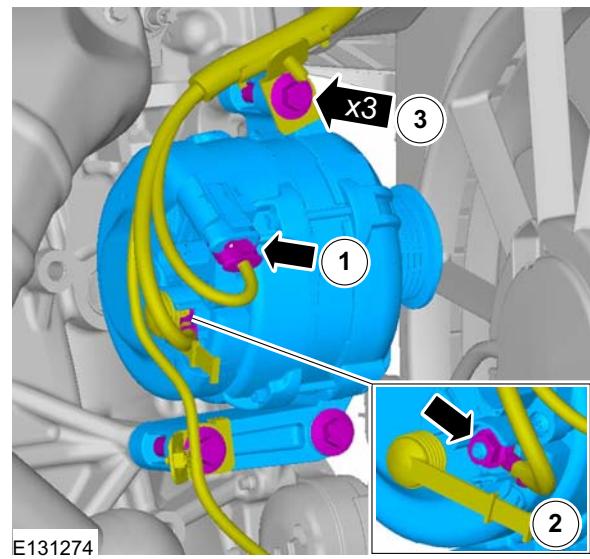
7. Rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt.

Special Tool(s): 303-676

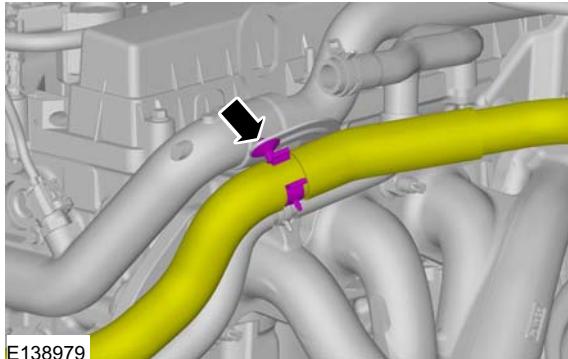


REMOVAL

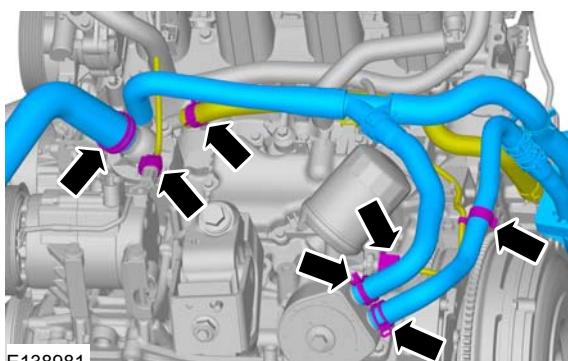
8.  **CAUTION:** Take extra care not to damage the wiring harnesses.



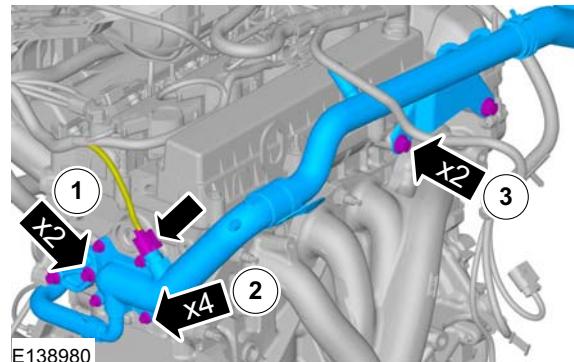
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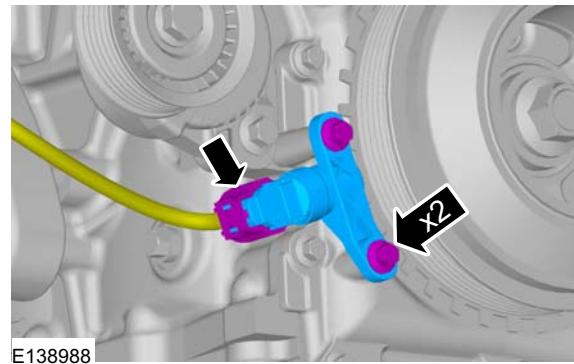
10. NOTE: Make sure that the hoses are installed to the noted removal position.



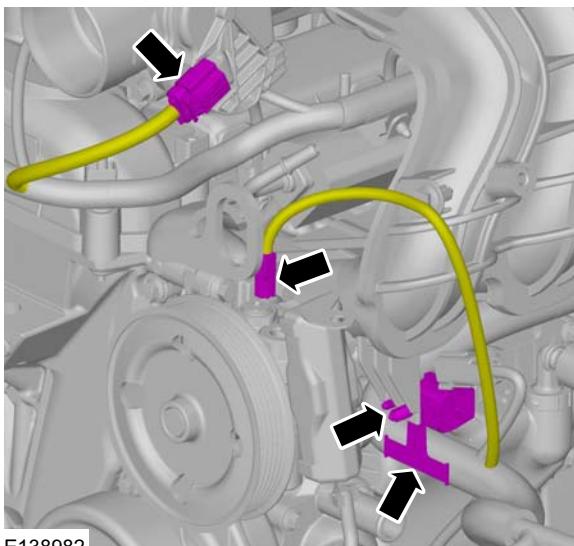
11. NOTE: Make sure that the hoses are installed to the noted removal position.



12.

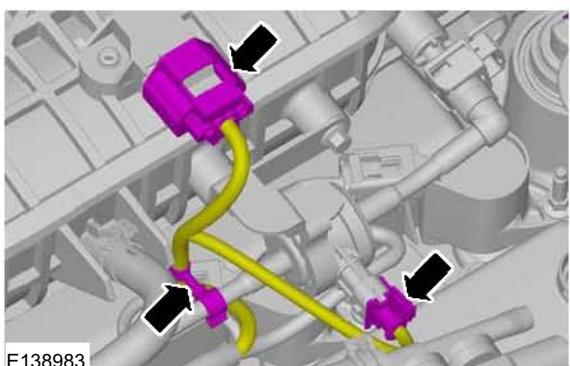


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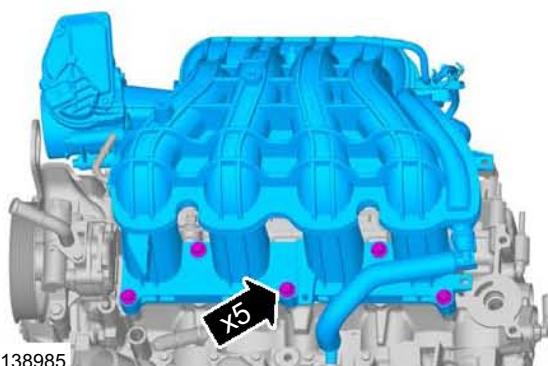


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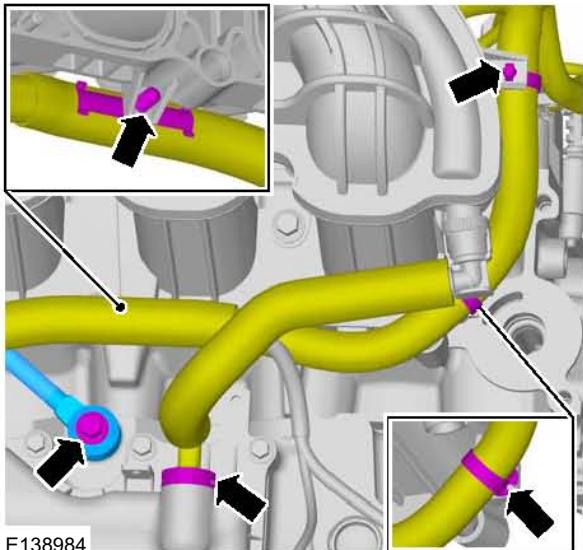
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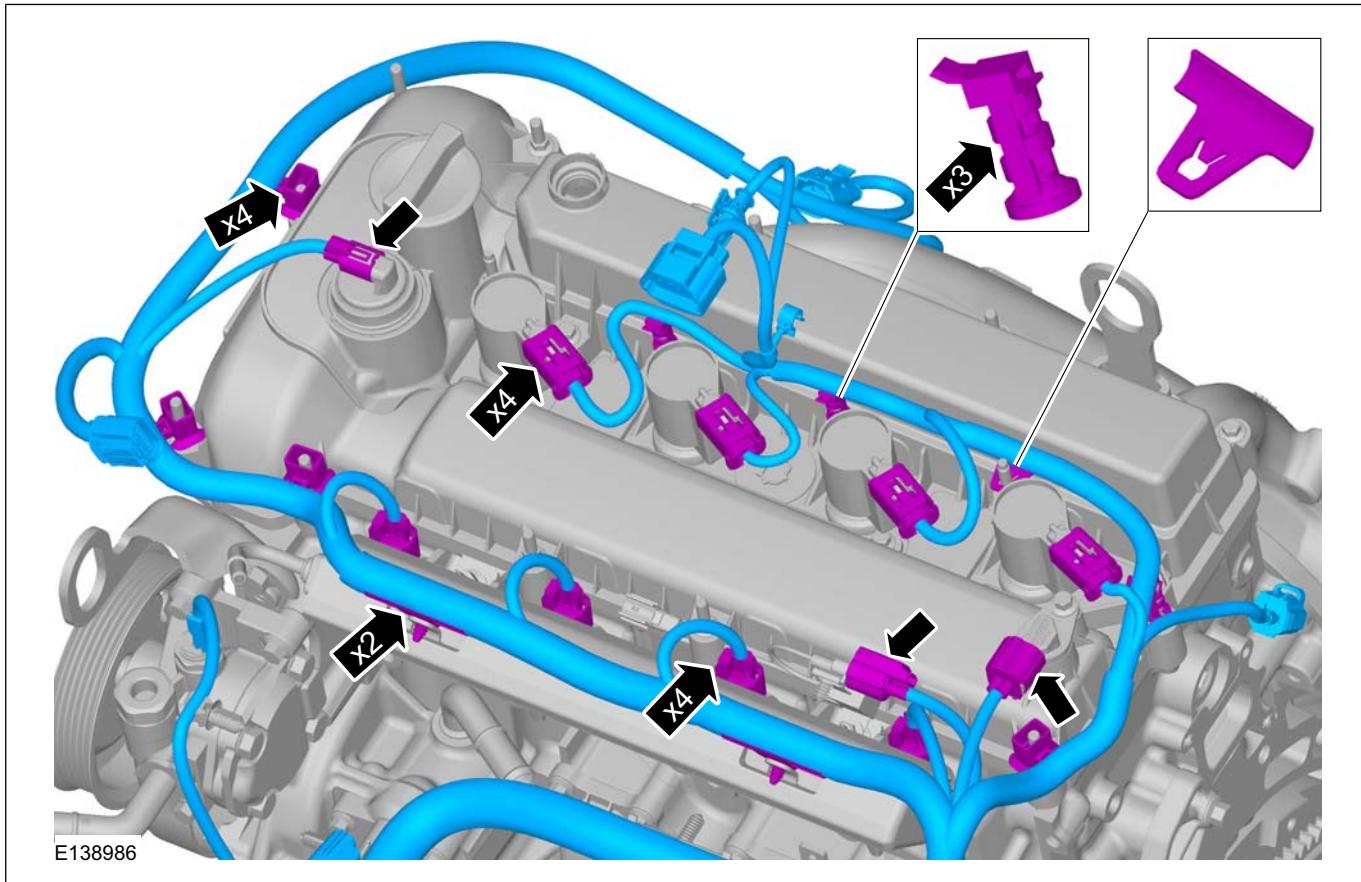
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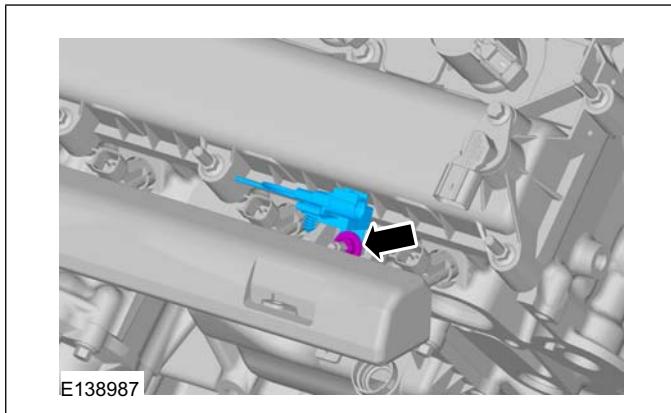
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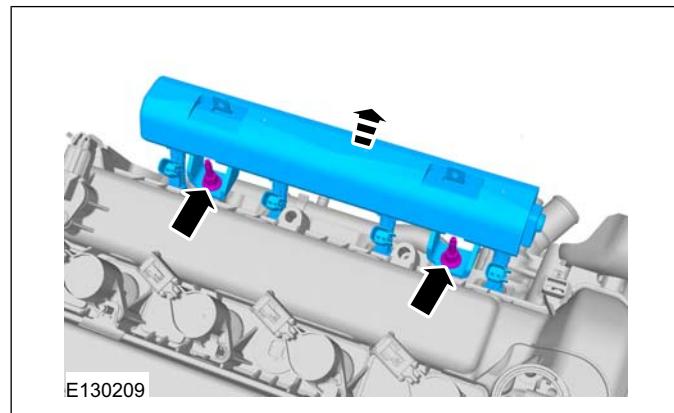
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REMOVAL

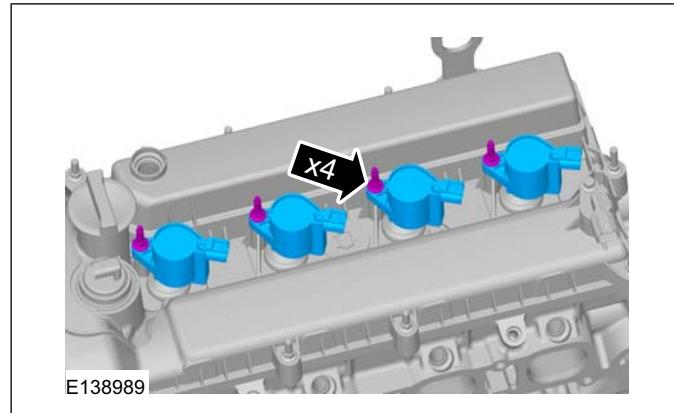
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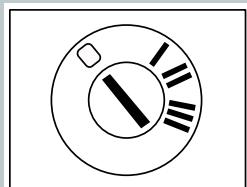
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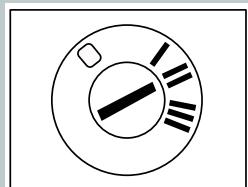
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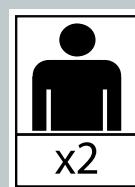
DESCRIPTION AND OPERATION



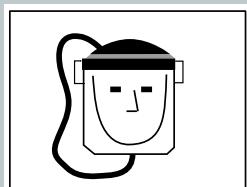
1



2



3



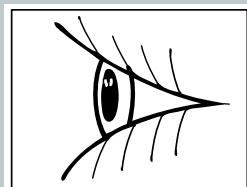
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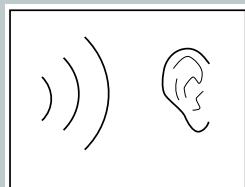
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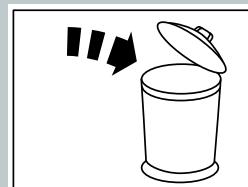
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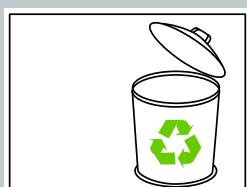
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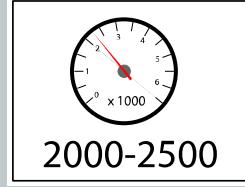
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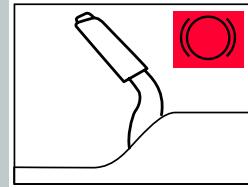
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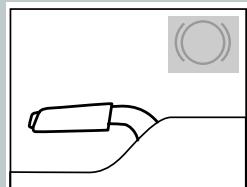
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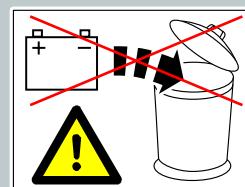
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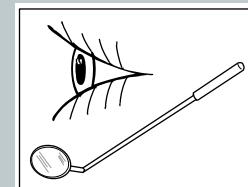
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13



14



15

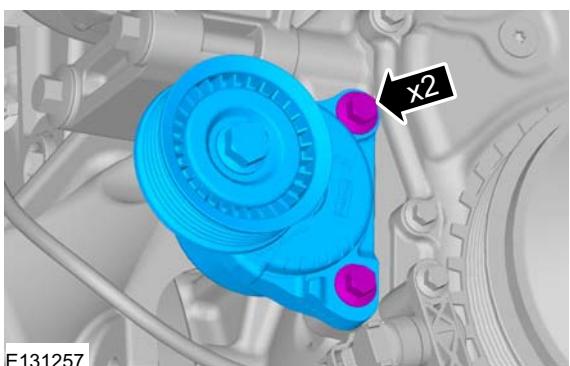


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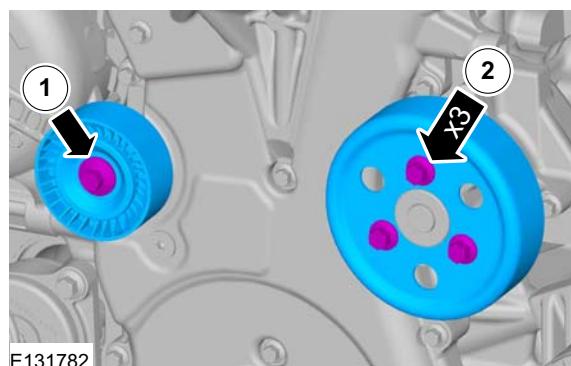
E88981

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

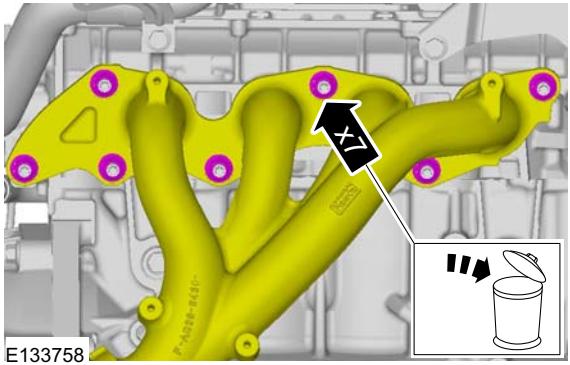
Item	Description
3	The procedure step requires the aid of the specified number of supporting technicians

REMOVAL**21.**

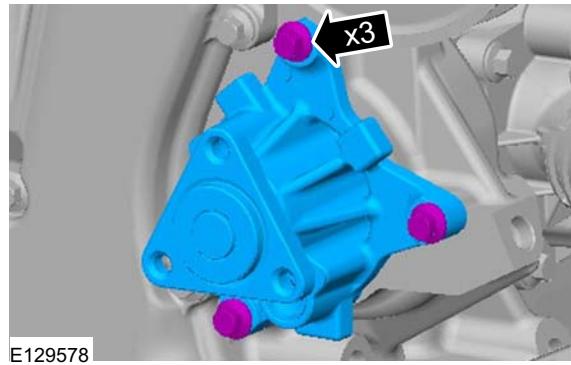
E131257

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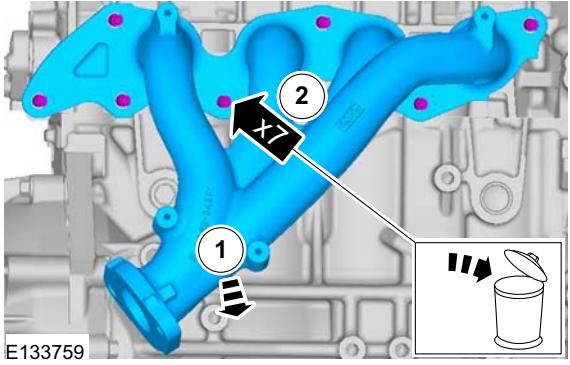
E131782

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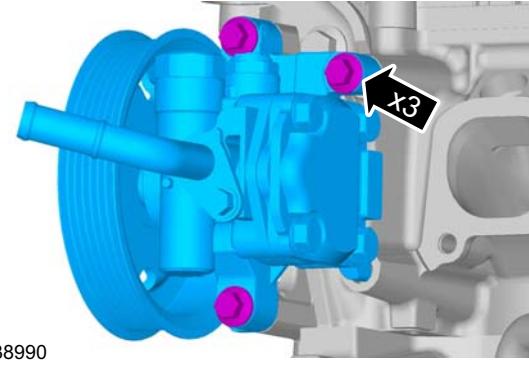
E133758

25.

E129578

23.

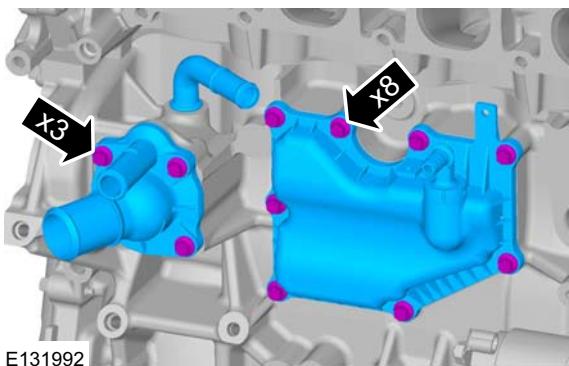
E133759

26.

E138990

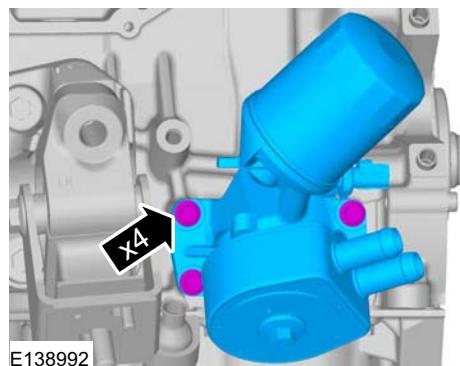
REMOVAL

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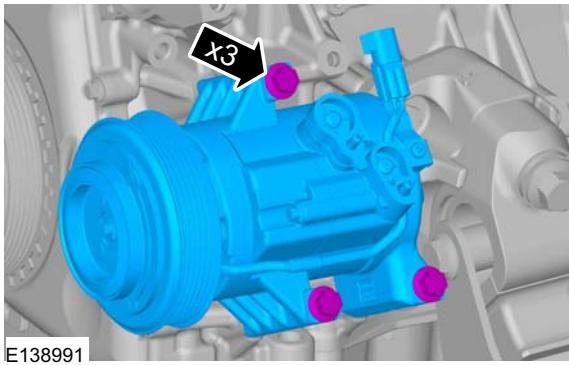


4x4

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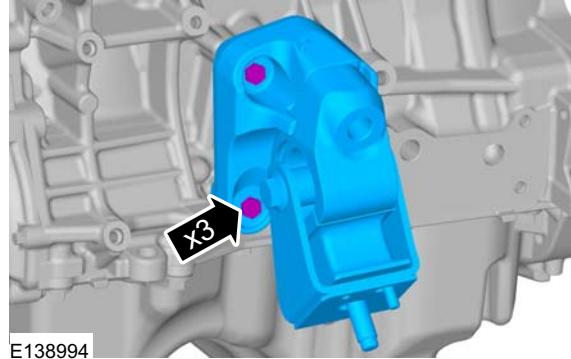


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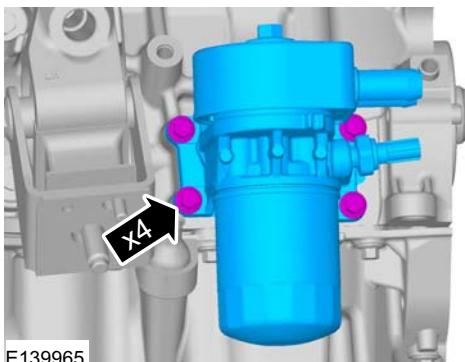
All vehicles

31.

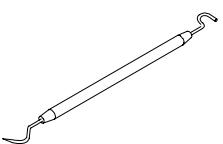
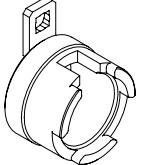
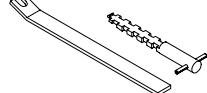
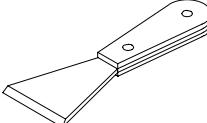
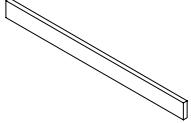


4x2

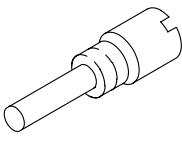
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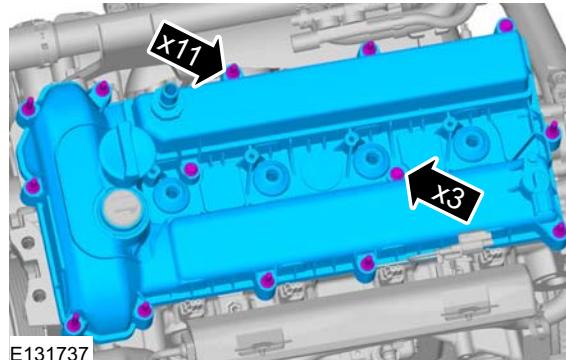
DISASSEMBLY**Engine(21 134 8)****Disassembly****Special Tool(s) / General Equipment**

	100-010 Remover, O-Ring Seal 17063
	303-1416 Tool, Crank Damper Holding E134674
	303-409 Remover Crankshaft Seal E134603
	303-428 Separator, Oil Pan 21179
	303-462 Installer, Connecting Rod E139375
	303-465 Tool, Camshaft Align Timing E134673

Special Tool(s) / General Equipment

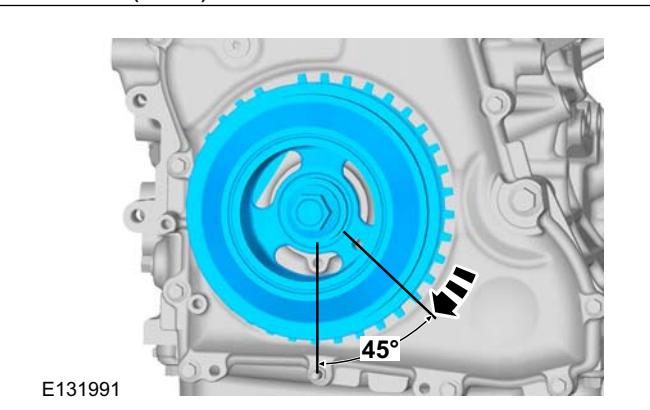
	303-507 Timing Peg, Crankshaft TDC PZ21210
2 mm Punch	

1.



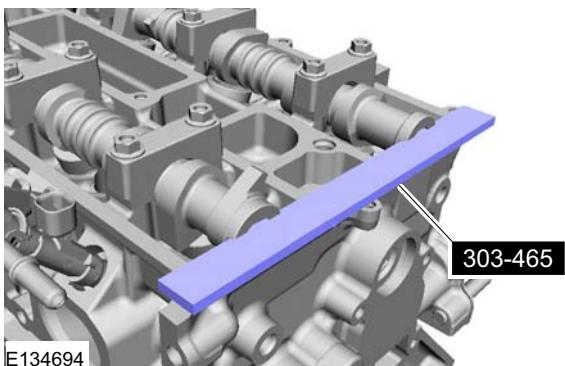
2. **CAUTION: Only rotate the crankshaft clockwise.**

Rotate the crankshaft until piston No. 1 is approximately 45 degrees before top dead center (TDC).

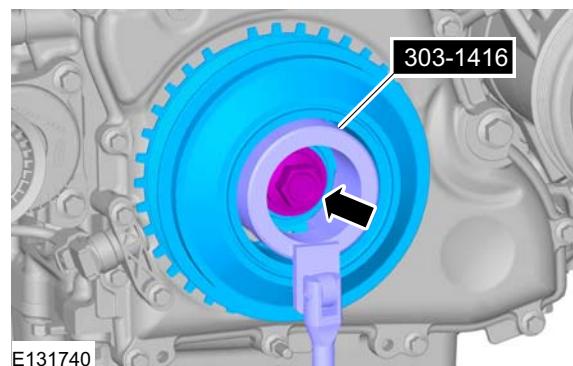


DISASSEMBLY

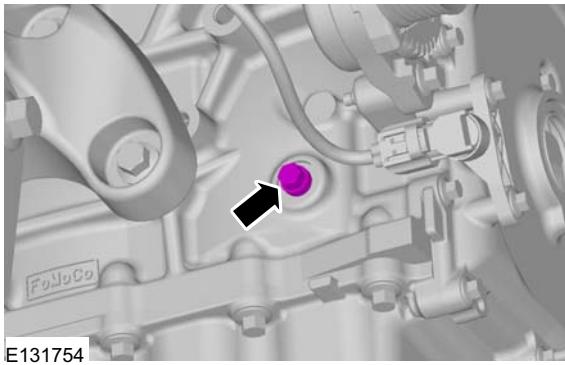
3. Special Tool(s): 303-465



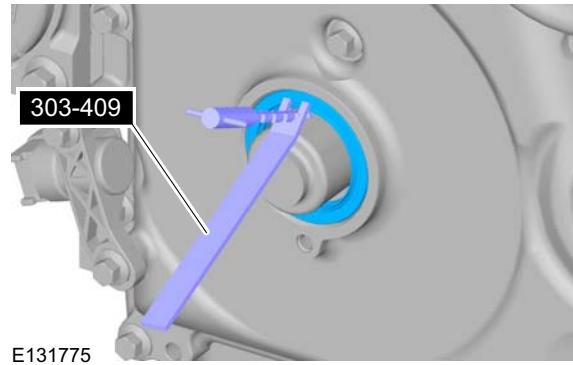
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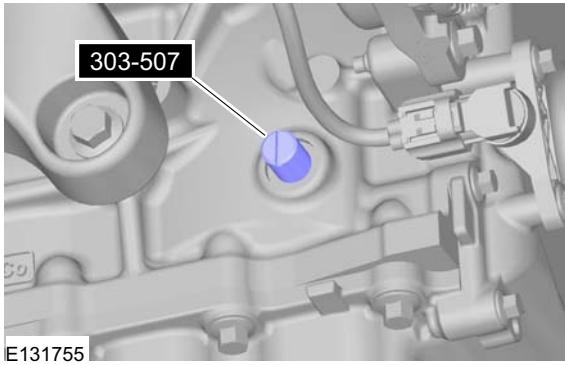
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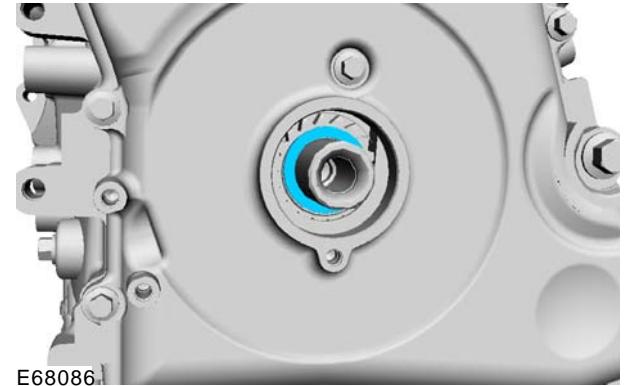
7. Special Tool(s): 303-409



5. Special Tool(s): 303-507

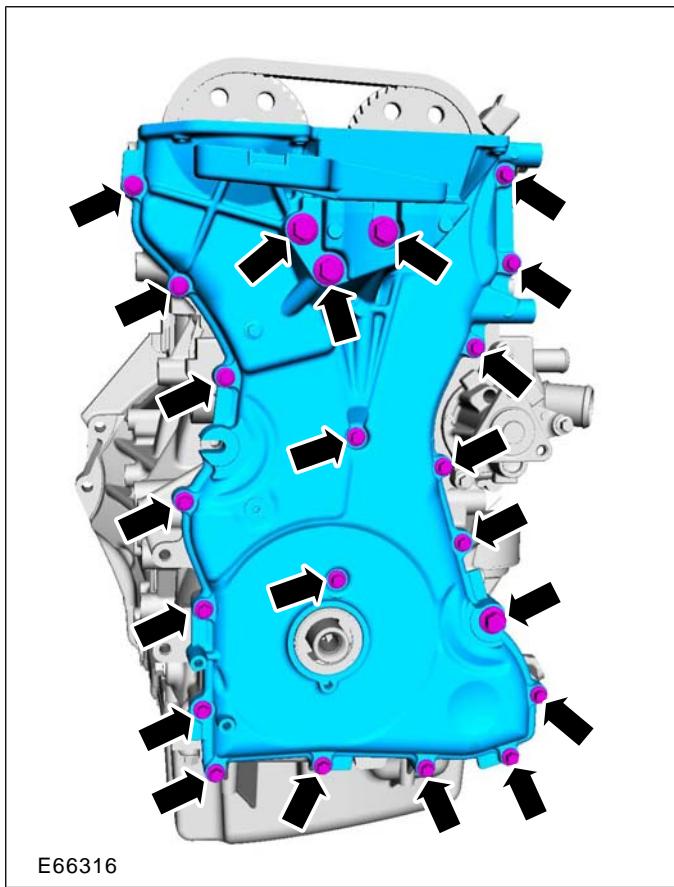


8. Discard the friction washer.

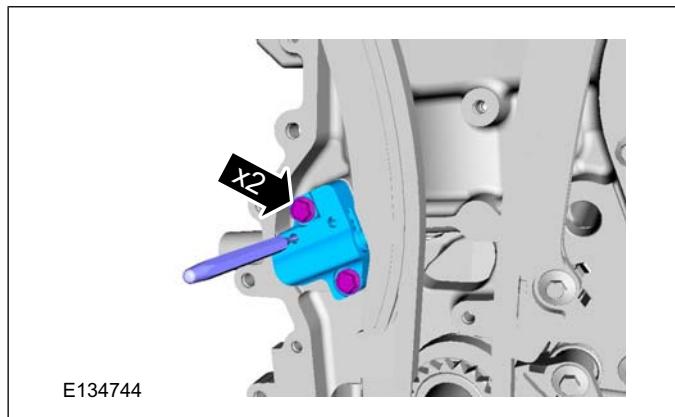
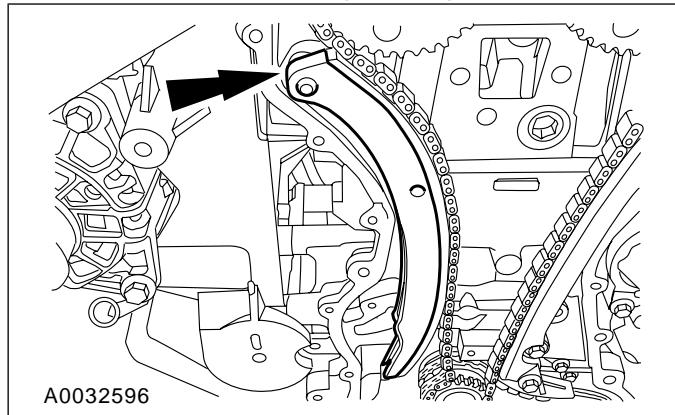


DISASSEMBLY

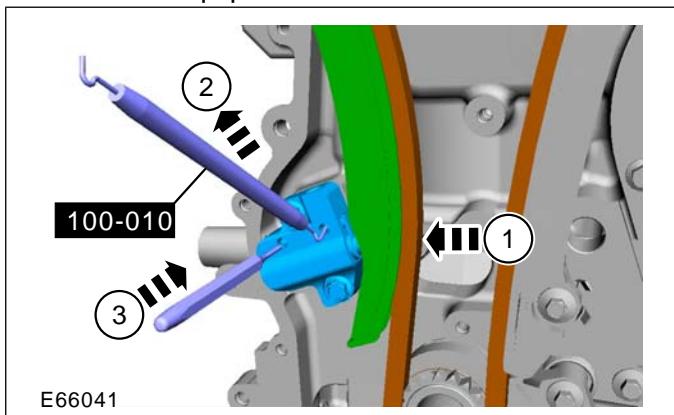
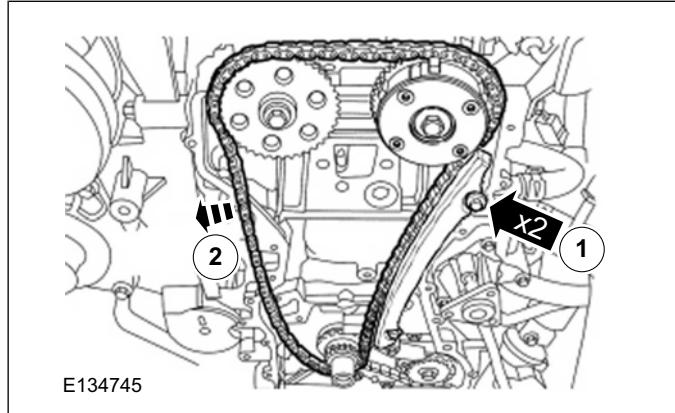
9.



11.

**12 Remove the RH timing chain guide.**

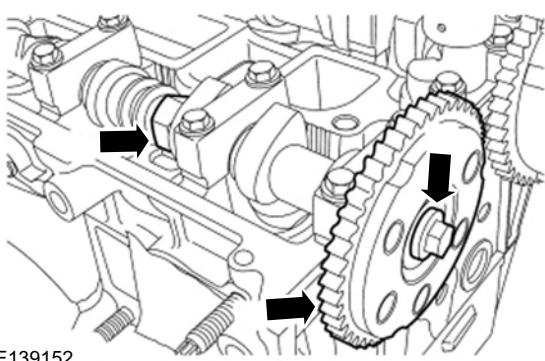
10. Special Tool(s): 100-010
General Equipment: 2 mm Punch

**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.

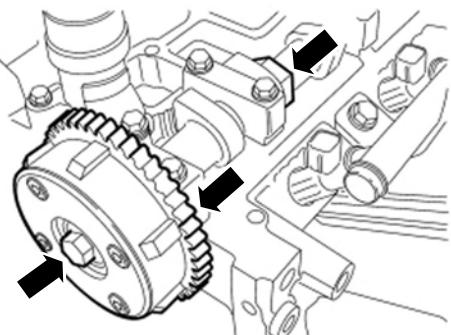
DISASSEMBLY

Remove the bolt and the exhaust camshaft sprocket.

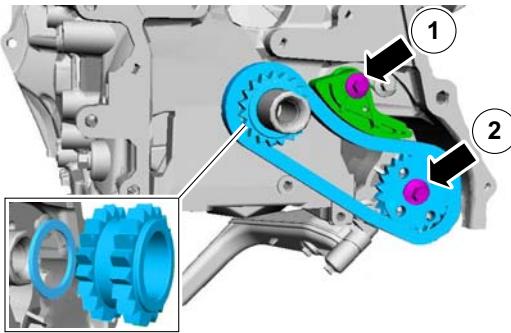


15. ! CAUTION: Use an open-ended wrench to hold the camshafts by the hexagon to prevent the camshafts from turning.

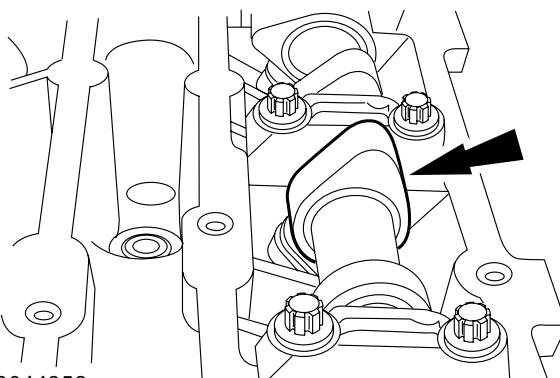
Remove the bolt and the camshaft phaser and sprocket.



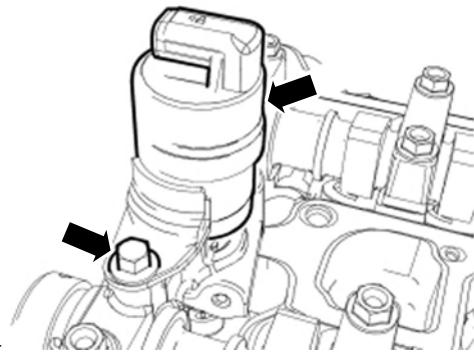
16. ! CAUTION: Make sure that a new friction washer is installed.



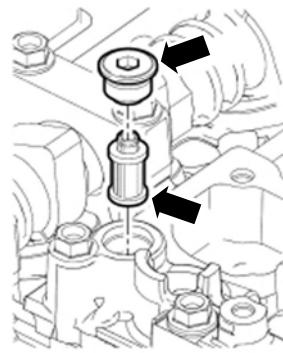
17. Mark the position of the camshaft lobes on the No. 1 cylinder for assembly reference.



18. Remove the bolt and the VCT solenoid.



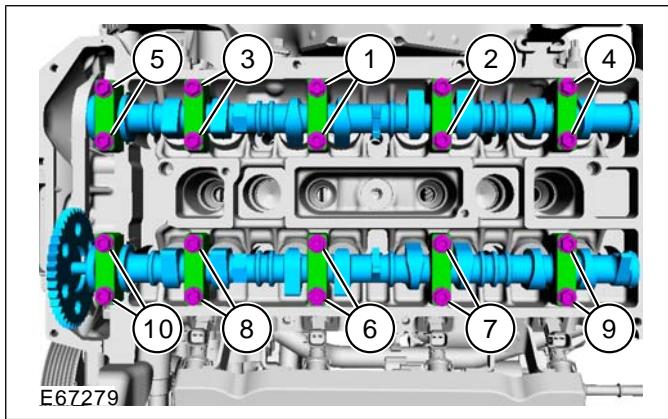
19. Remove the plug and the VCT system oil filter from the intake camshaft thrust cap.



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.

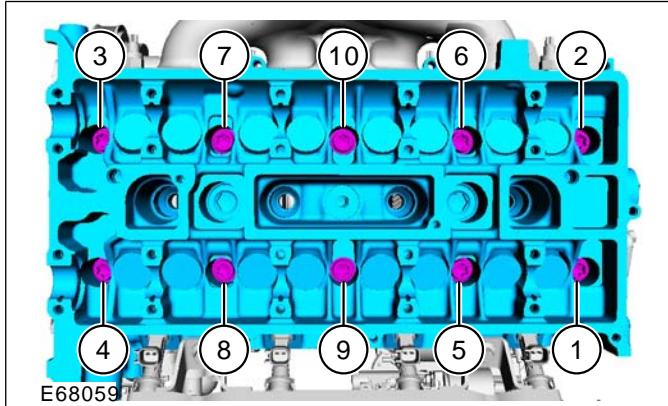


21. NOTE: If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions.

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.

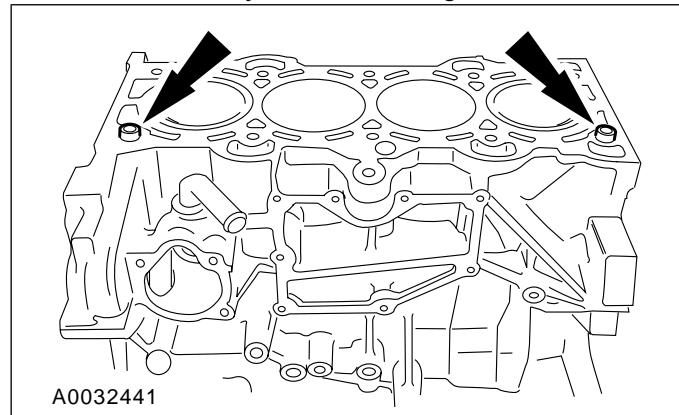


23. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion.

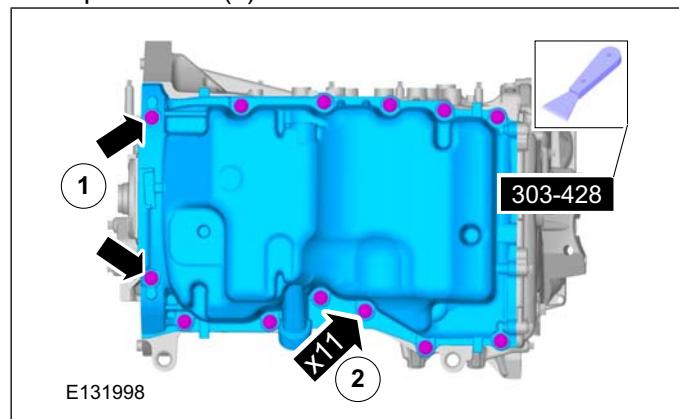
Refer to: [Cylinder Head Distortion \(303-00 Engine System - General Information, General Procedures\)](#).

Refer to: [Cylinder Block Distortion \(303-00 Engine System - General Information, General Procedures\)](#).

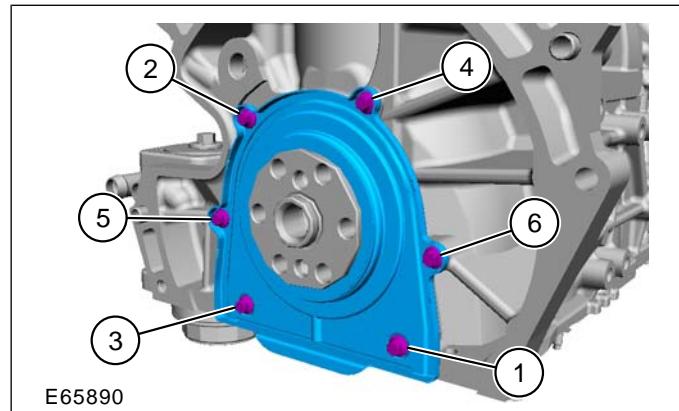
24. Remove the cylinder head alignment dowels.



25. Special Tool(s): 303-428

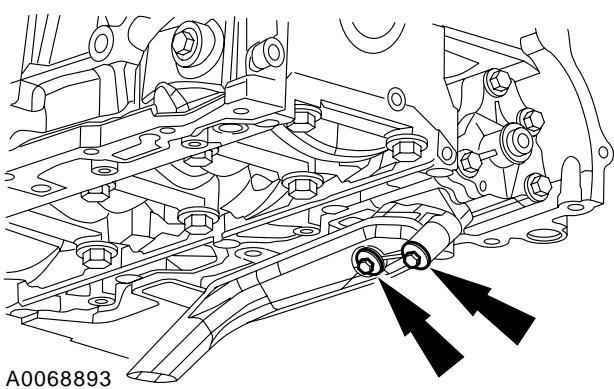


26.

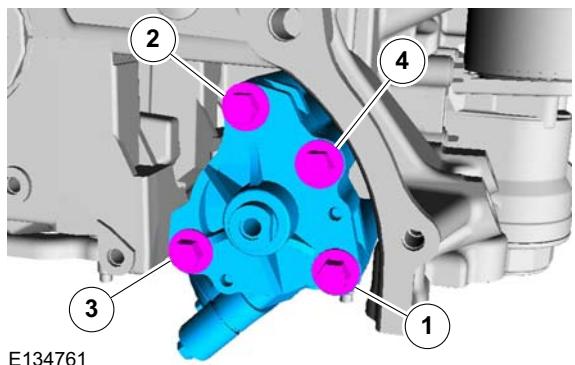


DISASSEMBLY

27. Remove the bolts, oil pump pickup tube and discard the gasket.

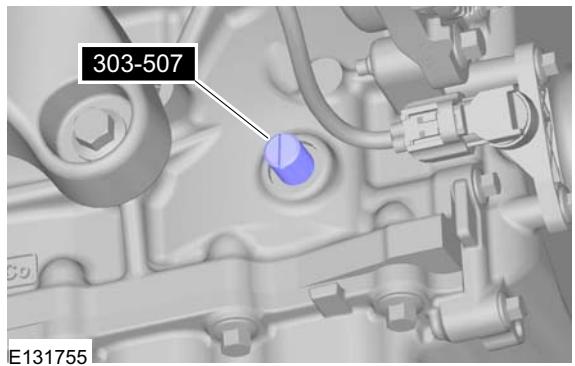


28.

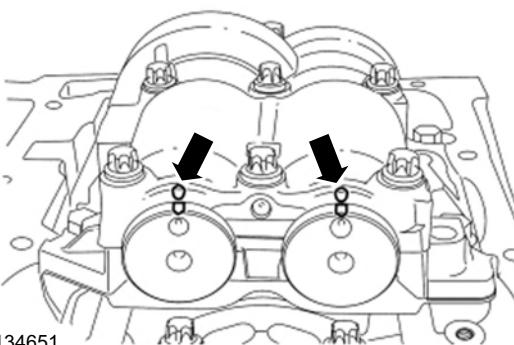


29. Rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the crankshaft TDC timing peg.

Special Tool(s): 303-507

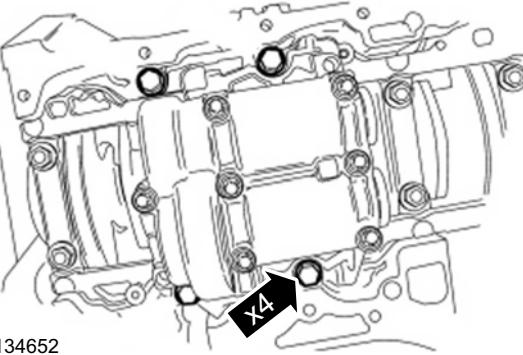


30. Mark the balancer unit front shafts on the top for reference that the balancer unit is at TDC.



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



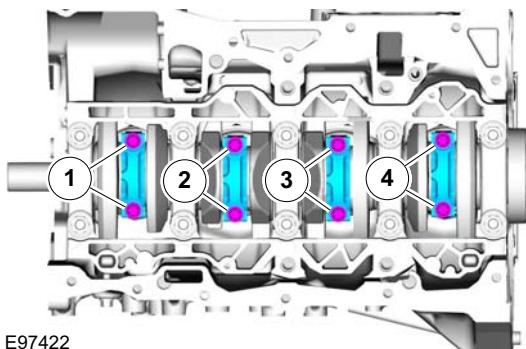
33. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following manufacturer's instructions.

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.

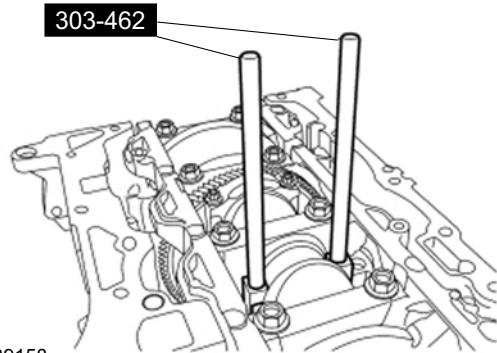


E97422

- 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

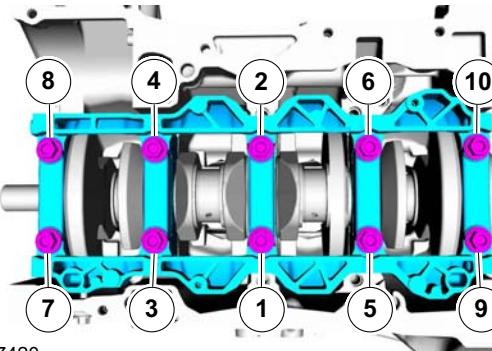
- 36. NOTE:** Note the position of each component before removal.



E97390

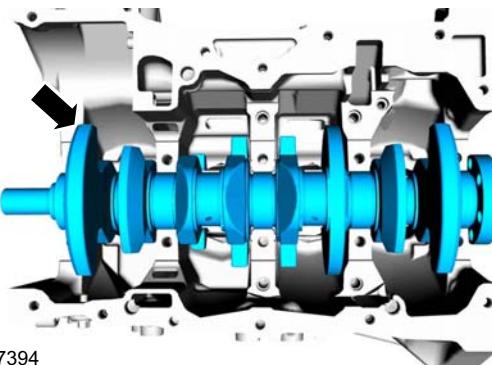
37. Repeat the previous 2 steps until all the piston or rod assemblies are removed from the engine block.

- 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.



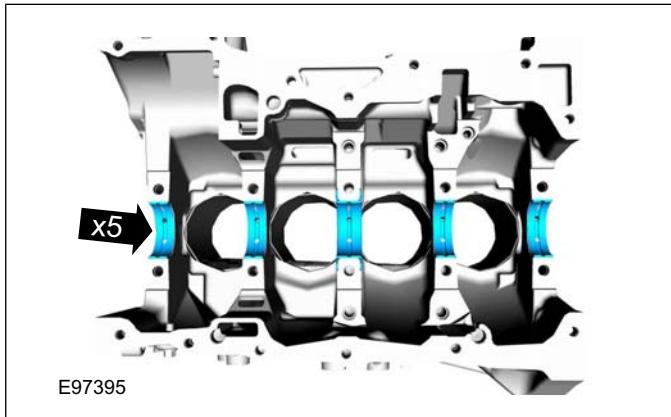
E97393

- 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.

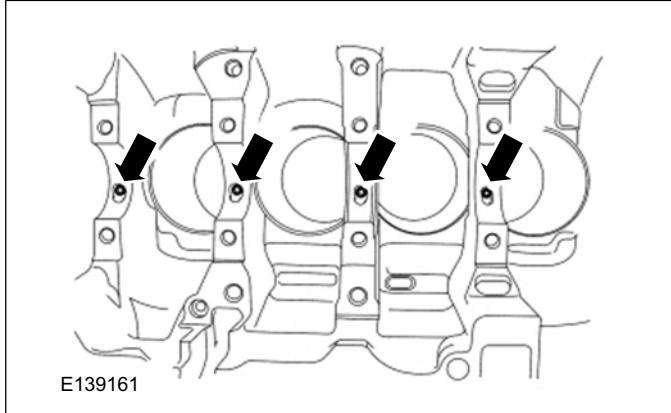
Remove the main bearings from the cylinder block.



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).

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

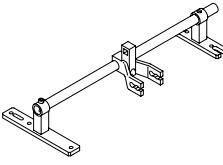
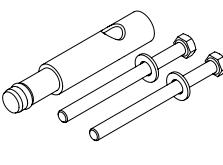
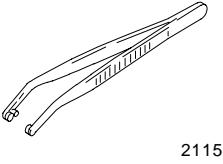
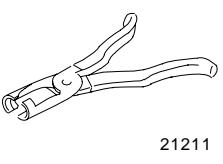
Mandatory Protective equipment - Health and safety symbols

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

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

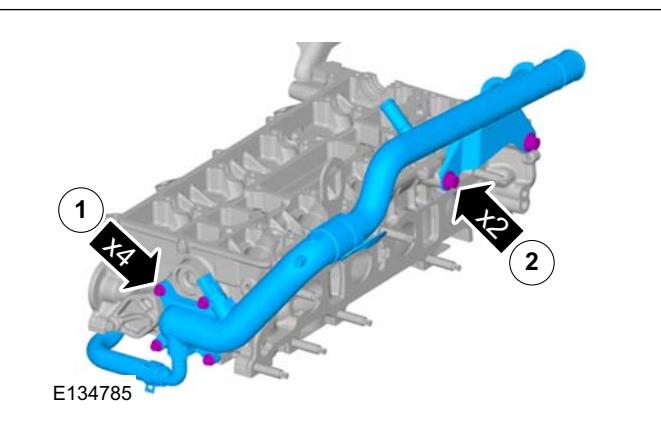
Cylinder Head(21 165 6)

Special Tool(s)

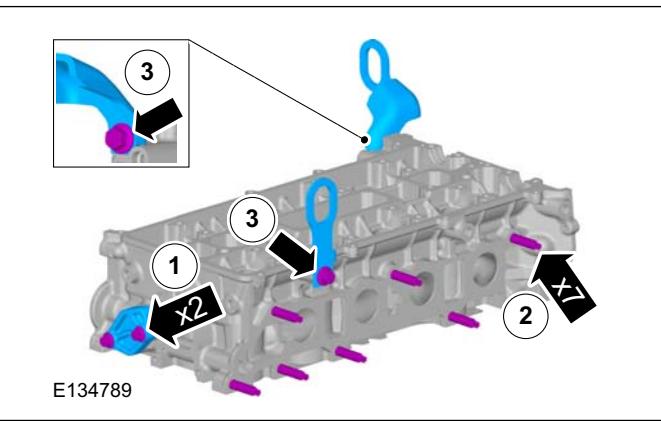
	303-361B Compressor, Valve Spring E62757
	303-361B-06 Adapter for 303-361B E62041
	303-362 Installer, Valve Stem Collets 21156
	303-508 Pliers, Valve Stem Seal 21211

1. Refer to: Cylinder Head (303-01 Engine - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

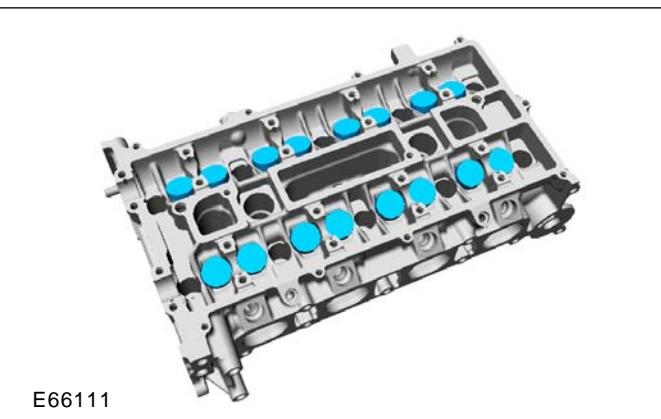
2. 1. Torque: 10 Nm
2. Torque: 48 Nm



3. 1. Torque: 25 Nm
2. Torque: 17 Nm
3. Torque: 45 Nm



4.

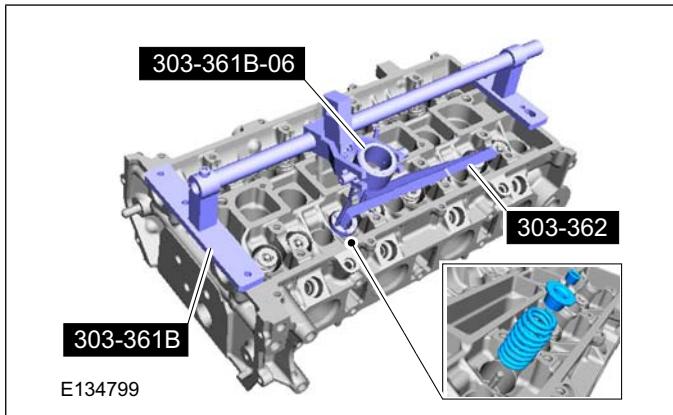


Disassembly

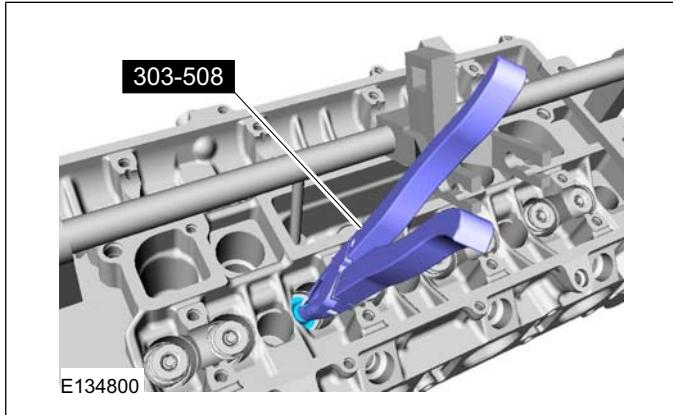
NOTE: Disassembly steps in this procedure may contain assembly details.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

5. Special Tool(s): 303-361B, 303-361B-06,
303-362

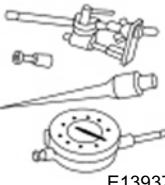
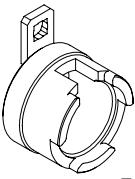
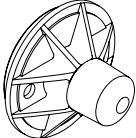
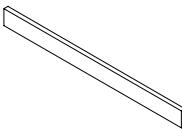


6. Special Tool(s): 303-508

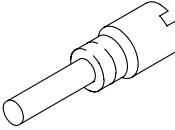
**Assembly**

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.

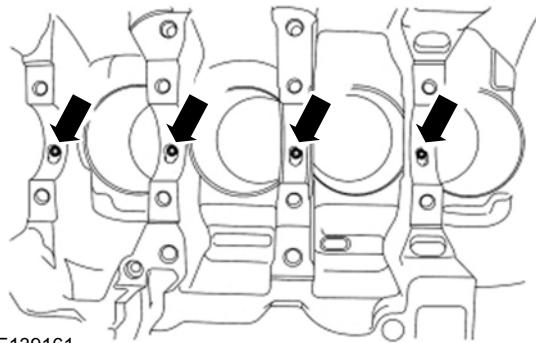
NOTE: Assembly of the engine requires various inspections/measurements of the engine components (engine block, crankshaft, connecting rods, pistons and piston rings). These inspections/measurements will aid in determining if the engine components will require replacement.

- 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.

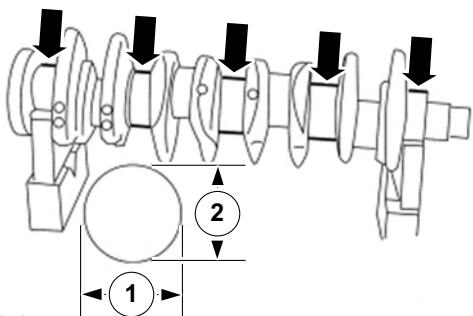
Install the 4 oil squirters.

Torque: 4 Nm



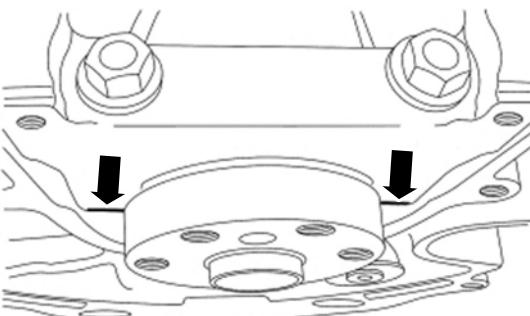
E139161

- Measure each of the crankshaft main bearing journal diameters in at least 2 directions and record the smallest diameter for each journal.



E139173

- Position the main bearing beam in the engine block with the main bearing beam mounted flush with the rear face of the engine block.

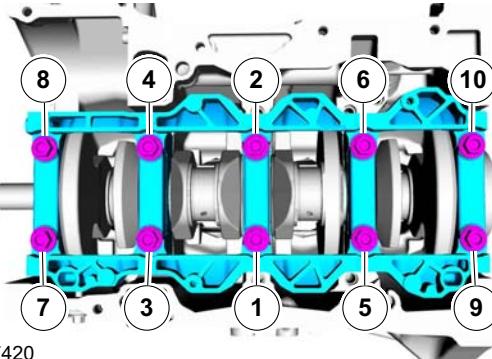


E139174

- Using the original main bearing beam bolts, install and tighten the 10 main bearing beam bolts.

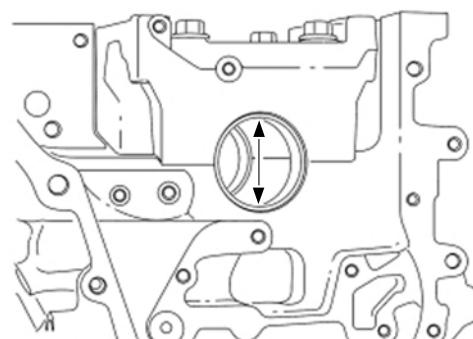
Torque:

- Stage 1: 5 Nm
- Stage 2: 25 Nm
- Stage 3: 90 °



E97420

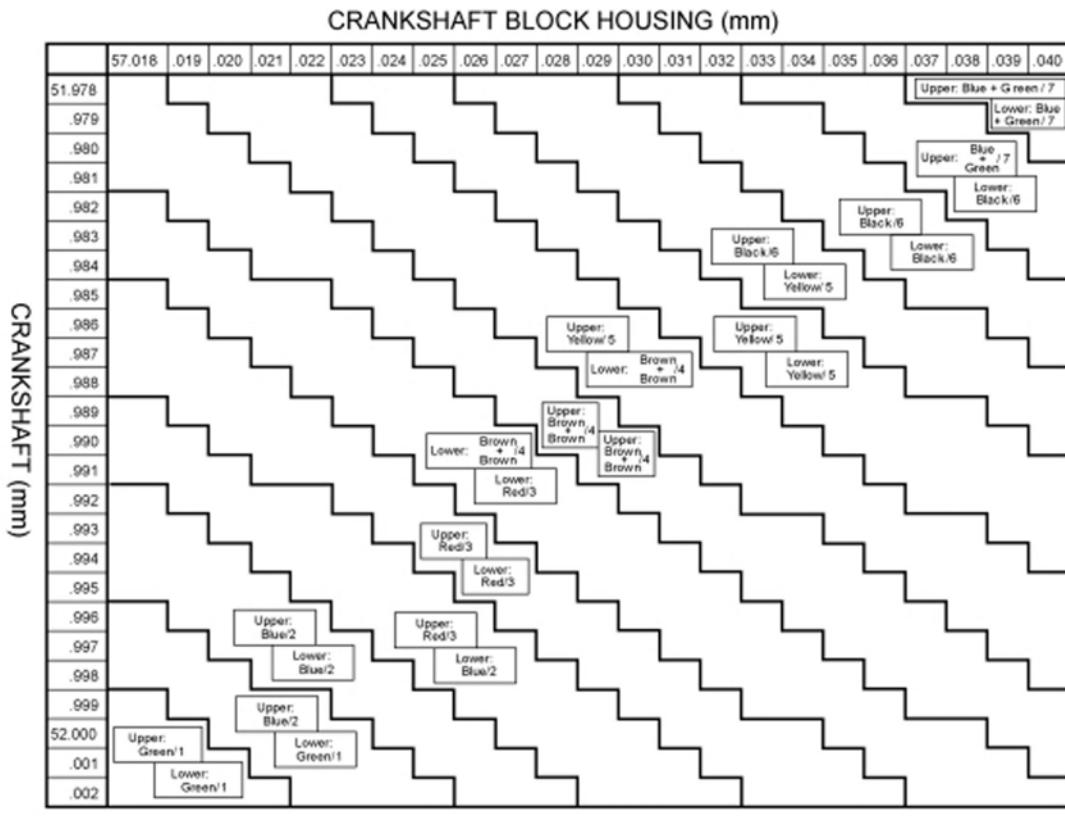
- Measure each crankshaft block main bearing bore diameter.
- Remove the bolts and the main bearing beam.
- Discard the main bearing beam bolts.



E139176

ASSEMBLY

7. Using the chart, select the crankshaft main bearings.



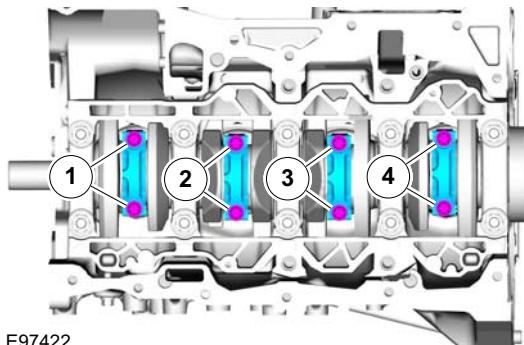
E139177

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.

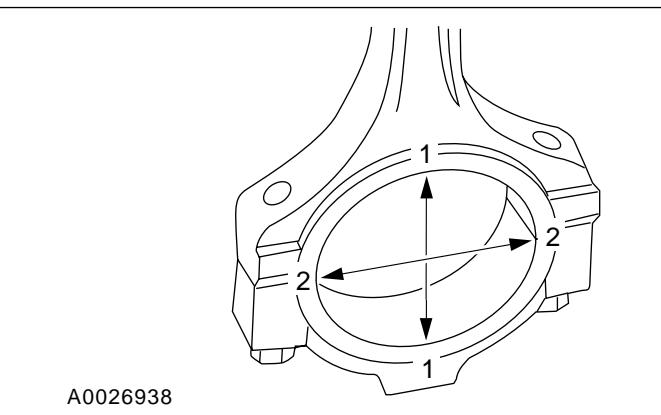
Torque:

- Stage 1: 29 Nm
- Stage 2: 90 °



E97422

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.

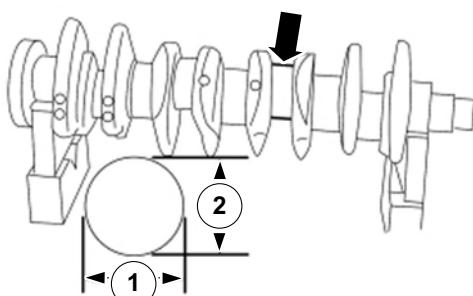


A0026938

10. Measure each of the crankshaft connecting rod bearing journal diameters in at least 2 directions.

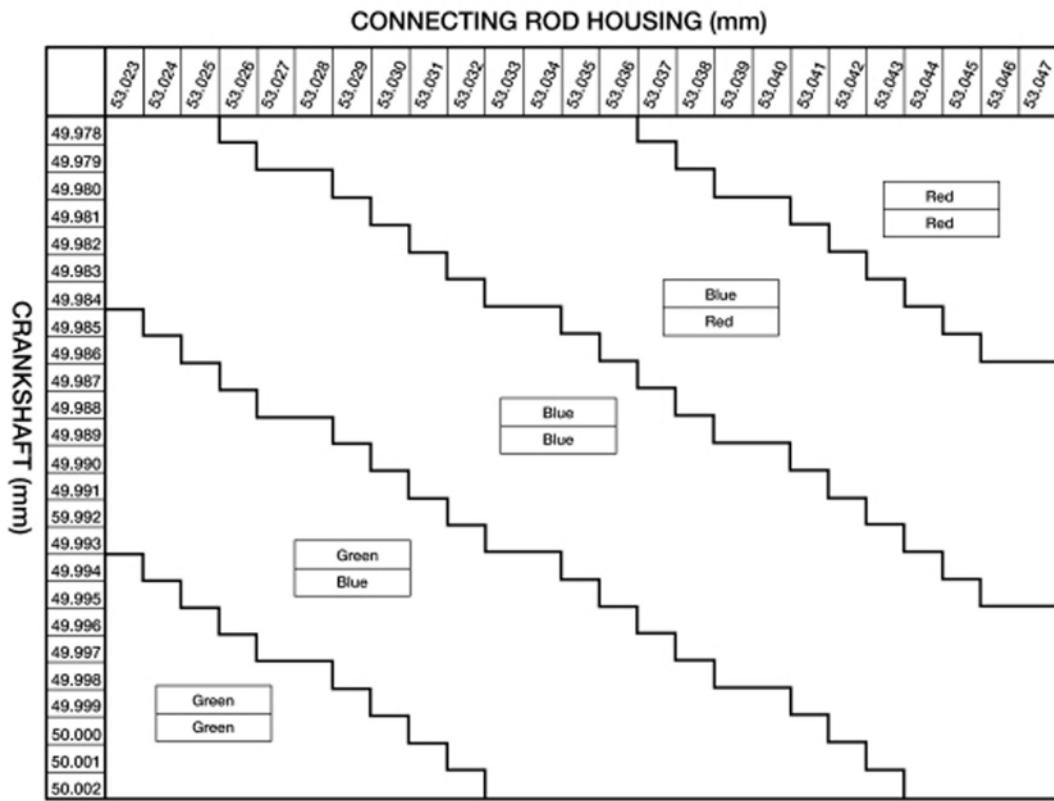
ASSEMBLY

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.



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.

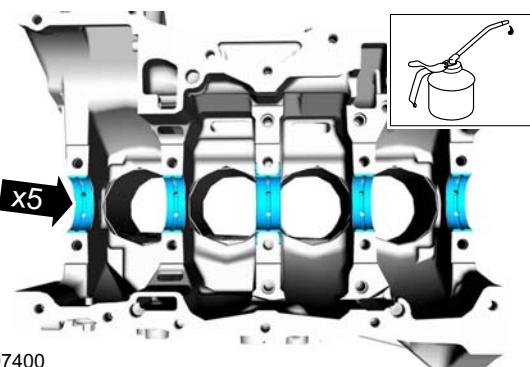
NOTE: If reusing the crankshaft main bearings, install them in their original positions and orientation as noted during disassembly.

NOTE: The center bulkhead is the thrust bearing.

NOTE: Make sure that these components are installed to the noted removal position.

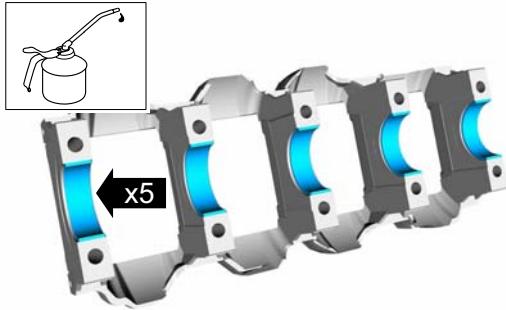
ASSEMBLY

Lubricate the upper crankshaft main bearings with clean engine oil and install the 5 crankshaft main bearings in the cylinder block.



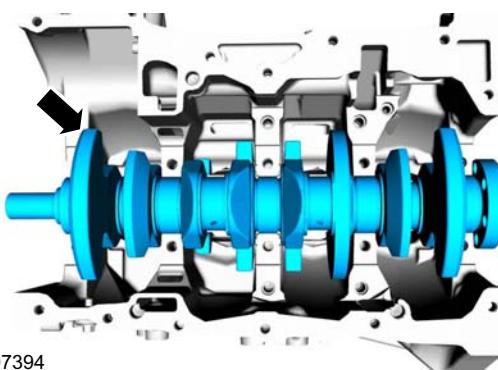
13. NOTE: If reusing the crankshaft main bearings, install them in their original positions and orientation as noted during disassembly.

Lubricate the crankshaft main bearings with clean engine oil and install the 5 crankshaft main bearings in the main bearing beam.

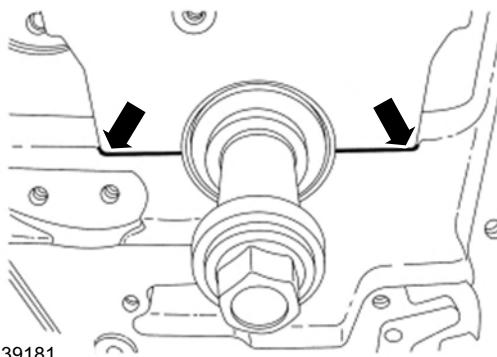


14. Lubricate journals on the crankshaft with clean engine oil.

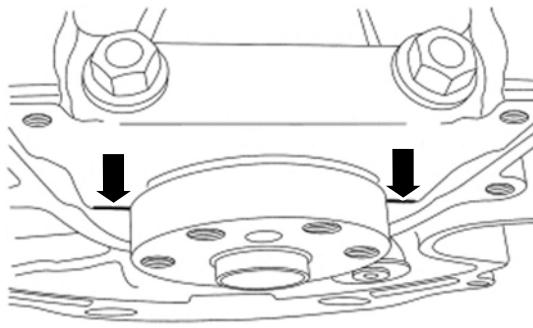
15. Position the crankshaft in the cylinder block.



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.

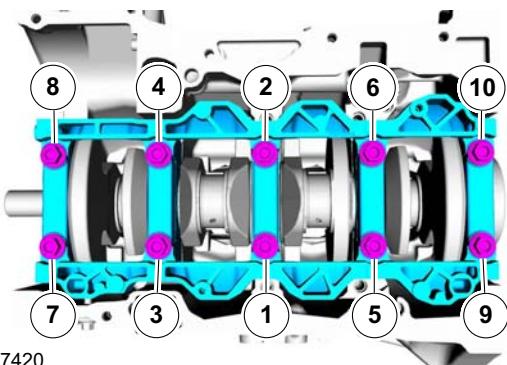
NOTE: Position the crankshaft to the rear of the cylinder block, then position the crankshaft to

ASSEMBLY

the front of the cylinder block before tightening the main bearing beam bolts.

Torque:

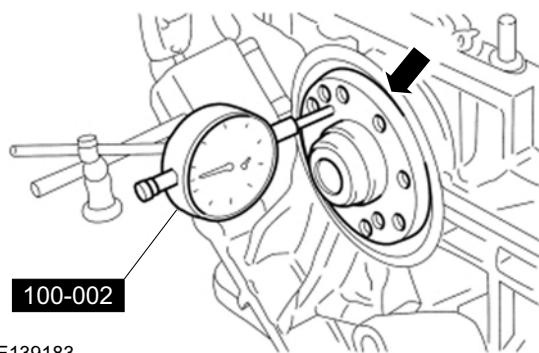
- Stage 1: 5 Nm
- Stage 2: 25 Nm
- Stage 3: Loosen: 90°



- 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.



- 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.

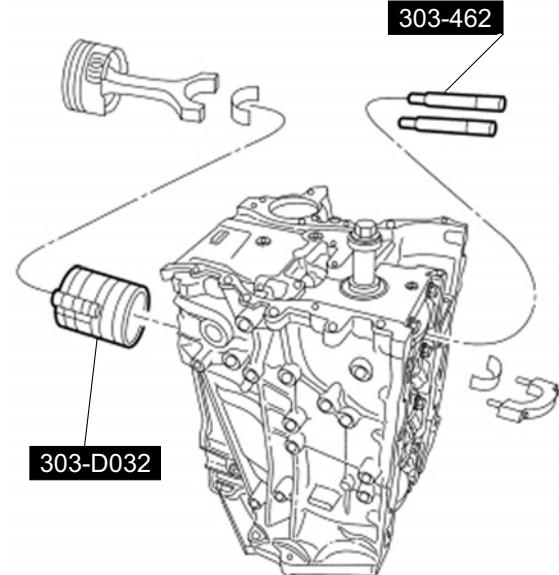
NOTE: Lubricate the pistons, piston rings, connecting rod bearings and the entire cylinder bores with clean engine oil.

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.



- 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

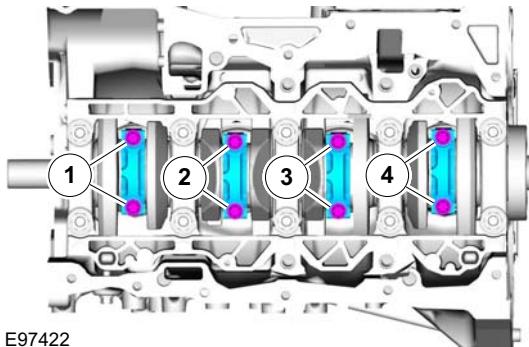
connecting rods for cylinders 2 and 3 and tighten.

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:

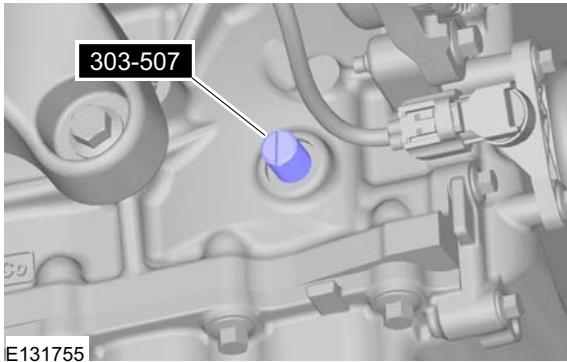
- Stage 1: 29 Nm
- Stage 2: 90 °



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

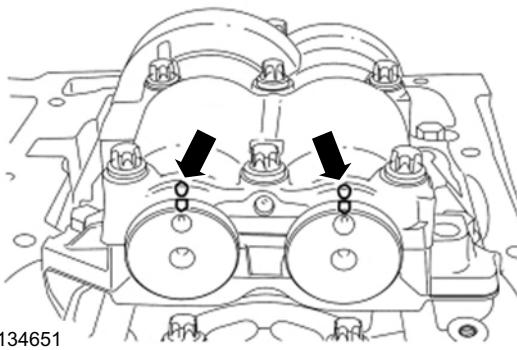
23. NOTE: Due to the precision interior construction of the balancer unit, it should not be disassembled.

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.

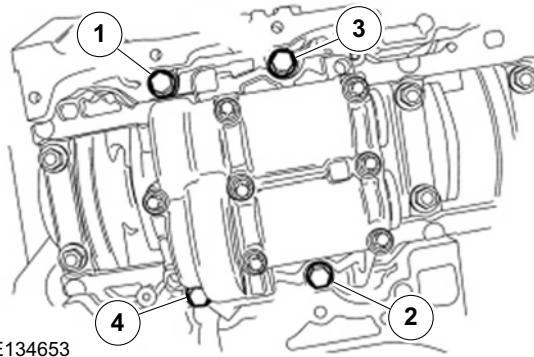
24. With the balancer unit shaft marks in the TDC position, slowly install the balancer unit to the cylinder block to avoid interference between the crankshaft drive gear and the balancer unit driven gear.



25. Install the balancer unit bolts.

Torque:

- Stage 1: 25 Nm
- Stage 2: 50 Nm



26. Remove the Special Tool(s): 303-507

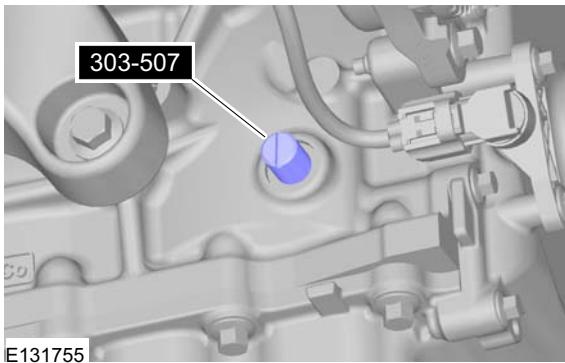


E131755

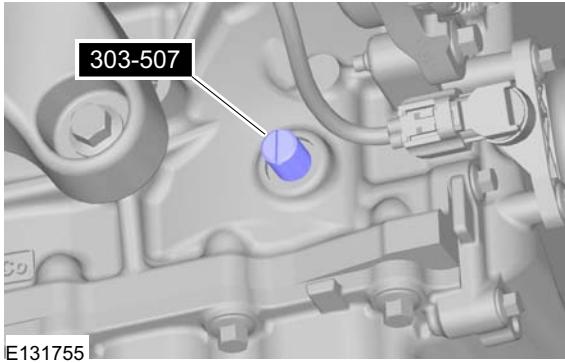
ASSEMBLY

- 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.

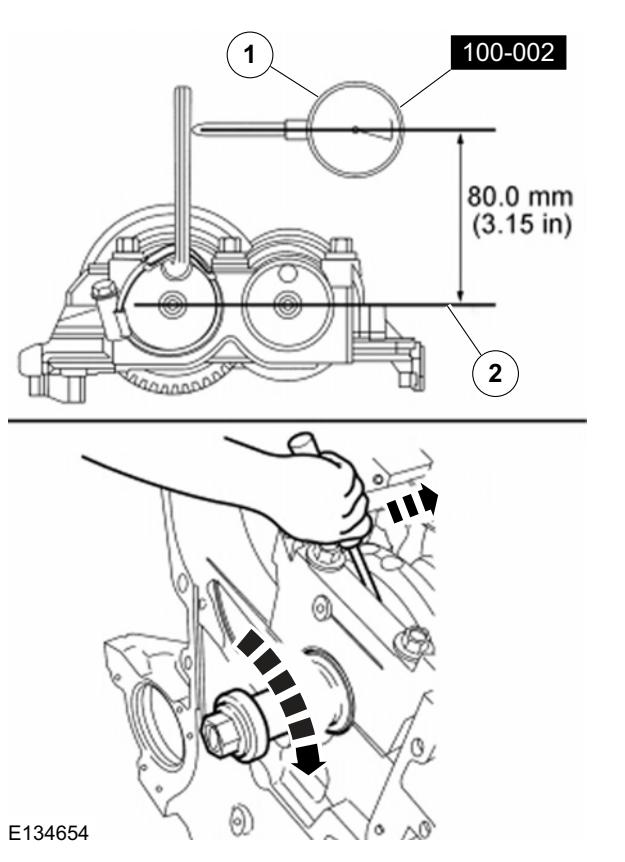
NOTE: The measurement must be taken with the dial indicator gauge with holding fixture, a 5 mm allen wrench and worm clamp set up as shown. Mark the allen wrench with a file 80 mm (3.149 in) above the driven gear shaft center. Make sure the worm clamp and allen wrench are not touching the balance shaft 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.

DESCRIPTION AND OPERATION



1



2



3



4



5



6

E89019

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.

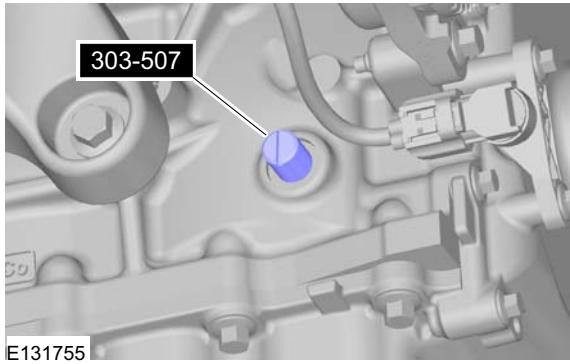
ASSEMBLY

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.

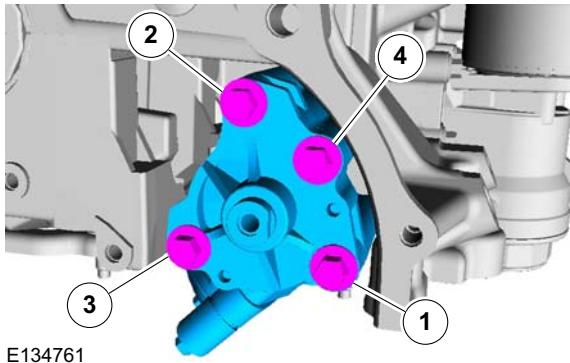
Special Tool(s): 303-507



33. NOTE: Clean the oil pump and cylinder block mating surfaces with metal surface prep.

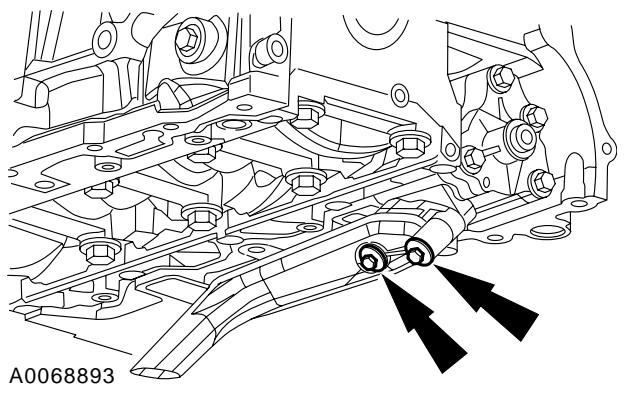
Torque:

- Stage 1: 10 Nm
- Stage 2: 20 Nm



34. Install a new oil pump pickup tube gasket and the pickup tube.

Torque: 10 Nm

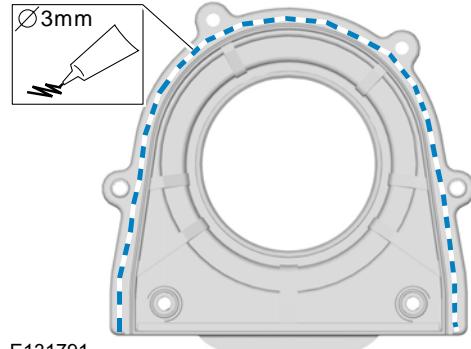


35. CAUTION: Install the crankshaft rear seal carriers within five minutes of applying the sealer.

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

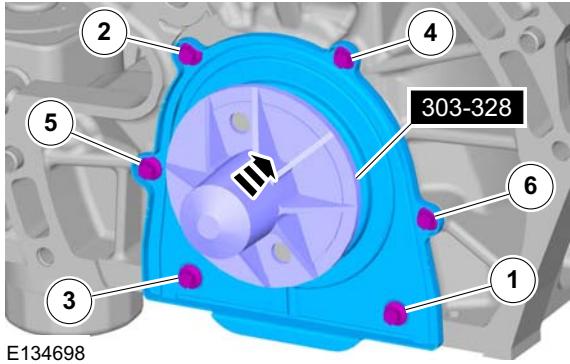


ASSEMBLY

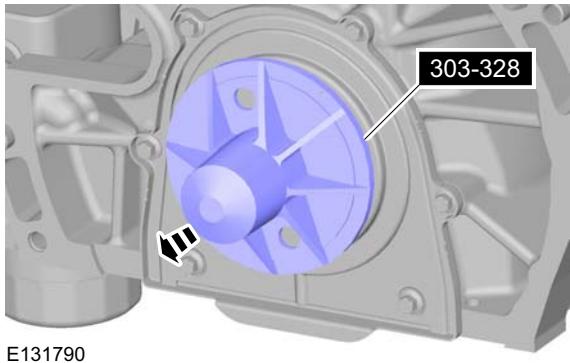
36. NOTE: New crankshaft rear seal carriers are supplied with an alignment sleeve which must be removed after installation.

Special Tool(s): 303-328

Torque: 10 Nm



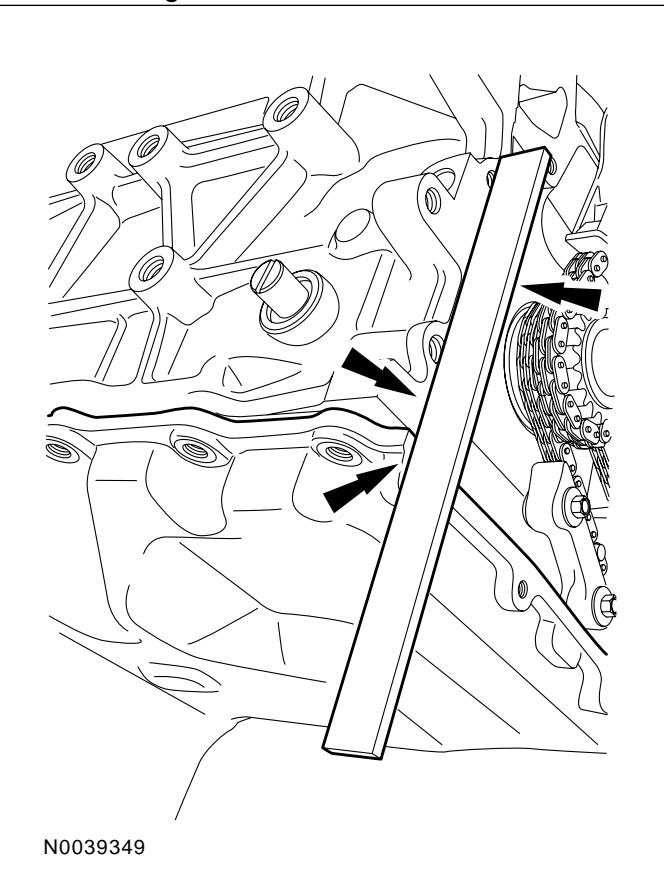
37. Remove the Special Tool(s): 303-328



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.

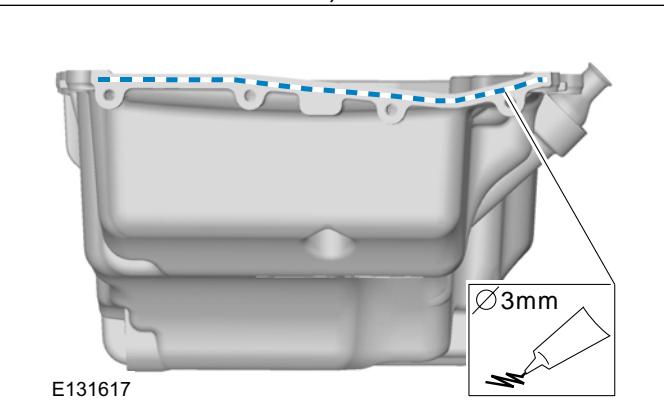


40. CAUTION: Install the oil pan within five minutes of applying the sealer.

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



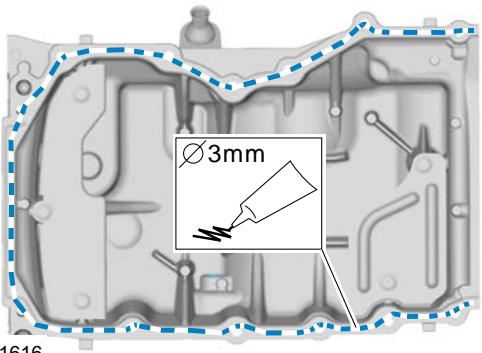
41. CAUTION: Install the oil pan within five minutes of applying the sealer.

NOTE: Do not damage the mating faces.

ASSEMBLY

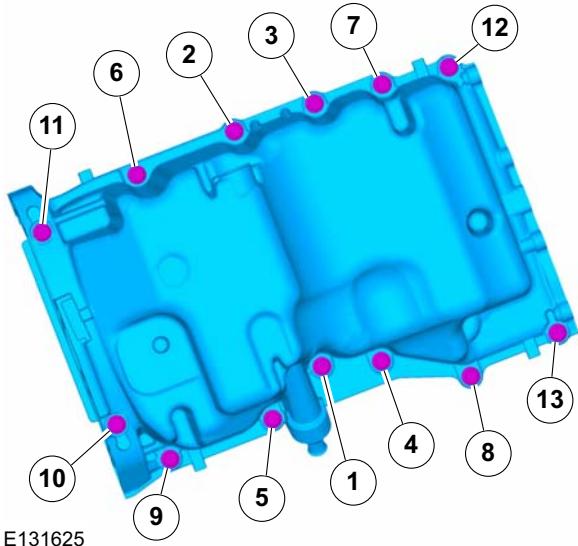
NOTE: Mating surface should not have traces of oil to improve the adhesion.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant

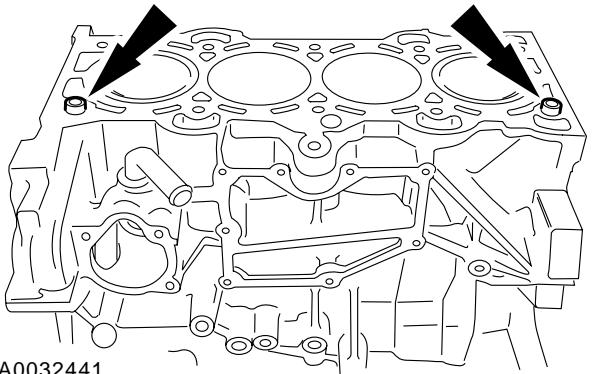


42 Install the oil pan.

Torque: 25 Nm



- 43. • Install the cylinder head alignment dowels.
- Dowels must be fully seated in the cylinder block.



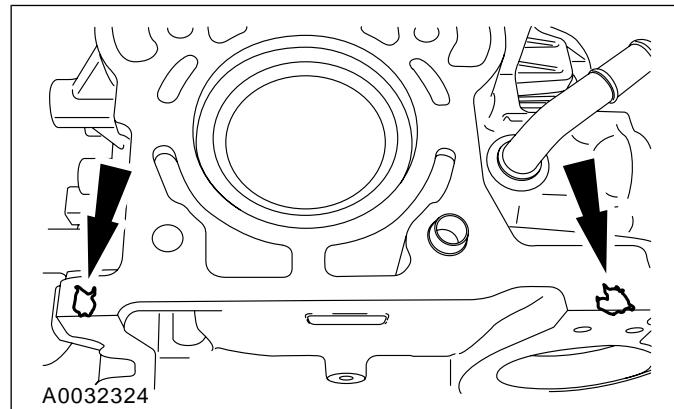
44. **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

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.

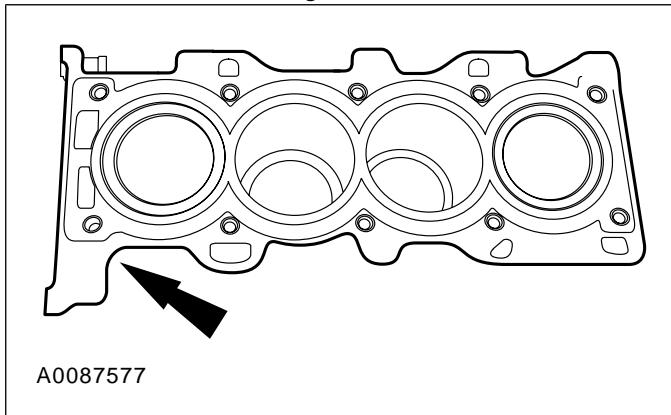
- Clean the cylinder head-to-cylinder block mating surface of both the cylinder head and the cylinder block in the following sequence.
- 1. Remove any large deposits of silicone or gasket material with a plastic scraper.
- 2. Apply silicone gasket remover, following package directions, and allow to set 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.



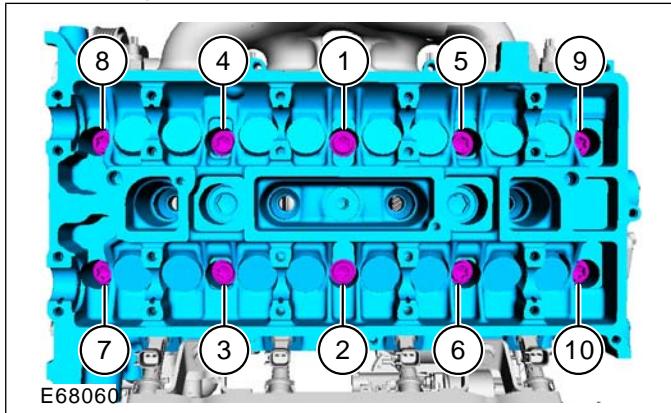
47. **⚠ CAUTION:** Make sure that new bolts are installed.

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.

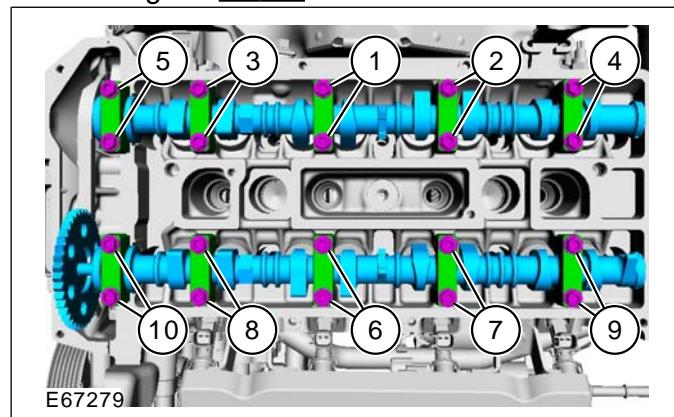
Install the camshafts approximately at valve overlap position cylinder No. 4 and tighten the

camshaft bearing cap bolts one at a time until finger-tight.

Material: Hypoid Oil 85W-90 (SQ-M2C9002-AA / A72SX-19K261-CA) transmission fluid

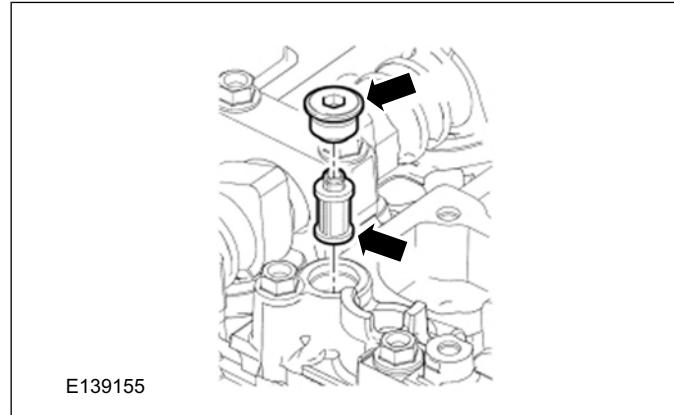
Torque:

- Stage 1: 7 Nm
- Stage 2: 16 Nm



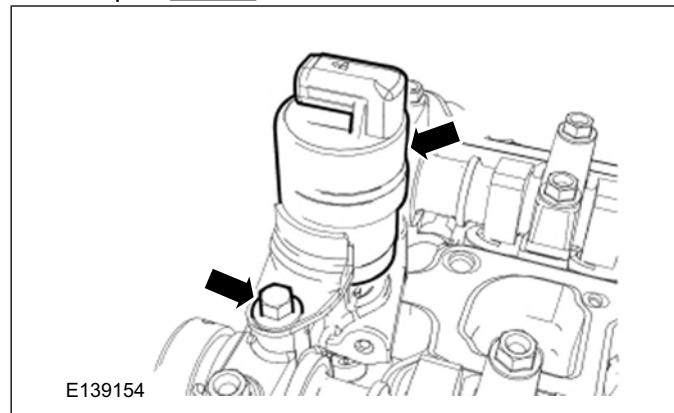
50. Install the variable camshaft timing (VCT) system oil filter and the plug in the intake camshaft thrust cap.

Torque: 17 Nm



51. Install the VCT solenoid and the bolt.

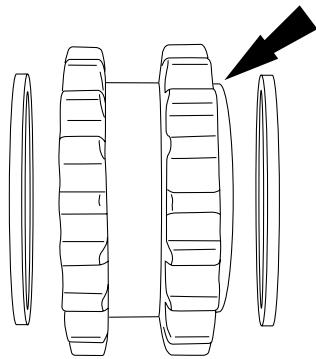
Torque: 10 Nm



ASSEMBLY

52 NOTE: Install a new crankshaft sprocket diamond washer on both sides of the crankshaft sprocket.

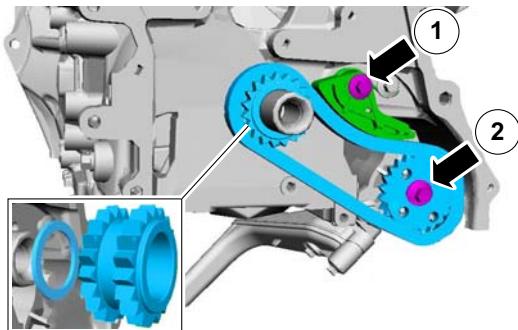
- Install the crankshaft sprocket, new crankshaft sprocket diamond washers, oil pump chain and oil pump sprocket.
- The crankshaft sprocket flange must be facing away from the engine block.



A0083166

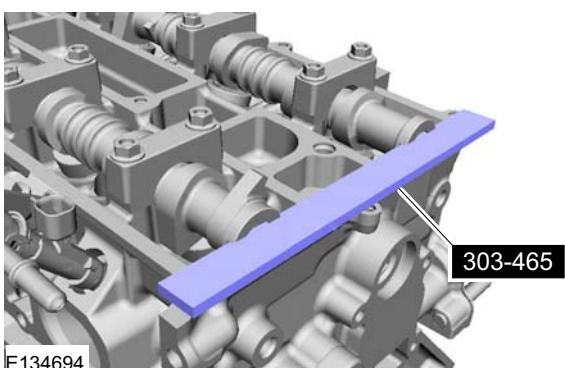
53. CAUTION: Make sure that a new friction washer is installed.

- Torque: 10 Nm
- Torque: 25 Nm



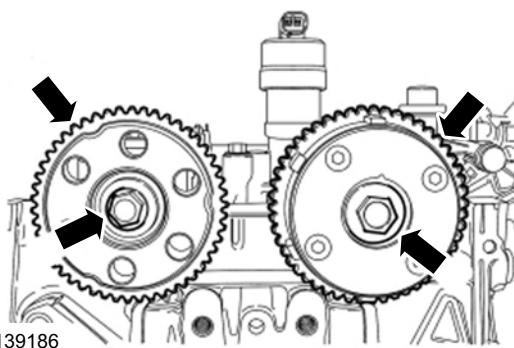
E134760

54. Special Tool(s): 303-465

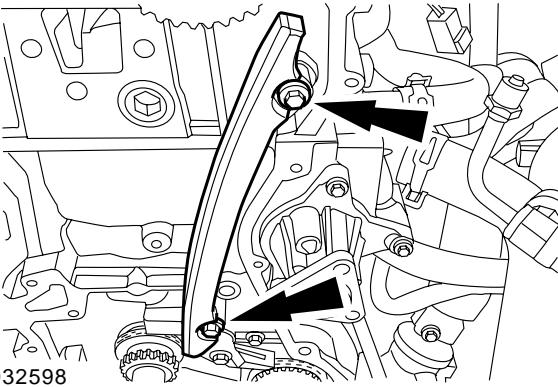


E134694

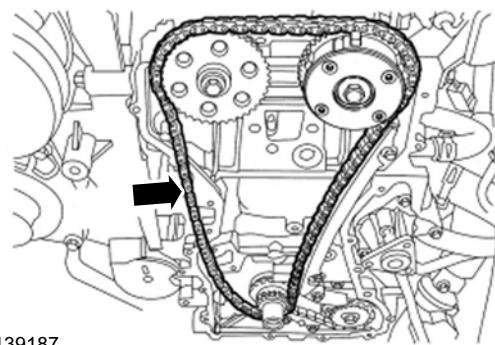
Install the camshaft sprockets and the bolts.



56. Install the timing chain guide and the bolts.
Torque: 10 Nm



57. Install the timing chain.

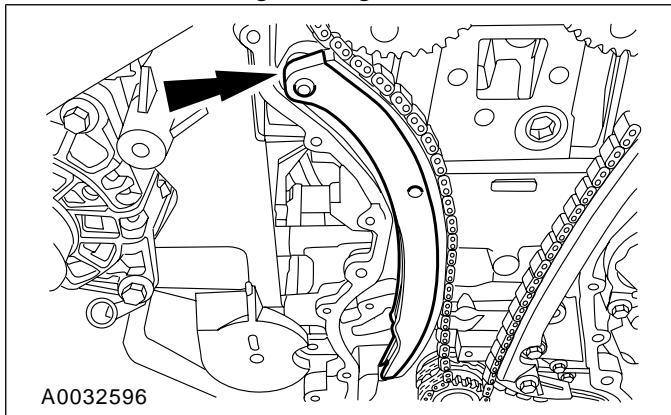


58. NOTE: If the timing chain tensioner plunger and ratchet assembly are not pinned in the compressed position, follow the next 4 steps.

55. NOTE: Hand tighten the bolts at this stage.

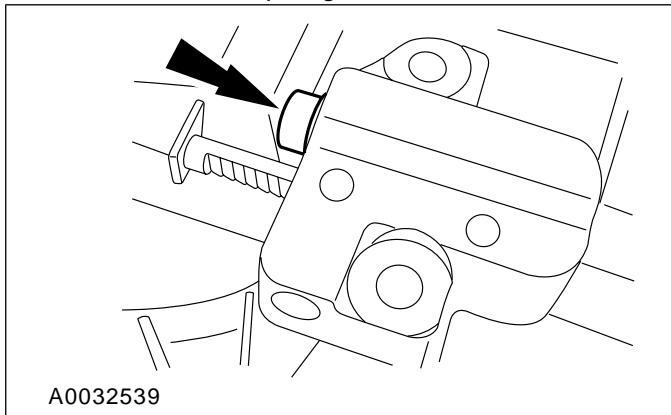
ASSEMBLY

Install the timing chain guide.

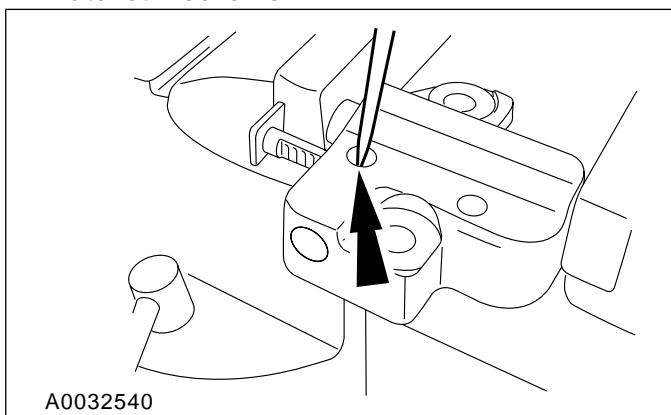


- 59. ! CAUTION: Do not compress the ratchet assembly. This will damage the ratchet assembly.**

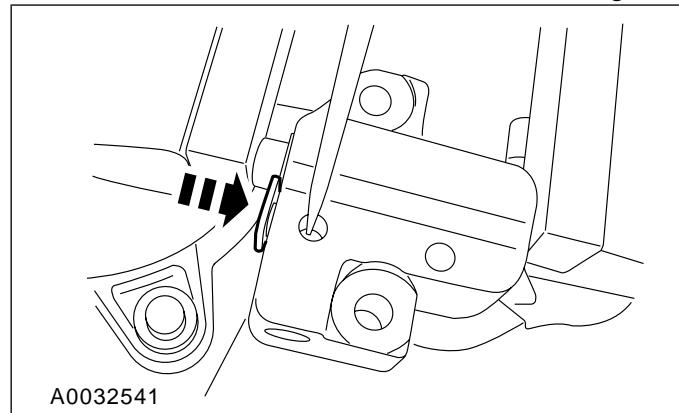
Using the edge of a vise, compress the timing chain tensioner plunger.



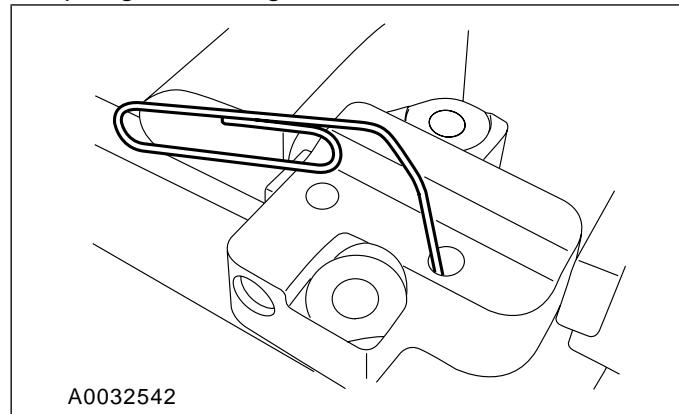
- 60. Using a small pick, push back and hold the ratchet mechanism.**



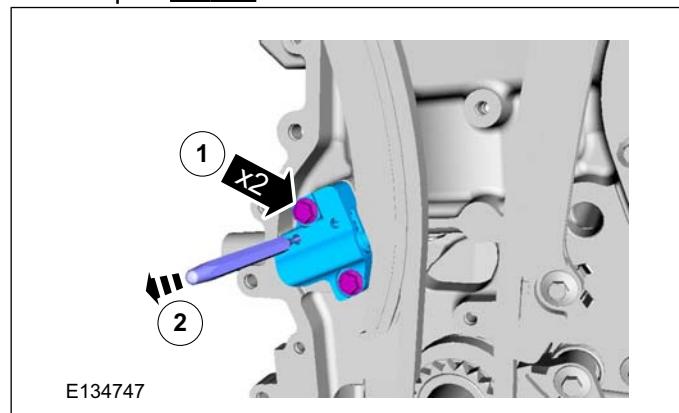
- 61. While holding the ratchet mechanism, push the ratchet arm back into the tensioner housing.**



- 62. Install a paper clip into the hole in the tensioner housing to hold the ratchet assembly and the plunger in during installation.**



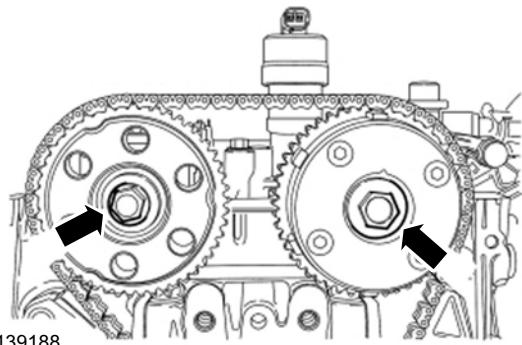
- 63. Install the timing chain tensioner and the bolts.**
Torque: 10 Nm



ASSEMBLY

64.  **CAUTION:** Use an open-ended wrench to hold the camshafts by the hexagon to prevent the camshafts from turning.

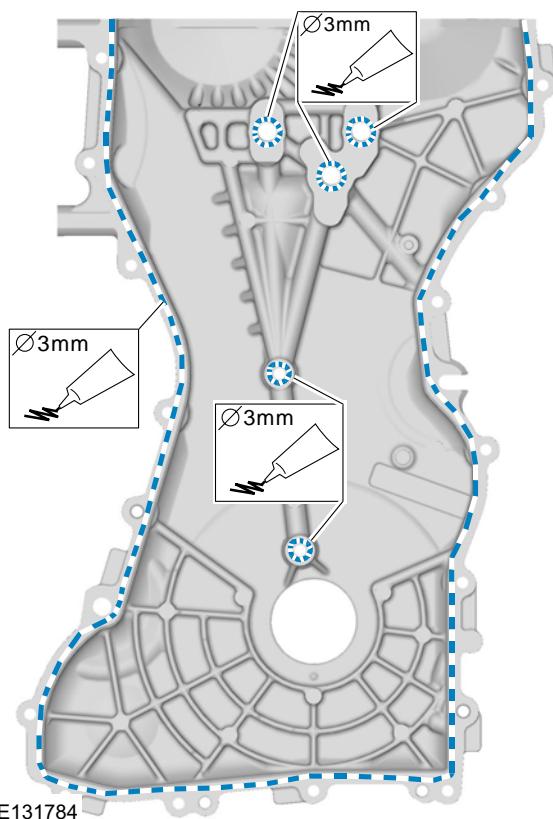
Torque: 72 Nm



65.  **CAUTION:** Install the engine front cover within five minutes of applying the sealer.

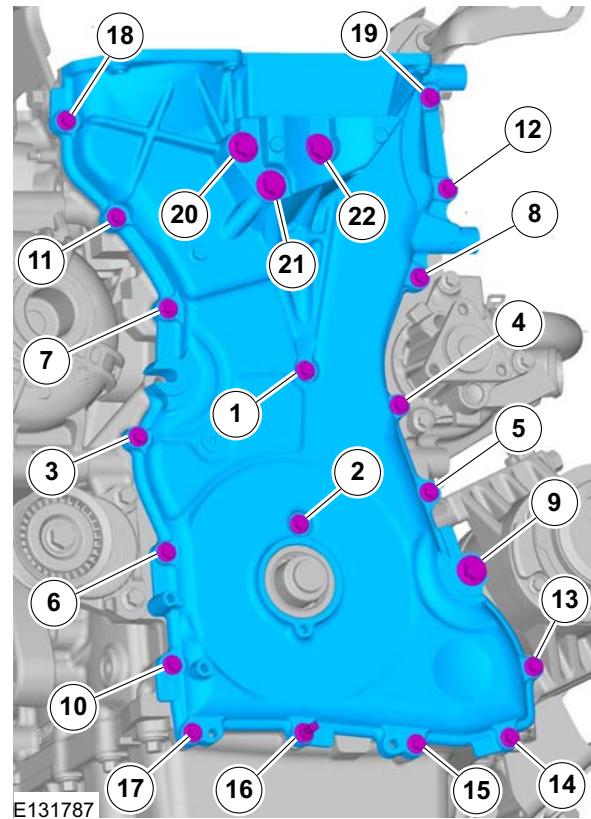
NOTE: The engine front cover must be installed and the bolts tightened within 4 minutes of applying the silicone gasket and sealant.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant

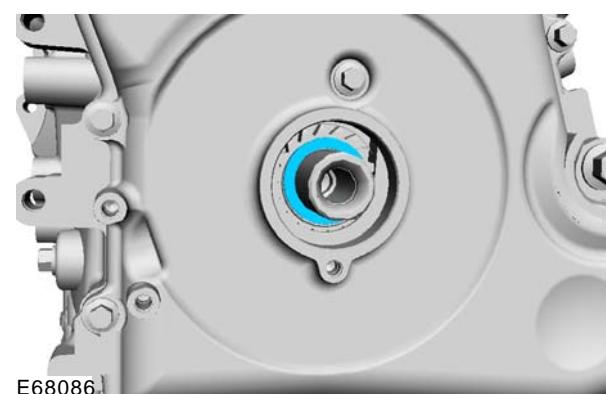


66. **Torque:**

- 1 - 8 10 Nm
- 9 48 Nm
- 10 - 19 10 Nm
- 20 - 22 48 Nm

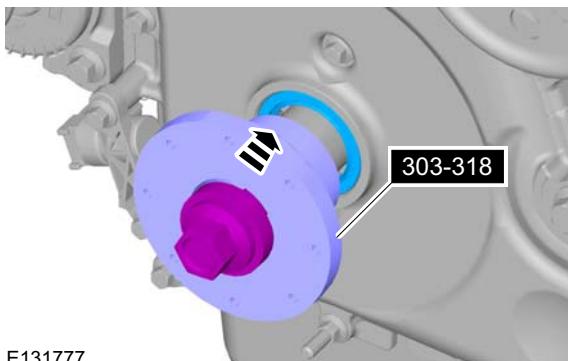


67.  **CAUTION:** Make sure that a new friction washer is installed.

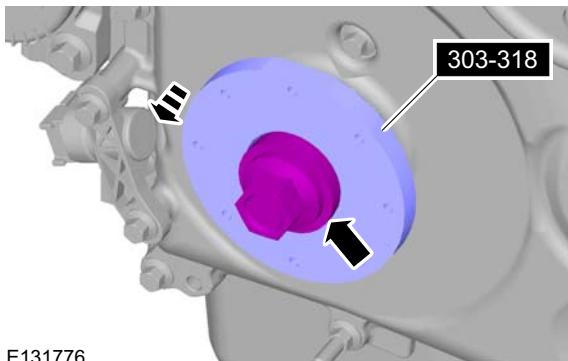


ASSEMBLY

- 68.** Special Tool(s): 303-318
Torque: 50 Nm

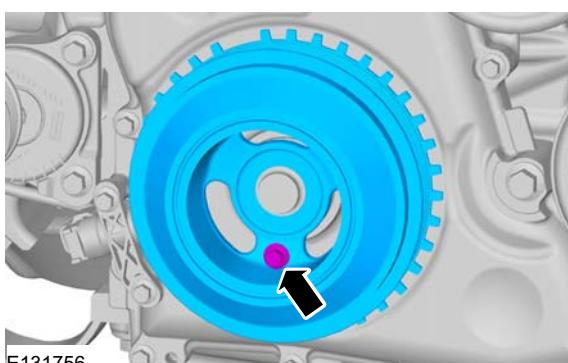


- 69.** Remove the Special Tool(s): 303-318



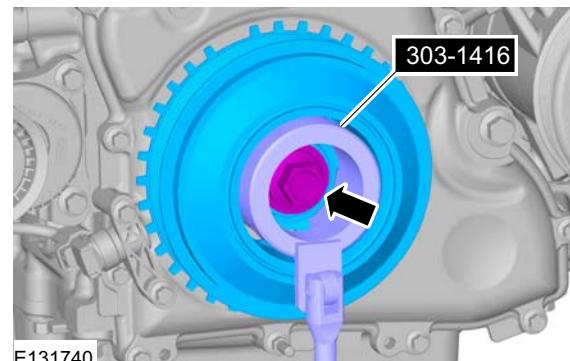
- 70. NOTE:** Hand tighten the bolt at this stage.

- Bolt M6 x 18 mm

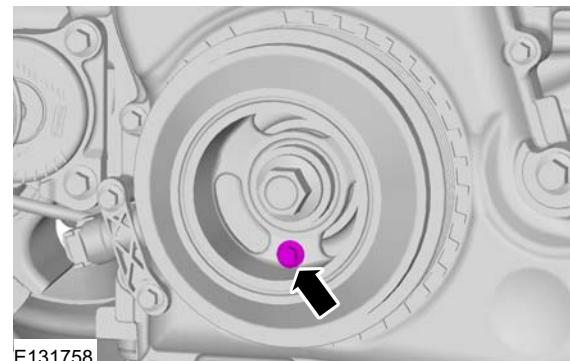


- 71.** **CAUTION:** Make sure that a new bolt is installed.

- Special Tool(s): 303-1416
Torque:
• Stage 1: 100 Nm
• Stage 2: 90°



- 72** Remove the 6 mm x 18 mm bolt.



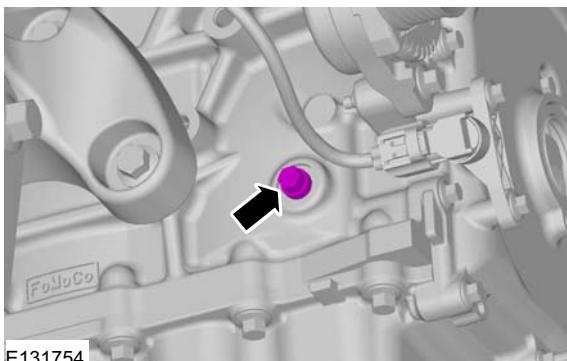
- 73.** Remove the Special Tool(s): 303-507



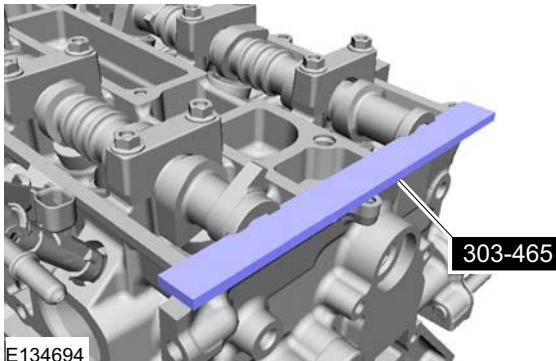
ASSEMBLY

74. Install the engine plug bolt.

Torque: 20 Nm

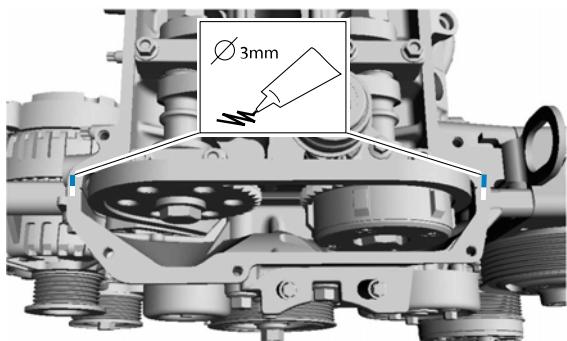


75. Remove the Special Tool(s): 303-465



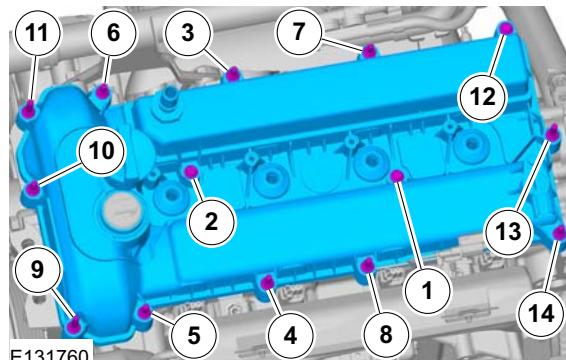
76. NOTE: The valve cover must be secured within 4 minutes of silicone gasket application. If the valve cover is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with metal surface prep.

Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant

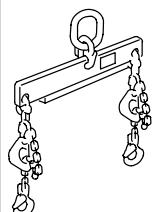


77. NOTE: The gasket is to be reused unless damaged.

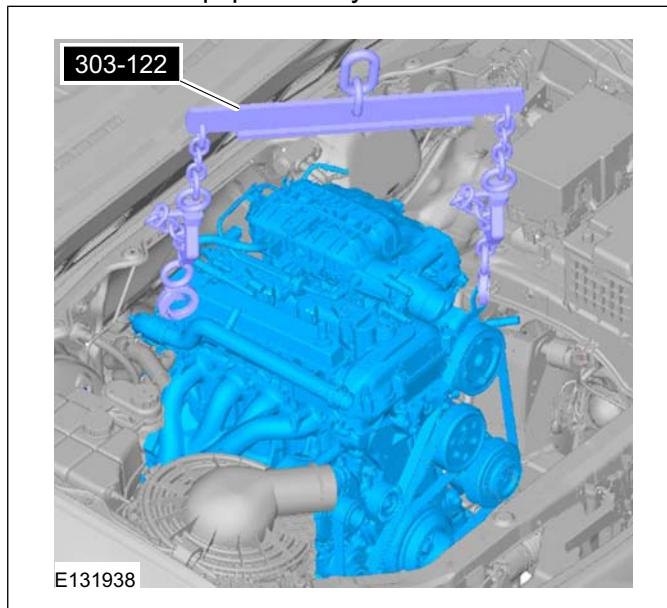
Torque: 10 Nm



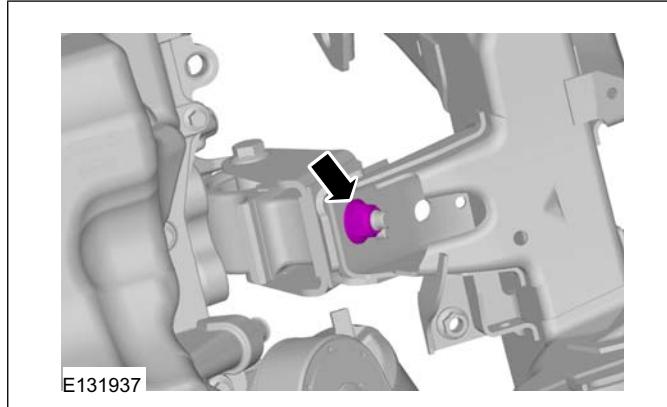
INSTALLATION**Engine — Vehicles With: 5-Speed Manual Transmission - MT75(21 132 0; 21 132 6; 21 132 7)****Installation****Special Tool(s) / General Equipment**

	303-122 Lifting Bracket, Engine
21068A	Hydraulic Jib Crane

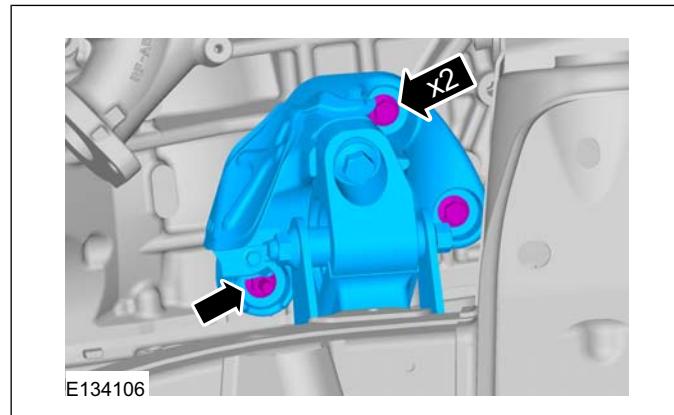
1. Special Tool(s): 303-122
General Equipment: Hydraulic Jib Crane



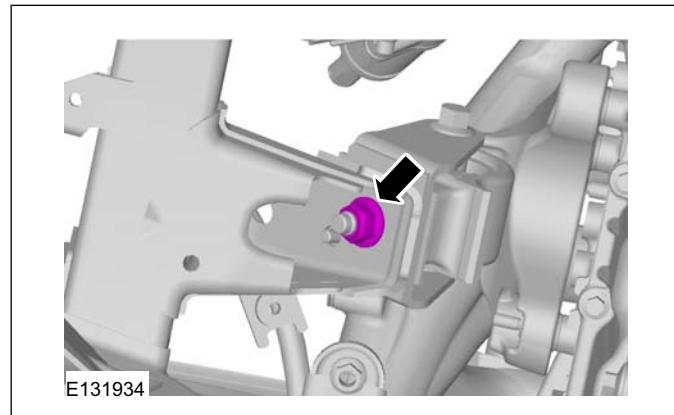
2. NOTE: Hand tighten the nut at this stage.



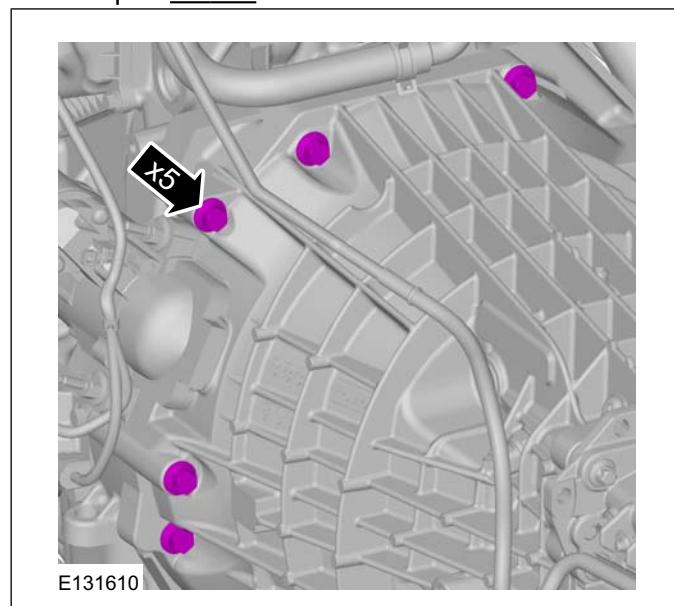
3. NOTE: Hand tighten the bolts at this stage.



4. NOTE: Hand tighten the nut at this stage.



5. Initially hand tighten the bolts.
Torque: 48 Nm



(96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma/3.2L Duratorq-TDCi (148kW/200PS) - Puma	
Fuel Tank and Lines	310-00B
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	310-01A
Acceleration Control	310-01B
	310-02

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GROUP 5 Body and Paint

Body and Paint

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Roof Sheet Metal Repairs	501-28
Side Panel Sheet Metal Repairs	501-29
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DESCRIPTION AND OPERATION



1



2



3



4



5



6



7

E89020

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

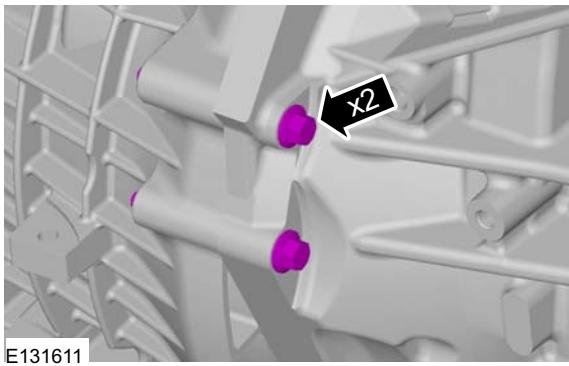
Warning symbols - Health and safety and component damage

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

INSTALLATION

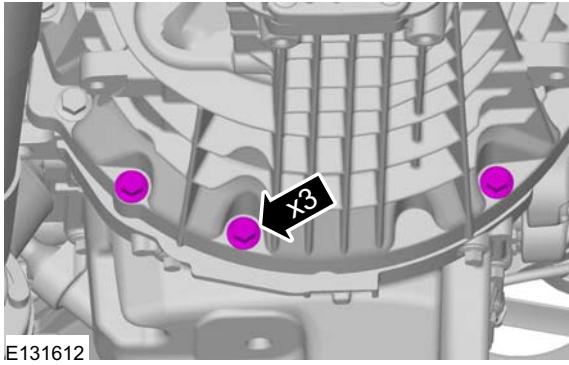
6. Initially hand tighten the bolts.

Torque: 48 Nm

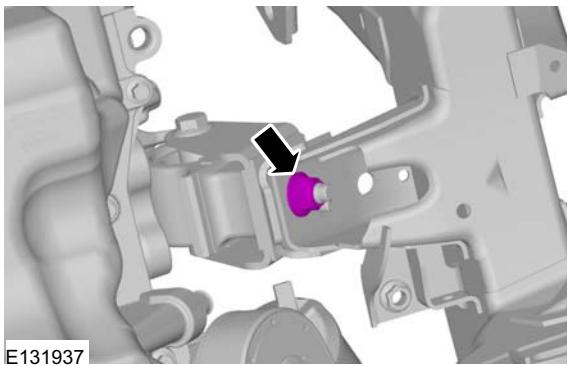


7. Initially hand tighten the bolts.

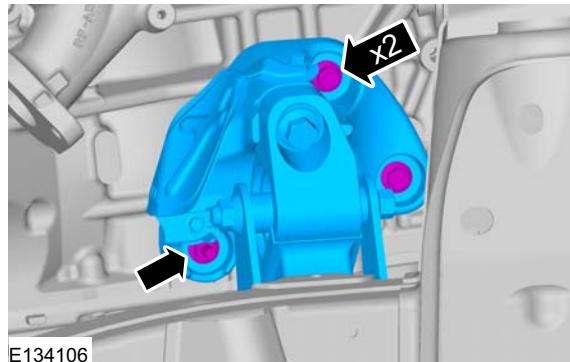
Torque: 48 Nm



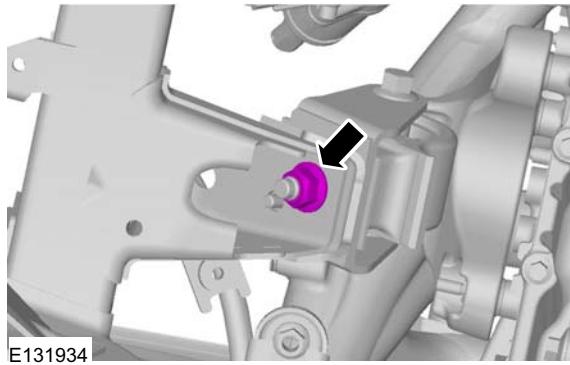
8. Torque: 80 Nm



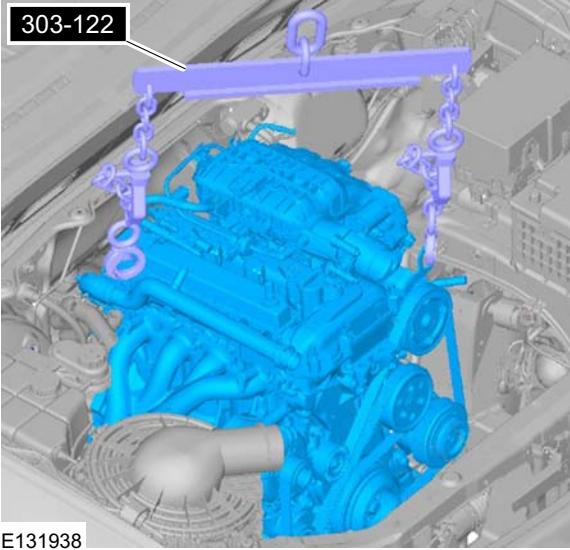
9. Torque: 48 Nm

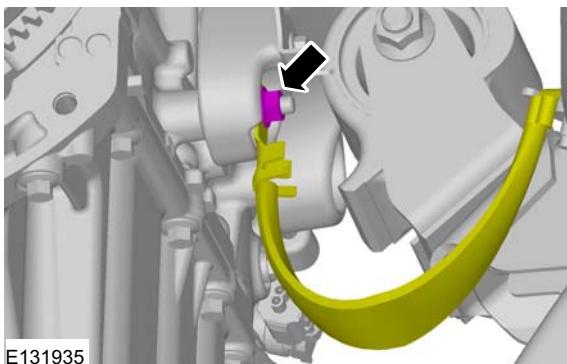
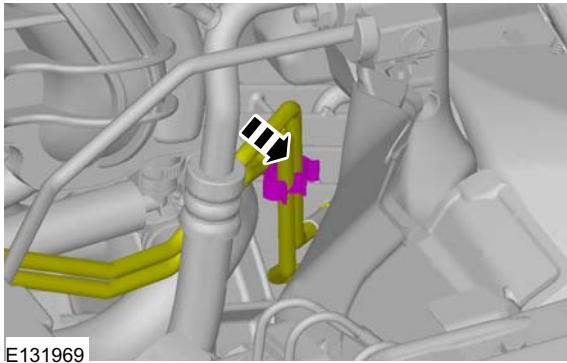


10. Torque: 80 Nm

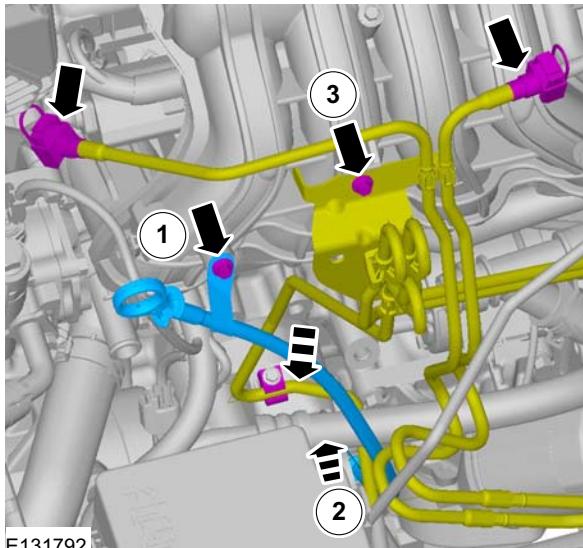


11. Remove the Special Tool(s): 303-122
General Equipment: Hydraulic Jib Crane



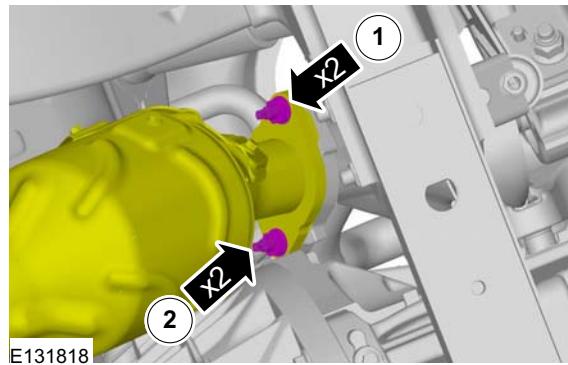
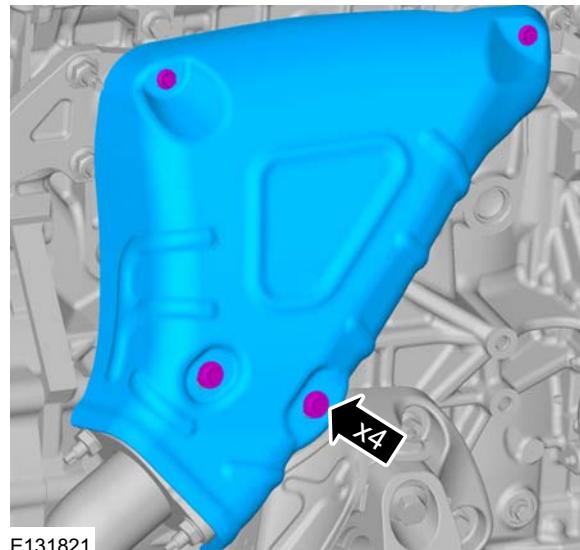
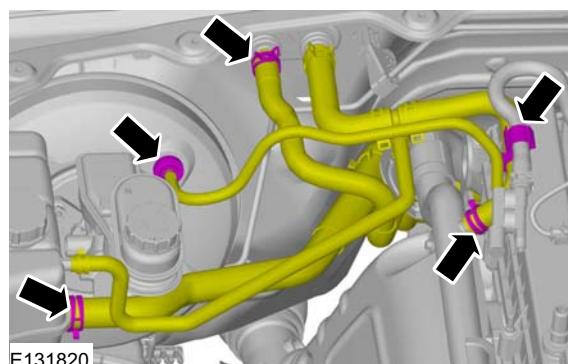
INSTALLATION**12 Torque: 30 Nm****13.**

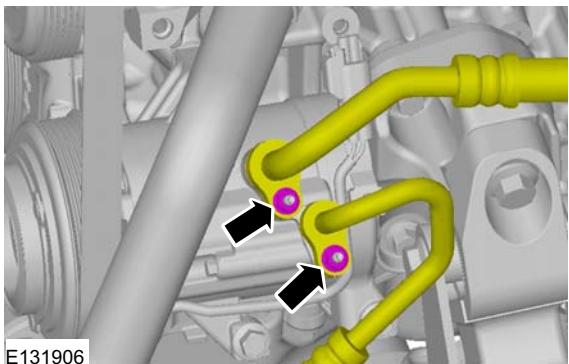
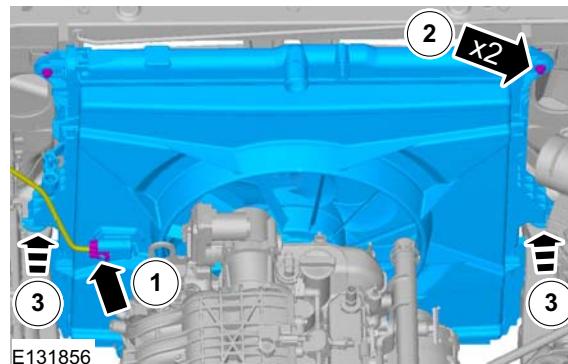
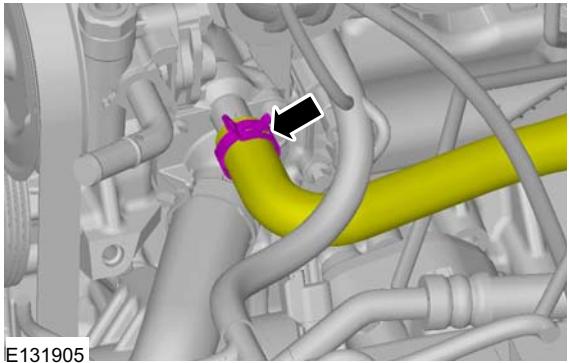
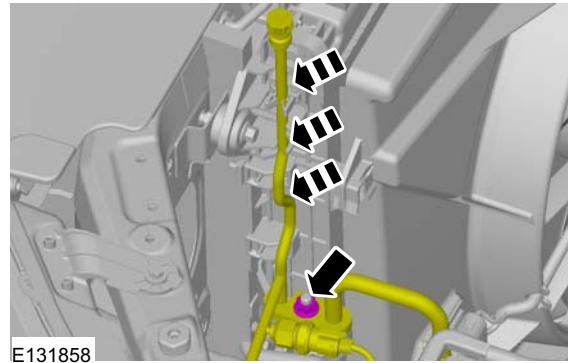
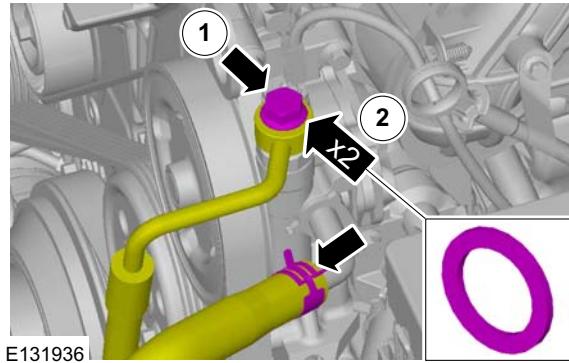
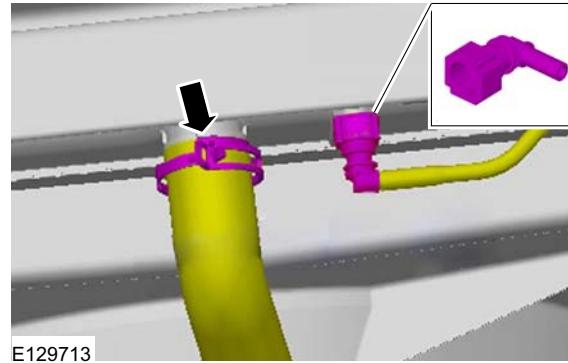
- 14.** 1. Torque: 10 Nm
3. Torque: 10 Nm

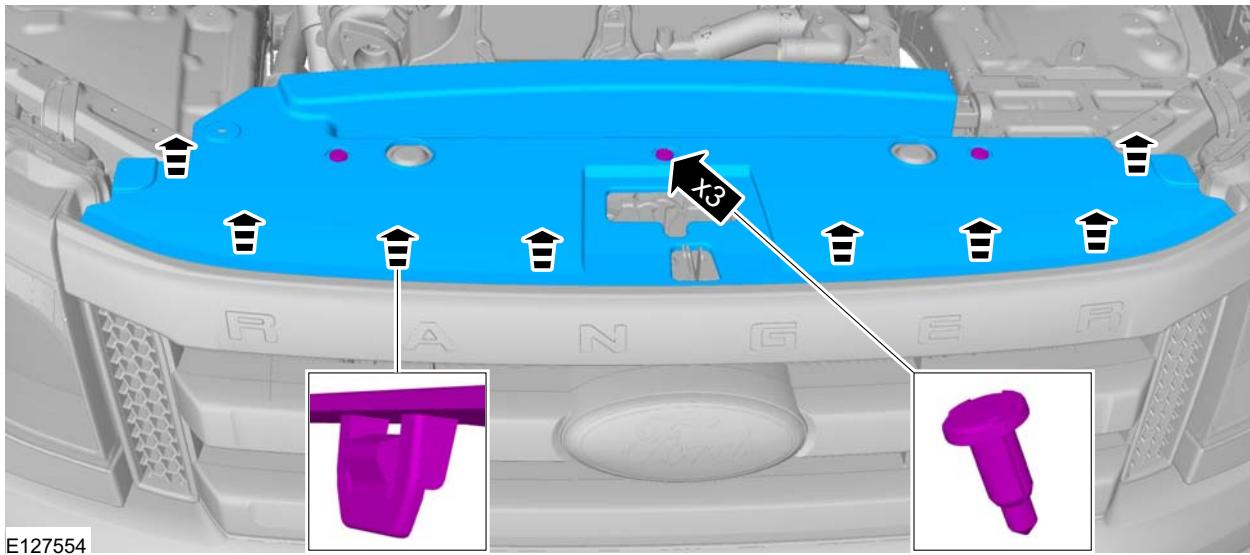
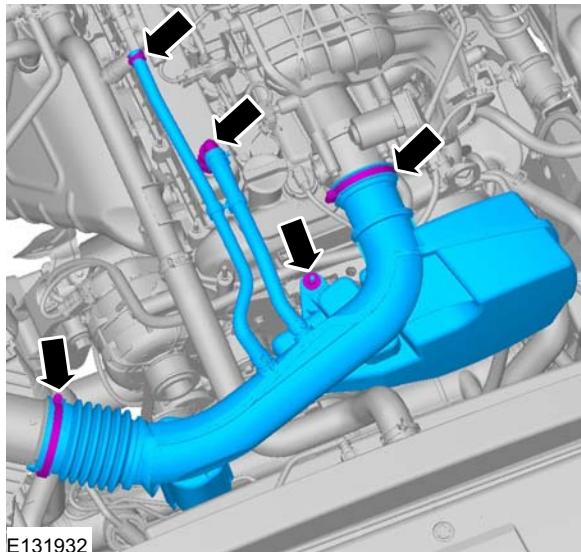
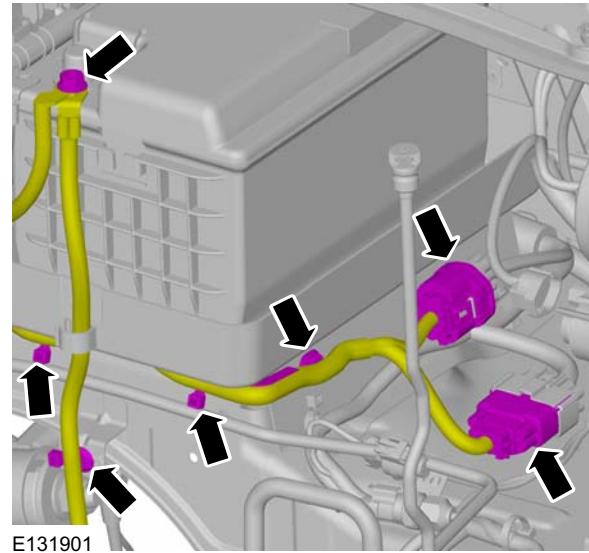
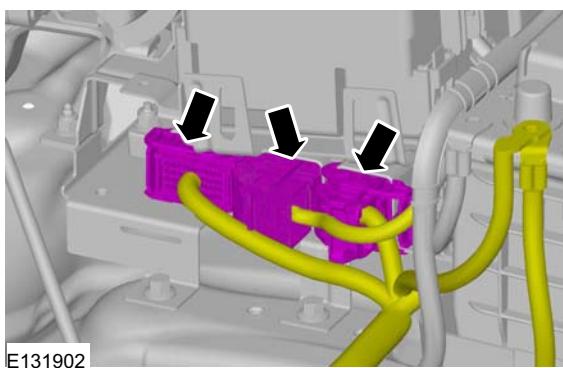


15. CAUTION: Over bending the exhaust flexible pipe may cause damage resulting in failure.

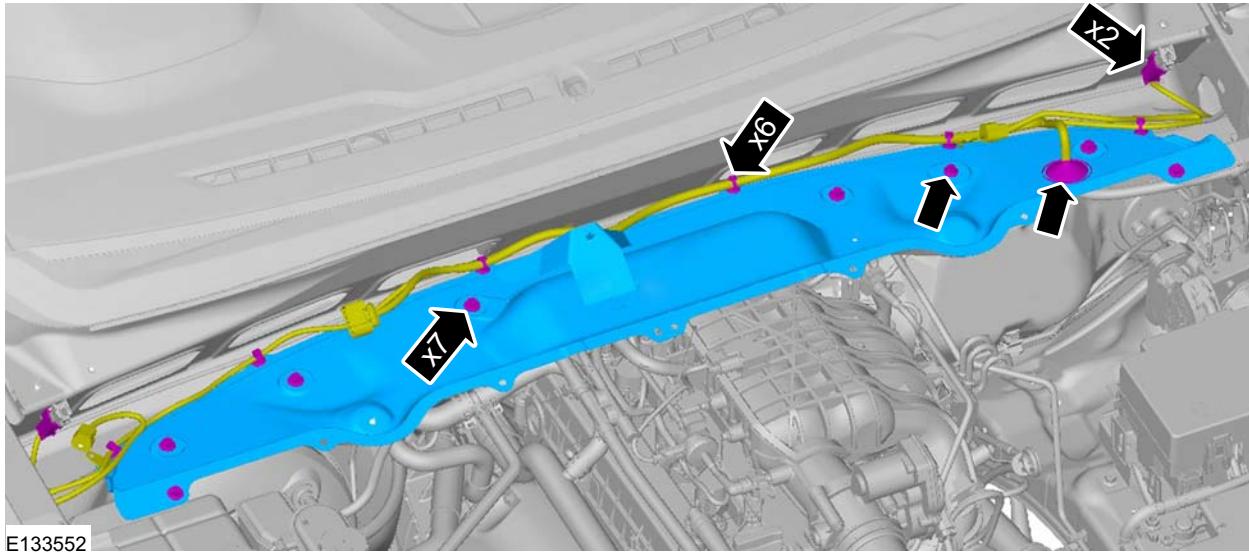
1. Install the exhaust flexible pipe flange nuts.
Torque: 48 Nm
2. Install the exhaust flexible pipe flange studs.
Torque: 25 Nm

**16. Torque: 10 Nm****17.**

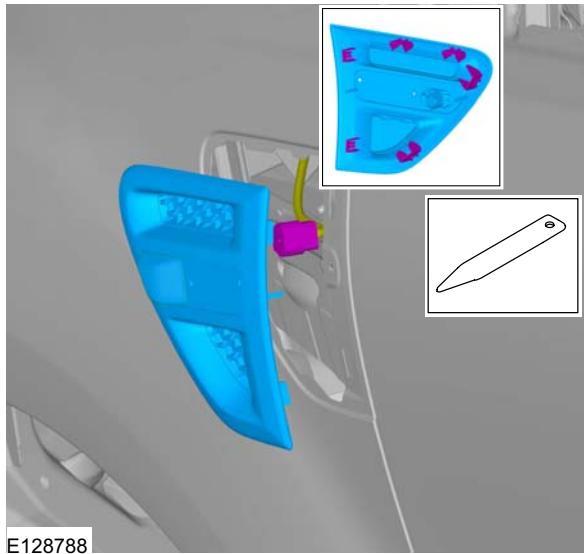
INSTALLATION**18.** Torque: 11 Nm**21.** Torque: 20 Nm**19.****22.** Torque: 23 Nm**20.** Torque: 35 Nm**23.****24.**

INSTALLATION**25.** Torque: 11 Nm**27.** Torque: 10 Nm**26.****28.** Torque: 14 Nm

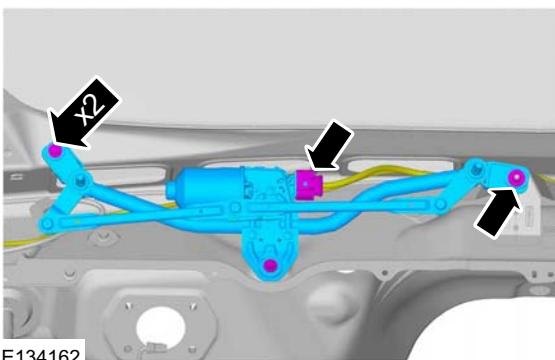
INSTALLATION



29. On both sides.

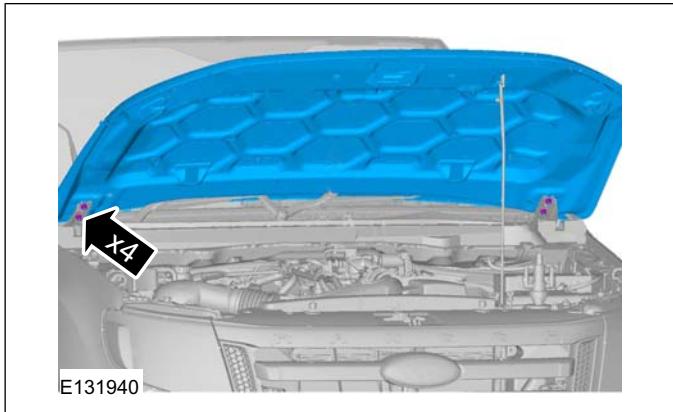


30. Torque: 11 Nm

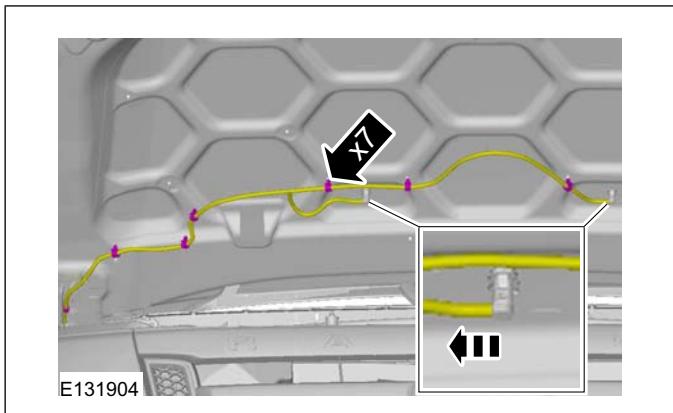


31. Refer to: **Cowl Panel Grille** (501-02 Front End Body Panels, Removal and Installation).

32 Torque: 30 Nm

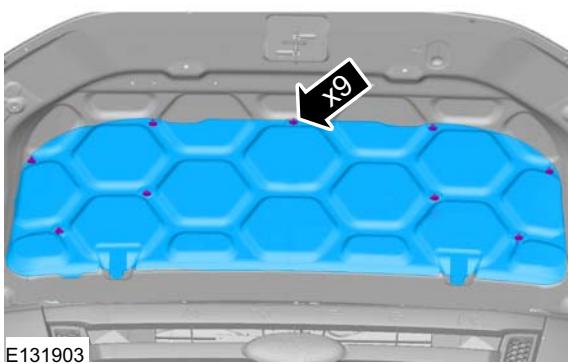


33.

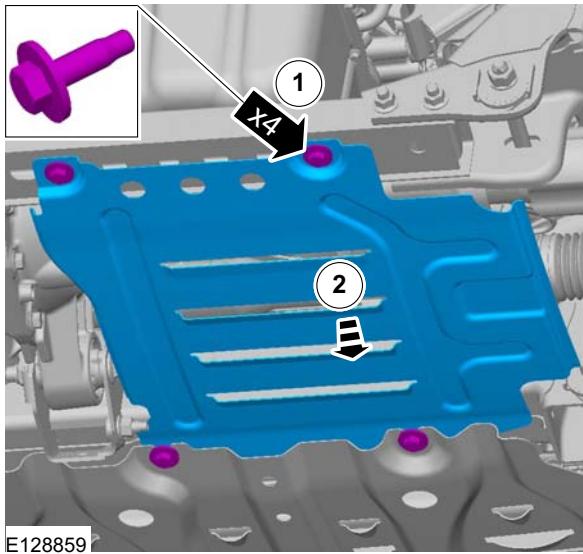


INSTALLATION

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).

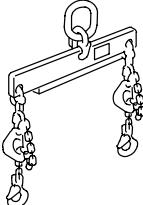
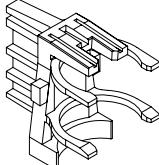
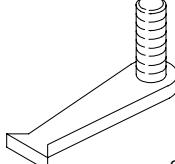
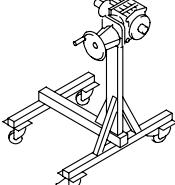
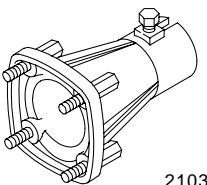
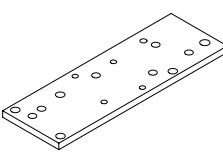
39. Refer to: **Starter Motor** (303-06 Starting System - 2.5L Duratec-HE (122kW/165PS) - MI4, Removal and Installation).

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

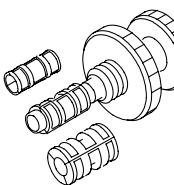
41. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).

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

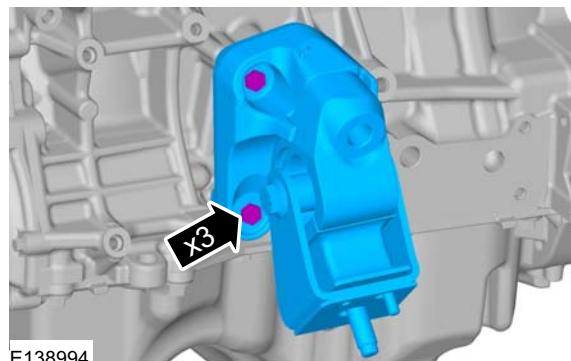
INSTALLATION**Engine Accessories(21 139 4)****Installation****Special Tool(s) / General Equipment**

	303-122 Lifting Bracket, Engine 21068A
	303-1417 Tool, Crank Sensor Alignment E134676
	303-254 Locking Tool, Flywheel 21135
	303-435 Mounting Stand 21187
	303-435-06 Mounting Bracket for 303-435 21031B
	303-435-14B Mounting Plate for 303-435-06 E62805

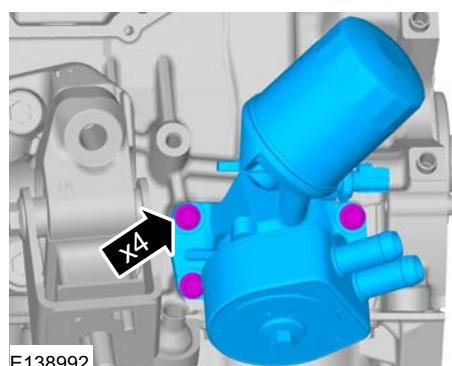
Special Tool(s) / General Equipment

	303-676 Release Tool, Belt Tensioner 303676
	308-204 Aligner, Clutch Disc 16067
Hydraulic Jib Crane	

All vehicles

1. Torque: 48 Nm

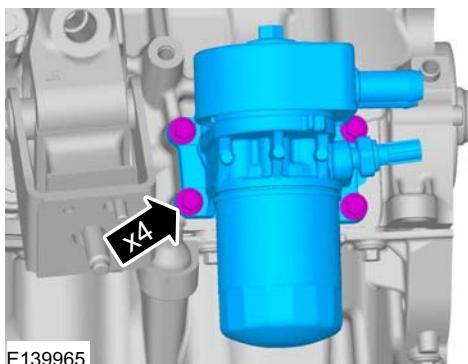
4x4

2. Torque: 25 Nm

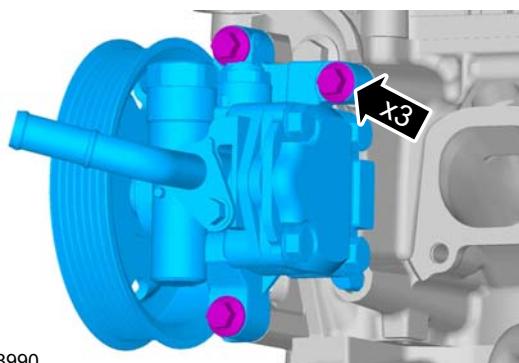
INSTALLATION

4x2

3. Torque: 25 Nm

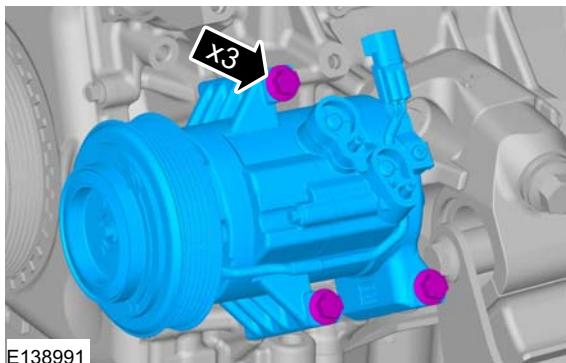


6. Torque: 23 Nm



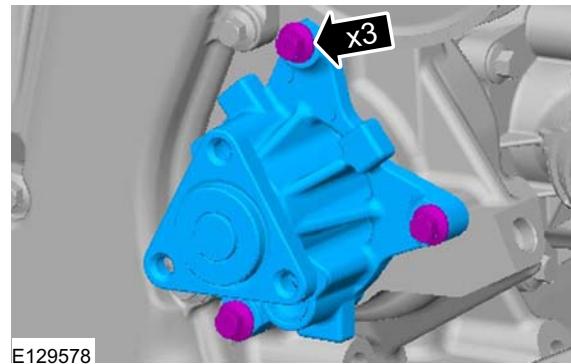
All vehicles

4. Torque: 25 Nm



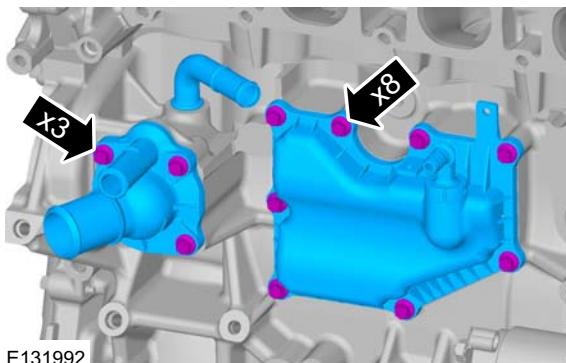
7. **NOTE:** Make sure that the mating faces are clean and free of foreign material.

Torque: 10 Nm



5. **NOTE:** The gasket is to be reused unless damaged.

Torque: 10 Nm



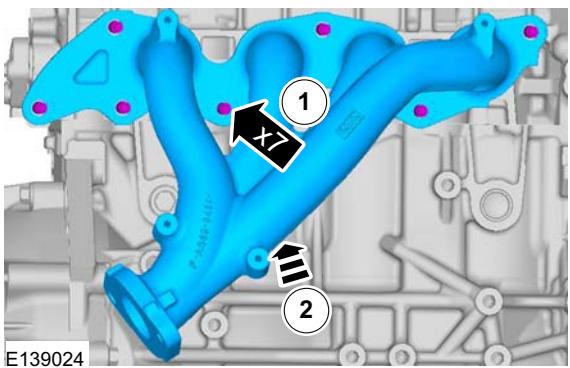
8. **1.** Torque: 25 Nm

2. **NOTE:** Install all the bolts finger tight before final tightening.

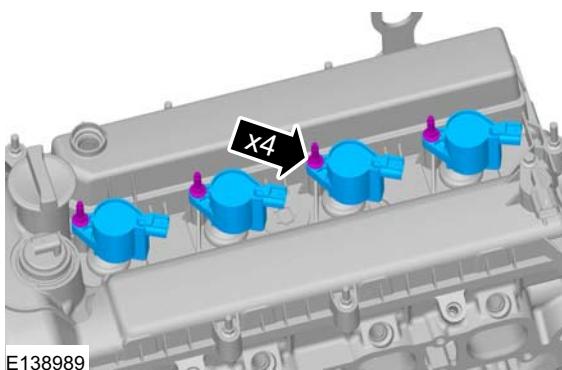


INSTALLATION

9. Torque: 17 Nm

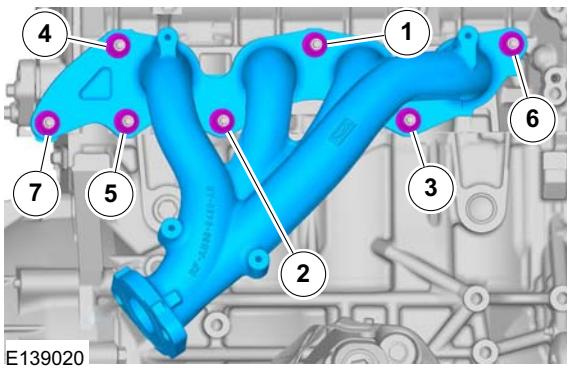


12 Torque: 8 Nm



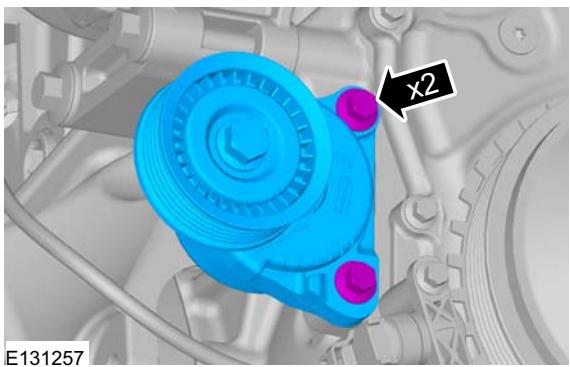
10. **NOTE:** Make sure that a new exhaust manifold gasket is installed.

Torque: 55 Nm

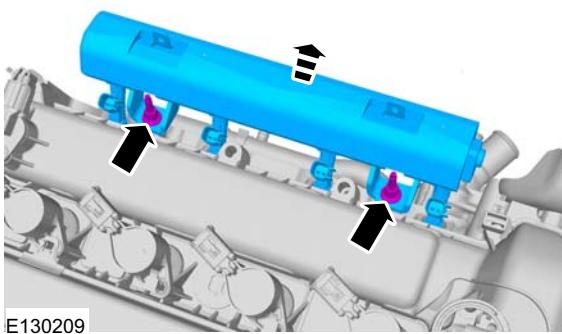


11. **NOTE:** The accessory drive belt tensioner must be replaced as a complete unit.

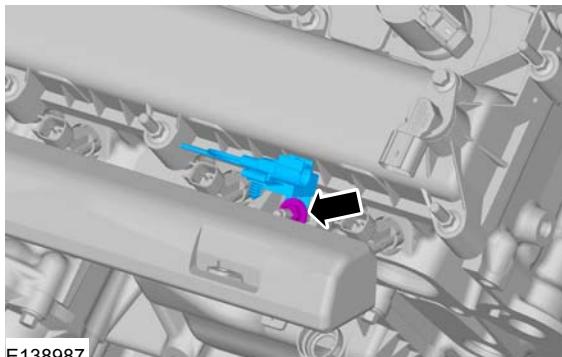
Torque: 25 Nm



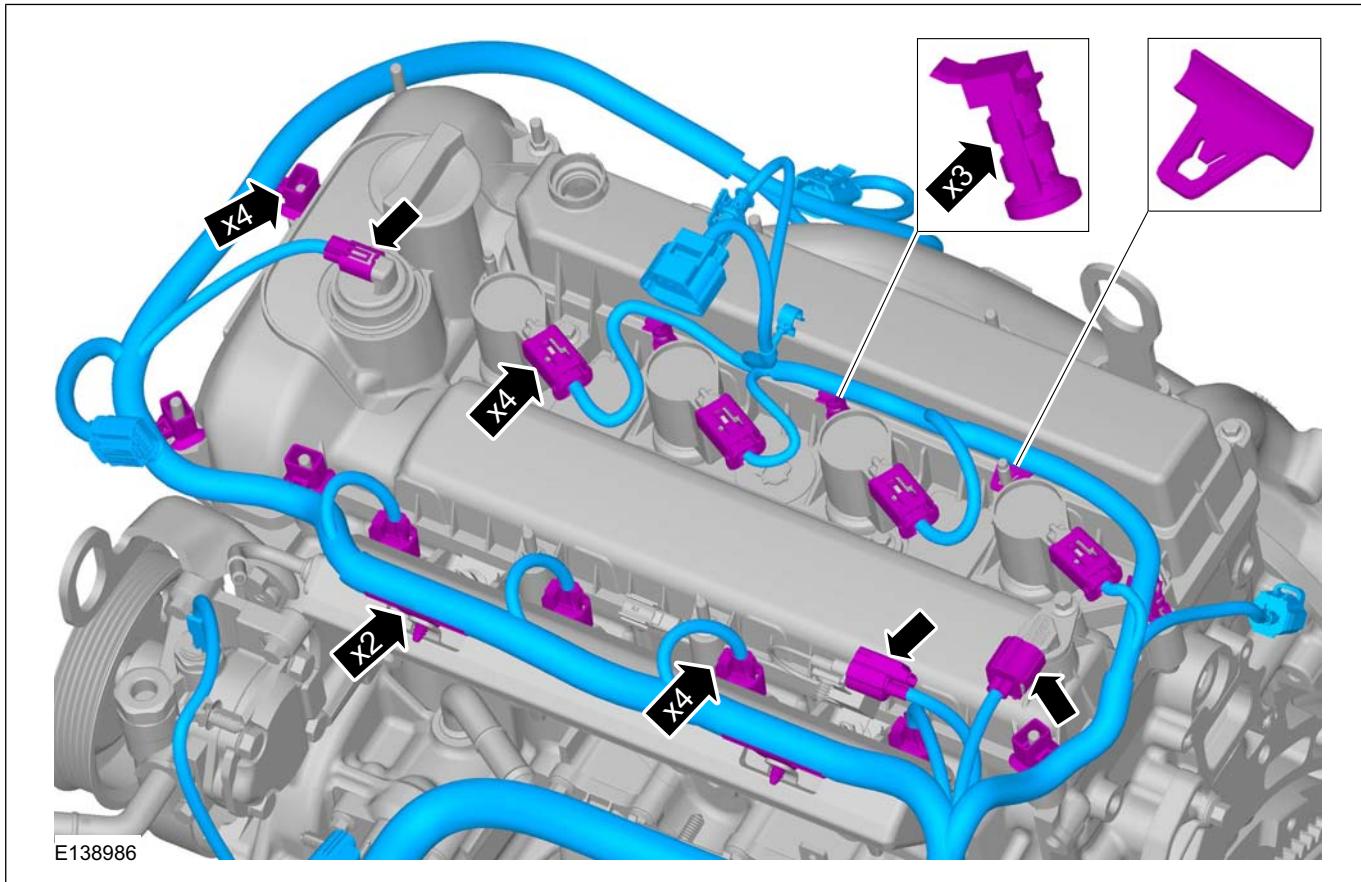
13. Torque: 23 Nm



14. Torque: 10 Nm



15.

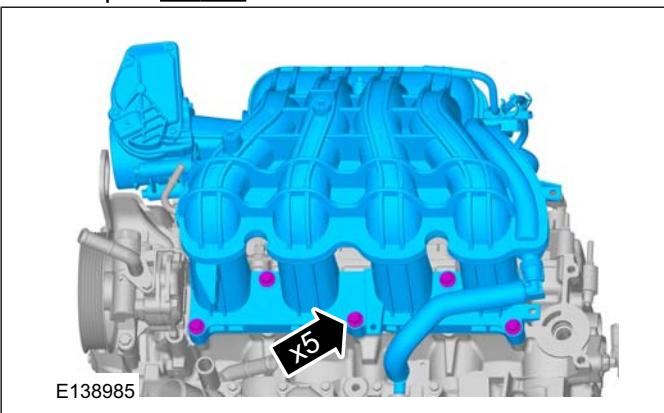
INSTALLATION

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



DESCRIPTION AND OPERATION



1



2



3



4



5



6



7



8



9



10



11



12

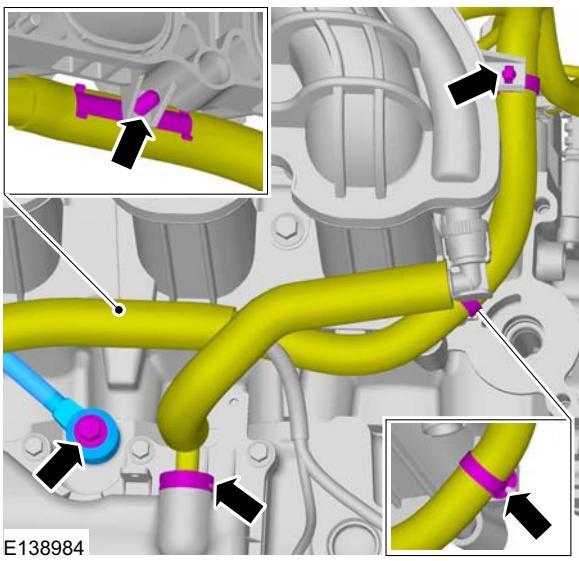
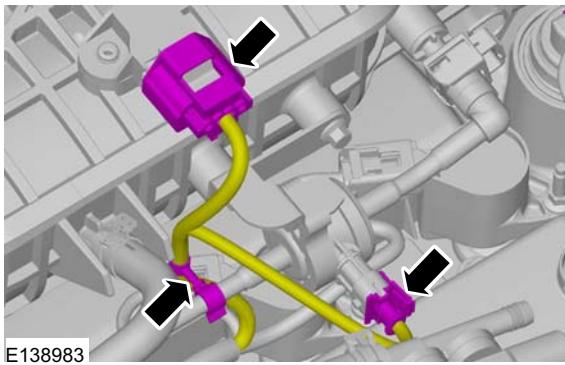
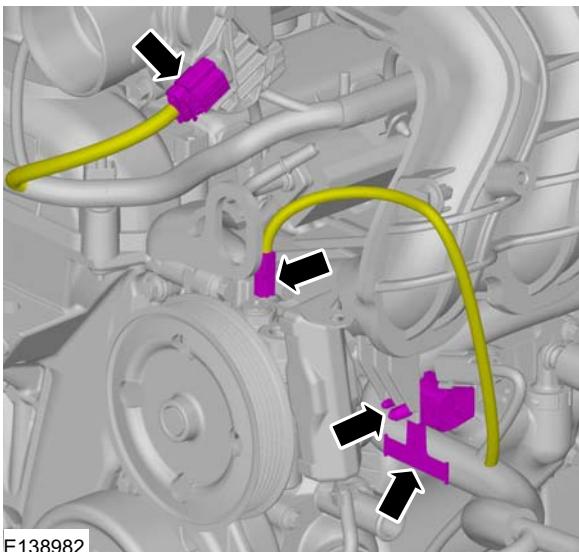
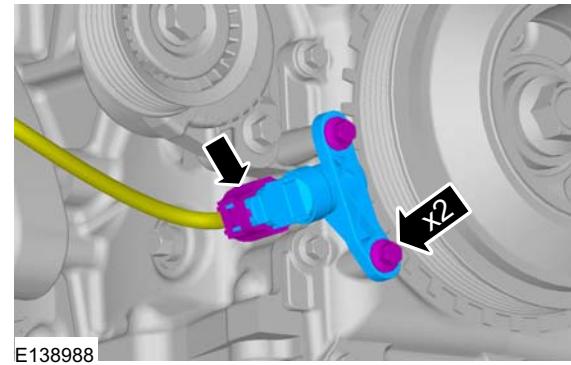


13

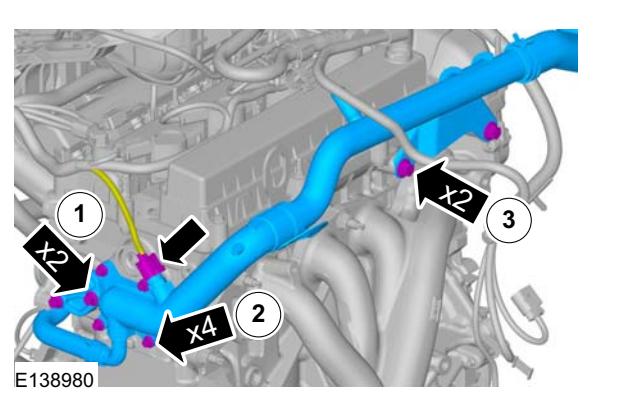
E89021

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

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

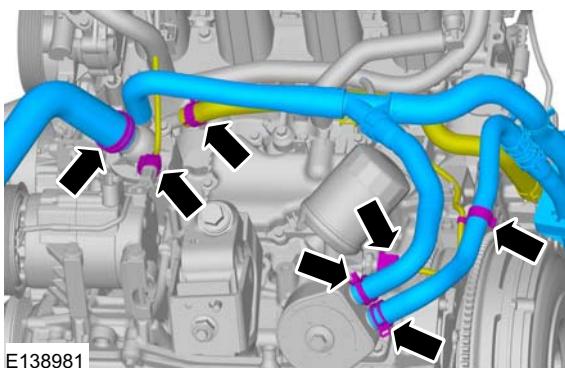
INSTALLATION**17. Torque: 20 Nm****18.****19.****20. Special Tool(s): 303-1417****21. Torque: 7 Nm****22 NOTE:** The gasket is to be reused unless damaged.

1. Torque: 25 Nm
2. Torque: 10 Nm
3. Torque: 48 Nm

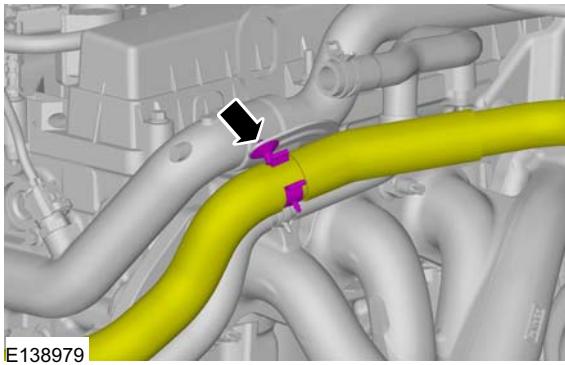


INSTALLATION

23.

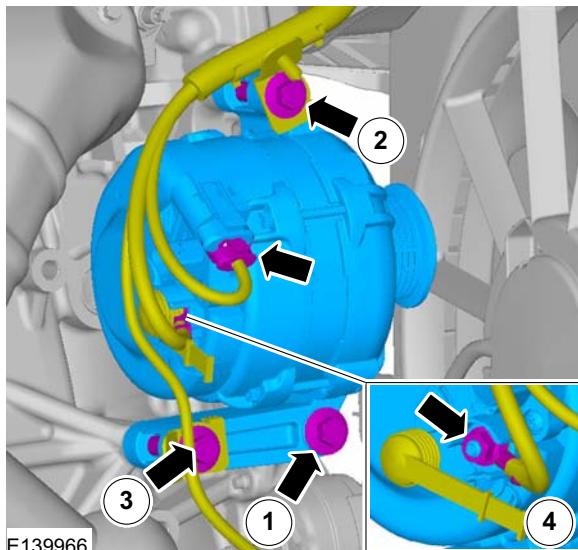


24.



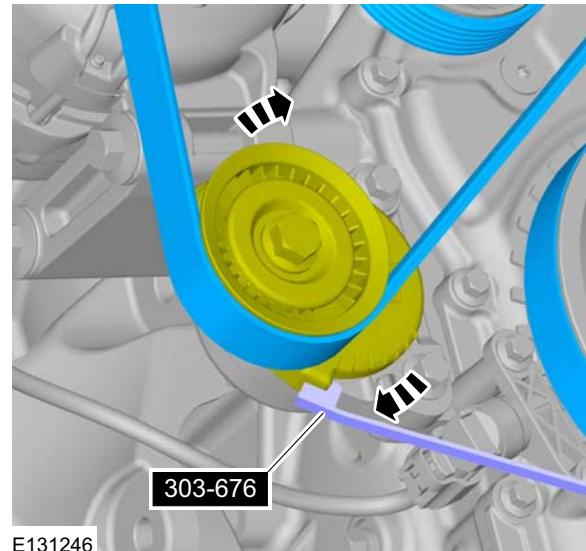
25. CAUTION: Take extra care not to damage the wiring harnesses.

1. Torque: 48 Nm
2. Torque: 48 Nm
3. Torque: 48 Nm
4. Torque: 15 Nm

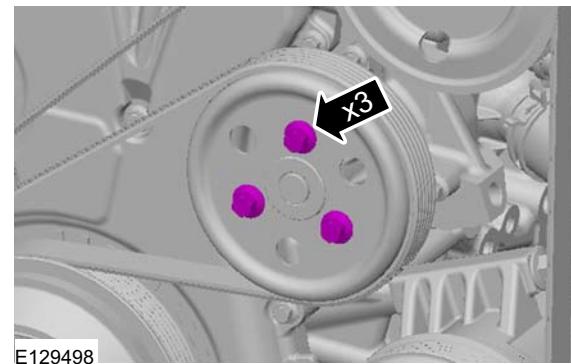


26. Rotate the accessory drive belt tensioner clockwise and install the accessory drive belt.

Special Tool(s): 303-676



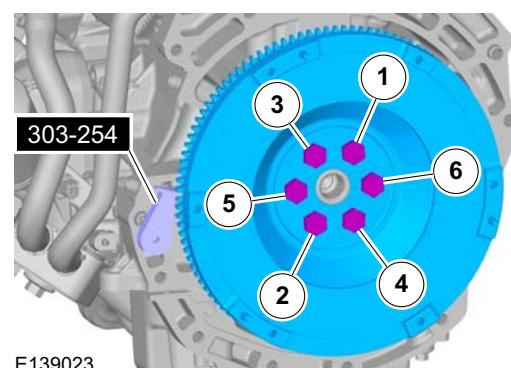
27. Torque: 20 Nm



28. Special Tool(s): 303-254

Torque:

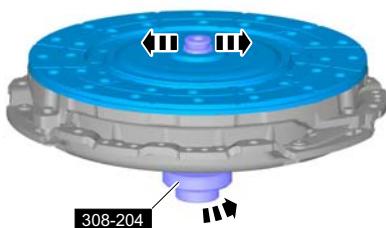
- Stage 1: 50 Nm
- Stage 2: 80 Nm
- Stage 3: 112 Nm



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



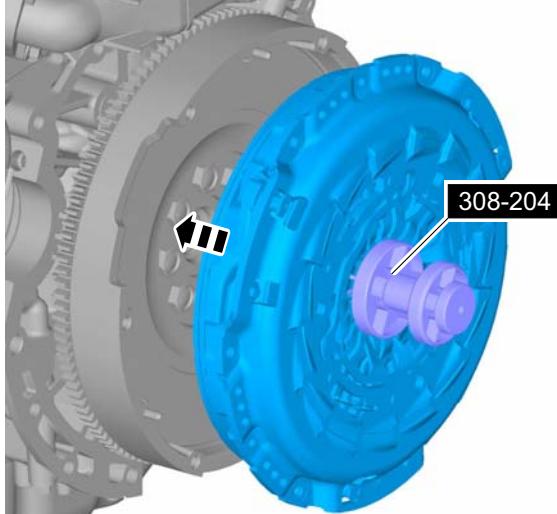
E129961

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.

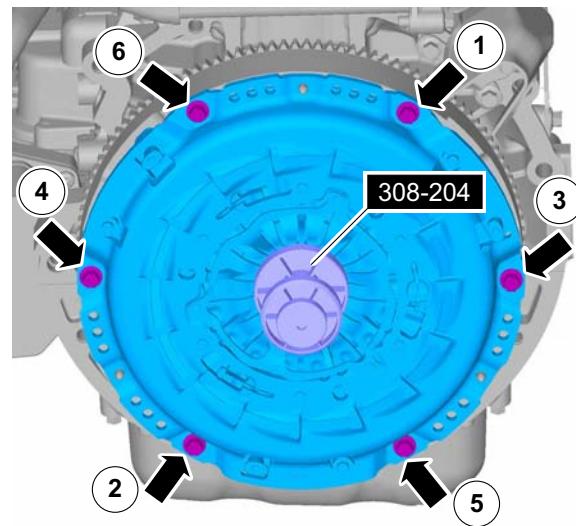
Special Tool(s): 308-204



E129962

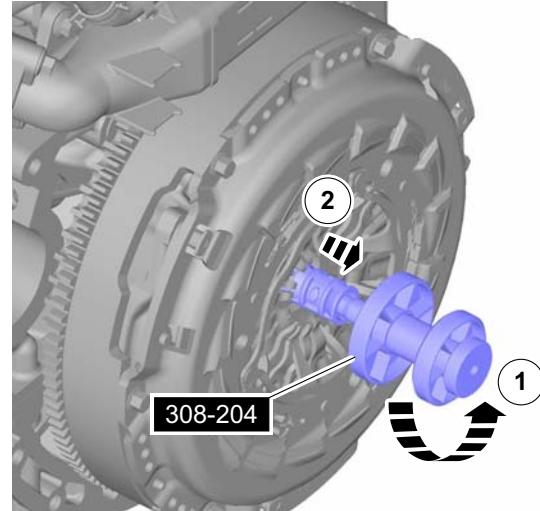
32. Special Tool(s): 308-204

Torque: 30 Nm



E129963

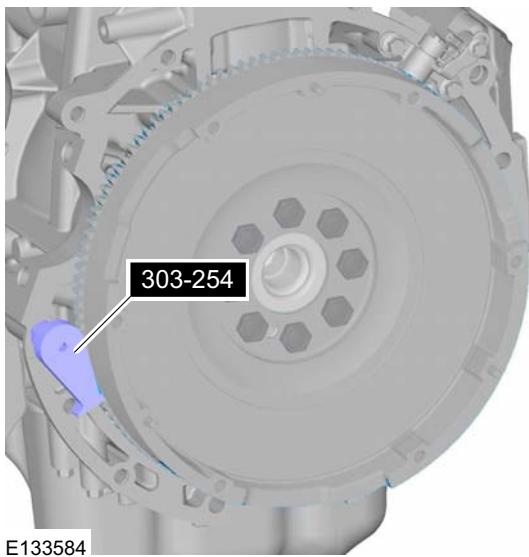
33. Remove the Special Tool(s): 308-204



E129984

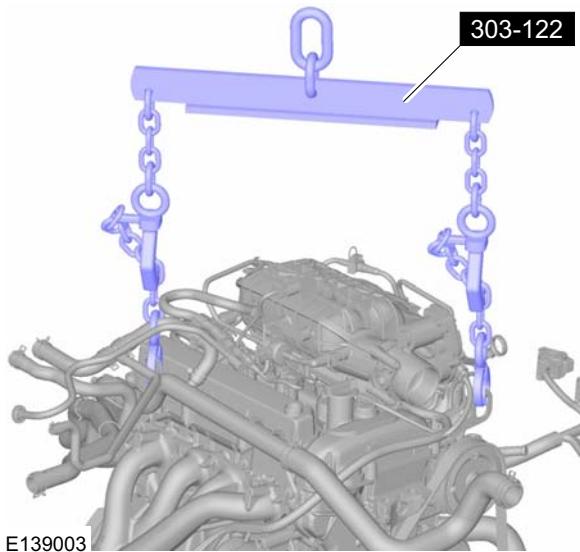
INSTALLATION

34. Remove the Special Tool(s): 303-254



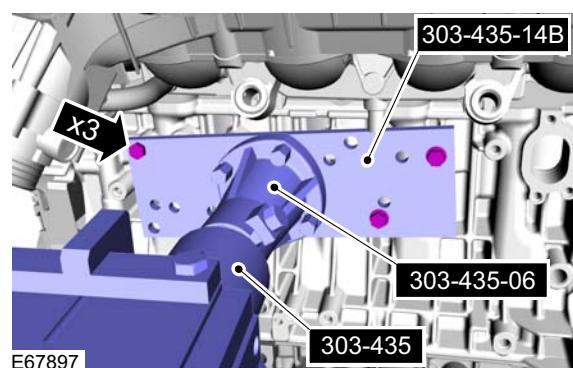
35. Special Tool(s): 303-122

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:BT50 & Ranger

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INSTALLATION

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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

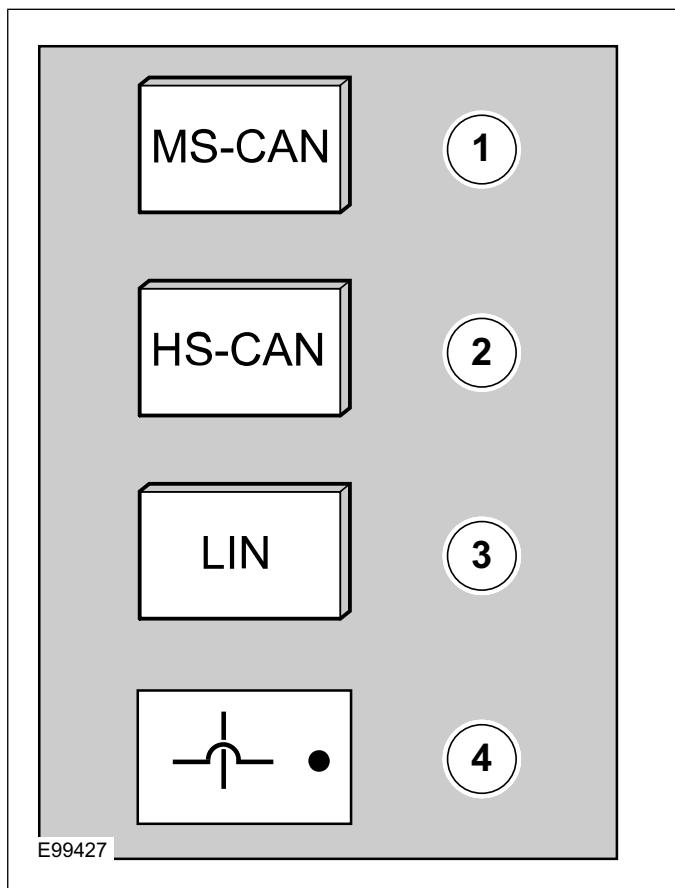
Lubricants, Fluids, Sealers and Adhesives

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

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

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

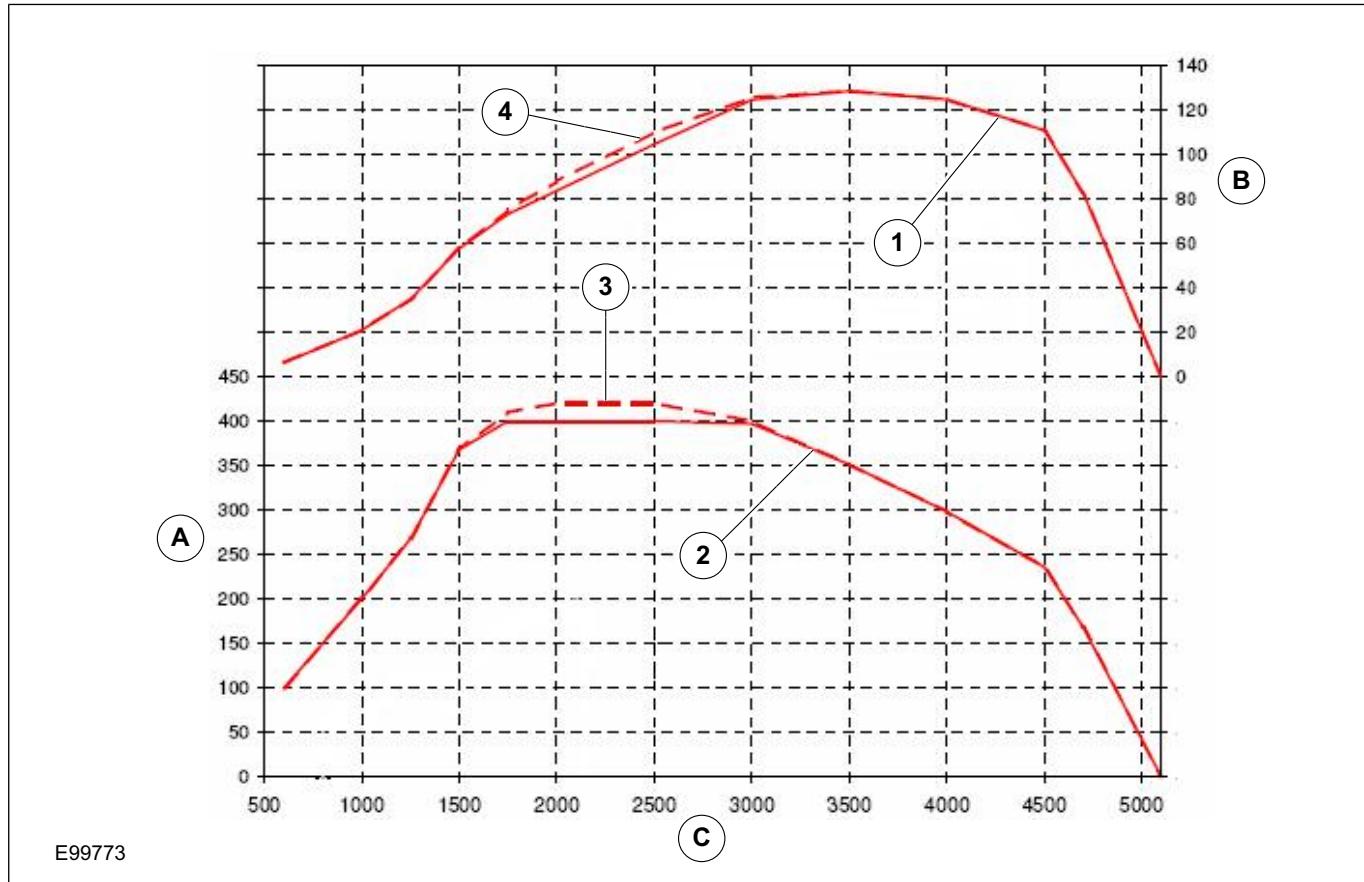
Diagnosis

- Via the DLC (data link connector) with IDS (Integrated Diagnostic System)

Specification

Torque and power output:

DESCRIPTION AND OPERATION

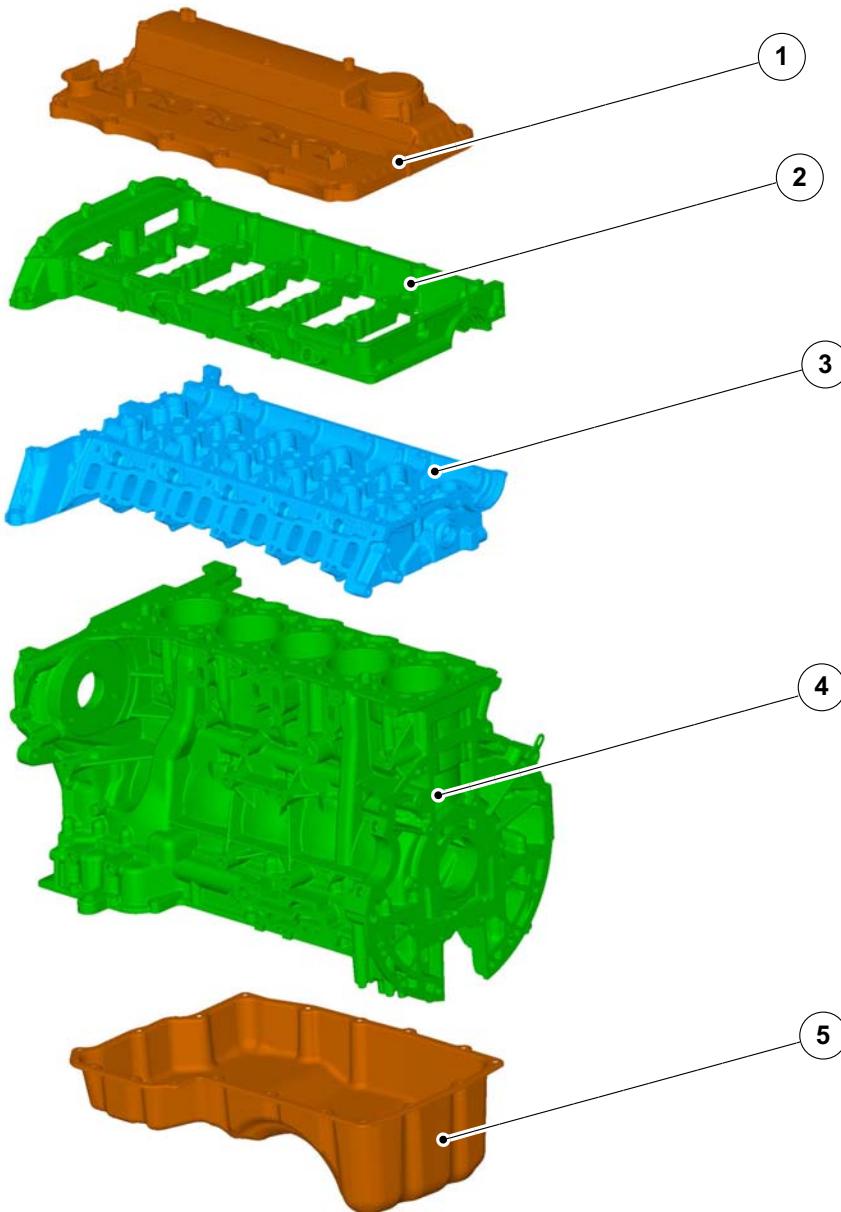


Item	Description
A	Torque (nm)
B	Power output(Kw)
c	Engine speed
1	Power output curve

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



E131683

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

303-01B-10

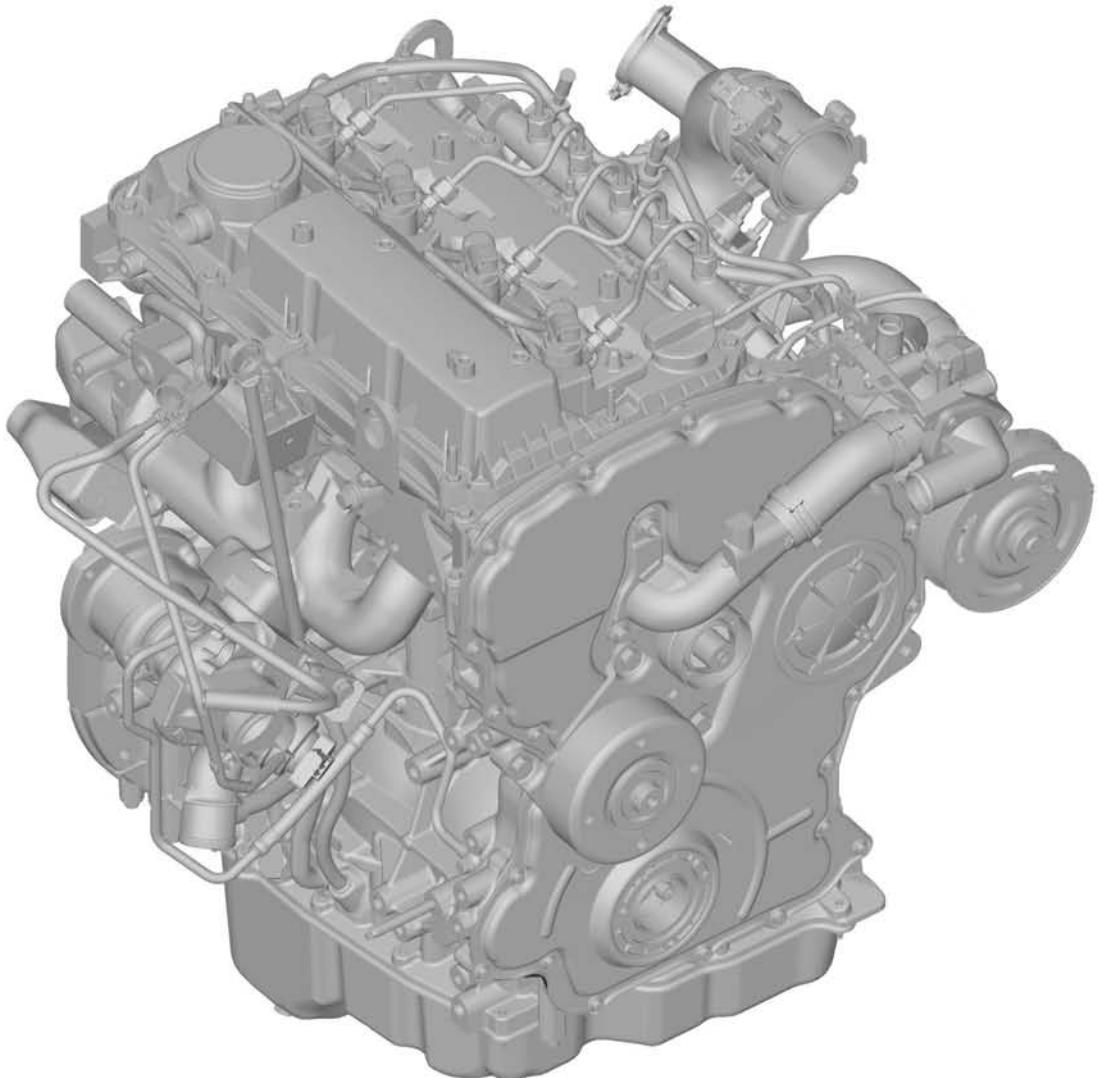
- Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma

303-01B-10

DESCRIPTION AND OPERATION

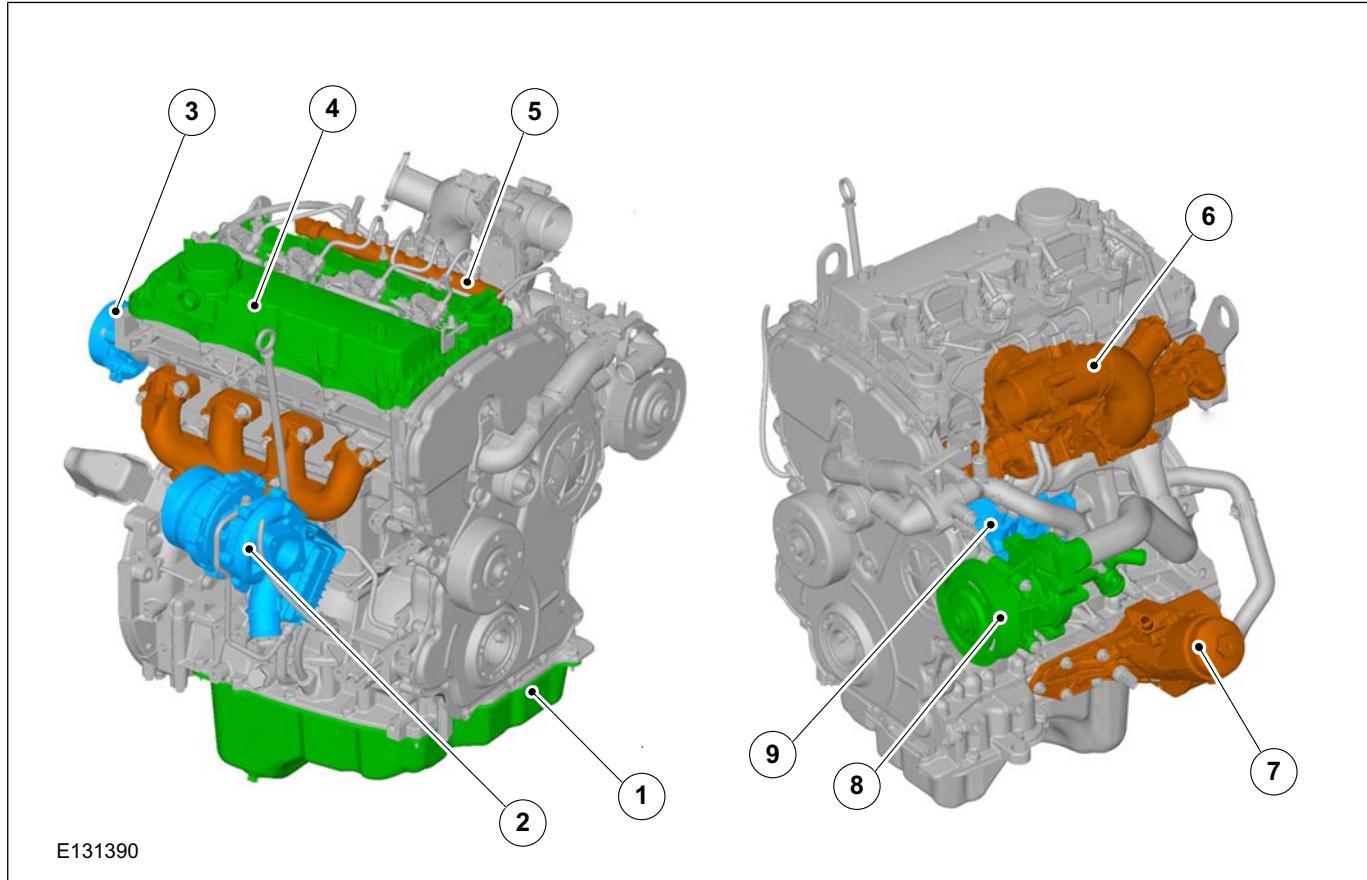
Engine

Engine -component location



E131389

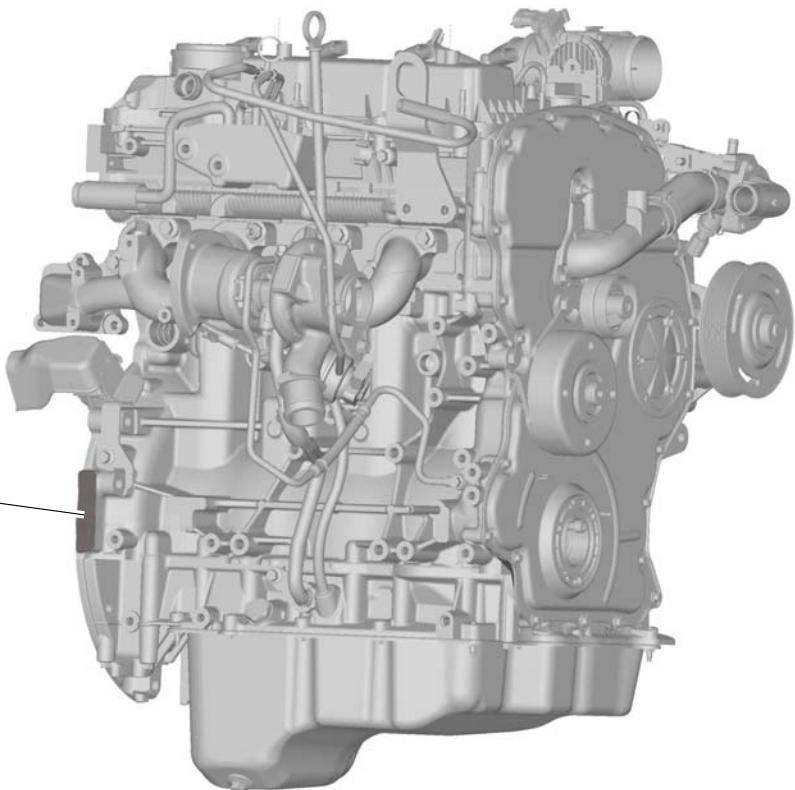
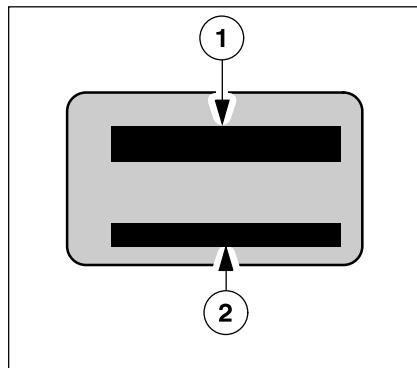
DESCRIPTION AND OPERATION



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

E131401

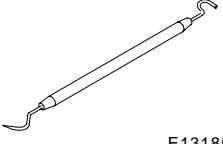
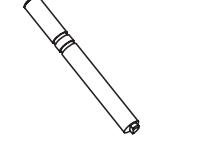
2.

Item	Description
1	Engine code
2	Engine serial number

REMOVAL AND INSTALLATION

Camshafts(21 284 0)

Special Tool(s) / General Equipment

	100-010 Remover, O-Ring Seal E131853
	303-1562 Timing Tool E131853
2 mm Punch	
6 mm Drill Bit	

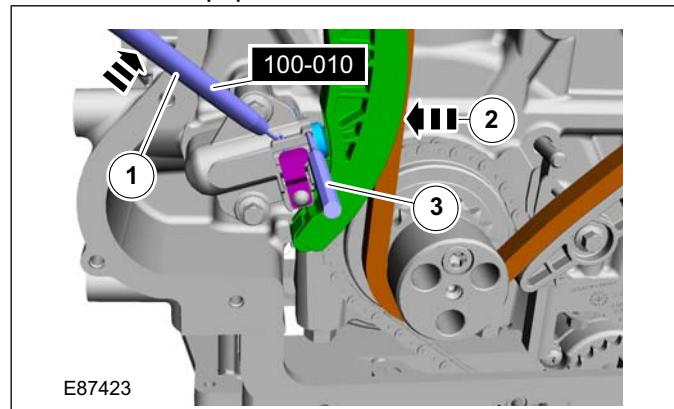
Removal

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.

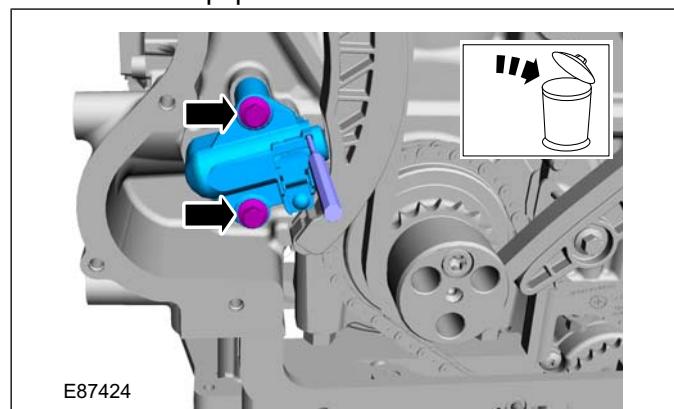
NOTE: Removal steps in this procedure may contain installation details.

- 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).
- 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).
- 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).
- 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).

- Special Tool(s): 100-010
General Equipment: 2 mm Punch

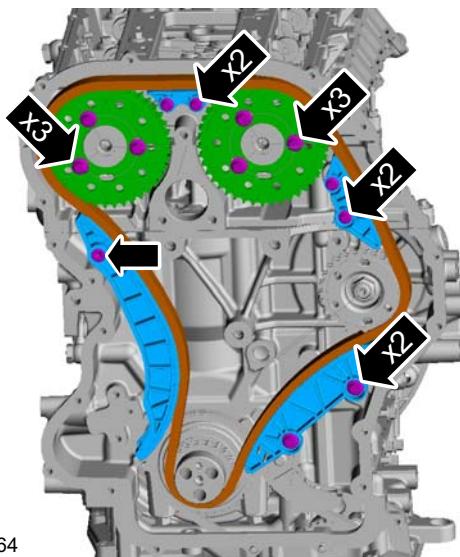


- General Equipment: 2 mm Punch

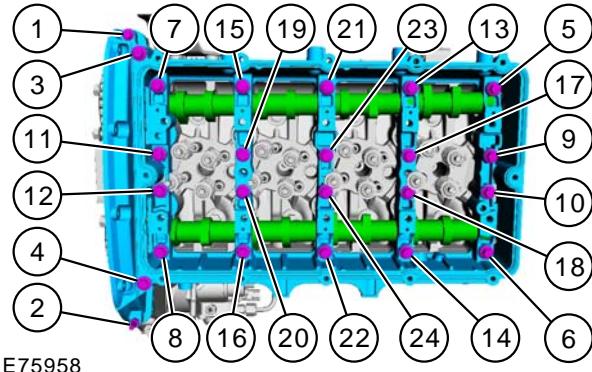


REMOVAL AND INSTALLATION

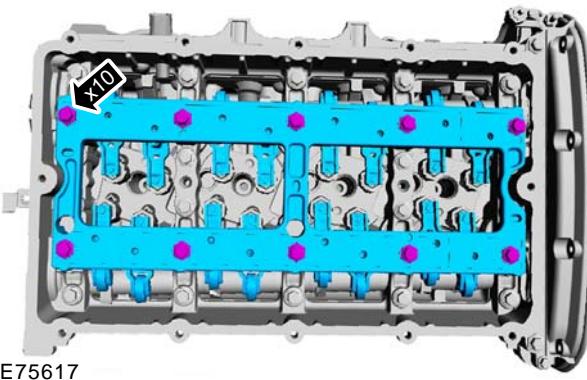
7.



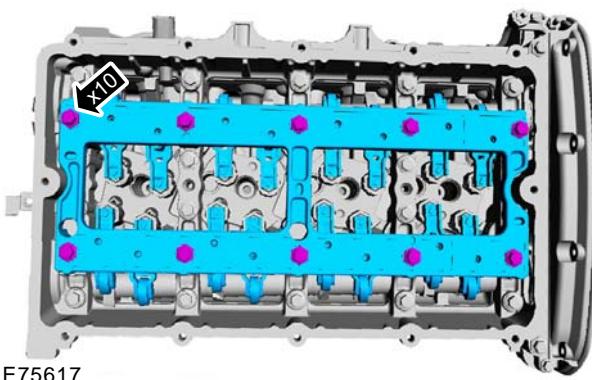
1. • Bolts 1 to 22
Torque: 23 Nm
- Bolts 23 to 25
Torque: 10 Nm



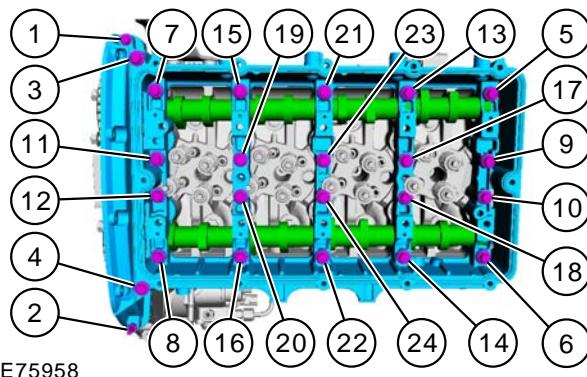
8.



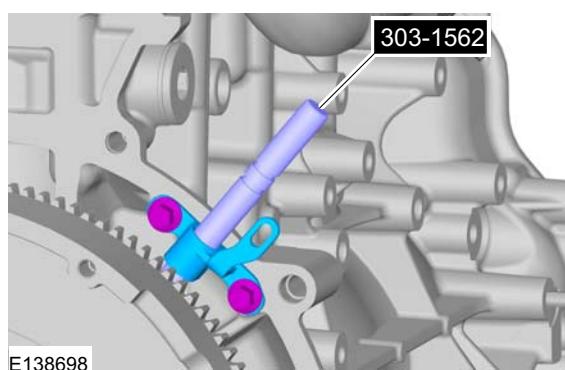
2. Torque:
 - Stage 1: 10 Nm
 - Stage 2: 30°



9. ⚠ CAUTION: Remove the camshaft carrier bolts in the sequence shown.



3. Install the Special Tool(s): 303-1562



Installation

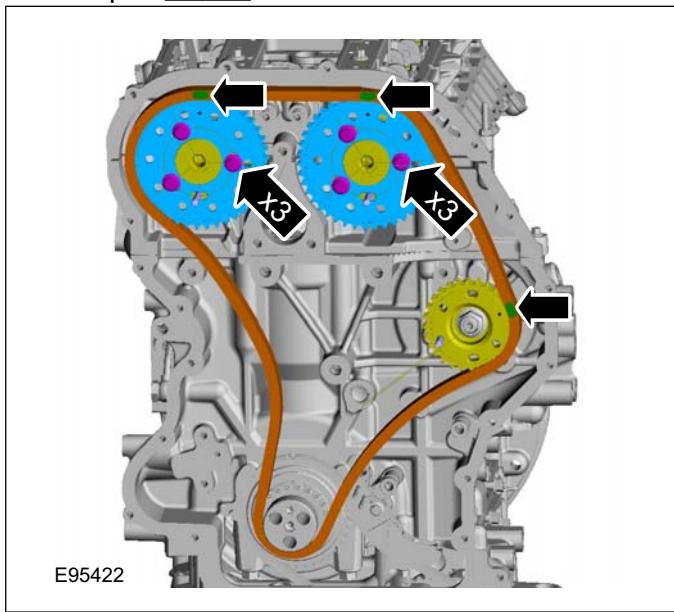
NOTE: Clean the mating faces of the camshaft carrier and the cylinder head.

REMOVAL AND INSTALLATION

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

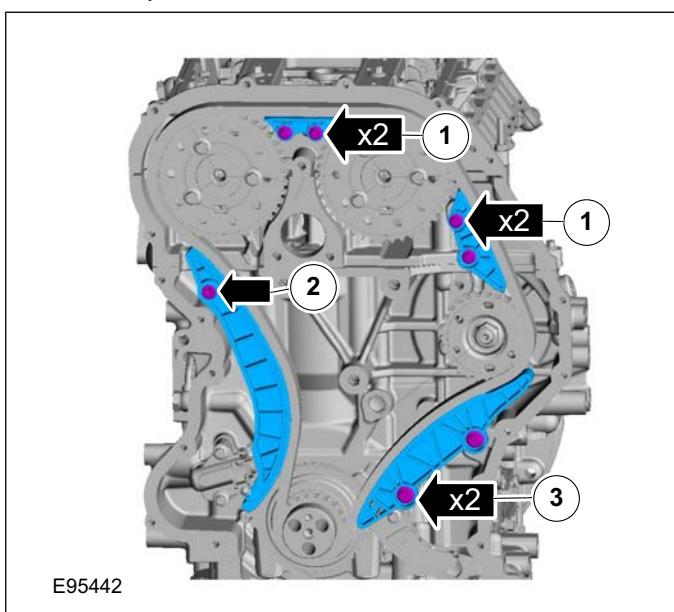
General Equipment: 6 mm Drill Bit

Torque: 33 Nm

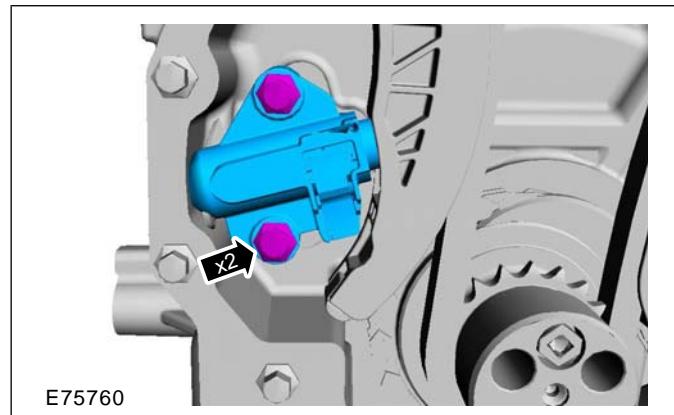


- 5. Remove the 6 mm drill bits.**

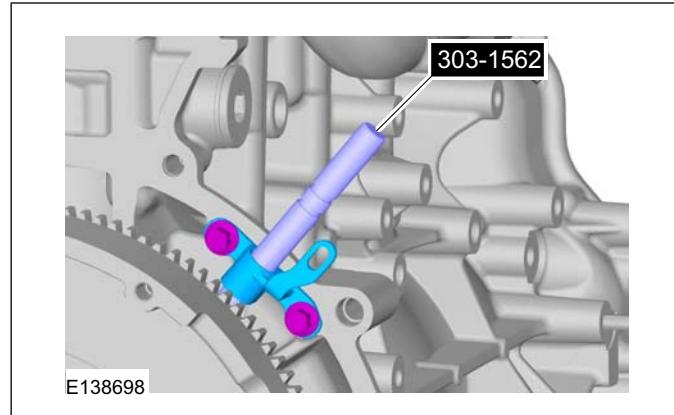
- 6.** 1. Torque: 15 Nm
2. Torque: 40 Nm
3. Torque: 40 Nm



- 7. NOTE:** Make sure that a new component is installed.

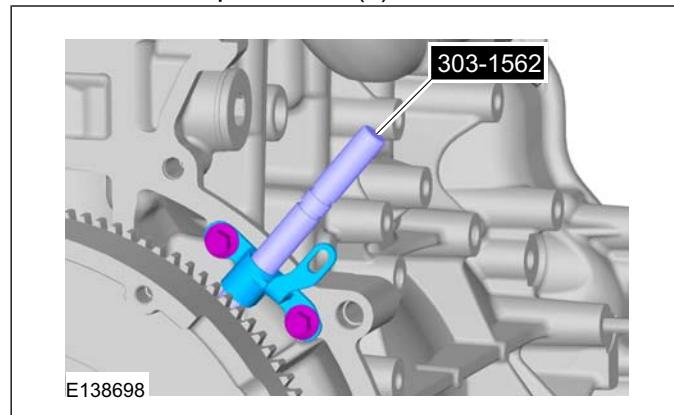


- 8. Remove the Special Tool(s): 303-1562**



- 9. Rotate the engine two revolutions.**

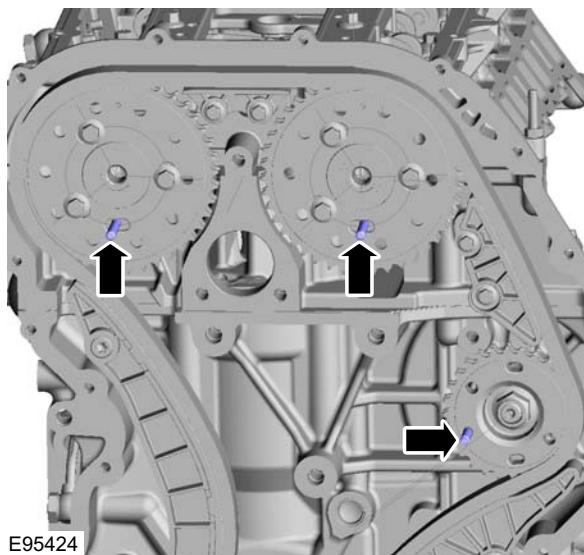
- 10. Install the Special Tool(s): 303-1562**



REMOVAL AND INSTALLATION

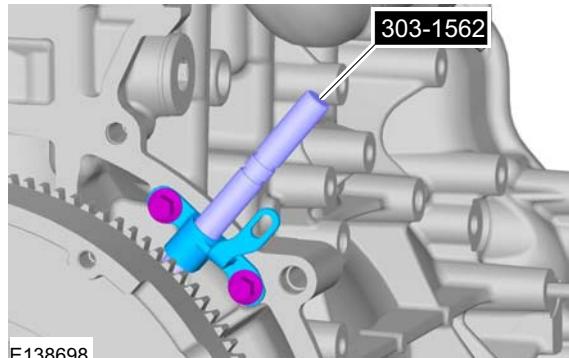
11. Check the valve timing by inserting the drill bits.
If the drill bits cannot be inserted repeat the timing steps.

General Equipment: 6 mm Drill Bit



- 12 Remove the 6 mm drill bits.

- 13 Remove the Special Tool(s): 303-1562



- 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\).](#)

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 Alkalies

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

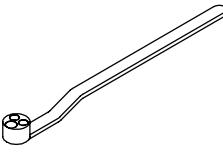
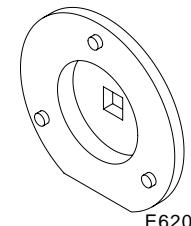
See also [Chlorofluorocarbon, Chemical Materials](#)

Highly flammable, combustible – observe No Smoking policy.

REMOVAL AND INSTALLATION

Crankshaft Front Seal(21 467 0)

Special Tool(s)

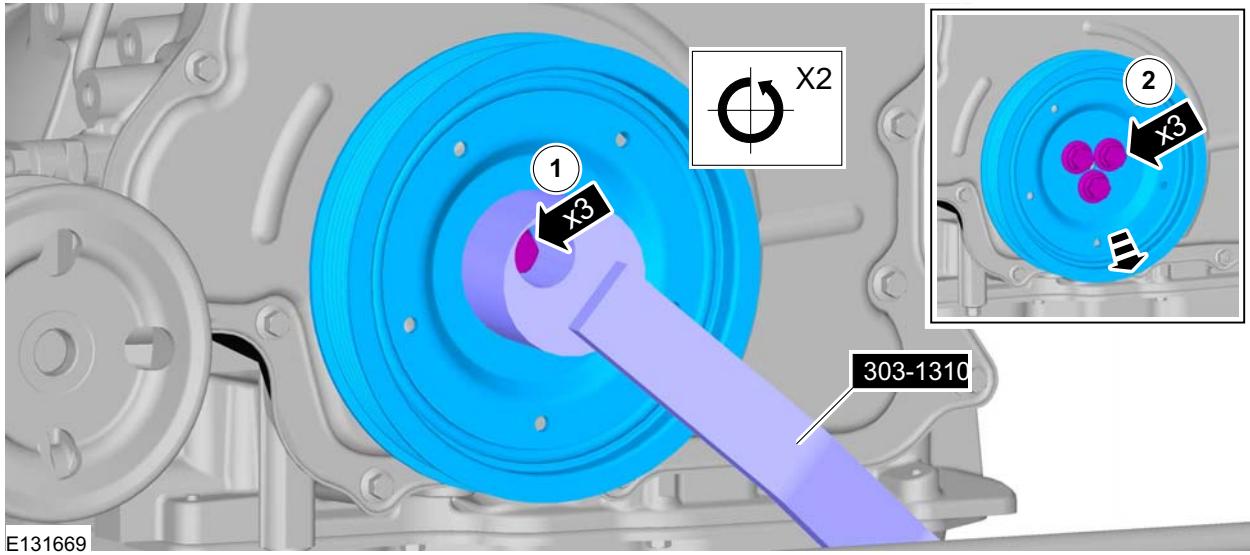
	303-1310 Holding Wrench, Crankshaft
	303-679A Remover/Installer, Engine Front Cover Inspection Plate

Removal

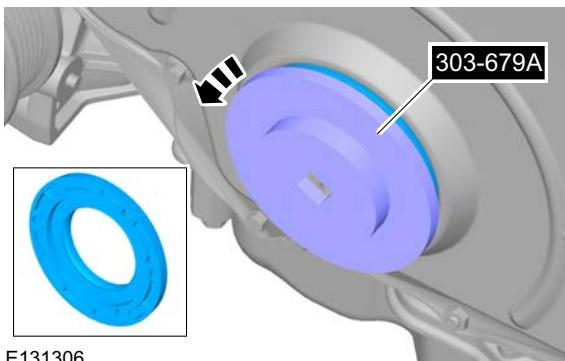
NOTE: Removal steps in this procedure may contain installation details.

- 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\).](#)
1. Do not completely loosen the crankshaft pulley bolts.

Special Tool(s): 303-1310



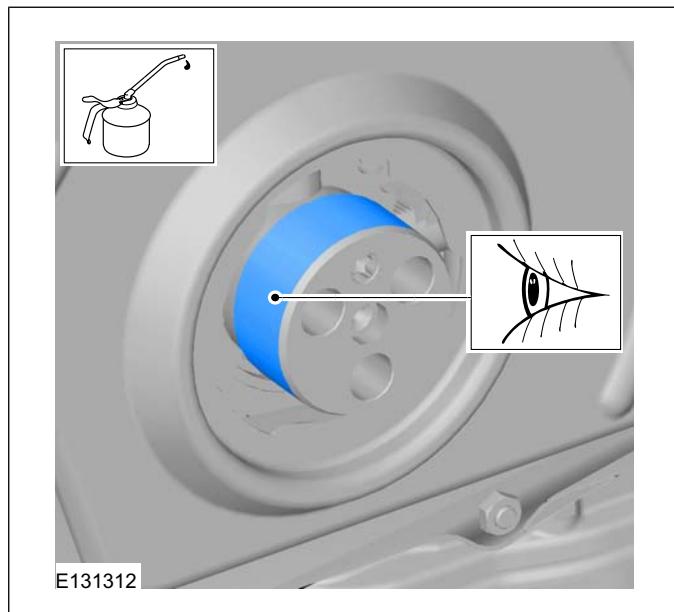
- Special Tool(s): 303-1310



REMOVAL AND INSTALLATION

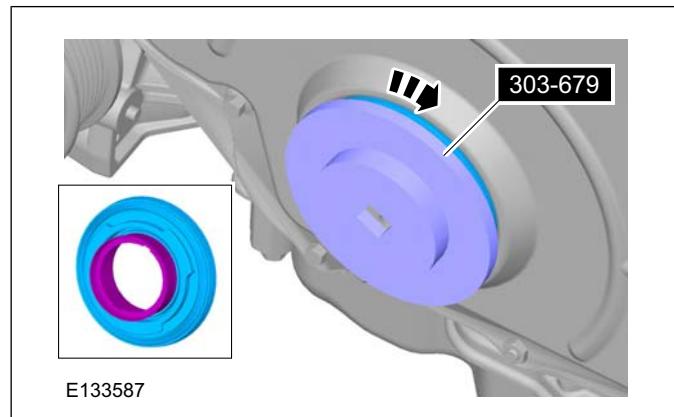
Installation

- NOTE:** Make sure that mounting face is clean and lubricated.

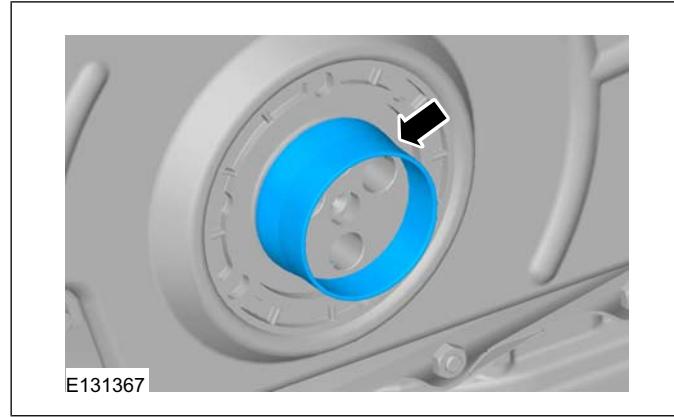


- CAUTION:** A new crankshaft seal carrier is supplied with an alignment sleeve that must not be removed until the crankshaft seal is fully installed. Failure

to follow this instruction may result in damage to the crankshaft.



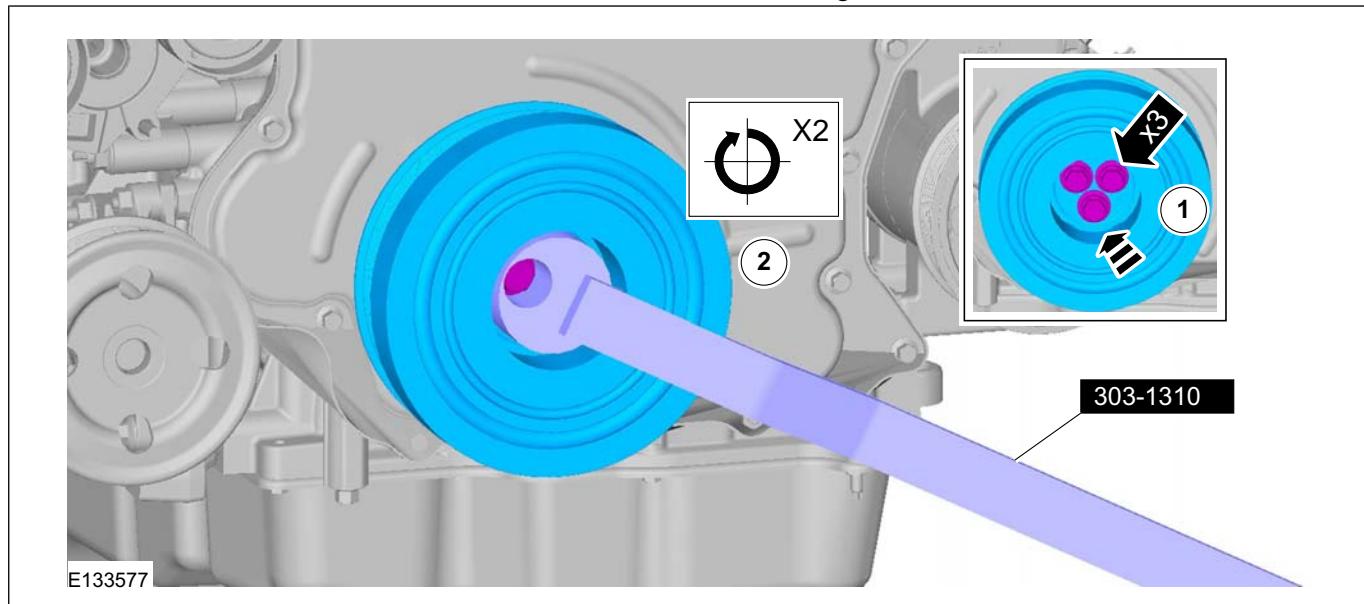
3.



- NOTE:** Initially hand tighten the fasteners.

Torque:

- Stage 1: 45 Nm
- Stage 2: 120°



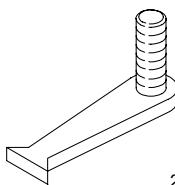
REMOVAL AND INSTALLATION

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)

	303-254 Locking Tool, Flywheel
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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

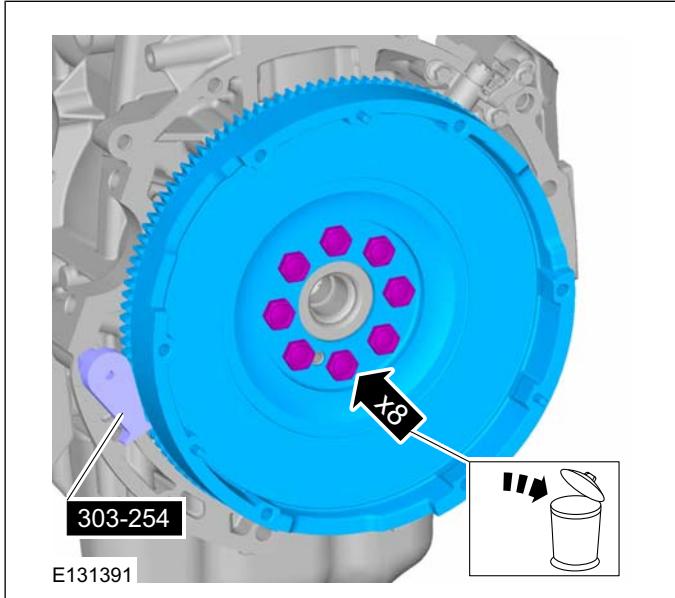
- Refer to: [Transmission - 2WD \(307-01\)](#)
Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, Removal).
Refer to: [Transmission - 4WD \(307-01\)](#)
Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, Removal).

Vehicles with manual transmission

- 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 \(308-01 Clutch - Vehicles With: 6-Speed Manual Transmission - MT82, Removal and Installation\).](#)

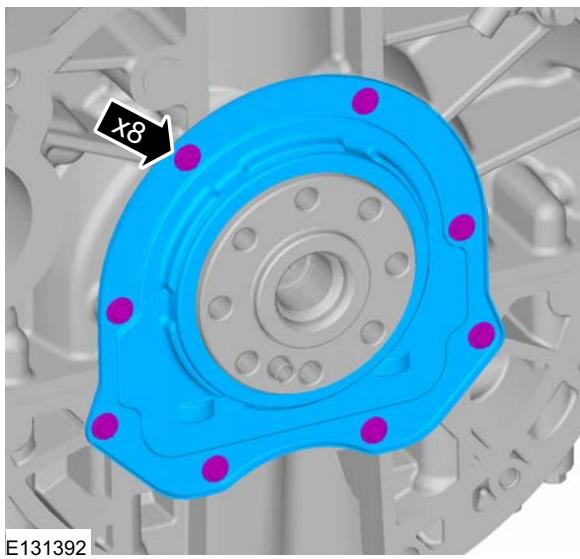
All vehicles

- Special Tool(s): 303-254



REMOVAL AND INSTALLATION

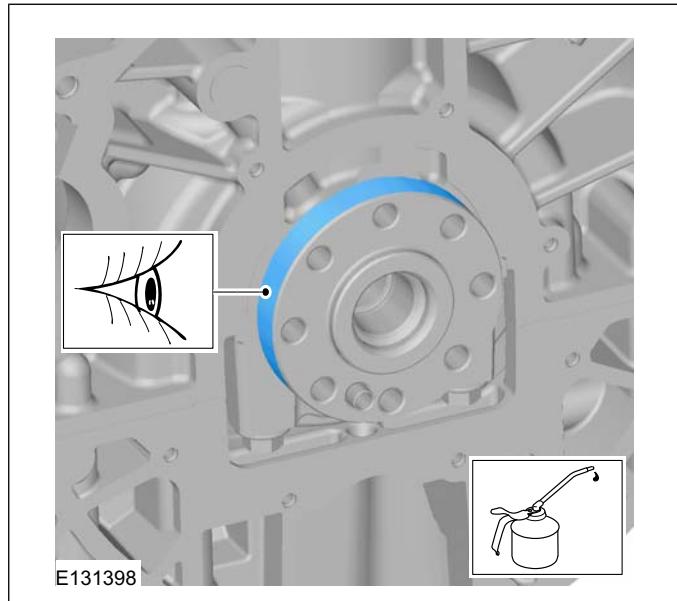
4.



Installation

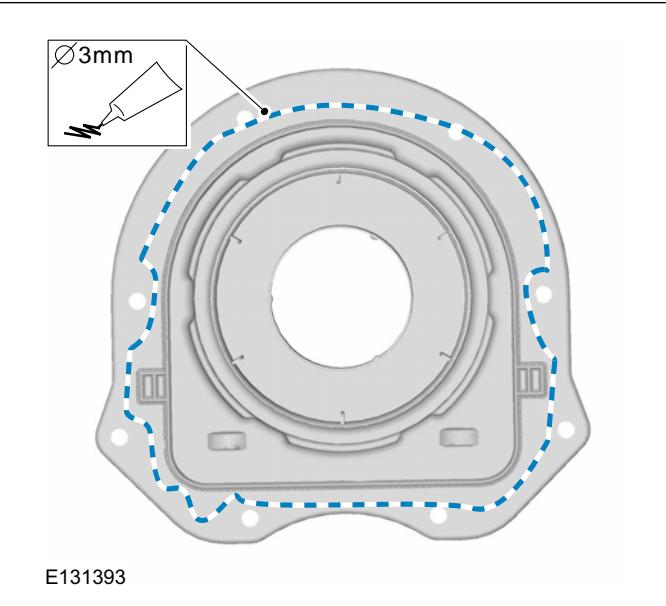
All vehicles

1.



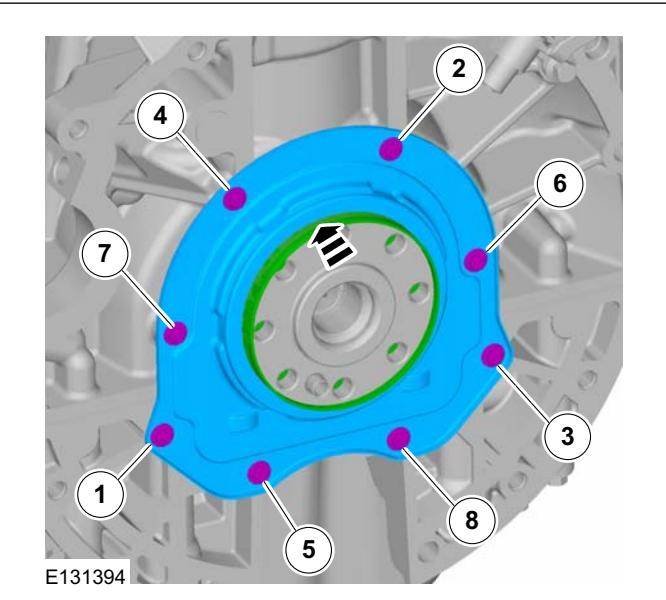
2. NOTE: Install new crankshaft rear seal carrier within five minutes after applying the recommended sealant.

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.

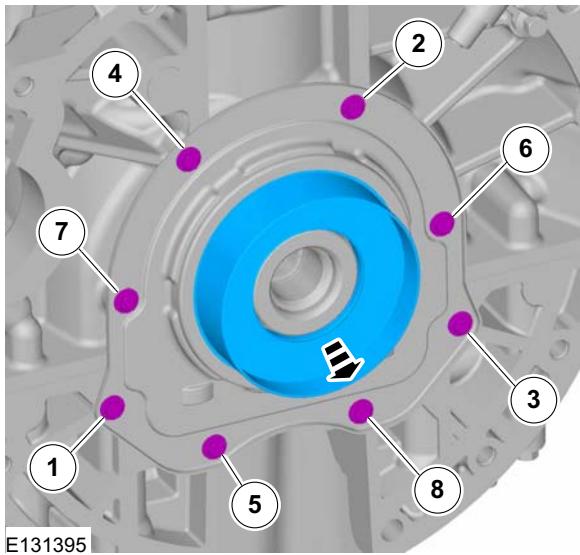
Hand tighten the bolts at this stage.



REMOVAL AND INSTALLATION

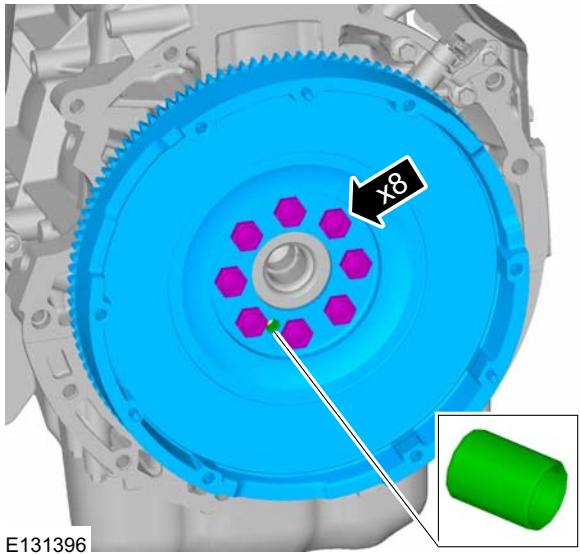
4. NOTE: New crankshaft seal carriers are supplied with an alignment sleeve which must be removed after installation.

Torque: 10 Nm



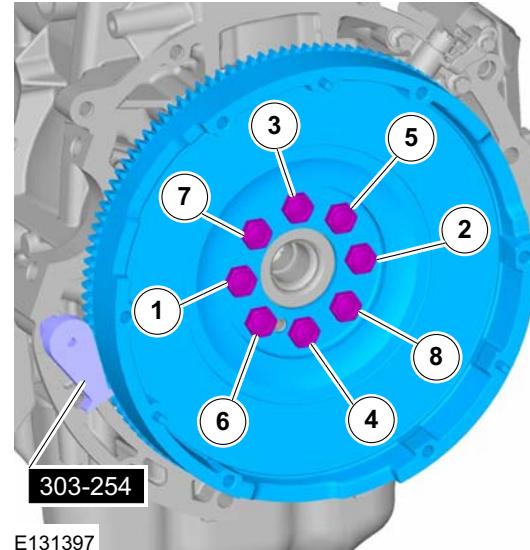
5. NOTE: Make sure that flywheel is in full contact with flywheel flange before installing the flywheel bolts.

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

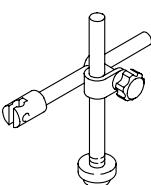
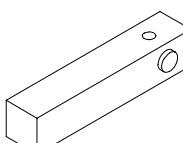
8. Refer to: Transmission - 2WD (307-01 Automatic Transmission/Transaxle - Vehicles With: 6-Speed Automatic Transaxle - 6R80, Installation).

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)

	205-069 Dial Indicator Gauge (Metric) 15046
	205-070 Holding Fixture, Dial Indicator Gauge 15022A
	303-432 Holding Fixture, Dial Indicator Gauge (Cylinder Liner Protrusion) 21183A

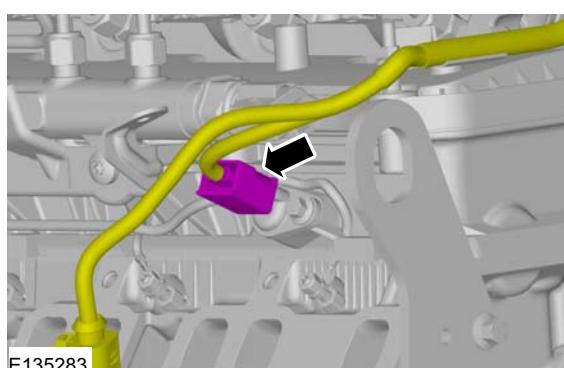
Removal

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

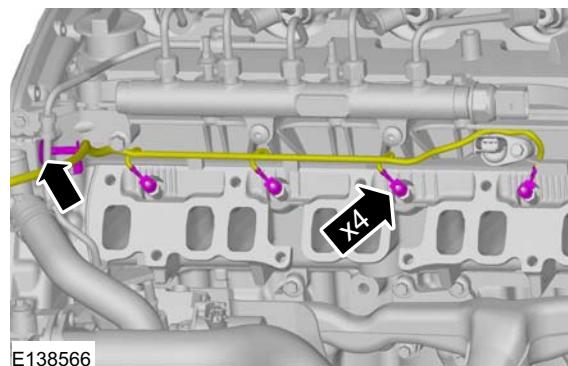
All vehicles

- 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.



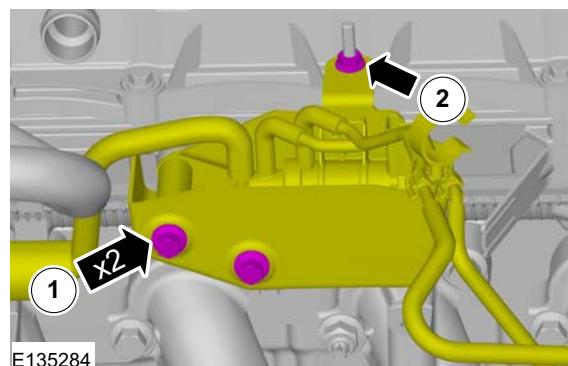
3. Torque: 3 Nm



Vehicles with fixed vane turbocharger

4. 1. Torque: 10 Nm

2. Torque: 12 Nm

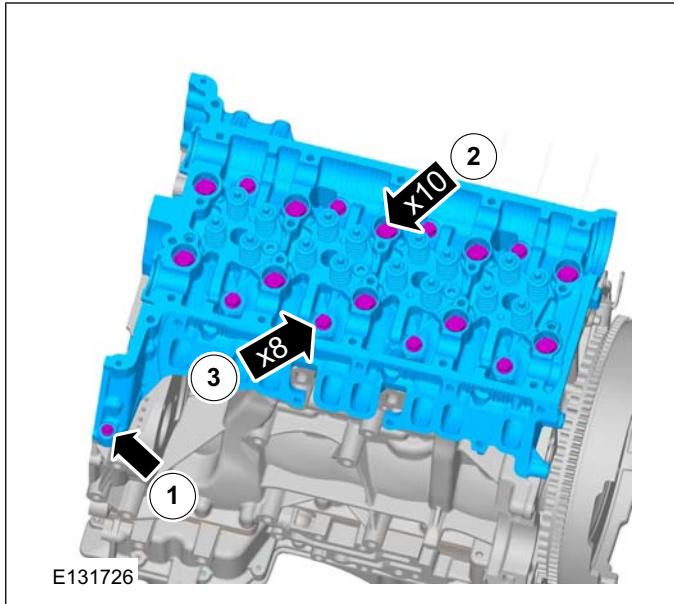


REMOVAL AND INSTALLATION

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).

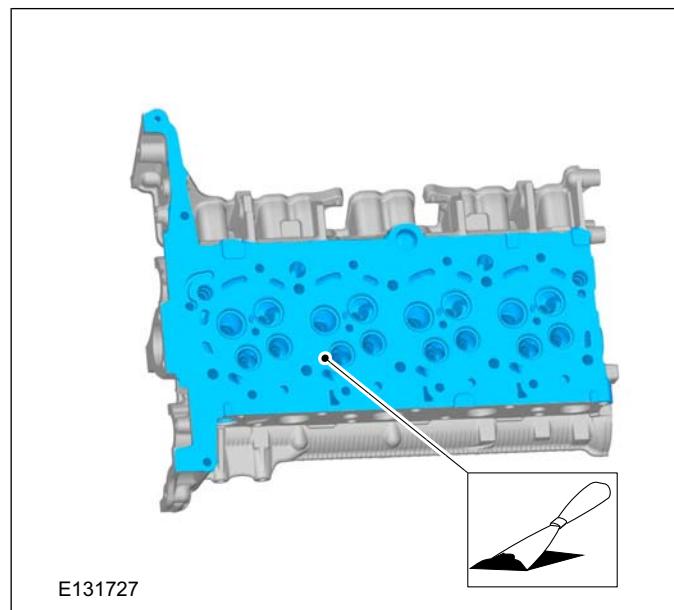
8.



Installation

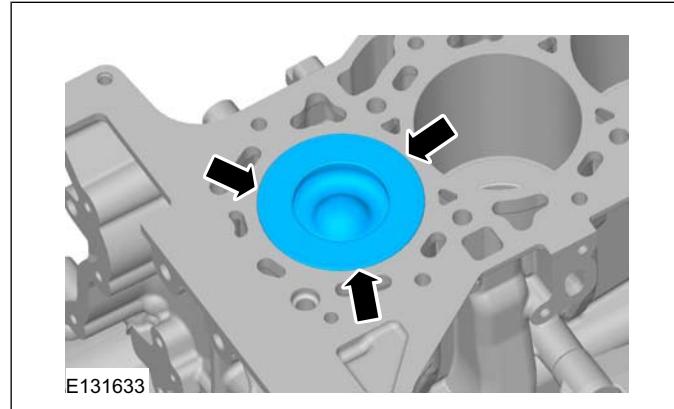
1. **WARNING:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak

paths. Use a plastic scraping tool to remove all traces of the head gasket.



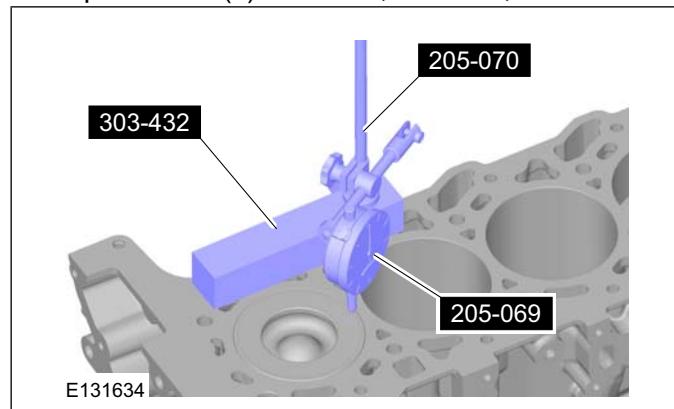
2. **NOTE:** Measure the piston protrusion of each cylinder at top dead center (TDC)

Measure the distance between the piston crown and the cylinder block at the points indicated.



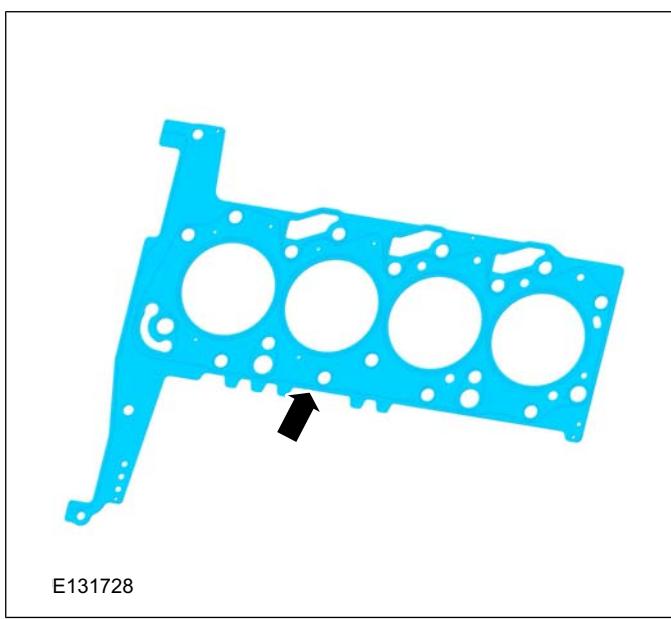
3. **NOTE:** The largest measurement determines the choice of the cylinder head gasket.

Special Tool(s): 303-432, 205-070, 205-069

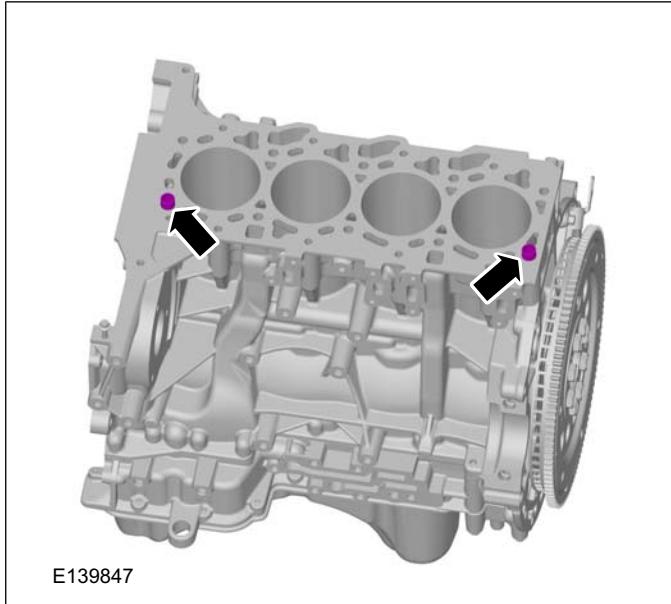


REMOVAL AND INSTALLATION

4. NOTE: Make sure that new component is installed.



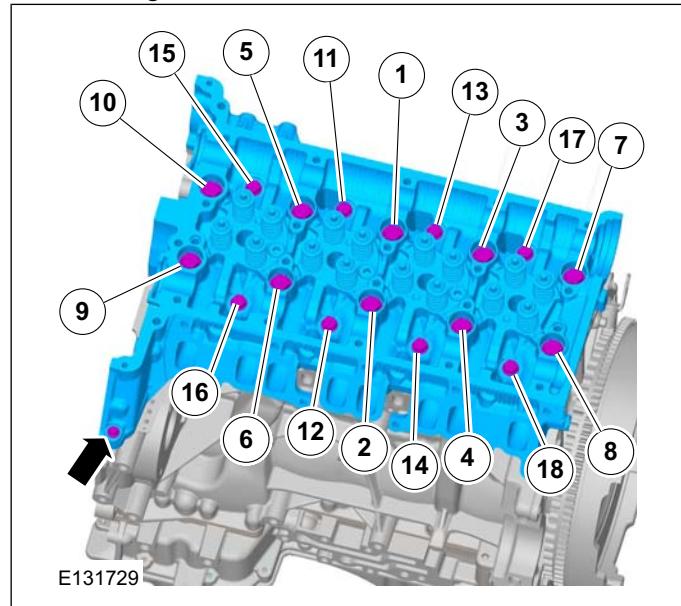
5.



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°



7. To install, reverse the removal procedure.

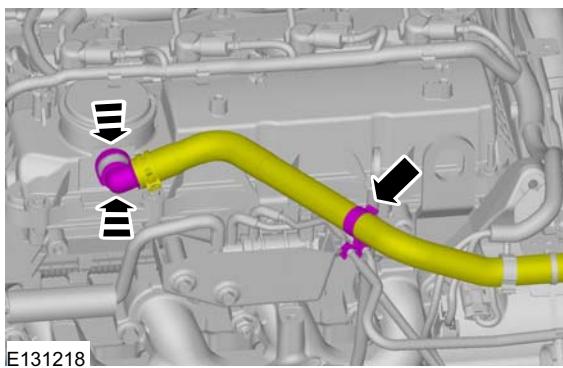
REMOVAL AND INSTALLATION

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).**

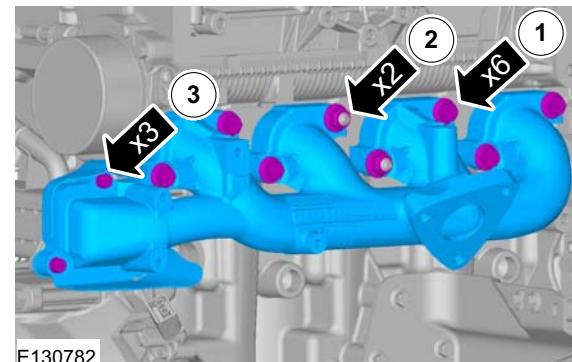
Refer to: **Turbocharger - 2.2L Duratorq-TDCi (88kW/120PS) - Puma/2.2L Duratorq-TDCi (96kW/130PS) - Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma, RHD 4WD/RHD RWD (303-04 Fuel Charging and Controls - Turbocharger, Removal and Installation).**

3. 1. Torque: 25 Nm
2. Torque: 23 Nm
3. Torque: 9 Nm

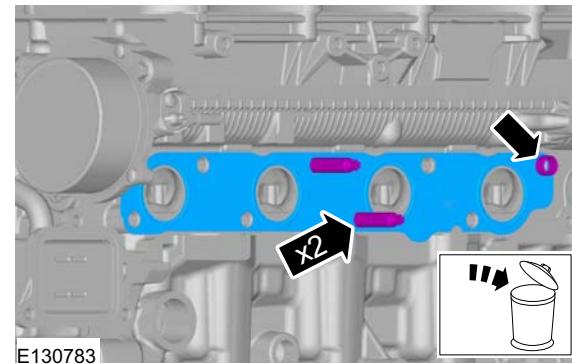
4. 1. Torque: 55 Nm

2. Torque: 40 Nm

3. Torque: 15 Nm



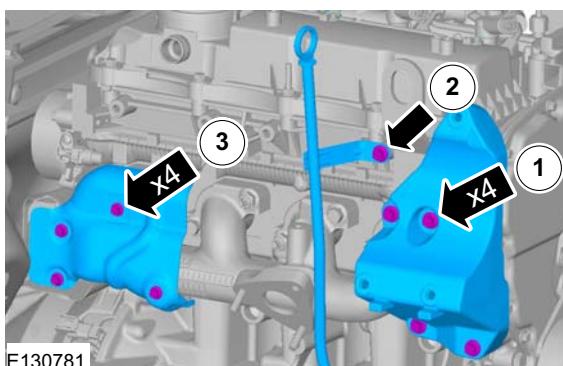
5.



Installation

NOTE: Install new exhaust manifold studs, bolts, nuts, gaskets and O-ring seals.

1. To install , reverse the removal procedure.



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 Epoxyde 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

REMOVAL AND INSTALLATION

Intake Manifold(21 183 0)

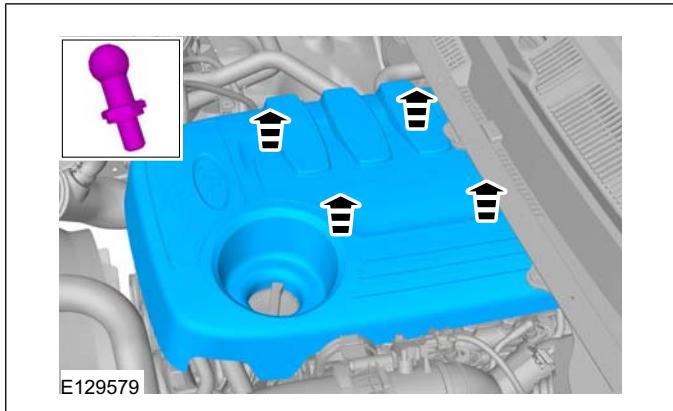
Removal

WARNINGS:

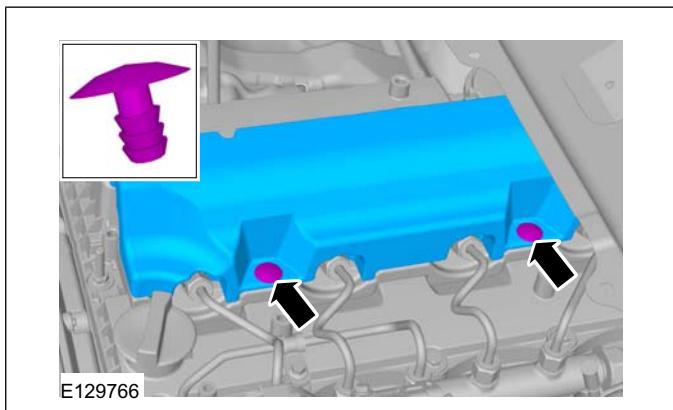
- ⚠ Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.**
- ⚠ Do not carry out any repairs to the fuel injection 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.

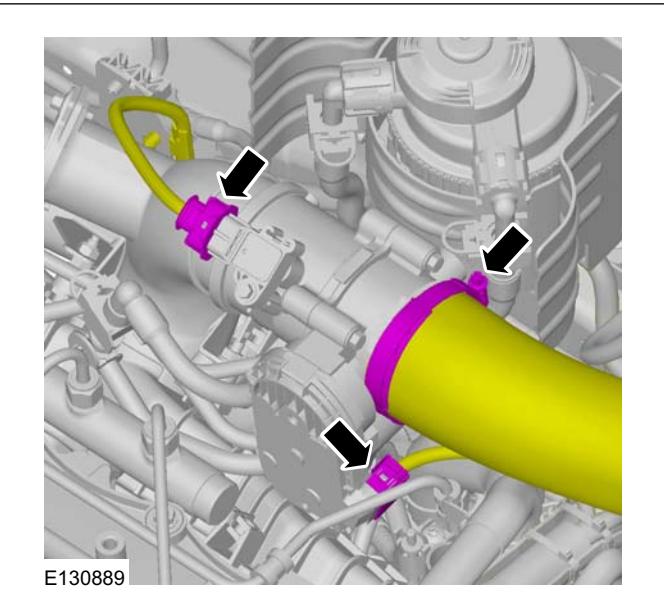


2.

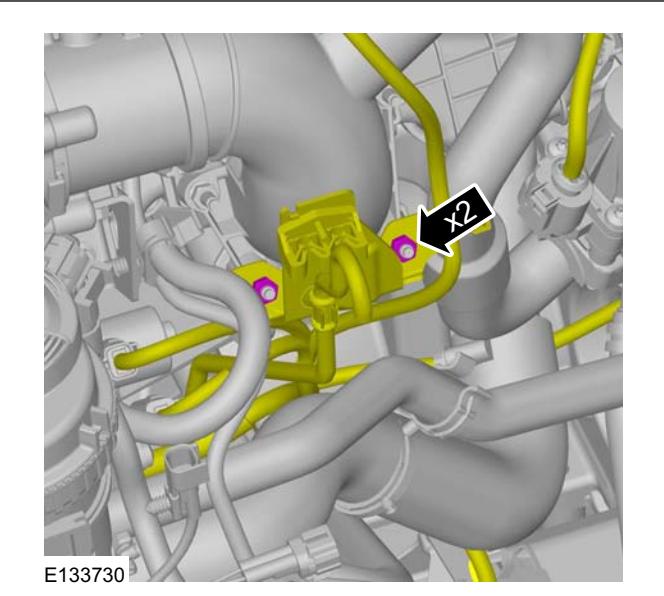


- 3. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).**

4.

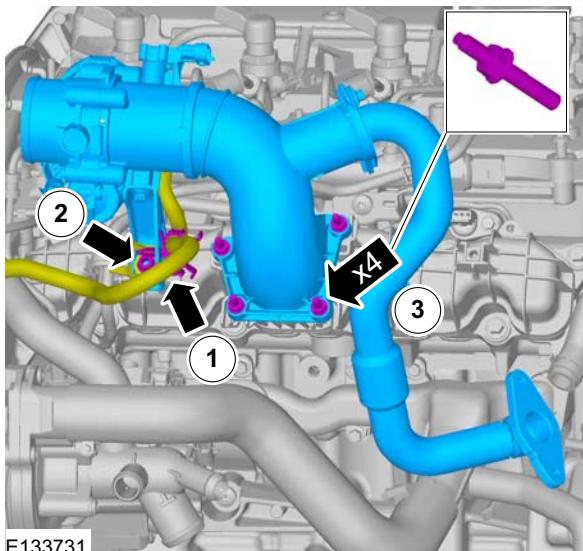


- 5. Torque: 11 Nm**

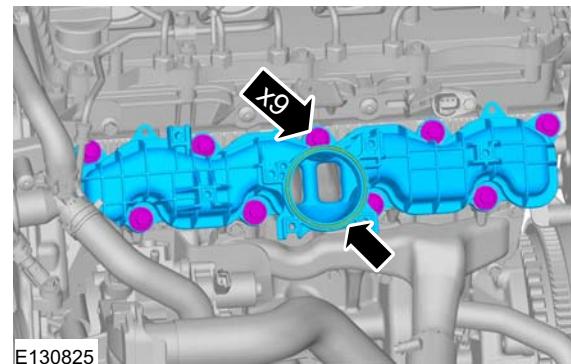


REMOVAL AND INSTALLATION

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, Removal and Installation).
7. 2. Torque: 10 Nm
3. Torque: 15 Nm



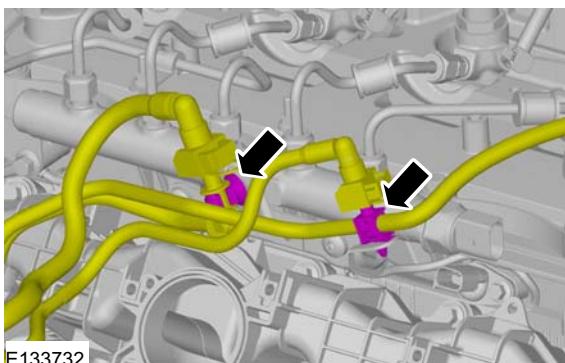
9. Torque: 25 Nm



Installation

1. **NOTE:** Inspect the intake manifold gaskets, Install new intake manifold gaskets if necessary.
- To install, reverse the removal procedure.

8.



303-01B-29

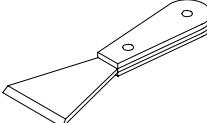
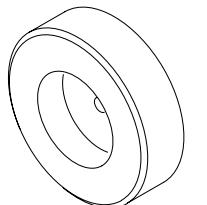
- Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma

303-01B-29

REMOVAL AND INSTALLATION

Timing Cover(21 146 0)

Special Tool(s)

	303-428 Separator, Oil Pan 21179
	303-682 Aligner, Engine Front Cover 303682

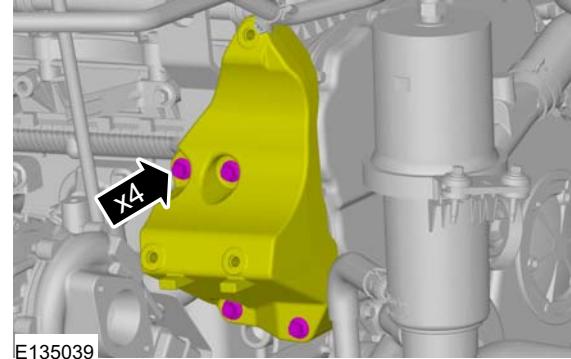
Materials

Name	Specification
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

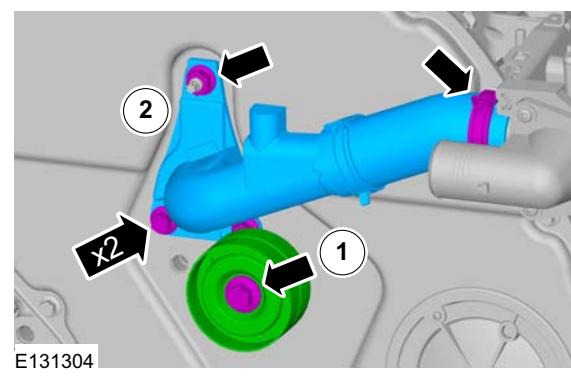
Removal

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

- Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
- 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).
- 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).
- Torque: 25 Nm

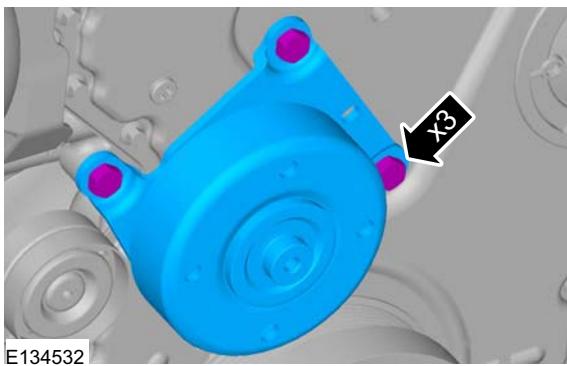


1. Torque: 48 Nm
- Torque: 23 Nm



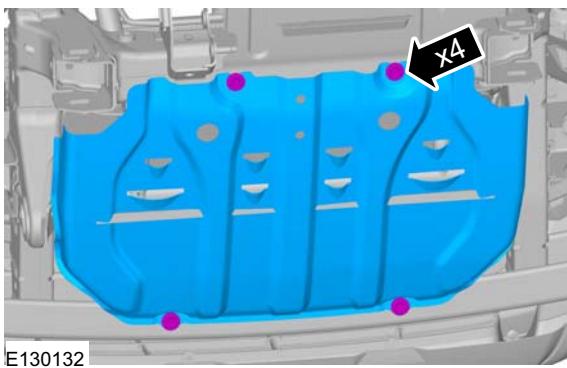
REMOVAL AND INSTALLATION

6. Torque: 48 Nm



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

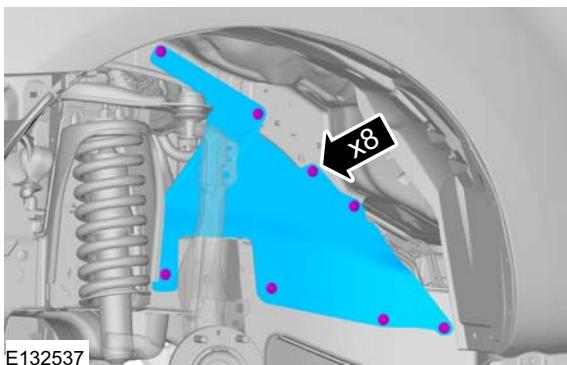
8. Torque: 30 Nm



9. **NOTE:** Remove front RH wheel only.

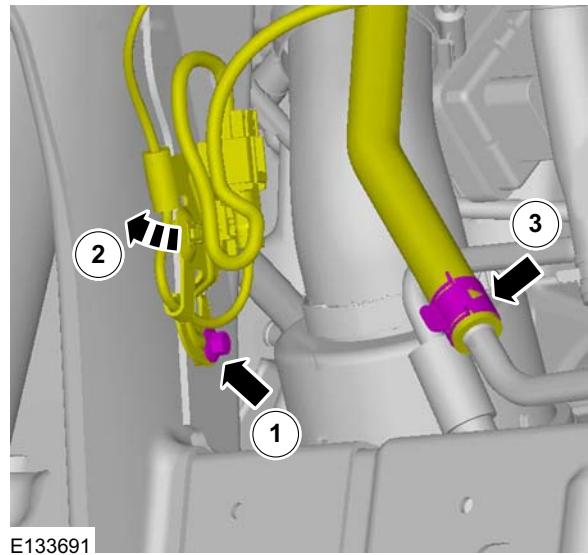
Refer to: **Wheel and Tire** (204-04 Wheels and Tires, Removal and Installation).

10.

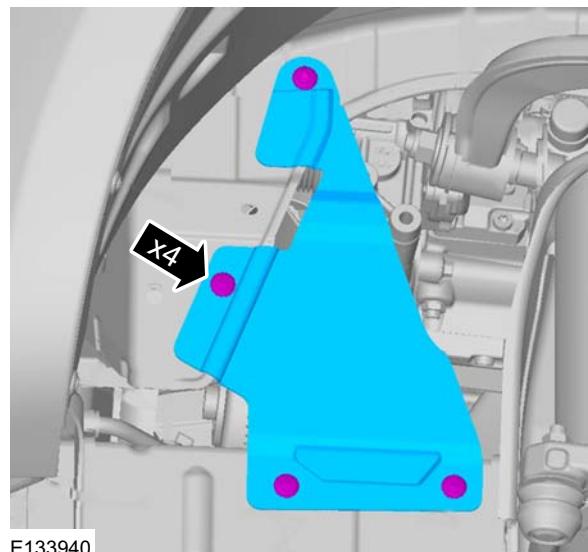


11. **CAUTION:** Cap the power steering line to prevent fluid loss or dirt ingress.

Torque: 7 Nm



12



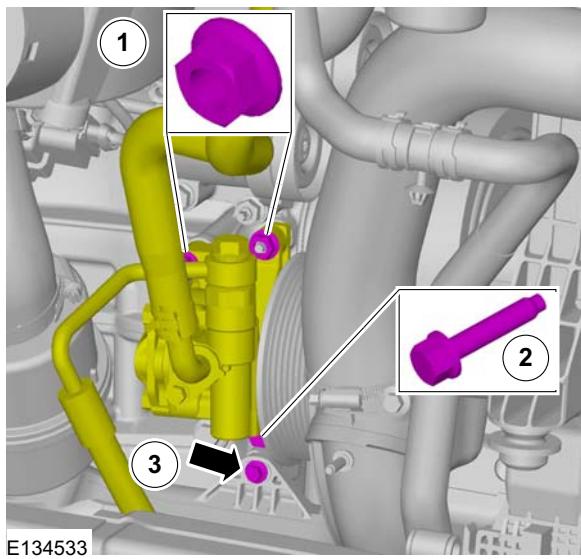
303-01B-31

- Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma

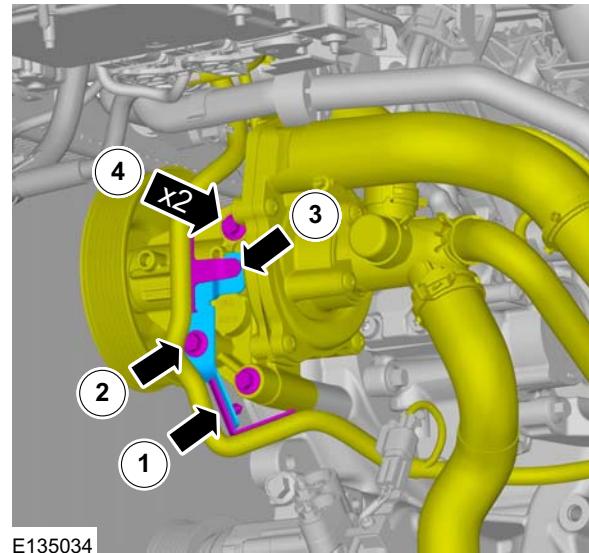
303-01B-31

REMOVAL AND INSTALLATION

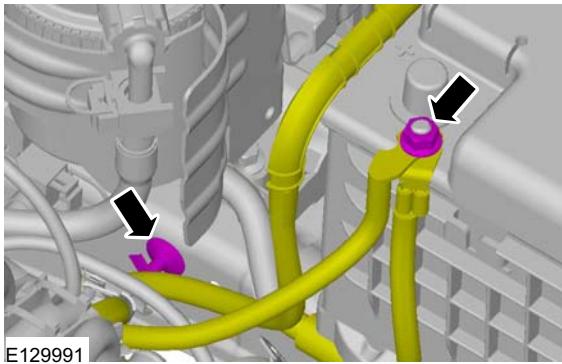
13. 1. Torque: 20 Nm
2. Torque: 20 Nm
3. Torque: 18 Nm



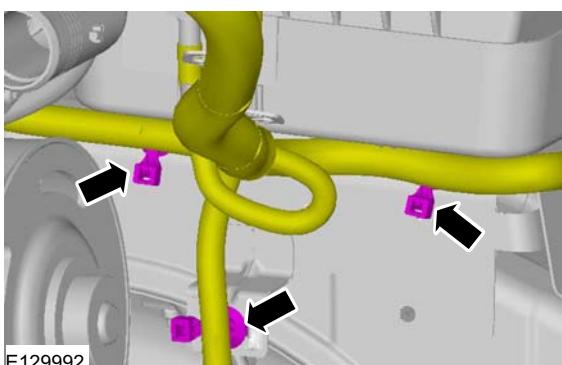
16. 2. Torque: 23 Nm
4. Torque: 23 Nm



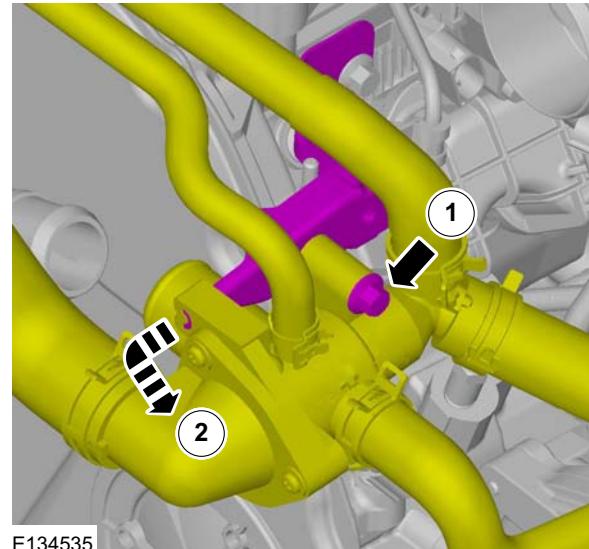
14. Torque: 22 Nm



- 15.



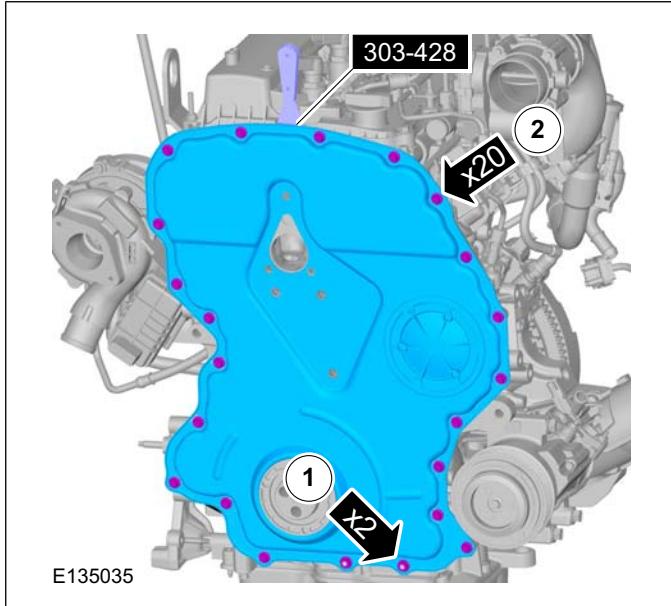
17. Torque: 23 Nm



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

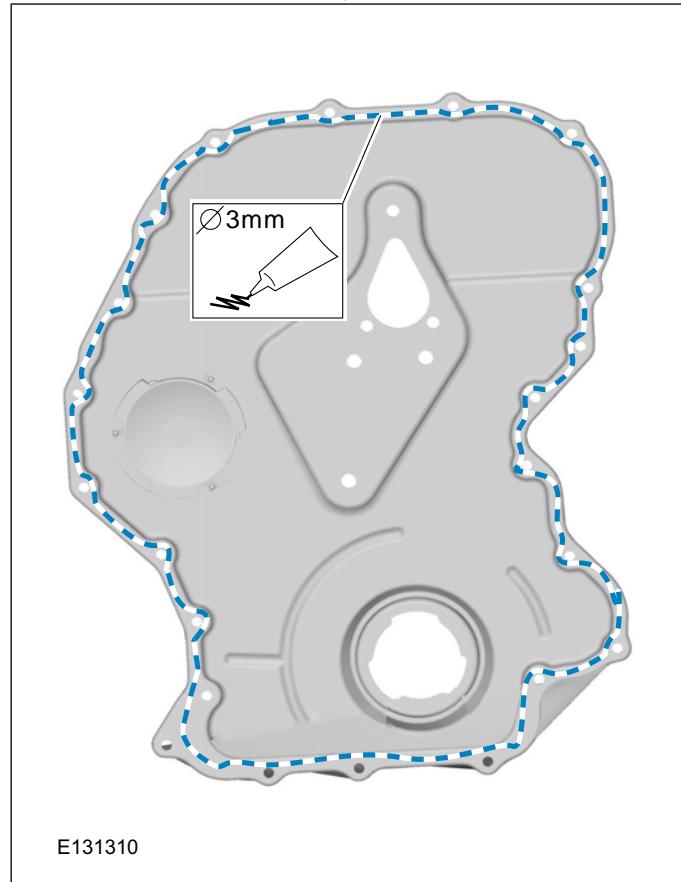


Installation

- CAUTION:** Install timing cover with in five minutes of applying the sealant.

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

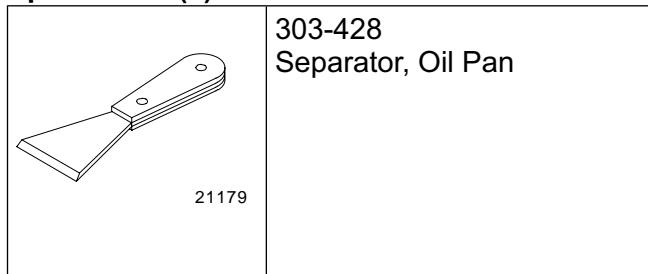


3. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Oil Pan(21 154 0)

Special Tool(s)



Materials

Name	Specification
Silicone Sealant LB	WSE-M4G323-A4 / 2U7J-M4G323-AA

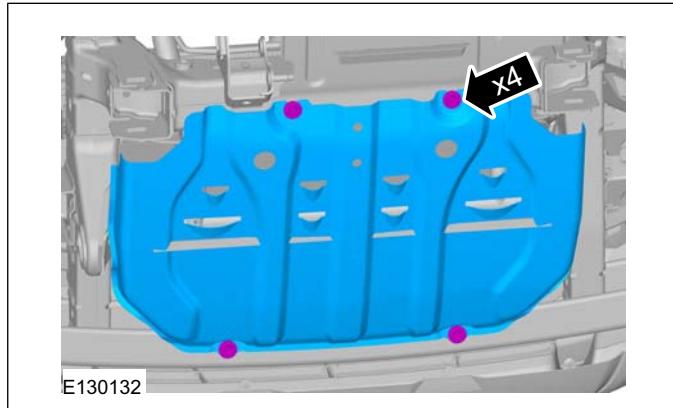
Removal

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).

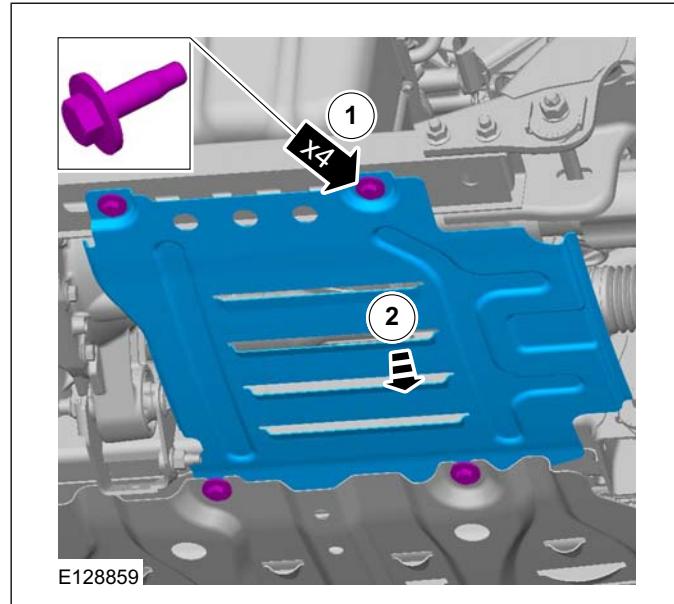
4x4

4. Torque: 30 Nm

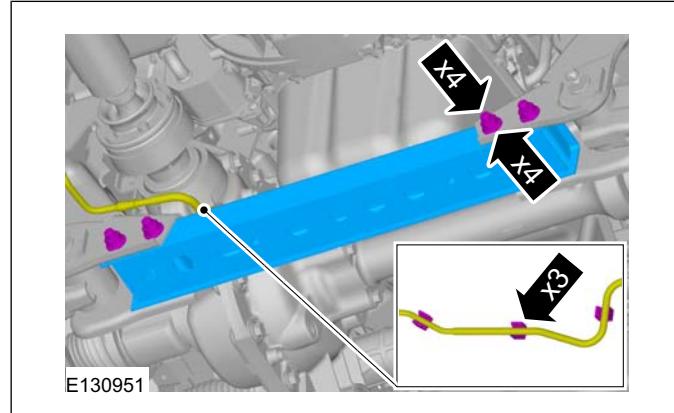


All vehicles

5. Torque: 30 Nm



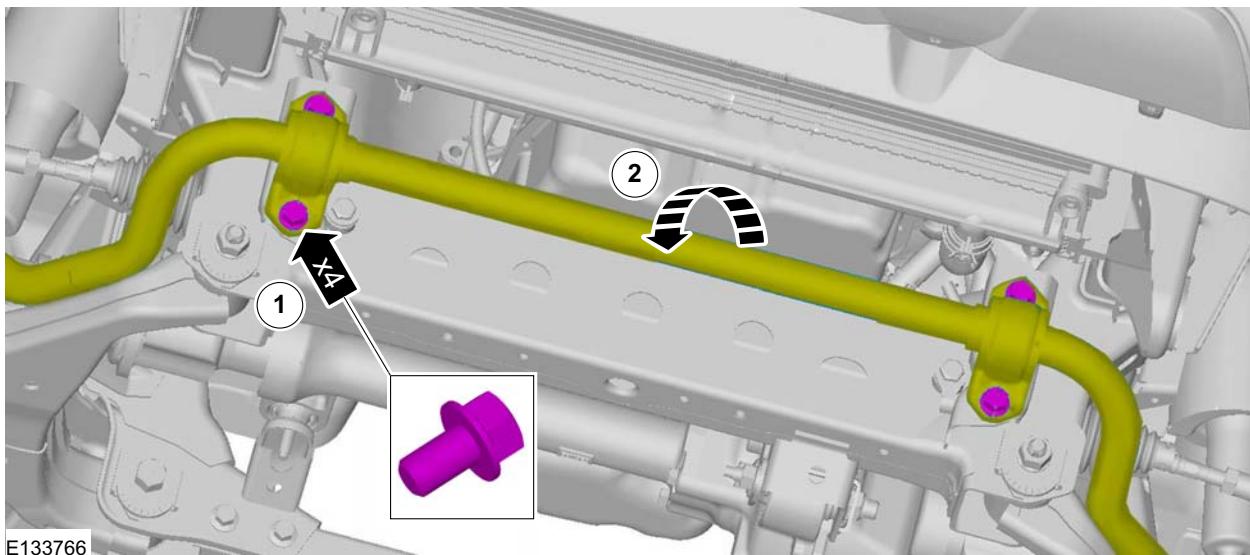
6. Torque: 90 Nm



4x4

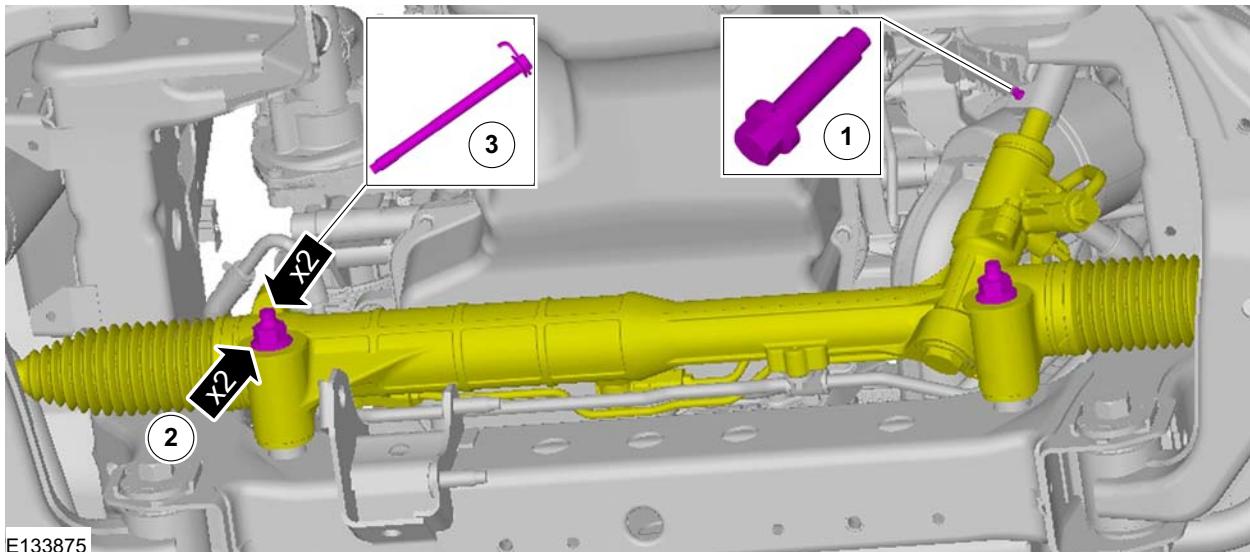
7. Torque: 30 Nm

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.

303-01B-36

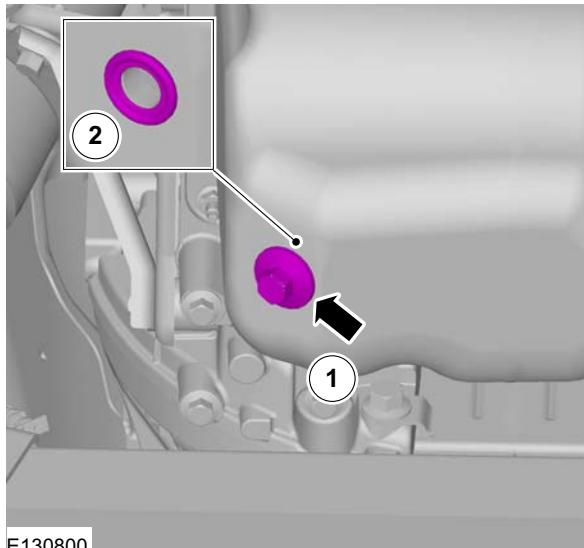
- Puma/2.2L Duratorq-TDCi (110kW/150PS) - Puma

303-01B-36

REMOVAL AND INSTALLATION

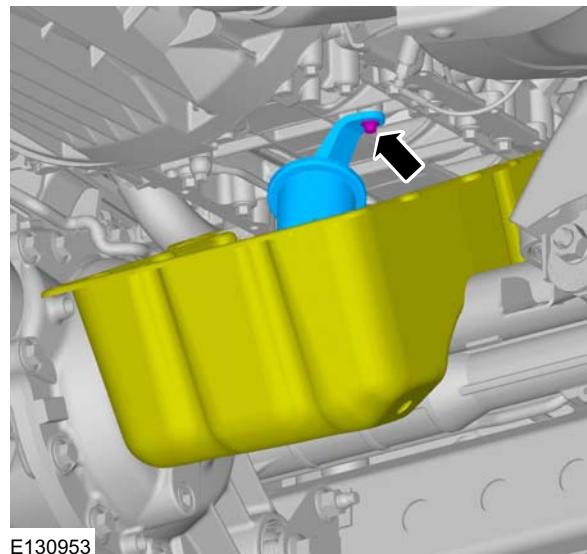
Drain the oil into a suitable container.

Torque: 39 Nm

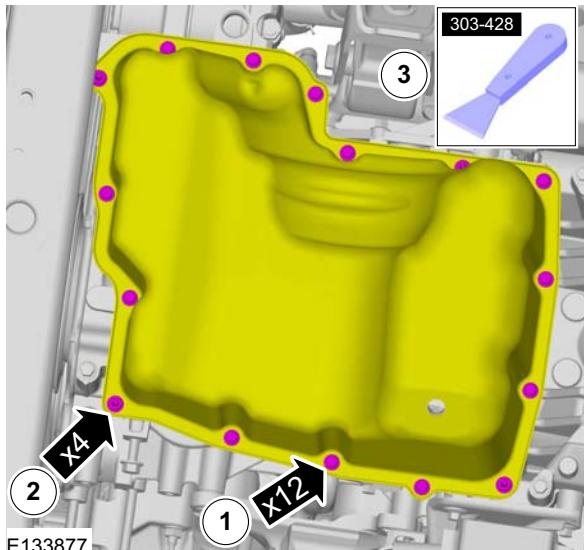


4x4

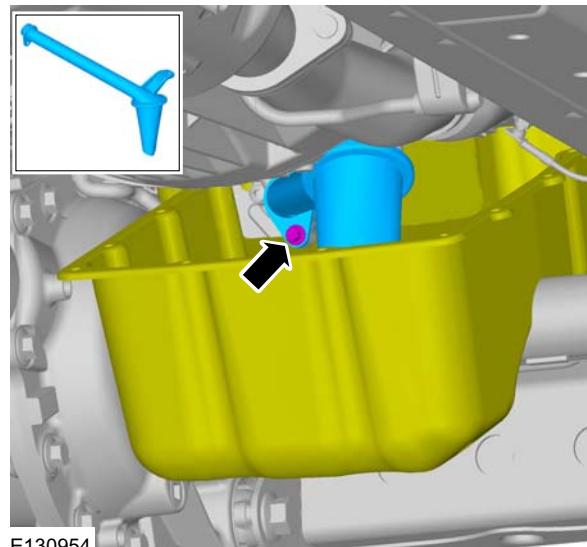
11. Torque: 10 Nm



10. Special Tool(s): 303-428



12 Torque: 10 Nm



DESCRIPTION AND OPERATION

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 Alkalies](#).

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.

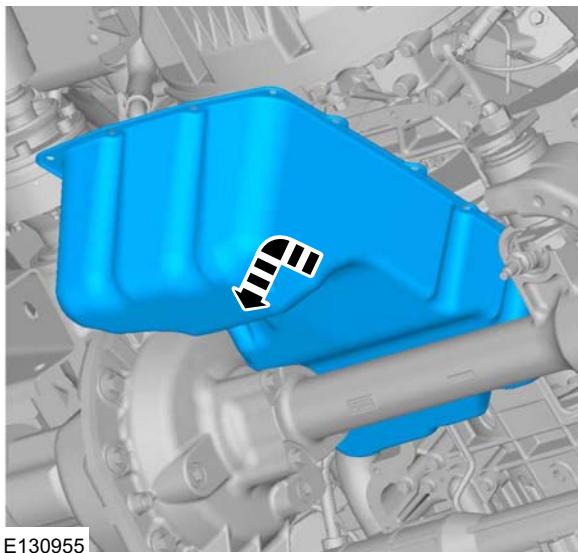
The effects of excessive exposure to chemicals may be immediate or delayed; briefly experienced or permanent; cumulative; superficial; life threatening; or may reduce life expectancy.

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

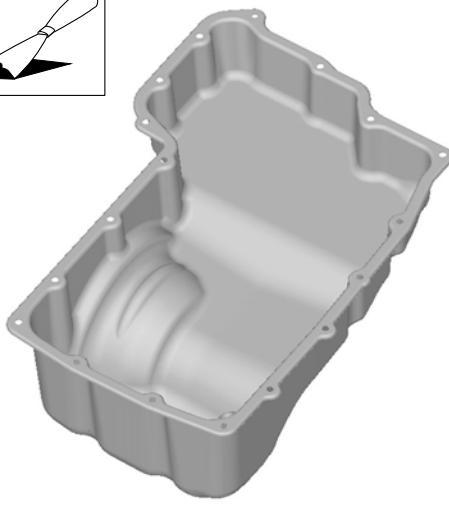
REMOVAL AND INSTALLATION

13.



Installation

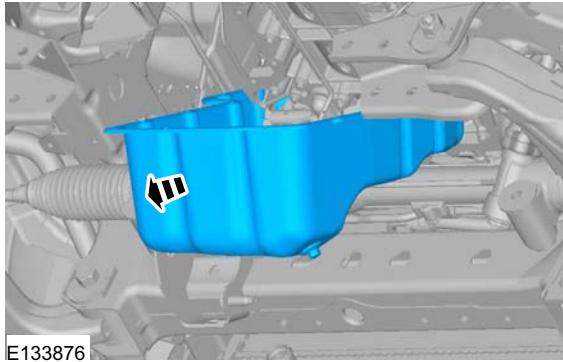
- WARNING:** Take extra care not to damage the mating faces.



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All vehicles

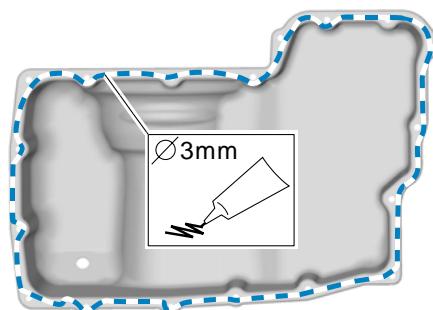
14.



- CAUTION:** Install the oil pan within five minutes of applying the sealer.

NOTE: Take extra care not to damage the mating faces.

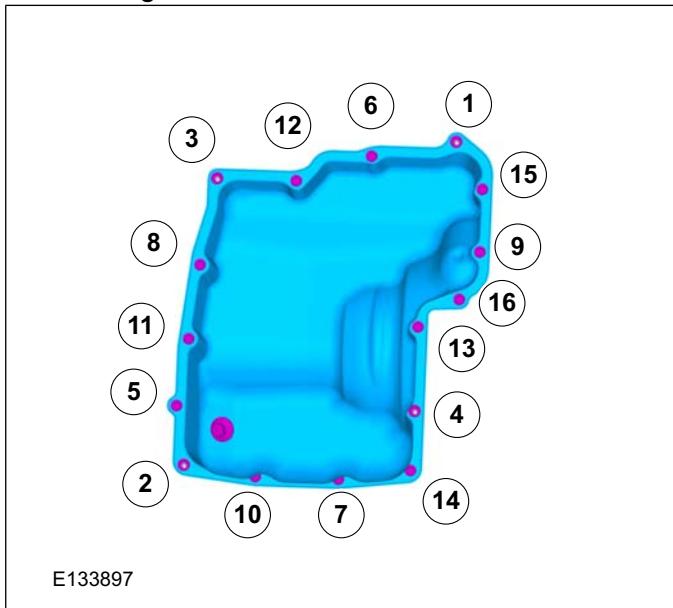
Material: Silicone Sealant LB (WSE-M4G323-A4 / 2U7J-M4G323-AA) sealant



REMOVAL AND INSTALLATION

3. Torque:

- Stage 1: 7 Nm
- Stage 2: 14 Nm



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).