



Mack Chassis - Timing Gear Plate Repair

Information

This solution provides supplementary information to be used when installing a Timing Gear Plate with Integrated Seal.

Repair Criteria

For inspection procedures and repair criteria, refer to [TSB M-212-003 Timing Gear Plate, Inspection in Impact](#).

Tools

- **For Turbo Compound:** A new Turbo Component Support Tool has been developed. This tool is designed to support the TC unit in place while performing TGP Repair.
 - Tool Part Number 88800826.
 - For additional information, see Tool Bulletin [STB22-005M](#) and the [Trucks Academy Video](#).
- A list of other tools required can be found on the Job Aid included at the end of this solution.

Parts

- **PART KITS** have been developed to include all necessary parts for a complete repair. New Seal Conditioner will be included in all kits (instructions for seal condition application below):
 - **VGT Engines:** Spare Parts Kit 24459407
 - **Turbo Compound Engines:** Spare Parts Kit 24459389

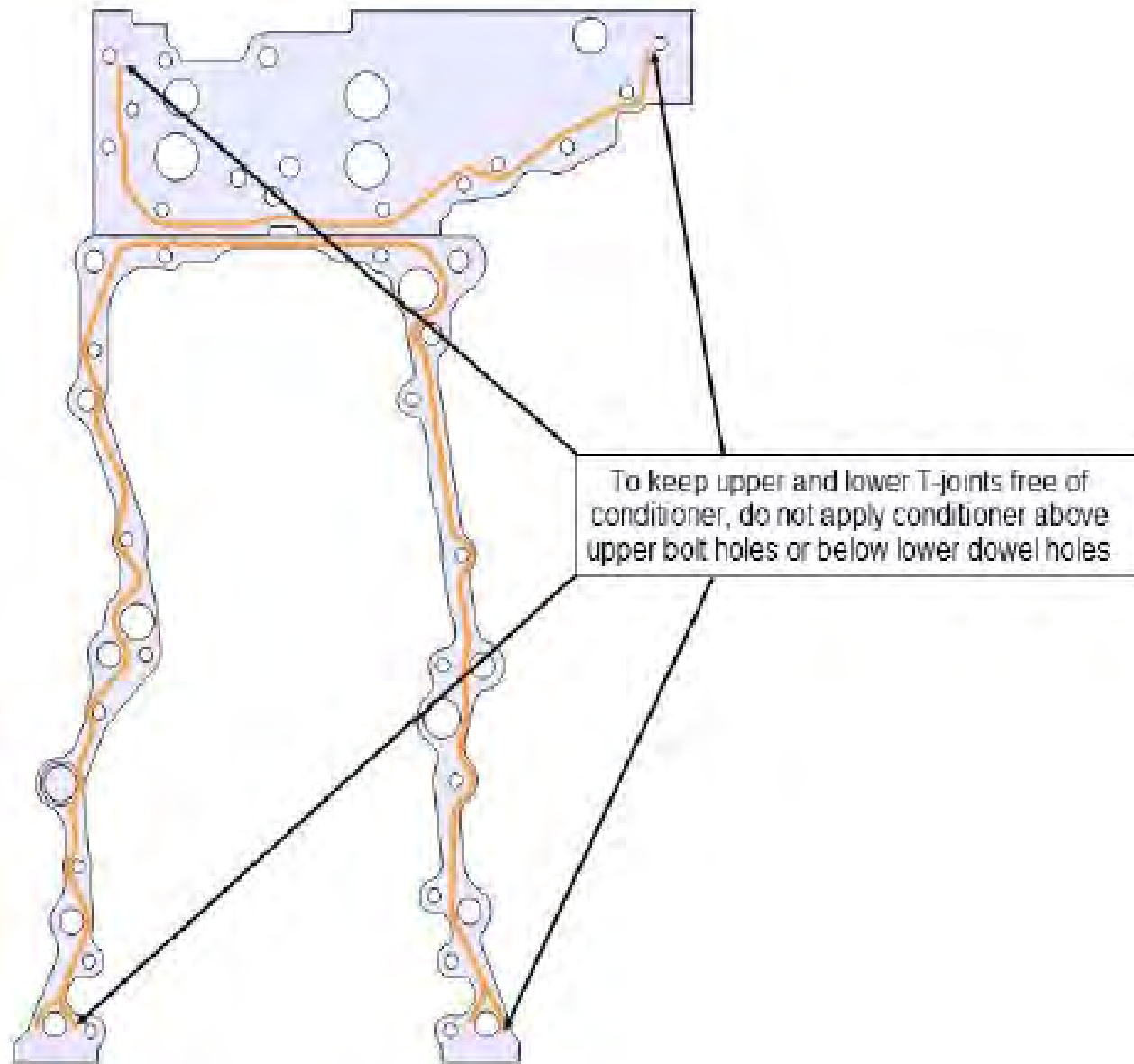
Repair

The timing gear plate replacement procedure in Impact should be utilized for this repair **in addition to the supplementary installation steps for application of the seal conditioner below.**

- The Impact procedure is [Operation 2152-03-03-05 Timing Gear Plate, Replacement - Transmission and Clutch Removed](#).
- **IMPORTANT:** Loosening of the rocker shaft and overhead adjustment **IS NOT REQUIRED** when following the Impact instructions. There are new steps included in the Impact procedure for setting gear backlash.

Seal Conditioner Application

1. Clean engine block TGP seal mating surface of any oil, grease, dirt. Inspect and clean the TGP bolt holes in rear of the engine block.
2. Apply a **LIGHT FILM** of the seal conditioner (included in the part kit) with a gloved finger to the TGP mating seal surface of the block.
 - Avoid getting conditioner in bolt holes.
 - Remove any excess seal conditioner from bolt holes.
 - **IMPORTANT:** To keep conditioner from contaminating the T-joints, conditioner should not be applied beyond the corresponding dowel or bolt holes in the block. The correct application pattern is shown below:



2a. IMPORTANT: For a turbo compound engine, grease should be applied to the surface of the TC unit.



3. Install the TGP on the engine block per the Impact procedure. **Remove any excess seal conditioner from T-joints.**
4. Refer to the Impact operation for installation of timing gears and set-up procedures.
5. Prior to the installation of the flywheel housing (FWH) onto the TGP, clean the FWH mating surface of any oil, grease, dirt. Inspect and clean the TGP bolt holes in the FWH.
6. Complete the installation of the flywheel housing onto the engine following the procedure in Impact.

7. After the flywheel housing has been reinstalled, wipe away any conditioner that has squeezed from the joints.

Video

A video of the procedure can be found below. Click the YouTube button in the lower right-hand corner of the video to view the video full-size.

Job Aid

A Job Aid outlining repair times, document information, and a tool list can be found below (click on the pictures to expand to a larger size)



Timing Gear Plate, Integrated Plate

Job Aid

- Coolant Extractor 85112740
- Drain Hose 9096048
- Disassembly Tool J-44773
- Cranking Tool 88840317
- Fixture 88800570
- Impact Wrench 9996400
- Puller 9990192
- Disassembly Tool 88800502
- Guide 9996267
- Rocker Indicator 9999683

Magnetic Stand 9999696

Timing Kit J-44514B

Assembly Tool 88800619

Assembly Tool 9990166

Align Tool 85111422

Setting Tool 8880031

Align tool 9990024

Fixture 9996657

Transmission jack and plate

TC Support Plate

Special Tools



| | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> 1) Secure the truck for service, disconnect negative cable 2) Drain air and coolant 3) Remove interior components. 4) Remove transmission 5) Remove air cleaner box, CAC pipe and Diffuser pipe 6) Remove EGR valve, EGR crossover pipe, valve cover, spacer frame, and upper timing cover. 7) Remove all electrical, coolant lines, air lines, and brackets from the rear of the engine 8) Remove air compressor, starter, and lardem pump. | <p>Teardown 0-4 Hrs.</p> | <ol style="list-style-type: none"> 9) Remove oil pan and Remove of filters. 10) Place the engine on TDC. 11) Raise and support the engine and Remove engine mounting brackets from flywheel housing 12) Remove engine mounts from the frame. 13) Remove clutch, pressure plate, and flywheel 14) Install TC support tool. (TC Engine Only) 15) Remove all hardware securing the flywheel housing and remove the flywheel housing. 16) Remove timing gears <ul style="list-style-type: none"> - Tandem idler gear (a puller may be required to remove the gear) - TC Idler Gear (TC Engine Only) - Cam gear, Double idler gear and Adjustable idler gear 17) Install aligning device, removed TGP hardware, and remove TGP. |
| <ol style="list-style-type: none"> 18) Apply seal conditioner to the back and head 19) Install TGP and new mounting bolts. 20) Install all timing gears verifying timing and gear lash are correct. 21) Make sure to remove alignment device. 22) Apply seal conditioner to the TGP. 23) Install flywheel housing and torque all securing hardware to spec 24) Remove TC support tool. (TC Engine Only) 25) Install engine mounting brackets to flywheel housing and engine mounts in frame. 26) Lower engine onto the engine mounts, install and torque engine mounting bolts. 27) Clean and install oil pan, hook up level sensor, dipstick, and fill tube 28) Replace of filters and fill engine with new oil. 29) Install air main box, flywheel, and starter 30) Install upper timing cover, valve cover, and EGR cross over pipe. 31) Install lardem pump, air compressor, all compressor line and connection. 32) Connect E1 (engine interface) connector. | <p>Install 9-13 Hrs.</p> | <ol style="list-style-type: none"> 33) Install all electrical, coolant lines, air lines, and brackets from the rear of the engine. 34) Install EGR valve, EGR hot pipe, diffuser pipe, flex pipe, and install hot side CAC pipe 35) Install air cleaner housing and turbo inlet pipe 36) Install clutch and pressure plate 37) Ready transmission for installation and install trans. 38) Route and secure battery cables, trans cooler coolant lines, air lines, and electrical harness. 39) Install drive line 40) Fill engine with coolant. 41) Connect batteries, Start engine and check for leaks. |
| <p>Training Video available at macktrainingsupport.com</p> | | <p>Additional Communications</p> |
| <p>Turbo Compound Support Bracket</p> | | <p>TSE M-212-001 Timing gear plate, Inspection/Repair</p> |
| <p>Timing Gear Plate Install</p> | | <p>Repair operation 2152-03-03-05 (Timing Gear Plate, Replacement) in Impact.</p> |



Warranty Information

Warranty Information can be found in the Warranty Operations Manual, [6.2.1.1 - TIMING GEAR PLATE - Clean Claim Template](#).

- Log in to TDP prior to clicking the link.

Additional Information

- Use of recommended oils is advised. The Recommended Oil List can be found in Impact or by clicking [here](#).



Tags

[mack](#)

[tgp](#)

[timing gear plate](#)

[oil leak](#)

[unlocking uptime](#)

Categories *

[Make and Model > Mack > CXU/CHU/PI - Pinnacle](#)

[Make and Model > Mack > LR](#)

[Make and Model > Mack > MRU/TE - TerraPro](#)

[Powerplant > Mack > MP7](#)

[Powerplant > Mack > MP8](#)

[Vehicle System > Engine](#)

[Make and Model > Mack > AN - Anthem](#)

[Make and Model > Mack > GU/GR - Granite](#)

Related links and attachments

[Mack TGP Job Aid V3](#)



Feedback

[Give feedback](#) to help improve the content of this article



Special Tools Bulletin

To: Service Managers
Parts Managers
Technicians

Region: U.S.
 CAN

Bulletin:
Date: December 21, 2022
Valid to: December 31, 2023
Action Required? Yes No

From: Tyler Griffin – Proprietary Systems & Components Specialist.
Subject: Mack Essential Tool Shipment

The tools listed below will be shipped **automatically** to all Mack dealers (full-line, parts & service, and satellite locations) from the PDC. These tools are necessary to service the Mack product. Each dealer will be invoiced on **ET1201M**. **This tool is used to hold the Turbo Compound in place while performing Timing Gear Plate repairs. Repair instructions and videos are below.**

| Part Number | Description | Quantity |
|-------------|-------------------------------------|----------|
| 88800826 | 13 L Turbo Compound Support Bracket | 1 |

Please advise your parts department staff to expect these Essential Tools for the Service Department.

You may order additional Essential Tools; pricing is available on the Parts System.

Contact Information

If you have questions, please contact your District Service Manager.



Essential Special Tool 88800826

**Turbo Compound Support – *while performing
TGP (Timing Gear Plate) oil leak repairs***

Instructions:

1. Remove the starter.
2. Remove the Turbo Compound oil feed line.
3. Remove the EGR heat shield.
4. Remove top V-band clamp for the EGR cooler's hot pipe.
5. Remove bottom V-band clamp for the EGR cooler's hot pipe.
6. Remove the EGR cooler's hot pipe.
 - A. Make sure to remove the EGR cooler rear seal.
7. Disconnect and set aside the following line sets:
 - A. Aftertreatment Hydrocarbon Injector
 - B. Exhaust gas pressure line
 - C. Engine brake
 - D. Turbo compound buffer supply
8. – Unplug camshaft sensor harness.
9. – **IMPORTANT:** There is a key fastener/bolt that threads in the timing gear plate. This fastener/bolt is hidden and must be removed prior to installing the Turbo compound tool.
10. – Here you see the Turbo compound tool and its mounting hardware.
 - A. 2-3 fasteners depending on EM level.
11. – First you will remove the 2-exhaust heat shield mounting bolts, and Turbo Compound lifting eye bolt.
 - A. 2-3 fasteners depending on EM level.
12. – Next secure the Turbo Compound tool bracket to the cylinder head, utilizing the bolt holes from the previously removed exhaust heat shield bolts.
13. – At this point you will need to prep the threaded rod with one of the nuts from the hardware kit. You will thread one of the nuts about $\frac{1}{4}$ of the way up on the threaded rod.
14. – Securing the Turbo Compound tool mounting bracket to the Turbo Compound housing.
 - A. Slide the supplied threaded rod through the slotted hole in the Turbo Compound tool mounting bracket.
 - B. Thread the rod in the bolt hole from the previously removed Turbo Compound lifting eye bolt, thread the rod until it bottoms out.
 - C. Secure the rod to the Turbo Compound housing by running the previously installed nut flush with the housing, and slightly tighten.
 - D. Install the second nut above on the threaded rod above the Turbo Compound tool mounting bracket. Thread nut down flush with the mounting bracket and slightly tighten.
- 15– Tool Removal:
 - A. Loosen both nuts on the threaded rod.
 - B. Unthread rod from the Turbo Compound lifting eye bolt hole. You do not have to fully remove the threaded rod from the mounting bracket.
 - C. Remove both Turbo Compound tool mounting bracket bolts at cylinder head.





Please see attached training video that can also be found in TDP under training videos.


[TC Bracket Mack 1 - YouTube](#)


21527-3 Timing Gear Plate, Replacement


Transmission and Clutch Removed


 Illustrations may differ slightly from the actual vehicle being serviced. However, key components addressed in this information are represented as accurately as possible.


 Colors used in illustrations are for highlighting purposes only and do not correspond to the actual colors of the vehicle.

 All threaded fasteners that do not have a tightening torque specification in the information are tightened to a standard torque. Standard torques are available in the following specification. [▶ Standard Tightening Torques](#)

| | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
|  CAUTION | |
| Risk of material damage. | |
| Any damage or deformation to the EGR (Exhaust Gas Recirculation) pipes can affect their function and lifetime. The corrugated steel bellows are sensitive to dents. | |
| ▶ | Use caution when working on or near the EGR pipes. |
| ▶ | Do not try to force the pipe into place by bending, twisting, or stretching the bellows. |

| | |
|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
|  WARNING | |
| Risk of burn injuries. | |
| Heated components and mechanical parts can cause burns. | |
| ▶ | Exercise caution when working with heated components. Always use the appropriate protective equipment. |

| | |
|----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  WARNING | |
| Risk of burn injuries. | |
| The coolant may be hot. | |
| ▶ | The cooling system is under pressure and can reach the temperature sufficient to cause burns. Allow the coolant temperature to reach the safe level before starting the work. |
| ▶ | Remove the coolant tank cap carefully. Use appropriate protective equipment. |

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|  CAUTION | |
| Risk of material damage. | |
| Using the wrong type of oil filter could result in damage to bearings, crankshaft, and connected parts as a result of unfiltered oil entering the lubrication system. | |
| ▶ | Only use oil filters approved by the manufacturer. |

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|----------------------------------------------------------------------------------------------------|--|
|  CAUTION | |
| Service Information Advisory. | |

If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

▶ You must read and understand the precautions and guidelines in Service Information, Function Group 2, "General Safety Practices, Engine" before performing this procedure.

Special tools

| | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 85112740 | 88800031 | 88800502 | 88800570 | 88800619 |
| 88840317 | 88870002 | 88870012 | 88870039 | 9990166 |
| 9990192 | 9996049 | 9996400 | 9998267 | 9999683 |
| 9999696 | | | | |

1 Unlatch and raise the hood.

2 Remove the lower right splash shield.


3 Remove the lower left splash shield.

4 Perform this procedure when the condition below is met.

Conditions

- Certain vehicle applications may require the engine cover to be removed

▶ Remove the engine cover if needed.



Service hint
To gain better access to the engine.

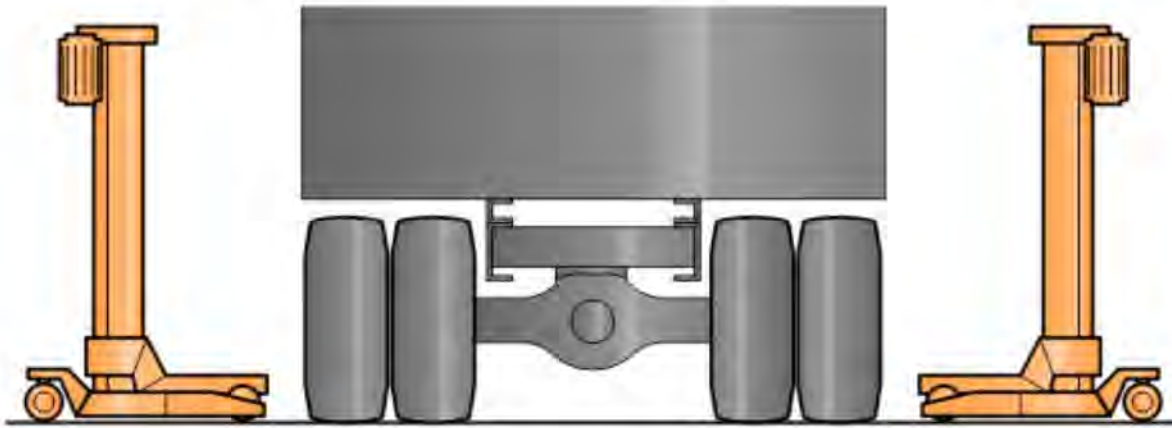
5 Perform this procedure when the condition below is met.

Conditions

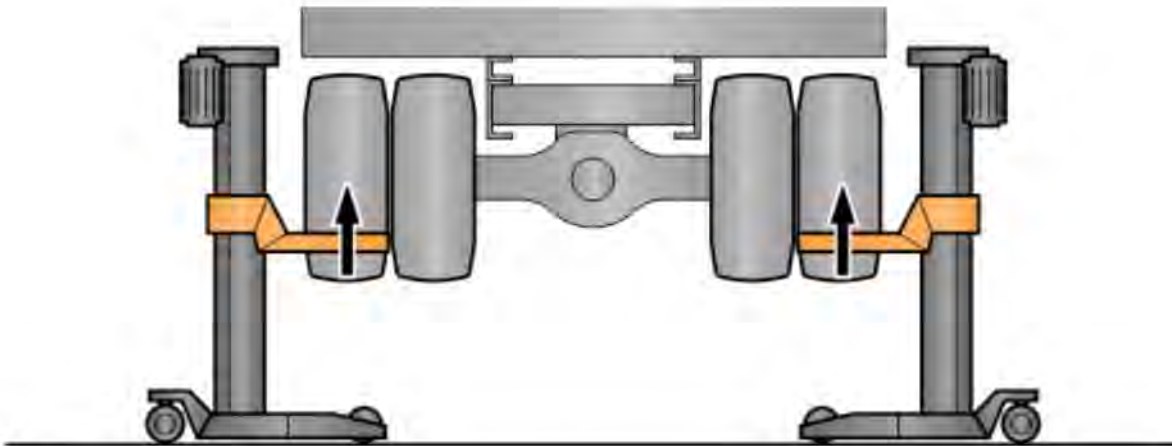
- If the vehicle is equipped with a removable bumper end cap

▶ Remove the end cap.

6 Position the column lifts.



7 Raise the vehicle.



8 Perform this procedure when the condition below is met.

Conditions

- If the coolant is not drained, then drain the coolant
- ▶ Drain the cooling system using either a coolant extractor or a drain hose and pan.

Required material

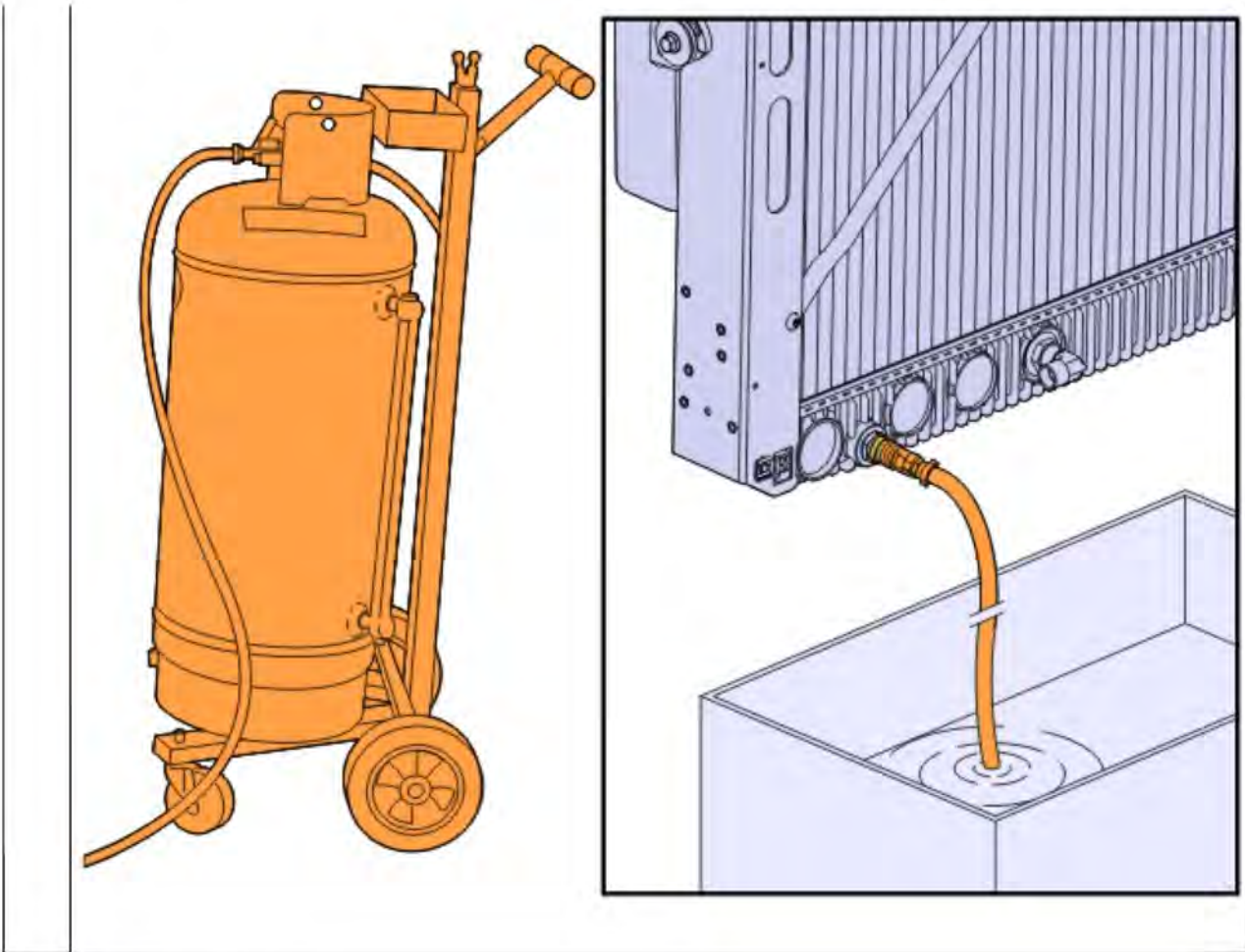
COOLANT EXTRACTOR/INJECTOR [85112740](#)


DRAIN_HOSE [9996049](#)

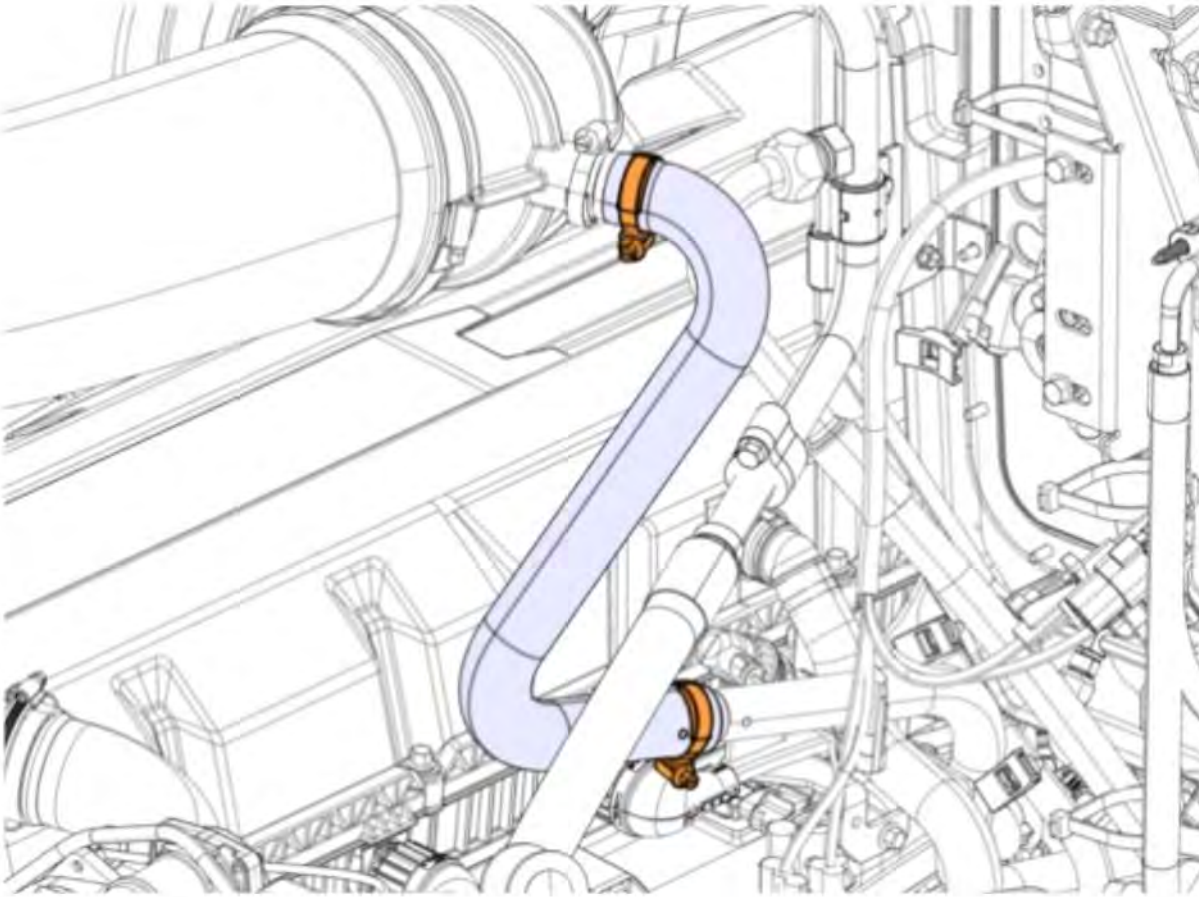


Note

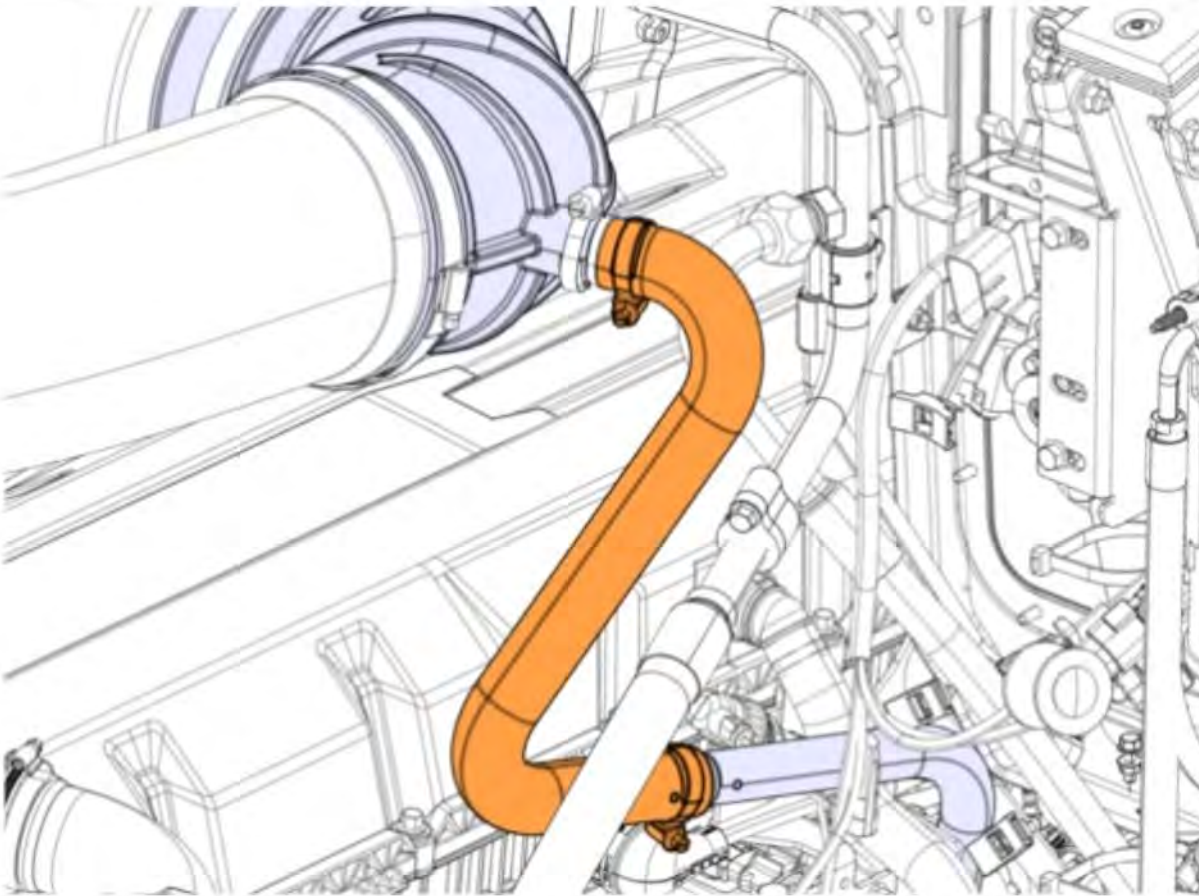
Take the collected coolant to a recycling facility as per local safety regulations.



- 9 Loosen the clamps.
- | | |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------|
|  | <p>Note Note the orientations and the positions.</p> |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------|



10 Remove the hose.



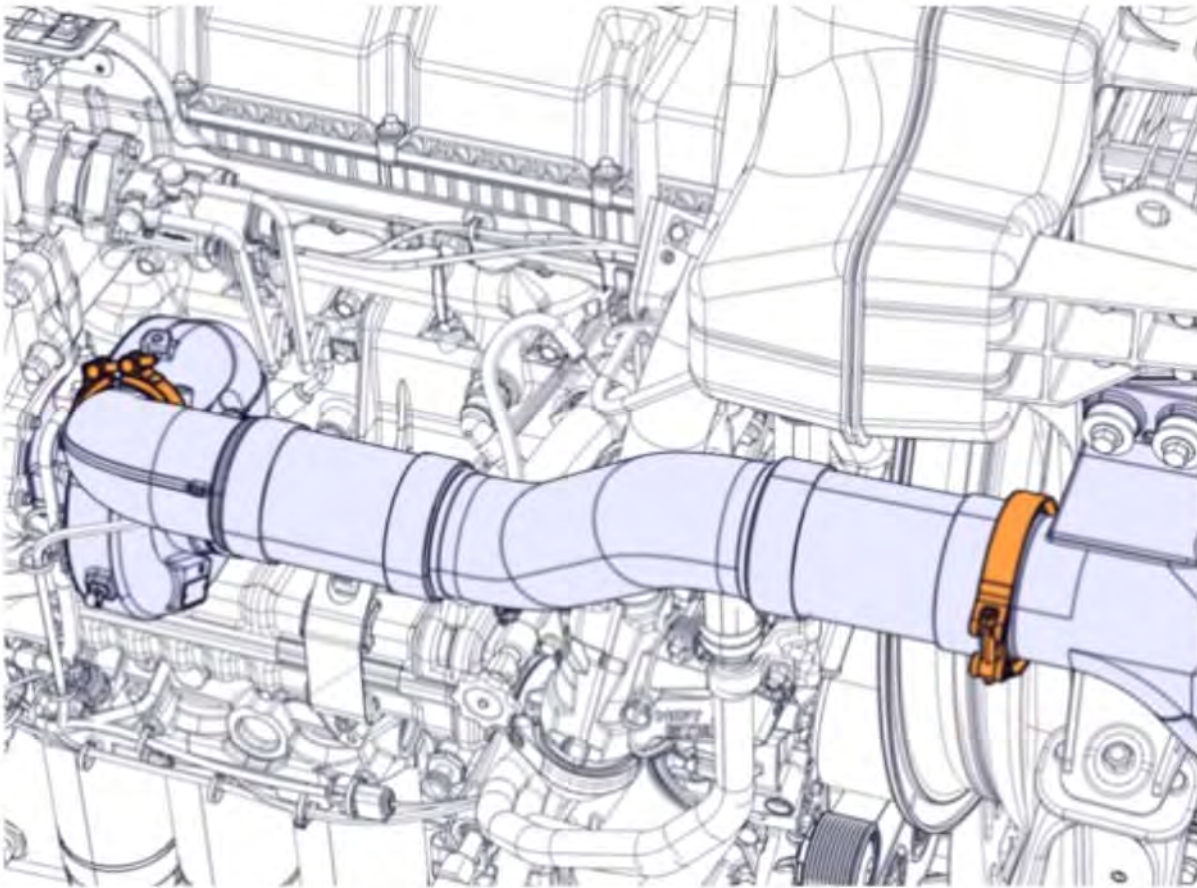
11 Remove the V-clamps.

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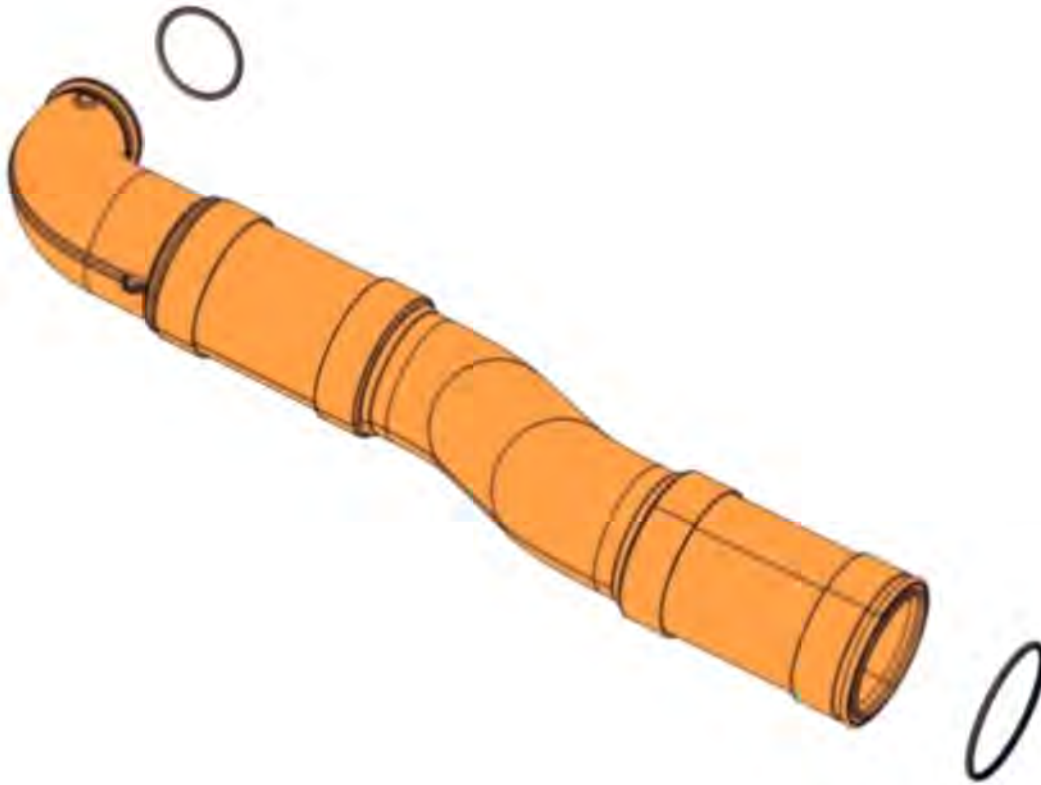
**Note**

Note the position.



| | |
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| 12 | Remove the charge air pipe. |
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|----|-------------------|
| 13 | Remove the seals. |
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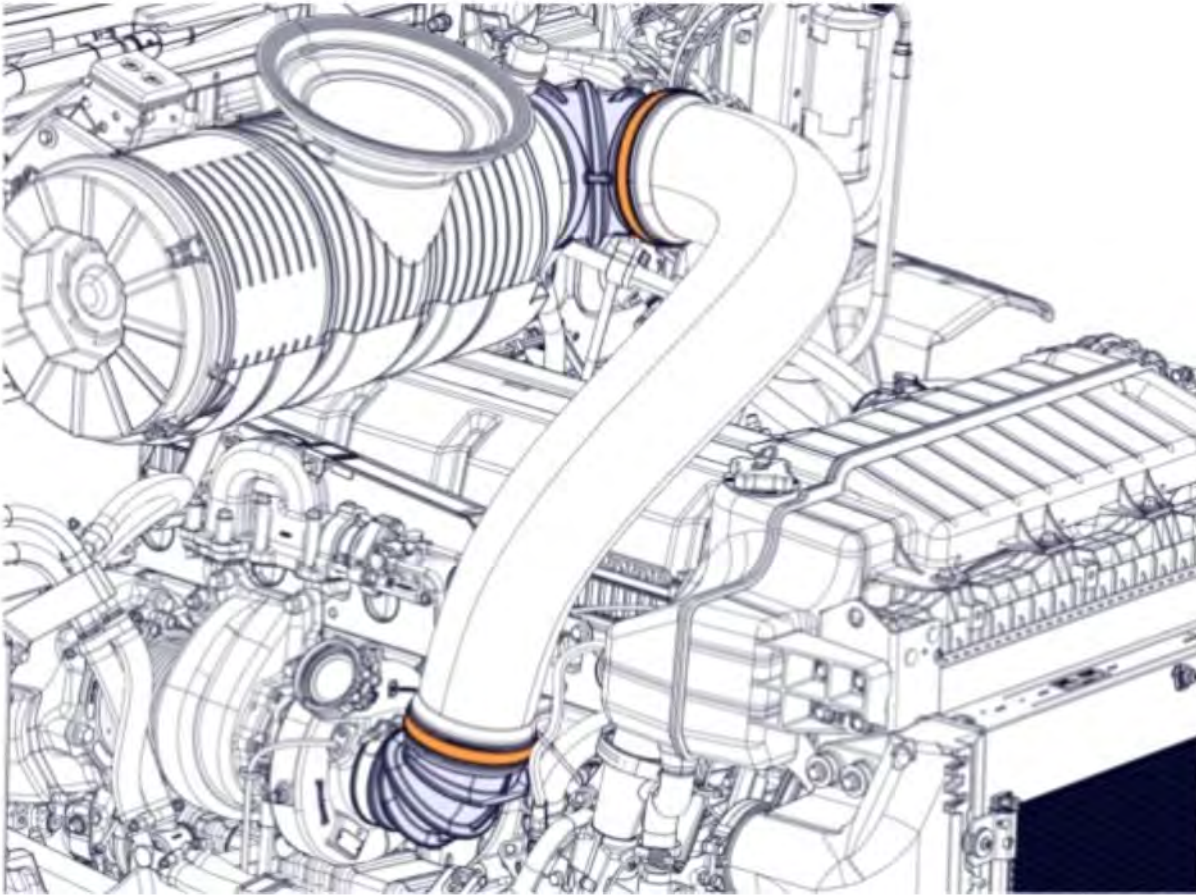


14 Loosen the clamps.

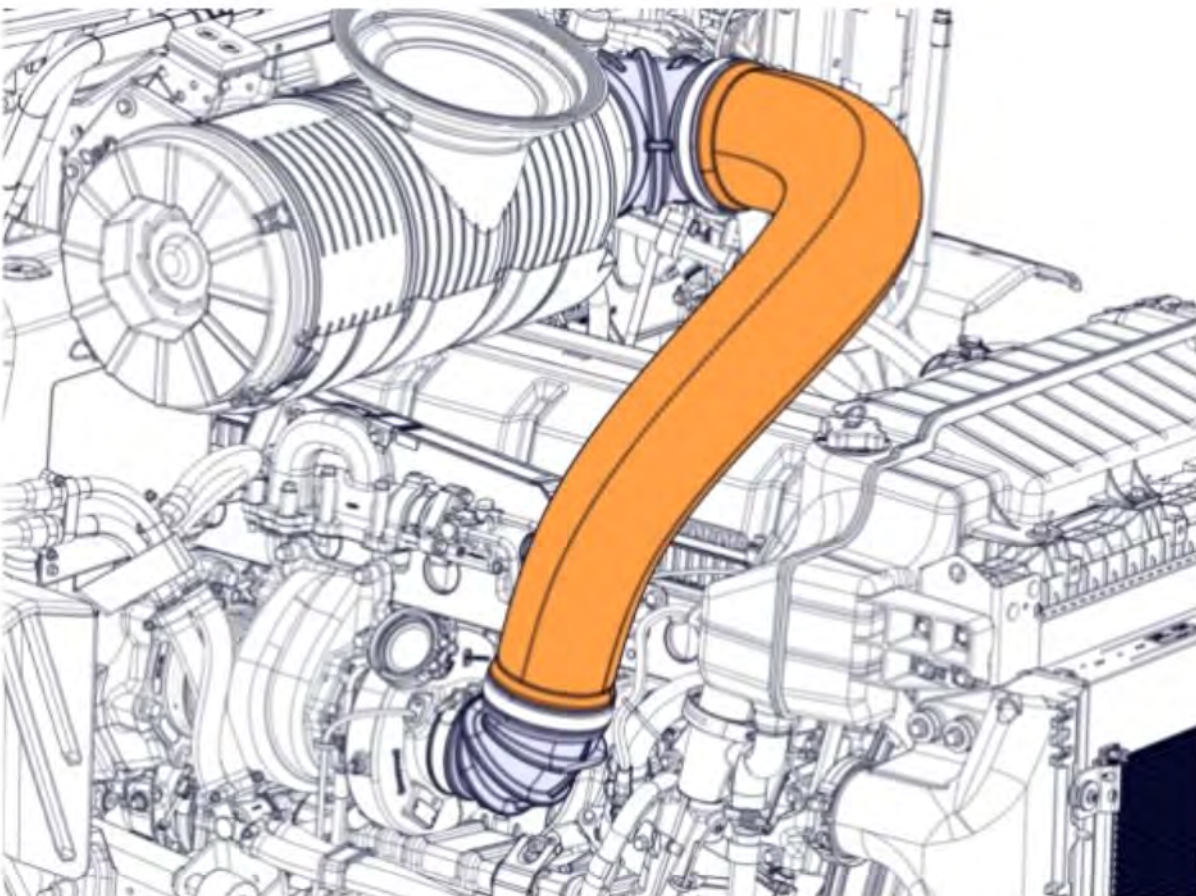


Note

Note the orientations and the positions.



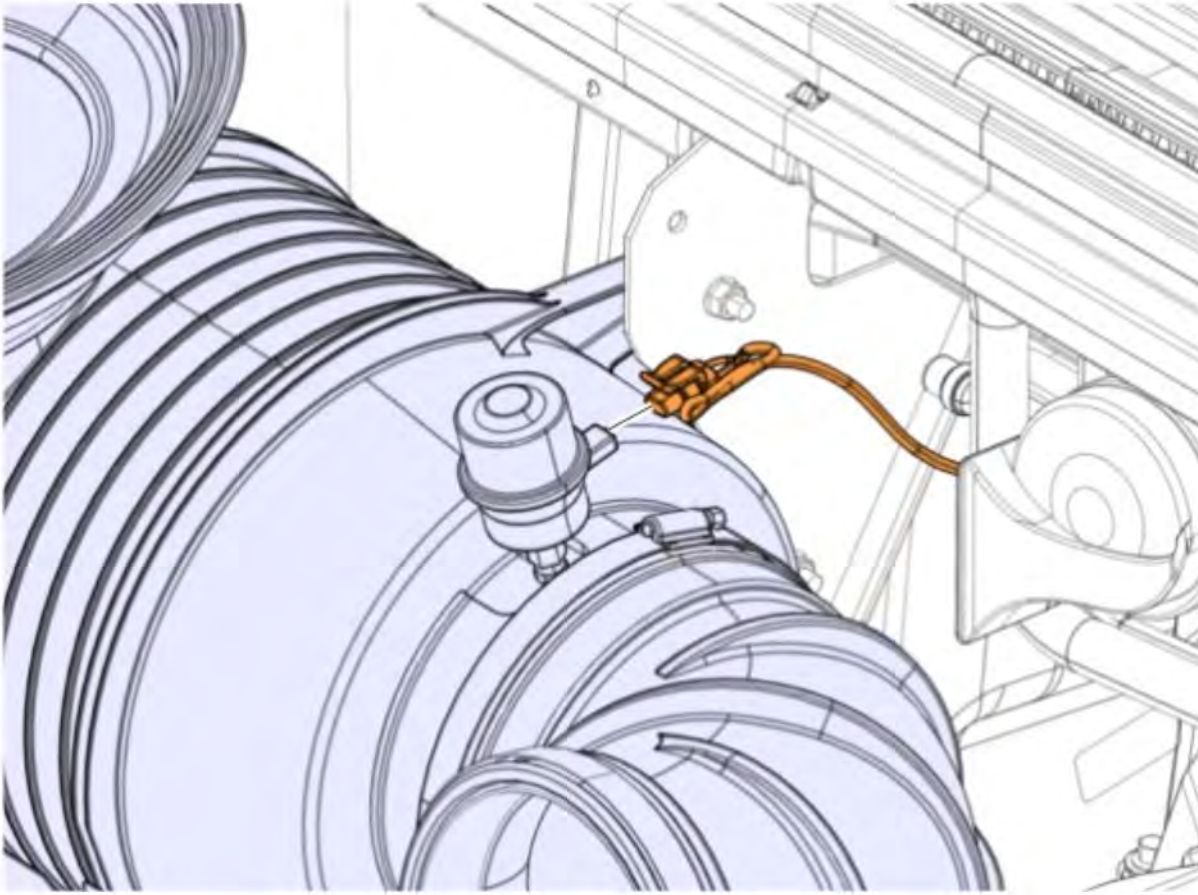
15 Remove the duct.



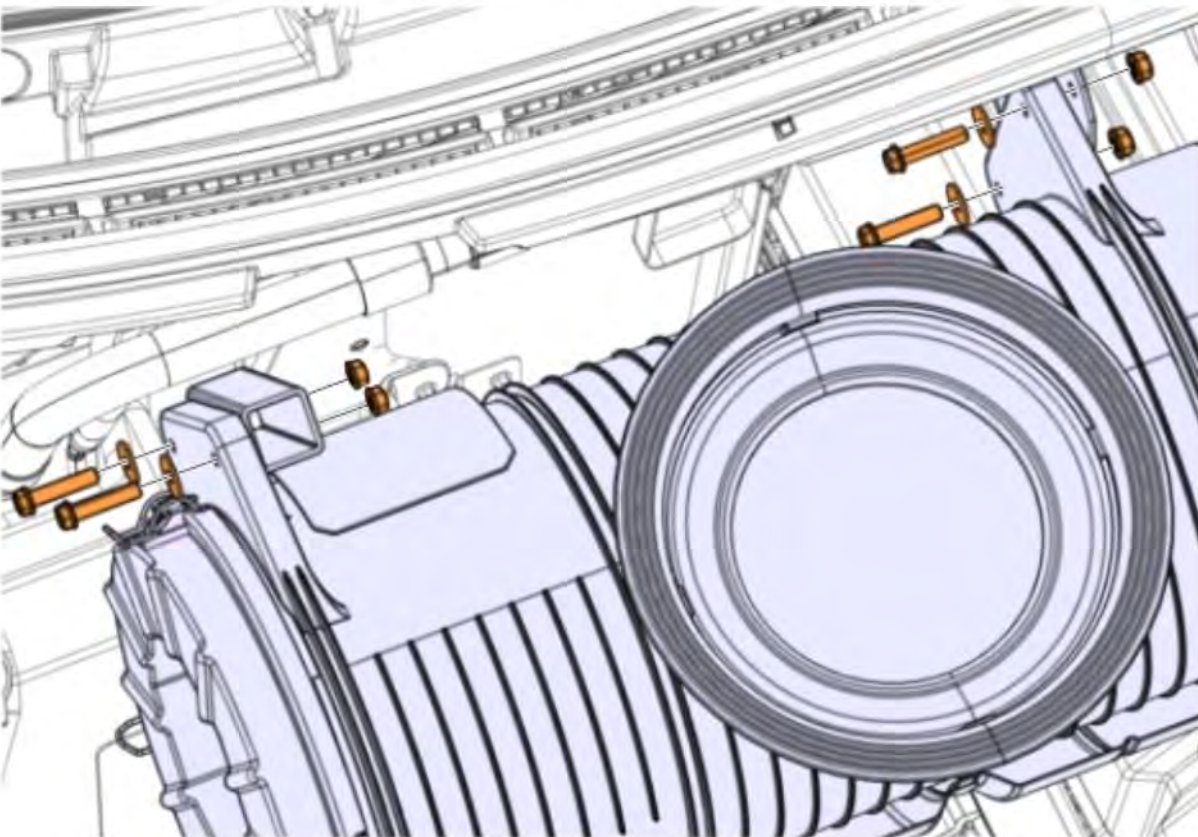
16 Disconnect the connector.

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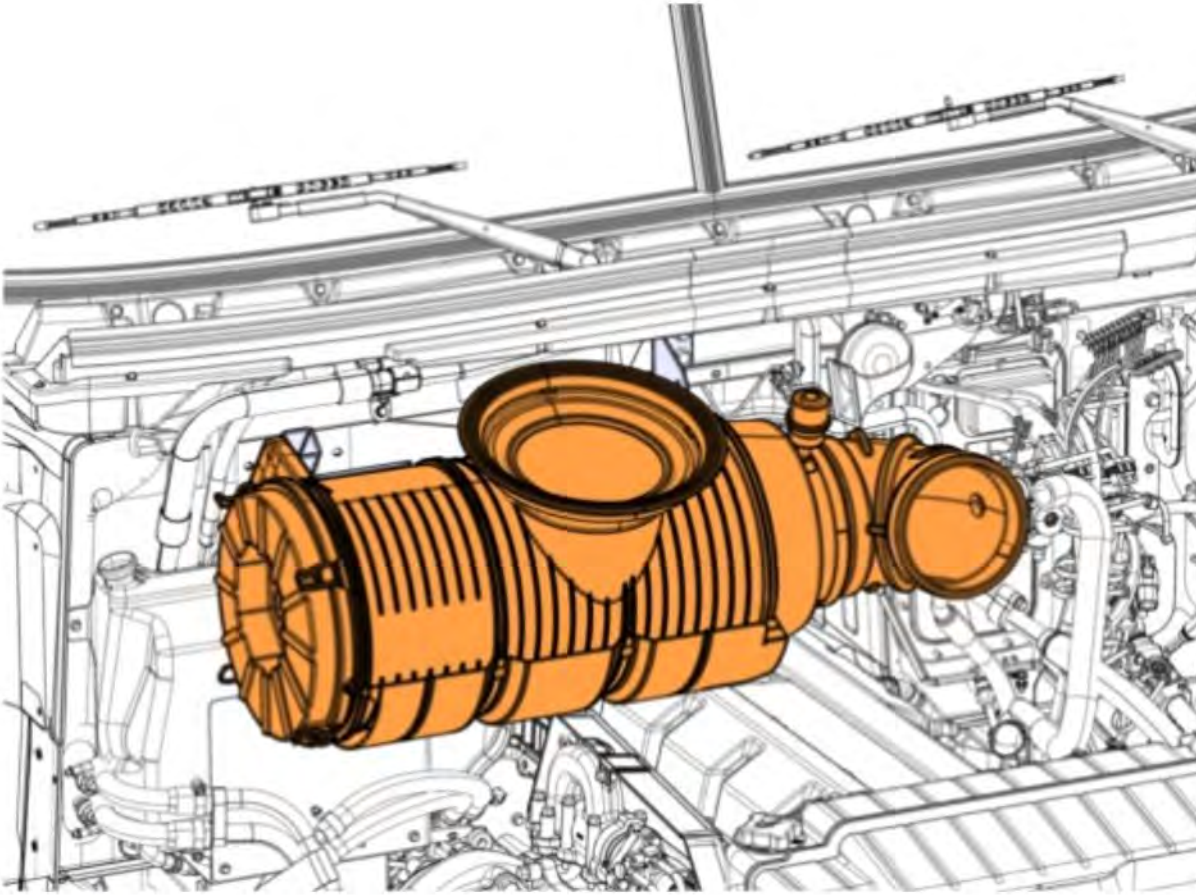
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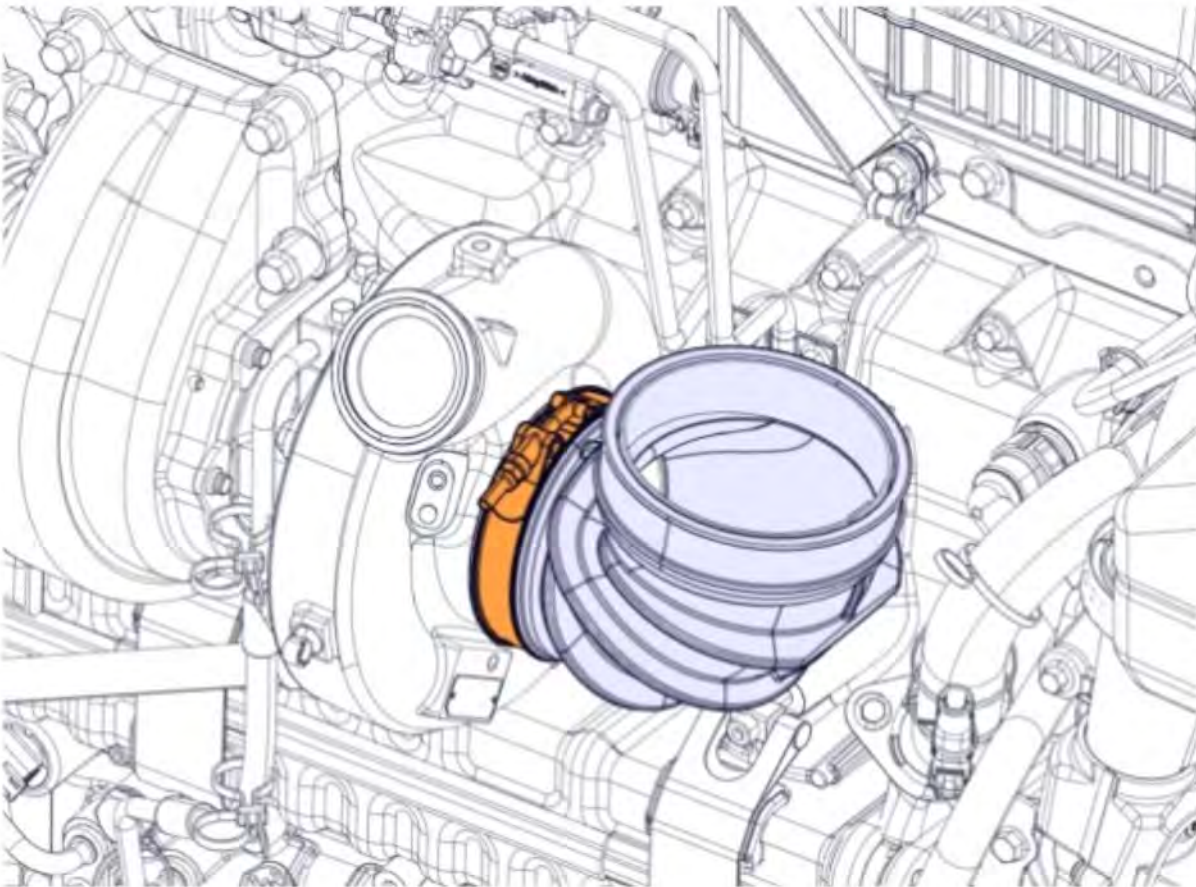
17 Remove the screws, nuts and the washers.



18 Remove the housing.



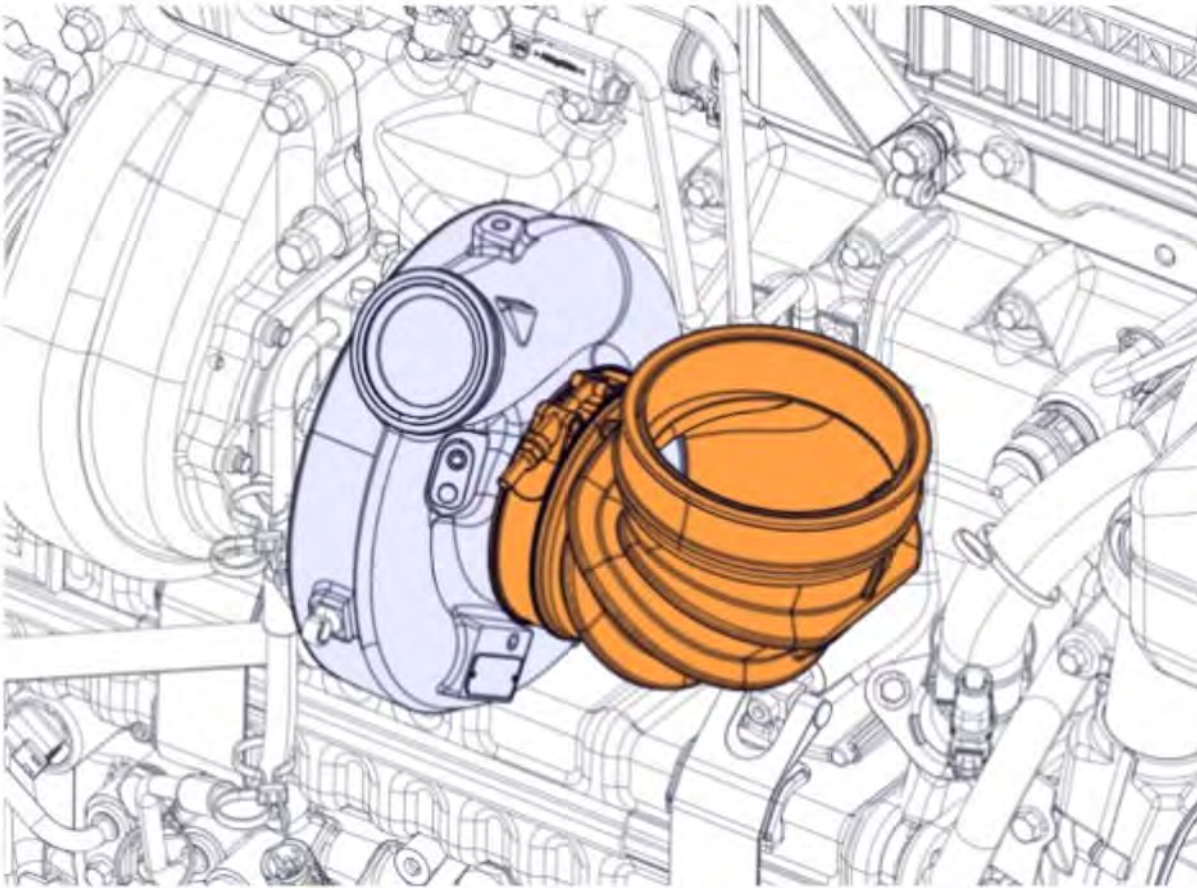
19 Loosen the clamp.



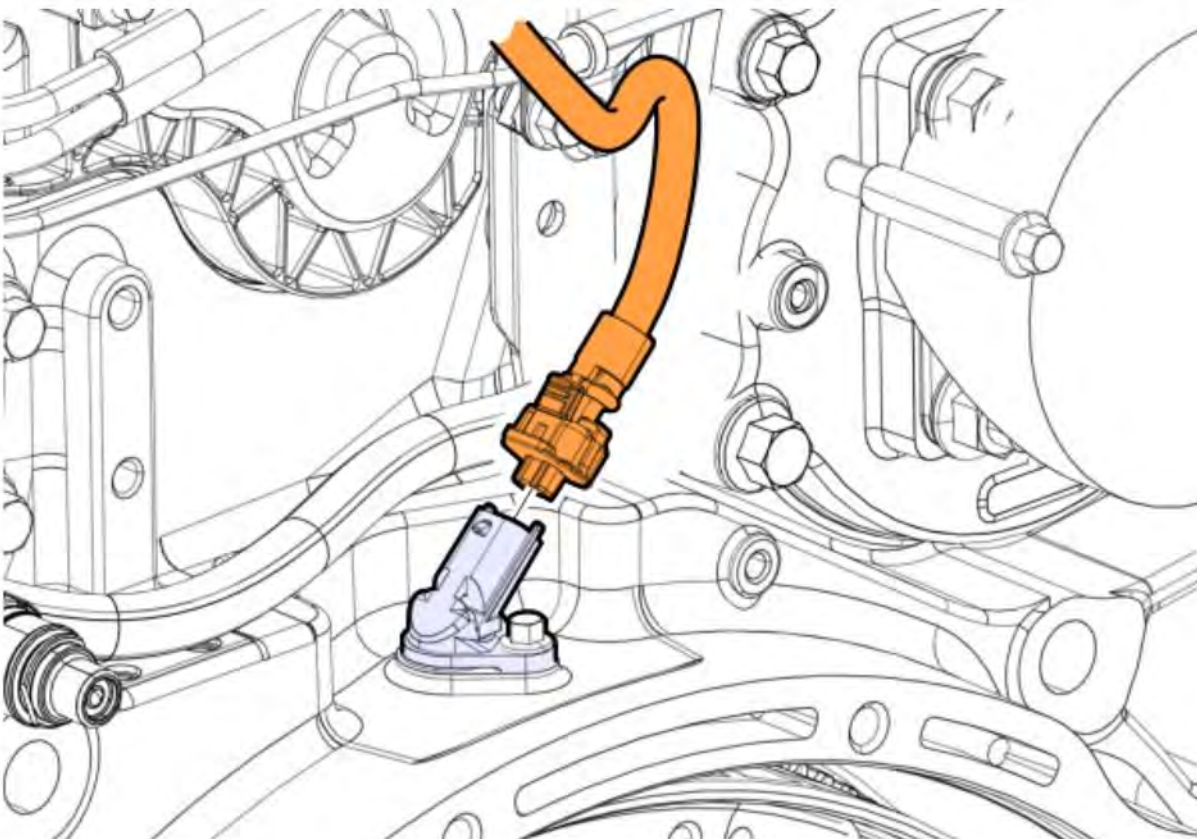
20 Remove the duct.

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| | |
|----|---------------------------|
| 21 | Disconnect the connector. |
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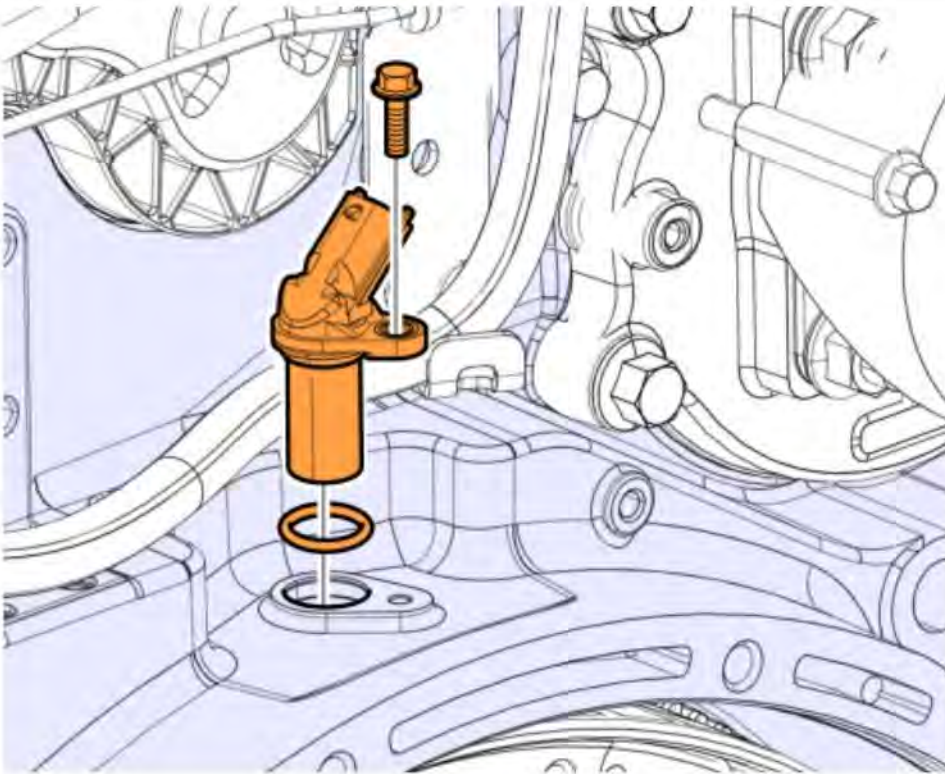
| | |
|----|-------------------|
| 22 | Remove the screw. |
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| | |
|----|--------------------|
| 23 | Remove the sensor. |
|----|--------------------|

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| | |
|----|--------------------|
| 24 | Remove the O-ring. |
|----|--------------------|

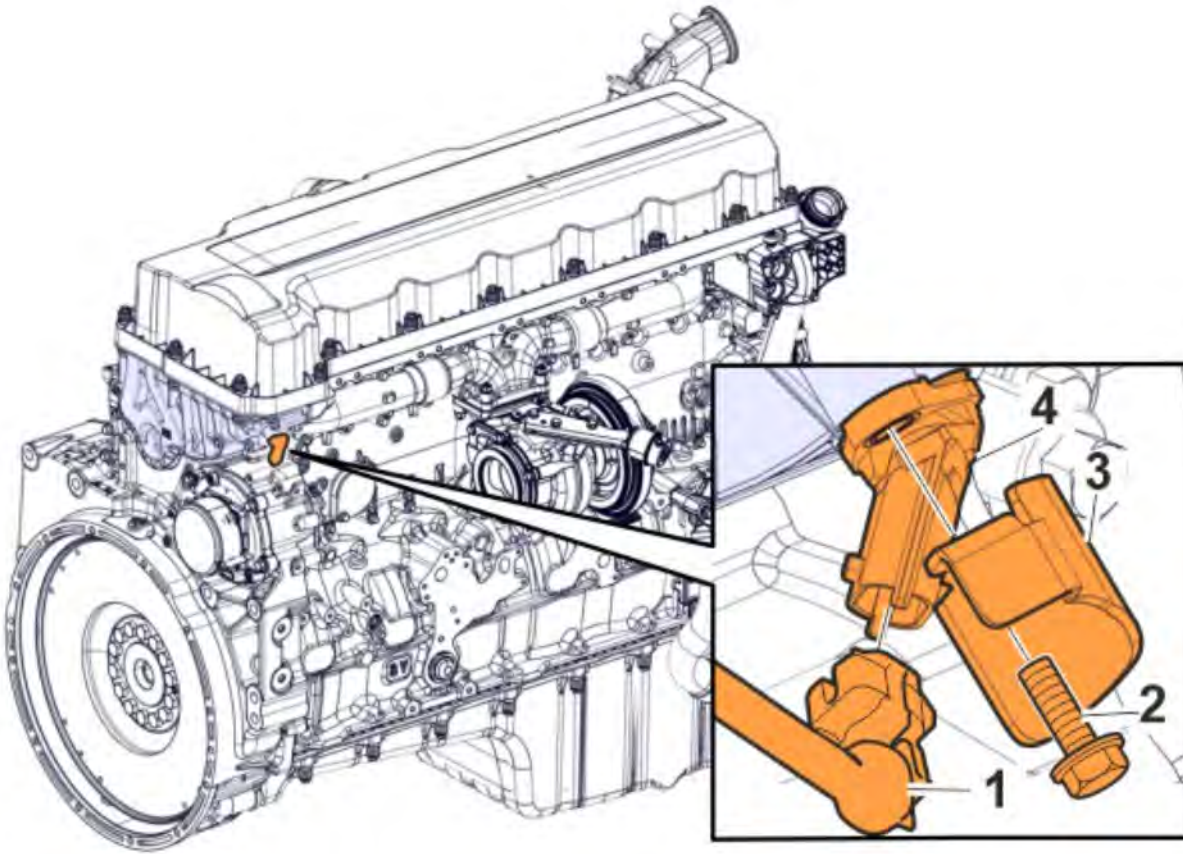


| | |
|----|-------------------------------|
| 25 | Disconnect the connector (1). |
|----|-------------------------------|

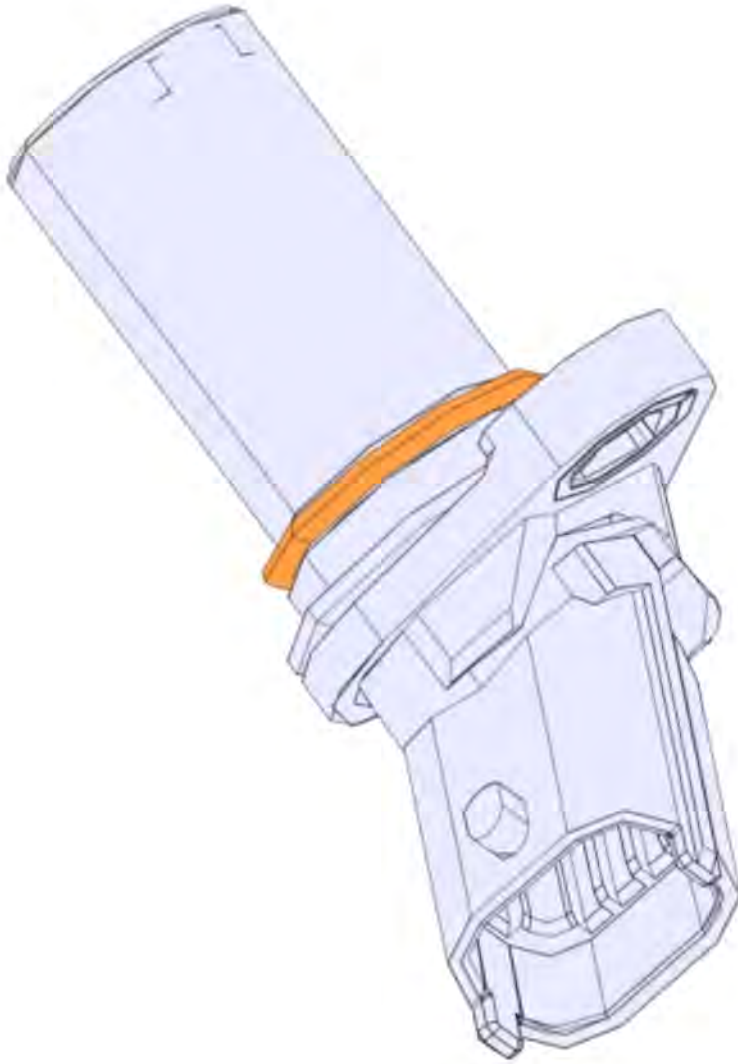
| | |
|----|-----------------------|
| 26 | Remove the screw (2). |
|----|-----------------------|

| | |
|----|-----------------------------|
| 27 | Remove the heat shield (3). |
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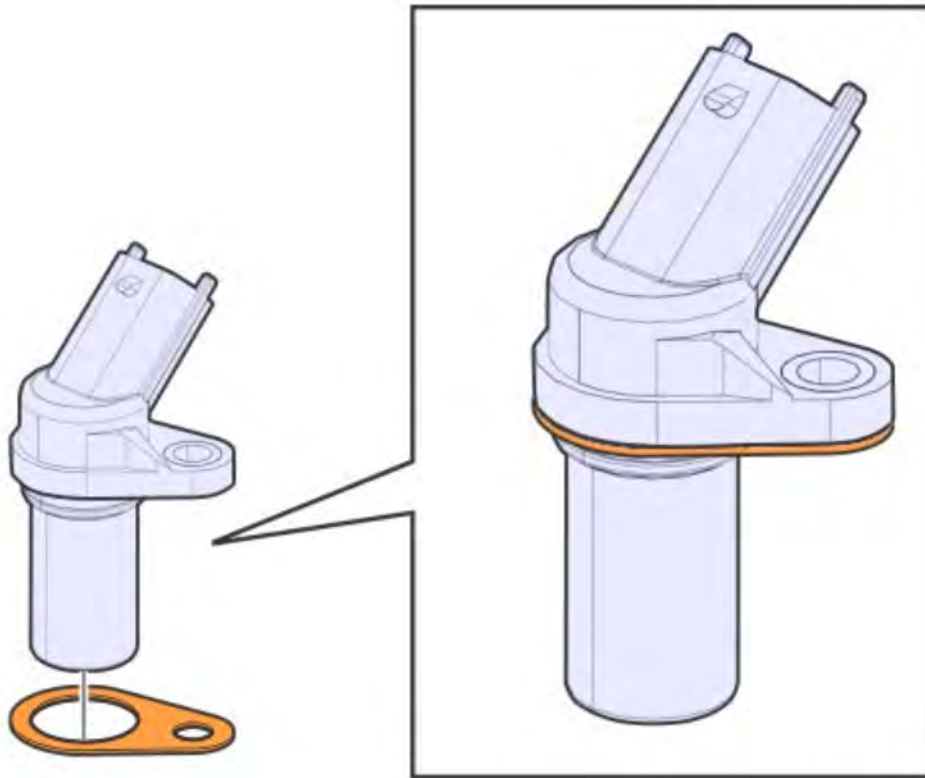
| | |
|----|------------------------|
| 28 | Remove the sensor (4). |
|----|------------------------|



| | |
|----|--------------------|
| 29 | Remove the O-ring. |
|----|--------------------|



| | |
|----|-----------------------------|
| 30 | Remove the shims as needed. |
|----|-----------------------------|

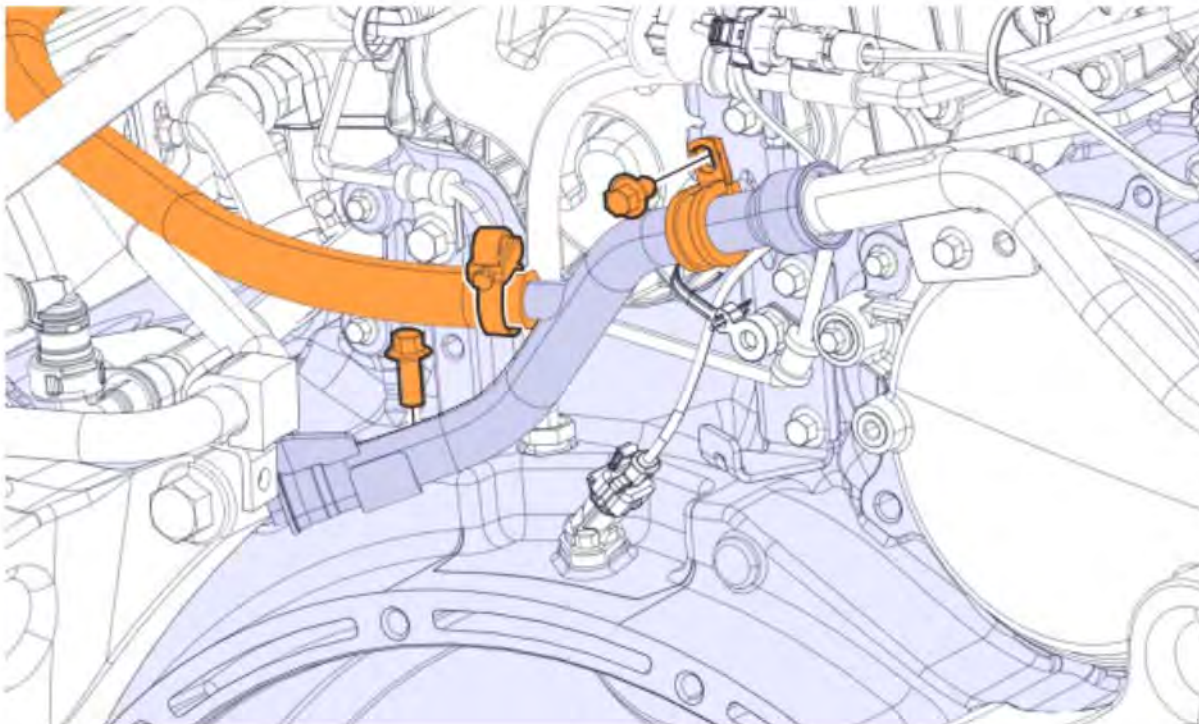


| | |
|----|-------------------|
| 31 | Loosen the clamp. |
|----|-------------------|

| | |
|----|------------------|
| 32 | Remove the hose. |
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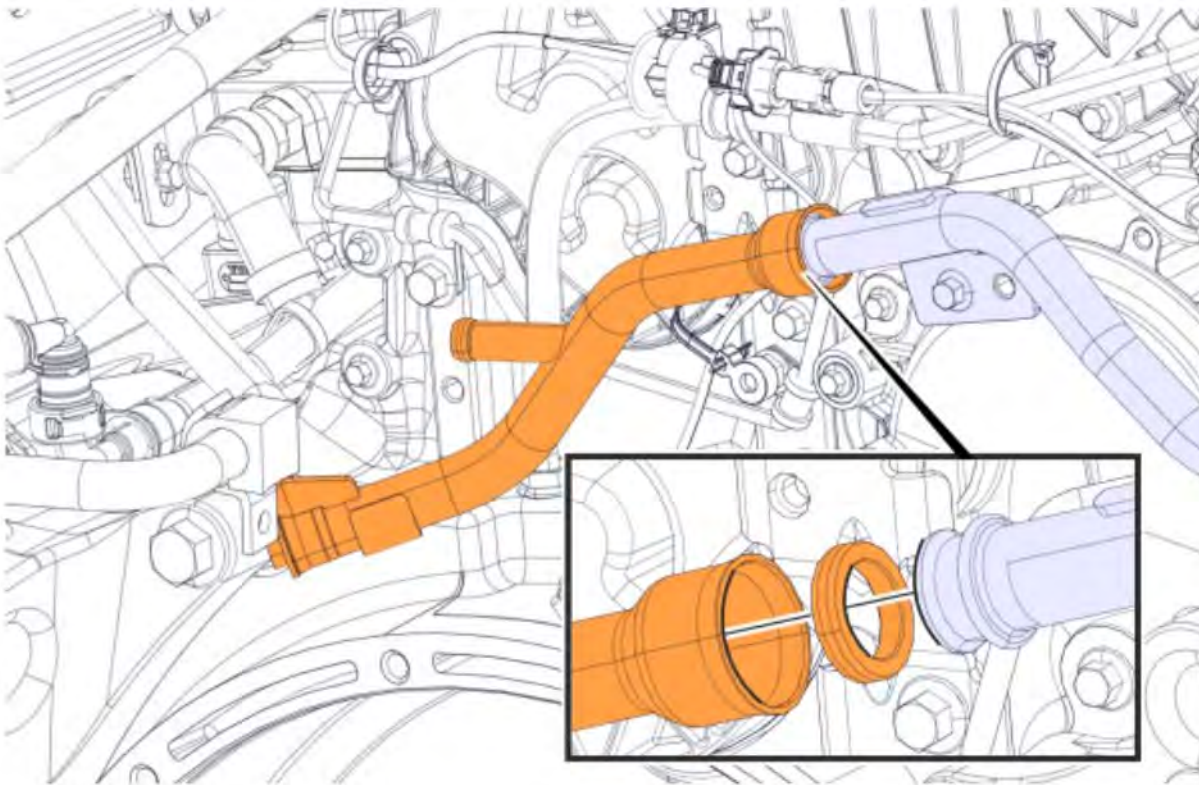
| | |
|----|--------------------|
| 33 | Remove the screws. |
|----|--------------------|

| | |
|----|-------------------|
| 34 | Remove the clamp. |
|----|-------------------|

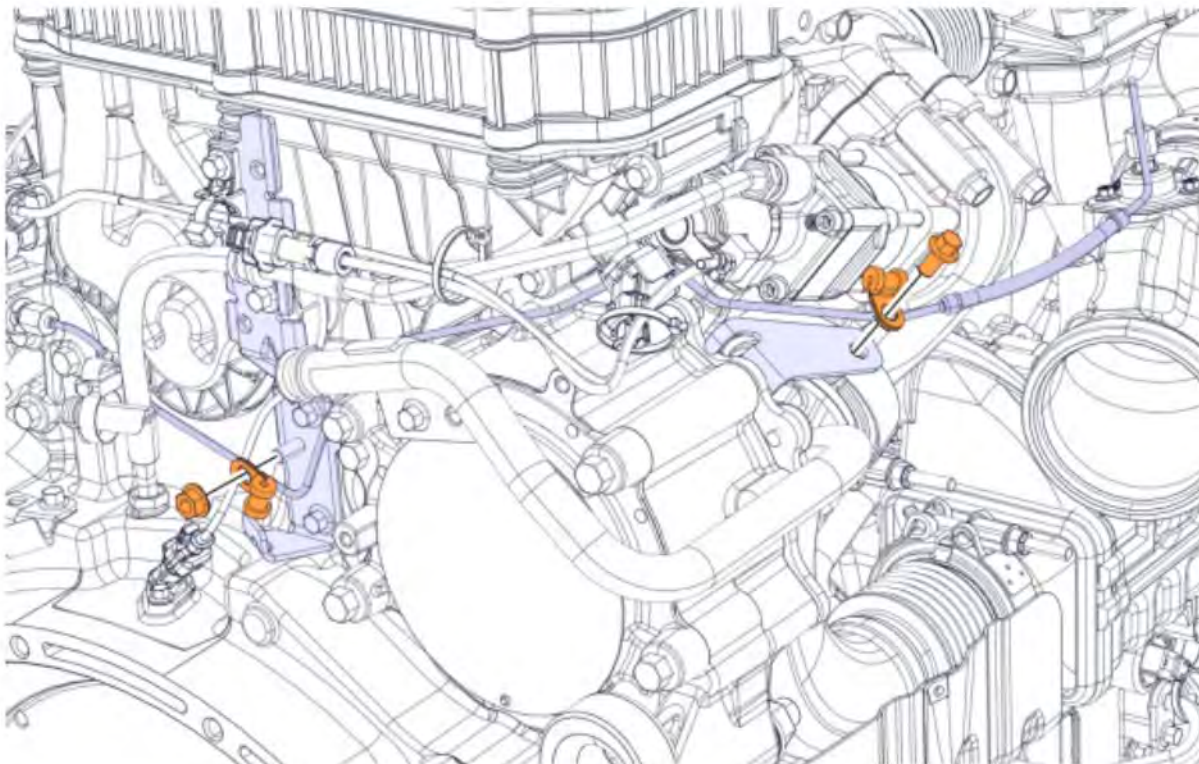


| | |
|----|------------------|
| 35 | Remove the pipe. |
|----|------------------|

36 Remove the seal.

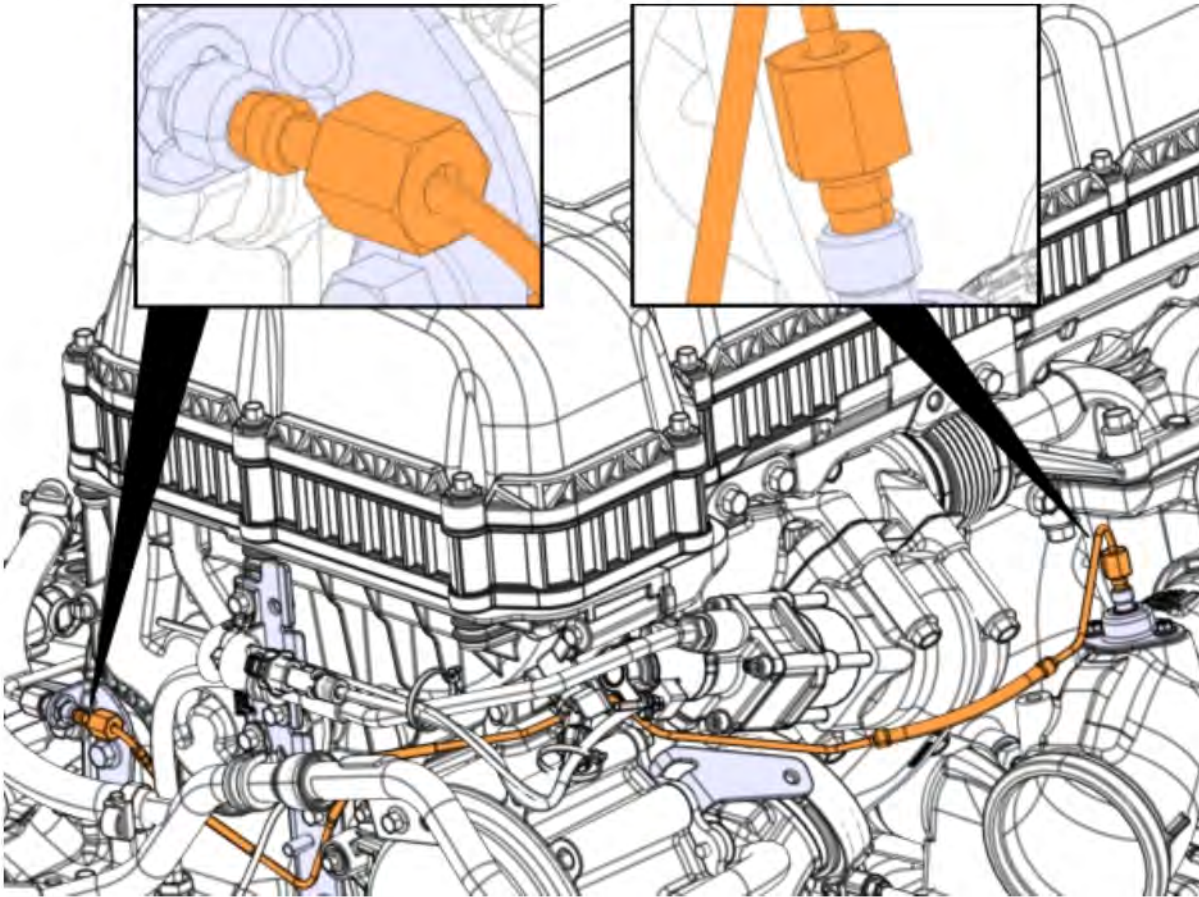


37 Remove the screws and clamps.



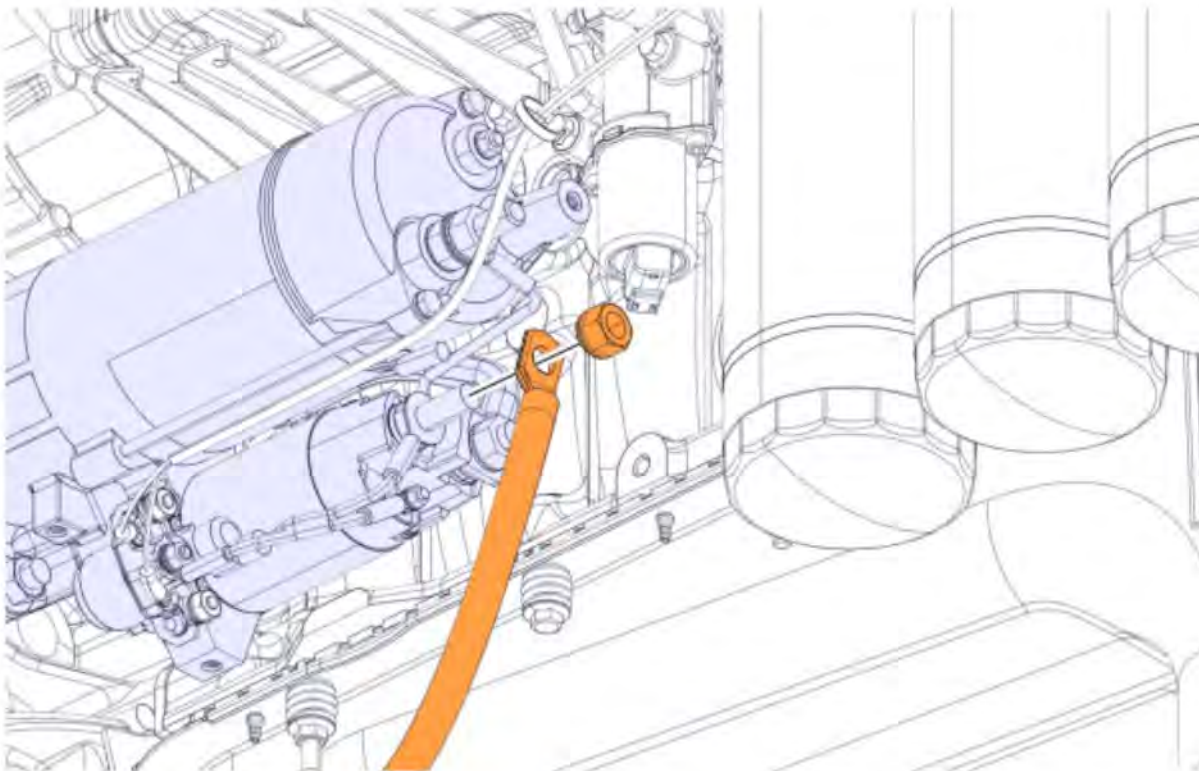
38 Loosen the nuts.

39 Remove the pipe.



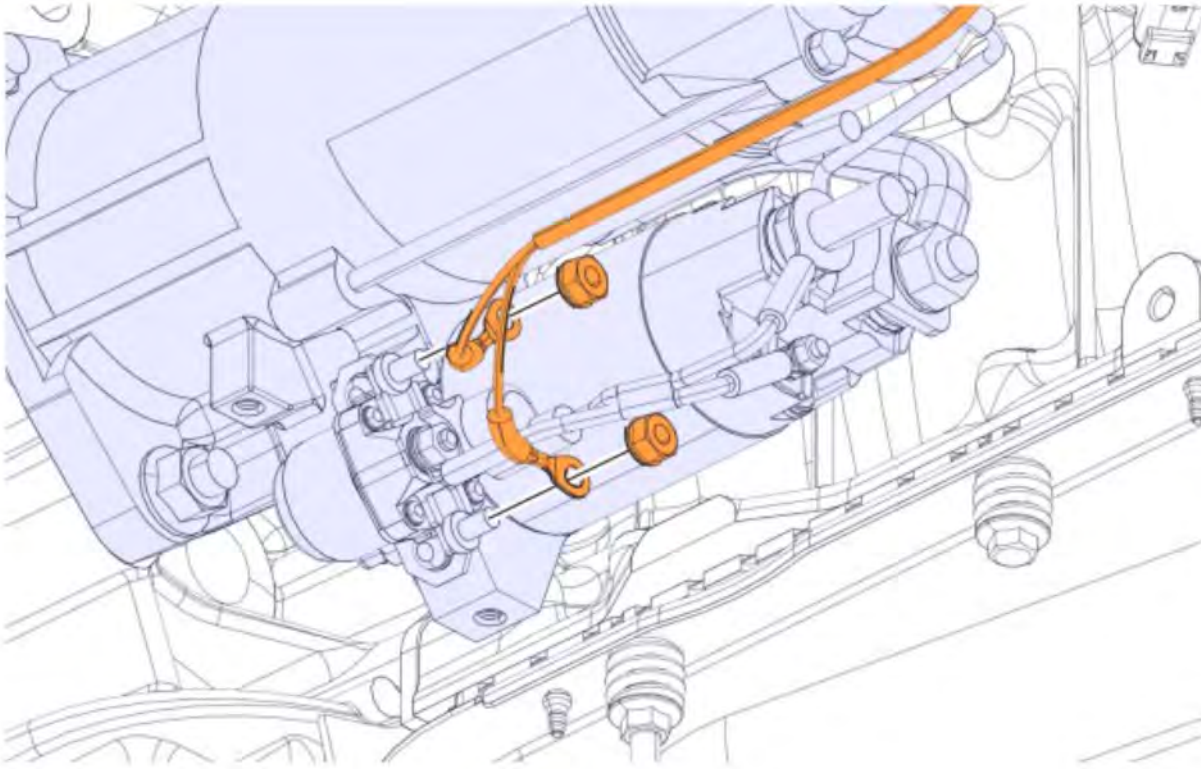
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|-----------|-----------------|
| 40 | Remove the nut. |
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| | |
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| 41 | Remove the cable terminal. |
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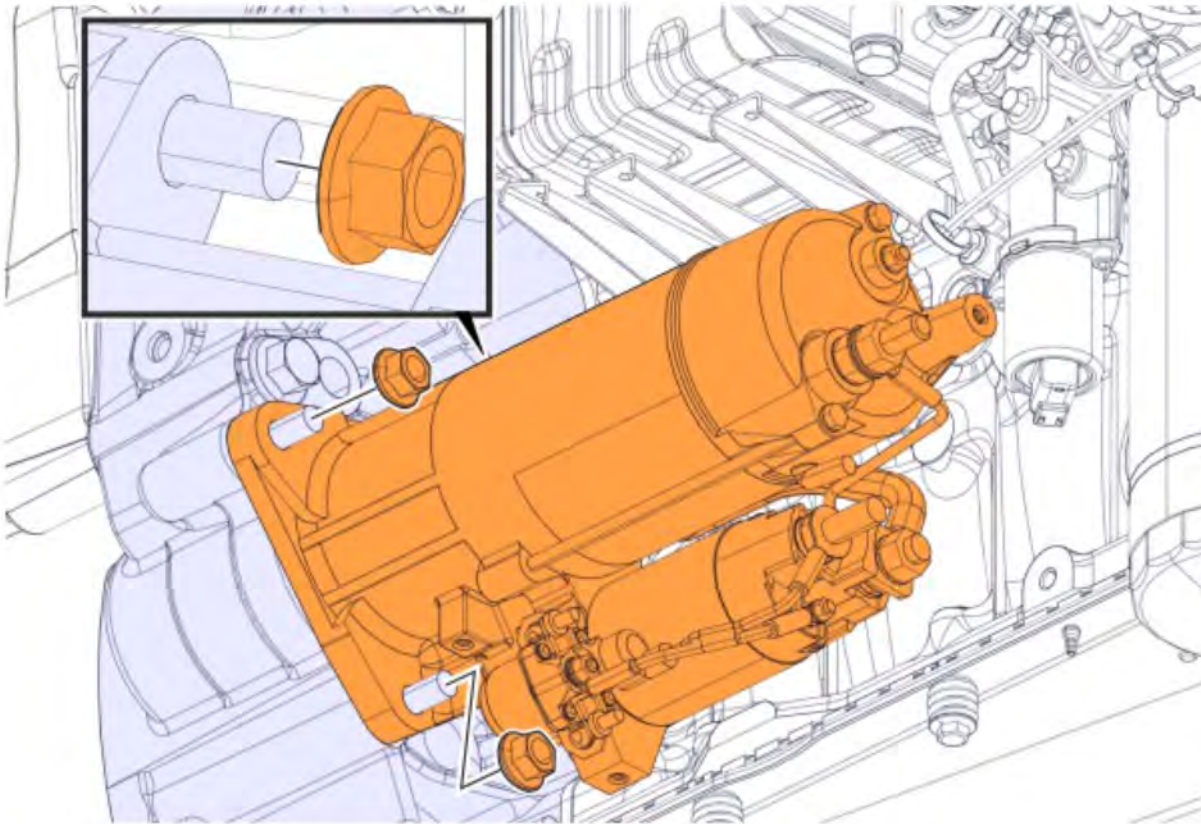
| | |
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| 42 | Remove the nuts. |
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| | |
|-----------|-----------------------------|
| 43 | Remove the cable terminals. |
|-----------|-----------------------------|



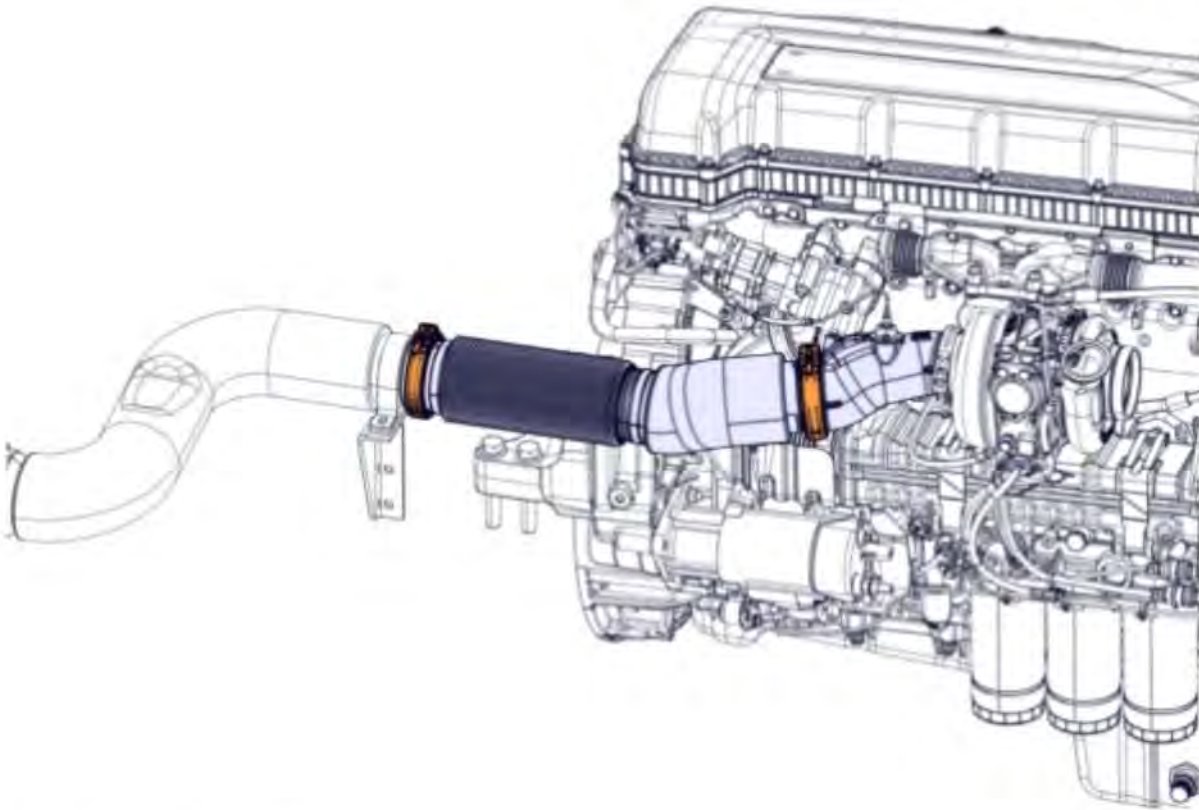
44 Remove the nuts.

45 Remove the starter motor.



46 Remove the clamps.

i **Note**
 Note the orientations and the positions.

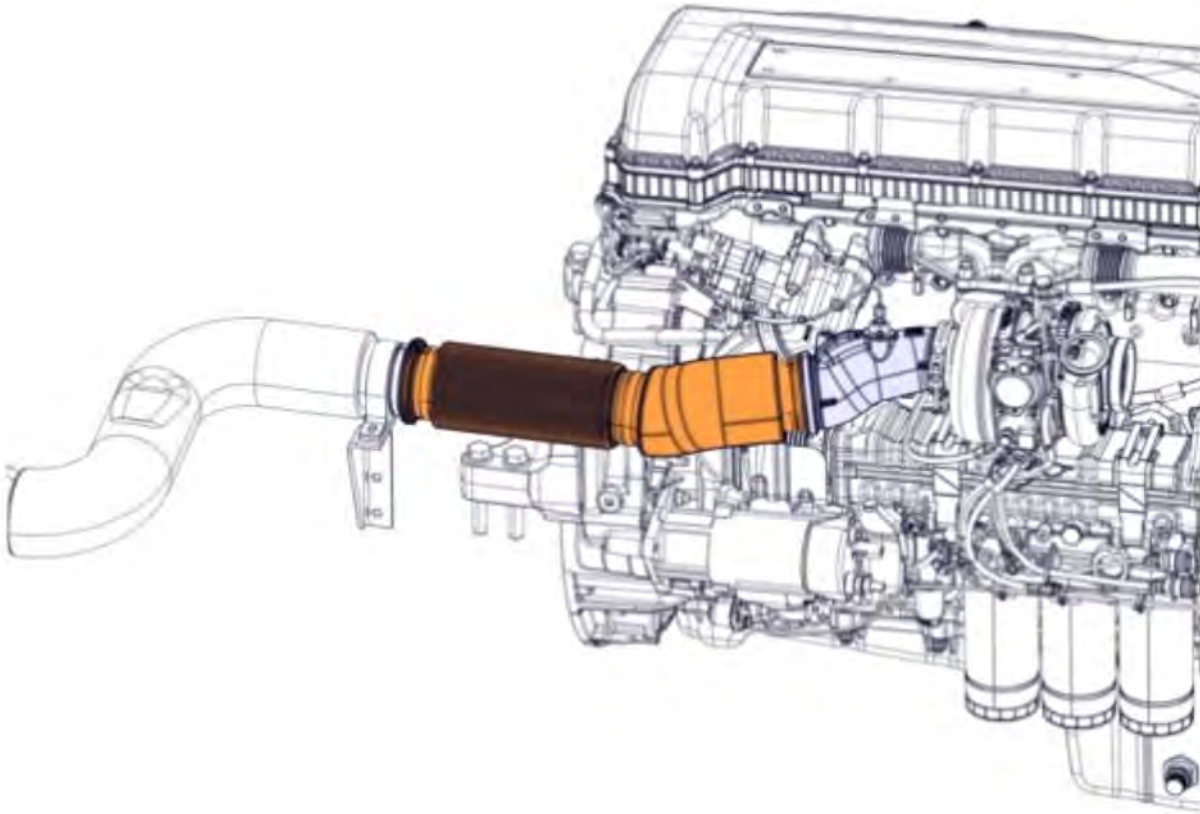


47 Remove the pipe.



Note

Note the orientation and the position.



| | |
|----|---------------------|
| 48 | Remove the gaskets. |
|----|---------------------|



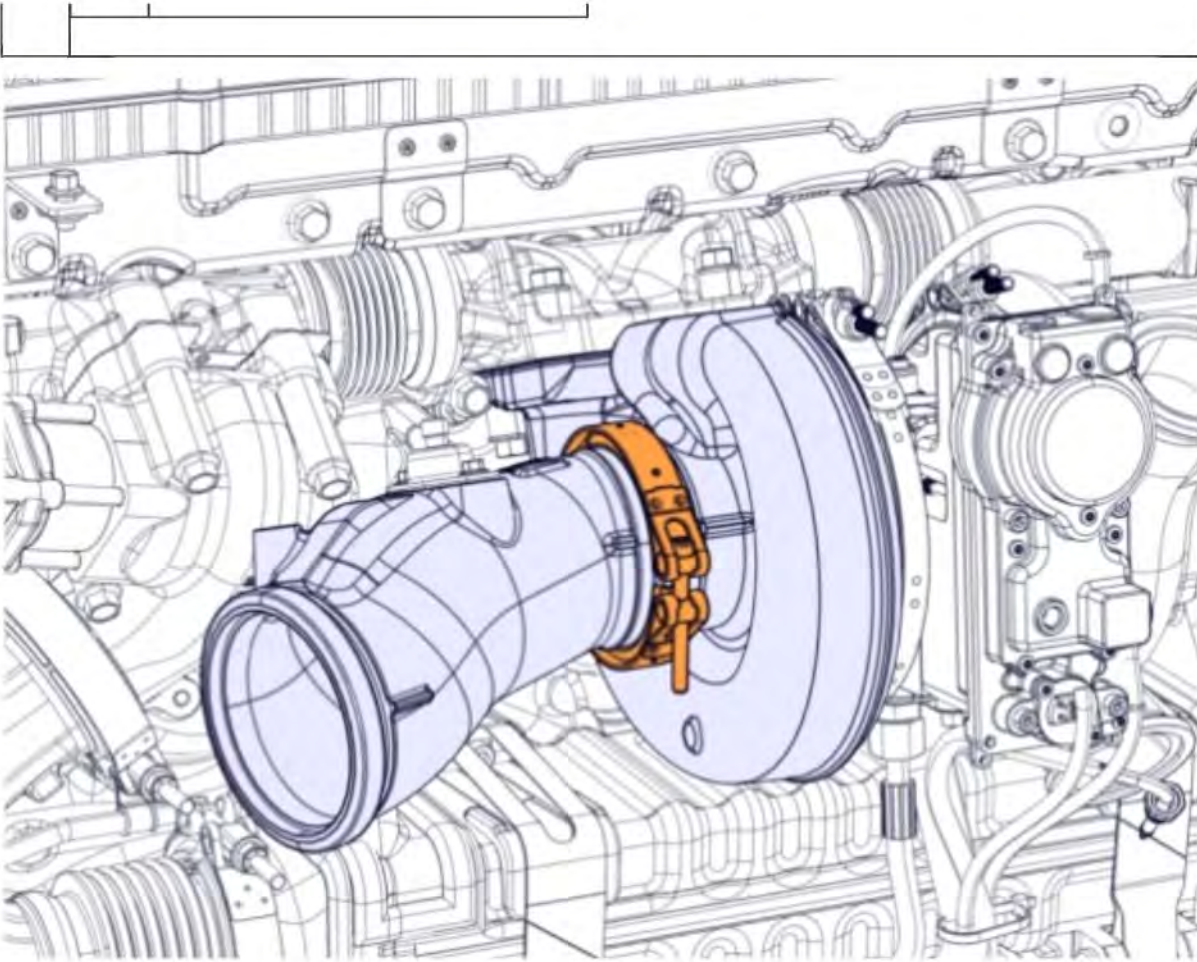
| | |
|----|-------------------|
| 49 | Remove the clamp. |
|----|-------------------|

**Note**

Note the orientation and the position.

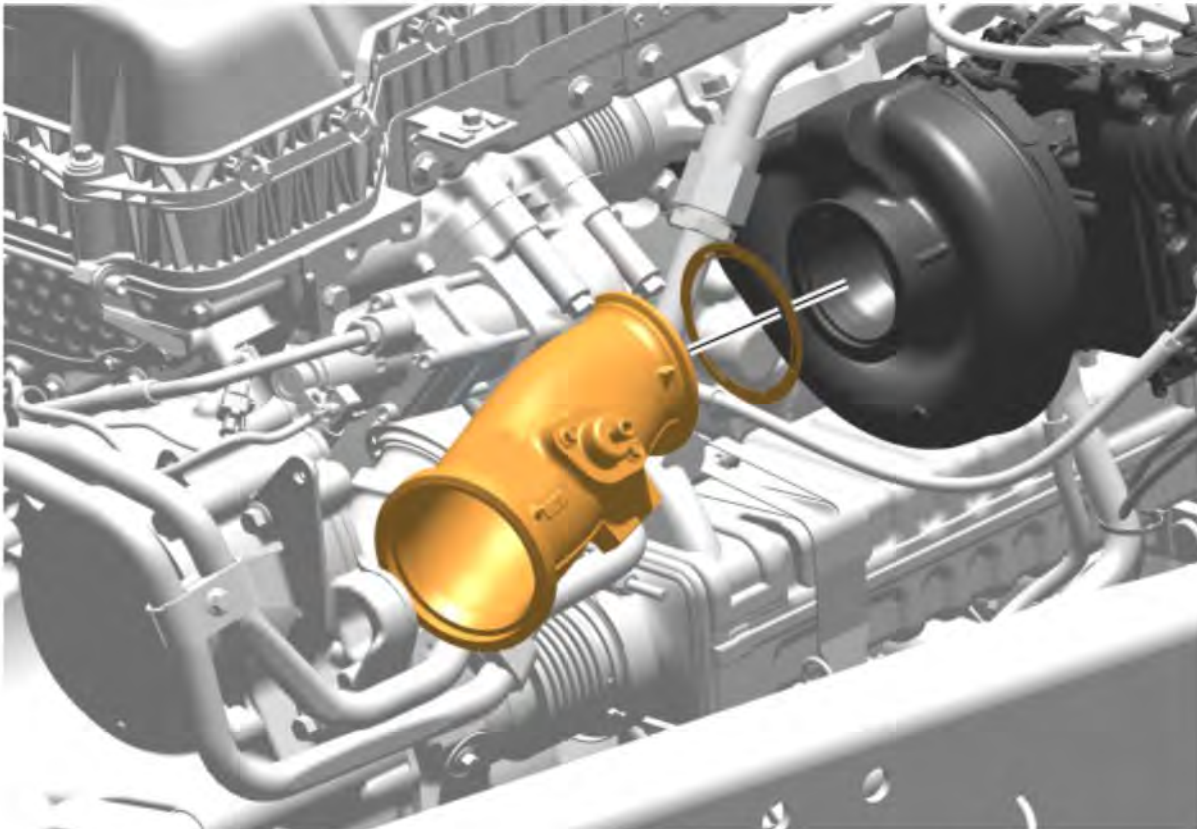
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| | |
|----|----------------------|
| 50 | Remove the diffuser. |
|----|----------------------|

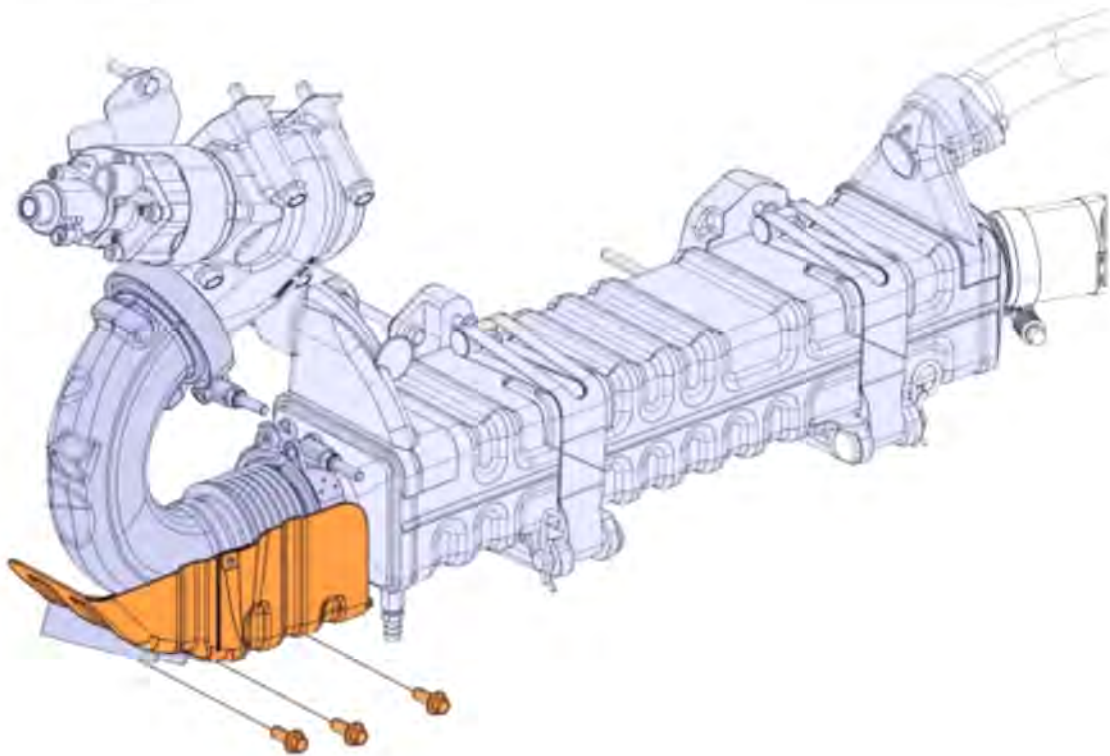
| | |
|----|--------------------|
| 51 | Remove the gasket. |
|----|--------------------|



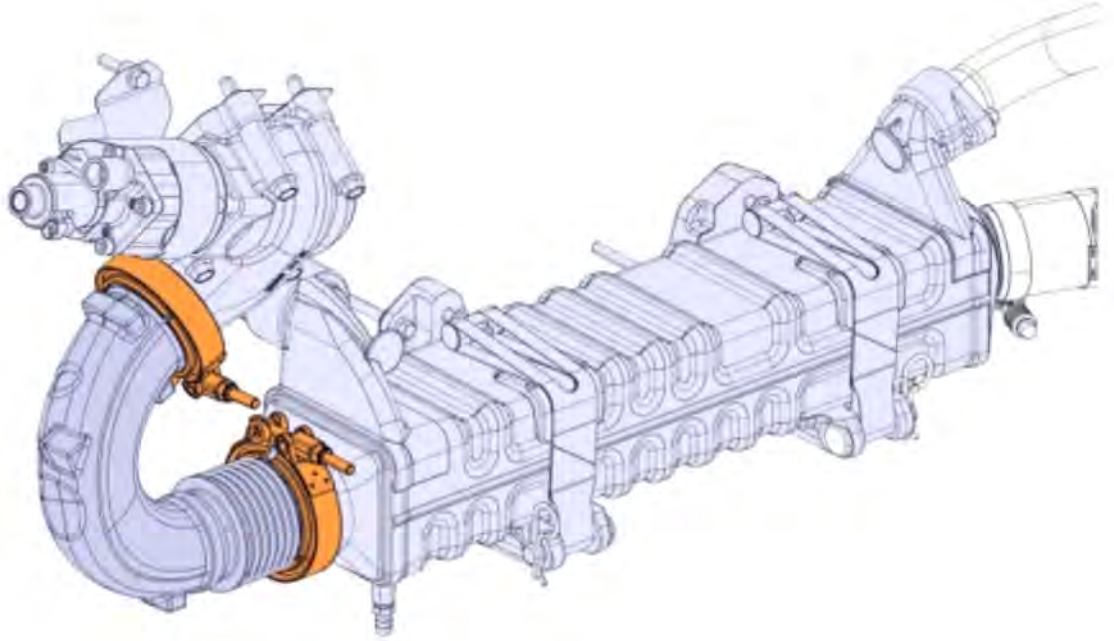
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| | |
|----------------------------------------------------------------------------------------------------------|-------------------------|
|  WARNING | |
| Risk of burn injuries. Heated components and mechanical parts can cause burns. | |
| ▶ Exercise caution when working with heated components. Always use the appropriate protective equipment. | |
| 52 | Remove the screws. |
| 53 | Remove the heat shield. |

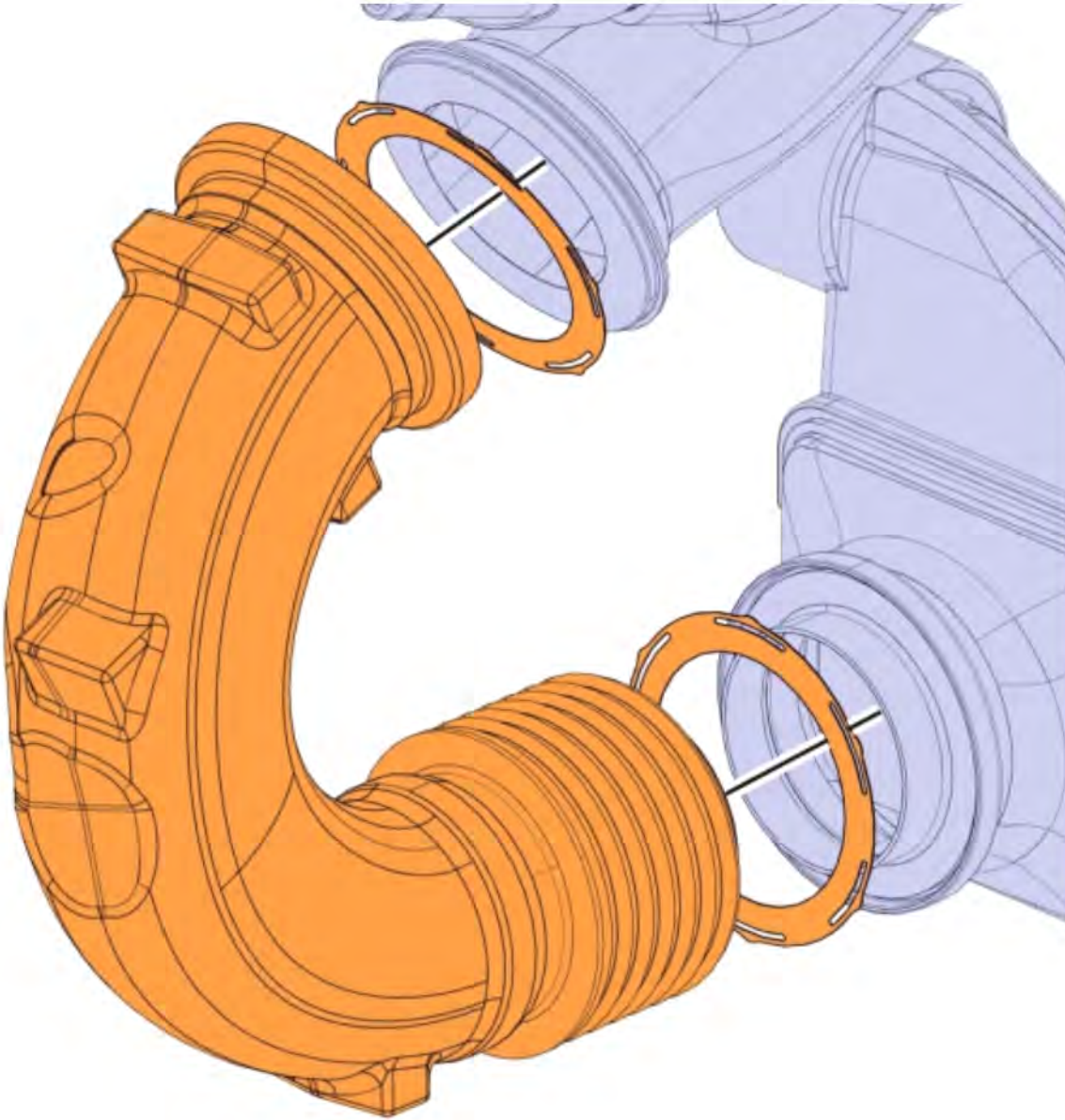


| | | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------|
| 54 | Remove the V-clamps. | | |
| <table border="1" style="width: 100%;"> <tr> <td style="width: 10%; text-align: center;"></td> <td>Note Note the V-clamp positions.</td> </tr> </table> | |  | Note Note the V-clamp positions. |
|  | Note Note the V-clamp positions. | | |



| | |
|----|------------------|
| 55 | Remove the pipe. |
|----|------------------|

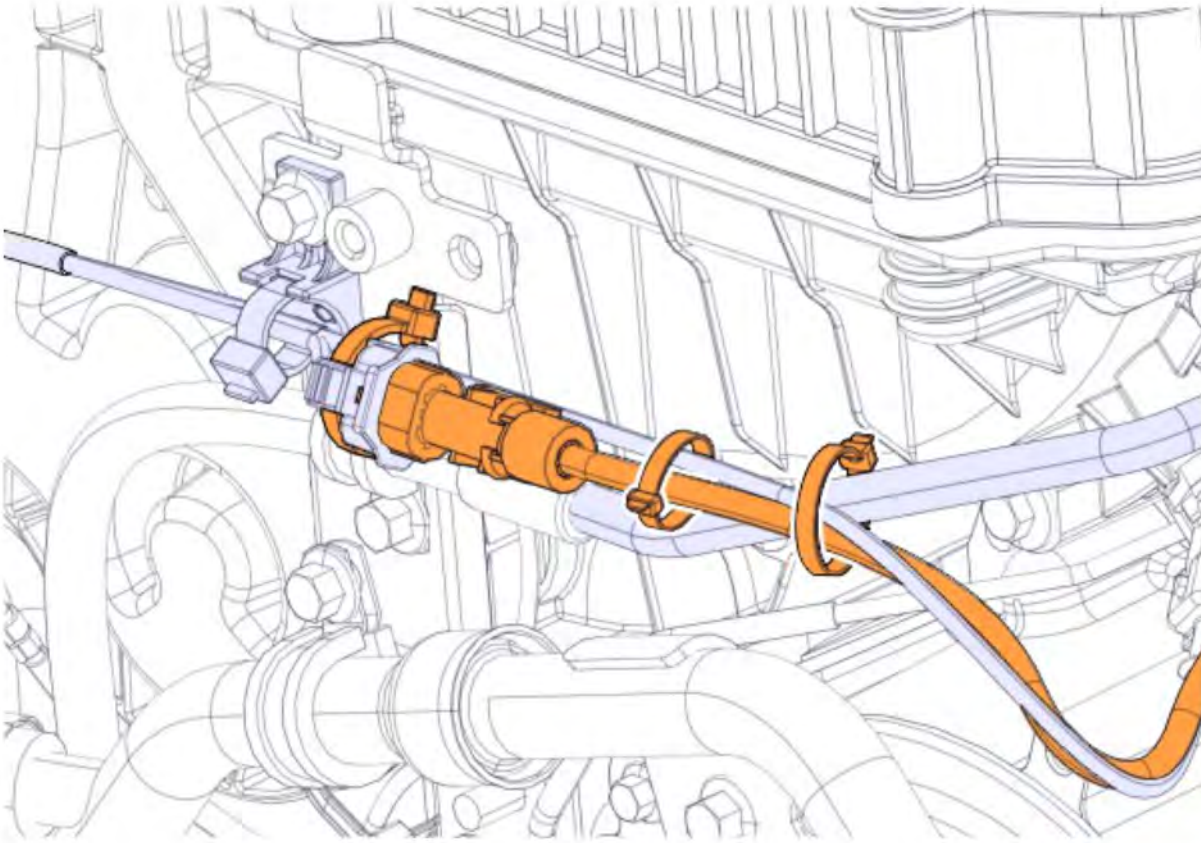
| | |
|----|---------------------|
| 56 | Remove the gaskets. |
|----|---------------------|



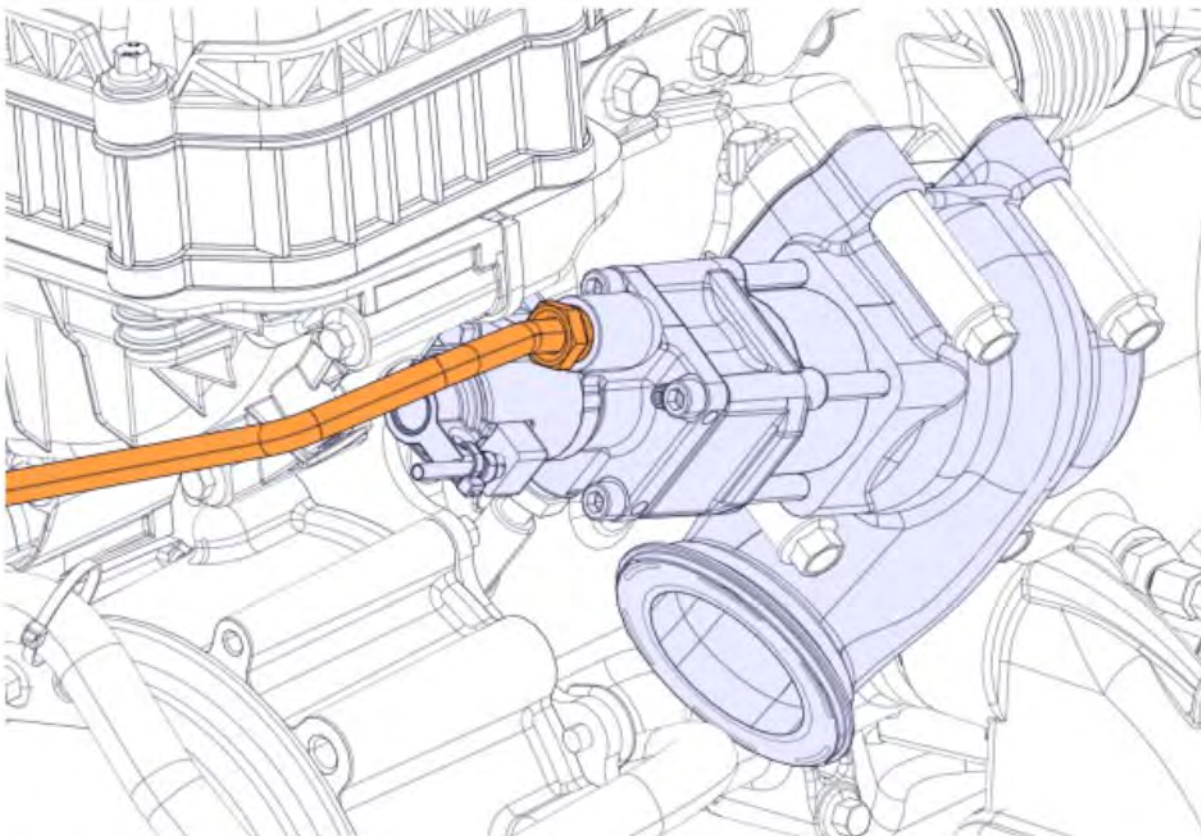
| | |
|----|------------------------|
| 57 | Remove the cable ties. |
|----|------------------------|

| | |
|----|---------------------------|
| 58 | Disconnect the connector. |
|----|---------------------------|

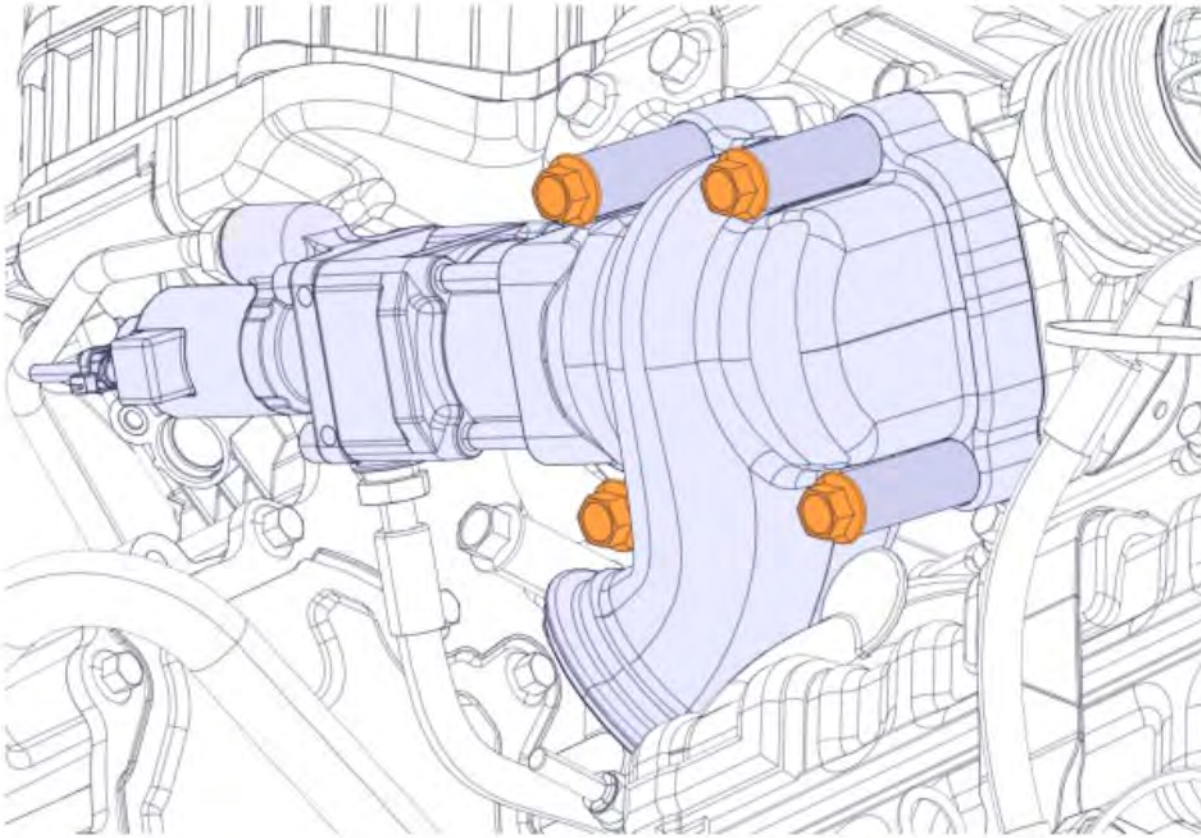
| | |
|----|-----------------------|
| 59 | Move the cable aside. |
|----|-----------------------|



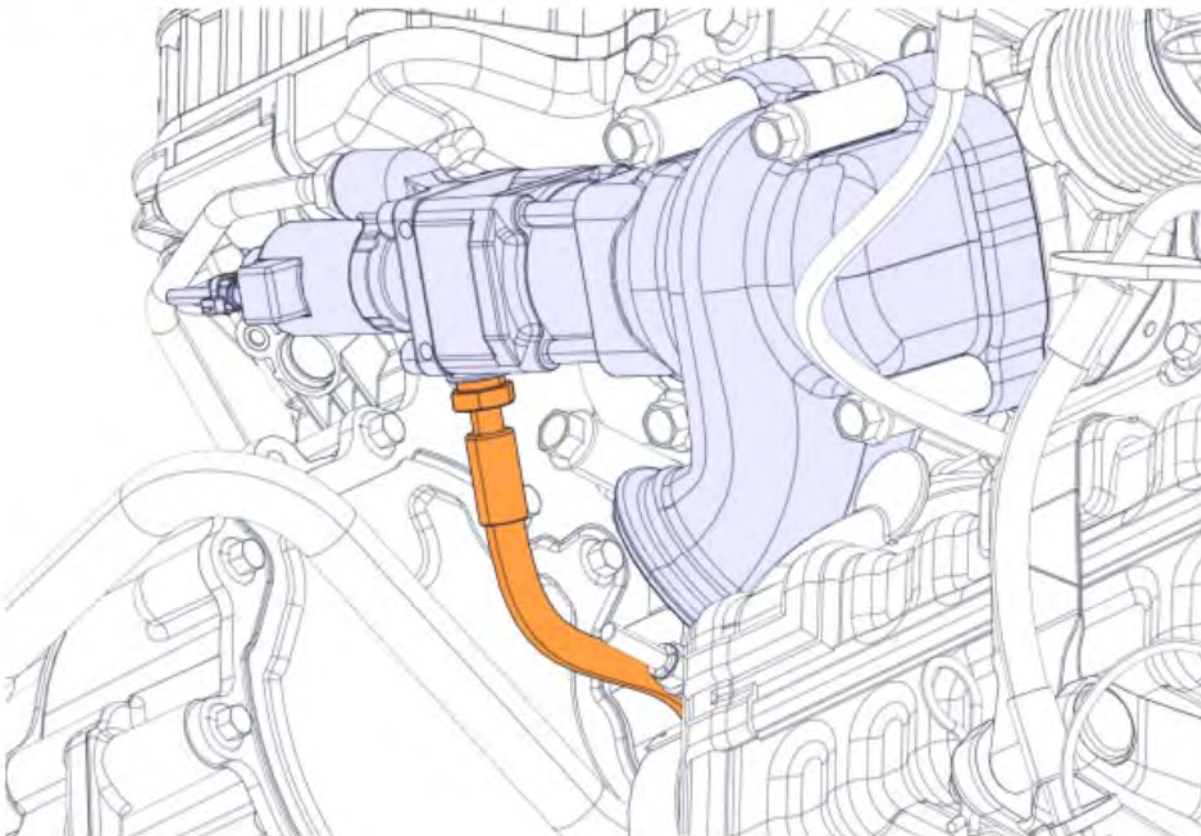
| | |
|----|------------------|
| 60 | Loosen the pipe. |
|----|------------------|



| | |
|----|--------------------|
| 61 | Loosen the screws. |
|----|--------------------|

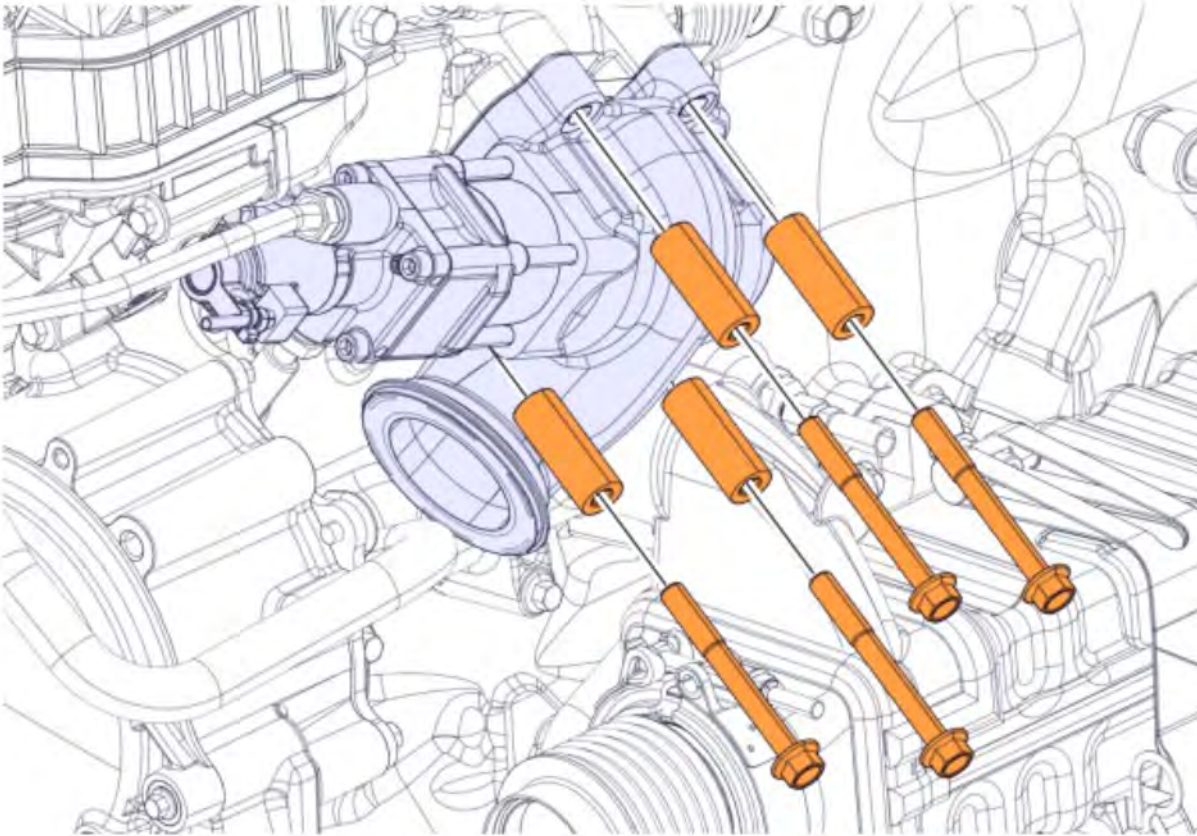


| | |
|----|------------------|
| 62 | Loosen the pipe. |
|----|------------------|

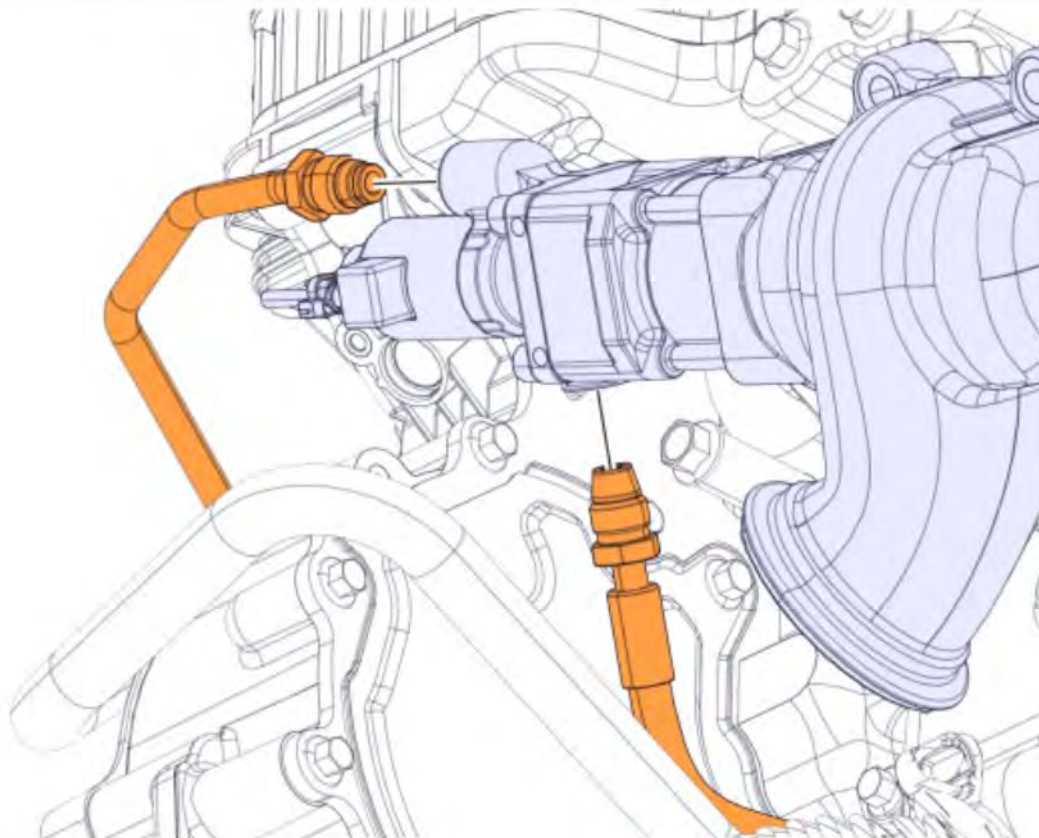


| | |
|----|--------------------|
| 63 | Remove the screws. |
|----|--------------------|

| | |
|----|---------------------|
| 64 | Remove the spacers. |
|----|---------------------|

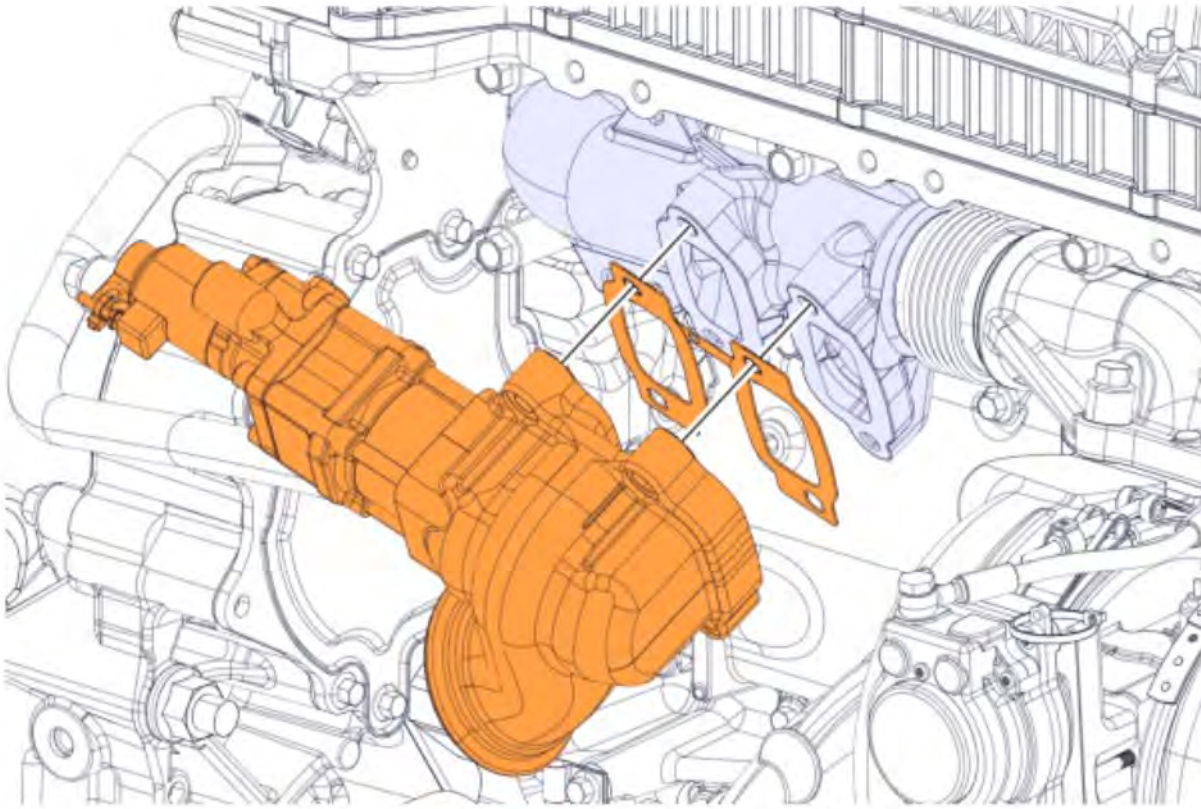


| | |
|----|-------------------|
| 65 | Remove the pipes. |
|----|-------------------|

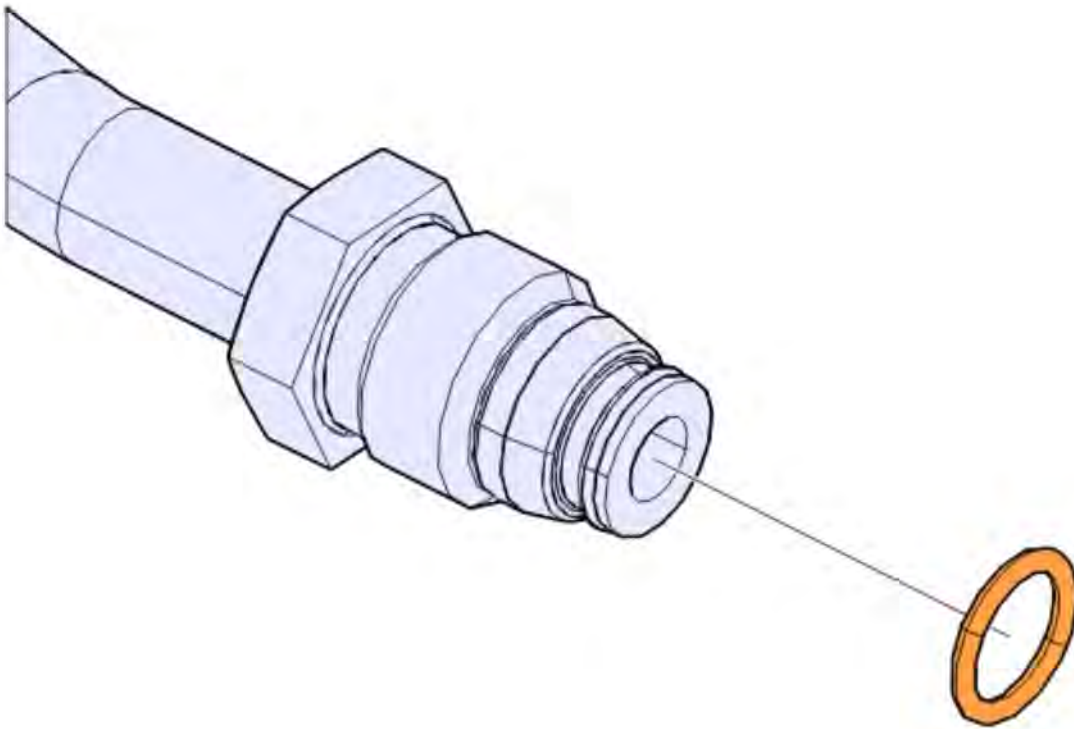


| | |
|----|-------------------|
| 66 | Remove the valve. |
|----|-------------------|

| | |
|----|--------------------|
| 67 | Remove the gasket. |
|----|--------------------|

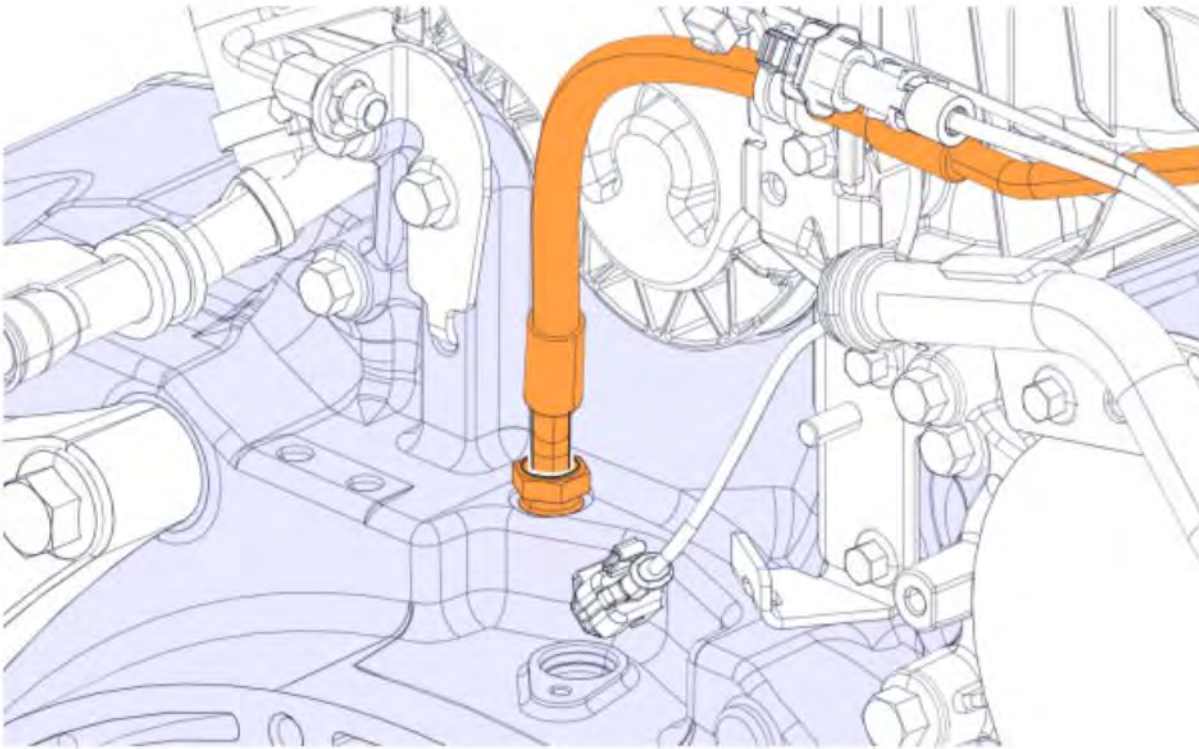


| | |
|----|------------------|
| 68 | Remove the seal. |
|----|------------------|

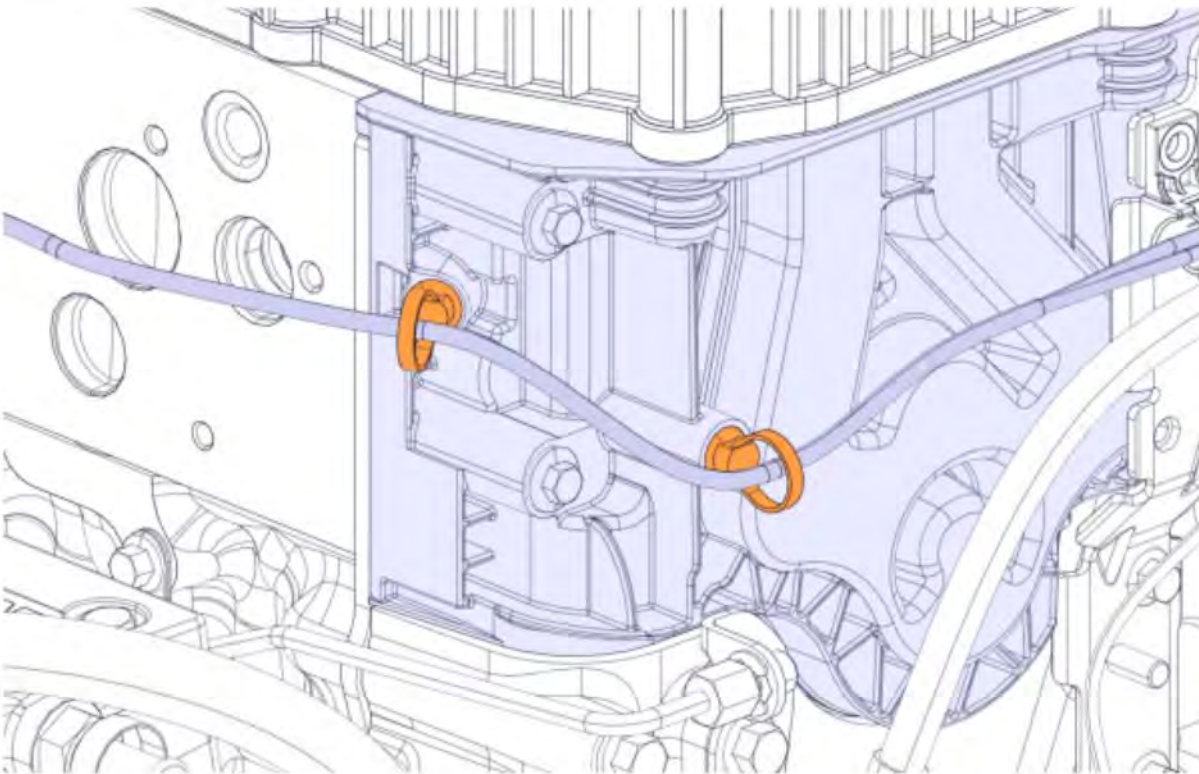


| | |
|----|-----------------|
| 69 | Loosen the nut. |
|----|-----------------|

| | |
|----|------------------|
| 70 | Remove the hose. |
|----|------------------|

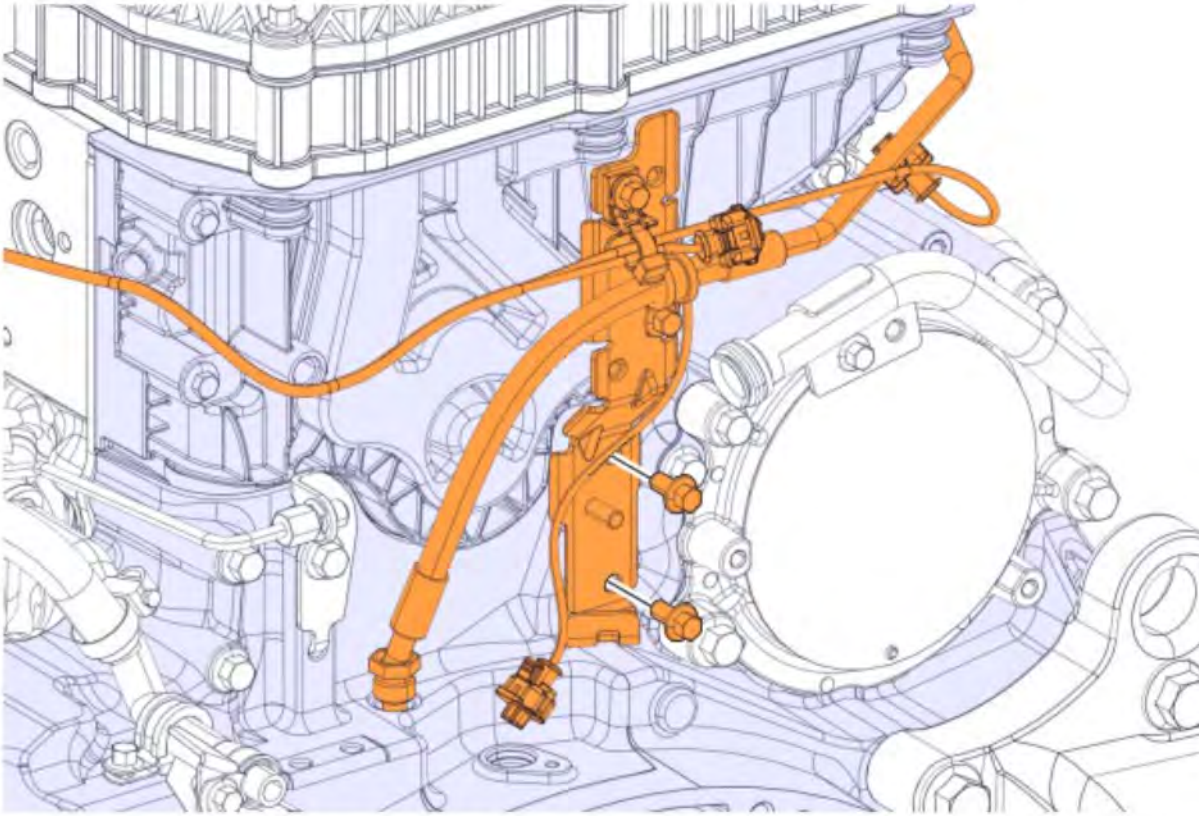


| | |
|----|------------------------|
| 71 | Remove the cable ties. |
|----|------------------------|

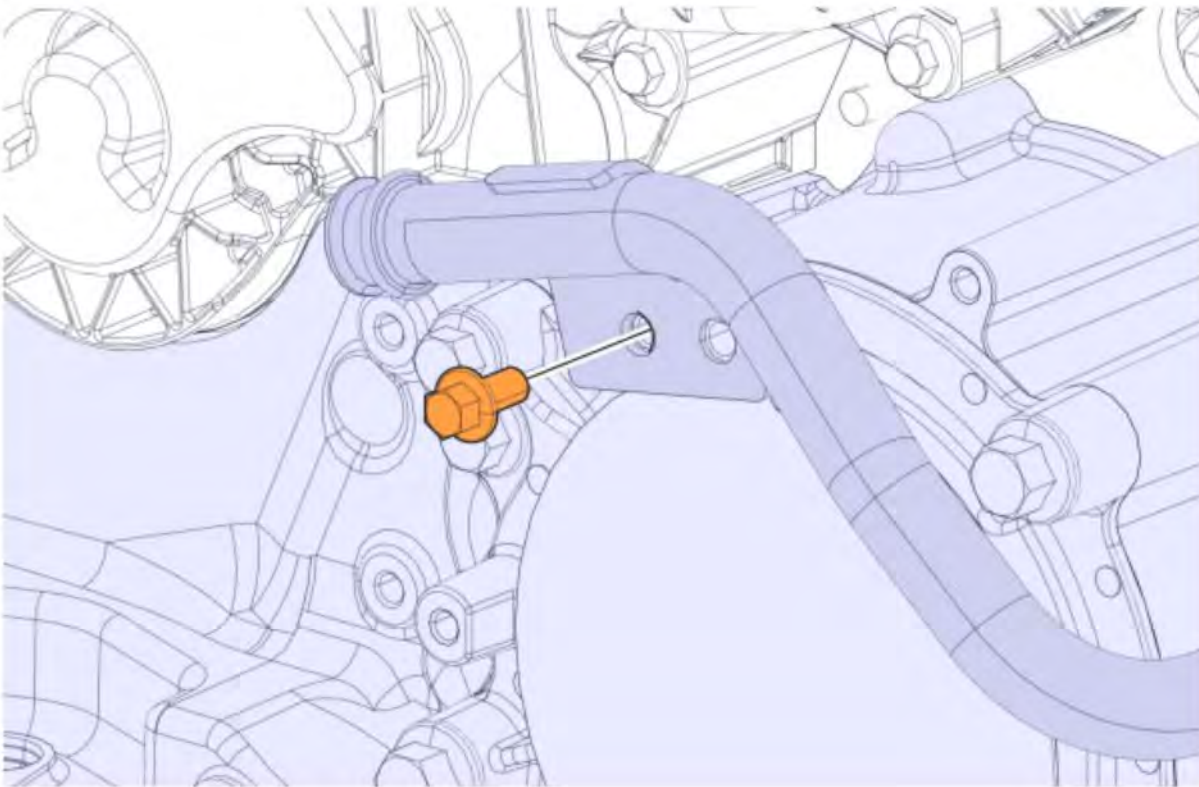


| | |
|----|--------------------|
| 72 | Remove the screws. |
|----|--------------------|

| | |
|----|--------------------------|
| 73 | Move the assembly aside. |
|----|--------------------------|

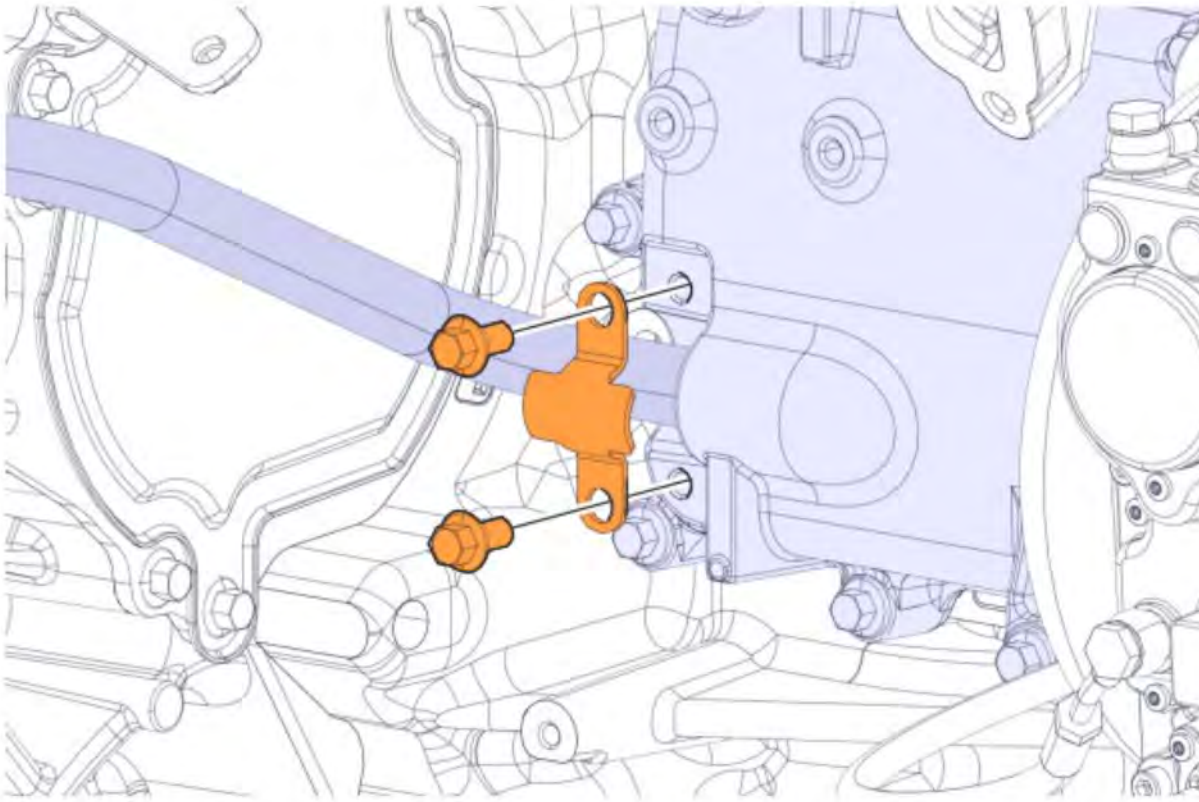


| | |
|----|-------------------|
| 74 | Remove the screw. |
|----|-------------------|



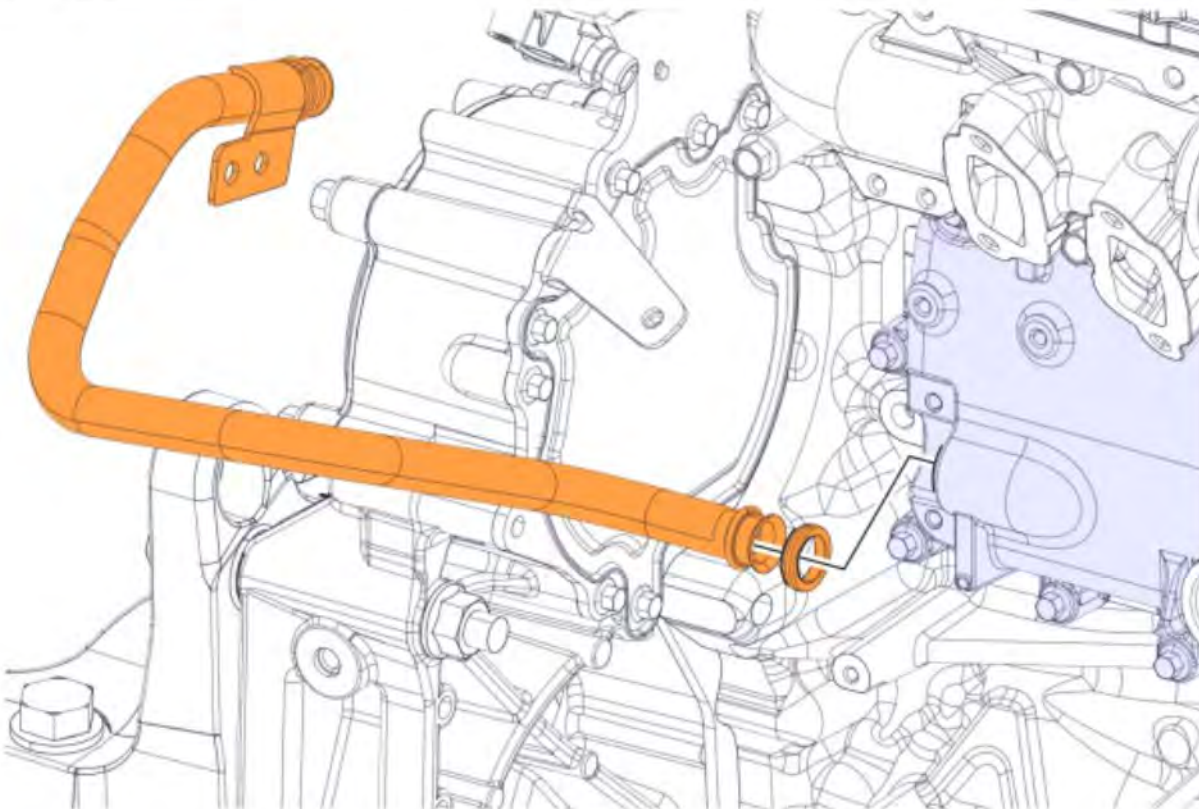
| | |
|----|--------------------|
| 75 | Remove the screws. |
|----|--------------------|

| | |
|----|-------------------|
| 76 | Remove the clamp. |
|----|-------------------|



| | |
|-----------|------------------|
| 77 | Remove the pipe. |
|-----------|------------------|

| | |
|-----------|------------------|
| 78 | Remove the seal. |
|-----------|------------------|



| | |
|-----------|--------------------|
| 79 | Remove the screws. |
|-----------|--------------------|

| | |
|-----------|------------------|
| 80 | Remove the pump. |
|-----------|------------------|

Note

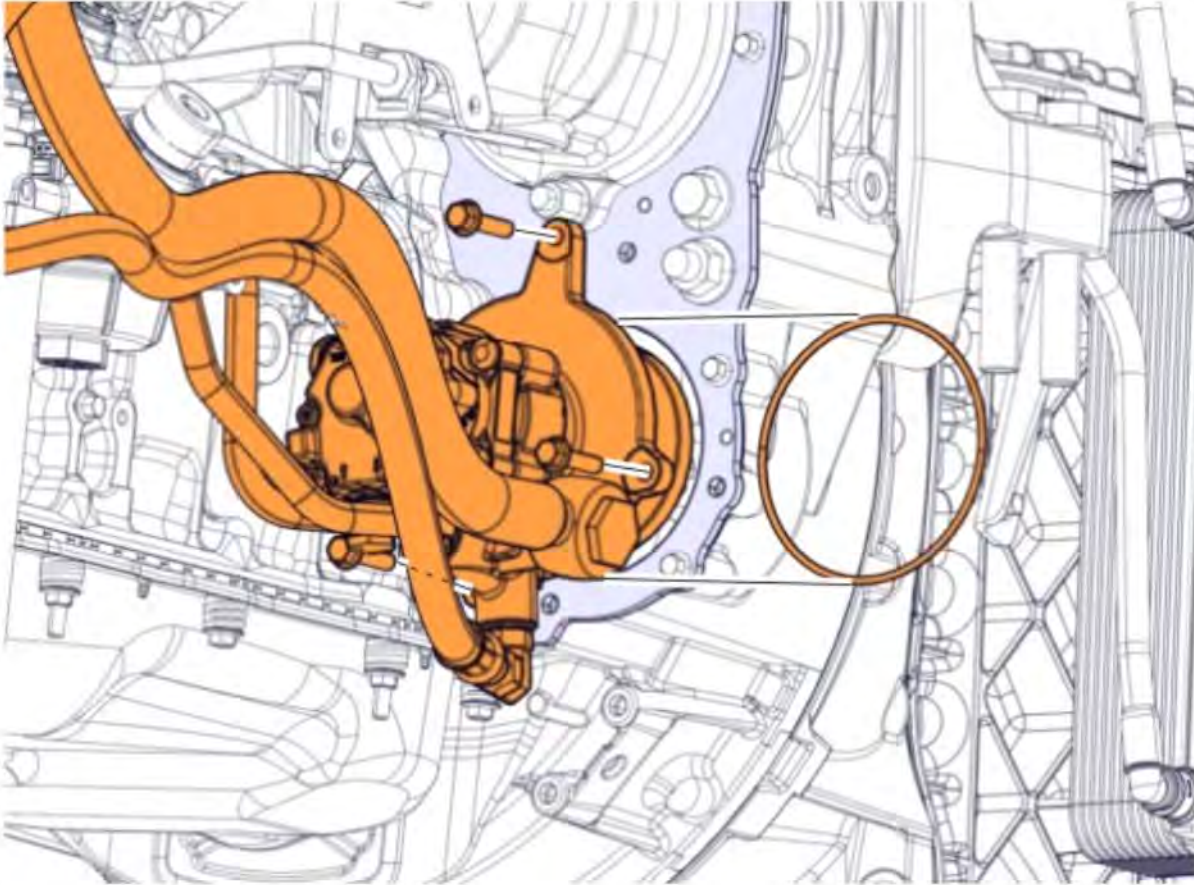
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i Leave the pipes connected to the pump.

i **Note**
Support the pump.

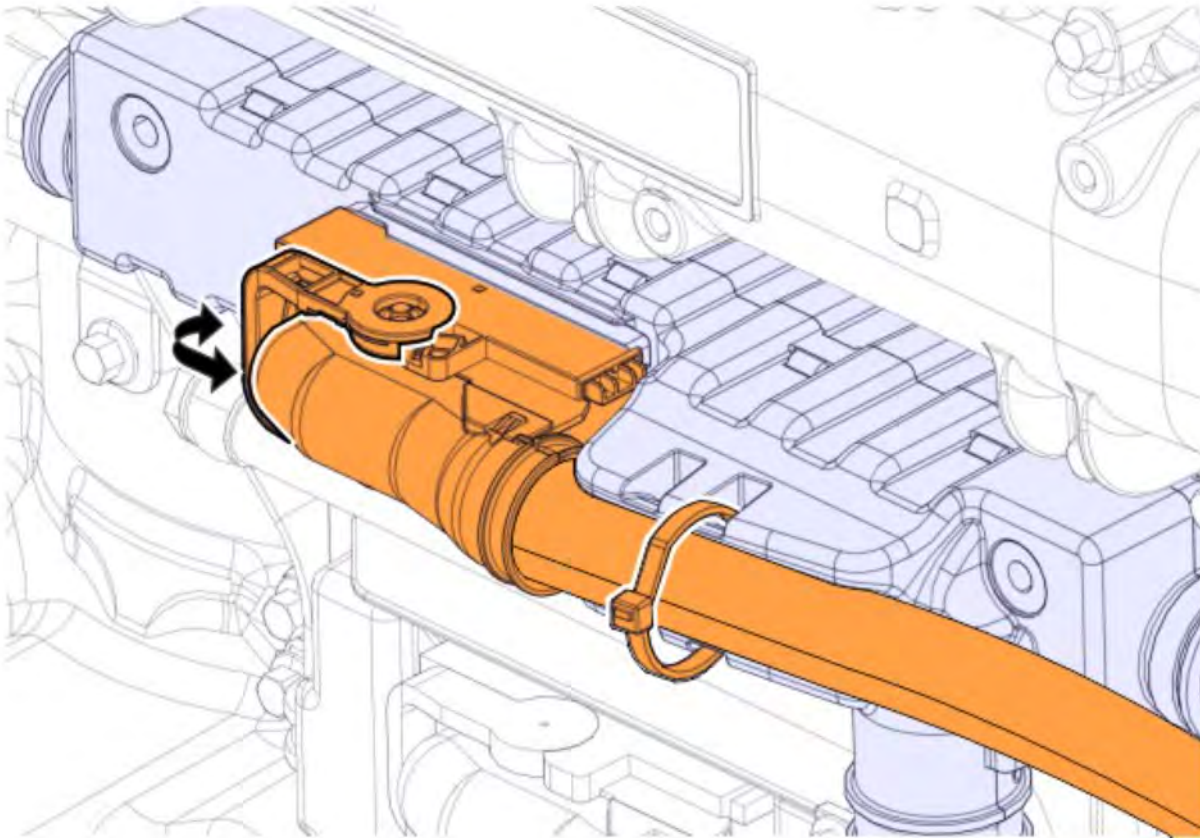
81 Remove the seal.



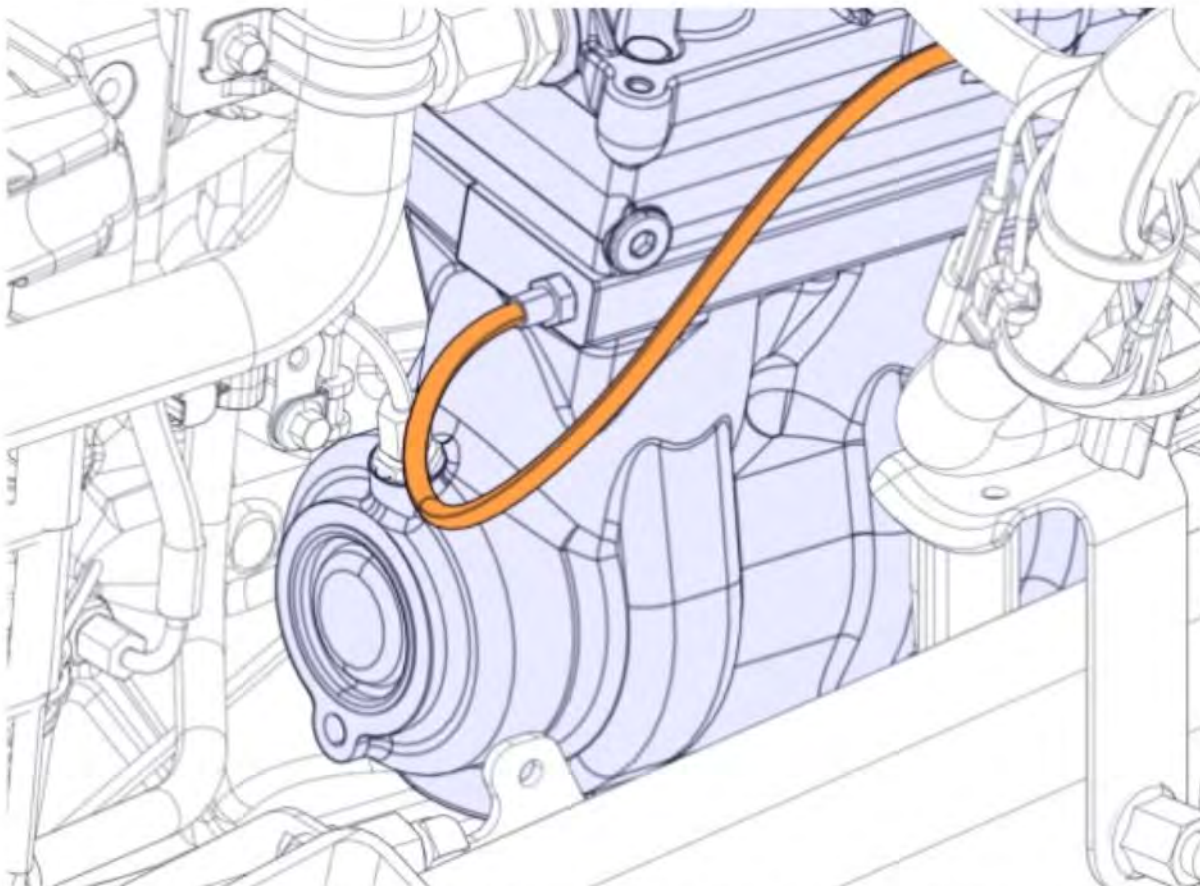
82 Remove the cable ties.

i **Note**
Note the positions.

83 Disconnect the connector.



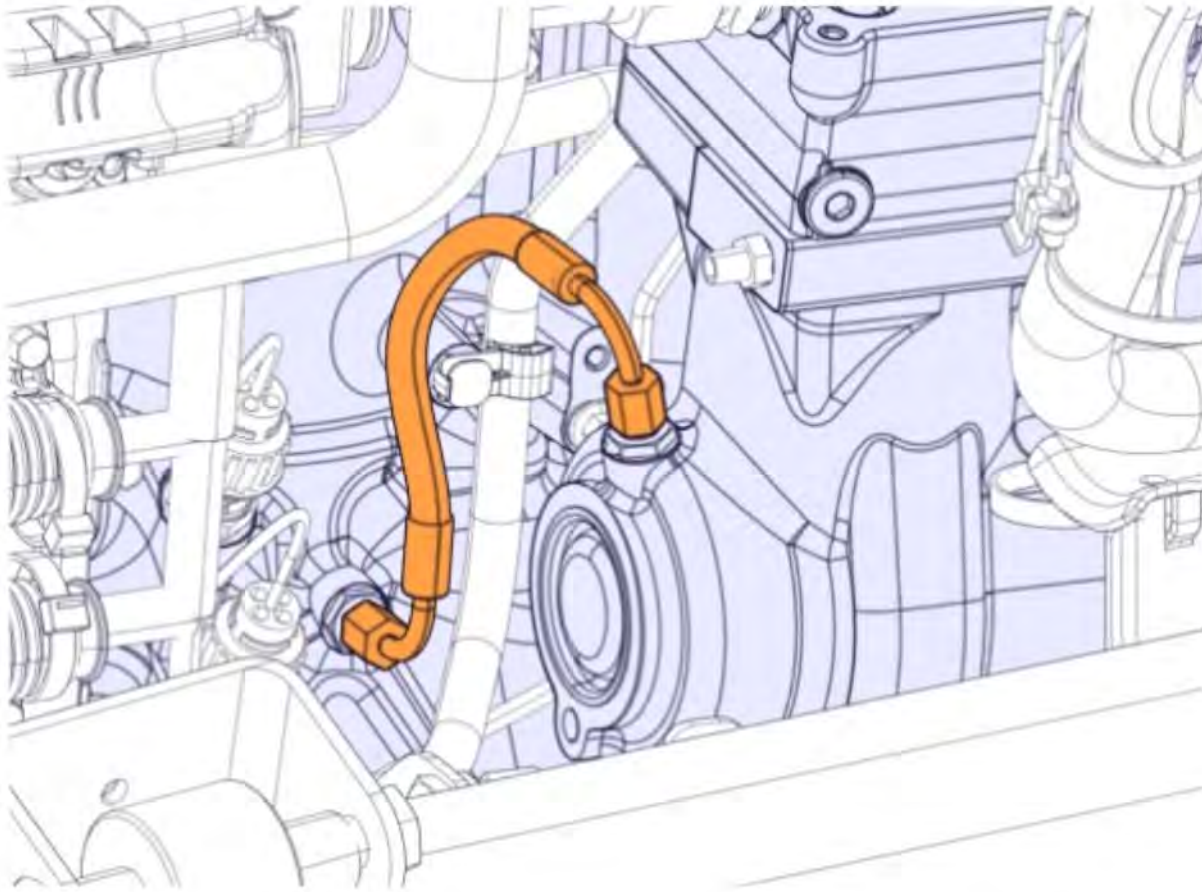
| | | |
|-----------|--------------------------|--------------------------|
| 84 | Disconnect the air line. | |
| | Required material | |
| | DISASSEMBLY TOOL | 88870002 |
| | | |



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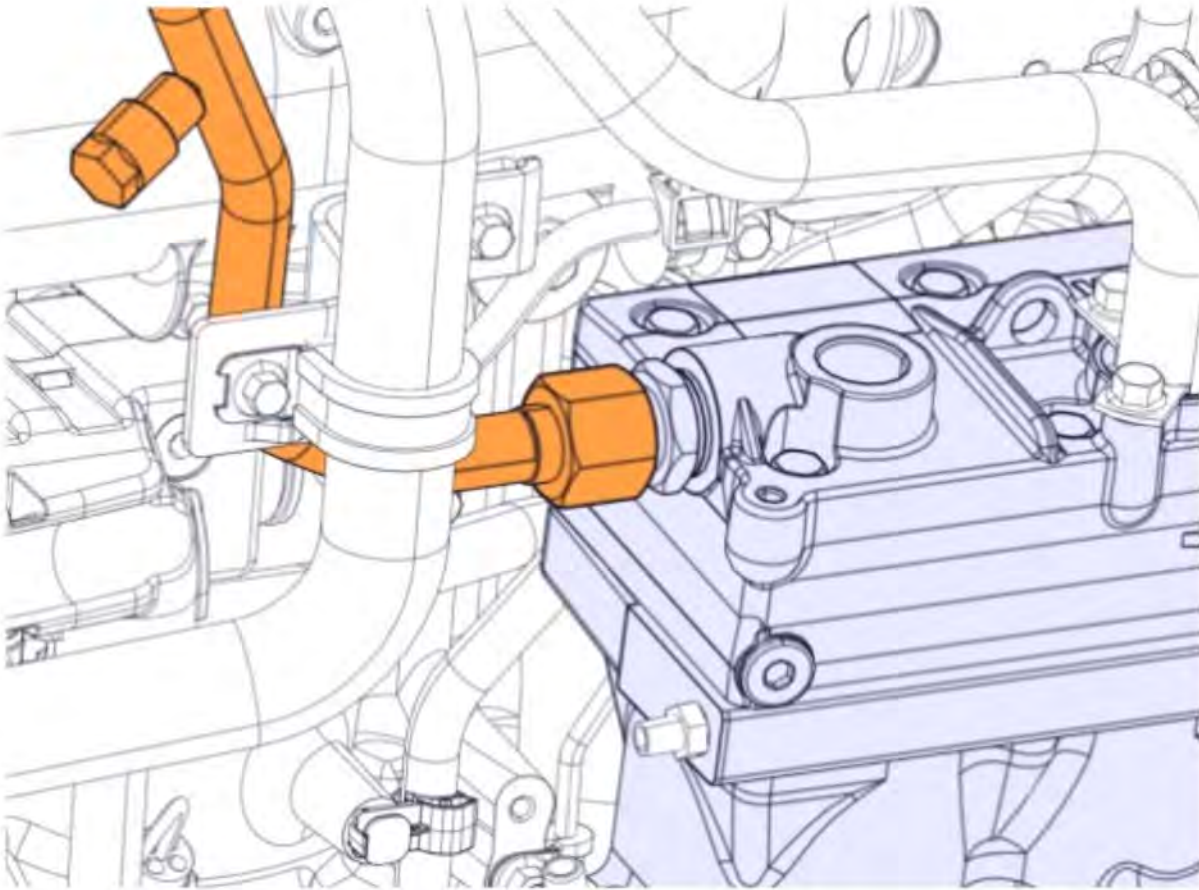
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| | |
|----|----------------------|
| 85 | Remove the oil hose. |
|----|----------------------|

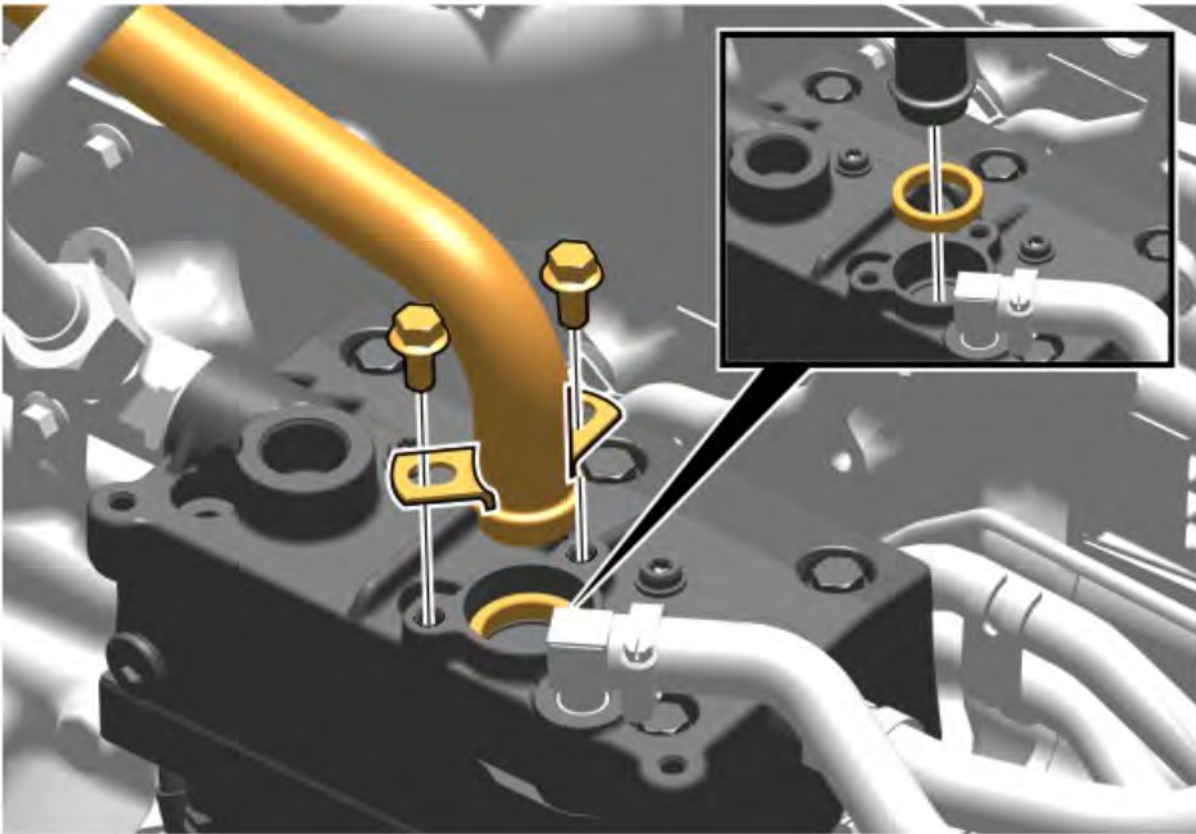


| | |
|----|-----------------|
| 86 | Loosen the nut. |
|----|-----------------|

| | |
|----|------------------|
| 87 | Remove the pipe. |
|----|------------------|

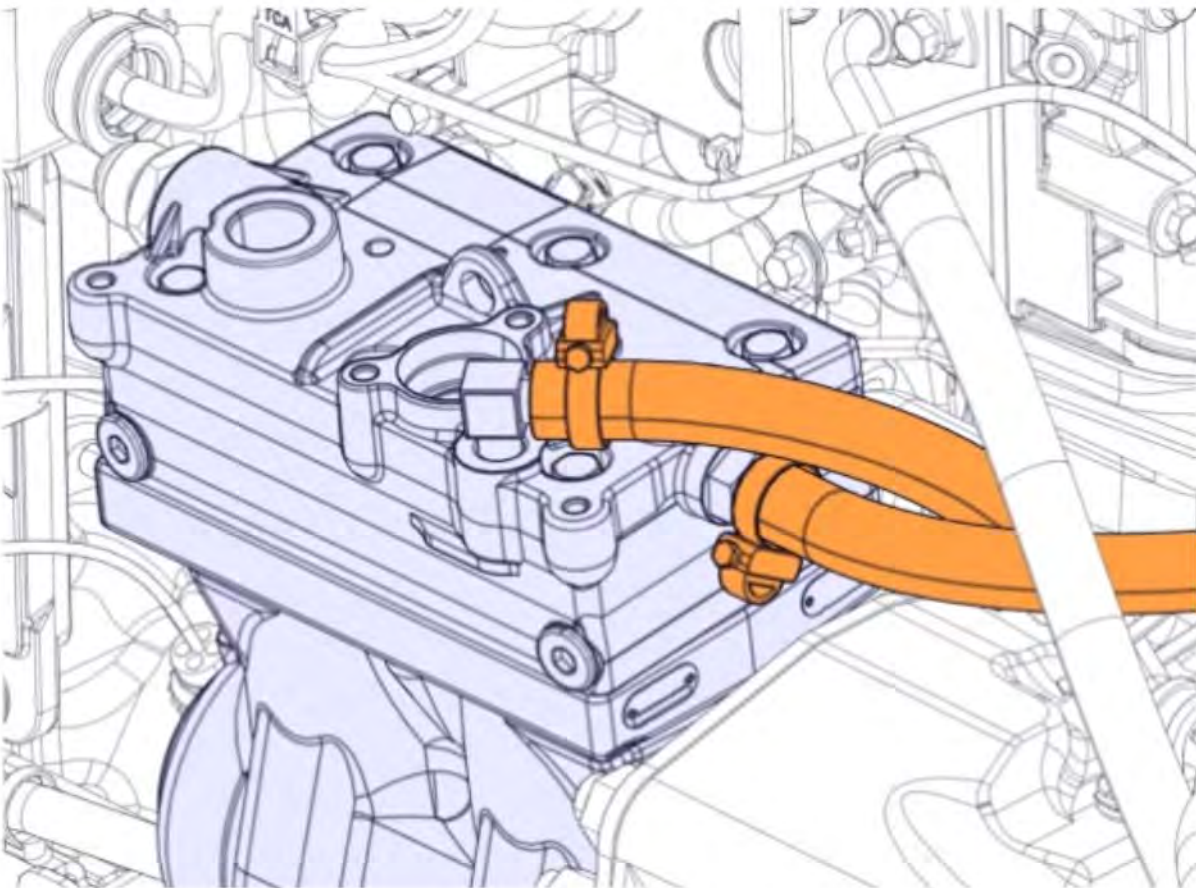


| | |
|----|--------------------------|
| 88 | Remove the screws. |
| 89 | Remove the lock braces. |
| 90 | Move aside the pipe. |
| 91 | Remove the sealing ring. |



| | |
|-----------|--------------------|
| 92 | Loosen the clamps. |
|-----------|--------------------|

| | |
|-----------|-------------------|
| 93 | Remove the hoses. |
|-----------|-------------------|



| | |
|-----------|------------------|
| 94 | Remove the nuts. |
|-----------|------------------|

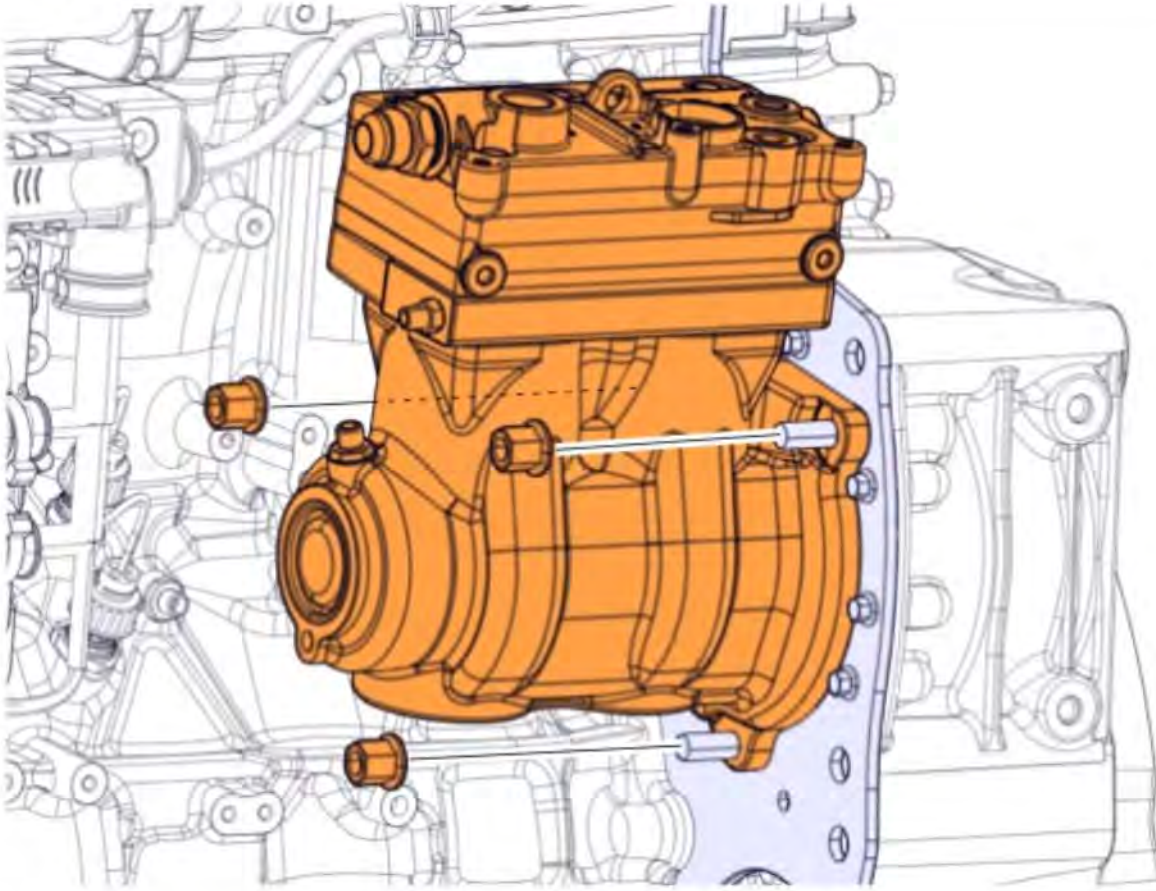
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**CAUTION****Risk of serious injury.**

Heavy component.

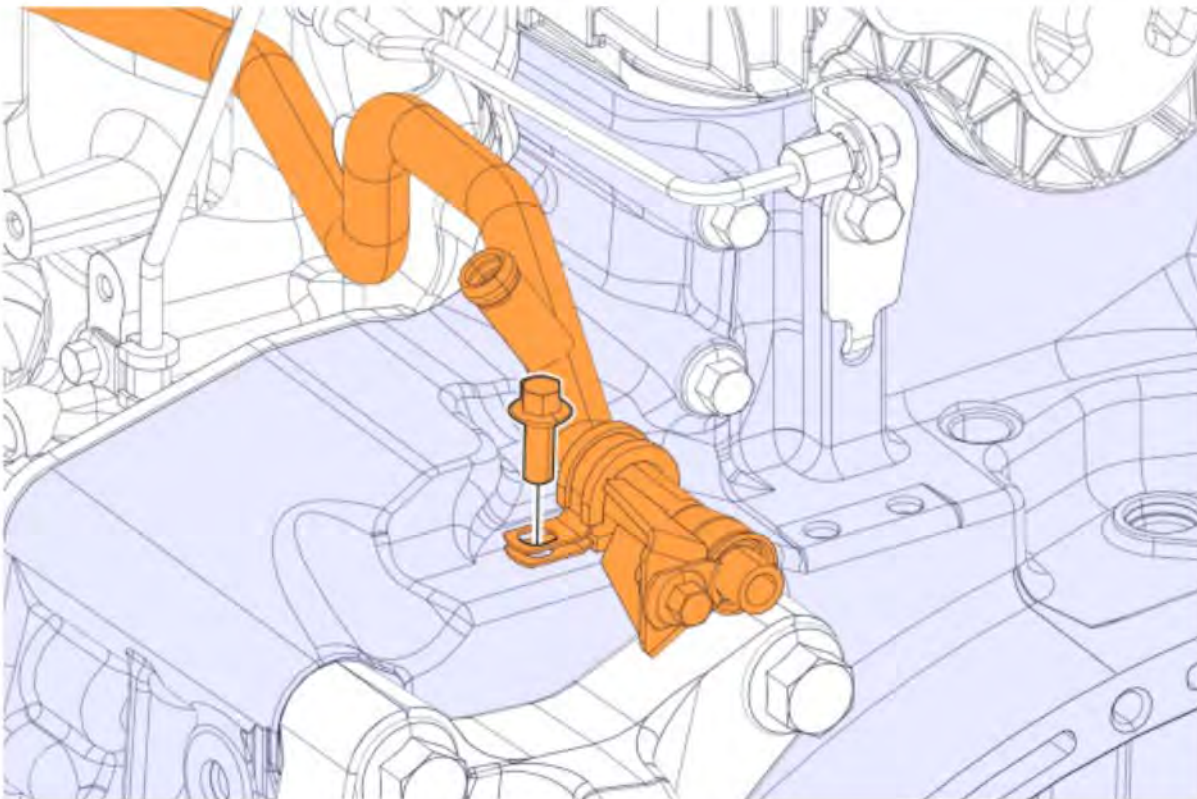
► Exercise caution when moving the component. Use appropriate tools.

95 Remove the compressor.**96** Remove the O-ring.



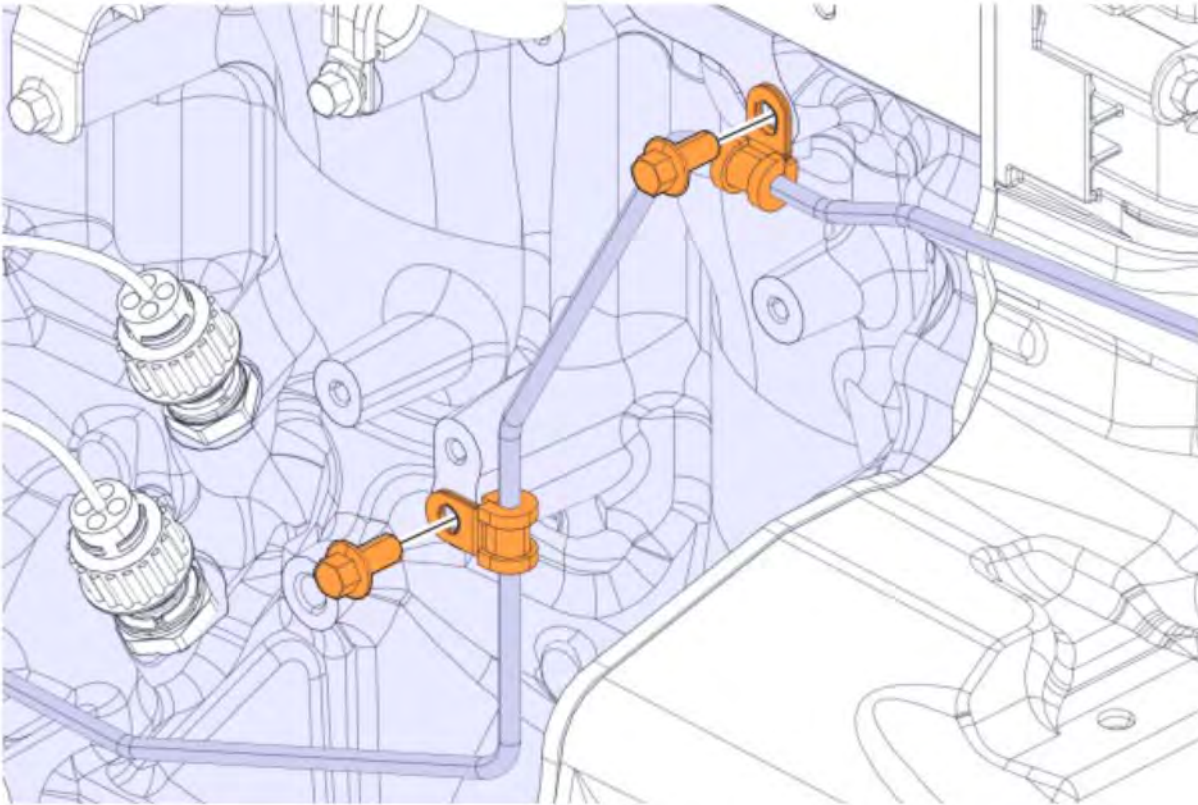
| | |
|-----------|-------------------|
| 97 | Remove the screw. |
|-----------|-------------------|

| | |
|-----------|----------------------|
| 98 | Move aside the pipe. |
|-----------|----------------------|



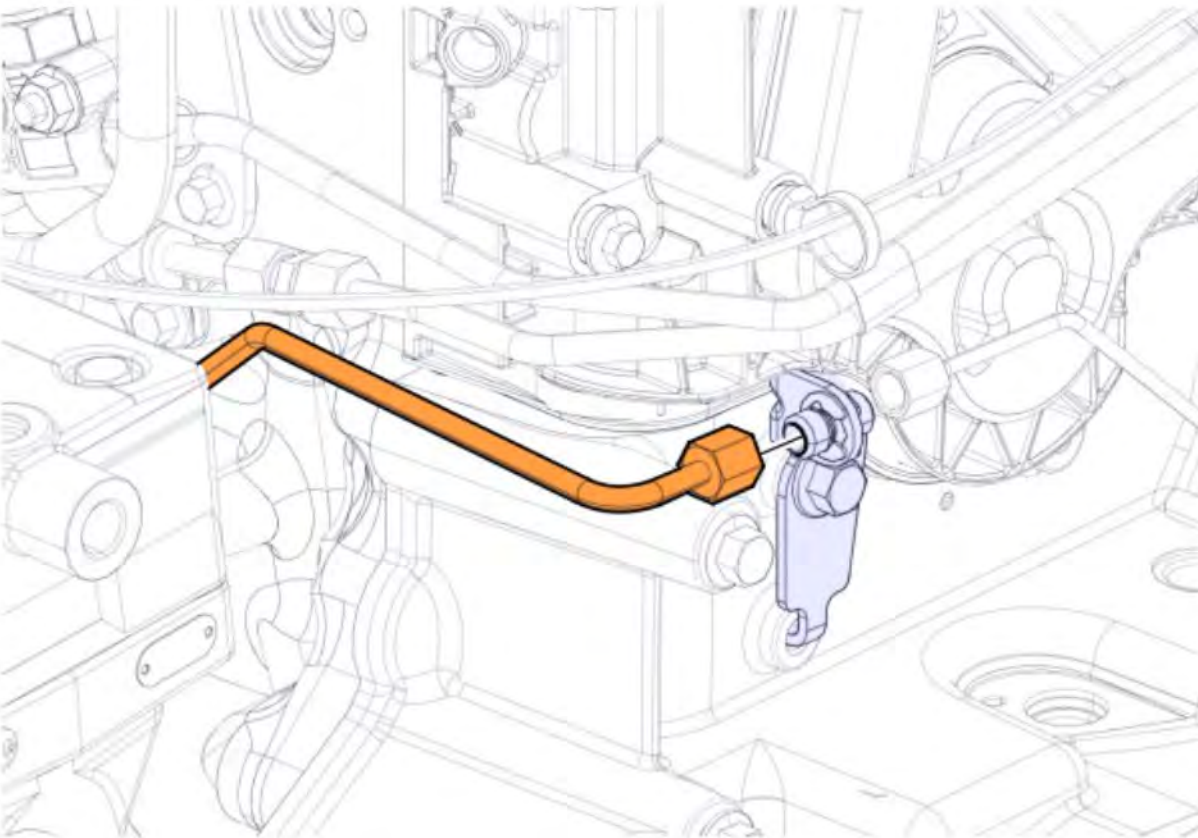
| | |
|-----------|--------------------|
| 99 | Remove the screws. |
|-----------|--------------------|

| | |
|------------|--------------------|
| 100 | Remove the clamps. |
|------------|--------------------|



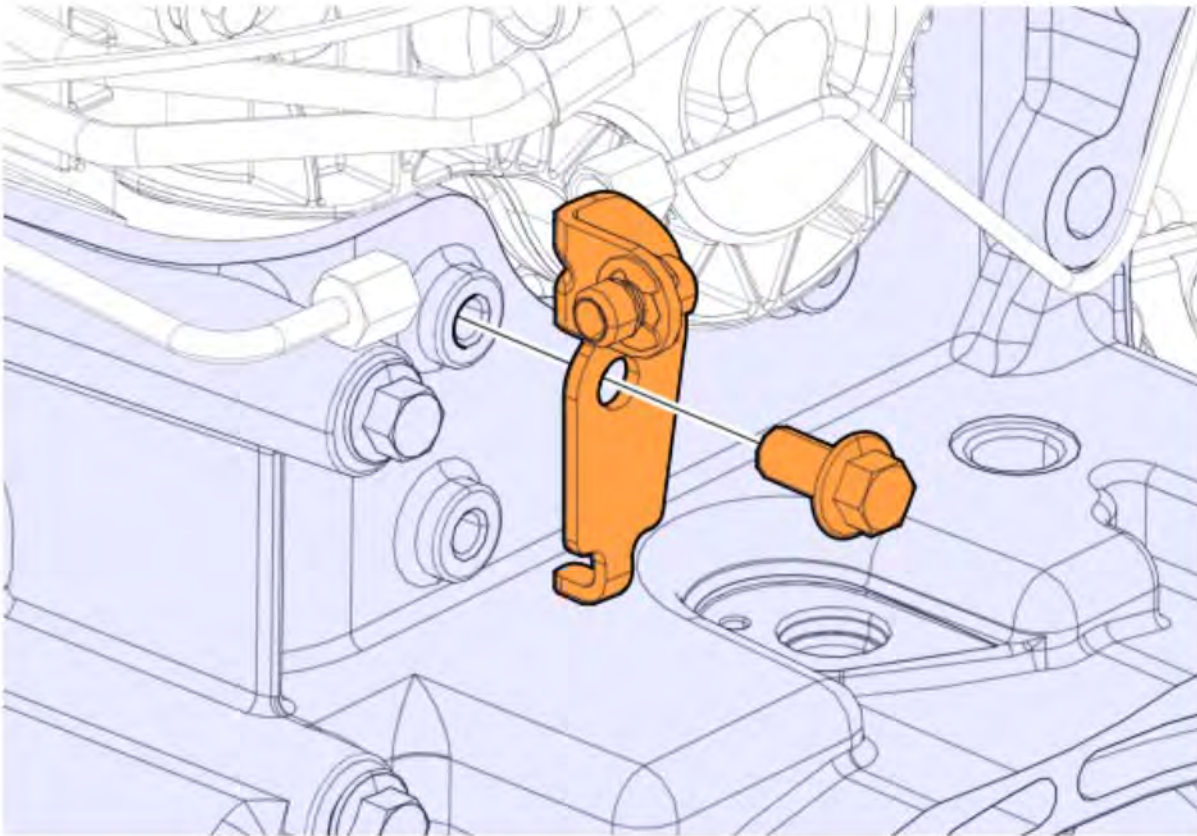
| | |
|-----|-----------------|
| 101 | Loosen the nut. |
|-----|-----------------|

| | |
|-----|------------------|
| 102 | Remove the pipe. |
|-----|------------------|



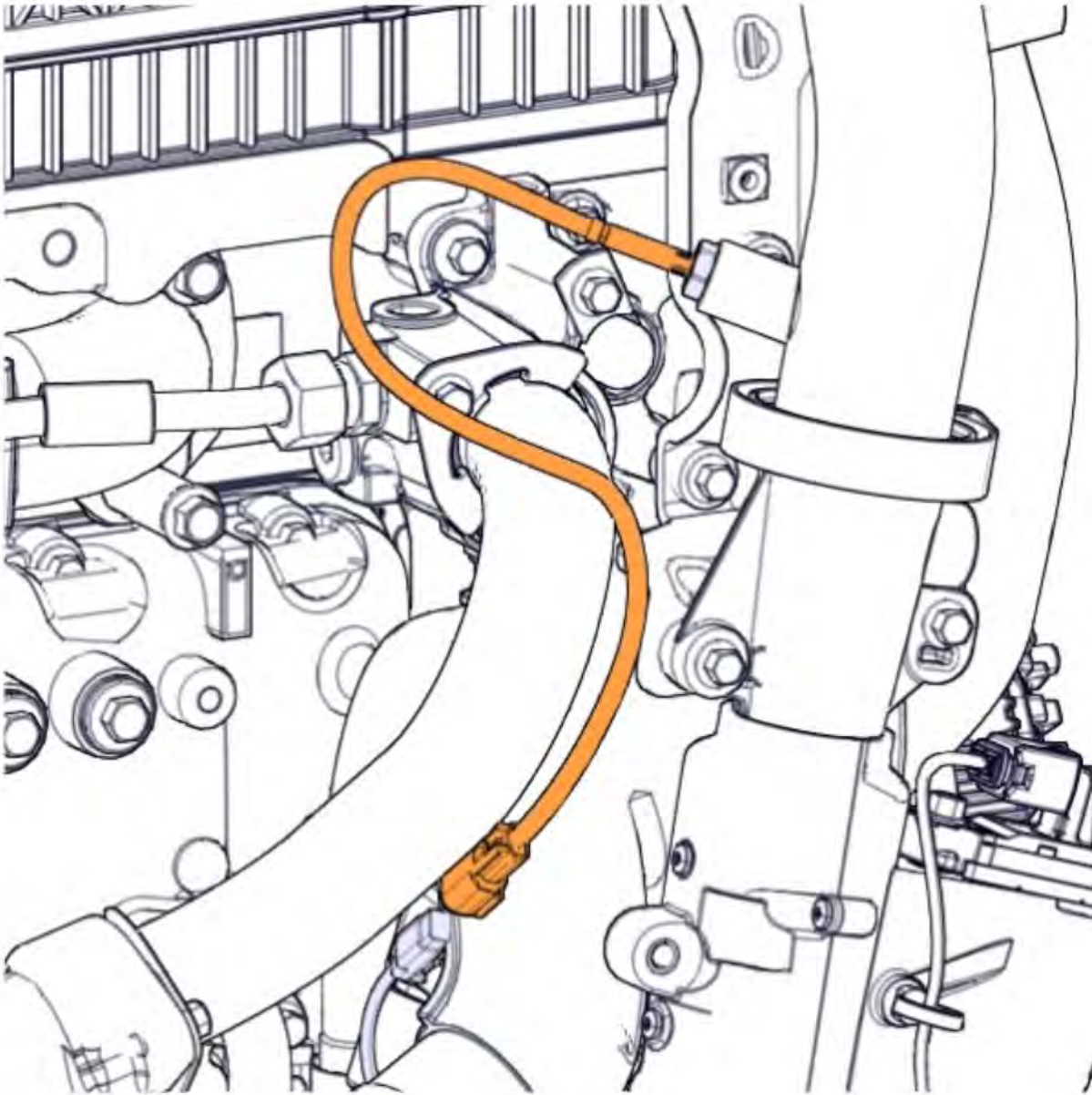
| | |
|-----|-------------------|
| 103 | Remove the screw. |
|-----|-------------------|

| | |
|-----|---------------------|
| 104 | Remove the bracket. |
|-----|---------------------|



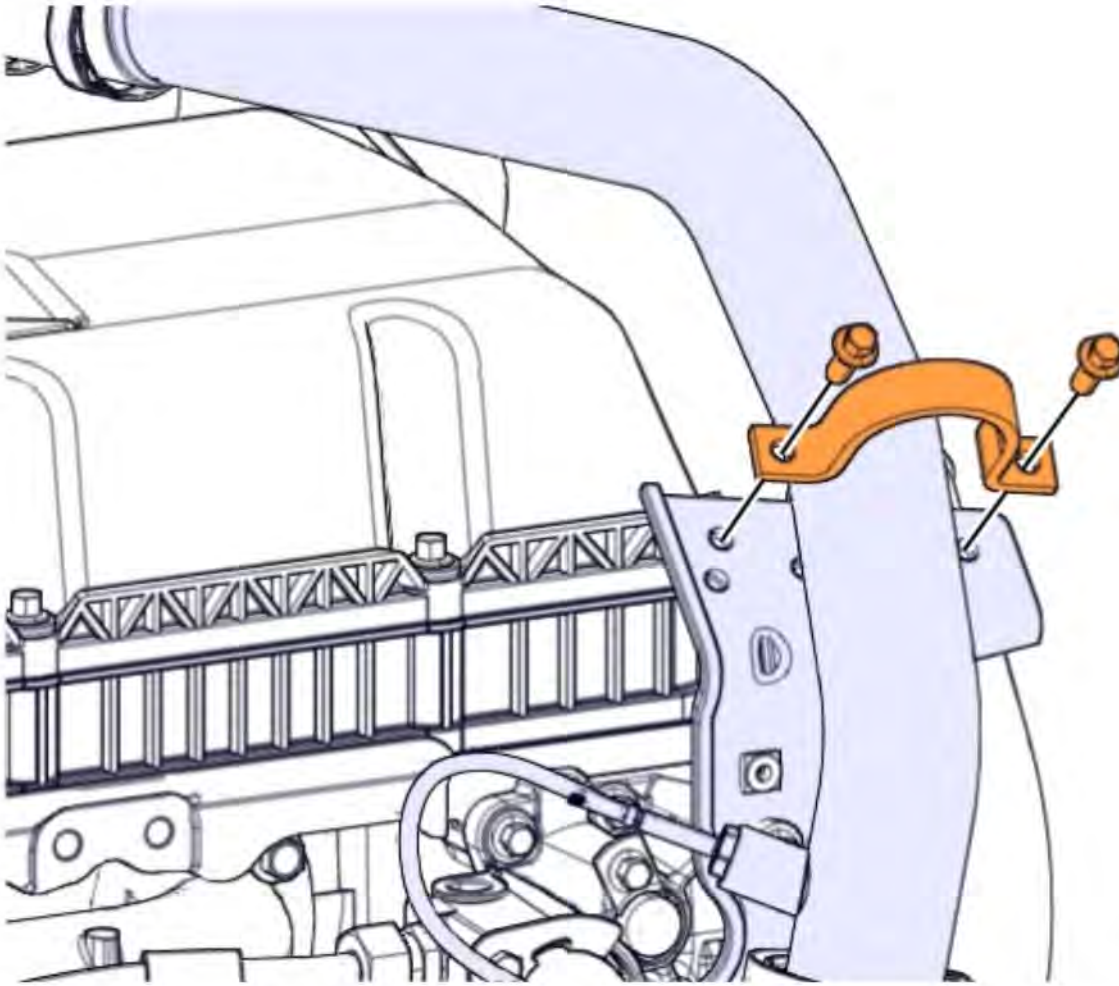
| | |
|-----|---------------------------|
| 105 | Disconnect the connector. |
|-----|---------------------------|

| | |
|-----|-----------------------|
| 106 | Remove the cable tie. |
|-----|-----------------------|



| | |
|-----|--------------------|
| 107 | Remove the screws. |
|-----|--------------------|

| | |
|-----|-------------------|
| 108 | Remove the clamp. |
|-----|-------------------|

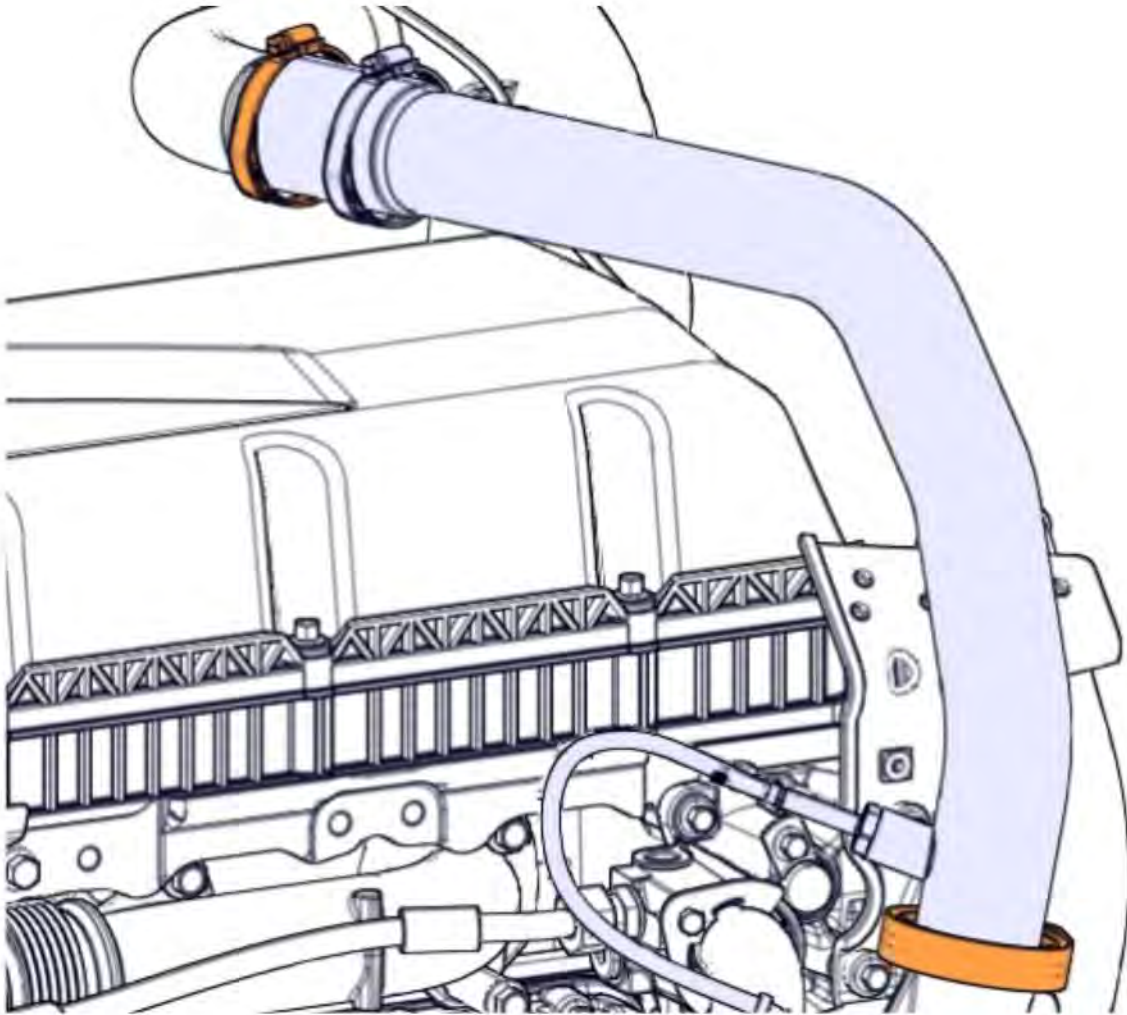


109 Loosen the clamps.

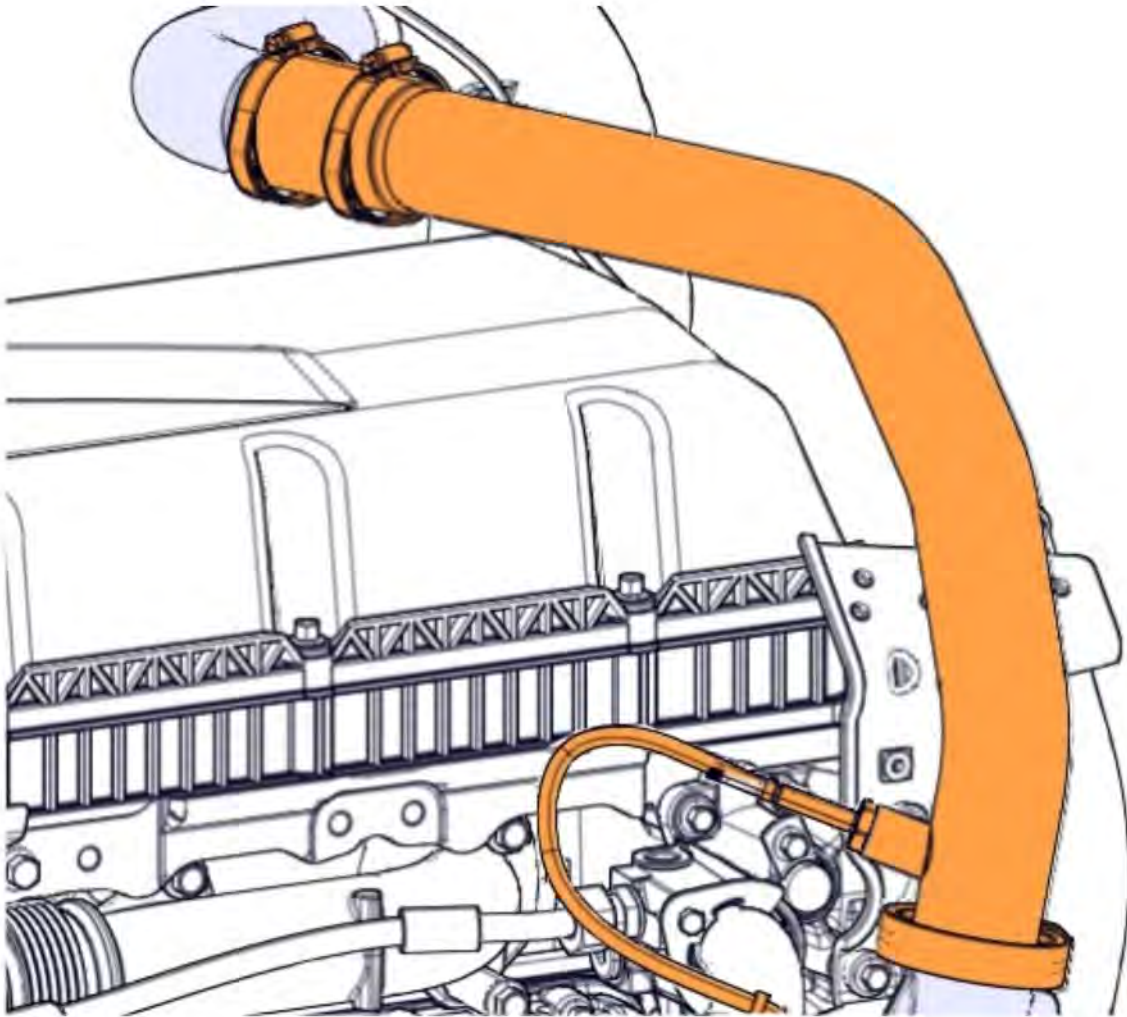


Note

Note the positions.

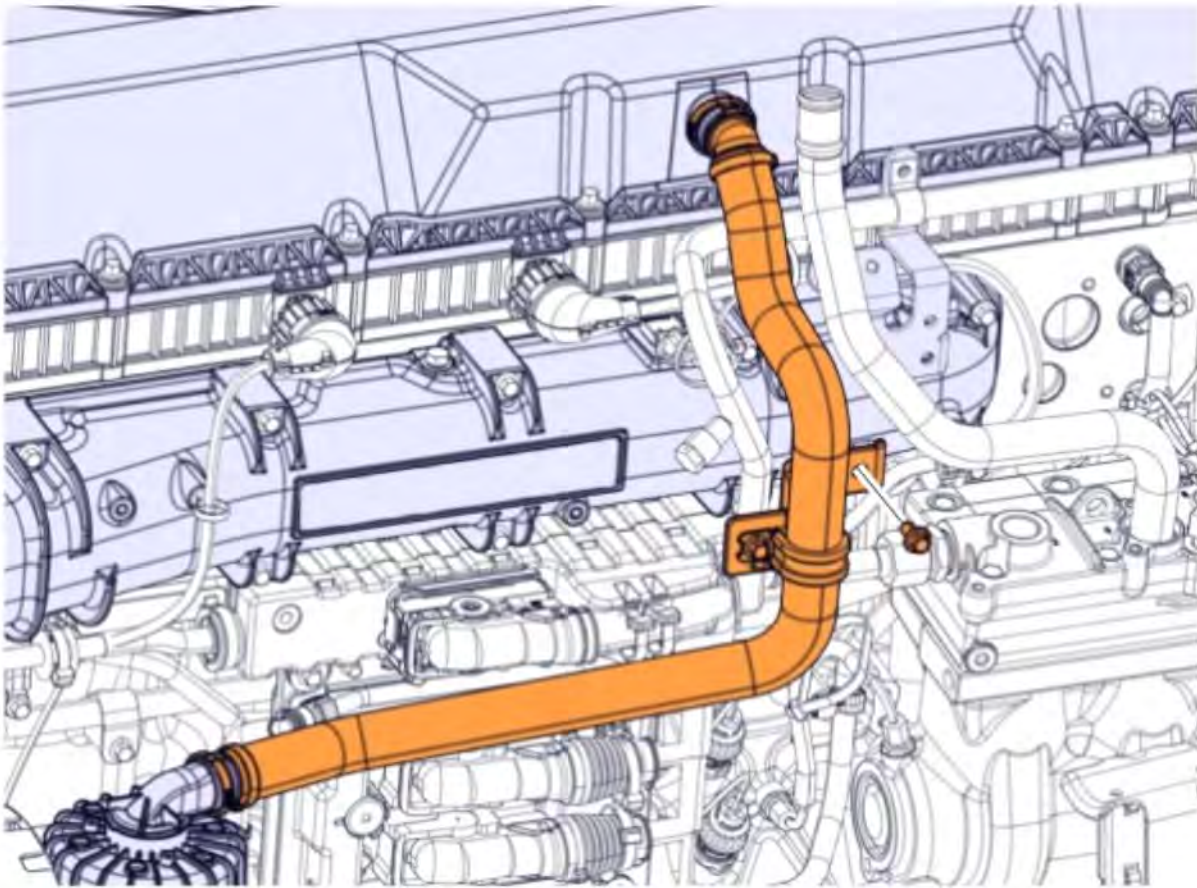


| | |
|-----|------------------|
| 110 | Remove the pipe. |
|-----|------------------|



| | |
|-----|-------------------|
| 111 | Remove the screw. |
|-----|-------------------|

| | |
|-----|------------------|
| 112 | Remove the pipe. |
|-----|------------------|

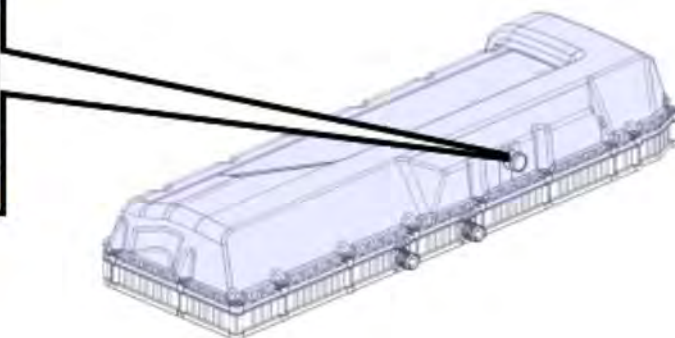
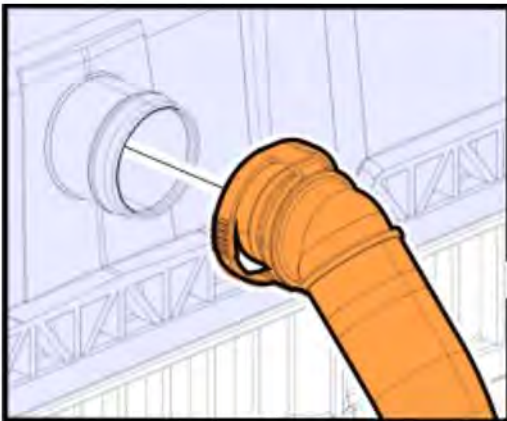


113 Remove the pipe.



Note

If not previously removed.



114 Loosen the screws.

115 Remove the valve cover.

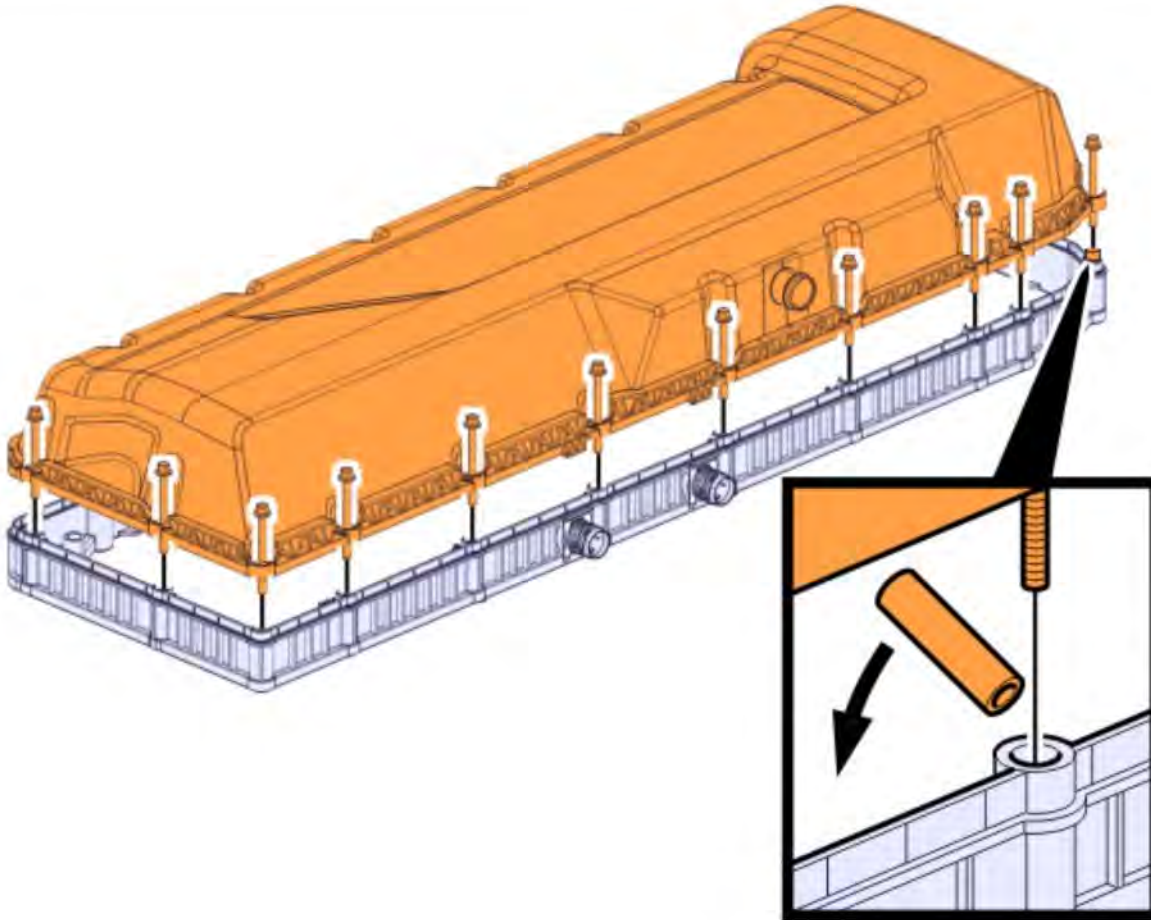


Service hint

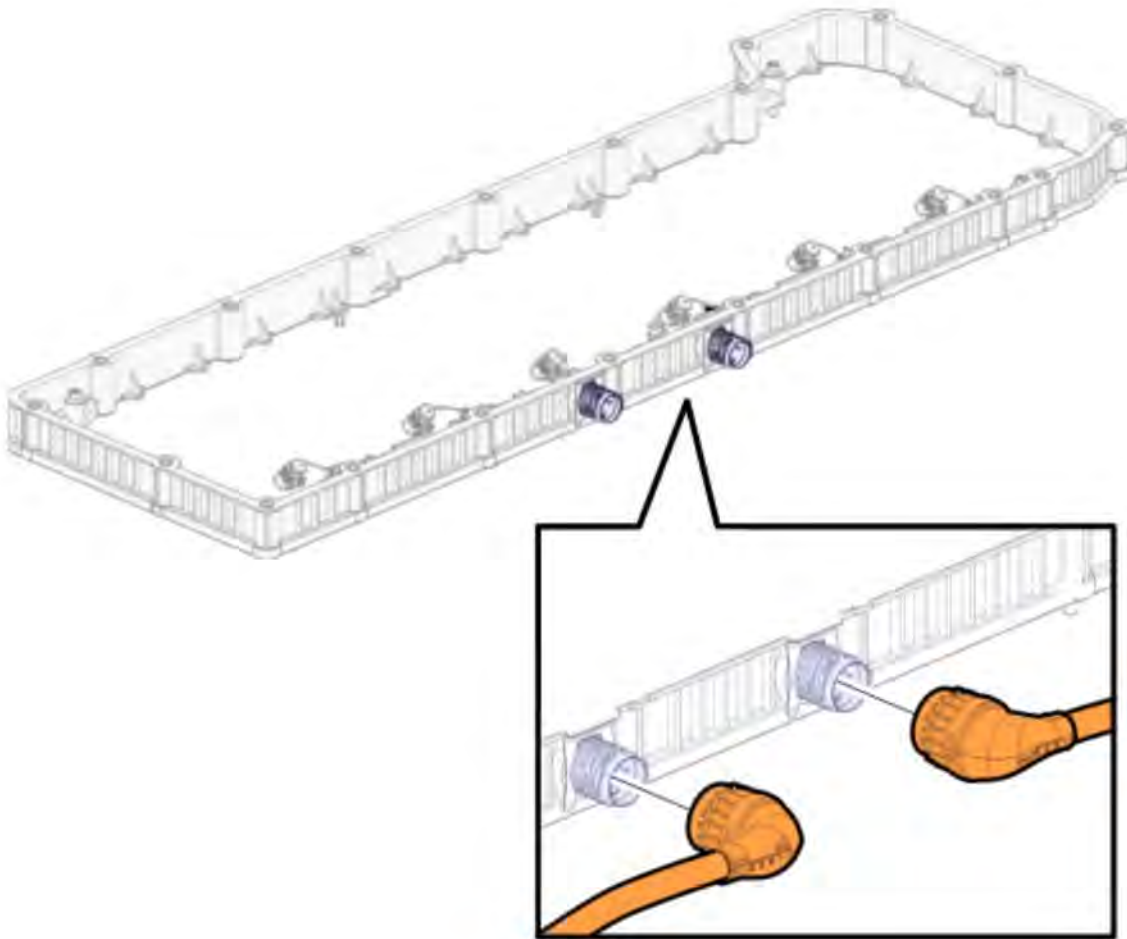
It is possible, when removing a valve cover screw, that the crush sleeve is drawn out with it. Take care to prevent the sleeve from falling into the gear train as this could result in engine damage.

**Service hint**

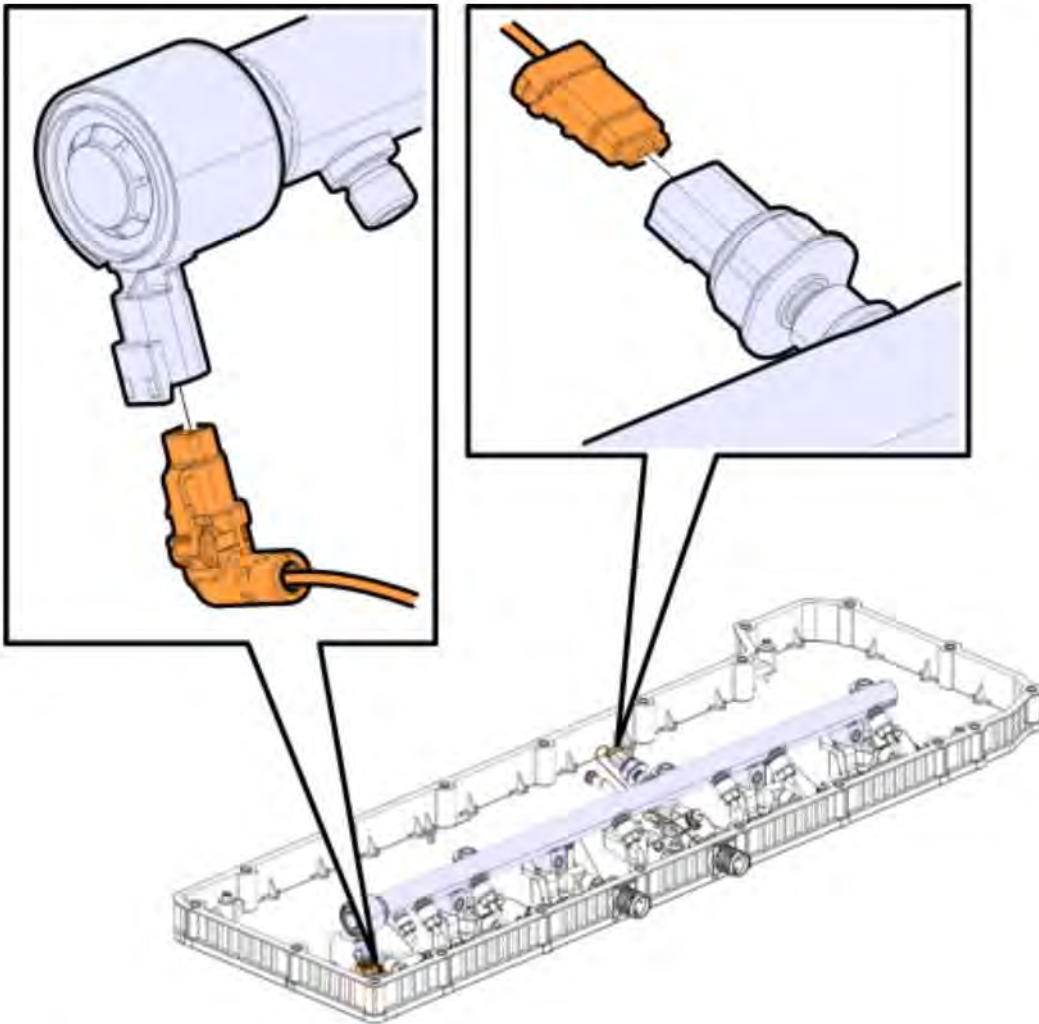
You do not need to loosen the valve or adjust the injector or the rocker arm shaft to replace the timing gear plate. A revised procedure for adjusting gear lash has been created.



116 Disconnect the connectors.



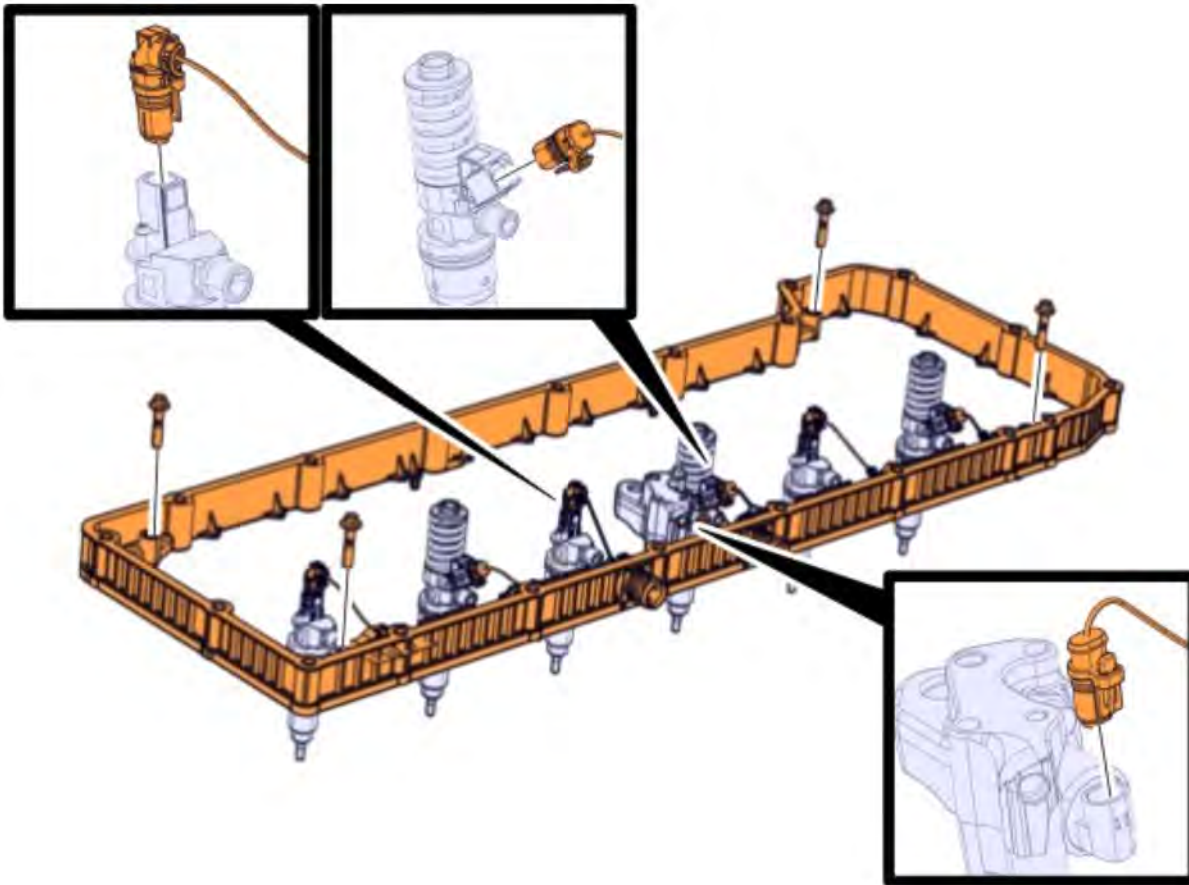
| | |
|-----|----------------------------|
| 117 | Disconnect the connectors. |
|-----|----------------------------|



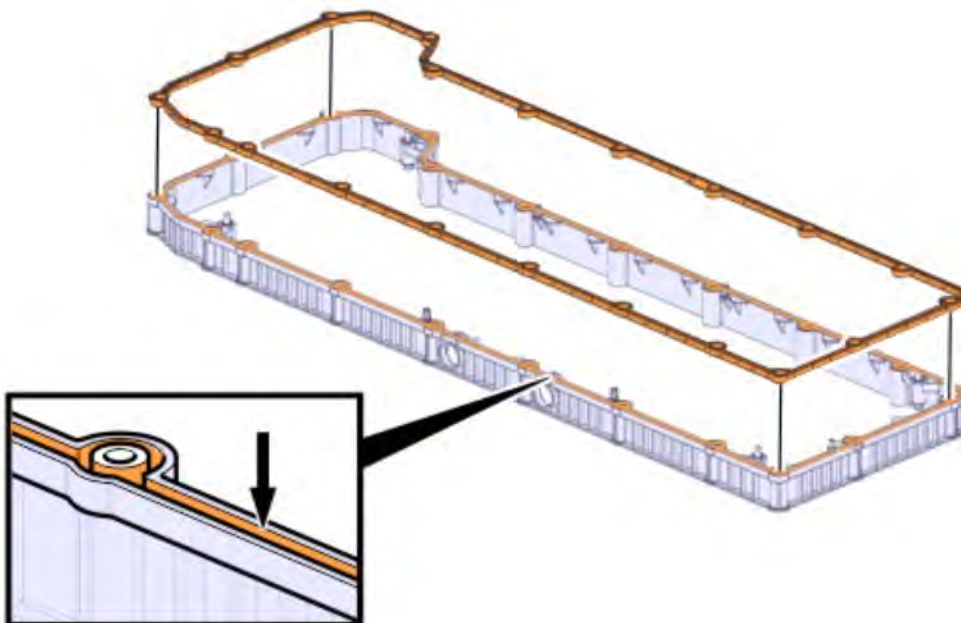
| | |
|-----|--------------------|
| 118 | Loosen the screws. |
|-----|--------------------|

| | |
|-----|----------------------------|
| 119 | Disconnect the connectors. |
|-----|----------------------------|

| | |
|-----|-------------------|
| 120 | Remove the frame. |
|-----|-------------------|



121 Remove the gasket.



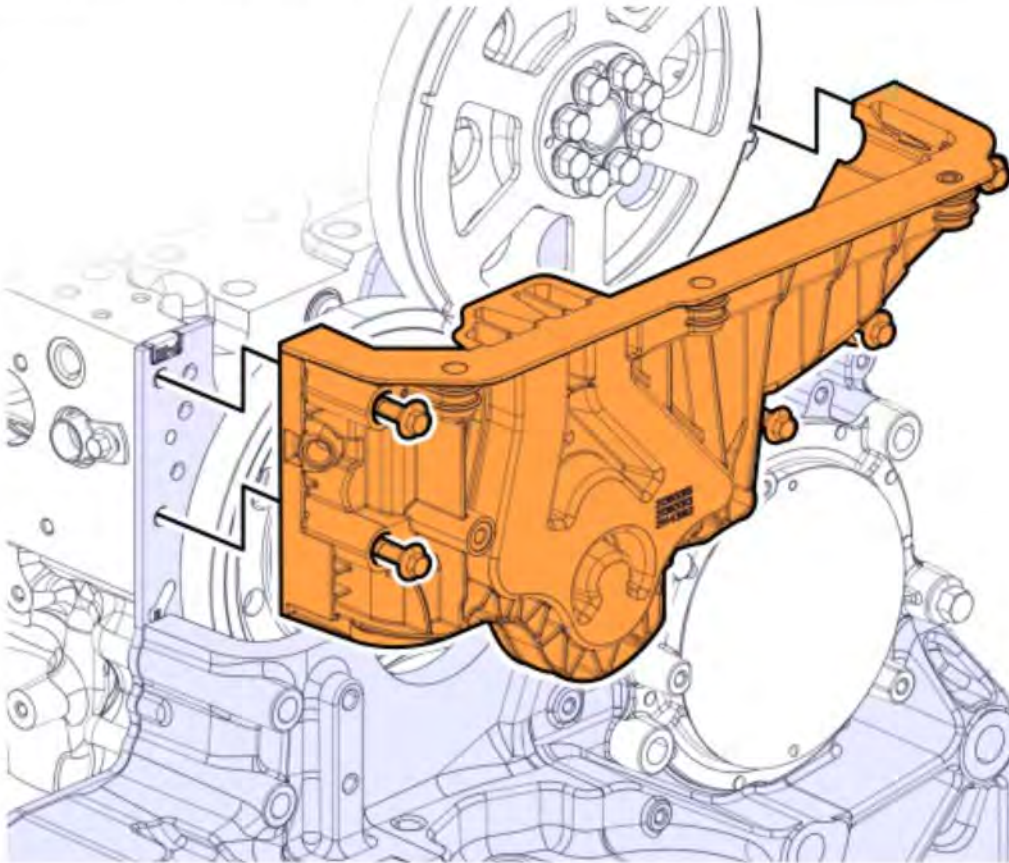
122 Remove the screws.



Service hint

The screws cannot be removed from the timing gear cover.

123 Remove the timing gear cover.

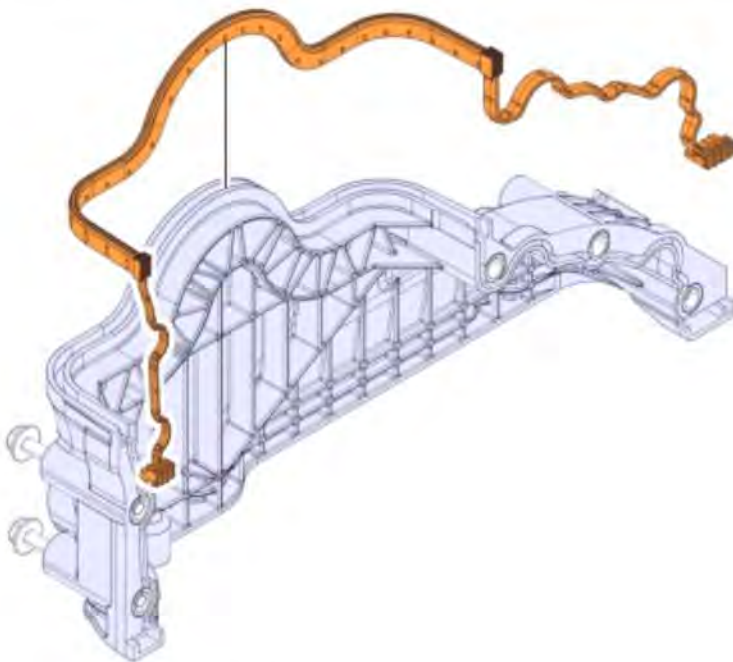


124 Remove the gasket.



Note

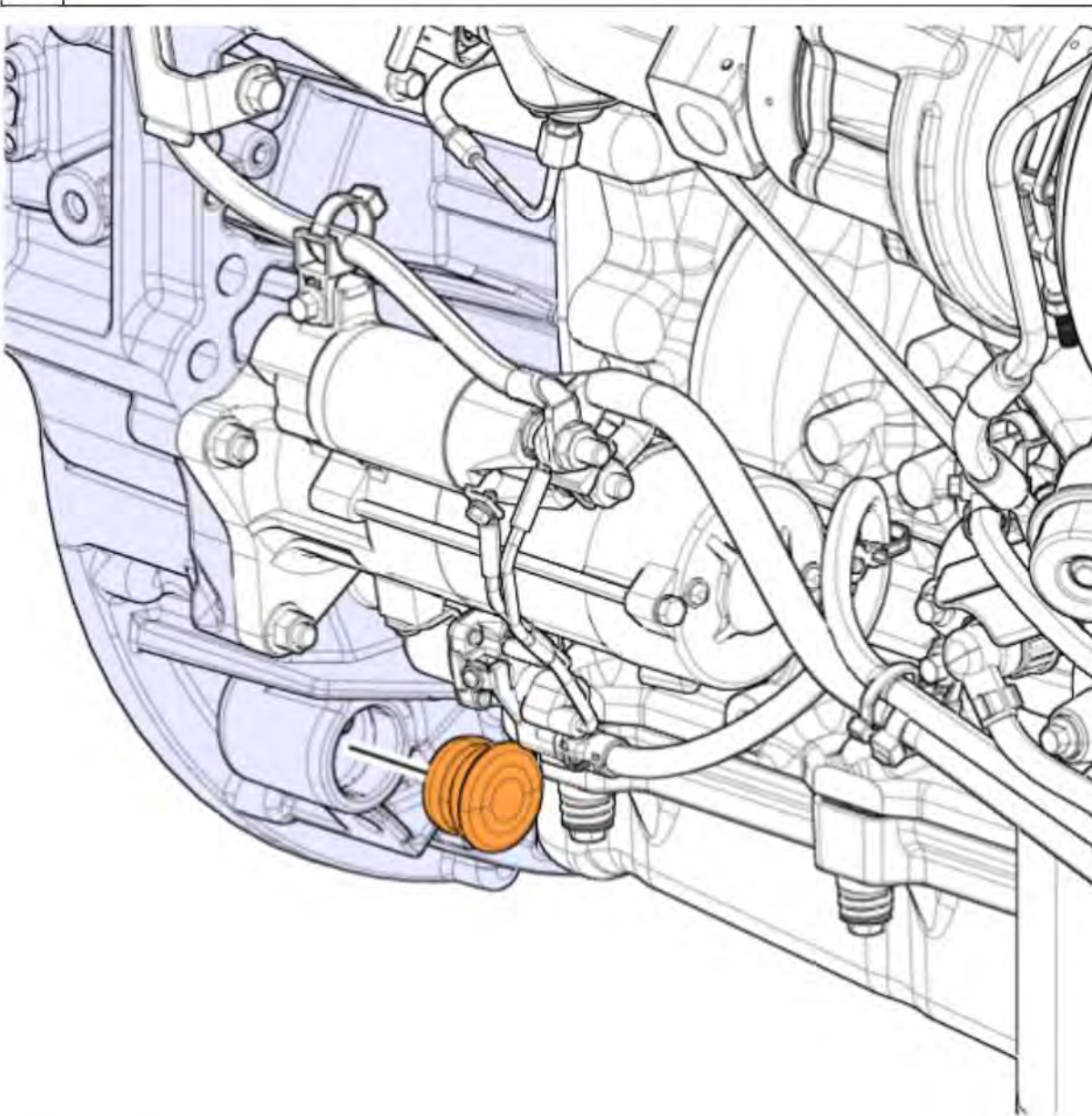
Discard the gasket.



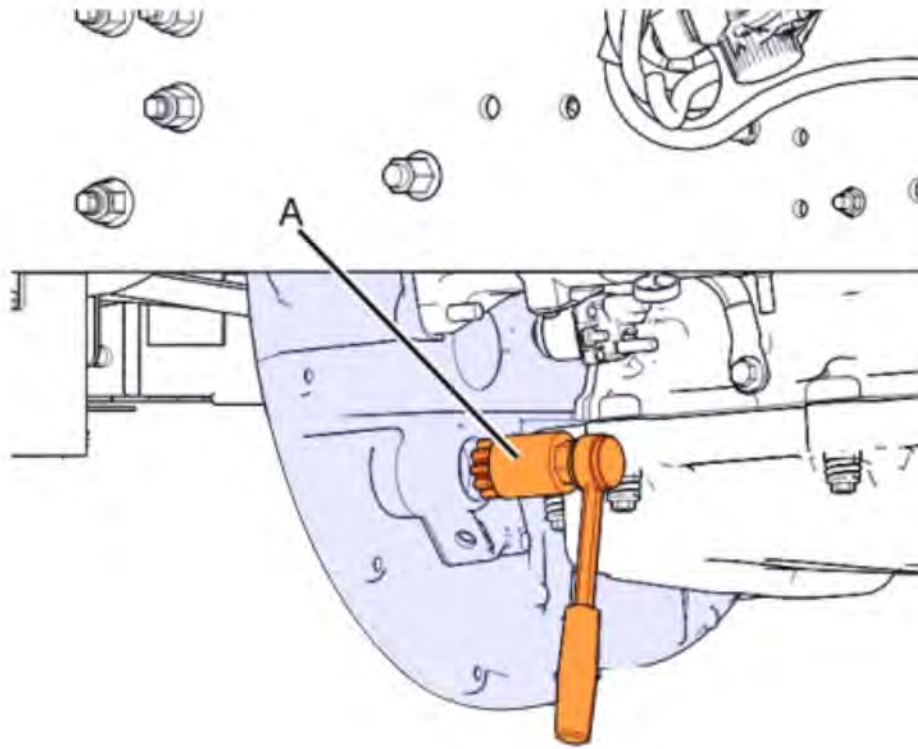
125 Remove the plug.

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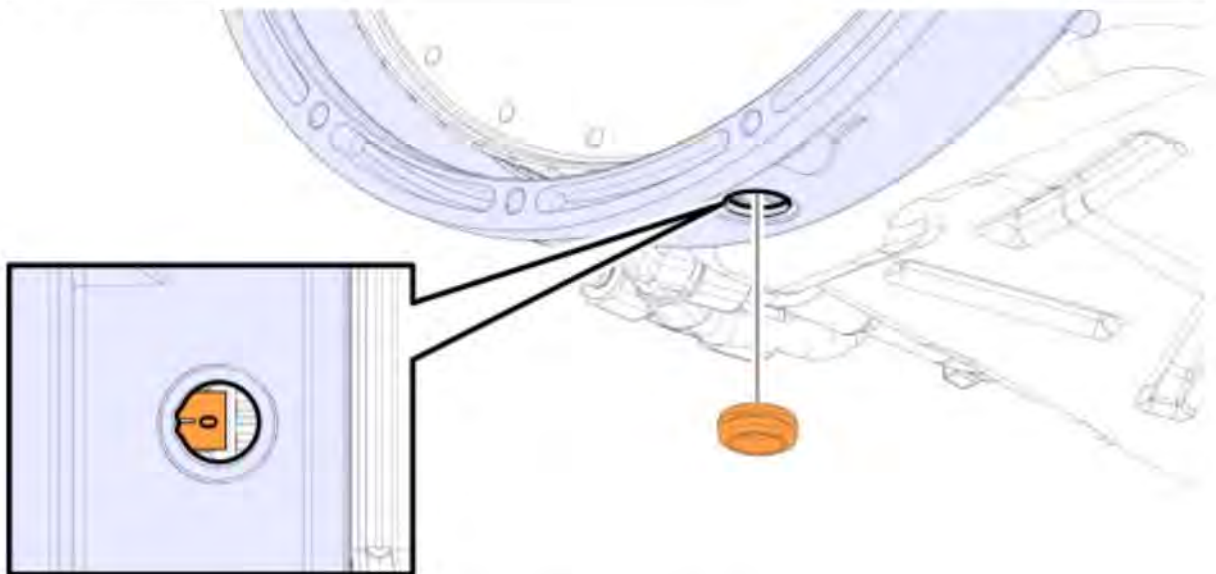


| | |
|--------------------------|--------------------------------|
| 126 | Install the cranking tool (A). |
| Required material | |
| CRANKING TOOL | 88840317 |



127 Remove the plug.

128 Check the marking (0).



129 Perform this procedure when the condition below is met.

Conditions

- If the flywheel is not in the TDC (Top Dead Center) position.

- ▶ Rotate the flywheel to the TDC marking (0).

Note
Do not use power tools.

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Note

Rotate the flywheel in the normal engine rotation direction.

130 This step contains 2 alternatives.

Select one of the valid alternatives below.

Alternative 1 / 2

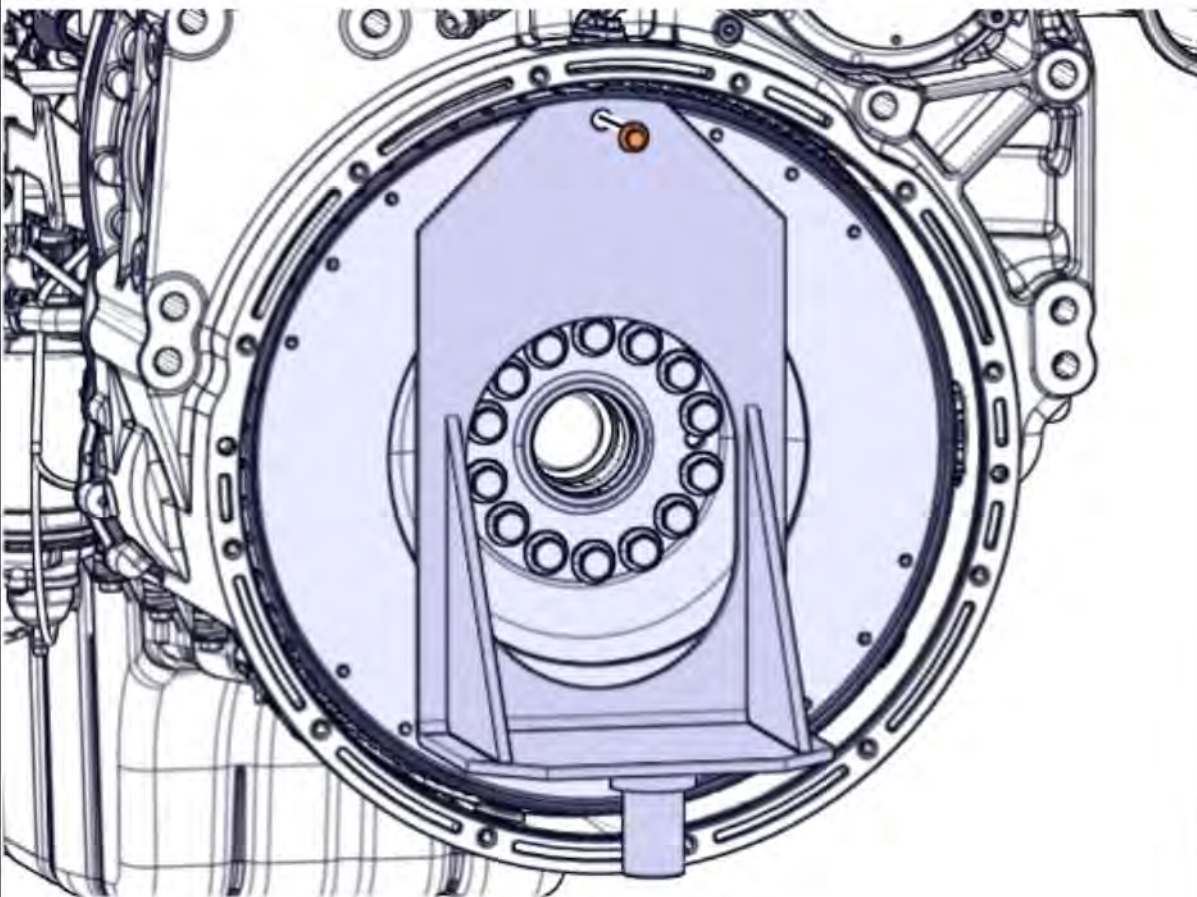
- ▶ Install the tool.

Required material

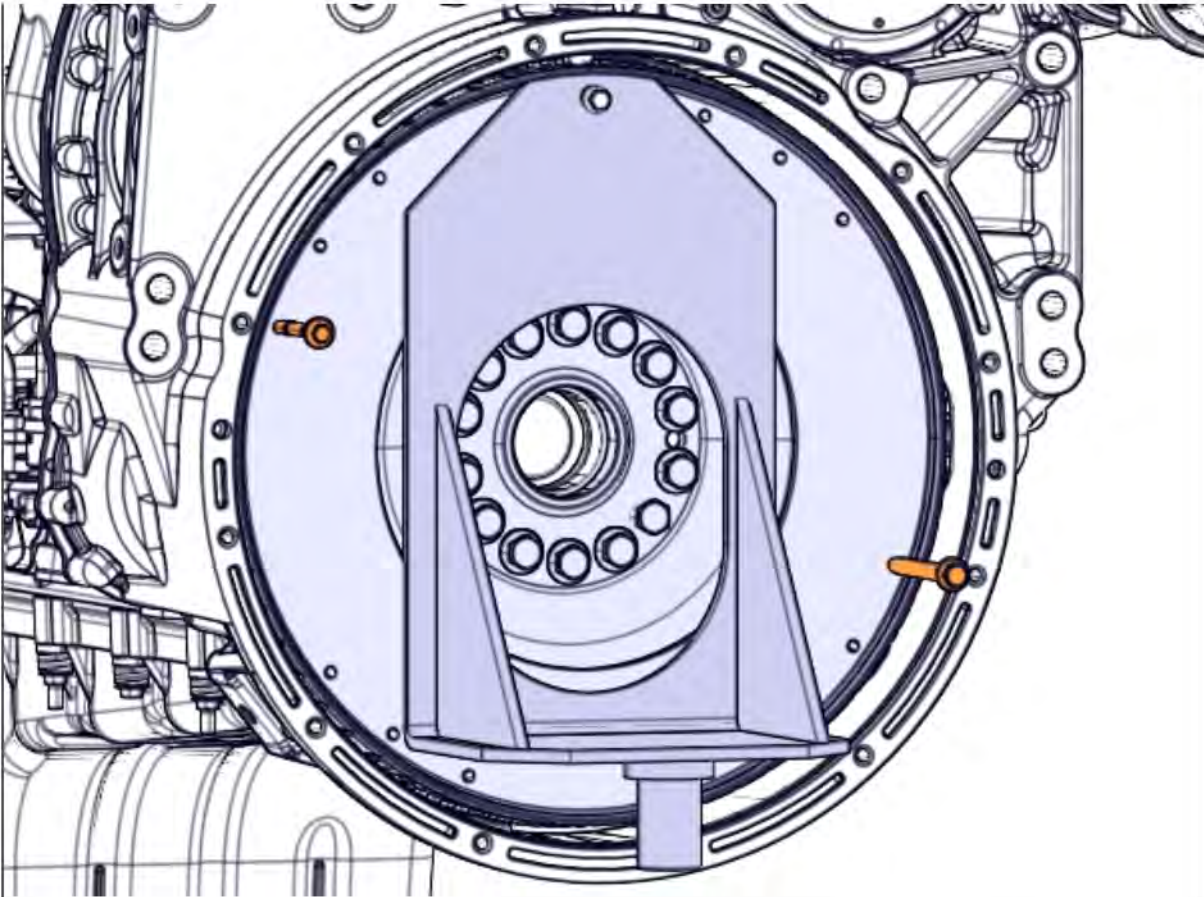
fixture

[88800570](#)

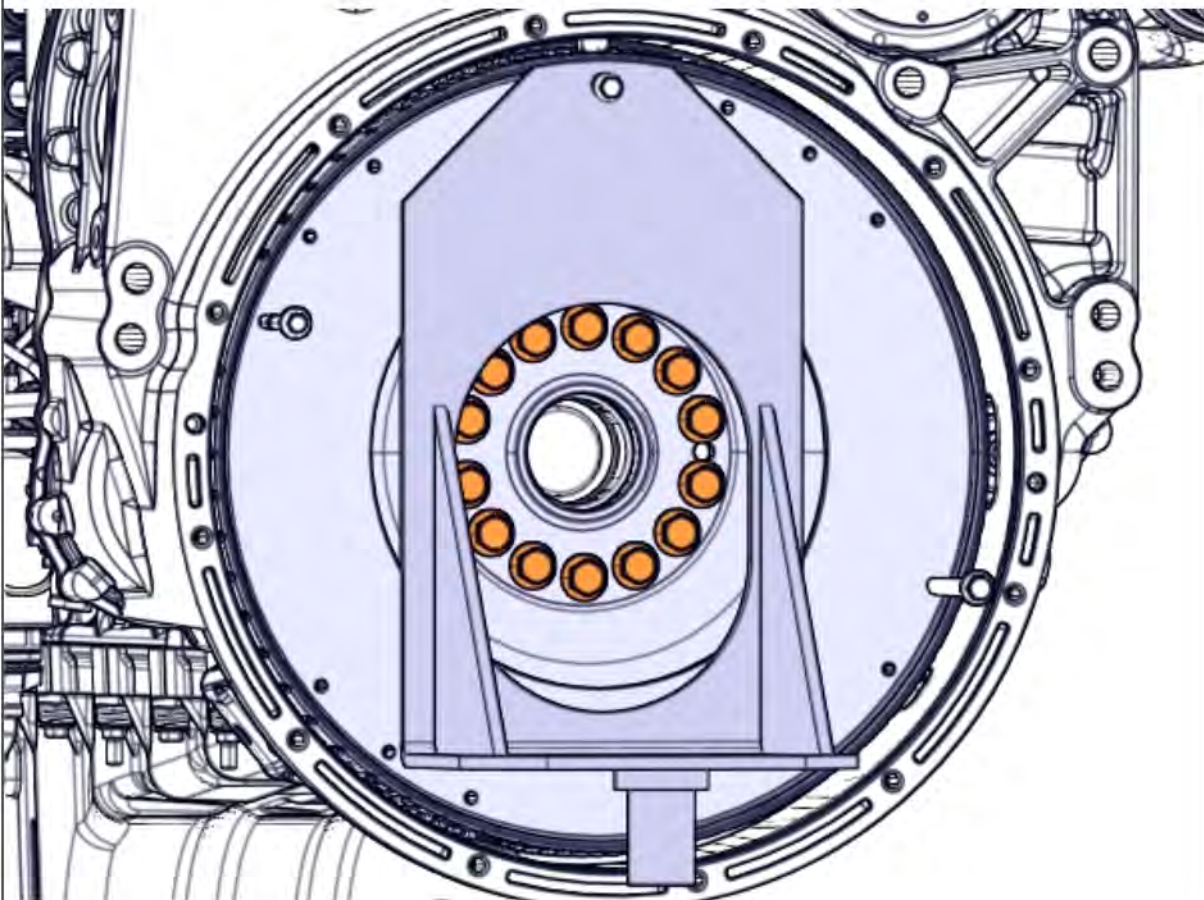
- ▶ Install the screw.



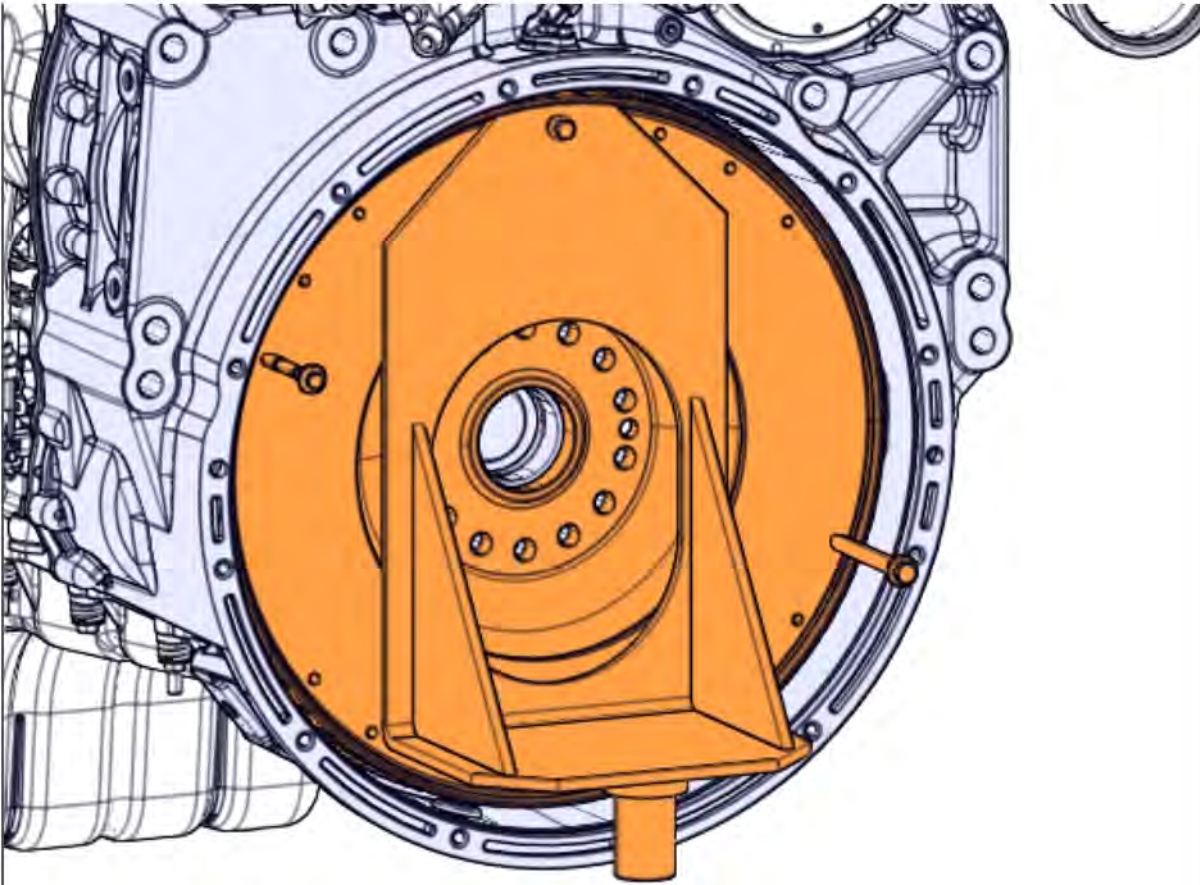
- ▶ Install the screws.



▶ Remove the screws.

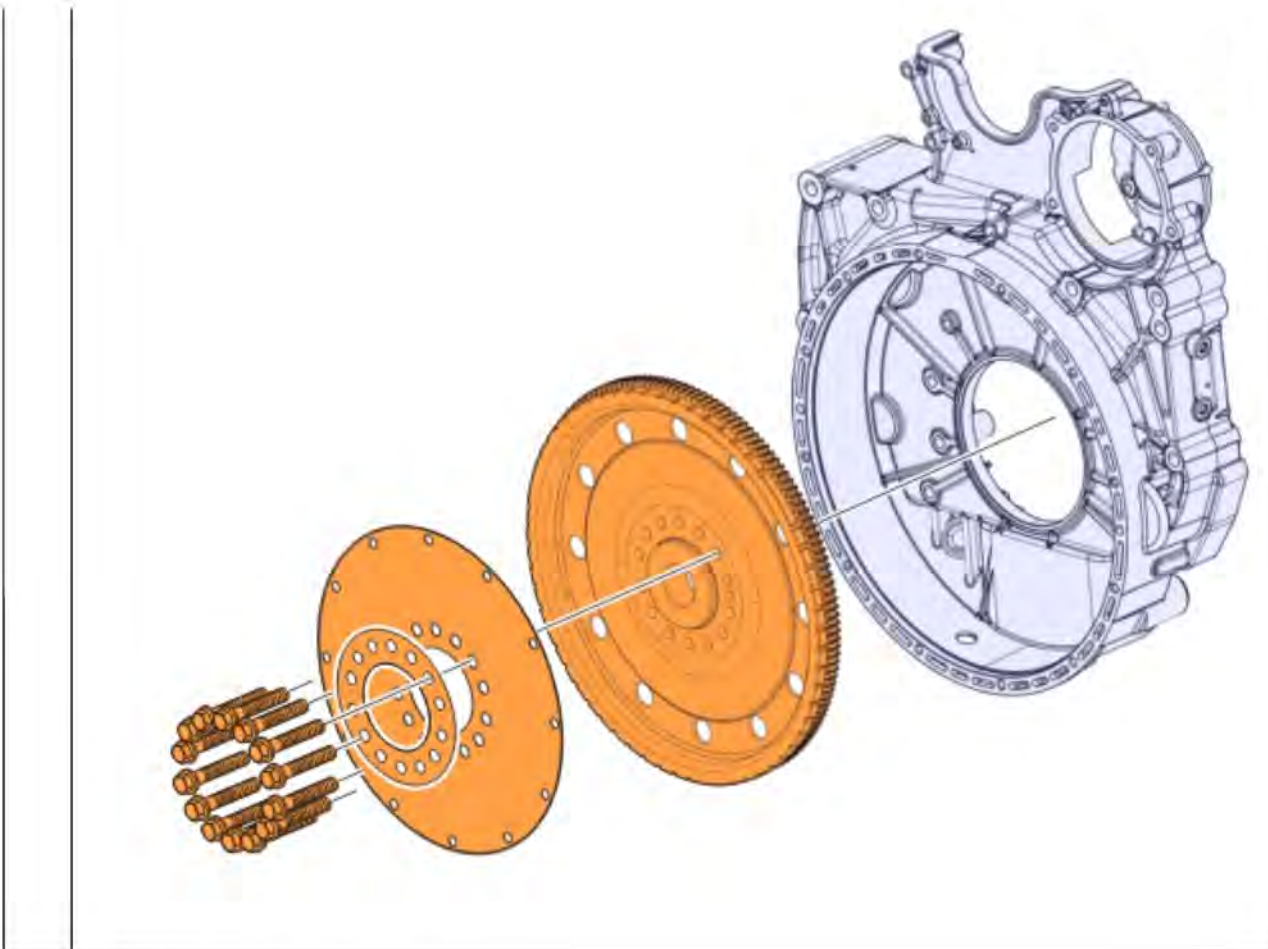


▶ Remove the flywheel.



Alternative 2 / 2

- ▶ Remove the screws.
- ▶ Remove the thrust plate.
- ▶ Remove the flexplate.
- ▶ Remove the flywheel.



131 Position a draining container.



WARNING

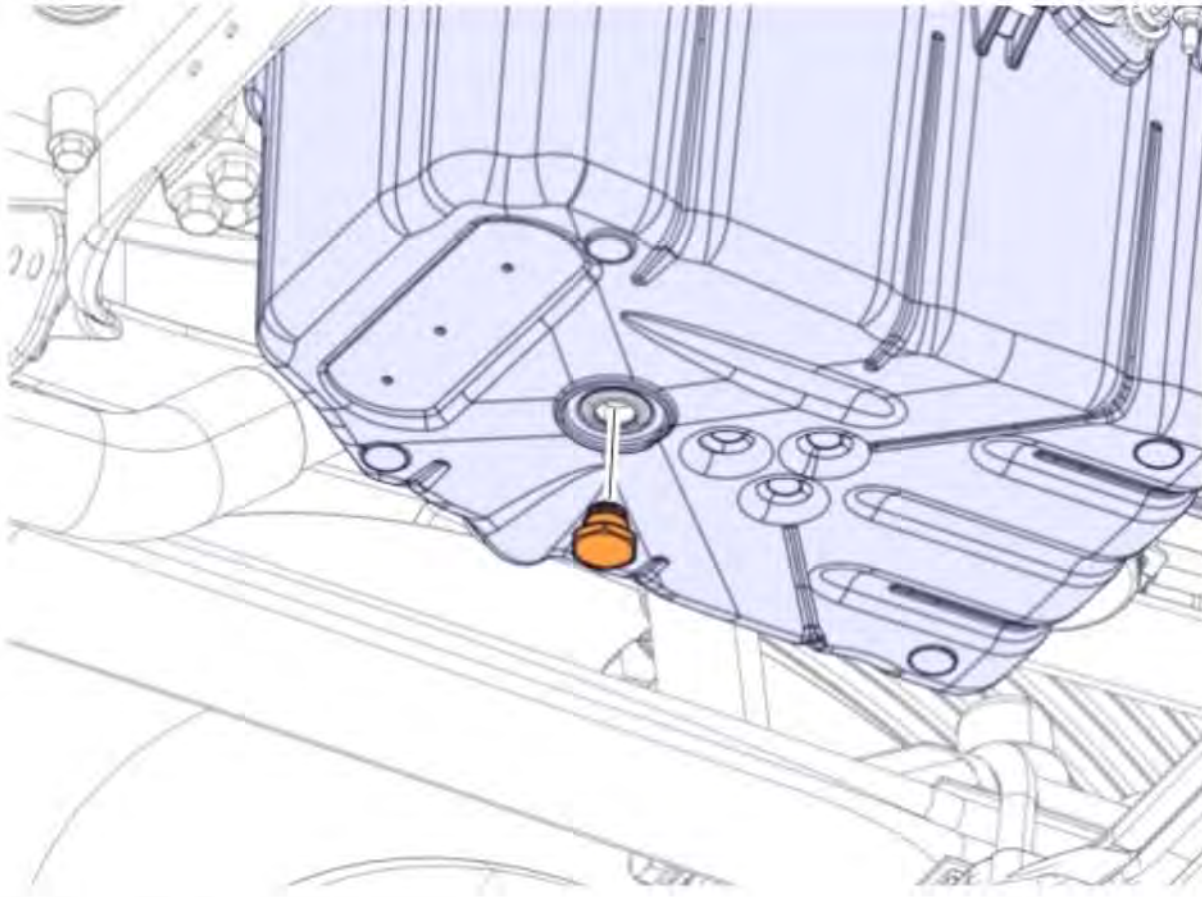
Risk of serious burns.

Contact with a hot engine or hot engine oil can cause serious burns.

- ▶ Take precautions when draining the oil. Wear gloves and let the engine cool down before draining.

132 Remove the drain plug.

133 Drain the oil.





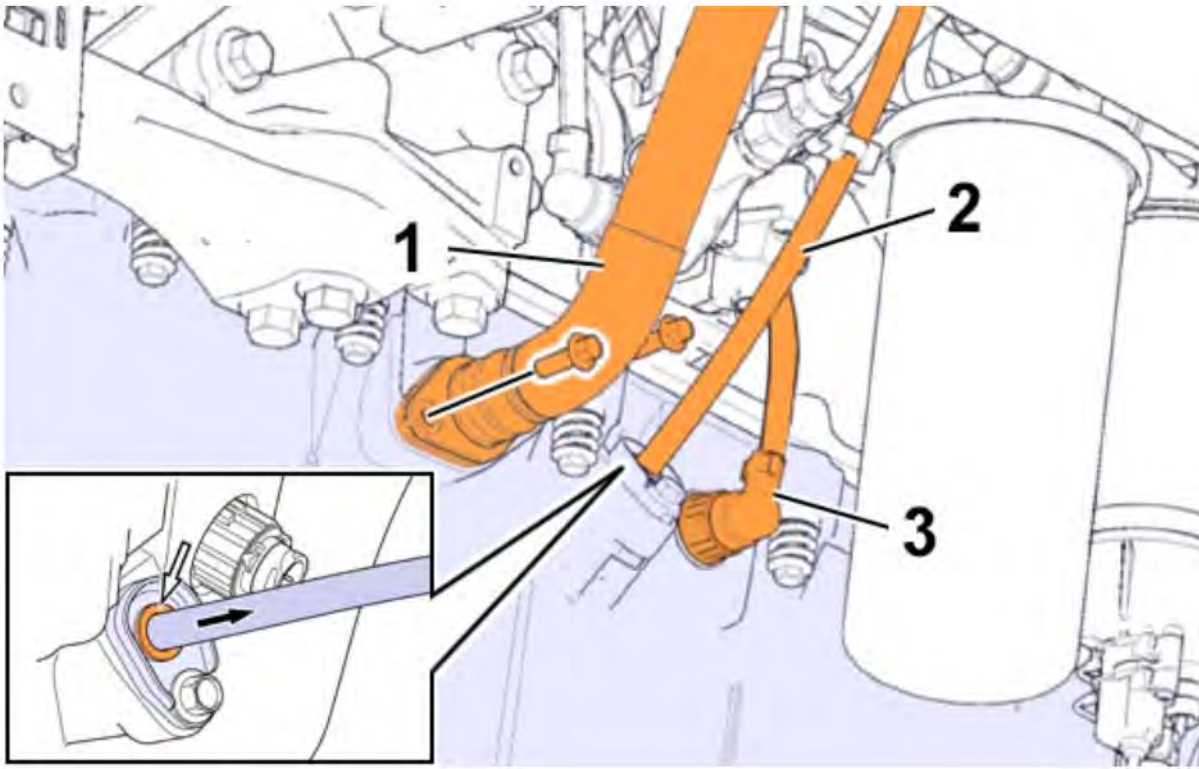
| | | | |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------------------------------------|
| 134 | Install the drain plug. | | |
| | <table border="1" style="width: 100%;"> <tr> <td style="width: 10%; text-align: center;">i</td> <td>Note Always use a new gasket.</td> </tr> </table> | i | Note Always use a new gasket. |
| i | Note Always use a new gasket. | | |

| | | |
|------------|--------------------------|------------------------------------------|
| 135 | Torque tighten the plug. | |
| | Tightening torque | |
| | Oil pan, drain plug | 60 ±10 Nm (44 ±7 lb _f ·ft) |

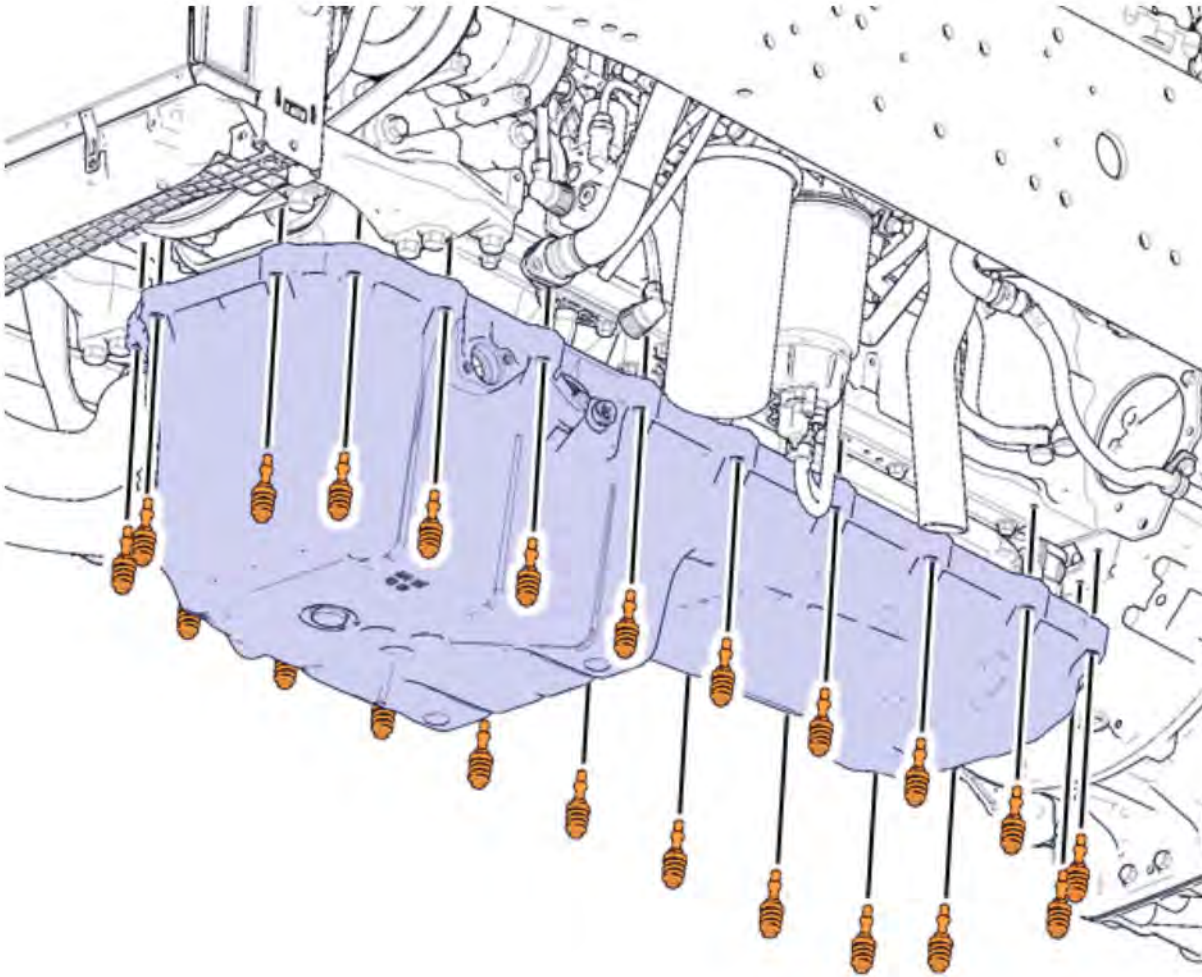
| | | |
|------------|--------------------------------------------------------------|----------------------------|
| 136 | Remove the dipstick. | |
| | Tech data | |
| | The distance the dipstick is drawn out from the outer casing | ≈ 0.5 m (1 ft – 7.7 in) |



| | |
|-------------------------------------------------------------------------------------|--------------------------------------------------------|
| 137 | Disconnect the connector (3). |
| 138 | Depress the release ring (2) remove the dipstick pipe. |
|  | <p>Note Pull to remove.</p> |
|  | <p>Note Use a suitable tool to depress.</p> |
| 139 | Remove the screws. |
| 140 | Remove the pipe (1). |



| | |
|-----|--------------------|
| 141 | Remove the screws. |
|-----|--------------------|

**142** Remove the oil pan.**Note**

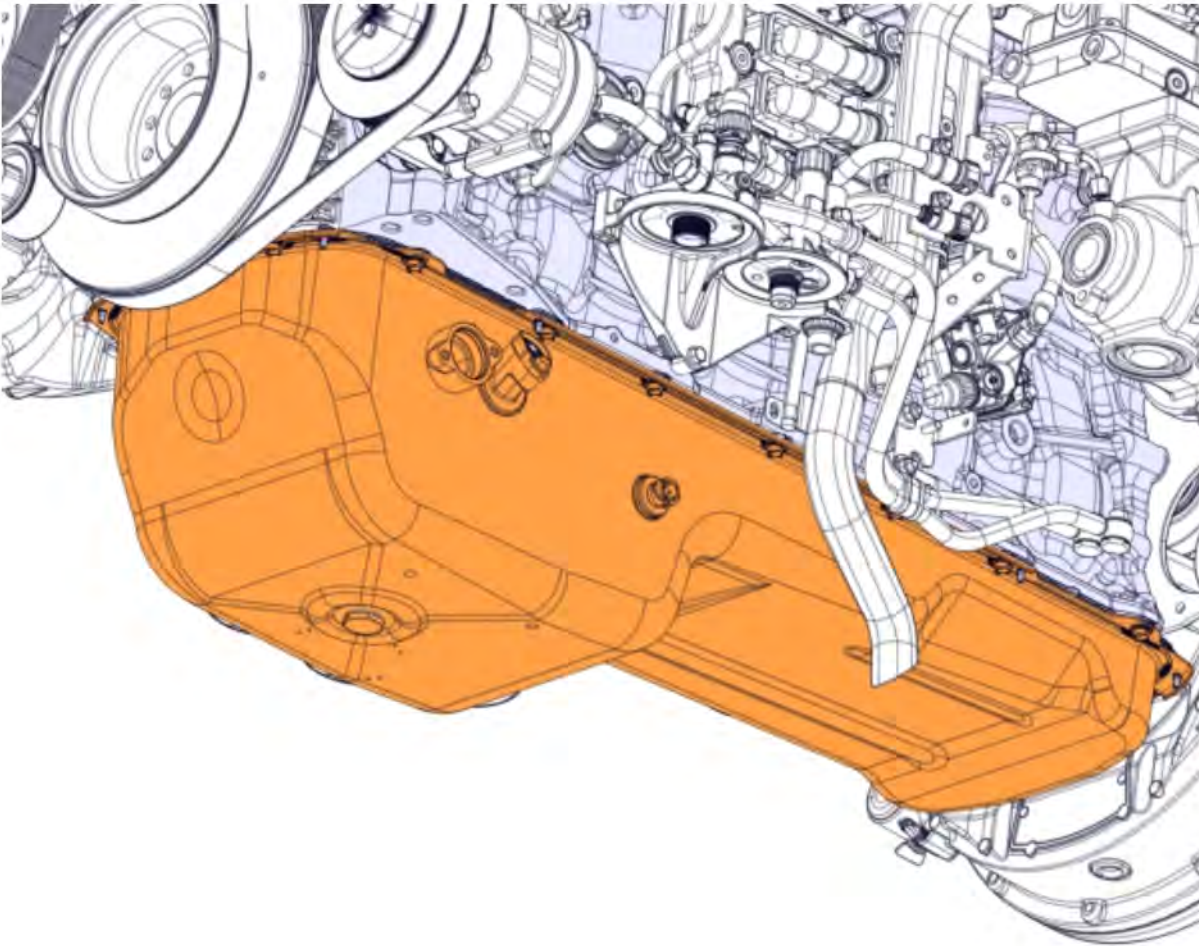
Get help if needed.

**Note**

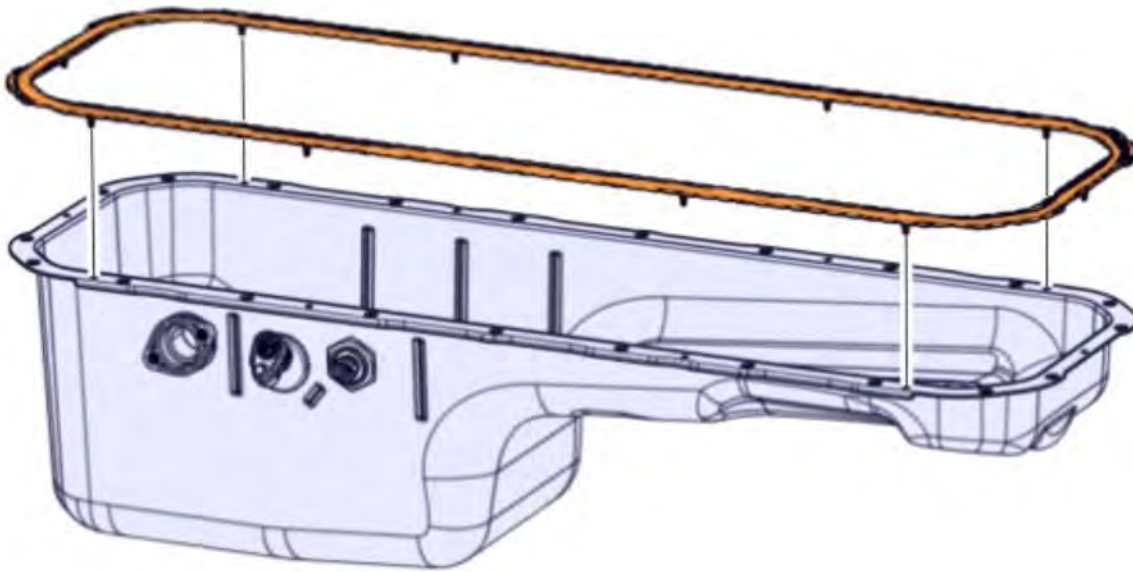
Lower the component carefully.

**Note**

Ensure that there is no damage to the oil pickup tube and oil pump gear.

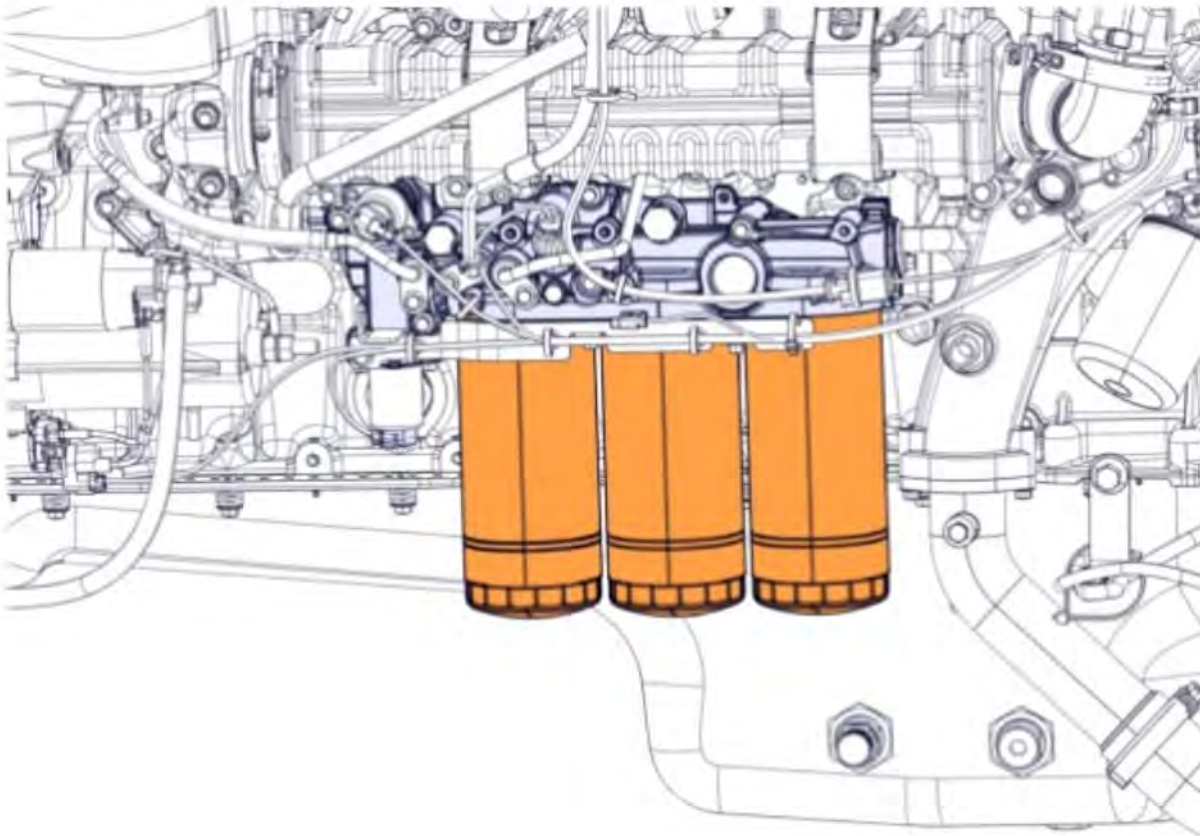


| | |
|-----|--------------------|
| 143 | Remove the gasket. |
|-----|--------------------|



| | |
|-----|-------------------------------|
| 144 | Clean the oil filter housing. |
|-----|-------------------------------|

| | |
|-----|-------------------------|
| 145 | Remove the oil filters. |
|-----|-------------------------|



146 This step contains 2 alternatives.
 Select one of the valid alternatives below.

Alternative 1 / 2

Conditions

- Old variant of seal

▶ Install tool (B) on tool (A).

Required material

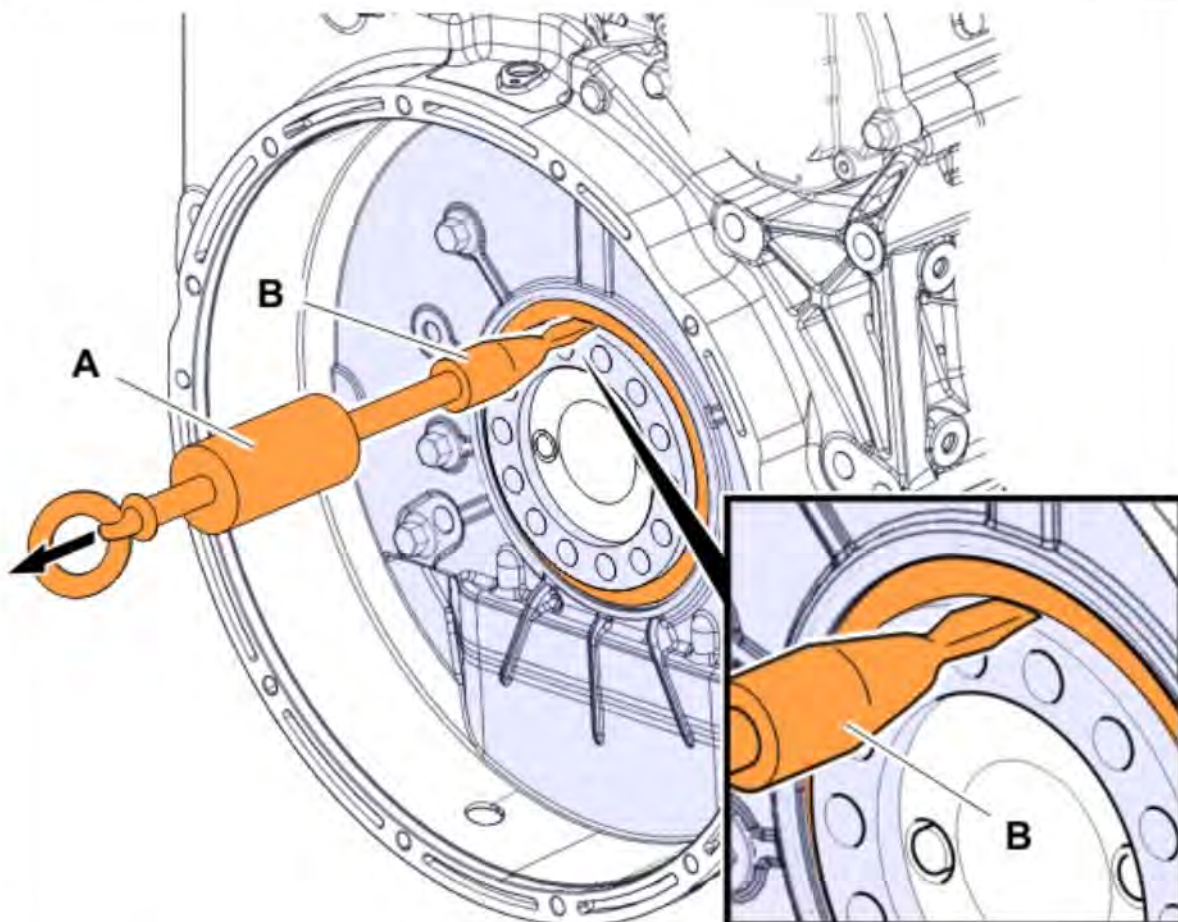
| | |
|---------------|-------------------------|
| IMPACT WRENCH | 9996400 |
| puller | 9990192 |

i Note
 Ensure that the tools are clean and intact.

▶ Insert the puller (B) between the seal and the crankshaft using an impact wrench (A).

i Note
 Take care not to damage the crankshaft surface.

▶ Remove the seal.



Alternative 2 / 2

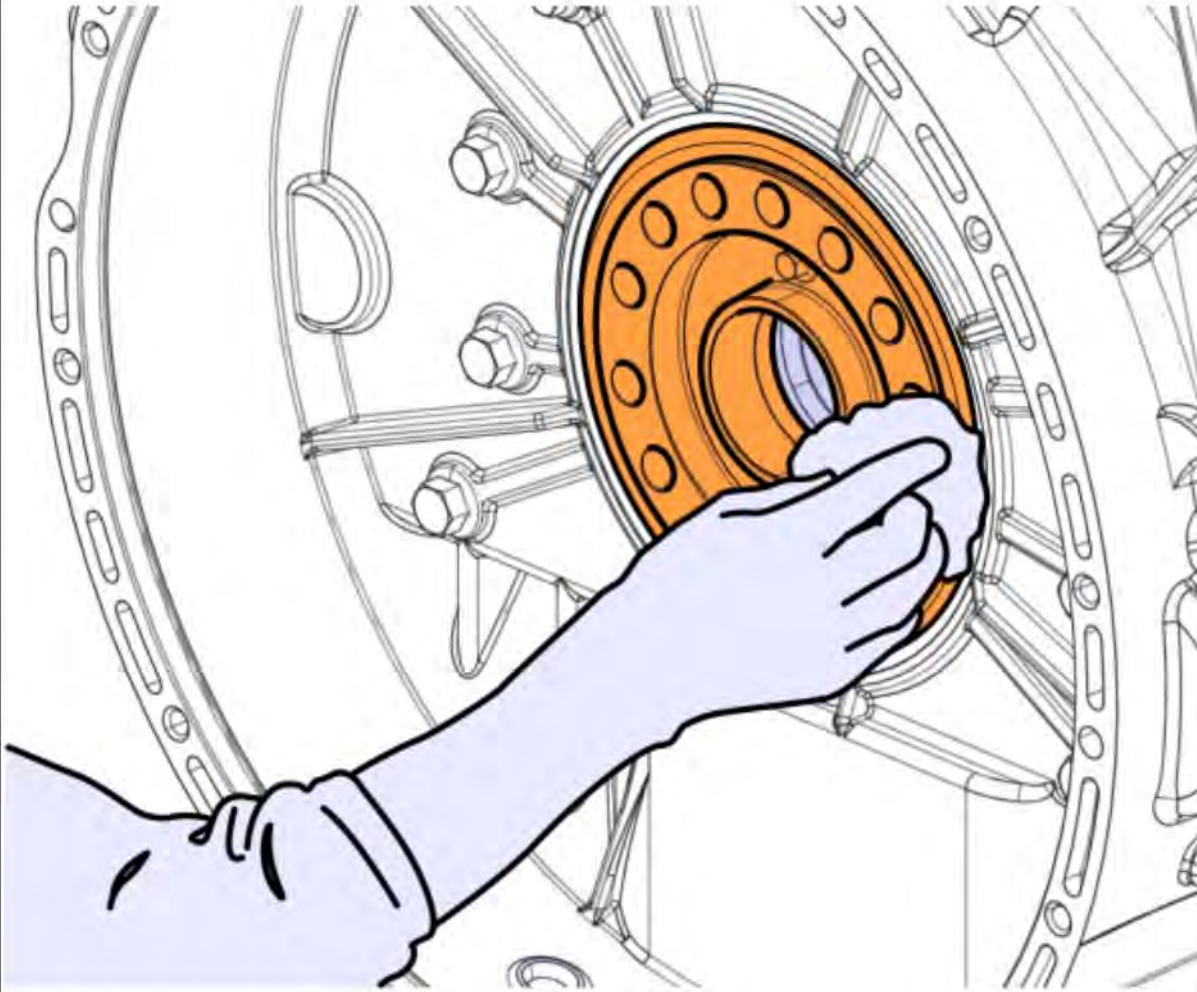
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Conditions

- New variant of seal

- ▶ Clean the area around the seal.



- ▶ Release the seal.



Service hint

Tap the seal to loosen it from the contact surfaces.



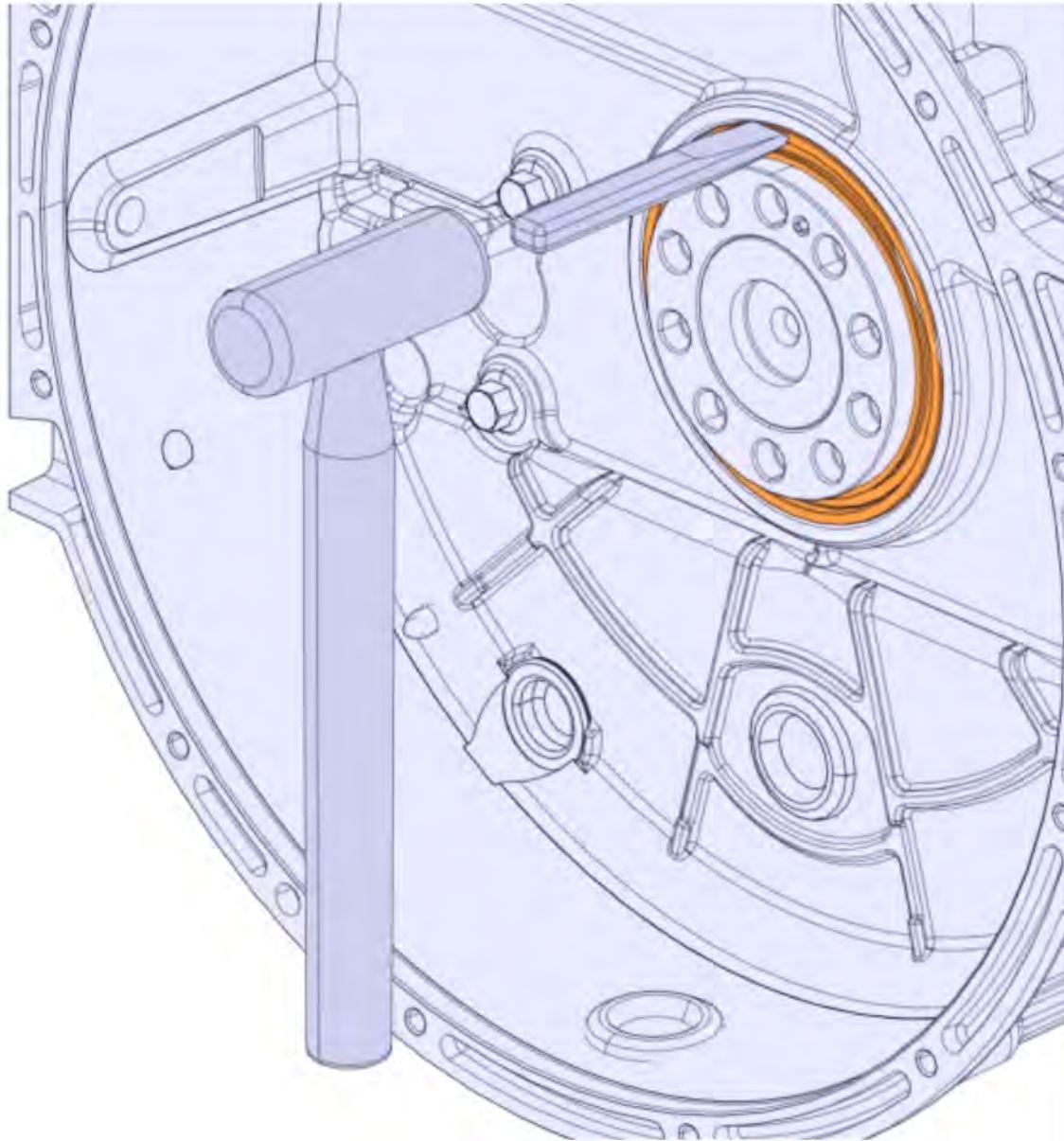
Service hint

Use a plastic chisel and a hammer.



Service hint

Lubricate the contact surfaces to facilitate removal of the seal.



► Install the tool.

Required material

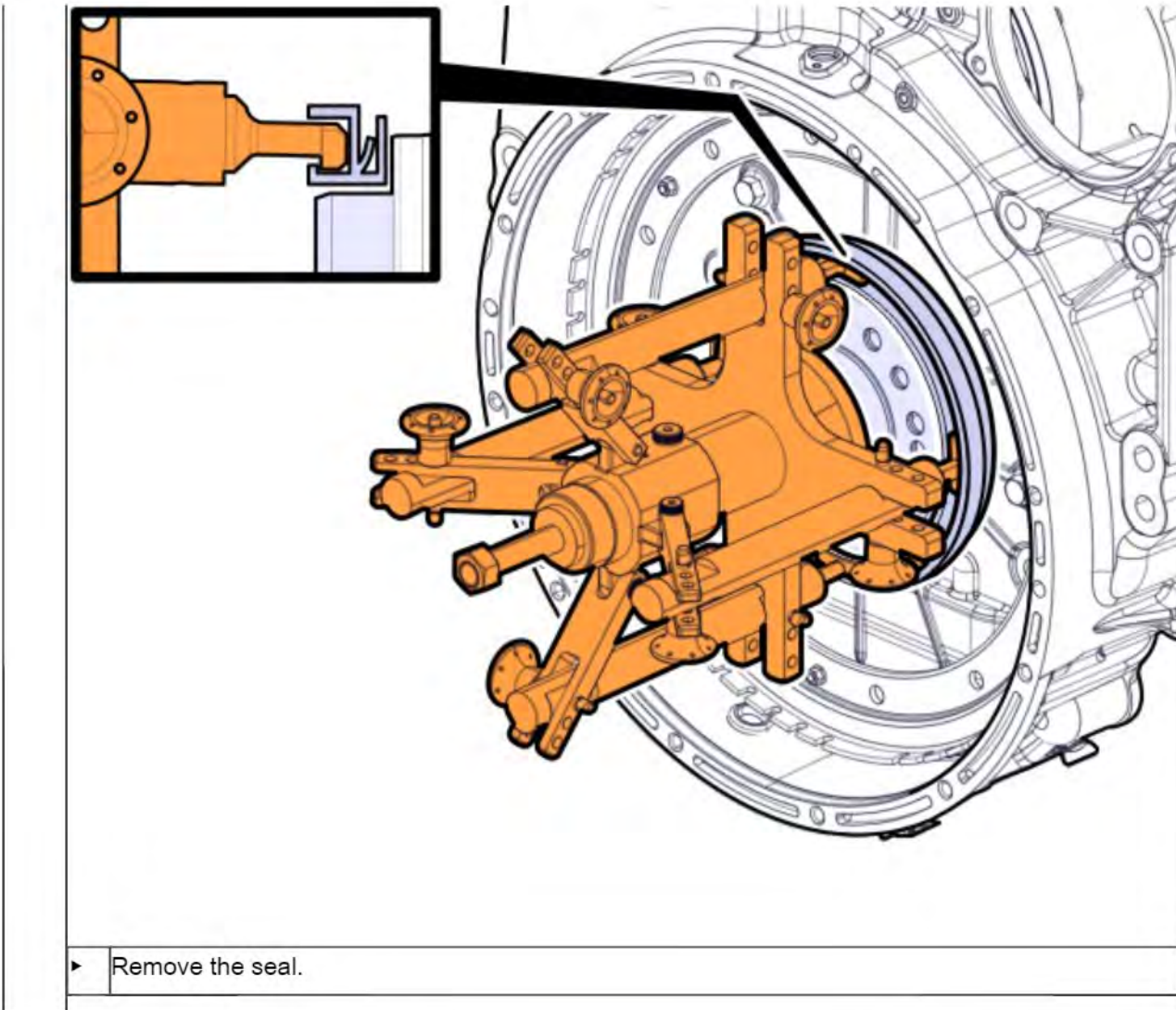
DISASSEMBLY TOOL

[88800502](#)

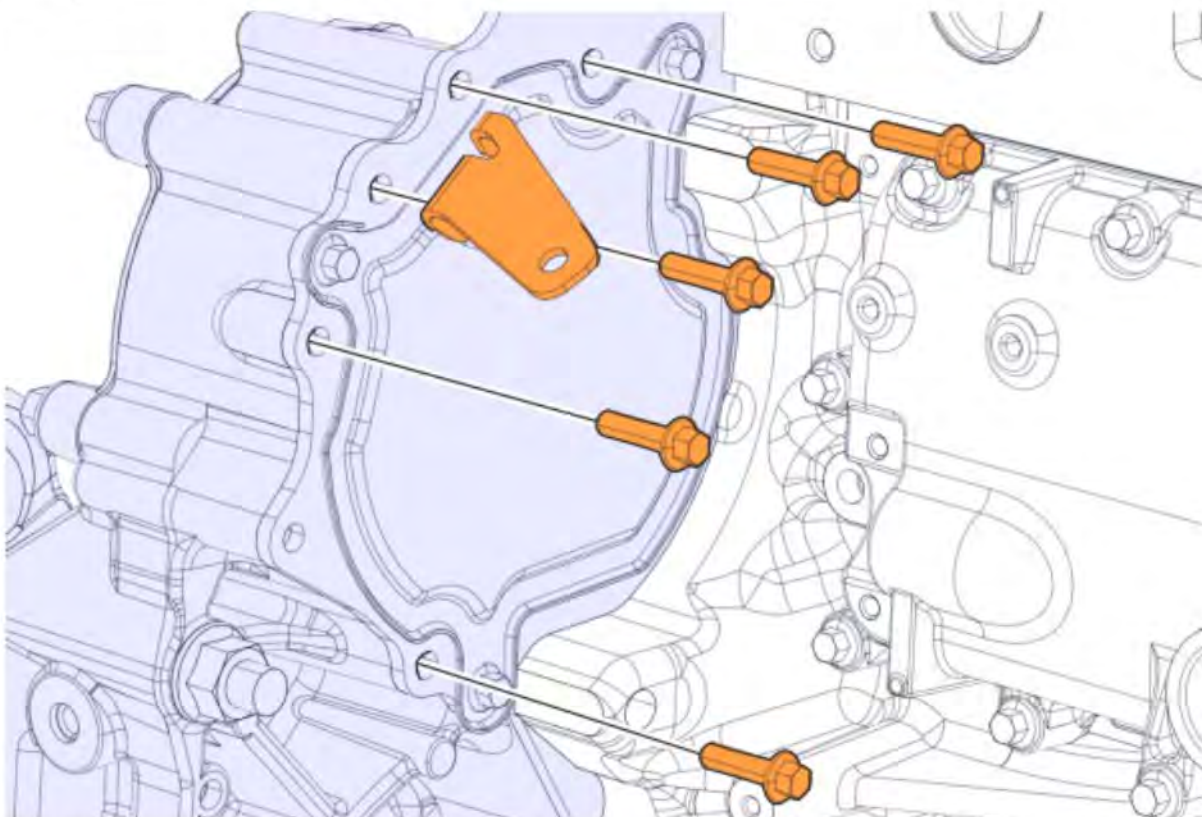


Note

The arms of the tool can be adjusted to different diameters.



147 Remove the screws and bracket.



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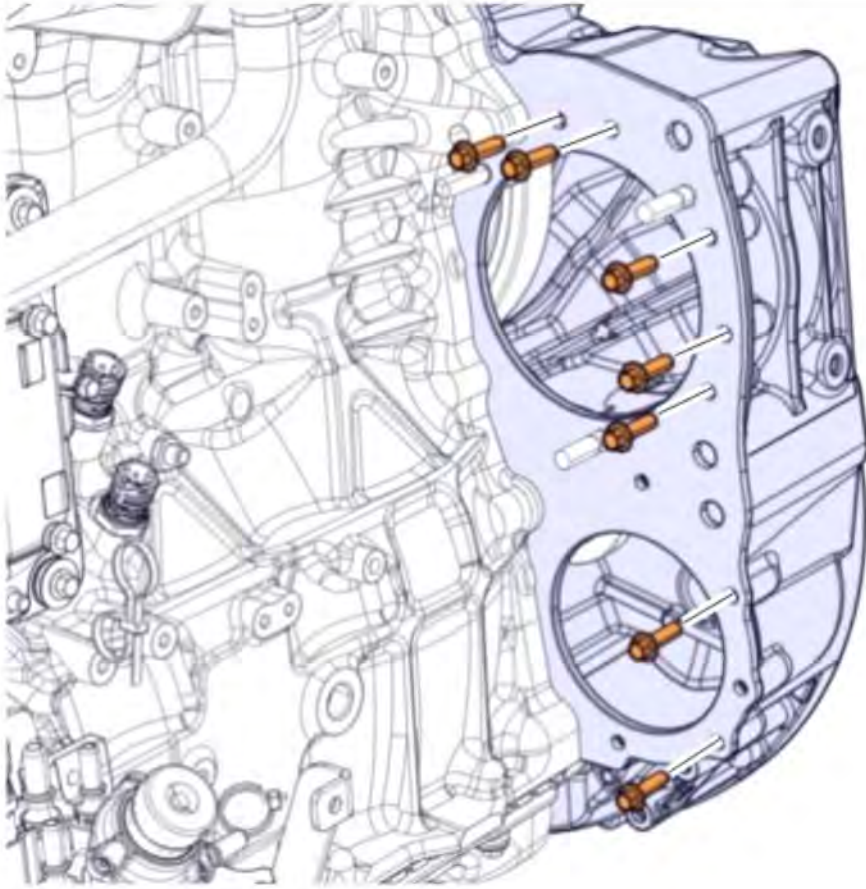
The information contained herein is current at the time of its original distribution, but is subject to change. The reader is advised that printed copies are uncontrolled.

148 Remove the screws.

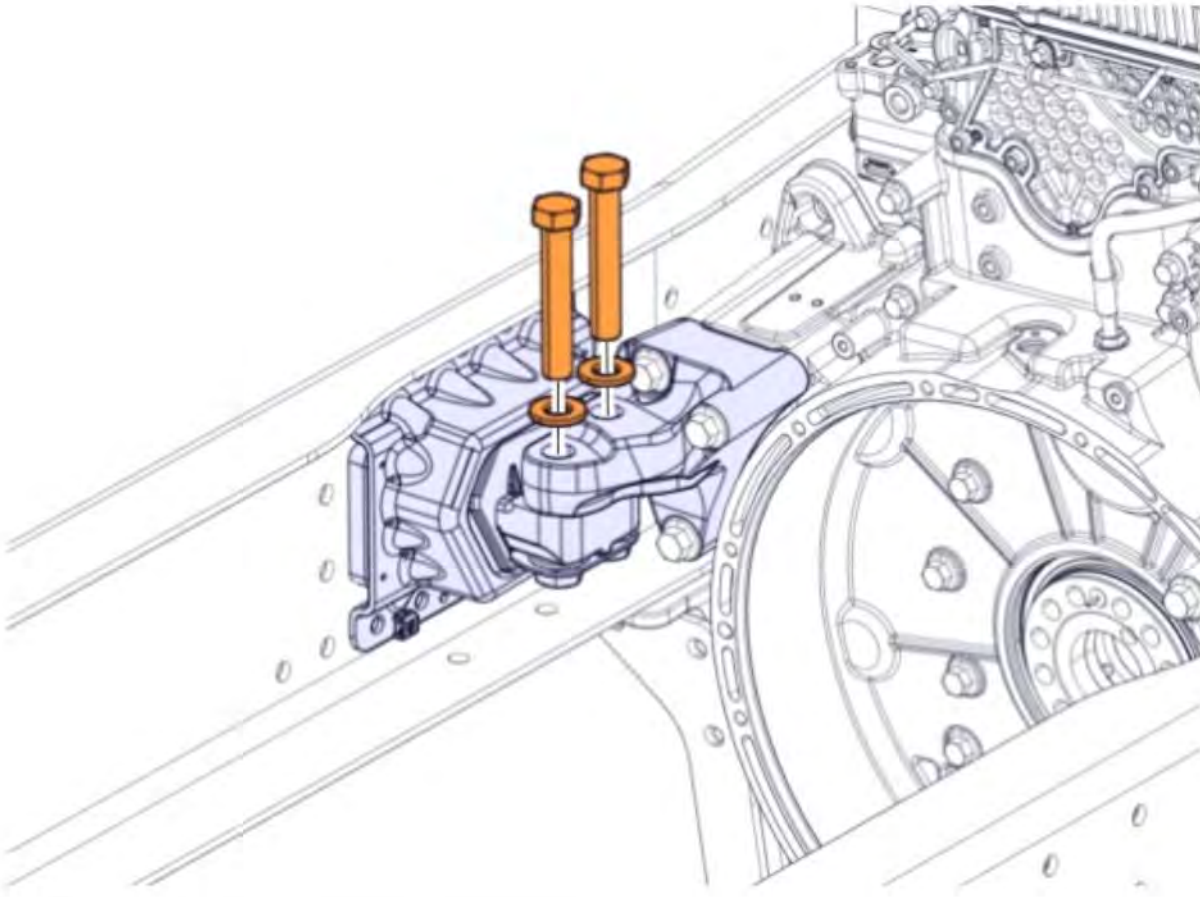


Note

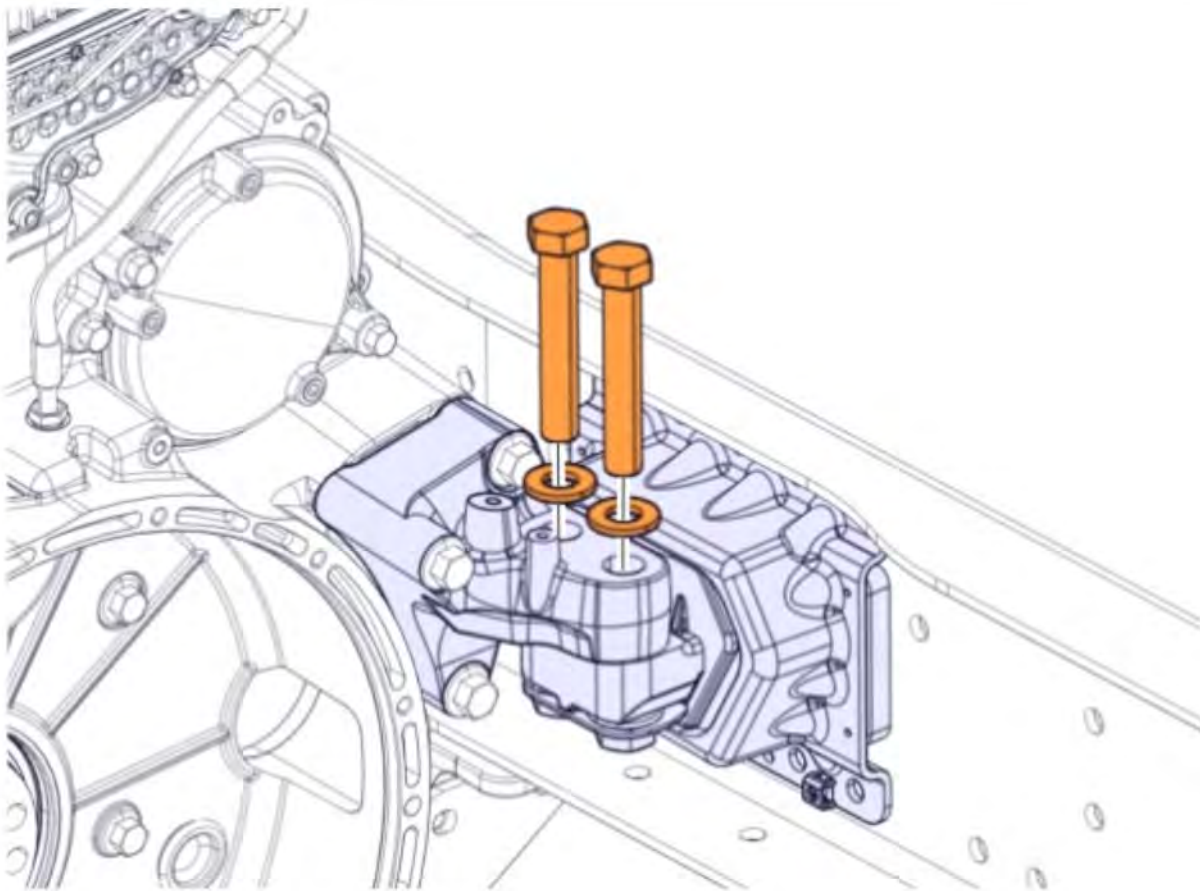
Some housings may not include all the screws shown.



149 Remove the screws.



150 Remove the screws.



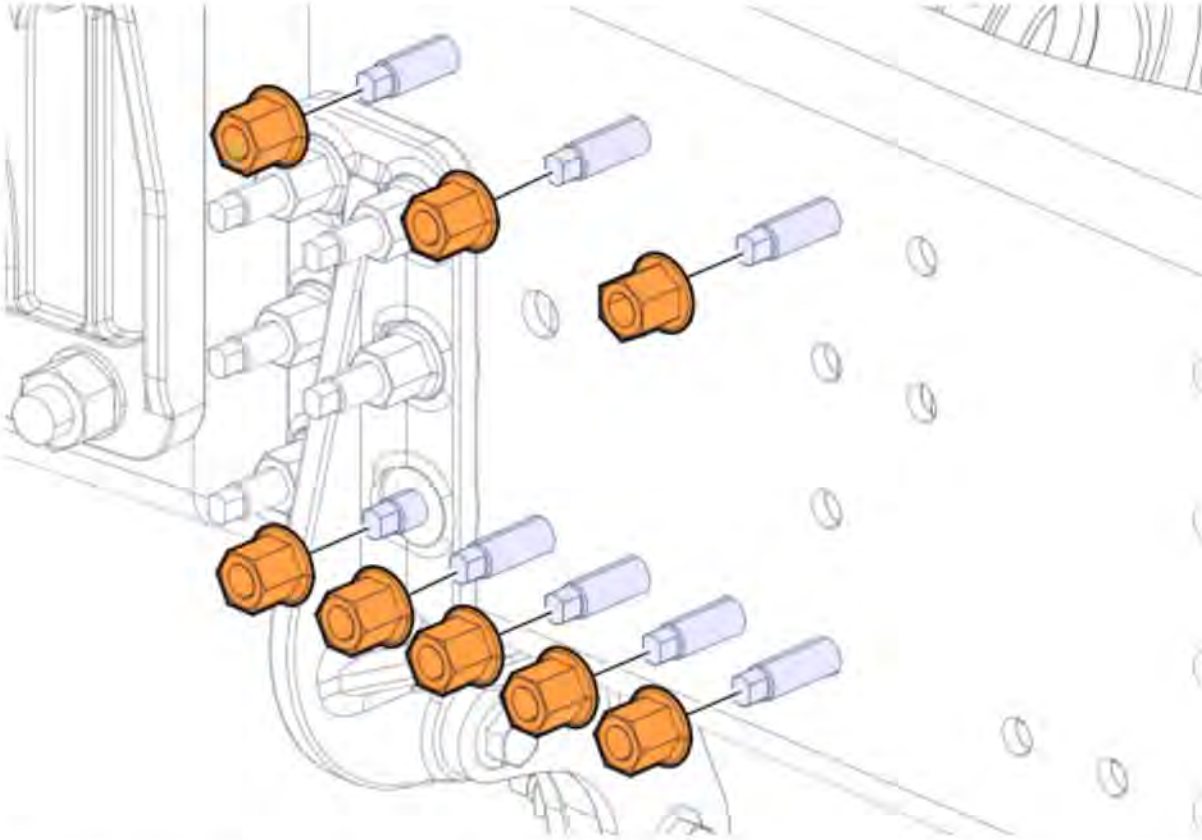
| | |
|-----------------------------------------------------------------------------------|----------------|
|  | CAUTION |
|-----------------------------------------------------------------------------------|----------------|

Risk of serious injury.
Heavy component.

▶ Exercise caution when moving the component. Use appropriate tools.

151 Safely lift and support the engine.

152 Remove the nuts.



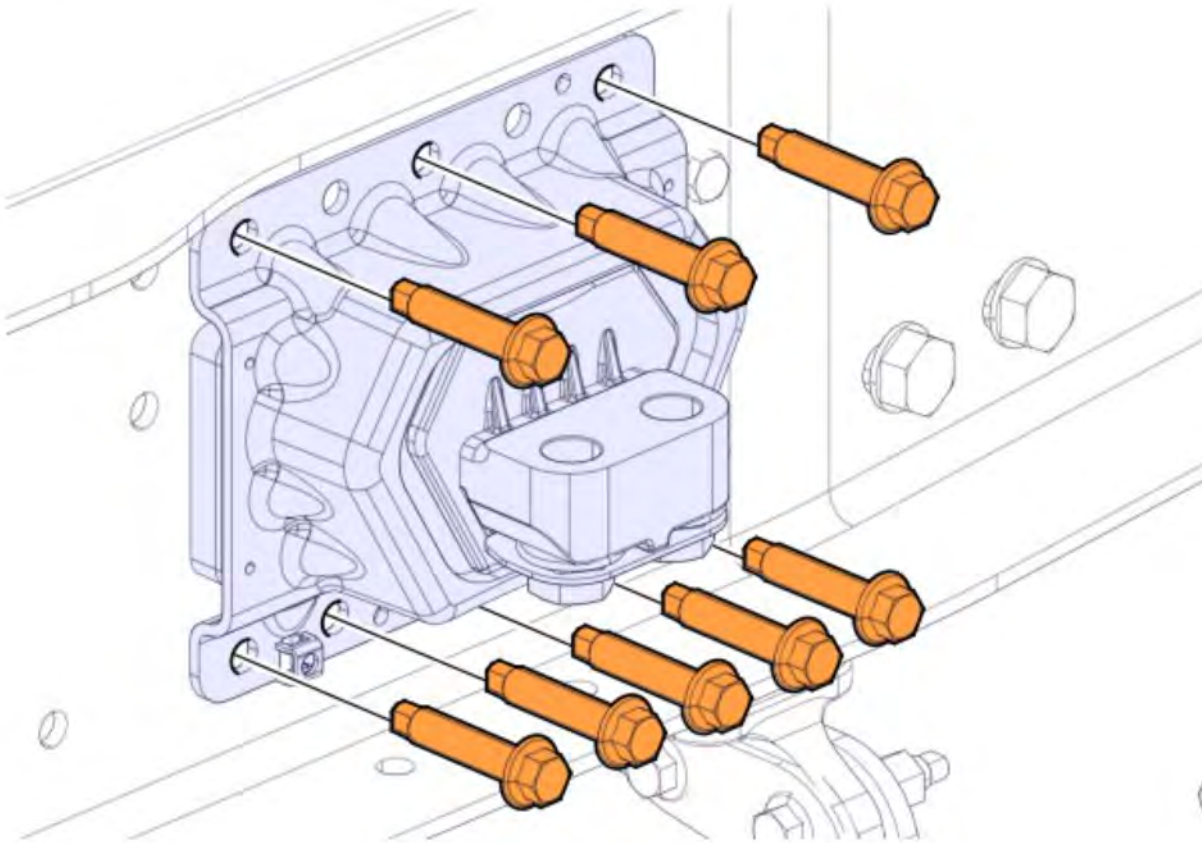
153 Perform this procedure when the condition below is met.

Conditions

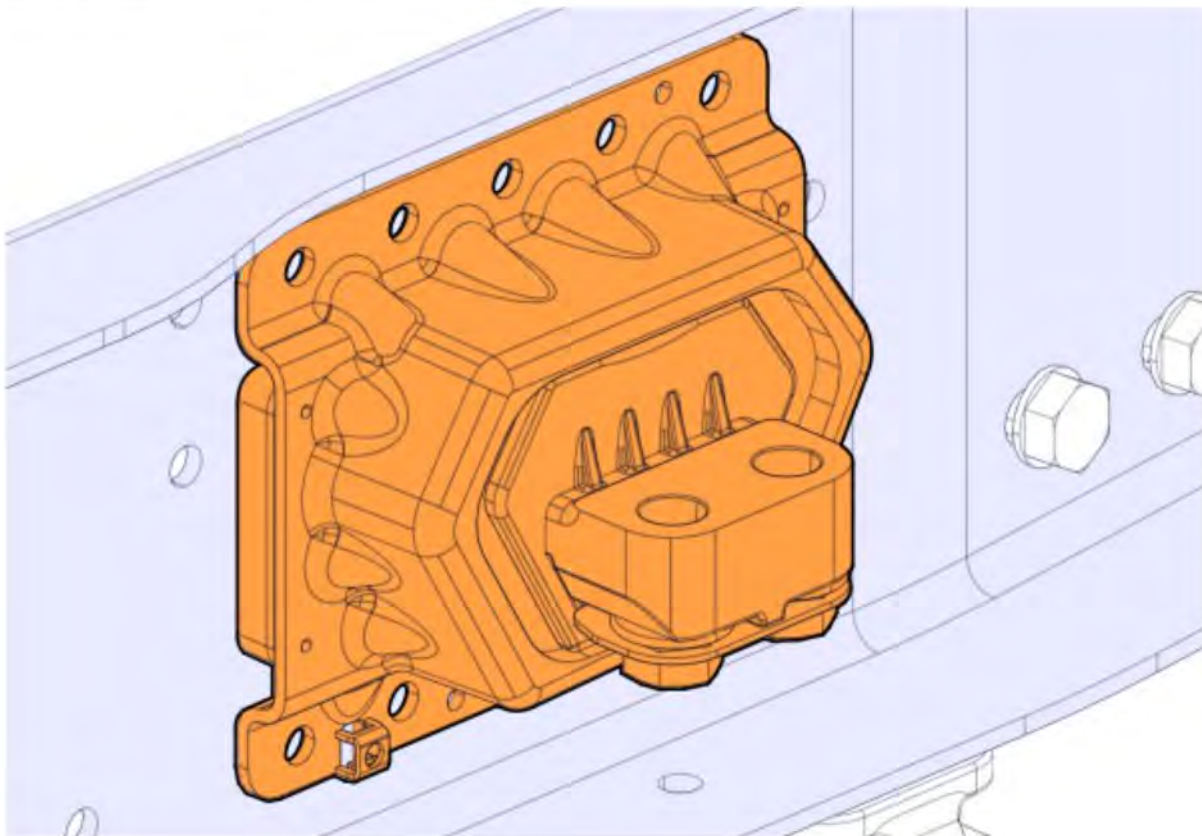
- If the screw has a non-removable nut

▶ Cut the nut to remove it.

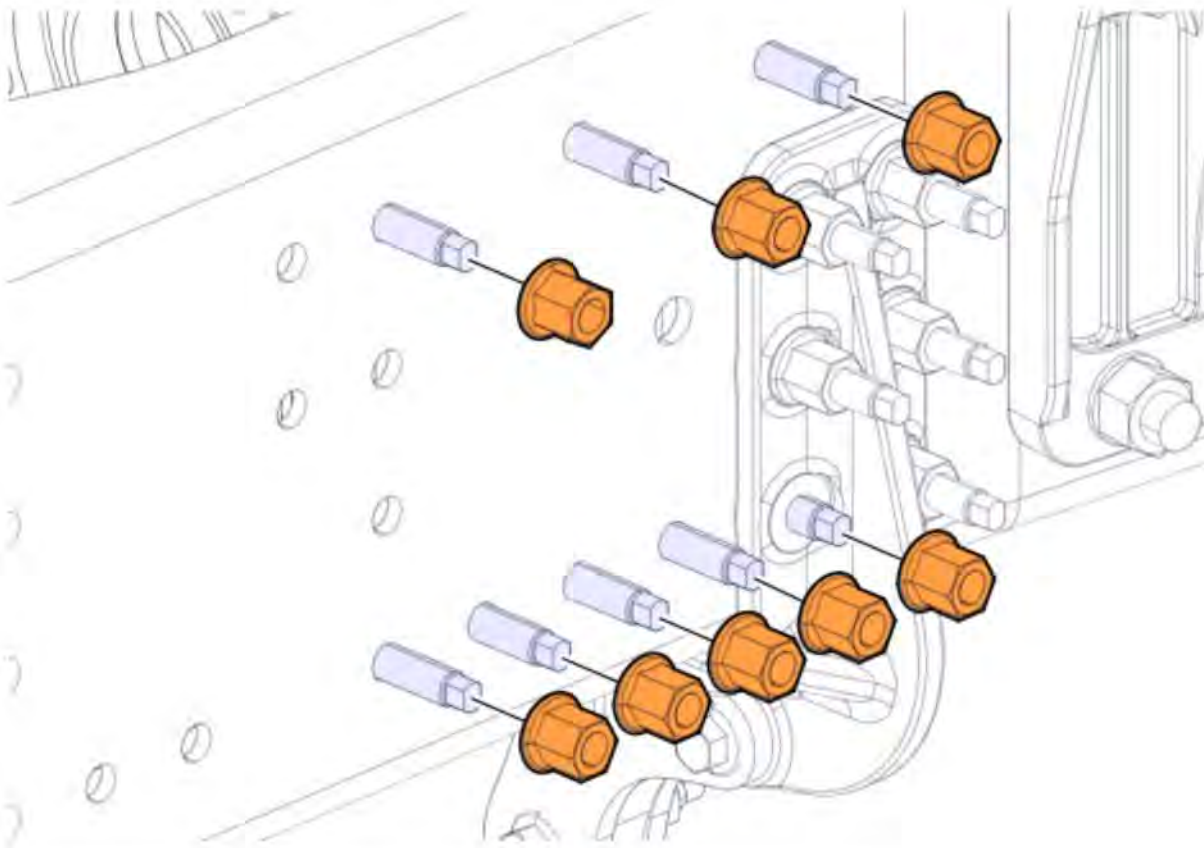
154 Remove the screws.



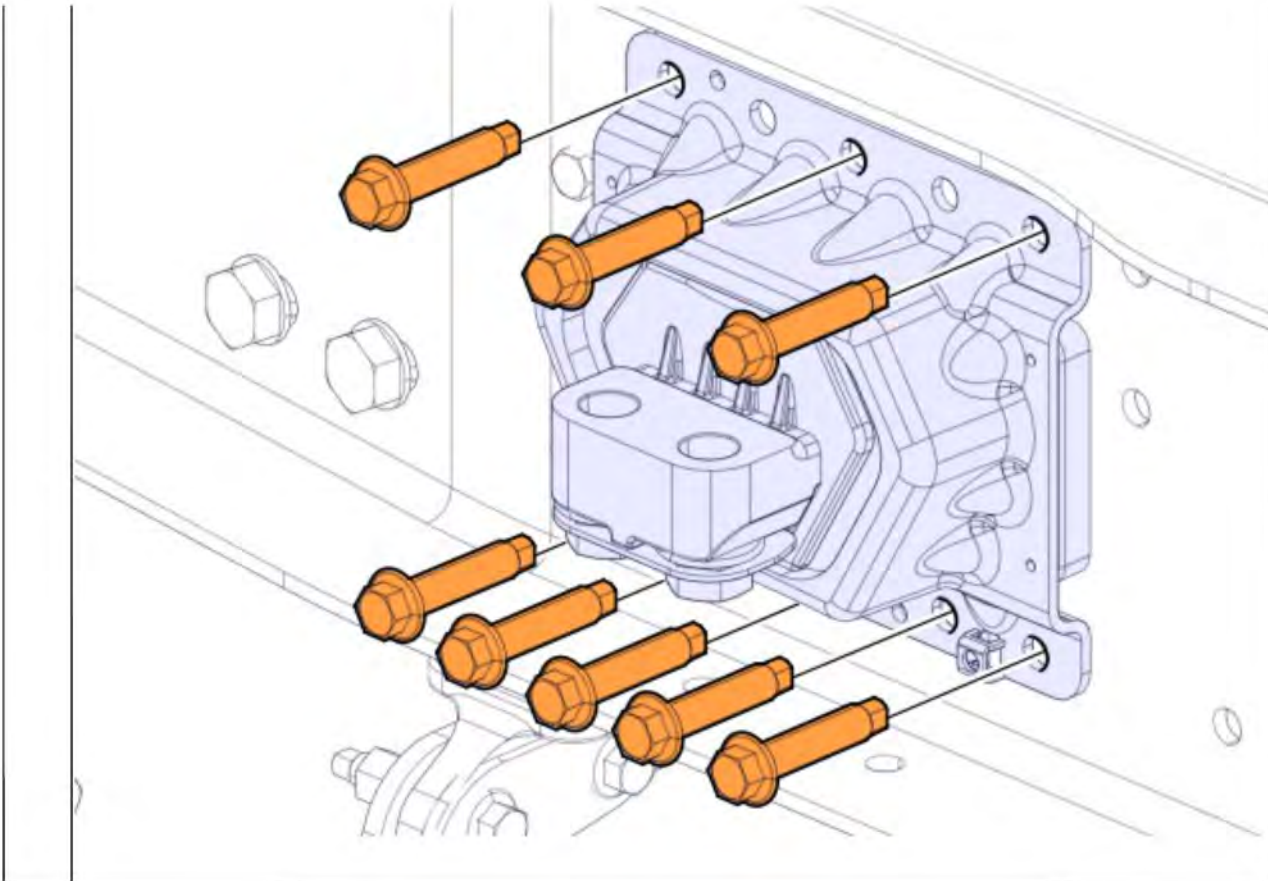
| | |
|-----|----------------------------|
| 155 | Remove the rubber cushion. |
|-----|----------------------------|



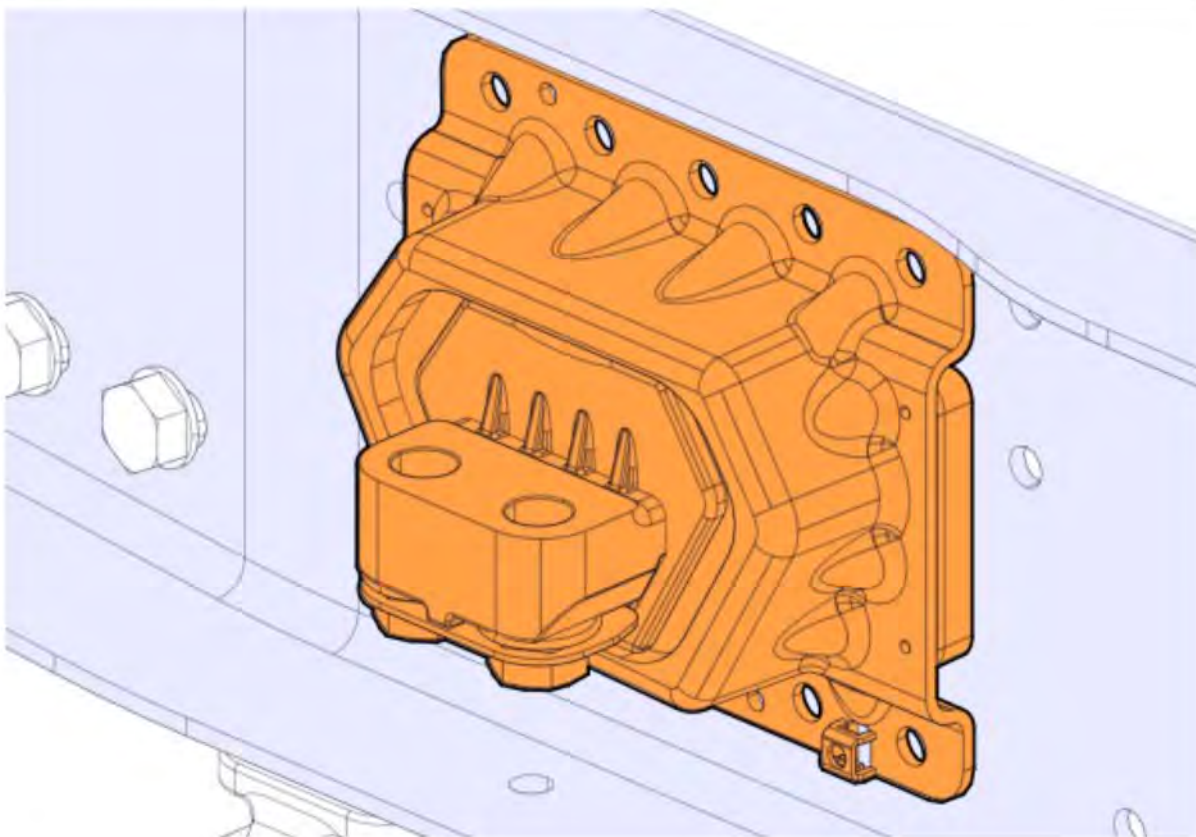
| | |
|-----|------------------|
| 156 | Remove the nuts. |
|-----|------------------|



| | |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 157 | <p>Perform this procedure when the condition below is met.</p> <p>Conditions</p> <ul style="list-style-type: none"> • If the screw has a non-removable nut <ul style="list-style-type: none"> ▶ Cut the nut to remove it. ▶ Remove the screws. |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

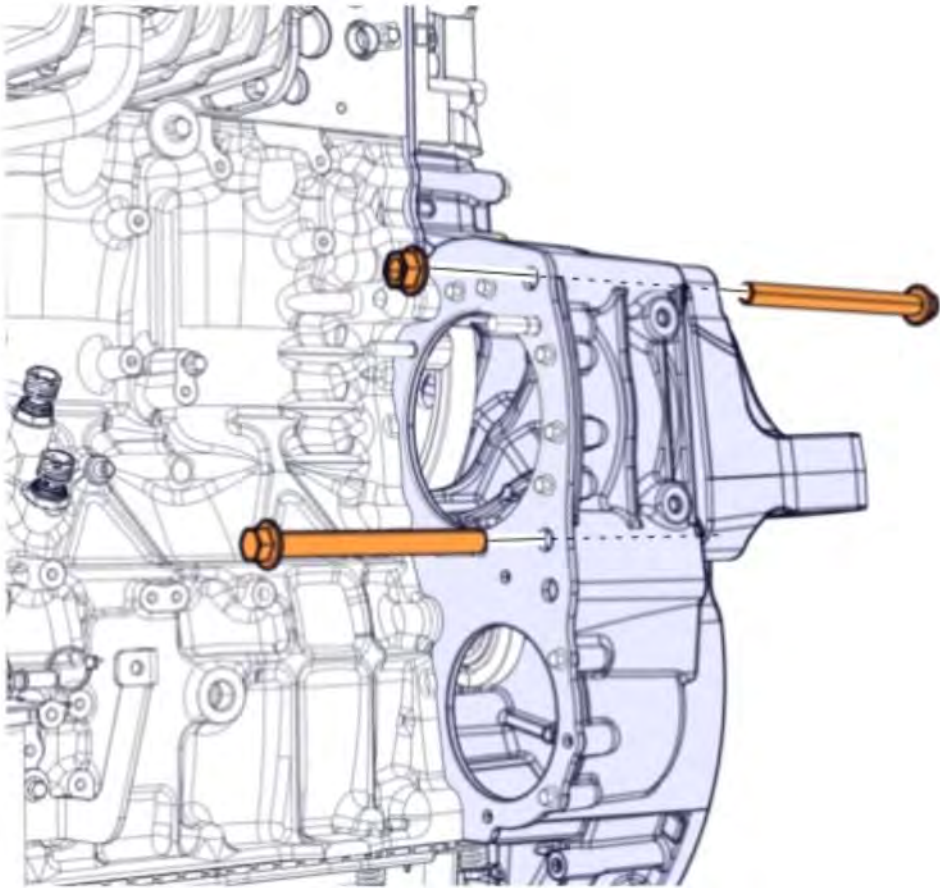


158 Remove the rubber cushion.



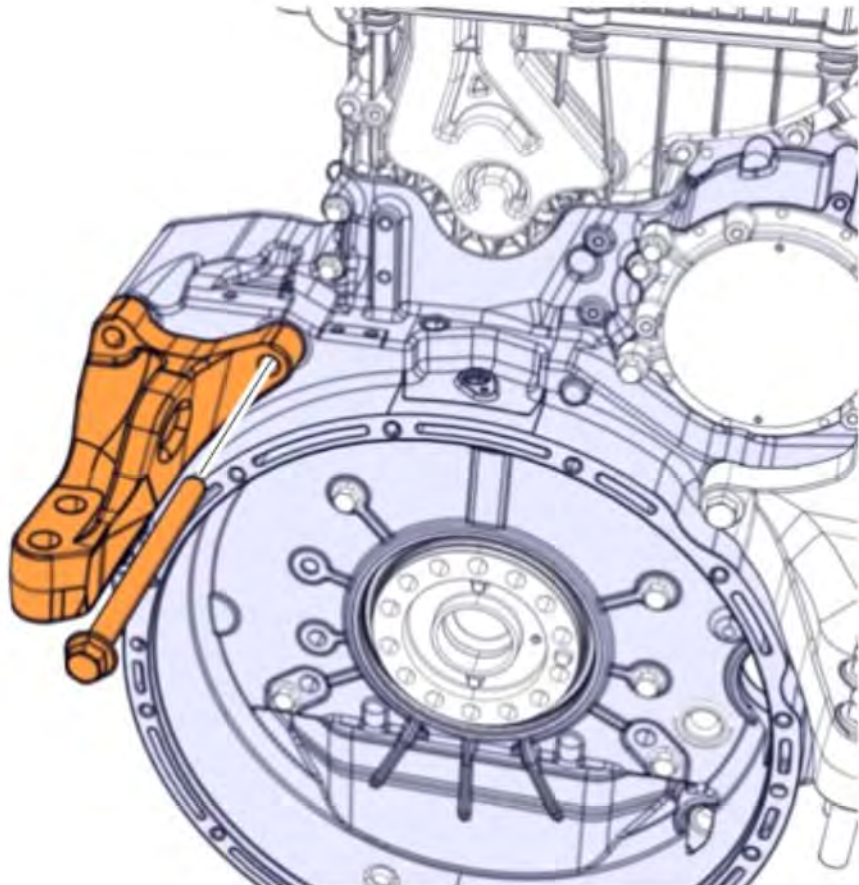
159 Remove the nut and screw.

160 Remove the screw.



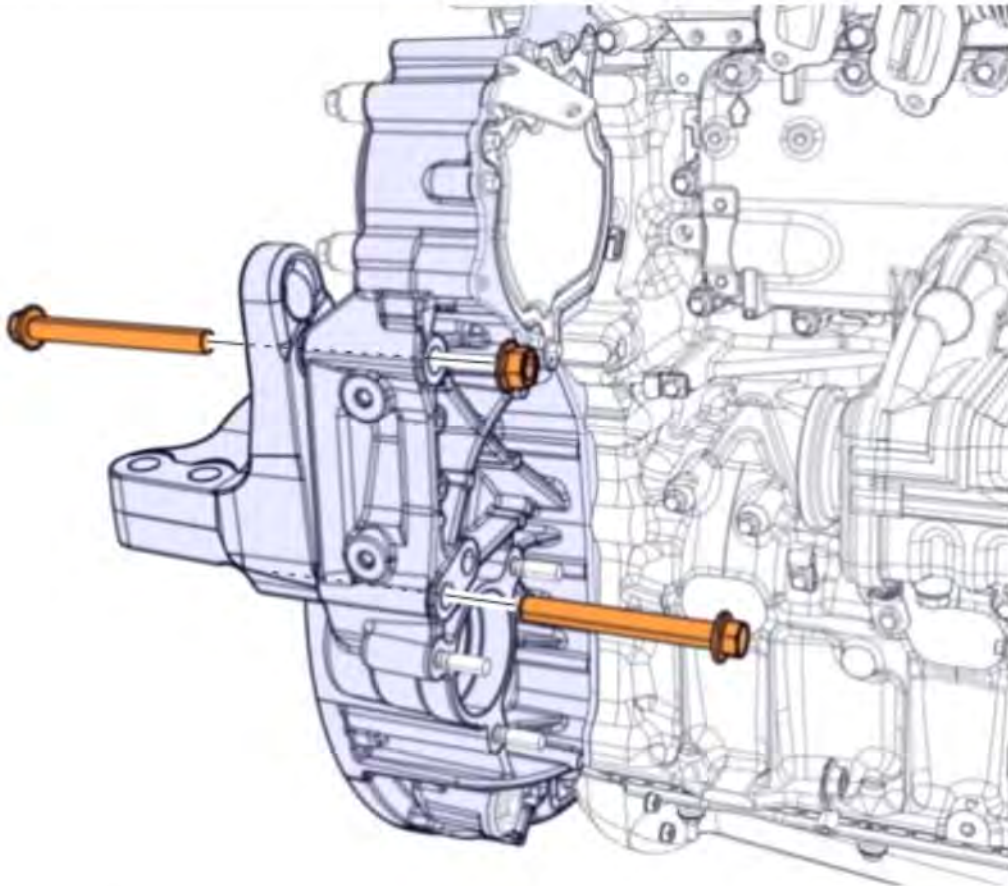
| | |
|------------|-------------------|
| 161 | Remove the screw. |
|------------|-------------------|

| | |
|------------|---------------------|
| 162 | Remove the bracket. |
|------------|---------------------|



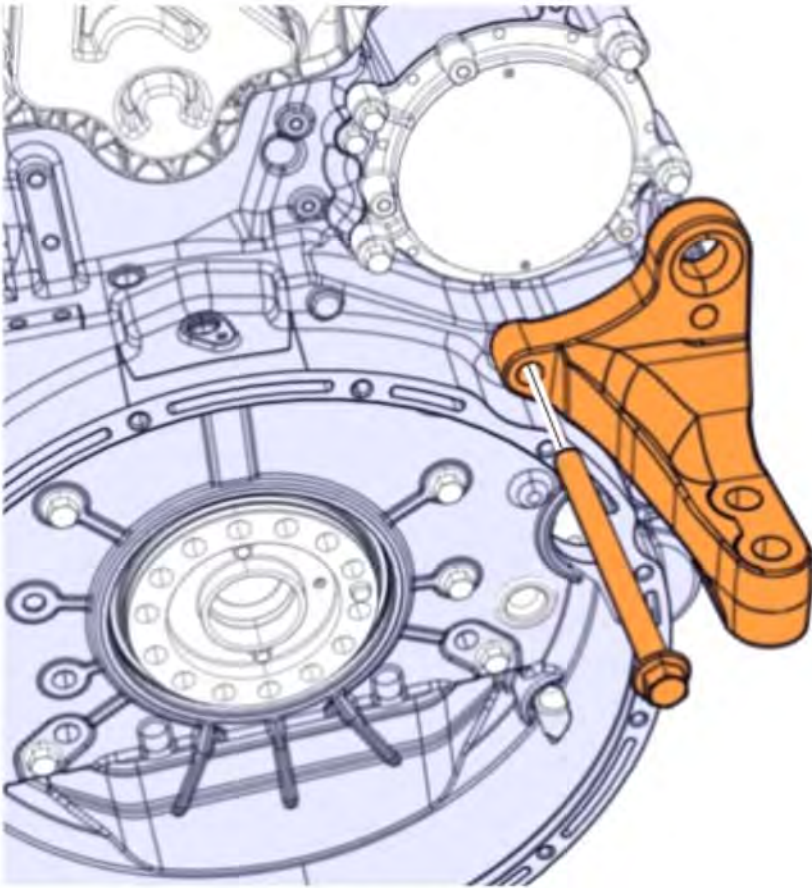
| | |
|-----|---------------------------|
| 163 | Remove the nut and screw. |
|-----|---------------------------|

| | |
|-----|-------------------|
| 164 | Remove the screw. |
|-----|-------------------|

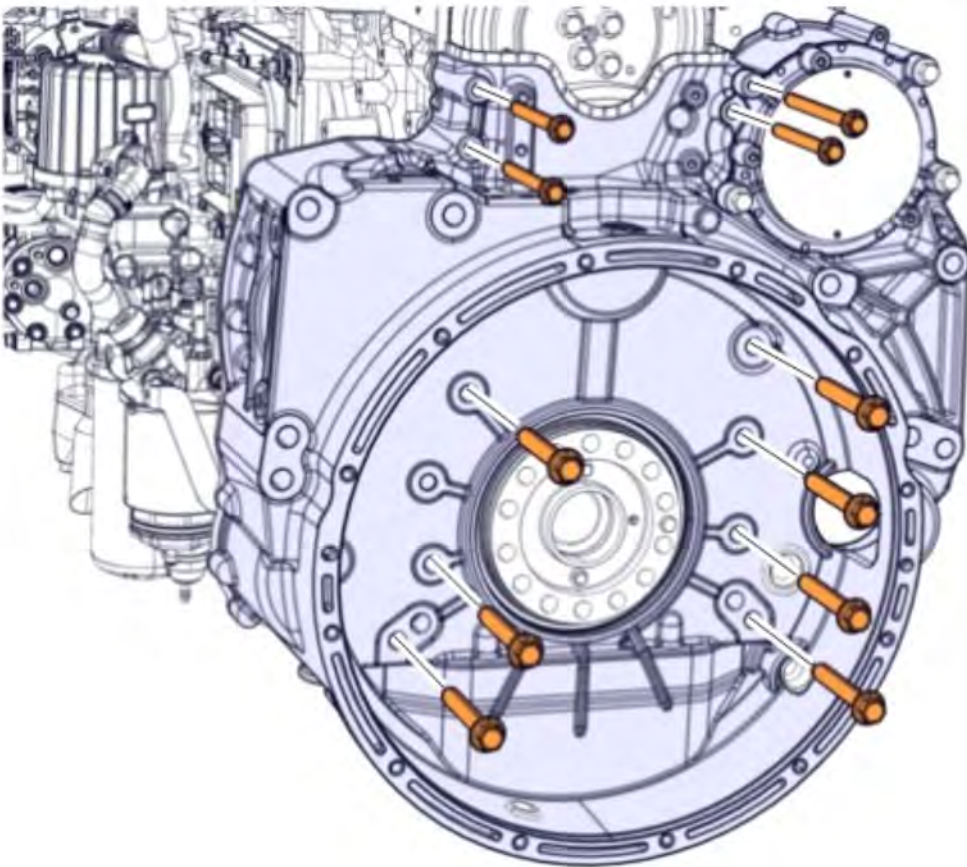



| | |
|-----|-------------------|
| 165 | Remove the screw. |
|-----|-------------------|

| | |
|-----|---------------------|
| 166 | Remove the bracket. |
|-----|---------------------|



167 Remove the screws.



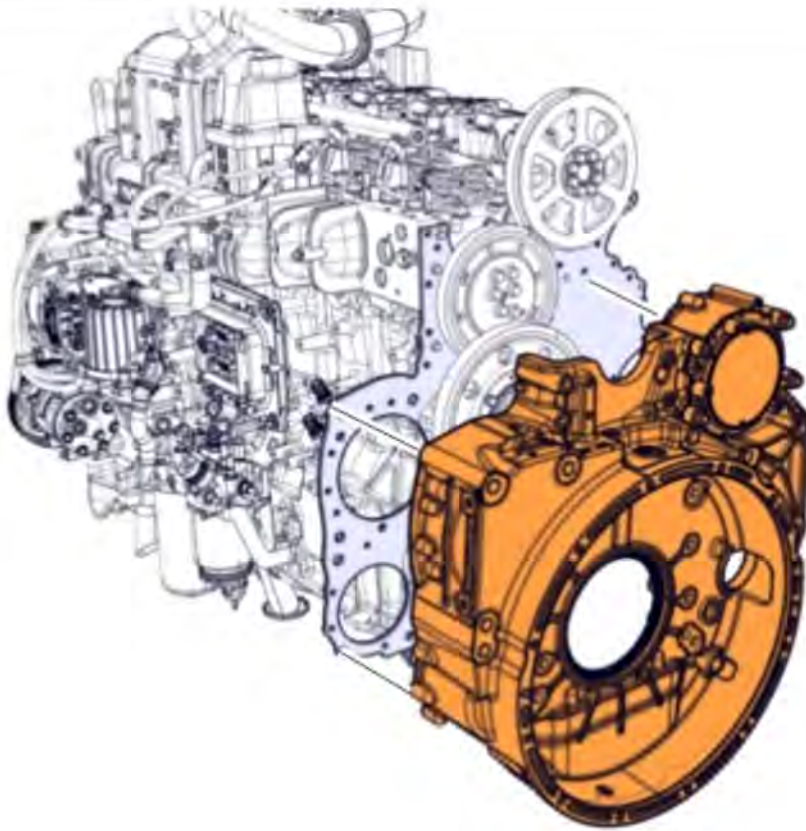
| |
|--------------------------------------------------------------------------------------------------|
|  CAUTION |
|--------------------------------------------------------------------------------------------------|

Risk of serious injury.

Heavy component.

▶ Exercise caution when moving the component. Use appropriate tools.

| | |
|------------|------------------------------|
| 168 | Remove the flywheel housing. |
|------------|------------------------------|



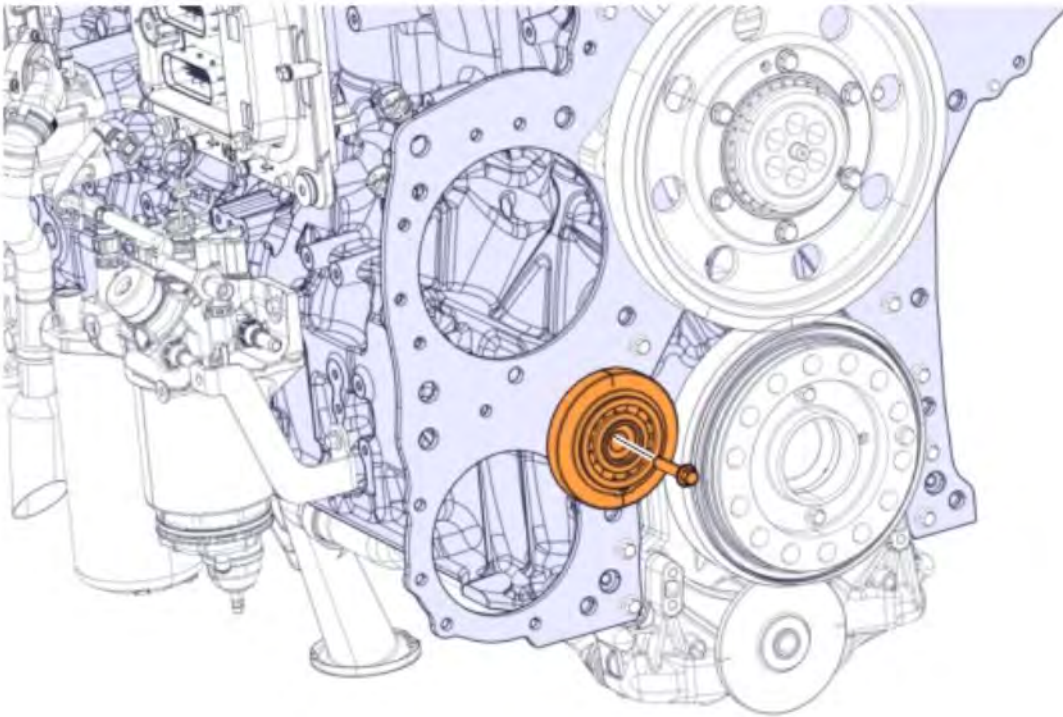
| | |
|------------|-------------------|
| 169 | Remove the screw. |
|------------|-------------------|

| | |
|------------|------------------|
| 170 | Remove the gear. |
|------------|------------------|

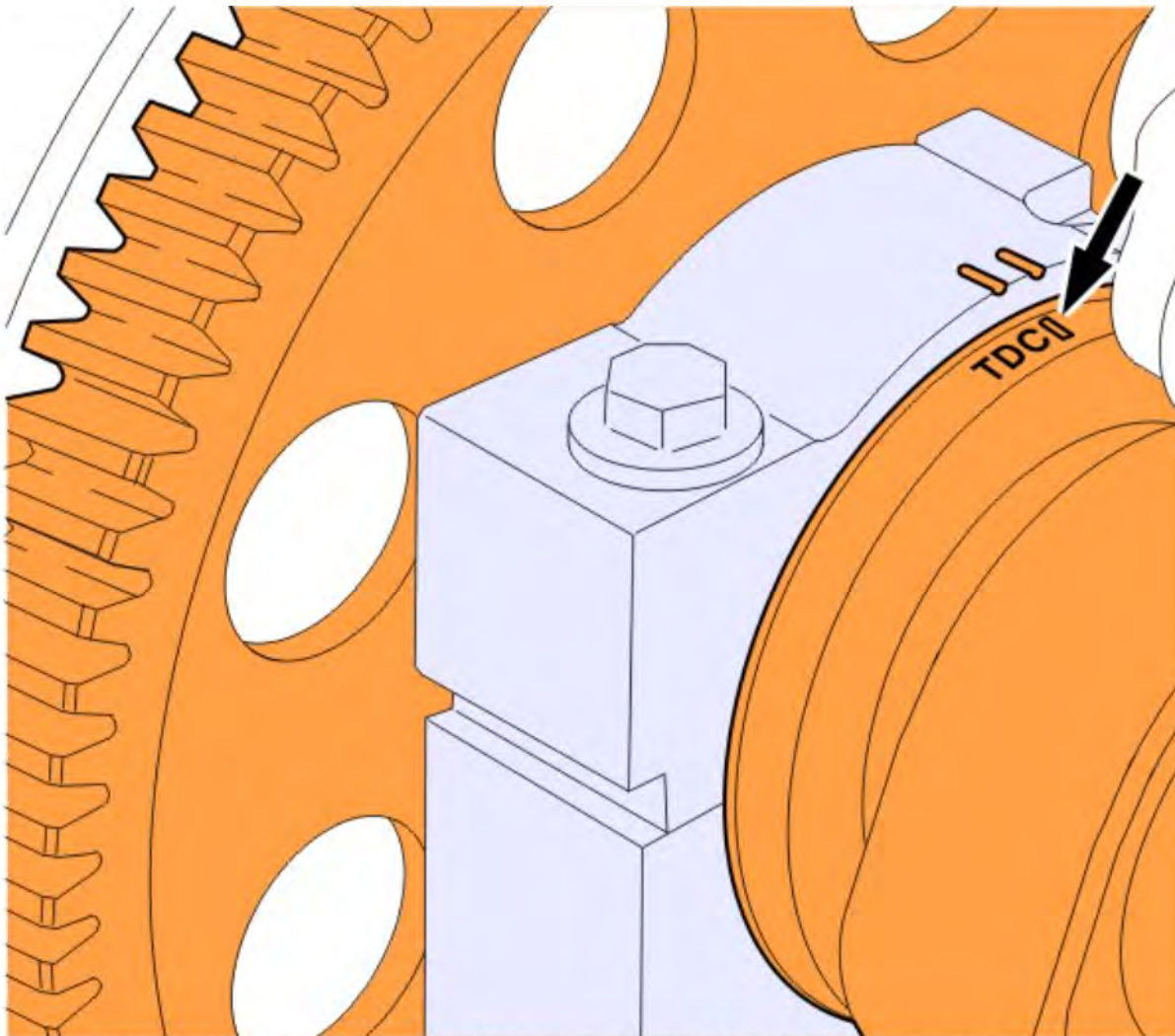


Service hint

The gear may be stuck in the timing gear plate. Loosely reinstall the fastener and use a suitable puller.



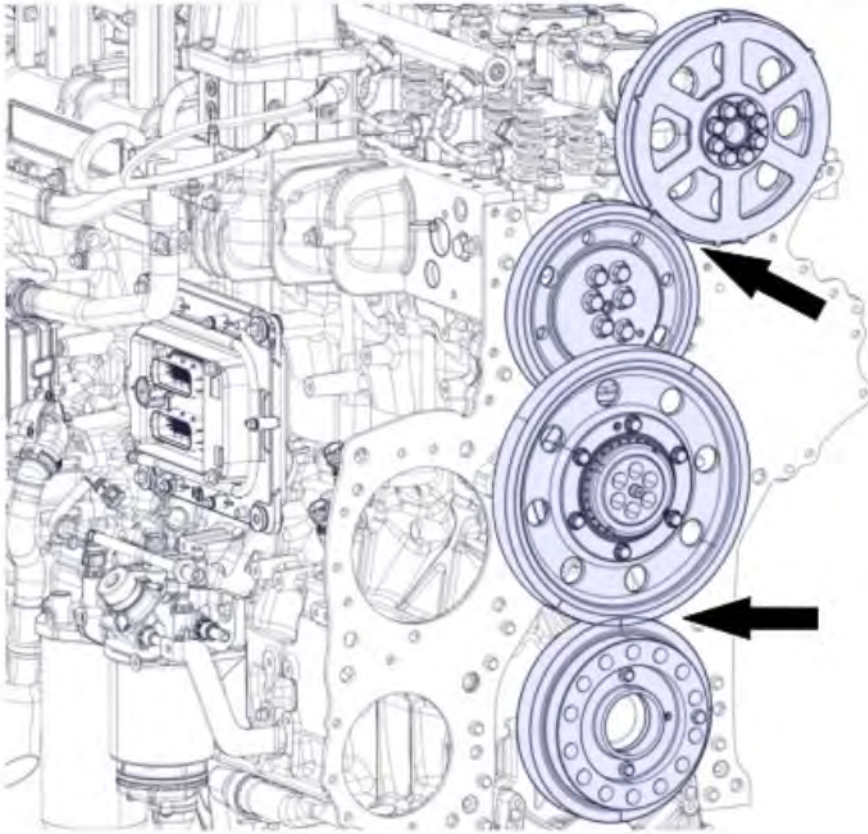
171 Check that the timing marks are at TDC.



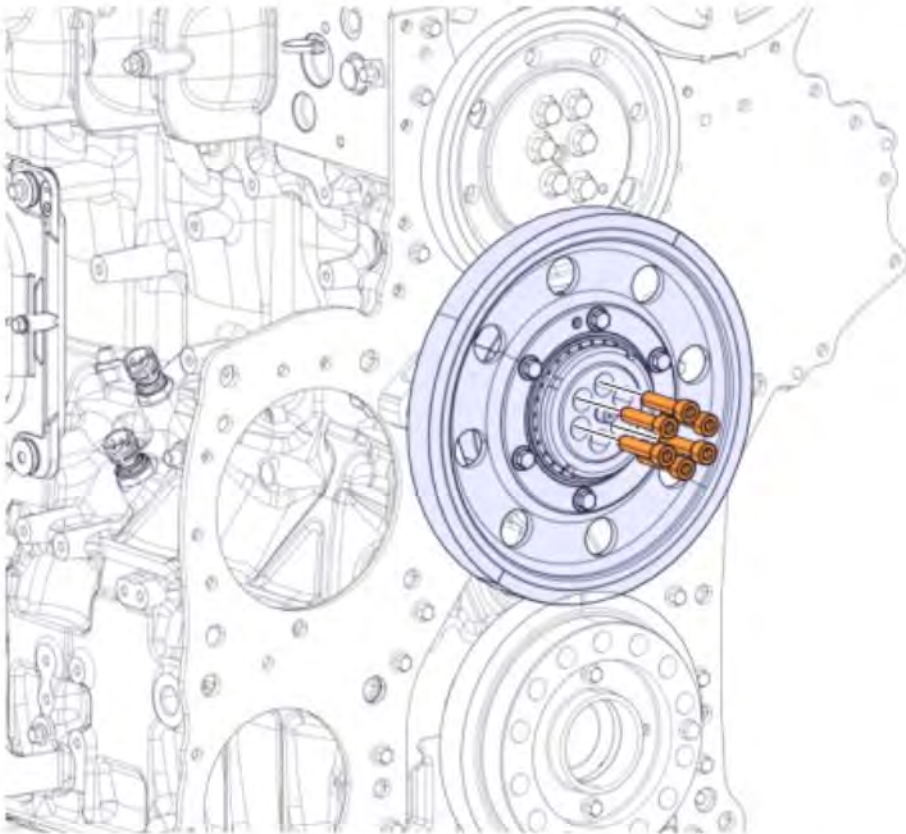
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172 Mark the gears for reference.



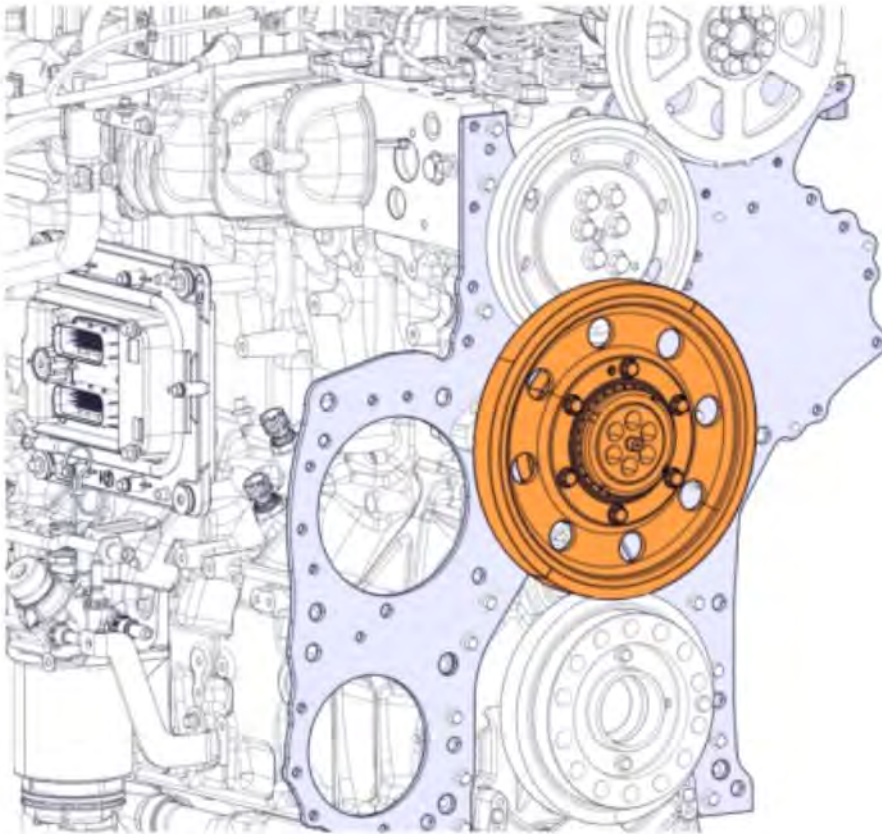
173 Remove the screws.



174 Remove the gears.

**Note**

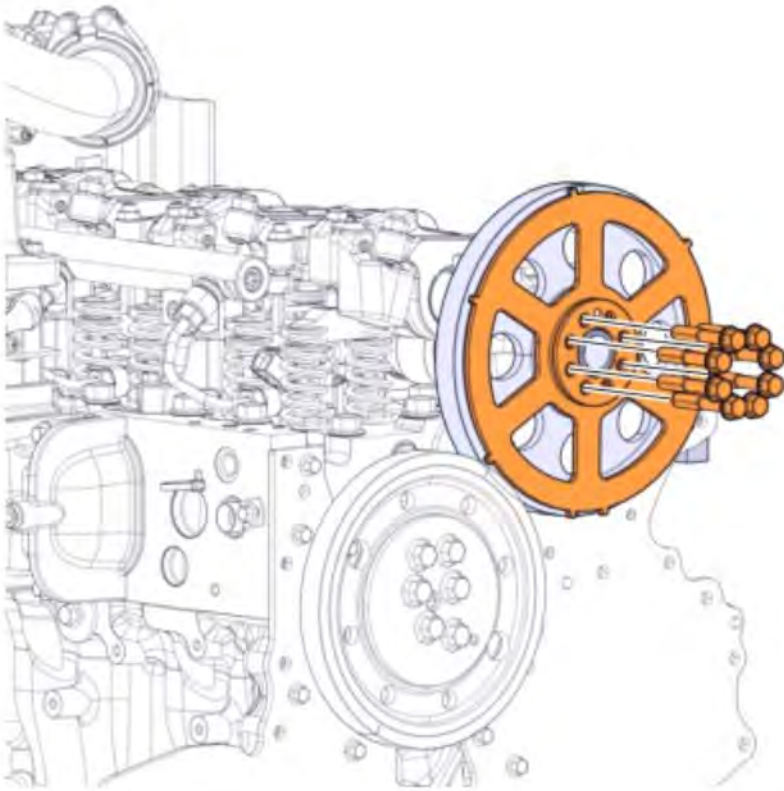
Do not separate the gears.



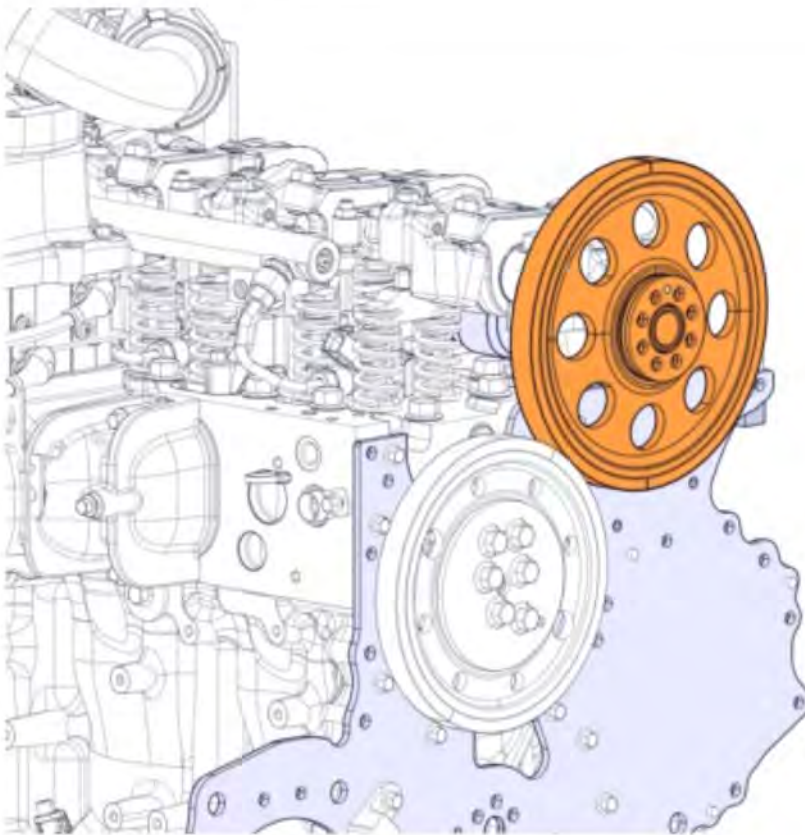
175 Remove the screws and the tone wheel.

**Note**

Discard the screws.



176 Remove the gear.



CAUTION

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Risk of material damage.

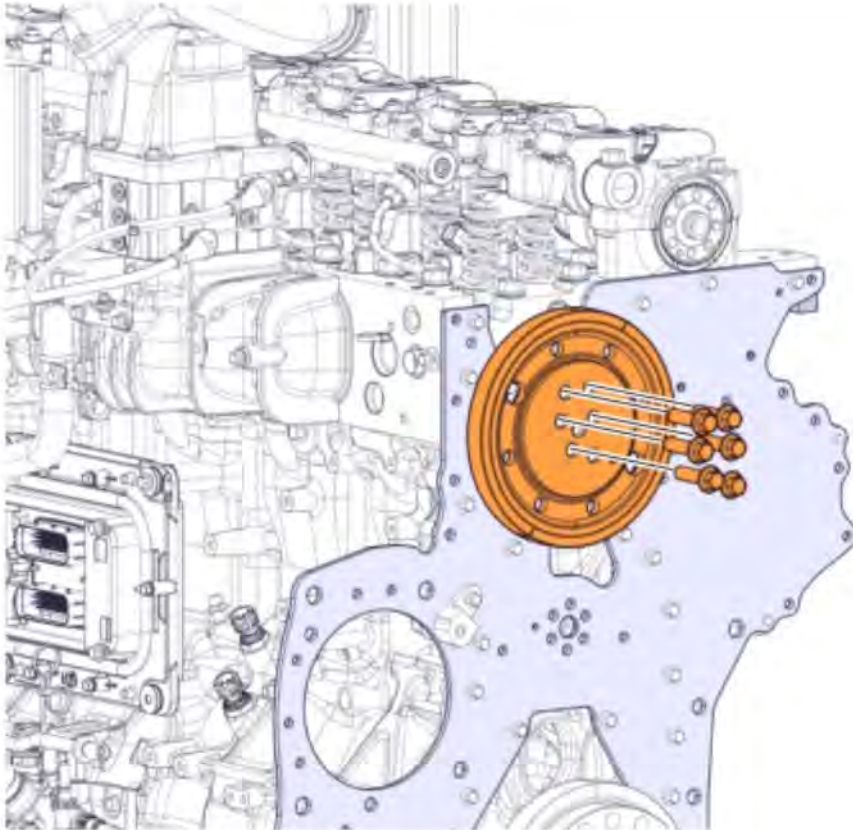
The idler gear can be damaged if mishandled.

- ▶ Take care while removing the idler gear screws.
- ▶ Secure the idler gear while removing the idler gear hub screws.

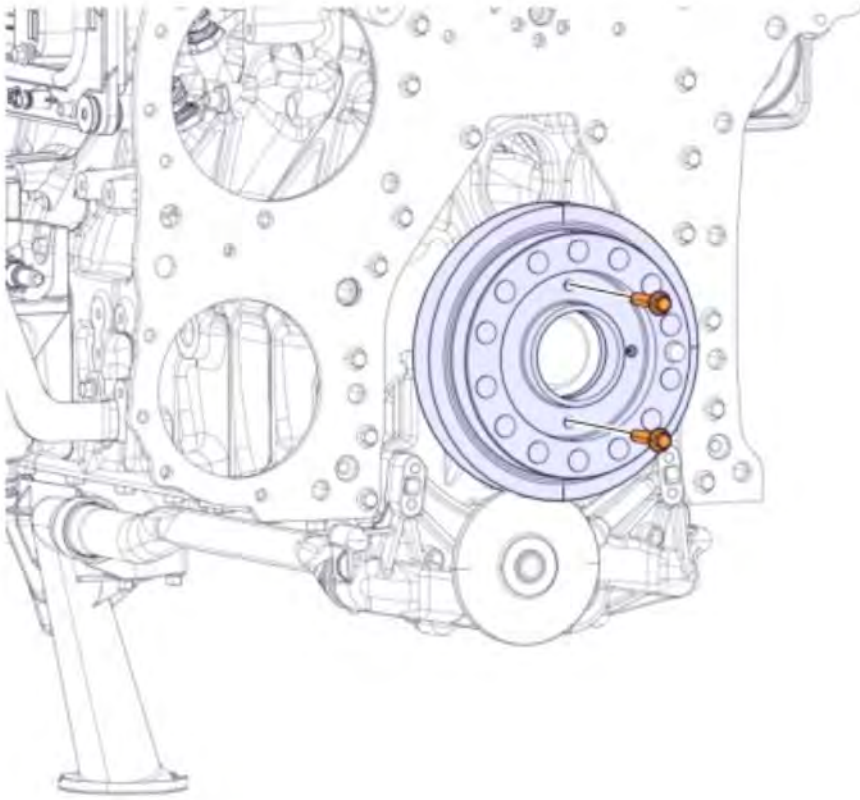
177 Remove the screws.

178 Remove the gear.

179 Remove the thrust washer.



180 Remove the screws.

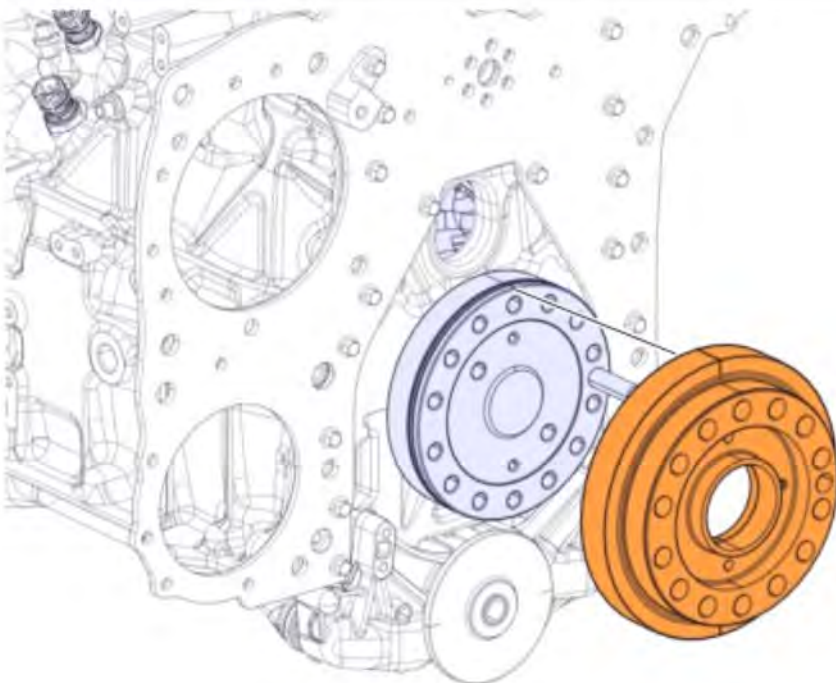


181 Remove the gear and the seal.



Note

Use a suitable tool.



182 Clean the crankshaft.

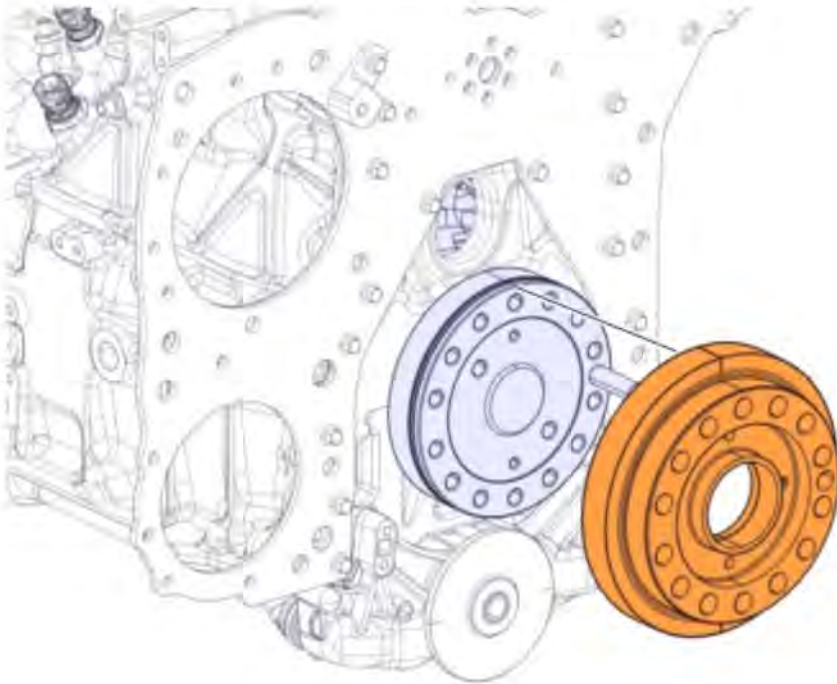
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| | | | |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------------------|
| 183 | Install the seal. | | |
| | <table border="1" style="width: 100%;"> <tr> <td style="width: 20px; text-align: center;">i</td> <td>Note Use a new part.</td> </tr> </table> | i | Note Use a new part. |
| i | Note Use a new part. | | |

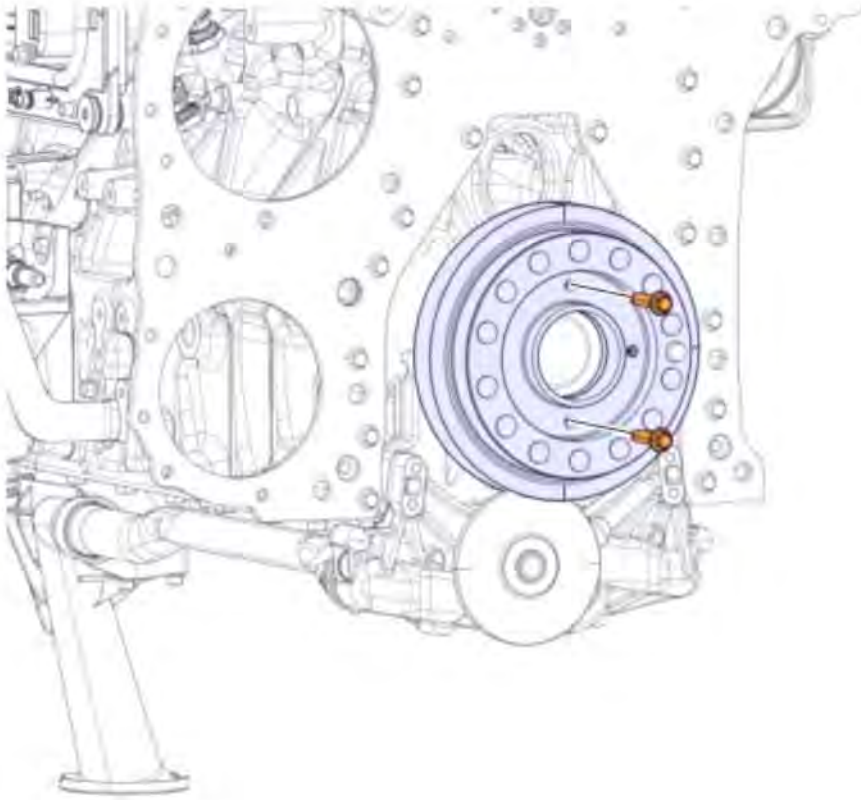
| | | | |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------------------------------------|
| 184 | Lubricate the gear contact surface. | | |
| | <table border="1" style="width: 100%;"> <tr> <td style="width: 20px; text-align: center;">i</td> <td>Note Use recommended lubricant.</td> </tr> </table> | i | Note Use recommended lubricant. |
| i | Note Use recommended lubricant. | | |

| | |
|------------|-------------------|
| 185 | Install the gear. |
|------------|-------------------|



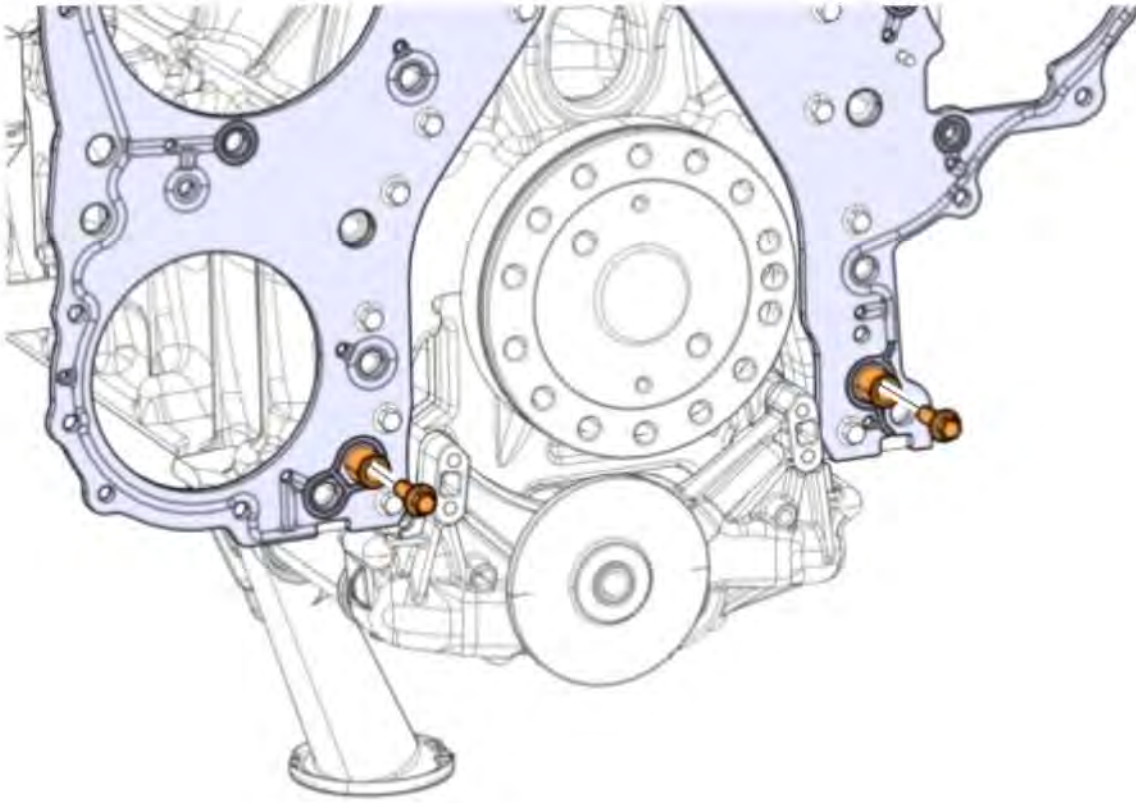
| | |
|------------|---------------------|
| 186 | Install the screws. |
|------------|---------------------|

| | | |
|------------|----------------------------|-----------------------------------------|
| 187 | Torque tighten the screws. | |
| | Tightening torque | |
| | Crankshaft gear, screw | 24 ±4 Nm (18 ±3 lb _f -ft) |



| | | | |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------|
| 188 | Install the tools. | | |
| | Required material | | |
| | GUIDE | 9998267 | 2 pcs |
| | <div style="border: 1px solid black; padding: 5px;"> <div style="display: flex; align-items: center;"> <div style="background-color: #4a7ebb; color: white; padding: 2px 5px; border-radius: 3px; text-align: center; width: 20px; height: 20px; margin-right: 5px;">i</div> <div> <p>Note</p> <p>The tools act as guides for timing gear plate alignment.</p> <p>Do not remove the tools until the timing gear plate is installed.</p> </div> </div> </div> | | |

| | | |
|------------|--------------------------------|-----------------------------------|
| 189 | Torque tighten the screws. | |
| | Tightening torque | |
| | Timing gear plate, tool, screw | 60 Nm (44 lb _f ·ft) |

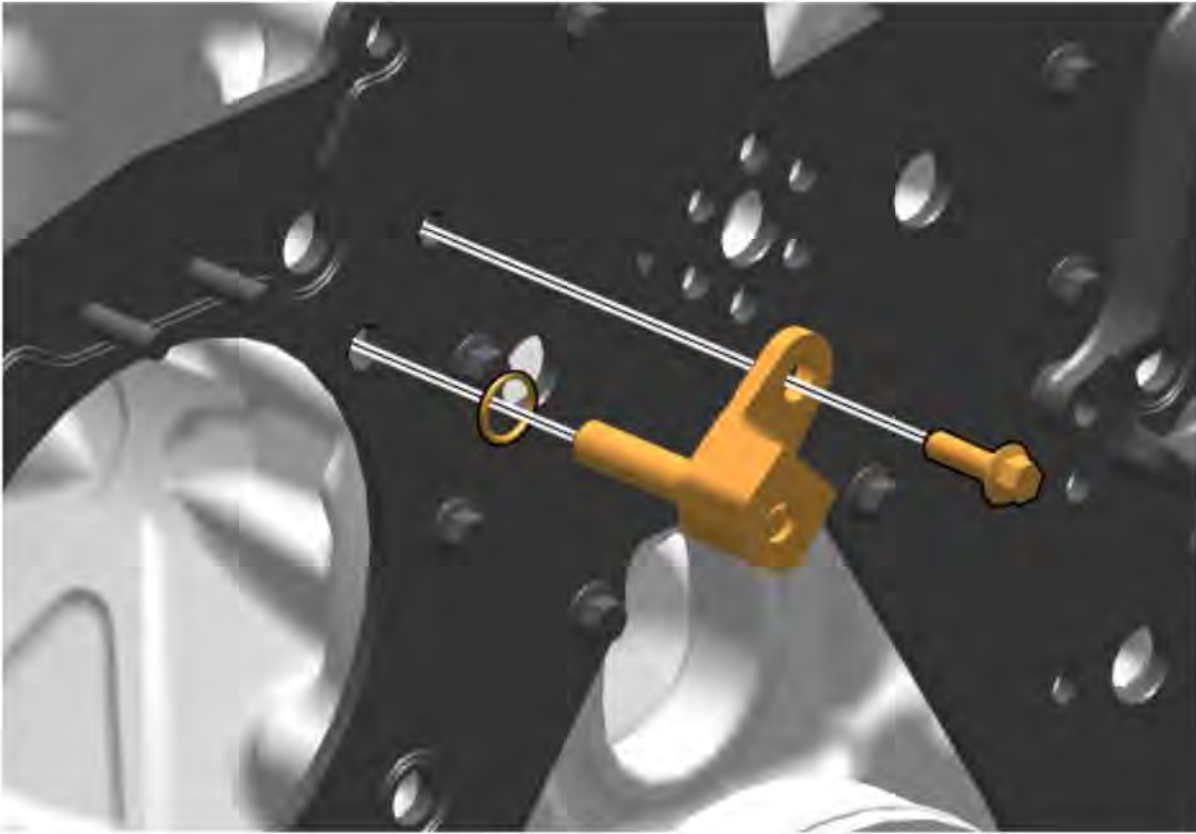


| | |
|-----|-------------------|
| 190 | Remove the screw. |
|-----|-------------------|

| | |
|-----|---------------------|
| 191 | Remove the bracket. |
|-----|---------------------|

**Note**

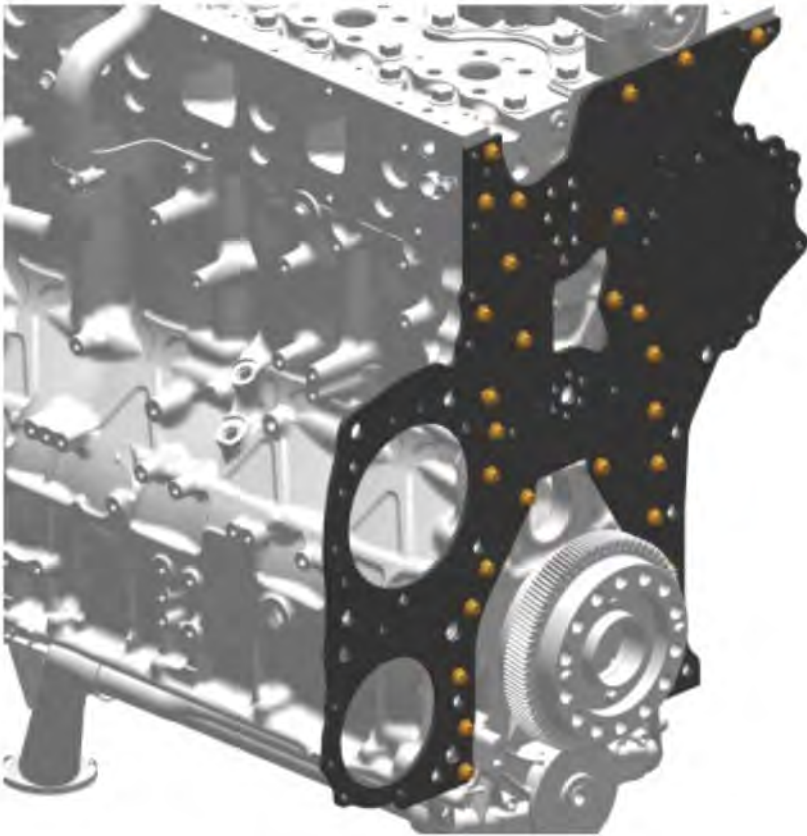
Discard the O-ring.

**CAUTION****Risk of serious injury.**

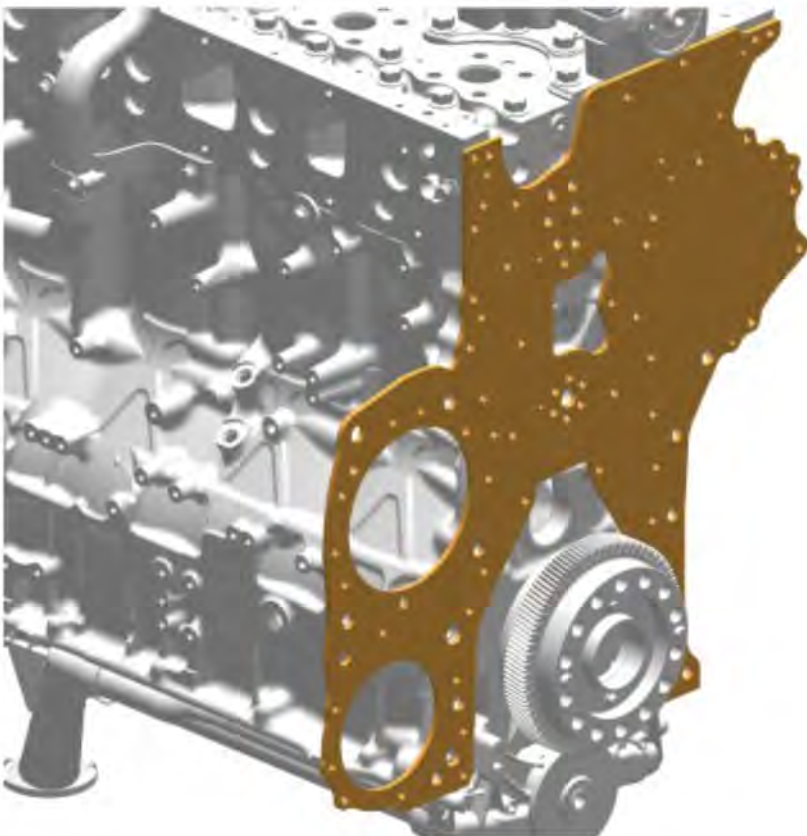
Heavy component.

▶ Exercise caution when moving the component. Use appropriate tools.

192 Remove the screws.



| | |
|------------|-------------------------------|
| 193 | Remove the timing gear plate. |
|------------|-------------------------------|



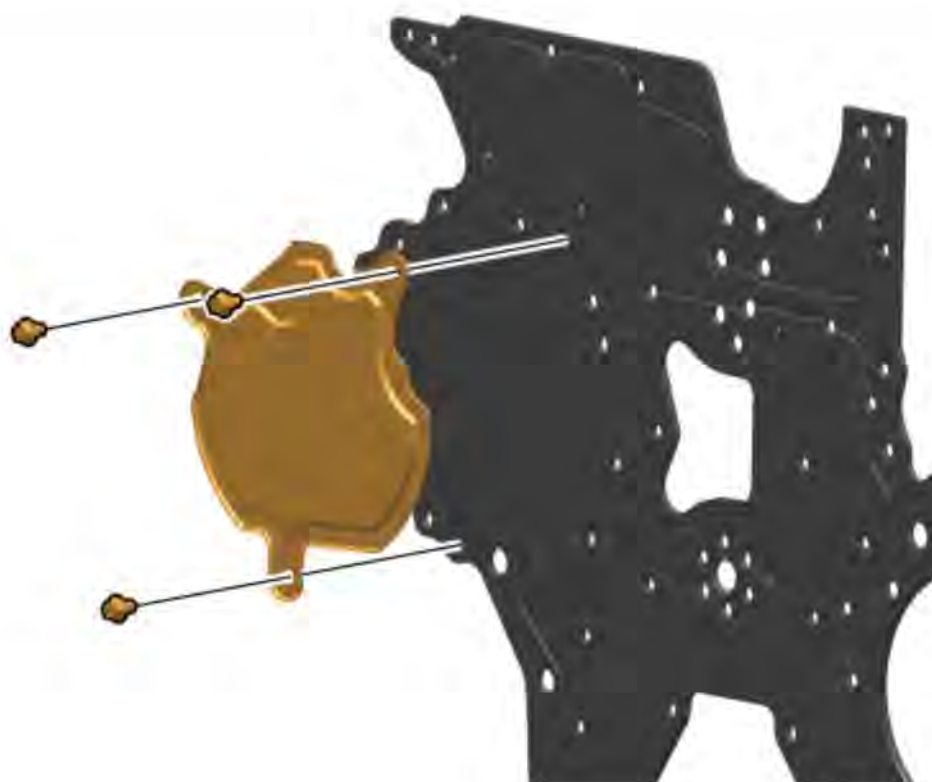
| | |
|------------|--------------------|
| 194 | Remove the screws. |
|------------|--------------------|

| | |
|------------|--------------------------|
| 195 | Remove the noise shield. |
|------------|--------------------------|

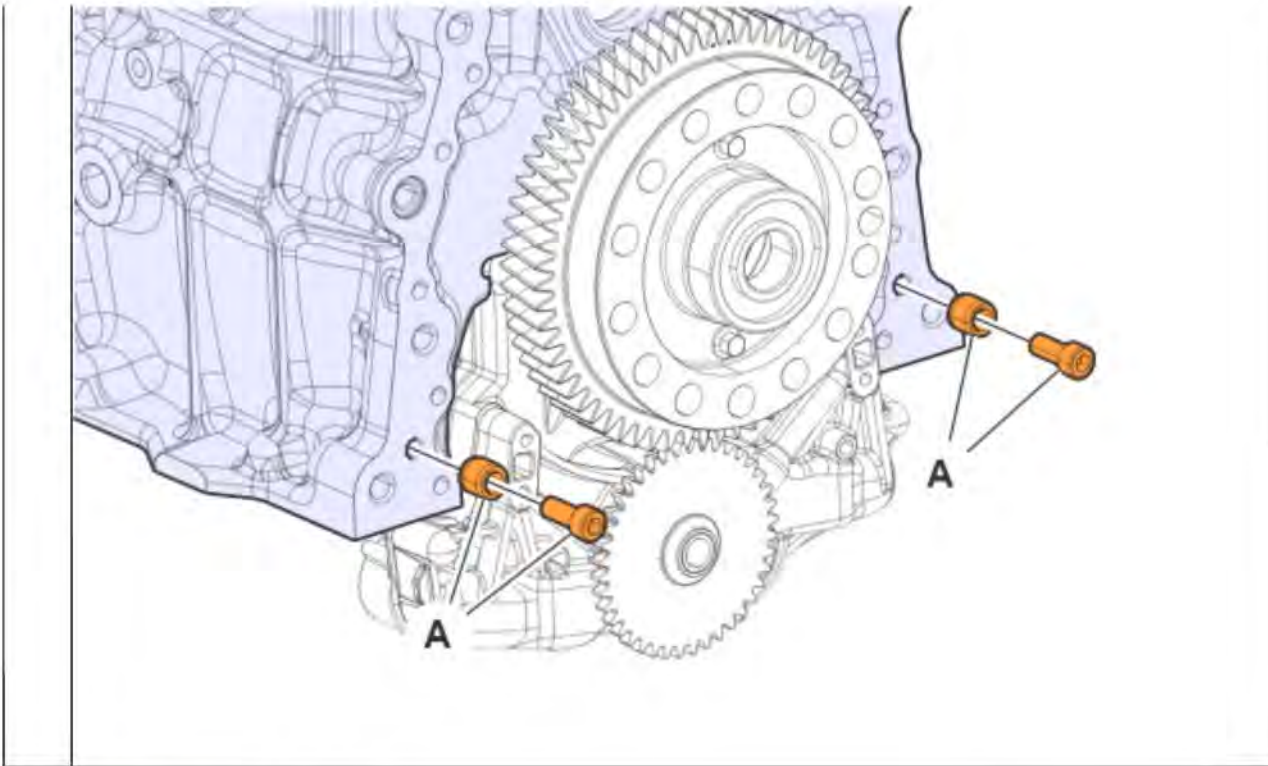
[Service hint](#)



Discard the noise shield if the timing gear plate has integrated seals, because a new noise shield will come with the timing gear plate.



| | | | | | |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------|-------------------------|-------|
| 196 | <p>Perform this procedure when the condition below is met.</p> <p>Conditions</p> <ul style="list-style-type: none"> • If not previously installed <p>▶ Install the tools (A).</p> <p>Required material</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">A</td> <td style="width: 40%;">GUIDE</td> <td style="width: 30%;">9998267</td> <td style="width: 20%;">2 pcs</td> </tr> </table> <p>Note Ensure that the tools are clean and damage free.</p> <p>▶ Install the screws.</p> <p>Note Hand tighten.</p> | A | GUIDE | 9998267 | 2 pcs |
| A | GUIDE | 9998267 | 2 pcs | | |



197 Install the timing gear plate.



Note

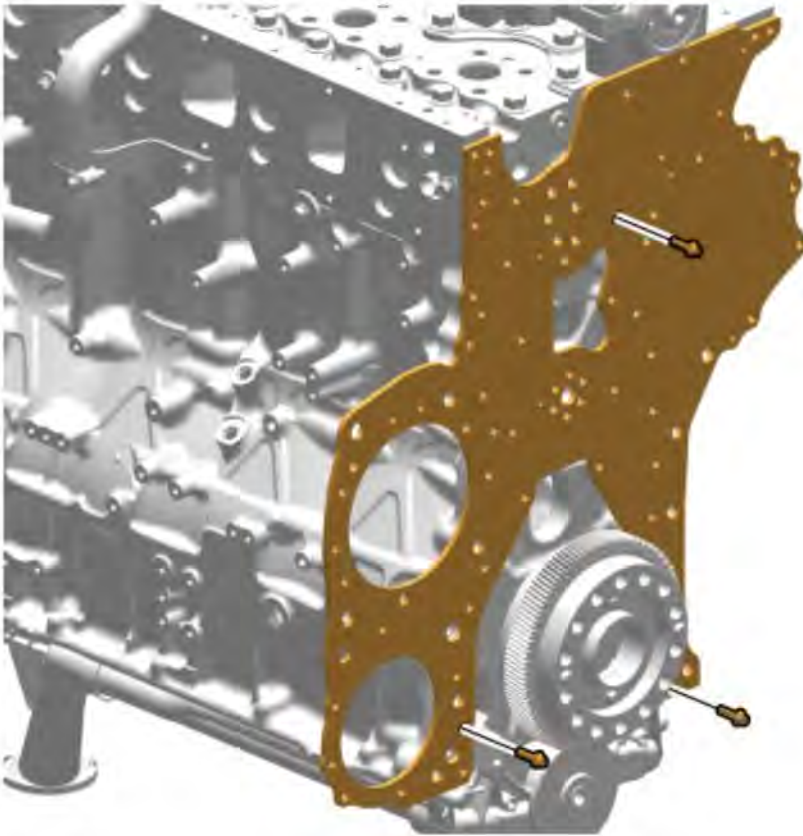
Ensure that the timing gear plate and the engine block are clean of sealant.




198 Install the screws.



Note

Hand tighten the screws.

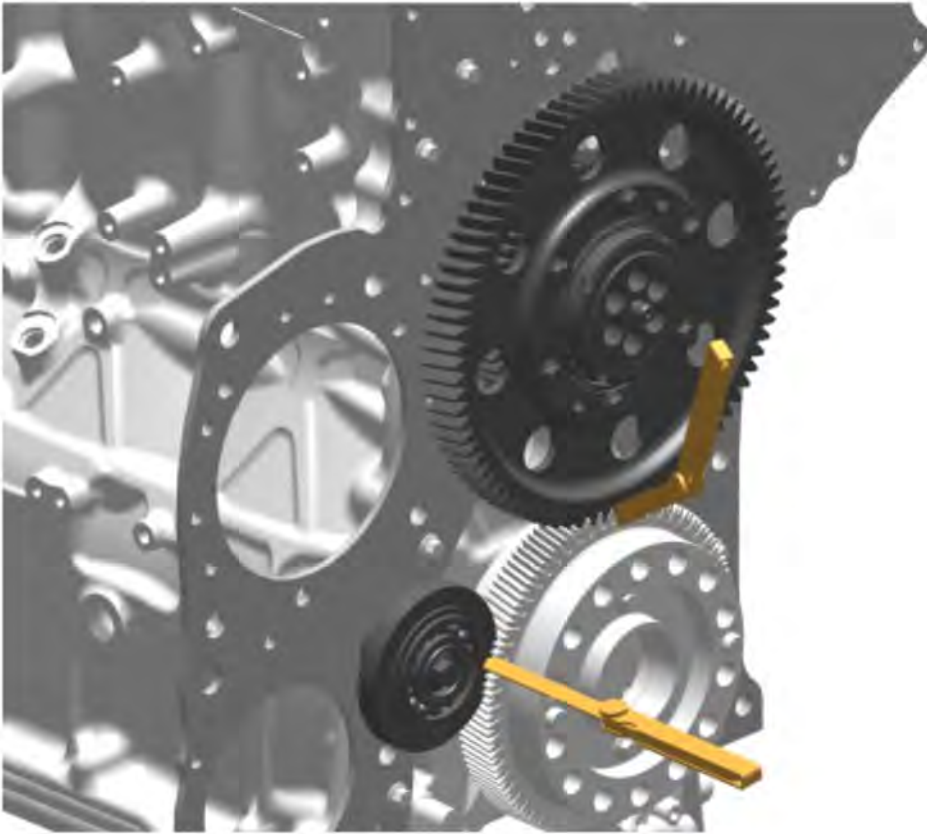


| | | | |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------|
| 199 | Install the gears. | | |
| 200 | Install the screws. <table border="1"><tr><td></td><td>Note Use a washer for the small idler gear.</td></tr></table> |  | Note Use a washer for the small idler gear. |
|  | Note Use a washer for the small idler gear. | | |
| 201 | Hand tighten the screws. | | |

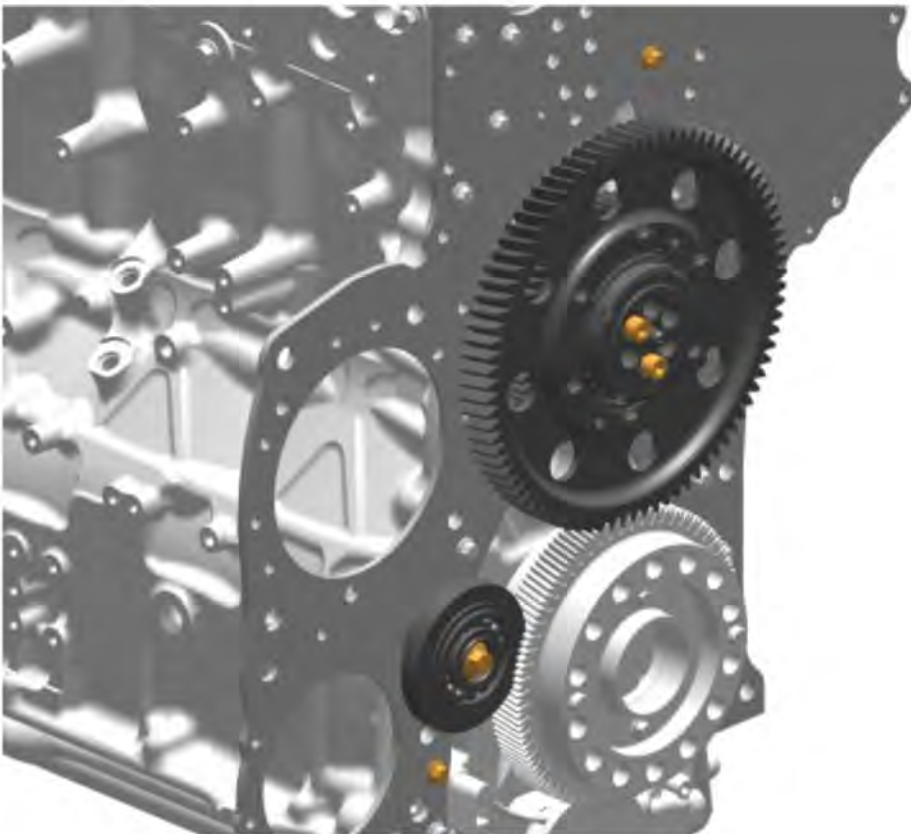


| | | |
|-----|----------------------------|----------------------|
| 202 | Install the feeler gauges. | |
| | Tech data | |
| | Feeler gauge, thickness | 0.1 mm (0.004 in) |

| | | |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 203 | Adjust the clearance. | |
| | <div style="border: 1px solid black; padding: 5px; display: inline-block;"> Note Use a plastic mallet to adjust the timing gear plate. </div> | |
| | <div style="border: 1px solid black; padding: 5px; display: inline-block;"> Note Ensure that the feeler gauges are difficult to move between the teeth. </div> | |
| | <div style="border: 1px solid black; padding: 5px; display: inline-block;"> Note Ensure equal resistance on both feeler gauges. </div> | |



204 Tighten the screws.



205 Place a dial indicator into position.



Note

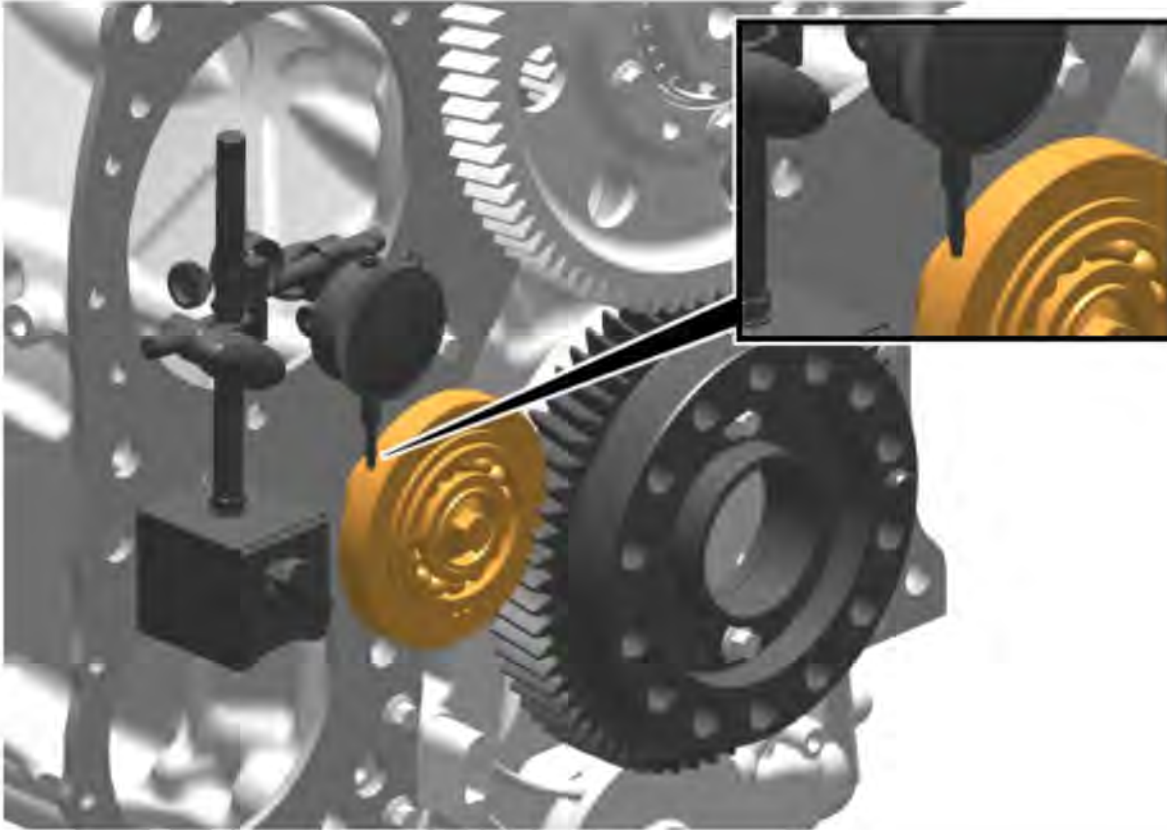
Use caution that the timing plate seal is not damaged.



Note

Ensure that the probe tip touches the gear tooth.

206 Set the dial to zero.



207 Turn the idler gear by hand.

208 Read and record the amount of backlash.

Tech data

| | |
|-----------------------------------|---------------------------------------|
| Idler gear, tooth flank clearance | 0.05 – 0.17 mm (0.002 – 0.0067 in) |
|-----------------------------------|---------------------------------------|

209 Perform this procedure when the condition below is met.

Conditions

- If the backlash is out of specification
- ▶ Adjust the timing plate.

210 Install the tools.

Required material

| | |
|------------------|-------------------------|
| ROCKER_INDICATOR | 9999683 |
| MAGNETIC STAND | 9999696 |



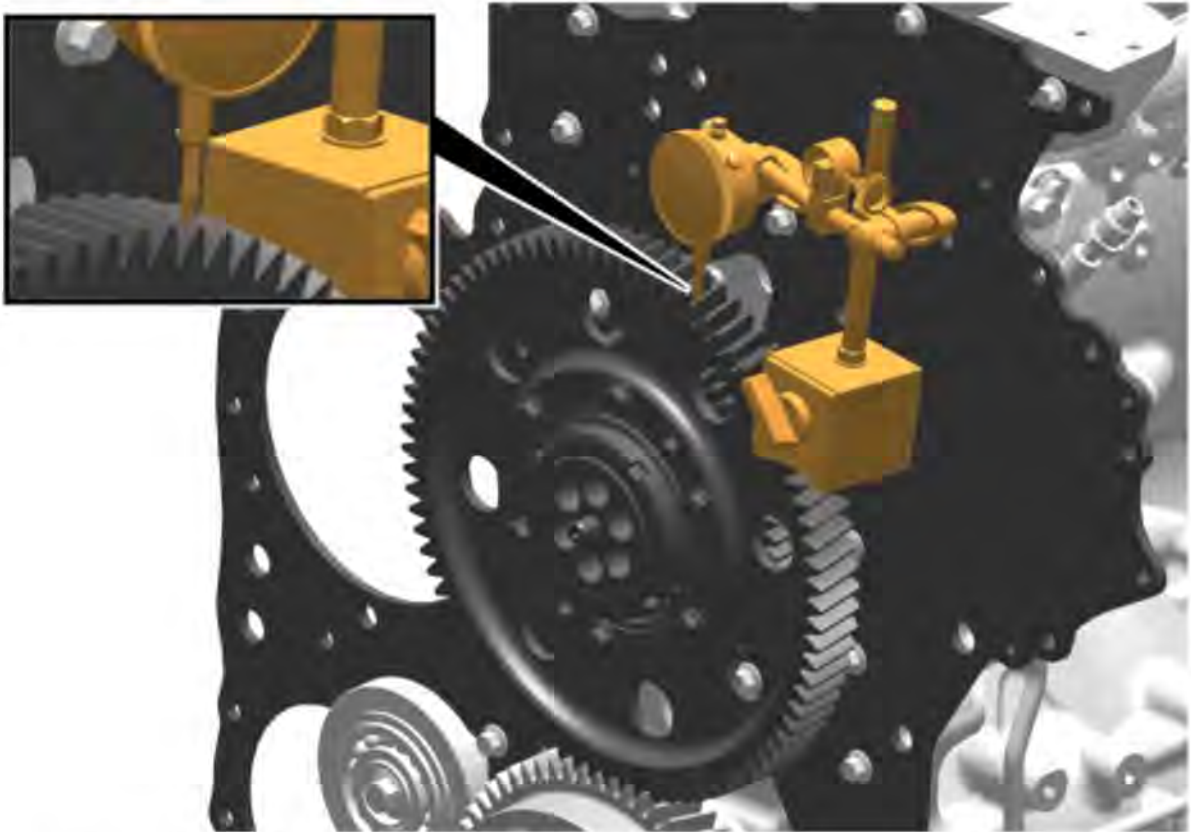
Note

Ensure that the probe tip touches the gear tooth.

211 Check the backlash.

Tech data

| | |
|----------------|---------------------------------------|
| Gear, backlash | 0.05 – 0.17 mm (0.002 – 0.0067 in) |
|----------------|---------------------------------------|



212 Perform this procedure when the condition below is met.

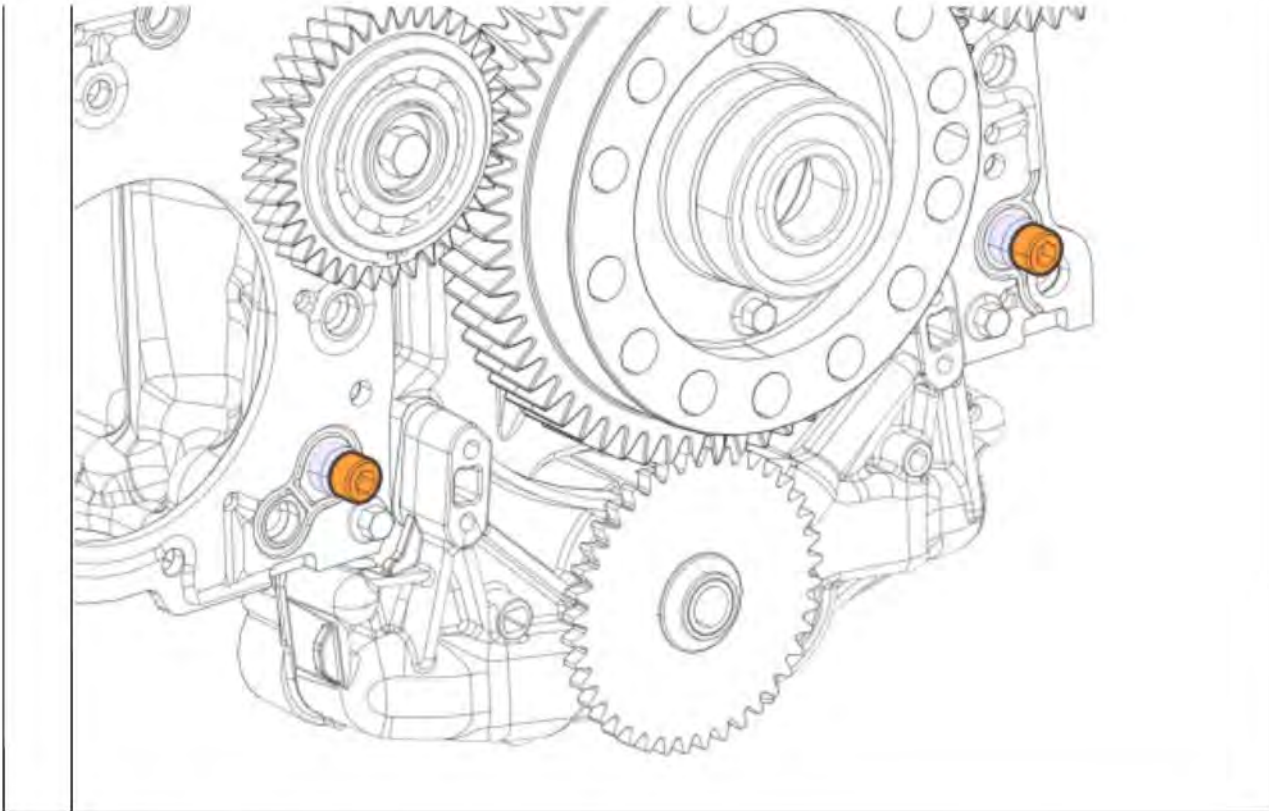
Conditions

- If the backlash is out of the specification
- ▶ Adjust the timing gear plate.

213 Perform this procedure when the condition below is met.

Conditions

- If all of the clearances are within the specifications
- ▶ Tighten the screws.



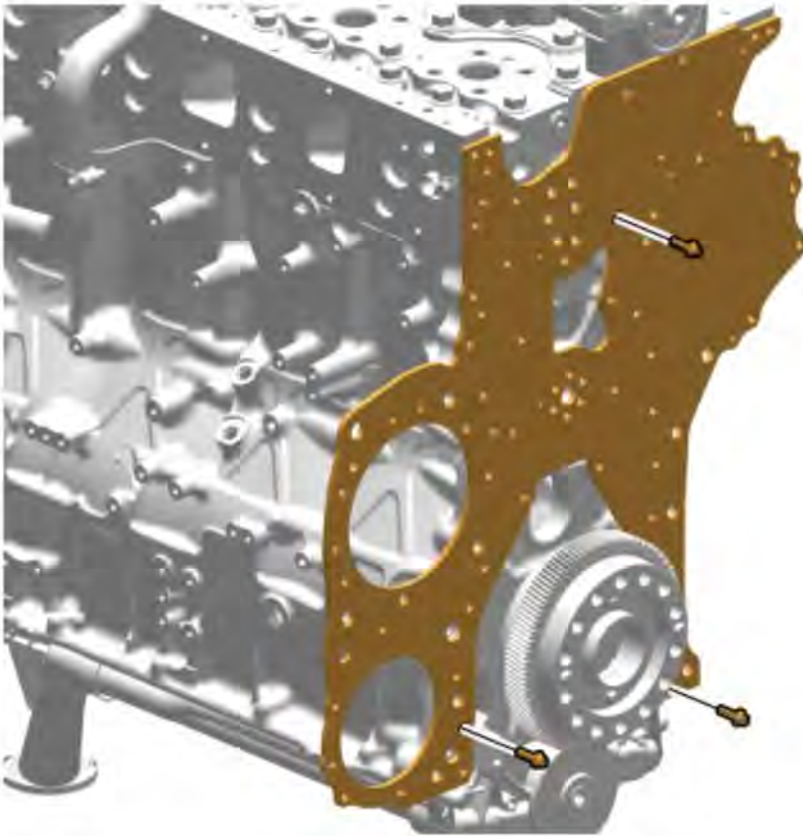
| | |
|-----|--------------------|
| 214 | Remove the screws. |
|-----|--------------------|

| | |
|-----|-------------------|
| 215 | Remove the gears. |
|-----|-------------------|



| | |
|-----|--------------------|
| 216 | Remove the screws. |
|-----|--------------------|

| | |
|-----|-------------------------------|
| 217 | Remove the timing gear plate. |
|-----|-------------------------------|



218 Clean the contact surfaces carefully.






Note

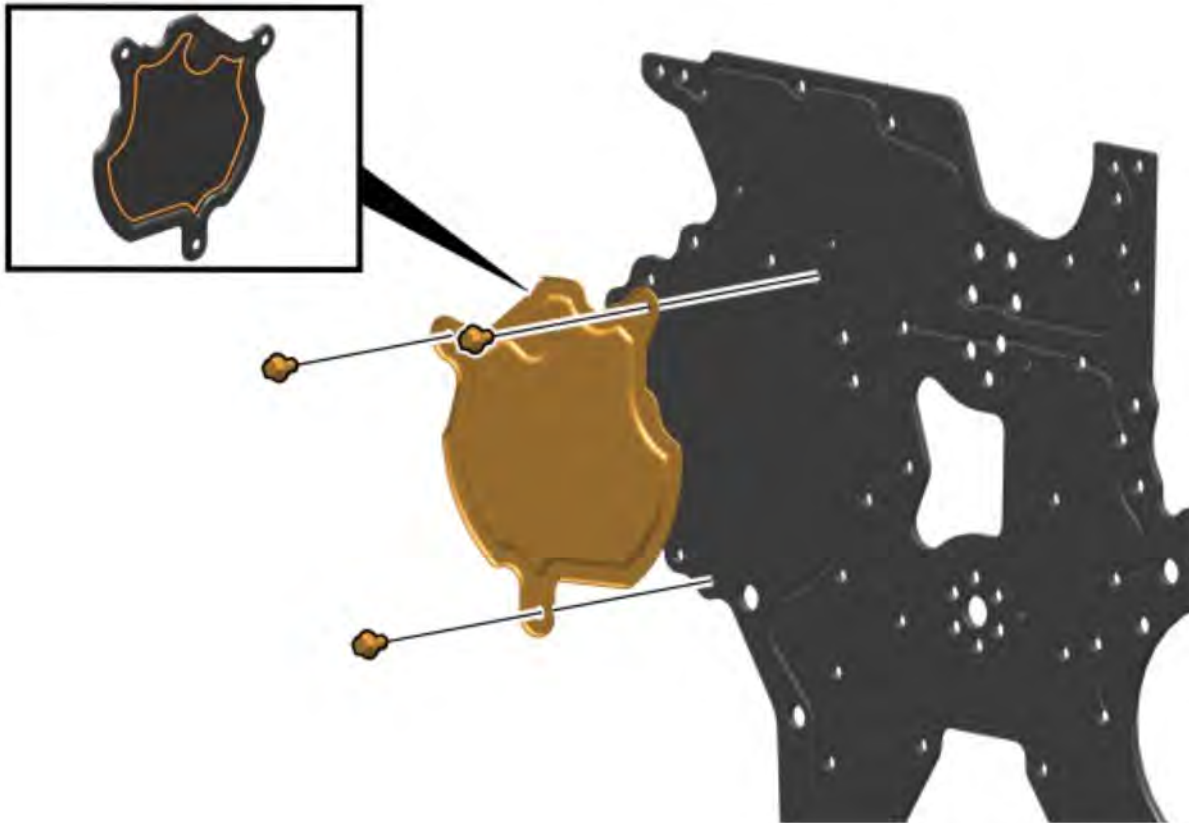
Do not use any tools that may damage the sealing surfaces.

219 Inspect the sealing strip surfaces on both side of the timing gear plate.

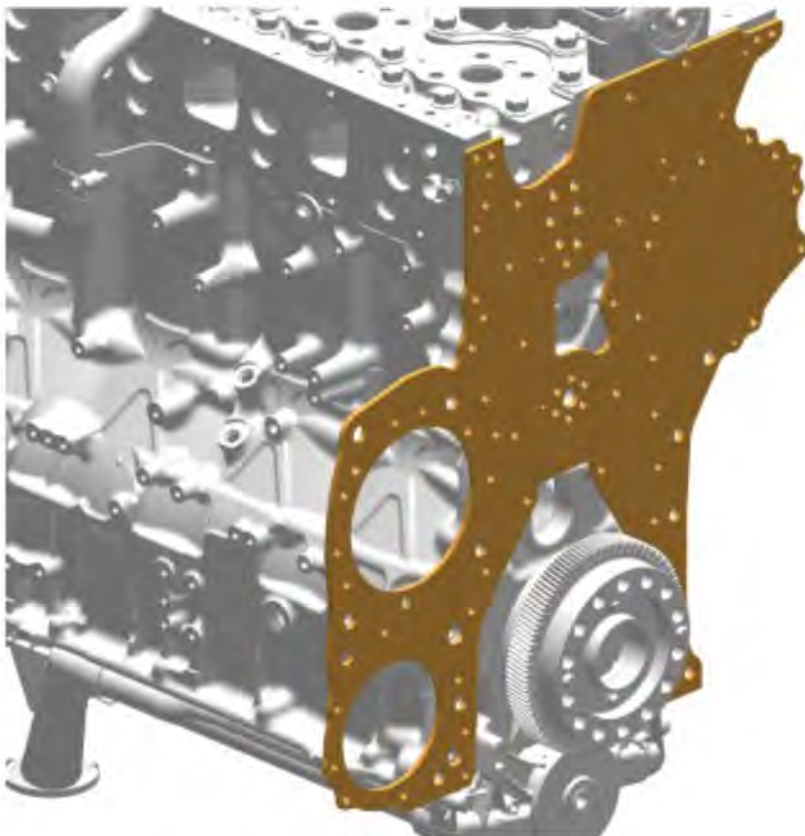
220 If the sealing strip is completely loose or damaged, the timing gear plate must be replaced.



| | |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| 221 | Apply the sealant. |
| Tech data | |
| Sealant, bead thickness | 2 mm (0.08 in) |
|  | Note Use recommended sealant. |
|  | Note Ensure that the surfaces are completely clean of oil and grease. |
| 222 | Install the noise shield. |
|  | Note Install the noise shield within 20 minutes of applying the sealant. |
| 223 | Install the screws. |



224 Install the timing gear plate.



225 Install the screws.



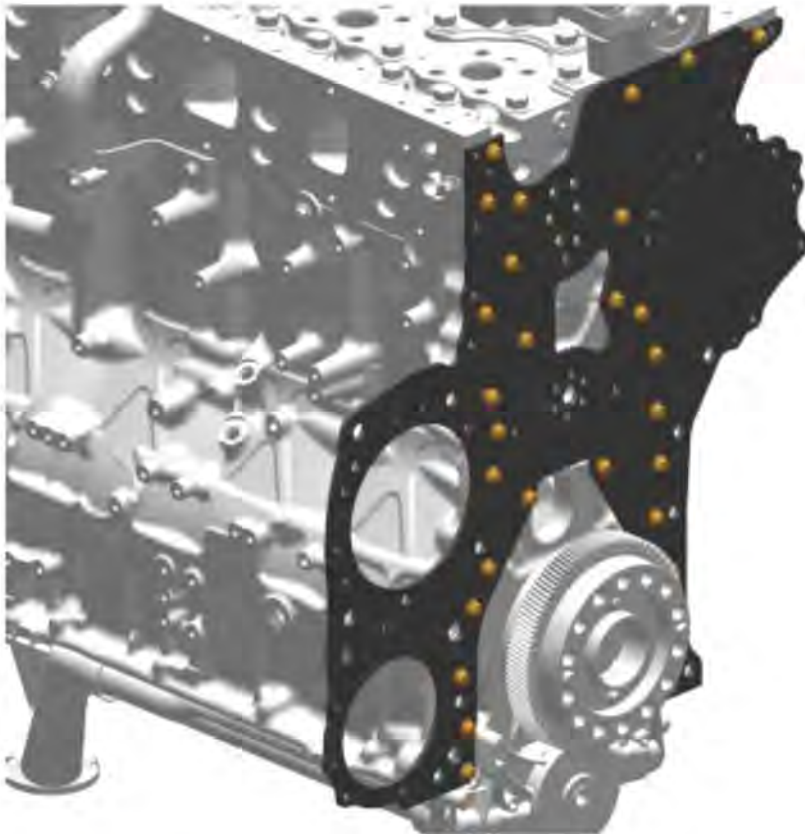
Note

Use new parts.



Note

Only use screws that are pre-treated with locking compound.



226 Lubricate the O-ring.



Note

Use a new part.



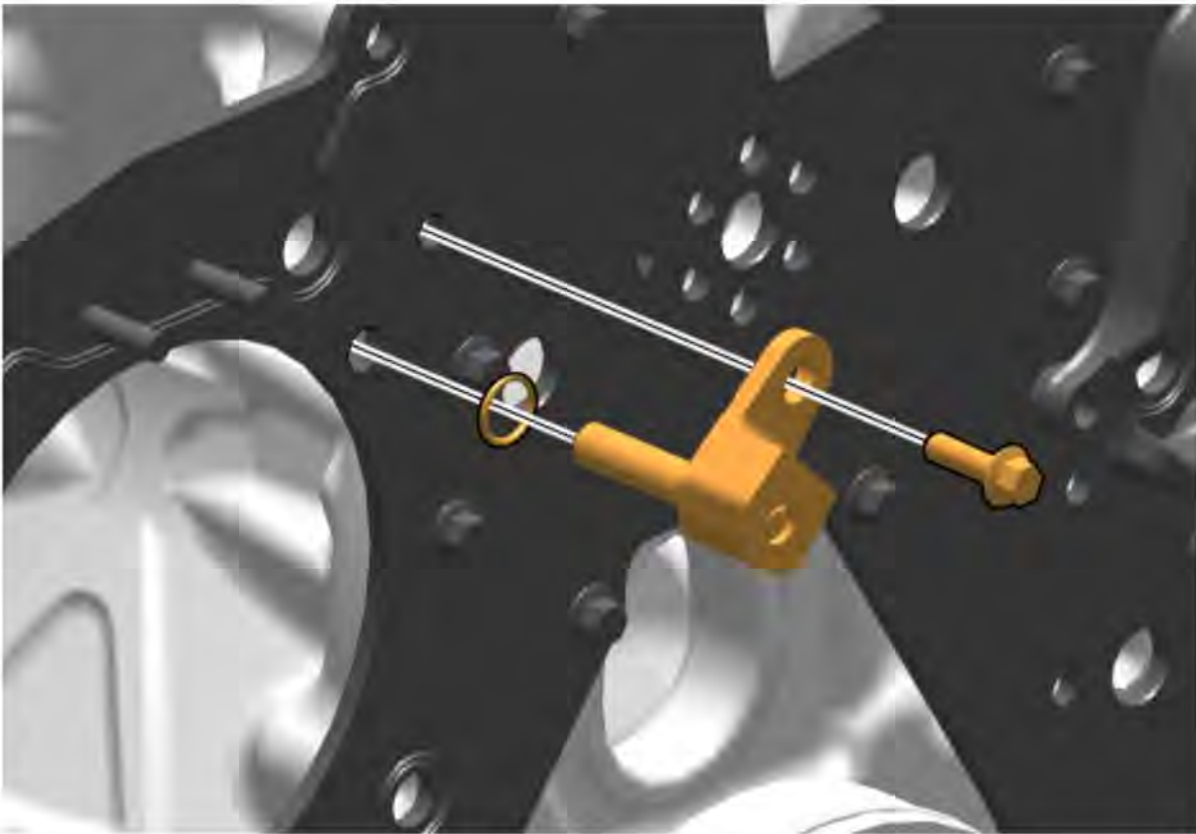
Note

Use recommended oil.

227 Install the O-ring.

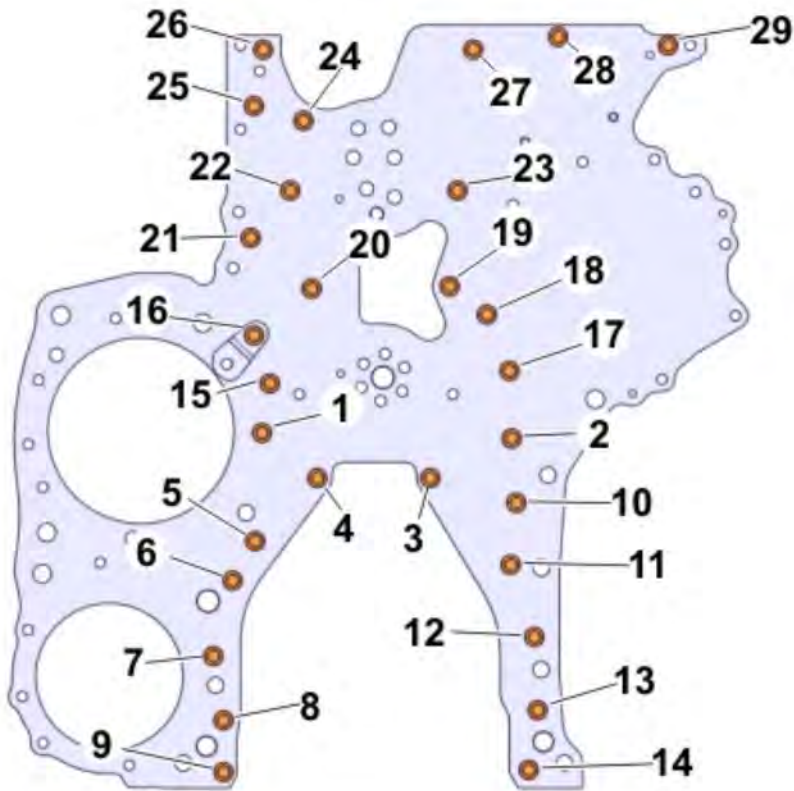
228 Install the bracket.

229 Install the screw.

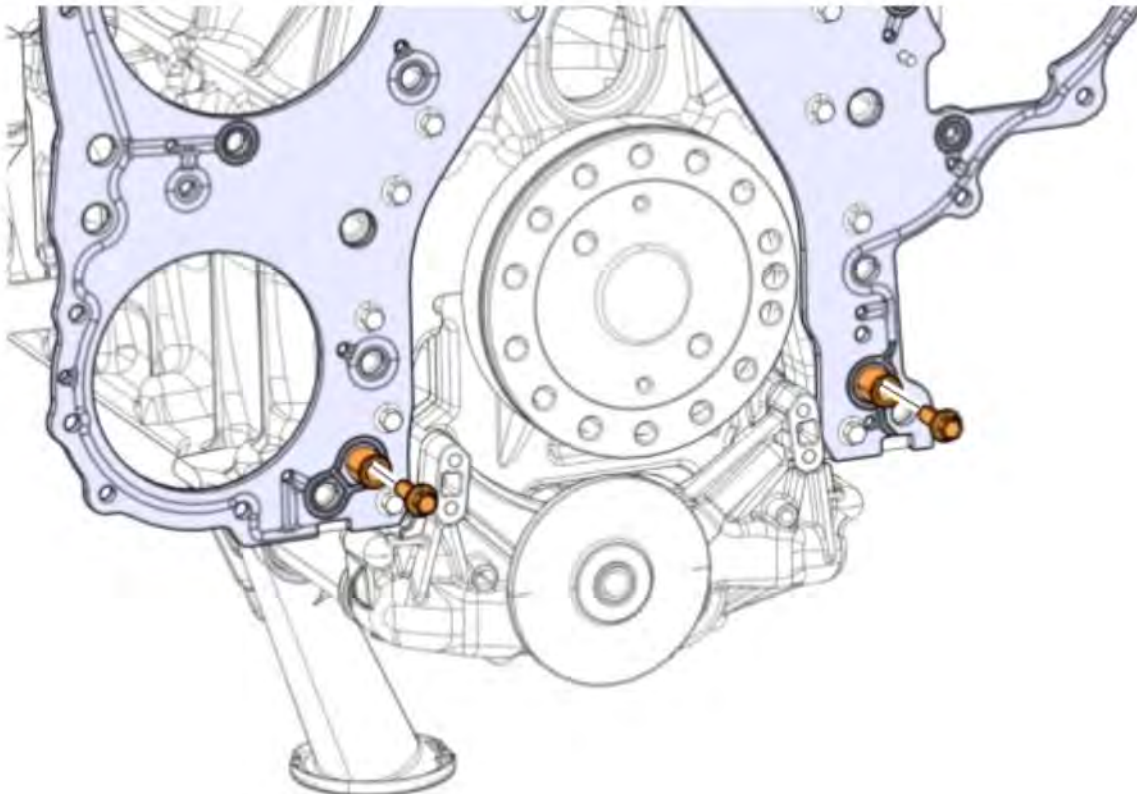


| | |
|-----|----------------------------|
| 230 | Torque tighten the screws. |
|-----|----------------------------|

| | |
|--------------------------|-----------------------------|
| Tightening torque | |
| Timing gear plate, screw | Tightening sequence: 1 - 28 |
| | 28 ±4 Nm |
| | (21 ±3 lb _f ·ft) |



| | |
|------------|-------------------|
| 231 | Remove the tools. |
|------------|-------------------|

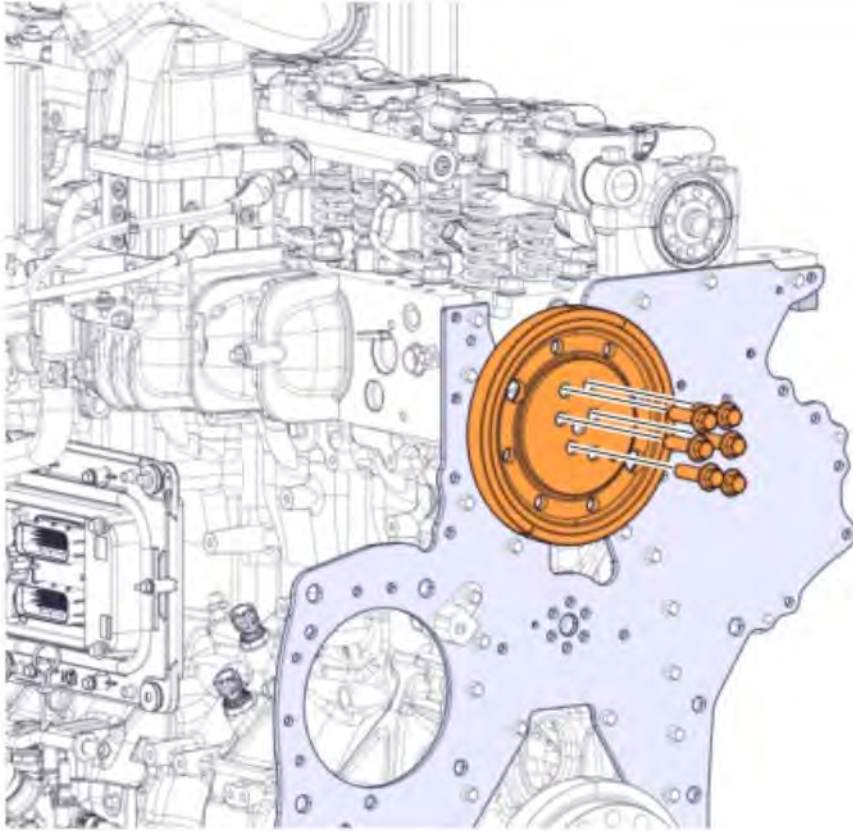


| | |
|------------|------------------------------|
| 232 | Clean the timing gear plate. |
|------------|------------------------------|

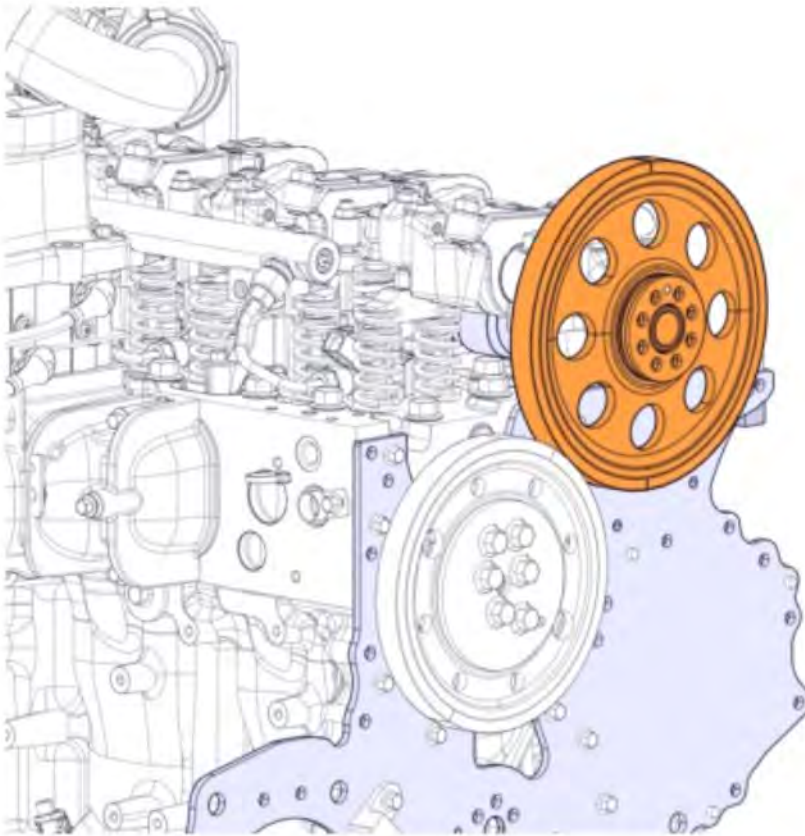
| | |
|------------|----------------------------|
| 233 | Install the thrust washer. |
|------------|----------------------------|

| | |
|-----|-------------------|
| 234 | Install the gear. |
|-----|-------------------|

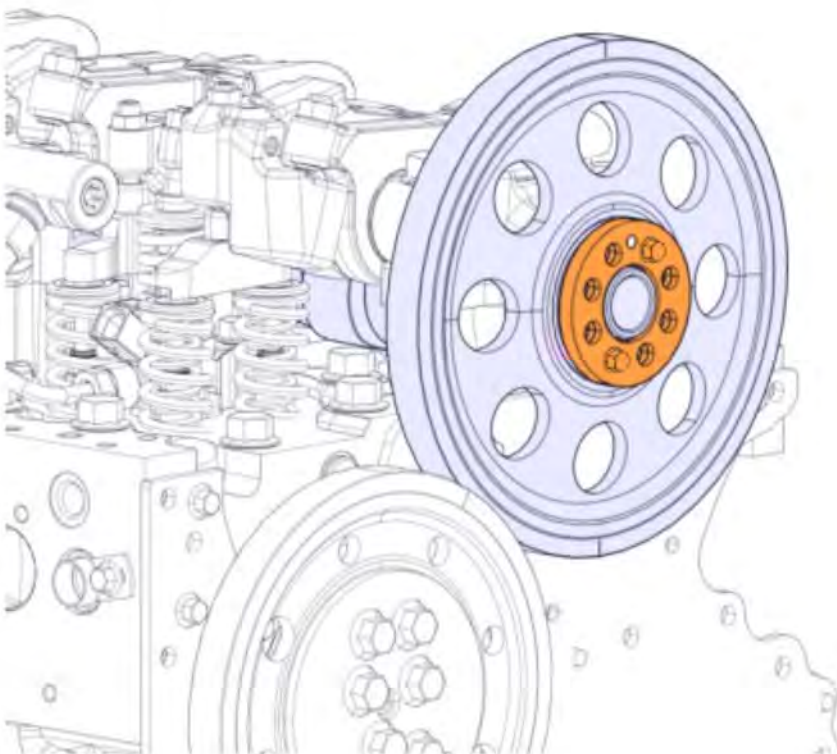
| | | | |
|----------|-------------------------------------------------------------------------------------------------------|----------|-----------------------------------------|
| 235 | Install the screws. | | |
| | <table border="1"><tr><td>i</td><td>Note Hand tighten the screws.</td></tr></table> | i | Note Hand tighten the screws. |
| i | Note Hand tighten the screws. | | |



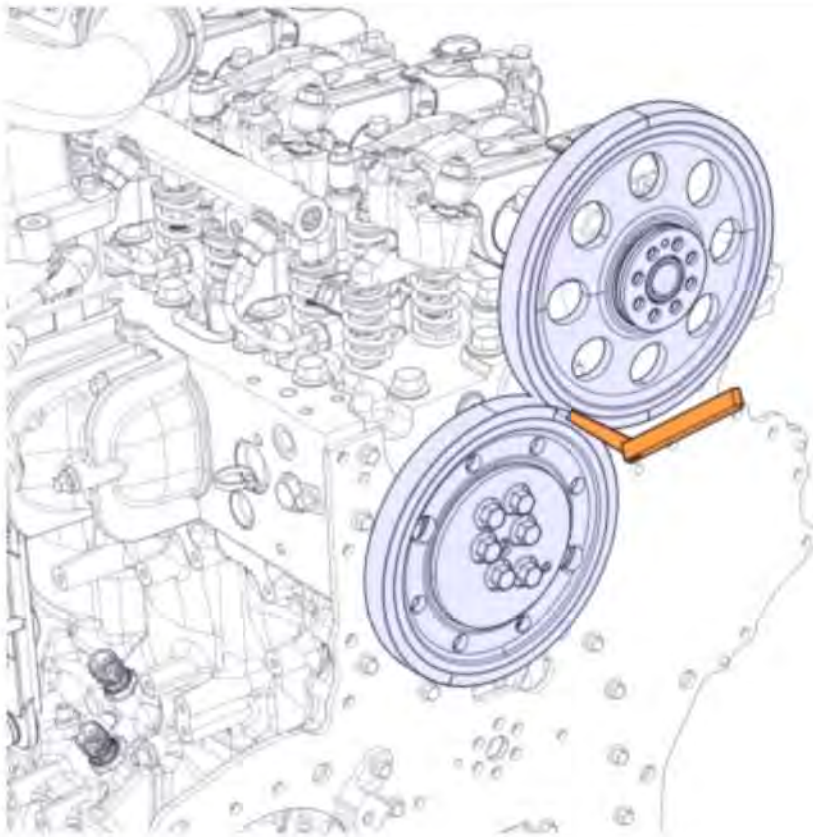
| | |
|-----|-------------------|
| 236 | Install the gear. |
|-----|-------------------|



| | |
|------------|------------------------------|
| 237 | Install the tool. |
| | Required material |
| | kit 88870039 |

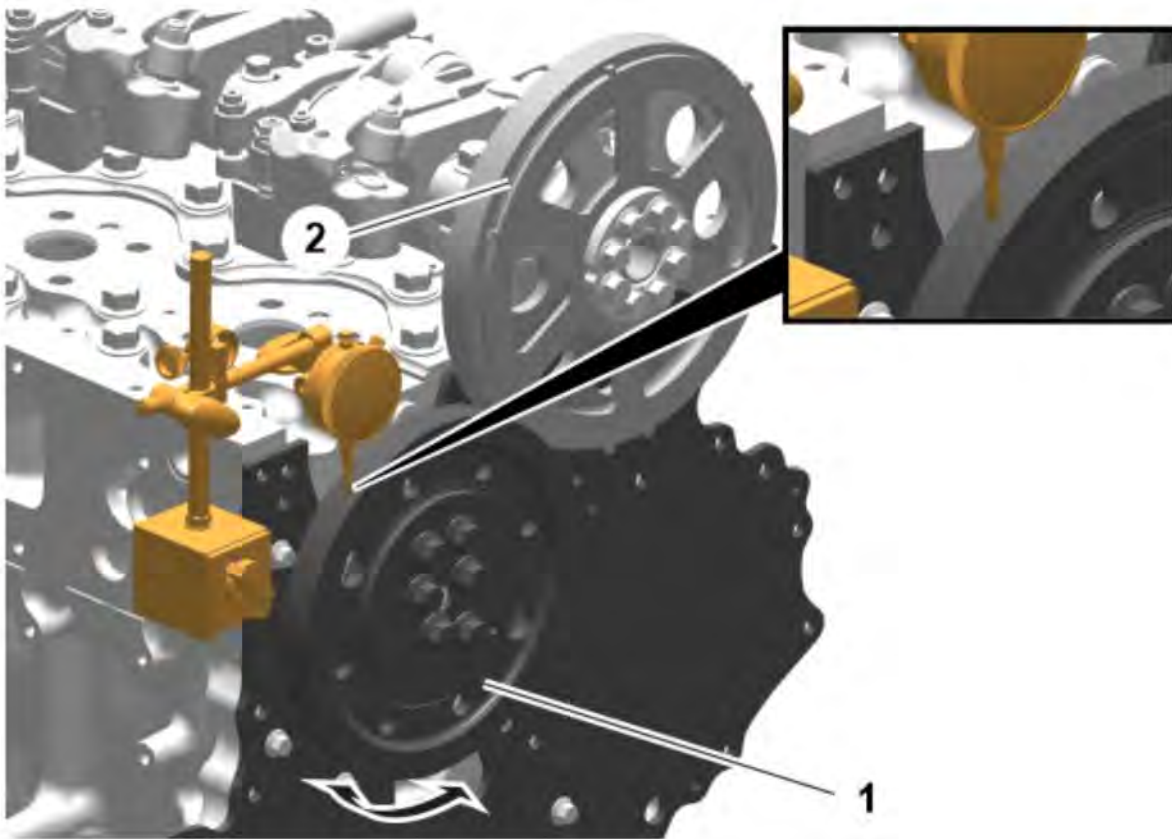


| | | |
|------------|---------------------------|----------------------|
| 238 | Install the feeler gauge. | |
| | Tech data | |
| | Feeler gauge, thickness | 0.1 mm (0.004 in) |

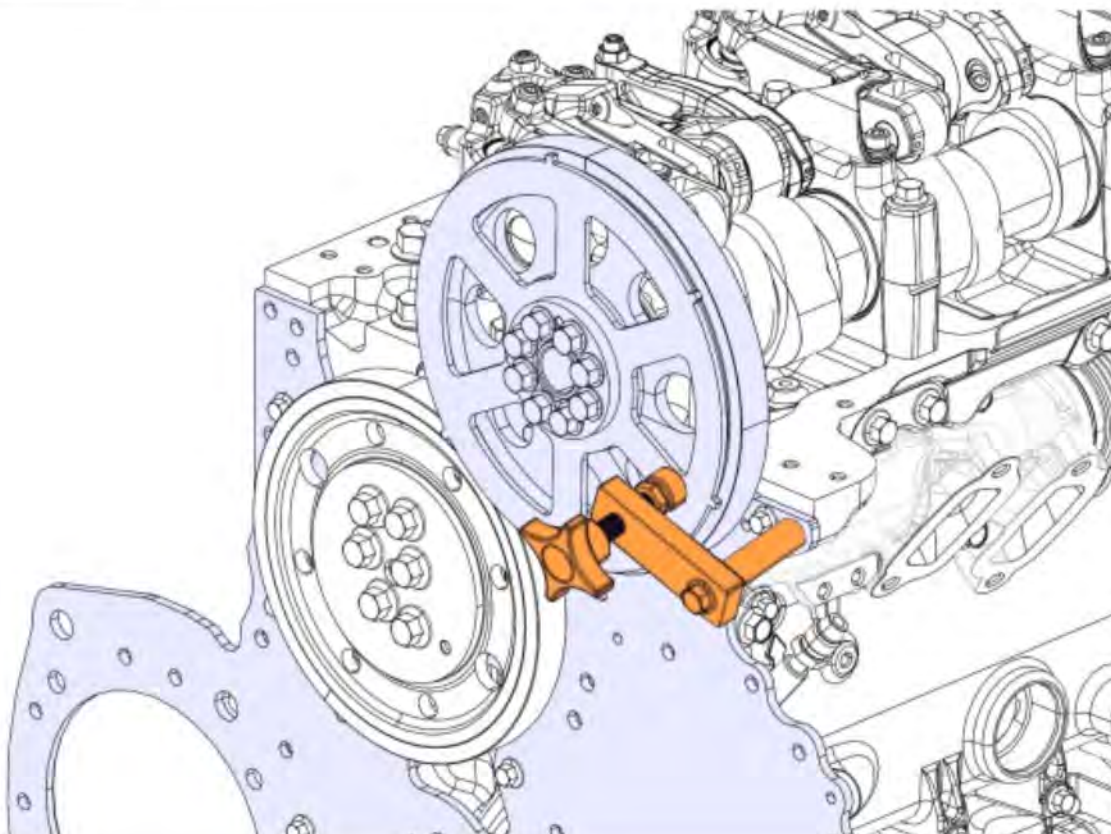


| | | |
|------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| 239 | Adjust the clearance. | |
| | i | Note Adjust the idler gear to adjust the clearance. |
| i | Note Ensure that a feeler gauge inserted between the teeth is difficult to move. | |

| | | |
|------------|------------------------------------------------------------------|-------------------------|
| 240 | Install the tools. | |
| | Required material | |
| | MAGNETIC STAND | 9999696 |
| | ROCKER_INDICATOR | 9999683 |
| i | Note Ensure that the probe tip touches the gear tooth. | |



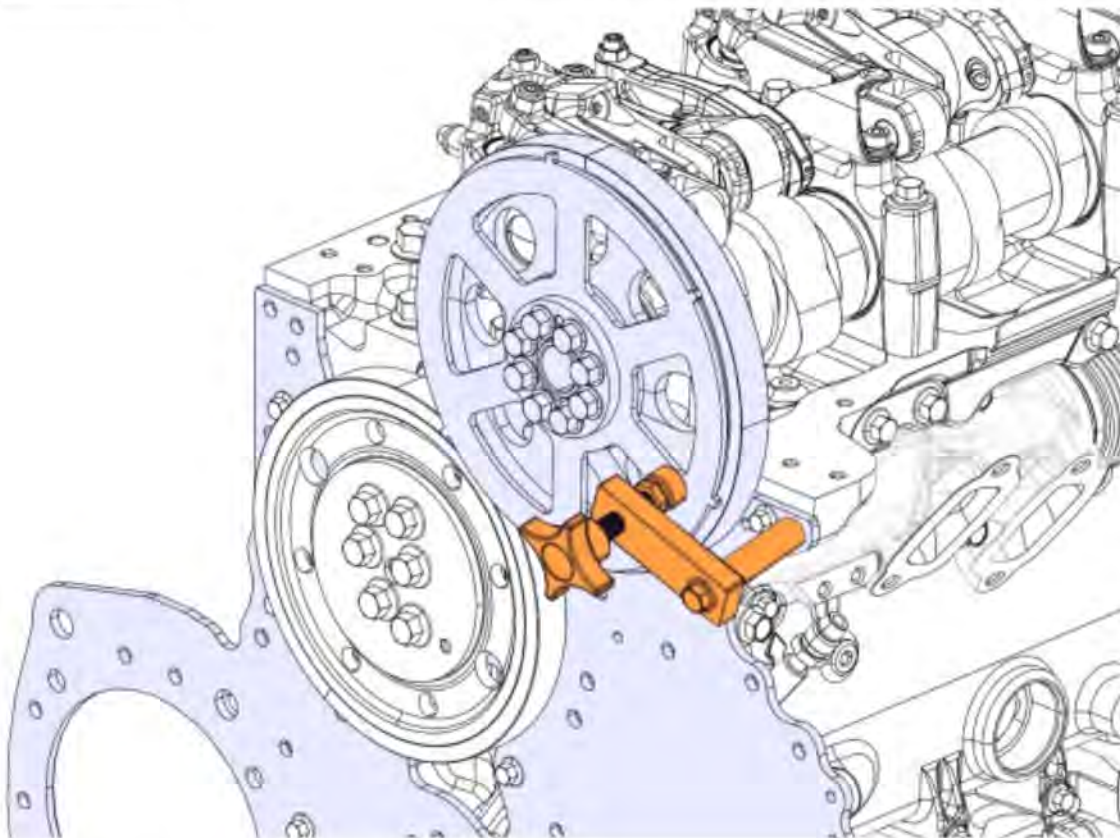
| | |
|--------------------------|--------------------------|
| 241 | Install the tool. |
| Required material | |
| kit | 88870039 |
| | |



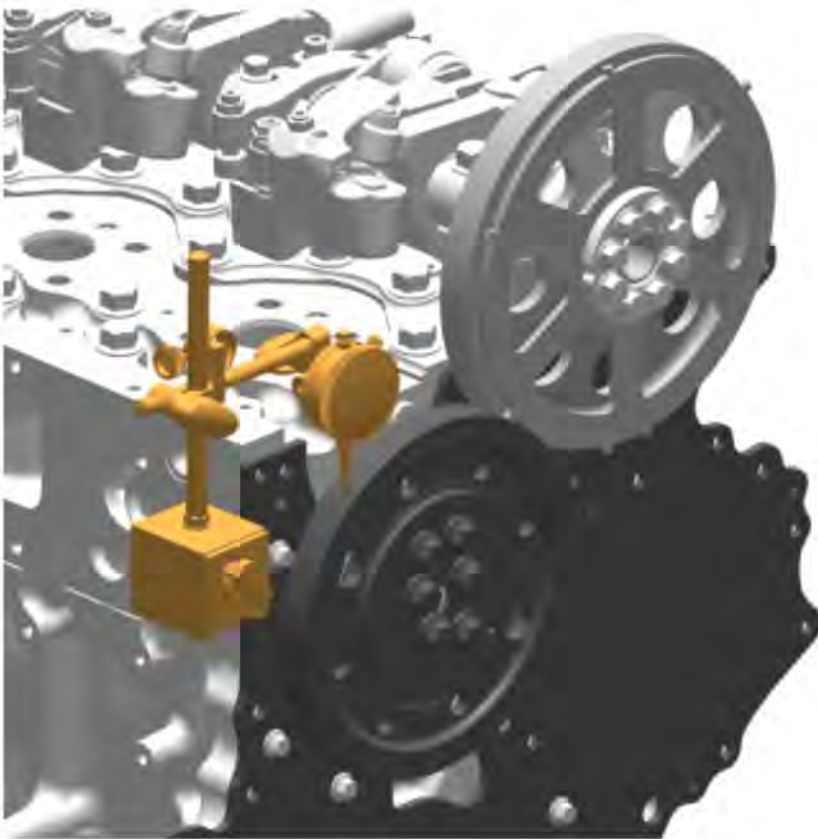
| | | |
|--------------------|-------------------------------------------|-----------------------------------|
| 242 | Check the backlash between gears 1 and 2. | |
| Tech data | | |
| Backlash clearance | | 0.1 ±0.05 mm (0.004 ±0.002 in) |

| | | | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|--|----------|----------------------------------------------------------------|
| 243 | Perform this procedure when the condition below is met. | | | |
| Conditions | | | | |
| <ul style="list-style-type: none"> If the backlash is not within specified value. | | | | |
| <ul style="list-style-type: none"> Readjust the gears. | | | | |
| <table border="1" style="width: 100%;"> <tr> <td style="width: 10%; text-align: center;">i</td> <td>Note The tool must be removed to readjust the gears.</td> </tr> </table> | | | i | Note The tool must be removed to readjust the gears. |
| i | Note The tool must be removed to readjust the gears. | | | |

| | |
|------------|------------------|
| 244 | Remove the tool. |
|------------|------------------|

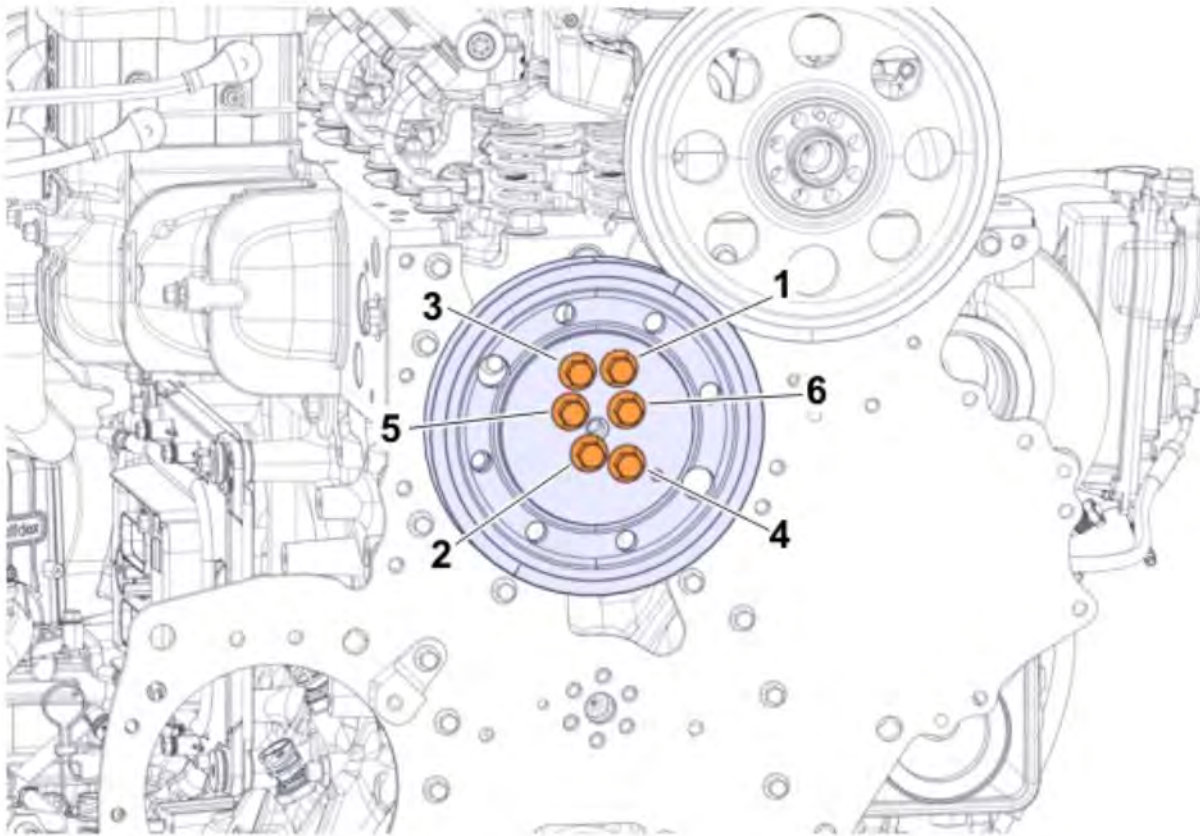


| | |
|------------|-------------------|
| 245 | Remove the tools. |
|------------|-------------------|

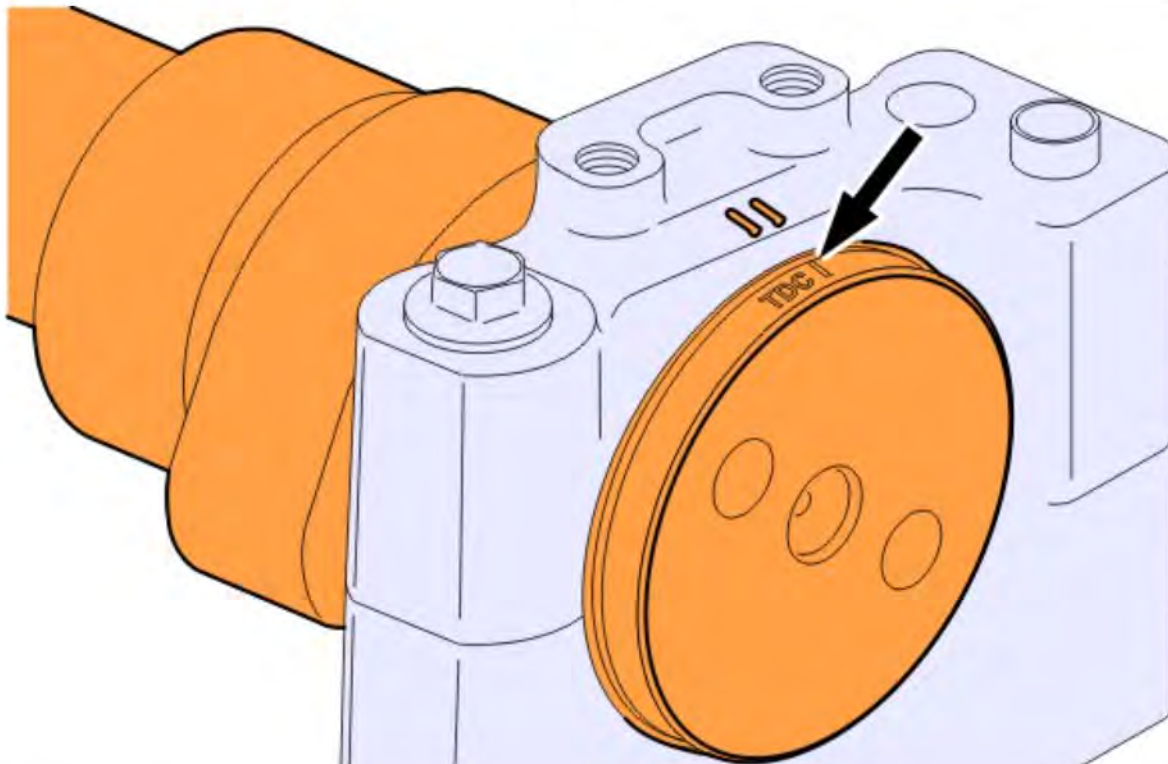


| | |
|------------|----------------------------|
| 246 | Torque tighten the screws. |
|------------|----------------------------|

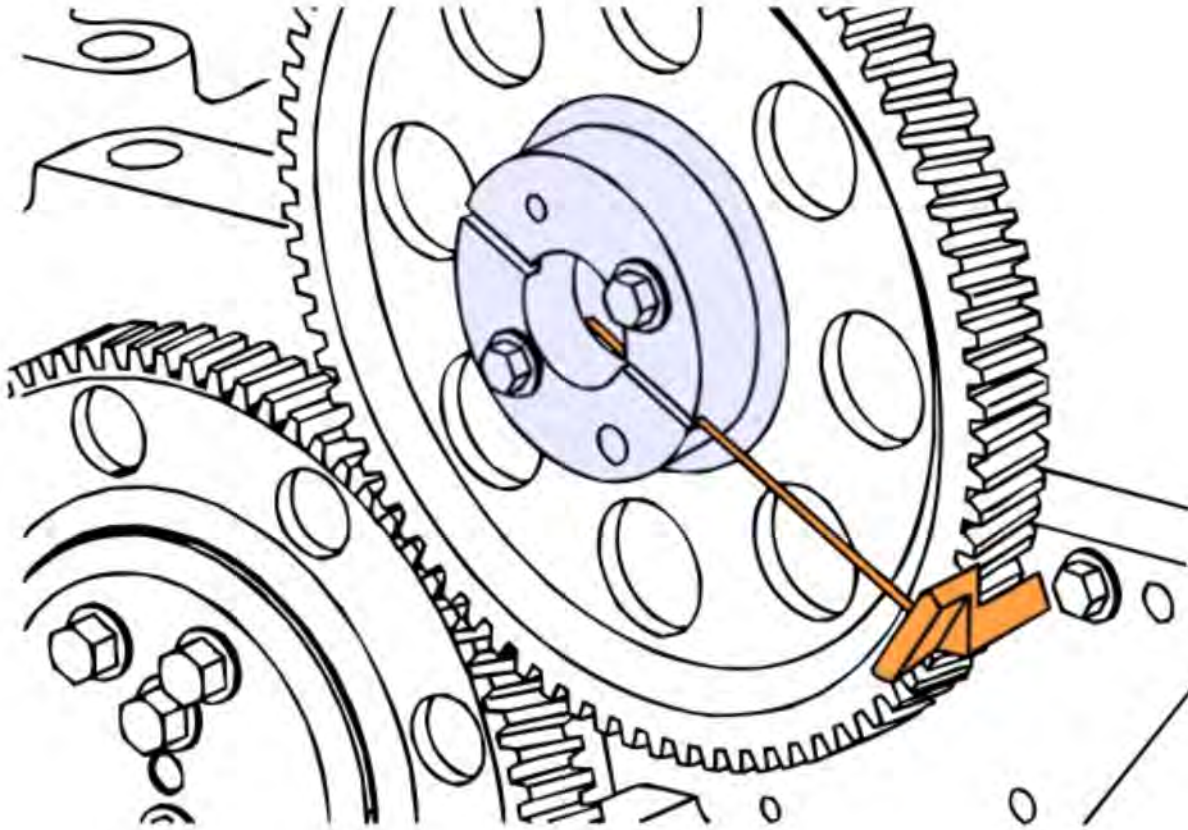
| Tightening torque | | |
|-------------------|----|-----------------------------------------|
| Idler gear, screw | 1. | Tightening sequence: 1–6 |
| | | 35 ±4 Nm (26 ±3 lb _f -ft) |
| | 2. | Tightening sequence: 1–6 |
| | | 120 ±5° |



247 Verify that the camshaft position markings are at (TDC).



| | |
|--------------------------|-------------------------------|
| 248 | Install the cam gear aligner. |
| Required material | |
| kit | 88870039 |



249 Install the gears.



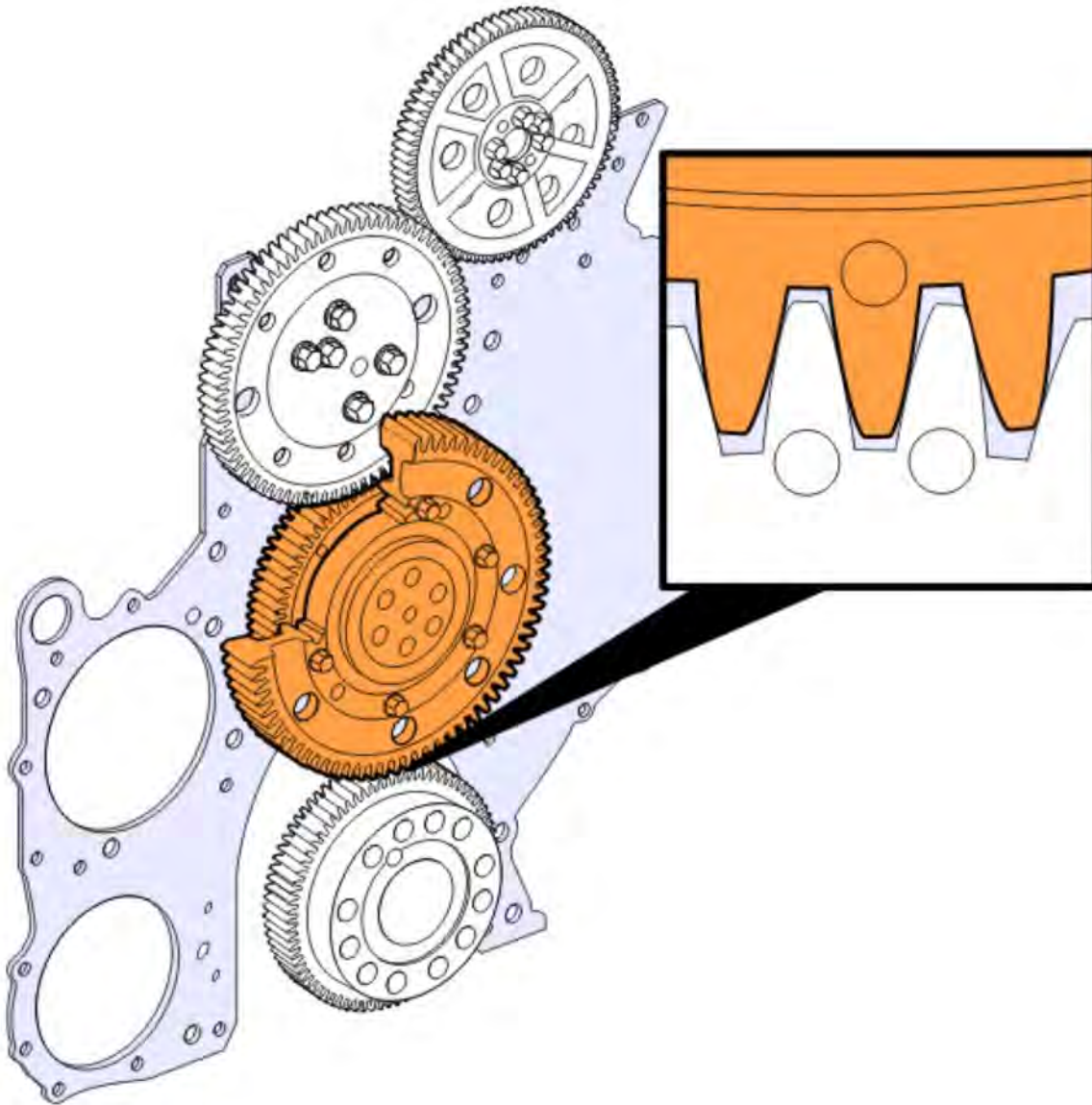
Note

Ensure the markings correctly align.



Note

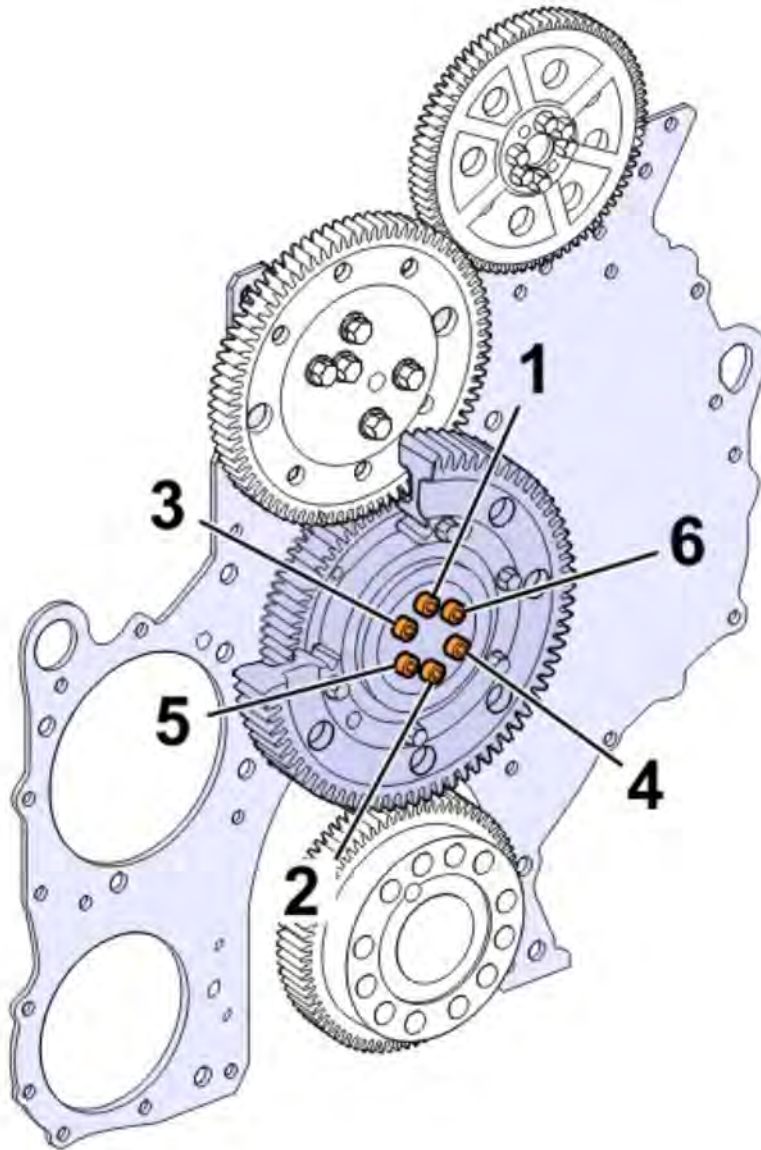
Remove the cam gear aligner.



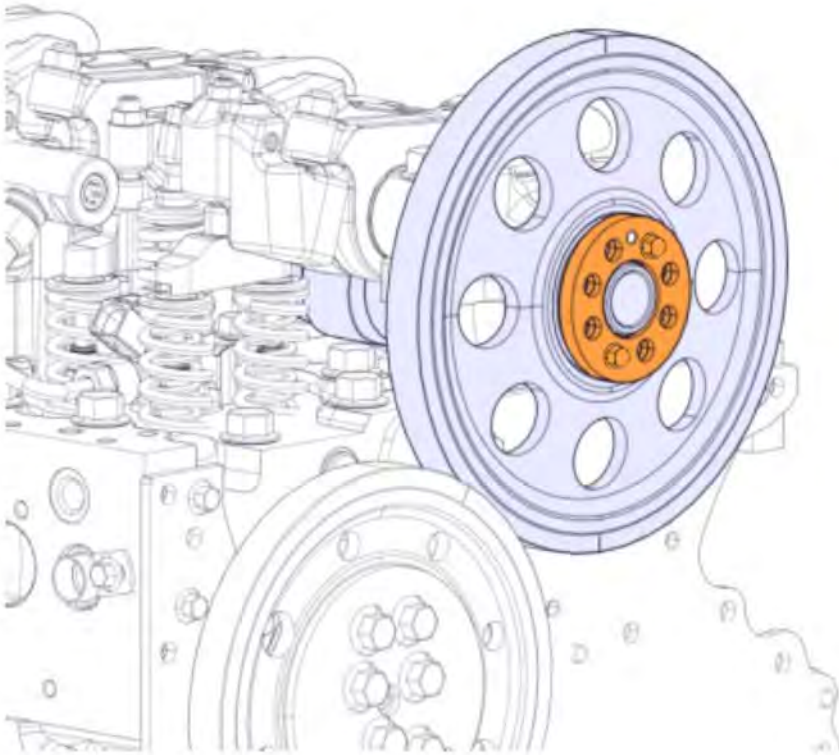
| | | | | | |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|--|----------------|
| 250 | Install the screws. | | | | |
| | <table border="1" style="border-collapse: collapse;"> <tr> <td style="text-align: center; width: 20px;">i</td> <td>Note</td> </tr> <tr> <td></td> <td>Use new parts.</td> </tr> </table> | i | Note | | Use new parts. |
| i | Note | | | | |
| | Use new parts. | | | | |

| | |
|------------|----------------------------|
| 251 | Torque tighten the screws. |
|------------|----------------------------|

| Tightening torque | | |
|--------------------------|----|-----------------------------------------|
| Double idler gear, screw | 1. | Tightening sequence: 1-6 |
| | | 25 ±3 Nm (18 ±2 lb _f -ft) |
| | 2. | Tightening sequence: 1-6 |
| | | 110 ±5° |



| | |
|-----|------------------|
| 252 | Remove the tool. |
|-----|------------------|

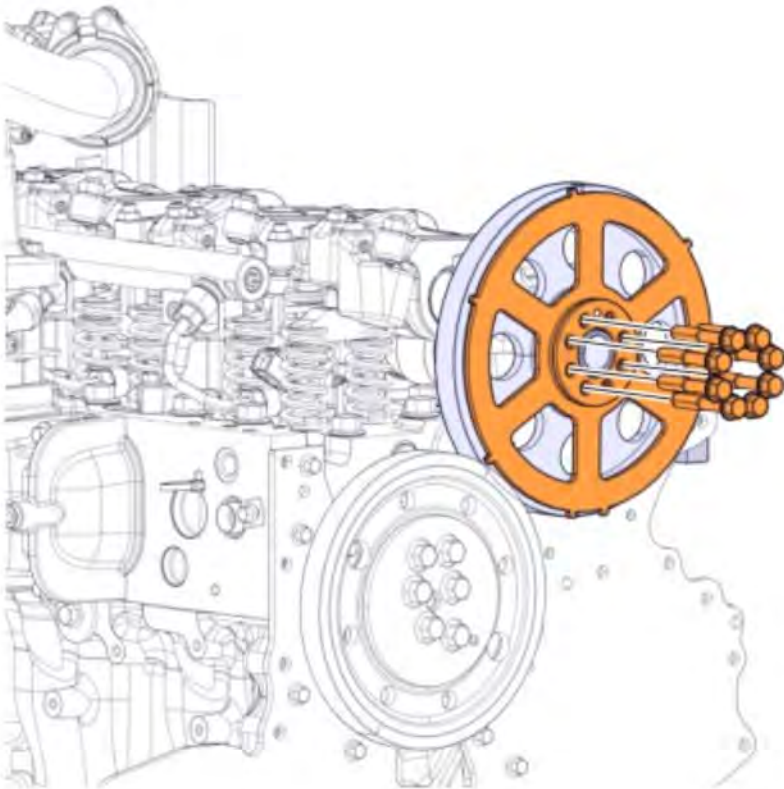


253 Install the tone wheel and screws.



Note

Use new screws.

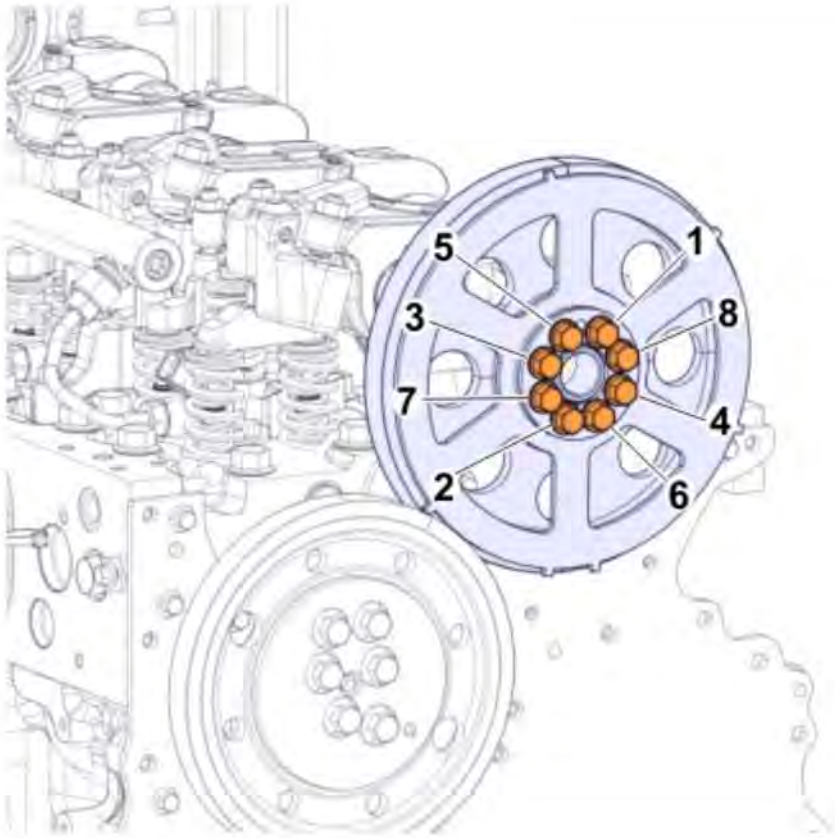


254 Torque tighten the screws.

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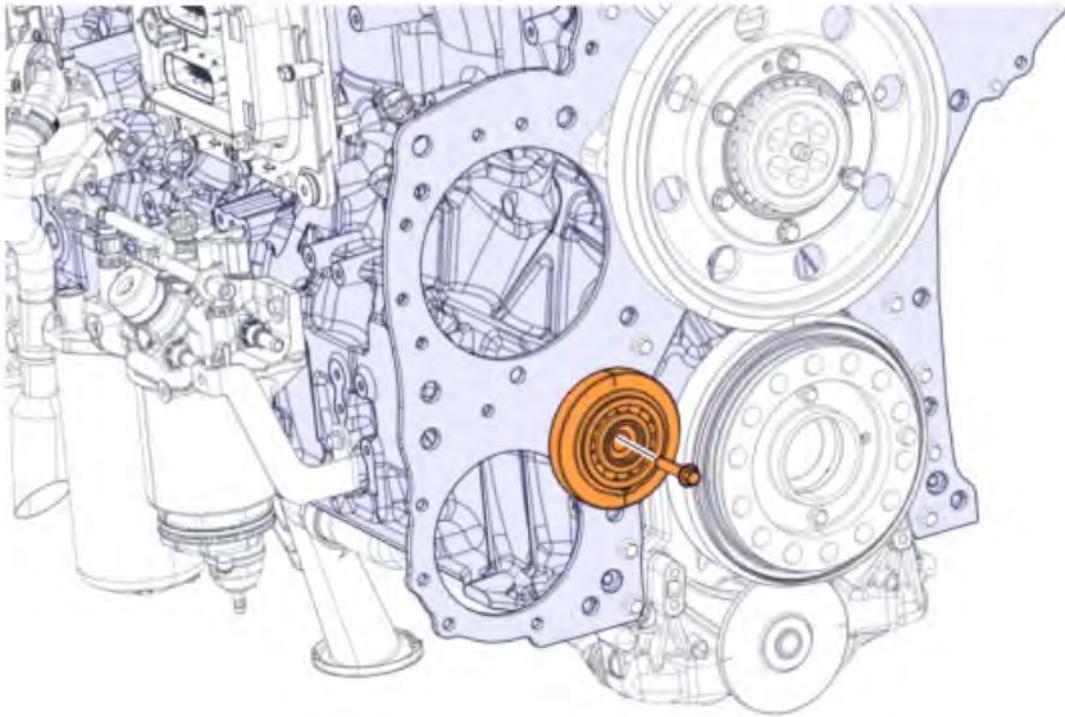
| Tightening torque | | |
|----------------------|----|-----------------------------------------|
| Camshaft gear, screw | 1. | Tightening sequence: 1-8 |
| | | 45 ±5 Nm (33 ±4 lb _f .ft) |
| | 2. | Tightening sequence: 1-8 |
| | | 90 ±5° |



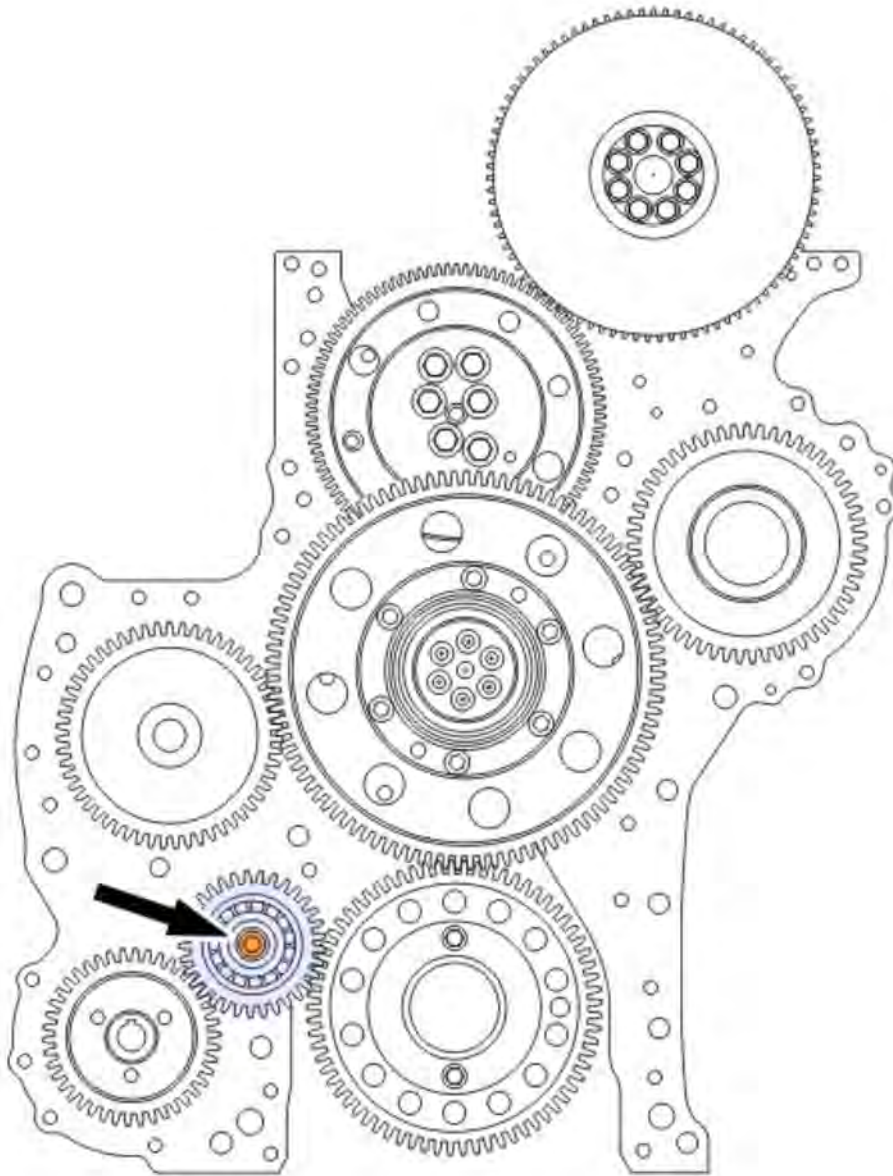
255 Install the gear.

256 Install the screw.

257 Torque tighten the screw.



| Tightening torque | |
|-------------------------------|--------------------------------------------|
| Idler gear, servo pump, screw | 140 ±10 Nm (103 ±7 lb _f ·ft) |
| | |



258 Clean the contact surfaces carefully.

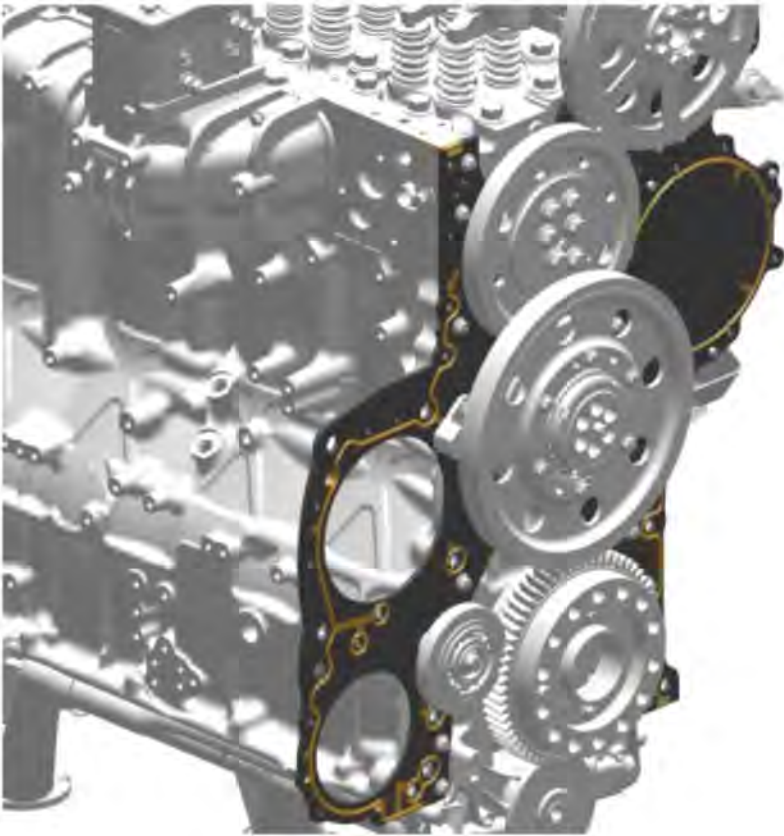


Note

Do not use any tools that may damage the sealing surfaces.

259 Inspect the sealing strip surfaces on both side of the timing gear plate.

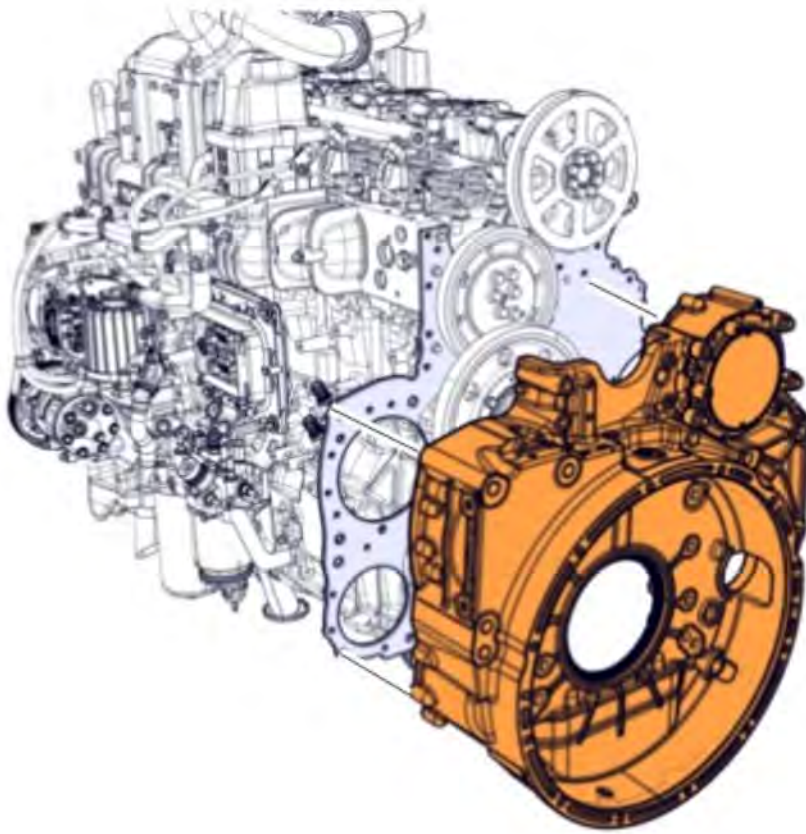
260 If the sealing strip is completely loose or damaged, the timing gear plate must be replaced.

**CAUTION****Risk of serious injury.**

Heavy component.

- ▶ Exercise caution when moving the component. Use appropriate tools.

261 Install the flywheel housing.

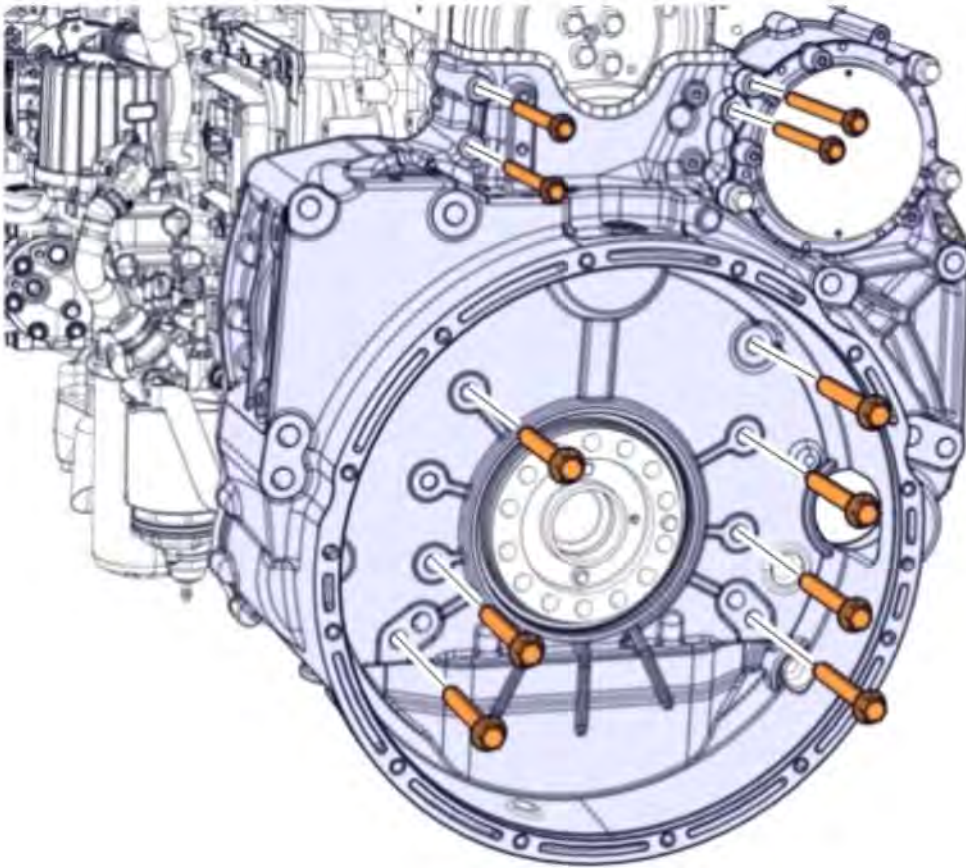


262 Install the screws.



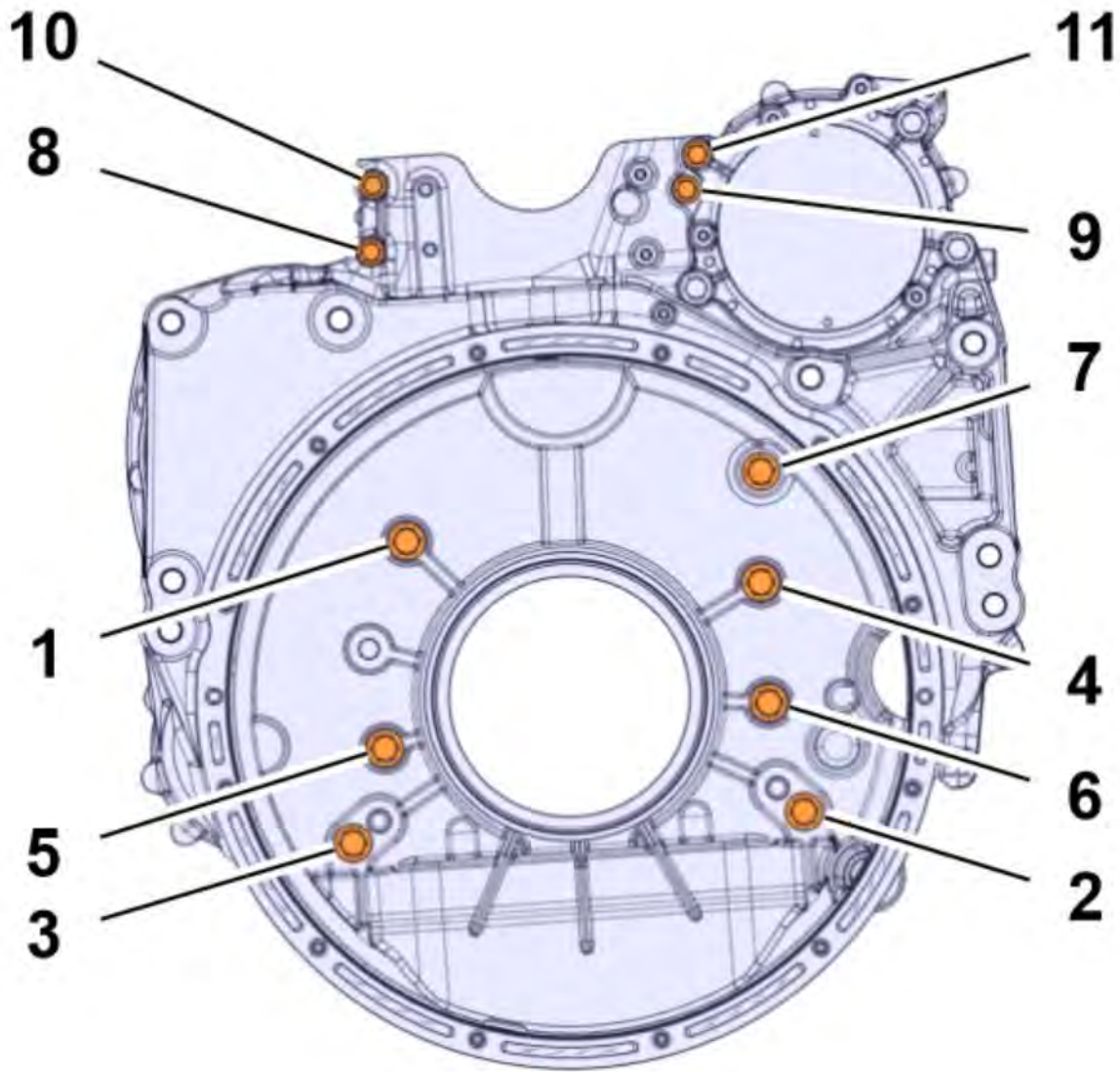
Note

Remove the alignment dowels.



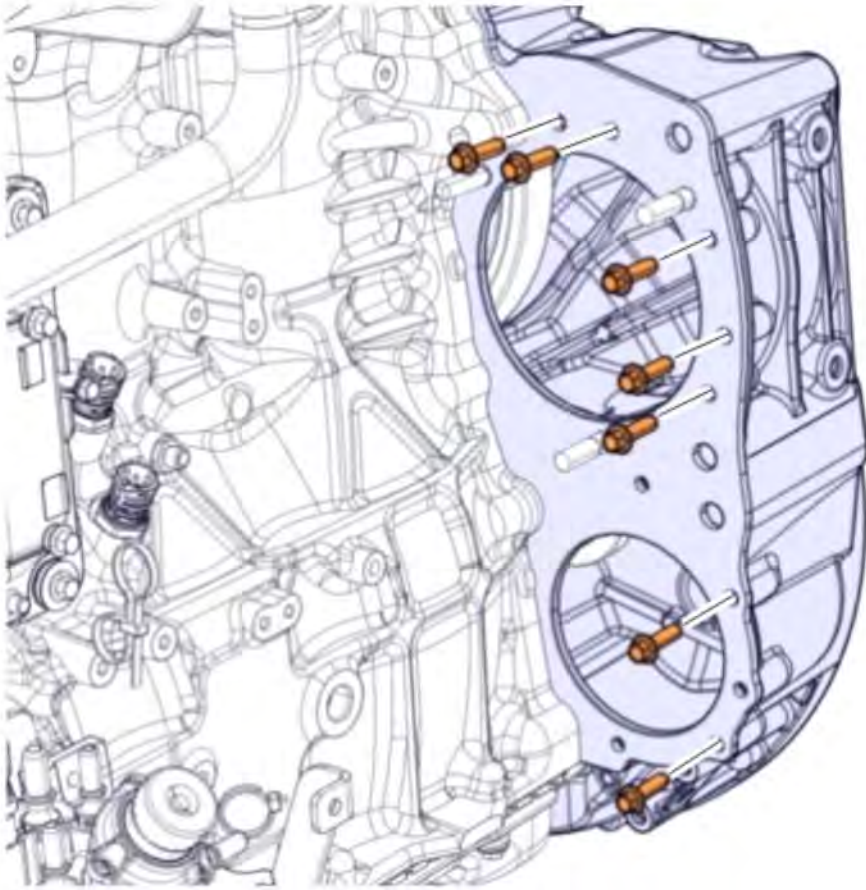
263 Torque tighten the screws.

| Tightening torque | | |
|-------------------------|----|---------------------------------------------|
| Flywheel housing, screw | 1. | M14 |
| | | Tightening sequence: 1-7 |
| | | 36 ±10 Nm (27 ±7 lb _f .ft) |
| | 2. | M14 |
| | | Tightening sequence: 1-7 |
| | | 160 ±20 Nm (118 ±15 lb _f .ft) |
| | 3. | M10 |
| | | Tightening sequence: 8--11 |
| | | 60 ±10 Nm (44 ±7 lb _f .ft) |



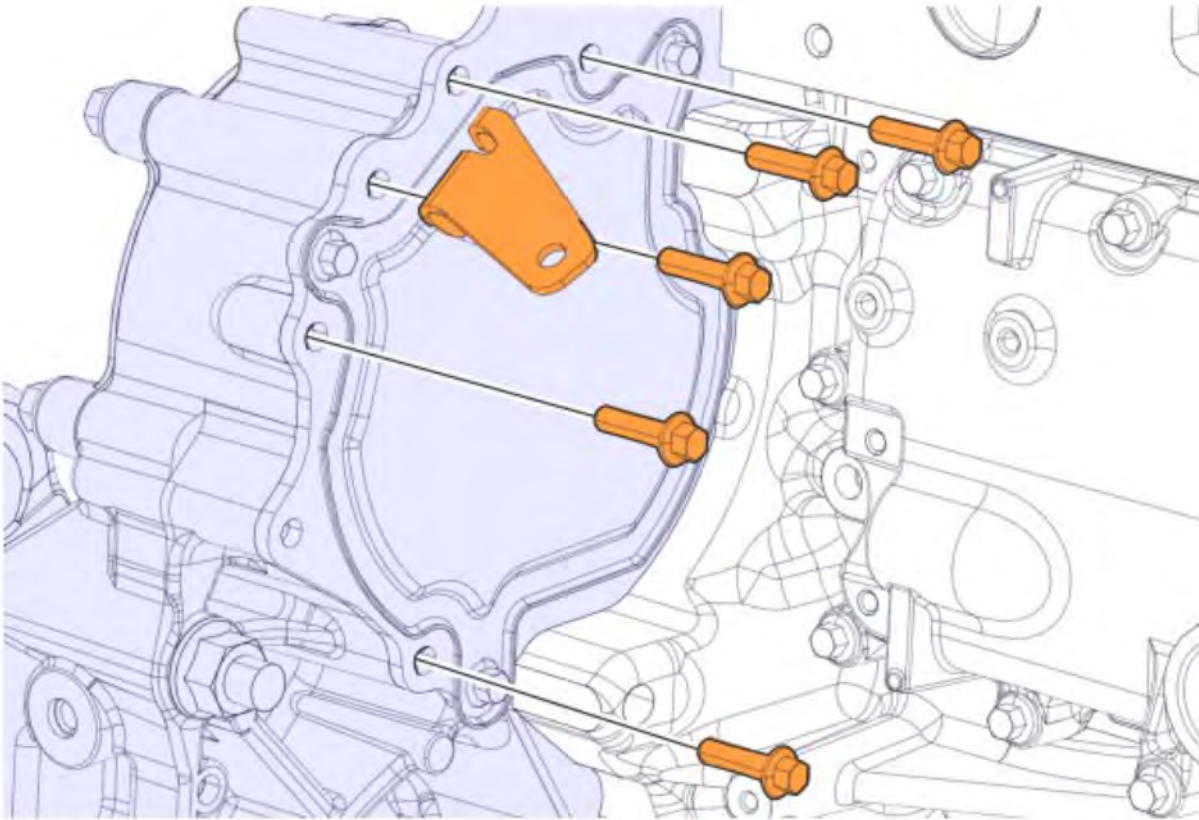
| | | | | | |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|-----------------------------------------------------|--|
| 264 | Install the screws. | | | | |
| | <table border="1" style="width: 100%;"> <tr> <td style="width: 20px; text-align: center;">i</td> <td>Note</td> </tr> <tr> <td colspan="2">Some housings may not include all the screws shown.</td> </tr> </table> | i | Note | Some housings may not include all the screws shown. | |
| i | Note | | | | |
| Some housings may not include all the screws shown. | | | | | |

| | | |
|------------|----------------------------|-----------------------------|
| 265 | Torque tighten the screws. | |
| | Tightening torque | |
| | Screw | M8 |
| | | 24 ±4 Nm |
| | | (18 ±3 lb _f -ft) |



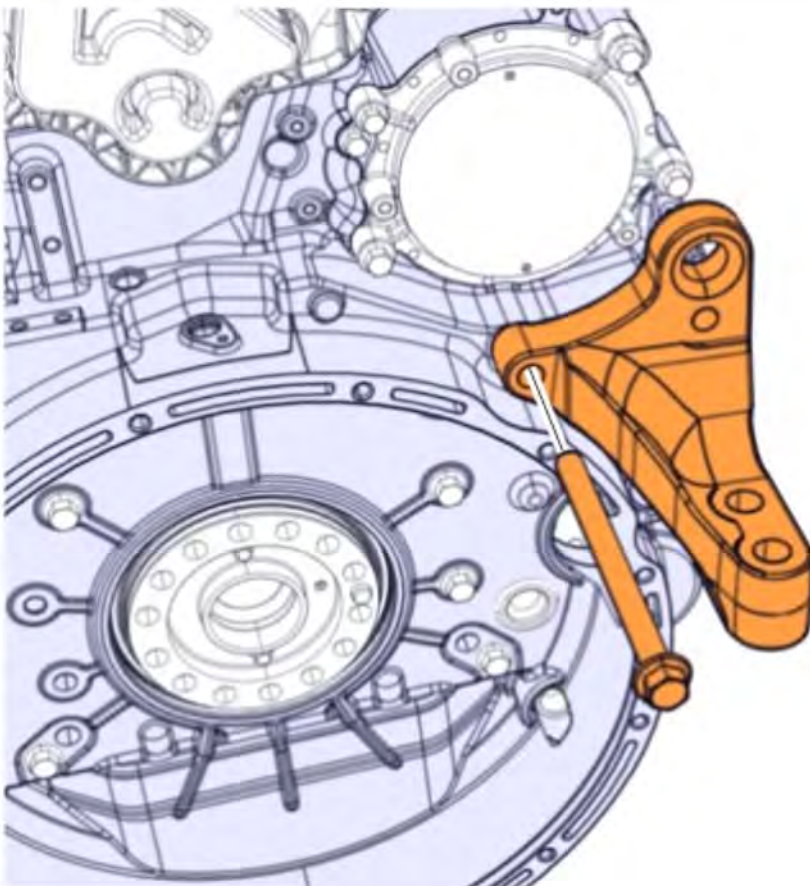
| | |
|-----|-------------------------------------|
| 266 | Install the bracket and the screws. |
|-----|-------------------------------------|

| | | |
|-----|----------------------------|-----------------------------|
| 267 | Torque tighten the screws. | |
| | Tightening torque | |
| | Screw | M8 |
| | | 24 ±4 Nm |
| | | (18 ±3 lb _f -ft) |



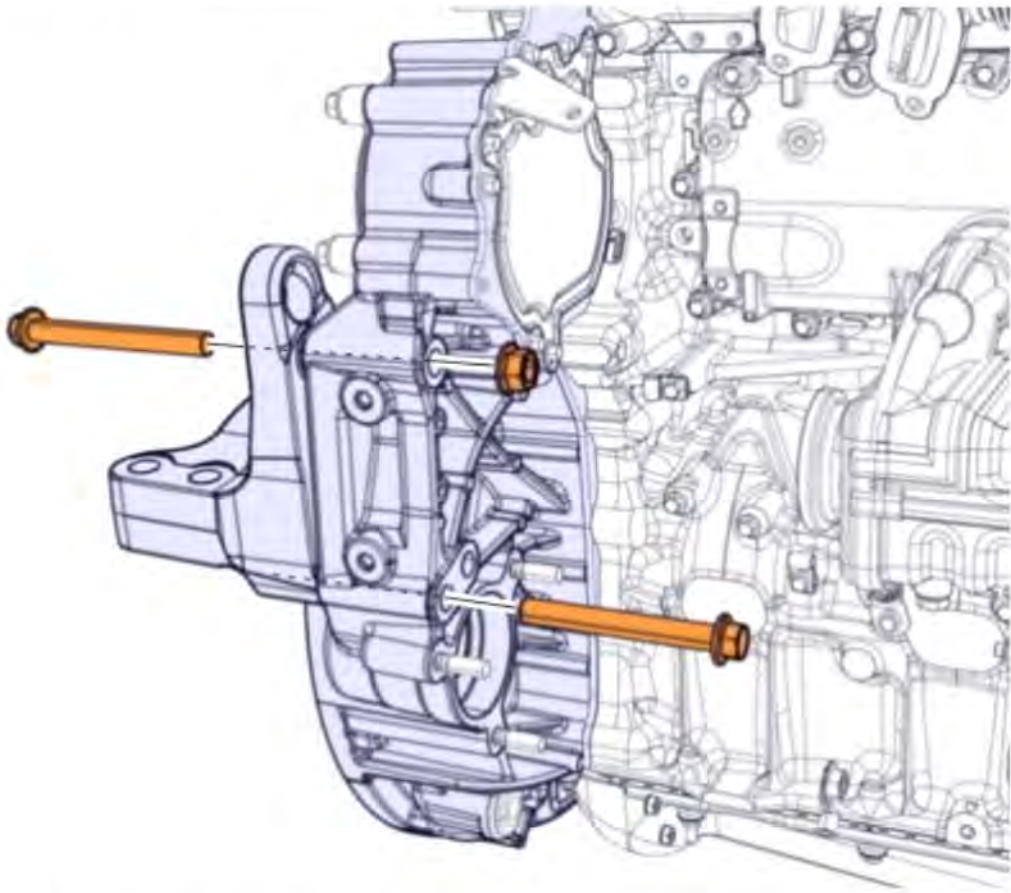
| | |
|------------|----------------------|
| 268 | Install the bracket. |
|------------|----------------------|

| | |
|------------|--------------------|
| 269 | Install the screw. |
|------------|--------------------|



| | |
|------------|--------------------|
| 270 | Install the screw. |
|------------|--------------------|

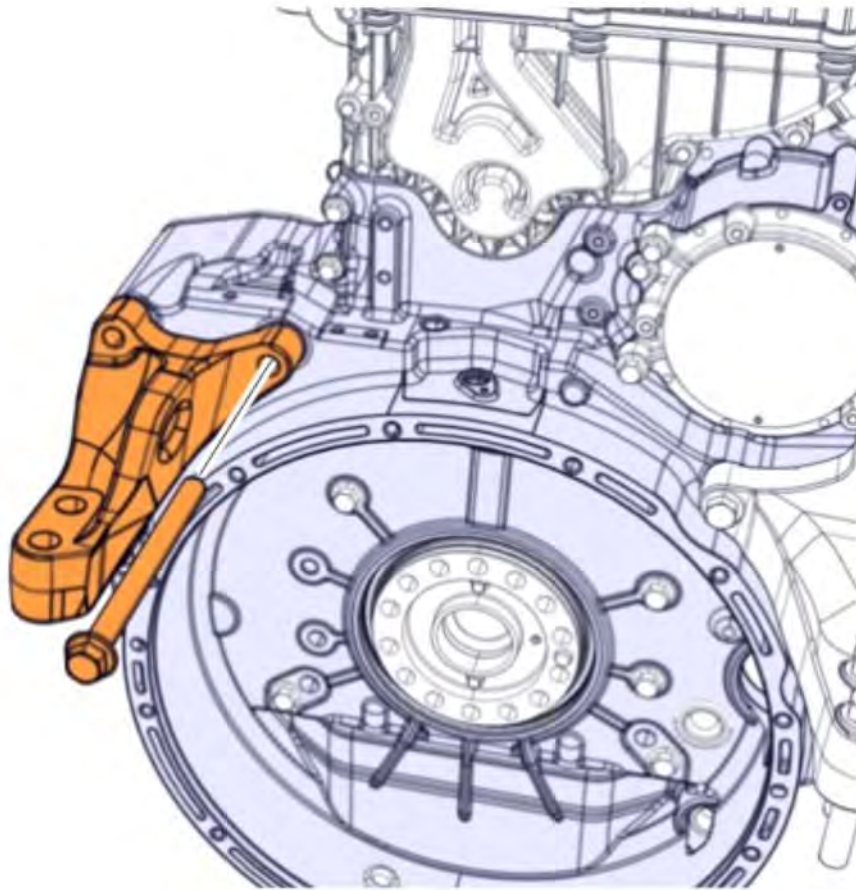
271 Install the screw and nut.



| | | |
|-----|-----------------------------------------------|---------------------------------------------|
| 272 | Torque tighten the screws and nut. | |
| | Tightening torque | |
| | Engine bracket, flywheel housing, rear, screw | 275 ±45 Nm (203 ±33 lb _f -ft) |

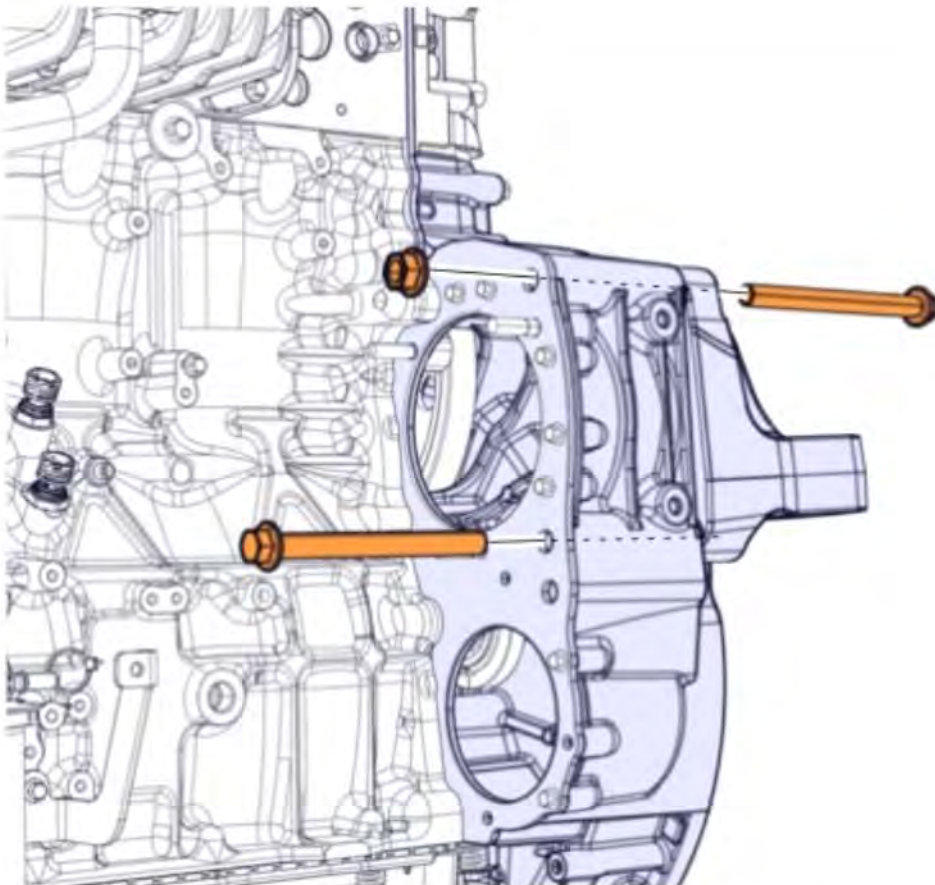
273 Install the bracket.

274 Install the screw.



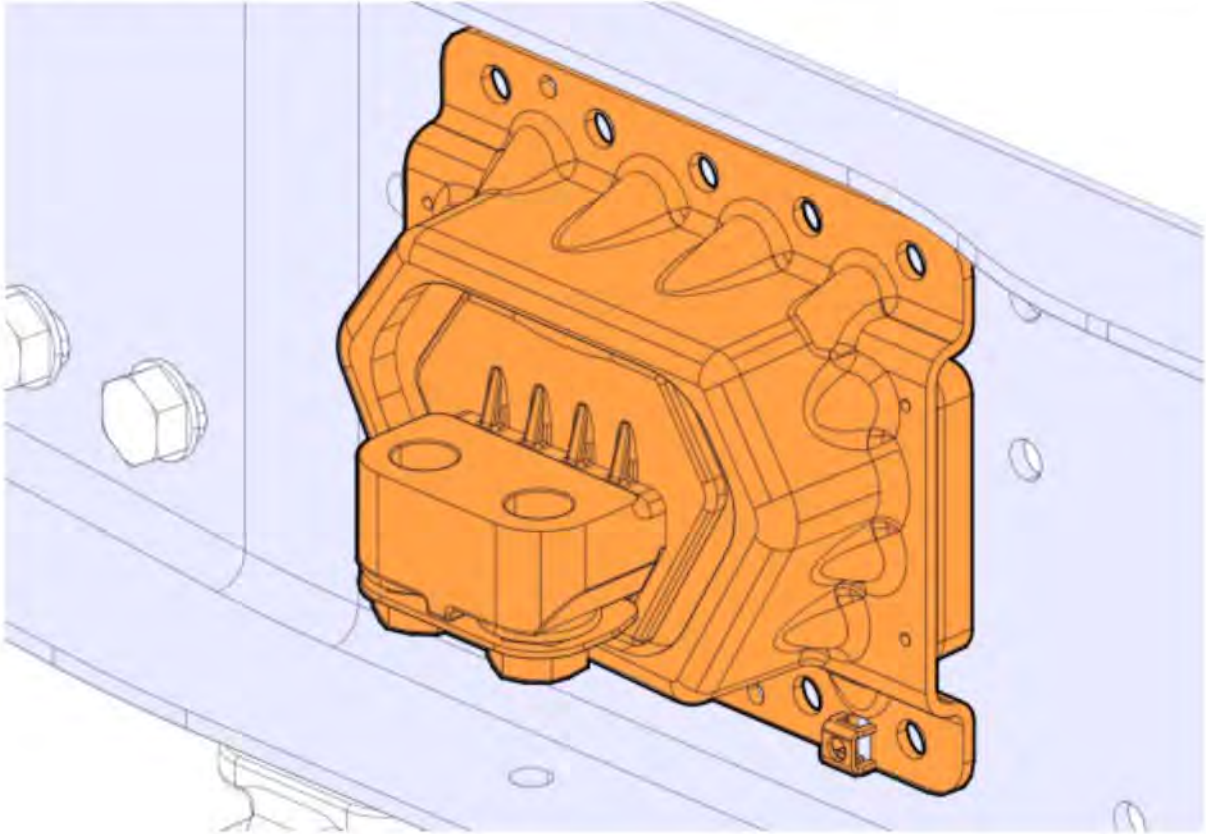
| | |
|-----|--------------------|
| 275 | Install the screw. |
|-----|--------------------|

| | |
|-----|----------------------------|
| 276 | Install the screw and nut. |
|-----|----------------------------|

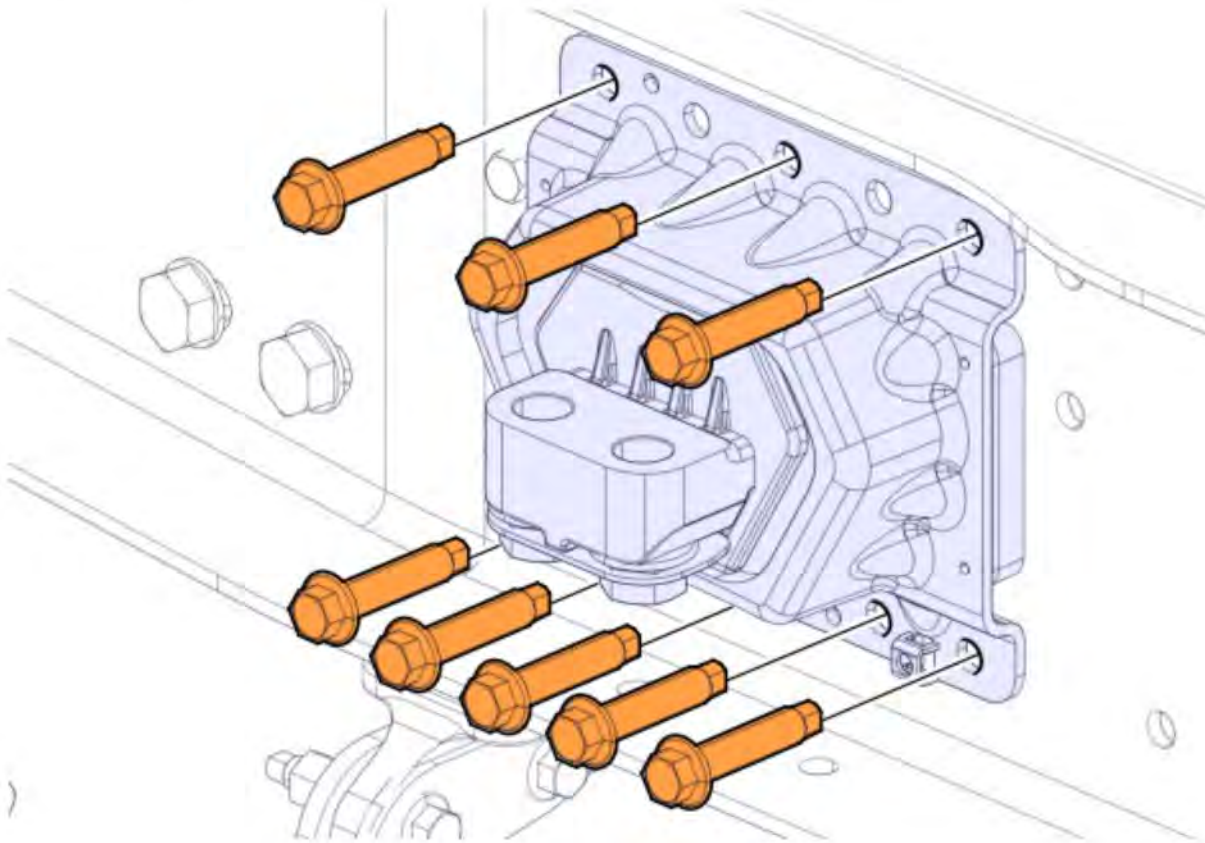


| | | |
|-----------------------------------------------|------------------------------------|---------------------------------------------|
| 277 | Torque tighten the screws and nut. | |
| Tightening torque | | |
| Engine bracket, flywheel housing, rear, screw | | 275 ±45 Nm (203 ±33 lb _f ·ft) |

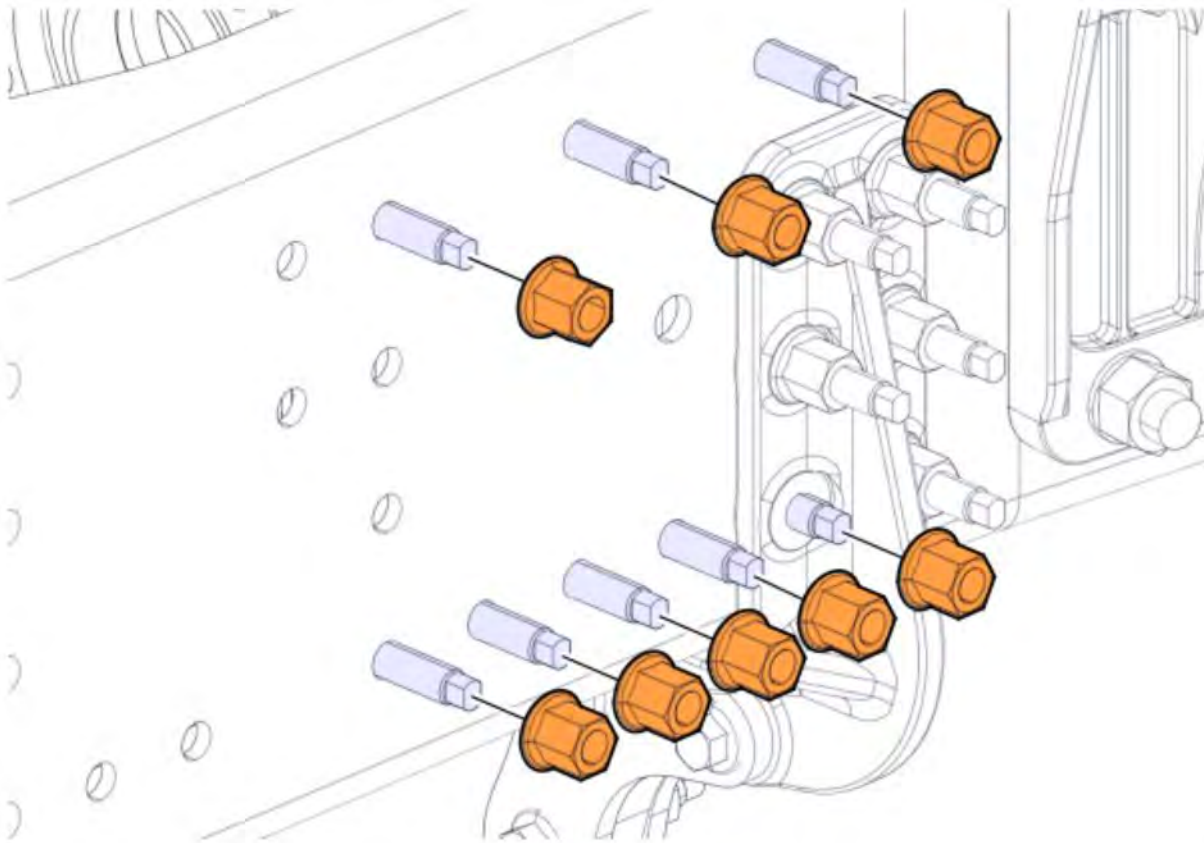
278 Install the rubber cushion.



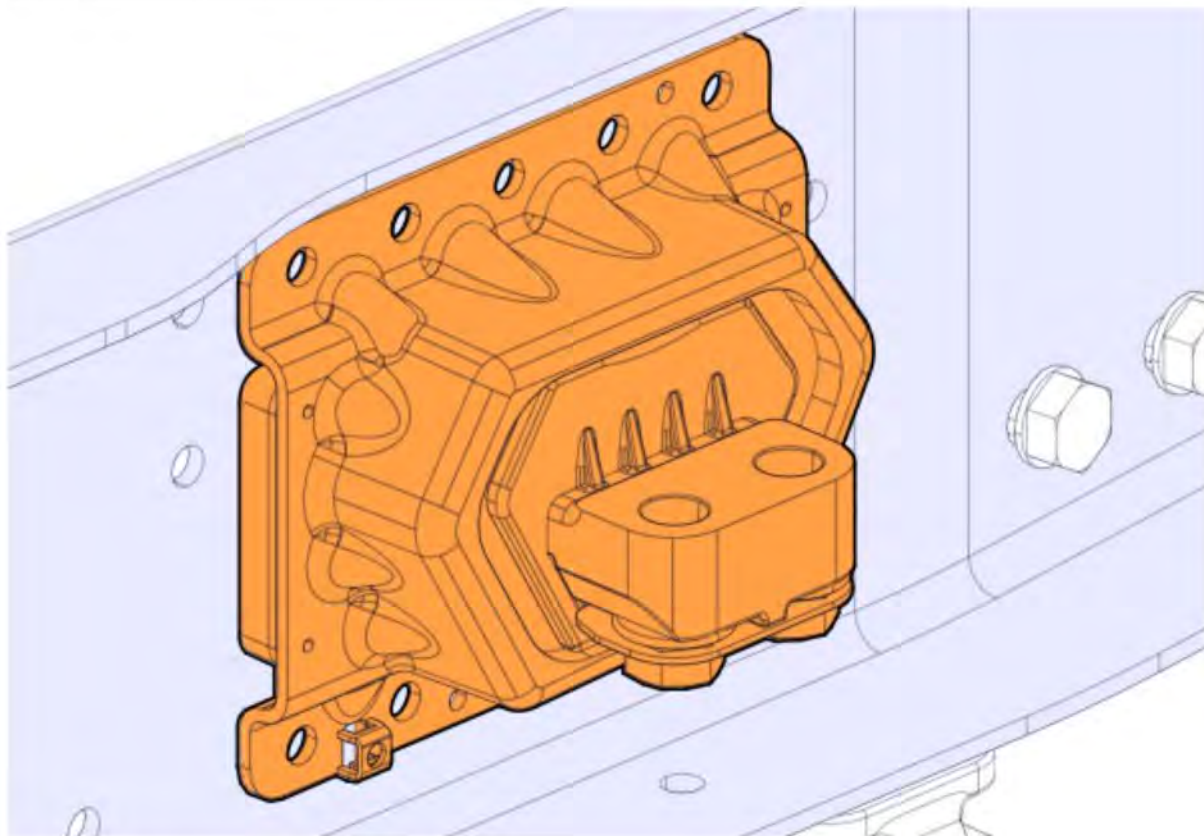
279 Install the screws.



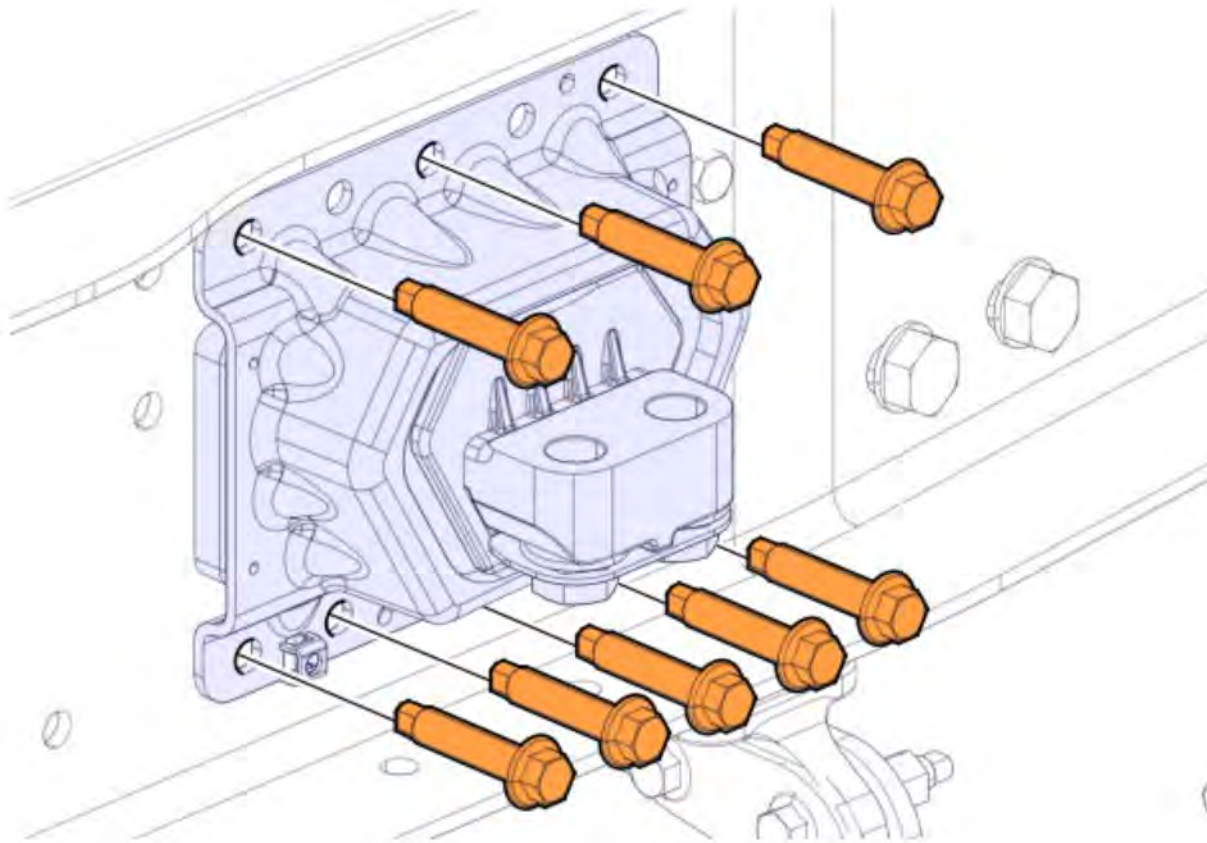
| | | |
|-----|--------------------------|---------------------------------------------|
| 280 | Install the nuts. | |
| 281 | Torque tighten the nuts. | |
| | Tightening torque | |
| | Rear cushion, screw | 140 ±25 Nm (103 ±18 lb _f ·ft) |



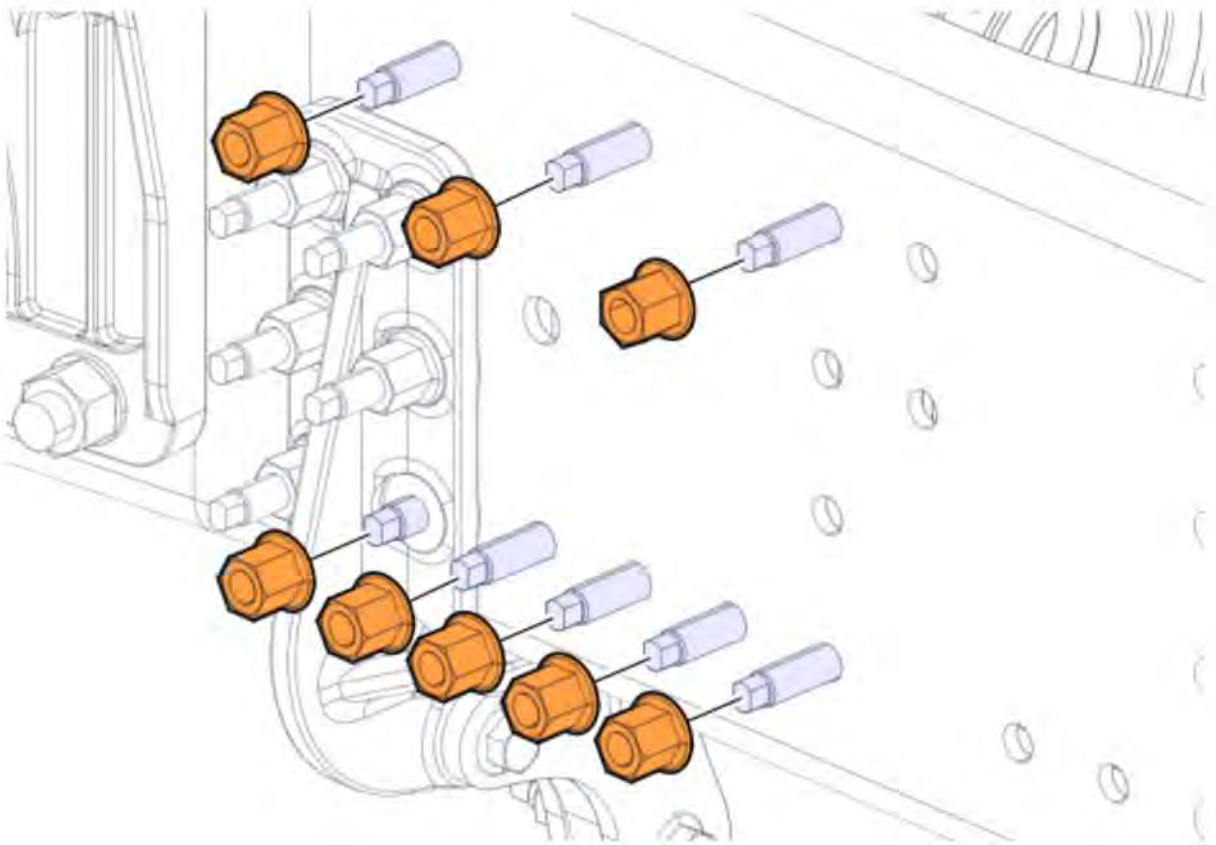
282 Install the rubber cushion.



283 Install the screws.



| | | |
|-----|--------------------------|---------------------------------------------|
| 284 | Install the nuts. | |
| 285 | Torque tighten the nuts. | |
| | Tightening torque | |
| | Rear cushion, screw | 140 ±25 Nm (103 ±18 lb _f -ft) |



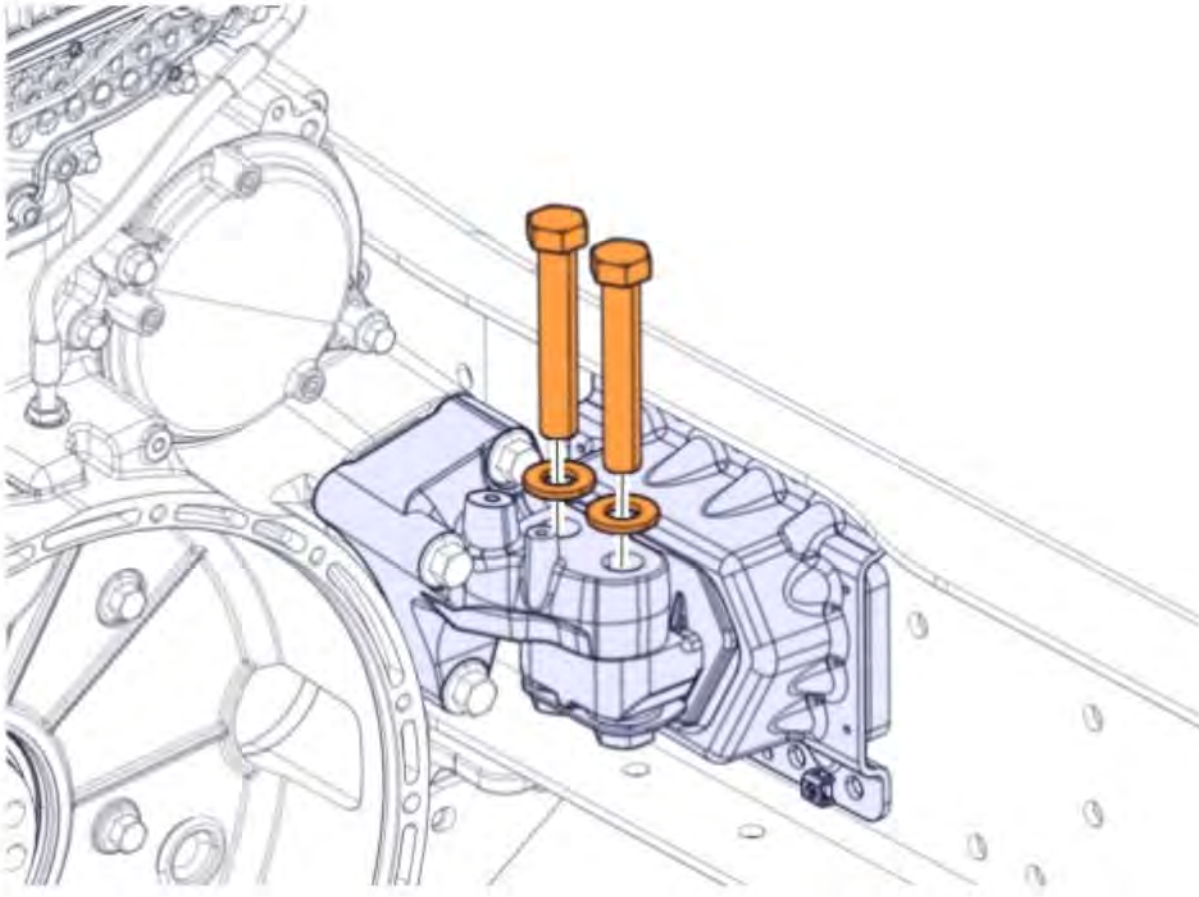
286 Lower the engine onto the rubber cushions.

287 Install the screws and washers.

288 Torque tighten the screws.

Tightening torque

| | |
|---------------------------------------|---------------------------------------------|
| Engine bracket, rubber cushion, screw | 540 ±90 Nm (398 ±66 lb _f ·ft) |
|---------------------------------------|---------------------------------------------|

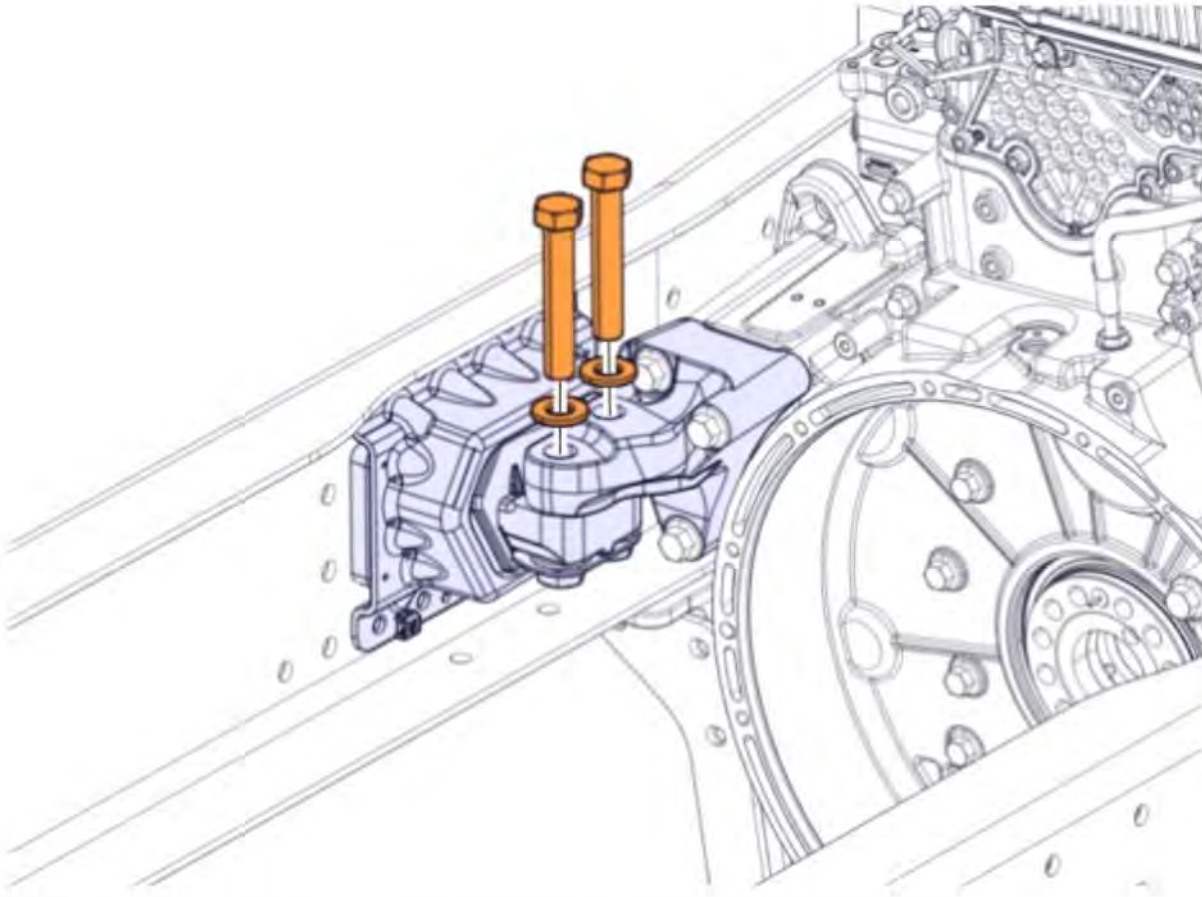


289 Install the screws and washers.

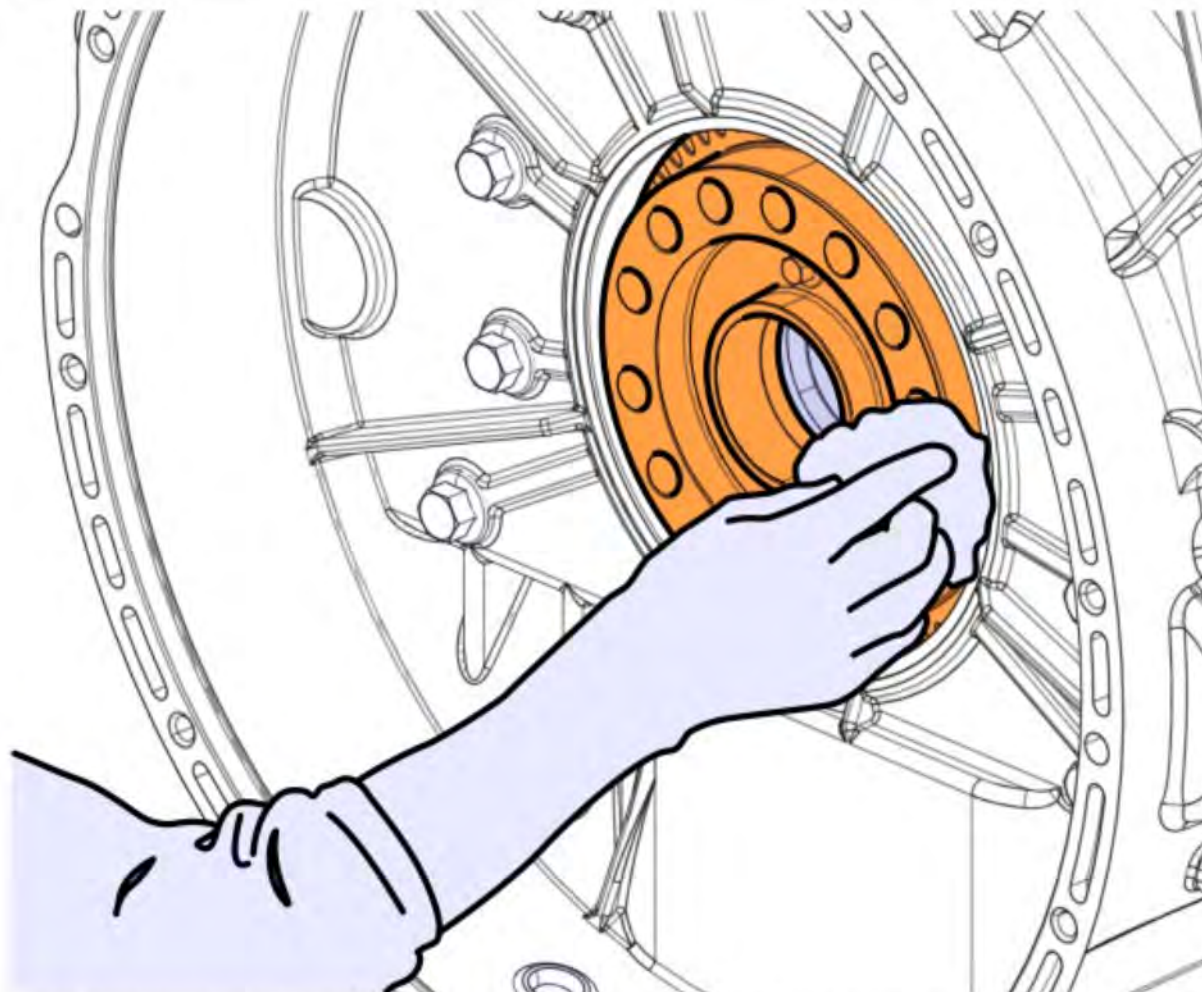
290 Torque tighten the screws.

Tightening torque

| | |
|---------------------------------------|---------------------------------------------|
| Engine bracket, rubber cushion, screw | 540 ±90 Nm (398 ±66 lb _f ·ft) |
|---------------------------------------|---------------------------------------------|




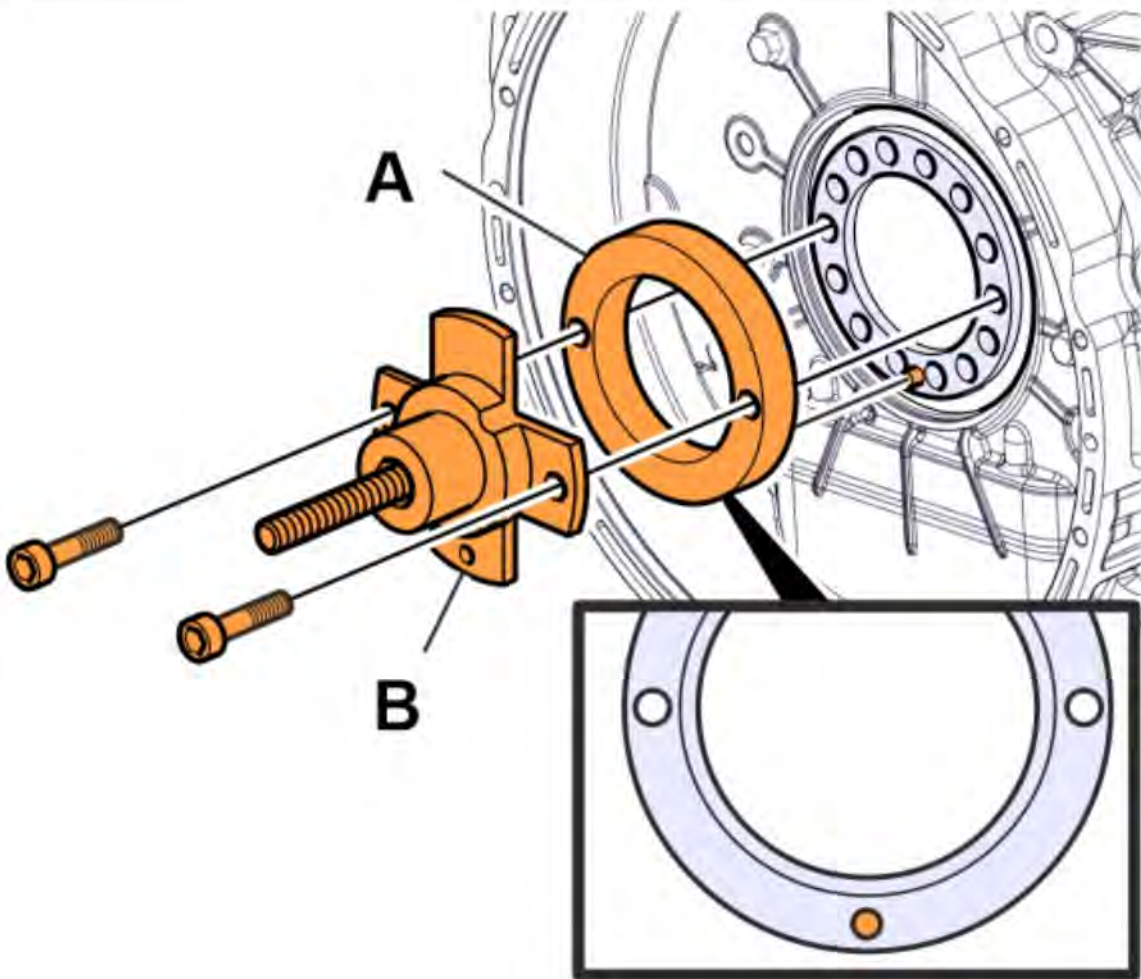
291 Clean the contact surfaces.






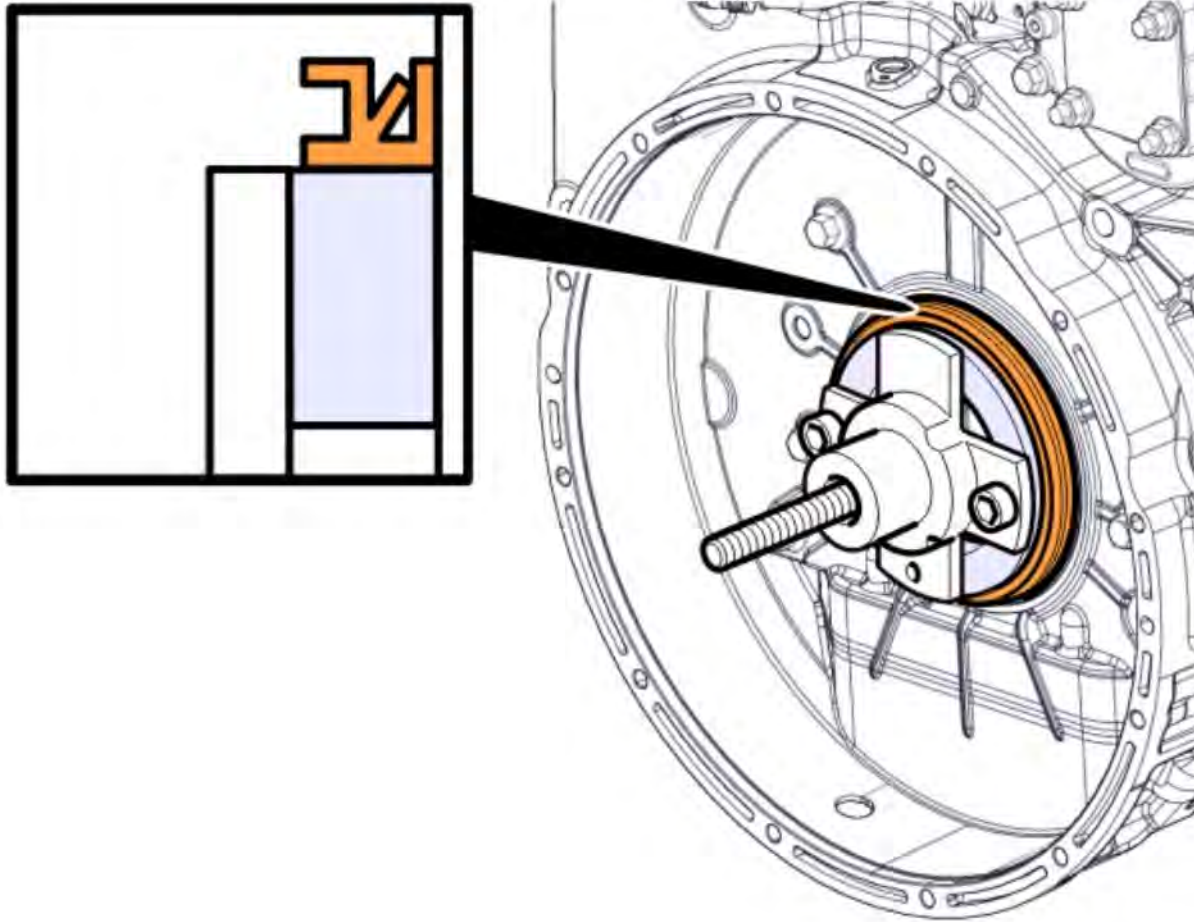
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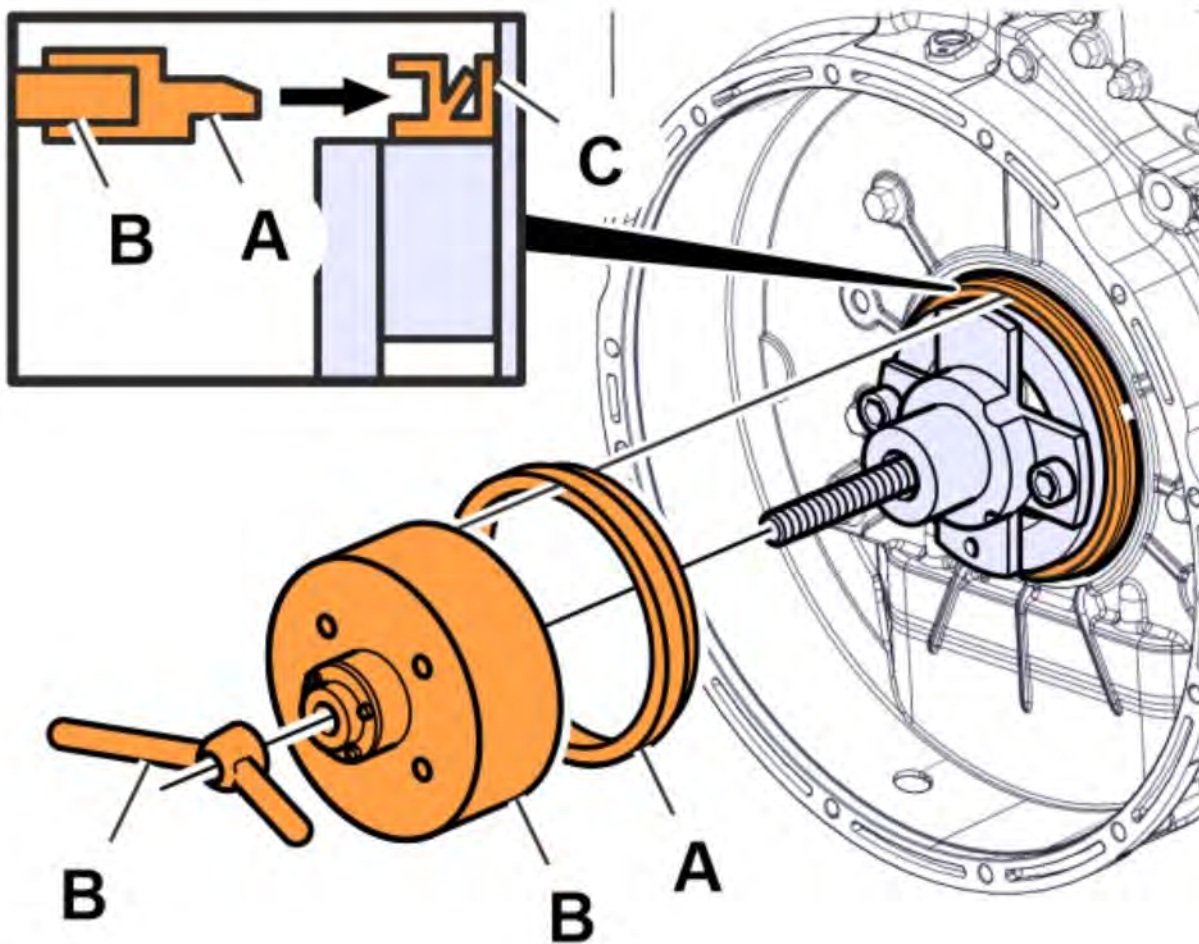
| | | | |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------|
| 292 | Install the spacer and the tool on the crankshaft. | | |
| 293 | Install the screws. | | |
| | Required material | | |
| | A | ASSEMBLY TOOL | 88800619 |
| | B | ASSEMBLY TOOL | 9990166 |
| |  Service hint Ensure that the spacer and the tool are properly positioned on the crankshaft's internal guide and are flat against the crankshaft before tightening the screws. | | |



| | | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--|--|
| 294 | Position the seal. | | |
|  Note Always use a new type of seal. | | | |
|  Note Lubricate the seal to facilitate installation. | | | |
|  Service hint The text on the seal must be turned away from the engine. | | | |



| | | | |
|-----|--------------------------------|---------------|--------------------------|
| 295 | Install the installation tool. | | |
| | Required material | | |
| | A | ASSEMBLY TOOL | 88800619 |
| | B | ASSEMBLY TOOL | 9990166 |
| | C | Seal | |

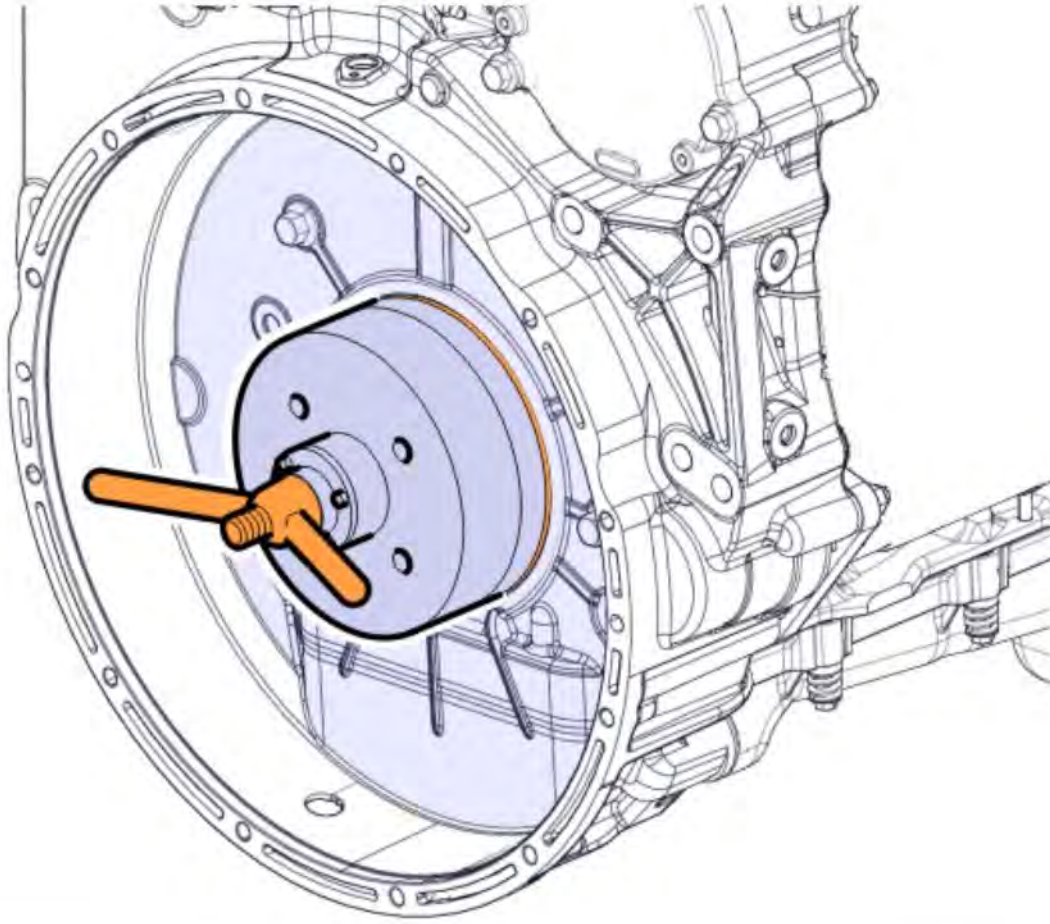


296 Press the cassette seal into place by turning the handle.

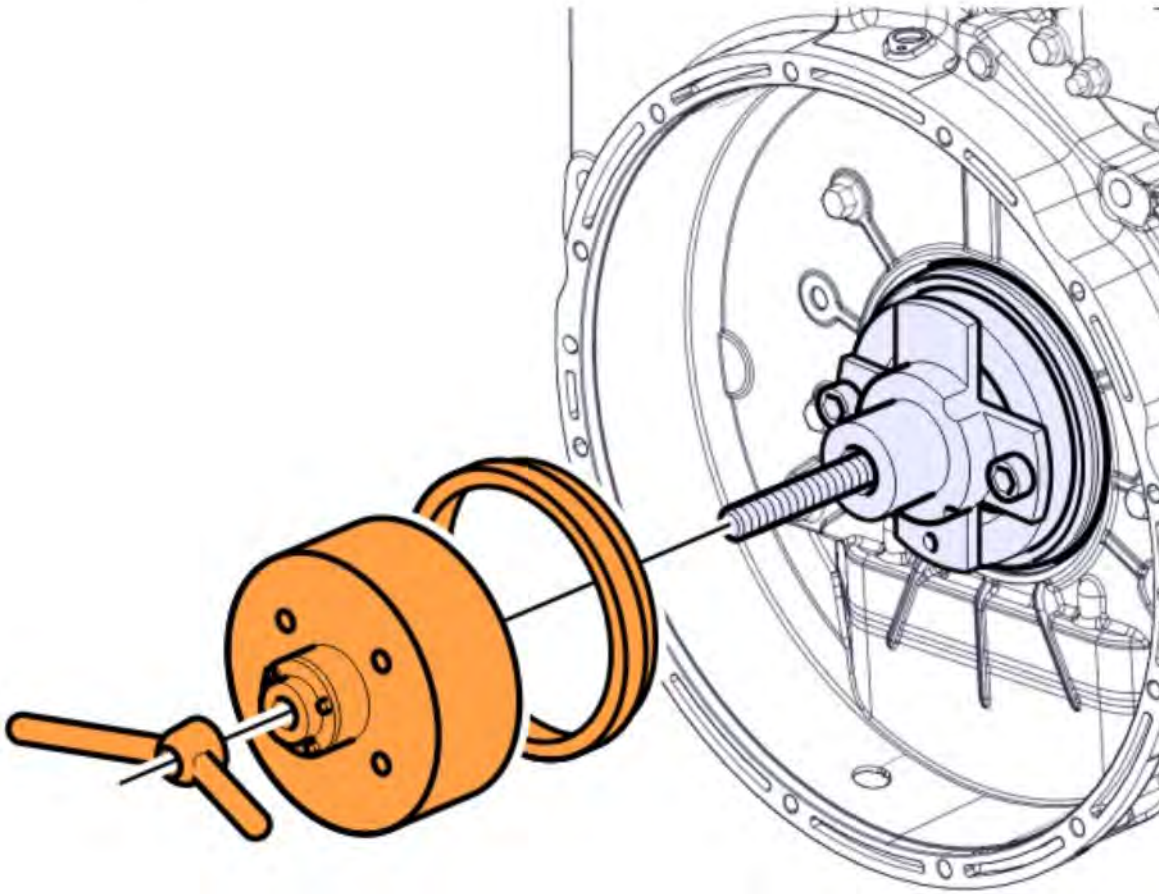


Note

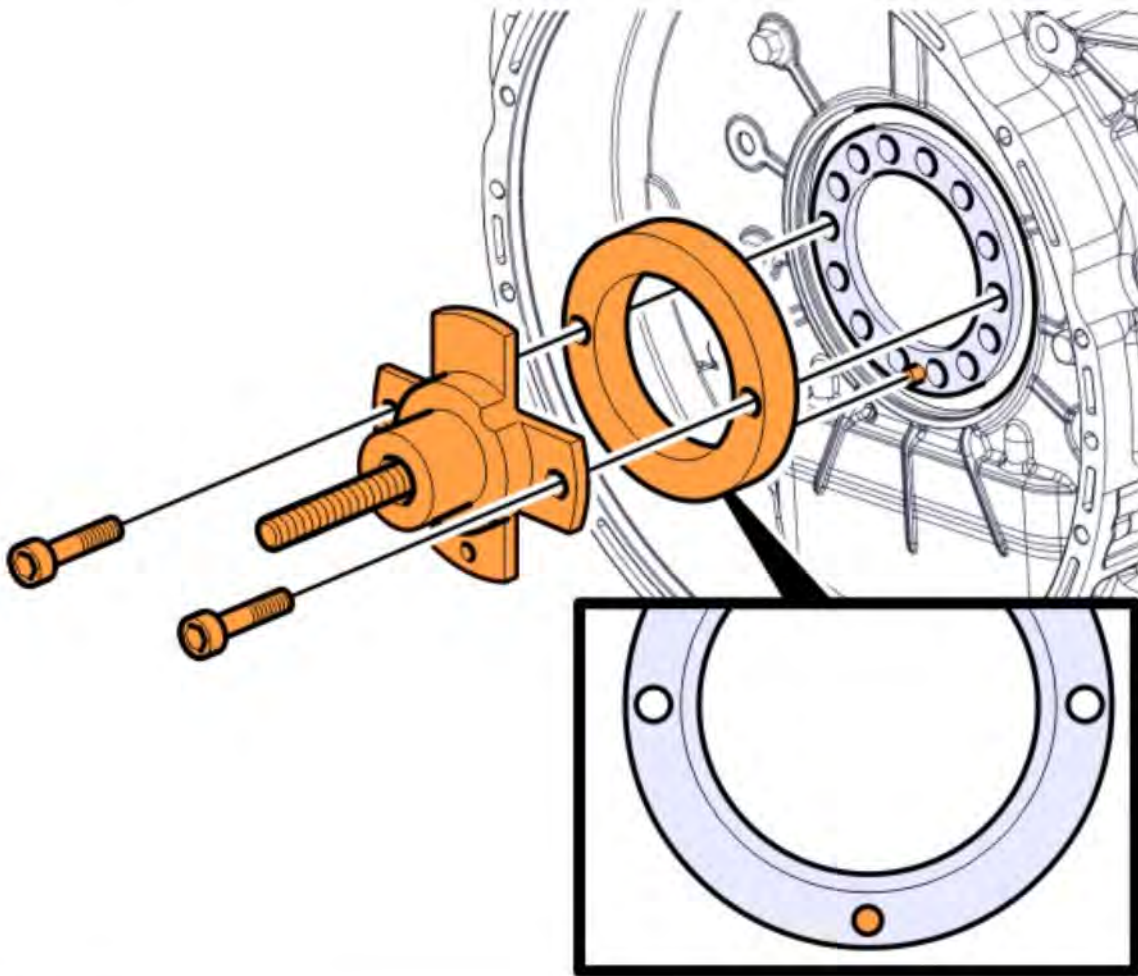
The cassette seal is correctly located in the flywheel housing when the tool bottoms out.



| | |
|-----|-------------------------------|
| 297 | Remove the adapter and cover. |
|-----|-------------------------------|



| | |
|-----|---------------------------------|
| 298 | Remove the tool and the spacer. |
|-----|---------------------------------|

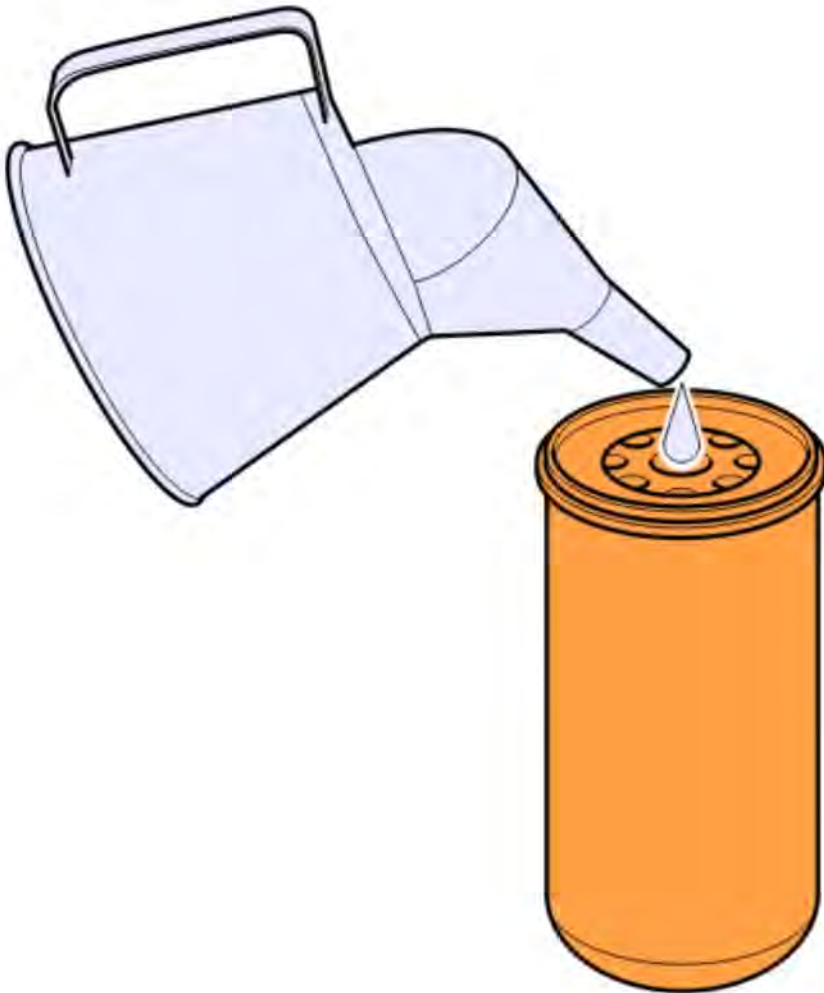


299 Fill the filters with engine oil.



Note

Use new filters.



300 Apply engine oil to the gasket.

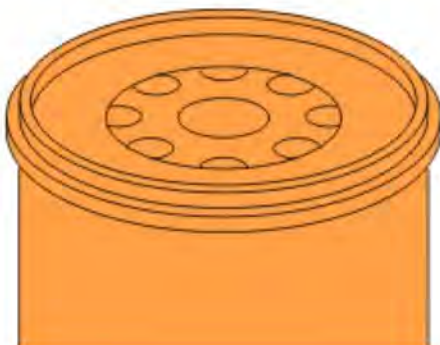
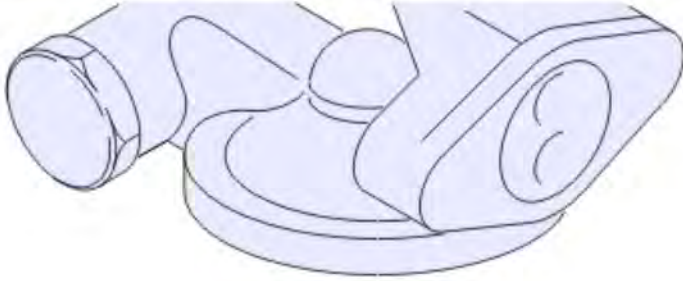


Note

Use recommended oil.



301 Install the filters.



⚠ DANGER

Risk of material damage, serious personal injury or death.

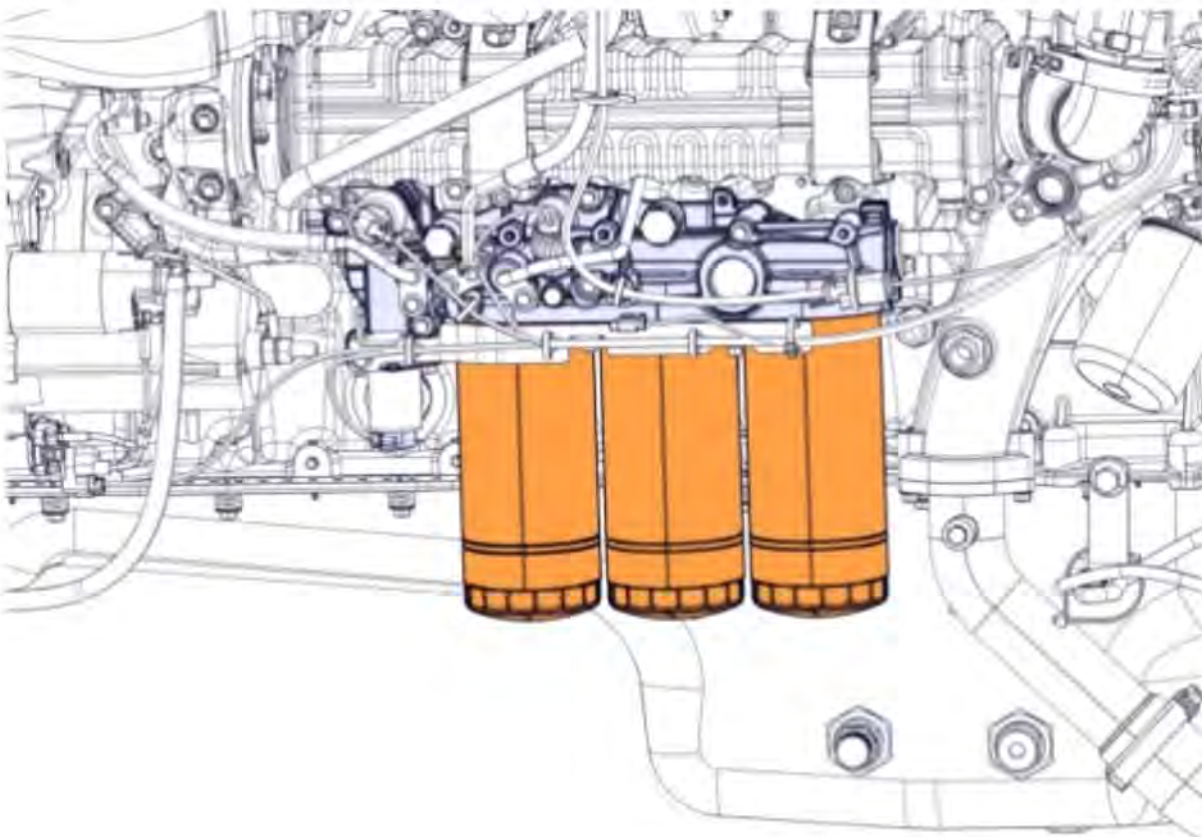
Connections that are not tightened in accordance with specified tightening torques may cause leakage.

- ▶ Tighten connections according to service information.

302 Torque-tighten the filters.

Tightening torque

| | |
|------------|-----------------------------------------|
| Oil filter | 25 ±5 Nm (18 ±4 lb _f .ft) |
|------------|-----------------------------------------|



303 Clean the contact surfaces.



Note

Ensure that the surfaces are completely clean of oil and grease

304 Remove hardened sealant.

305 Apply recommended sealant as illustrated.

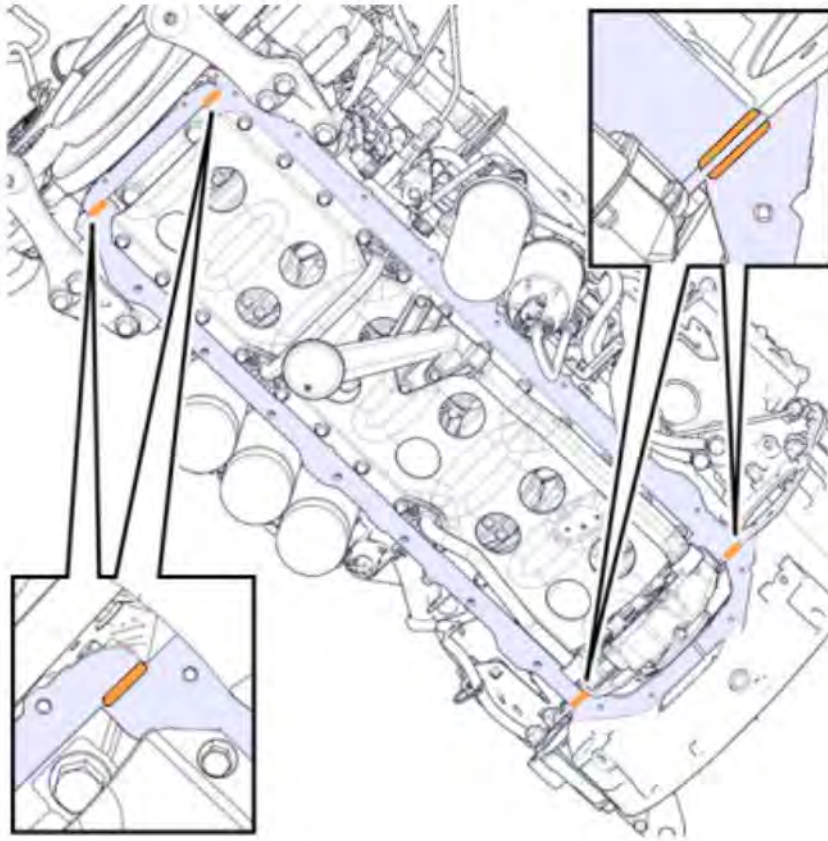
Tech data

| | |
|-------------------------|------|
| Sealant, bead thickness | 2 mm |
|-------------------------|------|

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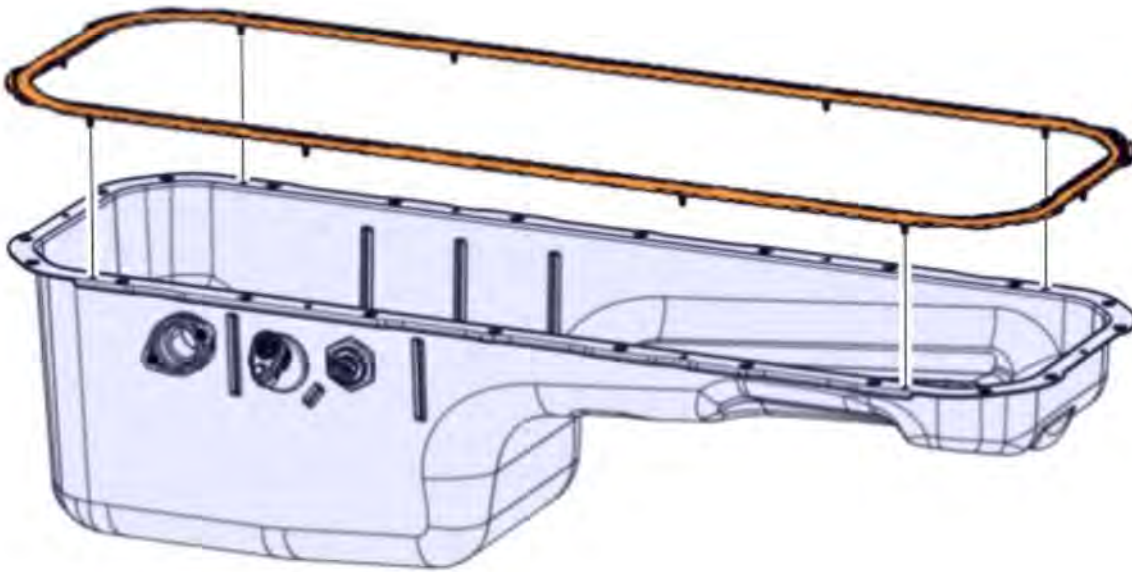
306 Install the gasket.

**Note**

Use a new part.

**Note**

Install the gasket within 20 minutes of sealant application.

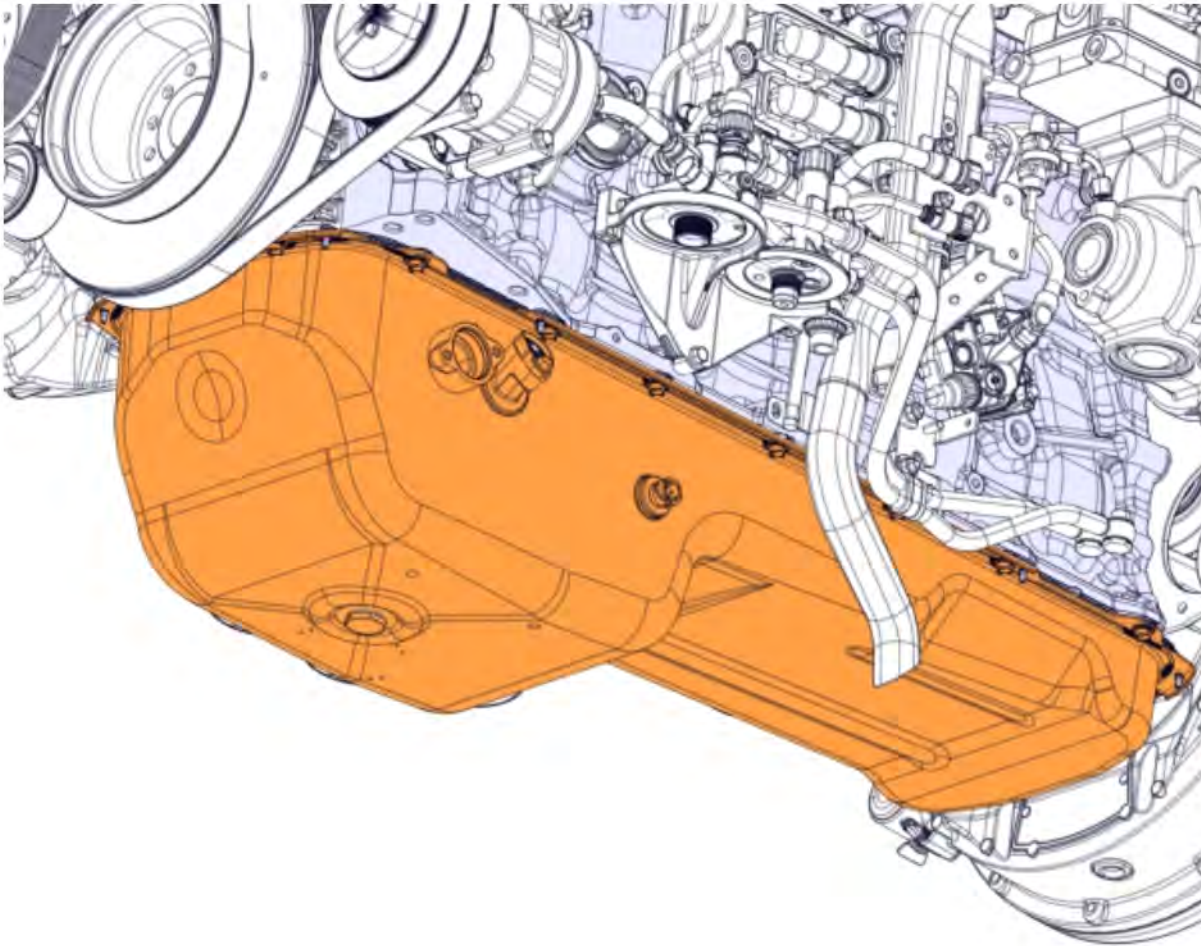


307 Install the oil pan.



Note

Assistance may be required.

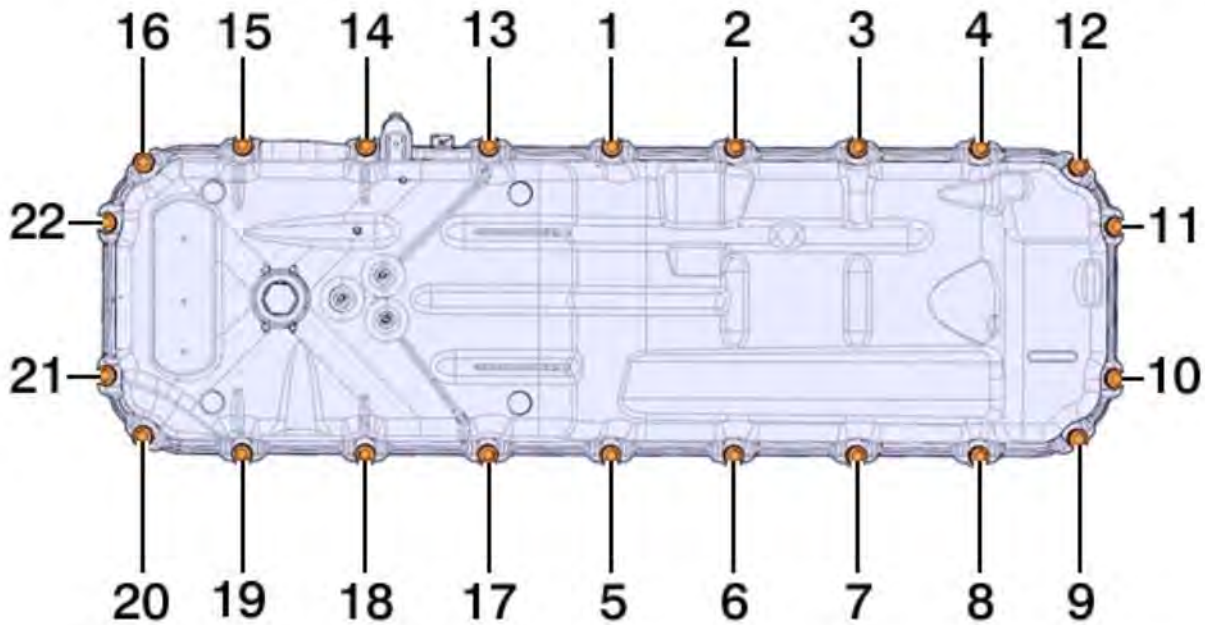


| | |
|-----|---------------------|
| 308 | Install the screws. |
|-----|---------------------|



309 Torque tighten the screws.

| Tightening torque | |
|-------------------|-----------------------------------------|
| Oil pan, screw | Tightening sequence: 1-22 |
| | 24 ±4 Nm (18 ±3 lb _f ·ft) |



310 Install the seal.

| | |
|----------|--------------------------------|
| i | Note Use a new part. |
|----------|--------------------------------|

311 Install the pipe (A).

312 Install the outer casing (B).

| | |
|----------|-------------------------------------------------------------|
| i | Note Check the outer casing for correct position. |
|----------|-------------------------------------------------------------|

313 Connect the connector (C).



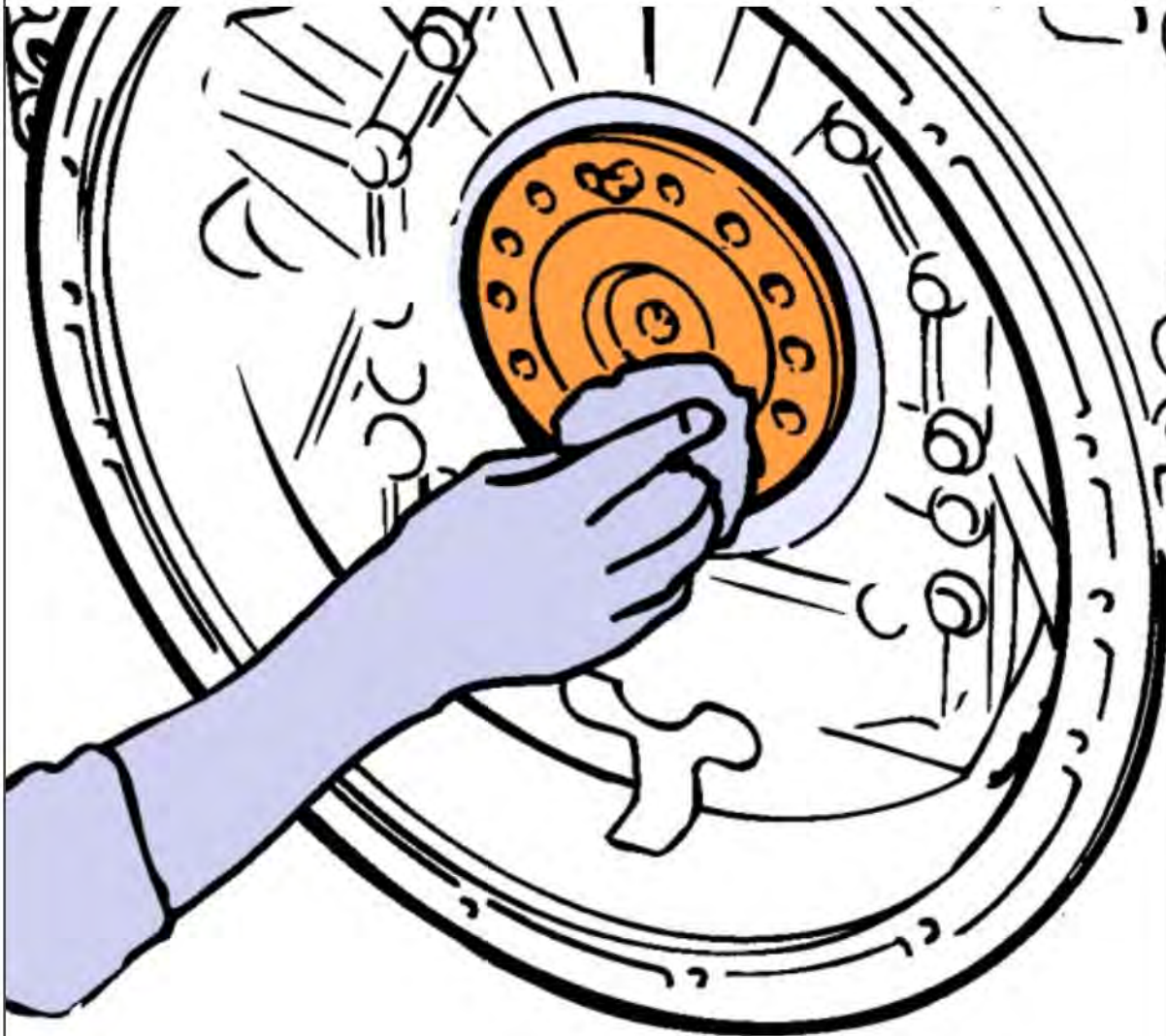
314 This step contains 2 alternatives.

Select one of the valid alternatives below.

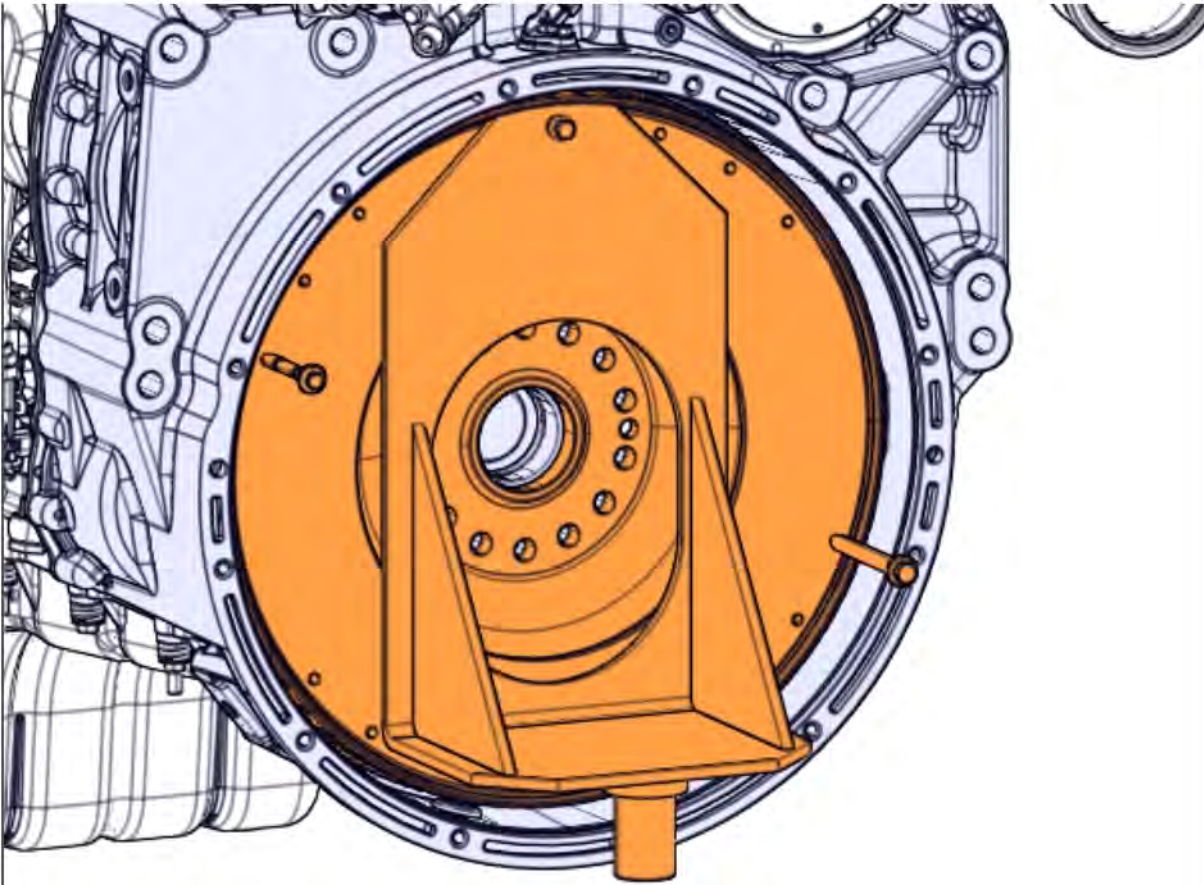
Alternative 1 / 2

▶ Clean the crankshaft flange.

▶ Check the crankshaft seal.



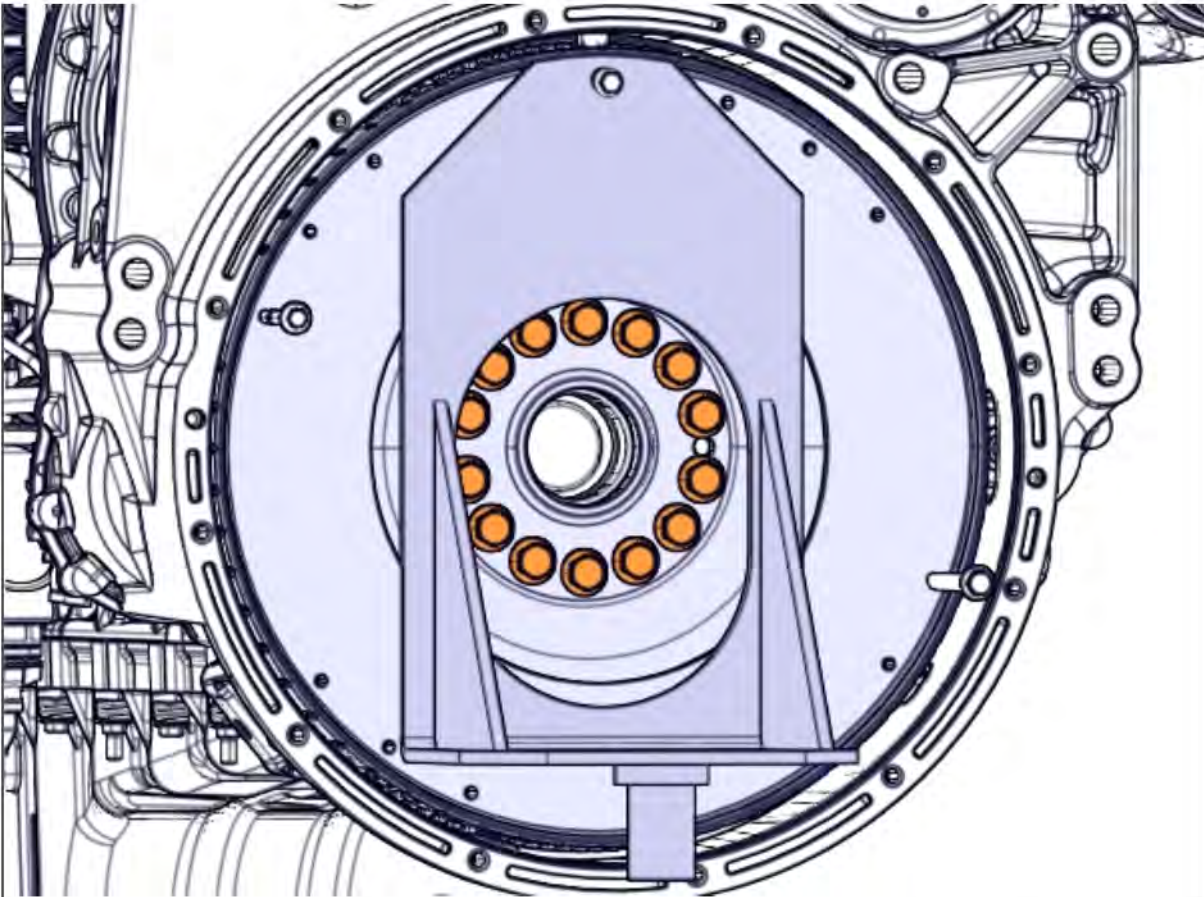
▶ Install the flywheel.



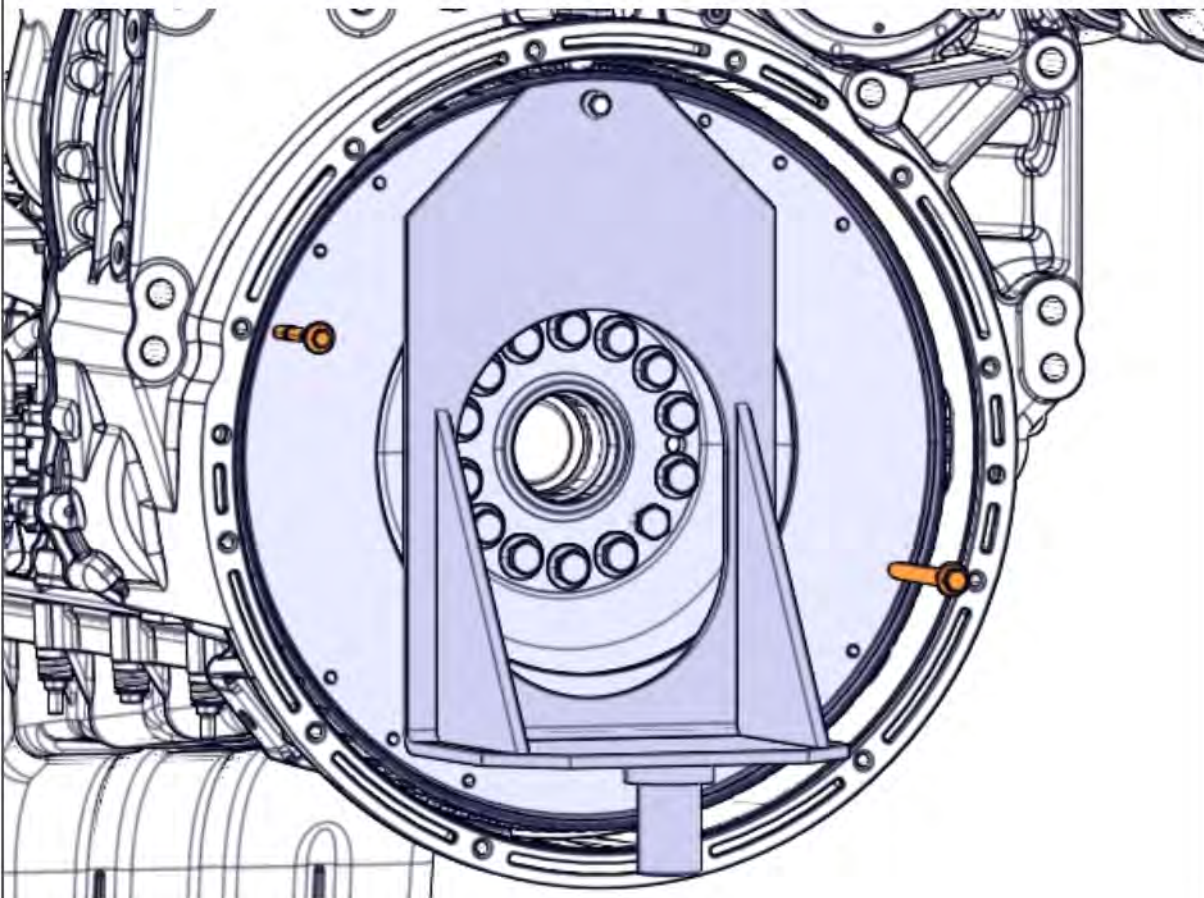
- ▶ Install the screws.

**Note**

Hand tighten the screws.

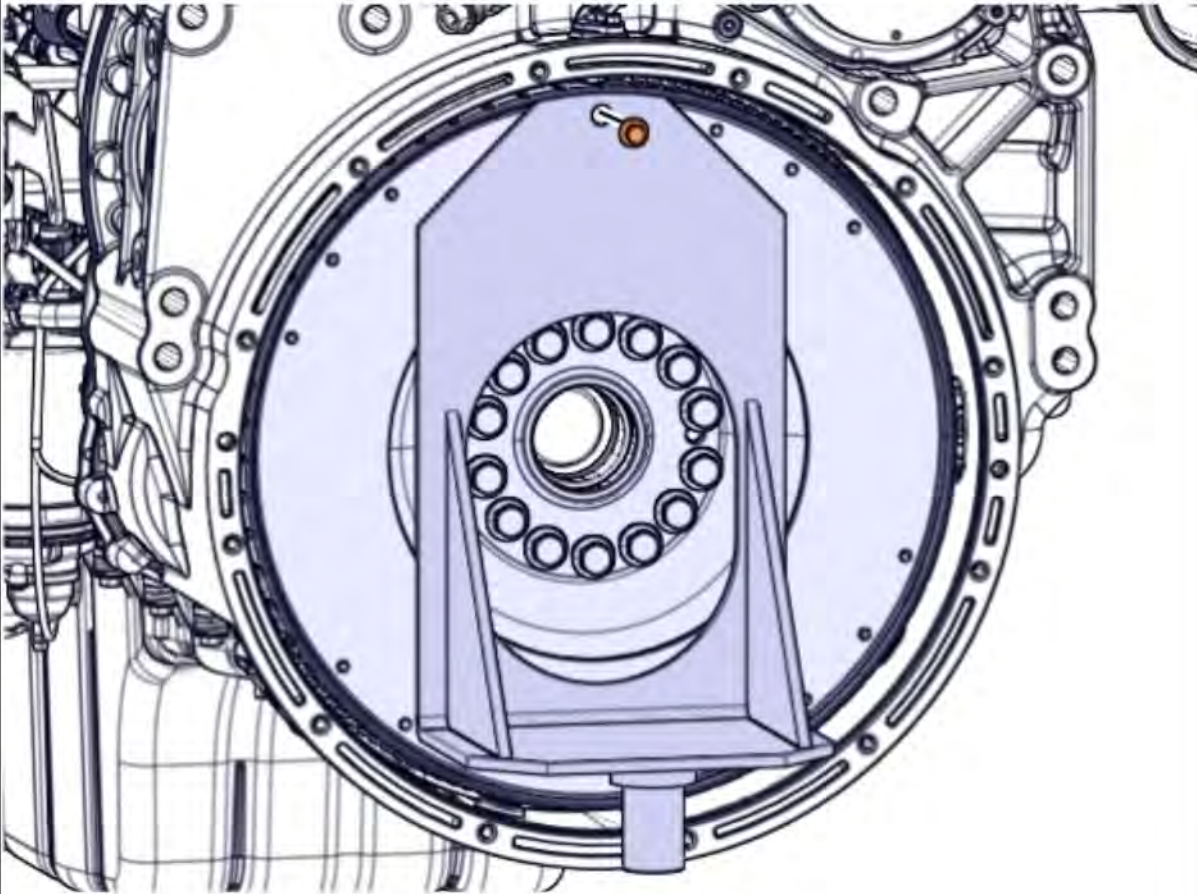


▶ Remove the screws.



▶ Remove the screw.

▶ Remove the tool.



Alternative 2 / 2

▶ Clean the crankshaft flange.

▶ Check the crankshaft seal.



▶ Install the flywheel.

▶ Install the flexplate.

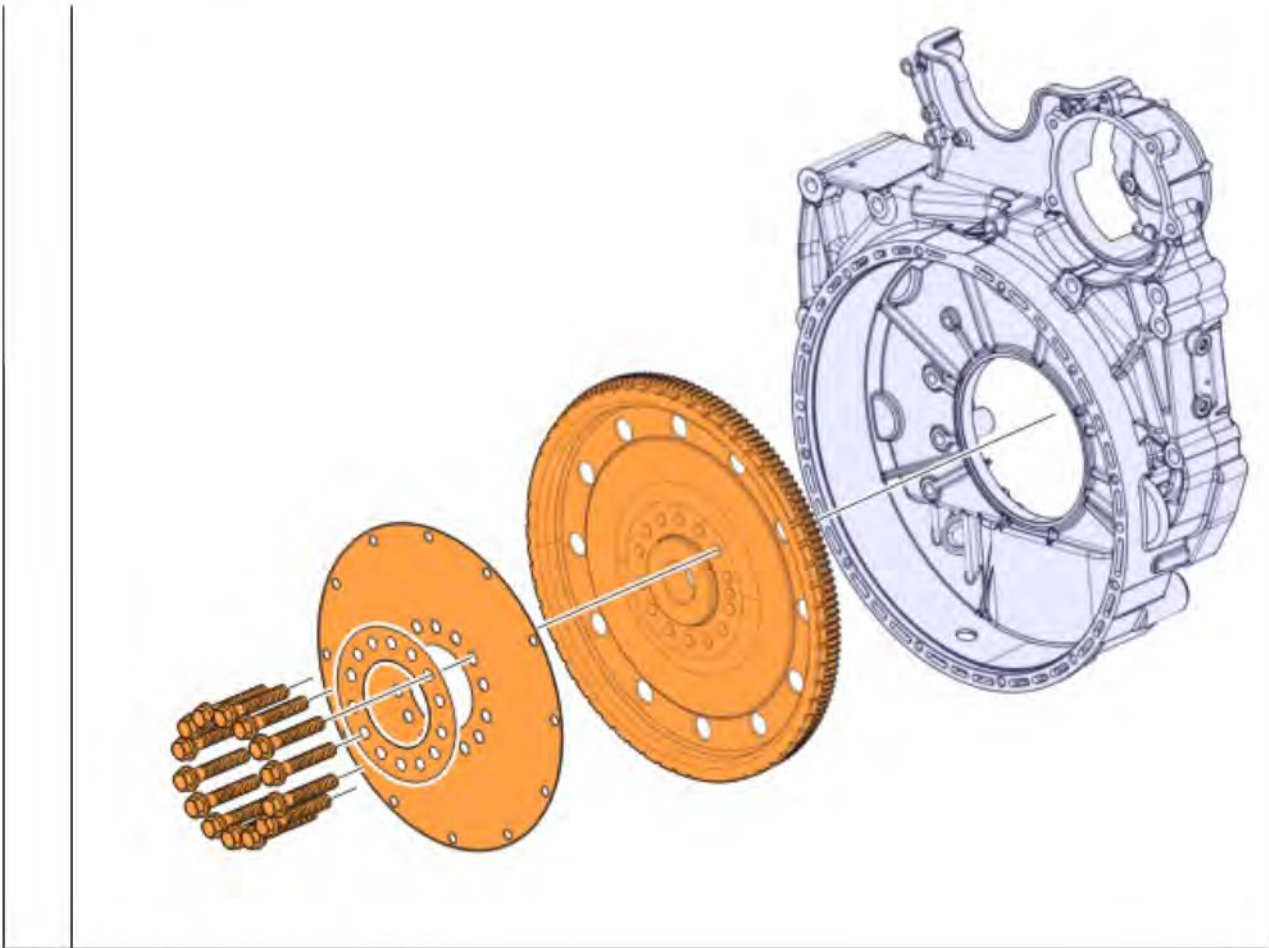
▶ Install the thrust plate.

▶ Install the screws.

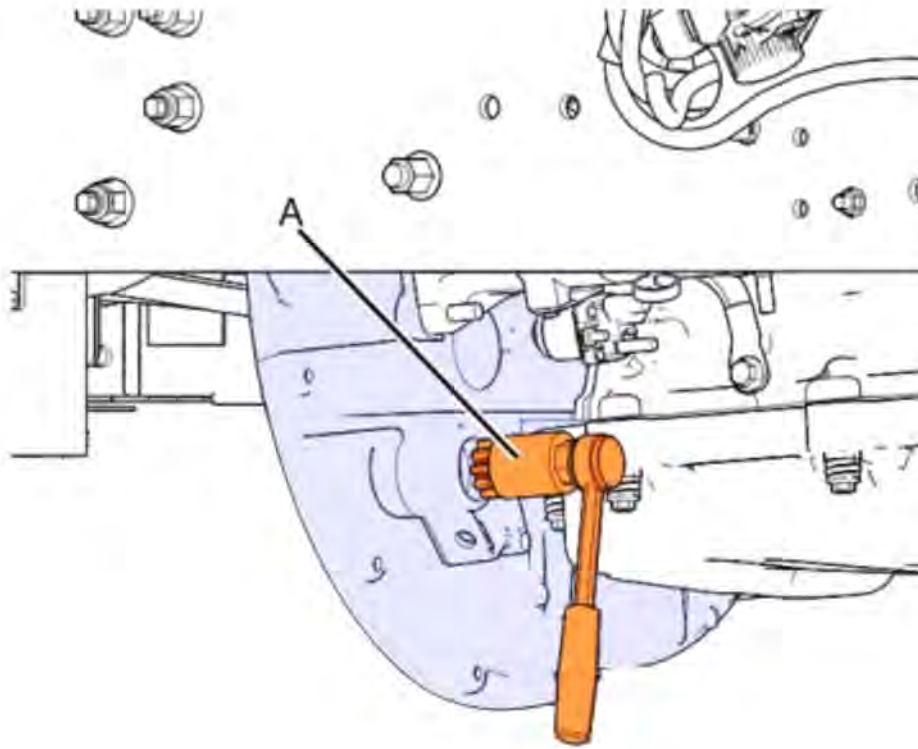


Note

Hand tighten.

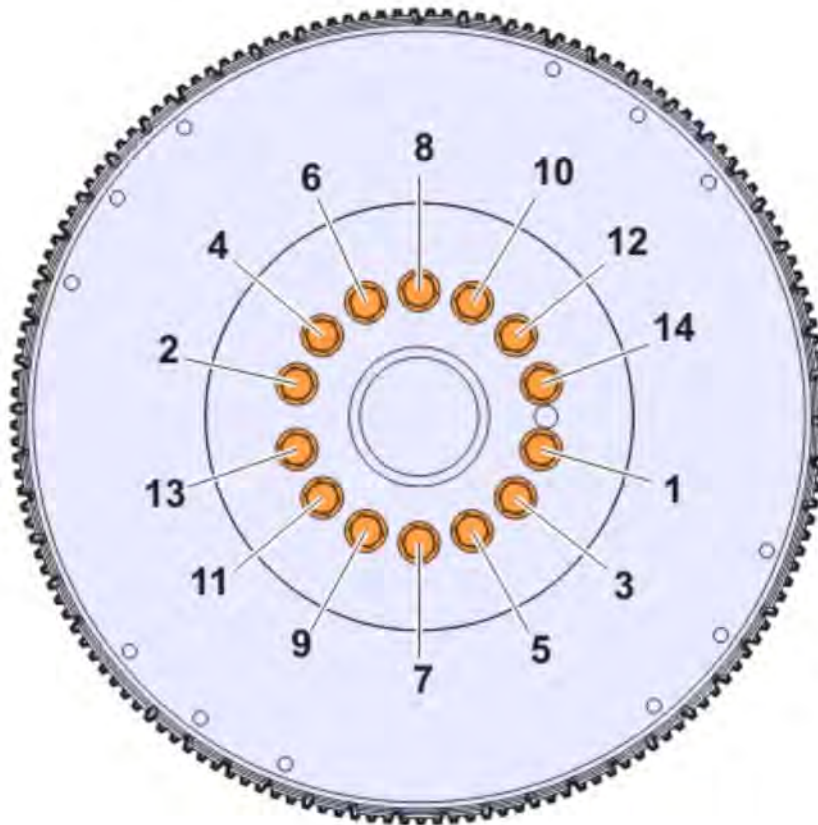


| | | |
|------------|--------------------------------|--------------------------|
| 315 | Install the cranking tool (A). | |
| | Required material | |
| | CRANKING TOOL | 88840317 |
| | | |



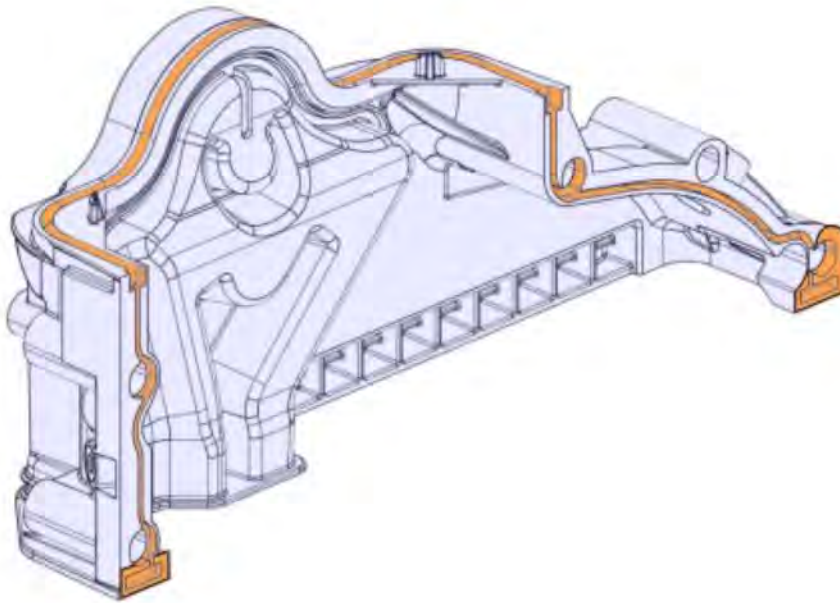
316 Torque tighten the screws.

| Tightening torque | | |
|-------------------|----|-----------------------------------------|
| Flywheel, screw | 1. | Tightening sequence: 1-14 |
| | | 60 ±5 Nm (44 ±4 lb _f .ft) |
| | 2. | Tightening sequence: 1-14 |
| | | 120 ±10° |

**Note**

Use the cranking tool with a drawbar handle as counterhold.

317 Clean the contact surfaces.

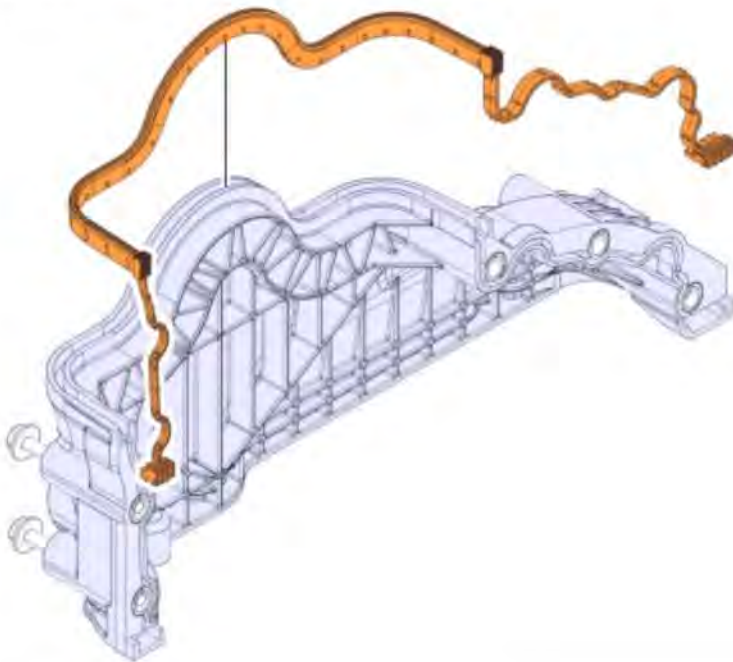


318 Install the gasket.



Note

Use a new part.



319 Clean the contact surfaces carefully.

320 Install the timing gear cover.



Note

Take care not to damage the gasket.

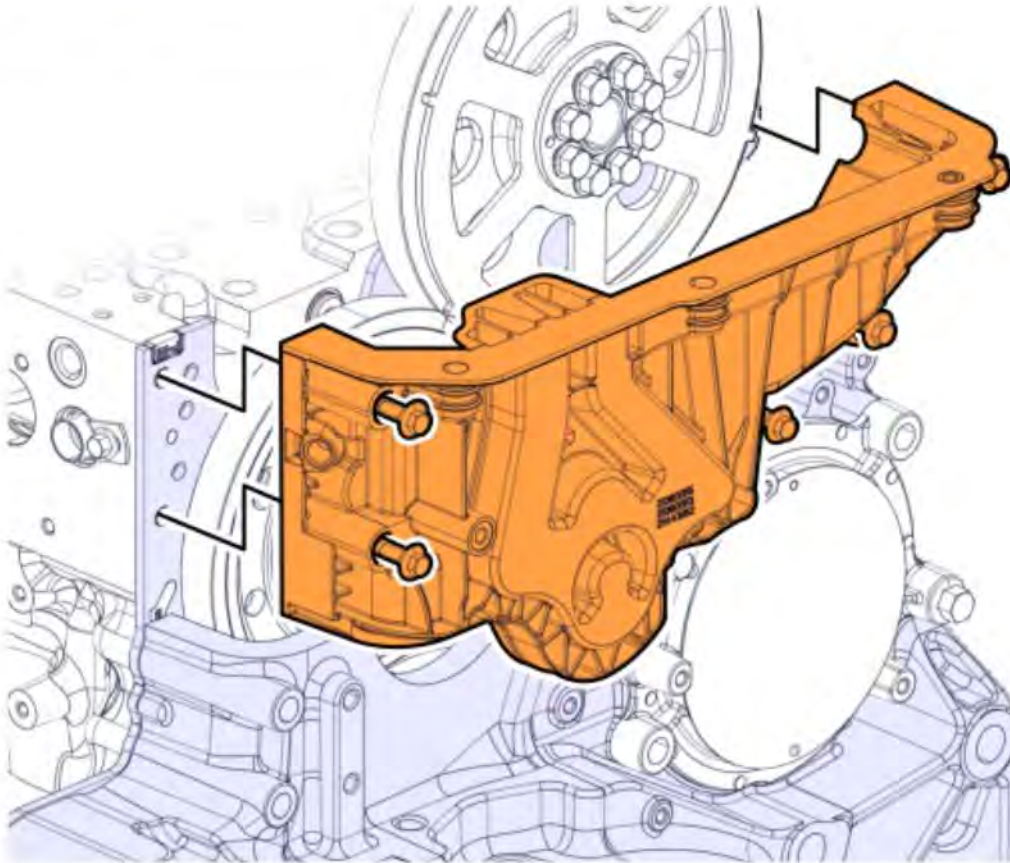
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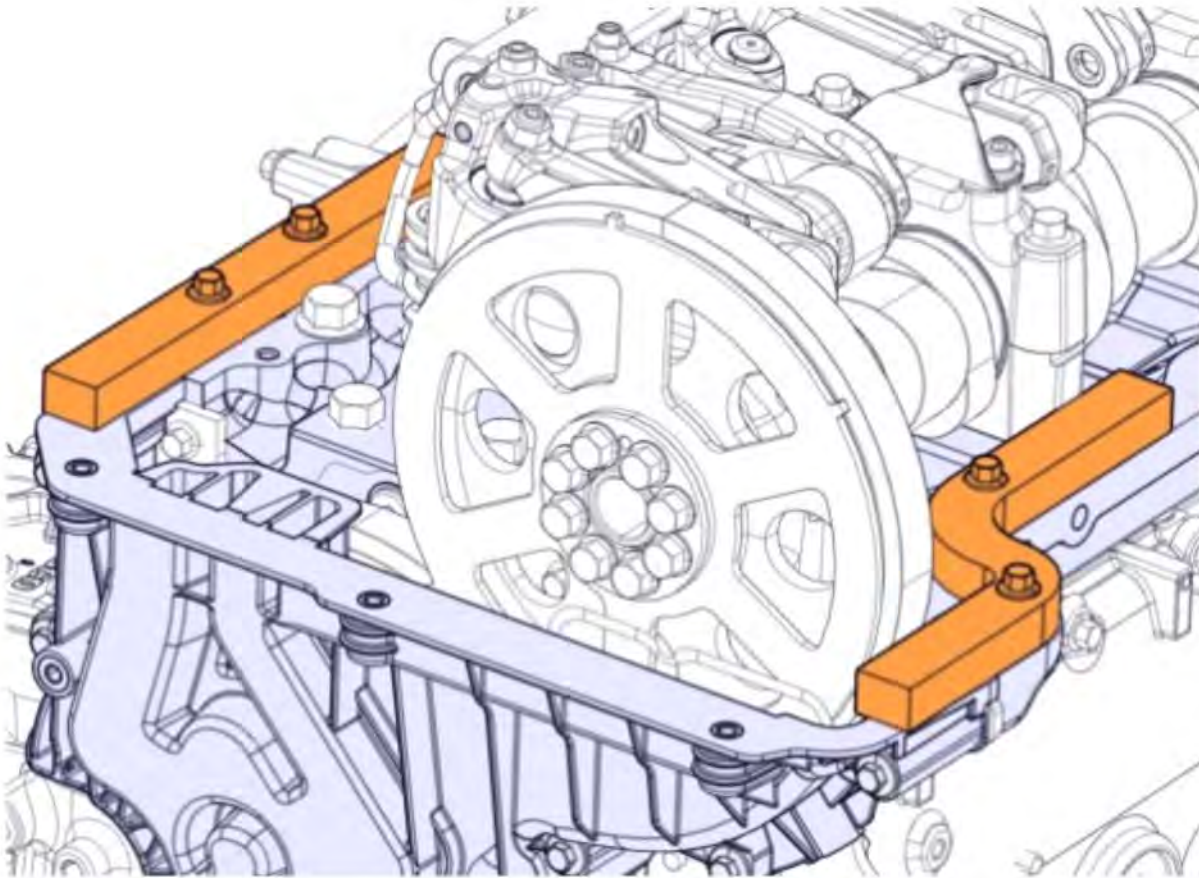
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Check that the gasket is correctly located in the groove.



| | |
|--------------------------|--------------------------|
| 321 | Install the tools. |
| Required material | |
| kit | 88870012 |
| | |



322 Gently tighten the timing gear cover screws.



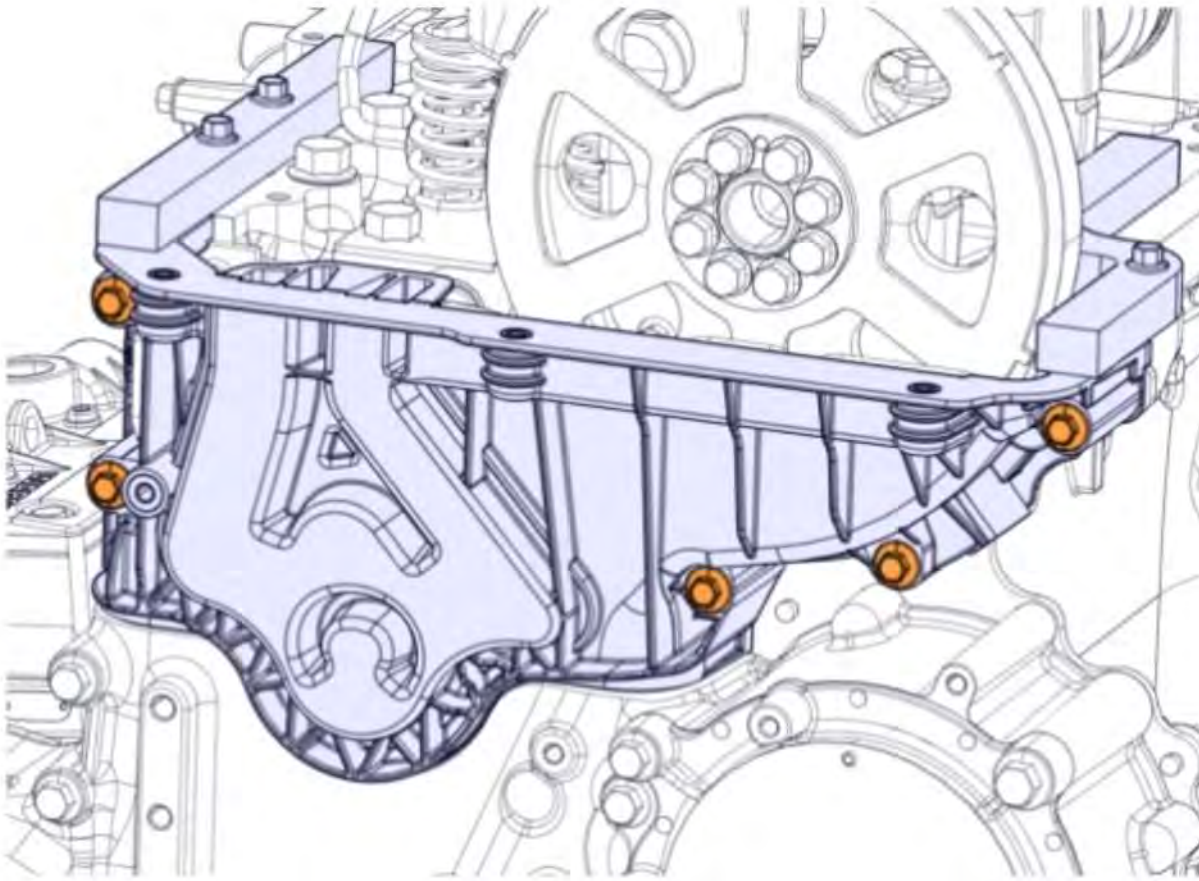
Note

Ensure that the timing gear cover aligns with the cylinder head on both sides.



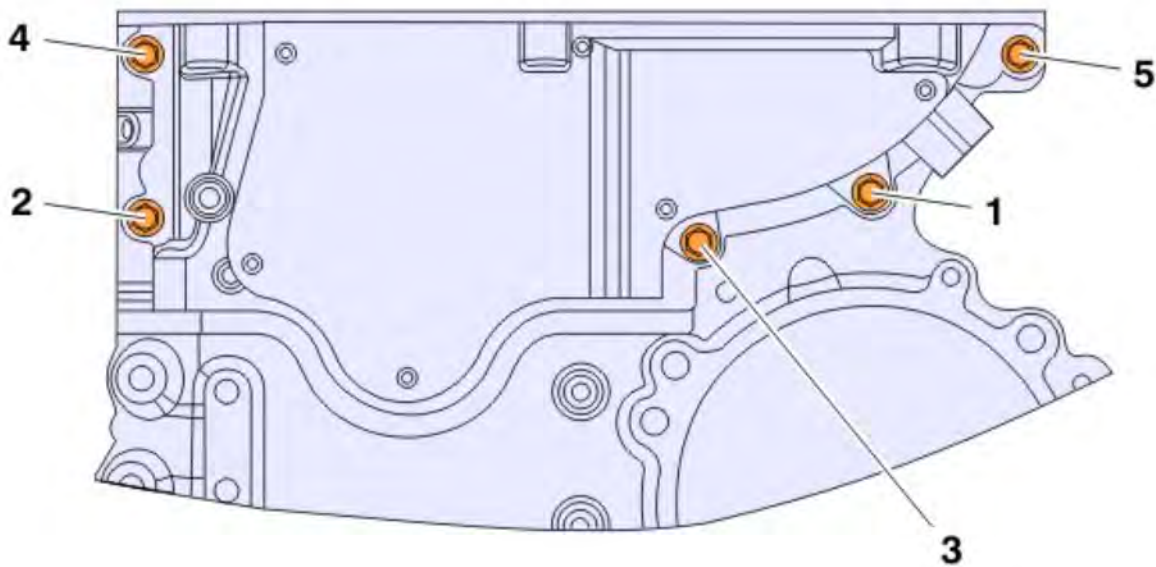
Note

Ensure that the timing gear cover is in contact with the timing gear plate.

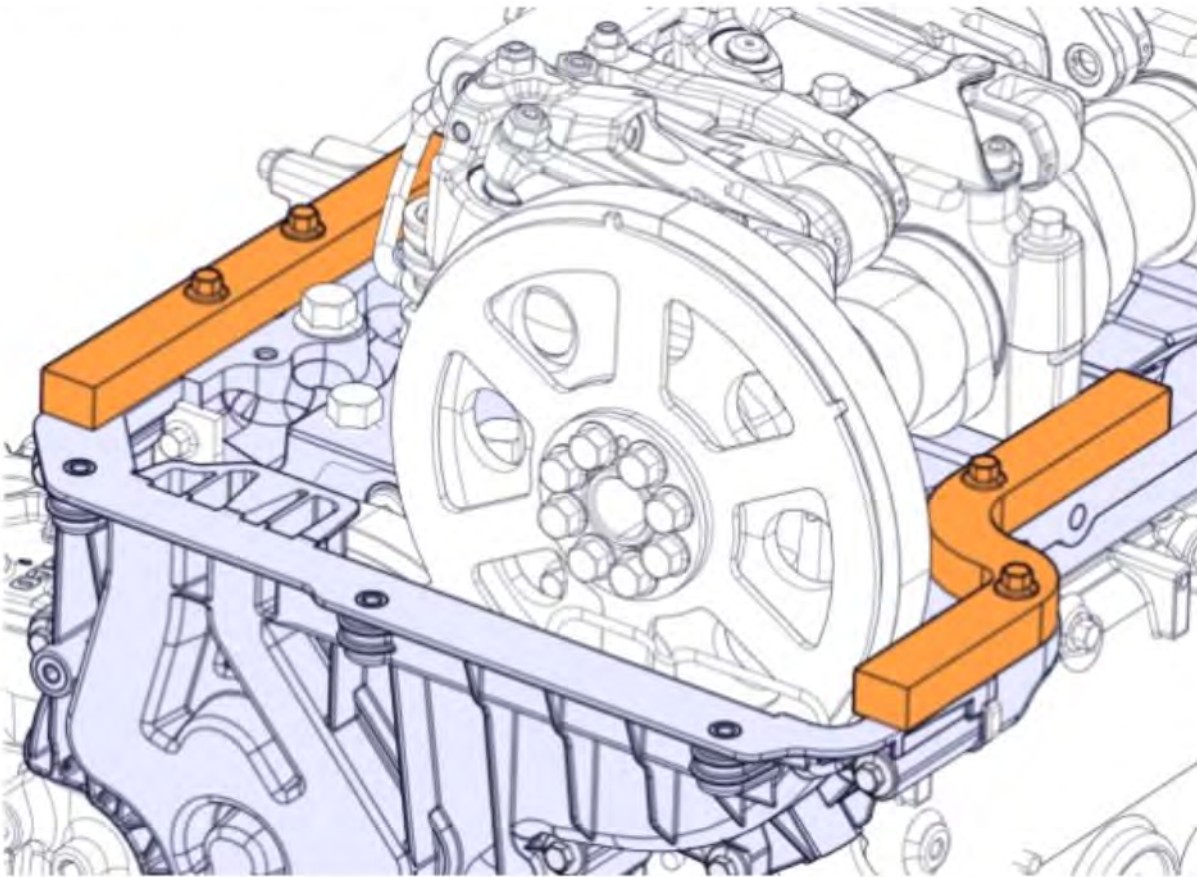


323 Torque tighten the screws.

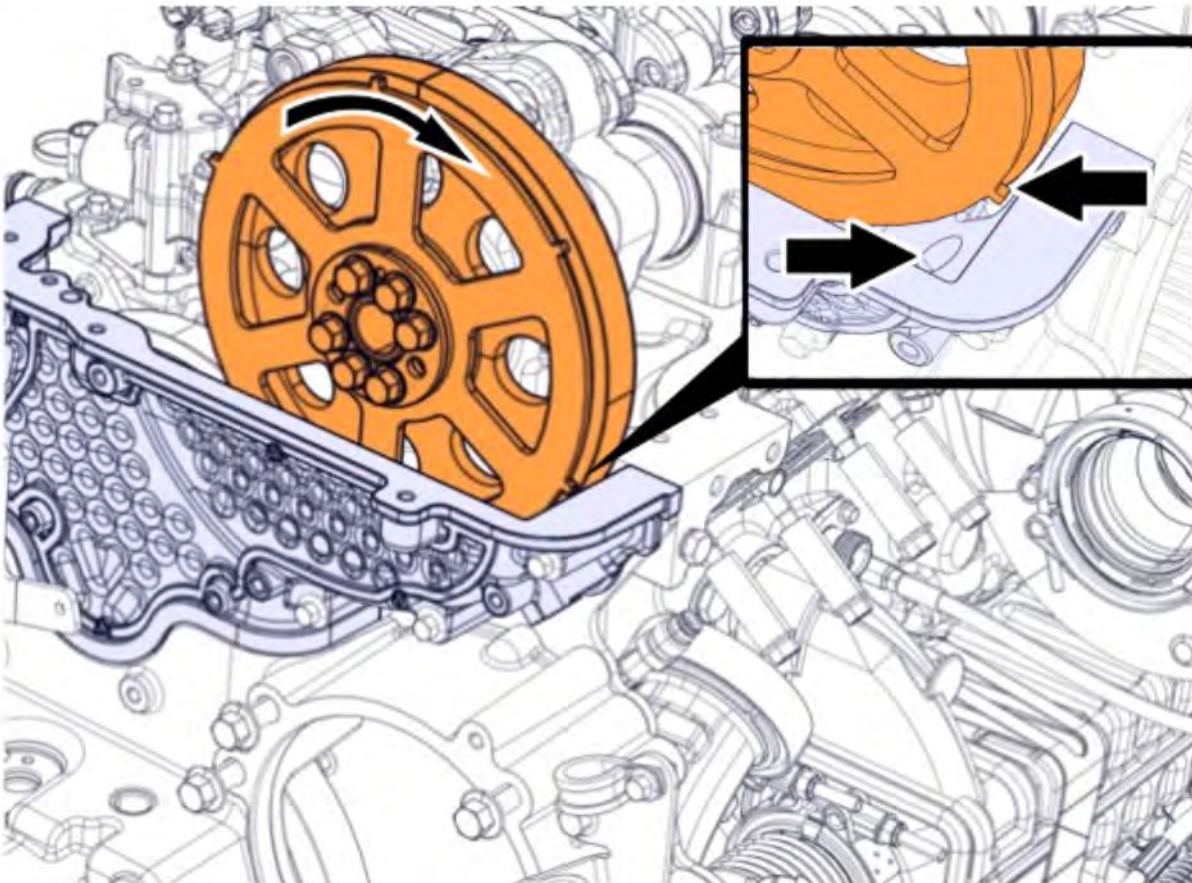
| Tightening torque | |
|---------------------------------|---------------------------------------------------------------------|
| Upper timing gear casing, screw | Tightening sequence: 1-5 27 ±3 Nm (20 ±2 lb _f ·ft) |



324 Remove the tools.

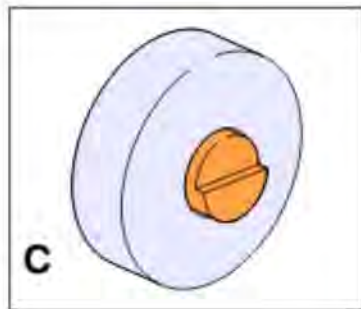
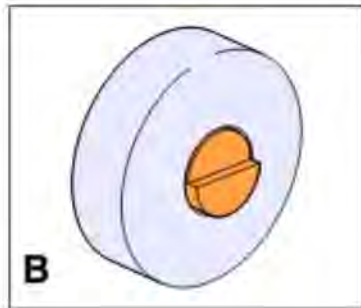
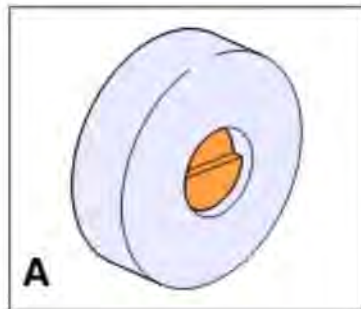
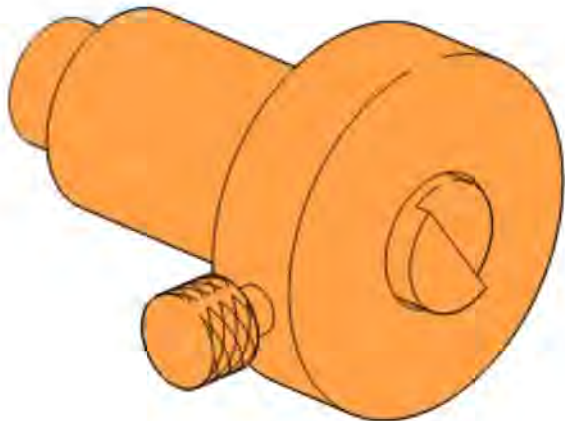


325 Rotate the gear so that a tooth on the sensor wheel aligns with the sensor location.



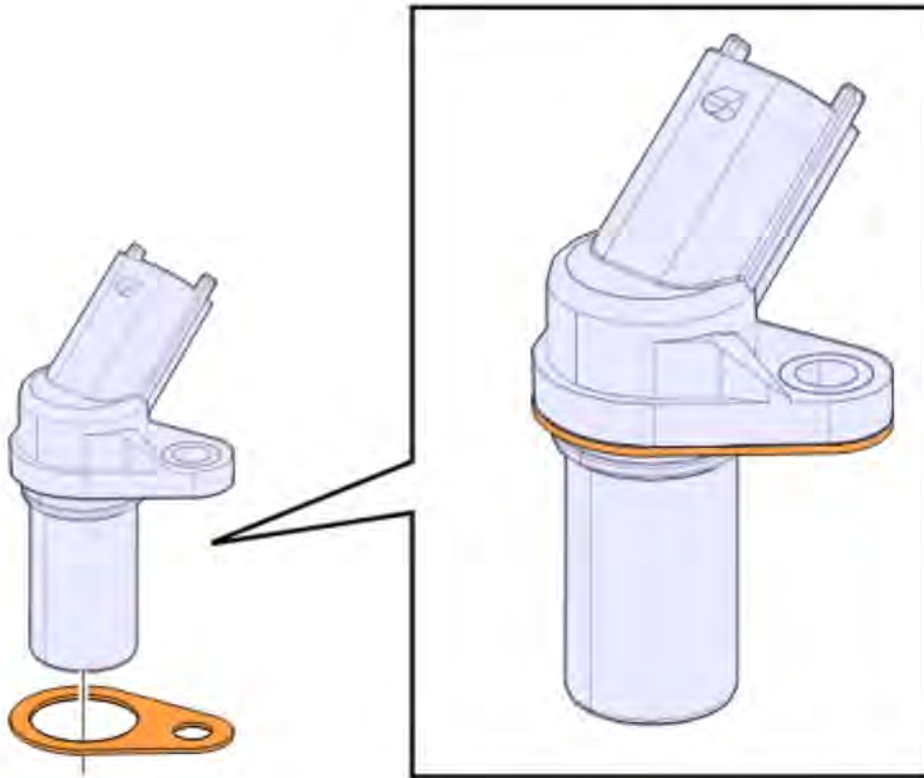
| | | |
|-----|---------------------------|--------------------------|
| 326 | Install the setting tool. | |
| | Required material | |
| | SETTING TOOL | 88800031 |

| | | |
|-----|--------------------------------------------|-------|
| 327 | Read off the setting tool. | |
| | Impulse sensor, number of shims | |
| | Conditions: A: No edge outside the tool. | 0 pcs |
| | Conditions: B: One edge outside the tool. | 1 pc |
| | Conditions: C: Two edges outside the tool. | 2 pcs |



| | |
|-----|--------------------------|
| 328 | Remove the setting tool. |
|-----|--------------------------|

| | |
|-----|------------------------------|
| 329 | Install the shims as needed. |
|-----|------------------------------|



330 Remove the old sealant from the contact surfaces (A).



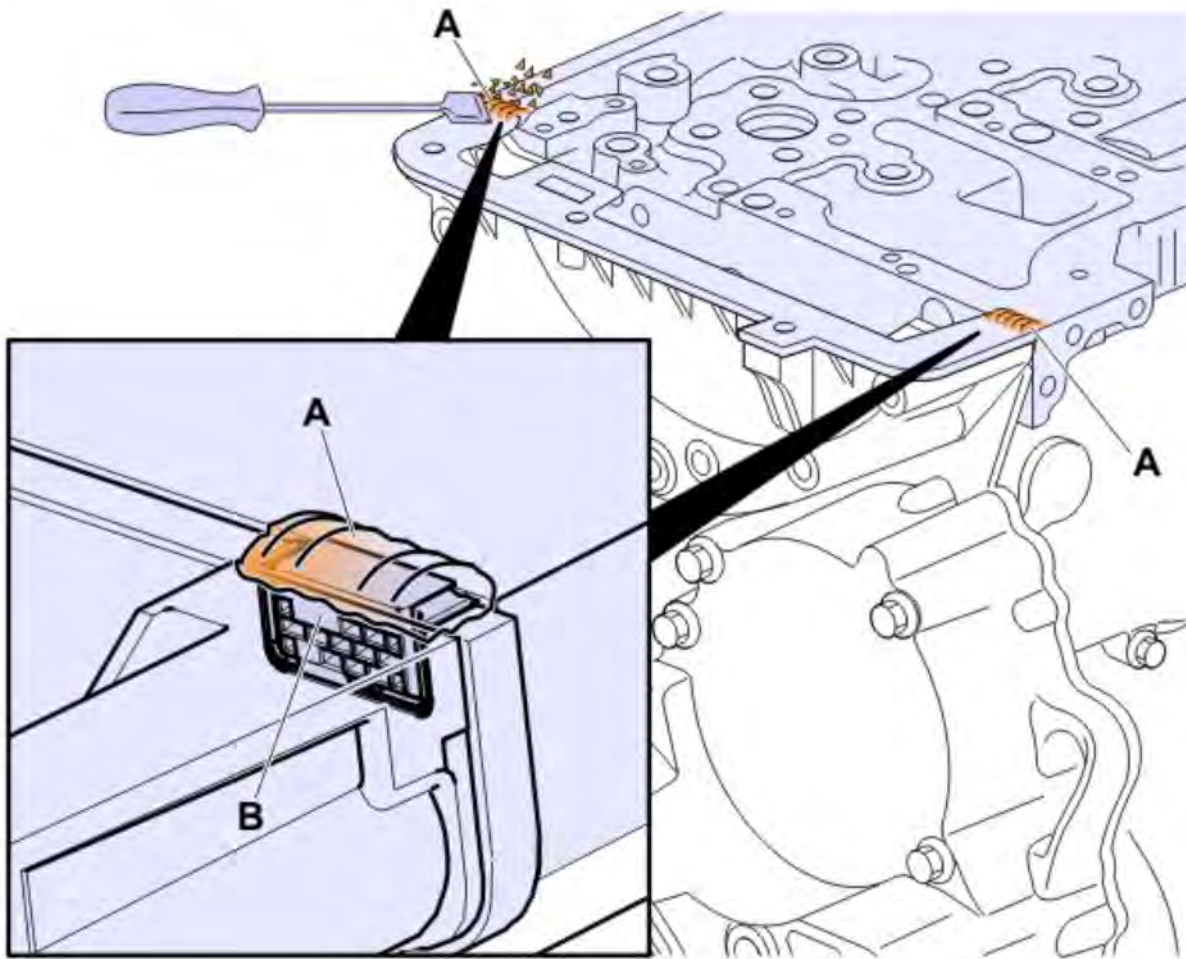
Note

Ensure that the surfaces are completely clean from sealant.

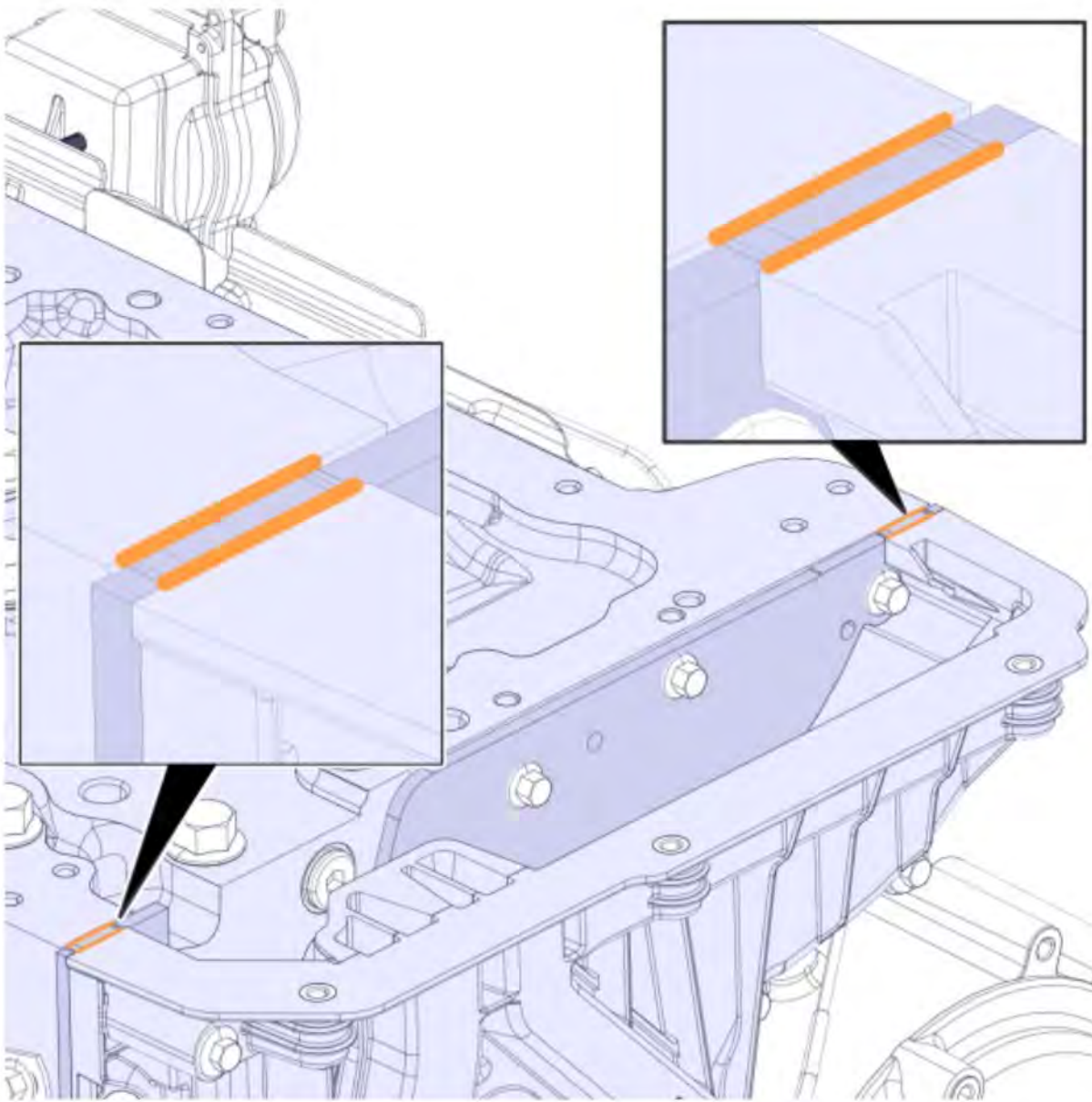


Note

Ensure that the sealant on the timing gear plate is not damaged (B).



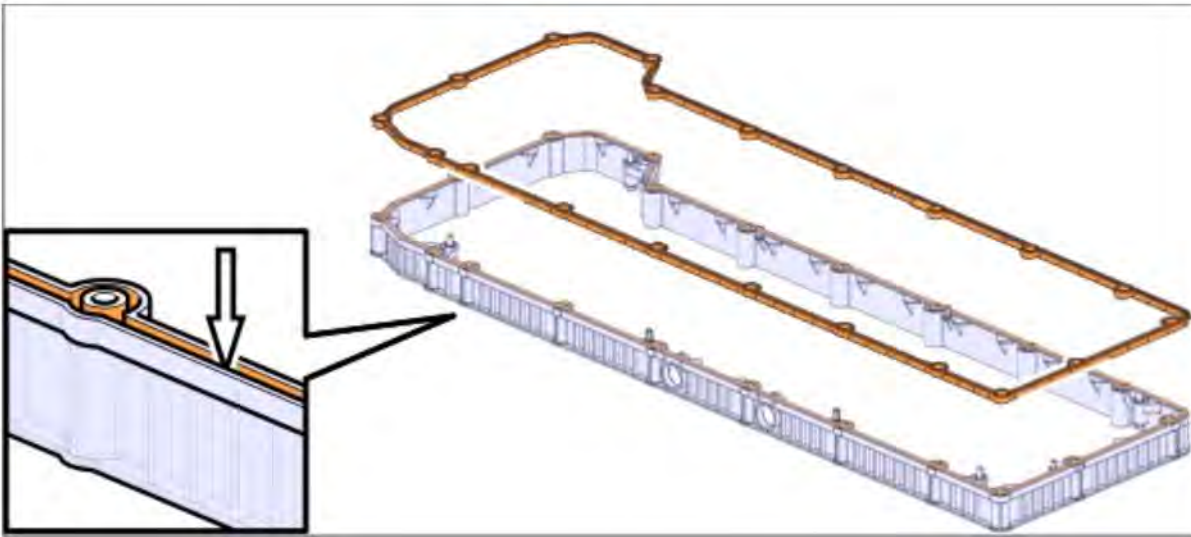
| | | |
|-------------------------|-----------------------------------------------------------------------------------|-------------------|
| 331 | Apply sealant. | |
| Tech data | | |
| Sealant, bead thickness | | 2 mm (0.08 in) |
| i | Note Use recommended sealant. | |
| i | Note Install the valve cover within 20 minutes of applying the sealant. | |



| | |
|-----|---------------------------------------|
| 332 | Clean the contact surfaces carefully. |
|-----|---------------------------------------|

| | | | |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------|
| 333 | Clean the groove. | | |
| | <table border="1" style="width: 100%;"> <tr> <td style="width: 20px; text-align: center;">i</td> <td>Note Ensure that the surfaces are completely clean of oil and grease.</td> </tr> </table> | i | Note Ensure that the surfaces are completely clean of oil and grease. |
| i | Note Ensure that the surfaces are completely clean of oil and grease. | | |

| | | | |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------------------|
| 334 | Install the gasket. | | |
| | <table border="1" style="width: 100%;"> <tr> <td style="width: 20px; text-align: center;">i</td> <td>Note Use a new part.</td> </tr> </table> | i | Note Use a new part. |
| i | Note Use a new part. | | |

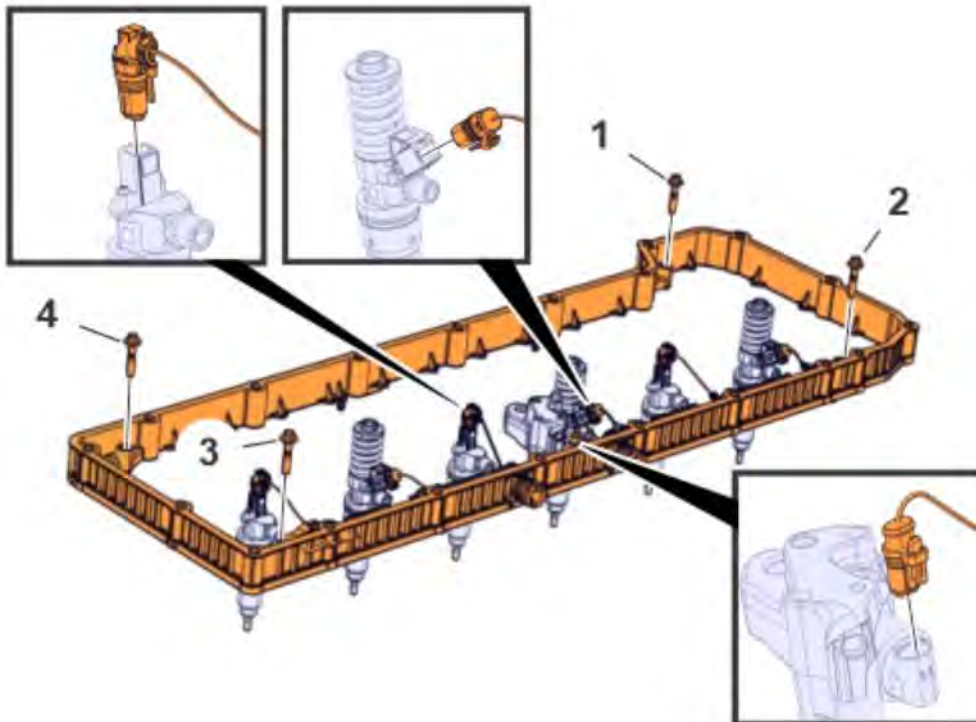


335 Install the frame.

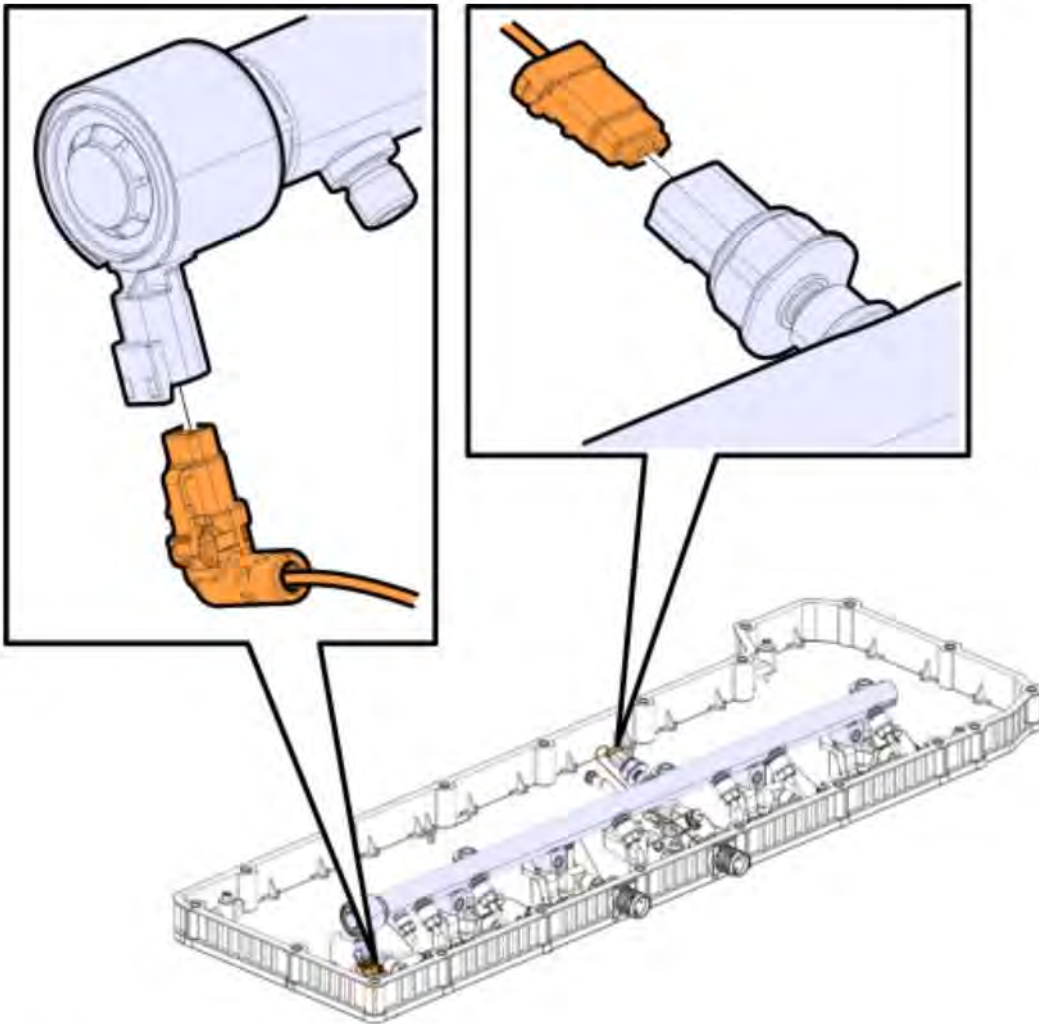
336 Torque tighten the screws.

| | |
|--------------------------|-----------------------------|
| Tightening torque | |
| Lower valve cover, screw | Tightening sequence: 1-4 |
| | 24 ±4 Nm |
| | (18 ±3 lb _f -ft) |

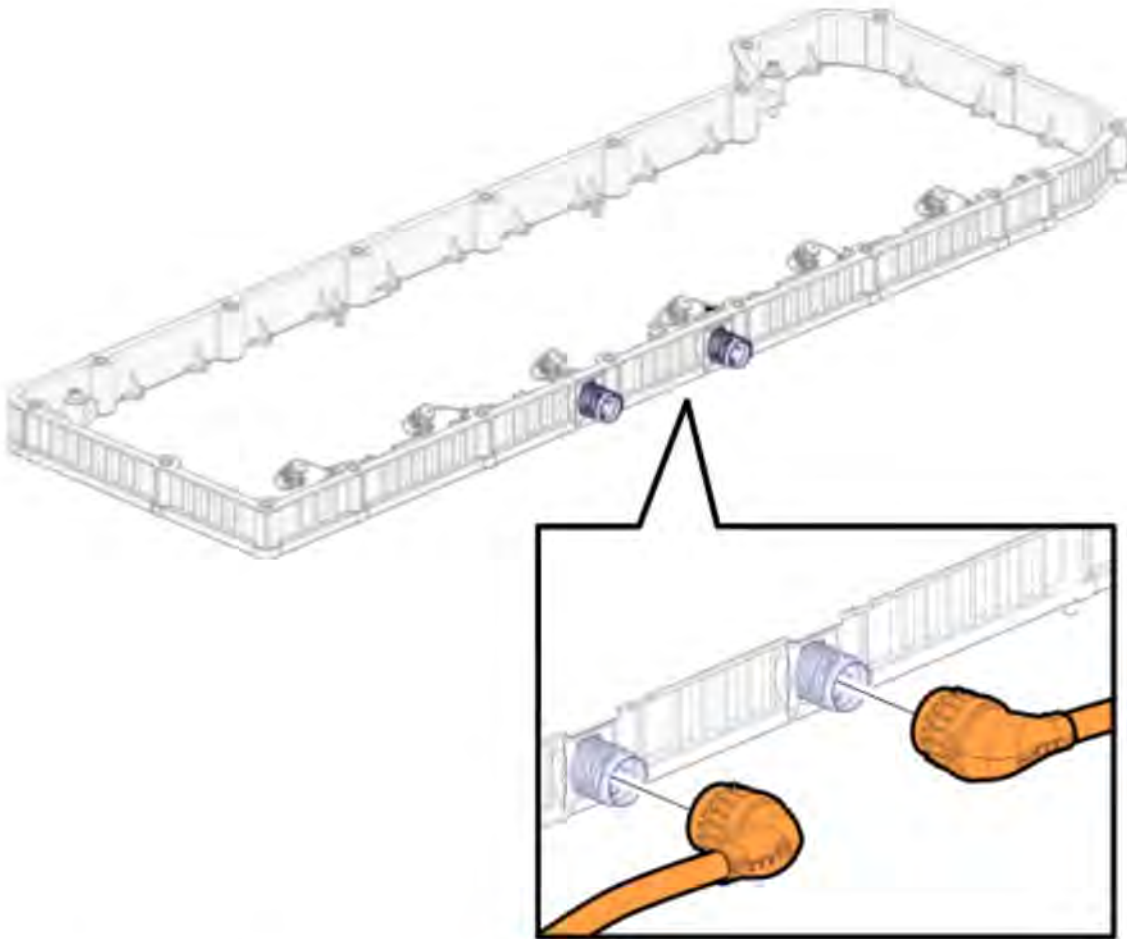
337 Connect the connectors.



338 Connect the connectors.



339 Connect the connectors.



340 Position the screws.



Note

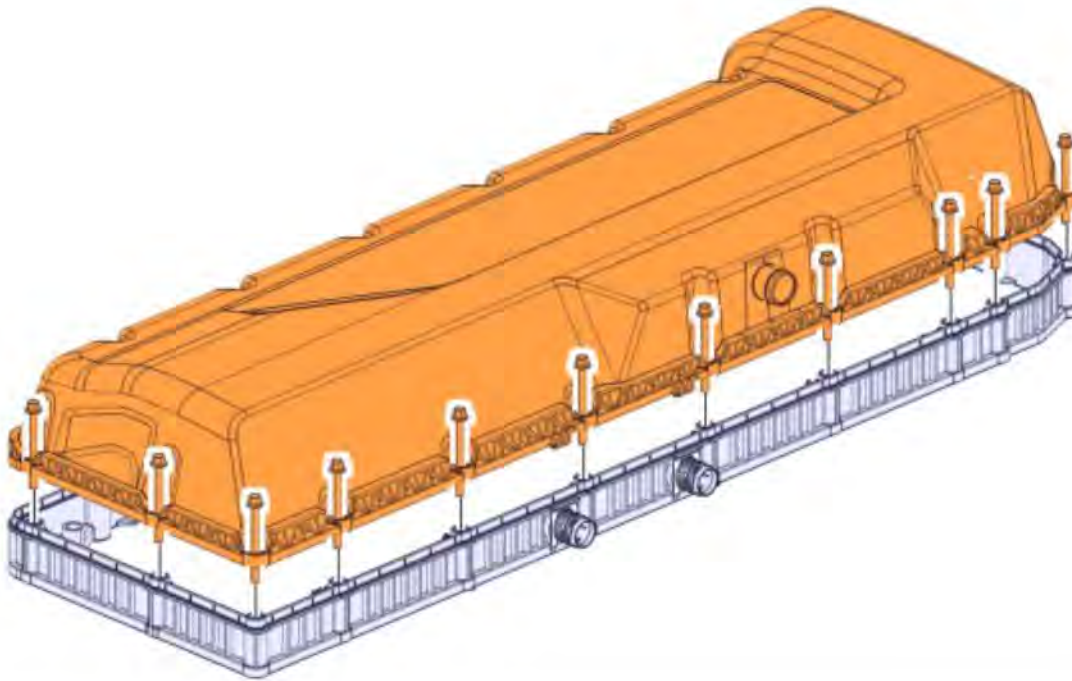
Inspect the gasket, replace as needed.



Service hint

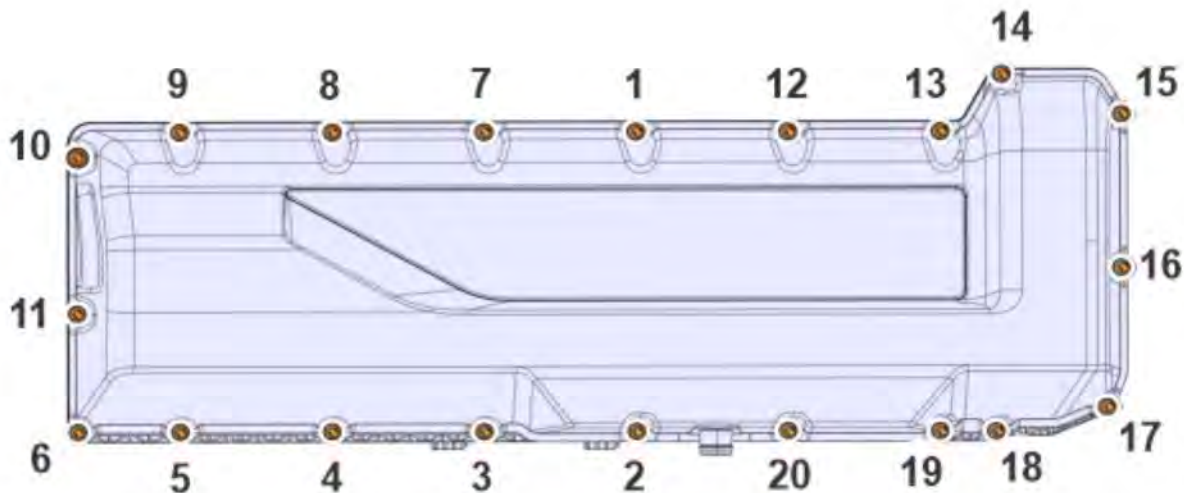
Temporarily securing the screws at the rear of the cover in the uppermost position will aid in installation

341 Install the valve cover.



342 Tighten the screws to torque.

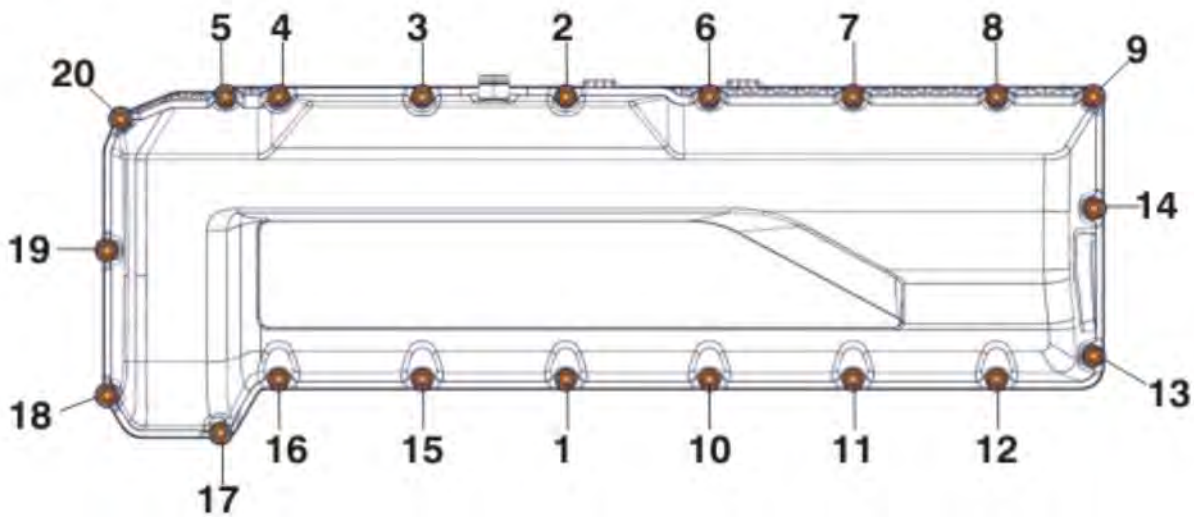
| Tightening torque | |
|--------------------|-----------------------------------------|
| Valve cover, screw | Tightening sequence: 1-20 |
| | 24 ±4 Nm (18 ±3 lb _f -ft) |



| Tightening torque | |
|--------------------|-----------------------------------------|
| Valve cover, screw | Tightening sequence: 1-20 |
| | 24 ±4 Nm (18 ±3 lb _f -ft) |

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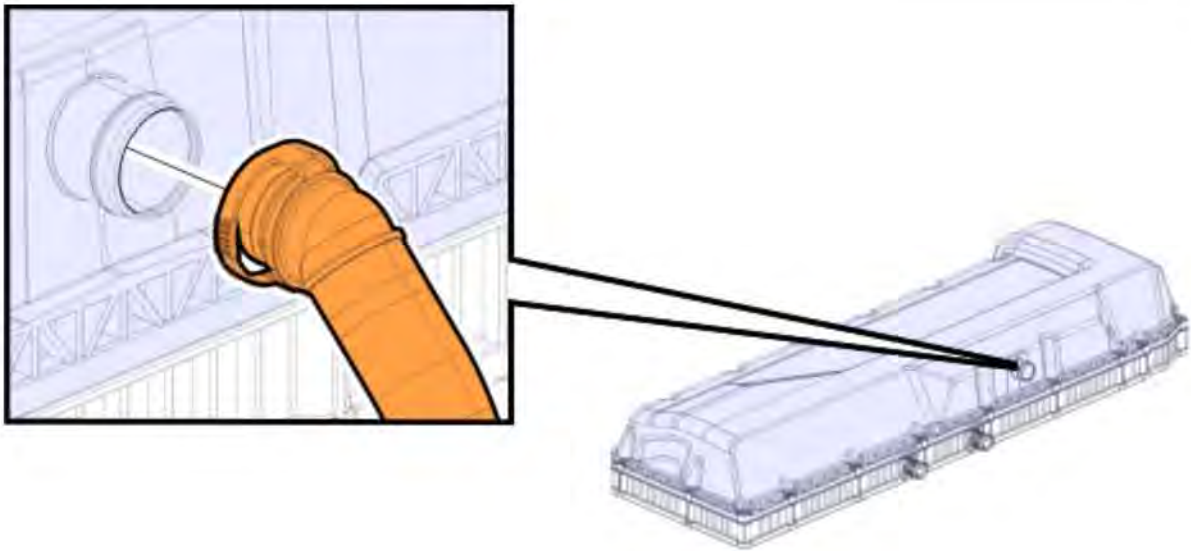
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343 Install the pipe.

i **Note**
If not previously installed.

i **Note**
Inspect the internal sealing ring.



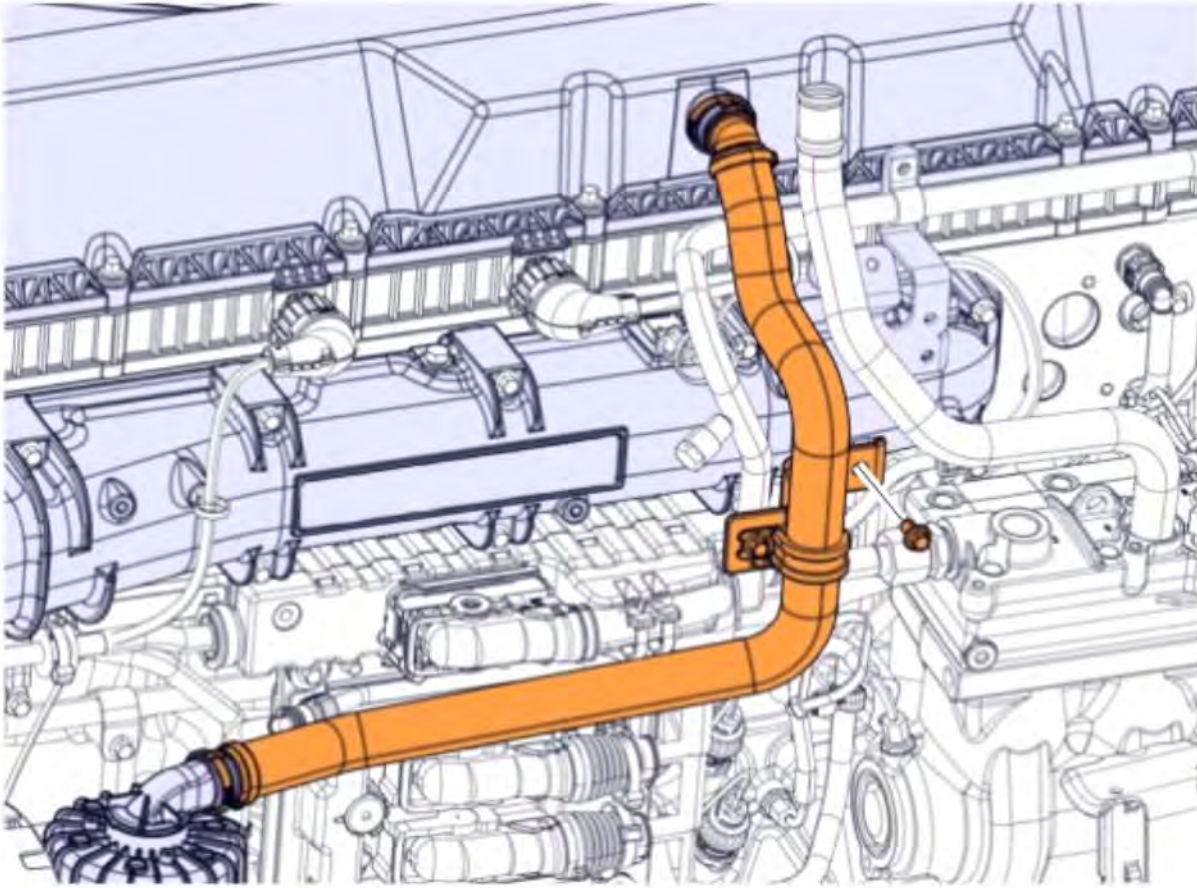
344 Install the pipe.

345 Install the screw.

346 Torque-tighten the screw.

Tightening torque

| | |
|-------|-----------------------------|
| Screw | M8 |
| | 24 ±4 Nm |
| | (18 ±3 lb _f -ft) |

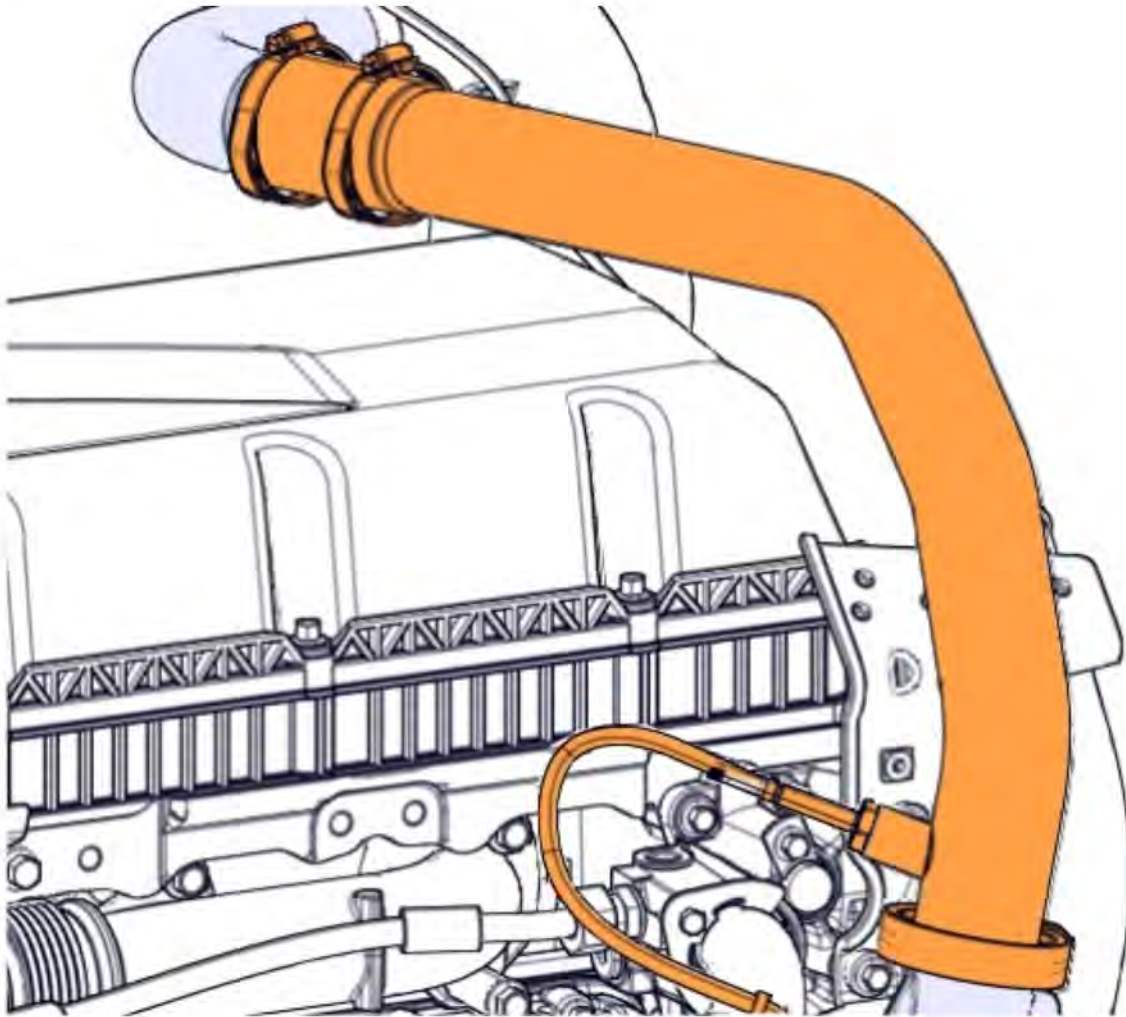


347 Install the pipe.



Note

Check the sealing ring and hose for damage; replace as needed.

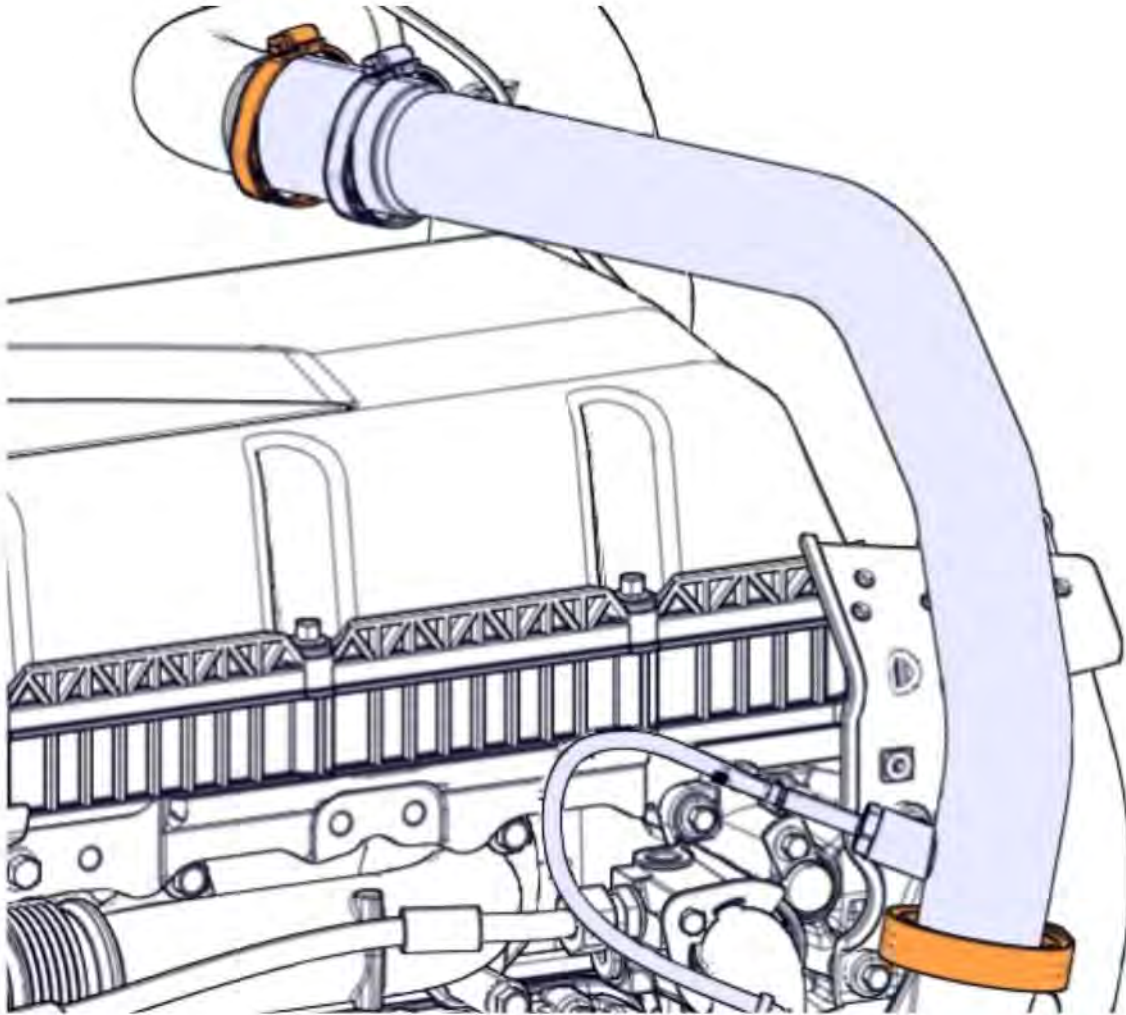


348 Position the clamps.

| | |
|----------|--------------------------|
| i | Note As noted. |
|----------|--------------------------|

349 Tighten the clamps to torque.

| Tightening torque | |
|--------------------|---------------------------------------------|
| V band clamp screw | 10.2 ±1 Nm (90 ±9 lb _f ·in) |
| Tightening torque | |
| Hose clamp | 11.9 ±2 Nm (105 ±18 lb _f ·in) |

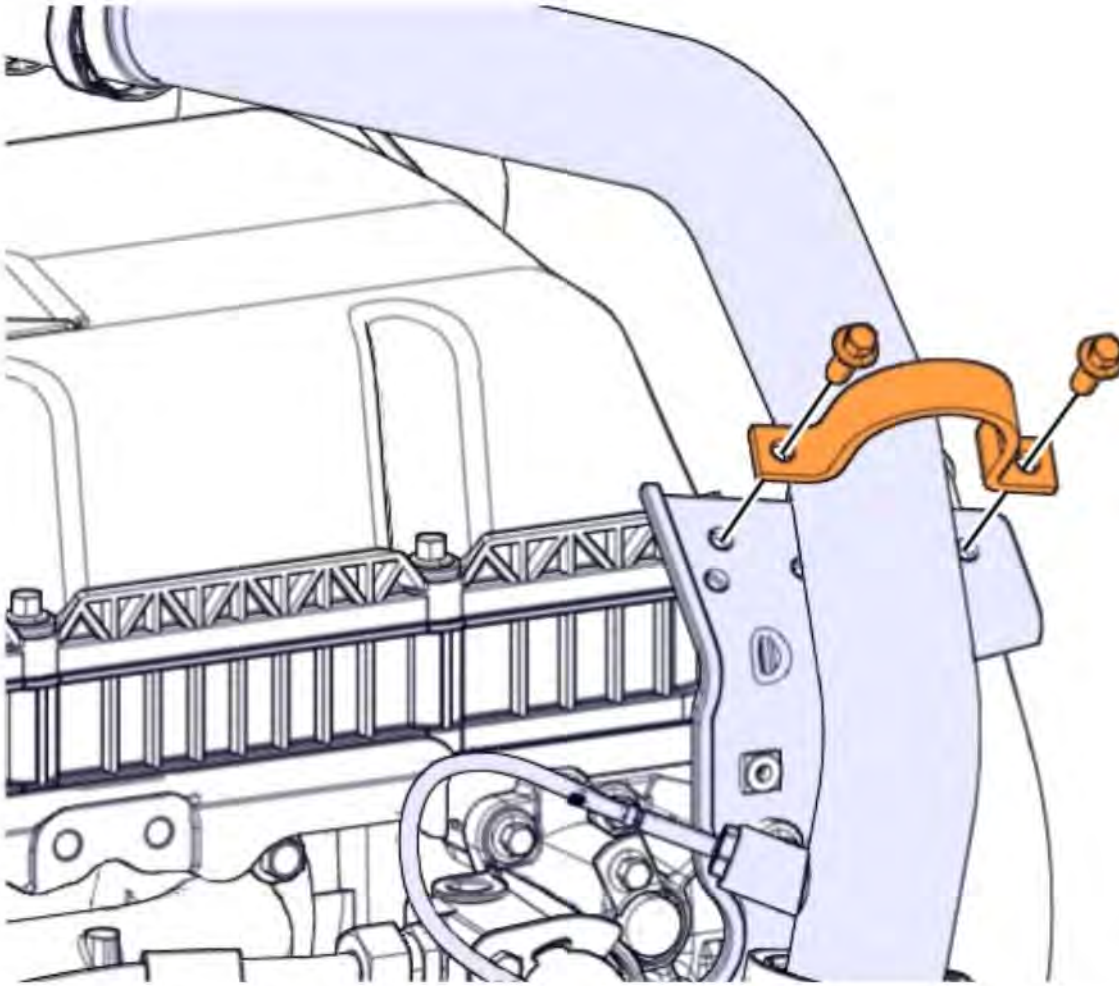


350 Install the clamp.

351 Torque tighten the screws.

Tightening torque

| | |
|-------|-----------------------------|
| Screw | M8 |
| | 24 ±4 Nm |
| | (18 ±3 lb _f .ft) |

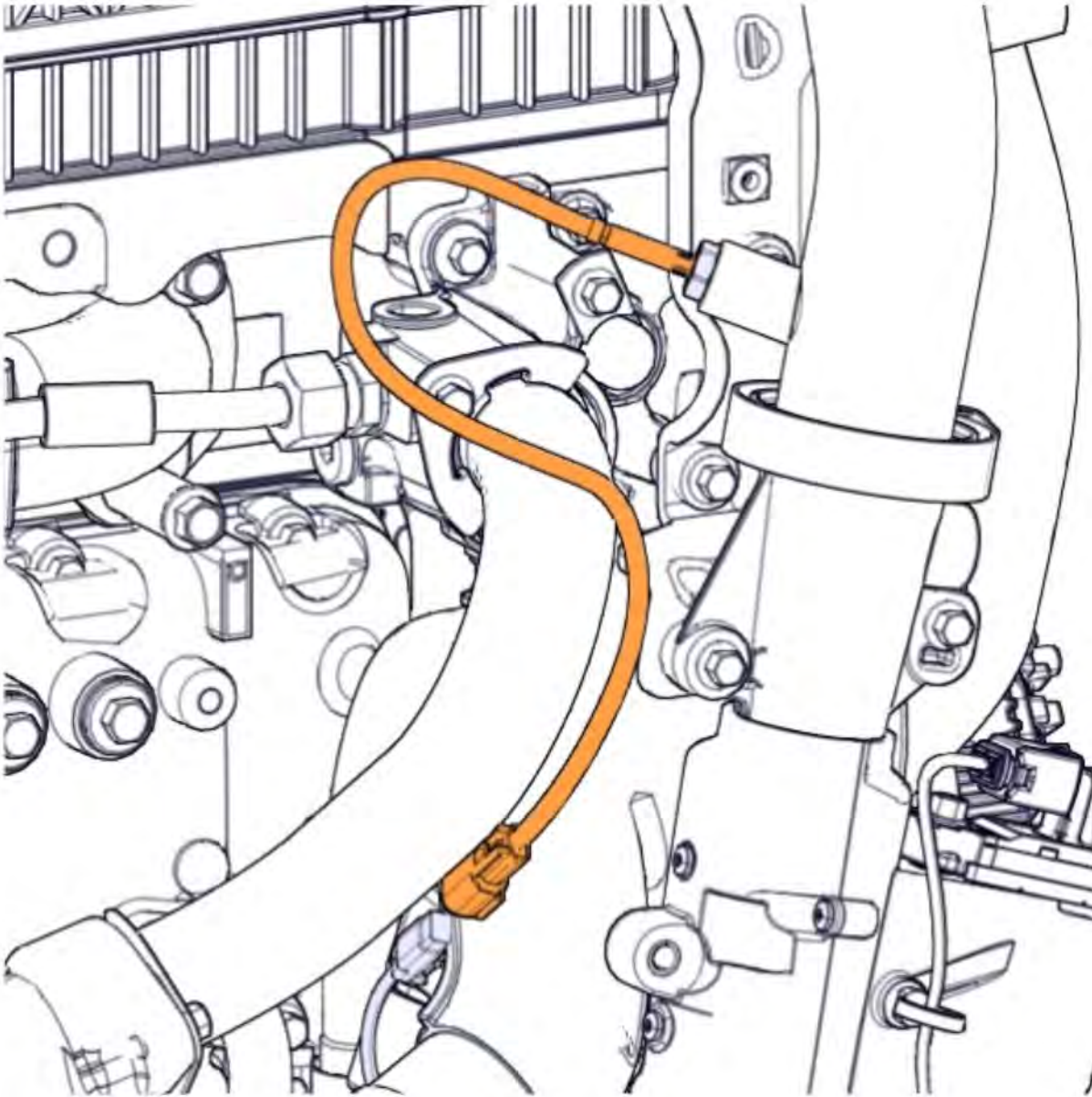


| | |
|-----|------------------------|
| 352 | Connect the connector. |
|-----|------------------------|

| | |
|-----|------------------------|
| 353 | Install the cable tie. |
|-----|------------------------|

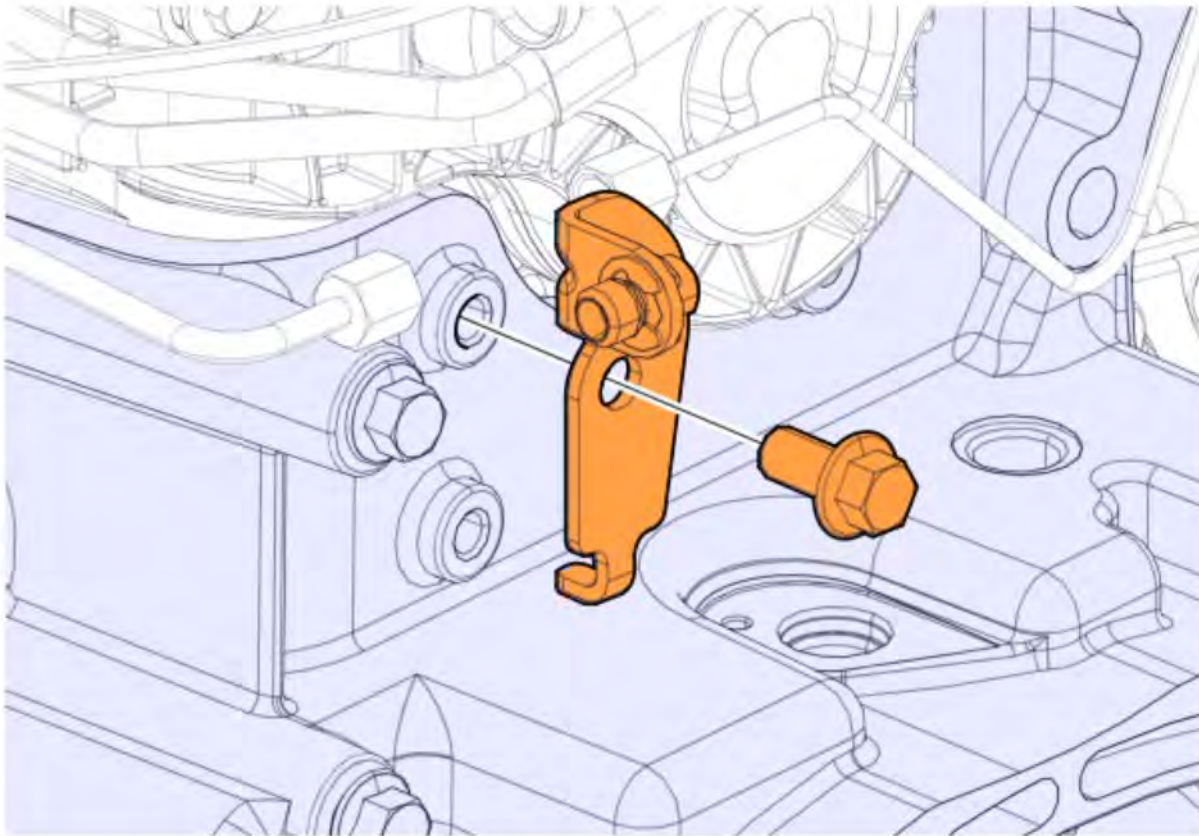
**Note**

Use a new part.



| | |
|-----|----------------------|
| 354 | Install the bracket. |
|-----|----------------------|

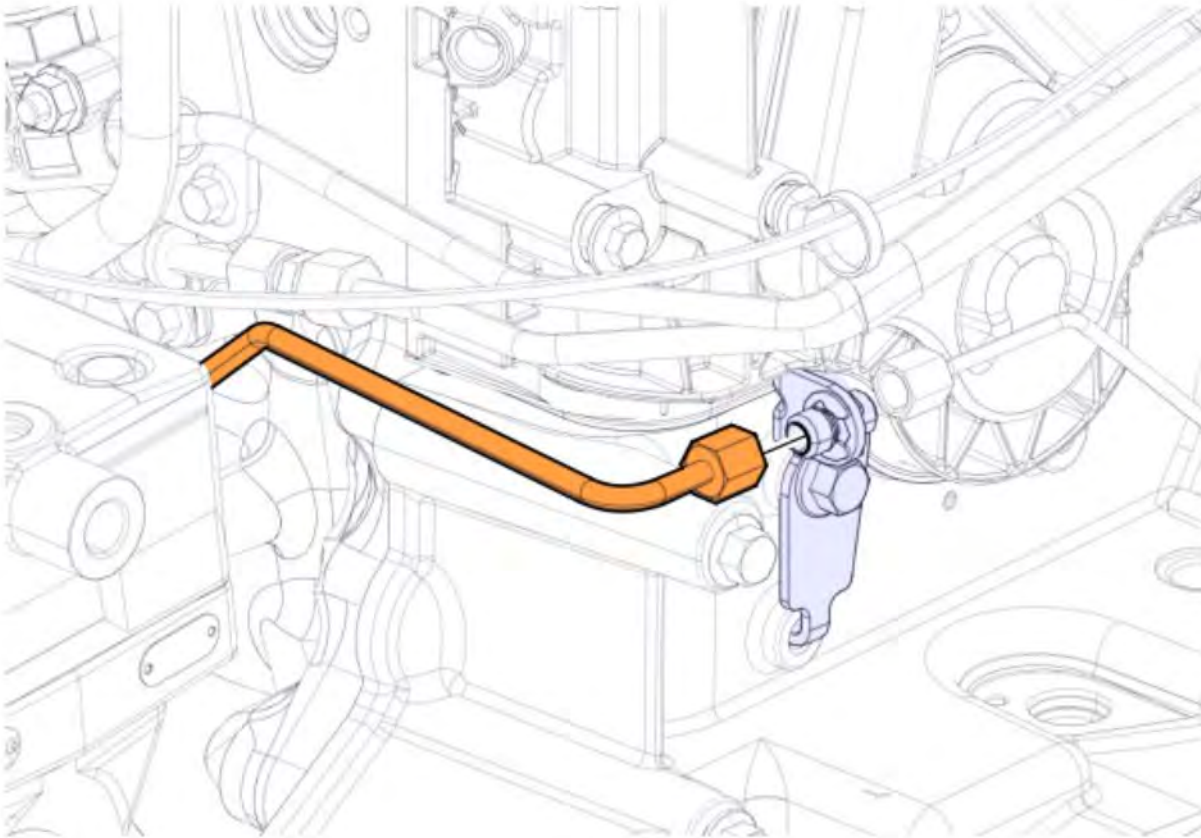
| | |
|-----|--------------------|
| 355 | Install the screw. |
|-----|--------------------|



| | |
|------------|------------------|
| 356 | Install the nut. |
|------------|------------------|

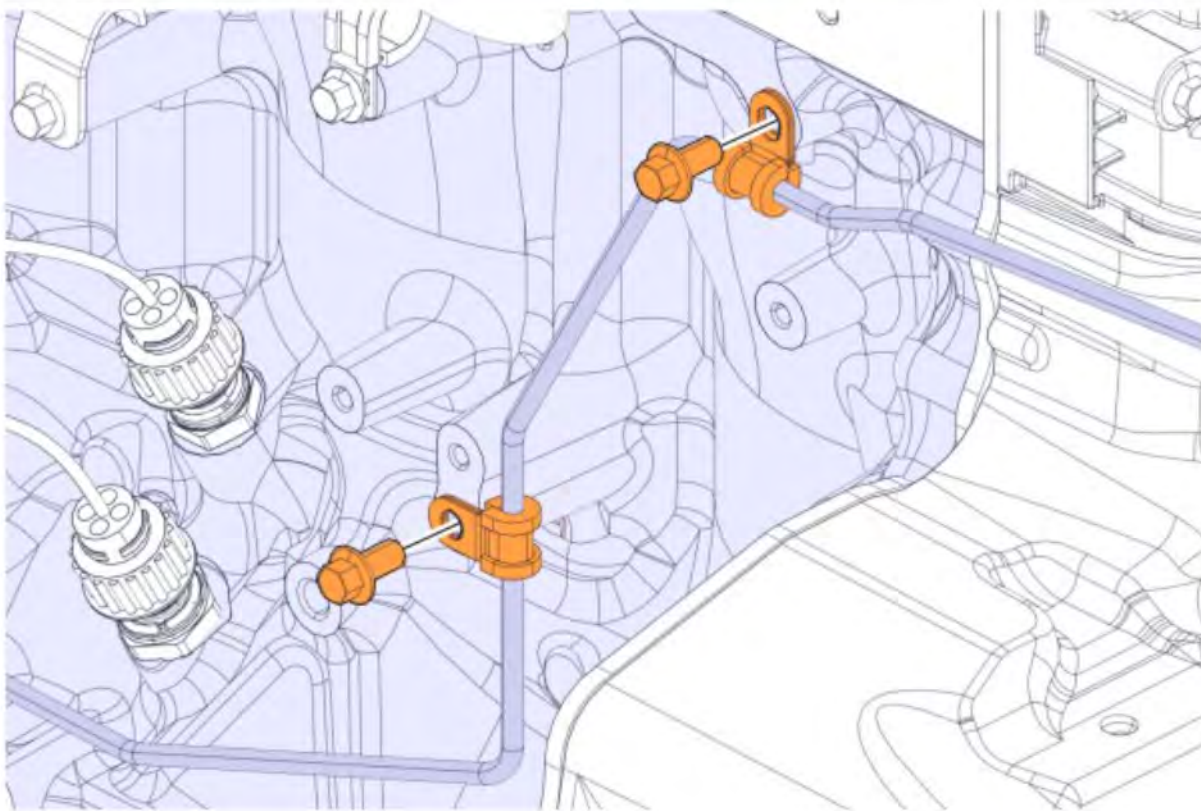
| | |
|------------|-------------------------|
| 357 | Torque tighten the nut. |
|------------|-------------------------|

| Tightening torque | |
|-------------------|-----------------------------------------|
| Fitting | #4 |
| | 15 ±1 Nm (11 ±1 lb _f .ft) |



| | |
|-----|---------------------|
| 358 | Install the clamps. |
|-----|---------------------|

| | |
|-----|---------------------|
| 359 | Install the screws. |
|-----|---------------------|

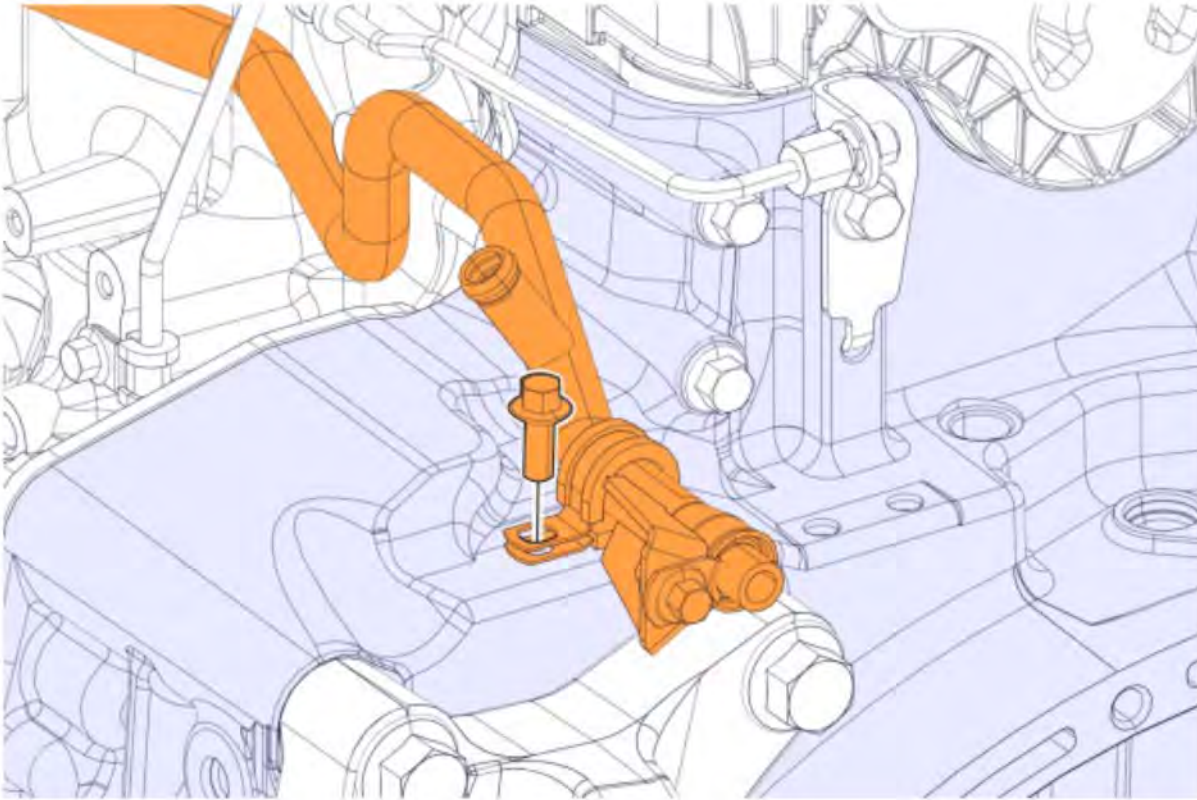


| | |
|-----|--------------------|
| 360 | Position the pipe. |
|-----|--------------------|

| | |
|-----|--------------------|
| 361 | Install the screw. |
|-----|--------------------|

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362 Lubricate the O-ring.



Note

Use a new part.



Note

Use recommended oil.

363 Install the O-ring.




| |
|----------------------------------------------------------------------------------------------------|
|  CAUTION |
|----------------------------------------------------------------------------------------------------|

Risk of serious injury.
 Heavy component.

▶ Exercise caution when moving the component. Use appropriate tools.

364 Install the compressor.

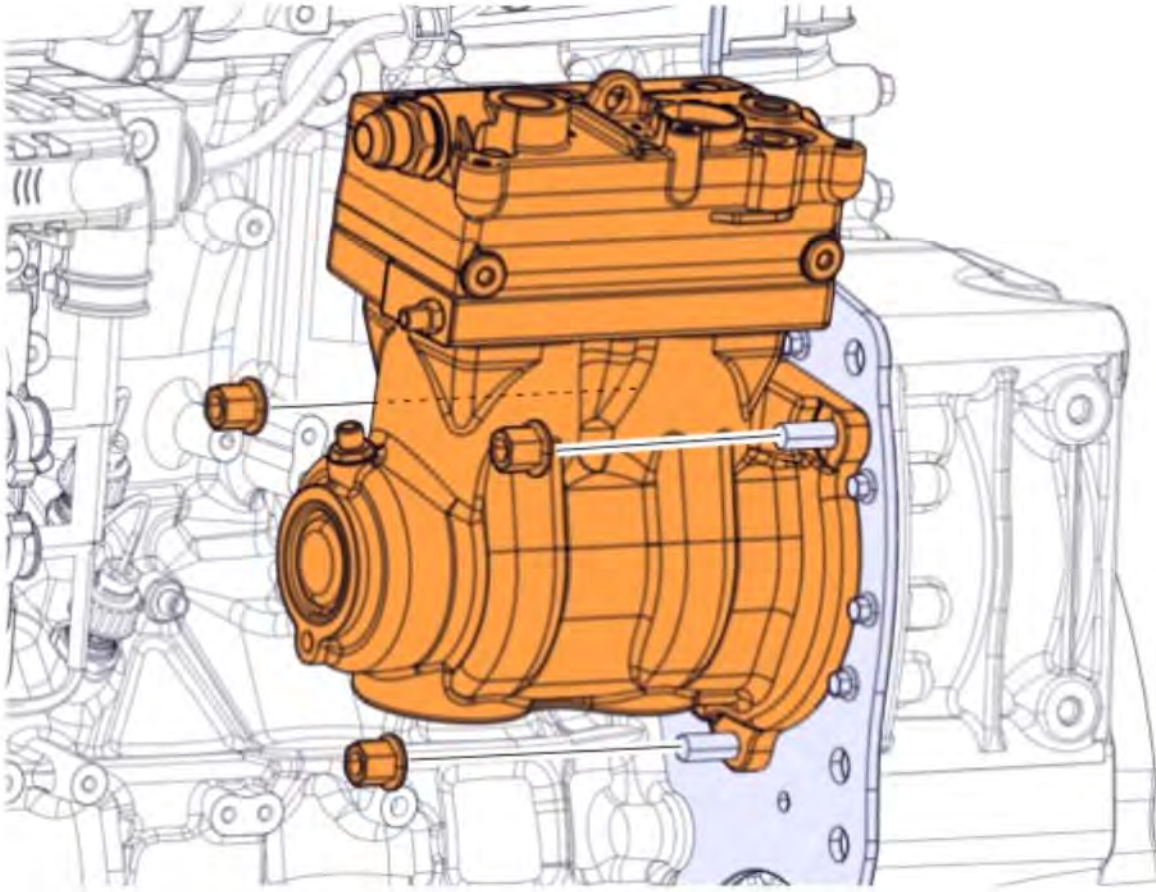
| | |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------|
|  | Note Take care not to damage surrounding components. |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------|

365 Install the nuts.

366 Torque tighten the nuts diagonally.

| Tightening torque | |
|--------------------------|-------------------------------------------|
| Compressor, mounting nut | 85 ±15 Nm (63 ±11 lb _f -ft) |

367 Repeat the operation a second time.

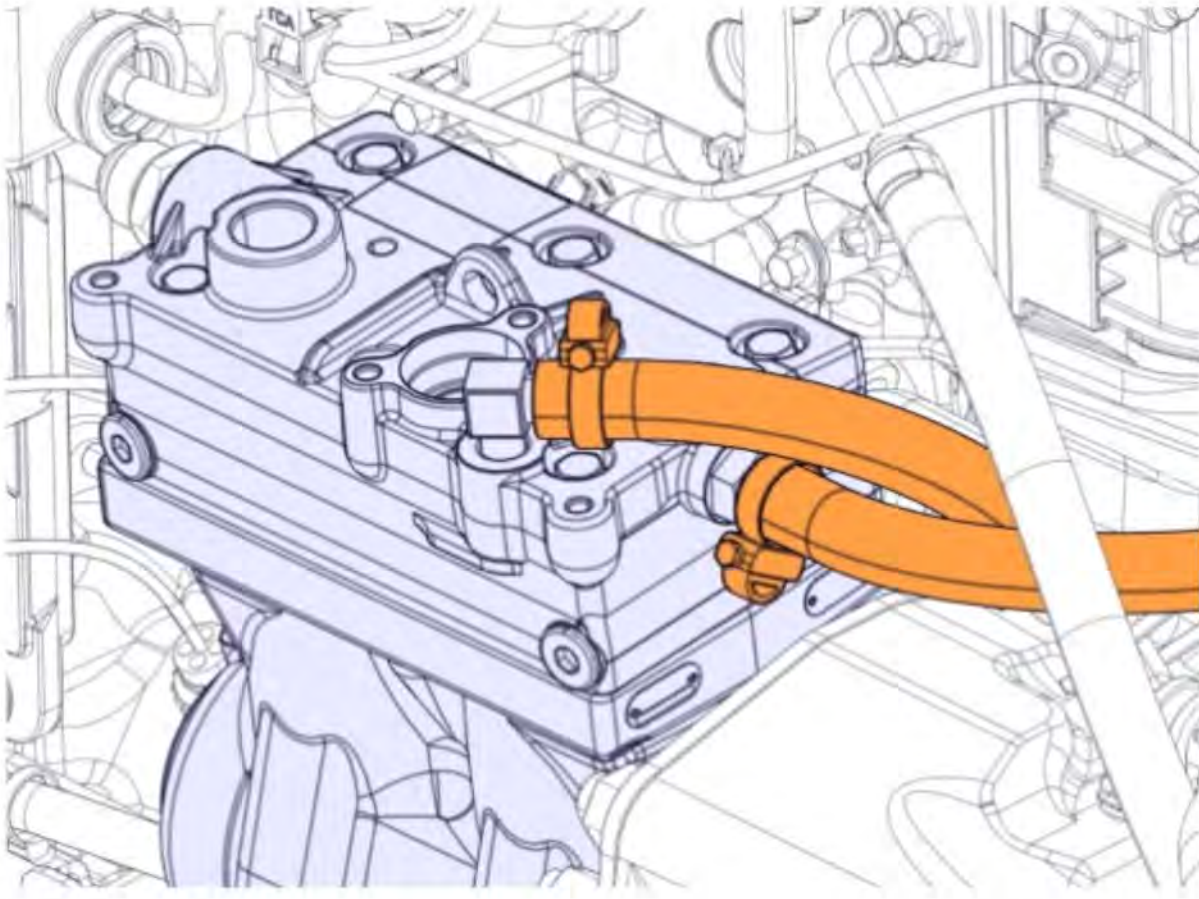


| | |
|------------|--------------------|
| 368 | Connect the hoses. |
|------------|--------------------|

| | |
|------------|----------------------------|
| 369 | Torque tighten the clamps. |
|------------|----------------------------|

| | |
|--------------------------|--|
| Tightening torque | |
|--------------------------|--|

| | |
|---------------------------------|----------------------------------------------------------------|
| Compressor, coolant hose, clamp | $3 \pm 0.5 \text{ Nm}$ $(2 \pm 0.4 \text{ lb}_f\text{-ft})$ |
|---------------------------------|----------------------------------------------------------------|



370 Lubricate the sealing ring.

| | |
|----------|-------------------------------------|
| i | Note Use recommended oil. |
|----------|-------------------------------------|

371 Install the sealing ring.

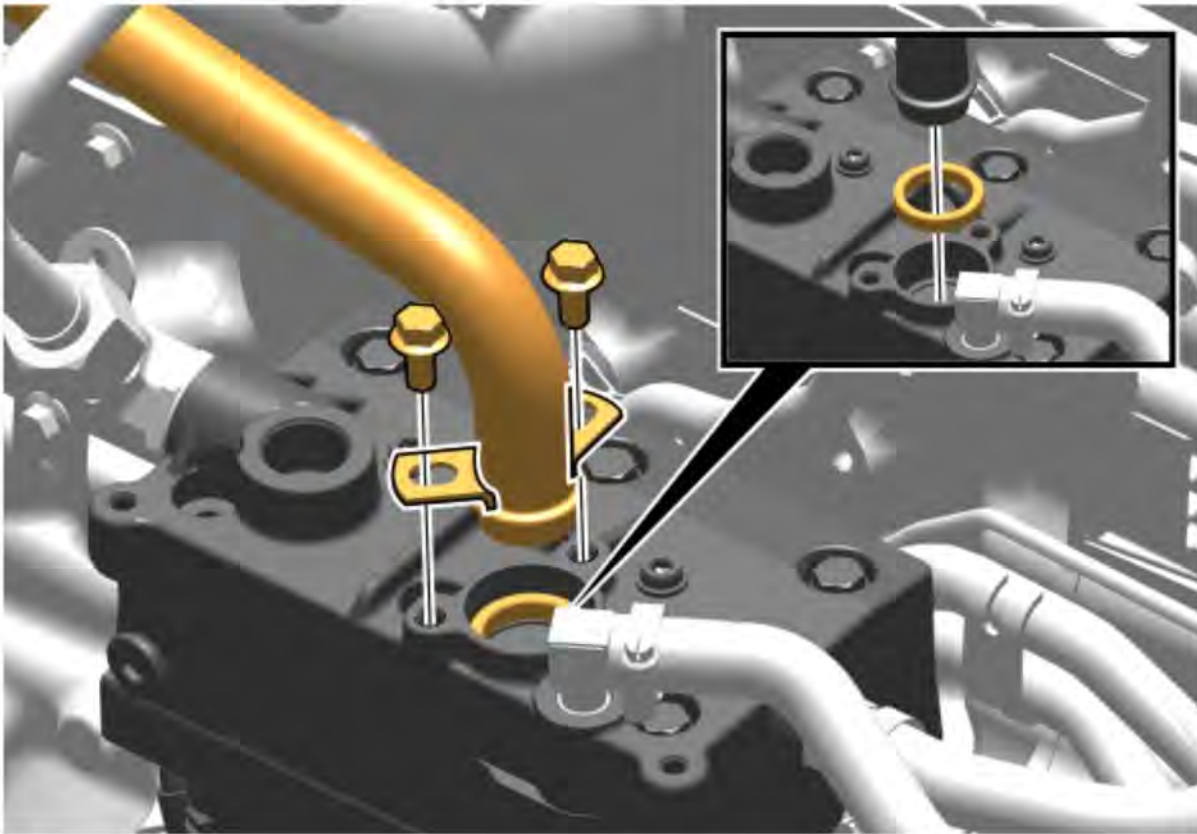
| | |
|----------|--------------------------------|
| i | Note Use a new part. |
|----------|--------------------------------|

372 Install the pipe along with the lock braces.

373 Install the screws.

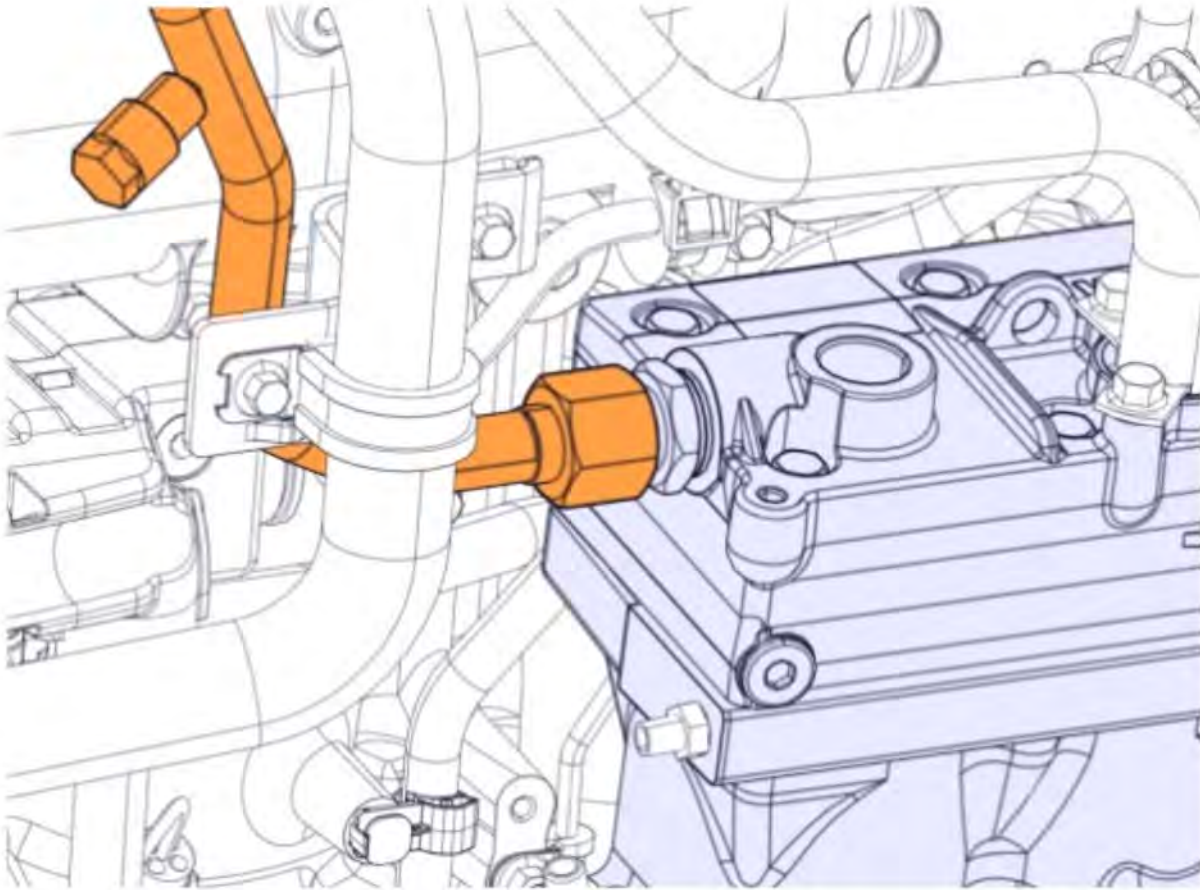
374 Torque tighten the screws.

| Tightening torque | |
|-------------------|-----------------------------|
| Lock brace, screw | M8 |
| | 24 ±4 Nm |
| | (18 ±3 lb _f .ft) |



| | |
|------------|-------------------|
| 375 | Install the pipe. |
|------------|-------------------|

| | | |
|------------|-----------------------------|--------------------------------------------|
| 376 | Torque tighten the nut. | |
| | Tightening torque | |
| | Compressor, air outlet, nut | 130 ±20 Nm (96 ±15 lb _f -ft) |
| | | |

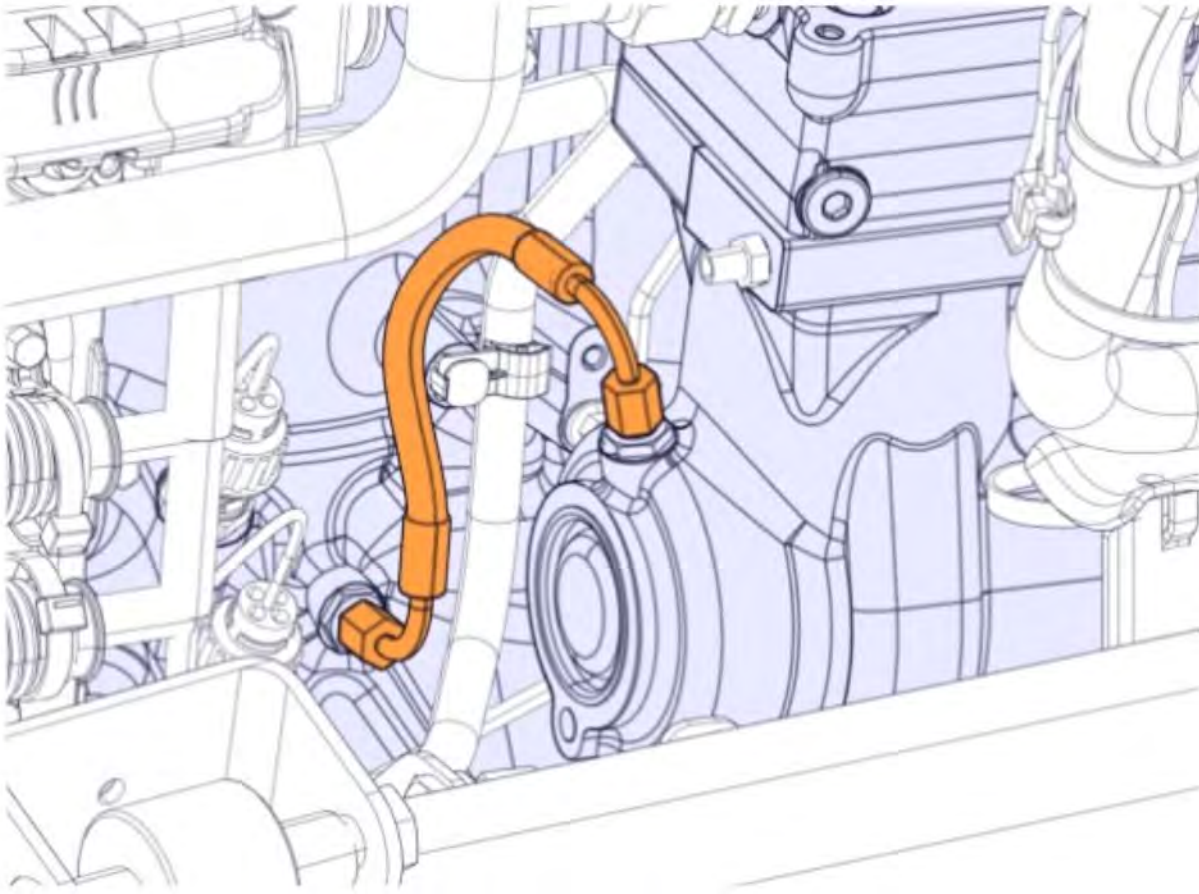


| | |
|------------|-----------------------|
| 377 | Install the oil hose. |
|------------|-----------------------|

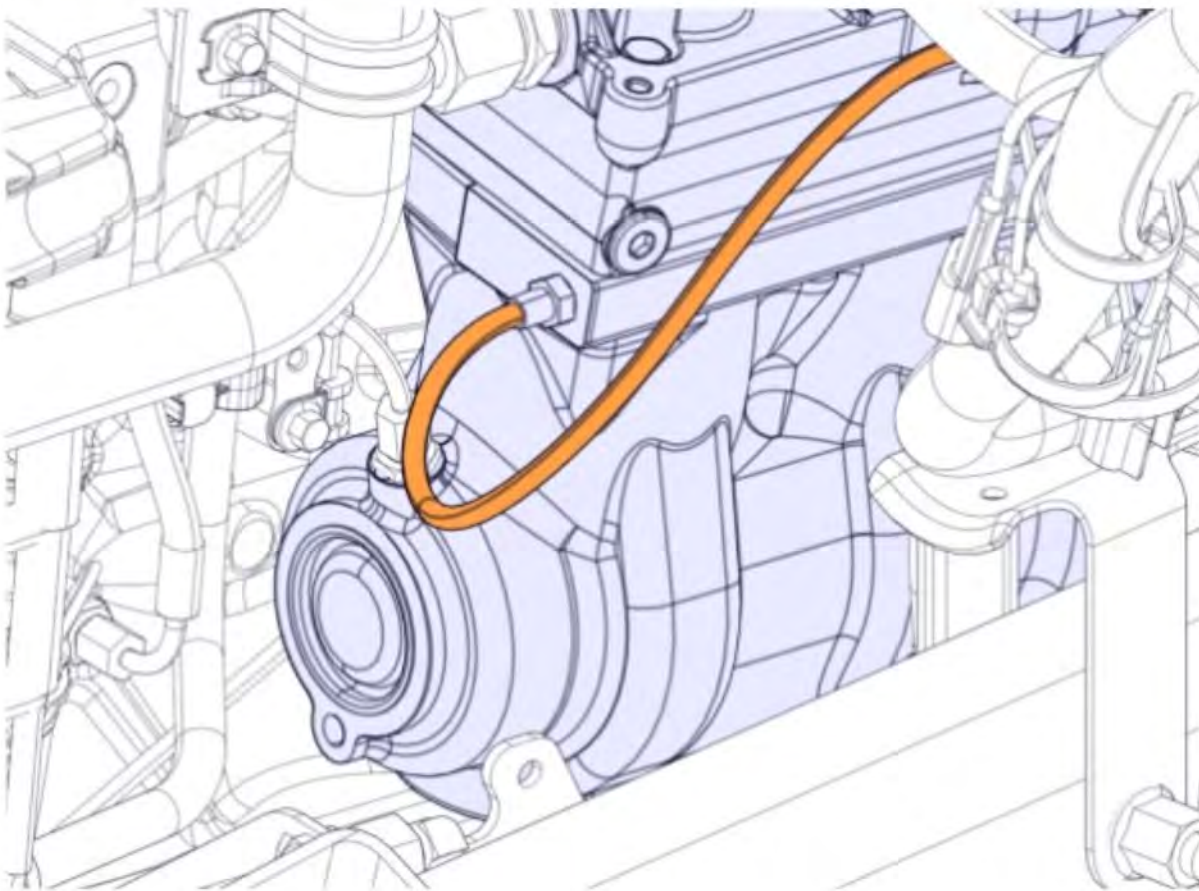
| | |
|------------|----------------------------------|
| 378 | Torque tighten the fitting nuts. |
|------------|----------------------------------|

| | |
|--------------------------|--|
| Tightening torque | |
|--------------------------|--|

| | |
|-------------------------------|-----------------------------------------|
| Compressor, oil hose, fitting | 15 ±3 Nm (11 ±2 lb _f ·ft) |
|-------------------------------|-----------------------------------------|



379 Connect the air line.

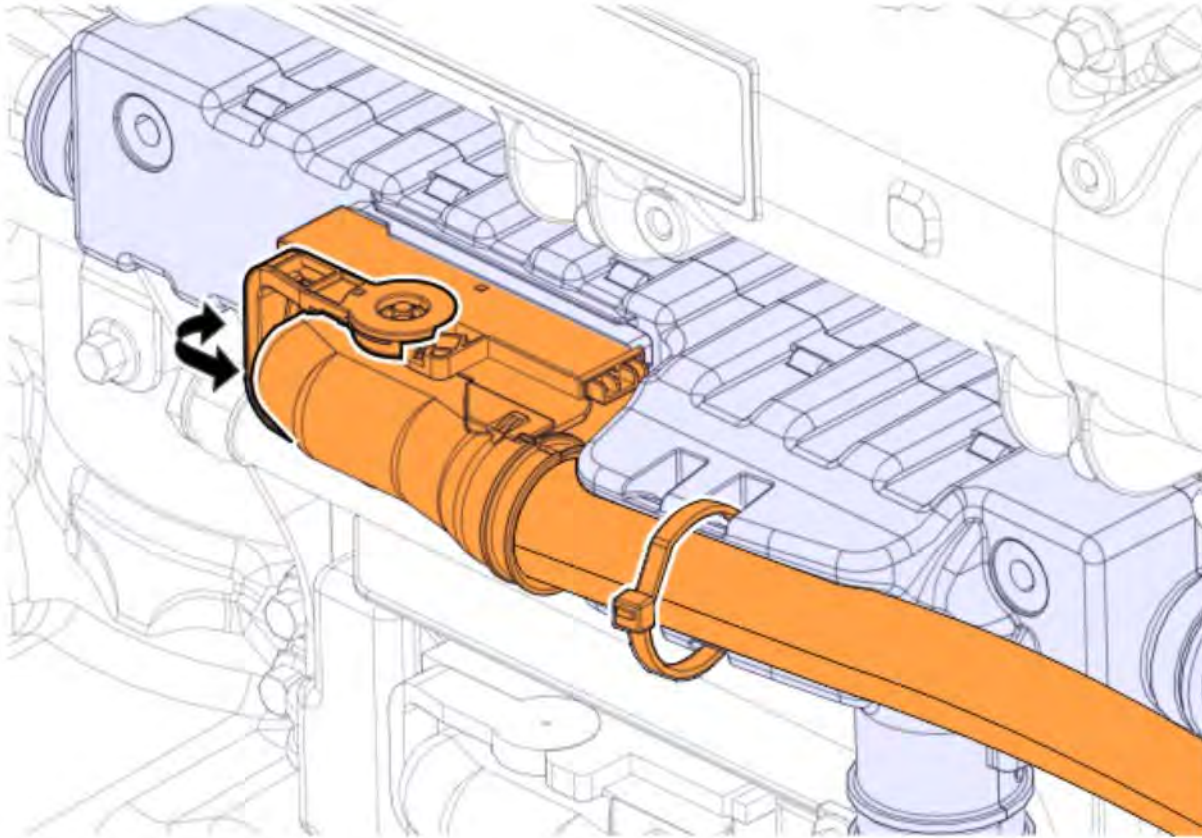


380 Connect the connector.

381 Install the cable ties.

i **Note**
Use new parts.

i **Note**
As noted.



382 Lubricate the seal.

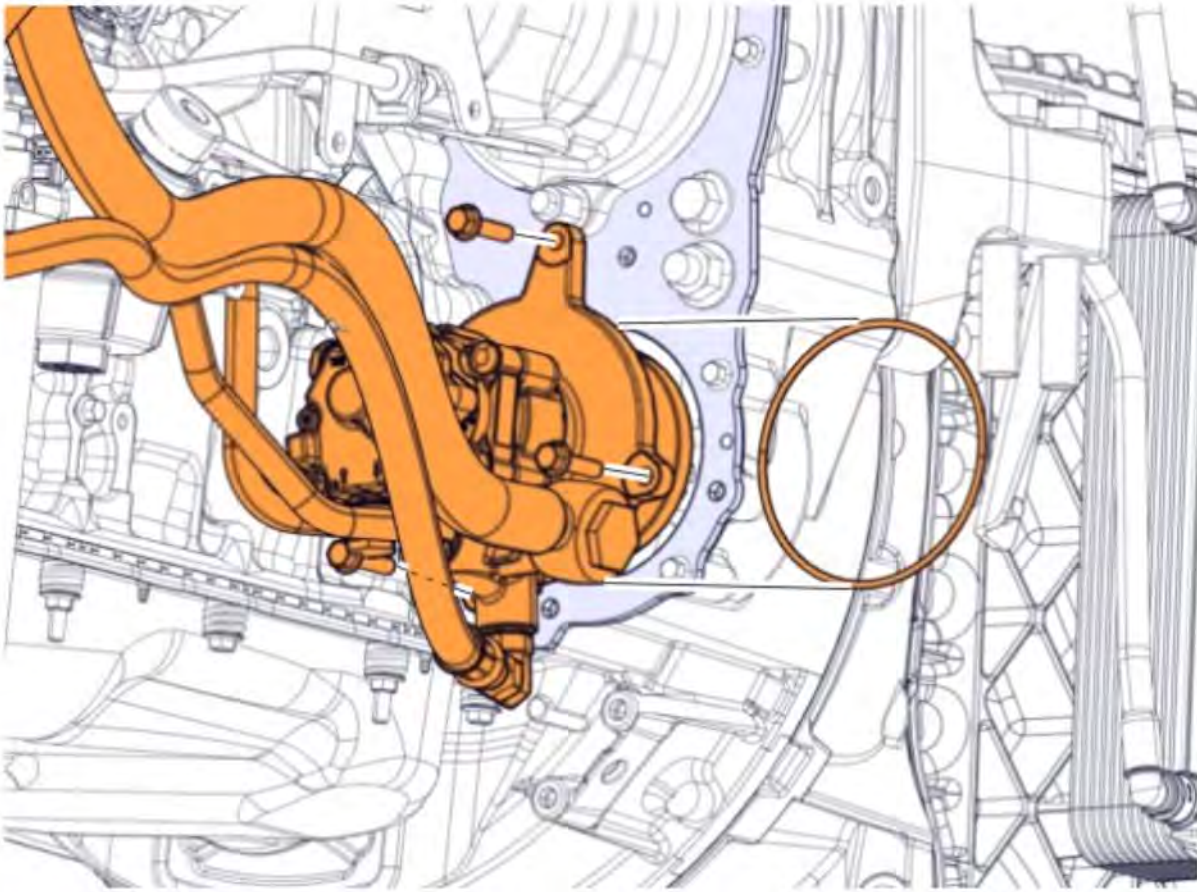
383 Install the seal.

i **Note**
Use a new part

i **Note**
Use recommended oil.

384 Install the pump.

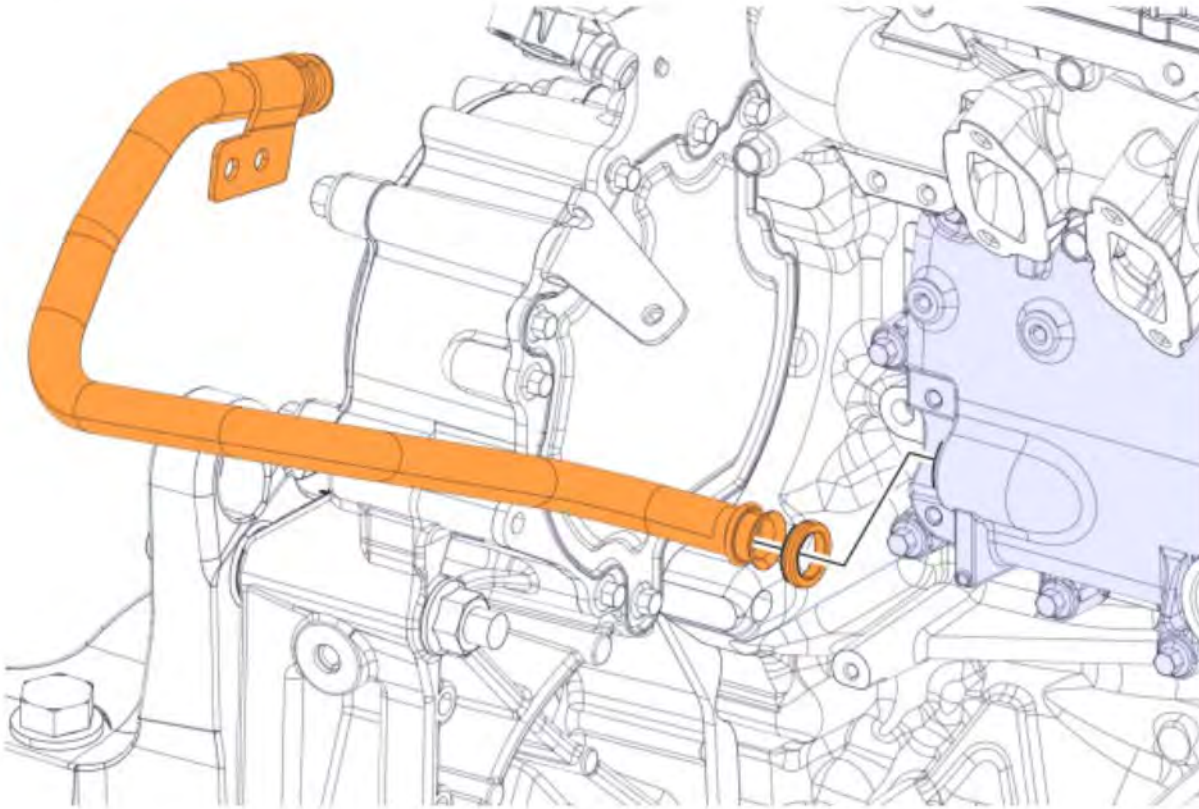
385 Install the screws.



| | | |
|------------|----------------------------|-----------------------------------------|
| 386 | Torque tighten the screws. | |
| | Tightening torque | |
| | Screw | M8 |
| | | 24 ±4 Nm (18 ±3 lb _f .ft) |
| | | |

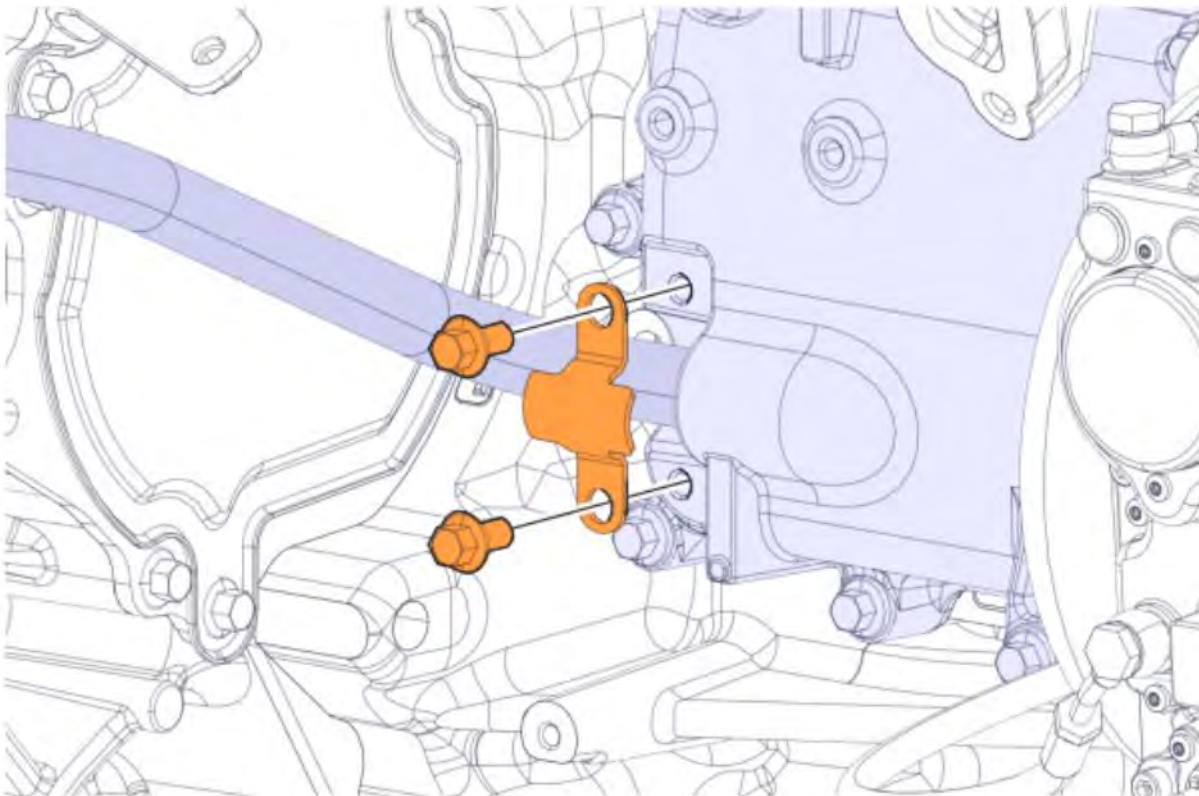
| | | |
|------------|-------------------|--------------------------------|
| 387 | Install the seal. | |
| | i | Note Use a new part. |
| | | |

| | |
|------------|-------------------|
| 388 | Install the pipe. |
|------------|-------------------|

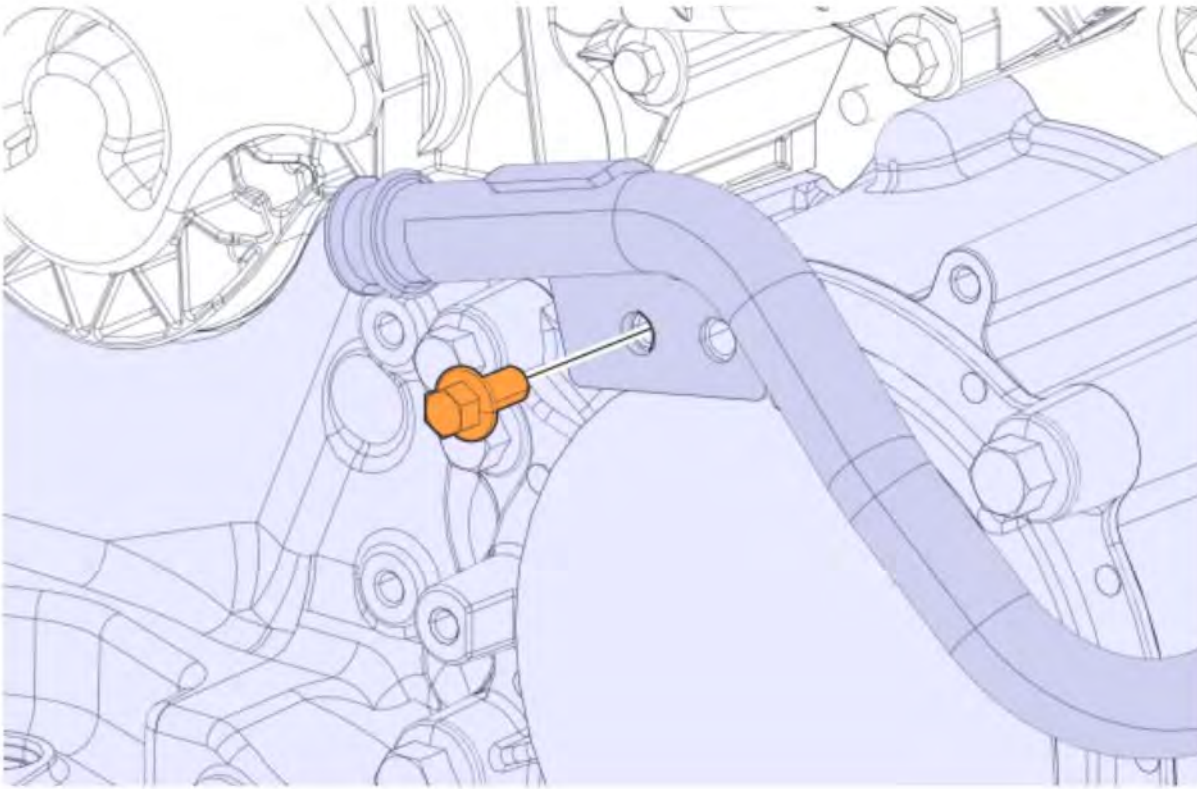


389 Install the clamp.

390 Install the screws.

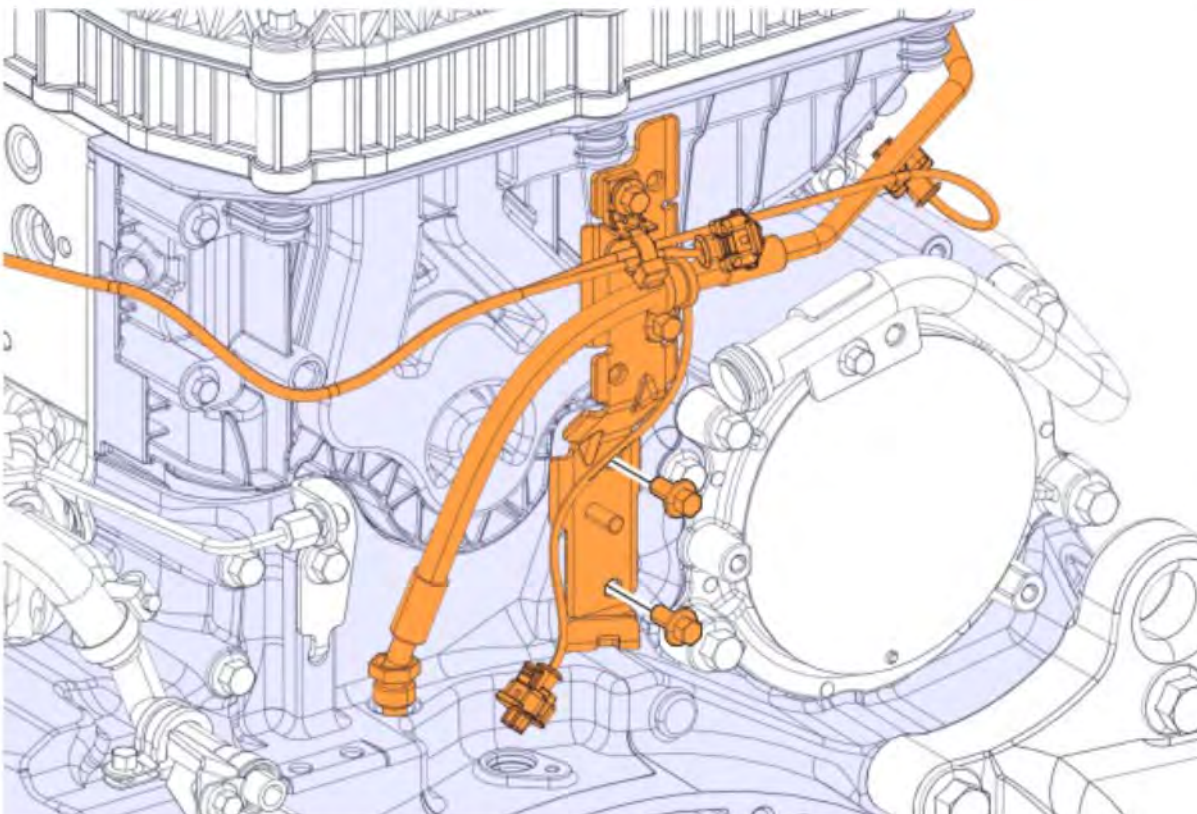


391 Install the screw.



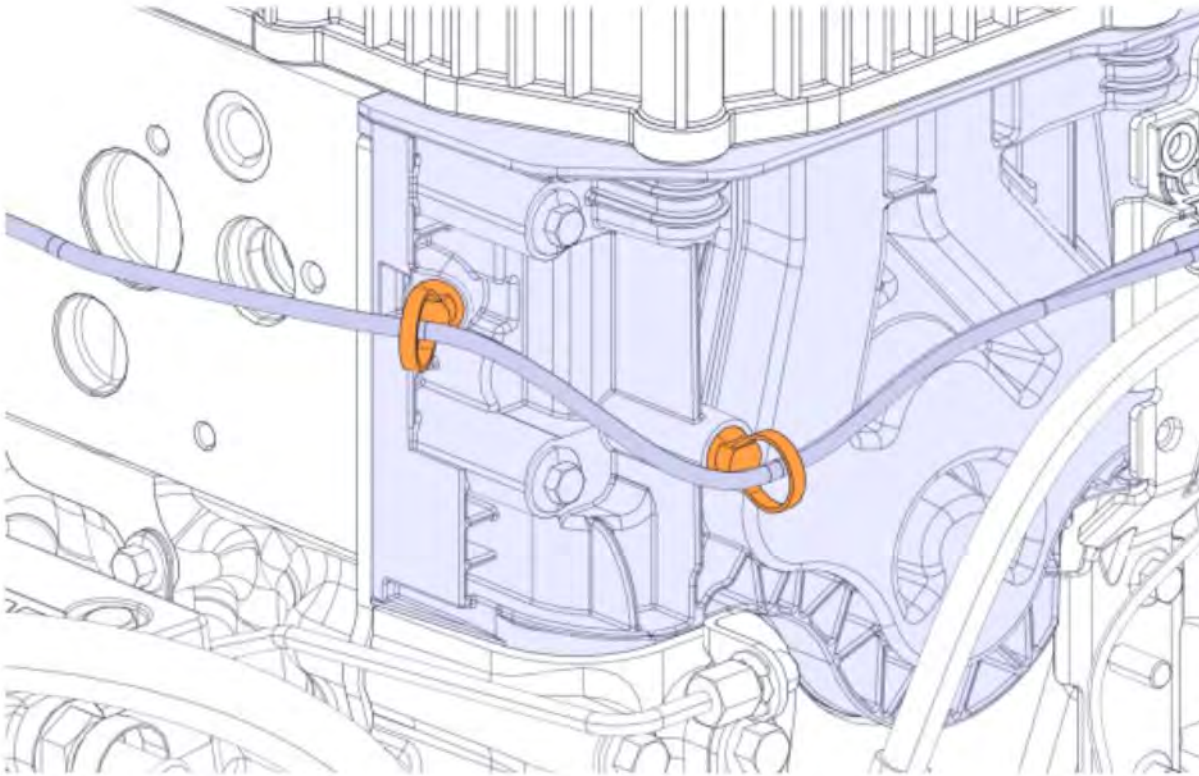
392 Position the assembly.

393 Install the screws.



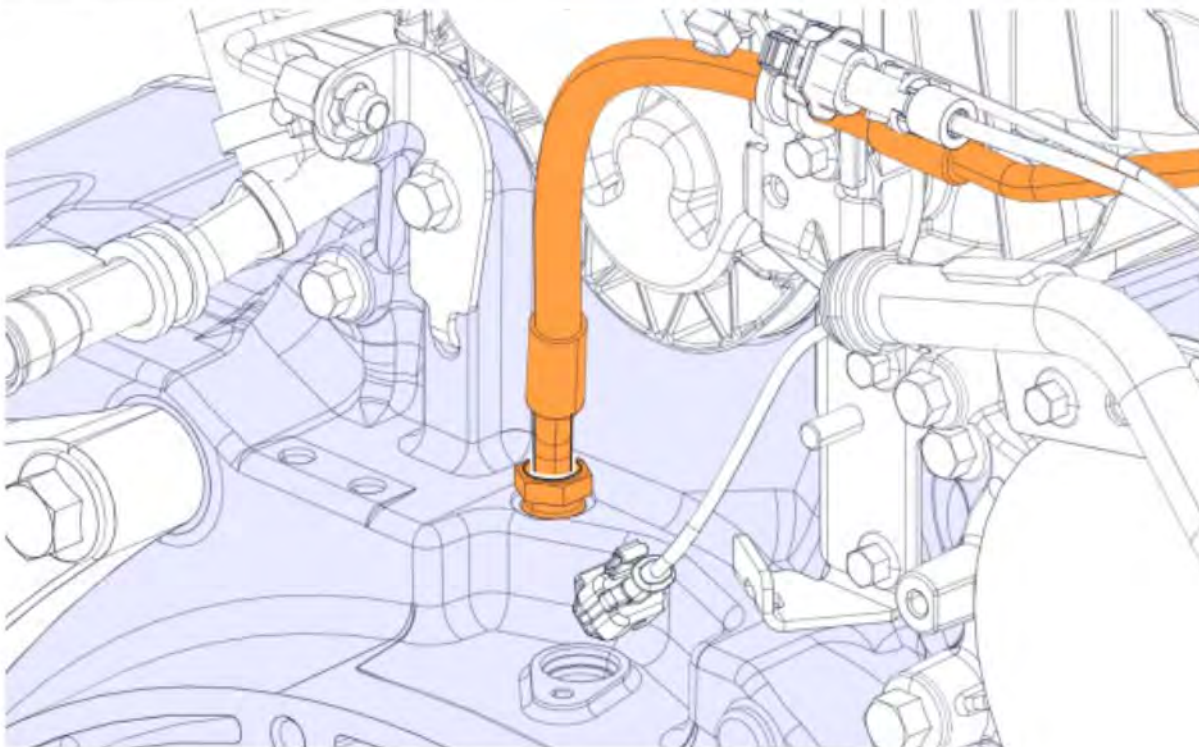
394 Install the cable ties.

i **Note**
Use new parts.



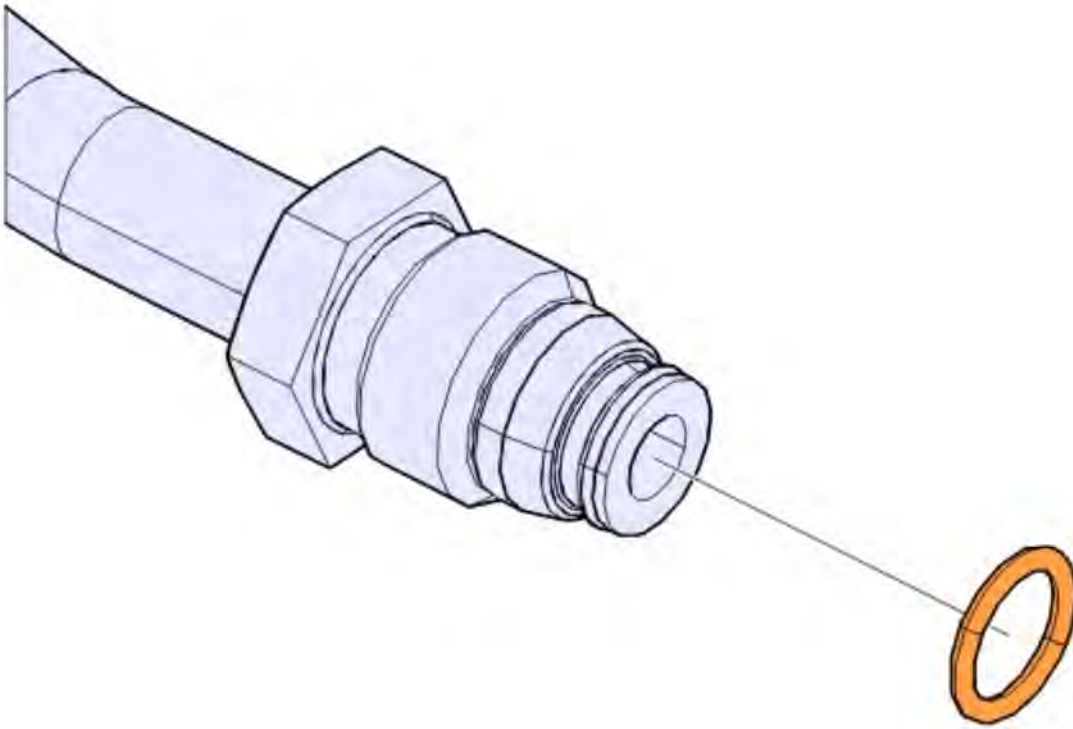
| | |
|------------|-------------------|
| 395 | Install the hose. |
|------------|-------------------|

| | |
|------------|------------------|
| 396 | Tighten the nut. |
|------------|------------------|

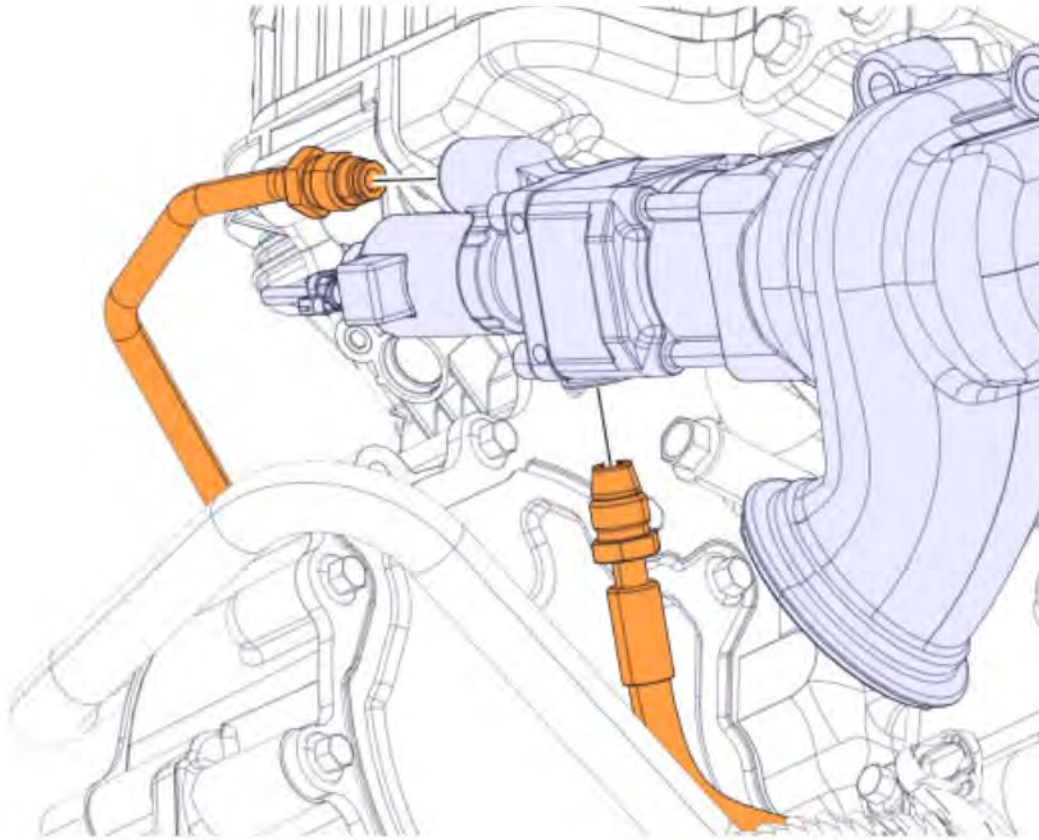


| | |
|------------|----------------------------|
| 397 | Clean the contact surface. |
|------------|----------------------------|

| | |
|-------------------------------------------------------------------------------------|--------------------------------|
| 398 | Install the seal. |
|  | Note Use a new part. |



| | |
|-----|--------------------|
| 399 | Install the pipes. |
|-----|--------------------|



400 Install the gasket.



Note

Use a new part.

401 Position the valve.

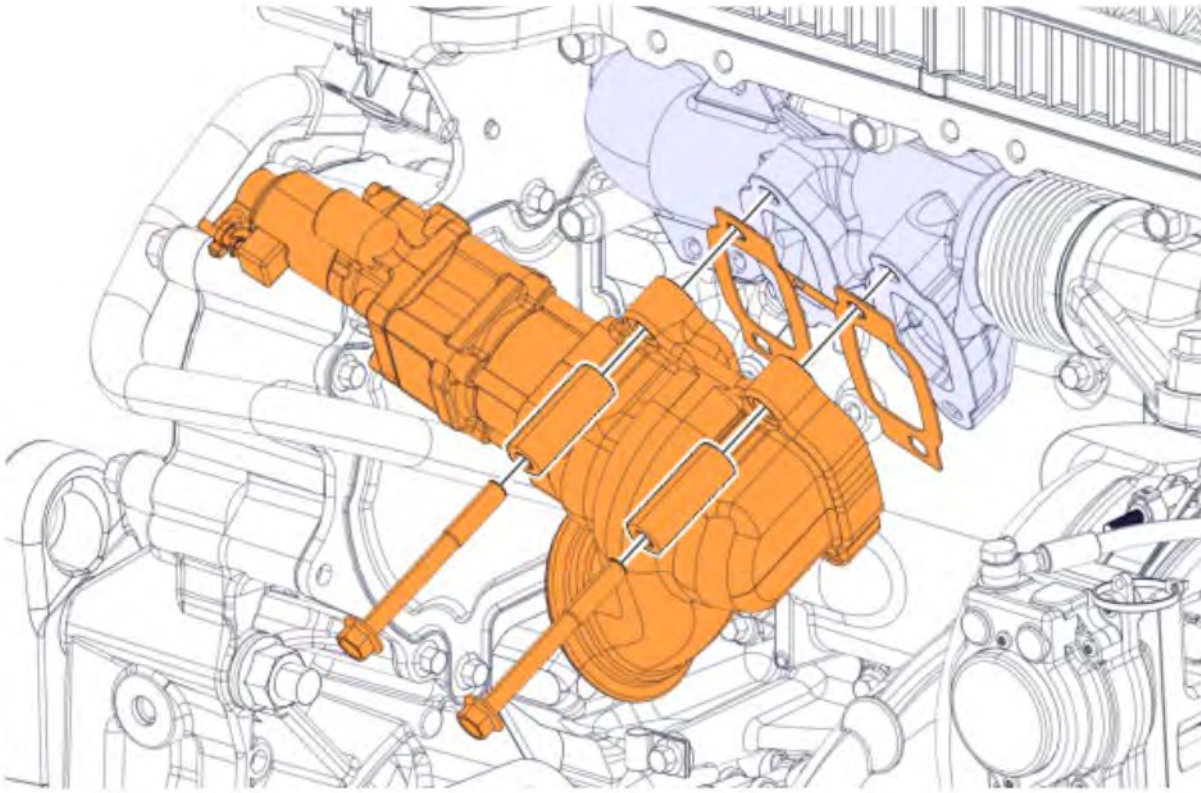
402 Install the spacers.

403 Install the screws.



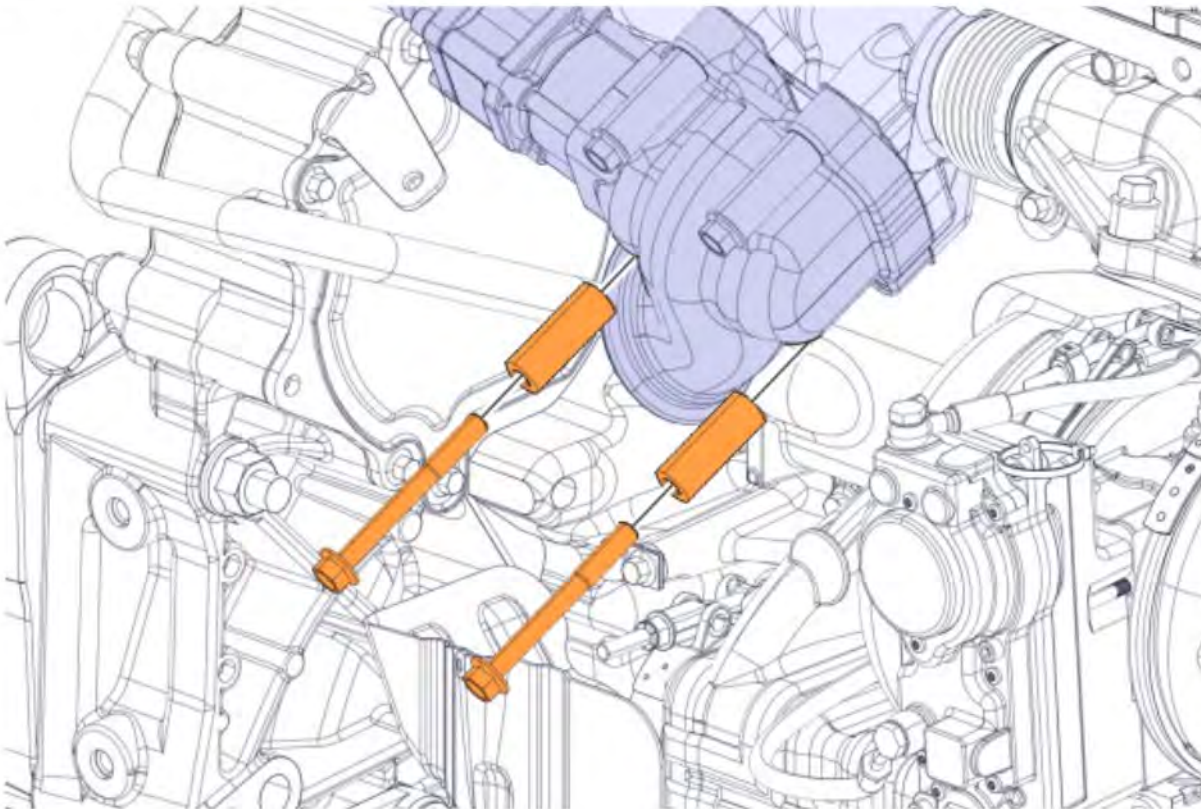
Note

Use the two upper fasteners to hold the gasket in place.



| | |
|------------|----------------------|
| 404 | Install the spacers. |
|------------|----------------------|

| | |
|------------|---------------------|
| 405 | Install the screws. |
|------------|---------------------|



| | |
|------------|----------------------------|
| 406 | Torque tighten the screws. |
|------------|----------------------------|

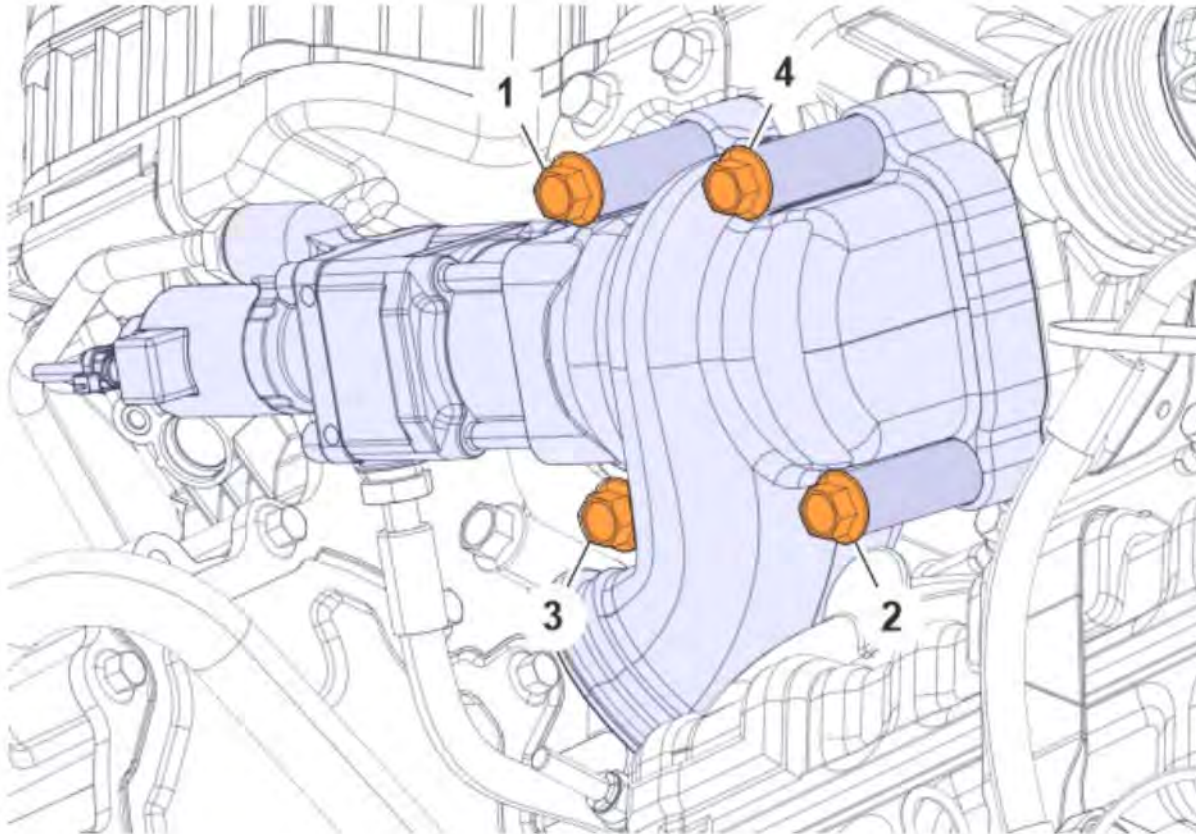
| | |
|--|--------------------------|
| | Tightening torque |
|--|--------------------------|

| | |
|--|------------------|
| | EGR valve, screw |
|--|------------------|

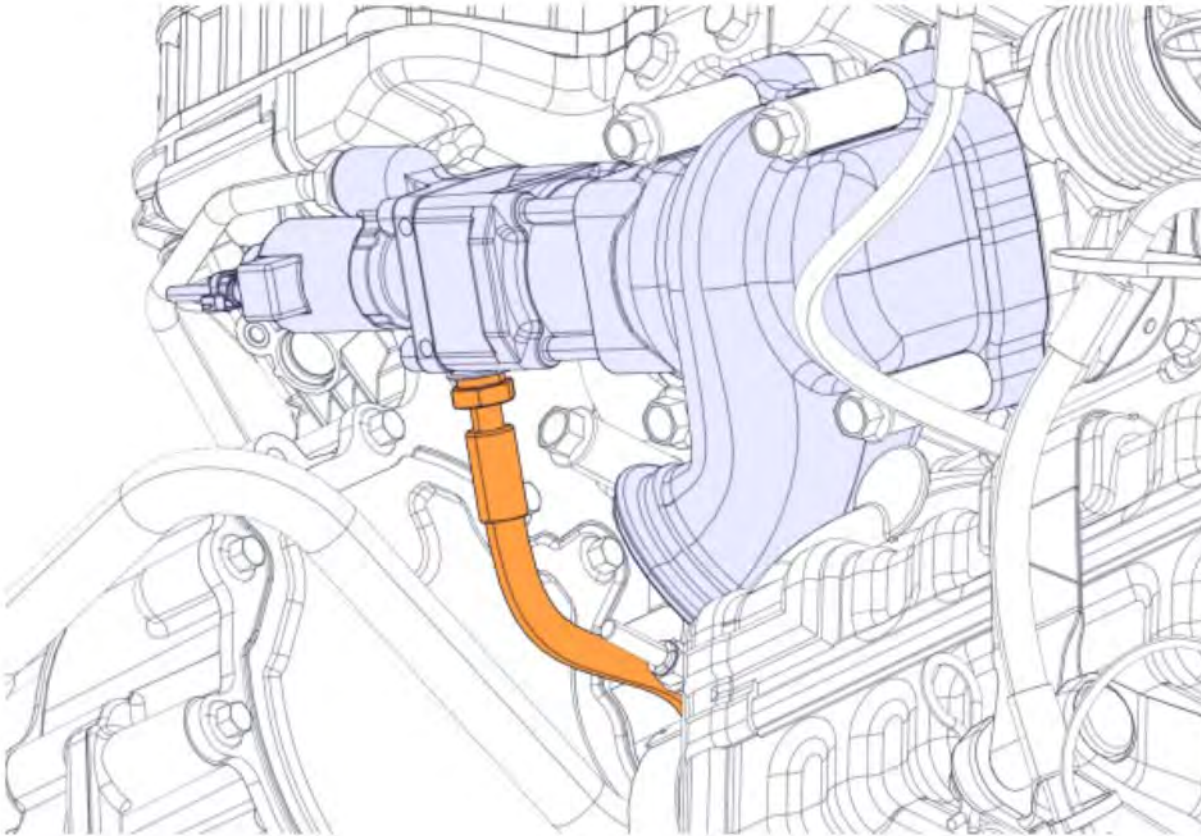
| | |
|--|----|
| | 1. |
|--|----|

| | |
|--|--------------------------|
| | Tightening sequence: 1-4 |
|--|--------------------------|

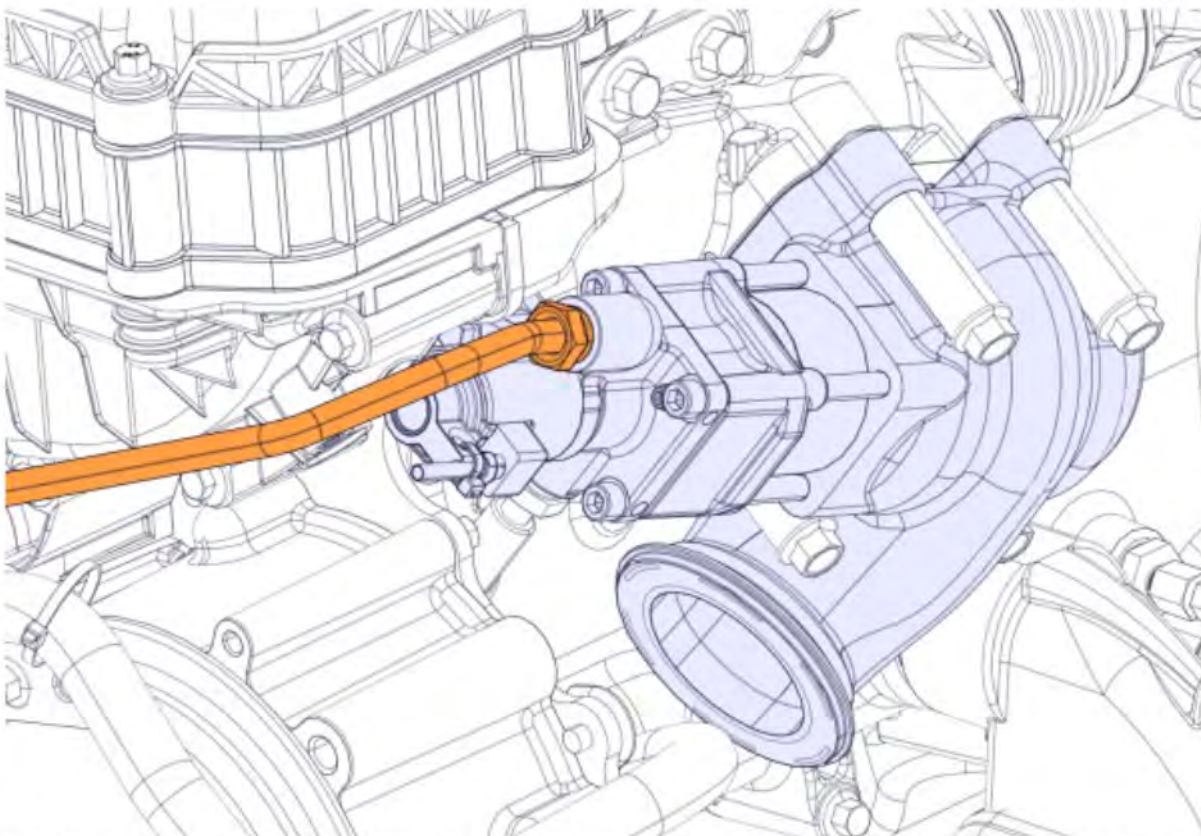
| | | |
|--|----|-----------------------------------------|
| | | 20 ±4 Nm (15 ±3 lb _f .ft) |
| | 2. | Tightening sequence: 1-4 |
| | | 52 ±4 Nm (38 ±3 lb _f .ft) |



| | | |
|-----|--------------------------|-----------------------------------------|
| 407 | Torque tighten the pipe. | |
| | Tightening torque | |
| | EGR valve, nipple | 25 ±4 Nm (18 ±3 lb _f .ft) |



| | | |
|------------|--------------------------|--------------------------------------------------------------|
| 408 | Torque tighten the pipe. | |
| | Tightening torque | |
| | EGR valve, nipple | $25 \pm 4 \text{ Nm}$ $(18 \pm 3 \text{ lb}_f\text{-ft})$ |

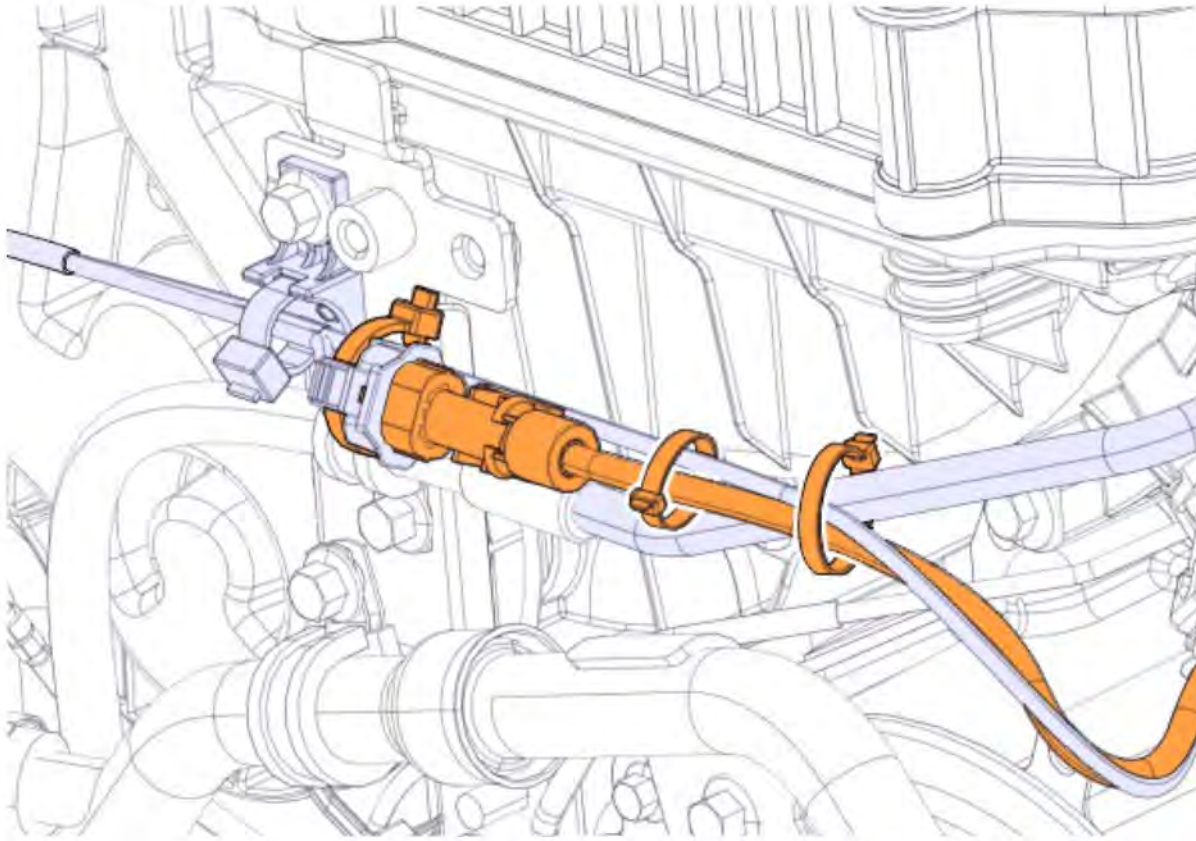


| | |
|-----|---------------------|
| 409 | Position the cable. |
|-----|---------------------|

| | |
|-----|------------------------|
| 410 | Connect the connector. |
|-----|------------------------|

| | |
|-----|-------------------------|
| 411 | Install the cable ties. |
|-----|-------------------------|

| | |
|----------|-------------------------------|
| i | Note Use new parts. |
|----------|-------------------------------|

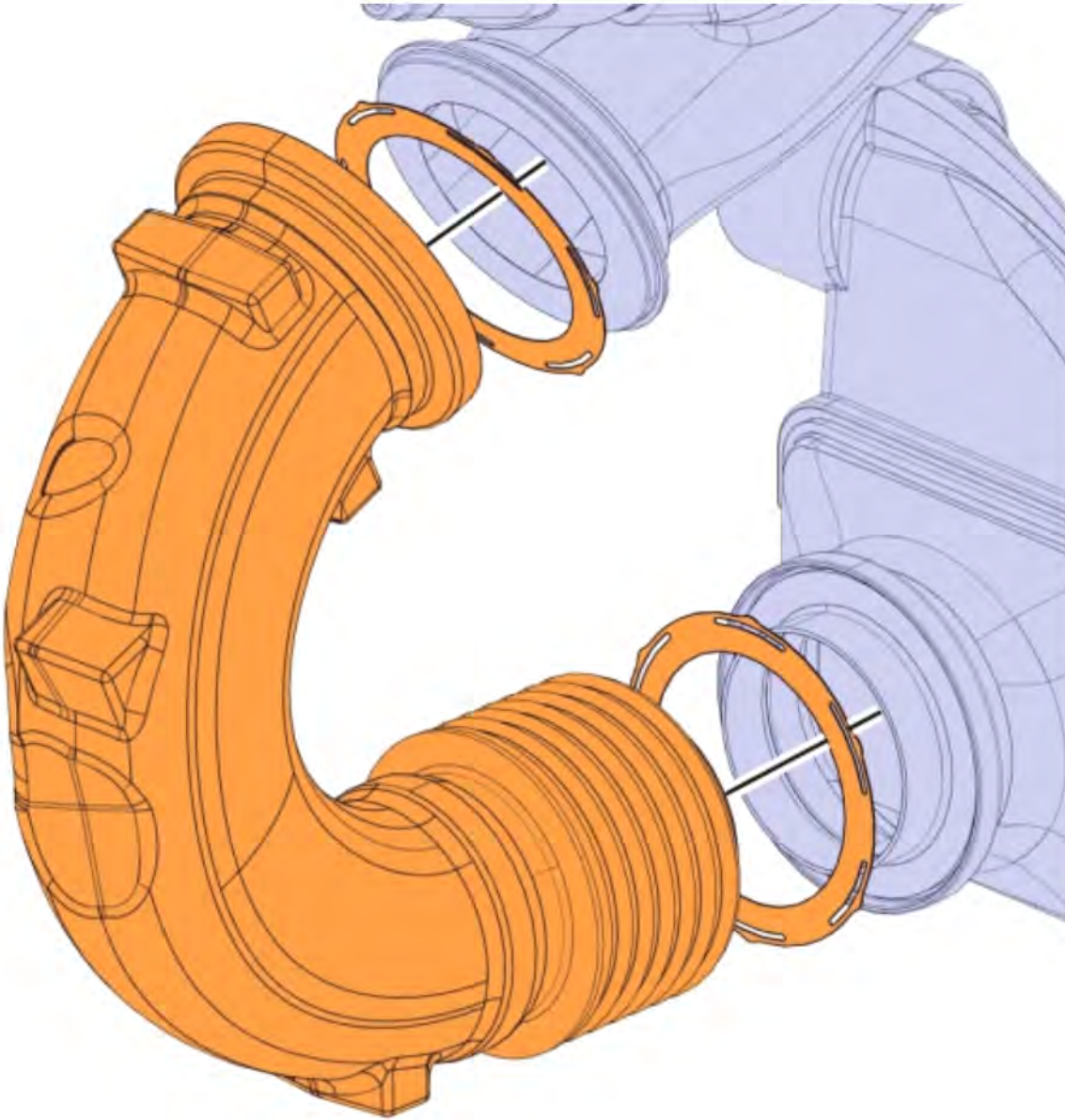


| | |
|-----|-----------------------------|
| 412 | Clean the contact surfaces. |
|-----|-----------------------------|

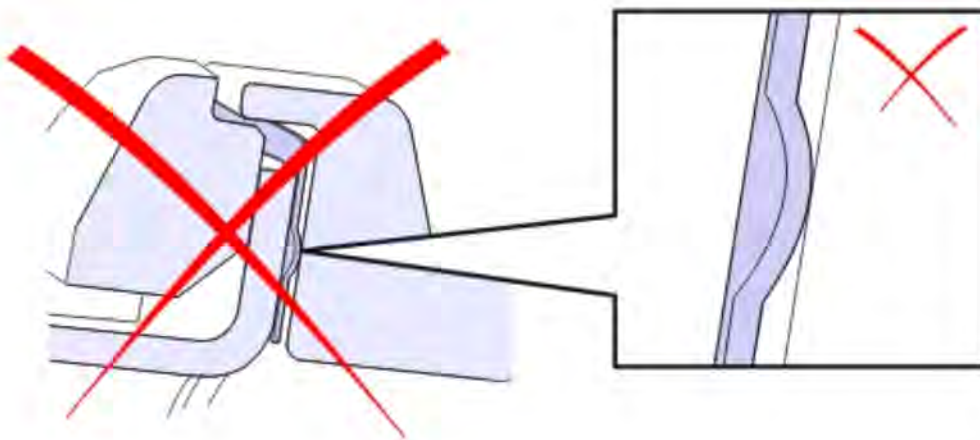
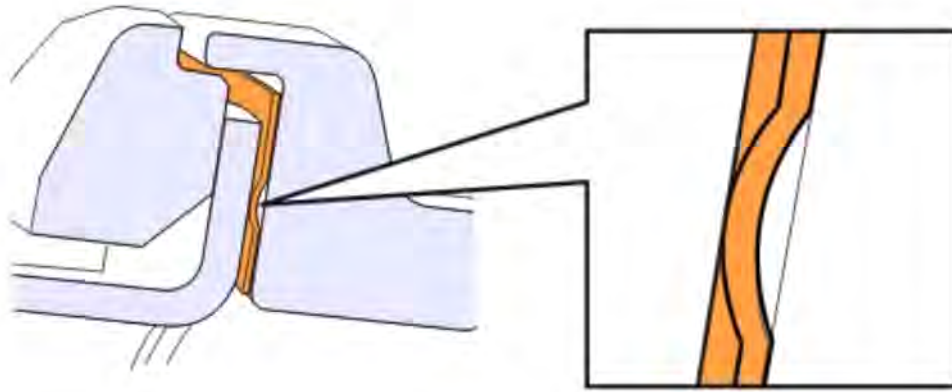
| | |
|-----|----------------------|
| 413 | Install the gaskets. |
|-----|----------------------|


| | |
|----------|-------------------------------|
| i | Note Use new parts. |
|----------|-------------------------------|

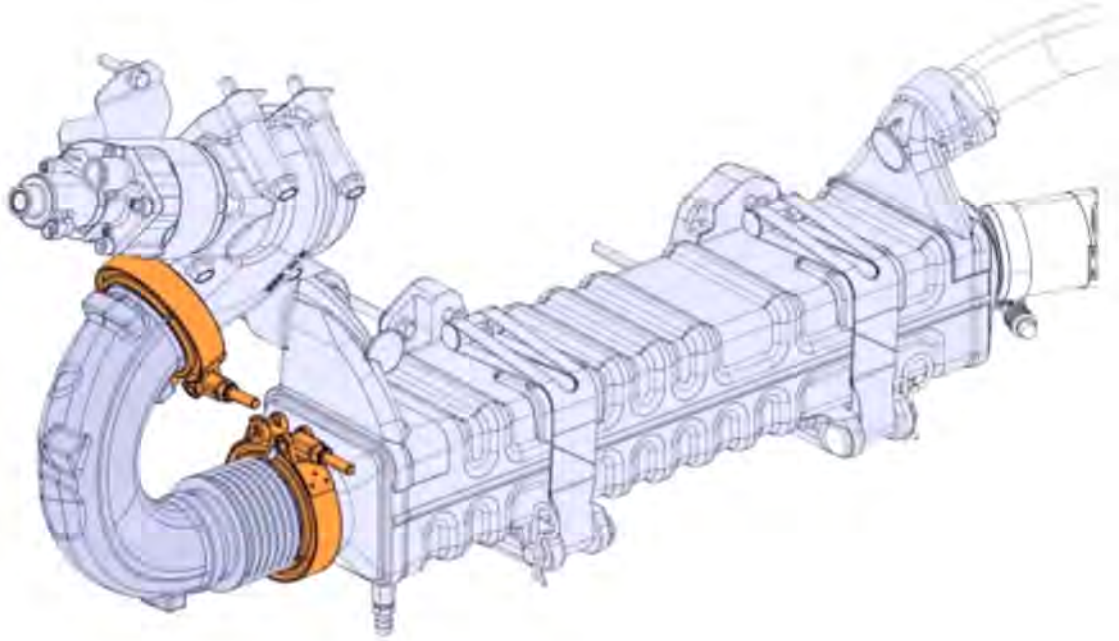
| | |
|-----|-------------------|
| 414 | Install the pipe. |
|-----|-------------------|



| | |
|-----|--------------------------------------------------|
| 415 | Check that the gaskets are positioned correctly. |
|-----|--------------------------------------------------|



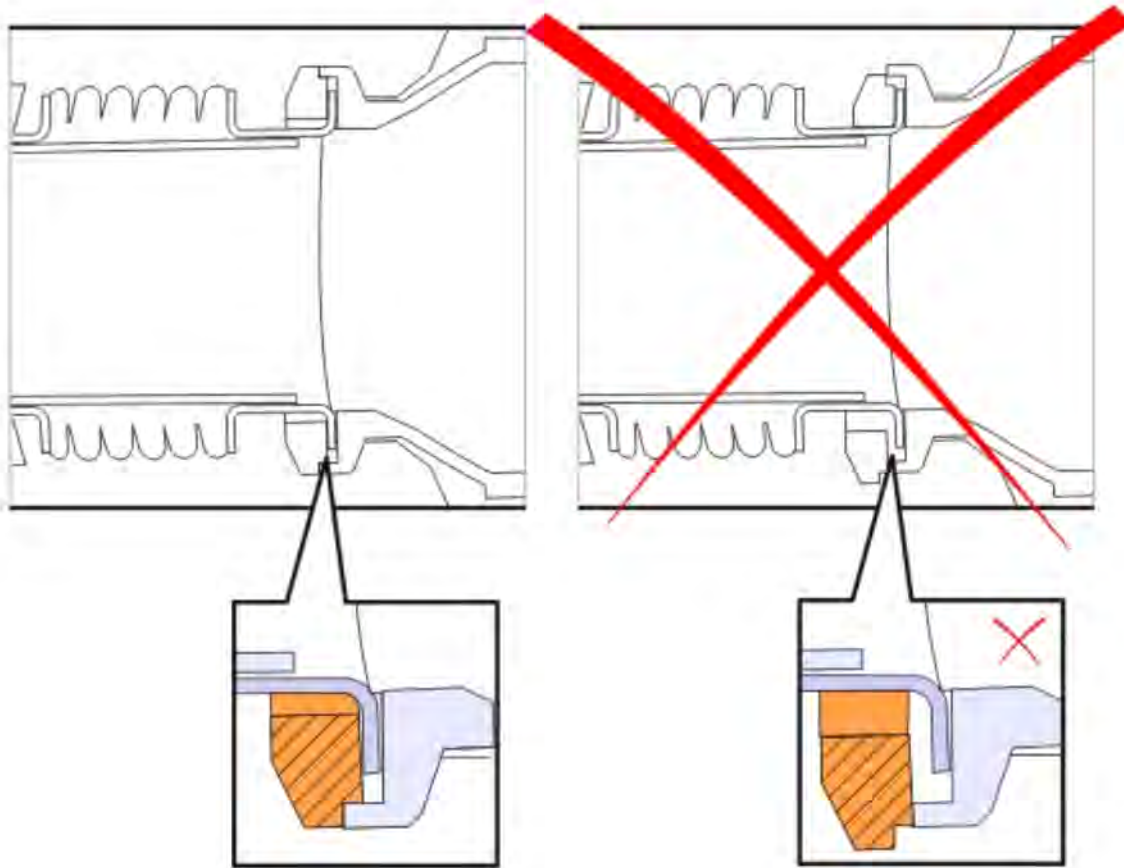
| | |
|-------------------------------------------------------------------------------------|-----------------------------------|
| 416 | Install the V-clamps. |
|  | Note Install as marked. |
|  | Note Use new parts. |

**CAUTION****Risk of material damage.**

Incorrect installation of the gasket or collar will cause exhaust leakage. The exhaust leakage could damage components in the surrounding area.

- ▶ Pay close attention to installing the inlet pipe correctly. Ensure that the gasket and collar are positioned correctly.

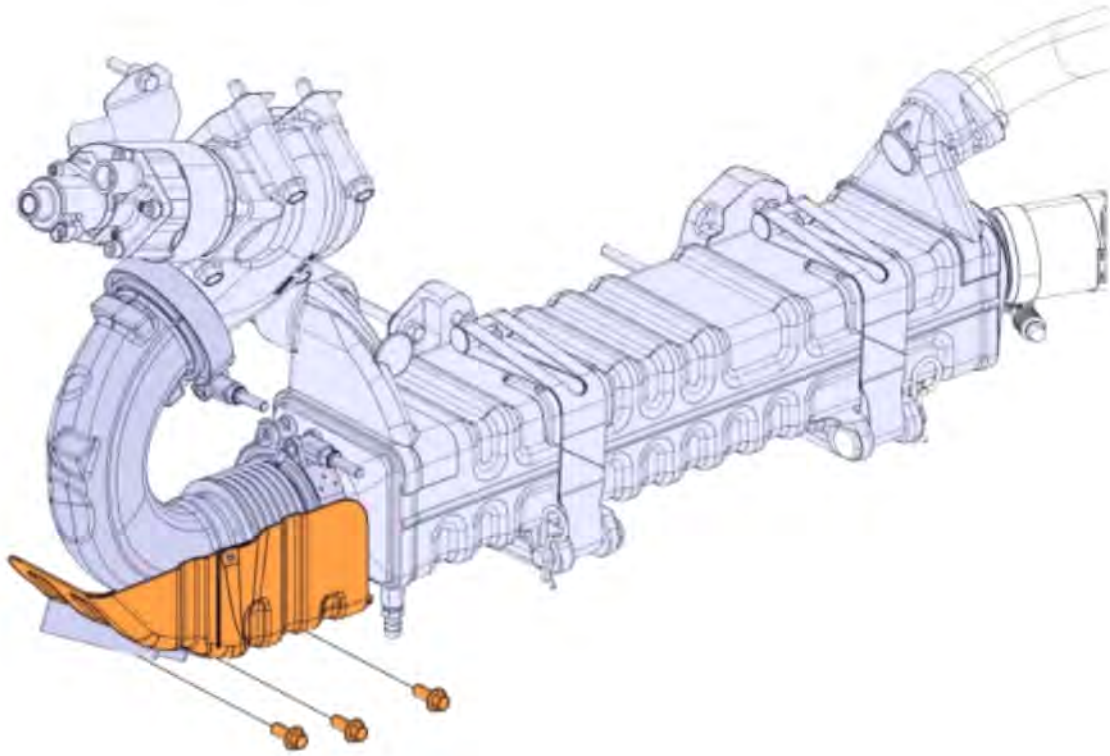
417 Check before tightening that the sliding collar is centered in the cooler flange.






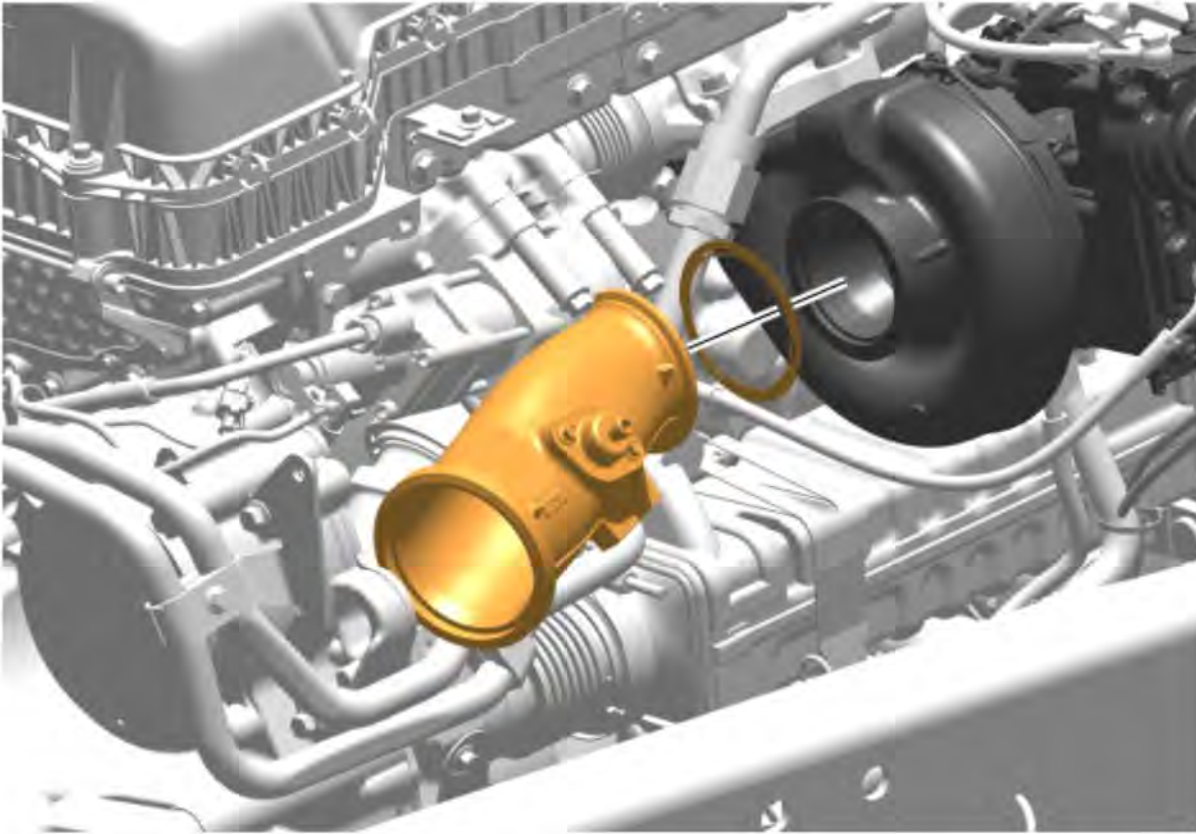
| | | | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------|----------|----------------------------------------------------------------------|
| 418 | Torque tighten the V-clamps. | | | |
| | Tightening torque | | | |
| | V-clamp, screw | 20 ±4 Nm (15 ±3 lb _f -ft) | | |
| <table border="1" style="width: 100%;"> <tr> <td style="text-align: center;">i</td> <td>Note After tightening, check the position of the V-clamps.</td> </tr> </table> | | | i | Note After tightening, check the position of the V-clamps. |
| i | Note After tightening, check the position of the V-clamps. | | | |

419 Install the heat shield.

420 Install the screws.



| | | | |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------|
| 421 | Clean the mating surfaces. | | |
| 422 | Install the gasket. <table border="1" data-bbox="159 1093 427 1196"><tr><td data-bbox="159 1093 236 1160"></td><td data-bbox="236 1093 427 1196">Note Use a new part.</td></tr></table> |  | Note Use a new part. |
|  | Note Use a new part. | | |
| 423 | Install the diffuser. | | |



424 Install the clamp.



Note

Use a new part.



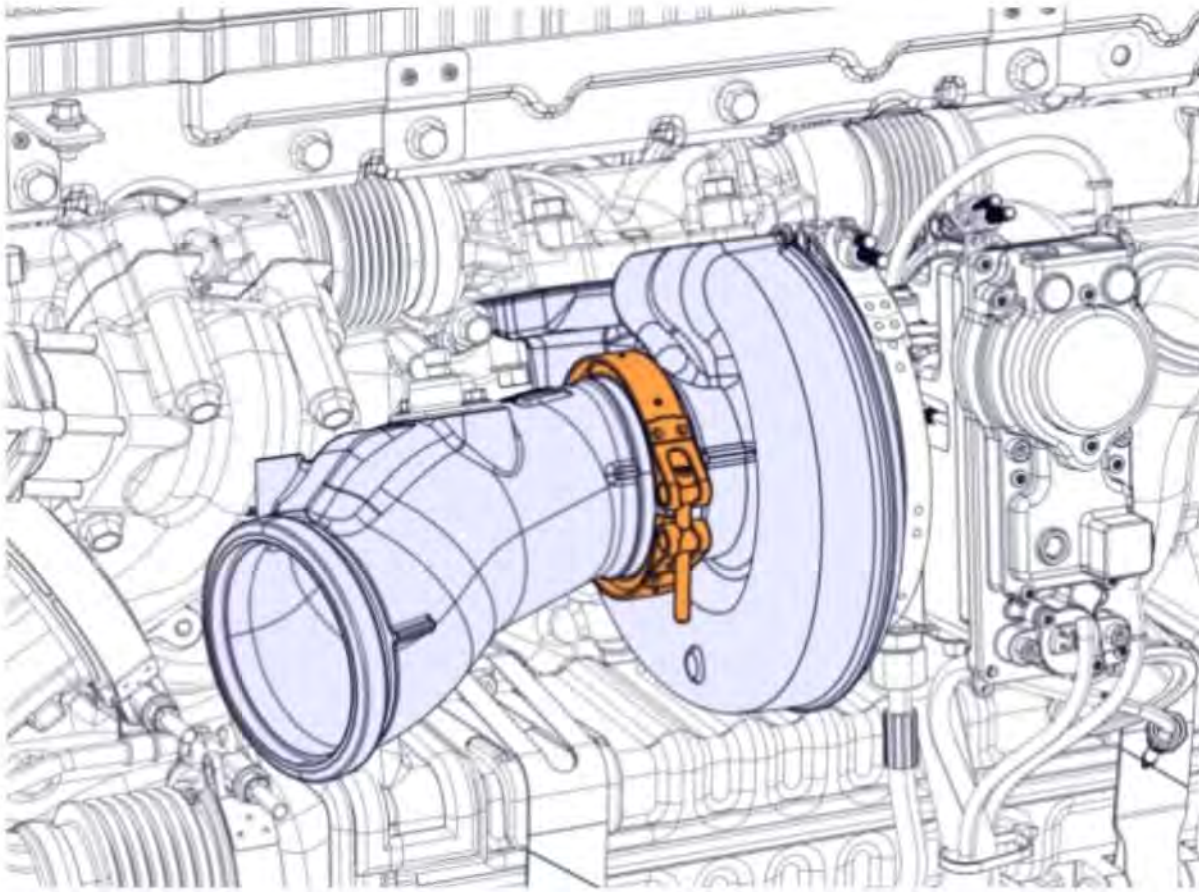
Note

Seat the clamp by tapping it into place between tightening sequences.



Note

Only use a suitable hand tool.



⚠ DANGER

Risk of material damage, serious personal injury or death.

Connections that are not tightened in accordance with specified tightening torques may cause leakage.

- ▶ Tighten connections according to service information.

| | | |
|------------|---------------------------------------|---------------------------------|
| 425 | Torque tighten the clamp in sequence. | |
| | Tightening torque | |
| | V-clamp, pre-torque | 7 Nm (5 lb _f ·ft) |

| | | |
|------------|-----------------------------------------------------------------------|-----------------------------------------|
| 426 | Seat the clamp by tapping it into place between tightening sequences. | |
| | Tightening torque | |
| | V-clamp, final torque | 14 ±2 Nm (10 ±1 lb _f ·ft) |

427 This step contains 2 alternatives.
Select one of the valid alternatives below.

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Alternative 1 / 2**Conditions**

- If the pipe is reused
- ▶ Clean the pipe mating surfaces.
- ▶ Install the gaskets.



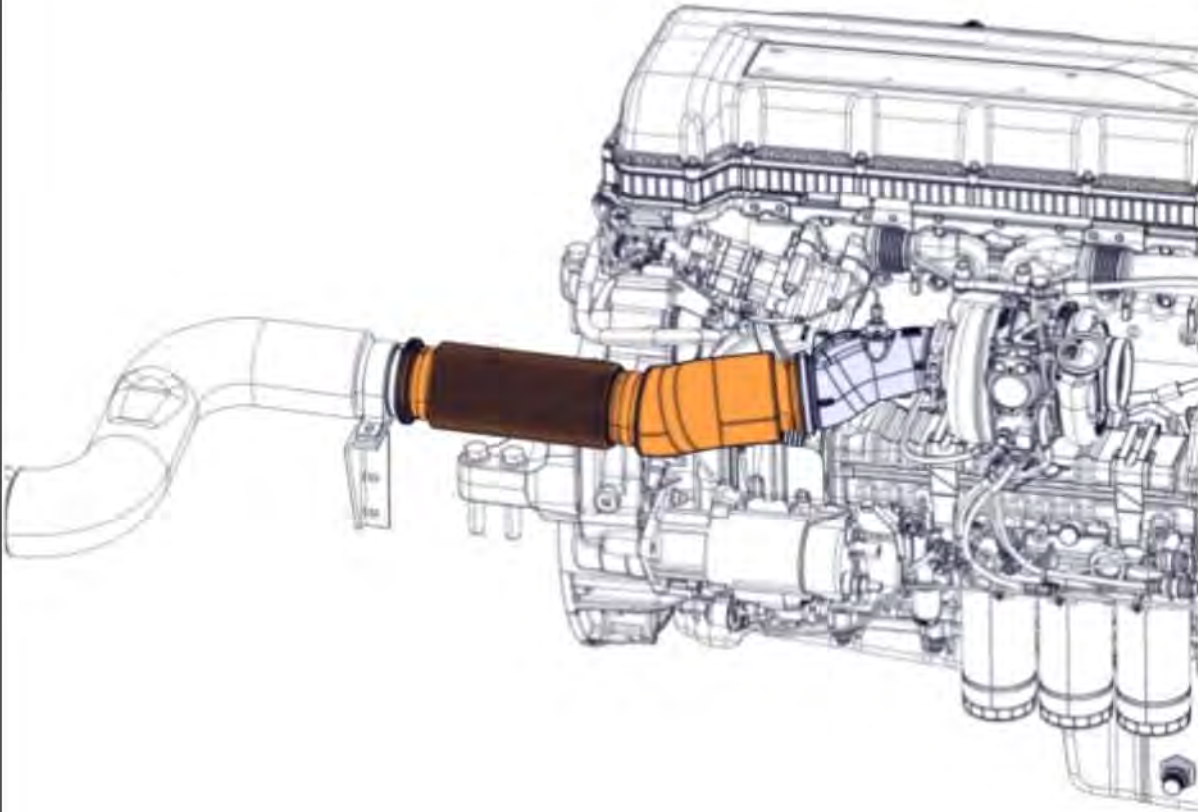
Note
Use new parts.



- ▶ Install the pipe.



Note
As noted.



▶ Install the clamps.



Note
Use new parts.

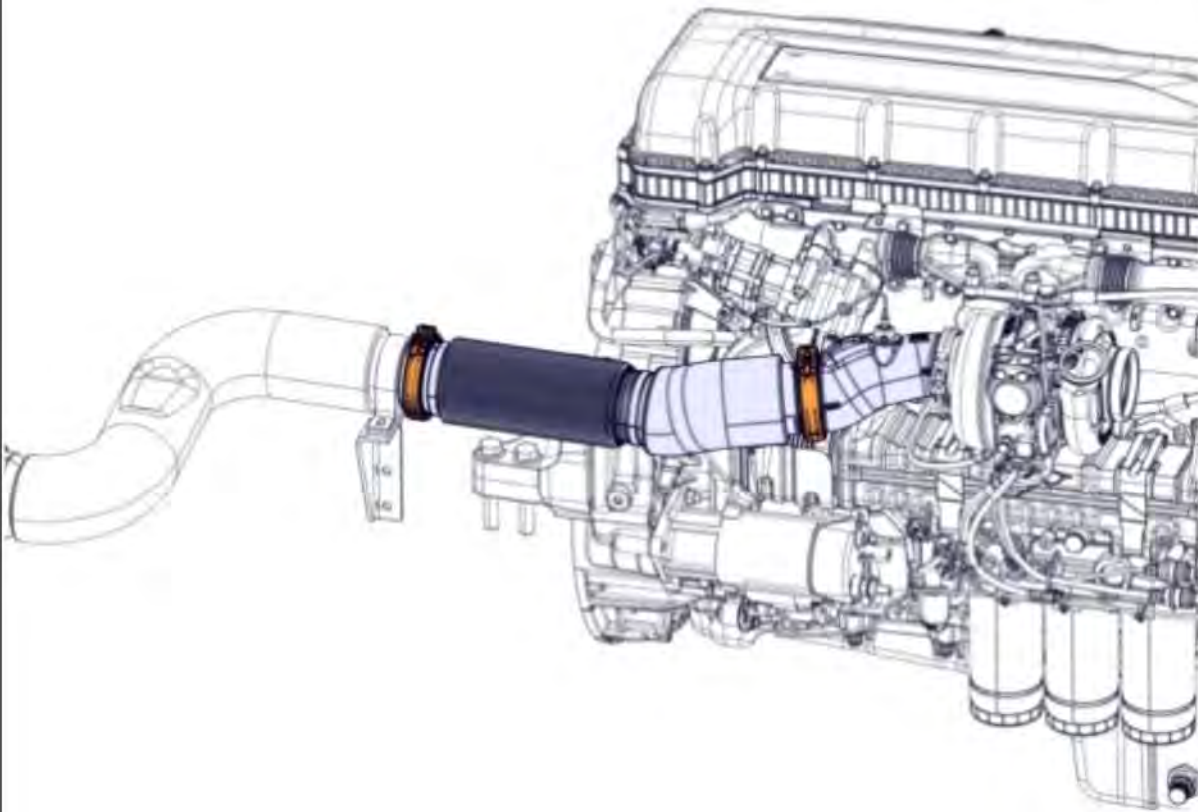


Note
As noted.

▶ Torque tighten the clamps.

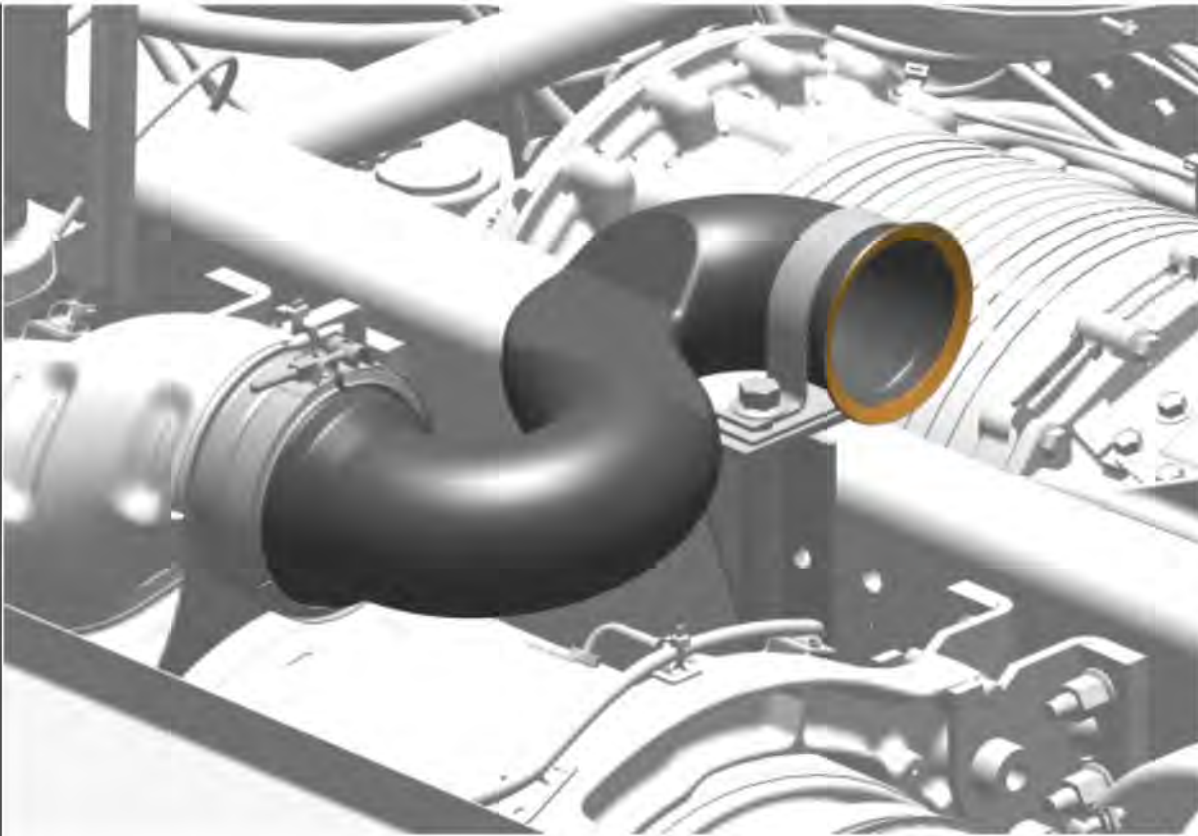
Tightening torque

| | |
|-------------|-----------------------------------|
| Pipe, clamp | 5.6 Nm (4 lb _f ·ft) |
|-------------|-----------------------------------|

**Alternative 2 / 2****Conditions**

- If the pipe is replaced

- ▶ Clean the surface.



- ▶ Check the length (A) of the flexible hose.

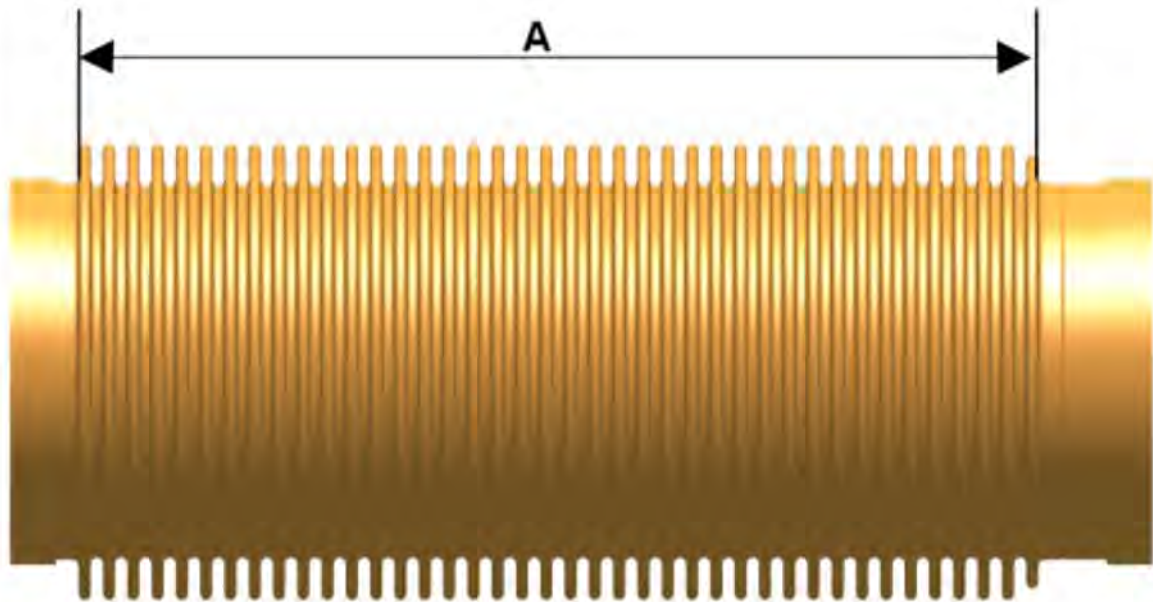
Tech data

| | |
|---------------------------|--------------------------------|
| Flexible hose, length (A) | 267 ±10 mm (10.51 ±0.39 in) |
|---------------------------|--------------------------------|



Note

Ensure that the length is according to the specification.



► Position the exhaust pipe.



Note

Use a new gasket.



Note

The markings indicate the flow direction.



Note

The exhaust pipe should be fixed as straight as possible.



Note

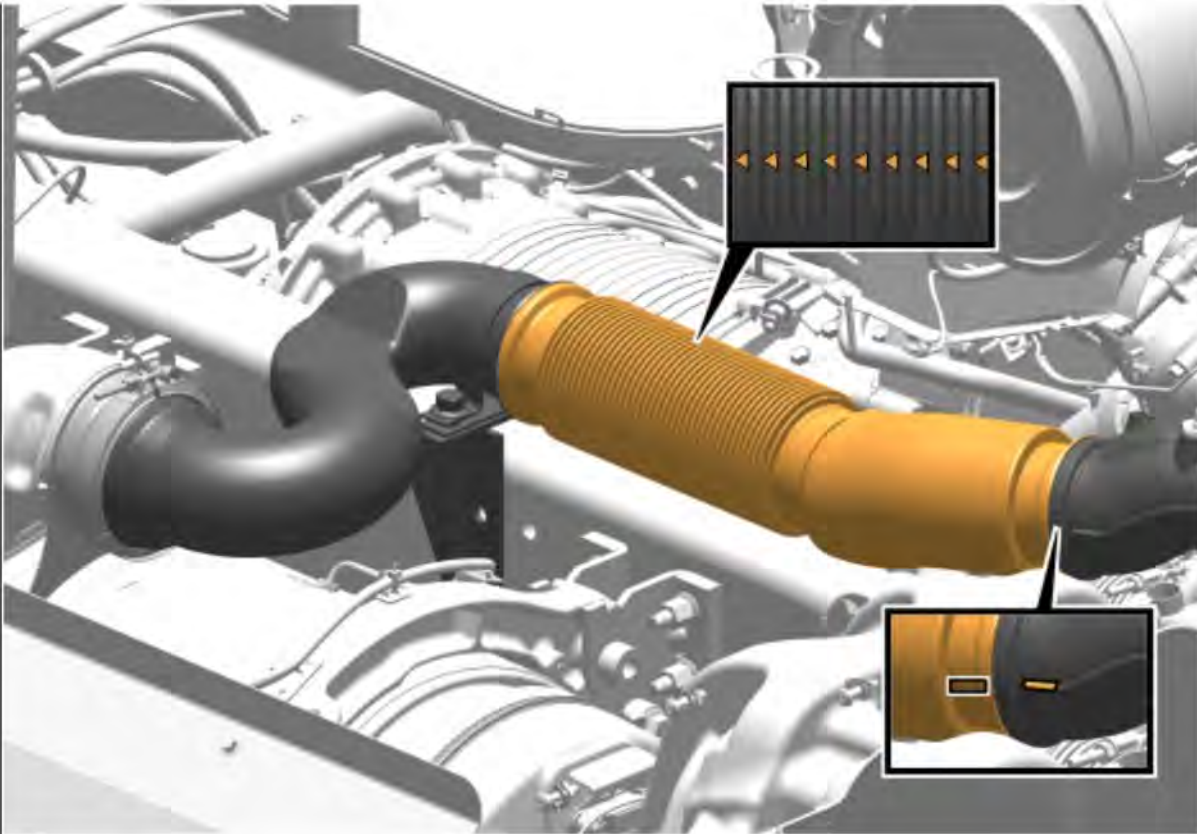
Ensure that flexible hose is not twisted or bent more than the specification.



Service hint

Ensure that 11 L engines are aligned with Red line.

Ensure that 13 L engines are aligned with Black line.



▶ Install the V-clamps.



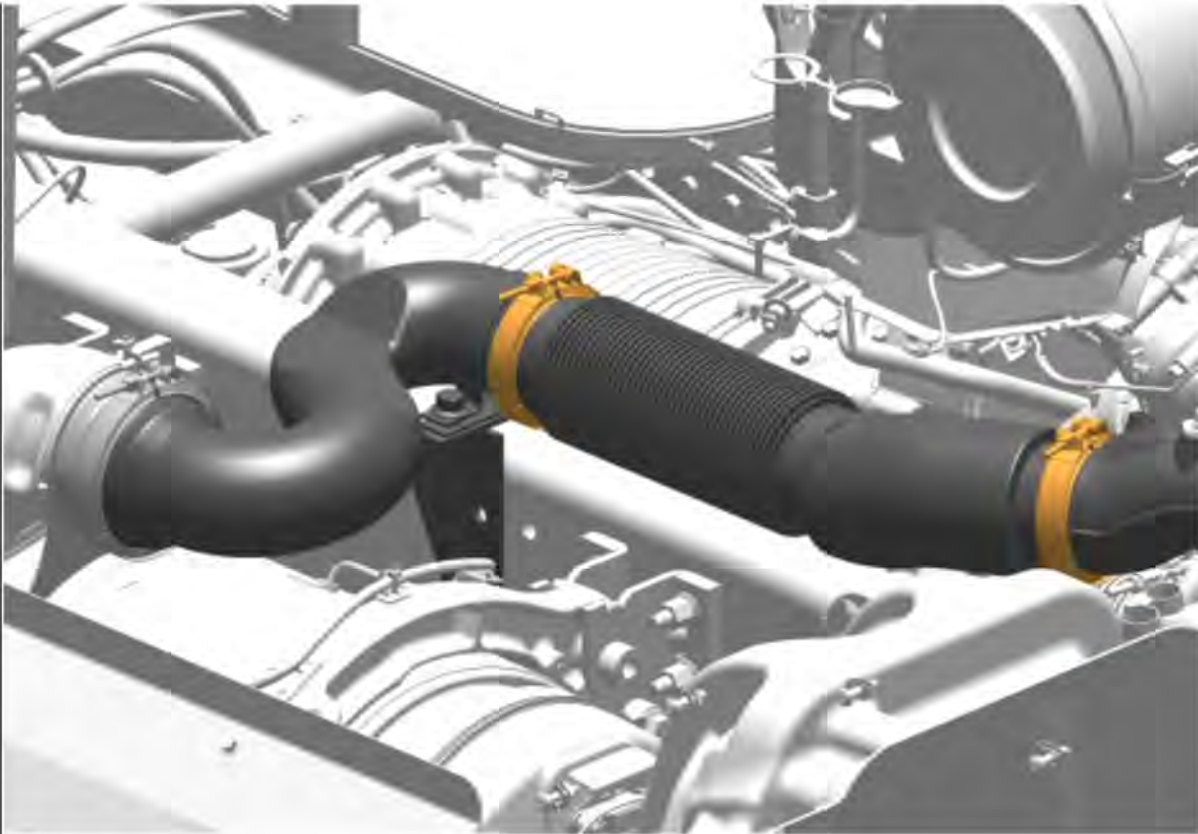
Note
Use new parts.



Note
As noted.



Note
Do not torque tighten the V-clamps.



- ▶ Check the alignment of the flexible hose.

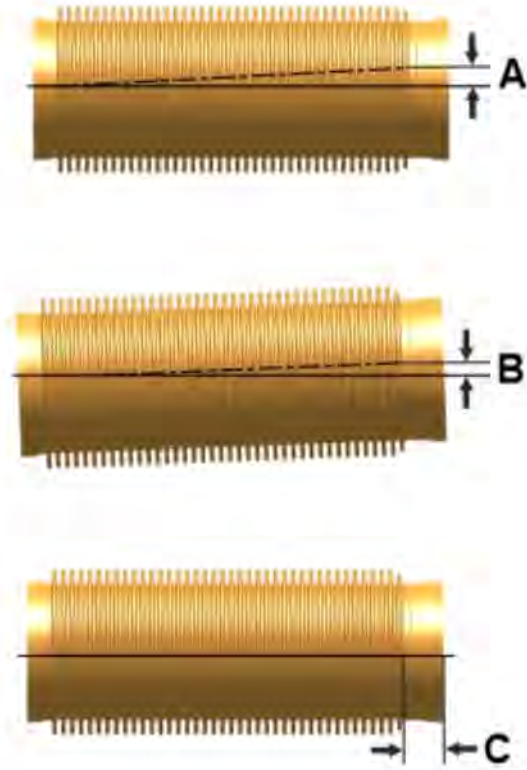
Tech data

| | |
|------------------------------------------|------------------------|
| Flexible hose, torsion displacement (A) | ±2 mm (±0.08 in) |
| Flexible hose, parallel displacement (B) | ±5 mm (±0.2 in) |
| Flexible hose, axial displacement (C) | ±6.5 mm (±0.256 in) |



Note

Ensure that the flexible hose is aligned according to specifications.



► Perform this procedure when the condition below is met.

Conditions

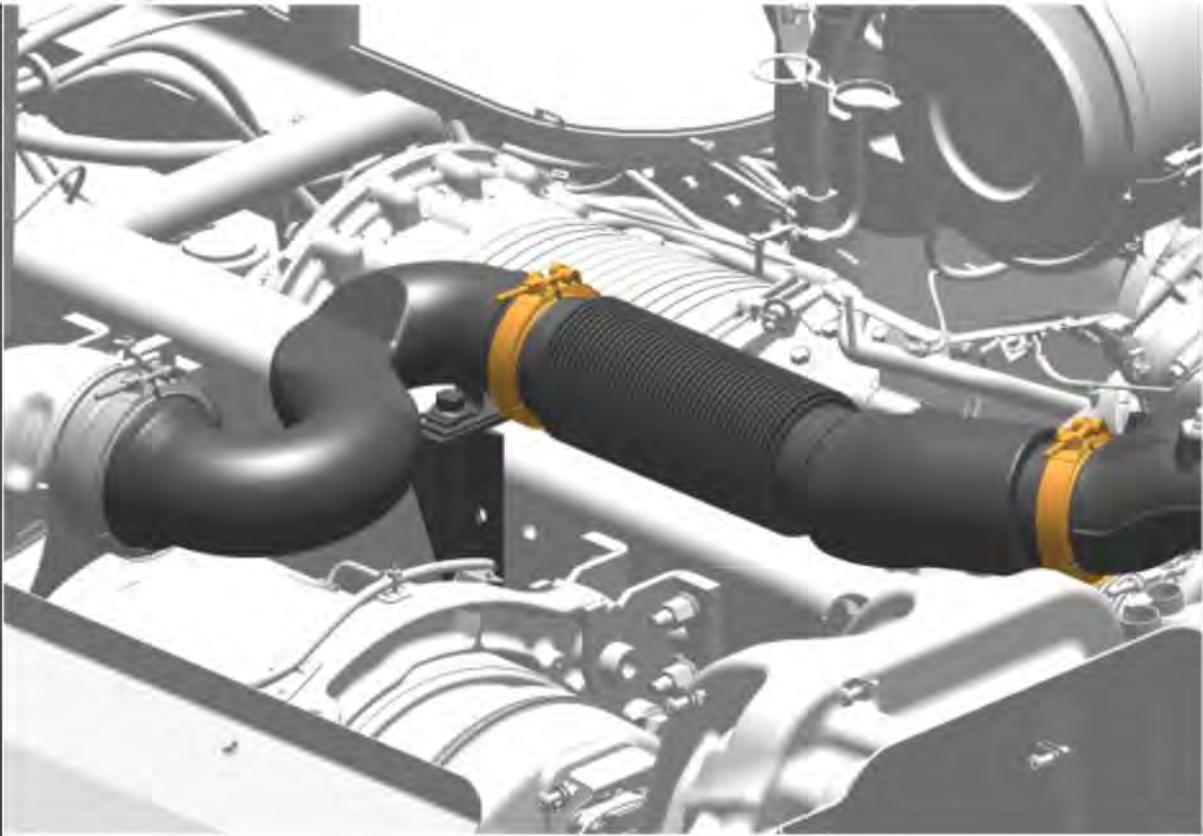
- If the flexible hose length and alignment is not according to the specification

► Loosen the exhaust pipe at the turbocharger end and align as per specifications.

► Torque tighten the V-clamps.

Tightening torque

| | |
|-------------|-----------------------------------|
| Pipe, clamp | 5.6 Nm (4 lb _f ·ft) |
|-------------|-----------------------------------|



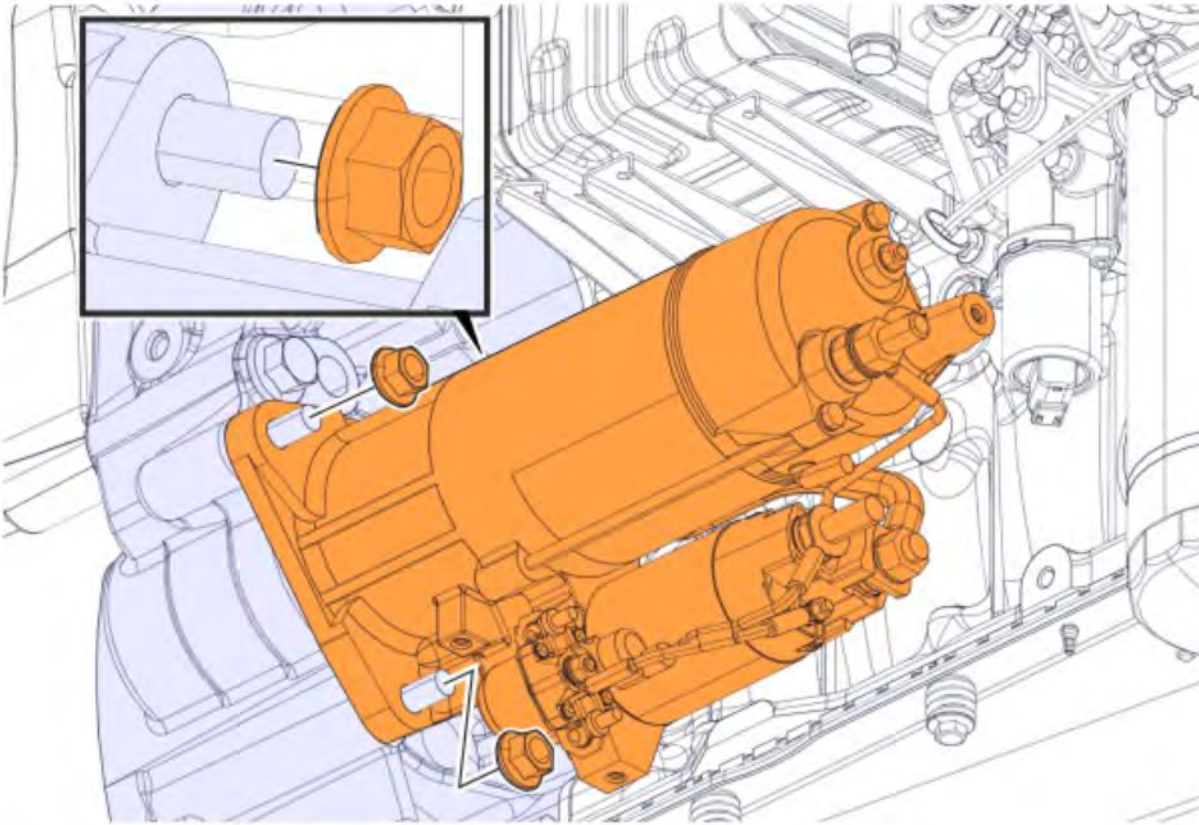
428 Install the starter motor.

429 Install the nuts.

430 Tighten the nuts to torque.

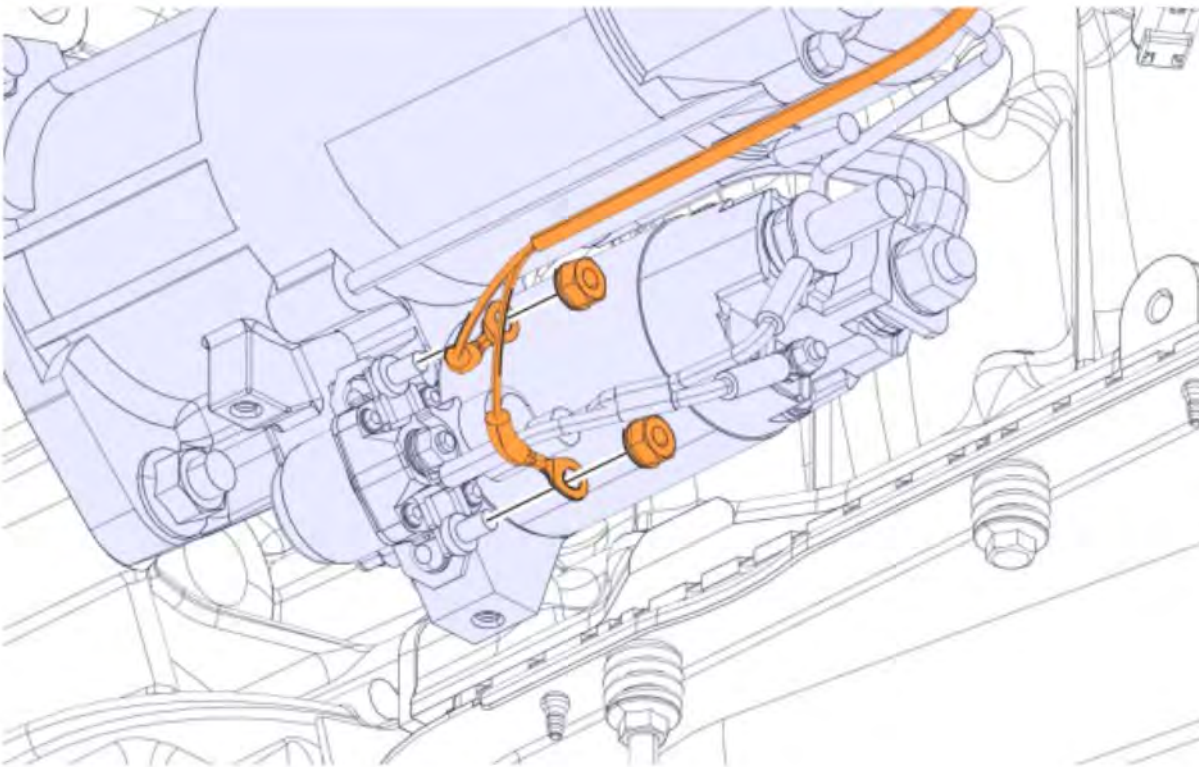
Tightening torque

| | |
|--------------------|-----------------------------------------|
| Starter motor, nut | 48 ±8 Nm (35 ±6 lb _f .ft) |
|--------------------|-----------------------------------------|



| | |
|------------|------------------------------|
| 431 | Install the cable terminals. |
|------------|------------------------------|

| | |
|------------|-------------------|
| 432 | Install the nuts. |
|------------|-------------------|



| | |
|------------|-----------------------------|
| 433 | Install the cable terminal. |
|------------|-----------------------------|

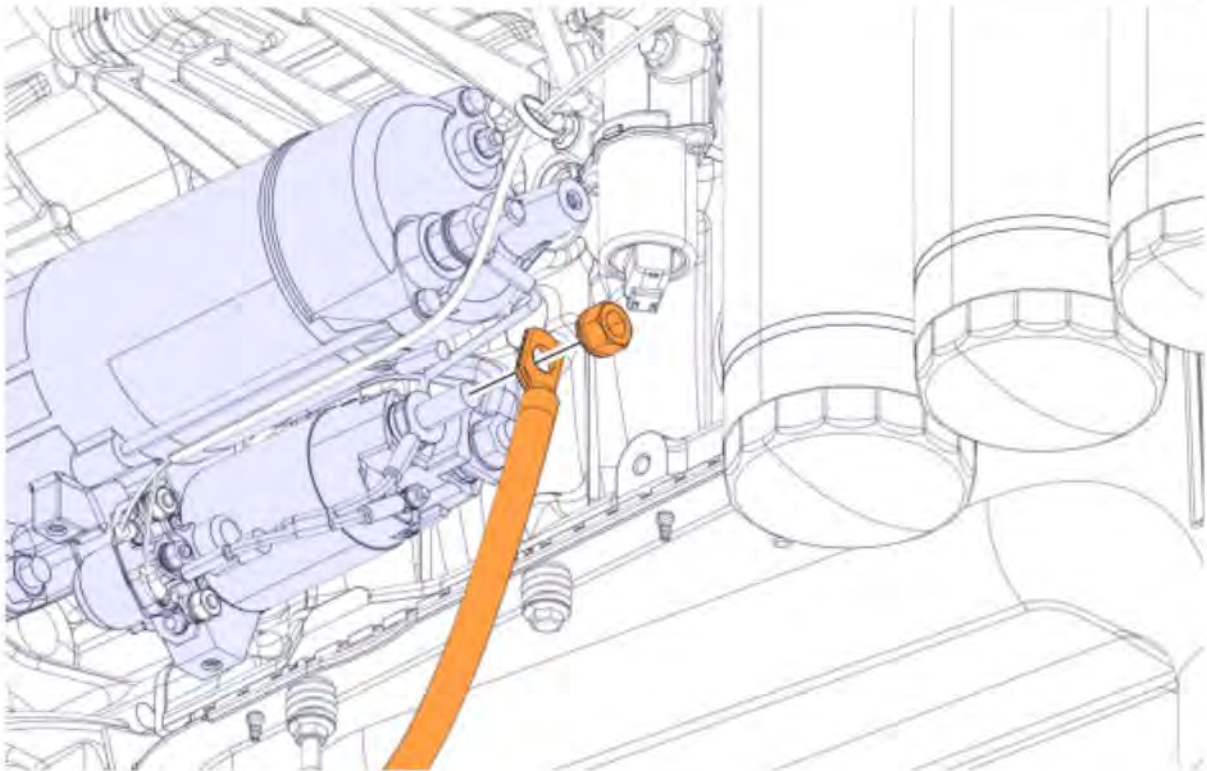
| | |
|------------|------------------|
| 434 | Install the nut. |
|------------|------------------|

| | |
|------------|-------------------------|
| 435 | Torque tighten the nut. |
|------------|-------------------------|

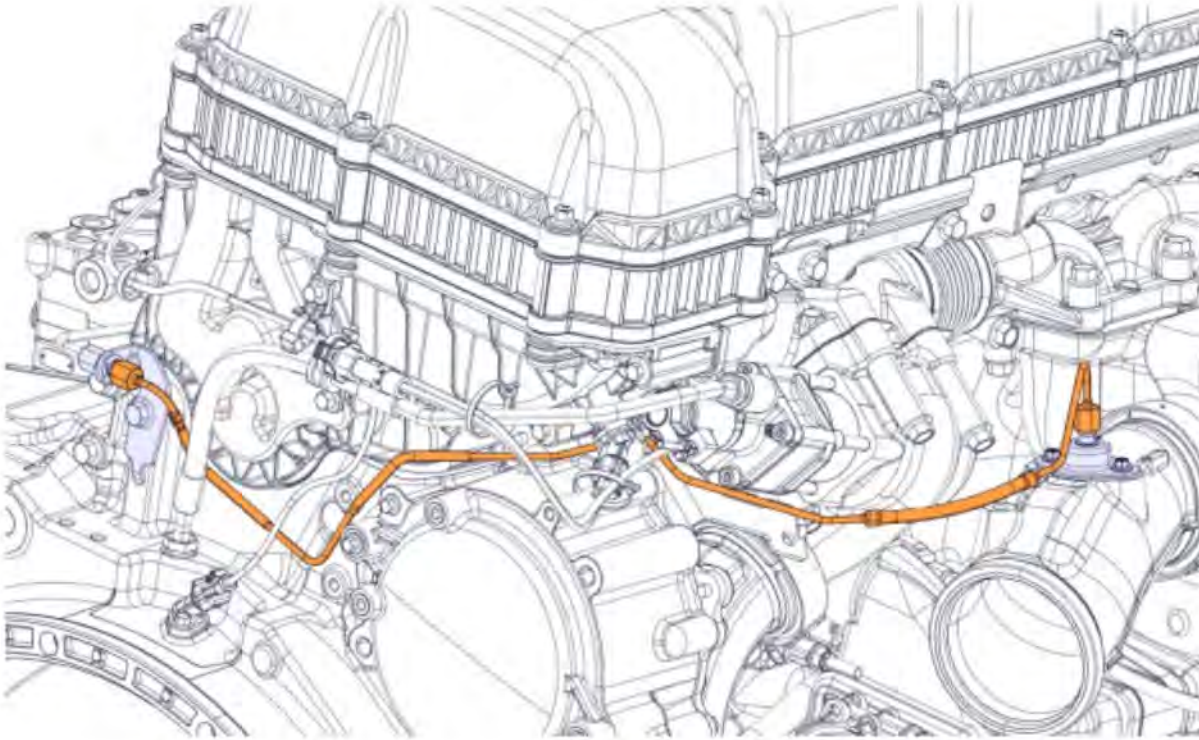
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| Tightening torque | |
|---------------------------------|-------------------------------------------|
| Starter solenoid, terminal, nut | M10 |
| | 18 ±3.6 Nm (13 ±3 lb _f .ft) |
| Tightening torque | |
| Starter solenoid, terminal, nut | M12 |
| | 25 ±5 Nm (18 ±4 lb _f .ft) |

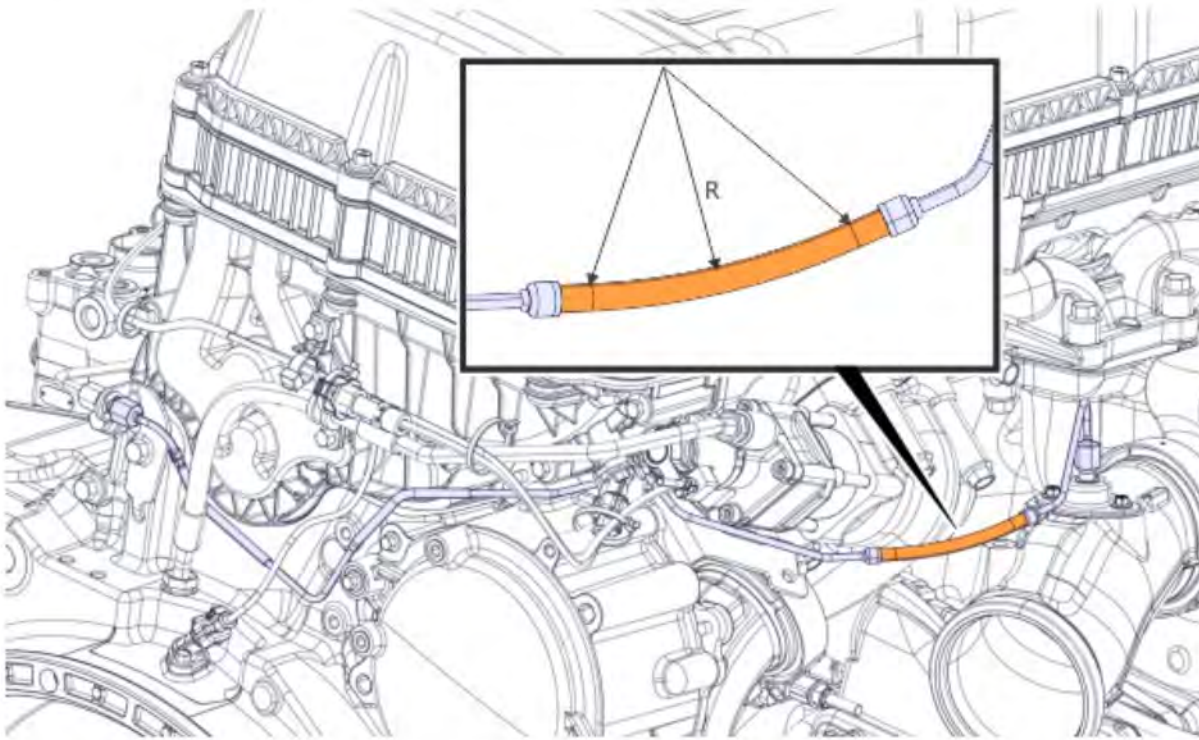


| | |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 436 | <p>Position the pipe.</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>i Note The pipe can be reused only a limited number of times.</p> </div> <div style="border: 1px solid black; padding: 5px;"> <p>i Note If there are no clips, replace the pipe.</p> </div> |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



| | |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 437 | <p>Perform this procedure when the condition below is met.</p> <p>Conditions</p> <ul style="list-style-type: none"> • If the pipe is reused, remove a clip. ▶ If there are no clips, replace the pipe. ▶ When installing new pipe, do not remove any clips. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>i Note If the pipe has been disconnected on either end for service, this counts as reuse.</p> </div> |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| 438 | <p>Ensure that the tube is not bent at the crimp.</p> <table border="1" style="width: 100%; margin-top: 10px;"> <tr> <th colspan="2" style="background-color: #e0e0e0;">Tech data</th> </tr> <tr> <td style="width: 70%;">Fuel pipe, radius (R)</td> <td style="text-align: right;">≥50 mm (≥1.97 in)</td> </tr> </table> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>i Note The minimum bend radius is 50 mm at the flexible line.</p> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>i Note Do not twist the tube and crimp.</p> </div> | Tech data | | Fuel pipe, radius (R) | ≥50 mm (≥1.97 in) |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--|-----------------------|----------------------|
| Tech data | | | | | |
| Fuel pipe, radius (R) | ≥50 mm (≥1.97 in) | | | | |

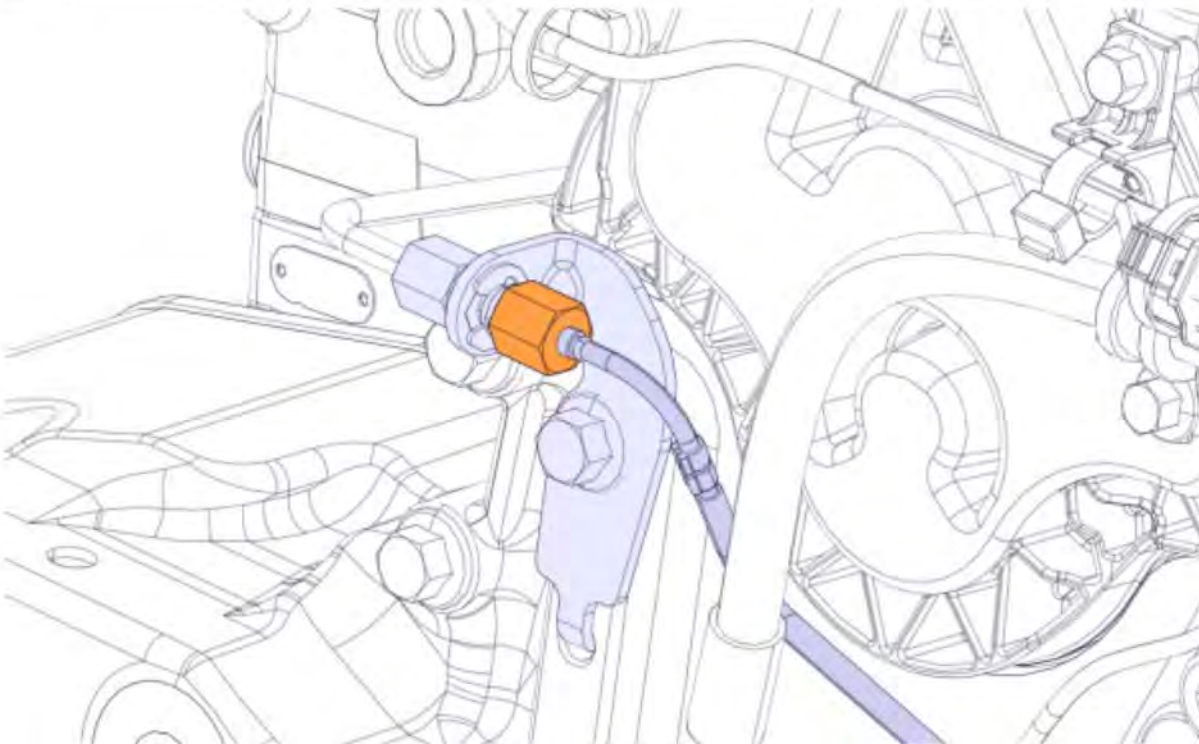


439 Install the nut.

440 Torque tighten the nut.

Tightening torque

| | |
|----------------|-----------------------------------------|
| Fuel pipe, nut | 15 ±2 Nm (11 ±1 lb _f -ft) |
|----------------|-----------------------------------------|



441 Install the nut.

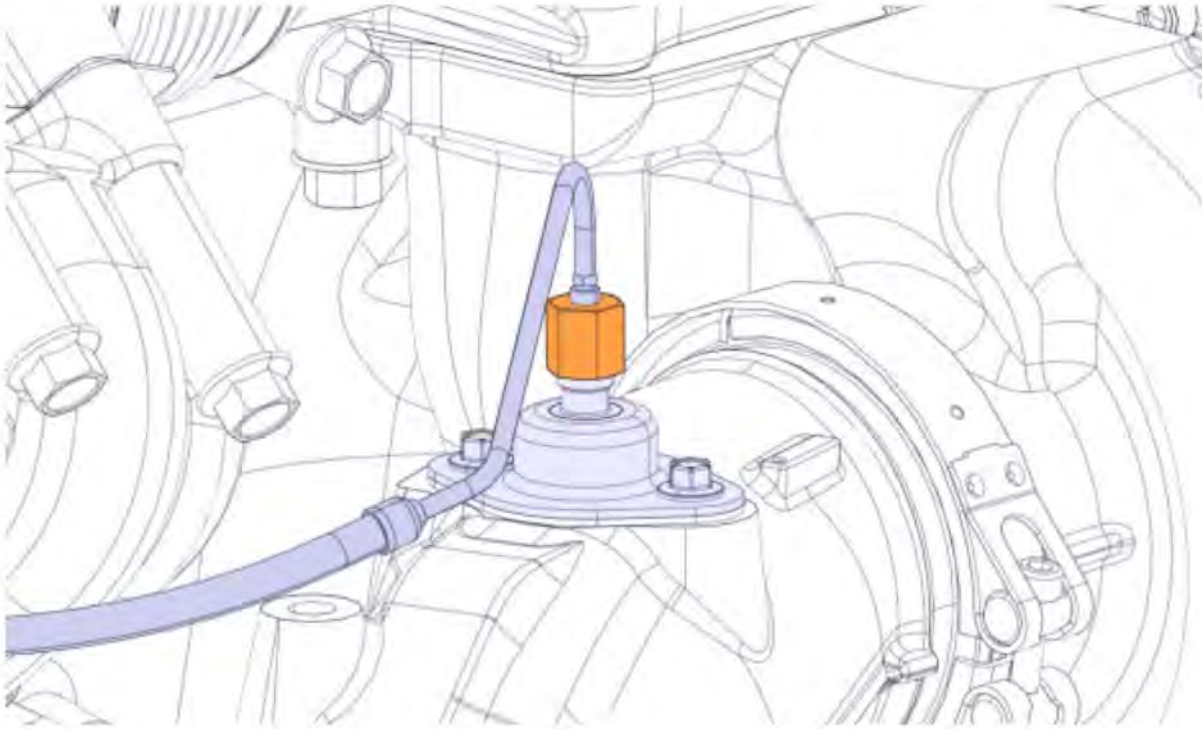
Note

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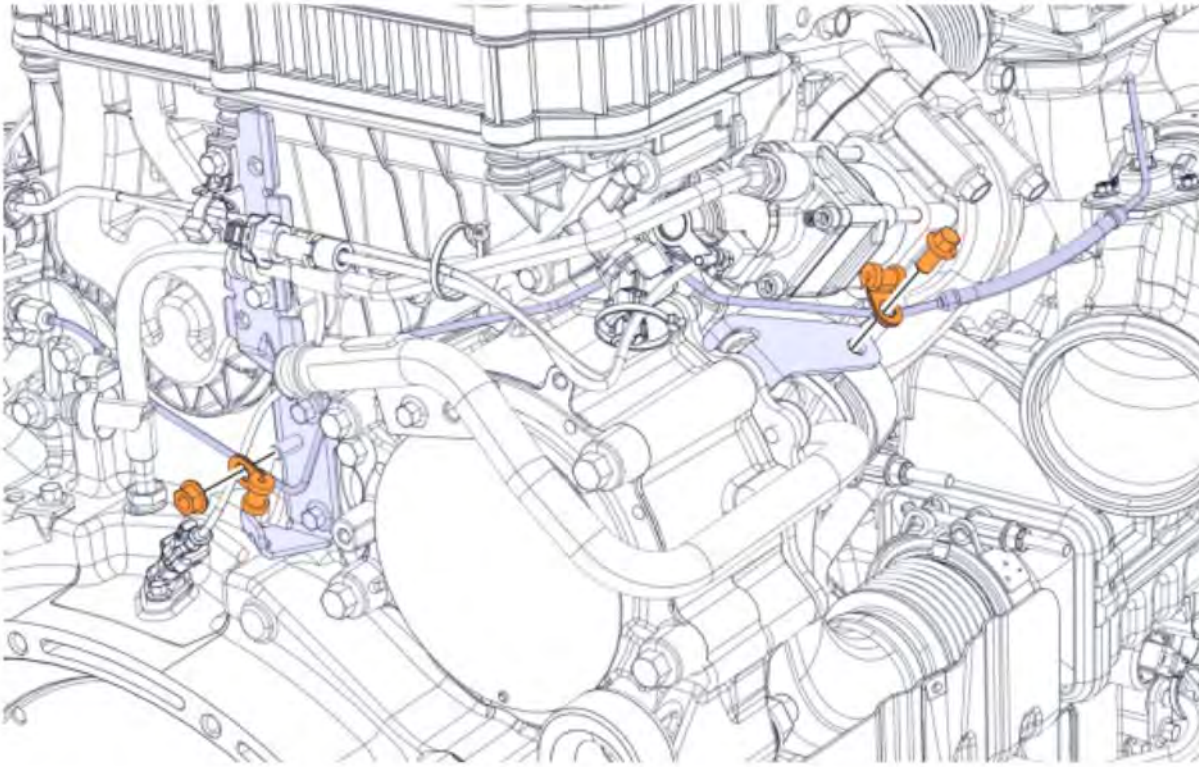
Hand tighten the nut.



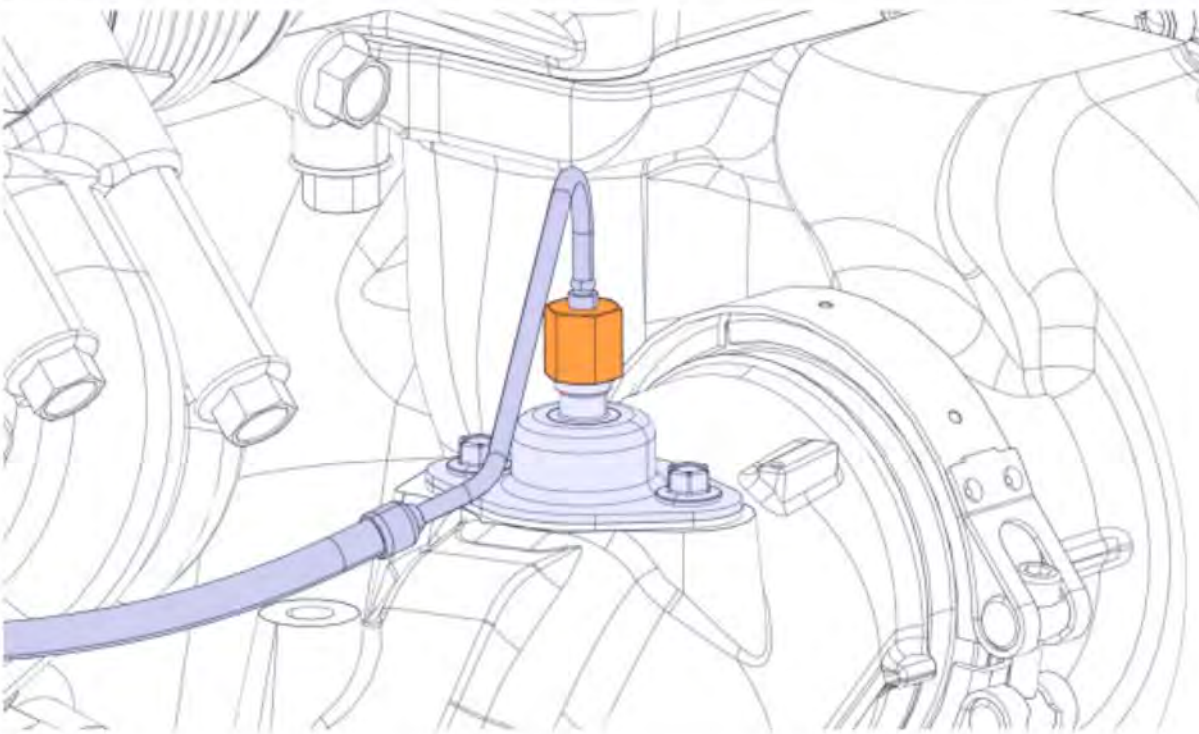
442 Install the clamp along with the screw and nut.

| | | |
|------------|---------------------------|-----------------------------------------|
| 443 | Torque tighten the screw. | |
| | Tightening torque | |
| | Fuel pipe, screw | 24 ±4 Nm (18 ±3 lb _f .ft) |

| | | |
|------------|--------------------------|-----------------------------------------|
| 444 | Torque tighten the nut. | |
| | Tightening torque | |
| | Fuel pipe, nut | 24 ±4 Nm (18 ±3 lb _f .ft) |



| | | |
|------------|--------------------------|--------------------------------------------------------------|
| 445 | Torque tighten the nut. | |
| | Tightening torque | |
| | Injector pipe, nut | $25 \pm 6 \text{ Nm}$ $(18 \pm 4 \text{ lb}_f\text{-ft})$ |

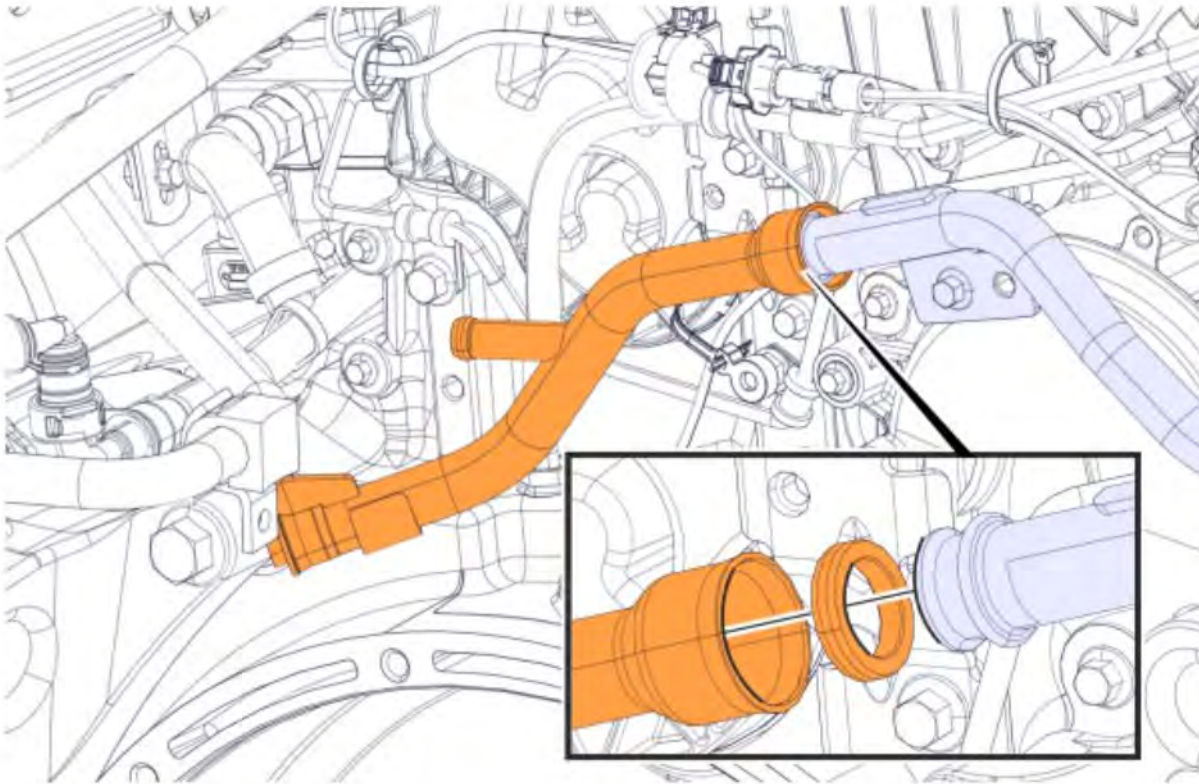


| | |
|------------|-------------------|
| 446 | Install the seal. |
|------------|-------------------|

| | |
|------------|-------------------|
| 447 | Install the pipe. |
|------------|-------------------|

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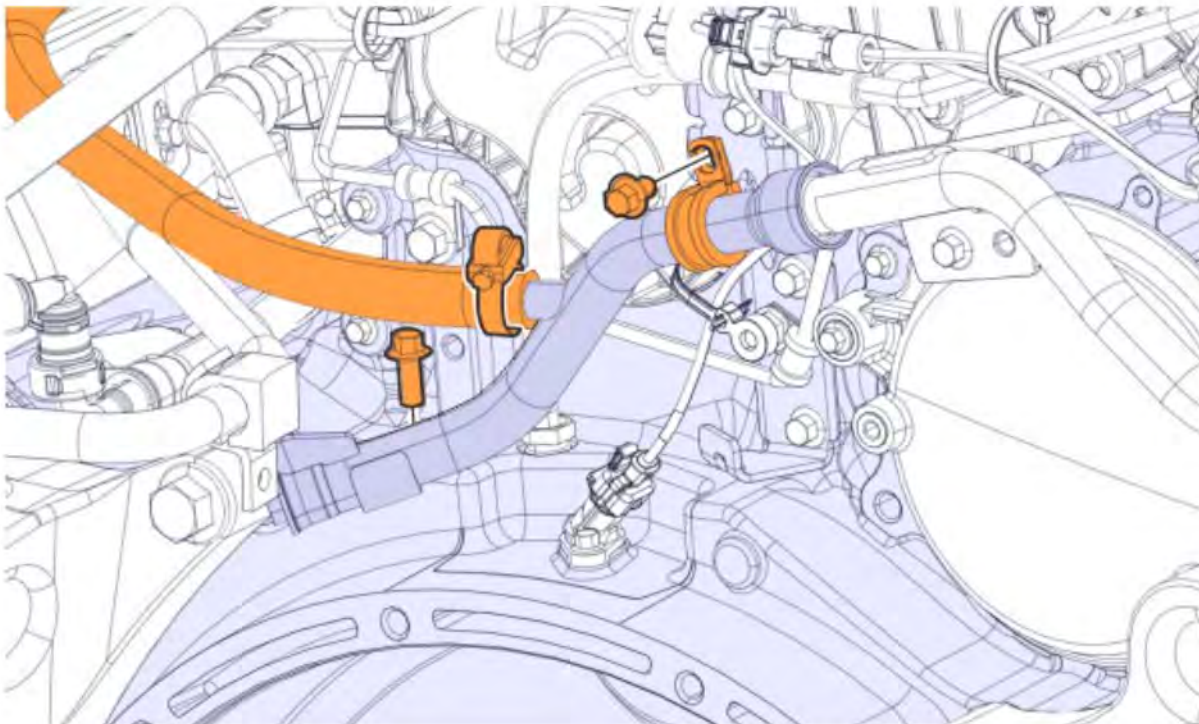


448 Install the clamp.

449 Install the screws.

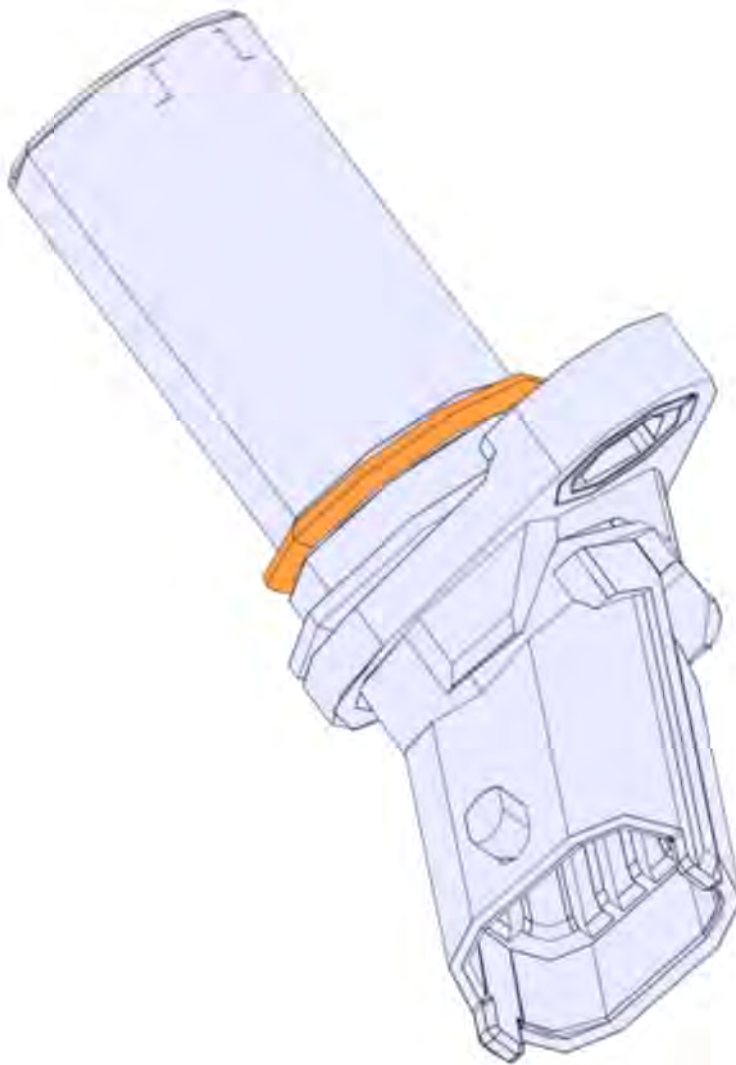
450 Install the hose.

451 Tighten the clamp.



452 Install the o-ring.

i **Note**
Use a new part.



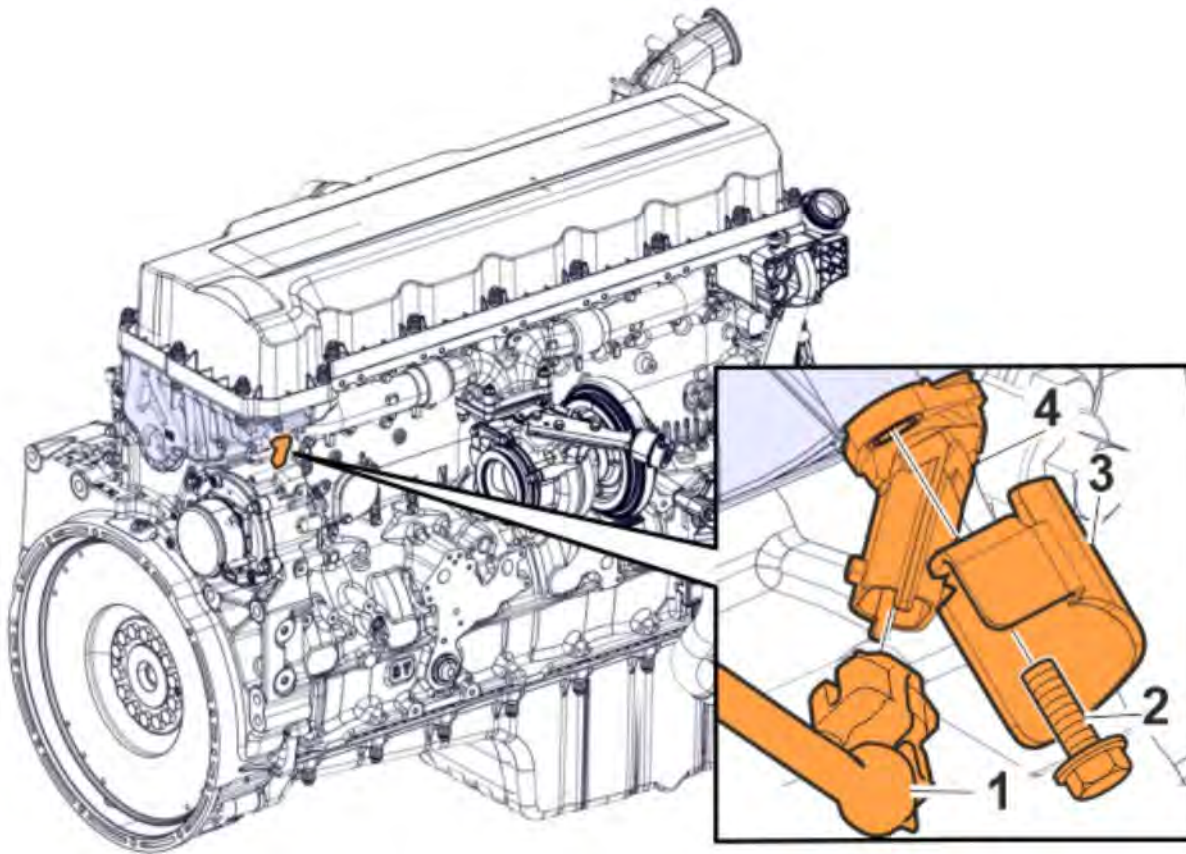
| | | | |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------------------------------------------------------------|
| 453 | Install the sensor (4). | | |
| | <table border="1" style="width: 100%;"> <tr> <td style="width: 20px; text-align: center;"></td> <td>Service hint Install the sensor and shims previously recorded.</td> </tr> </table> | | Service hint Install the sensor and shims previously recorded. |
| | Service hint Install the sensor and shims previously recorded. | | |

| | |
|------------|------------------------------|
| 454 | Install the heat shield (3). |
|------------|------------------------------|

| | |
|------------|------------------------|
| 455 | Install the screw (2). |
|------------|------------------------|

| | | | |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| 456 | Tighten the screw to torque. | | |
| | Tightening torque | | |
| | <table border="1" style="width: 100%;"> <tr> <td style="width: 50%;">Camshaft speed sensor, screw</td> <td style="text-align: center;">8 ±2 Nm (6 ±1 lb_f-ft)</td> </tr> </table> | Camshaft speed sensor, screw | 8 ±2 Nm (6 ±1 lb _f -ft) |
| Camshaft speed sensor, screw | 8 ±2 Nm (6 ±1 lb _f -ft) | | |

| | |
|------------|----------------------------|
| 457 | Connect the connector (1). |
|------------|----------------------------|

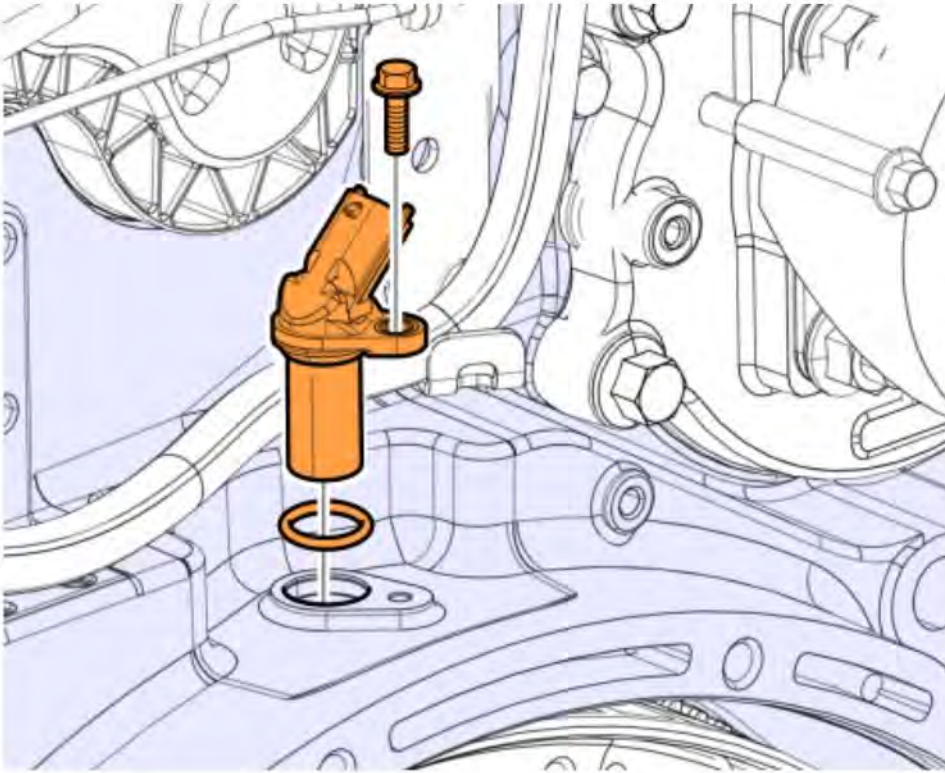


| | | | | | |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|-----------------|--|
| 458 | Install the o-ring. | | | | |
| | <table border="1" style="border-collapse: collapse; width: 100%;"> <tr> <td style="text-align: center; width: 20px;">i</td> <td style="padding: 2px;">Note</td> </tr> <tr> <td colspan="2" style="padding: 2px;">Use a new part.</td> </tr> </table> | i | Note | Use a new part. | |
| i | Note | | | | |
| Use a new part. | | | | | |

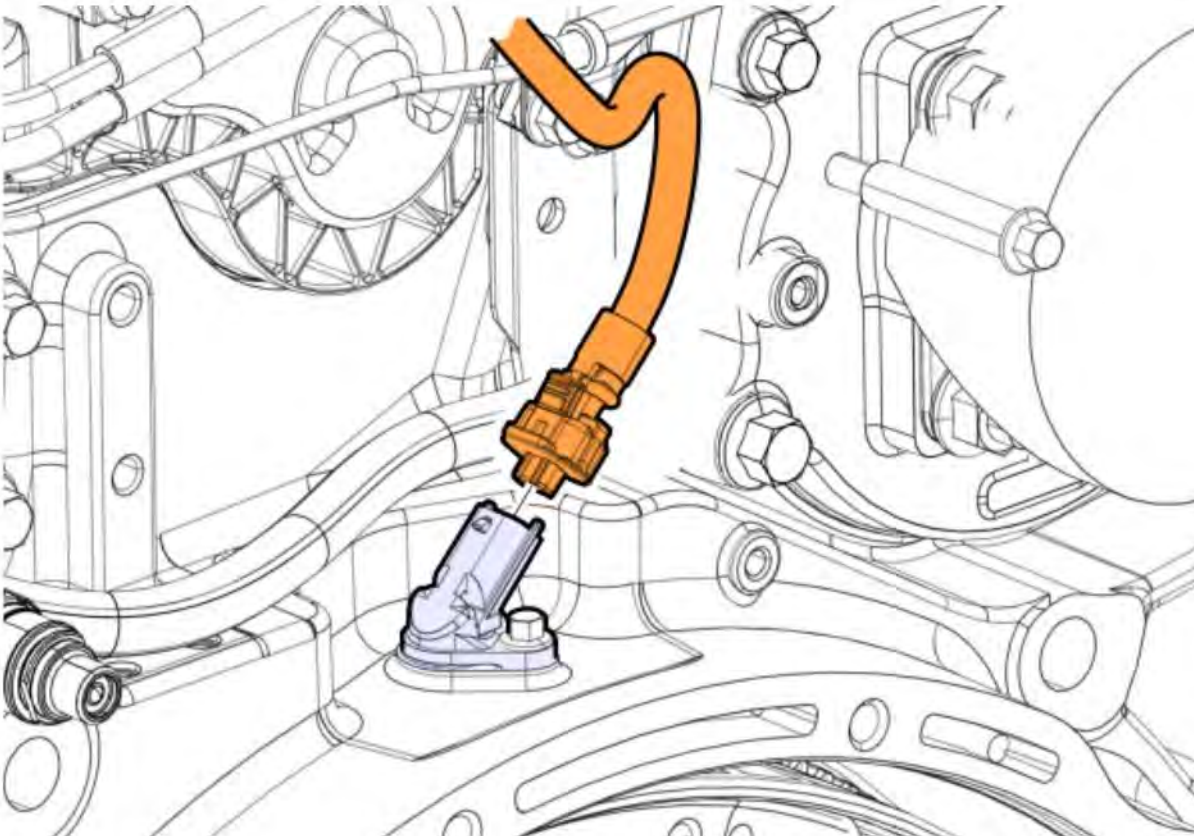
| | |
|------------|---------------------|
| 459 | Install the sensor. |
|------------|---------------------|

| | |
|------------|--------------------|
| 460 | Install the screw. |
|------------|--------------------|

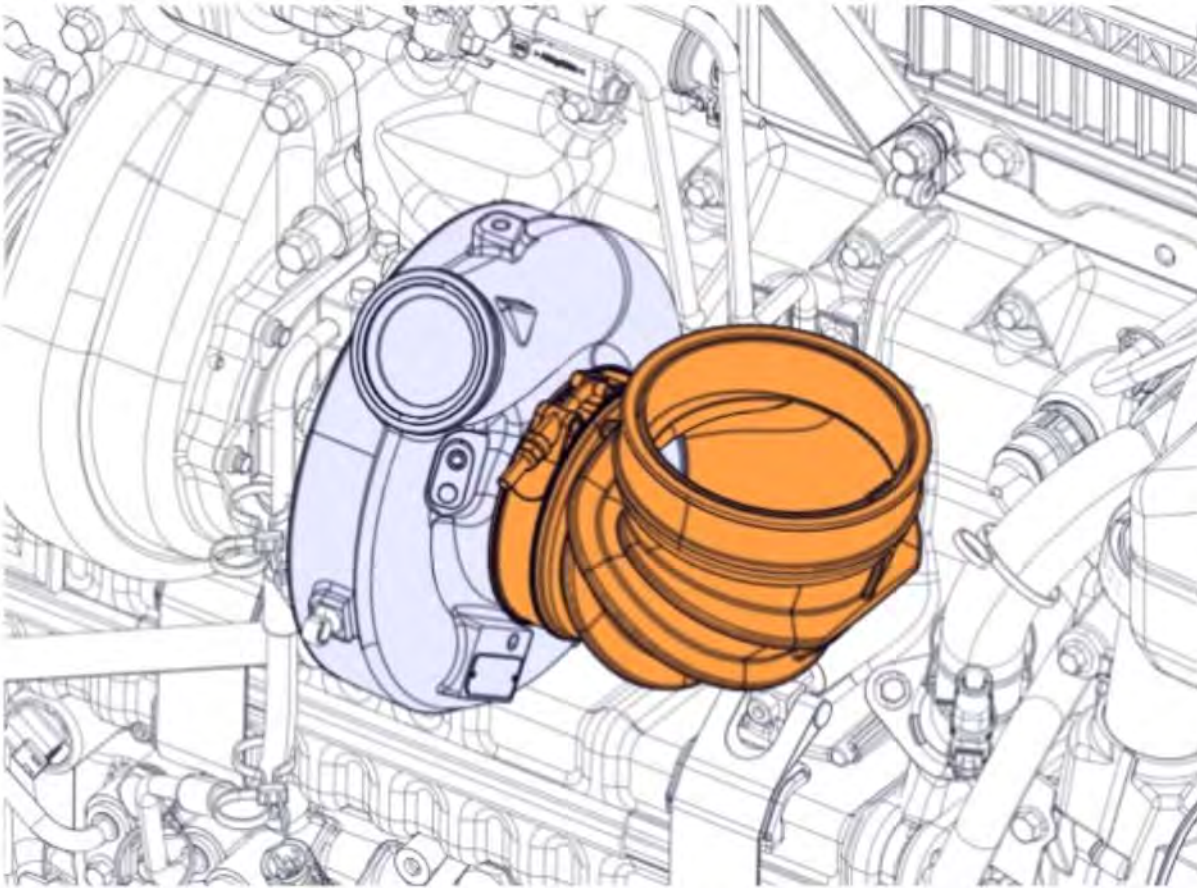
| | | |
|------------|------------------------------|------------------------------------------------------------|
| 461 | Tighten the screw to torque. | |
| | Tightening torque | |
| | Camshaft speed sensor, screw | $8 \pm 2 \text{ Nm}$ $(6 \pm 1 \text{ lb}_f\text{-ft})$ |



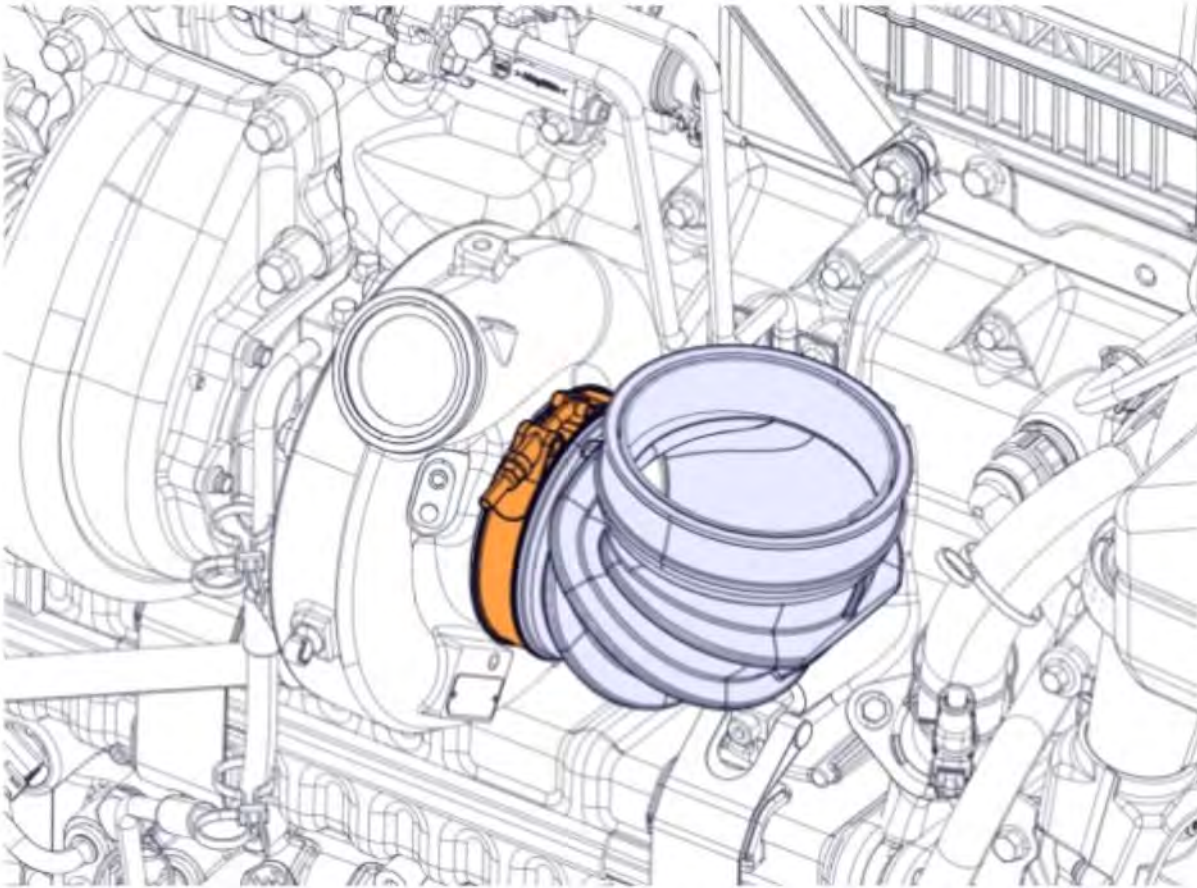
462 Connect the connector.



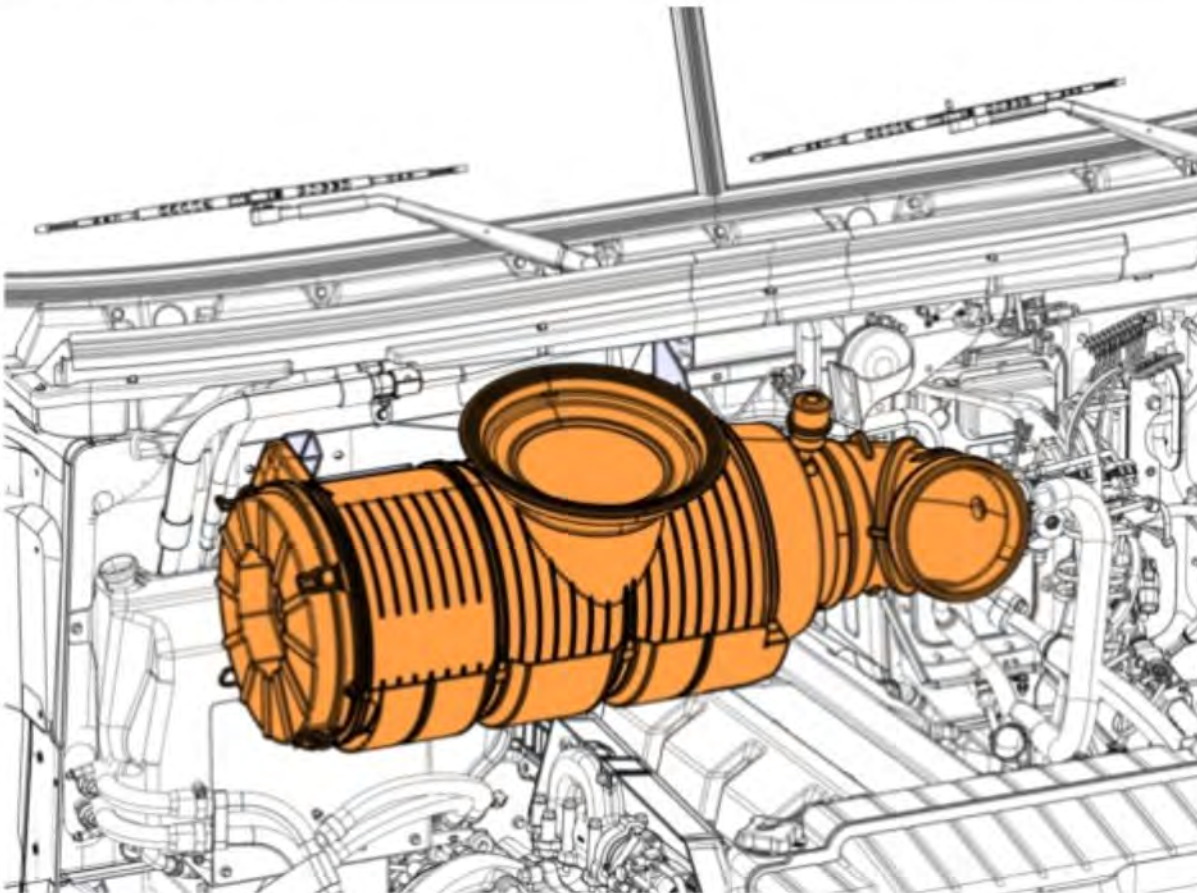
463 Install the duct.



| | | |
|------------|---------------------------|-------------------------------------------------------------|
| 464 | Torque-tighten the clamp. | |
| | Tightening torque | |
| | Air duct, clamp | $9 \pm 1 \text{ Nm}$ $(80 \pm 9 \text{ lb}_f\text{-in})$ |



465 Position the housing.

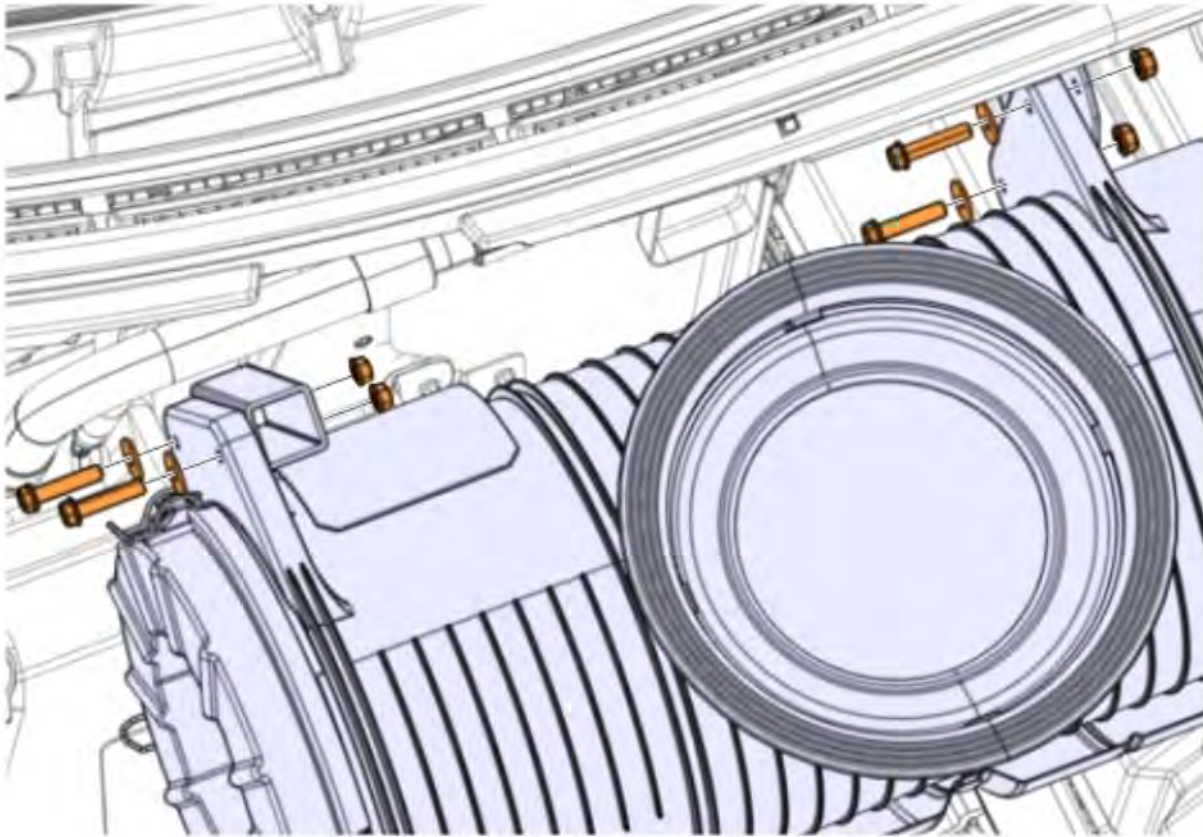


466 Install the screws, washers and the nuts.

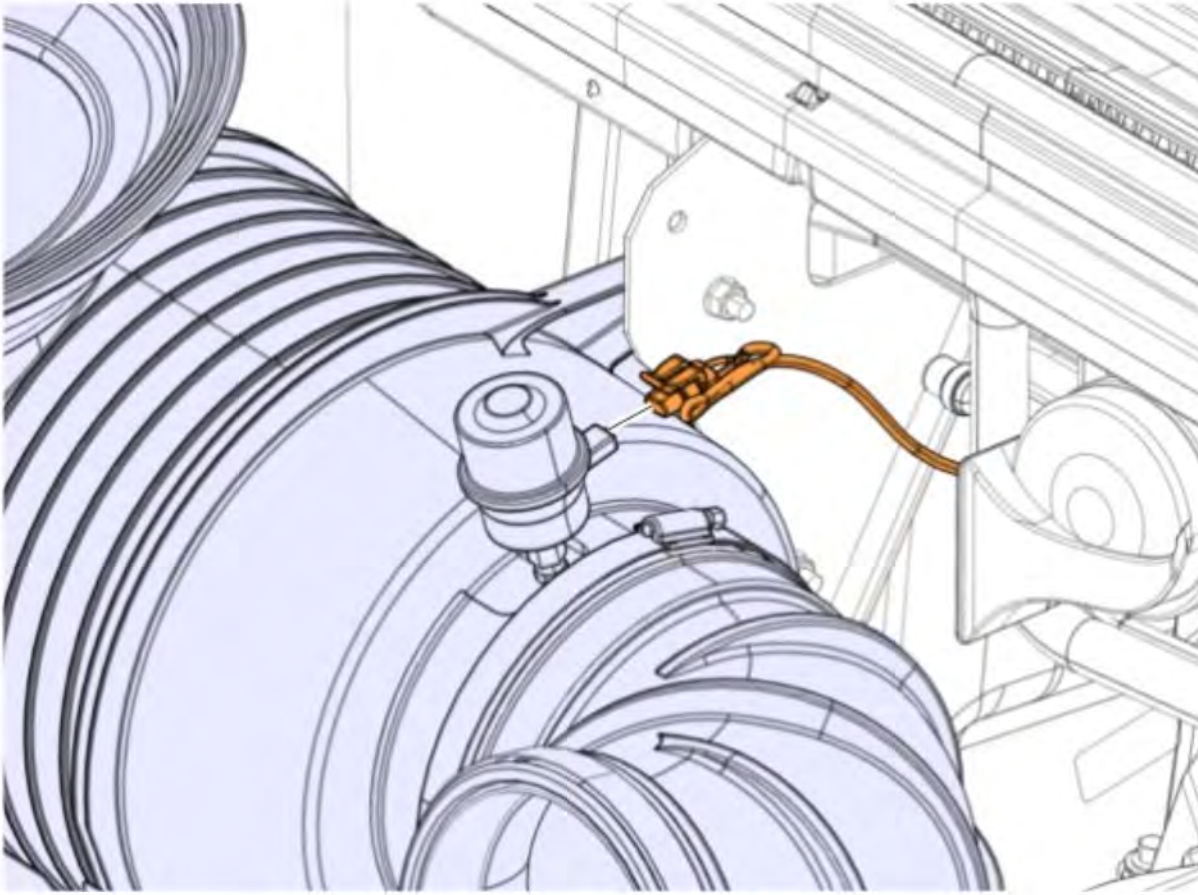
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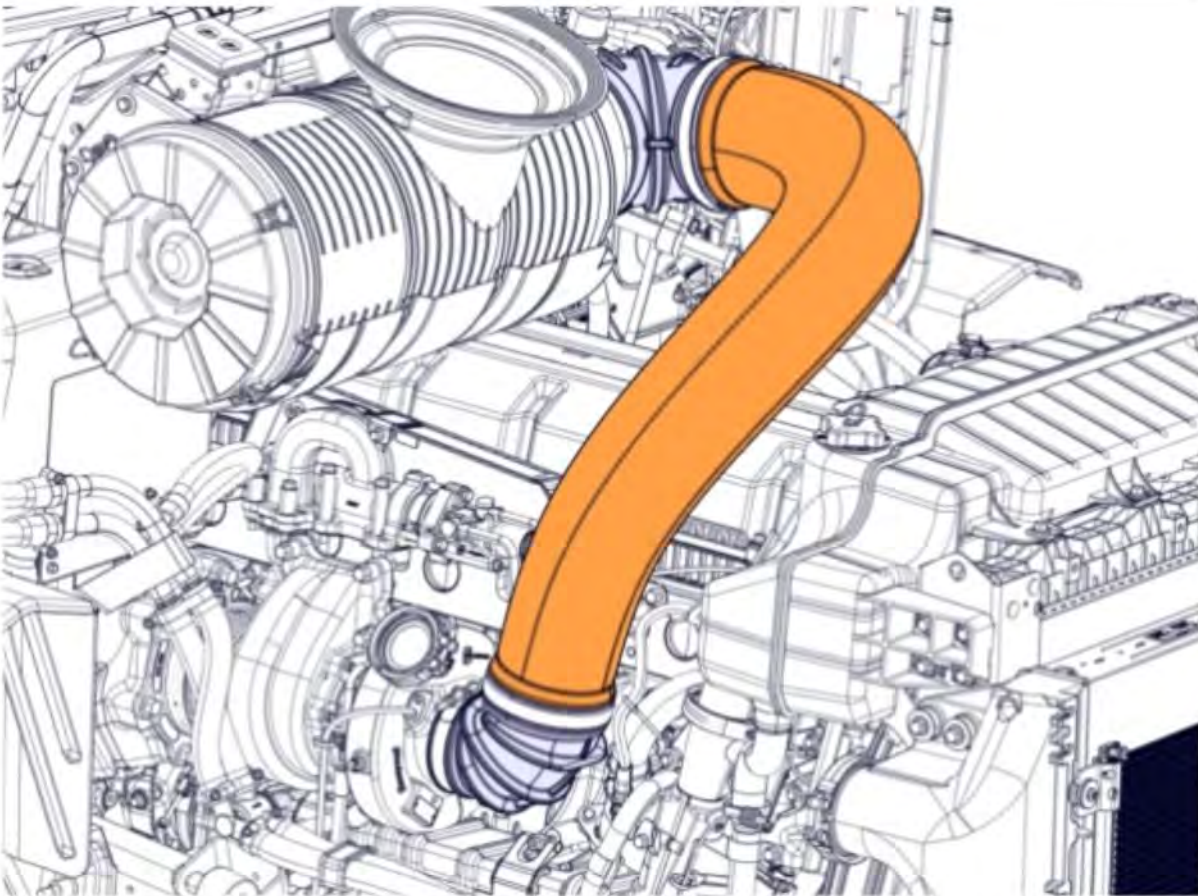
| | | |
|---------------------------|-----------------------------|--|
| 467 | Torque tighten the screws. | |
| Tightening torque | | |
| Air filter housing, screw | M8 | |
| | 5.6 ±0.6 Nm | |
| | (50 ±5 lb _f ·in) | |



| | | |
|-----|------------------------|--|
| 468 | Connect the connector. | |
|-----|------------------------|--|



469 Install the air duct.

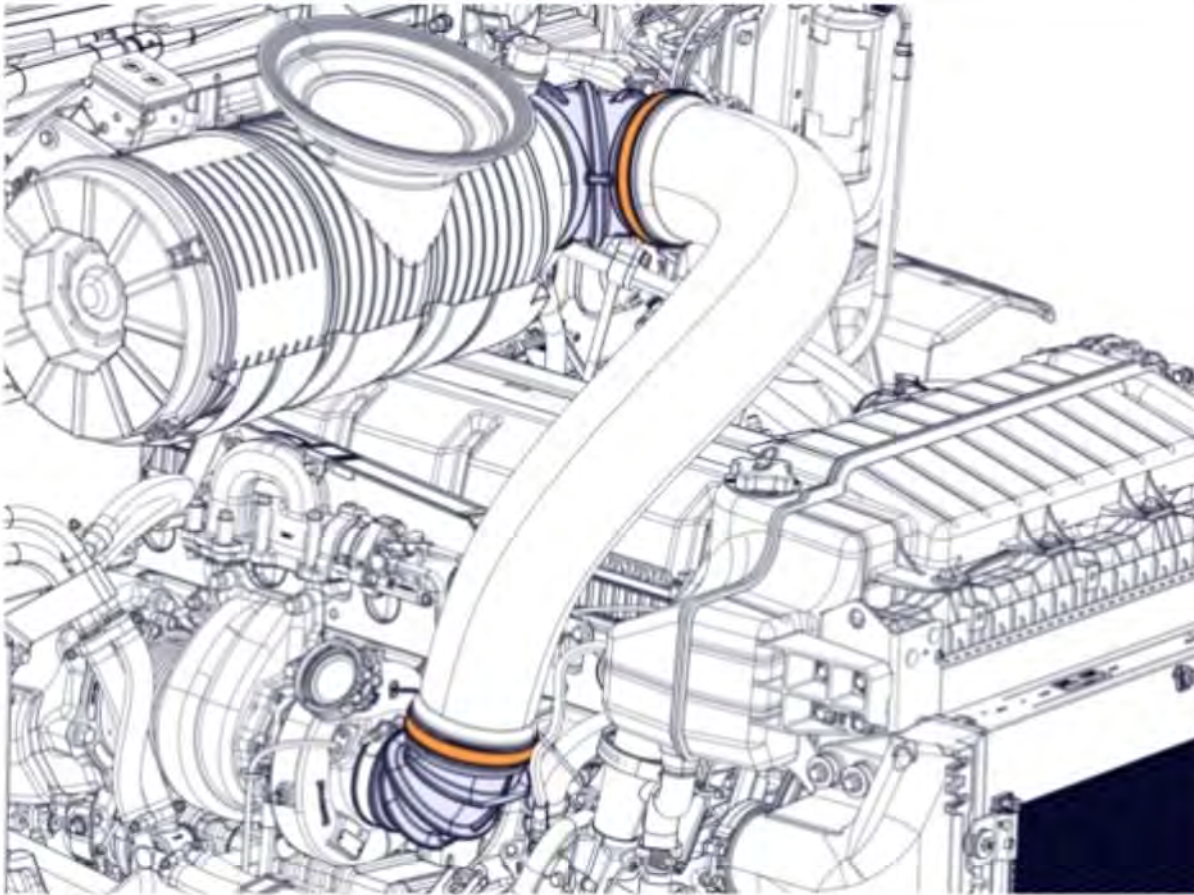


470 Tighten the clamps to torque.

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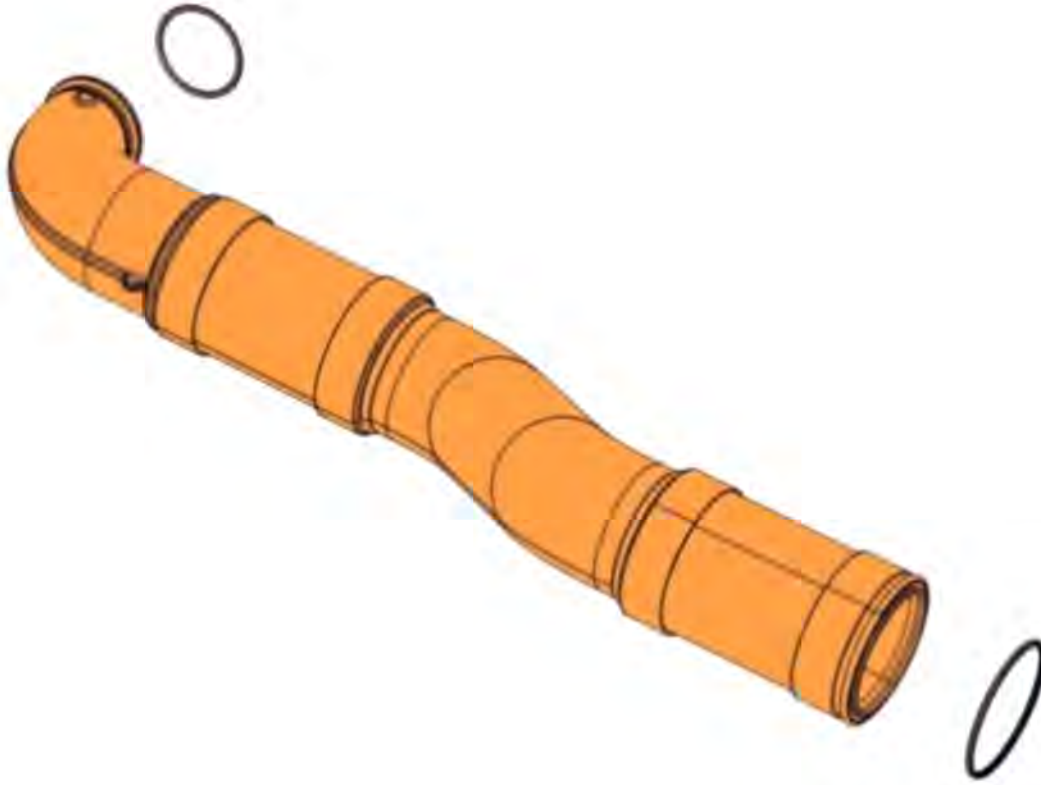
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| Tightening torque | | | |
|---------------------------------------------------------------------------------------------|----------------------------------------|----------|--------------------------|
| Air duct, clamp | 9 ±1 Nm (80 ±9 lb _f ·in) | | |
| <table border="1"> <tr> <td>i</td> <td>Note As noted.</td> </tr> </table> | | i | Note As noted. |
| i | Note As noted. | | |



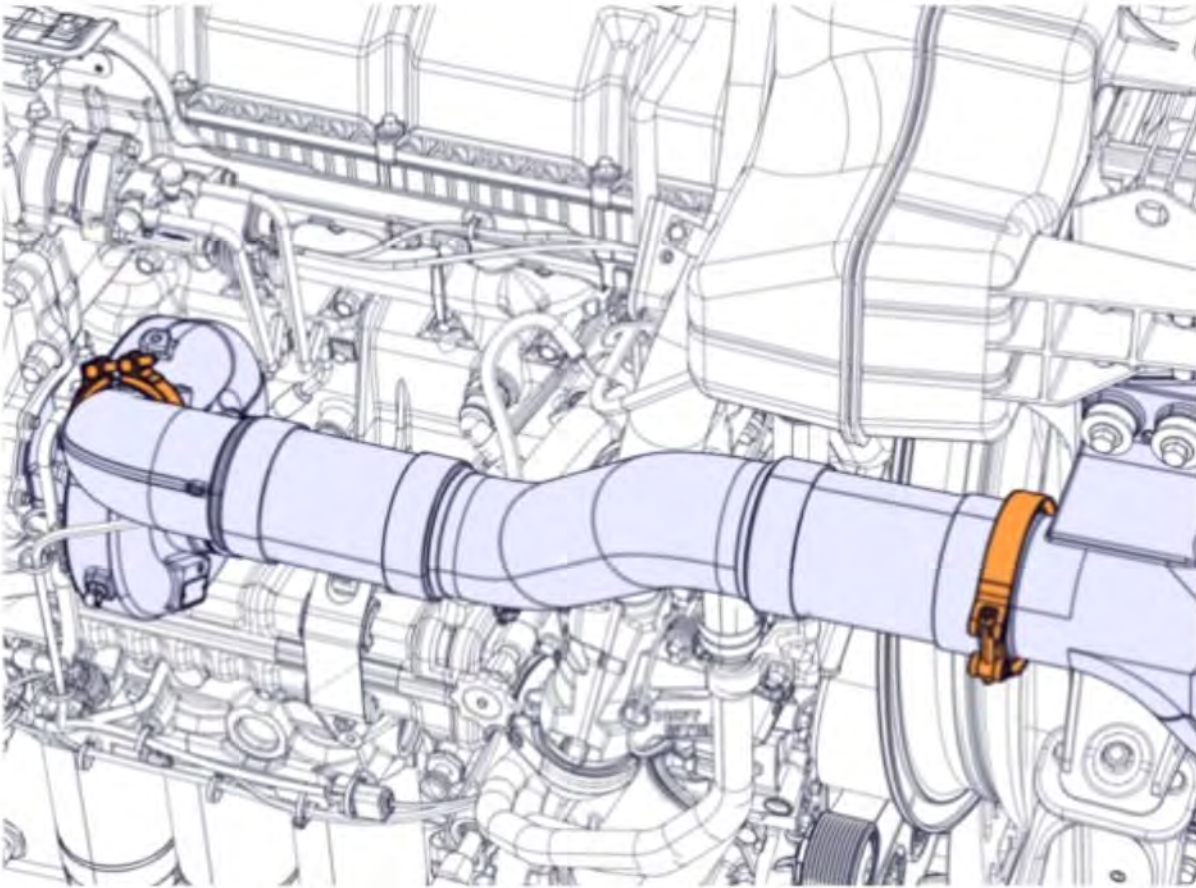
| | | | |
|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|----------|------------------------------------------------------|
| 471 | Install the seals. | | |
| <table border="1"> <tr> <td>i</td> <td>Note Inspect the seals, replace as needed.</td> </tr> </table> | | i | Note Inspect the seals, replace as needed. |
| i | Note Inspect the seals, replace as needed. | | |

| | |
|-----|------------------------------|
| 472 | Install the charge air pipe. |
|-----|------------------------------|

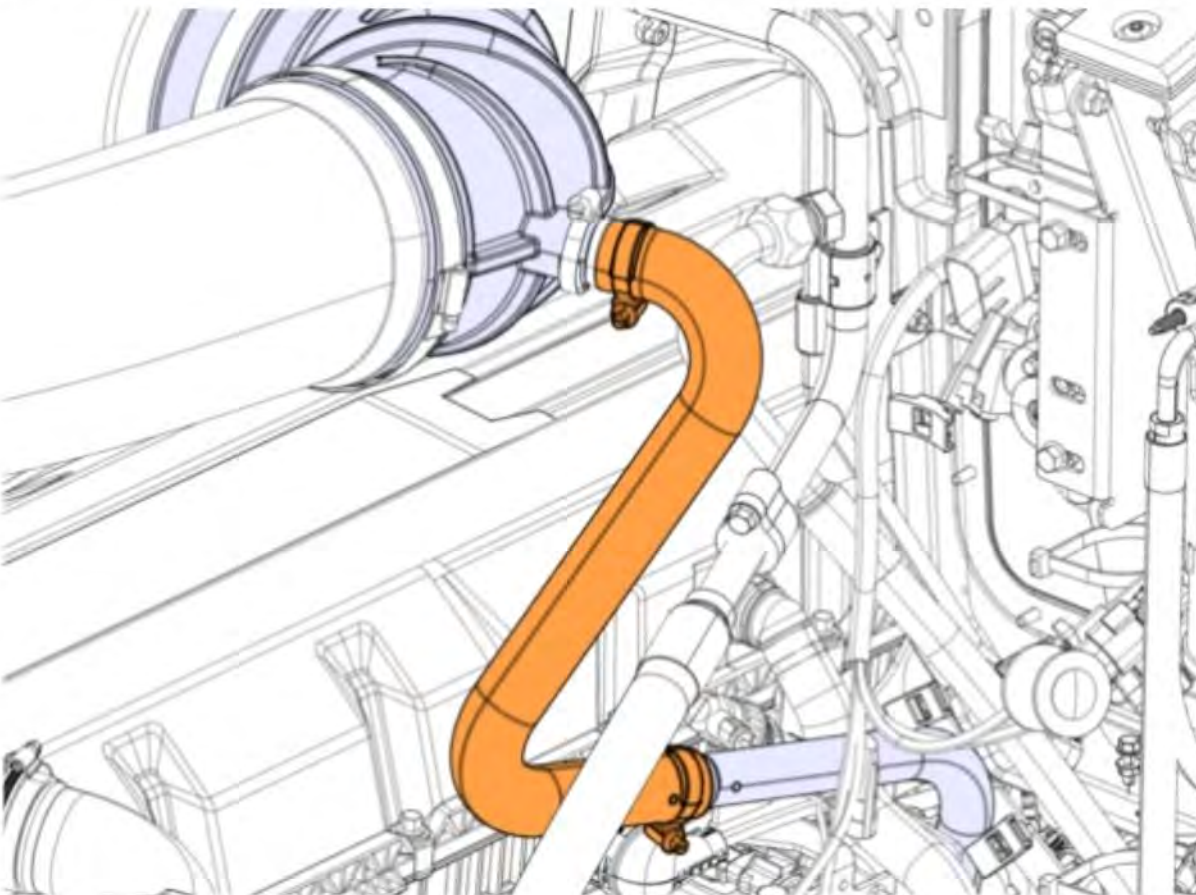


| | | | |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------------------------|
| 473 | Install the V-clamps. | | |
| | <table border="1" style="border-collapse: collapse;"> <tr> <td style="text-align: center; width: 20px;">i</td> <td>Note Note the orientation.</td> </tr> </table> | i | Note Note the orientation. |
| i | Note Note the orientation. | | |

| | | |
|------------|---------------------------------|------------------------------------------------------------|
| 474 | Tighten the V-clamps to torque. | |
| | Tightening torque | |
| | V-clamp, screw | $7 \pm 1 \text{ Nm}$ $(5 \pm 1 \text{ lb}_f\text{-ft})$ |



475 Install the hose.



476 Position the clamps.

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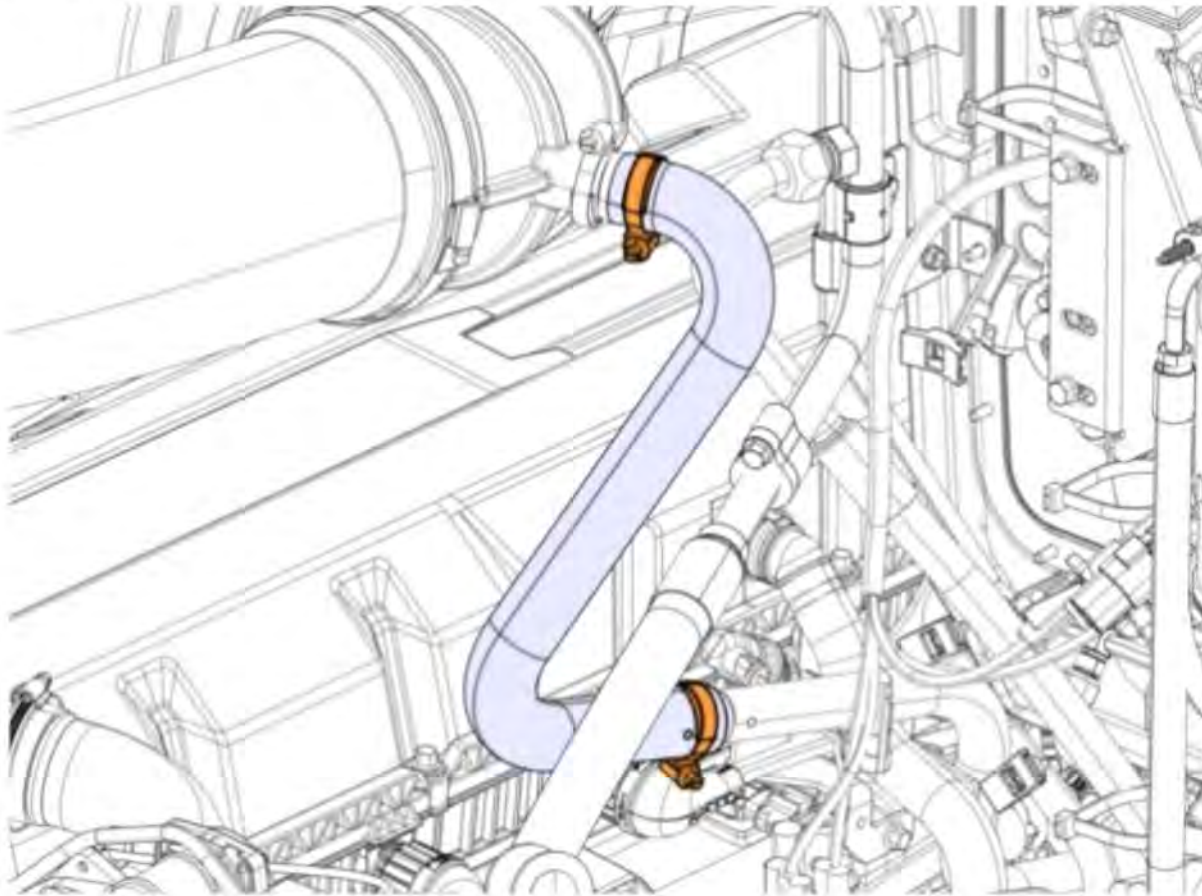


Note
As noted.

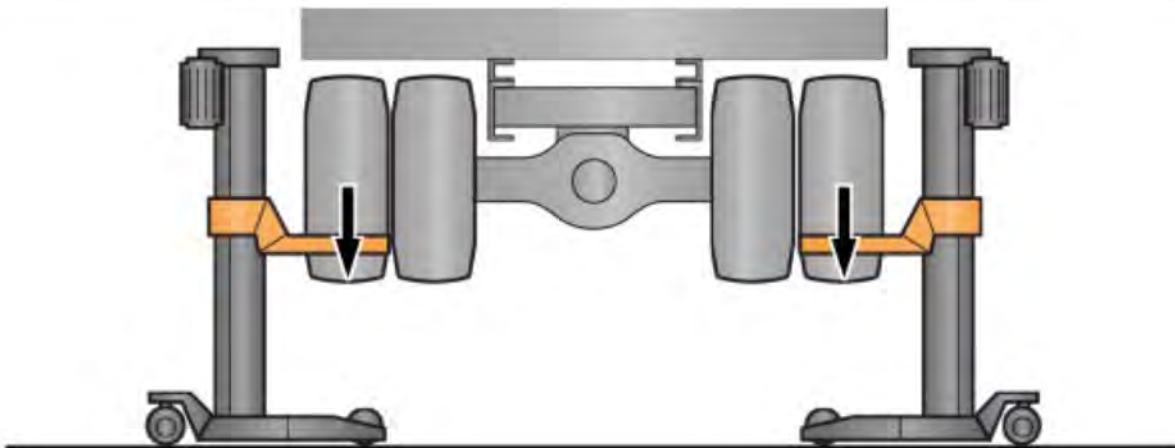
477 Tighten the clamps to torque.

Tightening torque

| | |
|--------------|-----------------------------------------------|
| Clamp, screw | 3.95 ±0.6 Nm (35.0 ±5 lb _f ·in) |
|--------------|-----------------------------------------------|



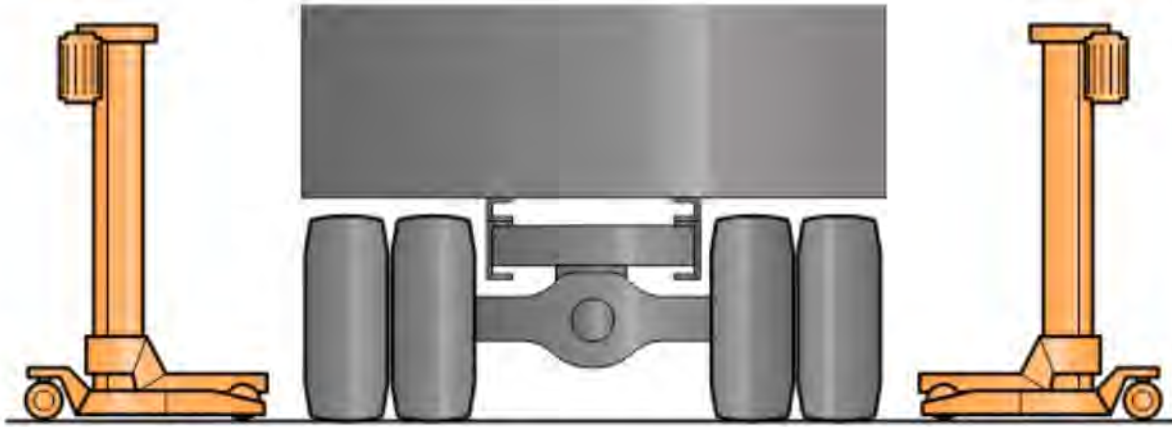
478 Lower the vehicle.



479 Remove the column lifts.

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480 Perform this procedure when the condition below is met.

Conditions

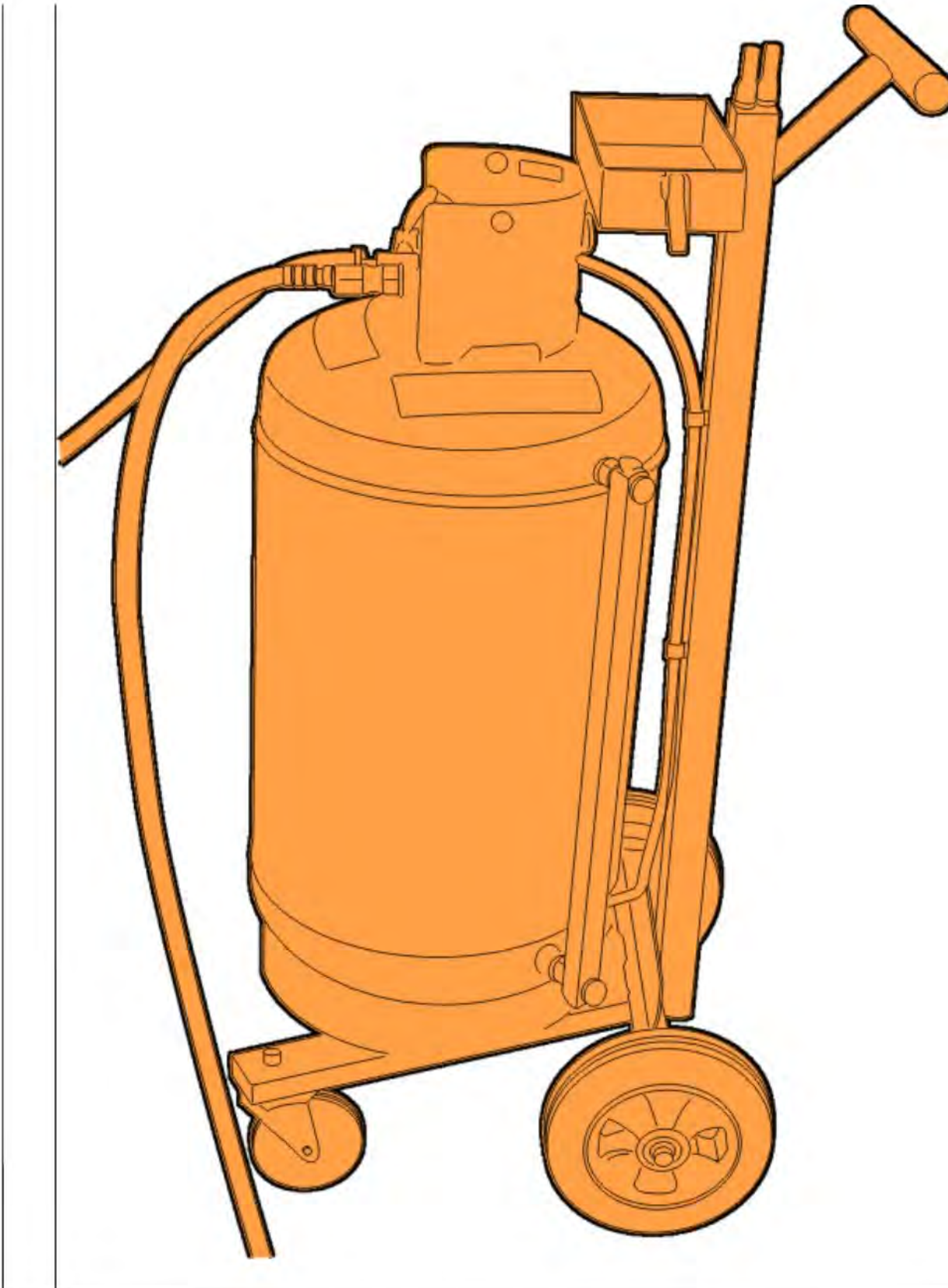
- If all of the coolant connections have been made, fill the coolant system.

► Fill the cooling system.



Note

Use approved coolant.



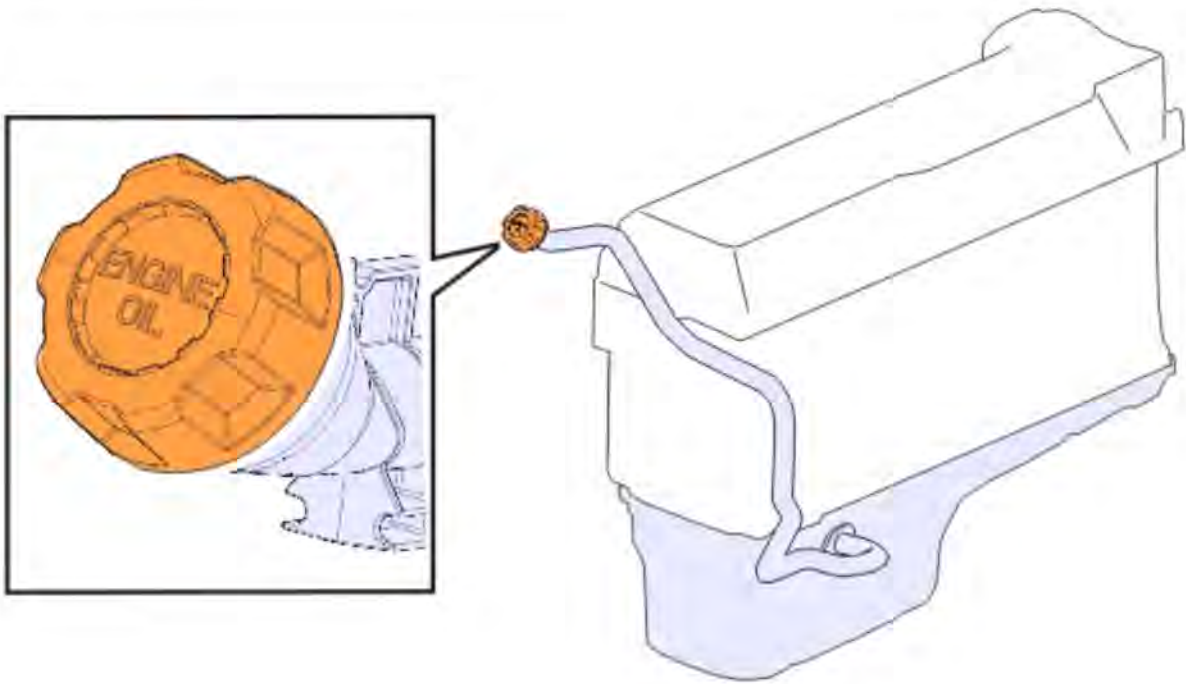
| | |
|------------|-------------------------------------------------------------------------------|
| 481 | Perform this procedure when the condition below is met. |
| | Conditions |
| | <ul style="list-style-type: none"> • If the end cap is removed |
| | <ul style="list-style-type: none"> ▶ Install the end cap. |

482 Fill with engine oil.

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| | |
|----------|-------------------------------------|
| i | Note Use recommended oil. |
|----------|-------------------------------------|



| | |
|------------|-------------------------------------------------------------------------------------------------|
| 483 | Perform this procedure when the condition below is met. |
| | Conditions |
| | <ul style="list-style-type: none"> • If the engine cover was removed for service |
| | <ul style="list-style-type: none"> ▶ Install the engine cover. |

| | |
|------------|--------------------------------------------|
| 484 | Install the lower left side splash shield. |
|------------|--------------------------------------------|

| | |
|------------|---------------------------------------------|
| 485 | Install the lower right side splash shield. |
|------------|---------------------------------------------|

| | |
|------------|-------------------------------------------------|
| 486 | Lower the hood. |
| i | Note Ensure that the hood is latched. |