

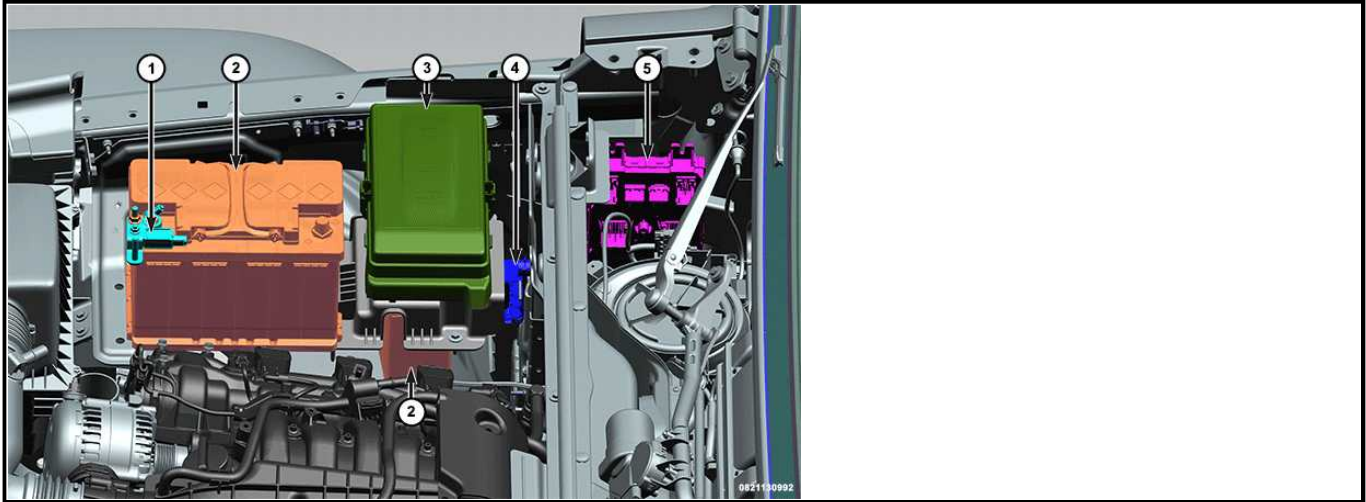
2021 ELECTRICAL

3.0L Battery (Service Information) - Gladiator [EXJ]

DESCRIPTION AND OPERATION

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DESCRIPTION



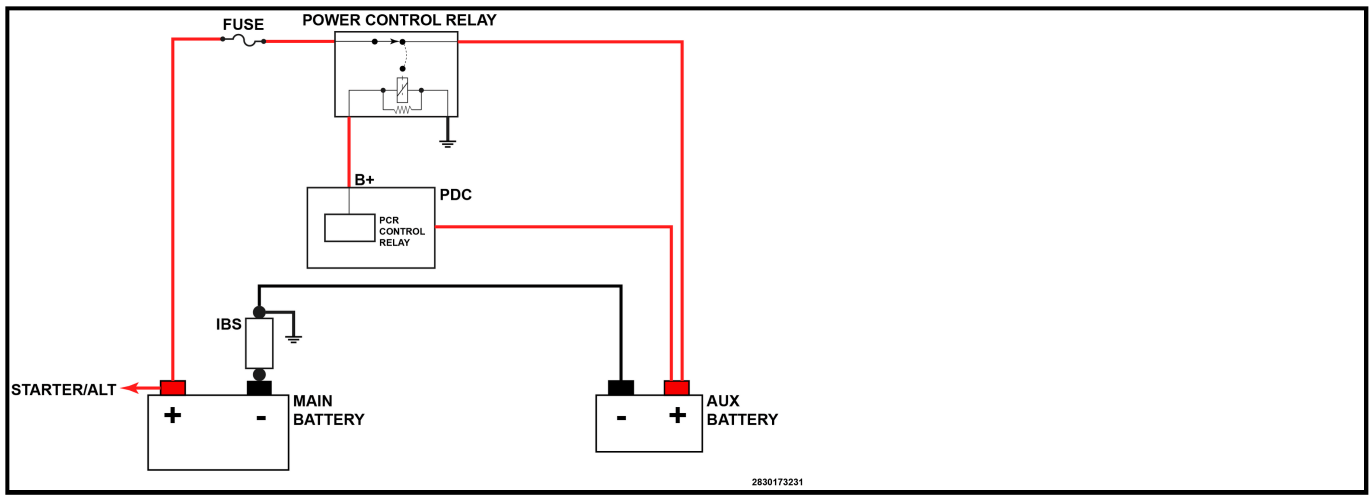
COMPONENT INDEX

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-	PCR Control Relay - Located in the PDC
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SYSTEM OPERATION - DUAL BATTERY 12 VOLT BATTERY SYSTEM

The dual battery Engine Stop/Start (ESS) system consists of four main components that are connected to and operate the starting, charging and vehicle electrical systems. These are the main battery, auxiliary battery, Power Control Relay (PCR) and dual battery system fuse. The power control relay separates the system into two sides, the main battery side and auxiliary battery side. The generic graphic below shows a simplified diagram of the components for ease in understanding the system configuration.

- The **main battery** is the larger battery that is directly connected to the starter and alternator when the batteries are isolated.
- The **auxiliary battery** is the smaller battery that is directly connected to the Power Distribution Center (PDC) powering the modules and accessories when the batteries are isolated. The negative cable for the auxiliary battery connects to the main battery negative cable end.



There is an Intelligent Battery Sensor (IBS) connected in series on the main battery negative cable which provides information about the batteries to the Body Control Module (BCM) over a Local Interface Network (LIN) bus. The IBS monitors the current flow going out of the battery, and current flowing into the battery during charging to make these calculations. Some of the information stored and provided by the IBS are:

- Battery voltage
- Battery temperature
- Battery State of Charge (SOC) - The battery SOC is the percentage of battery charge based on measured voltage, charge and discharge rates.
- Battery State of Function (SOF) - The SOF is the calculated voltage that the battery will drop to when the starter is engaged to crank the engine.
- Battery State of Health (SOH) - The SOH is the measurement of current battery capacity along with depreciation in battery health.

The BCM broadcasts the IBS data over the CAN bus. The Powertrain Control Module will use the battery SOC to determine charge rates as well as when to allow features such as the Engine Stop/Start (ESS) system to function. The BCM will use the battery information received from the IBS to make decisions on load shedding when battery SOC is determined to be low.

In a normally functioning system, **the two batteries and sides of the system are always connected through the power control relay except for the brief periods during cranking events.** Both batteries are connected to the entire electrical system during this mode. This allows charging of the auxiliary battery through its connection to the main battery side, and the main battery to be connected to the Power Distribution Center (PDC) and assist the auxiliary battery in operating the modules and accessories. Since the batteries are nearly always connected, the IBS info provided will be the average SOC of the two batteries. The PCM can determine the SOC of each battery during a cranking event when the batteries are isolated for a brief period during initial starter engagement. During this period, the battery voltage provided to the PCM is coming from only the auxiliary battery, and the battery voltage reported from the IBS will only be reporting the main battery voltage. This helps the PCM to make a determination on allowing ESS operation.

FUNCTIONAL DESCRIPTION - BATTERIES

Batteries are designed to store electrical energy in a chemical form. A standard 12 volt battery will typically have 6 cells connected in series that are made up of a positive and negative plate. Each cell will typically provide approximately 2.1 volts. As the battery discharges, the flow of electrons causes a chemical reaction between the sulfuric acid and the plates causing the plates to become sulfated with lead. Charging the battery will reverse the process, changing the plates back into spongy lead and lead dioxide, and the water back into sulfuric acid.

The battery is vented to release excess hydrogen gas that is created when the battery is being charged or discharged. However, even with these vents, hydrogen gas can collect in or around the battery. If hydrogen gas is exposed to flame or sparks, it may ignite. If the electrolyte level is low, the battery may arc internally and explode.

The dual battery Engine Stop/Start (ESS) system has a main battery and auxiliary battery.

- The main battery is the larger battery that is directly connected to the starter and alternator when the batteries are disconnected.
- The auxiliary battery is the smaller battery that is directly connected to the Power Distribution Center (PDC) powering the modules and accessories when the batteries are disconnected.

In a normally functioning system, **the two batteries and sides of the system are always connected through the power control relay except for the brief periods during cranking events.** Both batteries are connected to the entire electrical system during this mode. This allows charging of the auxiliary battery through its connection to the main battery side, and the main battery to be connected to the Power Distribution Center (PDC) and assist the auxiliary battery in operating the modules and accessories.

CHARGING AND TESTING THE BATTERIES: The batteries should be charged one of two ways depending on the situation and reason for charging.

1. **CHARGING USING THE GR8 BATTERY TESTER** - It was previously documented to never blind charge a vehicle at the pole clamp. However, if the vehicle is brought in with a battery issue or complaint, and the battery is being charged and tested using the GR8 Battery Tester, the tester should be connected directly to the Pole clamp at the negative Battery post. With the updates done on the GR8 Battery Tester, it will not test the battery correctly if connected and charged through the IBS. After performing any testing requiring blind charging, a battery has been replaced or after any repairs are made, the IBS learning curve should be initiated to allow the IBS to update quickly. **See the IBS Component Functional Description information for details on initiating the IBS learning curve.**
2. **CHARGING USING A STANDARD BATTERY CHARGER** - This should only be performed if the vehicle was not brought in for a battery issue and the batteries are depleted during service. The batteries should be charged through the IBS. To do this the negative clamp on the charger should be placed on the negative cable attachment to the IBS, the Jump Post terminal if equipped, or a good chassis ground, NOT the Pole clamp at the negative Battery post. Without proper clamp placement, the IBS data will not update.

The PCM performs diagnostics to determine if the batteries are connected and disconnected at the appropriate times. To do this the PCM monitors the main battery voltage from the IBS feedback and the auxiliary battery voltage from the fused B+ circuit at the PCM.

FUNCTIONAL DESCRIPTION - BATTERY CABLES

The battery cables connect the battery terminal posts to the vehicle electrical systems. These cables also provide a path back to the battery for electrical current generated by the charging system to restore the voltage potential of the batteries. The female battery terminal clamps on the ends of the battery cables provide a strong and reliable connection of the battery cable to the battery terminal posts. The terminal pinch bolts allow the female terminal clamps to be tightened around the male terminal posts on the top of the battery. The eyelet terminals secured to the opposite ends of the battery cables from the female battery terminal clamps provide secure and reliable connection of the battery cables to the vehicle electrical systems.

On dual battery systems, the negative battery cable from the auxiliary battery connects to the negative battery cable of the main battery at the battery cable end. Both batteries are then grounded through the main battery cable connection to ground.

FUNCTIONAL DESCRIPTION - INTELLIGENT BATTERY SENSOR (IBS)

The Intelligent Battery Sensor (IBS) is an electrical shunt with a microprocessor that is mounted in-line with the negative battery cable. The IBS monitors the battery voltage as well as current flow into and out of the battery. The IBS has a built-in thermistor that calculates the battery temperature. The microprocessor uses this data to calculate battery State of Charge (SOC), battery internal resistance, charge received, electrical demand, and time in service. This information is reported through the LIN Bus circuit to the Body Control Module (BCM). The BCM broadcasts the information to the Powertrain Control Module (PCM) over the CAN Bus.

The IBS SOC data is also used by the BCM and other modules to determine when to begin disabling certain vehicle features that draw excessive electrical loads due to a low battery SOC. The SOC threshold for starting to disable features can vary based on vehicle and engine but is typically in the 50% to 60% range.

On the dual battery Stop/Start systems, the IBS is connected to the main battery. Since the two batteries are connected to each other most of the time, the battery SOC reported by the IBS is reporting the average SOC of the two batteries. It is possible for one battery to be fully charged and the other battery discharged causing the overall SOC to be low. If the SOC is low, both batteries should be checked for proper charge and functionality before checking for an issue with the IBS.

The IBS SOC may read low when both batteries test good. The following items can contribute to, and should be considered when diagnosing a low SOC condition before replacing an IBS or battery:

- If the vehicle is jump started at the battery posts bypassing the IBS.
- If the battery is blind charged at the battery posts bypassing the IBS.
- Repeated short trip driving events not allowing enough charge time.
- The IBS accuracy is off and needs to relearn the battery SOC.

Depending on the vehicle, there could be a non-MIL DTC (P057F) set, or an EVIC message indicating a low battery state of charge limiting some features, such as ESS. In some cases, properly charging the batteries through the IBS can raise the IBS SOC enough to regain functionality and repair the issue. However, it can sometimes take two or three, 4-hour BUS off sleep cycles for an IBS to learn and update the battery SOC. The IBS can be initiated into a learning curve by completely disconnecting the IBS from the battery, and disconnecting harness connector for 20 seconds. The IBS battery feed, LIN Bus and ground circuits should be checked before reconnecting the IBS. The IBS should default to approximately 80% SOC when reconnected. However, the IBS accuracy is determined to be low until the IBS can relearn battery SOC. This occurs after an engine run cycle and a subsequent ignition off sleep cycle of between one to four hours. Some features will be disabled until the IBS SOC is updated.

FUNCTIONAL DESCRIPTION - POWER DISTRIBUTION CENTER (PDC)

The Power Distribution Center (PDC) is designed to provide safe, reliable, centralized and convenient access to distribution of the electrical current required to operate all of the many standard and optional factory-installed electrical and electronic powertrain, chassis, safety, comfort and convenience systems. At the same time, these systems were designed to provide centralized locations for conducting diagnosis of faulty circuits and for sourcing the additional current requirements of many aftermarket vehicle accessory and convenience items. The PDC connects directly to the Battery Positive (B+) cable.

The power distribution systems also incorporate the following various types of circuit control, and protection features:

- Automatic resetting circuit breakers
- Cartridge fuses
- Blade fuses
- Removable relays
- Non serviceable Printed Circuit Board (PCB) relays

FUNCTIONAL DESCRIPTION - BODY CONTROL MODULE (BCM)

The Body Control Module (BCM) is the gateway for all bus communications needing to be gated from one bus network to a different bus network.

The BCM obtains battery voltage information from the Intelligent Battery Sensor (IBS) over the Local Interface Network (LIN) bus. The BCM is the LIN master for the IBS and manages the IBS initialization, LIN communication, signal gating and IBS diagnostics.

Load Shedding

Using the LIN, the BCM communicates with the IBS to provide load shedding. Load shedding is activated under the following conditions:

- The engine must be running with an engine speed equal to or higher than 400 RPM for greater than 50 seconds.
- The battery State of Charge (SOC) supplied signal value sent by the IBS over the LIN bus to the BCM must be less than or equal to 55%.
- The battery voltage measured by the IBS and supplied to the BCM over the LIN bus must be less than or equal to 12.2 volts.

When the vehicle is in a load shed operating state, the BCM will bus a signal to the Instrument Panel Cluster (IPC) to illuminate the "Battery Saver On" indicator.

If the battery SOC rises to a level equal to or greater than 65% and the battery voltage rises to 13 volts or higher, load shedding will begin to reverse itself putting the vehicle back to a normal operating state.

Any transition of the ignition state will reset all of the load shed output signals and therefore cancel load shedding operation.

Battery Critical State

If the battery SOC is equal to or less than 35% and the battery voltage is equal to or less than 11.8 volts, a "Battery Reached Critical State" output signal is broadcast by the BCM. Another condition to set this output signal is that the battery voltage is less than or equal to 10.9 volts and the state of charge is less than or equal to 55%.

When the battery reaches critical state, only electrical loads essential to vehicle operation are allowed to be turned on. The following actions are recommended to be taken:

- Heated seats and the heated steering wheel are disabled for the duration of the ignition cycle
- Rear defroster and heated mirrors time out in 30 seconds each time the customer turns them on for the duration of the ignition cycle
- The Heating, Ventilation, and Air Conditioning (HVAC) system is allowed only minimal loads for visibility requirements for the duration of the ignition cycle
- On vehicles equipped with an eTorque system, the Power Inverter Module (PIM) is disabled for the duration of the ignition cycle
- Audio and Telematic systems will only allow minimal loads for communications and emergency requirements for the duration of the ignition cycle

There is no load shed recovery for a battery critical state and the vehicle operation will remain in this state until the ignition is cycled.

Inputs

- Battery voltage, temperature and state of charge information is provided through LIN communication from the IBS

Outputs

- IBS LIN communication for strategy management
- The BCM broadcasts the battery information on both the Controller Area Network-Chassis (CAN-C) and the CAN-Interior High Speed (CAN-IHS) data bus networks
- Load shedding management to the relevant nodes on all bus networks

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - DUAL BATTERIES 12 VOLT SYSTEM

WARNING: IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING OR LOOSE POSTS, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY OR VEHICLE DAMAGE MAY RESULT.

WARNING: EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY OR VEHICLE DAMAGE MAY RESULT.

WARNING: THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.

DIAGNOSIS AND TESTING - BATTERY SYSTEM: The battery, starting, and charging systems are inter-related. The diagnostics covered below are testing the complete system. In order for the engine to start and the batteries to maintain a proper charge, all of the components that are used in these systems must perform within specifications. It is important that the battery, starting, and charging systems be thoroughly tested and inspected any time a battery needs to be charged or replaced. The cause of abnormal battery discharge, overcharging or early battery failure must be diagnosed and corrected before a battery is replaced and before a vehicle is returned to service. The Powertrain Control Module (PCM) monitors these systems for faults. If the PCM has a Diagnostic Trouble Code (DTC) stored against any of these systems, the DTC(s) should be diagnosed using the DTC diagnostic test procedure.

PRELIMINARY BATTERY CHECKS: Verify each of the following before charging and testing the batteries.

1. Inspect the batteries for any physical damage to the battery or posts.
 - If physical damage is obvious, replace the battery and retest.
2. Verify the batteries are the proper size and rating for the vehicle. Refer to **BATTERY** .
 - If the either battery does not meet the required specifications, replace the battery and retest.
3. Verify the battery and cable connections are tight and clean. Check the battery cable connections at the battery posts, alternator terminal and ground locations.
 - Clean and repair any poor connections and retest.
4. Verify the charging system is operating properly.
 - If the charging system output is low, repair the inoperative charging system.
5. If the vehicle has a no crank condition but the electrical system has power check the starting system operation.
 - Repair the inoperative starting system if required.
6. If applicable, check the battery electrolyte level. Always use the necessary safety precautions when working with batteries to prevent possible serious or fatal injury.
 - If the electrolyte level is low, fill to the proper level and retest.
7. If the battery, starting and charging systems test good, but the battery discharges after sitting for a short period, check the electrical system for an ignition off draw. Refer to **IGNITION OFF DRAW TEST** .

If all preliminary checks are good, continue testing the battery system below.

CHECKING FOR A DISCONNECT BETWEEN THE BATTERIES: Besides an open cable or poor connection, the two components that can cause a disconnect between the batteries is the power control relay and the fuse.

TECH TIPS:

- The normally closed power control relay should be de-energized and closed 99% of the time. It is only opened by the PCM during the starter in-rush at initial engine cranking.
- On some vehicles with a fuse array, the nuts that connect the cables to the fuse array can loosen and lose the proper torque. This can cause an excessive current draw condition damaging the fuse and causing a disconnect between the power control relay and main battery. This can often be seen by discoloration of the cable ends. at the fuse location.

1. **This step is checking for a disconnect between the batteries at the power control relay.** Measure the voltage at both cable end terminals of the power control relay. This can be done with the engine running, with the ignition on or off. The voltage should be the same at both terminals.
 1. If the voltage is not the same on both terminals, the normally closed relay is stuck open. The power control relay will be stuck open if it is being energized. This can happen if there is voltage on the control circuit due to the PCR control relay in the PDC being stuck on, or if the control circuit is shorted to voltage. Continue to step 2.
 2. If the voltage is the same at both terminals, the relay is not stuck open. Continue to step 3.
2. Disconnect the power control relay harness connector. This should cause the relay to de-energize and close if it is being electrically held on (open). Check for voltage on the control circuit.
 1. If voltage is present, the PCR control relay inside the PDC is stuck on, or the control circuit between the PCR control relay and the power control relay is shorted to voltage.
 2. If voltage is NOT present, and the relay is still open with the harness connector unplugged, replace the faulty power control relay.
3. Measure the voltage across the terminals of the main battery. Compare the main battery voltage to the voltage at the power control relay terminals. If there are no disconnects between the main battery and power control relay, the voltage readings will be the same.
 1. If the voltage reading at the power control relay is lower than the main battery voltage, there is a disconnect. Check the fuse in the system between the main battery and power control relay. If the fuse is open, verify the cables are not shorted to ground and replace the fuse or fuse array depending on vehicle configuration. If the fuse is good, check the positive cables and connections on the main battery side of the system for opens or poor connections.

NOTE: It is very important to torque the nut holding the cables to the correct specification. A loose torque on a cable nut can cause excessive current draw on the system and damage the fuse.

2. If the main battery voltage matches the power control relay, continue to the CHECKING FOR A DEPLETING OR DEPLETED AUXILIARY BATTERY information below.

CHECKING FOR A DEPLETING OR DEPLETED AUXILIARY BATTERY: On some vehicles the auxiliary battery can be difficult to access for testing with the GR8 battery tester. This information describes an alternative way of to perform a State Of Charge (SOC) check of the auxiliary battery to determine if the GR8 battery tester should be used. This should be done after testing for and determining there is not a disconnect between the main battery and power control relay.

TECH TIPS:

- If the auxiliary battery requires testing with the GR8 battery tester, **the GR8 battery tester must be connected directly to the battery posts.**
- After either battery is charged or replaced, an IBS reset should be performed. If the IBS reset is not performed, it can take several days of run time and sleep cycles for the IBS to learn the battery SOC after a battery is blind charge or replaced. The IBS reset allows the IBS to start with a default 80% SOC, and will detect that the battery has been charged or replaced. This can allow many of the vehicle features to operate normally. The IBS also initiates a quick learning curve which allows the IBS to update the actual battery SOC after a 4 hour sleep cycle.

1. Turn the ignition off. To check the auxiliary battery SOC, measure the voltage as close to the auxiliary battery as possible (recommend at the power control relay). Disconnect the main battery positive cable. **Use caution** when disconnecting the positive cable since the electrical system is still connected to and powered by the auxiliary battery. The auxiliary battery voltage should not drop off drastically. Typically it should still be above 12v if the battery is charged properly.
 1. If the voltage drops sharply when the main battery is disconnected, verify a good auxiliary battery ground cable connection at the main battery negative terminal. If the connection is good, the auxiliary battery should be isolated and tested with the GR8 battery tester. Refer to the CHECKING FOR A DEPLETING OR DEPLETED BATTERY WITH THE GR8 TESTER information below.
 - Perform an IBS reset by removing the IBS from the battery cable end and disconnecting the IBS harness connector for 30 seconds after an auxiliary battery is charged or replaced. This will allow the IBS to default to an 80% SOC and initiate the quick learning curve.
 2. If the voltage is near or above 12v, continue to step 2.
2. To load test the auxiliary battery without the GR8 battery tester, turn the ignition on, and turn on several loads (headlights, HVAC blower, rear defrost, etc.) for approximately 1 1/2 minutes while monitoring the auxiliary battery voltage at the power control relay. **DO NOT EXCEED 2 MINUTES.** The voltage should be near or above 10v after approximately 1 1/2 minutes. Next turn the loads and ignition off. Monitor the voltage for another 1 1/2 minutes at the power control relay. The voltage should recover back to 12v.
 1. If the auxiliary battery does not appear to be charged or functioning as described, isolate and test the auxiliary battery at the battery posts with the GR8 battery tester.
 - Perform an IBS reset by removing the IBS from the battery cable end and disconnecting the IBS harness connector for 30 seconds after an auxiliary battery is charged or replaced. This will allow the IBS to default to an 80% SOC and initiate the quick learning curve.
 2. If the auxiliary battery appears to be charged and functioning properly, isolate and test the main battery with the GR8 battery tester. Refer to the TESTING A BATTERY WITH THE GR8 TESTER information below.

TESTING A BATTERY WITH THE GR8 TESTER: Always use the Midtronics GR8 Instruction information that was supplied with the tester as a reference. If the Instruction information is not available the following procedure can be used:

WARNING: Always wear appropriate eye protection and use extreme caution when working with batteries.

NOTE: Previous service information reported never to blind charge the battery around the Intelligent Battery Sensor (IBS). Software changes to the GR8 battery tester has improved how the battery is tested. However, this requires the GR8 battery tester to be connected directly to the battery posts, bypassing the IBS when testing the main battery. Before connecting the GR8 battery tester, verify that the tester has been updated to the latest software version.

1. Disconnect the battery positive and negative cables to isolate the battery. Connect the (special tool #GR8-1220KIT-CHRY, AGM Battery Tester/Charger Station) directly to the battery posts and select the battery charging and testing procedure on the screen.
2. Follow the prompts on the GR8 battery tester screen and fill in the vehicle information.
3. When the battery test has completed, the tester will display the results on the screen.
4. While viewing the battery test result, press the CODE button and the tester will prompt you for the last 4 digits of the Vehicle Identification Number (VIN). Use the UP/DOWN arrow buttons to scroll to the correct character; then press ENTER to select and move to the next digit. Then press the ENTER button to view the SERVICE CODE. Pressing the CODE button a second time will return you to the test results.
 1. If the battery fails the load testing below, record the failure code and replace the battery.
 2. If the battery DOES NOT fail the load testing below, reconnect the battery and retest the system. If the battery, starting and charging systems test good, but the battery discharges after sitting, check

the electrical system for an ignition off draw. Refer to **IGNITION OFF DRAW TEST** .

NOTE: The **SERVICE CODE** is required on every warranty claim submitted for battery replacement.

NOTE: Perform an IBS reset by removing the IBS from the battery cable end and disconnecting the IBS harness connector for 30 seconds after an auxiliary battery is charged or replaced. This will allow the IBS to default to an 80% SOC and initiate the quick learning curve. For a detailed explanation on the IBS reset, refer to the Battery System Description and Operation.

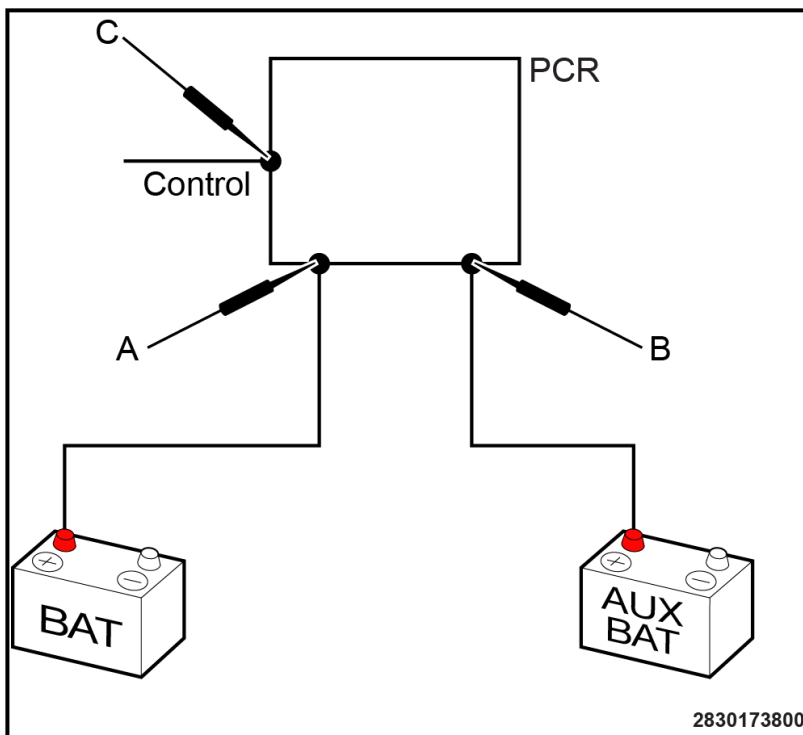
CHECKING FOR THE POWER CONTROL RELAY NOT DISCONNECTING PROPERLY WHEN COMMANDED DURING CRANKING: It can be difficult to test the power control relay for properly disconnecting during an engine cranking event without using a lab scope. This is due to the relay only being energized (opened) for approximately 20-40ms.

TECH TIPS:

- The normally closed power control relay should be closed 99% of the time. It is only opened by the PCM during the starter in-rush at initial engine cranking.
 - A severely depleted auxiliary battery could set a fault due to the voltage difference between the batteries being less than the calibrated threshold during a cranking event when the batteries are separated.
1. Disconnect the power control relay harness connector. Load test the power control relay coil ground circuit.
 1. If the ground circuit fails the load test, repair the ground circuit for an open or high resistance.
 2. If the ground circuit passes the load test, reconnect the power control relay harness connector.
 - Continue to step 2 to test without a lab scope.
 - Continue to step 4 to test with a lab scope.
 2. The relay should energize and open when 12v is supplied to the relay on the control circuit, which comes from the output of the PCR control relay inside the PDC. The PCR control relay is typically a Printed Circuit Board (PCB) relay which cannot be removed and jumped across. Turn the ignition on and perform one of the following to energize the power control relay:
 1. If there is an actuator available in the scan tool, command the power control relay on.
 2. Using a test light connected to ground, back probe the PCR control relay low side driver control circuit at the PDC connector to energize the relay.
 3. Using a fused jumper connected to B+, back probe the power control relay control circuit at the power control relay harness connector to energize the relay.

Continue to step 3.

3. With 12v provided to the power control relay, measure the voltage at both cable end terminals of the power control relay. If the relay is disconnected, the voltage on the auxiliary battery terminal should start to drop below the voltage on the main battery terminal due to the load on the auxiliary battery.
 1. If the voltage starts to drop on the terminal that leads to the auxiliary battery, the relay is functioning properly.
 2. If the voltage drops drastically below approximately 8v on the terminal connected to the auxiliary battery, isolate and test the auxiliary battery with the GR8 battery tester.
 3. If the voltage at both terminals remains the same, replace the power control relay and retest.
 - Perform an IBS reset by removing the IBS from the battery cable end and disconnecting the IBS harness connector for 30 seconds after an auxiliary battery is charged or replaced. This will allow the IBS to default to an 80% SOC and initiate the quick learning curve.



4. To test with a lab scope, connect channel A to the main battery side terminal of the power control relay. Connect channel B to the auxiliary battery side terminal of the power control relay. Connect channel C to the control circuit at the power control relay. Set the channels to the 20v scale. Crank the engine and record the voltage reads. The voltage on the main battery (channel A) side should drop considerably during cranking. At initial starter in-rush the voltage can drop to as low as 7.0 volts. If the power control relay is operating correctly, you should simultaneously see 12v present on the control circuit (channel C) and the auxiliary battery side voltage (channel B) should stay near 12v during the initial 20-40ms of starter engagement. After this brief period, channel C should drop back to 0v and the relay will de-energize (close), and the voltages should equalize on channel A and channel B.
1. If the auxiliary battery voltage (channel B) stays near 12v as the main battery voltage (channel A) drops at initial cranking, the power control relay and system are functioning properly.
 2. If the auxiliary battery voltage (channel B) stays the same as the main battery voltage (channel A) when the voltage drops at initial cranking, the power control relay likely did not open.
 - If 12v was present on the control circuit (channel C), the relay is faulty. Replace the relay and retest.
 - If 12v was NOT present on the control circuit (channel C), check the control circuit and fuse for an open. If the fuse is open, check the circuit for a short to ground. If the circuit and fuse check good, check the operation of the PCR Control Relay inside the PDC.
 3. If the auxiliary battery voltage (channel B) drops severely (below approximately 8.0 volts) but is not the same as the main battery voltage (channel A) at initial cranking, the auxiliary battery is likely faulty or severely undercharged. Test the auxiliary battery using the GR8 Battery Tester.

IGNITION OFF DRAW TEST

The term Ignition-OFF Draw (IOD) identifies a normal condition where power is being drained from the battery with the ignition switch in the OFF position. A normal vehicle electrical system will draw up to 50 milliamperes (0.050 ampere) with the ignition switch in the OFF position, and all non-ignition controlled circuits in proper working order. Up to 50 mA are needed to enable the memory functions for the Powertrain Control Module (PCM), digital clock, electronically tuned radio, and other modules which may vary with the vehicle equipment.

Excessive IOD can be caused by:

- Electrical items left on
- Inoperative or improperly adjusted switches
- Inoperative or shorted electronic modules and components

- An internally shorted generator
- Intermittent shorts in the wiring

If the IOD is over 50 milliamperes, the problem must be found and corrected before replacing a battery. In most cases, the battery can be charged and returned to service after the excessive IOD condition has been corrected.

1. Verify that all electrical accessories are OFF. Turn OFF all lamps, remove the ignition key, and close all doors. If the vehicle is equipped with an illuminated entry system or an electronically tuned radio, allow the electronic timer function of these systems to shut OFF (time out). This may take up to thirty minutes.

Refer to the following Electronic Module Ignition-OFF Draw Table for more information:

ELECTRONIC MODULE IGNITION-OFF DRAW (IOD) TABLE			
Module	Time Out? (If Yes, Interval And Wake-Up Input)	IOD	IOD After Time Out
Radio	No	200 mA for 30 minutes after ignition is shut OFF. Base vehicle IOD 25 mA when bus(es) are down and all modules are in 'sleep' mode.	N/A
USB/MEDIA Ports	Yes/Ignition on	0.38mA for 60 minutes after ignition is shut OFF. Base vehicle IOD 25 mA when bus(es) are down and all modules are in 'sleep' mode.	N/A
Audio Power Amplifier	No	up to 1 mA	N/A
Powertrain Control Module (PCM)	No	0.95 mA	N/A
Instrument Panel Cluster (IPC)	No	0.44 mA	N/A

2. Determine that the under hood lamp is operating properly, then disconnect the lamp wire harness connector or remove the lamp bulb.
3. Turn OFF all electrical accessories.
4. Disconnect and isolate the negative battery cable. If equipped with an Intelligent Battery Sensor (IBS), disconnect the IBS connector first before disconnecting the negative battery cable.

NOTE: If equipped, disconnect the negative side of the Auxiliary Battery. This must be disconnected for the duration of the test.

CAUTION: Do not open any doors, or turn on any electrical accessories with the lowest milliampere scale selected, or the multi-meter may be damaged.

5. Connect a 10 gauge jumper wire between the negative battery cable and the negative battery post.
6. Turn the ignition key ON and then OFF and wait for all systems to enter sleep mode. **This can take up to 60 minutes.**

NOTE: Do not break the connection between the jumper wire and the battery. If the connection between the negative battery and the negative cable terminal clamp is lost during any part of the IOD test, the electronic timer function will be activated and all of the tests will have to be repeated.

7. Set an electronic digital multimeter to its highest amperage scale. Connect the multimeter to the battery negative cable terminal clamp and the negative battery terminal, but not on the jumper connection.

8. Remove the jumper wire without breaking the digital multimeter connection.
9. The multimeter leads must be securely clamped to the battery negative cable terminal clamp and the negative battery terminal, but not the jumper wire.
10. The high amperage IOD reading on the multimeter should be very low or nonexistent, depending upon the electrical equipment in the vehicle. If the amperage reading remains high, remove and replace each fuse or circuit breaker in the Body Control Module (BCM) and Power Distribution Center (PDC), one at a time until the amperage reading becomes very low, or nonexistent. Refer to the appropriate wiring information for complete BCM and PDC, circuit breaker, and circuit identification. This will isolate each circuit and identify the circuit that is the source of the high amperage IOD. If the amperage reading remains high after removing and replacing each fuse, disconnect the wire harness from the generator. If the amperage reading now becomes very low or nonexistent, diagnose and repair the Charging System as necessary. After the high amperage IOD has been corrected, switch the multimeter to progressively lower amperage scales and, if necessary, repeat the fuse and circuit breaker remove-and-replace process to identify and correct all sources of excessive IOD. It is now safe to select the lowest milliampere scale of the multimeter to check the low-amperage IOD.
11. Observe the multimeter reading. The low-amperage IOD should not exceed 50 milliamperes (0.050 ampere). If the current draw exceeds 50 milliamperes, isolate each circuit using the fuse and circuit breaker remove-and-replace process. The multimeter reading will drop to within the acceptable limit when the source of the excessive current draw is disconnected. Repair this circuit as required; whether a wiring short, incorrect switch adjustment, or an inoperative component is the cause.

OPEN CIRCUIT VOLTAGE TEST

A battery open circuit voltage (no load) test will show the approximate state of charge of a battery.

Before proceeding with this test, completely charge the battery. Refer to [12 VOLT BATTERY CHARGING](#) .

1. Before measuring the open circuit voltage, the surface charge must be removed from the battery. Turn on the headlights for 15 seconds, then allow up to five minutes for the battery voltage to stabilize.
2. Disconnect and isolate the negative battery cable. If equipped with an Intelligent Battery Sensor (IBS), disconnect the IBS connector first before disconnecting the negative battery cable.
3. Using a voltmeter connected to the battery posts (see the instructions provided by the manufacturer of the voltmeter), measure the open-circuit voltage.

See the Open Circuit Voltage Table. This voltage reading will indicate the battery state of charge, but will not reveal its cranking capacity. If a battery has an open-circuit voltage reading of 12.4 volts or greater, it may be load tested to reveal its cranking capacity.

OPEN CIRCUIT VOLTAGE TABLE	
Open Circuit Voltage	Charge Percentage
11.7 volts or less	0%
12.0 volts	25%
12.2 volts	50%
12.4 volts	75%
12.8 volts or more	100%

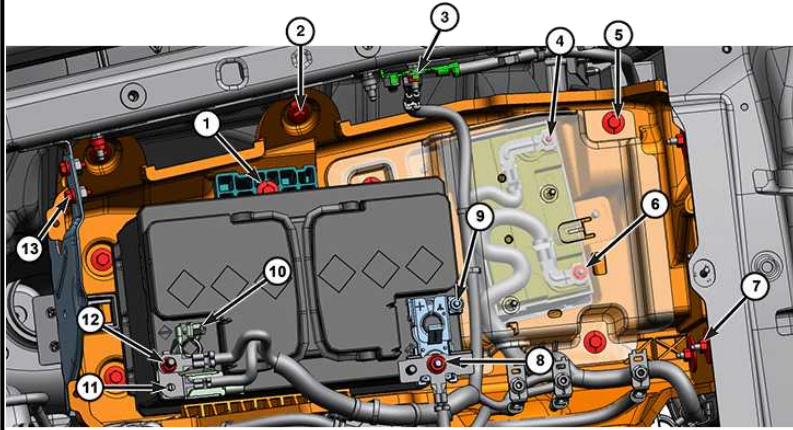
TECHNICAL SPECIFICATIONS

BATTERY

Â	3.6L w/ESS	3.6L w/ESS Optional	3.0L Diesel	Auxiliary Battery
Voltage (V)	12	12	12	12
Capacity (Ah)	65	70	80	12
Intensity (A)	600	650	700	200

TORQUE SPECIFICATIONS

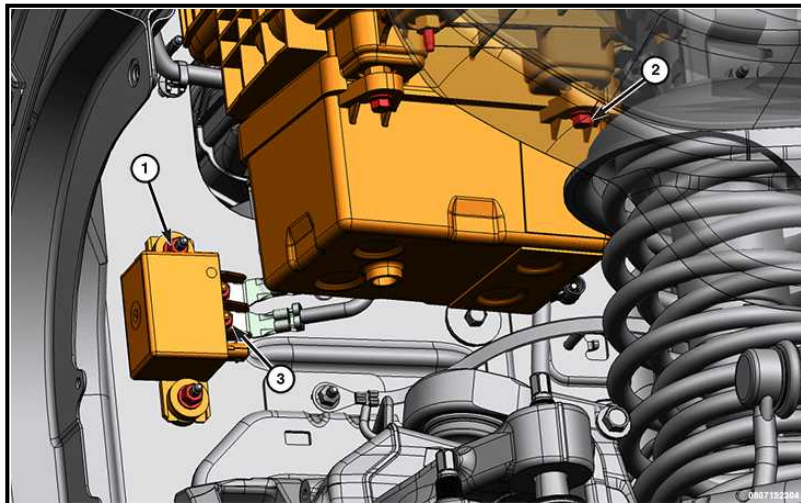
BATTERY SYSTEM



6807193360

CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	Battery Hold Down Bolt	6 N.m (53 In. Lbs.)	-
2	Battery Tray Bolts	6 N.m (53 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
3	Negative Battery Cable to Body M6	12 N.m (9 Ft. Lbs.)	-
4	Auxiliary Battery - M6 Double Ended Torx Stud	6 N.m (53 In. Lbs.)	-
5	Auxiliary Battery Cover to Battery Tray	4 N.m (35 In. Lbs.)	-
6	Auxiliary Battery M6 Nut	6 N.m (53 In. Lbs.)	-
7	Battery Tray Nuts	4 N.m (35 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
8	Battery Positive Cable M6	9 N.m (80 In. Lbs.)	-
9	Battery Positive Cable M5	9 N.m (80 In. Lbs.)	-
10	Intelligent Battery Sensor (IBS) To Negative Post	7 N.m (62 In. Lbs.)	-
11	Auxiliary Negative Cable to Negative Cable at Battery	8 N.m (71 In. Lbs.)	-
12	Negative Cable To Intelligent Battery Sensor (IBS)	10 N.m (89 In. Lbs.)	-
13	Battery Tray To Front Bracket Support	4 N.m (35 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
-	Negative Battery Cable to Body M8	8 N.m (71 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	PCR Mount To Ground	11 N.m (8 Ft. Lbs.)	-
2	Auxiliary Battery Tray To Battery Tray	8 N.m (71 In. Lbs.)	-
3	B+ Wire To PCR Positive Terminals	11 N.m (8 Ft. Lbs.)	-
-	Battery Ground To Frame	8 N.m (71 In. Lbs.)	-
-	Ground To PCR Bracket	9 N.m (80 In. Lbs.)	Right Hand Drive Only
-	Negative Cable Stud	15 N.m (11 Ft. Lbs.)	Right Hand Drive Only



STANDARD PROCEDURE

12 VOLT BATTERY CHARGING

WARNING: Never exceed twenty amperes when charging a cold (-1°C [30°F] or lower) battery. The battery may arc internally and explode. Personal injury or vehicle damage may result.

WARNING: If the battery shows signs of freezing, leaking, loose posts, do not test, assist-boost, or charge. The battery may arc internally and explode. Personal injury or vehicle damage may result.

WARNING: EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY OR VEHICLE DAMAGE MAY RESULT.

WARNING: THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.

CAUTION: Always disconnect and isolate the battery negative cable before charging a battery. Do not exceed sixteen volts while charging a battery. Damage to the vehicle electrical system components may result.

CAUTION: Battery electrolyte will bubble inside the battery case during normal battery charging. Electrolyte boiling or being discharged from the battery vents indicates a battery overcharging condition. Immediately reduce the charging rate or turn off the charger to evaluate the battery condition. Damage to the battery may result from overcharging.

CAUTION:

The battery should not be hot to the touch. If the battery feels hot to the touch, turn off the charger and let the battery cool before continuing the charging operation. Damage to the battery may result.

CHARGING A BATTERY: Batteries should be charged one of two ways depending on the situation and reason for charging. A battery is fully-charged when:

- The Midtronics (special tool #GR8-1220KIT-CHRY, AGM Battery Tester/Charger Station) tester indicates battery is GOOD.
- All of the battery cells are gassing freely during battery charging.
- An Open-circuit voltage of the battery is 12.6 volts or above.

NOTE:

It was previously documented to never blind charge a vehicle at the pole clamp. However, if the vehicle is brought in with a battery issue or complaint, and the battery is being charged and tested using the GR8 Battery Tester, the tester should be connected directly to the Pole clamp at the negative Battery post. With the updates done on the GR8 Battery Tester, it will not test the battery correctly if connected and charged through the Intelligent Battery Sensor (IBS). After performing any testing requiring blind charging, a battery has been replaced or after any repairs are made, the IBS reset should be initiated to allow the IBS to update quickly. See the IBS Component Functional Description information in the Battery System Description and Operation for details on initiating the IBS learning curve.

CHARGING USING THE GR8 BATTERY TESTER (RECOMMENDED)

1. The GR8 tester software has been updated to improve testing and charging. Before connecting the GR8 battery tester, verify that the tester has been updated to the latest software version.
2. Disconnect the battery cables from the battery posts.
3. Connect the GR8 battery tester to the vehicle and select battery charging.
4. Pick the type of battery being charged (AGM, Lead Sulfated).

NOTE:

If unsure which type of battery is being tested, check the sticker on top of the battery. AGM batteries will typically be called out on the sticker indicating that the battery is an AGM battery. On some vehicles the battery thermal cover may need to be pulled back to see the sticker.

5. Charge the battery with the GR8 tester.

NOTE:

An AGM battery should never be charged above 14.4 volts. A standard flooded battery should not be charged above 14.4 volts for an extended period.

6. The screen should display the amperage, voltage, and the expected charge time.

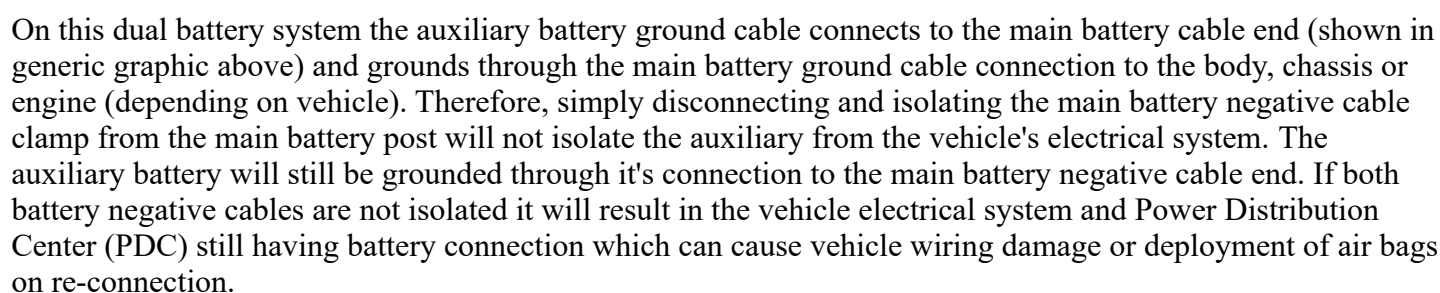
CHARGING USING A STANDARD BATTERY CHARGER

- This should only be performed if the vehicle was not brought in for a battery issue and a battery is depleted during service. The battery should be charged through the IBS. To do this the negative clamp on the charger should be placed on the negative cable attachment to the IBS, the Jump Post terminal if equipped, or a good chassis ground, NOT the Pole clamp at the negative Battery post. Without proper clamp placement, the IBS data will not update.

NOTE:

An AGM battery should never be charged above 14.4 volts. A standard flooded battery should not be charged above 14.4 volts for an extended period.

BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM



1. Turn the ignition off. Wait five minutes to allow the main modules to go to sleep.
2. Disconnect and isolate the supplemental (auxiliary) battery negative cable from the main battery negative cable end. This will disconnect and isolate the auxiliary battery ground.
3. The main battery ground can be disconnected by removing the main battery negative cable from the negative battery cable end, or by disconnecting the IBS connector, loosening the negative battery clamp nut and removing the negative battery cable end from the battery post. Either method will disconnect the main battery. Both batteries should be disconnected from the vehicle electrical system.
4. Measure the voltage at the PDC positive battery cable connection to verify the vehicle electrical system is powered down.

NOTE: On some vehicles a small amount of voltage may be present (typically less than approximately 0.5 volts) due to capacitors in some modules still having voltage stored. Anything less than 1.0 volts should be safe.

1. Connect the main battery negative clamp to the post and tighten to the proper specifications, or connect the main battery negative cable to the negative cable clamp. Refer to **TORQUE SPECIFICATIONS** . If the main battery negative cable is connected with a nut, install the nut and tighten to the proper specifications. Refer to **TORQUE SPECIFICATIONS** .
2. Connect the IBS harness connector if disconnected.
3. Connect the auxiliary battery negative cable to the main battery negative cable clamp. If connected by a nut, install the nut and tighten to the proper specifications. Refer to **TORQUE SPECIFICATIONS** .

NOTE: Overtightening of the nuts connecting the negative cables to the IBS may cause damage to the IBS or break the stud.

BATTERY

REMOVAL AND INSTALLATION

PRIMARY BATTERY - LHD

REMOVAL

WARNING: To protect the hands from battery acid, a suitable pair of heavy duty rubber gloves should be worn when removing or servicing a battery. Safety glasses also should be worn.

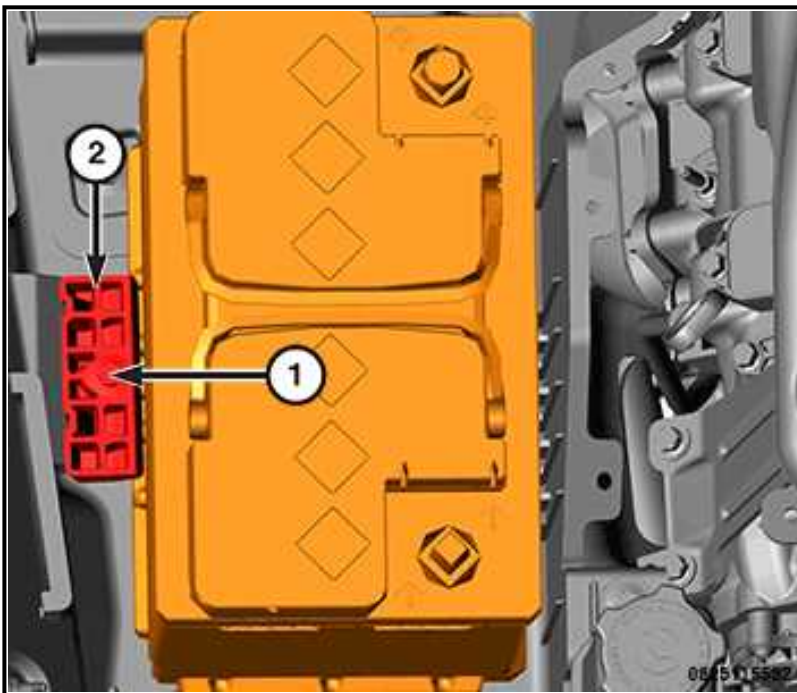
WARNING: Remove metallic jewelry to avoid injury by accidental arcing of battery current.

WARNING: The battery negative and positive cable polarity are different from the gasoline engine equipped vehicles to the diesel engine equipped vehicles. Please note the location of the positive and negative cables prior to service of the battery or related components.

1. Disconnect and isolate the negative battery cable(s). Refer to [REMOVAL AND INSTALLATION](#) .
2. Disconnect and isolate the positive battery cable.

NOTE: On the positive cable there is a plastic clip that will be attached to the cable, you must use a trim stick to remove the clip lock to the battery or it will break off from the cable.

3. Remove the thermal guard (if equipped) from the battery.



1 - Battery Bracket Bolt
2 - Battery Bracket

4. Remove the battery bracket bolt and remove the battery bracket.
5. Remove the battery from the vehicle.

INSTALLATION

WARNING: The battery negative and positive cable polarity are different from the gasoline engine equipped vehicles to the diesel engine equipped vehicles. Please note the location of the positive and negative cables prior to service of the battery or related components.

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

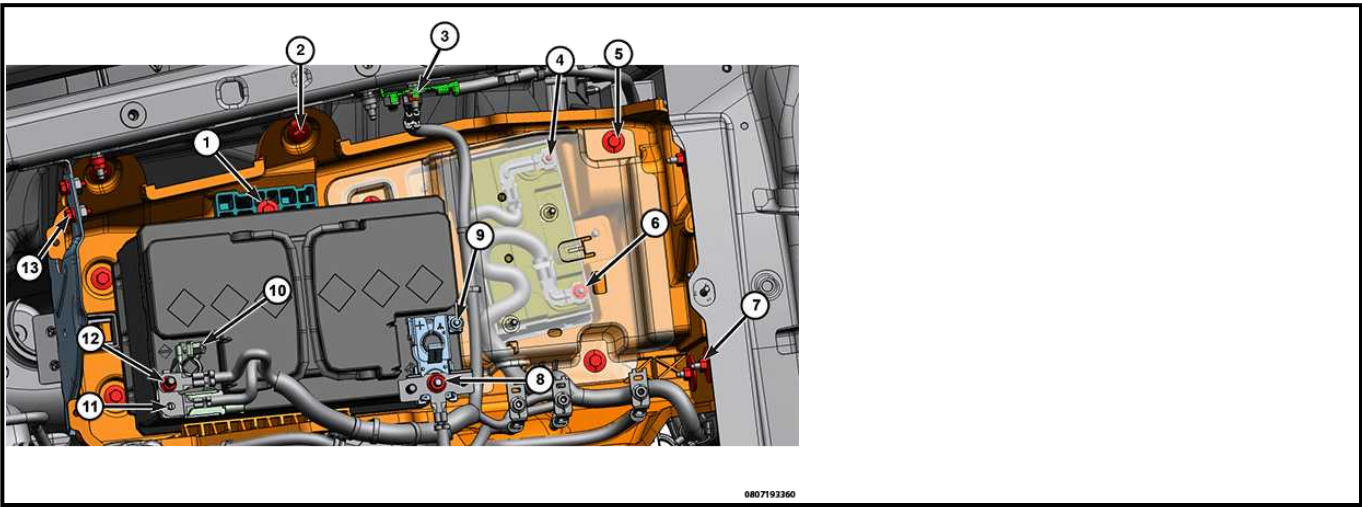
- When replacing the battery, the thermal guard **MUST** be transferred to the new battery (if equipped).
- Install the battery in the vehicle making sure that the thermal guard (if equipped) is present and the battery is properly positioned in the battery tray.

NOTE: Left hand drive gasoline engine shown, left hand drive diesel similar. Right hand drive gasoline and diesel similar with the battery and related components packaged on the left side of the engine compartment.

- Verify that all features are operating properly before returning vehicle.

TORQUE SPECIFICATIONS

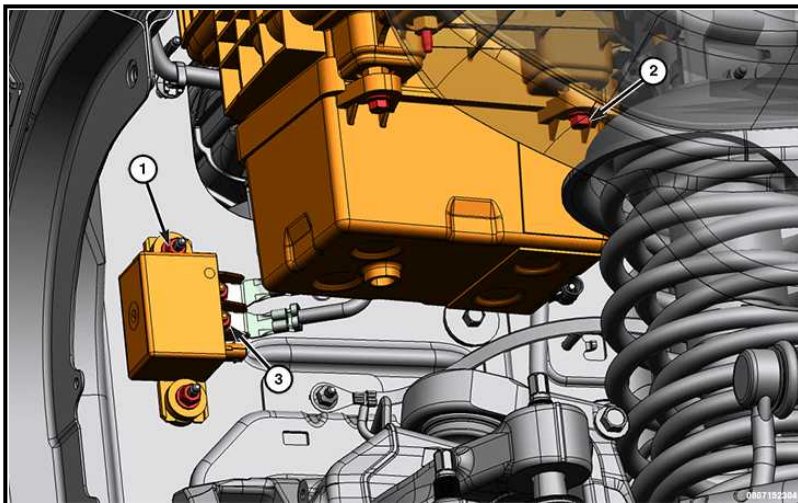
BATTERY SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	Battery Hold Down Bolt	6 N.m (53 In. Lbs.)	-
2	Battery Tray Bolts	6 N.m (53 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
3	Negative Battery Cable to Body M6	12 N.m (9 Ft. Lbs.)	-
4	Auxiliary Battery - M6 Double Ended Torx Stud	6 N.m (53 In. Lbs.)	-
5	Auxiliary Battery Cover to Battery Tray	4 N.m (35 In. Lbs.)	-
6	Auxiliary Battery M6 Nut	6 N.m (53 In. Lbs.)	-
7	Battery Tray Nuts	4 N.m (35 In. Lbs.)	Do not reuse these fasteners. If removed, a

CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
			NEW fastener must be installed and tightened to specifications.
8	Battery Positive Cable M6	9 N.m (80 In. Lbs.)	-
9	Battery Positive Cable M5	9 N.m (80 In. Lbs.)	-
10	Intelligent Battery Sensor (IBS) To Negative Post	7 N.m (62 In. Lbs.)	-
11	Auxiliary Negative Cable to Negative Cable at Battery	8 N.m (71 In. Lbs.)	-
12	Negative Cable To Intelligent Battery Sensor (IBS)	10 N.m (89 In. Lbs.)	-
13	Battery Tray To Front Bracket Support	4 N.m (35 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
-	Negative Battery Cable to Body M8	8 N.m (71 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	PCR Mount To Ground	11 N.m (8 Ft. Lbs.)	-
2	Auxiliary Battery Tray To Battery Tray	8 N.m (71 In. Lbs.)	-
3	B+ Wire To PCR Positive Terminals	11 N.m (8 Ft. Lbs.)	-
-	Battery Ground To Frame	8 N.m (71 In. Lbs.)	-
-	Ground To PCR Bracket	9 N.m (80 In. Lbs.)	Right Hand Drive Only
-	Negative Cable Stud	15 N.m (11 Ft. Lbs.)	Right Hand Drive Only



BATTERY, SUPPLEMENTAL

REMOVAL AND INSTALLATION

SUPPLEMENTAL BATTERY - LHD

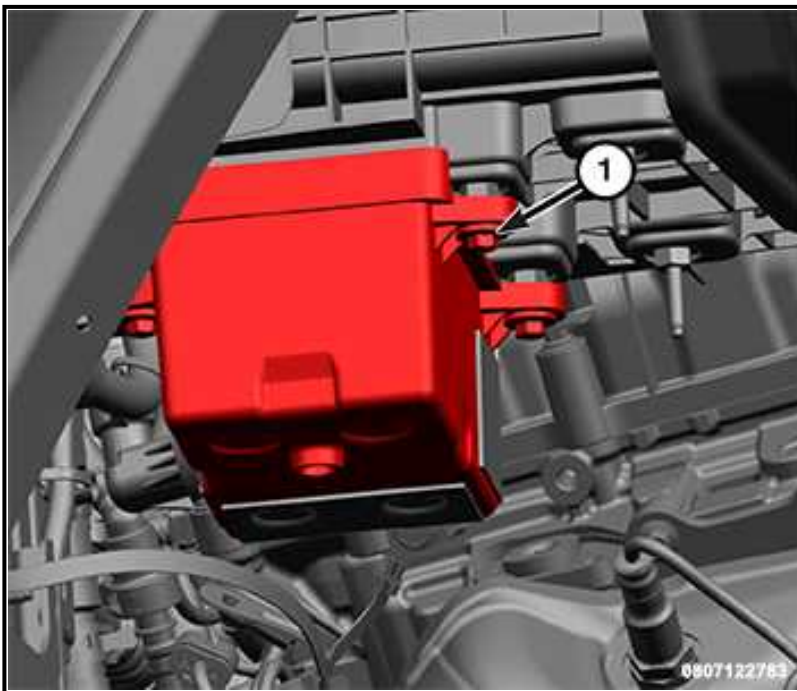
REMOVAL

WARNING: To protect the hands from battery acid, a suitable pair of heavy duty rubber gloves should be worn when removing or servicing a battery. Safety glasses also should be worn.

WARNING: Remove metallic jewelry to avoid injury by accidental arcing of battery current.

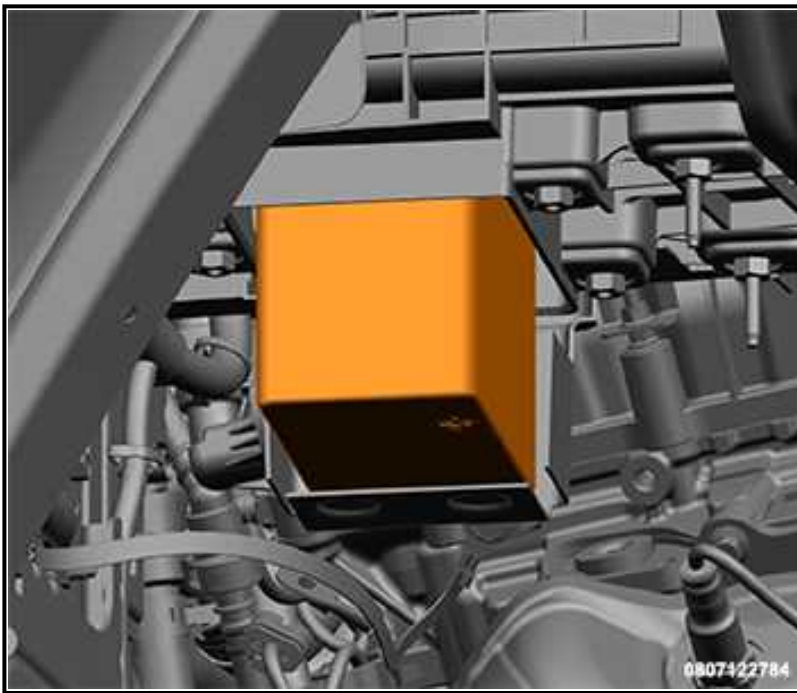
WARNING: The battery negative and positive cable polarity are different from the gasoline engine equipped vehicles to the diesel engine equipped vehicles. Please note the location of the positive and negative cables prior to service of the battery or related components.

1. Disconnect and isolate the negative battery cable(s). Refer to [REMOVAL AND INSTALLATION](#) .
2. Remove the right front splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) [SHIELD, SPLASH, REAR WHEELHOUSE, REMOVAL AND INSTALLATION](#) .



1 - Supplemental Battery Tray Bolts

3. Remove the 3 bolts from the bottom of the Supplemental battery tray.



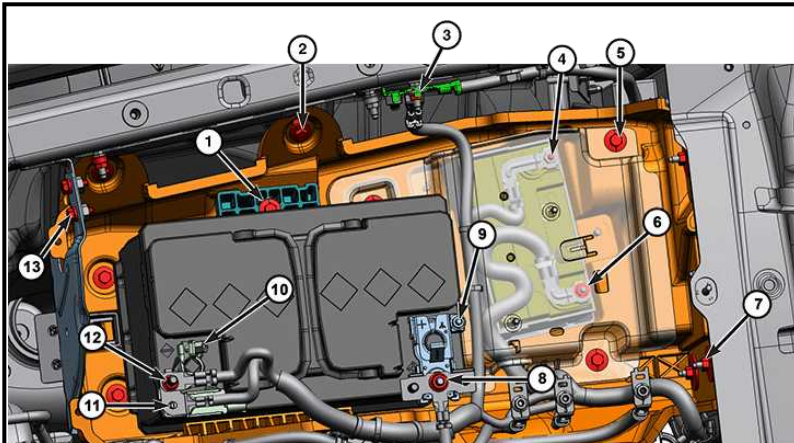
4. Remove the battery far enough out to gain access to the negative and positive cables for the supplemental battery. Disconnect and isolate both cables.
5. Remove the supplemental battery.

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

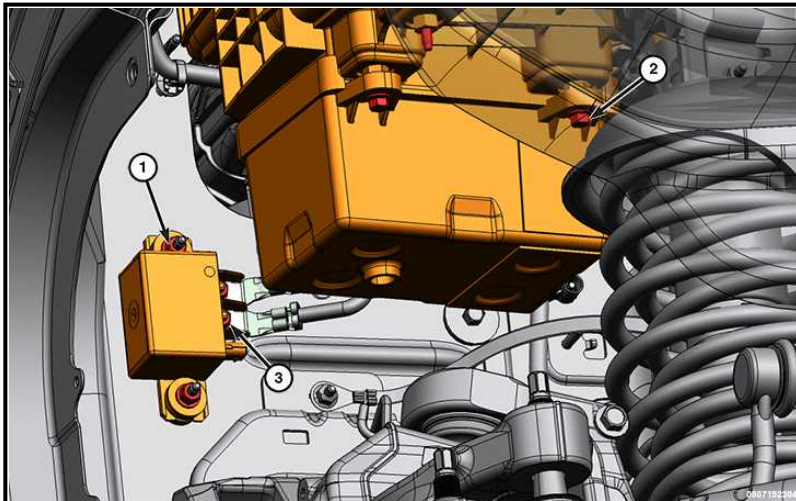
BATTERY SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	Battery Hold Down Bolt	6 N.m (53 In. Lbs.)	-
2	Battery Tray Bolts	6 N.m (53 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
3	Negative Battery Cable to Body M6	12 N.m (9 Ft. Lbs.)	-
4	Auxiliary Battery - M6 Double Ended Torx Stud	6 N.m (53 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
5	Auxiliary Battery Cover to Battery Tray	4 N.m (35 In. Lbs.)	-
6	Auxiliary Battery M6 Nut	6 N.m (53 In. Lbs.)	-
7	Battery Tray Nuts	4 N.m (35 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
8	Battery Positive Cable M6	9 N.m (80 In. Lbs.)	-
9	Battery Positive Cable M5	9 N.m (80 In. Lbs.)	-
10	Intelligent Battery Sensor (IBS) To Negative Post	7 N.m (62 In. Lbs.)	-
11	Auxiliary Negative Cable to Negative Cable at Battery	8 N.m (71 In. Lbs.)	-
12	Negative Cable To Intelligent Battery Sensor (IBS)	10 N.m (89 In. Lbs.)	-
13	Battery Tray To Front Bracket Support	4 N.m (35 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
-	Negative Battery Cable to Body M8	8 N.m (71 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	PCR Mount To Ground	11 N.m (8 Ft. Lbs.)	-
2	Auxiliary Battery Tray To Battery Tray	8 N.m (71 In. Lbs.)	-
3	B+ Wire To PCR Positive Terminals	11 N.m (8 Ft. Lbs.)	-
-	Battery Ground To Frame	8 N.m (71 In. Lbs.)	-
-	Ground To PCR Bracket	9 N.m (80 In. Lbs.)	Right Hand Drive Only
-	Negative Cable Stud	15 N.m (11 Ft. Lbs.)	Right Hand Drive Only



SUPPLEMENTAL BATTERY - DIESEL

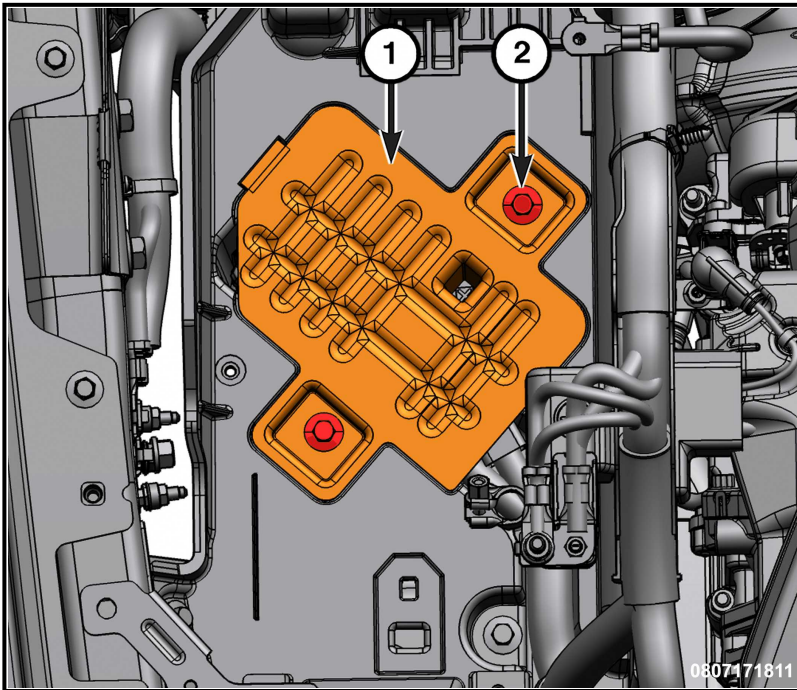
REMOVAL

WARNING: To protect the hands from battery acid, a suitable pair of heavy duty rubber gloves should be worn when removing or servicing a battery. Safety glasses also should be worn.

WARNING: Remove metallic jewelry to avoid injury by accidental arcing of battery current.

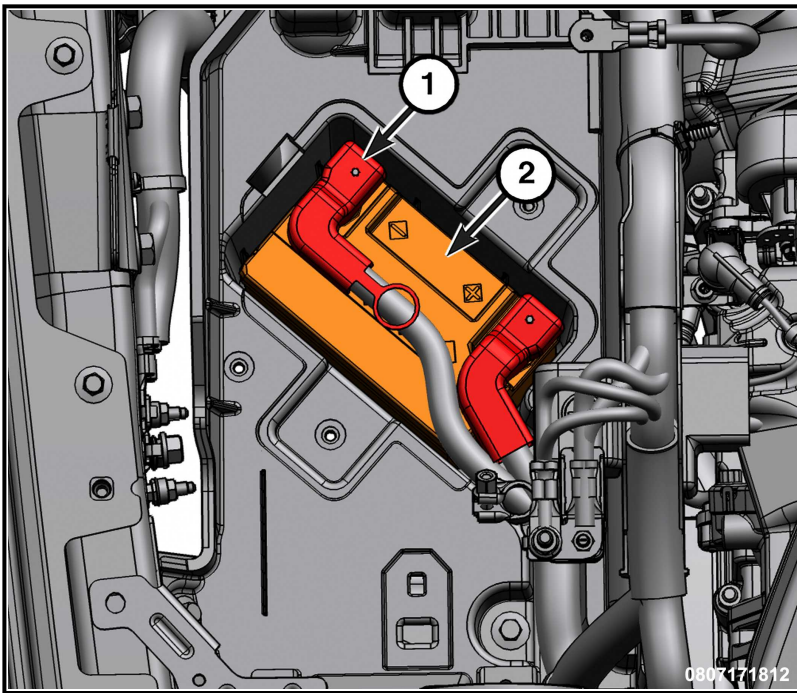
WARNING: The battery negative and positive cable polarity are different from the gasoline engine equipped vehicles to the diesel engine equipped vehicles. Please note the location of the positive and negative cables prior to service of the battery or related components.

1. Remove the main battery Refer to **BATTERY, REMOVAL AND INSTALLATION**, or **BATTERY, SUPPLEMENTAL, REMOVAL AND INSTALLATION**.



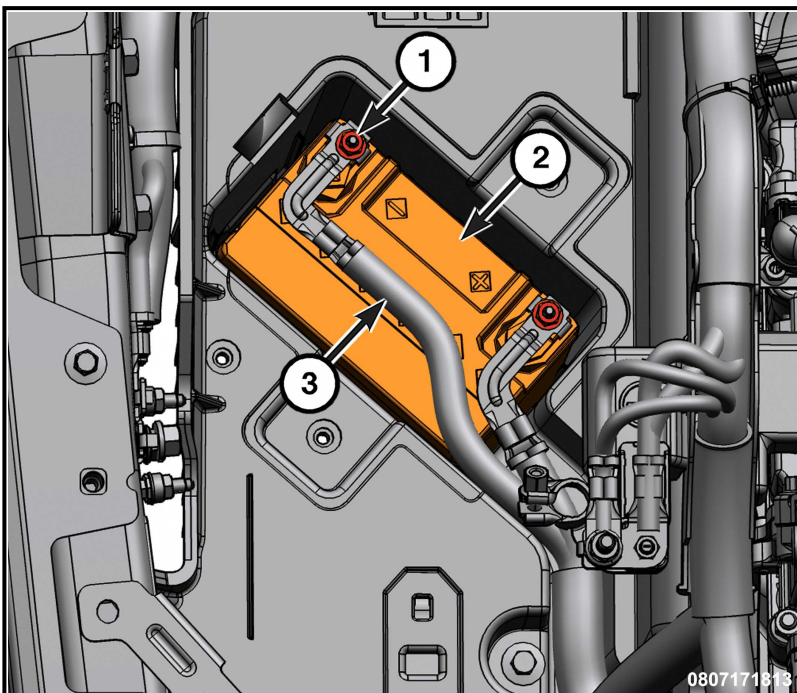
1 - Supplemental Battery Cover
2 - Cover Bolts

2. Remove the fasteners and the supplemental battery cover from the vehicle.



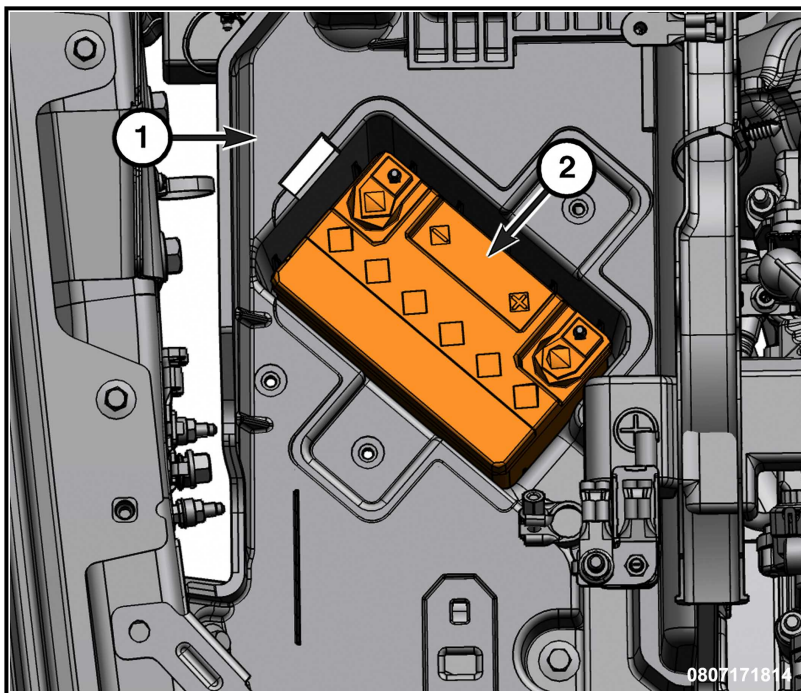
- | |
|-----------------------------|
| 1 - Battery Terminal Covers |
| 2 - Supplemental Battery |

3. Release the protective battery terminal covers from the battery terminals and set aside.



- | |
|--------------------------------|
| 1 - Battery Terminal Fasteners |
| 2 - Supplemental Battery |

4. Remove the fasteners from the supplemental battery post and set aside.



1 - Battery Tray
2 - Supplemental Battery

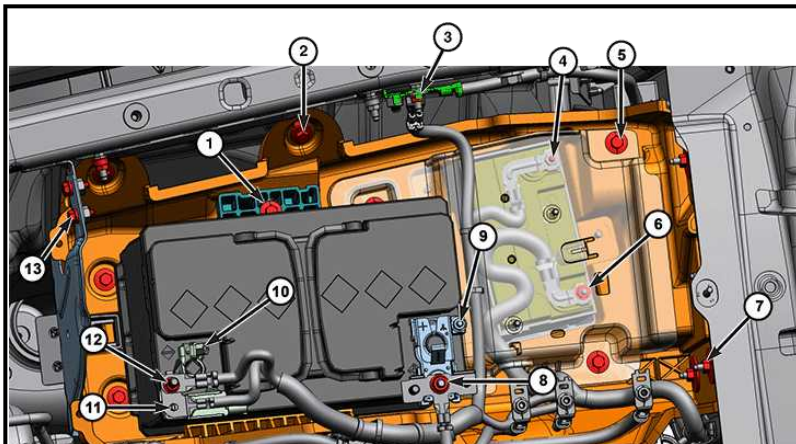
5. Remove the supplemental battery from the battery tray.

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

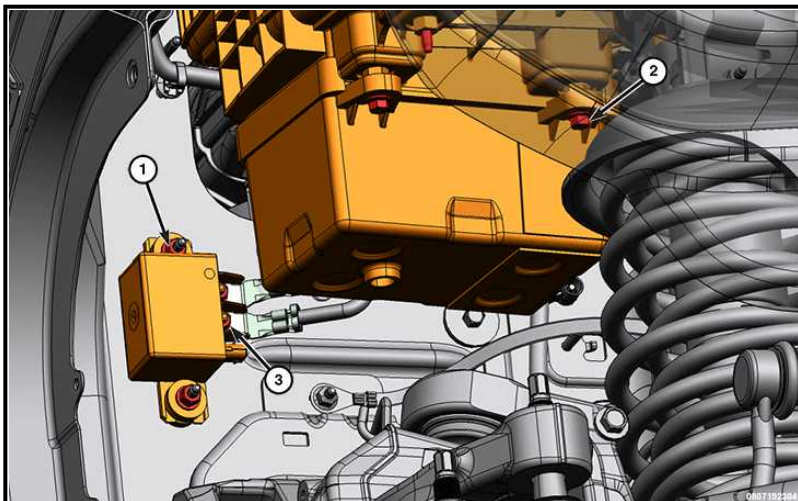
BATTERY SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	Battery Hold Down Bolt	6 N.m (53 In. Lbs.)	-
2	Battery Tray Bolts	6 N.m (53 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
3	Negative Battery Cable to Body M6	12 N.m (9 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
4	Auxiliary Battery - M6 Double Ended Torx Stud	6 N.m (53 In. Lbs.)	-
5	Auxiliary Battery Cover to Battery Tray	4 N.m (35 In. Lbs.)	-
6	Auxiliary Battery M6 Nut	6 N.m (53 In. Lbs.)	-
7	Battery Tray Nuts	4 N.m (35 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
8	Battery Positive Cable M6	9 N.m (80 In. Lbs.)	-
9	Battery Positive Cable M5	9 N.m (80 In. Lbs.)	-
10	Intelligent Battery Sensor (IBS) To Negative Post	7 N.m (62 In. Lbs.)	-
11	Auxiliary Negative Cable to Negative Cable at Battery	8 N.m (71 In. Lbs.)	-
12	Negative Cable To Intelligent Battery Sensor (IBS)	10 N.m (89 In. Lbs.)	-
13	Battery Tray To Front Bracket Support	4 N.m (35 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
-	Negative Battery Cable to Body M8	8 N.m (71 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	PCR Mount To Ground	11 N.m (8 Ft. Lbs.)	-
2	Auxiliary Battery Tray To Battery Tray	8 N.m (71 In. Lbs.)	-
3	B+ Wire To PCR Positive Terminals	11 N.m (8 Ft. Lbs.)	-
-	Battery Ground To Frame	8 N.m (71 In. Lbs.)	-
-	Ground To PCR Bracket	9 N.m (80 In. Lbs.)	Right Hand Drive Only
-	Negative Cable Stud	15 N.m (11 Ft. Lbs.)	Right Hand Drive Only



CABLES, BATTERY

REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

The Battery cables for the battery Negative and Positive cables are part of the main harness and are not serviced separately. Please review the parts look up for the correct main harness per the application.

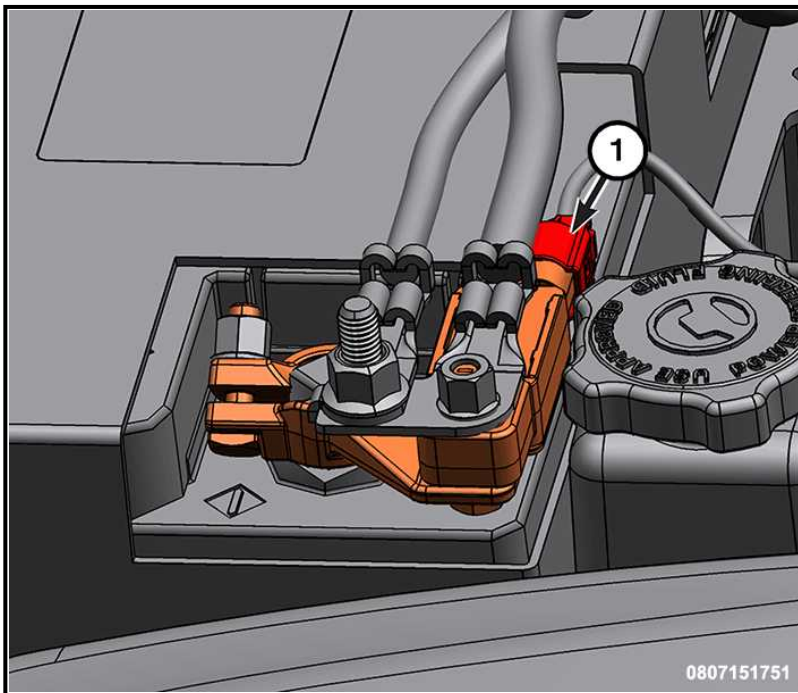
SENSOR, INTELLIGENT BATTERY (IBS)

REMOVAL AND INSTALLATION

INTELLIGENT BATTERY SENSOR (IBS)

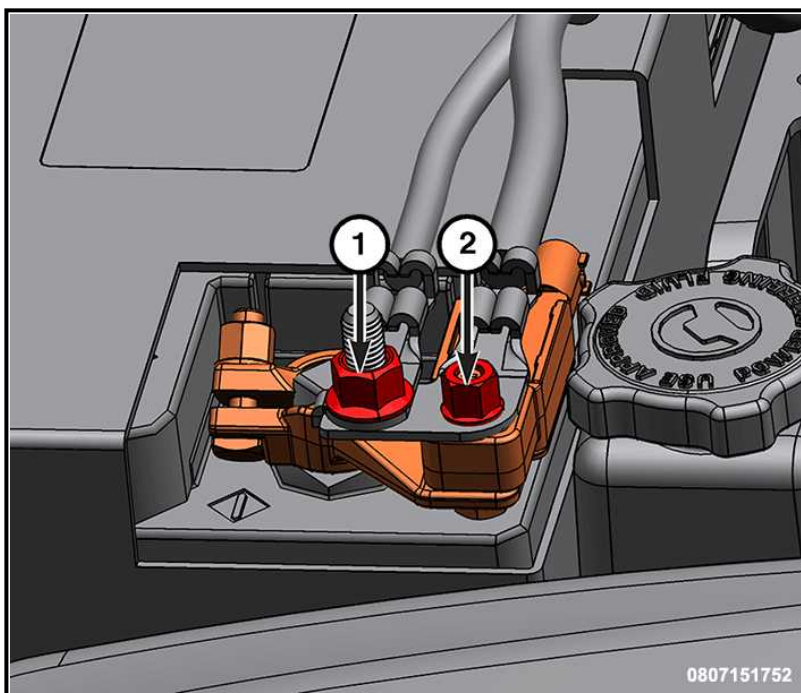
REMOVAL

NOTE: Vehicle with auxiliary battery shown all others similar.



1 - IBS Wire Harness Connector

1. Disconnect the electrical connector from the IBS.

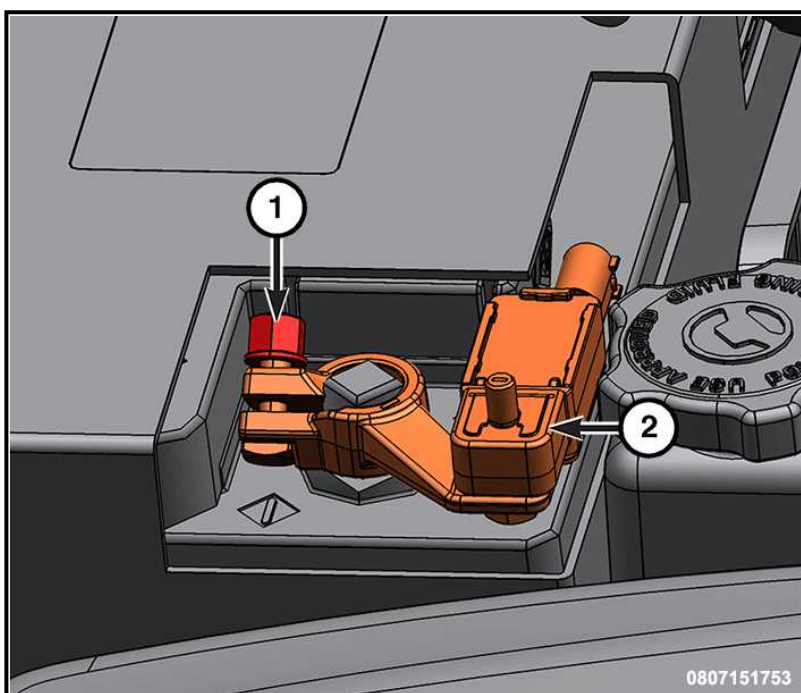


1 - M8 Nut

2 - M6 Nut

NOTE: Failure to isolate the negative cables may cause damage to the auxiliary battery and other components.

2. Stabilize the IBS, remove the M8 nut, remove the M6 nut, remove and isolate both negative battery cables.



1 - M6 Nut

2 - Intelligent Battery Sensor (IBS)

NOTE: Do not remove the M6 nut from the IBS, it is a capture nut and if removed will damage the IBS.

3. Loosen the M6 nut from the IBS, using the appropriate battery terminal puller, remove the IBS from the negative battery post.

INSTALLATION

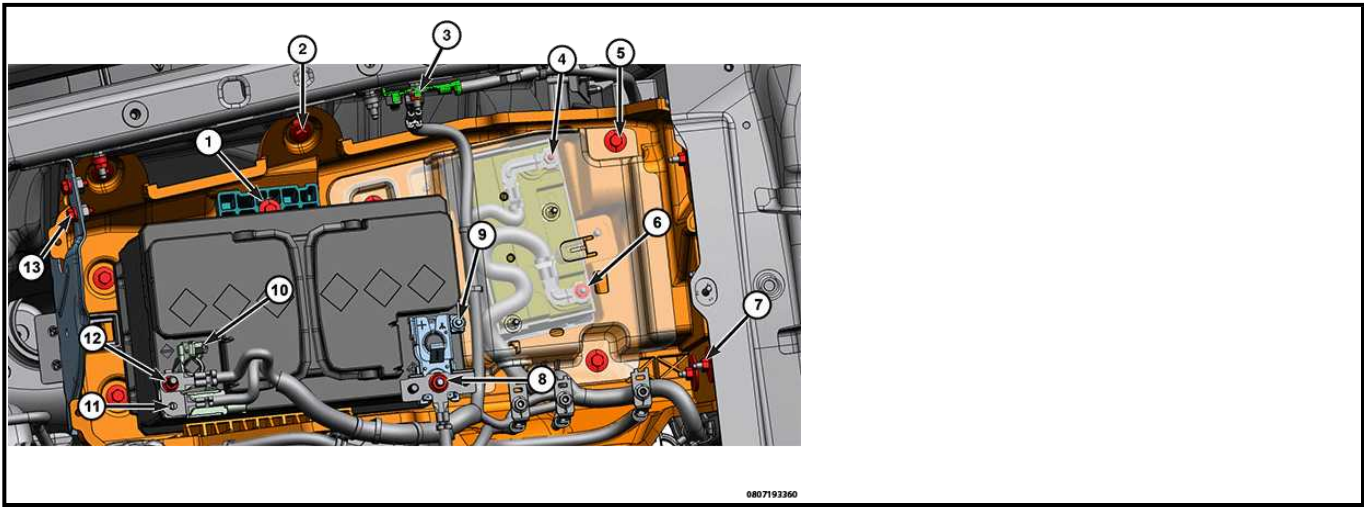
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- **DO NOT** use a hammer to tap down the sensor. Use a post spreader to open the post if reusing the existing sensor.
- Avoid IBS rotation during tightening to avoid contact of the 2 way connector or breakage may occur.
- Place the IBS onto the negative battery post and push the IBS down until properly seated on the negative battery post. Stabilize the IBS and tighten the battery terminal nut.

TORQUE SPECIFICATIONS

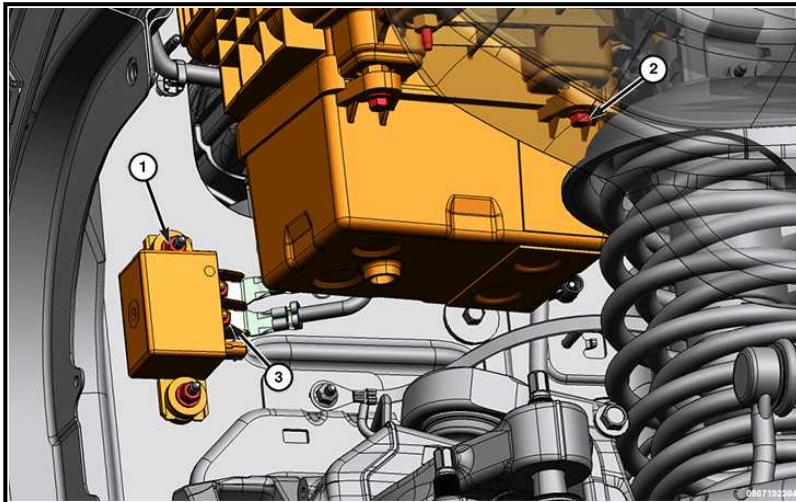
BATTERY SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	Battery Hold Down Bolt	6 N.m (53 In. Lbs.)	-
2	Battery Tray Bolts	6 N.m (53 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
3	Negative Battery Cable to Body M6	12 N.m (9 Ft. Lbs.)	-
4	Auxiliary Battery - M6 Double Ended Torx Stud	6 N.m (53 In. Lbs.)	-
5	Auxiliary Battery Cover to Battery Tray	4 N.m (35 In. Lbs.)	-
6	Auxiliary Battery M6 Nut	6 N.m (53 In. Lbs.)	-
7	Battery Tray Nuts	4 N.m (35 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
8	Battery Positive Cable M6	9 N.m (80 In. Lbs.)	-
9	Battery Positive Cable M5	9 N.m (80 In. Lbs.)	-
10	Intelligent Battery Sensor (IBS) To Negative Post	7 N.m (62 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
11	Auxiliary Negative Cable to Negative Cable at Battery	8 N.m (71 In. Lbs.)	-
12	Negative Cable To Intelligent Battery Sensor (IBS)	10 N.m (89 In. Lbs.)	-
13	Battery Tray To Front Bracket Support	4 N.m (35 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
-	Negative Battery Cable to Body M8	8 N.m (71 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	PCR Mount To Ground	11 N.m (8 Ft. Lbs.)	-
2	Auxiliary Battery Tray To Battery Tray	8 N.m (71 In. Lbs.)	-
3	B+ Wire To PCR Positive Terminals	11 N.m (8 Ft. Lbs.)	-
-	Battery Ground To Frame	8 N.m (71 In. Lbs.)	-
-	Ground To PCR Bracket	9 N.m (80 In. Lbs.)	Right Hand Drive Only
-	Negative Cable Stud	15 N.m (11 Ft. Lbs.)	Right Hand Drive Only



TRAY, BATTERY

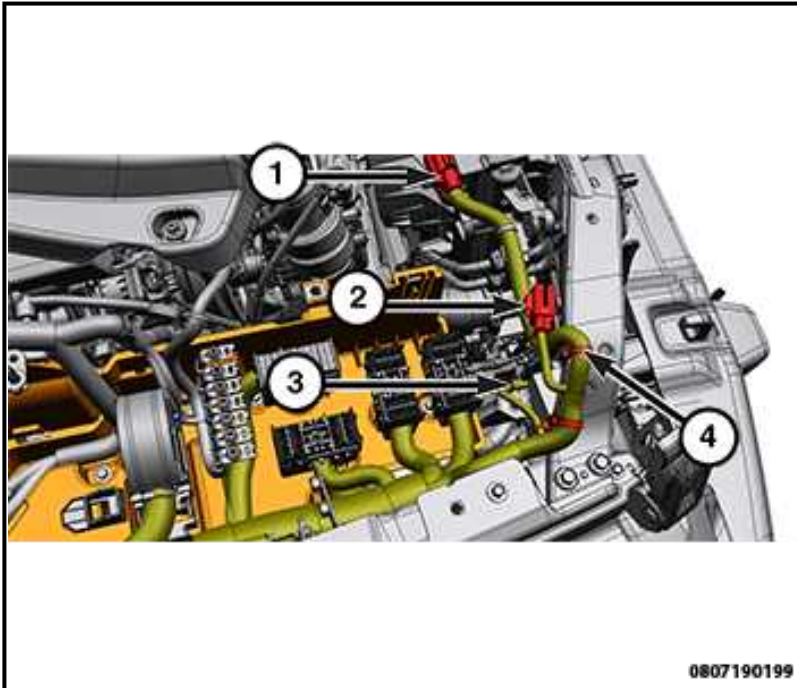
REMOVAL AND INSTALLATION

BATTERY TRAY - DIESEL

REMOVAL

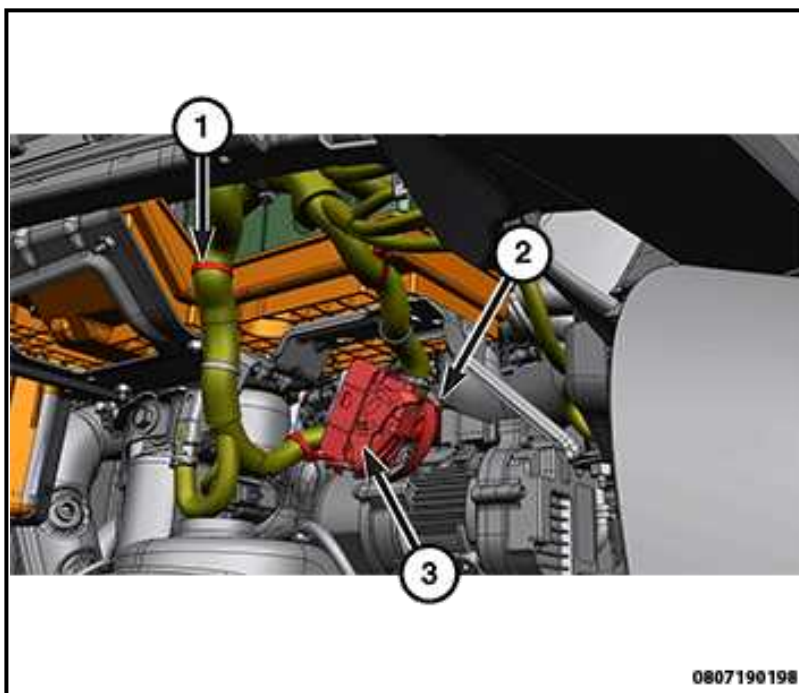
1. Disconnect and isolate the negative battery cable. If equipped with an Intelligent Battery Sensor (IBS), disconnect the IBS connector first before disconnecting the negative battery cable.
2. Remove the supplemental battery. Refer to **BATTERY, REMOVAL AND INSTALLATION**, or **BATTERY, SUPPLEMENTAL, REMOVAL AND INSTALLATION**.
3. Remove the Power Distribution Center (PDC). Refer to **CENTER, POWER DISTRIBUTION (PDC), REMOVAL AND INSTALLATION**.

4. Remove the Powertrain Control Module (PCM). Refer to [MODULE, POWERTRAIN CONTROL \(PCM\), REMOVAL AND INSTALLATION](#) .
5. Remove the right head lamp unit. Refer to [UNIT, HEADLAMP, REMOVAL AND INSTALLATION](#) .
6. Disconnect the glow plug relay.
7. Remove the fastener and position power steering reservoir aside.



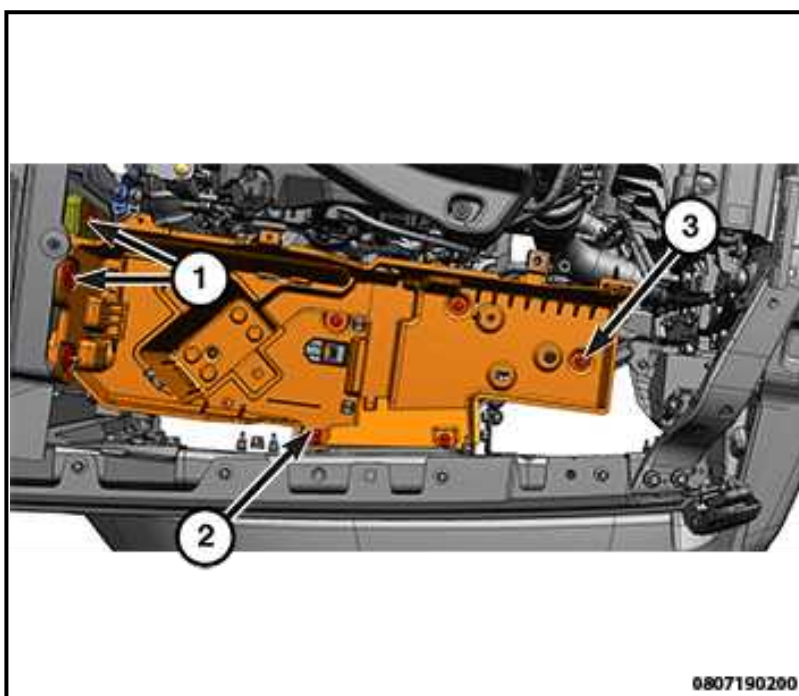
1 - Cooling Fan Wire Harness Connector
2 - Wire Harness Connector
3 - Head Lamp Harness Clip
4 - Cooling Fan Harness Clip

8. Disconnect the wire harness connector for the electric cooling fan module.
9. Disconnect the wire harness connector secured to the core support.
10. Remove the clip holding the head lamp harness to the core support.
11. Remove the clip for the electric cooling fan module and set the harness aside.
12. Remove the right front splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) [SHIELD, SPLASH, REAR WHEELHOUSE, REMOVAL AND INSTALLATION](#) .



1 - PDC Harness to Battery Tray Clip
2 - Power Steering Pump Wire Harness Connector
3 - Wire Harness Connector

13. Remove the clip securing the PDC harness to the battery tray.
14. Disconnect the electronic power steering pump wire harness connector.
15. Disconnect the wire harness connector.



1 - Battery Tray and Heat Shield Nut
2 - Battery Tray to Load Beam Bolts
3 - Battery Tray to Frame Rail Bolts

16. Remove the nut securing the battery tray and heat shield to the bulkhead.
17. Remove the bolts securing the battery tray to the load beam.
18. Remove the bolts (3) securing the battery tray to the frame rail and remove the battery tray from the vehicle.

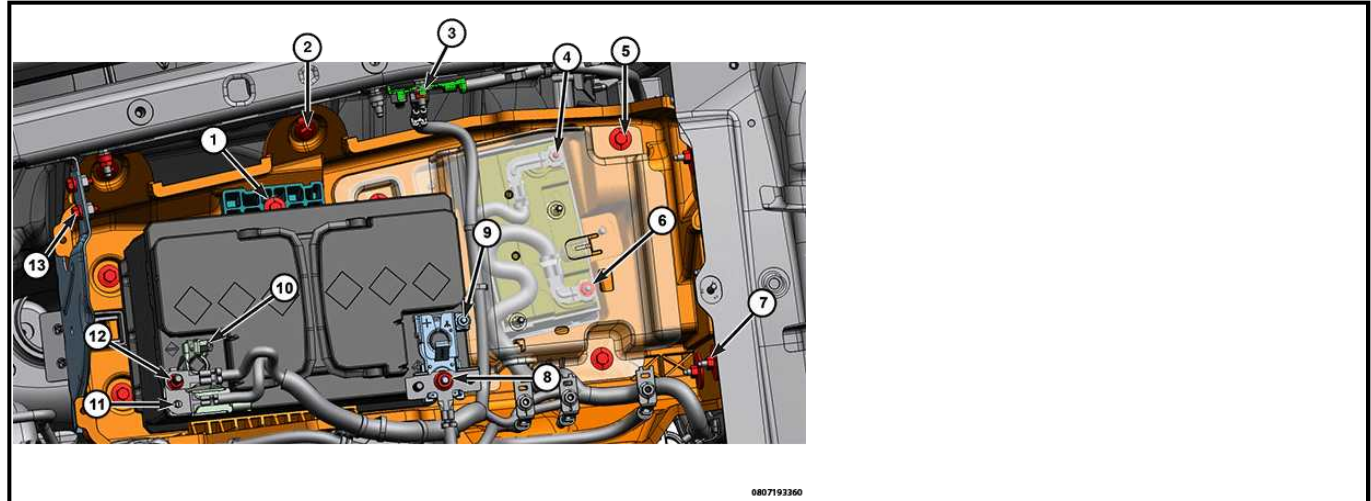
INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

During installation, torque the fasteners to the specifications in the torque table(s) below.

TORQUE SPECIFICATIONS

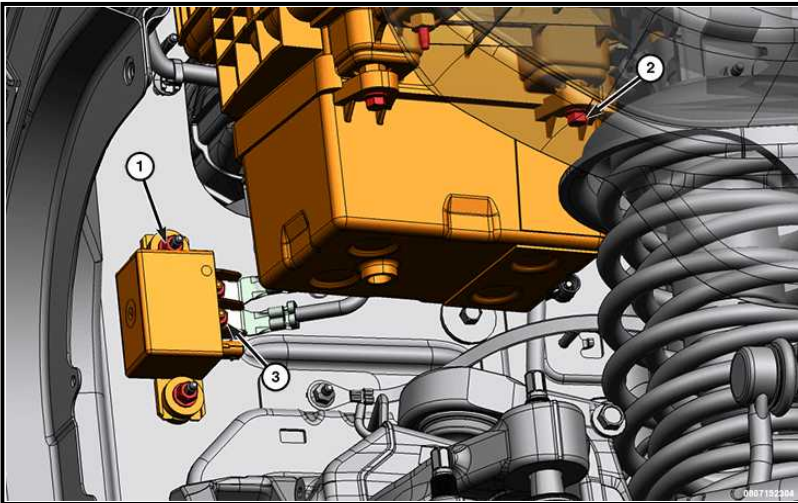
BATTERY SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	Battery Hold Down Bolt	6 N.m (53 In. Lbs.)	-
2	Battery Tray Bolts	6 N.m (53 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
3	Negative Battery Cable to Body M6	12 N.m (9 Ft. Lbs.)	-
4	Auxiliary Battery - M6 Double Ended Torx Stud	6 N.m (53 In. Lbs.)	-
5	Auxiliary Battery Cover to Battery Tray	4 N.m (35 In. Lbs.)	-
6	Auxiliary Battery M6 Nut	6 N.m (53 In. Lbs.)	-
7	Battery Tray Nuts	4 N.m (35 In. Lbs.)	Do not reuse these fasteners. If removed, a NEW fastener must be installed and tightened to specifications.
8	Battery Positive Cable M6	9 N.m (80 In. Lbs.)	-
9	Battery Positive Cable M5	9 N.m (80 In. Lbs.)	-
10	Intelligent Battery Sensor (IBS) To Negative Post	7 N.m (62 In. Lbs.)	-
11	Auxiliary Negative Cable to Negative Cable at Battery	8 N.m (71 In. Lbs.)	-
12	Negative Cable To Intelligent Battery Sensor (IBS)	10 N.m (89 In. Lbs.)	-
13	Battery Tray To Front Bracket Support	4 N.m (35 In. Lbs.)	Do not reuse these fasteners. If removed, a

CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
			NEW fastener must be installed and tightened to specifications.
-	Negative Battery Cable to Body M8	8 N.m (71 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	PCR Mount To Ground	11 N.m (8 Ft. Lbs.)	-
2	Auxiliary Battery Tray To Battery Tray	8 N.m (71 In. Lbs.)	-
3	B+ Wire To PCR Positive Terminals	11 N.m (8 Ft. Lbs.)	-
-	Battery Ground To Frame	8 N.m (71 In. Lbs.)	-
-	Ground To PCR Bracket	9 N.m (80 In. Lbs.)	Right Hand Drive Only
-	Negative Cable Stud	15 N.m (11 Ft. Lbs.)	Right Hand Drive Only



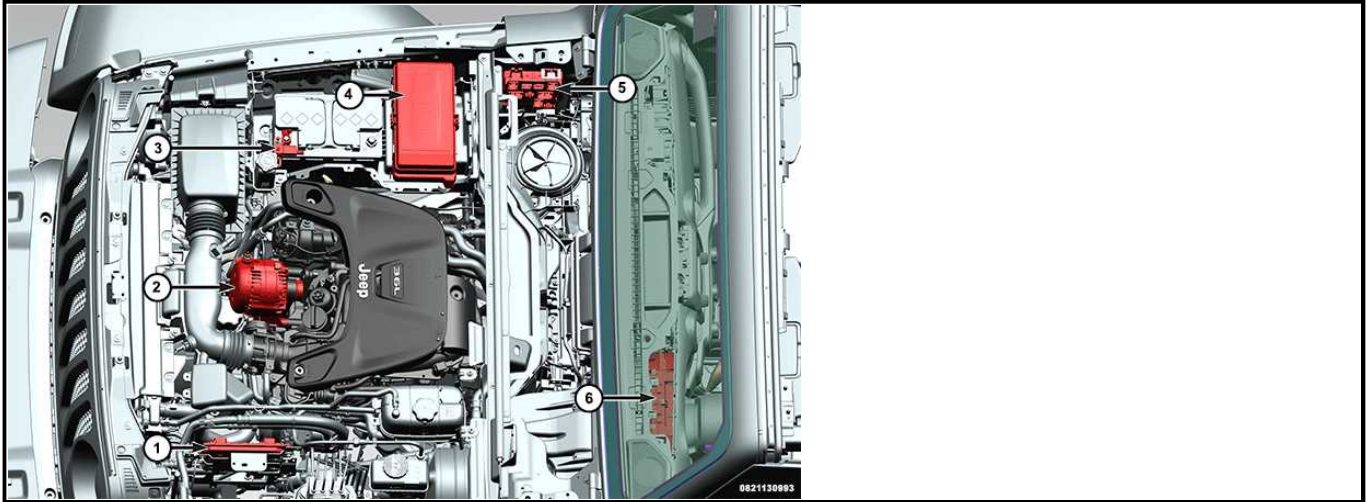
2021 ELECTRICAL

3.0L Charging System (Service Information) - Gladiator [EXJ]

DESCRIPTION AND OPERATION

DESCRIPTION AND OPERATION

DESCRIPTION

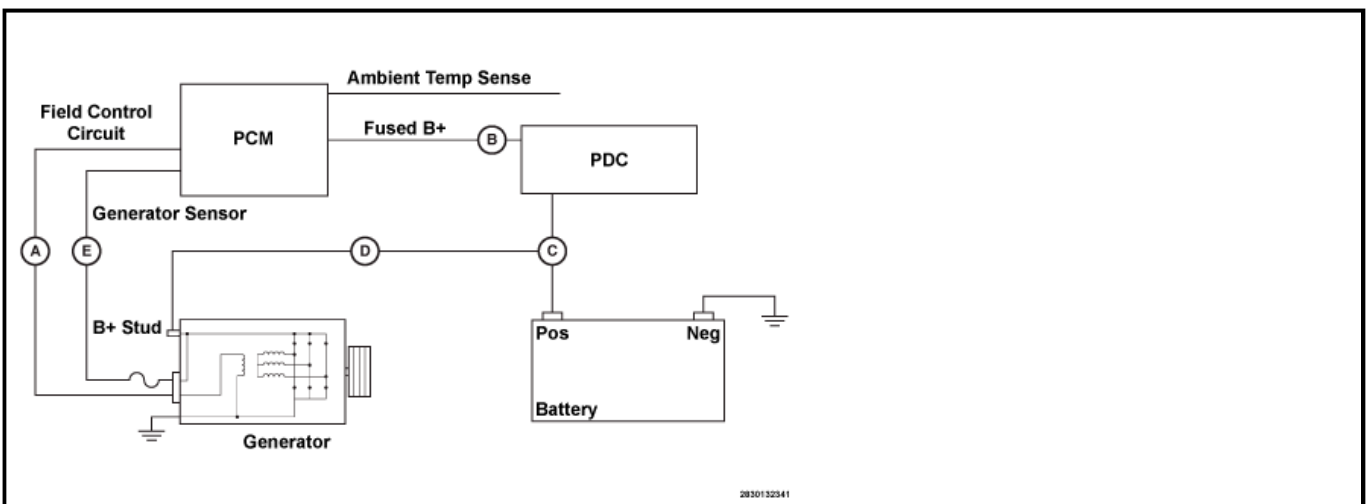


The charging system consists of the following components:

COMPONENT INDEX

1.	Refer to POWERTRAIN CONTROL MODULE (PCM) with an integrated Electronic Voltage Regulator (EVR).
2.	Refer to GENERATOR .
3.	Refer to INTELLIGENT BATTERY SENSOR (IBS) .
4.	Refer to POWER DISTRIBUTION CENTER (PDC) .
5.	Refer to BODY CONTROL MODULE (BCM) .
6.	Refer to INSTRUMENT PANEL CLUSTER (IPC) .

STANDARD GENERATOR SYSTEM OPERATION



The Electronic Voltage Regulation (EVR) system maintains the system voltage at a desired level by turning the Pulse Width Modulated (PWM) generator field control circuit (A) on and off. When the generator field is turned on, the system voltage increases. When the generator field is turned off, the system voltage slowly drops. The rate at which this happens is dependent upon the existing electrical loads, ambient under hood temperature,

and the engine speed. A constant system voltage (B, C, D) can be maintained only when the generator field is switched on and off at a duty cycle that very accurately emulates the existing electrical loads given the existing ambient under hood temperature and engine speed.

During normal operation, the voltage reading at the generator output stud will be very close to the target charging voltage viewed on the scan tool. This is the system voltage and is sensed by the PCM through the fused B+ circuit (B). With the generator connector plugged in, the voltage reading on the generator sense circuit will be approximately 3.5 volts less than the voltage at the generator output stud due the resistor inside the generator. This is the generator sense (E) input to the PCM. These two voltage sense inputs are used and compared during the different diagnostics performed on the EVR System by the PCM.

In diagnostic mode, when the PCM detects that the output voltage is too high or too low, the PCM runs a series of diagnostics to determine the cause. When the diagnostic is initiated, the PCM will change the field control circuit and look for a change in the output voltage. If no reaction is detected, the PCM rationalizes that it has lost control of the generator field control (A) due to an open or shorted condition. If the generator field control is active, and the engine speed is above a calibrated threshold, the PCM will run a series of tests that turn the generator field control off and on for a brief period of time and monitors the system voltage (B) for a calibrated amount of change in the voltage, to determine a failure of the generator. This diagnostic test requires repeated failures to insure that an erroneous fault is not set.

BODY CONTROL MODULE (BCM)

Refer to [COMPONENT INDEX](#).

NOTE: The following information applies to vehicles equipped with a smart generator.

The BCM has two functions:

- it is the gateway for the battery status signals coming from the Intelligent Battery Sensor (IBS) to the Controller Area Network-Chassis (CAN-C) network
- it receives information from some vehicle loads and manages voltage limits by increasing or decreasing the generator voltage output. The battery voltage limits are monitored while these requested voltage changes are occurring. The BCM calculates the limits of the maximum charging voltage by utilizing a LIN bus message from the IBS indicating the battery temperature.

Depending on the state of some electrical loads and the maximum charging limit already calculated by the BCM, the BCM will set the minimum and maximum voltage limits for the generators target voltage. These limits are then broadcast on the CAN-C network.

The following signals are transmitted by BCM to the PCM using the CAN-C network:

- The battery current
- The battery temperature (B°C)
- The battery voltage (V)
- The battery state of charge (%)
- The maximum voltage allowed by BCM (V)
- The minimum voltage allowed by BCM (V)
- The IBS status signals
- The SAM failure status

The value of the voltage high strategy calculated by the BCM is performed by reading the following signals:

- High beams activated
- Front fog lamps activated
- Rear fog lamps activated
- The front wiper motor low or high state

- Rear wiper motor activated
- Low beams activated
- Positive Temperature Coefficient (PTC) heaters are present
- Programmable auxiliary switches are on. An equipped Power Take-Off (PTO) unit is an example of when you would find an auxiliary switch bank.
- Battery maximum charging voltage. This condition is always active.

The value of the voltage low strategy calculated by the BCM is performed by reading the following signals:

- High beams activated
- Front fog lamps activated
- Rear fog lamps activated
- The front wiper motor low or high state
- Rear wiper motor activated
- Low beams activated
- PTC heaters are present
- Programmable auxiliary switches are on. An equipped PTO unit is an example of when you would find an auxiliary switch bank.
- Requests from the Heating Ventilation and Air Conditioning (HVAC) system.

GENERATOR

Refer to [COMPONENT INDEX](#).

Standard Generator

As the energized rotor begins to rotate within the generator, the spinning magnetic field induces a current into the windings of the stator coil.

The Y type stator winding connections deliver the induced Alternating Current (AC) to positive and negative diodes for rectification. From the diodes, rectified Direct Current (DC) is delivered to the vehicles electrical system through the generator, battery, and ground terminals.

Noise emitting from the generator may be caused by:

- Worn, loose or defective bearings
- Loose or defective drive pulley
- Incorrect, worn, damaged or misadjusted drive belt
- Loose mounting bolts
- Misaligned drive pulley
- Defective stator or diode
- Damaged internal fins

INSTRUMENT PANEL CLUSTER (IPC)

Refer to [COMPONENT INDEX](#).

The IPC will switch on the charge system indicator (battery indicator, battery telltale) and the charging system audible chime when the IPC receives indication of a charging system failure from the PCM over the CAN-C network.

INTELLIGENT BATTERY SENSOR (IBS)

Refer to [COMPONENT INDEX](#).

The IBS serves two primary purposes. The first is to provide the PCM with both immediate and historical calculated battery information, so the PCM can precisely control the charging system. The second purpose is to provide calculated data to the BCM for operation of the load-shedding feature. A fused power circuit and the bus are connected to the IBS through a two-terminal connector.

The IBS contains a low value resistor, or shunt. The shunt creates voltage drop, which is read by an internal controller to determine the current flow in and out of the battery. In addition to the shunt, the IBS contains a sensor to monitor the battery's temperature. Data gathered by the IBS, including temperature, voltage, and current measurements, are transmitted over a communication bus to the BCM, which is the LIN master node of the IBS. In addition to real-time measurements, the IBS transmits some calculated battery data over the bus, including SOC, State of Health (SOH), and State of Function (SOF). These values are calculated by storing measurements over time.

- SOC = Battery SOC is expressed as a percentage. The IBS calculates the SOC based on measured voltage, and charge and discharge rates. Therefore, SOC is not a direct percentage of battery voltage.
- SOF = Battery SOF is a calculated prediction of the lowest voltage the battery will drop to during engine cranking.

The battery sensor is readable and diagnosable by using the diagnostic scan tool which can display all of the available parameters needed for vehicle servicing or trouble shooting.

When the IBS is powered up for the first time or is powered after a battery disconnect, it enters a "recalibration" phase, where the IBS must recognize the type of battery and its characteristics and state. This information is sent to the IBS by the BCM. In this phase the tolerances on the state functions (SOC, SOF) are greater than in normal working condition. When the IBS is disconnected from the battery, the device loses its stored memory. When power is restored, the IBS starts a relearn process. Until the relearn process is complete, accurate battery state information is unavailable to other vehicle systems. The IBS relearn process requires one start and at least four hours of quiescent time (vehicle off, electrical system asleep). The relearn process is restarted every time power is reconnected to the IBS. This has a major effect on the Engine Start Stop (ESS) feature.

POWERTRAIN CONTROL MODULE (PCM)

Refer to [**COMPONENT INDEX**](#).

The IBS and BCM communicate with the PCM to provide the proper charging strategy for the vehicle based on ambient temperature, vehicle electrical load and voltage.

POWER DISTRIBUTION CENTER (PDC)

Refer to [**COMPONENT INDEX**](#).

The PDC for this vehicle is designed to provide safe, reliable, centralized and convenient access to distribution of the electrical current required to operate all of the many standard and optional factory-installed electrical and electronic powertrain, chassis, safety, comfort and convenience systems. At the same time, these systems were designed to provide centralized locations for conducting diagnosis of faulty circuits and for sourcing the additional current requirements of many aftermarket vehicle accessory and convenience items. The PDC connects directly to the B+ cable.

This power distribution system also incorporates various types of circuit control and protection features, including:

- Automatic resetting circuit breakers
- Cartridge fuses
- Blade fuses
- Printed Circuit Board (PCB) and non-PCB Relays

SYSTEM OPERATION - SMART CHARGING SYSTEM

Most current vehicles utilize the Smart Charging control strategy. This strategy helps to improve vehicle performance, reduce CO2 emissions and increase fuel efficiency. The control strategy takes into account battery state of charge and electrical loads on the battery, as well as engine load. Vehicles that utilize the Smart Charging control strategy are equipped with an Intelligent Battery Sensor (IBS). The IBS is an important component of the Smart Charging control strategy.

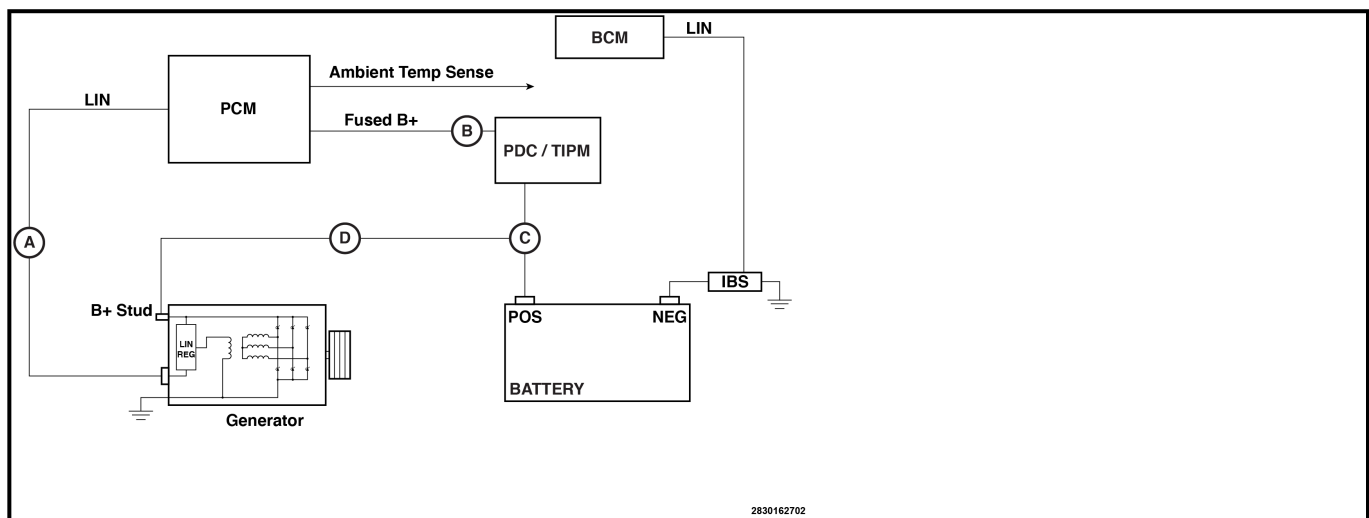
- **Idle and acceleration:** Charging is typically suspended during idle and acceleration conditions. Due to this strategy it can be common for the alternator output to be equal to, or close to typical battery voltage at idle and during engine acceleration.
- **Steady state speeds:** During steady state speeds the charge rate is typically low, just enough to maintain battery voltage.
- **Deceleration (regenerative braking):** The charge rate is typically very high during deceleration.

The Smart Charging strategy can be used with any combination of the following vehicle configurations:

- Single Battery System
- Dual Battery System
- Electronic Voltage Regulation (EVR) Charging systems which use a standard alternator directly controlled by the PCM
- Charging systems using a smart alternator communicating with the PCM via LIN Bus

On vehicles equipped with a smart alternator, the PCM sends voltage set point and ramp time commands to the alternator via a LIN bus communication circuit. The alternator controls the charging rate based on these commands.

FUNCTIONAL DESCRIPTION - SMART ALTERNATOR



The Smart Alternator communicates with the Powertrain Control Module (PCM) over a Pulse Width Modulated (PWM) LIN BUS communication circuit. The Smart Alternator contains an internal Intelligent Voltage Regulator that controls the Alternator overall operation. The Smart Alternator requires Battery supply on the Fused B+ circuit and a good case ground to power up the internal regulator and operate correctly. **The PCM sends the Smart Alternator the following messages/commands over the LIN BUS circuit:**

- Wake-up signal
- Voltage set point
- Ramp time
- Maximum current output based on operating and environmental conditions

The Smart Alternator controls the charging rate based on the PCM input commands. The Smart Alternator also performs diagnostics for electrical and mechanical faults with the Alternator. **The Smart Alternator sends the**

following information/faults regarding diagnostics and Alternator load conditions back to the PCM over the LIN BUS circuit:

- Regulator duty cycle
- Internal Battery voltage
- Measured energizing current
- Integrated circuit temperature
- Pulley rotational speed
- Error messages for internal mechanical error, electrical error, or over temperature error

FUNCTIONAL DESCRIPTION - INTELLIGENT BATTERY SENSOR (IBS)

The Intelligent Battery Sensor (IBS) is an electrical shunt with a microprocessor that is mounted in-line with the negative Battery Cable. The IBS monitors the Battery voltage as well as current flow into and out of the battery. The IBS also has a built-in thermistor that calculates the battery temperature. The microprocessor uses this data to calculate Battery State of Charge (SOC), battery internal resistance, charge received, electrical demand, and time in service. This information is reported through the LIN Bus circuit to the Body Control Module (BCM). The BCM broadcasts the information to the Powertrain Control Module (PCM) over the CAN Bus.

The IBS SOC data is also used by the BCM and other modules to determine when to begin disabling certain vehicle features that draw excessive electrical loads due to a low battery SOC. The SOC threshold for starting to disable features can vary based on vehicle and engine but is typically in the 50% to 60% range. The following items can contribute to, and should be considered when diagnosing a low SOC condition before replacing an IBS or battery:

- If the vehicle is jump started at the battery posts bypassing the IBS.
- If the battery is blind charged at the battery posts bypassing the IBS.
- Repeated short trip driving events not allowing enough charge time.
- The IBS accuracy is off and needs to relearn the battery SOC.

Depending on the vehicle, there could be a non-MIL DTC (P057F) set, or an EVIC message indicating a low battery state of charge limiting some features, such as ESS. In some cases, properly charging the batteries through the IBS can raise the IBS SOC enough to regain functionality and repair the issue. However, it can sometimes take two or three, 4-hour BUS off sleep cycles for an IBS to learn and update the Battery SOC. The IBS can be initiated into a learning curve by completely disconnecting the IBS from the battery, and disconnecting harness connector for 20 seconds. The IBS battery feed, LIN Bus and ground circuits should be checked before reconnecting the IBS. The IBS should default to approximately 80% SOC when reconnected. However, the IBS accuracy is determined to be low until the IBS can relearn battery SOC. This occurs after an engine run cycle and a subsequent ignition off sleep cycle of between one to four hours. Some features will be disabled until the IBS SOC is updated.

FUNCTIONAL DESCRIPTION - POWER DISTRIBUTION CENTER (PDC)

The PDC is designed to provide safe, reliable, centralized and convenient access to distribution of the electrical current required to operate all of the many standard and optional factory-installed electrical and electronic powertrain, chassis, safety, comfort and convenience systems. At the same time, these systems were designed to provide centralized locations for conducting diagnosis of faulty circuits and for sourcing the additional current requirements of many aftermarket vehicle accessory and convenience items. The PDC connects directly to the Battery Positive (B+) cable.

The power distribution systems also incorporate various types of circuit control and protection features, including:

- Automatic resetting circuit breakers
- Cartridge fuses

- Blade fuses
- Removable Relays
- Non serviceable Printed Circuit Board (PCB) Relays

The charging system is protected by a larger amperage fuse that is typically in the fuse array attached to the PDC.

FUNCTIONAL DESCRIPTION - INSTRUMENT PANEL CLUSTER (IPC)

The IPC will turn on the charge system indicator (battery indicator, battery telltale) and the charging system audible chime when the IPC receives indication of a charging system failure from the PCM over the Controller Area Network-Chassis (CAN-C) network.

FUNCTIONAL DESCRIPTION - BODY CONTROL MODULE (BCM)

The BCM is the gateway for all bus communications needing to be gated from one bus network to a different bus network. This grants the modules on different busses the ability to interact with each other. If the Local Interface Network (LIN) or CAN bus communications go down, the BCM will set the appropriate DTCs and display Signal Not Available (SNA) values.

The Intelligent Battery Sensor (IBS) communicates with the BCM through a LIN bus circuit. The BCM collects information relating to battery state of charge, temperature and electrical loads on the battery from the IBS. This information is broadcast over the bus networks to other modules, including the Powertrain Control Module (PCM) which uses this information to control and monitor the charging system.

FUNCTIONAL DESCRIPTION - POWERTRAIN CONTROL MODULE (PCM)

The PCM communicates and commands the charging rate to the Smart Alternator via the LIN bus circuit. The PCM does not directly perform diagnostics of the Smart Alternator. However, the PCM does store and report the faults communicated from the Smart Alternator via the LIN bus circuit.

The PCM diagnostic monitor compares the reported battery voltage from the Intelligent Battery Sensor (IBS) to the currently requested set voltage from the Smart Alternator. A fault will be detected if the absolute difference (VOLTAGE_DELTA) between commanded Smart Alternator and actual IBS voltage values vary from one another above a calibrated threshold for an accumulated period of time. When the PCM determines there is a charging system failure the PCM will send a message to the Instrument Cluster to illuminate the check gauges lamp (if equipped) with the engine running.

DIAGNOSIS AND TESTING

CHARGING SYSTEM - SMART ALTERNATOR

The PCM does not directly perform diagnostics for the Smart Alternator. However, the PCM does store and report the faults communicated from the Smart Alternator via the LIN bus circuit. The PCM diagnostic monitor compares the reported battery voltage from the Intelligent Battery Sensor (IBS) to the currently requested set voltage from the Smart Alternator. A fault will be detected if the absolute difference (VOLTAGE_DELTA) between commanded Smart Alternator and actual IBS voltage values vary from one another above a calibrated threshold over an accumulated period.

CHARGING SYSTEM TESTING

PRELIMINARY INSPECTION

Perform the following inspections before diagnosing the Smart Alternator system:

1. Verify proper battery condition and charge level.
2. Inspect condition and connections at the battery cable terminals, battery posts, ground locations and Smart Alternator. They should be clean and tight. Repair as required.

3. Inspect all fuses in both the BCM and Power Distribution Center (PDC) for tightness in receptacles. They should be properly installed and tight. Repair or replace as required.
4. Inspect Alternator drive belt and tensioner condition. Verify proper belt tension.

DIAGNOSTIC OVERVIEW - SMART ALTERNATOR

PCM DIAGNOSTICS: When an electrical, mechanical or over-temp fault is detected and reported by the Smart Alternator to the PCM, the PCM sets a fault (P-code) and sends a default voltage set point of 14.0 volts to the Smart Alternator. Most vehicles will combine the failure modes into one fault code (P065A). However, some vehicles will separate each failure mode and set individual DTCs. **It is important to note that on vehicles that use the combined P065A fault** that this DTC can also set if the **difference** between the commanded set point and IBS voltage feedback are greater than a calibrated threshold. This means that the charging output should be checked before condemning an Alternator as faulty when a DTC is present.

When communication is lost between the PCM and Smart Alternator, the Smart Alternator will default to a voltage set point between 13.5 and 14.0 volts. The PCM will set a loss of communication fault (U-code) against the Smart Alternator. Besides an open or shorted LIN Bus circuit, the PCM can also lose communication with the Smart Alternator if the battery supply (open in the cable) or case ground to the Smart Alternator is lost. An open charging system fuse can cause a loss of battery supply to the Smart Alternator.

DIAGNOSTIC STRATEGY: Since the Smart Charging system does not always charge at idle, it is not unusual to see typical battery voltage present at the Smart Alternator stud during idling. Monitoring the voltage at the Smart Alternator stud at idle is not an effective way of checking the Smart Alternator output capability. This could lead to misdiagnosis and unnecessary replacement of the Smart Alternator. If it is suspected that the Smart Alternator is not charging to the level commanded by the PCM, a more effective way to determine this is to disconnect the LIN Bus circuit at the Smart Alternator and monitoring the voltage alternator stud. Disconnecting the communication line should cause the Smart Alternator to default to charging between approximately 13.5 and 14 volts. If the voltage does not increase to 13.5 to 14.0 volts at idle with the LIN Bus circuit open, the Smart Alternator is most likely faulty.

NOTE: This method only applies to the Smart Alternators, not to the Electronic Voltage Regulation (EVR) charging systems with a standard Alternator. Standard Alternators are controlled directly by the PCM using a PWM voltage supply to energize the field.

TECHNICAL SPECIFICATIONS

GENERATOR

3.6L W/ESS	180/220/240 AMP
3.0L Diesel	180/220/240 AMP

TORQUE SPECIFICATIONS

CHARGING SYSTEM - 3.0L

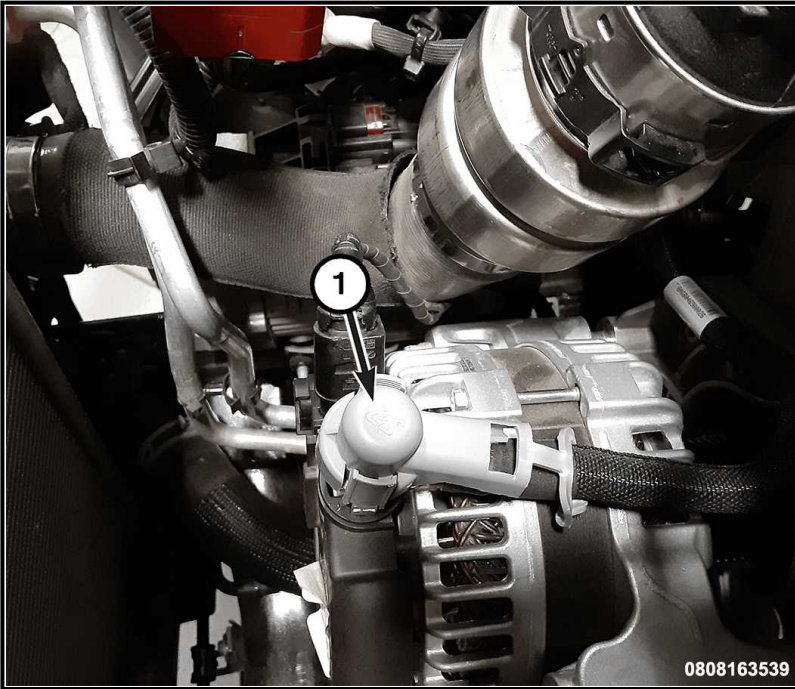
DESCRIPTION	SPECIFICATION	COMMENT
Generator Bolts	63 N.m (48 Ft. Lbs.)	-
Generator B+ Cable Nut	20 N.m (15 Ft. Lbs.)	-
Generator Nut	63 N.m (48 Ft. Lbs.)	-
Generator Stud	10 N.m (89 In. Lbs.)	-

GENERATOR

REMOVAL AND INSTALLATION

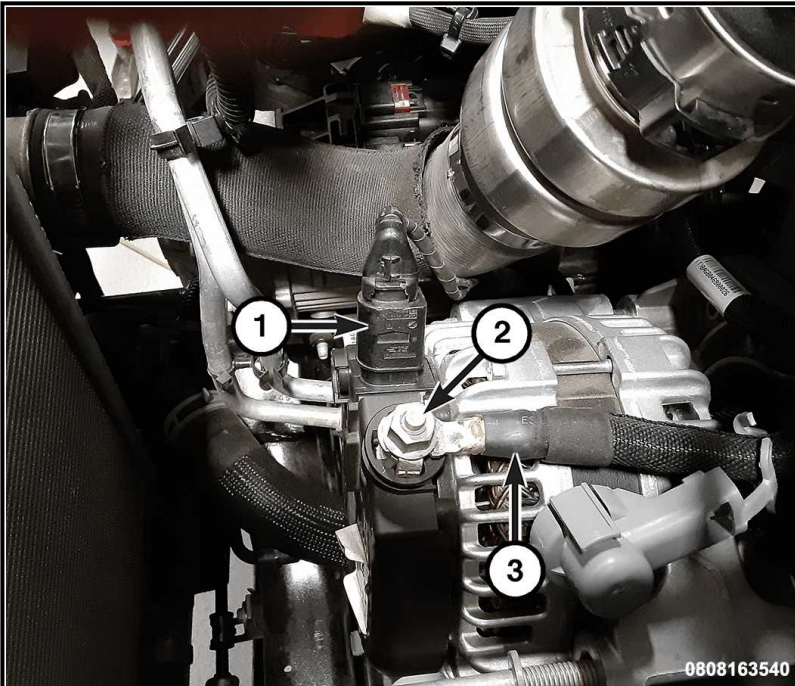
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the serpentine belt. Refer to [BELT, SERPENTINE, REMOVAL AND INSTALLATION](#) .
3. Remove the cooling fan. Refer to [FAN, COOLING, REMOVAL AND INSTALLATION](#) .



1 - B+ Cable Protective Cover

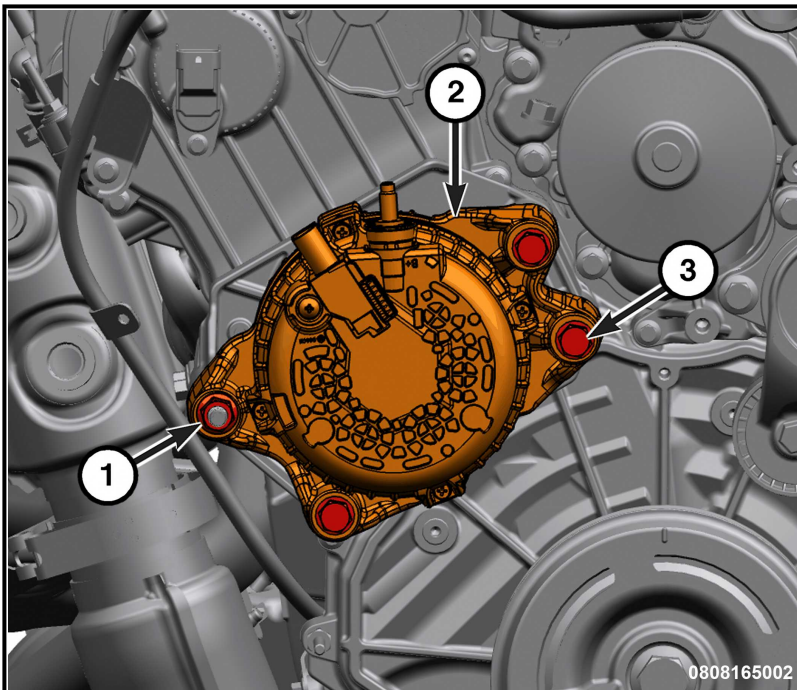
4. Remove the protective cover from the B+ cable.



1 - Wire Harness Connector
2 - B+ Nut
3 - Cable

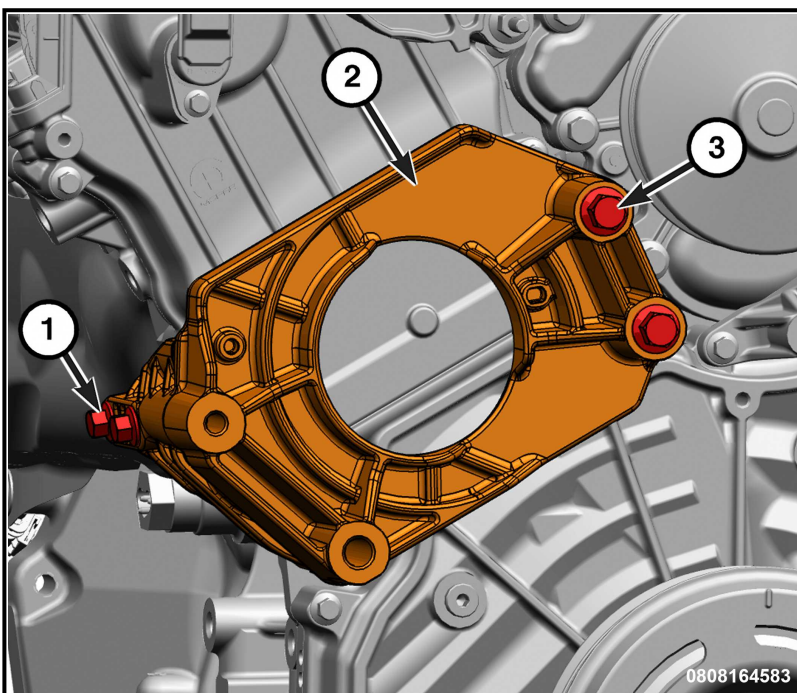
5. Disconnect the field generator wire harness connector.

6. Remove the B+ nut and cable from the generator.



1 - Generator Nut
2 - Generator
3 - Generator Bolts

7. Remove the fasteners and the generator.



1 - Generator Bolts
2 - Generator Mounting Bracket
3 - Generator Bolts

8. If necessary, remove the bolts and the generator mounting bracket.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Position the generator and route the serpentine belt on the generator before installing the generator bolts.

TORQUE SPECIFICATIONS

CHARGING SYSTEM - 3.0L

DESCRIPTION	SPECIFICATION	COMMENT
Generator Bolts	63 N.m (48 Ft. Lbs.)	-
Generator B+ Cable Nut	20 N.m (15 Ft. Lbs.)	-
Generator Nut	63 N.m (48 Ft. Lbs.)	-
Generator Stud	10 N.m (89 In. Lbs.)	-

2021 ENGINE

3.0L Engine (Service Information) (1 Of 3) - Gladiator [EXJ]

DESCRIPTION

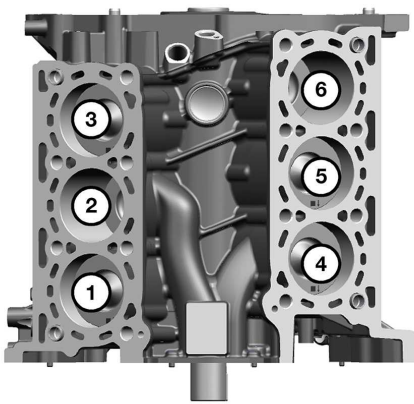
3.0L COMMON RAIL DIESEL ENGINE

The 3.0L (183 C.I.D.) six cylinder "common rail" direct injection engine is a 60B° overhead valve design. The engine features are listed below:

- A cast iron cylinder block
- Aluminum cross flow cylinder heads
- Chain driven dual overhead camshafts per bank, with 4 valves per cylinder
- Central fuel injectors
- Finger Follower Actuated Valves with Hydraulic Adjusters
- Turbocharger and intercooler
- Oil Jet Cooled Pistons
- Swirl Intake Ports
- Water cooled exhaust gas recirculation, Compliance with EURO V emission regulations
- Chain driven D.O.H.C. per bank of cylinders, with 4 valves per cylinder

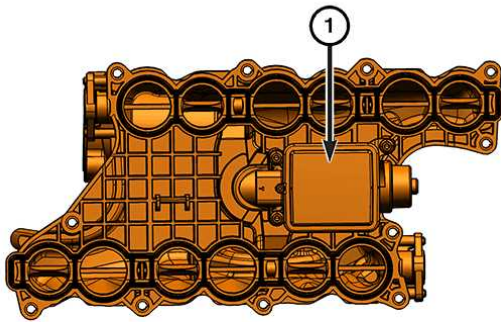
Cylinders are numbered front to back, beginning with the right bank. The right bank cylinders are numbered 1, 2, 3. The left bank cylinders 4, 5, 6. The fuel injection or

2-5-3-6.



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SWIRL VALVE



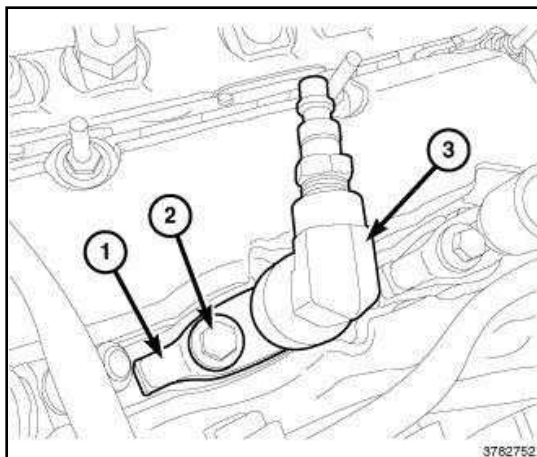
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1 - SWIRL VALVE

- The intake manifold features swirl intake ports to reduce particulates at low engine speeds. Each cylinder incorporates one swirl port and one charge port. The swirl valves are normally open by spring force. The valves are connected together via a linkage which is operated by the swirl valve actuator (1). The swirl valves are normally open by spring force. In the lower engine speed and load range, the swirl valves are closed by the swirl valve actuator (1). The entire air mass flow is through the swirl ports only, which results in greater swirling. The increased swirling produces uniform combustion for better engine performance and reduction of particulates. As load increases, the swirl valves open, so that optimal swirling and the required air mass are provided for the current operating conditions.
- The swirl valve actuator is not serviceable. If diagnosis has led you to replace the swirl valve actuator then the whole intake manifold needs to be replaced.

DIAGNOSIS AND TESTING

CYLINDER COMPRESSION TEST



1. Warm up the engine to operating temperature (approximately 80 B°C, 176 B°F).
2. Shut the engine off.
3. Disable the low pressure fuel pump.
4. Remove the fuel injector. Refer to [INJECTOR\(S\), FUEL, REMOVAL AND INSTALLATION](#).
5. Crank the engine several times with the starter to eliminate combustion residues in the cylinders.
6. Insert the (special tool #VM.10357, Adapter, Compression Test) (3) into fuel injector hole of cylinder to be tested. Install fuel injector clamp (1), bolt (2) and secure.
7. Test compression pressure by cranking engine with starter for at least 8 revolutions.

DESCRIPTION	SPECIFICATION	DIFFERENCE BETWEEN
Cylinder Compression	21 - 25 Bar (304 - 362 psi)	5 Bar (73 psi)

8. Carry out the test procedure at the remaining cylinders in the same way.
9. Remove the (special tool #VM.10357, Adapter, Compression Test) from cylinder head.
10. Install the fuel injector. Refer to [INJECTOR\(S\), FUEL, REMOVAL AND INSTALLATION](#).

CYLINDER LEAKAGE TEST

The cylinder leakage test provides an accurate means for determining engine condition.

Cylinder leakage testing will detect:

- Exhaust and intake valve leaks (improper seating).
- Leaks between adjacent cylinders or into water jacket.

1. Check the coolant level and fill as required. DO NOT install the radiator cap.
2. Start and operate the engine until it attains normal operating temperature.
3. Turn the engine OFF.
4. Remove the fuel injector. Refer to [INJECTOR\(S\), FUEL, REMOVAL AND INSTALLATION](#).
5. Set the piston of the cylinder to be tested at Top Dead Center (TDC) on the compression stroke.
6. Install the (special tool #VM.10357, Adapter, Compression Test) into the fuel injector bore of cylinder to be tested. Install fuel injector clamp, nut, and securely tighten.
7. **Calibrate the tester according to the manufacturer's instructions.** The shop air source for testing should maintain a regulated air pressure at 552 kPa (80 psi).
8. Connect the leakage tester and perform the leakage test procedure on each cylinder according to the tester manufacturer's instructions.
9. As each cylinder is pressurized, listen for the air escaping through the EGR air flow control valve, tailpipe, and the oil filler cap opening. Check for bubbles in the oil.
10. All gauge pressure indications should be equal, with **no more** than 25% leakage.
11. If leakage is greater than 25%, Refer to CYLINDER LEAKAGE DIAGNOSIS CHART below.

CYLINDER LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly.	Inspect the valve and valve seat. Reface if necessary. Inspect valve springs. Replace if necessary.
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly.	Inspect the valve and valve seat. Reface if necessary. Inspect valve springs. Replace if necessary.
AIR ESCAPES THROUGH RADIATOR	Head gasket leaking or cracked cylinder head or block.	Remove the cylinder head and inspect. Replace if necessary.
MORE THAN 50% LEAKAGE FROM ADJACENT CYLINDERS	Head gasket leaking or crack in cylinder head or block between adjacent cylinders.	Remove the cylinder head and inspect. Replace if necessary.
MORE THAN 25% LEAKAGE AND AIR ESCAPES THROUGH OIL FILLER CAP OPENING ONLY	Stuck or broken piston rings; cracked piston; worn rings and/or cylinder wall.	Inspect for broken rings or piston. Measure cylinder diameter, taper and out-of-roundness. Replace defective part as necessary.

ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTION
LUBRICATING OIL PRESSURE LOW	1. Low oil level.	1. Check and fill with clean engine oil. Check for a severe oil leak, worn ring (oil), oil leaking from the turbocharger to the intake, or other root causes for low oil level.
	2. Oil viscosity thin, diluted or wrong specification.	2. Verify the correct engine oil is being used. Check for reduced viscosity from oil dilution.
	3. Improperly operating pressure switch/gauge.	3. Verify the pressure switch is functioning correctly. If not, replace switch/gauge.
	4. Relief valve stuck open.	4. Check/replace valve.

CONDITION	POSSIBLE CAUSES	CORRECTION
	5. If cooler was replaced, shipping plugs may have been left in cooler.	5. Check/remove shipping plugs.
	6. Worn oil pump.	6. Check and replace oil pump.
	7. Suction tube loose or seal leaking.	7. Check and replace seal.
	8. Loose main bearing cap.	8. Check and install new bearing. Tighten cap to proper torque.
	9. Worn bearings or wrong bearings installed.	9. Inspect and replace connecting rod or main bearings. Check and replace di cooling nozzles.
	10. Directed piston cooling nozzles under piston, bad fit into main carrier.	10. Check directed piston cooling nozzles position.
LUBRICATING OIL PRESSURE TOO HIGH	11. Loose directed piston cooling nozzle.	11. Tighten directed piston cooling nozzle.
	1. Pressure switch/gauge not operating properly.	1. Verify pressure switch is functioning correctly. If not, replace switch/gauge
	2. Engine running too cold.	2. Coolant temperature below normal.
	3. Oil viscosity too thick.	3. Verify the correct oil is being used.
LUBRICATING OIL LOSS	4. Oil pressure relief valve stuck closed or binding.	4. Check and replace valve.
	1. External leaks.	1. Visually inspect for oil leaks. Repair as required.
	2. Crankcase overfilled.	2. Verify that the correct dipstick is being used.
	3. Incorrect oil specification or viscosity.	3. Verify the correct engine oil is being used. Check for reduced viscosity from dilution. Review/reduce oil change intervals.
	4. Oil cooler leak.	4. Check and replace the oil cooler.
	5. High blow-by forcing oil out the breather.	5. Check the breather tube area for signs of oil loss. Perform the required repe
COMPRESSION KNOCKS	6. Turbocharger leaking oil to the air intake.	6. Inspect the air ducts for evidence of oil transfer. Repair as required (slight c normal).
	1. Air in the fuel system.	1. Identify location of air leak and repair. Do not bleed high pressure fuel syst
	2. Poor quality fuel or water/gasoline contaminated fuel.	2. Verify by operating from a temporary tank with good fuel. Clean and flush Replace fuel/water separator filter.
	3. Engine overloaded.	3. Verify the engine load rating is not being exceeded.
EXCESSIVE VIBRATION	4. Improperly operating injectors.	4. Check and replace misfiring/inoperative injectors.
	1. Loose or broken engine mounts.	1. Replace engine mounts.
	2. Damaged fan or improperly operating accessories.	2. Check and replace the vibrating components.
	3. Improperly operating vibration damper.	3. Inspect/replace vibration damper.
	4. Improperly operating balance shaft.	4. Inspect/replace balance shaft.
	5. Improperly operating electronically controlled viscous fan drive.	5. Inspect/replace fan drive.
	6. Worn or damaged generator bearing.	6. Check/replace generator.
	7. Flywheel housing misaligned.	7. Check/correct flywheel alignment.
	8. Loose or broken power component.	8. Inspect the crankshaft and rods for damage that causes an unbalance condit Repair/replace as required.
EXCESSIVE ENGINE NOISES	9. Worn or unbalanced driveline components.	9. Check/repair driveline components.
	1. Drive belt squeal, insufficient tension or abnormally high loading.	1. Check the automatic tensioner and inspect the drive belt. Make sure water t tensioner pulley, fan hub, generator and power steering pump turn freely.
	2. Intake air or exhaust leaks.	2. Refer to Excessive Exhaust Smoke. Refer to the appropriate diagnostic info
	3. Excessive valve lash.	3. Adjust valves. Make sure the rocker arms are not bent. Replace bent or sev components.
	4. Turbocharger noise.	4. Check turbocharger impeller and turbine wheel for housing contact. Repair required.
	5. Geartrain noise.	5. Visually inspect and measure gear backlash. Replace gears as required.
	6. Power function knock.	6. Check/replace rod and main bearings.

ENGINE LUBRICATION DIAGNOSTIC TABLE

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-rings. Misaligned or damaged.	1. Replace as necessary.
	2. Loose fasteners, broken or porous metal parts.	2. Tighten fasteners, Repair or replace the metal
	3. Crankshaft rear oil seal.	3. Replace rear crankshaft oil seal. Refer to SEAL CRANKSHAFT OIL, REAR, REMOVAL AND INSTALLATION .
	4. Crankshaft seal flange. Scratched, nicked or grooved.	4. Polish or replace the crankshaft.
	5. Oil pan flange cracked.	5. Replace oil pan. Refer to PAN, OIL, REMOVAL AND INSTALLATION .
	6. Damaged or misaligned crankshaft front oil seal.	6. Replace the crankshaft front oil seal. Refer to CRANKSHAFT OIL, FRONT, REMOVAL AND INSTALLATION .
	7. Scratched or damaged vibration damper hub.	7. Polish or replace the vibration damper.
OIL PRESSURE DROP	1. Low oil level.	1. Check and correct oil level.
	2. Faulty oil pressure sensor.	2. Replace the oil pressure sensor. Refer to ENGINE SENSORS, REMOVAL AND INSTALLATION .
	3. Low oil pressure.	3. Check the main bearing and rod bearing clear
	4. Clogged oil filter.	4. Replace oil filter. Refer to FILTER, ENGINE REMOVAL AND INSTALLATION .
	5. Worn oil pump.	5. Replace the oil pump. Refer to PUMP, ENGINE REMOVAL AND INSTALLATION .
	6. Thin or diluted oil.	6. Change the oil and filter. Refer to FILTER, ENGINE OIL .
	7. Excessive bearing clearance.	7. Replace the engine long block. Refer to LONG BLOCK REPLACEMENT .
	8. Oil pump relief valve stuck.	8. Replace the oil pump. Refer to PUMP, ENGINE REMOVAL AND INSTALLATION .

CONDITION	POSSIBLE CAUSES	CORRECTION
	9. Oil pump pick-up loose, damaged or clogged.	9. Replace the oil pump pick-up. Refer to PICK PUMP, REMOVAL AND INSTALLATION .
OIL PUMPING AT RINGS	1. Worn or damaged rings.	1. Replace the engine long block. Refer to LONG BLOCK REPLACEMENT .
	2. Carbon in oil ring slots.	2. Replace the engine long block. Refer to LONG BLOCK REPLACEMENT .
	3. Worn valve guides.	3. Replace the cylinder heads. Refer to CYLINDER HEAD ASSEMBLY, REMOVAL AND INSTALLATION .
	4. Leaking valve guide seals.	4. Replace the valve guide seals. Refer to CYLINDER HEAD ASSEMBLY, DISASSEMBLY AND INSTALLATION .

ENGINE PERFORMANCE DIAGNOSTIC TABLE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery.	1. Charge or replace as necessary.
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply light mineral grease to the terminals.
	3. Faulty starter.	3. Refer to STARTER, REMOVAL AND INSTALLATION .
	4. Faulty camshaft position sensor.	4. Replace the Camshaft Position (CMP) sensor. Refer to CAMSHAFT POSITION SENSOR, REMOVAL AND INSTALLATION .
	5. Faulty crankshaft position sensor.	5. Replace Crank Position (CKP) sensor. Refer to CRANK POSITION SENSOR, REMOVAL AND INSTALLATION .
	6. Faulty fuel pump, relay or wiring.	6. Repair or replace as necessary.
	7. Dirt or water in fuel system.	7. Clean system and replace fuel filter.
ENGINE STALLS OR ROUGH IDLE	1. Vacuum leak.	1. Inspect intake manifold and vacuum hoses, and replace as necessary.
	2. Faulty crank position sensor.	2. Replace Crank Position (CKP) sensor. Refer to CRANK POSITION SENSOR, REMOVAL AND INSTALLATION .
	3. Incorrect camshaft timing.	3. Refer to ENGINE TIMING VERIFICATION .
ENGINE LOSS OF POWER	1. Dirt or water in fuel system.	1. Clean system and replace fuel filter.
	2. Faulty fuel pump.	2. Replace the fuel pump.
	3. Blown cylinder head gasket.	3. Replace the cylinder head gasket.
	4. Low compression.	4. Repair as necessary. Refer to CYLINDER COMPRESSION TEST .
	5. Burned, warped or pitted valves.	5. Replace as necessary.
	6. Plugged or restricted exhaust system.	6. Inspect and replace as necessary.
	7. Incorrect camshaft timing.	7. Refer to ENGINE TIMING VERIFICATION .
ENGINE MISSES ON ACCELERATION	1. Dirt in fuel system.	1. Clean fuel system.
	2. Burned, warped or pitted valves.	2. Replace as necessary.
ENGINE MISSES AT HIGH SPEED	1. Dirt or water in fuel system.	1. Clean system and replace fuel filter.

INTAKE AIR SYSTEM LEAK DETECTION

The purpose of this video is used as an example to help the technician diagnosis leaks in the following systems:

- Charge Air Cooler and Hoses
- Intake Manifold
- EGR System
- Exhaust System Testing (video not shown connect to exhaust system)
- Turbocharger

REQUIRED TOOLS

- (special tool #2049200090, Regulator, Pressure Test)
- (special tool #2048001090, Adapter, Large 61mm)
- (special tool #2048002090, Adapter, Small 51mm Air Leak Test)

OIL CONSUMPTION TEST AND DIAGNOSIS

The following diagnostic procedures are used to determine the source of excessive internal oil Consumption, these procedures and tests apply to vehicles with 50, 000 or more miles.

NOTE: Engine oil consumption may be greater than normal during engine break-in. Repairs should be delayed until vehicle has been driven 100 miles.

Severe service (high ambient temperature, short trips, heavy loading, trailer towing, off-road, or law enforcement use) may result in greater oil consumption than normal.

Sustained high speed driving and high engine RPM operation may result in increased oil consumption.

Failure to comply with the recommended oil type and viscosity rating, as outlined in the owner's manual, may impact oil economy as well as fuel economy.

Oil consumption may increase with vehicle age and mileage due to normal engine wear.

NOTE: Because a few drops of external oil leakage per mile can quickly account for the loss of one quart of oil in a few hundred miles, engine oil leaks are present.

- Oil leakage is not the same as oil consumption and all external leakage must be eliminated before any action can be taken to verify and/or correct oil consumption.
- Verify that the engine has the correct oil level dipstick and dipstick tube installed.
- Verify that the engine is not being run in an overfilled condition. Check the oil level 15 minutes after a hot shutdown with the vehicle parked on a level surface. The oil level should be above MAX or the FULL mark on the dipstick.

OIL CONSUMPTION TEST

1. Check the oil level at least 15 minutes after a hot shutdown.
2. If the oil level is low, top off with the proper viscosity and API service level engine oil. Add one bottle of MOPARB® 4-In-1 Leak Detection Dye into the engine.
3. Tamper proof the oil pan drain plug, oil filter, dipstick and oil fill cap.
4. Record the vehicle mileage.
5. Instruct the customer to drive the vehicle as usual.
6. Ask the customer to return to the servicing dealer after accumulating 500 miles. Check the oil level at least 15 minutes after a hot shutdown. If the oil level is half "FULL" and "ADD" mark continue with the next step.
7. Using a black light, re-check for any external engine oil leaks, repair as necessary, if no external engine oil leaks are present, continue with oil consumption diagnosis.

OIL CONSUMPTION DIAGNOSIS

1. Perform a cylinder compression test and cylinder leak down test using the standard leak down gauge following manufacturers suggested best practices.
2. If one or more cylinders have more than 15% leak down further engine tear down and inspection will be required.
3. If the compression is good it can be assumed the valve guide seals or valve guides are at fault.

TOP 18 REASONS THAT MAY LEAD TO ENGINE OIL CONSUMPTION

1. Tapered and Out-of-Round Cylinders

The increased piston clearances permit the pistons to rock in the worn cylinders. While tilted momentarily, an abnormally large volume of oil is permitted to enter piston. The rings, also tilted in the cylinder, permit oil to enter on one side. Upon reversal of the piston on each stroke, some of this oil is passed into the combustion chamber.

2. Distorted Cylinders

This may be caused by unequal heat distribution or unequal tightening of cylinder head bolts. This condition presents a surface which the rings may not be able to seal. In this case, there may be areas where the rings will not remove all of the excess oil. When combustion takes place, this oil will be burned and cause high oil consumption.

3. Improper operation of "Closed Crankcase Ventilation (CCV)" system

The main purpose of the Closed Crankcase Ventilation (CCV) is to recirculate blow-by gases back from the crankcase area through the engine to consume unburned fuel. The system uses a filter, tubing, and rubber hoses that route crankcase blow by gases to the intake manifold. Vacuum within the engine intake manifold pulls the blow-by gases into the combustion chamber along with the regular intake air and fuel mixture.

The CCV system can become clogged with sludge and varnish deposits and trap blow by gases in the crankcase. This degrades the oil, promoting additional formation of sludge. If left uncorrected, the result is plugged oil rings, oil consumption, rapid ring wear due to sludge buildup, ruptured gaskets and seals due to crankcase pressure.

4. Worn Piston Ring Grooves

For piston rings to form a good seal, the sides of the ring grooves must be true and flat - not flared or shouldered. Piston rings in tapered or irregular grooves will not seal properly, consequently, oil will pass around behind the rings into the combustion chamber.

5. Worn, Broken or Stuck Piston Rings

When piston rings are broken, worn or stuck to such an extent that the correct tension and clearances are not maintained, this will allow oil to be drawn into the cylinder on the intake stroke and hot gases of combustion to be blown down the cylinder past the piston on the power stroke. All of these conditions will result in burning of oil on the cylinders, pistons and rings.

6. Cracked or Broken Ring Lands

Cracked or broken ring lands prevent the rings from seating completely on their sides and cause oil pumping. This condition will lead to serious damage to the cylinders and rings. Cracked or broken ring lands cannot be corrected by any means other than piston replacement.

7. Worn Valve Stems and Guides

When wear has taken place on valve stems and valve guides, the vacuum in the intake manifold will draw oil and oil vapor between the intake valve stems and guides and then into the cylinder where it will be burned.

8. Bent or Misaligned Connecting Rods

Bent or misaligned connecting rods will not allow the pistons to ride straight in the cylinders. This will prevent the pistons and rings from forming a proper seal and promote oil consumption. In addition, it is possible that a bearing in a bent connecting rod will not have uniform clearance on the connecting rod wrist pin. Under load, the bearing will wear rapidly and throw off an excessive amount of oil into the cylinder.

9. Fuel Dilution

If raw fuel is allowed to enter the lubrication system, the oil will become thinner and more volatile and will result in higher oil consumption. The following conditions can cause fuel dilution:

- Excess fuel can enter and mix with the oil via a leaking fuel injector
- Restricted air intake
- Excessive idling

10. Contaminated Cooling Systems

Corrosion, rust, scale, sediment or other formations in the water jacket and radiator will prevent a cooling system from extracting heat efficiently. This is likely to cause engine overheating thus leading to higher oil consumption.

11. Oil Viscosity

The use of oil with a viscosity that is too light may result in high oil consumption. Refer to the vehicle owner's manual for the proper oil viscosity to be used under normal conditions and/or ambient temperatures.

12. Dirty Engine Oil

Failure to change the oil and filter at proper intervals may cause the oil to be so dirty that it will promote accumulation of sludge and varnish and restrict oil passage to the pistons. This will increase oil consumption; dirty oil by nature is also consumed at a higher rate than clean oil.

13. Crankcase Overfull

Due to an error in inserting the oil dip stick so that it does not come to a seat on its shoulder, a low reading may be obtained. Additional oil may be added to make normal with the stick in this incorrect position which will actually make the oil level too high. If the oil level is so high that the lower ends of the connecting rods can excessive quantities of oil will be thrown on the cylinder walls and some of it will work its way up into the combustion chamber.

14. Excessively High Oil Pressure

A faulty oil pressure relief valve may cause the oil pressure to be too high. The result will be that the engine will be flooded with an abnormally large amount of oil that which occurs with worn bearings. This condition may also cause the oil filter to burst.

15. Aftermarket Performance Chips and Modification

Increasing performance through the use of performance/power enhancement products to a stock or factory engine will increase the chance of excessive oil consumption.

16. Lugging Engine

Lugging is running the engine at a lower RPM in a condition where a higher RPM (more power/torque) should be implemented. Especially susceptible on vehicle manual transmission. This driving habit causes more stress loading on the piston and can lead to increases in engine oil consumption.

17. Turbocharged Engines

There is a possibility for higher crankcase pressure (as compared to naturally aspirated engines) which is normal for turbocharged engines. This condition causes engine oil to enter the intake manifold, charge air cooler and associated plumbing to and from the charge air cooler, also a leaking turbocharger seal will draw oil into the combustion chamber where it will burn (blue smoke from tail pipe may be present) and form carbon deposits which contribute to further oil consumption as they interfere with valve function.

18. Restricted Air Intake

Excessive restriction in the air intake system will increase engine vacuum and can increase oil consumption, an extremely dirty air filter would be one example of this.

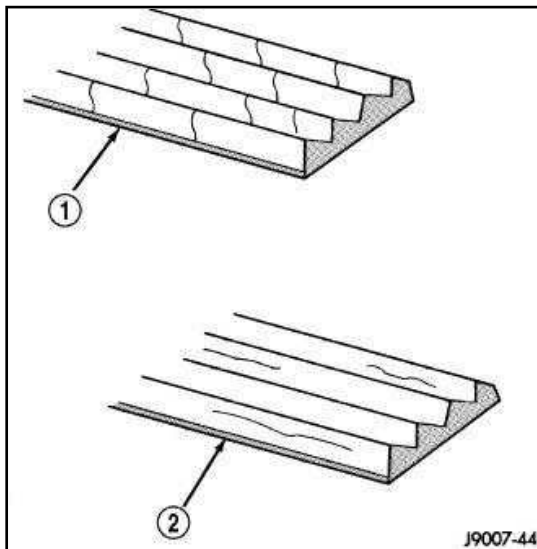
SERPENTINE BELT

ACCESSORY DRIVE BELT DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (One or more ribs has separated from belt body)	1. Foreign objects imbedded in pulley grooves.	1. Remove the foreign objects from pulley grooves.
	2. Installation damage.	2. Replace the belt.
RIB OR BELT WEAR	1. Pulley misaligned.	1. Align the pulley(s).
	2. Abrasive environment.	2. Clean the pulley(s). Replace the belt if necessary.
	3. Rusted pulley(s).	3. Clean rust from the pulley(s).
	4. Sharp or jagged pulley groove tips.	4. Replace the pulley. Inspect the belt.
	5. Belt rubber deteriorated.	5. Replace the belt.
BELT SLIPS	1. Belt slipping because of insufficient tension.	1. Inspect/Replace tensioner if necessary.
	2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, engine coolant).	2. Replace the belt and clean the pulleys. Repair engine coolant leak.
	3. Driven component bearing failure (seizure).	3. Replace the faulty component or bearing.
	4. Belt glazed or hardened from heat and excessive slippage.	4. Replace the belt.
LONGITUDINAL BELT CRACKING	1. Belt has mis-tracked from pulley groove.	1. Replace the belt.
	2. Pulley groove tip has worn away rubber to tensile member.	2. Replace the belt.
"GROOVE JUMPING" (Belt does not maintain correct position on pulley)	1. Incorrect belt tension.	1. Inspect/Replace tensioner if necessary (See Belt Tensioner Diagnosis).
	2. Pulley(s) not within design tolerance.	2. Replace the pulley(s).
	3. Foreign object(s) in grooves.	3. Remove foreign objects from grooves.
	4. Pulley misalignment.	4. Align the component.
	5. Belt cordline is broken.	5. Replace the belt.
BELT BROKEN (Note: Identify and correct problem before new belt is installed)	1. Incorrect belt tension.	1. Inspect/Replace tensioner if necessary (See Belt Tensioner Diagnosis).
	2. Tensile member damaged during belt installation.	2. Replace the belt.
	3. Severe misalignment.	3. Align the pulley(s).
	4. Bracket, pulley, or bearing failure.	4. Replace the defective component and belt.
NOISE (Objectionable squeal, squeak, or rumble is heard or felt while drive belt is in operation)	1. Incorrect belt tension.	1. Inspect/Replace tensioner if necessary (See Belt Tensioner Diagnosis).
	2. Bearing noise.	2. Locate and repair.
	3. Belt misalignment.	3. Align belt/pulley(s).
	4. Belt to pulley mismatch.	4. Install the correct belt.
	5. Driven component induced vibration.	5. Locate defective driven component and repair.
	6. Generator pulley.	6. Check the clutch in the generator pulley is v correctly (See Automatic Belt Tensioner Diagnosis).
TENSION SHEETING FABRIC FAILURE (Woven fabric on outside, circumference of belt has cracked or separated from body of belt)	1. Tension sheeting contacting stationary object.	1. Correct the rubbing condition.
	2. Excessive heat causing woven fabric to age.	2. Replace the belt.
	3. Tension sheeting splice has fractured.	3. Replace the belt.
CORD EDGE FAILURE (Tensile member exposed at edges of belt or separated from belt body)	1. Incorrect belt tension.	1. Inspect/Replace the tensioner if necessary.
	2. Belt contacting stationary object.	2. Replace the belt.
	3. Pulley(s) out of tolerance.	3. Replace the pulley.
	4. Insufficient adhesion between tensile member and rubber matrix.	4. Replace the belt.

VISUAL DIAGNOSIS

NOTE: Diesel Engine: If a belt is broken or frayed, inspect the engine speed sensor (located near crankshaft damper) for damage.



- 1 - NORMAL CRACKS BELT OK
2 - NOT NORMAL CRACKS REPLACE BELT

- When diagnosing serpentine belts, small cracks that run across the ribbed surface of the belt from rib to rib (1), are considered normal. These are not a reason to replace the belt. However, cracks running along a rib (2) (not across) are **not** normal. Any belt with cracks running along a rib must be replaced. Also replace the belt if it has excessive fraying, fraying cords or severe glazing.
- Refer to ACCESSORY DRIVE BELT DIAGNOSIS CHART for further belt diagnosis.

NOISE DIAGNOSIS

- Noises generated by the serpentine belt are most noticeable at idle. Before replacing the serpentine belt to resolve a noise condition, inspect all of the accessory drive pulleys for misalignment, glazing, or excessive end play.

AUTOMATIC BELT TENSIONER

The automatic (spring) belt tensioner cannot be adjusted or repaired. It is designed to maintain proper belt tension throughout its life and the life of the belt.

Visual Diagnosis

With the belt on the drive:

- Check to see if the belt tensioner is against the stop or free-arm stop. Replace the belt if this condition is seen.
- Check to see if the serpentine belt is tracking all the way to one edge of the tensioner pulley. If a witness ("glaze") mark considerable wider than the belt is seen on the belt tensioner and adjacent pulleys should be reviewed.

Belt Tensioner Diagnosis

- Remove the serpentine belt by pulling the belt tensioner back with a breaker bar. Slowly return the belt tensioner to its free arm stop.
- With the breaker bar, slowly pull the belt tensioner back from the free arm stop to the install stop and slowly release again. If the belt tensioner exhibits excessive hesitancy during this cycle, replace the tensioner.
- Check for metal-to-metal contact between arm and springcase. Replace if metal-to-metal contact is seen.
- Check to see if there are any cracks in the belt tensioner or in the stops on the springcase are broken. Replace belt tensioner if either of these conditions are seen.
- Check to see whether the pulley spins freely, without noise or roughness which could be an indicator of potential failure.

NOTE: When reinstalling the belt make sure that the belt is properly seated in the grooves of ALL pulleys.

SMOKE DIAGNOSIS CHARTS

The following charts include possible causes and corrections for **excess or abnormal** exhaust smoke. Small amounts of exhaust smoke (at certain times) are to be considered normal for a diesel powered engine.

EXCESSIVE BLACK SMOKE	
POSSIBLE CAUSE	CORRECTION
Air filter dirty or plugged.	Check and replace the filter if necessary.
Air intake system restricted.	Check the entire air intake system including all hoses and tubes for restriction or damage. Repair/replace as necessary.
Air Leak in Intake System.	Check the entire air intake system including all hoses and tubes for collapse, clamps, or holes in rubber ducts. Also check the intake manifold for loose mounting hardware.
Diagnostic Trouble Codes (DTCs) active or multiple, intermittent DTCs.	Refer to 3.0L DIESEL - DIAGNOSTIC CODE INDEX .
Powertrain Control Module (PCM) has incorrect calibration.	Refer to 3.0L DIESEL - DIAGNOSTIC CODE INDEX .
Exhaust system restriction is above specifications.	Check the exhaust pipes for damage/restrictions. Repair as necessary.
Fuel grade is not correct or fuel quality is poor.	Temporarily change fuel brands and note condition. Change brand if necessary.
Fuel injection pump malfunctioning.	A DTC may have been set. If so, Refer to 3.0L DIESEL - DIAGNOSTIC CODE INDEX .
Fuel injector malfunctioning.	A DTC may have been set. Perform "Injector Classification Programming" using the appropriate tool. Also and, Return Fuel Quantity Test. Refer to 3.0L DIESEL - DIAGNOSTIC CODE INDEX .

EXCESSIVE BLACK SMOKE

POSSIBLE CAUSE	CORRECTION
	CODE INDEX .
Fuel injector lower washer doubled or missing.	Remove and inspect the fuel injector washer.
Fuel return system restricted.	Check the fuel return lines for restriction.
Intake manifold restricted.	Remove the restriction.
Manifold Air Pressure (Boost) Sensor or sensor circuit malfunctioning.	A DTC should have been set. Refer to 3.0L DIESEL - DIAGNOSTIC CODE INDEX .
Turbocharger air intake restriction.	Remove the restriction.
Turbocharger damaged.	Replace the turbocharger.
Turbocharger has excess build up on compressor wheel or diffuser vanes.	Clean the turbocharger with a suitable cleaner.
Turbocharger wheel clearance out of specification.	Replace the turbocharger.

EXCESSIVE WHITE SMOKE

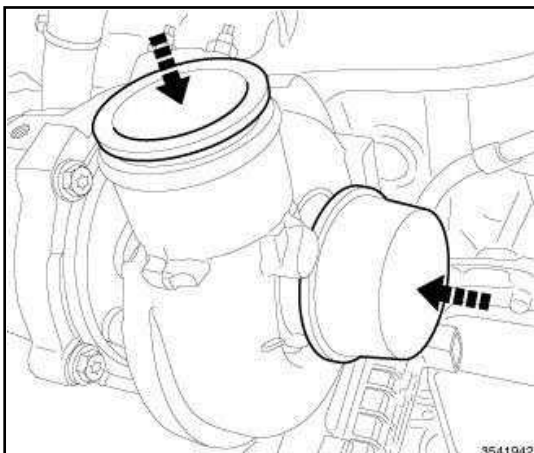
POSSIBLE CAUSE	CORRECTION
Air in the fuel supply: Possible leak in fuel supply side.	Inspect the fuel system.
Coolant leaking into the combustion chamber.	Perform the cooling system pressure test.
Diagnostic Trouble Codes (DTCs) active or multiple, intermittent DTCs.	Refer to 3.0L DIESEL - DIAGNOSTIC CODE INDEX .
In very cold ambient temperatures, engine block heater is malfunctioning (if equipped).	Refer to DIAGNOSIS AND TESTING .
Powertrain Control Module (PCM) has incorrect calibration.	A DTC should have been set. Refer to 3.0L DIESEL - DIAGNOSTIC CODE INDEX .
Fuel filter plugged.	Refer to DIAGNOSIS AND TESTING .
Fuel grade not correct or fuel quality is poor.	Temporarily change fuel brands and note condition. Change brand if necessary.
Fuel injector malfunctioning.	A DTC should have been set. Perform "Injector Identification Programming Cutout Test" using scan tool to isolate individual cylinders. Also. Refer to 3.0L DIESEL - DIAGNOSTIC CODE INDEX .
Fuel injector hold-down(s) loose.	Replace the copper washer(s) (shim) and tighten to specifications.
Fuel injector protrusion not correct.	Check washer (shim) at bottom of fuel injector for correct thickness.
Fuel injection pump malfunctioning.	A DTC should have been set. Refer to 3.0L DIESEL - DIAGNOSTIC CODE INDEX .
Fuel supply side restriction.	Refer to DIAGNOSIS AND TESTING for fuel system testing.
Intake manifold air temperature sensor malfunctioning.	A DTC should have been set. Refer to 3.0L DIESEL - DIAGNOSTIC CODE INDEX .
Intake manifold heater circuit not functioning correctly in cold weather.	A DTC should have been set. Refer to 3.0L DIESEL - DIAGNOSTIC CODE INDEX . Also check the heater elements for correct operation.
Intake manifold heater elements not functioning correctly in cold weather.	A DTC should have been set if heater elements are malfunctioning. Refer to 3.0L DIESEL - DIAGNOSTIC CODE INDEX .
Internal engine damage (scuffed cylinder).	Analyze engine oil and inspect oil filter to locate area of probable damage.
Restriction in fuel supply side of fuel system.	Refer to DIAGNOSIS AND TESTING for fuel system testing.

EXCESSIVE BLUE SMOKE

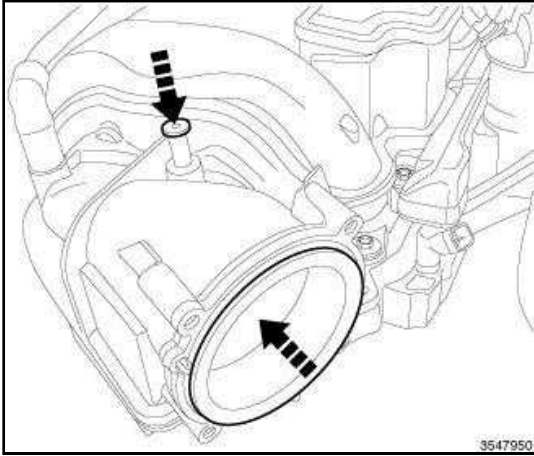
POSSIBLE CAUSE	CORRECTION
Dirty air cleaner or restricted turbocharger intake duct.	Check the air cleaner housing for debris and replace filter as necessary.
Air leak in boost system between turbocharger compressor outlet and intake manifold.	Service the charge air system.
Obstruction in exhaust manifold.	Remove the exhaust manifold and inspect for blockage.
Restricted turbocharger drain tube.	Remove the turbocharger drain tube and remove obstruction.
Crankcase ventilation system plugged.	Inspect the oil separator system for function and clear drain back hole in cylinder cover/intake manifold.
Valve seals are worn, brittle, or improperly installed.	Replace the valve stem oil seals.
Valve stems or guides are worn.	Remove the valves and inspect valves and guides.
Broken or Improperly installed piston rings.	Tear down the engine and inspect piston rings.
Excessive piston ring end gap.	Remove the pistons and measure piston ring end gap.
Excessive cylinder liner wear and taper.	Remove the pistons and measure cylinder liner wear and taper.
Cylinder damage.	Remove the pistons and inspect cylinder liner for cracks or porosity. Repair or replace cylinder liner if necessary.
Piston damage.	Remove the pistons and inspect for cracks, holes. Measure piston for out-of-round and taper.
Turbocharger failure.	Replace the turbocharger.

STANDARD PROCEDURE

DUST COVERS AND PROTECTIVE CAPS

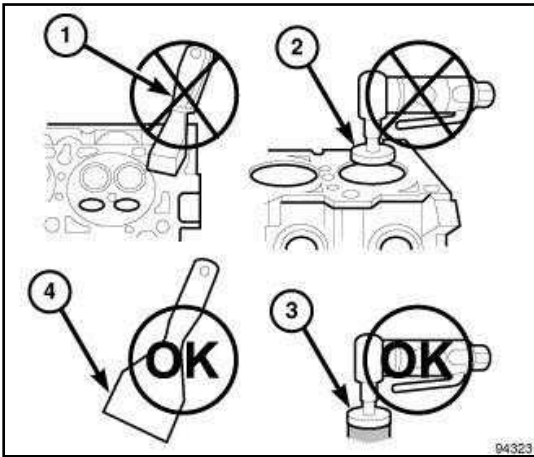


To avoid the possibility of dust, dirt, moisture and other foreign debris being introduced to the engine during service, cover or cap all openings when hoses and tubes are



Covers installed over openings will reduce the possibility of foreign materials entering the engine systems. Using the (special tool #10368, Set, Universal Protective Cap appropriate cover needed for the procedure.

ENGINE GASKET SURFACE PREPARATION



To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components and multi-layer steel cylinder h

Never use the following to clean gasket surfaces:

- Metal scraper (1).
- Abrasive pad or paper to clean cylinder block and head.
- High speed power tool with an abrasive pad or a wire brush (2).

NOTE: Multi-Layer Steel (MLS) head gaskets require a scratch free sealing surface.

Only use the following for cleaning gasket surfaces:

- Solvent or a commercially available gasket remover.
- Plastic or wood scraper (4).
- High speed power tool with a plastic bristle brush style disc (3).

Sealing surfaces must be free of grease or oil residue. Clean surfaces with MoparB® brake parts cleaner (or equivalent).

FORM-IN-PLACE GASKETS AND SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired **form-in-place gasket material unless specified**. Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can r

can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

There are numerous types of form-in-place gasket materials that are used in the engine area. MoparB® Engine RTV, MoparB® ATF-RTV, and MoparB® Gasket Maker have different properties and can not be used in place of the other.

MOPARB® ENGINE RTV MS-GF44B

MoparB® Engine RTV is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealin exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this n properly cure. Always inspect the package for the expiration date before use.

MOPARB® ATF RTV MS-GF41B

MoparB® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmis coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect expiration date before use.

MOPARB® GASKET MAKER MS-CD98D

MoparB® Gasket Maker is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if 1 tube. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPARB® GASKET SEALANT MS-CD78D

MoparB® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can with applicator.

MOPARB® THREEBOND ENGINE RTV SEALANT

MOPARB® THREEBOND ENGINE RTV SEALANT is a unique gasket material that is specially made to retain adhesion and sealing properties when used to seal con engine oil.

FORM-IN-PLACE GASKET AND SEALER APPLICATION

Assembling parts using a form-in-place gasket requires care but it's easier than using precut gaskets.

MoparB® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. Be certain the material surrounds each material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent seal location.

MoparB® Engine RTV MS-GF44B or ATF RTV MS-GF41B gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All material circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. torqued in place while the sealant is still wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing material

MoparB® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. The assembly. Material in a can with applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel

REPAIR DAMAGED OR WORN THREADS

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads can not be repaired in the following locations:

- Camshaft bearing cap attaching threads
- Crankshaft main bearing cap bolt threads in the engine block
- Cylinder head bolt holes in the engine block

Repairing damaged or worn threads that can be repaired:

- Drill out worn or damaged threads.
- Tap the hole with a special Heli-Coil Tap, or equivalent.
- Instal an insert into the tapped hole to bring the hole back to its original thread size.

HYDROSTATIC LOCK

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

1. Disconnect and isolate the negative cable.
2. Inspect air cleaner, induction system, and intake manifold to ensure system is dry and clear of foreign material.
3. Place a shop towel around the fuel injectors to catch any fluid that may possibly be under pressure in the cylinder head. Remove the fuel injectors. Refer to [INJECTION REMOVAL AND INSTALLATION](#).

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

4. With all injectors removed, rotate the crankshaft using the crankshaft.
5. Identify the fluid in the cylinders (coolant, fuel, oil, etc.).
6. Be sure all fluid has been removed from the cylinders.
7. Repair engine or components as necessary to prevent this problem from occurring again.
8. Squirt a small amount of engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.
9. Install fuel injectors. Refer to [INJECTOR\(S\), FUEL, REMOVAL AND INSTALLATION](#).
10. Drain the engine oil. Remove and discard the oil filter.
11. Install the drain plug and tighten to the proper specifications. Refer to [TORQUE SPECIFICATIONS](#).
12. Install a **NEW** oil filter and tighten to the proper specifications. Refer to [TORQUE SPECIFICATIONS](#).
13. Fill engine crankcase with the specified amount and grade of oil. Refer to [CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS](#).
14. Connect the negative cable.
15. Start the engine, allow to warm, turn engine off and check for any leaks.

TECHNICAL SPECIFICATIONS

ENGINE SPECIFICATIONS DIESEL

General Description

DESCRIPTION	SPECIFICATION
Displacement 3.0L	3.0L (2987 cc) (182.28 CID)
Bore	83 mm (3.27 in.)
Stroke	92 mm (3.62)
Compression Ratio	16:1
Valves Per Cylinder	4

DESCRIPTION	SPECIFICATION
Weight	234 Kg (516 lbs.)
Power Output	194 Kw (260 HP) @ 3600 RPM
Torque	650 N.m (479 ft. lbs.) @ 1800-2200 RPM
Idle Speed - Warm	650 RPM
Max RPM in Gear	4600
Max RPM in Neutral	4000
Ribbed V-Belt Tension	Automatic Belt Tensioner Roller
Thermostat Opening	98B° C (208B° F)
Cooling System Capacity	11 L (11.6 Qts.)
Engine Oil Capacity	8.8 L (9.3 Qts.) W/Filter Change
Timing System	Chain Driven Dual Overhead Camshafts
Air Intake	Dry Filter With Turbocharger and Charge Air Cooler
Fuel Supply	Electric Pump In The Fuel Tank
Fuel System	Direct Fuel Injection Common Rail System
Combustion Cycle	4 Stroke Diesel
Cylinder Compression Difference Between Cylinders	5 Bar (73 psi.)
Cooling System	Water Cooling
Engine Pre Heat	Glow Plug
Glow Plug Type	Ceramic NGK CZ506
Glow Plug Voltage	7 Volts
Emission Standards	(NAFTA) : LEVIII / Tier 3 LEV160/BIN160 (CARB/EPA)
Injection Pressure	2000 Bar (29, 008 psi)
Injection Pump	Bosch CP4.20/2, 2000 Bar (29, 008 psi)
Injection Order	1-4-2-5-3-6
Injector Type	CRI 2-20
Lubrication	Pressure Lubricated By Rotary Pump
Oil Quantity with Filter	7.8L L (8.2 Qts)
Oil Pressure 105B° C (221B° F)	1.1 Bar (15.9 psi.) at Idle 4.5 Bar (58 psi) at 3600 RPM
Engine Rotation	Clockwise Viewed From Front Cover

CRANKSHAFT

DESCRIPTION	SPECIFICATION		
	Metric		Standard
Crankshaft Journal Diameter	B		
Tolerance Class A	67.500 - 67.494 mm		2.6575 - 2.6572 ir
Tolerance Class B	67.494 - 67.488 mm		2.6572 - 2.6570 ir
Tolerance Class C	67.488 - 67.482 mm		2.6570 - 2.6568 ir
Main Bearing Journal Diameter 1 - 4	B		
Tolerance Class	Mark	B	
A	D	73.958 mm	2.91173 in.
	E	73.957 mm	2.91169 in.
	F	73.956 mm	2.91165 in.
	G	73.955 mm	2.91161 in.
	H	73.954 mm	2.91157 in.
	I	73.953 mm	2.91153 in.
	J	73.952 mm	2.91149 in.
B	K	73.951 mm	2.91145 in.
	L	73.950 mm	2.91141 in.
	M	73.949 mm	2.91137 in.
	N	73.948 mm	2.91133 in.
	O	73.947 mm	2.91129 in.
C	P	73.946 mm	2.91125 in.
	Q	73.945 mm	2.91118 in.
	R	73.944 mm	2.91118 in.
	S	73.943 mm	2.91114 in.
	T	73.942 mm	2.91110 in.
	U	73.941 mm	2.91106 in.
	V	73.940 mm	2.91102 in.
Axial play of crankshaft	B	0.12 - 0.31 mm	0.005 - 0.0122 in

CRANKSHAFT BEARINGS

MAIN BEARINGS			
CLASS	COLOR	Crankshaft Bearing Shell Thickness	
1	BLACK	1.991 - 1.994 mm	0.07839 - 0.07850
2	PINK	1.994 - 1.997 mm	0.07850 - 0.07862
3	RED	1.997 - 2.000 mm	0.07862 - 0.07874
4	BLUE	2.000 - 2.003 mm	0.07874 - 0.07886
5	YELLOW	2.003 - 2.006 mm	0.07886 - 0.07898
6	GREEN	2.006 - 2.009 mm	0.07898 - 0.07909

CRANKSHAFT BEARINGS MB1 - MB4

MAIN BEARINGS UPPER AND LOWER CLASS SELECTION FOR MB1 - MB4	
MB1 - MB4	CRANKSHAFT MAIN BEARINGS DIAMETER

MAIN BEARINGS UPPER AND LOWER CLASS SELECTION FOR MB1 - MB4

			Class A							Class B							Class		
			D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
			73.958 mm 2.91173 in.	73.957 mm 2.91169 in.	73.956 mm 2.91165 in.	73.955 mm 2.91161 in.	73.954 mm 2.91157 in.	73.953 mm 2.91154 in.	73.952 mm 2.91150 in.	73.951 mm 2.91146 in.	73.950 mm 2.91142 in.	73.949 mm 2.91138 in.	73.948 mm 2.91134 in.	73.947 mm 2.91130 in.	73.946 mm 2.91126 in.	73.945 mm 2.91122 in.	73.944 mm 2.91118 in.	73.943 mm 2.91114 in.	7
BLOCK MAIN JOURNAL DIAMETER	Class A	D	78.000 mm 3.07087 in.	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	4
		E	78.001 mm 3.07091 in.	2	2	2	3	3	3	3	3	4	4	4	4	4	4	4	5
		F	78.002 mm 3.07094 in.	2	2	3	3	3	3	3	4	4	4	4	4	4	5	5	
		G	78.003 mm 3.07098 in.	2	3	3	3	3	3	4	4	4	4	4	4	4	5	5	
		H	78.004 mm 3.07102 in.	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	
		I	78.005 mm 3.07106 in.	3	3	3	3	3	4	4	4	4	4	5	5	5	5	5	
		J	78.006 mm 3.07110 in.	3	3	3	3	4	4	4	4	4	5	5	5	5	5	5	
	Class B	K	78.007 mm 3.07114 in.	3	3	3	4	4	4	4	4	5	5	5	5	5	5	5	6
		L	78.008 mm 3.07118 in.	3	3	4	4	4	4	4	5	5	5	5	5	5	6	6	
		M	78.009 mm 3.07122 in.	3	4	4	4	4	4	5	5	5	5	5	5	6	6	6	
		N	78.010 mm 3.07126 in.	4	4	4	4	4	5	5	5	5	5	6	6	6	6	6	
		O	78.011 mm 3.07130 in.	4	4	4	4	5	5	5	5	5	5	6	6	6	6	6	
		P	78.012 mm 3.07134 in.	4	4	4	4	5	5	5	5	5	6	6	6	6	6	6	
	Class C	Q	78.013 mm 3.07138 in.	4	4	4	5	5	5	5	5	6	6	6	6	6	6	N.A.	
		R	78.014 mm 3.07142 in.	4	4	5	5	5	5	5	6	6	6	6	6	6	N.A.	N.A.	
		S	78.015 mm 3.07146 in.	4	5	5	5	5	5	6	6	6	6	6	6	N.A.	N.A.	N.A.	
		T	78.016 mm 3.07150 in.	5	5	5	5	5	6	6	6	6	6	6	N.A.	N.A.	N.A.	N.A.	
		U	78.017 mm 3.07154 in.	5	5	5	5	6	6	6	6	6	6	N.A.	N.A.	N.A.	N.A.	N.A.	
		V	78.018 mm 3.07157 in.	5	5	5	5	6	6	6	6	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	

CRANKSHAFT BEARINGS MB2 - MB3

MAIN BEARINGS UPPER AND LOWER CLASS SELECTION FOR MB2 - MB3																		
MB2 - MB3			CRANKSHAFT MAIN BEARINGS DIAMETER															
			Class A								Class B						Class	
			D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
			73.958 mm 2.91173 in.	73.957 mm 2.91169 in.	73.956 mm 2.91165 in.	73.955 mm 2.91161 in.	73.954 mm 2.91157 in.	73.953 mm 2.91154 in.	73.952 mm 2.91150 in.	73.951 mm 2.91146 in.	73.950 mm 2.91142 in.	73.949 mm 2.91138 in.	73.948 mm 2.91134 in.	73.947 mm 2.91130 in.	73.946 mm 2.91126 in.	73.945 mm 2.91122 in.	73.944 mm 2.91118 in.	73.943 mm 2.91114 in.
BLOCK MAIN JOURNAL DIAMETER	Class A	D	78.000 mm 3.07087 in.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	1	1	1	1	1	1	1
		E	78.001 mm 3.07091 in.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	1	1	1	1	1	1	1	2
		F	78.002 mm 3.07094 in.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	1	1	1	1	1	1	1	2	2
		G	78.003 mm 3.07098 in.	N.A.	N.A.	N.A.	N.A.	N.A.	1	1	1	1	1	1	1	2	2	2
		H	78.004 mm 3.07102 in.	N.A.	N.A.	N.A.	N.A.	1	1	1	1	1	1	1	2	2	2	2
		I	78.005 mm 3.07106 in.	N.A.	N.A.	N.A.	N.A.	1	1	1	1	1	1	2	2	2	2	2
		J	78.006 mm 3.07110 in.	N.A.	N.A.	N.A.	1	1	1	1	1	1	2	2	2	2	2	2
	Class B	K	78.007 mm 3.07114 in.	N.A.	N.A.	1	1	1	1	1	1	2	2	2	2	2	2	3
		L	78.008 mm 3.07118 in.	N.A.	1	1	1	1	1	1	2	2	2	2	2	2	3	3
		M	78.009 mm 3.07122 in.	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3
		N	78.010 mm 3.07126 in.	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3
		O	78.011 mm 3.07130 in.	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3
		P	78.012 mm 3.07134 in.	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3
		Q	78.013 mm 3.07138 in.	1	1	1	2	2	2	2	2	3	3	3	3	3	3	4
	Class C	R	78.014 mm 3.07142 in.	1	1	2	2	2	2	2	3	3	3	3	3	3	4	4
		S	78.015 mm 3.07146 in.	1	2	2	2	2	2	3	3	3	3	3	3	4	4	4
		T	78.016 mm 3.07150 in.	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4
		U	78.017 mm 3.07154 in.	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4
		V	78.018 mm	2	2	2	2	3	3	3	3	3	4	4	4	4	4	4

MAIN BEARINGS UPPER AND LOWER CLASS SELECTION FOR MB2 - MB3

		3.07157 in.																
--	--	----------------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

CYLINDER HEAD

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Cylinder Head Height	133 B± 0.06 mm	5.2362 B± 0.0023 in.
Cylinder Head Flatness Deformation Tolerance	0.1 mm	0.0039 in.
Valve Seat Width in Cylinder Head	B	
Intake valve	28.060 / -0.3 mm	1.1047 / -0.0118 in.
Exhaust valve	24.680 / -0.3 mm	0.9716 / -0.0118 in.
Valve Face Angle in Head	2B°15'/2B°	2B°15'/2B°
Internal Diameter of Valve Guide for Intake / Exhaust Valve	5+0.033 / +0.015 mm	0.1968+0.001 / +0.0005 in.
Valve Guide Installation Height	75.565 B± 0.3 mm (intake) 75.58 B± 0.3 mm (exhaust)	2.9750 B± 0.0118 in. (intake) 2.9756 B± 0.0118 in. (exhaust)
Cylinder Head Bolts	B	
Thread Diameter	14 x 1.5 mm	NA

HEAD GASKET SELECTION CHART

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Piston Clearance	0.130 - 0.220 mm	0.0051 - 0.0086 in.
Cylinder Head Gasket Thickness	1.00 mm	0.0377 in.
Gasket Identification	NO HOLE	
B		
Piston Clearance	0.221 - 0.310 mm	0.0087 - 0.0122 in.
Cylinder Head Gasket Thickness	1.10 mm	0.0417 in.
Gasket Identification	ONE HOLE	
B		
Piston Clearance	0.311 - 0.402 mm	0.0122 - 0.0158 in.
Cylinder Head Gasket Thickness	1.20 mm	0.0456 in.
Gasket Identification	TWO HOLES	

CYLINDER BORE

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Cylinder Bore Internal Diameter	82.995 - 83.025 mm	3.2675 - 3.2687 in.
Roundness Tolerance	0.006 mm	0.0002 in.
Honing Angle	40B° B± 5	40B° B± 5

CAMSHAFT

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Camshaft End Play	0.1 / 0.3 mm	0.0039 / 0.0118 in.
Intake camshaft Height	3.95 mm	0.1555 in.
Exhaust Camshaft Height	3.95 mm	0.1555 in.
Outer Journal Diameter at Camshaft	23.95 mm	0.9429 in.
Inner Journal Diameter at Camshaft	24 mm	0.9448 in.
Camshaft Journal Clearance	B	
Min	0.03 mm	0.0018 in.
Max	0.07 mm	0.0028 in.
Cylinder Head On Right Valve Timing At 2 mm Valve Lift and A New Timing Chain	B	
Inlet Valve Opens After TDC	19.6B°	19.6B°
Inlet Valve Closes After BDC	5.6B°	5.6B°
Outlet Valve Opens After TDC	17.9B°	17.9B°
Outlet Valve Closes After BDC	27.9B°	27.9B°
Cylinder Head On Right Valve Timing At 2 mm Valve Lift And A Used Timing Chain	B	
Inlet Valve Opens After TDC	21.5B°	21.5B°
Inlet Valve Closes After BDC	3.7B°	3.7B°
Outlet Valve Opens After TDC	16.0B°	16.0B°
Outlet Valve Closes After BDC	26.0B°	26.0B°
Cylinder Head On Left Valve Timing At 2 mm Valve Lift and A New Timing Chain	B	
Inlet Valve Opens After TDC	20.7B°	20.7B°
Inlet Valve Closes After BDC	4.5B°	4.5B°
Outlet Valve Opens After TDC	16.8B°	16.8B°
Outlet Valve Closes After BDC	26.8B°	26.8B°
Cylinder Head On Left Valve Timing At 2 mm Valve Lift And A Used Timing Chain	B	
Inlet Valve Opens After TDC	21.5B°	21.5B°
Inlet Valve Closes After BDC	3.7B°	3.7B°
Outlet Valve Opens After TDC	16.0B°	16.0B°
Outlet Valve Closes After BDC	26.0B°	26.0B°

VALVES

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Intake Valve Face Angle	2.25B°	2.25B°
Exhaust Valve Face Angle	2B°	2B°
Intake Valve Head Diameter	27.5 mm	1.0826 in.
Exhaust Valve Head Diameter	24 mm	0.9448 in.
Intake Valve Stem Diameter	5 mm	0.1968 in.
Exhaust Valve Stem Diameter	5 mm	0.1968 in.
Intake Valve Stem Projection	B	
Min	0.382 mm	0.0150 in.
Max	0.6 mm	0.0236 in.
Exhaust Valve Stem Projection	B	
Min	0.382 mm	0.0150 in.
Max	0.6 mm	0.0236 in.
Springs	B	
Free Length	44.1 mm	1.7362 in.
Valve Closed	34 mm	1.3385 in.
Valve Open	25.5 mm	1.003 in.

PISTONS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Piston Diameter	B	
Tolerance Class A	82.930 - 82.940 mm	3.26496 - 3.26535 in.
Tolerance Class B	82.940 - 82.950 mm	3.26535 - 3.26575 in.
Tolerance Class C	82.950 - 82.960 mm	3.26575 - 3.26614 in.

PISTON RINGS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Cylinder Compression 1st Sealing Ring Gap	0.32 - 0.42 mm	0.0126 - 0.01654 in.
Cylinder Compression 2nd Sealing Ring Gap	0.7 - 0.85 mm	0.02756 - 0.03346 in.
Engine Piston Oil Scrapper Ring Gap	0.25 - 0.5 mm	0.00984 - 0.01969
Sealing Ring Seat in Piston - 1st Groove	1.63+0.010/-0.010 mm	0.0642 -0.0004 / 0.0004 in.
Sealing Ring Seat in Piston - 2nd Groove	1.58 +0.010/-0.010 mm	0.0622 -0.0004 / 0.0004 in.
Sealing Ring Seat in Piston - 3rd Groove	2.03 +0.010 / -0.010 mm	0.0799 -0.0004 / 0.0004 in.
Cylinder Compression 1st Sealing Ring Thickness	0.15 - 0.010 / -0.030 mm	0.0591 -0.0004 / -0.0012 in.
Cylinder Compression 2nd Sealing Ring Thickness	0.15 - 0.010 / -0.030 mm	0.0591 -0.0004 / -0.0012 in.
Engine Piston Oil Scraper Ring Thickness	2.0 -0.010 / -0.030 mm	0.0787 -0.0004 / -0.0012 in.
Cylinder Compression 1st Sealing Ring End Float	0.130 - 0.170 mm	0.00512 - 0.00669 in.
Cylinder Compression 2nd Sealing Ring End Float	0.075 - 0.120 mm	0.00295 - 0.00472 in.
Engine Piston Oil Scraper Ring End Float	0.030 - 0.070 mm	0.00118 - 0.00276 in.

CONNECTING RODS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Connecting Rod Length	162.1 mm	6.382 in.
Connecting Rod Bolt	2 x M9 x 1 Grade: 12.9	NA
Upper Connecting Rod Eye Diameter	30 -0.014 / +0.006 mm	+1.1811 +0.00055 / +0.00024
Connecting Rod Sideways Play	0.1 - 0.3 mm	0.0039 - 0.018
Connecting Rod Weight	878 grams	30.97 oz.

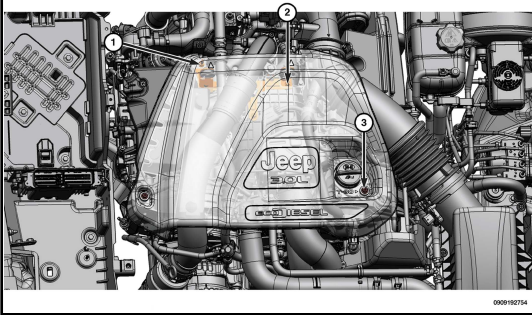
CONNECTING ROD BEARINGS

CONNECTING ROD BEARINGS			
CLASS	COLOR	BEARING THICKNESS	
1	PINK	1.725 - 1.728 mm	0.06791 - 0.06803
2	RED	1.728 - 1.731 mm	0.06803 - 0.06815
3	BLUE	1.731 - 1.734 mm	0.06815 - 0.06827
4	YELLOW	1.734 - 1.737 mm	0.06827 - 0.06839
5	GREEN	1.737 - 1.740 mm	0.06839 - 0.06850

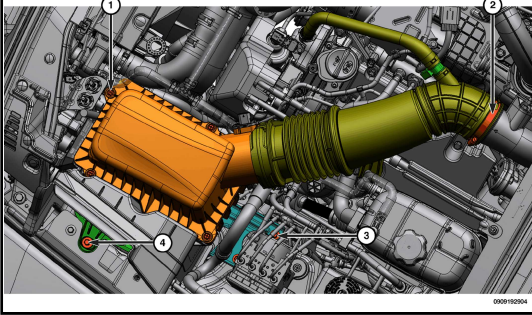
CONNECTING ROD BEARINGS

CONNECTING ROD BEARING CLASS SELECTION			CRANKSHAFT PIN DIAMETER		
			Class A	Class B	Class C
			71.000 - 71.006 mm 2.79528 - 2.79551 in.	71.006 - 71.012 mm 2.79551 - 2.79575 in	71.012 - 71.018 mm 2.79575 - 2.79599 in
Connecting Rod Diameter	Class A	67.494 - 67.500 mm 2.65724 - 2.65748 in.	PINK / PINK (UPPER/LOWER)	RED / RED (UPPER/LOWER)	BLUE / BLUE (UPPER/LOWER)
	Class B	67.488 - 67.494 mm 2.65701 - 2.65724 in.	RED / RED (UPPER/LOWER)	BLUE / BLUE (UPPER/LOWER)	YELLOW / YELLOW (UPPER/LOWER)
	Class C	67.482 - 67.488 mm 2.65677 - 2.65701 in.	BLUE / BLUE (UPPER/LOWER)	YELLOW / YELLOW (UPPER/LOWER)	GREEN / GREEN (UPPER/LOWER)
GEOMETRIC CLEARANCE DIAMETER: 0.044 - 0.062 mm / 0.001732 - 0.002441 in.					

TORQUE SPECIFICATIONS



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Engine Cover Bracket Nut	9 N.m (80 In. Lbs.)	-
2	Engine Cover Bracket Bolt	9 N.m (80 In. Lbs.)	-
3	Engine Cover bolts	4 N.m (35 In. Lbs.)	-



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Air Cleaner Cover Bolt	5 N.m (44 In. Lbs.)	-
2	Fresh Air Inlet Hose Clamp	4 N.m (35 In. Lbs.)	-
3	Air Cleaner Body Bracket Bolt	9 N.m (80 In. Lbs.)	-
4	Air Cleaner Body Bolt	5 N.m (44 In. Lbs.)	-
-	Air Cleaner Body Bracket Nut	9 N.m (80 In. Lbs.)	-

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Intake Manifold Bolts	12 N.m (9 Ft. Lbs.)	Tightening Sequence
2	Throttle Body Support Bracket to Intake Manifold	9 N.m (80 In. Lbs.)	-
3	Throttle / Airflow Control Valve Bolts	9 N.m (80 In. Lbs.)	-

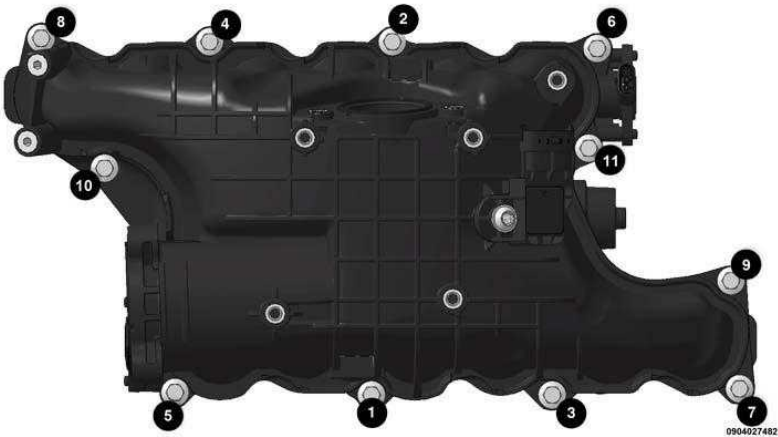
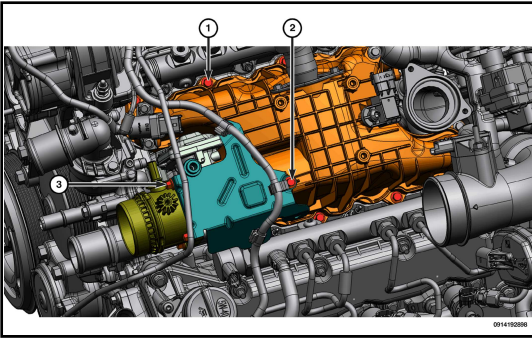
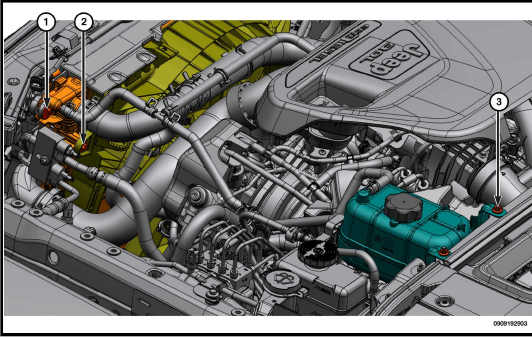


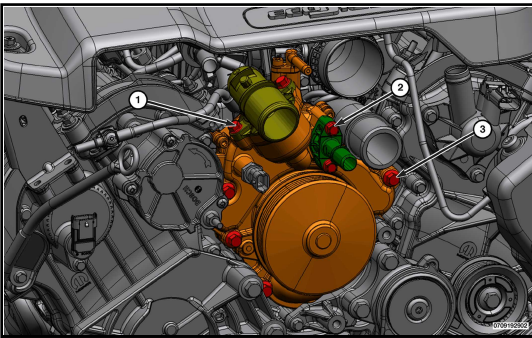
Fig. 1: Intake Manifold Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC



COOLING SYSTEM - 3.0L DIESEL

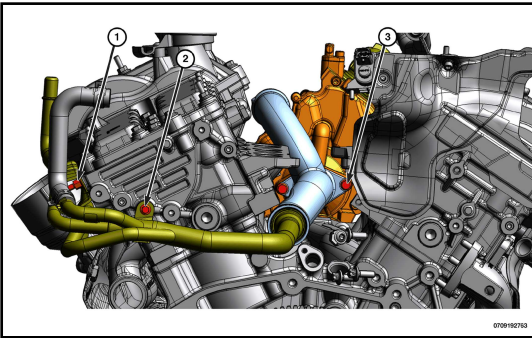


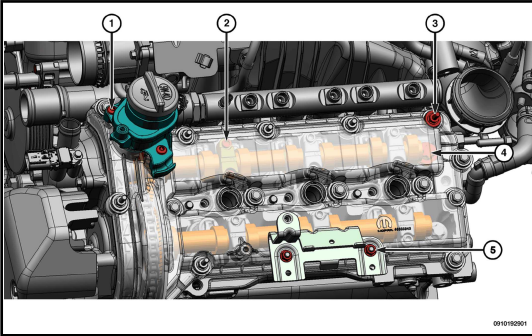
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90B° and then tighten to 32 N.m (24 Ft. Lbs.).	-
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-





CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1	Oil Filler Neck Assembly to Valve Cover	Tighten Securely	-
2	Camshaft Bearing Cap Bolts	11 N.m (8 Ft. Lbs.)	Tightening Sequence
3	Cylinder Head Cover Bolts	Torque Procedure: 1. Tighten the cylinder head cover bolts finger tight. 2. Tighten bolts to 8 N.m (71 In. Lbs.). 3. Loosen each bolt 90B°. 4. Tighten bolts to 10 N.m (89 In. Lbs.).	Tightening Sequence
4	Cylinder Head Bolts (M14)	Torque Procedure: 1. Tighten the cylinder head bolts finger tight. 2. Tighten bolts to 30 N.m (22 Ft. Lbs.). 3. Tighten bolts an additional 75B° in sequence. 4. Tighten bolts an additional 75B° in sequence. 5. Tighten bolts an additional 75B° in sequence.	Tightening Sequence
5	Fuel Line Support Bracket Nuts	6 N.m 53 (In. Lbs.)	-
-	Coolant Tube Bolt	25 N.m (18 Ft. Lbs.)	-
-	Engine Wire Harness Bolts	11 N.m (8 Ft. Lbs.)	-
-	Heat Shield Bracket Nuts	6 N.m 53 (In. Lbs.)	-

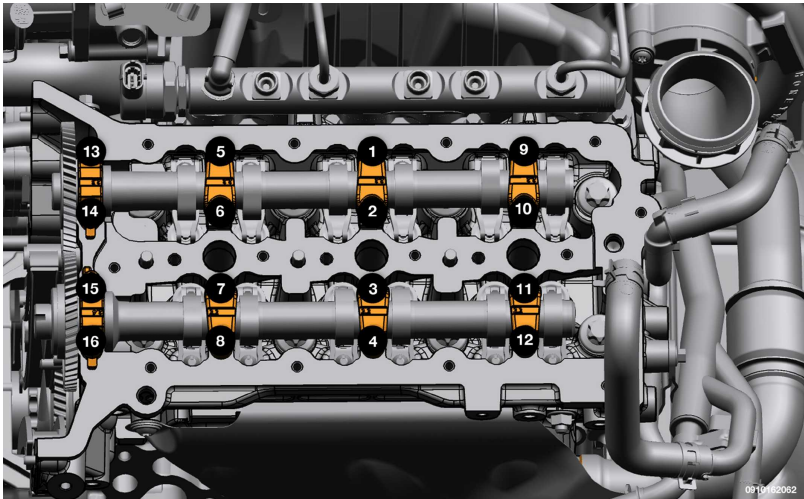


Fig. 2: Camshaft Bearing Cap Tightening Sequence 3.0L
Courtesy of CHRYSLER GROUP, LLC

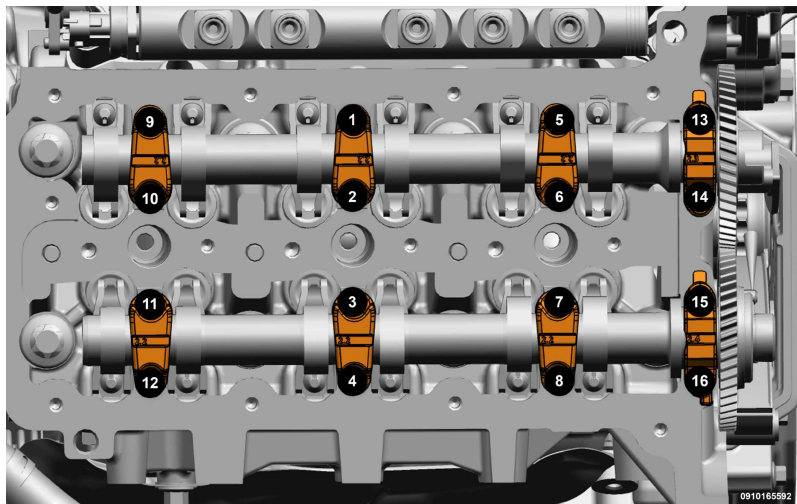


Fig. 3: Front Bearing Caps Bolts Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC

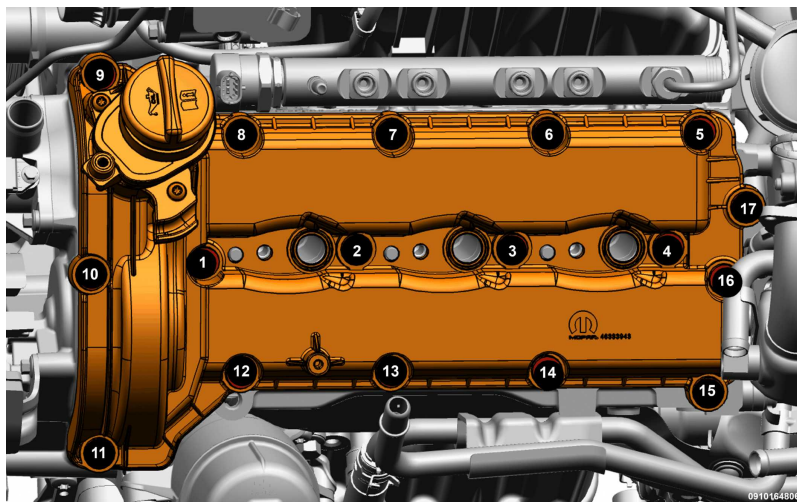


Fig. 4: Cylinder Head Cover Bolts Tightening Sequence - Left
 Courtesy of CHRYSLER GROUP, LLC

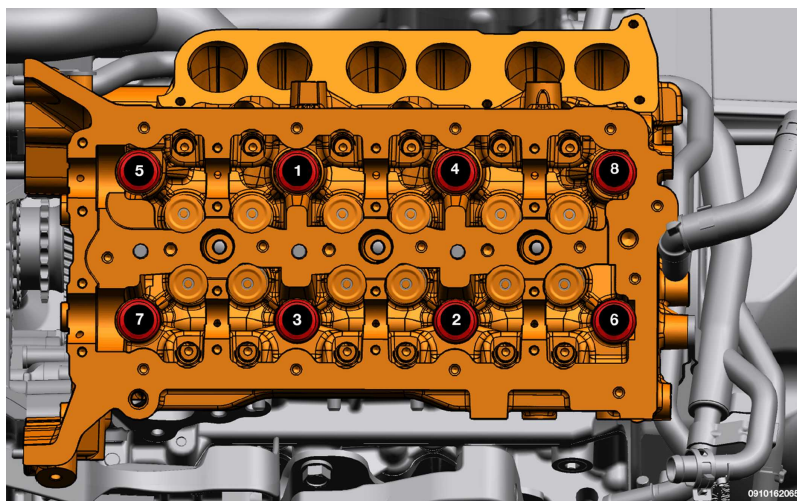
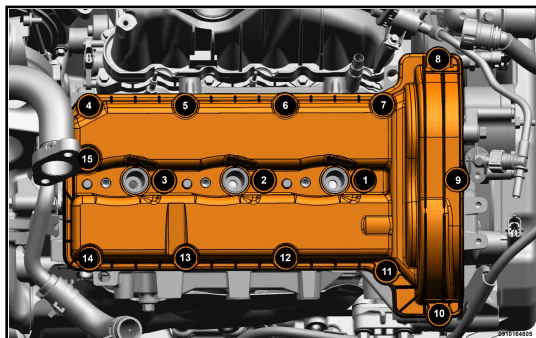


Fig. 5: Cylinder Head Bolts Tightening Sequence - Left
Courtesy of CHRYSLER GROUP, LLC

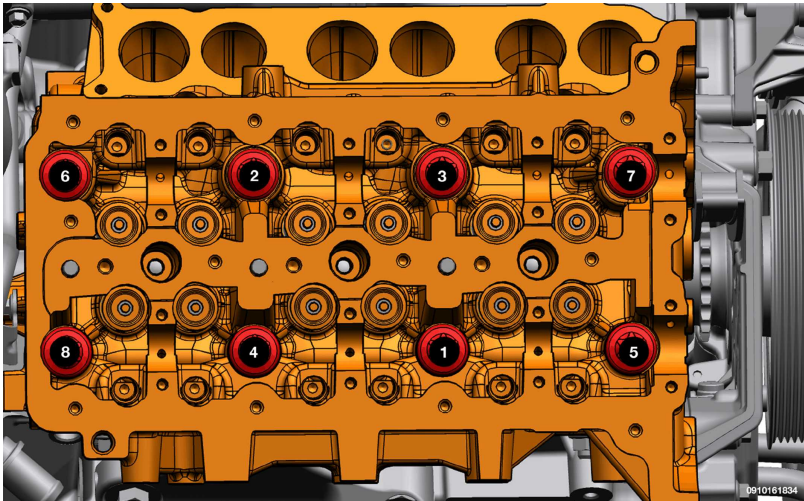
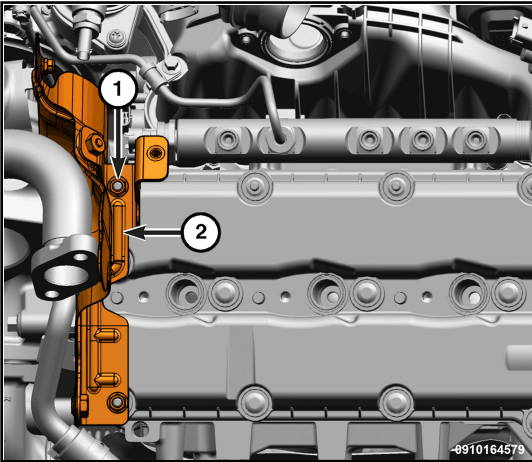
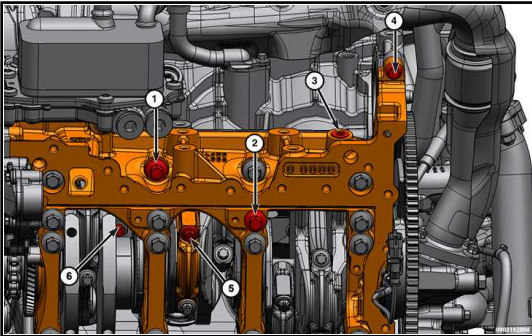


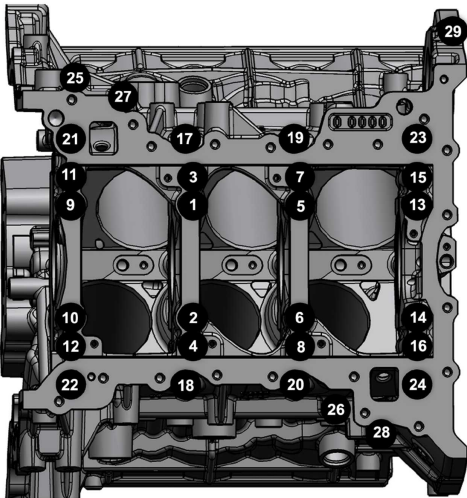
Fig. 6: Cylinder Head Bolts Tightening Sequence - Right
Courtesy of CHRYSLER GROUP, LLC



ENGINE BLOCK



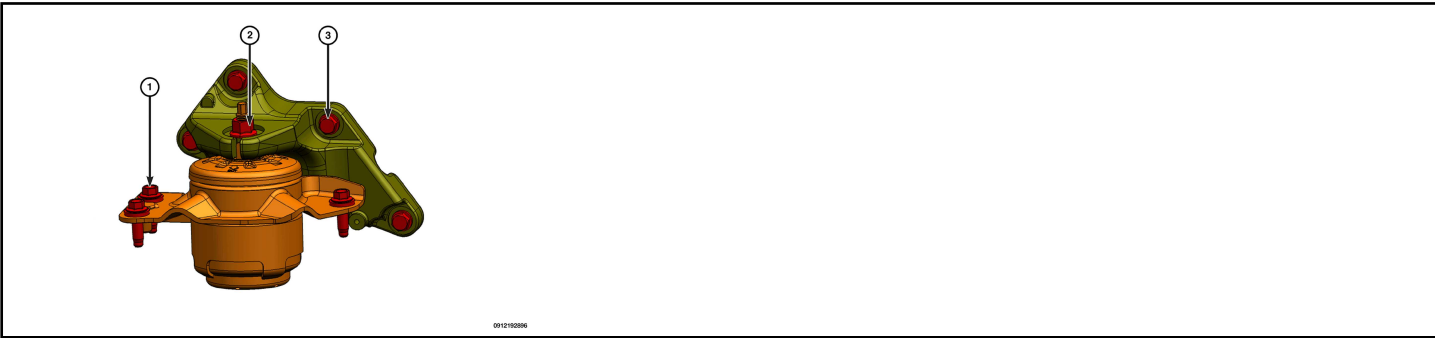
CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1, 2, 4	Bedplate Bolts	Torque Procedure: 1. Using NEW bolts, install the 26 M12 bolts (1 - 26) and the three M8 bolts (27 - 29) finger tight. 2. Tighten all M12 bolts (1 - 4, 7 - 10, 13 - 16, 19 - 22) to 45 N.m (33 Ft. Lbs.). 3. Tighten the M12 bolts (1 - 16) an additional 110B°. 4. Tighten the M12 bolts (25 and 26) to 120 N.m (89 Ft. Lbs.). 5. Tighten the M12 bolts (17 - 24) to 25 N.m (18 Ft. Lbs.). 6. Tighten the M12 bolts (17 - 24) an additional 55B°. 7. Tighten the M12 bolts (21 - 24) an additional 75B°. 8. Tighten the three M8 bolts (27 - 29) to 30 N.m (22 Ft. Lbs.).	Tightening Sequence
3	Engine Block Timing Plug	30 N.m (22 Ft. Lbs.)	-
5	Piston Rod Cap Bolt	-	Serviced with Assembly
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-
-	Engine Ground to Engine Block	20 N.m (15 Ft. Lbs.)	-
-	Engine Lifting Brackets	55 N.m (41 Ft. Lbs.)	-



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Fig. 7: Bed Plate Tightening Sequence 3.0L(1 OF 2)
Courtesy of CHRYSLER GROUP, LLC

ENGINE MOUNTS

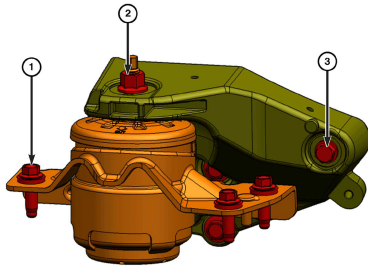


RIGHT ENGINE MOUNT

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Mount Isolator Bolts	55 N.m (41 Ft. Lbs.)	-
2	Engine Mount Isolator Nut	115 N.m (85 Ft. Lbs.)	-
3	Engine Mount Bracket Bolts	55 N.m (41 Ft. Lbs.)	-

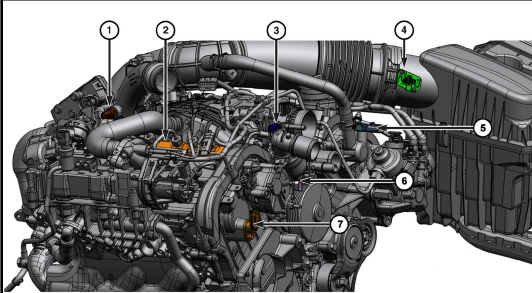
LEFT ENGINE MOUNT

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Mount Isolator Bolts	55 N.m (41 Ft. Lbs.)	-
2	Engine Mount Isolator Nut	115 N.m (85 Ft. Lbs.)	-
3	Engine Mount Bracket Bolts	55 N.m (41 Ft. Lbs.)	-
-	Transmission Coolant/Heater Tube Bolt	20 N.m (15 ft. lbs.)	-



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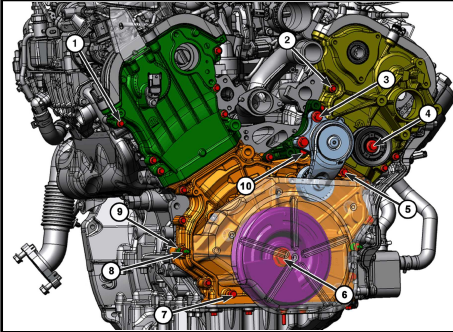
ENGINE SENSORS



0902182855

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Inlet Air Temperature (IAT) Sensor	20 N.m (15 Ft. Lbs.)	-
2	Fuel Pressure Sensor	Tighten Securely	-
3	Outlet Air Temperature (IAT) Sensor	Turn Clockwise 1/4 to Lock	-
4	MAF Sensor	Tighten Securely	-
5	Crankcase Pressure Sensor	Tighten Securely	-
6	Engine Coolant Temperature (ECT) Sensor	11 N.m (8 Ft. Lbs.)	-
7	Camshaft Position Sensor Bolt	8 N.m (71 In. Lbs.)	-
-	Boost Pressure Sensor	Tighten Securely	-
-	Crankshaft Position (CKP) Sensor Bolt	6 N.m (53 In. Lbs.)	-
-	Crankshaft Position Sensor Wire Harness Connector Bracket Bolt	8 N.m (71 In. Lbs.)	-
-	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
-	Engine Oil Pressure (EOP) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Engine Oil Temperature (EOT) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Banjo Bolt	28 N.m (21 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Bracket Bolts	11 N.m (8 Ft. Lbs.)	-
-	Exhaust Temperature Sensor	45 N.m (33 Ft. Lbs.)	-
-	Fuel Pressure Sensor	70 N.m (52 Ft. Lbs.)	-
-	Oxygen (O2) Sensor	50 N.m (37 Ft. Lbs.)	-
-	Delta Pressure Sensor	Tighten Securely	-

FRONT ENGINE



0903182759

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1, 2	Timing Chain Cover Bolts	Torque Procedure: 1. Tighten the M6 bolts finger tight. 2. Tighten the M6 bolts to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and retighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
3	Belt Tensioner Pulley Bolt	45 N.m (33 Ft. Lbs.)	-
4	Idler Pulley Bolts	32 N.m (24 Ft. Lbs.)	-
5, 9	Timing Chain Cover Bolts (lower)	Torque Procedure: 1. Tighten the lower timing cover bolts (1 and 3) finger tight. 2. Tighten the M6 bolts (1 - 8) to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and tighten to 15 N.m (Ft. Lbs.). 4. Install the oil pan-to-lower chain cover bolts and tighten (9 - 13) to 15 N.m (11 Ft. Lbs.). 5. Loosen each bolt one at a time 90B° and tighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence Position 2 and 3 are double ends
6	Vibration Damper Bolt	100 N.m (74 Ft. Lbs.) + 125B°	-
7	Vibration Damper Cover Bolts	10 N.m (7 Ft. Lbs.)	-
8	Vibration Damper Cover Nut	9 N.m (80 In. Lbs.)	-
10	Belt Tensioner to Mounting Bracket - M10 Bolt	45 N.m (33 Ft. Lbs.)	-
11	Belt Tensioner to Mounting Bracket - M6 Bolt	11 N.m (8 Ft. Lbs.)	-
-	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Oil Breather/Camshaft Seal Housing Bolts	14 N.m (10 Ft. Lbs.)	-
-	Vacuum Pump Bolt	30 N.m (22 Ft. Lbs.)	-

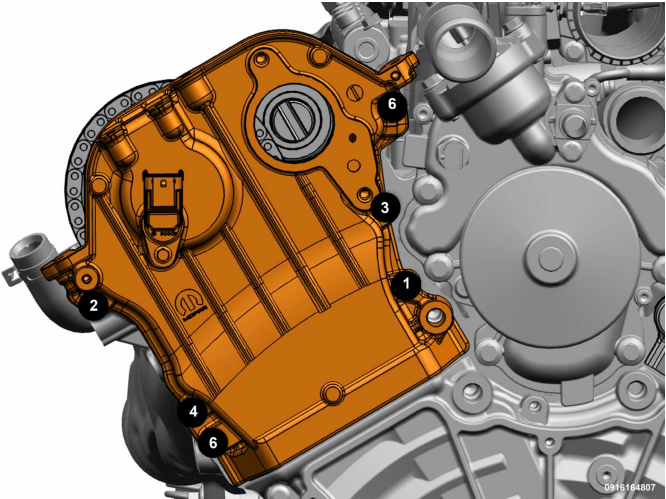
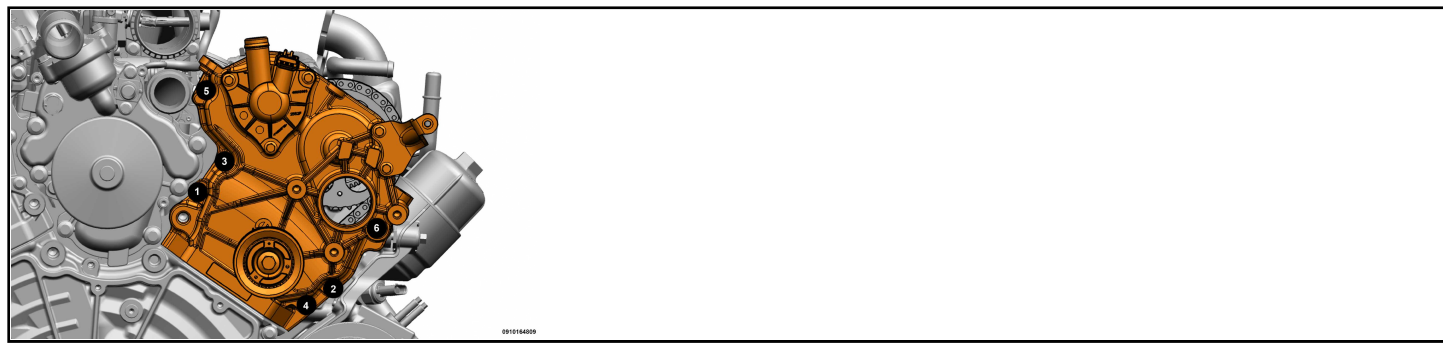
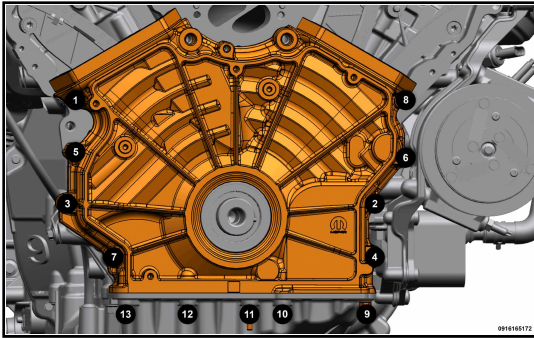
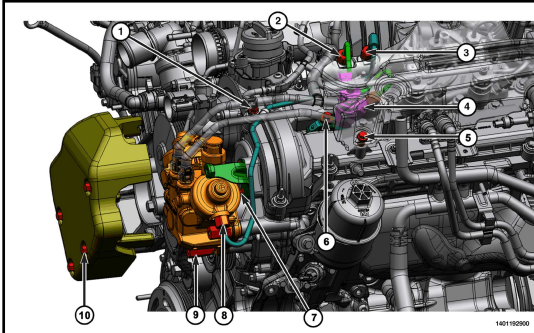


Fig. 8: Right Upper Timing Cover Bolts Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC

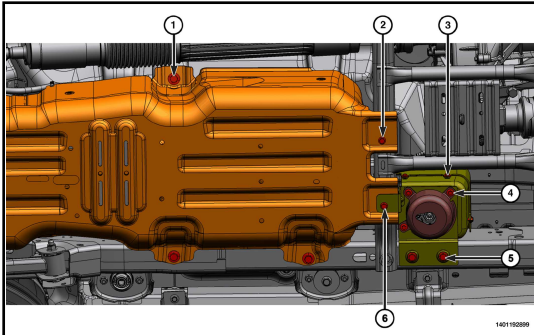


FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75B°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75B°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75B°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75B°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90B° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
B	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



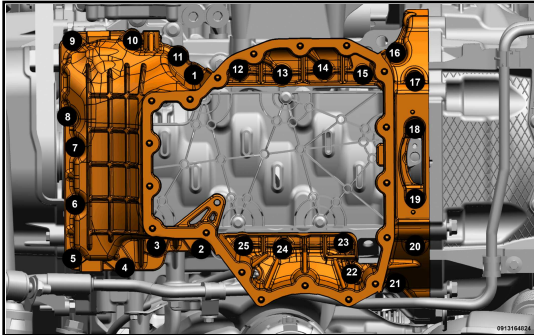
IGNITION SYSTEM

DESCRIPTIONS	SPECIFICATIONS	COMMENT
Glow Plug (Ceramic)	8 N.m (71 In. Lbs.)	-

LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-

1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts 7-13 one at a time 90B° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90B° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence NOTE: Bolts in the following positions are stud bolts (4, 6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure: 1. Tighten the lower oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts one at a time 90B° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence
7	Oil Cooler Bolts	30 N.m (22 Ft. Lbs.)	-
-	Dipstick Tube Bolt (head)	11 N.m (8 Ft. Lbs.)	-
-	Dipstick Tube Bolt (sump)	11 N.m (8 Ft. Lbs.)	-
-	Windage Tray	11 N.m (8 Ft. Lbs.)	-



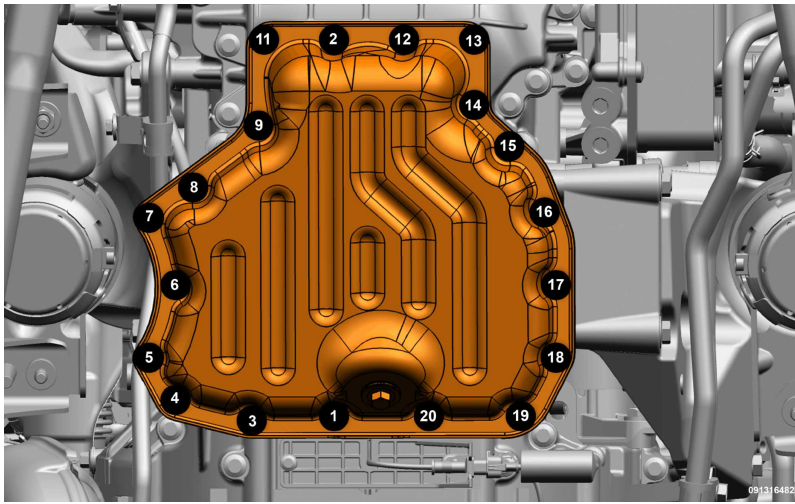
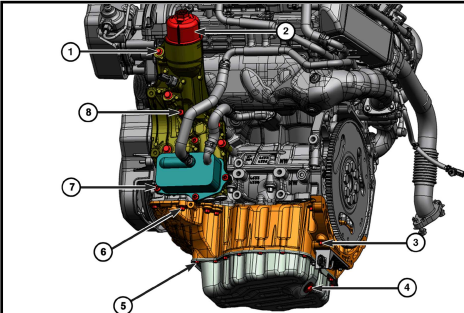
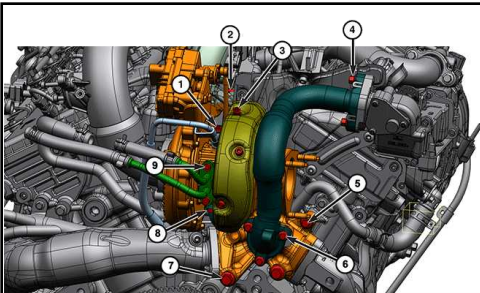


Fig. 9: Lower Oil Pan Bolts Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC

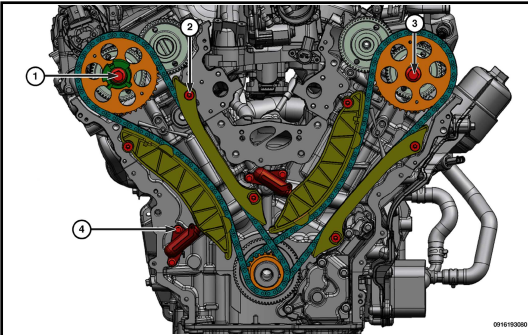


TURBOCHARGER



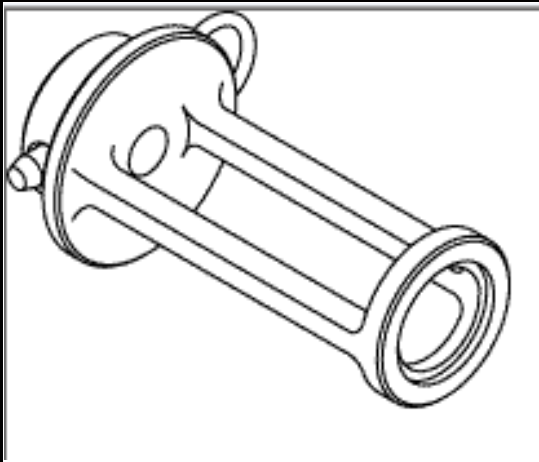
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

VALVE TIMING

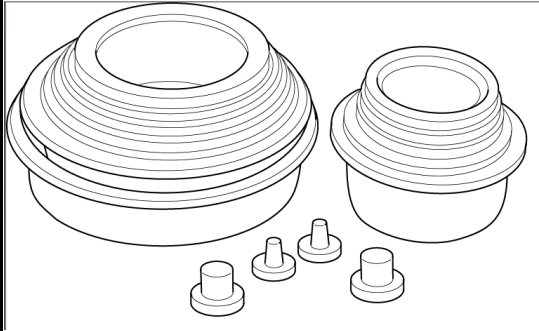


CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Fuel Injection Pump Drive Gear Bolt (On Left Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 75B°	-
2	Timing Chain Guide Bolts	30 N.m (22 Ft. Lbs.)	-
3	Reluctor Wheel Bolt (On Right Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 73B°	-
4	Timing Chain Tensioner	14 N.m (11 Ft. Lbs.)	-
-	Oil Separator Bolt	30 N.m (22 Ft. Lbs.)	-

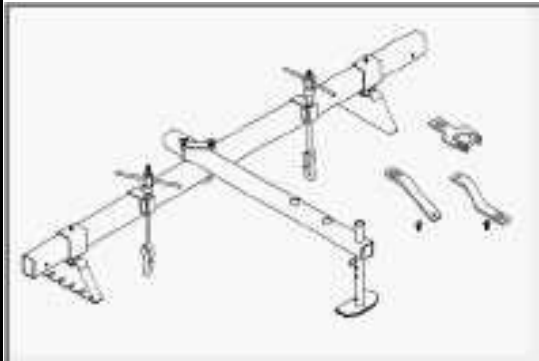
SPECIAL TOOLS



10224 - Adapter, Valve Spring
(Originally Shipped In Kit Number(s) 10223.)



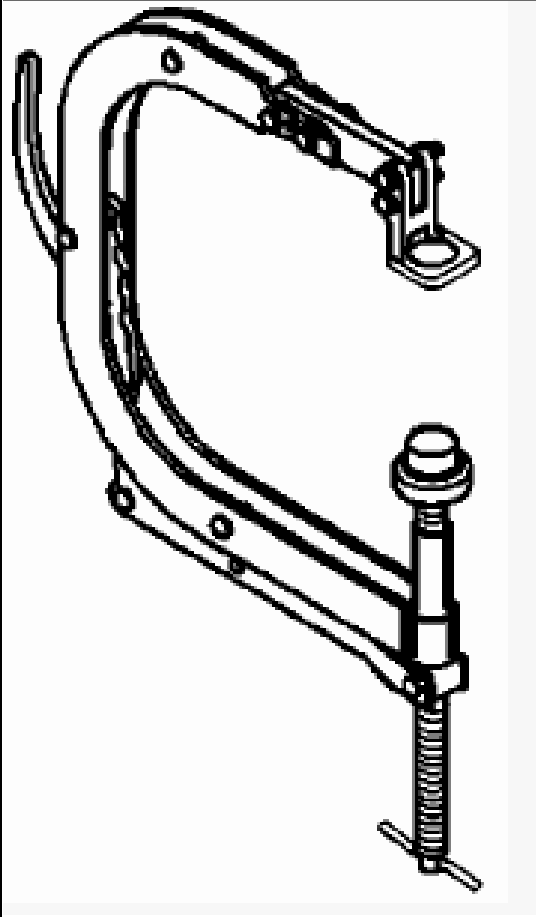
10368 - Set, Universal Protective Cap



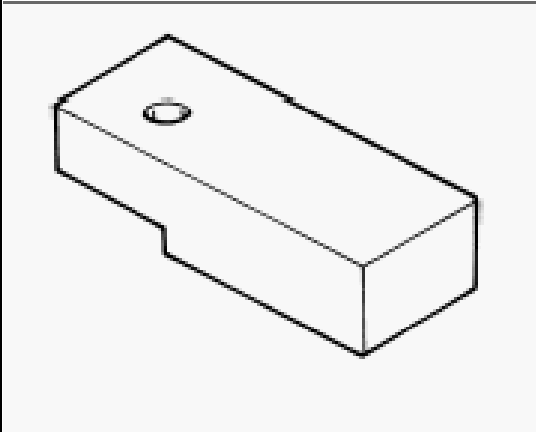
8534C - Fixture, Driveline Support
(Originally Shipped In Kit Number(s) 8534, 8534B, 8849, 9565.)



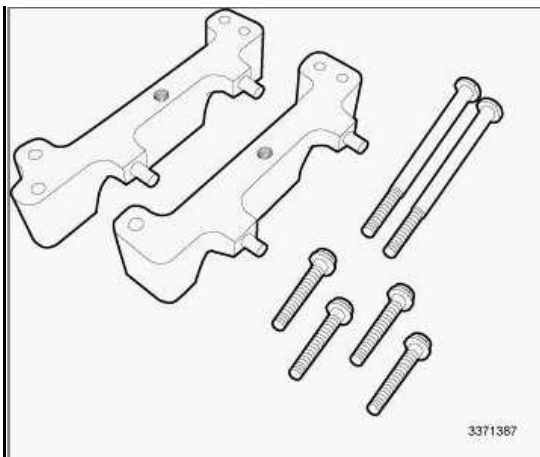
C-3339A - Set, Dial Indicator
(Originally Shipped In Kit Number(s) 9202.)



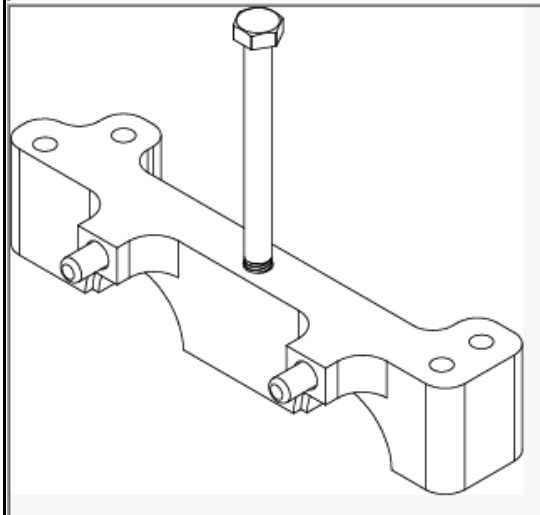
C-3422-D - Compressor, Valve Spring



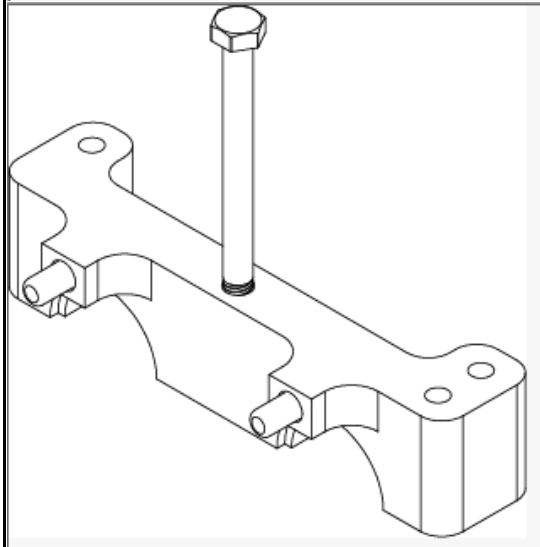
D-115-2A - Block, Scooter
(Originally Shipped In Kit Number(s) 9329-SUP, 9515-SUP, 9516-SUP, 9517-SUP, 9518, 9519, 9541-SUP, 9694, 9926.)



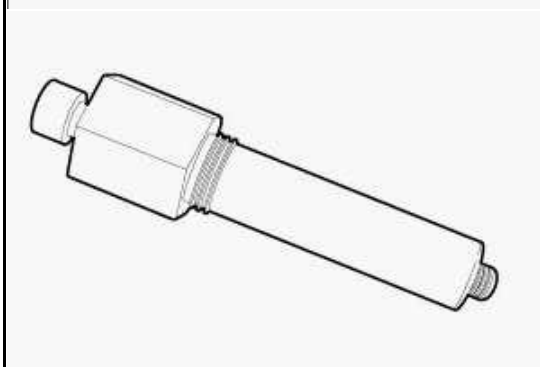
VM.10338A - Tool, Camshaft Timing



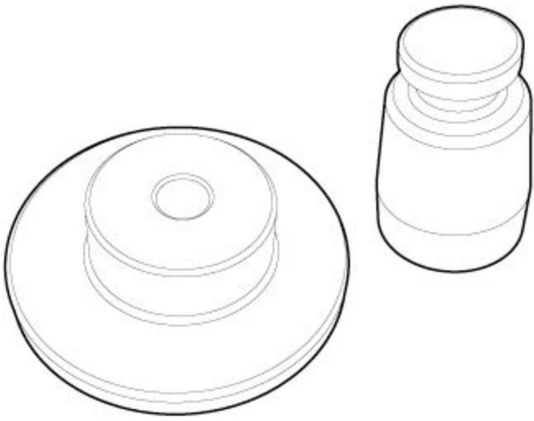
VM.10338-1 - Timing Tool, Camshaft (Right)



VM.10338-2 - Timing Tool, Camshaft (Left)

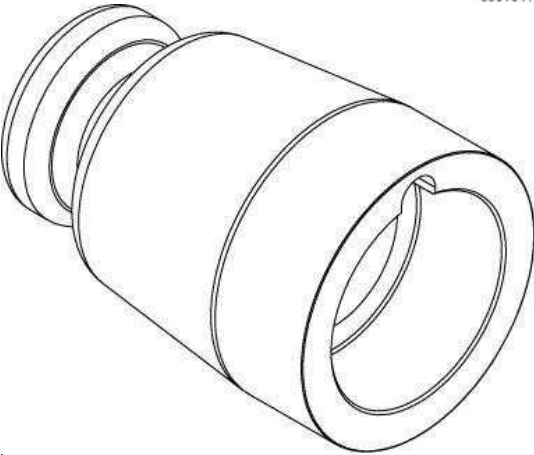


VM.10339 - Tool, Crankshaft Timing

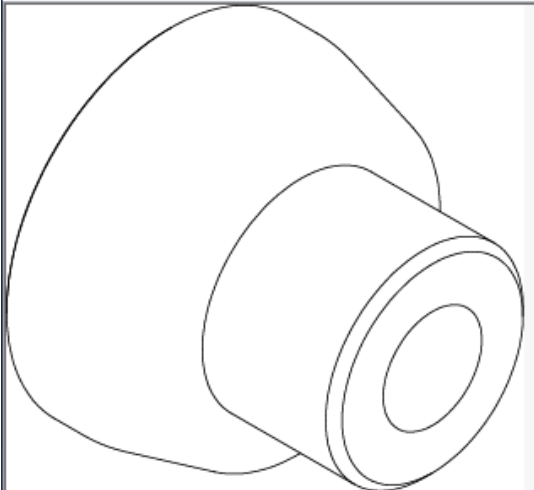


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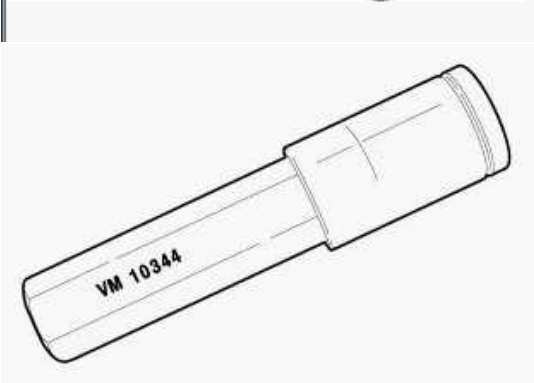
VM.10340 - Tool, Front Oil Seal Guide/Seal Installer
(Originally Shipped In Kit Number(s).)



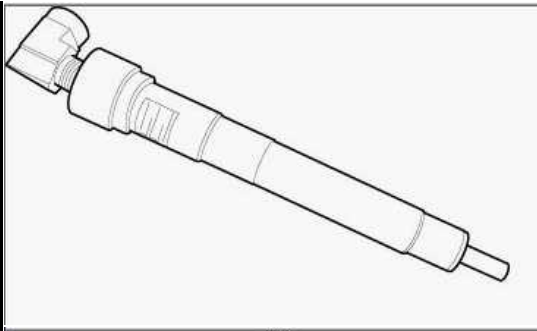
VM.10340-2 - Guide, Front Seal
(Originally Shipped In Kit Number(s) 10488.)



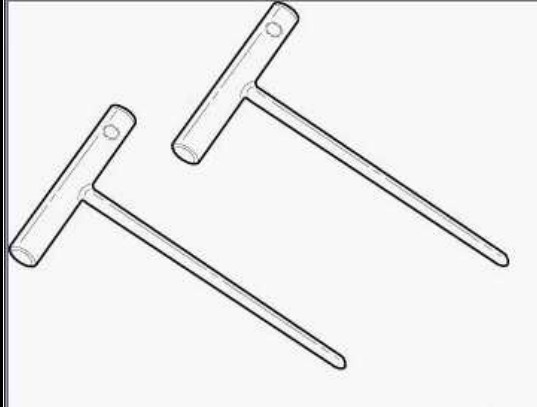
VM.10341-1 - Guide, Rear Seal



VM.10344 - Tool, Oil Separator Remover/Installer



VM.10357 - Adapter, Compression Test



VM.10359A - Pin, Tensioner



2048001090 - Adapter, Large 61mm



2048002090 - Adapter, Small 51mm Air Leak Test



2049200090 - Regulator, Pressure Test



2069500090 - Remover, Engine Bed Plate



2072800090 - Kit, Engine Lift Bracket - 3.0L TD V-6 GEN3



2072801090 - Lift Bracket, Left Side

2072802090 - Lift Bracket, Right Side

2072803090 - Lift Bracket, Front



2072900090 - Installer, Front Camshaft Seal



2073000090 - Installer, Front Crankshaft Seal



2073100090 - Kit, Cylinder Head Alignment



**ESSENTIAL
TOOLS**

2073101090 - Tool, Left Side Outboard Alignment



**ESSENTIAL
TOOLS**

2073102090 - Tool, Left Side Inboard Alignment



**ESSENTIAL
TOOLS**

2073103090 - Tool, Right Side Outboard Alignment



**ESSENTIAL
TOOLS**

2073104090 - Tool, Right Side Inboard Alignment



2073200090 - Installer, Rear Crankshaft Oil Seal



2073300140 - Wrench, Fuel Rail Pressure Sensor

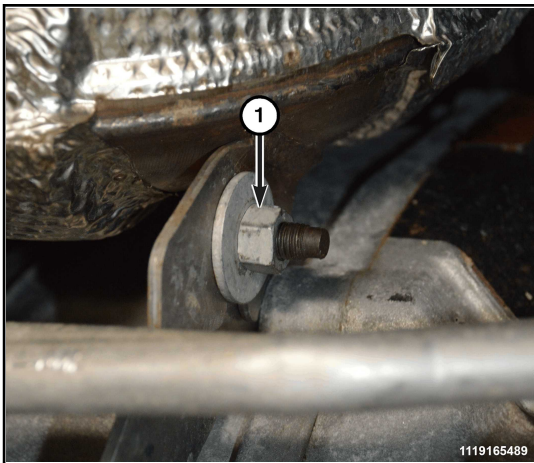
ENGINE ASSEMBLY

REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

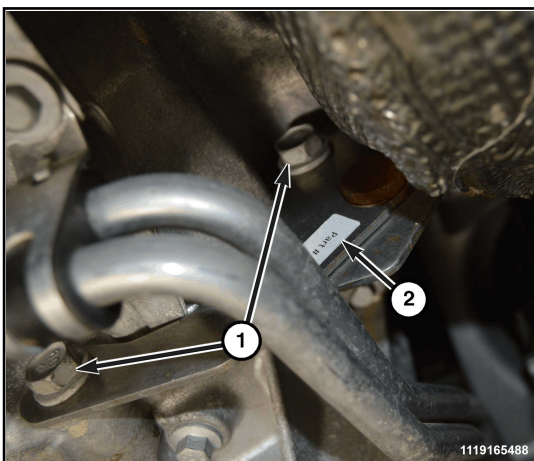
REMOVAL

1. Remove the cab. Refer to [CAB, REMOVAL AND INSTALLATION](#).
2. Remove the Diesel Particulate Filter (DPF) elbow. Refer to [FILTER, DIESEL PARTICULATE, REMOVAL AND INSTALLATION](#).
3. Remove the Low Pressure (LP) EGR tube. Refer to [TUBE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#).



1 - Steady Rest Bracket Nut

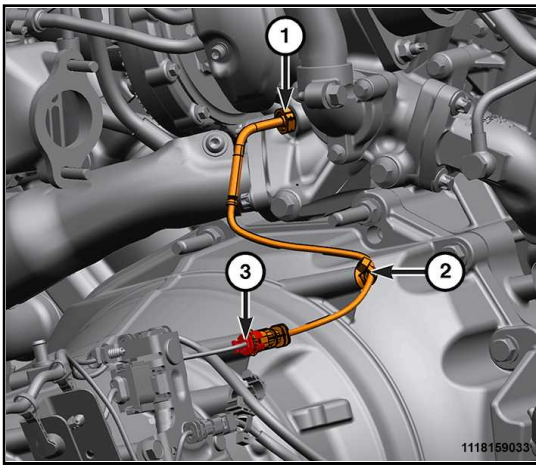
4. Remove the steady rest bracket nut.



1 - Exhaust Bracket Bolts

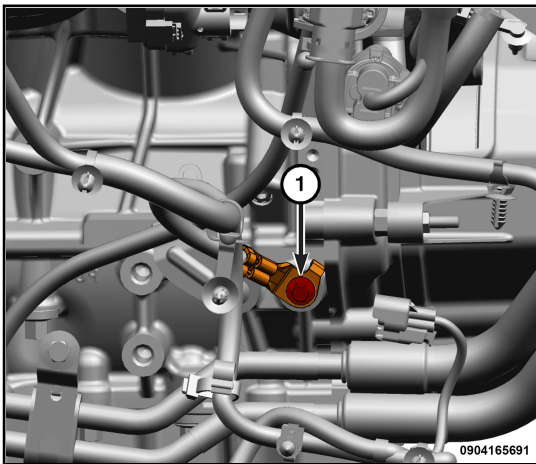
2 - Exhaust Bracket

5. Remove the exhaust bracket bolts and the exhaust bracket.



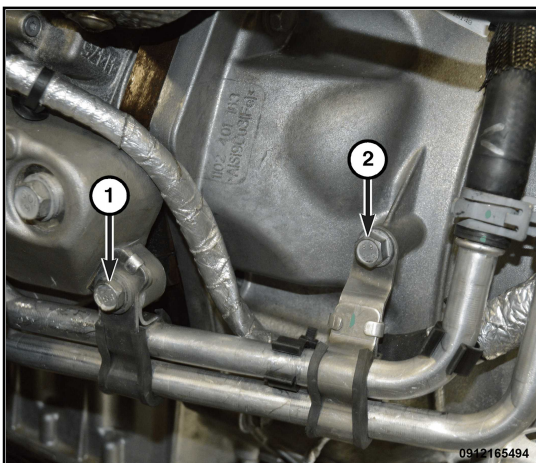
1 - Exhaust Gas Temperature Sensor 1/1
2 - Wire Retainer
3 - Exhaust Gas Temperature Sensor Wire Harness Connector

6. Disconnect the Exhaust Gas Temperature (EGT) sensor 1/1 wire harness connector and detach the wire from retainers.



1 - Ground Cable Bolt

7. Remove the ground cable bolt securing the ground cable (right side).

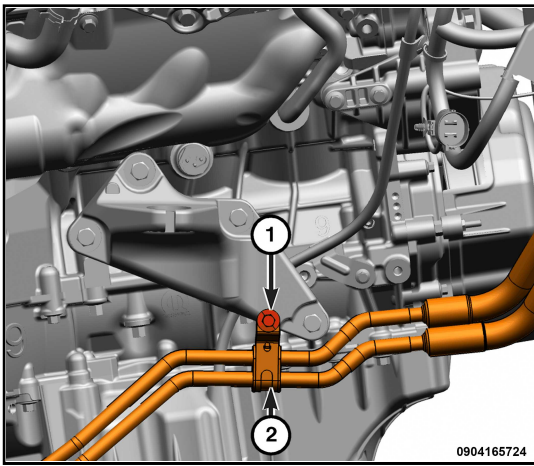


1 - Transmission Cooler Coolant Lines Bolt
2 - Transmission Cooler Coolant Lines Bolt

8. Remove the transmission cooler coolant lines bolts securing the transmission cooler coolant lines.

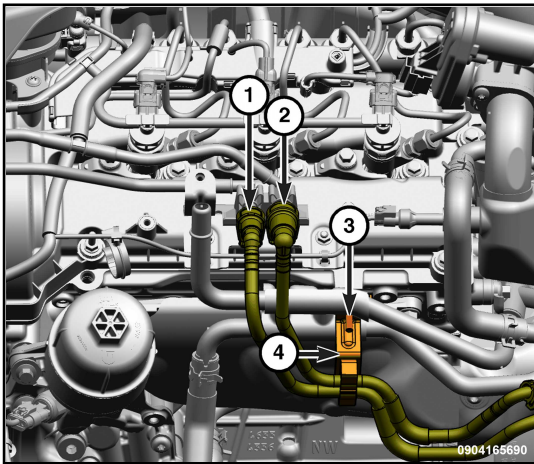
9. Remove the generator. Refer to [GENERATOR, REMOVAL AND INSTALLATION](#) .

10. Detach the wire harness retainer behind the generator.



1 - Transmission Cooler Line Bolt
2 - Transmission Cooler Line

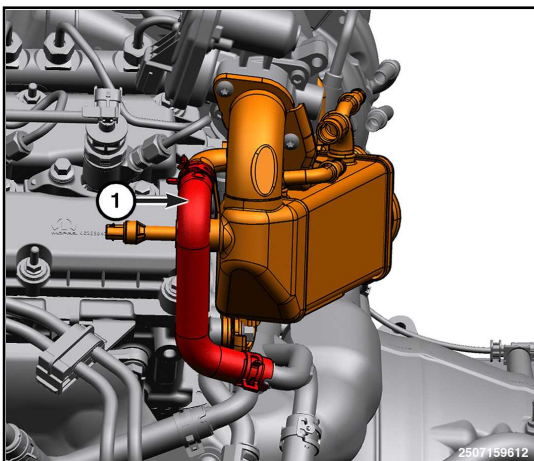
11. Remove the transmission cooler line bolt securing the transmission cooler line to engine mount bracket (right side).



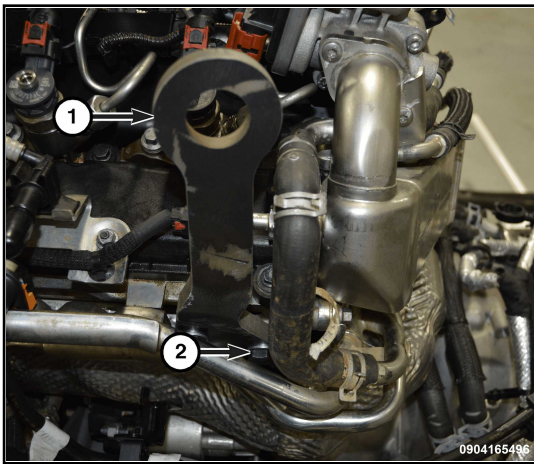
1 - Low Pressure Fuel Supply Line
2 - Low Pressure Fuel Return Line
3 - Low Pressure Fuel Supply/Fuel Return Line Bracket Bolt
4 - Low Pressure Fuel Supply/Return Line Bracket

12. Disconnect the low pressure fuel supply line and the fuel return line. Refer to [STANDARD PROCEDURE](#).

13. Remove the low pressure fuel supply/fuel return line bracket bolt and position aside the low pressure fuel supply/fuel return line bracket.



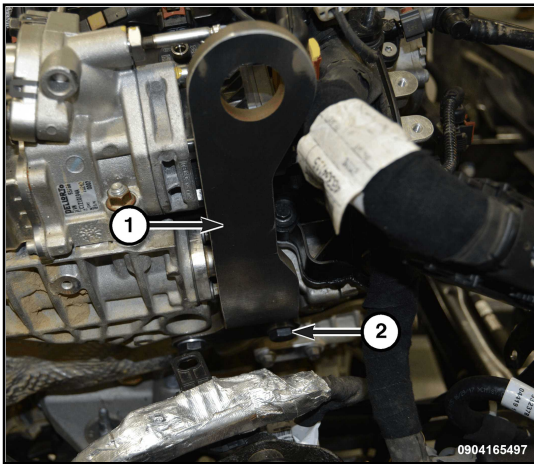
14. Remove the coolant hose from the LP EGR cooler.



1 - Left Side Lift Bracket

2 - Left Side Lift Bracket Bolt

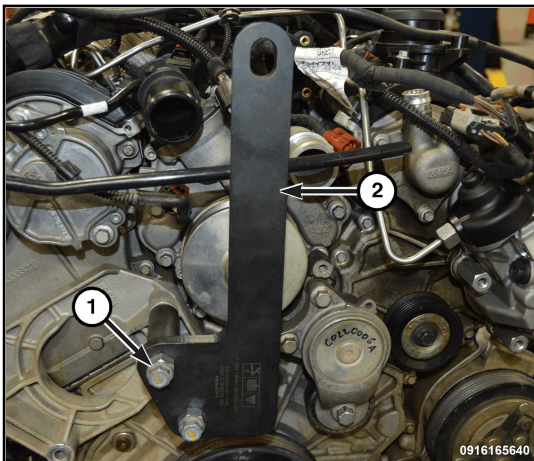
15. Install the (special tool #2072801090, Lift Bracket, Left Side) and securely tighten bolts.



1 - Right Side Lift Bracket

2 - Right Side Lift Bracket Bolt

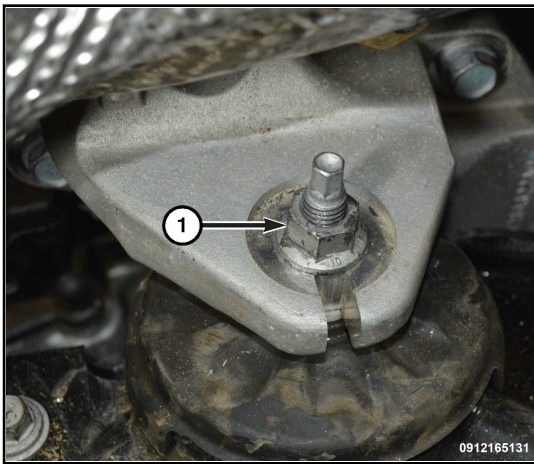
16. Install the (special tool #2072802090, Lift Bracket, Right Side) and securely tighten bolts.



1 - Front Lift Bracket Bolt

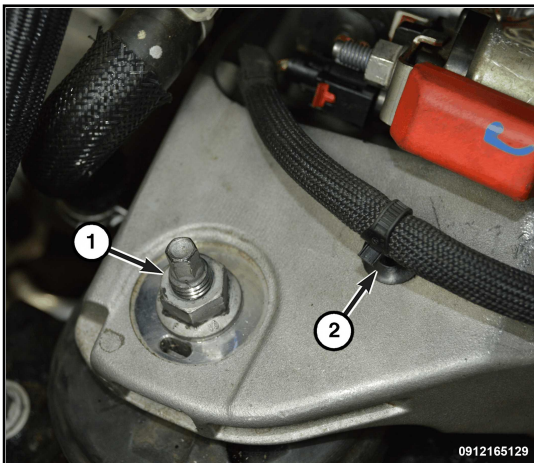
2 - Front Lift Bracket

17. Install the (special tool #2072803090, Lift Bracket, Front) and securely tighten bolts.



1 - Right Side Engine Mount Nut

18. Remove the right side engine mount nut.

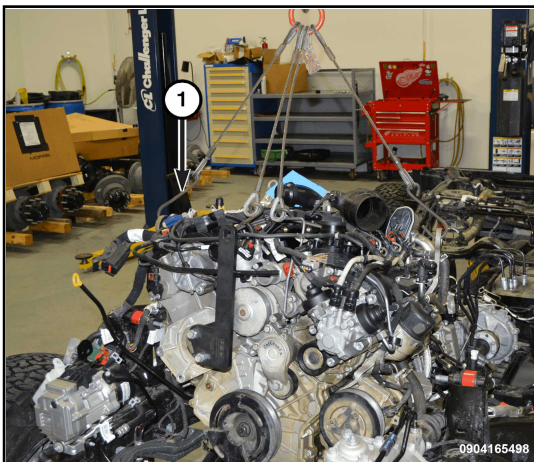


1 - Left Side Engine Mount Nut

2 - Wire Harness Retainer(s)

19. Remove the left side engine mount nut.

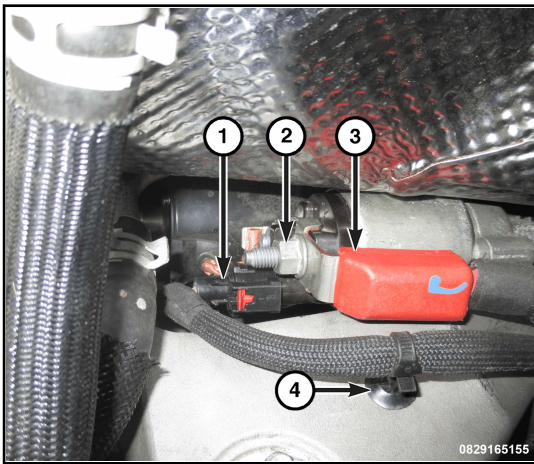
20. Detach the wire harness retainer(s).



1 - Engine Lifting Device

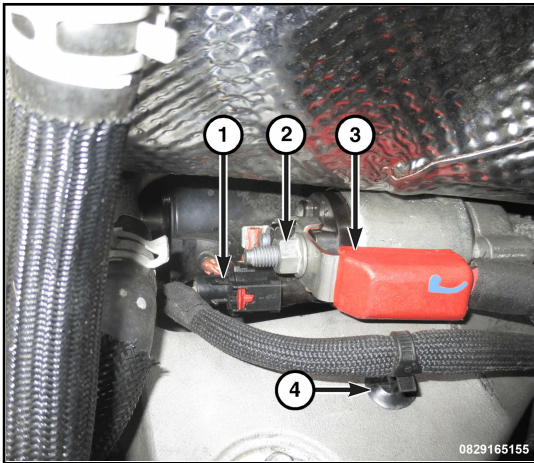
21. Position the engine hoist and connect engine lifting device to the engine lift fixtures.

22. Partially raise the engine and transmission.



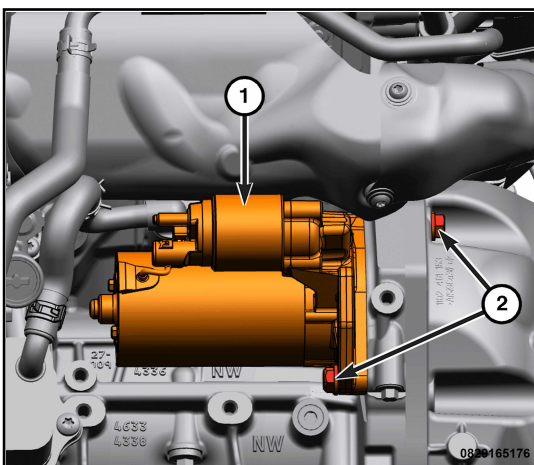
1 - Starter Solenoid Wire Harness Connector
2 - Battery Cable Nut
3 - Battery Cable
4 - Wire Harness Retainer

23. Disconnect the starter solenoid wire harness connector and detach the wire harness retainers.
24. Remove the B+ cover from the battery cable.
25. Remove the battery cable nut and the battery cable from the starter.



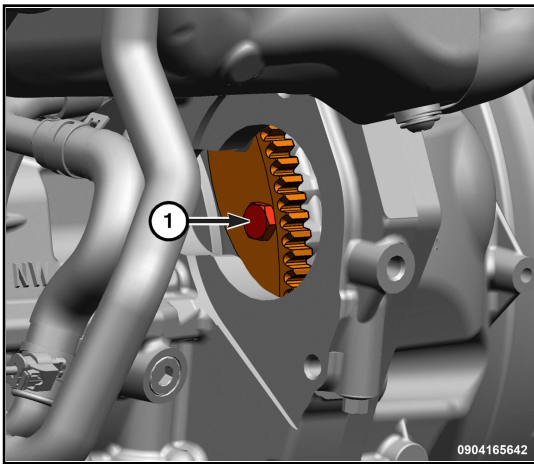
1 - Starter Solenoid Wire Harness Connector
2 - Battery Cable Nut
3 - Battery Cable
4 - Wire Harness Retainer

26. Remove the left engine mount bracket bolts and the left engine mount bracket.



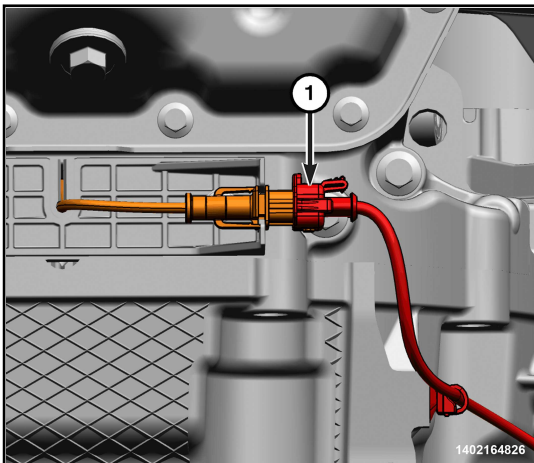
1 - Starter
2 - Starter To Transmission Bolts

27. Remove the starter to transmission bolts and the starter assembly.



1 - Torque Converter Bolts

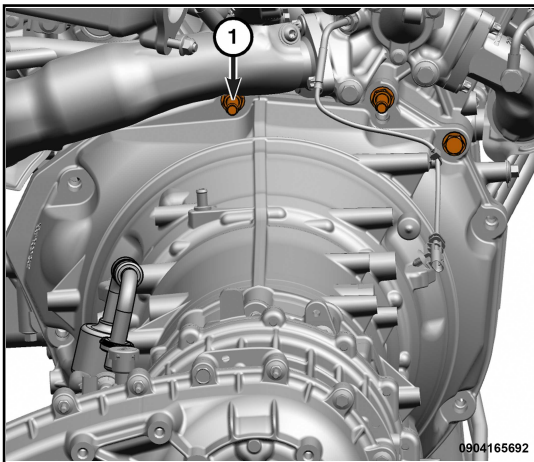
28. Paint mark the flex plate to torque converter relation and remove the torque converter bolts.



1 - Crankshaft Position Sensor Wire Harness Connector

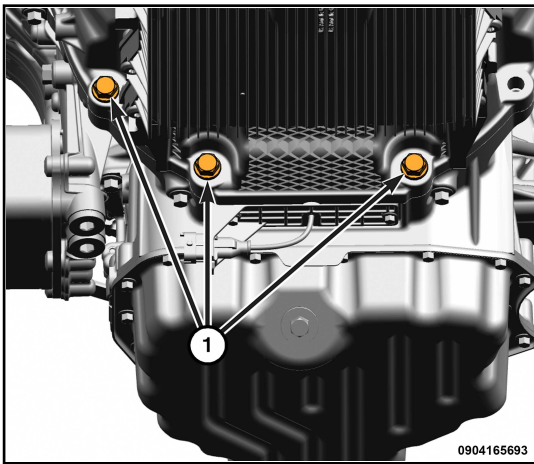
29. Disconnect the Crankshaft Position Sensor (CKP) wire harness connector.

30. Position floor jack under the transmission.



1 - Upper Transmission-to-Engine Bolts

31. Remove the upper transmission-to-engine bolts.



1 - Lower Transmission-to-Engine Bolts

32. Remove the lower transmission-to-engine bolts.
33. Slightly raise the engine and transmission together.
34. Remove the engine from vehicle.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

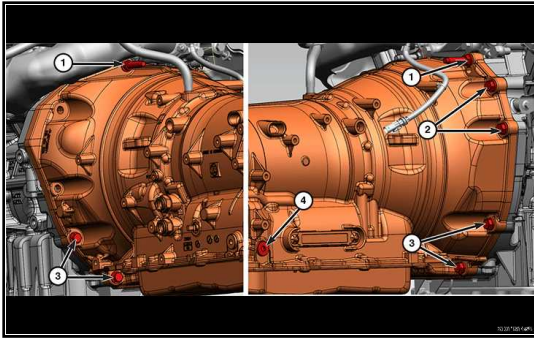
1. Carefully align the engine assembly in the engine bay area and align with the transmission, **Do Not** lower the engine.
2. Align the engine to transmission, and lower the engine mounts into position.
3. Install the lower transmission-to-engine block bolt and tighten to the proper torque specifications.
4. Install the upper transmission-to-engine bolts and tighten to the proper torque specifications.
5. Remove the floor jack from under the transmission.
6. Install the Crankshaft Position Sensor (CKP) wire harness connector.
7. Verify that the torque converter is pulled flush to the flexplate.

NOTE: Verify paint mark alignment.

8. Install the torque converter bolts and tighten the to proper torque specifications.
9. Install the starter and tighten the starter to transmission bolts to the proper torque specifications.
10. Install the left engine mount bracket and tighten the left engine mount bracket bolts to the proper torque specifications.
11. Install the battery cable and tighten the battery cable nut to the proper torque specifications.
12. Install the B+ cover to the battery cable.
13. Install the starter solenoid wire harness connector and attach the wire harness retainers.
14. Lower the engine and transmission together.
15. Remove the engine lifting device.
16. Install the left engine mount nut and tighten to the proper torque specifications.
17. Attach the wire harness retainer(s).
18. Install the right engine mount nut and tighten to the proper torque specifications.
19. Remove the bolts and the (special tool #2072803090, Lift Bracket, Front).
20. Remove the bolts and the (special tool #2072802090, Lift Bracket, Right Side).
21. Remove the bolt and the (special tool #2072801090, Lift Bracket, Left Side).
22. Install the coolant hose to the LP EGR cooler.
23. Install the fuel line bracket and securely tighten the fuel line bracket bolt.
24. Connect the low pressure fuel supply and fuel return lines.
25. Install the transmission cooler line bolt securing the transmission cooler line to engine mount bracket (right side) and securely tighten.
26. Attach the wire harness retainer behind the generator.
27. Install the generator. Refer to [GENERATOR, REMOVAL AND INSTALLATION](#) .
28. Install the trans cooler coolant lines bolts securing the trans cooler coolant lines and securely tighten.
29. Install the ground cable bolt securing the ground cable (right side) and securely tighten.
30. Connect the exhaust temperature sensor 1/1 wire harness connector and attach the wire to the retainers.
31. Install the exhaust bracket and tighten the exhaust bracket bolts to the proper torque specifications.
32. Install the steady rest bracket nut and securely tighten.
33. Install the Low Pressure (LP) EGR tube. Refer to [TUBE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#) .
34. Install the Diesel Particulate Filter (DPF) elbow. Refer to [FILTER, DIESEL PARTICULATE, REMOVAL AND INSTALLATION](#) .
35. Install a **NEW** oil filter. Refer to [FILTER, ENGINE OIL, REMOVAL AND INSTALLATION](#) .
36. Fill engine with the recommended engine oil. Refer to [CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS](#) .
37. Install the cab. Refer to [CAB, REMOVAL AND INSTALLATION](#) .

TORQUE SPECIFICATIONS

BELLHOUSING AND OIL FILL PLUG



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Bellhousing to Engine Double Ended Studs	48 N.m (35 Ft. Lbs.)	-
2	Bellhousing to Engine Bolts	50 N.m (37 Ft. Lbs.)	-
3	Bellhousing To Engine Oil Pan Bolts	50 N.m (37 Ft. Lbs.)	-
4	Transmission Oil Fill Plug	35 N.m (26 Ft. Lbs.)	Located on right side of transmission case.

EXHAUST - 3.0L DIESEL

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	Tightening Sequence
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

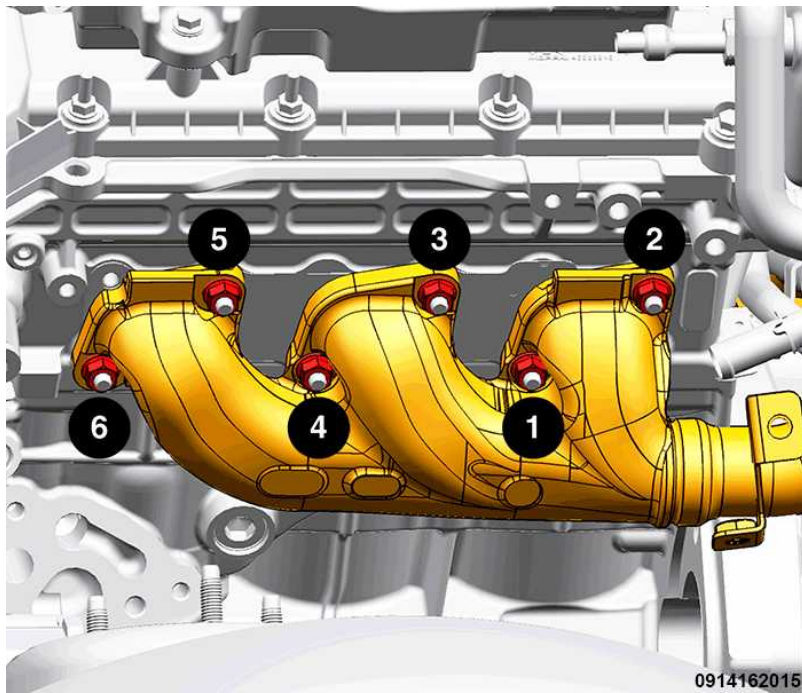


Fig. 10: Exhaust Manifold Tightening Sequence LH
 Courtesy of CHRYSLER GROUP, LLC

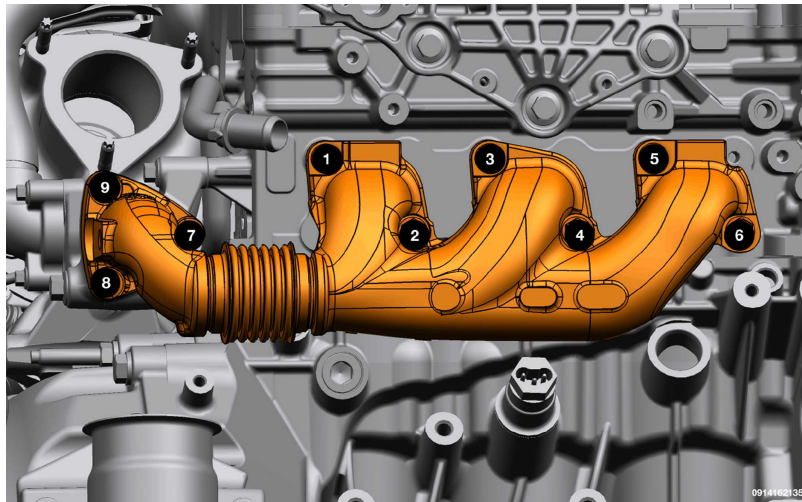


Fig. 11: Exhaust Manifold Tightening Sequence RH
 Courtesy of CHRYSLER GROUP, LLC

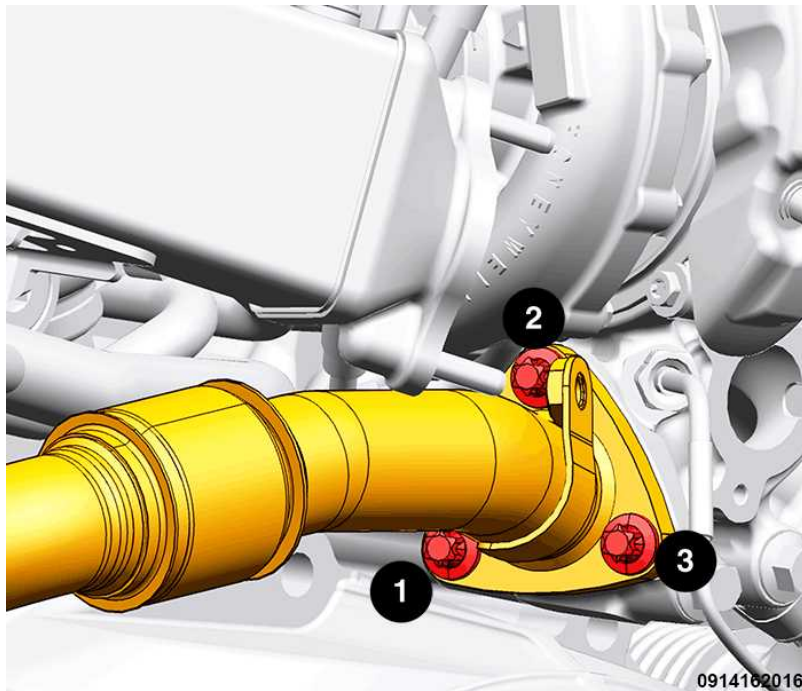
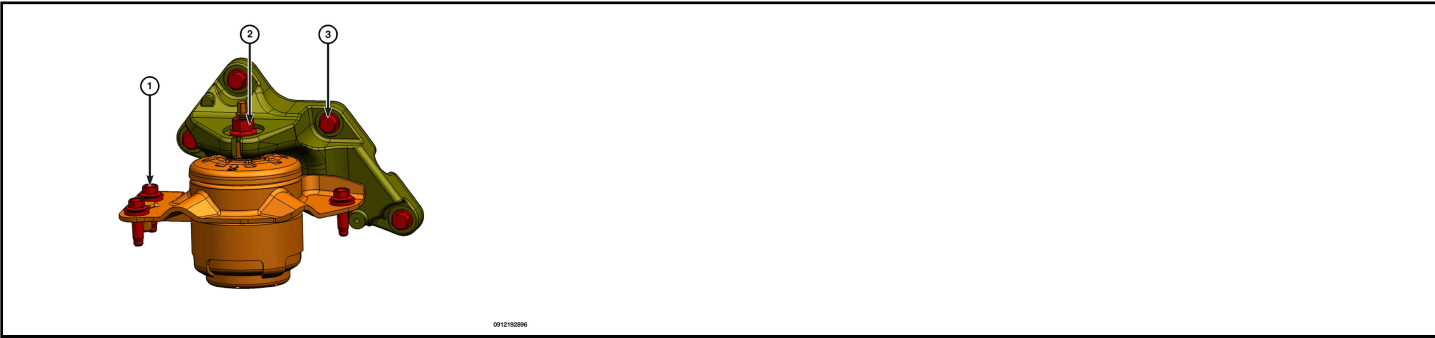


Fig. 12: Exhaust Manifold Flange Tightening Sequence LH
Courtesy of CHRYSLER GROUP, LLC

ENGINE MOUNTS

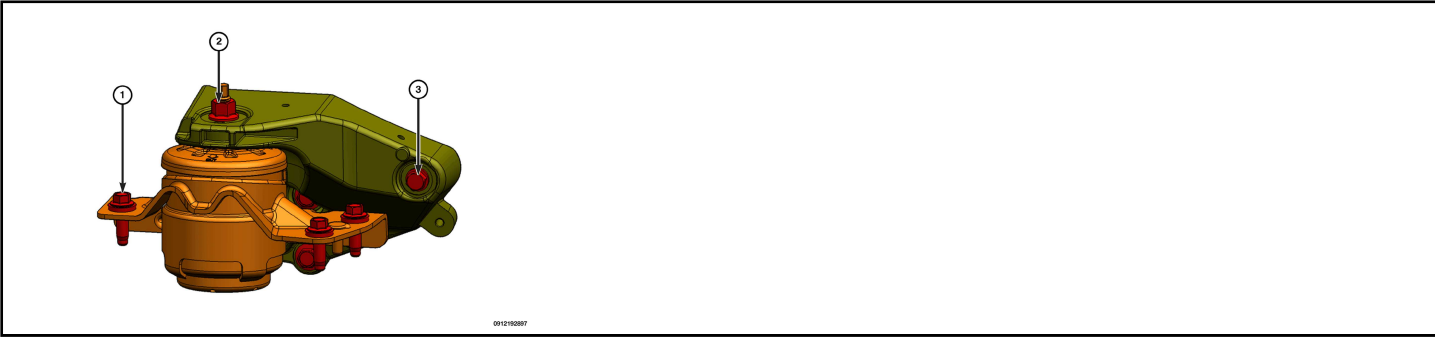


RIGHT ENGINE MOUNT

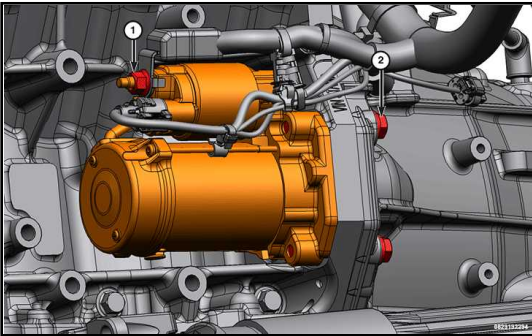
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Mount Isolator Bolts	55 N.m (41 Ft. Lbs.)	-
2	Engine Mount Isolator Nut	115 N.m (85 Ft. Lbs.)	-
3	Engine Mount Bracket Bolts	55 N.m (41 Ft. Lbs.)	-

LEFT ENGINE MOUNT

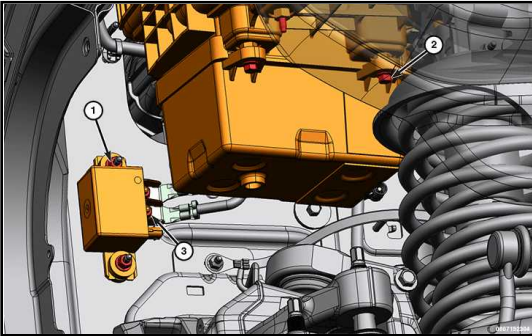
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Mount Isolator Bolts	55 N.m (41 Ft. Lbs.)	-
2	Engine Mount Isolator Nut	115 N.m (85 Ft. Lbs.)	-
3	Engine Mount Bracket Bolts	55 N.m (41 Ft. Lbs.)	-
-	Transmission Coolant/Heater Tube Bolt	20 N.m (15 ft. lbs.)	-



STARTING SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Starter B+ Cable Nut	11 N.m (8 Ft. Lbs.)	-
2	Starter to Engine Block Bolts	47 N.m (35 Ft. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	PCR Mounting Bolt	11 N.m (8 Ft. Lbs.)	-
2	Auxiliary Battery Tray To Battery Tray	Refer to Battery Torque Table	-
3	B+ Wire To PCR Positive Terminals	11 N.m (8 Ft. Lbs.)	-
-	Ground To PCR Bracket	9 N.m (80 In. Lbs.)	Right Hand Drive (C
-	PCR To Chassis Ground	11 N.m (8 Ft. Lbs.)	-
-	Remote Start Antenna (RSA) to Cab Back	6 N.m (53 In. Lbs.)	-

FLEXPLATE AND TORQUE CONVERTER

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Flexplate to Crankshaft Bolts	Torque Procedure: 1. With clean engine oil, lubricate the fastener side of backing plate. 2. Tighten the fasteners 50 N.m (37 ft. lbs.) . 3. Loosen one fastener at a time and then retighten the fastener 125 N.m (92 ft. lbs.) . 4. Using a torque angle gauge, tighten each fastener an additional 30 B° .	Do not reuse these fasteners. If removed, a fastener must be installed and tightened to specifications. Tightening Sequence
2	Torque Converter to Flex Plate Bolt	41 N.m (30 Ft. Lbs.)	Do not reuse these fasteners. If removed, a fastener must be installed and tightened to specifications. NOTE: If old fastener must be re-used, Loc-TiteB® must be applied to the threads.

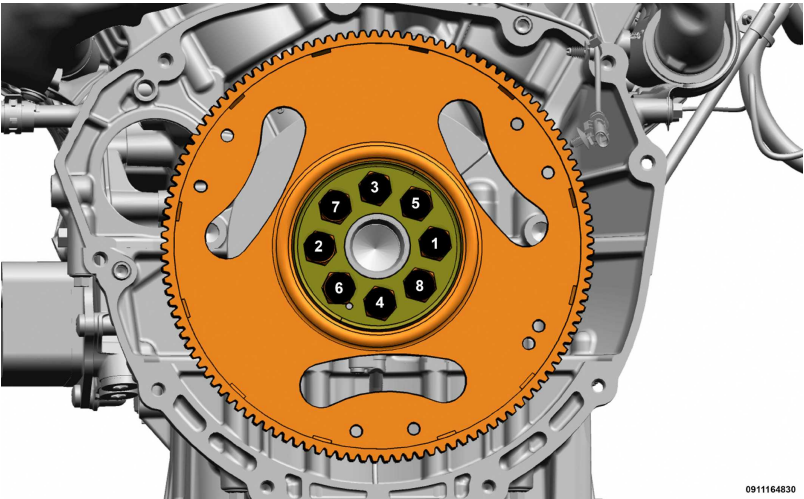


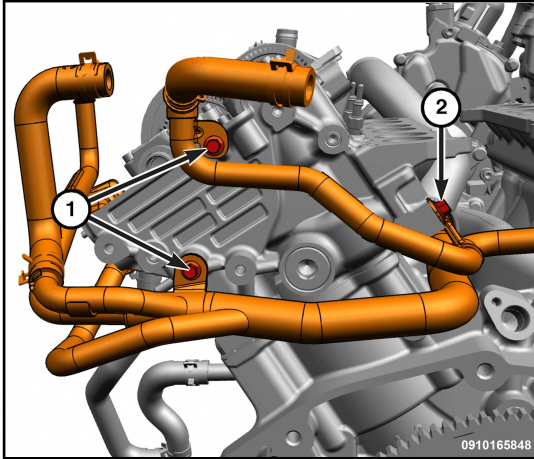
Fig. 13: Flexplate Bolt Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC



LONG BLOCK REPLACEMENT

1. Remove the engine from the vehicle. Refer to [ENGINE ASSEMBLY, REMOVAL AND INSTALLATION](#).
2. Remove the engine wire harness.
3. Remove the right side and left side fuel injectors. Refer to [INJECTOR\(S\), FUEL, REMOVAL AND INSTALLATION](#) .
4. Remove the right side and left side fuel rail. Refer to [RAIL\(S\), FUEL, REMOVAL AND INSTALLATION](#) .
5. Remove the glow plugs. Refer to [GLOW PLUG, REMOVAL AND INSTALLATION](#) .
6. Remove the intake manifold. Refer to [MANIFOLD, INTAKE, REMOVAL AND INSTALLATION](#).
7. Remove the turbocharger. Refer to [TURBOCHARGER, REMOVAL AND INSTALLATION](#) .

8. Remove the water pump. Refer to [PUMP, WATER, REMOVAL AND INSTALLATION](#) .

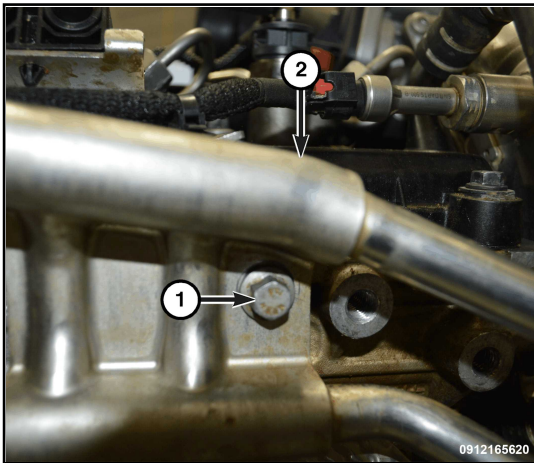


1 - Left Front Coolant Tube Bolt

2 - Left Rear Coolant Tube Bolts

9. Remove the left front coolant tube bolt.

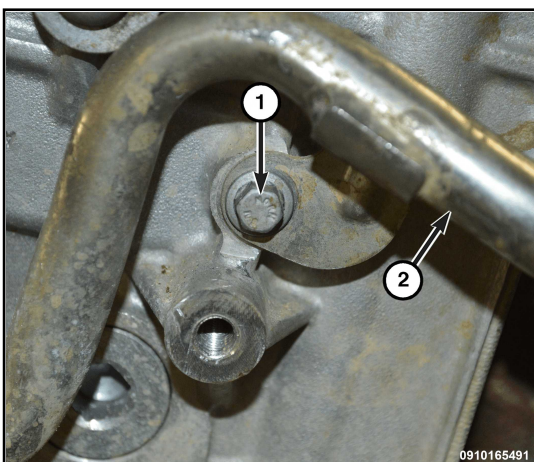
10. Remove the left rear coolant tube bolts.



1 - Left Side Coolant Tube Bolts

2 - Left Side Coolant Tube(s)

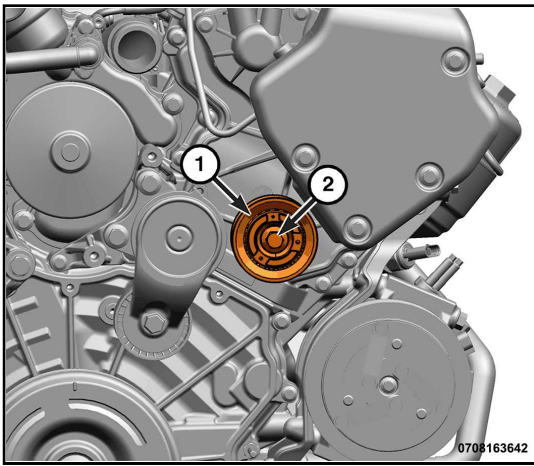
11. Remove the left side coolant tube bolts and the left side coolant tube(s).



1 - Right Side Coolant Tube Bolts

2 - Right Side Coolant Tube

12. Remove the right side coolant tube bolt and the right side coolant tube.



1 - Left Idler Pulley
2 - Left Idler Pulley Bolt

13. Remove the left idler pulley bolt and the left idler pulley.
14. Remove the Camshaft Position (CMP) sensor. Refer to [ENGINE SENSORS, REMOVAL AND INSTALLATION](#).
15. Remove the generator. Refer to [GENERATOR, REMOVAL AND INSTALLATION](#).
16. Remove the A/C compressor. Refer to [COMPRESSOR, A/C, REMOVAL AND INSTALLATION](#).

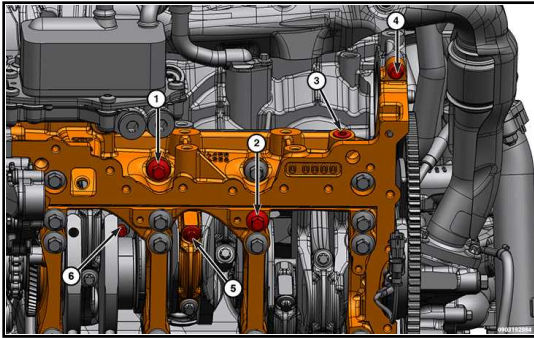
NOTE: DO NOT REUSE THE OLD OIL COOLER ADAPTER.

17. Remove the oil cooler adapter. Refer to [ADAPTER/COOLER, OIL FILTER, REMOVAL AND INSTALLATION](#).
18. Remove the right fuel injection pump to fuel rail fuel tube. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).
19. Remove the left fuel injection pump to fuel rail fuel tube. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).
20. Remove the fuel injection pump. Refer to [ASSEMBLY, FUEL PUMP, REMOVAL AND INSTALLATION](#).
21. Remove the starter motor. Refer to [STARTER, REMOVAL AND INSTALLATION](#).
22. Remove the vibration damper. Refer to [DAMPER, VIBRATION, REMOVAL AND INSTALLATION](#).
23. Remove the flex plate. Refer to [FLEXPLATE, REMOVAL AND INSTALLATION](#).
24. In the reverse order install all the parts removed onto the new engine.
25. Install the flex plate. Refer to [FLEXPLATE, REMOVAL AND INSTALLATION](#).
26. Install the vibration damper. Refer to [DAMPER, VIBRATION, REMOVAL AND INSTALLATION](#).
27. Install the starter motor. Refer to [STARTER, REMOVAL AND INSTALLATION](#).
28. Install the fuel injection pump. Refer to [ASSEMBLY, FUEL PUMP, REMOVAL AND INSTALLATION](#).
29. Install the left fuel injection pump to fuel rail fuel tube. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).
30. Removed the crankshaft locking tool.
31. Install the engine block plug and tighten to the proper torque specifications.
32. Install the right fuel injection pump to fuel rail fuel tube. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).
33. Prime the engine oil pump. Refer to [PRIMING THE OIL PUMP](#).

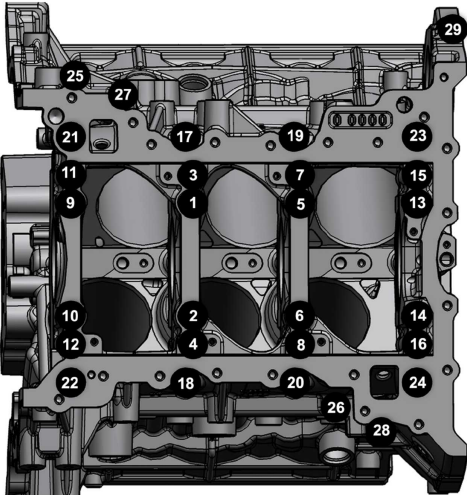
NOTE: DO NOT REUSE THE OLD OIL COOLER ADAPTER.

34. Install a **NEW** oil cooler adapter. Refer to [ADAPTER/COOLER, OIL FILTER, REMOVAL AND INSTALLATION](#).
35. Install the A/C compressor. Refer to [COMPRESSOR, A/C, REMOVAL AND INSTALLATION](#).
36. Install the generator. Refer to [GENERATOR, REMOVAL AND INSTALLATION](#).
37. Install the Camshaft Position (CMP) sensor. Refer to [ENGINE SENSORS, REMOVAL AND INSTALLATION](#).
38. Install the left idler pulley and tighten the bolt to the proper torque specifications.
39. Install the right side coolant tube and tighten the coolant tube bolts to the proper torque specifications.
40. Install the left side coolant tube(s) and tighten the coolant tube bolt to the proper torque specifications.
41. Install the left rear coolant tube bolts and tighten to the proper torque specifications.
42. Install the left front coolant tube bolt and tighten to the proper torque specifications.
43. Install the water pump. Refer to [PUMP, WATER, REMOVAL AND INSTALLATION](#).
44. Install the turbocharger. Refer to [TURBOCHARGER, REMOVAL AND INSTALLATION](#).
45. Install the intake manifold. Refer to [MANIFOLD, INTAKE, REMOVAL AND INSTALLATION](#).
46. Install the glow plugs. Refer to [GLOW PLUG, REMOVAL AND INSTALLATION](#).
47. Install the right side and left side fuel rail. Refer to [RAIL\(S\), FUEL, REMOVAL AND INSTALLATION](#).
48. Install the right side and left side fuel injectors. Refer to [INJECTOR\(S\), FUEL, REMOVAL AND INSTALLATION](#).
49. Install the engine wire harness.
50. Install the engine into the vehicle. Refer to [ENGINE ASSEMBLY, REMOVAL AND INSTALLATION](#).

ENGINE BLOCK



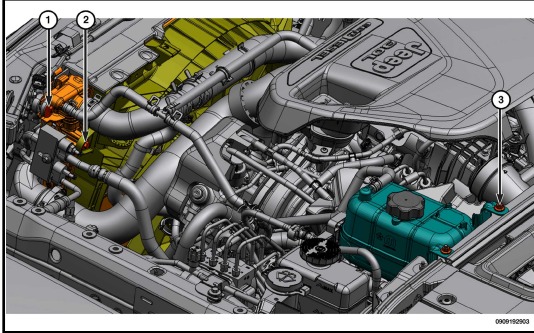
CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1, 2, 4	Bedplate Bolts	Torque Procedure: - Using NEW bolts, install the 26 M12 bolts (1 - 26) and the three M8 bolts (27 - 29) finger tight. - Tighten all M12 bolts (1 - 4, 7 - 10, 13 - 16, 19 - 22) to 45 N.m (33 Ft. Lbs.). - Tighten the M12 bolts (1 - 16) an additional 110B°. - Tighten the M12 bolts (25 and 26) to 120 N.m (89 Ft. Lbs.). - Tighten the M12 bolts (17 - 24) to 25 N.m (18 Ft. Lbs.). - Tighten the M12 bolts (17 - 24) an additional 55B°. - Tighten the M12 bolts (21 - 24) an additional 75B°. - Tighten the three M8 bolts (27 - 29) to 30 N.m (22 Ft. Lbs.).	Tightening Sequence
3	Engine Block Timing Plug	30 N.m (22 Ft. Lbs.)	-
5	Piston Rod Cap Bolt	-	Serviced with Assembly
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-
-	Engine Ground to Engine Block	20 N.m (15 Ft. Lbs.)	-
-	Engine Lifting Brackets	55 N.m (41 Ft. Lbs.)	-



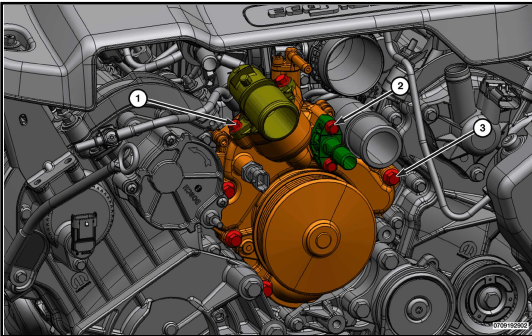
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Fig. 14: Bed Plate Tightening Sequence 3.0L (2 OF 2)
 Courtesy of CHRYSLER GROUP, LLC

COOLING SYSTEM - 3.0L DIESEL

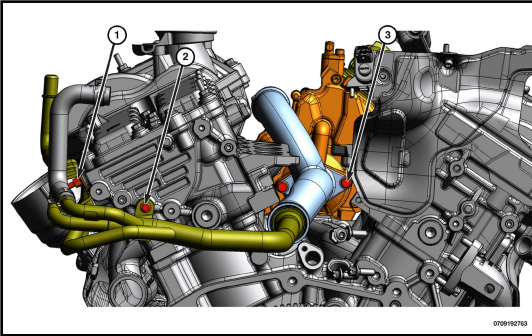


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-

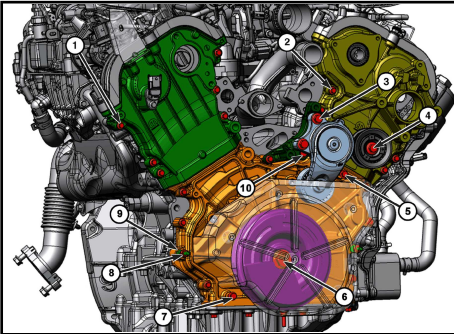


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90B° and then tighten to 32 N.m (24 Ft. Lbs.).	-
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-

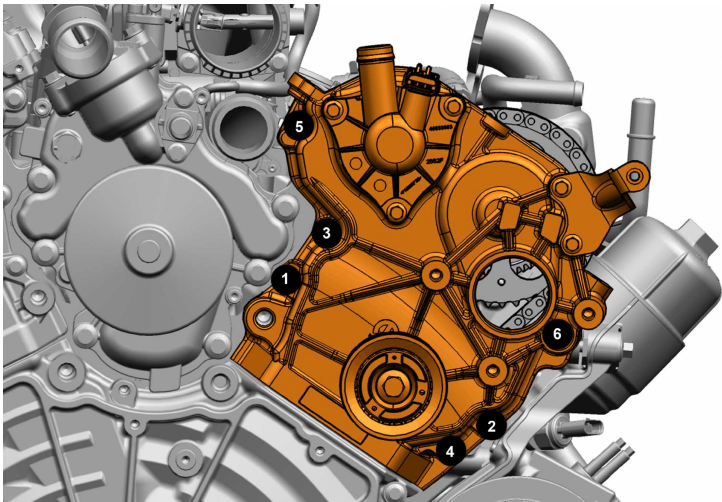


FRONT ENGINE



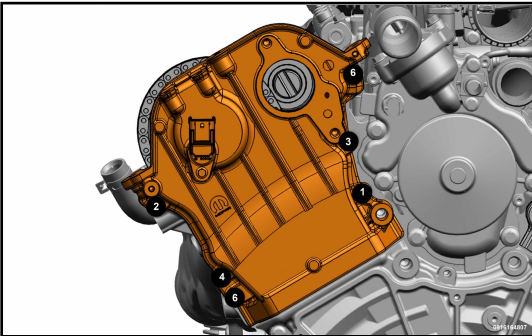
CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1, 2	Timing Chain Cover Bolts	Torque Procedure: 1. Tighten the M6 bolts finger tight. 2. Tighten the M6 bolts to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and retighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence
3	Belt Tensioner Pulley Bolt	45 N.m (33 Ft. Lbs.)	-
4	Idler Pulley Bolts	32 N.m (24 Ft. Lbs.)	-

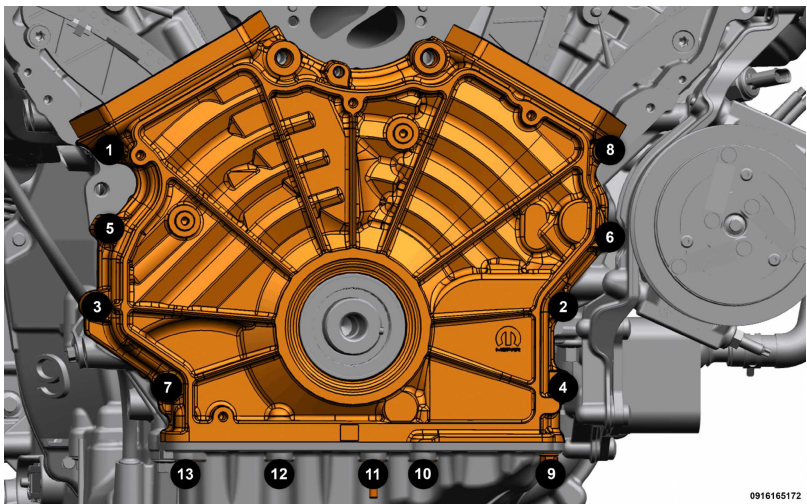
CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
5, 9	Timing Chain Cover Bolts (lower)	Torque Procedure: 1. Tighten the lower timing cover bolts (1 and 3) finger tight. 2. Tighten the M6 bolts (1 - 8) to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and tighten to 15 N.m (Ft. Lbs.). 4. Install the oil pan-to-lower chain cover bolts and tighten (9 - 13) to 15 N.m (11 Ft. Lbs.). 5. Loosen each bolt one at a time 90B° and tighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence Position 2 and 3 are double ends
6	Vibration Damper Bolt	100 N.m (74 Ft. Lbs.) + 125B°	-
7	Vibration Damper Cover Bolts	10 N.m (7 Ft. Lbs.)	-
8	Vibration Damper Cover Nut	9 N.m (80 In. Lbs.)	-
10	Belt Tensioner to Mounting Bracket - M10 Bolt	45 N.m (33 Ft. Lbs.)	-
11	Belt Tensioner to Mounting Bracket - M6 Bolt	11 N.m (8 Ft. Lbs.)	-
-	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Oil Breather/Camshaft Seal Housing Bolts	14 N.m (10 Ft. Lbs.)	-
-	Vacuum Pump Bolt	30 N.m (22 Ft. Lbs.)	-



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Fig. 15: Left Upper Timing Cover Bolts Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC





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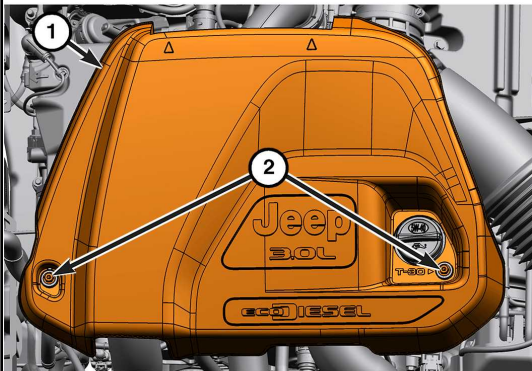
Fig. 16: Lower Timing Chain Cover Bolts Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC

COVER, ENGINE

REMOVAL AND INSTALLATION

ENGINE COVER

REMOVAL



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- 1 - Engine Cover
- 2 - Engine Cover Bolts

1. Remove the engine cover bolts and the engine cover.

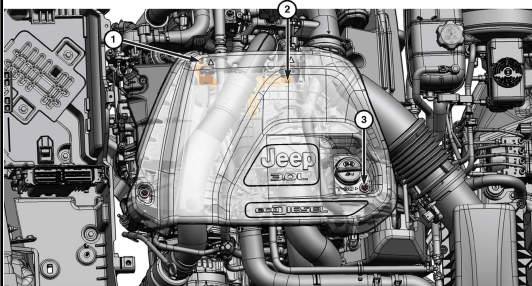
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

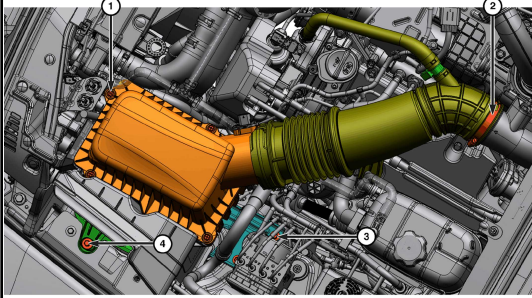
TORQUE SPECIFICATIONS

INTAKE AIR



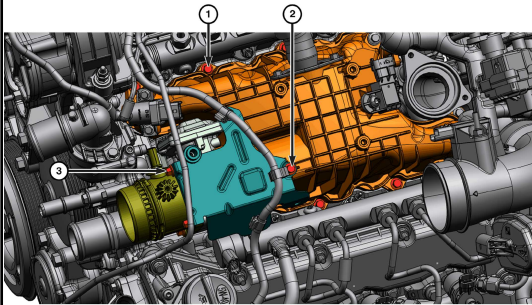
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CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Engine Cover Bracket Nut	9 N.m (80 In. Lbs.)	-
2	Engine Cover Bracket Bolt	9 N.m (80 In. Lbs.)	-
3	Engine Cover bolts	4 N.m (35 In. Lbs.)	-



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Air Cleaner Cover Bolt	5 N.m (44 In. Lbs.)	-
2	Fresh Air Inlet Hose Clamp	4 N.m (35 In. Lbs.)	-
3	Air Cleaner Body Bracket Bolt	9 N.m (80 In. Lbs.)	-
4	Air Cleaner Body Bolt	5 N.m (44 In. Lbs.)	-
-	Air Cleaner Body Bracket Nut	9 N.m (80 In. Lbs.)	-

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Intake Manifold Bolts	12 N.m (9 Ft. Lbs.)	Tightening Sequence
2	Throttle Body Support Bracket to Intake Manifold	9 N.m (80 In. Lbs.)	-
3	Throttle / Airflow Control Valve Bolts	9 N.m (80 In. Lbs.)	-



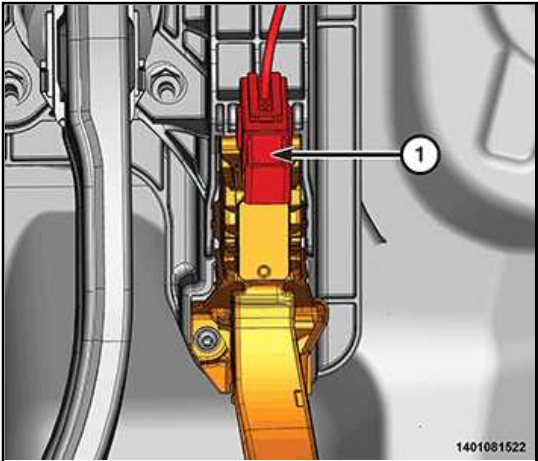
ENGINE SENSORS

REMOVAL AND INSTALLATION

PEDAL POSITION SENSOR

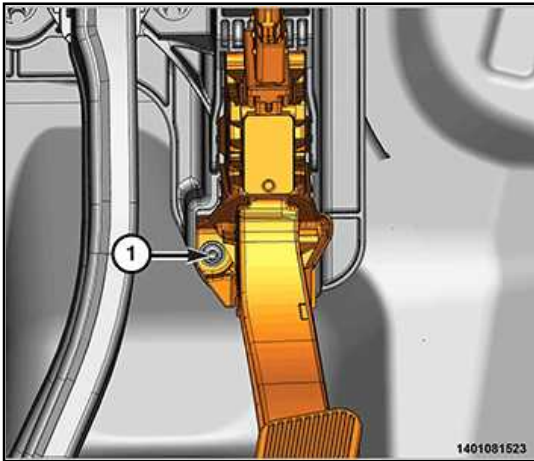
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .



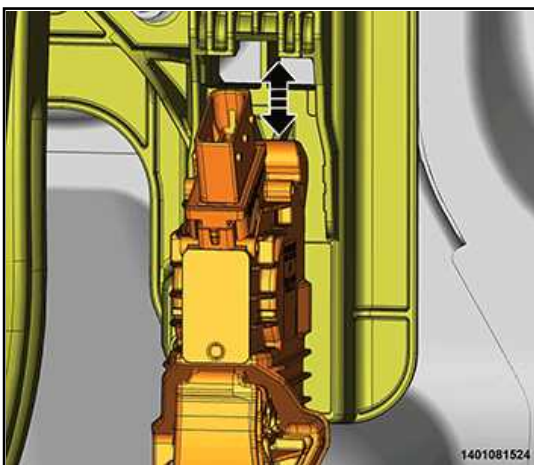
1 - Accelerator Pedal Wire Harness Connector

2. Disconnect the accelerator pedal wire harness connector.



1 - Accelerator Pedal Mounting Bolts

3. Remove the accelerator pedal mounting bolts.



4. Push up and remove the accelerator pedal assembly.

INSTALLATION

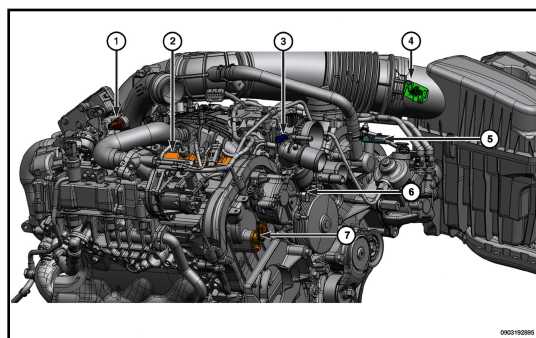
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.

During installation, torque the fasteners to the specifications in the torque table(s) below.

- Use a scan tool and select the ETC RELEARN function to relearn the APPS values.

TORQUE SPECIFICATIONS

ENGINE SENSORS



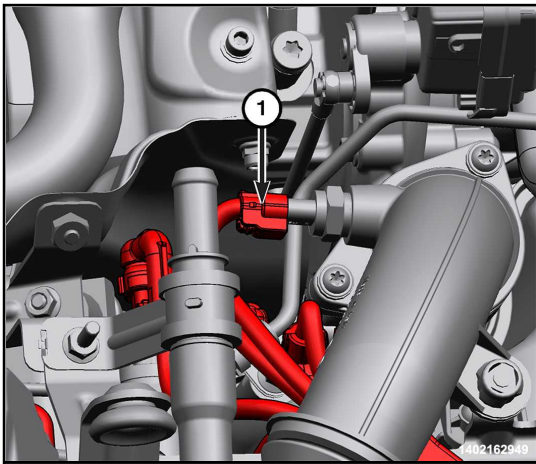
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Inlet Air Temperature (IAT) Sensor	20 N.m (15 Ft. Lbs.)	-
2	Fuel Pressure Sensor	Tighten Securely	-
3	Outlet Air Temperature (IAT) Sensor	Turn Clockwise 1/4 to Lock	-
4	MAF Sensor	Tighten Securely	-
5	Crankcase Pressure Sensor	Tighten Securely	-
6	Engine Coolant Temperature (ECT) Sensor	11 N.m (8 Ft. Lbs.)	-
7	Camshaft Position Sensor Bolt	8 N.m (71 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	Boost Pressure Sensor	Tighten Securely	-
-	Crankshaft Position (CKP) Sensor Bolt	6 N.m (53 In. Lbs.)	-
-	Crankshaft Position Sensor Wire Harness Connector Bracket Bolt	8 N.m (71 In. Lbs.)	-
-	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
-	Engine Oil Pressure (EOP) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Engine Oil Temperature (EOT) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Banjo Bolt	28 N.m (21 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Bracket Bolts	11 N.m (8 Ft. Lbs.)	-
-	Exhaust Temperature Sensor	45 N.m (33 Ft. Lbs.)	-
-	Fuel Pressure Sensor	70 N.m (52 Ft. Lbs.)	-
-	Oxygen (O2) Sensor	50 N.m (37 Ft. Lbs.)	-
-	Delta Pressure Sensor	Tighten Securely	-

INLET AIR TEMPERATURE SENSOR

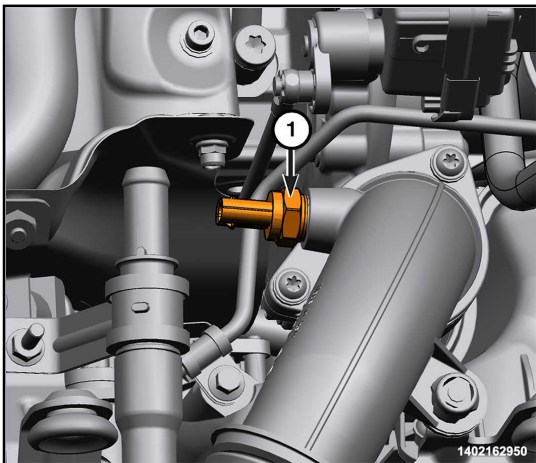
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#).



1 - Inlet Air Temperature Sensor Wire Harness Connector

3. Disconnect the inlet air temperature sensor wire harness connector.



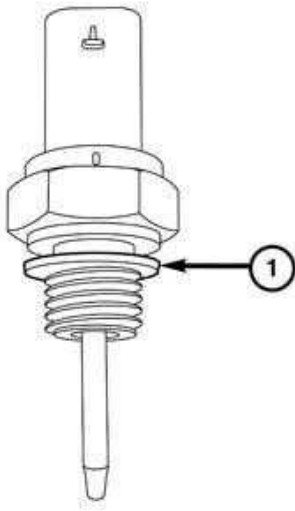
1 - Inlet Air Temperature Sensor

4. Remove the inlet air temperature sensor.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.

During installation, torque the fasteners to the specifications in the torque table(s) below.



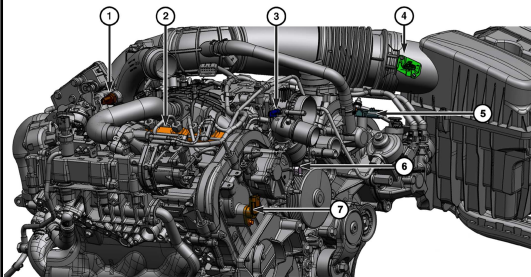
2506003889

1 - Sealing Washer

- Inspect the inlet air temperature sensor sealing washer.

TORQUE SPECIFICATIONS

ENGINE SENSORS



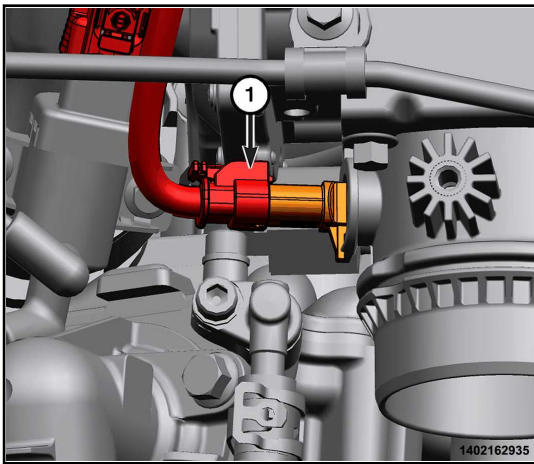
DRG110285

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Inlet Air Temperature (IAT) Sensor	20 N.m (15 Ft. Lbs.)	-
2	Fuel Pressure Sensor	Tighten Securely	-
3	Outlet Air Temperature (IAT) Sensor	Turn Clockwise 1/4 to Lock	-
4	MAF Sensor	Tighten Securely	-
5	Crankcase Pressure Sensor	Tighten Securely	-
6	Engine Coolant Temperature (ECT) Sensor	11 N.m (8 Ft. Lbs.)	-
7	Camshaft Position Sensor Bolt	8 N.m (71 In. Lbs.)	-
-	Boost Pressure Sensor	Tighten Securely	-
-	Crankshaft Position (CKP) Sensor Bolt	6 N.m (53 In. Lbs.)	-
-	Crankshaft Position Sensor Wire Harness Connector Bracket Bolt	8 N.m (71 In. Lbs.)	-
-	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
-	Engine Oil Pressure (EOP) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Engine Oil Temperature (EOT) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Banjo Bolt	28 N.m (21 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Bracket Bolts	11 N.m (8 Ft. Lbs.)	-
-	Exhaust Temperature Sensor	45 N.m (33 Ft. Lbs.)	-
-	Fuel Pressure Sensor	70 N.m (52 Ft. Lbs.)	-
-	Oxygen (O2) Sensor	50 N.m (37 Ft. Lbs.)	-
-	Delta Pressure Sensor	Tighten Securely	-

OUTLET AIR TEMPERATURE SENSOR

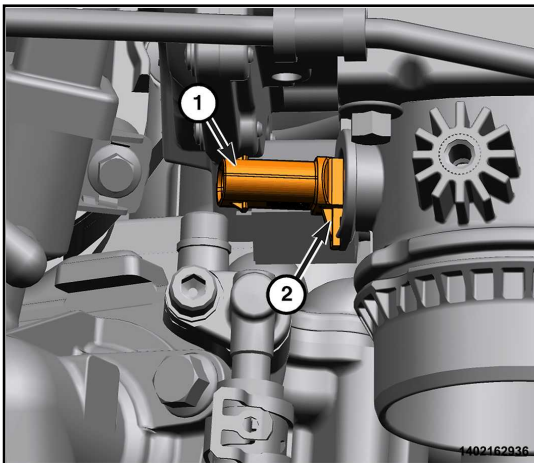
REMOVAL

- Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#).
- Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#).



1 - Outlet Air Temperature Sensor Wire Harness Connector

3. Disconnect the outlet air temperature sensor wire harness connector.



1 - Outlet Air Temperature Sensor

2 - Tab

4. Release the tab and turn counter clockwise 1/4 turn and remove the outlet air temperature sensor.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.



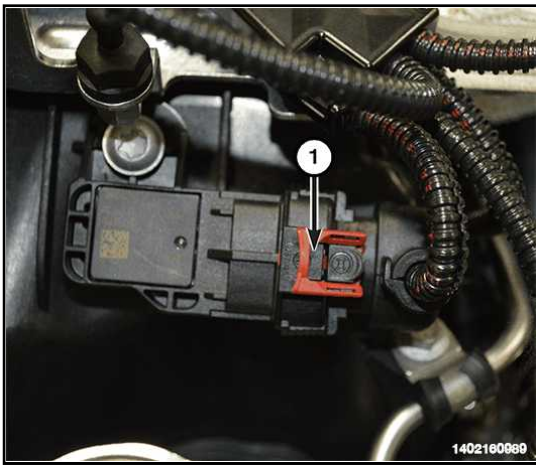
1 - O-ring

- Lubricate O-ring.
- Install the outlet air temperature sensor and turn clockwise 1/4 to lock in place.

BOOST PRESSURE SENSOR

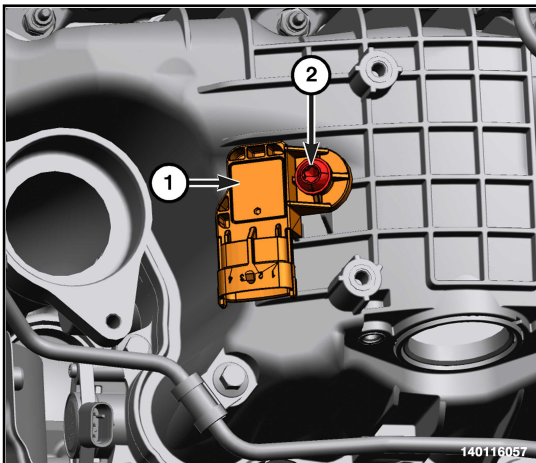
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#).
3. Remove the turbocharger outlet elbow. Refer to [COOLER AND HOSES, CHARGE AIR, REMOVAL AND INSTALLATION](#) .



1 - Boost Pressure Sensor Wire Harness Connector

4. Disconnect the boost pressure sensor wire harness connector.



1 - Boost Pressure Sensor
2 - Boost Pressure Sensor Bolt

5. Remove the boost pressure sensor bolt and the boost pressure sensor.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.

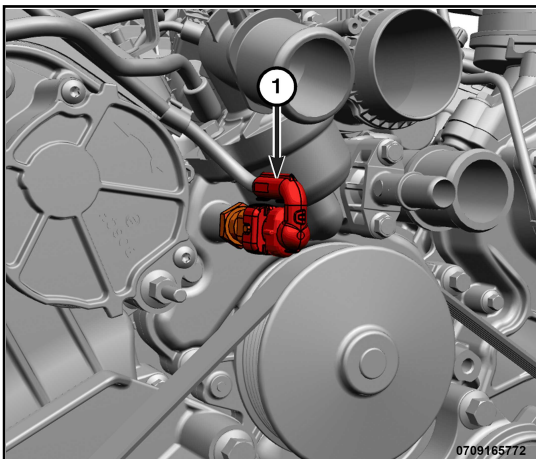
- Install the boost pressure sensor and securely tighten the boost pressure sensor bolt.

COOLANT TEMPERATURE SENSOR

REMOVAL

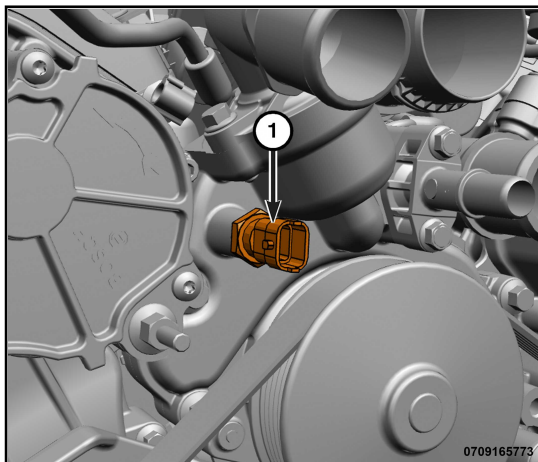
WARNING: Hot, pressurized coolant can cause injury by scalding. Cooling system must be partially drained before removing the coolant te

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
3. Partially drain the cooling system. Refer to [DRAINING](#) .



1 - Engine Coolant Temperature Sensor Wire Harness Connector

4. Unlock and disconnect the Engine Coolant Temperature (ECT) sensor wire harness connector.



1 - Engine Coolant Temperature Sensor

5. Remove the ECT sensor.

INSTALLATION

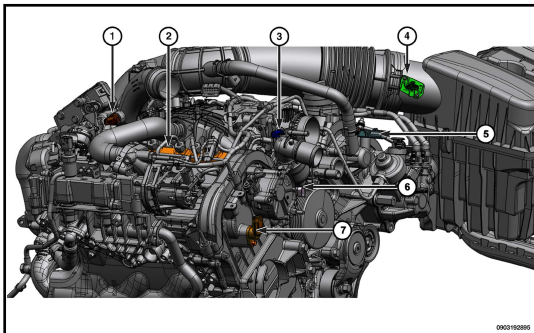
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.

During installation, torque the fasteners to the specifications in the torque table(s) below.

- Fill the cooling system. Refer to [STANDARD PROCEDURE - FILLING](#).

TORQUE SPECIFICATIONS

ENGINE SENSORS

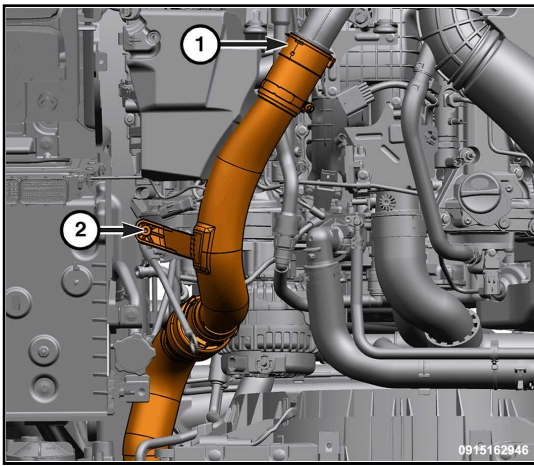


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Inlet Air Temperature (IAT) Sensor	20 N.m (15 Ft. Lbs.)	-
2	Fuel Pressure Sensor	Tighten Securely	-
3	Outlet Air Temperature (IAT) Sensor	Turn Clockwise 1/4 to Lock	-
4	MAF Sensor	Tighten Securely	-
5	Crankcase Pressure Sensor	Tighten Securely	-
6	Engine Coolant Temperature (ECT) Sensor	11 N.m (8 Ft. Lbs.)	-
7	Camshaft Position Sensor Bolt	8 N.m (71 In. Lbs.)	-
-	Boost Pressure Sensor	Tighten Securely	-
-	Crankshaft Position (CKP) Sensor Bolt	6 N.m (53 In. Lbs.)	-
-	Crankshaft Position Sensor Wire Harness Connector Bracket Bolt	8 N.m (71 In. Lbs.)	-
-	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
-	Engine Oil Pressure (EOP) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Engine Oil Temperature (EOT) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Banjo Bolt	28 N.m (21 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Bracket Bolts	11 N.m (8 Ft. Lbs.)	-
-	Exhaust Temperature Sensor	45 N.m (33 Ft. Lbs.)	-
-	Fuel Pressure Sensor	70 N.m (52 Ft. Lbs.)	-
-	Oxygen (O2) Sensor	50 N.m (37 Ft. Lbs.)	-
-	Delta Pressure Sensor	Tighten Securely	-

CAMSHAFT POSITION SENSOR

REMOVAL

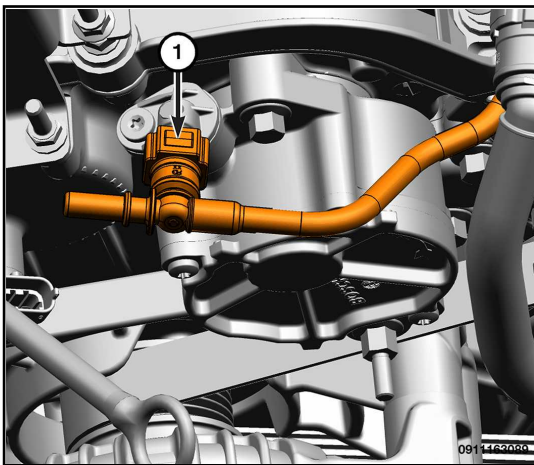
1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#).



1 - Charge Air Cooler Hose Bracket Bolt

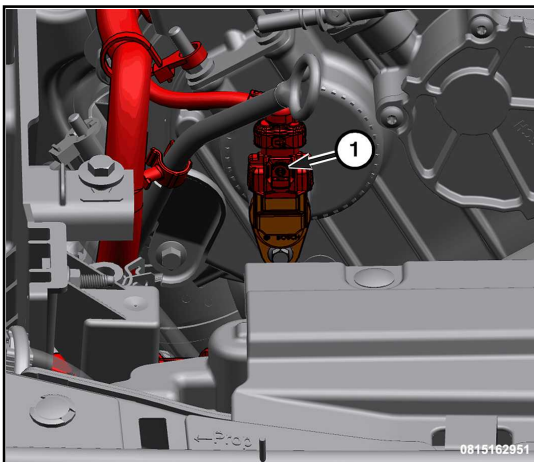
2 - Retaining Clip

2. Remove the Charge Air Cooler (CAC) bracket bolt.
3. Release the retaining clip and disconnect the CAC hose from the turbocharger elbow.



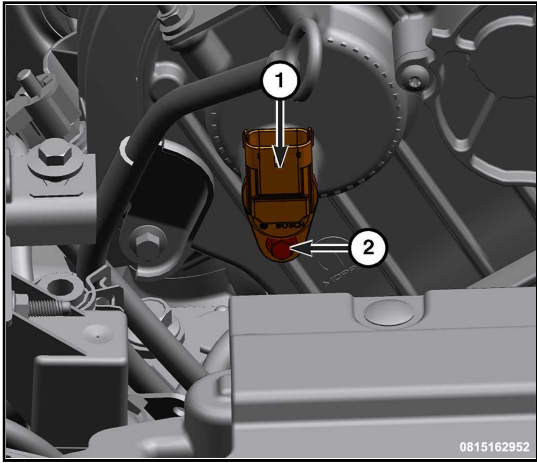
1 - Vacuum Line

4. Disconnect the vacuum hose from the vacuum pump.



1 - Camshaft Position Sensor Harness Connector

5. Disconnect the Camshaft Position (CMP) sensor wire harness connector.



1 - Camshaft Position Sensor
2 - Camshaft Position Sensor Bolt

6. Remove the CMP sensor bolt and the CMP sensor.

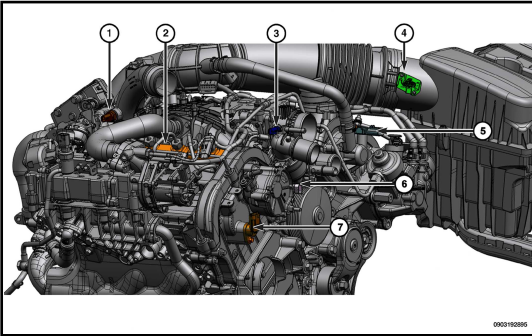
INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

During installation, torque the fasteners to the specifications in the torque table(s) below.

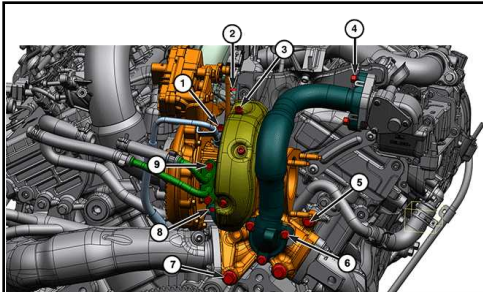
TORQUE SPECIFICATIONS

ENGINE SENSORS



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Inlet Air Temperature (IAT) Sensor	20 N.m (15 Ft. Lbs.)	-
2	Fuel Pressure Sensor	Tighten Securely	-
3	Outlet Air Temperature (IAT) Sensor	Turn Clockwise 1/4 to Lock	-
4	MAF Sensor	Tighten Securely	-
5	Crankcase Pressure Sensor	Tighten Securely	-
6	Engine Coolant Temperature (ECT) Sensor	11 N.m (8 Ft. Lbs.)	-
7	Camshaft Position Sensor Bolt	8 N.m (71 In. Lbs.)	-
-	Boost Pressure Sensor	Tighten Securely	-
-	Crankshaft Position (CKP) Sensor Bolt	6 N.m (53 In. Lbs.)	-
-	Crankshaft Position Sensor Wire Harness Connector Bracket Bolt	8 N.m (71 In. Lbs.)	-
-	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
-	Engine Oil Pressure (EOP) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Engine Oil Temperature (EOT) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Banjo Bolt	28 N.m (21 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Bracket Bolts	11 N.m (8 Ft. Lbs.)	-
-	Exhaust Temperature Sensor	45 N.m (33 Ft. Lbs.)	-
-	Fuel Pressure Sensor	70 N.m (52 Ft. Lbs.)	-
-	Oxygen (O2) Sensor	50 N.m (37 Ft. Lbs.)	-
-	Delta Pressure Sensor	Tighten Securely	-

TURBOCHARGER



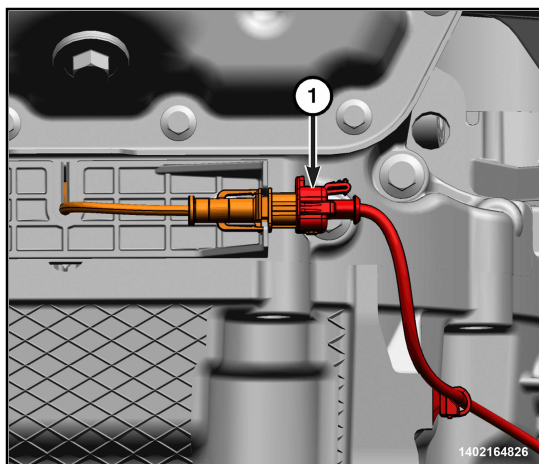
0015102105

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

CRANKSHAFT POSITION SENSOR

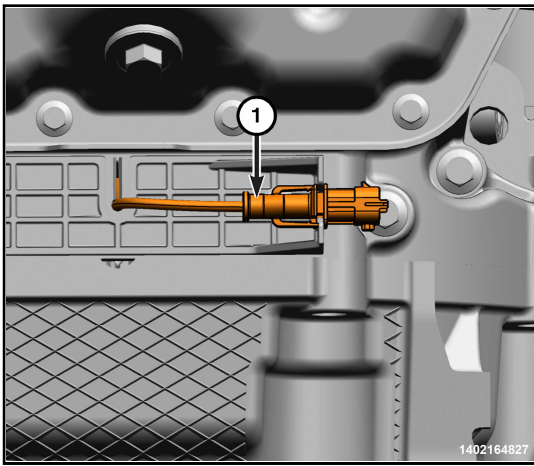
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .



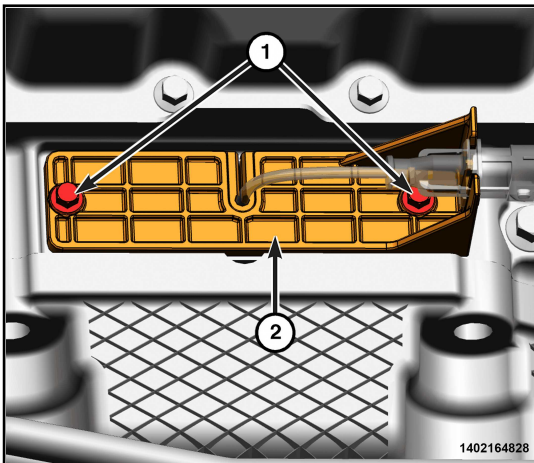
1 - Crankshaft Position Sensor Wire Harness Connector

2. Disconnect Crankshaft Position Sensor (CKP) wire harness connector.



1 - Wire Harness Connector

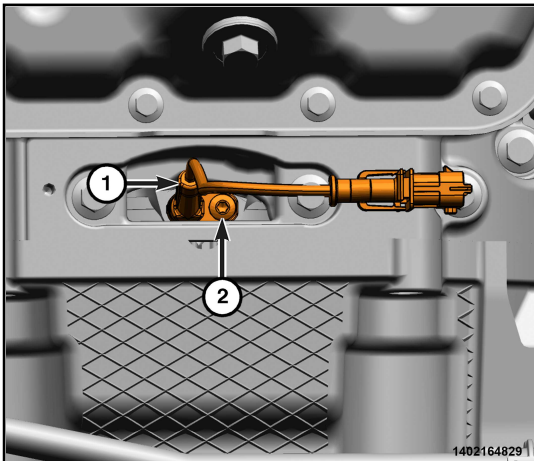
3. Detach the wire harness connector from the bracket.



1 - Access Cover Bolts

2 - Access Cover

4. Remove the access cover bolts and the access cover.



1 - Crankshaft Position Sensor

2 - Crankshaft Position Sensor Bolt

5. Remove the CKP sensor bolt and the CKP sensor.

INSTALLATION

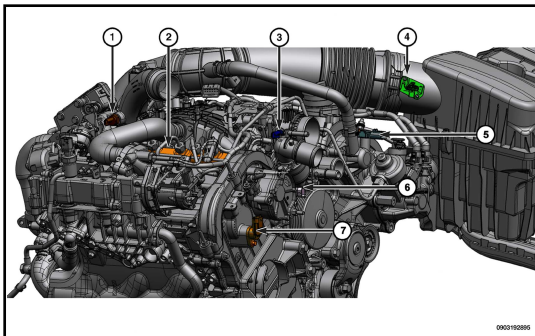
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.

During installation, torque the fasteners to the specifications in the torque table(s) below.

- Clean the area and bore around Crankshaft Position Sensor (CKP).

TORQUE SPECIFICATIONS

ENGINE SENSORS

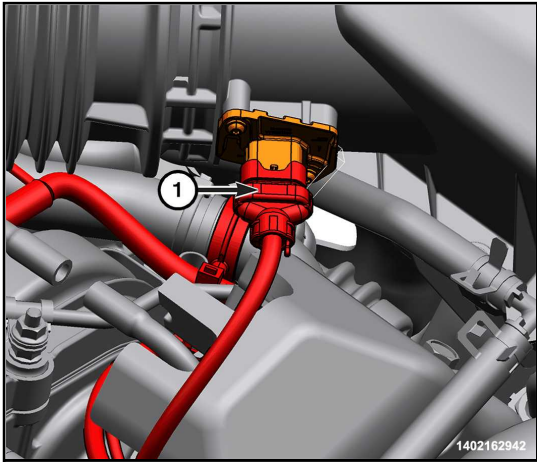


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Inlet Air Temperature (IAT) Sensor	20 N.m (15 Ft. Lbs.)	-
2	Fuel Pressure Sensor	Tighten Securely	-
3	Outlet Air Temperature (IAT) Sensor	Turn Clockwise 1/4 to Lock	-
4	MAF Sensor	Tighten Securely	-
5	Crankcase Pressure Sensor	Tighten Securely	-
6	Engine Coolant Temperature (ECT) Sensor	11 N.m (8 Ft. Lbs.)	-
7	Camshaft Position Sensor Bolt	8 N.m (71 In. Lbs.)	-
-	Boost Pressure Sensor	Tighten Securely	-
-	Crankshaft Position (CKP) Sensor Bolt	6 N.m (53 In. Lbs.)	-
-	Crankshaft Position Sensor Wire Harness Connector Bracket Bolt	8 N.m (71 In. Lbs.)	-
-	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
-	Engine Oil Pressure (EOP) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Engine Oil Temperature (EOT) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Banjo Bolt	28 N.m (21 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Bracket Bolts	11 N.m (8 Ft. Lbs.)	-
-	Exhaust Temperature Sensor	45 N.m (33 Ft. Lbs.)	-
-	Fuel Pressure Sensor	70 N.m (52 Ft. Lbs.)	-
-	Oxygen (O2) Sensor	50 N.m (37 Ft. Lbs.)	-
-	Delta Pressure Sensor	Tighten Securely	-

MASS AIR FLOW SENSOR

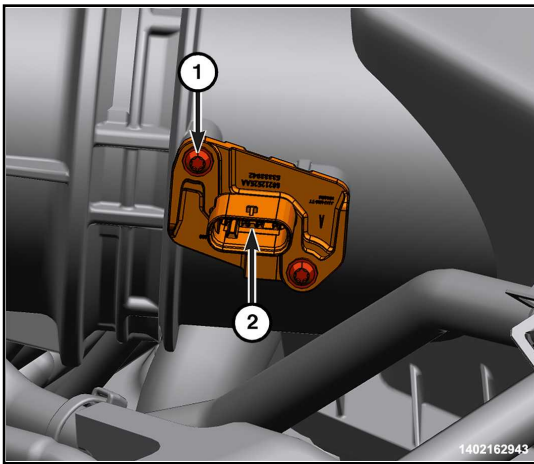
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#).



1 - Mass Air Flow Sensor Wiring Harness Connector

2. Disconnect the Mass Air Flow (MAF) sensor wiring harness connector.



- | |
|---------------------------------|
| 1 - Mass Air Flow Sensor Screws |
| 2 - Mass Air Flow Sensor |

3. Remove the MAF sensor screws and the MAF sensor.

INSTALLATION

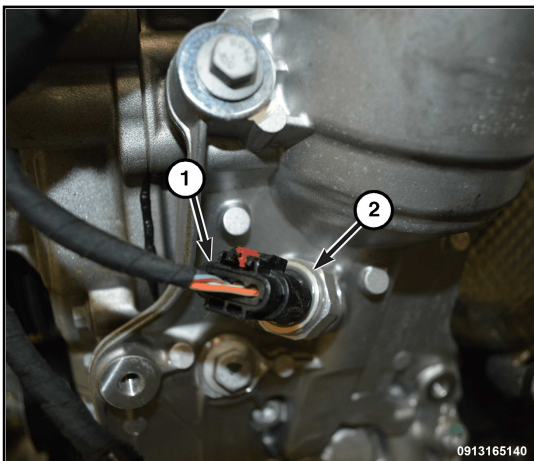
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.

- Install the MAF sensor and securely tighten screws.
- Using a scan tool, perform **Mass Air Flow Sensor Reset** function found under ENGINE MISC. FUNCTIONS.

OIL PRESSURE SENSOR

REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#).
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#).



- | |
|---|
| 1 - Engine Oil Pressure Sensor Wire Harness Connector |
| 2 - Engine Oil Pressure Sensor |

3. Disconnect the engine oil pressure sensor wire harness connector.
4. Remove the engine oil pressure sensor.

INSTALLATION

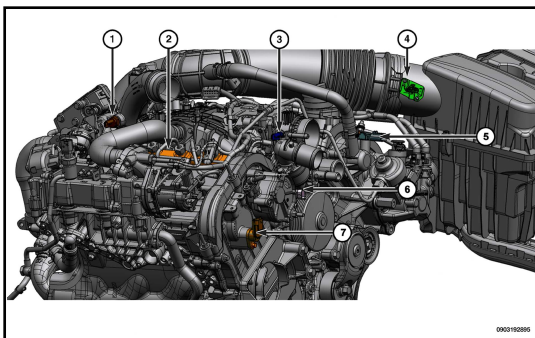
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.

During installation, torque the fasteners to the specifications in the torque table(s) below.

- Start vehicle and inspect for leaks.

TORQUE SPECIFICATIONS

ENGINE SENSORS

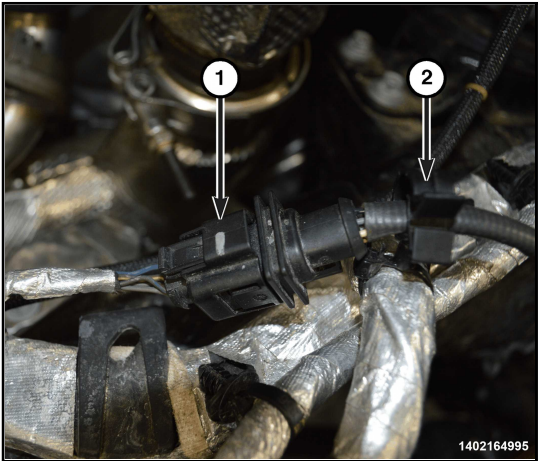


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Inlet Air Temperature (IAT) Sensor	20 N.m (15 Ft. Lbs.)	-
2	Fuel Pressure Sensor	Tighten Securely	-
3	Outlet Air Temperature (IAT) Sensor	Turn Clockwise 1/4 to Lock	-
4	MAF Sensor	Tighten Securely	-
5	Crankcase Pressure Sensor	Tighten Securely	-
6	Engine Coolant Temperature (ECT) Sensor	11 N.m (8 Ft. Lbs.)	-
7	Camshaft Position Sensor Bolt	8 N.m (71 In. Lbs.)	-
-	Boost Pressure Sensor	Tighten Securely	-
-	Crankshaft Position (CKP) Sensor Bolt	6 N.m (53 In. Lbs.)	-
-	Crankshaft Position Sensor Wire Harness Connector Bracket Bolt	8 N.m (71 In. Lbs.)	-
-	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
-	Engine Oil Pressure (EOP) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Engine Oil Temperature (EOT) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Banjo Bolt	28 N.m (21 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Bracket Bolts	11 N.m (8 Ft. Lbs.)	-
-	Exhaust Temperature Sensor	45 N.m (33 Ft. Lbs.)	-
-	Fuel Pressure Sensor	70 N.m (52 Ft. Lbs.)	-
-	Oxygen (O2) Sensor	50 N.m (37 Ft. Lbs.)	-
-	Delta Pressure Sensor	Tighten Securely	-

OXYGEN SENSOR

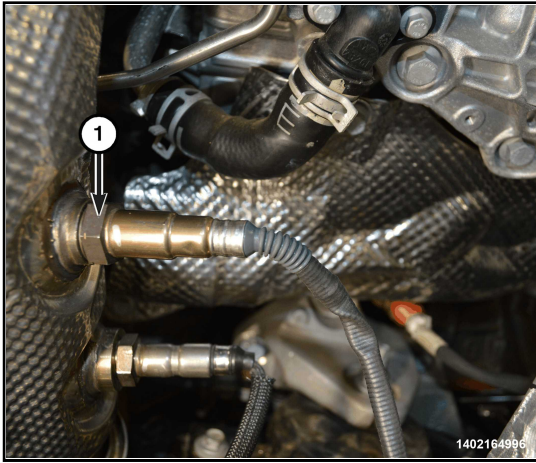
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
3. Remove the right front tire and wheel assembly. Refer to [REMOVAL AND INSTALLATION](#) .
4. Remove the right front wheelhouse splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) .



1 - Oxygen Sensor Wire Harness Connector
2 - Wire Harness Retainers

5. Disconnect the oxygen sensor wire harness connector.
6. Remove the oxygen sensor wire harness from the wire harness retainers.



1 - Oxygen Sensor

7. Remove the oxygen sensor.

INSTALLATION

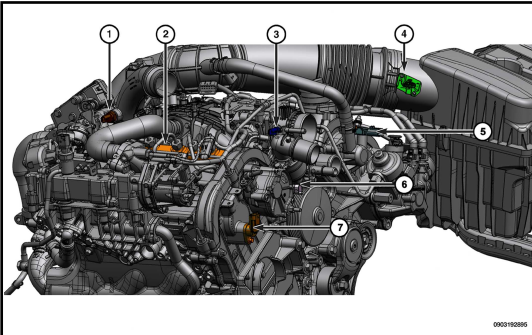
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.

During installation, torque the fasteners to the specifications in the torque table(s) below.

- Using the scan tool, perform **Oxygen Sensor Reset** function found under ENGINE MISC. FUNCTIONS.

TORQUE SPECIFICATIONS

ENGINE SENSORS



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Inlet Air Temperature (IAT) Sensor	20 N.m (15 Ft. Lbs.)	-
2	Fuel Pressure Sensor	Tighten Securely	-
3	Outlet Air Temperature (IAT) Sensor	Turn Clockwise 1/4 to Lock	-
4	MAF Sensor	Tighten Securely	-
5	Crankcase Pressure Sensor	Tighten Securely	-
6	Engine Coolant Temperature (ECT) Sensor	11 N.m (8 Ft. Lbs.)	-
	Camshaft Position Sensor Bolt	8 N.m (71 In. Lbs.)	-
-	Boost Pressure Sensor	Tighten Securely	-
-	Crankshaft Position (CKP) Sensor Bolt	6 N.m (53 In. Lbs.)	-
-	Crankshaft Position Sensor Wire Harness Connector Bracket Bolt	8 N.m (71 In. Lbs.)	-
-	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
-	Engine Oil Pressure (EOP) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Engine Oil Temperature (EOT) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Banjo Bolt	28 N.m (21 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Bracket Bolts	11 N.m (8 Ft. Lbs.)	-
-	Exhaust Temperature Sensor	45 N.m (33 Ft. Lbs.)	-
-	Fuel Pressure Sensor	70 N.m (52 Ft. Lbs.)	-
-	Oxygen (O2) Sensor	50 N.m (37 Ft. Lbs.)	-
-	Delta Pressure Sensor	Tighten Securely	-

FUEL TEMPERATURE SENSOR

The fuel temperature sensor is only serviced as part of the fuel filter/water separator housing. Remove the fuel filter/water separator assembly. Refer to [FILTER\(S\), FU INSTALLATION](#) .

WATER IN FUEL SENSOR

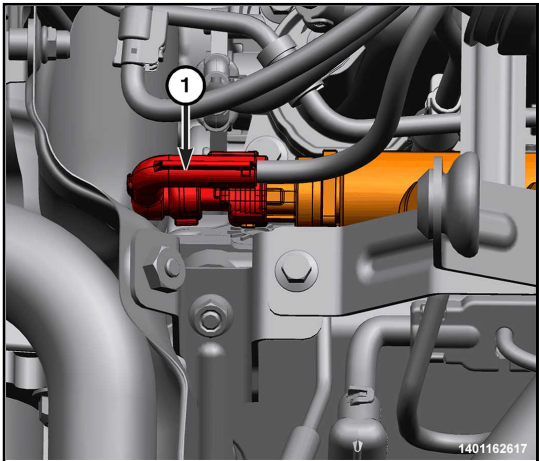
- The Water In Fuel (WIF) sensor is not a serviceable item. If diagnosis led you to replace the fuel heater, then the fuel filter/water separator housing must be replaced. Refer to [FILTER\(S\), FUEL, REMOVAL AND INSTALLATION](#) .

REMOVAL

WARNING: Observe the following precautions when working on fuel systems: No sparks, open flames or smoking. Avoid inhaling and swal eye and skin contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing. Fail these precautions may result in fire, explosion, property damage, and serious or fatal injury.

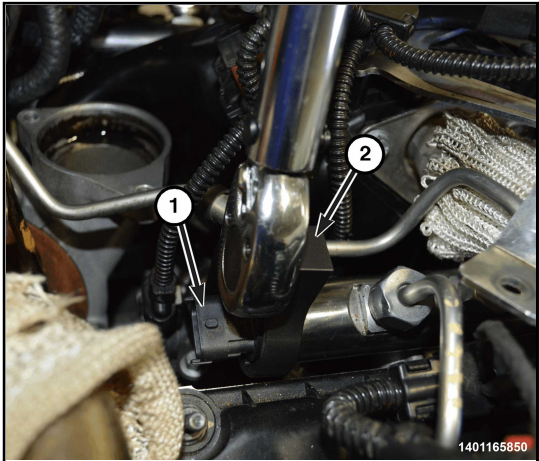
WARNING: High-pressure lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high 008 psi). Use extreme caution when inspecting for high-pressure fuel leaks. Fuel under this amount of pressure can penetrate s personal injury or death. Inspect for high-pressure fuel leaks with a sheet of cardboard. Wear safety goggles and adequate prot when servicing fuel system.

- 1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#).
- 2. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#).
- 3. Disconnect the boost pressure wire harness connector.
- 4. Disconnect the swirl valve wire harness connector.



1 - Fuel Pressure Sensor Wire Harness Connector

- 5. Disconnect the fuel pressure sensor wire harness connector.
- 6. Disconnect cylinder No. 3 glow plug wire harness connector.
- 7. Remove the engine cover bracket bolts and the engine cover bracket.
- 8. Clean the area around the fuel pressure sensor.



1 - Fuel Pressure Sensor
2 - Fuel Rail Pressure Sensor Wrench

- 9. Using the (special tool #2073300140, Wrench, Fuel Rail Pressure Sensor), remove the fuel pressure sensor.
- 10. Install a protective cap over opening.

INSTALLATION

WARNING: Observe the following precautions when working on fuel systems: No sparks, open flames or smoking. Avoid inhaling and swal eye and skin contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing. Fail these precautions may result in fire, explosion, property damage, and serious or fatal injury.

WARNING: High-pressure lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high 008 psi). Use extreme caution when inspecting for high-pressure fuel leaks. Fuel under this amount of pressure can penetrate s personal injury or death. Inspect for high-pressure fuel leaks with a sheet of cardboard. Wear safety goggles and adequate prot when servicing fuel system.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.

During installation, torque the fasteners to the specifications in the torque table(s) below.

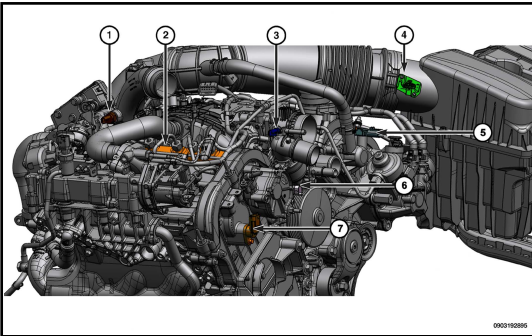
- Remove the protective cap from the opening.

NOTE: Whenever the fuel pressure sensor is replaced.

- Using the scan tool, perform **Oxygen Sensor Value Reset** function found under ENGINE MISCELLANEOUS FUNCTIONS.

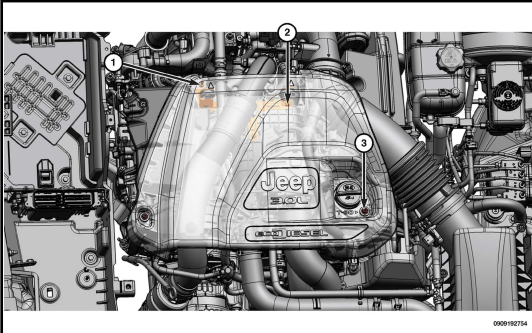
TORQUE SPECIFICATIONS

ENGINE SENSORS

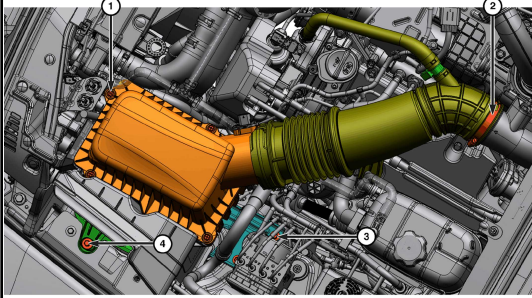


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Inlet Air Temperature (IAT) Sensor	20 N.m (15 Ft. Lbs.)	-
2	Fuel Pressure Sensor	Tighten Securely	-
3	Outlet Air Temperature (IAT) Sensor	Turn Clockwise 1/4 to Lock	-
4	MAF Sensor	Tighten Securely	-
5	Crankcase Pressure Sensor	Tighten Securely	-
6	Engine Coolant Temperature (ECT) Sensor	11 N.m (8 Ft. Lbs.)	-
7	Camshaft Position Sensor Bolt	8 N.m (71 In. Lbs.)	-
-	Boost Pressure Sensor	Tighten Securely	-
-	Crankshaft Position (CKP) Sensor Bolt	6 N.m (53 In. Lbs.)	-
-	Crankshaft Position Sensor Wire Harness Connector Bracket Bolt	8 N.m (71 In. Lbs.)	-
-	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
-	Engine Oil Pressure (EOP) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Engine Oil Temperature (EOT) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Banjo Bolt	28 N.m (21 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Bracket Bolts	11 N.m (8 Ft. Lbs.)	-
-	Exhaust Temperature Sensor	45 N.m (33 Ft. Lbs.)	-
-	Fuel Pressure Sensor	70 N.m (52 Ft. Lbs.)	-
-	Oxygen (O2) Sensor	50 N.m (37 Ft. Lbs.)	-
-	Delta Pressure Sensor	Tighten Securely	-

INTAKE AIR

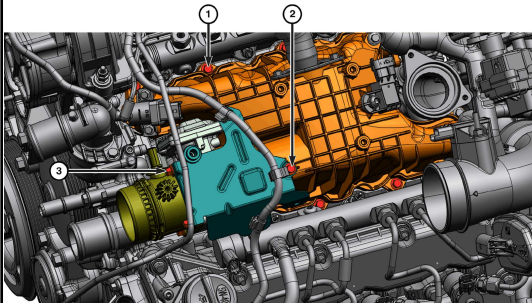


CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Engine Cover Bracket Nut	9 N.m (80 In. Lbs.)	-
2	Engine Cover Bracket Bolt	9 N.m (80 In. Lbs.)	-
3	Engine Cover bolts	4 N.m (35 In. Lbs.)	-



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Air Cleaner Cover Bolt	5 N.m (44 In. Lbs.)	-
2	Fresh Air Inlet Hose Clamp	4 N.m (35 In. Lbs.)	-
3	Air Cleaner Body Bracket Bolt	9 N.m (80 In. Lbs.)	-
4	Air Cleaner Body Bolt	5 N.m (44 In. Lbs.)	-
-	Air Cleaner Body Bracket Nut	9 N.m (80 In. Lbs.)	-

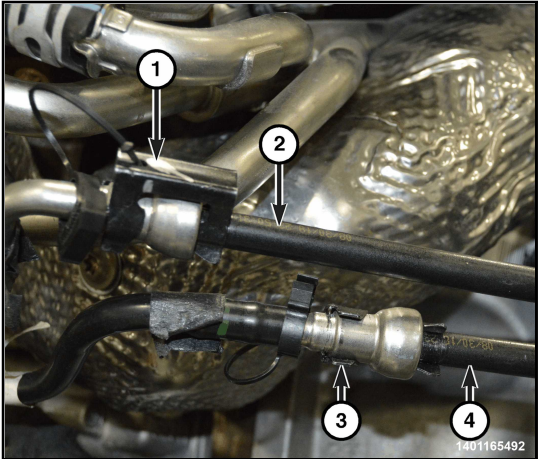
CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Intake Manifold Bolts	12 N.m (9 Ft. Lbs.)	Tightening Sequence
2	Throttle Body Support Bracket to Intake Manifold	9 N.m (80 In. Lbs.)	-
3	Throttle / Airflow Control Valve Bolts	9 N.m (80 In. Lbs.)	-



LOW PRESSURE - FUEL PRESSURE SENSOR

REMOVAL

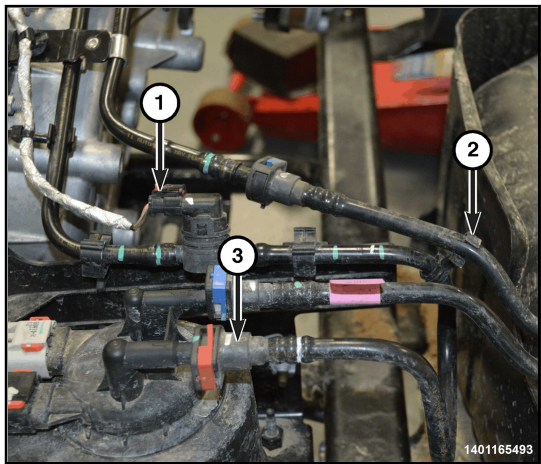
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .



1 - Safety Clip

2 - Low Pressure Fuel Return Line
3 - Safety Clip
4 - Low Pressure Fuel Supply Line

3. Remove the safety clip and disconnect the low pressure fuel supply line. Refer to [STANDARD PROCEDURE](#) .



1 - Low Pressure Fuel Pressure Sensor Wire Harness Connector
2 - Retaining Clip
3 - Fuel Supply Line

4. Disconnect the Low Pressure (LP) fuel pressure sensor wire harness connector.
5. Remove fuel line from the retaining clip.
6. Disconnect the fuel supply line from the fuel filter/water separator housing and remove the LP fuel pressure sensor line assembly. Refer to [STANDARD PROCE](#)

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.

- Start the engine and check for leaks.

ACCESSORY DRIVE

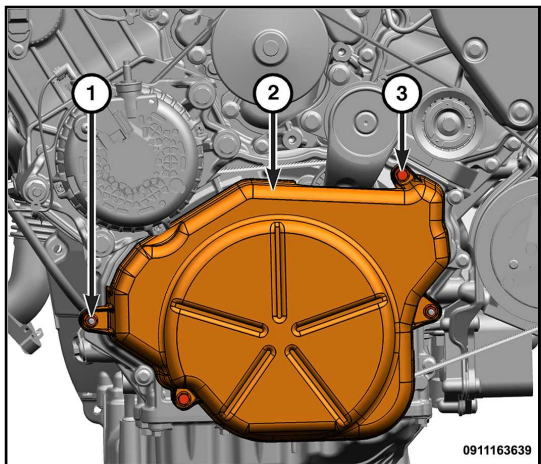
BELT, SERPENTINE

REMOVAL AND INSTALLATION

SERPENTINE BELT

REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#).

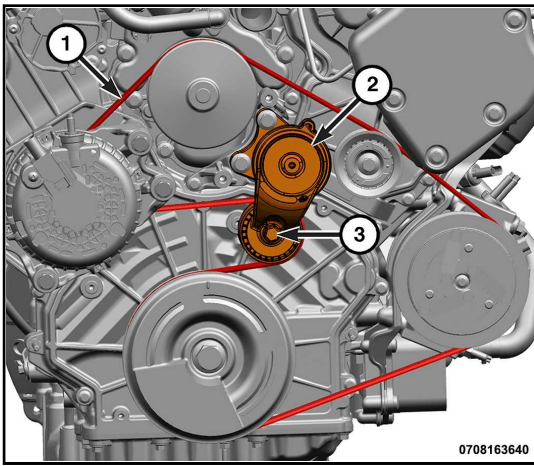


1 - Vibration Damper Cover Nut
2 - Vibration Damper Cover
3 - Vibration Damper Cover Bolts

3. Remove the nut, bolts and the vibration damper cover.

CAUTION: Do not let the tensioner arm snap back to the freearm position, severe damage may occur to the tensioner.

4. Remove the cooling fan. Refer to [FAN, COOLING, REMOVAL AND INSTALLATION](#) .



1 - Serpentine Belt
2 - Belt Tensioner
3 - Belt Tensioner Pulley Bolt

5. Rotate belt tensioner until it contacts its stop and insert a pin to lock the tensioner.

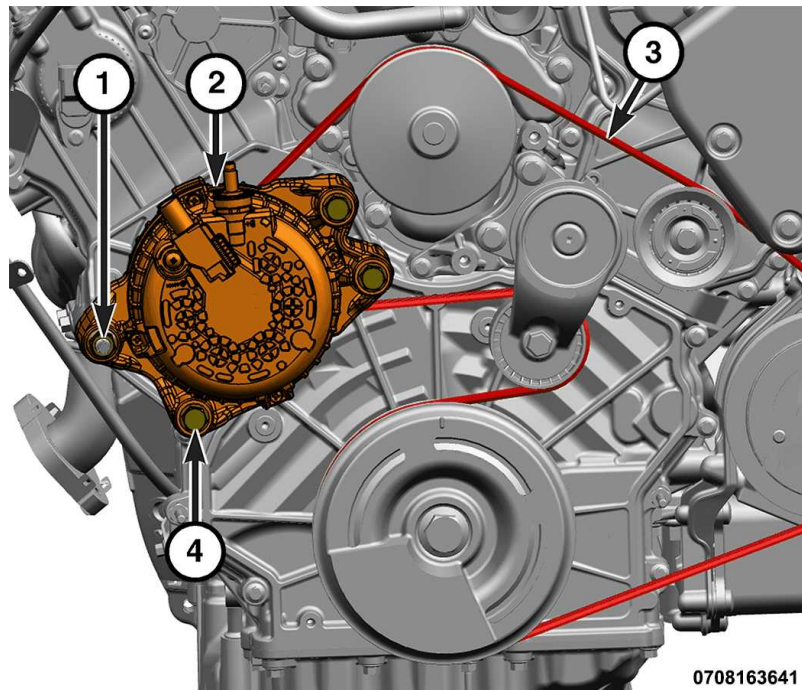
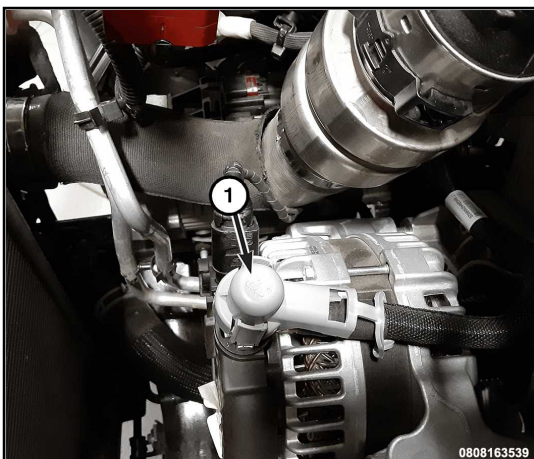


Fig. 17: Accessory Drive Belt Routing
Courtesy of CHRYSLER GROUP, LLC

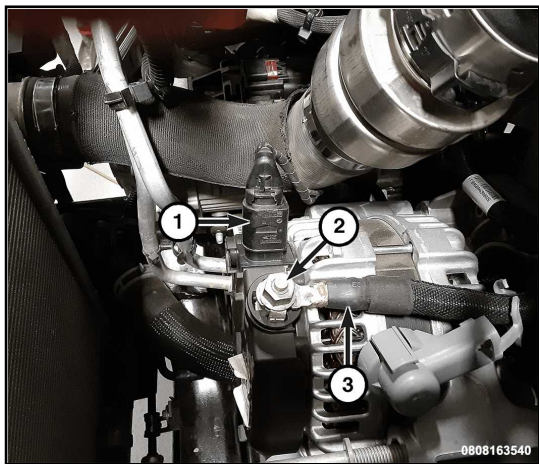
1 - Generator Nut
2 - Generator
3 - Serpentine Belt
4 - Generator Bolts

6. Loosen the generator bolts and nut and slide the generator forward to remove the serpentine belt.



1 - B+ Cable Cover

7. Remove the B+ cable cover.



1 - Generator Harness Connector
2 - B+ Cable Nut
3 - B+ Cable

8. Remove the nut and the B+ cable.

9. Disconnect the generator wire harness connector.

10. Remove the serpentine belt.

INSTALLATION

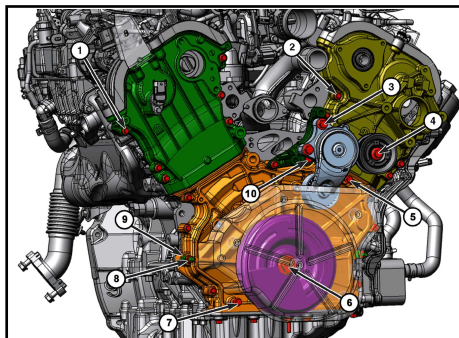
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.

- Check condition of the serpentine belt and all pulleys.
- Rotate the tensioner and remove the pin and slowly let the tensioner rotate into the serpentine belt.

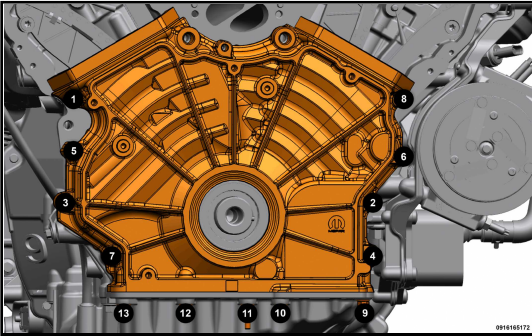
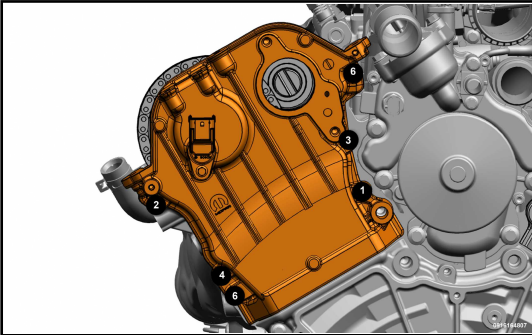
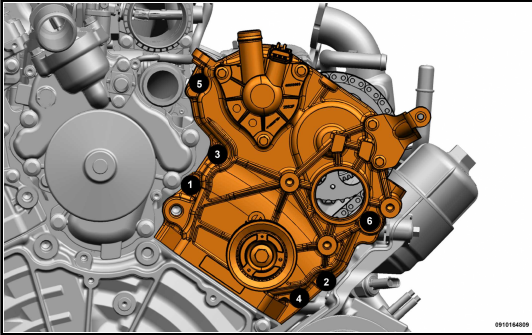
TORQUE SPECIFICATIONS

FRONT ENGINE



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1, 2	Timing Chain Cover Bolts	Torque Procedure: 1. Tighten the M6 bolts finger tight. 2. Tighten the M6 bolts to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and retighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence
3	Belt Tensioner Pulley Bolt	45 N.m (33 Ft. Lbs.)	-
4	Idler Pulley Bolts	32 N.m (24 Ft. Lbs.)	-
5, 9	Timing Chain Cover Bolts (lower)	Torque Procedure: 1. Tighten the lower timing cover bolts (1 and 3) finger tight. 2. Tighten the M6 bolts (1 - 8) to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and tighten to 15 N.m (Ft. Lbs.). 4. Install the oil pan-to-lower chain cover bolts and tighten	Tightening Sequence Position 2 and 3 are double ends

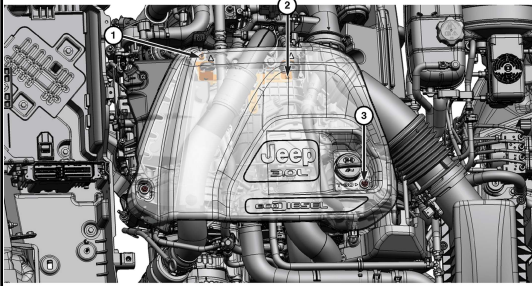
CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
		(9 - 13) to 15 N.m (11 Ft. Lbs.). 5. Loosen each bolt one at a time 90B° and tighten to 15 N.m (11 Ft. Lbs.).	
6	Vibration Damper Bolt	100 N.m (74 Ft. Lbs.) + 125B°	-
7	Vibration Damper Cover Bolts	10 N.m (7 Ft. Lbs.)	-
8	Vibration Damper Cover Nut	9 N.m (80 In. Lbs.)	-
10	Belt Tensioner to Mounting Bracket - M10 Bolt	45 N.m (33 Ft. Lbs.)	-
11	Belt Tensioner to Mounting Bracket - M6 Bolt	11 N.m (8 Ft. Lbs.)	-
-	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Oil Breather/Camshaft Seal Housing Bolts	14 N.m (10 Ft. Lbs.)	-
-	Vacuum Pump Bolt	30 N.m (22 Ft. Lbs.)	-



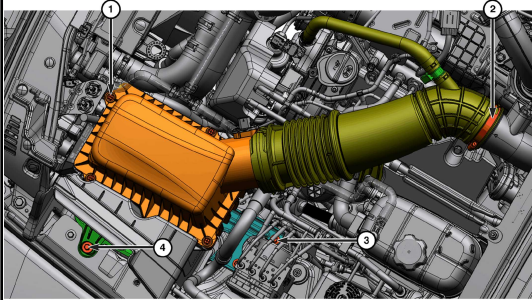
CHARGING SYSTEM - 3.0L

DESCRIPTION	SPECIFICATION	COMMENT
Generator Bolts	63 N.m (48 Ft. Lbs.)	-
Generator B+ Cable Nut	20 N.m (15 Ft. Lbs.)	-
Generator Nut	63 N.m (48 Ft. Lbs.)	-
Generator Stud	10 N.m (89 In. Lbs.)	-

INTAKE AIR

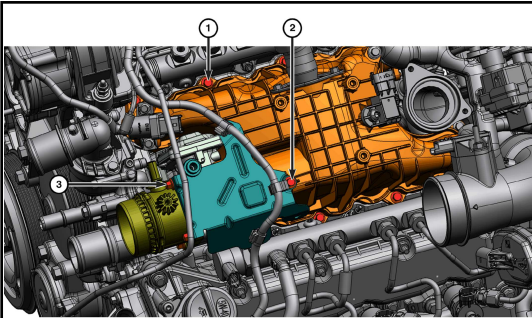


CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Engine Cover Bracket Nut	9 N.m (80 In. Lbs.)	-
2	Engine Cover Bracket Bolt	9 N.m (80 In. Lbs.)	-
3	Engine Cover bolts	4 N.m (35 In. Lbs.)	-



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Air Cleaner Cover Bolt	5 N.m (44 In. Lbs.)	-
2	Fresh Air Inlet Hose Clamp	4 N.m (35 In. Lbs.)	-
3	Air Cleaner Body Bracket Bolt	9 N.m (80 In. Lbs.)	-
4	Air Cleaner Body Bolt	5 N.m (44 In. Lbs.)	-
-	Air Cleaner Body Bracket Nut	9 N.m (80 In. Lbs.)	-

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Intake Manifold Bolts	12 N.m (9 Ft. Lbs.)	Tightening Sequence
2	Throttle Body Support Bracket to Intake Manifold	9 N.m (80 In. Lbs.)	-
3	Throttle / Airflow Control Valve Bolts	9 N.m (80 In. Lbs.)	-



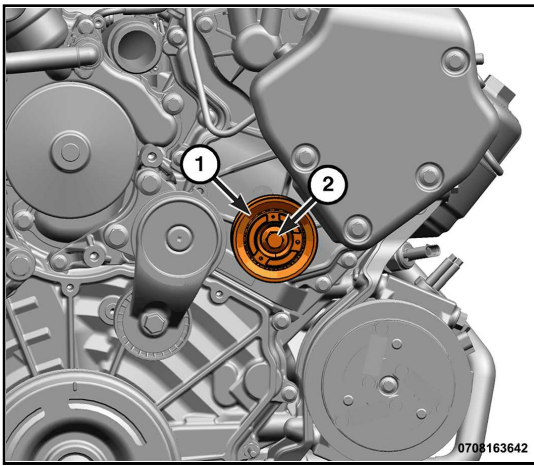
PULLEY, IDLER

REMOVAL AND INSTALLATION

IDLER PULLEY

REMOVAL

1. Remove the serpentine belt. Refer to [BELT, SERPENTINE, REMOVAL AND INSTALLATION](#).



1 - Idler Pulley
2 - Idler Pulley Bolt

2. Remove the idler pulley bolt and the idler pulley.

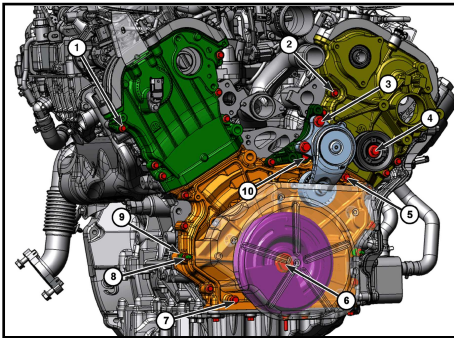
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

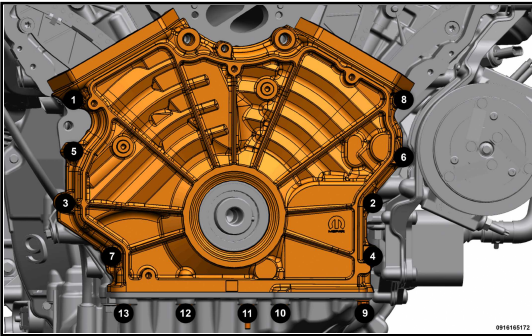
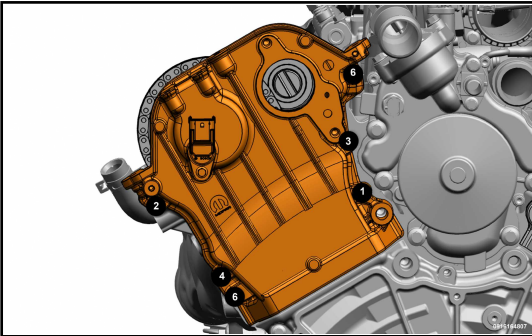
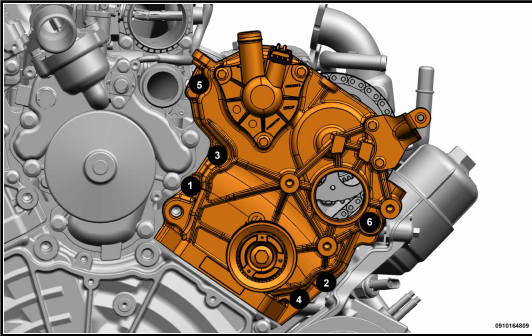
TORQUE SPECIFICATIONS

FRONT ENGINE



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1, 2	Timing Chain Cover Bolts	Torque Procedure: 1. Tighten the M6 bolts finger tight. 2. Tighten the M6 bolts to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and retighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence
3	Belt Tensioner Pulley Bolt	45 N.m (33 Ft. Lbs.)	-
4	Idler Pulley Bolts	32 N.m (24 Ft. Lbs.)	-
5, 9	Timing Chain Cover Bolts (lower)	Torque Procedure: 1. Tighten the lower timing cover bolts (1 and 3) finger tight. 2. Tighten the M6 bolts (1 - 8) to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and tighten to 15 N.m (Ft. Lbs.). 4. Install the oil pan-to-lower chain cover bolts and tighten (9 - 13) to 15 N.m (11 Ft. Lbs.). 5. Loosen each bolt one at a time 90B° and tighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence Position 2 and 3 are double ends
6	Vibration Damper Bolt	100 N.m (74 Ft. Lbs.) + 125B°	-
7	Vibration Damper Cover Bolts	10 N.m (7 Ft. Lbs.)	-
8	Vibration Damper Cover Nut	9 N.m (80 In. Lbs.)	-
10	Belt Tensioner to Mounting Bracket - M10 Bolt	45 N.m (33 Ft. Lbs.)	-

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
11	Belt Tensioner to Mounting Bracket - M6 Bolt	11 N.m (8 Ft. Lbs.)	-
-	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Oil Breather/Camshaft Seal Housing Bolts	14 N.m (10 Ft. Lbs.)	-
-	Vacuum Pump Bolt	30 N.m (22 Ft. Lbs.)	-



TENSIONER, BELT

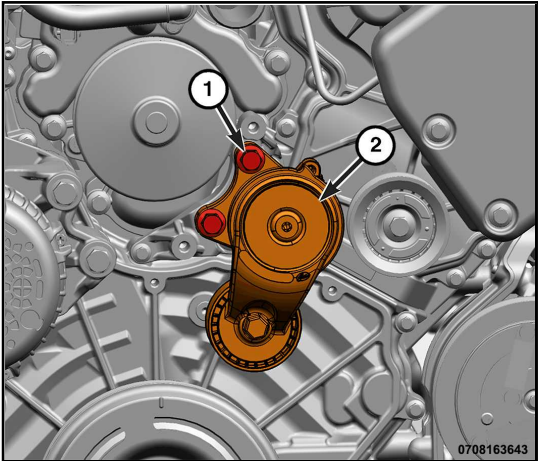
REMOVAL AND INSTALLATION

BELT TENSIONER

REMOVAL

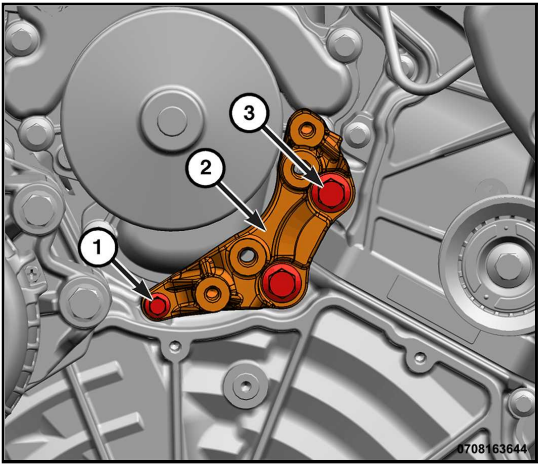
WARNING: Because of high spring tension, do not attempt to disassemble automatic tensioner. Unit is serviced as an assembly (except for tensioner).

1. Remove the serpentine belt. Refer to [BELT, SERPENTINE, REMOVAL AND INSTALLATION](#).



1 - Belt Tensioner Bolts
2 - Belt Tensioner

2. Remove the belt tensioner bolts and the belt tensioner.



1 - Belt Tensioner Bracket Bolt
2 - Belt Tensioner Bracket
3 - Belt Tensioner Bracket Bolts

3. If necessary, remove the belt tensioner bracket bolts and the belt tensioner bracket.

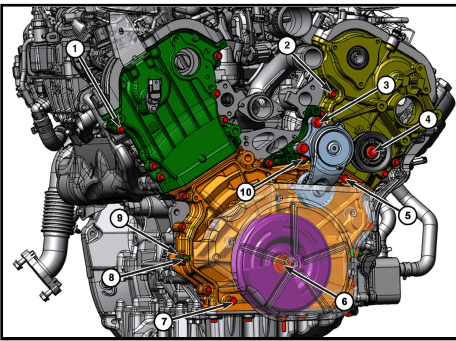
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

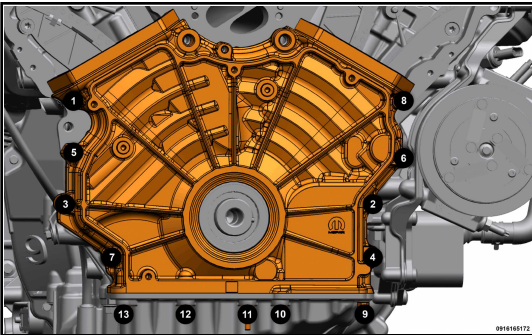
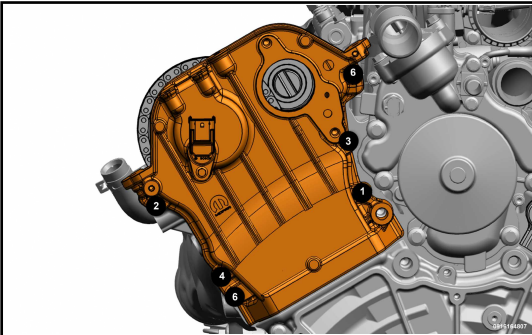
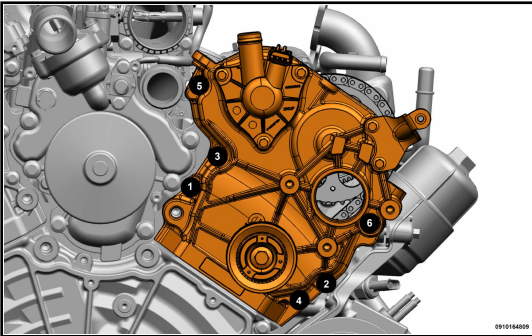
TORQUE SPECIFICATIONS

FRONT ENGINE



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1, 2	Timing Chain Cover Bolts	Torque Procedure: 1. Tighten the M6 bolts finger tight. 2. Tighten the M6 bolts to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and retighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence
3	Belt Tensioner Pulley Bolt	45 N.m (33 Ft. Lbs.)	-
4	Idler Pulley Bolts	32 N.m (24 Ft. Lbs.)	-
5, 9	Timing Chain Cover Bolts (lower)	Torque Procedure: 1. Tighten the lower timing cover bolts (1 and 3) finger tight. 2. Tighten the M6 bolts (1 - 8) to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and tighten to 15 N.m (11 Ft. Lbs.). 4. Install the oil pan-to-lower chain cover bolts and tighten (9 - 13) to 15 N.m (11 Ft. Lbs.). 5. Loosen each bolt one at a time 90B° and tighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence Position 2 and 3 are double ends
6	Vibration Damper Bolt	100 N.m (74 Ft. Lbs.) + 125B°	-

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
7	Vibration Damper Cover Bolts	10 N.m (7 Ft. Lbs.)	-
8	Vibration Damper Cover Nut	9 N.m (80 In. Lbs.)	-
10	Belt Tensioner to Mounting Bracket - M10 Bolt	45 N.m (33 Ft. Lbs.)	-
11	Belt Tensioner to Mounting Bracket - M6 Bolt	11 N.m (8 Ft. Lbs.)	-
-	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Oil Breather/Camshaft Seal Housing Bolts	14 N.m (10 Ft. Lbs.)	-
-	Vacuum Pump Bolt	30 N.m (22 Ft. Lbs.)	-



AIR INTAKE SYSTEM

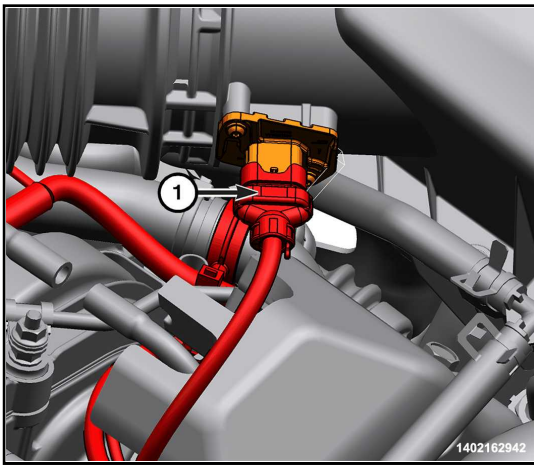
AIR CLEANER

REMOVAL AND INSTALLATION

AIR CLEANER

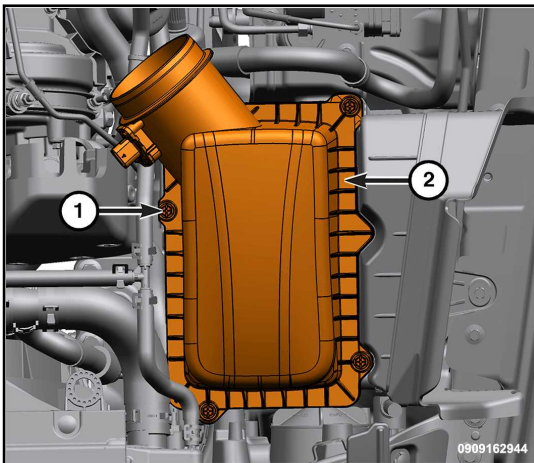
REMOVAL

- 1. Loosen the clamp and remove the clean air hose.



1 - Mass Air Flow Wire Harness Connector

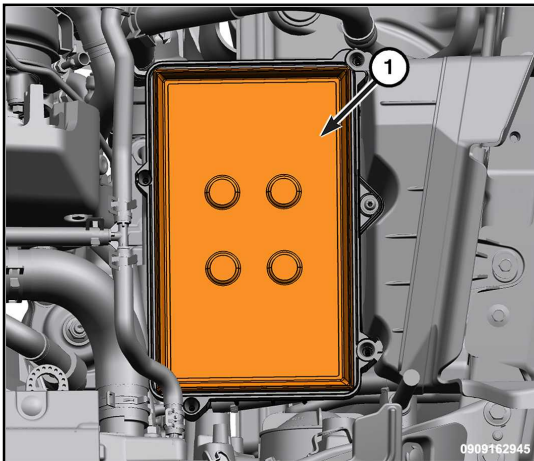
2. Disconnect the Mass Air Flow (MAF) wire harness connector.



1 - Air Cleaner Cover Screws

2 - Air Cleaner Cover

3. Unscrew the air cleaner cover screws and remove the air cleaner cover.



1 - Air Cleaner Element

4. Remove the air cleaner element from the housing.

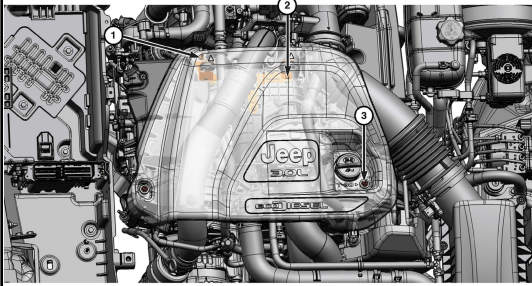
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

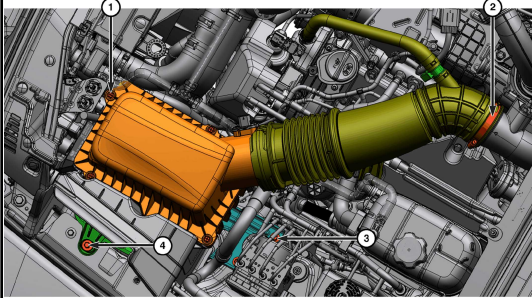
Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

INTAKE AIR

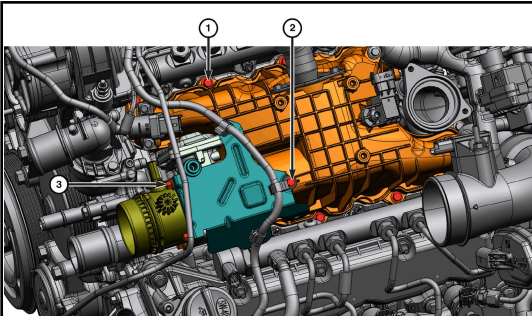


CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Engine Cover Bracket Nut	9 N.m (80 In. Lbs.)	-
2	Engine Cover Bracket Bolt	9 N.m (80 In. Lbs.)	-
3	Engine Cover bolts	4 N.m (35 In. Lbs.)	-



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Air Cleaner Cover Bolt	5 N.m (44 In. Lbs.)	-
2	Fresh Air Inlet Hose Clamp	4 N.m (35 In. Lbs.)	-
3	Air Cleaner Body Bracket Bolt	9 N.m (80 In. Lbs.)	-
4	Air Cleaner Body Bolt	5 N.m (44 In. Lbs.)	-
-	Air Cleaner Body Bracket Nut	9 N.m (80 In. Lbs.)	-

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Intake Manifold Bolts	12 N.m (9 Ft. Lbs.)	Tightening Sequence
2	Throttle Body Support Bracket to Intake Manifold	9 N.m (80 In. Lbs.)	-
3	Throttle / Airflow Control Valve Bolts	9 N.m (80 In. Lbs.)	-



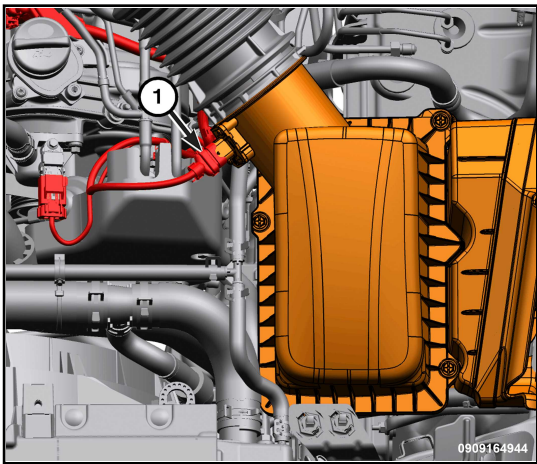
BODY, AIR CLEANER

REMOVAL AND INSTALLATION

AIR CLEANER BODY

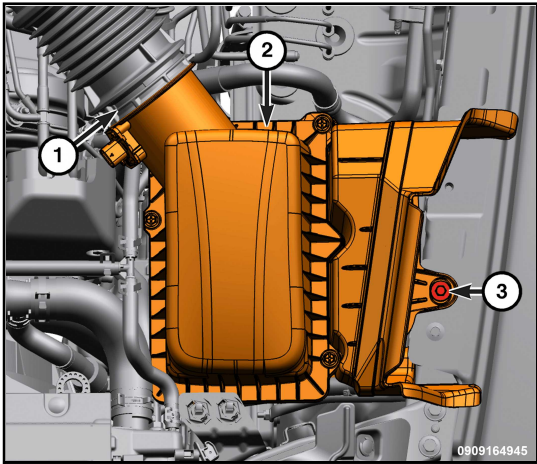
REMOVAL

1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#).



1 - Mass Air Flow Sensor Wire Harness Connector

2. Disconnect the Mass Air Flow (MAF) sensor wire harness connector.



1 - Clean Air Hose
2 - Air Cleaner Body
3 - Air Cleaner Body Bolt

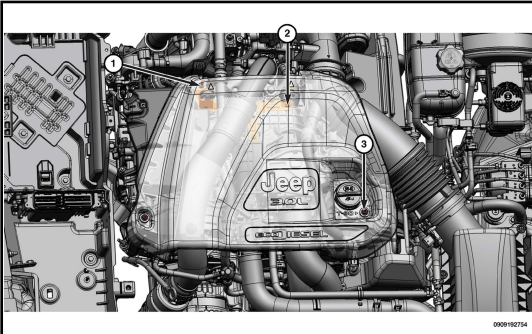
3. Remove the clean air hose.
4. Remove the air cleaner body bolt then lift up and the air cleaner body.

INSTALLATION

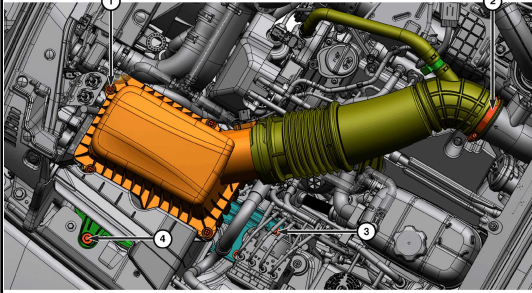
During installation, torque the fasteners to the specifications in the torque table(s) below.
Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

INTAKE AIR

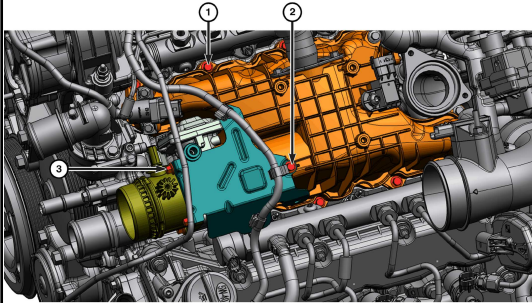


CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Engine Cover Bracket Nut	9 N.m (80 In. Lbs.)	-
2	Engine Cover Bracket Bolt	9 N.m (80 In. Lbs.)	-
3	Engine Cover bolts	4 N.m (35 In. Lbs.)	-



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Air Cleaner Cover Bolt	5 N.m (44 In. Lbs.)	-
2	Fresh Air Inlet Hose Clamp	4 N.m (35 In. Lbs.)	-
3	Air Cleaner Body Bracket Bolt	9 N.m (80 In. Lbs.)	-
4	Air Cleaner Body Bolt	5 N.m (44 In. Lbs.)	-
-	Air Cleaner Body Bracket Nut	9 N.m (80 In. Lbs.)	-

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Intake Manifold Bolts	12 N.m (9 Ft. Lbs.)	Tightening Sequence
2	Throttle Body Support Bracket to Intake Manifold	9 N.m (80 In. Lbs.)	-
3	Throttle / Airflow Control Valve Bolts	9 N.m (80 In. Lbs.)	-



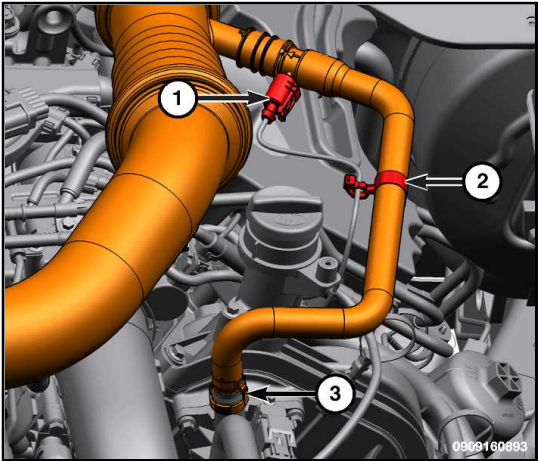
HOSE, CLEAN AIR

REMOVAL AND INSTALLATION

CLEAN AIR HOSE

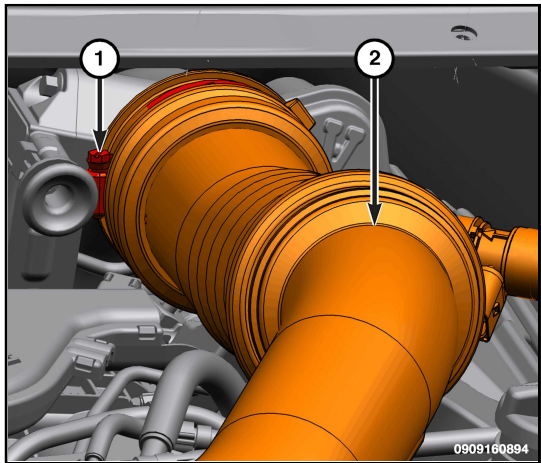
REMOVAL

1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#).



1 - Closed Crankcase Ventilation Heater Wire Harness Connector
2 - Wire Harness Retainer
3 - Crankcase Breather Hose

2. Disconnect the crankcase breather hose.
3. Disconnect the Closed Crankcase Ventilation (CCV) heater wire harness connector and detach the wire harness retainer.
4. Disconnect the clean air hose from the air cleaner body.



1 - Clean Air Hose Clamp
2 - Clean Air Hose

5. Loosen clean air hose clamp and remove the clean air hose from the turbocharger elbow.

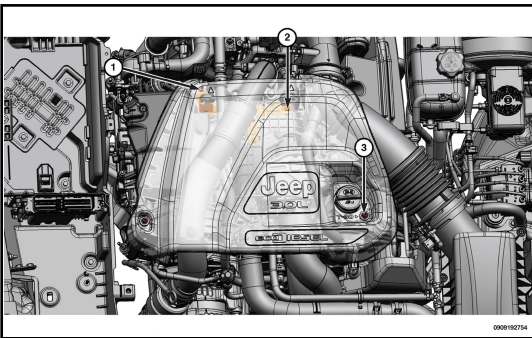
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

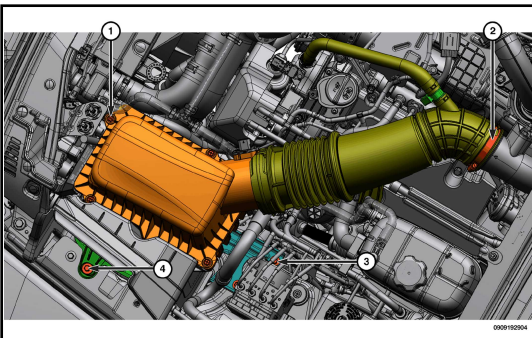
Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

INTAKE AIR

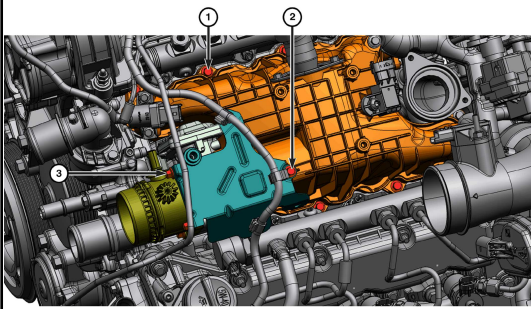


CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Engine Cover Bracket Nut	9 N.m (80 In. Lbs.)	-
2	Engine Cover Bracket Bolt	9 N.m (80 In. Lbs.)	-
3	Engine Cover bolts	4 N.m (35 In. Lbs.)	-



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Air Cleaner Cover Bolt	5 N.m (44 In. Lbs.)	-
2	Fresh Air Inlet Hose Clamp	4 N.m (35 In. Lbs.)	-
3	Air Cleaner Body Bracket Bolt	9 N.m (80 In. Lbs.)	-
4	Air Cleaner Body Bolt	5 N.m (44 In. Lbs.)	-
-	Air Cleaner Body Bracket Nut	9 N.m (80 In. Lbs.)	-

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Intake Manifold Bolts	12 N.m (9 Ft. Lbs.)	Tightening Sequence
2	Throttle Body Support Bracket to Intake Manifold	9 N.m (80 In. Lbs.)	-
3	Throttle / Airflow Control Valve Bolts	9 N.m (80 In. Lbs.)	-



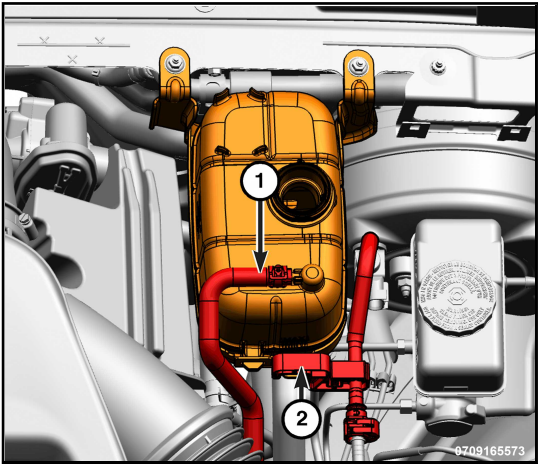
MANIFOLD, INTAKE

REMOVAL AND INSTALLATION

INTAKE MANIFOLD

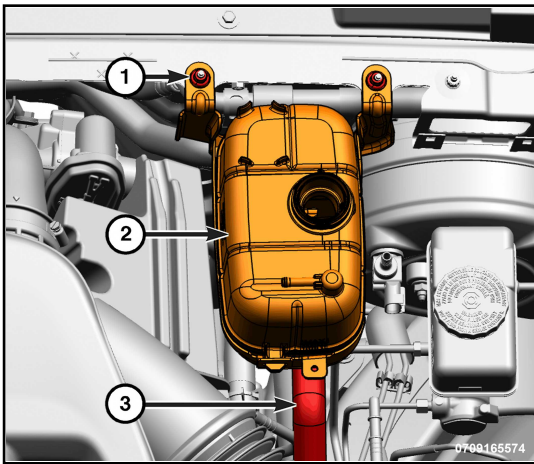
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#).



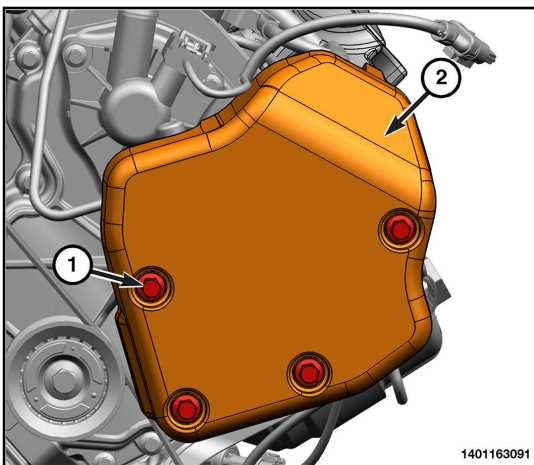
1 - Coolant Hose
2 - Vacuum Line

3. Detach the vacuum line from the coolant bottle bracket.



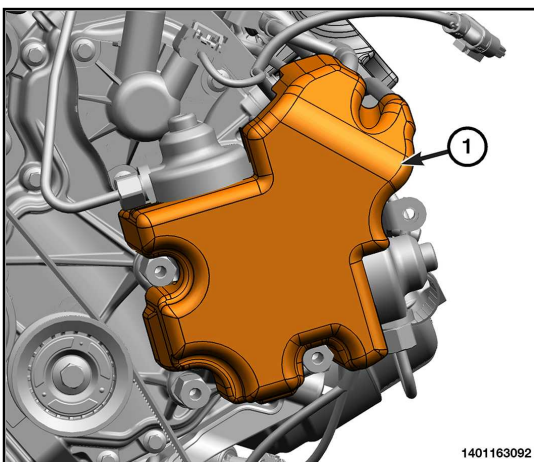
1 - Coolant Bottle Nuts
2 - Coolant Bottle
3 - Coolant Hose

4. Remove the coolant bottle nuts and position aside the coolant bottle.
5. Remove the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#).
6. Remove the LP differential pressure sensor. Refer to [SENSOR, DIFFERENTIAL PRESSURE, REMOVAL AND INSTALLATION](#).
7. Remove the left side fuel rail cover. Refer to [RAIL\(S\), FUEL, REMOVAL AND INSTALLATION](#).
8. Remove the turbocharger inlet elbow. Refer to [COOLER AND HOSES, CHARGE AIR, REMOVAL AND INSTALLATION](#).
9. Remove the right side Charge Air Cooler (CAC) hose. Refer to [COOLER AND HOSES, CHARGE AIR, REMOVAL AND INSTALLATION](#).
10. Remove the turbocharger outlet elbow. Refer to [COOLER AND HOSES, CHARGE AIR, REMOVAL AND INSTALLATION](#).
11. Remove the right side fuel rail cover. Refer to [RAIL\(S\), FUEL, REMOVAL AND INSTALLATION](#).
12. Remove the upper EGR tube. Refer to [TUBE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#).
13. Disconnect the boost pressure sensor wire harness connector.
14. Disconnect the swirl valve wire harness connector (right side).
15. Disconnect the fuel pressure sensor wire harness connector.
16. Remove the fuel rail cross-over tube. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).
17. Release the retaining lock and disconnect the Charge Air Cooler (CAC) hose from the EGR air flow control valve.



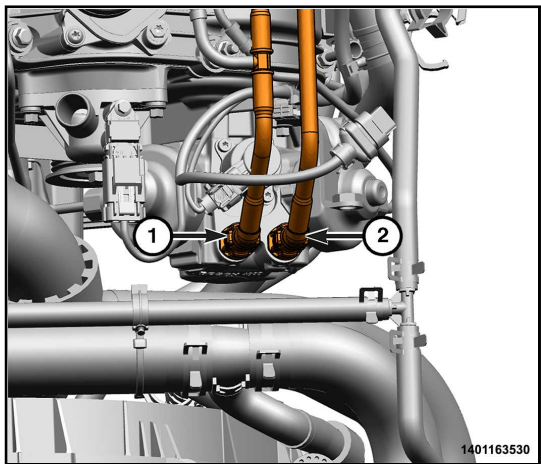
1 - Fuel Injection Pump Blocker Plate Bolts
2 - Fuel Injection Pump Blocker Plate

18. Remove the fuel injection pump blocker plate bolts and the fuel injection pump blocker plate.



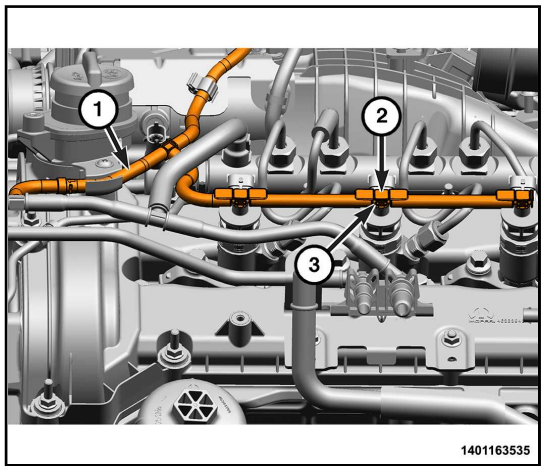
1 - Fuel Injection Pump Silencer

19. Remove the fuel injection pump silencer.



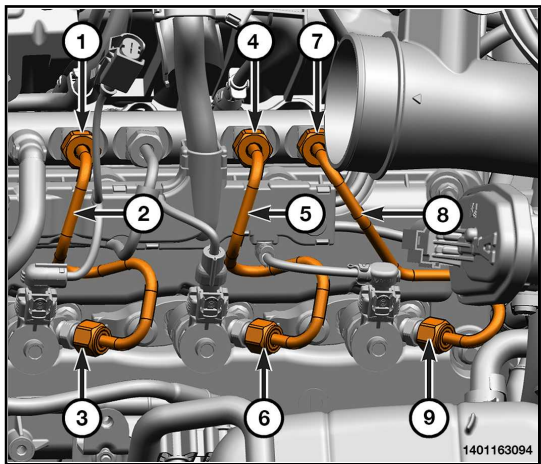
1 - Fuel Return Line
2 - Fuel Supply Line

20. Disconnect the fuel supply line and fuel return lines from the fuel injection pump.



1 - Retainer
2 - Locking Tab
3 - Fuel Return Line

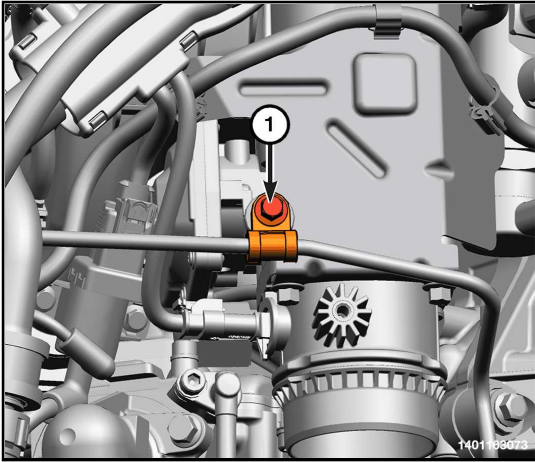
21. Lift up on the locking tab to unlock the lock.
 22. Disconnect the fuel return line by wiggling the hose free from the fuel injector.



1 - Union Nut
2 - Cylinder No. 4 Fuel Tube
3 - Union Nut
4 - Union Nut
5 - Cylinder No. 5 Fuel Tube
6 - Union Nut
7 - Union Nut
8 - Cylinder No. 6 Fuel Tube

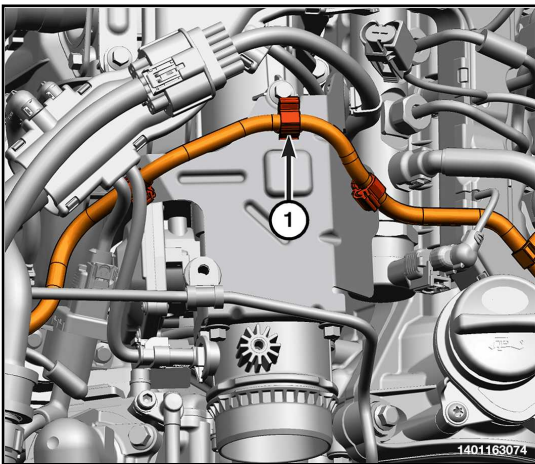
NOTE: Use a backing wrench on the fuel injector when unscrewing the union nut.

23. Unscrew the union nuts and remove cylinder No. 4 fuel tubes. Discard the fuel tubes.
24. Install protective caps onto the fuel injectors and fuel rail.
25. Unscrew the union nuts and remove cylinder No. 5 fuel tube. Discard the fuel tube.
26. Install protective caps onto the fuel injectors and fuel rail.
27. Unscrew the union nuts and remove cylinder No. 6 fuel tube. Discard the fuel tube.
28. Install protective caps onto the fuel injectors and fuel rail.



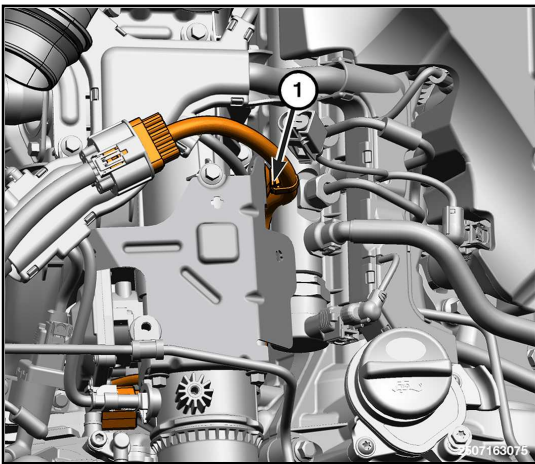
1 - Fuel Tube Bolt

29. Remove the fuel tube bolt.



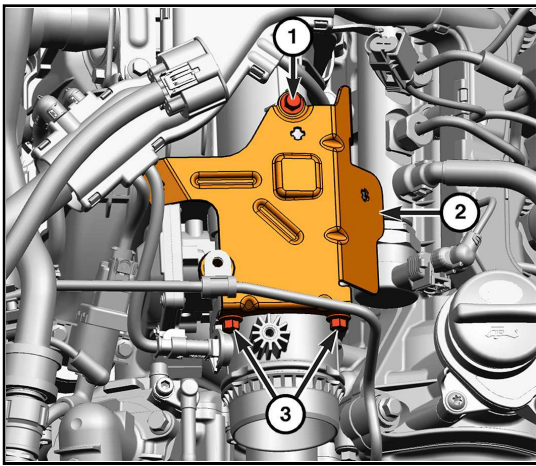
1 - Fuel Injector Fuel Return Hoses Retainers

30. Detach the fuel injector fuel return hoses retainers from fuel line support bracket.



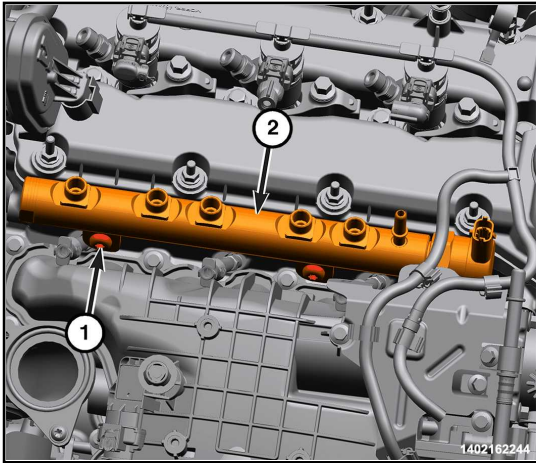
1 - Engine Wire Harness Retainer

31. Detach the engine wire harness retainer from the fuel line support bracket.
32. Disconnect the engine wire harness connector.



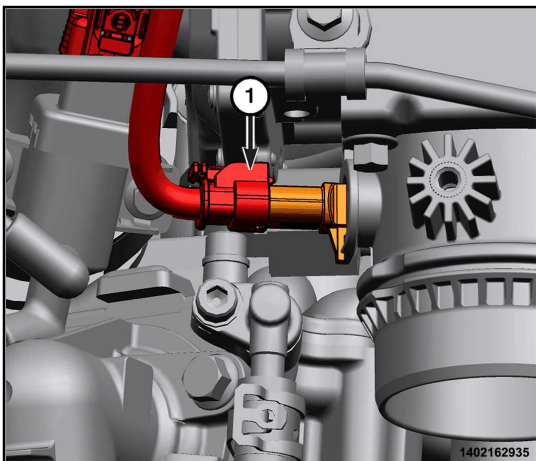
1 - Fuel Line Support Bracket Bolt
2 - Fuel Line Support Bracket
3 - Fuel Line Support Bracket Bolts

33. Remove the fuel line support bracket bolts and the fuel line support bracket.
34. Disconnect cylinder No. 6 glow plug wire harness connectors.
35. Disconnect the turbocharger actuator wire harness connectors.
36. Disconnect the fuel pressure wire harness connectors.



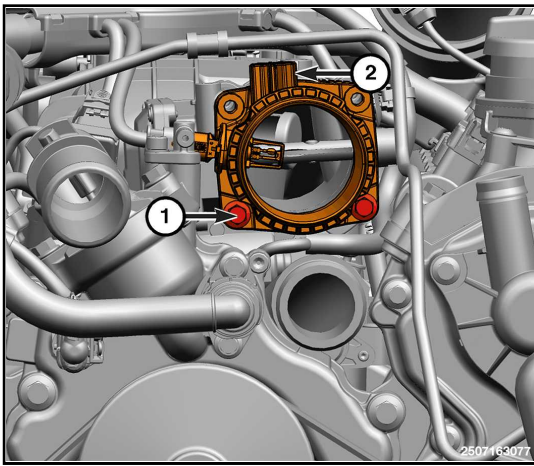
1 - Left Fuel Rail Bolts
2 - Left Fuel Rail

37. Using the (special tool #2025400090, Remover-Installer, Fuel Rail Bolt), remove the left fuel rail bolts and the left fuel rail.



1 - Outlet Air Temperature Sensor Wire Harness Connector
--

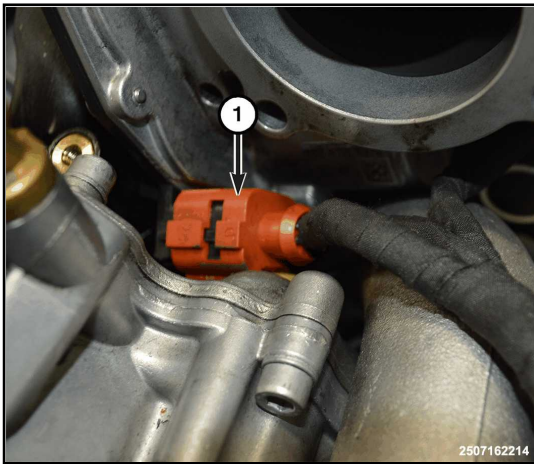
38. Disconnect the outlet air temperature sensor wire harness connector.



1 - Air Intake Housing Bolts

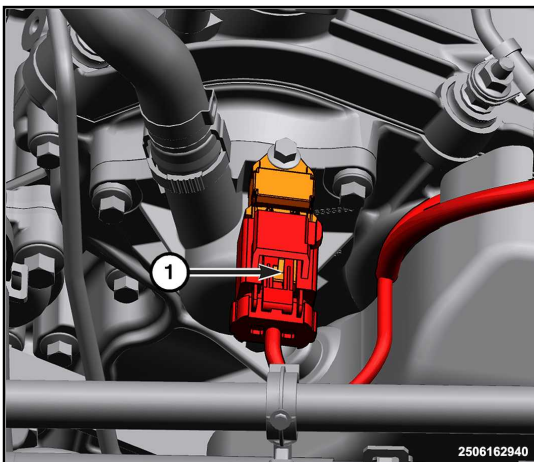
2 - Air Intake Housing

39. Remove the air intake housing bolts and the air intake housing.



1 - EGR Airflow Control Valve Wire Harness Connector

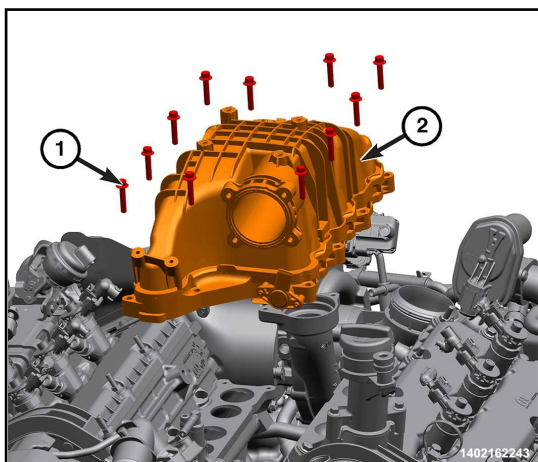
40. Reposition and lift up the EGR airflow control valve, disconnect the EGR airflow control valve wire harness connector and remove the EGR airflow control valve.
41. Remove the EGR bypass solenoid. Refer to [VACUUM ACTUATOR, EGR BYPASS, REMOVAL AND INSTALLATION](#).
42. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#).
43. Remove the left front wheelhouse splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#).
44. Disconnect the oil pressure sensor wire harness connector.
45. Disconnect the A/C compressor wire harness connectors and detach the wire harness retainers.
46. Remove the support and lower the vehicle.



1 - Oil Vapor Pressure Sensor Wire Harness Connector

47. Disconnect the oil vapor pressure sensor wire harness connector.
48. Disconnect the fuel quantity solenoid wire harness connector.
49. Detach the wire harness retainer from left front cylinder head cover.
50. Disconnect the LP EGR temperature sensor wire harness connectors and detach wire harness retainers.
51. Disconnect the LP EGR valve wire harness connector.
52. Disconnect the fuel quantity solenoid wire harness connector.

53. Disconnect the left side fuel injector wire harness connectors
54. Disconnect the cylinder No. 4 and No. 5 glow plugs wire harness connectors.
55. Disconnect the right side glow plugs wire harness connectors.
56. Disconnect the exhaust pressure sensor wire harness connector.
57. Remove the oil filler tube bolts and the oil filler tube.
58. Position the engine wire harness aside.



- | |
|---------------------------|
| 1 - Intake Manifold Bolts |
| 2 - Intake Manifold |

CAUTION: Do Not rest the intake manifold on the swirl valve actuator. Care must be taken when handling the swirl valve assembly.

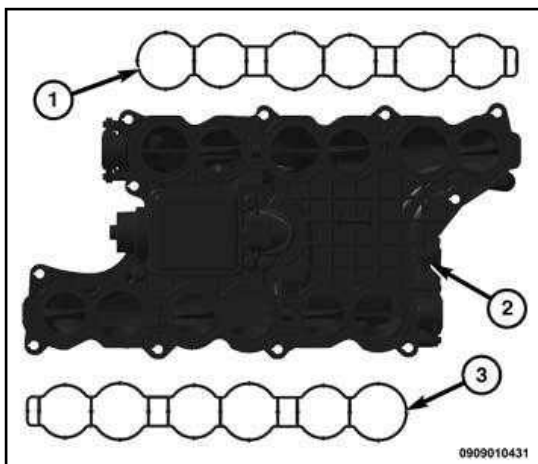
59. Remove the intake manifold bolts and the intake manifold.
60. Remove and discard the intake manifold gaskets.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

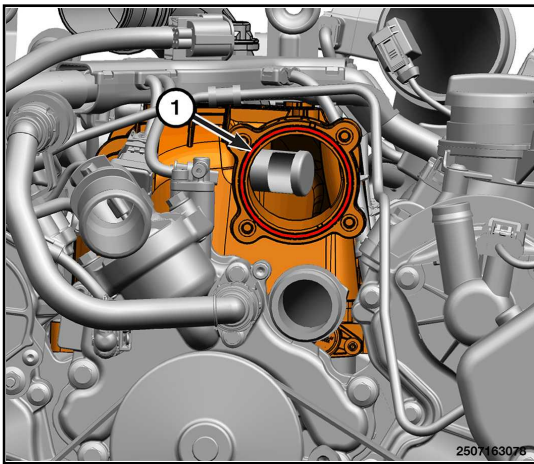
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should installation.

- Clean the gasket sealing surfaces. Refer to the appropriate information .



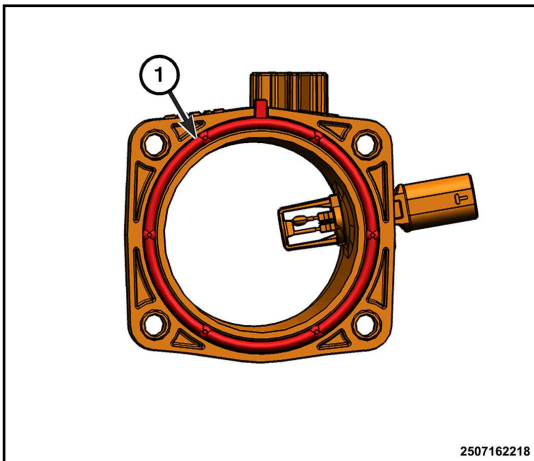
- | |
|----------------------------|
| 1 - Intake Manifold Gasket |
| 2 - Intake Manifold |
| 3 - Intake Manifold Gasket |

- Install a **NEW** intake manifold gaskets.
- Install the intake manifold and using the tightening sequence shown in the torque table tighten the intake manifold bolts to proper torque specifications.



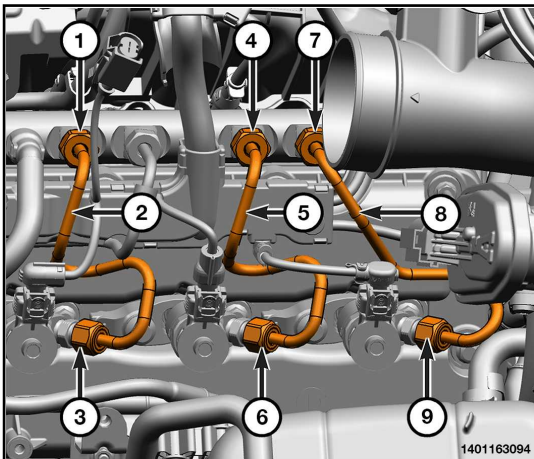
1 - O-ring

- Install a **NEW** O-ring to the intake manifold.



1 - O-ring

- Install a **NEW** O-ring to the air inlet housing.
- Remove the protective caps from the fuel injectors and fuel rail.

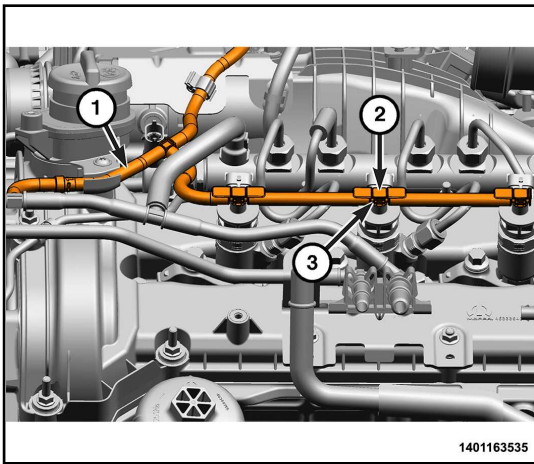


1 - Union Nut
2 - Cylinder No. 4 Fuel Tube
3 - Union Nut
4 - Union Nut
5 - Cylinder No. 5 Fuel Tube
6 - Union Nut
7 - Union Nut
8 - Cylinder No. 6 Fuel Tube
9 - Union Nut

NOTE: The fuel tubes are a one time only use and must be replaced anytime they have been removed.

NOTE: Use a backing wrench on the fuel injector when tightening the union nut.

- Install the **NEW** fuel tube and using the tightening procedure shown in the torque table tighten union nuts to the proper torque specifications.



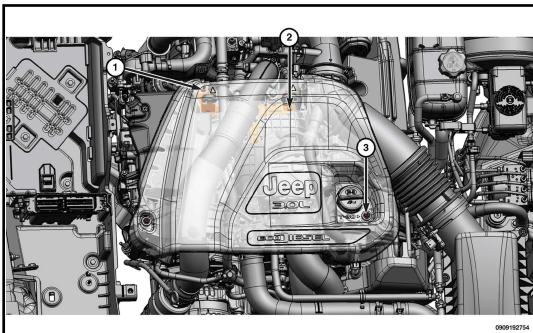
1 - Retainer
2 - Locking Tab
3 - Fuel Return Line

NOTE: Do not use any type of lubrication when installing the fuel injector return line.

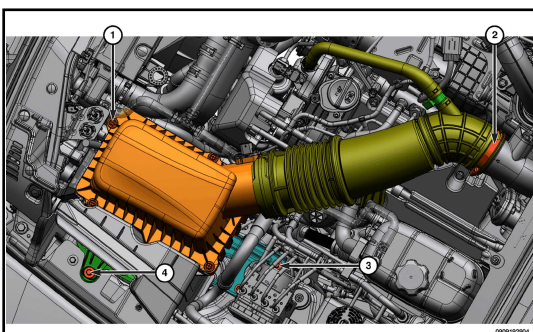
- Install the fuel injector return line and **be sure it is fully seated.**
- Push down on the lock tab to lock in place.
- Install the coolant bottle for and tighten the bolts to the proper torque specifications.
- Start the engine, allow to warm, turn the engine off and inspect for leaks.

TORQUE SPECIFICATIONS

INTAKE AIR



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Engine Cover Bracket Nut	9 N.m (80 In. Lbs.)	-
2	Engine Cover Bracket Bolt	9 N.m (80 In. Lbs.)	-
3	Engine Cover bolts	4 N.m (35 In. Lbs.)	-



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Air Cleaner Cover Bolt	5 N.m (44 In. Lbs.)	-
2	Fresh Air Inlet Hose Clamp	4 N.m (35 In. Lbs.)	-
3	Air Cleaner Body Bracket Bolt	9 N.m (80 In. Lbs.)	-
4	Air Cleaner Body Bolt	5 N.m (44 In. Lbs.)	-
-	Air Cleaner Body Bracket Nut	9 N.m (80 In. Lbs.)	-

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Intake Manifold Bolts	12 N.m (9 Ft. Lbs.)	Tightening Sequence
2	Throttle Body Support Bracket to Intake Manifold	9 N.m (80 In. Lbs.)	-
3	Throttle / Airflow Control Valve Bolts	9 N.m (80 In. Lbs.)	-



LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-
1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts 7-13 one at a time 90B° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90B° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence NOTE: Bolts in the following positions are stud bolts (4, 6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure: 1. Tighten the lower oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts one at a time 90B° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence
7	Oil Cooler Bolts	30 N.m (22 Ft. Lbs.)	-
-	Dipstick Tube Bolt (head)	11 N.m (8 Ft. Lbs.)	-
-	Dipstick Tube Bolt (sump)	11 N.m (8 Ft. Lbs.)	-
-	Windage Tray	11 N.m (8 Ft. Lbs.)	-

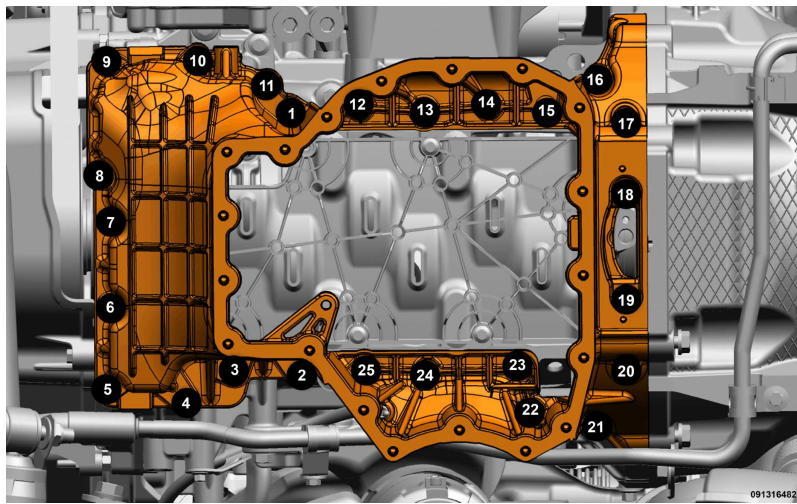
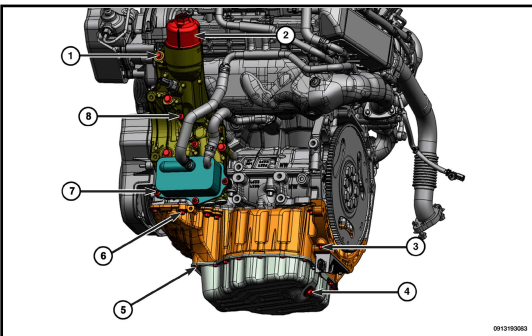
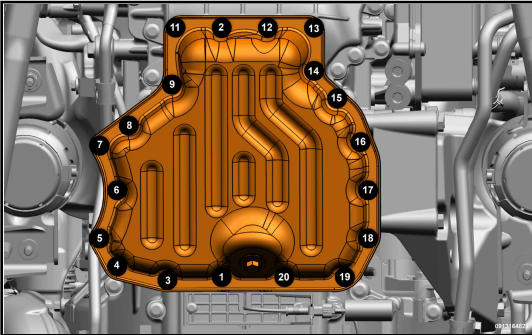
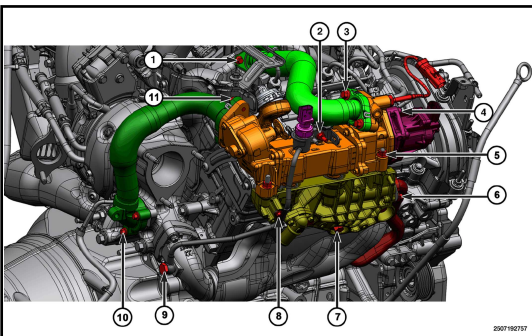


Fig. 18: Upper Oil Pan Bolts Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC



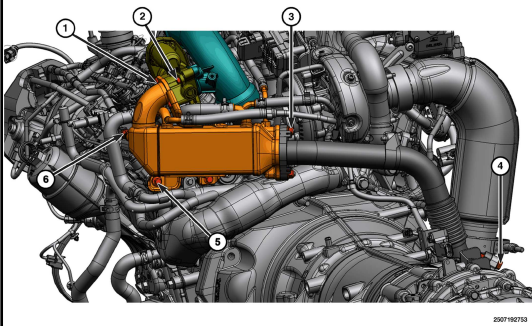
EGR SYSTEM



HIGH PRESSURE EGR

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-

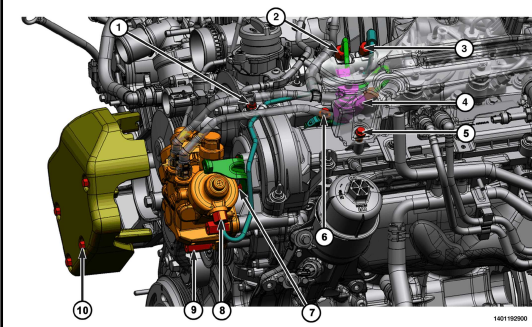
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



LOW PRESSURE EGR

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

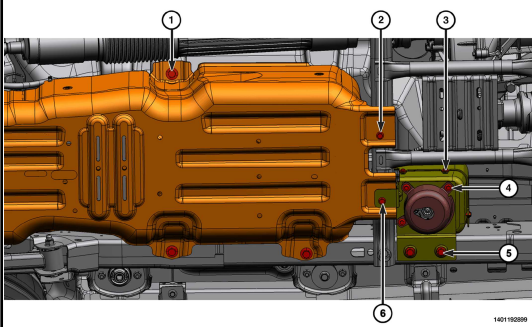
FUEL SYSTEM



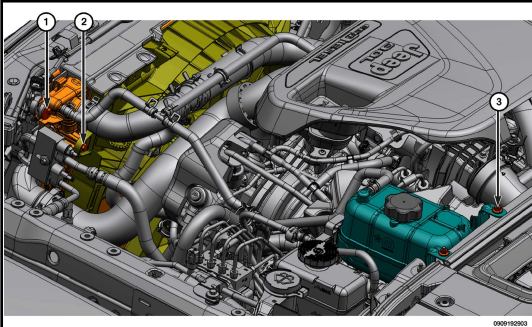
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75B°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75B°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75B°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75B°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90B° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
B	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-

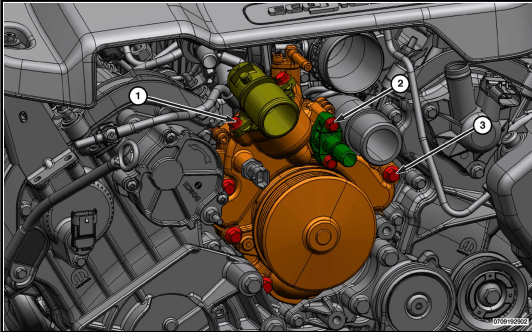
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



COOLING SYSTEM - 3.0L DIESEL

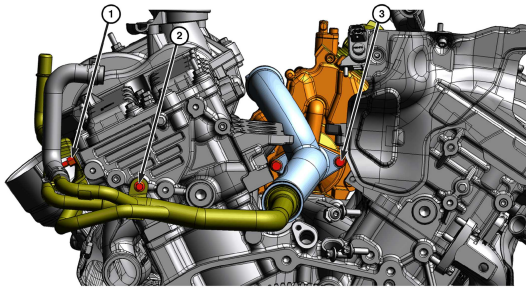


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90B° and then tighten to 32 N.m (24 Ft. Lbs.).	-
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-



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2021 ENGINE

3.0L Engine (Service Information) (2 Of 3) - Gladiator [EXJ]

CYLINDER HEAD

DESCRIPTION

CAMSHAFT

DESCRIPTION

- The camshafts are multiple-piece components with six machined lobes that are mounted to a hollow shaft with an interference fit. The cam lobes are induction hardened. Each camshaft has four bearing journals except for the right-bank intake camshaft. Due to the longer length needed to accommodate the centrifugal oil separator, the right-bank intake camshaft has five bearing journals. The camshaft journals have the same diameter and are supplied with oil pressure through lubrication passages in the cylinder head journals.

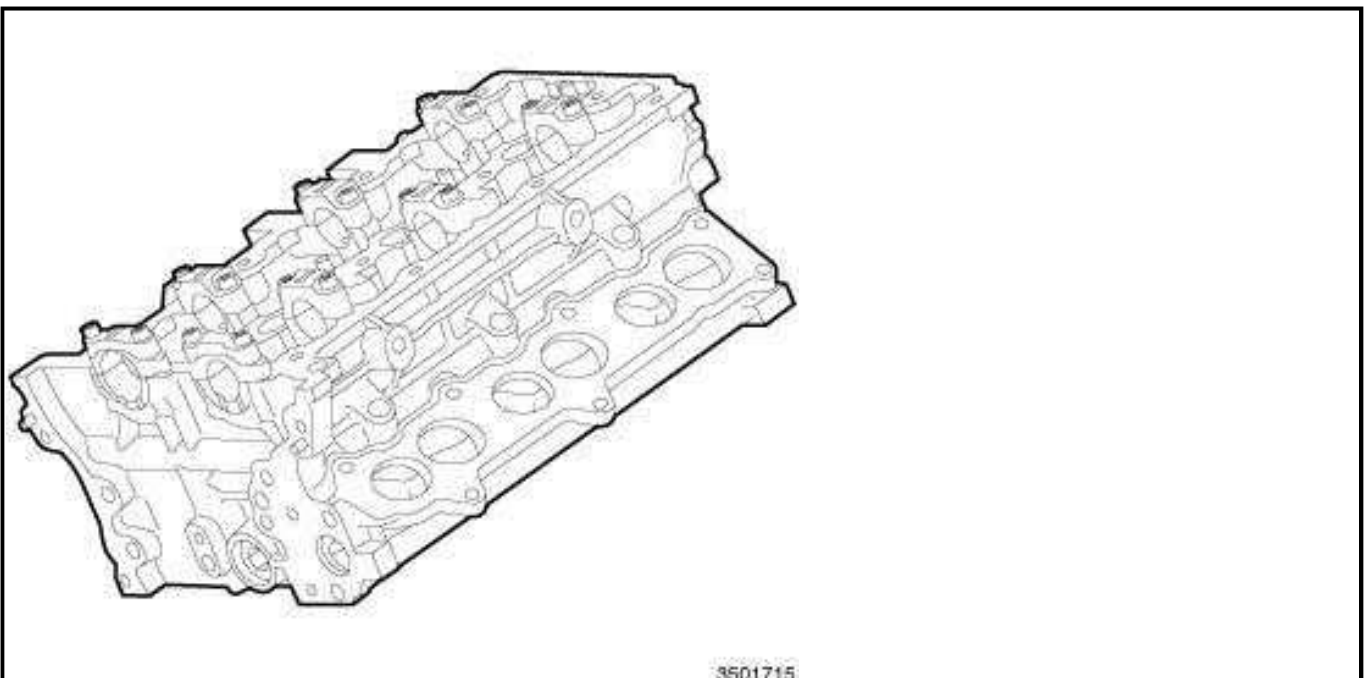
OPERATION

- Each cylinder has two intake and two exhaust valves, and one glow plug. Valve lash is controlled by hydraulic lifter/roller finger followers inside the cylinder head, in bores under the camshafts. The finger followers transfer the camshaft lobe movement into vertical valve movement. The valve moves by the lobe of the camshaft pressing down on the finger follower roller.
- The finger followers are located on top of the hydraulic lifters and the valves. The finger followers are not held rigidly into position; instead, they are held in position by resting on top of the valve and the hydraulic lifter pivoting ball.

WARNING: When the hydraulic lash adjusters are removed from the engine, they must be stored upright and in clean conditions. Install the finger followers and hydraulic lifters in the same location as removed.

WARNING: Replacement of the camshaft will also require replacement of the finger followers and hydraulic lifters.

CYLINDER HEAD



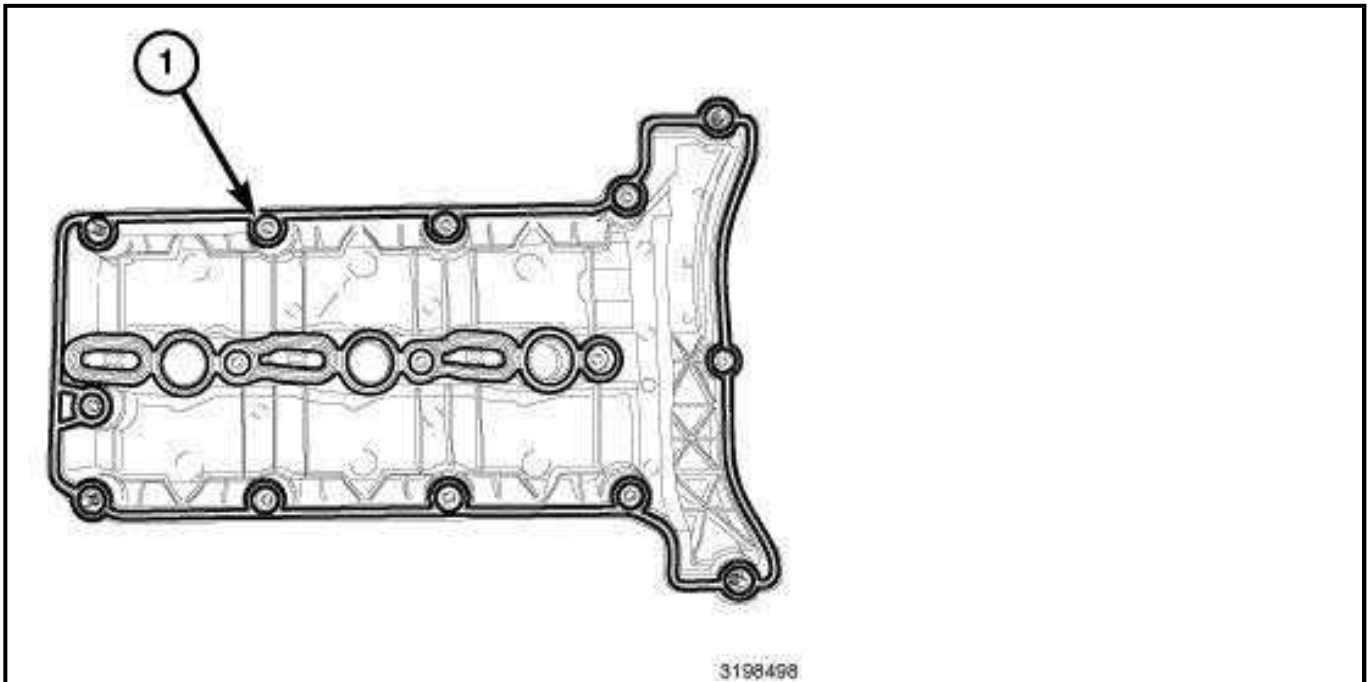
The cylinder heads on the 3.0L V-6 are of a cross-flow design and have the following features:

- High-Strength Cast Aluminum Alloy Construction.
- Four Valves per Cylinder.
- Roller Finger Followers/Lifter Assemblies.
- Pressed-in Valve Guides and Valve Seats.

NOTE: The valve seats and valve guides are not serviceable.

The cylinder head can not be resurfaced. The cylinder head uses a Multi-layered Steel gasket for sealing. Anytime the cylinder head is removed a new gasket and bolts must be used.

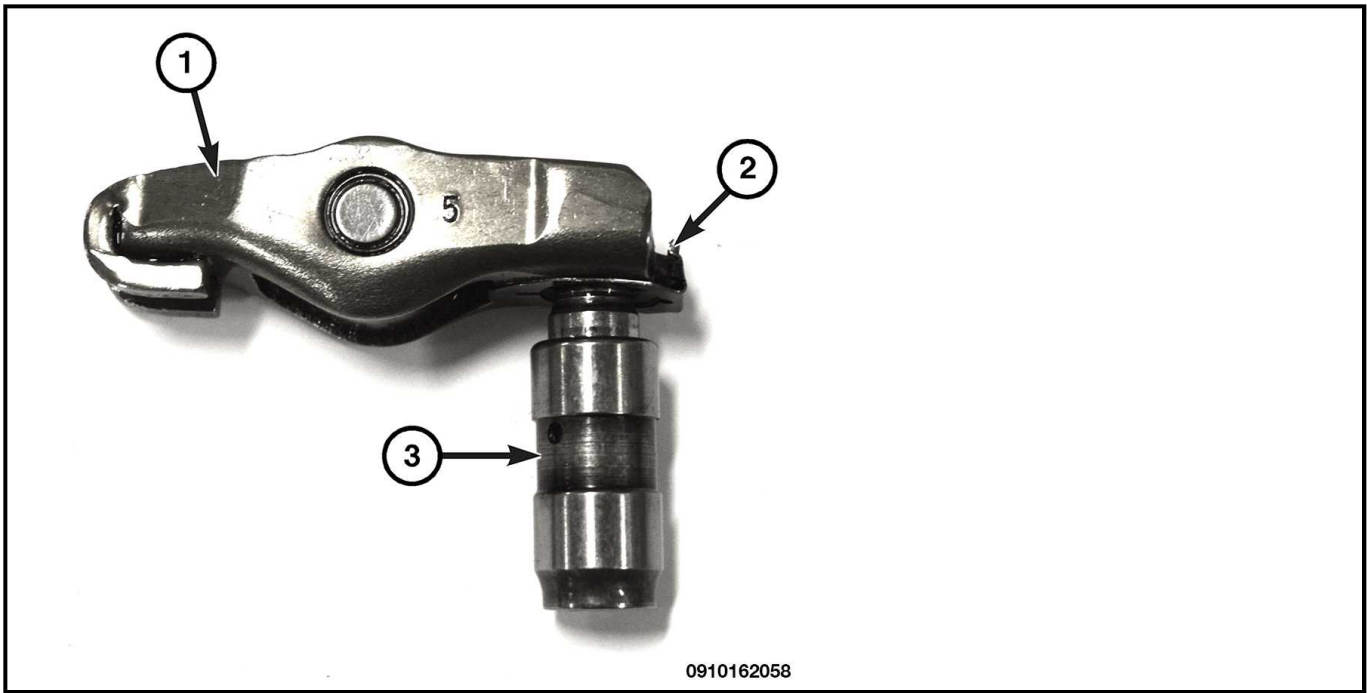
CYLINDER HEAD COVER



1 - Cylinder Head Cover Gasket

- The 3.0L cylinder head cover is made of an injection molded composite and is used to cover the camshafts, lifters and followers.
- The cylinder head cover gasket is not serviceable, if the gasket is found to be defective then a new cylinder head cover must be installed.

LIFTER

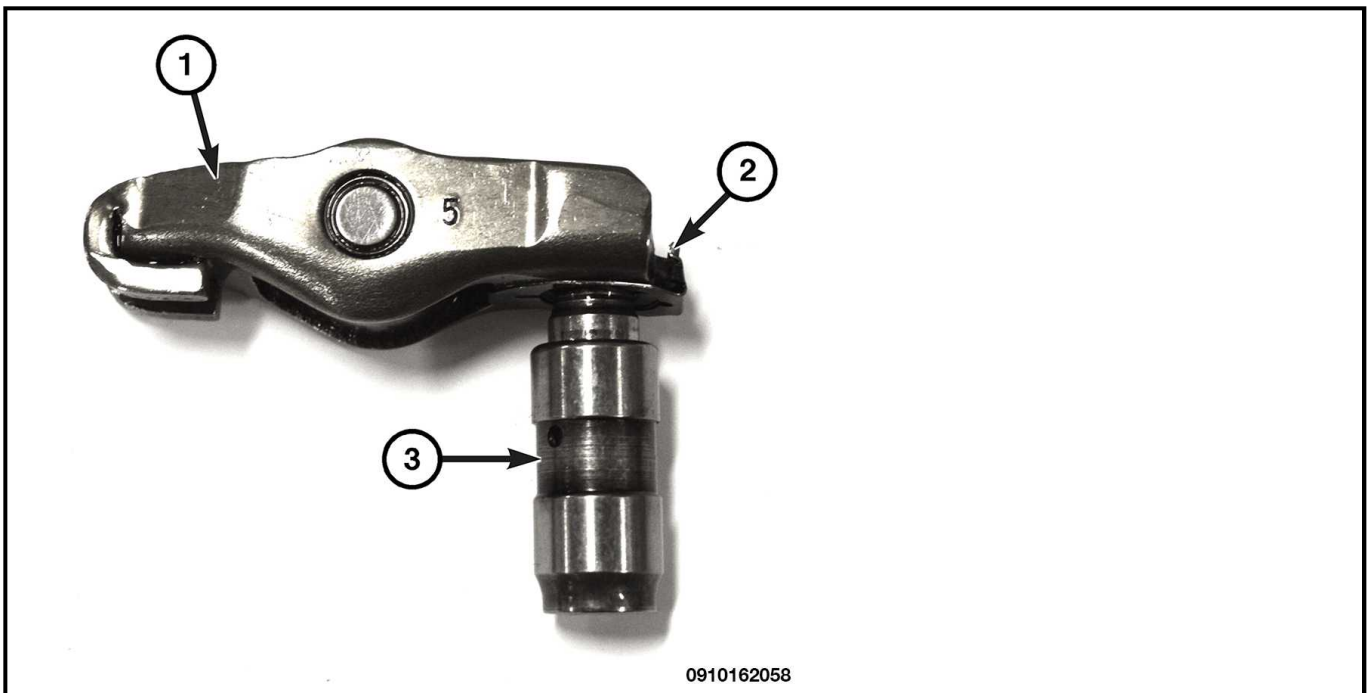


1 - Rocker Arm
2 - Spring Clip
3 - Hydraulic Lifters

- Valve lash is controlled by hydraulic lifters located inside the cylinder head, in lifter bores below the camshafts.

ROCKER ARM

DESCRIPTION



- The rocker arms are located on the top of the hydraulic lifters and the valves. The rocker arms are held in position by resting on top of the valve and the hydraulic lifter pivoting ball. There is a spring clip that holds the rocker arm to the hydraulic lifters pivoting ball.

OPERATION

- The rocker arms are used as a link between the camshaft and valves. As the camshaft rotates, the lobes of the camshafts apply downward pressure on the rocker arms. This pressure is then transmitted to the valves which causes the valves to open.

STANDARD PROCEDURE

VALVE SERVICE

This procedure is done with the cylinder head removed from the engine block. Refer to cylinder head removal/installation procedure for servicing the appropriate cylinder head. Refer to [CYLINDER HEAD ASSEMBLY, REMOVAL AND INSTALLATION](#). Cylinder head disassembly. Refer to [CYLINDER HEAD ASSEMBLY, DISASSEMBLY AND ASSEMBLY](#).

VALVE CLEANING

1. Clean all carbon deposits from the combustion chambers, valve ports, valve stems, valve stem guides and cylinder head.
2. Use a smooth stone or a jewelers file to remove any burrs on the top of the valve stem, especially around the groove for the locks.
3. Clean all residue and gasket material from the engine cylinder head machined gasket surface.

VALVE SEAT REFACING

1. Install a pilot of the correct size in the valve guide bore. Reface the valve seat to the specified angle with a good dressing stone. Remove only enough metal to provide a smooth finish.
2. Use tapered stones to obtain the specified seat width when required.

VALVE GUIDES

VALVE GUIDE STEM CLEARANCE THRESHOLDS		
B	Minimum	Maximum
Intake Valve Guide Stem Clearance	0.382 mm (0.150 in.)	0.6 mm (0.023 in.)
Exhaust Valve Guide Stem Clearance	0.382 mm (0.150 in.)	0.6 mm (0.023 in.)

VALVE STEM-TO-GUIDE CLEARANCE MEASUREMENT

1. Measure and record internal diameter of valve guides. Valve guide internal diameter is 6.0 to 6.012 mm (0.2362 to 0.2366 in.).
2. Measure valve stems and record diameters. Intake valve stem diameter 5 mm (0.1968 in.). Exhaust valve stem diameter 5 mm (0.1968 in.).
3. Subtract diameter of valve stem from internal diameter of its respective valve guide to obtain valve stem clearance in valve guide. Clearance of inlet valve stem in valve guide is 0.03 to 0.06 mm (.0011 to .0023 in). Clearance of exhaust valve stem in valve guide is 0.04 to 0.07 mm (.0015 to .0027 in).
4. If valve stem clearance in valve guide exceeds tolerances, new valve guides must be installed.

CLEANING

- Thoroughly clean the engine cylinder head and cylinder block mating surfaces. Clean the intake and exhaust manifold and engine cylinder head mating surfaces. Clean the injector bores. Remove all gasket material and carbon. Refer to [STANDARD PROCEDURE](#).
- Check to ensure that no fuel injector washer seals are left in the injector bores.
- Check to ensure that no coolant or foreign material has fallen into the tappet bore area.
- Remove the carbon deposits from the combustion chambers and top of the pistons.

INSPECTION

CYLINDER HEAD

If the cylinder head has been removed due to an engine overheating concern or a head gasket leak it is very important to check for the cylinder head surface being warped.

Use a straight edge and feeler gauge to check the cylinder head and engine block mating surfaces for warped spots.

The cylinder head thickness is $133 \text{ B} \pm 0.06 \text{ mm}$ ($5.2362 \text{ B} \pm 0.0023 \text{ in.}$) and the cylinder head flatness tolerance is 0.1 mm (0.0039 in.).

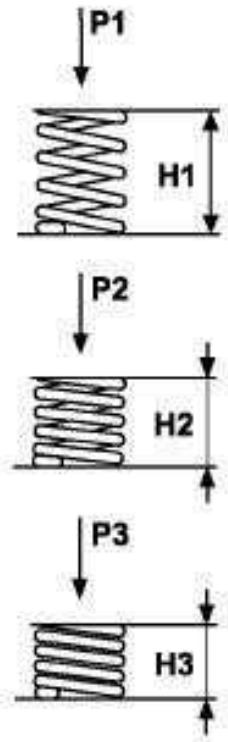
If the cylinder head is out of specification, then the cylinder head **must be replaced** .

LIFTER



1. Clean each lifter assembly in cleaning solvent to remove all varnish and sludge deposits. Inspect for indications of scuffing on the side and base of each lifter body.
2. Squeeze the lifter and be sure that the spring returns the lifter to its correct position.
3. Inspect the rocker arm roller for damage or excessive wear.
4. Replace any worn or damaged components.

VALVE SPRING



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DESCRIPTION	LOAD Kg (ft. lbs.)	HEIGHT mm	STATE
P1			
H1	0 Kg (0 ft. lbs.)	44.1 mm (1.736 in.)	Free Length
P2			
H2	24 Kg (53 ft. lbs.)	34 mm (1.338 in.)	Closed Valve
P3			
H3	46 Kg (101 ft. lbs.)	25.5 mm (1.003 in.)	Valve Open

1. Inspect for cracks in the combustion chambers and valve ports.
2. Inspect for cracks on the exhaust seat.
3. Inspect for cracks in the gasket surface at each coolant passage.
4. Inspect valves for burned, cracked or warped heads.
5. Inspect for scuffed or bent valve stems.
6. Replace valves displaying any damage.
7. Use the above table for check valve spring height.

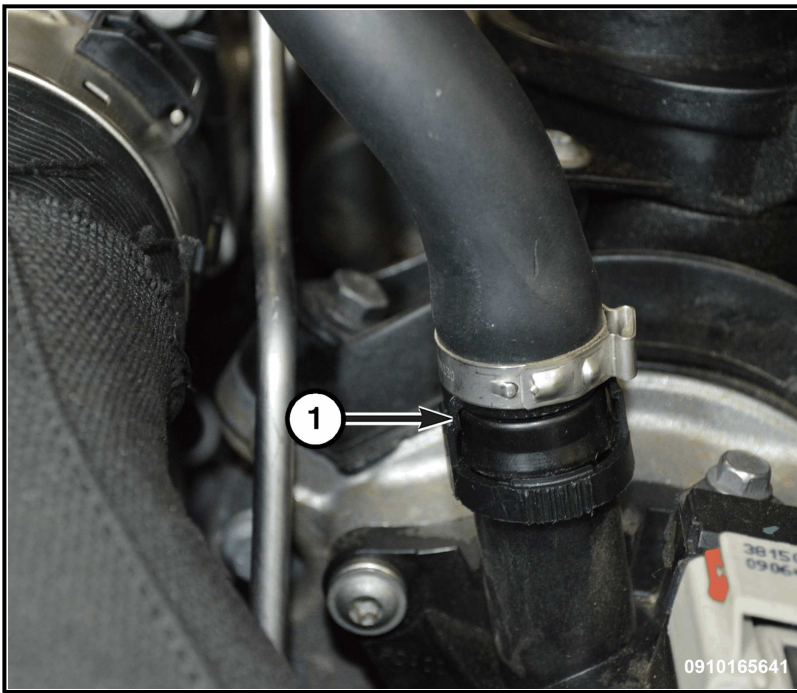
SEAL(S), CAMSHAFT

REMOVAL AND INSTALLATION

CAMSHAFT SEAL

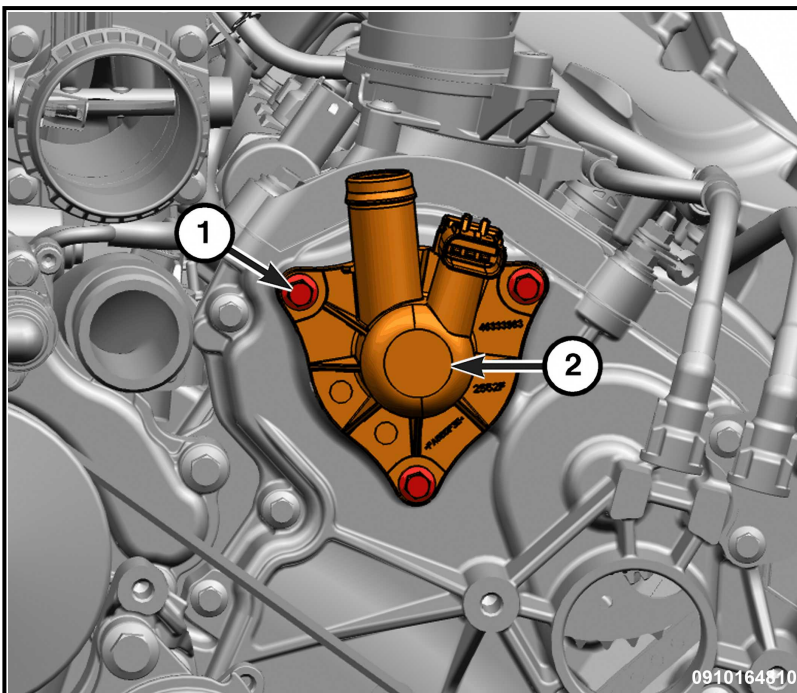
REMOVAL

1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



1 - Closed Crankcase Ventilation Hose

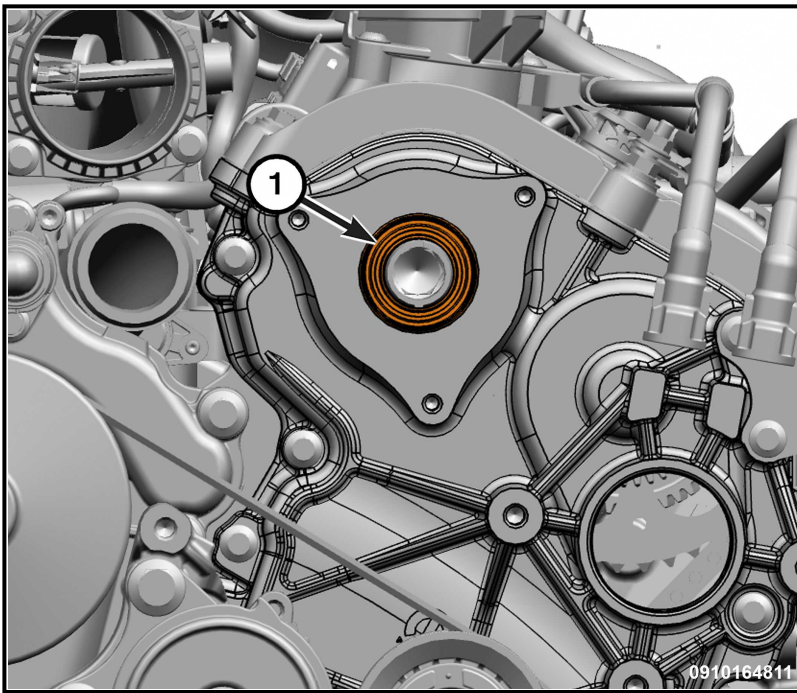
2. Disconnect the Closed Crankcase Ventilation (CCV) hose from the engine oil separator cover.



1 - Engine Oil Separator Cover Bolts

2 - Engine Oil Separator Cover

3. Remove the engine oil separator cover bolts and the engine oil separator cover.
4. Remove and discard the gasket.



1 - Camshaft Oil Seal

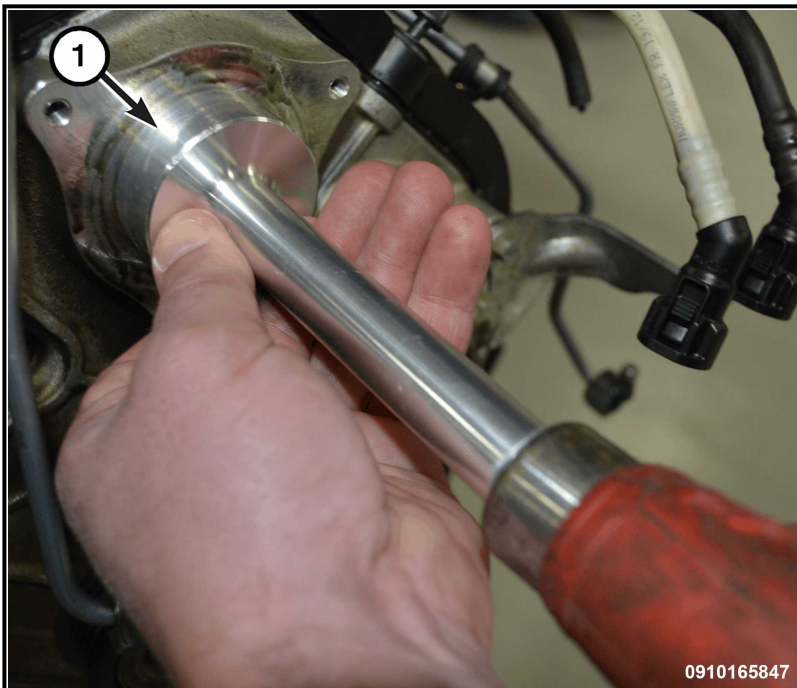
5. Using a suitable tool remove the camshaft oil seal.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

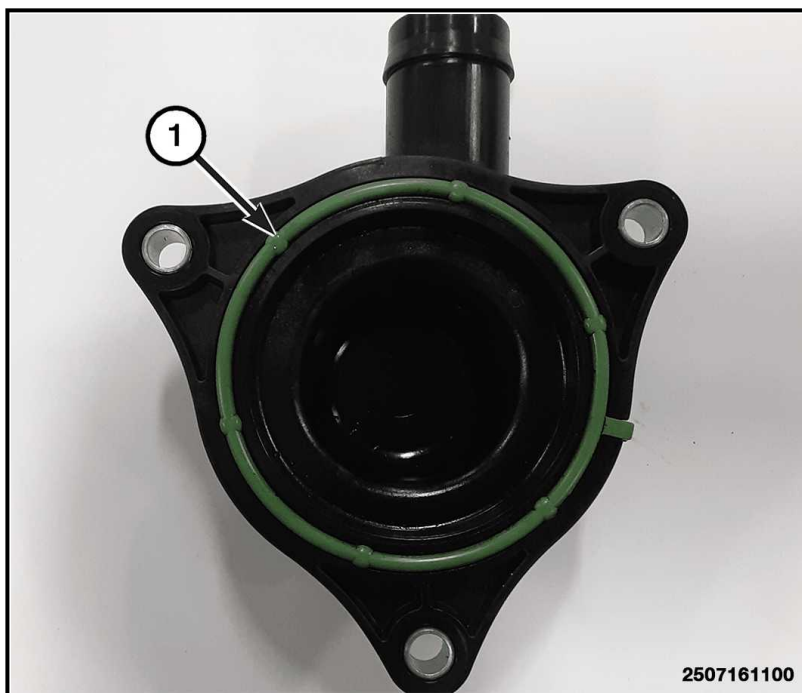
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean all gasket sealing mating surfaces.



1 - Front Camshaft Seal Installer Tool

- Using the (special tool #2072900090, Installer, Front Camshaft Seal), install the camshaft seal to left upper timing cover.

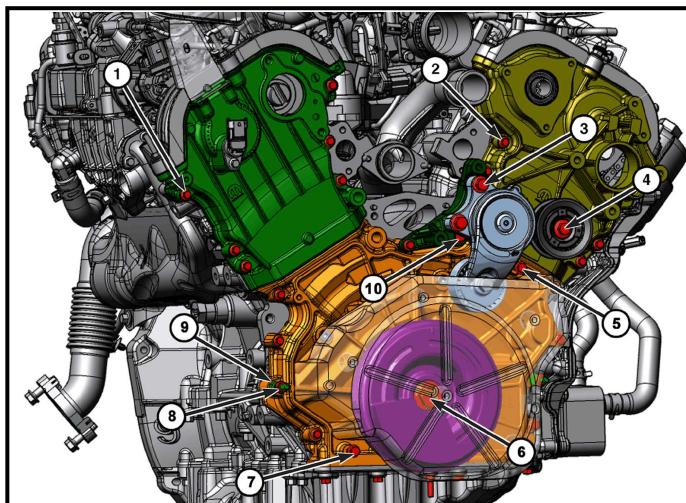


1 - O-ring

- Install a **NEW** O-ring to the engine oil separator cover.

TORQUE SPECIFICATIONS

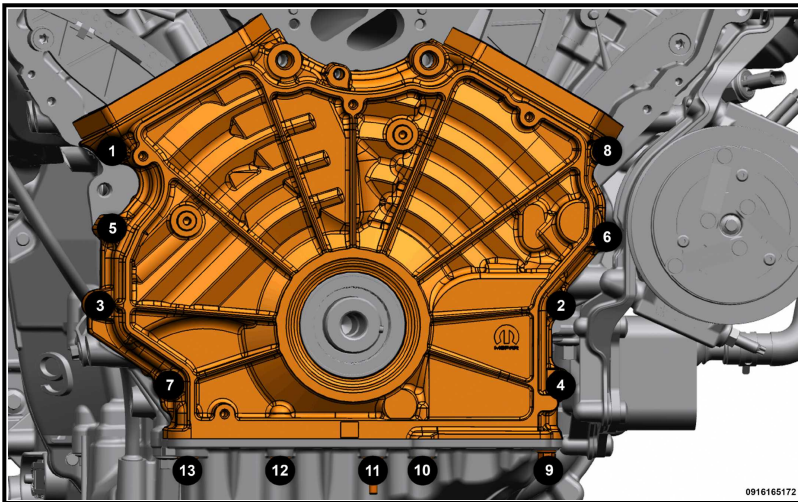
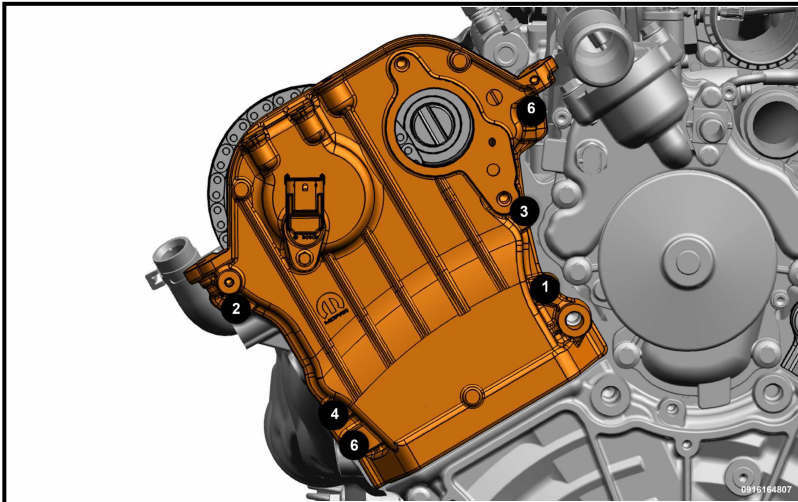
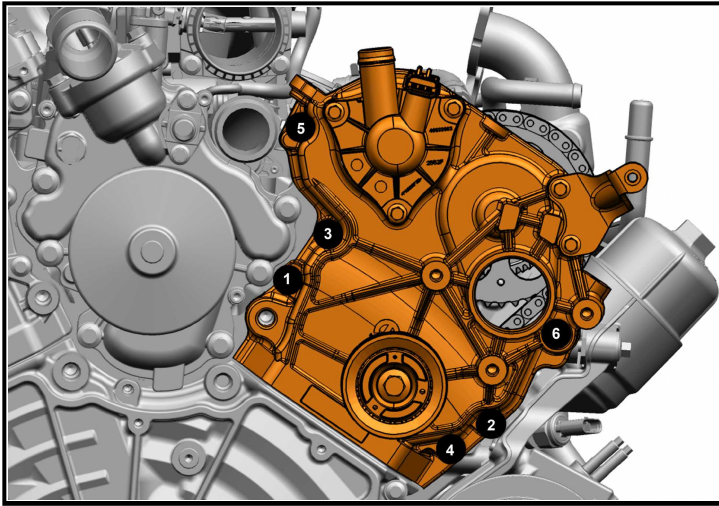
FRONT ENGINE



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CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1, 2	Timing Chain Cover Bolts	Torque Procedure: 1. Tighten the M6 bolts finger tight. 2. Tighten the M6 bolts to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and retighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence
3	Belt Tensioner Pulley Bolt	45 N.m (33 Ft. Lbs.)	-

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
4	Idler Pulley Bolts	32 N.m (24 Ft. Lbs.)	-
5, 9	Timing Chain Cover Bolts (lower)	Torque Procedure: 1. Tighten the lower timing cover bolts (1 and 3) finger tight. 2. Tighten the M6 bolts (1 - 8) to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and tighten to 15 N.m (Ft. Lbs.). 4. Install the oil pan-to-lower chain cover bolts and tighten (9 - 13) to 15 N.m (11 Ft. Lbs.). 5. Loosen each bolt one at a time 90B° and tighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence Position 2 and 3 are double ended studs.
6	Vibration Damper Bolt	100 N.m (74 Ft. Lbs.) + 125B°	-
7	Vibration Damper Cover Bolts	10 N.m (7 Ft. Lbs.)	-
8	Vibration Damper Cover Nut	9 N.m (80 In. Lbs.)	-
10	Belt Tensioner to Mounting Bracket - M10 Bolt	45 N.m (33 Ft. Lbs.)	-
11	Belt Tensioner to Mounting Bracket - M6 Bolt	11 N.m (8 Ft. Lbs.)	-
-	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Oil Breather/Camshaft Seal Housing Bolts	14 N.m (10 Ft. Lbs.)	-
-	Vacuum Pump Bolt	30 N.m (22 Ft. Lbs.)	-



CAMSHAFT, ENGINE

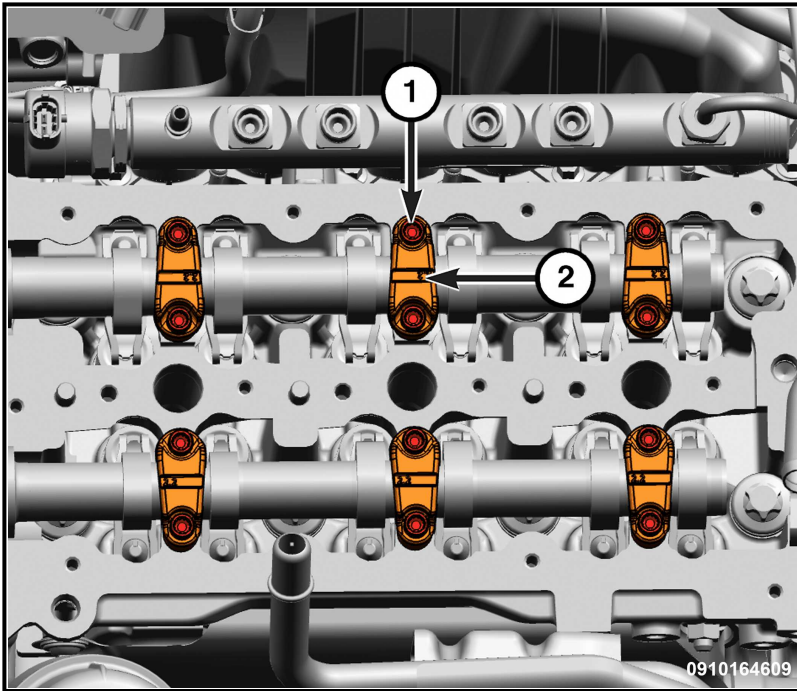
REMOVAL AND INSTALLATION

LEFT CAMSHAFTS

REMOVAL

1. Remove the left timing chain and sprockets. Refer to [CHAIN AND SPROCKETS, TIMING, REMOVAL AND INSTALLATION](#).
2. Remove the bolts and the left (special tool #VM.10338A-2, Timing Tool, Camshaft (Left)).
3. **Check the camshafts end play using** (special tool #C-3339A, Set, Dial Indicator). **End play should be between 0.1 mm - 0.3 mm (0.003 in. - 0.011 in.). If the camshaft endplay is not within specification,**

replace the cylinder head.

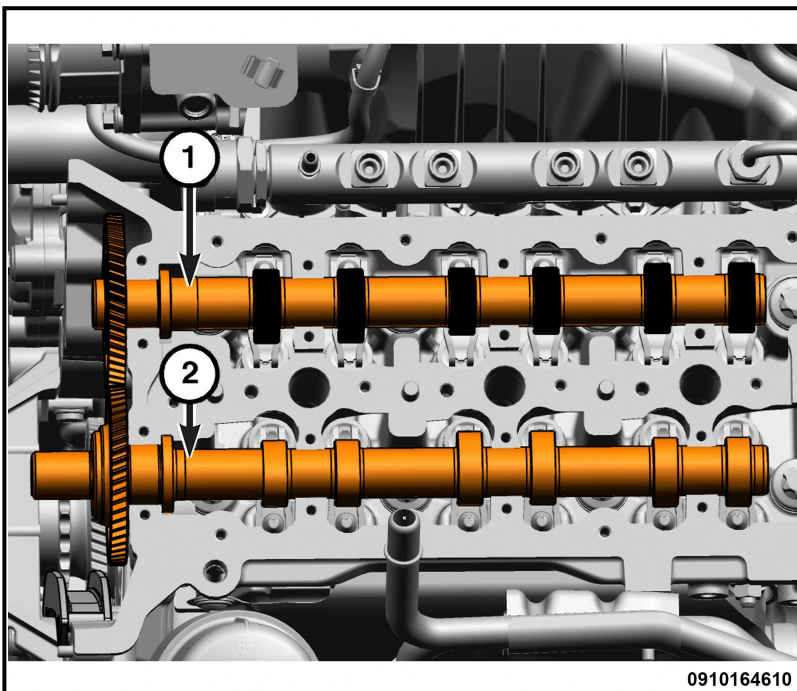


1 - Bearing Cap Bolts

2 - Bearing Caps

NOTE: Make a reference in the order the camshaft bearing caps were removed.

4. Remove the bearing cap bolts and the intake and exhaust camshaft bearing caps.



1 - Intake Camshaft

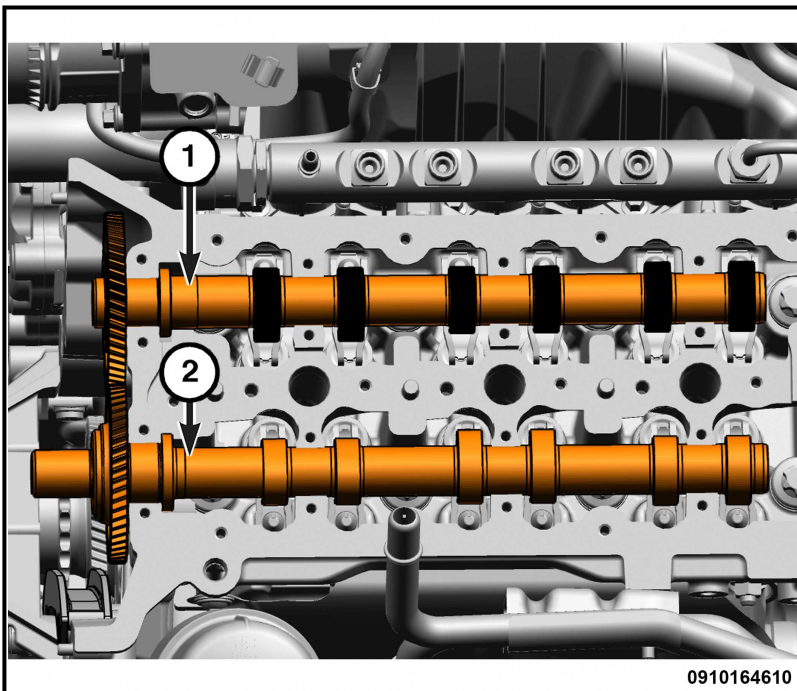
2 - Exhaust Camshaft

5. Remove the left side intake camshaft and exhaust camshaft.

INSTALLATION

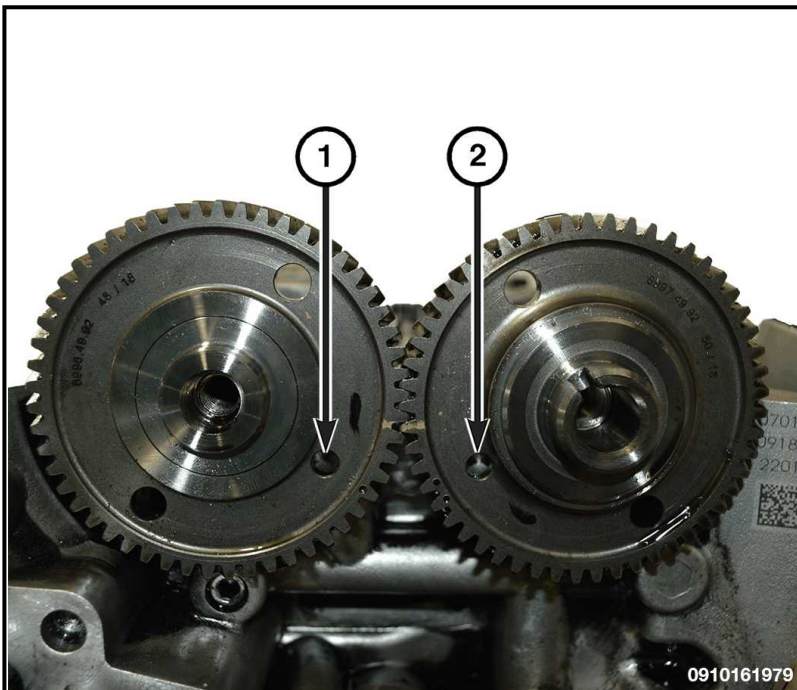
During installation, torque the fasteners to the specifications in the torque table(s) below.

1. Clean all gasket sealing and mating surfaces.
2. Lubricate camshafts with MoparB® Engine Oil Supplement, or equivalent. Refer to [CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS](#).



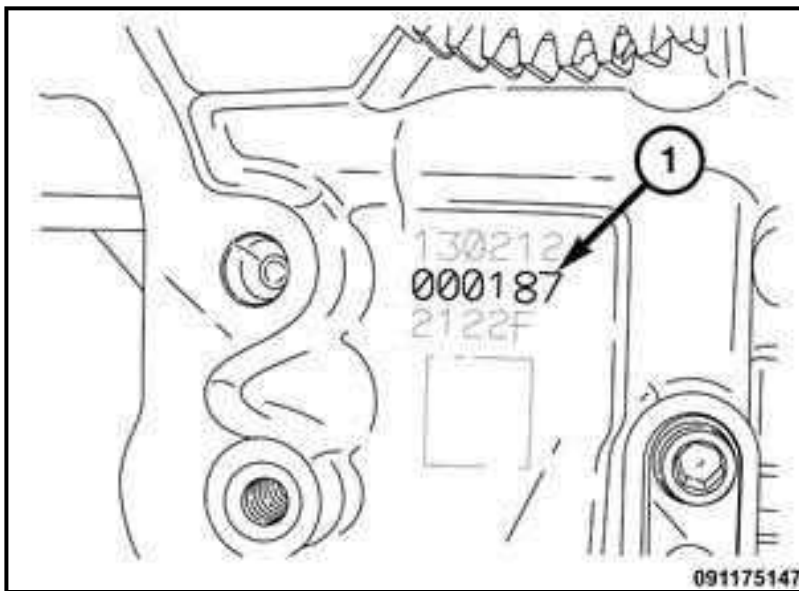
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|----------------------|
| 1 - Intake Camshaft |
| 2 - Exhaust Camshaft |

3. Carefully install the left side intake camshaft and exhaust camshaft to cylinder head journals.



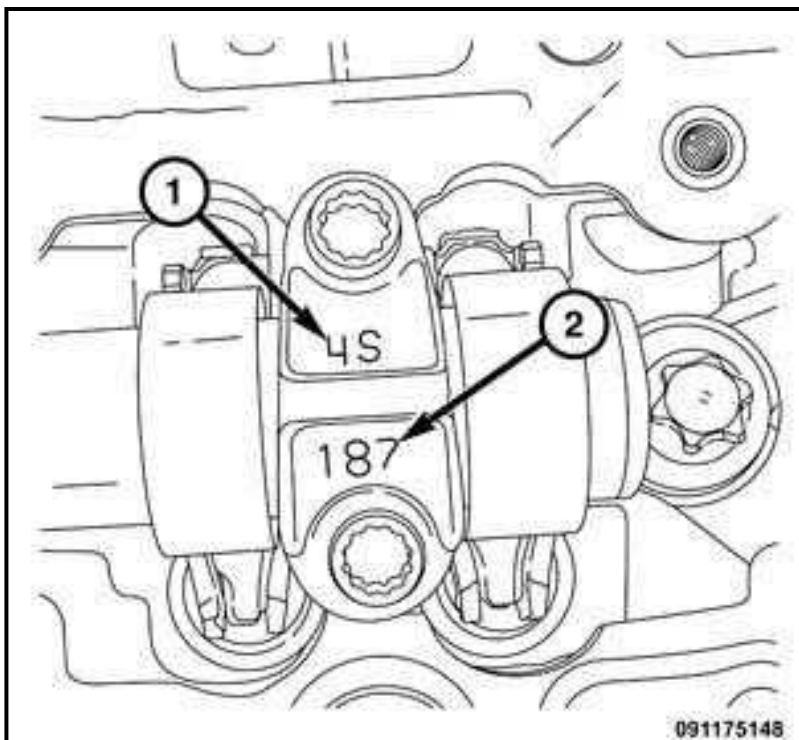
- | |
|---------------------------------------|
| 1 - Intake Camshaft Gear Timing Mark |
| 2 - Exhaust Camshaft Timing Gear Mark |

4. Set the intake camshaft gear timing mark at the four O'clock position and the exhaust camshaft timing gear mark to the eight O'clock position.



1 - Identification No.

5. Verify the identification No. on front of cylinder head.

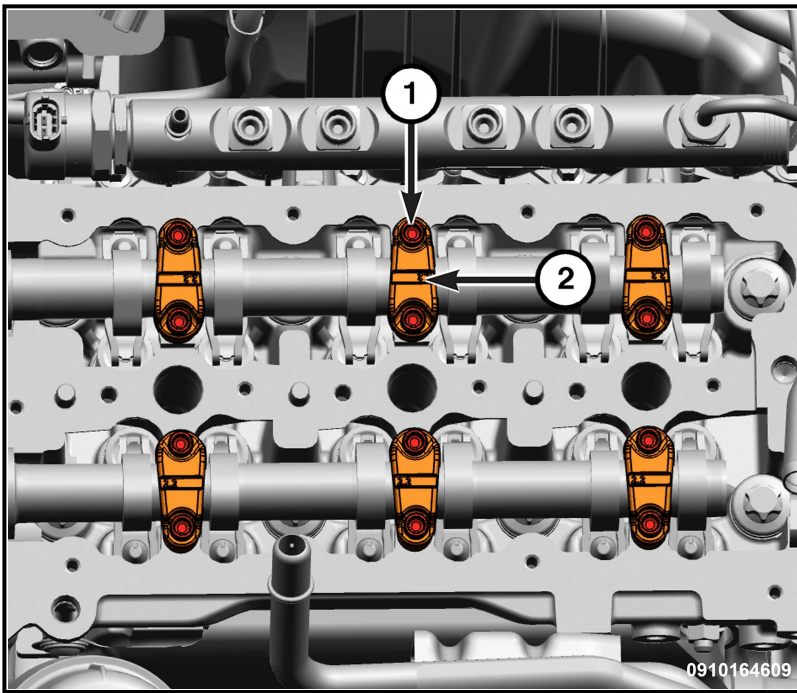


1 - "S" Exhaust Side Bearing Cap

2 - Identification No.

NOTE: When installing the bearing caps, be sure to install the "A" on the intake side and the "S" on the exhaust side in the rightful order.

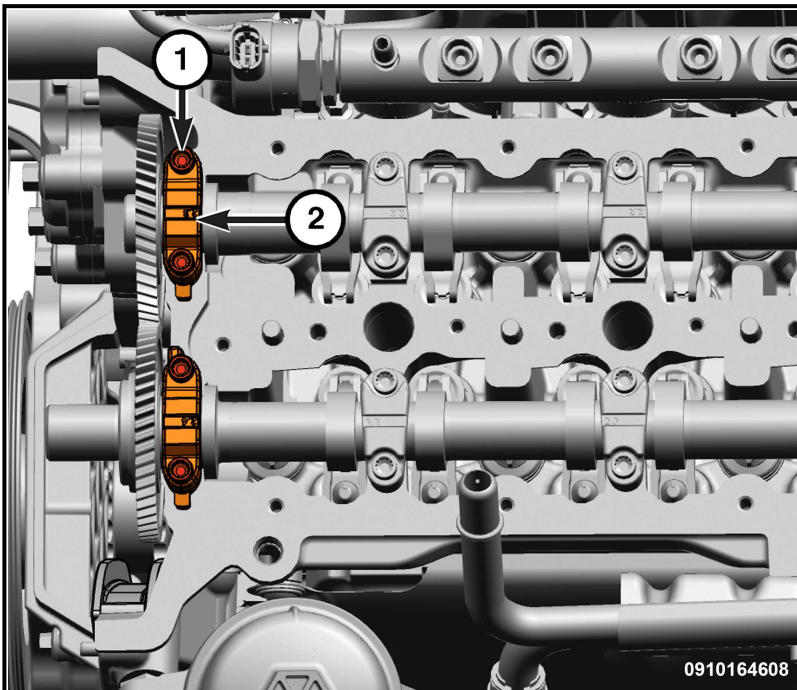
6. The identification No. on the camshaft bearing cap should match the cylinder head number.



1 - Bearing Cap Bolts

2 - Bearing Caps

7. Install the camshaft bearing caps in the rightful order and tighten each bearing cap bolt finger tight.
8. Check the camshaft for proper timing. Refer to [ENGINE TIMING VERIFICATION](#) .



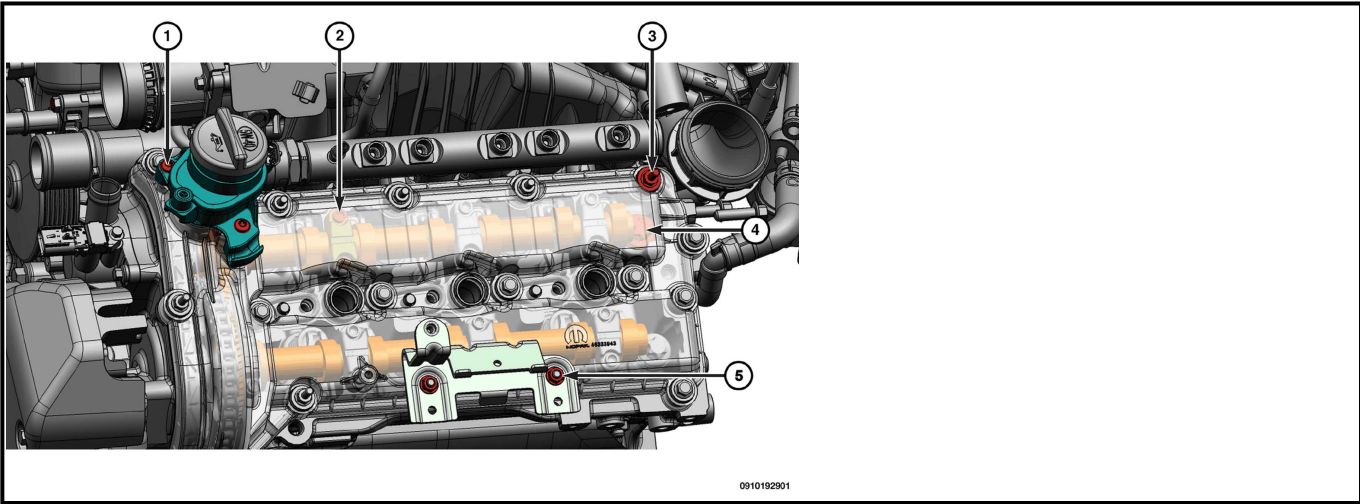
1 - Front Bearing Caps Bolts

2 - Front Bearing Caps

9. Install the front two bearing caps and tighten the bearing caps bolts finger tight.
10. Using the tightening sequence shown in the torque table, tighten the bearing caps bolts to proper torque specifications.
11. Install the left timing chain and sprocket. Refer to [CHAIN AND SPROCKETS, TIMING, REMOVAL AND INSTALLATION](#) .
12. Start engine, allow to warm, turn engine off and inspect for leaks.

TORQUE SPECIFICATIONS

CYLINDER HEAD



CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1	Oil Filler Neck Assembly to Valve Cover	Tighten Securely	-
2	Camshaft Bearing Cap Bolts	11 N.m (8 Ft. Lbs.)	Tightening Sequence
3	Cylinder Head Cover Bolts	Torque Procedure: 1. Tighten the cylinder head cover bolts finger tight. 2. Tighten bolts to 8 N.m (71 In. Lbs.). 3. Loosen each bolt 90B°. 4. Tighten bolts to 10 N.m (89 In. Lbs.).	Tightening Sequence
4	Cylinder Head Bolts (M14)	Torque Procedure: 1. Tighten the cylinder head bolts finger tight. 2. Tighten bolts to 30 N.m (22 Ft. Lbs.). 3. Tighten bolts an additional 75B° in sequence. 4. Tighten bolts an additional 75B° in sequence. 5. Tighten bolts an additional 75B° in sequence.	Tightening Sequence
5	Fuel Line Support Bracket Nuts	6 N.m 53 (In. Lbs.)	-

CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
-	Coolant Tube Bolt	25 N.m (18 Ft. Lbs.)	-
-	Engine Wire Harness Bolts	11 N.m (8 Ft. Lbs.)	-
-	Heat Shield Bracket Nuts	6 N.m 53 (In. Lbs.)	

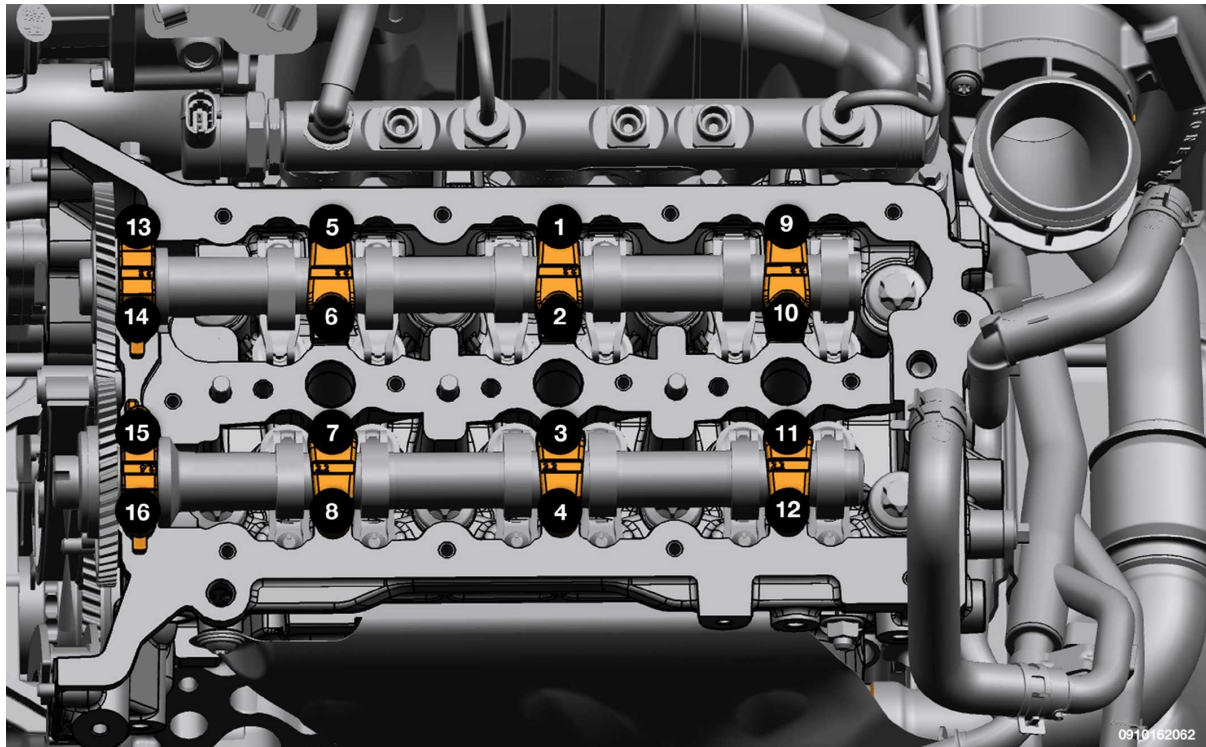


Fig. 1: Camshaft Bearing Cap Tightening Sequence 3.0L

Courtesy of CHRYSLER GROUP, LLC

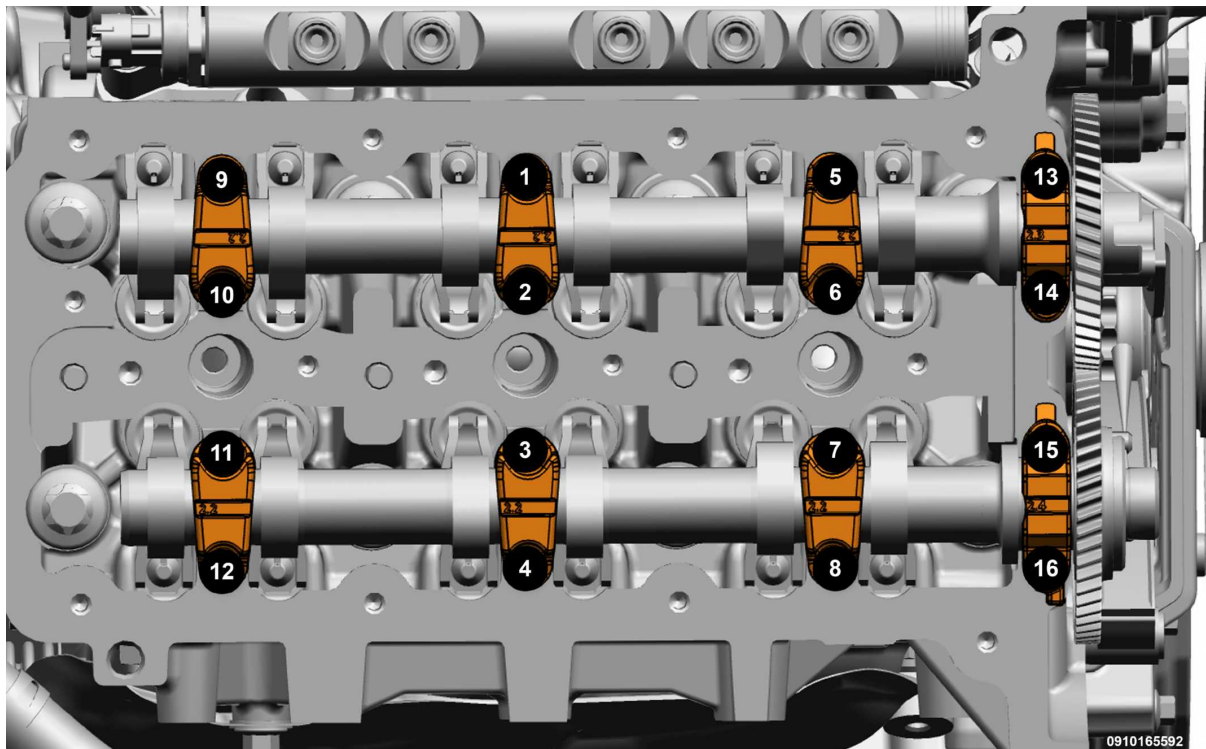


Fig. 2: Front Bearing Caps Bolts Tightening Sequence

Courtesy of CHRYSLER GROUP, LLC

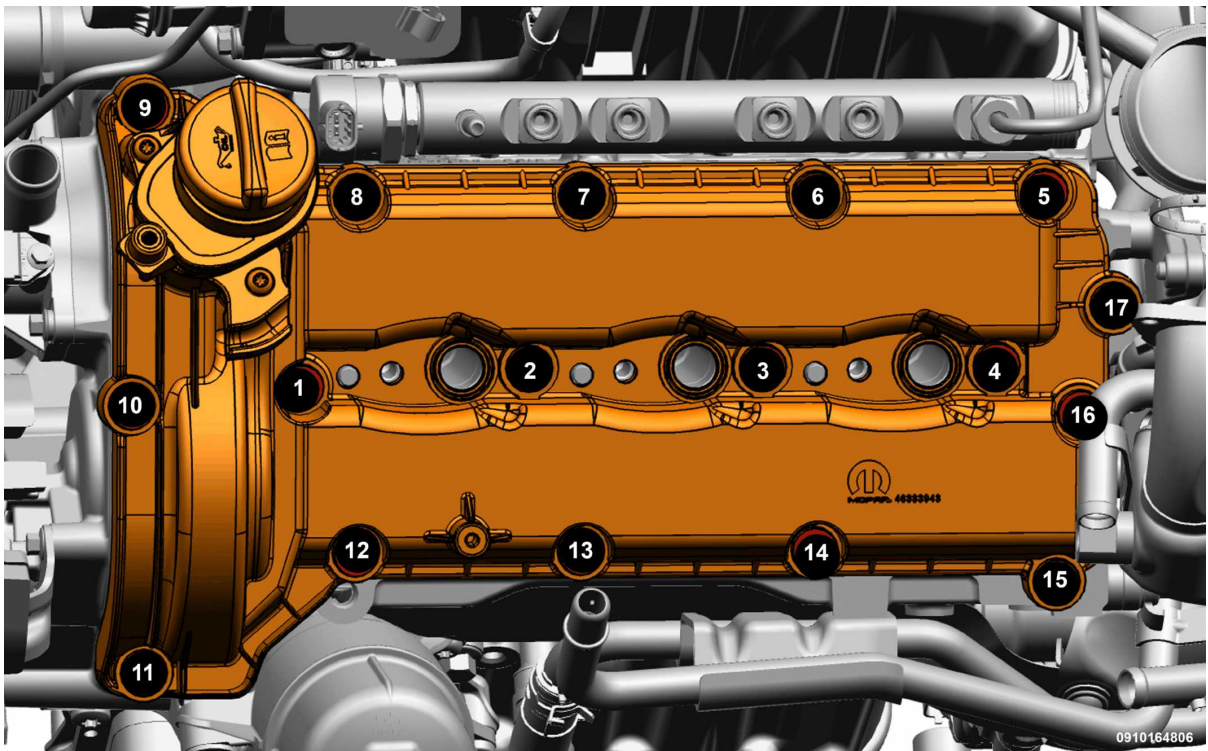


Fig. 3: Cylinder Head Cover Bolts Tightening Sequence - Left
 Courtesy of CHRYSLER GROUP, LLC

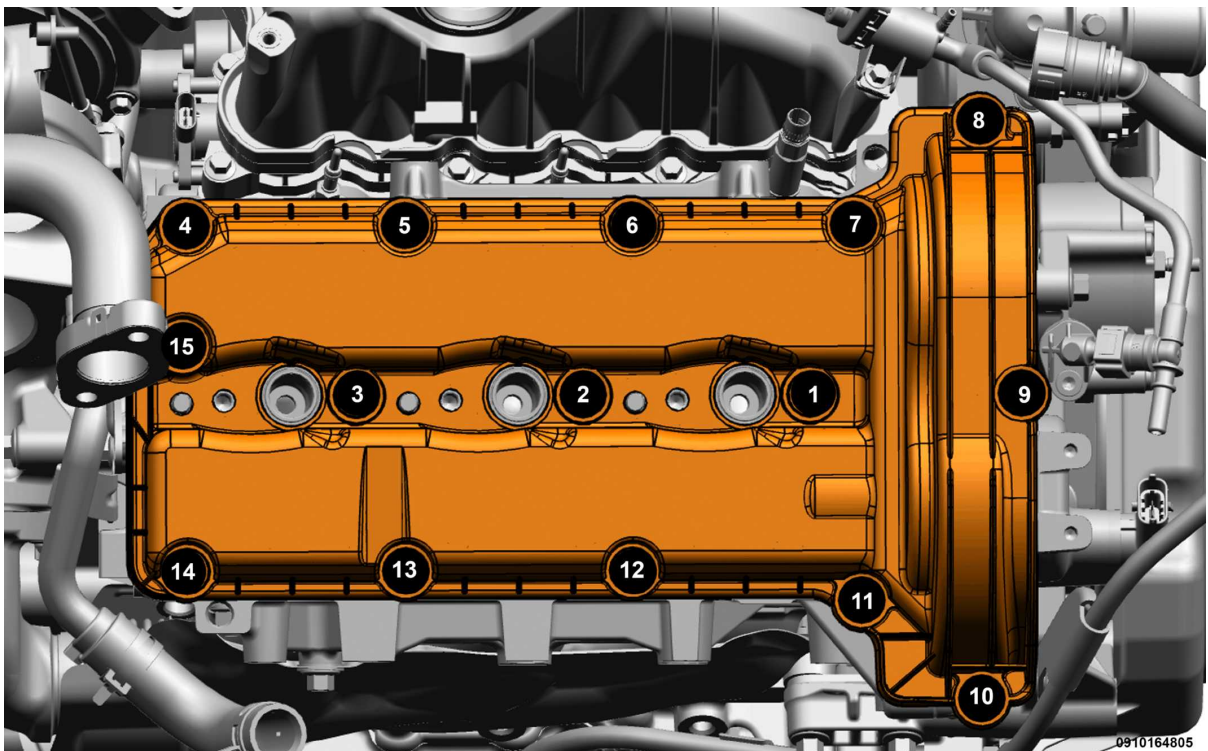


Fig. 4: Cylinder Head Cover Bolts Tightening Sequence - Right
 Courtesy of CHRYSLER GROUP, LLC

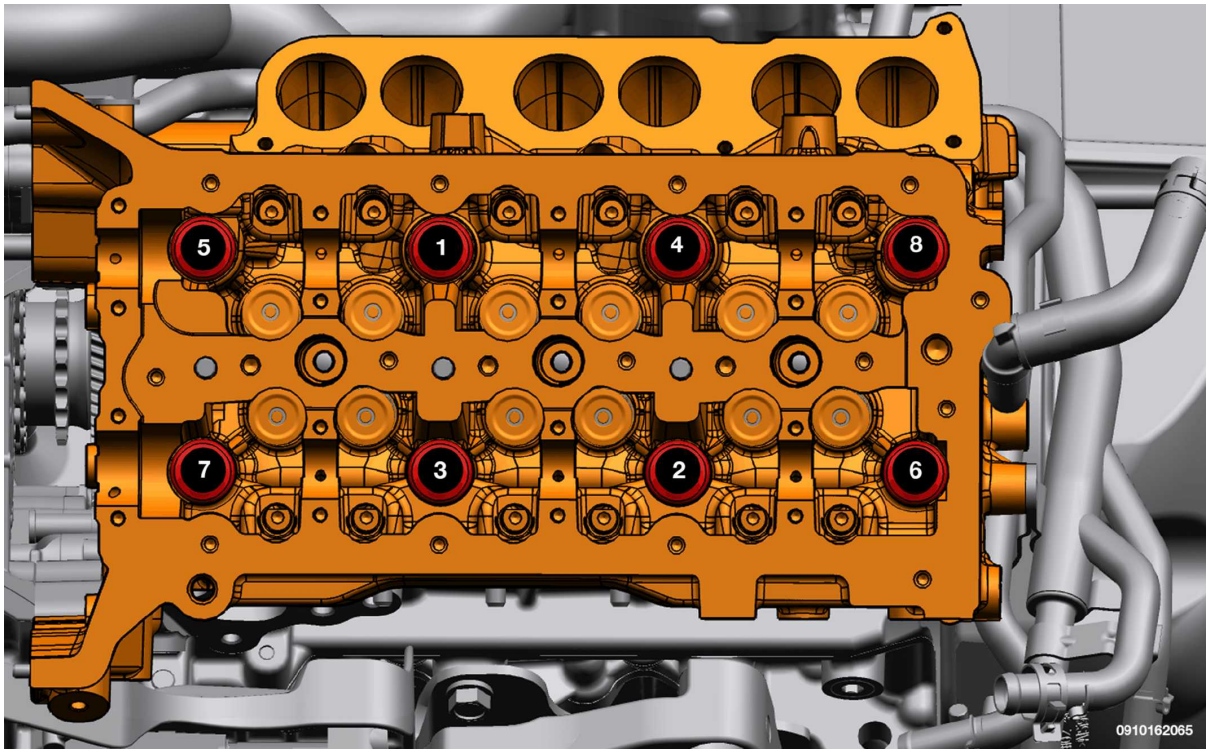


Fig. 5: Cylinder Head Bolts Tightening Sequence - Left
 Courtesy of CHRYSLER GROUP, LLC

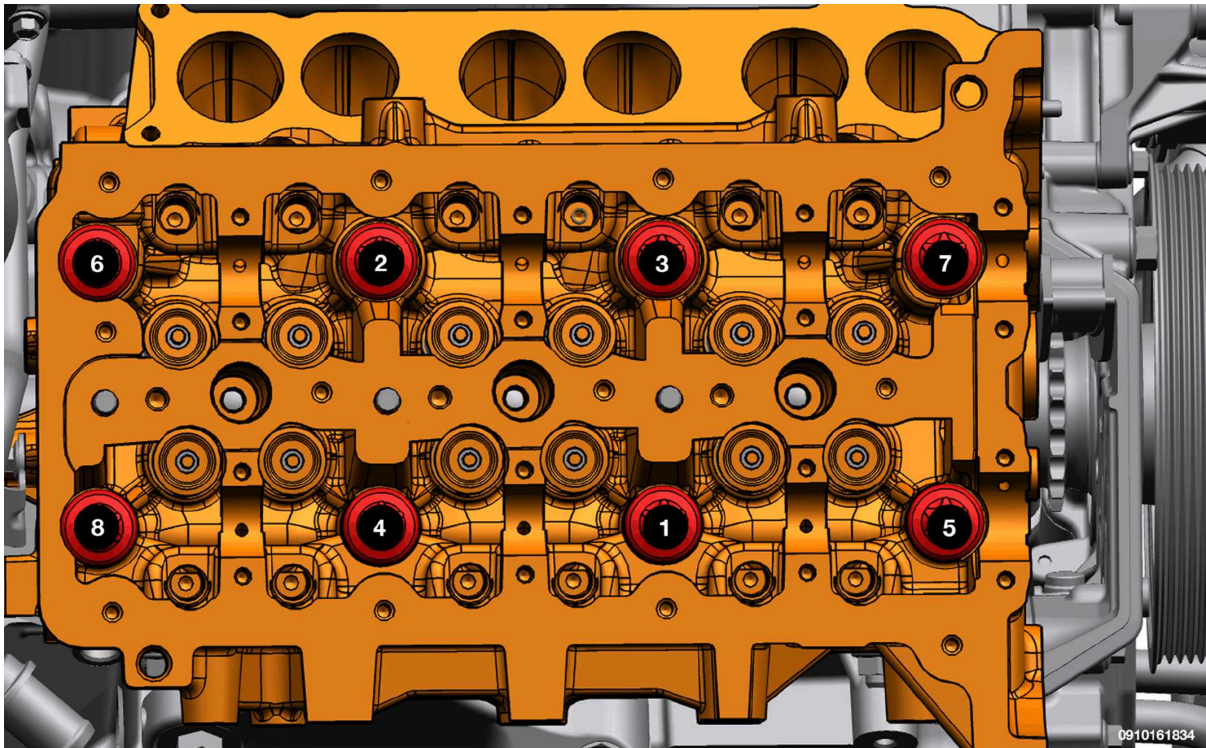
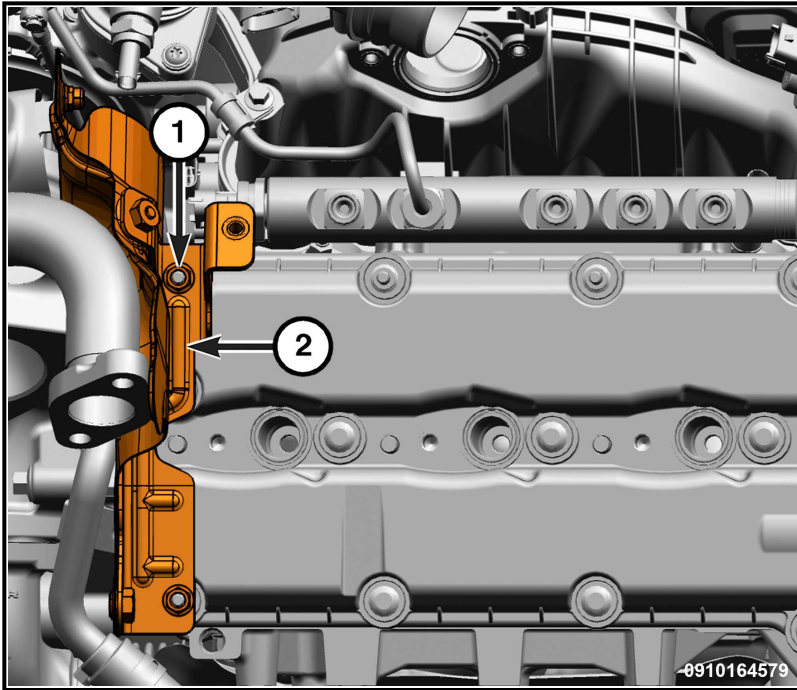


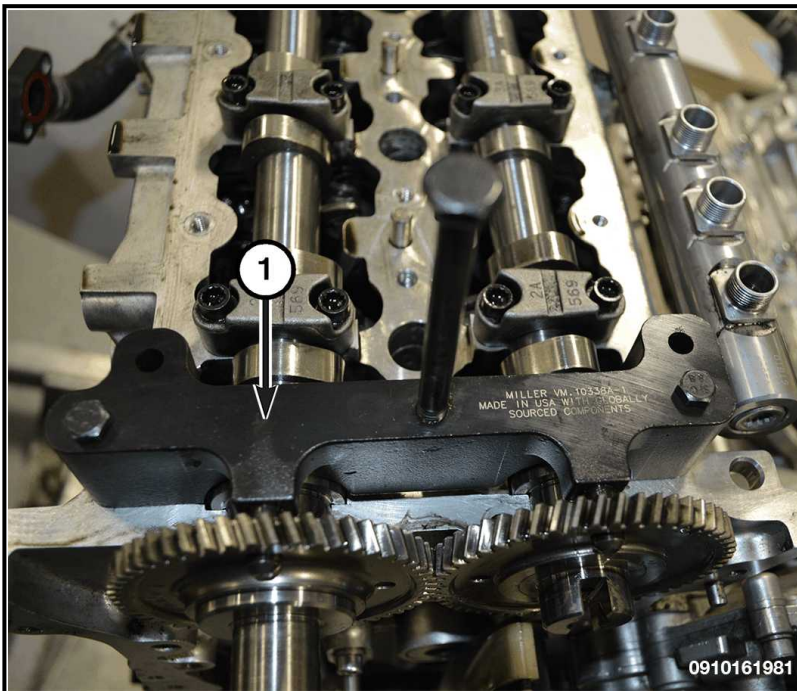
Fig. 6: Cylinder Head Bolts Tightening Sequence - Right
 Courtesy of CHRYSLER GROUP, LLC



RIGHT CAMSHAFTS

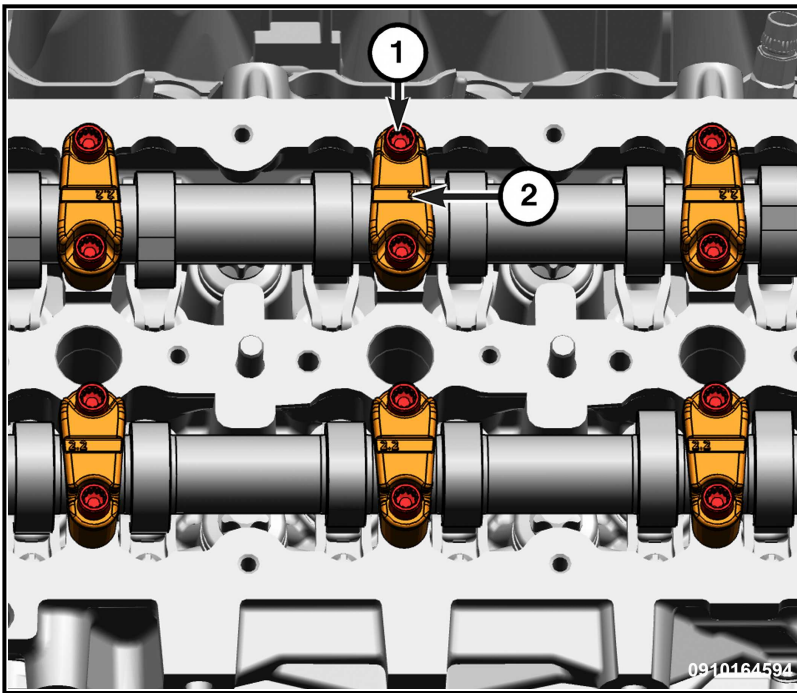
REMOVAL

1. Remove the right timing chain and sprocket. Refer to [CHAIN AND SPROCKETS, TIMING, REMOVAL AND INSTALLATION](#).



1 - Right Camshaft Timing Tool

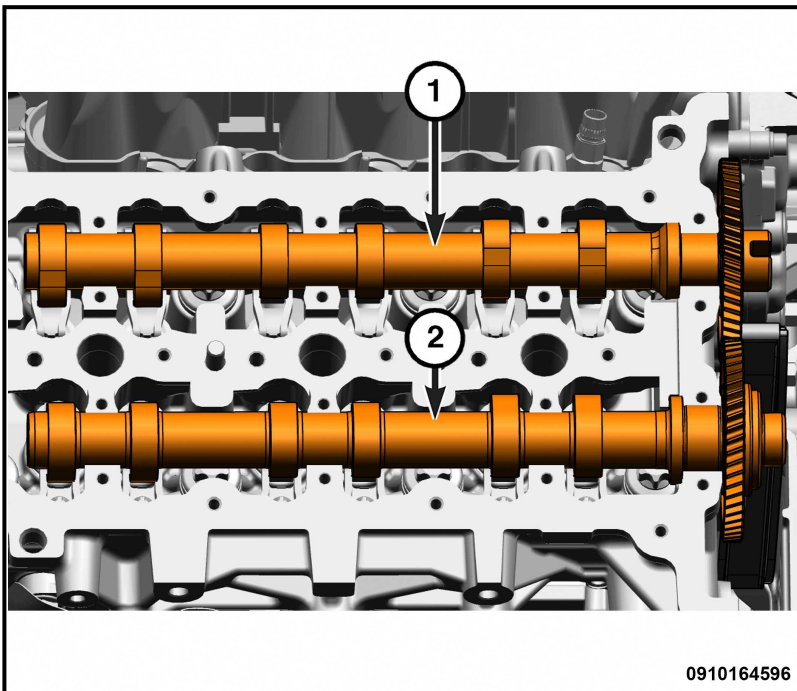
2. Remove the bolts and the right locking tool.
3. **Check the camshafts end play using** (special tool #C-3339A, Set, Dial Indicator). **End play should be between 0.1 mm - 0.3 mm (0.003 in. - 0.011 in.). If the camshaft endplay is not within specification, replace the cylinder head.**



1 - Bearing Cap Bolts
2 - Bearing Caps

NOTE: Make a reference in the order the camshaft bearing caps were removed.

- Remove the bearing cap bolts and the intake and exhaust camshaft bearing caps.



1 - Intake Camshaft
2 - Exhaust Camshaft

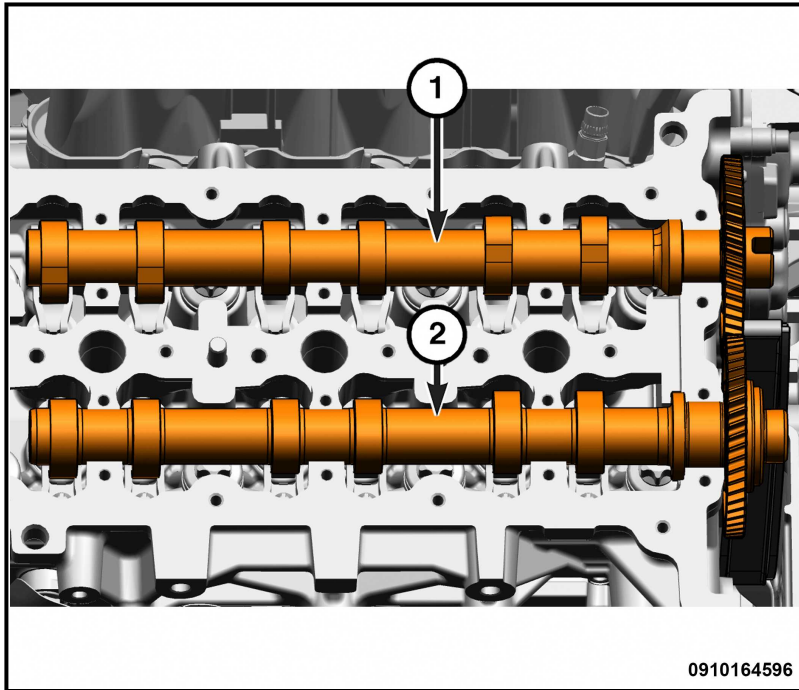
- Remove the right side intake camshaft and exhaust camshaft.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

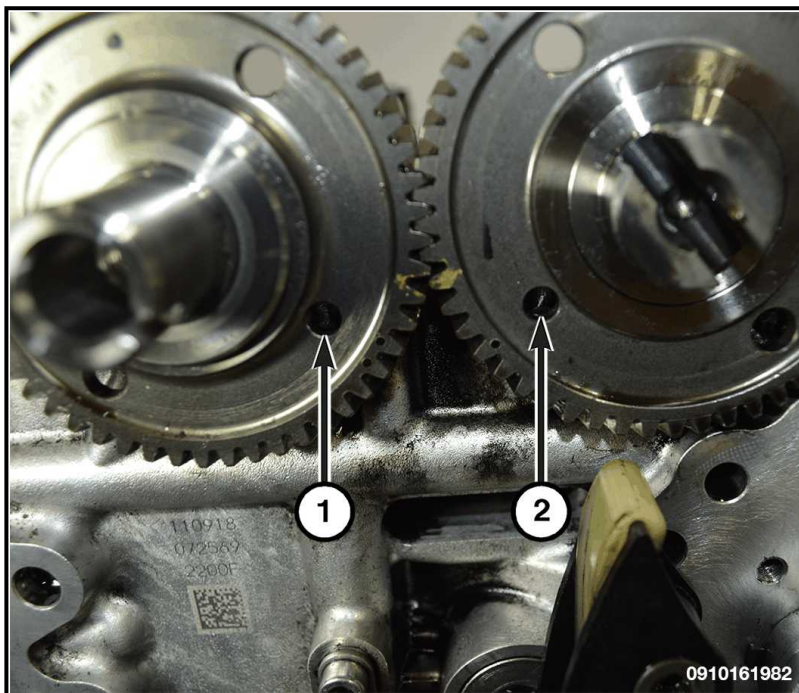
- Clean all gasket and mating surfaces.

2. Lubricate camshafts with MoparB® Engine Oil Supplement, or equivalent. Refer to [CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS](#).



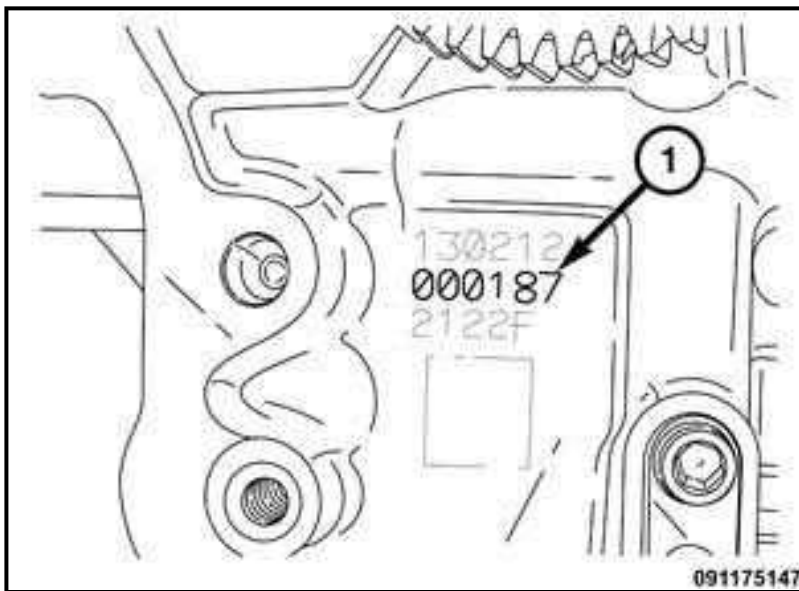
- | |
|----------------------|
| 1 - Intake Camshaft |
| 2 - Exhaust Camshaft |

3. Carefully install the right side intake camshaft and exhaust camshaft onto cylinder head journals.



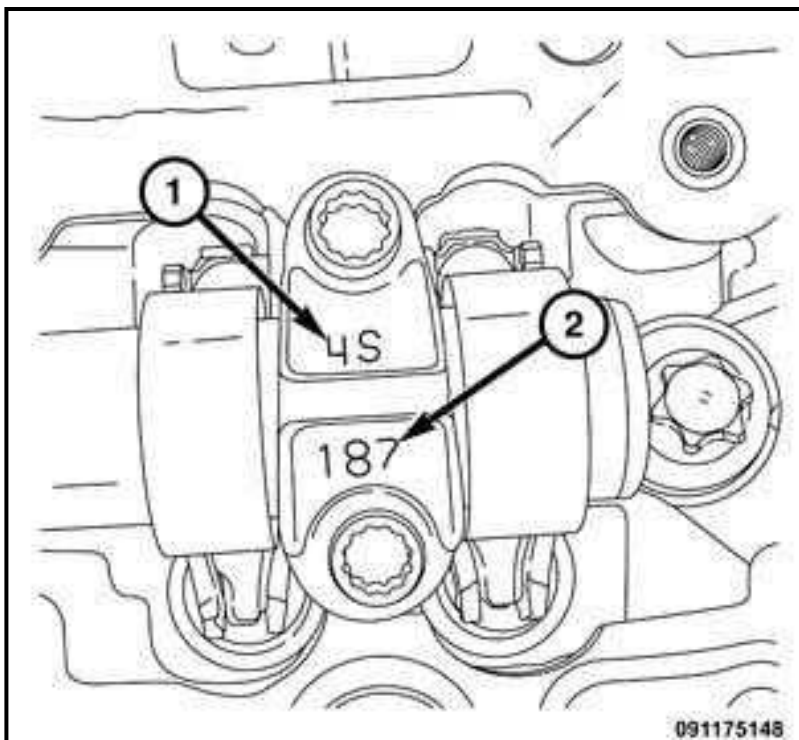
- | |
|---------------------------------------|
| 1 - Exhaust Camshaft Gear Timing Mark |
| 2 - Intake Camshaft Timing Gear Mark |

4. Set the exhaust camshaft gear timing mark at the four O'clock position and the intake camshaft timing gear mark to the seven O'clock position.



1 - Identification No.

5. Verify the Identification No. on front of cylinder head.

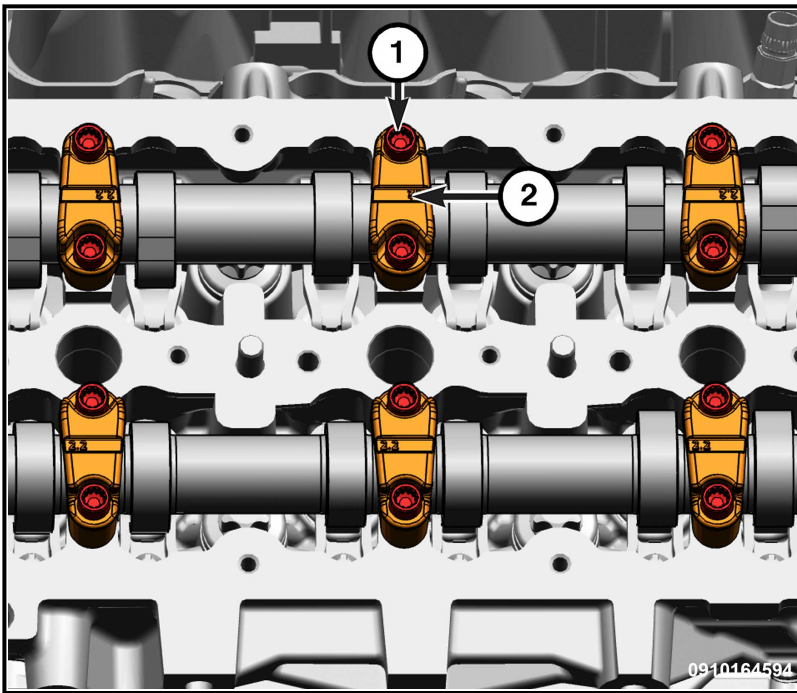


1 - "S" Exhaust Side Bearing Cap

2 - Identification No.

NOTE: When installing the bearing caps, be sure to install the "A" on the intake side and the "S" on the exhaust side in the rightful order.

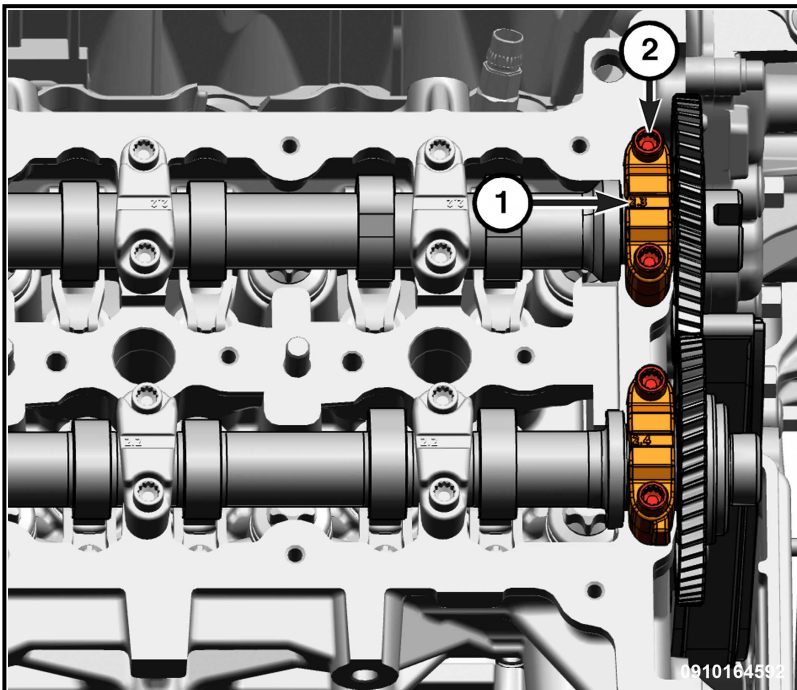
6. The identification No. on the camshaft bearing cap should match the cylinder head number.



1 - Bearing Cap Bolts

2 - Bearing Caps

7. Install the camshaft bearing caps in the rightful order and tighten each bolt finger tight.
8. Check the camshaft for proper timing. Refer to [ENGINE TIMING VERIFICATION](#) .



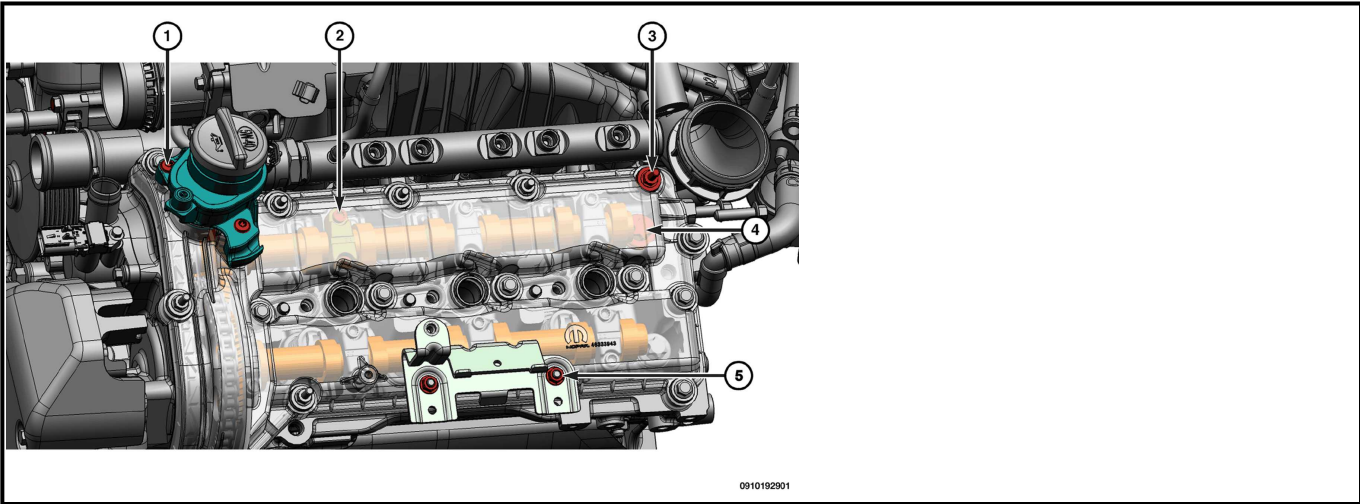
1 - Right Front Bearing Caps

2 - Right Front Bearing Caps Bolts

9. Install the front two bearing caps and tighten the bearing caps bolts finger tight.
10. Using the tightening sequence shown in the torque table, tighten bearing the caps bolts to the proper torque specifications.
11. Install the right timing chain sprocket. Refer to [CHAIN AND SPROCKETS, TIMING, REMOVAL AND INSTALLATION](#) .
12. Start engine, allow to warm, turn engine off and inspect for leaks.

TORQUE SPECIFICATIONS

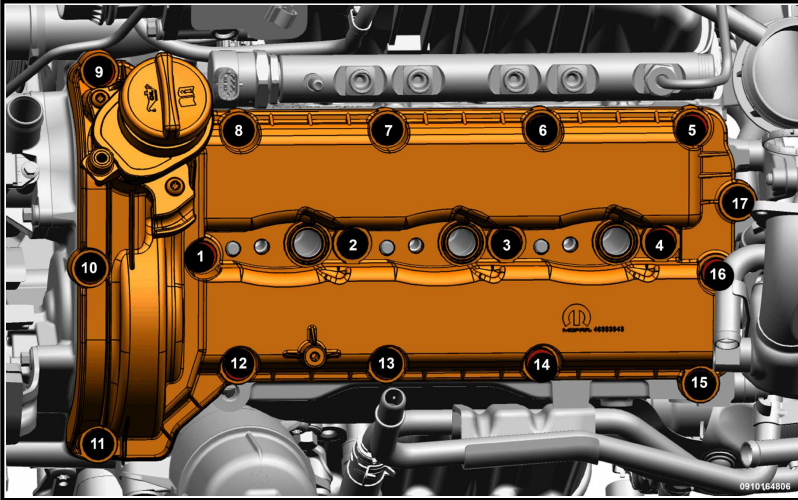
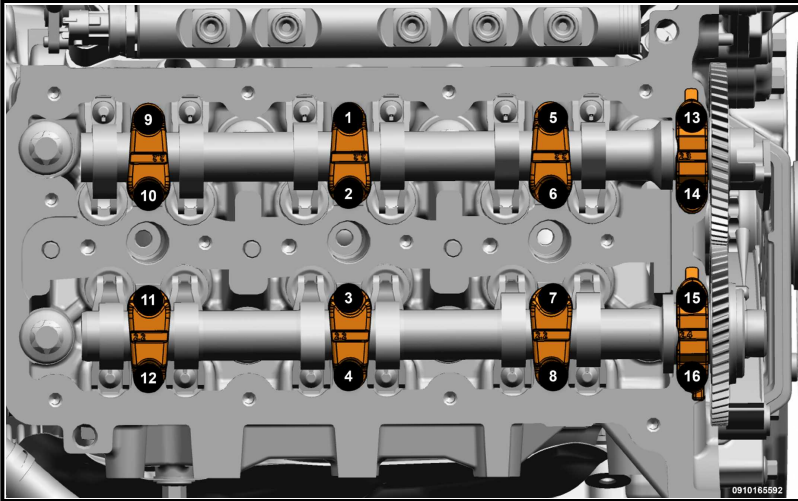
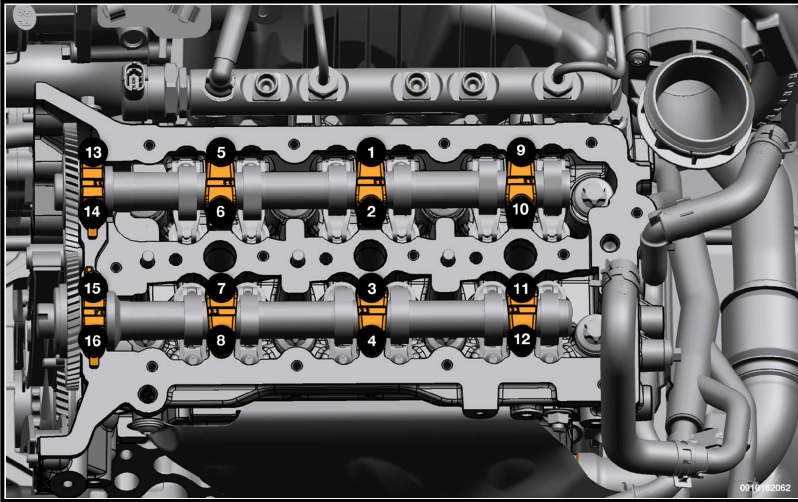
CYLINDER HEAD

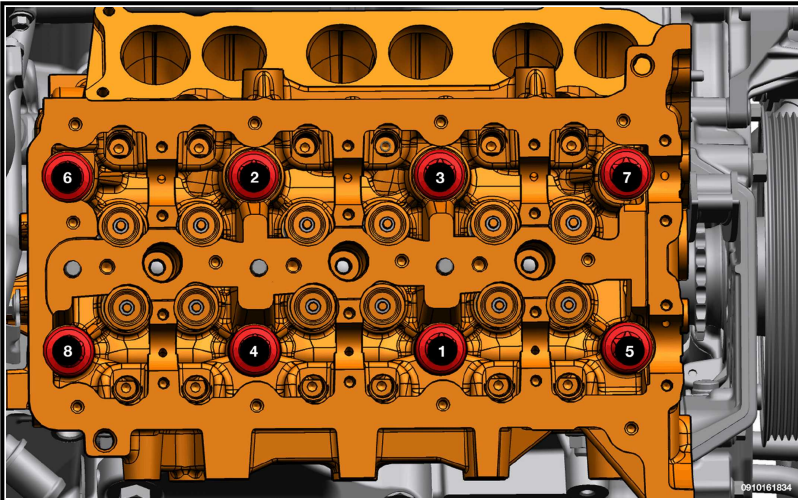
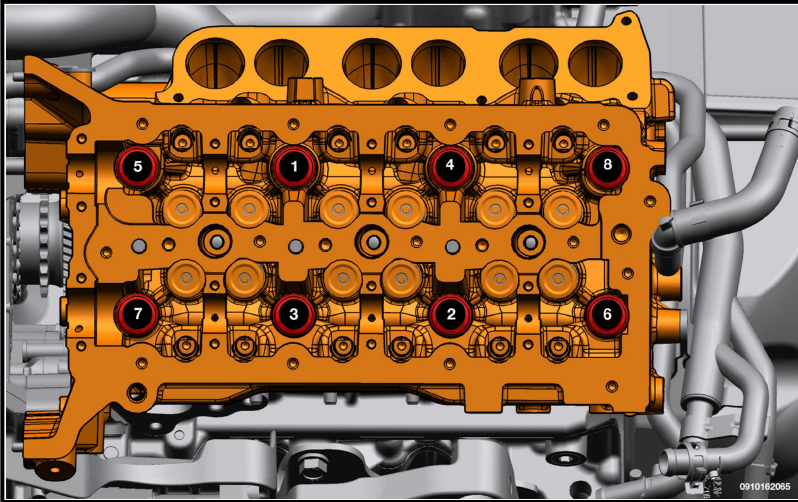
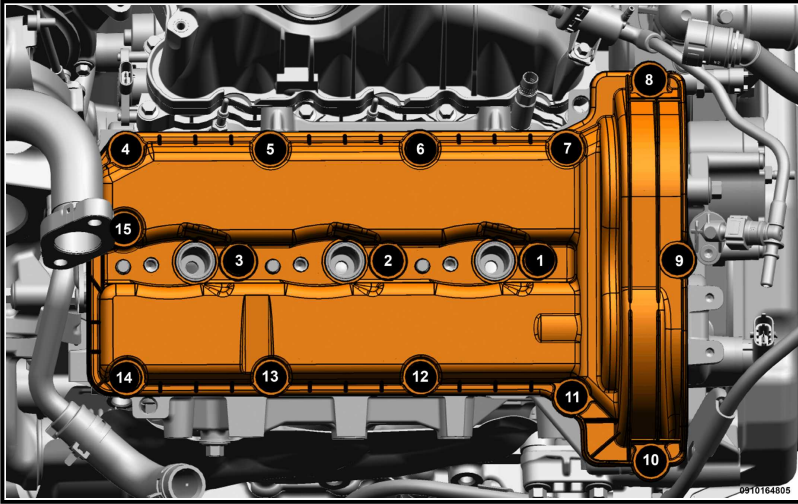


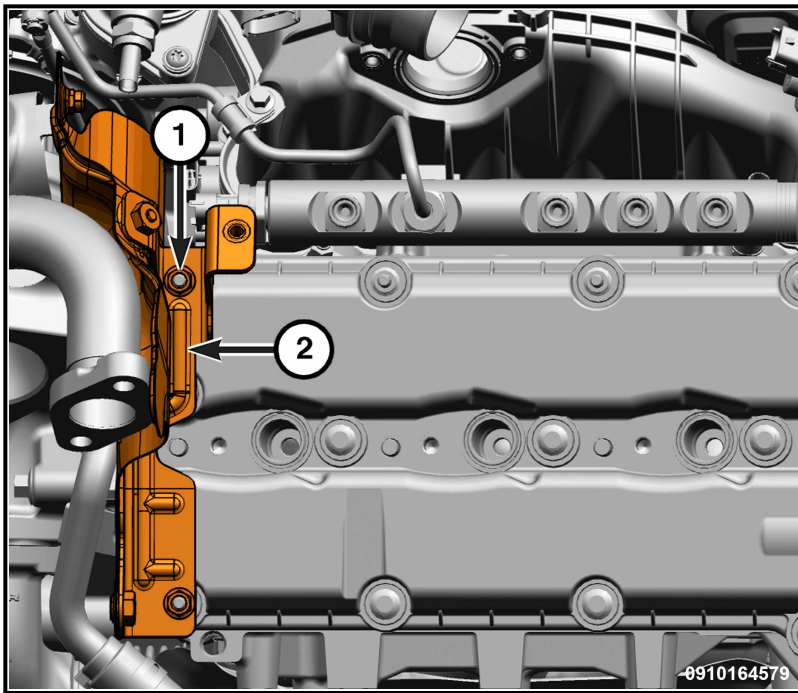
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CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1	Oil Filler Neck Assembly to Valve Cover	Tighten Securely	-
2	Camshaft Bearing Cap Bolts	11 N.m (8 Ft. Lbs.)	Tightening Sequence
3	Cylinder Head Cover Bolts	Torque Procedure: 1. Tighten the cylinder head cover bolts finger tight. 2. Tighten bolts to 8 N.m (71 In. Lbs.). 3. Loosen each bolt 90B°. 4. Tighten bolts to 10 N.m (89 In. Lbs.).	Tightening Sequence
4	Cylinder Head Bolts (M14)	Torque Procedure: 1. Tighten the cylinder head bolts finger tight. 2. Tighten bolts to 30 N.m (22 Ft. Lbs.). 3. Tighten bolts an additional 75B° in sequence. 4. Tighten bolts an additional 75B° in sequence. 5. Tighten bolts an additional 75B° in sequence.	Tightening Sequence
5	Fuel Line Support Bracket Nuts	6 N.m 53 (In. Lbs.)	-

CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
-	Coolant Tube Bolt	25 N.m (18 Ft. Lbs.)	-
-	Engine Wire Harness Bolts	11 N.m (8 Ft. Lbs.)	-
-	Heat Shield Bracket Nuts	6 N.m 53 (In. Lbs.)	







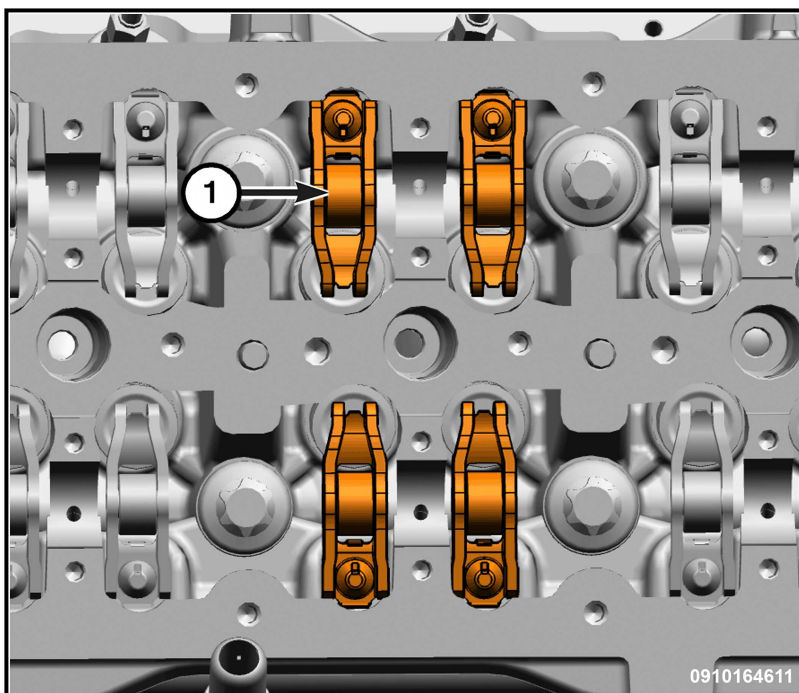
CYLINDER HEAD ASSEMBLY

REMOVAL AND INSTALLATION

LEFT CYLINDER HEAD

REMOVAL

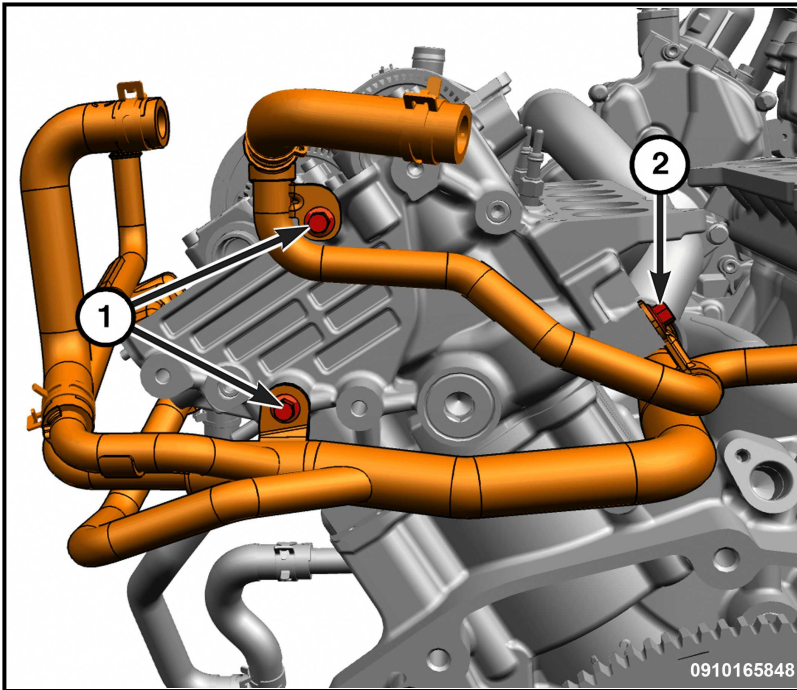
1. Remove the left exhaust manifold. Refer to [MANIFOLD, EXHAUST, REMOVAL AND INSTALLATION](#) .
2. Remove the intake manifold. Refer to [MANIFOLD, INTAKE, REMOVAL AND INSTALLATION](#) .
3. Remove the glow plugs. Refer to [GLOW PLUG, REMOVAL AND INSTALLATION](#) .
4. Remove the left side intake and exhaust camshafts. Refer to [CAMSHAFT, ENGINE, REMOVAL AND INSTALLATION](#) .



1 - Rocker Arm

5. Remove the rocker arm/lifter assembly and note their original location.

6. Remove the Low Temperature (LT) EGR cooler. Refer to [COOLER, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#) .

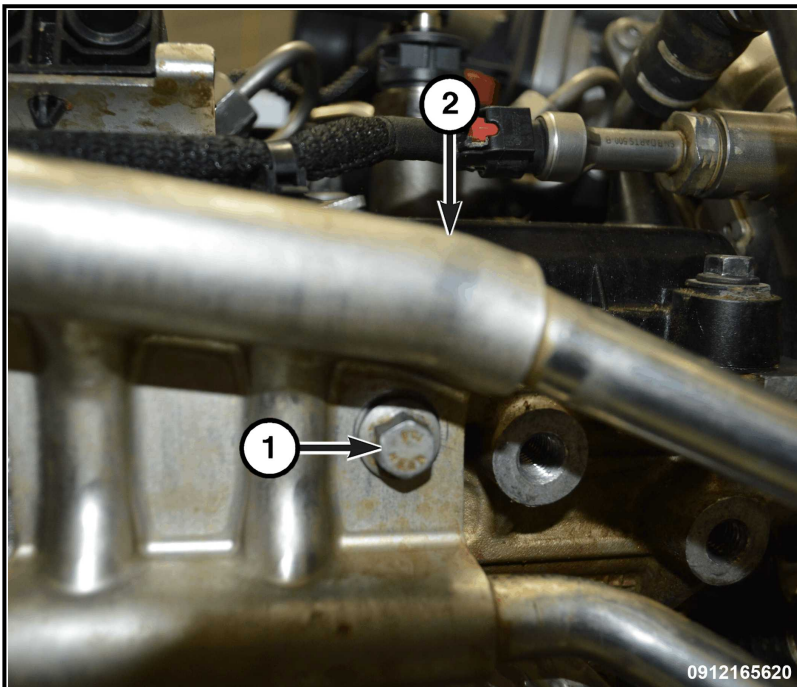


1 - Coolant Tube Bolts

2 - Coolant Tube Bolt

7. Remove the coolant tube bolt securing the coolant tube to the cylinder head (intake side).

8. Remove the coolant tube bolts securing the coolant tubes to the back of the cylinder head.

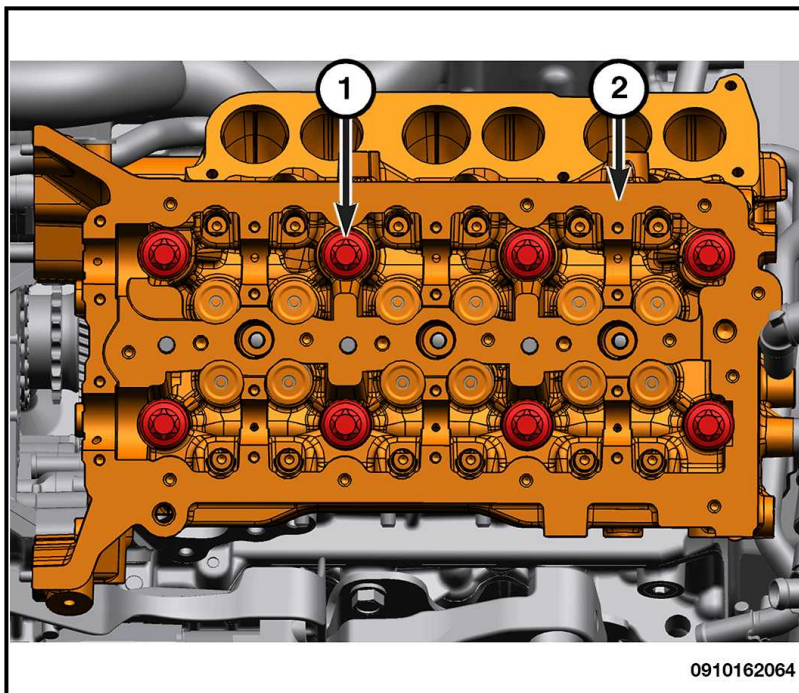


1 - Coolant Tube Bolt

2 - Coolant Tube

9. Remove the coolant tube bolt securing the coolant tube to the side of the cylinder head.

10. Remove the water pump. Refer to [PUMP, WATER, REMOVAL AND INSTALLATION](#).



1 - Cylinder Head Bolts
2 - Cylinder Head

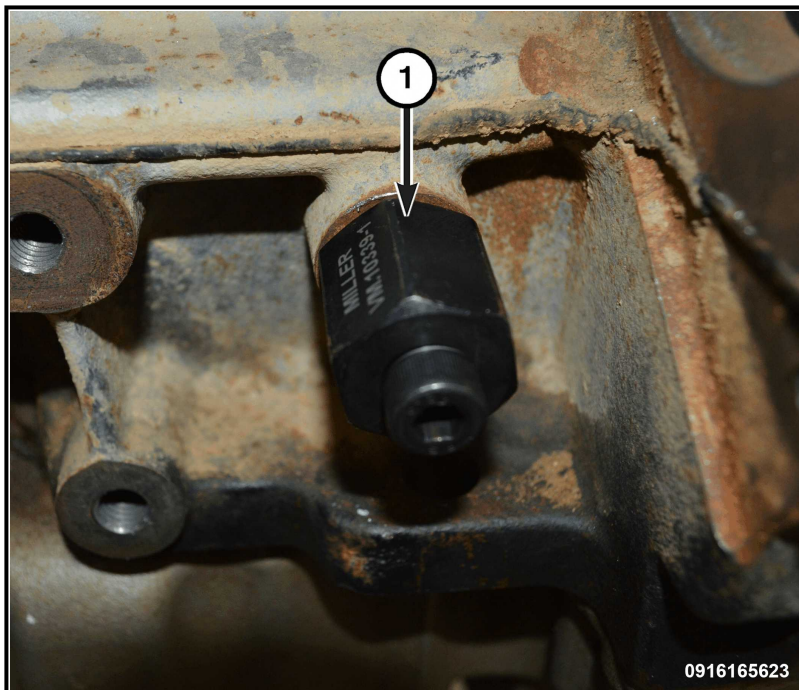
NOTE: Do Not store the cylinder head on the sealing surface.

11. Remove the cylinder head bolts and the cylinder head from the engine and discard the cylinder head bolts.
12. Remove and discard the head gasket.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

1. Clean and inspect gasket mating surfaces. Refer to [CYLINDER HEAD, CLEANING](#) .



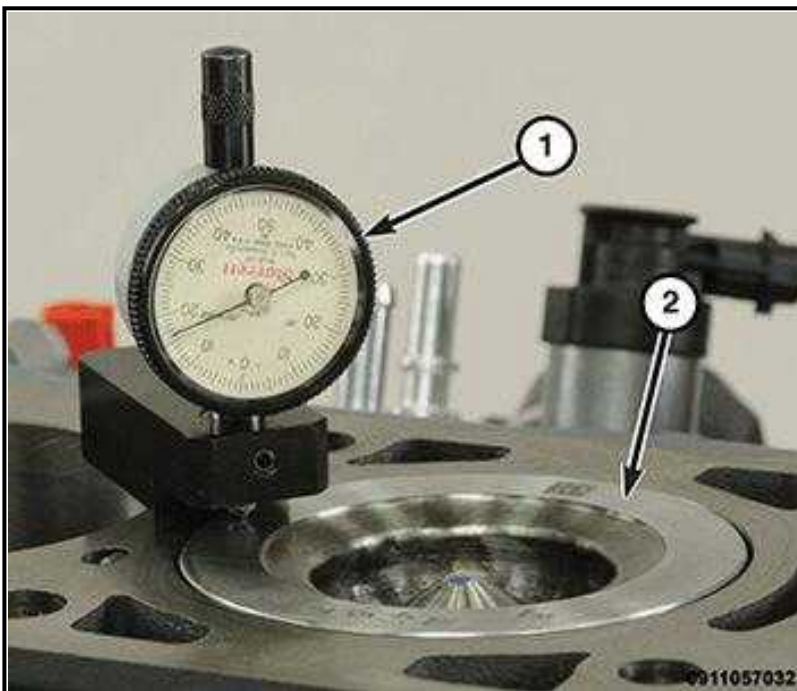
1 - Crankshaft Timing Tool

2. Remove the (special tool #VM.10339, Tool, Crankshaft Timing).
3. Set the number one piston to top dead center (TDC).



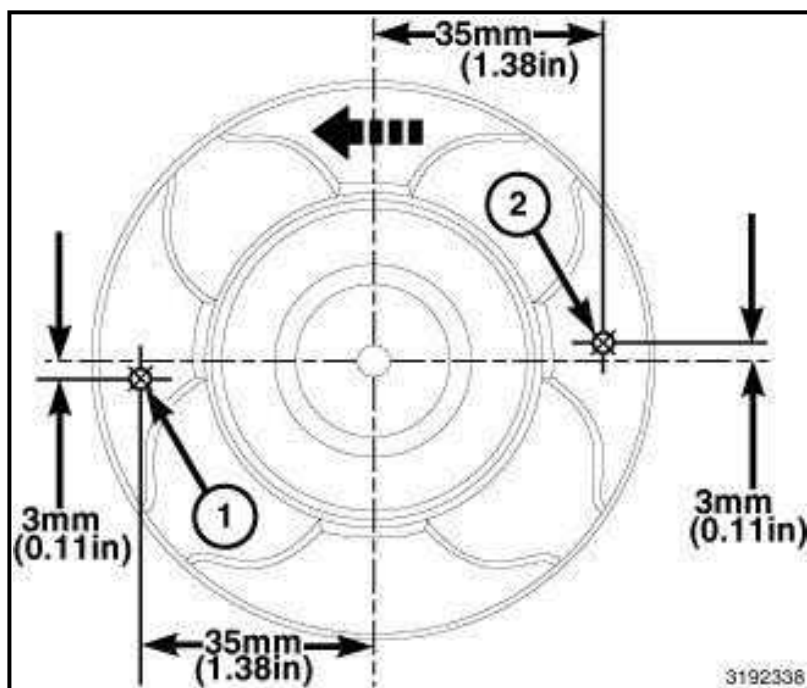
- | |
|--------------------|
| 1 - Dial Indicator |
| 2 - Scooter Block |

4. Using the (special tool #D-115-2A, Block, Scooter) and the (special tool #C-3339A, Set, Dial Indicator), position the scooter block with dial indicator flat on the cylinder block head surface and zero the dial indicator.



- | |
|--------------------|
| 1 - Dial Indicator |
| 2 - Piston |

5. Position the scooter block with dial indicator onto the piston.

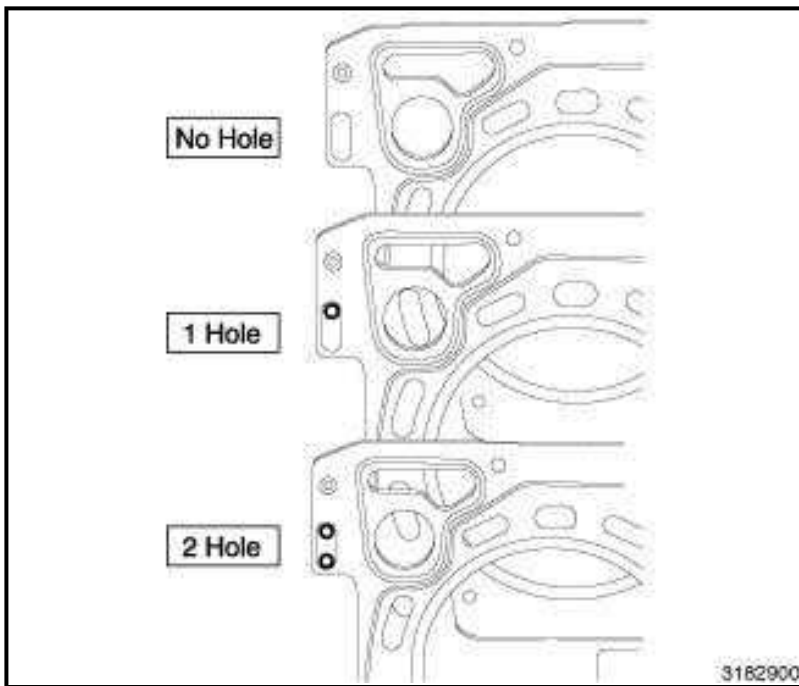


1 - Front Measurement Location

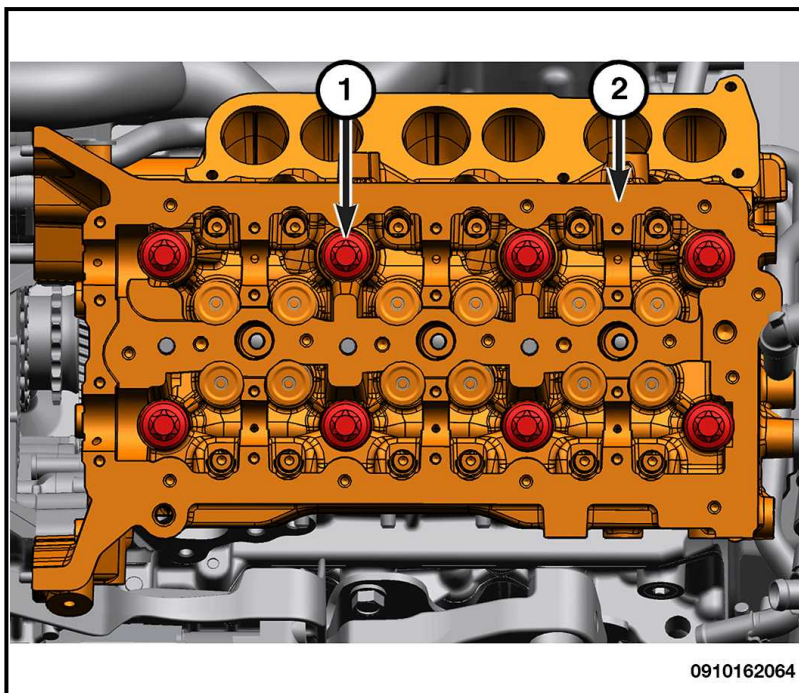
2 - Rear Measurement Location

6. Measure the front height of the piston in the location illustrated and record measurement.
7. Measure the rear height of the piston in the location illustrated and record measurement.
8. Repeat the procedure for each cylinder.
9. Average the 3 piston protrusion readings to determine the required gasket thickness.

HEAD GASKET SELECTION CHART		
B	Metric	Standard
PISTON CLEARANCE	0.130 - 0.220 mm	0.0051 - 0.0086 in.
CYLINDER HEAD GASKET THICKNESS	0.96 mm	0.0377 in.
GASKET IDENTIFICATION	NO HOLE	
B		
PISTON CLEARANCE	0.221 - 0.310 mm	0.0087 - 0.0122 in.
CYLINDER HEAD GASKET THICKNESS	1.06 mm	0.0417 in.
GASKET IDENTIFICATION	ONE HOLE	
B		
PISTON CLEARANCE	0.311 - 0.402 mm	0.0122 - 0.0158 in.
CYLINDER HEAD GASKET THICKNESS	1.16 mm	0.0456 in.
GASKET IDENTIFICATION	TWO HOLES	

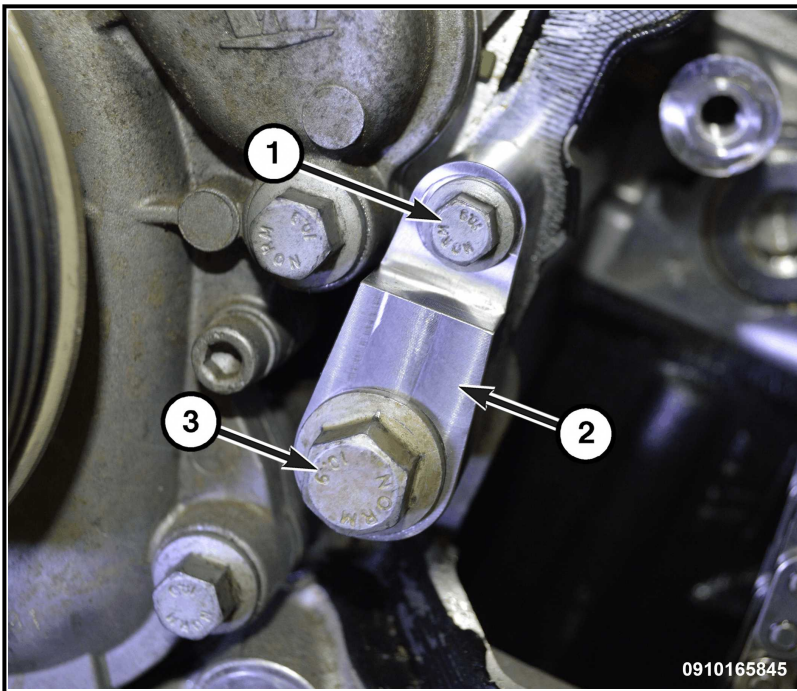


10. Select the appropriate cylinder head gasket from the cylinder head gasket chart.
11. Install the **NEW** head gasket on the engine block. Be sure the coolant passages align (part number should be facing up).



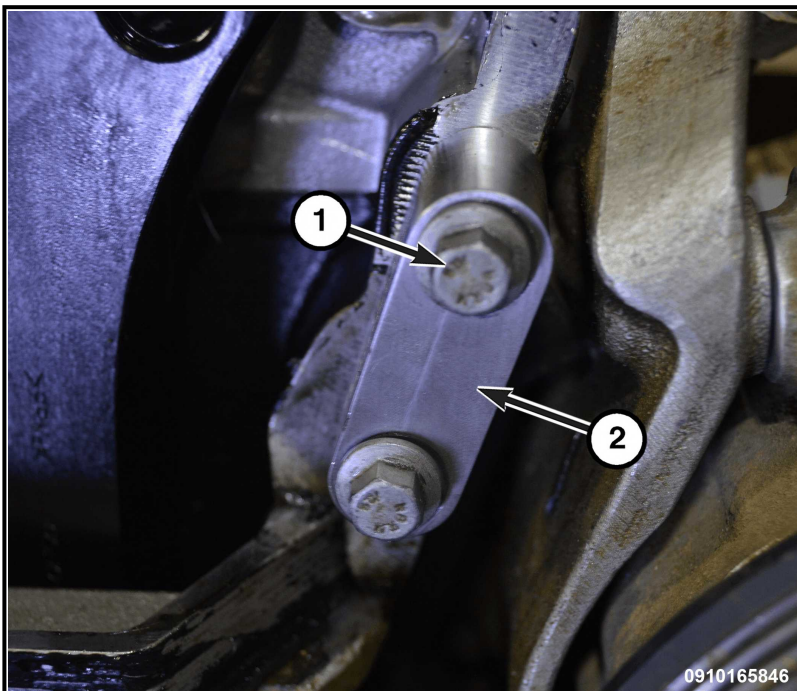
1 - Cylinder Head Bolts
2 - Cylinder Head

12. Install the cylinder head to the engine and tighten the **NEW** cylinder head bolts finger tight.



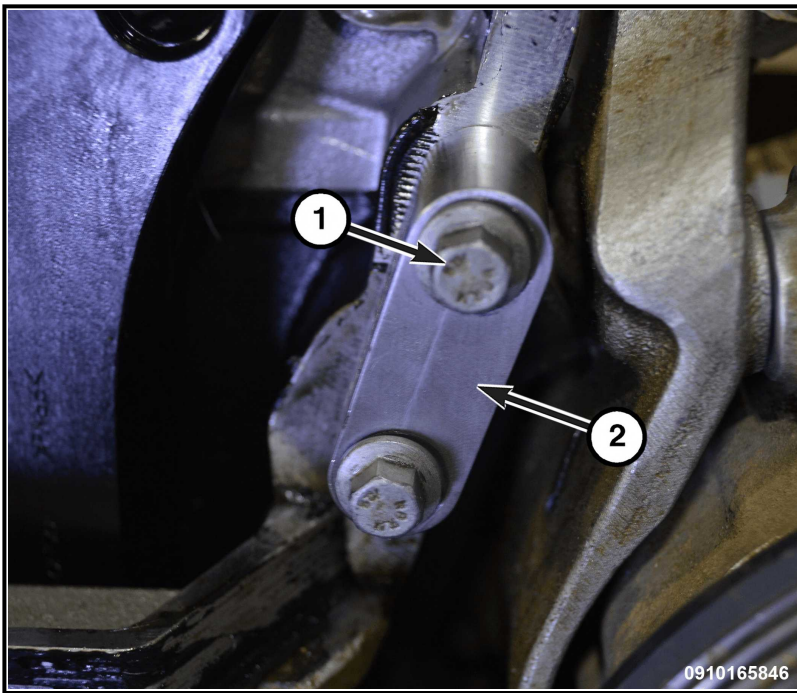
1 - Alignment Tool Upper Bolt
2 - Left Side Inboard Alignment Tool
3 - Alignment Tool Lower Bolt

13. Install the (special tool #2073102090, Tool, Left Side Inboard Alignment) and securely tighten the alignment tool upper/lower bolts.



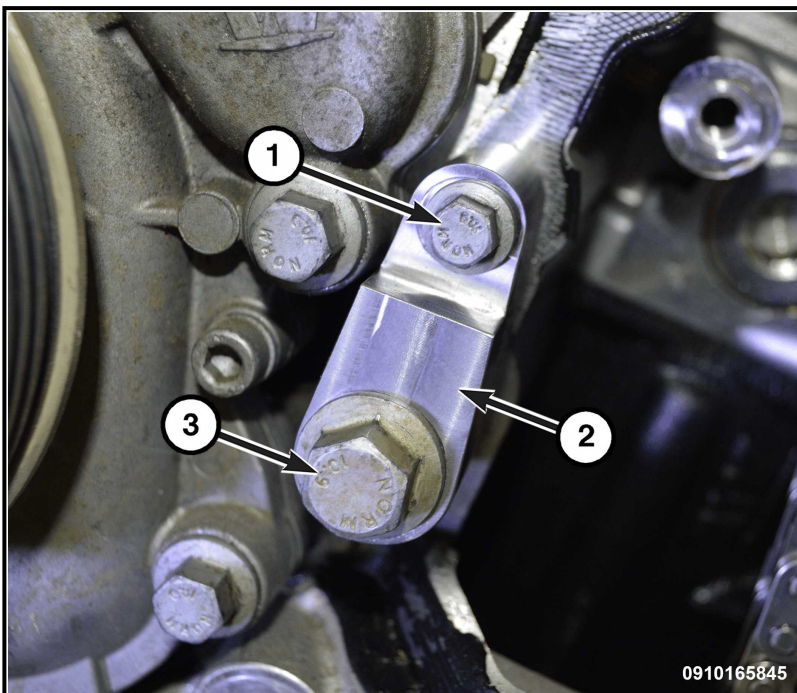
1 - Alignment Tool Bolts
2 - Left Side Outboard Alignment Tool

14. Install the (special tool #2073101090, Tool, Left Side Outboard Alignment) and securely tighten the alignment tool bolts.
15. Using the tightening sequence shown in the torque table below, tighten the cylinder head bolts to proper torque specifications.



1 - Alignment Tool Bolts
2 - Left Side Outboard Alignment Tool

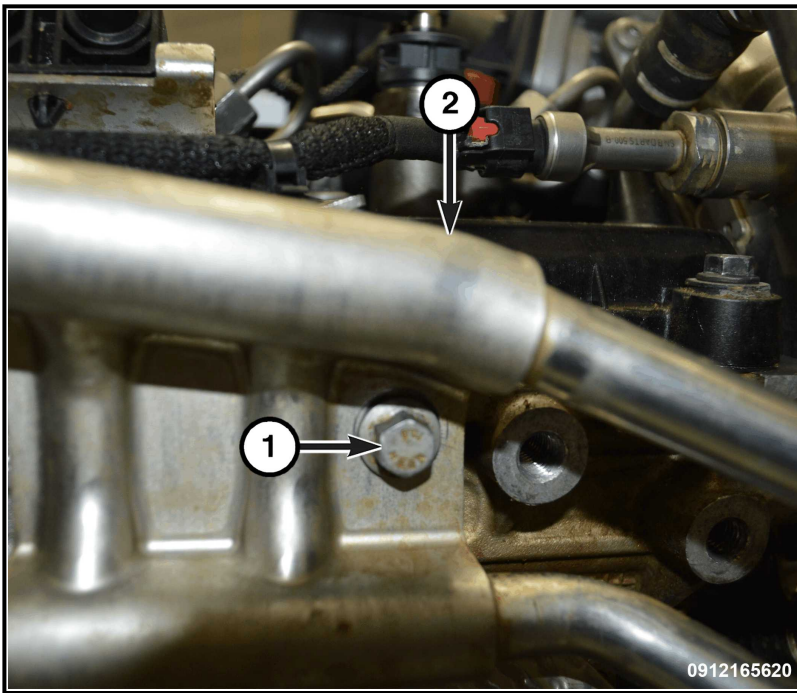
16. Remove the alignment tool bolts and (special tool #2073101090, Tool, Left Side Outboard Alignment).



1 - Upper Bolt
2 - Left Side Inboard Alignment Tool
3 - Lower Bolt

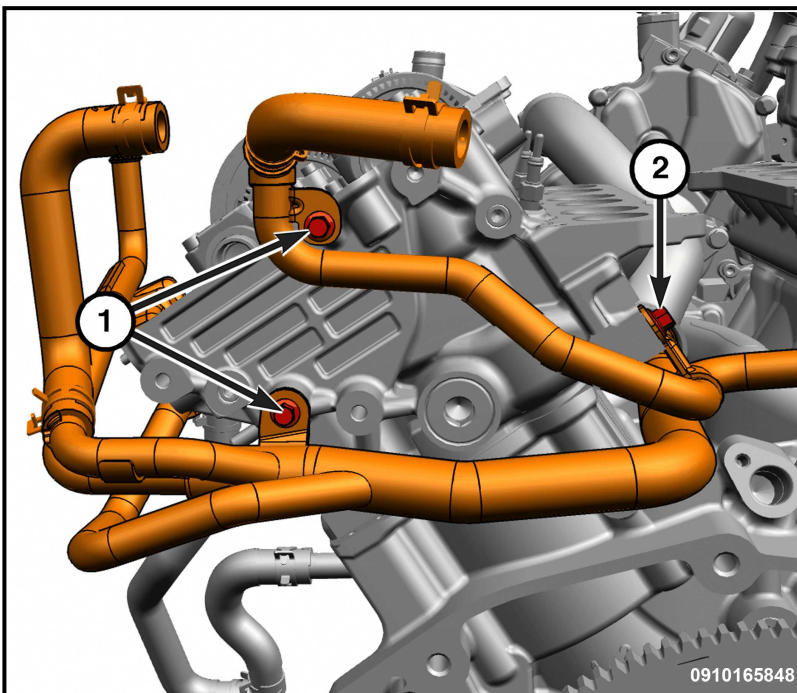
17. Remove the upper/lower bolts and (special tool #2073102090, Tool, Left Side Inboard Alignment).

18. Install the water pump housing assembly. Refer to [PUMP, WATER, REMOVAL AND INSTALLATION](#).



1 - Coolant Tube Bolt
2 - Coolant Tube

19. Install the coolant tube bolt securing the coolant tube to the side of the cylinder head and tighten to the proper torque specifications.



1 - Coolant Tube Bolts
2 - Coolant Tube Bolt

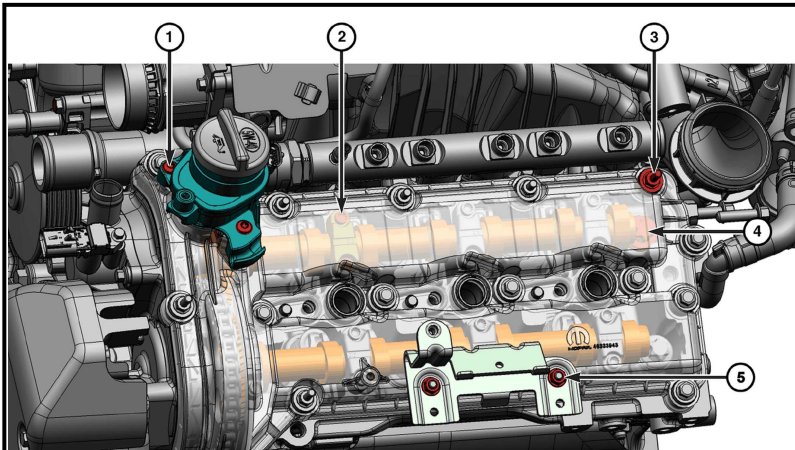
20. Install the coolant tubes bolts securing the coolant tubes to the back of the cylinder head and tighten to the proper torque specifications.
21. Install the coolant tubes bolt securing the coolant tube to the cylinder head, (intake side) and tighten to the proper torque specifications.
22. Install the Low Temperature (LT) EGR cooler. Refer to [COOLER, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#) .

NOTE: The rocker arms and hydraulic lifters must be installed in their original locations.

23. Install the rocker arms and hydraulic lifters in their original location as noted during removal.
24. Install the left side intake and exhaust camshafts. Refer to [CAMSHAFT, ENGINE, REMOVAL AND INSTALLATION](#).
25. Install the glow plugs. Refer to [GLOW PLUG, REMOVAL AND INSTALLATION](#).
26. Install the intake manifold. Refer to [MANIFOLD, INTAKE, REMOVAL AND INSTALLATION](#).
27. Install the left exhaust manifold. Refer to [MANIFOLD, EXHAUST, REMOVAL AND INSTALLATION](#).

TORQUE SPECIFICATIONS

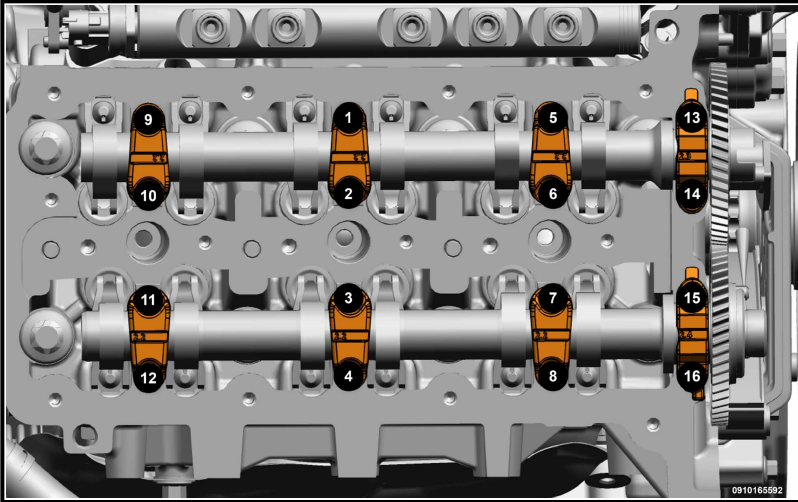
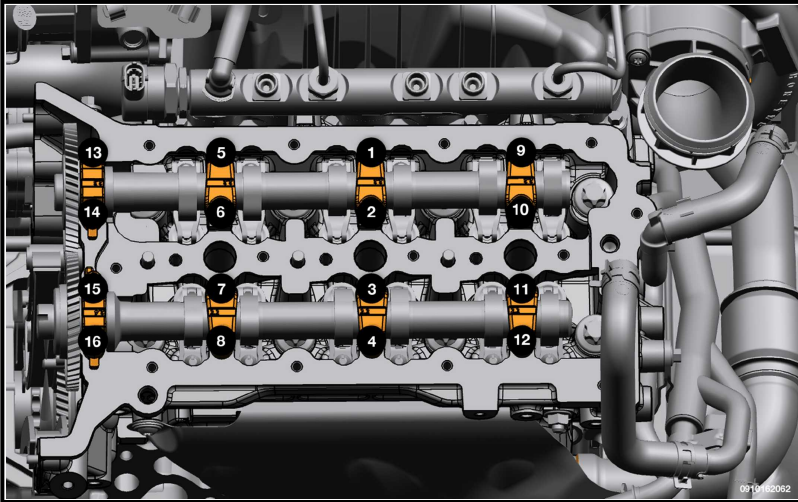
CYLINDER HEAD

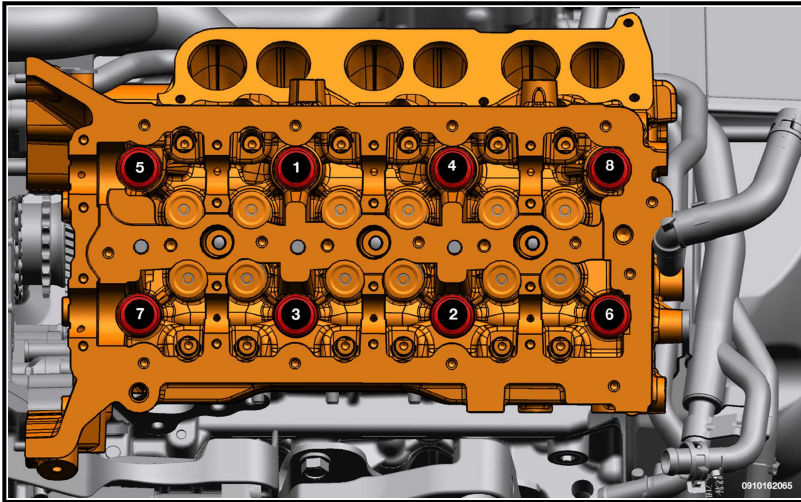
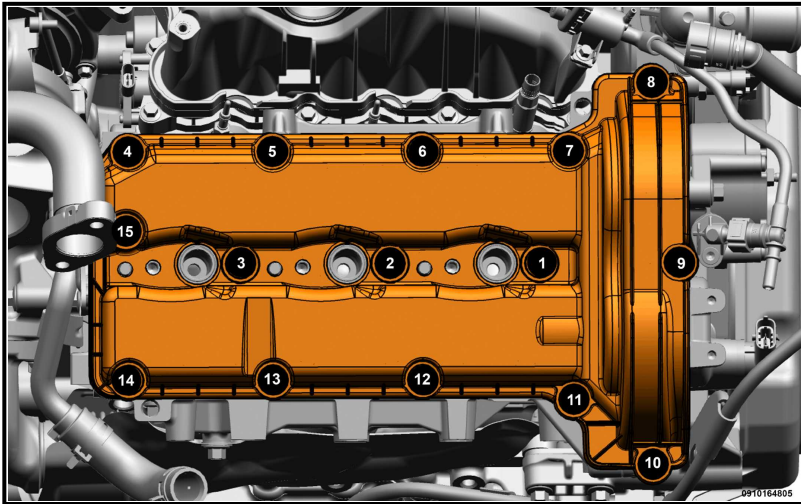
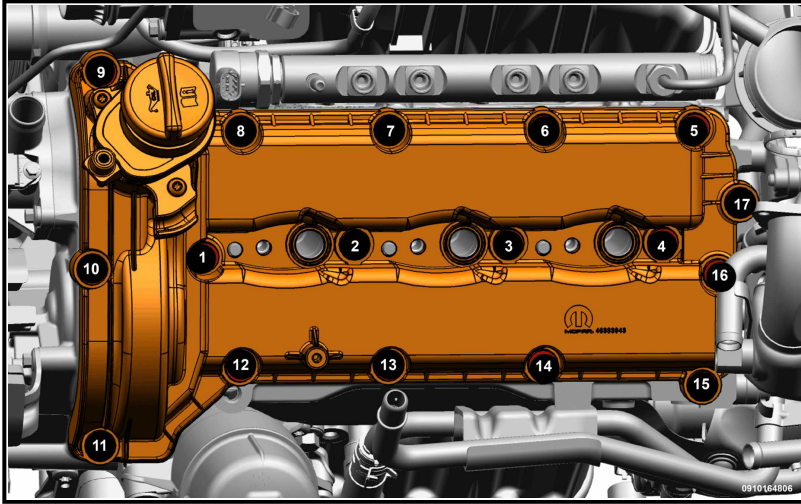


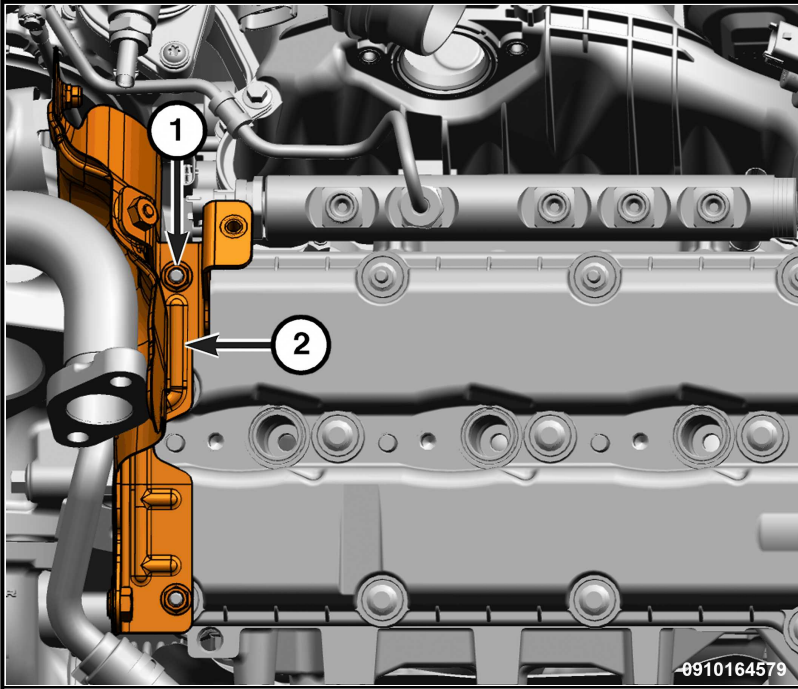
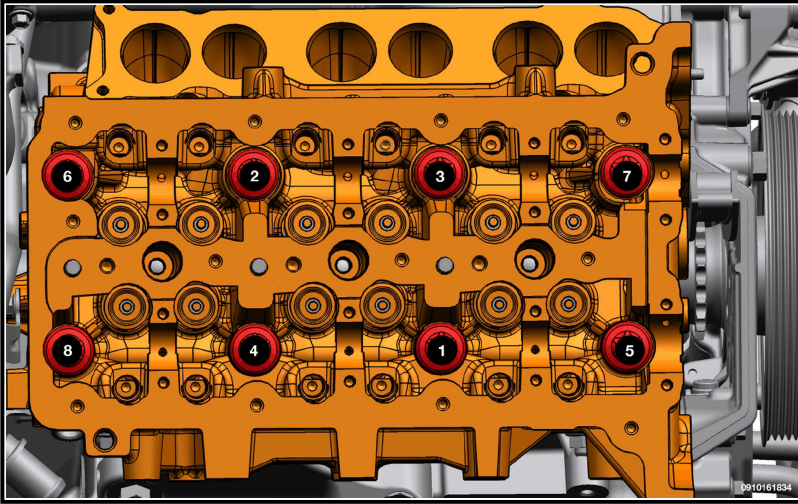
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CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1	Oil Filler Neck Assembly to Valve Cover	Tighten Securely	-
2	Camshaft Bearing Cap Bolts	11 N.m (8 Ft. Lbs.)	Tightening Sequence
3	Cylinder Head Cover Bolts	Torque Procedure: 1. Tighten the cylinder head cover bolts finger tight. 2. Tighten bolts to 8 N.m (71 In. Lbs.). 3. Loosen each bolt 90B°. 4. Tighten bolts to 10 N.m (89 In. Lbs.).	Tightening Sequence
4	Cylinder Head Bolts (M14)	Torque Procedure: 1. Tighten the cylinder head bolts finger tight. 2. Tighten bolts to 30 N.m (22 Ft. Lbs.). 3. Tighten bolts an additional 75B° in	Tightening Sequence

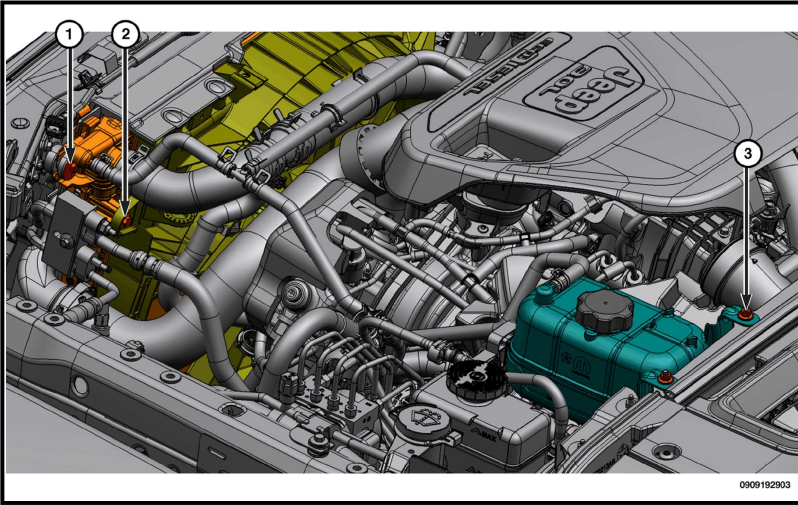
CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
		sequence. 4. Tighten bolts an additional 75B° in sequence. 5. Tighten bolts an additional 75B° in sequence.	
5	Fuel Line Support Bracket Nuts	6 N.m 53 (In. Lbs.)	-
-	Coolant Tube Bolt	25 N.m (18 Ft. Lbs.)	-
-	Engine Wire Harness Bolts	11 N.m (8 Ft. Lbs.)	-
-	Heat Shield Bracket Nuts	6 N.m 53 (In. Lbs.)	





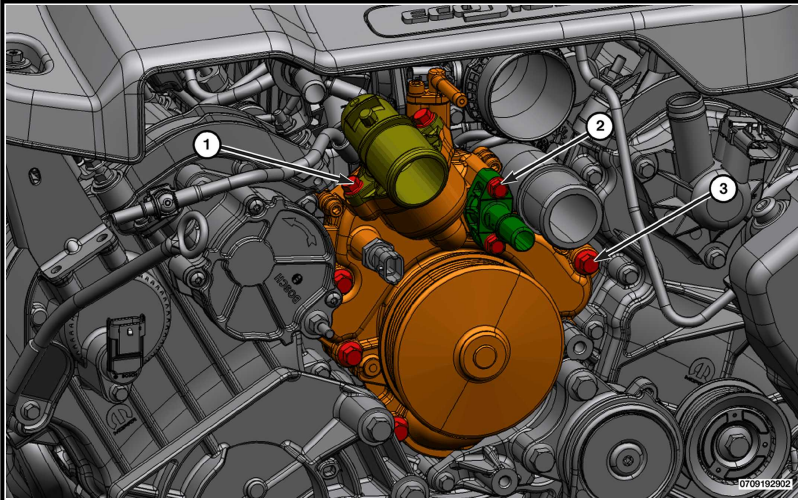


COOLING SYSTEM - 3.0L DIESEL



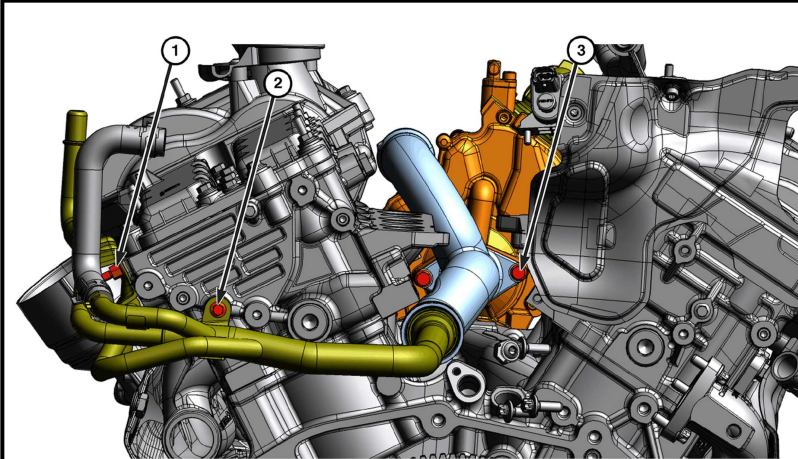
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-

CalloUT	DEscriPtiON	SPeCifiCatiON	COmmenT
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



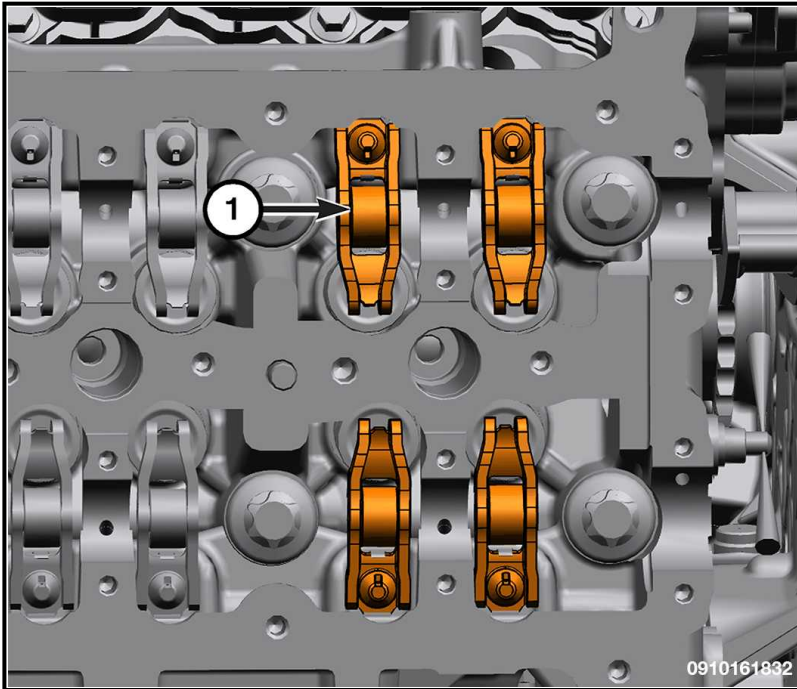
CalloUT	DEscriPtiON	SPeCifiCatiON	COmmenT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90B° and then tighten to 32 N.m (24 Ft. Lbs.).	-
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

CalloUT	DEscriPtiON	SPeCifiCatiON	COmmenT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-



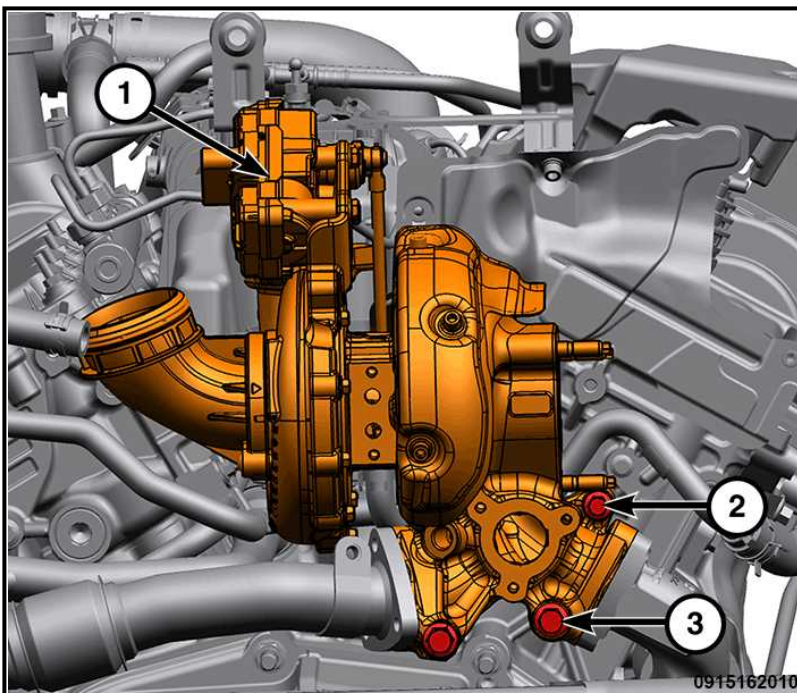
REMOVAL

1. Remove the right exhaust manifold. Refer to [MANIFOLD, EXHAUST, REMOVAL AND INSTALLATION](#) .
2. Remove the intake manifold. Refer to [MANIFOLD, INTAKE, REMOVAL AND INSTALLATION](#) .
3. Remove the glow plugs. Refer to [GLOW PLUG, REMOVAL AND INSTALLATION](#) .
4. Remove the right side intake and exhaust camshaft shafts. Refer to [CAMSHAFT, ENGINE, REMOVAL AND INSTALLATION](#).



1 - Rocker Arm

5. Remove the rocker arm/lifter assemblies and note their original location.

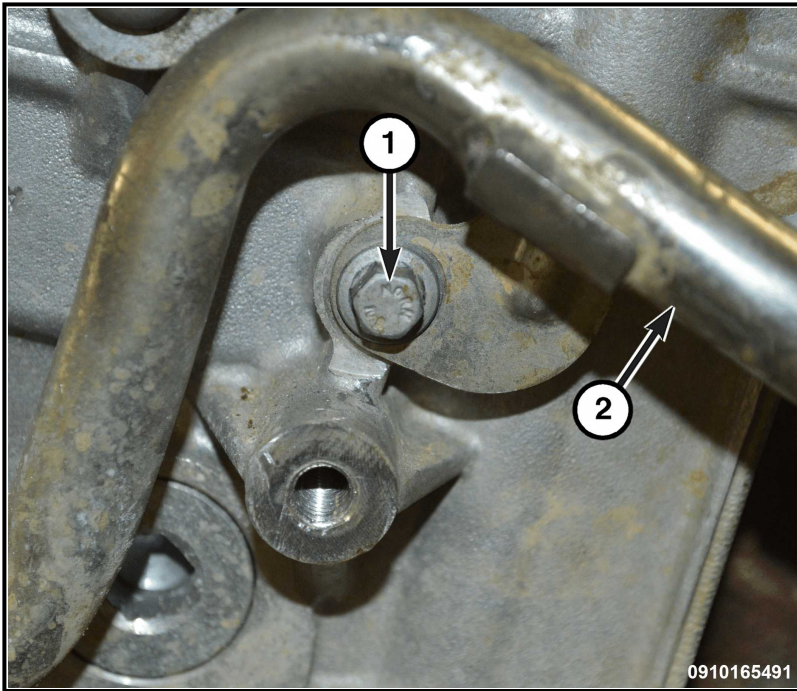


1 - Turbocharger

2 - Turbocharger Bolt

3 - Turbocharger Bolt

6. Remove the turbocharger bolts securing the turbocharger to the cylinder head.

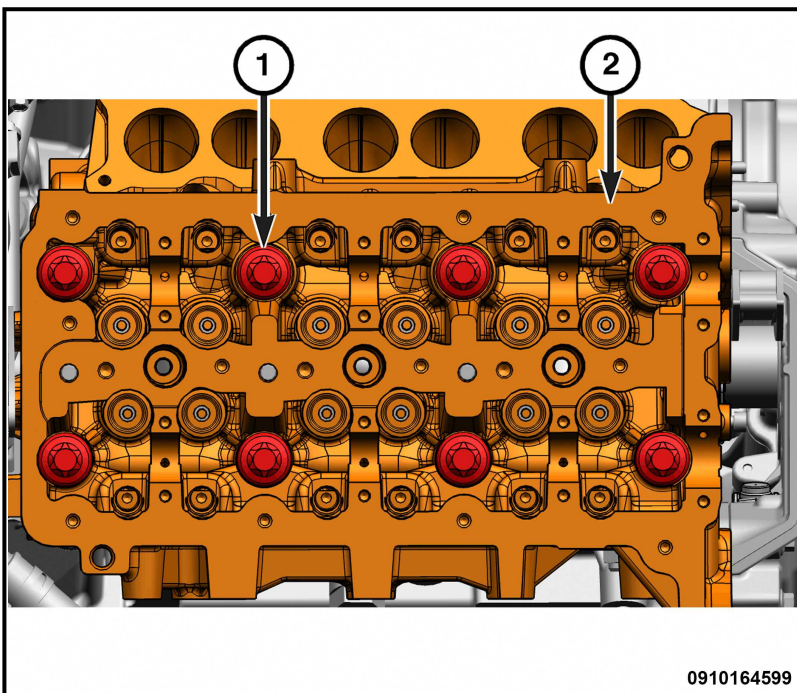


1 - Coolant Tube Bolt

2 - Coolant Tube

7. Remove the coolant tube bolt securing the coolant tube to the cylinder head.

8. Remove the water pump assembly. Refer to [PUMP, WATER, REMOVAL AND INSTALLATION](#).



1 - Cylinder Head Bolts

2 - Cylinder Head

NOTE: Do Not store the cylinder head on the sealing surface.

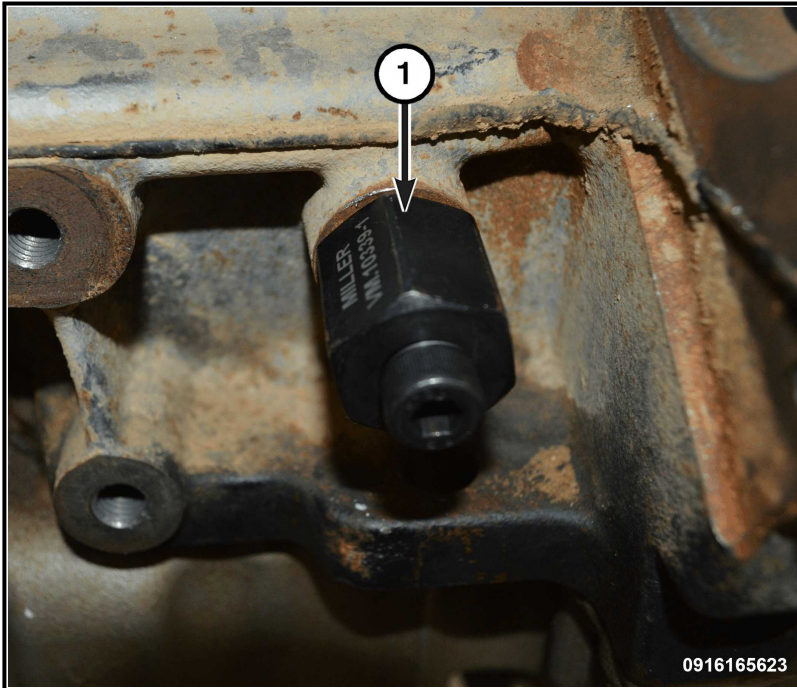
9. Remove the cylinder head bolts and the cylinder head from the engine block and discard the bolts.

10. Remove and discard the head gasket.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

1. Clean and inspect gasket mating surfaces. Refer to [CYLINDER HEAD, CLEANING](#) .



1 - Crankshaft Timing Tool

2. Remove the (special tool #VM.10339, Tool, Crankshaft Timing).



1 - Dial Indicator

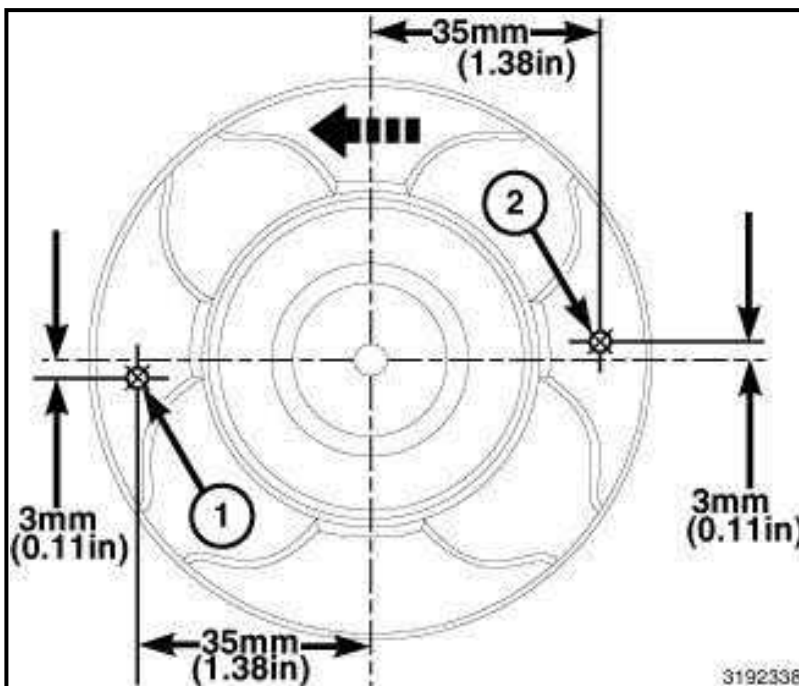
2 - Scooter Block

3. Set the number one piston to top dead center (TDC).
4. Using the (special tool #D-115-2A, Block, Scooter) and the (special tool #C-3339A, Set, Dial Indicator), position the dial indicator flat on the cylinder block head surface and zero the dial indicator.



1 - Dial Indicator
2 - Piston

5. Position the scooter block with dial indicator onto the piston.

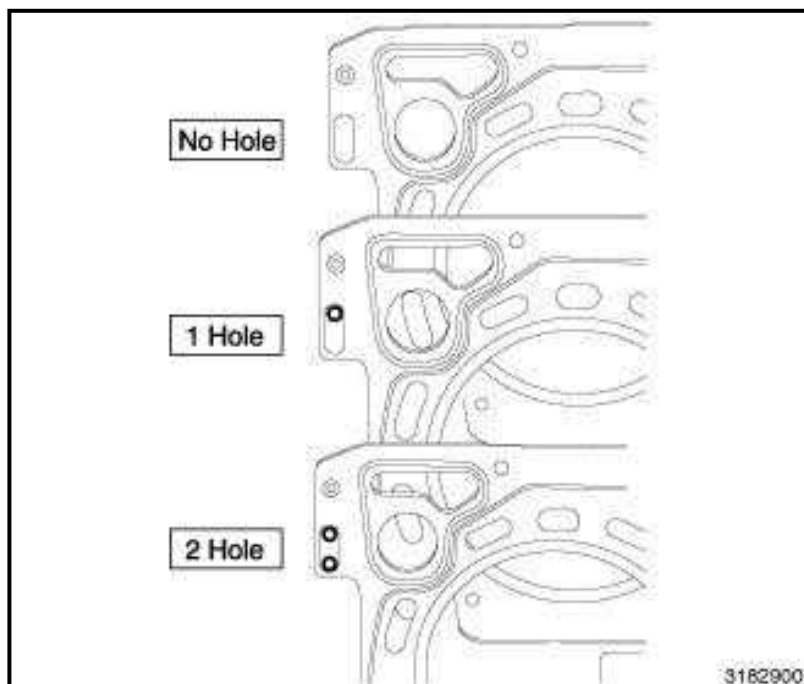


1 - Front Measurement Location
2 - Rear Measurement Location

6. Measure the front height of the piston in the location illustrated and record measurement.
7. Measure the rear height of the piston in the location illustrated and record measurement.
8. Repeat the procedure for each cylinder.
9. Average the 3 pistons protrusion readings to determine the required gasket thickness.

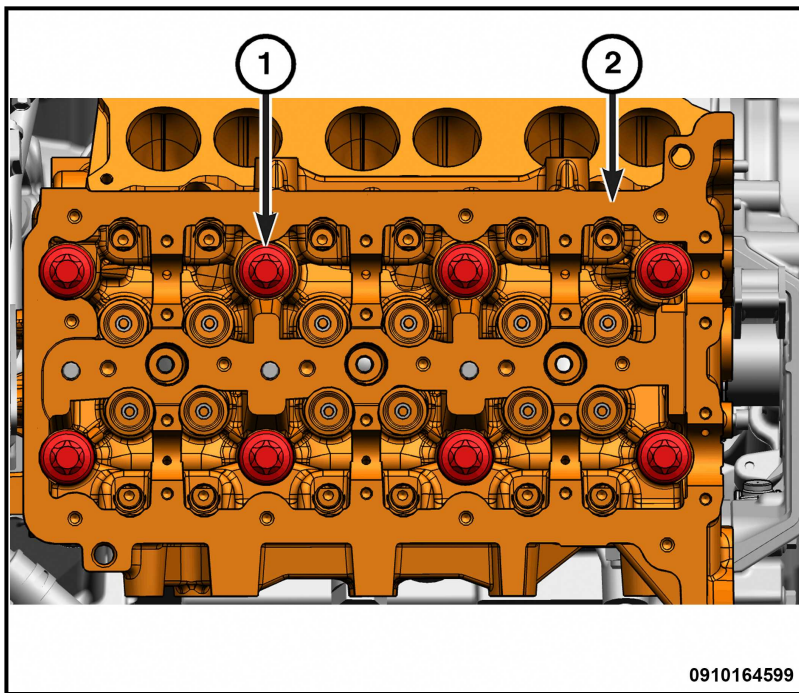
HEAD GASKET SELECTION CHART		
B	Metric	Standard
PISTON CLEARANCE	0.130 - 0.220 mm	0.0051 - 0.0086 in.

HEAD GASKET SELECTION CHART		
CYLINDER HEAD GASKET THICKNESS	0.96 mm	0.0377 in.
GASKET IDENTIFICATION	NO HOLE	
B		
PISTON CLEARANCE	0.221 - 0.310 mm	0.0087 - 0.0122 in.
CYLINDER HEAD GASKET THICKNESS	1.06 mm	0.0417 in.
GASKET IDENTIFICATION	ONE HOLE	
B		
PISTON CLEARANCE	0.311 - 0.402 mm	0.0122 - 0.0158 in.
CYLINDER HEAD GASKET THICKNESS	1.16 mm	0.0456 in.
GASKET IDENTIFICATION	TWO HOLES	



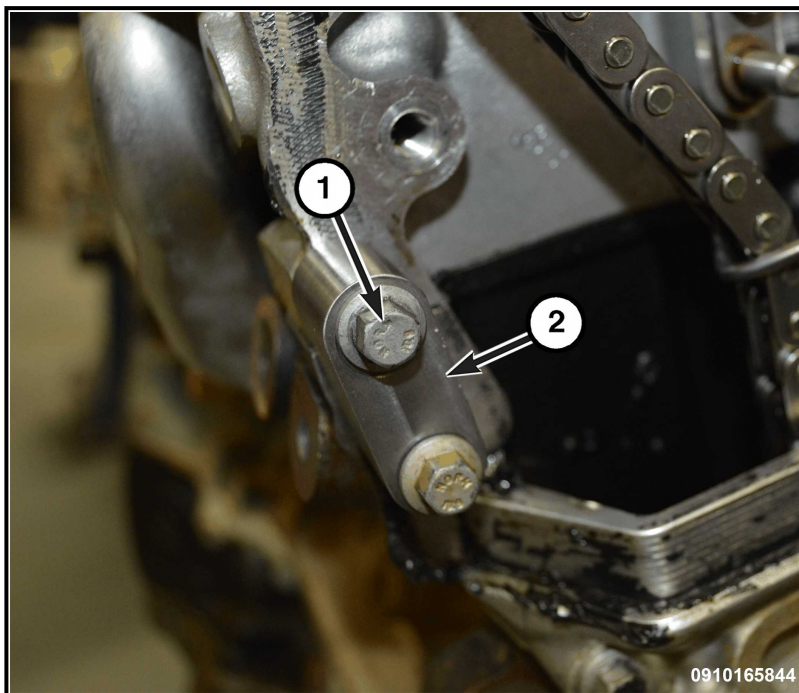
NOTE: The above illustration shows gasket identification marks.

10. Select the appropriate cylinder head gasket from the cylinder head gasket chart.
11. Install the **NEW** head gasket to the engine block. Be sure the coolant passages align (part number should be facing up).



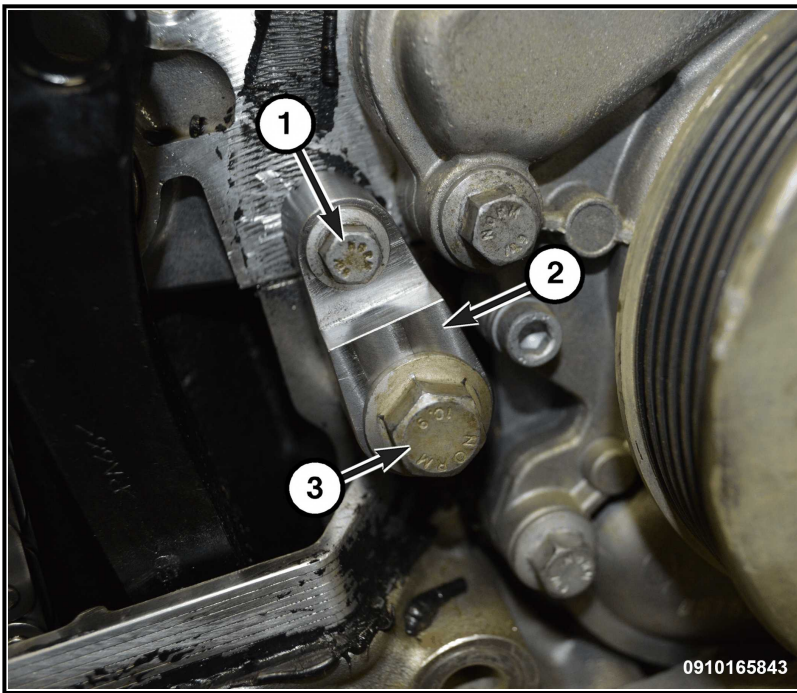
1 - Cylinder Head Bolts
2 - Cylinder Head

12. Install the cylinder head to the engine and tighten the **NEW** cylinder head bolts finger tight.



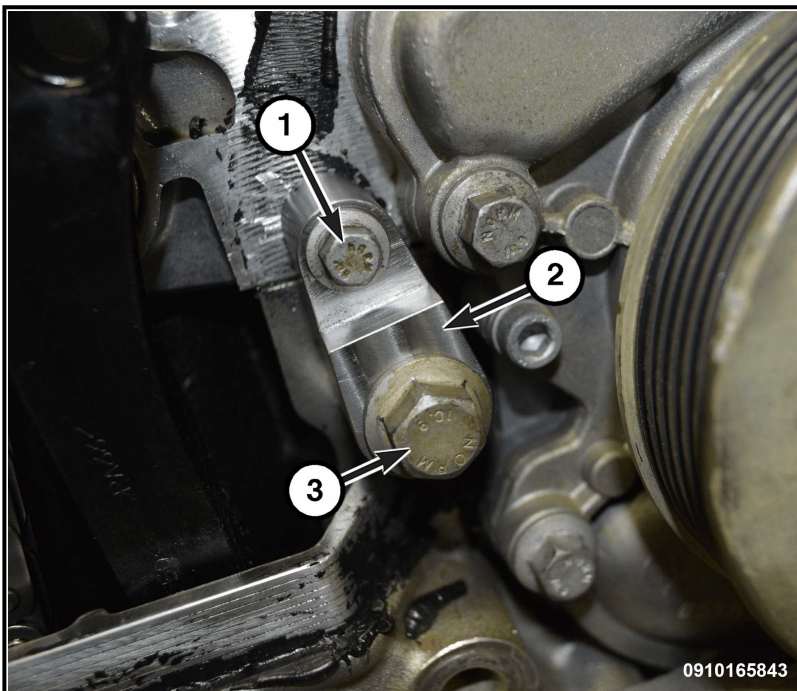
1 - Alignment Tool Bolts
2 - Right Side Outboard Alignment Tool

13. Install the (special tool #2073103090, Tool, Right Side Outboard Alignment) and securely tighten the alignment tool bolts.



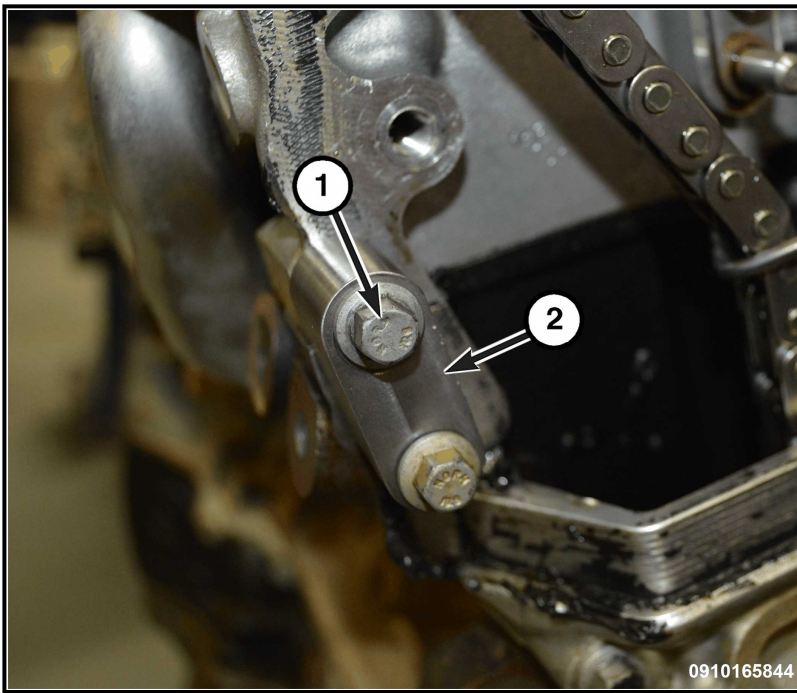
1 - Alignment Tool Upper Bolt
2 - Right Side Inboard Alignment Tool
3 - Alignment Tool Lower Bolt

14. Install the (special tool #2073104090, Tool, Right Side Inboard Alignment) and securely tighten the alignment tool upper/lower bolts.
15. Using the tightening sequence shown in the torque table below, tighten the cylinder head bolts to proper torque specifications.



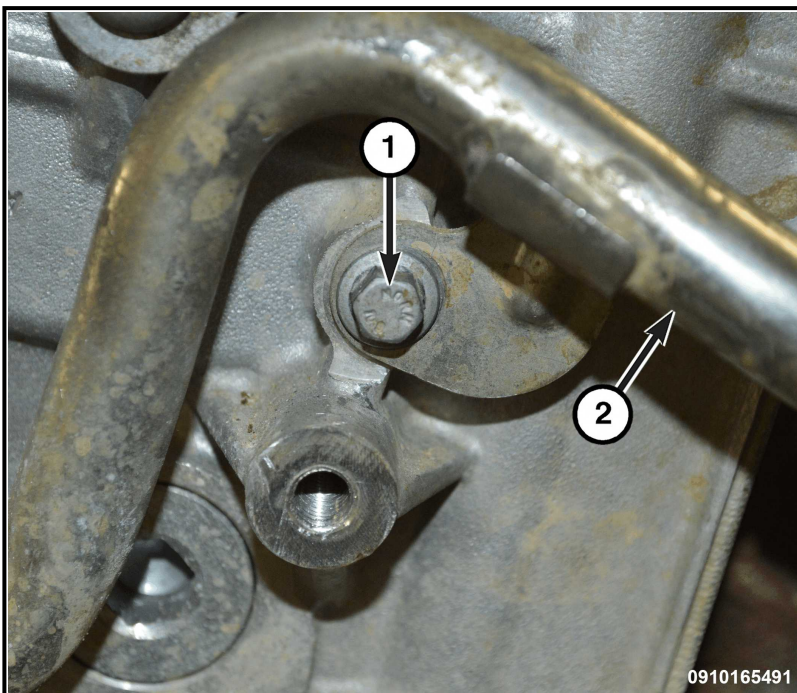
1 - Upper Bolt
2 - Right Side Inboard Alignment Tool
3 - Lower Bolt

16. Remove the alignment tool bolts and (special tool #2073104090, Tool, Right Side Inboard Alignment).



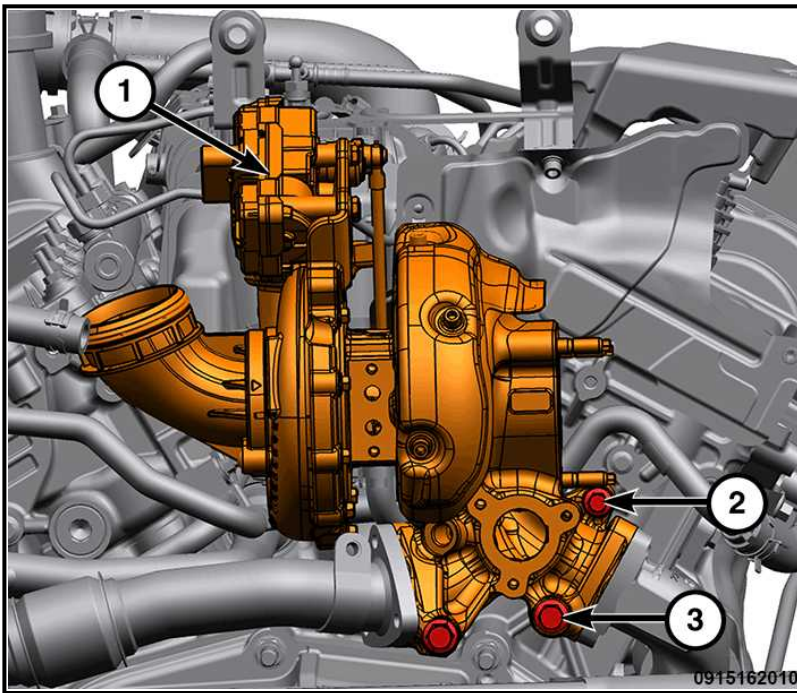
1 - Alignment Tool Bolts
2 - Right side Outboard Alignment Tool

17. Remove the alignment tool bolts and (special tool #2073103090, Tool, Right Side Outboard Alignment).



1 - Coolant Tube Bolt
2 - Coolant Tube

18. Install the coolant tube bolt securing the coolant tube to the cylinder head and tighten to the proper torque specifications.

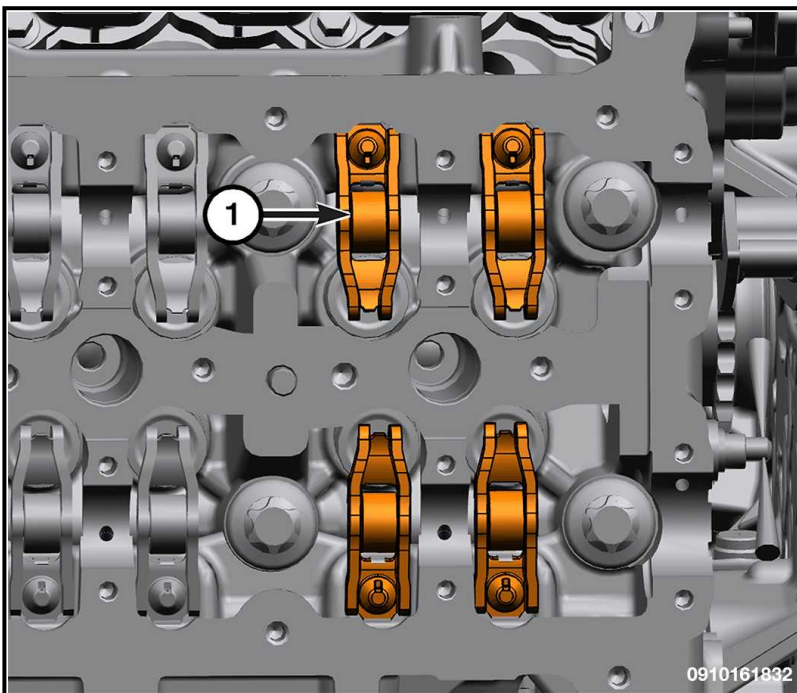


1 - Turbocharger

2 - Turbocharger Bolt

3 - Turbocharger Bolt

19. Install the turbocharger bolts securing the turbocharger to the cylinder head and tighten to the proper torque specifications.
20. Install the water pump. Refer to [PUMP, WATER, REMOVAL AND INSTALLATION](#).



1 - Rocker Arm

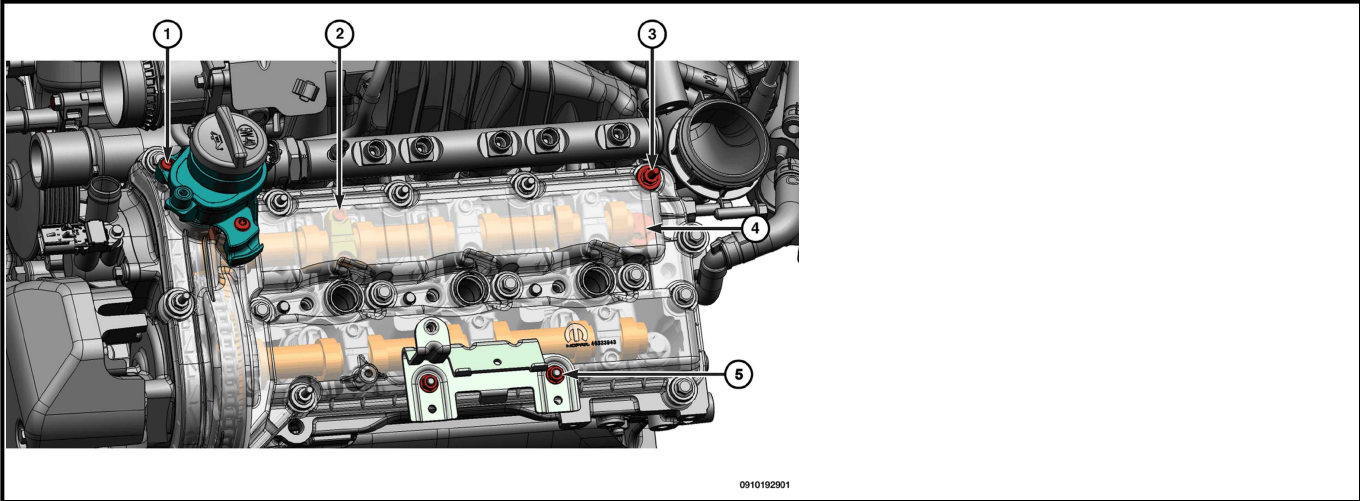
NOTE: Rocker arm/lifter assemblies must be installed in same location as when removed.

21. Install the rocker arm/lifter assembly into their original position as noted during removal.
22. Install the right side intake and exhaust camshafts. Refer to [CAMSHAFT, ENGINE, REMOVAL AND INSTALLATION](#).

- 23. Install the glow plugs. Refer to [GLOW PLUG, REMOVAL AND INSTALLATION](#) .
- 24. Install the intake manifold. Refer to [MANIFOLD, INTAKE, REMOVAL AND INSTALLATION](#) .
- 25. Install the right exhaust manifold. Refer to [MANIFOLD, EXHAUST, REMOVAL AND INSTALLATION](#) .

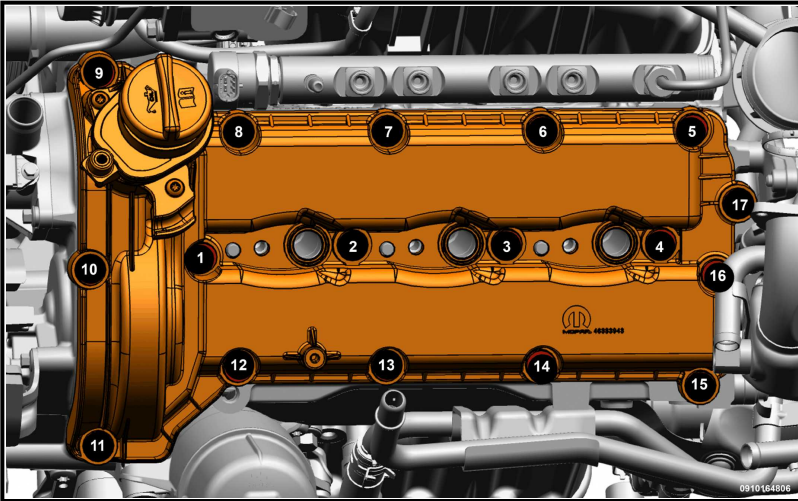
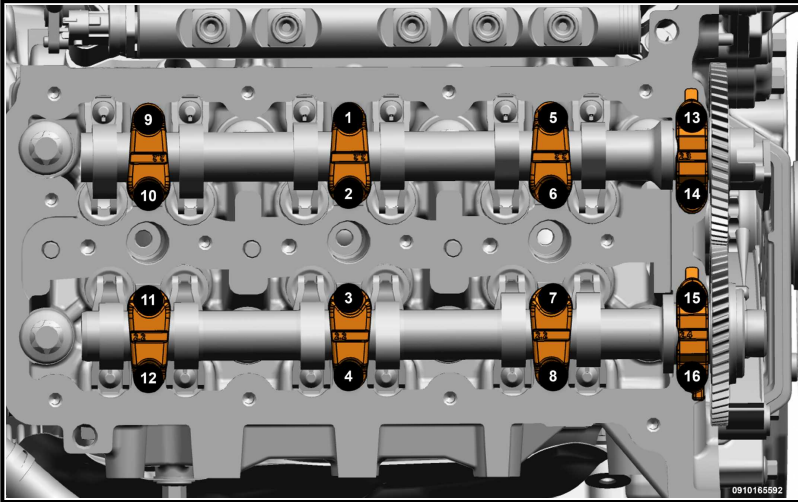
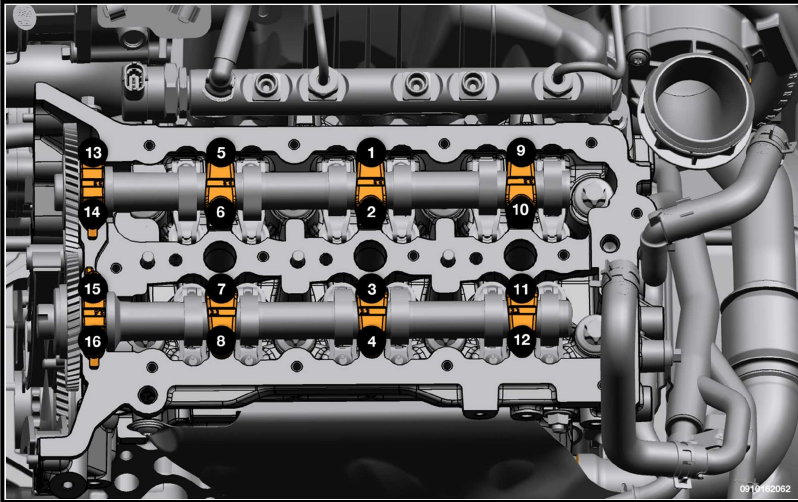
TORQUE SPECIFICATIONS

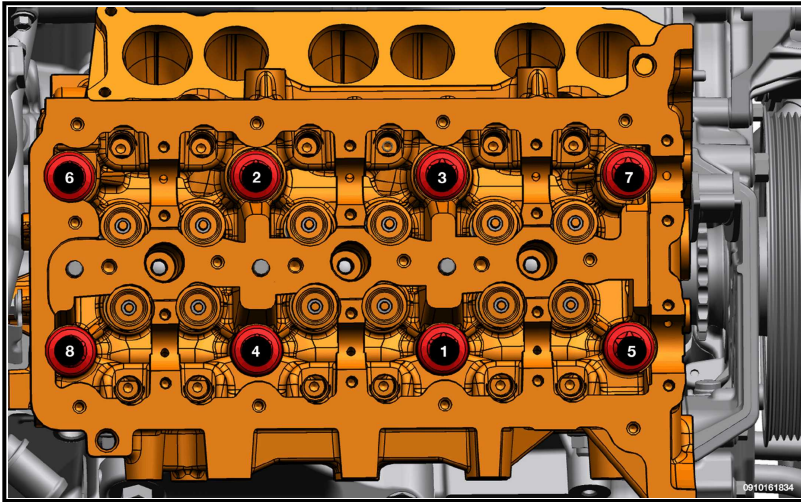
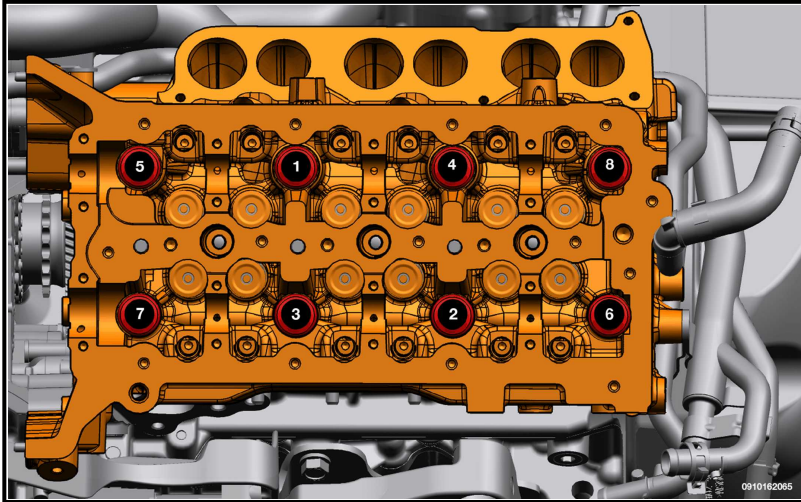
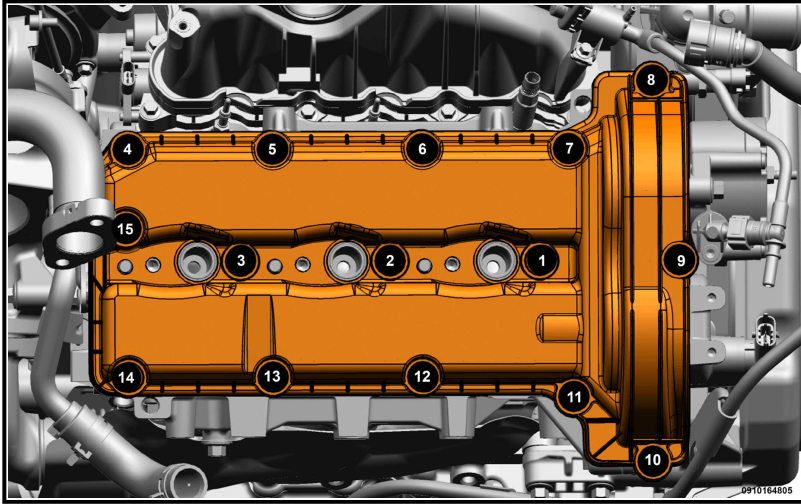
CYLINDER HEAD

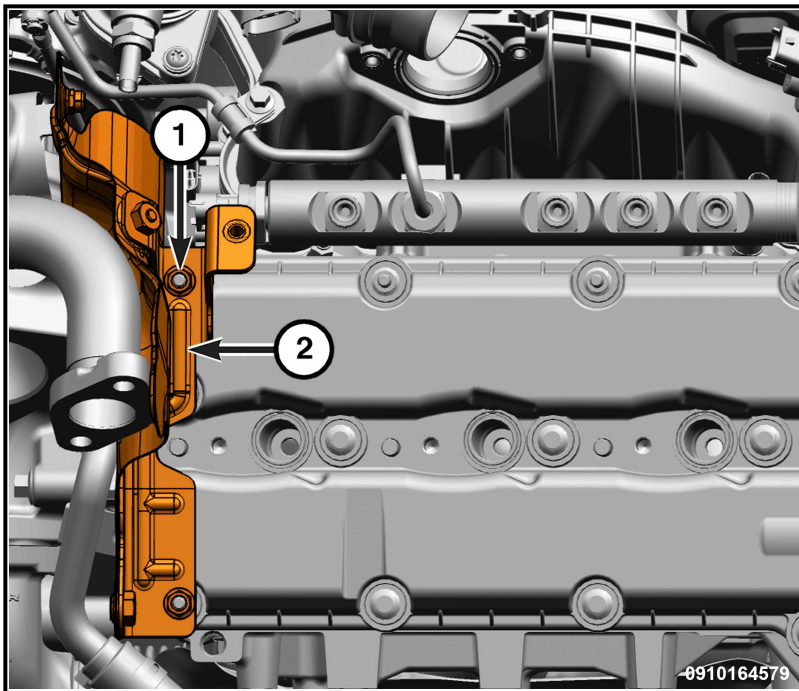


CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1	Oil Filler Neck Assembly to Valve Cover	Tighten Securely	-
2	Camshaft Bearing Cap Bolts	11 N.m (8 Ft. Lbs.)	Tightening Sequence
3	Cylinder Head Cover Bolts	Torque Procedure: 1. Tighten the cylinder head cover bolts finger tight. 2. Tighten bolts to 8 N.m (71 In. Lbs.). 3. Loosen each bolt 90B°. 4. Tighten bolts to 10 N.m (89 In. Lbs.).	Tightening Sequence
4	Cylinder Head Bolts (M14)	Torque Procedure: 1. Tighten the cylinder head bolts finger tight. 2. Tighten bolts to 30 N.m (22 Ft. Lbs.). 3. Tighten bolts an additional 75B° in sequence. 4. Tighten bolts an additional 75B° in sequence.	Tightening Sequence

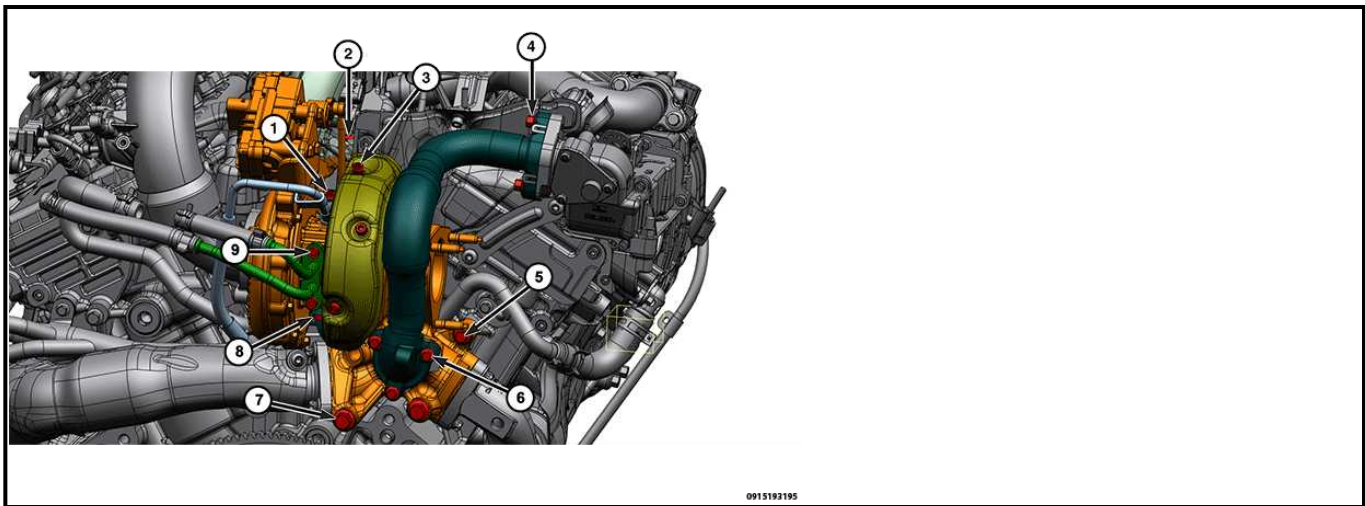
CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
		5. Tighten bolts an additional 75B° in sequence.	
5	Fuel Line Support Bracket Nuts	6 N.m 53 (In. Lbs.)	-
-	Coolant Tube Bolt	25 N.m (18 Ft. Lbs.)	-
-	Engine Wire Harness Bolts	11 N.m (8 Ft. Lbs.)	-
-	Heat Shield Bracket Nuts	6 N.m 53 (In. Lbs.)	







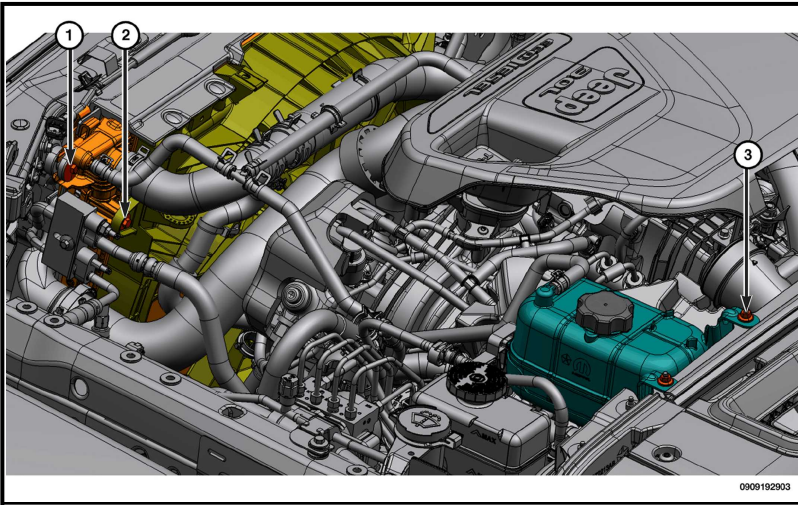
TURBOCHARGER



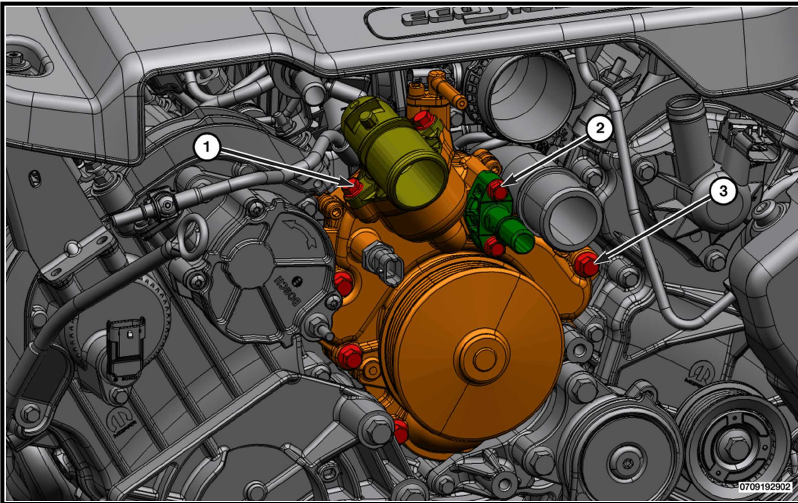
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

COOLING SYSTEM - 3.0L DIESEL

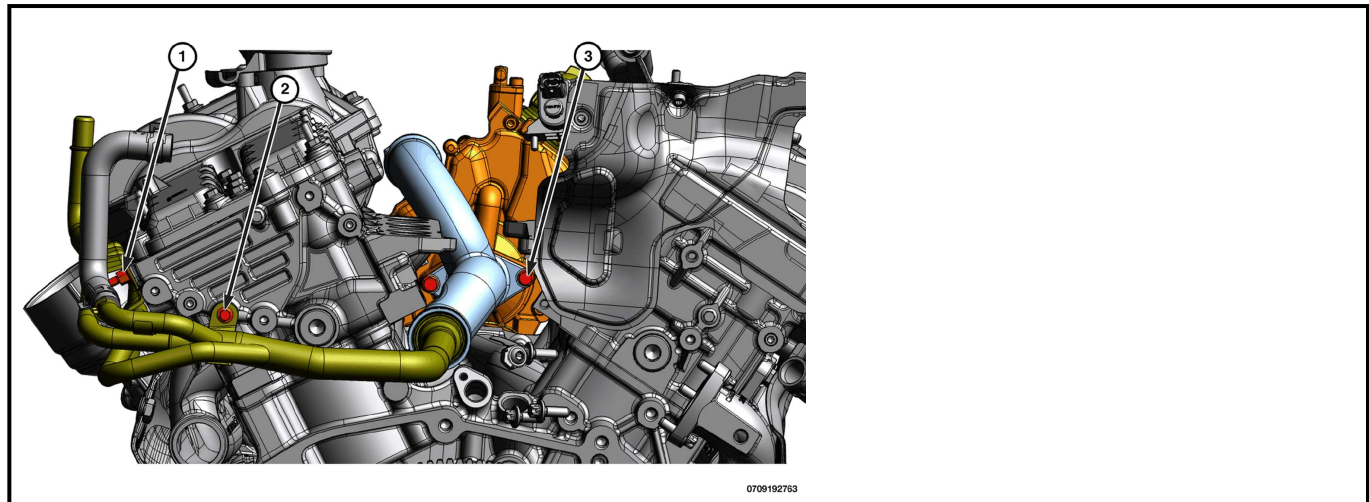


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90B° and then tighten to 32 N.m (24 Ft. Lbs.).	-
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-



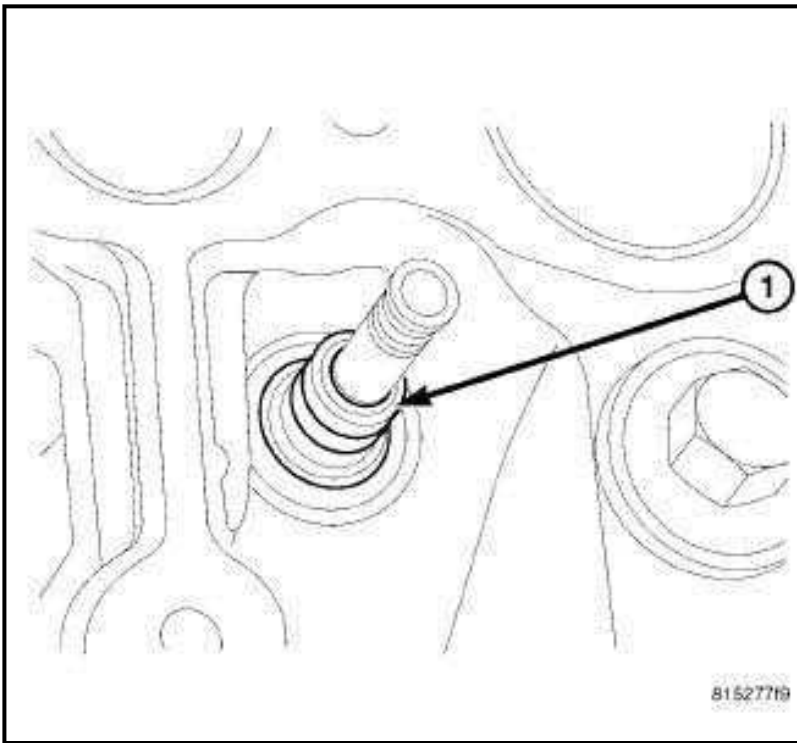
DISASSEMBLY AND ASSEMBLY

DISASSEMBLY AND ASSEMBLY - OFF VEHICLE

DISASSEMBLY

The intake and exhaust valves and springs are **NOT** interchangeable. Mark the valves and springs accordingly for installation. Correctly identify the part numbers for **NEW** springs being installed.

1. Use Valve Spring Compressor Tool (special tool #C-3422-D, Compressor, Valve Spring) and Valve Spring Compressor Adapter (special tool #10224, Adapter, Valve Spring) and compress each valve spring.
2. Remove the valve locks, retainers, and springs.
3. Use a smooth stone or a jewelers file to remove any burrs on the top of the valve stem, especially around the groove for the locks.
4. Remove the valves, and place them in a rack in the same order as removed.



1 - Typical Valve Seal

5. Remove the valve seal.
6. Repeat this procedure for all cylinders.

ASSEMBLY

Follow the disassembly procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Verify that the garter spring is intact around the top of the valve guide seal.
- Coat the valve stems with clean engine oil and install the valves into the cylinder head.

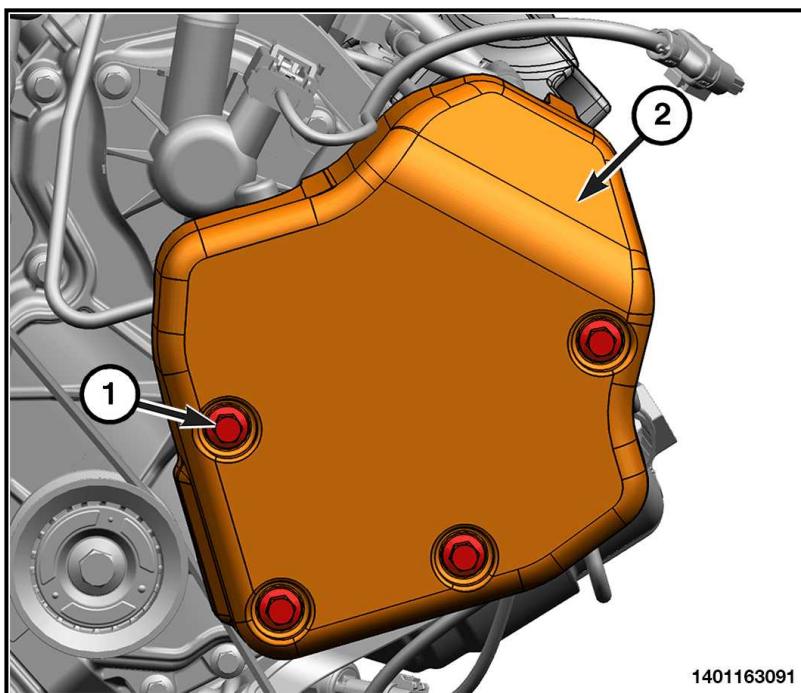
COVER(S), CYLINDER HEAD

REMOVAL AND INSTALLATION

LEFT BANK

REMOVAL

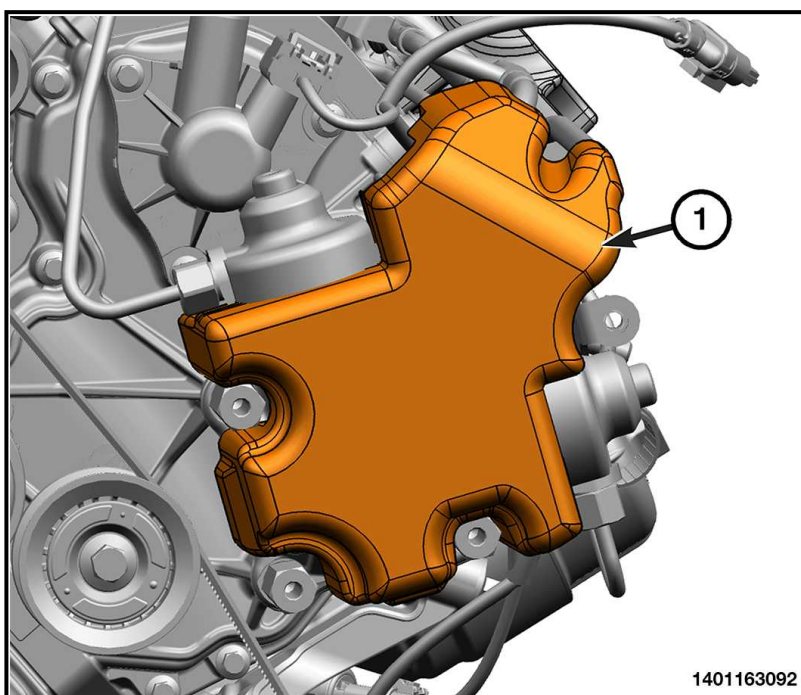
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
3. Drain the cooling system. Refer to [DRAINING](#) .
4. Remove the support and lower the vehicle.
5. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
6. Remove the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#) .
7. Remove the air cleaner body. Refer to [BODY, AIR CLEANER, REMOVAL AND INSTALLATION](#) .
8. Remove the left bank fuel injectors. Refer to [INJECTOR\(S\), FUEL, REMOVAL AND INSTALLATION](#) .
9. Remove the low pressure EGR valve. Refer to [VALVE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#) .
10. Disconnect the heater hose.



1 - Fuel Injection Pump Blocker Plate Cover Bolts

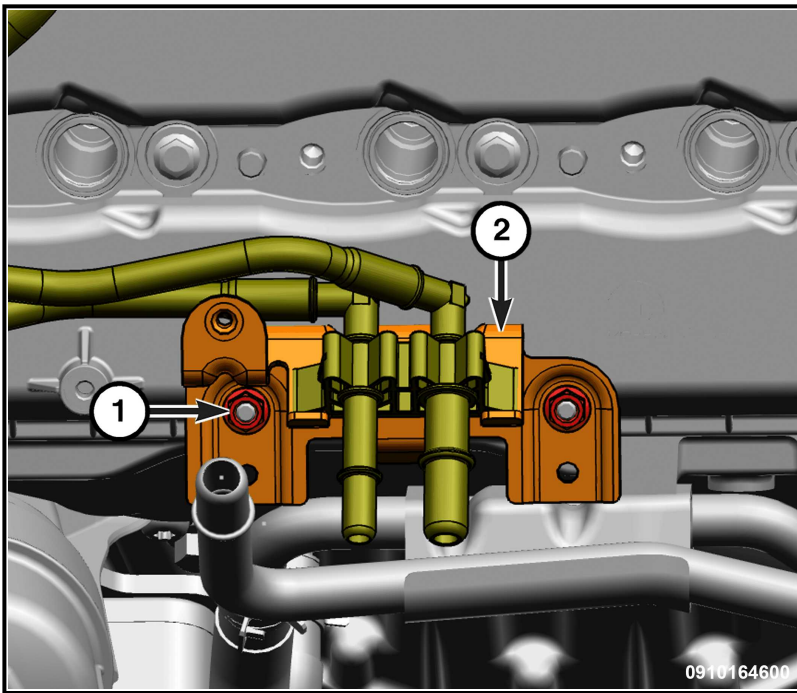
2 - Fuel Injection Pump Blocker Plate Cover

11. Remove the fuel injection pump blocker plate cover bolts and the fuel injection pump blocker plate cover.



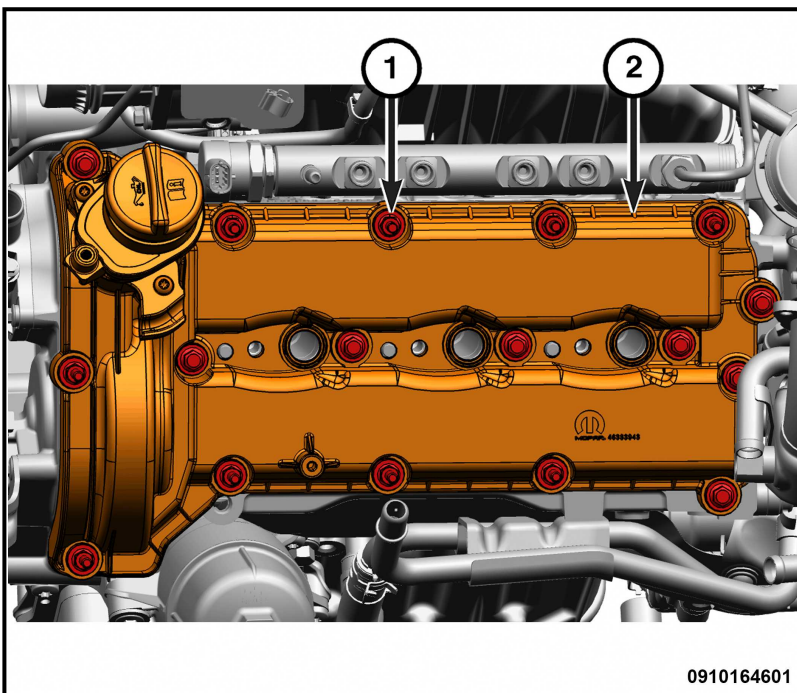
1 - Fuel Injection Pump Silencer

12. Remove the fuel injection pump silencer.
13. Disconnect the low pressure supply and return lines and position aside. Refer to [STANDARD PROCEDURE](#).



1 - Fuel Line Bracket Nuts
2 - Fuel Line Bracket

14. Remove the fuel line bracket nuts and the fuel line bracket.
15. Disconnect the brake booster vacuum hose.
16. Disconnect the two heater hoses at bulk head.
17. Disconnect the glow plug wire harness connector.



1 - Left Cylinder Head Cover Bolts
2 - Left Cylinder Head Cover

18. Loosen the left cylinder head cover bolts and remove the left cylinder head cover.

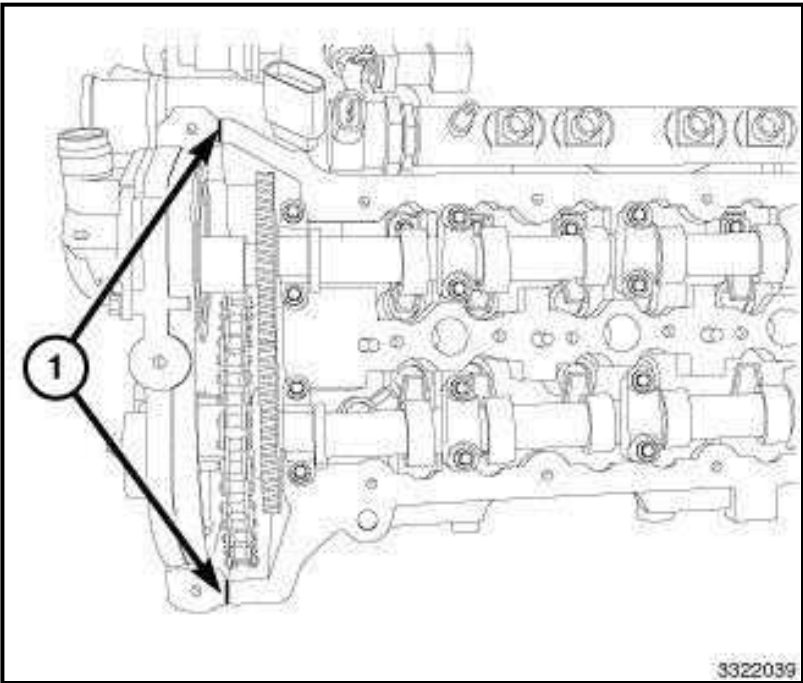
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

NOTE: The cylinder head cover gasket is not serviceable, if the gasket is found to be defective then a new cylinder head cover must be installed.

- Clean and inspect all sealing surfaces and the gasket for damage and replace the cylinder head cover with a new one if the gasket is found to be defective. Refer to [STANDARD PROCEDURE](#) .

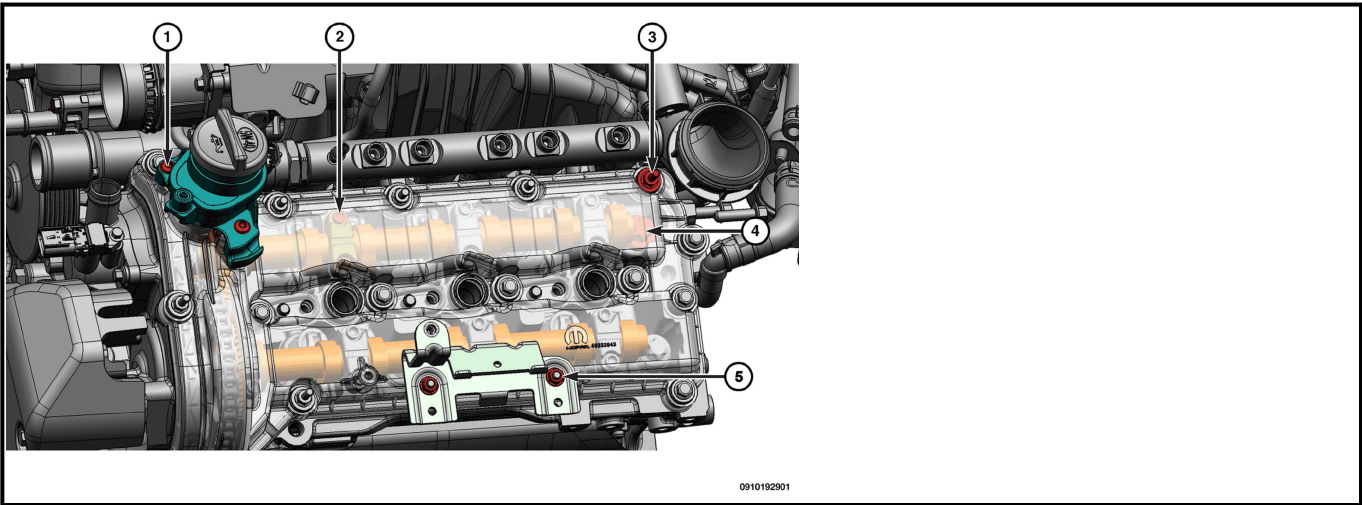


1 - T-joints

- Apply a 3 mm wide bead of MoparB® Threebond Engine RTV Sealant at the T-joints.
- The cylinder head cover bolts must be tightened in the sequence shown in the torque table below to proper torque specifications.

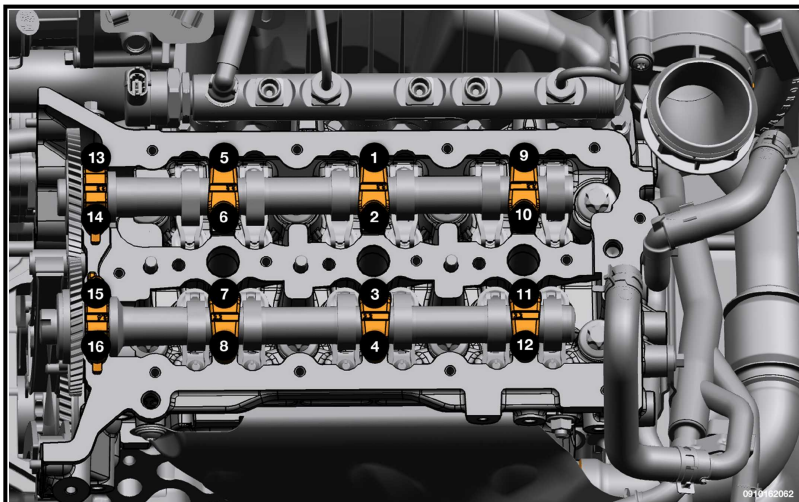
TORQUE SPECIFICATIONS

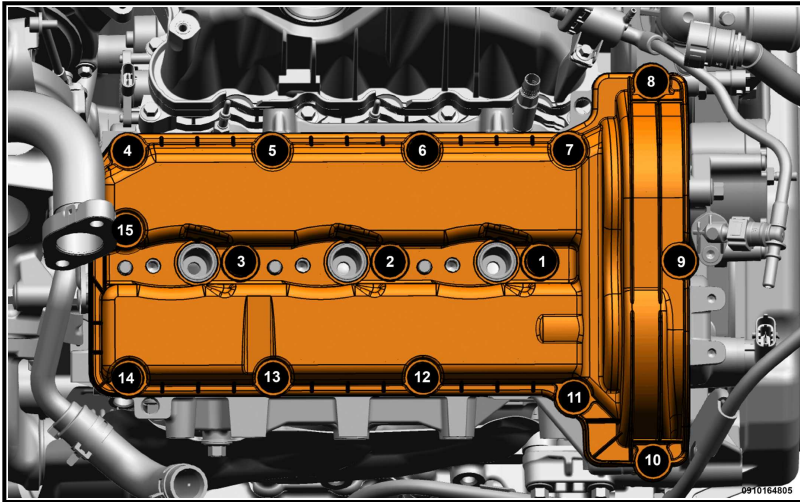
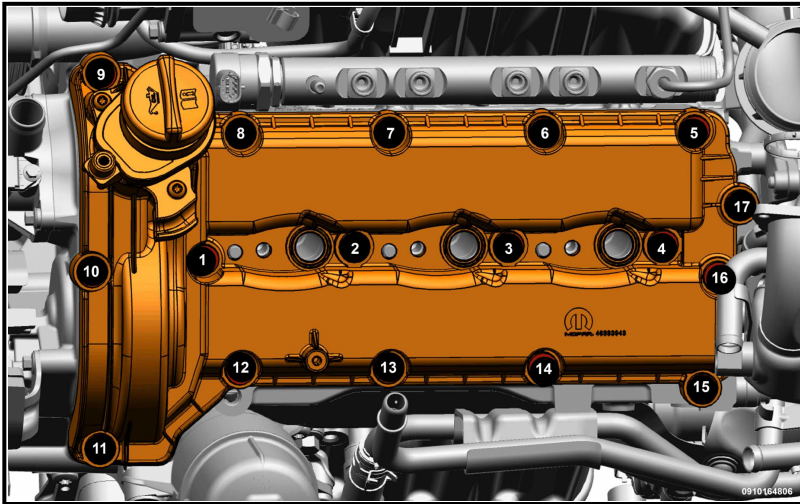
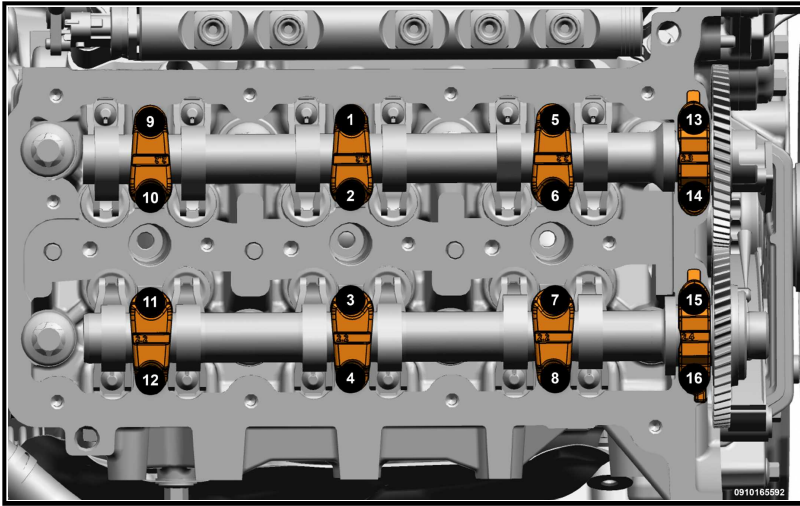
CYLINDER HEAD

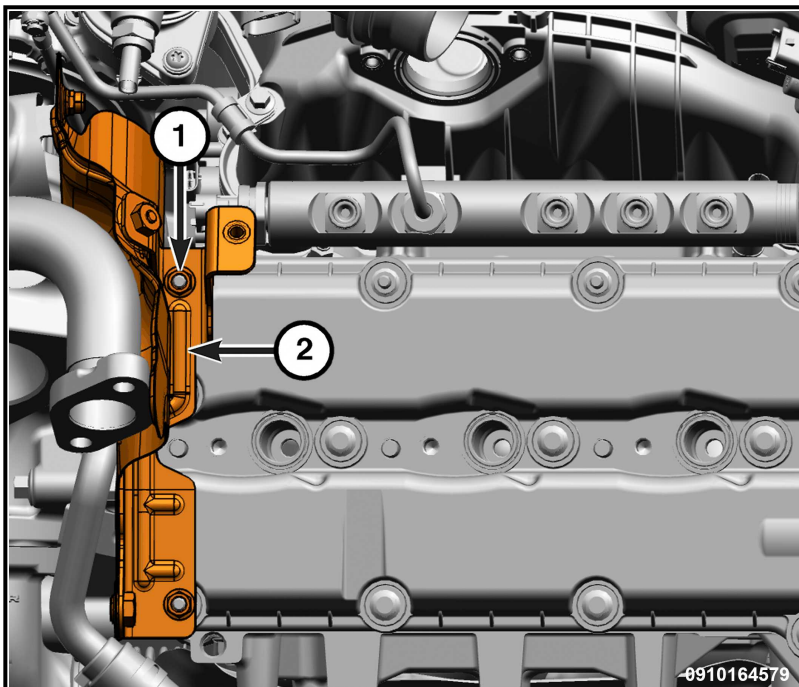
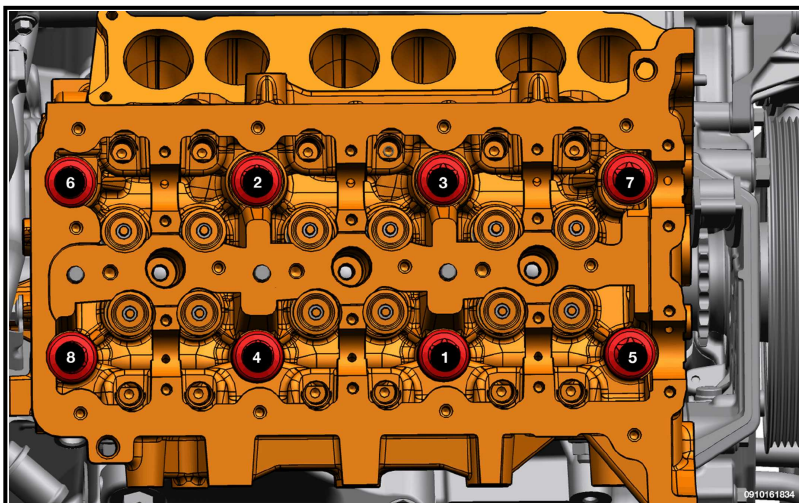
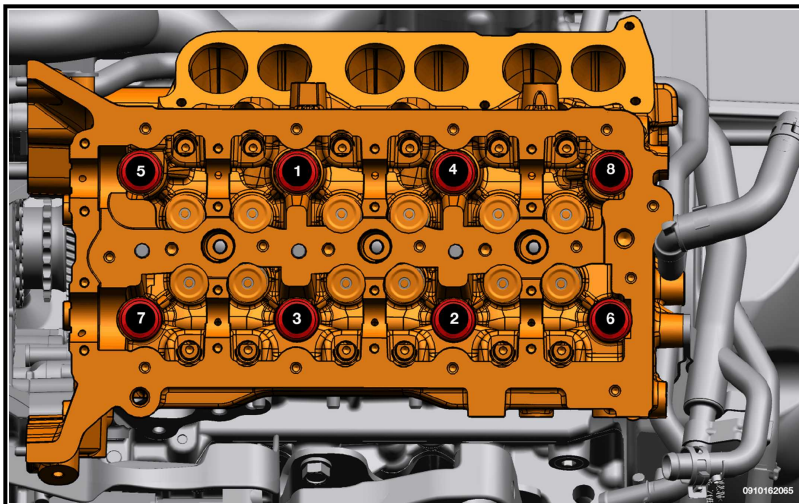


CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1	Oil Filler Neck Assembly to Valve Cover	Tighten Securely	-

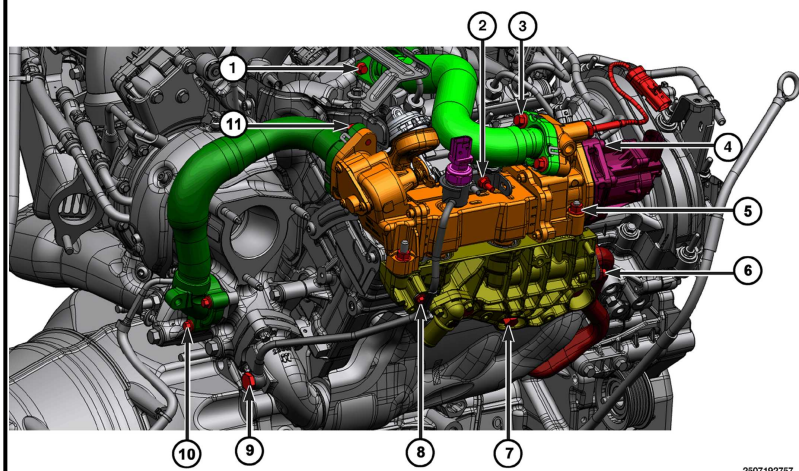
CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
2	Camshaft Bearing Cap Bolts	11 N.m (8 Ft. Lbs.)	Tightening Sequence
3	Cylinder Head Cover Bolts	Torque Procedure: 1. Tighten the cylinder head cover bolts finger tight. 2. Tighten bolts to 8 N.m (71 In. Lbs.). 3. Loosen each bolt 90B°. 4. Tighten bolts to 10 N.m (89 In. Lbs.).	Tightening Sequence
4	Cylinder Head Bolts (M14)	Torque Procedure: 1. Tighten the cylinder head bolts finger tight. 2. Tighten bolts to 30 N.m (22 Ft. Lbs.). 3. Tighten bolts an additional 75B° in sequence. 4. Tighten bolts an additional 75B° in sequence. 5. Tighten bolts an additional 75B° in sequence.	Tightening Sequence
5	Fuel Line Support Bracket Nuts	6 N.m 53 (In. Lbs.)	-
-	Coolant Tube Bolt	25 N.m (18 Ft. Lbs.)	-
-	Engine Wire Harness Bolts	11 N.m (8 Ft. Lbs.)	-
-	Heat Shield Bracket Nuts	6 N.m 53 (In. Lbs.)	







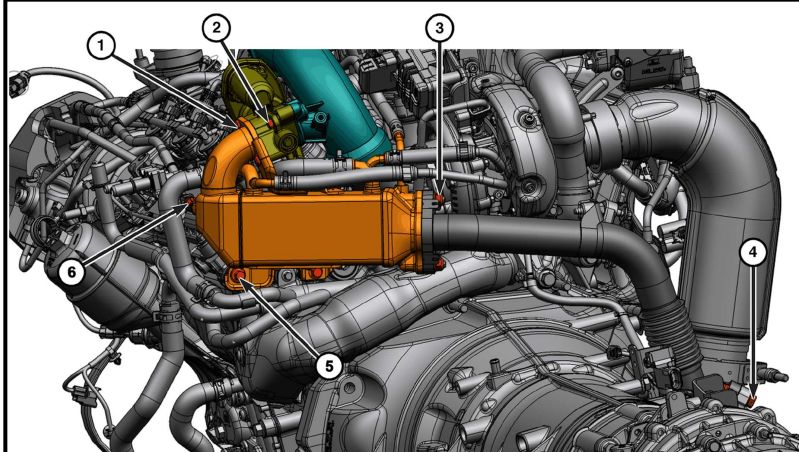
EGR SYSTEM



2507192757

HIGH PRESSURE EGR

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-

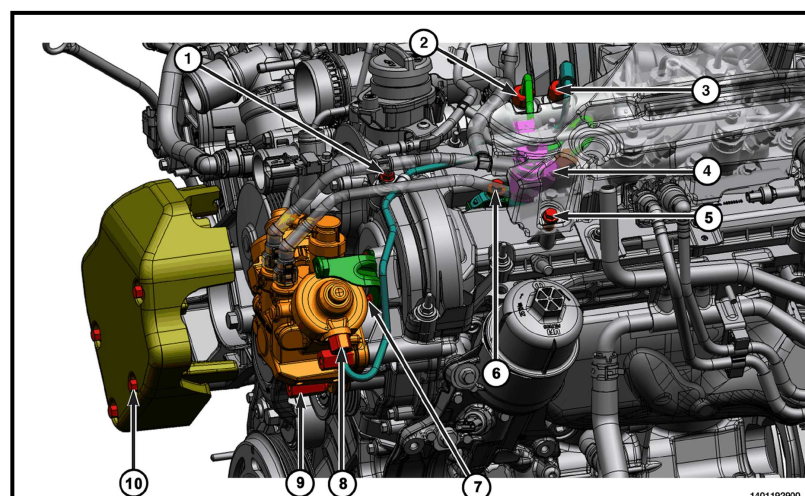


2507192753

LOW PRESSURE EGR

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

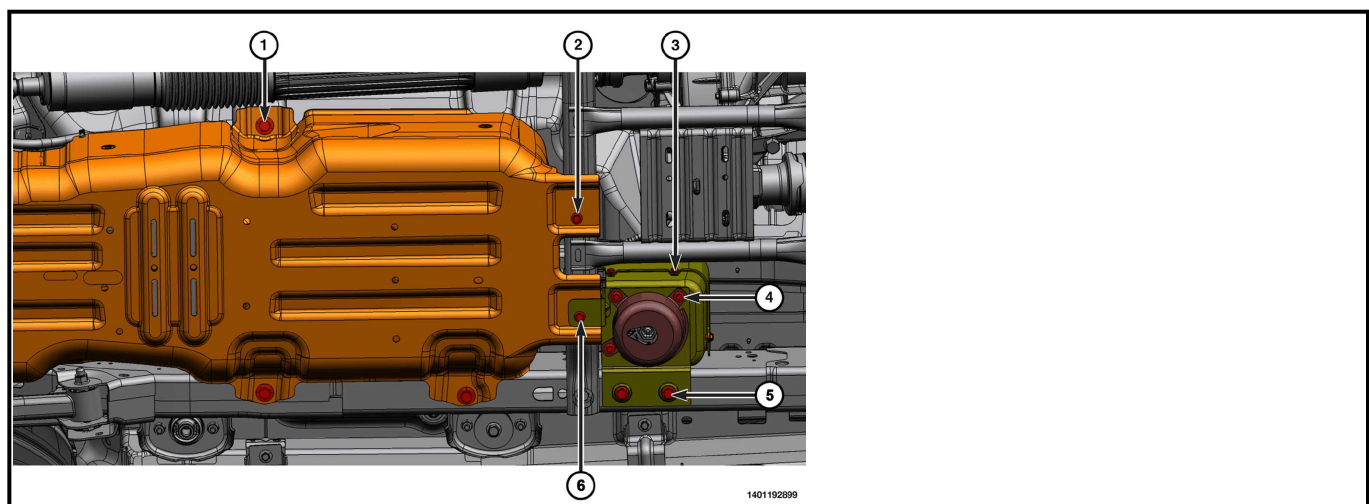
FUEL SYSTEM



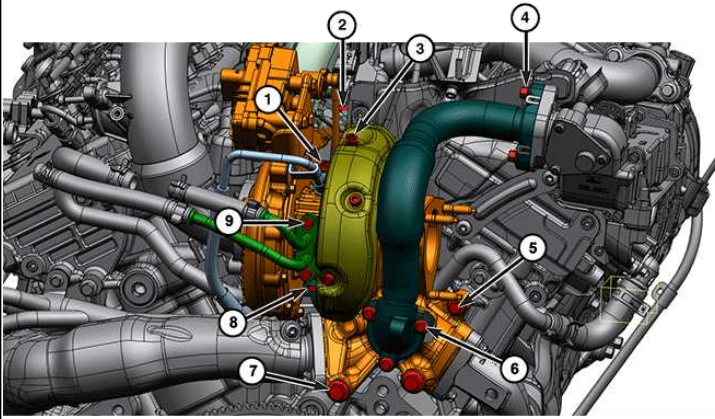
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75B°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75B°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75B°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75B°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90B° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
B	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



TURBOCHARGER



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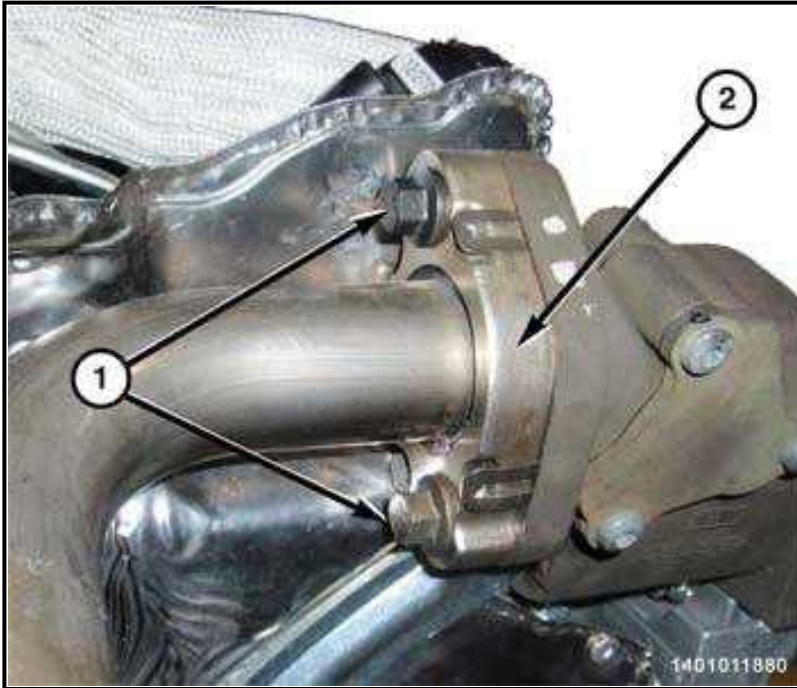
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

RIGHT BANK

REMOVAL

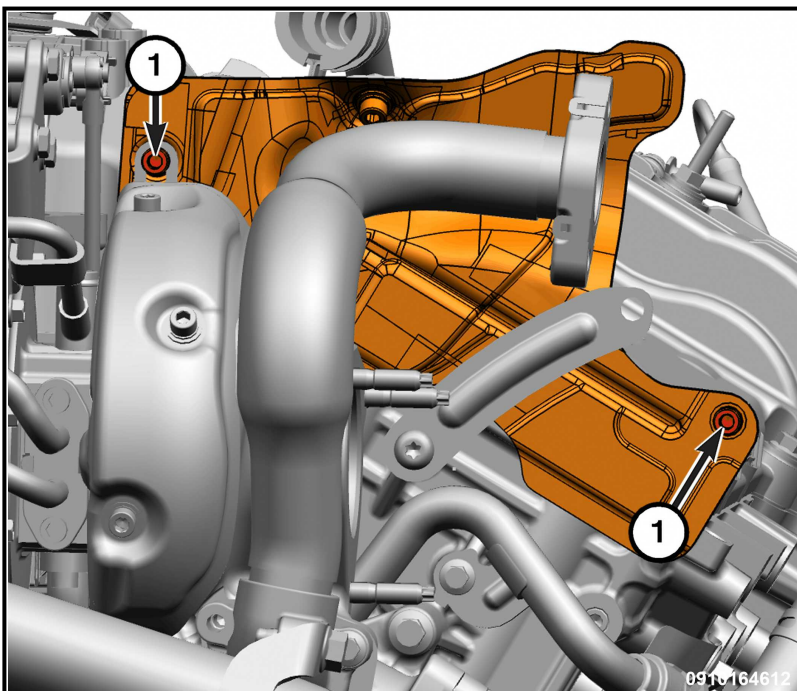
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .

2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
3. Drain the cooling system. Refer to [DRAINING](#) .
4. Remove support and lower the vehicle.
5. Remove the engine cover and brackets. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
6. Remove the right Charge Air Cooler (CAC) hose. Refer to [COOLER AND HOSES, CHARGE AIR, REMOVAL AND INSTALLATION](#) .



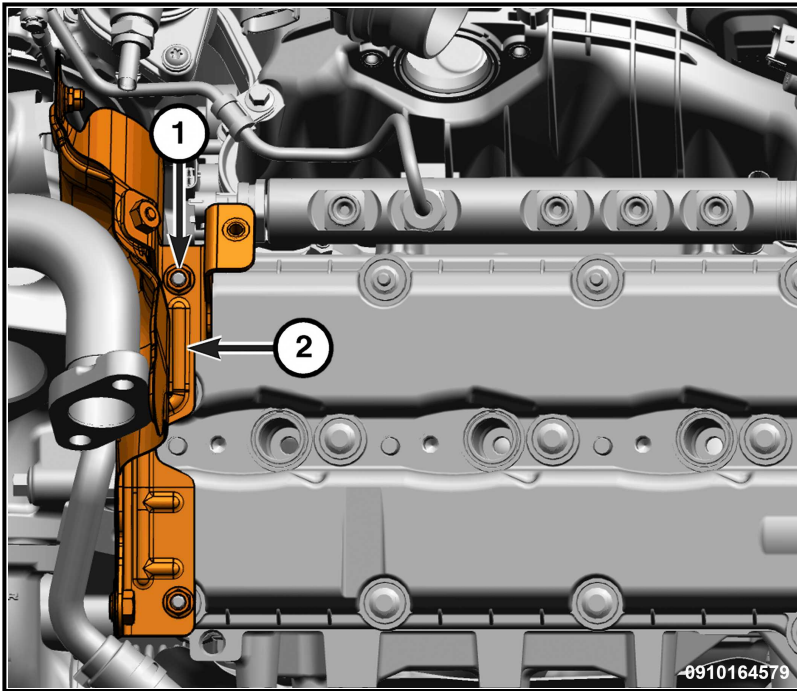
- | |
|---|
| 1 - Turbocharger-To-EGR Cooler Tube Bolts |
| 2 - Turbocharger-To-EGR Cooler Tube |

7. Remove the turbocharger-to-EGR cooler tube bolts.
8. Remove the high pressure EGR cooler. Refer to [COOLER, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#) .
9. Remove the right side fuel injectors. Refer to [INJECTOR\(S\), FUEL, REMOVAL AND INSTALLATION](#) .



1 - Heat Shield Bolts

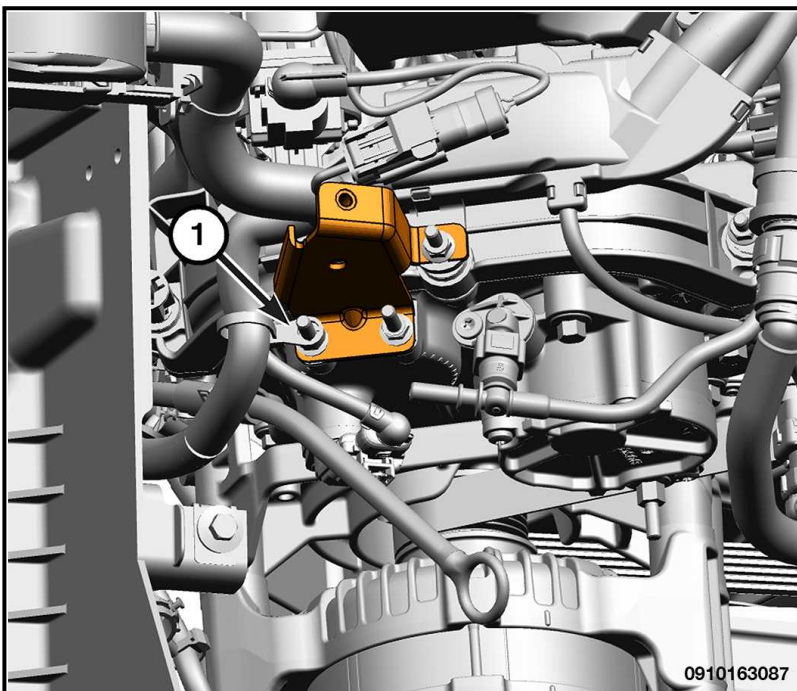
10. Remove the heat shield bolts.



1 - Heat Shield Bracket Nuts

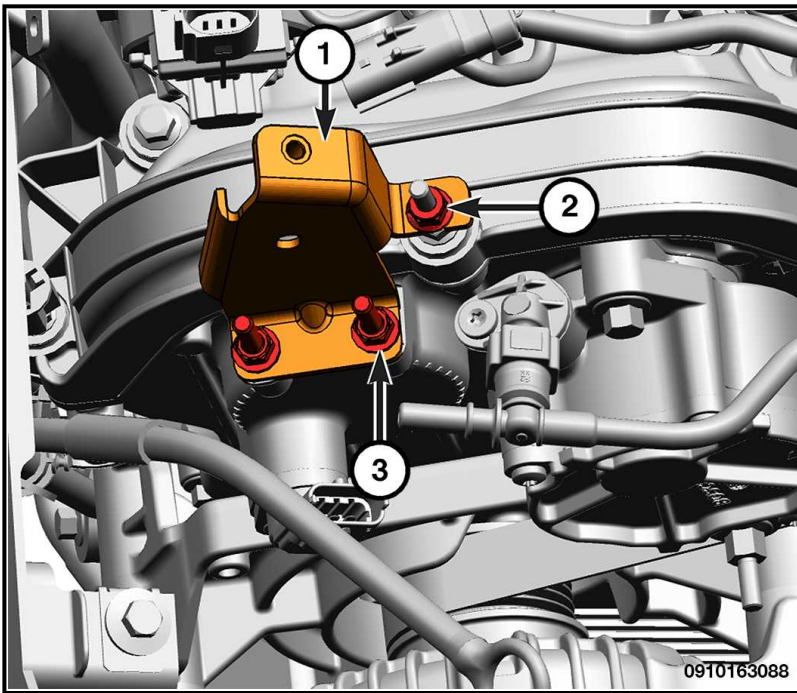
2 - Heat Shield Bracket

11. Remove the heat shield bracket nuts and the heat shield bracket.



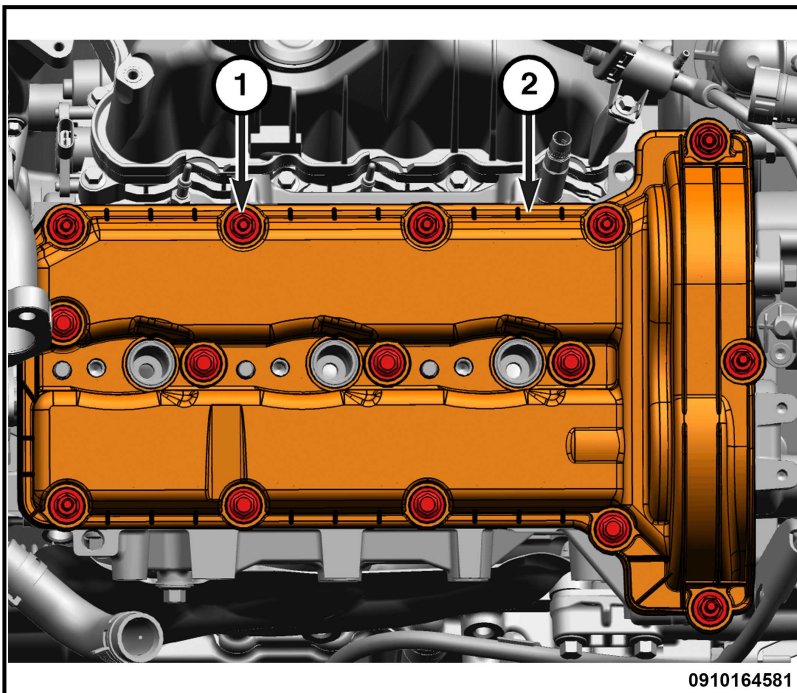
1 - Wire Harness Retainer

12. Detach the wire harness retainer.



1 - Charge Air Cooler Hose Support Bracket
2 - Charge Air Cooler Hose Support Bracket Nut
3 - Charge Air Cooler Hose Support Bracket Bolts

13. Remove the Charge Air Cooler (CAC) hose support bracket bolts, nut and the CAC hose support bracket.



1 - Cylinder Head Cover Bolts
2 - Cylinder Head Cover

14. Remove the cylinder head cover bolts and the cylinder head cover.

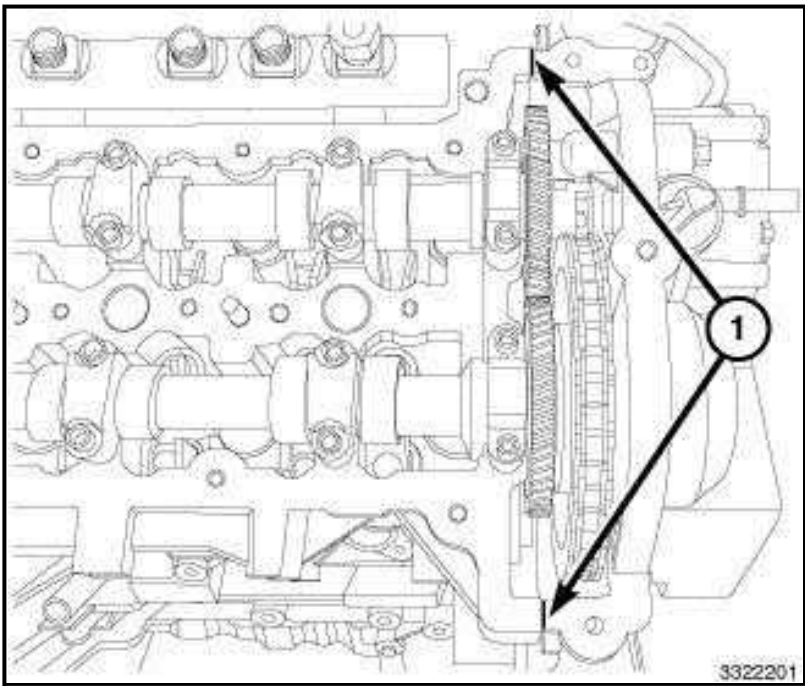
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

NOTE: The cylinder head cover gasket is not serviceable, if the gasket is found to be defective then a new cylinder head cover must be installed.

- Clean and inspect all sealing surfaces and the gasket for damage and replace the cylinder head cover with a new one if the gasket is found to be defective. Refer to **STANDARD PROCEDURE** .

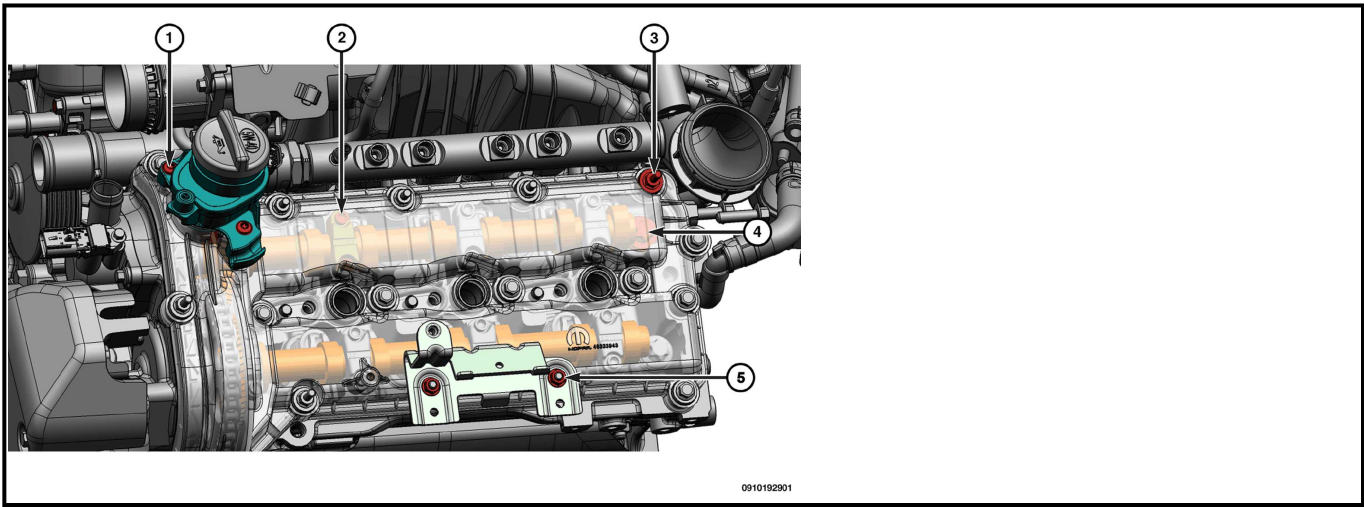


1 - T-joints

- Apply a 3 mm wide bead of MoparB® Threebond Engine RTV Sealant at the T-joint (1).
- The cylinder head cover bolts must be tightened in the sequence shown in the torque table below to proper torque specifications.

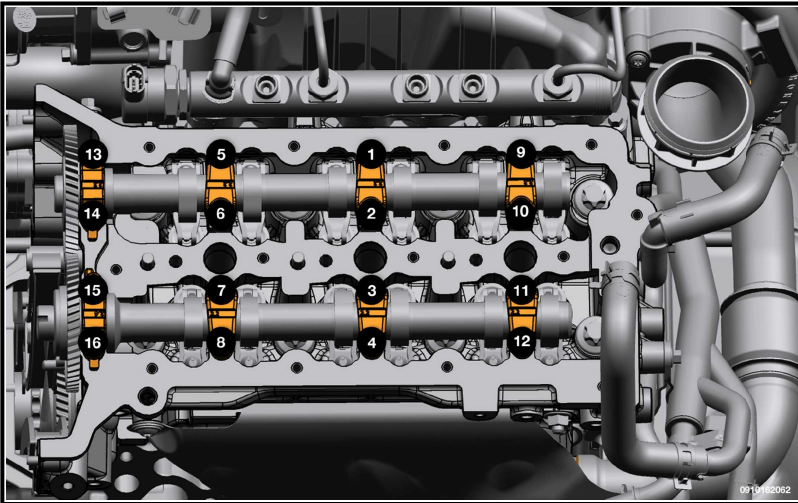
TORQUE SPECIFICATIONS

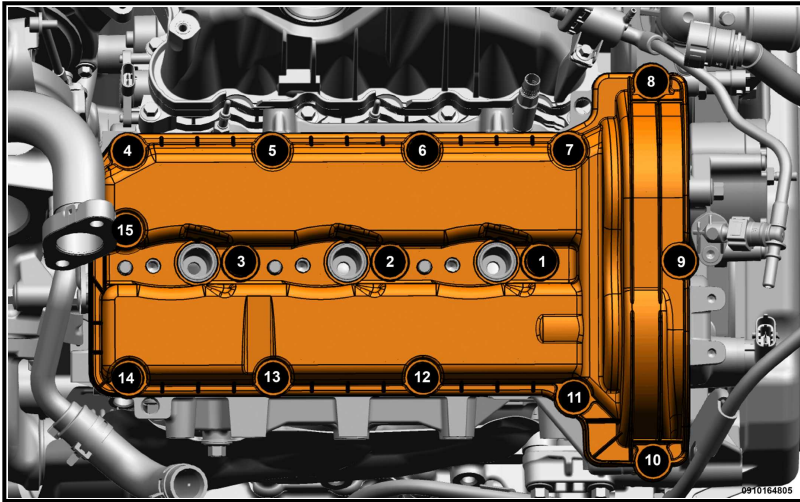
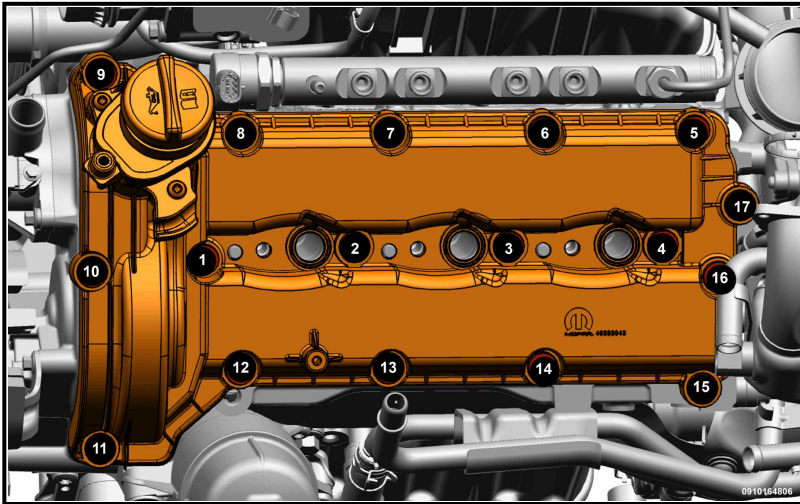
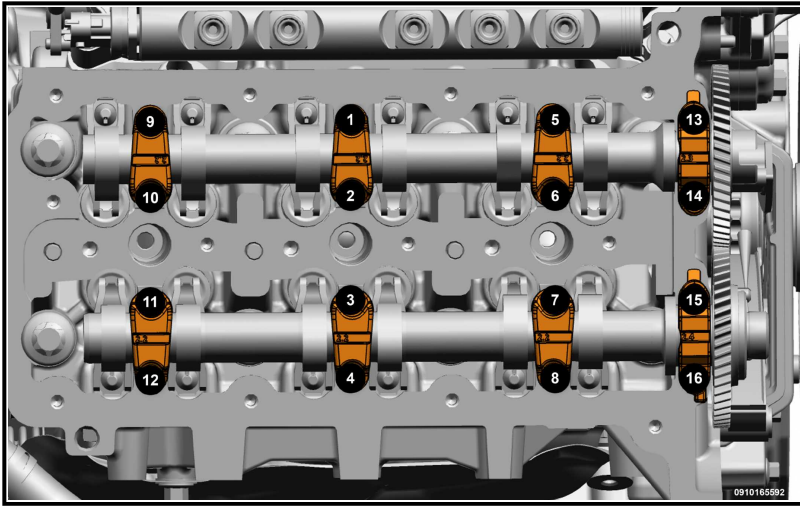
CYLINDER HEAD

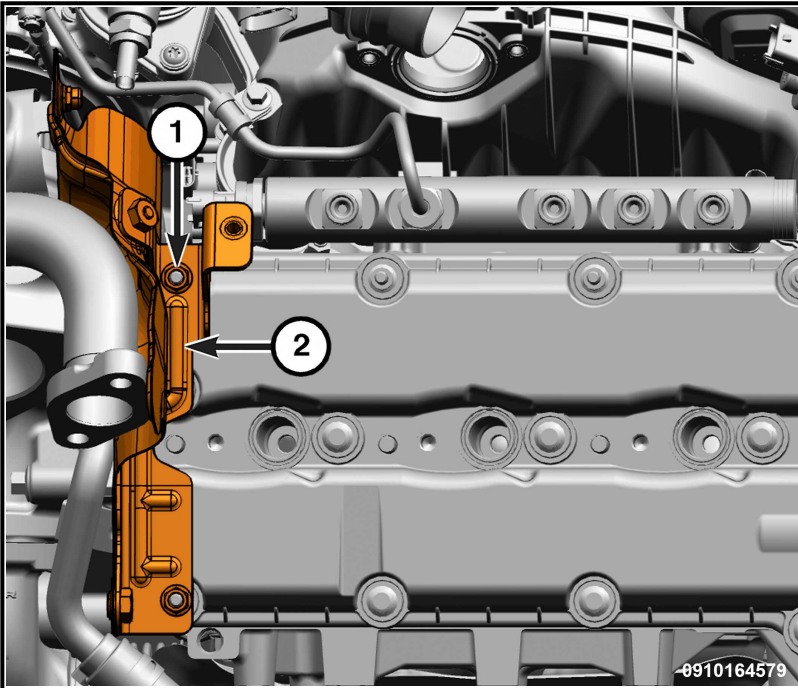
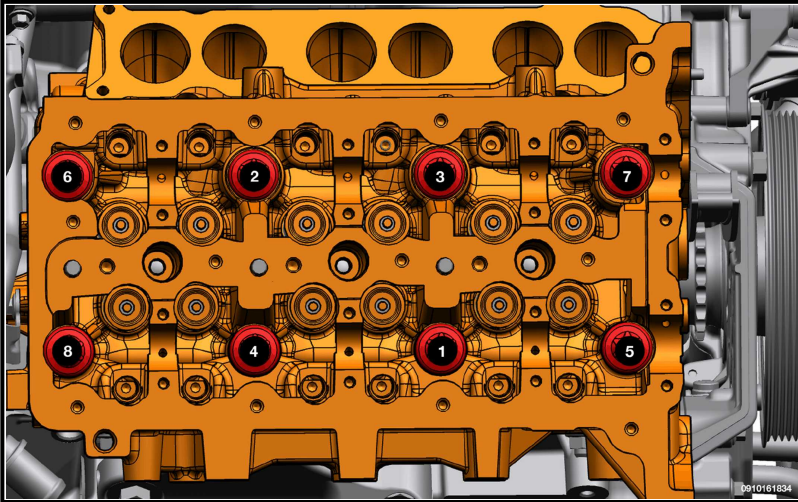
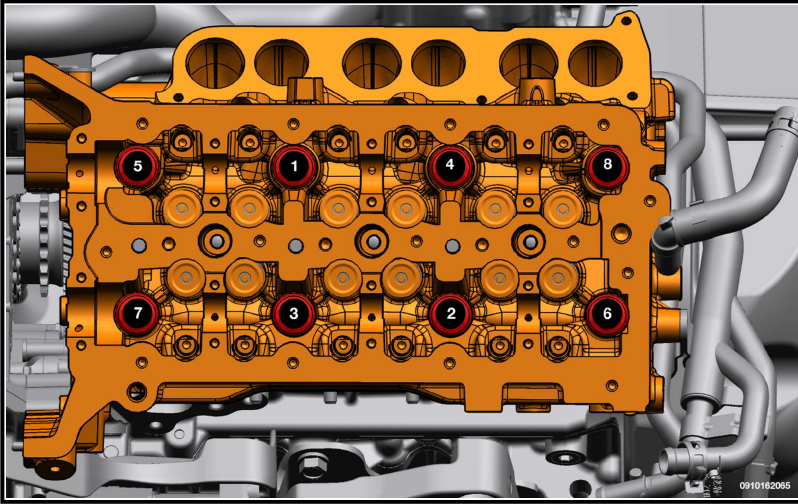


CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1	Oil Filler Neck Assembly to Valve Cover	Tighten Securely	-
2	Camshaft Bearing Cap Bolts	11 N.m (8 Ft. Lbs.)	Tightening Sequence
3	Cylinder Head Cover Bolts	Torque Procedure:	Tightening Sequence

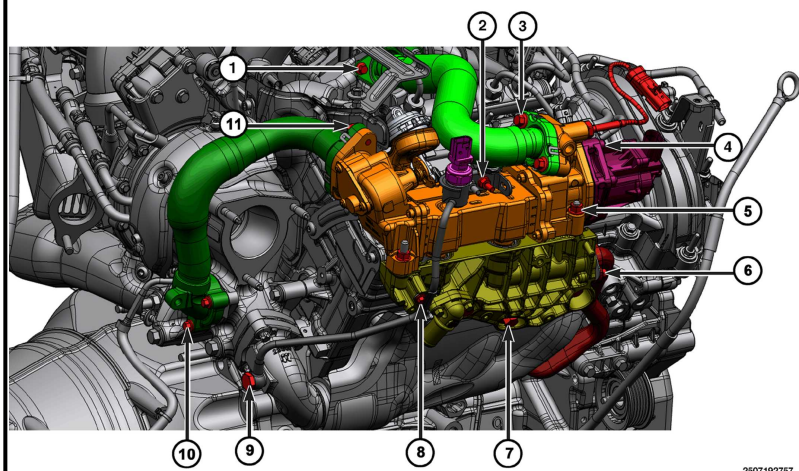
CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
		1. Tighten the cylinder head cover bolts finger tight. 2. Tighten bolts to 8 N.m (71 In. Lbs.). 3. Loosen each bolt 90B°. 4. Tighten bolts to 10 N.m (89 In. Lbs.).	
4	Cylinder Head Bolts (M14)	Torque Procedure: 1. Tighten the cylinder head bolts finger tight. 2. Tighten bolts to 30 N.m (22 Ft. Lbs.). 3. Tighten bolts an additional 75B° in sequence. 4. Tighten bolts an additional 75B° in sequence. 5. Tighten bolts an additional 75B° in sequence.	Tightening Sequence
5	Fuel Line Support Bracket Nuts	6 N.m 53 (In. Lbs.)	-
-	Coolant Tube Bolt	25 N.m (18 Ft. Lbs.)	-
-	Engine Wire Harness Bolts	11 N.m (8 Ft. Lbs.)	-
-	Heat Shield Bracket Nuts	6 N.m 53 (In. Lbs.)	







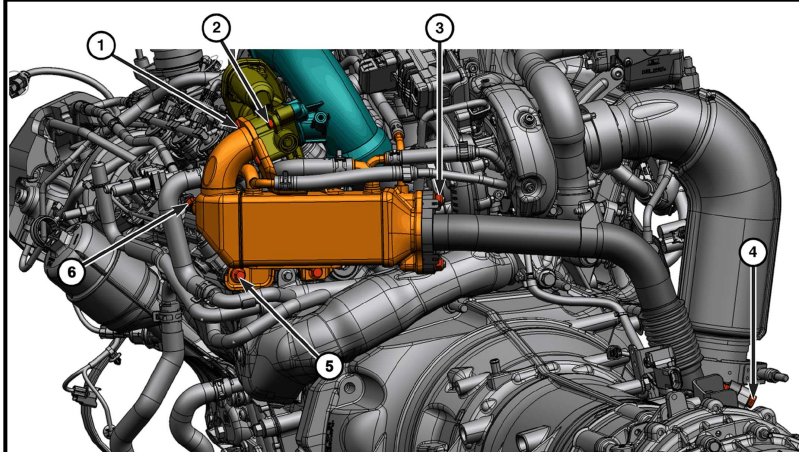
EGR SYSTEM



2507192757

HIGH PRESSURE EGR

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-

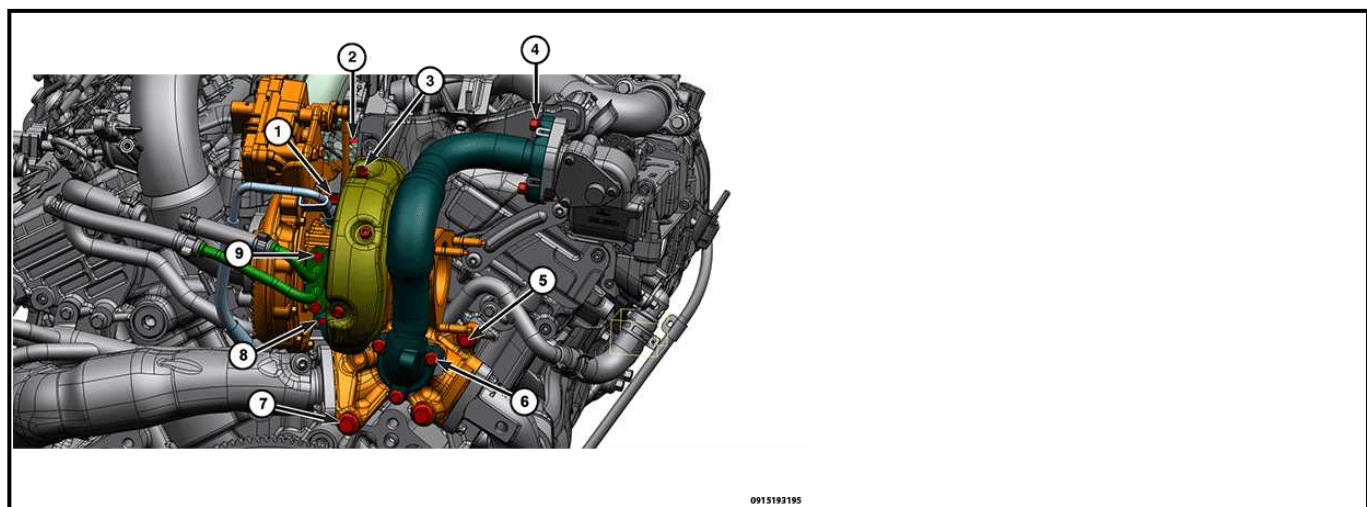


2507192753

LOW PRESSURE EGR

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

TURBOCHARGER



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

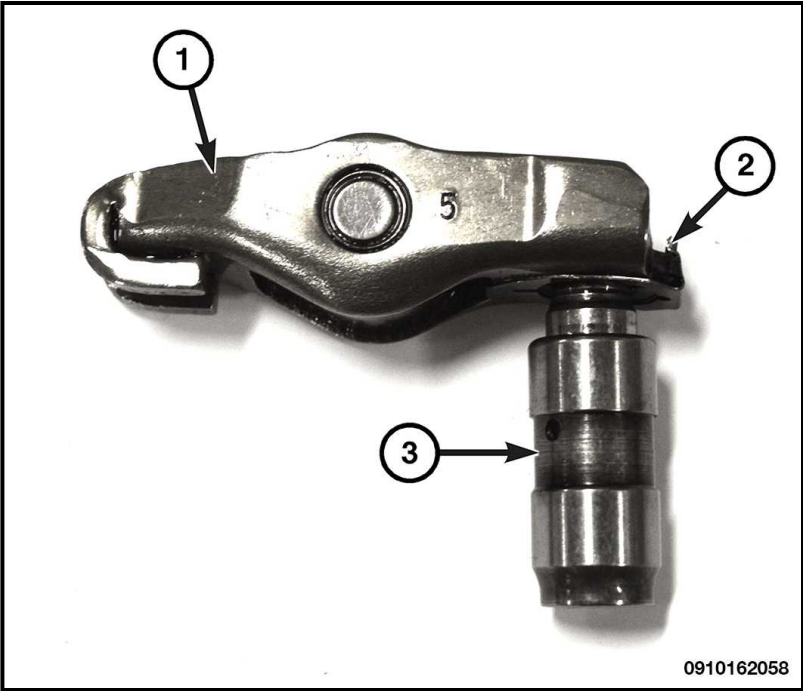
LIFTER(S), HYDRAULIC

REMOVAL AND INSTALLATION

HYDRAULIC LIFTERS

REMOVAL

1. Remove the appropriate valve rocker arm(s). Refer to [ROCKER ARM, VALVE, REMOVAL AND INSTALLATION](#).



1 - Rocker Arm
2 - Retainer
3 - Lifter

NOTE: When the lifters are removed from the engine, they must be stored upright and in clean conditions.

2. Remove the retainer and the lifter from the rocker arm.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

CAUTION: When the lifters are removed from the engine, they must be stored upright and in clean conditions. Install the rocker arms and lifters in the same location as

when removed.

CAUTION: Replacement of the camshaft will also require replacement of the rocker arms and lifters.

NOTE: Rocker arms and lifters must be installed in the same location as when removed.

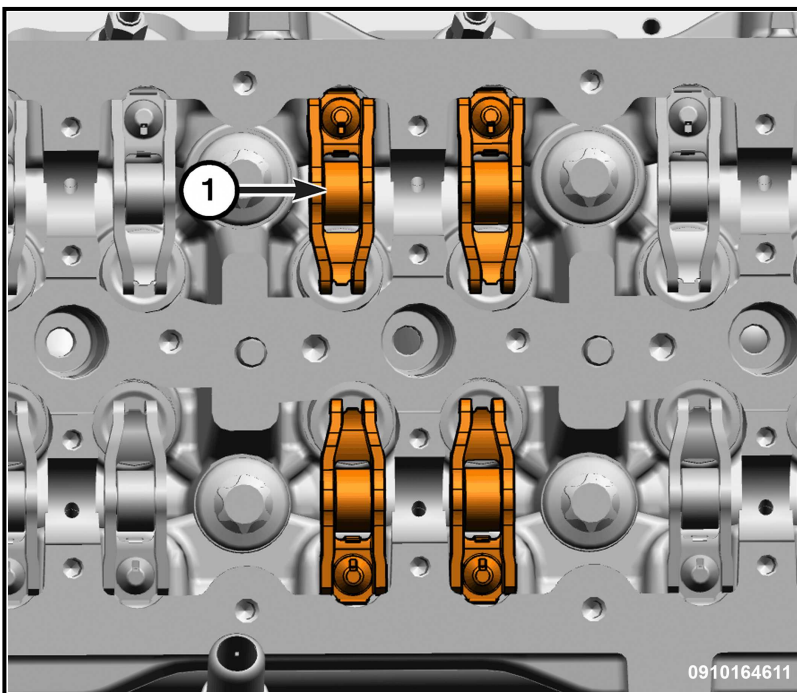
ROCKER ARM, VALVE

REMOVAL AND INSTALLATION

LEFT

REMOVAL

1. Remove the left exhaust and intake camshafts. Refer to [CAMSHAFT, ENGINE, REMOVAL AND INSTALLATION](#).



1 - Rocker Arm

NOTE: Rocker arms and lifters must be installed in the same location as when removed and stored in the up right position.

2. Remove the rocker arm and lifter assembly.

INSTALLATION

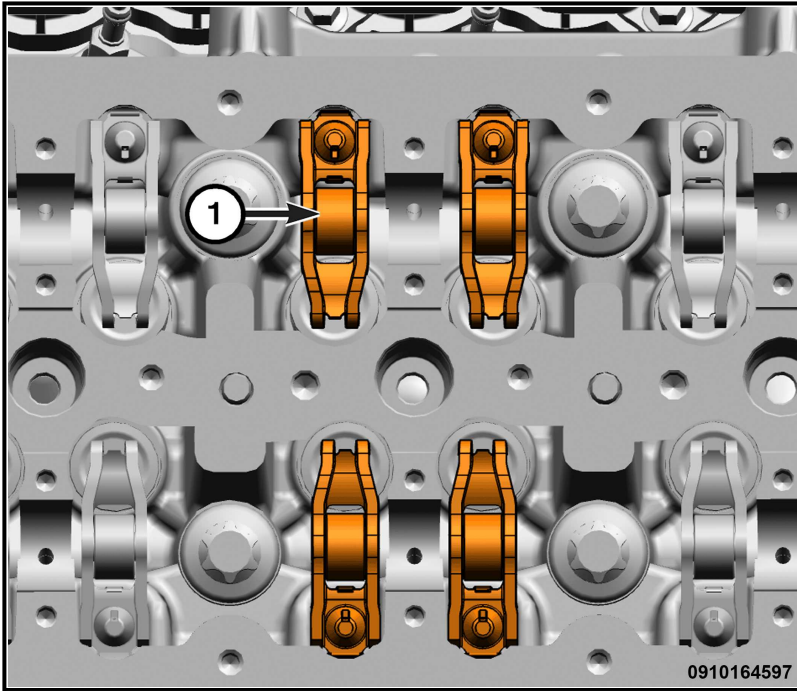
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

NOTE: Rocker arms and lifters must be installed in the same location as when removed.

RIGHT

REMOVAL

1. Remove the right exhaust and intake camshafts. Refer to [CAMSHAFT, ENGINE, REMOVAL AND INSTALLATION](#).



1 - Rocker Arm

NOTE: Rocker arms and lifters must be installed in the same location as when removed and stored in the up right position.

2. Remove the rocker arm and lifter assembly.

INSTALLATION

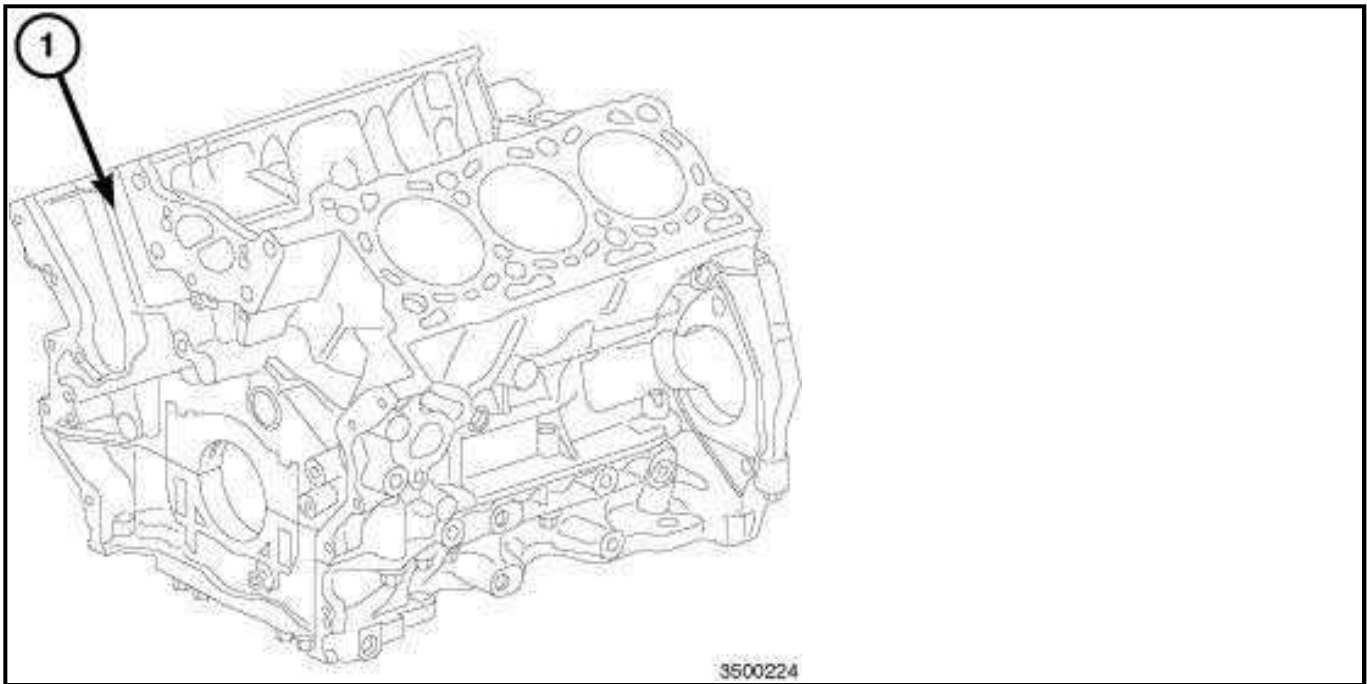
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

NOTE: Rocker arms and lifters must be installed in the same location as when removed.

ENGINE BLOCK

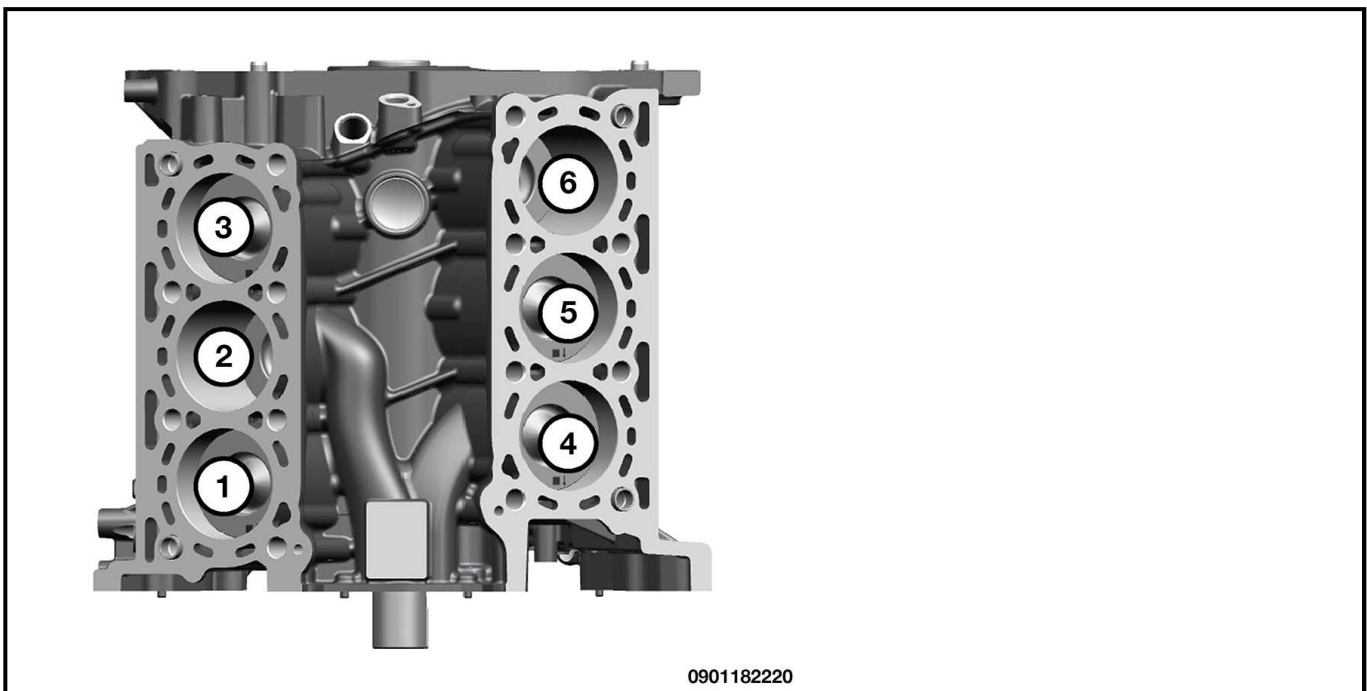
DESCRIPTION

ENGINE BLOCK



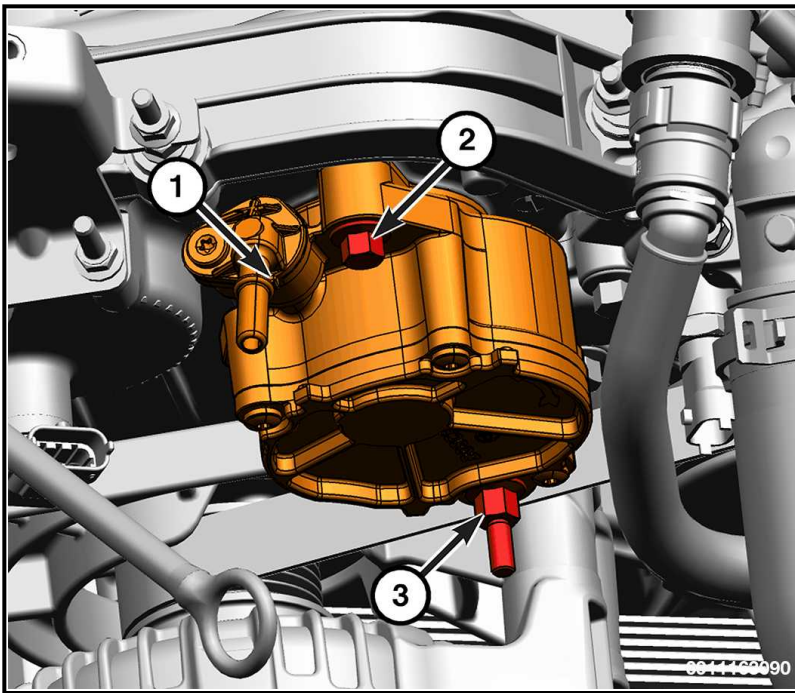
1 - Cast Iron Cylinder Block

The 3.0L engine utilizes a cast Iron cylinder block with a bedplate design. The cylinder angle is 60 degrees V block design. The cylinder block has increased rigidity that reduces structural flexing, plus a fractured connecting rod cap design that can not distort connecting rod cap fit.



Cylinders are numbered front to back, beginning with the right bank. The right bank cylinders are numbered 1, 2, 3. The left bank cylinders 4, 5, 6. The fuel injection order of the engine is 1-4-2-5-3-6.

VACUUM PUMP



1 - Vacuum Pump
2 - Vacuum Pump Bolt
3 - Vacuum Pump Studbolt

- The vacuum pump is a constant displacement, vane-type pump. Vacuum is generated by vanes mounted in the pump rotor. The rotor is located in the pump housing and is pressed onto the pump shaft.
- The vacuum pump operates by a slotted extension attached to the vacuum pump shaft. The vacuum pump shaft slotted extension fits into, and is driven by, the intake camshaft gear.
- The vacuum pump rotating components are internally lubricated and the vacuum pump has no serviceable parts. Do not disassemble or attempt to repair the pump.

OPERATION

- Vacuum pump output is transmitted to the EGR vacuum bypass solenoid and brake vacuum booster, systems through a supply hose. The hose is connected to an outlet port on the pump housing and uses an in-line check valve to retain system vacuum when vehicle is not running.
- Pump output ranges from a minimum of 8.5 to 25 inches vacuum.
- The pump rotor and vanes are rotated by the slotted pump drive gear which fits into the camshaft drive gear.

ENGINE INTERNALS

The follow engine internal components **are not serviceable** on the vehicle.

- Connecting rod bearings
- Crankshaft main bearings
- Crankshaft
- Piston, piston rings, piston pin, and connecting rods
- If replacement is needed then the engine has to be replaced refer to long block replacement. Refer to **ENGINE ASSEMBLY, REMOVAL AND INSTALLATION** .

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - VACUUM PUMP

1. Connect a vacuum gauge to the booster check valve with a short length of hose and T-fitting.

2. Start the engine allowing the engine to run for 30 seconds. Vacuum should be 18 inches HG (609 millibars). Verify the vacuum line is not leaking. If no leak is present replace vacuum pump. Refer to **PUMP, VACUUM, REMOVAL AND INSTALLATION**.

STANDARD PROCEDURE

CHECKING CRANKSHAFT END PLAY

1. Mount a dial indicator to a stationary point at rear of engine. Locate the probe perpendicular against the rear of the crankshaft.
2. Move the crankshaft all the way to the front of its travel.
3. Zero the dial indicator.
4. Move the crankshaft all the way to the rear of its travel and record the reading on the dial indicator. For crankshaft end play clearances refer to the engine specification chart. Refer to **ENGINE SPECIFICATIONS DIESEL**.

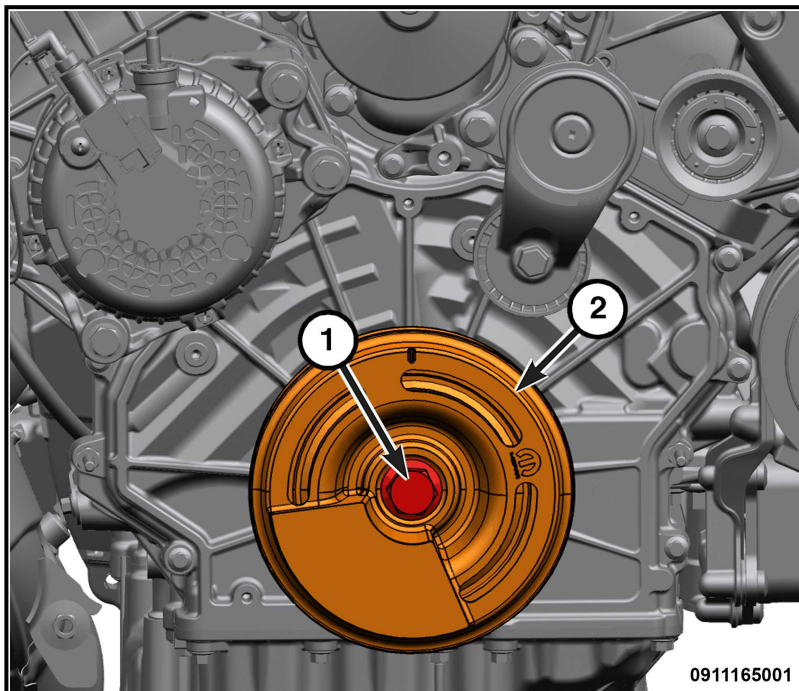
DAMPER, VIBRATION

REMOVAL AND INSTALLATION

VIBRATION DAMPER

REMOVAL

1. Raise and support the vehicle. Refer to **HOISTING, STANDARD PROCEDURE**.
2. Remove the serpentine belt. Refer to **BELT, SERPENTINE, REMOVAL AND INSTALLATION**.
3. Lock the engine 60 degrees ATDC. Refer to **ENGINE TIMING VERIFICATION**.



1 - Vibration Damper Bolt
2 - Vibration Damper

NOTE: The crankshaft damper bolt is a left hand thread.

4. Remove the vibration damper bolt and the vibration damper.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

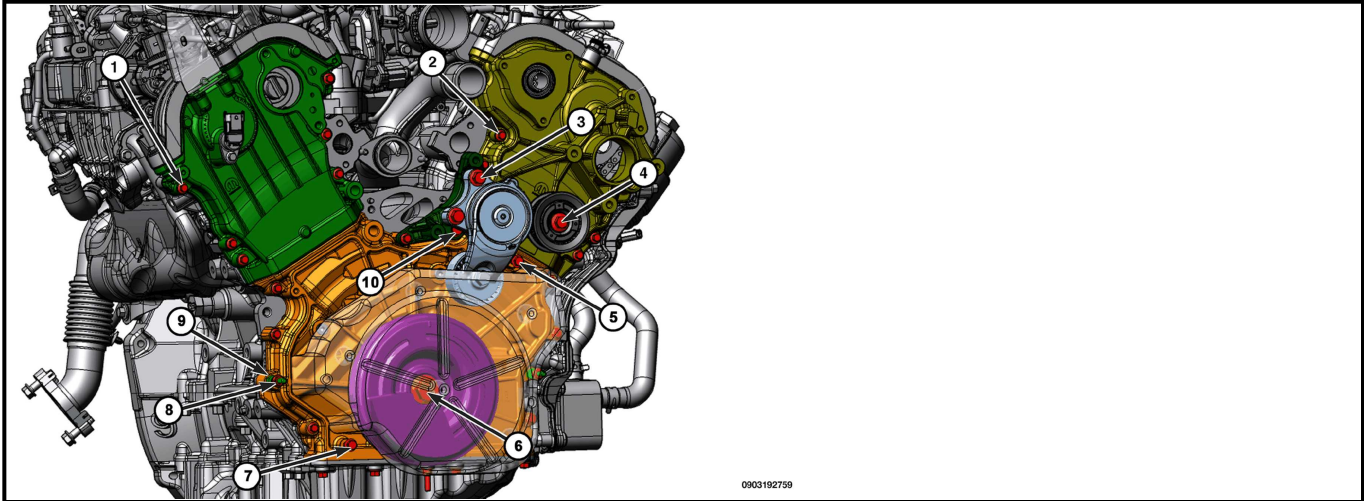
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

NOTE: **The crankshaft damper bolt is a left hand thread.**

- Remove the (special tool #VM.10339, Tool, Crankshaft Timing).

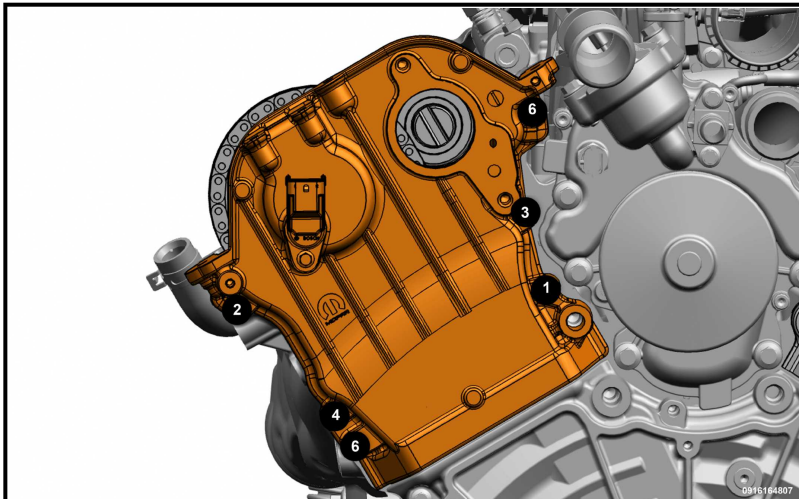
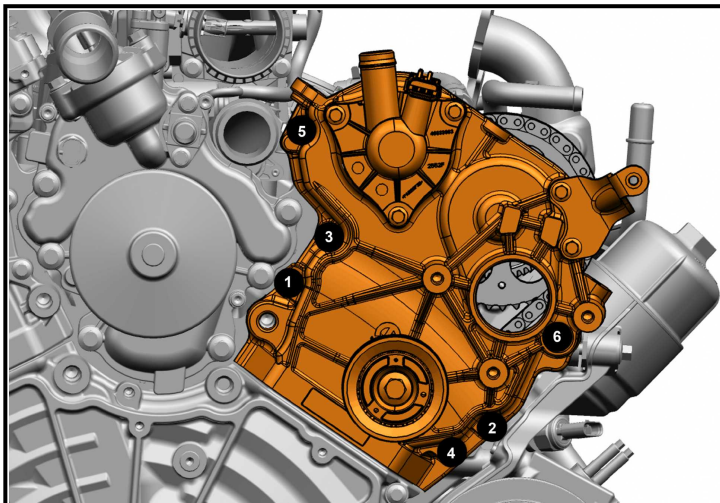
TORQUE SPECIFICATIONS

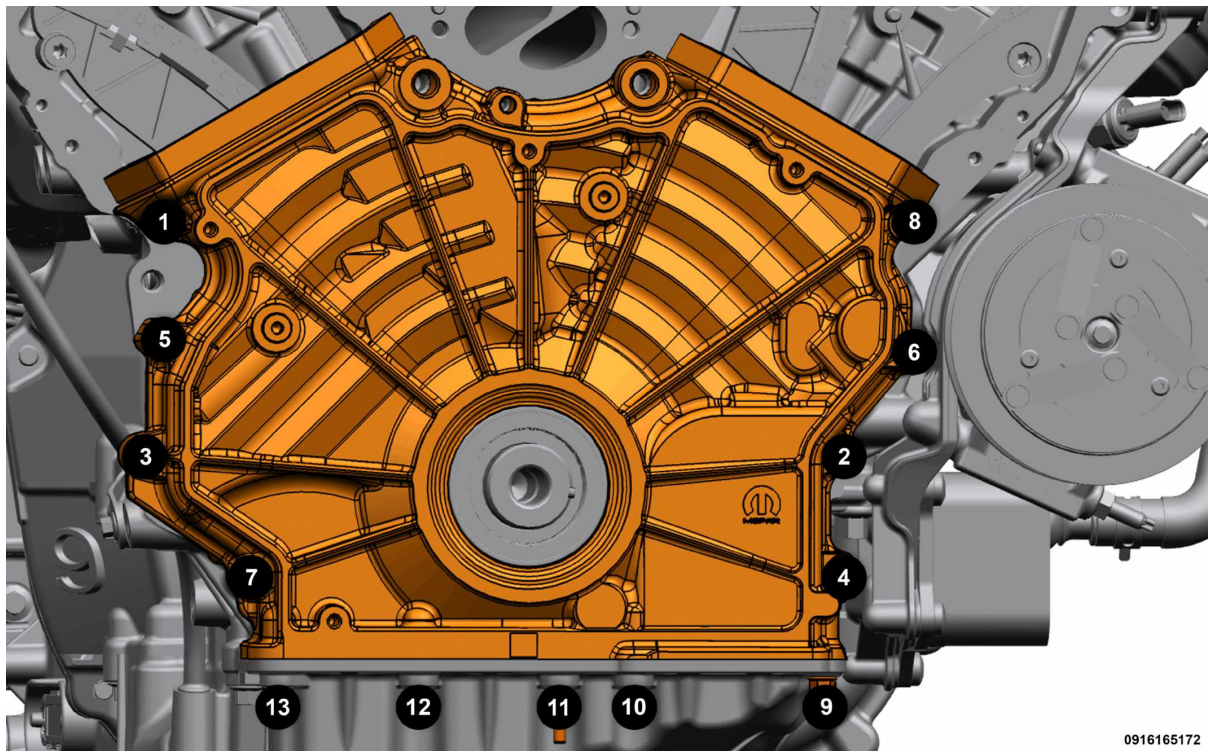
FRONT ENGINE



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1, 2	Timing Chain Cover Bolts	Torque Procedure: 1. Tighten the M6 bolts finger tight. 2. Tighten the M6 bolts to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and retighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence
3	Belt Tensioner Pulley Bolt	45 N.m (33 Ft. Lbs.)	-
4	Idler Pulley Bolts	32 N.m (24 Ft. Lbs.)	-
5, 9	Timing Chain Cover Bolts (lower)	Torque Procedure: 1. Tighten the lower timing cover bolts (1 and 3) finger tight. 2. Tighten the M6 bolts (1 - 8) to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and tighten to 15 N.m (Ft. Lbs.). 4. Install the oil pan-to-lower chain	Tightening Sequence Position 2 and 3 are double ended studs.

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
		cover bolts and tighten (9 - 13) to 15 N.m (11 Ft. Lbs.). 5. Loosen each bolt one at a time 90B° and tighten to 15 N.m (11 Ft. Lbs.).	
6	Vibration Damper Bolt	100 N.m (74 Ft. Lbs.) + 125B°	-
7	Vibration Damper Cover Bolts	10 N.m (7 Ft. Lbs.)	-
8	Vibration Damper Cover Nut	9 N.m (80 In. Lbs.)	-
10	Belt Tensioner to Mounting Bracket - M10 Bolt	45 N.m (33 Ft. Lbs.)	-
11	Belt Tensioner to Mounting Bracket - M6 Bolt	11 N.m (8 Ft. Lbs.)	-
-	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Oil Breather/Camshaft Seal Housing Bolts	14 N.m (10 Ft. Lbs.)	-
-	Vacuum Pump Bolt	30 N.m (22 Ft. Lbs.)	-





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Fig. 7: Lower Timing Chain Cover Bolts Tightening Sequence

Courtesy of CHRYSLER GROUP, LLC

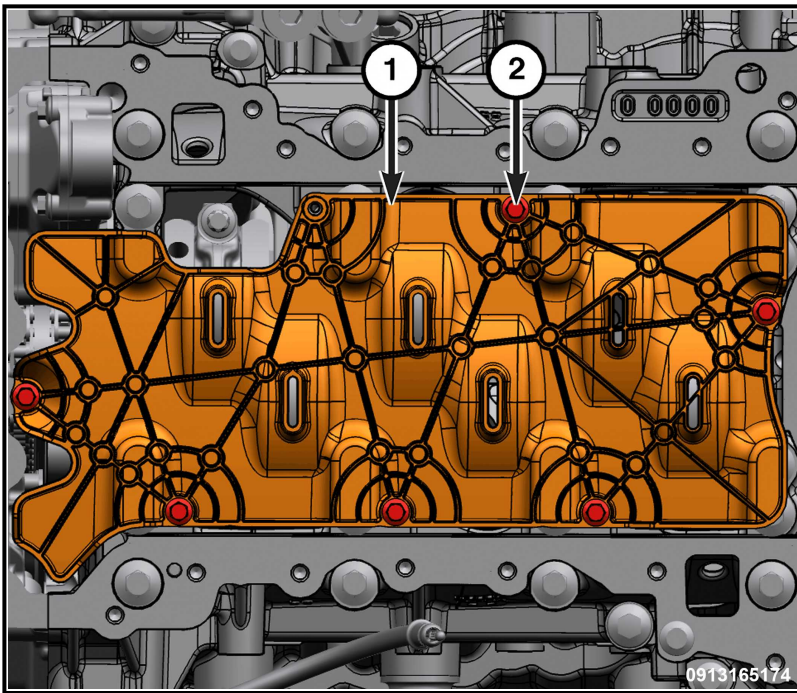
PLATE, BED

REMOVAL AND INSTALLATION

BED PLATE

REMOVAL

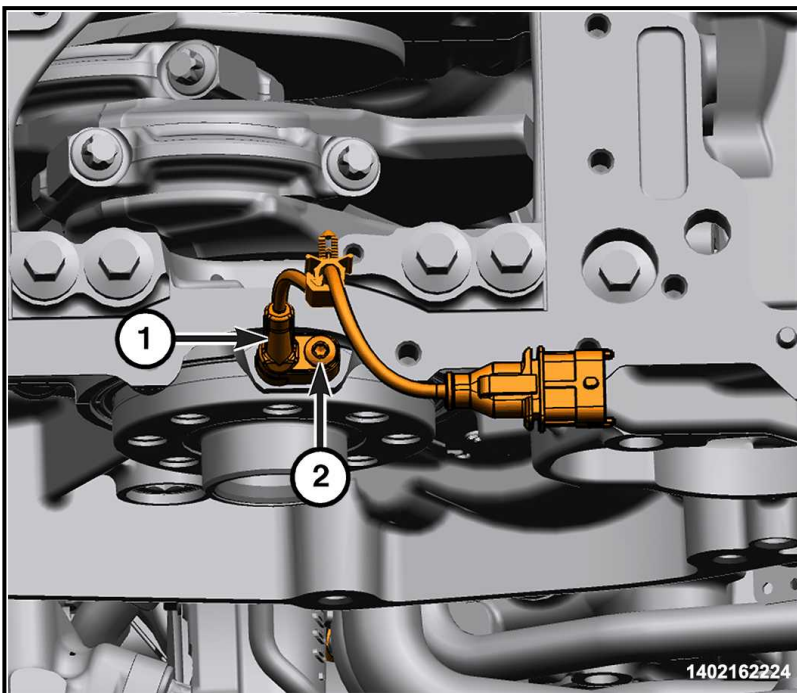
1. Remove the engine from the vehicle. Refer to [**ENGINE ASSEMBLY, REMOVAL AND INSTALLATION**](#) .
2. Mount the engine to a suitable engine stand.
3. Remove the flexplate, counter weight, and tone wheel. Refer to [**FLEXPLATE, REMOVAL AND INSTALLATION**](#) .
4. Check the crankshaft end play. Refer to [**CRANKSHAFT, STANDARD PROCEDURE**](#) .
5. Remove the upper oil pan. Refer to [**PAN, OIL, REMOVAL AND INSTALLATION**](#) .
6. Remove the oil pump. Refer to [**PUMP, ENGINE OIL, REMOVAL AND INSTALLATION**](#) .



1 - Windage Tray

2 - Windage Tray Bolts

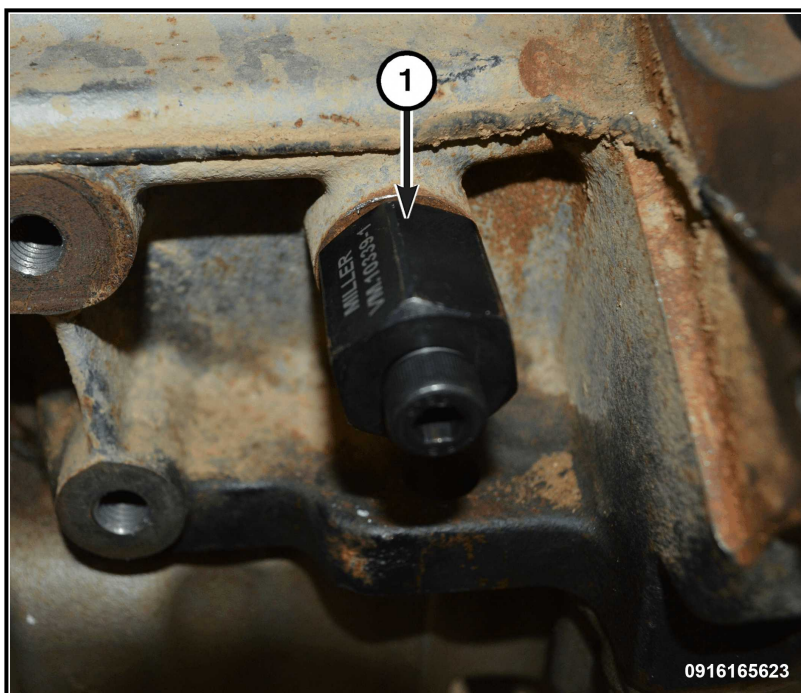
7. Remove the windage tray bolts and the windage tray.



1 - Crankshaft Position Sensor

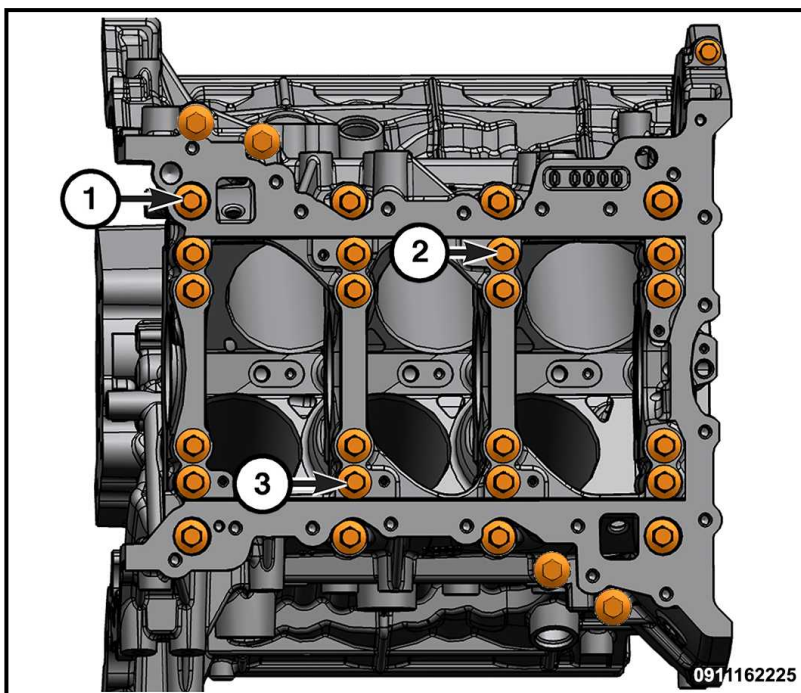
2 - Crankshaft Position Sensor Bolt

8. Remove the Crankshaft Position Sensor (CKP) bolt and the CKP sensor.



1 - Crankshaft Timing Tool

9. Remove the (special tool #VM.10339, Tool, Crankshaft Timing).

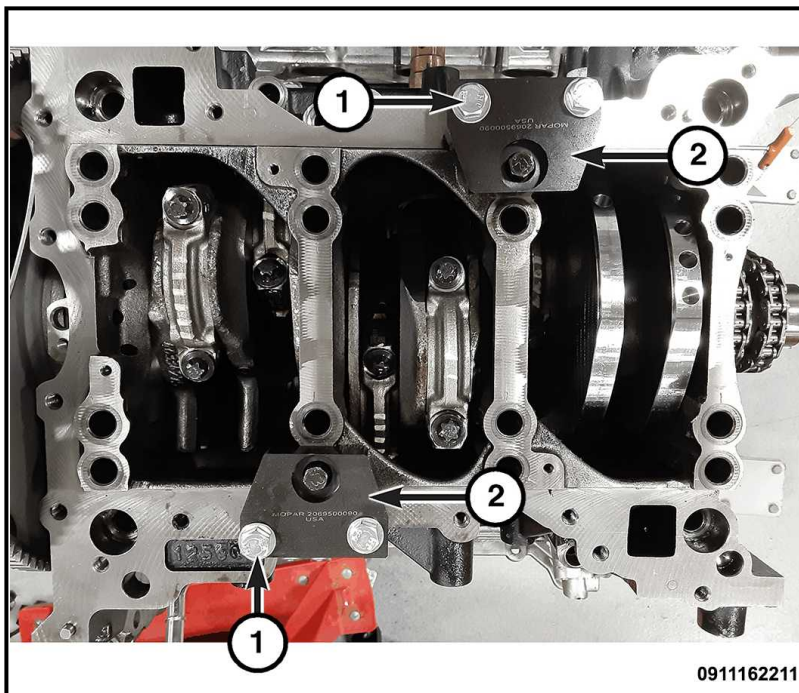


1 - Bed Plate Bolts

2 - Bed Plate Bolts

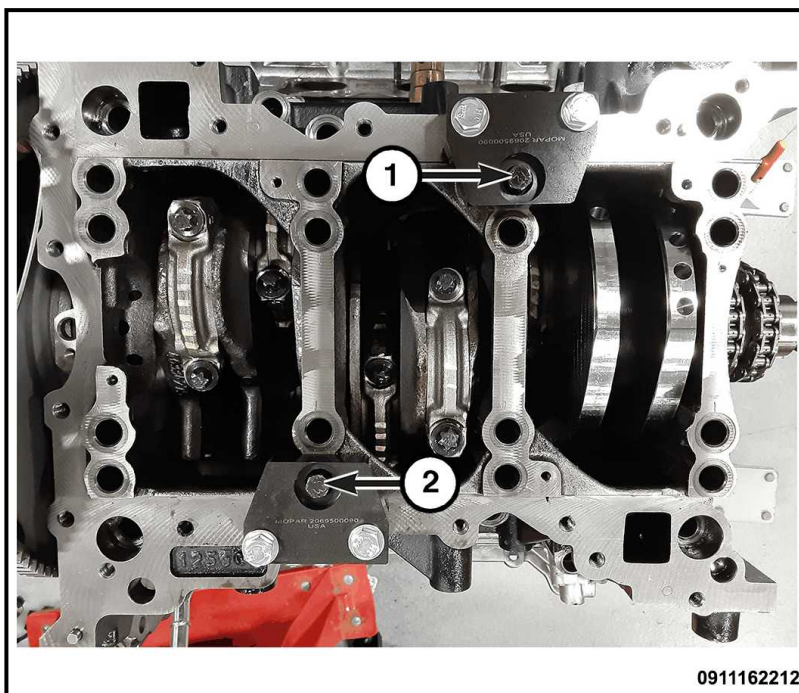
3 - Bed Plate Bolts

10. Remove the bed plate bolts securing the bed plate to engine block except bolts (2, 3).



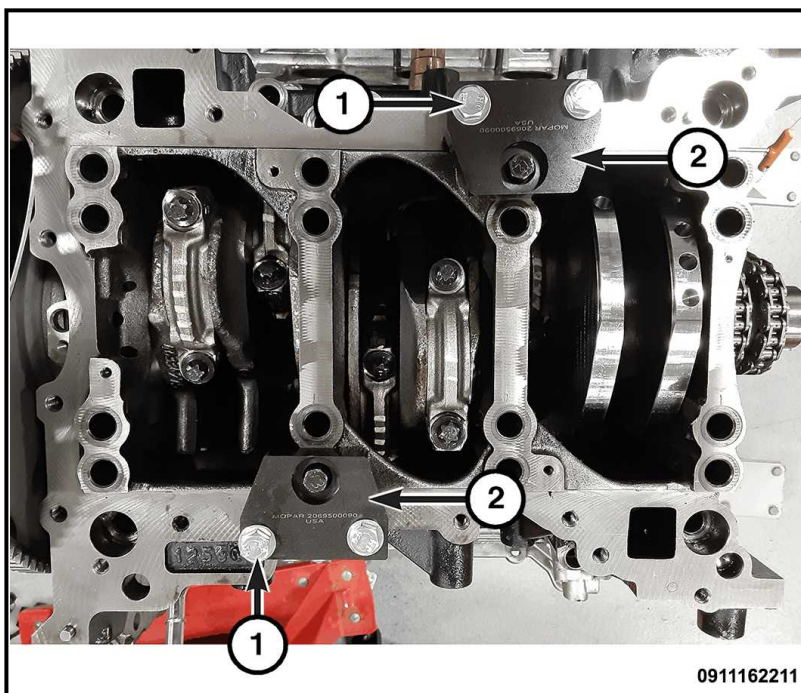
- | |
|------------------------------------|
| 1 - Engine Bed Plate Remover Bolts |
| 2 - Engine Bed Plate Remover Tool |

11. Install the (special tool #2069500090, Remover, Engine Bed Plate) and securely tighten bolts.



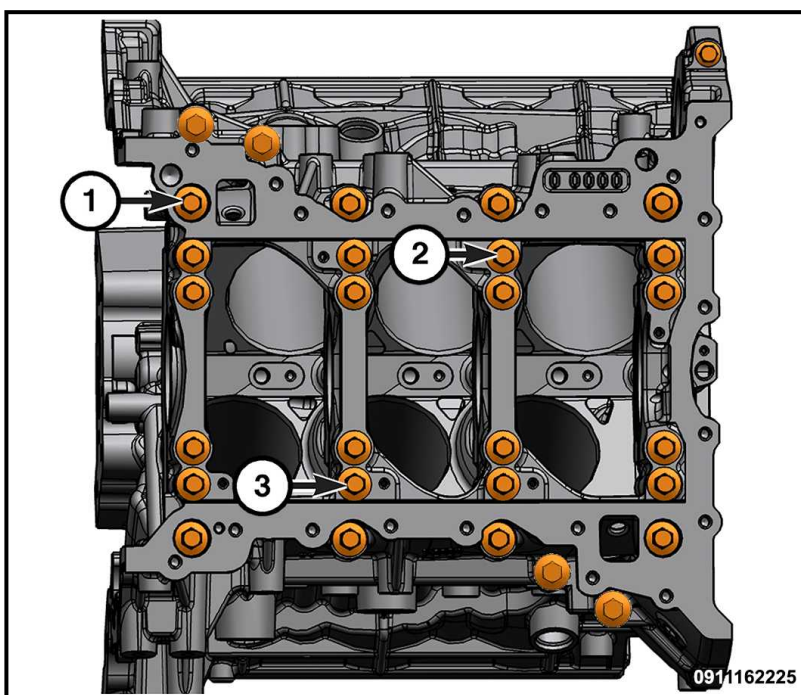
- | |
|--------------------|
| 1 - Bed Plate Bolt |
| 2 - Bed Plate Bolt |

12. Loosen the bed plate bolts in half turn increments until seal is broken.



1 - Engine Bed Plate Remover Bolts
2 - Engine Bed Plate Remover Tool

13. Remove the engine bed plate remover bolts and the (special tool #2069500090, Remover, Engine Bed Plate).



1 - Bed Plate Bolts
2 - Bed Plate Bolts
3 - Bed Plate Bolts

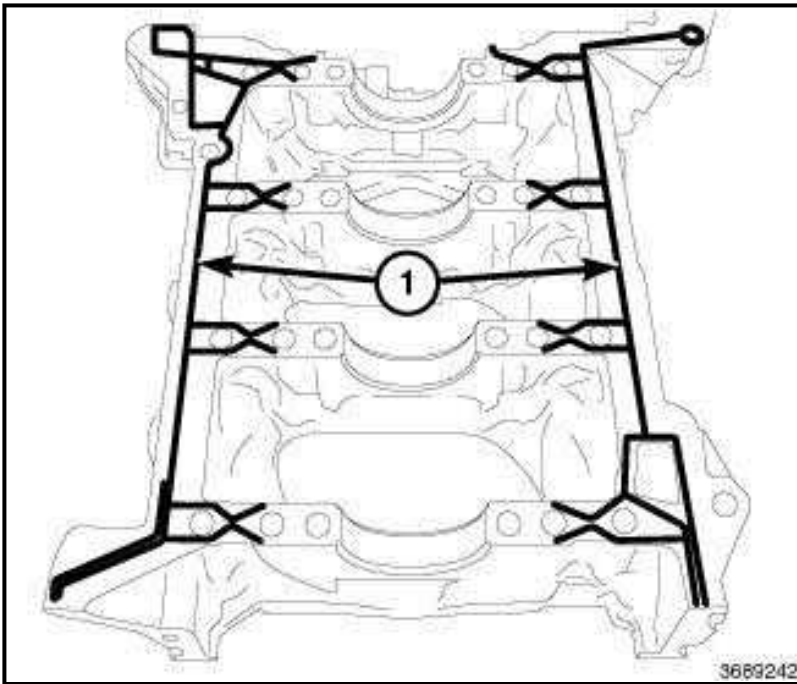
14. Remove the remaining bed plate bolts and the bed plate.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

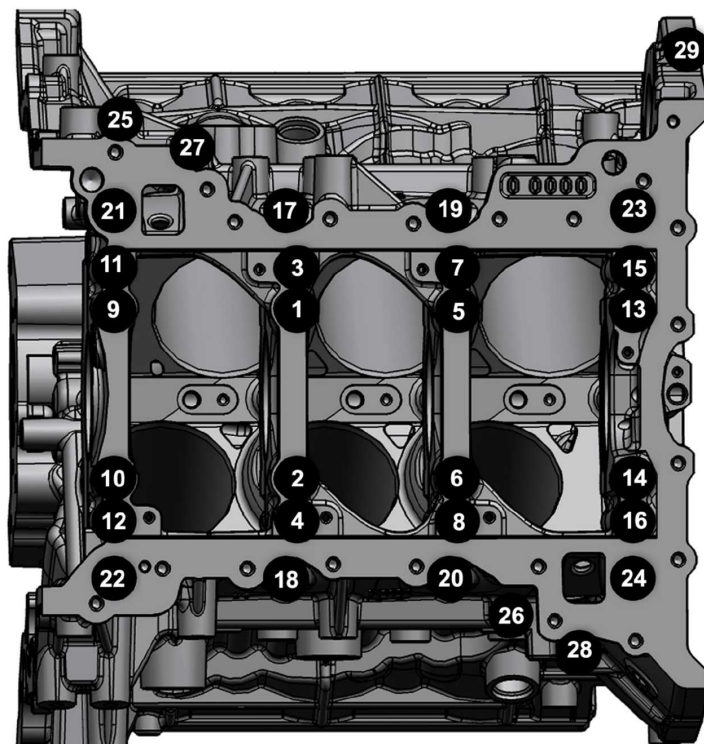
- Clean the gasket sealing surfaces. Refer to [STANDARD PROCEDURE](#) .



1 - MoparB® Threebond Engine RTV Sealant

NOTE: Do not let the bed plate sit for longer than 10 minutes after applying sealing compound.

- Using MoparB® Threebond Engine RTV Sealant, apply a 1.5 mm thick bead of sealing compound to the bed plate as illustrated and **DO NOT** spread the sealing bead.
- Install the bed plate onto the engine block.

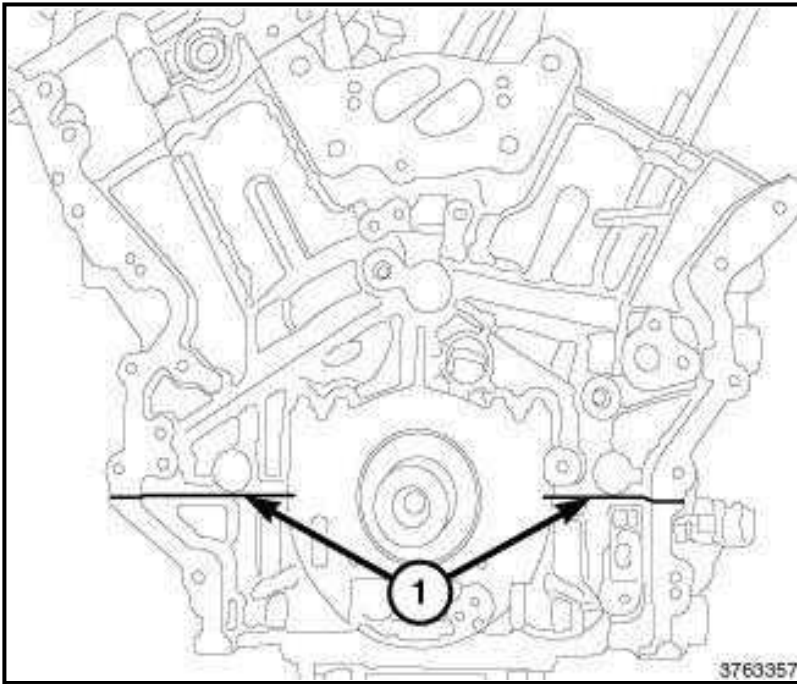


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Fig. 8: Bed Plate Tightening Sequence 3.0L (1 OF 2)
Courtesy of CHRYSLER GROUP, LLC

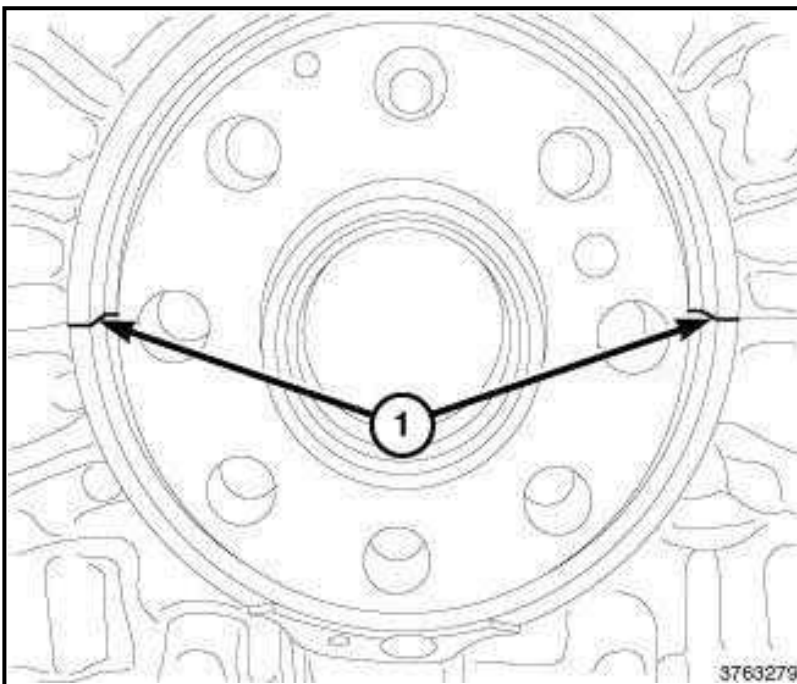
- Install **NEW** 26 M12 bed plate bolts (1 - 26) and the three M8 bed plate bolts (27 - 29). The bed plate bolts must be tightened in the sequence shown in the torque table below to proper torque specifications.

- The crankshaft should turn freely. If the crankshaft does not turn freely loosen and re-torque the bed plate bolts.



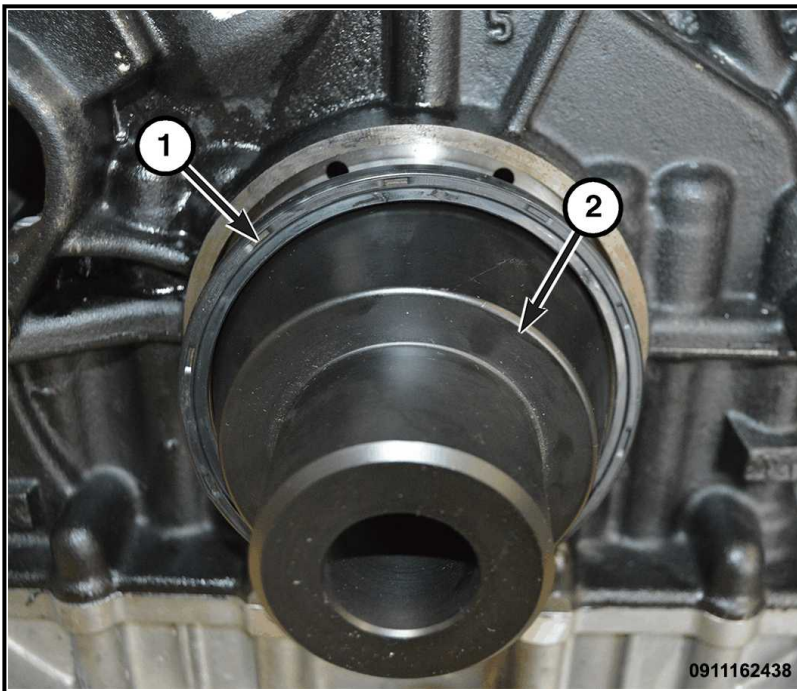
1 - MoparB® Threebond Engine RTV Sealant

- Remove any excess MoparB® Threebond Engine RTV Sealant that may have squeezed out in the front of engine T-joint.



1 - MoparB® Threebond Engine RTV Sealant

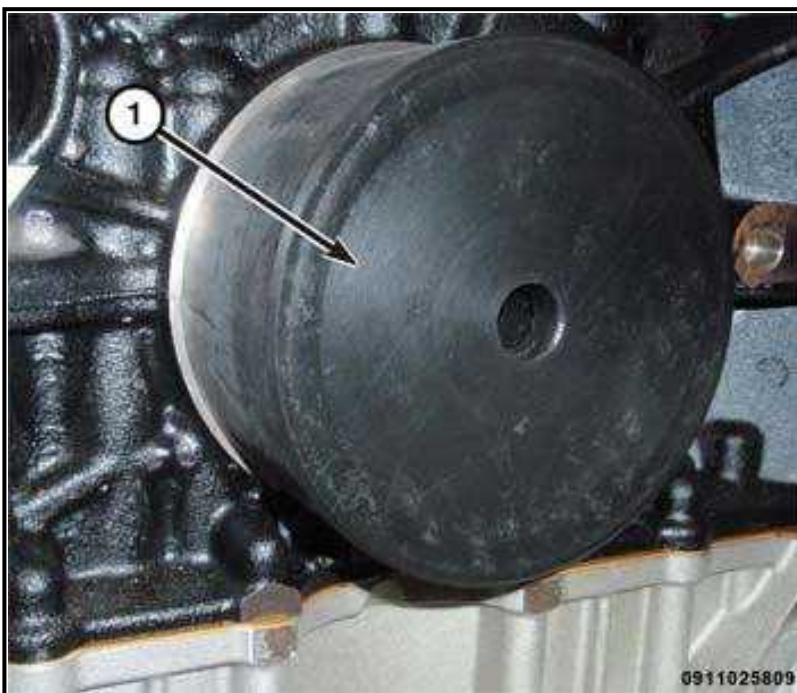
- Remove any excess MoparB® Threebond Engine RTV Sealant that may have squeezed out in rear oil seal bay.
- Check the crankshaft end play. Refer to [CRANKSHAFT, STANDARD PROCEDURE](#) .



1 - Rear Crankshaft Oil Seal

2 - Rear Seal Guide Tool

- Install the (special tool #VM.10341-1, Guide, Rear Seal) and slide the rear oil seal onto the crankshaft.
- Remove the (special tool #VM.10341-1, Guide, Rear Seal).



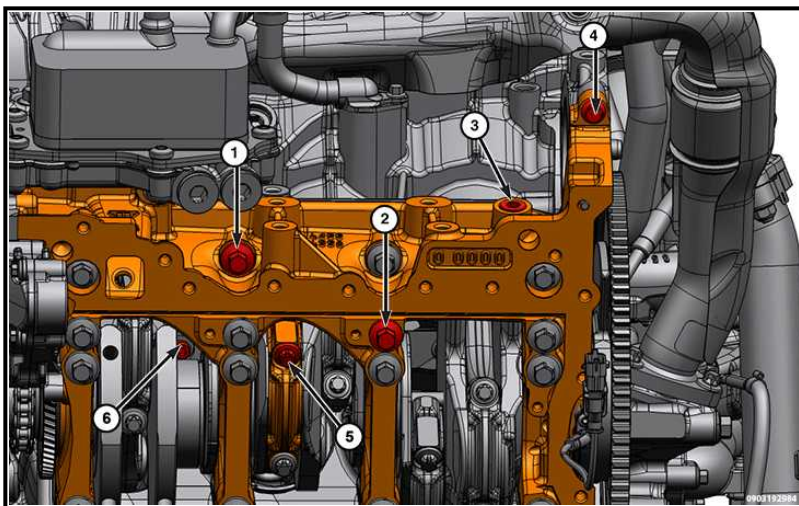
1 - Rear Crankshaft Oil Seal Installer Tool

NOTE: Position the flat portion of the Rear Seal Installer should be facing down giving you clearance by the Crankshaft Position Sensor (CKP) boss.

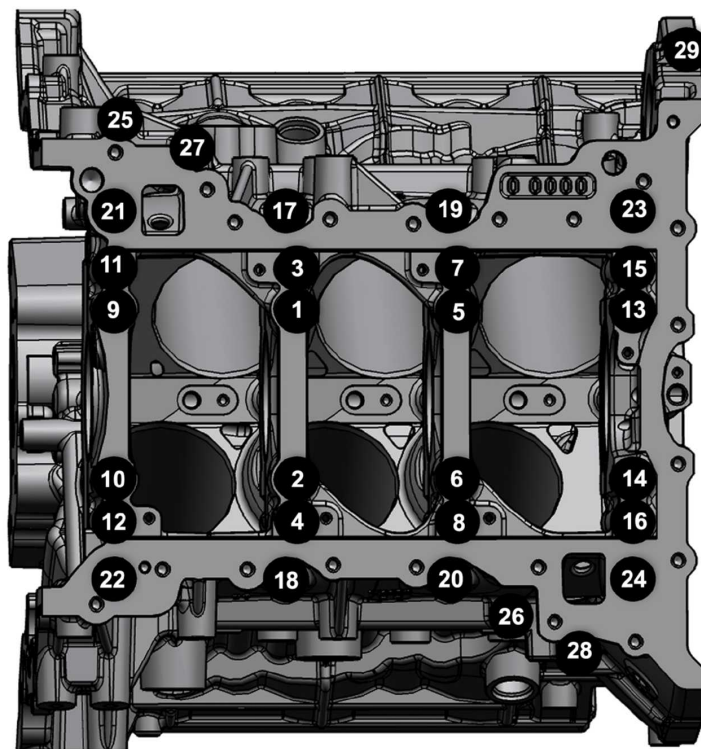
- Using the (special tool #2073200090, Installer, Rear Crankshaft Oil Seal) install the rear main oil seal into the engine block.

TORQUE SPECIFICATIONS

ENGINE BLOCK



CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1, 2, 4	Bedplate Bolts	Torque Procedure: 1. Using NEW bolts, install the 26 M12 bolts (1 - 26) and the three M8 bolts (27 - 29) finger tight. 2. Tighten all M12 bolts (1 - 4, 7 - 10, 13 - 16, 19 - 22) to 45 N.m (33 Ft. Lbs.). 3. Tighten the M12 bolts (1 - 16) an additional 110B°. 4. Tighten the M12 bolts (25 and 26) to 120 N.m (89 Ft. Lbs.). 5. Tighten the M12 bolts (17 - 24) to 25 N.m (18 Ft. Lbs.). 6. Tighten the M12 bolts (17 - 24) an additional 55B°. 7. Tighten the M12 bolts (21 - 24) an additional 75B°. 8. Tighten the three M8 bolts (27 - 29) to 30 N.m (22 Ft. Lbs.).	Tightening Sequence
3	Engine Block Timing Plug	30 N.m (22 Ft. Lbs.)	-
5	Piston Rod Cap Bolt	-	Serviced with Assembly
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-
-	Engine Ground to Engine Block	20 N.m (15 Ft. Lbs.)	-
-	Engine Lifting Brackets	55 N.m (41 Ft. Lbs.)	-



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Fig. 9: Bed Plate Tightening Sequence 3.0L (2 OF 2)

Courtesy of CHRYSLER GROUP, LLC

LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-

1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts 7-13 one at a time 90B° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90B° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence NOTE: Bolts in the following positions are stud bolts (4, 6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure:	Tightening Sequence

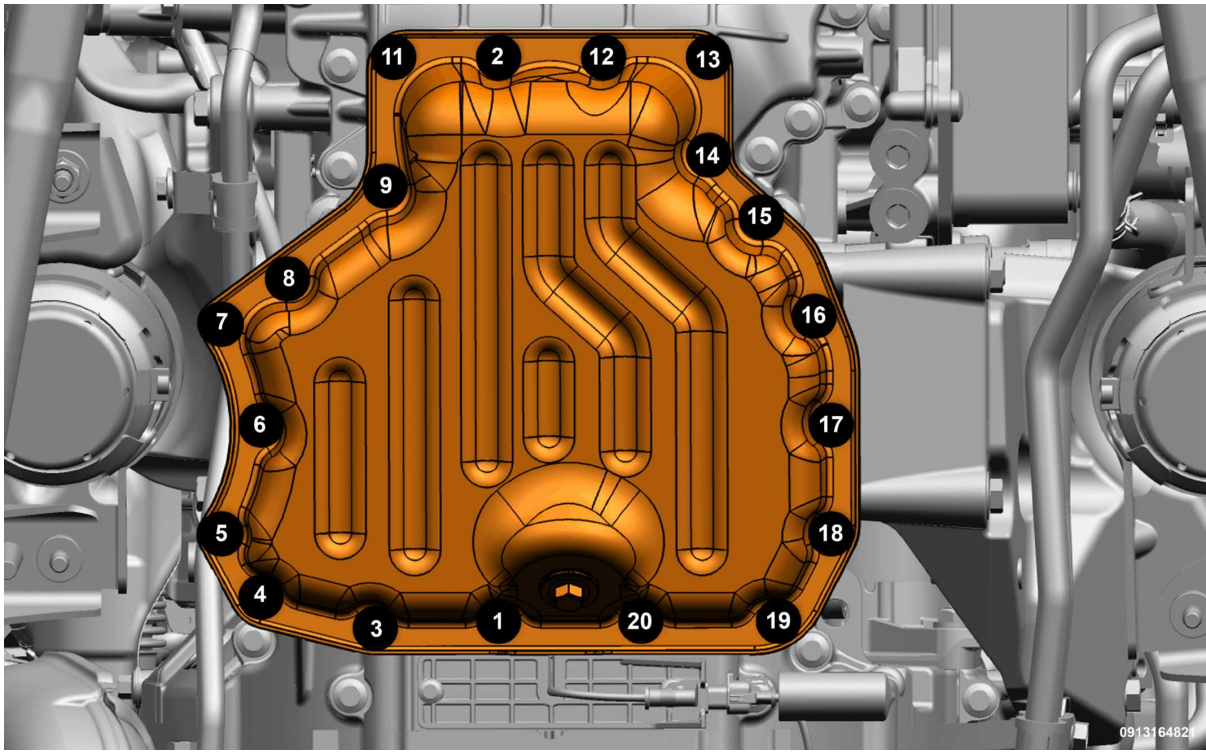
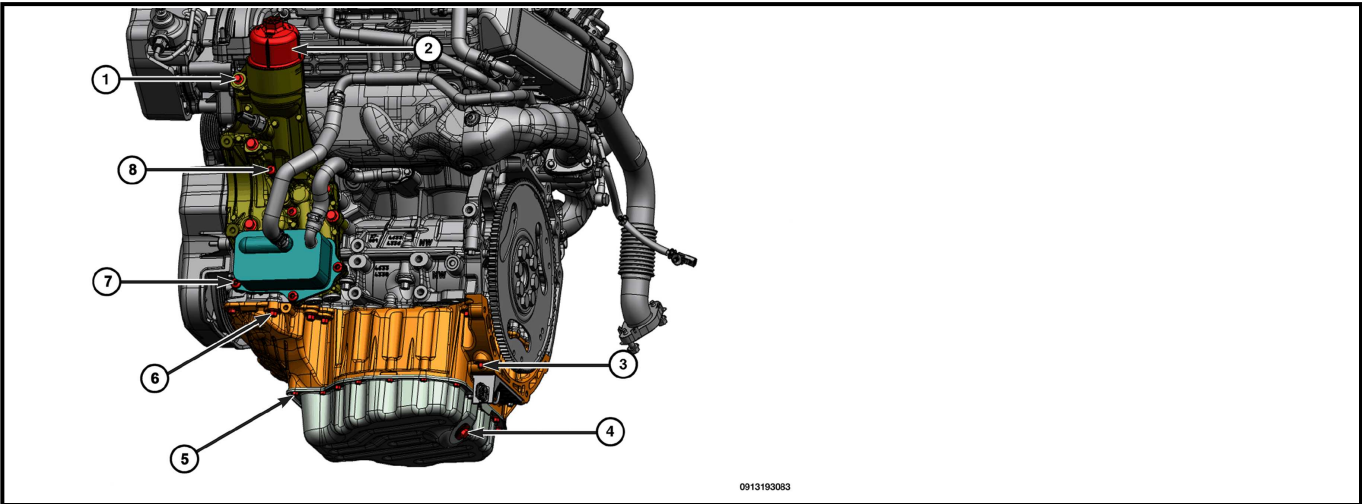
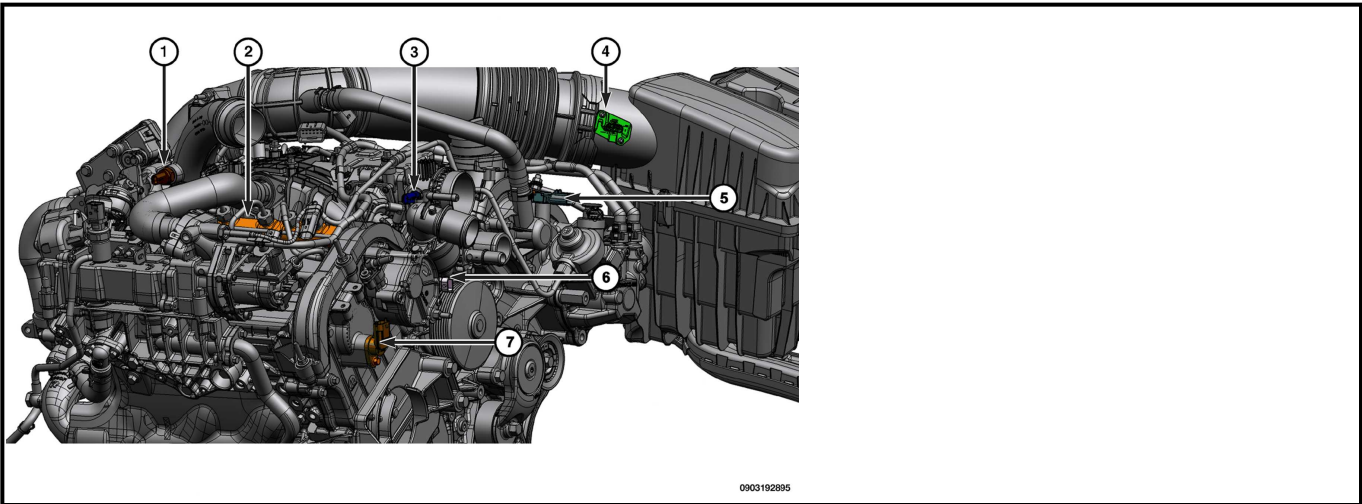


Fig. 11: Lower Oil Pan Bolt Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC



ENGINE SENSORS



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Inlet Air Temperature (IAT) Sensor	20 N.m (15 Ft. Lbs.)	-
2	Fuel Pressure Sensor	Tighten Securely	-
3	Outlet Air Temperature (IAT) Sensor	Turn Clockwise 1/4 to Lock	-
4	MAF Sensor	Tighten Securely	-
5	Crankcase Pressure Sensor	Tighten Securely	-
6	Engine Coolant Temperature (ECT) Sensor	11 N.m (8 Ft. Lbs.)	-
7	Camshaft Position Sensor Bolt	8 N.m (71 In. Lbs.)	-
-	Boost Pressure Sensor	Tighten Securely	-
-	Crankshaft Position (CKP) Sensor Bolt	6 N.m (53 In. Lbs.)	-
-	Crankshaft Position Sensor Wire Harness Connector Bracket Bolt	8 N.m (71 In. Lbs.)	-
-	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
-	Engine Oil Pressure (EOP) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Engine Oil Temperature (EOT) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Banjo Bolt	28 N.m (21 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Bracket Bolts	11 N.m (8 Ft. Lbs.)	-
-	Exhaust Temperature Sensor	45 N.m (33 Ft. Lbs.)	-
-	Fuel Pressure Sensor	70 N.m (52 Ft. Lbs.)	-
-	Oxygen (O2) Sensor	50 N.m (37 Ft. Lbs.)	-
-	Delta Pressure Sensor	Tighten Securely	-

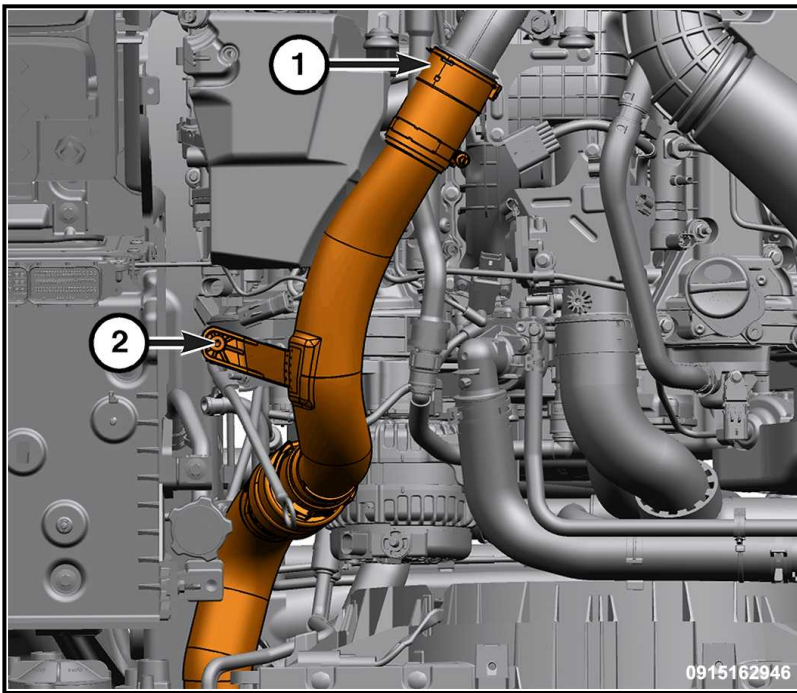
PUMP, VACUUM

REMOVAL AND INSTALLATION

VACUUM PUMP

REMOVAL

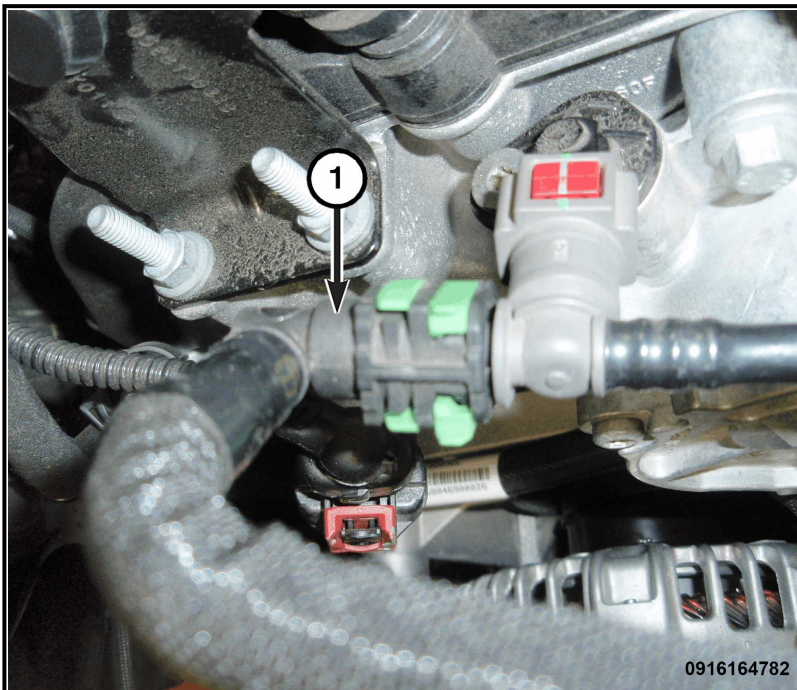
1. Remove the engine cover. Refer to **COVER, ENGINE, REMOVAL AND INSTALLATION** .



1 - Retaining Clip

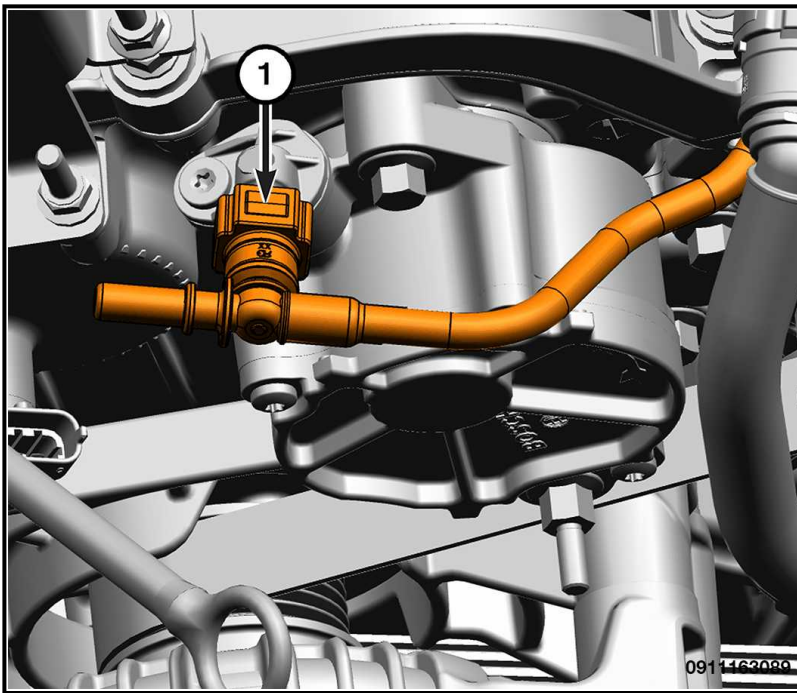
2 - Charge Air Cooler Hose Bolt

2. Remove the Charge Air Cooler (CAC) hose bolt securing the CAC hose to the support bracket.
3. Release the retaining clip and disconnect the CAC hose from the turbocharger elbow.



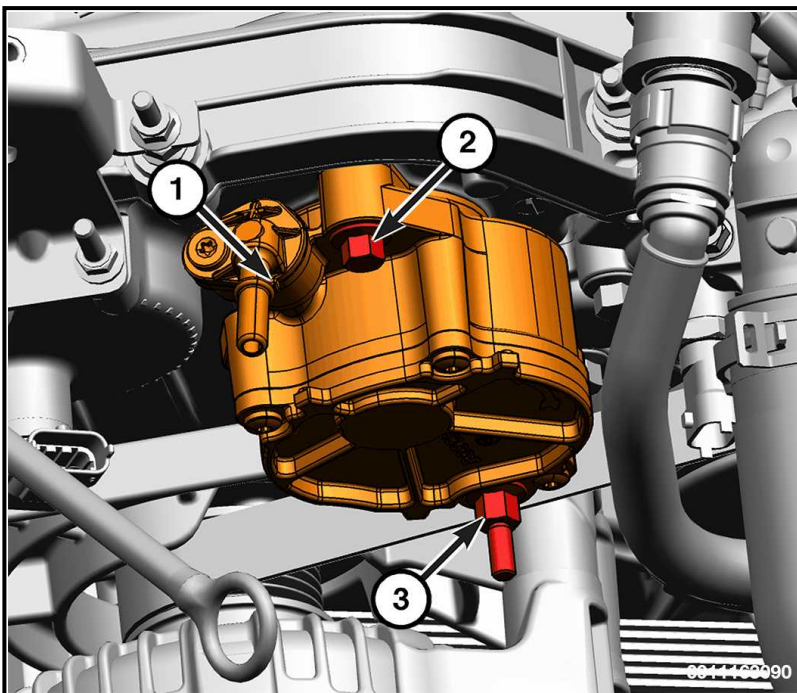
1 - Vacuum Hose

4. Disconnect the vacuum hose.



1 - Vacuum Line

5. Disconnect the vacuum line from the vacuum pump.



1 - Vacuum Pump

2 - Vacuum Pump Bolt

3 - Vacuum Pump Studbolt

NOTE: Observe position of driver on rear of pump upon removal.

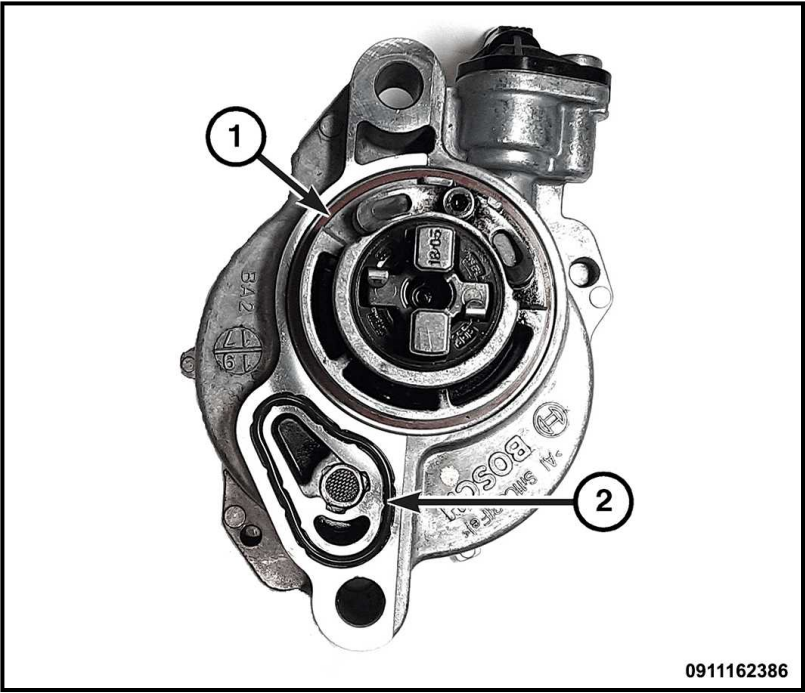
6. Remove the vacuum pump bolts and the vacuum pump.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean all the gasket sealing surfaces.

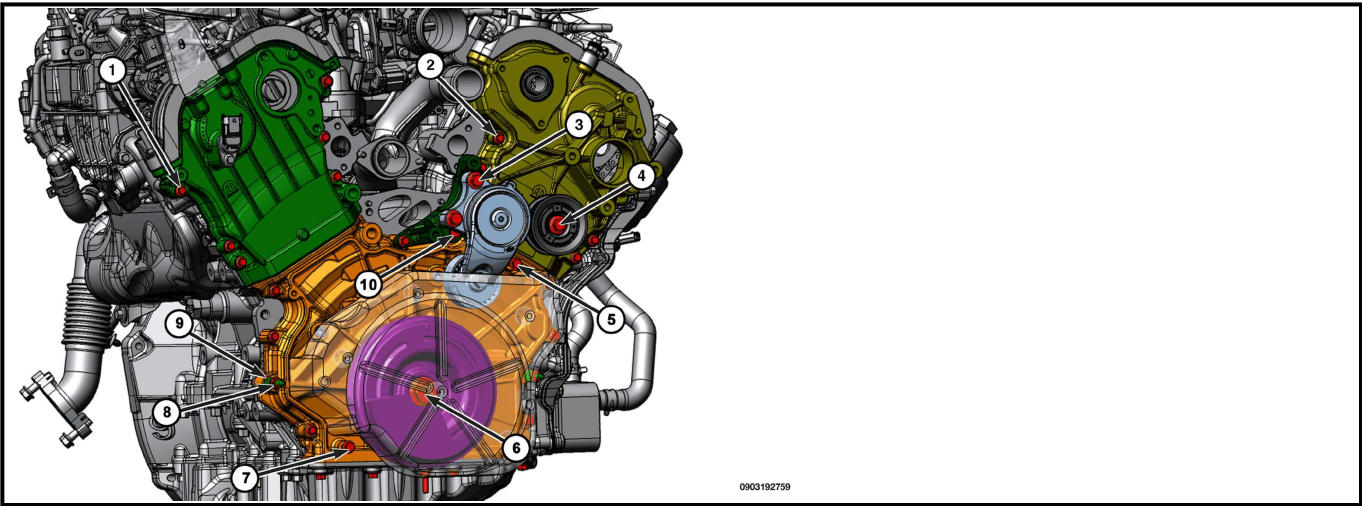


1 - O-ring
2 - O-ring

- Install a **NEW** O-ring seals onto the vacuum pump.
- Position driver on rear of pump and install the vacuum pump and tighten the bolts to the proper torque specifications.
- Start the engine and inspect for leaks.

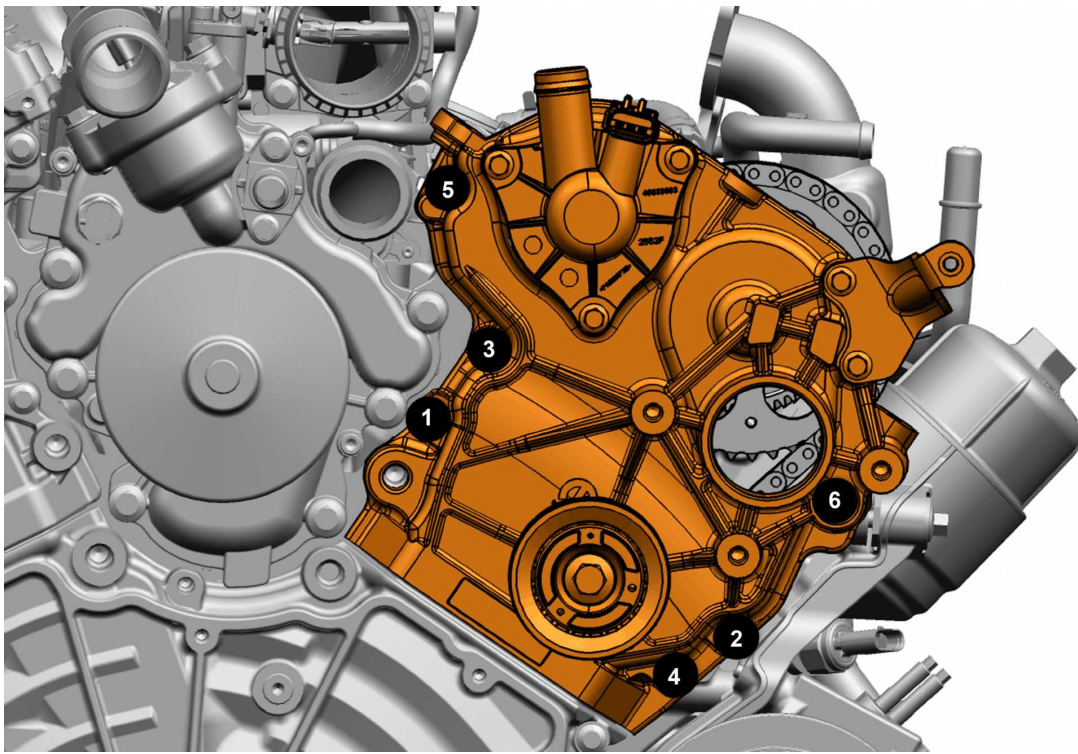
TORQUE SPECIFICATIONS

FRONT ENGINE



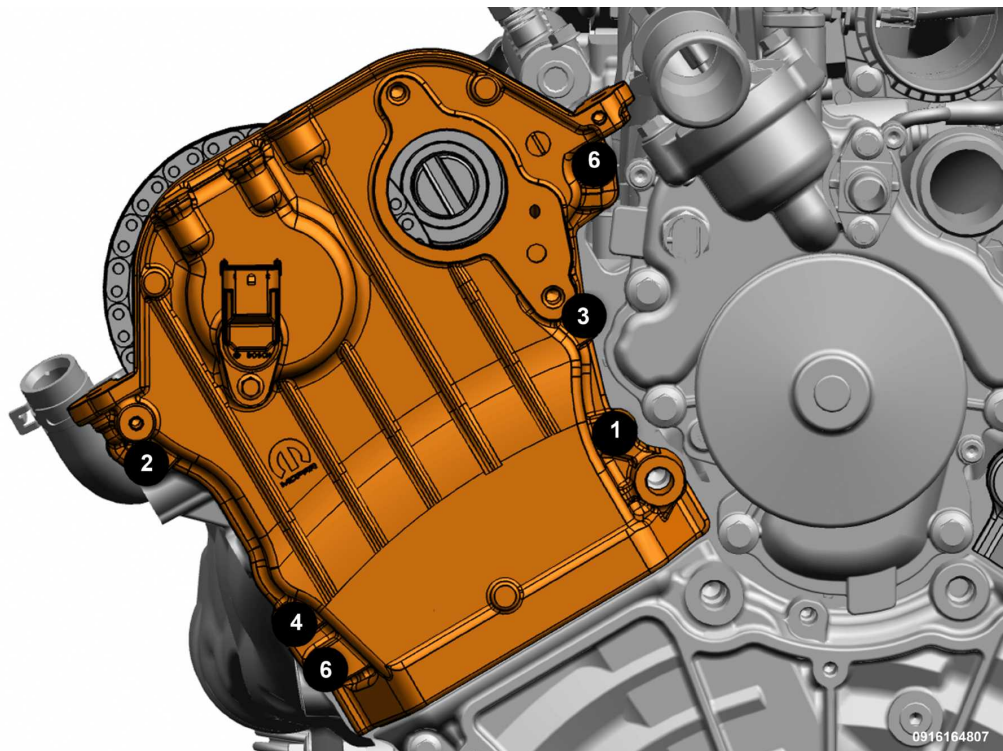
CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1, 2	Timing Chain Cover Bolts	Torque Procedure: 1. Tighten the M6 bolts finger tight. 2. Tighten the M6 bolts to 9 N.m (80	Tightening Sequence

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
		In. Lbs.). 3. Loosen the M6 bolts 60B° and retighten to 15 N.m (11 Ft. Lbs.).	
3	Belt Tensioner Pulley Bolt	45 N.m (33 Ft. Lbs.)	-
4	Idler Pulley Bolts	32 N.m (24 Ft. Lbs.)	-
5, 9	Timing Chain Cover Bolts (lower)	Torque Procedure: 1. Tighten the lower timing cover bolts (1 and 3) finger tight. 2. Tighten the M6 bolts (1 - 8) to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and tighten to 15 N.m (Ft. Lbs.). 4. Install the oil pan-to-lower chain cover bolts and tighten (9 - 13) to 15 N.m (11 Ft. Lbs.). 5. Loosen each bolt one at a time 90B° and tighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence Position 2 and 3 are double ended studs.
6	Vibration Damper Bolt	100 N.m (74 Ft. Lbs.) + 125B°	-
7	Vibration Damper Cover Bolts	10 N.m (7 Ft. Lbs.)	-
8	Vibration Damper Cover Nut	9 N.m (80 In. Lbs.)	-
10	Belt Tensioner to Mounting Bracket - M10 Bolt	45 N.m (33 Ft. Lbs.)	-
11	Belt Tensioner to Mounting Bracket - M6 Bolt	11 N.m (8 Ft. Lbs.)	-
-	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Oil Breather/Camshaft Seal Housing Bolts	14 N.m (10 Ft. Lbs.)	-
-	Vacuum Pump Bolt	30 N.m (22 Ft. Lbs.)	-



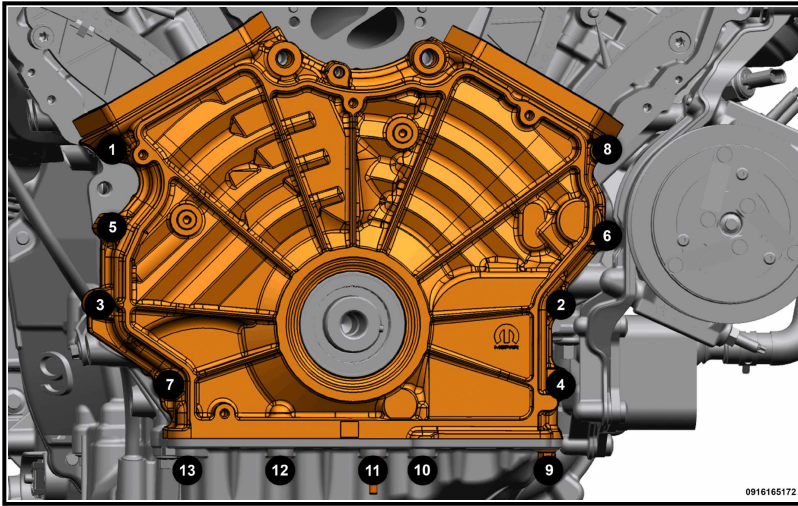
0910164809

Fig. 12: Left Upper Timing Cover Bolts Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC



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Fig. 13: Right Upper Timing Cover Bolts Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC



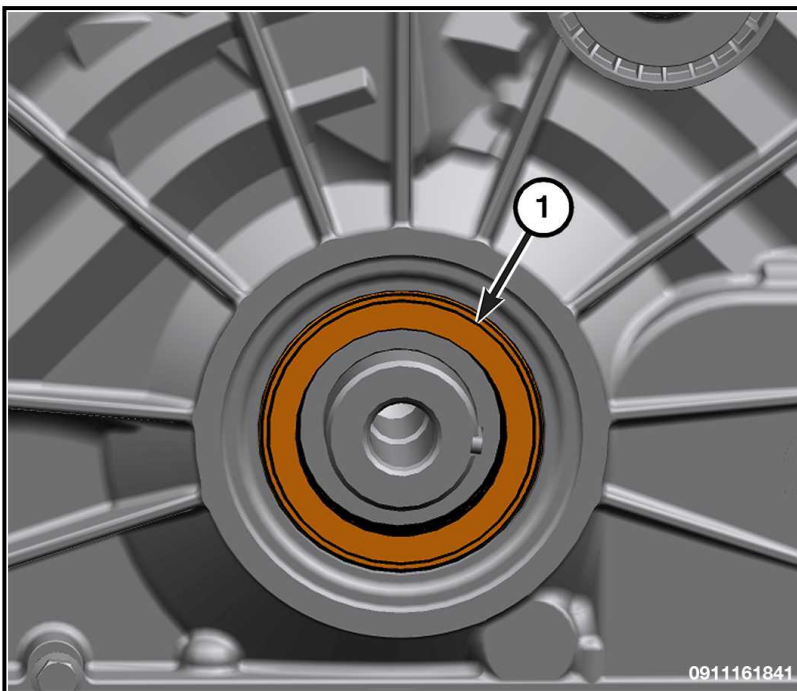
SEAL, CRANKSHAFT OIL, FRONT

REMOVAL AND INSTALLATION

FRONT CRANKSHAFT OIL SEAL

REMOVAL

1. Remove the vibration damper. Refer to [DAMPER, VIBRATION, REMOVAL AND INSTALLATION](#).



1 - Front Crankshaft Oil Seal

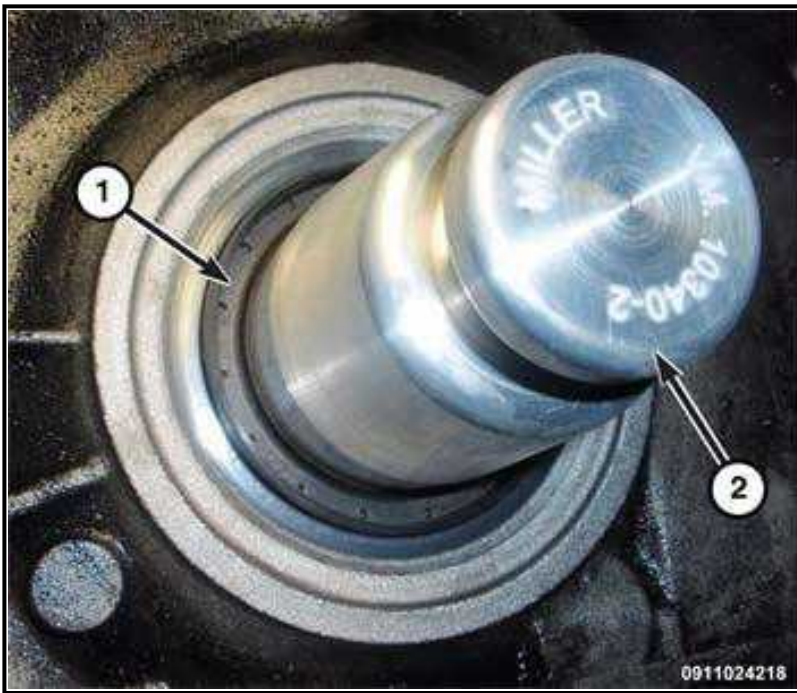
CAUTION: Care must be taken when removing the crankshaft seal. DO NOT damage or gouge the timing chain cover.

2. Using a suitable seal puller, remove the front crankshaft oil seal.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

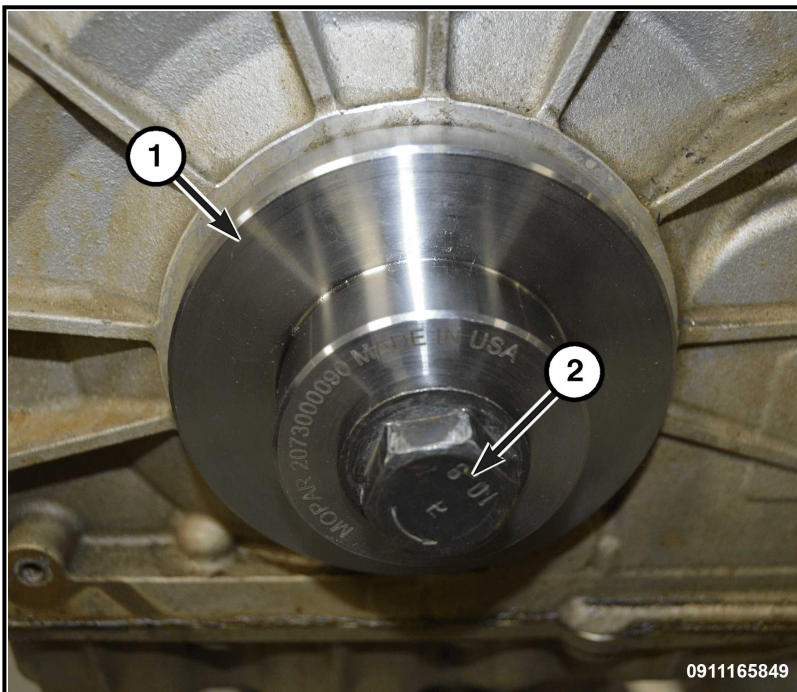
1. Clean timing chain cover seal surface.



1 - Front Crankshaft Oil Seal
2 - Front Seal Guide Tool

NOTE: Install the front crankshaft oil seal so the lip of seal face towards the engine.

2. Install the (special tool #VM.10340-2, Guide, Front Seal) and position the front crankshaft oil seal in place.
3. Remove the (special tool #VM.10340-2, Guide, Front Seal).



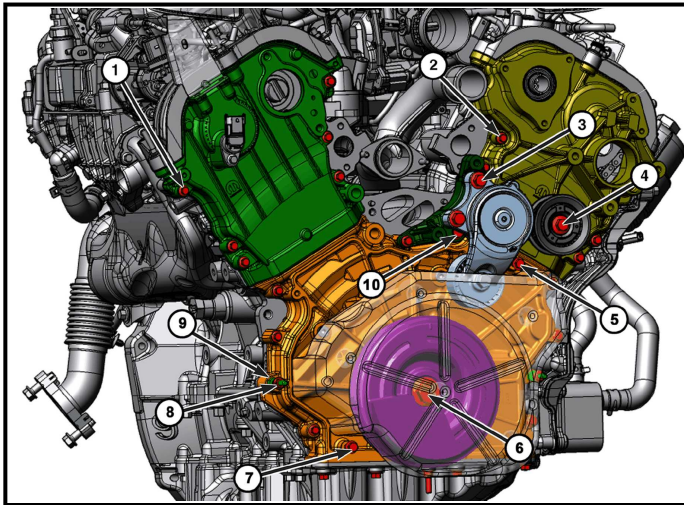
1 - Front Crankshaft Seal Installer
2 - Vibration Damper Bolt

4. Using the (special tool #2073000090, Installer, Front Crankshaft Seal), install the front crankshaft oil seal using the vibration damper bolt to draw the seal in place.
5. Remove the vibration damper bolt and the front crankshaft seal installer.

6. Install the vibration damper. Refer to [DAMPER, VIBRATION, REMOVAL AND INSTALLATION.](#)

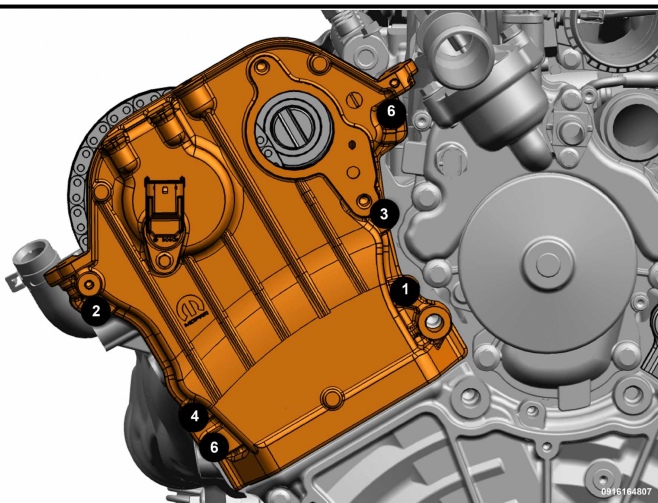
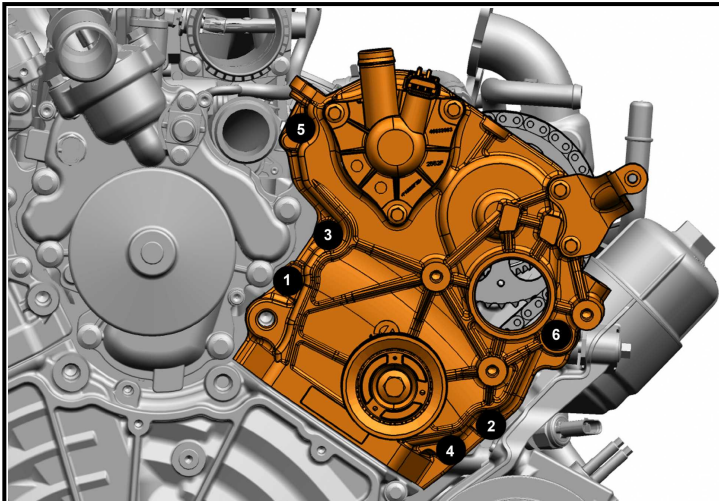
TORQUE SPECIFICATIONS

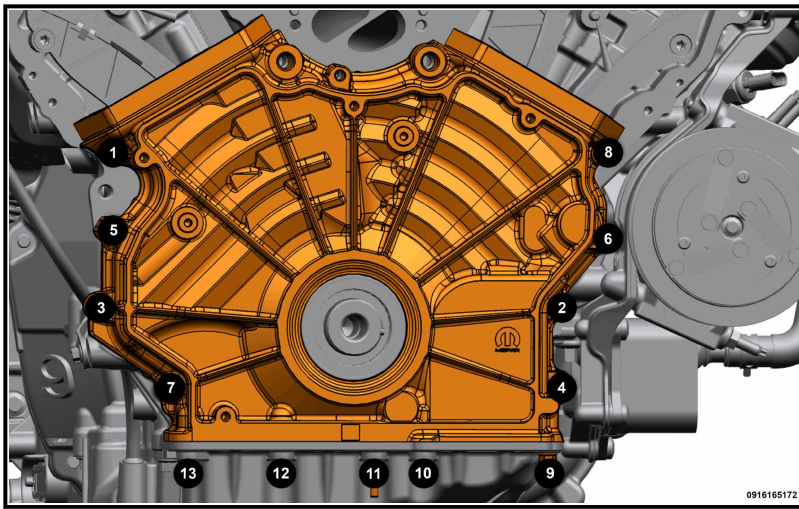
FRONT ENGINE



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1, 2	Timing Chain Cover Bolts	Torque Procedure: 1. Tighten the M6 bolts finger tight. 2. Tighten the M6 bolts to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and retighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence
3	Belt Tensioner Pulley Bolt	45 N.m (33 Ft. Lbs.)	-
4	Idler Pulley Bolts	32 N.m (24 Ft. Lbs.)	-
5, 9	Timing Chain Cover Bolts (lower)	Torque Procedure: 1. Tighten the lower timing cover bolts (1 and 3) finger tight. 2. Tighten the M6 bolts (1 - 8) to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60B° and tighten to 15 N.m (Ft. Lbs.). 4. Install the oil pan-to-lower chain cover bolts and tighten (9 - 13) to 15 N.m (11 Ft. Lbs.).	Tightening Sequence Position 2 and 3 are double ended studs.

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
		5. Loosen each bolt one at a time 90B° and tighten to 15 N.m (11 Ft. Lbs.).	
6	Vibration Damper Bolt	100 N.m (74 Ft. Lbs.) + 125B°	-
7	Vibration Damper Cover Bolts	10 N.m (7 Ft. Lbs.)	-
8	Vibration Damper Cover Nut	9 N.m (80 In. Lbs.)	-
10	Belt Tensioner to Mounting Bracket - M10 Bolt	45 N.m (33 Ft. Lbs.)	-
11	Belt Tensioner to Mounting Bracket - M6 Bolt	11 N.m (8 Ft. Lbs.)	-
-	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Oil Breather/Camshaft Seal Housing Bolts	14 N.m (10 Ft. Lbs.)	-
-	Vacuum Pump Bolt	30 N.m (22 Ft. Lbs.)	-





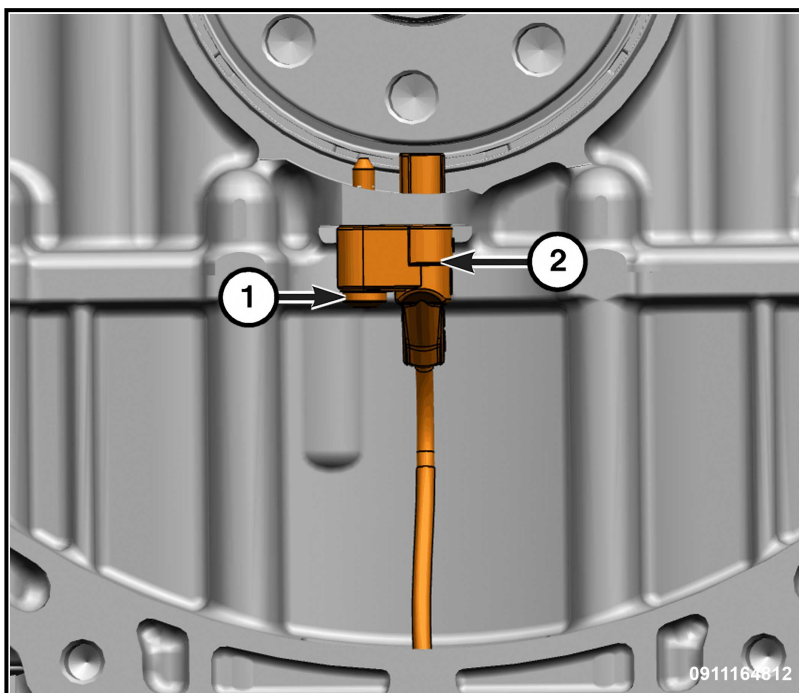
SEAL, CRANKSHAFT OIL, REAR

REMOVAL AND INSTALLATION

REAR CRANKSHAFT OIL SEAL

REMOVAL

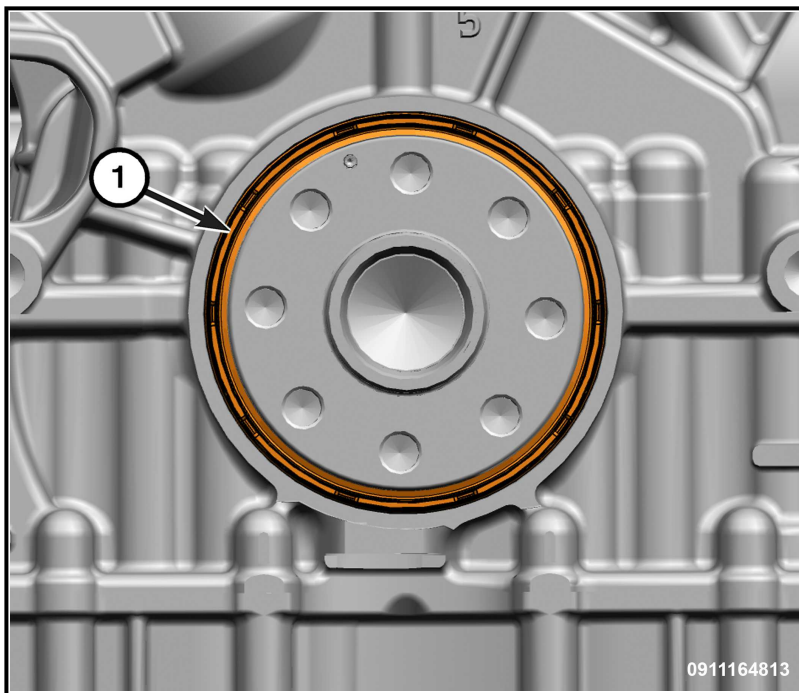
1. Remove the flex plate, counter weight, and tone wheel. Refer to [FLEXPLATE, REMOVAL AND INSTALLATION](#) .



1 - Crankshaft Position Sensor Bolt

2 - Crankshaft Position Sensor

2. Remove the Crankshaft Position sensor (CKP) bolt and the CKP sensor.



1 - Rear Crankshaft Oil Seal

NOTE: Use care not to damage the rear crankshaft oil seal sealing surface.

3. Using suitable seal puller, remove the rear crankshaft oil seal.

INSTALLATION

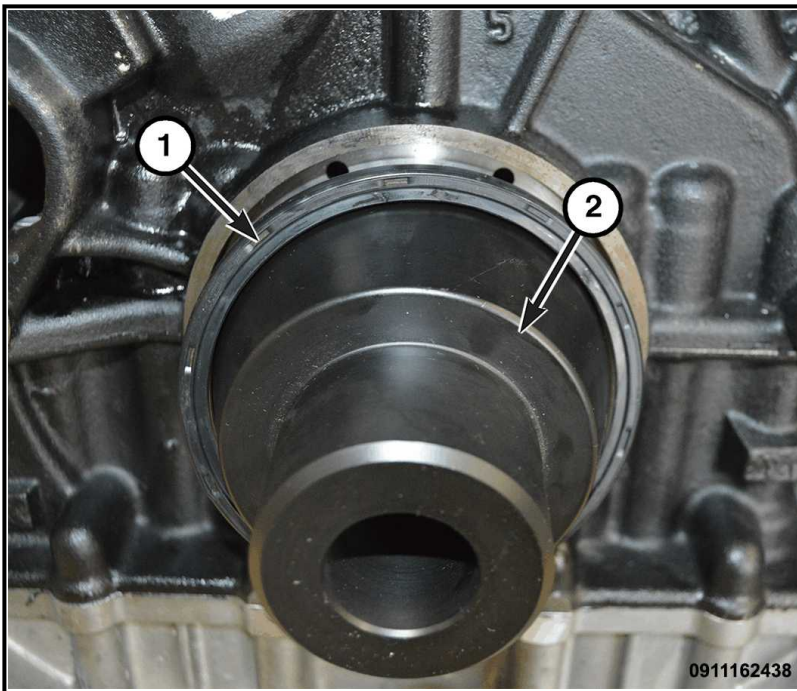
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean around the rear crankshaft oil seal surface area.

NOTE: Install the rear crankshaft oil seal so the lip of seal face towards the engine.

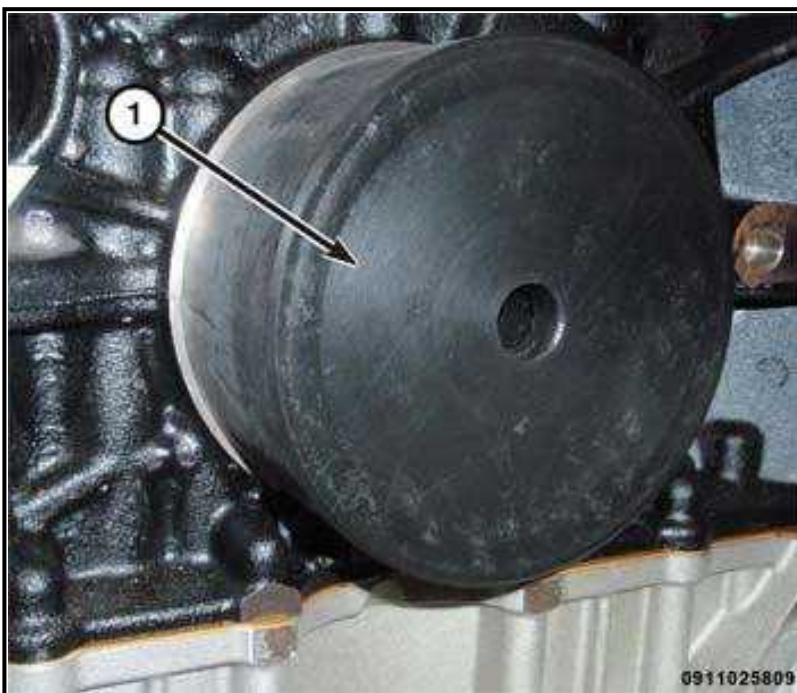
- Lubricate the lip of the rear crankshaft oil seal with clean engine oil.



1 - Rear Crankshaft Oil Seal

2 - Rear Seal Guide Tool

- Install the (special tool #VM.10341-1, Guide, Rear Seal) and slide the rear oil seal onto the crankshaft.
- Remove the (special tool #VM.10341-1, Guide, Rear Seal).



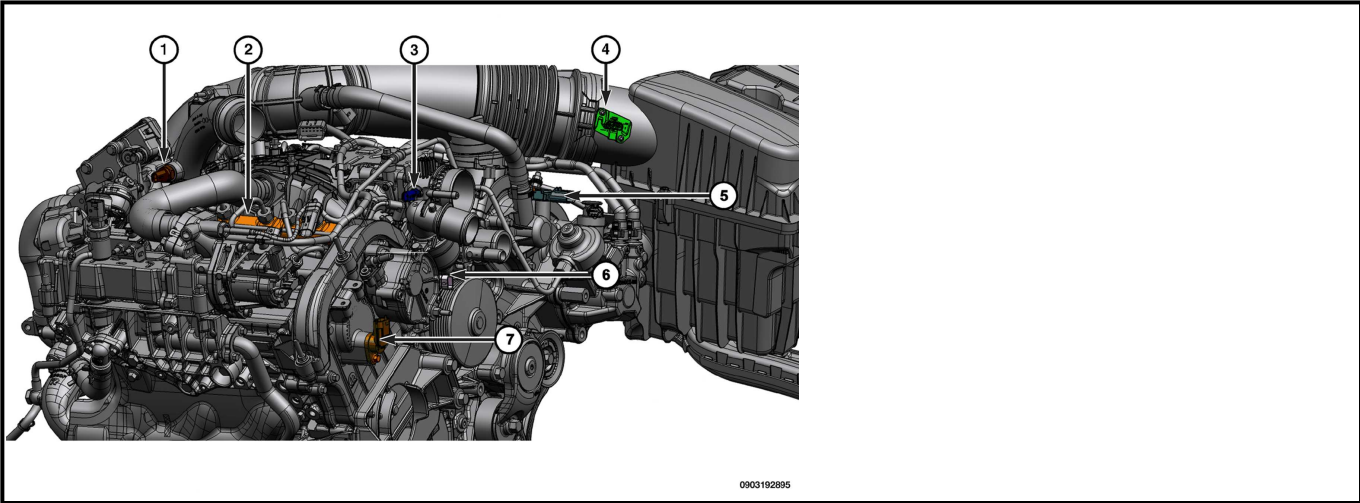
1 - Rear Crankshaft Oil Seal Installer

NOTE: Position the flat portion of the Rear Seal Installer should be facing down giving you clearance by the Crankshaft Position Sensor (CKP) boss.

- Using the (special tool #2073200090, Installer, Rear Crankshaft Oil Seal) install the rear main oil seal into the engine block.
- Clean the area and bore around Crankshaft Position sensor (CKP).

TORQUE SPECIFICATIONS

ENGINE SENSORS



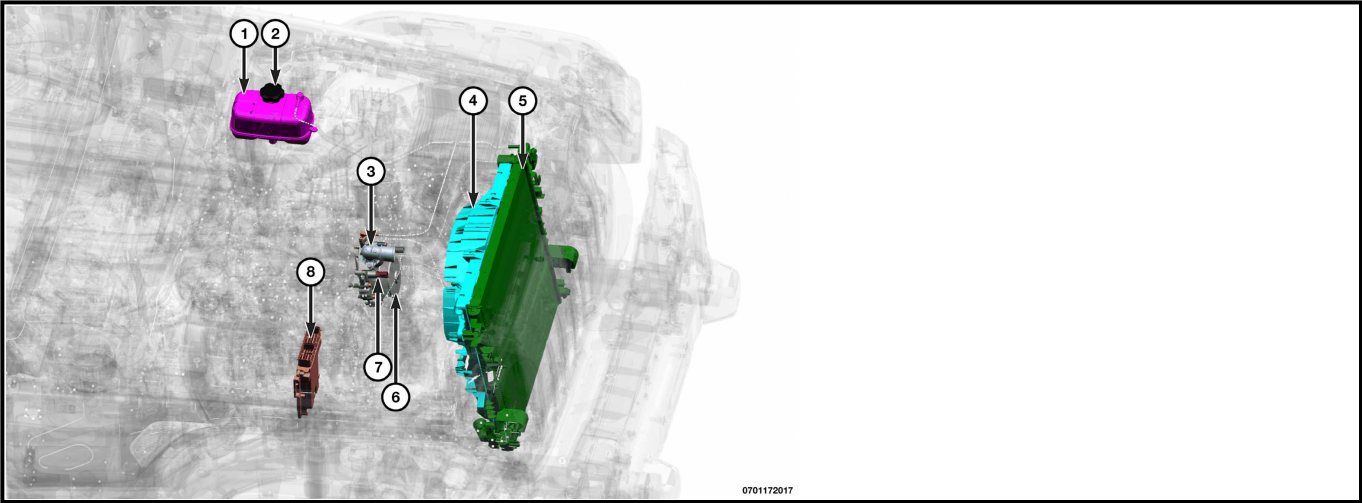
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CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Inlet Air Temperature (IAT) Sensor	20 N.m (15 Ft. Lbs.)	-
2	Fuel Pressure Sensor	Tighten Securely	-
3	Outlet Air Temperature (IAT) Sensor	Turn Clockwise 1/4 to Lock	-
4	MAF Sensor	Tighten Securely	-
5	Crankcase Pressure Sensor	Tighten Securely	-
6	Engine Coolant Temperature (ECT) Sensor	11 N.m (8 Ft. Lbs.)	-
7	Camshaft Position Sensor Bolt	8 N.m (71 In. Lbs.)	-
-	Boost Pressure Sensor	Tighten Securely	-
-	Crankshaft Position (CKP) Sensor Bolt	6 N.m (53 In. Lbs.)	-
-	Crankshaft Position Sensor Wire Harness Connector Bracket Bolt	8 N.m (71 In. Lbs.)	-
-	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
-	Engine Oil Pressure (EOP) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Engine Oil Temperature (EOT) Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor	20 N.m (15 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Banjo Bolt	28 N.m (21 Ft. Lbs.)	-
-	Exhaust Pressure Sensor Tube Bracket Bolts	11 N.m (8 Ft. Lbs.)	-
-	Exhaust Temperature Sensor	45 N.m (33 Ft. Lbs.)	-
-	Fuel Pressure Sensor	70 N.m (52 Ft. Lbs.)	-
-	Oxygen (O2) Sensor	50 N.m (37 Ft. Lbs.)	-
-	Delta Pressure Sensor	Tighten Securely	-

ENGINE COOLING

DESCRIPTION

COOLING SYSTEM



DESCRIPTION

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible, maintains normal operating temperature and prevents overheating.

The cooling system also provides a means of heating the passenger compartment and cooling the engine oil.

The cooling system consists of the following components:

COMPONENT INDEX

1.	Refer to PRESSURIZED COOLANT BOTTLE.
2.	Refer to PRESSURE CAP.
3.	Refer to THERMOSTAT AND HOUSING ASSEMBLY.
4.	Refer to ELECTRIC COOLING FAN.
5.	Refer to RADIATOR.
6.	Refer to WATER PUMP.
7.	Refer to ENGINE COOLANT TEMPERATURE (ECT) SENSOR.
8.	Refer to POWERTRAIN CONTROL MODULE.
-	Refer to COOLANT.

OPERATION

The cooling system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system. A separate and remotely mounted, pressurized coolant bottle is used. When the engine is cold the thermostat is closed. The cooling system has no flow through the radiator or engine oil cooler. The coolant flows through the engine, water pump, Exhaust Gas Recirculation (EGR) Cooler, and passenger compartment heater core. When the engine is warm the thermostat is full open. Coolant flows through the engine, radiator, engine oil cooler, passenger compartment heater core, and water pump.

COOLANT

Refer to COMPONENT INDEX.

The cooling system is designed around the coolant. The coolant must accept heat from engine metal, in the cylinder head area near the exhaust valves and engine block. Then coolant carries the heat to the radiator where the tube/fin radiator can transfer the heat to the air. The use of aluminum cylinder blocks, cylinder heads, and water pumps requires special corrosion protection. MoparB® Antifreeze/Coolant, or the equivalent ethylene-glycol base coolant with organic corrosion inhibitors (called OAT, for Organic Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% ethylene-glycol and 50% distilled water to obtain a freeze point of -37B°C (-35B°F). If it becomes contaminated, drain, flush, and replace with fresh properly mixed coolant solution.

PRESSURE CAP

Refer to [**COMPONENT INDEX**](#).

All radiators are equipped with a pressure cap. This cap releases pressure at a point within the range of 124-145 kPa (18-21 psi). The pressure relief point (in pounds) is engraved on top of the cap. The cooling system will operate at pressures slightly above atmospheric pressure. This results in a higher coolant boiling point allowing increased radiator cooling capacity. The cap contains a spring-loaded pressure relief valve. This valve opens when system pressure reaches the release range of 124-145 kPa (18-21 psi). A rubber gasket seals the radiator filler neck. This is done to maintain vacuum during coolant cool-down and to prevent leakage when system is under pressure.

ELECTRIC COOLING FAN

Refer to [**COMPONENT INDEX**](#).

The electric cooling fan replaces the engine driven mechanical fan. The electric cooling fan is integral to the fan shroud and is located between the radiator and the engine. The electric fan is controlled by the Powertrain Control Module (PCM). The electric cooling fan is not serviceable. Any failure of the fan blade, electric motor or fan shroud requires replacement of the fan module.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

Refer to [**COMPONENT INDEX**](#).

The Engine Coolant Temperature (ECT) sensor is used to sense engine coolant temperature. The sensor protrudes into the thermostat housing. The ECT sensor is a two-wire Negative Thermal Coefficient (NTC) sensor. Meaning, as engine coolant temperature increases, resistance (voltage) in the sensor decreases. As temperature decreases, resistance (voltage) in the sensor increases. At key-on, the PCM sends out a regulated 5 volt signal to the ECT sensor. The PCM then monitors the signal as it passes through the ECT sensor to the sensor ground (sensor return). When the engine is cold, the PCM will operate in Open Loop cycle. It will demand slightly richer air-fuel mixtures and higher idle speeds. This is done until normal operating temperatures are reached.

The pressurized coolant bottle is mounted on top of the radiator. The coolant recovery/overflow bottle is made of high temperature plastic. The radiator overflow hose and the bypass hose connects to the top of bottle in order to help get trapped air out of the coolant system. Coolant is drawn back into the engine through the lower hose.

POWERTRAIN CONTROL MODULE

Refer to [**COMPONENT INDEX**](#).

Inputs

- Indicates whether the ECC/HVAC is requesting A/C compressor activation or not.
- Pressure Sensor.
- Engine Oil Temperature.
- Engine Coolant Temperature.
- DPF Regeneration.
- Engine RPM.
- Engine Run Status.
- Intake Air Temp.
- Engine Thermal Management Demand.
- Vehicle speed.
- Commanded ignition switch status.
- Hood ajar status.
- Ambient Temp Sensor A/D Voltage.

- Maximum A/C demand to powertrain.
- Transmission fluid temperature.

Outputs

- Cooling fan request.
- Radiator Fan request.
- Fan PWM duty cycle command [%].

PRESSURIZED COOLANT BOTTLE

Refer to [COMPONENT INDEX](#).

The coolant reserve/overflow system consists of a radiator mounted pressurized cap, a plastic coolant recovery bottle, a hose connecting the radiator and recovery bottle, and an overflow tube on the side of the bottle. As air is removed from the cooling system, it gathers in the pressurized coolant bottle. This pressure is released into the atmosphere through the pressure valve located in the radiator pressure cap when pressure reaches 21 PSI (145 kPa.).

RADIATOR

Refer to [COMPONENT INDEX](#).

A heavy duty cross-flow aluminum/plastic radiator is used. The radiator consists of an aluminum core and plastic end tanks, which are fastened to the core with clinch tabs and sealed with a high temperature rubber gasket. Vehicles equipped with automatic transmissions use a combination A/C condenser/transmission oil cooler located on the front of the radiator. If the plastic tank has been damaged, individual parts are not available, and the radiator must be replaced. As air passes through the radiator core, the heat within the coolant is dissipated into the ambient air.

THERMOSTAT AND HOUSING ASSEMBLY

Refer to [COMPONENT INDEX](#).

A pellet-type thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. On all engines the thermostat is closed below 90B°C (195B°F). Above this temperature, coolant is allowed to flow to the radiator. This provides quick engine warm up and overall temperature control. The same thermostat is used for winter and summer seasons. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes other problems. These are: longer engine warm-up time, unreliable warm-up performance, increased exhaust emissions and crankcase condensation. This condensation can result in sludge formation. The wax pellet is located in a sealed container at the spring end of the thermostat. When heated, the pellet expands, overcoming closing spring tension and water pump pressure to force the valve to open.

WATER PUMP

Refer to [COMPONENT INDEX](#).

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core. The pump is driven from the engine crankshaft by a single serpentine main drive belt. The water pump impeller is pressed onto the rear of a shaft that rotates in bearings pressed into the housing. The housing has two small holes to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant mixture. No additional lubrication is necessary. The water pump is mounted directly to the timing chain cover and is equipped with a non serviceable integral pulley. The water pump is used to circulate coolant through the cooling system. The coolant is pumped through the engine block, cylinder head, heater core, EGR cooler, viscous heater, and radiator.

COOLANT

CAUTION: Mixing of engine coolant (antifreeze) other than specified Organic Additive Technology (OAT) engine coolant (antifreeze), may result in engine damage and

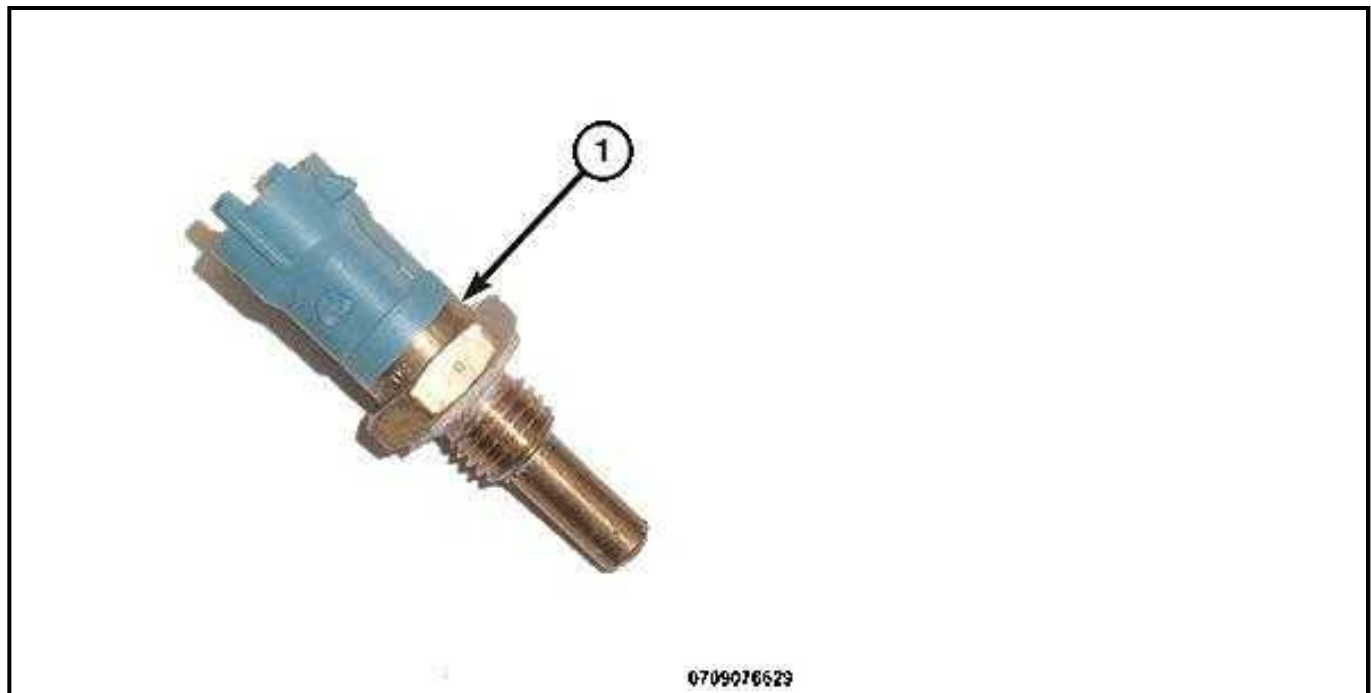
may decrease corrosion protection. Organic Additive Technology (OAT) engine coolant is different and should not be mixed with Hybrid Organic Additive Technology (HOAT) engine coolant (antifreeze). If a non-OAT engine coolant (antifreeze) is introduced into the cooling system in an emergency, it should be replaced with the specified engine coolant (antifreeze) as soon as possible.

To find the coolant needed. Refer to [CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS](#)

The cooling system is designed around the coolant. The coolant must accept heat from engine metal, in the cylinder head area near the exhaust valves and engine block. Then coolant carries the heat to the radiator where the tube/fin radiator can transfer the heat to the air.

The use of aluminum cylinder blocks, cylinder heads, and water pumps requires special corrosion protection. MoparB® Antifreeze/Coolant, or the equivalent ethylene-glycol base coolant with organic corrosion inhibitors (called OAT, for Organic Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% ethylene-glycol and 50% distilled water to obtain a freeze point of -37B°C (-35B°F). If it becomes contaminated, drain, flush, and replace with fresh properly mixed coolant solution.

COOLANT TEMPERATURE SENSOR



1 - Engine Coolant Temperature Sensor

The Engine Coolant Temperature (ECT) sensor is located on the upper portion of the water pump housing by the thermostat. The Engine Coolant Temperature (ECT) sensor is used to sense engine coolant temperature.

The ECT sensor is a two-wire Negative Thermal Coefficient (NTC) sensor. Meaning, as engine coolant temperature increases, resistance (voltage) in the sensor decreases. As temperature decreases, resistance (voltage) in the sensor increases.

ENGINE BLOCK HEATER



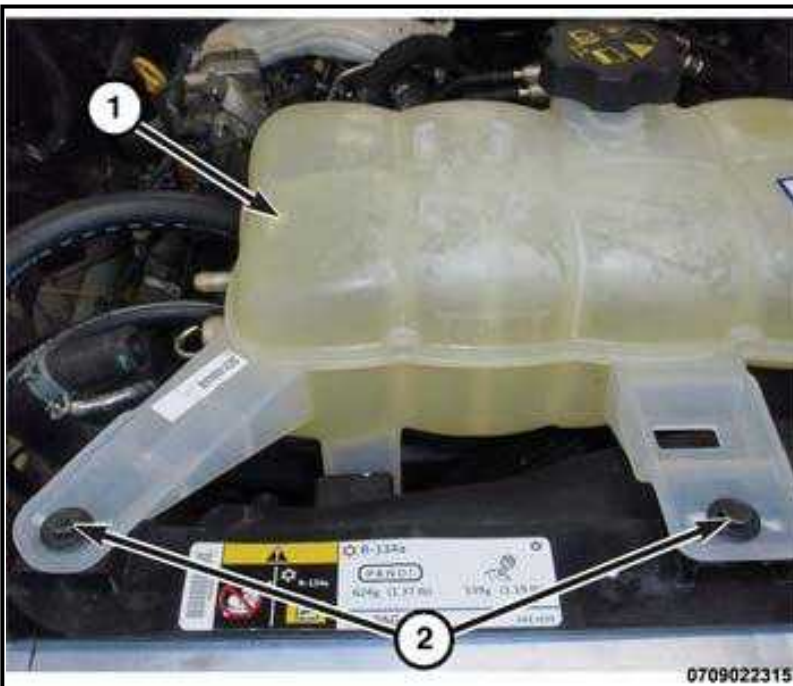
1 - Engine Block Heater

WARNING: Do not operate engine unless block heater cord has been disconnected from power source and secured in place. The power cord must be secured in its retaining clips and routed away from exhaust manifolds and moving parts.

- The engine block heater on the 3.0L diesel engine is located on the right side of the engine under the exhaust manifold.
- The engine block heater is equipped with a power cord. The cord is attached to an engine compartment components with wire harness retainers. The heater warms the engine coolant providing easier engine starting and faster warm-up in low temperatures. The heater is mounted in the engine cylinder block with the heating element immersed in engine coolant.

PRESSURIZED COOLANT BOTTLE

DESCRIPTION



1 - Pressurized Coolant Bottle

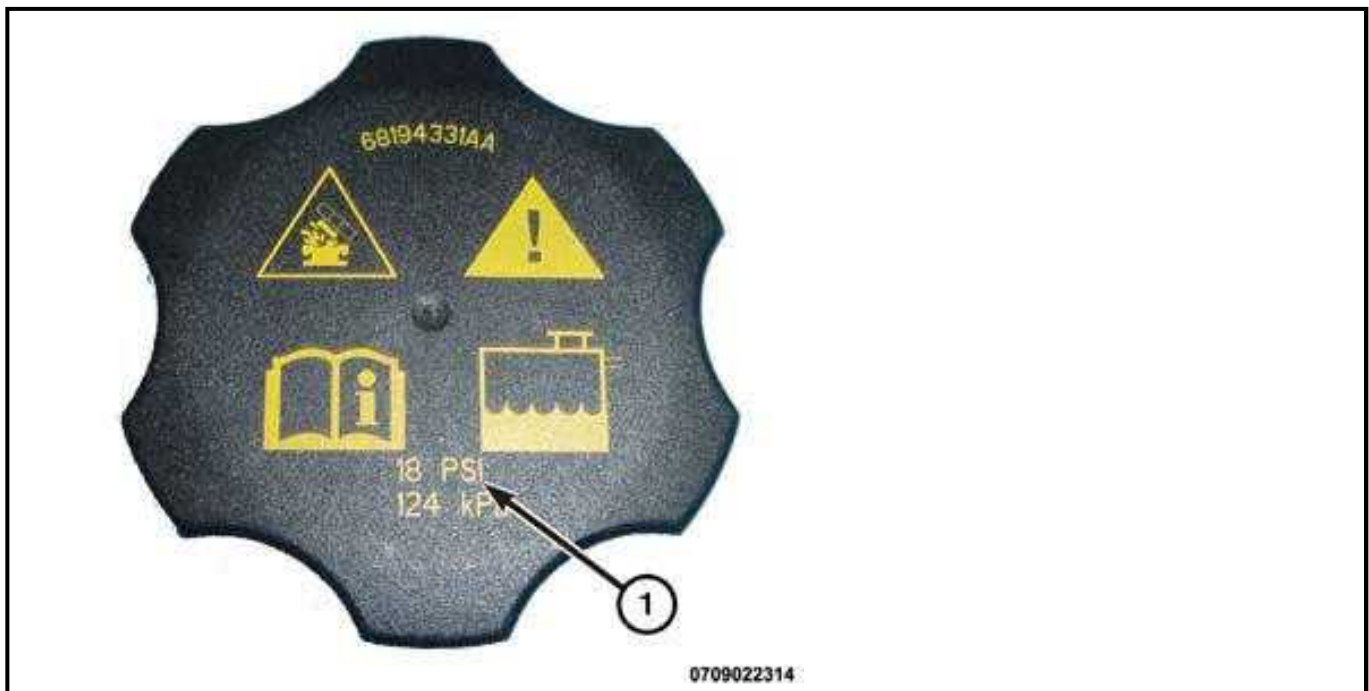
2 - Pressurized Coolant Bottle Bolts

- The pressurized coolant bottle is mounted on top of the radiator. The coolant recovery/overflow bottle is made of high temperature plastic. The radiator overflow hose and the bypass hose connects to the top of bottle in order to help get trapped air out of the coolant system. Coolant is drawn back into the engine through the lower hose.

OPERATION

- The pressure bottle works in conjunction with the cooling system pressure cap to keep the coolant free of trapped air. It provides a volume for expansion and contraction, a convenient and safe method for checking coolant level, and adjusting coolant level at atmospheric pressure. It also provides some reserve coolant to cover minor leaks and evaporation or boiling losses.

RADIATOR CAP - 3.0L DIESEL



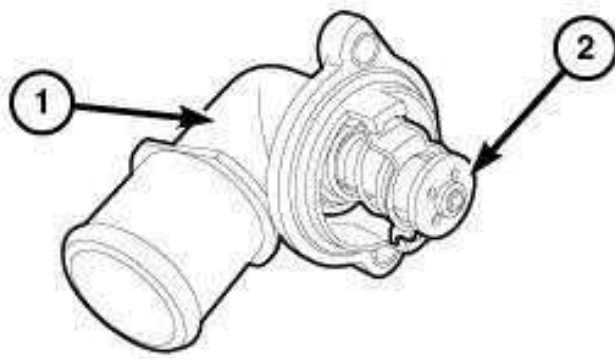
1 - Pressure Cap

This cooling systems are equipped with a pressure cap. The pressure cap is located on top of the pressurized coolant bottle. The cap releases pressure at some point within a range of 18 psi (124 kPa). The pressure relief point (in pounds) is engraved on top of the cap.

The cooling system will operate at pressures slightly above atmospheric pressure. This results in a higher coolant boiling point allowing increased radiator cooling capacity. The cap contains a spring-loaded pressure relief valve. This valve opens when system pressure reaches the release range of 18 psi (124 kPa).

Two O-ring gasket seals the pressurized coolant bottle. This is done to maintain vacuum during coolant cool-down and to prevent leakage when system is under pressure.

THERMOSTAT



3104833

1 - Thermostat Housing

2 - Thermostat

CAUTION: The Thermostat and housing is serviced as an assembly. Do not remove the thermostat from the housing. Damage to the thermostat may occur.

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing.

- A pellet-type thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. On diesel engine, the thermostat is closed below 208B°F (98B°C). Above this temperature, coolant is allowed to flow to the radiator. This provides quick engine warm up and overall temperature control.
- The same thermostat is used for winter and summer seasons. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes other problems. These are: longer engine warm-up time, unreliable warm-up performance, increased exhaust emissions and crankcase condensation. This condensation can result in sludge formation.
- The thermostat is part of the housing.

WATER PUMP

DESCRIPTION

- The water pump is mounted to the front of the engine and is driven from the engine crankshaft by a single serpentine belt.
- The water pump impeller is pressed onto the rear of a shaft that rotates in bearings pressed into the housing. The housing has two small holes to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant mixture. No additional lubrication is necessary.

OPERATION

- A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core, this coolant absorbs the heat generated when the engine is running. The pump is driven by the engine crankshaft via a drive belt.

DIAGNOSIS AND TESTING

AERATION

If coolant level drops below a certain point, aeration will occur drawing air into the water pump resulting in the following:

- High reading shown on the temperature gauge.
- Loss of coolant flow through the heater core.
- Corrosion in the cooling system.
- Water pump seal may run dry, increasing the risk of premature seal failure.

NOTE: Combustion gases leaking into the coolant can also cause the above problems.

DEAERATION

As air is removed from the cooling system, it gathers in the pressurized coolant bottle. This pressure is released into the atmosphere through the pressure valve located in the radiator pressure cap when pressure reaches 21 psi (145 kPa.).

NOTE: Deaeration does not occur at engine idle, higher engine speeds are required. Normal driving will deaerate the cooling system.

To effectively deaerate the system, multiple thermal cycles of the system may be required.

PRELIMINARY CHECKS

ENGINE COOLING SYSTEM OVERHEATING

Establish what driving conditions caused the complaint. Abnormal loads on the cooling system such as the following may be the cause:

- Prolonged idle.
- Very high ambient temperature.
- Excessive payload or towing.
- Slow traffic.
- Traffic jams.
- High speed or steep grades.
- Snow plow restricting airflow through cooling module.
- Debris on front of the grill or the cooling module that is restricting airflow.

Driving techniques that avoid overheating are:

- Idle with A/C off when temperature gauge is at end of normal range.
- Increasing engine speed up to 2000 rpm with transmission in park or neutral for more airflow is recommended.

TRAILER TOWING

Consult Trailer Towing portion of the owners manual. Do not exceed the limits.

RECENT SERVICE OR ACCIDENT REPAIR:

Determine if any recent service has been performed on vehicle that may affect the cooling system. This may be:

- Engine adjustments (incorrect timing).
- Slipping engine accessory drive belt(s).
- Brakes (possibly dragging).

- Changed parts. Incorrect water pump or pump rotating in wrong direction due to belt not correctly routed.
- Reconditioned radiator or cooling system refilling (possibly under filled or air trapped in system).
- Service to electrically controlled viscous fan clutch.

NOTE: If investigation reveals none of the previous items as a cause for an engine overheating complaint, refer to the **COOLING SYSTEM DIAGNOSIS CHART**.

These charts are to be used as a quick-reference only.

COOLING SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOW. NOTE: Information on dash cluster is displayed based on broadcast data from PCM. DTC will be set for engine sensor circuit issues.	1. Vehicle is equipped with a heavy duty cooling system.	1. None. System operating normally.
B	2. Thermostat stuck open.	2. Inspect and test thermostat. Refer to DIAGNOSIS AND TESTING .
	3. Coolant level low.	3. Fill cooling system. Refer to STANDARD PROCEDURE - FILLING .
	4. Temperature gauge not functioning correctly.	4. Check cluster. Refer to DIAGNOSIS AND TESTING - INSTRUMENT CLUSTER .
	5. Engine sensor stuck in range.	5. Monitor sensor with scan tool to verify sensor reading changes with increasing temperature.
	6. Engine sensor failed out of range.	6. A DTC will be set.
	7. Electronically Controlled Viscous Fan Drive/mechanical viscous fan not operating properly.	7. Check Electronically Controlled Viscous Fan Drive.
TEMPERATURE GAUGE READS HIGH. COOLANT MAY OR MAY NOT BE LEAKING FROM SYSTEM. NOTE: Temperature information	1. Vehicle overloaded, high ambient (outside) temperatures with A/C turned on, stop and go driving or prolonged operation at idle speeds.	1. Temporary condition, repair not required. Notify customer of vehicle operation instructions located in Owner's Manual.

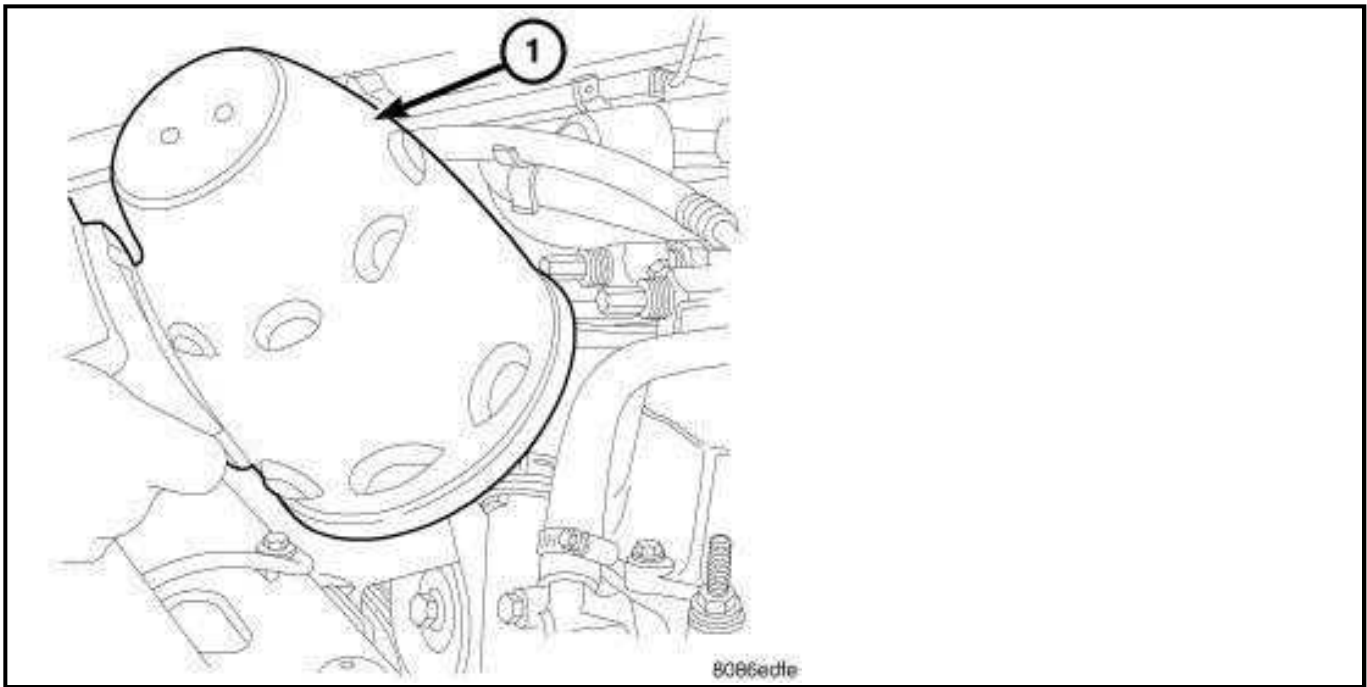
CONDITION	POSSIBLE CAUSES	CORRECTION
displayed on dash cluster and EVIC are based on broadcast data from PCM. If engine temperatures exceed thresholds, power is reduced and a message of 'Oil Temp High - Speed May be Reduced' is displayed on the EVIC.		
B	2. Electronically-controlled viscous fan clutch not functioning correctly.	2. Troubleshoot and if necessary repair the electronic viscous fan clutch.
	3. Temperature gauge not functioning correctly.	3. Check cluster. Refer to <u>DIAGNOSIS AND TESTING - INSTRUMENT CLUSTER</u> .
	4. Air trapped in cooling system.	4. Drain and refill cooling system. Refer to <u>DRAINING</u> , and <u>STANDARD PROCEDURE - FILLING</u> .
	5. Radiator cap faulty.	5. Replace radiator cap.
	6. Plugged A/C or radiator cooling fins.	6. Clean all debris away from A/C and radiator cooling fins.
	7. Coolant mixture incorrect.	7. Drain cooling system and refill with correct mixture. Refer to <u>DRAINING</u> , and <u>STANDARD PROCEDURE - FILLING</u> .
	8. Thermostat stuck shut.	8. Inspect and test thermostat or replace the thermostat.
	9. Bug screen or winter front being used.	9. Remove bug screen or winter front.
	10. Cylinder head gasket leaking.	10. Check for leaking head gaskets. Refer to <u>STANDARD PROCEDURE</u> .
	11. Heater core leaking.	11. Replace heater core.
	12. Cooling system hoses leaking.	12. Tighten clamps or Replace hoses.
	13. Brakes dragging.	13. Check brakes. Refer to <u>DIAGNOSIS AND TESTING - BASE BRAKE SYSTEM</u> .
	14. Accessory drive belt.	14. Inspect and replace as necessary. Refer to <u>BELT, SERPENTINE, REMOVAL AND INSTALLATION</u> .

CONDITION	POSSIBLE CAUSES	CORRECTION
	15. Water Pump.	15. Inspect and replace as necessary.
	16. Engine sensor stuck in range.	16. Monitor sensor with scan tool to verify sensor reading changes increase in temperature.
	17. Temperature sensor failed - Too High.	17. Clear the existing overheat fault. Drive the vehicle until thermostat opens. Verify that fault code does not return and coolant does not reach threshold of 230 degrees F.
TEMPERATURE GAUGE READING INCONSISTENT (ERRATIC, CYCLES OR FLUCTUATES). NOTE: Information on dash cluster is displayed based on broadcast data from PCM. DTC will be set for engine sensor circuit issues.	1. Heavy duty cooling system, extreme cold ambient (outside) temperature or heater blower motor in high position.	1. None. System operating normally.
B	2. Temperature gauge or sensor defective.	2. Check cluster or engine coolant temp sensor. Refer to <u>DIAGNOSIS AND TESTING - INSTRUMENT CLUSTER</u> .
	3. Temporary heavy usage or load.	3. None. Normal condition.
	4. Air trapped in cooling system.	4. Fill cooling system. Refer to <u>STANDARD PROCEDURE - FILLING</u> .
	5. Water pump.	5. Replace water pump.
	6. Air leak on suction side of water pump.	6. Check for leak. Refer to <u>DIAGNOSIS AND TESTING</u> .
RADIATOR CAP LEAKING STEAM AND OR COOLANT INTO RESERVOIR BOTTLE. (TEMPERATURE GAUGE MAY READ HIGH).	1. Radiator cap defective.	1. Replace radiator cap.
	2. Radiator neck surface damaged.	2. Replace radiator. Refer to <u>RADIATOR, REMOVAL AND INSTALLATION</u> .
HOSE OR HOSES COLLAPSE WHEN ENGINE IS COOLING.	1. Vacuum created in cooling system on engine cool-down is not being relieved through coolant reservoir/overflow system.	1. Replace radiator cap, check vent hose between radiator and reservoir bottle for blockage also check reservoir bottle vent for blockage.
NOISY FAN.	1. Fan blade(s) loose, damaged.	1. Replace fan blade assembly.

CONDITION	POSSIBLE CAUSES	CORRECTION
	2. Electronically controlled viscous fan drive/mechanical viscous fan.	2. None. Normal condition.
	3. Fan blades striking surrounding objects.	3. Locate contact point and repair as necessary.
	4. Electronically controlled viscous fan drive/mechanical viscous fan bearing concern.	4. Check viscous fan drive.
	5. Electronically controlled viscous fan/mechanical viscous fan stuck on.	5. Check viscous fan drive.
	6. Obstructed air flow through radiator.	6. Remove obstruction.
INADEQUATE AIR CONDITIONER PERFORMANCE (COOLING SYSTEM SUSPECTED).	1. Radiator and/or A/C condenser air flow obstructed.	1. Remove obstruction and/or clean.
	2. Electronically controlled viscous fan drive/ /mechanical viscous fan not working.	2. Check viscous fan drive.
	3. Air seals around radiator damaged or missing.	3. Inspect air seals, repair or replace as necessary.
INADEQUATE HEATER PERFORMANCE. GAUGE MAY OR MAY NOT READ LOW.	1. Heavy duty cooling system, and cooler ambient temperatures.	1. None. Normal condition.
	2. Obstruction in heater hoses.	2. Remove hoses, remove obstruction.
	3. Electronically controlled viscous fan/ /mechanical viscous fan stuck on.	Check viscous fan drive.
	4. Water pump damaged.	4. Replace water pump.
HEAT ODOR.	1. Damaged or missing exhaust system heat shields.	1. Repair or replace damaged or missing exhaust system heat shields.
	2. Electronically controlled viscous fan drive/mechanical viscous fan damaged.	2. Check viscous fan drive.

COOLING SYSTEM LEAKS

ULTRAVIOLET LIGHT METHOD



1 - TYPICAL BLACK LIGHT TOOL

A leak detection additive is available through the parts department that can be added to the engine cooling system. The additive is highly visible under ultraviolet light (black light). Pour one ounce of additive into the engine cooling system. Place the heater control unit in HEAT position. Start and operate the engine until the radiator upper hose is warm to the touch. Aim the commercially available black light at the components to be checked. If leaks are present, the black light will cause the additive to glow a bright green color.

The black light can be used in conjunction with a Pressure Tester to determine if any external leaks exist.

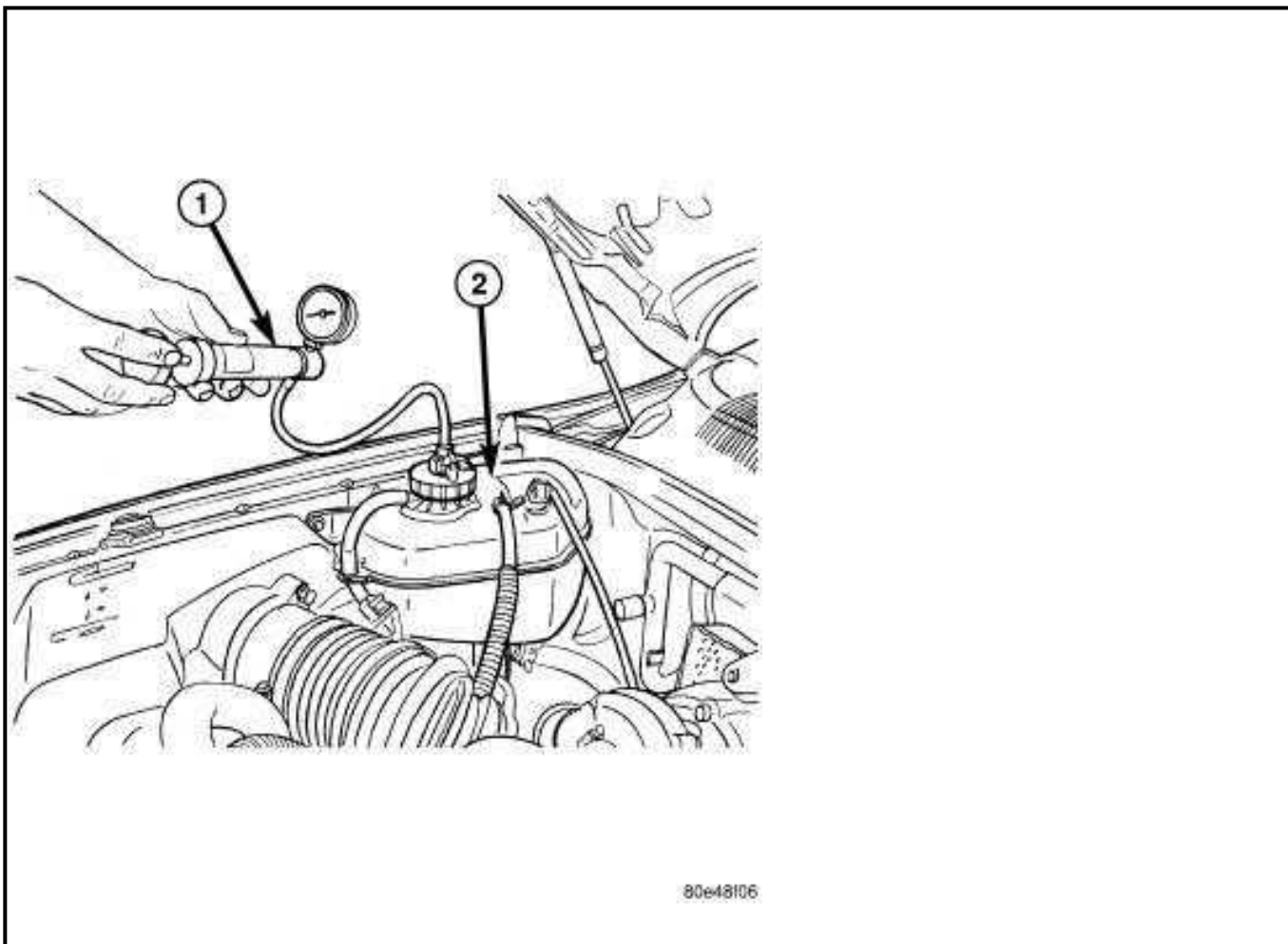
PRESSURE TESTER METHOD

The engine should be at normal operating temperature. Recheck the system cold if the cause of coolant loss is not located during the warm engine examination.

WARNING: Hot, pressurized coolant can cause injury by scalding.

Carefully remove the radiator pressure cap from the filler neck and check the coolant level. Push down on the cap to disengage it from the stop tabs. Wipe the inside of the filler neck and examine the lower inside sealing seat for nicks, cracks, paint, dirt and solder residue. Inspect the radiator to reserve/overflow tank hose for internal obstructions. Insert a wire through the hose to be sure it is not obstructed.

Inspect the cams on the outside of the filler neck. If the cams are damaged, seating of the pressure cap valve and tester seal will be affected.



Attach the SVT275 Cooling Pressure Tester (1) available from MoparB® Service Equipment, or an equivalent pressure tester to the pressurized coolant bottle (2).

Operate the tester pump to apply 103.4 kPa (15 psi) pressure to the system. If the hoses enlarge excessively or bulge while testing, replace as necessary. Observe the gauge pointer and determine the condition of the cooling system according to following criteria:

Holds Steady: If the pointer remains steady for two minutes, serious coolant leaks are not present in system. However, there could be an internal leak that does not appear with normal system test pressure. If it is certain that coolant is being lost and leaks cannot be detected, inspect for interior leakage.

Drops Slowly: Indicates a small leak or seepage is occurring. Examine all of the connections for seepage or slight leakage with a flashlight. Inspect the radiator, hoses, gasket edges and heater. Seal the small leak holes with a Sealer Lubricant (or equivalent). Repair the leak holes and inspect the system again with pressure applied.

Drops Quickly: Indicates that serious leakage is occurring. Examine the system for external leakage. Block side panels are embossed to highlight core plugs. Remove embossed noise panels to inspect and or repair core plugs. If leaks are not visible, inspect for internal leakage.

INTERNAL LEAKAGE INSPECTION

Remove the engine oil pan drain plug and drain a small amount of engine oil. If coolant is present in the pan, it will drain first because it is heavier than oil. An alternative method is to operate engine for a short period to churn the oil. After this is done, remove the engine dipstick and inspect for water globules. Also inspect the transmission dipstick for water globules and transmission fluid cooler for leakage.

WARNING: With radiator pressure tester tool installed on radiator, do not allow pressure to exceed 145 kpa (21 psi). Pressure will build up quickly if a combustion leak is

present. To release pressure, rock tester from side to side. When removing tester, do not turn tester more than 1/2 turn if system is under pressure.

Operate the engine without the pressure cap on the radiator until the thermostat opens. Attach a Pressure Tester to the filler neck. If pressure builds up quickly it indicates a combustion leak exists. This is usually the result of a cylinder head gasket leak or crack in engine. Repair as necessary.

If there is not an immediate pressure increase, pump the Pressure Tester. Do this until indicated pressure is within system range of 110 kPa (16 psi). Fluctuation of the gauge pointer indicates compression or combustion leakage into cooling system.

Because the vehicle is equipped with a catalytic converter, **do not** short out cylinders to isolate compression leak.

If the needle on dial of the pressure tester does not fluctuate, race engine a few times to check for an abnormal amount of coolant or steam. This would be emitting from exhaust pipe. Coolant or steam from exhaust pipe may indicate a faulty cylinder head gasket, cracked engine cylinder block or cylinder head.

COMBUSTION LEAKAGE TEST - WITHOUT PRESSURE TESTER

WARNING: Do not remove cylinder block drain plugs or loosen radiator draincock with system hot and under pressure. Serious burns from coolant can occur.

CAUTION: Avoid overheating. Do not operate engine for an excessive period of time. Open draincock immediately after test to eliminate boil over.

- Add coolant to radiator to bring level to within 6.3 mm (1/4 in) of the top of the thermostat housing.
- Start engine and accelerate rapidly three times, to approximately 3000 rpm while observing coolant. If internal engine combustion gases are leaking into cooling system, bubbles will appear in coolant. If bubbles do not appear, internal combustion gas leakage is not present.

RADIATOR CAP

Remove the cap. Be sure that the sealing surfaces are clean. Moisten the rubber gasket with water and install the cap on a commercially available pressure tester.

Using the cooling system tester, bring the pressure up to the pressure prescribed on cap. If the pressure cap fails to the prescribed pressure, replace the cap.

The pressure cap may test properly while positioned on the pressure test tool. It may not hold pressure or vacuum when installed. If the test passes on the tool but there is sufficient evidence that the cap fails on the vehicle, inspect the neck for damage or debris that may prevent the cap from sealing properly.

CAUTION: Radiator pressure testing tools are very sensitive to small air leaks which will not cause cooling system problems. A pressure cap that does not have a history of coolant loss should not be replaced just because it leaks slowly when tested with this tool. Add water to tool. Turn tool upside down and recheck pressure cap to confirm that cap needs replacement.

COOLANT CONCENTRATION TESTING

CAUTION: Do not mix types of coolant - corrosion protection will be severely reduced.

CAUTION: Do not use coolant additives that are claimed to improve engine cooling.

Check coolant concentration when any additional coolant is added to the system, or after a coolant drain, flush and refill. Use of a hydrometer or the (special tool #8286, Refractometer) can be used to test coolant concentration.

- A hydrometer tests the amount of glycol in a mixture by measuring the specific gravity of the mixture. The higher the concentration of ethylene glycol, the larger the number of balls that will float, and the higher the freeze protection (up to a maximum of 60% by volume glycol).
 - The (special tool #8286, Refractometer) tests the amount of glycol in a coolant mixture by measuring the amount a beam of light bends as it passes through the fluid.
 - Some coolant manufacturers use other types of glycols in their coolant formulations. Propylene glycol is the most common new coolant. However, propylene glycol based coolants do not provide the same freezing protection and corrosion protection and are not recommended.
1. Visually inspect the coolant for contamination. Must be free of oil, dirt and/or other materials that can adversely affect the cooling system.
 - If the coolant is **found to be contaminated** after a visual inspection, discard the coolant.
 - If the coolant is **found to be clear of contamination** after a visual inspection the test the coolant concentration.



2. Using a (special tool #8286, Refractometer) or equivalent, following the manufacturer's instructions, test the coolant freeze point:
 - If the coolant freeze point **is between** -31B°C and -45B°C (-25B°F and -50B°F), save the coolant for reuse.
 - If the coolant freeze point **is not between** -31B°C and -45B°C (-25B°F and -50B°F), discard the coolant.

RADIATOR COOLANT FLOW

Use the following procedure to determine if coolant is flowing through the cooling system.

1. Idle engine until operating temperature is reached. If the upper radiator hose is warm to the touch, the thermostat is opening and coolant is flowing to the radiator.

WARNING: Hot, pressurized coolant can cause injury by scalding. Using a rag to cover the radiator pressure cap, open radiator cap slowly to the first stop. This will allow any built-up pressure to vent to the reserve/overflow tank. After pressure build-up has been released, remove cap from filler neck.

2. Drain a small amount of coolant from the radiator until the ends of the radiator tubes are visible through the filler neck. Idle the engine at normal operating temperature. If coolant is flowing past the exposed

tubes, the coolant is circulating.

STANDARD PROCEDURE

CLEANING/REVERSE FLUSHING

CLEANING

Drain the cooling system and refill with water. Run the engine with the radiator cap installed until the upper radiator hose is hot. Stop the engine and drain the water from system. If the water is dirty, fill the system with water, run the engine and drain the system. Repeat this procedure until the water drains clean.

REVERSE FLUSHING

Reverse flushing of the cooling system is the forcing of water through the cooling system. This is done using air pressure in the opposite direction of normal coolant flow. It is usually only necessary with very dirty systems with evidence of partial plugging.

REVERSE FLUSHING RADIATOR

Disconnect the radiator hoses from the radiator inlet and outlet. Attach a portion of the radiator hose to the radiator bottom outlet fitting and insert the flushing gun. Connect a water supply hose and air supply hose to the flushing gun.

CAUTION: Internal radiator pressure must not exceed 138 kPa (20 psi) as damage to radiator may result.

Allow the radiator to fill with water. When the radiator is filled, apply air in short blasts. Allow the radiator to refill between blasts. Continue this reverse flushing until clean water flows out through the rear of the radiator cooling tube passages.

REVERSE FLUSHING ENGINE

Drain the cooling system. Remove the thermostat housing and thermostat. Install the thermostat housing. Disconnect the radiator upper hose from the radiator and attach the flushing gun to the hose. Disconnect the radiator lower hose from the water pump and attach a lead-away hose to the water pump inlet fitting.

CAUTION: On vehicles equipped with a heater water control valve, be sure the heater control valve is closed (heat off). This will prevent coolant flow with scale and other deposits from entering the heater core.

Connect the water supply hose and air supply hose to flushing gun. Allow the engine to fill with water. When the engine is filled, apply air in short blasts, allowing the system to fill between air blasts. Continue until clean water flows through the lead away hose.

Remove the lead away hose, flushing gun, water supply hose and air supply hose. Remove the thermostat housing and install the thermostat. Install the thermostat housing with a replacement gasket. Refer to Thermostat Replacement. Connect the radiator hoses. Refill the cooling system with the correct antifreeze/water mixture. Refer to [**CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS**](#) . Refer to Refilling the Cooling System.

CHEMICAL CLEANING

In some instances, use a radiator cleaner (MoparB® Radiator Kleen or equivalent) before flushing. This will soften scale and other deposits and aid flushing operation.

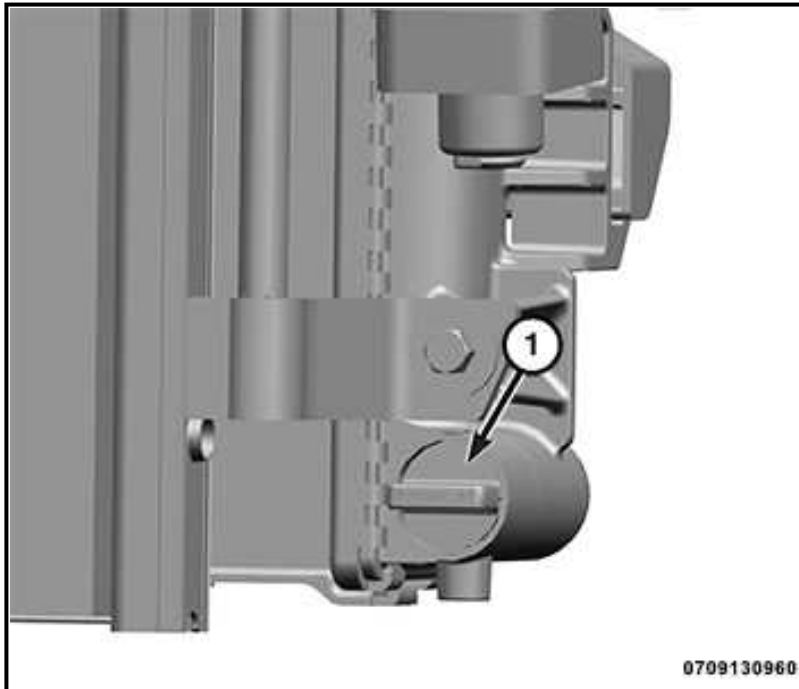
CAUTION: Follow manufacturers instructions when using these products.

DRAINING

WARNING:

Do not remove or loosen the coolant pressure cap, cylinder block drain plugs, or the draincock when the system is hot and under pressure because serious burns from the coolant can occur.

1. Remove the front air dam. Refer to [AIR DAM, FRONT, REMOVAL AND INSTALLATION](#).



1 - Petcock

NOTE: The petcock is located on the front of the radiator, lower left side.

2. Make sure the system is not pressurized and open the petcock.
3. If equipped and necessary, remove the cylinder block drain plug(s).

COOLANT SYSTEM AIR EVACUATION

Evacuating or purging air from the cooling system involves the use of a pressurized air operated vacuum generator. The vacuum created allows for a quick and complete coolant refilling while removing any airlocks present in the system components.

NOTE:

To avoid damage to the cooling system, ensure that no component would be susceptible to damage when a vacuum is drawn on the system.

WARNING:

ANTIFREEZE IS AN ETHYLENE GLYCOL BASE COOLANT AND IS HARMFUL IF SWALLOWED OR INHALED. IF SWALLOWED, DRINK TWO GLASSES OF WATER AND INDUCE VOMITING. IF INHALED, MOVE TO FRESH AIR AREA. SEEK MEDICAL ATTENTION IMMEDIATELY. DO NOT STORE IN OPEN OR UNMARKED CONTAINERS. WASH SKIN AND CLOTHING THOROUGHLY AFTER COMING IN CONTACT WITH ETHYLENE GLYCOL. KEEP OUT OF REACH OF CHILDREN. DISPOSE OF GLYCOL BASED COOLANT PROPERLY. CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA. DO NOT OPEN A COOLING SYSTEM WHEN THE ENGINE IS AT OPERATING TEMPERATURE OR HOT UNDER PRESSURE; PERSONAL INJURY CAN RESULT. AVOID RADIATOR COOLING FAN WHEN ENGINE COMPARTMENT RELATED SERVICE IS PERFORMED; PERSONAL INJURY CAN RESULT.

WARNING:

WEAR APPROPRIATE EYE AND HAND PROTECTION WHEN PERFORMING THIS PROCEDURE.

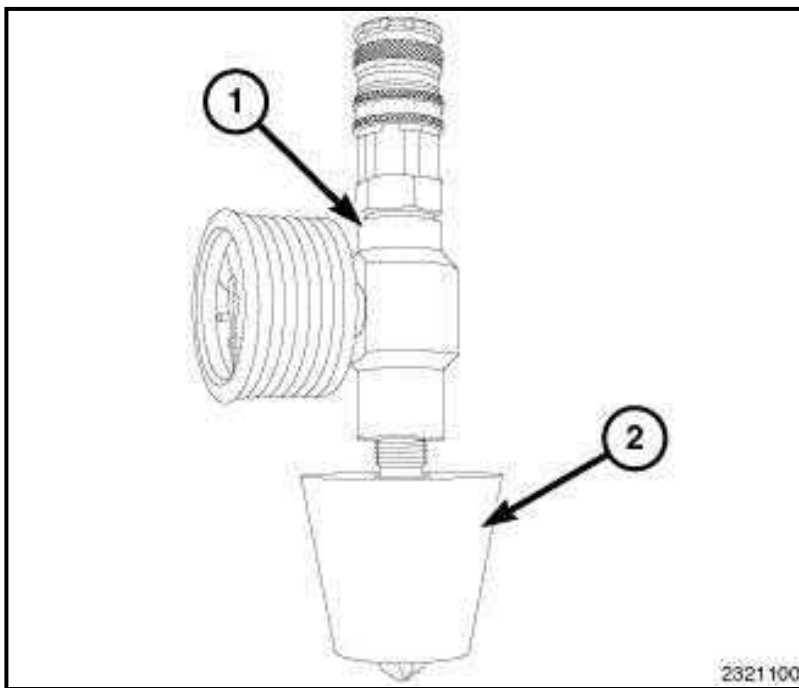
NOTE:

The service area where this procedure is performed should have a minimum shop air requirement of 80 psi (5.5 bar) and should be equipped with an air dryer system.

NOTE:

For best results, the radiator should be empty. The vehicle's heater control should be set to the heat position (ignition may need to be turned to the on position but do not start the engine).

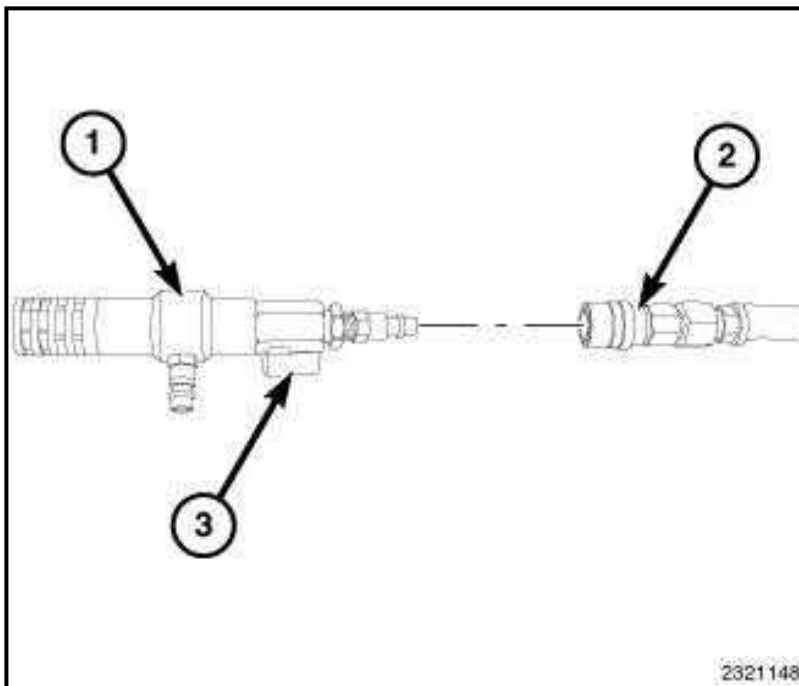
1. Test the coolant concentration level and be sure the concentration level is correct. Refer to [DIAGNOSIS AND TESTING](#) .
2. Refer to the Mopar Essential Tools and Service Equipment (special tool #399-550000, Tool, UView Airlift™ Cooling System Refill) or equivalent and follow tool's operating manual for specific assembly steps.



1 - Vacuum Gauge

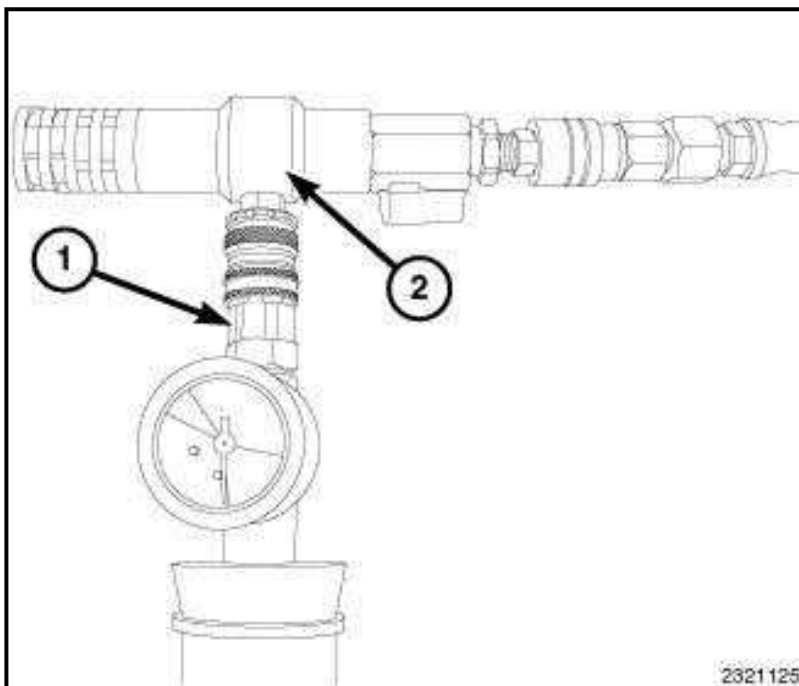
2 - Adapter Cone

3. Choose an appropriate adapter cone that will fit the vehicle's radiator filler neck or reservoir tank.
4. Attach the adapter cone to the vacuum gauge.



1 - Vacuum Generator/Venturi
2 - Airline Hose
3 - Vacuum Generator/Venturi Ball Valve

5. Make sure the vacuum generator/venturi ball valve is closed and attach an airline hose (minimum shop air requirement of 80 psi (5.5 bar) to the vacuum generator/venturi.
6. Position the adaptor cone/vacuum gauge assembly into the radiator filler neck or reservoir tank. Ensure that the adapter cone is sealed properly.



1 - Adaptor Cone/Vacuum Gauge Assembly
2 - Vacuum Generator/Venturi

7. Connect the vacuum generator/venturi to the positioned adaptor cone/vacuum gauge assembly.
8. Open the vacuum generator/venturi ball valve.

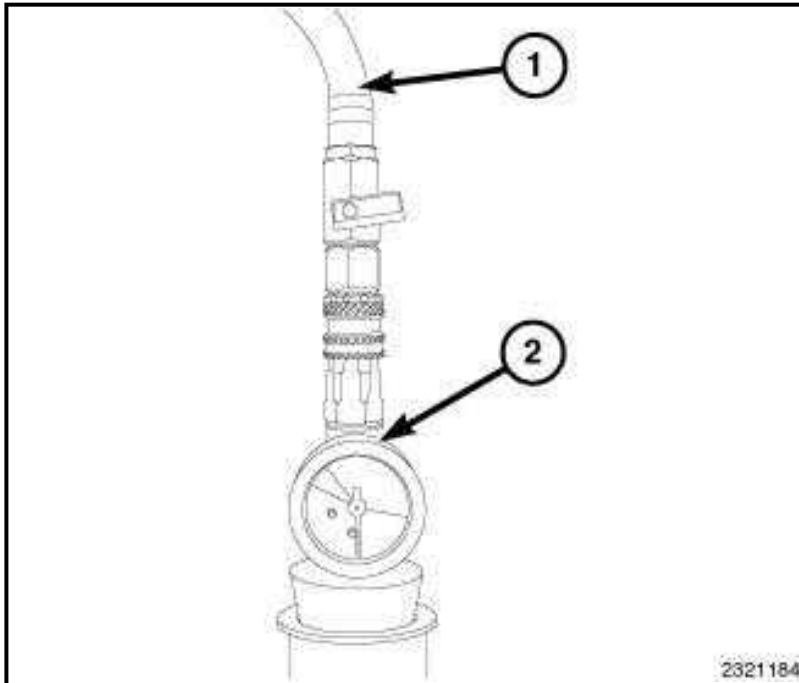
NOTE: Do not bump or move the assembly as it may result in loss of vacuum. Some radiator overflow hoses may need to be clamped off to obtain

vacuum.

9. Let the system run until the vacuum gauge shows a good vacuum through the cooling system. Refer to the tool's operating manual for appropriate pressure readings.

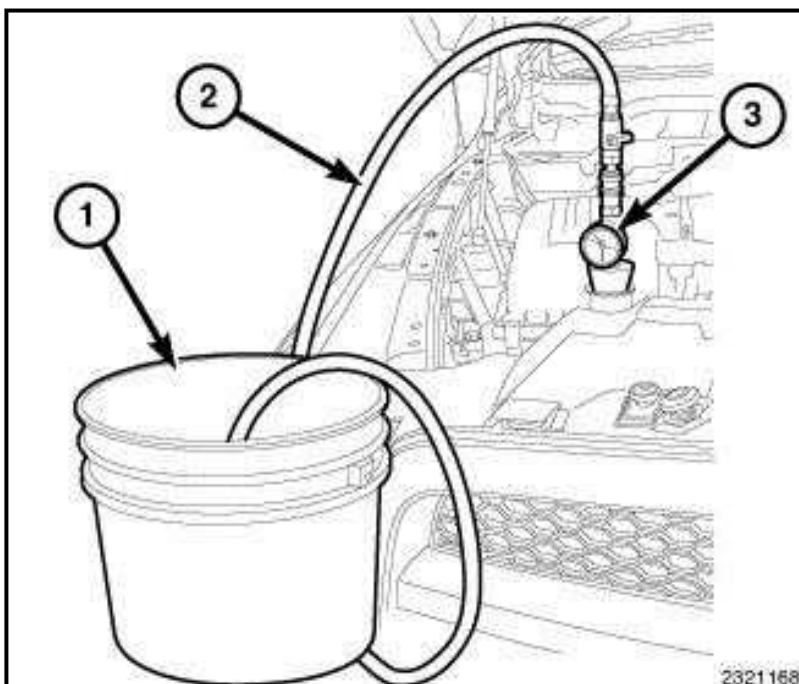
NOTE: If a strong vacuum is being created in the system, it is normal to see the radiator hoses collapse.

10. Close the vacuum generator/venturi ball valve.



1 - Vacuum Generator/Venturi And Airline
2 - Adaptor Cone/Vacuum Gauge Assembly

11. Disconnect the vacuum generator/venturi and airline from the adaptor cone/vacuum gauge assembly.
12. Wait approximately 20 seconds, if the pressure readings do not move, the system has no leaks. If the pressure readings move, a leak could be present in the system and the cooling system should be checked for leaks and the procedure should be repeated.



1 - Suction Hose
2 - Suction Hose
3 - Adaptor Cone/Vacuum Gauge Assembly

13. Place the tool's suction hose into the coolant's container.

NOTE: Ensure there is a sufficient amount of coolant, mixed to the required strength/protection level available for use. For best results and to assist the refilling procedure, place the coolant container at the same height as the radiator filler neck. Always draw more coolant than required. If the coolant level is too low, it will pull air into the cooling system which could result in airlocks in the system.

14. Connect the tool's suction hose to the adaptor cone/vacuum gauge assembly.

15. Open the suction hose's ball valve to begin refilling the cooling system.

16. When the vacuum gauge reads zero, the system is filled.

NOTE: On some remote pressurized tanks, it is recommended to stop filling when the proper level is reached.

17. Close the suction hose's ball valve and remove the suction hose from the adaptor cone/vacuum gauge assembly.

18. Remove the adaptor cone/vacuum gauge assembly from the radiator filler neck or reservoir tank.

19. With heater control unit in the HEAT position, operate engine with container cap in place.

20. After engine has reached normal operating temperature, shut engine off and allow it to cool. When engine is cooling down, coolant will be drawn into the radiator from the pressure container.

21. Add coolant to the recovery bottle/container as necessary. **Only add coolant to the container when the engine is cold. Coolant level in a warm engine will be higher due to thermal expansion.** Add necessary coolant to raise container level to the COLD MINIMUM mark after each cool down period.

22. Once the appropriate coolant level is achieved, attach the radiator cap or reservoir tank cap.

STANDARD PROCEDURE - FILLING

WARNING: ANTIFREEZE COOLANT IS HARMFUL IF SWALLOWED OR INHALED. IF SWALLOWED, DRINK TWO GLASSES OF WATER AND INDUCE VOMITING. IF INHALED, MOVE TO FRESH AIR AREA. SEEK MEDICAL ATTENTION IMMEDIATELY. DO NOT STORE IN OPEN OR UNMARKED CONTAINERS. WASH SKIN AND CLOTHING THOROUGHLY AFTER COMING IN CONTACT WITH ETHYLENE GLYCOL. KEEP OUT OF REACH OF CHILDREN. DISPOSE OF GLYCOL BASED COOLANT PROPERLY. CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA. DO NOT OPEN A COOLING SYSTEM WHEN THE ENGINE IS AT OPERATING TEMPERATURE OR HOT UNDER PRESSURE; PERSONAL INJURY CAN RESULT. AVOID RADIATOR COOLING FAN AND OTHER MOVING COMPONENTS WHEN ENGINE COMPARTMENT RELATED SERVICE IS PERFORMED; PERSONAL INJURY CAN RESULT.

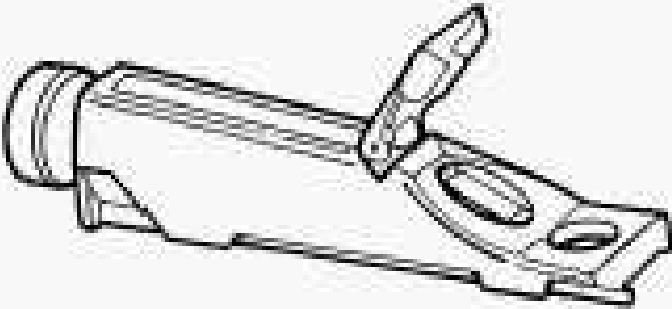
WARNING: WEAR APPROPRIATE EYE AND HAND PROTECTION WHEN PERFORMING THIS PROCEDURE.

CAUTION: Do not use well water or suspect water supply in cooling system. A 50/50 mixture of the recommended antifreeze coolant and distilled water is recommended.

NOTE: Cooling system fill procedure is critical to overall cooling system performance.

NOTE: Make sure all hoses are connected and radiator draincock is closed. Draincock should be hand tightened only.

SPECIAL TOOLS

	8286 - Refractometer
	8875A - Disconnect, Transmission Cooler Line (Originally Shipped In Kit Number(s) 9202, 9328, 9328-CAN, 9329, 9516, 9575.)

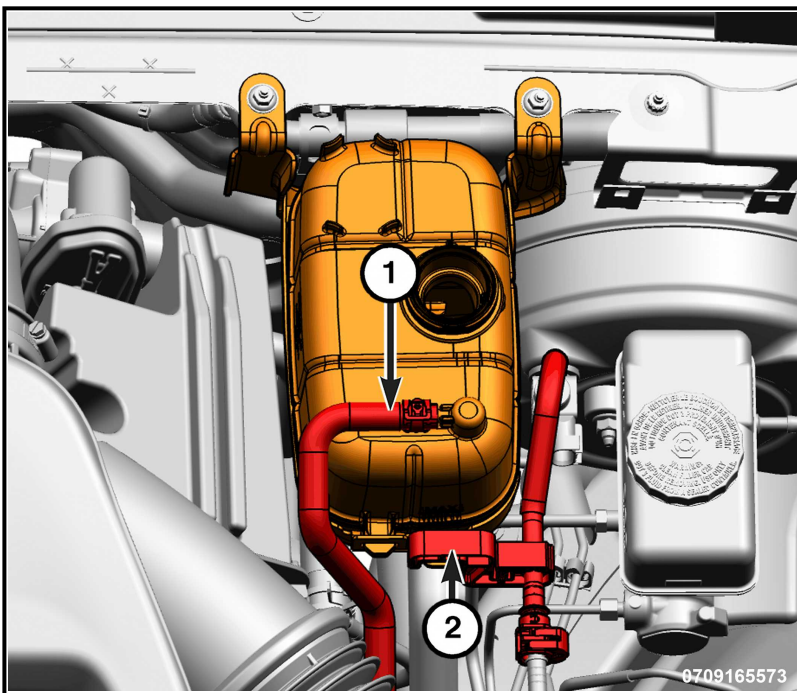
BOTTLE, PRESSURIZED COOLANT

REMOVAL AND INSTALLATION

PRESSURIZED COOLANT BOTTLE

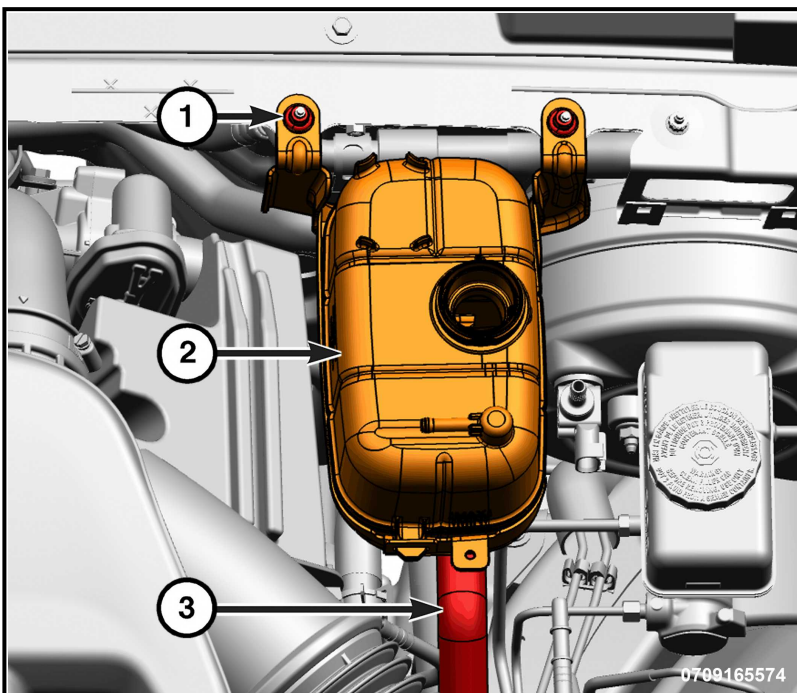
REMOVAL

1. Drain the Engine Cooling System. Refer to **DRAINING** .



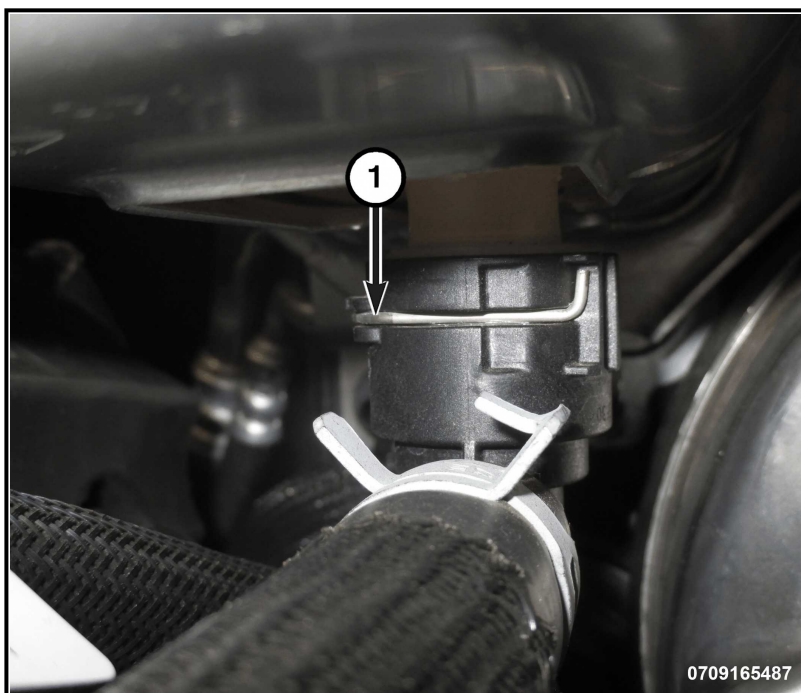
1 - Coolant Vent Hose
2 - Vacuum Hose Retainer

2. Disconnect the coolant vent hose from the pressurized coolant bottle.
3. Remove the vacuum hose retainer from the pressurized coolant bottle.



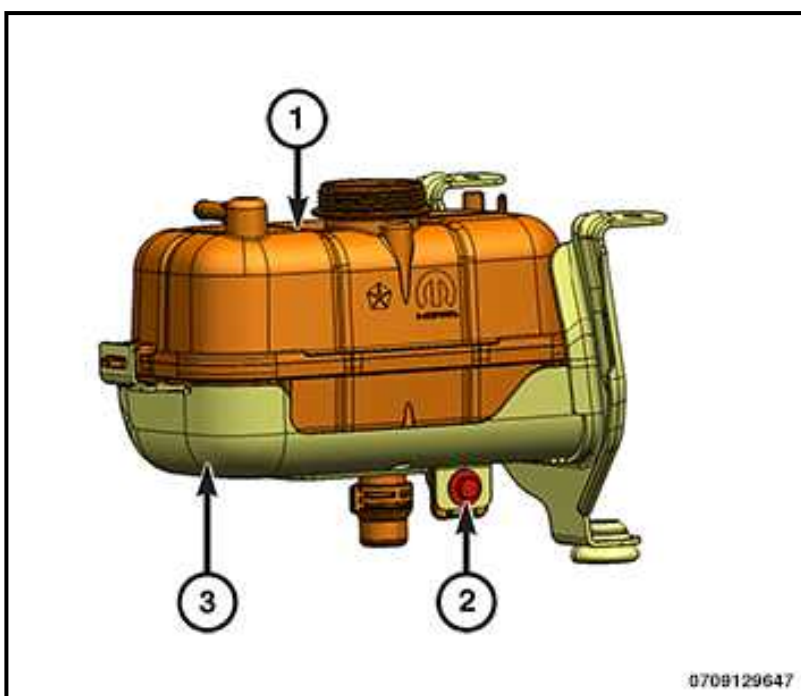
1 - Pressurized Coolant Bottle Nuts
2 - Pressurized Coolant Bottle
3 - Lower Coolant Hose

4. Remove the pressurized coolant bottle nuts and lift up the pressurized coolant bottle to gain access to the lower coolant hose.



1 - Coolant Hose

5. Disconnect the coolant hose and remove the pressurized coolant bottle.



1 - Pressurized Coolant Bottle

2 - Pressurized Coolant Bottle Bolt

3 - Bracket

6. If necessary, remove the pressurized coolant bottle bolt and the pressurized coolant bottle from the bracket.

INSTALLATION

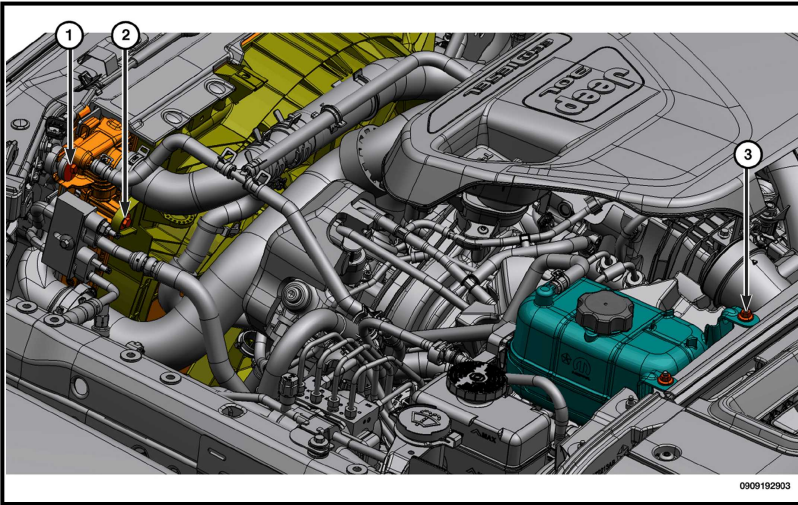
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

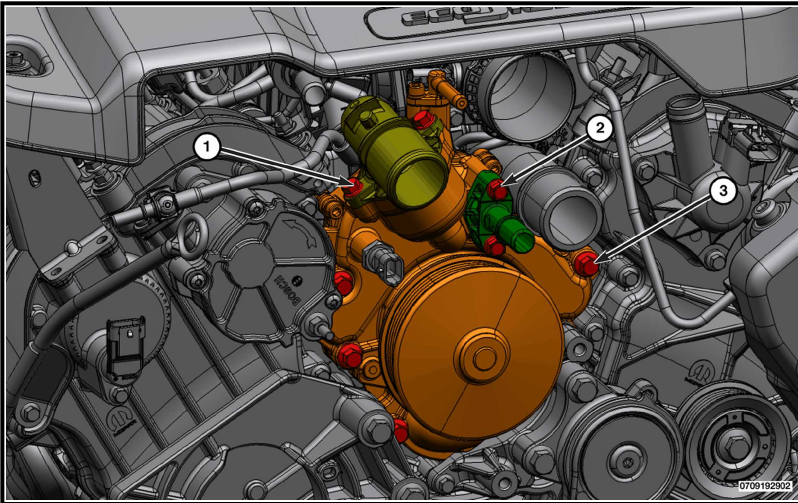
- Fill and leak check the engine coolant system. Refer to **STANDARD PROCEDURE - FILLING**, and **COOLING SYSTEM LEAKS**.

TORQUE SPECIFICATIONS

COOLING SYSTEM - 3.0L DIESEL



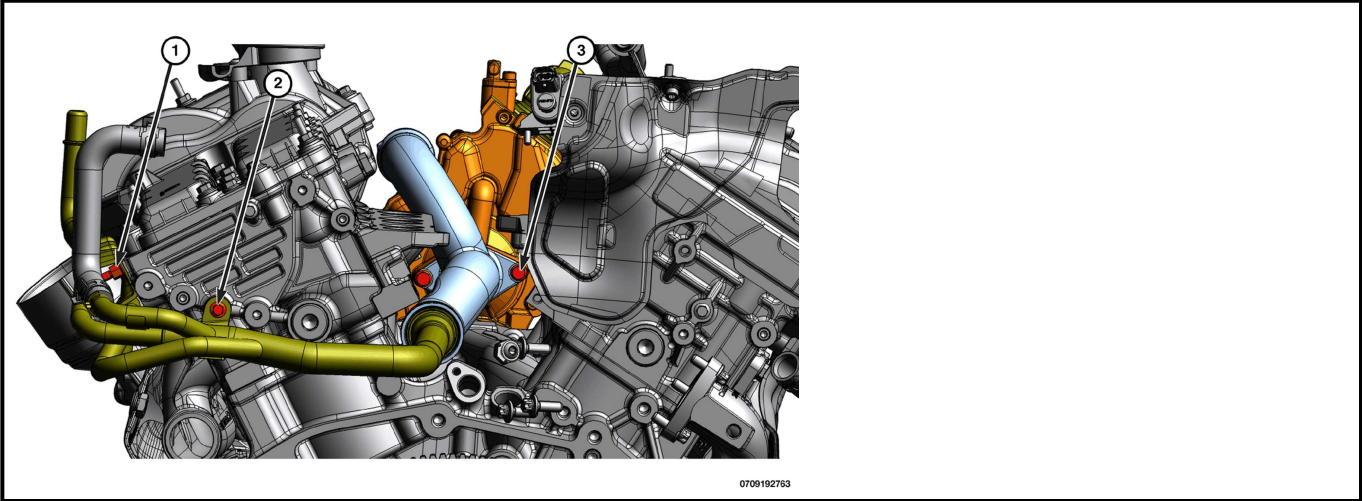
CalloUT	DEscriPtion	SPeCifiCation	CoMMeNT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



CalloUT	DEscriPtion	SPeCifiCation	CoMMeNT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90B° and	-

CalloUT	DEscriPtion	SPeCifiCation	COmmenT
		then tighten to 32 N.m (24 Ft. Lbs.).	
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

CalloUT	DEscriPtion	SPeCifiCation	COmmenT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-

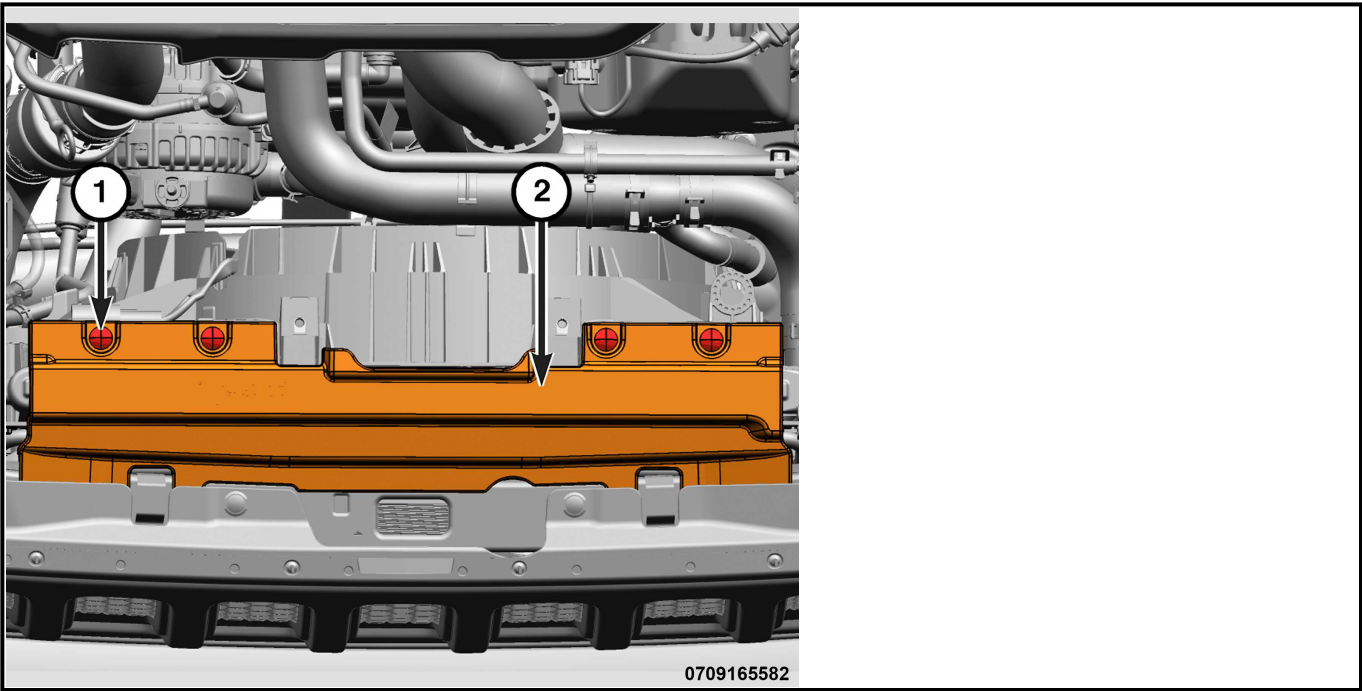


FAN, COOLING

REMOVAL AND INSTALLATION

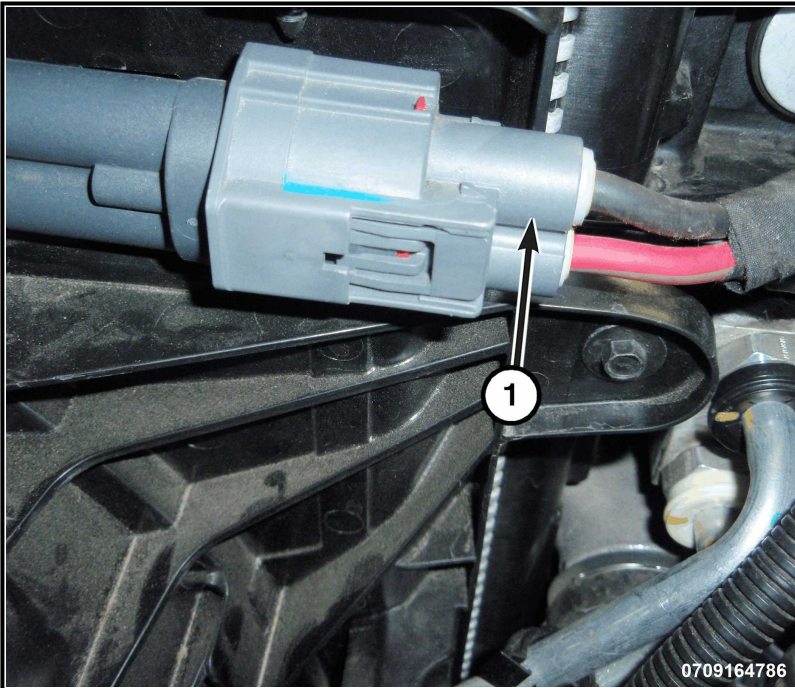
COOLING FAN

REMOVAL



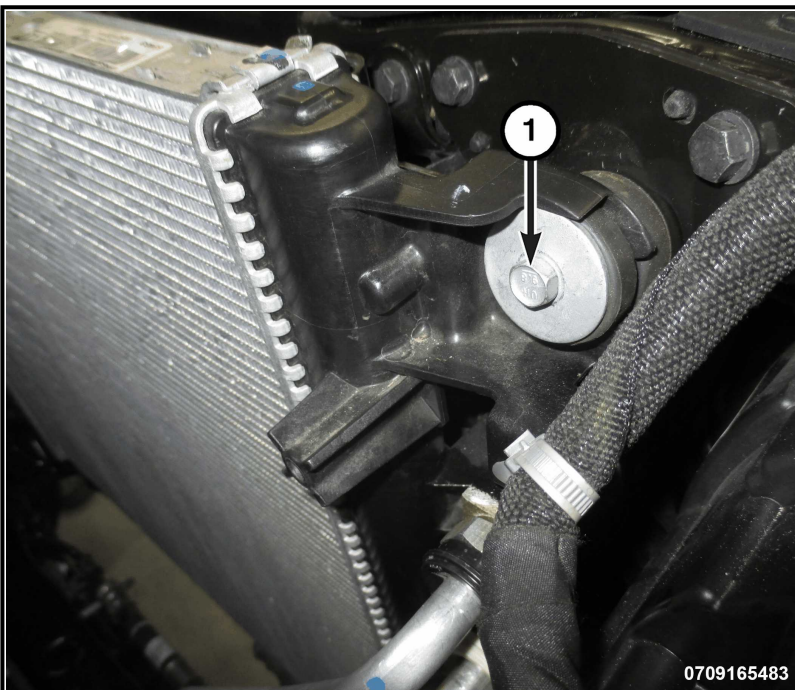
1 - Push Pins Retainers
2 - Upper Radiator Seal

1. Remove the push pins retainers and upper radiator seal.
2. Remove the grille. Refer to [GRILLE, REMOVAL AND INSTALLATION](#) .
3. Remove the right headlamp units. Refer to [UNIT, HEADLAMP, REMOVAL AND INSTALLATION](#) .



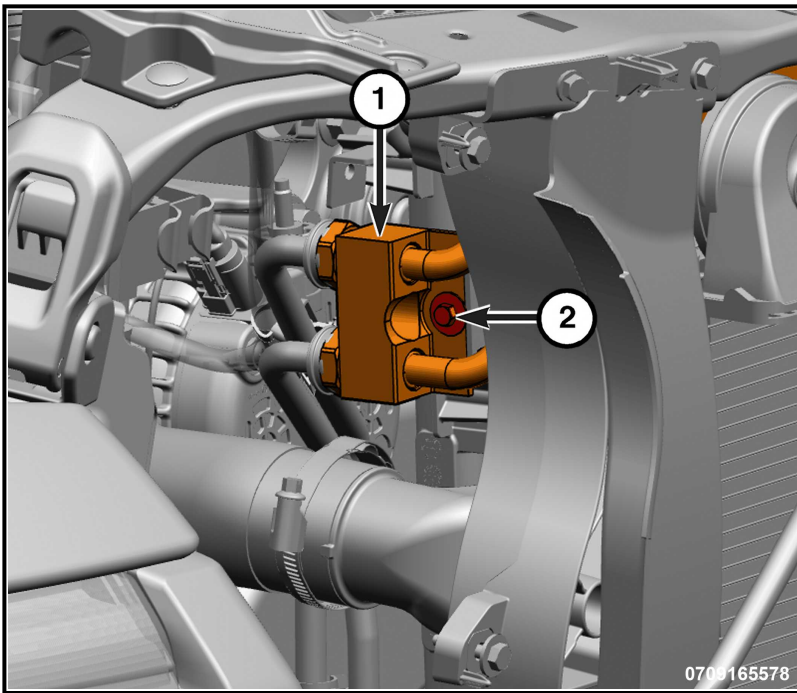
1 - Fan Wire Harness Connectors

4. Disconnect the cooling fan wire harness connectors and detach the wire harness connector from fan shroud.



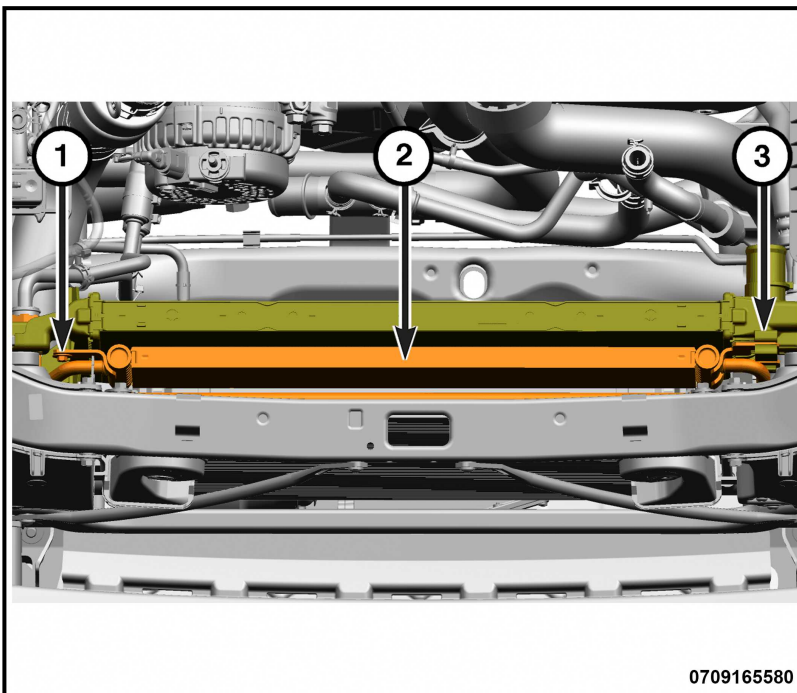
1 - Right Radiator Bolt

5. Remove the right radiator bolt.
6. Remove the right radiator grommet.



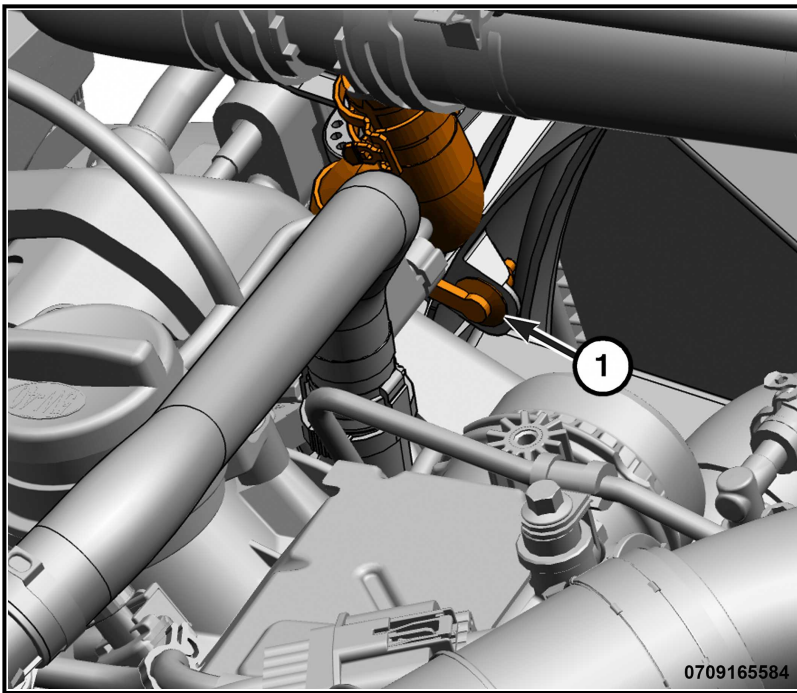
1 - Transmission Cooler Line Manifold
2 - Transmission Cooler Line Manifold Bolt

7. Remove the transmission cooler line manifold bolt securing the transmission cooler line manifold to the radiator.



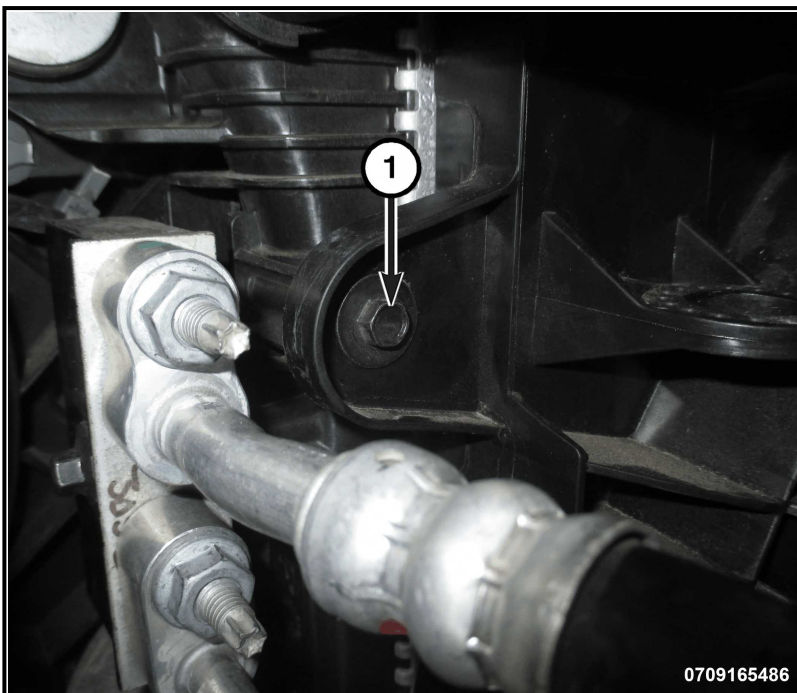
1 - Transmission Cooler Bolt
2 - Transmission Cooler
3 - Tab

8. Remove the transmission cooler bolt securing the transmission cooler to the radiator.
9. Detach the transmission lines from the cooling fan shroud and position aside.



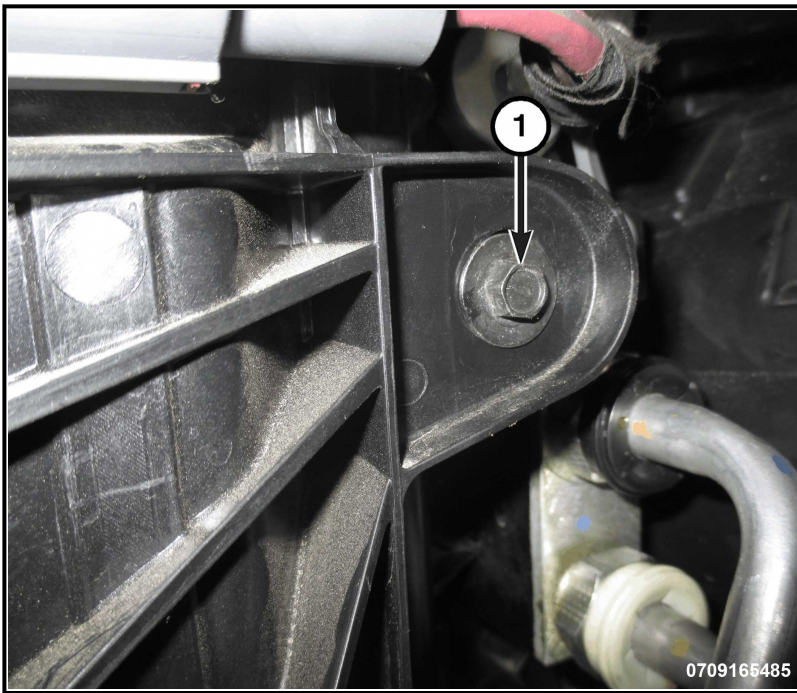
1 - Coolant Hose Retainer

10. Remove the coolant hose retainer (left side).



1 - Left Cooling Fan Bolt

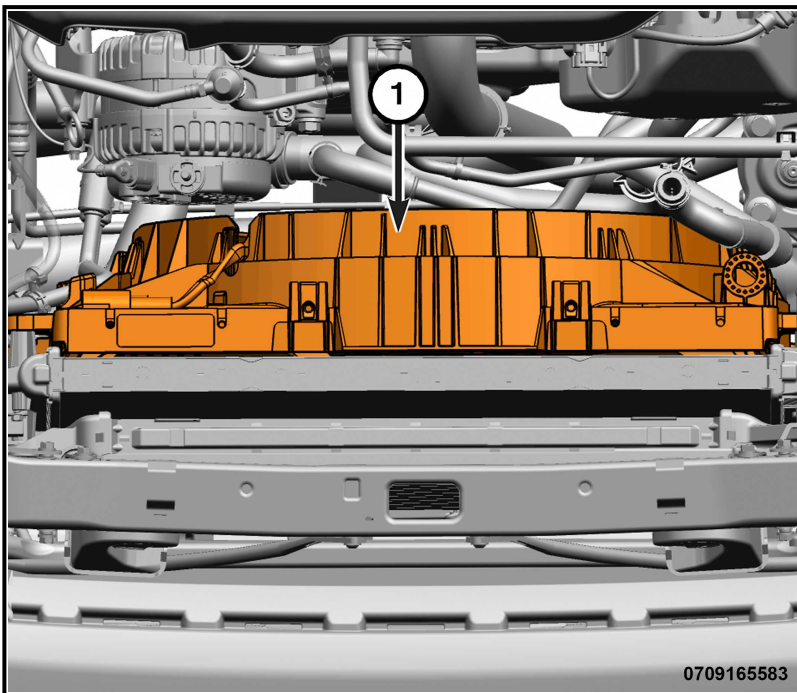
11. Remove the left cooling fan bolt.



1 - Right Cooling Fan Bolt

12. Remove the right cooling fan bolt.

13. Insert a piece of cardboard between the cooling fan and the radiator



1 - Cooling Fan

14. Remove the cooling fan by pulling upwards and away from the radiator.

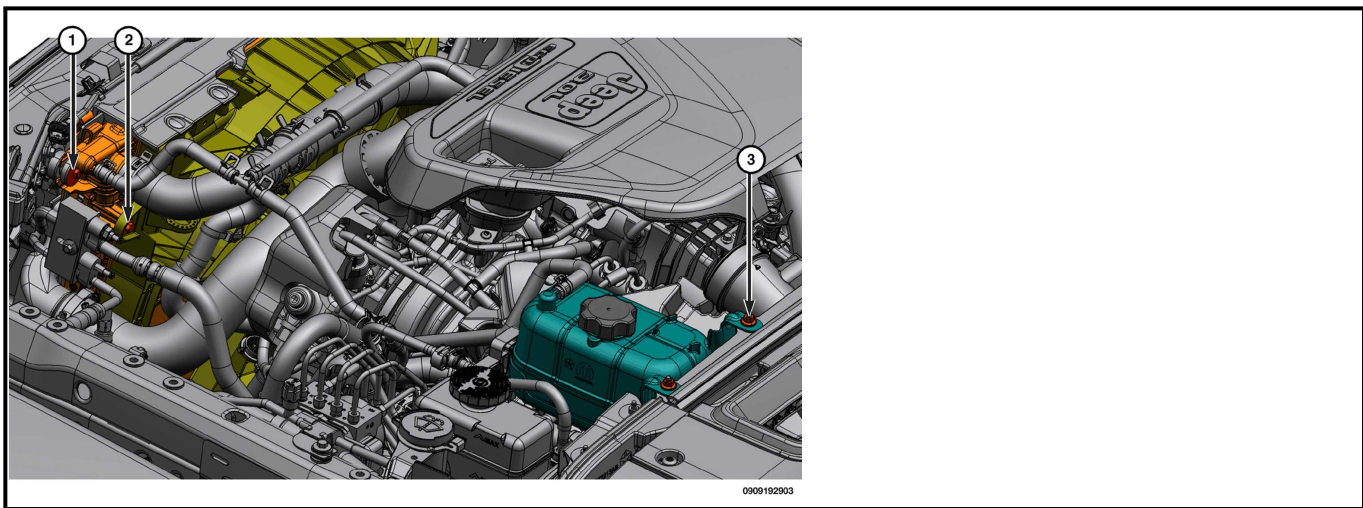
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

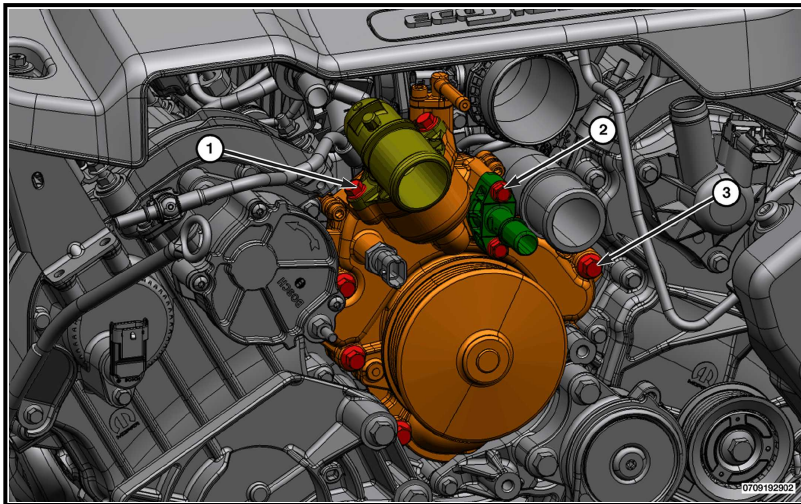
Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

COOLING SYSTEM - 3.0L DIESEL



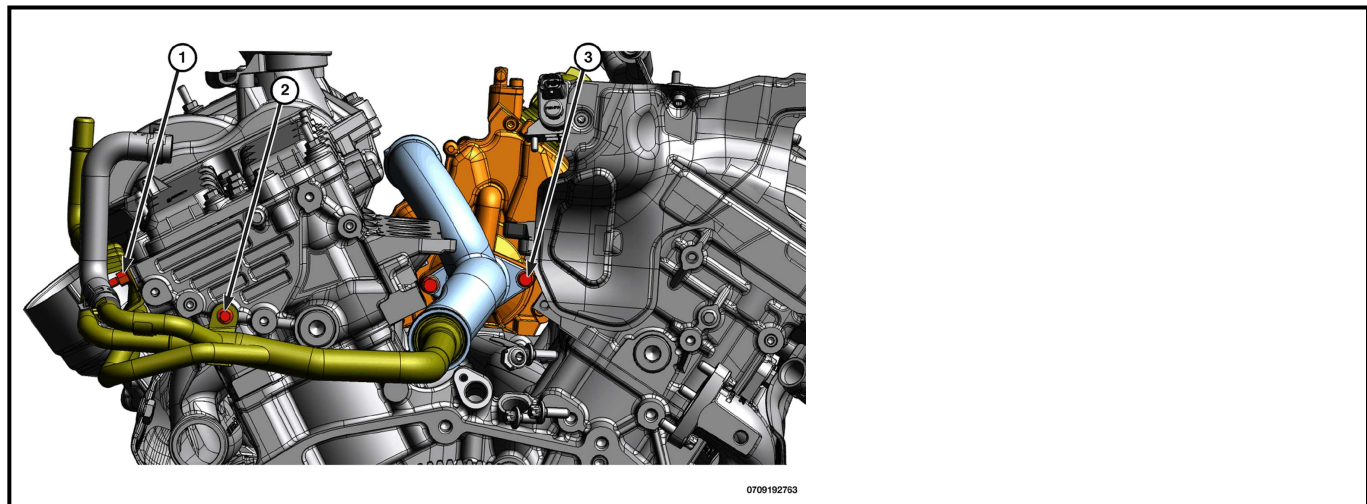
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90B° and then tighten to 32 N.m (24 Ft. Lbs.).	-
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-



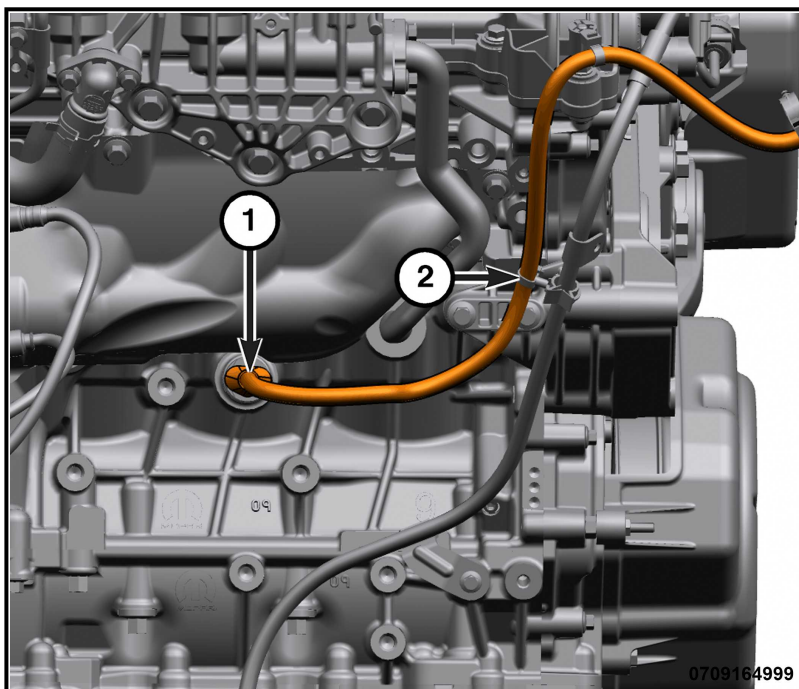
HEATER, COOLANT

REMOVAL AND INSTALLATION

ENGINE BLOCK HEATER

REMOVAL

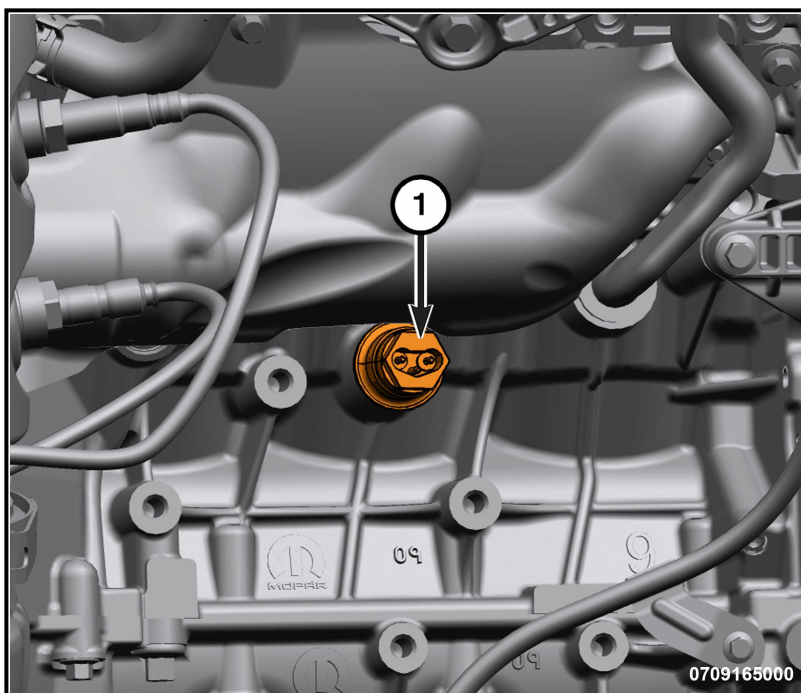
1. Drain the cooling system. Refer to [DRAINING](#) .
2. Remove the right front wheelhouse splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) .



1 - Power Cord

2 - Power Cord Retainer

3. Remove the power cord from heater element.



1 - Engine Block Heater

4. Remove the engine block heater.

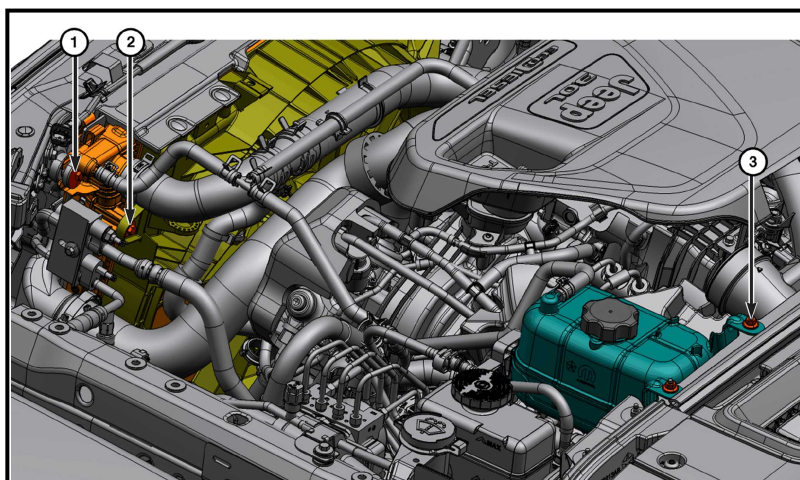
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

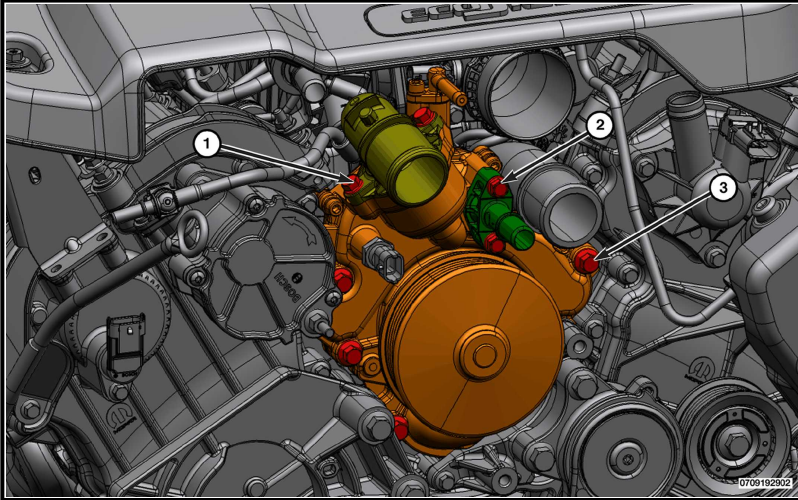
- Clean and inspect the threads in the cylinder block and heater element.
- Coat the heater element threads with LoctiteB® 572 thread sealer.
- Fill cooling system with recommended coolant. Refer to [STANDARD PROCEDURE - FILLING](#) .
- Start and warm the engine.
- Check the block heater for leaks.

COOLING SYSTEM - 3.0L DIESEL



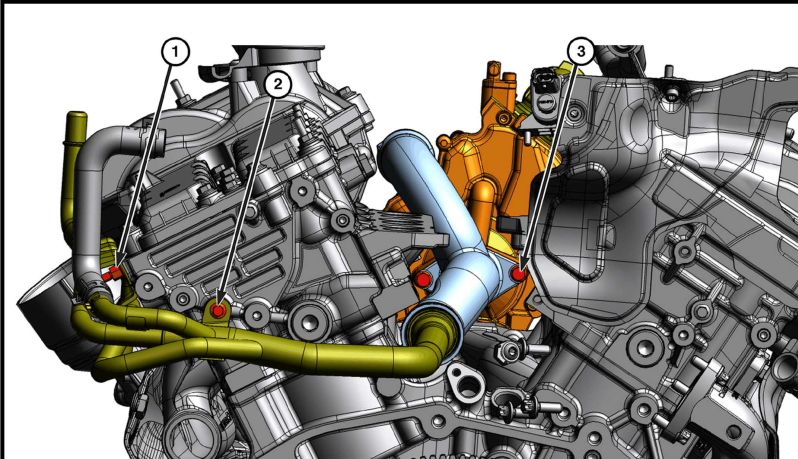
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90B° and then tighten to 32 N.m (24 Ft. Lbs.).	-
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-



THERMOSTAT

REMOVAL AND INSTALLATION

THERMOSTAT

REMOVAL

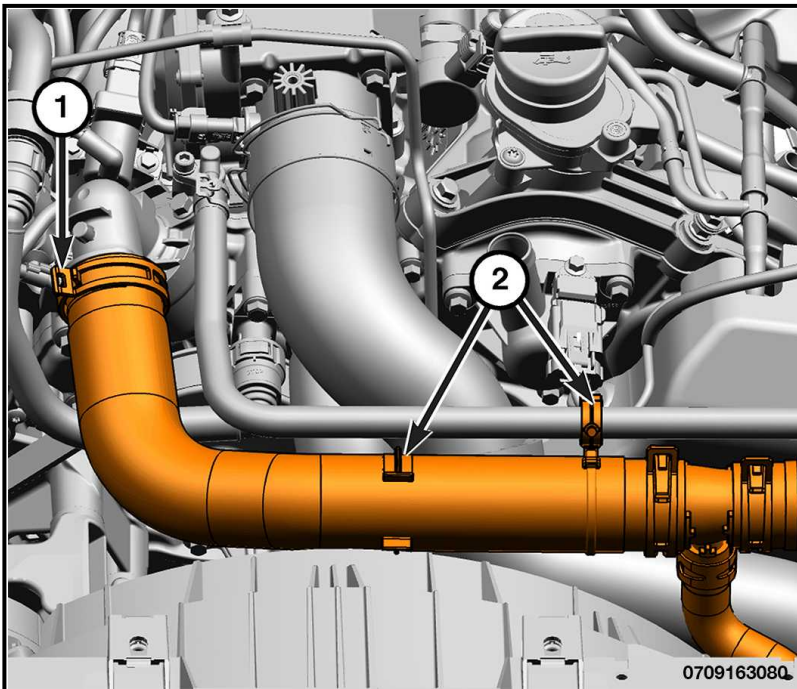
WARNING:

Do not loosen radiator draincock with system hot and pressurized. Serious burns from coolant can occur.

CAUTION:

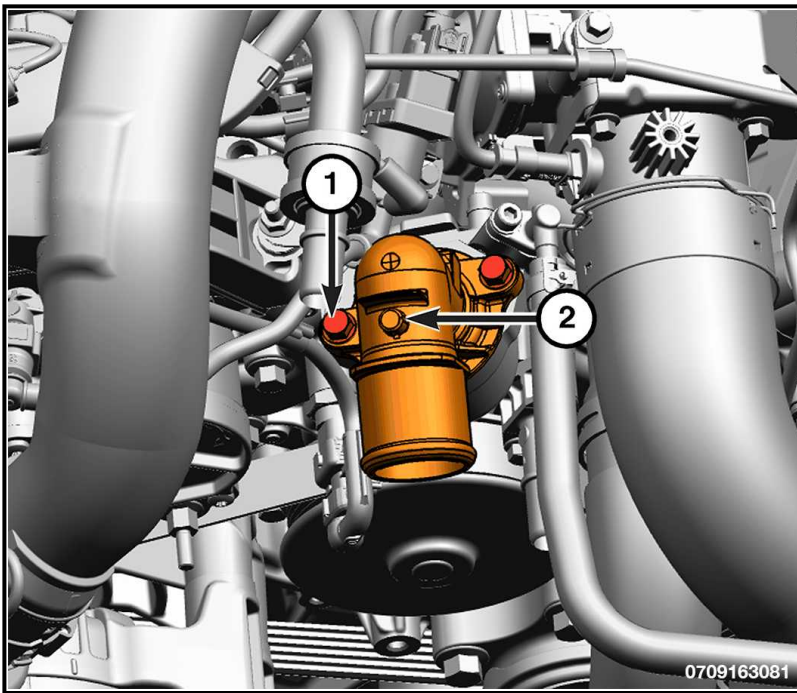
The Thermostat and housing is serviced as an assembly. Do not remove the thermostat from the housing. Damage to the thermostat may occur.

1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
2. Drain the cooling system. Refer to [DRAINING](#) .



1 - Upper Radiator Hose
2 - Retainers

3. Remove the upper radiator hose from the thermostat housing and position aside.



1 - Thermostat Housing Bolts

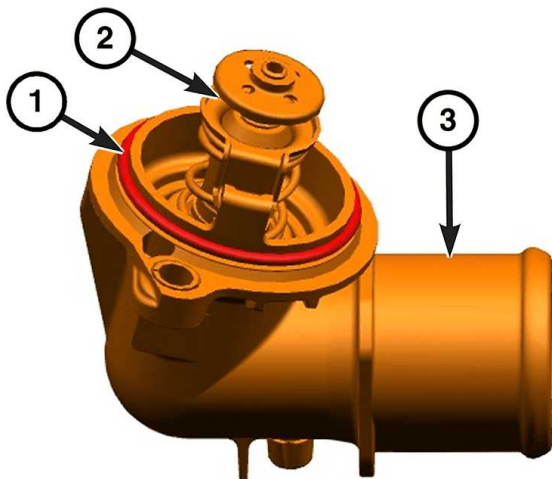
2 - Thermostat Housing

4. Remove the thermostat housing bolts and the thermostat housing.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.



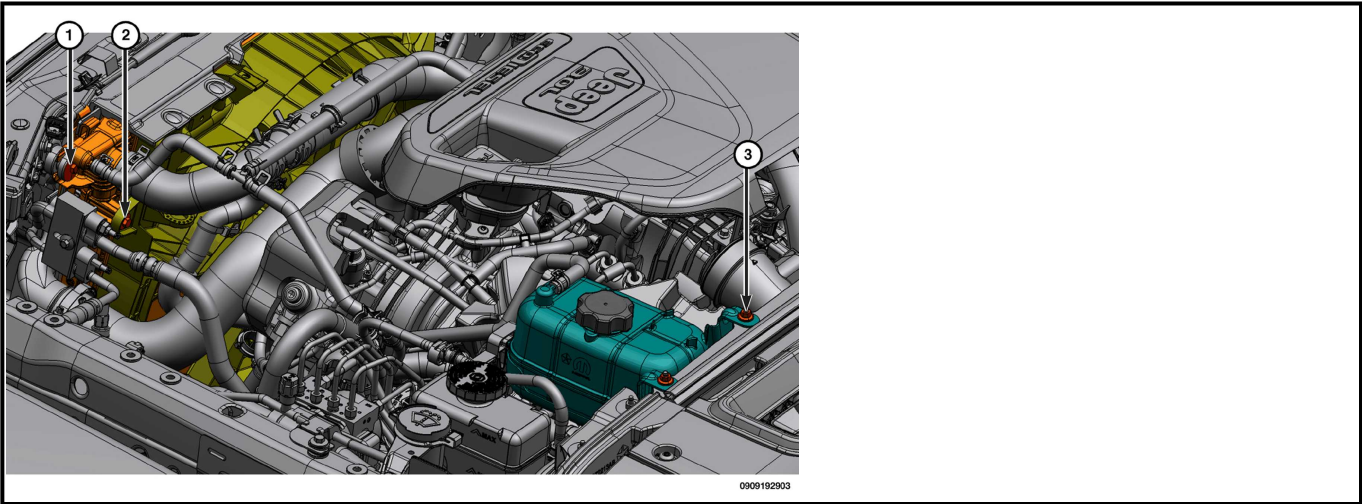
0904162153

1 - O-ring

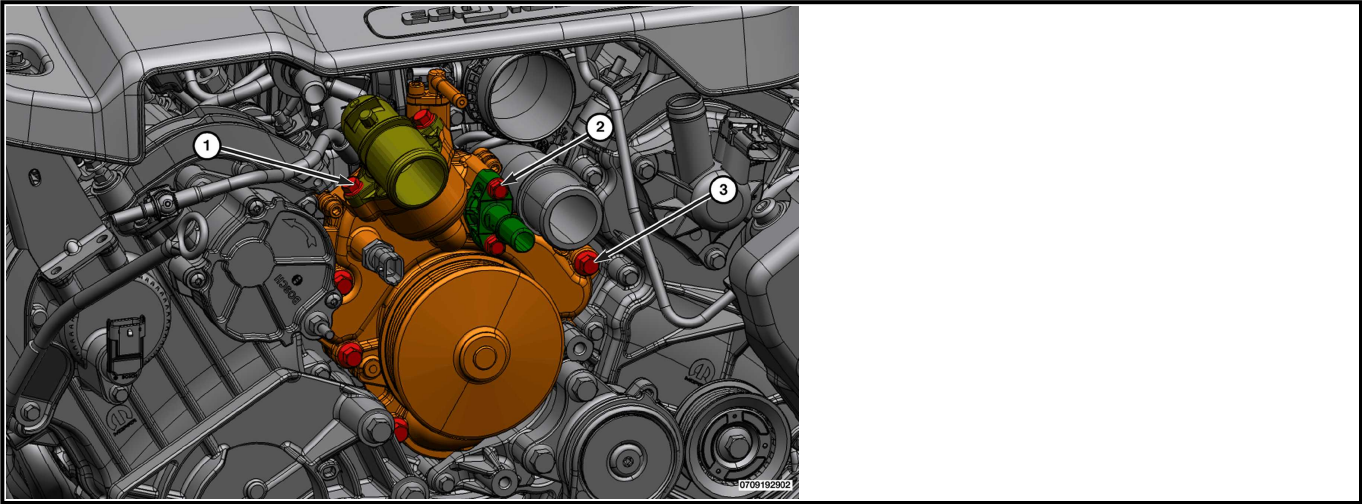
- Install a **NEW** O-ring onto the thermostat housing.
- Fill cooling system. Refer to **STANDARD PROCEDURE - FILLING** .
- Start and warm the engine and check for leaks.

TORQUE SPECIFICATIONS

COOLING SYSTEM - 3.0L DIESEL



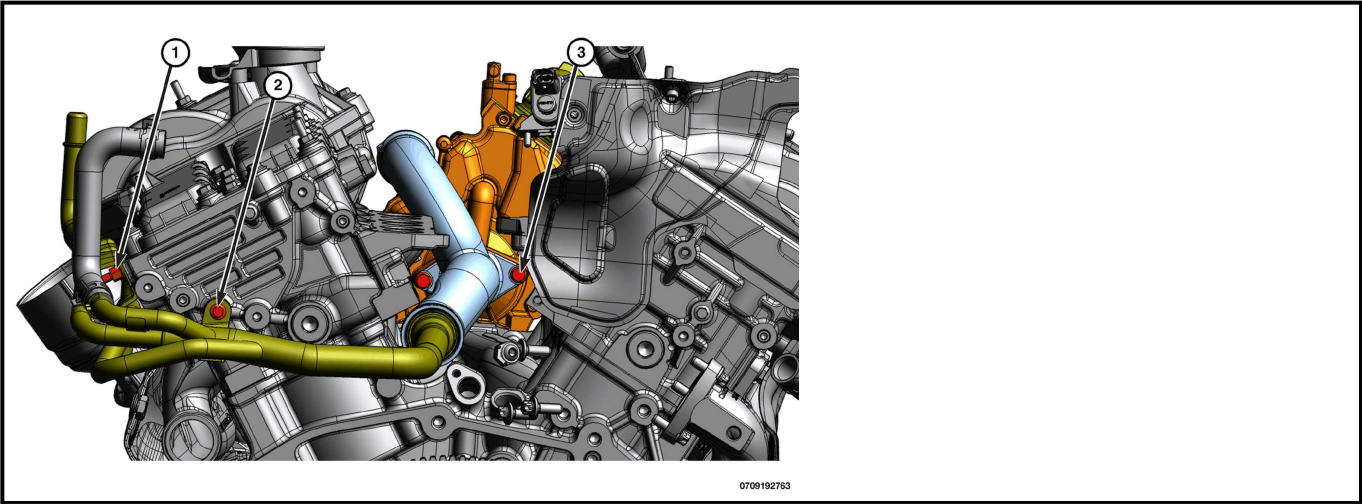
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90B° and then tighten to 32 N.m (24 Ft. Lbs.).	-

CalloUT	DEscriPtion	SPeCifiCation	COmmenT
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

CalloUT	DEscriPtion	SPeCifiCation	COmmenT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-



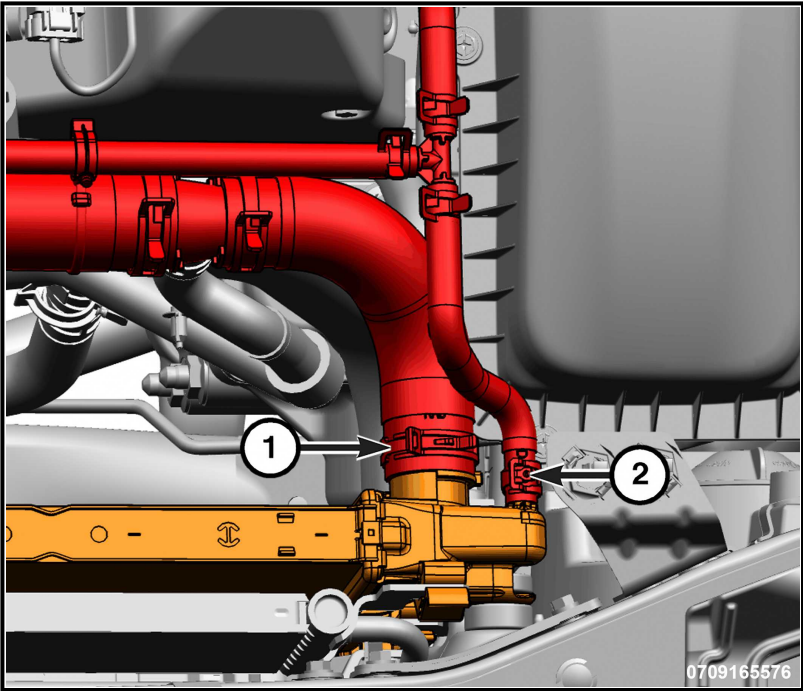
RADIATOR

REMOVAL AND INSTALLATION

ENGINE RADIATOR

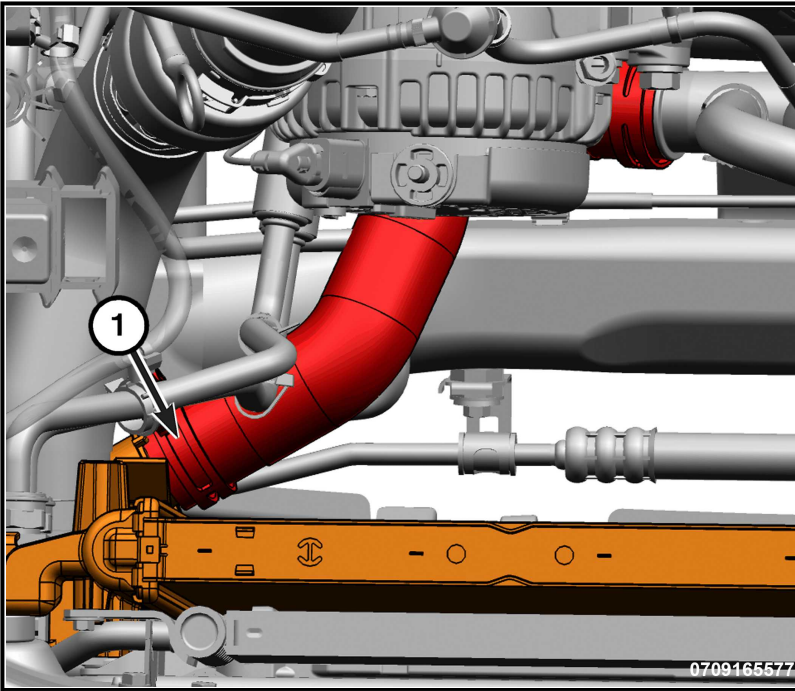
REMOVAL

1. Drain the cooling system. Refer to [DRAINING](#) .
2. Remove the cooling fan. Refer to [FAN, COOLING, REMOVAL AND INSTALLATION](#).



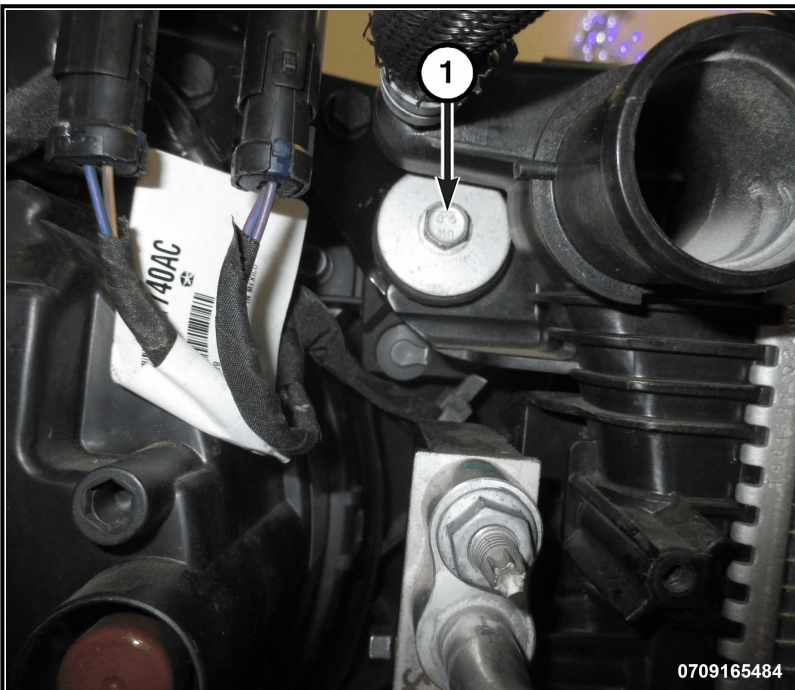
1 - Upper Radiator Hose
2 - Coolant Hose

3. Disconnect the coolant hose.
4. Disconnect the upper radiator hose.



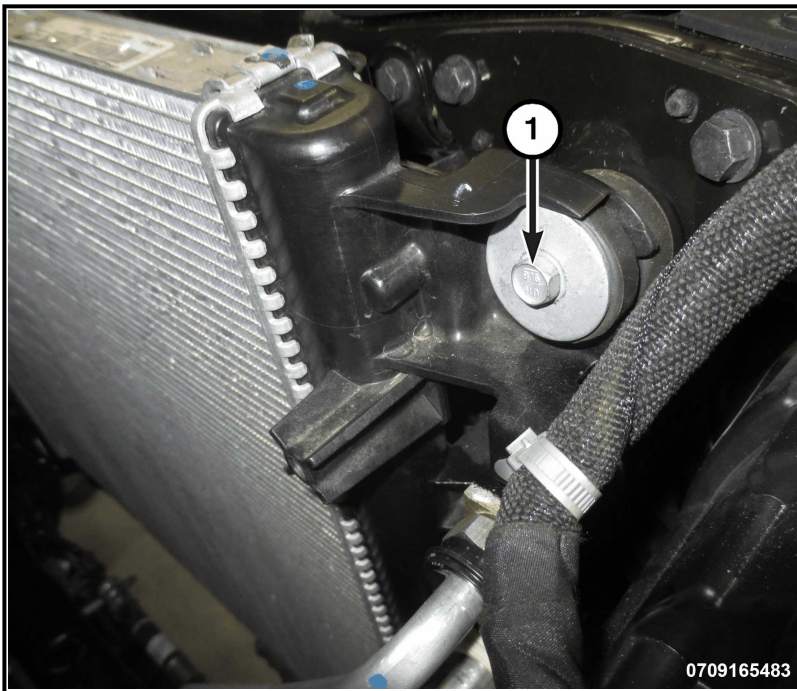
1 - Lower Radiator Hose

5. Remove the lower radiator hose and position the hose aside.
6. Remove the grille. Refer to [GRILLE, REMOVAL AND INSTALLATION](#).



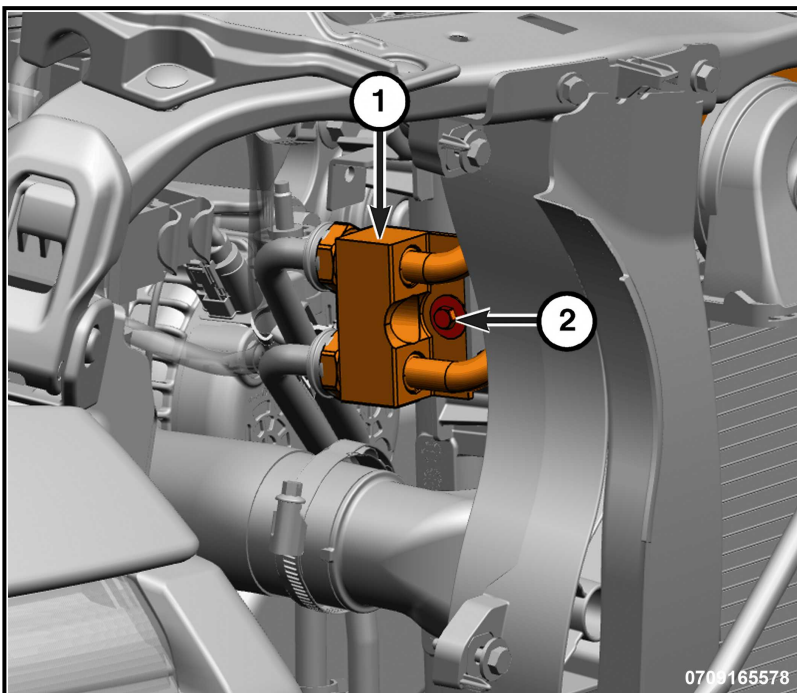
1 - Left Radiator Bolt

7. Remove the left radiator bolt.



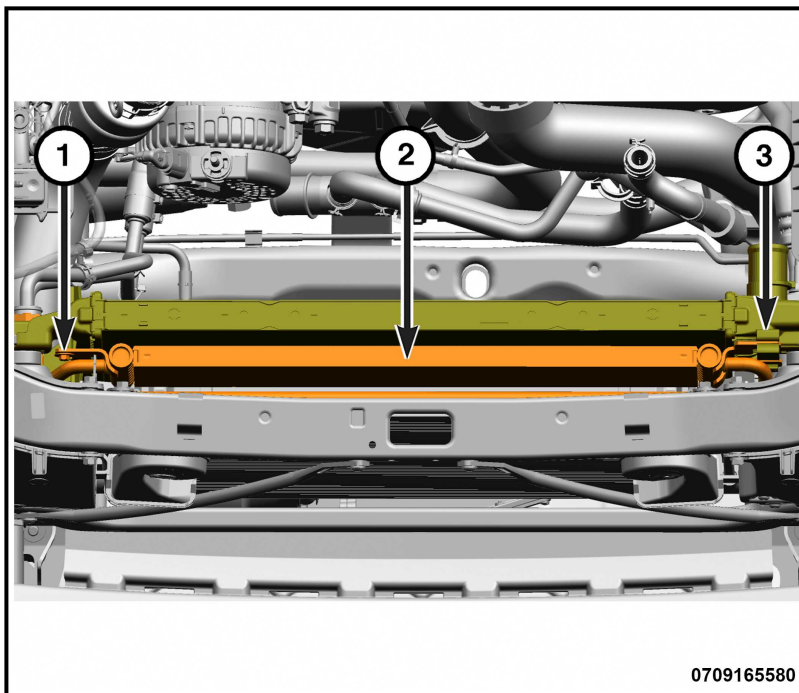
1 - Right Radiator Bolt

8. Remove the right radiator bolt.
9. Tilt the radiator inward to gain access to the transmission cooler.
10. Remove the right headlight unit. Refer to [UNIT, HEADLAMP, REMOVAL AND INSTALLATION](#) .



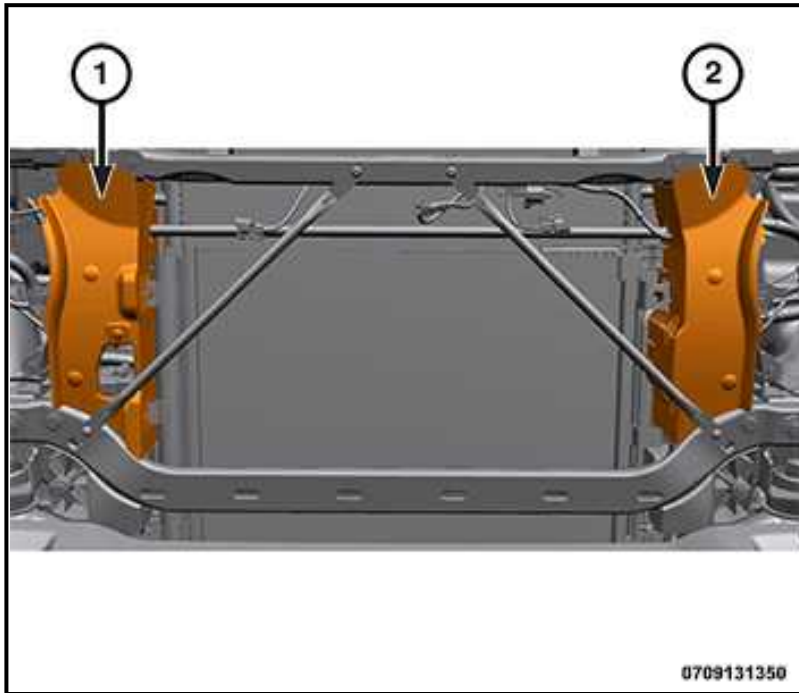
1 - Transmission Cooler Line Manifold
2 - Transmission Cooler Line Manifold Bolt

11. Working from the right front, remove the transmission cooler manifold bolt securing the transmission cooler manifold to the radiator.



1 - Transmission Cooler Bolt
2 - Transmission Cooler
3 - Tab

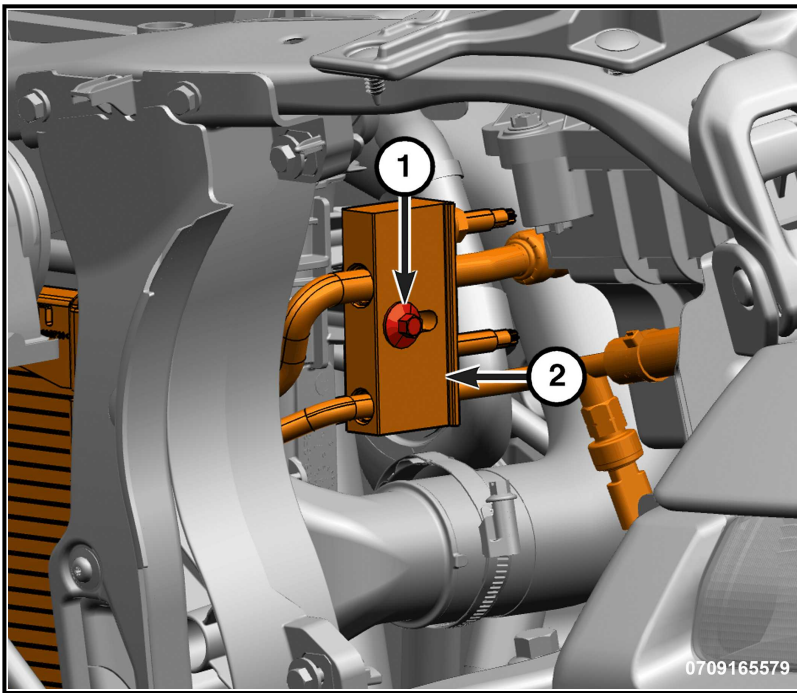
12. Working from the front, remove the right transmission cooler bolt, release the tab and lift up transmission cooler to separate transmission cooler from the radiator.



1 - Right Side Radiator Air Deflector
2 - Left Side Radiator Air Deflector

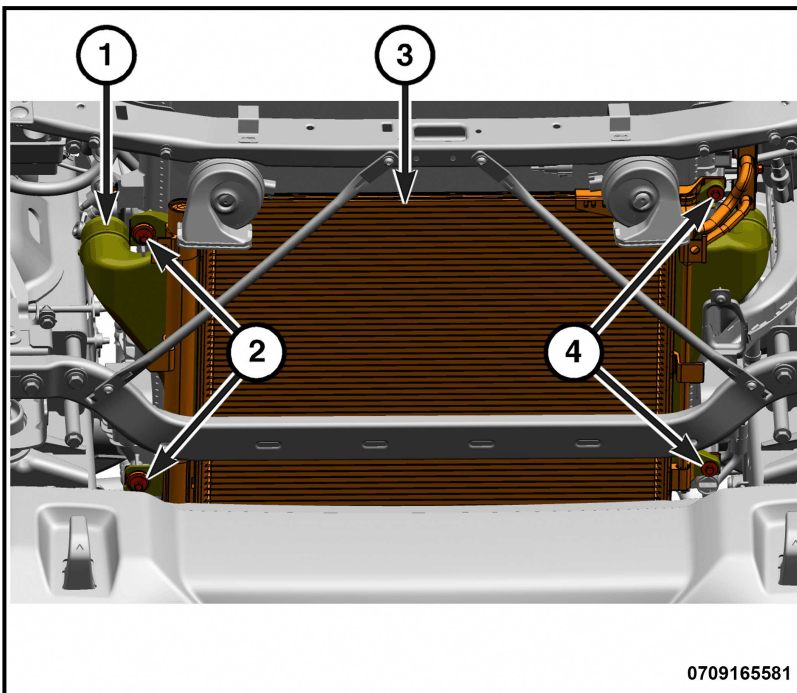
13. Working from the front remove the left side radiator air deflector and right side radiator air deflector.

14. Remove the left headlight unit. Refer to [UNIT, HEADLAMP, REMOVAL AND INSTALLATION](#) .



1 - A/C Condenser Manifold Bolt
2 - A/C Condenser Manifold

15. Remove the left side A/C condenser manifold bolt from the side of the radiator.



1 - Charge Air Cooler
2 - Right Side A/C Condenser Bolts
3 - A/C Condenser
4 - Left Side A/C Condenser Bolts

16. Working from the front, remove the right side A/C condenser bolts.

17. Working from the front, remove the left side A/C condenser bolts and separate the A/C condenser from the Charge Air Cooler (CAC) and radiator.

18. Carefully lift up on the radiator and remove it from the vehicle.

INSTALLATION

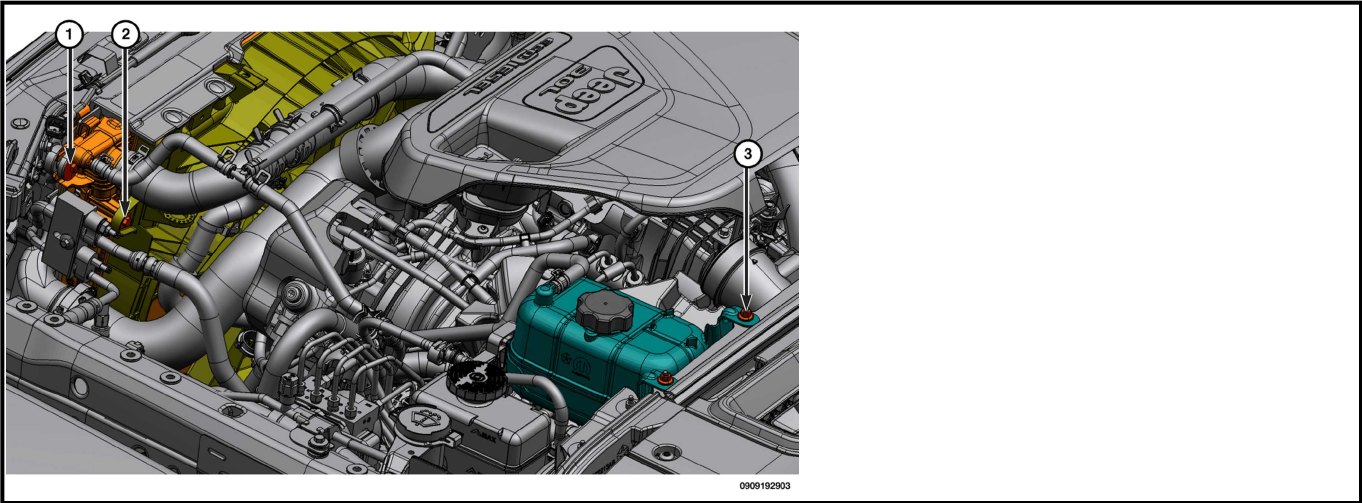
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

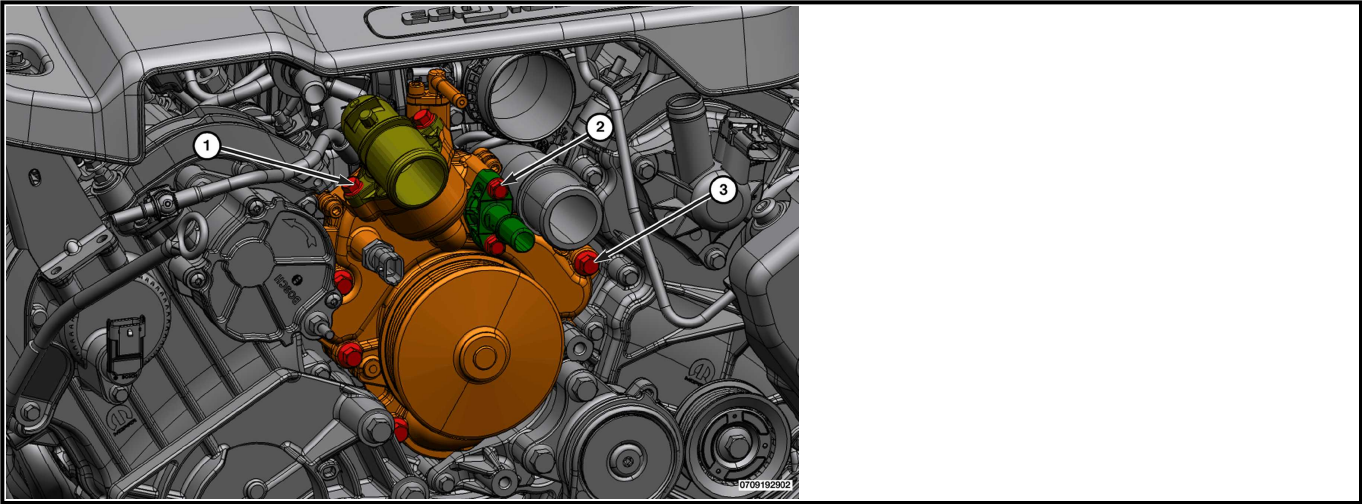
- Fill the cooling system. Refer to **STANDARD PROCEDURE - FILLING** .

TORQUE SPECIFICATIONS

COOLING SYSTEM - 3.0L DIESEL



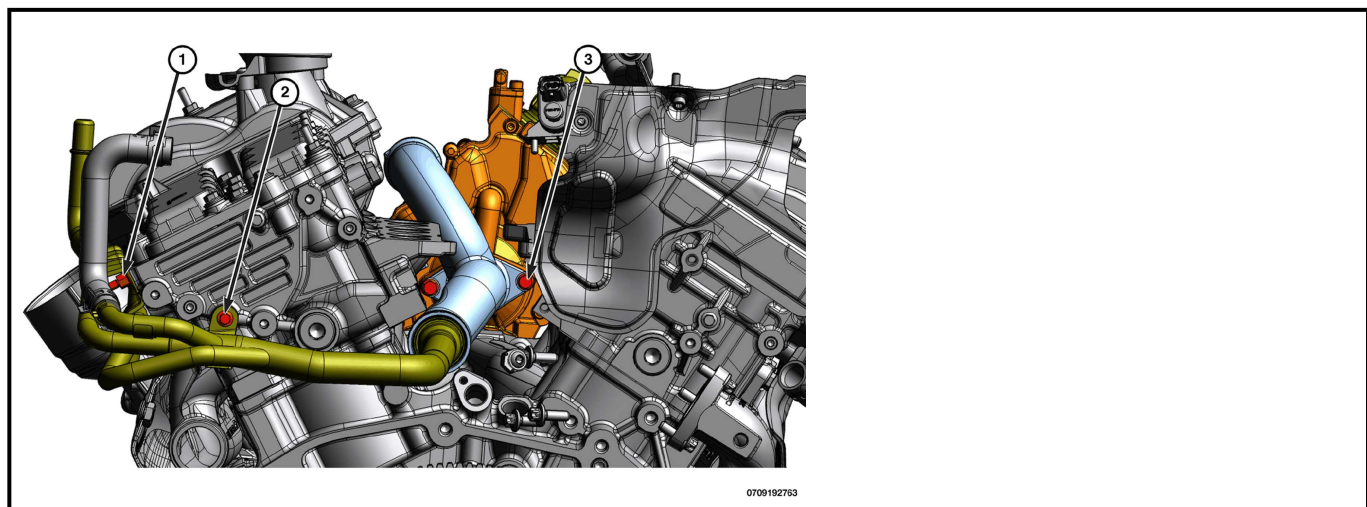
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



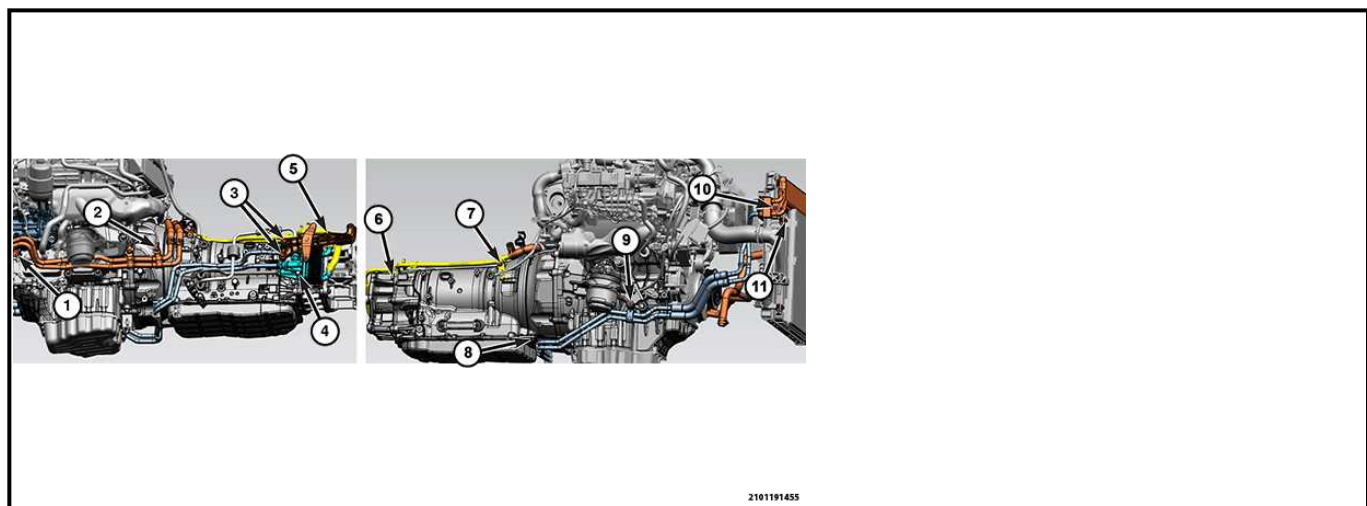
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
		to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90B° and then tighten to 32 N.m (24 Ft. Lbs.).	
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-



TRANSMISSION OIL COOLER AND HEATER



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Transmission Oil Heater Line Bracket To AC Compressor Nut	9 N. m (80 In. Lbs.)	-
2	Transmission Oil Heater Line Bracket To Transmission Bolts	20 N. m (15 Ft. Lbs.)	-
3	Transmission Oil Heater To Transmission Bolts (Passing	23 N. m (17 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
	Through Transfer Case Cable Support Bracket)		
4	Transmission Oil Heater To Transmission Bolt	23 N. m (17 Ft. Lbs.)	-
5	Transfer Case Cable Support to Bracket Nut	19 N. m (14 Ft. Lbs.)	-
6	Transmission Oil Heater Line Bracket To Case Bolt	22 N. m (16 Ft. Lbs.)	-
7	Transmission Oil Heater Line Bracket To Transmission Bolt	22 N. m (16 Ft. Lbs.)	-
8	Transmission Oil Cooler Line Bracket To Transmission Bolt	9 N. m (80 In. Lbs.)	-
9	Transmission Oil Cooler Line Bracket To Engine Mount Bracket Bolt	9 N. m (80 In. Lbs.)	-
10	Transmission Oil Cooler Line Manifold To Radiator Bolt	-	Tighten Securely
11	Transmission Oil Cooler Line To Radiator Bolt	-	Tighten Securely

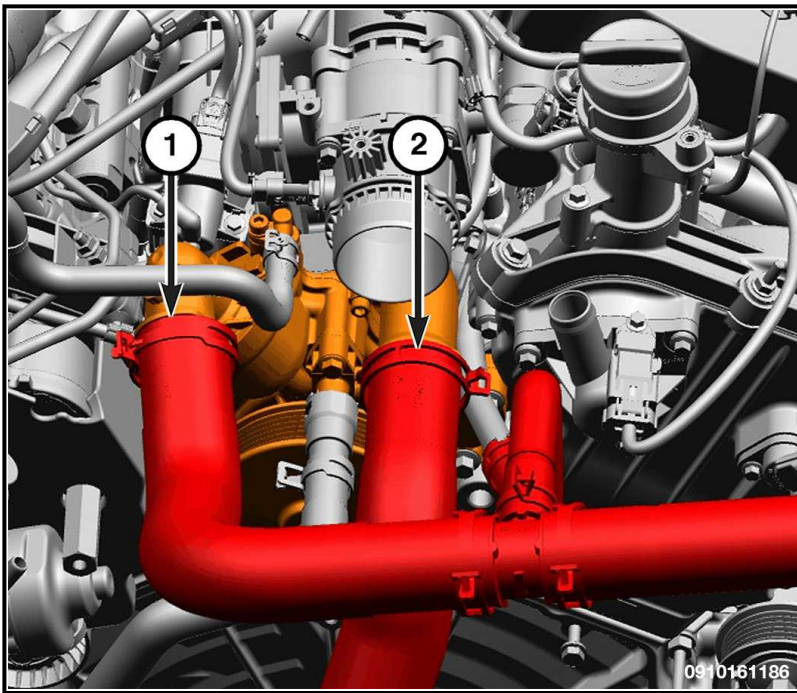
PUMP, WATER

REMOVAL AND INSTALLATION

COOLANT PUMP

REMOVAL

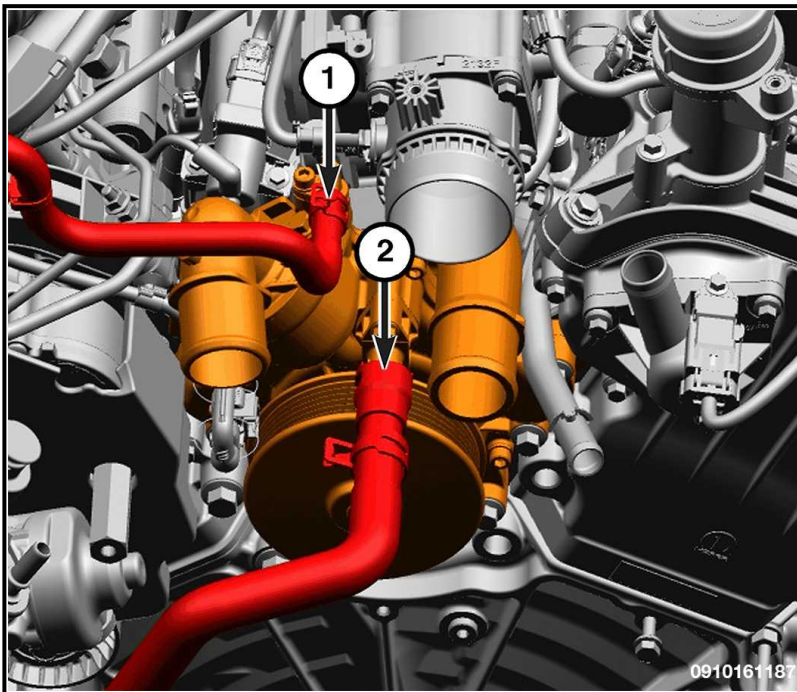
1. Raise and support the vehicle. Refer to **HOISTING, STANDARD PROCEDURE** .
2. Drain the cooling system. Refer to **DRAINING** .
3. Remove the left fuel rail supply tube. Refer to **LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION** .
4. Remove the belt tensioner and tensioner mounting bracket. Refer to **BELT, SERPENTINE, REMOVAL AND INSTALLATION** .



1 - Upper Radiator Hose

2 - Lower Radiator Hose

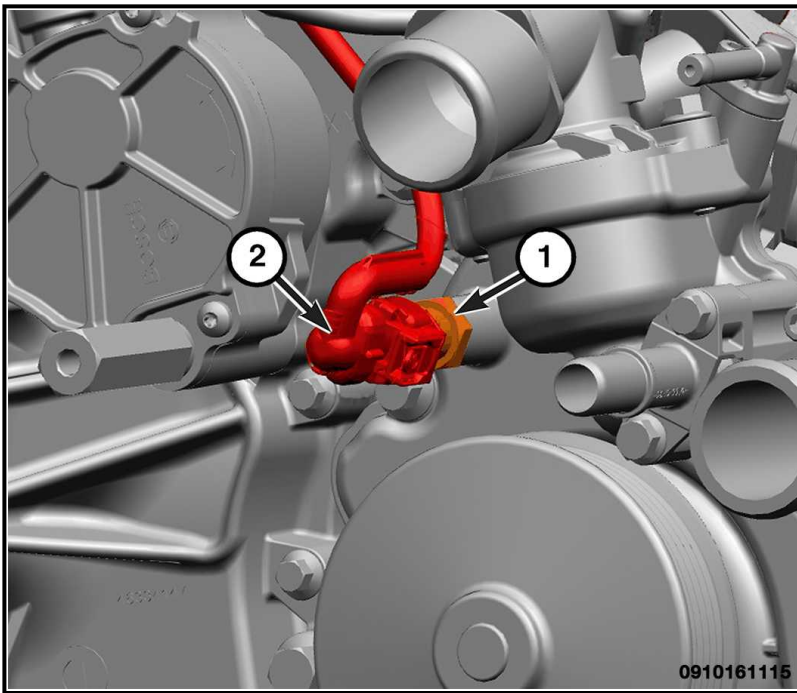
5. Disconnect the upper radiator hose from the thermostat housing.
6. Disconnect the lower radiator hose from the coolant inlet tube.



1 - Pressurized Coolant Bottle Coolant Hose

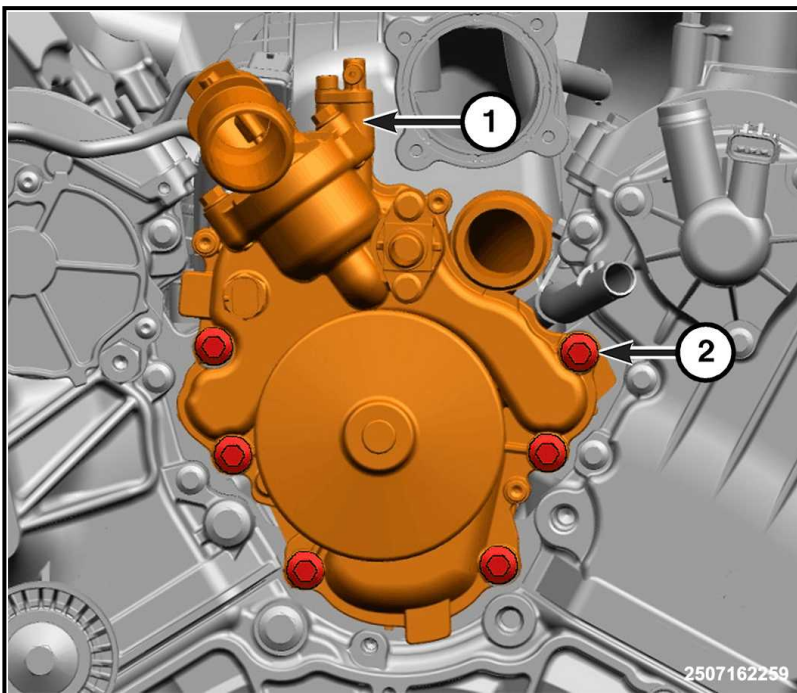
2 - Coolant Bypass Hose

7. Disconnect the pressurized coolant bottle coolant hose from the coolant pump.
8. Disconnect the coolant bypass hose quick coupling from the coolant pump.



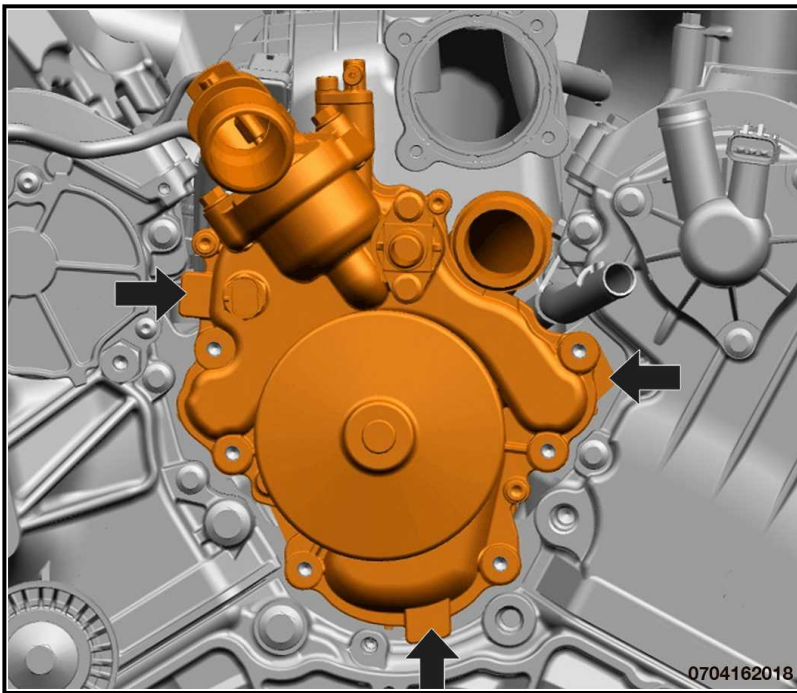
- | |
|--|
| 1 - Engine Coolant Temperature Sensor |
| 2 - Engine Coolant Temperature Sensor Wire Harness Connector |

9. Unlock and disconnect the Engine Coolant Temperature (ECT) sensor wire harness connector.



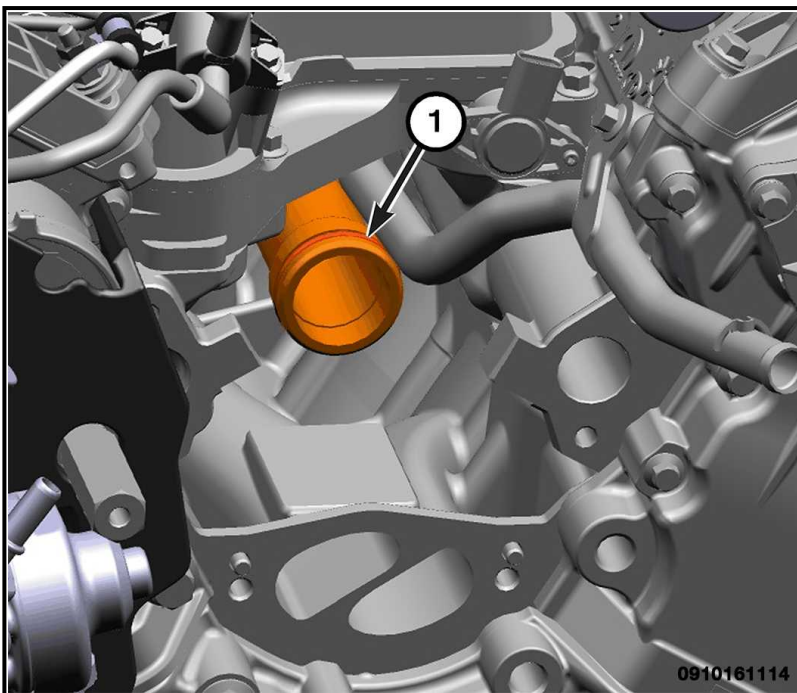
- | |
|------------------------|
| 1 - Coolant Pump |
| 2 - Coolant Pump Bolts |

10. Remove the coolant pump bolts from the coolant pump.



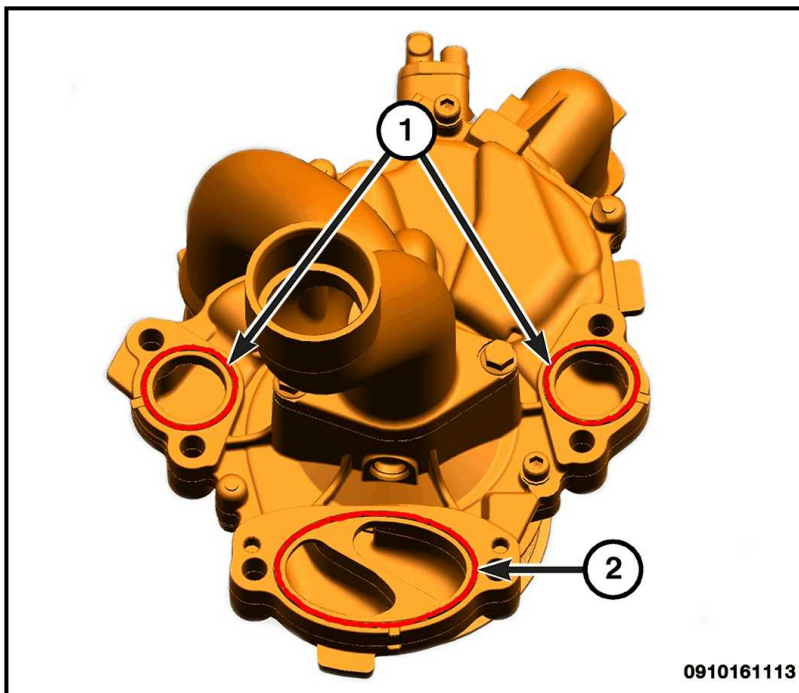
1 - Coolant Pump Assembly

11. Use the indicated pry points, if necessary, and remove the coolant pump assembly.



1 - O-ring

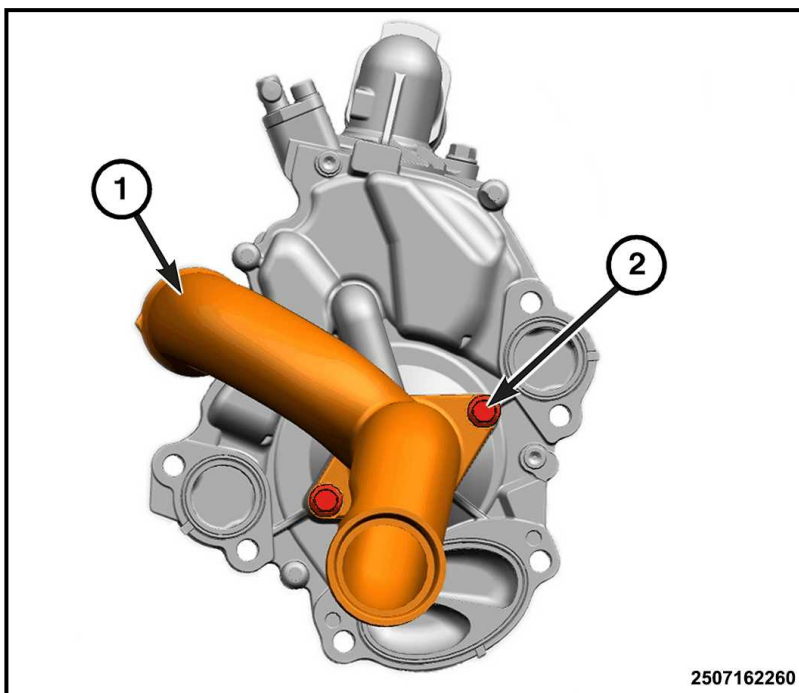
12. Remove and discard the O-ring from the engine coolant tube.



1 - O-ring

2 - O-ring

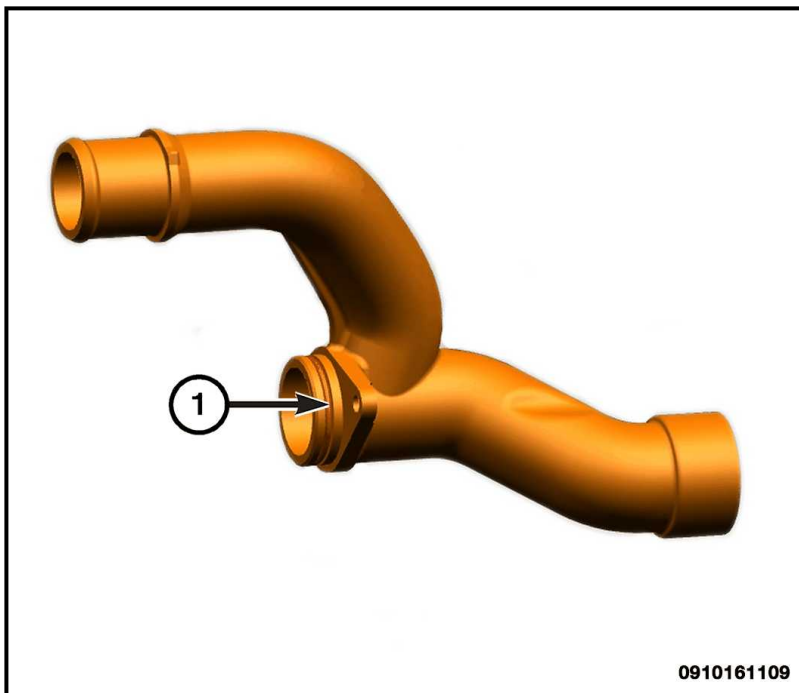
13. Remove and discard the O-rings from the coolant pump.



1 - Coolant Inlet Tube

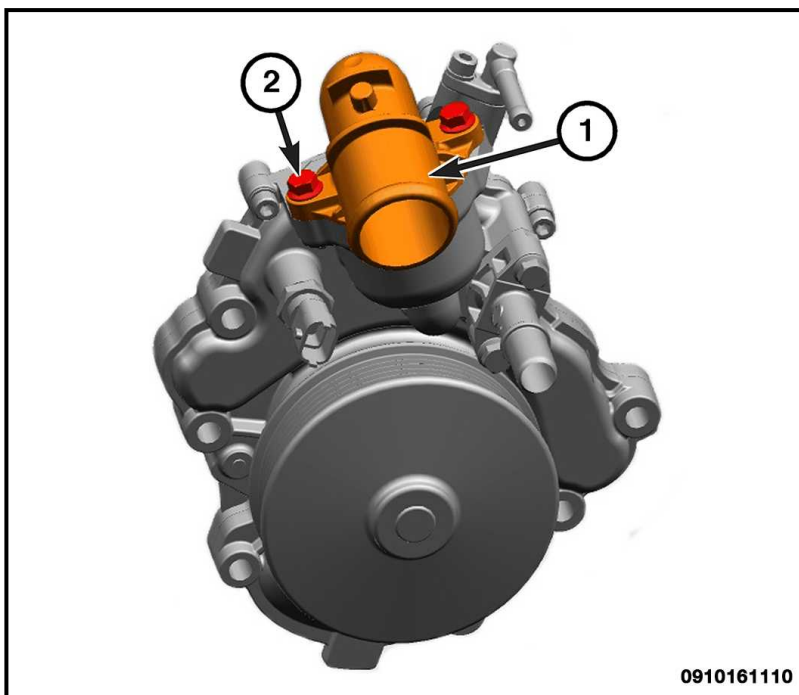
2 - Coolant Inlet Tube Bolts

14. Remove the coolant inlet tube bolts and the coolant inlet tube.



1 - O-ring

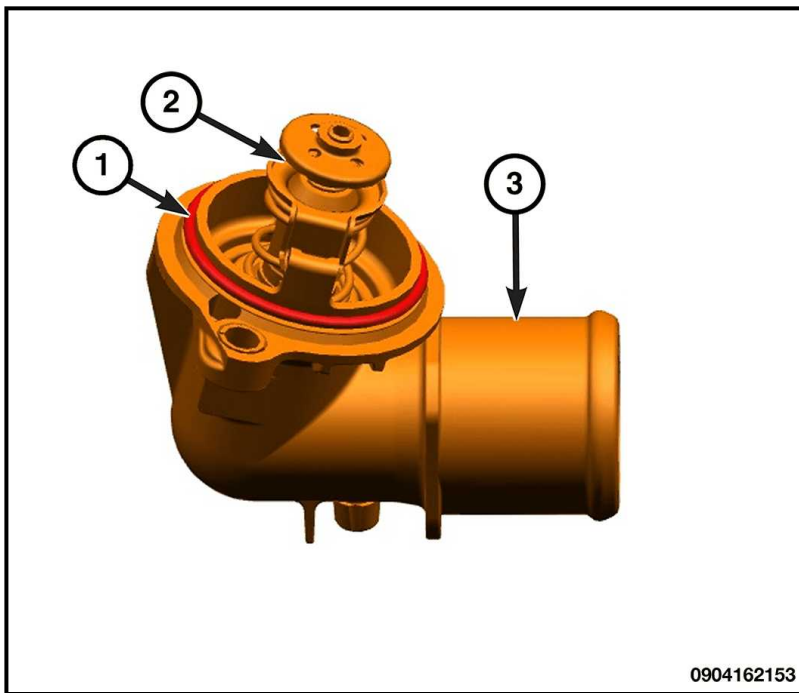
15. Remove and discard the O-ring from the coolant inlet tube.



1 - Thermostat Housing

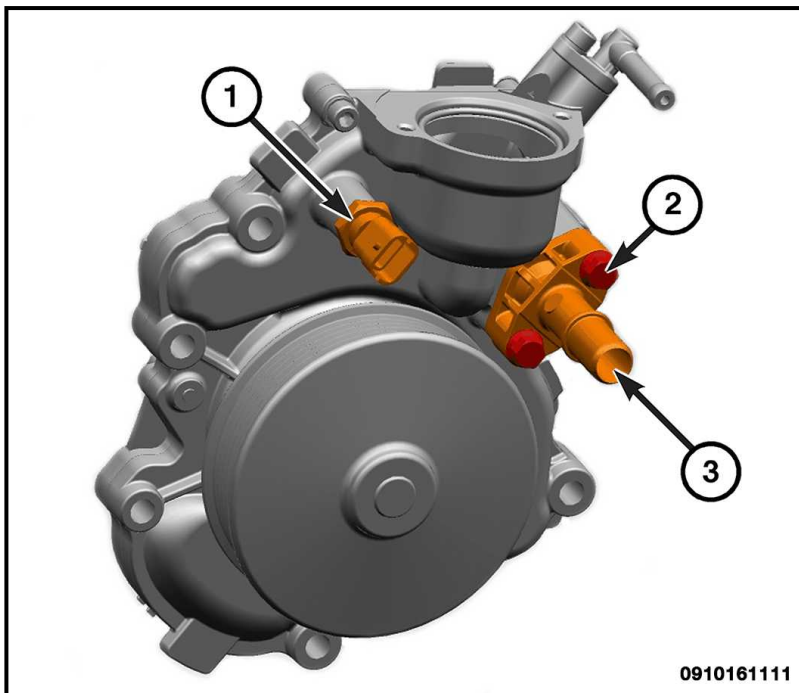
2 - Thermostat Housing Bolts

16. Remove the thermostat housing bolts and the thermostat housing.



1 - O-ring

17. Remove and discard the O-ring from the thermostat housing.



1 - Engine Coolant Temperature Sensor
2 - Coolant Bypass Tube Bolts
3 - Coolant Bypass Tube

18. Remove the ECT sensor.

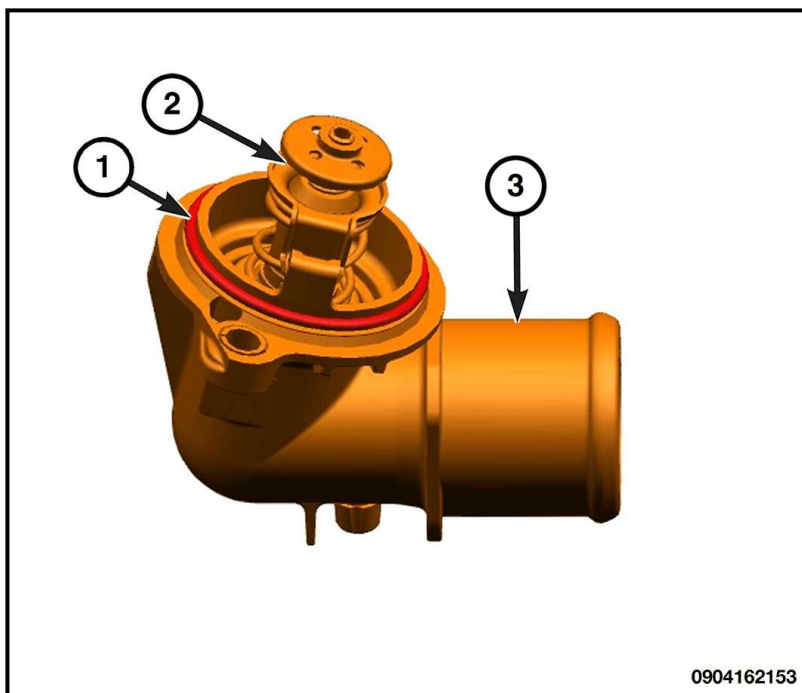
19. Remove the coolant bypass tube bolts and the coolant bypass tube.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

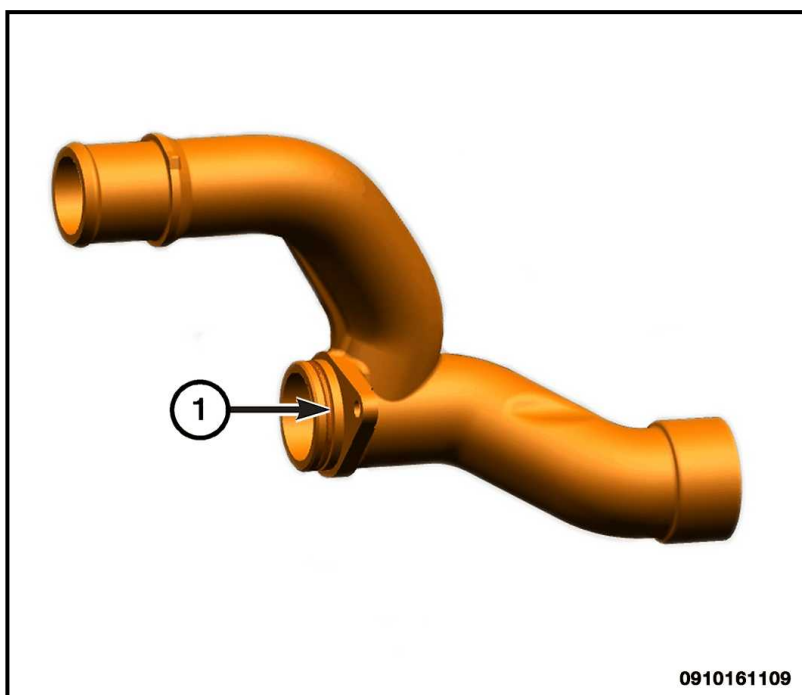
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean all O-ring sealing surfaces.



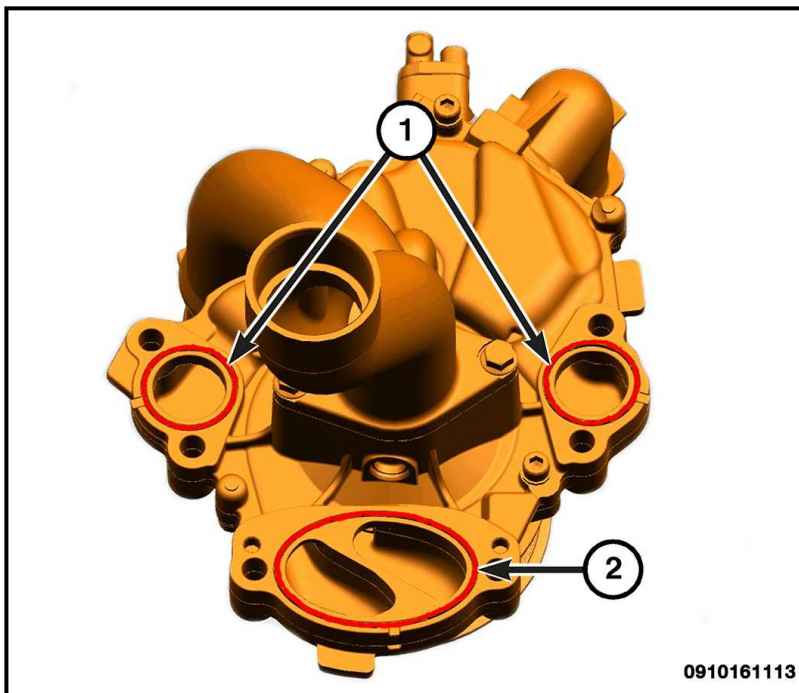
1 - O-ring

- Install a **NEW** O-ring on the thermostat housing.



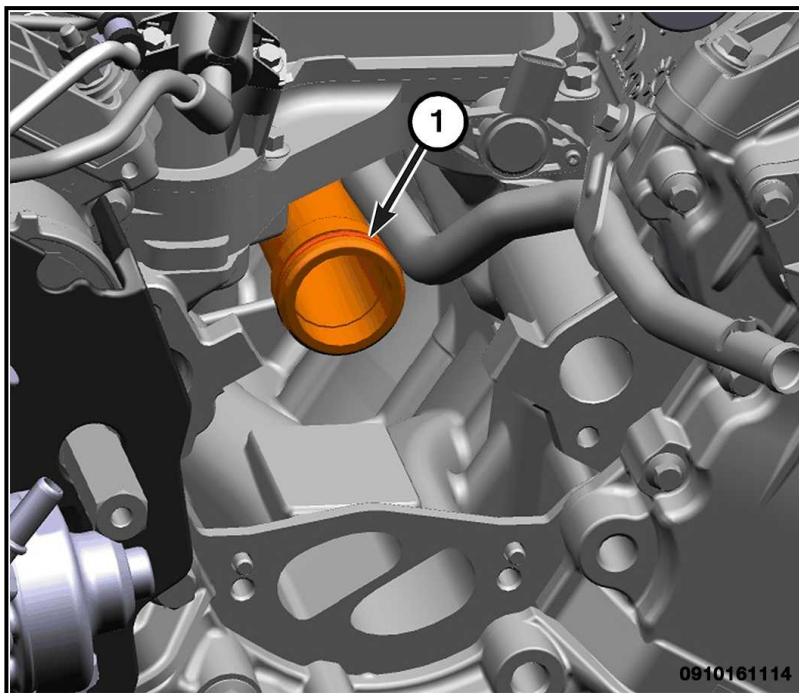
1 - O-ring

- Install a **NEW** O-ring on the coolant inlet tube.



1 - O-ring
2 - O-ring

- Install **NEW** O-rings on the coolant pump.

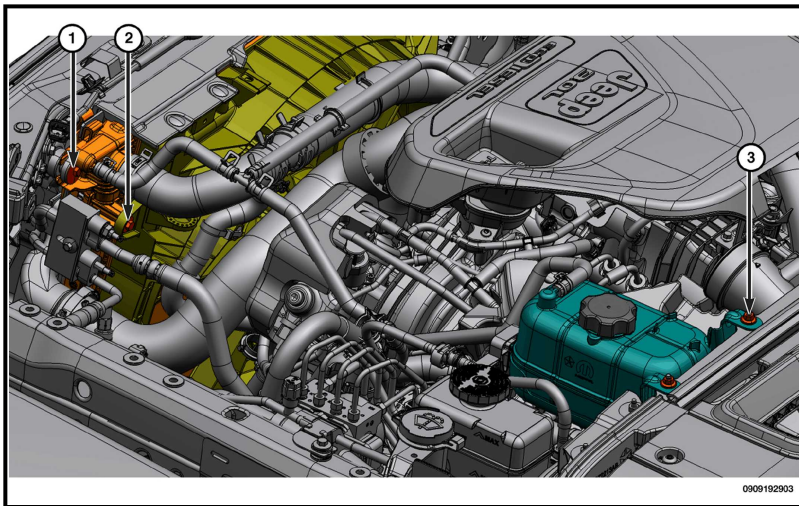


1 - O-ring

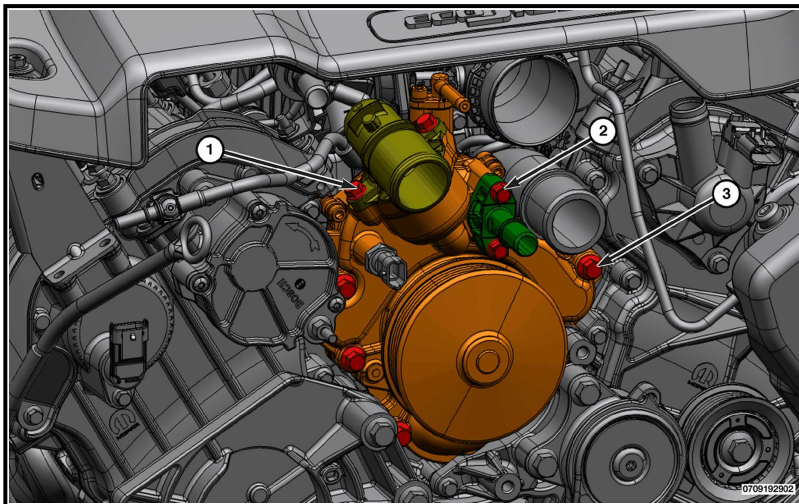
- Install a **NEW** O-ring on the engine coolant tube.
- Install the coolant pump and using the tightening sequence shown in the torque table below, tighten the water pump bolts to the proper torque specifications.
- Evacuate and fill the cooling system. Refer to [COOLANT SYSTEM AIR EVACUATION](#), and [STANDARD PROCEDURE - FILLING](#) .
- Check the cooling system for leaks. Refer to [COOLING SYSTEM LEAKS](#) .

TORQUE SPECIFICATIONS

COOLING SYSTEM - 3.0L DIESEL

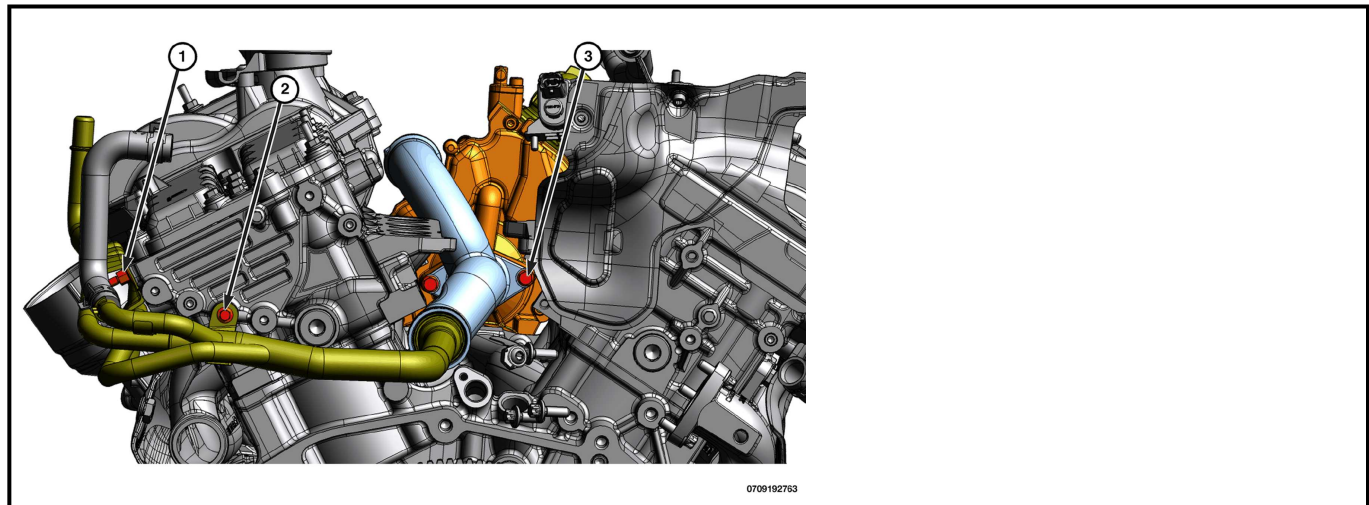


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90B° and then tighten to 32 N.m (24 Ft. Lbs.).	-
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

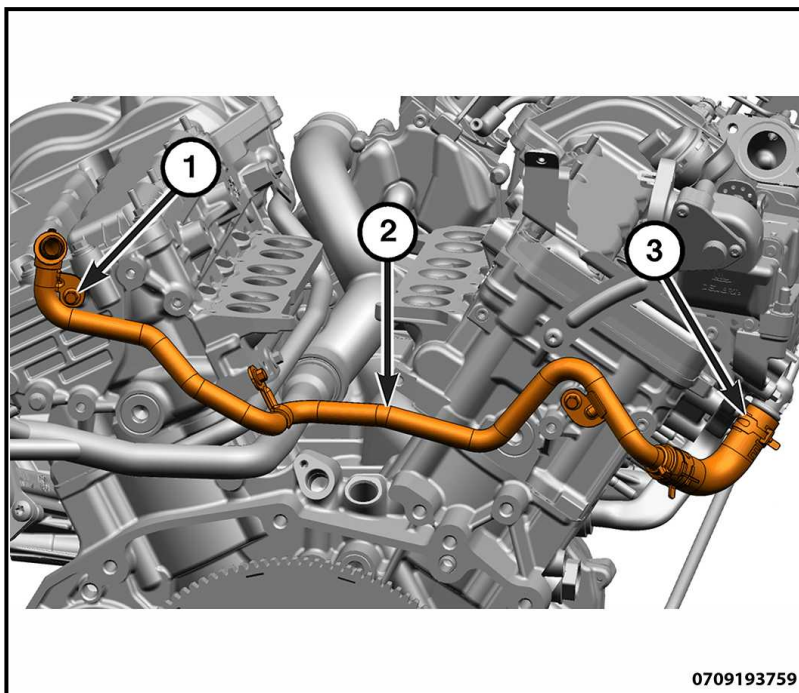
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-



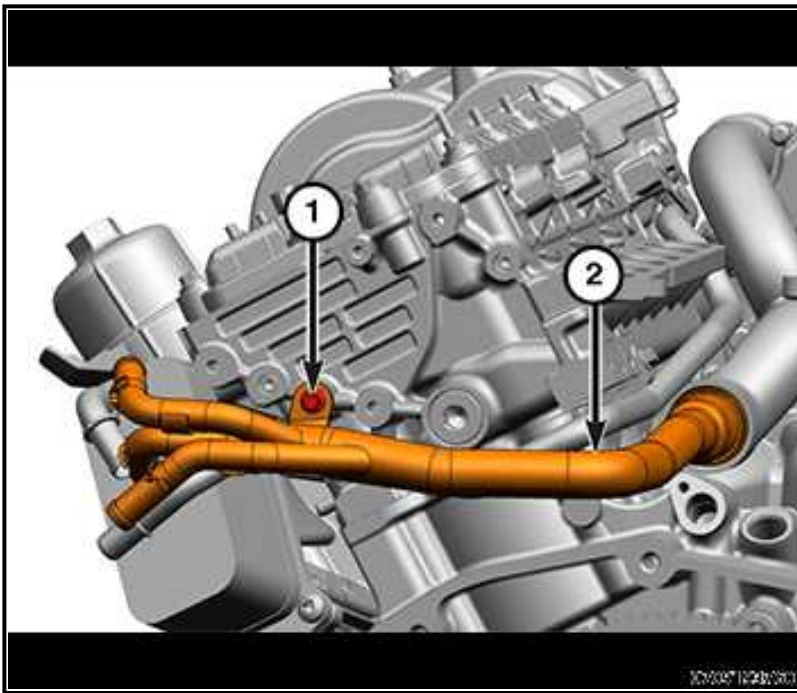
COOLANT PUMP COOLANT TUBES

REMOVAL

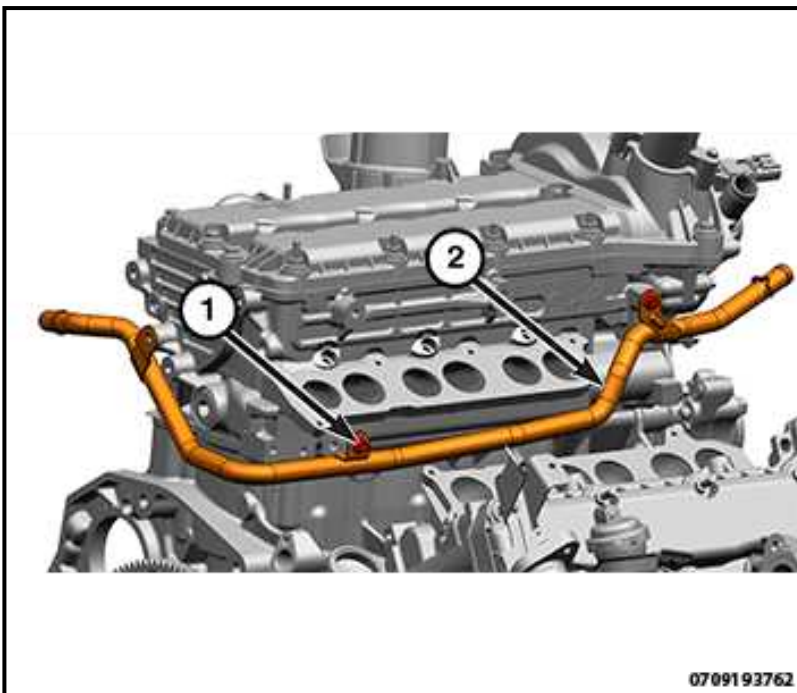
1. Remove the turbocharger. Refer to [TURBOCHARGER, REMOVAL AND INSTALLATION](#).



2. Disconnect the coolant hose (3) from the EGR cooler manifold.
3. Remove the bolts (1) and the right side coolant tube (2).

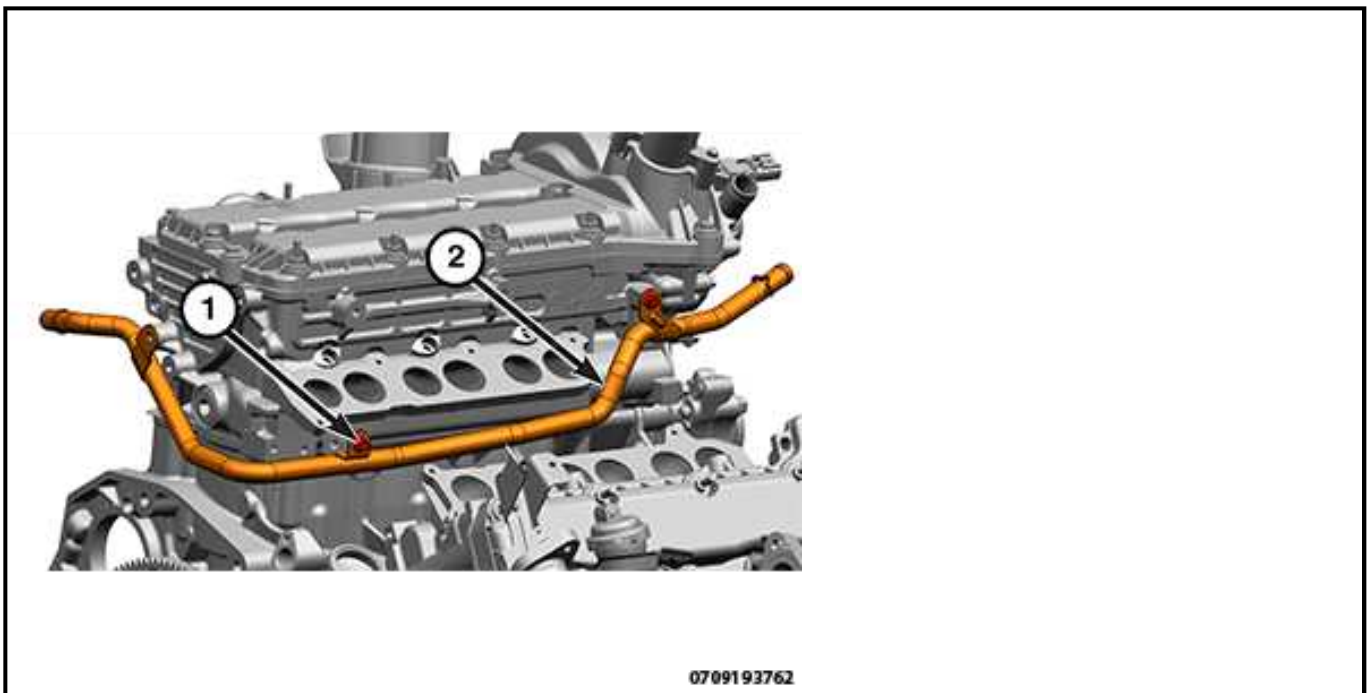


4. Disconnect the coolant hoses from the coolant tube (2).
5. Remove the bolt (1) and the left side coolant tube (2).

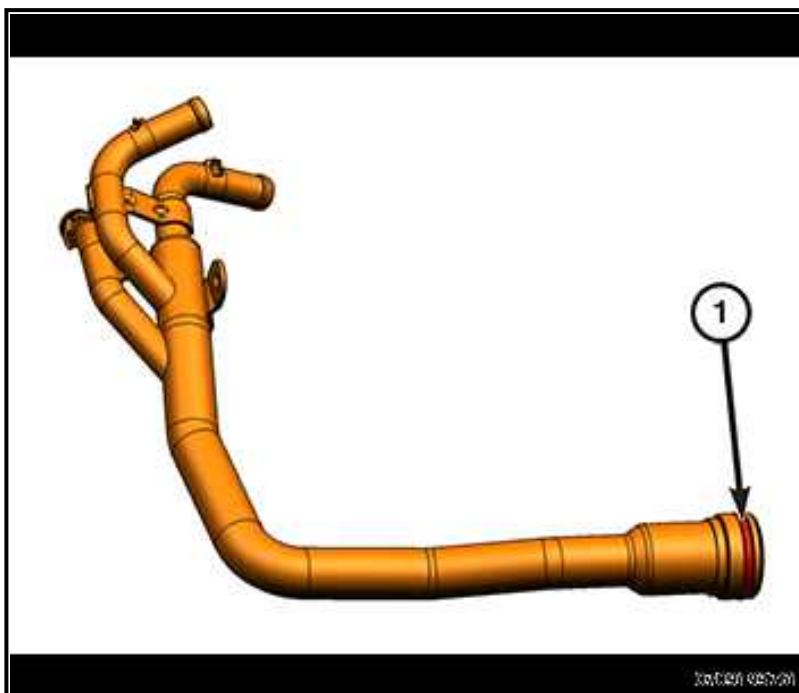


6. Disconnect the coolant hose from the coolant tube (2).
7. Remove the bolts (1) and the bypass coolant tube (2) from the engine.

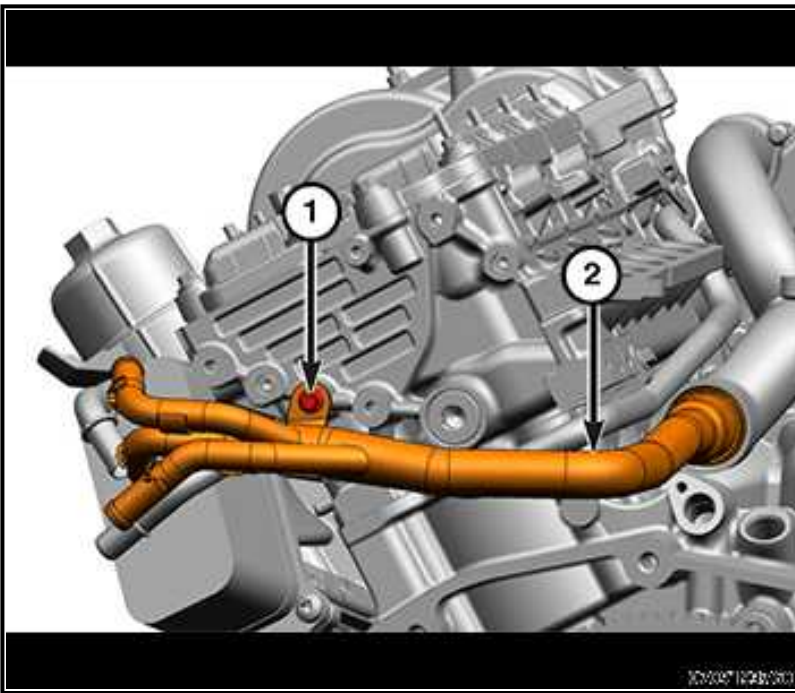
INSTALLATION



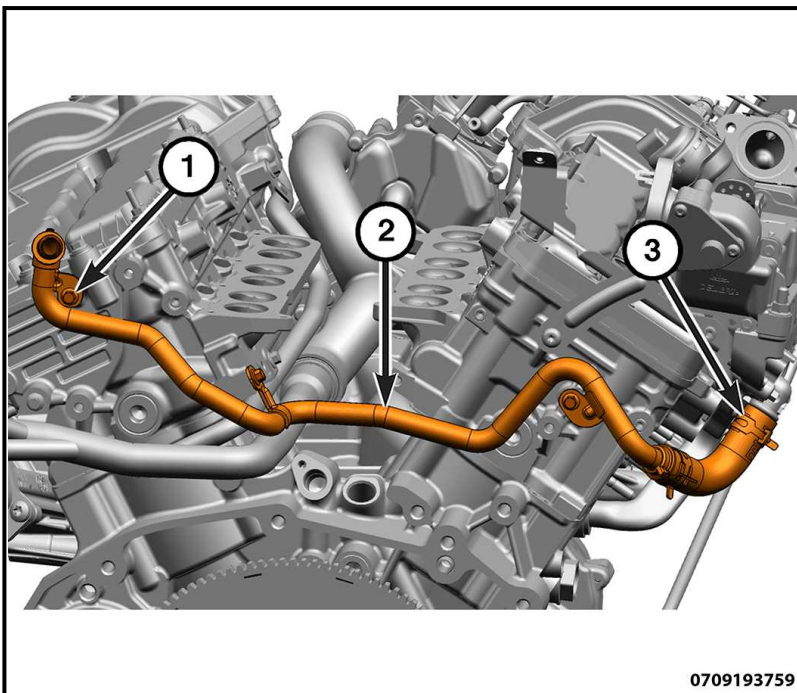
1. Install the bypass coolant tube (2) and tighten the bolts (1) to the proper specifications. Refer to [COOLING SYSTEM - 3.0L DIESEL](#).
2. Connect the coolant hose to the coolant tube (2).



3. Install a **NEW** O-ring (1) onto the coolant tube.



4. Install the left side coolant tube (2) and tighten the bolts (1) to the proper specifications. Refer to [COOLING SYSTEM - 3.0L DIESEL](#) .
5. Connect the coolant hoses to the coolant tube (2).

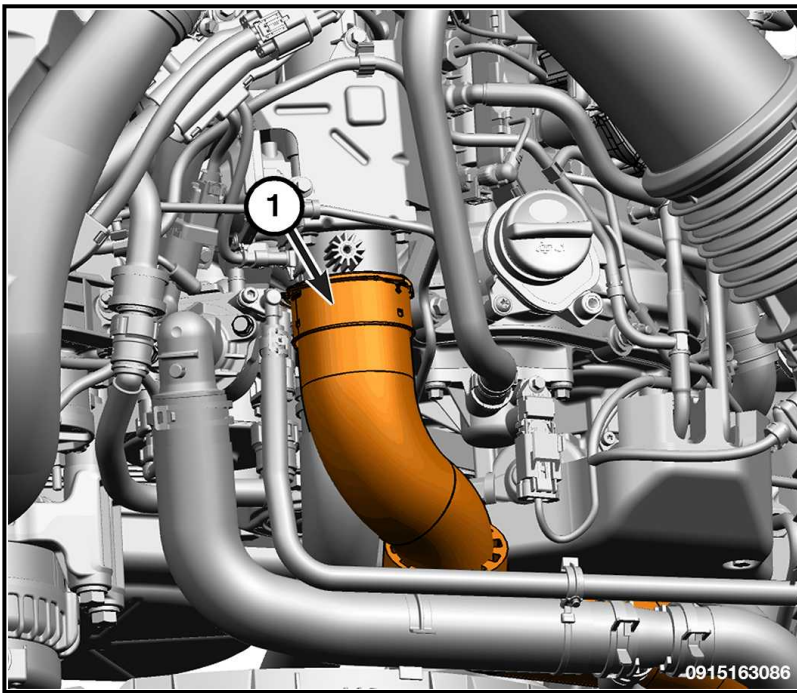


6. Install the right side coolant tube (2) and tighten the bolts (1) to the proper specifications. Refer to [COOLING SYSTEM - 3.0L DIESEL](#) .
7. Connect the coolant hose (3) to the EGR cooler manifold.
8. Install the turbocharger. Refer to [TURBOCHARGER, REMOVAL AND INSTALLATION](#) .

COOLANT PUMP BYPASS

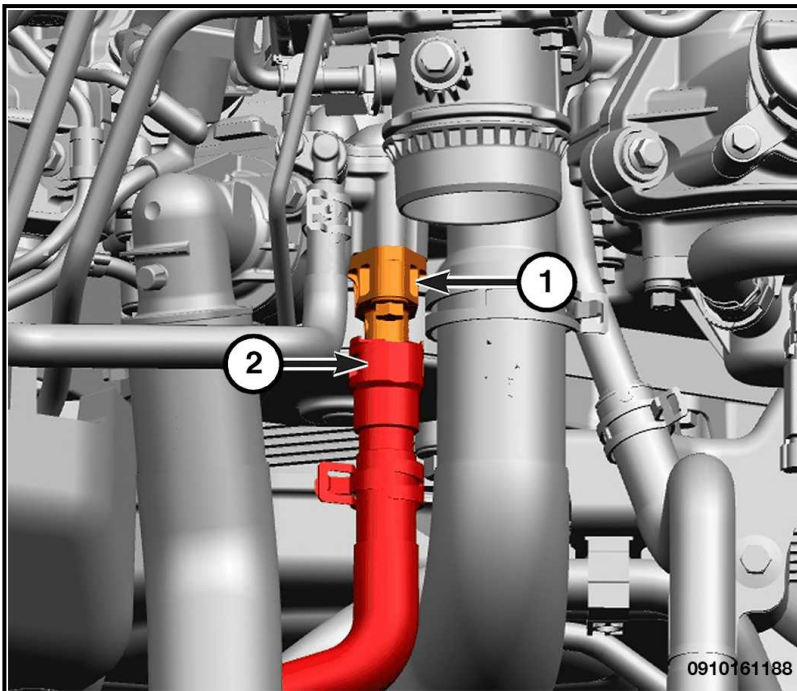
REMOVAL

1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
3. Drain the cooling system. Refer to [DRAINING](#) .



1 - Charge Air Cooler Hose

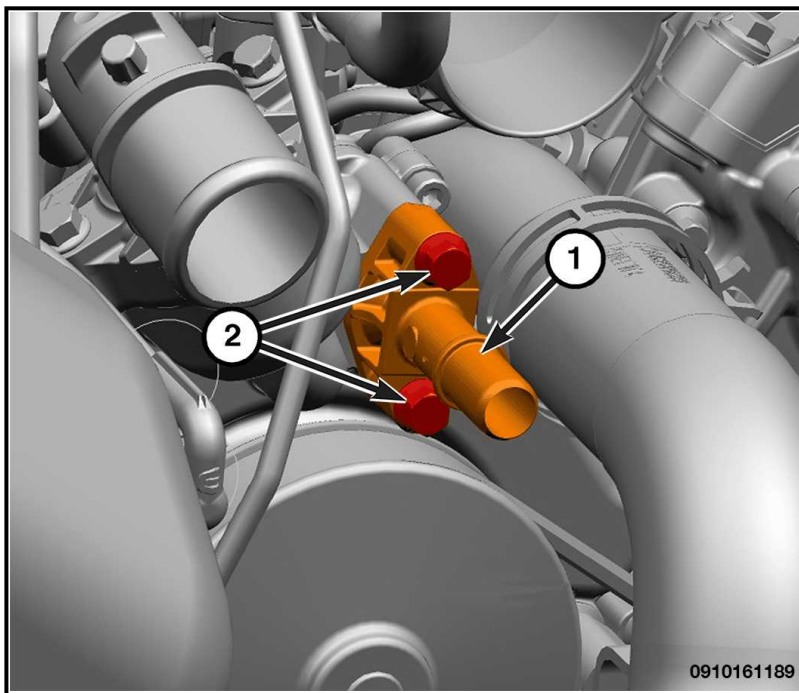
4. Release the retaining lock and disconnect the Charge Air Cooler (CAC) hose from the Exhaust Gas Recirculation (EGR) air flow control valve.



1 - Coolant Pump Bypass

2 - Coolant Hose Quick Coupling

5. Disconnect the coolant hose quick coupling from the coolant pump bypass.



1 - Coolant Bypass
2 - Coolant Bypass Bolts

6. Remove the coolant bypass bolts and the coolant bypass.

INSTALLATION

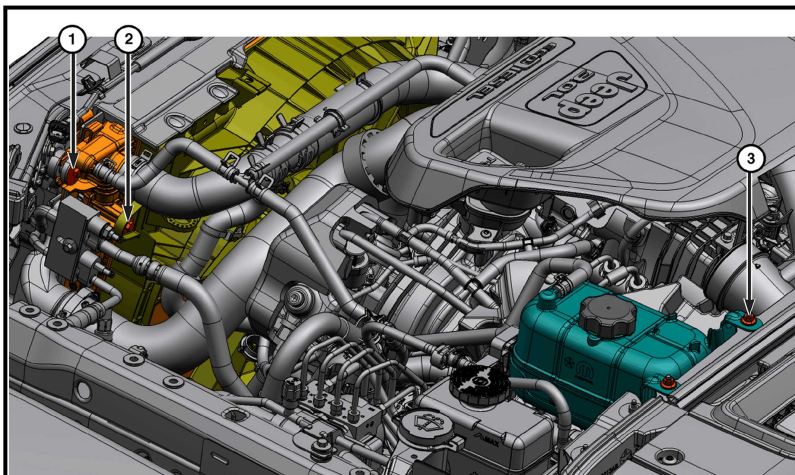
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the O-ring sealing surface.
- Evacuate and fill the cooling system. Refer to [COOLANT SYSTEM AIR EVACUATION](#), and [STANDARD PROCEDURE - FILLING](#) .
- Check the cooling system for leaks. Refer to [COOLING SYSTEM LEAKS](#) .

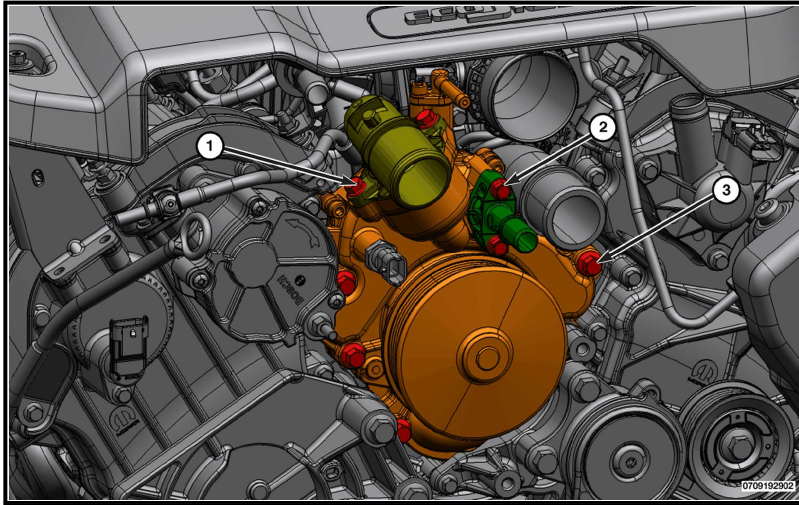
TORQUE SPECIFICATIONS

COOLING SYSTEM - 3.0L DIESEL



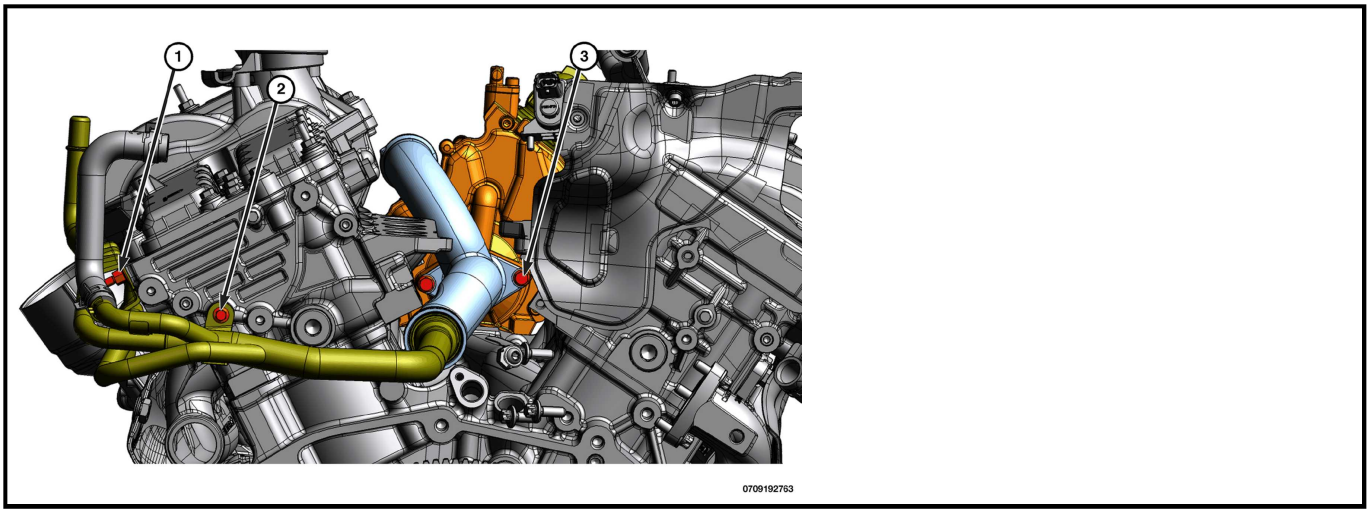
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90B° and then tighten to 32 N.m (24 Ft. Lbs.).	-
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-



ENGINE MOUNTING

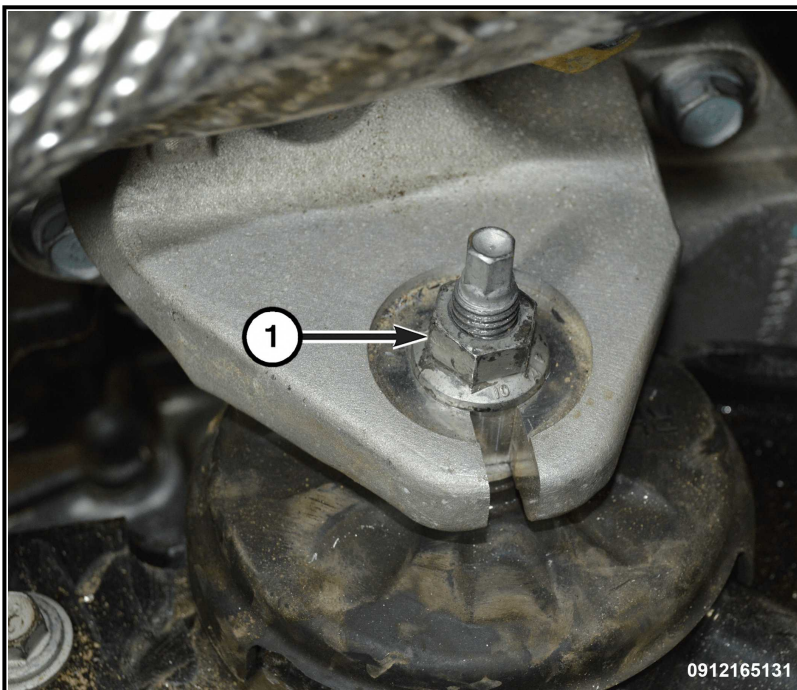
INSULATOR, ENGINE MOUNT, LEFT

REMOVAL AND INSTALLATION

LEFT

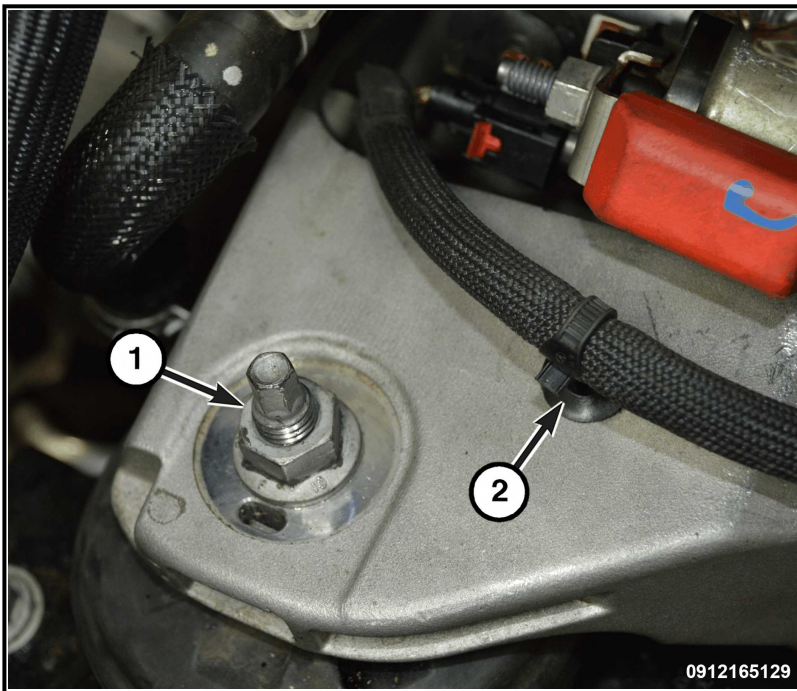
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the air cleaner body. Refer to [BODY, AIR CLEANER, REMOVAL AND INSTALLATION](#) .
3. Remove the left front wheelhouse splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) .
4. Remove the right front wheel house splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) .



1 - Engine Mount Nut

5. Remove the right engine mount nut securing the engine mount.

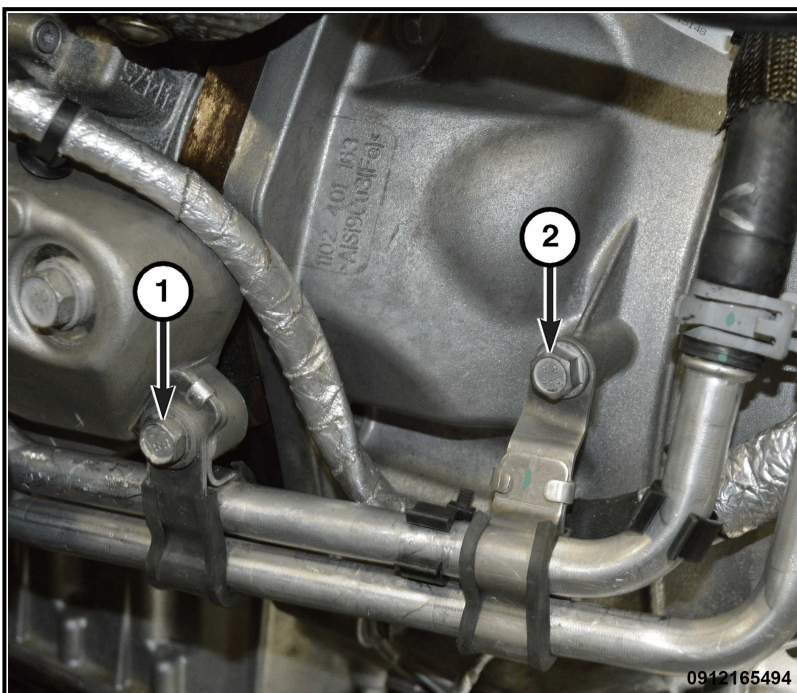


1 - Left Engine Mount Nut

2 - Wire Harness Retainer(s)

6. Remove the left engine mount nut.

7. Detach the wire harness retainer(s).



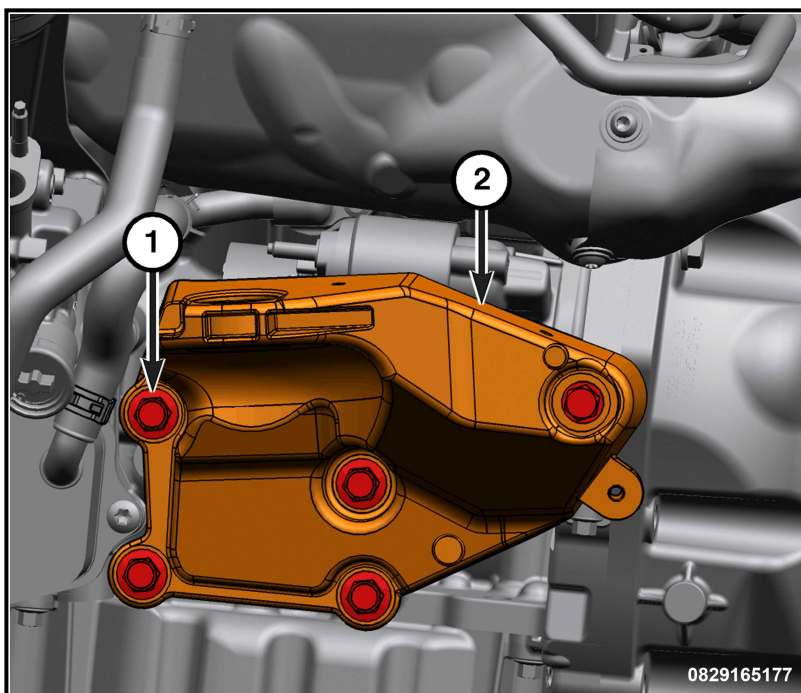
1 - Transmission Coolant Tube Bolt

2 - Transmission Coolant Tube Bolt

8. Remove the transmission coolant tube bolts.

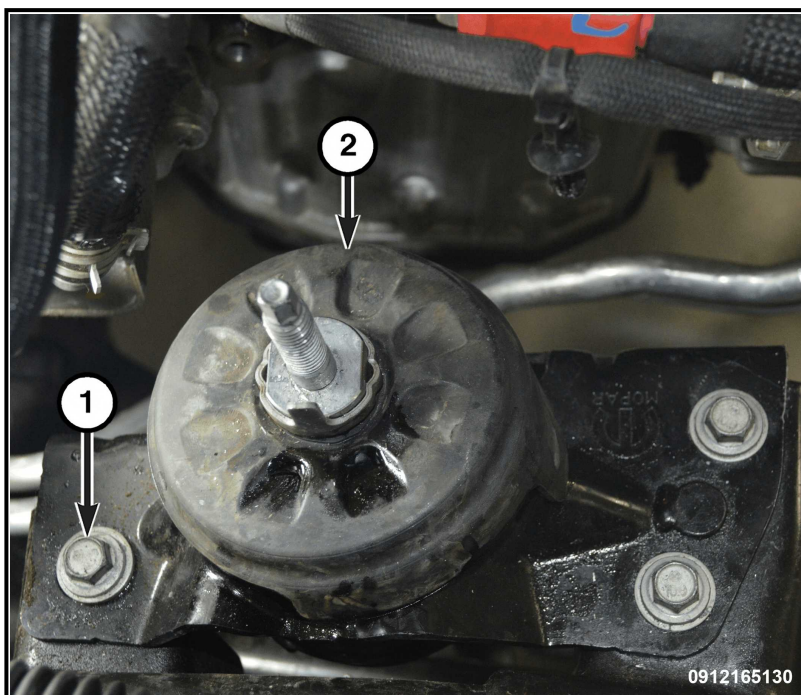
9. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .

10. Position a jack stand under the engine and raise up the engine.



1 - Left Engine Mount Bracket Bolts
2 - Left Engine Mount Bracket

11. Remove the left engine mount bracket bolts and the left engine mount bracket.



1 - Left Engine Mount Bolts
2 - Left Engine Mount

12. Remove the left engine mount bolts and the left engine mount.

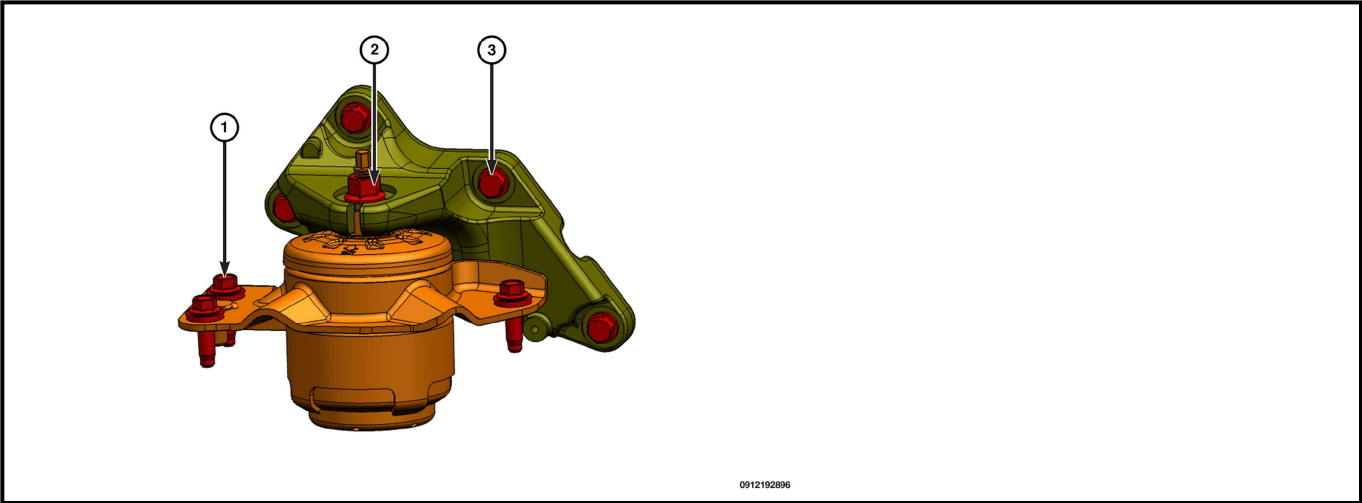
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

ENGINE MOUNTS

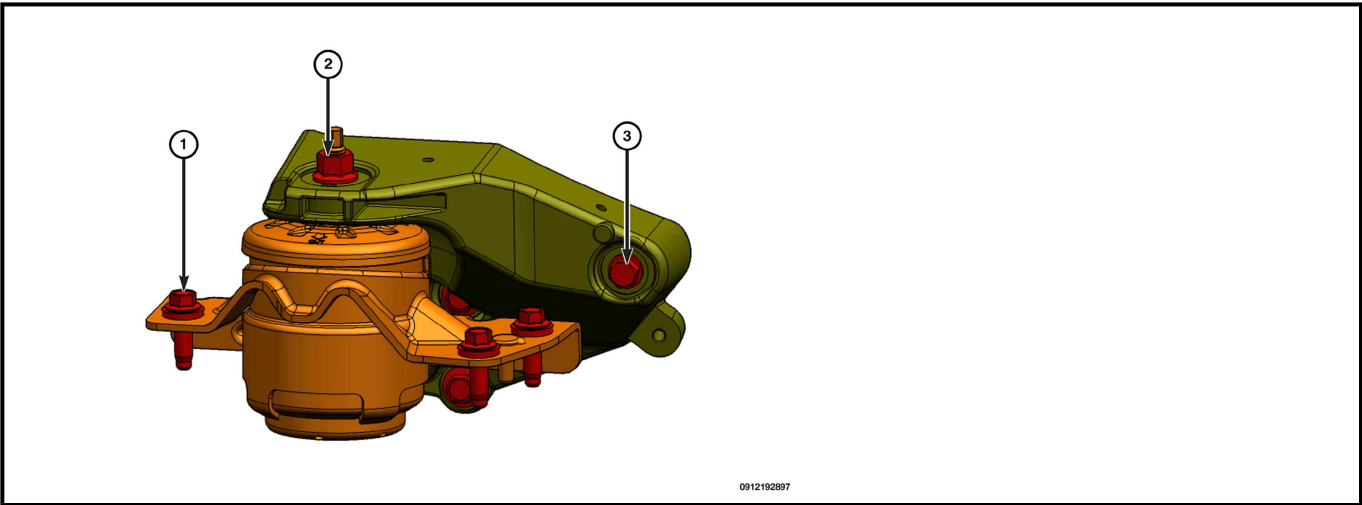


RIGHT ENGINE MOUNT

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Mount Isolator Bolts	55 N.m (41 Ft. Lbs.)	-
2	Engine Mount Isolator Nut	115 N.m (85 Ft. Lbs.)	-
3	Engine Mount Bracket Bolts	55 N.m (41 Ft. Lbs.)	-

LEFT ENGINE MOUNT

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Mount Isolator Bolts	55 N.m (41 Ft. Lbs.)	-
2	Engine Mount Isolator Nut	115 N.m (85 Ft. Lbs.)	-
3	Engine Mount Bracket Bolts	55 N.m (41 Ft. Lbs.)	-
-	Transmission Coolant/Heater Tube Bolt	20 N.m (15 ft. lbs.)	-



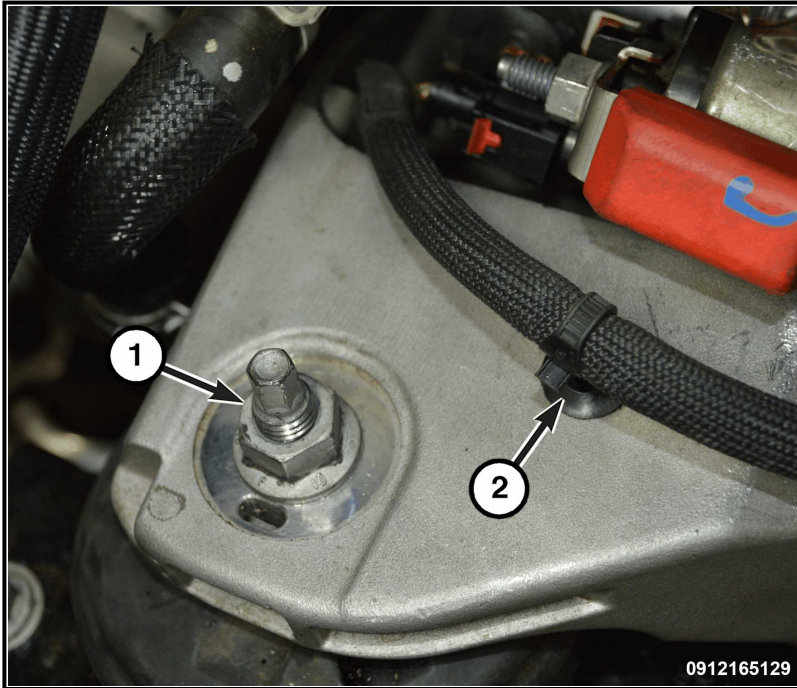
INSULATOR, ENGINE MOUNT, RIGHT

REMOVAL AND INSTALLATION

RIGHT

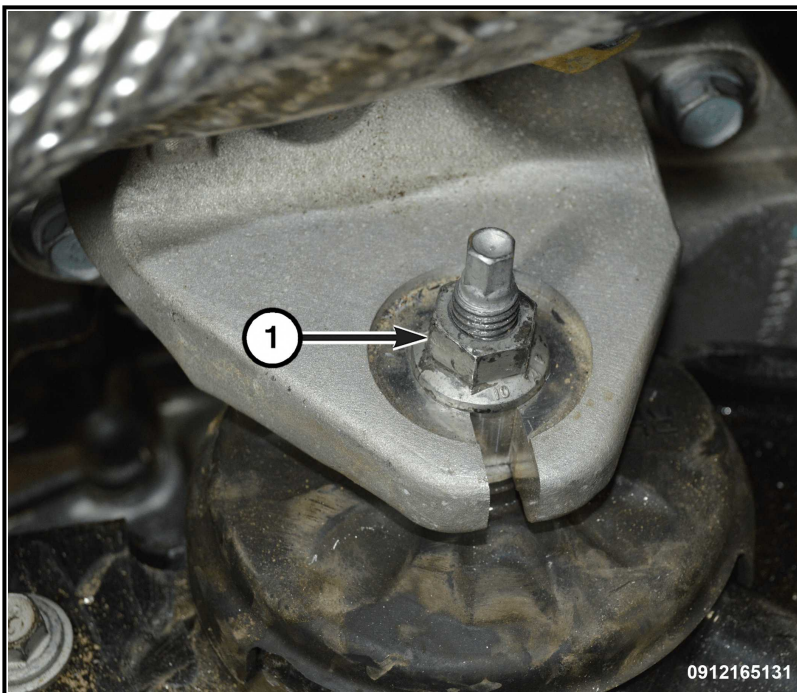
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the air cleaner body. Refer to [BODY, AIR CLEANER, REMOVAL AND INSTALLATION](#) .
3. Remove the left front wheel house splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) .
4. Remove the right front wheel house splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) .



- | |
|------------------------------|
| 1 - Left Engine Mount Nut |
| 2 - Wire Harness Retainer(s) |

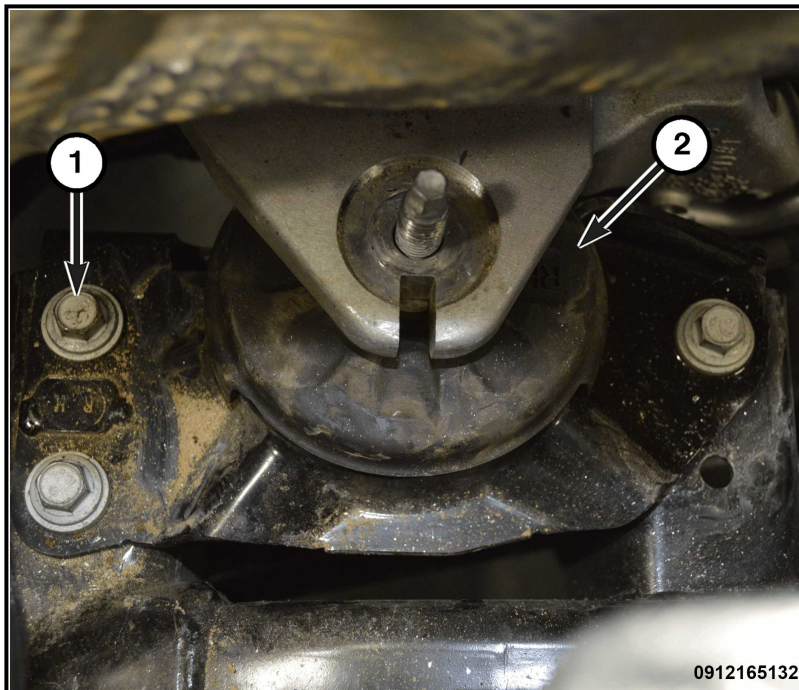
5. Remove the left side engine mount nut.



- | |
|----------------------------|
| 1 - Right Engine Mount Nut |
|----------------------------|

6. Remove the right side engine mount nut.
7. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .

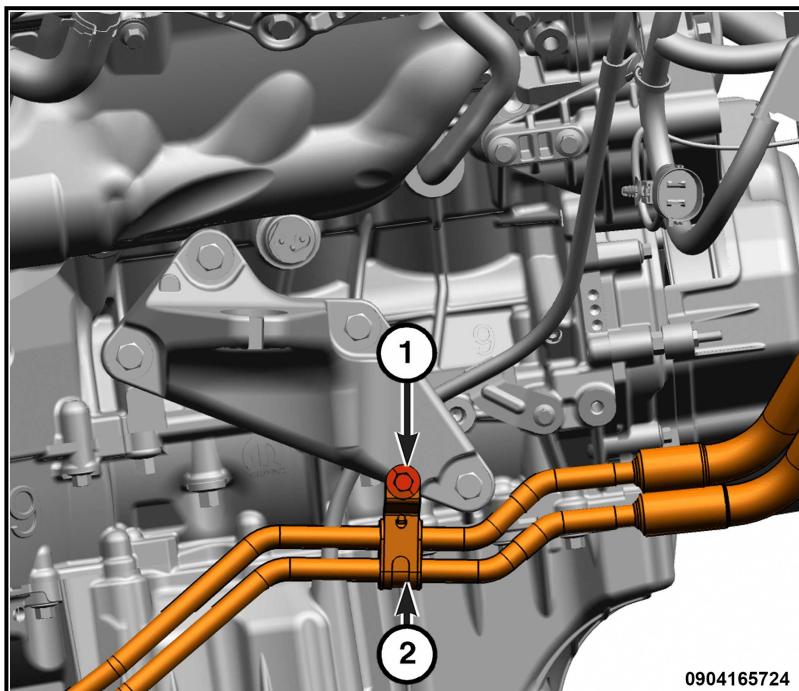
8. Position a jack stand under the engine and raise up the engine.



1 - Right Engine Mount Bolts

2 - Right Engine Mount

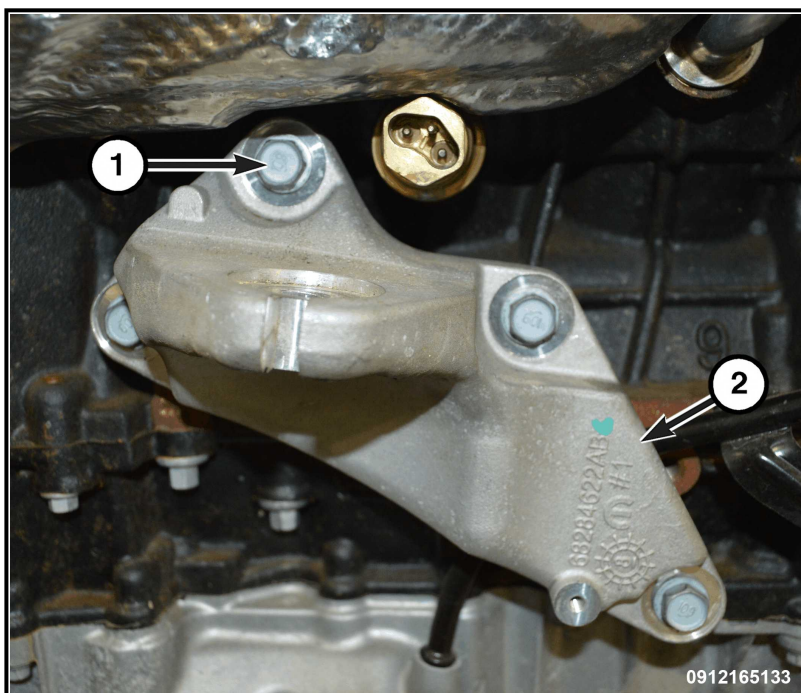
9. Remove the right engine mount bolts and the right engine mount.



1 - Transmission Cooler Line Bolt

2 - Transmission Cooler Line Bracket

10. If necessary, remove the transmission cooler line bolt securing the transmission cooler line to engine mount bracket (right side).



1 - Right Engine Mount Bracket Bolts
2 - Right Engine Mount Bracket

11. If necessary, remove the right engine mount bracket bolts and the right engine mount bracket.

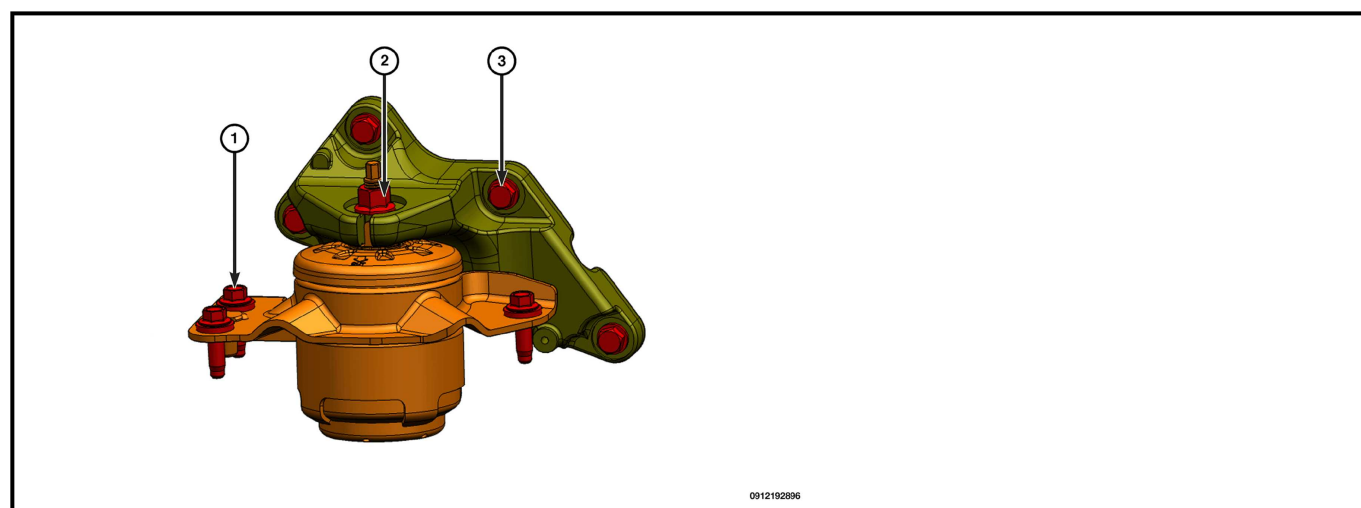
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

ENGINE MOUNTS

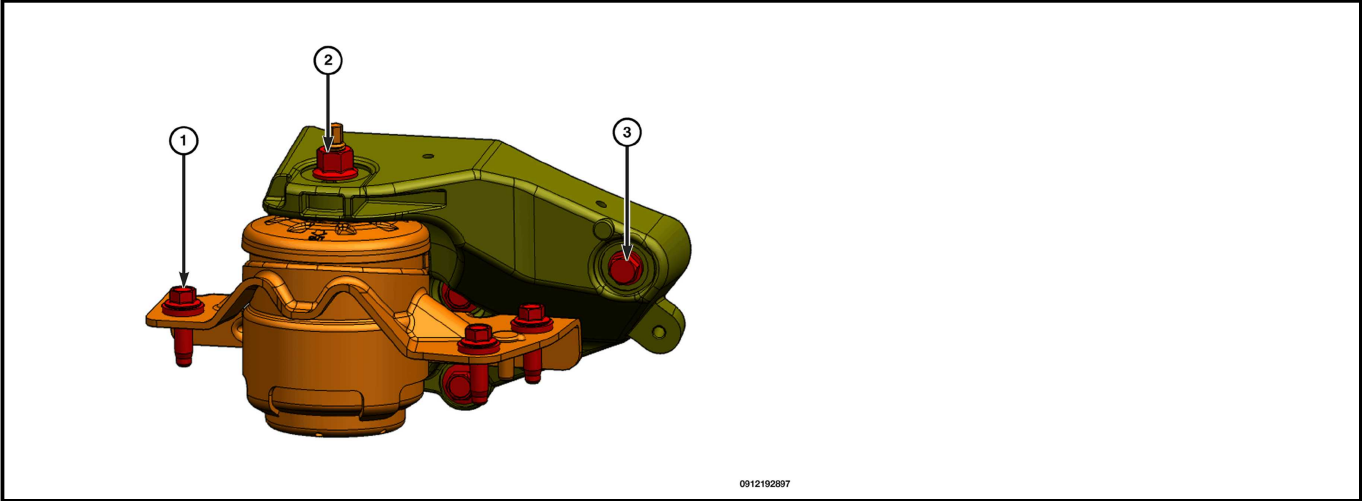


RIGHT ENGINE MOUNT

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Mount Isolator Bolts	55 N.m (41 Ft. Lbs.)	-
2	Engine Mount Isolator Nut	115 N.m (85 Ft. Lbs.)	-
3	Engine Mount Bracket Bolts	55 N.m (41 Ft. Lbs.)	-

LEFT ENGINE MOUNT

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Mount Isolator Bolts	55 N.m (41 Ft. Lbs.)	-
2	Engine Mount Isolator Nut	115 N.m (85 Ft. Lbs.)	-
3	Engine Mount Bracket Bolts	55 N.m (41 Ft. Lbs.)	-
-	Transmission Coolant/Heater Tube Bolt	20 N.m (15 ft. lbs.)	-



2021 ENGINE

3.0L Engine (Service Information) (3 Of 3) - Gladiator [EXJ]

FUEL SYSTEM

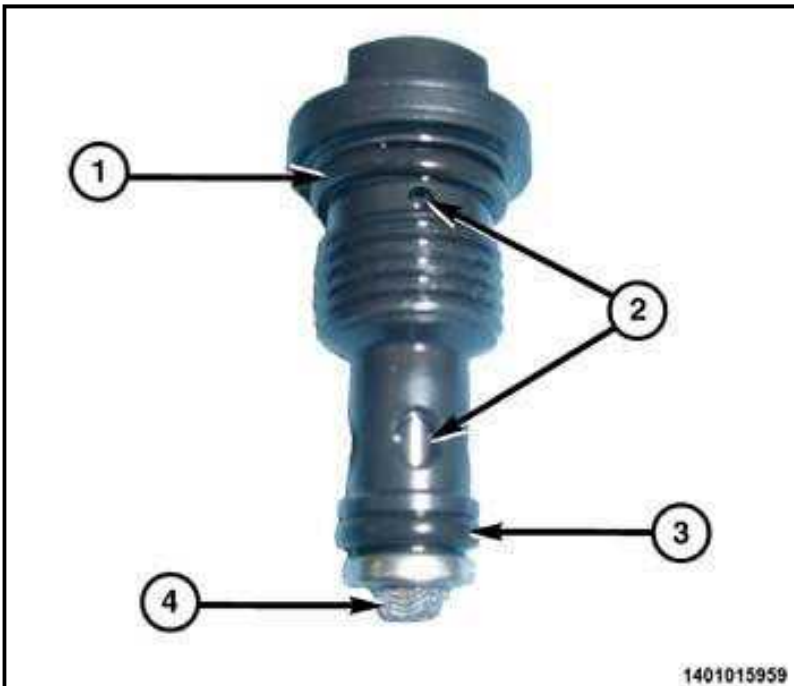
DESCRIPTION AND OPERATION

CASCADE OVERFLOW VALVE



1 - Cascade Overflow Valve

- The Cascade Overflow Valve is located on the high pressure fuel injection pump.



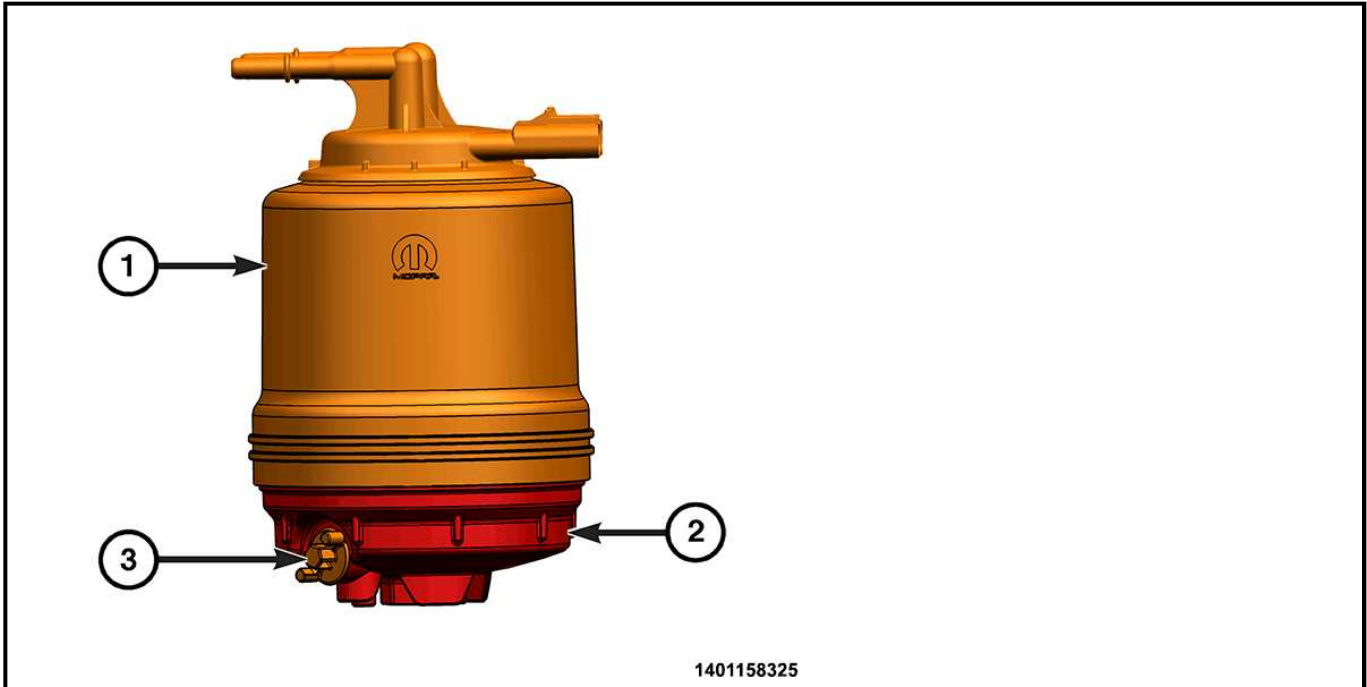
- | |
|--------------|
| 1 - O-ring |
| 2 - Orifices |
| 3 - O-ring |

4 - Filter Screen

- The Cascade Overflow Valve houses a filter screen for filtering the incoming diesel fuel to the fuel injection pump. If the filter starts to get restricted or one of the orifices gets plugged, it will effect fuel flow volume.

FUEL FILTER/WATER SEPARATOR

DESCRIPTION



1 - Fuel Filter/Water Separator

2 - Fuel Filter Cover

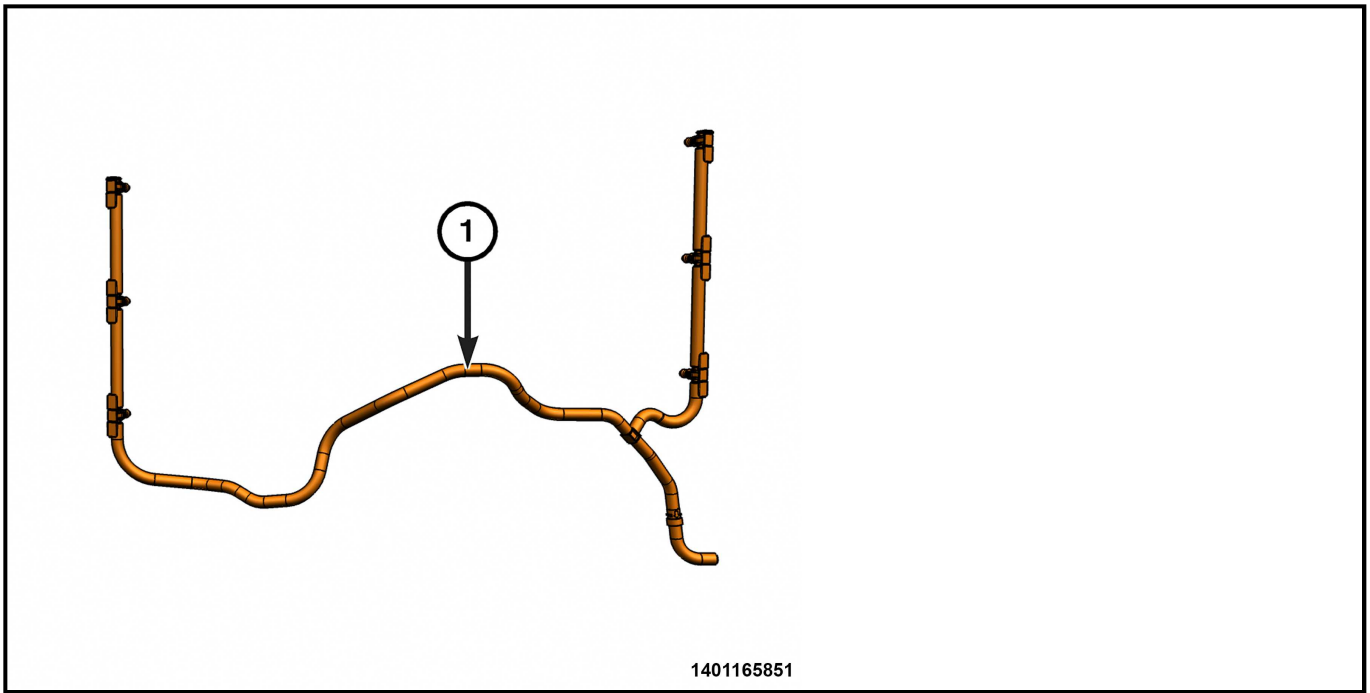
3 - Drain Valve

- The fuel filter/water separator assembly is mounted to the underbody of the vehicle, directly behind the fuel tank. The assembly includes the internal fuel filter, fuel heater & fuel temperature sensor, Water-In-Fuel (WIF) sensor.
- If the water is detected in the fuel, a red lamp flashes and a chime sounds to indicate the need to drain the water from the fuel.

OPERATION

- The fuel filter/water separator protects the fuel injection pump by removing water and contaminants from the fuel. The construction of the filter/separator allows fuel to pass through it, but helps prevent moisture (water) from doing so. Moisture collects at the bottom of the filter.
- Refer to the maintenance schedules in the owners manual for the recommended fuel filter replacement intervals.

FUEL INJECTOR RETURN LINES



1 - Fuel Injector Return Line

- The fuel injector return line returns the used fuel via the fuel return line from the fuel injection pump. The fuel injector return line is equipped with a one-way check valve that is not serviceable.

FUEL PRESSURE REGULATOR

Description

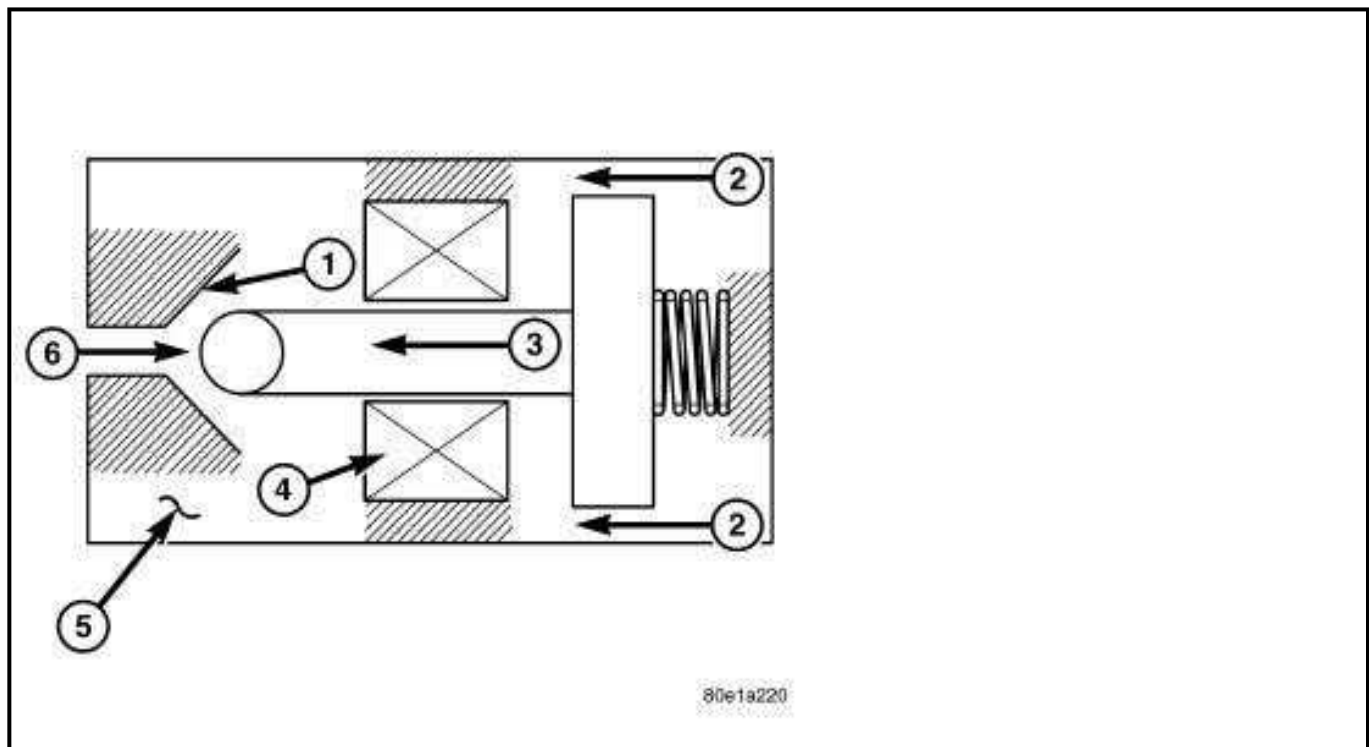


1 - O-ring

2 - Fuel Pressure Regulator

- The fuel pressure regulator is attached to the fuel rail. The fuel pressure regulator is a serviceable item. Check the O-ring whenever the regulator is serviced or replaced. The fuel pressure regulator controls and maintains constant rail pressure with a control current transmitted by the Powertrain Control Module (PCM).

Operation



1 - Ball Seat
2 - Spring Force
3 - Piston
4 - Coil
5 - Solenoid
6 - Inlet

- High pressure which is present in the fuel rail flows to the ball seat of the solenoid. The specified pressure required by the system is built up in the rail by the fuel pressure solenoid building up a magnetic force which corresponds to this specific pressure by means of a control current from the Powertrain Control Module (PCM). This magnetic force equals a certain outlet cross section at the ball seat of the solenoid. The rail pressure is altered as a result of the quantity of fuel which flows off. The current fuel pressure is signaled by the fuel pressure sensor to the PCM. The controlled fuel flows back along the return fuel line, into the tank.
- In a de-energized state, the fuel pressure solenoid is closed as the spring force presses the ball into the ball seat. When driving, the fuel pressure solenoid is constantly open. When the engine is started, the fuel pressure solenoid is held closed by a magnetic force. When driving, the pressure of the fluid counteracts the magnetic force of the coil and the slight spring force.

FUEL PUMP MODULE

The fuel pump module assembly is located on the top of the fuel tank. The fuel tank module assembly contains the following components:

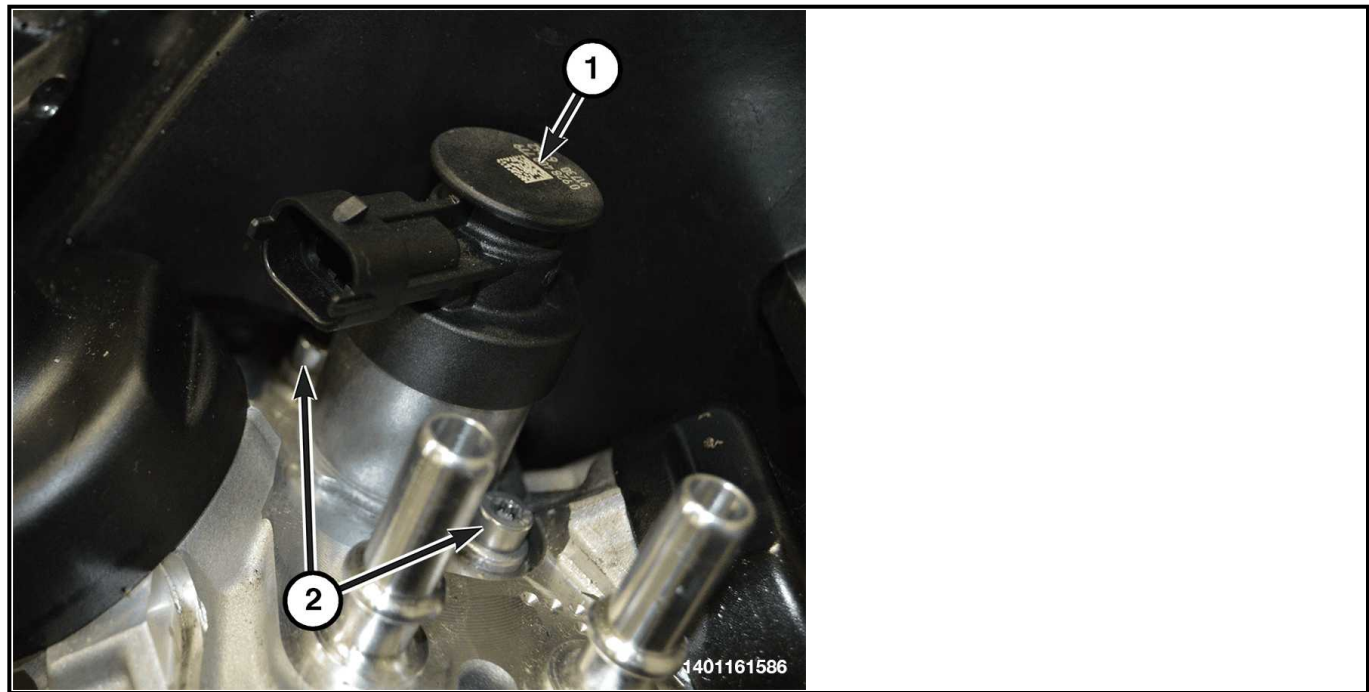
- An electric fuel transfer (lift) pump
- A fuel reservoir
- A separate in-tank fuel filter
- A fuel gauge sending unit (fuel level sensor)
- A lock ring to retain pump module to tank
- A soft gasket between tank flange and module
- Fuel line return connection

The electric fuel pump is located inside of the fuel pump module. A 12 volt, permanent magnet, electric motor powers the fuel pump. The electric fuel pump is not a separate, serviceable component.

The fuel gauge sending unit (fuel level sensor) is attached to the fuel pump module. The sending unit consists of a float, an arm, and a variable resistor track (card). The sensor is non-servicable. If replacement is necessary, the fuel pump module assembly must be replaced.

FUEL QUALITY SOLENOID

DESCRIPTION



1 - Fuel Quantity Solenoid Screws
2 - Fuel Quantity Solenoid

- The fuel quantity solenoid is located in the top of the fuel injection pump. The solenoid is pulse width modulated by the Powertrain Control Module (PCM) and meters the amount of fuel that flows into the high pressure elements inside of the fuel injection pump. The solenoid is also inactive during the first 30 seconds to allow maximum fuel pressure to the fuel rail during start up.

OPERATION

- The fuel quantity solenoid is a pulse width modulated valve that controls the amount of fuel sent or delayed to the high pressure pump elements inside of the high pressure pump. The Powertrain Control Module (PCM) determines the fuel pressure set point based on engine sensor inputs. If the actual fuel rail pressure is too low, the PCM commands the solenoid to allow more fuel to flow to the high pressure pump. This minimizes the difference between the actual fuel rail pressure reading and the set point. The PCM will also operate the solenoid, delaying fuel if the fuel rail pressure becomes too high.
- The fuel quantity solenoid is commanded open by the PCM to allow the high pressure pump to build maximum pressure 1800 bar (26, 106 psi) the solenoid also has fuel tank heat protection function that meters the exact amount of fuel to prevent excess heated fuel from returning to the fuel tank.

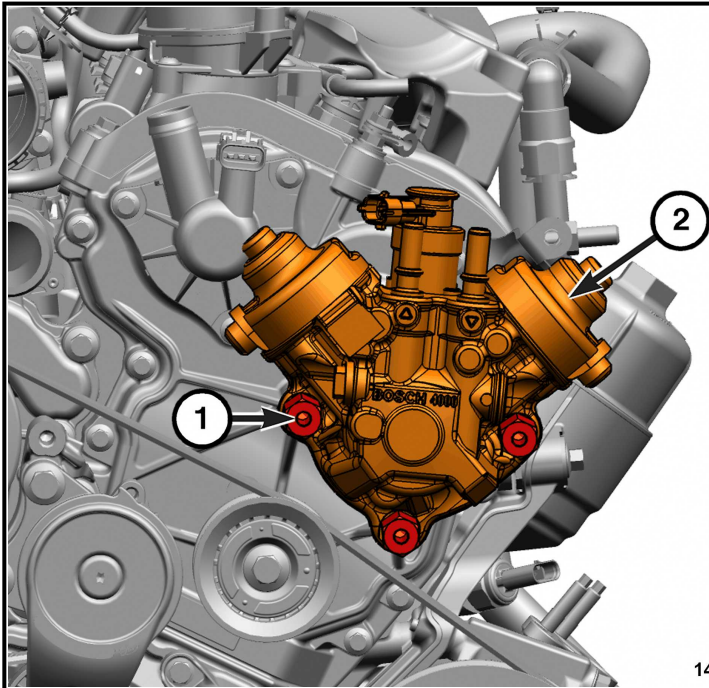
HIGH PRESSURE FUEL PUMP

DESCRIPTION

WARNING: High pressure fuel lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 1800 bar (26, 106 psi). Use extreme caution when inspecting for high pressure fuel leaks. Fuel

under this amount of pressure can penetrate skin causing personal injury or death. Inspect for high pressure fuel leaks with a sheet of cardboard. Wear safety goggles and adequate protective clothing when servicing fuel system.

CAUTION: Cranking the engine for an extended time without a fuel supply may damage the fuel injection pressure pump.

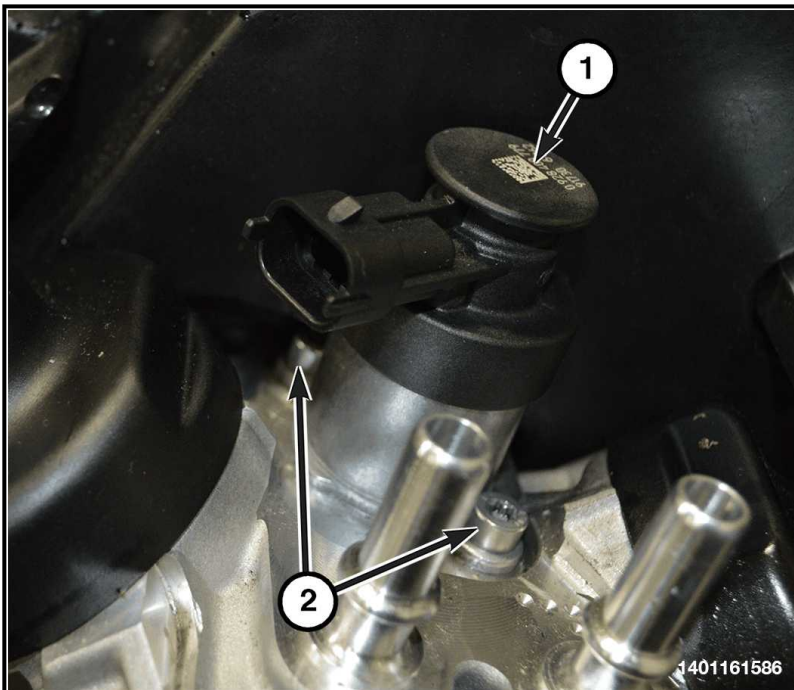


1401165588

1 - High Pressure Fuel Pump Bolts

2 - High Pressure Fuel Pump

The High Pressure Fuel Pump (HPFP) is mounted to the cylinder head and there is a protection blocker plate attached to the front of the high pressure fuel pump.



1401161586

1 - Fuel Quantity Solenoid

2 - Fuel Quantity Solenoid Screws

The only serviceable parts on the High Pressure Fuel Pump (HPFP) is the Fuel Quantity Solenoid (FQS), the drive gear, and the O-ring.

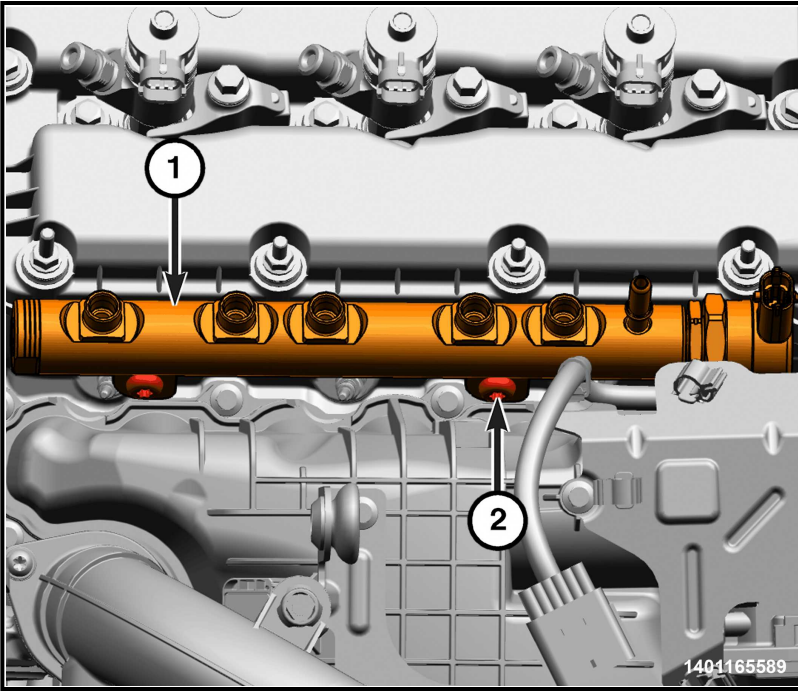
OPERATION

The High Pressure Delivery Pump (HPDP) supplies pressurized fuel between 200-1800 bar (2, 900 - 26, 106 psi) to the fuel rail and fuel injectors. The cascade valve, located inside the HPDP regulates the pressure in the low side and diverts some of the fuel entering for lubrication of the pump. The Powertrain Control Module (PCM) monitors high side fuel pressure via a fuel pressure sensor. Based on readings from the fuel pressure sensor, the PCM controls the output pressure of the pump using the Fuel Quantity Solenoid (FQS), which mounts to the HPDP.

NOTE: **The high pressure pump must not be disassembled or opened. The high pressure pump has a screen filter that is not serviceable. If diagnosis has led you to believe that the filter is restricted or plugging up then the high pressure pump needs to be replaced.**

FUEL RAIL

DESCRIPTION



1 - Fuel Rail
2 - Fuel Rail Bolts

The high pressure pump supplies diesel fuel to the fuel rail (left side shown) which deliveries high pressure fuel to all injectors. A fuel rail pressure sensor, fuel rail pressure solenoid, and the return flow line are all combined to keep the fuel pressure in the fuel rail at the required pressure.

OPERATION

The stored fuel volume inside the rail acts as a damper for pressure fluctuations which result because of a pulsating supply and brief large extractions of fuel during injector firing. The rail primarily influences the atomization of fuel at the injector nozzle, and the accuracy of injected quantity during injection.

QUICK-CONNECT FITTING

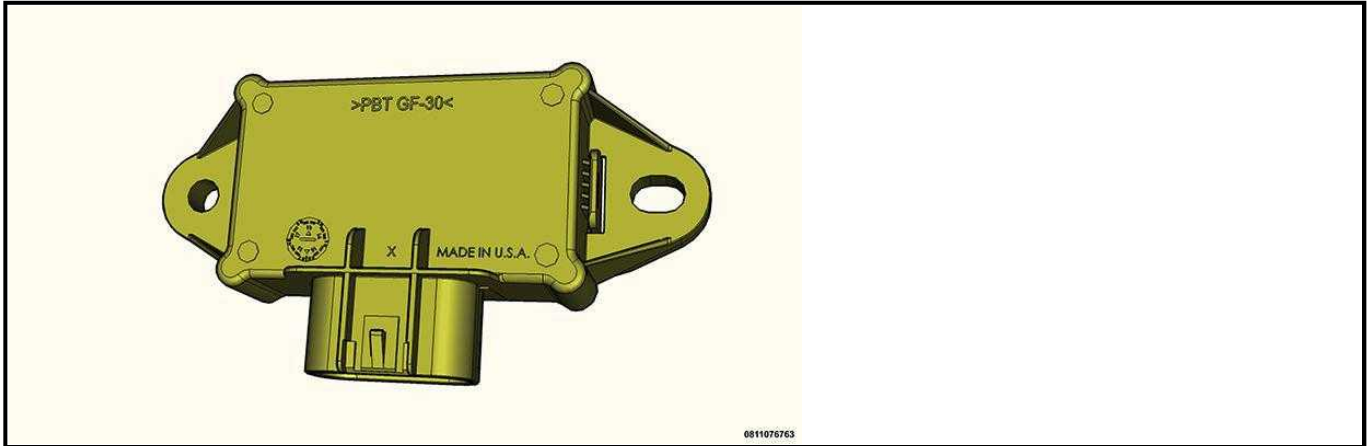
Different types of quick-connect fittings are used to attach the various fuel system components, lines and tubes. These are a single-button type, a two-button type, a pinch type, a single-tab type, a two-tab type, or a plastic

retainer ring type. Some are equipped with safety latch clips. Some may require the use of a special tool for disconnection and removal. Refer to Quick-Connect Fittings Removal/Installation for more information.

CAUTION: Before separating a Quick-Connect fitting, pay attention to what type of fitting is being used. This will prevent unnecessary fitting or fitting latch breakage.

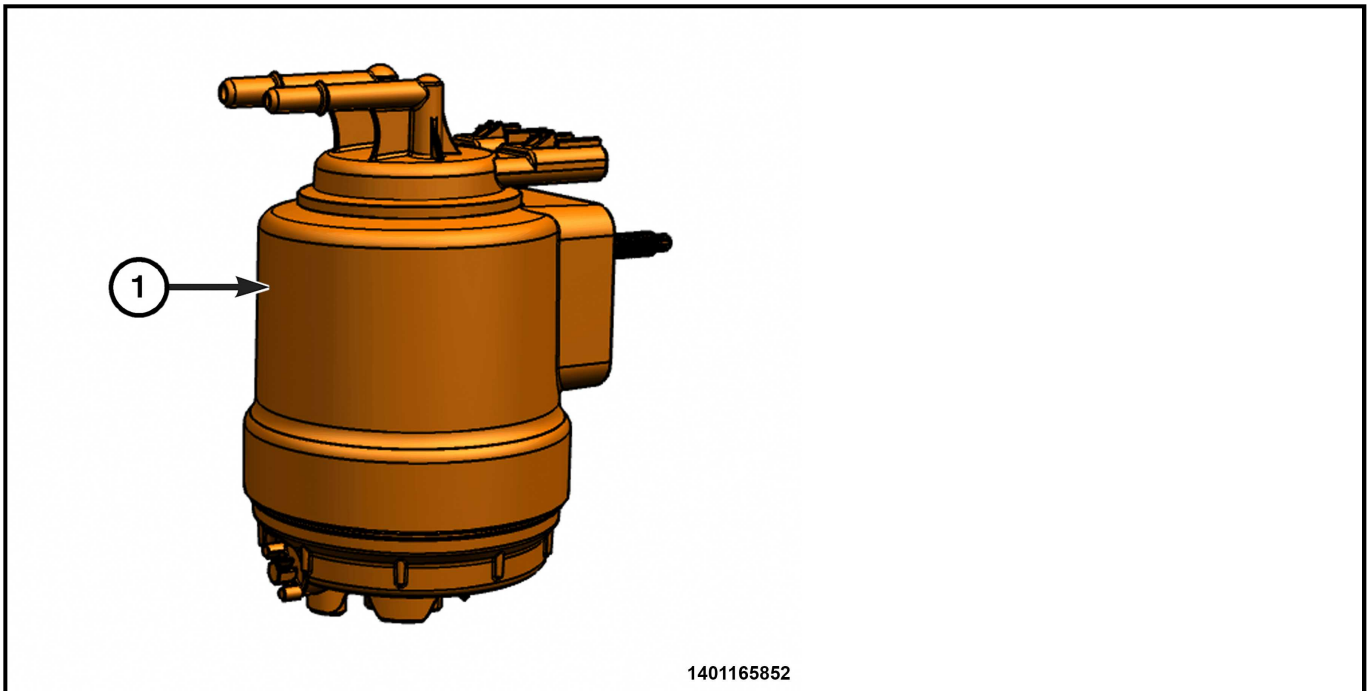
CAUTION: The interior components (O-rings, clips and latches) of Quick-Connect fittings are not serviced separately, but new plastic spacers and latches are available for some types. If service parts are not available, do not attempt to repair the damaged fitting or fuel line (tube). If repair is necessary, replace the complete fuel line (tube) assembly.

FUEL PUMP CONTROL MODULE



- The Fuel Pump Control Module (FPCM) is secured to the right side rear frame crossmember.

WATER IN FUEL SENSOR



1 - Fuel Filter Housing

DESCRIPTION

- The Water In Fuel (WIF) sensor is located in the fuel filter housing. The WIF sensor detects the presence of water in the fuel. If water is present in the fuel, a signal is sent to the Powertrain Control Module

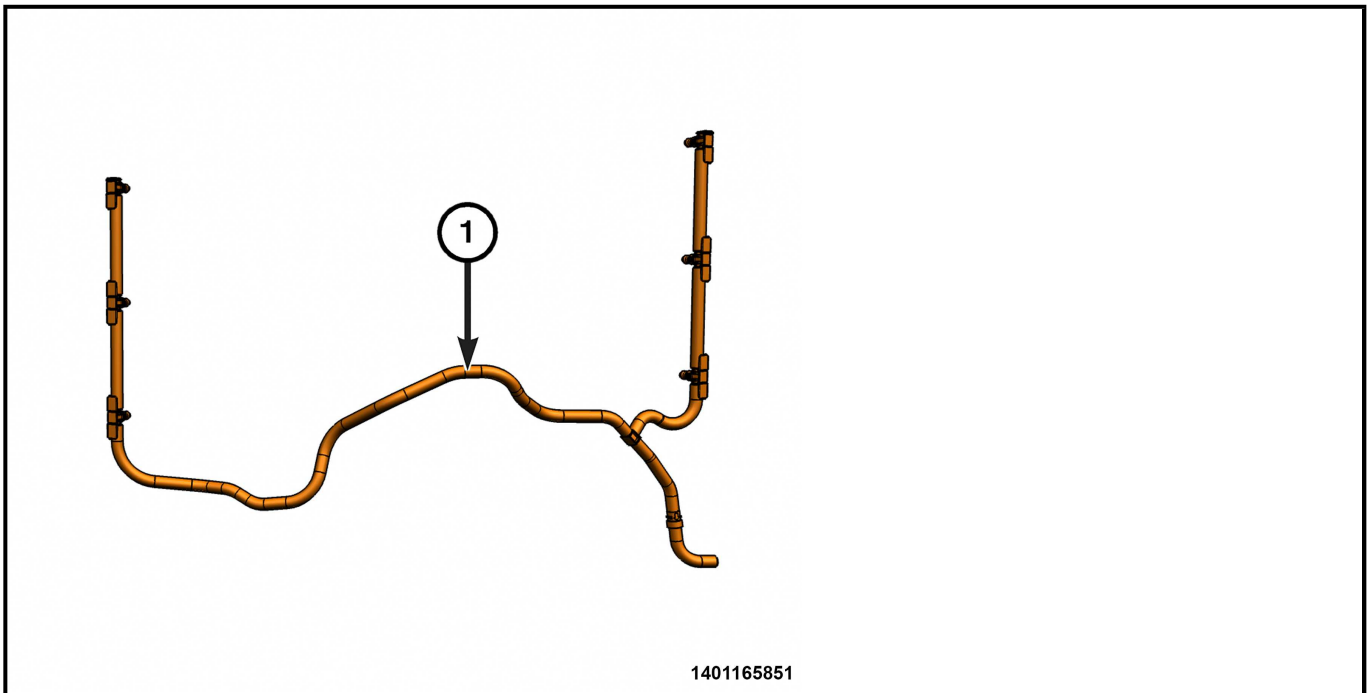
(PCM) and the PCM signals the instrument cluster, over the CAN bus, to illuminate the water in fuel warning. The WIF sensor is not a serviceable item.

Operation

- The non-dielectric properties of the water allow the sensors probes to close the electronic circuit when water is present in the system. When diesel fuel is present in the system, its dielectric (does not conduct electricity well) properties do not allow any electrical contact between the probes. A 12V power signal is always present in order to illuminate the indicator on the instrument cluster.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - FUEL INJECTOR RETURN LINE

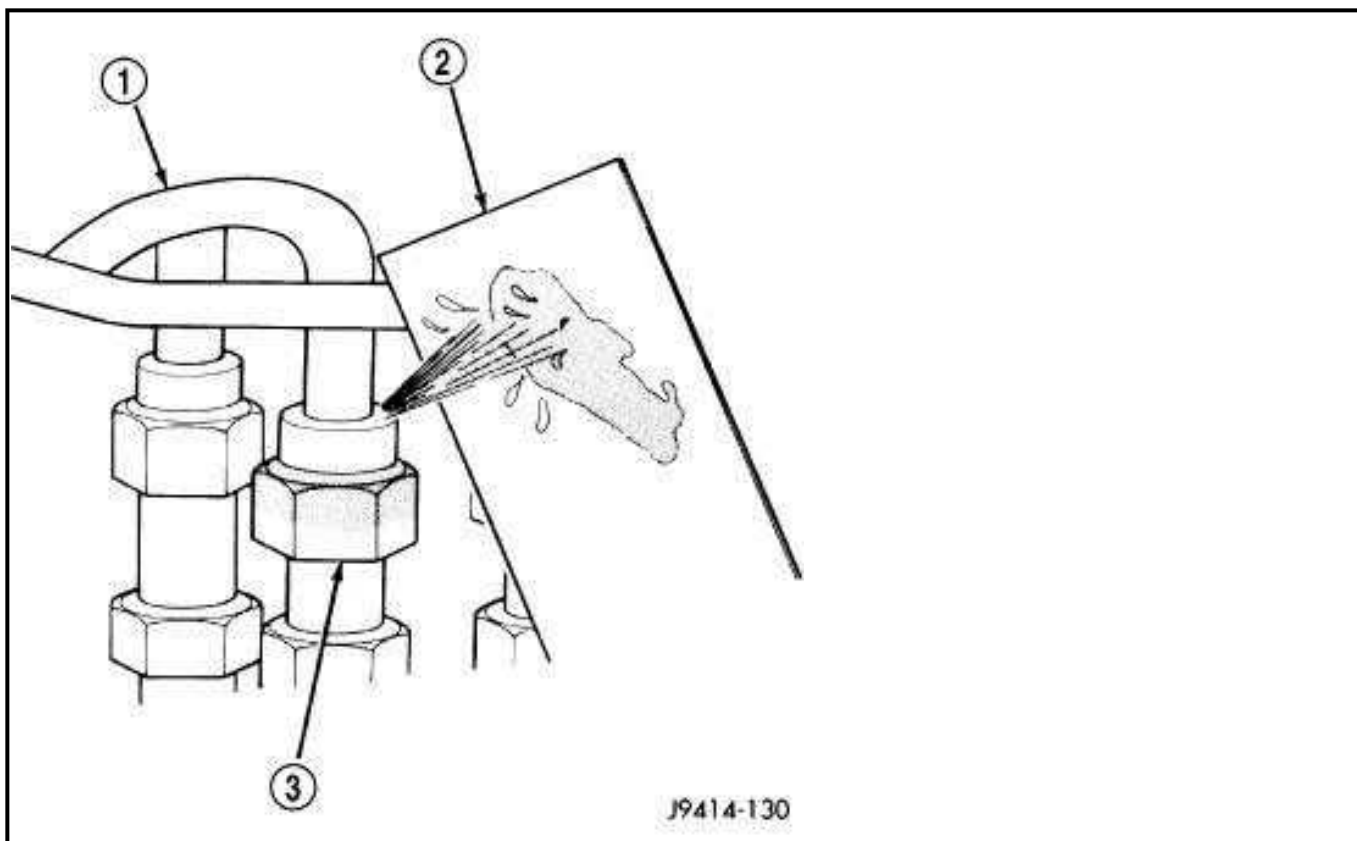


1 - Fuel Injector Return Line

NOTE: The fuel injector return line should be removed from engine.

- To test the low pressure fuel injector return line one-way check valve, try to blow through the return line opening. If air is passing through the one-way check valve, it is bad and the fuel injector return line needs to be replaced.

DIAGNOSIS AND TESTING - HIGH - PRESSURE FUEL LINE LEAKS



1 - High-Pressure Line
2 - Cardboard
3 - Typical High-Pressure Fitting

- High-pressure fuel line leaks can cause starting problems and poor engine performance.

WARNING: High-pressure fuel lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 200, 000 kpa (29, 008 psi). Use extreme caution when inspecting for high-pressure fuel leaks. Inspect for high-pressure fuel leaks with a sheet of cardboard. High fuel injection pressure can cause personal injury if contact is made with the skin.

- Start the engine. Move the cardboard over the suspected high-pressure fuel line leak, and check for fuel spray onto the cardboard. If line is leaking, re-torque line while engine is shutdown. Replace damaged, restricted or leaking high-pressure fuel lines with the correct replacement line.

CAUTION: The high-pressure fuel lines must be clamped securely in place in the brace. The lines cannot contact each other or other components. Do not attempt to weld high-pressure fuel lines or to repair lines that are damaged. Only use the recommended lines when replacement of high-pressure fuel line is necessary.

STANDARD PROCEDURE

DEF FLUID-DIRT-METAL-OR-OTHER FOREIGN DEBRIS

If the fuel system has been contaminated with DEF Fluid, Dirt, Metal, or Other Foreign Objects, the following procedure must be followed:

1. Remove all fuel from the fuel tank. Use an appropriate fuel container. Refer to **DRAINING FUEL TANK - DIESEL** . Dispose of the contaminated fuel using the proper procedures.

CAUTION: Dispose of petroleum based products in a manner consistent with all applicable Local, State, Federal, and Provincial regulations.

2. Remove the fuel tank. Refer to **TANK, FUEL, REMOVAL AND INSTALLATION**.
3. Ensure the swirl pot indentation below the in-tank electric fuel pump inlet is completely drained of any contaminated fuel and thoroughly clean the fuel tank.
4. Completely drain the low pressure fuel lines and flush with clean diesel fuel, then install a **NEW** fuel filter.
5. Install the fuel tank, and fill with clean diesel fuel.
6. Remove the fuel quantity solenoid and inspect filter screen for DEF fluid crystals, excessive metal, or sand debris. Refer to **VALVE, REMOVAL AND INSTALLATION**. If debris is present skip down to step 10.
7. Disconnect the low pressure return line.
8. Connect a clean hose to the low pressure return line fitting and place the other end in a suitable clean container.
9. Turn the ignition ON, and collect the fuel escaping from the low pressure return into a clean container. Check the fuel sample for metal chips, dirt, or other foreign matter.
10. If any dirt, metal chips, or DEF fluid is present in the fuel sample, completely clean the low pressure side of the fuel injection system, then install **NEW** fuel injectors, the high pressure fuel injection pump, and fuel rails along with **NEW** fuel tubes.

FUEL SYSTEM PRIMING - DIESEL

- A certain amount of air may become trapped in the fuel system when fuel system components on the supply and/or high-pressure side are serviced or replaced. When air becomes trapped in the system, it may be necessary to prime the system before starting the vehicle. Fuel system priming can be accomplished by using the vehicle's in-tank electric fuel pump (lift pump).
 - The in-tank electric fuel pump (lift pump) is self priming: When the key is first turned on (without cranking engine), the pump operates for approximately 30 seconds and then shuts off. The pump will also operate for up to 25 seconds after the starter is quickly engaged, and then disengaged without allowing the engine to start. The pump shuts off immediately if the key is on and the engine stops running.
1. Turn the key to the "Run" position. If the vehicle is equipped with a push button start, press the start button 2 times, without pressing the brake pedal, to place the ignition in run. The in-tank electric fuel pump (lift pump) will operate for approximately 30 seconds.
 2. Turn the ignition to the OFF position, and leave it off for at least 5 minutes. Repeat Step 1.
 3. Fuel system priming is now completed.
 4. Attempt to start engine. If engine will not start, proceed to following steps. **When engine does start, it may run erratically and be noisy for a few minutes. This is a normal condition.**

CAUTION: Do not engage the starter motor for more than 30 seconds at a time. Allow two minutes between cranking intervals.

5. Perform previous fuel priming procedure steps using fuel transfer pump. Be sure fuel is present at fuel tank.

WARNING: The fuel injection pump supplies extremely high fuel pressure to each individual injector through the high-pressure lines. Fuel under this amount of pressure can penetrate the skin and cause personal injury. Wear safety goggles and adequate protective clothing. Do not loosen fuel fittings while engine is running.

WARNING: Engine may start while cranking starter motor.

DRAINING FUEL TANK - DIESEL

CONVENTIONAL PROCEDURE

Due to a one-way check valve installed into the fuel fill fitting at the tank, the tank cannot be drained at the fuel fill cap.

1. Disconnect the fuel supply line at the quick-connect fitting near the cowl. Refer to [LINES AND TUBES, FUEL](#).
2. Install the appropriate Fuel Line Adapters / Fitting from the (special tool #8978A, Decay Tool, Fuel). Route the opposite end of this hose to an diesel fuel draining station.

NOTE: **Activation of the fuel pump module may time out and need to be restarted several times to completely drain the fuel tank.**

3. Using a diagnostic scan tool, activate the fuel pump module until the fuel tank has been evacuated.

ALTERNATIVE PROCEDURE

NOTE: **If the electric fuel pump is not operating, the fuel tank must be removed and drained through the fuel pump module opening of the fuel tank.**

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#).
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#).
3. Remove fuel pump module. Refer to [ASSEMBLY, FUEL PUMP, REMOVAL AND INSTALLATION](#).
4. After fuel pump module has been removed, drain fuel into an approved diesel fuel draining station.

INJECTOR QUANTITY ADJUSTMENT

- The injector quantity adjustment, or classification of injectors describes the quantity, or fuel delivery characteristic of the injector. This will make it possible to match the Powertrain Control Module (PCM) fuel delivery strategy to the mechanical characteristics of the injector within a more narrowly graduated range. Injector classification can only be performed with a scantool.
- The fuel injectors used in this vehicle have a seven digit alphanumeric code, which allows the PCM to determine the fuel quantity characteristic of each injector.
- When carrying out service procedures where the injectors are removed from the cylinder head, it is important to observe the original locations of each individual injector, as installing an original injector in the wrong location, vehicle driveability and smoking concerns could result.
- If an injector(s) is replaced, or if there is any concern that an injector may not be installed in its original location, the injector quantity adjustment procedure must be performed with the scan tool in order to program the quantity classification (seven digit alphanumeric code) to the corresponding cylinder in the engine control module.

INJECTOR CLASSIFICATION PROCEDURE

NOTE: **The engine must not be running for this procedure.**

NOTE: **If installing a NEW injector, make a note of the seven digit alphanumeric code. You will need to enter it into the scan tool during the Injector Quantity Adjustment procedure.**

NOTE: **Before performing this procedure, if the PCM has been replaced, or if any injector has been installed anywhere but its original location, make a note of the seven digit alphanumeric codes and the physical location of each injector. You will need to enter them into the scan tool during the Injector Quantity Adjustment procedure.**

1. Turn the ignition switch "ON".
2. Using a scantool, select PCM View, then MISCELLANEOUS FUNCTIONS.

3. Select the Injector Quantity Adjustment, then NEXT.
4. If the PCM was replaced, the Injector EEPROM Location procedure must be performed. Select YES, then NEXT, and follow the directions on the scan tool. Otherwise, go to step 5.
5. Select the injector(s) that has been replaced, access the keyboard function, and type the seven digit alphanumeric code next to the cylinder number that corresponds to the physical location where the injector has been installed.
6. Click NEXT. The scan tool will prompt to turn the ignition switch off for 12 seconds.
7. Repeat step 5 and 6 for any other injectors that are new, or have been moved from their original location. Once injectors are classified, cycle ignition to complete.
8. Once the seven digit alphanumeric codes for all injectors have been entered into the PCM, cycle ignition to complete the procedure.

QUICK-CONNECT FITTINGS

CAUTION: Before separating a Quick-Connect fitting, pay attention to what type of fitting is being used. This will prevent unnecessary fitting or fitting latch breakage.

CAUTION: The interior components (O-rings, clips) of quick-connect fittings are not serviced separately, but new plastic spacers and latches are available for some types. If service parts are not available, do not attempt to repair the damaged fitting or fuel line (tube). If repair is necessary, replace the complete fuel line (tube) assembly.

Different types of quick-connect fittings are used to attach the various fuel system components, lines and tubes. There are specific methods required to release each type of fitting without damaging the fitting or components that they are attached to. Some are equipped with safety latch clips. Some quick-connect fittings require the use of a special tool for disconnection and removal.

NOTE: Care must be used when separating fittings. Over-flexing may cause the tube to become deformed or damaged.

The following are the various types of automotive quick-connect fittings:

- Redundant Latch Single Button Type Fitting
- Single Button Type Fitting
- Pinch Type Fitting
- Pinch Type Fitting With Lock Tab
- Single Tab Type Fitting
- Two Tab Type Fitting
- Plastic Retainer Ring Type Fitting
- Latch Clip Type 1 Fitting
- Latch Clip Type 2 Fitting
- Two Button Type Fitting
- Wing Type Fitting

DISCONNECTING

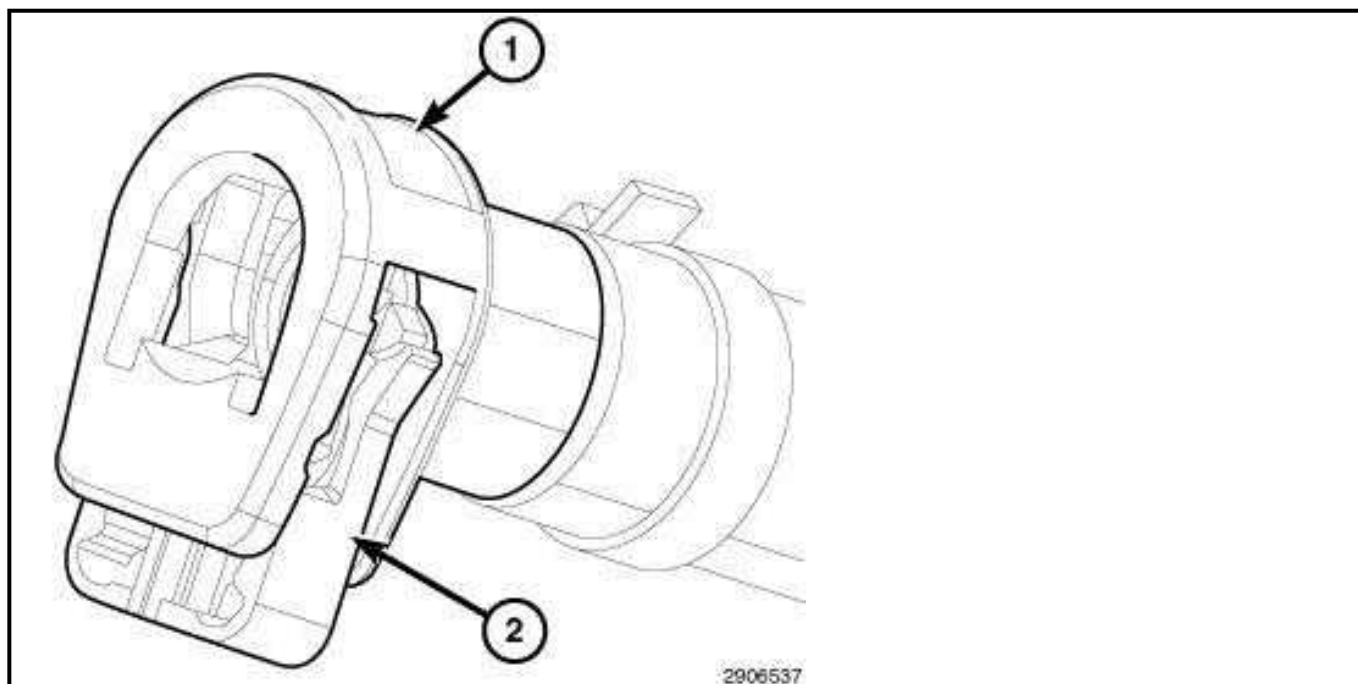
WARNING: On vehicles equipped with gasoline engines, the fuel system is under a constant pressure (even with engine off). Before servicing any fuel system hose, fitting or line, fuel system pressure must be released.

For the fuel system pressure release procedure. Refer to the appropriate information .

CAUTION: Before separating a Quick-Connect fitting, pay attention to what type of fitting is being used. This will prevent unnecessary fitting or fitting latch breakage.

CAUTION: The interior components (O-rings, clips) of quick-connect fittings are not serviced separately, but new plastic spacers and latches are available for some types. If service parts are not available, do not attempt to repair the damaged fitting or fuel line (tube). If repair is necessary, replace the complete fuel line (tube) assembly.

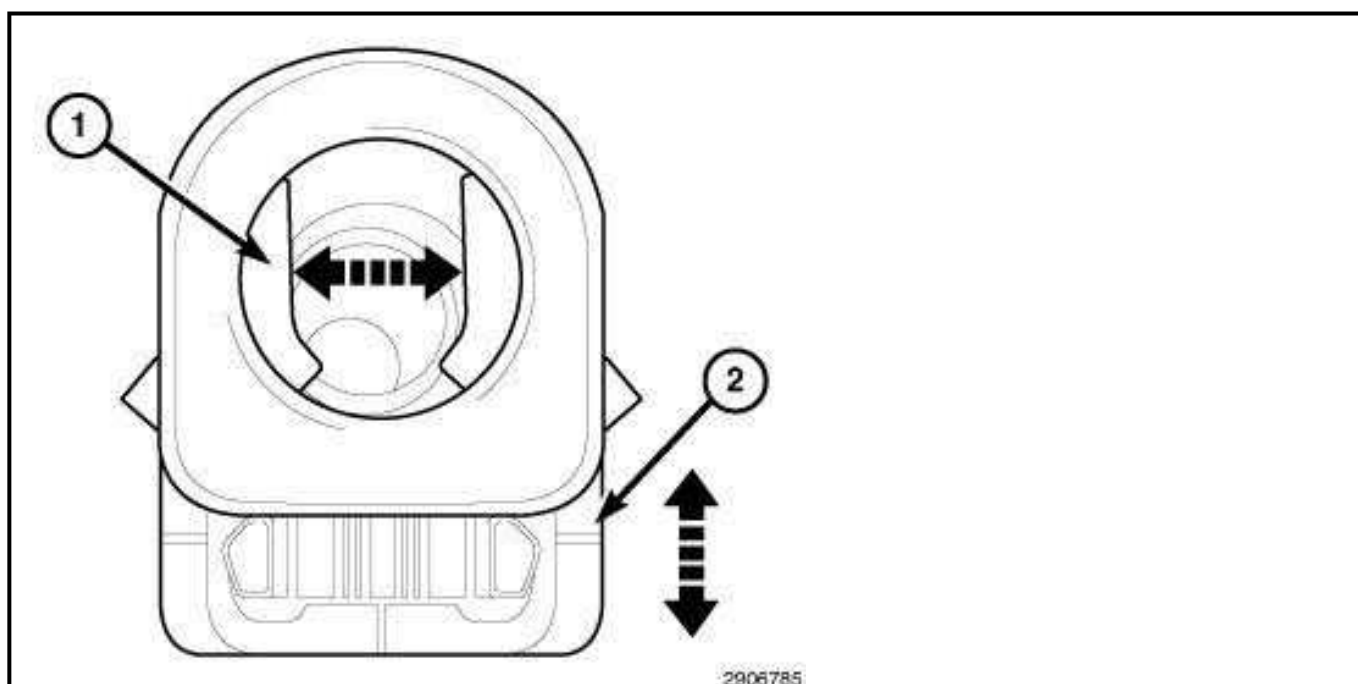
REDUNDANT LATCH SINGLE BUTTON TYPE FITTING:



1 - Single Push Button

2 - Redundant Latch

This type of quick-connect fitting is equipped with a redundant latch and a single push button that releases two internal latches located in the quick-connect fitting. Special tools are not required for removal.



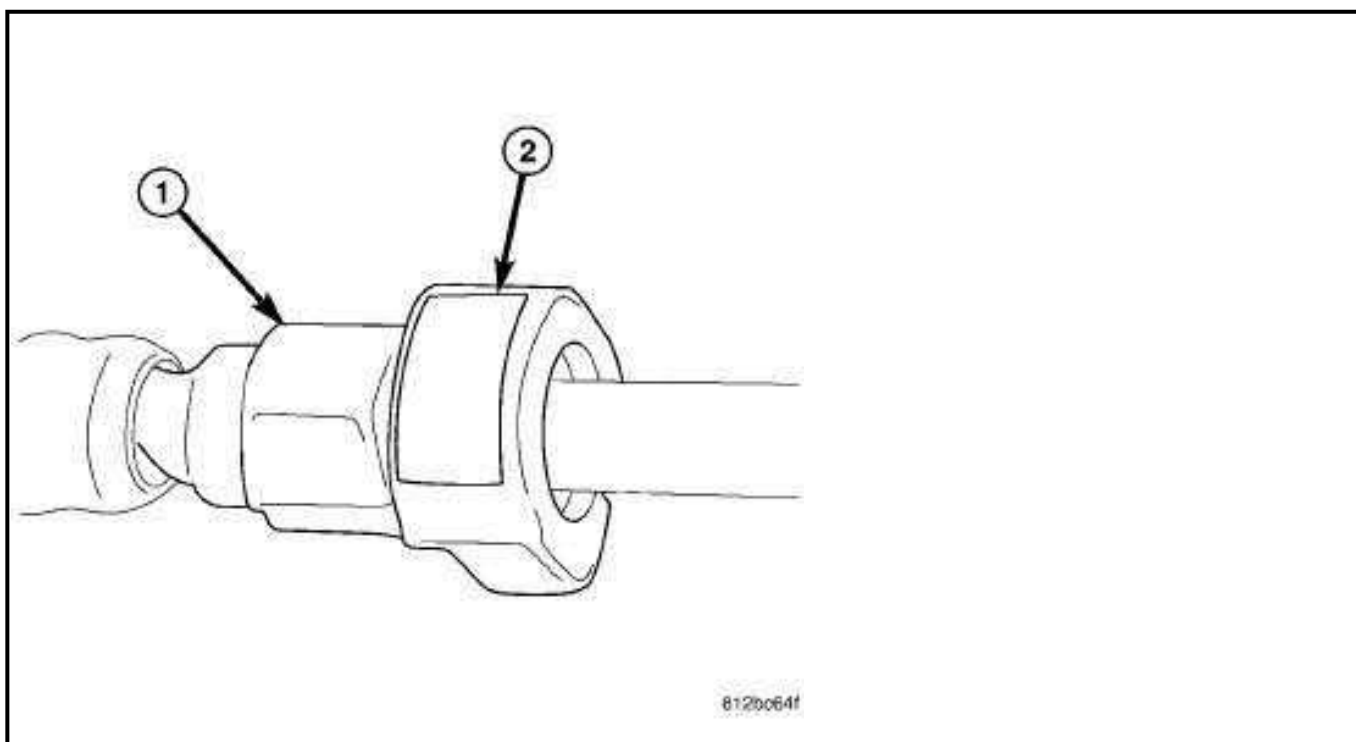
1 - Internal Latches

2 - Redundant Latch

CAUTION: Do not pry or pull up on the push button as damage to the latches of the quick-connect fitting will occur.

1. Pull the redundant latch out away from the quick-connect fitting.
2. Press on the push button with your thumb, release the internal latches and remove the quick-connect fitting from the fuel system component.

SINGLE BUTTON TYPE FITTING:

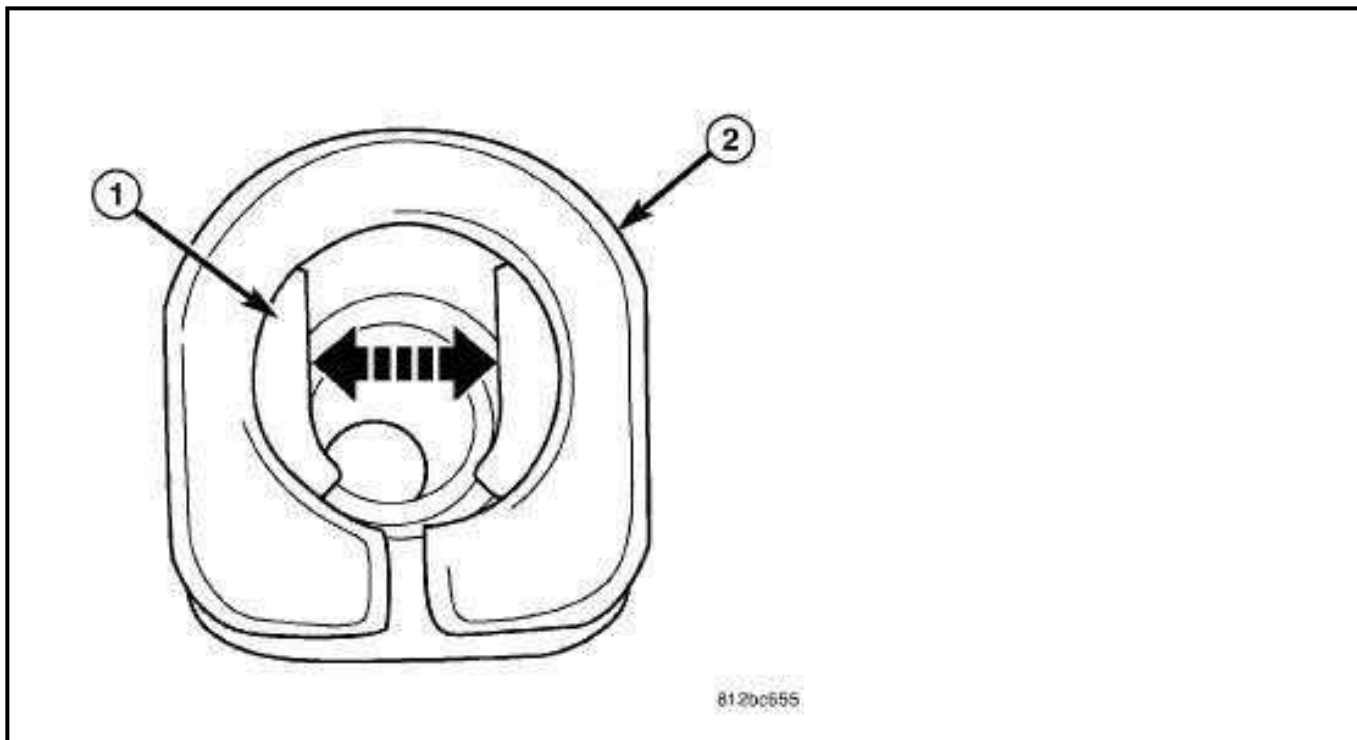


1 - Quick-Connect Fitting

2 - Single Push Button

CAUTION: Do not pry or pull up on the push button as damage to the latches of the quick-connect fitting will occur.

This type of quick-connect fitting is equipped with a single push button that releases two internal latches located in the quick-connect fitting. Special tools are not required for removal.

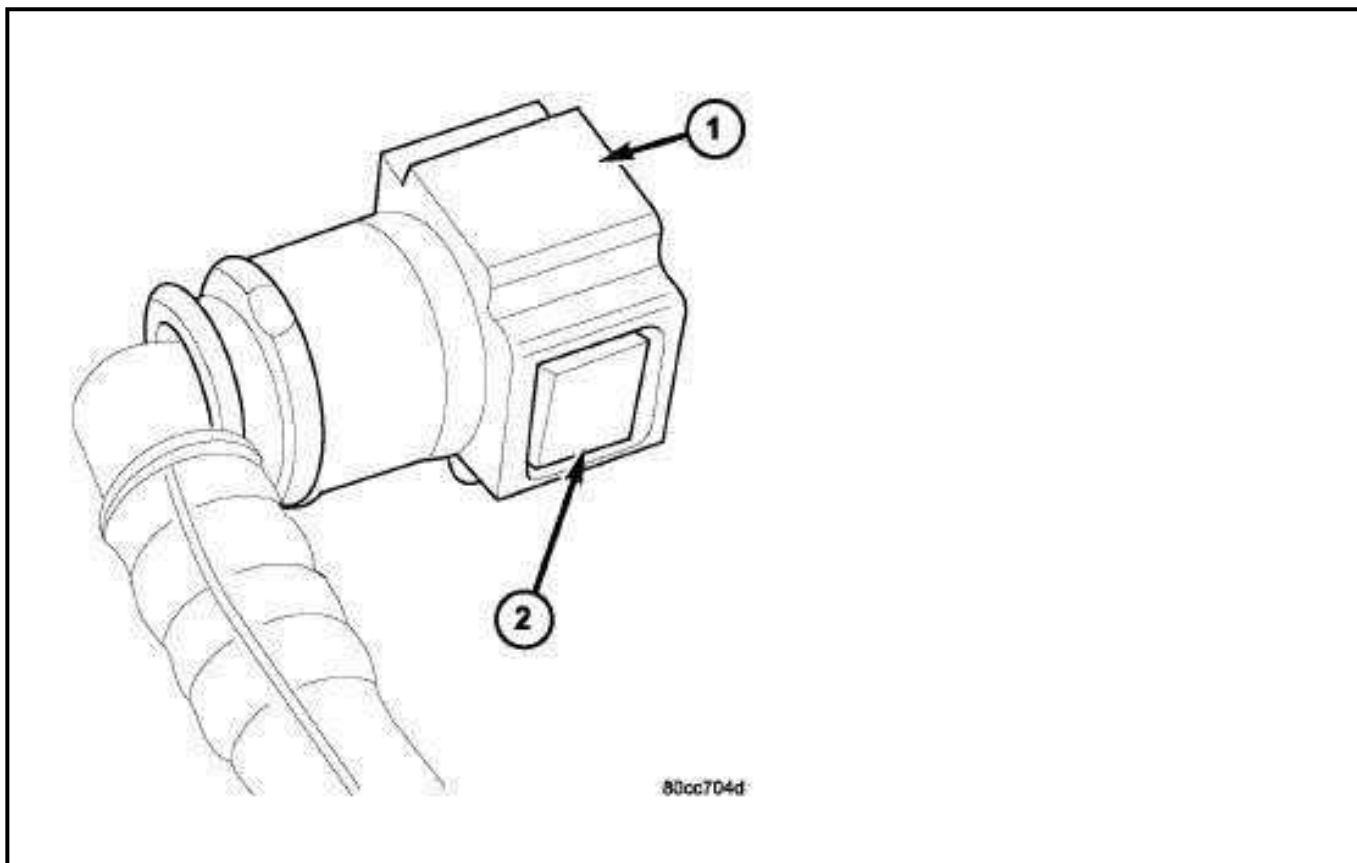


1 - Internal Latches

2 - Quick-Connect Fitting

1. Press on the push button with your thumb, release the internal latches.
2. Remove the quick-connect fitting from the fuel system component.

2 BUTTON TYPE FITTING



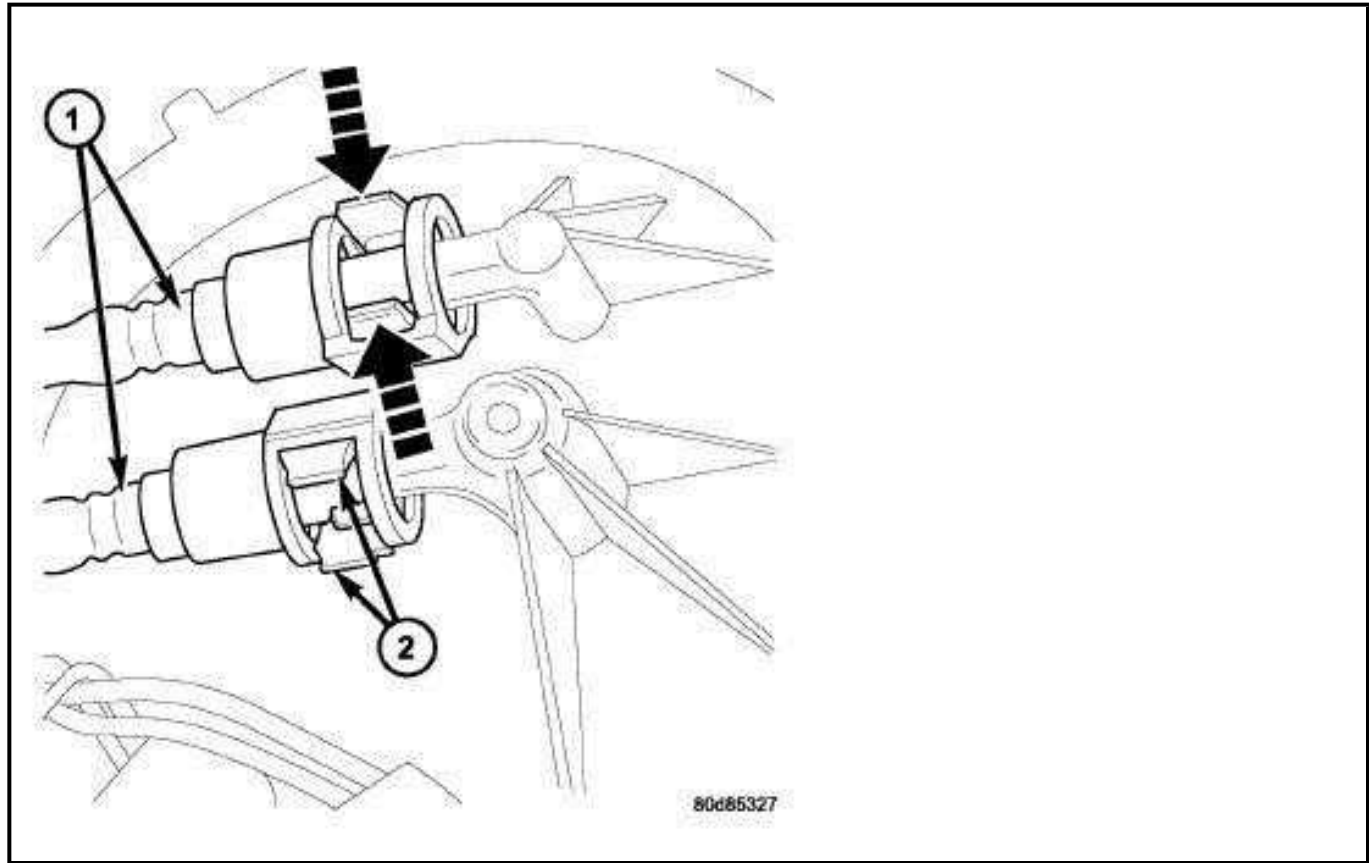
1 - Quick-Connect Fitting

2 - Two Push Buttons

This type of quick-connect fitting is equipped with two push buttons that releases two internal latches located in the quick-connect fitting. Special tools are not required for removal.

1. Press on both push buttons with your thumb, release the internal latches.
2. While holding the two push buttons simultaneously, remove the quick-connect fitting from the fuel system component.

PINCH TYPE FITTING

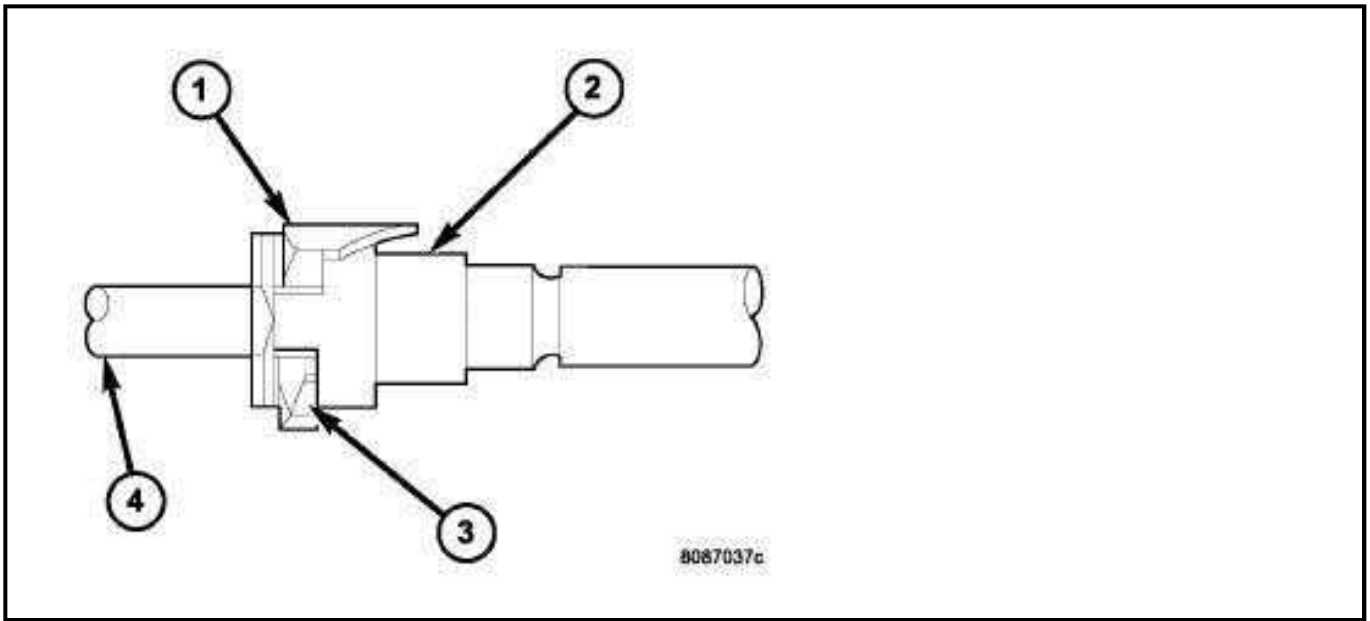


1 - Quick-Connect Fitting
2 - Two Finger Tabs

This type of quick-connect fitting is equipped with two finger tabs. Special tools are not required for removal.

1. Pinch both tabs together and release the quick-connect fitting.
2. Remove the quick-connect fitting from the fuel system component.

SINGLE TAB TYPE FITTING

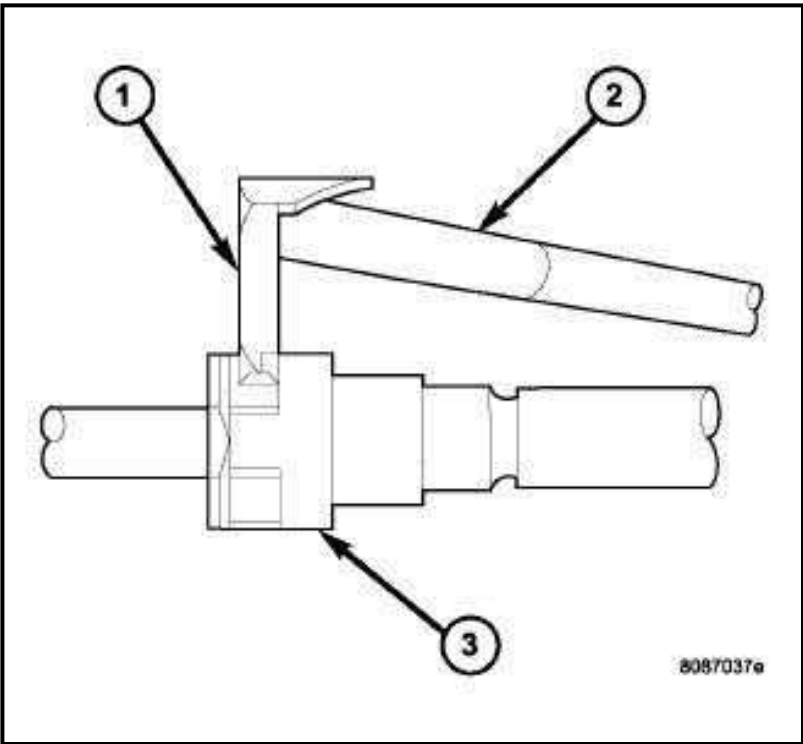


1 - Single Pull Tab
2 - Quick-Connect Fitting
3 - Release Tab
4 - Fuel System Component

This type of quick-connect fitting is equipped with a single pull tab. The tab is removable. After tab is removed, the quick-connect fitting can be separated from the fuel system component. Special tools are not required for removal.

1. Press release tab on side of fitting to release pull tab.

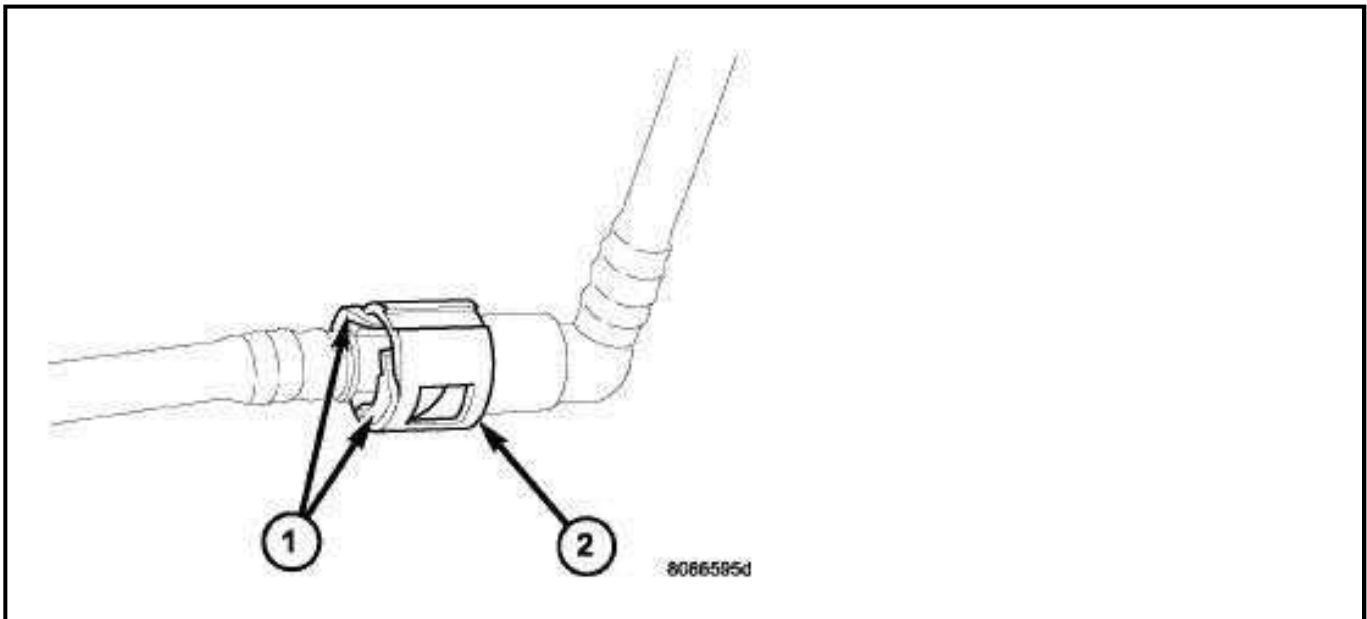
NOTE: If release tab is not pressed prior to releasing pull tab, pull tab will be damaged.



1 - Pull Tab
2 - Screwdriver
3 - Quick-Connect Fitting

2. While pressing the release tab on the side of the quick-connect fitting use a screwdriver to pry up the pull tab.
3. Raise the pull tab until it separates from the quick-connect fitting.
4. Remove the quick-connect fitting from the fuel system component.

TWO TAB TYPE FITTING



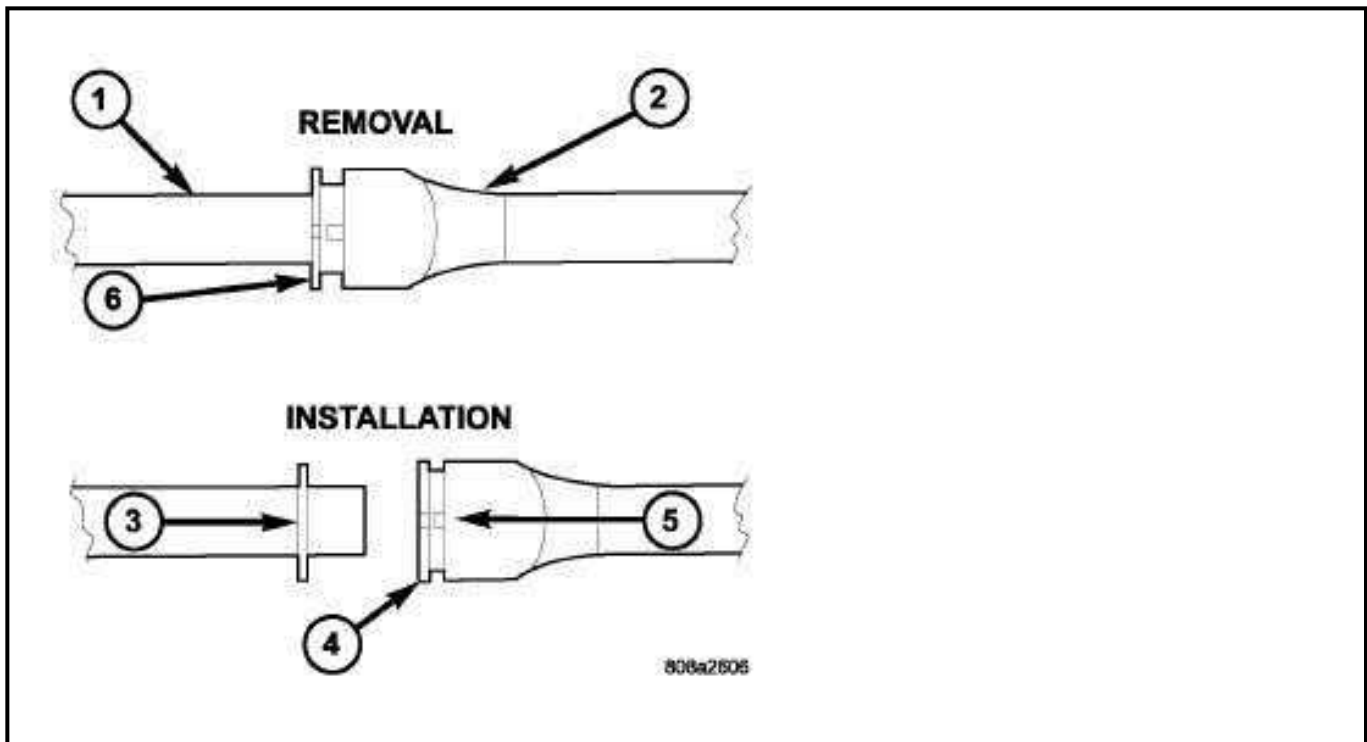
1 - Tabs

2 - Quick-Connect Fitting

This type of quick-connect fitting is equipped with tabs located on both sides of the fitting. These tabs are integral to the fuel system component. The plastic tabs will remain on the component being serviced after the quick-connect fitting is removed. The O-ring and spacer will remain in the quick-connect fitting. Special tools are not required for removal.

1. Squeeze the plastic tabs against the sides of component being serviced with your fingers.
2. Remove the quick-connect fitting from the fuel system component.

PLASTIC RETAINER RING TYPE FITTING



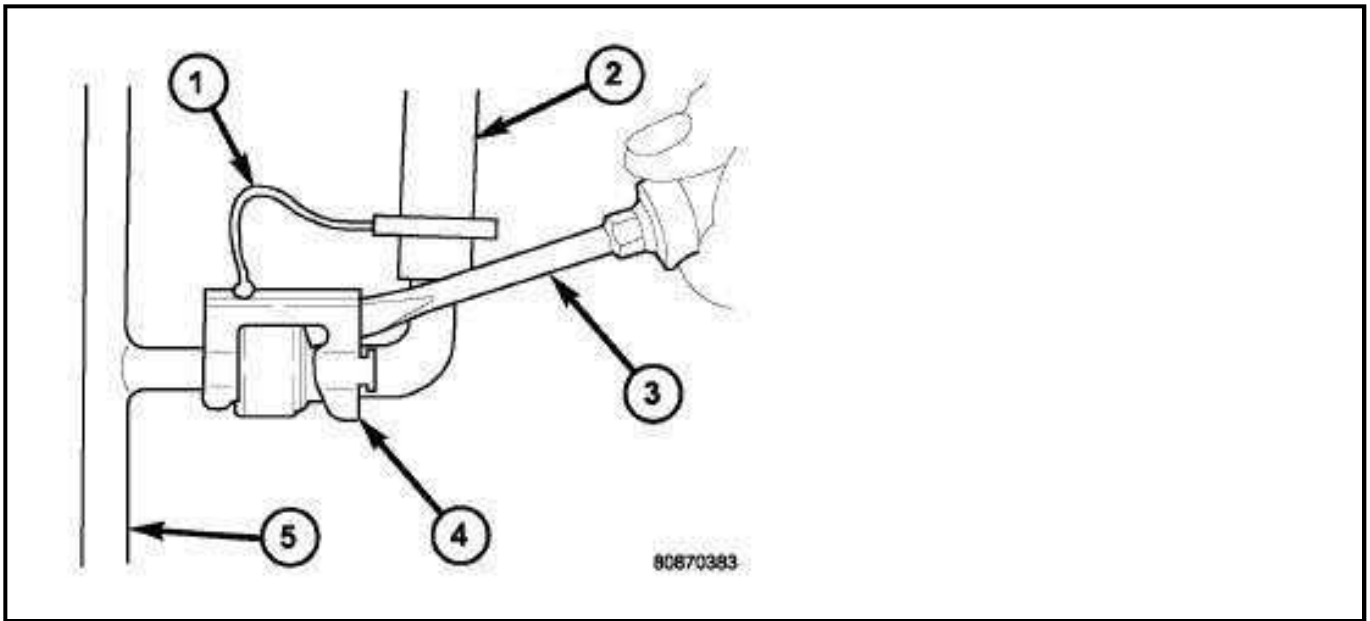
1 - Fuel System Component
2 - Quick-Connect Fitting
3 - Fuel System Component
4 - Round Plastic Retainer Ring
5 - Quick-Connect Fitting
6 - Round Plastic Retainer Ring

This type of fitting can be identified by the use of a round plastic retainer ring usually black in color. Special tools are not required for removal.

NOTE: The round plastic retainer ring must be pressed squarely into the quick-connect fitting body. If this retainer is cocked during removal it will be difficult to disconnect the quick-connect fitting. Use an open-end wrench on the shoulder of the plastic retainer ring to aid in disconnection.

1. Firmly push the quick-connect fitting towards the component being serviced while firmly pushing the round plastic retainer ring into the quick-connect fitting. With the round plastic ring depressed, remove the quick-connect fitting from the fuel system component.
2. After removal the plastic retainer ring will remain with the quick-connect fitting.

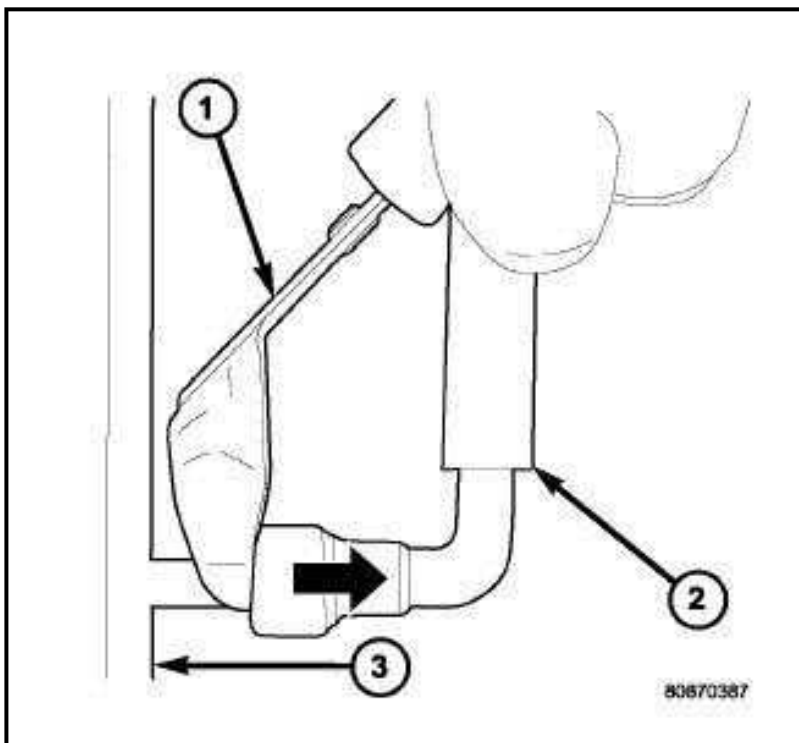
LATCH CLIP TYPE 1 FITTING



1 - Latch Clip Tether
2 - Fuel Line
3 - Screwdriver
4 - Latch Clip
5 - Fuel System Component

Depending on vehicle model and engine, 2 different types of safety latch clips are used. One is tethered to fuel line and the other is not. A special tool will be necessary to disconnect the fuel line after latch clip is removed. The latch clip may be used on certain fuel line and fuel rail connections or to join fuel lines together.

1. Pry up on the latch clip with a screwdriver.
2. Slide the latch clip away from the quick-connect fitting while lifting the screwdriver and position aside.



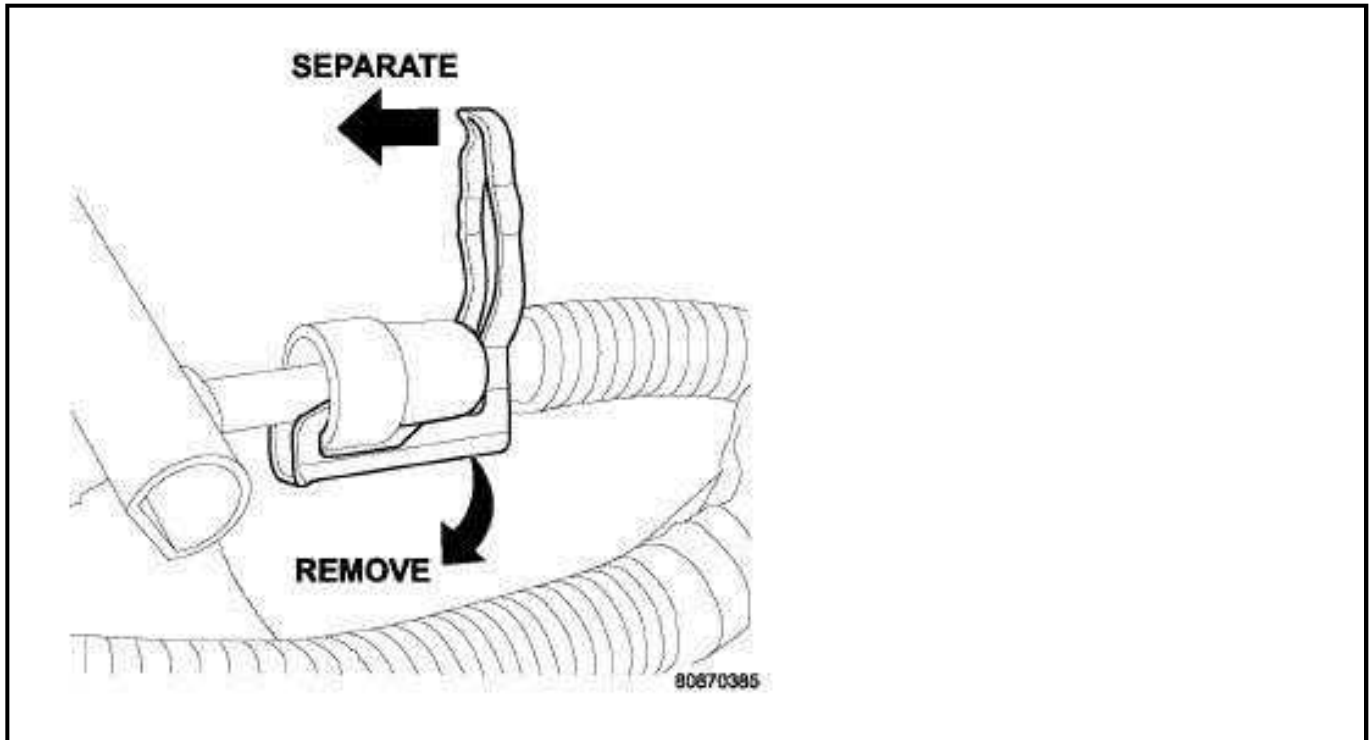
1 - Fuel Line Removal Tool
2 - Fuel Line
3 - Fuel System Component

3. Insert the commercially available fuel line removal tool into the quick-connect fitting and release the internal latches.

NOTE: After removal the internal latches will remain in the quick-connect fitting.

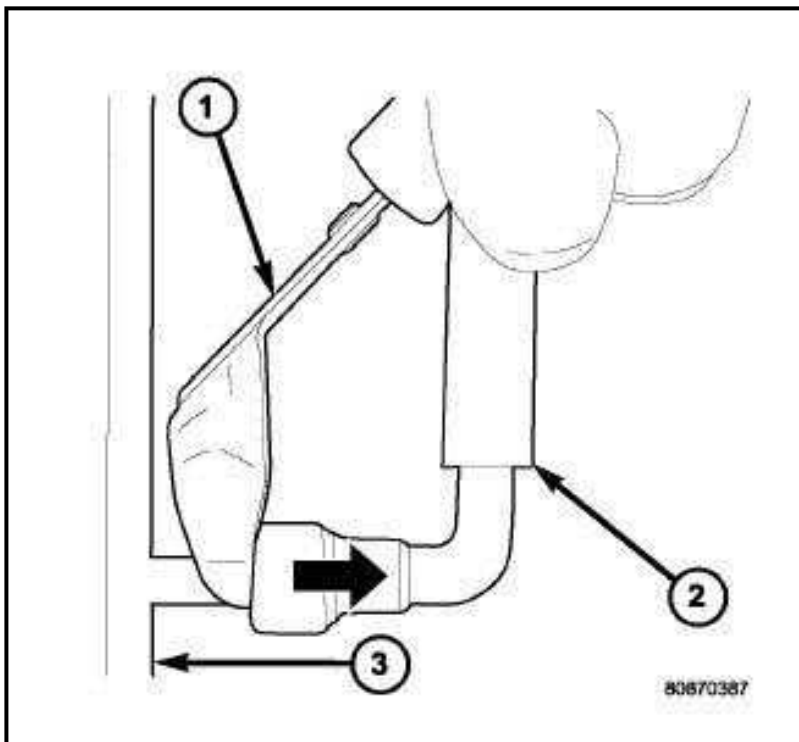
4. With the commercially available fuel line removal tool still inserted, remove the quick-connect fitting from the fuel system component.

LATCH CLIP TYPE 2 FITTING



Depending on vehicle model and engine, 2 different types of safety latch clips are used. One is tethered to the fuel line and the other is not. A special tool will be necessary to disconnect the fuel line after the latch clip is removed. The latch clip may be used on certain fuel line and fuel rail connections or to join fuel lines together.

1. Unlatch the small arms on the end of clip, swing away and separate from the fuel system component.
2. Slide the latch clip away from the quick-connect fitting while lifting with a screwdriver and position aside.



1 - Fuel Line Removal Tool

2 - Fuel Line

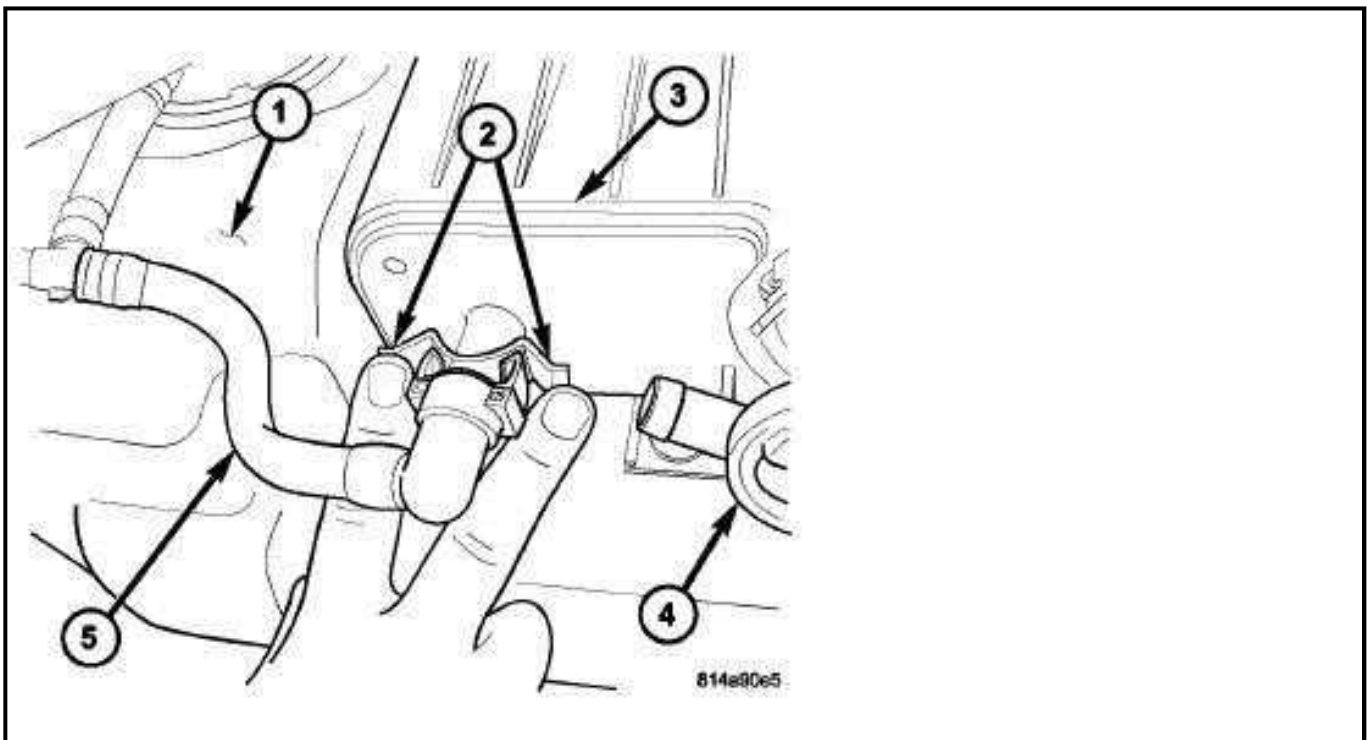
3 - Fuel System Component

3. Insert the commercially available fuel line removal tool into the quick-connect fitting and release the internal latches.

NOTE: After removal the internal latches will remain in the quick-connect fitting.

4. With the commercially available fuel line removal tool inserted, remove the quick-connect fitting from the fuel system component.

WING TYPE FITTING



1 - Fuel Tank

2 - Wings
3 - EVAP Canister
4 - Emission Component
5 - Vapor Hose

The wing type fitting is used on fuel system and emission components. The wing type fitting is most commonly used on the EVAP canister. Special tools are not required for removal.

1. Using two fingers, press both wings and release the locking tabs.

NOTE: After removal the locking tabs will remain with the quick-connect fitting.

2. While holding the wings, remove the quick-connect fitting from the fuel system component.

CONNECTING

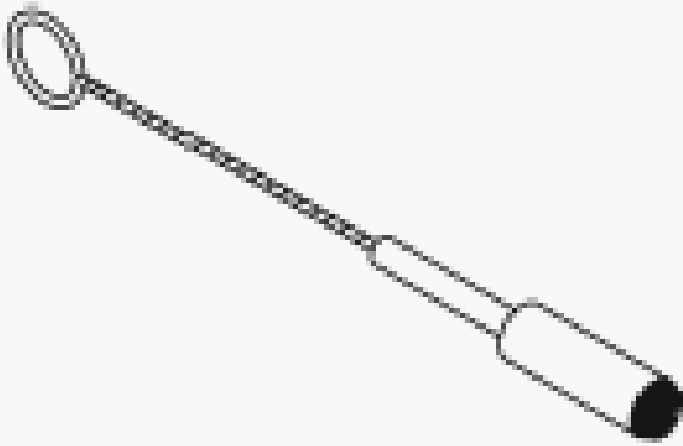
1. Inspect the quick-connect fitting body and fuel system components for damage. Replace as necessary.
2. Prior to connecting any quick-connect fitting to components, check condition of fitting and components. Clean parts with a lint-free cloth. Lubricate with clean engine oil.
3. Insert the quick-connect fitting onto the fuel tube or fuel system component until the built-in stop on the fuel tube or component rests against the back of fitting.
4. Continue pushing until a click is felt.
5. Perform the specific instructions if equipped with the following quick-connectors:
 - **Redundant Latch Single Button Type Fitting:** Push redundant latch until it locks into position in the quick-connect fitting.
 - **Single Tab Type Fitting:** Push new tab down until it locks into position in the quick-connect fitting.
 - **Latch Clip Type Fitting:** Install latch clip (snaps into position). **If latch clip will not snap into position, this indicates the quick-connect fitting is not properly installed onto fuel system component, recheck the connection.**
6. Verify a locked condition by firmly pulling on the quick-connect fitting connection of the fuel system component.

SPECIFICATIONS

FUEL SYSTEM PRESSURE - DIESEL

The correct fuel pressure from the in-tank electric fuel pump to the high pressure injection pump for this vehicle is 4.5 bar (65.2 psi) and 7.0 bar (101.5 psi). The correct flow rate for the in-tank electric fuel pump is approximately 53 gph (201 lph) at an ambient temperature of 73° F (23° C) and a constant battery voltage of 13 volts DC.

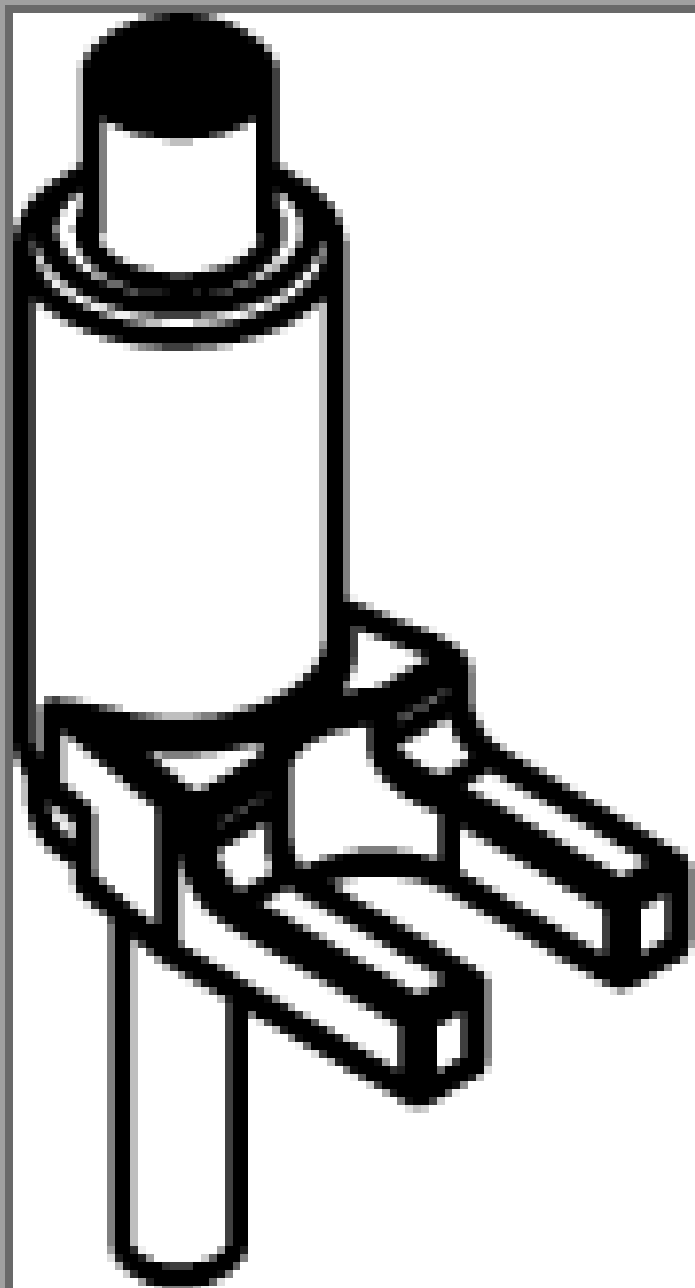
SPECIAL TOOLS



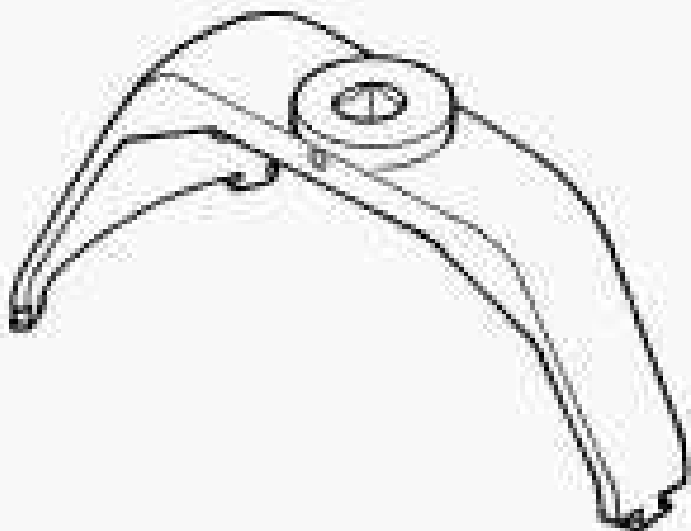
9717 - Brush, Injector Bore
(Originally Shipped In Kit Number(s)
9910.)



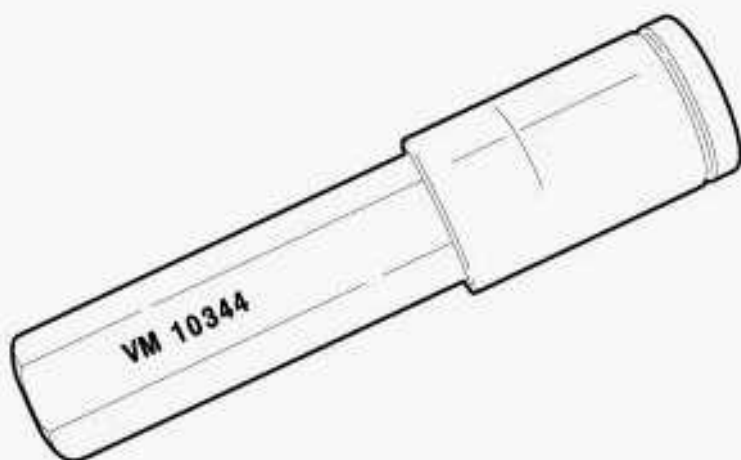
8978A - Decay Tool, Fuel



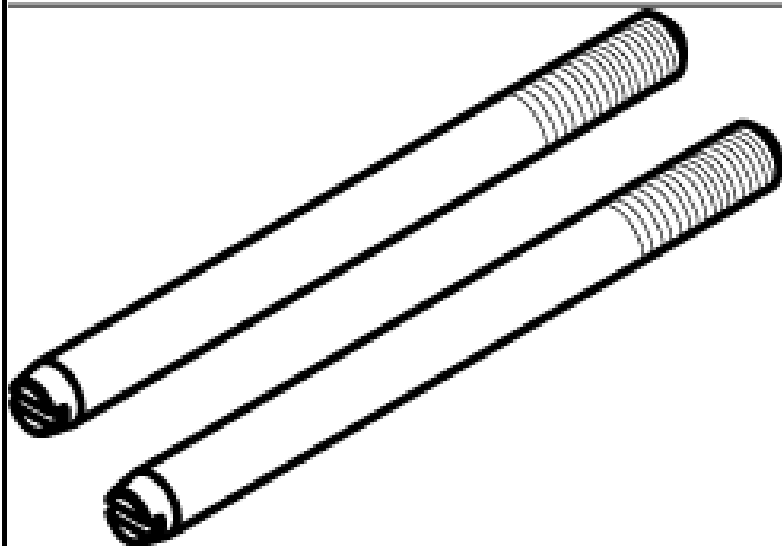
VM.10358A - Remover, Fuel Injector



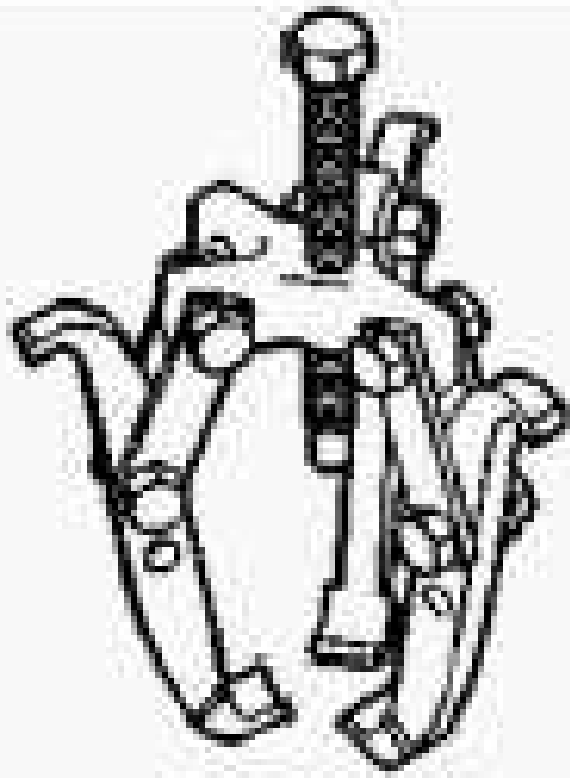
9340 - SAE Fuel Pump Lock Ring
Wrench
(Originally Shipped In Kit Number(s)
9327, 9327CC, 9397, 9575.)



VM.10344 - Tool, Oil Separator
Remover/Installer



VM.10345 - Tool, High Pressure Pump
Installation



1023 - Puller
(Originally Shipped In Kit Number(s)
8678.)



2025400090 - Remover-Installer, Fuel
Rail Bolt



2073300140 - Wrench, Fuel Rail Pressure Sensor

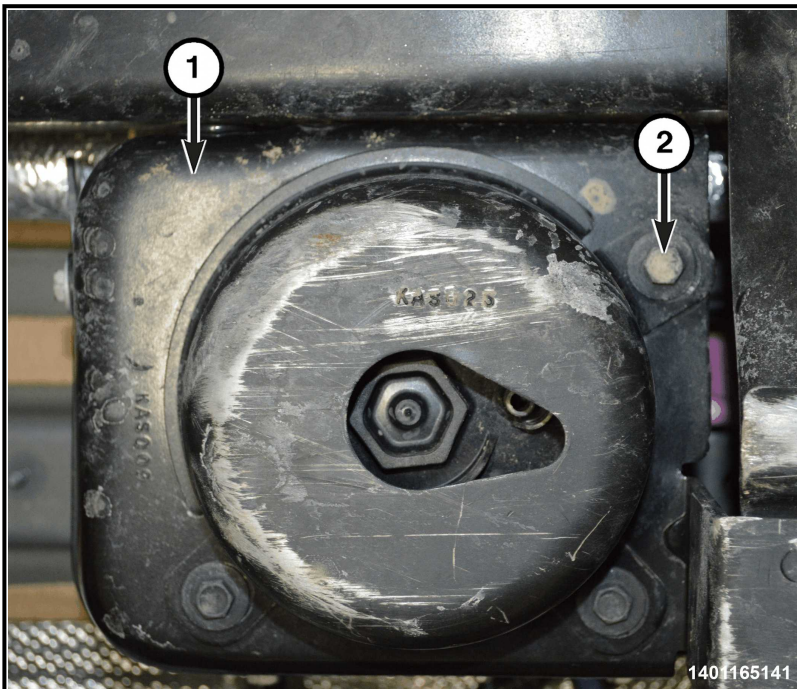
FILTER(S), FUEL

REMOVAL AND INSTALLATION

FUEL FILTER

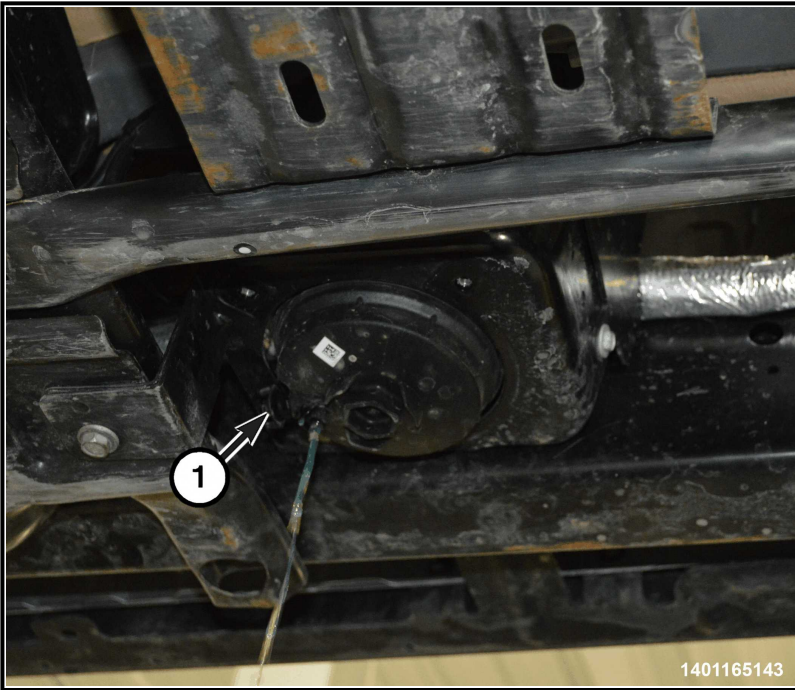
REMOVAL

1. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .



- | |
|----------------------------------|
| 1 - Fuel Filter Skid Plate |
| 2 - Fuel Filter Skid Plate Bolts |

2. Remove the fuel filter skid plate bolts and the fuel filter skid plate.



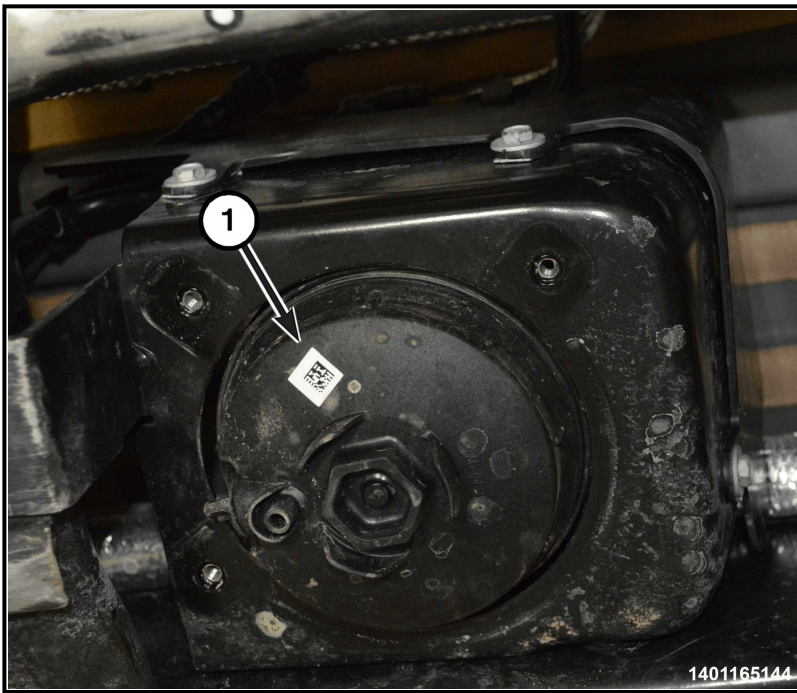
1 - Drain Plug

3. Loosen the drain plug and drain the fuel filter/water separator into a suitable container.



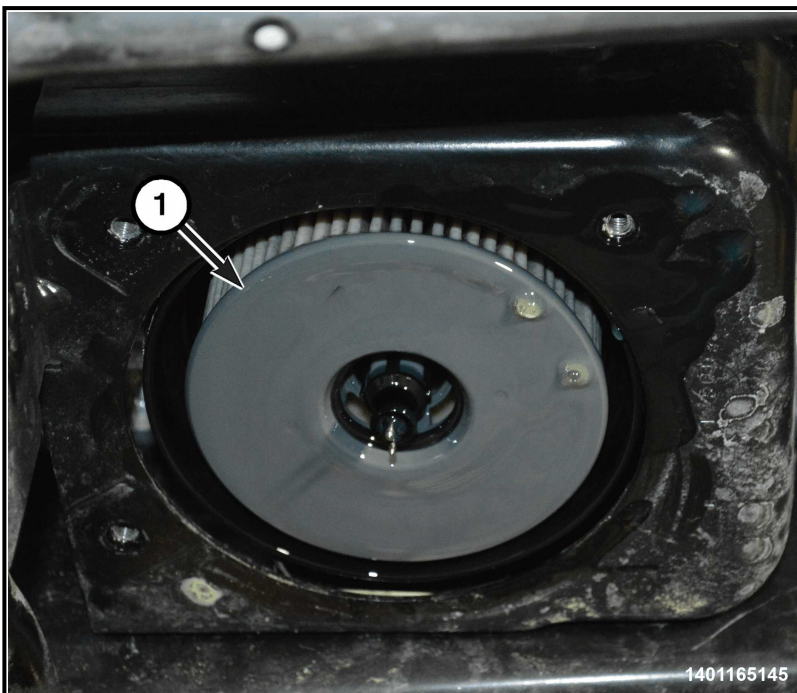
1 - Drain Plug

4. Securely tighten the drain plug.



1 - Fuel Filter Cover

5. Remove the fuel filter cover.



1 - Fuel Filter

6. Pull down and remove the fuel filter from the housing.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

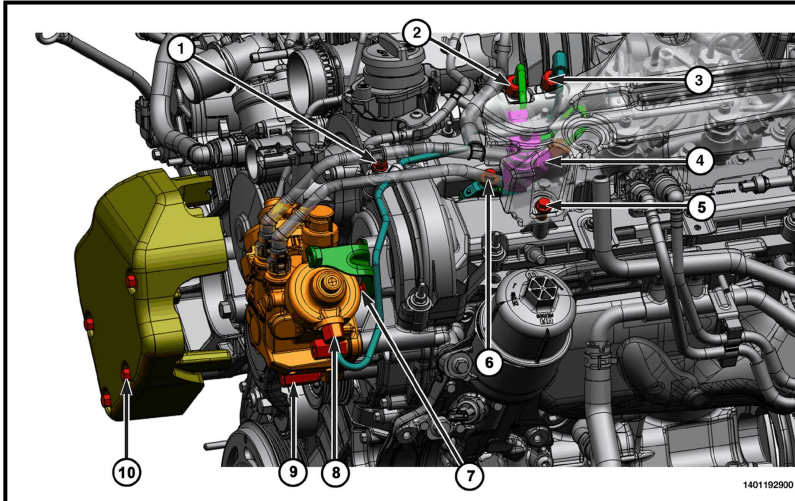
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Lubricate the O-ring seal with clean diesel fuel and install a **NEW** O-ring seal fuel filter cover.
- Align the tabs and push up and install the fuel filter to the housing.
- Prime the fuel system. Refer to [**FUEL SYSTEM PRIMING - DIESEL**](#) .

- Start the vehicle and inspect for leaks.

TORQUE SPECIFICATIONS

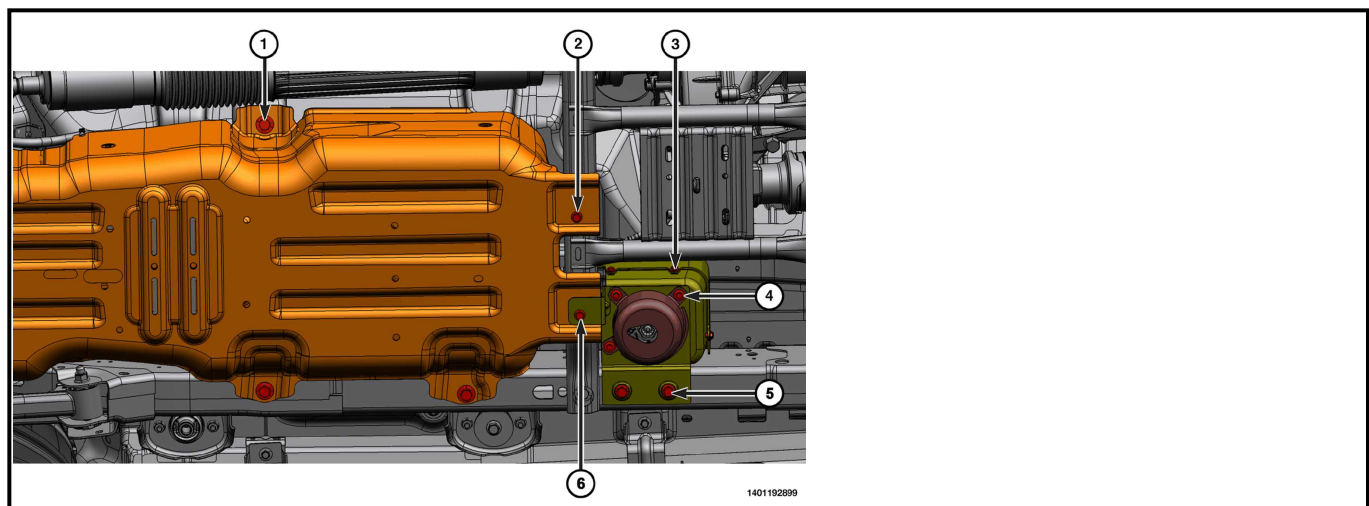
FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure:	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
		1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Â	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-

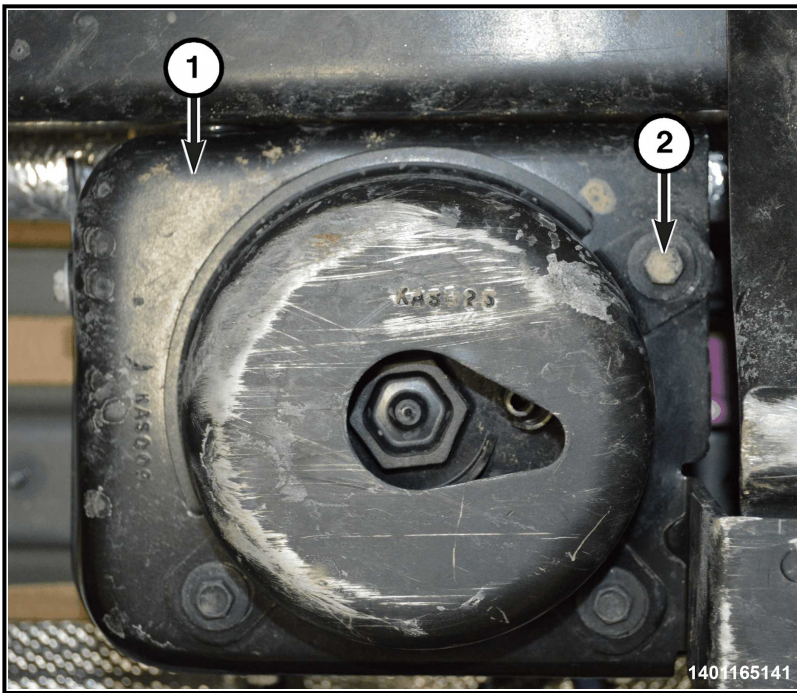


FUEL FILTER/WATER SEPARATOR

REMOVAL

WARNING: No sparks, open flames or smoking. Risk of poisoning from inhaling and swallowing fuel. Risk of injury to eyes and skin from contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing.

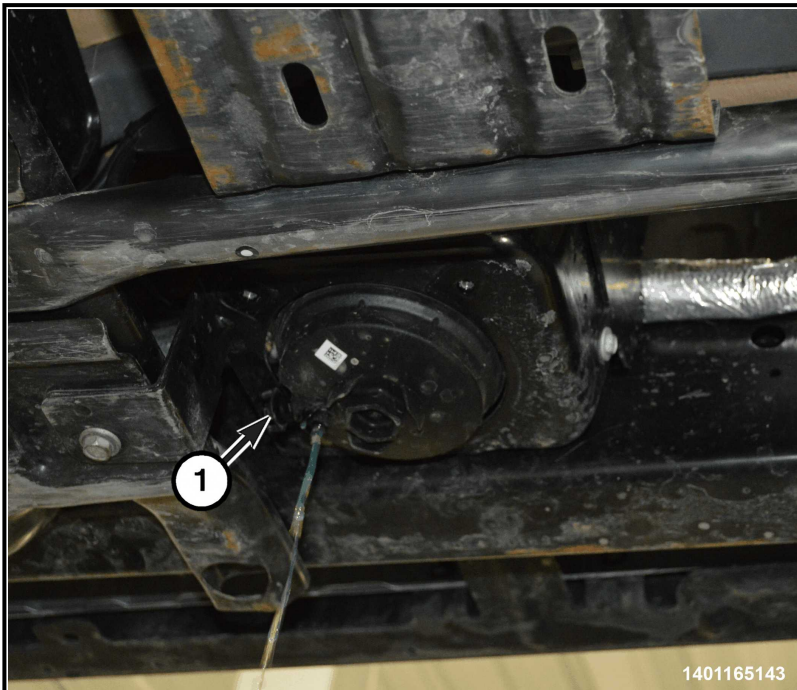
1. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .



1 - Fuel Filter Skid Plate Bolts

2 - Fuel Filter Skid Plate

2. Remove the fuel filter skid plate bolts and the fuel filter skid plate.



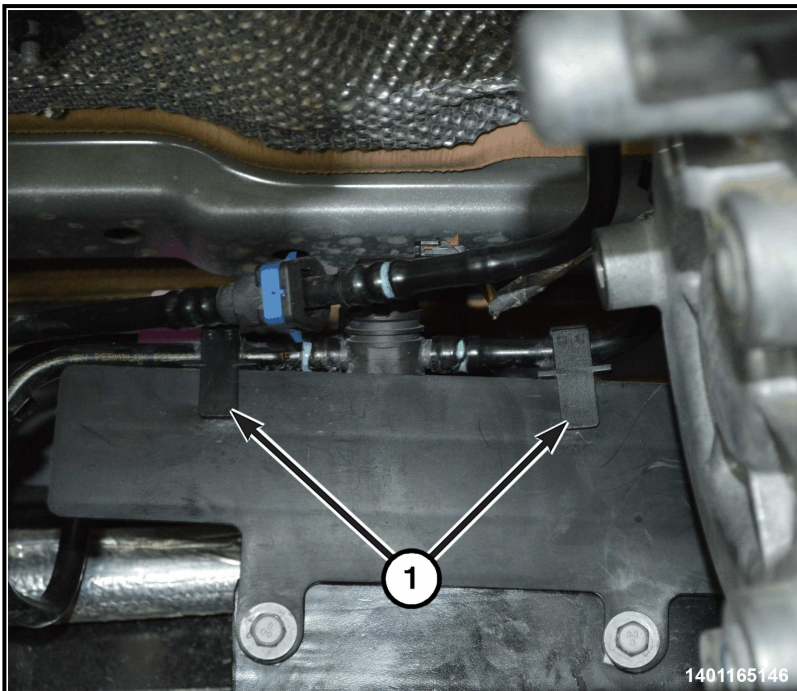
1 - Drain Plug

3. Loosen the drain plug and drain the fuel filter/water separator into a suitable container.



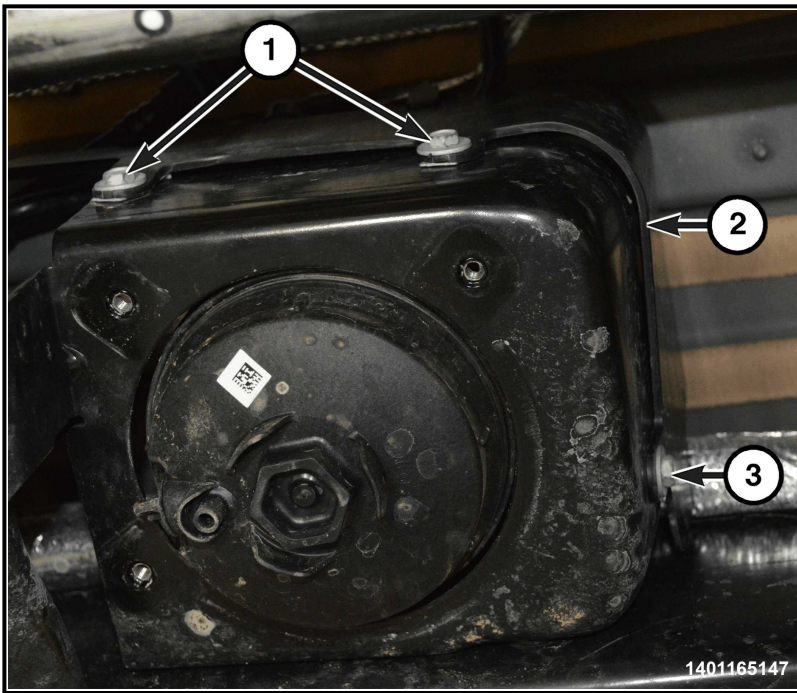
1 - Drain Plug

4. Securely tighten the drain plug.



1 - Fuel Line Retainers

5. Detach the fuel line retainers.

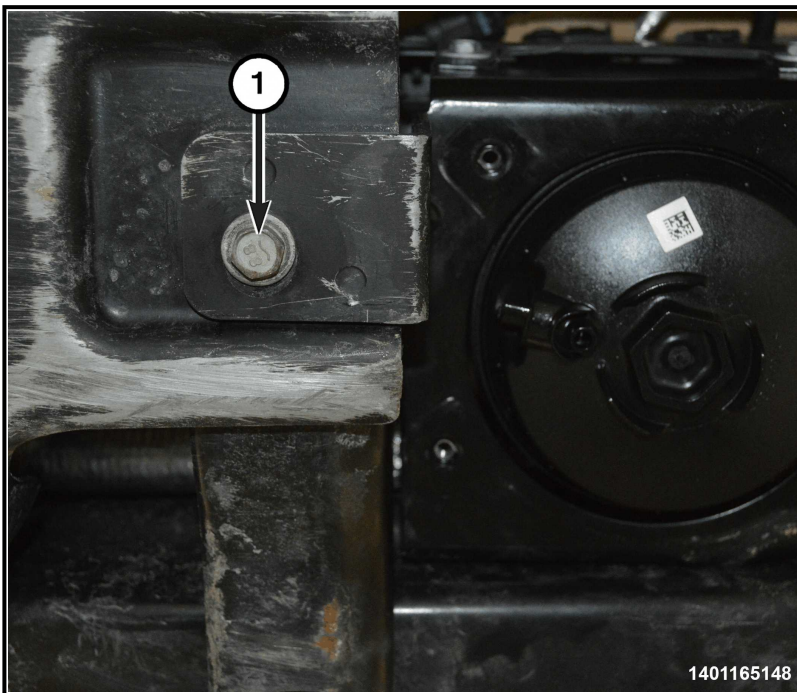


1 - Upper Shield Bolts

2 - Upper Shield

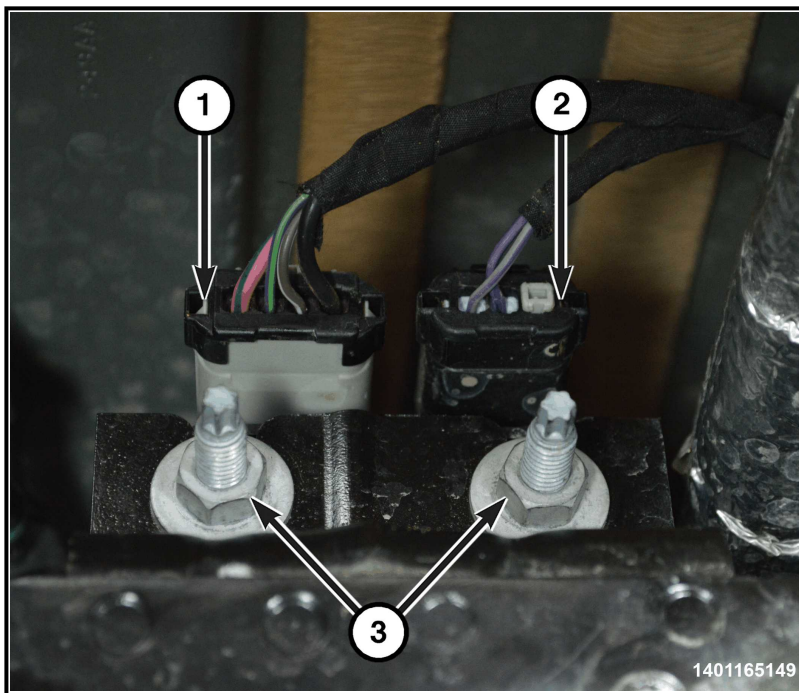
3 - Upper Shield Bolt

6. Remove the upper shield bolt(s) and the upper shield.



1 - Fuel Filter/Water Separator Shield To Fuel Tank Shield Bolt

7. Remove the fuel filter/water separator shield to fuel tank shield bolt.



1 - Fuel Heater/Temperature Sensor Wire Harness Connector
2 - Water In Fuel Sensor Wire Harness Connector
3 - Fuel Filter/Water Separator Nuts

8. Disconnect the fuel heater/temperature sensor wire harness connector.
9. Disconnect the Water In Fuel (WIF) sensor wire harness connector.
10. Remove the fuel filter/water separator nuts securing the fuel filter/water separator assembly and position aside.



1 - Fuel Filter/Water Separator Bracket To Frame Inner Bolt

11. Remove the fuel filter/water separator bracket to frame inner bolt and lower the fuel filter/water separator.
12. Disconnect the fuel filter/water separator inlet and outlet fuel lines and remove the fuel filter/water separator. Refer to **REMOVAL AND INSTALLATION** .

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

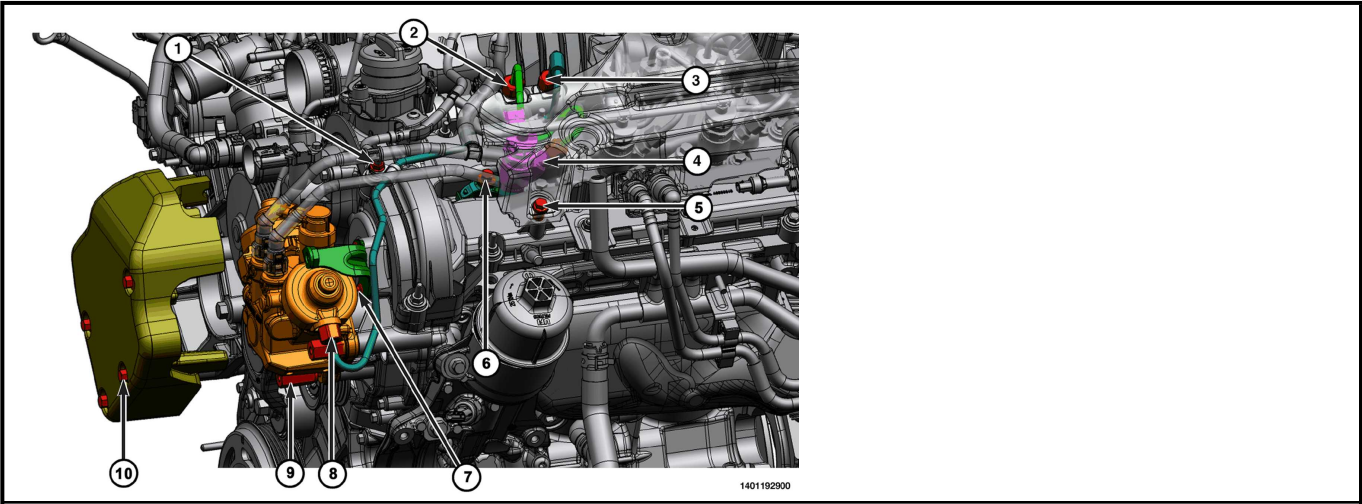
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

WARNING: No sparks, open flames or smoking. Risk of poisoning from inhaling and swallowing fuel. Risk of injury to eyes and skin from contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing.

- Make sure fuel filter drain port is closed.
- Prime the fuel system. Refer to [FUEL SYSTEM PRIMING - DIESEL](#) .
- Start the engine and inspect for leaks.

TORQUE SPECIFICATIONS

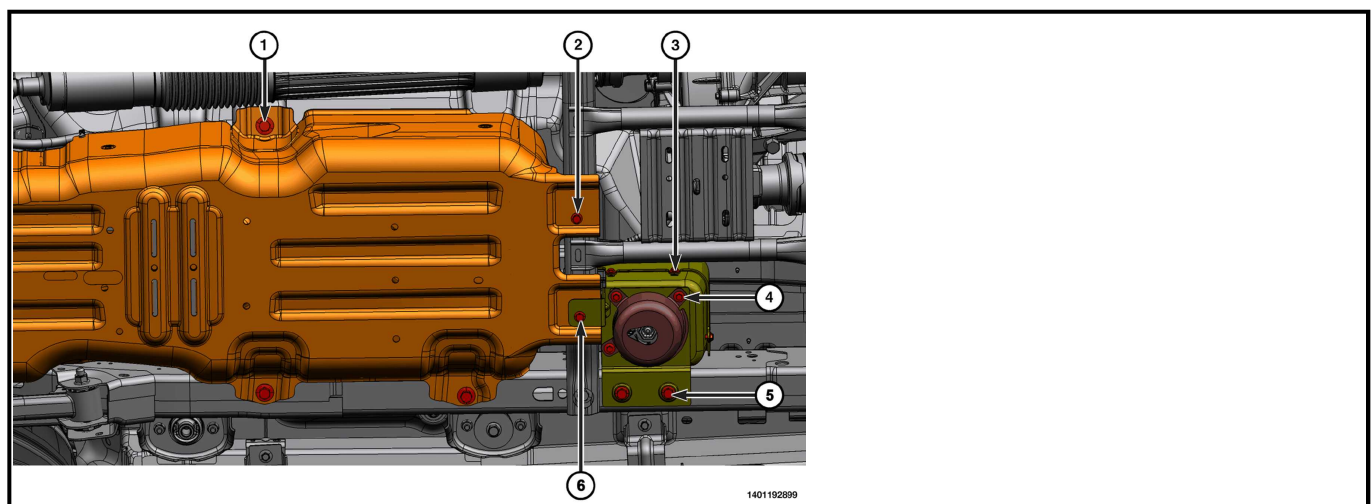
FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Â	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

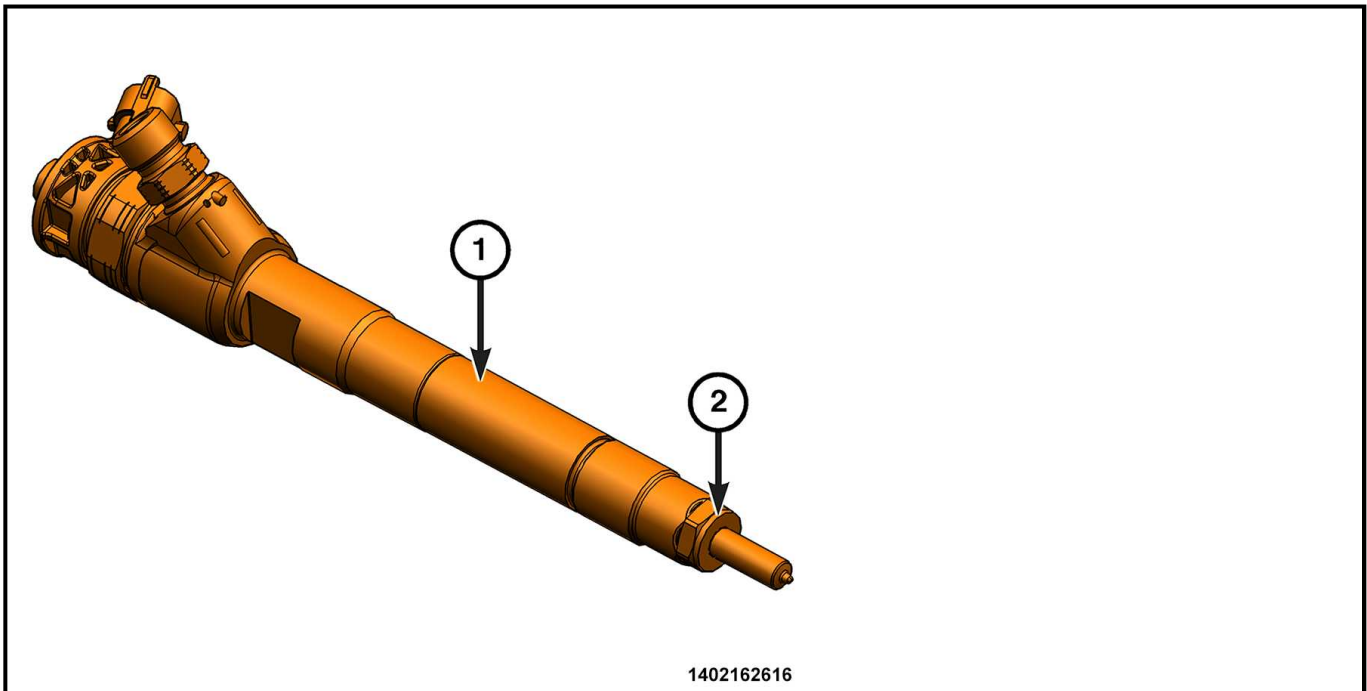
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



INJECTOR(S), FUEL

CLEANING

FUEL INJECTOR CLEANING



1 - Fuel Injector Body

2 - Copper Sealing Washer

NOTE: Before cleaning the injector bore, seal the injector holes in the injector bore with the appropriate cap to prevent debris from falling into the cylinder.

1. Remove and discard the fuel injector O-ring seal.
2. Using a lint-free rag, wipe the cylinder head around the fuel injector.
3. Wipe out the injector bore with a lint-free cloth.

CAUTION: Make sure the injector bore bottom is clean of debris otherwise a leak could occur.

4. Clean the bottom of the fuel injector bore with (special tool #9717, Brush, Injector Bore) and **make sure the old copper sealing washer is not stuck in the bore**.
5. Blow out the recess with shop air and clean again with a lint-free cloth and cover over.
6. Perform these steps for each injector recess.
7. Clean the fuel injector body with a wire brush.
8. Remove the copper sealing washer and clean the sealing surface.
9. Check the tip of the injector, if the tip is found to be loose then replace the injector with a **NEW** one.

NOTE: **DO NOT** clean the tip of the fuel injector with a wire brush. Use a lint-free cloth.

10. Clean the fuel injector tips with a lint-free cloth.

NOTE: **DO NOT** apply anti-seize lubricant to the fuel injector nozzle, only apply anti-seize lubricant to the fuel injector body.

11. Lubricate the fuel injector body with Nickel Anti-Seize Lubricant.

NOTE: Always replace the seals in the cylinder head cover and replace the copper sealing washer on the bottom of injector.

REMOVAL AND INSTALLATION

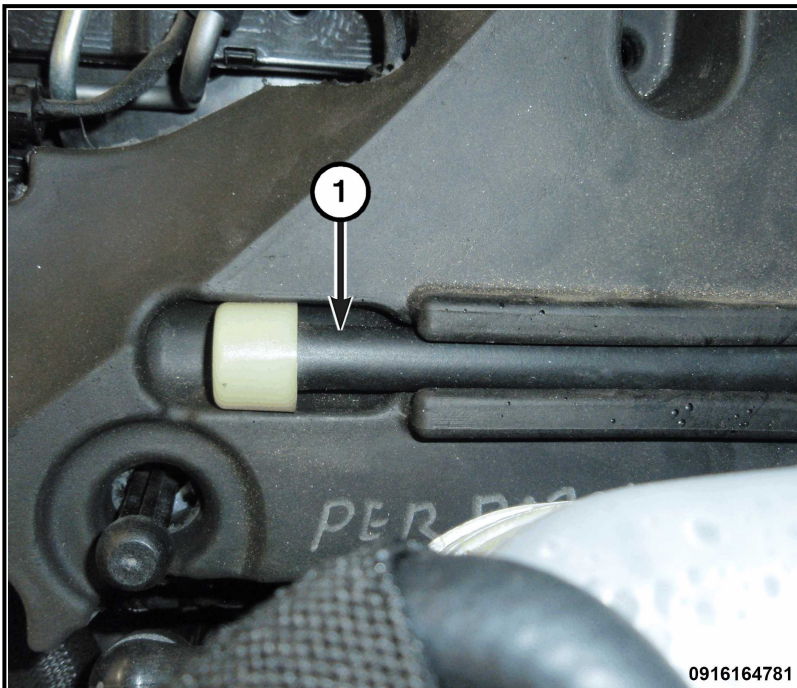
LEFT BANK

REMOVAL

WARNING: Observe the following precautions when working on fuel systems: No sparks, open flames or smoking. Avoid inhaling and swallowing fuel. Avoid eye and skin contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing. Failure to observe these precautions may result in fire, explosion, property damage, and serious or fatal injury.

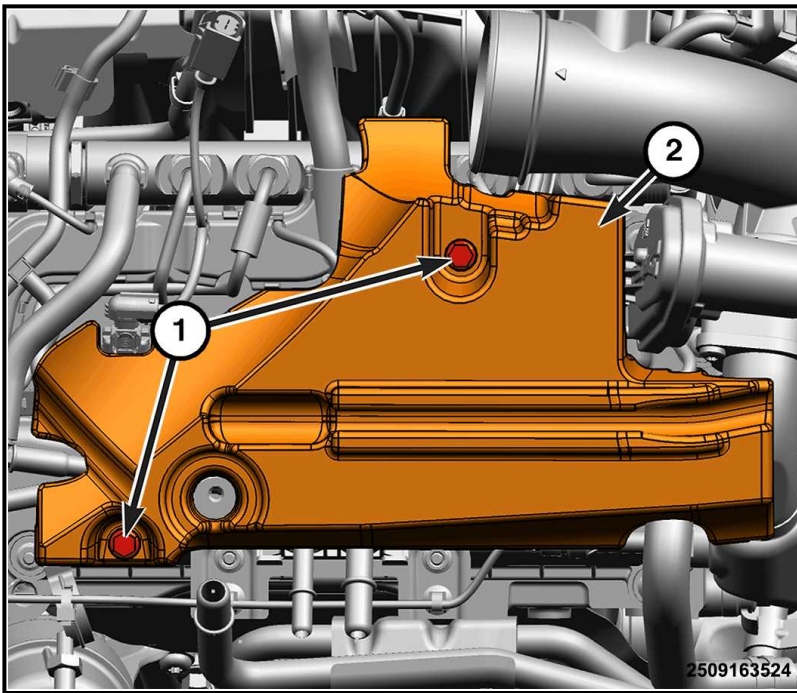
WARNING: High-pressure lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 2000 bar (29, 008 psi). Use extreme caution when inspecting for high-pressure fuel leaks. Fuel under this amount of pressure can penetrate skin causing personal injury or death. Inspect for high-pressure fuel leaks with a sheet of cardboard. Wear safety goggles and adequate protective clothing when servicing fuel system.

1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
2. Remove the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#) .



1 - Vent Hose

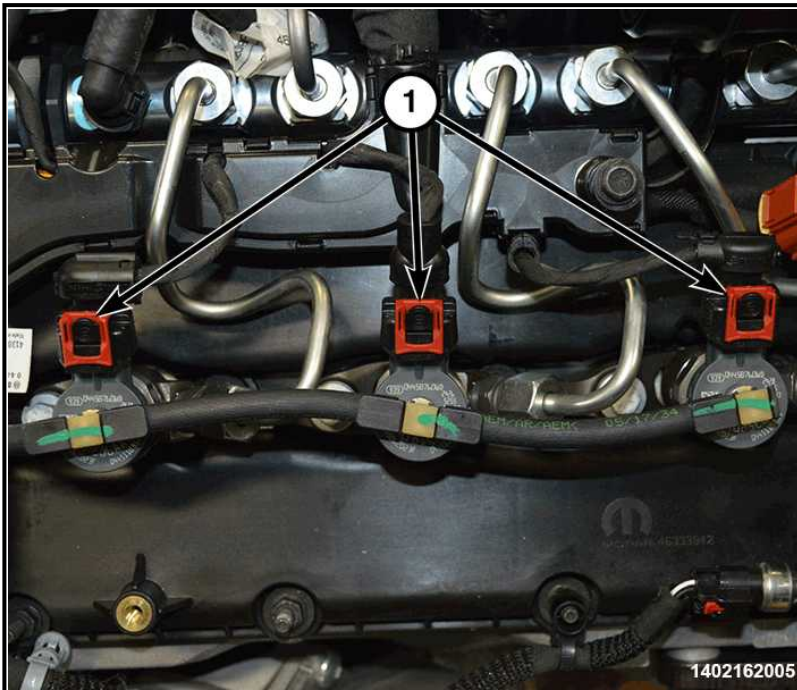
3. Remove the vent hose.



1 - Left Fuel Rail Cover Bolts

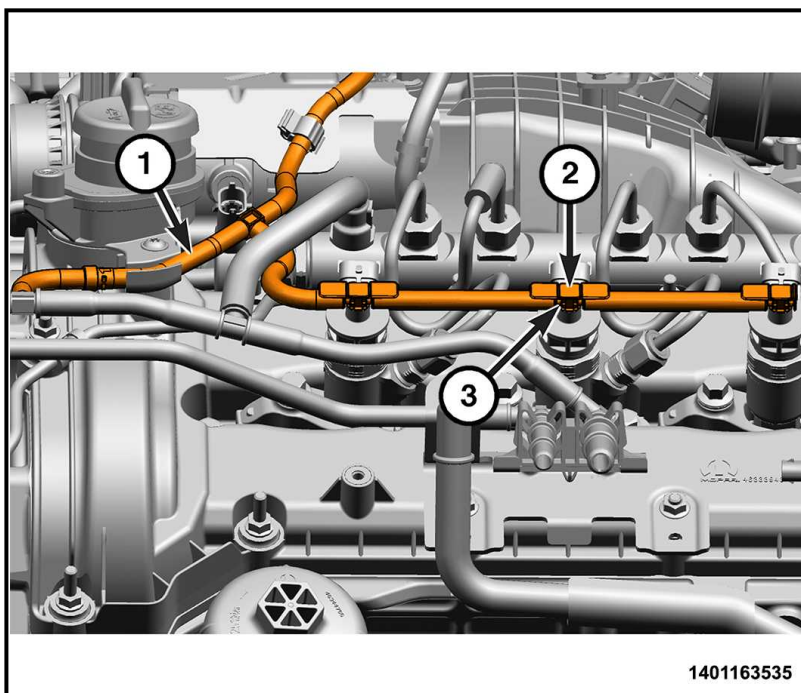
2 - Left Fuel Rail Cover

4. Remove the left fuel rail cover bolts and the left fuel rail cover.



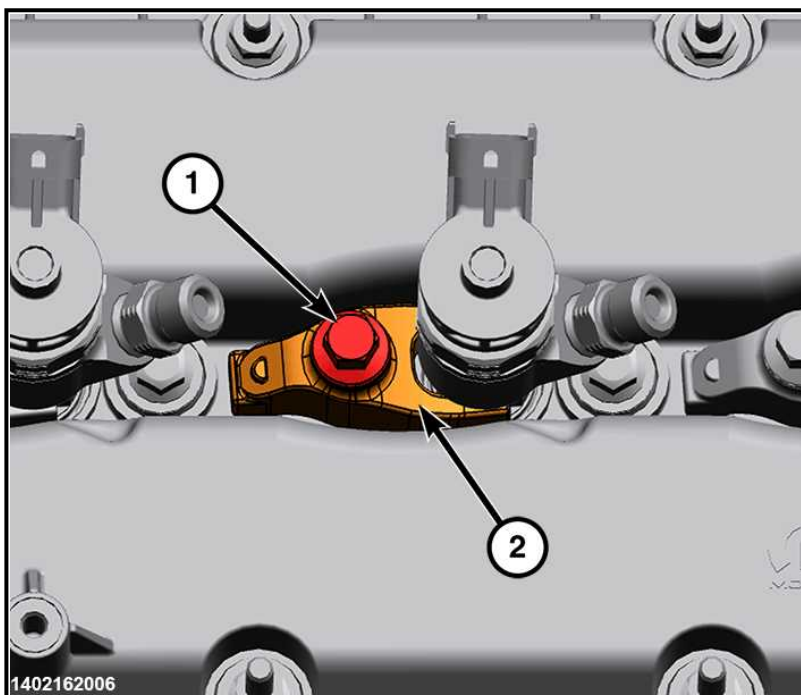
1 - Fuel Injector Wire Harness Connectors

5. Disconnect the fuel injector wire harness connector(s).



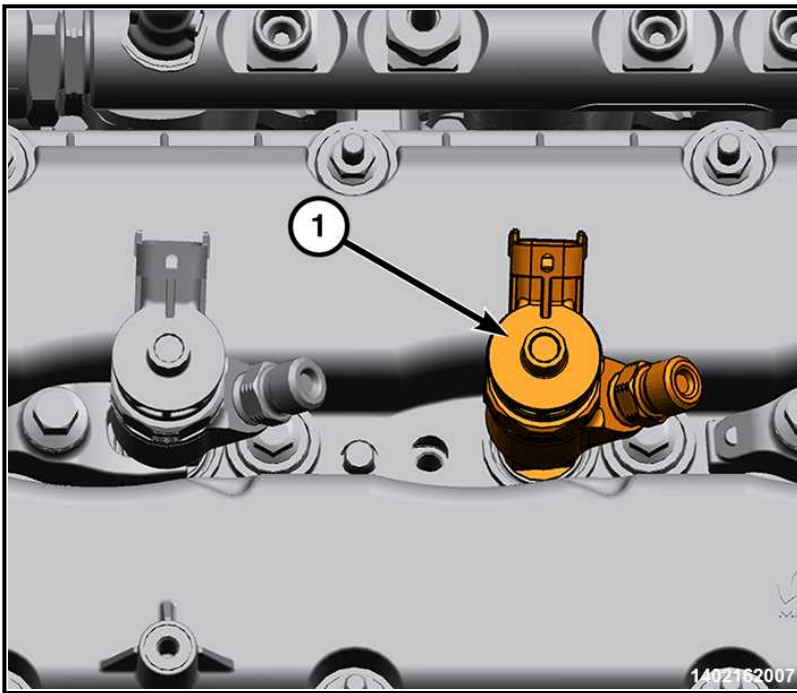
1 - Fuel Return Line
2 - Locking Tab
3 - Fuel Return Line

6. Lift up on the to unlock the lock.
7. Disconnect the fuel return line by wiggling the hose free from the fuel injector.
8. Remove the fuel tubes. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).
9. Clean the area around the fuel injector to be removed, so that no debris falls into the injector bore.



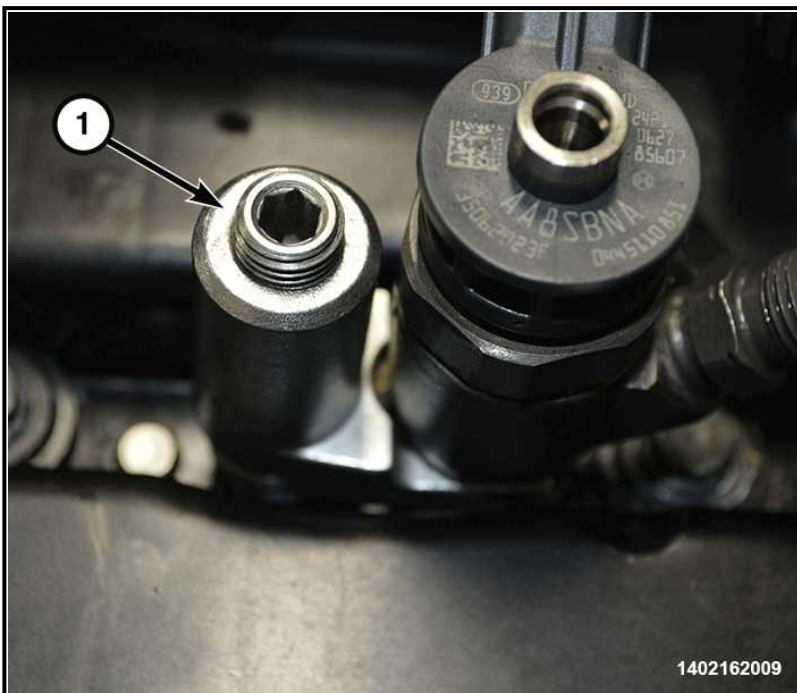
1 - Fuel Injector Clamp Bolt
2 - Fuel Injector Clamp

10. Remove the fuel injector clamp bolt and the fuel injector clamp.



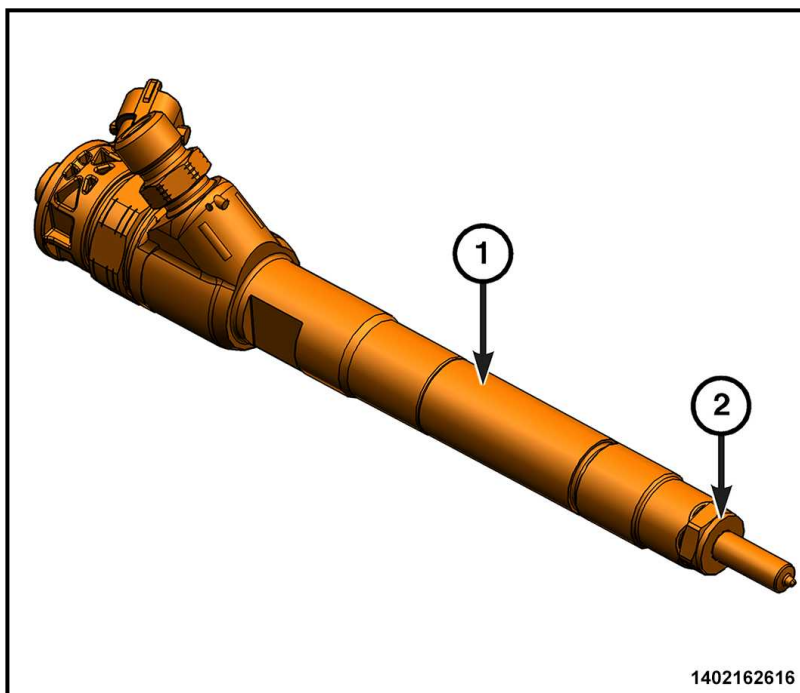
1 - Fuel Injector

11. Using your hand, pull the fuel injector straight up from the cylinder head for removal. Discard the lower sealing washer and place a protective cap over the nozzle and injector bore.



1 - Fuel Injector Remover Tool

12. If injector can't be removed by hand, install the (special tool #VM.10358A, Remover, Fuel Injector) to remove the fuel injector. Discard lower sealing washer and place a protective cap over the nozzle and injector bore.



- | |
|---------------------------|
| 1 - Fuel Injector |
| 2 - Copper Sealing Washer |

NOTE: Check and **MAKE SURE** that the copper sealing washer did not remain in the cylinder head.

13. Remove and discard lower copper sealing washer and place a protective cap over the nozzle and injector bore.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

WARNING: No sparks, open flames or smoking. Risk of poisoning from inhaling and swallowing fuel. Risk of injury to eyes and skin from contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing.

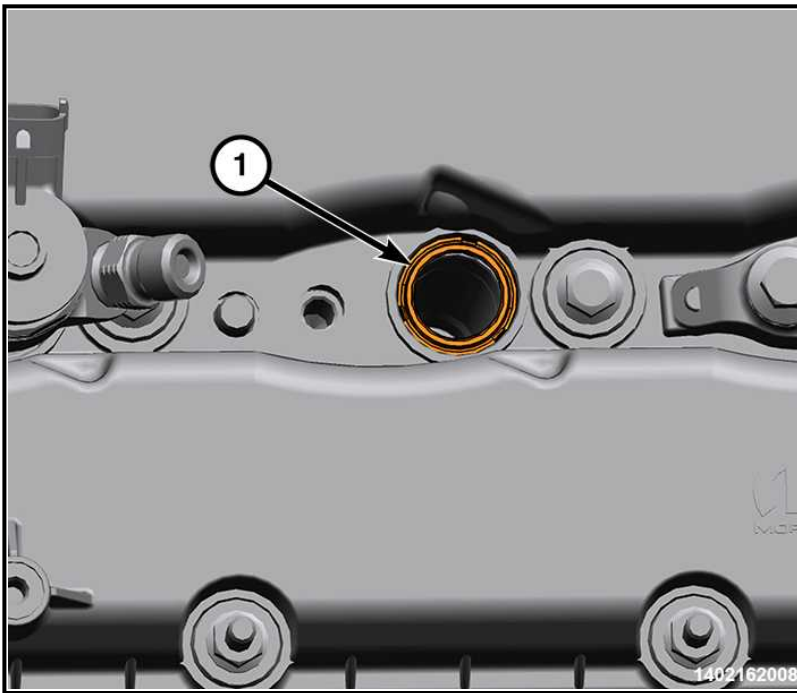
NOTE: Check the tip of the injector, if it is found to be loose then replace the fuel injector with a **NEW** one.

NOTE: Any time a **NEW** fuel injector is being installed, or if an existing injector is installed in any location other than its original location, the injector quantity adjustment procedure must be performed. Refer to **INJECTOR QUANTITY ADJUSTMENT** .

- Remove the protective cap from the appropriate injector bore.

NOTE: Make sure the old copper sealing washer is not stuck in bore.

- Clean the fuel injectors and injector bore. Refer to **INJECTOR(S), FUEL, CLEANING**.



1 - Fuel Injector Seal

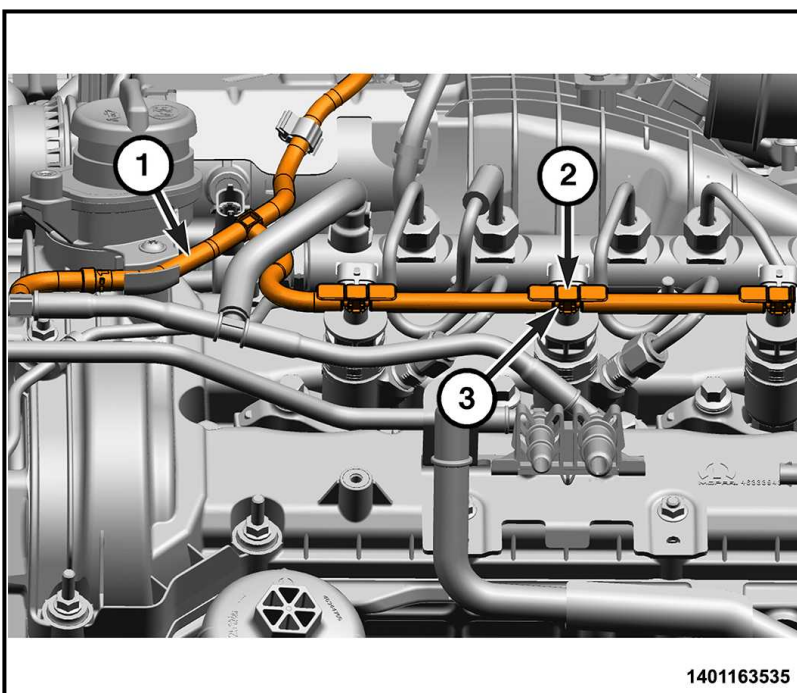
- Install a **NEW** fuel injector seal in the cylinder head cover.

NOTE: Do Not apply any lubricant to the fuel injector nozzle. Care must be taken not to restrict the discharge orifices in the nozzle.

- Install a **NEW** copper sealing washer onto the fuel injector.
- Lubricate the injector body with Nickel Anti-Seize Lubricant.

NOTE: Fuel tubes are a one time only use and must be replaced anytime they have been removed.

- Install the **NEW** fuel tubes. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).



1 - Fuel Return Line

2 - Locking Tab

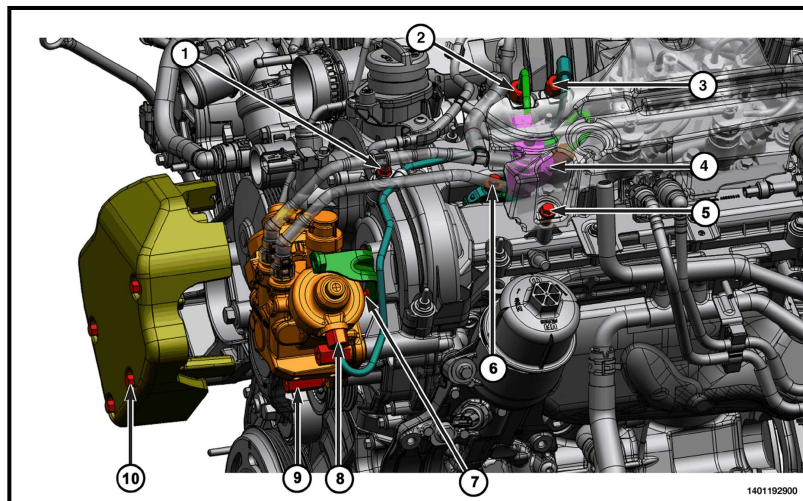
3 - Fuel Return Line

NOTE: Do not use any type of lubrication when installing the fuel injector return line.

- Install the fuel injector return line and **be sure it is fully seated**.
- Push down on the lock tab to lock in place.
- Install the fuel rail cover and securely tighten the fuel rail cover bolts.
- Start the engine and inspect. Using a soapy water solution, and spray around the fuel injectors to **verify no combustion leaks** are present. Turn the engine off, repair any leaks before continuing.
- When ever a **NEW** fuel injector is replaced run oxygen sensor value rest function.
- Using the scan tool, perform **Oxygen Sensor Value Reset** function found under ENGINE MISCELLANEOUS FUNCTIONS.

TORQUE SPECIFICATIONS

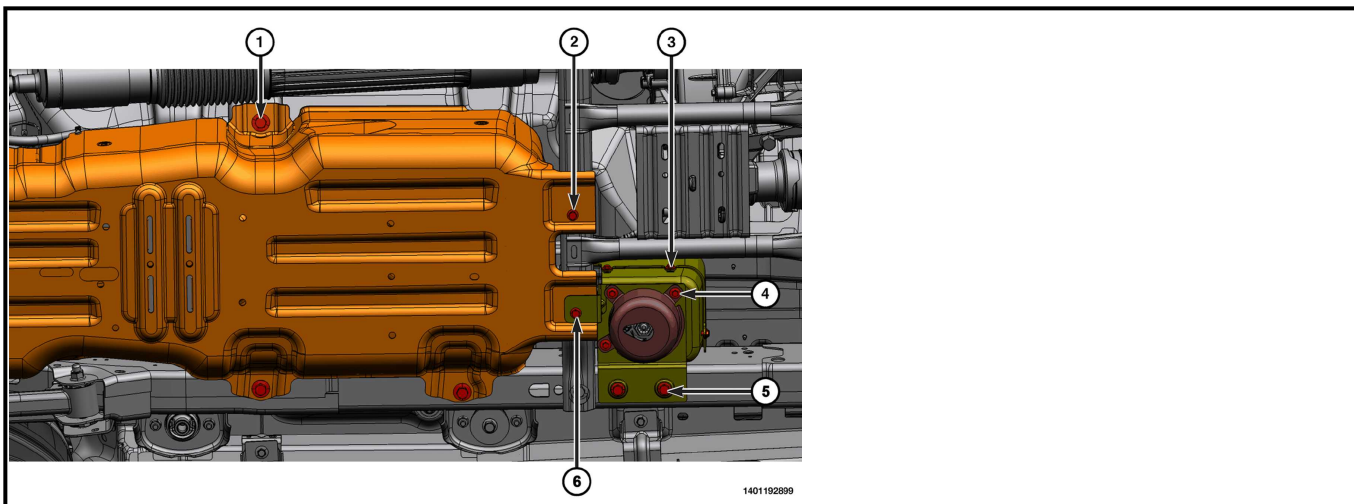
FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Å	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



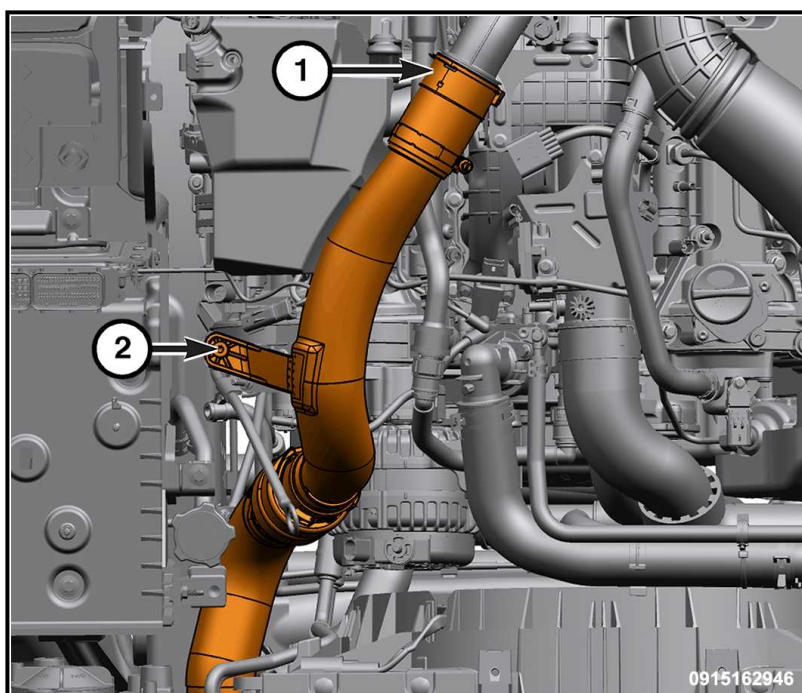
RIGHT BANK

REMOVAL

WARNING: Observe the following precautions when working on fuel systems: No sparks, open flames or smoking. Avoid inhaling and swallowing fuel. Avoid eye and skin contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing. Failure to observe these precautions may result in fire, explosion, property damage, and serious or fatal injury.

WARNING: High-pressure lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 2000 bar (29, 008 psi). Use extreme caution when inspecting for high-pressure fuel leaks. Fuel under this amount of pressure can penetrate skin causing personal injury or death. Inspect for high-pressure fuel leaks with a sheet of cardboard. Wear safety goggles and adequate protective clothing when servicing fuel system.

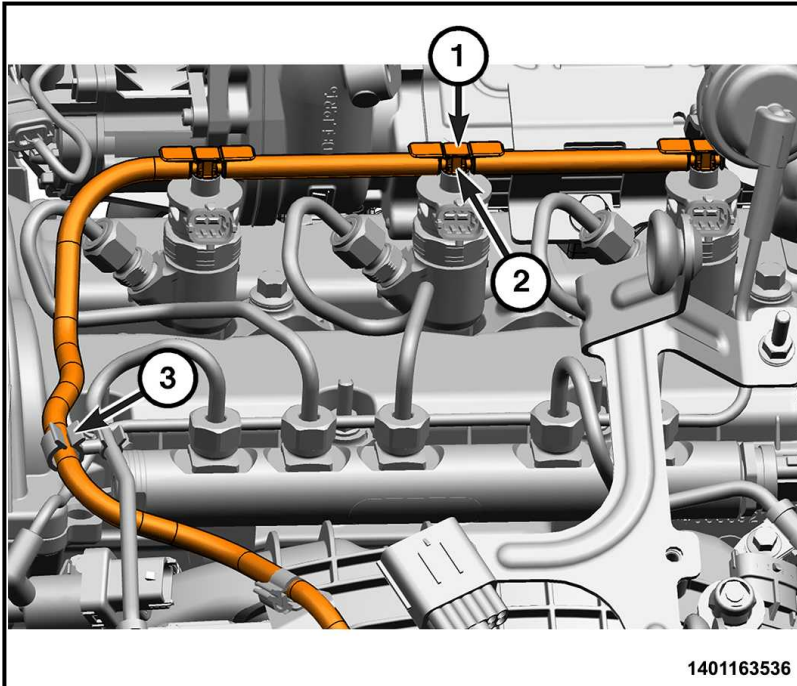
1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



1 - Retaining Clip

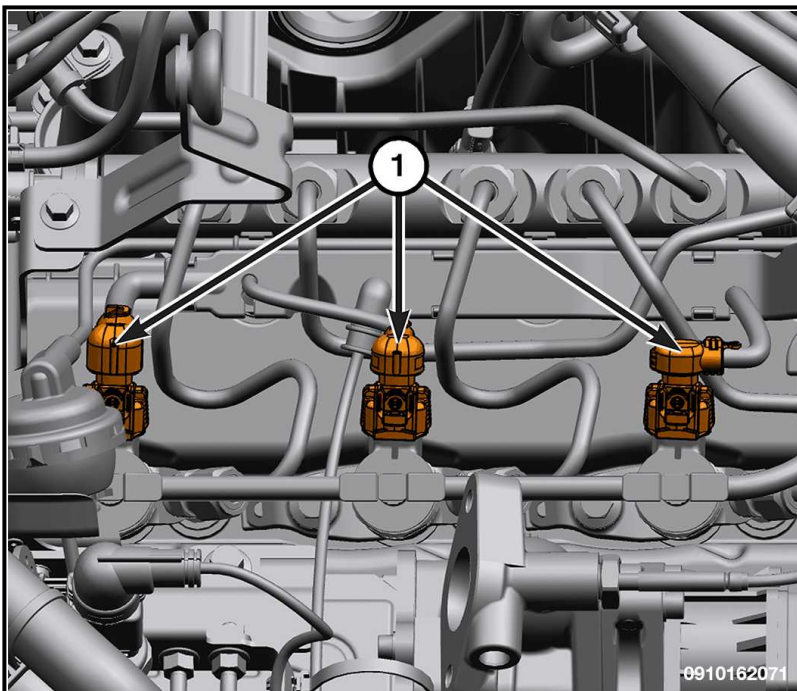
2 - Charge Air Cooler Hose Bolt

2. Remove the Charge Air Cooler (CAC) hose bolt securing the CAC hose to the support bracket.
3. Release the retaining clip and disconnect the CAC hose from the turbocharger elbow.
4. Disconnect the vacuum hose from the vacuum pump.
5. Remove the upper EGR tube. Refer to **TUBE, EXHAUST GAS RECIRCULATION (EGR), REMOVAL AND INSTALLATION**.



- | |
|-------------------------------|
| 1 - Locking Tab |
| 2 - Fuel Return Line |
| 3 - Fuel Return Line Retainer |

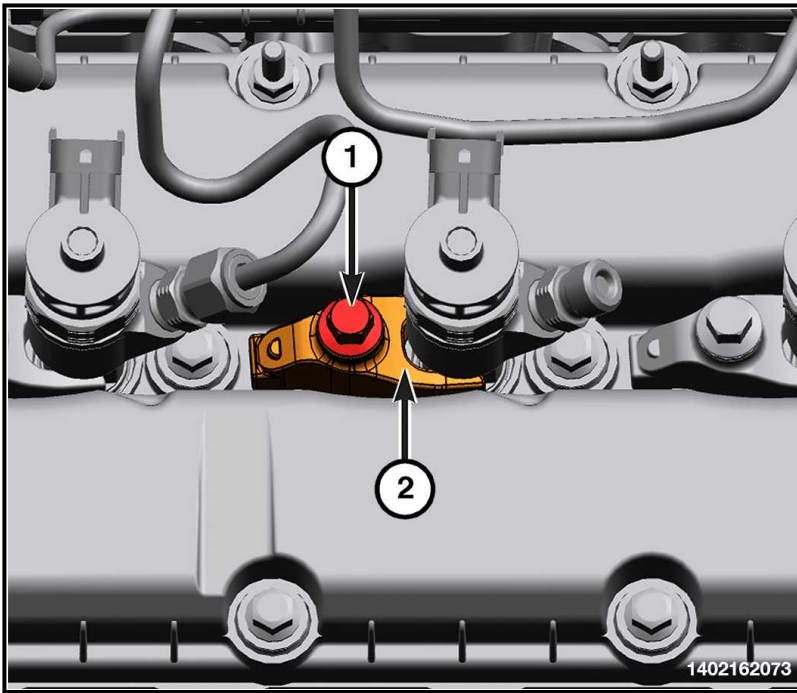
6. Lift up on the locking retaining tab to unlock the lock.
7. Disconnect the fuel return line by wiggling the hose free from the fuel injector.



- | |
|---|
| 1 - Fuel Injector Wire Harness Connectors |
|---|

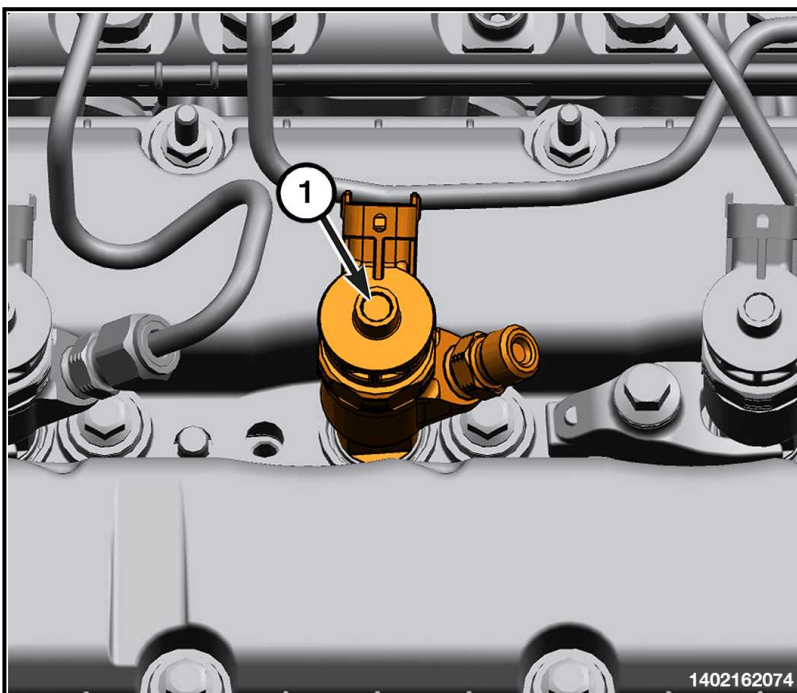
8. Disconnect the fuel injector wire harness connector(s).

9. Remove the fuel tubes. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).
10. Clean the area around the fuel injector to be removed, so no debris falls into the injector bore.



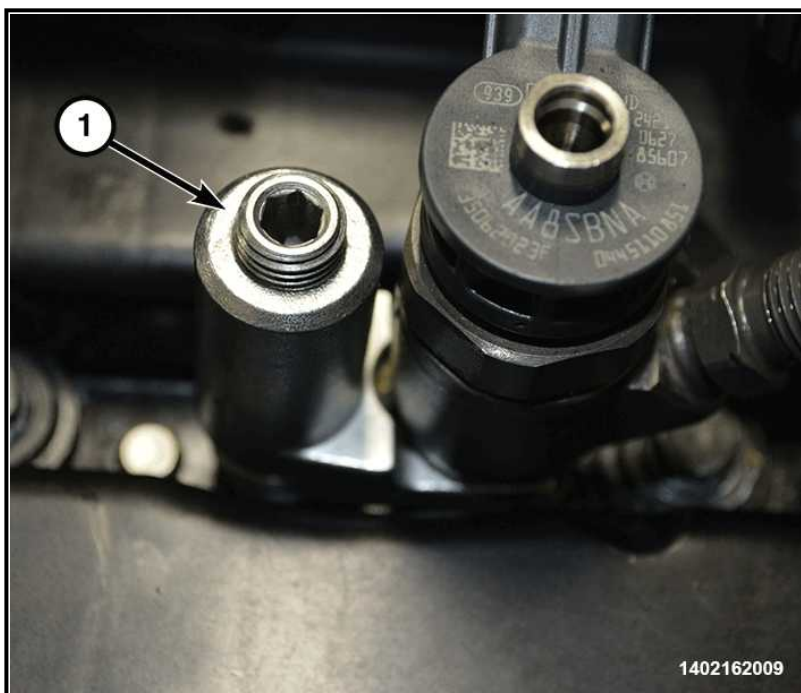
- | |
|------------------------------|
| 1 - Fuel Injector Clamp Bolt |
| 2 - Fuel Injector Clamp |

11. Remove the fuel injector clamp bolt and the fuel injector clamp.



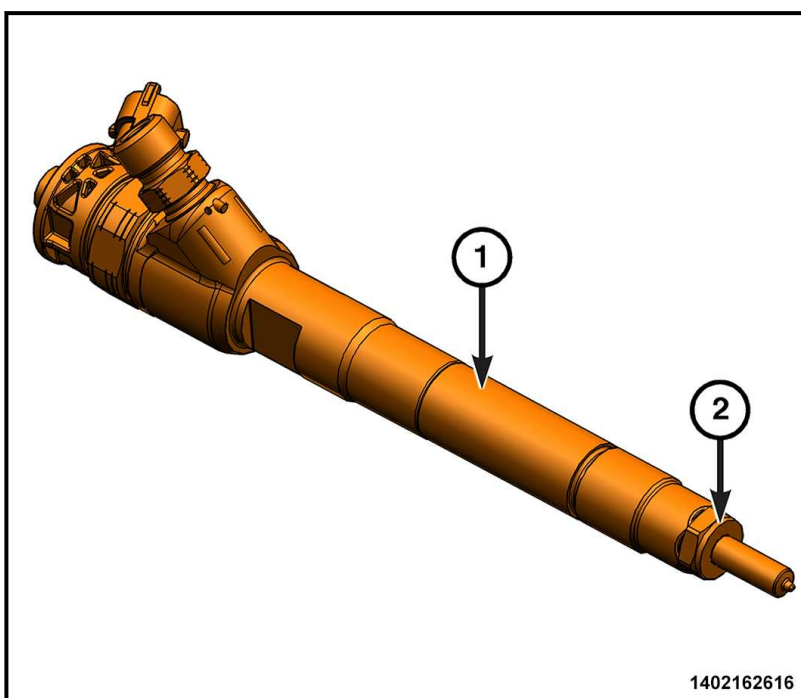
- | |
|-------------------|
| 1 - Fuel Injector |
|-------------------|

12. Using your hand, pull fuel injector straight up from cylinder head for removal. Discard the lower sealing washer and place a protective cap over the nozzle and injector bore.



1 - Fuel Injector Remover Tool

13. If injector can't be removed by hand, install the (special tool #VM.10358A, Remover, Fuel Injector) to remove the fuel injector. Discard the lower sealing washer and place a protective cap over the nozzle and injector bore.



1 - Fuel Injector

2 - Copper Sealing Washer

NOTE: Check and **MAKE SURE** that the copper sealing washer did not remain in the cylinder head.

14. Remove and discard lower copper sealing washer and place a protective cap over the nozzle and injector bore.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

WARNING: No sparks, open flames or smoking. Risk of poisoning from inhaling and swallowing fuel. Risk of injury to eyes and skin from contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing.

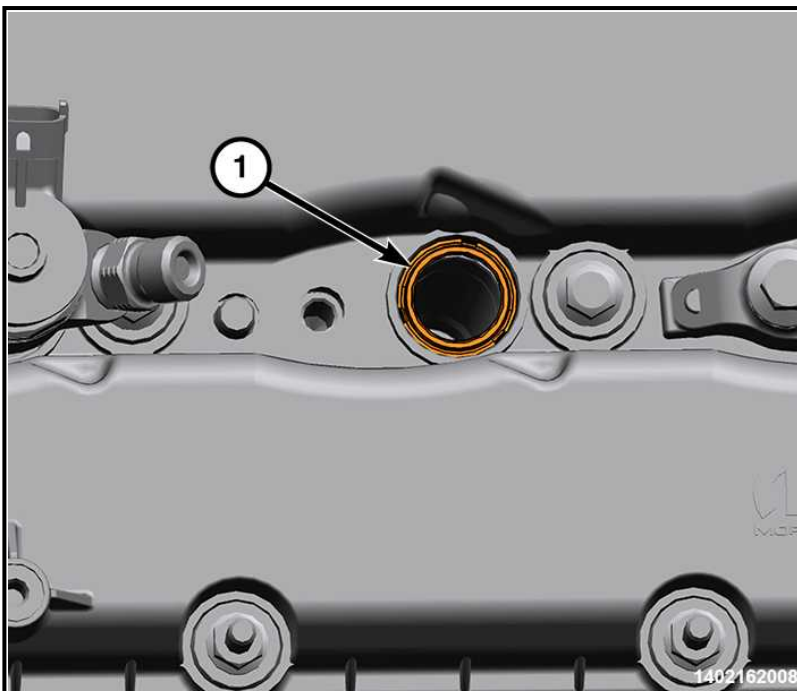
NOTE: Check the tip of the injector, if it is found to be loose then replace it with a **NEW** one.

NOTE: Any time a new fuel injector is being installed, or if an existing injector is installed in any location other than its original location, the injector quantity adjustment procedure must be performed. Refer to [INJECTOR QUANTITY ADJUSTMENT](#) .

- Remove the protective cap from the appropriate injector bore.

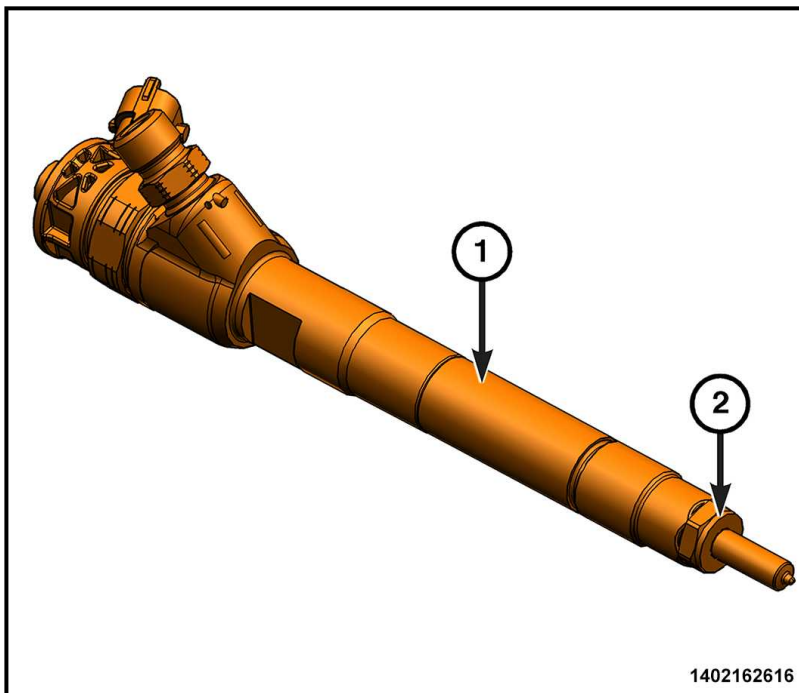
NOTE: Make sure the old copper sealing washer is not stuck in injector bore.

- Clean the fuel injectors and the injector bore. Refer to [INJECTOR\(S\), FUEL, CLEANING](#).



1 - Fuel Injector Seal

- Install a **NEW** fuel injector seal in the cylinder head cover.



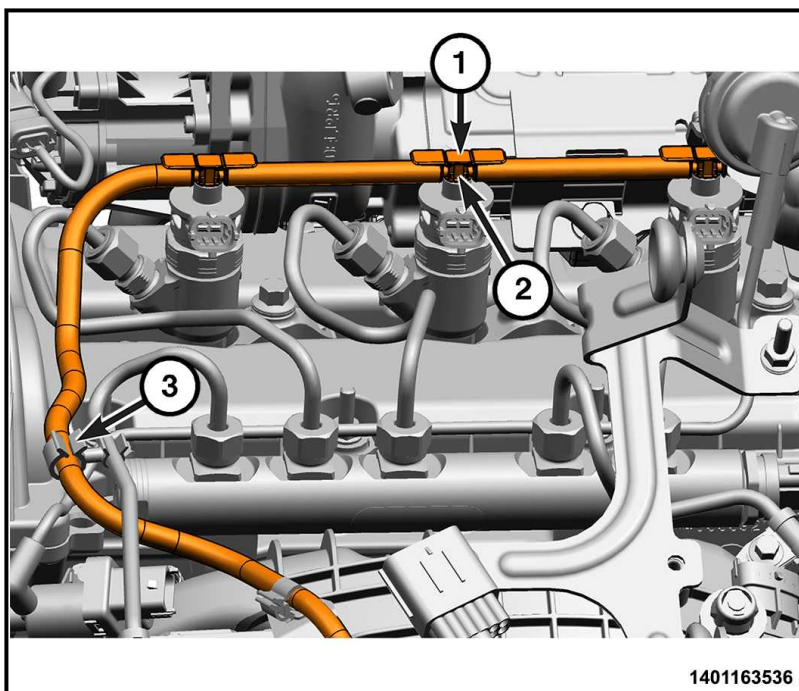
1 - Fuel Injector
2 - Copper Sealing Washer

NOTE: Do Not apply any lubricant to the fuel injector nozzle. Care must be taken not to restrict the discharge orifices in the nozzle.

- Install a **NEW** copper sealing washer onto the fuel injector.
- Lubricate the fuel injector body with Nickel Anti-Seize Lubricant.

NOTE: Fuel tubes are a one time only use and must be replaced anytime they have been removed.

- Install the **NEW** fuel tubes. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION.](#)



1 - Locking Tab
2 - Fuel Return Line

NOTE: Do not use any type of lubrication when installing the fuel injector return line.

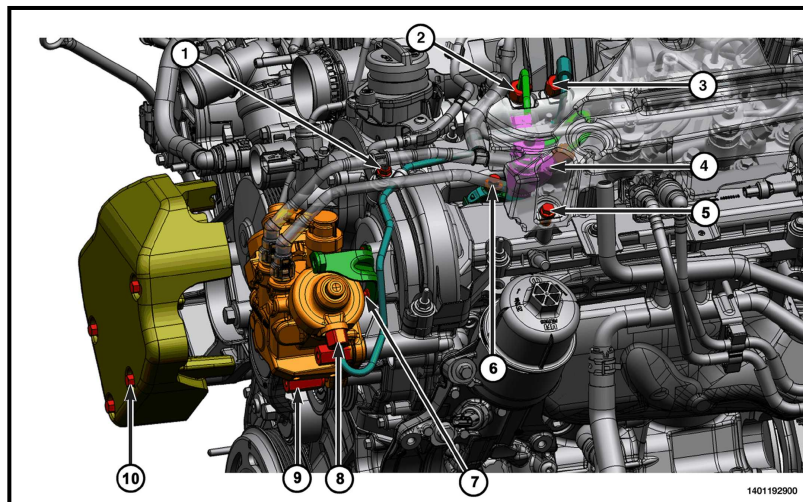
- Install the fuel injector return line and **be sure it is fully seated.**
- Push down on the lock tab to lock in place.
- Start the engine and inspect for leaks. Using a soapy water solution, and spray around the fuel injectors to **verify no combustion leaks** are present. Turn the engine off, repair any leaks before continuing.

NOTE: When ever a **NEW** fuel injector is replaced run oxygen sensor value rest function.

- Using the scan tool, perform **Oxygen Sensor Value Reset** function found under ENGINE MISCELLANEOUS FUNCTIONS.

TORQUE SPECIFICATIONS

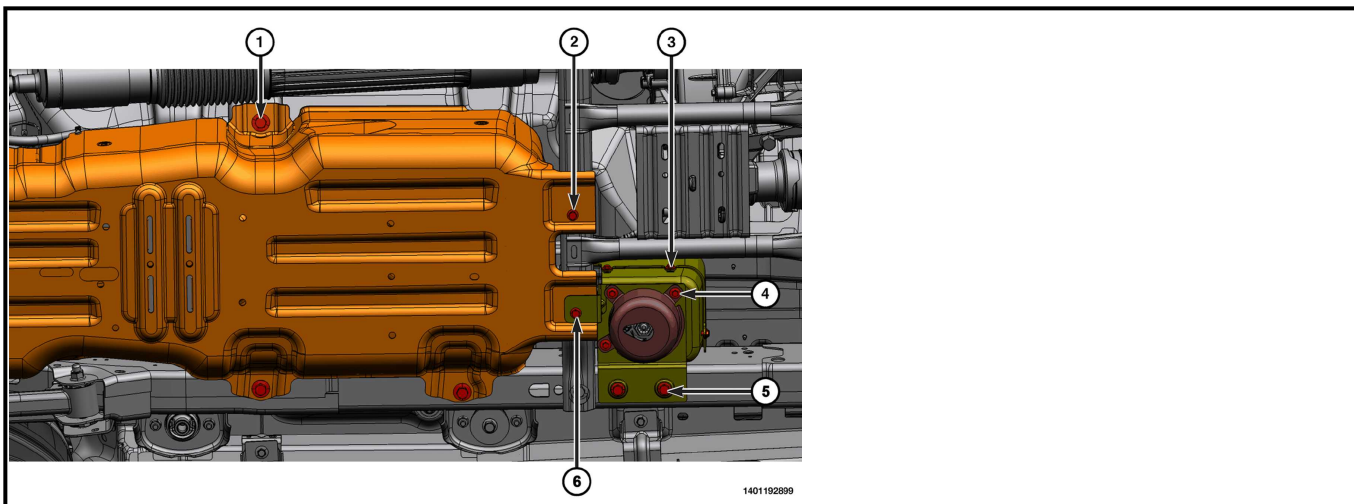
FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Å	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



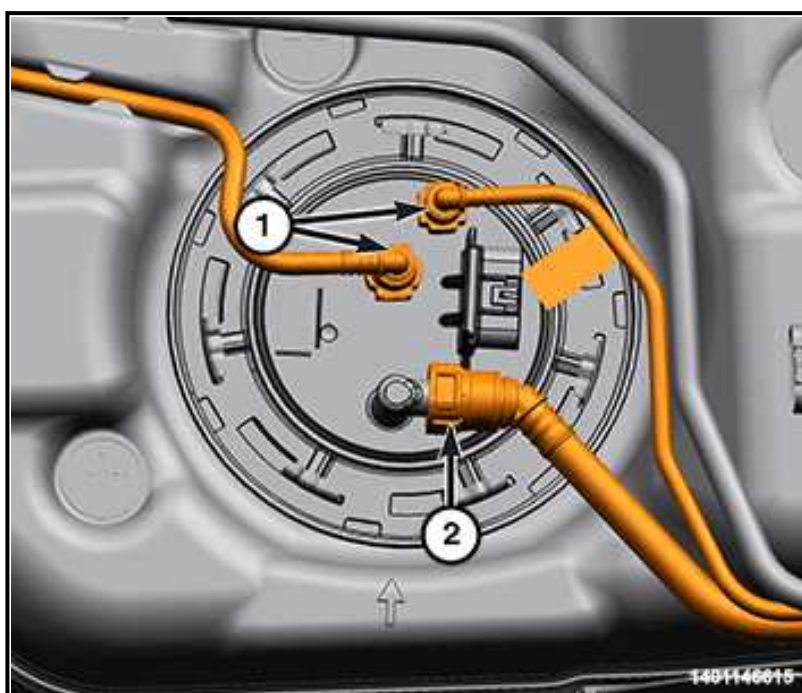
ASSEMBLY, FUEL PUMP

REMOVAL AND INSTALLATION

FUEL PUMP

REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#).
2. Remove the fuel tank. Refer to [TANK, FUEL, REMOVAL AND INSTALLATION](#).



- | |
|----------------------------------|
| 1 - Fuel Supply and Return Lines |
| 2 - Fuel Tank Purge Line |

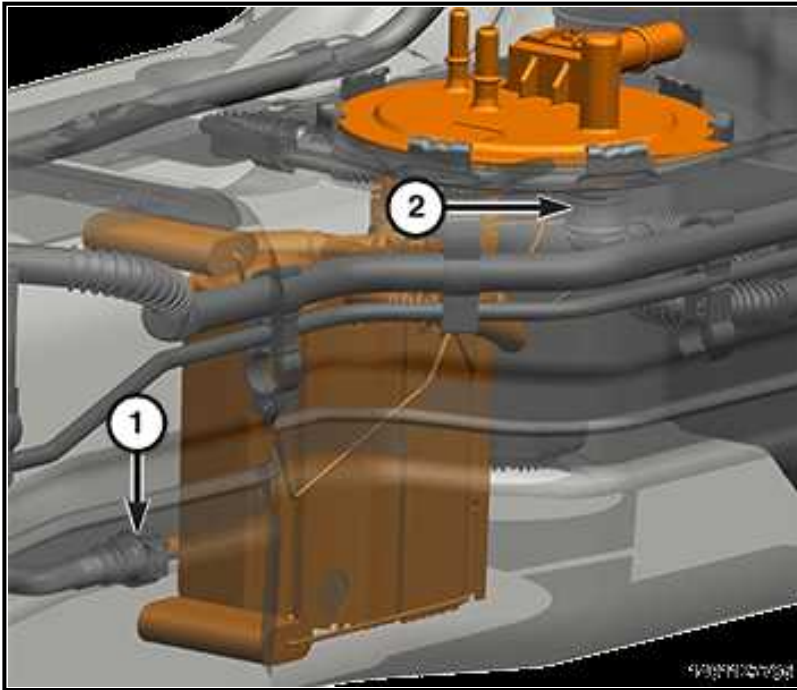
3. Disconnect the fuel supply and return line quick connect fitting. Refer to [REMOVAL AND INSTALLATION](#).
4. Disconnect the fuel tank purge line quick connect fitting. Refer to [REMOVAL AND INSTALLATION](#).

NOTE: Prior to removing the fuel pump module, use compressed air to remove any accumulated dirt and debris from around fuel tank opening.

CAUTION: An indexing arrow is located on top of the main fuel pump module to clock it's position into the fuel tank, note it's location for reassembly.

5. Position the SAE Fuel Pump Lock Ring Wrench (special tool #9340, SAE Fuel Pump Lock Ring Wrench) into the notches on the outside edge of the lock ring.
6. Install a 1/2 inch drive breaker bar into the SAE Fuel Pump Lock Ring Wrench (special tool #9340, SAE Fuel Pump Lock Ring Wrench).
7. Rotate the breaker bar counterclockwise and remove the lock ring.

CAUTION: Whenever the fuel pump module is serviced, the rubber O-ring seal must be replaced.



- | |
|------------------------|
| 1 - Fuel Pickup Tube |
| 2 - Internal Vent Line |

8. Disconnect the internal tank lines from the fuel pump module while removing from the tank.
9. Remove and discard the rubber O-ring seal.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

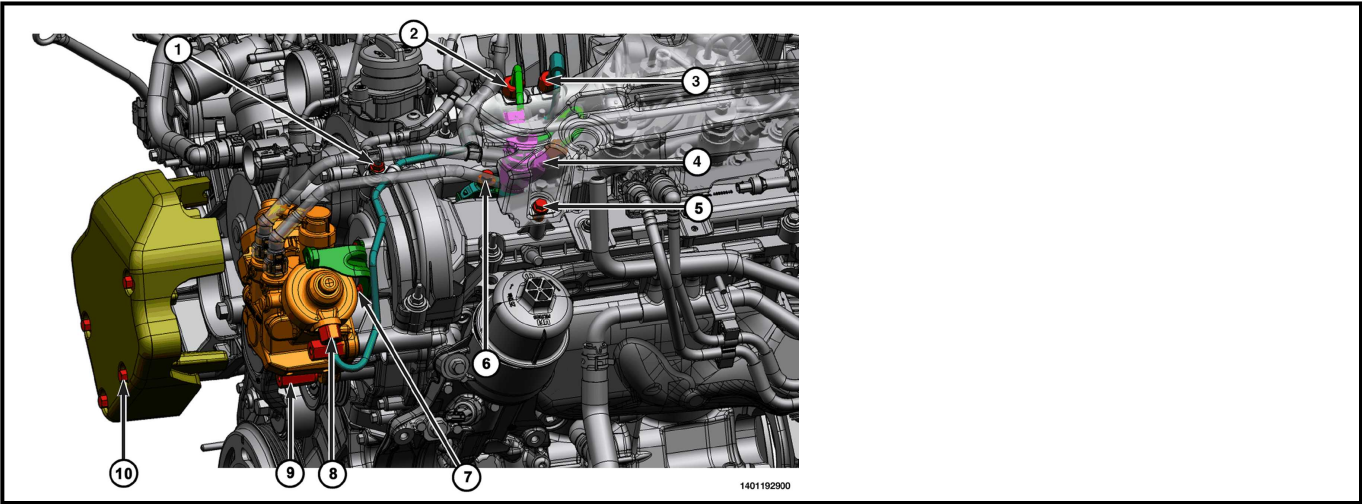
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

CAUTION: An indexing arrow is located on top of the main fuel pump module to clock it's position into the fuel tank. The fuel pump module must be installed in the same position as removed.

- Use a **NEW** rubber O-ring seal with the fuel pump module.
- Rotate the fuel pump module until the embossed alignment arrow points to the center alignment mark or the same position as noted during removal. This step must be performed to prevent the float from contacting the side of the fuel tank.
- Use the Fuel Pump Lock Ring Wrench (special tool #9340, SAE Fuel Pump Lock Ring Wrench) and a 1/2 inch drive breaker bar to tighten the lock ring.
- Rotate the breaker bar clockwise until all seven notches of the lock ring have engaged.
- Verify that the fuel line quick connect fittings are completely engage and locked on the fuel pump.
- Start the engine and check for leaks at all fuel tank connections.

TORQUE SPECIFICATIONS

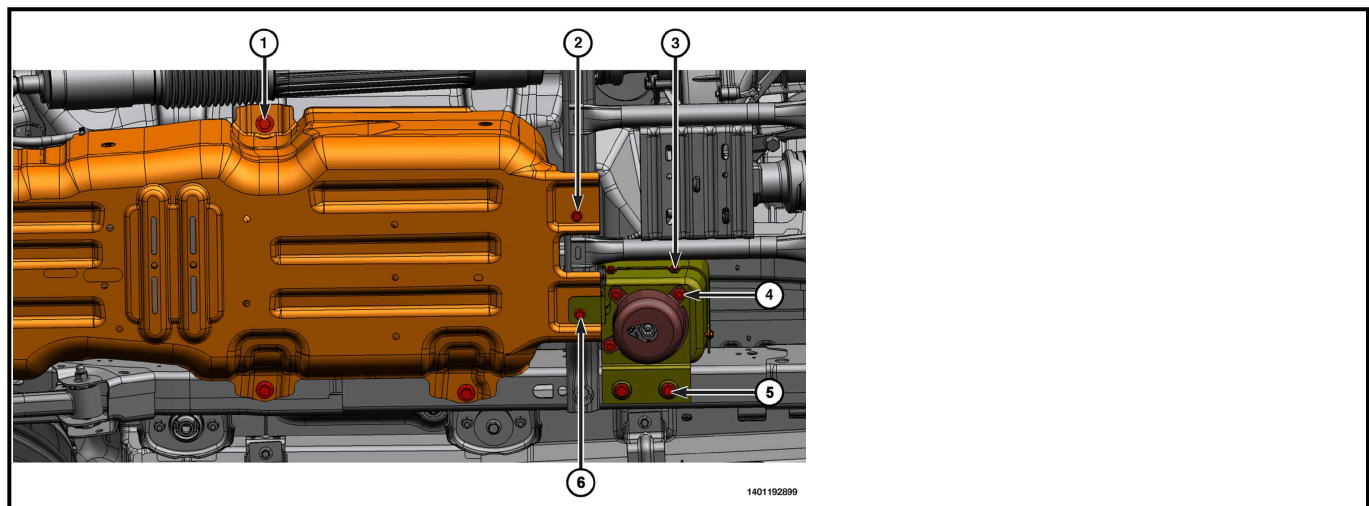
FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
		2. Tighten to 7 N.m (62 In. Lbs.)	
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Â	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



HIGH PRESSURE FUEL PUMP

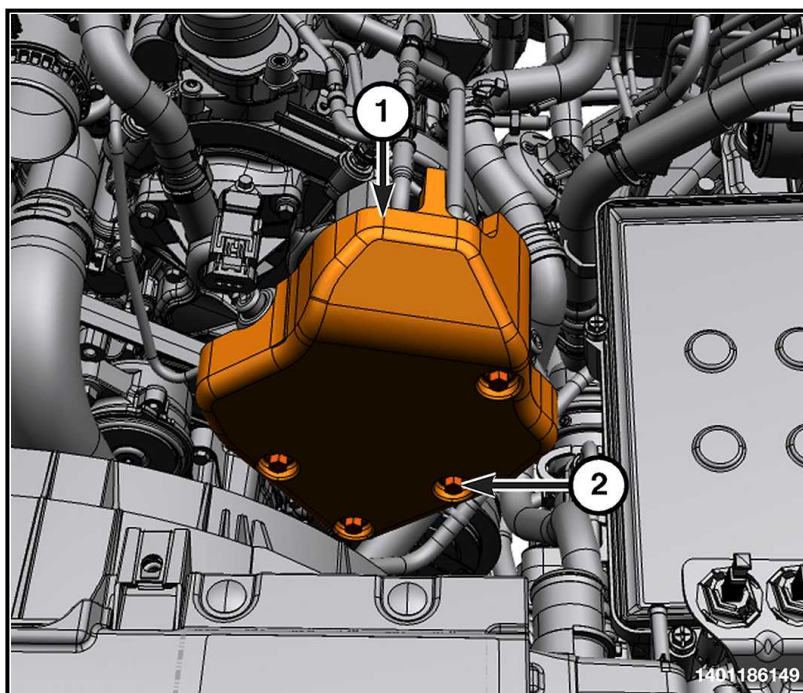
REMOVAL

WARNING: High-pressure lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 2000 bar (29, 008 psi). Use extreme caution when inspecting for high-pressure fuel leaks. Fuel under this amount of pressure can penetrate skin causing personal injury or death. Inspect for high-pressure fuel leaks with a sheet of cardboard. Wear safety goggles and adequate protective clothing when servicing fuel system.

NOTE: When key is cycled to the off position, fuel system pressure automatically bleeds down.

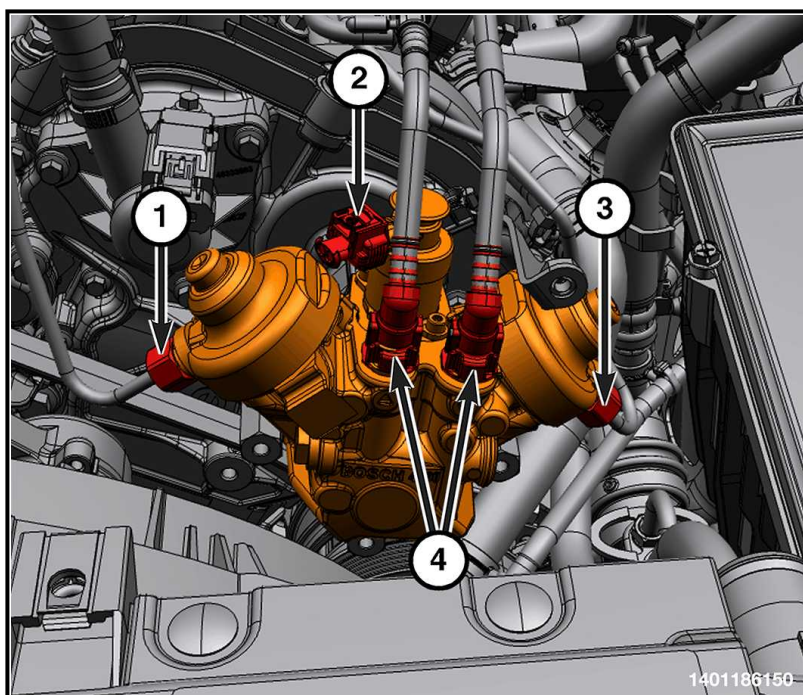
This procedure is for the removal and installation of the fuel injection pump only. The fuel injection pump can be replaced without needing to perform the entire base engine valve timing procedure. This procedure gives instruction on how to properly align the new fuel injection pump. If the base engine valve timing must be performed. Refer to [VALVE TIMING](#) . The timing of the pump is crucial and the gear must not be moved once the pump is removed from the timing cover

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .



- | |
|---|
| 1 - Fuel Injection Pump Blocker Plate |
| 2 - Fuel Injection Pump Blocker Plate Bolts |

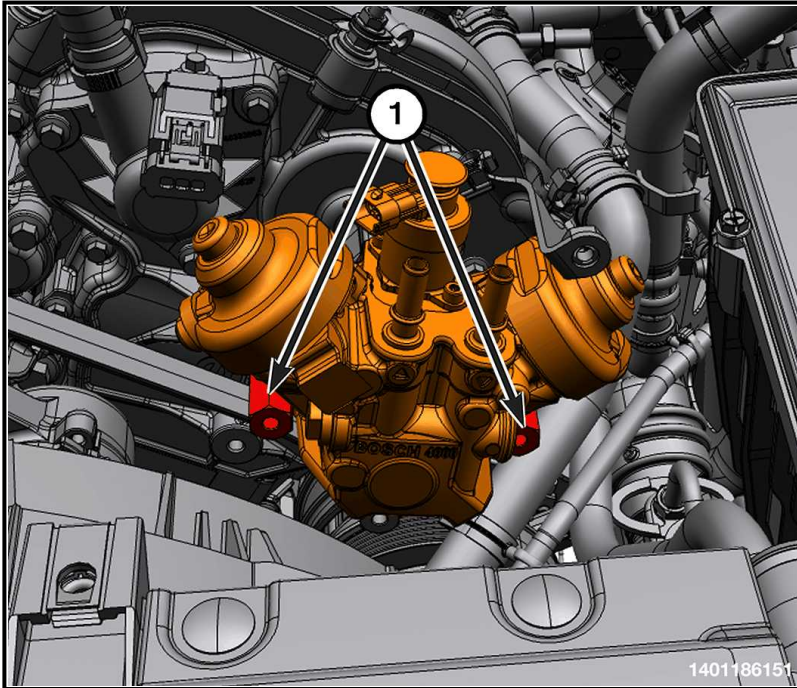
2. Remove the fuel injection pump blocker plate bolts and the fuel injection pump blocker plate from the fuel injection pump.



- | |
|---|
| 1 - Fuel Rail Supply Tubes |
| 2 - Fuel Quantity Solenoid Wire Harness Connector |
| 3 - Fuel Rail Supply Tubes |

4 - Low Pressure Fuel Supply/Return Lines

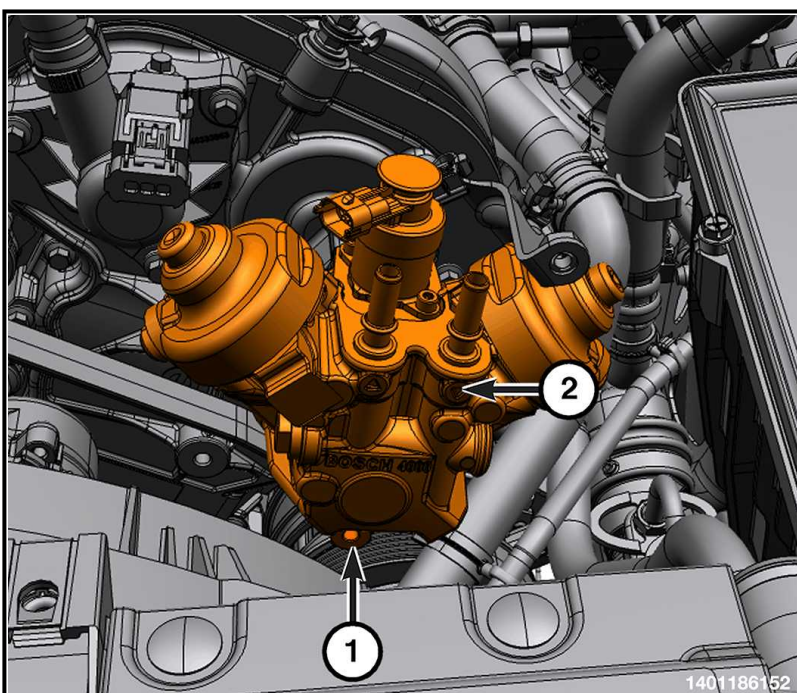
3. Remove the fuel rail supply tubes. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).
4. Disconnect the low pressure fuel supply/return lines.
5. Disconnect the fuel quantity solenoid wire harness connector.



1 - Fuel Injection Pump Upper Bolts

6. Remove the fuel injection pump upper bolts from the fuel injection pump.
7. Install the (special tool #VM.10345, Tool, High Pressure Pump Installation) in the upper locations.

NOTE: The timing of the pump is crucial and the gear must not be moved once the pump is removed from the timing cover.



1 - Fuel Injection Pressure Pump Lower Bolt

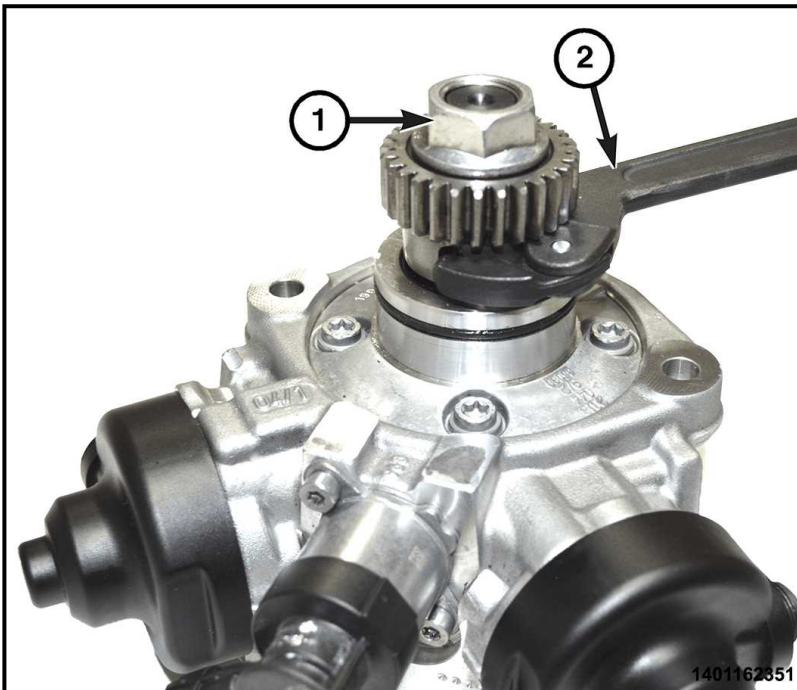
2 - Fuel Injection Pressure Pump

8. Remove the fuel injection pump lower bolt and the fuel injection pump.



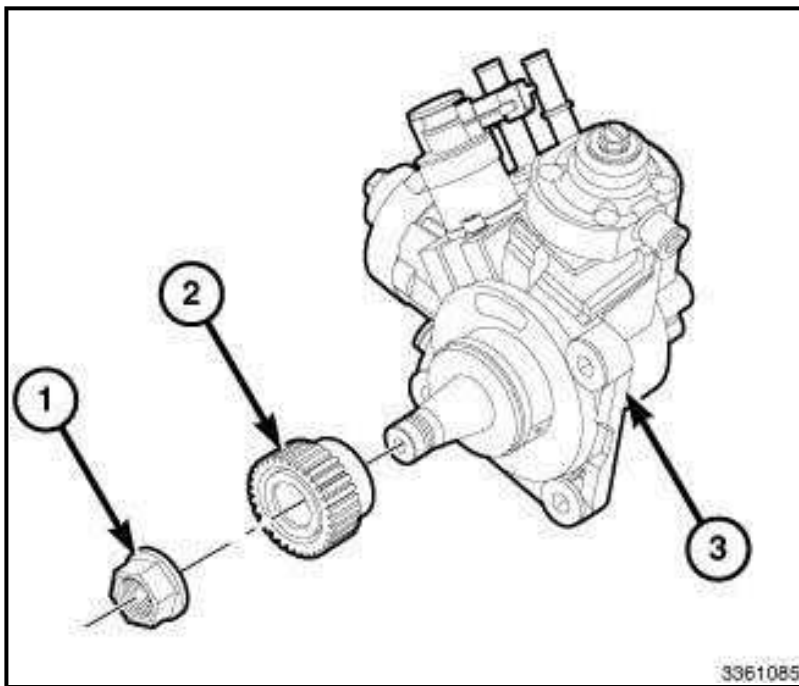
NOTE: The fuel injection pump needs to be timed using a commercially available degree wheel.

9. Install the degree wheel onto the fuel injection pump with the zero at the fuel quantity solenoid then mark the location of the hole in the gear on the degree wheel.



- | |
|----------------------------------|
| 1 - Fuel Injection Pump Gear Nut |
| 2 - Spanner Wrench |

10. Using a commercially available spanner wrench such as Blue Point APS35IB or equivalent to hold fuel injection pump gear. Remove the fuel injection pump gear nut.



1 - Fuel Injection Pump Gear Nut
2 - Fuel Injection Pump Gear
3 - Fuel Injection Pump

11. The use of (special tool #1023, Puller) or a commercially available gear puller is required to remove the fuel injection pump gear.

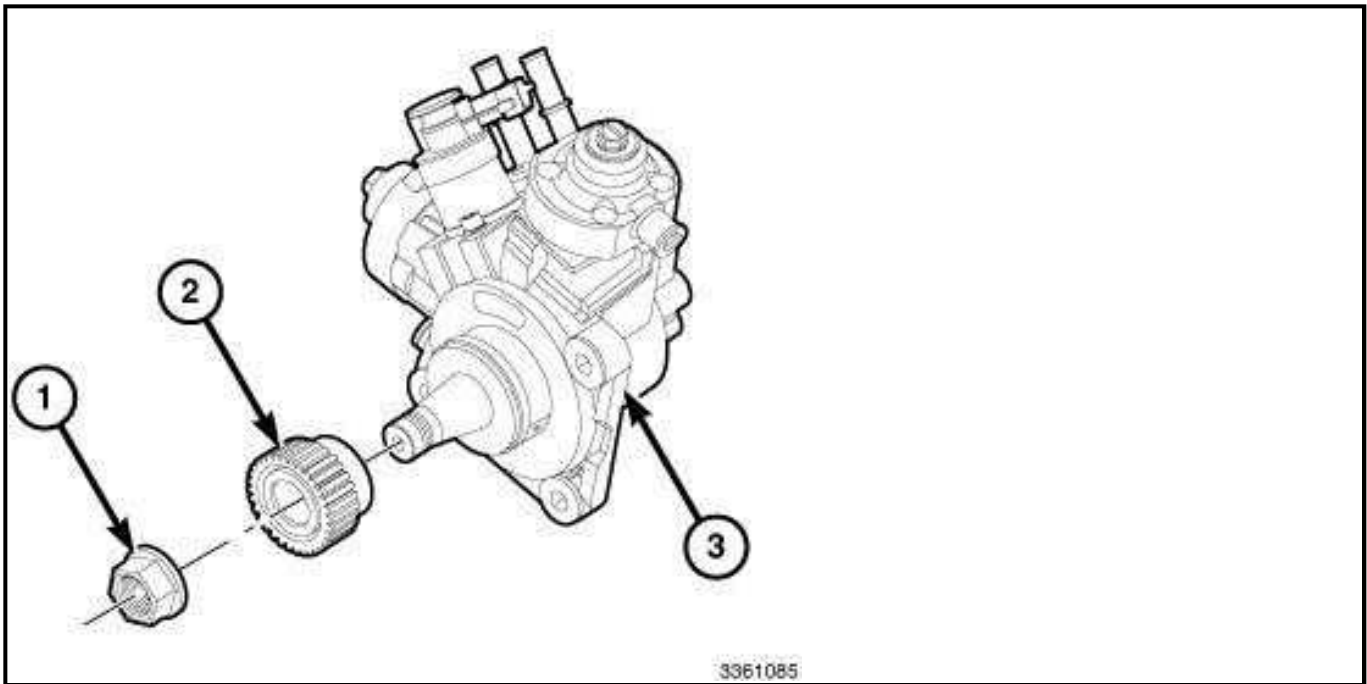
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

WARNING: High-pressure lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 2000 bar (29, 008 psi). Use extreme caution when inspecting for high-pressure fuel leaks. Fuel under this amount of pressure can penetrate skin causing personal injury or death. Inspect for high-pressure fuel leaks with a sheet of cardboard. Wear safety goggles and adequate protective clothing when servicing fuel system.

CAUTION: Do Not Force the high pressure pump into the right timing cover or attempt to seat it by drawing it in with the bolts. The pump gear must be properly aligned with the drive gear on the camshaft before the high pressure pump will seat on the cylinder head mounting surface. Failure to properly align drive gears will damage the high pressure pump or camshaft drive gear.

NOTE: The high pressure pump needs to be timed before it can be installed. Use a commercially available degree wheel to time the fuel injection pressure pump.

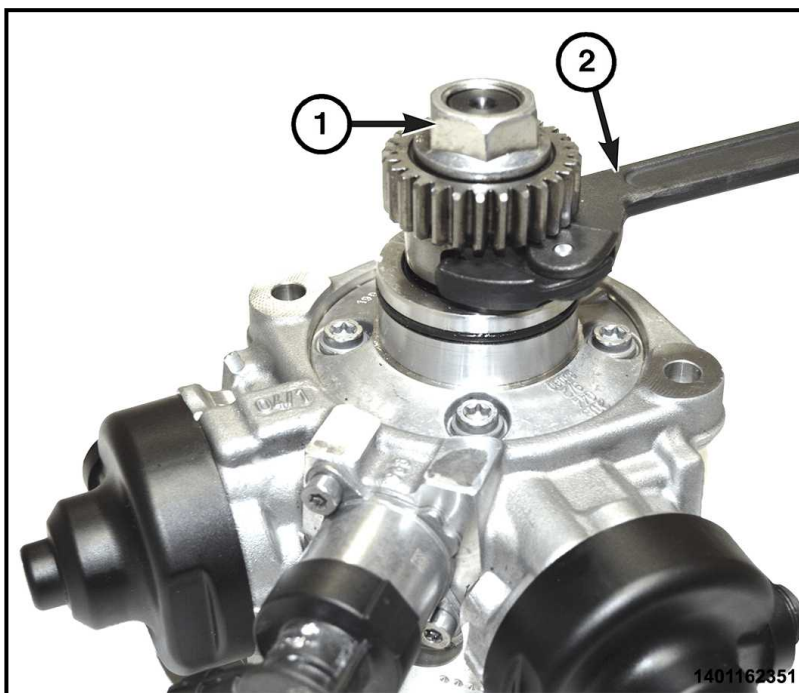


1 - Fuel Injection Pump Gear Nut

2 - Fuel Injection Pump Gear

3 - Fuel Injection Pump

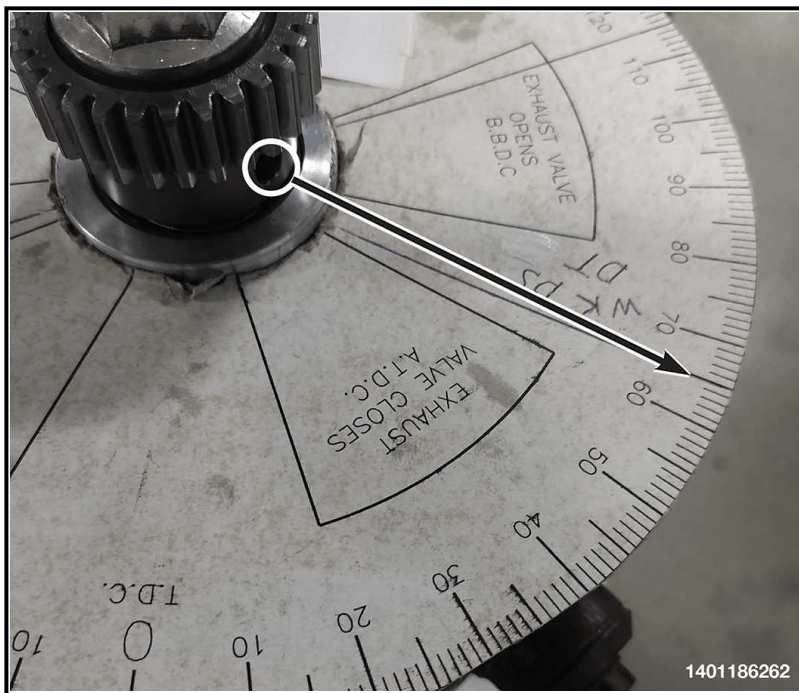
1. If removed, install the gear and nut onto the fuel injection pump and tighten the nut finger tight.



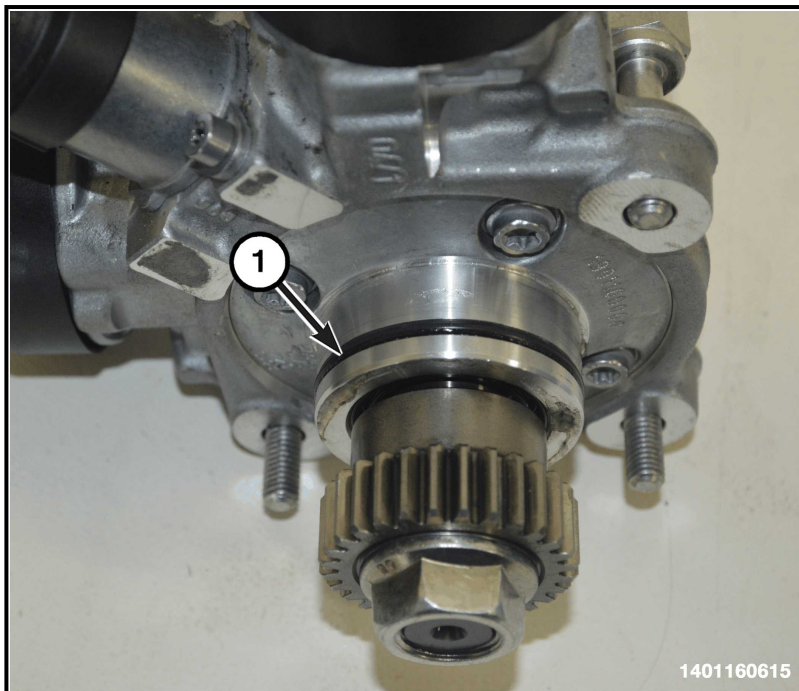
1 - Fuel Injection Pump Gear Nut

2 - Spanner Wrench

2. Using a commercially available spanner wrench such as Blue Point APS35IB or equivalent and tighten the fuel injection pump gear nut to the proper torque specifications.

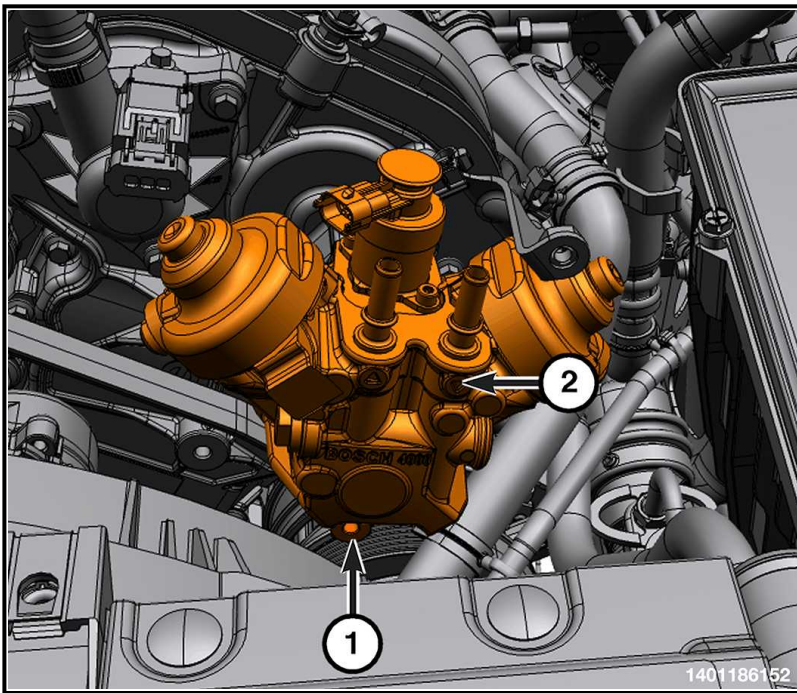


3. Install the degree wheel with the zero aligned with the fuel quantity solenoid and rotate the pump shaft so that the hole aligns with the reference mark on the degree wheel referenced during the removal.



1 - O-ring

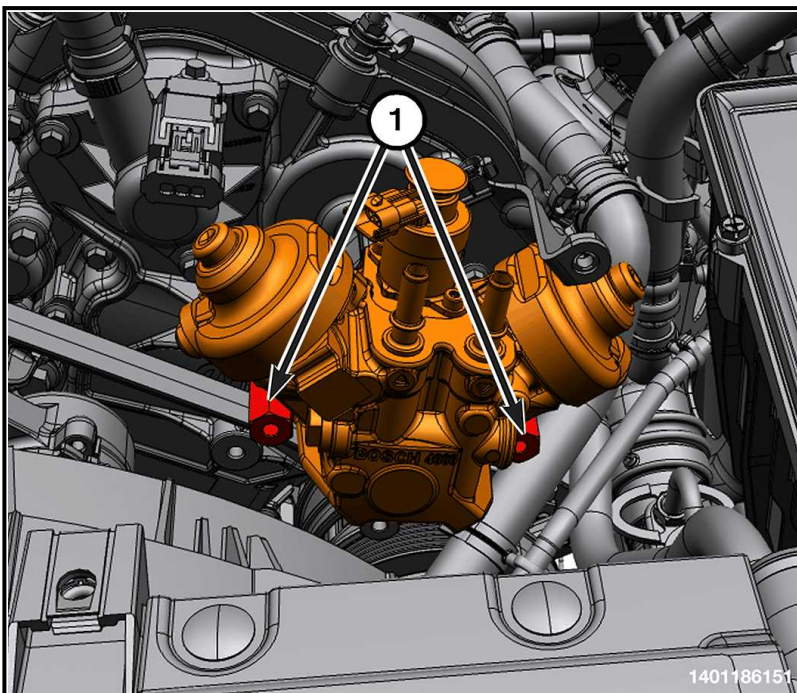
4. Install a **NEW** O-ring to the high pressure fuel injection pump.
5. Install the fuel injection pump onto the (special tool #VM.10345, Tool, High Pressure Pump Installation) into the studs installed in the upper timing cover.



1 - Fuel Injection Pressure Pump Lower Bolt

2 - Fuel Injection Pressure Pump

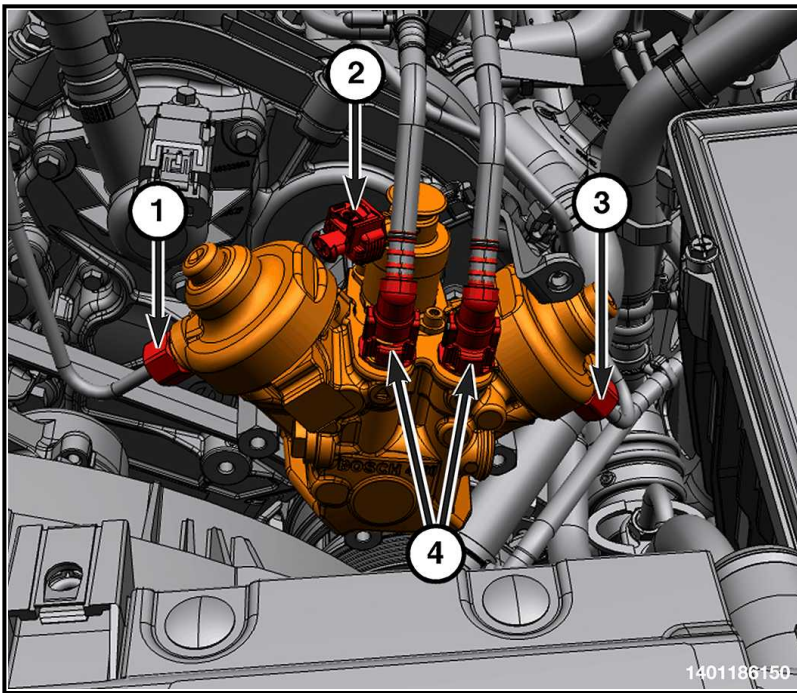
6. Install the fuel injection pump and hand tighten the bolt.



1 - High Pressure Fuel Injection Pump Upper Bolts

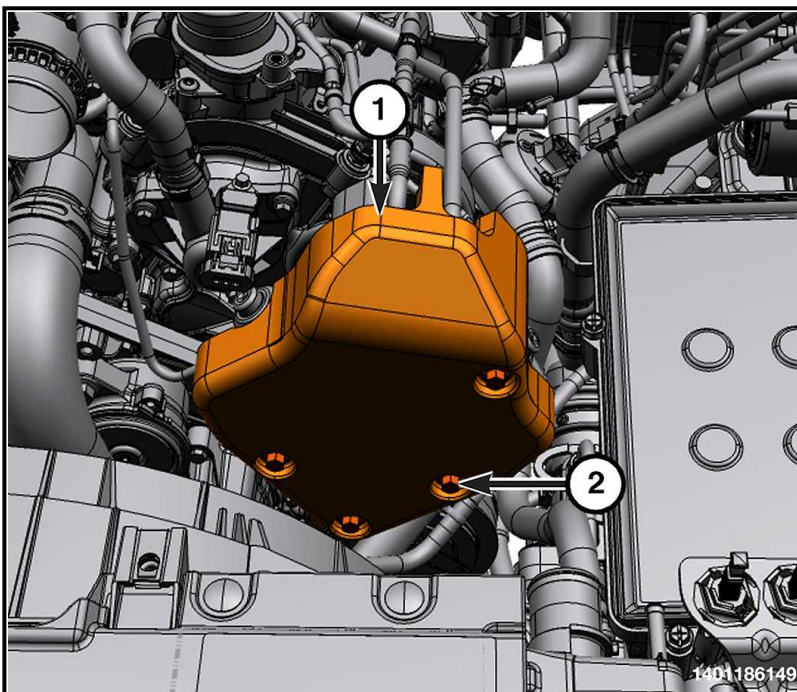
7. Remove the (special tool #VM.10345, Tool, High Pressure Pump Installation) and install the high pressure fuel injection pump upper bolts.

8. Tighten the high pressure fuel injection pump upper and lower bolts to the proper torque specifications.



1 - Fuel Rail Supply Tubes
2 - Fuel Quantity Solenoid Wire Harness Connector
3 - Fuel Rail Supply Tubes
4 - Low Pressure Fuel Supply/Return Lines

9. Connect the fuel quantity solenoid wire harness connector.
10. Connect the low pressure fuel supply/return lines.
11. Install the fuel rail supply tubes. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).



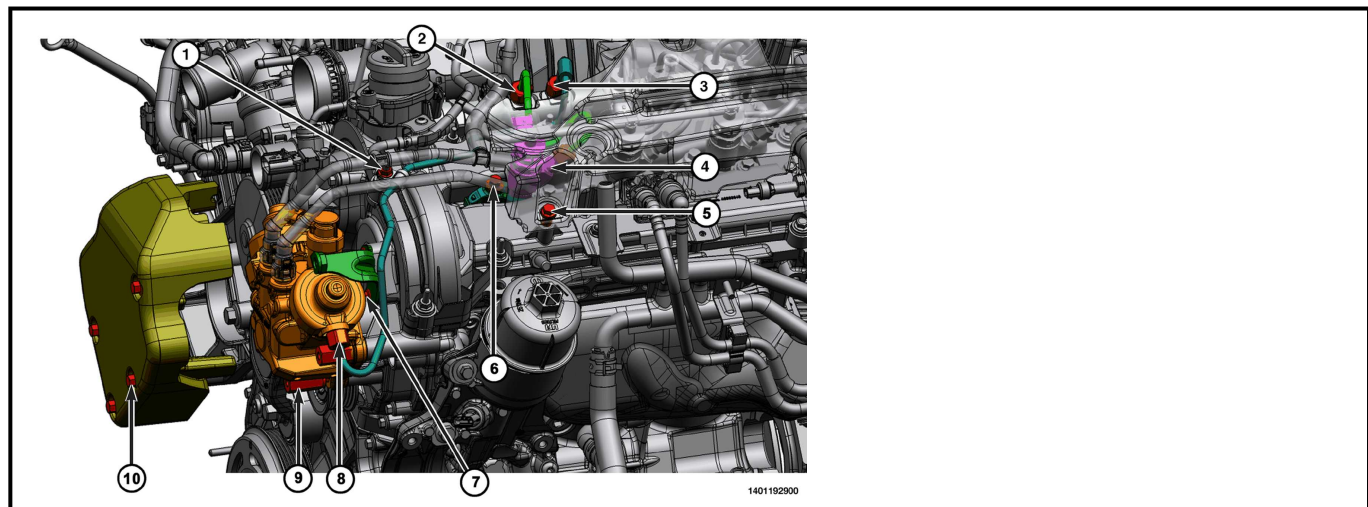
1 - Fuel Injection Pump Blocker Plate
2 - Fuel Injection Pump Blocker Plate Bolts

12. Install the fuel injection pump blocker plate and tighten the fuel injection pump blocker plate bolts to the proper torque specifications.
13. Connect the negative battery cable(s). Refer to [CABLES, BATTERY](#).

14. Start engine and check for leaks.

TORQUE SPECIFICATIONS

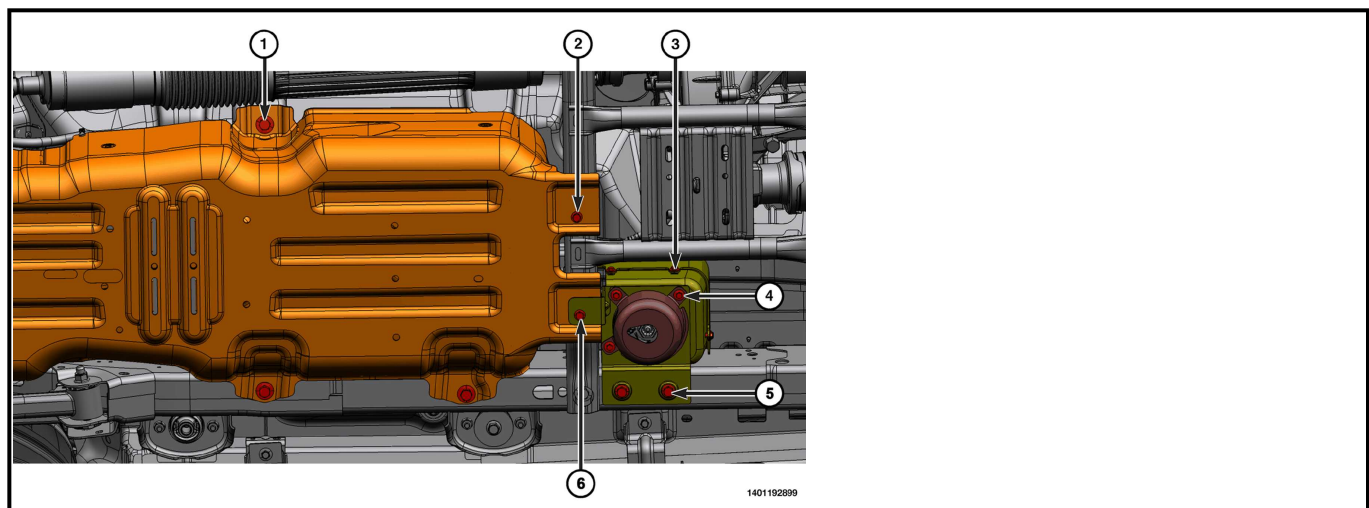
FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure:	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
		1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Â	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



MODULES

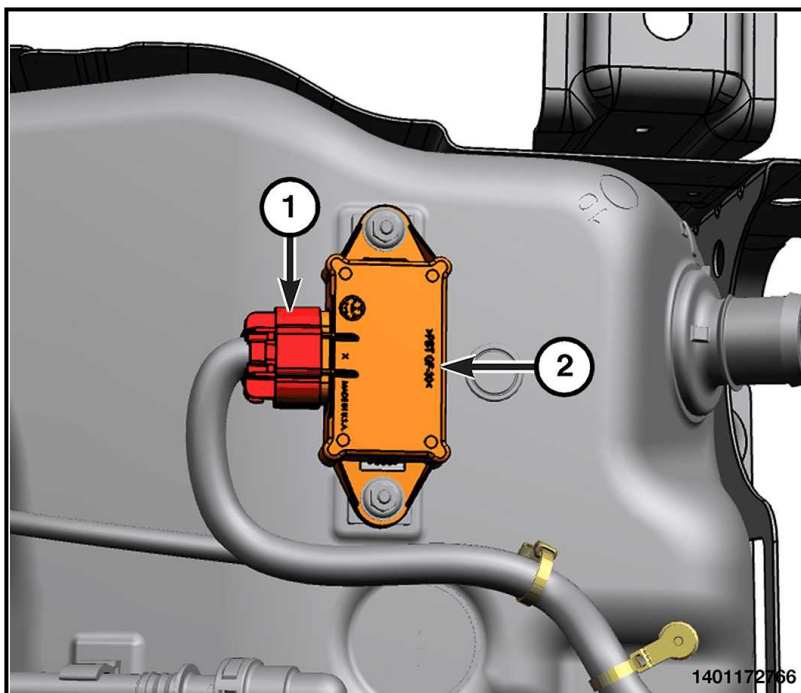
REMOVAL AND INSTALLATION

FUEL PUMP CONTROL MODULE

NOTE: If this Electronic Control Unit (ECU) is being replaced with a new unit, use a diagnostic scan tool to perform the Flash Programming Procedure (if available).

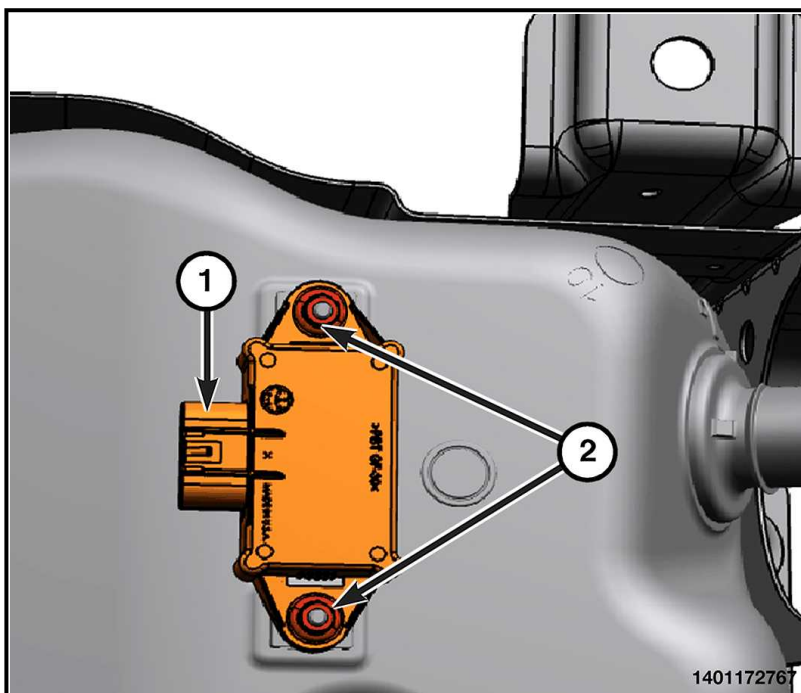
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .



- | |
|--|
| 1 - Fuel Pump Control Module Harness Connector |
| 2 - Fuel Pump Control Module |

3. Disconnect the fuel pump control module wire harness connector.



- | |
|-----------------------------------|
| 1 - Fuel Pump Control Module Nuts |
| 2 - Fuel Pump Control Module |

4. Remove the fuel pump control module nuts and the fuel pump control module.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

- Install the fuel pump control module and securely tighten the fuel pump control module nuts.

RAIL(S), FUEL

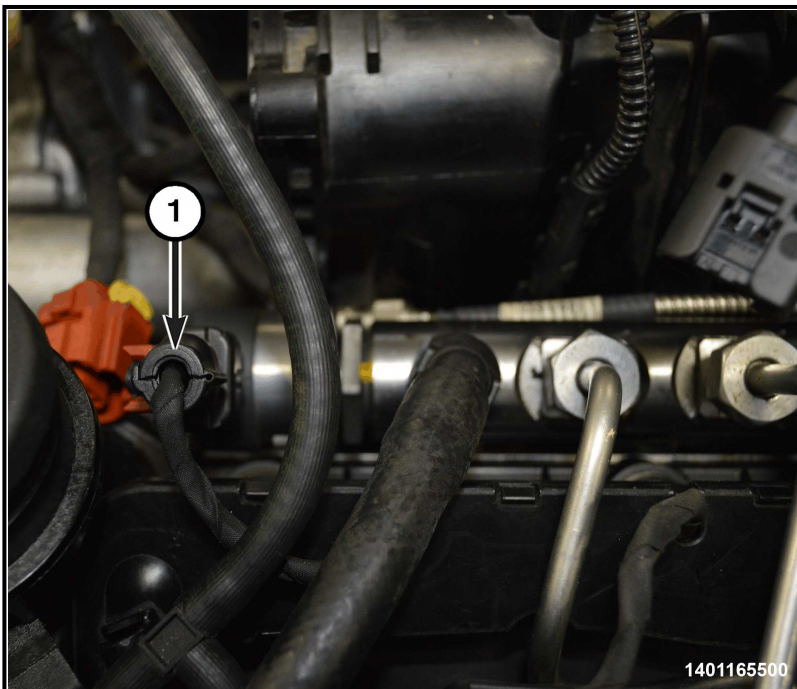
REMOVAL AND INSTALLATION

LEFT FUEL RAIL

REMOVAL

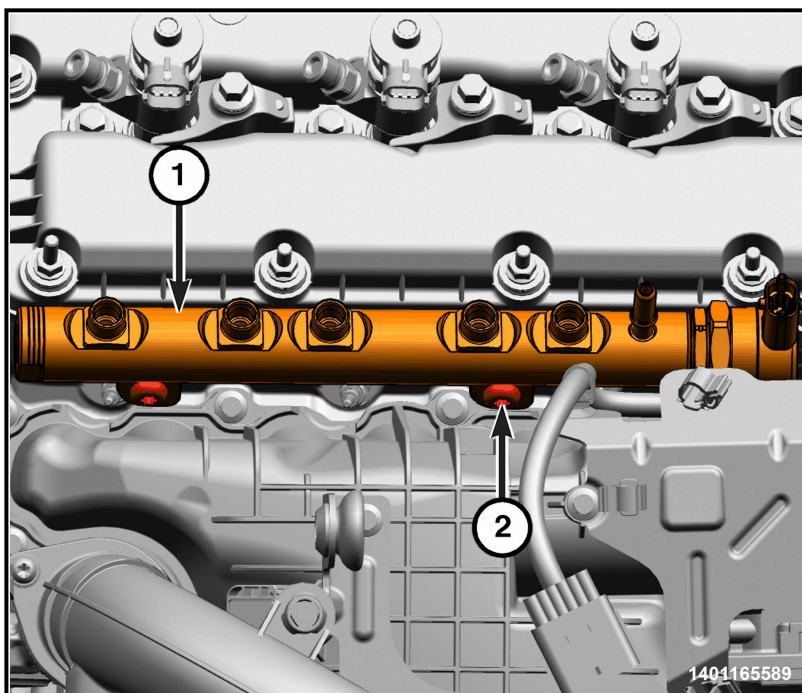
WARNING: No sparks, open flames or smoking. Risk of poisoning from inhaling and swallowing fuel. Risk of injury to eyes and skin from contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing.

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the left bank fuel tubes. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).



1 - Fuel Pressure Regulator Wire Harness Connector

3. Disconnect the fuel pressure regulator wire harness connector.
4. Disconnect the fuel rail return line and position aside.



1 - Left Fuel Rail
2 - Left Fuel Rail Bolts

5. Using the (special tool #2025400090, Remover-Installer, Fuel Rail Bolt), remove the left fuel rail bolts and the left fuel rail.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

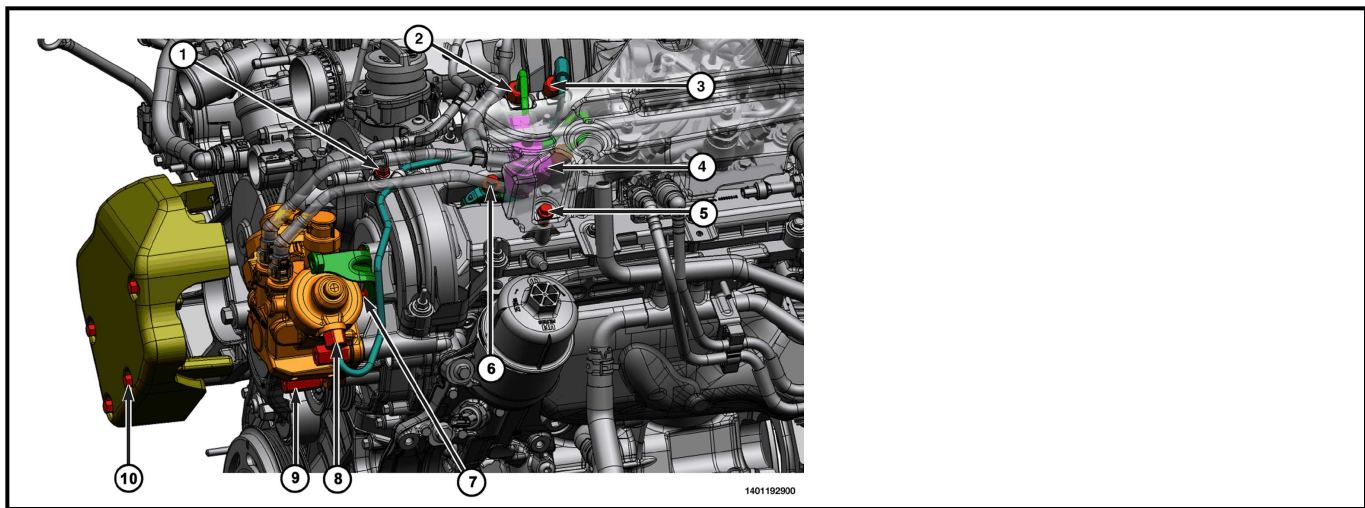
WARNING: No sparks, open flames or smoking. Risk of poisoning from inhaling and swallowing fuel. Risk of injury to eyes and skin from contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing.

NOTE: The fuel tubes must be replaced anytime they are removed.

- Install the **NEW** fuel tubes. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).
- Start engine, allow to warm, turn engine off and inspect for leaks.

TORQUE SPECIFICATIONS

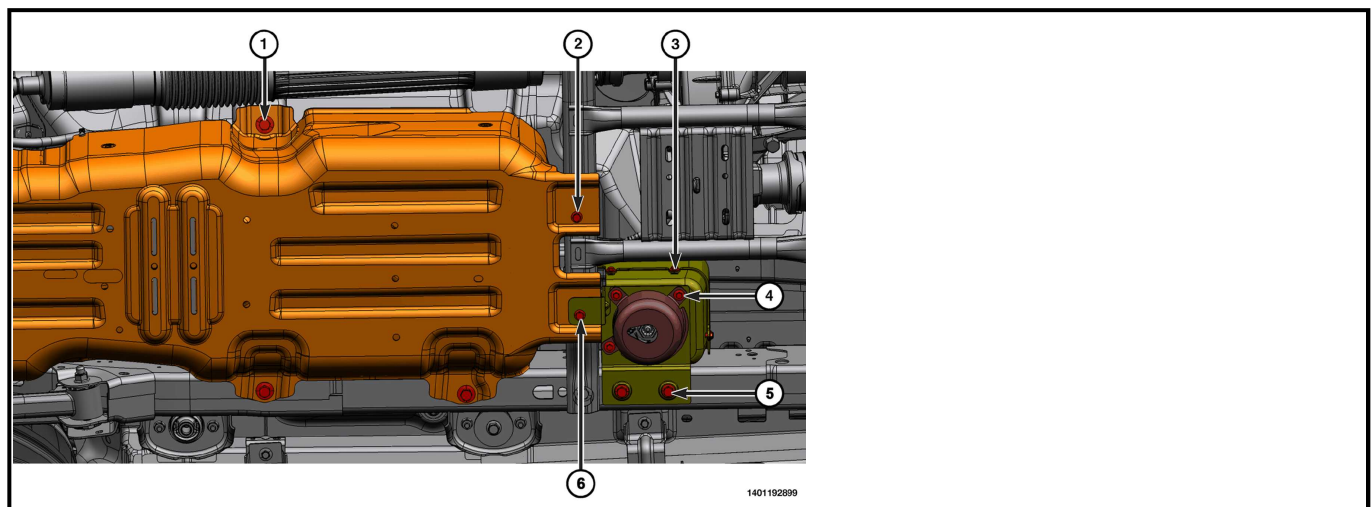
FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Â	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

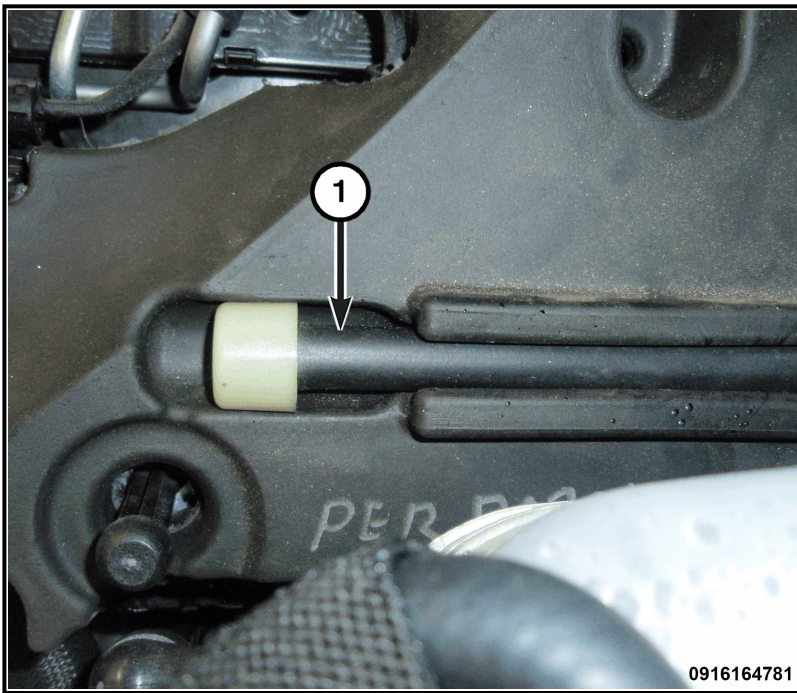
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



LEFT FUEL RAIL COVER

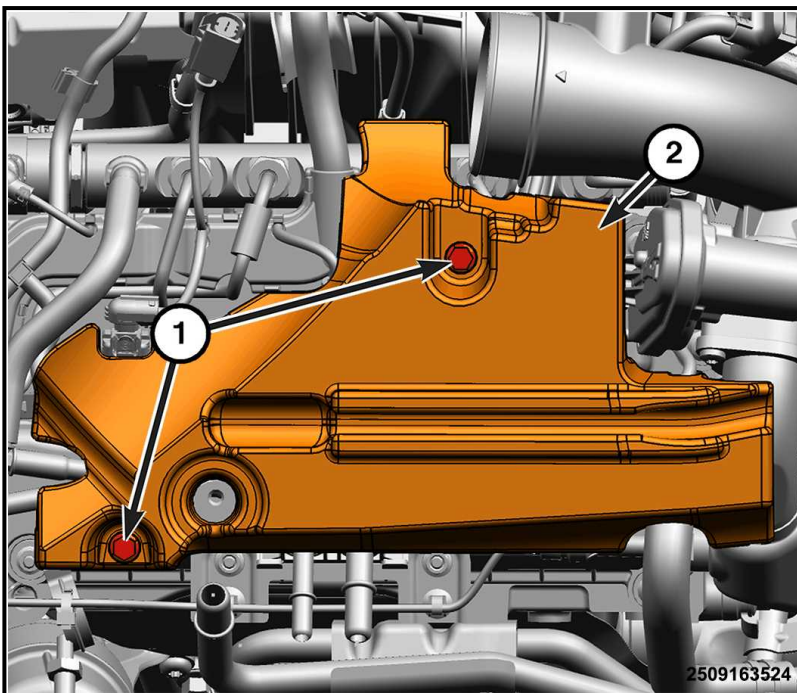
REMOVAL

1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



1 - Vent Hose

2. Remove the vent hose from the left fuel rail cover.



1 - Left Fuel Rail Cover Bolts

2 - Left Fuel Rail Cover

3. Remove the left fuel rail cover bolts and the left fuel rail cover.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

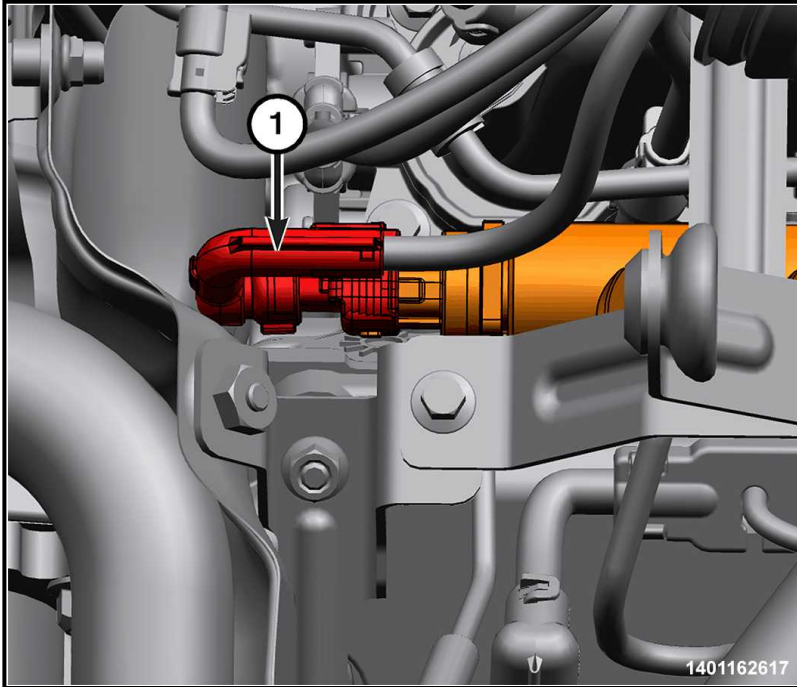
- Install the fuel rail cover and securely tighten the fuel rail cover bolts.

RIGHT FUEL RAIL

REMOVAL

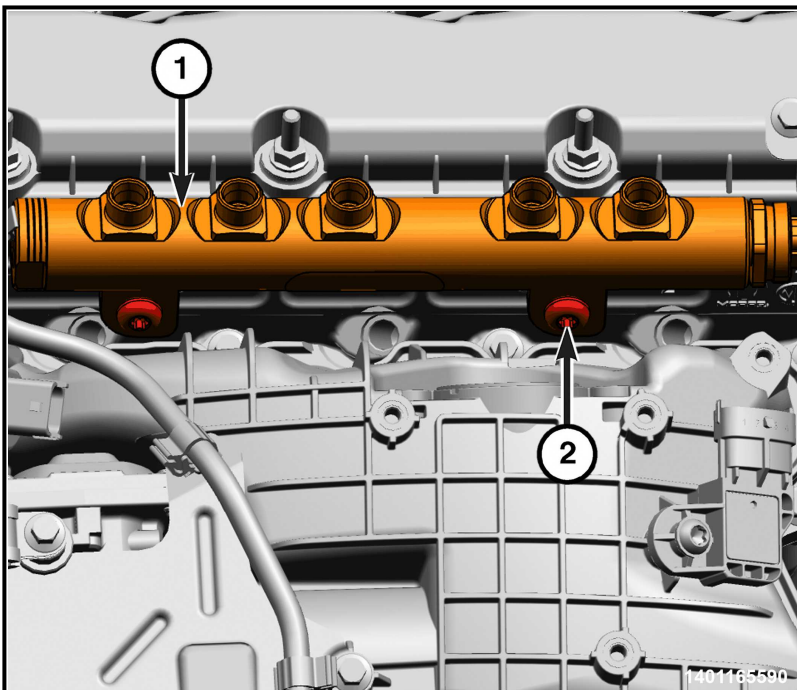
WARNING: No sparks, open flames or smoking. Risk of poisoning from inhaling and swallowing fuel. Risk of injury to eyes and skin from contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing.

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#).
2. Remove the right bank fuel tubes. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).



1 - Fuel Pressure Sensor Harness Connector

3. Disconnect the fuel pressure sensor harness connector.



1 - Right Fuel Rail

2 - Right Fuel Rail Bolts

4. Using the (special tool #2025400090, Remover-Installer, Fuel Rail Bolt), remove the right fuel rail bolts and the right fuel rail.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

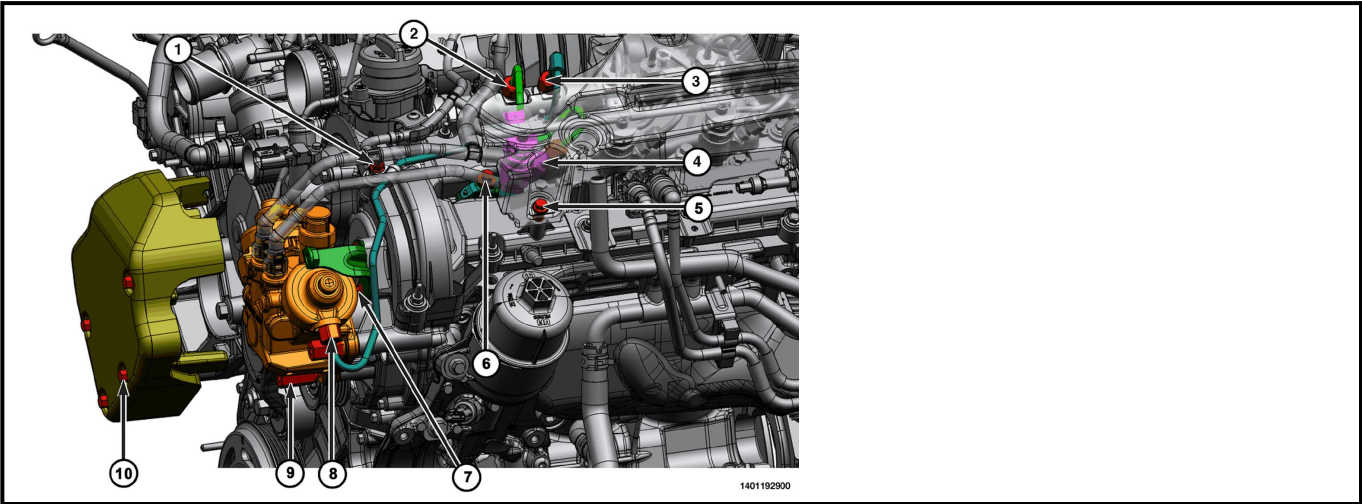
WARNING: No sparks, open flames or smoking. Risk of poisoning from inhaling and swallowing fuel. Risk of injury to eyes and skin from contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing.

NOTE: The fuel tubes must be replaced anytime they are removed.

- Install the NEW fuel tubes. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).
- Start the engine, allow the engine to warm, turn the engine off and inspect for leaks.

TORQUE SPECIFICATIONS

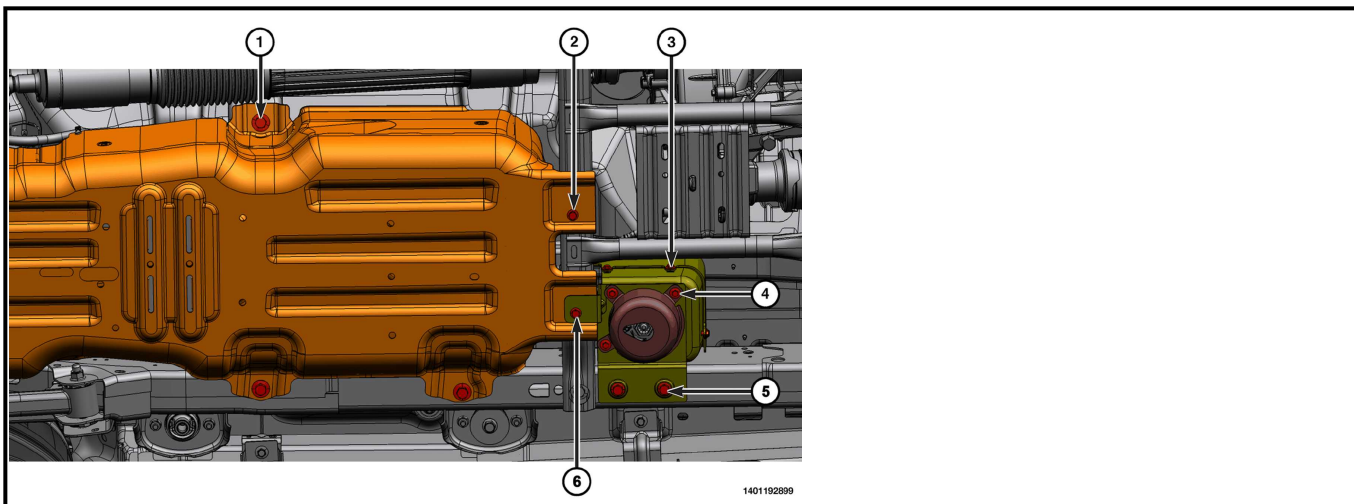
FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Å	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

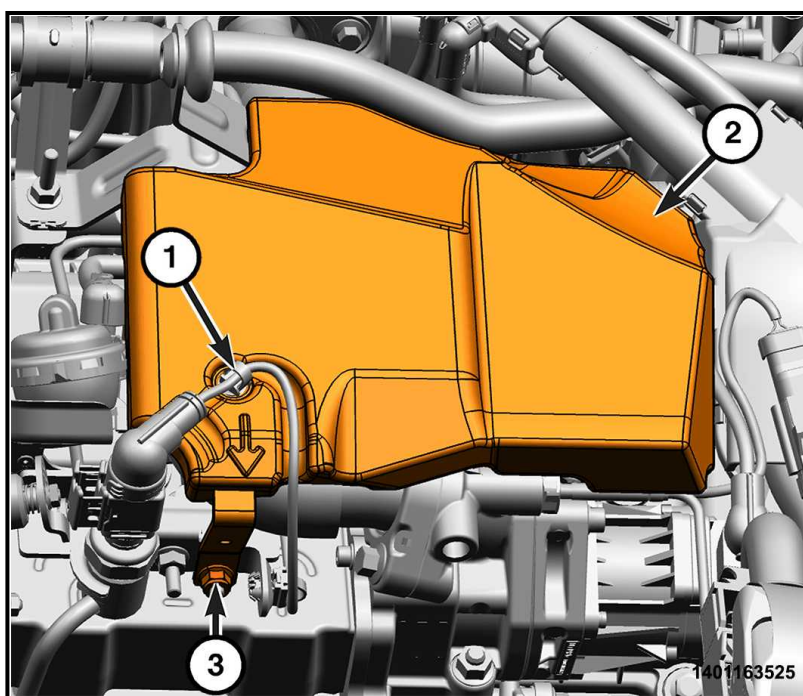
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



RIGHT FUEL RAIL COVER

REMOVAL

1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



1 - Wire Harness Retainer
2 - Fuel Rail Cover
3 - Fuel Rail Cover Nut

2. Loosen the fuel rail cover nut, detach the wire harness retainer and remove the fuel rail cover.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Install the fuel rail cover and securely tighten the fuel rail cover nut.

TANK, FUEL

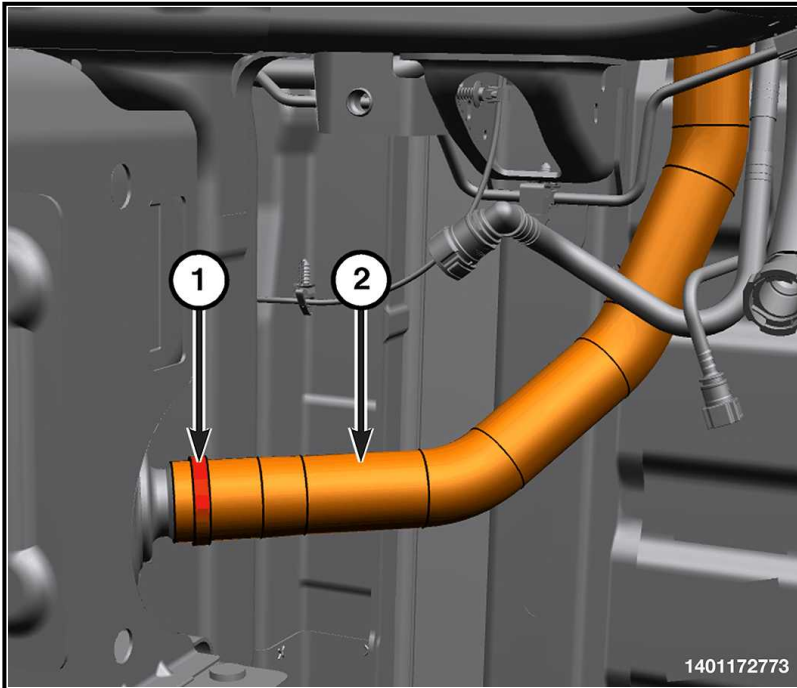
REMOVAL AND INSTALLATION

FUEL TANK

REMOVAL

WARNING: The fuel system may be under a constant pressure (even with the engine off). Before servicing the fuel pump module, the fuel system pressure must be released.

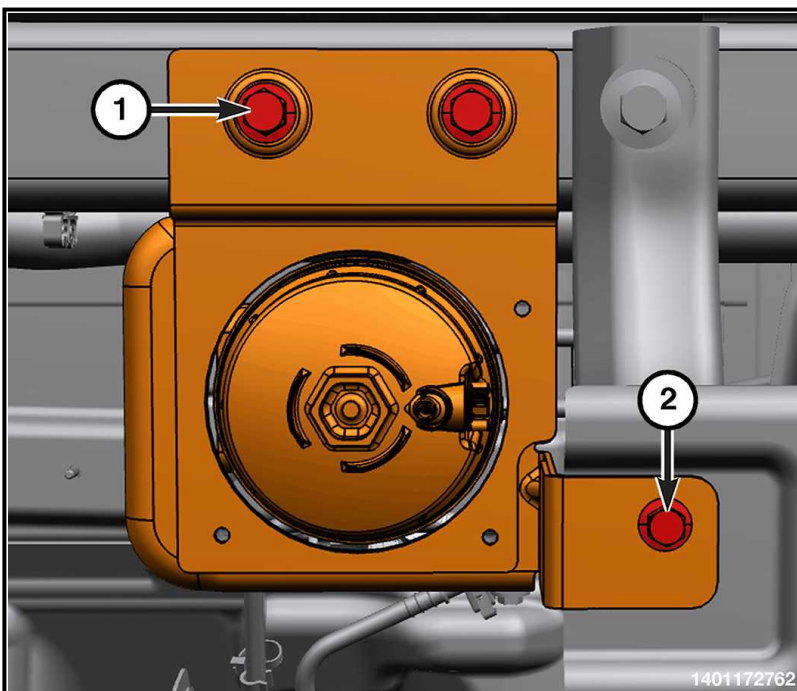
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#).
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#).
3. Remove the Diesel Exhaust Fluid (DEF) tank. Refer to [TANK, DIESEL EXHAUST FLUID, REMOVAL AND INSTALLATION](#).



1 - Filler Hose Clamp

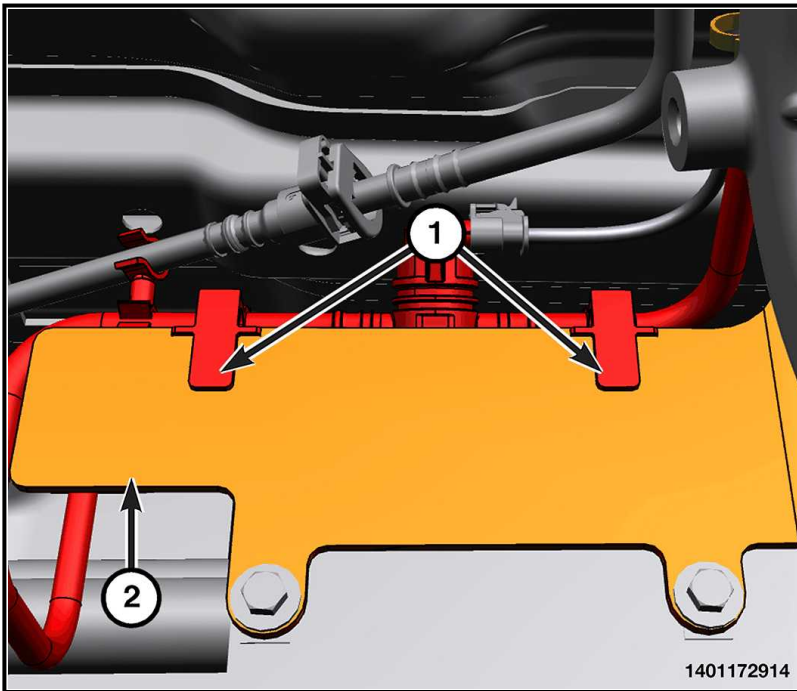
2 - Filler Hose

4. Loosen the filler hose clamp and disconnect filler hose from fuel tank.



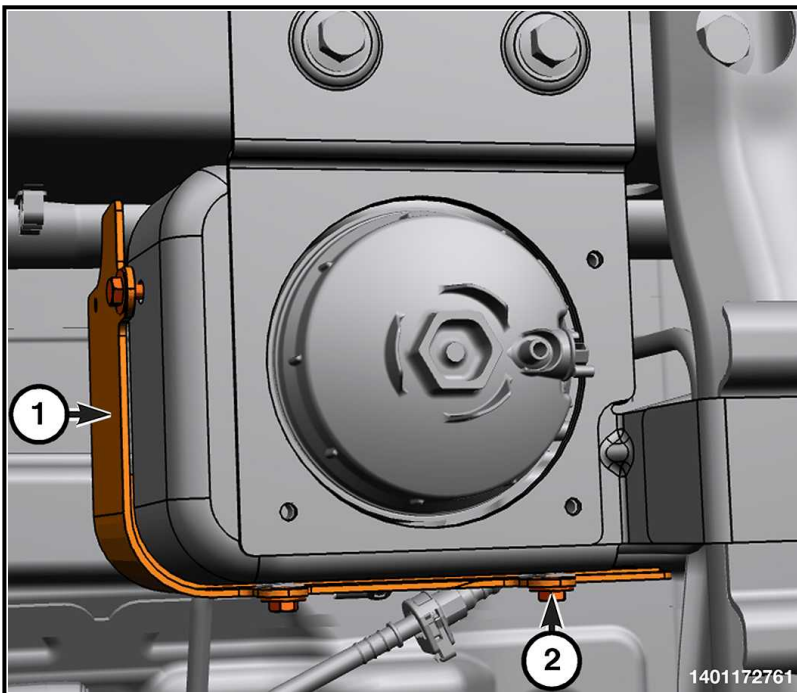
- | |
|--|
| 1 - Fuel Filter/Water Separator Bracket To Frame Bolts |
| 2 - Fuel Filter/Water Separator Bracket To Fuel Tank Shield Bolt |

5. Remove the fuel filter/water separator shield to frame bolts.
6. Remove the fuel filter/water separator shield to fuel tank shield bolt.



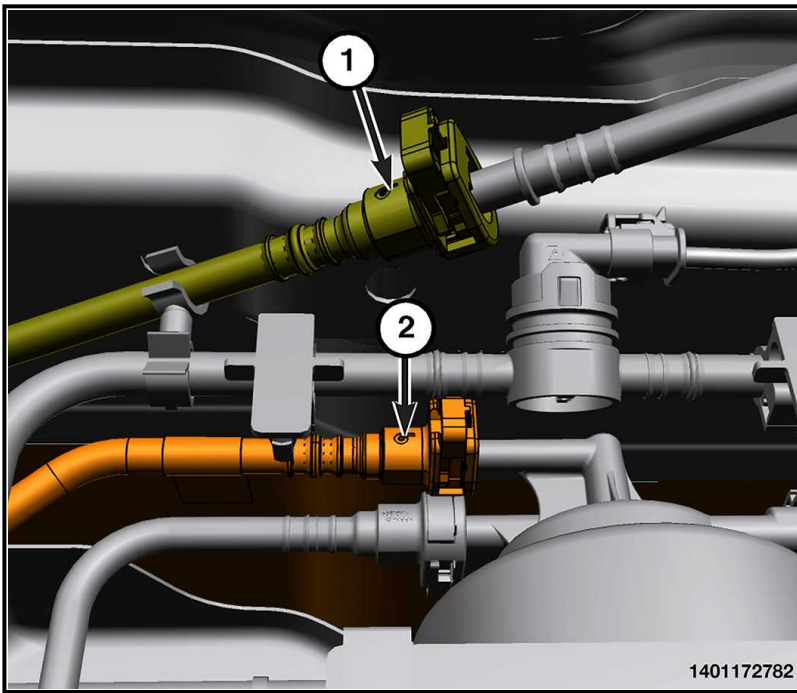
- | |
|-------------------------|
| 1 - Fuel Line Retainers |
| 2 - Shield |

7. Detach the fuel line retainers from the shield.



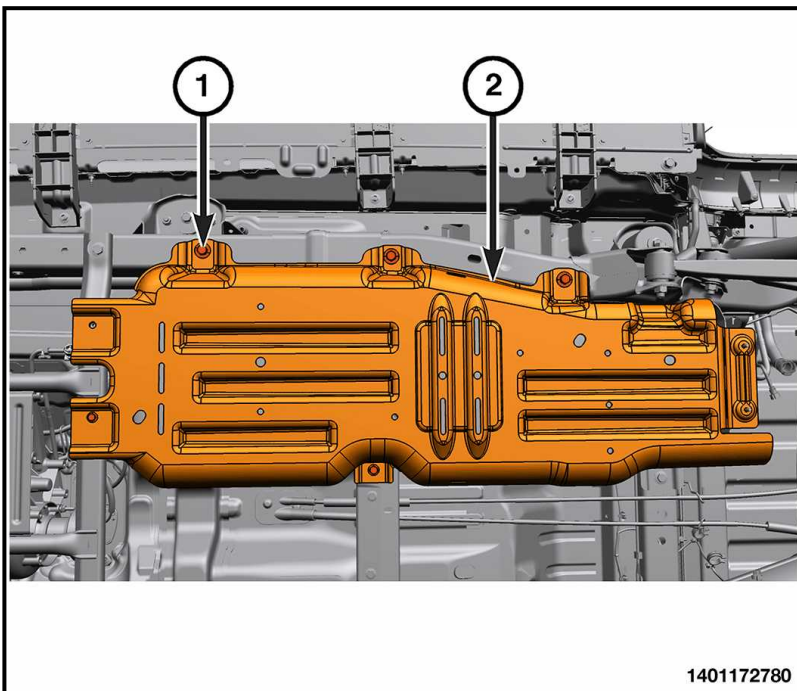
- | |
|-----------------------|
| 1 - Upper Shield |
| 2 - Upper Shield Bolt |

8. Remove the upper shield bolt and the upper shield.



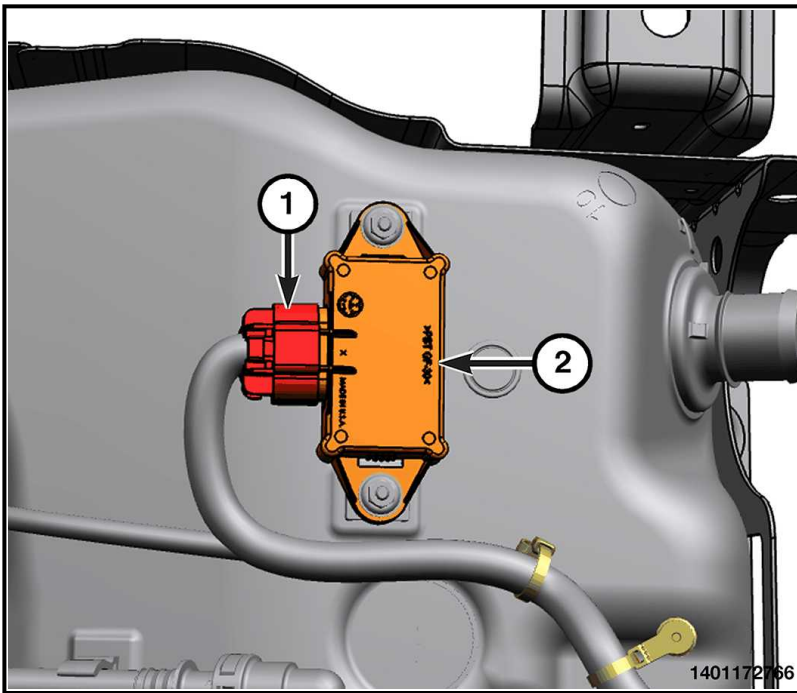
1 - Return Fuel Line Quick-Connect Fitting
2 - Fuel Supply Line Quick-Connect Fitting

9. Disconnect the fuel supply line quick-connect fitting. Refer to [REMOVAL AND INSTALLATION](#).
10. Disconnect the return fuel line quick-connect fitting. Refer to [REMOVAL AND INSTALLATION](#).
11. Position a hydraulic jack under the fuel tank.



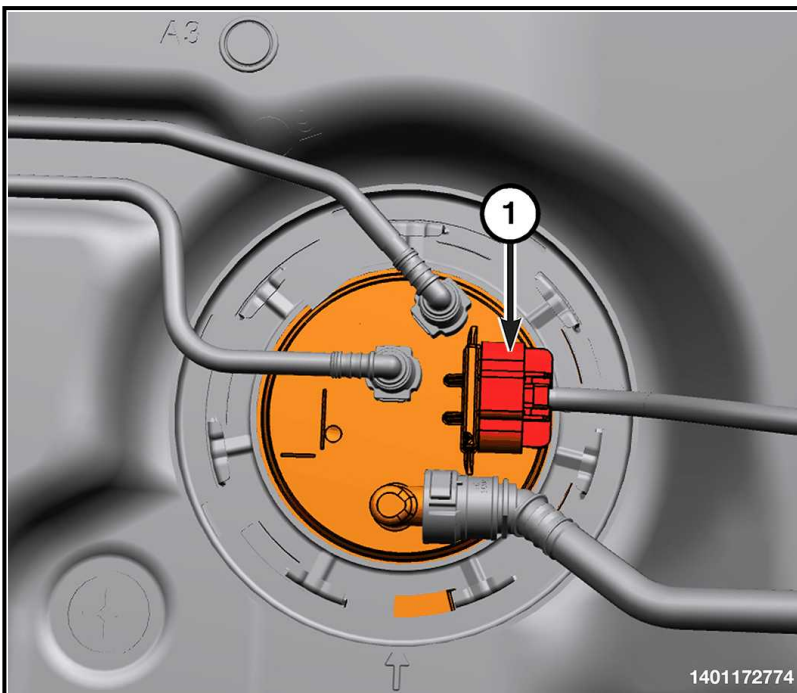
1 - Fuel Tank Bolts
2 - Fuel Tank

12. Remove the fuel tank bolts and securing fuel tank.
13. Partially lower the hydraulic jack.



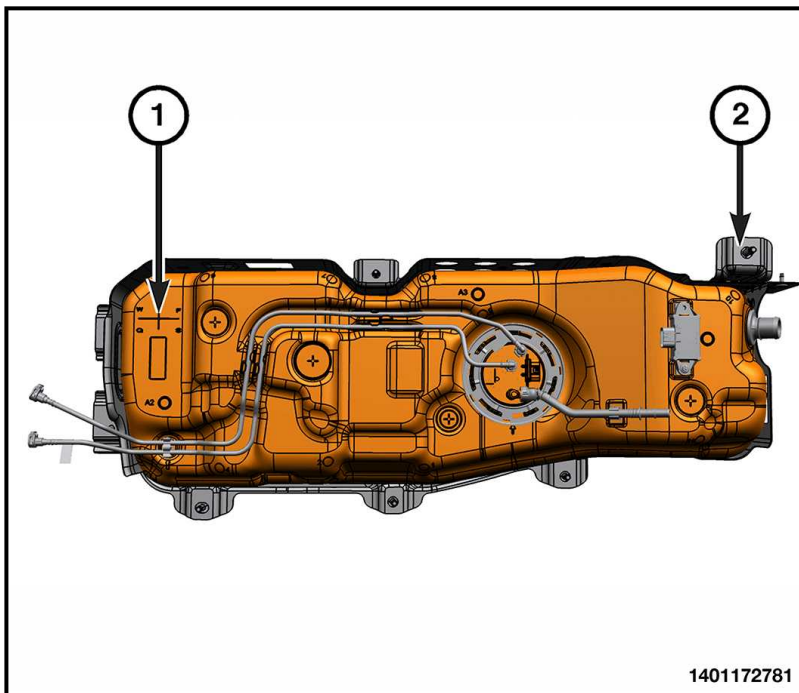
1 - Fuel Pump Control Module Wire Harness Connector

14. Disconnect the fuel pump control module wire harness connector.



1 - Fuel Pump Module Wire Harness Connector

15. Disconnect the fuel pump module wire harness connector.



1 - Fuel Tank
2 - Skid Plate

16. Lower the hydraulic jack and remove the fuel tank.

17. If necessary, removal the fuel pump module. Refer to [ASSEMBLY, FUEL PUMP, REMOVAL AND INSTALLATION](#).

INSTALLATION

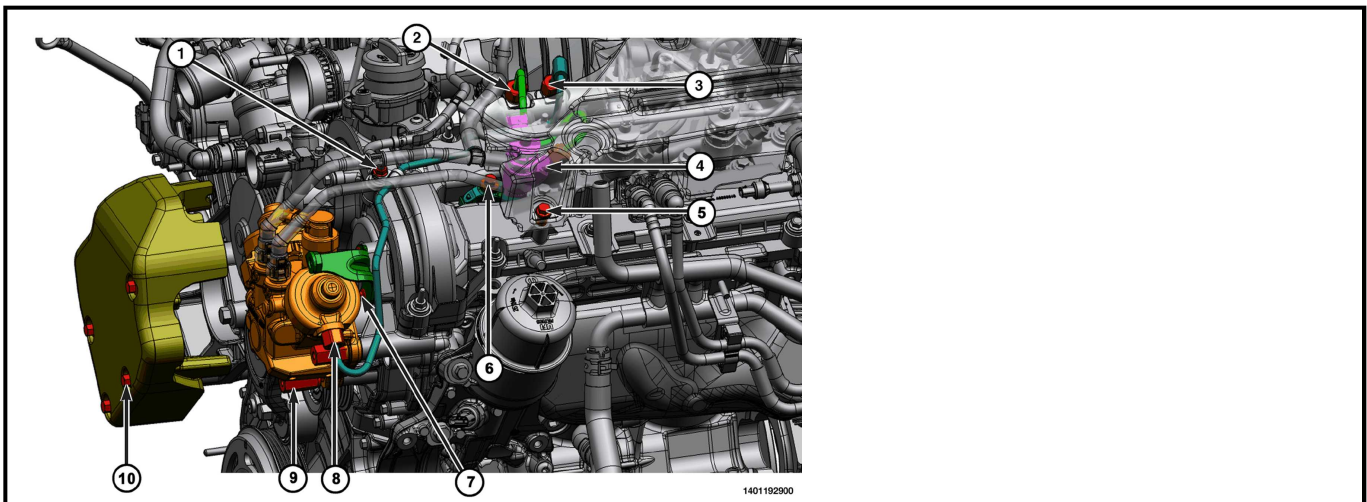
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

- Connect the filler hose to the fuel tank and securely tighten the filler hose clamp.
- Fill the fuel tank.
- Perform fuel system priming procedure. Refer to [FUEL SYSTEM PRIMING - DIESEL](#).
- Start the engine and check for leaks at all fuel tank connections.

TORQUE SPECIFICATIONS

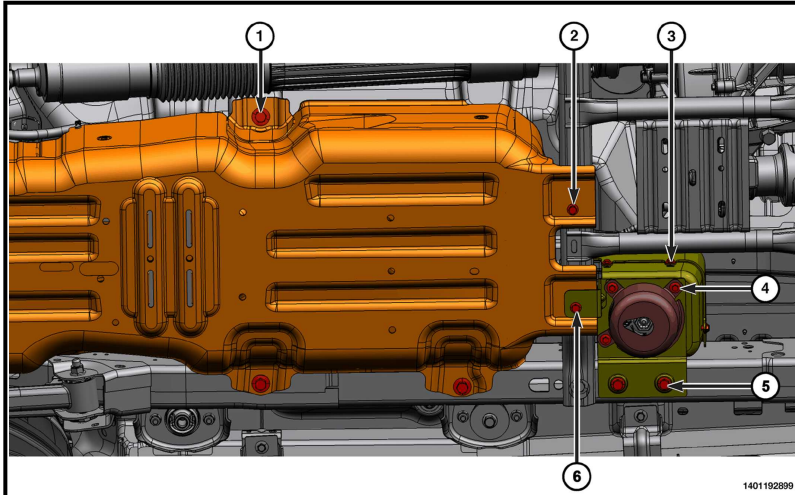
FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Â	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



LINES AND TUBES, FUEL

REMOVAL AND INSTALLATION

LEFT SIDE FUEL TUBES

REMOVAL

WARNING:

Observe the following precautions when working on fuel systems: No sparks, open flames or smoking. Avoid inhaling and swallowing fuel. Avoid eye and skin contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing. Failure to observe these precautions may result in fire, explosion, property damage, and serious or fatal injury.

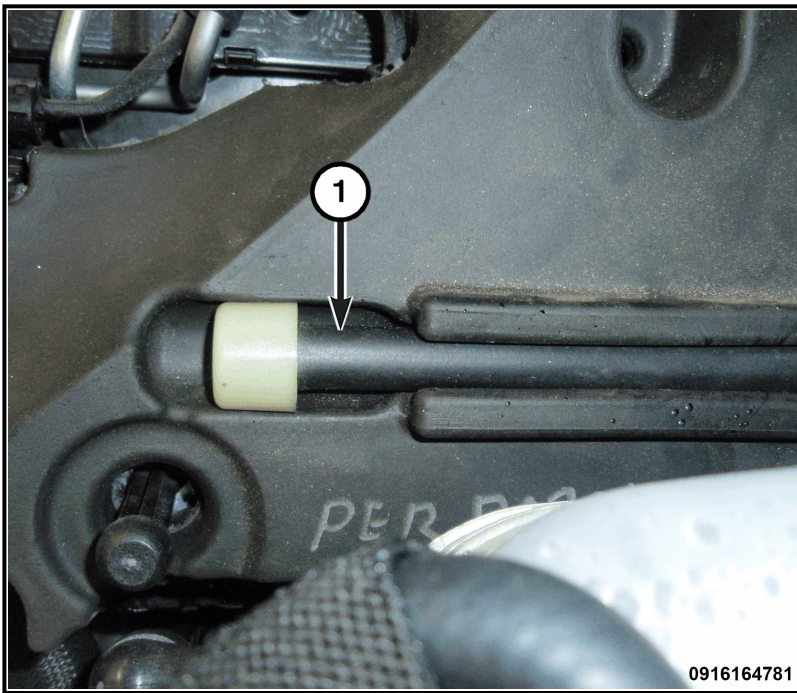
WARNING:

High-pressure lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 2000 bar (29, 008 psi). Use extreme caution when inspecting for high-pressure fuel leaks. Fuel under this amount of pressure can penetrate skin causing personal injury or death. Inspect for high-pressure fuel leaks with a sheet of cardboard. Wear safety goggles and adequate protective clothing when servicing fuel system.

NOTE:

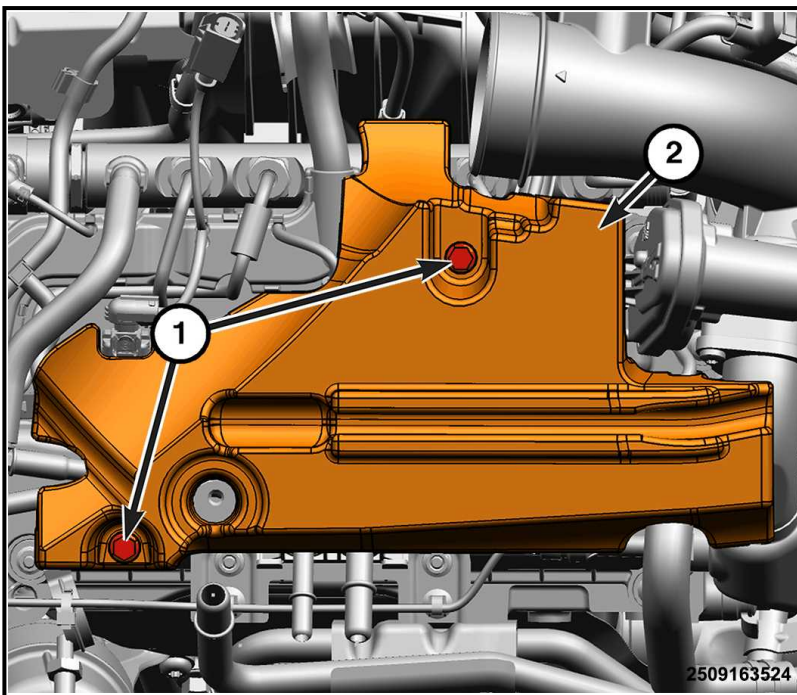
When key is cycled to the off position, fuel system pressure automatically bleeds down.

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
3. Remove the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#) .



1 - Vent Hose

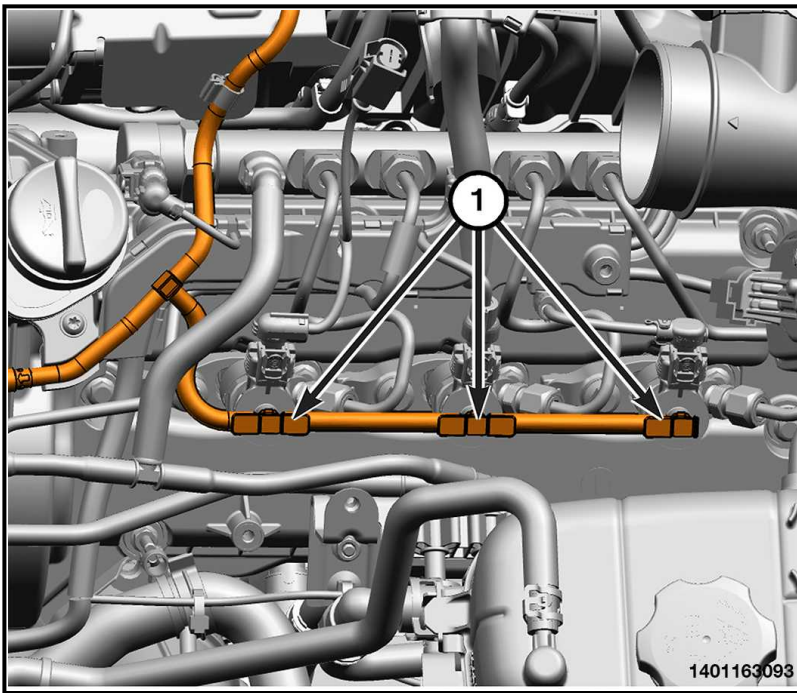
4. Remove the vent hose from the left fuel rail cover.



1 - Left Fuel Rail Cover Bolts

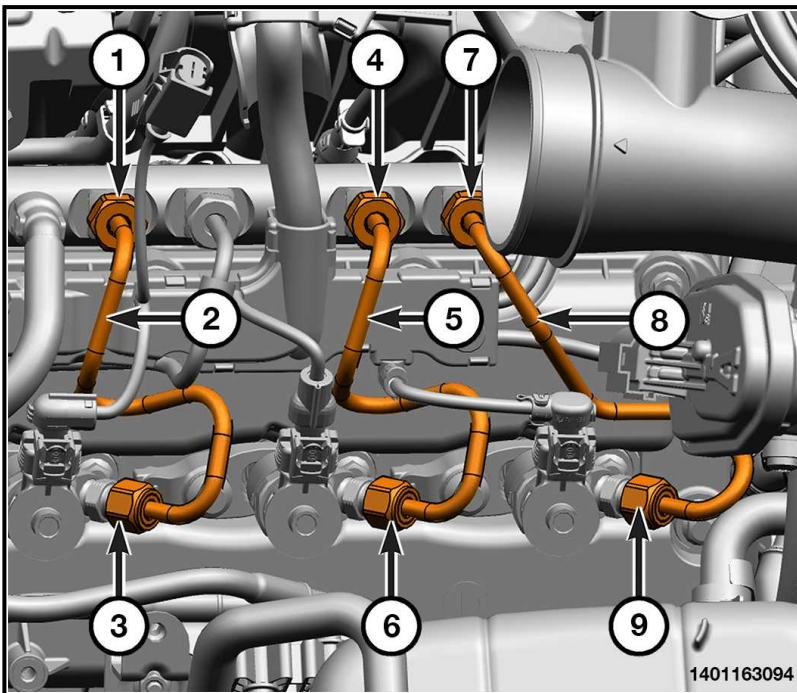
2 - Left Fuel Rail Cover

5. Remove the left fuel rail cover bolts and the left fuel rail cover.



1 - Locking Tab

6. Lift up on the locking tab to unlock the lock.
7. Disconnect the fuel return line by wiggling the hose free from the fuel injector.



1 - Union Nut

2 - Cylinder No. 4 Fuel Tube

3 - Union Nut

4 - Union Nut

5 - Cylinder No. 5 Fuel Tube

6 - Union Nut

7 - Union Nut

8 - Cylinder No. 6 Fuel Tube

9 - Union Nut

NOTE: Use a backing wrench on the fuel injector when unscrewing the union nut.

8. Unscrew the union nuts and remove cylinder No. 4 fuel tube and discard the fuel tube.
9. Install protective caps onto the fuel injectors and fuel rail.
10. Unscrew the union nuts and remove cylinder No. 5 fuel tube and discard the fuel tube.
11. Install protective caps onto the fuel injectors and fuel rail.
12. Unscrew the union nuts and remove cylinder No. 6 tube and discard the fuel tube.
13. Install protective caps onto the fuel injectors and fuel rail.

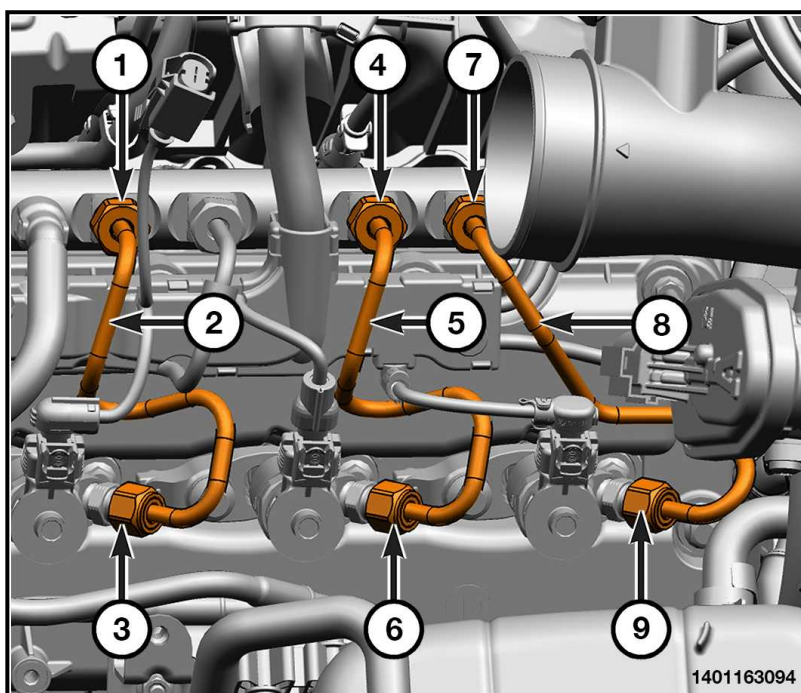
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

WARNING: Observe the following precautions when working on fuel systems: No sparks, open flames or smoking. Avoid inhaling and swallowing fuel. Avoid eye and skin contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing. Failure to observe these precautions may result in fire, explosion, property damage, and serious or fatal injury.

WARNING: High-pressure lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 2000 bar (29, 008 psi). Use extreme caution when inspecting for high-pressure fuel leaks. Fuel under this amount of pressure can penetrate skin causing personal injury or death. Inspect for high-pressure fuel leaks with a sheet of cardboard. Wear safety goggles and adequate protective clothing when servicing fuel system.



1 - Union Nut
2 - Cylinder No. 4 Fuel Tube
3 - Union Nut
4 - Union Nut
5 - Cylinder No. 5 Fuel Tube
6 - Union Nut
7 - Union Nut
8 - Cylinder No. 6 Fuel Tube

NOTE: The fuel tubes are a one time only use and must be replaced anytime they have been removed.

NOTE: Use a backing wrench on the fuel injector when tightening the union nut.

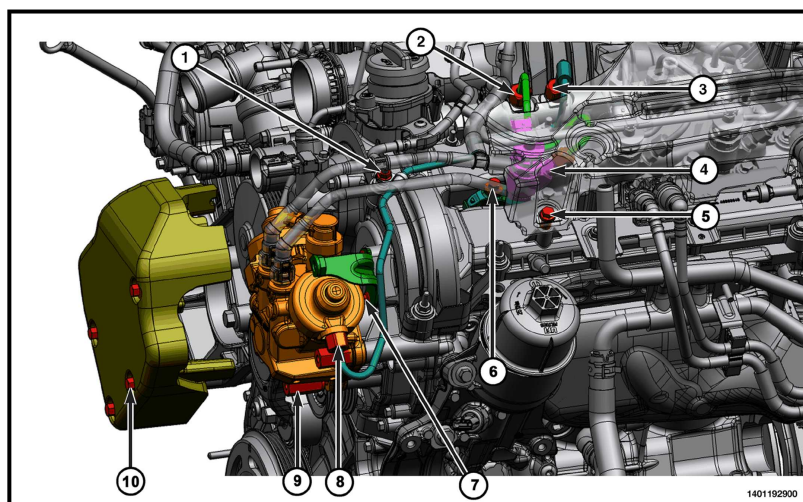
- Remove the protective caps from cylinder No. 6 fuel injector and fuel rail.
- Install the **NEW** fuel tube to cylinder No. 6 and tighten the union nuts finger tight.
- Tighten the fuel rail union nut to the proper torque specifications.
- Tighten the fuel injector union nut to the proper torque specifications.
- Remove the protective caps from cylinder No. 5 fuel injector and fuel rail.
- Install the **NEW** fuel tube to cylinder No. 5 and tighten the union nuts finger tight.
- Tighten the fuel rail union nuts to the proper torque specifications.
- Tighten the fuel injector union nut to the proper torque specifications.
- Remove the protective caps from cylinder No. 4 fuel injector and fuel rail.
- Install the **NEW** fuel tube to cylinder No. 4 and tighten the union nuts finger tight.
- Tighten the fuel rail union nut to the proper torque specifications.
- Tighten the fuel injector union nut to the proper torque specifications.

NOTE: Do not use any type of lubrication when installing the fuel injector return line.

- Install the fuel injector return line and **be sure it is fully seated**.
- Push down on the lock tab to lock in place.
- Install the left fuel rail cover and securely tighten the bolts.
- Start engine, allow to warm, turn engine off. Check and verify there are no leaks. Refer to the appropriate information .

TORQUE SPECIFICATIONS

FUEL SYSTEM

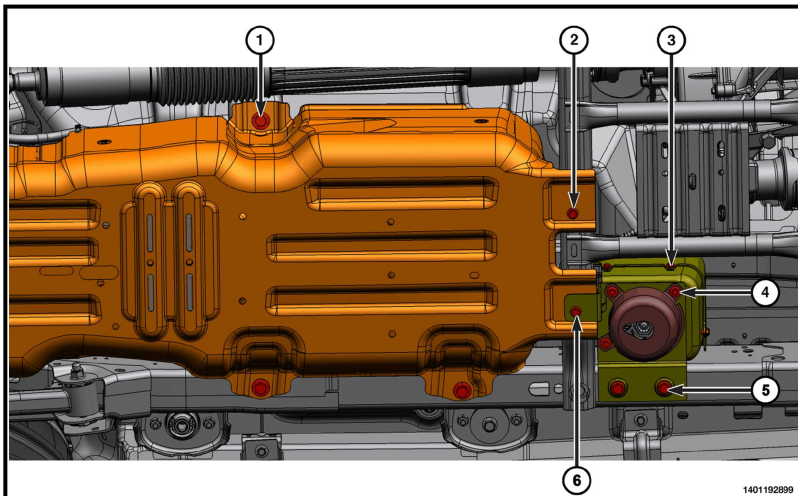


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel	5 N.m (44 In. Lbs.) + 75°	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
	Rail		
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Å	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



RIGHT SIDE FUEL TUBES

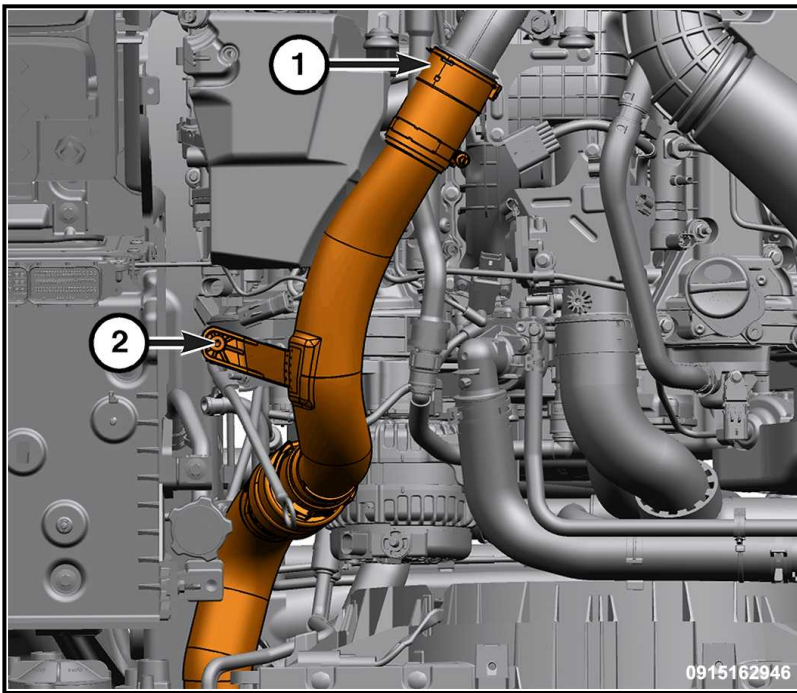
REMOVAL

WARNING: Observe the following precautions when working on fuel systems: No sparks, open flames or smoking. Avoid inhaling and swallowing fuel. Avoid eye and skin contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing. Failure to observe these precautions may result in fire, explosion, property damage, and serious or fatal injury.

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NOTE: When key is cycled to the off position, fuel system pressure automatically bleeds down.

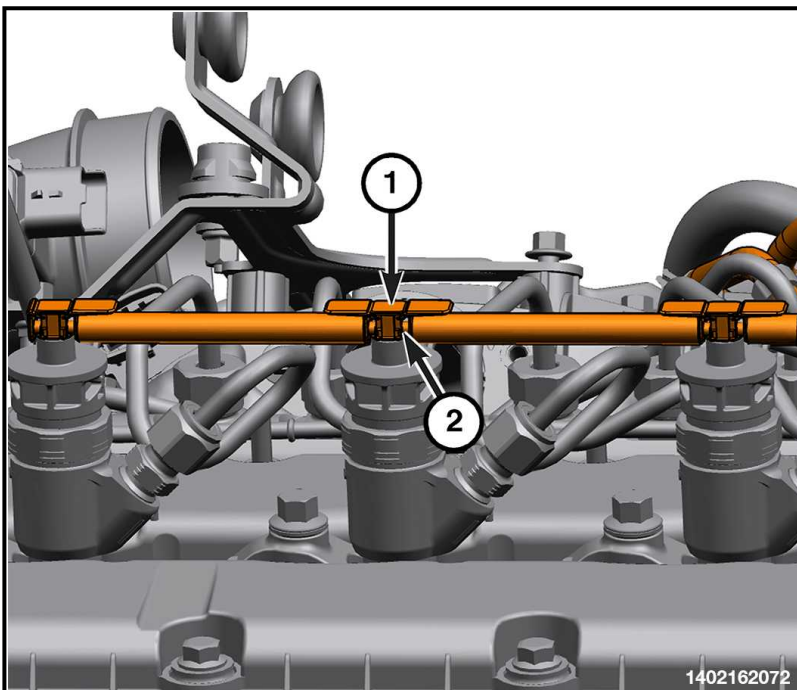
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



1 - Retaining Clip

2 - Charge Air Cooler Hose Bolt

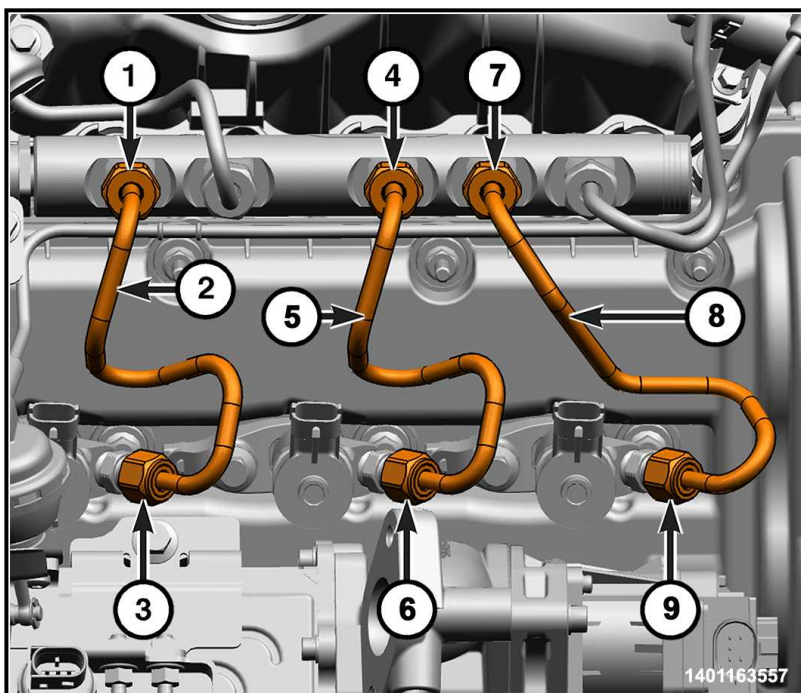
3. Remove the Charge Air Cooler (CAC) hose bolt.
4. Release the retaining clip and disconnect the CAC hose from the turbocharger elbow and position aside.
5. Disconnect the vacuum hose from the vacuum pump.
6. Remove the upper EGR tube. Refer to [TUBE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#).



1 - Locking Tabs

2 - Fuel Return Hose

7. Lift up on locking tabs to unlock the lock.
8. Remove the fuel return hose by wiggling hose free from the fuel injector.



1 - Union Nut
2 - Cylinder No. 3 Fuel Tube
3 - Union Nut
4 - Union Nut
5 - Cylinder No. 2 Fuel Tube
6 - Union Nut
7 - Union Nut
8 - Cylinder No. 1 Fuel Tube
9 - Union Nut

NOTE: Use a backing wrench on the fuel injector when unscrewing the union nut.

9. Unscrew the union nuts and remove cylinder No. 1 fuel tube and the discard fuel tube.
10. Install protective caps to the fuel injector and fuel rail for cylinder No. 1.
11. Unscrew the union nuts and remove cylinder No. 2 fuel tube and discard the fuel tube.
12. Install protective caps to the fuel injector and fuel rail for cylinder No. 2.
13. Unscrew the union nuts and remove cylinder No. 3 fuel tube and discard the fuel tube.
14. Install protective caps to the fuel injector and fuel rail for cylinder No. 3.

INSTALLATION

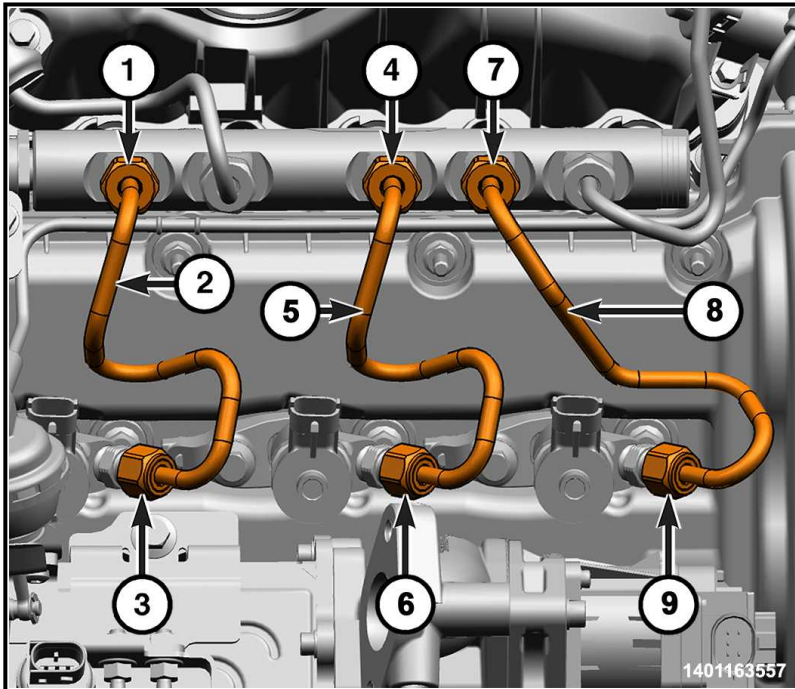
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

WARNING: Observe the following precautions when working on fuel systems: No sparks, open flames or smoking. Avoid inhaling and swallowing fuel. Avoid eye and skin contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing. Failure to observe these precautions may result in fire, explosion, property damage, and serious or fatal injury.

WARNING: High-pressure lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 2000 bar (29, 008 psi). Use extreme caution when inspecting for high-pressure fuel leaks. Fuel

under this amount of pressure can penetrate skin causing personal injury or death. Inspect for high-pressure fuel leaks with a sheet of cardboard. Wear safety goggles and adequate protective clothing when servicing fuel system.



1 - Union Nut
2 - Cylinder No. 3 Fuel Tube
3 - Union Nut
4 - Union Nut
5 - Cylinder No. 2 Fuel Tube
6 - Union Nut
7 - Union Nut
8 - Cylinder No. 1 Fuel Tube
9 - Union Nut

NOTE: The fuel tubes are a one time only use and must be replaced anytime they have been removed.

NOTE: Use a backing wrench on the fuel injector when tightening the union nut.

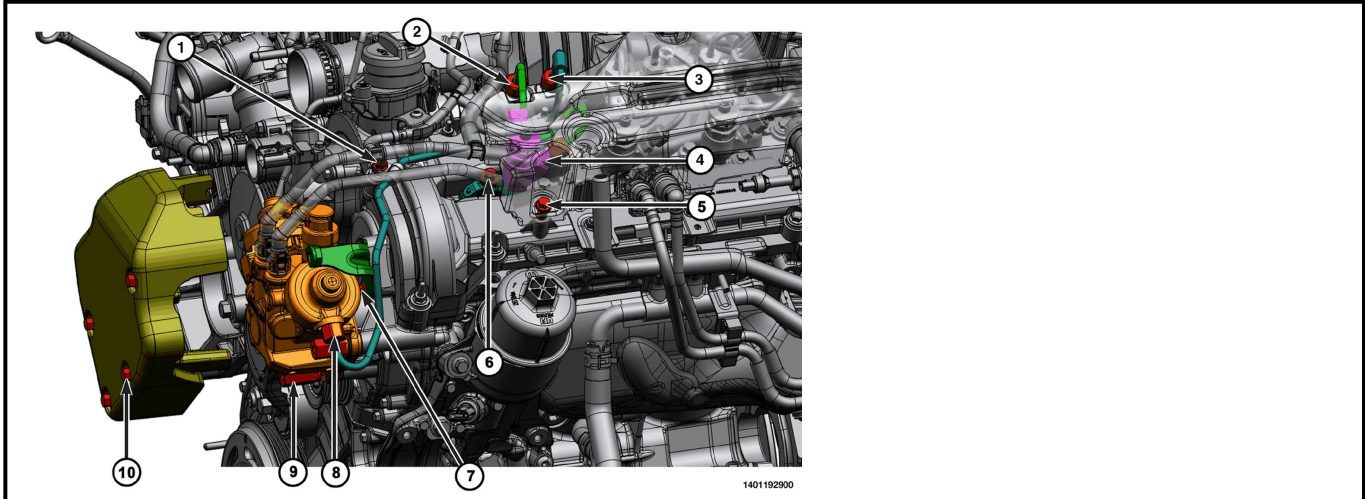
- Remove the protective caps from cylinder No. 3 fuel injector and fuel rail.
- Install the **NEW** fuel tube to cylinder No. 3 and tighten the union nuts finger tight.
- Tighten the fuel rail union nut to the proper torque specifications.
- Tighten the fuel injector union nut to the proper torque specifications.
- Remove the protective caps from cylinder No. 2 fuel injector and fuel rail.
- Install the **NEW** fuel tube to cylinder No. 2 and tighten the union nuts finger tight.
- Tighten the fuel rail union nut to the proper torque specifications.
- Tighten the fuel injector union nut to the proper torque specifications.
- Remove the protective caps from cylinder No. 1 fuel injector and fuel rail.
- Install the **NEW** fuel tube to cylinder No. 1 and tighten the union nuts finger tight.
- Tighten the fuel rail union nut to the proper torque specifications.
- Tighten the fuel injector union nut to the proper torque specifications.

NOTE: Do not use any type of lubrication when installing the fuel injector return hose.

- Install the fuel injector return hose and **be sure it is fully seated**.
- Push down on the lock tab to lock in place.
- Start engine, allow to warm, turn engine off. Check and verify there are no leaks. Refer to the appropriate information .

TORQUE SPECIFICATIONS

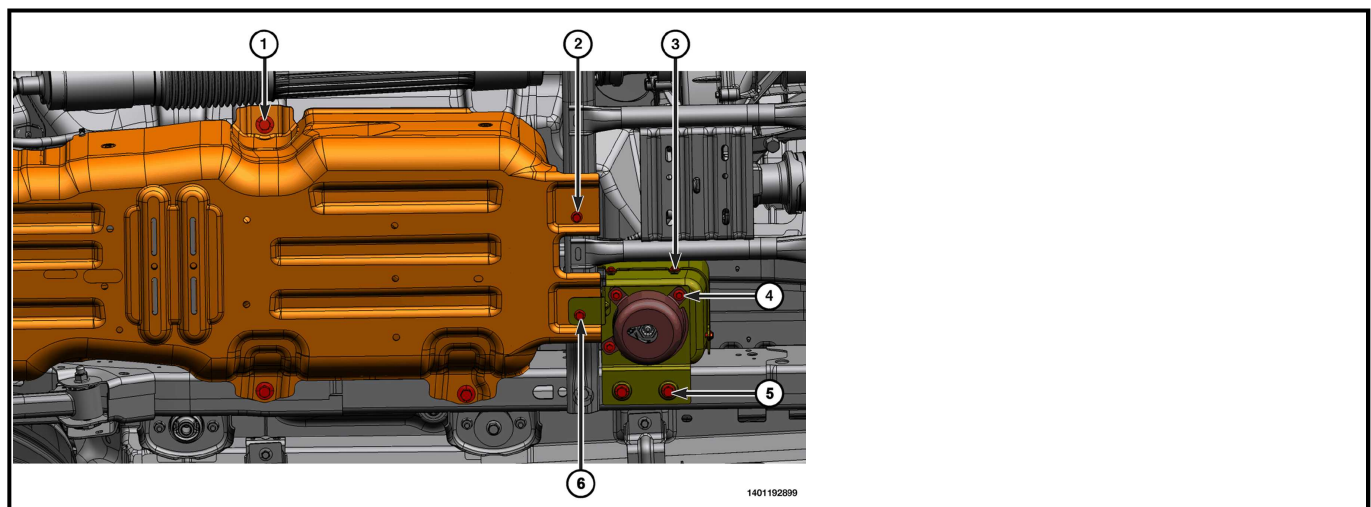
FUEL SYSTEM



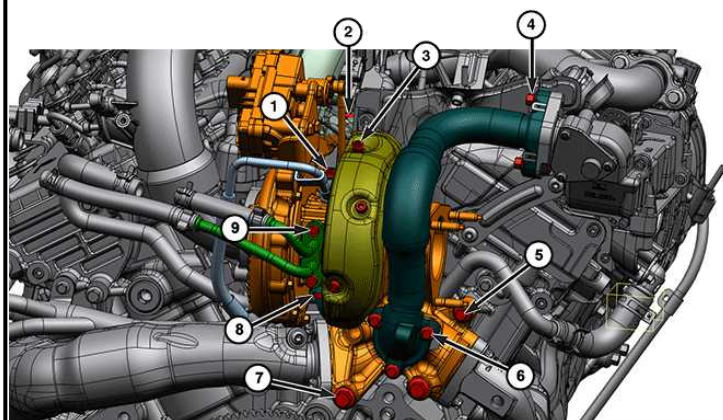
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
		2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Â	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



TURBOCHARGER



0915192195

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

FUEL INJECTOR RETURN LINES

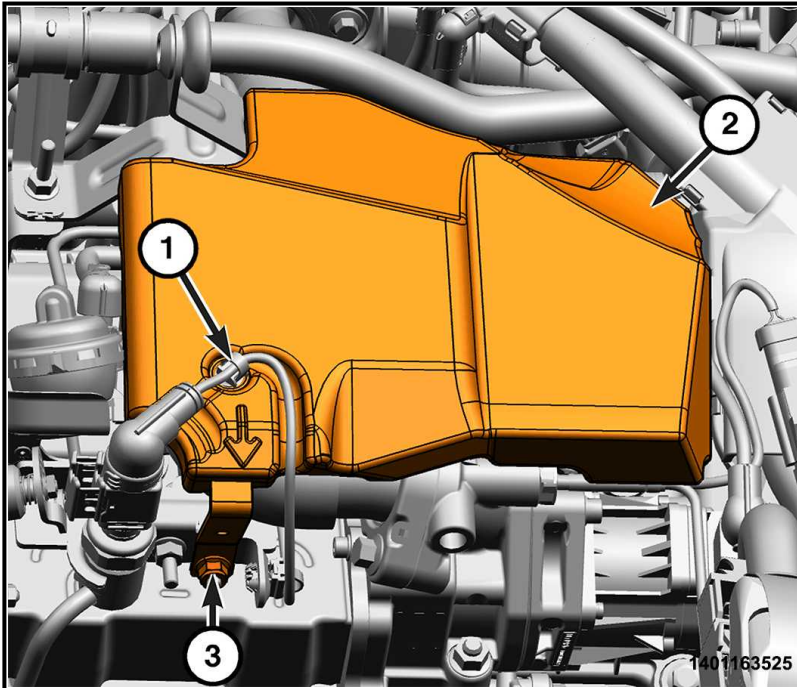
REMOVAL

WARNING:

Observe the following precautions when working on fuel systems: No sparks, open flames or smoking. Avoid inhaling and swallowing fuel. Avoid eye and skin contact with fuel. Pour fuels only into suitable and appropriately marked

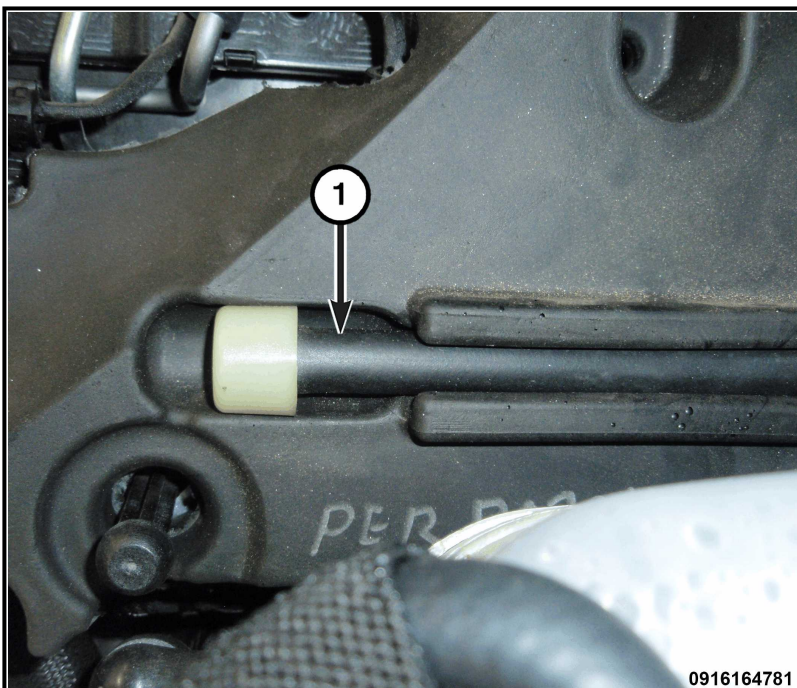
containers. Wear protective clothing. Failure to observe these precautions may result in fire, explosion, property damage, and serious or fatal injury.

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



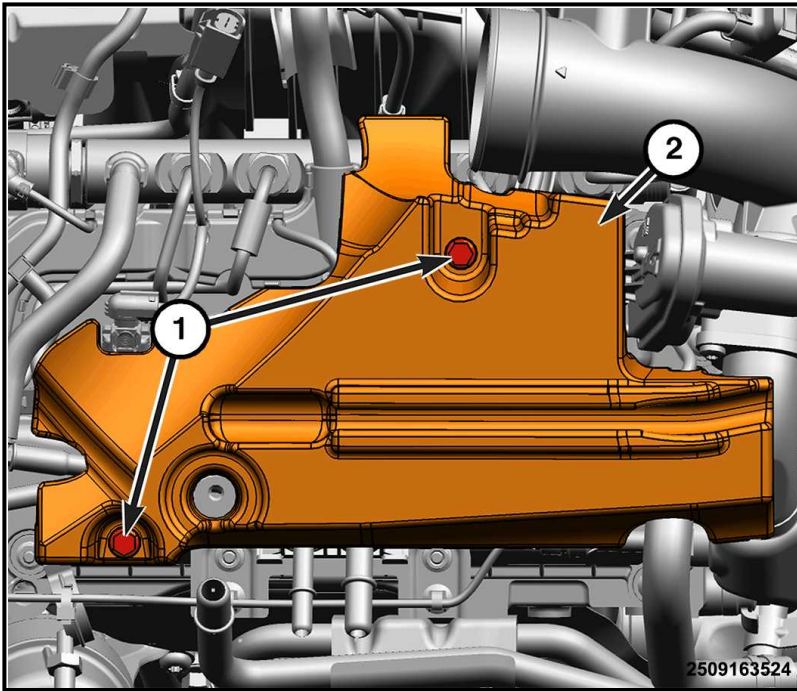
- | |
|-------------------------------|
| 1 - Wire Harness Retainer |
| 2 - Right Fuel Rail Cover |
| 3 - Right Fuel Rail Cover Nut |

3. Remove the wire harness retainer from the right fuel rail cover.
4. Loosen the right fuel rail cover nut and remove the right fuel rail cover.
5. Remove the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#) .



- | |
|---------------|
| 1 - Vent Hose |
|---------------|

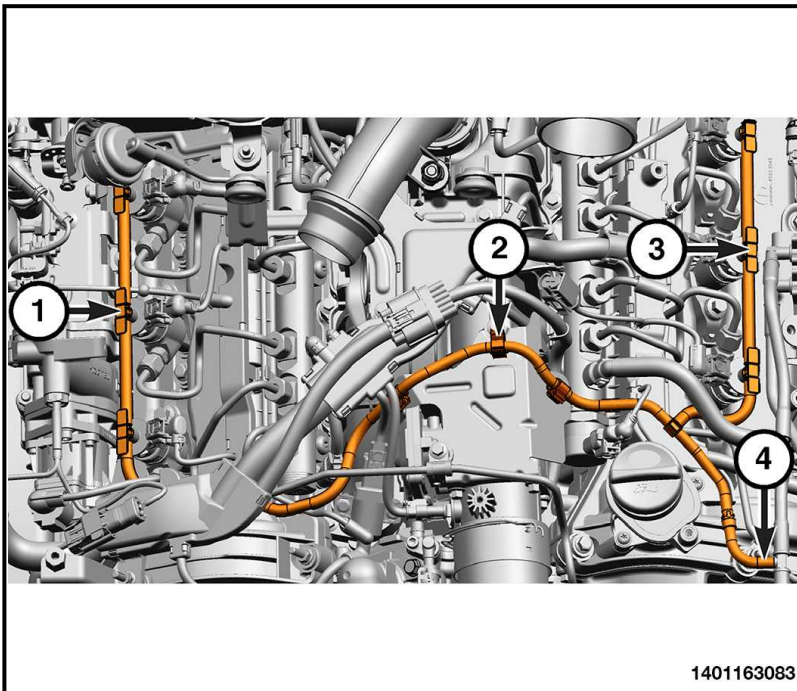
6. Remove the vent hose from the left fuel rail cover.



1 - Left Fuel Rail Cover Bolts

2 - Left Fuel Rail Cover

7. Remove the left fuel rail cover bolts and the left fuel rail cover.



1 - Locking Tabs

2 - Retainer

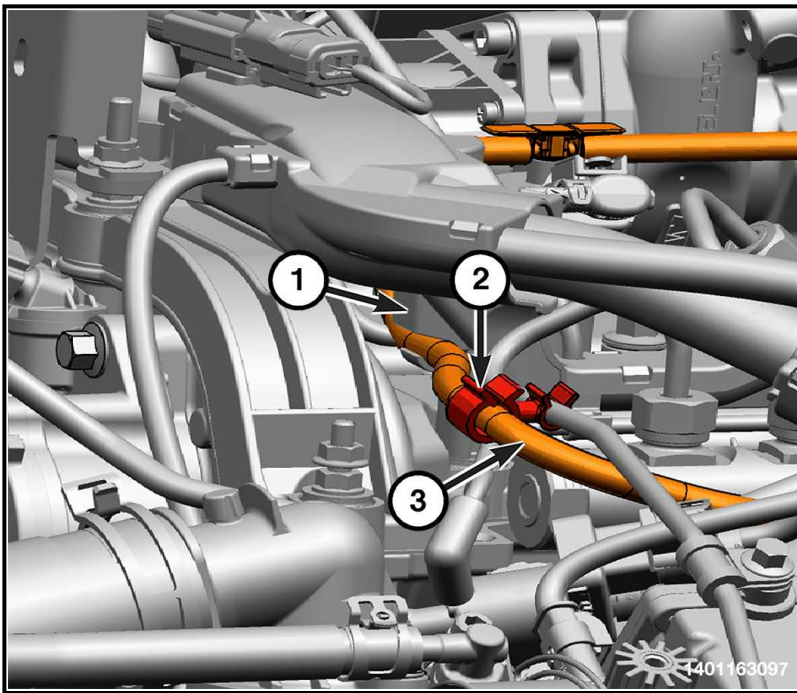
3 - Locking Tabs

4 - Fuel Injector Return Line

8. Lift up on locking tabs to unlock the lock.

9. Remove the fuel return line by wiggling hose free from the fuel injector.

10. Detach the fuel injector return line from the main fuel return line.



1 - Fuel Return Line Retainers
2 - Fuel Return Line Retainers
3 - Fuel Injector Return Line

11. Detach the fuel return line retainers.

12. Remove the fuel injector return line assembly.

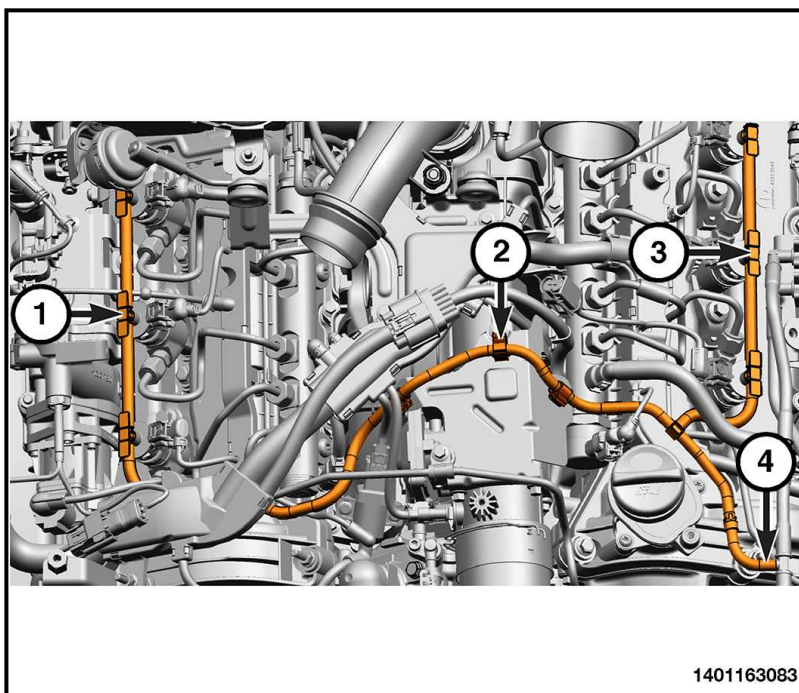
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

NOTE: Do not use any type of lubrication when installing the fuel injector return line.

- Inspect the fuel injector return line for cracks and inspect the O-ring seals for damage. Replace the fuel injector return line if a problem exists.

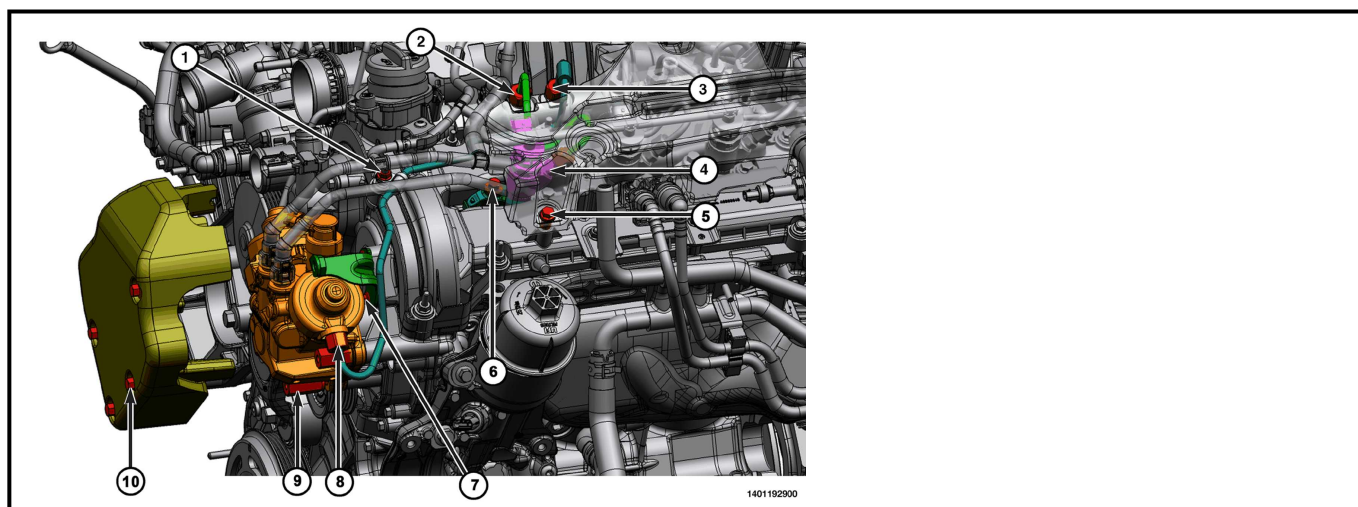


1 - Locking Tabs
2 - Retainer
3 - Locking Tabs
4 - Fuel Injector Return Line

- Position the fuel injector return line.
- Install the fuel injector return line to the fuel injector **and be sure it is fully seated.**
- Push down on the lock tabs to lock in place.
- Install the left fuel rail cover and securely tighten the bolts.
- Install the right bank fuel rail cover and securely tighten the nut.
- Install the wire harness retainer to the right fuel rail cover.

TORQUE SPECIFICATIONS

FUEL SYSTEM

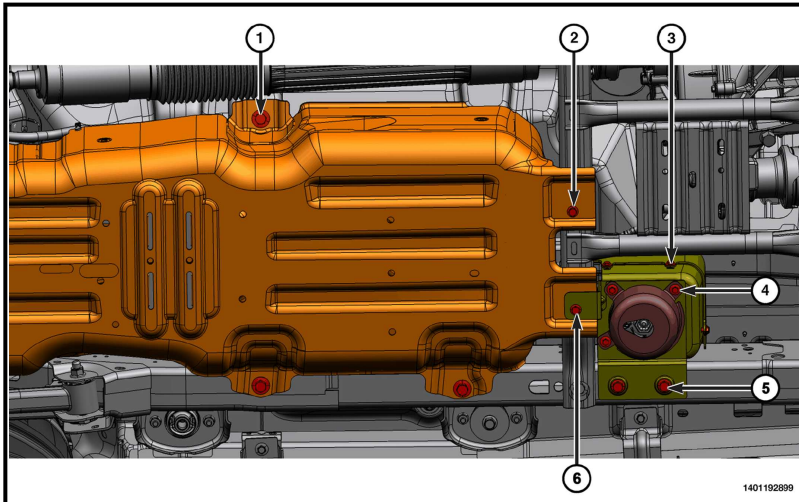


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel	5 N.m (44 In. Lbs.) + 75°	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
	Rail		
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Å	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-

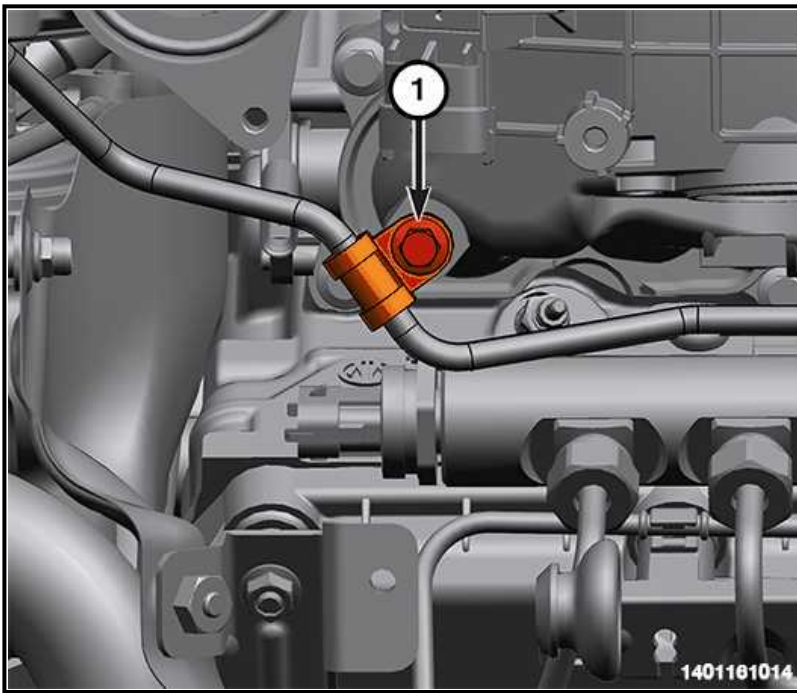
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



CROSSOVER FUEL TUBE

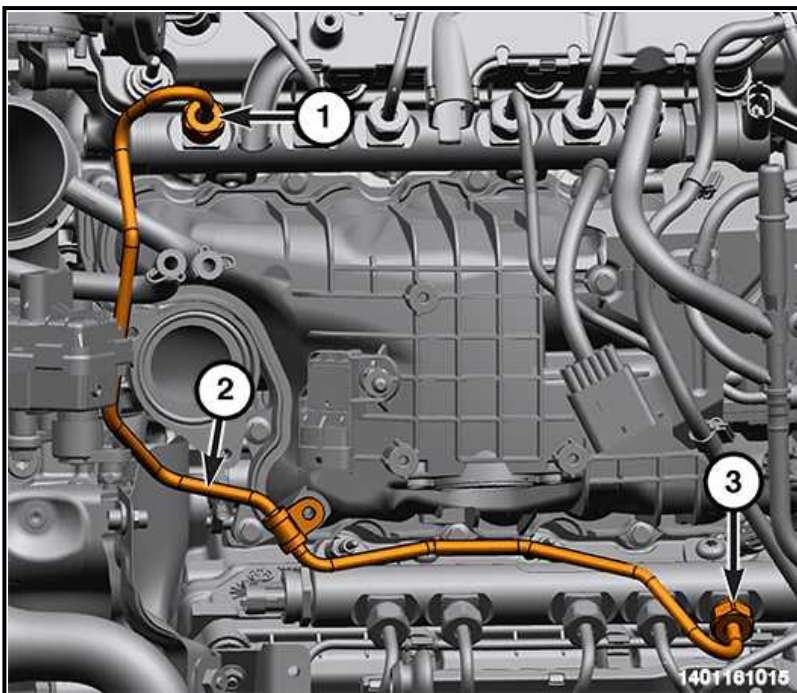
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
3. Detach the vacuum line from the coolant bottle bracket.
4. Remove the coolant bottle bolts and position aside the coolant bottle.
5. Remove the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#) .
6. Remove the turbocharger inlet elbow. Refer to [COOLER AND HOSES, CHARGE AIR, REMOVAL AND INSTALLATION](#) .
7. Remove the turbocharger outlet elbow. Refer to [COOLER AND HOSES, CHARGE AIR, REMOVAL AND INSTALLATION](#) .
8. Remove the upper EGR tube. Refer to [TUBE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#) .
9. Disconnect the boost pressure sensor wire harness connector.
10. Disconnect the swirl valve wire harness connector.
11. Disconnect the fuel pressure sensor wire harness connector.



1 - Fuel Crossover Tube Bolt

12. Remove the fuel crossover tube bolt.



1 - Union Nut

2 - Fuel Crossover Tube

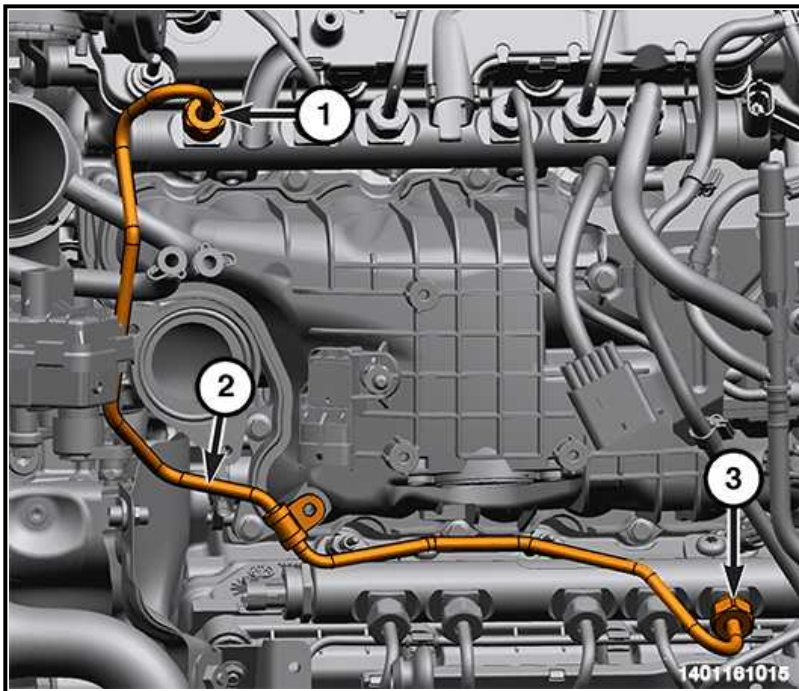
3 - Union Nut

13. Unscrew the union nuts and remove the fuel crossover tube and discard.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

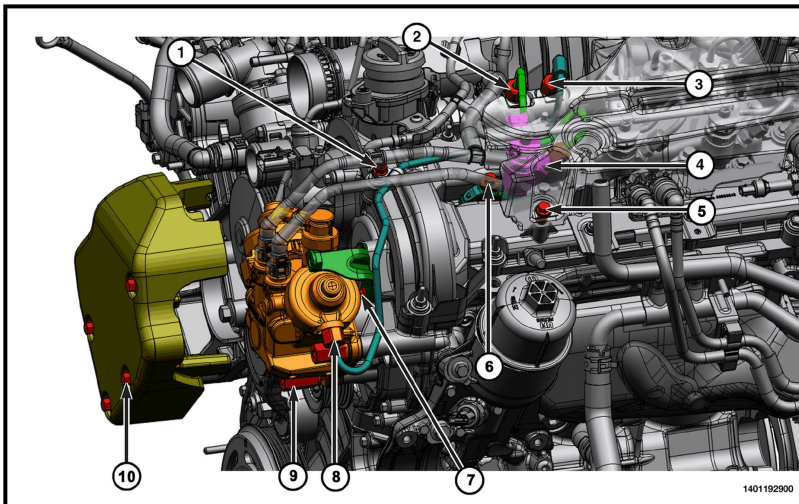


1 - Union Nut
2 - Fuel Crossover Tube
3 - Union Nut

- Install a **NEW** fuel crossover tube and tighten the union nuts to the proper torque specifications.
- Install the fuel crossover tube bolt and securely tighten.
- Start engine, allow to warm, turn engine off. Check and verify there are no leaks. Refer to **DIAGNOSIS AND TESTING - HIGH - PRESSURE FUEL LINE LEAKS** .

TORQUE SPECIFICATIONS

FUEL SYSTEM

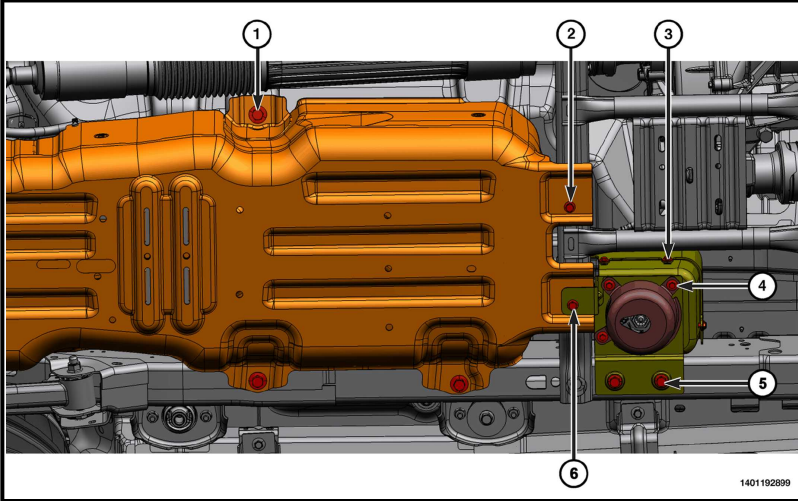


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-

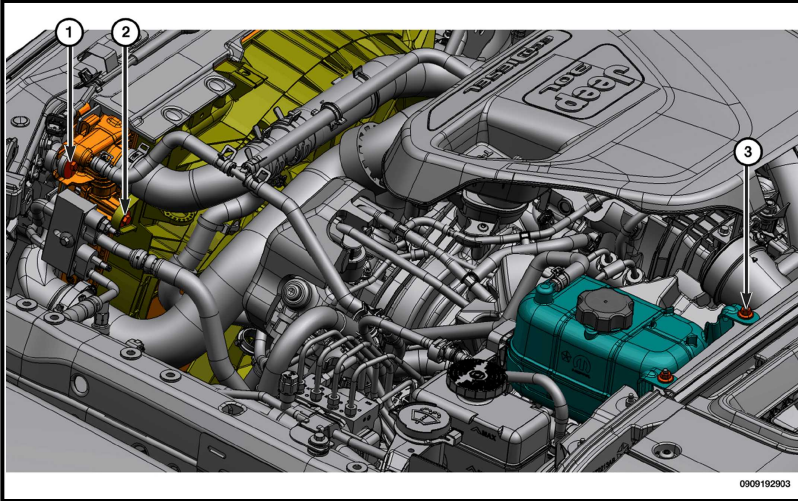
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Â	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-

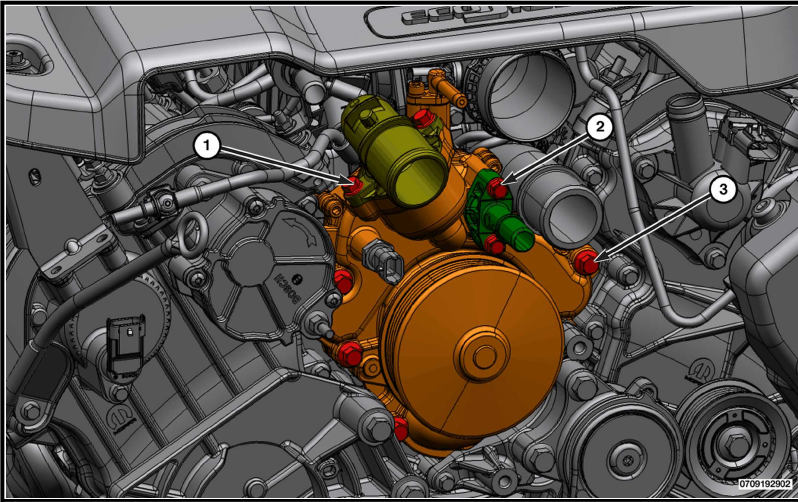
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



COOLING SYSTEM - 3.0L DIESEL

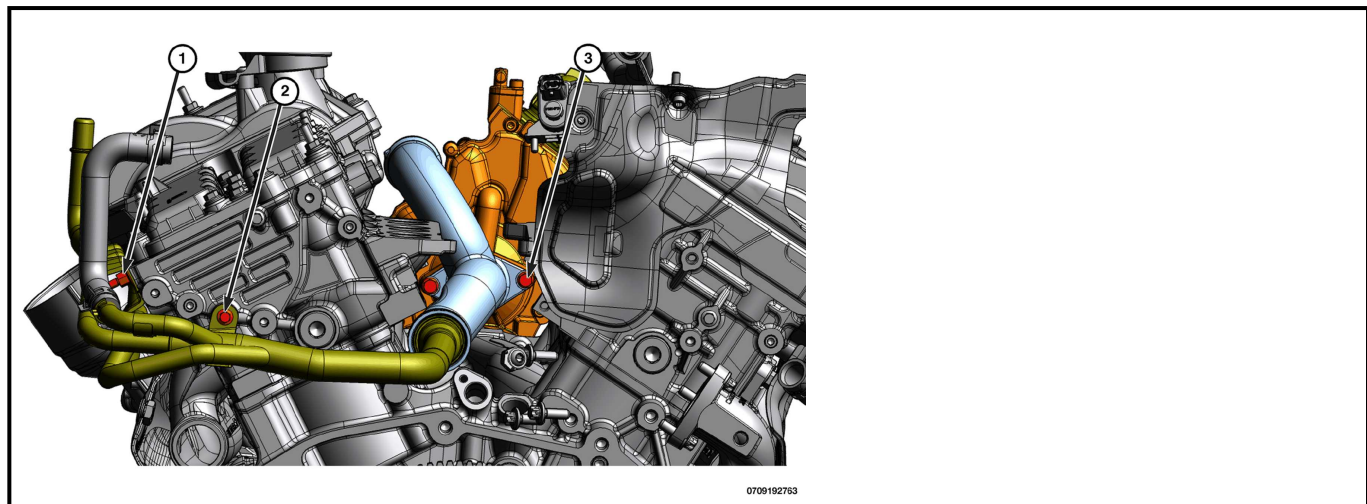


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90° and then tighten to 32 N.m (24 Ft. Lbs.).	-
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

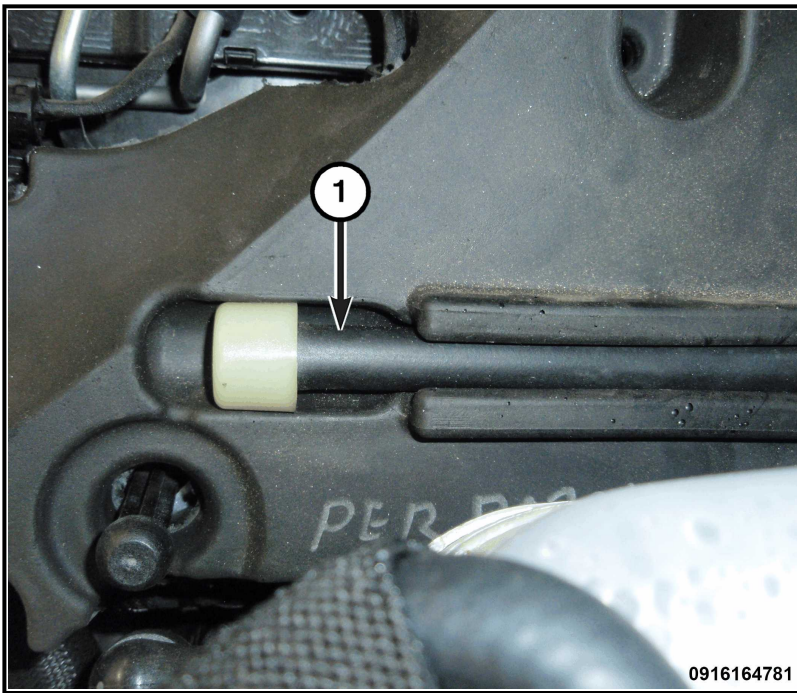
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-



LEFT FUEL RAIL SUPPLY LINE

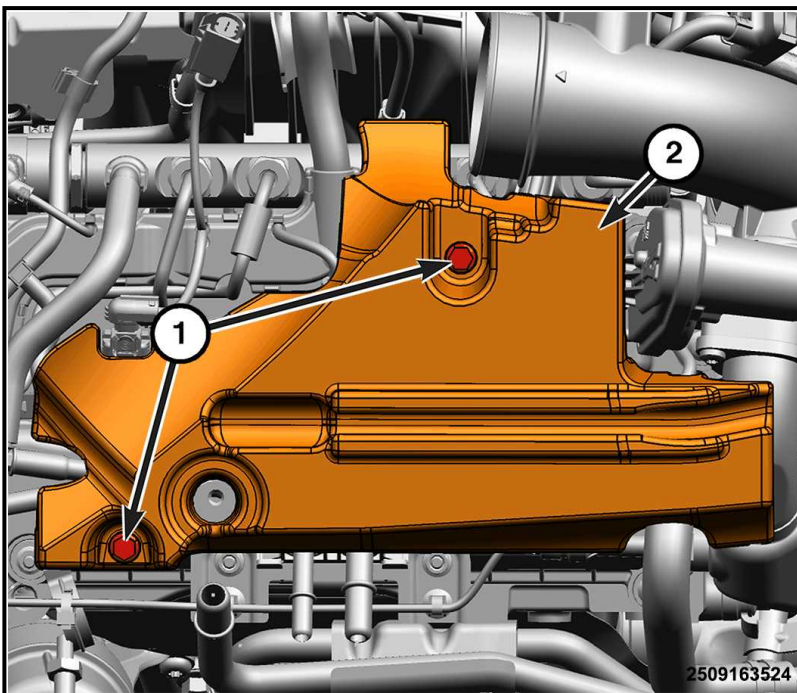
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
3. Remove the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#) .



1 - Vent Hose

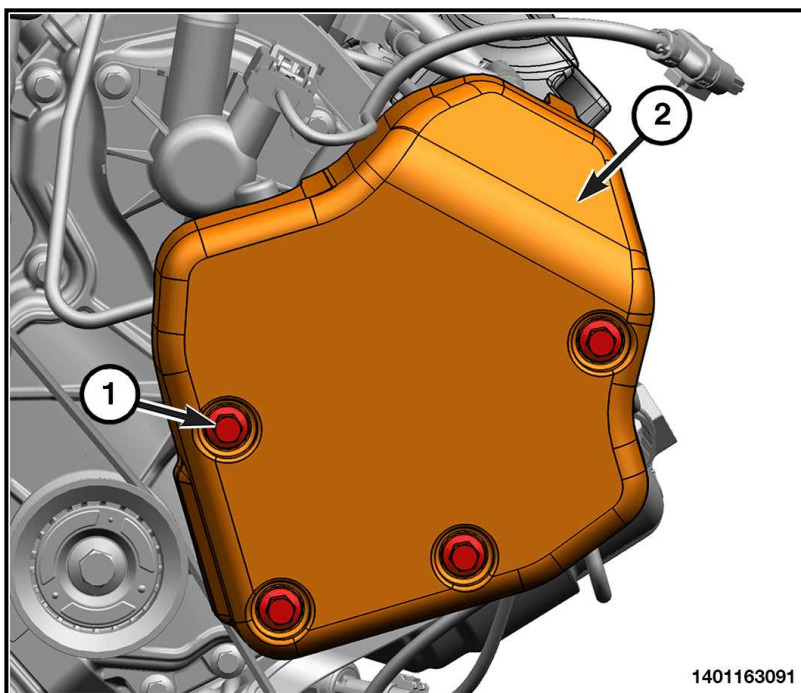
4. Remove the vent hose from the left fuel rail cover.



1 - Left Fuel Rail Cover Bolts

2 - Left Fuel Rail Cover

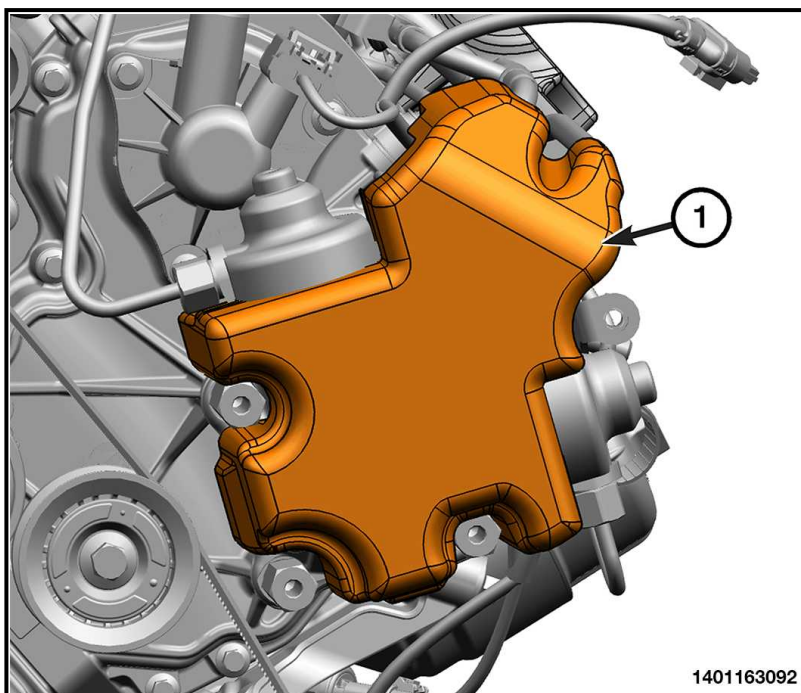
5. Remove the left fuel rail cover bolts and the left fuel rail cover.



1 - Fuel Injection Pump Blocker Plate Bolts

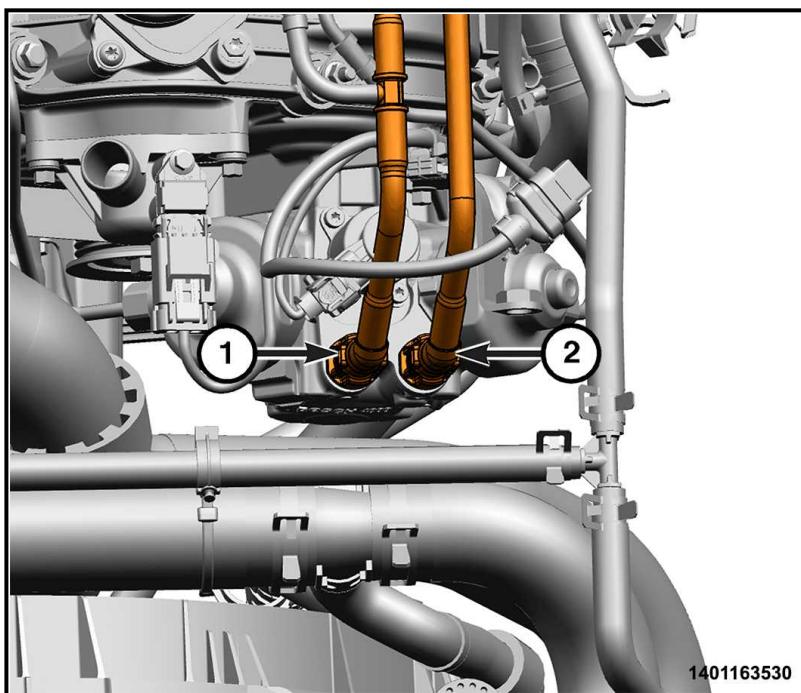
2 - Fuel Injection Pump Blocker Plate

6. Remove the fuel injection pump blocker plate bolts and the fuel injection pump blocker plate.



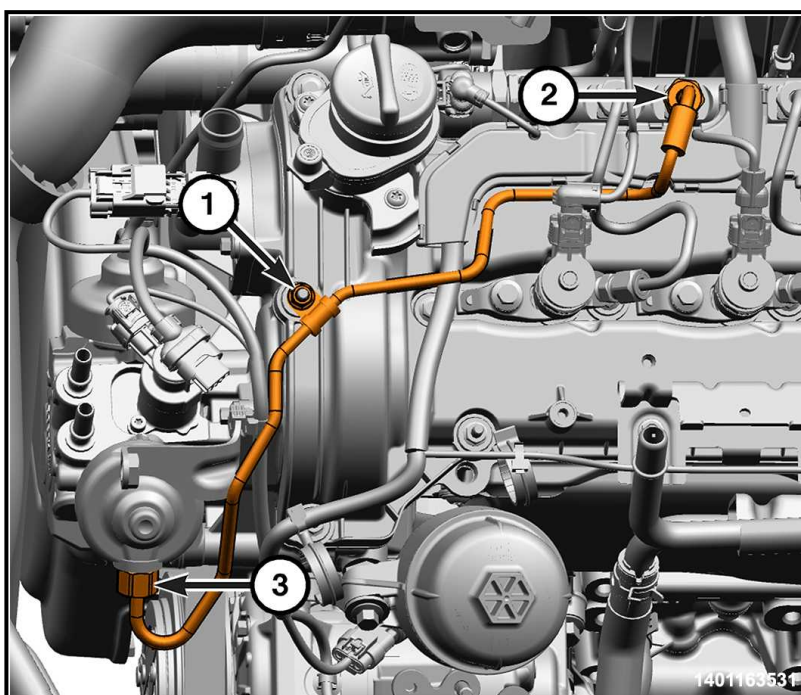
1 - Fuel Injection Pump Silencer

7. Remove the fuel injection pump silencer.



- | |
|------------------------------|
| 1 - Low Pressure Return Line |
| 2 - Low Pressure Supply Line |

8. Disconnect the low pressure supply and low pressure return lines from the fuel injection pump. Refer to **REMOVAL AND INSTALLATION** .



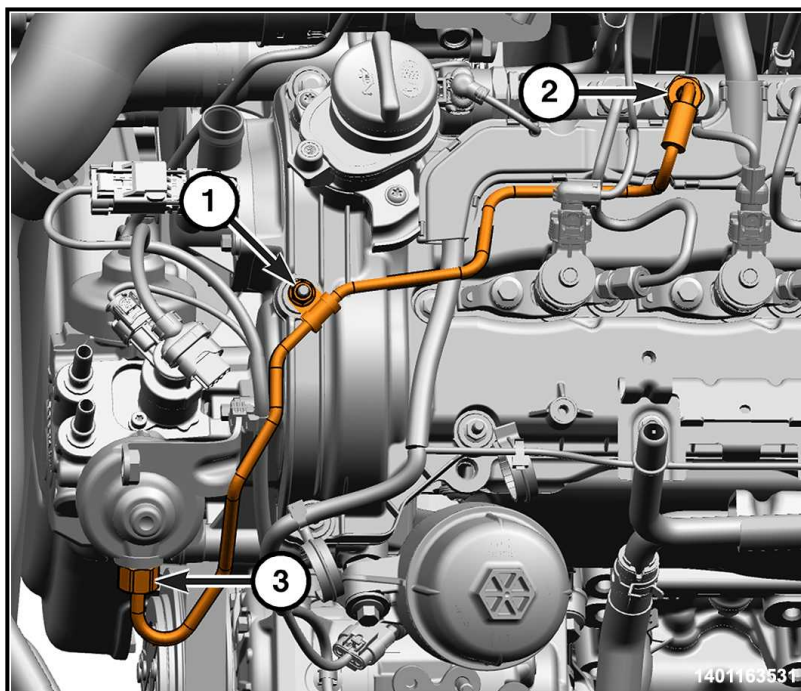
- | |
|---------------------------|
| 1 - Fuel Tube Bracket Nut |
| 2 - Union Nut |
| 3 - Union Nut |

9. Unscrew the fuel tube union nut from the fuel injection pump.
10. Remove the fuel tube bracket nut securing the fuel tube.
11. Unscrew the union nut from the fuel rail and remove and discard the fuel tube.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.



1 - Fuel Tube Nut

2 - Union Nut

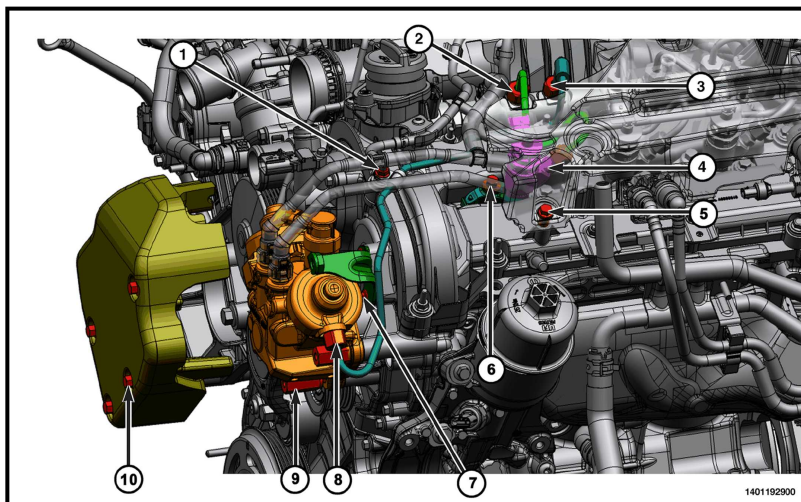
3 - Union Nut

NOTE: Fuel tubes are a one time only use and must be replaced anytime they have been removed.

- Install the **NEW** left high pressure fuel tube and tighten the union nuts to the proper torque specifications.
- Install the left fuel rail cover and securely tighten the left fuel rail cover bolts.
- Start engine, allow to warm, turn engine off. Check and verify there are no leaks. Refer to **DIAGNOSIS AND TESTING - HIGH - PRESSURE FUEL LINE LEAKS**.

TORQUE SPECIFICATIONS

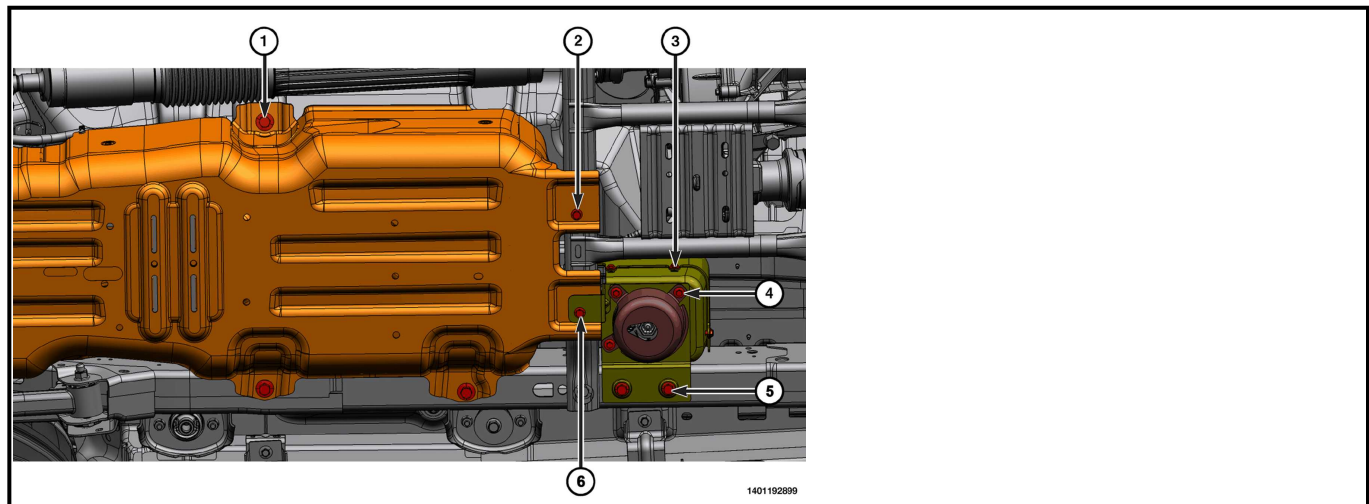
FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Â	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-

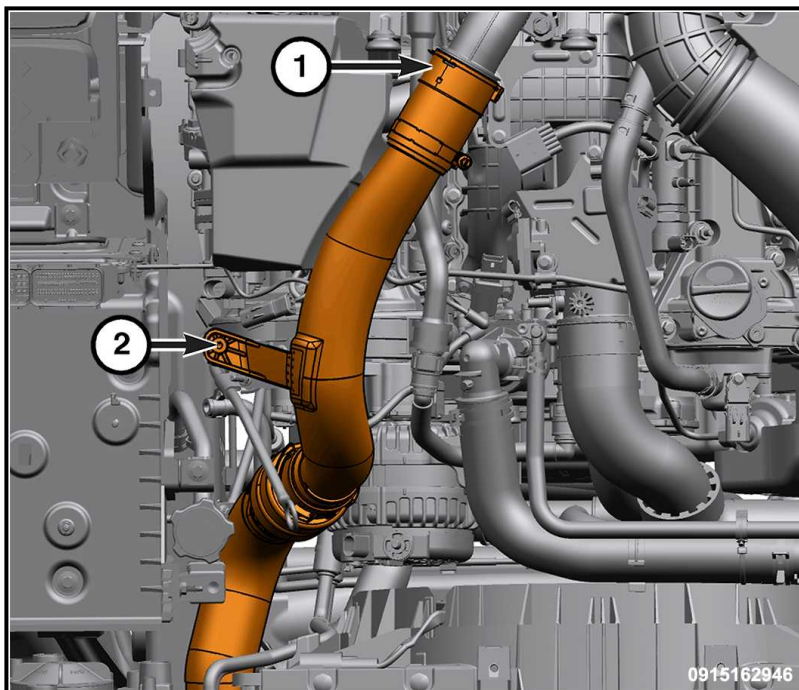
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



RIGHT FUEL RAIL SUPPLY LINE

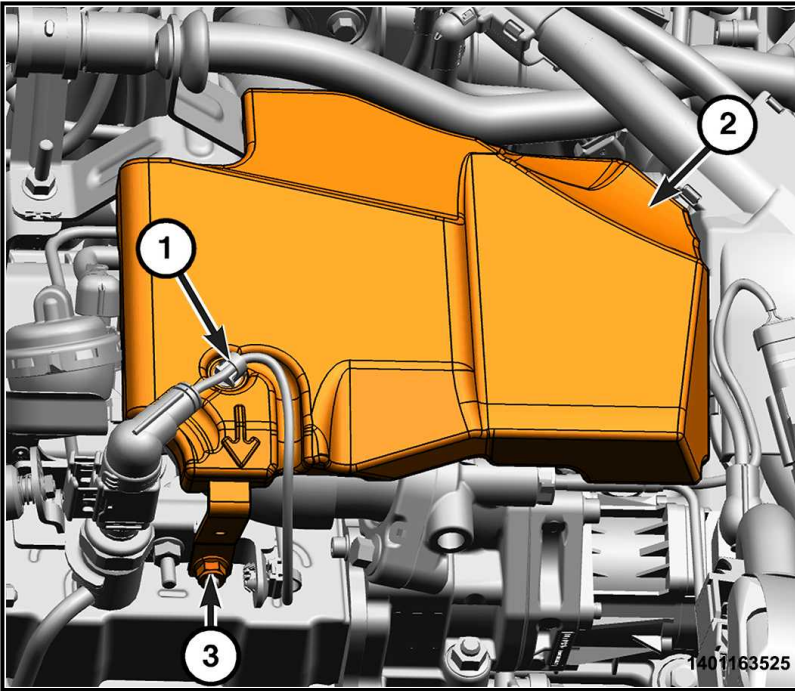
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



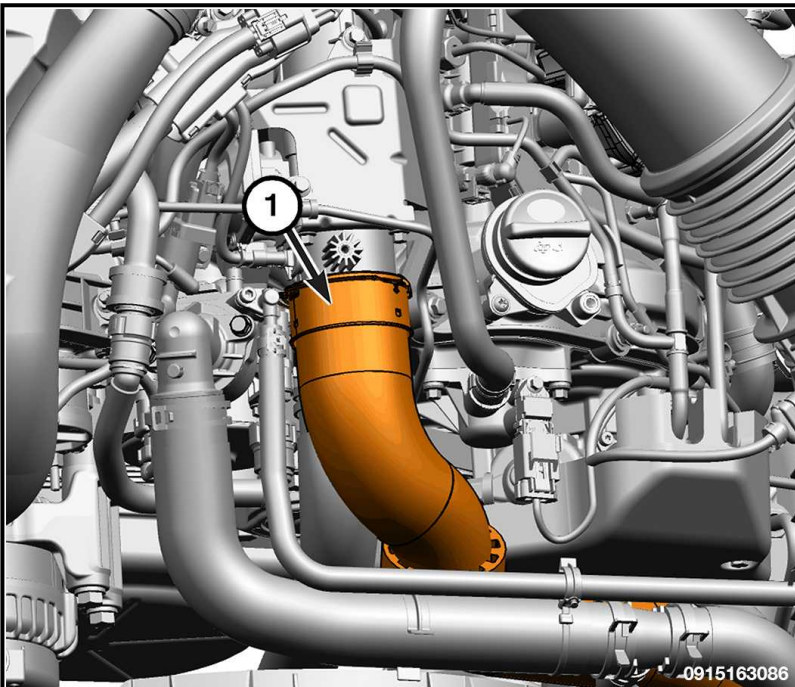
1 - Retaining Clip
2 - Charge Air Cooler Hose Bolt

3. Remove the Charge Air Cooler (CAC) hose bolt securing the CAC hose to the support bracket.
4. Release the retaining clip and disconnect the CAC hose from the turbocharger elbow and position aside.



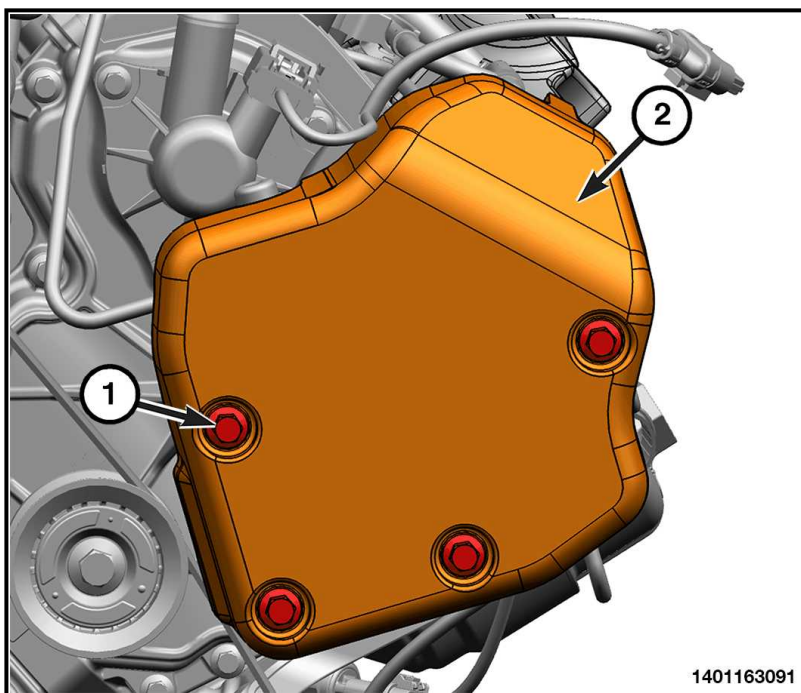
- | |
|---------------------------|
| 1 - Wire Harness Retainer |
| 2 - Fuel Rail Cover |
| 3 - Fuel Rail Cover Nut |

5. Loosen the fuel rail cover nut, detach the wire harness retainer and remove the fuel rail cover.



- | |
|----------------------------|
| 1 - Charge Air Cooler Hose |
|----------------------------|

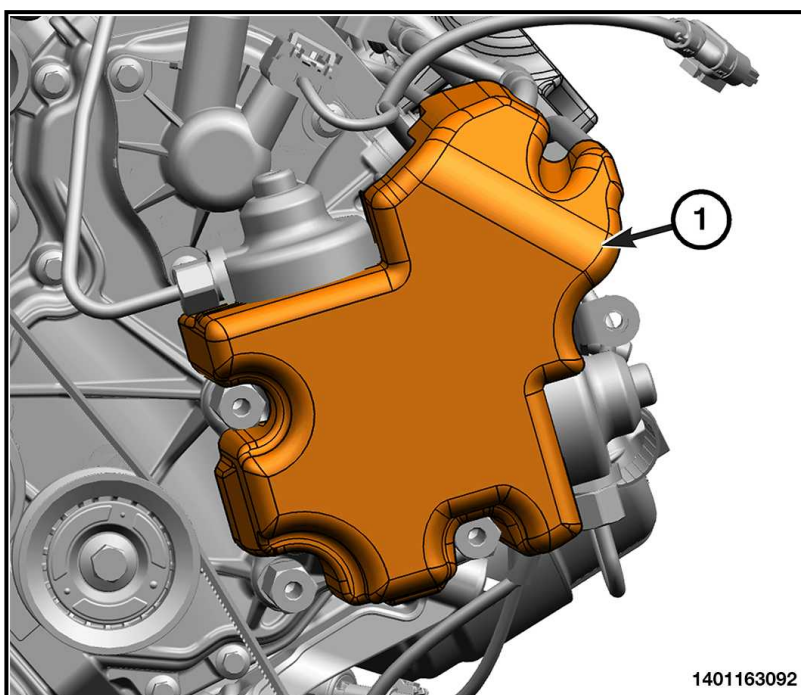
6. Release the retaining clip and disconnect the CAC hose from the EGR air flow control valve.



1 - Fuel Injection Pump Blocker Shield Bolts

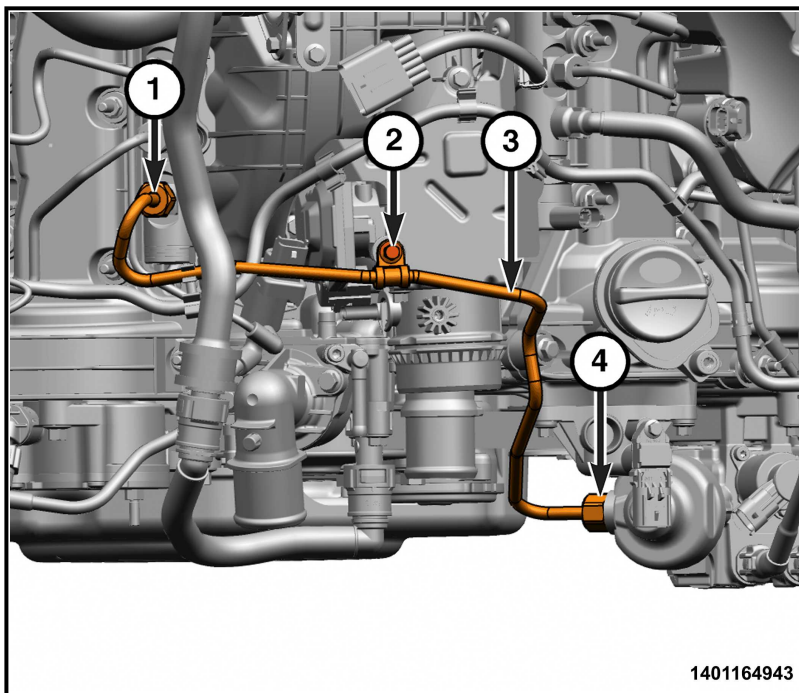
2 - Fuel Injection Pump Blocker Shield

7. Remove the fuel injection pump blocker shield bolts and the fuel injection pump blocker shield.



1 - Fuel Injection Pump Silencer

8. Remove the fuel injection pump silencer.



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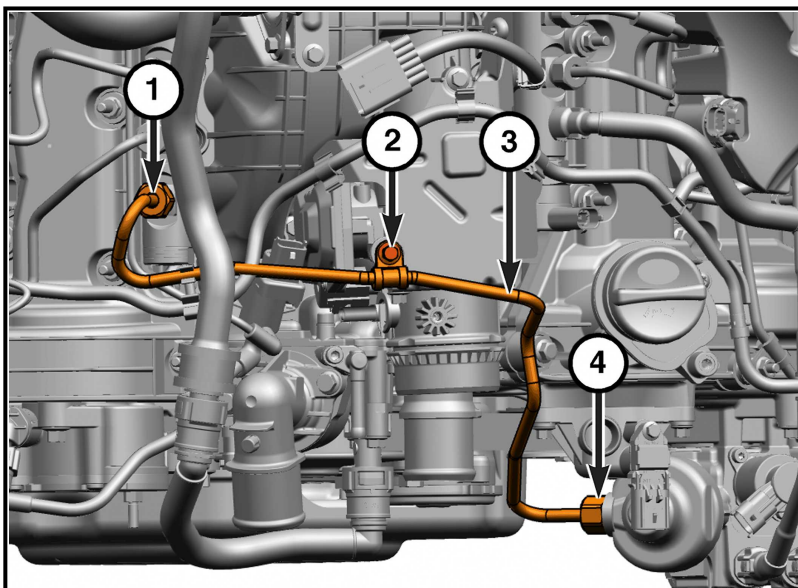
1 - Union Nut
2 - Fuel Tube Bolt
3 - Fuel Tube
4 - Union Nut

9. Remove the fuel tube bolt securing the fuel tube.
10. Unscrew the union nuts and remove and discard the fuel tube.
11. Install protective caps over the openings.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.



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1 - Union Nut

2 - Fuel Tube bracket Bolt

3 - Fuel Tube

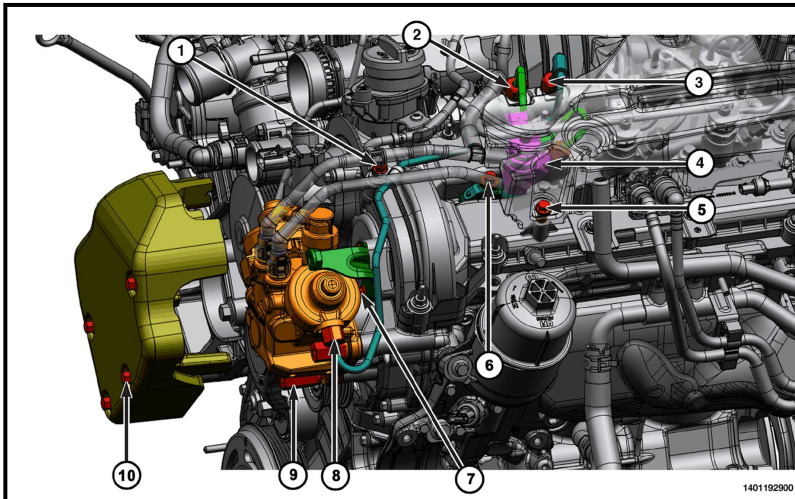
4 - Union Nut

NOTE: Fuel tubes are a one time only use and must be replaced anytime they have been removed.

- Install the **NEW** right high pressure fuel tube and tighten the union nuts to the proper torque specifications.
- Install the fuel tube bracket bolt and securely tighten.
- Install the fuel rail cover, attach wire harness retainer, and securely tighten the fuel rail cover nut.
- Start engine, allow to warm, turn engine off. Check and verify there are no leaks. Refer to **DIAGNOSIS AND TESTING - HIGH - PRESSURE FUEL LINE LEAKS** .

TORQUE SPECIFICATIONS

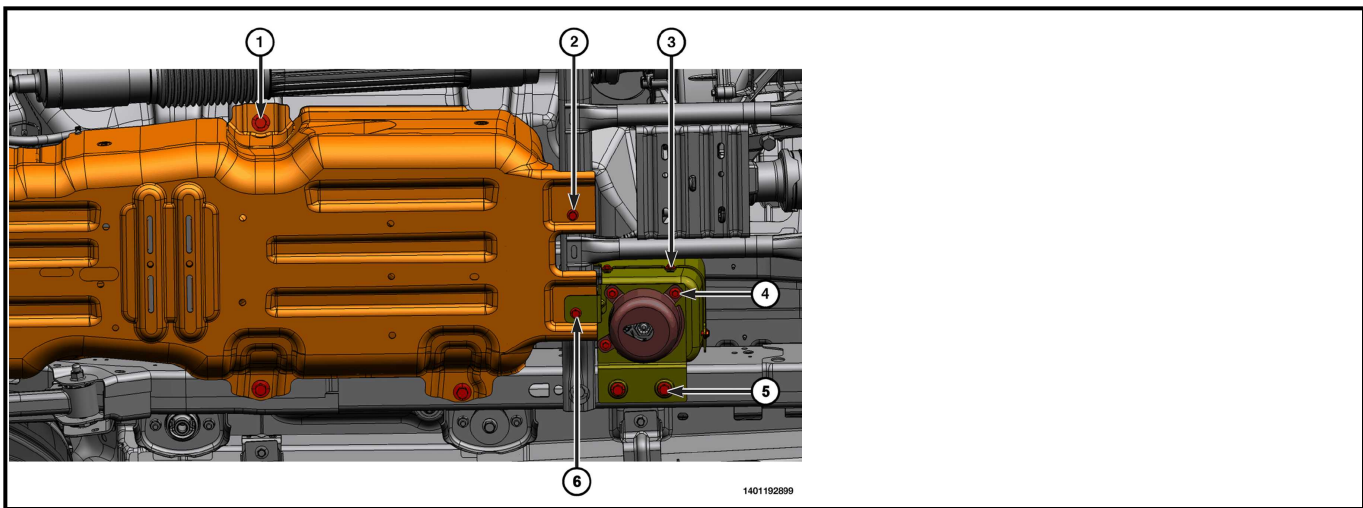
FUEL SYSTEM



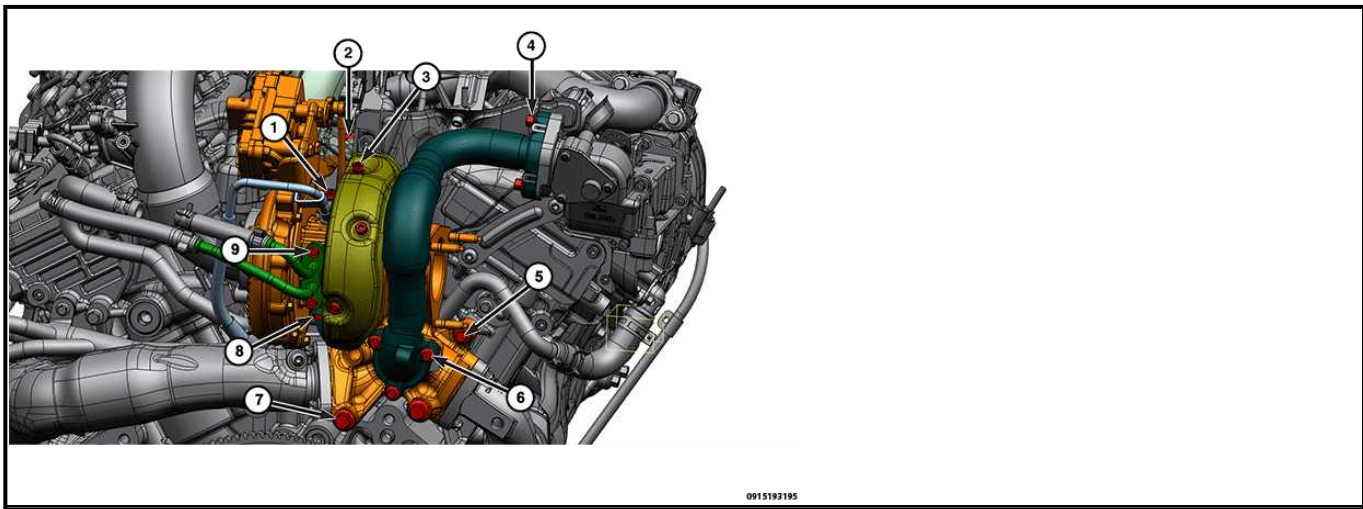
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Â	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



TURBOCHARGER



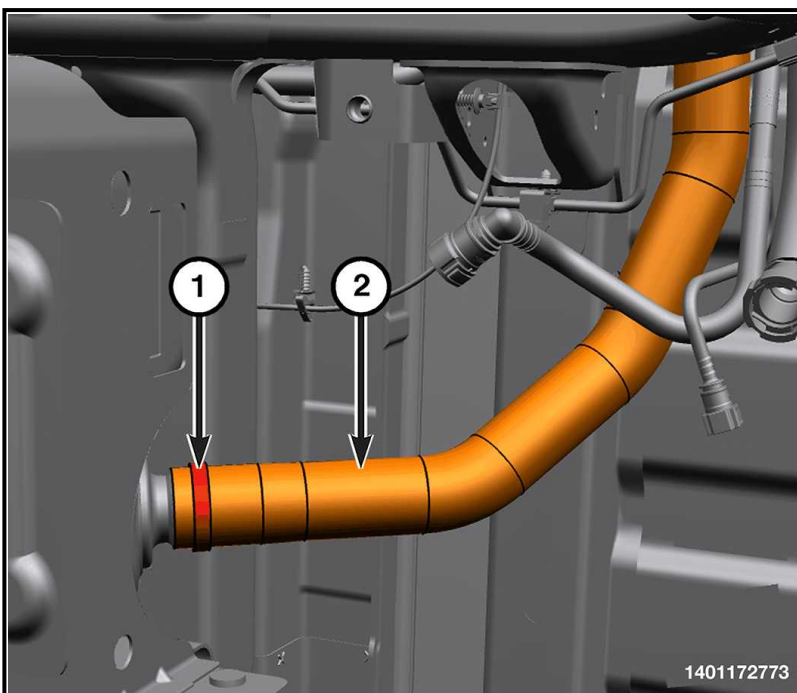
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

FUEL FILLER TUBE

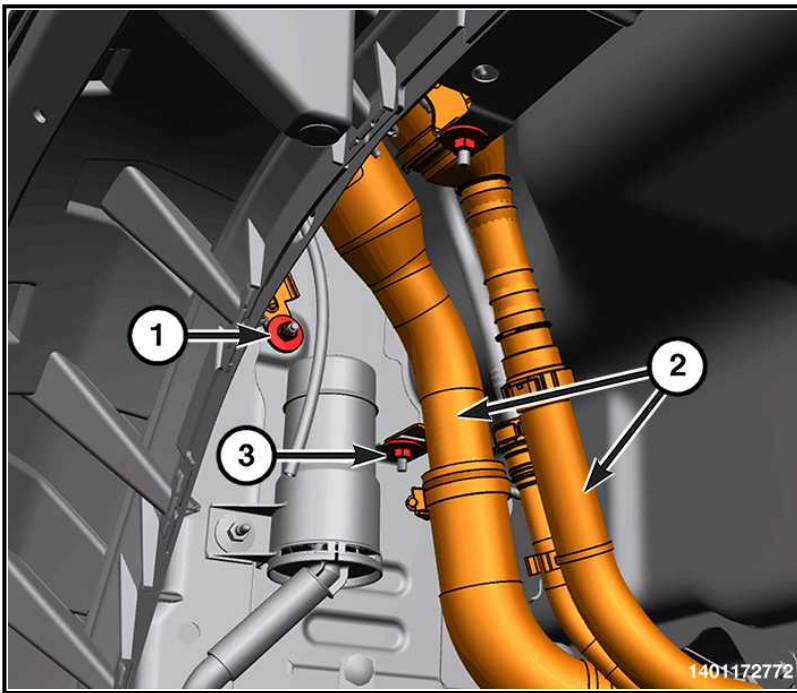
REMOVAL

1. Remove the fuel filler housing. Refer to [HOUSING, FUEL FILL, REMOVAL AND INSTALLATION](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
3. Remove the left rear wheel housing splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) .
4. Remove the Diesel Exhaust Fluid (DEF) tank. Refer to [TANK, DIESEL EXHAUST FLUID, REMOVAL AND INSTALLATION](#) .



1 - Filler Hose Clamp
2 - Filler Hose

5. Loosen the filler hose clamp and disconnect filler hose from fuel tank.



1 - Upper Fuel Filler Tube Nuts
2 - Fuel Filler Tube
3 - Lower Fuel Filler Tube Nut

6. Remove the two upper fuel filler tube nuts and the lower fuel filler tube nut securing the fuel filler tube and the DEF filler tube.

7. Carefully remove the fuel filler tube and the DEF filler tube.

INSTALLATION

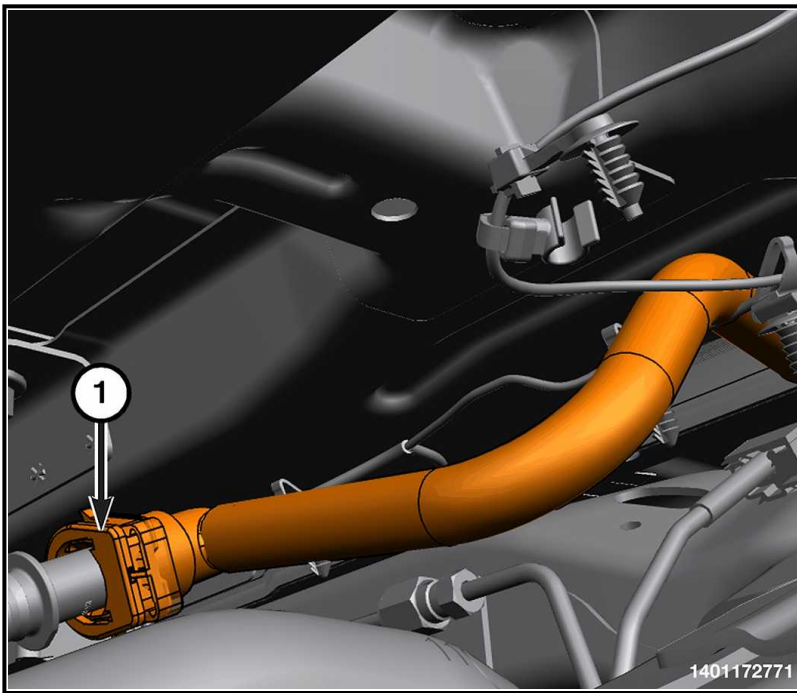
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Carefully route the fuel filler tube and the Diesel Exhaust Fluid (DEF) filler tube back in place.
- Install the lower fuel filler tube nut and the upper fuel filler tube nuts and securely tighten.
- Install the fuel filler tube to the fuel tank and securely tighten the fuel filler tube clamp.

VENT TUBE

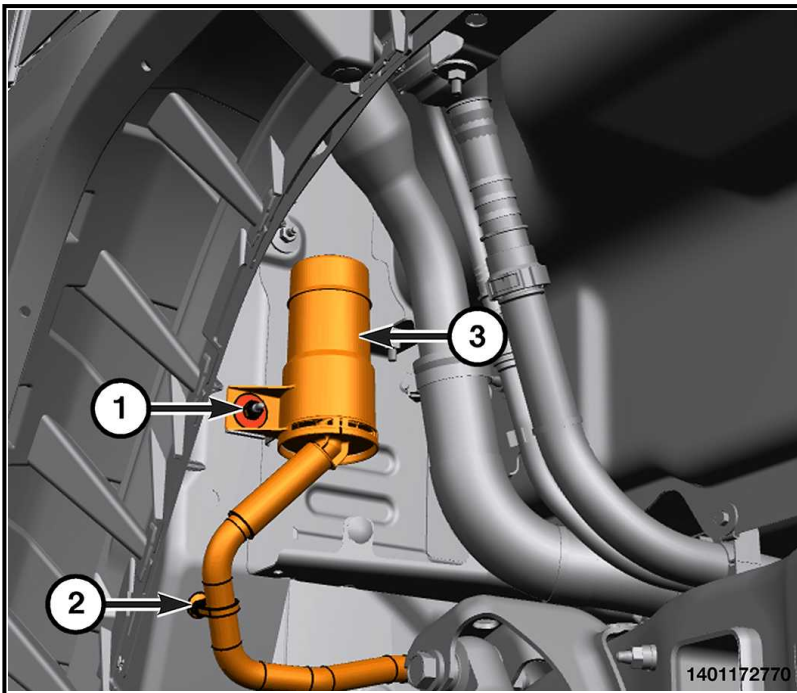
REMOVAL

1. Remove the left rear tire and wheel. Refer to [REMOVAL AND INSTALLATION](#) .
2. Remove the left rear wheelhouse splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) .



1 - Vent Tube Quick Connect Fitting

3. Disconnect the vent tube quick connect fitting.



1 - Vent Tube Nut

2 - Vent Tube Retainer

3 - Vent Tube Assembly

4. Remove the vent tube retainer.

5. Remove the vent tube nut and the vent tube assembly.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Install the vent tube assembly and securely tighten the vent tube nut.

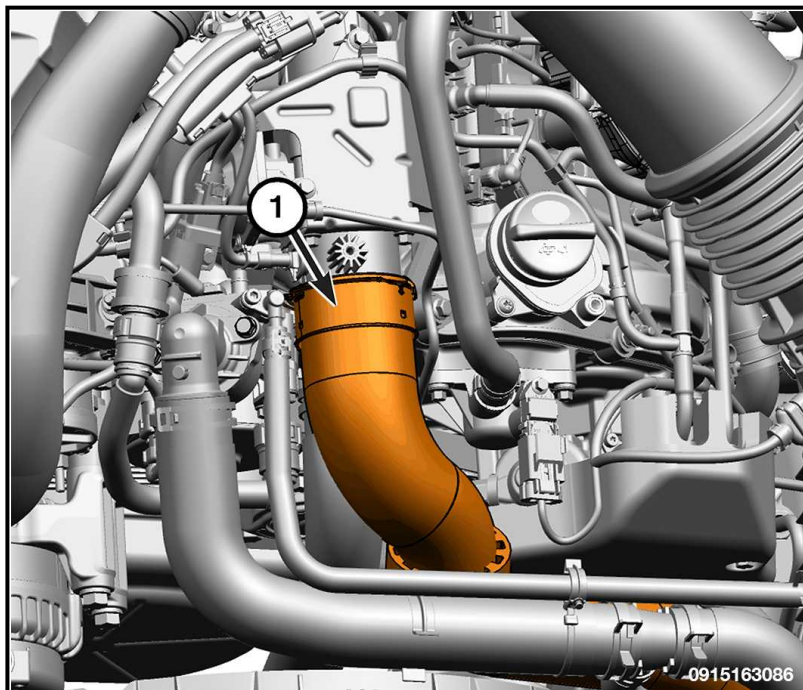
VALVE

REMOVAL AND INSTALLATION

CASCADE OVERFLOW VALVE

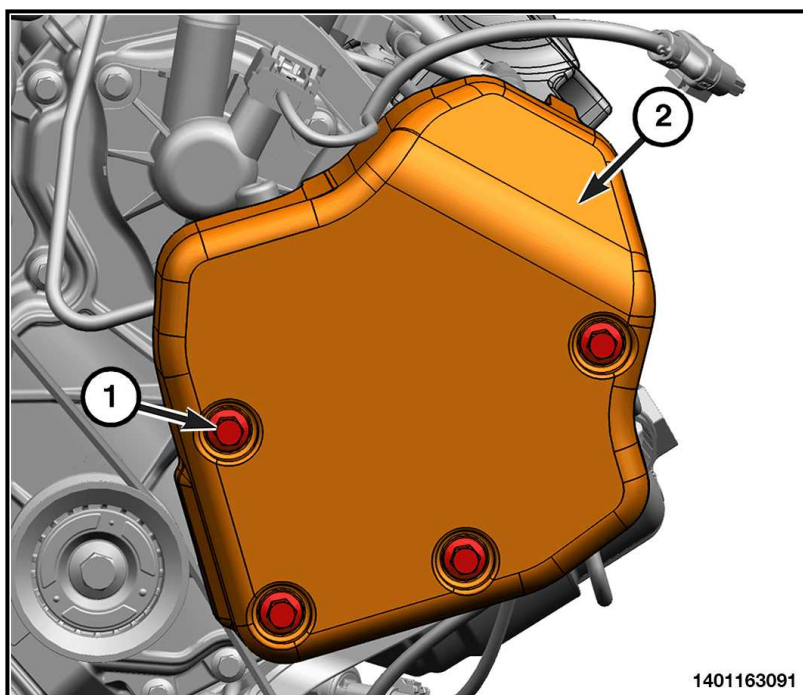
REMOVAL

1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



1 - Retaining Clip

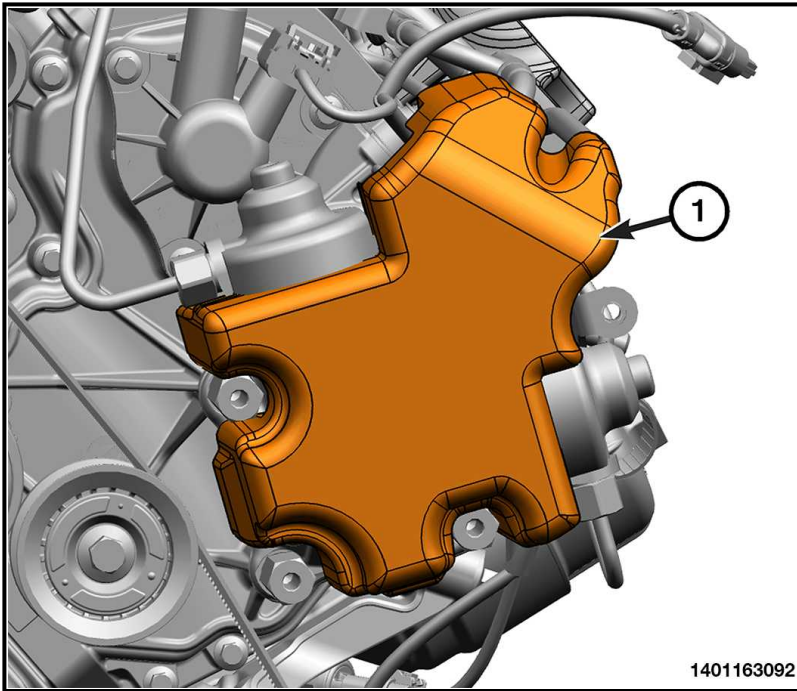
2. Release the retaining clip and disconnect the Charge Air Cooler (CAC) hose from the EGR air flow control valve.



1 - Fuel Injection Pump Blocker Plate Bolts

2 - Fuel Injection Pump Blocker Plate

3. Remove the fuel injection pump blocker plate bolts and the fuel injection pump blocker plate.



1 - Fuel Injection Pump Silencer

4. Remove the fuel injection pump silencer.



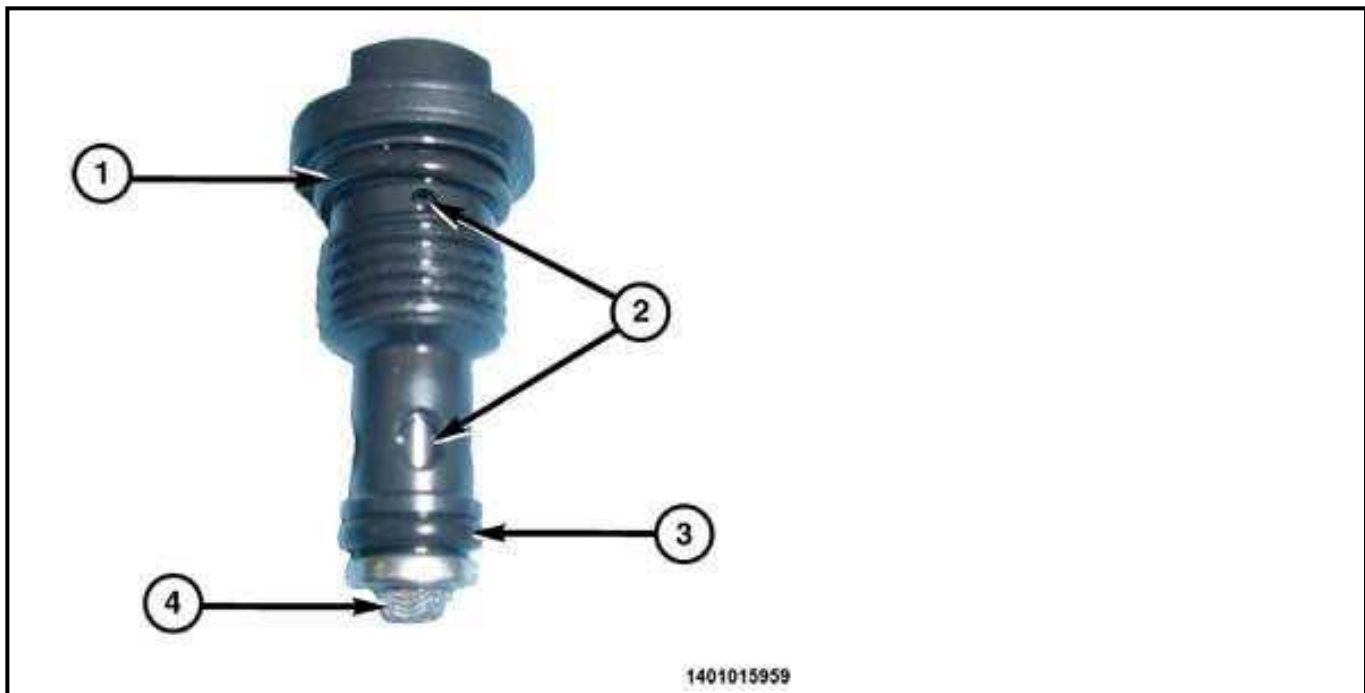
1 - Cascade Overflow Valve

5. Remove the cascade overflow valve.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

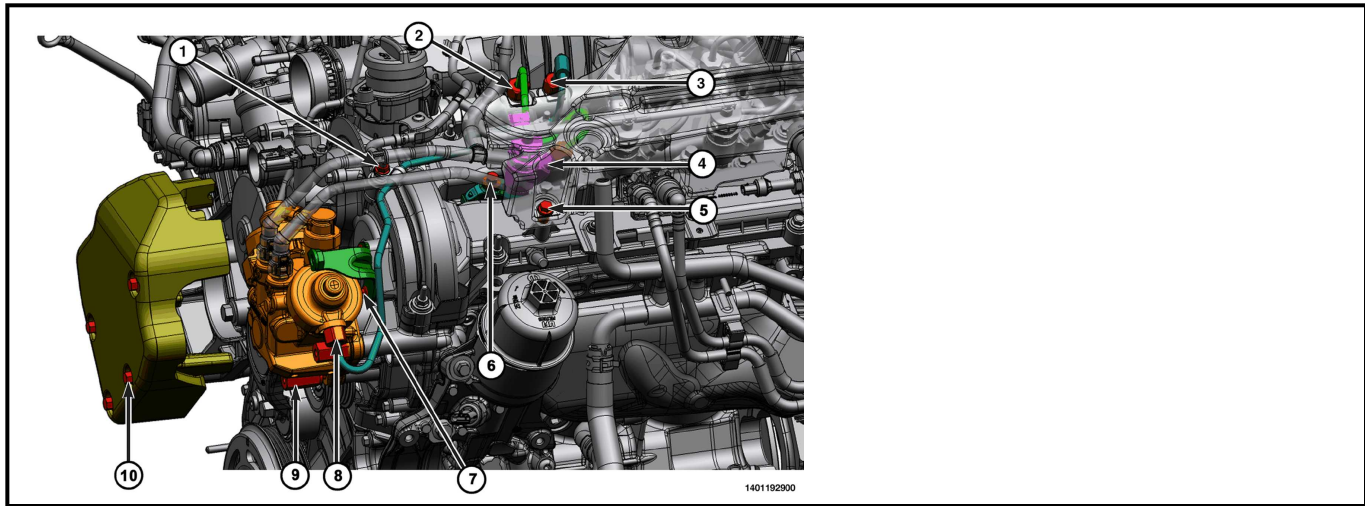


1 - O-ring
2 - Orifices
3 - O-ring
4 - Filter Screen

- Inspect the cascade overflow valve O-rings and filter screen.

TORQUE SPECIFICATIONS

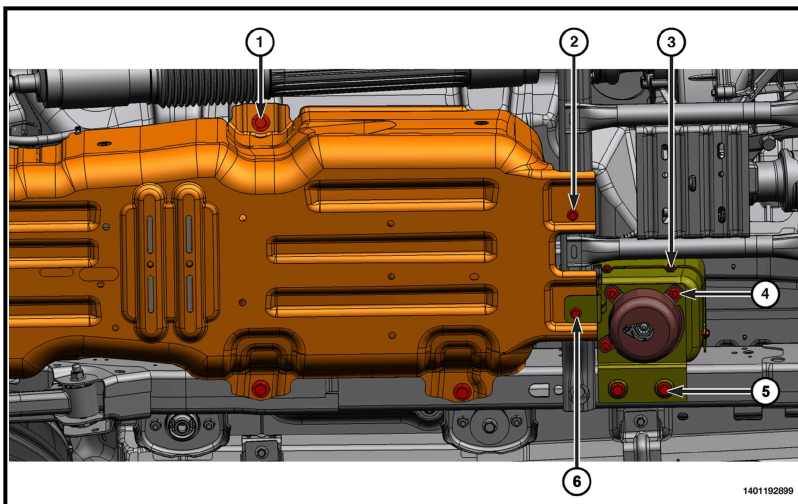
FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Å	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



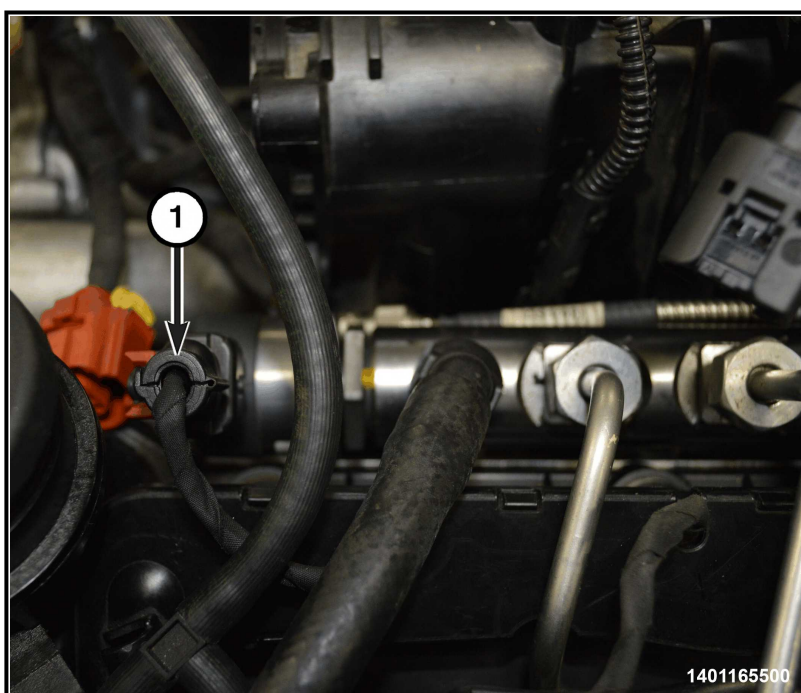
FUEL PRESSURE REGULATOR

REMOVAL

WARNING: Observe the following precautions when working on fuel systems: No sparks, open flames or smoking. Avoid inhaling and swallowing fuel. Avoid eye and skin contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing. Failure to observe these precautions may result in fire, explosion, property damage, and serious or fatal injury.

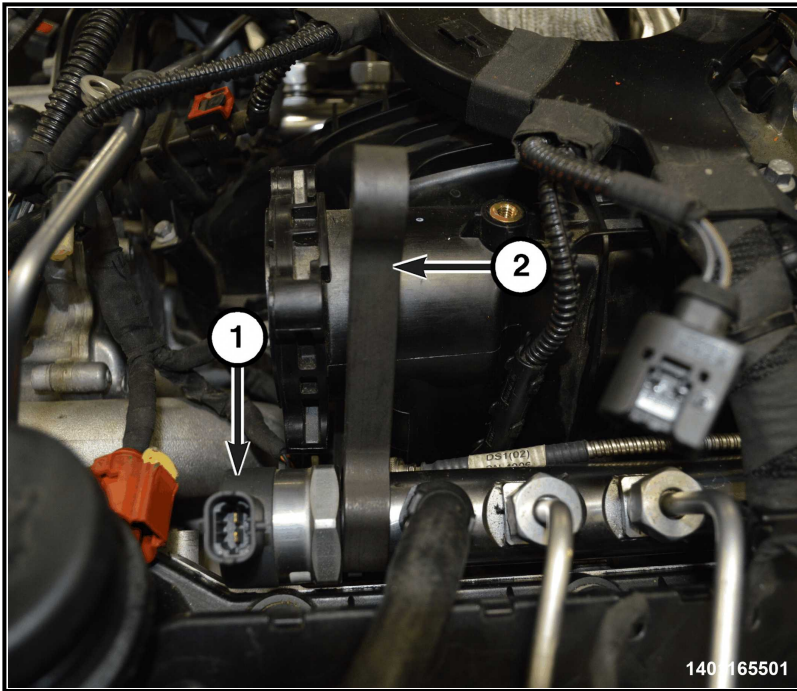
WARNING: High-pressure lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 2000 bar (29, 008 psi). Use extreme caution when inspecting for high-pressure fuel leaks. Fuel under this amount of pressure can penetrate skin causing personal injury or death. Inspect for high-pressure fuel leaks with a sheet of cardboard. Wear safety goggles and adequate protective clothing when servicing fuel system.

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
3. Clean the area around the fuel pressure regulator.



1 - Fuel Pressure Regulator Wire Harness Connector

4. Disconnect the fuel pressure regulator wire harness connector.



1 - Fuel Pressure Regulator

2 - Fuel Pressure Regulator Wrench Tool

5. Using the (special tool #VM.10491, Wrench, Fuel Pressure Regulator), remove the fuel pressure regulator.

6. Install a protective cap over opening in fuel rail.

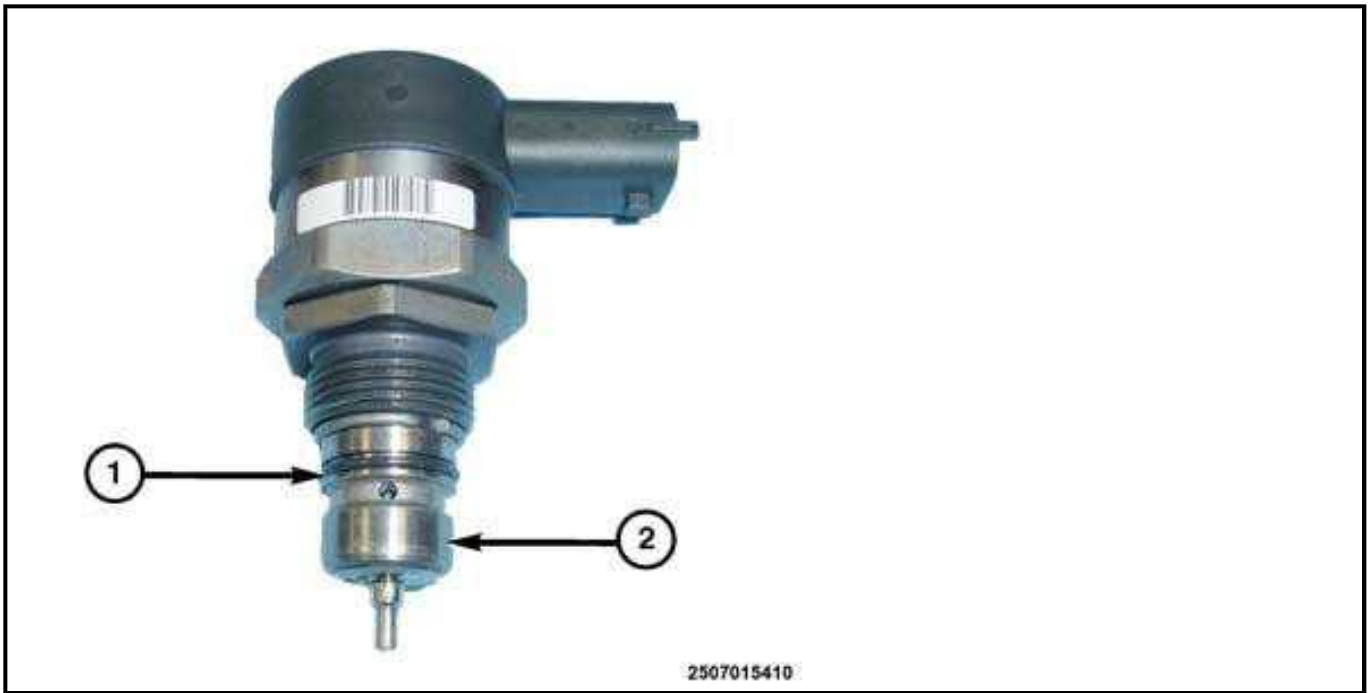
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

WARNING: Observe the following precautions when working on fuel systems: No sparks, open flames or smoking. Avoid inhaling and swallowing fuel. Avoid eye and skin contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing. Failure to observe these precautions may result in fire, explosion, property damage, and serious or fatal injury.

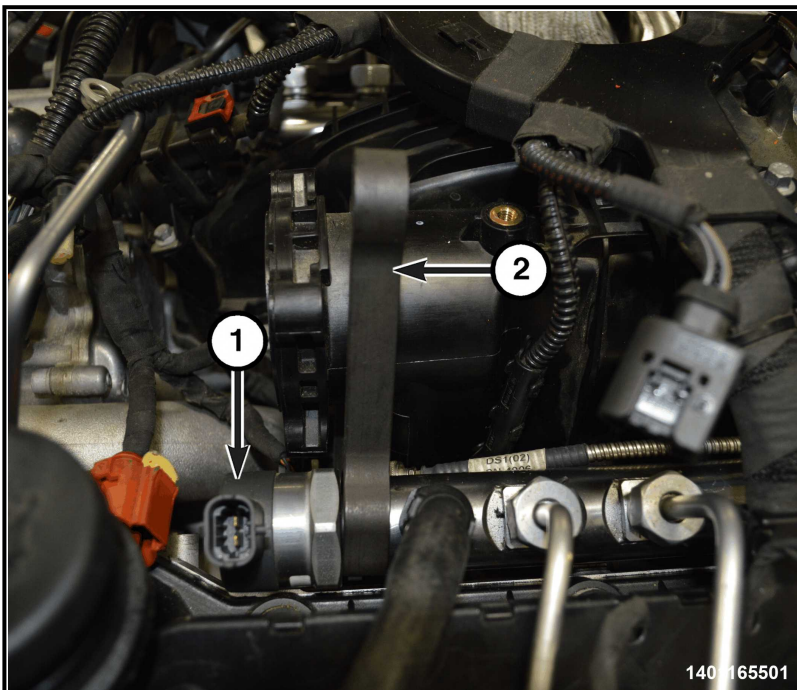
WARNING: High-pressure lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 2000 bar (29, 008 psi). Use extreme caution when inspecting for high-pressure fuel leaks. Fuel under this amount of pressure can penetrate skin causing personal injury or death. Inspect for high-pressure fuel leaks with a sheet of cardboard. Wear safety goggles and adequate protective clothing when servicing fuel system.



1 - O-ring

2 - Fuel Pressure Regulator

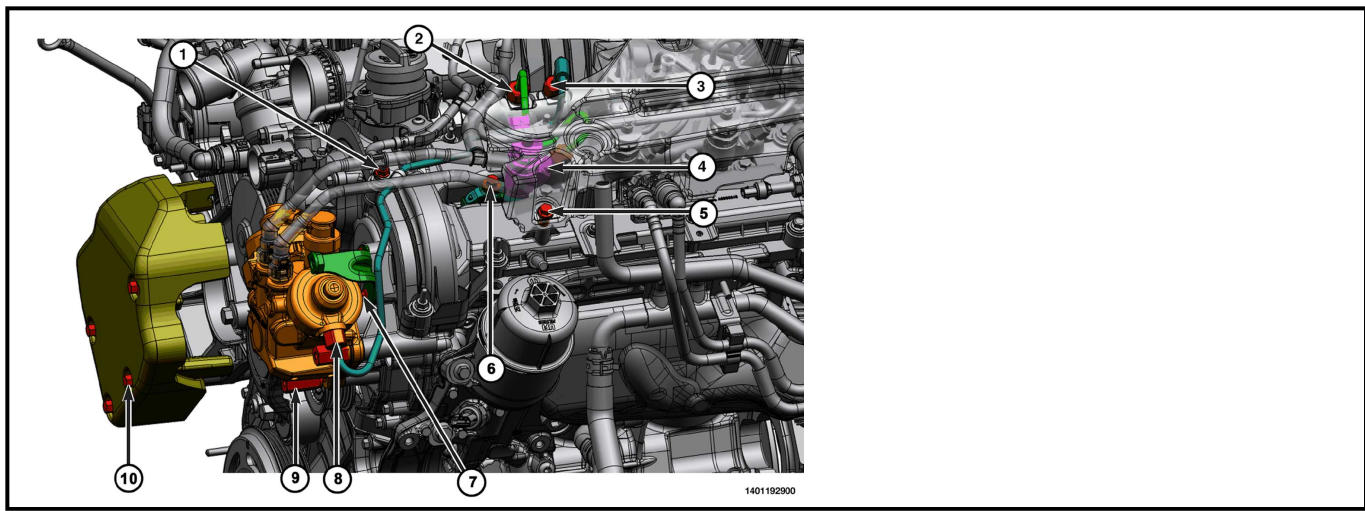
- Remove the protective cap from fuel rail opening.
- Make sure the fuel rail opening is clean of debris.
- Lubricate the O-ring with clean diesel fuel.



- Using the (special tool #VM.10491, Wrench, Fuel Pressure Regulator), install the fuel pressure regulator and tighten to the proper torque specifications.

TORQUE SPECIFICATIONS

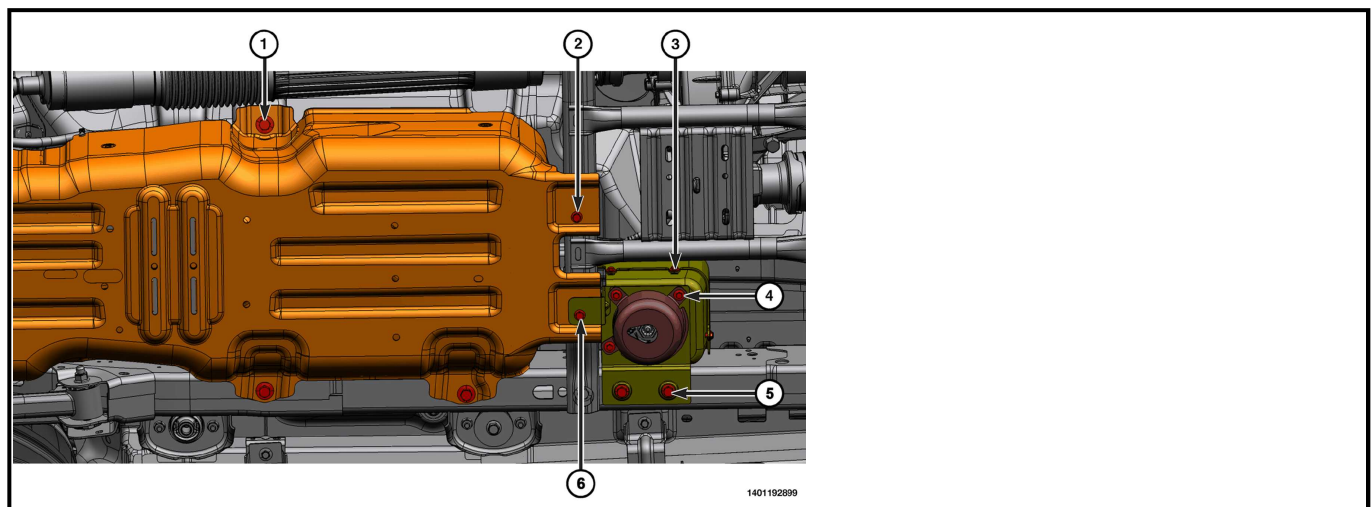
FUEL SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: Tighten to 60 N.m (44 Ft. Lbs.) Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: Tighten to 4 N.m (35 In. Lbs.) Tighten to 7 N.m (62 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Â	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-

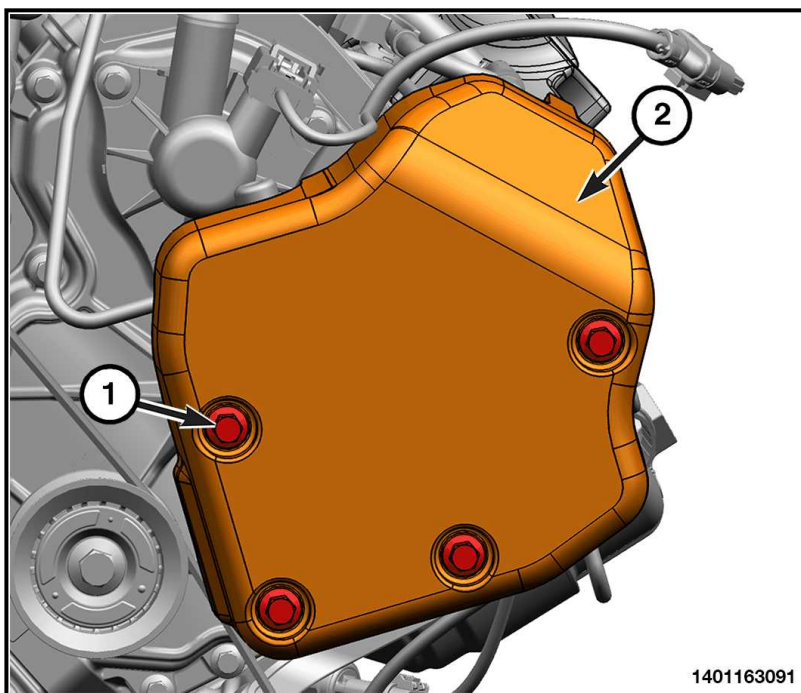


FUEL QUANTITY SOLENOID

REMOVAL

WARNING: No sparks, open flames or smoking. Risk of poisoning from inhaling and swallowing fuel. Risk of injury to eyes and skin from contact with fuel. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing.

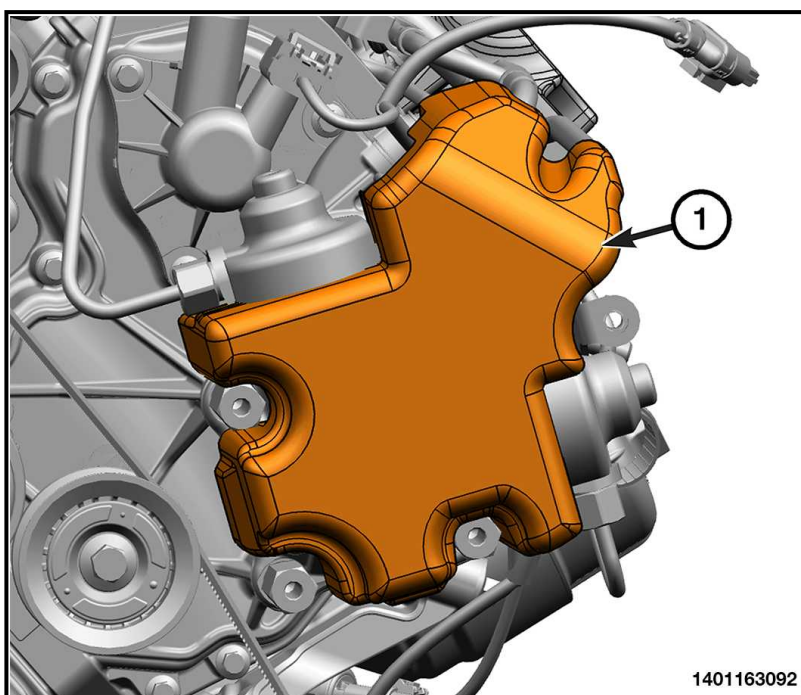
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#) .



1 - Fuel Injection Pump Blocker Plate Bolts

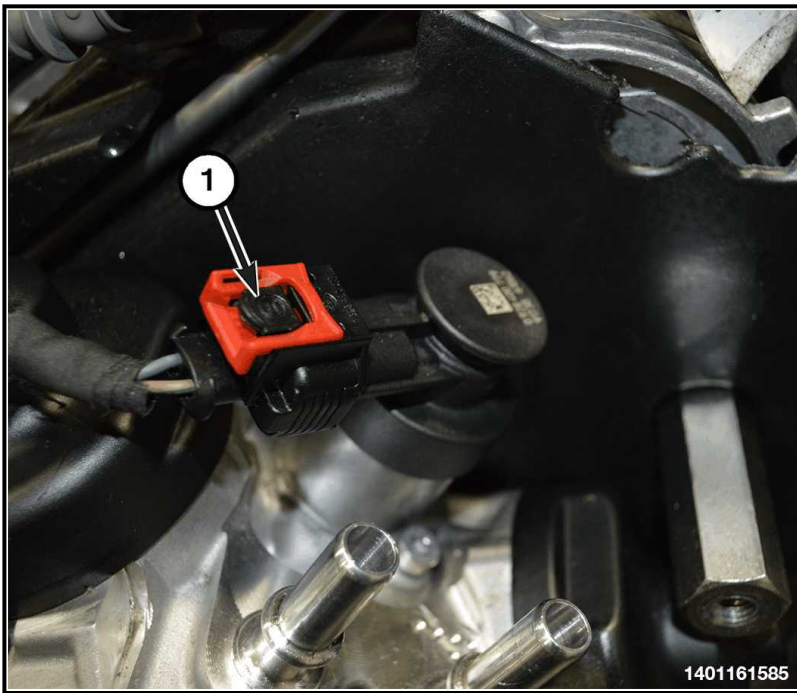
2 - Fuel Injection Pump Blocker Plate

3. Remove the fuel injection pump blocker plate bolts the fuel injection pump blocker plate.



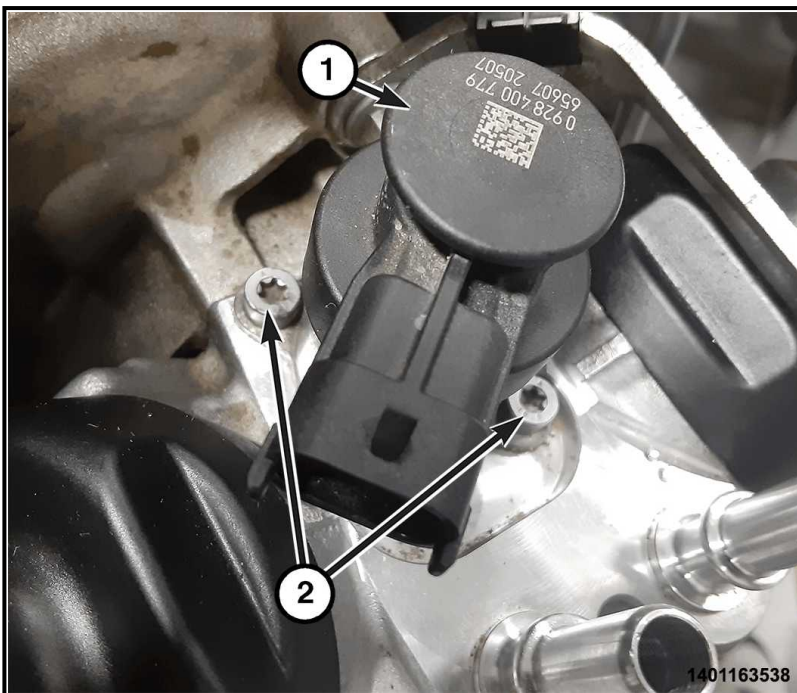
1 - Fuel Injection Pump Silencer

4. Remove the fuel injection pump silencer.



1 - Fuel Quantity Solenoid Wiring Harness Connector

5. Disconnect the fuel quantity solenoid wiring harness connector.



1 - Fuel Quantity Solenoid Screws

2 - Fuel Quantity Solenoid

6. Remove the fuel quantity solenoid screws and the fuel quantity solenoid.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.



1401161588

1 - O-rings

2 - Filter Screen

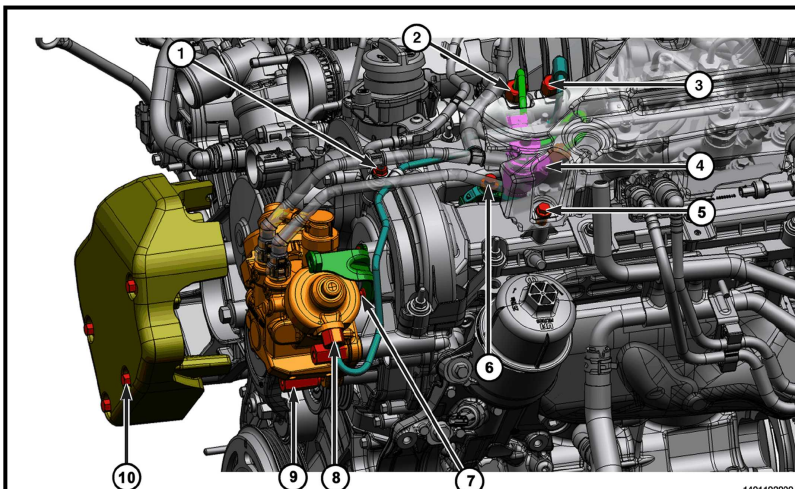
- Clean the sealing surfaces.

NOTE: If excessive metallic debris or sand is present on the filter screen, investigate if debris is also in the high pressure fuel pump and low-pressure supply lines.

- Inspect the fuel quantity solenoid filter screen and clean as necessary.
- Lubricate O-rings on the fuel quantity solenoid.
- Start the engine, allow to run, turn engine off and inspect for leaks.

TORQUE SPECIFICATIONS

FUEL SYSTEM



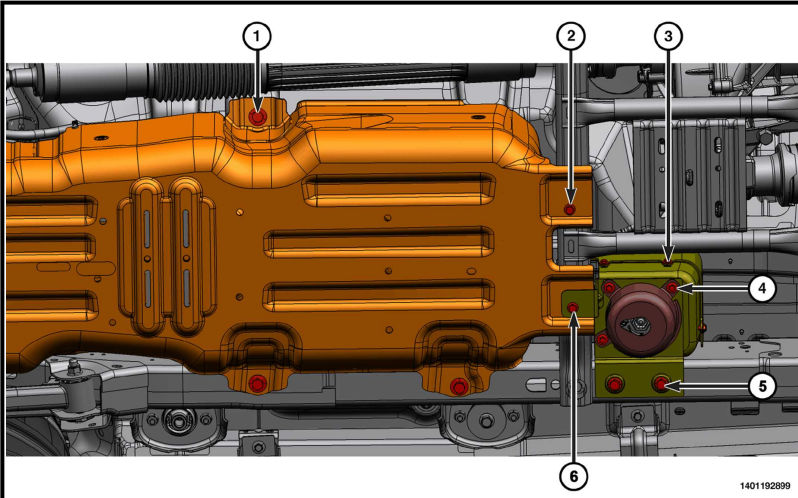
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CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	High Pressure to Valve Cover Bracket Nut	8 N.m (71 In. Lbs.)	-
2	High Pressure Pump Fuel Tube Union Nut at Fuel	5 N.m (44 In. Lbs.) + 75°	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
	Rail		
3	Fuel Tube Union Nut at Fuel Rail	5 N.m (44 In. Lbs.) + 75°	-
4	Fuel Tube Union Nut at Fuel Injector	11 N.m (8 Ft. Lbs.) + 75°	-
5	Fuel Injector NVH Cover Bolt	5 N.m (44 In. Lbs.)	-
6	Fuel Injector Tensioning Clamp Bolt	33 N.m (24 Ft. Lbs.)	-
7	High Pressure Pump Cover Bracket Bolts	8 N.m (71 In. Lbs.)	-
8	High Pressure Pump Fuel Tube Union Nut at High Pressure Pump	11 N.m (8 Ft. Lbs.) + 75°	-
9	Fuel Injection Pump Bolts	25 N.m (18 Ft. Lbs.)	-
10	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Cascade Overflow Valve	18 N.m (13 Ft. Lbs.)	-
-	Fuel Injection Pump Gear Nut	50 N.m (37 Ft. Lbs.)	-
-	Fuel Pressure Regulator	Torque Procedure: 1. Tighten to 60 N.m (44 Ft. Lbs.) 2. Loosen 90° then tighten to 85 N.m (63 Ft. Lbs.)	-
-	Fuel Quantity Solenoid Bolts	Torque Procedure: 1. Tighten to 4 N.m (35 In. Lbs.) 2. Tighten to 7 N.m (62 In. Lbs.)	-
-	Fuel Rail Bolt	25 N.m (18 Ft. Lbs.)	-
-	Filler Tube Ground Wire Nut	15 N.m (11 Ft. Lbs.)	-
Å	High Pressure Fuel Tube support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Fuel Tank Skid Plate to Frame Bolts	54 N.m (40 Ft. Lbs.)	-
2	Fuel Tank Skid Plate to Crossmember Bolts	25 N.m (18 Ft. Lbs.)	-
3	Fuel Filter/Water Separator Bottom Skid Plate Bolts	9 N.m (80 In. Lbs.)	-
4	Fuel Filter/Water Separator Side Shield Bolt	6 N.m (53 In. Lbs.)	-
5	Fuel Filter/Water Separator Bracket to Frame Bolts	30 N.m (22 Ft. Lbs.)	-

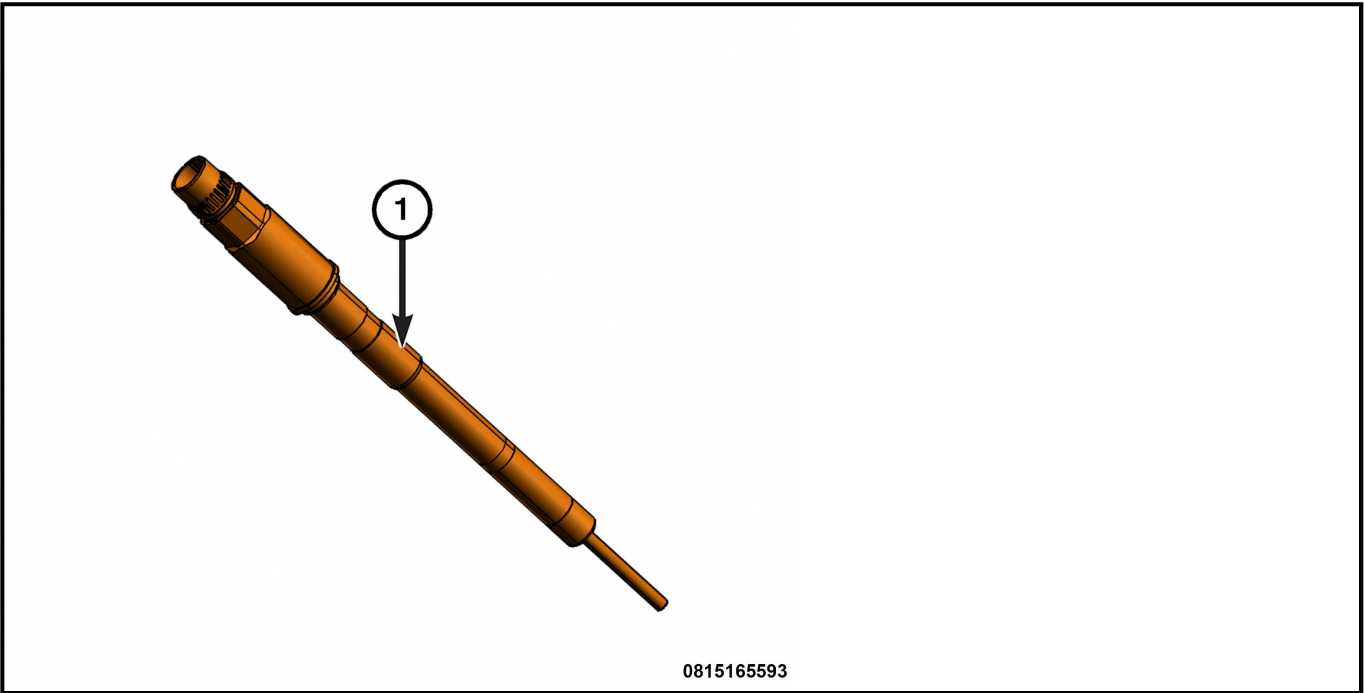
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
6	Fuel Filter/Water Separator Bracket to Fuel Tank Shield Bolt	25 N.m (18 Ft. Lbs.)	-
-	Fuel Filler to Body Bolt	8 N.m (71 In. Lbs.)	-
-	Fuel Bundle Clip Nuts	20 N.m (15 Ft. Lbs.)	-



IGNITION CONTROL [EXJ]

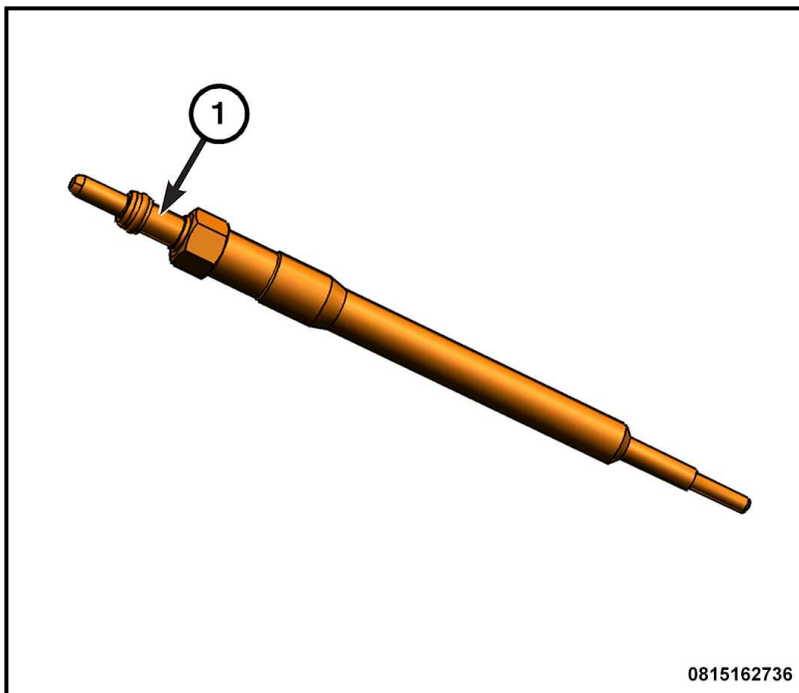
DESCRIPTION AND OPERATION

GLOW PLUG



1 - Pressure Sensor Glow Plug

- Cylinder No. 1 uses a pressure sensor glow plug.



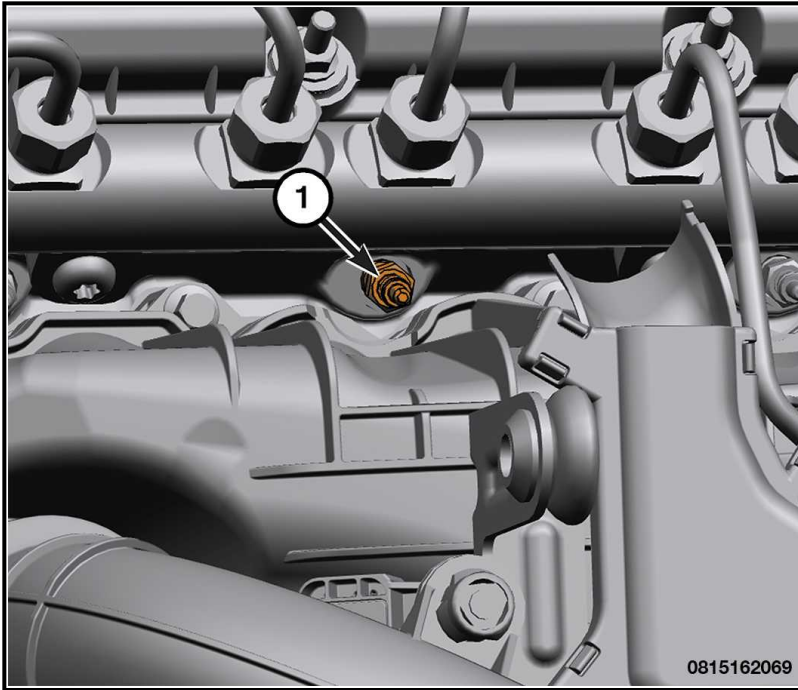
1 - Standard Glow Plug

- Cylinders 2 through 6 use the standard glow plug.

CAUTION: The glow plugs operate on a 7-volt system. The glow plugs DO NOT tolerate any over voltage. Full battery voltage will destroy the glow plug immediately. DO NOT test the glow plugs with a 12V source as damage will occur to the glow plug.

- CAUTION:**
- Never bend, bump or knock the fast metallic glow plugs.
 - Fast metallic glow plugs must not be handled loose in a container. Store, handle, and transport them only in original boxes.
 - If there is any doubt about the proper condition of a glow plug, do not reuse it.
 - Do not clean the glow plugs with abrasive or aggressive media.
 - Avoid dipping the glow plug into fluids.
 - Read Diagnostic Trouble Codes (DTCs). If a glow plug problem is indicated, do not start the engine.

CAUTION: Disregarding these instructions may cause severe engine damage.

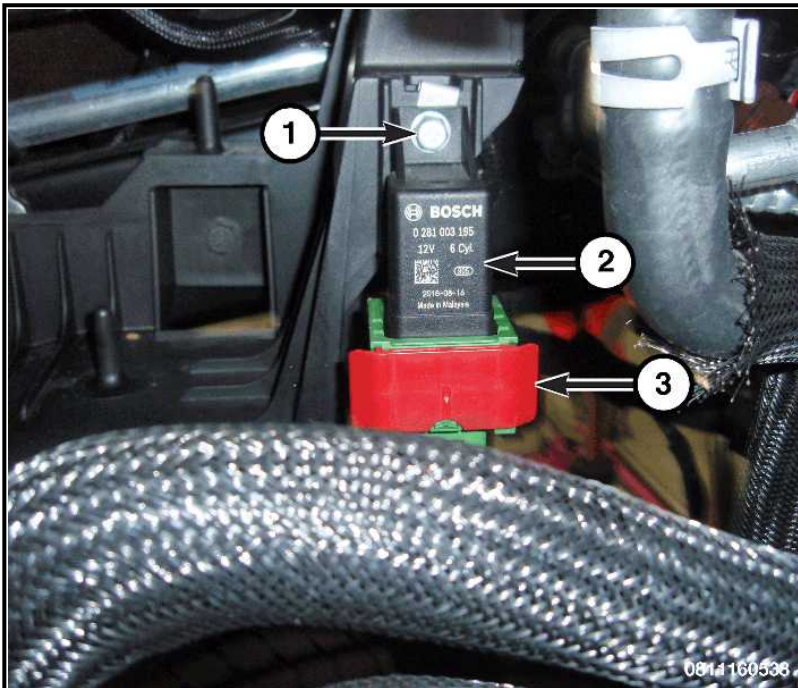


1 - Glow Plug

- Glow plugs are used to help start a cold or cool engine. The glow plugs will heat up and glow to heat the combustion chamber of each cylinder. An individual glow plug is used for each cylinder. Each glow plug is threaded into the side of the cylinder head below the fuel rail.

GLOW PLUG MODULE

DESCRIPTION



1 - Glow Plug Module Bolt

2 - Glow Plug Module

3 - Glow Plug Module Harness Connector

- The Glow Plug Module is located on the right fender well, under the coolant bottle.

OPERATION

- The Glow Plug Module is connected to a fused B(+) circuit and receives a path to ground at all times through the engine wiring harness. These connections allow it to remain functional regardless of the Electronic Ignition Switch (EIS) position. When the Powertrain Control Module (PCM) receives the On and Ignition Run signals from the EIS, it will send a signal through the LIN bus to actuate the Glow Plug Module for a period of time that depends on ambient air and engine coolant temperature.
- The Glow Plug Module utilizes integrated relays and microcontrollers to actuate the Glow Plugs based on input from the PCM. The Glow Plug Module has on-board diagnostic functions that will set powertrain DTCs, which will be transmitted to the PCM through the LIN bus. Because the Glow Plug Module uses microcontrollers to control battery voltage to the Glow Plugs, conventional diagnostic methods will not always prove conclusive when diagnosing problems with the Glow Plug Module and related circuits. For proper diagnosis of the Glow Plug Module, the LIN data bus or electronic communication related to Glow Plug Module operation, a diagnostic scan tool is required.

DIAGNOSIS AND TESTING

GLOW PLUG MODULE

The Powertrain Control Module (PCM) actuates the glow plug module via the LIN bus.

GLOW PLUGS

CAUTION: DO NOT attempt to start the engine until the glow plug system tests correctly.

CAUTION: The glow plugs operate on a 7-volt system. The glow plugs DO NOT tolerate any over voltage. Full battery voltage will destroy the glow plug immediately. DO NOT test the glow plugs with a 12V source as damage will occur to the glow plug.

NOTE: To ensure a good contact of the measurement connections the contacts have to be free of oil, dirt or corrosion.

1. Measure the electrical resistance of each glow plug while it is still installed in the cylinder head. Resistance should be between 0.2 E 5Ω between the electrical connector point on the glow plug and the cylinder head. The ground contact on the DVOM must be as close as possible to the point where the glow plug contacts the cylinder head to avoid erratic resistance measurements.
2. If the resistance is out of tolerance, remove the glow plug from the cylinder head and check the resistance again.
3. Dismantled state: measure between connection side (connector/thread) and housing.
4. Engine mounted state: measure between connection side (connector/thread) and engine mass.
5. Resistance value:
 - Resistance > 5 Ω: open circuit failure.
 - Resistance < 200 mΩ: short circuit failure.
 - 200 mΩ < Resistance < 5 Ω: glow plug OK.
6. Use the actuator test function of the scan tool to test the glow plug module and glow plug lamp. The glow plug module's on-board diagnostic tests will automatically check the electrical condition of the entire glow plug system.
7. After the scan tool glow plug actuator test function is complete, if MIL is OFF and no glow plug DTCs are present, testing is complete and the engine can be started.
8. If MIL is still ON, check the harness connectors of glow plugs, repair any loose or damaged connections, and run the glow plug actuator test again.
9. If MIL is still ON, check the electrical connectors of glow plugs and power up the glow plugs again.

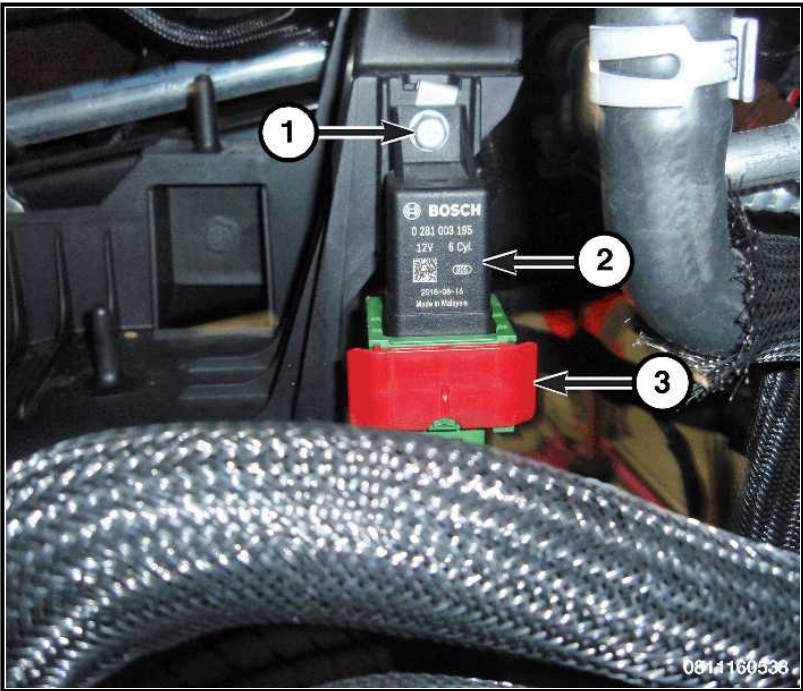
MODULES

REMOVAL AND INSTALLATION

GLOW PLUG MODULE

REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .



1 - Glow Plug Module Bolt
2 - Glow Plug Module
3 - Glow Plug Module Harness Connector

2. Disconnect the glow plug module wire harness connector.
3. Remove the glow plug module bolt and the glow plug module.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Install the glow plug module and securely tighten the glow plug module bolt.

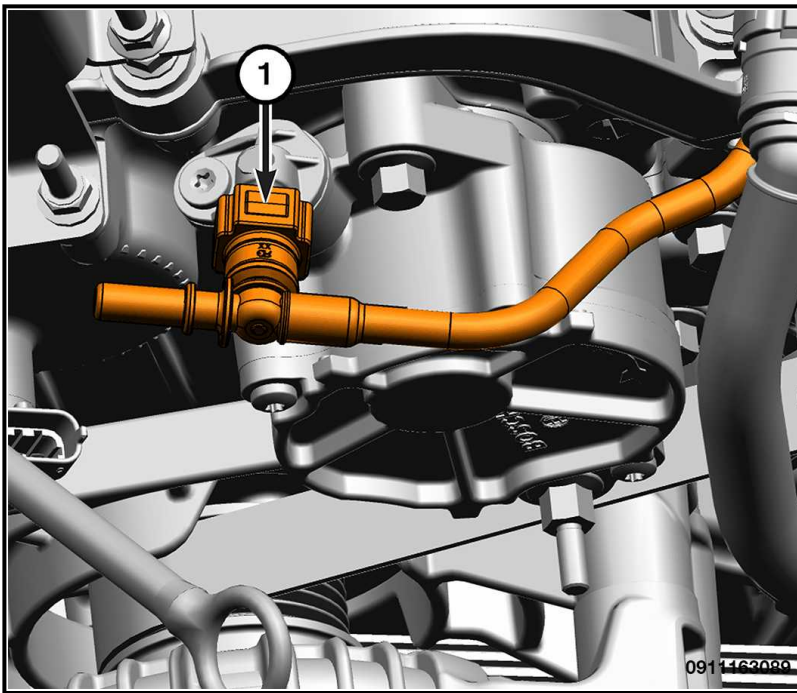
GLOW PLUG

REMOVAL AND INSTALLATION

GLOW PLUGS

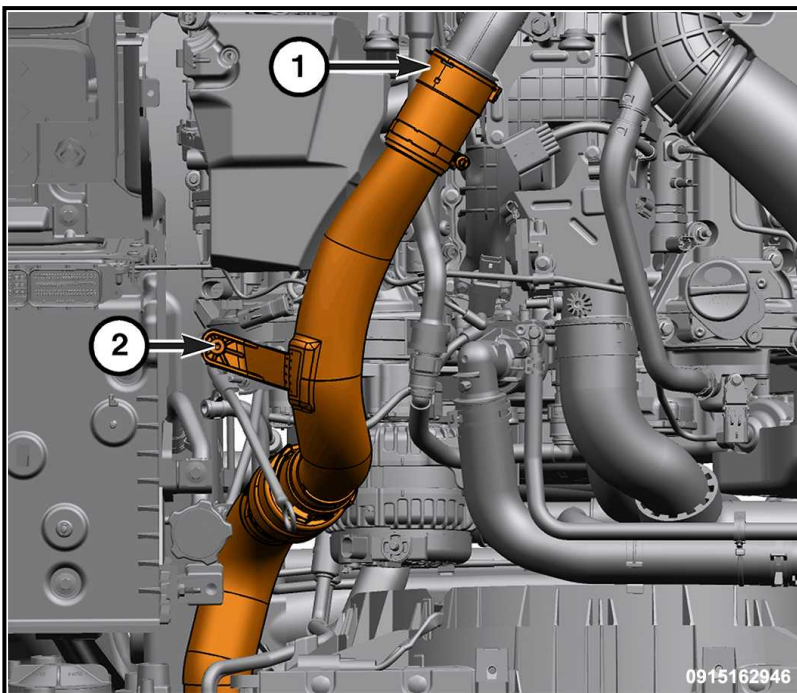
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
3. If servicing the glow plug(s) on the left side go to step 12. If servicing the glow plug(s) on the right side go to step 4.



1 - Vacuum Line

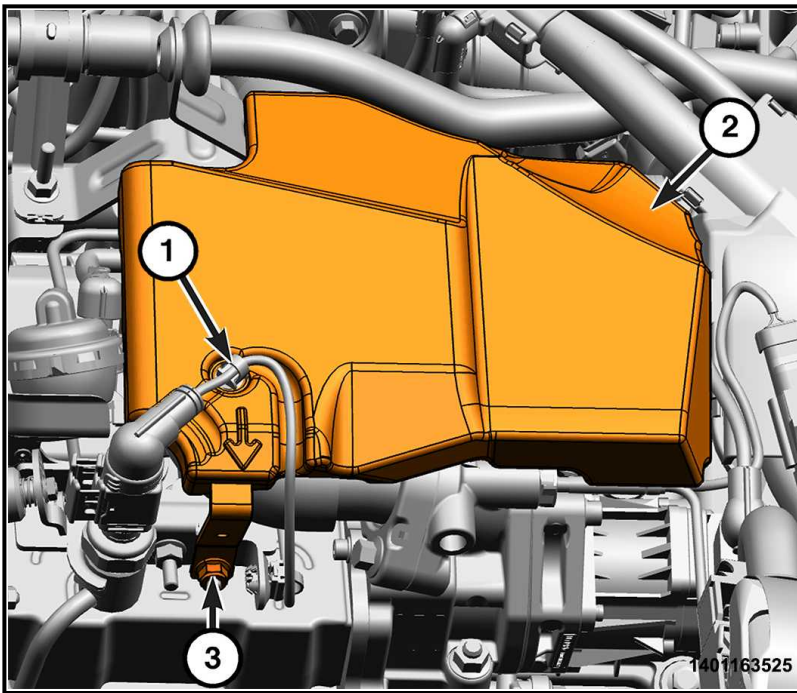
4. Remove the vacuum line from the vacuum pump.



1 - CAC Hose Bracket Bolt

2 - Retaining Clip

5. Remove the Charge Air Cooler (CAC) hose to the support bracket bolt.
6. Release the retaining clip, disconnect the CAC hose from the turbocharger elbow and position aside.

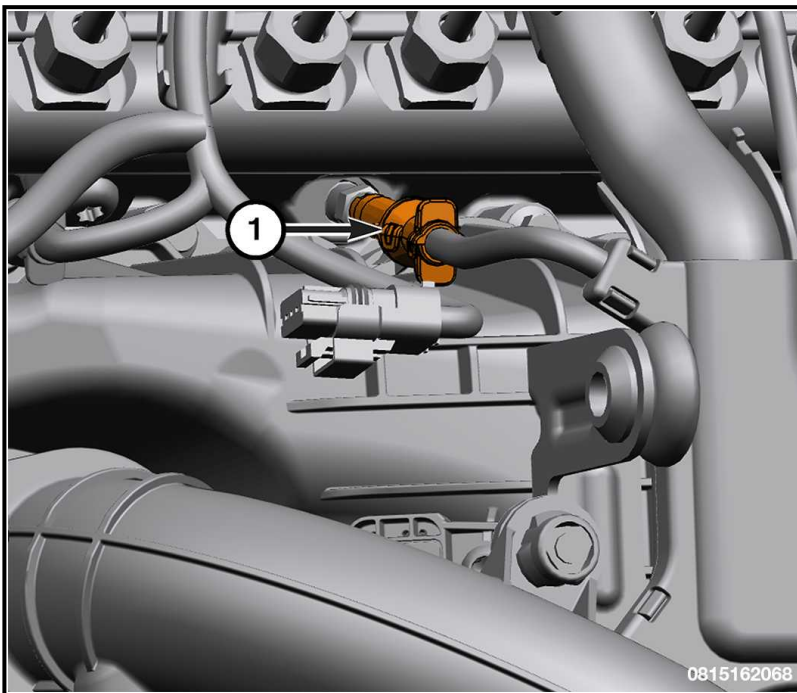


1 - Wire Harness Retainer

2 - Fuel Rail Cover

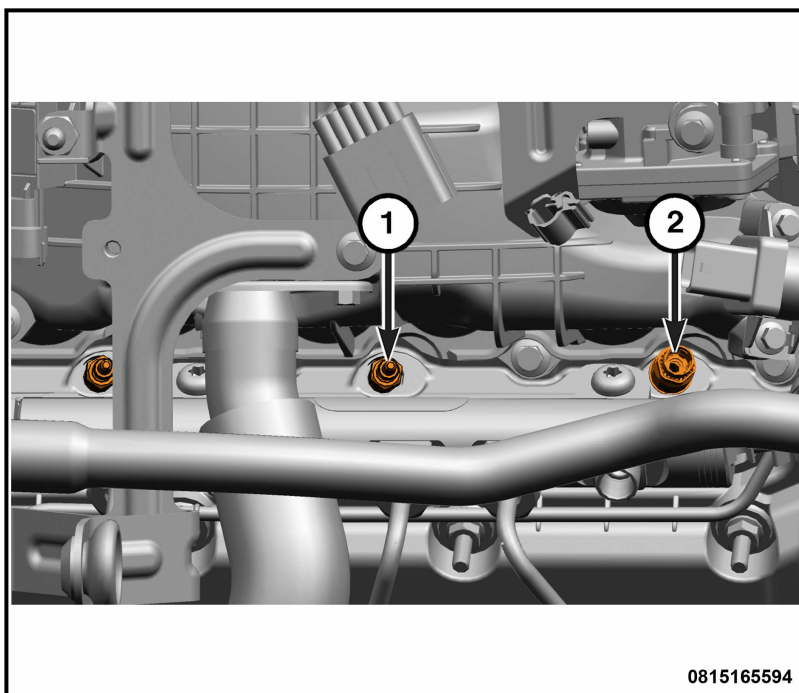
3 - Fuel Rail Cover Nut

7. Loosen the fuel rail cover nut, detach the wire harness retainer and remove the fuel rail cover.



1 - Glow Plug Harness Connector

8. Disconnect the glow plug wire harness connector.



1 - Glow Plug
2 - Pressure Sensor Glow Plug

9. Clean area around the glow plug.

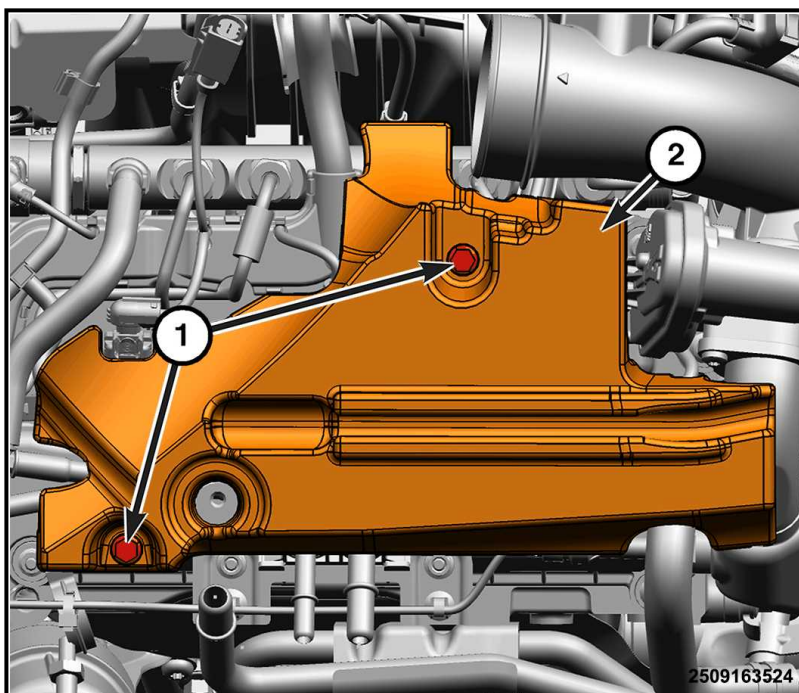
10. Remove the glow plug(s).

11. Remove the pressure sensor glow plug.

NOTE: Left side starts here.

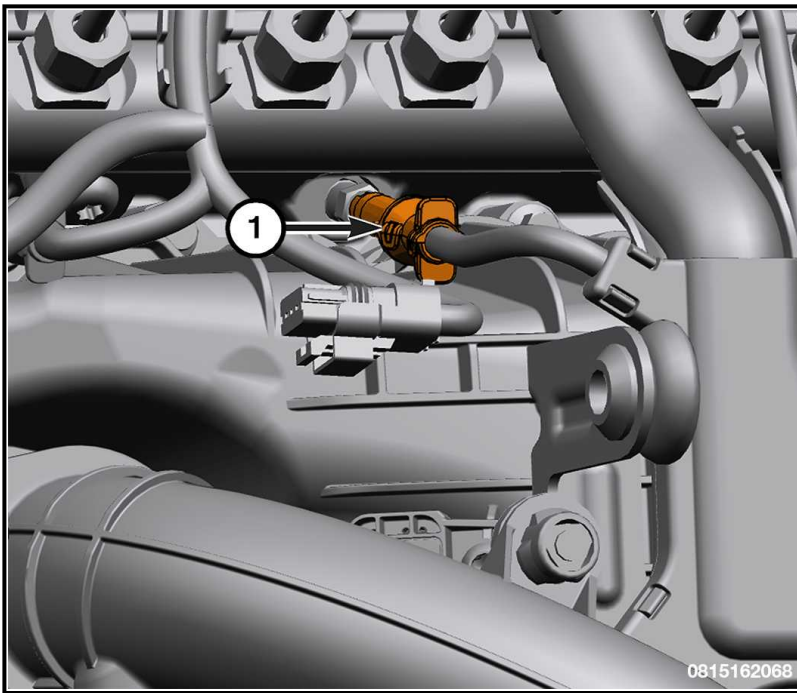
12. Remove the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#).

13. Remove the vent hose.



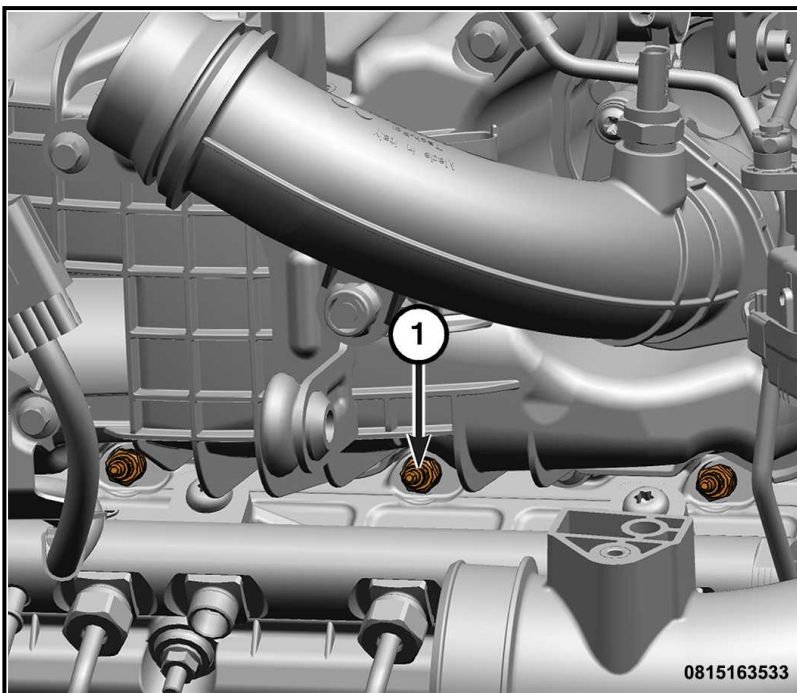
1 - Left Fuel Rail Cover
2 - Left Fuel Rail Cover Bolts

14. Remove the left fuel rail cover bolts and the left fuel rail cover.



1 - Glow Plug Harness Connector

15. Disconnect the glow plug wire harness connector.



1 - Glow Plug

16. Clean area around the glow plug.

17. Remove the glow plug(s).

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Install the left fuel rail cover and securely tighten the left fuel rail cover bolts.
- Install the fuel rail cover, attach the wire harness retainer and securely tighten the fuel rail cover nut.

TORQUE SPECIFICATIONS

IGNITION SYSTEM

DESCRIPTIONS	SPECIFICATIONS	COMMENT
Glow Plug (Ceramic)	8 N.m (71 In. Lbs.)	-

LUBRICATION

DESCRIPTION

LUBRICATION SYSTEM

- Gerotor type pump, gear driven from crankshaft.
- The oil filter/oil cooler housing is mounted on the left side of the engine block.
- Oil is circulated from the oil pump through oil/water cooler to the oil filter to the oil gallery feeding the timing chain tensioner, cylinder head, oil jets, crankshaft bearings, rod bearings and the turbocharger. The maximum oil temperature measured in the oil pan under continuous operating conditions should not exceed 135° C (275° F). The oil cooler maintains a maximum oil temperature of 140° C (284° F).
- The right cylinder head supplies oil to the timing chain oil jet, cam bearings, vacuum pump, and fuel injection pump.
- The left cylinder head supplies oil to the timing chain oil jet, and cam bearings.

NOTE: Before checking the engine oil level turn the engine off and wait 5 minutes for the oil to return to the oil pan.

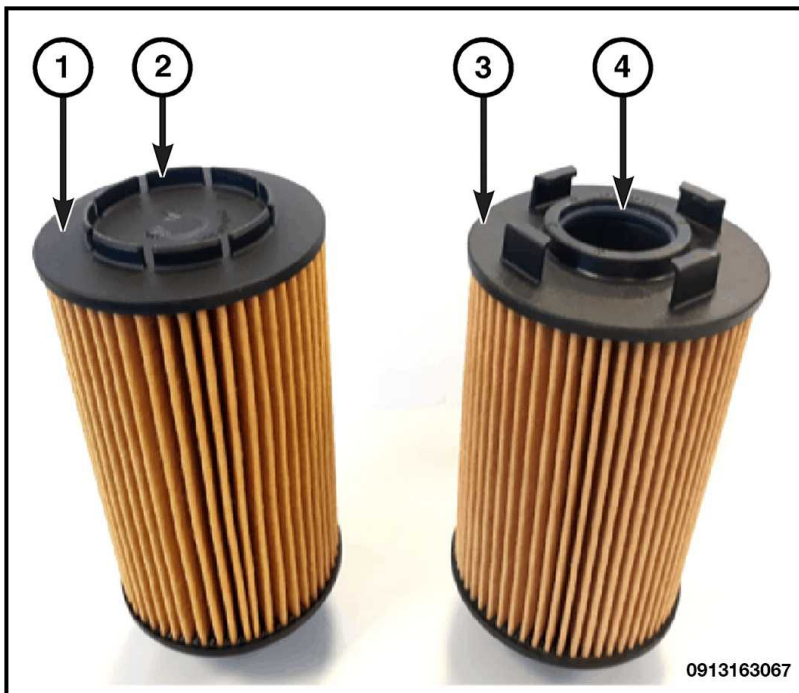
OIL FILTER

Gen 2 vs. Gen 3 Oil Filters



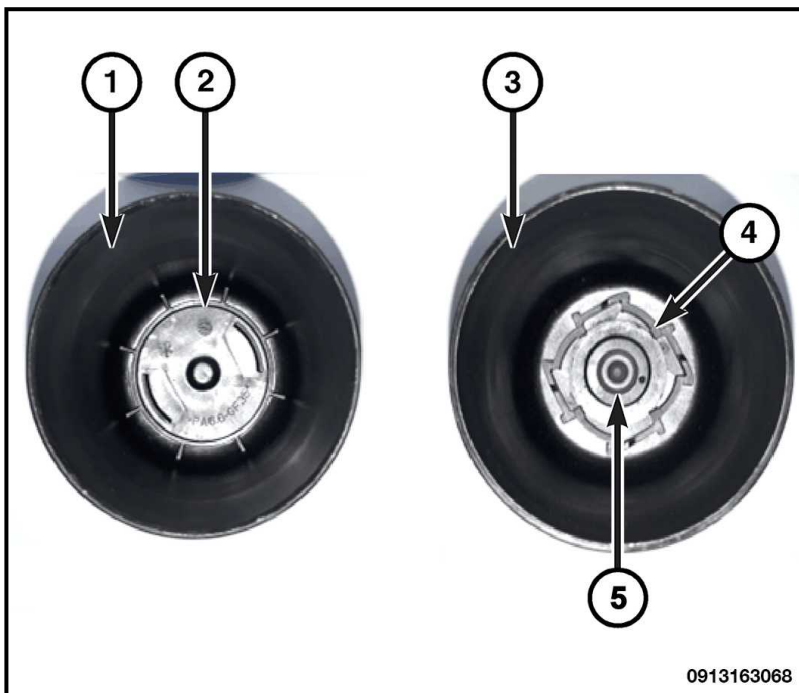
1 - Gen 2 Oil Filter
2 - Gen 3 Oil Filter

- The Gen 2 oil filter is taller than the Gen 3 oil filter by 4.5 mm.



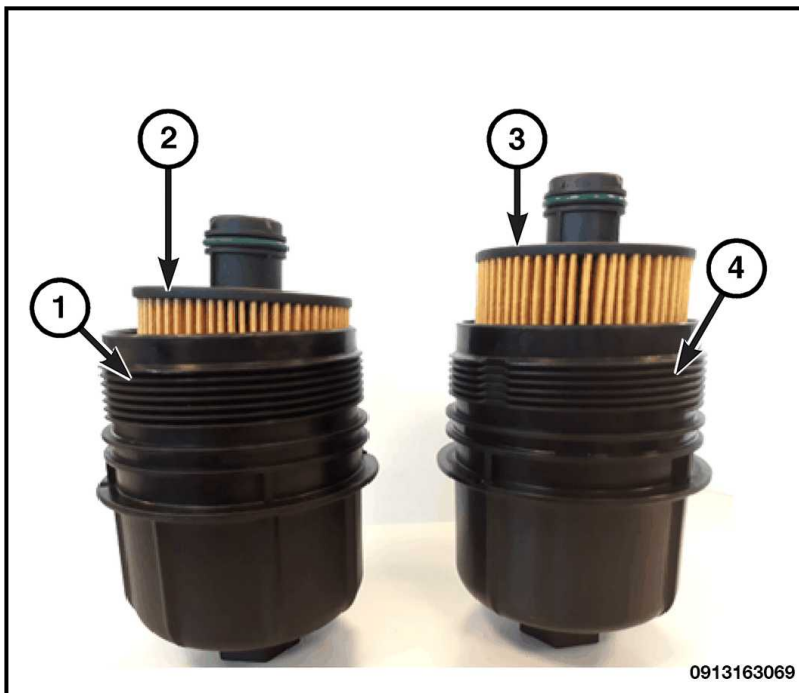
1 - Gen 2 Oil Filter
2 - Clamping Fitting
3 - Gen 3 Oil Filter
4 - Bypass Tunnel

- The clamping fitting on the Gen 2 oil filter is different from the Gen 3 oil filter. The Gen 3 oil filter uses a bayonet style clamp and is equipped with a bypass tunnel.



1 - Gen 2 Oil Filter Cap
2 - Clamp Style Fitting
3 - Gen 3 Oil Filter Cap
4 - Bayonet Style Fitting
5 - Oil Bypass Valve

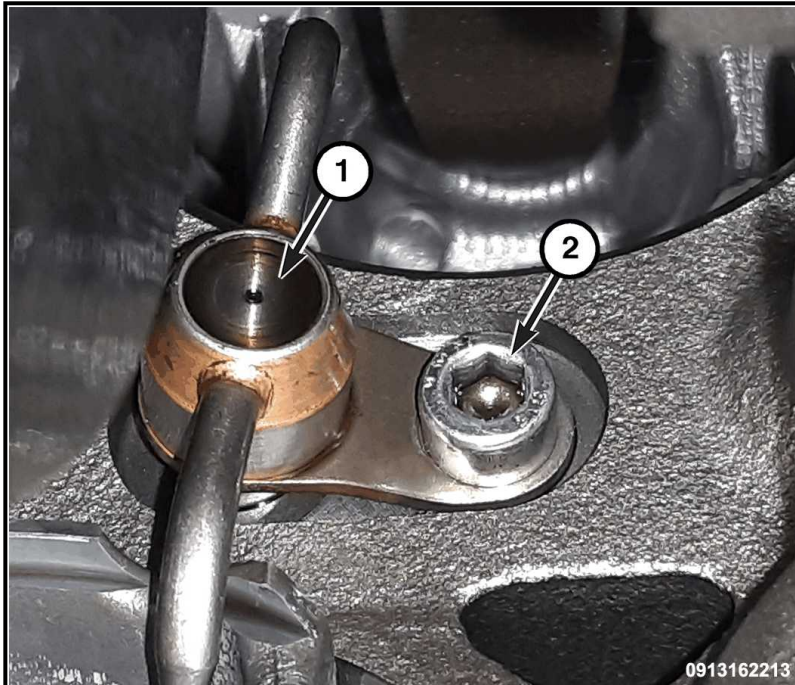
- The Gen 2 oil filter cap uses a clamp style fitting. The Gen 3 oil filter cap uses a bayonet style fitting and is equipped with a oil bypass valve.



1 - Gen 2 Oil Filter Cap
2 - Gen 3 Oil Filter
3 - Gen 2 Oil Filter
4 - Gen 3 Oil Filter Cap

- The Gen 3 oil filter will not fit in the Gen 2 oil filter cap.
- The Gen 2 oil filter will not fit in the Gen 3 oil filter cap.

OIL JETS

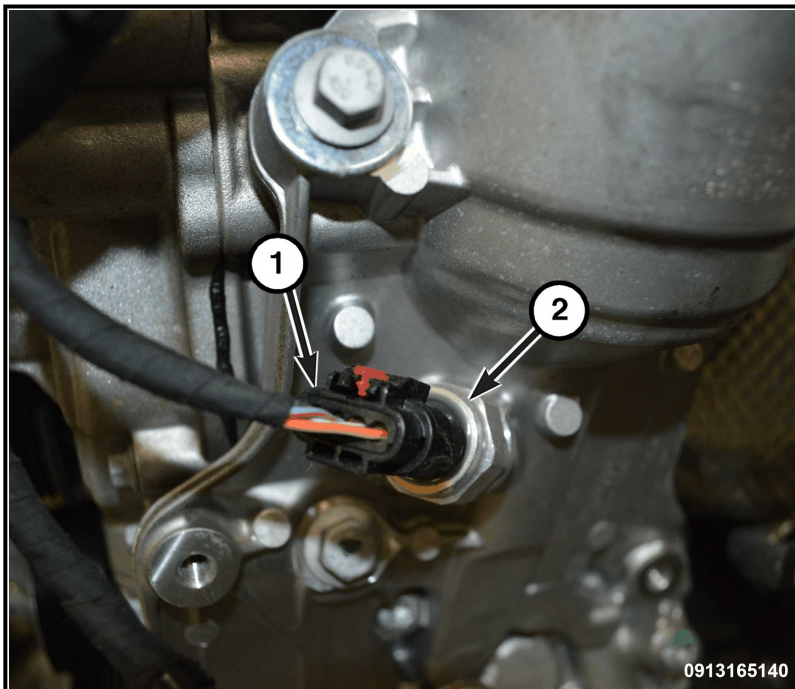


1 - Dual-Nozzle Oil Jets
2 - Dual-Nozzle Oil Jets Bolt

- Three dual-nozzle oil jets are bolted to the engine block underneath the main oil gallery. The jets connect with an oil-tight fit to the main gallery through lubrication passages. Each oil jet helps cool two opposite pistons. Proper oil jet alignment is important. Each nozzle is designed to alternatively spray oil through both cooling galleries within the piston. The oil spray is aimed at one of the cooling galleries as the

piston approaches TDC. As the piston approaches BDC, the oil spray is aimed at the adjacent cooling gallery.

OIL PRESSURE SENSOR



1 - Engine Oil Pressure Sensor Wire Harness Connector

2 - Engine Oil Pressure Sensor

- The engine oil pressure sensor is mounted on the oil cooler adapter. The sensor provides an output voltage to the PCM that corresponds to the engine oil pressure. Under certain operating conditions, for example low oil pressure, it may be necessary for the PCM to increase the engine idle speed to ensure adequate engine lubrication.
- The engine oil pressure sensor is a single wire sensor with a threaded pressure port. The pressure port is mounted to the oil cooler adapter housing through an access hole. An aluminum seal ring seals the engine oil pressure sensor to the oil cooler adapter housing.

STANDARD PROCEDURE

ENGINE OIL AND FILTER CHANGE

WARNING: New or used engine oil can be irritating to the skin. Avoid prolonged or repeated skin contact with engine oil. Contaminants in used engine oil, caused by internal combustion, can be hazardous to your health. Thoroughly wash exposed skin with soap and water. Do not wash skin with gasoline, diesel fuel, thinner, or solvents, health problems can result. Do not pollute, dispose of used engine oil properly. Contact your dealer or government agency for location of collection center in your area.

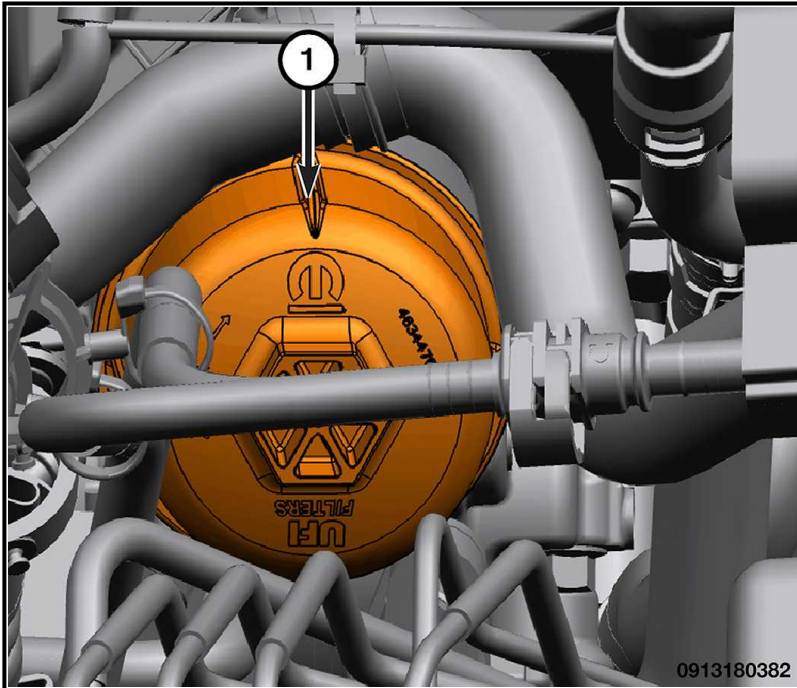
NOTE: The NEW oil filter and cap is serviced as one assembly DO NOT SEPARATE THEM.

Change the engine oil and filter at mileage and time intervals described in the Maintenance Schedule. Refer to **MAINTENANCE SCHEDULES, DESCRIPTION** .

1. Run the engine for five minutes to warm up the engine.
2. Position the vehicle on a level surface and turn the engine off.

3. If necessary, remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .

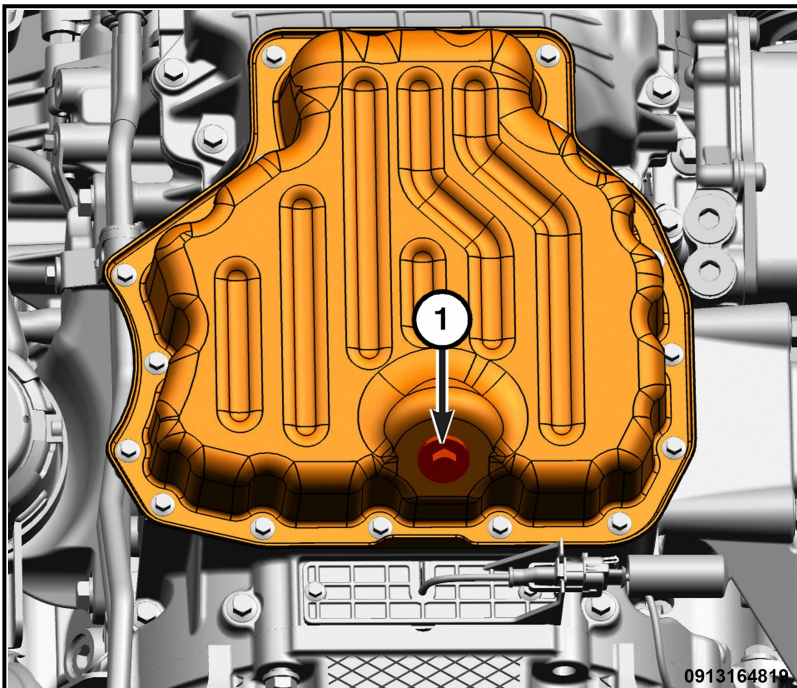
4. Place an oil absorbent cloth around the oil filter housing at the base.



1 - Oil Filter And Cap Assembly

5. Loosen the oil filter cap by rotating counterclockwise. Do not remove the oil filter cap at this time.

6. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .

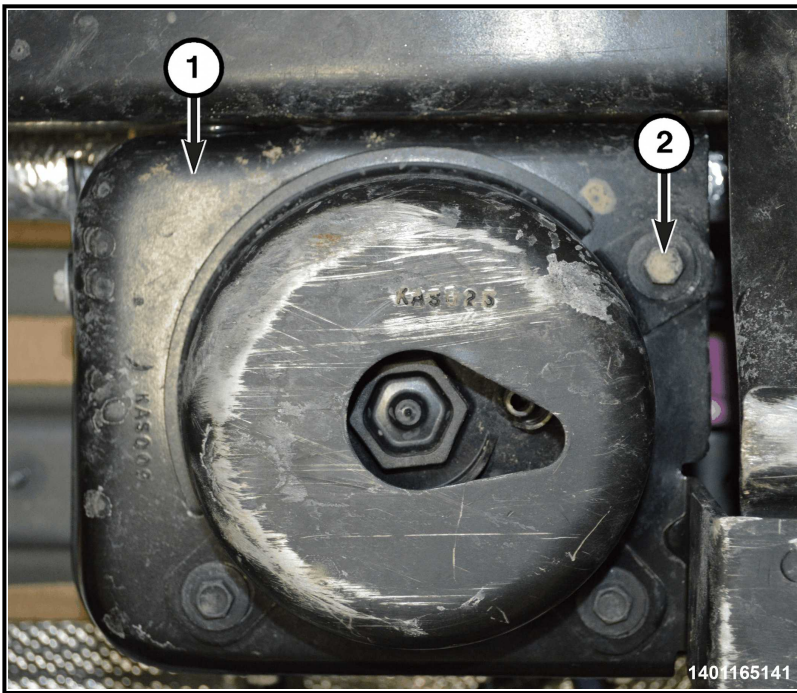


1 - Oil Pan Drain Plug

7. Place a suitable drain pan under the oil pan drain plug.

8. Drain the engine oil. Wait five minutes or until the oil stops dripping. Inspect the drain plug threads for stretching or other damage. Replace the drain plug if damaged.

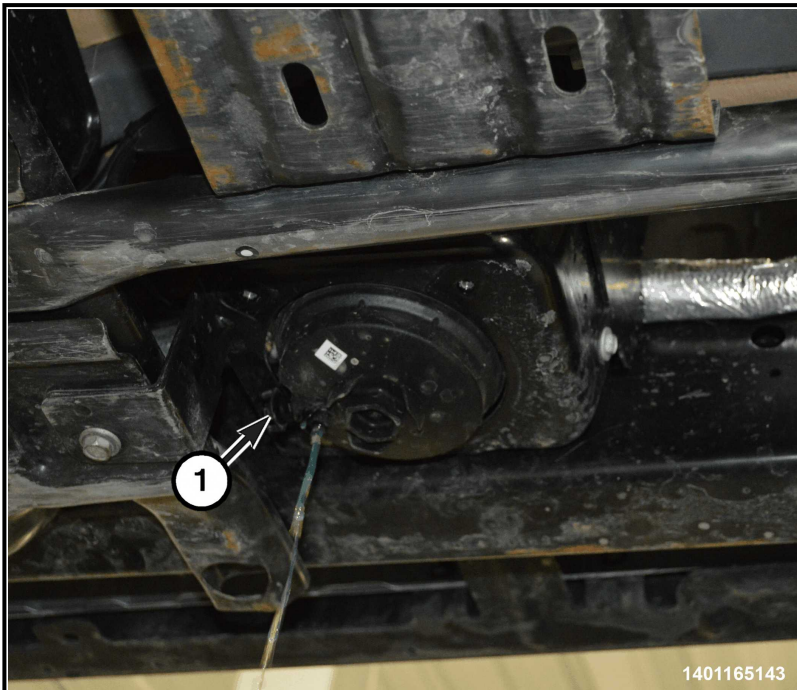
9. Install and tighten the drain plug to proper torque specifications.



1 - Fuel Filter Shield

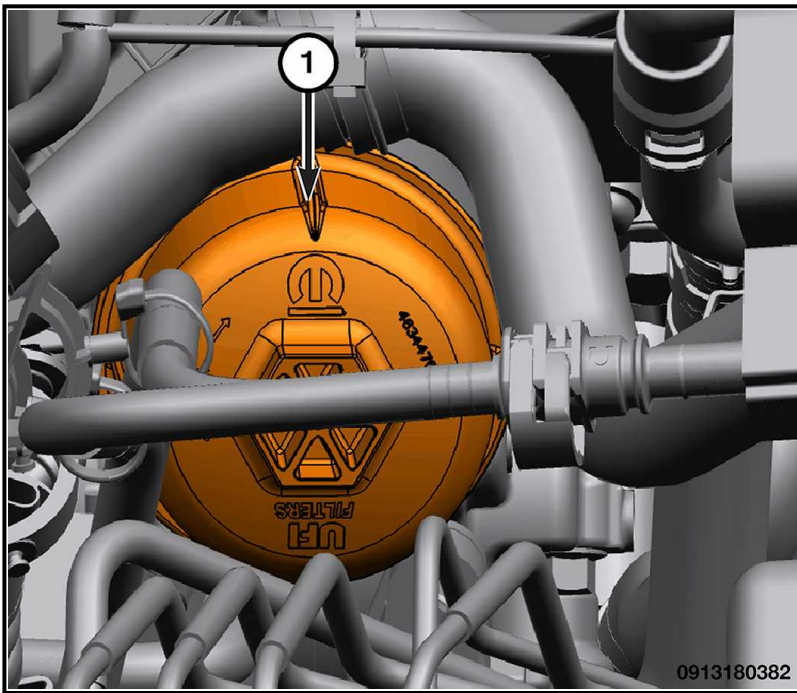
2 - Fuel Filter Shield Bolts

10. Remove the fuel filter shield bolts and the fuel filter shield.



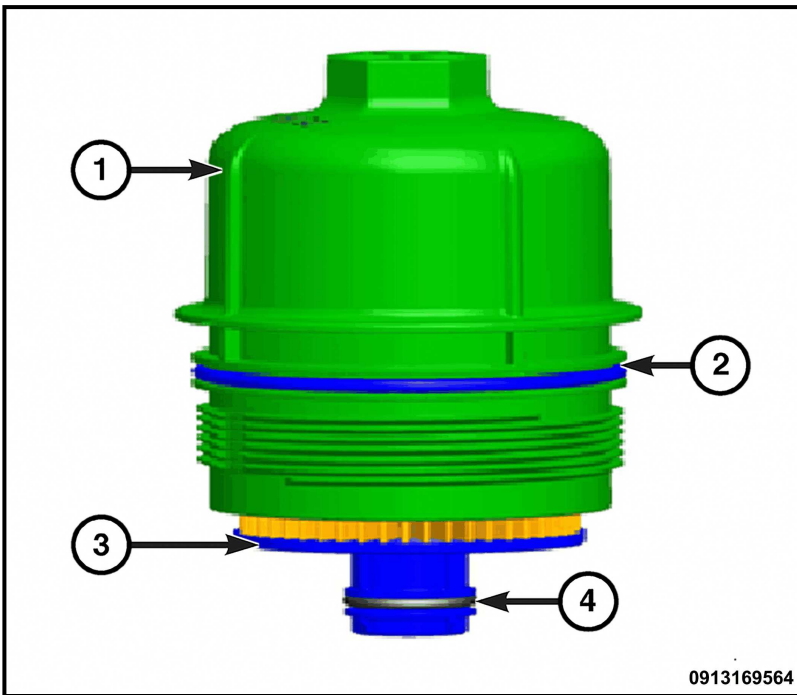
1 - Drain Plug

11. Loosen the drain plug and drain the fuel filter/water separator housing **to ensure there is no water present.**
12. Securely tighten the drain plug.
13. Remove the support and lower the vehicle.



1 - Oil Filter And Cap Assembly

- 14. Remove and discard the oil filter and cap assembly.
- 15. Using a suitable suction tool, remove the residual oil from oil filter housing.



1 - Oil Filter Cap
2 - Oil Filter Cap O-ring
3 - Oil Filter
4 - Oil Filter O-ring

- 16. Lubricate the **NEW** oil filter cap O-ring and oil filter O-ring.
- 17. Install the oil filter cap and tighten to proper torque specifications.
- 18. Fill the crankcase with the specified type and amount of engine oil. Refer to **CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS** .
- 19. Start the engine and run for one minute and inspect for leaks.
- 20. Stop the engine and wait five minutes then check the oil level.

21. Install the engine cover. Refer to **COVER, ENGINE, REMOVAL AND INSTALLATION** .

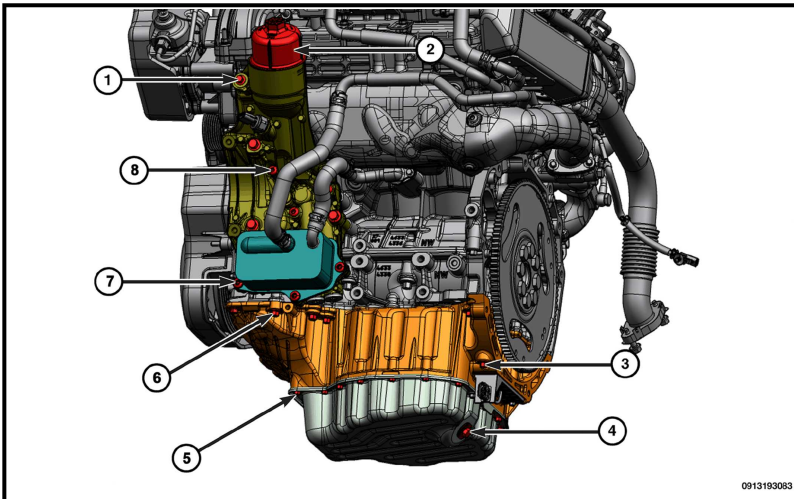
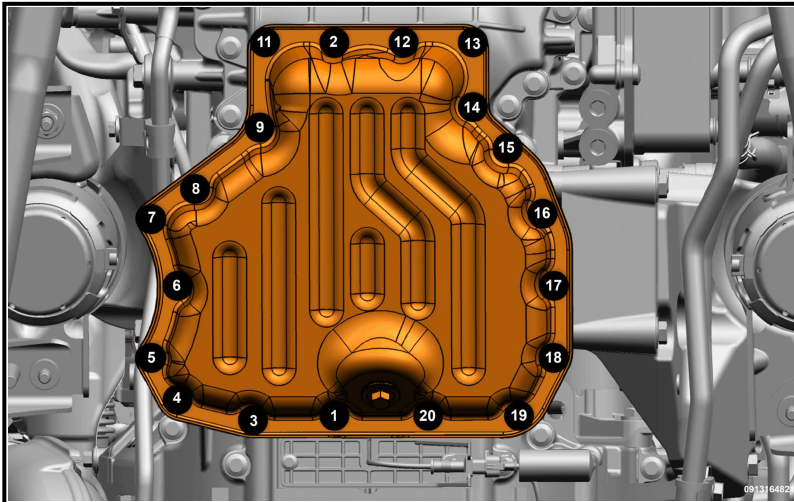
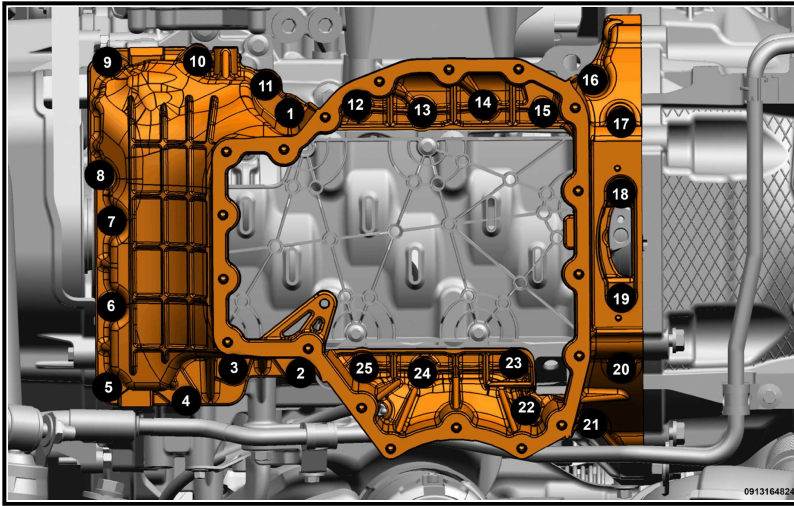
22. If equipped, reset the oil change indicator.

TORQUE SPECIFICATIONS

LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-

1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts 7-13 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence NOTE: Bolts in the following positions are stud bolts (4, 6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure: 1. Tighten the lower oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence
7	Oil Cooler Bolts	30 N.m (22 Ft. Lbs.)	-
-	Dipstick Tube Bolt (head)	11 N.m (8 Ft. Lbs.)	-
-	Dipstick Tube Bolt (sump)	11 N.m (8 Ft. Lbs.)	-
-	Windage Tray	11 N.m (8 Ft. Lbs.)	-



ENGINE OIL LEVEL CHECK

NOTE: The engine must be HOT when checking oil level.

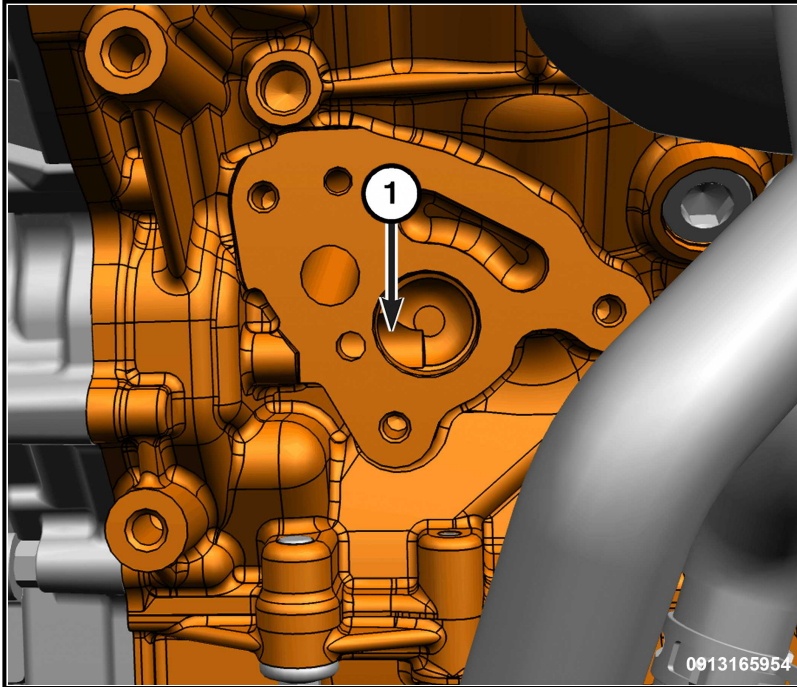
CAUTION: Do not operate engine if the oil level is above the MAX mark on the dipstick. Excessive oil volume can cause oil aeration which can lead to engine failure due to loss of oil pressure or increase in oil temperature.

- The best time to check engine oil level is after the engine is at operating temperature. Allow the engine to be shut off for at least 5 minutes before checking oil level.
- Checking the oil while the vehicle is on level ground will improve the accuracy of the oil level reading. When pulling the dipstick out often times oil will stick to the dipstick guide tube and give a higher than

actual reading. Remove the dipstick and observe oil level. It may be necessary to flip the dipstick over on the back side of the dipstick to obtain an accurate reading. Add oil only when the level is at or below the SAFE mark. If the oil level is in the safe range, do not add oil.

PRIMING THE OIL PUMP

1. Remove the oil cooler/filter adapter. Refer to [ADAPTER/COOLER, OIL FILTER, REMOVAL AND INSTALLATION](#).



1 - Oil Pump Priming Opening

2. Using a appropriate oil fill bottle with a straw, fill the oil pump through the oil pump priming opening with 7 ounces (200 ml) of the recommended engine oil. Refer to [CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS](#) .
3. Install the oil cooler/filter adapter. Refer to [ADAPTER/COOLER, OIL FILTER, REMOVAL AND INSTALLATION](#).

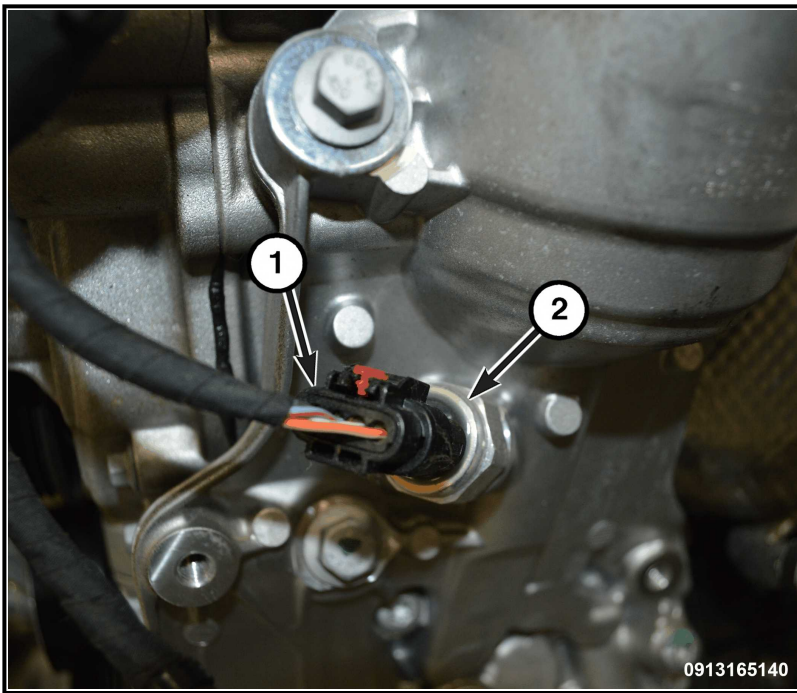
ADAPTER/COOLER, OIL FILTER

REMOVAL AND INSTALLATION

OIL FILTER COOLER ADAPTER

REMOVAL

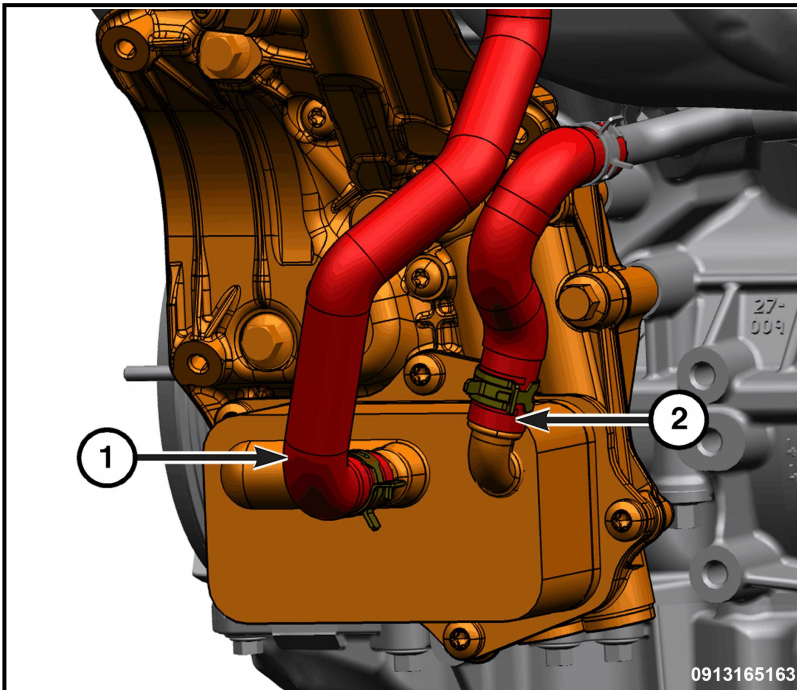
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
3. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
4. Drain the cooling system. Refer to [DRAINING](#) .
5. Drain the engine oil. Install and tighten the drain plug to the proper torque specifications.
6. Remove the support and lower the vehicle.
7. Remove the A/C compressor. Refer to [COMPRESSOR, A/C, REMOVAL AND INSTALLATION](#) .



1 - Oil Pressure Sensor Wire Harness Connector
--

2 - Oil Pressure Sensor

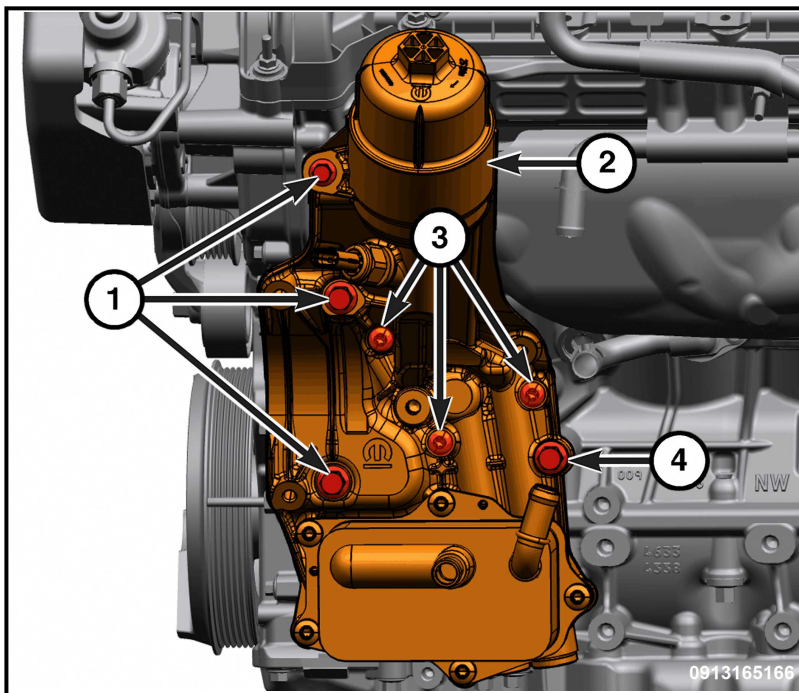
8. Disconnect the oil pressure sensor wire harness connector.



1 - Coolant Hose

2 - Coolant Hose

9. Disconnect the coolant hoses from the oil cooler.



1 - Oil Cooler Adapter Bolts
2 - Oil Cooler Adapter
3 - Oil Cooler Adapter Bolts
4 - Oil Cooler Adapter Bolts

10. Remove the oil cooler adapter bolts securing oil cooler adapter.

11. Remove the oil cooler adapter bolts and the oil cooler adapter.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the gasket sealing surfaces. Refer to [**STANDARD PROCEDURE**](#) .



1 - O-ring

- Install a **NEW** O-ring.
- Fill the cooling system. Refer to **STANDARD PROCEDURE - FILLING** .
- Change the oil filter and fill the engine with recommended engine oil. Refer to **CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS** .
- Start the engine and check for leaks.

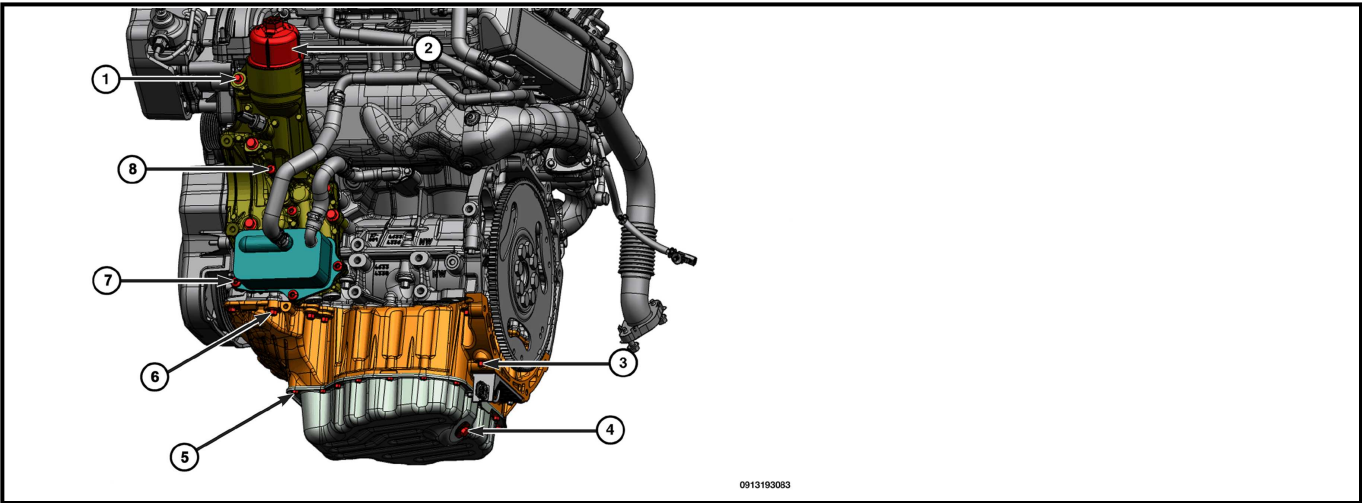
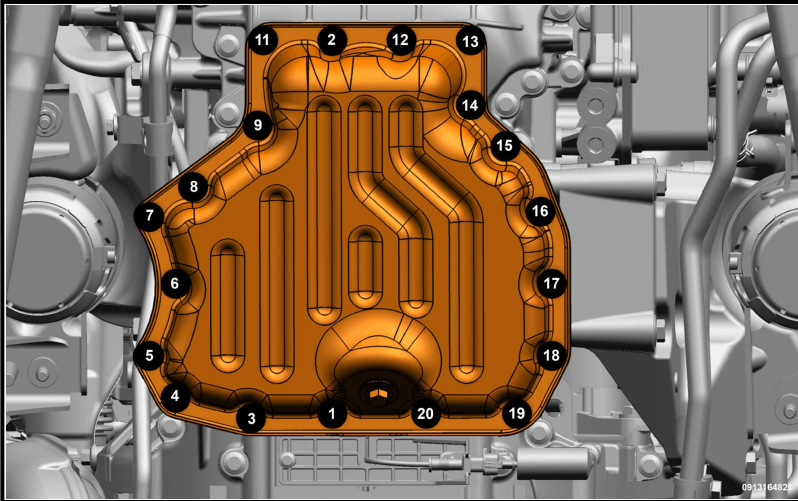
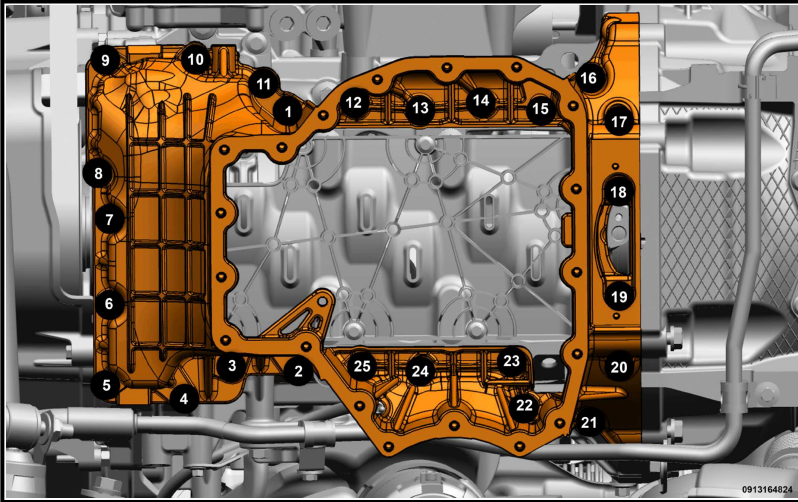
TORQUE SPECIFICATIONS

LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-

1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts 7-13 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence NOTE: Bolts in the following positions are stud bolts (4, 6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure: 1. Tighten the lower oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence
7	Oil Cooler Bolts	30 N.m (22 Ft. Lbs.)	-
-	Dipstick Tube Bolt (head)	11 N.m (8 Ft. Lbs.)	-

-	Dipstick Tube Bolt (sump)	11 N.m (8 Ft. Lbs.)	-
-	Windage Tray	11 N.m (8 Ft. Lbs.)	-



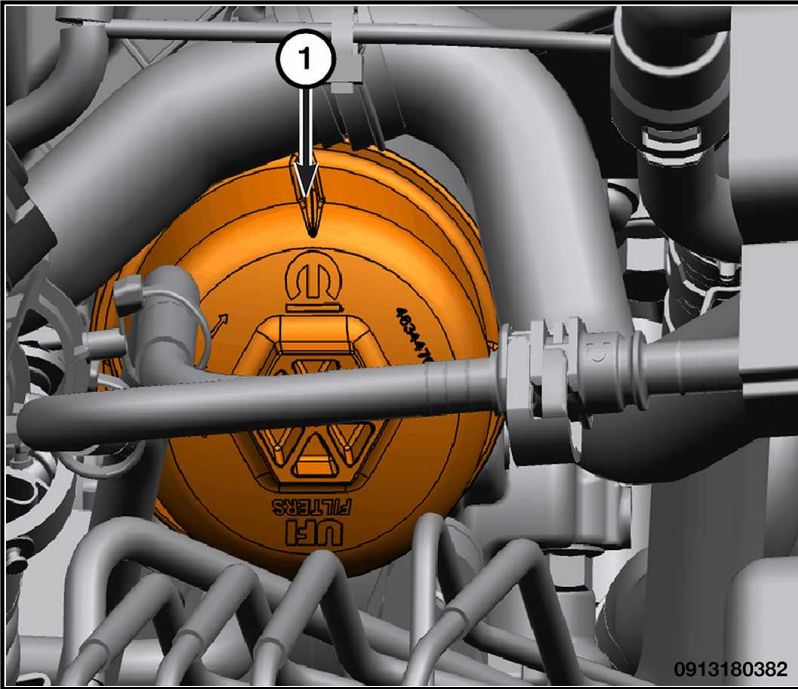
FILTER, ENGINE OIL

REMOVAL AND INSTALLATION

ENGINE OIL FILTER

NOTE: The NEW oil filter and cap is serviced as one assembly DO NOT SEPARATE THEM.

REMOVAL

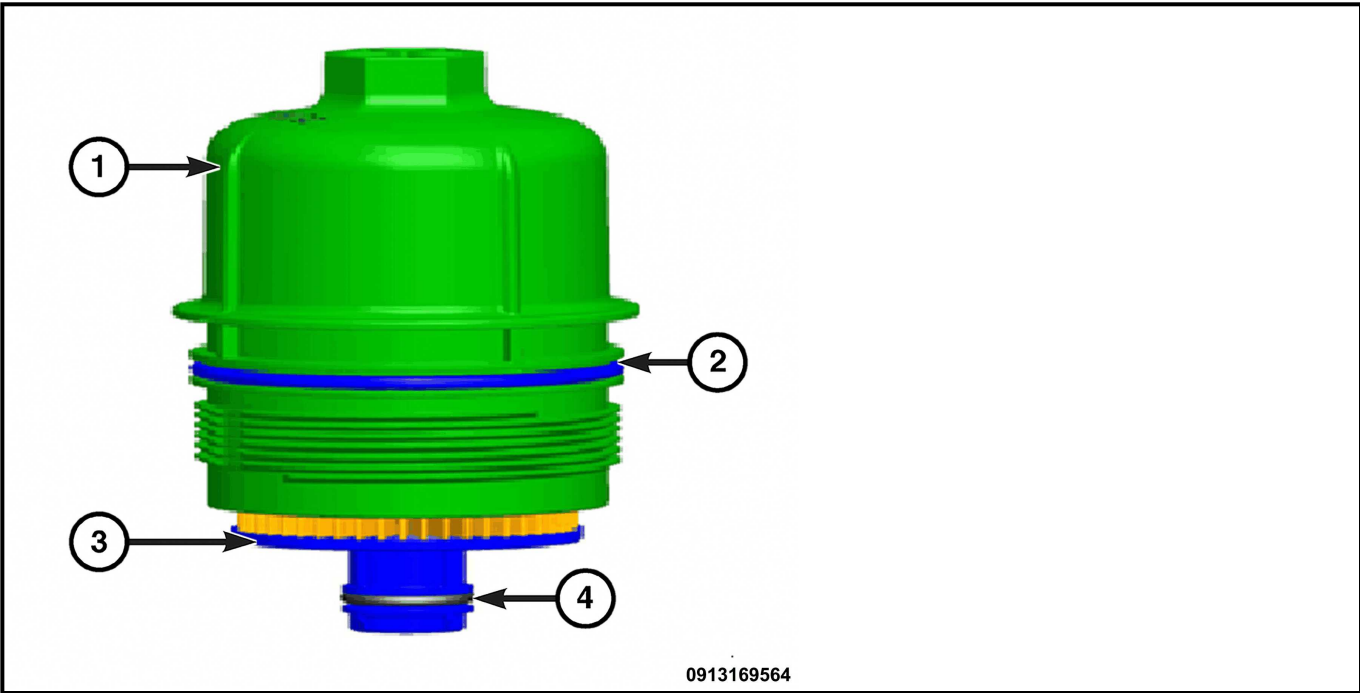


1 - Oil Filter And Cap Assembly

- 1. Remove and discard the oil filter and cap assembly.
- 2. Using a suitable suction tool, remove the residual oil from oil filter housing.

INSTALLATION

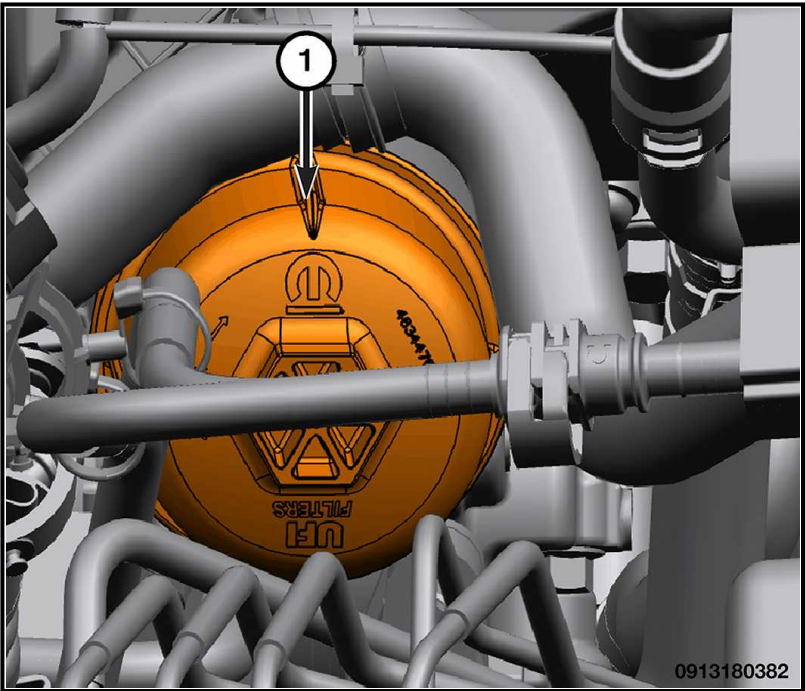
During installation, torque the fasteners to the specifications in the torque table(s) below.



1 - Oil Filter Cap
2 - Oil Filter Cap O-ring
3 - Oil Filter
4 - Oil Filter O-ring

- 1. Lubricate the NEW oil filter cap O-ring. Make sure the oil filter cap O-ring is in the correct location.

2. Lubricate the oil filter O-ring with clean engine oil.



1 - oil filter and cap assembly

NOTE: Remove any residual oil from oil filter housing before installing new oil filter.

NOTE: After replacing the oil filter/cap assembly be sure that there is no gap between the cap and the housing. If there is gap disassemble the oil filter/cap assembly and check that the thread are not damaged. If there is no damage repeat the installation process and recheck. If the thread is damaged replace the oil filter/cap assembly with a new one.

3. Install the **NEW** oil filter and cap assembly and tighten to proper torque specifications.

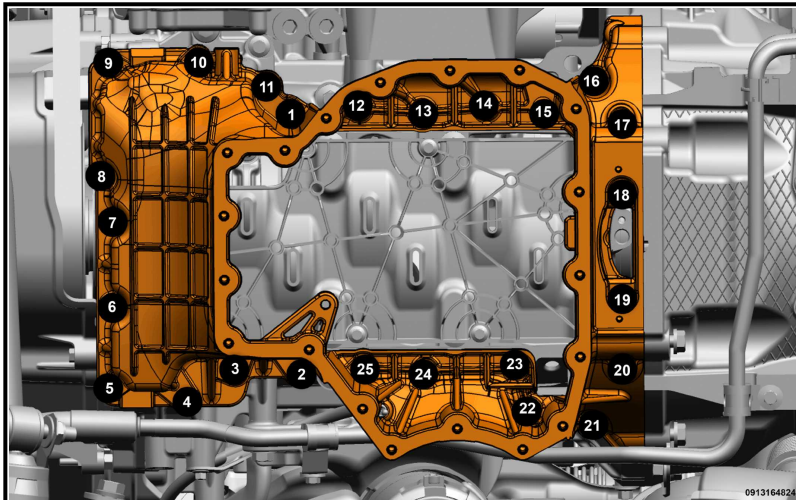
TORQUE SPECIFICATIONS

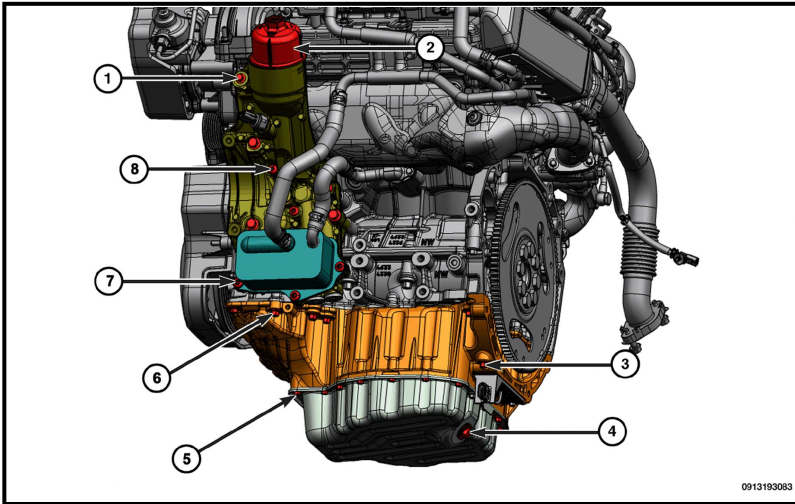
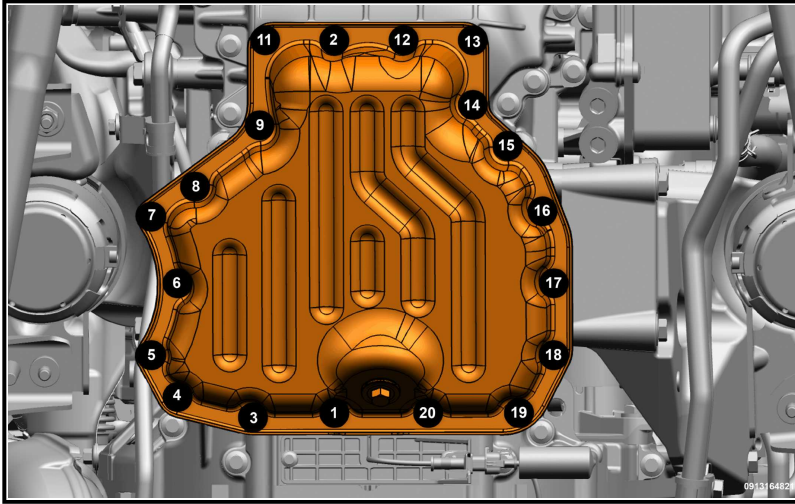
LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-

1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts 7-13 one at a time 90° in the	Tightening Sequence NOTE: Bolts in the following positions are stud bolts (4,

		sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure: 1. Tighten the lower oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence
7	Oil Cooler Bolts	30 N.m (22 Ft. Lbs.)	-
-	Dipstick Tube Bolt (head)	11 N.m (8 Ft. Lbs.)	-
-	Dipstick Tube Bolt (sump)	11 N.m (8 Ft. Lbs.)	-
-	Windage Tray	11 N.m (8 Ft. Lbs.)	-





JET, PISTON OIL COOLER

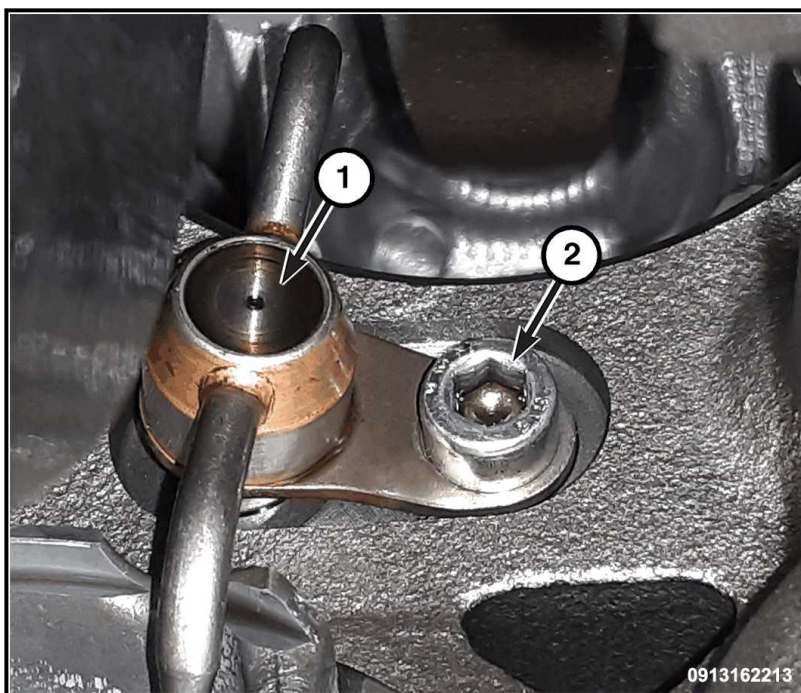
REMOVAL AND INSTALLATION

PISTON OIL COOLER JET

REMOVAL

CAUTION: Use caution when removing and installing oil jets. Damage to oil jet nozzle could cause severe engine damage.

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the bedplate. Refer to [PLATE, BED, REMOVAL AND INSTALLATION](#) .



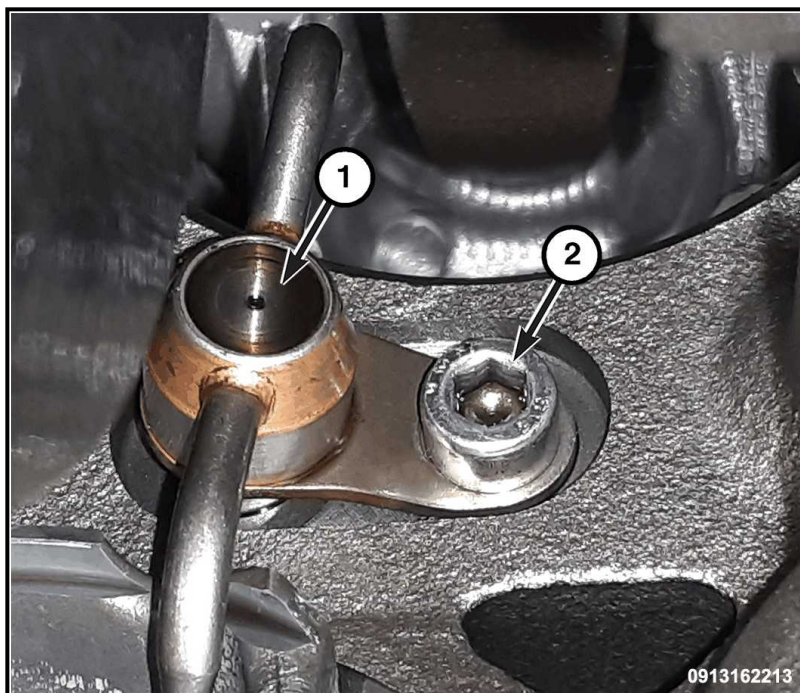
- | |
|------------------|
| 1 - Oil Jet |
| 2 - Oil Jet Bolt |

3. Remove the oil jet bolt and oil jet from the engine block.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.



- | |
|------------------|
| 1 - Oil Jet |
| 2 - Oil Jet Bolt |

CAUTION: Use caution when removing and installing oil jets. Damage to oil jet nozzle could cause severe engine damage.

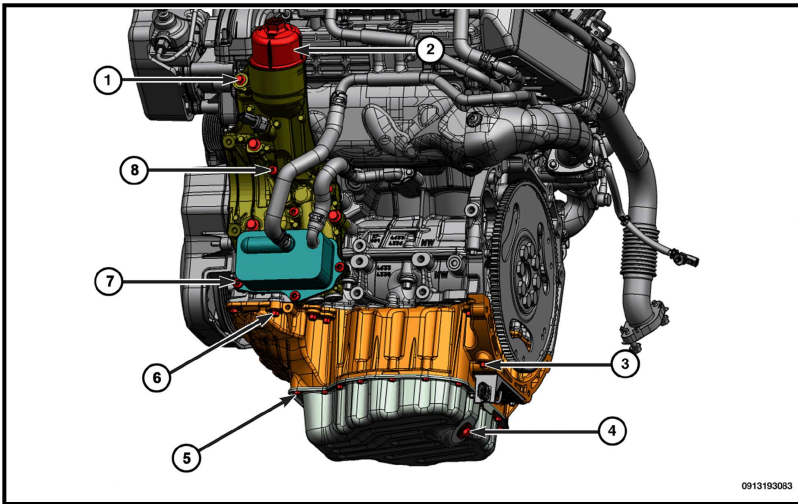
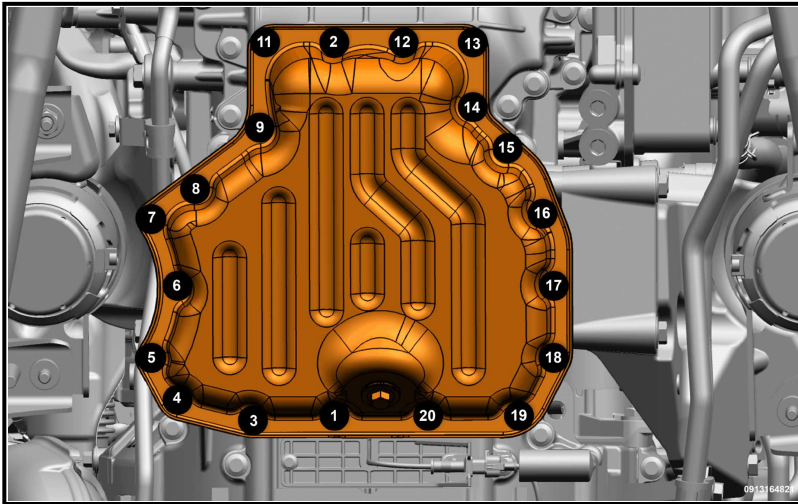
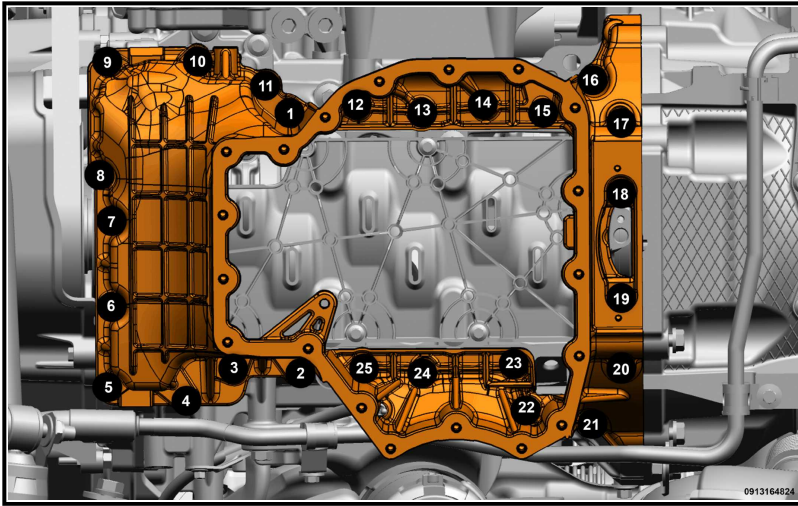
- Install the oil jet into engine block and tighten the oil jet bolt to proper torque specifications.

TORQUE SPECIFICATIONS

LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-

1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts 7-13 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence NOTE: Bolts in the following positions are stud bolts (4, 6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure: 1. Tighten the lower oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence
7	Oil Cooler Bolts	30 N.m (22 Ft. Lbs.)	-
-	Dipstick Tube Bolt (head)	11 N.m (8 Ft. Lbs.)	-
-	Dipstick Tube Bolt (sump)	11 N.m (8 Ft. Lbs.)	-
-	Windage Tray	11 N.m (8 Ft. Lbs.)	-



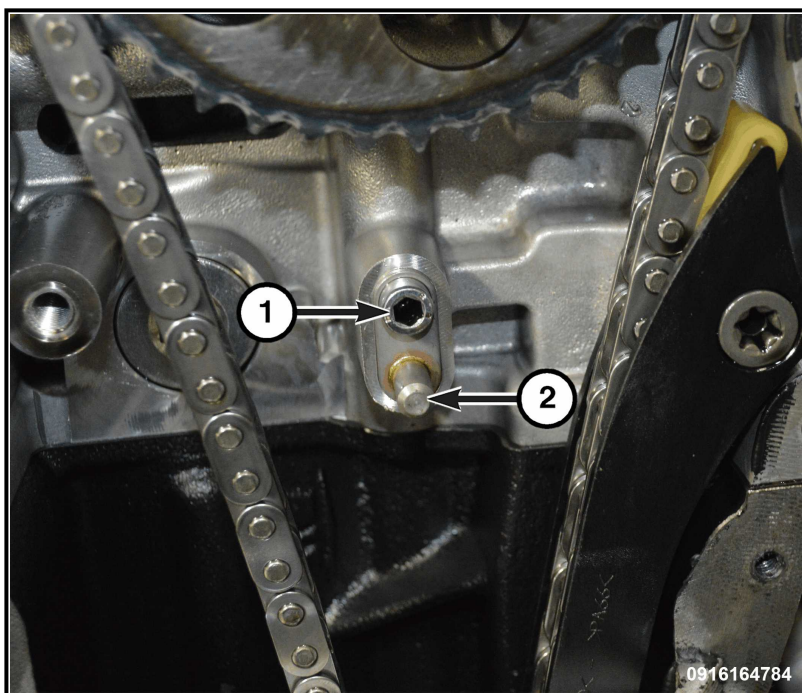
JET, TIMING CHAIN OIL

REMOVAL AND INSTALLATION

TIMING CHAIN OIL JET

REMOVAL

1. Disconnect and isolate the negative battery cable.
2. Remove the appropriate upper timing cover. Refer to COVER(S), ENGINE TIMING, REMOVAL AND INSTALLATION.



1 - Timing Chain Oil Jet Bolt

2 - Timing Chain Oil Jet

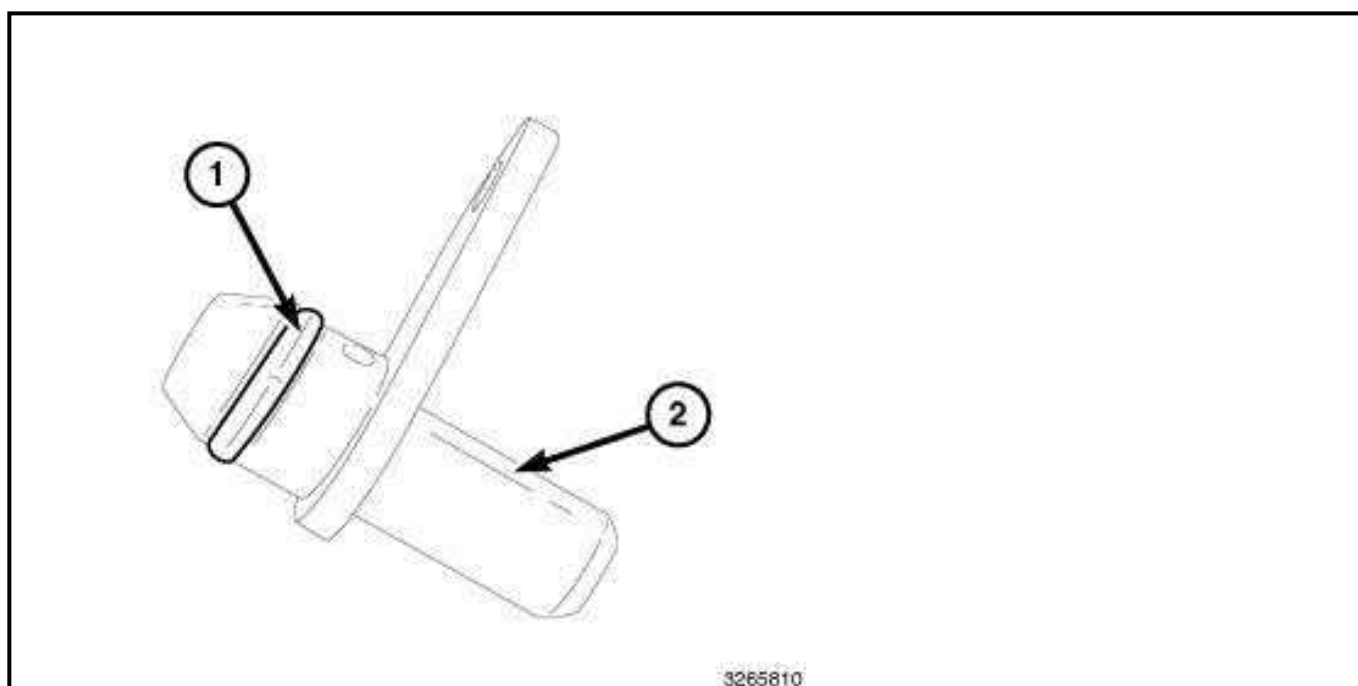
NOTE: Left side shown, right side similar.

3. Remove the timing chain oil jet bolt and the timing chain oil jet.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.



1 - O-ring

2 - Timing Chain Oil Jet

- Inspect the timing chain oil jet O-ring.

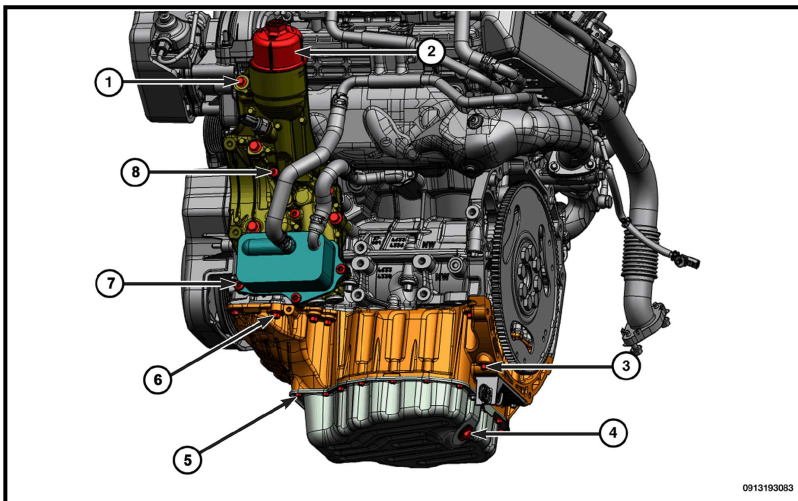
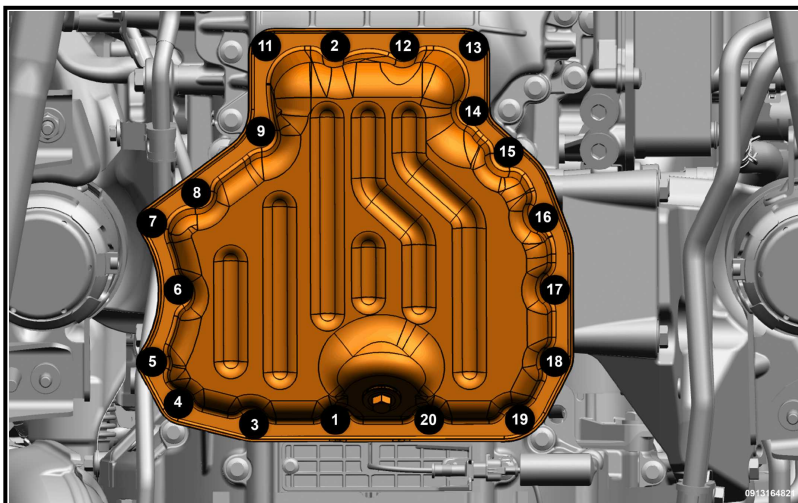
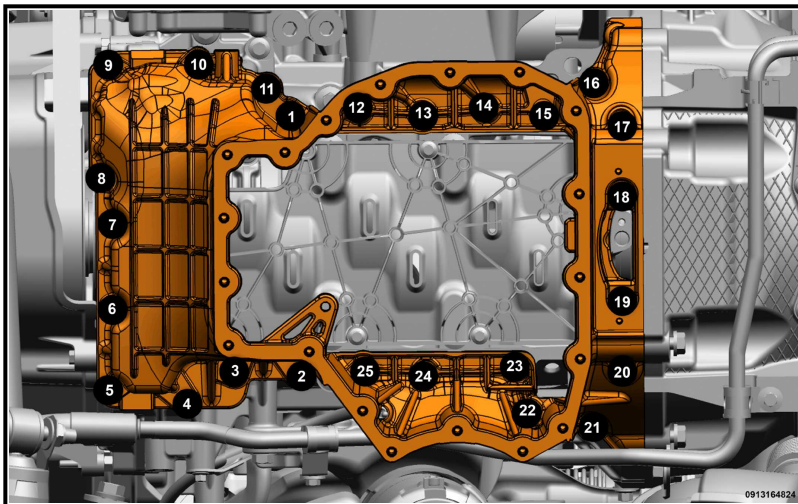
- Fill the engine oil to proper level.

TORQUE SPECIFICATIONS

LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-

1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts 7-13 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence NOTE: Bolts in the following positions are stud bolts (4, 6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure: 1. Tighten the lower oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence
7	Oil Cooler Bolts	30 N.m (22 Ft. Lbs.)	-
-	Dipstick Tube Bolt (head)	11 N.m (8 Ft. Lbs.)	-
-	Dipstick Tube Bolt (sump)	11 N.m (8 Ft. Lbs.)	-
-	Windage Tray	11 N.m (8 Ft. Lbs.)	-



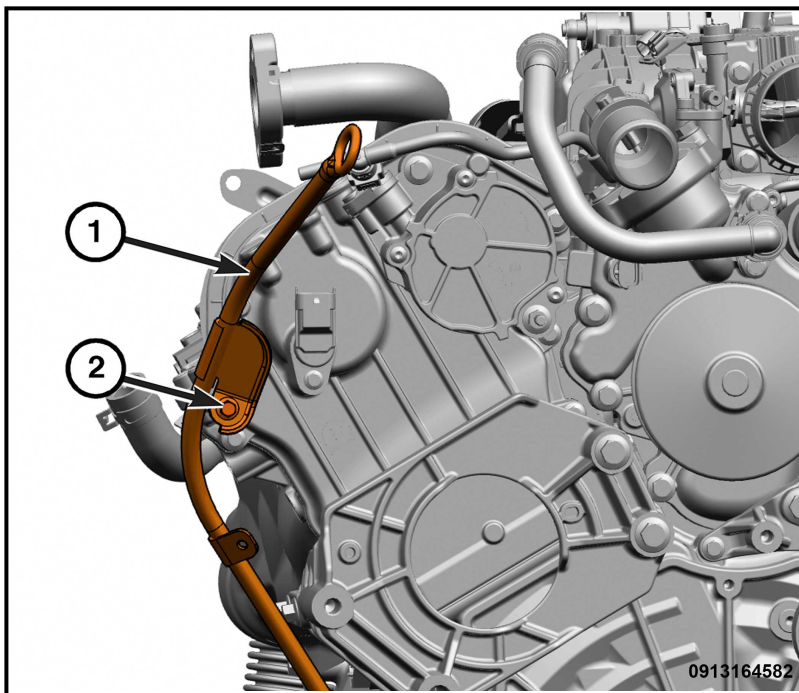
PAN, OIL

REMOVAL AND INSTALLATION

UPPER OIL PAN

REMOVAL

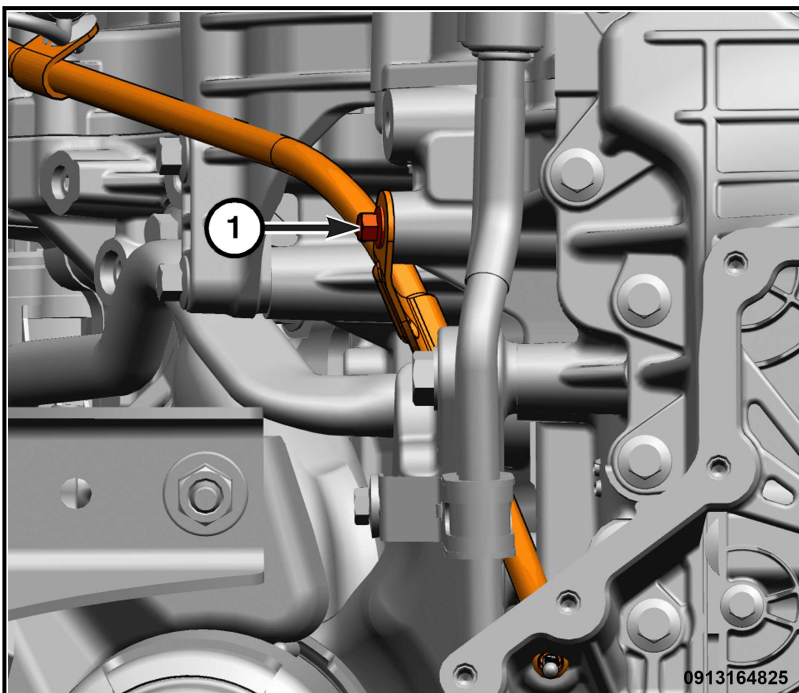
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .



1 - Upper Oil Dip Stick Tube

2 - Upper Oil Dip Stick Tube Bolt

2. Remove the upper oil dip stick tube bolt.

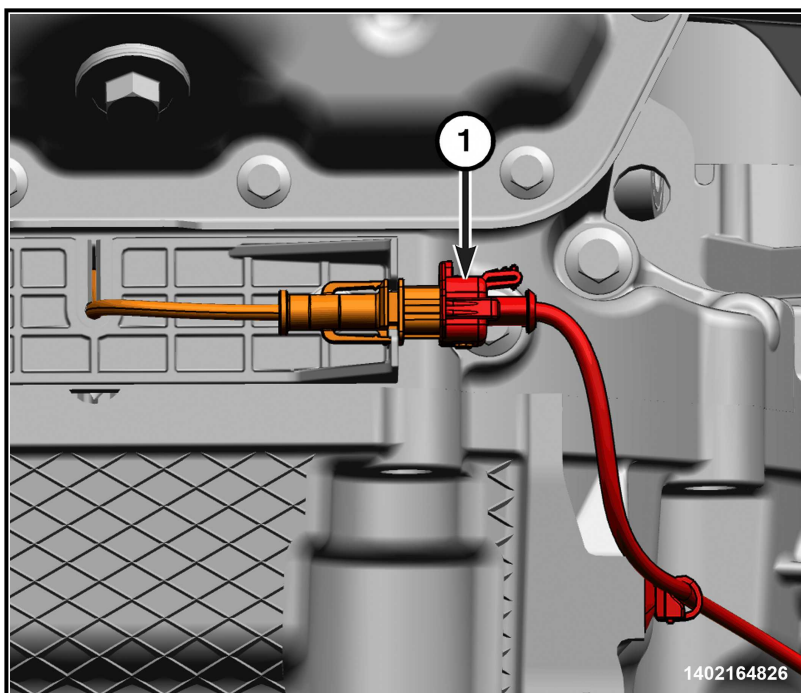


1 - Lower Oil Dip Stick Tube Bolt

3. Remove the lower oil dip stick tube bolt.

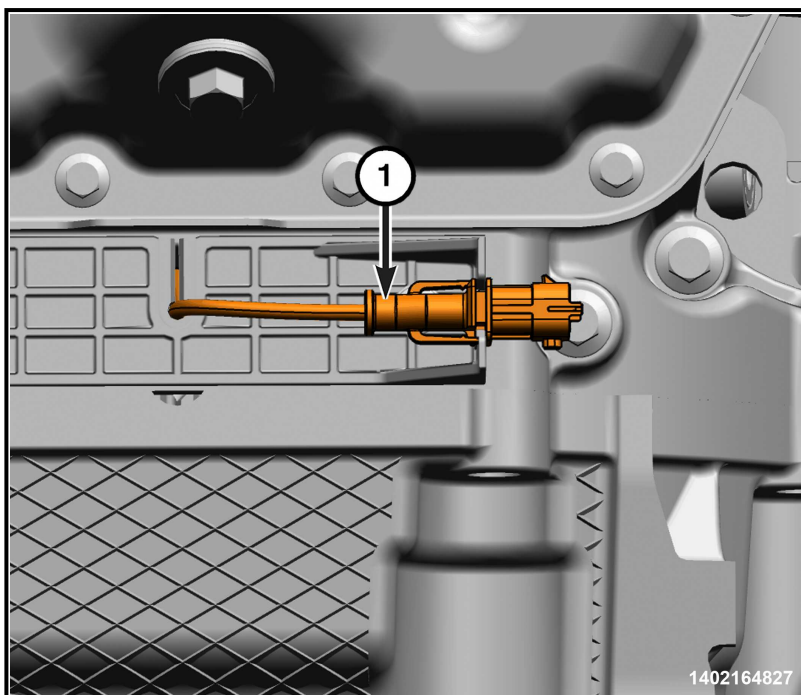
4. Remove the lower oil pan. Refer to [PAN, OIL, REMOVAL AND INSTALLATION](#).

5. Remove the four transmission-to-oil pan bolts.



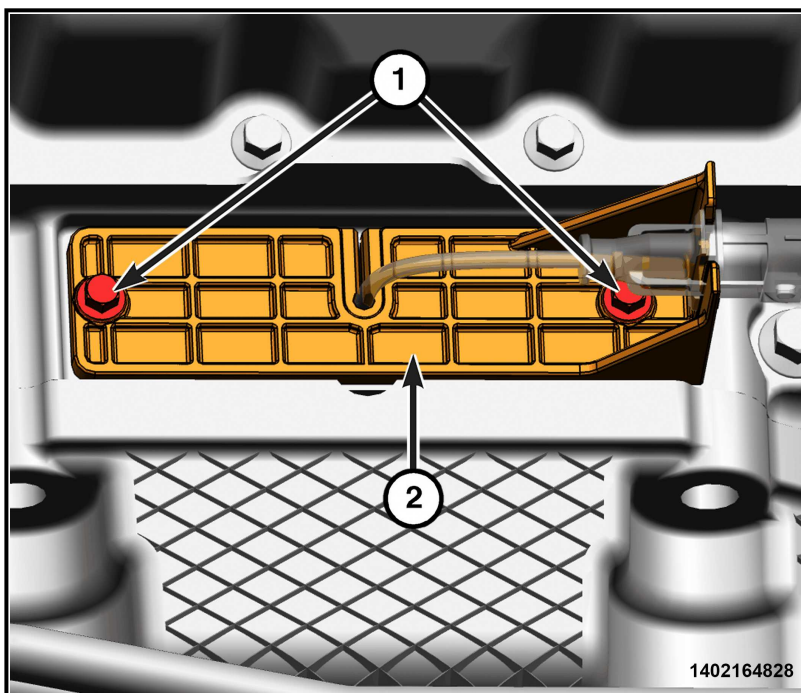
1 - Crankshaft Position Sensor Wire Harness Connector

6. Disconnect the Crankshaft Position Sensor (CKP) wire harness connector.



1 - Wire Harness Connector

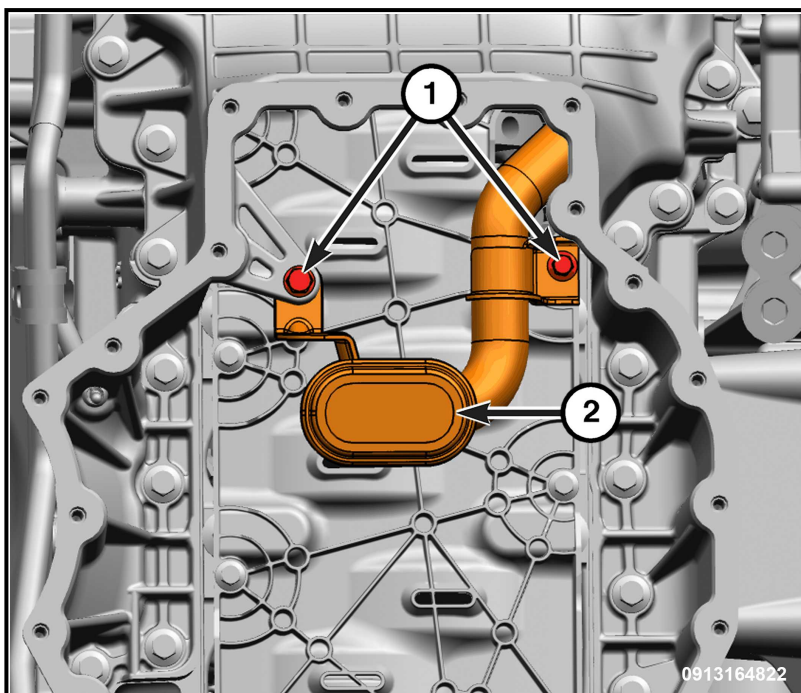
7. Detach the wire harness connector from the bracket.



1 - Access Cover Bolts

2 - Access Cover

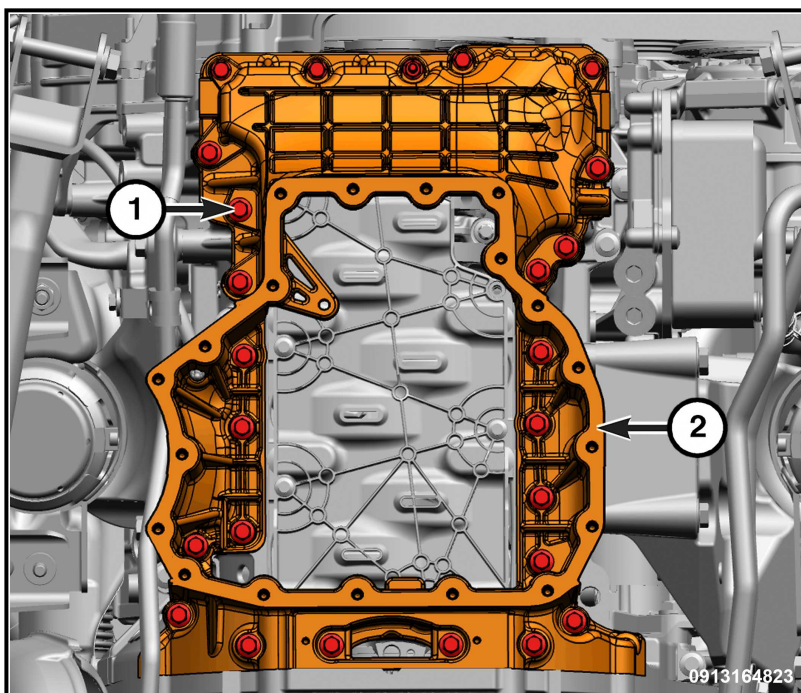
8. Remove the access cover bolts and the access cover.



1 - Oil Pump Pick-Up Tube Bolts

2 - Oil Pump Pick-Up Tube

9. Remove the oil pump pick-up tube bolts and the oil pump pick-up tube.



1 - Upper Oil Pan Bolts

2 - Upper Oil Pan

10. Remove the upper oil pan bolts and the upper oil pan.

INSTALLATION

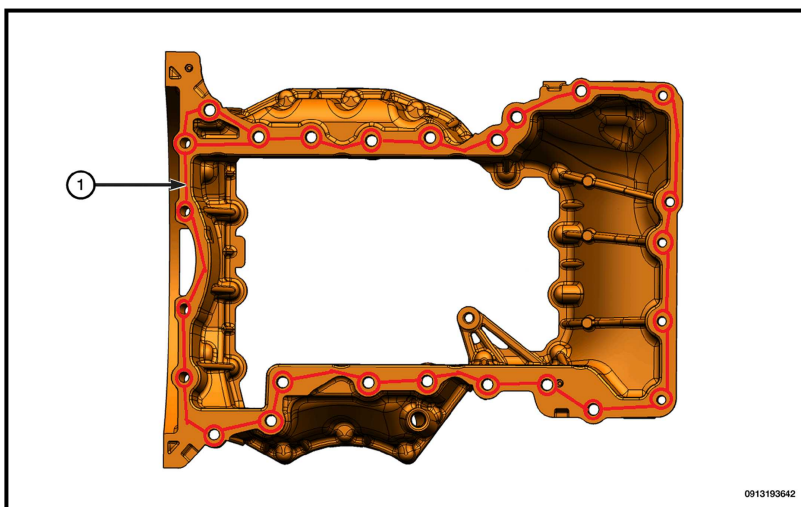
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the gasket sealing surfaces. Refer to [STANDARD PROCEDURE](#).

NOTE: Clean the oil pan sealing surfaces with isopropyl alcohol in preparation for sealant application.

- Apply a 3 mm wide bead of Mopar® Threebond Engine RTV Sealant to the timing cover to engine block T-joints.



1 - RTV Sealant

- Apply a 3 mm wide bead of Mopar® Threebond Engine RTV Sealant to the oil pan.

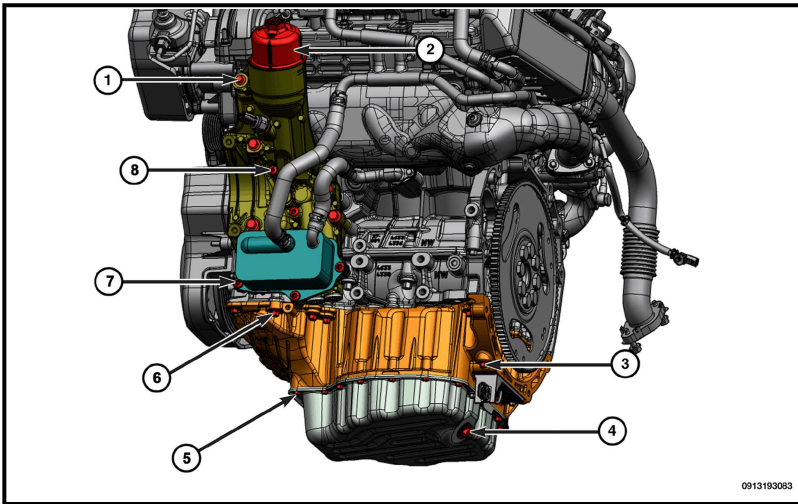
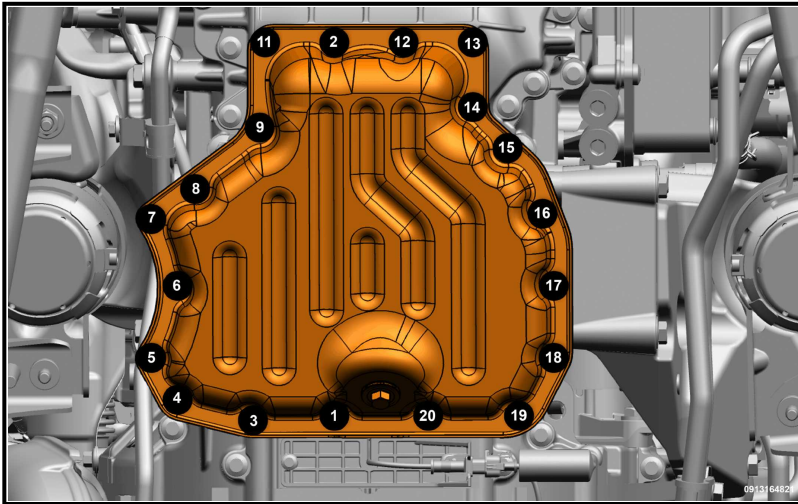
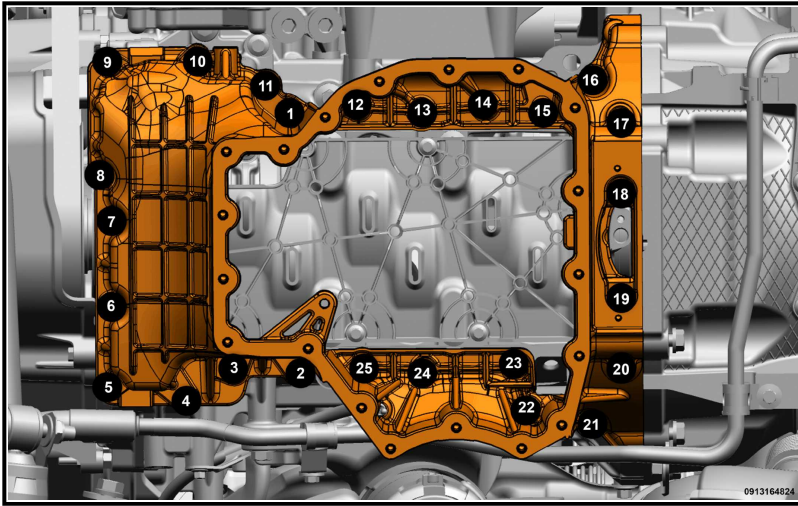
- Install the upper oil pan and using the tightening sequence shown in the torque table below, tighten the upper oil pan bolts to proper torque specifications.
- Install a **NEW** O-ring onto the oil pump pick-up tube.
- Replace the oil filter and fill the engine with recommended engine oil. Refer to **CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS**.

TORQUE SPECIFICATIONS

LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-

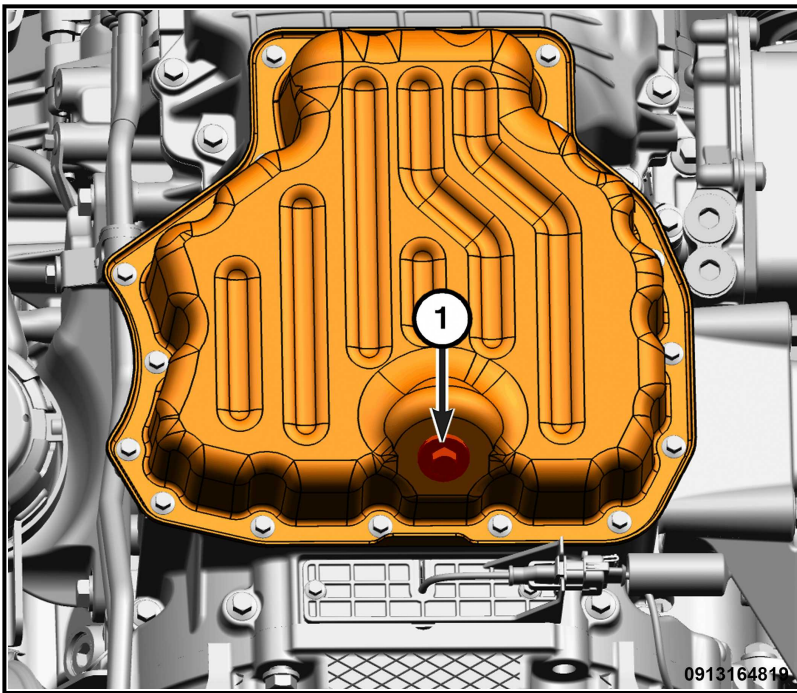
1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts 7-13 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence NOTE: Bolts in the following positions are stud bolts (4, 6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure: 1. Tighten the lower oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence
7	Oil Cooler Bolts	30 N.m (22 Ft. Lbs.)	-
-	Dipstick Tube Bolt (head)	11 N.m (8 Ft. Lbs.)	-
-	Dipstick Tube Bolt (sump)	11 N.m (8 Ft. Lbs.)	-
-	Windage Tray	11 N.m (8 Ft. Lbs.)	-



LOWER OIL PAN

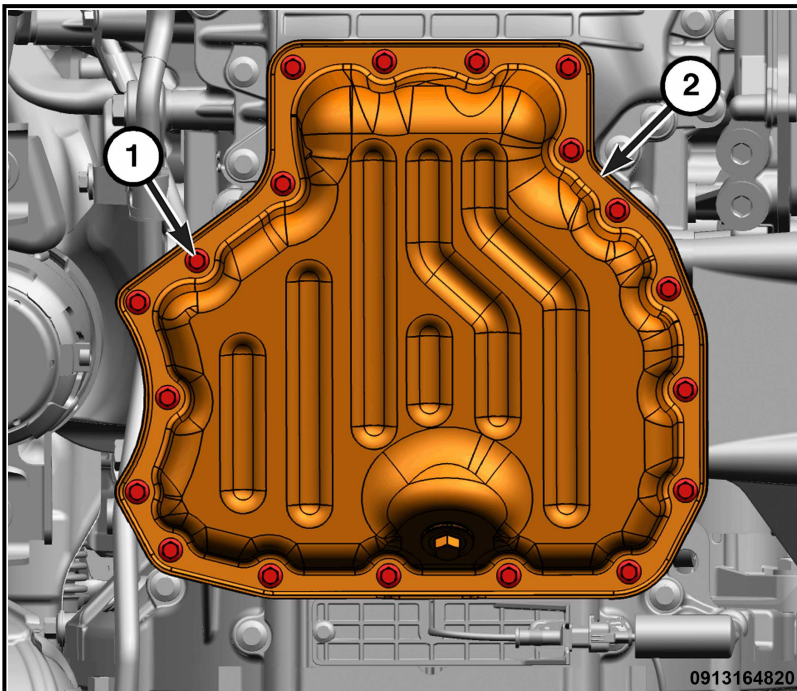
REMOVAL

1. Raise and support the vehicle. Refer to HOISTING, STANDARD PROCEDURE .



1 - Drain Plug

2. Remove the drain plug and drain the engine oil. Install and tighten the drain plug to the proper torque specifications.



1 - Lower Oil Pan Bolts

2 - Lower Oil Pan

3. Remove the lower oil pan bolts and the lower oil pan.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

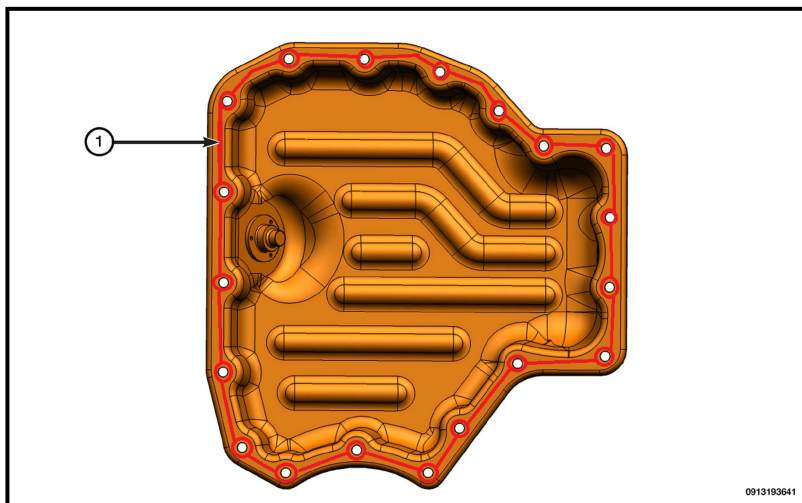
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean and gasket sealing surfaces. Refer to **STANDARD PROCEDURE**.

CAUTION: Engine assembly requires the use of a unique sealant that is compatible with engine oil. Using a sealant other than Mopar® Threebond Engine RTV Sealant may result in engine fluid leakage.

CAUTION: Following the application of Mopar® Threebond Engine RTV Sealant to the gasket surfaces, the components must be assembled within 10 minutes and the attaching fasteners must be tightened to specification within 45 minutes. Prolonged exposure to the air prior to assembly may result in engine fluid leakage.

NOTE: Sealing surfaces must be free of a gasket material and oil residue. Clean the oil pan sealing surfaces with isopropyl alcohol in preparation for sealant application.



1 - RTV Sealant

- Apply a 3 mm wide bead of Mopar® Threebond Engine RTV Sealant to the lower oil pan.
- Install the lower oil pan and using the tightening sequence shown in the torque table below, tighten the lower oil pan bolts to proper torque specifications.
- Fill the engine with recommended engine oil. Refer to [CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS](#).

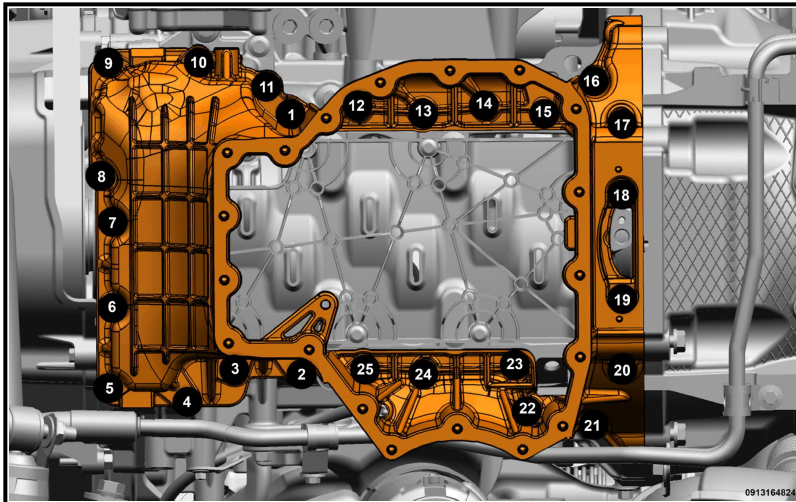
TORQUE SPECIFICATIONS

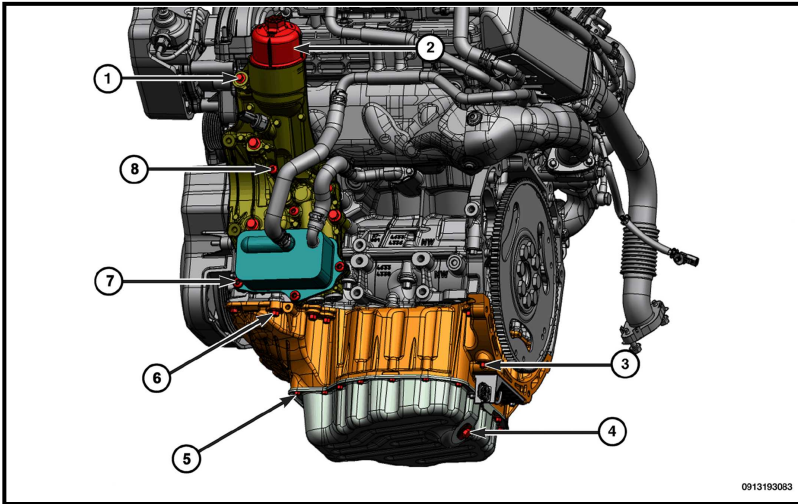
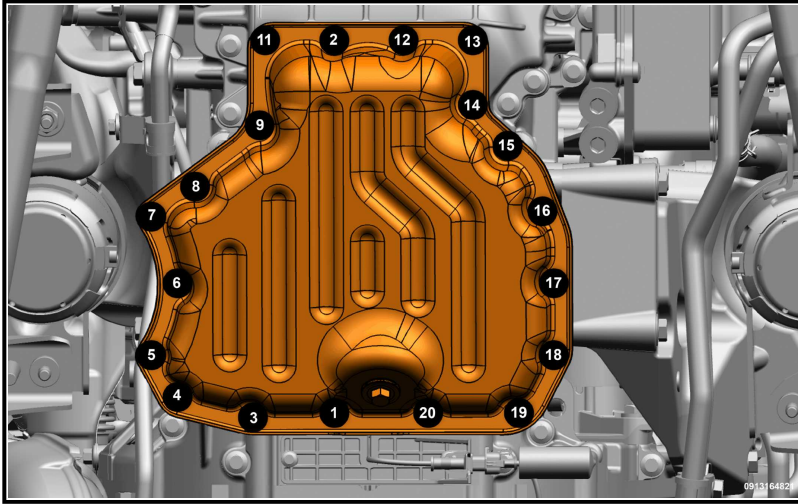
LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-

1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.).	Tightening Sequence NOTE: Bolts in the following positions are

		3. Loosen bolts 7-13 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	stud bolts (4, 6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure: 1. Tighten the lower oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence
7	Oil Cooler Bolts	30 N.m (22 Ft. Lbs.)	-
-	Dipstick Tube Bolt (head)	11 N.m (8 Ft. Lbs.)	-
-	Dipstick Tube Bolt (sump)	11 N.m (8 Ft. Lbs.)	-
-	Windage Tray	11 N.m (8 Ft. Lbs.)	-





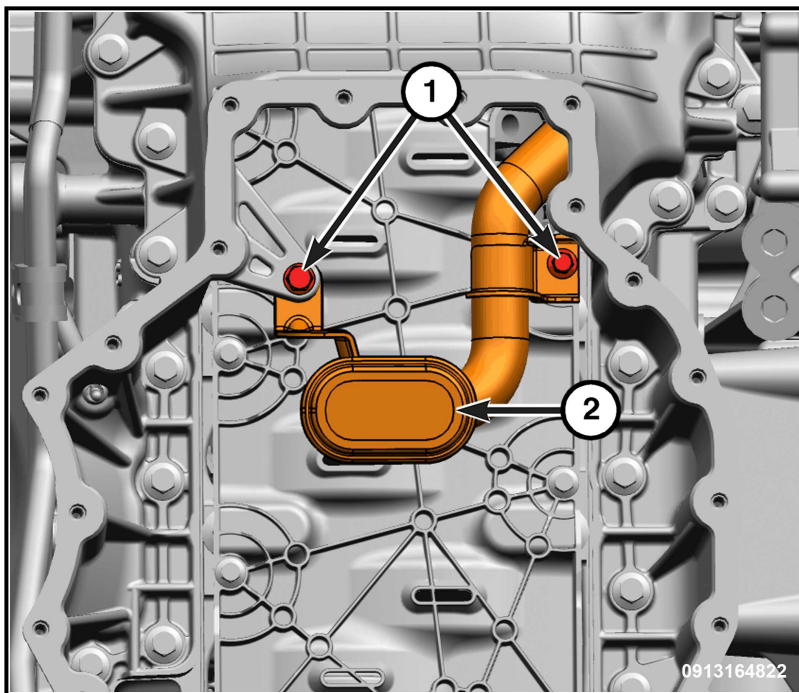
PICK-UP, OIL PUMP

REMOVAL AND INSTALLATION

OIL PUMP PICKUP TUBE

REMOVAL

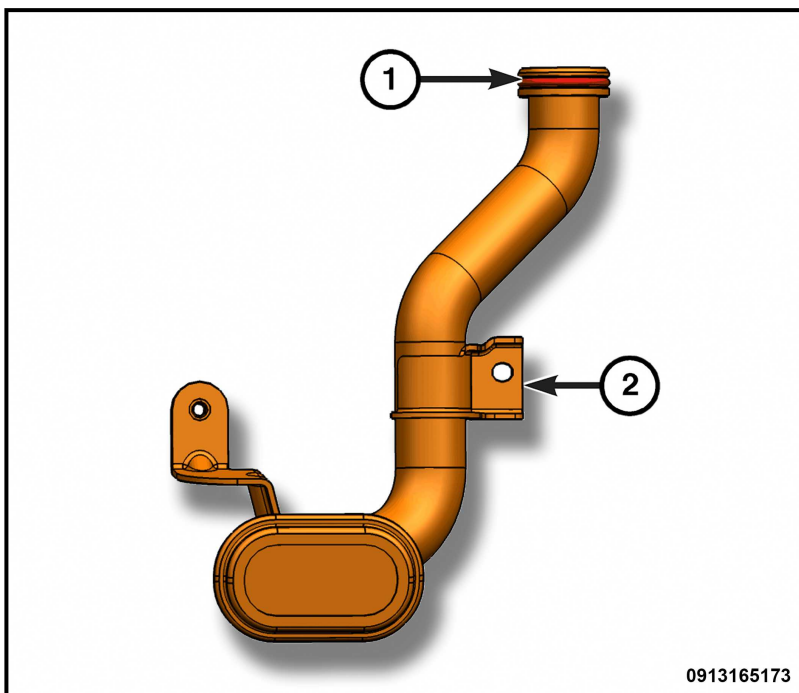
1. Disconnect and isolate the negative battery cable(s). Refer to **CABLES, BATTERY** .
2. Remove the lower oil pan. Refer to **PAN, OIL, REMOVAL AND INSTALLATION**.



1 - Oil Pump Pickup Tube Bolts

2 - Oil Pump Pickup Tube

3. Remove the oil pump pickup tube and the oil pump pickup tube from oil pump.



1 - O-ring

2 - Oil Pump Pickup Tube

4. Remove and discard the O-ring.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Lubricate and install a **NEW** O-ring onto the oil pump pickup tube.

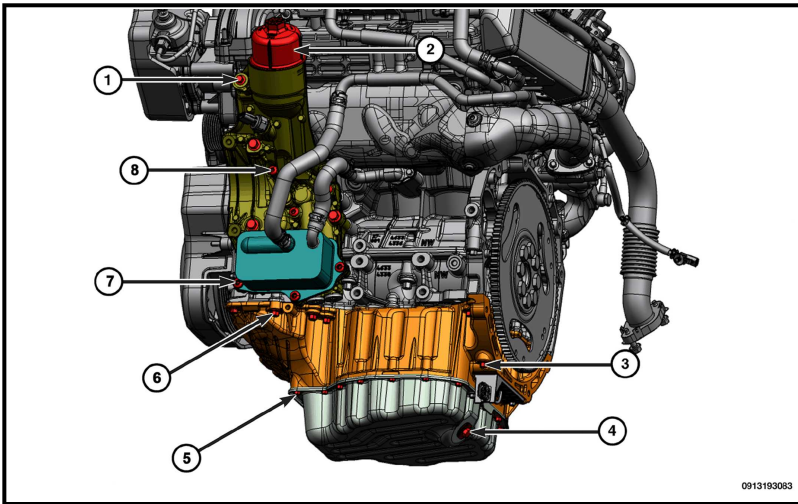
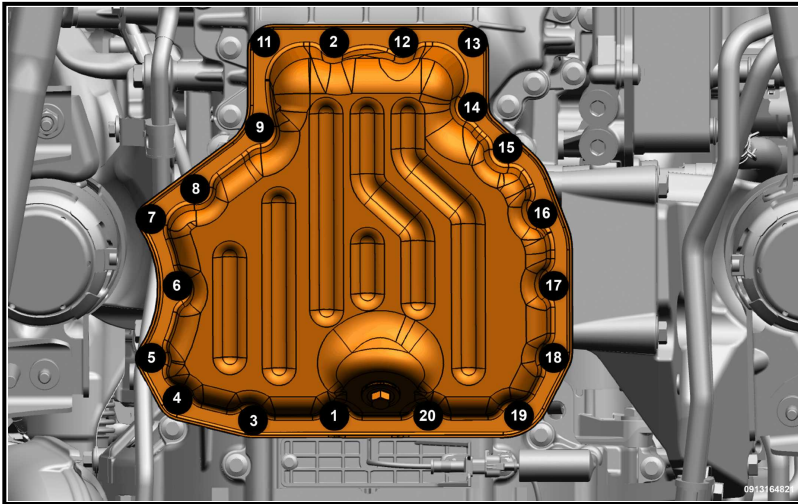
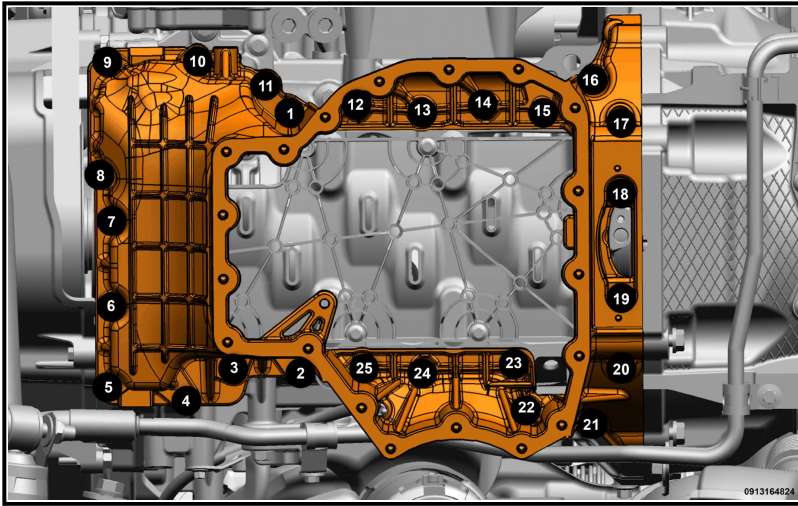
- Fill the engine to proper level with recommended engine oil. Refer to **CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS**.

TORQUE SPECIFICATIONS

LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-

1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts 7-13 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence NOTE: Bolts in the following positions are stud bolts (4, 6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure: 1. Tighten the lower oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence
7	Oil Cooler Bolts	30 N.m (22 Ft. Lbs.)	-
-	Dipstick Tube Bolt (head)	11 N.m (8 Ft. Lbs.)	-
-	Dipstick Tube Bolt (sump)	11 N.m (8 Ft. Lbs.)	-
-	Windage Tray	11 N.m (8 Ft. Lbs.)	-



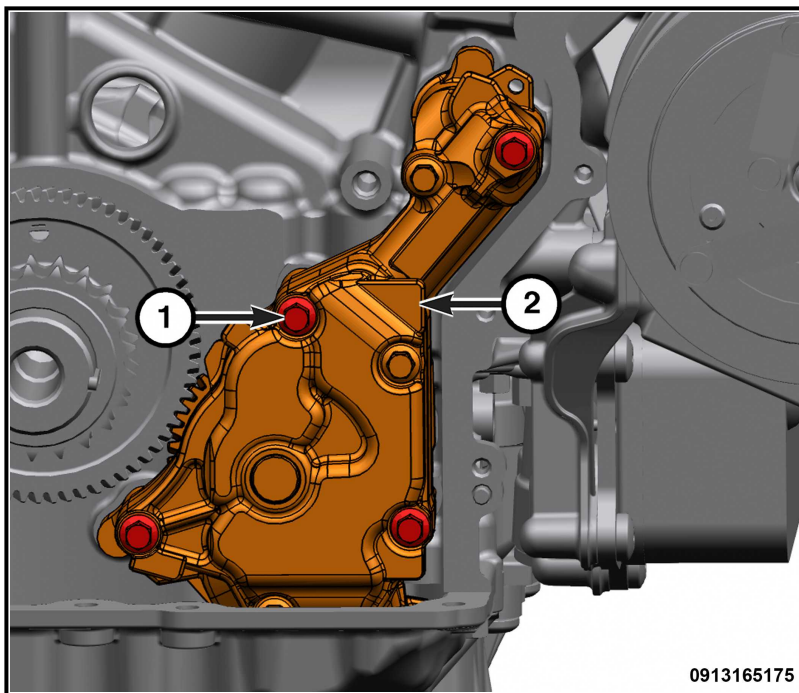
PUMP, ENGINE OIL

REMOVAL AND INSTALLATION

ENGINE OIL PUMP

REMOVAL

1. Remove the lower timing cover. Refer to **COVER(S), ENGINE TIMING, REMOVAL AND INSTALLATION/**.



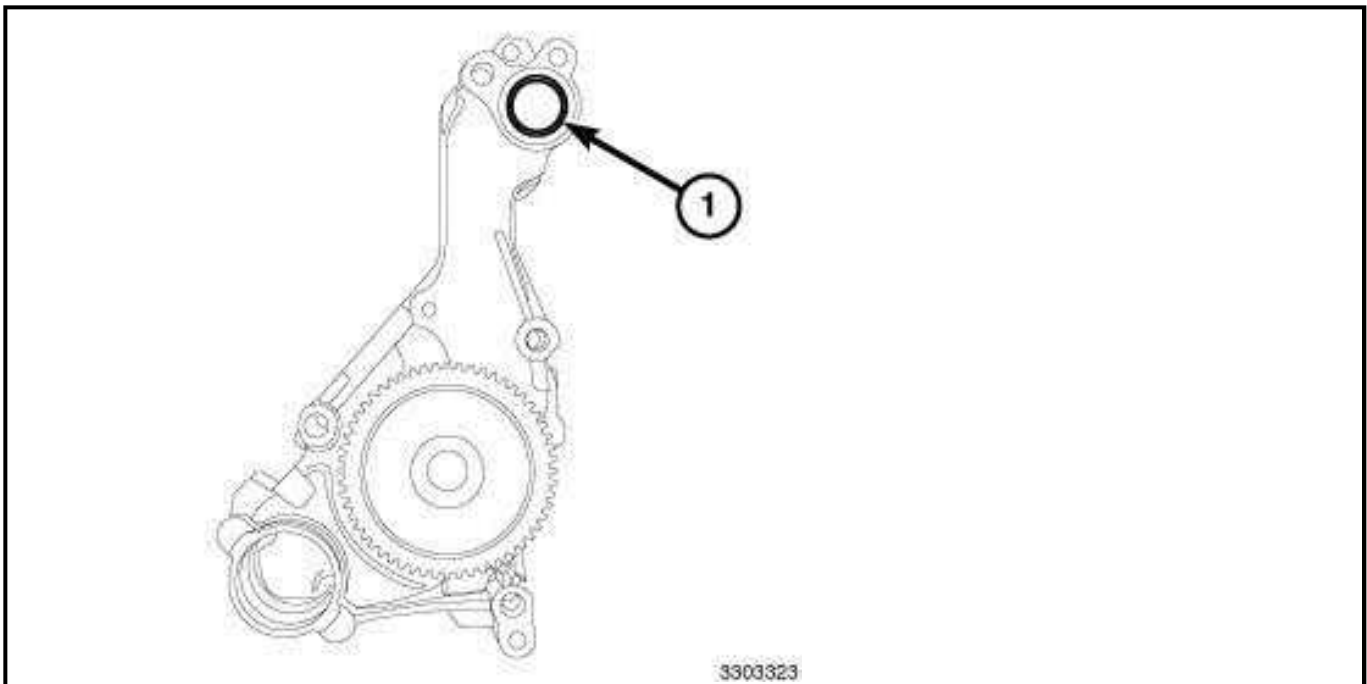
1 - Engine Oil Pump Bolts
2 - Engine Oil Pump

2. Remove the engine oil pump bolts and the engine oil pump.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.



1 - O-ring

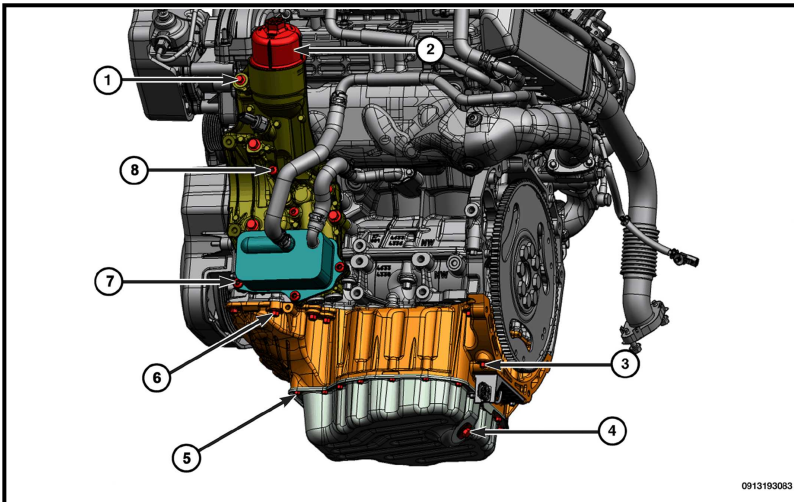
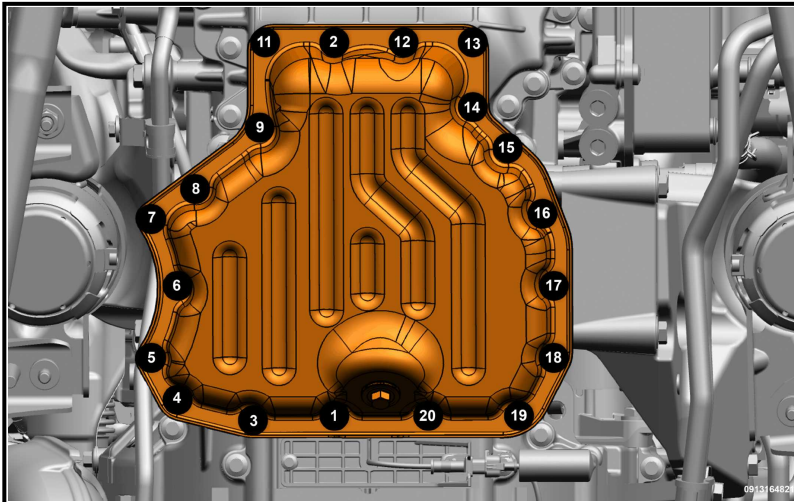
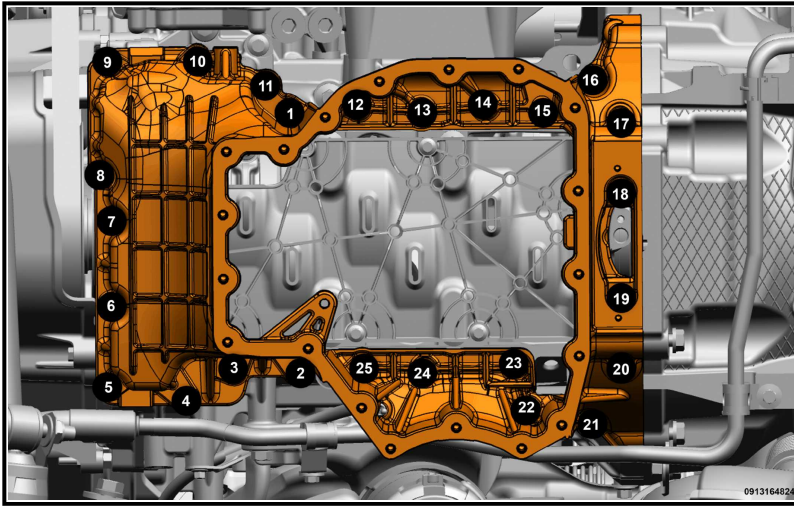
- Clean the gasket sealing surfaces. Refer to [STANDARD PROCEDURE](#) .
- Install a **NEW** O-ring onto the oil pump.

TORQUE SPECIFICATIONS

LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-

1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts 7-13 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence NOTE: Bolts in the following positions are stud bolts (4, 6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure: 1. Tighten the lower oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence
7	Oil Cooler Bolts	30 N.m (22 Ft. Lbs.)	-
-	Dipstick Tube Bolt (head)	11 N.m (8 Ft. Lbs.)	-
-	Dipstick Tube Bolt (sump)	11 N.m (8 Ft. Lbs.)	-
-	Windage Tray	11 N.m (8 Ft. Lbs.)	-



TURBOCHARGER SYSTEM

DESCRIPTION AND OPERATION

BOOST PRESSURE SERVOMOTOR

- The turbocharger boost pressure servomotor is bolted to the side of the turbocharger housing and is responsible for controlling turbocharger boost pressure. It controls the boost pressure by varying the position of the guide vanes. The servomotor operates in response to a PWM signal from the Powertrain Control Module (PCM).
- The turbocharger boost pressure servomotor is serviced with the turbocharger and **is not** serviceable separately. To replace the servomotor, replace the turbocharger. Refer to [TURBOCHARGER, REMOVAL AND INSTALLATION](#).

CHARGE AIR COOLER

- The charge air system consists of a inlet air compressor which is part of the turbocharger housing, charge air cooler locate in front of the radiator, and charge air cooler hoses.
- The charge air cooler is a heat exchanger that uses air flow from vehicle motion to dissipate heat from the intake air. As the turbocharger increases air pressure, the air temperature increases. Lowering the intake air temperature increases engine efficiency and power.

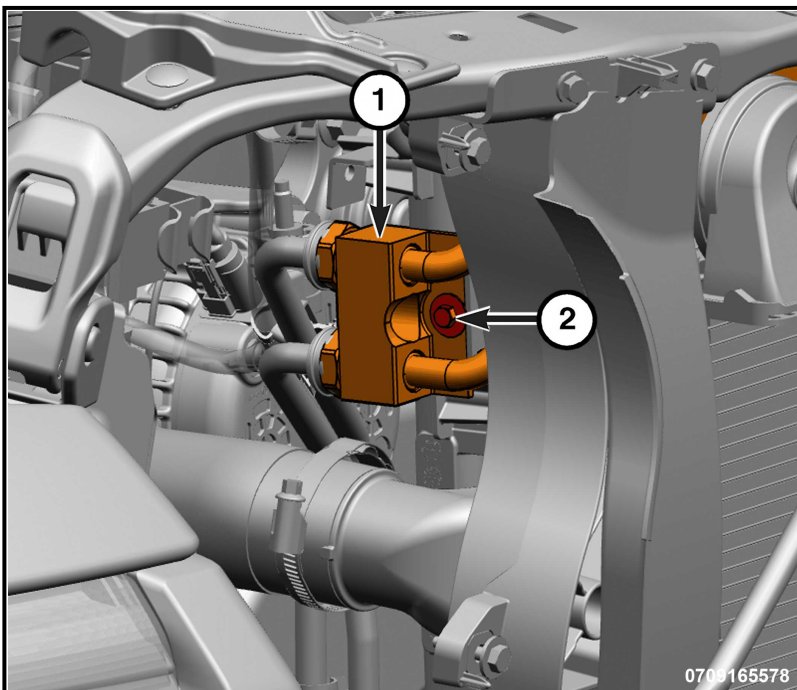
COOLER AND HOSES, CHARGE AIR

REMOVAL AND INSTALLATION

COOLER

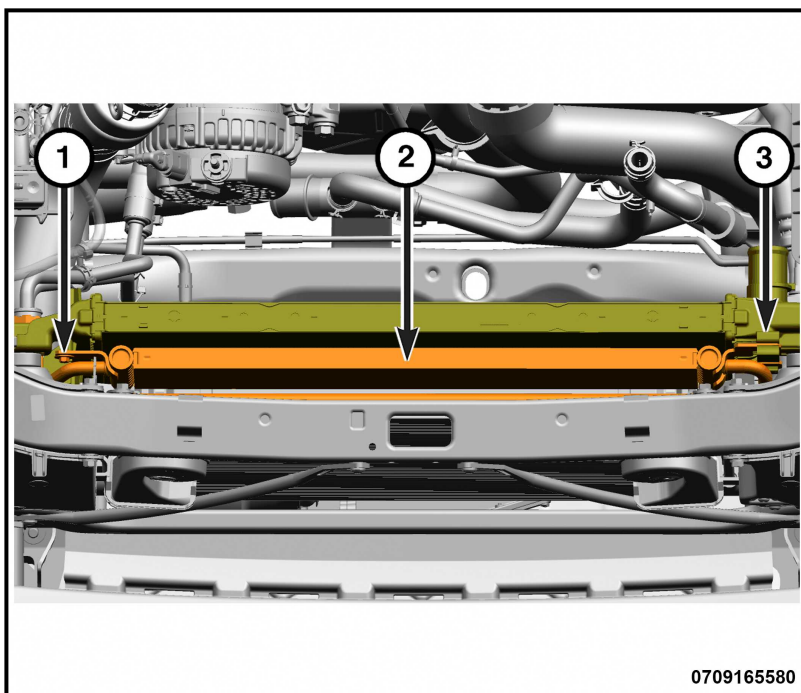
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the right headlight unit. Refer to [UNIT, HEADLAMP, REMOVAL AND INSTALLATION](#) .



1 - Transmission Cooler Line Manifold
2 - Transmission Cooler Line Manifold Bolt

3. Working from the right front, remove the transmission cooler line manifold bolt securing the transmission cooler line manifold to the radiator.

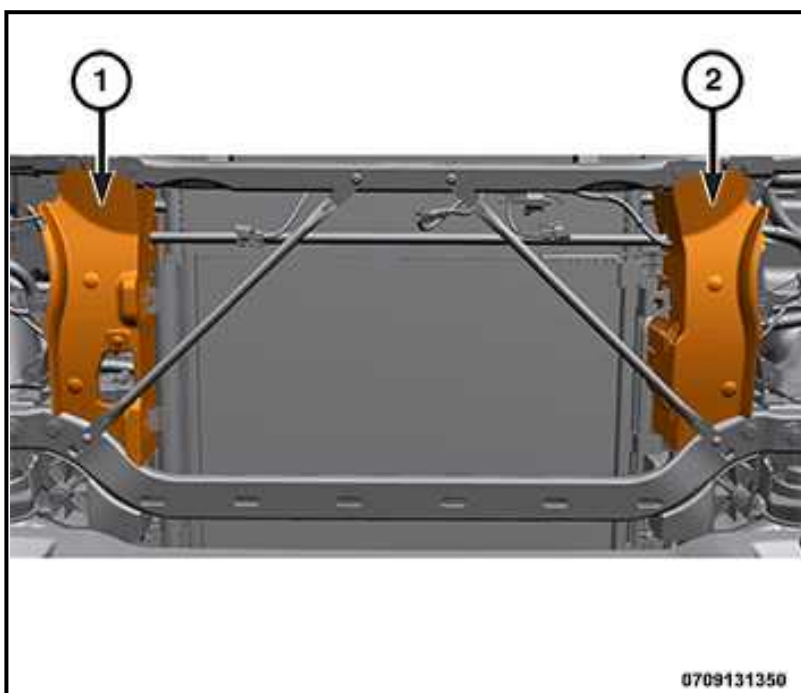


1 - Right Transmission Cooler Bolt

2 - Transmission Cooler

3 - Left Tab

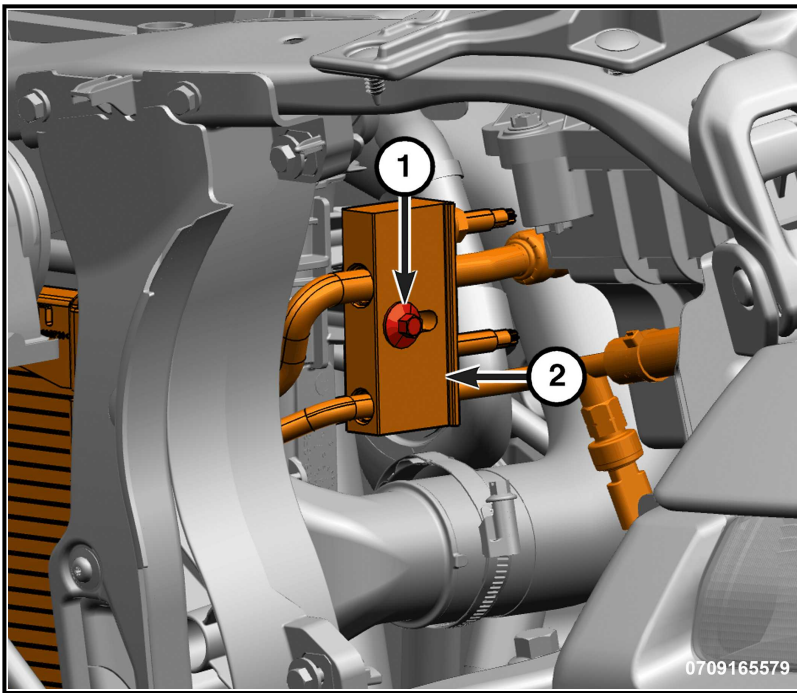
4. Working from the front, remove the right transmission cooler bolt, release the left tab and lift up transmission cooler to separate it from the radiator.



1 - Right Side Radiator Air Deflector

2 - Left Side Radiator Air Deflector

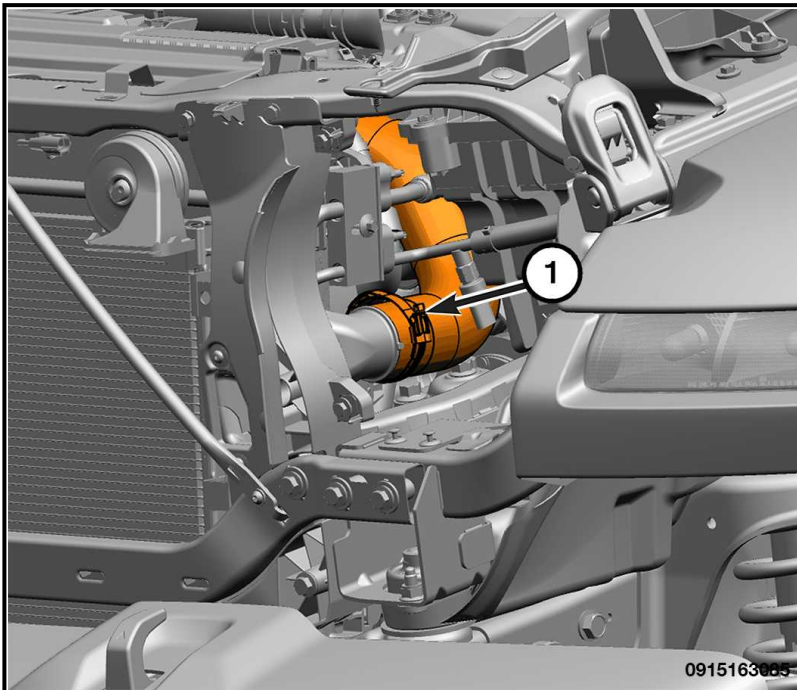
5. Working from the front remove the left side radiator air deflector and right side radiator air deflector.
6. Remove the left headlight unit. Refer to [UNIT, HEADLAMP, REMOVAL AND INSTALLATION](#).



1 - A/C Line Manifold

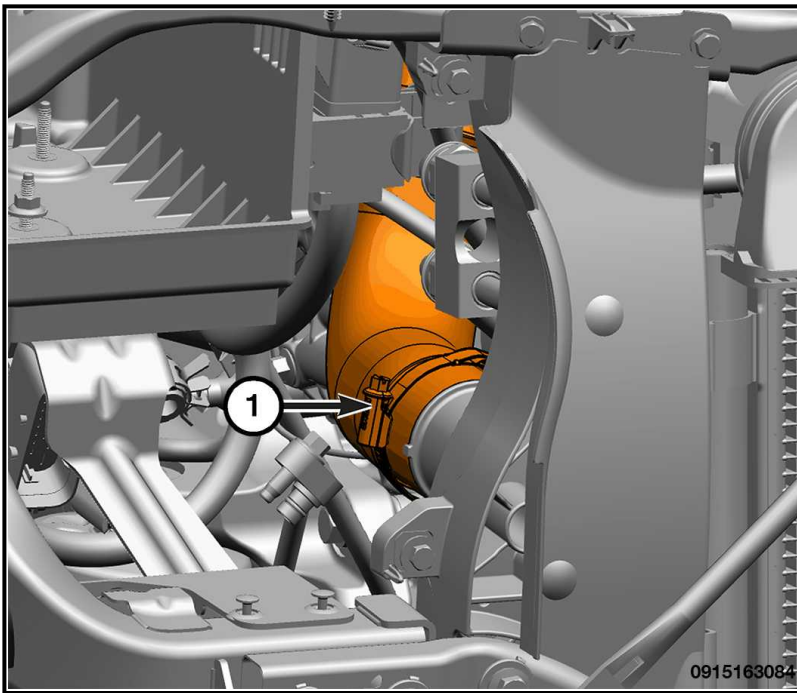
2 - A/C Line Manifold Bolt

7. Remove the A/C line manifold bolt securing the A/C line manifold.



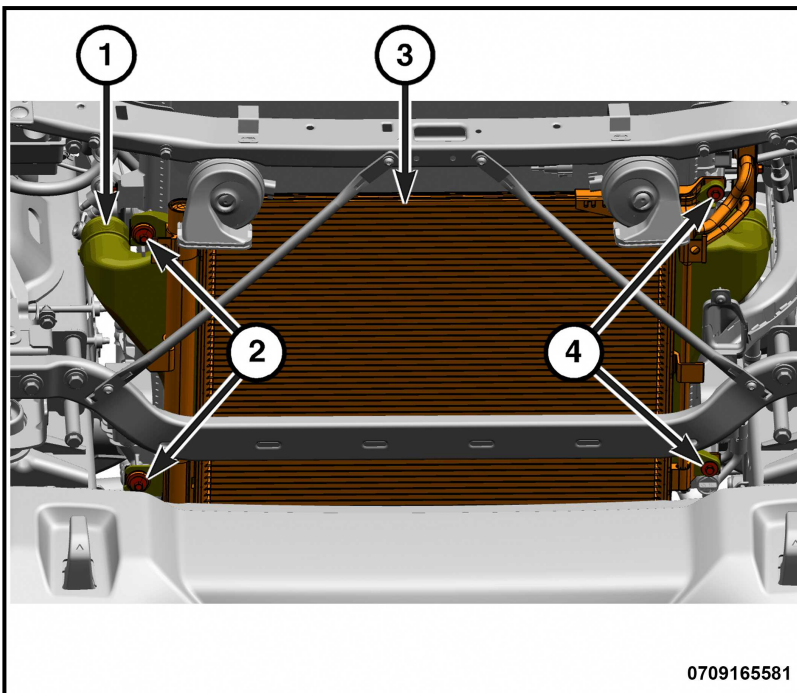
1 - Left Charge Air Cooler Hose

8. Loosen the left Charge Air Cooler (CAC) clamp and disconnect the left CAC hose.



1 - Right Charge Air Cooler Hose

9. Loosen the right CAC hose clamp and disconnect the right CAC hose.



1 - Charge Air Cooler

2 - A/C Condenser Bolts

3 - A/C Condenser

4 - A/C Condenser Bolts

10. Remove the A/C condenser bolts securing the A/C condenser and CAC to the radiator and separate the A/C condenser from the CAC.

11. Remove the CAC from the vehicle.

INSTALLATION

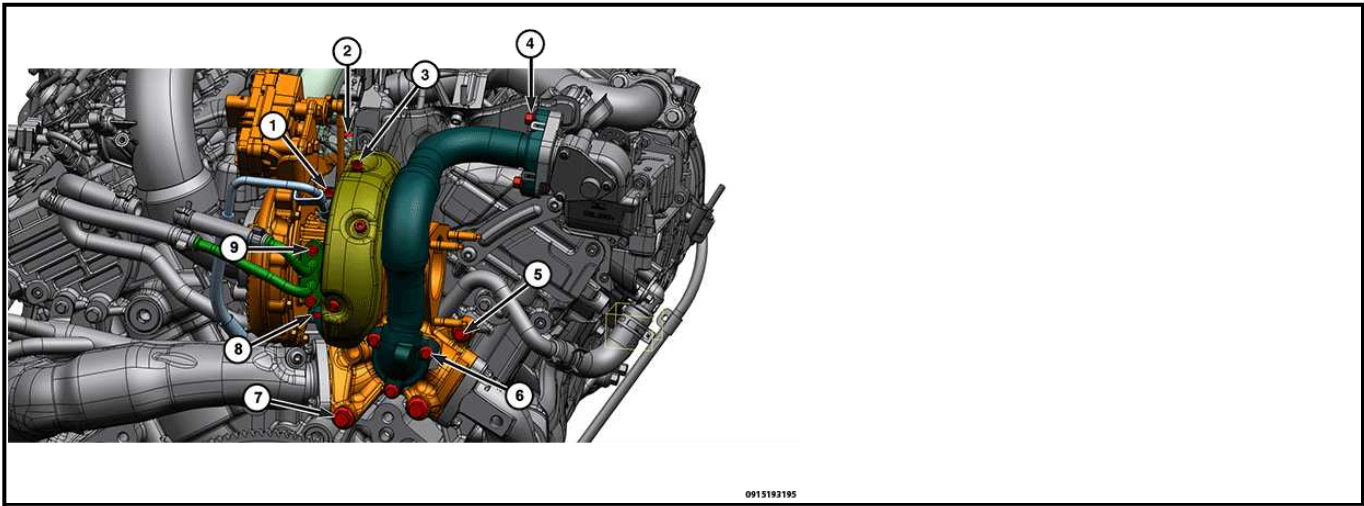
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Install the A/C line manifold to the radiator bolt and securely tighten.
- Install the right side transmission cooler bolt and securely tighten.
- Working from the right front, install the transmission cooler line manifold bolt and securely tighten.

TORQUE SPECIFICATIONS

TURBOCHARGER



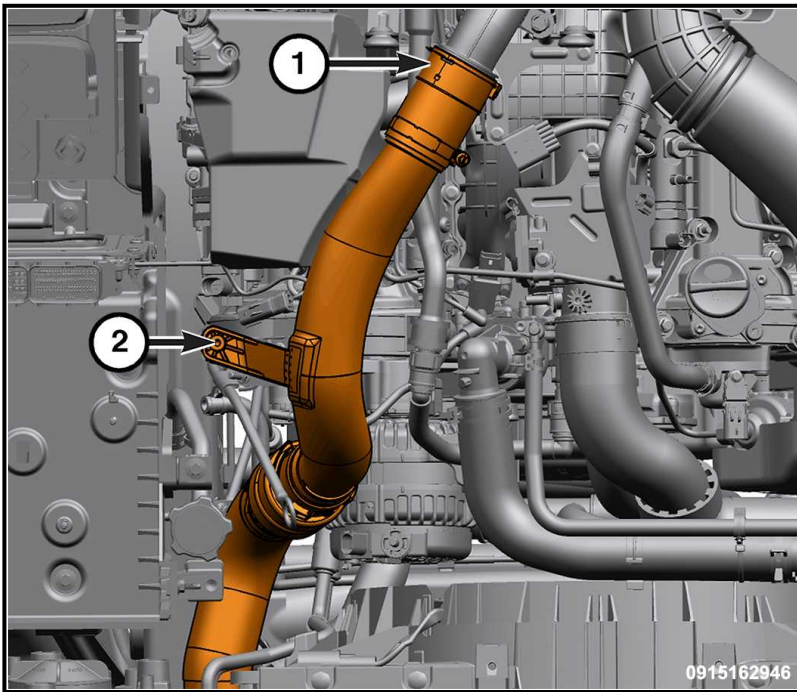
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

RIGHT HOSE

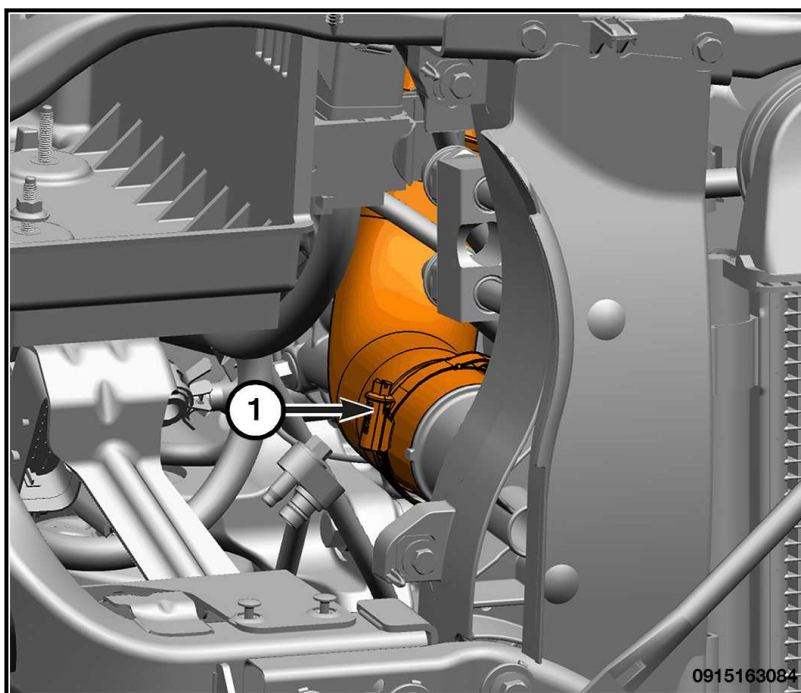
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



1 - Retaining Clip
2 - Charge Air Cooler Hose Support Bracket Bolt

3. Remove the Charge Air Cooler (CAC) hose support bracket bolt.
4. Release the retaining clip and disconnect the CAC hose from the turbocharger elbow.
5. Disconnect the vacuum hose from the vacuum pump.
6. Remove the right headlamp unit. Refer to [UNIT, HEADLAMP, REMOVAL AND INSTALLATION](#) .



1 - Right Charge Air Cooler Hose Clamp

7. Loosen the right CAC hose clamp and disconnect the right CAC hose from the CAC and remove it.

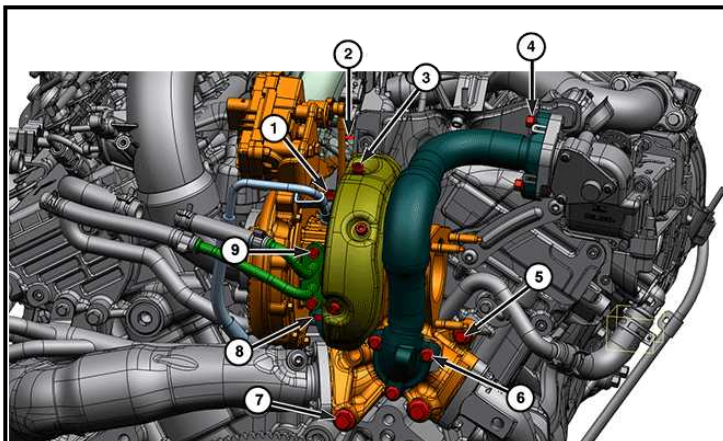
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

TURBOCHARGER



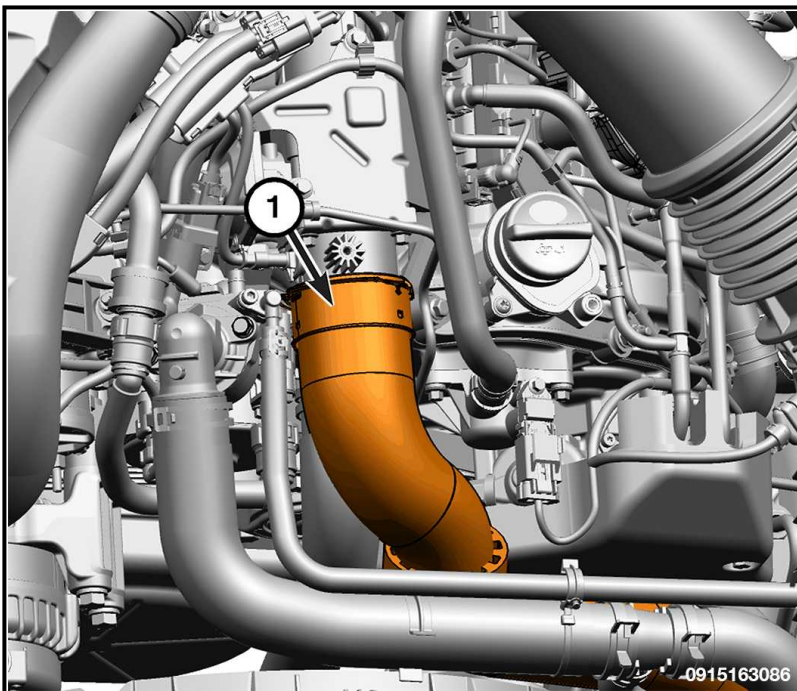
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

LEFT HOSE

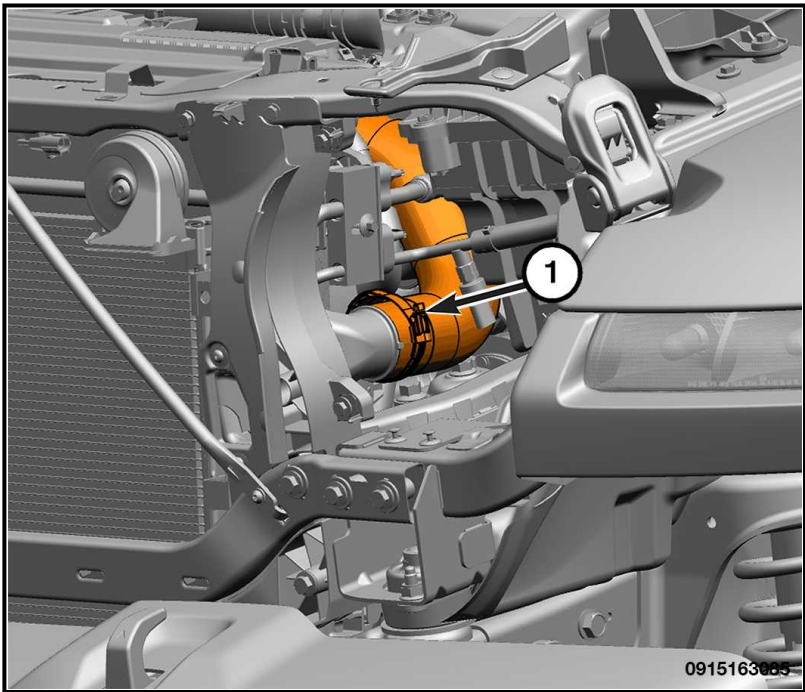
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



1 - Charge Air Cooler Hose

3. Release the retaining lock and disconnect the Charge Air Cooler (CAC) hose from the EGR air flow control valve.
4. Remove the left headlamp unit. Refer to [UNIT, HEADLAMP, REMOVAL AND INSTALLATION](#) .



1 - Left Charge Air Cooler Hose Clamp

5. Loosen the left CAC hose clamp and disconnect the left CAC hose from the CAC and remove it.

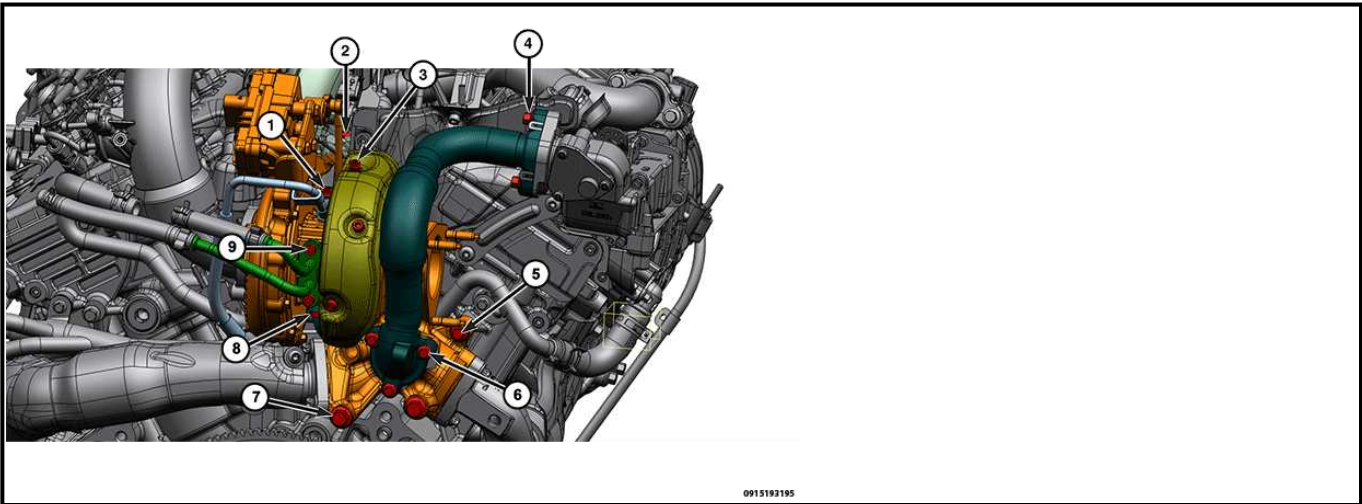
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

TURBOCHARGER



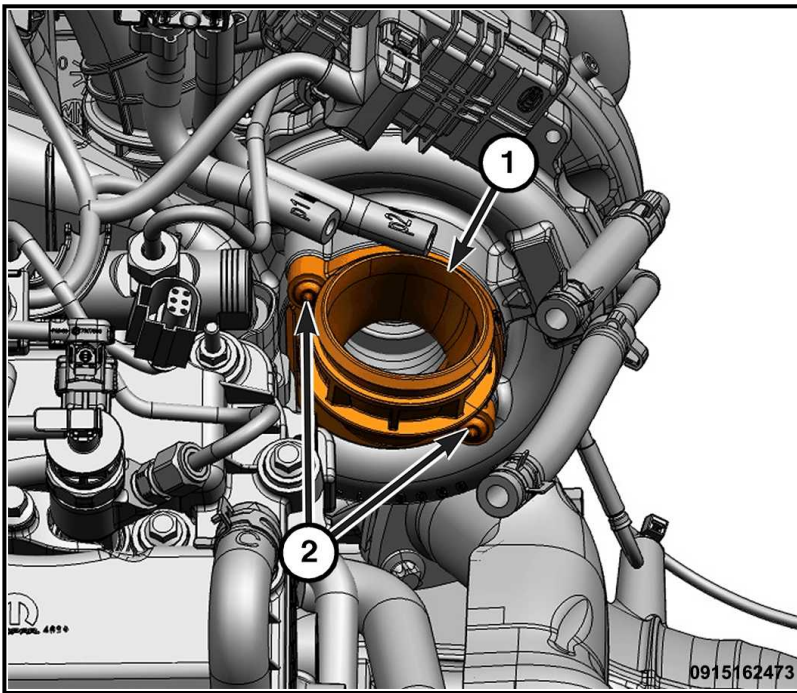
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

LOWER TURBOCHARGER INLET ELBOW

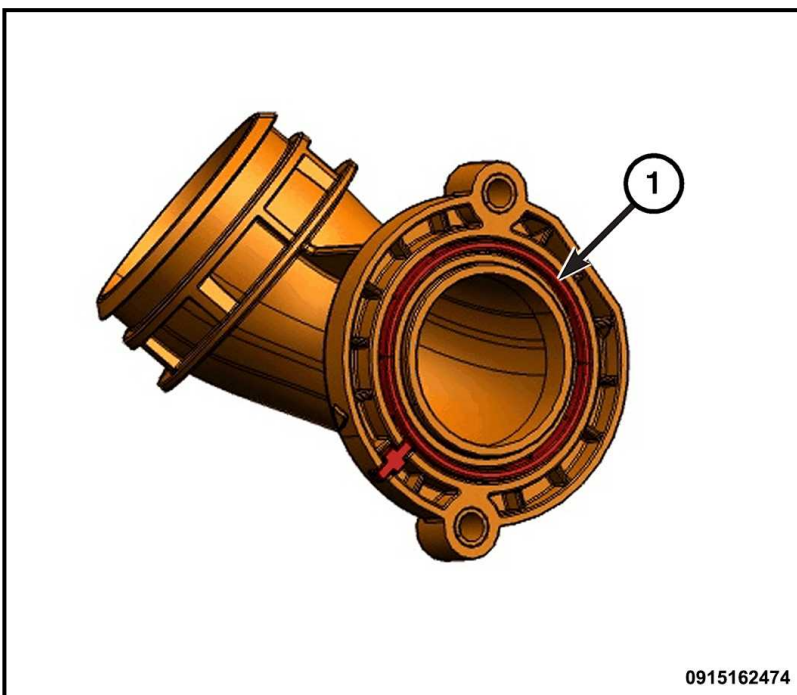
REMOVAL

1. Remove the low pressure EGR cooler. Refer to **COOLER, EXHAUST GAS RECIRCULATION (EGR), REMOVAL AND INSTALLATION** .



- | |
|--|
| 1 - Lower Turbocharger Inlet Elbow |
| 2 - Lower Turbocharger Inlet Elbow Bolts |

2. Remove and lower turbocharger inlet elbow bolts securing the lower turbocharger inlet elbow to the turbocharger.



- | |
|-------------------------------|
| 1 - Turbocharger Inlet Gasket |
|-------------------------------|

3. Remove and **DISCARD** the turbocharger inlet gasket.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

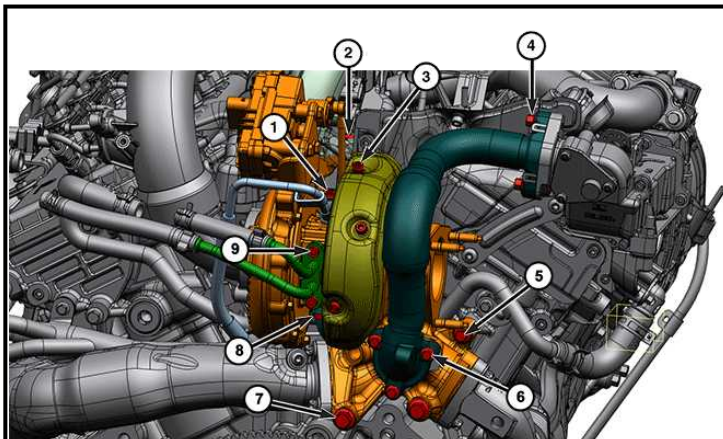
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the gasket sealing surfaces.

- Install a **NEW** lower turbocharger inlet elbow gasket to the turbocharger inlet.

TORQUE SPECIFICATIONS

TURBOCHARGER



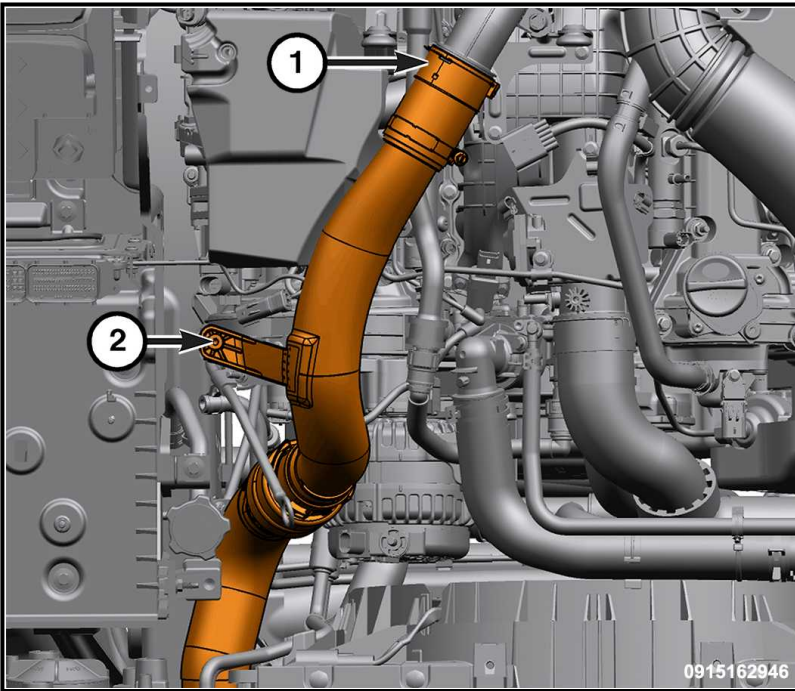
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CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

TURBOCHARGER OUTLET ELBOW

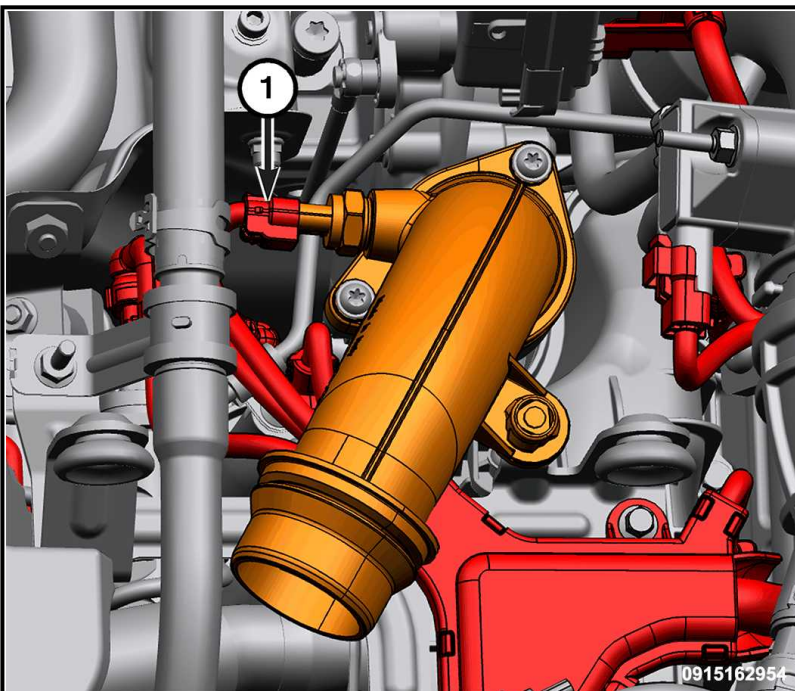
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



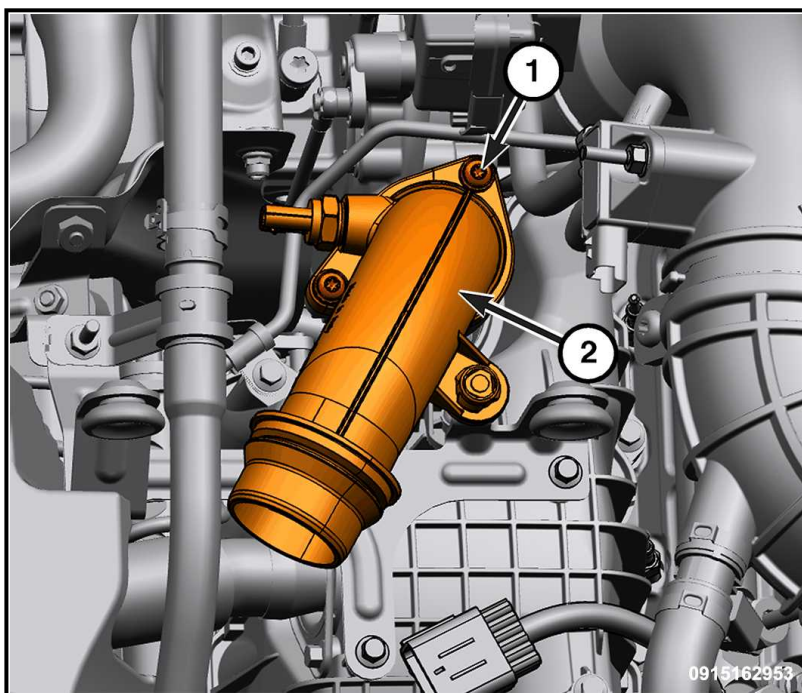
- | |
|---|
| 1 - Retaining Clip |
| 2 - Charge Air Cooler Hose Support Bracket Bolt |

3. Remove the Charge Air Cooler (CAC) hose support bracket bolt.
4. Release the retaining clip and disconnect the CAC hose from the turbocharger elbow and remove it.
5. Disconnect the vacuum hose at the vacuum pump.



- | |
|--|
| 1 - Outlet Air Temperature Sensor Wire Harness Connector |
|--|

6. Disconnect the outlet air temperature sensor wire harness connector.



1 - Turbocharger Outlet Elbow Bolts

2 - Turbocharger Outlet Elbow

7. Remove the turbocharger outlet elbow bolts and the turbocharger outlet elbow.

INSTALLATION

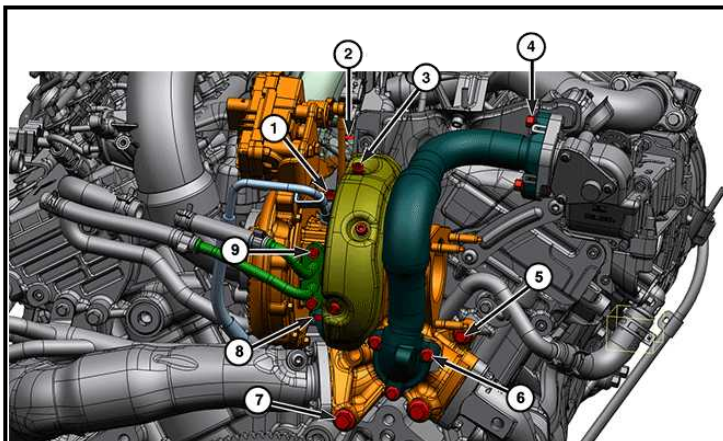
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Using a **NEW** gasket, install the turbocharger outlet elbow and securely tighten the bolts.

TORQUE SPECIFICATIONS

TURBOCHARGER



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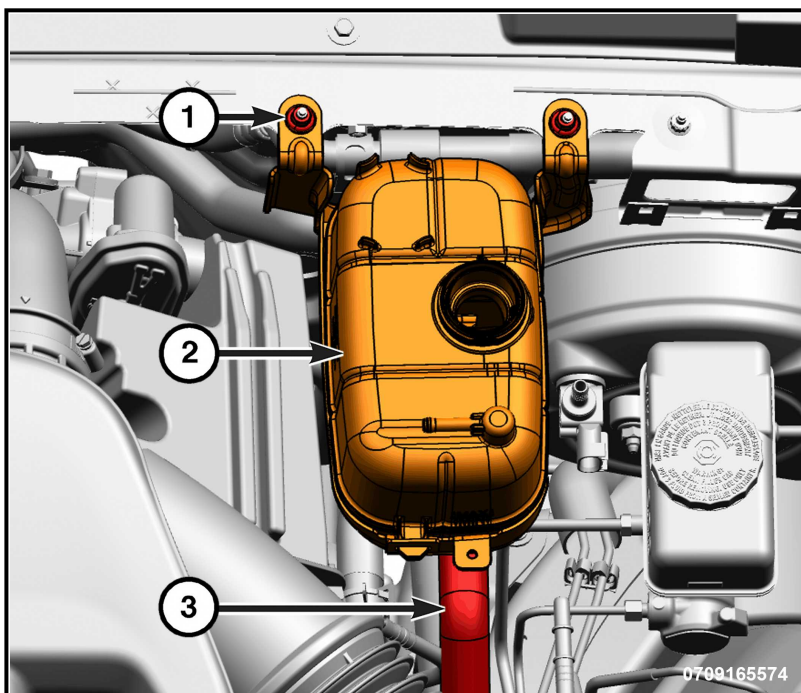
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

UPPER TURBOCHARGER INLET ELBOW

REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
3. Detach the brake booster vacuum hose from the bracket.

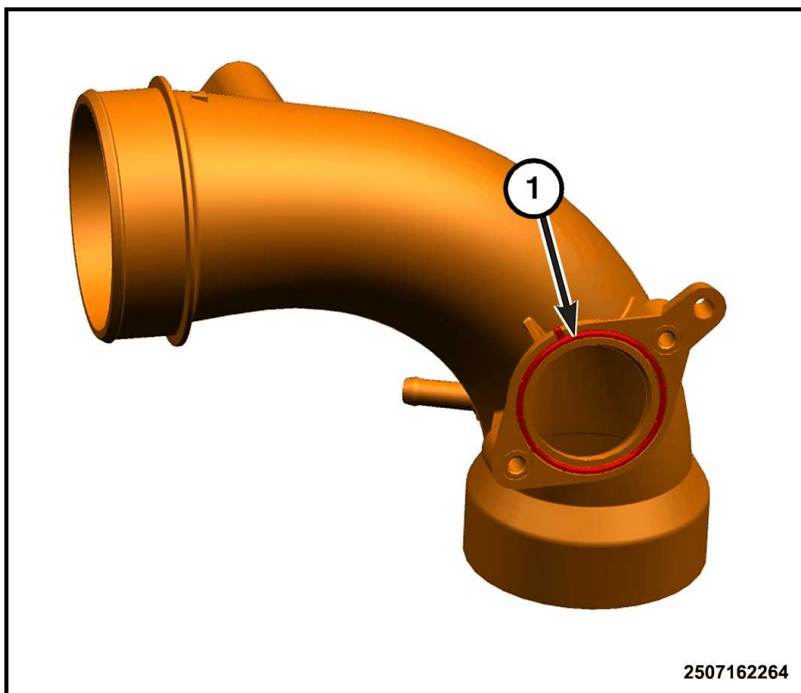


1 - Pressurized Coolant Bottle Nuts

2 - Pressurized Coolant Bottle

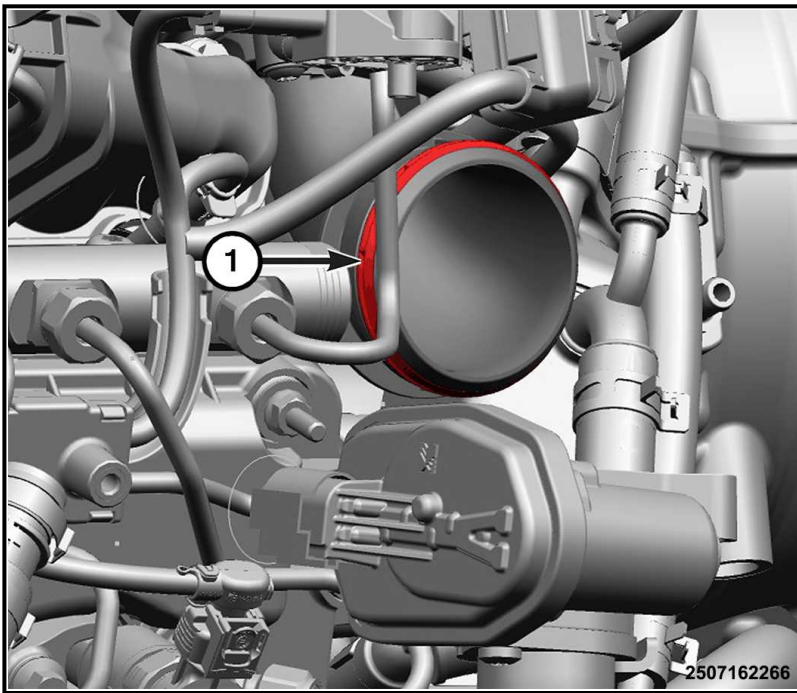
3 - Lower Coolant Hose

4. Remove the pressurized coolant bottle nuts and position aside the pressurized coolant bottle.
5. Remove the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#) .
6. Remove the left fuel rail cover. Refer to [RAIL\(S\), FUEL, REMOVAL AND INSTALLATION](#).
7. Remove the low pressure differential pressure sensor. Refer to [SENSOR, DIFFERENTIAL PRESSURE, REMOVAL AND INSTALLATION](#) .
8. Remove the low pressure EGR valve to the upper turbocharger inlet elbow bolts and remove the upper turbocharger inlet elbow.



1 - Low Pressure EGR Valve Gasket

9. Remove and **DISCARD** the low pressure EGR valve gasket.



1 - lower turbocharger inlet elbow gasket

10. Remove and **DISCARD** the lower turbocharger inlet elbow gasket.

INSTALLATION

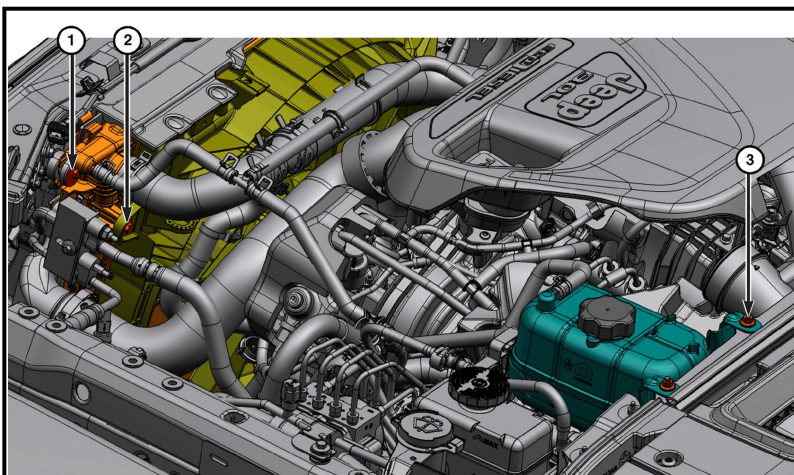
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the gasket sealing surfaces.
- Install a **NEW** gasket on the lower turbocharger inlet elbow.
- Install a **NEW** low pressure EGR valve gasket to the upper turbocharger inlet elbow.
- Install the upper turbocharger inlet elbow and securely tighten the low pressure EGR valve to the upper turbocharger inlet elbow bolts.
- Install the pressurized coolant bottle and tighten the pressurized coolant bottle nuts to the proper torque specifications.

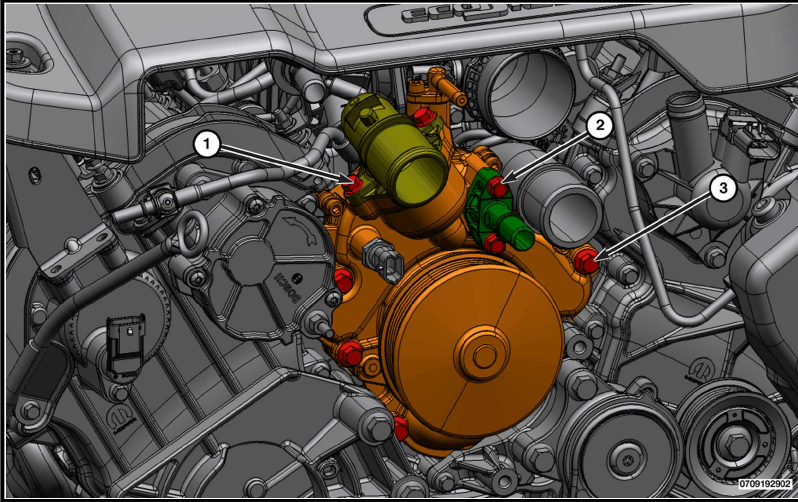
TORQUE SPECIFICATIONS

COOLING SYSTEM - 3.0L DIESEL



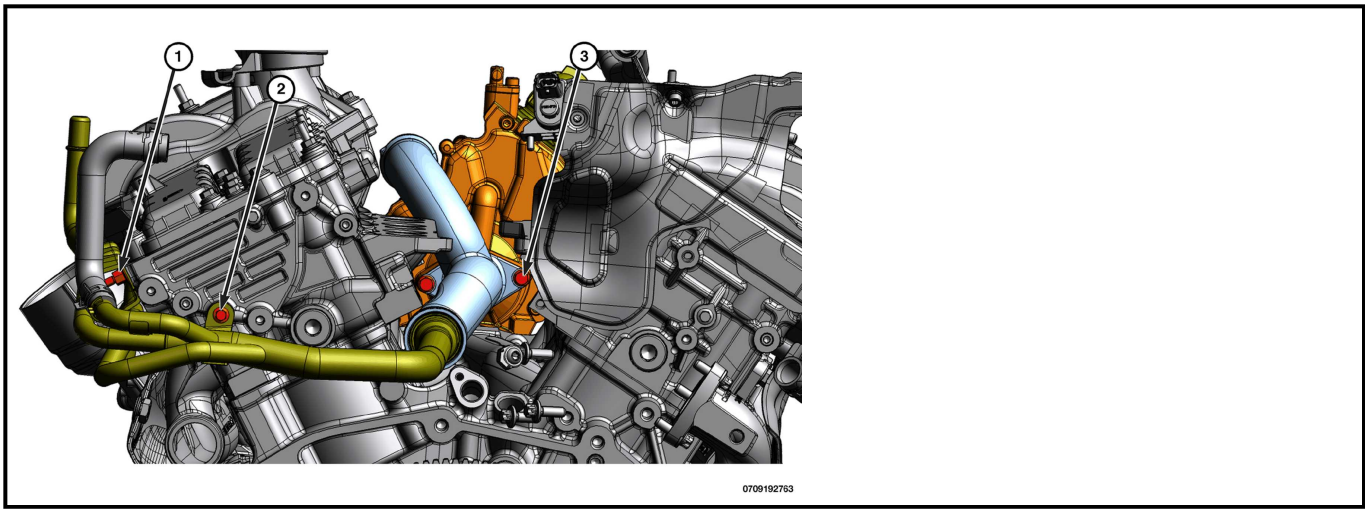
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CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Engine Radiator Bolts	11 N.m (8 Ft. Lbs.)	-
2	Cooling Fan Bolts	8 N.m (71 In. Lbs.)	-
3	Pressurized Coolant Bottle Nuts	10 N.m (89 In. Lbs.)	-
-	Pressurized Coolant Bottle Bolt	5 N.m (44 In. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Thermostat Housing Bolts	11 N.m (8 Ft. Lbs.)	-
2	Coolant Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-
3	Water Pump Bolts	Torque Procedure: 1. Tighten in a crisscross pattern to 25 N.m (18 Ft. Lbs.) 2. Loosen bolts one at a time 90° and then tighten to 32 N.m (24 Ft. Lbs.).	-
-	Block Heater	12 N.m (9 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1, 2	Coolant Tube Bolts	25 N.m (18 Ft. Lbs.)	-
3	Water Pump Inlet Tube Bolts	11 N.m (8 Ft. Lbs.)	-



LINES, TUBES AND HOSES, TURBOCHARGER, OIL AND COOLANT

REMOVAL AND INSTALLATION

OIL RETURN LINE

REMOVAL

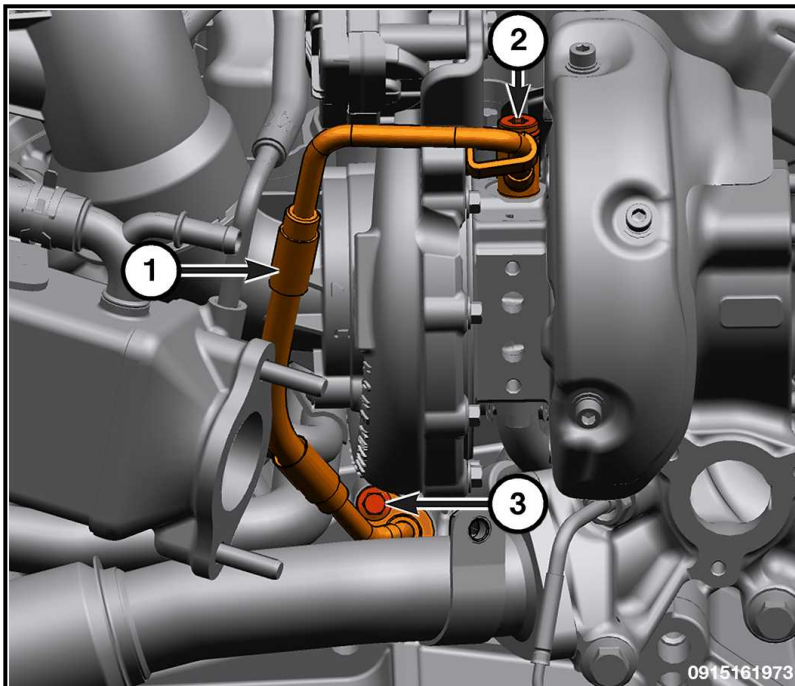
1. The turbocharger oil return tube is only serviced by removing the turbocharger, refer to turbocharger removal/installation procedure. Refer to **TURBOCHARGER, REMOVAL AND INSTALLATION**.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

OIL SUPPLY LINE

REMOVAL



- | |
|---|
| 1 - Turbocharger Oil Supply Line |
| 2 - Turbocharger Oil Supply Line Banjo Bolt |
| 3 - Turbocharger Oil Supply Line Bolt |

1. Remove the turbocharger oil supply line banjo bolt.

2. Remove the turbocharger oil supply line bolt and the turbocharger oil supply line.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.



1 - O-ring

- Install a **NEW** O-ring to the turbocharger oil supply line.

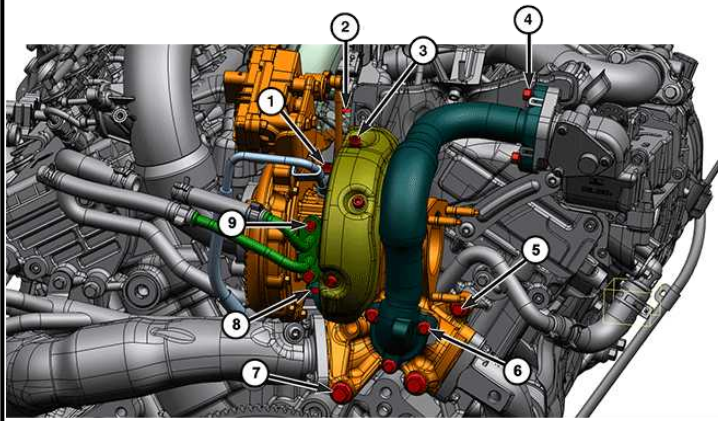


1 - Sealing Washers

- Install **NEW** sealing washers and the upper banjo bolt to the turbocharger oil supply line.

TORQUE SPECIFICATIONS

TURBOCHARGER



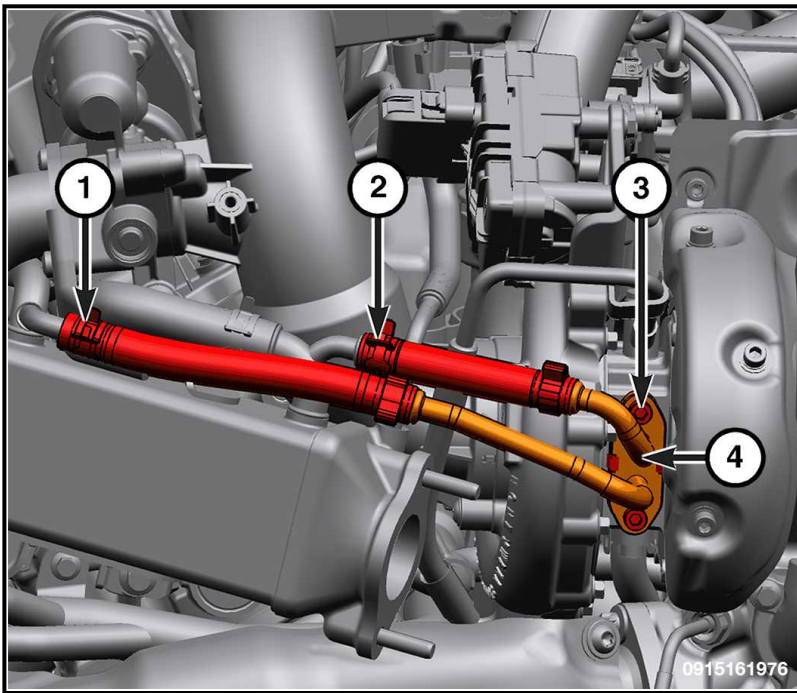
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CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

COOLANT SUPPLY

REMOVAL

1. Remove the cab. Refer to [CAB, REMOVAL AND INSTALLATION](#) .



1 - Coolant Hose
2 - Coolant Hose
3 - Turbocharger Coolant Tube Manifold Bolts
4 - Turbocharger Coolant Tube Manifold

2. Remove the coolant supply and return hoses.
3. Remove the turbocharger coolant tube manifold bolts and the turbocharger coolant tube manifold.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

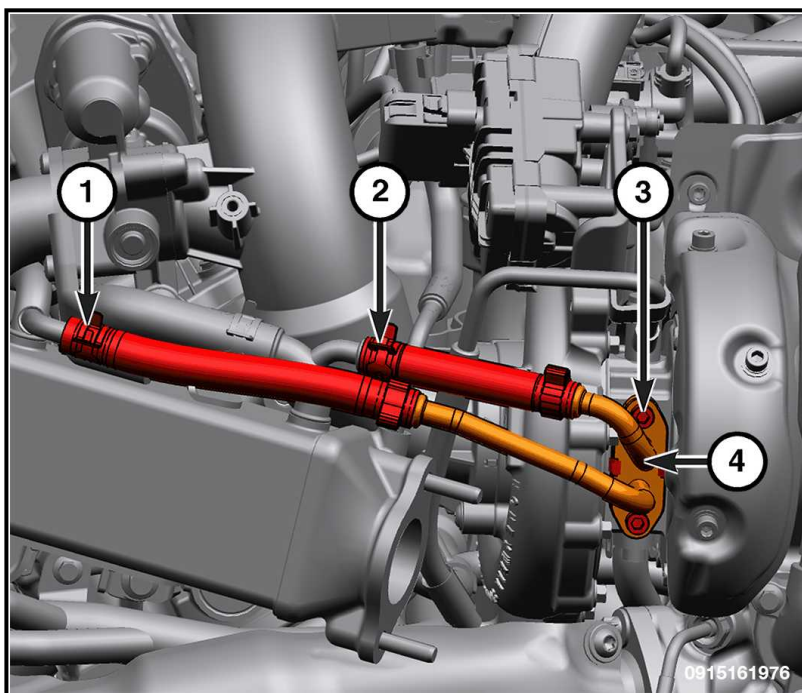
- Install a **NEW** gasket on the turbocharger coolant tube manifold.

TORQUE SPECIFICATIONS

COOLANT RETURN

REMOVAL

1. Remove the cab. Refer to [**CAB, REMOVAL AND INSTALLATION**](#) .



1 - Coolant Hose
2 - Coolant Hose
3 - Turbocharger Coolant Tube Manifold Bolts
4 - Turbocharger Coolant Tube Manifold

2. Disconnect the coolant supply and return hoses.
3. Remove the turbocharger coolant tube manifold bolts and the turbocharger coolant tube manifold.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

- Install a **NEW** gasket on the turbocharger coolant tube manifold.

TORQUE SPECIFICATIONS

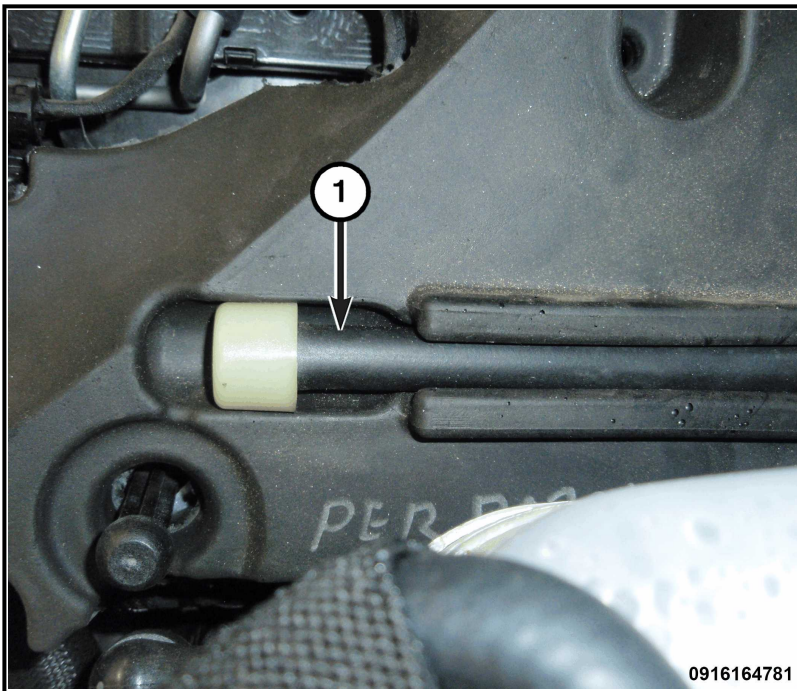
TURBOCHARGER

REMOVAL AND INSTALLATION

TURBOCHARGER

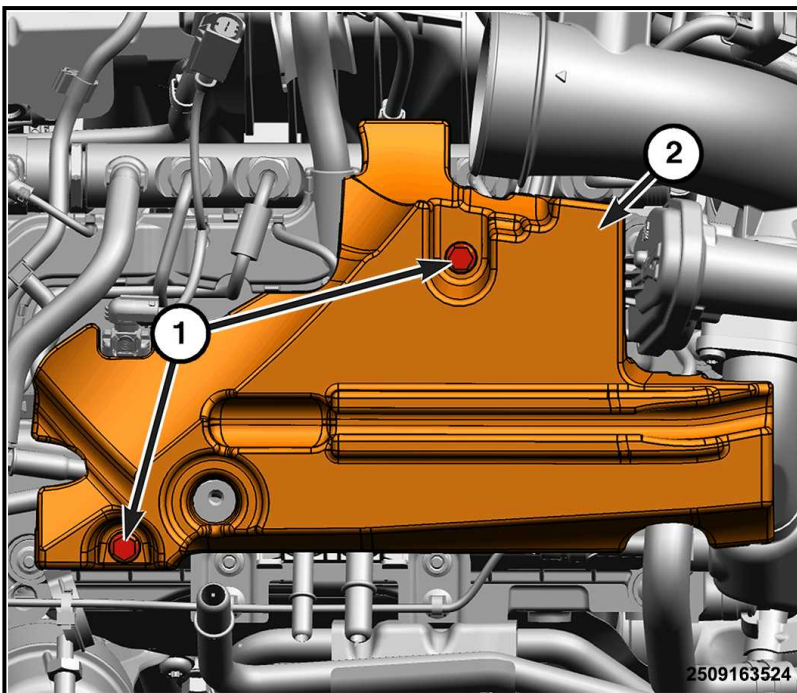
REMOVAL

1. Remove the Low Pressure (LP) Exhaust Gas Recirculation (EGR) tube. Refer to **TUBE, EXHAUST GAS RECIRCULATION (EGR), REMOVAL AND INSTALLATION** .
2. Remove the Diesel Particulate Filter (DPF) elbow. Refer to **FILTER, DIESEL PARTICULATE, REMOVAL AND INSTALLATION** .



1 - Vent Hose

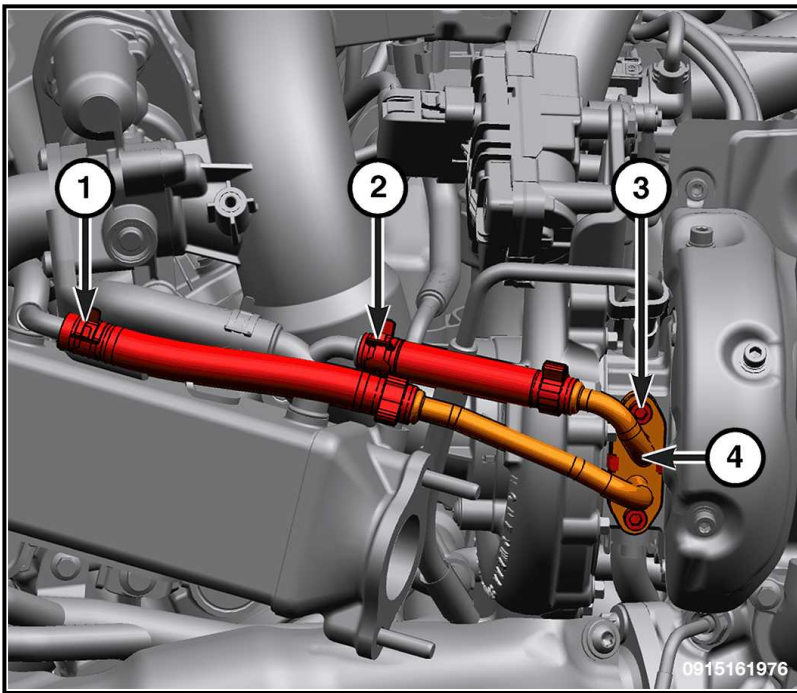
3. Remove the vent hose.



1 - Left Fuel Rail Cover Bolts

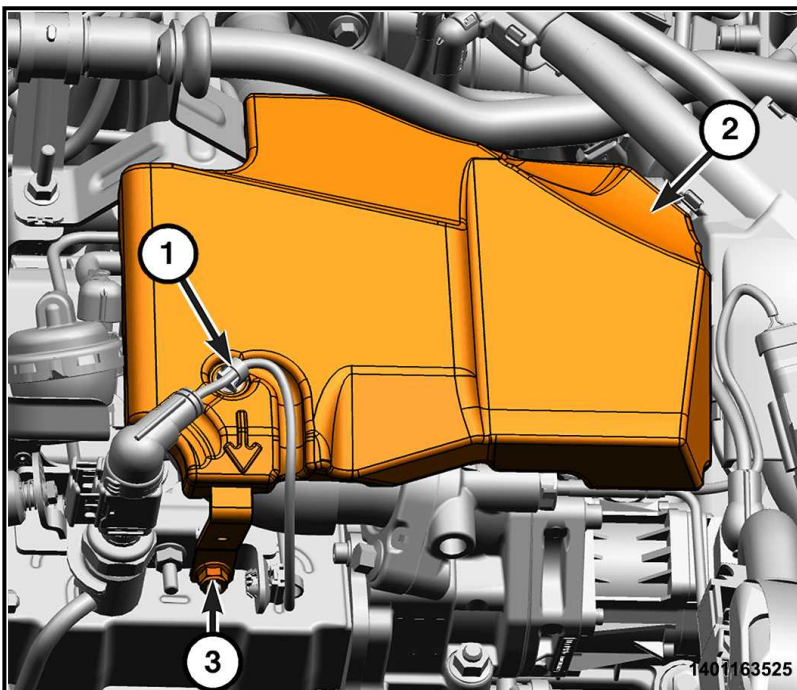
2 - Left Fuel Rail Cover

4. Remove the left fuel rail cover bolts and the left fuel rail cover.
5. Remove the differential pressure sensor from the turbocharger outlet elbow. Refer to [SENSOR, DIFFERENTIAL PRESSURE, REMOVAL AND INSTALLATION](#) .
6. Remove the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#) .
7. Remove the LP EGR valve. Refer to [VALVE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#) .
8. Remove the LP EGR cooler. Refer to [COOLER, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#) .



1 - Turbocharger to Low Pressure EGR Cooler Coolant Hose
2 - Low Pressure EGR Cooler to Turbocharger Coolant Hose
3 - Turbocharger Coolant Manifold Bolts
4 - Turbocharger Coolant Manifold

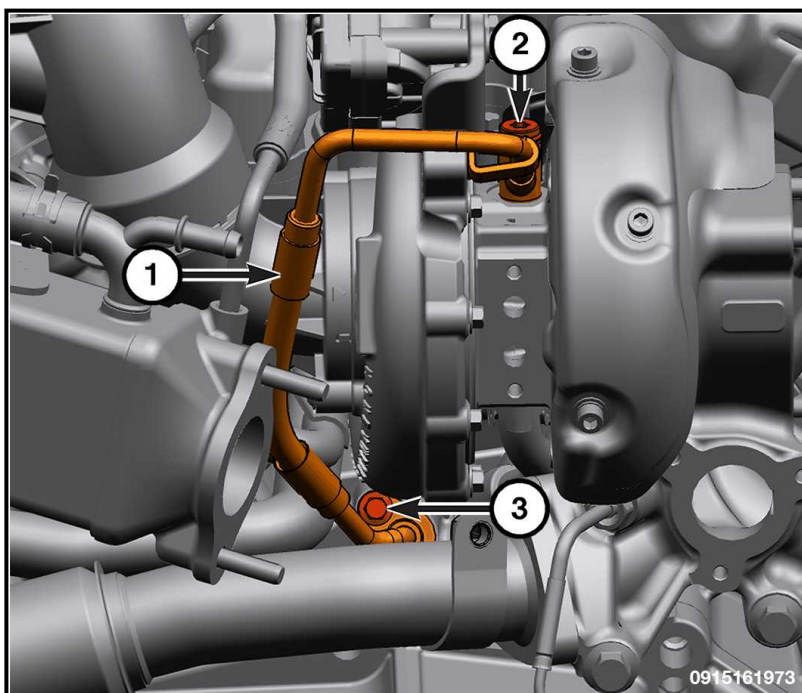
9. Disconnect the turbocharger to Low Pressure (LP) EGR cooler coolant hose.
10. Disconnect the LP EGR cooler to turbocharger coolant hose.
11. Remove the turbocharger coolant manifold bolts and the turbocharger coolant manifold.



1 - Wire Harness Retainer
2 - Right Fuel Rail Cover
3 - Right Fuel Rail Cover Nut

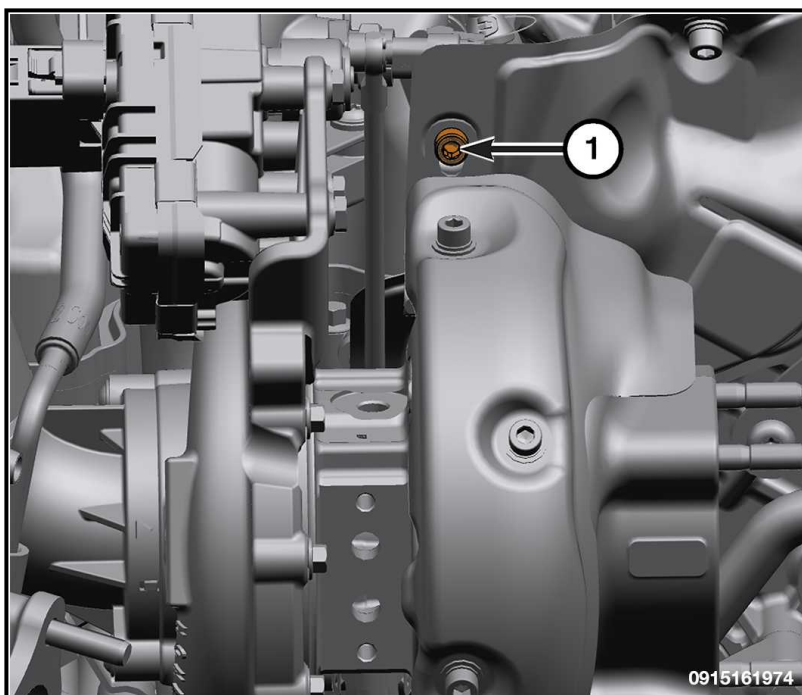
12. Loosen the right fuel rail cover nut, detach the wire harness retainer and remove the right fuel rail cover.
13. Remove the turbocharger outlet elbow. Refer to [COOLER AND HOSES, CHARGE AIR, REMOVAL AND INSTALLATION](#).

14. Remove the High Pressure (HP) EGR tube. Refer to [TUBE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#) .
15. Disconnect the turbocharger actuator wire harness connector.
16. Remove the exhaust pressure sensor tube. Refer to [SENSOR, EXHAUST PRESSURE, REMOVAL AND INSTALLATION](#) .
17. Disconnect the turbocharger actuator wire harness connector.



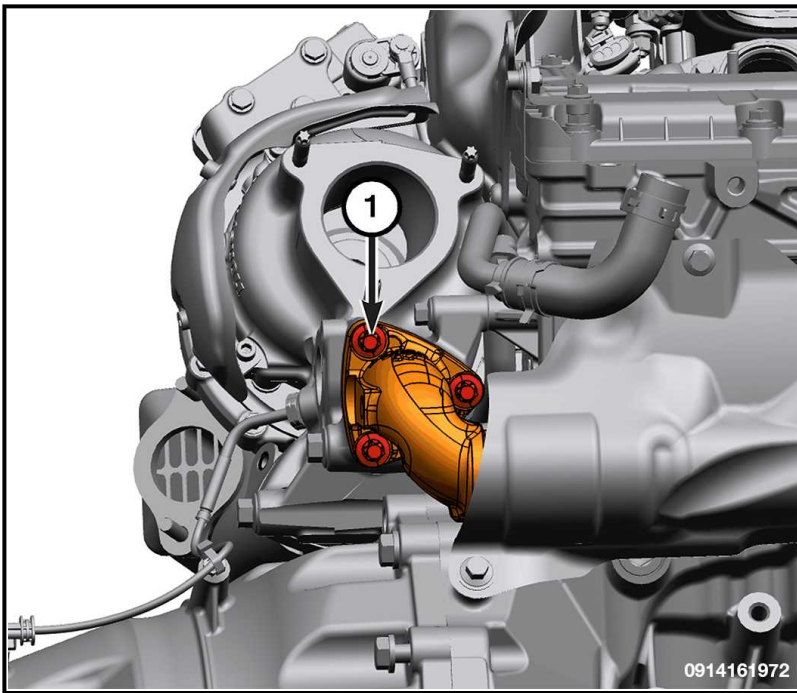
- | |
|--------------------------|
| 1 - Oil Supply Tube Bolt |
| 2 - Oil Supply Tube |
| 3 - Oil Supply Tube Bolt |

18. Remove the oil supply tube bolts and the oil supply tube.



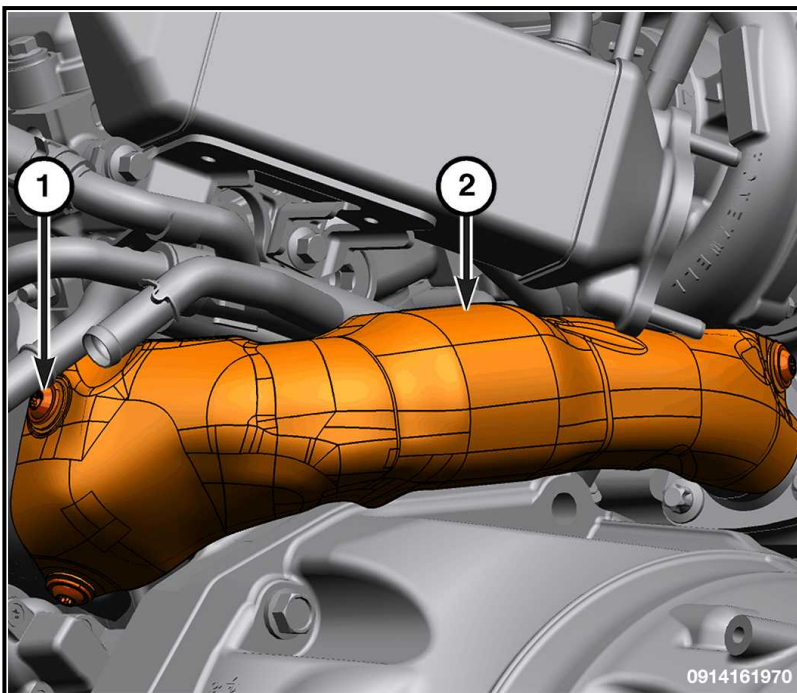
- | |
|-----------------------------------|
| 1 - Turbocharger Heat Shield Bolt |
|-----------------------------------|

19. Remove the turbocharger heat shield bolt.



1 - Right Exhaust Manifold To The Turbocharger Bolts
--

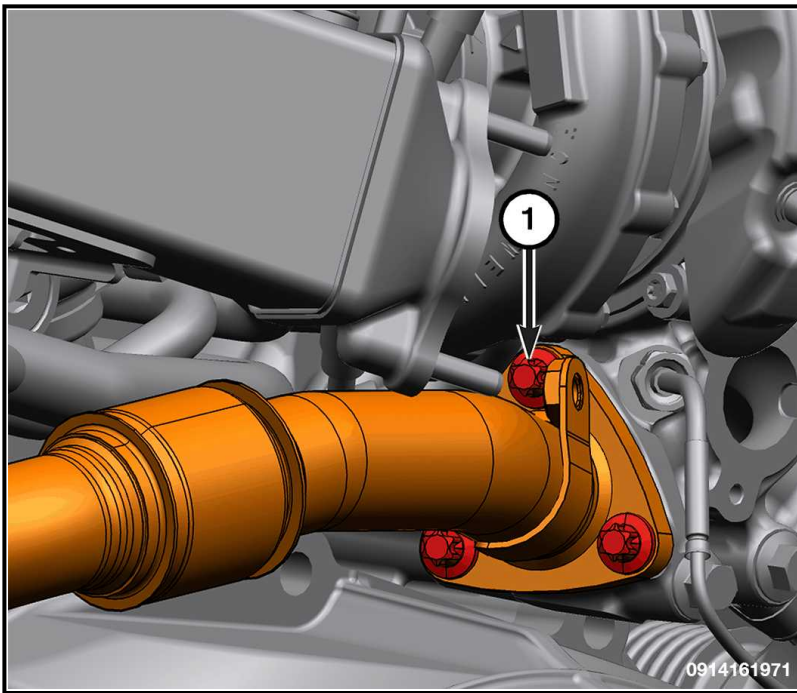
20. Remove the right exhaust manifold to the turbocharger bolts.



1 - Heat Shield Bolts

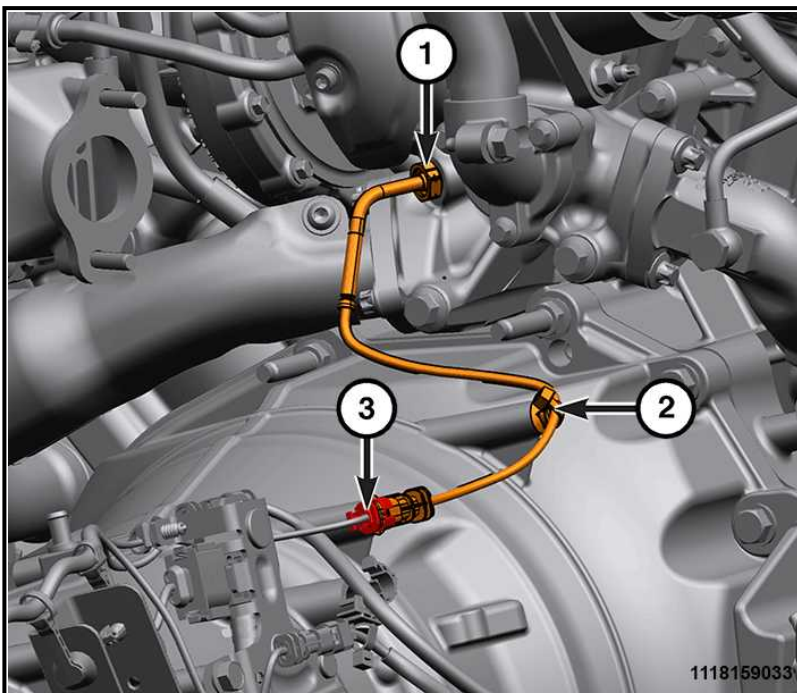
2 - Heat Shield

21. Remove the heat shield bolts and the heat shield.



1 - Left Exhaust Manifold To The Turbocharger Bolts

22. Remove the left exhaust manifold to the turbocharger bolts.

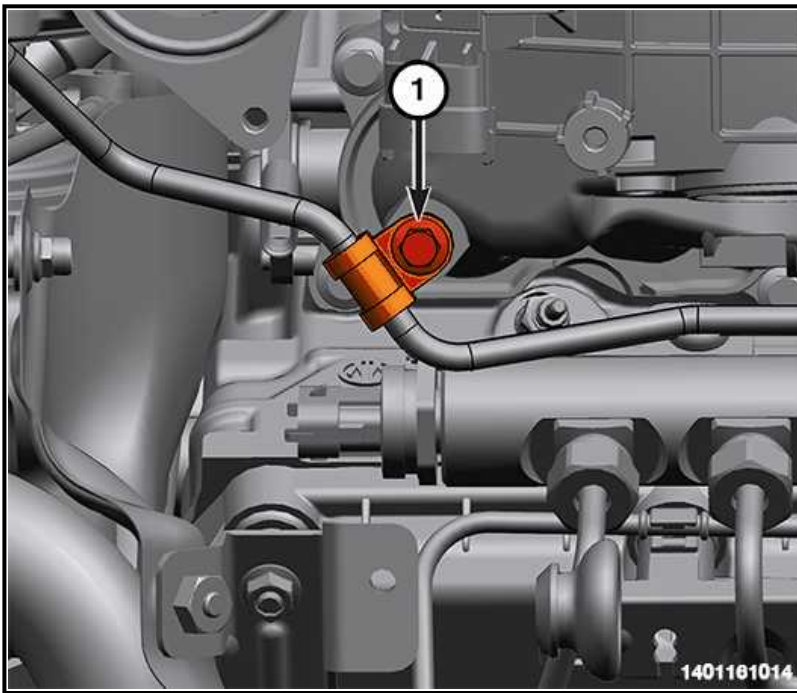


1 - Exhaust Gas Temperature Sensor 1/1

2 - Wire Harness Retainer

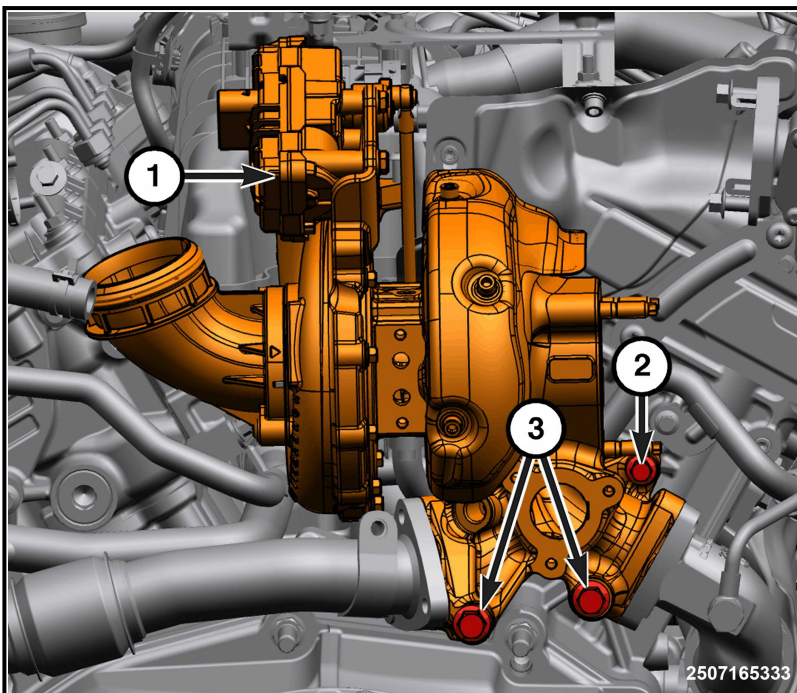
3 - Exhaust Gas Temperature Sensor 1/1 Wire Harness Connector

23. Disconnect the Exhaust Gas Temperature (EGT) sensor 1/1 wire harness connector and detach the wire harness retainer.



1 - Fuel Rail Crossover Tube Bolt

24. Remove the fuel rail crossover tube bolt.

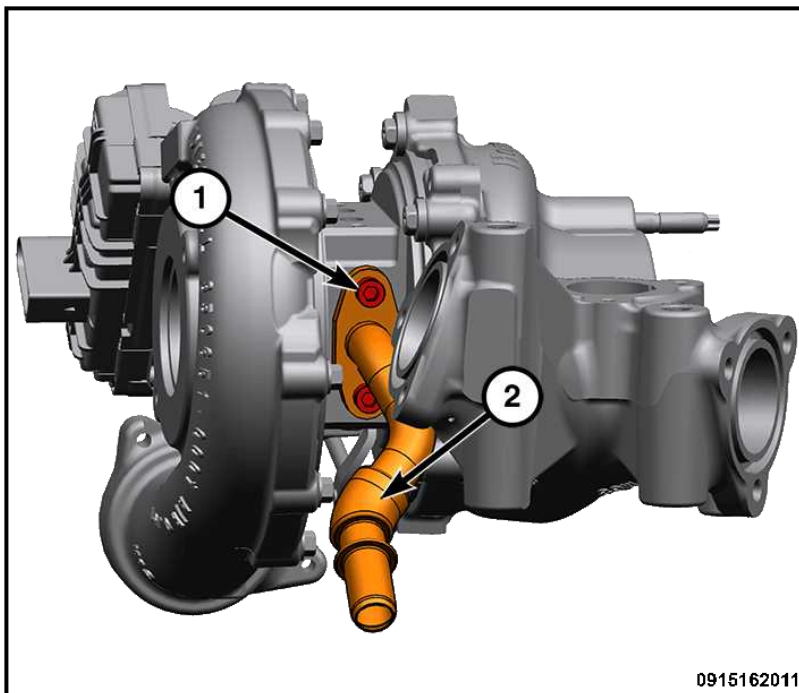


1 - Turbocharger

2 - Turbocharger Bolts (M8)

3 - Turbocharger Bolts (M10)

25. Remove the turbocharger bolts and the turbocharger.



1 - Turbocharger Oil Return Line Bolts
--

2 - Turbocharger Oil Return Line

26. If necessary, remove the turbocharger oil return line bolts and the turbocharger oil return line.

27. If necessary, remove and discard the gasket.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

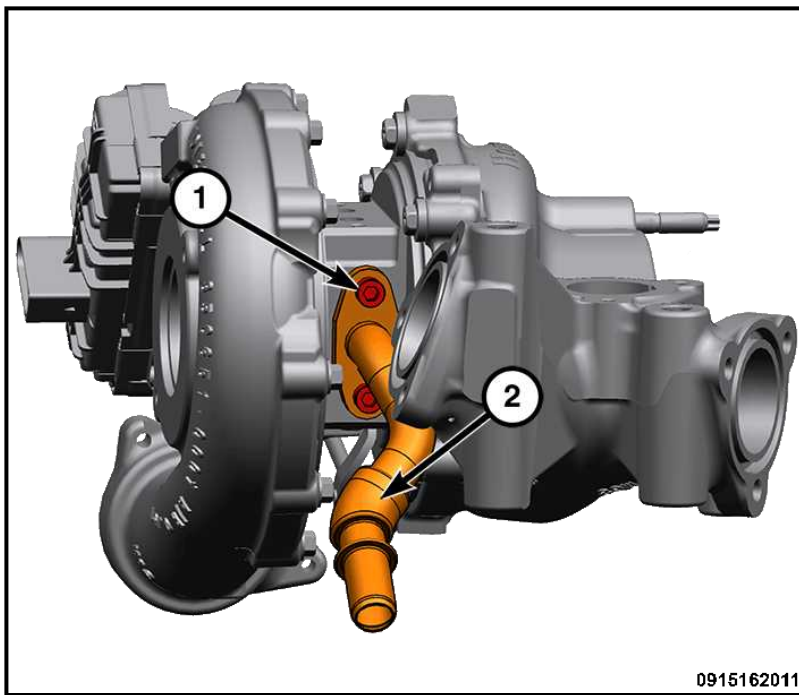
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the gasket sealing surfaces.

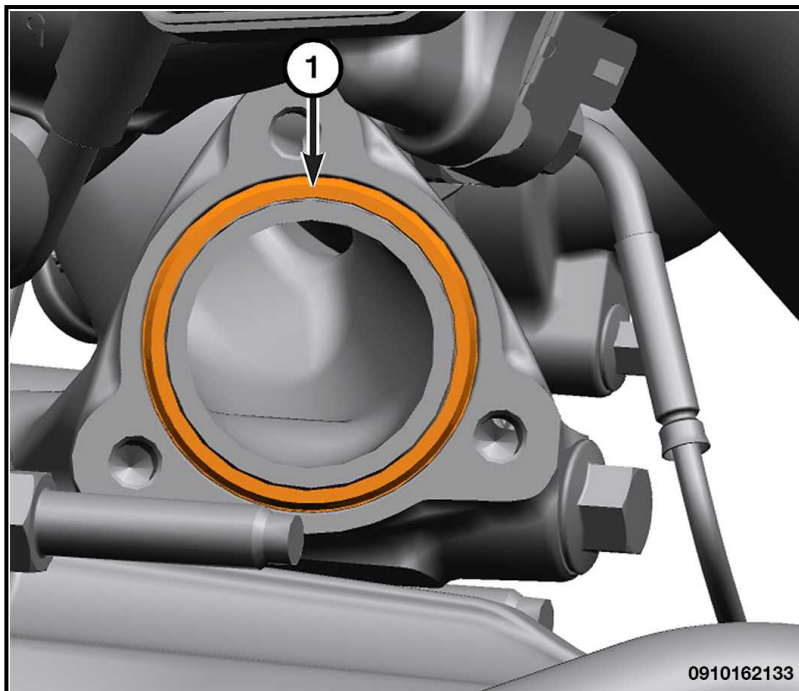


1 - Oil Return Grommet

- Inspect the oil return grommet and replace as necessary.

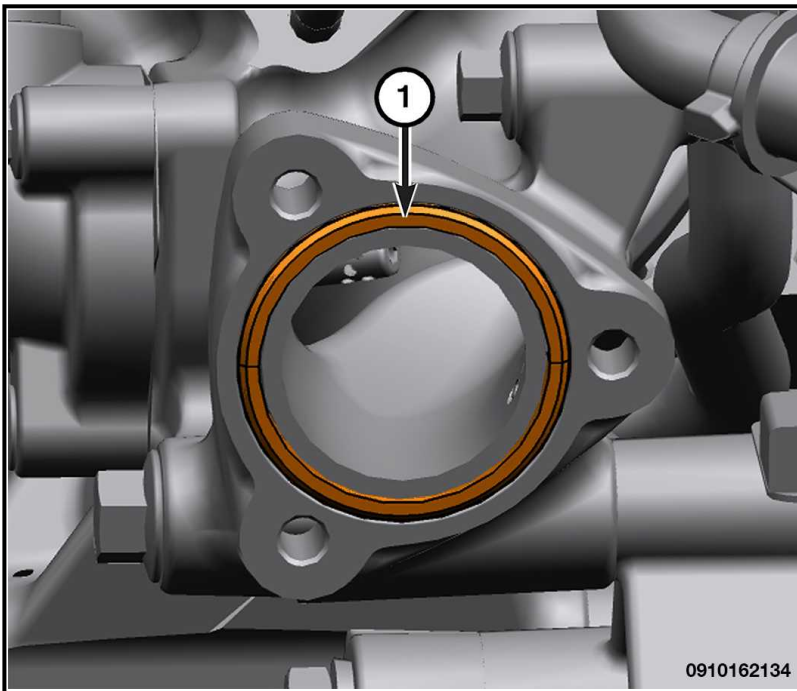


- If removed, using a **NEW** gasket, install the turbocharger oil return line and tighten the bolts to the proper torque specifications.



1 - Gasket

- Install a **NEW** gasket to the left side of turbocharger.



1 - Gasket

- Install a **NEW** gasket to the right side of turbocharger.
- Use care while positioning the turbocharger to the engine block while guiding the oil return tube into the grommet.
- Install the fuel cross over tube bolt and securely tighten.
- Install the right side exhaust manifold manifold-to-turbocharger bolts. Using the tightening sequence shown, tighten the right side exhaust manifold manifold-to-turbocharger bolts to the proper torque specifications.



1 - O-ring

- Install a **NEW** O-ring to the turbocharger oil supply line.

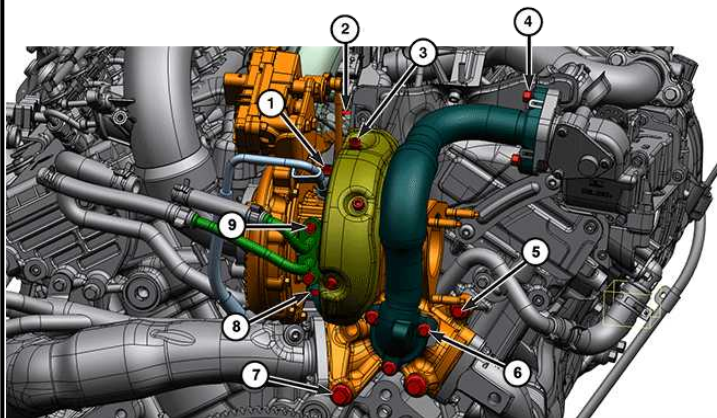


1 - Sealing Washers

- Install **NEW** sealing washers and the upper banjo bolt to the turbocharger oil supply line.
- Install the right fuel rail cover, attach the wire harness retainer and securely tighten the nut.
- Install the left fuel rail cover and securely tighten the bolts.

TORQUE SPECIFICATIONS

TURBOCHARGER



0915193195

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	Turbocharger Oil Supply Line at Turbocharger Banjo Bolt	25 N.m (18 Ft. Lbs.)	-
2	Turbocharger Inlet Elbow Bolts	10 N.m (89 In. Lbs.)	-
3	Turbocharger Heat Shield Bolt	11 N.m (8 Ft. Lbs.)	-
4	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
5	Turbocharger to Cylinder Head Bolt	25 N.m (18 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
6	Turbocharger Exhaust Tube-to-EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
7	Turbocharger to Engine Block Bolt	55 N.m (41 Ft. Lbs.)	-
8	Diesel Particulate Filter (DPF) Elbow to Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
9	Turbocharger Oil Return Line Bolts	13 N.m (10 Ft. Lbs.)	-
-	Charge Air Cooler Bolts	20 N.m (15 Ft. Lbs.)	-
-	Charge Air Cooler Hose Support Bracket Bolt	11 N.m (8 Ft. Lbs.)	-
-	Charge Air Cooler Hose Clamp	6 N.m (53 In. Lbs.)	-
-	Charge Air Cooler Hose Clamp at Resonator	5 N.m (44 In. Lbs.)	-
-	Turbocharger Coolant Tube Banjo Bolt	35 N.m (26 Ft. Lbs.)	-
-	Turbocharger Oil Supply Line Bolt	35 N.m (26 Ft. Lbs.)	-

EXHAUST - 3.0L DIESEL

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	Tightening Sequence
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	-
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	

DESCRIPTION	SPECIFICATION	COMMENT
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

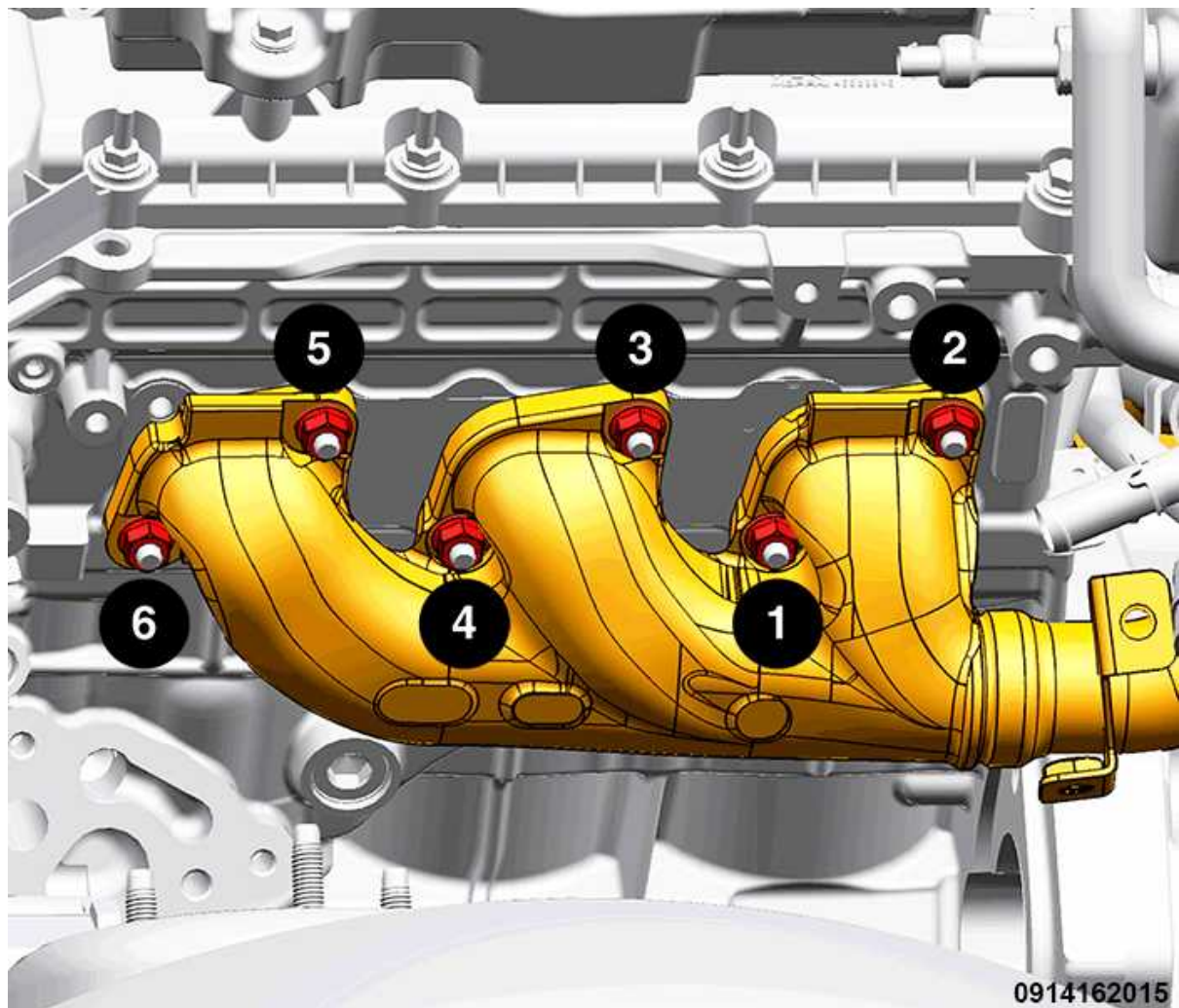


Fig. 1: Exhaust Manifold Tightening Sequence LH
 Courtesy of CHRYSLER GROUP, LLC

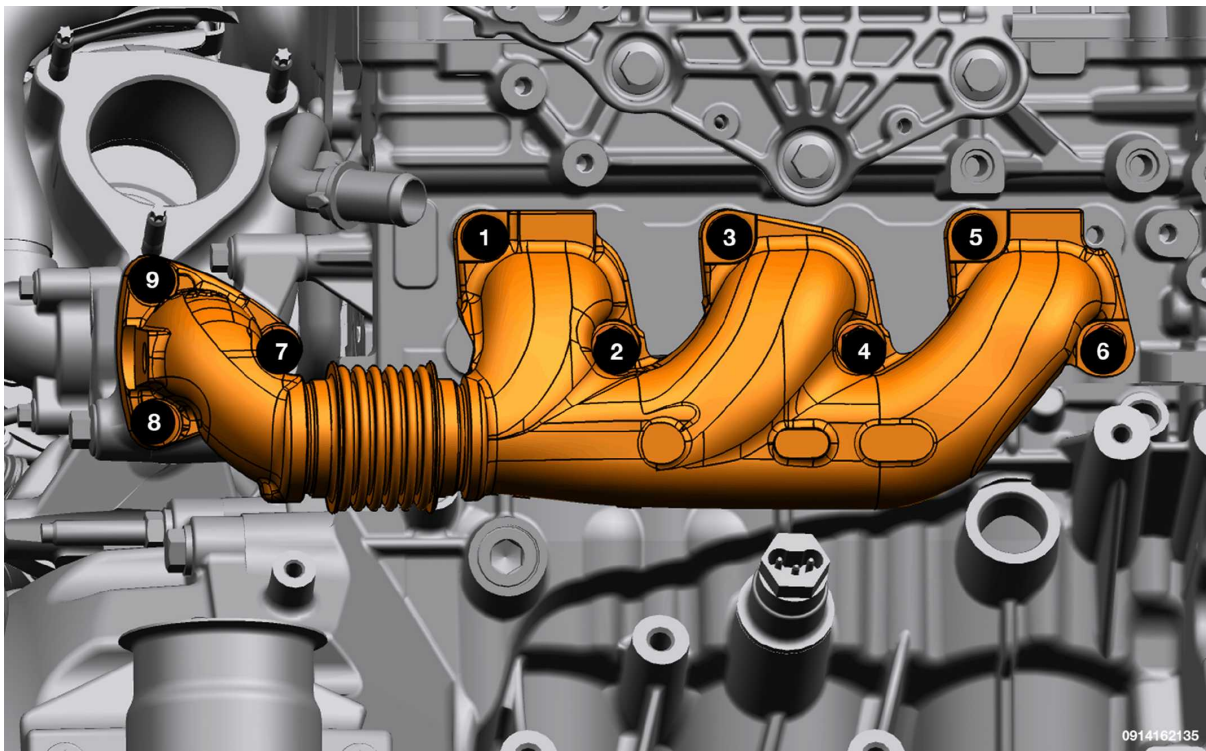


Fig. 2: Exhaust Manifold Tightening Sequence RH
 Courtesy of CHRYSLER GROUP, LLC

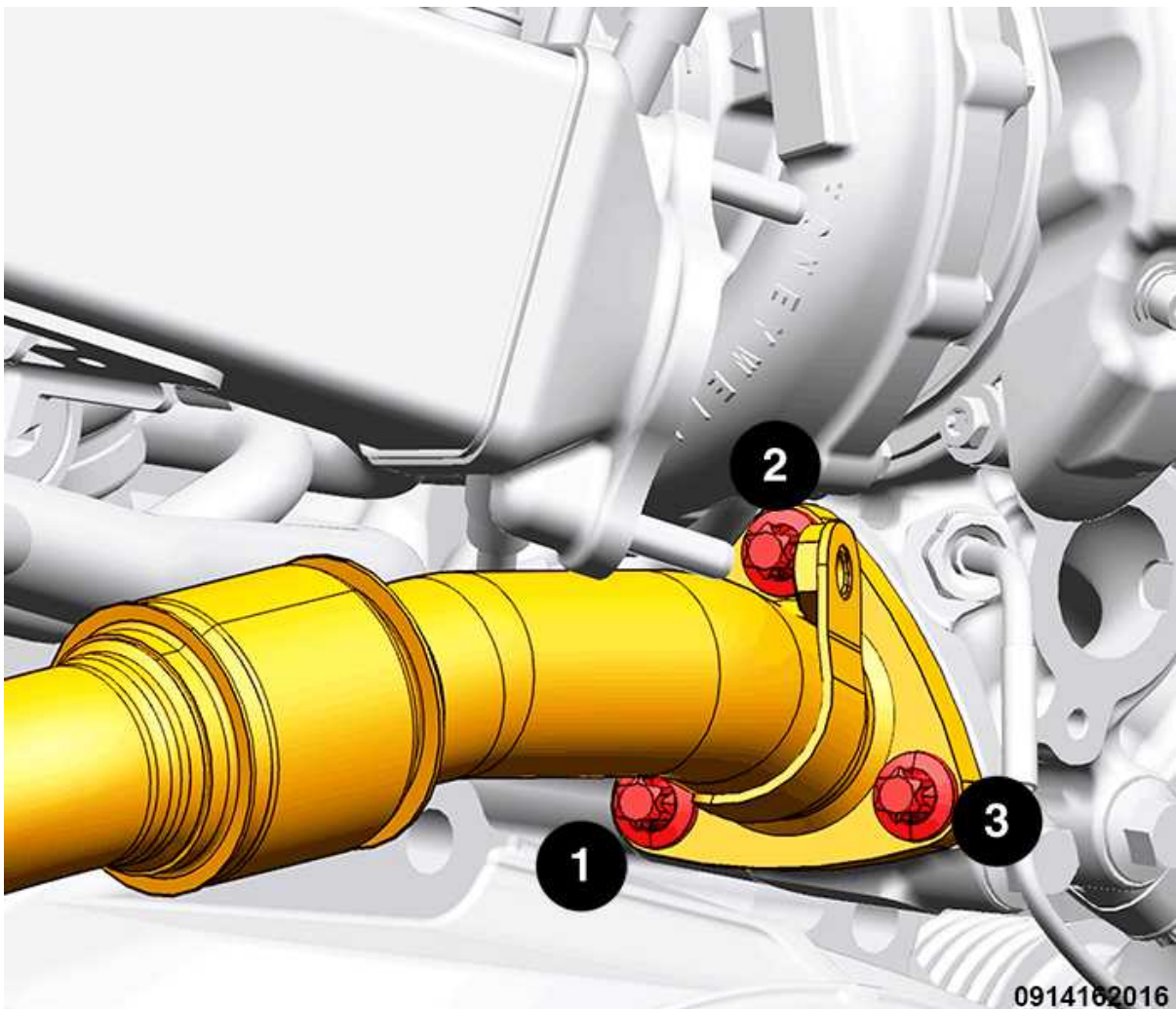


Fig. 3: Exhaust Manifold Flange Tightening Sequence LH
 Courtesy of CHRYSLER GROUP, LLC

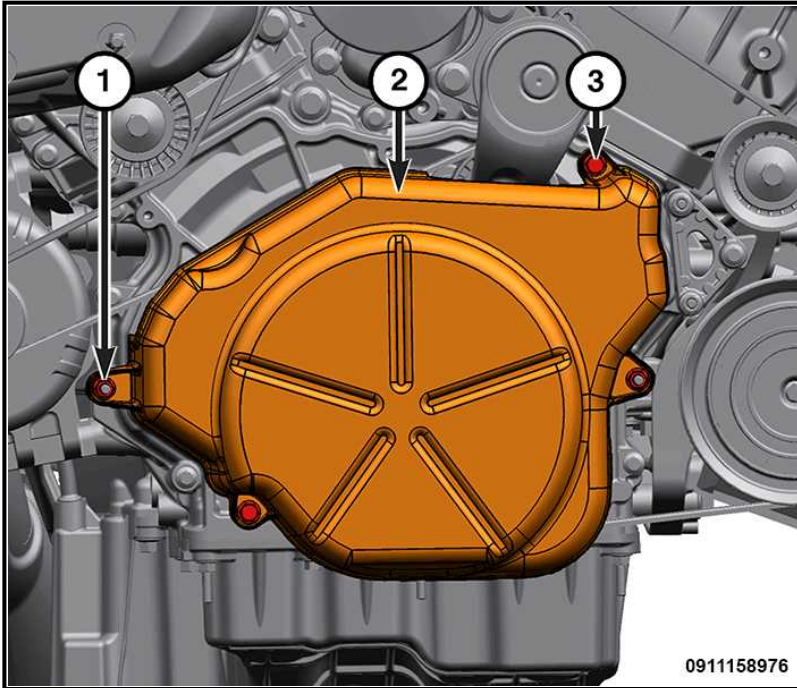
VALVE TIMING

STANDARD PROCEDURE

ENGINE TIMING VERIFICATION

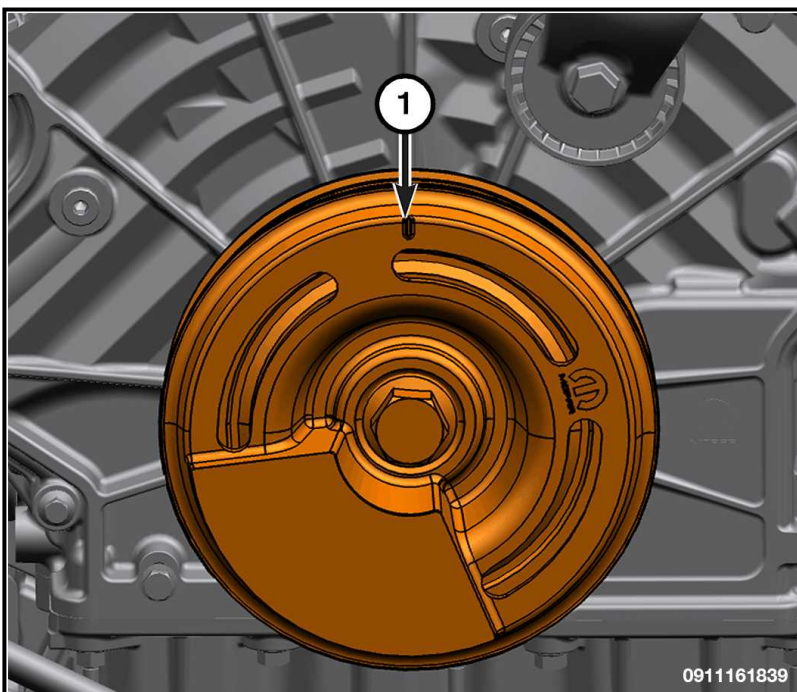
CRANKSHAFT ALIGNMENT - 60 DEGREES AFTER TDC

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .



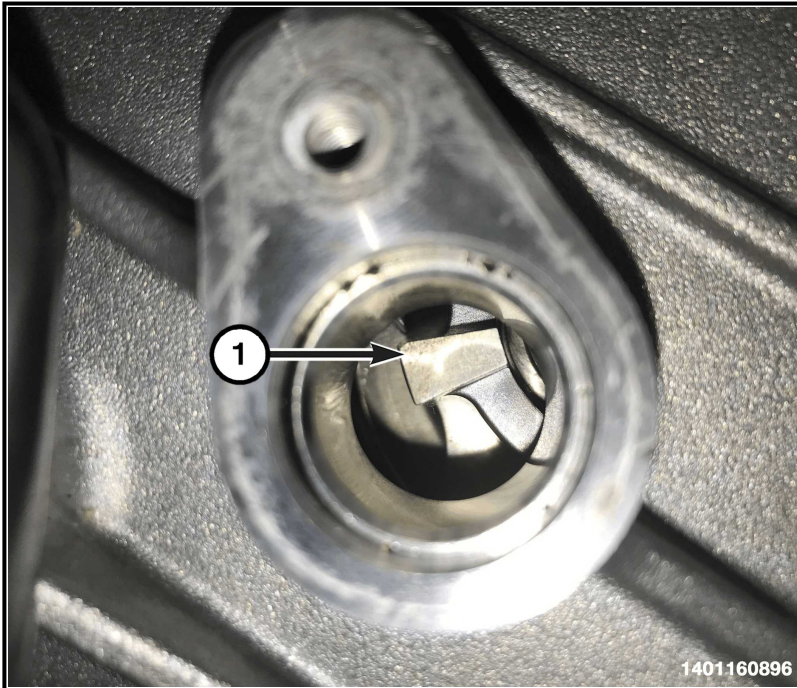
1 - Vibration Dampener Cover Nuts
2 - Vibration Dampener Cover
3 - Vibration Dampener Cover Bolts

2. Remove the vibration dampener cover nuts, vibration dampener cover bolts and the vibration dampener cover.



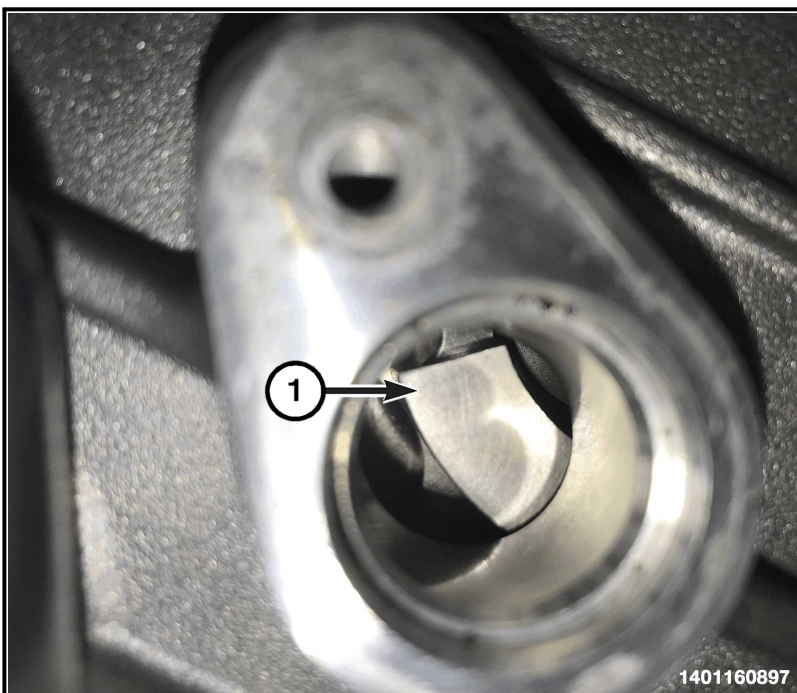
1 - Timing Mark

3. Rotate the engine until timing mark on the crankshaft is at the 12 O'clock position, (this is 60° ATDC).
4. Remove the Camshaft Position (CMP) sensor. Refer to [ENGINE SENSORS, REMOVAL AND INSTALLATION](#).



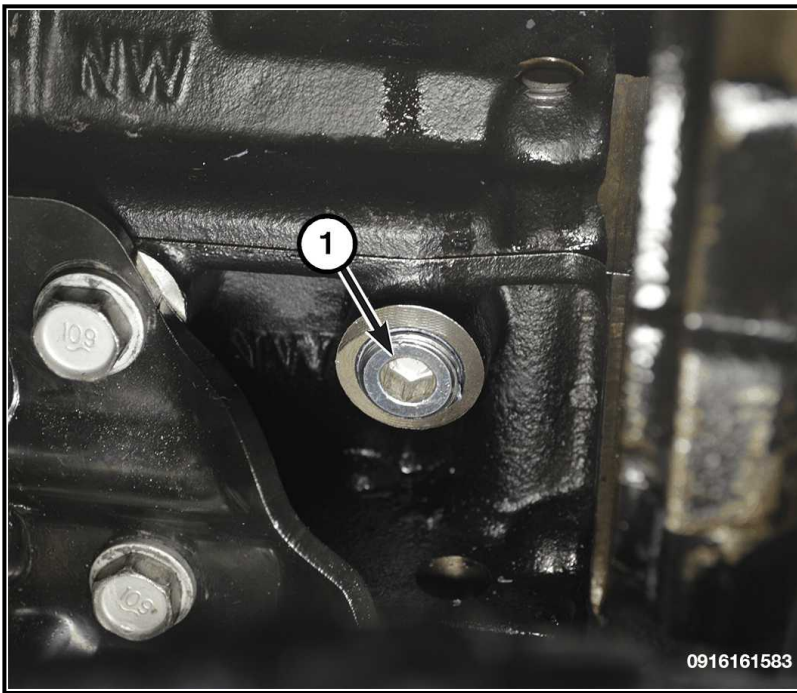
1 - Reluctor Wheel

5. Observe the location of the reluctor wheel. If the view matches the image the engine is correctly timed, proceed to step 7. If the view is different than the view in the image, go to the next step.



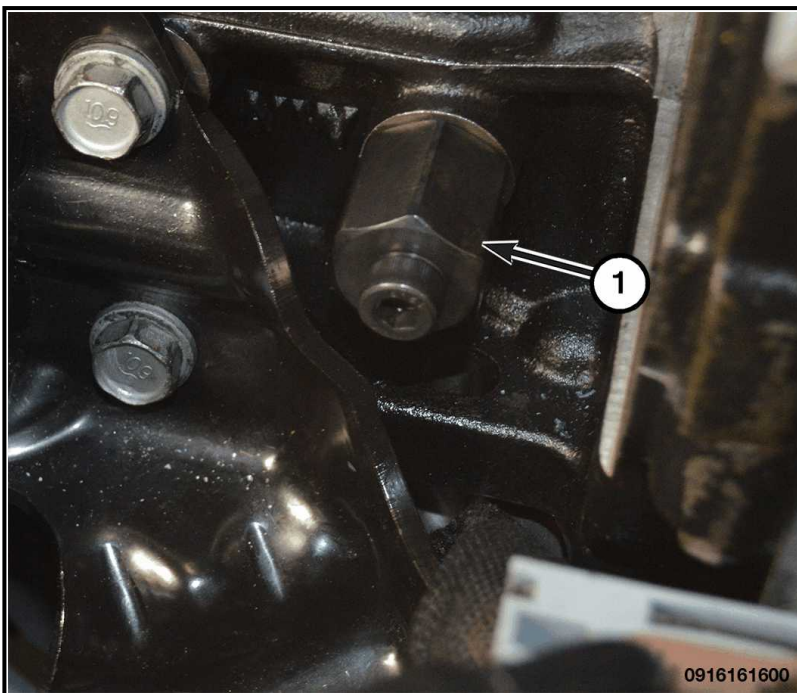
1 - Reluctor Wheel

6. If you see this view of the reluctor wheel the engine is 180° off time.
7. Install the Camshaft Position (CMP) sensor. Refer to [ENGINE SENSORS, REMOVAL AND INSTALLATION](#).



1 - Engine Block Plug

8. Remove the engine block plug.



1 - Crankshaft Timing Tool

9. Install the (special tool #VM.10339, Tool, Crankshaft Timing) into the starter side of the engine block. If the Crankshaft Locking Tool does not fully go into the engine block and stops short, the engine is not properly set to 60° ATDC. Rotate the engine so the Crankshaft Locking Tool fully engages into engine block and crankshaft. Once fully engaged, thread tool into engine block and install the bolt. The crankshaft is now set at 60° ATDC.

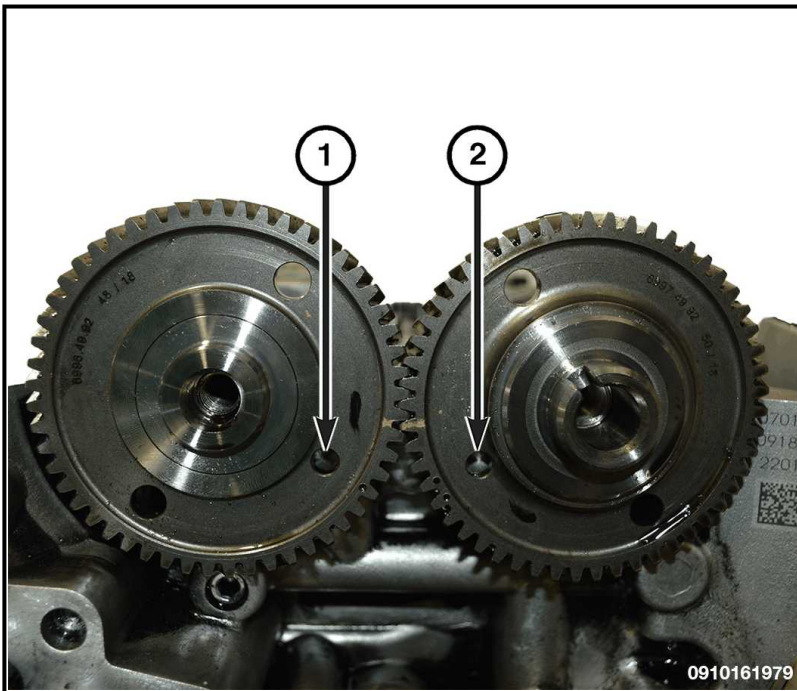
CAMSHAFT ALIGNMENT

The following tool are required for timing alignment of the camshafts.

- Left Camshaft - (special tool #VM.10338A-2, Timing Tool, Camshaft (Left))
- Right Camshaft - (special tool #VM.10338A-1, Timing Tool, Camshaft (Right))

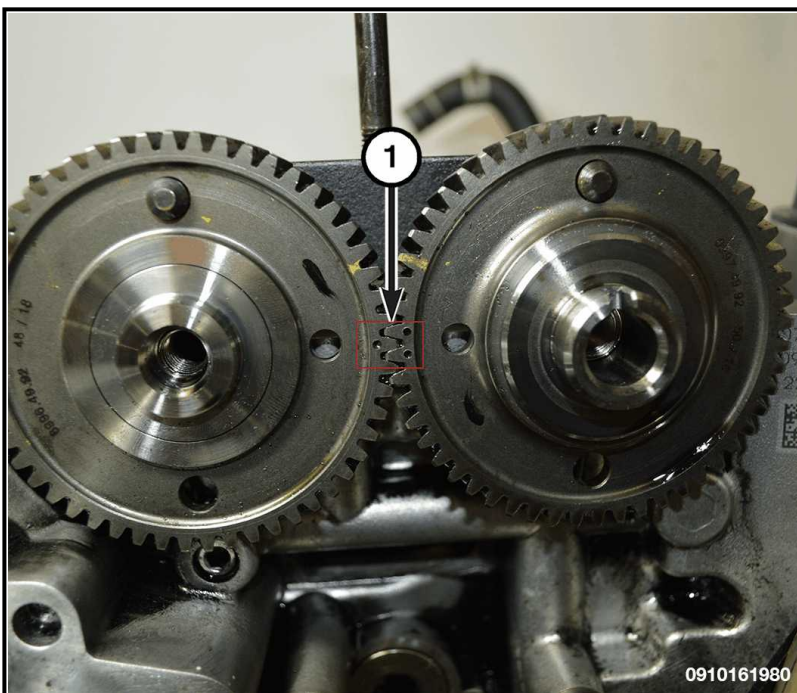
NOTE: This procedure is being shown on the left side cylinder head. The right side is similar.

1. The crankshaft should be locked at 60° ATDC prior to timing camshafts.



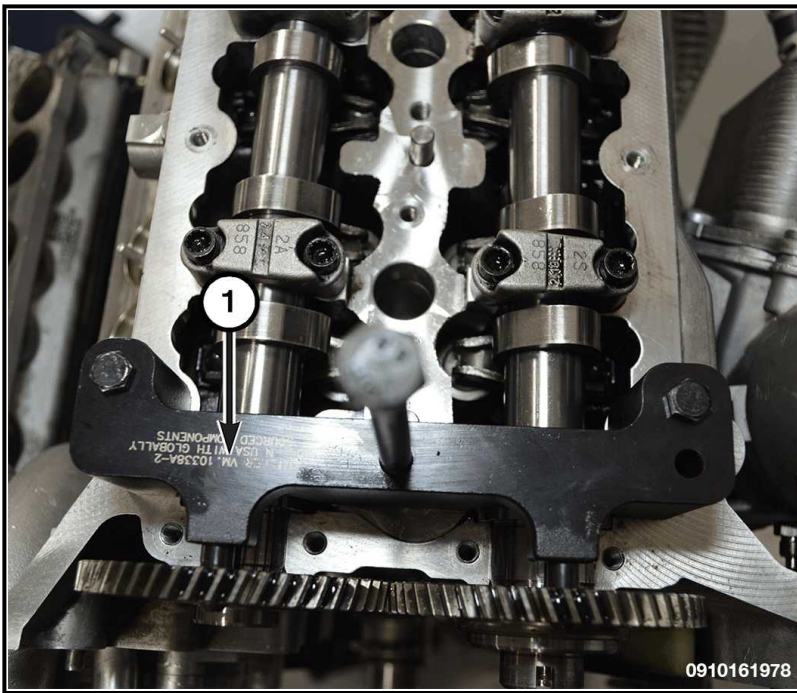
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|---------------------------------------|
| 1 - Intake Camshaft Gear Timing Mark |
| 2 - Exhaust Camshaft Timing Gear Mark |

2. The intake camshaft gear timing mark should be at the four O'clock position and the exhaust camshaft timing gear mark should be at the eight O'clock position.



- | |
|------------------------|
| 1 - Camshaft Gear Dots |
|------------------------|

3. Rotate the camshafts to line up the three camshaft gear dots and install the left camshaft alignment tool.



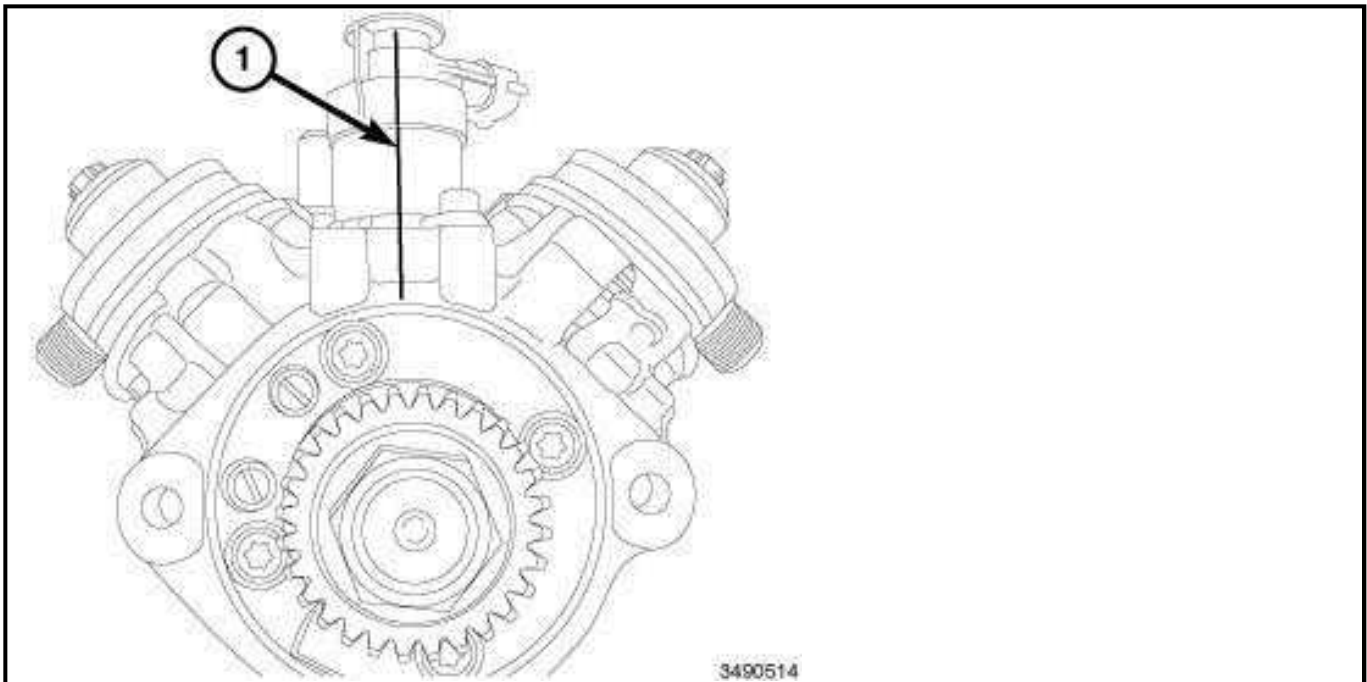
1 - Left Camshaft Alignment Tool

4. If the left camshaft alignment tool locking pins don't align up and fit into the holes on the camshaft gears then the camshafts are not timed properly.

FUEL INJECTION PUMP TIMING

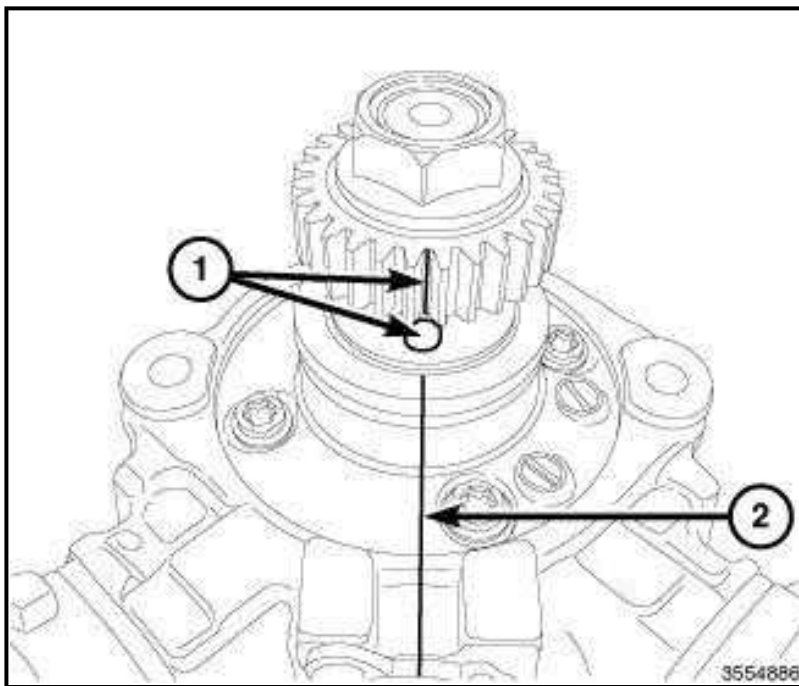
With the engine at base timing align the fuel injection pump as described below.

NOTE: If only the fuel injection pump is being replaced. Refer to [ASSEMBLY, FUEL PUMP, REMOVAL AND INSTALLATION](#).



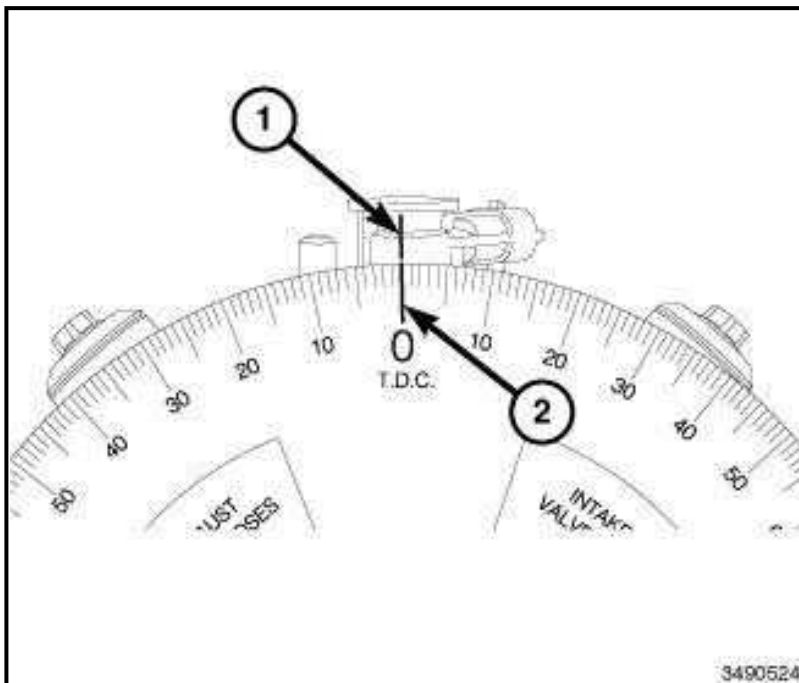
1 - Fuel Quantity Solenoid

1. Mark the center line on the fuel quantity solenoid with a paint pen as making a reference to zero 0°.



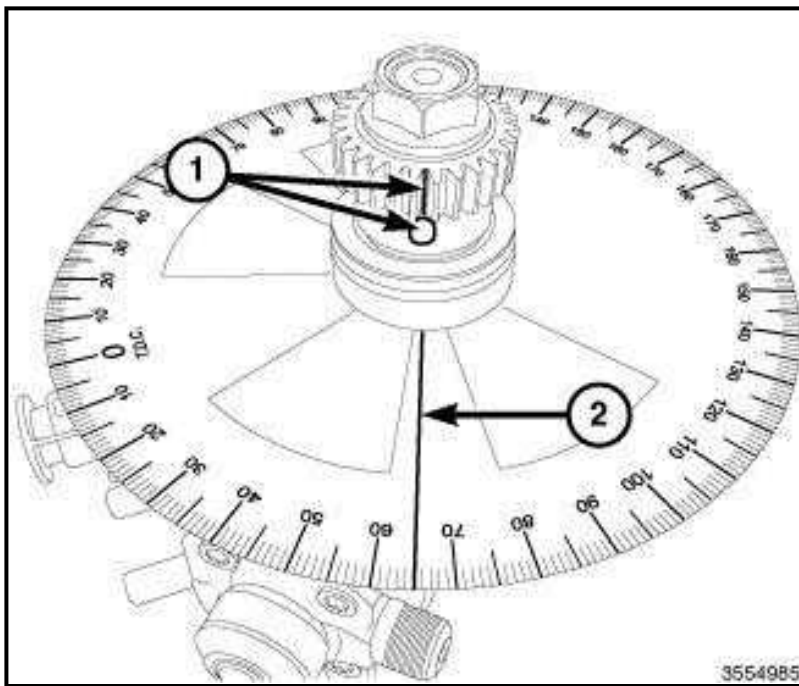
1 - Gear and Hole
2 - Reference Mark

2. Using a paint pen, mark the gear and hole as a reference mark.



1 - Fuel Quantity Solenoid
2 - Zero

3. Align the commercially available degree wheel to zero with the center line on fuel quantity solenoid.



1 - Index Mark

2 - Degree Wheel

4. Rotate the pump gear **counter clockwise** so the index mark on drive gear aligns at the 65° mark on the degree wheel.

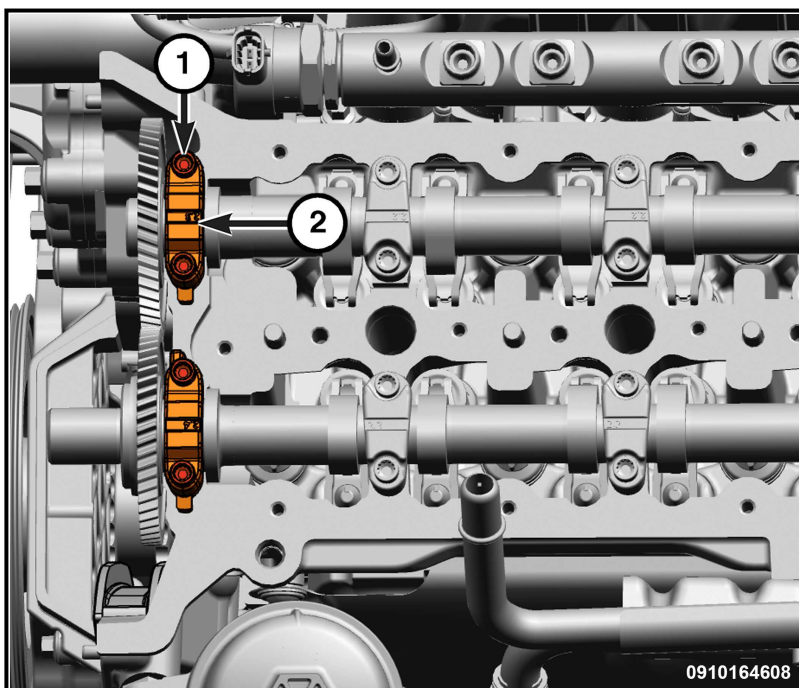
CHAIN AND SPROCKETS, TIMING

REMOVAL AND INSTALLATION

LEFT CAMSHAFT SPROCKET

REMOVAL

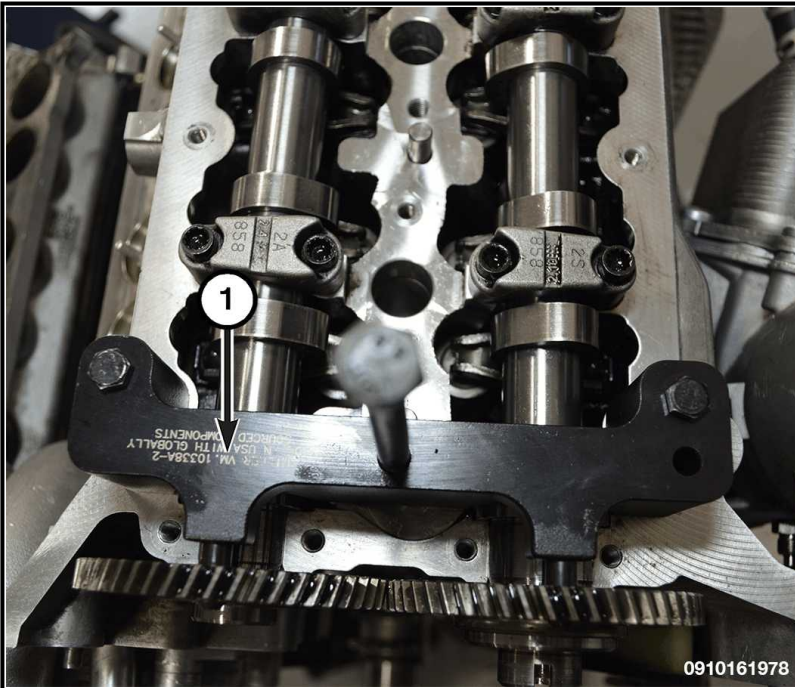
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#).
2. Remove the left upper timing cover. Refer to [COVER\(S\), ENGINE TIMING, REMOVAL AND INSTALLATION](#).
3. Lock the engine to 60 degrees ATDC. Refer to [VALVE TIMING](#).



1 - Left Front Bearing Caps Bolts

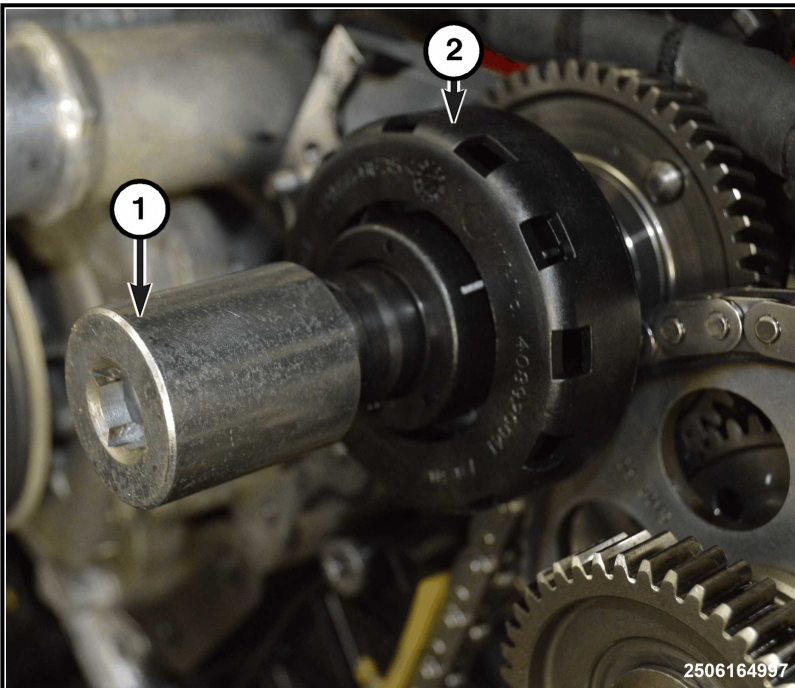
2 - Left Front Bearing Caps

4. Remove the two left front bearing caps bolts and the two left front bearing caps.



1 - Left Camshaft Timing Tool

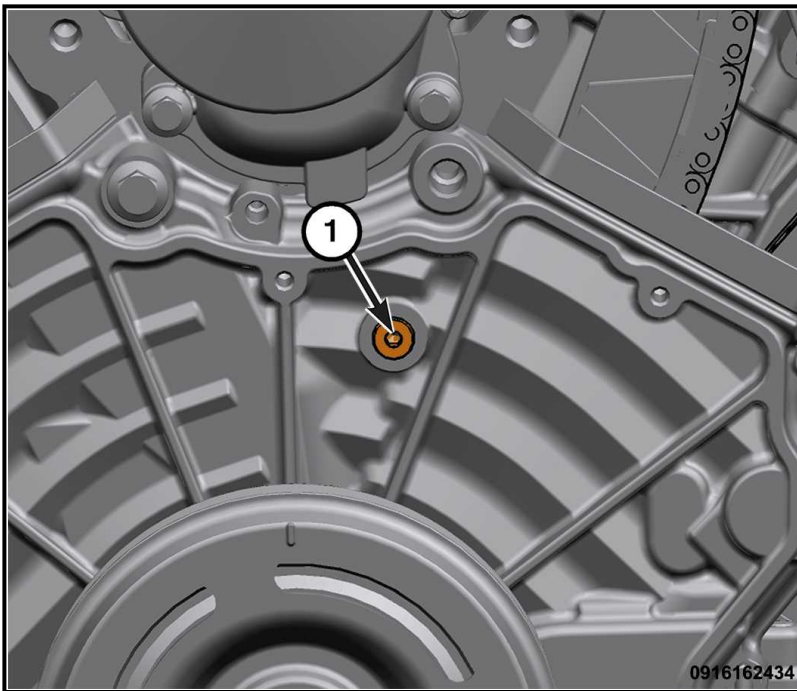
5. Install the (special tool #VM.10338A-2, Timing Tool, Camshaft (Left)) and securely tighten the bolts.



1 - Oil Separator Remover/Installer Tool
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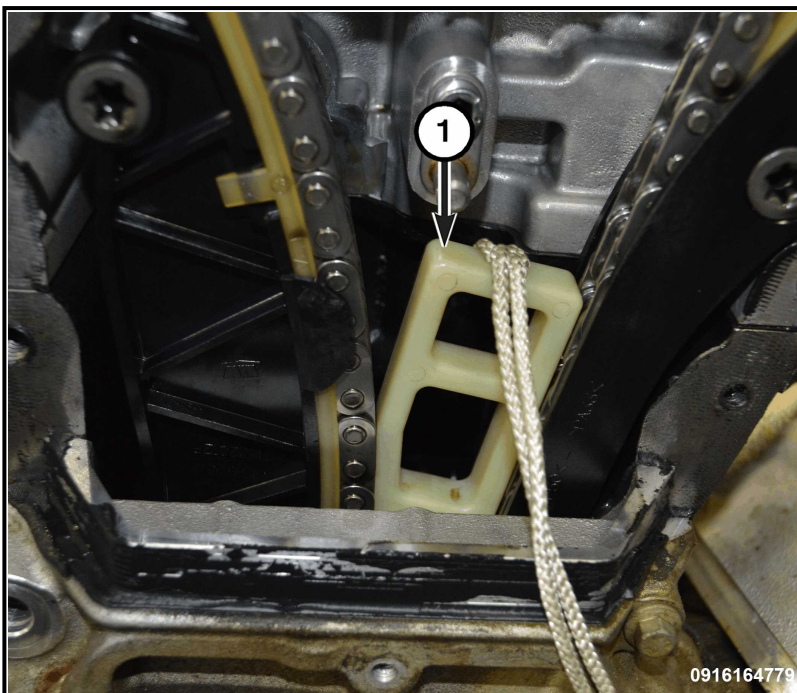
2 - Oil Separator

6. Using the (special tool #VM.10344, Tool, Oil Separator Remover/Installer), remove the oil separator from the left intake camshaft.



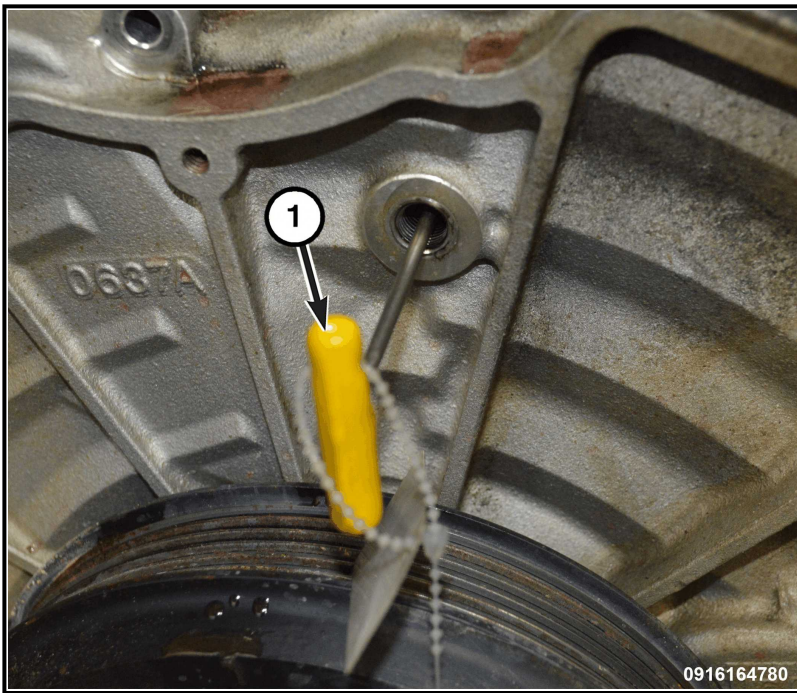
1 - Lower Timing Cover Plug

7. Remove the lower timing cover plug.



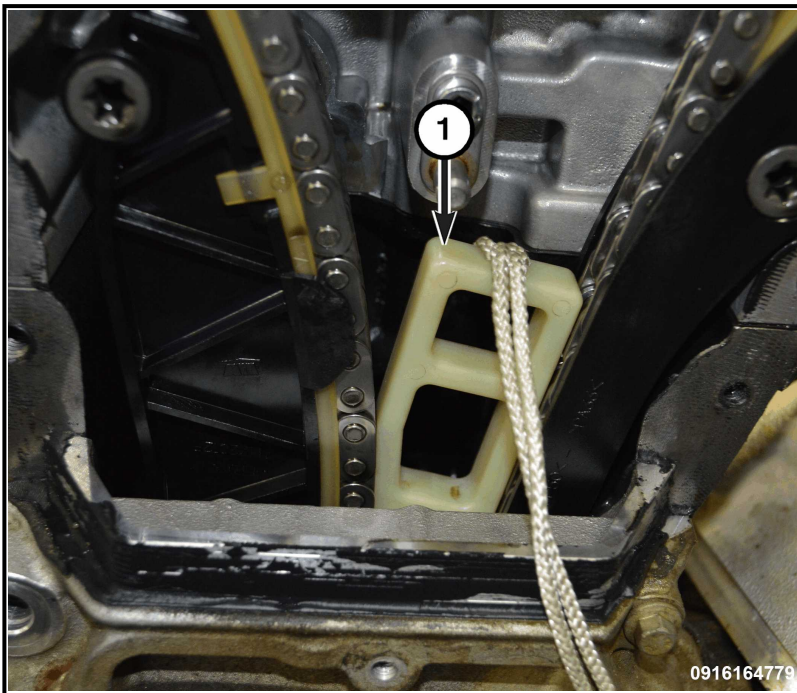
1 - Locking Wedge Tool

8. Install the (special tool #9867, Wedge, Locking) tool as shown.



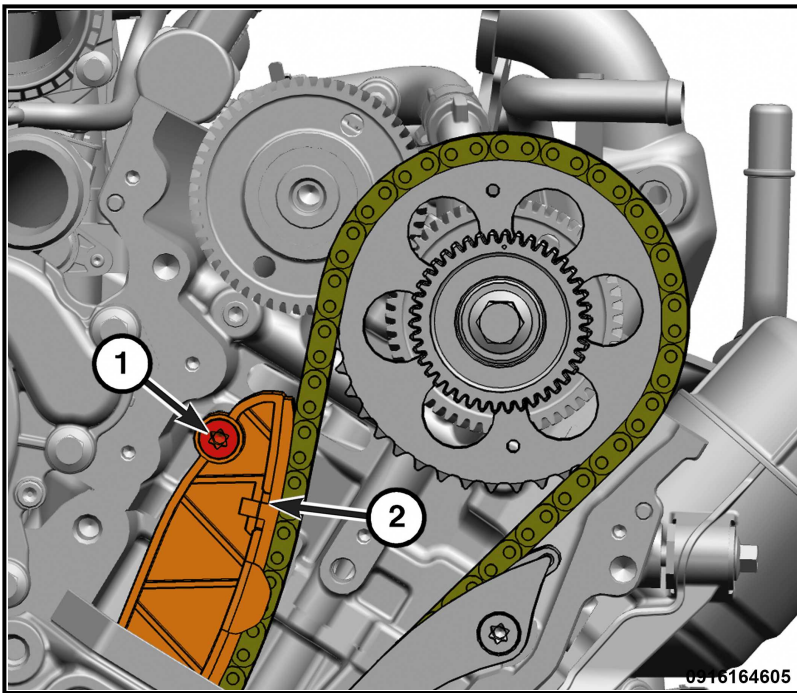
1 - Tensioner Pin Tool

9. Install the (special tool #VM.10359A, Pin, Tensioner) in the timing chain tensioner as shown.



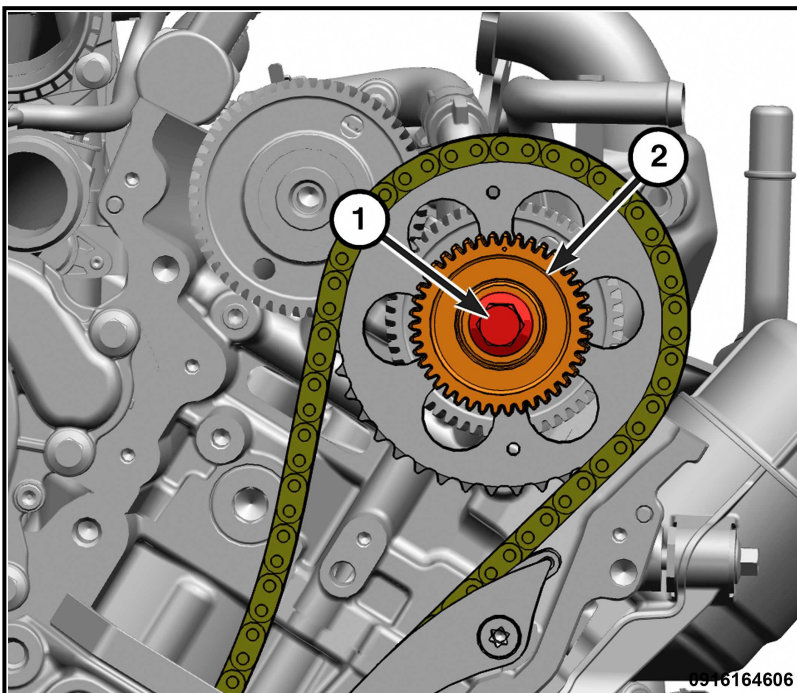
1 - Locking Wedge Tool

10. Remove the (special tool #9867, Wedge, Locking) tool.



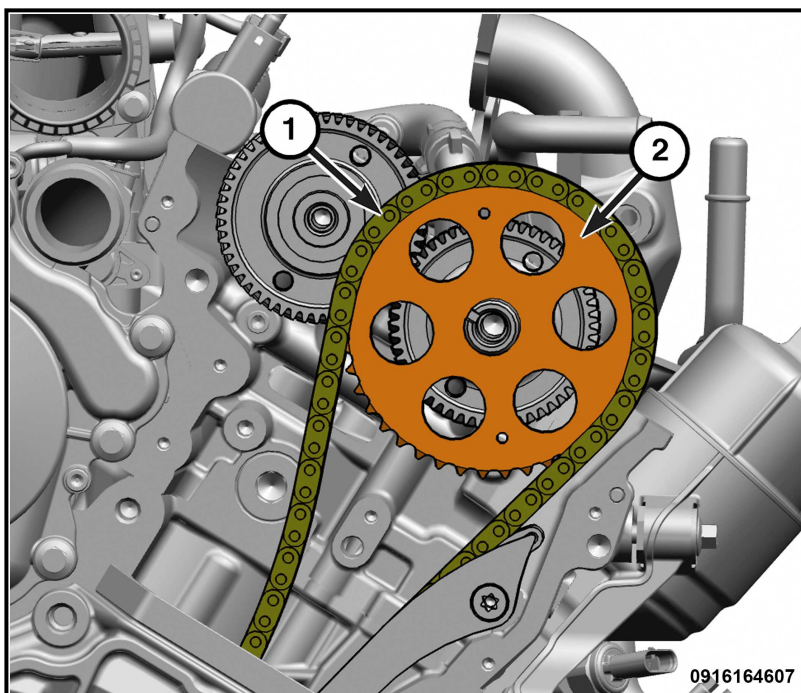
1 - Left Inner Timing Chain Guide Bolt
2 - Left Inner Timing Chain Guide

11. Remove the left inner timing chain guide bolt and the left inner timing chain guide.



1 - Fuel Injection Pump Drive Gear Bolt
2 - Fuel Injection Pump Drive Gear

12. Remove the fuel injection pump drive gear bolt and the fuel injection pump drive gear.



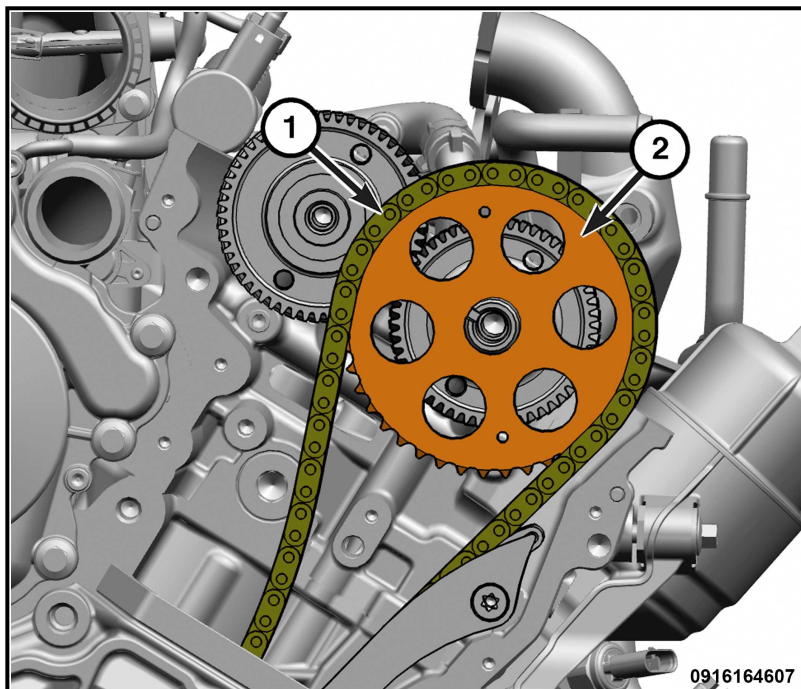
1 - Timing Chain

2 - Left Camshaft Timing Chain Sprocket

13. Slide the left camshaft timing chain sprocket off the camshaft and remove the camshaft sprocket. Using a cable tie, tie off the timing chain to prevent it from falling in the engine.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.



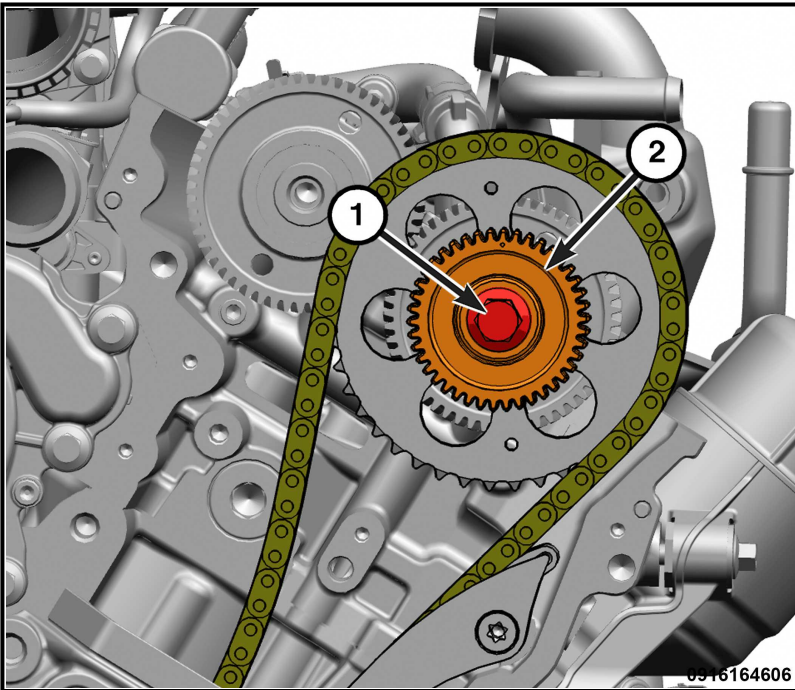
1 - Timing Chain

2 - Left Camshaft Timing Chain Sprocket

NOTE:

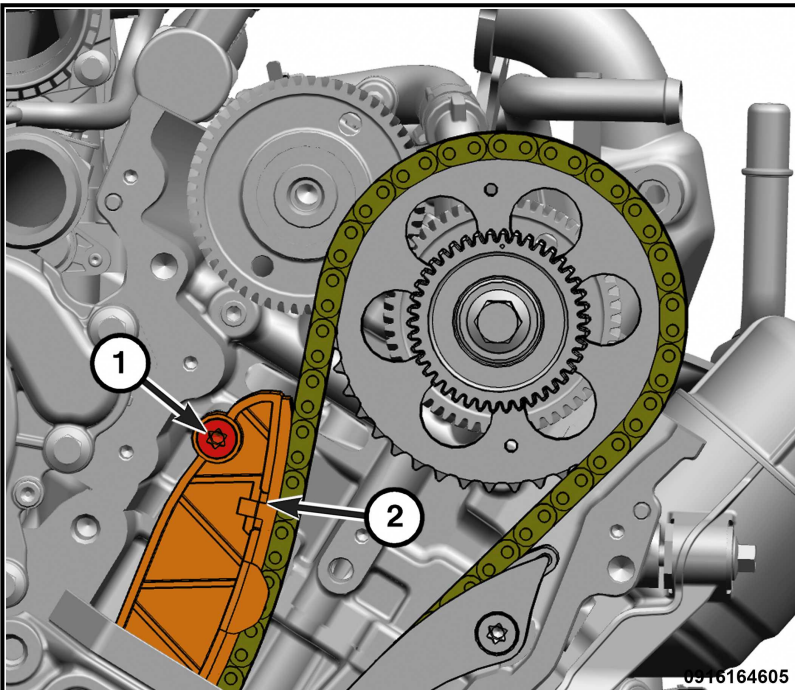
Be Sure the timing chain has not come off the crankshaft sprocket and is wedged between the two sprockets.

1. Cut the cable time and position the timing chain to the camshaft sprocket and install the left timing chain sprocket on the camshaft.
2. **Be sure the timing chain is still engaged on the crankshaft sprocket.**



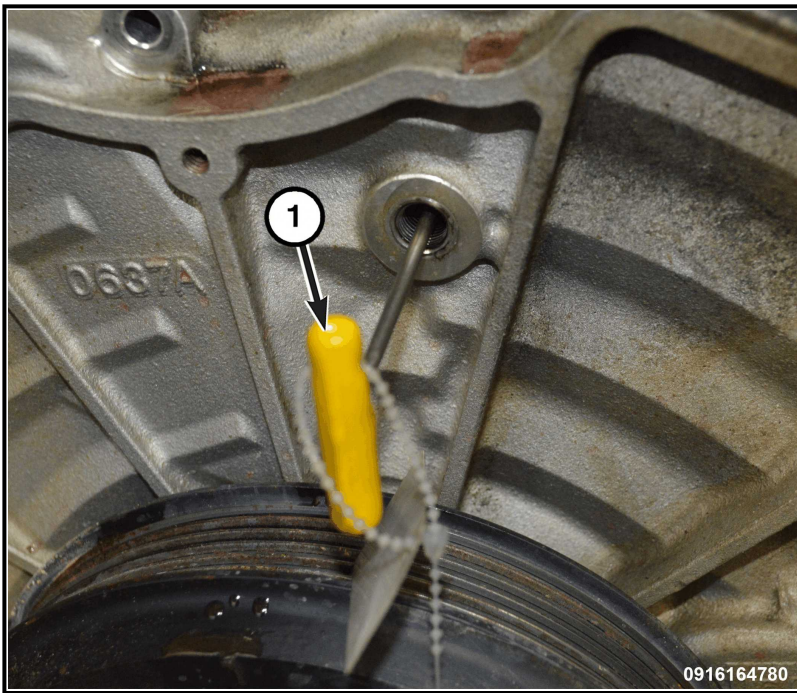
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|---|
| 1 - Fuel Injection Pump Drive Gear Bolt |
| 2 - Fuel Injection Pump Drive Gear |

3. Install the fuel injection pump drive gear and tighten the fuel injection pump drive gear bolt finger tight.



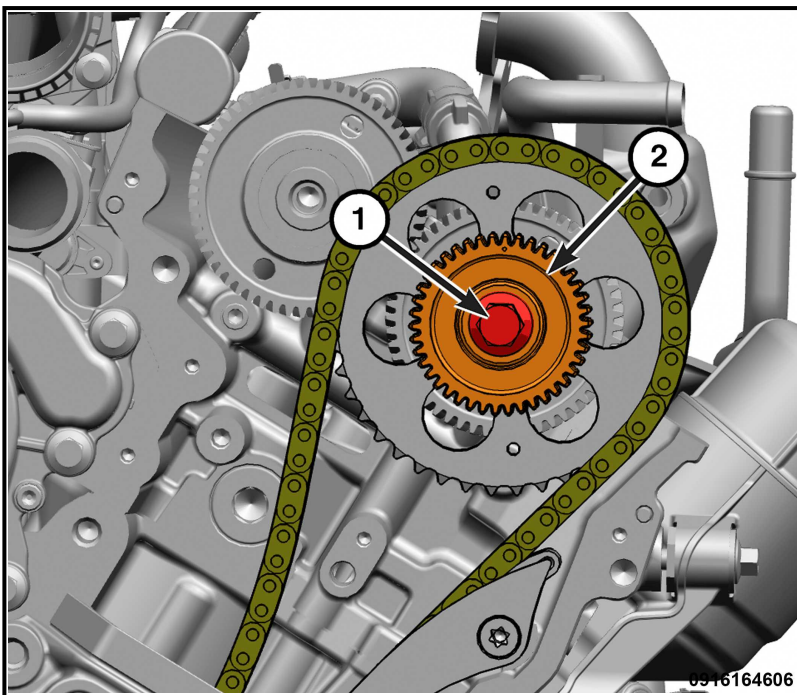
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| 1 - Left Inner Timing Chain Guide Bolt |
| 2 - Left Inner Timing Chain Guide |

4. Install the left inner timing chain guide and tighten the left inner timing chain guide bolt to the proper torque specifications.



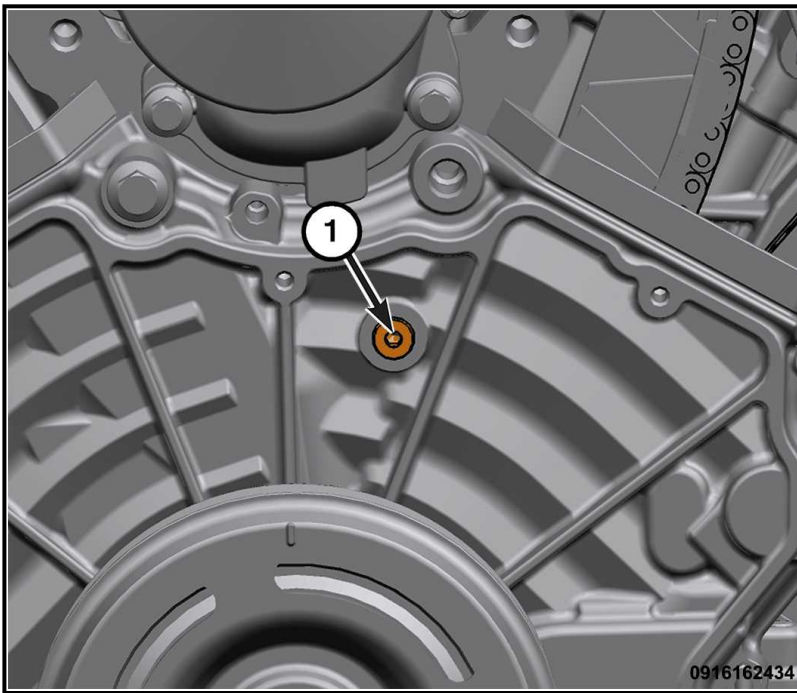
1 - Tensioner Pin Tool

5. Remove the (special tool #VM.10359A, Pin, Tensioner) from the timing chain tensioner.



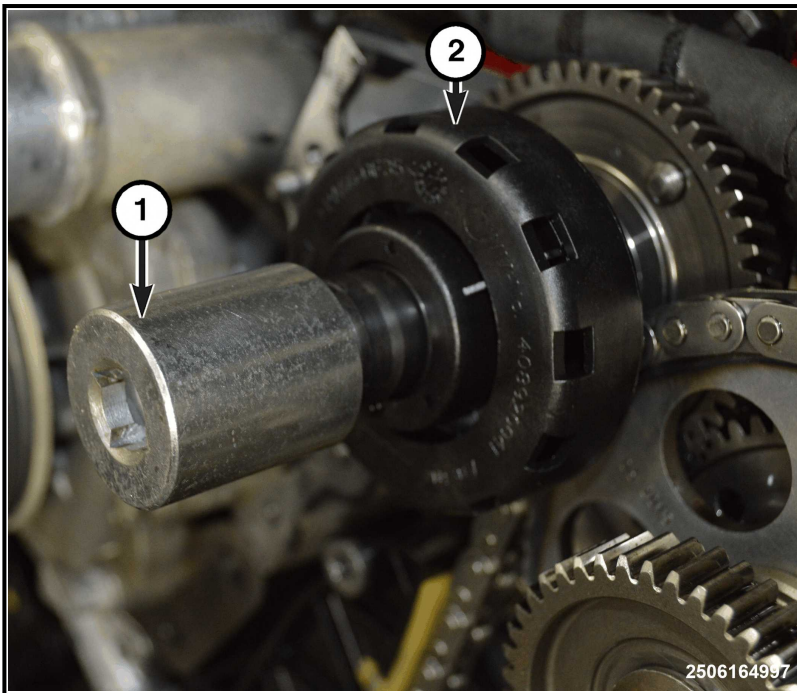
1 - Fuel Injection Pump Drive Gear Bolt

6. Tighten the fuel injection pump drive gear bolt to proper torque specifications.



1 - Lower Timing Cover Plug

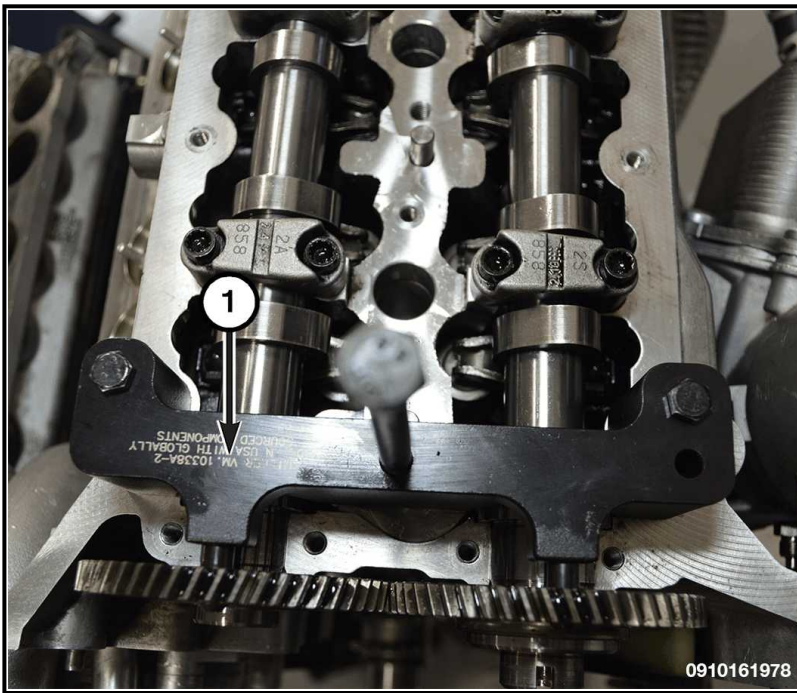
7. Install the lower timing cover plug and securely tighten.



1 - Oil Separator Remover/Installer Tool

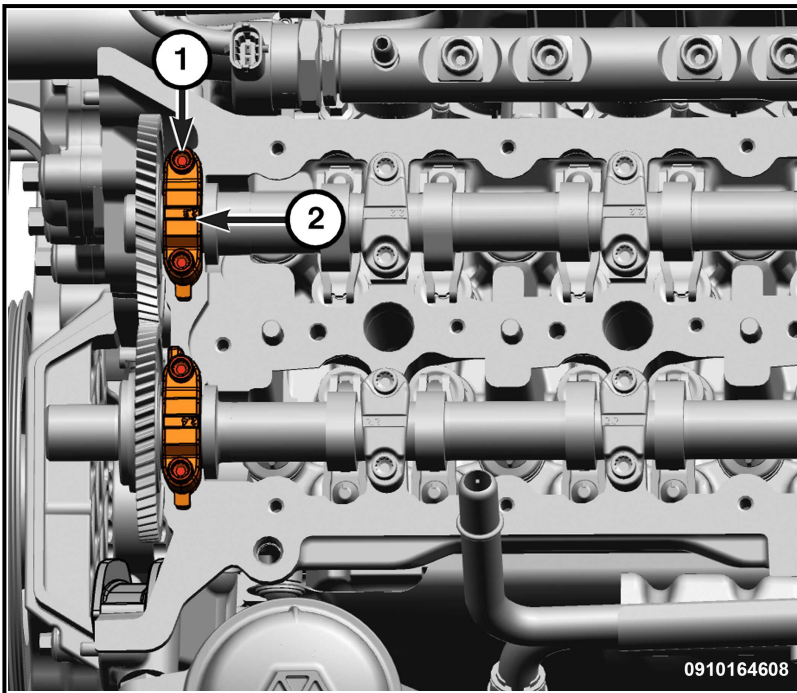
2 - Oil Separator

8. Using the (special tool #VM.10344, Tool, Oil Separator Remover/Installer), install the oil separator and tighten to the proper torque specifications.



1 - Left Camshaft Timing Tool

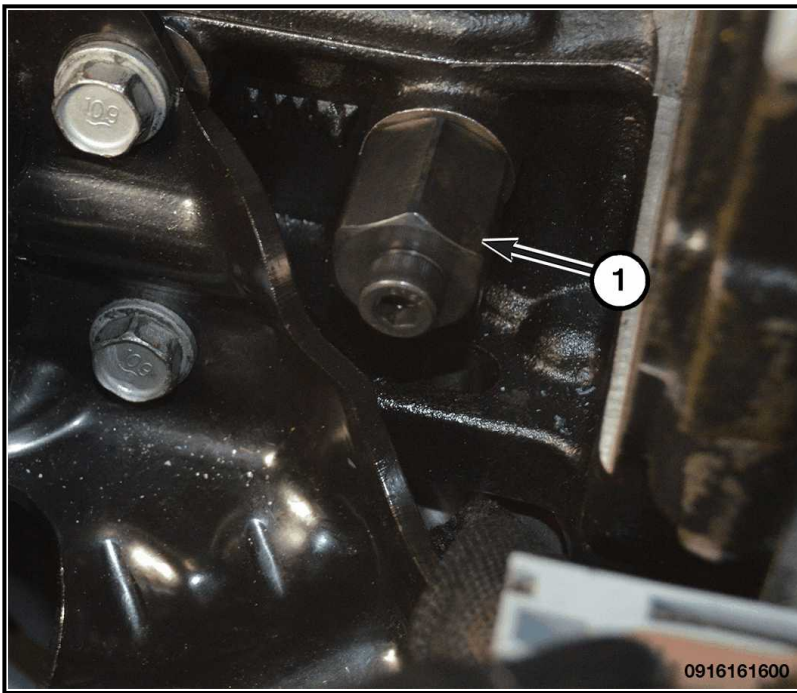
9. Remove the bolts and the (special tool #VM.10338-2, Timing Tool, Camshaft (Left)).



1 - Left Front Bearing Caps Bolts

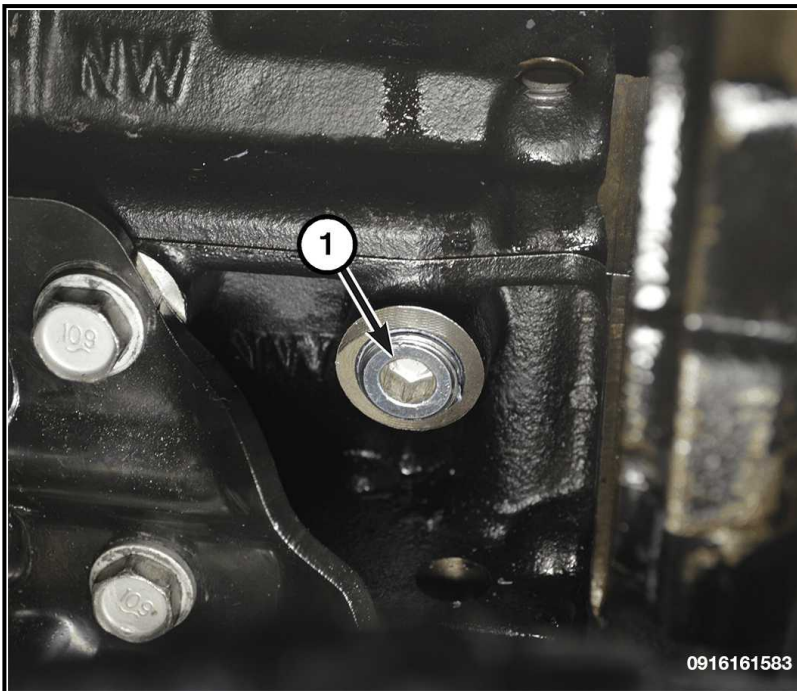
2 - Left Front Bearing Caps

10. Install the two left front camshaft bearing caps and tighten the bearing cap bolts to the proper torque specifications.



1 - Crankshaft Timing Tool

11. Remove the (special tool #VM.10339, Tool, Crankshaft Timing).

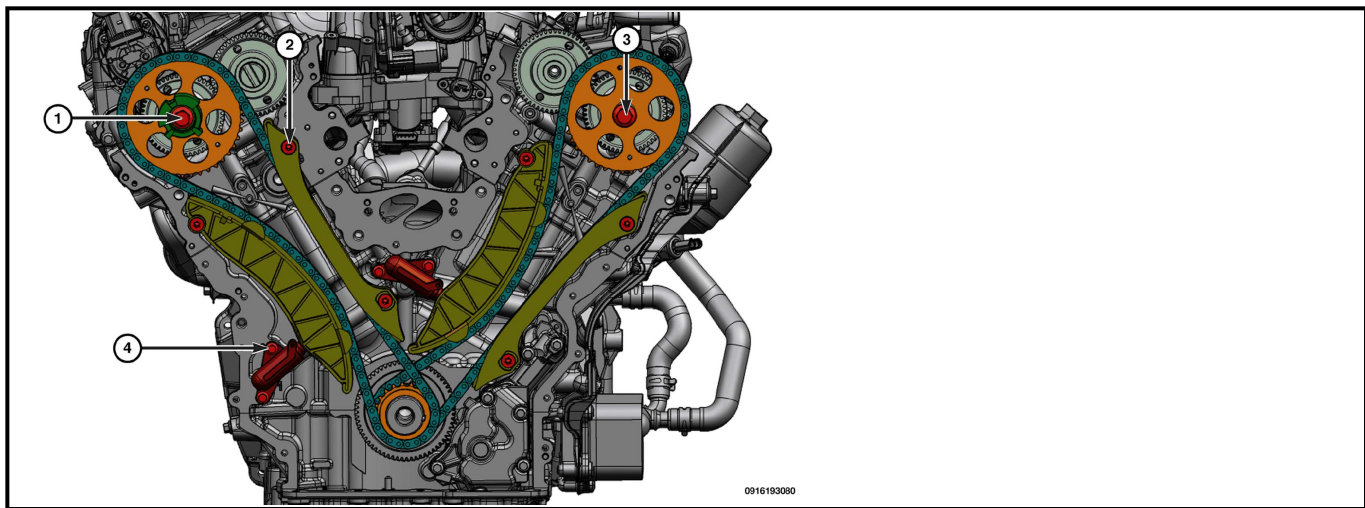


1 - Engine Block Plug

12. Install the engine block plug and tighten to the proper torque specifications.
13. Install the left upper timing cover. Refer to [COVER\(S\), ENGINE TIMING, REMOVAL AND INSTALLATION](#).
14. Connect the negative battery cable(s). Refer to [CABLES, BATTERY](#).

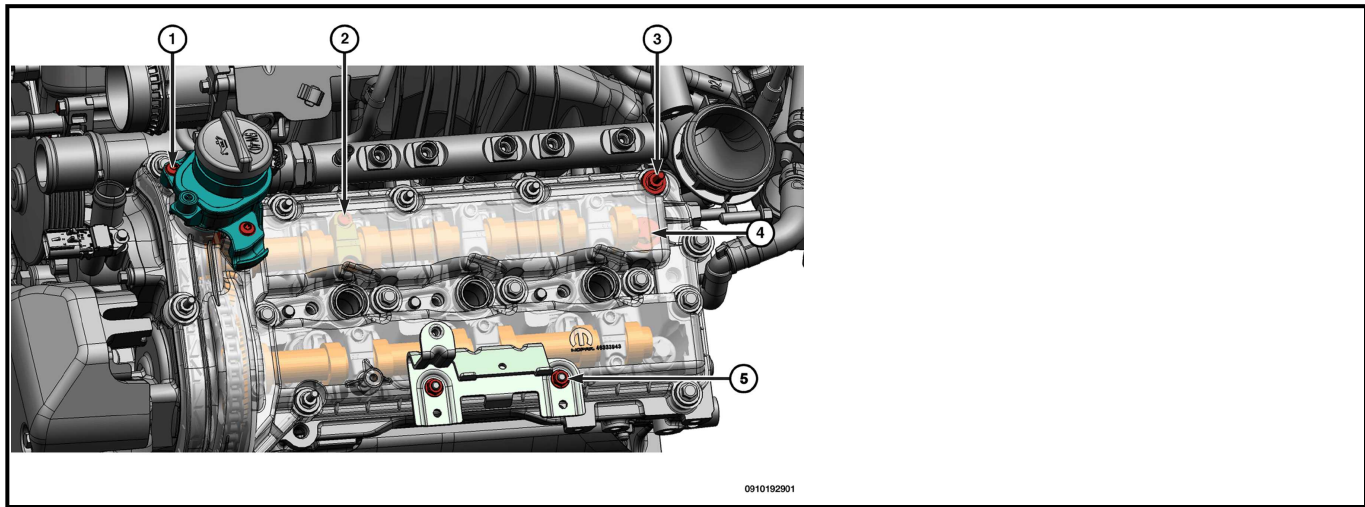
TORQUE SPECIFICATIONS

VALVE TIMING



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Fuel Injection Pump Drive Gear Bolt (On Left Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 75°	-
2	Timing Chain Guide Bolts	30 N.m (22 Ft. Lbs.)	-
3	Reluctor Wheel Bolt (On Right Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 73°	-
4	Timing Chain Tensioner	14 N.m (11 Ft. Lbs.)	-
-	Oil Separator Bolt	30 N.m (22 Ft. Lbs.)	-

CYLINDER HEAD



CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1	Oil Filler Neck Assembly to Valve Cover	Tighten Securely	-
2	Camshaft Bearing Cap Bolts	11 N.m (8 Ft. Lbs.)	Tightening Sequence
3	Cylinder Head Cover Bolts	Torque Procedure: 1. Tighten the cylinder head cover bolts finger tight. 2. Tighten bolts to 8 N.m (71 In. Lbs.). 3. Loosen each bolt 90°.	Tightening Sequence

CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
		4. Tighten bolts to 10 N.m (89 In. Lbs.).	
4	Cylinder Head Bolts (M14)	Torque Procedure: 1. Tighten the cylinder head bolts finger tight. 2. Tighten bolts to 30 N.m (22 Ft. Lbs.). 3. Tighten bolts an additional 75° in sequence. 4. Tighten bolts an additional 75° in sequence. 5. Tighten bolts an additional 75° in sequence.	Tightening Sequence
5	Fuel Line Support Bracket Nuts	6 N.m 53 (In. Lbs.)	-
-	Coolant Tube Bolt	25 N.m (18 Ft. Lbs.)	-
-	Engine Wire Harness Bolts	11 N.m (8 Ft. Lbs.)	-
-	Heat Shield Bracket Nuts	6 N.m 53 (In. Lbs.)	

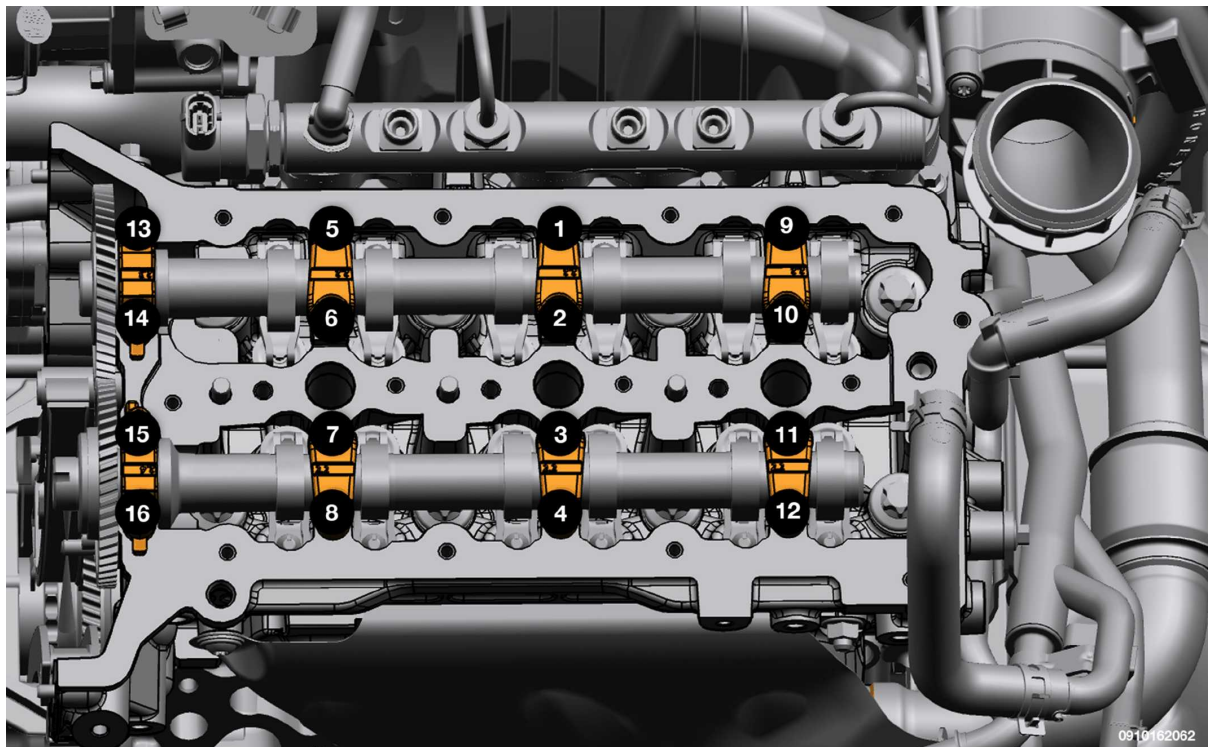


Fig. 4: Camshaft Bearing Cap Tightening Sequence 3.0L
 Courtesy of CHRYSLER GROUP, LLC

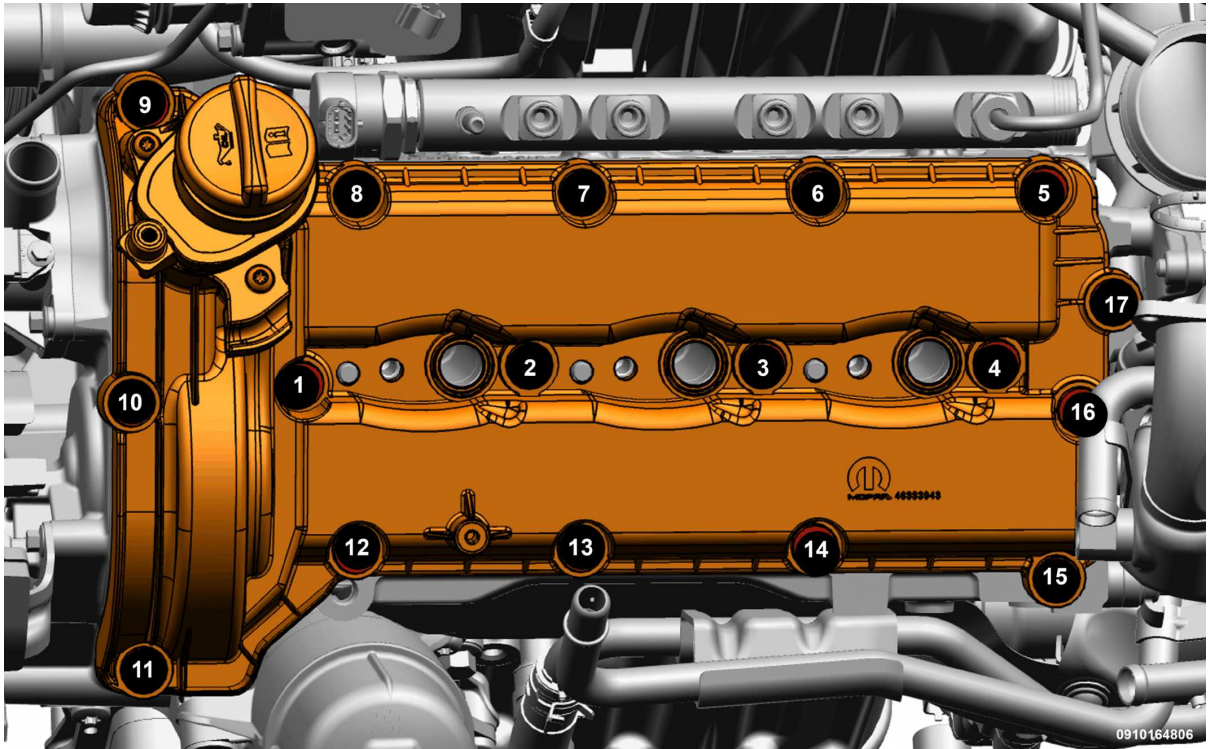
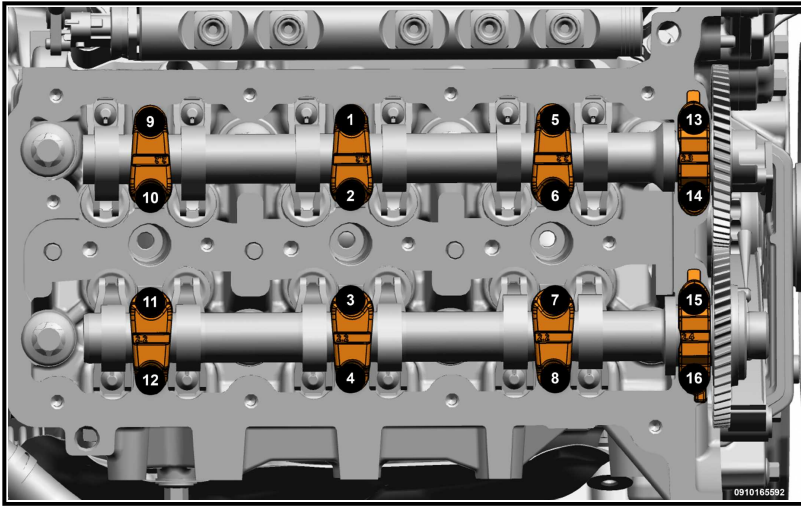


Fig. 5: Cylinder Head Cover Bolts Tightening Sequence - Left
 Courtesy of CHRYSLER GROUP, LLC

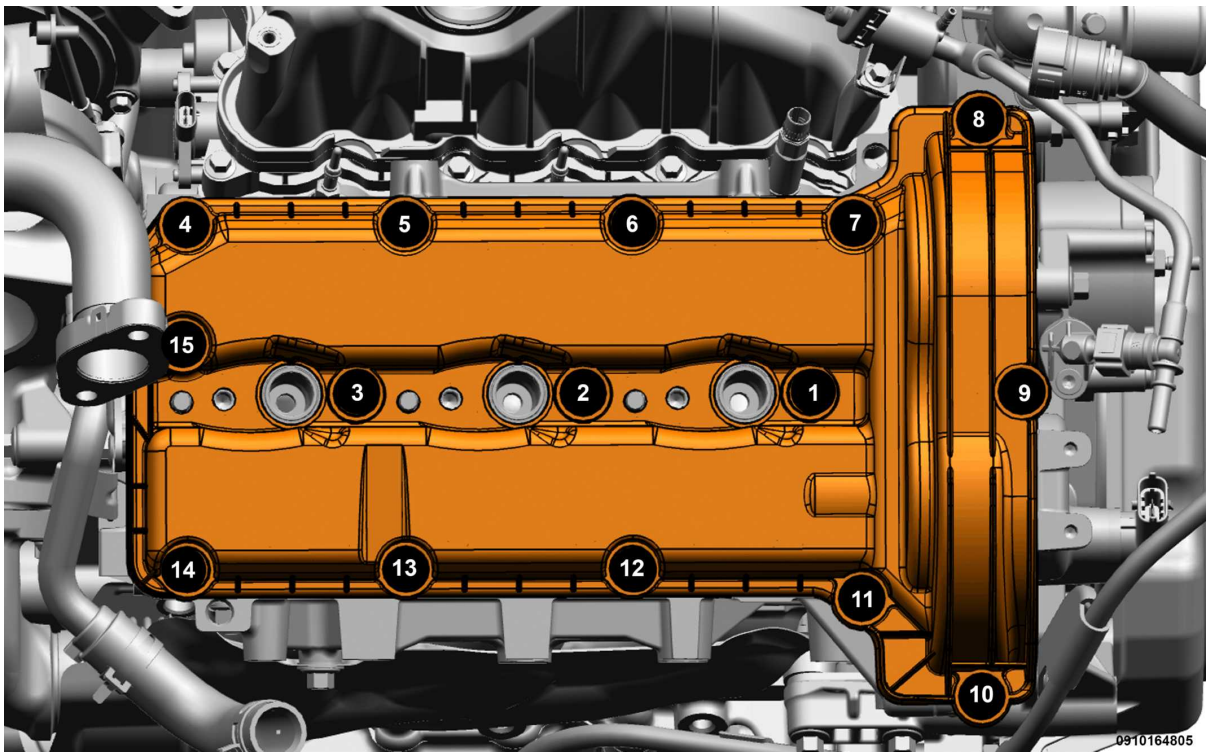


Fig. 6: Cylinder Head Cover Bolts Tightening Sequence - Right
 Courtesy of CHRYSLER GROUP, LLC

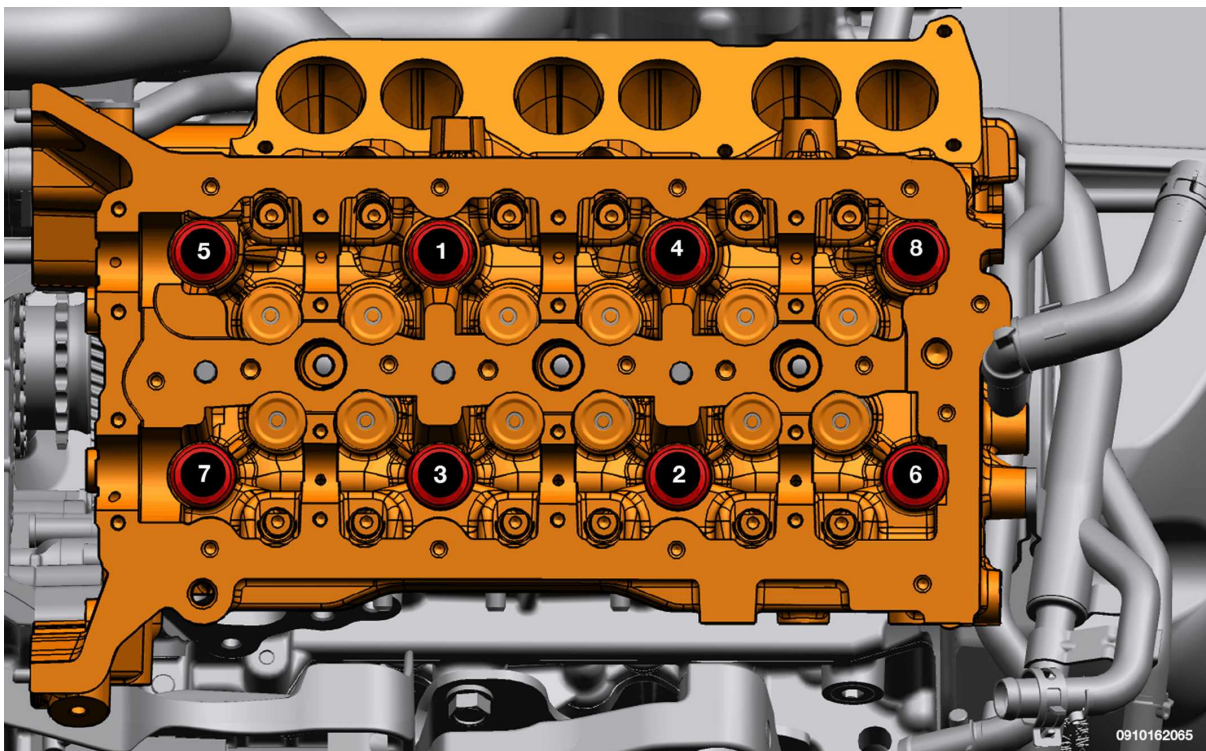


Fig. 7: Cylinder Head Bolts Tightening Sequence - Left
 Courtesy of CHRYSLER GROUP, LLC

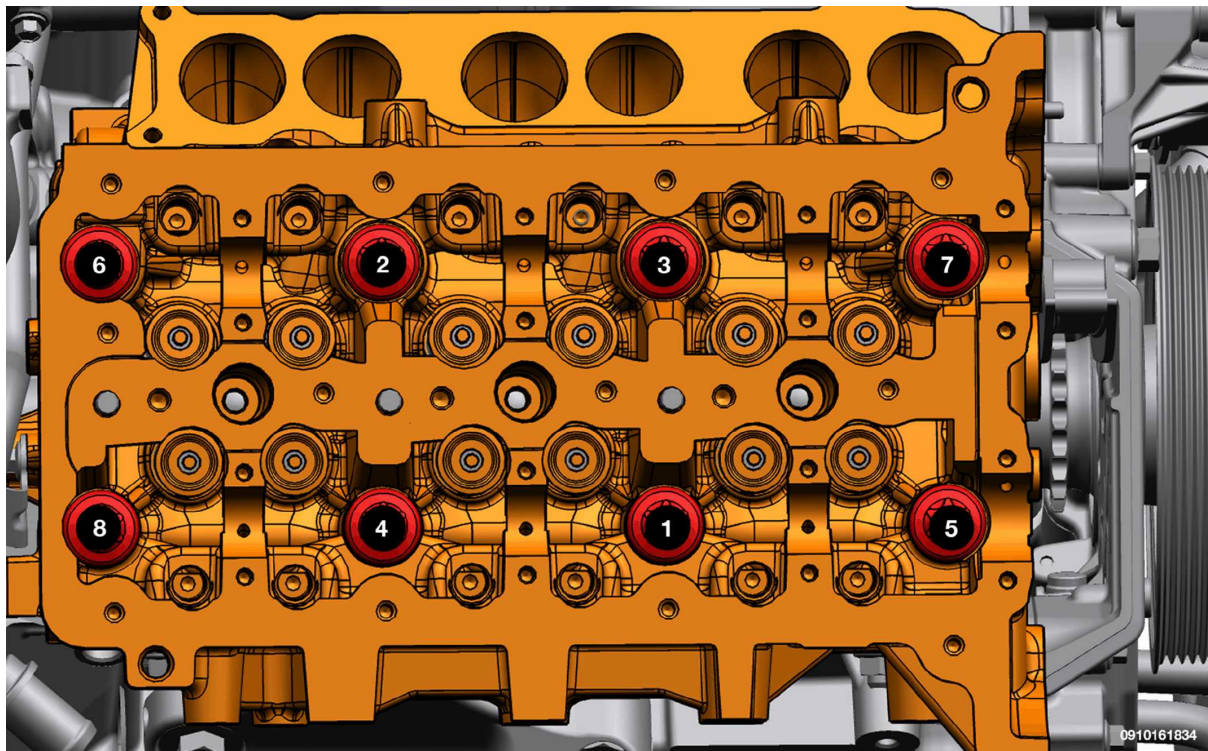
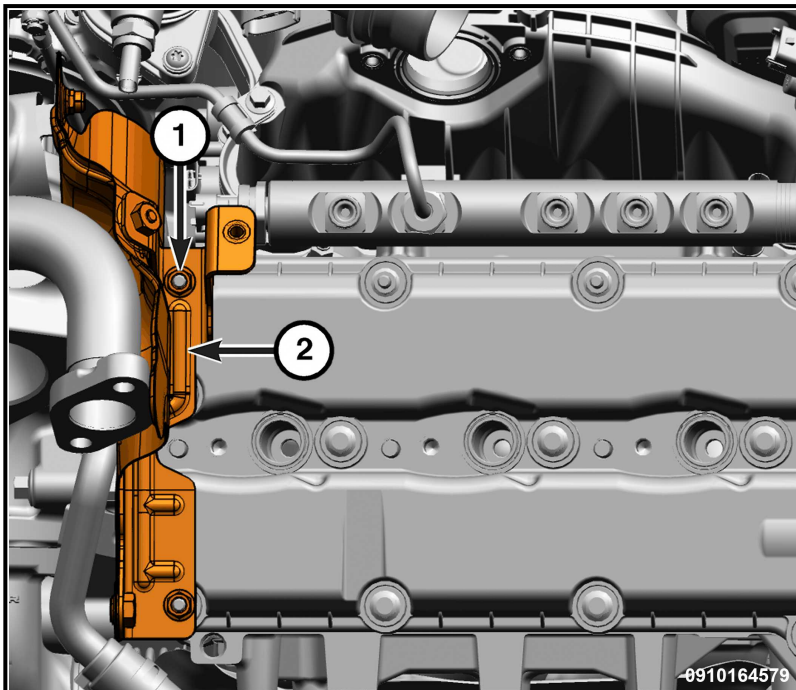
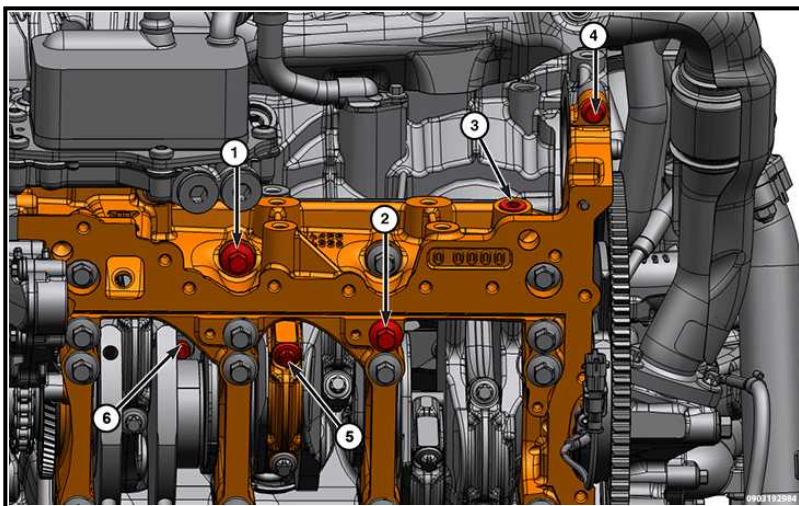


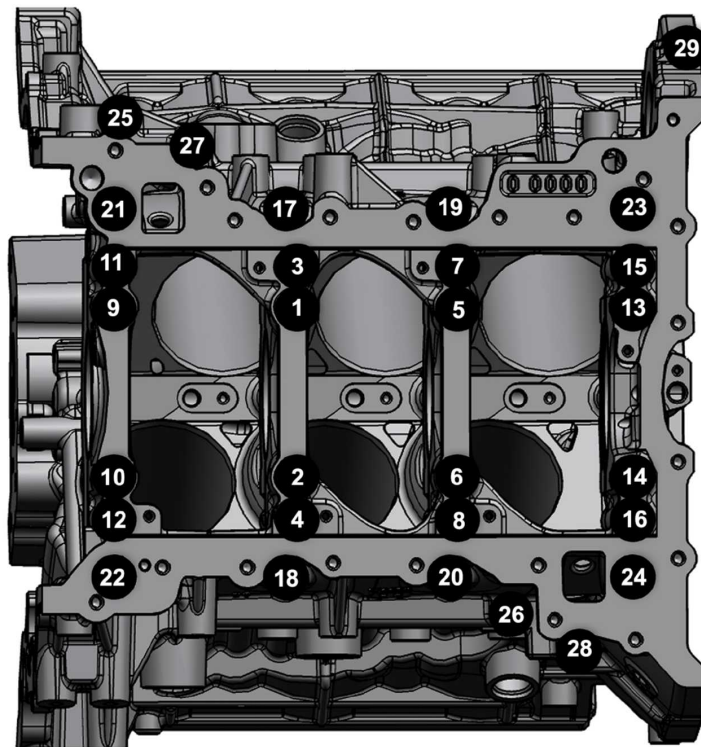
Fig. 8: Cylinder Head Bolts Tightening Sequence - Right
 Courtesy of CHRYSLER GROUP, LLC



ENGINE BLOCK



CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1, 2, 4	Bedplate Bolts	Torque Procedure: 1. Using NEW bolts, install the 26 M12 bolts (1 - 26) and the three M8 bolts (27 - 29) finger tight. 2. Tighten all M12 bolts (1 - 4, 7 - 10, 13 - 16, 19 - 22) to 45 N.m (33 Ft. Lbs.). 3. Tighten the M12 bolts (1 - 16) an additional 110°. 4. Tighten the M12 bolts (25 and 26) to 120 N.m (89 Ft. Lbs.). 5. Tighten the M12 bolts (17 - 24) to 25 N.m (18 Ft. Lbs.). 6. Tighten the M12 bolts (17 - 24) an additional 55°. 7. Tighten the M12 bolts (21 - 24) an additional 75°. 8. Tighten the three M8 bolts (27 - 29) to 30 N.m (22 Ft. Lbs.).	Tightening Sequence
3	Engine Block Timing Plug	30 N.m (22 Ft. Lbs.)	-
5	Piston Rod Cap Bolt	-	Serviced with Assembly
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-
-	Engine Ground to Engine Block	20 N.m (15 Ft. Lbs.)	-
-	Engine Lifting Brackets	55 N.m (41 Ft. Lbs.)	-



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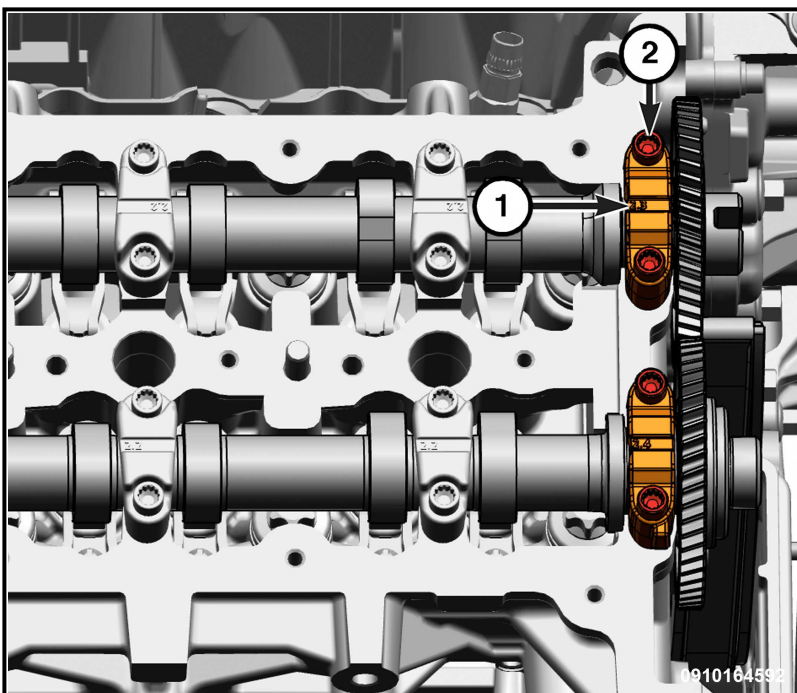
Fig. 9: Bed Plate Tightening Sequence 3.0L

Courtesy of CHRYSLER GROUP, LLC

RIGHT CAMSHAFT SPROCKET

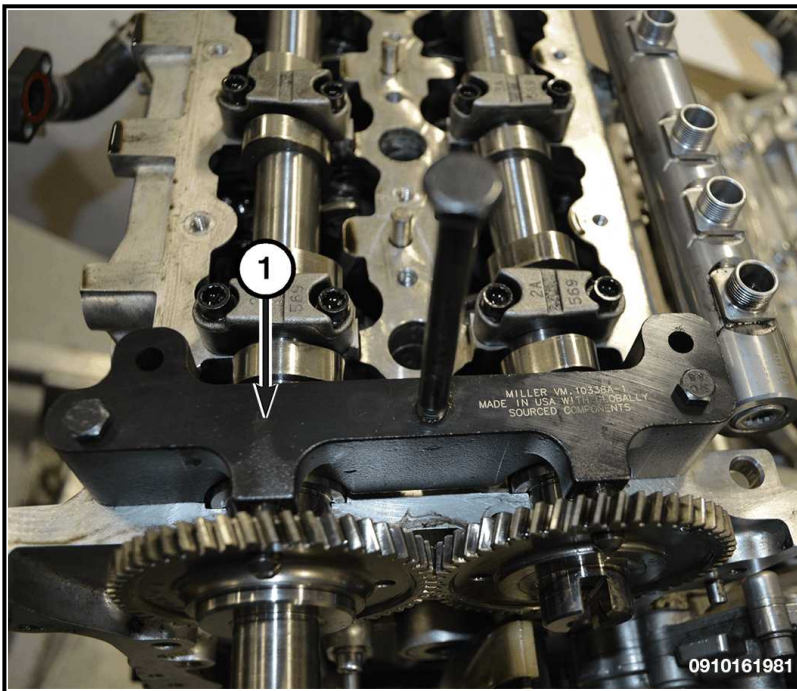
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the right upper timing cover. Refer to [COVER\(S\), ENGINE TIMING, REMOVAL AND INSTALLATION](#).
3. Lock the engine to 60 degrees ATDC. Refer to [VALVE TIMING](#) .



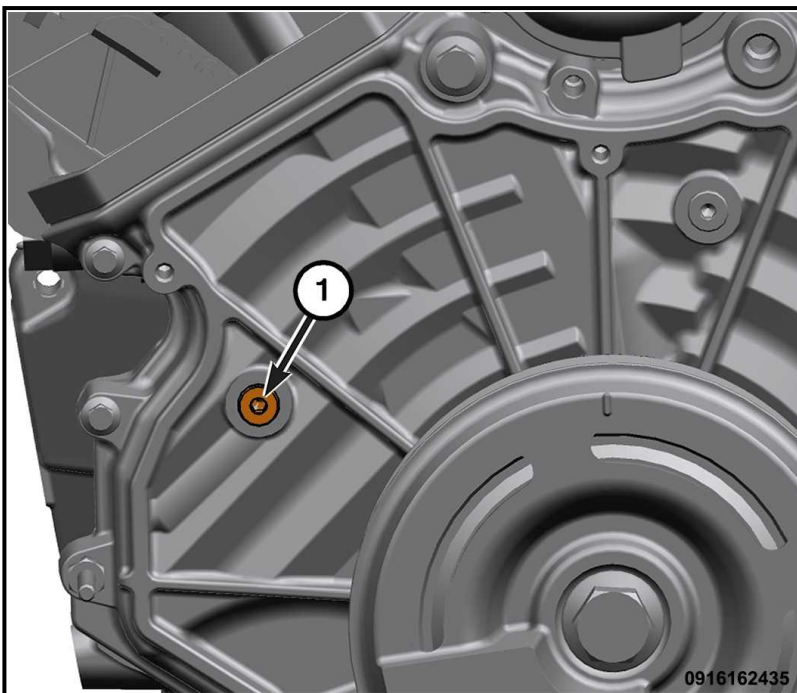
- | |
|------------------------------------|
| 1 - Right Front Bearing Caps |
| 2 - Right Front Bearing Caps Bolts |

4. Remove the two right front bearing caps bolts and the two right front bearing caps.



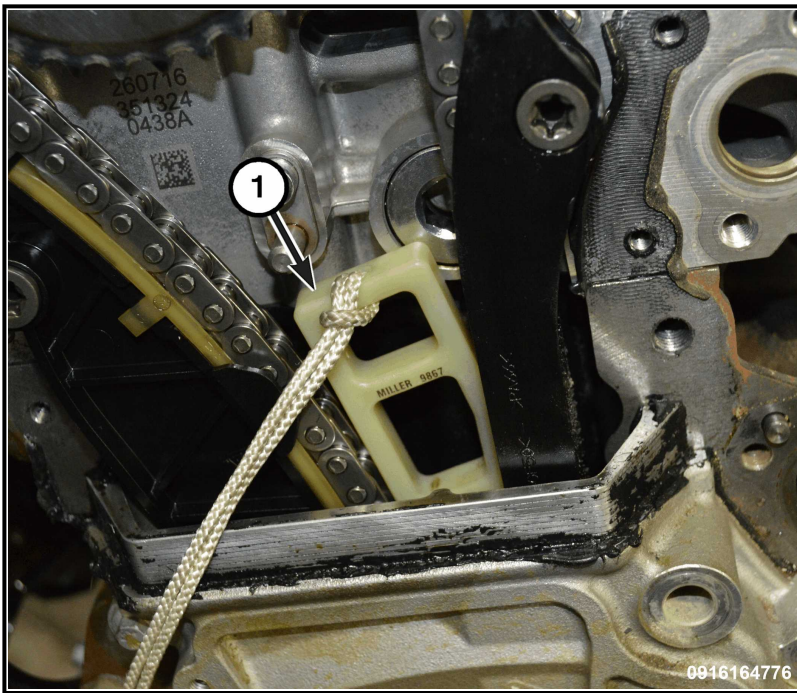
1 - Right Camshaft Timing Tool

5. Install the (special tool #VM.10338-1, Timing Tool, Camshaft (Right)) and securely tighten the bolts.



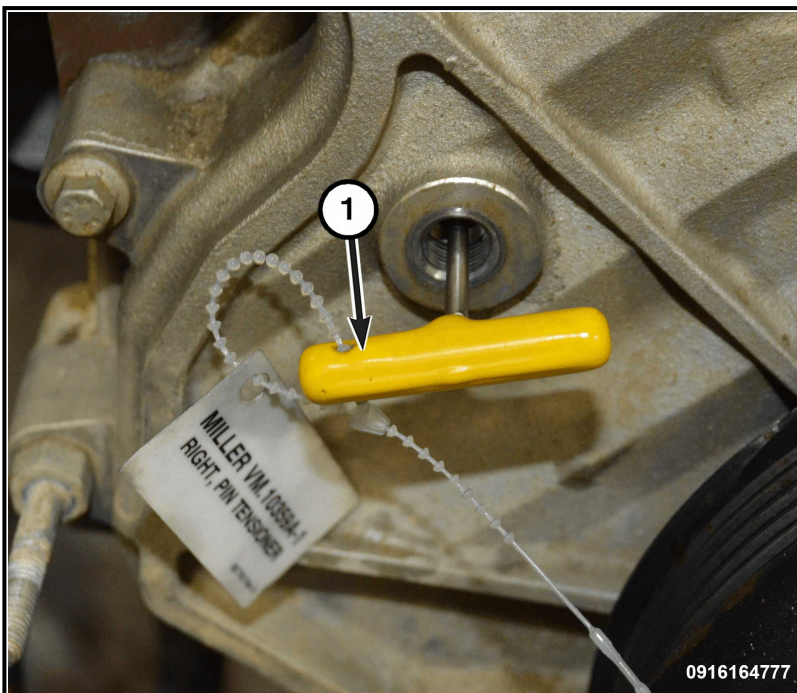
1 - Lower Timing Cover Plug

6. Remove the lower timing cover plug.



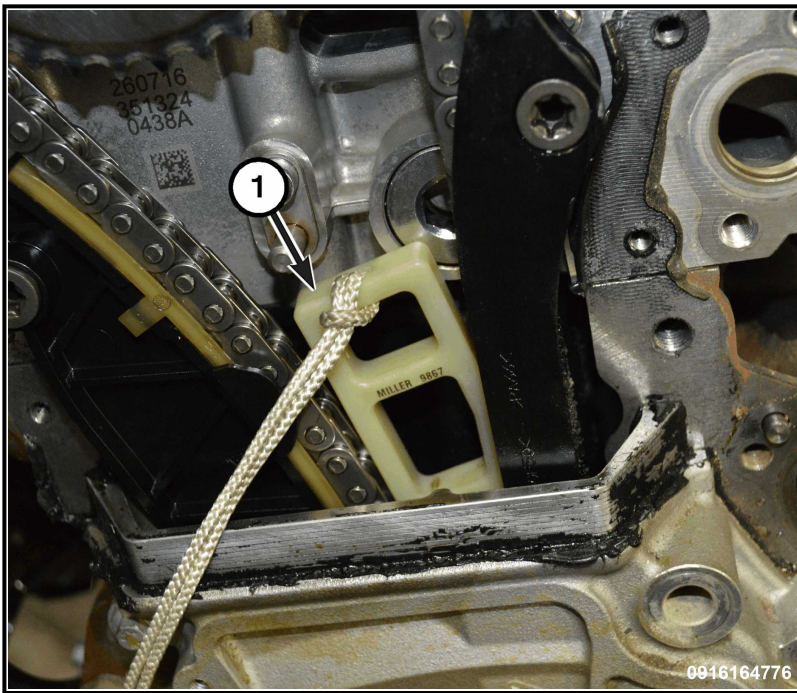
1 - Locking Wedge Tool

7. Install the (special tool #9867, Wedge, Locking) tool as shown.



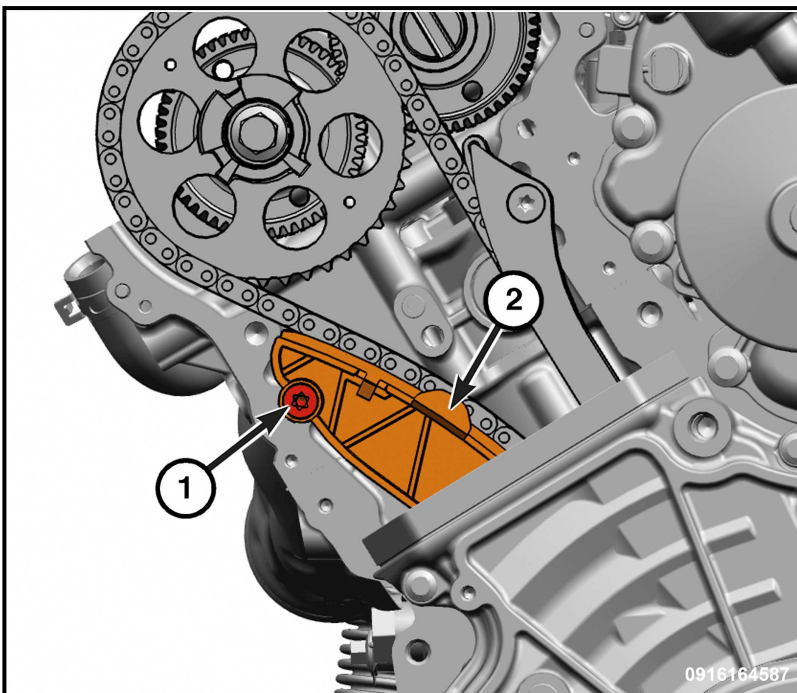
1 - Tensioner Pin Tool

8. Install the (special tool #VM.10359A, Pin, Tensioner) in the timing chain tensioner as shown.



1 - Locking Wedge Tool

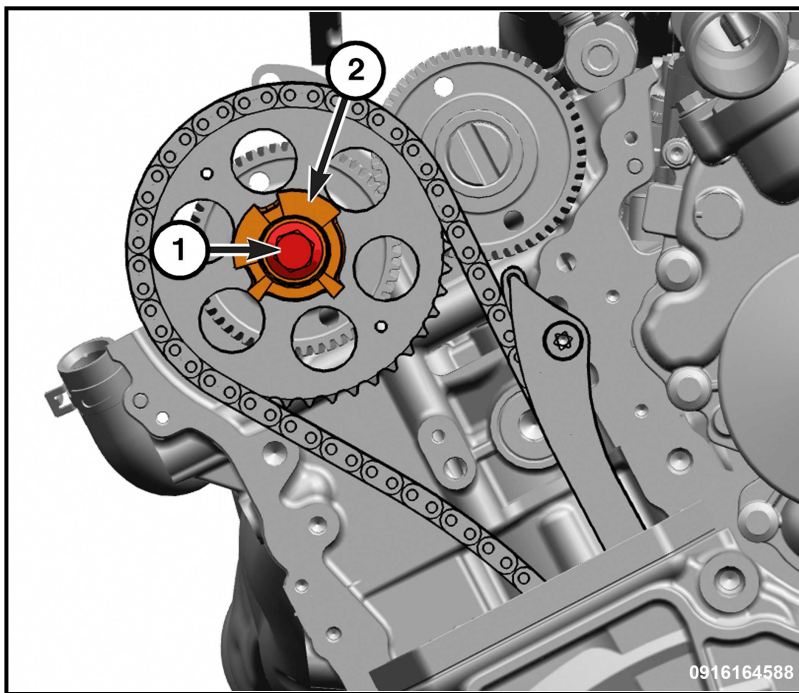
9. Remove the (special tool #9867, Wedge, Locking) tool.



1 - Right Outer Timing Chain Guide Bolt

2 - Right Outer Timing Chain Guide

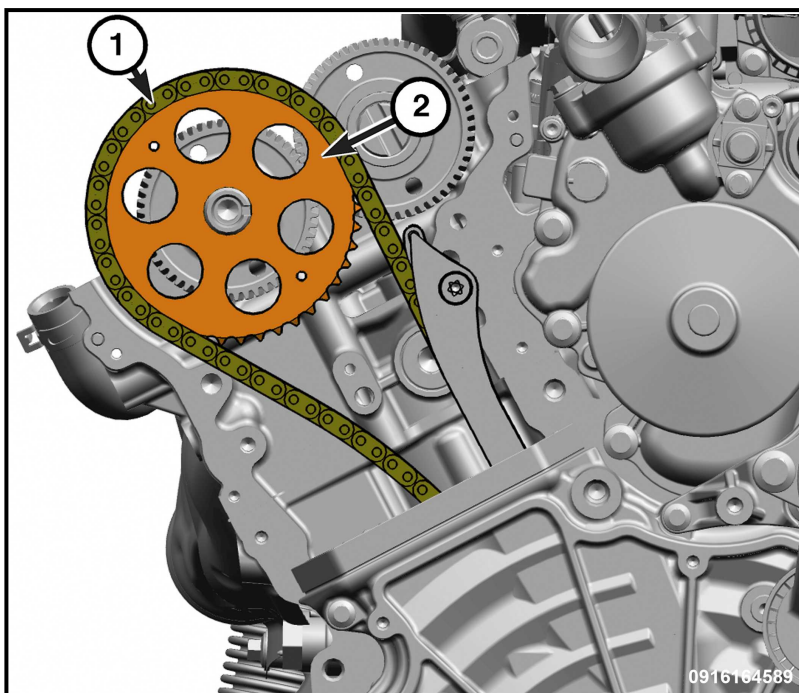
10. Remove the right outer timing chain guide bolt and the right outer timing chain guide.



1 - Reluctor Wheel Bolt

2 - Reluctor Wheel

11. Remove the reluctor wheel bolt and the reluctor wheel.



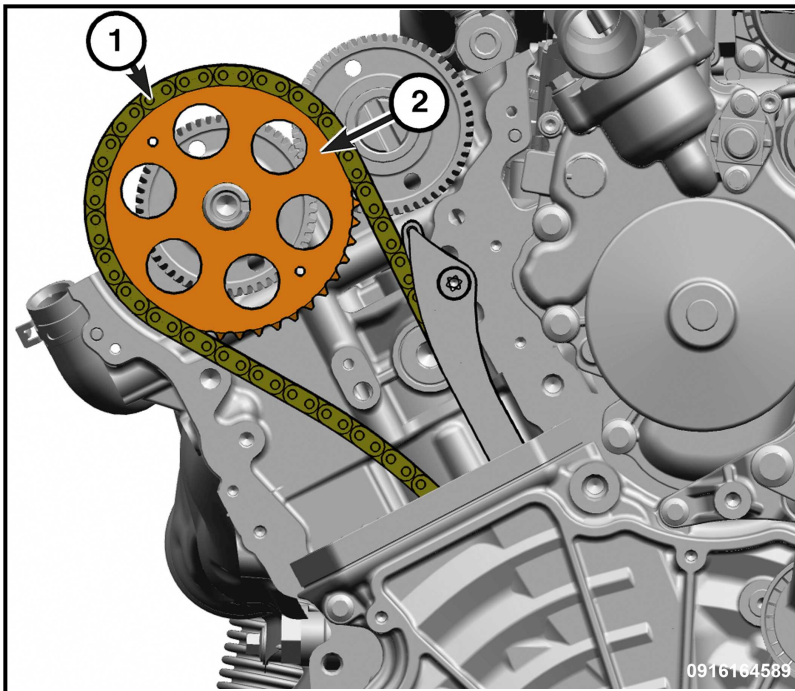
1 - Timing Chain

2 - Right Camshaft Sprocket

12. Slide the right camshaft sprocket off the camshaft and remove the camshaft sprocket. Using a cable tie, tie off the timing chain to prevent it from falling in the engine.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

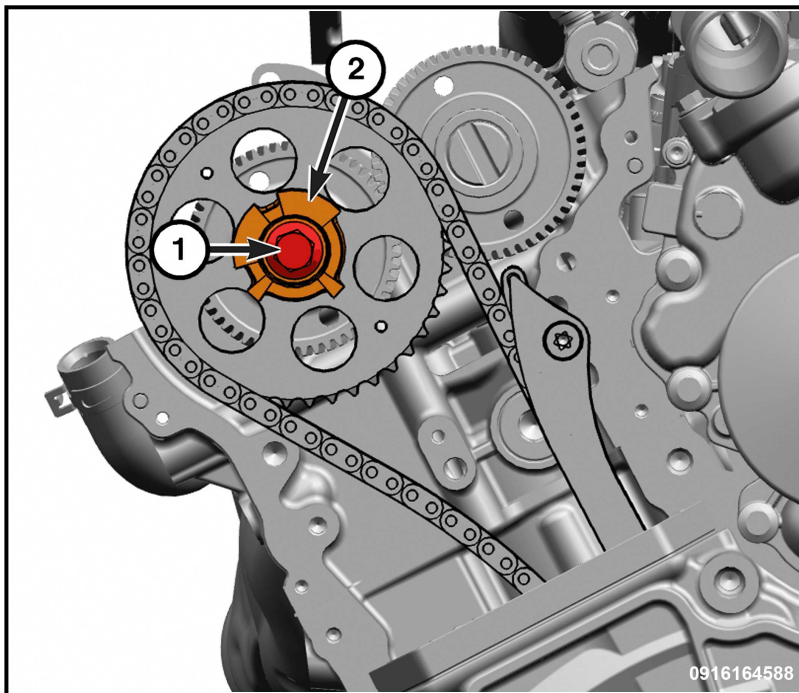


1 - Timing Chain

2 - Right Camshaft Sprocket

NOTE: Be sure the timing chain has not come off the crankshaft sprocket and is wedged between the two sprockets.

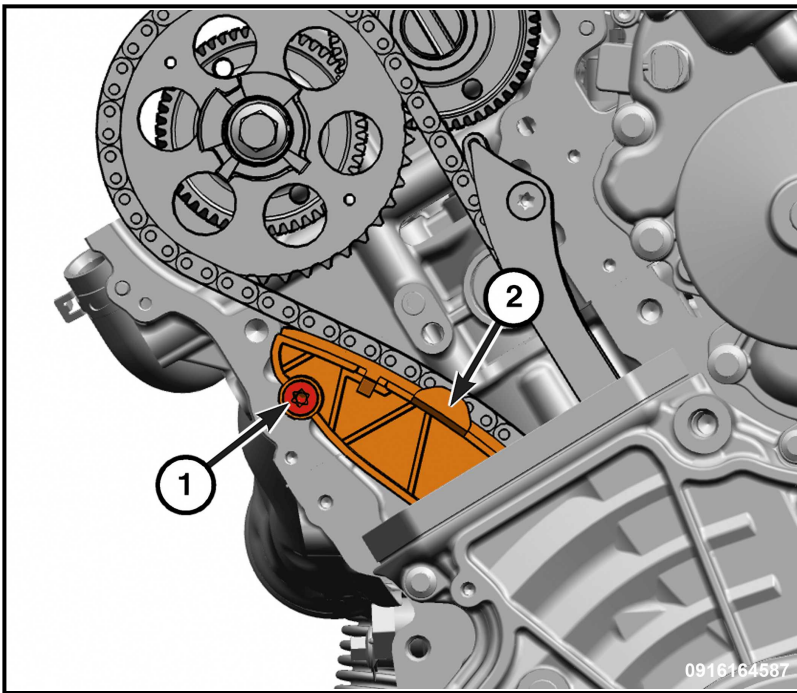
1. Cut the cable time and position the timing chain to the right camshaft sprocket and install the right camshaft sprocket on the camshaft.
2. Be sure the timing chain is still engaged on the crankshaft sprocket.



1 - Reluctor Wheel Bolt

2 - Reluctor Wheel

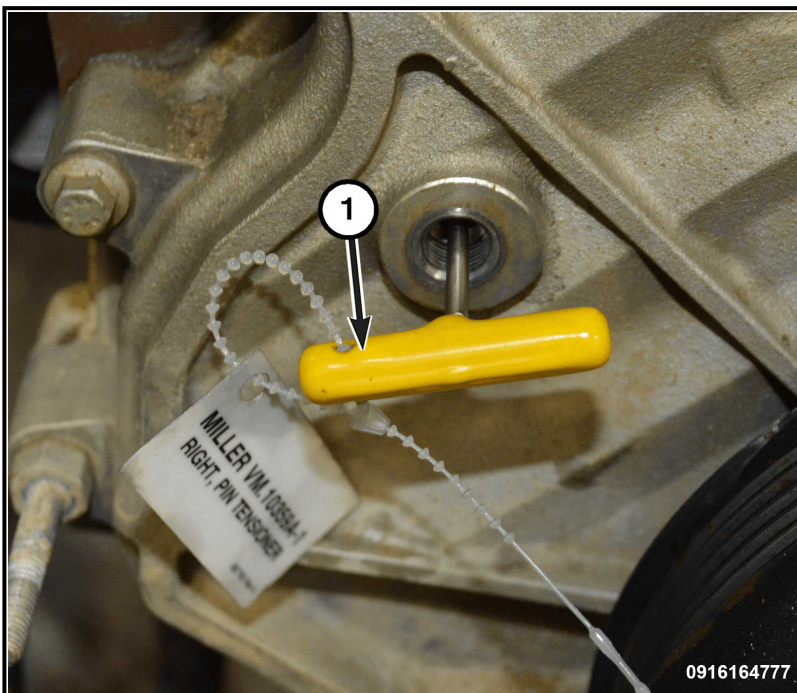
3. Install the reluctor wheel and tighten the reluctor wheel bolt finger tight.



1 - Right Outer Timing Chain Guide Bolt

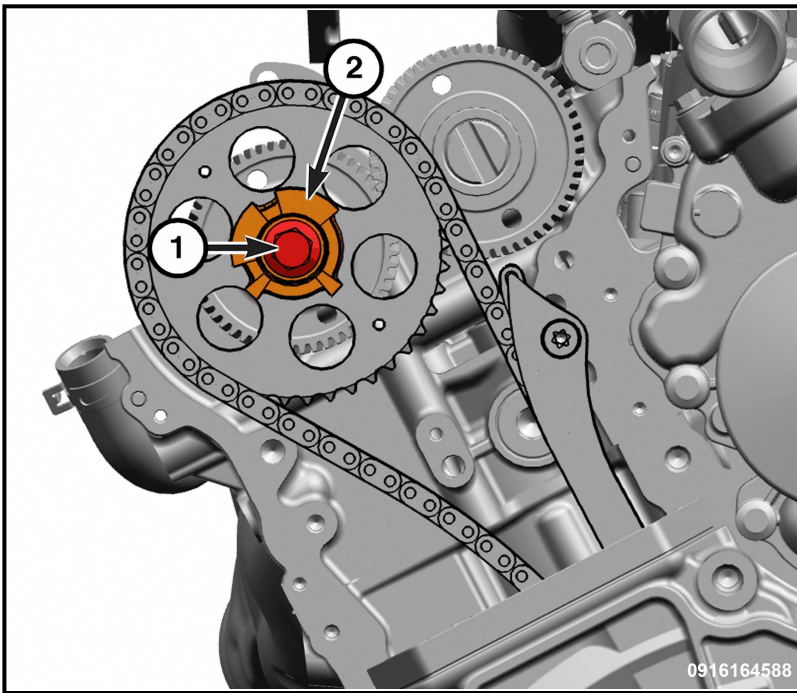
2 - Right Outer Timing Chain Guide

4. Install the right outer timing chain guide and tighten the right outer timing chain guide bolt to the proper torque specifications.



1 - Tensioner Pin Tool

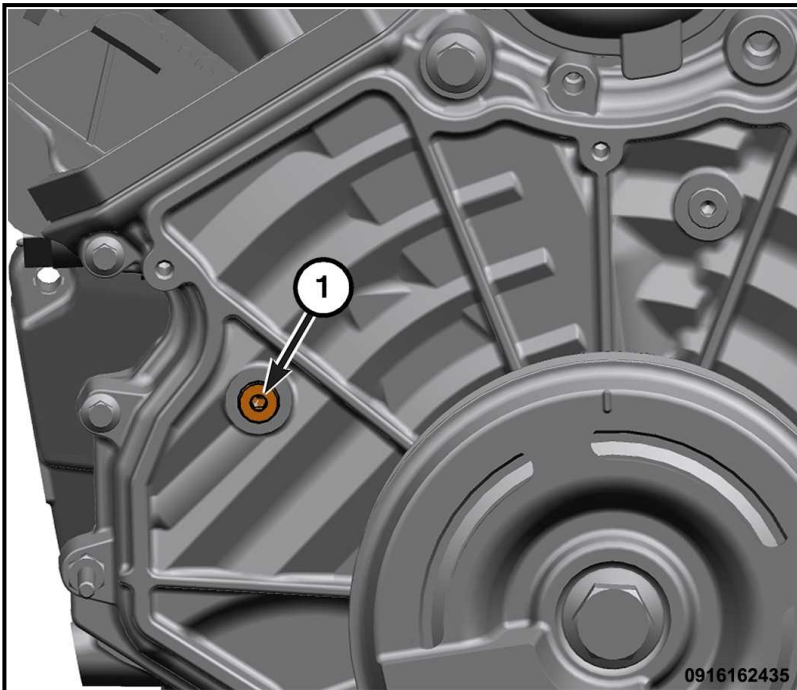
5. Remove the (special tool #VM.1035A, Pin, Tensioner) from the timing chain tensioner.



1 - Reluctor Wheel Bolt

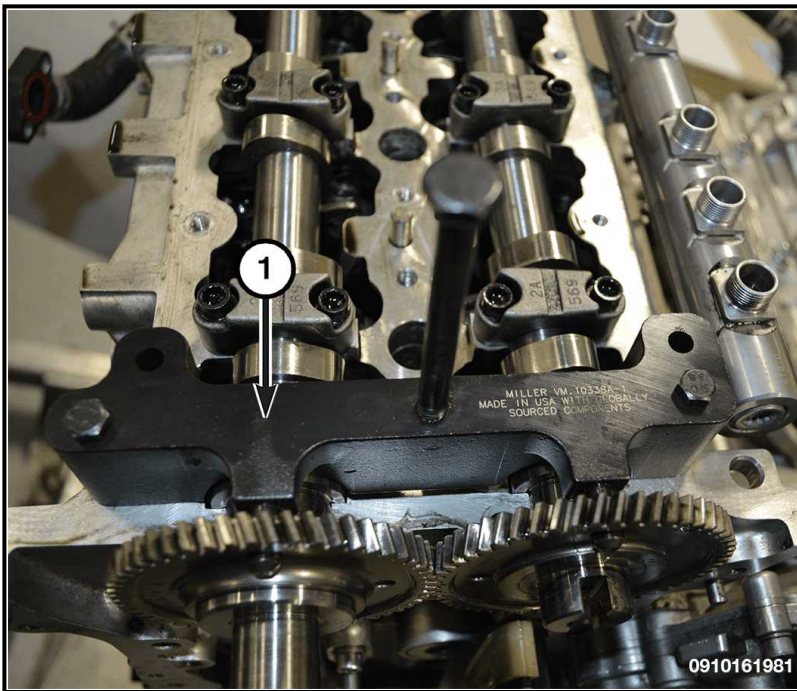
2 - Reluctor Wheel

6. Tighten the reluctor wheel bolt to the proper torque specifications.



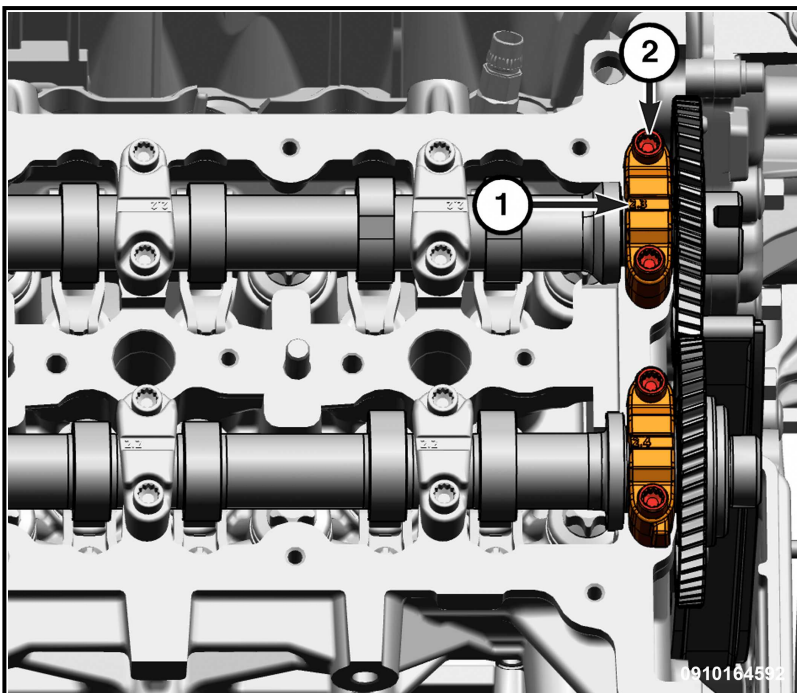
1 - Lower Timing Cover Plug

7. Install the lower timing cover plug and securely tighten.



1 - Right Camshaft Timing Tool

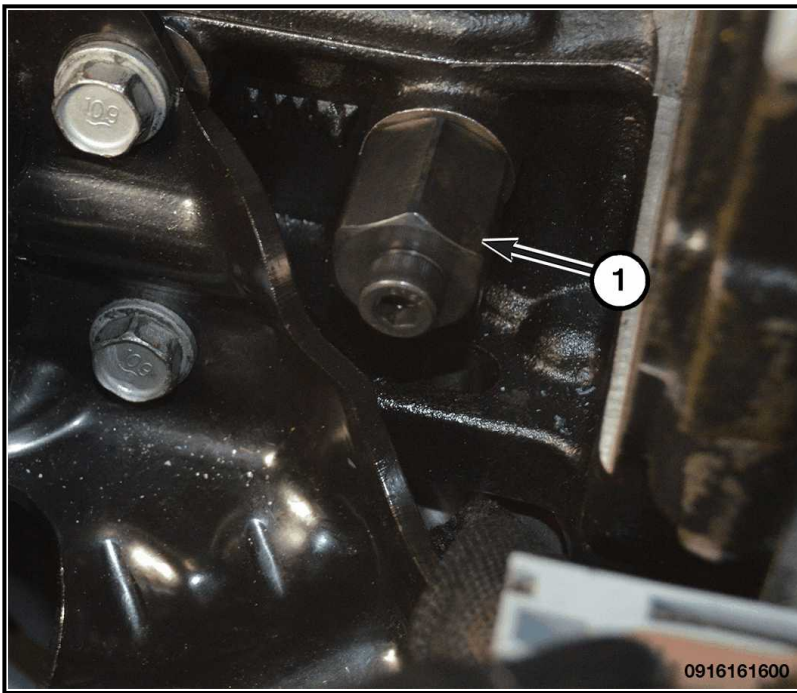
8. Remove the bolts and the (special tool #VM.10338-1, Timing Tool, Camshaft (Right)).



1 - Right Front Bearing Caps

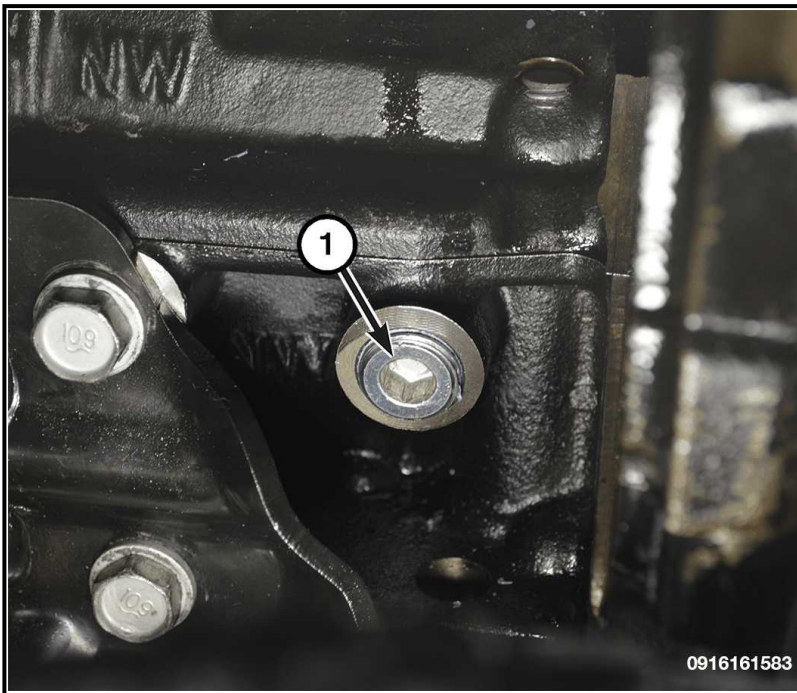
2 - Right Front Bearing Caps Bolts

9. Install the two right front camshaft bearing caps and tighten the bearing cap bolts to the proper torque specifications.



1 - Crankshaft Timing Tool

10. Remove the (special tool #VM.10339, Tool, Crankshaft Timing).



1 - Engine Block Plug

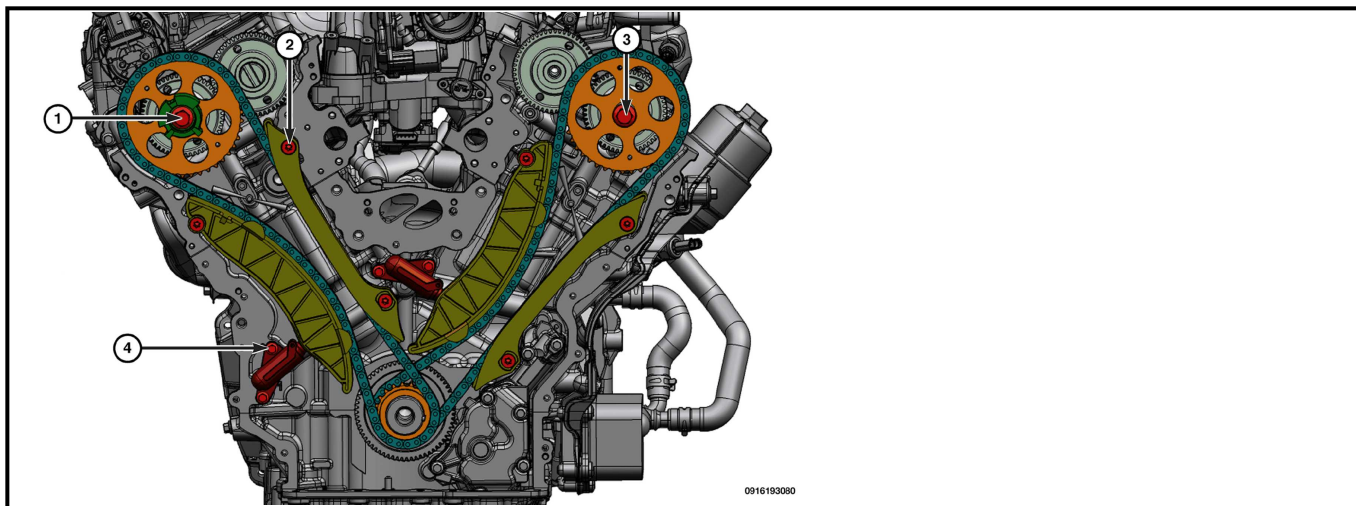
11. Install the engine block plug and tighten to the proper torque specifications.

12. Install the right upper timing cover. Refer to [COVER\(S\), ENGINE TIMING, REMOVAL AND INSTALLATION](#).

13. Connect the negative battery cable(s). Refer to [CABLES, BATTERY](#).

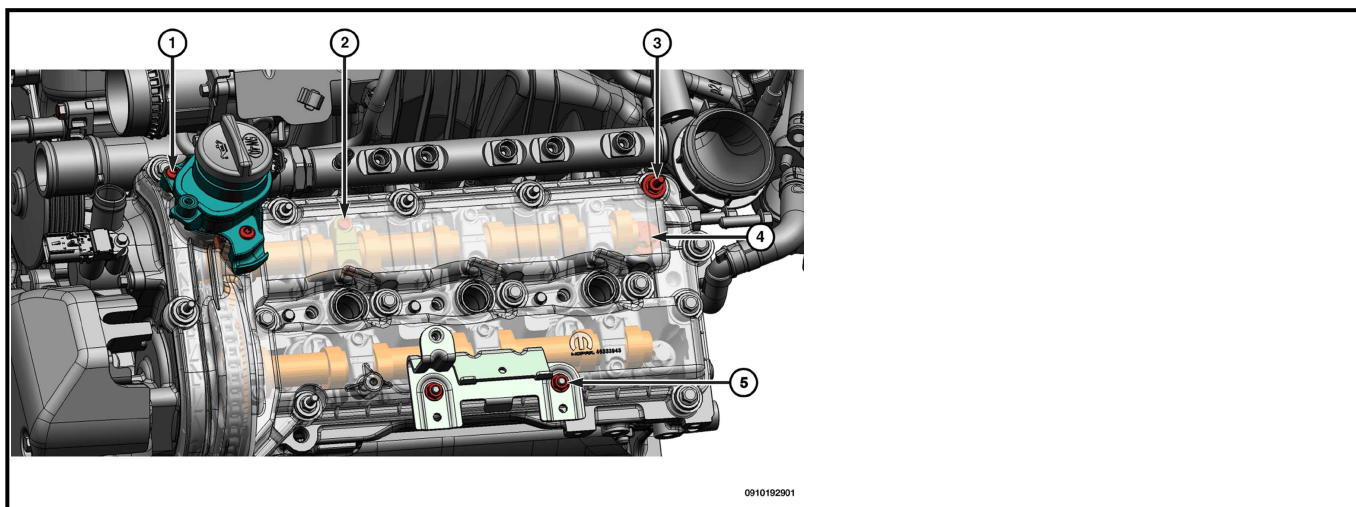
TORQUE SPECIFICATIONS

VALVE TIMING



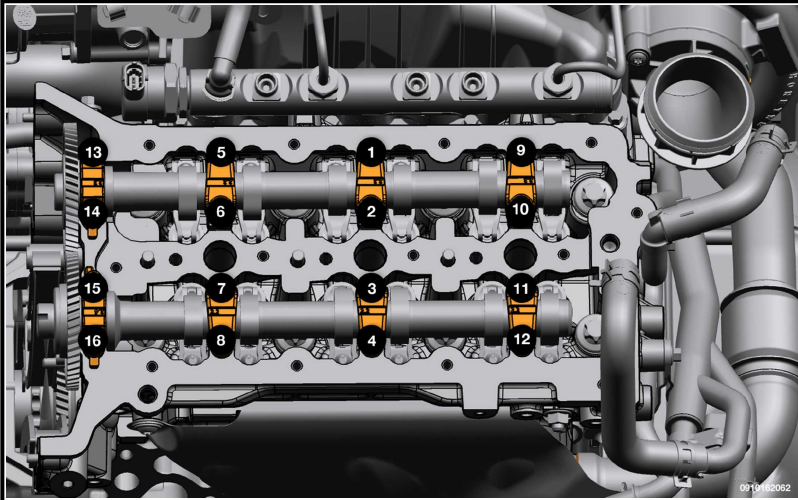
CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Fuel Injection Pump Drive Gear Bolt (On Left Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 75°	-
2	Timing Chain Guide Bolts	30 N.m (22 Ft. Lbs.)	-
3	Reluctor Wheel Bolt (On Right Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 73°	-
4	Timing Chain Tensioner	14 N.m (11 Ft. Lbs.)	-
-	Oil Separator Bolt	30 N.m (22 Ft. Lbs.)	-

CYLINDER HEAD



CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1	Oil Filler Neck Assembly to Valve Cover	Tighten Securely	-
2	Camshaft Bearing Cap Bolts	11 N.m (8 Ft. Lbs.)	Tightening Sequence
3	Cylinder Head Cover Bolts	Torque Procedure: 1. Tighten the cylinder head cover bolts finger tight. 2. Tighten bolts to 8 N.m (71 In. Lbs.). 3. Loosen each bolt 90°.	Tightening Sequence

CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
		4. Tighten bolts to 10 N.m (89 In. Lbs.).	
4	Cylinder Head Bolts (M14)	Torque Procedure: 1. Tighten the cylinder head bolts finger tight. 2. Tighten bolts to 30 N.m (22 Ft. Lbs.). 3. Tighten bolts an additional 75° in sequence. 4. Tighten bolts an additional 75° in sequence. 5. Tighten bolts an additional 75° in sequence.	Tightening Sequence
5	Fuel Line Support Bracket Nuts	6 N.m 53 (In. Lbs.)	-
-	Coolant Tube Bolt	25 N.m (18 Ft. Lbs.)	-
-	Engine Wire Harness Bolts	11 N.m (8 Ft. Lbs.)	-
-	Heat Shield Bracket Nuts	6 N.m 53 (In. Lbs.)	



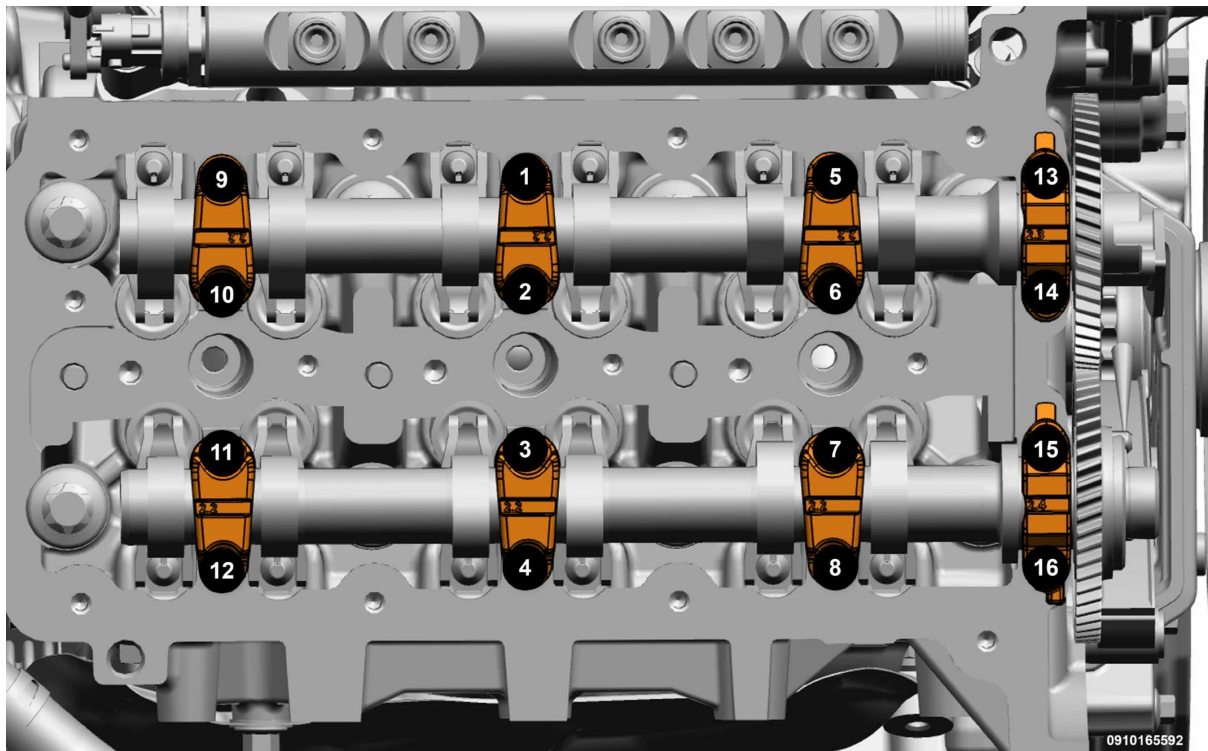
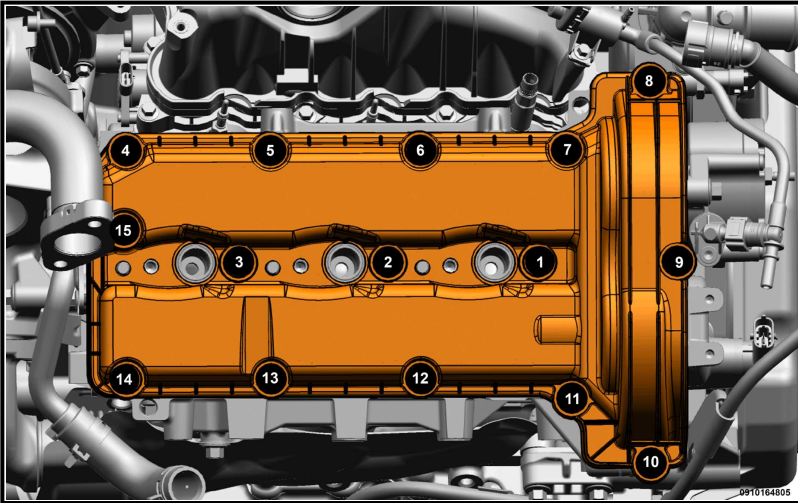
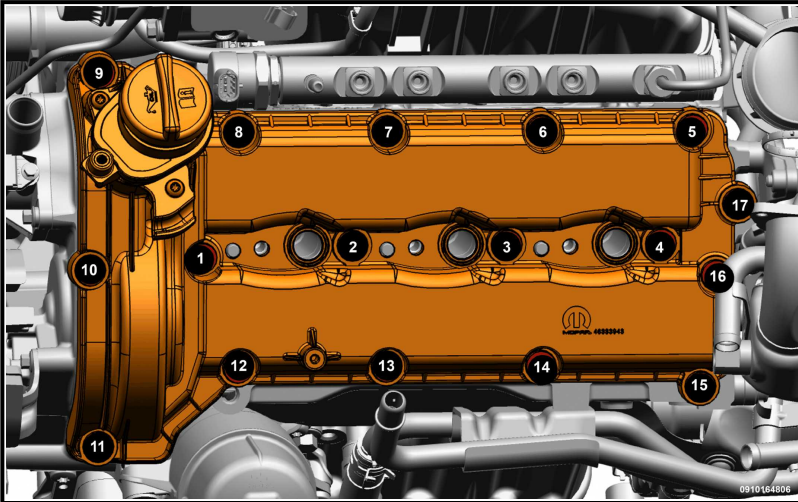
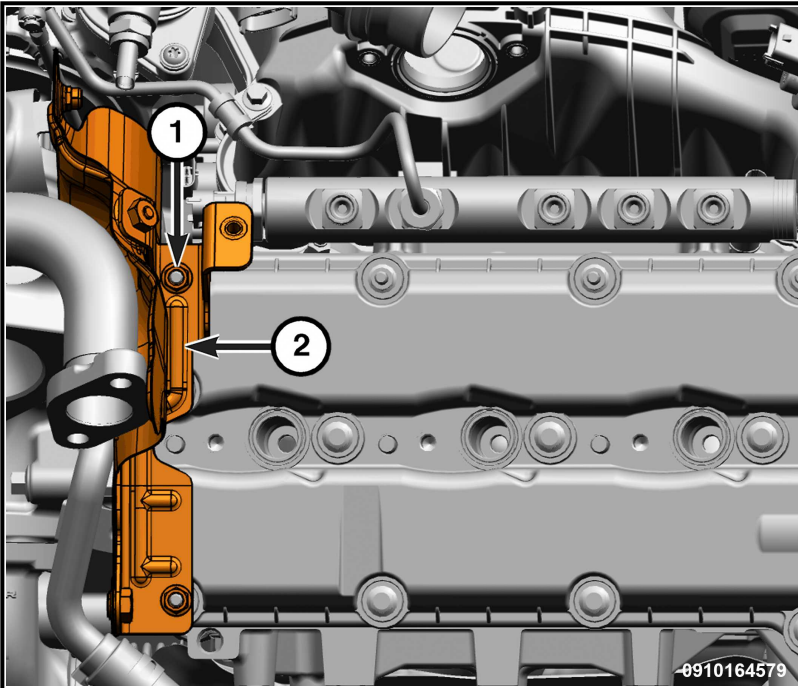
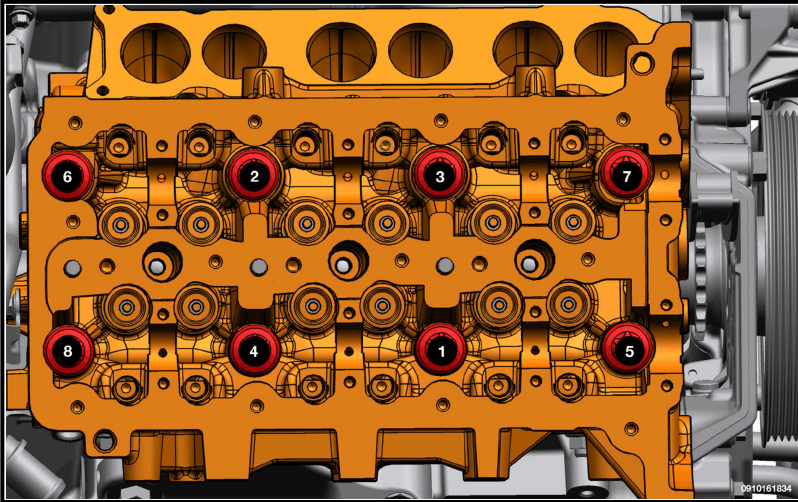
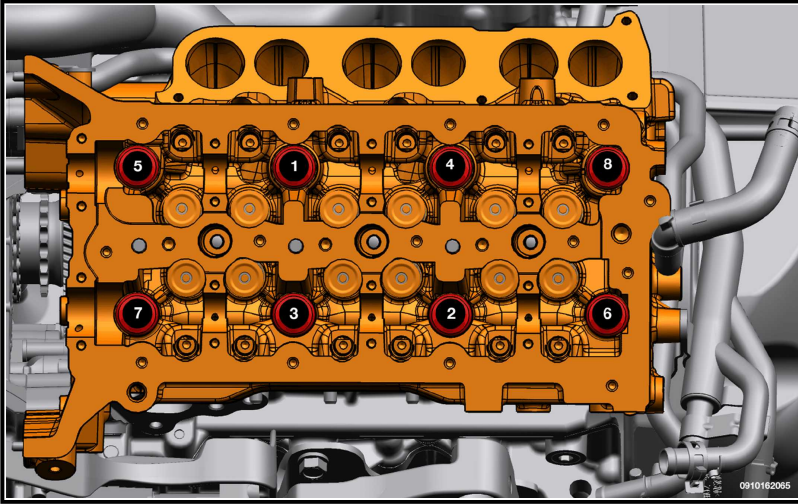
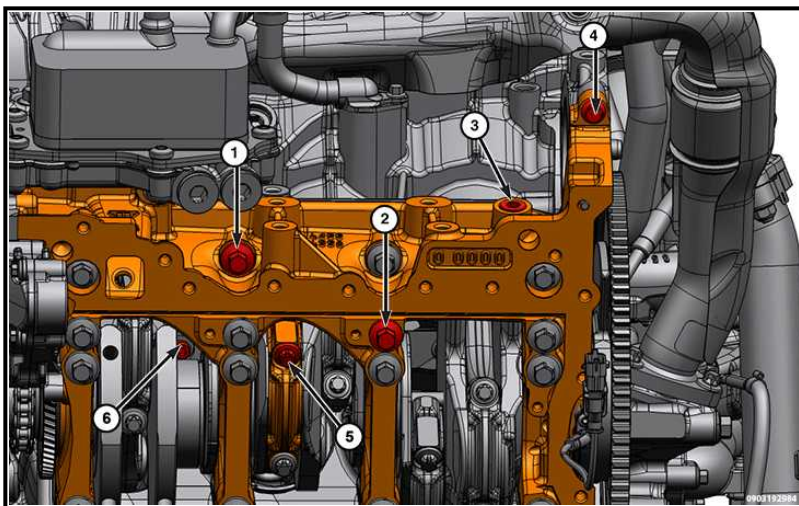


Fig. 10: Front Bearing Caps Bolts Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC

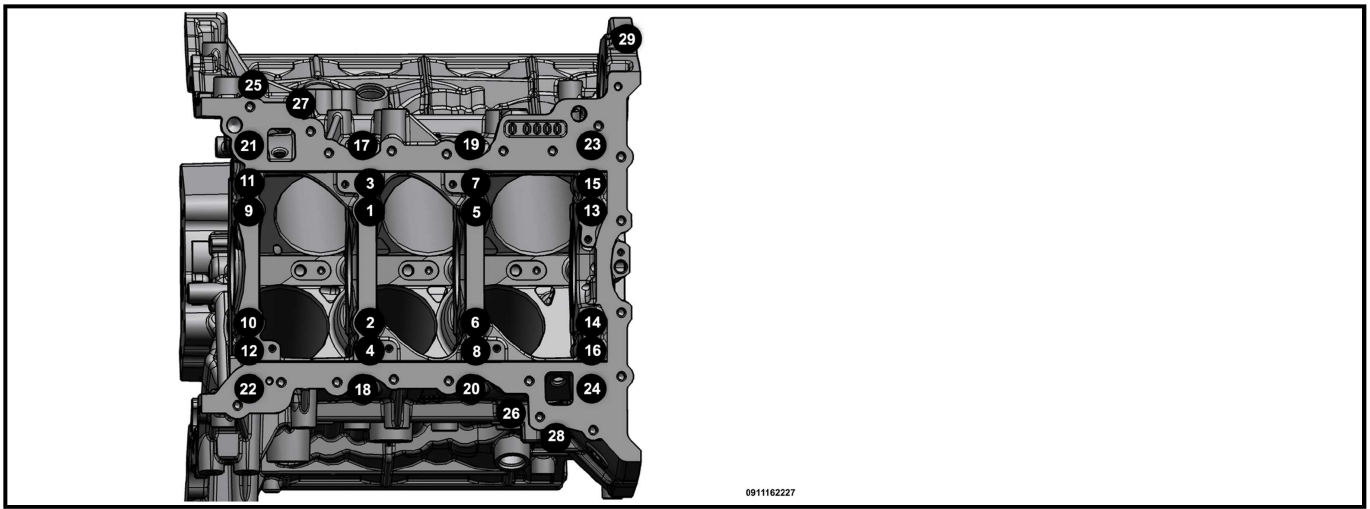




ENGINE BLOCK



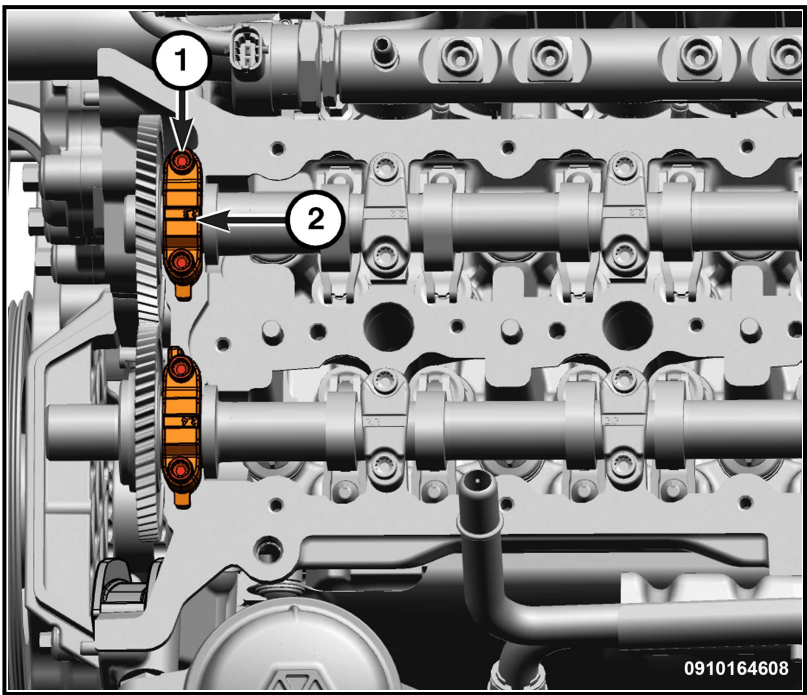
CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1, 2, 4	Bedplate Bolts	Torque Procedure: 1. Using NEW bolts, install the 26 M12 bolts (1 - 26) and the three M8 bolts (27 - 29) finger tight. 2. Tighten all M12 bolts (1 - 4, 7 - 10, 13 - 16, 19 - 22) to 45 N.m (33 Ft. Lbs.). 3. Tighten the M12 bolts (1 - 16) an additional 110°. 4. Tighten the M12 bolts (25 and 26) to 120 N.m (89 Ft. Lbs.). 5. Tighten the M12 bolts (17 - 24) to 25 N.m (18 Ft. Lbs.). 6. Tighten the M12 bolts (17 - 24) an additional 55°. 7. Tighten the M12 bolts (21 - 24) an additional 75°. 8. Tighten the three M8 bolts (27 - 29) to 30 N.m (22 Ft. Lbs.).	Tightening Sequence
3	Engine Block Timing Plug	30 N.m (22 Ft. Lbs.)	-
5	Piston Rod Cap Bolt	-	Serviced with Assembly
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-
-	Engine Ground to Engine Block	20 N.m (15 Ft. Lbs.)	-
-	Engine Lifting Brackets	55 N.m (41 Ft. Lbs.)	-



LEFT TIMING CHAIN

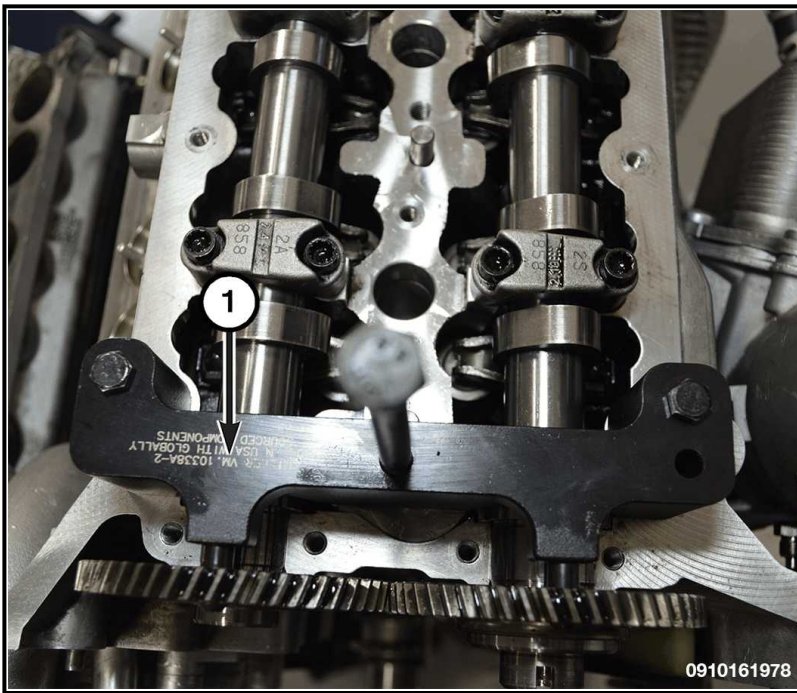
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
3. Remove the lower timing cover. Refer to [COVER\(S\), ENGINE TIMING, REMOVAL AND INSTALLATION](#) .
4. Lock the engine to 60 degrees ATDC. Refer to [VALVE TIMING](#) .



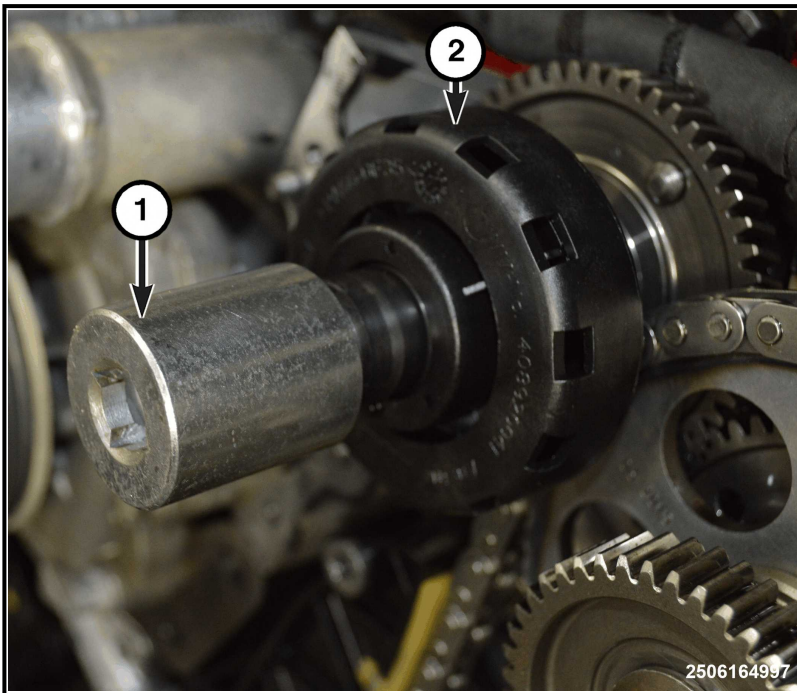
1 - Left Front Bearing Caps Bolts
2 - Left Front Bearing Caps

5. Remove the two left front bearing caps bolts and the two left front bearing caps.



1 - Left Camshaft Timing Tool

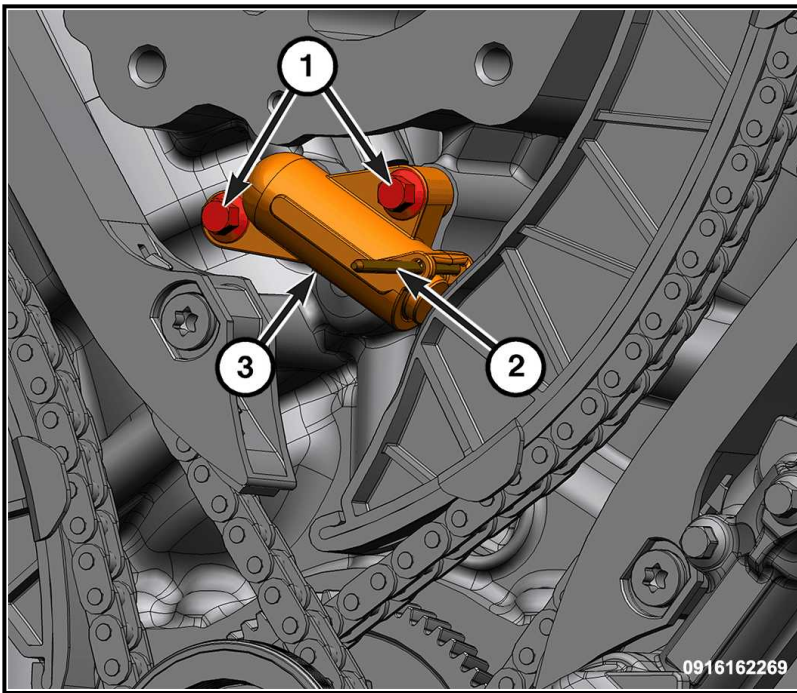
6. Install the (special tool #VM.10338-2, Timing Tool, Camshaft (Left)) and securely tighten the bolts.



1 - Oil Separator Remover/Installer Tool

2 - Oil Separator

7. Using the (special tool #VM.10344, Tool, Oil Separator Remover/Installer), remove the oil separator from the left intake camshaft.



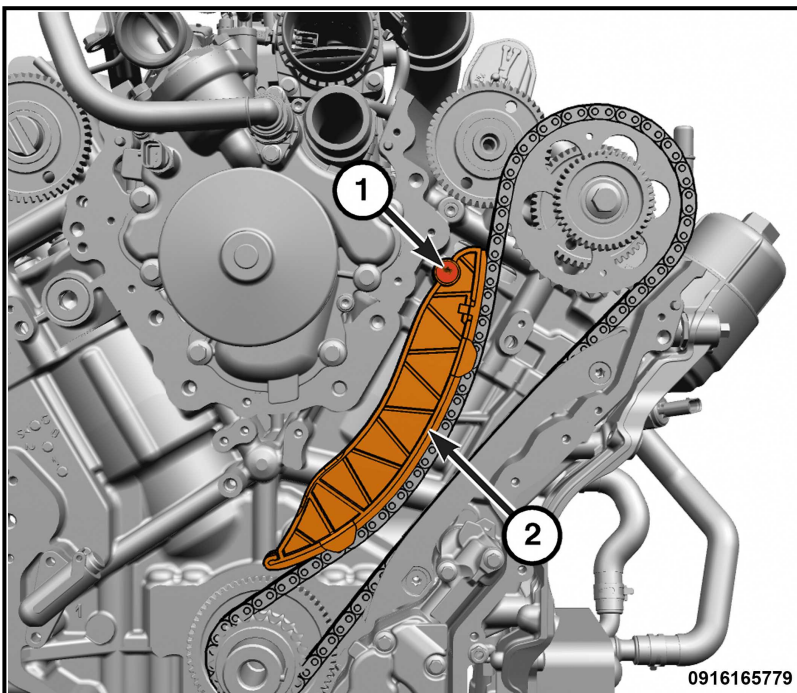
1 - Timing Chain Tensioner Bolts

2 - Tensioner Pin Tool

3 - Timing Chain Tensioner

8. Install the (special tool #VM.10359A, Pin, Tensioner) into the timing chain tensioner.

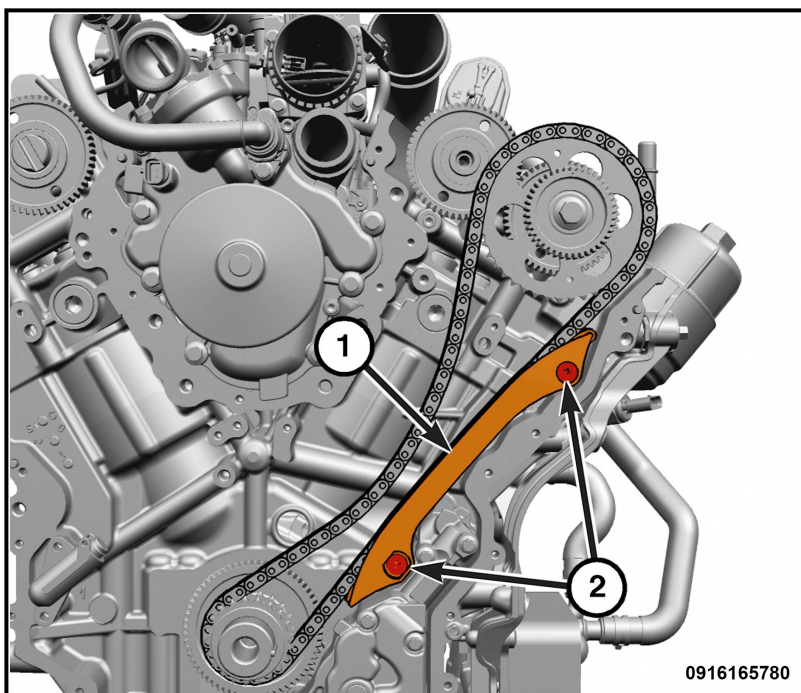
9. Remove the timing chain tensioner bolts and the left timing chain tensioner.



1 - Left Inner Timing Chain Guide Bolt

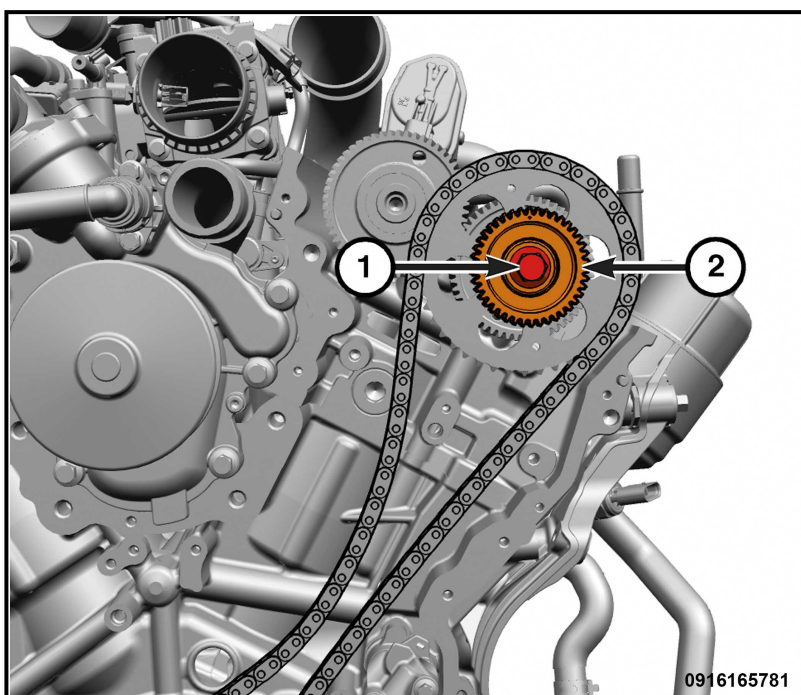
2 - Left Inner Timing Chain Guide

10. Remove the left inner timing chain guide bolt, and the left inner timing chain guide.



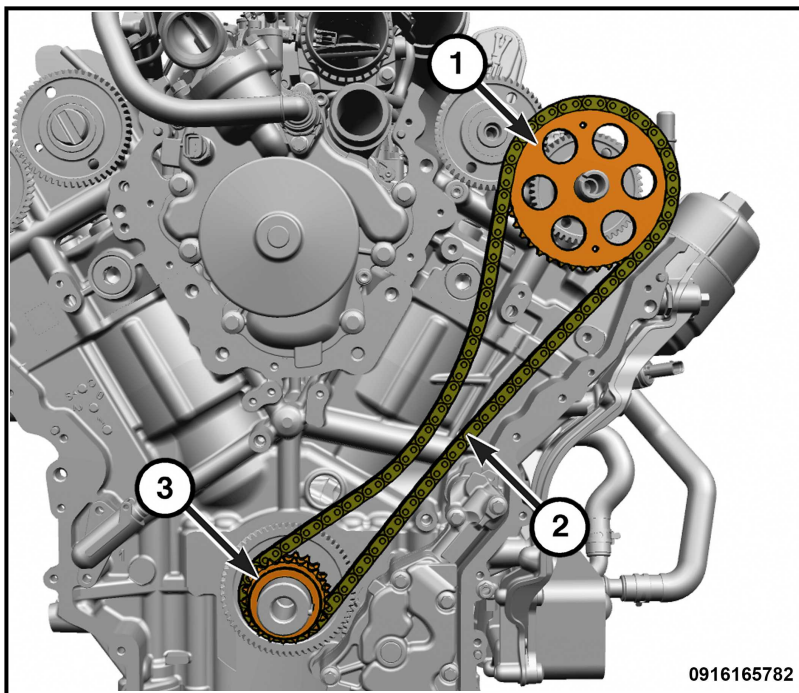
- | |
|---|
| 1 - Left Outer Timing Chain Guide |
| 2 - Left Outer Timing Chain Guide Bolts |

11. Remove the left outer timing chain guide bolts and the left outer timing chain guide.



- | |
|---|
| 1 - Fuel Injection Pump Drive Gear Bolt |
| 2 - Fuel Injection Pump Drive Gear |

12. Remove the fuel injection pump drive gear bolt and the fuel injection pump drive gear.



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1 - Left Camshaft Sprocket

2 - Timing Chain

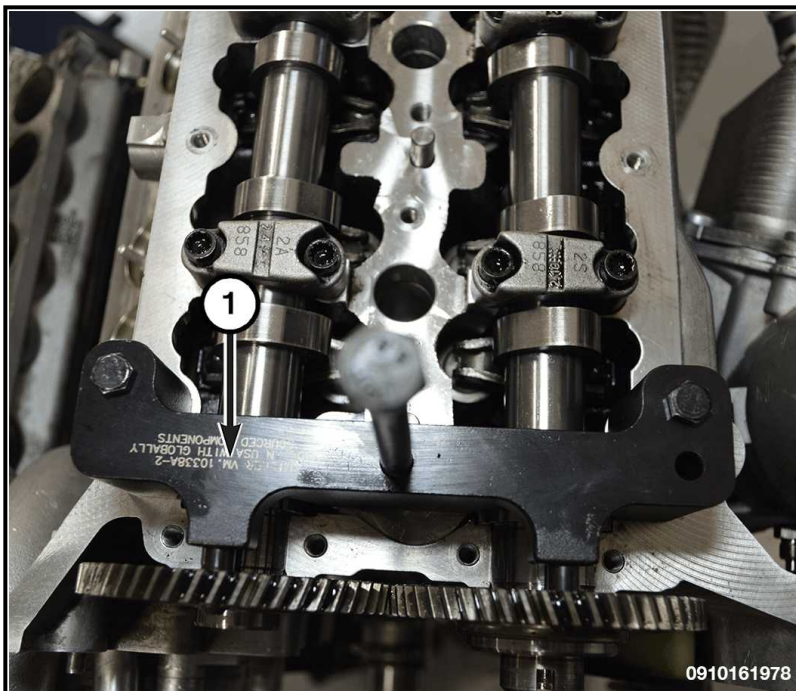
3 - Crankshaft Sprocket

13. Remove the left camshaft sprocket, timing chain and the crankshaft sprocket.

14. If necessary, remove the oil pump drive gear.

INSTALLATION

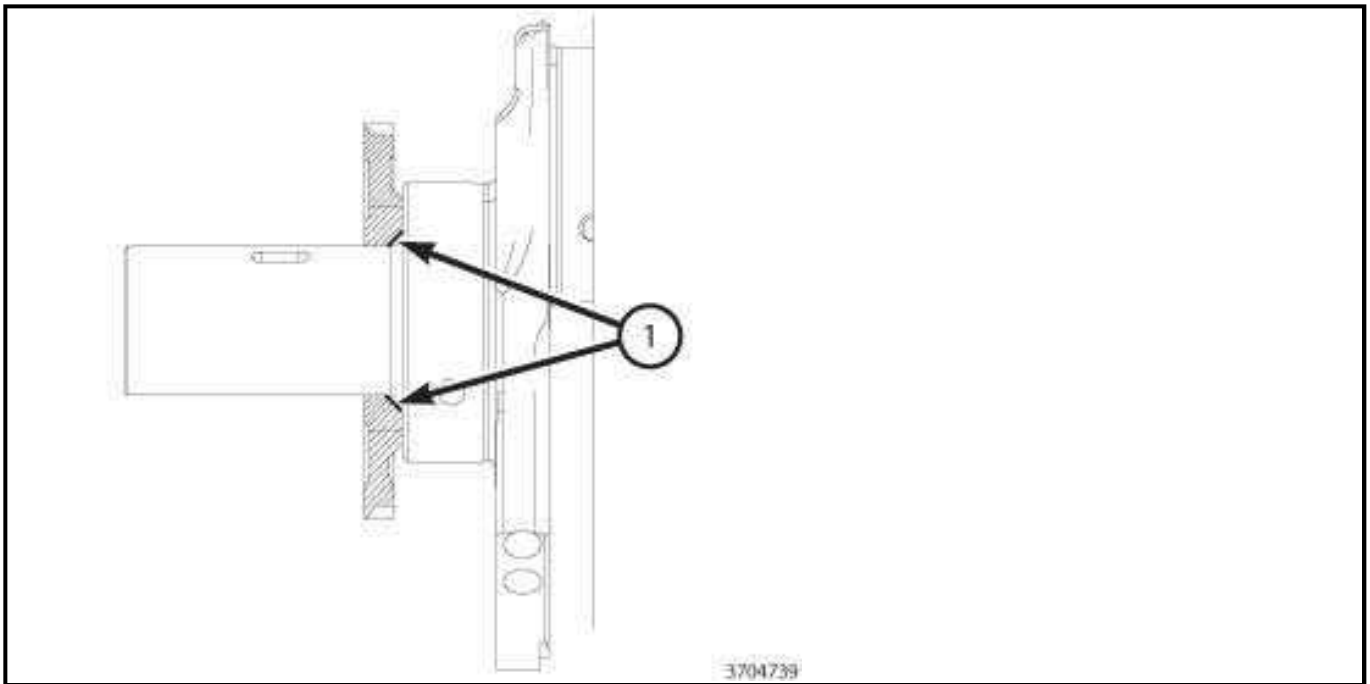
During installation, torque the fasteners to the specifications in the torque table(s) below.



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1 - Left Camshaft Timing Tool

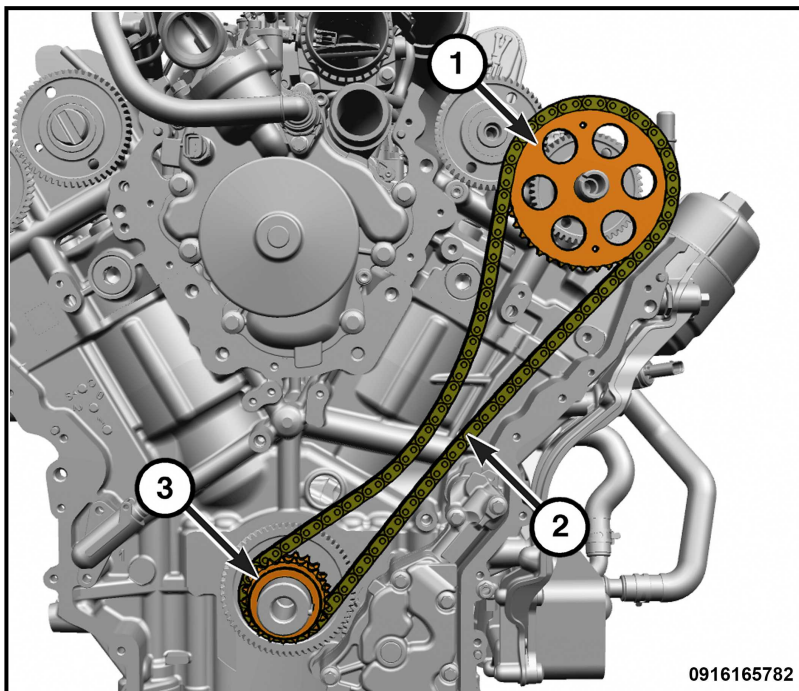
NOTE: The camshafts should already be timed and the (special tool #VM.10338-2, Timing Tool, Camshaft (Left)) installed.



1 - Oil Pump Drive Gear Beveled Edge

NOTE: The oil pump drive gear beveled edge which should be facing the engine.

1. If removed, install the oil pump drive gear with beveled edge facing the engine.

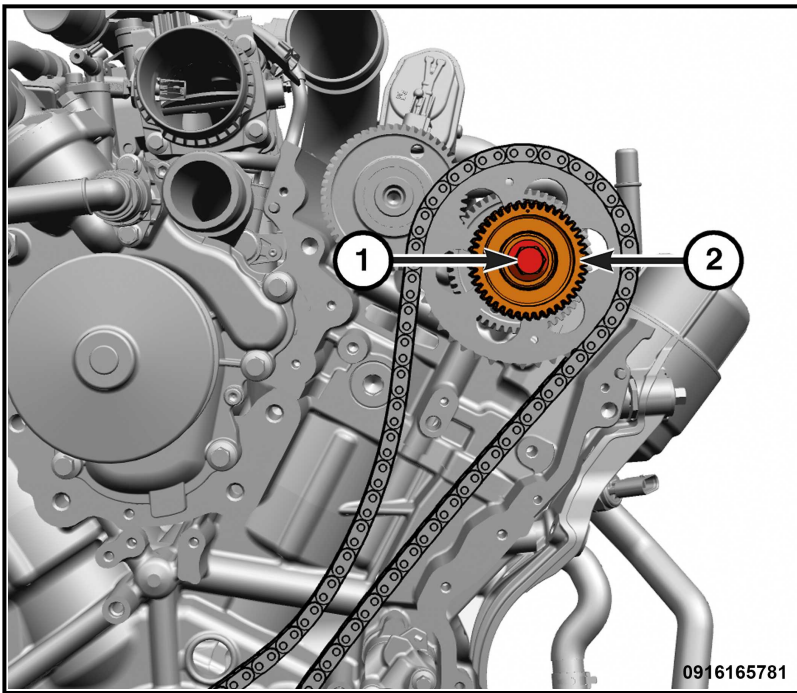


1 - Left Camshaft Sprocket

2 - Timing Chain

3 - Crankshaft Sprocket

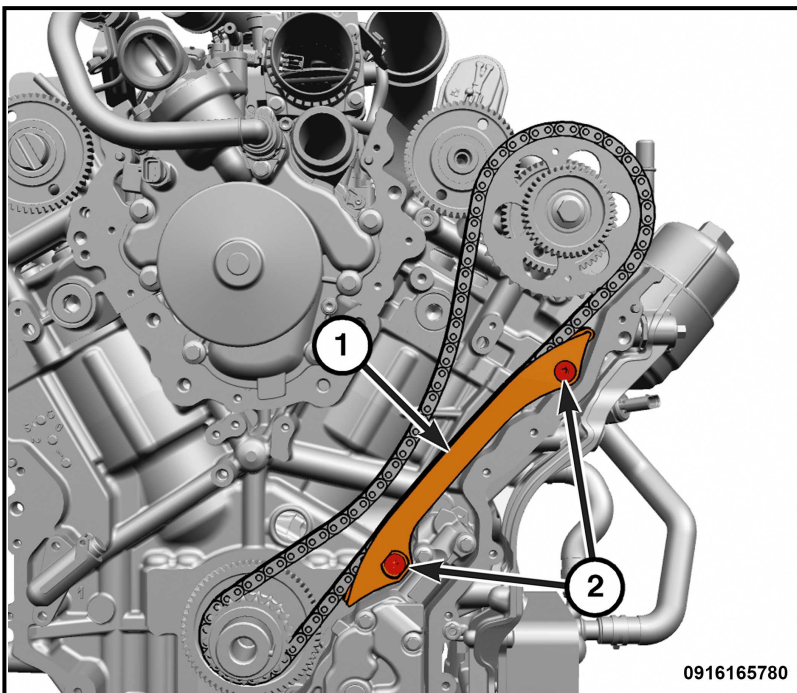
2. Install the crankshaft timing chain sprocket.
3. Install the left timing chain and camshaft timing chain sprocket.



1 - Fuel Injection Pump Drive Gear Bolt

2 - Fuel Injection Pump Drive Gear

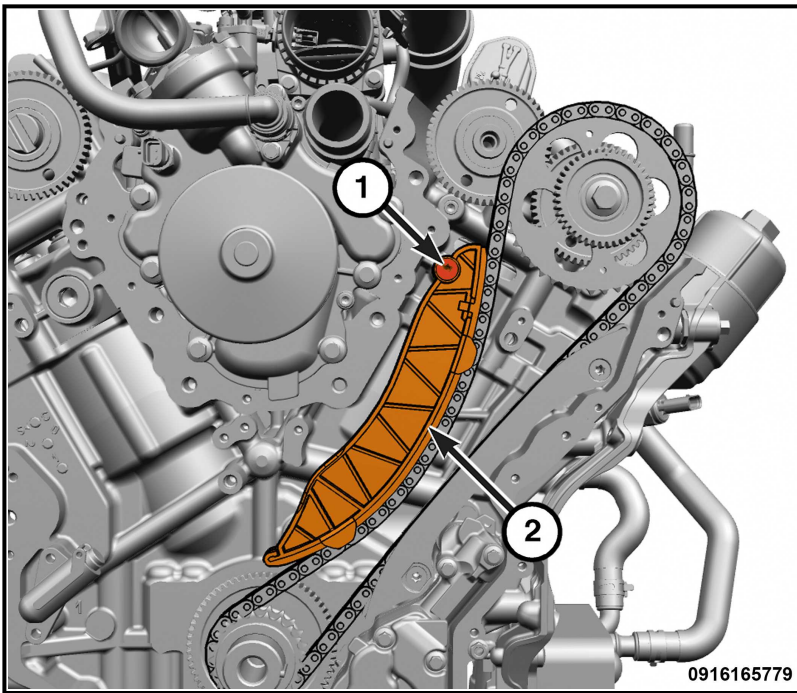
4. Install the fuel injection pump drive gear and tighten the fuel injection pump drive gear bolt finger tight.



1 - Left Outer Timing Chain Guide

2 - Left Outer Timing Chain Guide Bolts

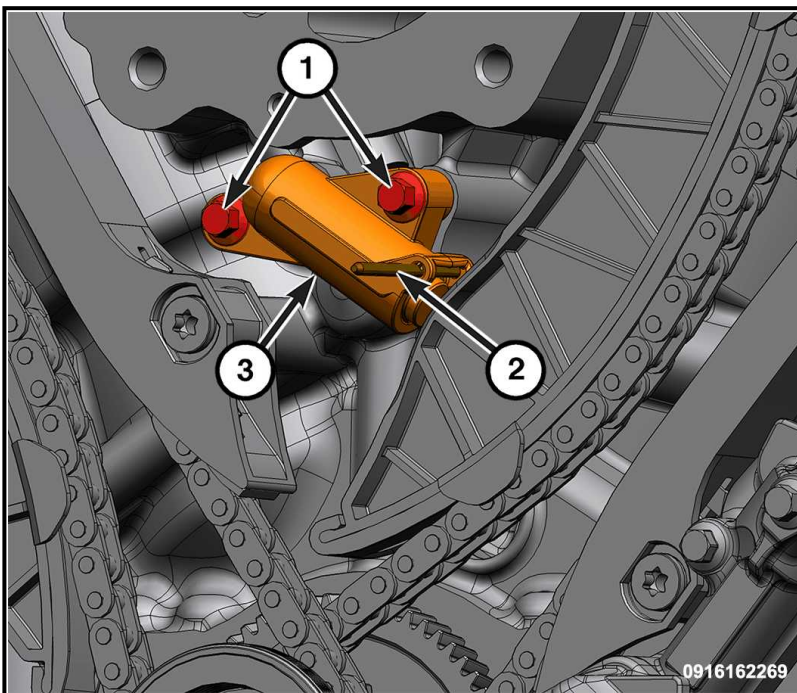
5. Install the left outer timing chain guide and tighten the left outer timing chain guide bolts to the proper torque specifications.



1 - Left Inner Timing Chain Guide Bolt

2 - Left Inner Timing Chain Guide

6. Install the left inner timing chain guide and tighten the left inner timing chain guide bolt to the proper torque specifications.

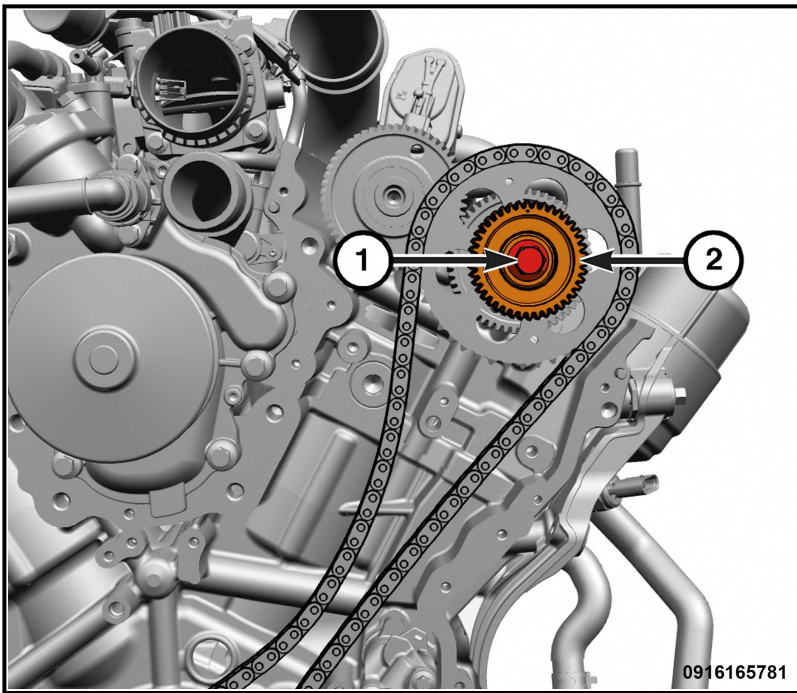


1 - Timing Chain Tensioner Bolts

2 - Tensioner Pin Tool

3 - Timing Chain Tensioner

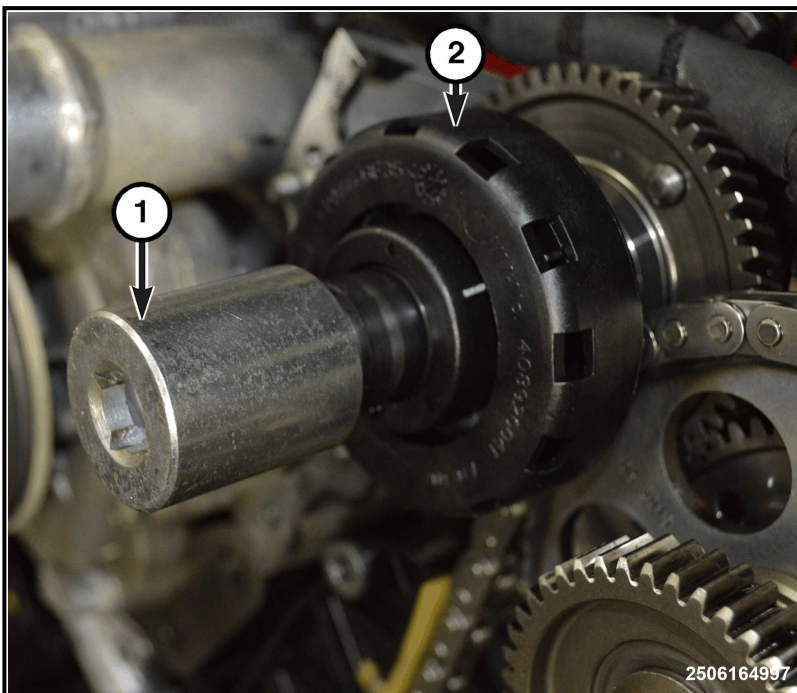
7. Install the left timing chain tensioner and tighten the left timing chain tensioner bolts to the proper torque specifications.
8. Remove the (special tool #VM.10359A, Pin, Tensioner) from the timing chain tensioner.



1 - Fuel Injection Pump Drive Gear Bolt

2 - Fuel Injection Pump Drive Gear

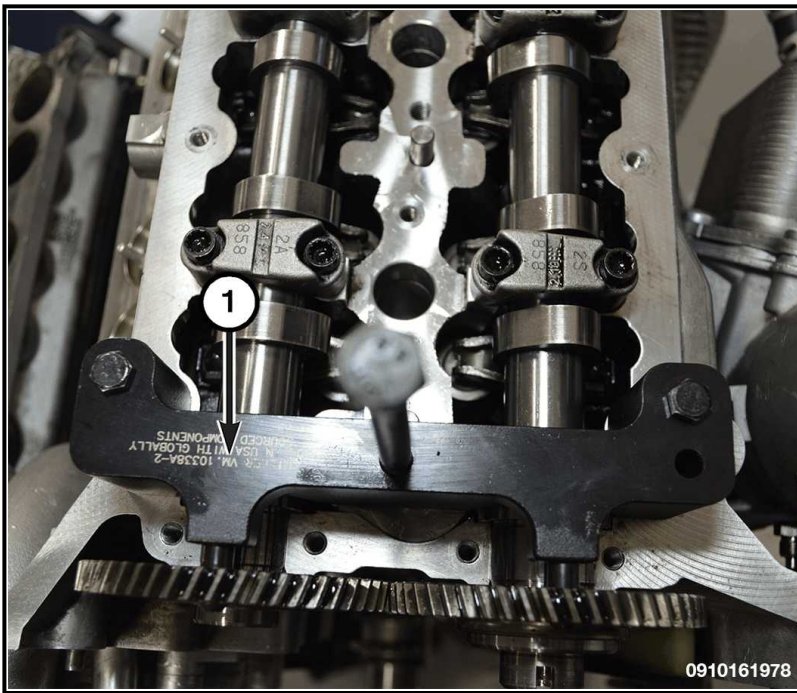
9. Tighten the fuel injection pump drive gear bolt to proper torque specifications.



1 - Oil Separator Remover/Installer Tool
--

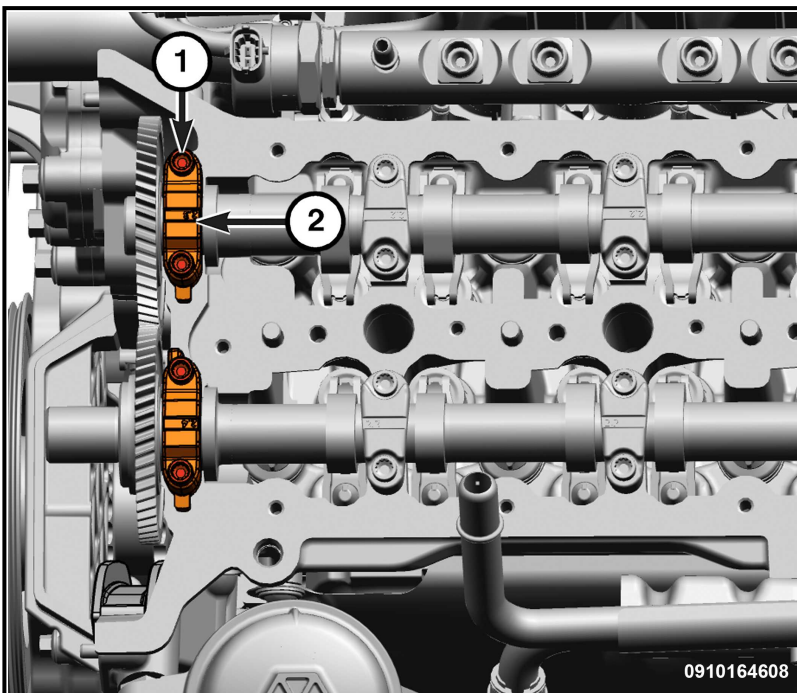
2 - Oil Separator

10. Using the (special tool #VM.10344, Tool, Oil Separator Remover/Installer), install the oil separator and tighten to the proper torque specifications.



1 - Left Camshaft Timing Tool

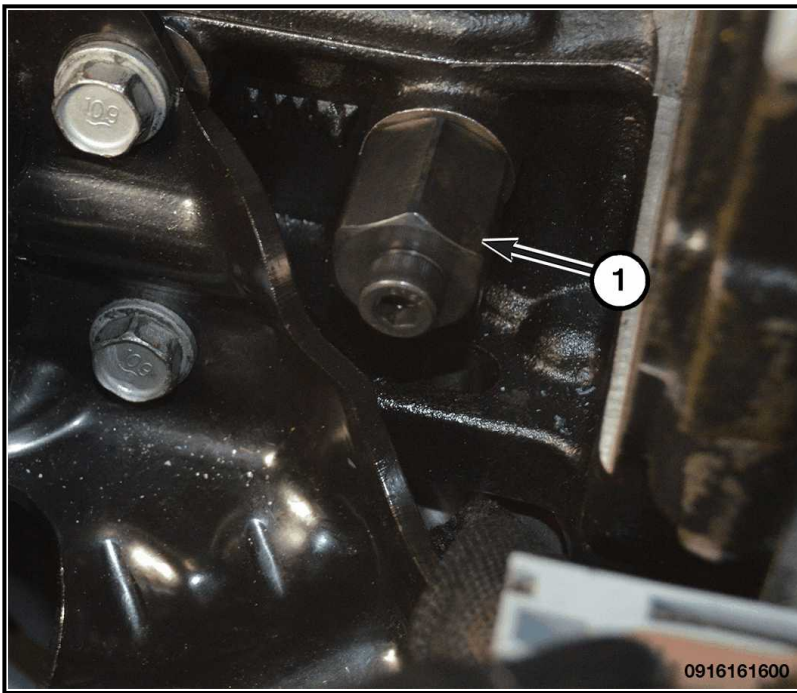
11. Remove the bolts and the (special tool #VM.10338-2, Timing Tool, Camshaft (Left)).



1 - Left Front Bearing Caps Bolts

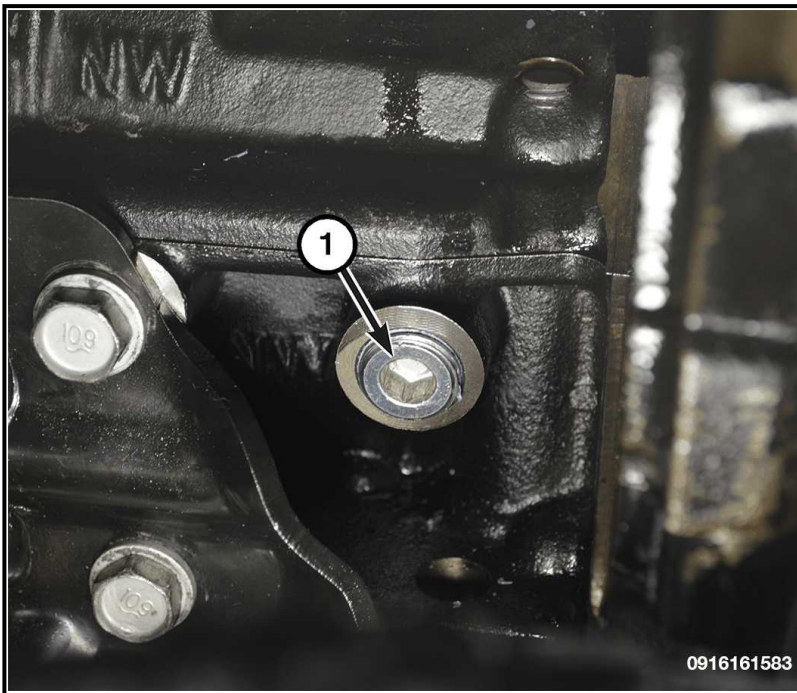
2 - Left Front Bearing Caps

12. Install the two left front camshaft bearing caps and tighten the bearing caps bolts to the proper torque specifications.



1 - Crankshaft Timing Tool

13. Remove the (special tool #VM.10339, Tool, Crankshaft Timing).

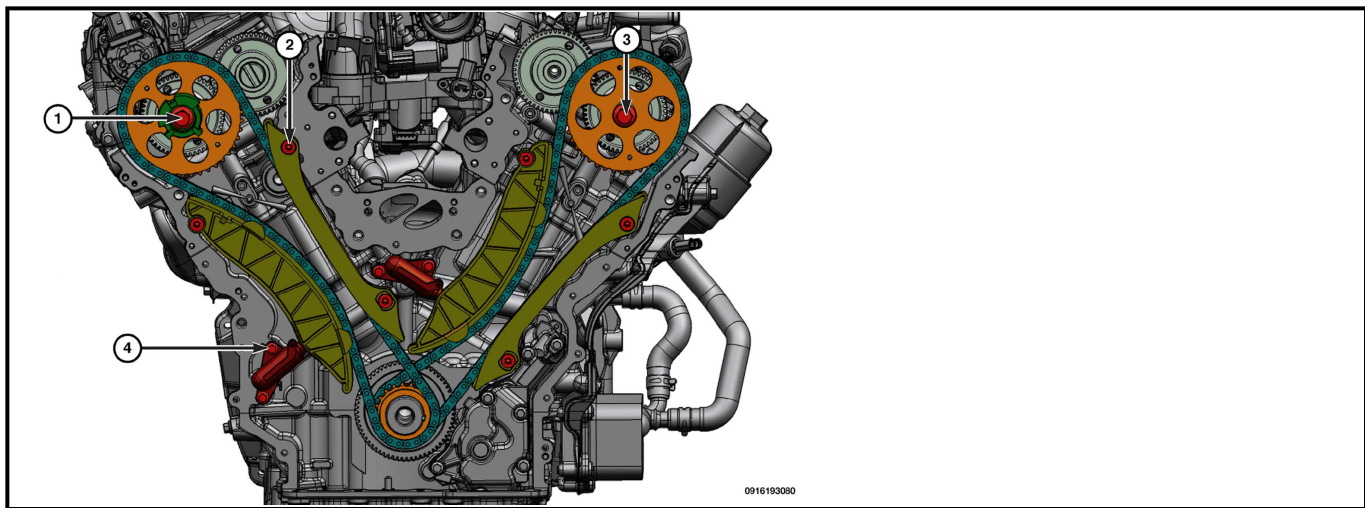


1 - Engine Block Plug

14. Install the engine block plug and tighten to the proper torque specifications.
15. Install the lower timing cover. Refer to [COVER\(S\), ENGINE TIMING, REMOVAL AND INSTALLATION](#).
16. Connect the negative battery cable(s). Refer to [CABLES, BATTERY](#).
17. Start engine and inspect for leaks. Care must be taken to observe the fuel system warnings.
18. Install the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#)

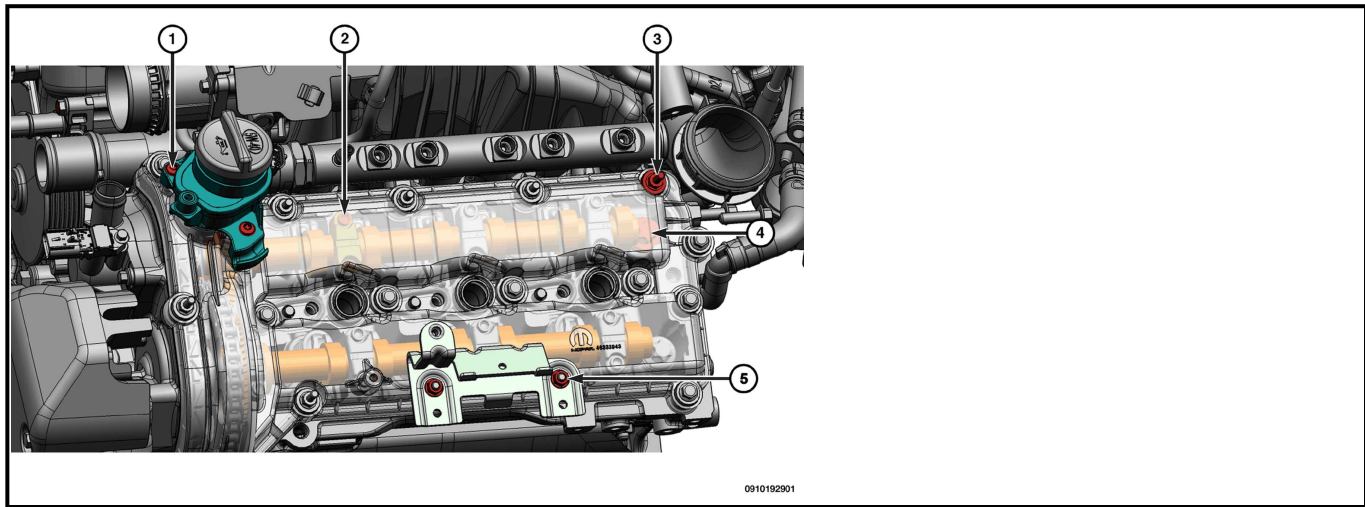
TORQUE SPECIFICATIONS

VALVE TIMING



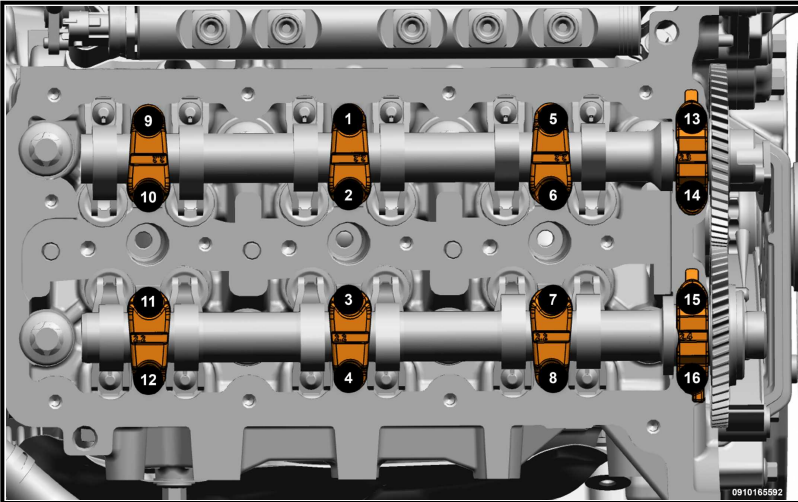
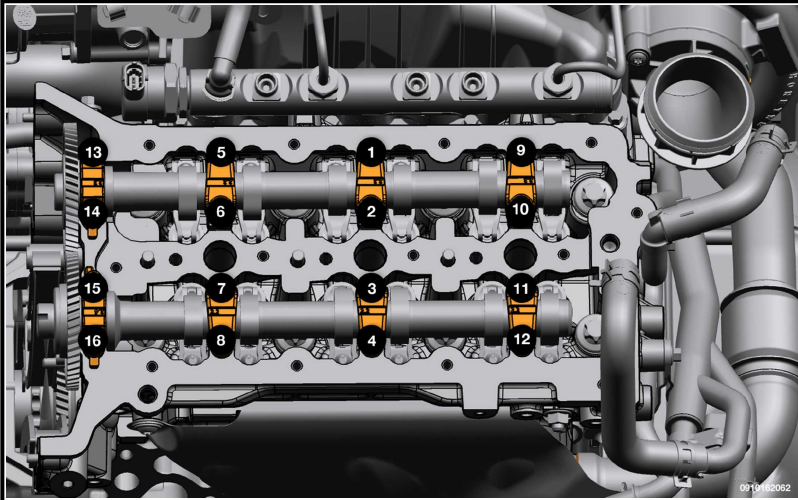
CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Fuel Injection Pump Drive Gear Bolt (On Left Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 75°	-
2	Timing Chain Guide Bolts	30 N.m (22 Ft. Lbs.)	-
3	Reluctor Wheel Bolt (On Right Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 73°	-
4	Timing Chain Tensioner	14 N.m (11 Ft. Lbs.)	-
-	Oil Separator Bolt	30 N.m (22 Ft. Lbs.)	-

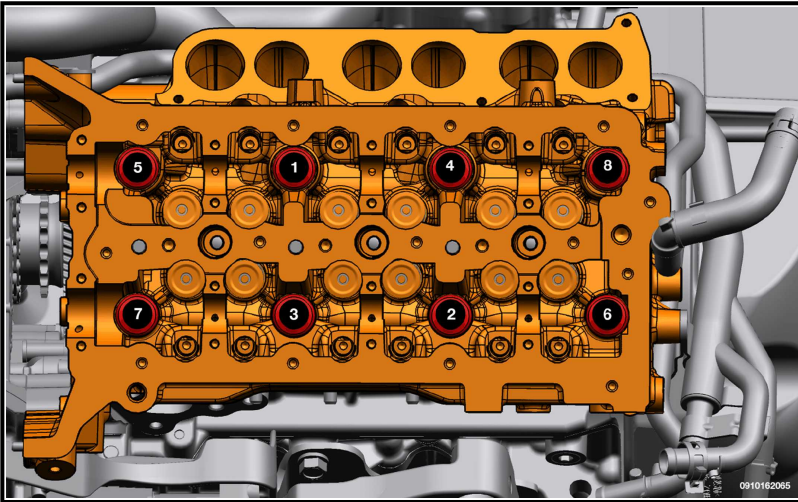
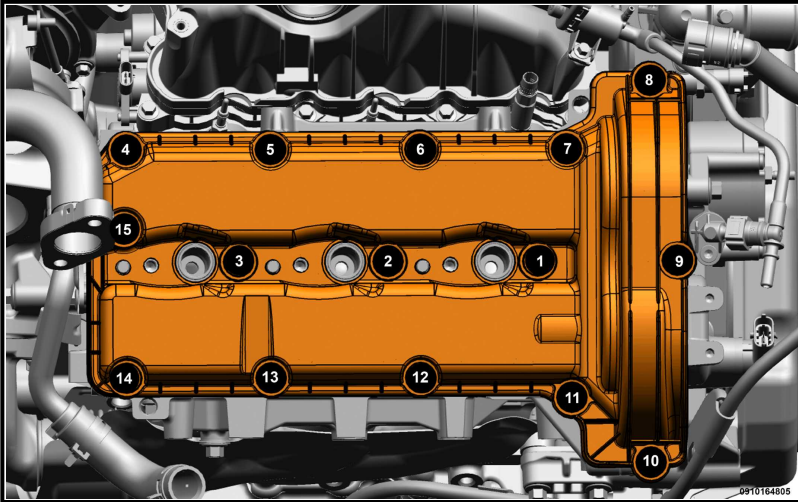
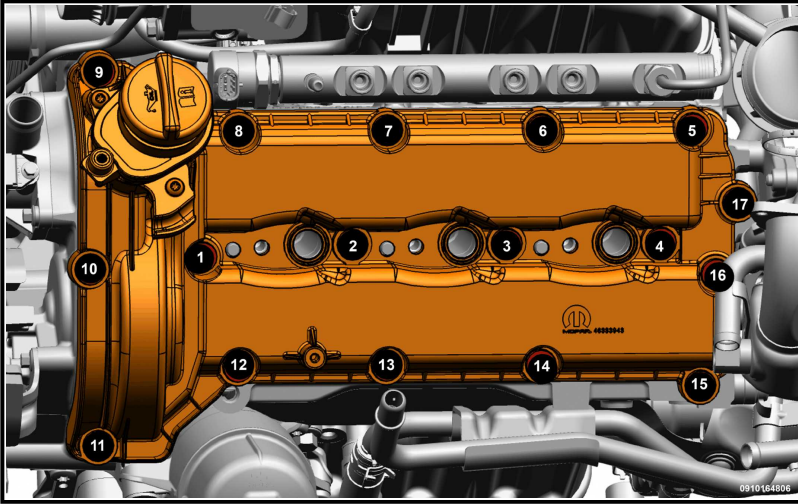
CYLINDER HEAD

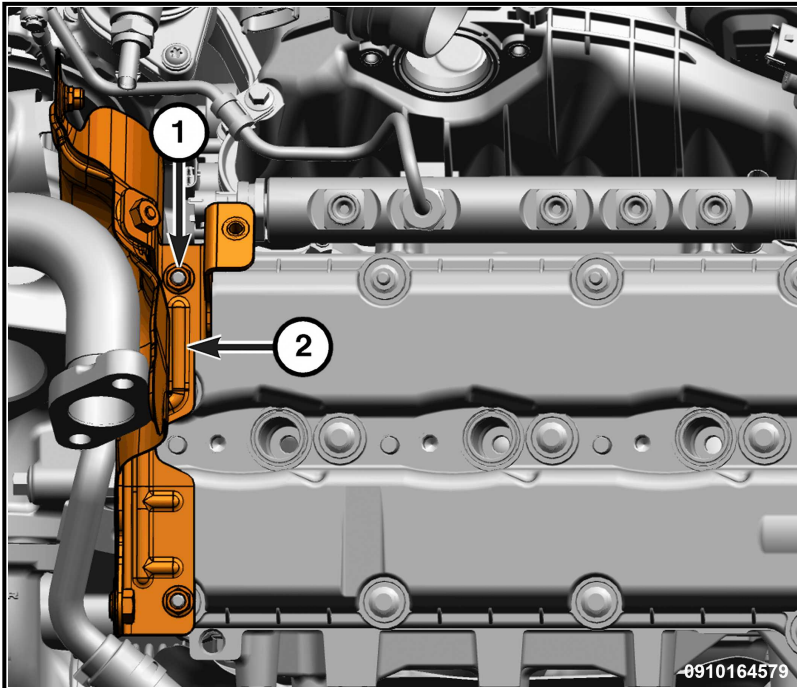
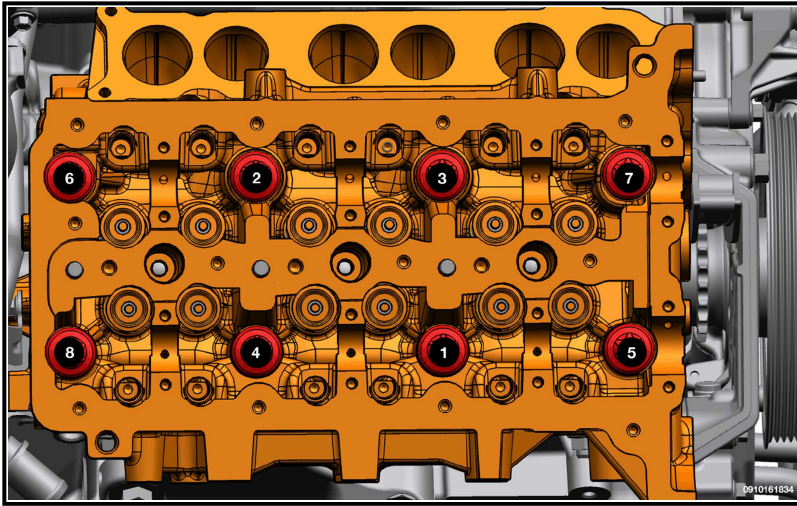


CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1	Oil Filler Neck Assembly to Valve Cover	Tighten Securely	-
2	Camshaft Bearing Cap Bolts	11 N.m (8 Ft. Lbs.)	Tightening Sequence
3	Cylinder Head Cover Bolts	Torque Procedure: 1. Tighten the cylinder head cover bolts finger tight. 2. Tighten bolts to 8 N.m (71 In. Lbs.). 3. Loosen each bolt 90°.	Tightening Sequence

CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
		4. Tighten bolts to 10 N.m (89 In. Lbs.).	
4	Cylinder Head Bolts (M14)	Torque Procedure: 1. Tighten the cylinder head bolts finger tight. 2. Tighten bolts to 30 N.m (22 Ft. Lbs.). 3. Tighten bolts an additional 75° in sequence. 4. Tighten bolts an additional 75° in sequence. 5. Tighten bolts an additional 75° in sequence.	Tightening Sequence
5	Fuel Line Support Bracket Nuts	6 N.m 53 (In. Lbs.)	-
-	Coolant Tube Bolt	25 N.m (18 Ft. Lbs.)	-
-	Engine Wire Harness Bolts	11 N.m (8 Ft. Lbs.)	-
-	Heat Shield Bracket Nuts	6 N.m 53 (In. Lbs.)	



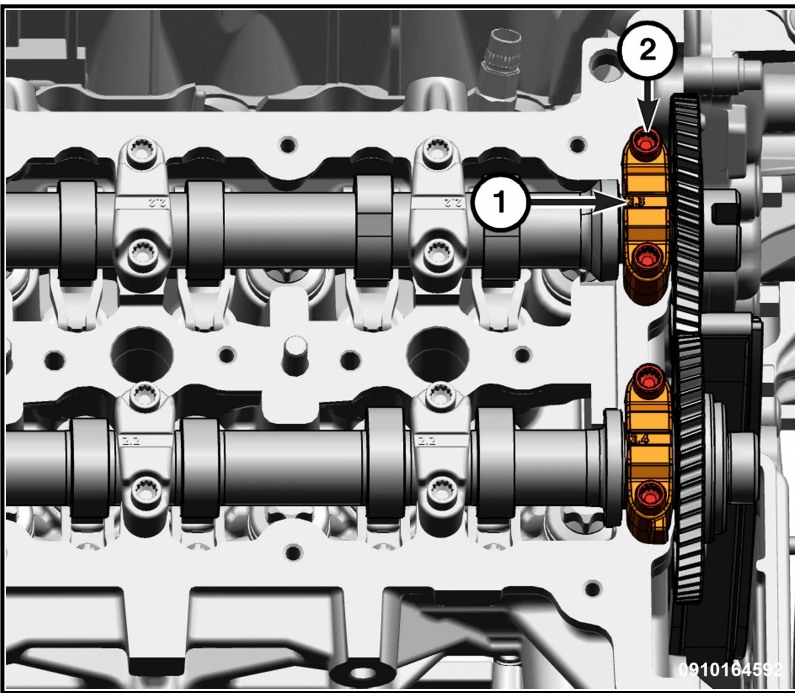




RIGHT TIMING CHAIN

REMOVAL

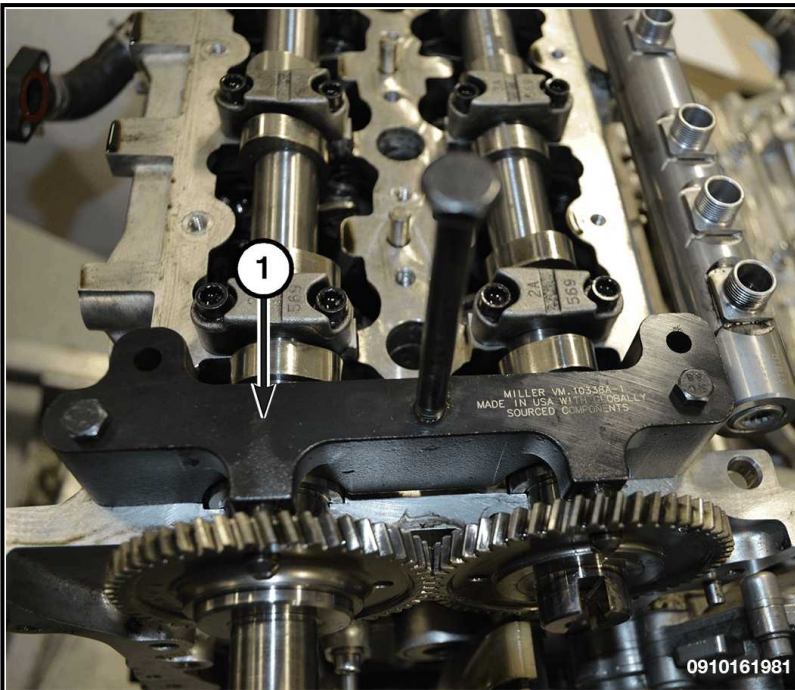
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
3. Remove the lower timing cover. Refer to [COVER\(S\), ENGINE TIMING, REMOVAL AND INSTALLATION](#) .
4. Lock the engine to 60 degrees ATDC. Refer to [VALVE TIMING](#) .



1 - Right Front Bearing Caps

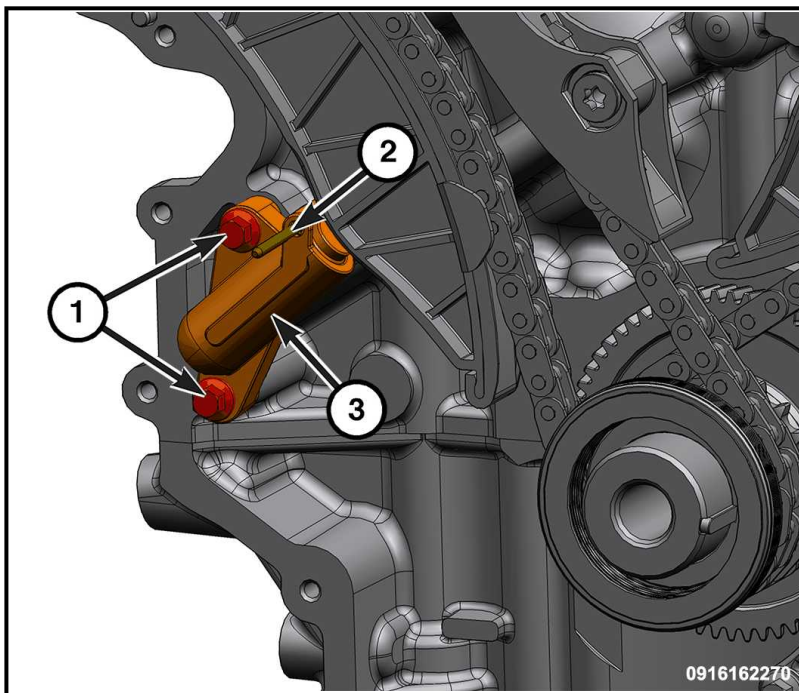
2 - Right Front Bearing Caps Bolts

5. Remove the two right front camshaft bearing caps bolts and the two right front camshaft bearing caps.



1 - Right Camshaft Timing Tool

6. Install the (special tool #VM.10338-1, Timing Tool, Camshaft (Right)) and securely tighten the bolts.



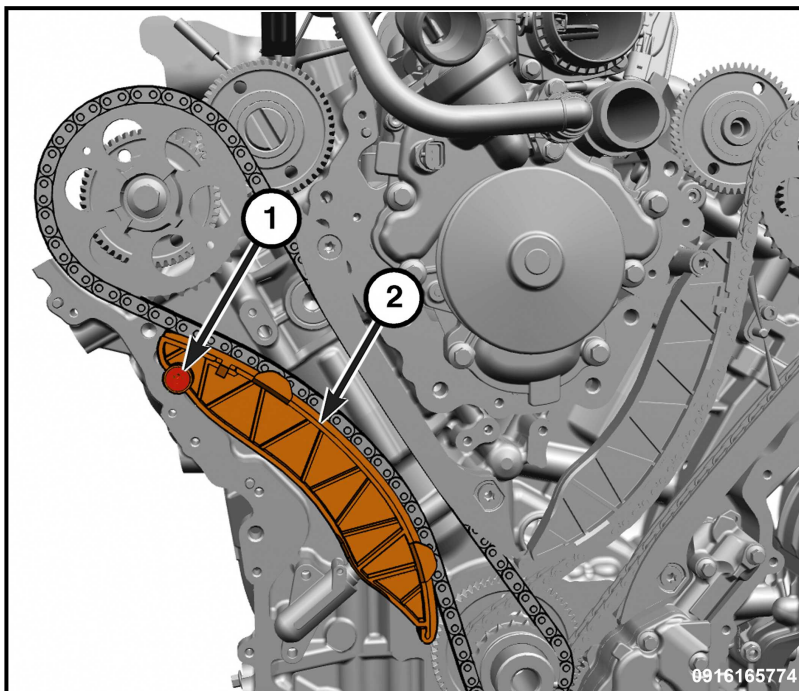
1 - Right Timing Chain Tensioner Bolts
--

2 - Tensioner Pin Tool

3 - Right Timing Chain Tensioner

7. Install the (special tool #VM.10359A, Pin, Tensioner) into the timing chain tensioner.

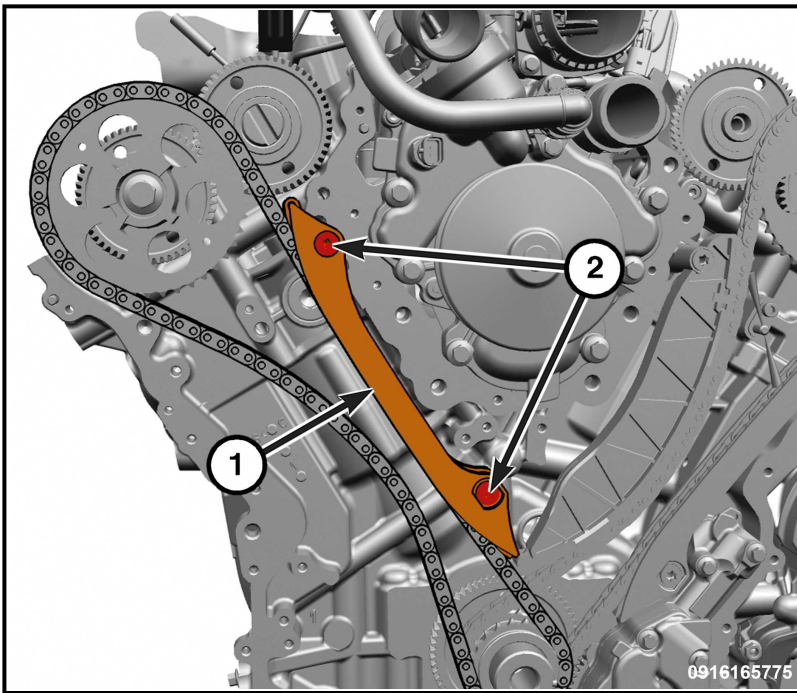
8. Remove the right timing chain tensioner bolts and the right timing chain tensioner.



1 - Right Outer Timing Chain Guide Bolt

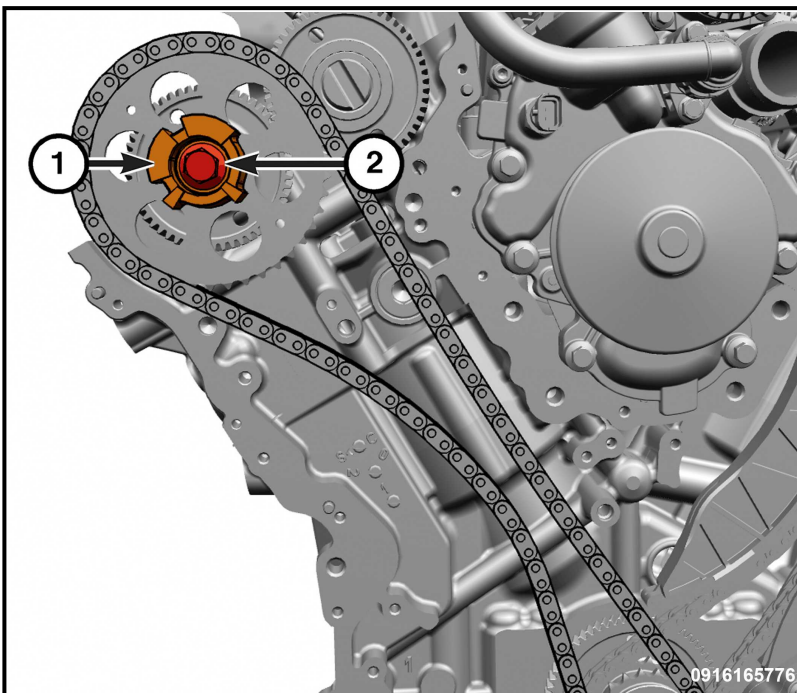
2 - Right Outer Timing Chain Guide

9. Remove the right outer timing chain guide bolts and the right outer timing chain guide.



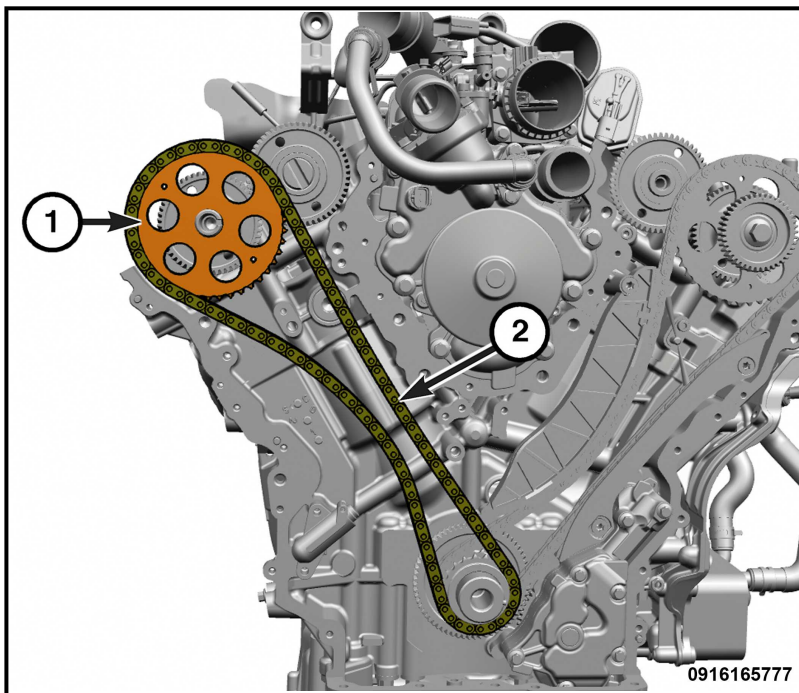
- | |
|---|
| 1 - Right Inner Timing Chain Guide |
| 2 - Right Inner Timing Chain Guide Bolt |

10. Remove the right inner timing chain guide bolts and the right inner timing chain guide.



- | |
|-------------------------|
| 1 - Reluctor Wheel Bolt |
| 2 - Reluctor Wheel |

11. Remove the reluctor wheel bolt and the reluctor wheel.



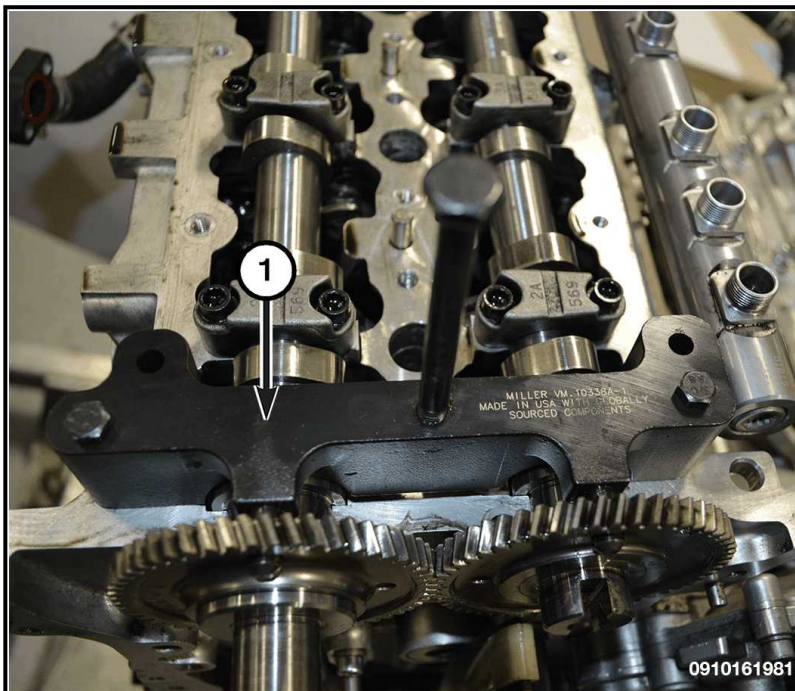
1 - Right Camshaft Sprocket

2 - Timing Chain

12. Remove the right camshaft sprocket and the timing chain.

INSTALLATION

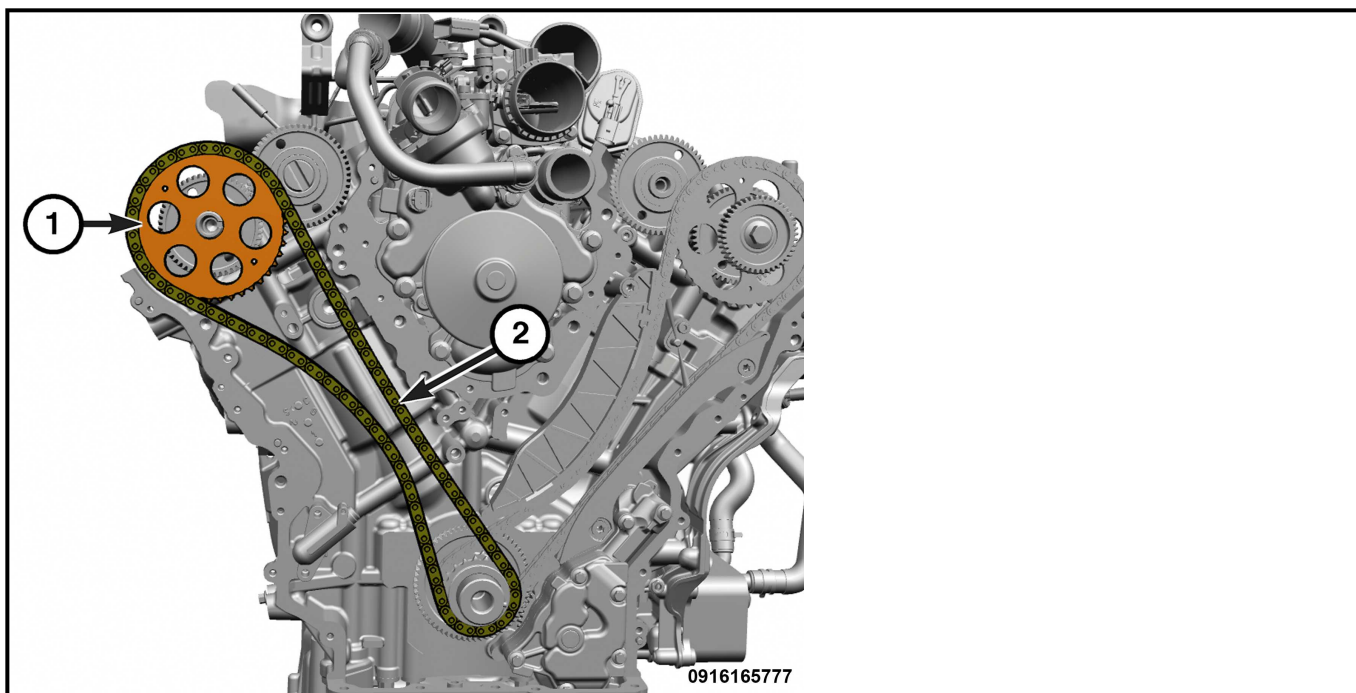
During installation, torque the fasteners to the specifications in the torque table(s) below.



1 - Right Camshaft Timing Tool

NOTE:

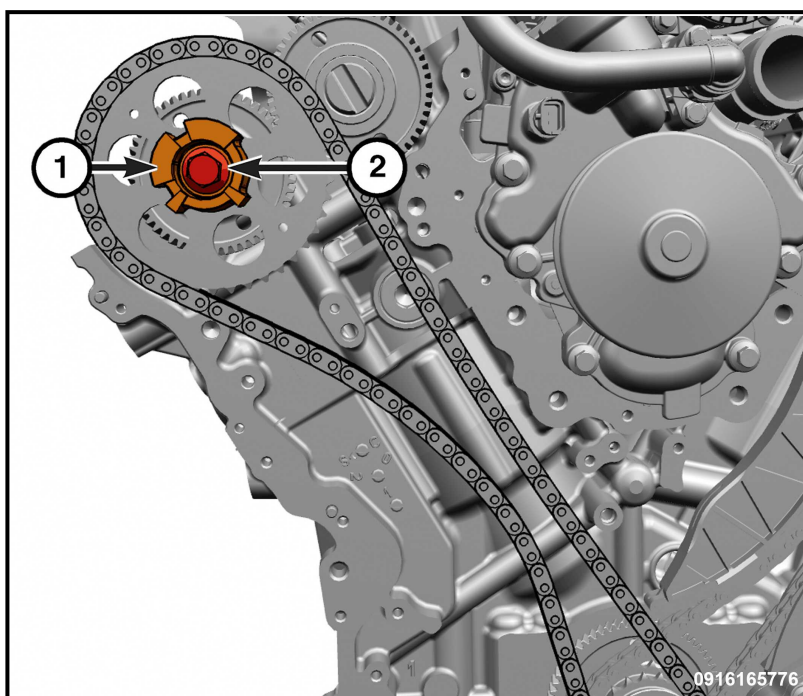
The camshafts should already be timed and the (special tool #VM.10338A, Tool, Camshaft Timing) installed.



1 - Right Camshaft Sprocket

2 - Timing Chain

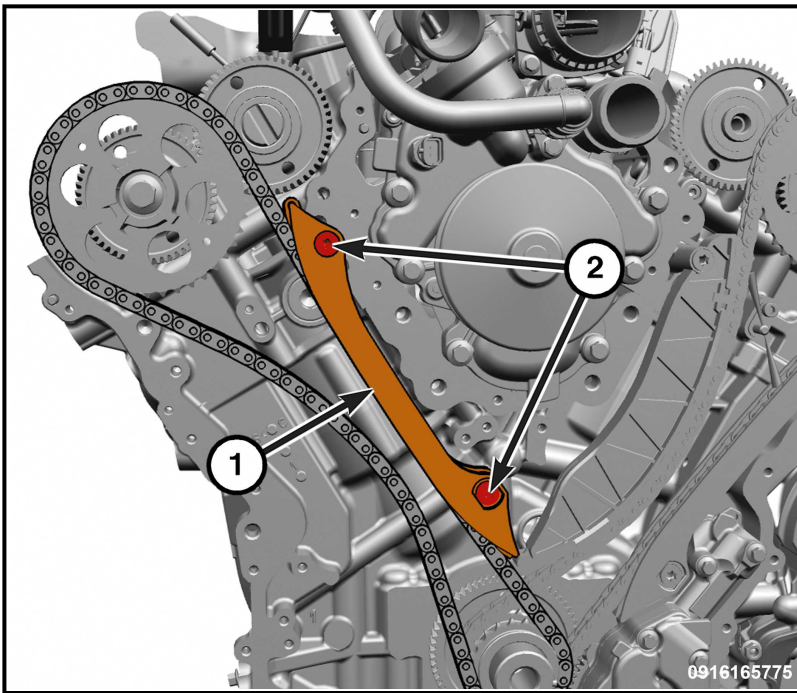
1. Install the timing chain and right camshaft sprocket.



1 - Reluctor Wheel Bolt

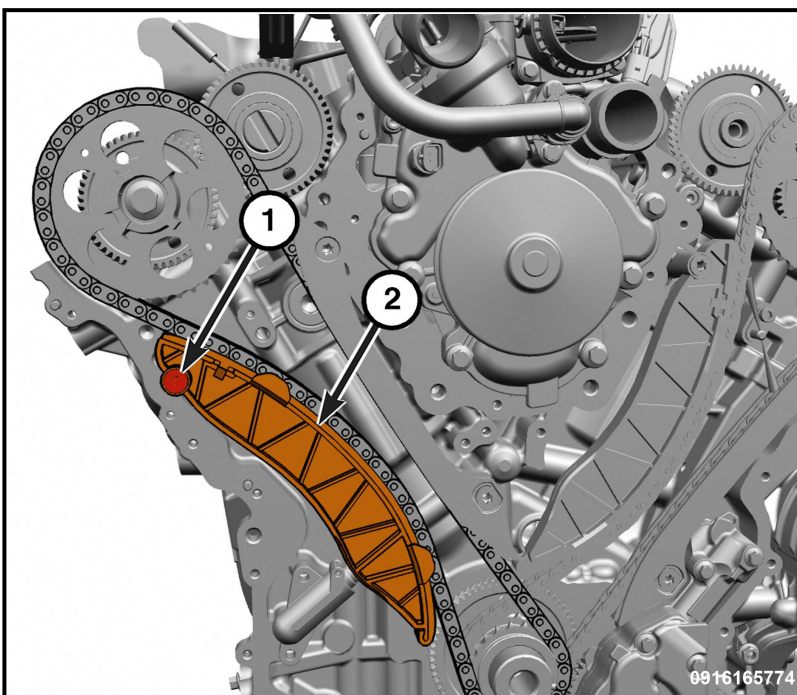
2 - Reluctor Wheel

2. Install the reluctor wheel and tighten the reluctor wheel bolt finger tight.



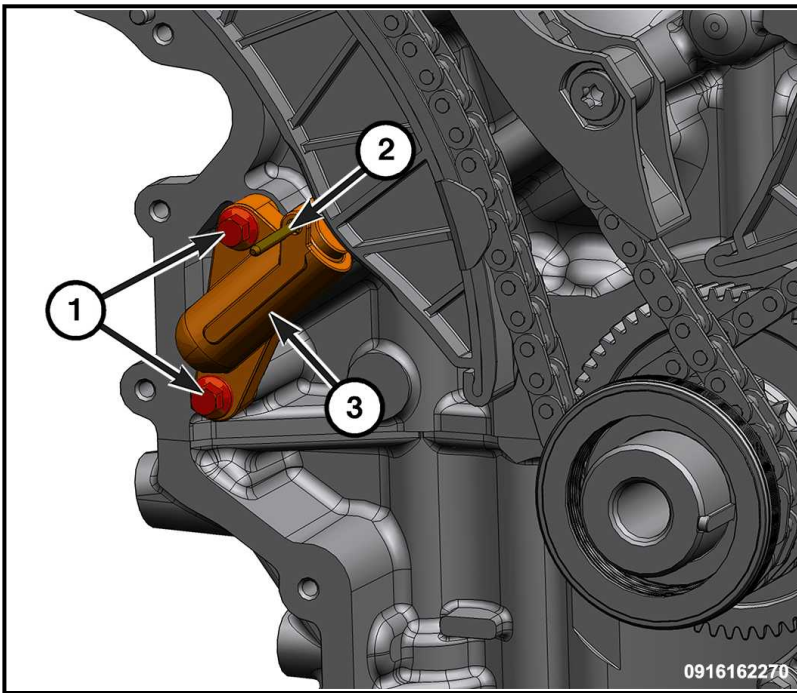
- | |
|---|
| 1 - Right Inner Timing Chain Guide |
| 2 - Right Inner Timing Chain Guide Bolt |

3. Install the right inner timing chain guide and tighten the right inner timing chain guide bolts to the proper torque specifications.



- | |
|---|
| 1 - Right Outer Timing Chain Guide Bolt |
| 2 - Right Outer Timing Chain Guide |

4. Install the right outer timing chain guide and tighten the right outer timing chain guide bolt to the proper torque specifications.

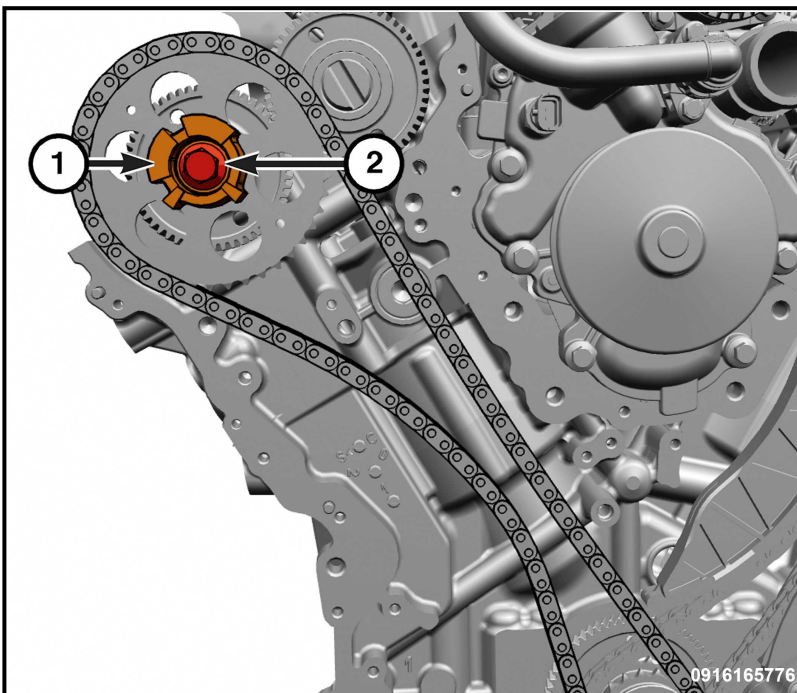


1 - Right Timing Chain Tensioner Bolts
--

2 - Tensioner Pin Tool

3 - Right Timing Chain Tensioner

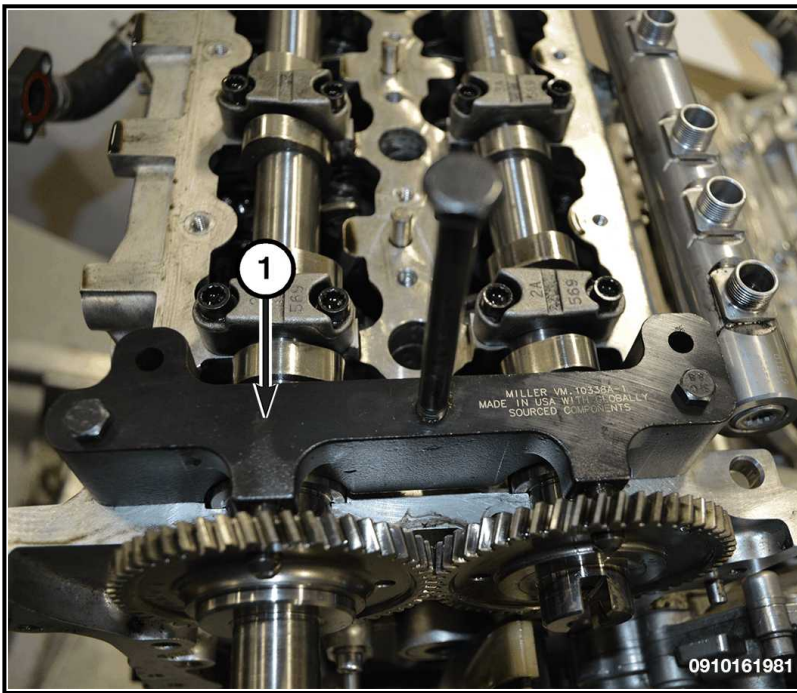
5. Install the right engine timing tensioner and tighten the right engine timing tensioner bolts to the proper torque specifications.
6. Remove the (special tool #VM.10359A, Pin, Tensioner) from the timing chain tensioner.



1 - Reluctor Wheel Bolt

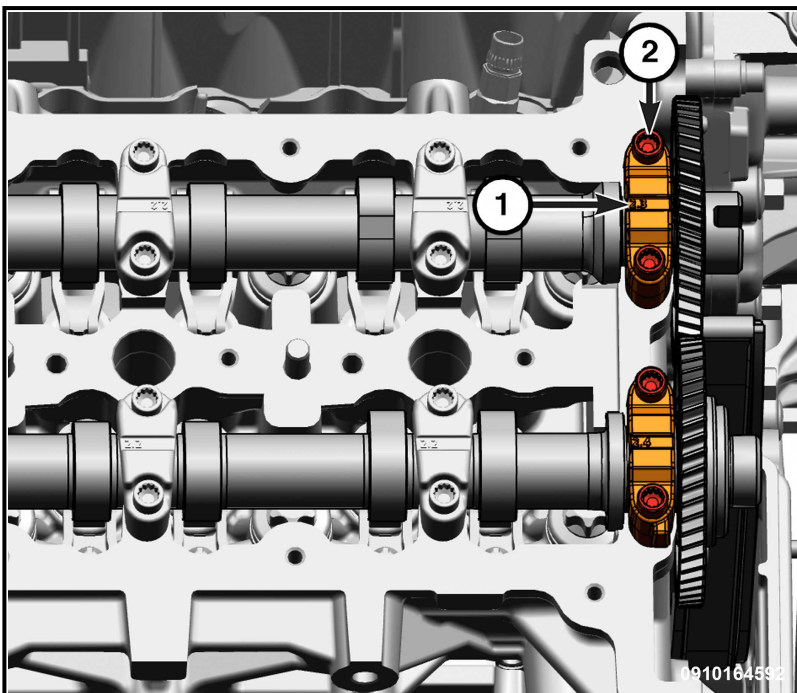
2 - Reluctor Wheel

7. Tighten the reluctor wheel bolt to the proper torque specifications.



1 - Right Camshaft Timing Tool

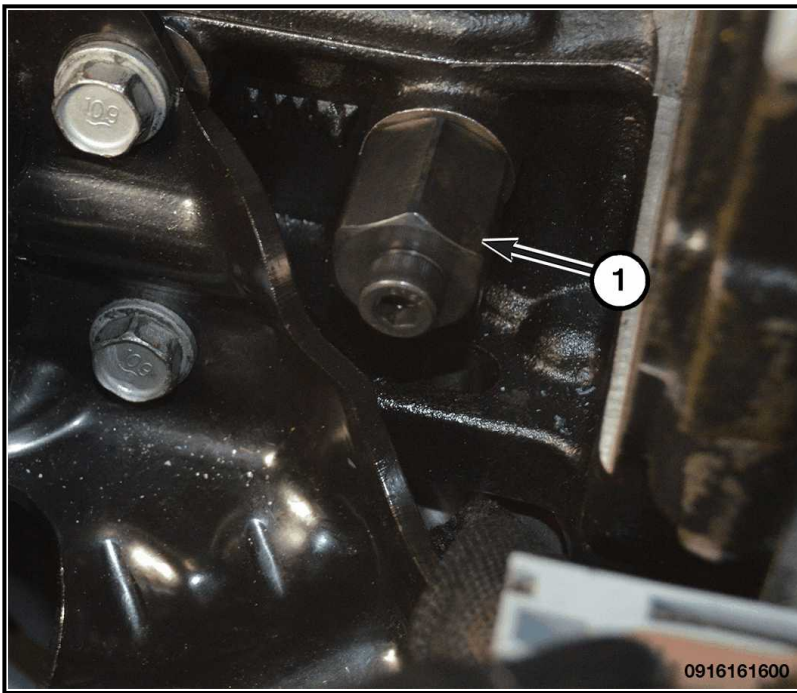
8. Remove the (special tool #VM.10338-1, Timing Tool, Camshaft (Right)).



1 - Right Front Bearing Caps

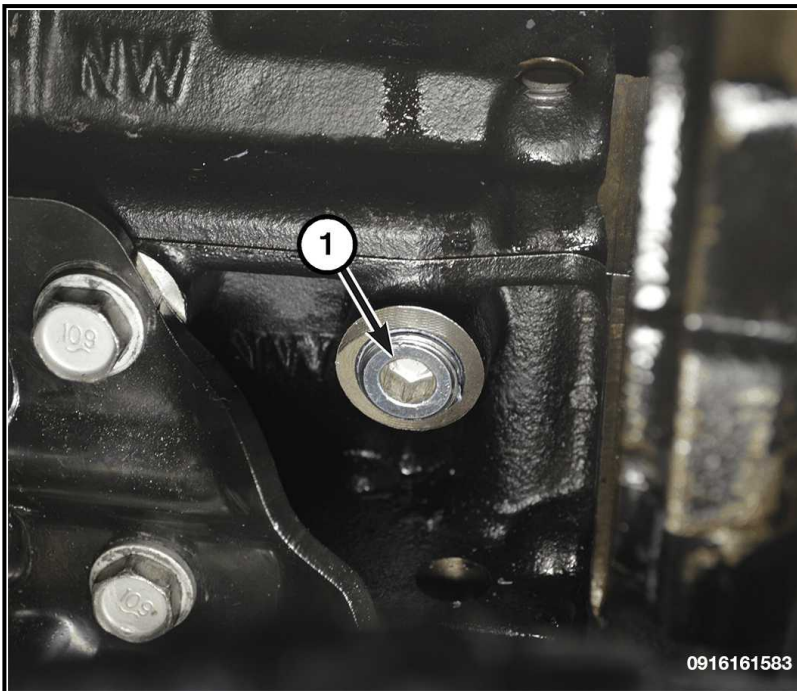
2 - Right Front Bearing Caps Bolts

9. Install the two right front camshaft bearing caps and tighten the bearing cap bolts to the proper torque specifications.



1 - Crankshaft Timing Tool

10. Remove the (special tool #VM.10339, Tool, Crankshaft Timing).

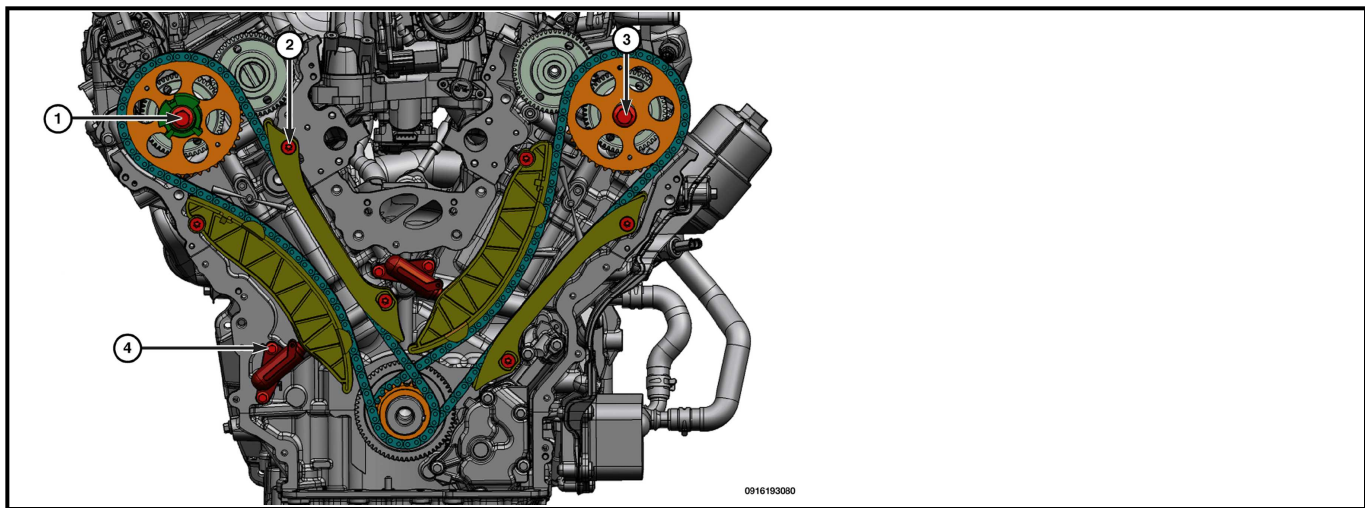


1 - Engine Block Plug

11. Install the engine block plug and tighten to the proper torque specifications.
12. Install the lower timing cover. Refer to [COVER\(S\), ENGINE TIMING, REMOVAL AND INSTALLATION](#).
13. Connect the negative battery cable(s). Refer to [CABLES, BATTERY](#).
14. Start engine and inspect for leaks. Care must be taken to observe the fuel system warnings.
15. Install the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#).

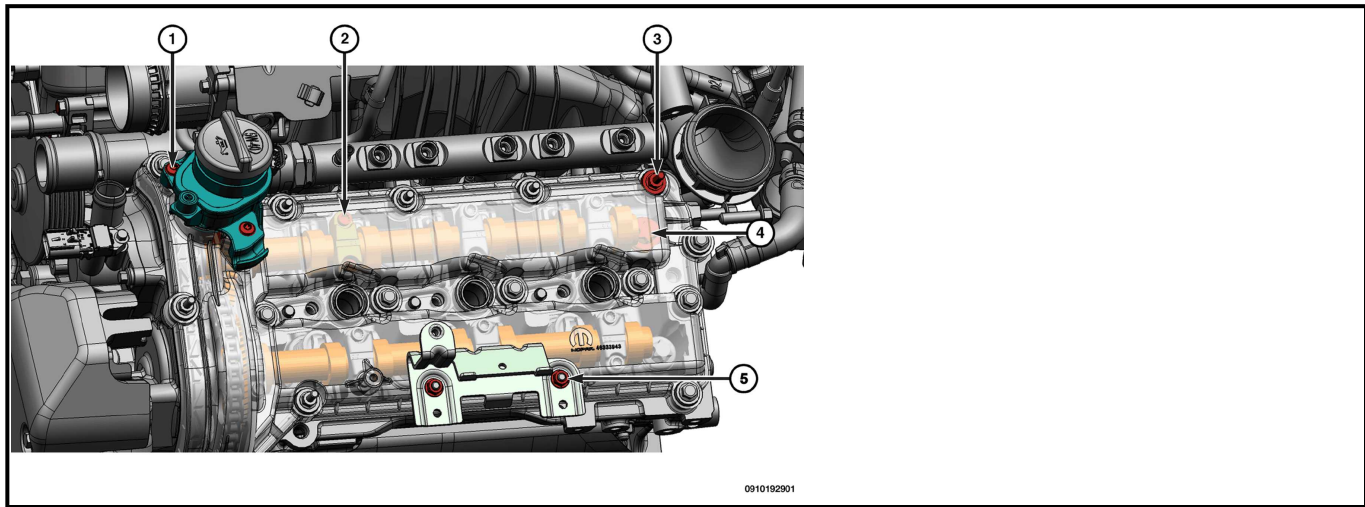
TORQUE SPECIFICATIONS

VALVE TIMING



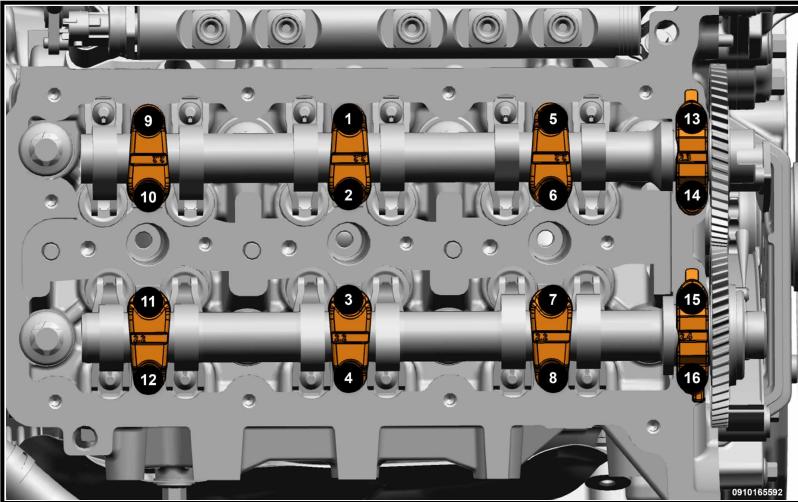
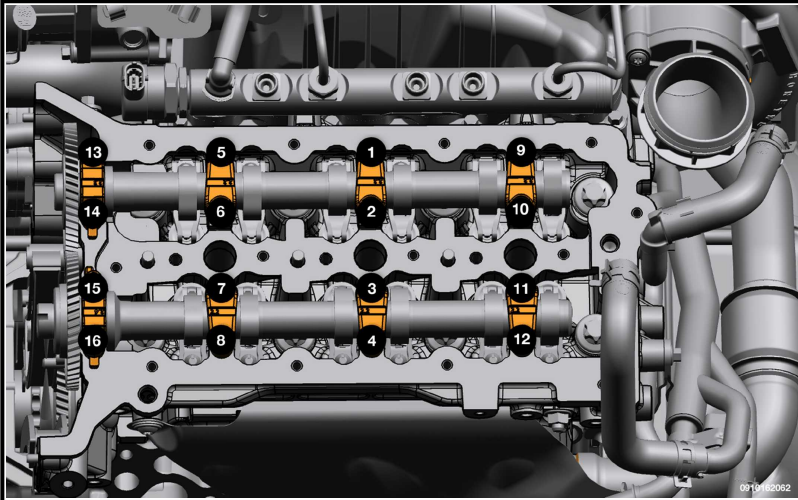
CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Fuel Injection Pump Drive Gear Bolt (On Left Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 75°	-
2	Timing Chain Guide Bolts	30 N.m (22 Ft. Lbs.)	-
3	Reluctor Wheel Bolt (On Right Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 73°	-
4	Timing Chain Tensioner	14 N.m (11 Ft. Lbs.)	-
-	Oil Separator Bolt	30 N.m (22 Ft. Lbs.)	-

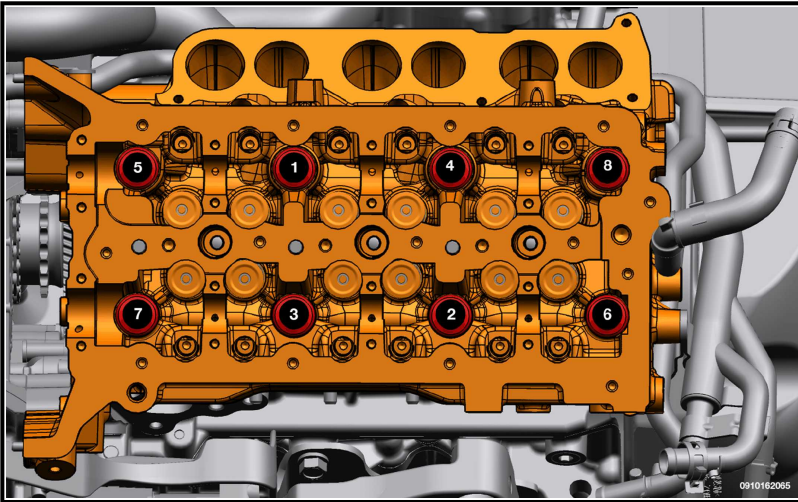
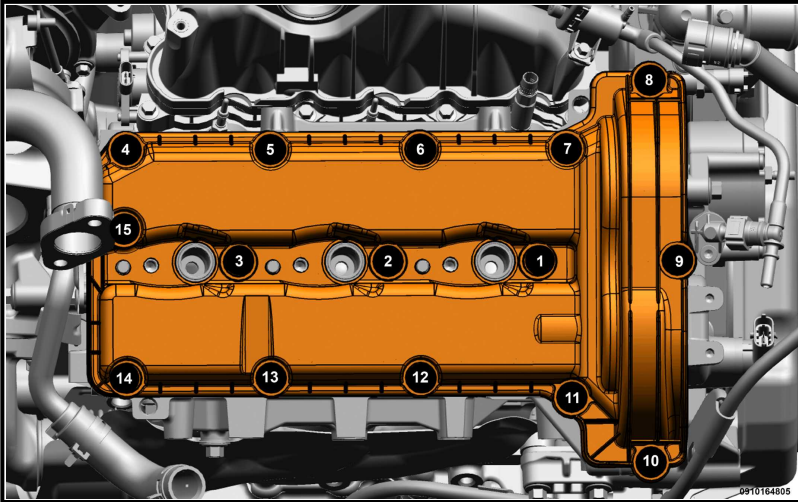
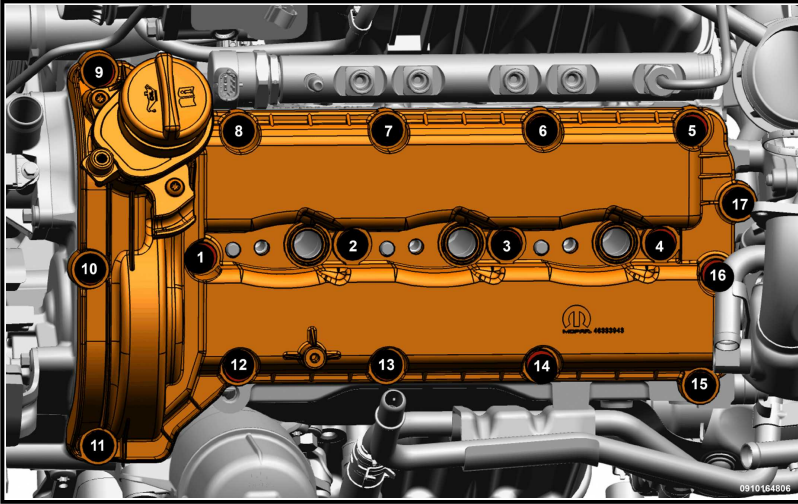
CYLINDER HEAD

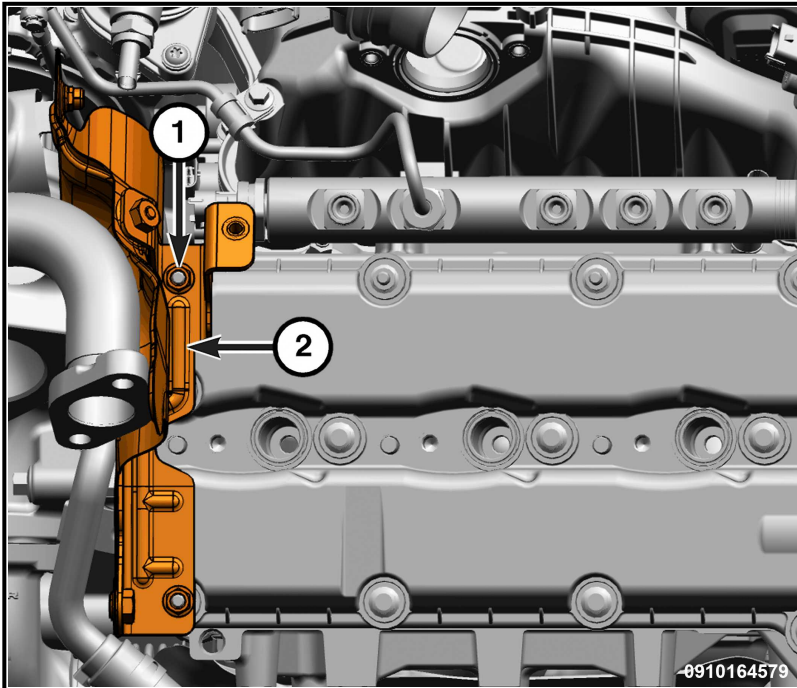
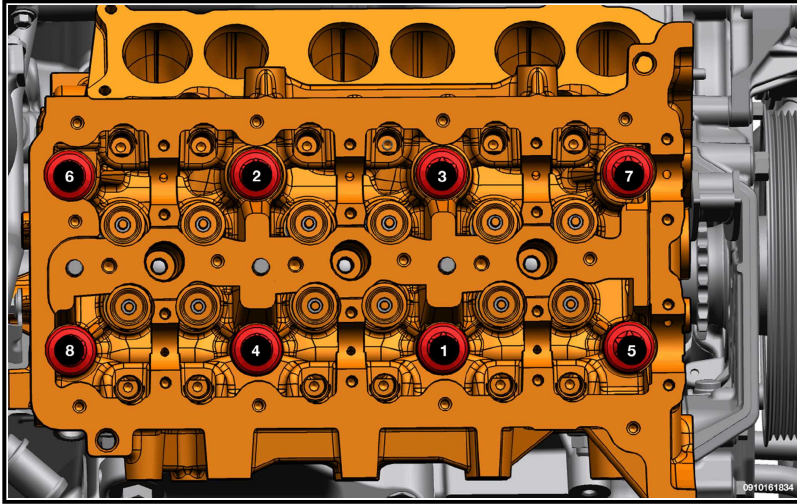


CALLOUT	DESCRIPTIONS	SPECIFICATION	COMMENT
1	Oil Filler Neck Assembly to Valve Cover	Tighten Securely	-
2	Camshaft Bearing Cap Bolts	11 N.m (8 Ft. Lbs.)	Tightening Sequence
3	Cylinder Head Cover Bolts	Torque Procedure: 1. Tighten the cylinder head cover bolts finger tight. 2. Tighten bolts to 8 N.m (71 In. Lbs.). 3. Loosen each bolt 90°.	Tightening Sequence

CalloUT	DESCRIPTIOnS	SPECIFICATIOn	COMMEnt
		4. Tighten bolts to 10 N.m (89 In. Lbs.).	
4	Cylinder Head Bolts (M14)	Torque Procedure: 1. Tighten the cylinder head bolts finger tight. 2. Tighten bolts to 30 N.m (22 Ft. Lbs.). 3. Tighten bolts an additional 75° in sequence. 4. Tighten bolts an additional 75° in sequence. 5. Tighten bolts an additional 75° in sequence.	Tightening Sequence
5	Fuel Line Support Bracket Nuts	6 N.m 53 (In. Lbs.)	-
-	Coolant Tube Bolt	25 N.m (18 Ft. Lbs.)	-
-	Engine Wire Harness Bolts	11 N.m (8 Ft. Lbs.)	-
-	Heat Shield Bracket Nuts	6 N.m 53 (In. Lbs.)	







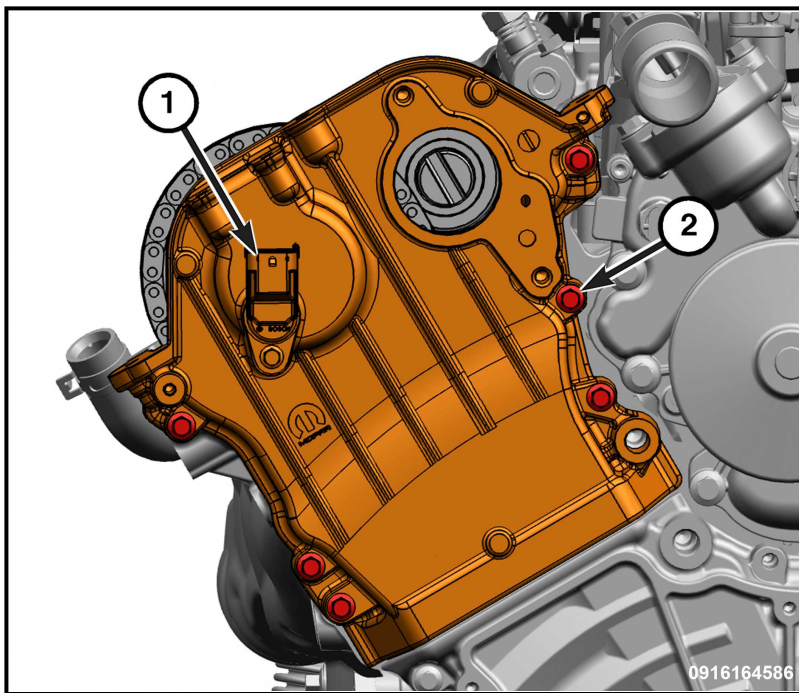
COVER(S), ENGINE TIMING

REMOVAL AND INSTALLATION

RIGHT UPPER TIMING COVER

REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the right cylinder head cover. Refer to [COVER\(S\), CYLINDER HEAD, REMOVAL AND INSTALLATION](#) .
3. Remove the mechanical vacuum pump. Refer to [PUMP, VACUUM, REMOVAL AND INSTALLATION](#) .



- | |
|-----------------------------|
| 1 - Right Upper Cover |
| 2 - Right Upper Cover Bolts |

4. Remove the right upper cover bolts and the right upper cover.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

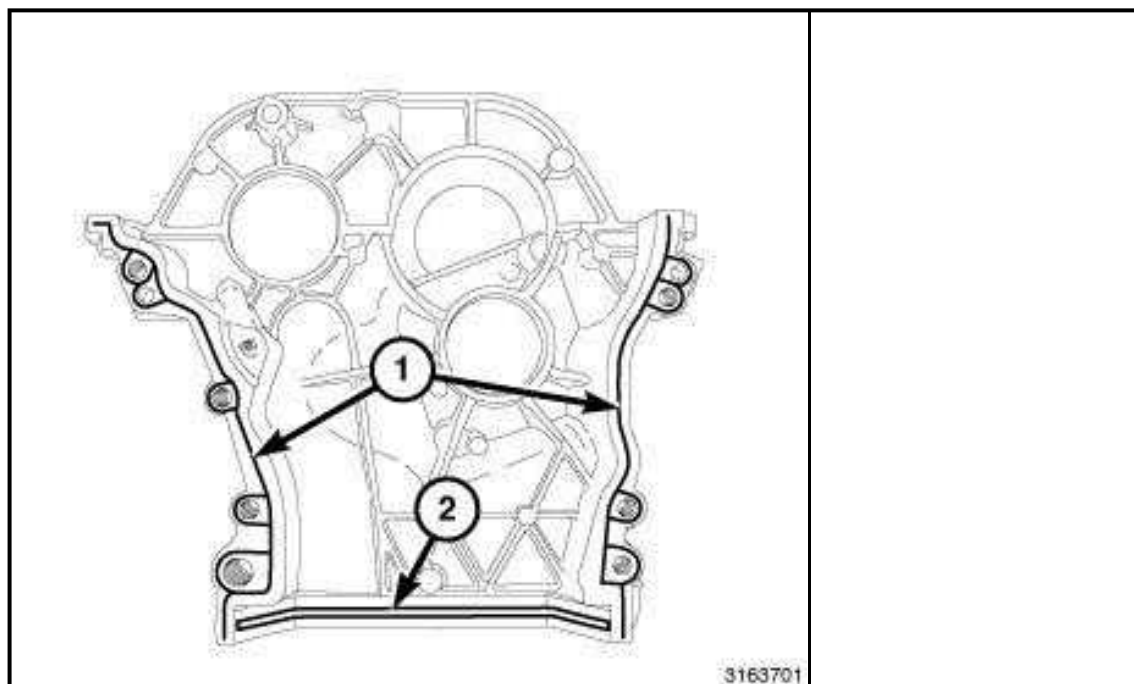
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the gasket sealing surfaces. Refer to [**STANDARD PROCEDURE**](#) .

CAUTION: Engine assembly requires the use of a unique sealant that is compatible with engine oil. Using a sealant other than Mopar® Threebond Engine RTV Sealant may result in engine fluid leakage.

CAUTION: Following the application of Mopar® Threebond Engine RTV Sealant to the gasket surfaces, the components must be assembled within 10 minutes and the attaching fasteners must be tightened to specification within 45 minutes. Prolonged exposure to the air prior to assembly may result in engine fluid leakage.

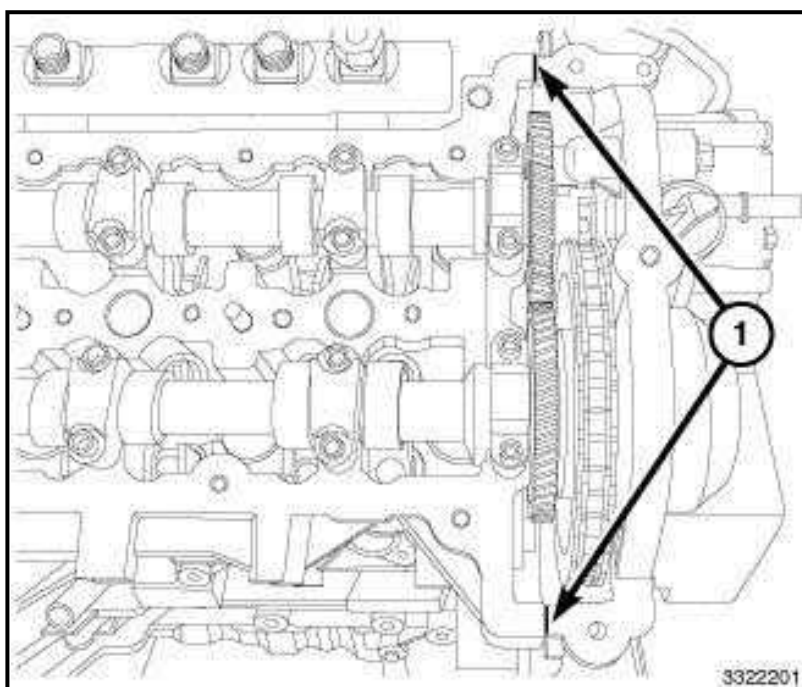
NOTE: Sealing surfaces must be free of a gasket material and oil residue. Clean the oil pan sealing surfaces with isopropyl alcohol in preparation for sealant application.



1 - Mopar® Threebond Engine RTV Sealant

2 - Mopar® Threebond Engine RTV Sealant

- Apply a 3 mm wide bead of Mopar® Threebond Engine RTV Sealant to locations of the right upper timing cover.
- Install the right upper timing cover and tighten the right upper timing cover bolts using the tightening sequence shown in the torque table to proper torque specifications.

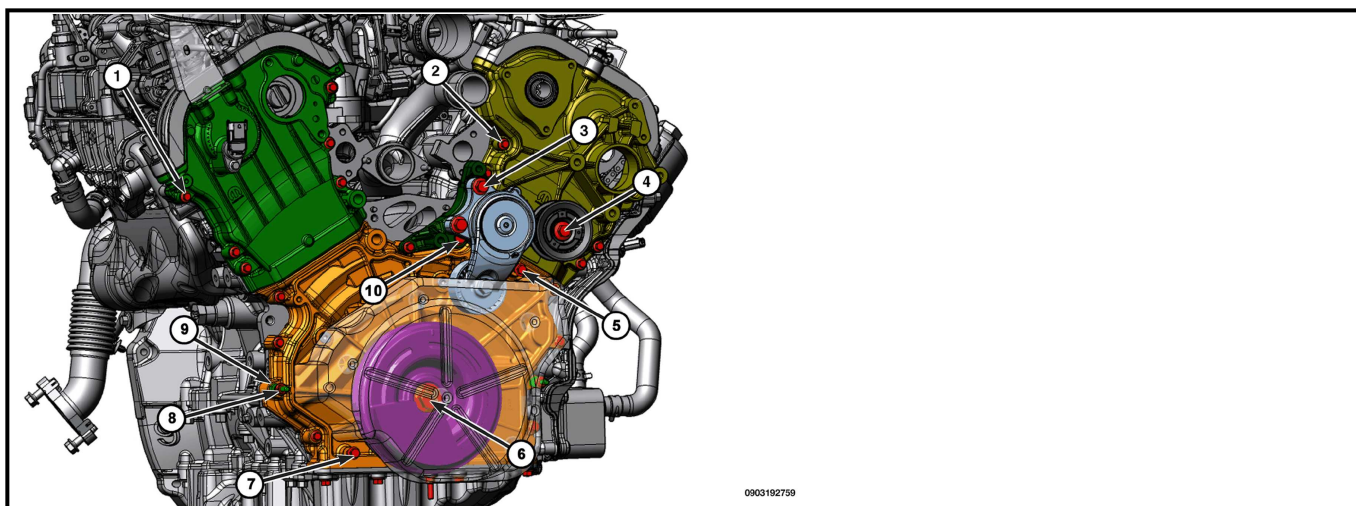


1 - T-joints

- Remove any of Mopar® Threebond Engine RTV Sealant that may have squeezed out of the right upper timing cover T-joints.
- Start the engine and check for leaks.

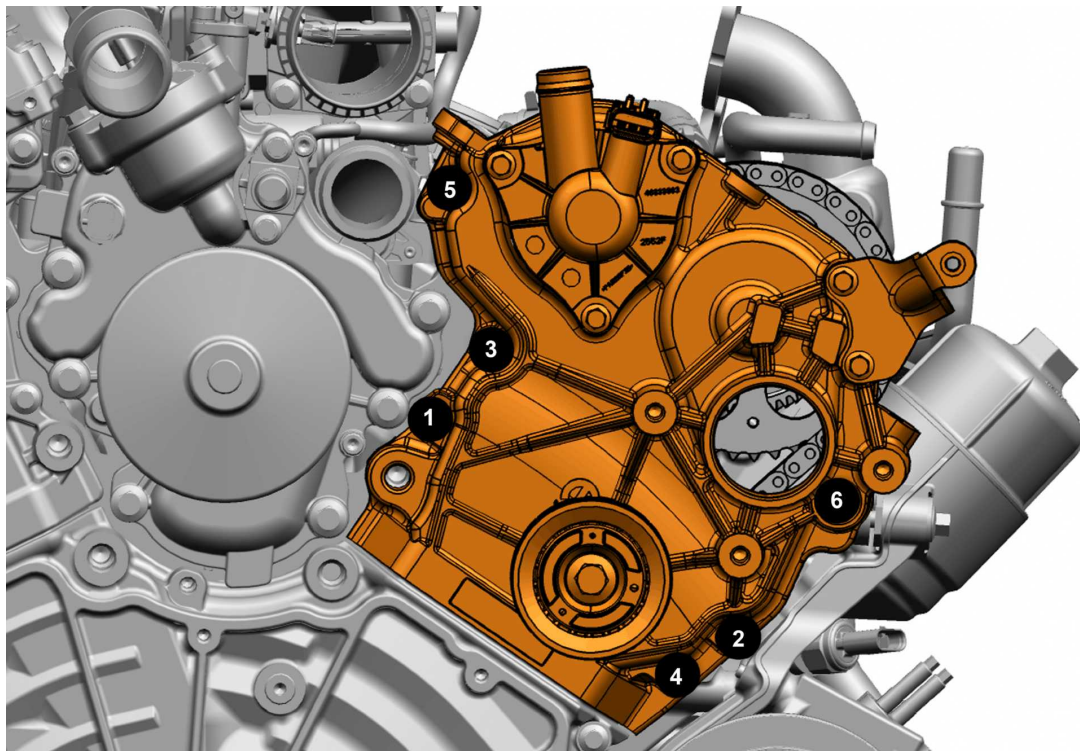
TORQUE SPECIFICATIONS

FRONT ENGINE



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1, 2	Timing Chain Cover Bolts	Torque Procedure: 1. Tighten the M6 bolts finger tight. 2. Tighten the M6 bolts to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60° and retighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence
3	Belt Tensioner Pulley Bolt	45 N.m (33 Ft. Lbs.)	-
4	Idler Pulley Bolts	32 N.m (24 Ft. Lbs.)	-
5, 9	Timing Chain Cover Bolts (lower)	Torque Procedure: 1. Tighten the lower timing cover bolts (1 and 3) finger tight. 2. Tighten the M6 bolts (1 - 8) to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60° and tighten to 15 N.m (Ft. Lbs.). 4. Install the oil pan-to-lower chain cover bolts and tighten (9 - 13) to 15 N.m (11 Ft. Lbs.). 5. Loosen each bolt one at a time 90° and tighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence Position 2 and 3 are double ended studs.
6	Vibration Damper Bolt	100 N.m (74 Ft. Lbs.) +	-

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
		125°	
7	Vibration Damper Cover Bolts	10 N.m (7 Ft. Lbs.)	-
8	Vibration Damper Cover Nut	9 N.m (80 In. Lbs.)	-
10	Belt Tensioner to Mounting Bracket - M10 Bolt	45 N.m (33 Ft. Lbs.)	-
11	Belt Tensioner to Mounting Bracket - M6 Bolt	11 N.m (8 Ft. Lbs.)	-
-	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Oil Breather/Camshaft Seal Housing Bolts	14 N.m (10 Ft. Lbs.)	-
-	Vacuum Pump Bolt	30 N.m (22 Ft. Lbs.)	-



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Fig. 11: Left Upper Timing Cover Bolts Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC

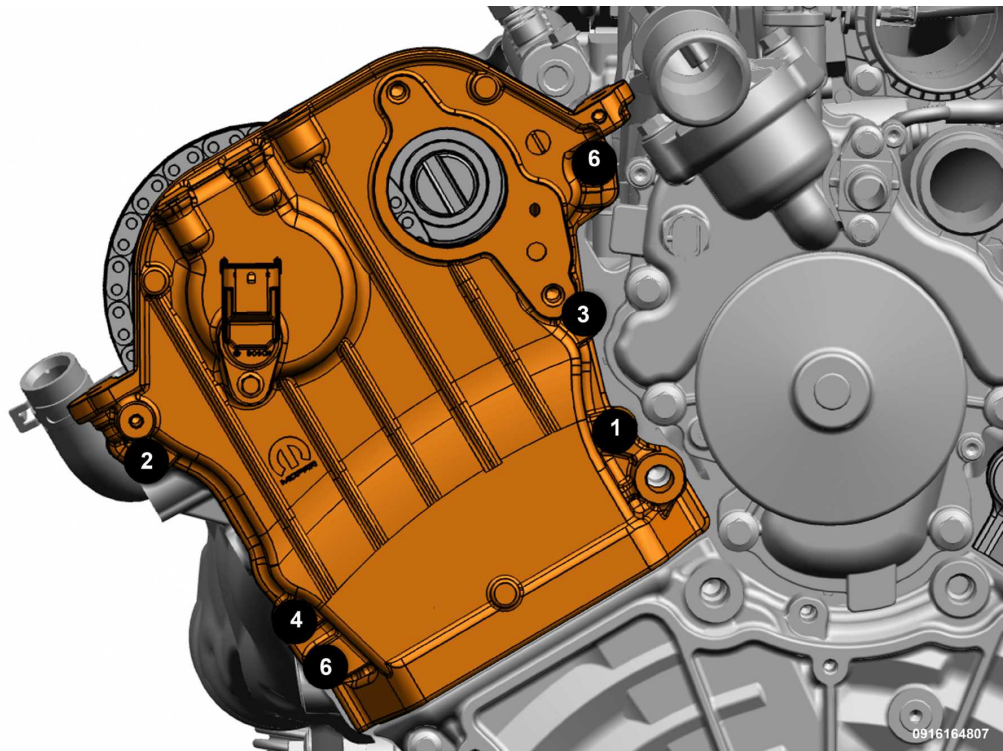


Fig. 12: Right Upper Timing Cover Bolts Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC

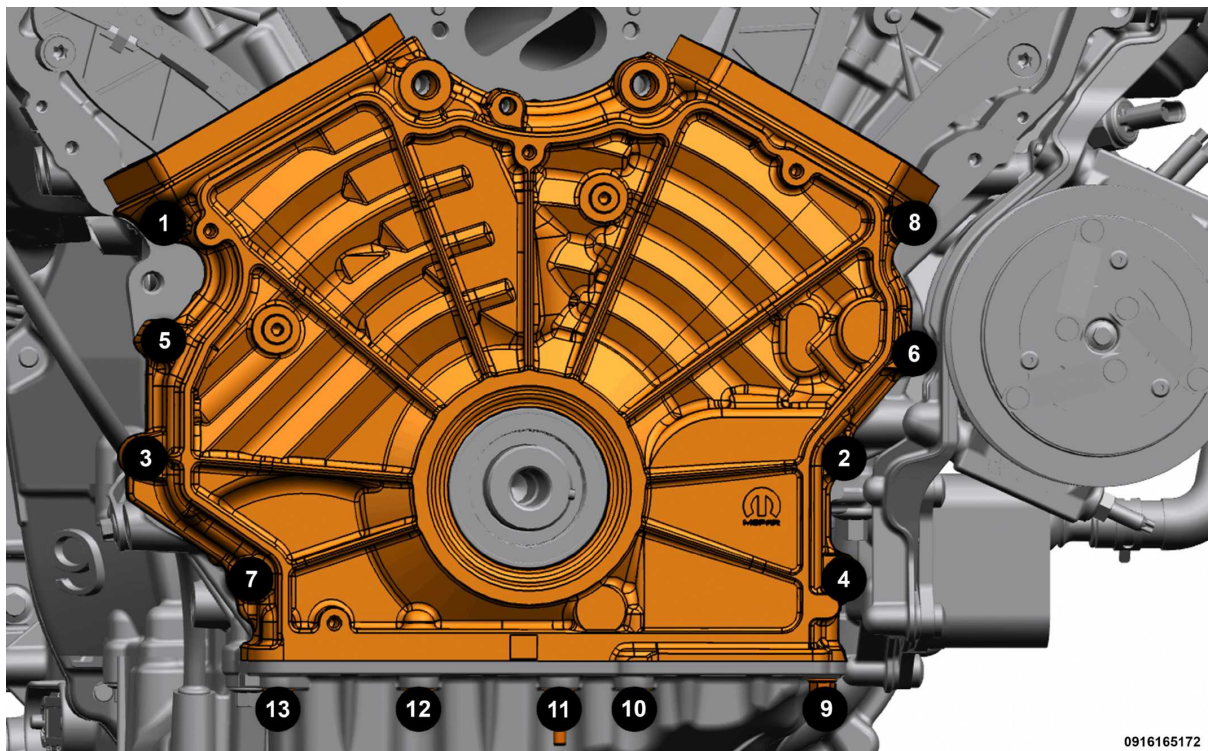


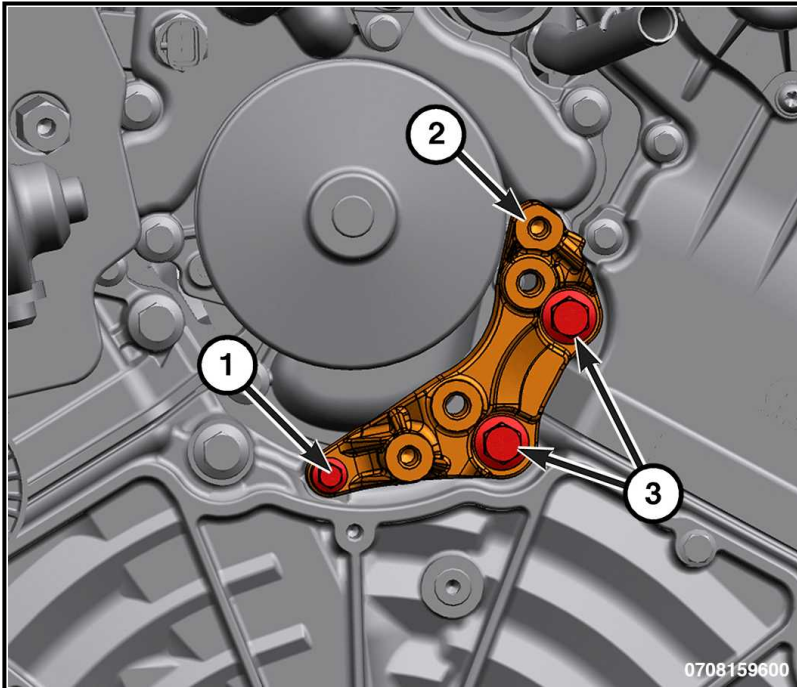
Fig. 13: Lower Timing Chain Cover Bolts Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC

LEFT UPPER TIMING COVER

REMOVAL

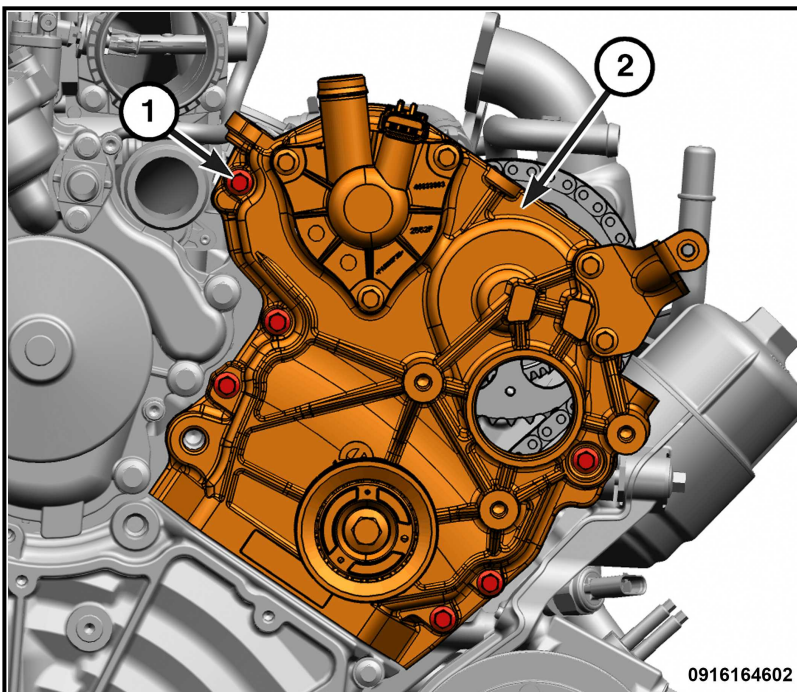
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the left cylinder head cover. Refer to [COVER\(S\), CYLINDER HEAD, REMOVAL AND INSTALLATION](#) .

3. Remove the fuel injection pump Refer to [ASSEMBLY, FUEL PUMP, REMOVAL AND INSTALLATION](#).
4. Remove the belt tensioner. Refer to [TENSIONER, BELT, REMOVAL AND INSTALLATION](#).



- | |
|--------------------------------------|
| 1 - Belt Tensioner Bracket M6 Bolts |
| 2 - Belt Tensioner Bracket |
| 3 - Belt Tensioner Bracket M10 Bolts |

5. Remove the belt tensioner bracket bolts and the belt tensioner bracket.



- | |
|-----------------------------|
| 1 - Left Timing Cover Bolts |
| 2 - Left Timing Cover |

6. Remove the left timing cover bolts and the left timing cover.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

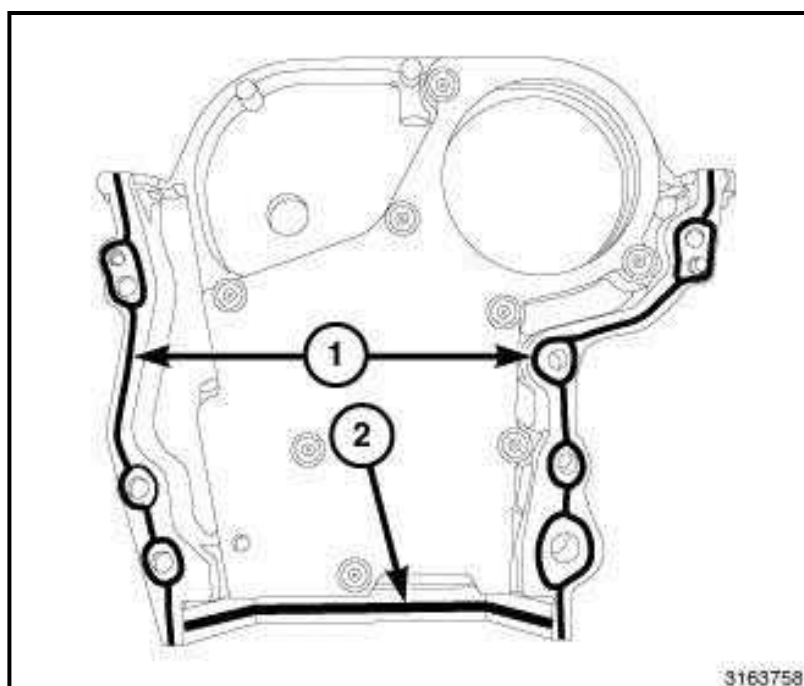
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the gasket sealing surfaces. Refer to [STANDARD PROCEDURE](#) .

CAUTION: Engine assembly requires the use of a unique sealant that is compatible with engine oil. Using a sealant other than Mopar® Threebond Engine RTV Sealant may result in engine fluid leakage.

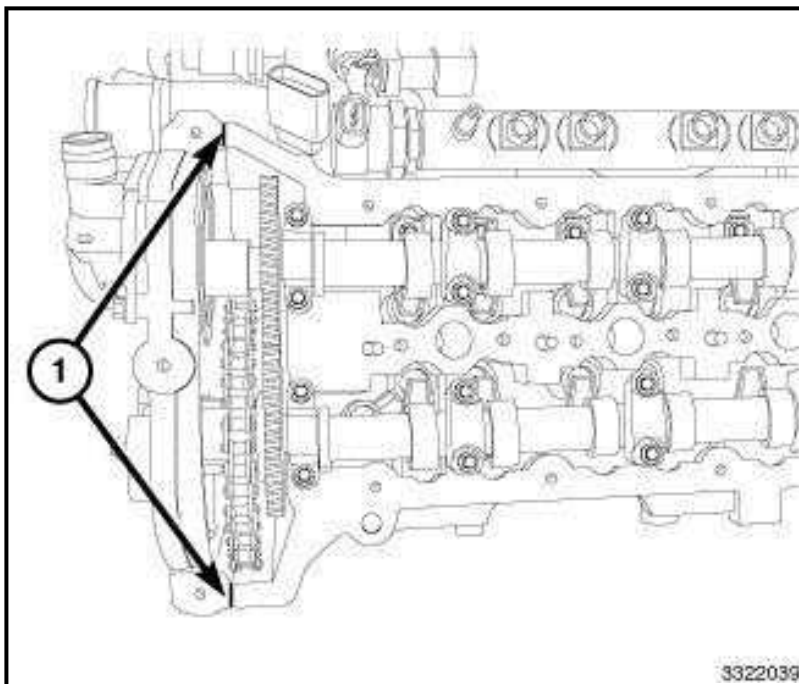
CAUTION: Following the application of Mopar® Threebond Engine RTV Sealant to the gasket surfaces, the components must be assembled within 10 minutes and the attaching fasteners must be tightened to specification within 45 minutes. Prolonged exposure to the air prior to assembly may result in engine fluid leakage.

NOTE: Sealing surfaces must be free of a gasket material and oil residue. Clean the oil pan sealing surfaces with isopropyl alcohol in preparation for sealant application.



1 - Mopar® Threebond Engine RTV Sealant
2 - Mopar® Threebond Engine RTV Sealant

- Apply a 3 mm wide bead of Mopar® Threebond Engine RTV Sealant to locations of the left upper timing cover.
- Install the left upper timing cover and tighten the left upper timing cover bolts using the tightening sequence shown in the torque table to proper torque specifications.

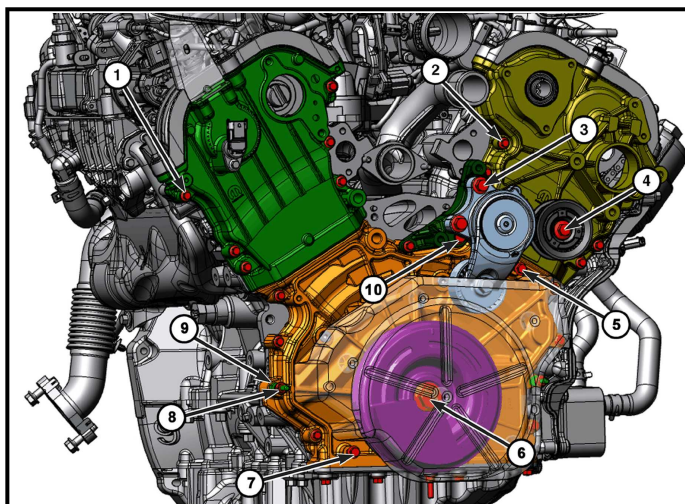


1 - T-joints

- Remove any of Mopar® Threebond Engine RTV Sealant that may have squeezed out of the left upper timing cover T-joints.
- Start the engine and check for leaks.

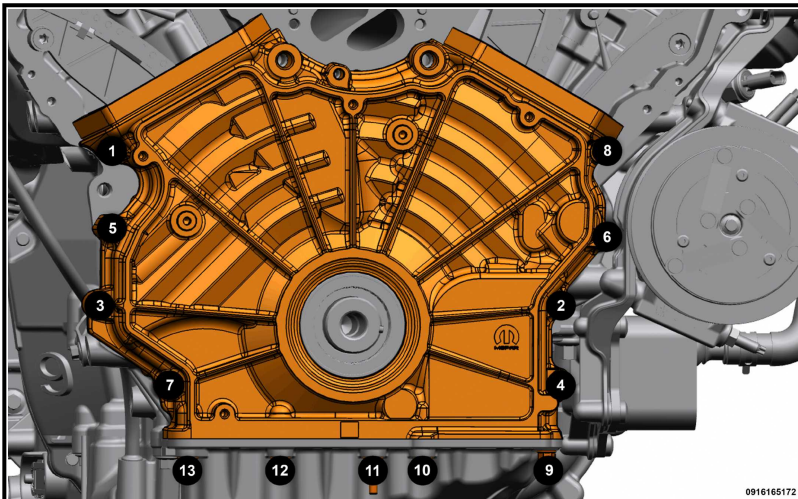
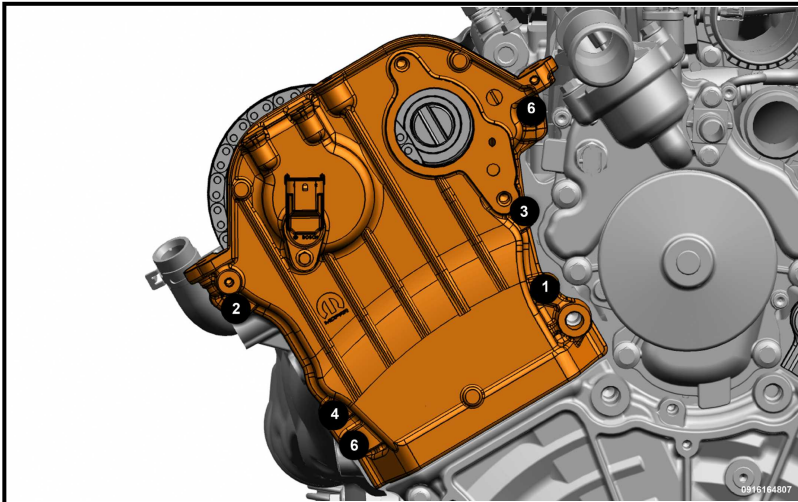
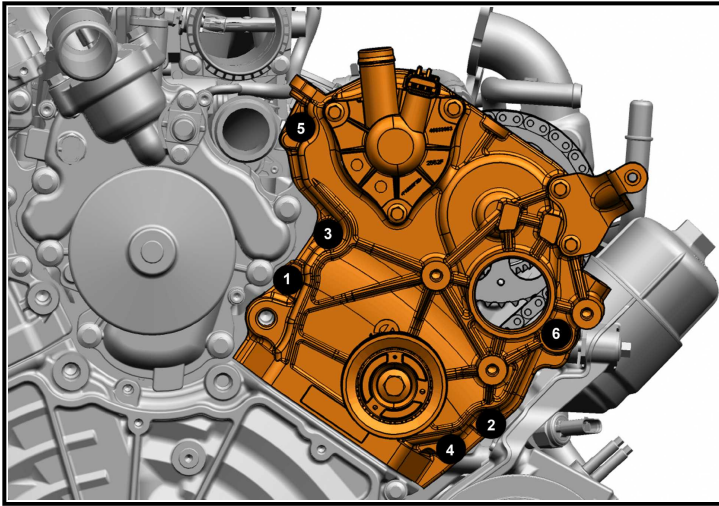
TORQUE SPECIFICATIONS

FRONT ENGINE



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1, 2	Timing Chain Cover Bolts	Torque Procedure: 1. Tighten the M6 bolts finger tight. 2. Tighten the M6 bolts to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60° and retighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
3	Belt Tensioner Pulley Bolt	45 N.m (33 Ft. Lbs.)	-
4	Idler Pulley Bolts	32 N.m (24 Ft. Lbs.)	-
5, 9	Timing Chain Cover Bolts (lower)	Torque Procedure: 1. Tighten the lower timing cover bolts (1 and 3) finger tight. 2. Tighten the M6 bolts (1 - 8) to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60° and tighten to 15 N.m (Ft. Lbs.). 4. Install the oil pan-to-lower chain cover bolts and tighten (9 - 13) to 15 N.m (11 Ft. Lbs.). 5. Loosen each bolt one at a time 90° and tighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence Position 2 and 3 are double ended studs.
6	Vibration Damper Bolt	100 N.m (74 Ft. Lbs.) + 125°	-
7	Vibration Damper Cover Bolts	10 N.m (7 Ft. Lbs.)	-
8	Vibration Damper Cover Nut	9 N.m (80 In. Lbs.)	-
10	Belt Tensioner to Mounting Bracket - M10 Bolt	45 N.m (33 Ft. Lbs.)	-
11	Belt Tensioner to Mounting Bracket - M6 Bolt	11 N.m (8 Ft. Lbs.)	-
-	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Oil Breather/Camshaft Seal Housing Bolts	14 N.m (10 Ft. Lbs.)	-
-	Vacuum Pump Bolt	30 N.m (22 Ft. Lbs.)	-



LOWER TIMING CHAIN COVER

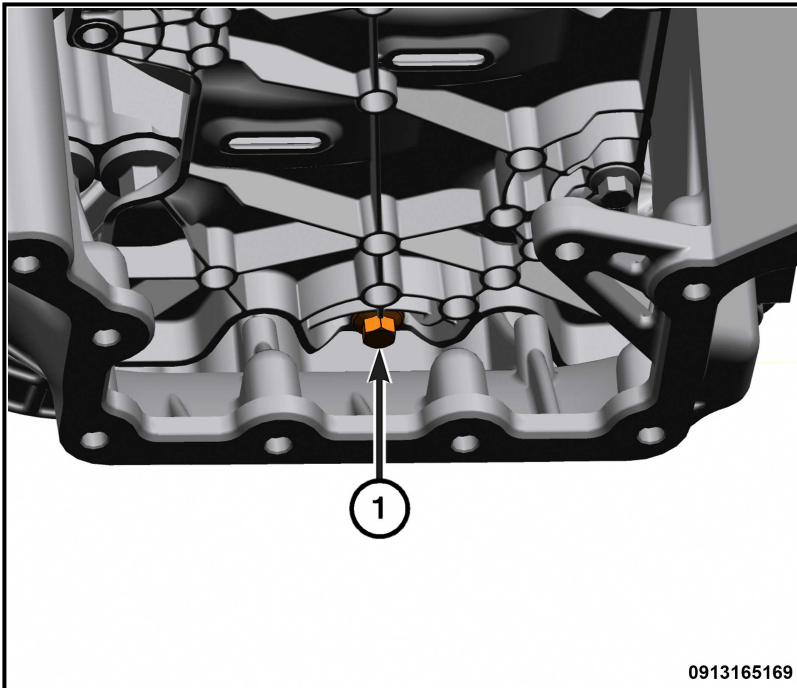
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the right and left upper timing chain cover. Refer to [COVER\(S\), ENGINE TIMING, REMOVAL AND INSTALLATION](#) .

NOTE: The vibration damper bolt is a left hand thread.

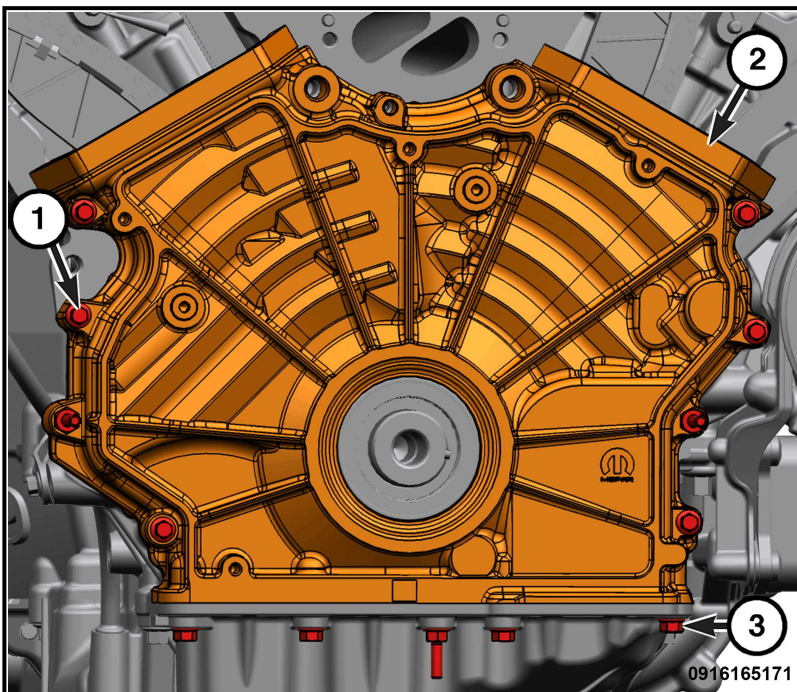
3. Remove the vibration damper. Refer to [DAMPER, VIBRATION, REMOVAL AND INSTALLATION](#) .
4. Remove the generator. Refer to [GENERATOR, REMOVAL AND INSTALLATION](#) .

5. Remove the lower oil pan. Refer to [PAN, OIL, REMOVAL AND INSTALLATION](#).



1 - Windage Tray Bolt

6. Remove the windage tray bolt securing the windage tray to the lower timing chain cover.



1 - Lower Timing Cover Bolts

2 - Lower Timing Cover

3 - Oil Pan-to-Lower Timing Chain Cover Bolts

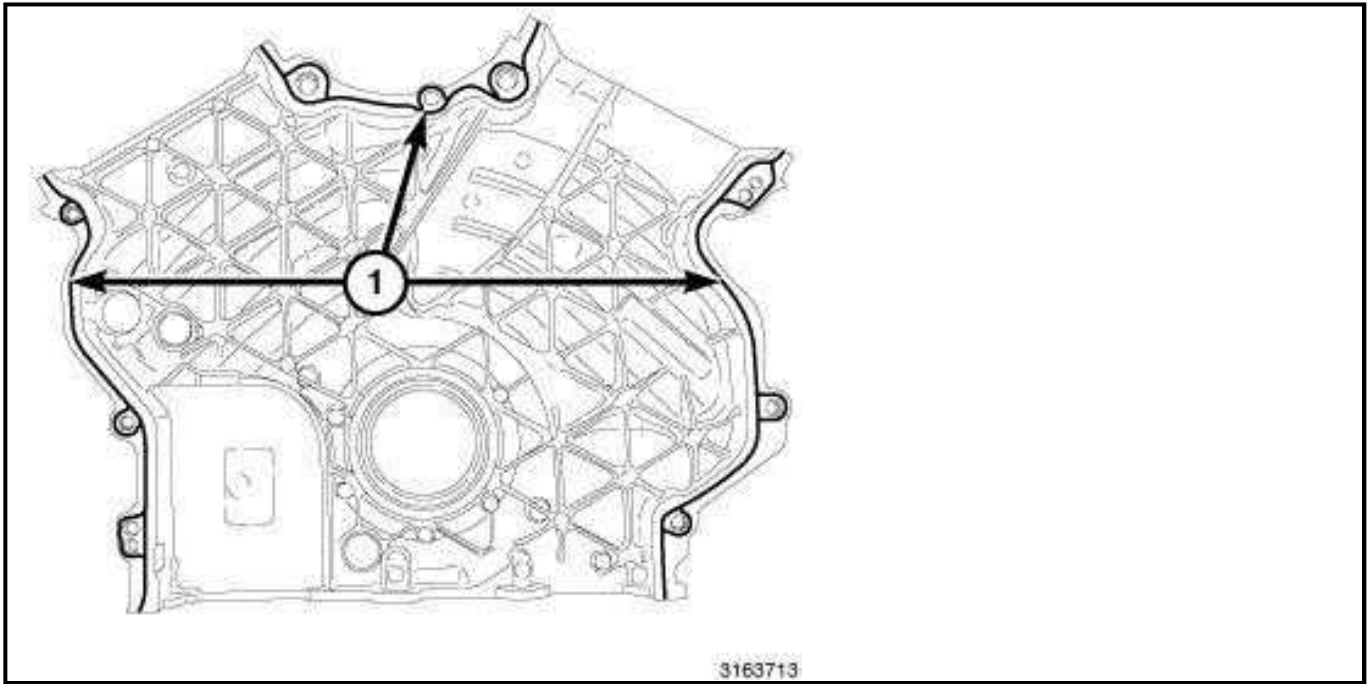
7. Remove the oil pan-to-lower timing chain cover bolts.

8. Remove the lower timing cover bolts and the lower timing chain cover.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.



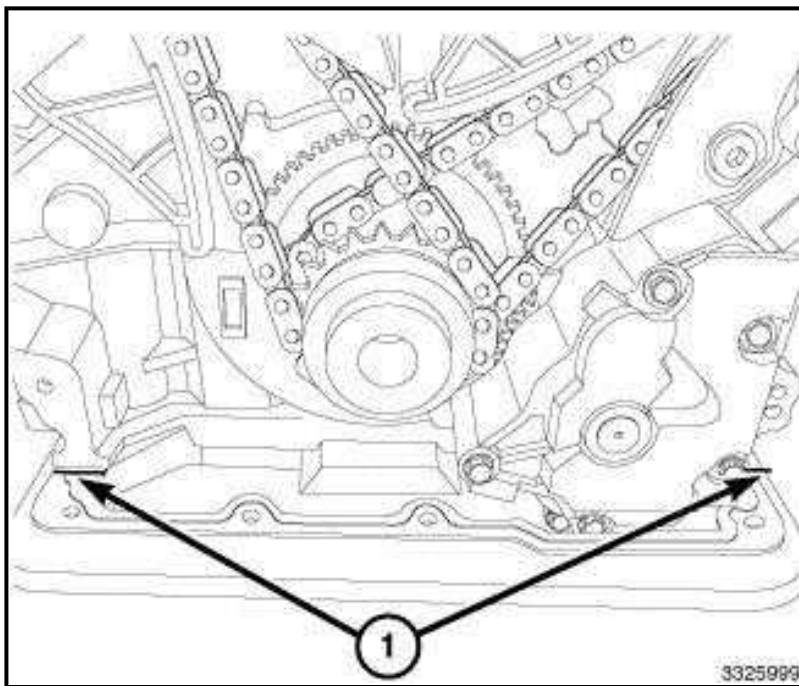
1 - Mopar® Threebond Engine RTV Sealant Locations

- Clean the oil pan sealing surfaces with isopropyl alcohol in preparation for sealant application. Refer to the appropriate information .

CAUTION: Engine assembly requires the use of a unique sealant that is compatible with engine oil. Using a sealant other than Mopar® Threebond Engine RTV Sealant may result in engine fluid leakage.

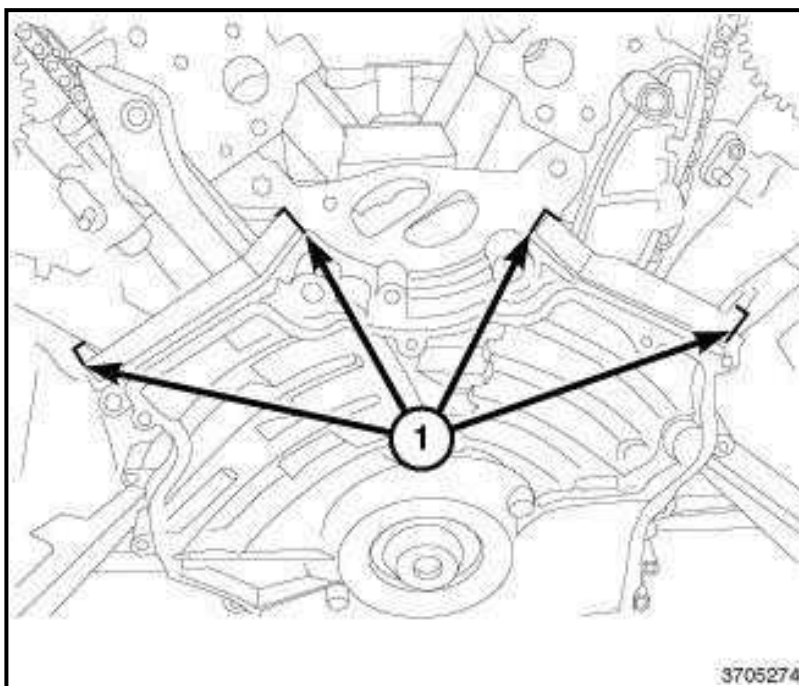
CAUTION: Following the application of Mopar® Threebond Engine RTV Sealant to the gasket surfaces, the components must be assembled within 10 minutes and the attaching fasteners must be tightened to specification within 45 minutes. Prolonged exposure to the air prior to assembly may result in engine fluid leakage.

- Apply a 3 mm wide bead of Mopar® Threebond Engine RTV Sealant to the following locations.



1 - T-joints

- Apply a 3 mm wide bead of Mopar® Threebond Engine RTV Sealant at the T-joints.
- Install the lower timing chain cover and tighten the lower timing cover bolts using the tightening sequence shown in the torque table to proper torque specifications.

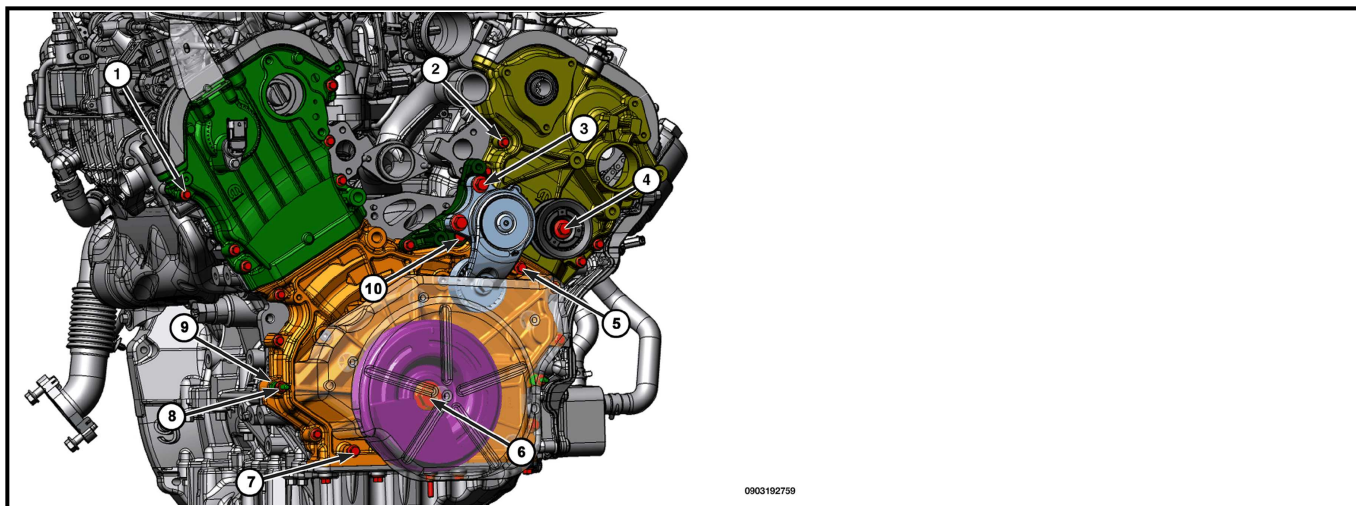


1 - Lower Timing Cover Joints

- Remove any of Mopar® Threebond Engine RTV Sealant that may have squeezed out of the lower timing cover joints.

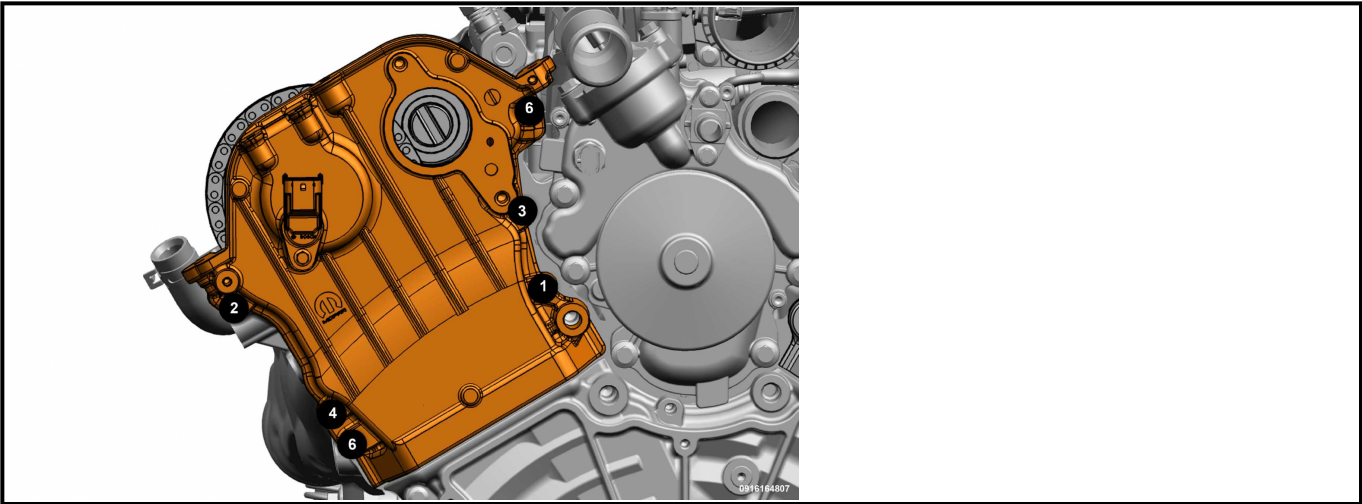
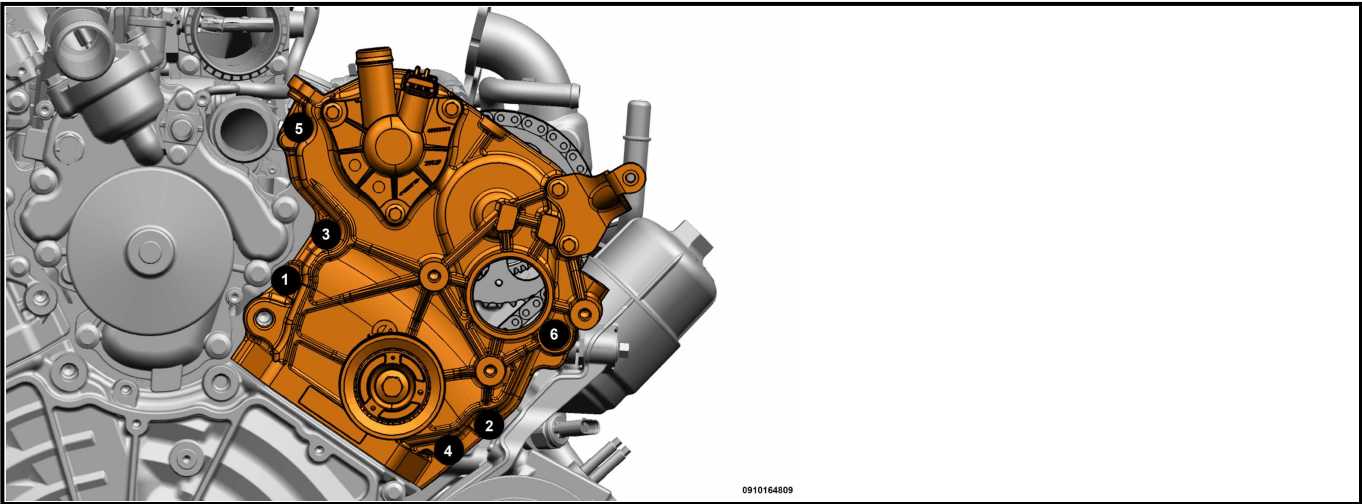
TORQUE SPECIFICATIONS

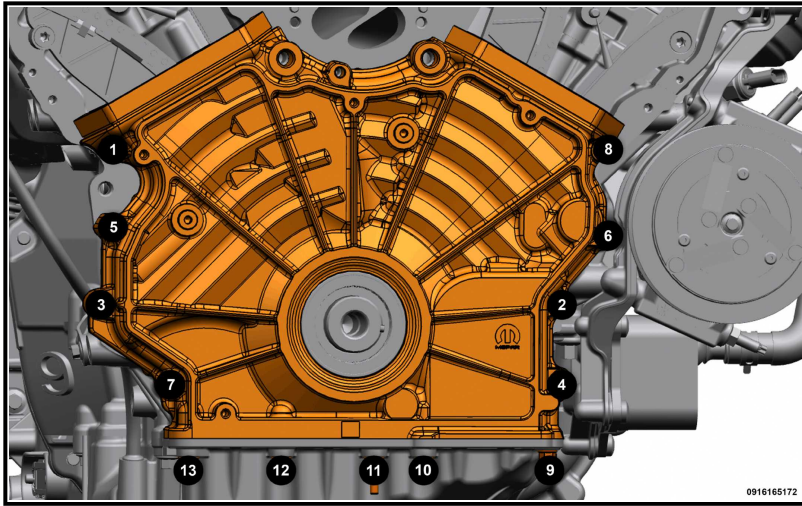
FRONT ENGINE



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1, 2	Timing Chain Cover Bolts	Torque Procedure: 1. Tighten the M6 bolts finger tight. 2. Tighten the M6 bolts to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60° and retighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence
3	Belt Tensioner Pulley Bolt	45 N.m (33 Ft. Lbs.)	-
4	Idler Pulley Bolts	32 N.m (24 Ft. Lbs.)	-
5, 9	Timing Chain Cover Bolts (lower)	Torque Procedure: 1. Tighten the lower timing cover bolts (1 and 3) finger tight. 2. Tighten the M6 bolts (1 - 8) to 9 N.m (80 In. Lbs.). 3. Loosen the M6 bolts 60° and tighten to 15 N.m (Ft. Lbs.). 4. Install the oil pan-to-lower chain cover bolts and tighten (9 - 13) to 15 N.m (11 Ft. Lbs.). 5. Loosen each bolt one at a time 90° and tighten to 15 N.m (11 Ft. Lbs.).	Tightening Sequence Position 2 and 3 are double ended studs.
6	Vibration Damper Bolt	100 N.m (74 Ft. Lbs.) +	-

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
		125°	
7	Vibration Damper Cover Bolts	10 N.m (7 Ft. Lbs.)	-
8	Vibration Damper Cover Nut	9 N.m (80 In. Lbs.)	-
10	Belt Tensioner to Mounting Bracket - M10 Bolt	45 N.m (33 Ft. Lbs.)	-
11	Belt Tensioner to Mounting Bracket - M6 Bolt	11 N.m (8 Ft. Lbs.)	-
-	Fuel Injection Pump Blocker Plate Bolts	25 N.m (18 Ft. Lbs.)	-
-	Oil Breather/Camshaft Seal Housing Bolts	14 N.m (10 Ft. Lbs.)	-
-	Vacuum Pump Bolt	30 N.m (22 Ft. Lbs.)	-





LUBRICATION

CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Oil Pump	14 N.m (11 Ft. Lbs.)	-
2, 3, 5	Oil Pickup Tube Bolts	11 N.m (8 Ft. Lbs.)	-
4	Oil Jet Bolt (timing chain)	11 N.m (8 Ft. Lbs.)	-
6	Oil Jet Bolt (piston)	11 N.m (8 Ft. Lbs.)	-

1	Oil Cooler/Oil Filter Housing Adapter Bolts	30 N.m (22 Ft. Lbs.)	-
2	Oil Filter Cap	25 N.m (18 Ft. Lbs.)	-
3, 6	Upper Oil Pan Bolts	Torque Procedure: 1. Tighten the upper oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts 7-13 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.). 4. Loosen bolts 1-6 and 14-25 one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence NOTE: Bolts in the following positions are stud bolts (4, 6, 16, 18, 20, 22, and 25).
4	Oil Drain Plug	45 N.m (33 Ft. Lbs.)	-
5	Lower Oil Pan Bolts	Torque Procedure: 1. Tighten the lower oil pan bolts finger tight. 2. Tighten the bolts to 15 N.m (11 Ft. Lbs.). 3. Loosen bolts one at a time 90° in the sequence shown, and retighten to 15 N.m (Ft. Lbs.).	Tightening Sequence
7	Oil Cooler Bolts	30 N.m (22 Ft. Lbs.)	-
-	Dipstick Tube Bolt (head)	11 N.m (8 Ft. Lbs.)	-
-	Dipstick Tube Bolt (sump)	11 N.m (8 Ft. Lbs.)	-
-	Windage Tray	11 N.m (8 Ft. Lbs.)	-

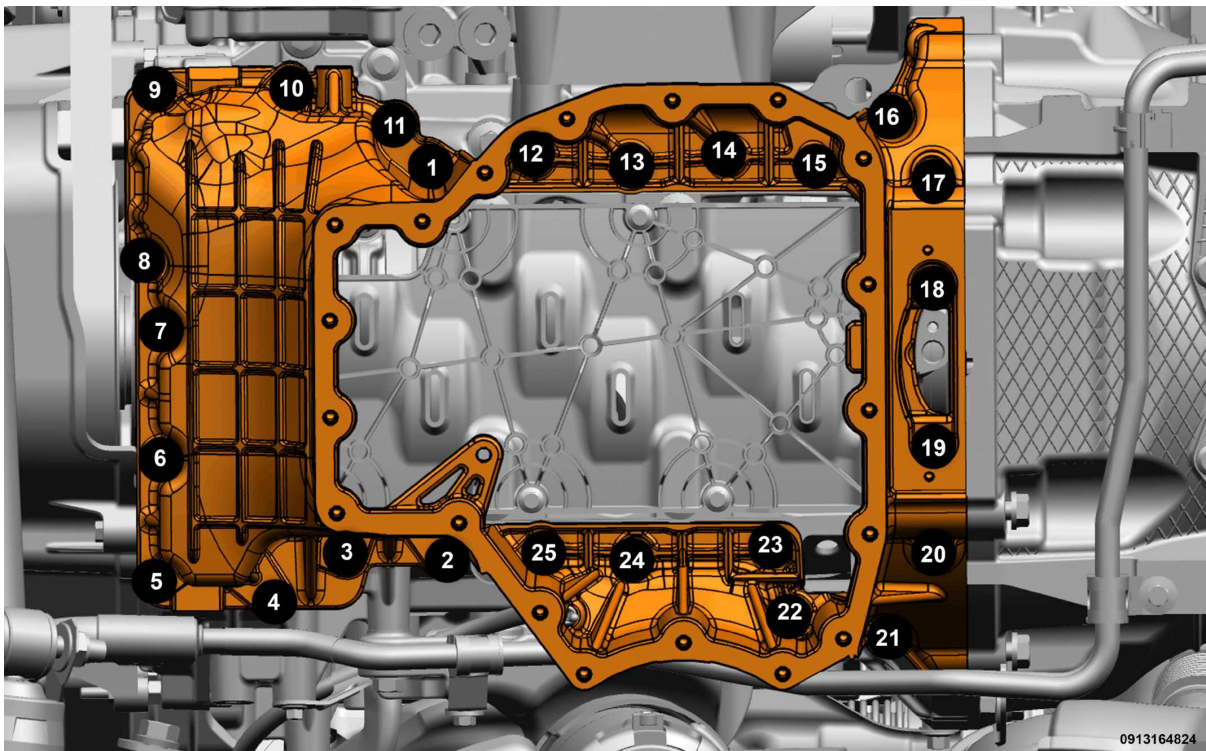


Fig. 14: Upper Oil Pan Bolts Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC

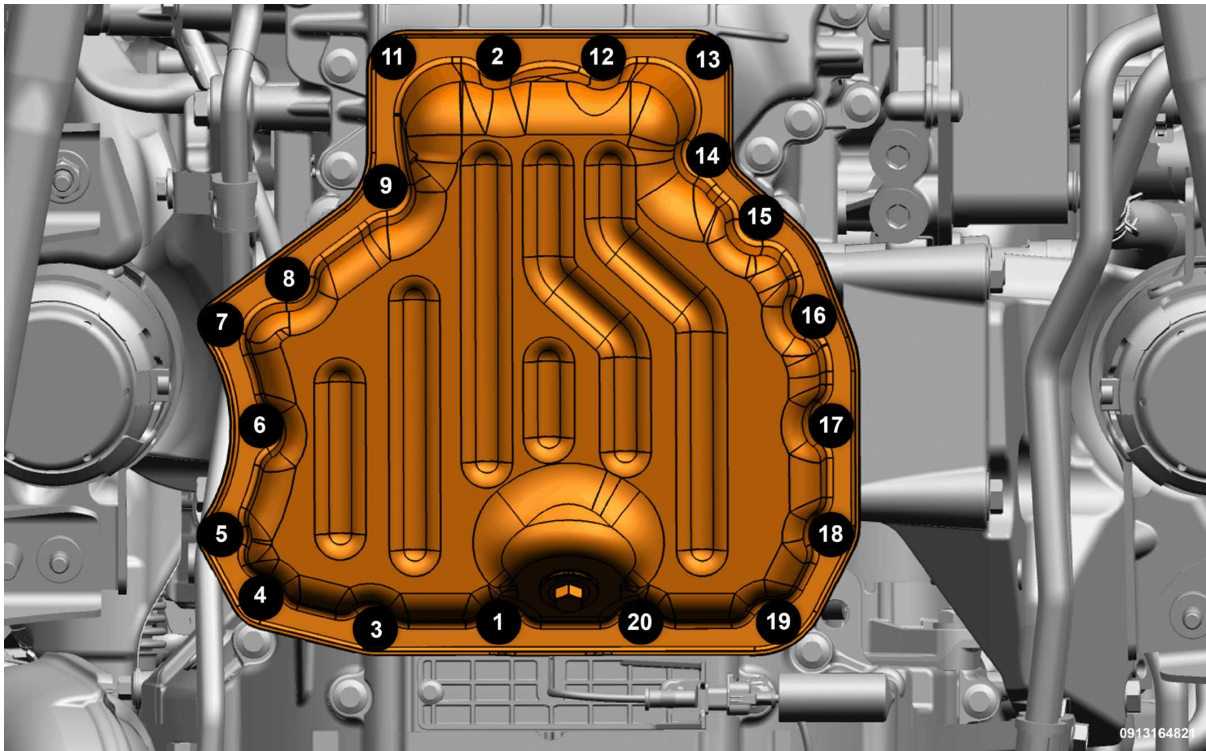
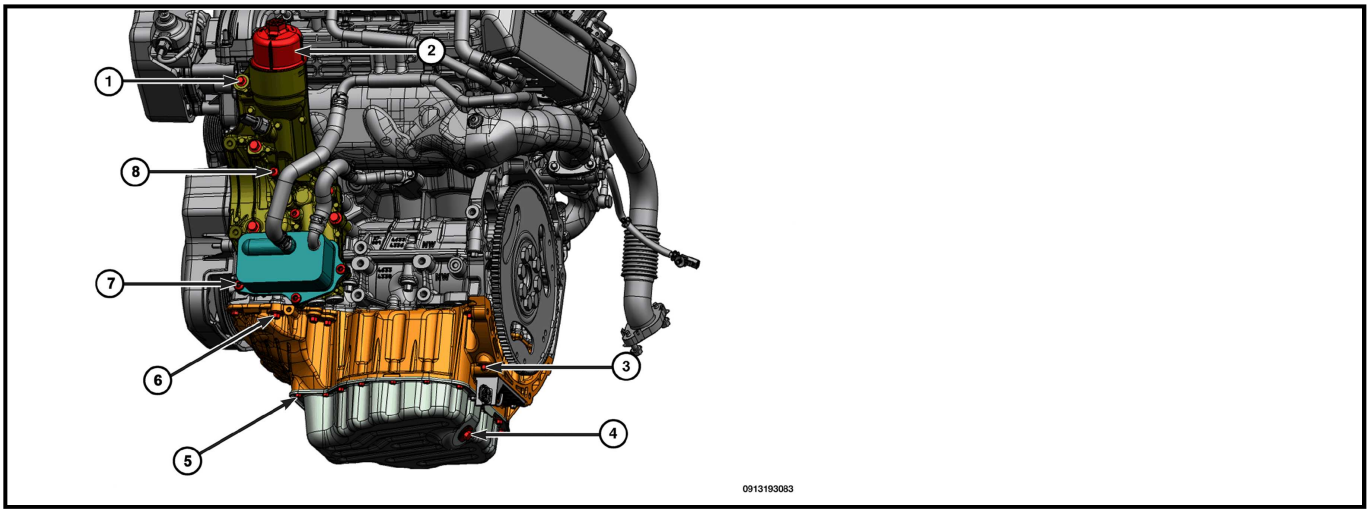


Fig. 15: Lower Oil Pan Bolt Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC



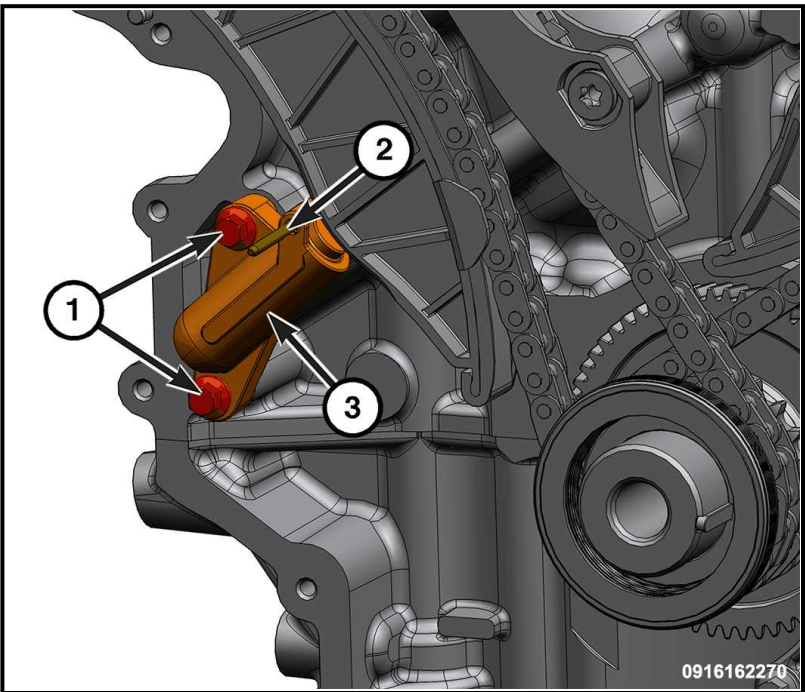
TENSIONER, ENGINE TIMING

REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

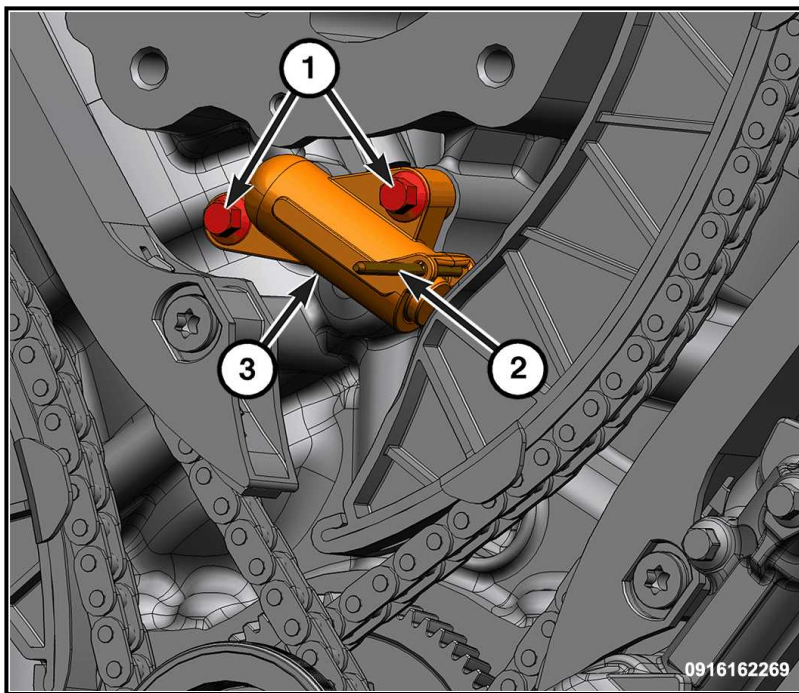
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to CABLES, BATTERY .
2. Remove the lower timing cover. Refer to COVER(S), ENGINE TIMING, REMOVAL AND INSTALLATION.



1 - Right Timing Chain Tensioner Bolts
2 - Tensioner Pin Tool
3 - Right Timing Chain Tensioner

3. Pushing back the tensioner piston, and install Tensioner Pin (special tool #VM.10359A, Pin, Tensioner).
4. Remove the right timing chain tensioner bolts and the right timing chain tensioner.



1 - Left Timing Chain Tensioner Bolts
2 - Tensioner Pin Tool
3 - Left Timing Chain Tensioner

5. Pushing back the piston, and install Tensioner Pin (special tool #VM.10359A, Pin, Tensioner).
6. Remove the left timing chain tensioner bolts and the left timing chain tensioner.

INSTALLATION

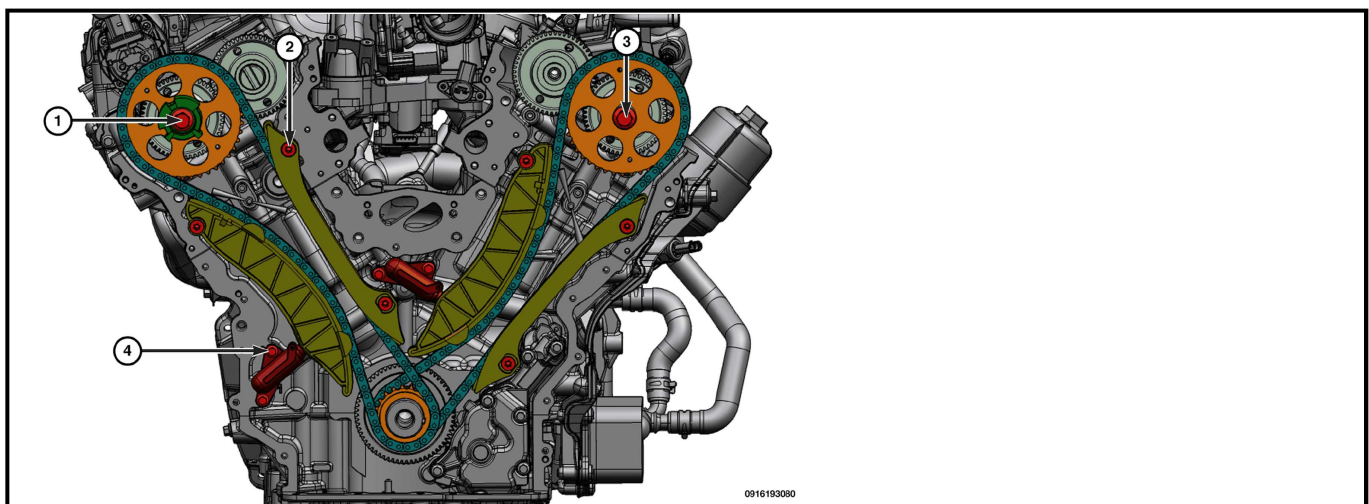
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Start the engine and inspect for leaks.

TORQUE SPECIFICATIONS

VALVE TIMING



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Fuel Injection Pump Drive Gear Bolt (On Left	30 N.m (22 Ft. Lbs.) + 75°	-

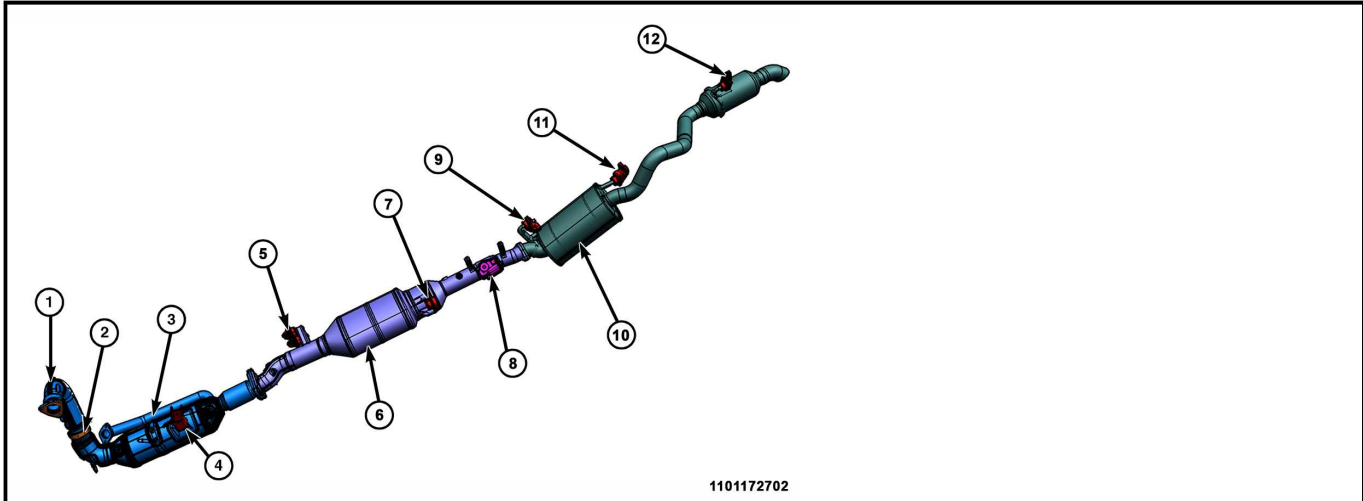
CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
	Camshaft Sprocket)		
2	Timing Chain Guide Bolts	30 N.m (22 Ft. Lbs.)	-
3	Reluctor Wheel Bolt (On Right Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 73°	-
4	Timing Chain Tensioner	14 N.m (11 Ft. Lbs.)	-
-	Oil Separator Bolt	30 N.m (22 Ft. Lbs.)	-

2021 ENGINE

3.0L - Exhaust System - Gladiator

DESCRIPTION

DIESEL ENGINE



1 - FRONT EXHAUST PIPE (ELBOW)	7 - EXHAUST ISOLATOR
2 - EXHAUST V-BAND CLAMP	8 - EXHAUST VALVE ACTUATOR
3 - DIESEL OXIDATION CATALYST (DOC)/DIESEL PARTICULATE FILTER (DEF)	9 - EXHAUST ISOLATOR
4 - EXHAUST BRACKET ISOLATOR	10 - EXHAUST MUFFLER
5 - EXHAUST ISOLATOR	11 - EXHAUST ISOLATOR
6 - SELECTIVE CATALYST REDUCTION (SCR)	12 - EXHAUST ISOLATOR

- The exhaust system must be properly aligned to prevent stress, leakage and body contact. Minimum clearance between any exhaust component and the body or frame is 25.4 mm (1.0 in.). If the system contacts any body panel, it may amplify objectionable noises from the engine or body.

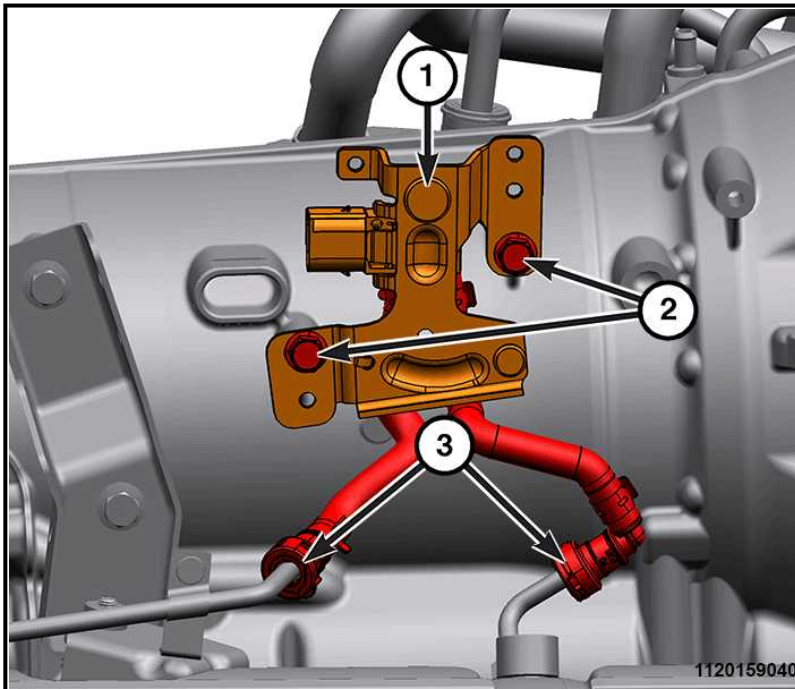
DESCRIPTION

- The first component of the aftertreatment system consists of two catalyst elements, working together to drastically reduce tailpipe emissions. The Diesel Oxidation Catalyst (DOC) is in the front half and the Diesel Particulate Filter (DPF) is in the back half. Also the Differential Pressure Sensor and a temperature sensor are used as monitor the DPF.

OPERATION

- The NO₂ molecules in the exhaust temperature range of 300 - 400B°C (572 - 753B°F) regenerate the Diesel Particulate Filter (DPF), which is passive regeneration. If the passive regeneration cannot keep up with the build up of soot in the DPF, the Powertrain Control Module (PCM) will actively regenerate the DPF to burn off soot. Residue remains inside the DPF in the form of non-burnable ash. Ash comes from the oils and other materials that are present in the soot. Ash is not eliminated by the regeneration cycle. Excessive ash accumulation requires replacement of the DPF. The DPF uses a silicon carbide wall-flow monolith with a platinum coating to trap particulates. The monolith contains a large number of square parallel channels, which run in the axial direction and are separated by thin porous walls. The channels are alternatively open at one end, and plugged at the other. The exhaust gases flow through the walls and escape through the pores in the wall material. Particulates, however, are too large to escape and are trapped in the monolith walls. The PCM starts the regeneration of the DPF if the soot load exceeds a mapped value. The PCM determines the load condition of the DPF based upon the engine operating points and the exhaust gas pressure upstream and downstream of the DPF. A pressure differential sensor

provides the pressure input to the PCM. During the regeneration process, the PCM raises the temperature in the DPF to burn off soot accumulated. Under normal operation, the engine does not produce enough heat to oxidize the soot in the DPF. This process requires temperatures above 550B°C (1, 022 B°F). The PCM calculates the ash mass stored in the DPF by using the total fuel consumption, which has a strong correlation with oil consumption.



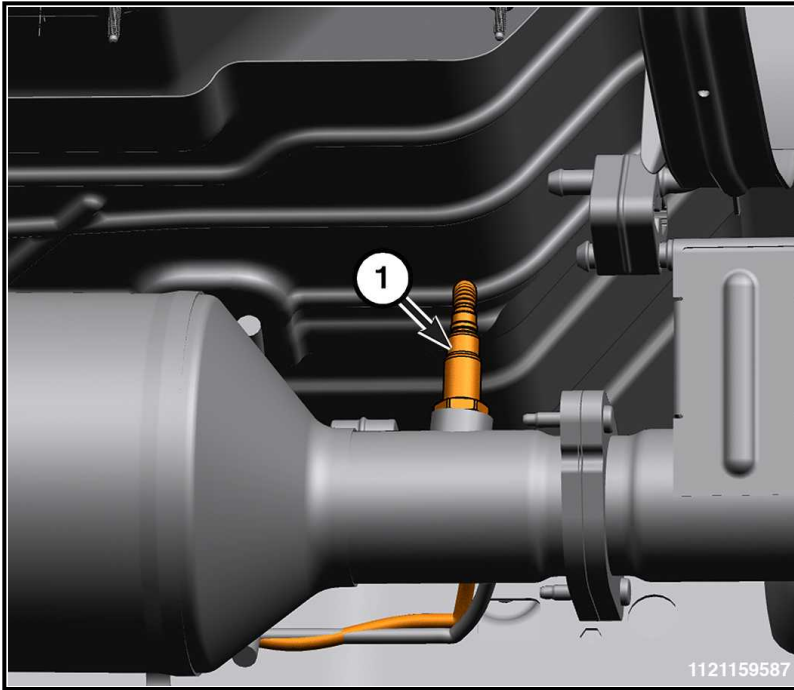
1 - Differential Pressure Sensor Bracket
2 - Differential Pressure Sensor Bracket Bolts
3 - Differential Pressure Sensor Tuber

- The Differential Pressure sensor is remotely mounted on the transmission housing. Two pressure tubes measure pressure before and after the Diesel Oxidation Catalyst (DOC)/Diesel Particulate Filter (DPF). The sensor is critical for fail-safe of regeneration strategy, because it interprets high pressure drops as possible high soot loads.
- The Exhaust Gas Temperature Sensor (EGT) operates as a typical two wire 5-Volt sensor. It sends a signal to the Powertrain Control Module (PCM) monitoring the temperature of the exhaust gases in the Diesel Particulate Filter.

The EGT Sensor are located:

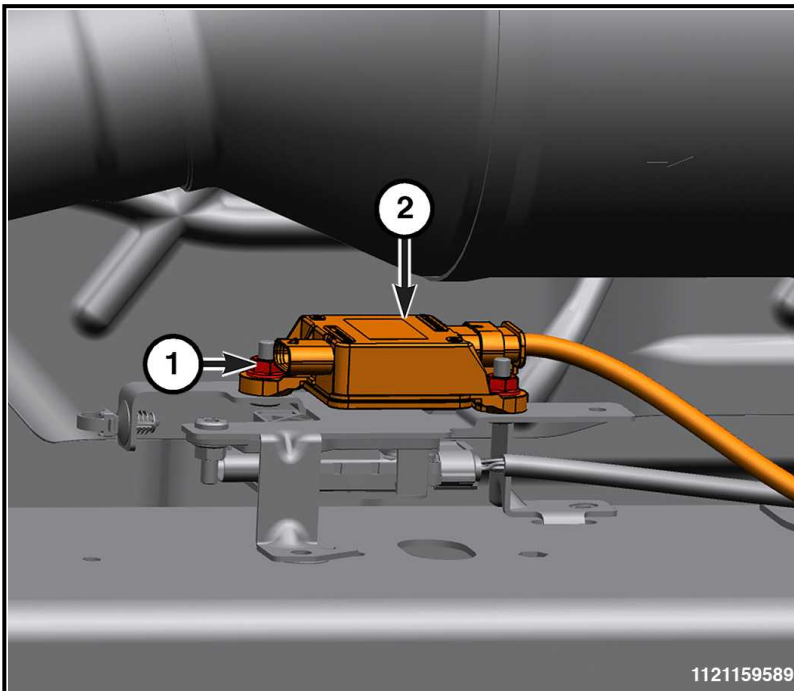
- 1/1 is located on the outlet of the turbocharger
- 1/2 is located on the inlet of the Diesel Oxidation Catalyst (DOC)/Diesel Particulate Filter (DPF)
- 1/3 is located between the DOC and the DPF
- 1/4 is located on the inlet of Selective Catalytic Reduction (SCR).

There are two types of heat shields used. One is stamped steel the other is molded foil sheets. The shields attach to the vehicle around the exhaust system to prevent heat from the exhaust system from entering the passenger area and other areas where the heat can cause damage to other components.



1 - PM Sensor

- The Particulate Matter (PM) sensor is located in the rear of the Selective Catalyst Reduction (SCR). The function of the PM sensor is to measure the tailpipe soot and to prove the Diesel Particulate Filter (DPF) is working according to On Board Diagnostic (ODB) requirements.



1 - PM Sensor Module Nuts

2 - PM Sensor Module

- The PM sensor module is only serviceable with the PM sensor.
- The Selective Catalytic Reduction (SCR) is a catalyst element made of copper zeolite used in reducing nitrous oxide gases (NOx) to an element of nitrogen. By injecting a Diesel Exhaust Fluid (DEF) solution upstream of a catalyst, the DEF solution will vaporize and decompose to form ammonia and carbon dioxide. When the ammonia vapor reacts with the NOx gas, it converts it to a harmless nitrogen and water by-product.

DIAGNOSIS AND TESTING

EXHAUST SYSTEM INSPECTION

EXHAUST SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE OR LEAKING EXHAUST GASES	1. Leaks at pipe joints.	1. Tighten clamps/bolts at leaking joints.
	2. Rust through or blown out muffler.	2. Replace muffler. Inspect exhaust system.
	3. Broken or rusted out exhaust pipe.	3. Replace exhaust pipe.
	4. Exhaust pipe leaking at manifold flange.	4. Tighten/replace flange attaching nuts/bolts.
	5. Exhaust manifold cracked or broken.	5. Replace exhaust manifold.
	6. Leak between exhaust manifold and cylinder head.	6. Tighten exhaust manifold to cylinder head bolts.
	7. Catalytic converter rusted or blown out.	7. Replace catalytic converter assembly and gasket.
	8. Restriction in exhaust system.	8. Remove restriction, if possible. Replace restricted part if necessary.

CAUTION:

When servicing or replacing exhaust system components, disconnect the oxygen sensor connector(s). Allowing the exhaust to hang by the oxygen sensor wires will damage the harness or oxygen sensor.

CATALYTIC CONVERTER

Look at the stainless steel body of the Catalytic Converter assembly, inspect for bulging or other distortion that could be a result of overheating. Inspect for:

- Indication of exhaust gas leakage such as soot trails
- Joint misalignment
- Denting of greater than 6.3 mm (0.25 in.)
- Outer shell torn, cracked or otherwise damaged
- Loose or damaged core

LEAK TESTING

WARNING: The normal operating temperature of the exhaust system is very high. Therefore, never work around or attempt to service any part of the exhaust system until it is cooled. Special care should be taken when working near the catalytic converter. The temperature of the converter rises to a high level after a short period of engine operation time.

1. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .

CAUTION: The air pressure must not exceed 4 psi, otherwise engine damage can occur.

2. Connect the (special tool #8404-ECT, Exhaust Cone, Truck) to an adjustable air pressure regulator.
3. Attach shop air to the air pressure regulator.
4. Adjust the air pressure regulator to 27.6 kPa (4 psi).
5. Insert the (special tool #8404-ECT, Exhaust Cone, Truck) into the vehicle tail pipe.
6. If the vehicle is equipped with dual exhaust, use an additional (special tool #8404-ECT, Exhaust Cone, Truck) equipped with an attached plug. Plug one side of the dual exhaust pipe. Pressurize the other as described.
7. Apply MoparB® Air Leak Detector or a mixture of liquid dish soap and water to the following areas:
 - All welded joints at least 18 inches rearward of the downstream oxygen sensor and forward to the cylinder head
 - Oxygen sensor seal points
 - Oxygen sensor boss welds
 - Flange/joint connection(s)
 - Exhaust manifold to cylinder head connection(s)
 - EGR solenoid gasket base and tube seal points (if equipped).
8. Watch for the liquid/soapy water to bubble.
9. Use the following definitions to help determine if system or component repair/replacement is necessary:
 - **Type 1 Leak** is defined as a leak where very small foam like bubbles 1 mm (0.039 in.) or less appear. Any Type 1 or greater leaks found in welded joints, O2 sensor seal points or O2 sensor boss welds must be repaired or the component must be replaced.
 - **Type 2 Leak** is defined as a leak where larger bubbles 8 mm (0.32 in.) or greater appear. A Type 2 Leak may also include at hissing sound (air pressure escaping) if the opening is too large to create bubbles. Any Type 2 or greater leaks found in flange or joint connections, exhaust manifold to cylinder head connections, or EGR gasket and tube seal points must be repaired or the components must be replaced.

Leak Location	Repair required if results at 4 psi reveal bubble size or hissing sound:
Welded joints	Type 1 - 1 mm (0.039 in.) or greater
O2 Sensor seal points	Type 1 - 1 mm (0.039 in.) or greater
O2 Sensor boss welds	Type 1 - 1 mm (0.039 in.) or greater
Flange/joint connections	Type 2 - 8 mm (0.315 in.) or greater
Exhaust Manifold to cylinder head connections	Type 2 - 8 mm (0.315 in.) or greater
EGR gasket and tube seal points (if equipped)	Type 2 - 8 mm (0.315 in.) or greater

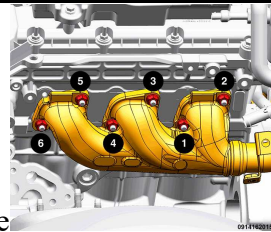
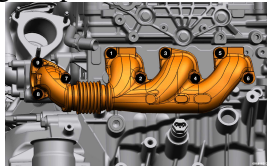
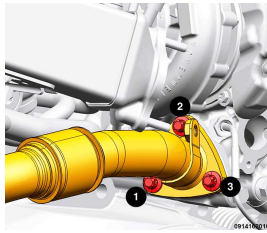
If a leak is found that matches the above definition, repair or replace the component as necessary.

Once the repair is complete, repeat the procedure to verify that all leaks have been repaired.

TECHNICAL SPECIFICATIONS

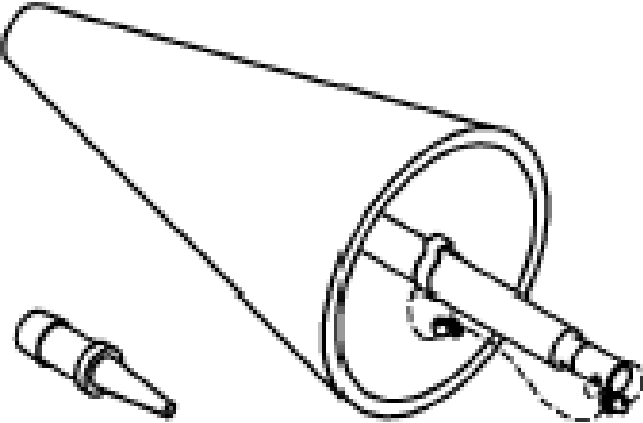
EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to- Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

SPECIAL TOOLS

	8404-ECT - Exhaust Cone, Truck (Originally Shipped In Kit Number(s) 8404-ECT.)
	2049500110 - Pliers, Exhaust System PSA

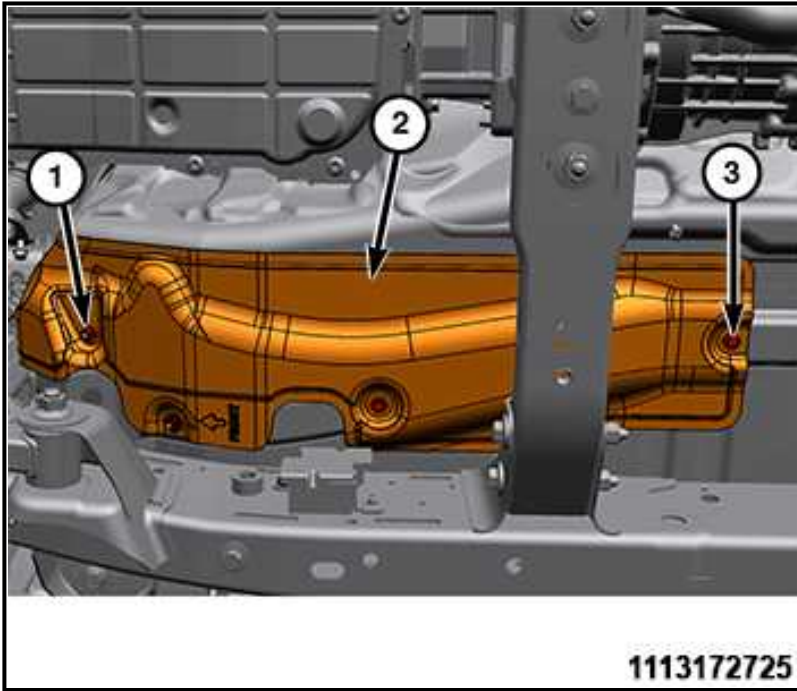
SHIELD, HEAT

REMOVAL AND INSTALLATION

FRONT HEAT SHIELD

REMOVAL

1. Remove the Diesel Particulate Filter (DPF). Refer to [FILTER, DIESEL PARTICULATE, REMOVAL AND INSTALLATION](#).



1 - Front Heat Shield Nut
2 - Front Heat Shield
3 - Front Heat Shield Nut

2. Remove the front heat shield nuts and the front heat shield.

INSTALLATION

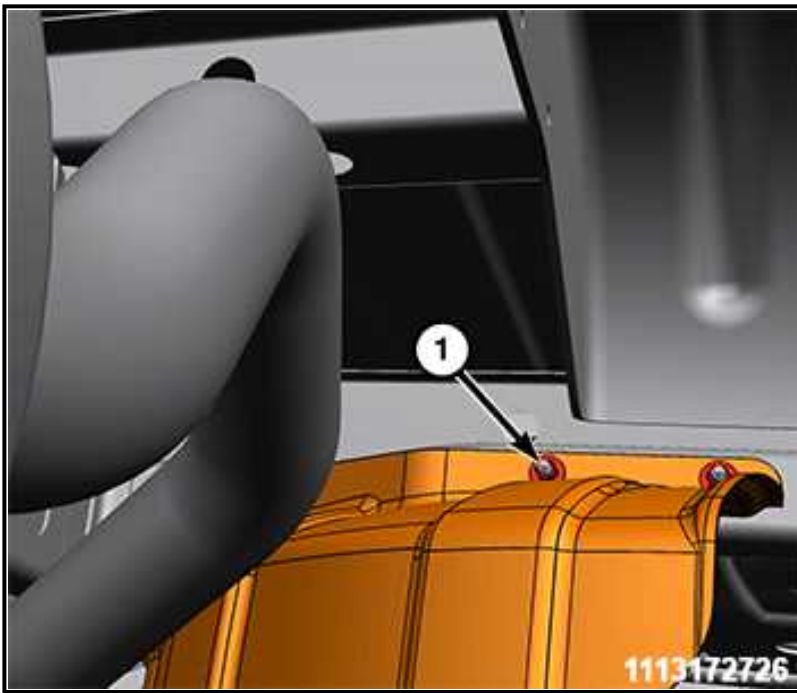
Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

- Install the front heat shield and securely tighten the front heat shield nuts.

REAR HEAT SHIELD

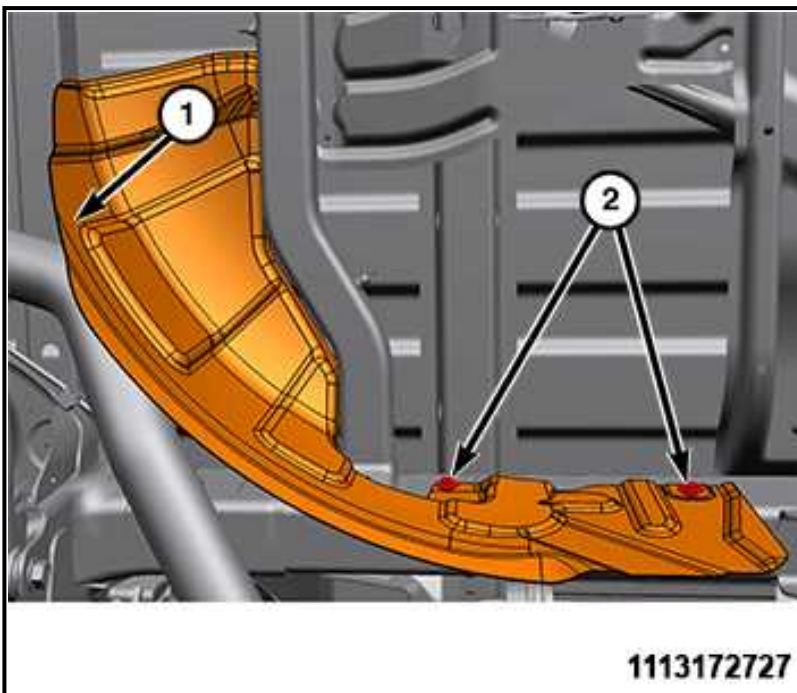
REMOVAL

1. Remove the spare tire.
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .



1 - Rear Heat Shield Nuts

3. Remove the rear heat shield nuts.



1 - Rear Heat Shield

2 - Rear Heat Shield Bolts

4. Remove the rear heat shield bolts and the rear heat shield.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

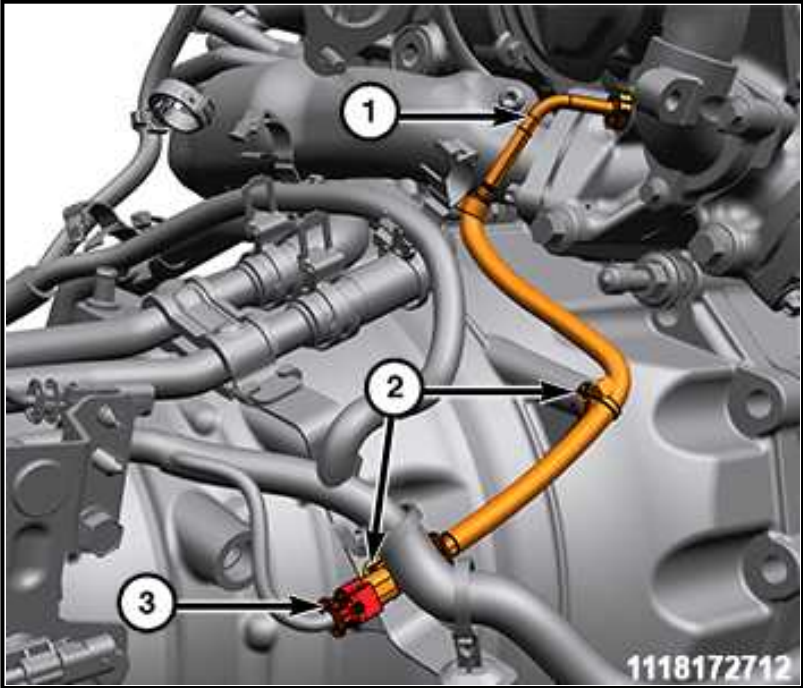
- Install the rear heat shield and securely tighten the rear heat shield bolts.

SENSOR, EXHAUST TEMPERATURE

REMOVAL AND INSTALLATION

REMOVAL

- 1. Disconnect and isolate the negative battery cable(s). Refer to [BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM](#) .
- 2. Remove the cab. Refer to [CAB, REMOVAL AND INSTALLATION](#) .
- 3. Remove the Low Pressure (LP) Exhaust Gas Recirculation (EGR) tube. Refer to [TUBE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#) .



1 - Exhaust Gas Temperature Sensor 1/1
2 - Wire Retainers
3 - Exhaust Gas Temperature Sensor 1/1 Wire Harness Connector

CAUTION: The exhaust gas temperature sensor requires care when handling and installing. The exhaust gas temperature sensor is sensitive to knocks and bending. For this reason if the exhaust gas temperature sensor has been dropped, it must not be installed as damage to the sensor may have occurred. Do not remove from packaging until ready to install. Failure to follow these instructions may result in damage to the exhaust gas temperature sensor.

- 4. Disconnect the Exhaust Gas Temperature (EGT) sensor 1/1 wire harness connector and detach the wire retainers.
- 5. Remove the EGT sensor 1/1.

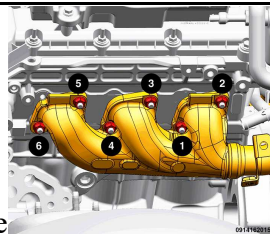
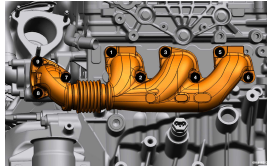
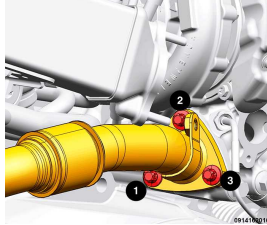
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

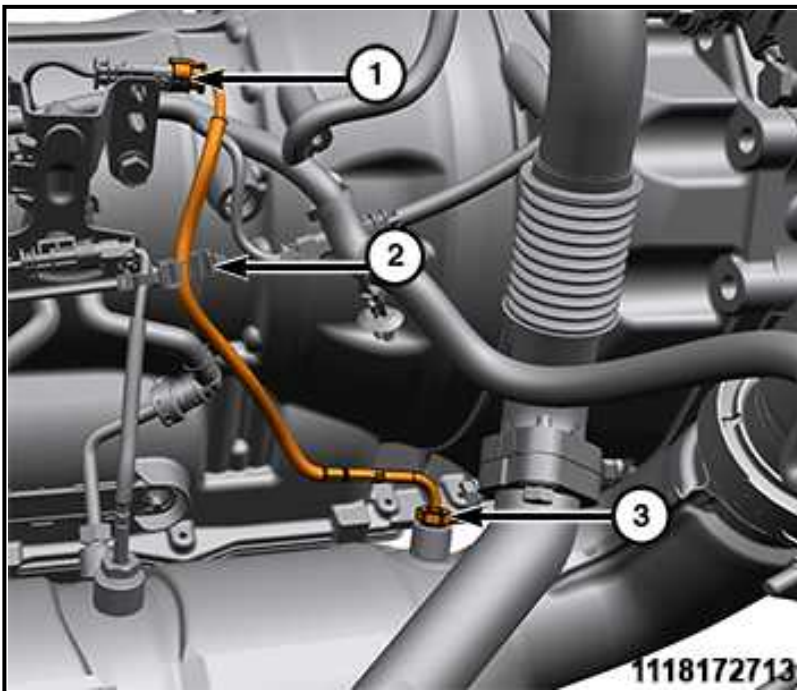
DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst	25 N.m (18 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Isolator Bolts		
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

EXHAUST GAS TEMPERATURE SENSOR 1/2

REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .



1 - Exhaust Gas Temperature Sensor 1/2 Wire Harness Connector
2 - Wire Retainer
3 - Exhaust Gas Temperature Sensor 1/2

3. Disconnect the Exhaust Gas Temperature (EGT) sensor 1/2 wire harness connector and open the wire retainer.

CAUTION:

The exhaust gas temperature sensor requires care when handling and installing. The exhaust gas temperature sensor is sensitive to knocks and bending. For this reason if the exhaust gas temperature sensor has been dropped, it must not be installed as damage to the sensor may have occurred. Do not remove from packaging until ready to install. Failure to follow these instructions may result in damage to the exhaust gas temperature sensor.

4. Remove the EGT sensor 1/2.

INSTALLATION

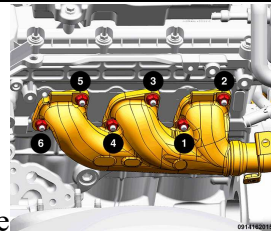
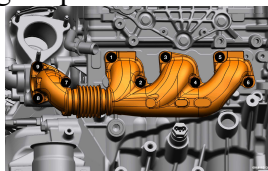
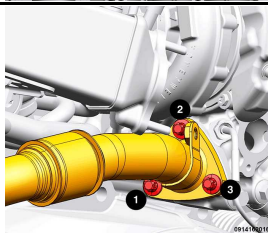
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

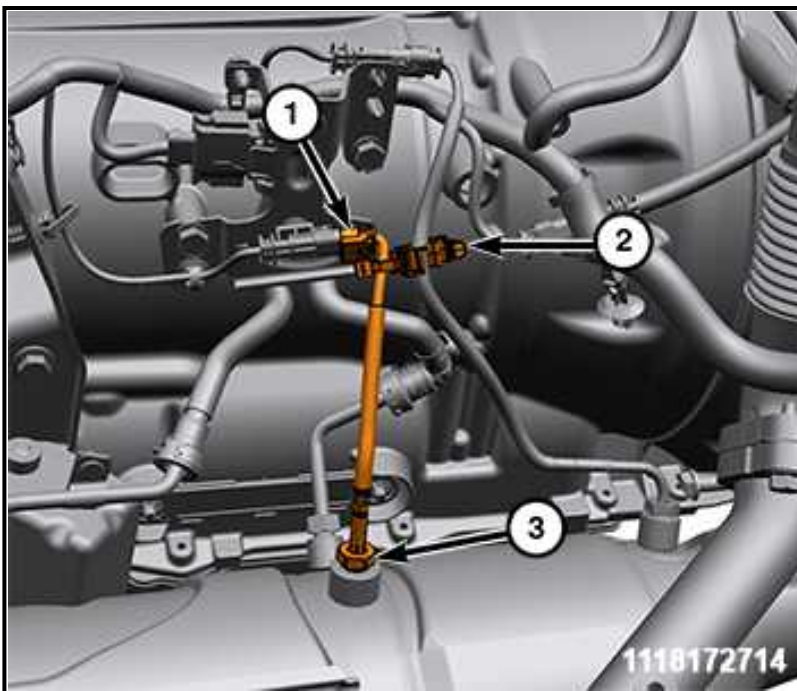
DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

EXHAUST GAS TEMPERATURE SENSOR 1/3

REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM](#) .
2. Remove the transmission skid plate. Refer to [PLATE, SKID, REMOVAL AND INSTALLATION](#) .



1 - Exhaust Gas Temperature 1/3 sensor wire harness connector
2 - Wire Retainer
3 - Exhaust Gas Temperature 1/3 sensor

3. Disconnect the Exhaust Gas Temperature (EGT) 1/3 sensor wire harness connector and open the wire retainer.

CAUTION: The exhaust gas temperature sensor requires care when handling and installing. The exhaust gas temperature sensor is sensitive to knocks and bending. For this reason if the exhaust gas temperature sensor has been dropped, it must not be installed as damage to the sensor may have occurred. Do not remove from packaging until ready to install. Failure to follow these instructions may result in damage to the exhaust gas temperature sensor.

4. Remove the EGT 1/3 sensor.

INSTALLATION

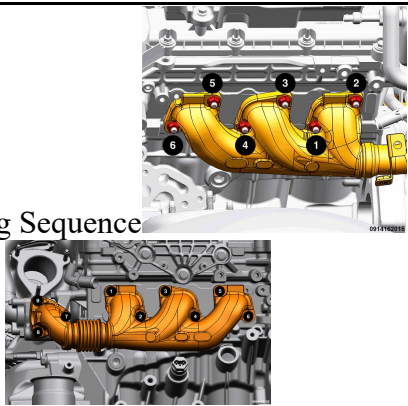
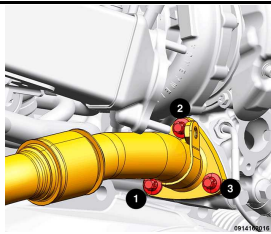
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

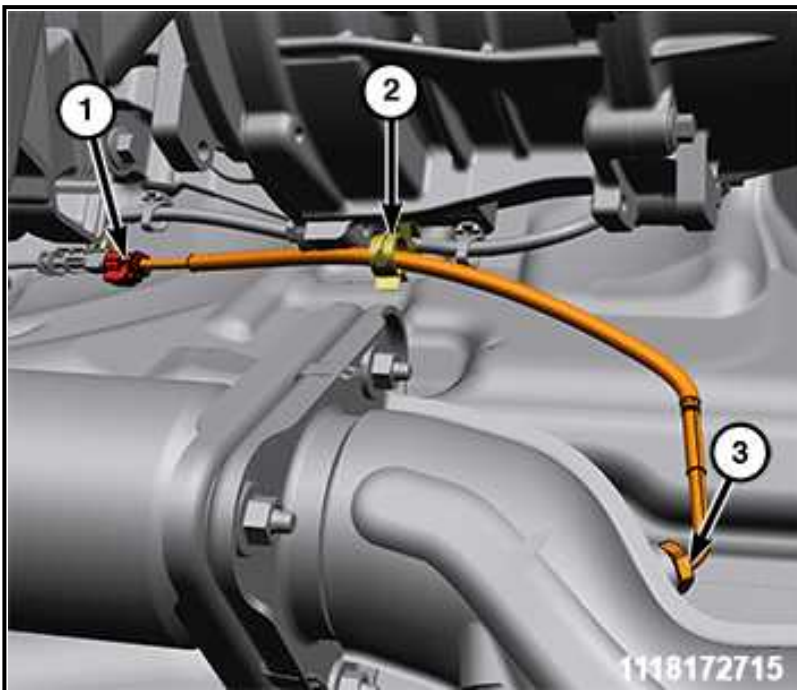
DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

EXHAUST GAS TEMPERATURE SENSOR 1/4

REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM](#) .
2. Remove the transmission skid plate. Refer to [PLATE, SKID, REMOVAL AND INSTALLATION](#) .



1 - Exhaust Gas Temperature Sensor 1/4 Wire Harness Connector
2 - Wire Harness Retainer
3 - Exhaust Gas Temperature Sensor 1/4

3. Disconnect the Exhaust Gas Temperature (EGT) sensor 1/4 wire harness connector and detach from retainer.

CAUTION:

The exhaust gas temperature sensor requires care when handling and installing. The exhaust gas temperature sensor is sensitive to knocks and bending. For this reason if the exhaust gas temperature sensor has been dropped, it must not be installed as damage to the sensor may have occurred. Do not remove from packaging until ready to install. Failure to

follow these instructions may result in damage to the exhaust gas temperature sensor.

4. Remove the EGT sensor 1/4.

INSTALLATION

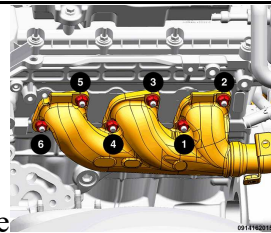
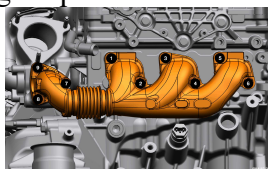
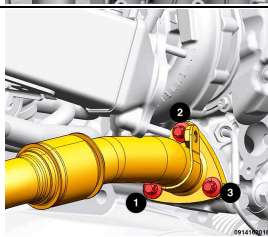
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

MANIFOLD, EXHAUST

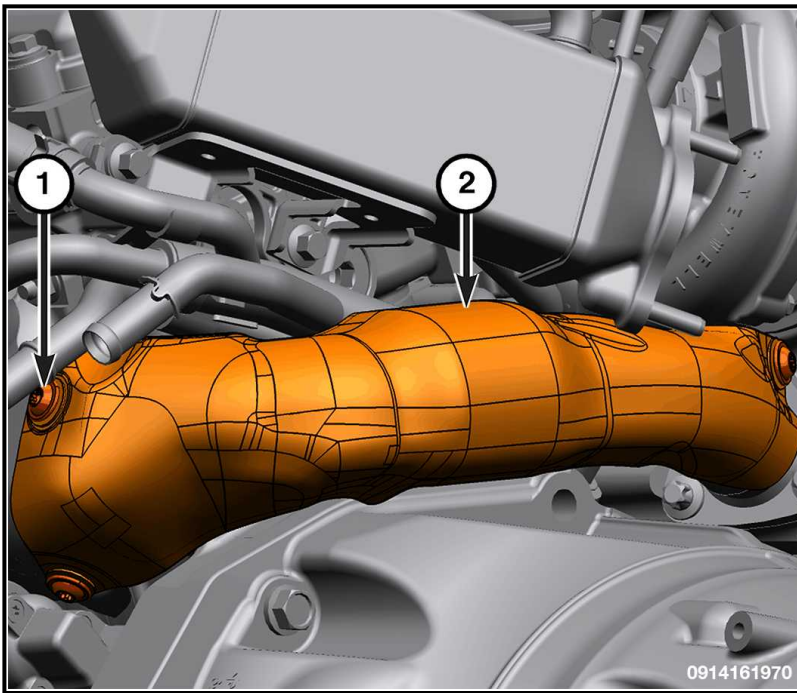
REMOVAL AND INSTALLATION

LEFT BANK

REMOVAL

WARNING: The normal operating temperature of the exhaust system is very high. Therefore, never work around or attempt to service any part of the exhaust system until it has cooled. Special care should be taken when working near the catalytic converter. The temperature of the converter rises to a high level after a short period of engine operation time.

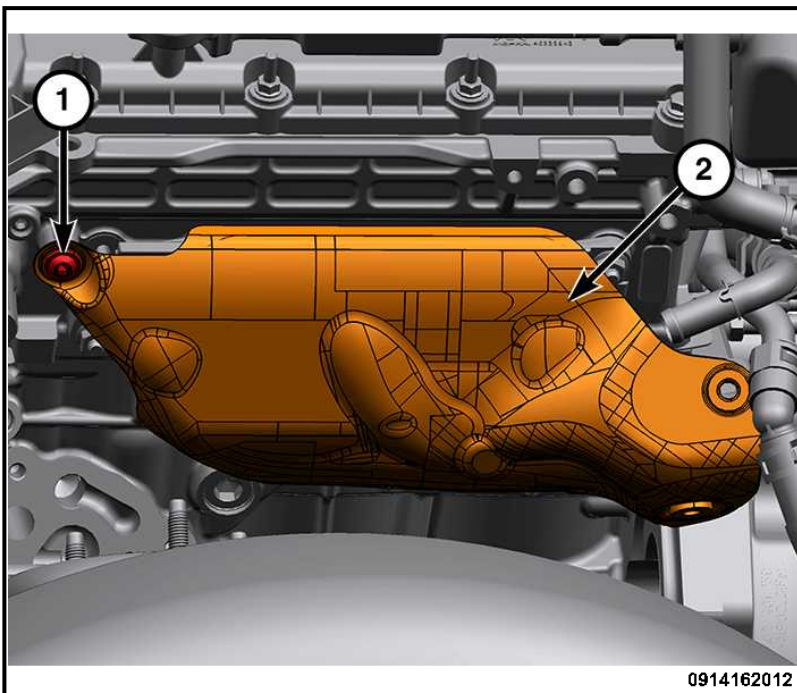
1. Remove the cab. Refer to [CAB, REMOVAL AND INSTALLATION](#) .
2. Remove the oil cooler adapter. Refer to [ADAPTER/COOLER, OIL FILTER, REMOVAL AND INSTALLATION](#) .



1 - Heat Shield Bolts

2 - Heat Shield

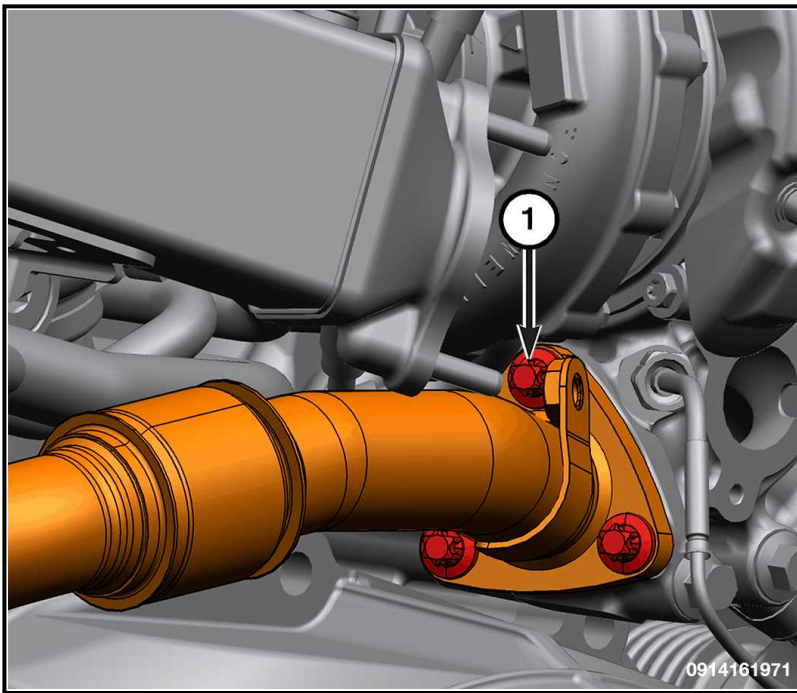
3. Remove the heat shield bolts and the heat shield.



1 - Exhaust Manifold Heat Shield Bolt

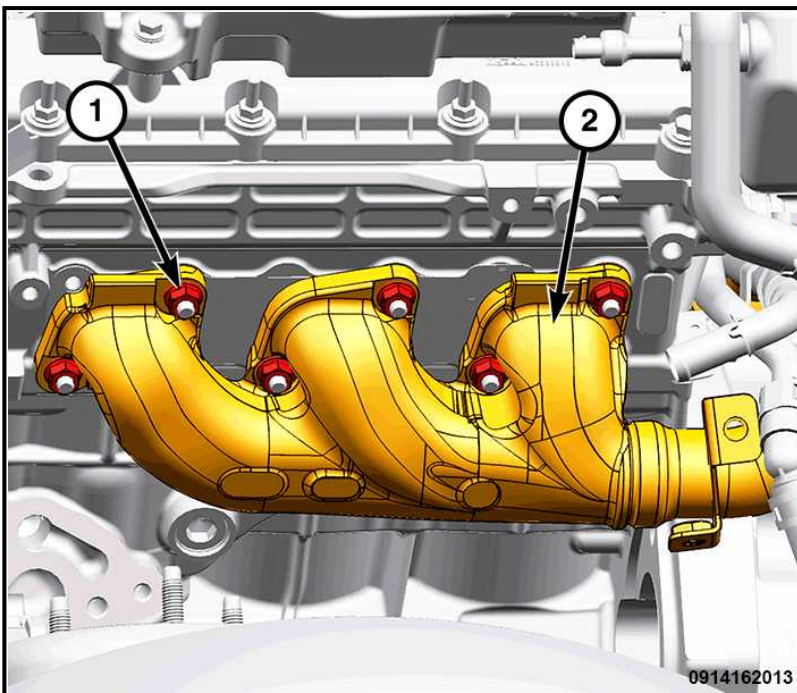
2 - Exhaust Manifold Heat Shield

4. Remove the left exhaust manifold heat shield bolt and the left exhaust manifold heat shield.



1 - Exhaust Manifold Pipe to Turbocharger Bolts

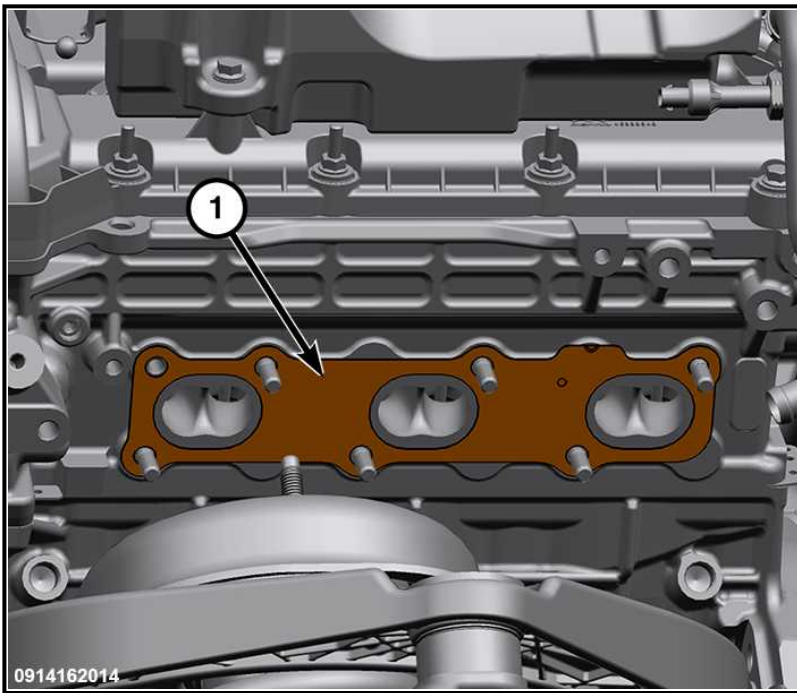
5. Remove the exhaust manifold pipe to turbocharger bolts.



1 - Left Exhausts Manifold Nuts

2 - Left Exhausts Manifold

6. Remove the left exhausts manifold nuts and the left exhausts manifold.



1 - Gasket

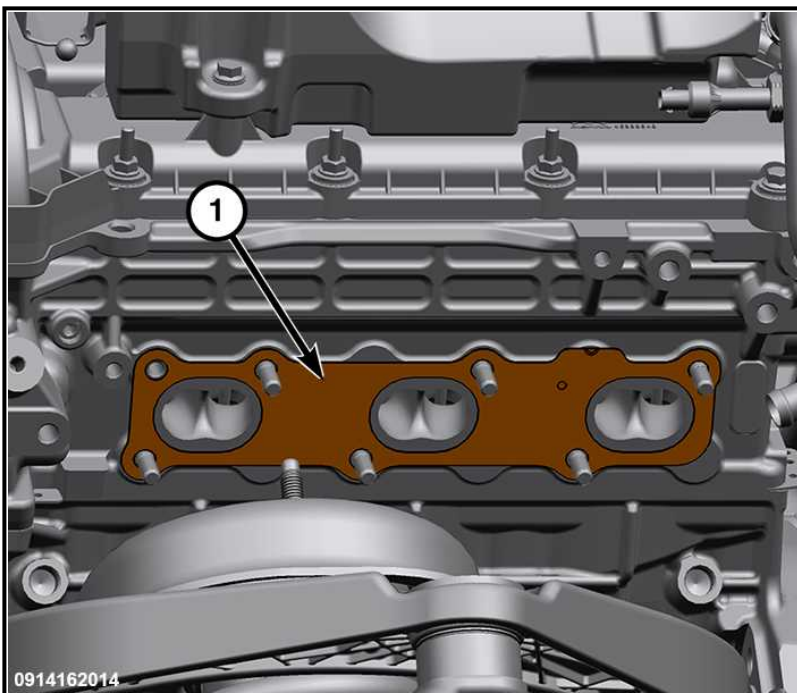
7. Remove and discard the gasket.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

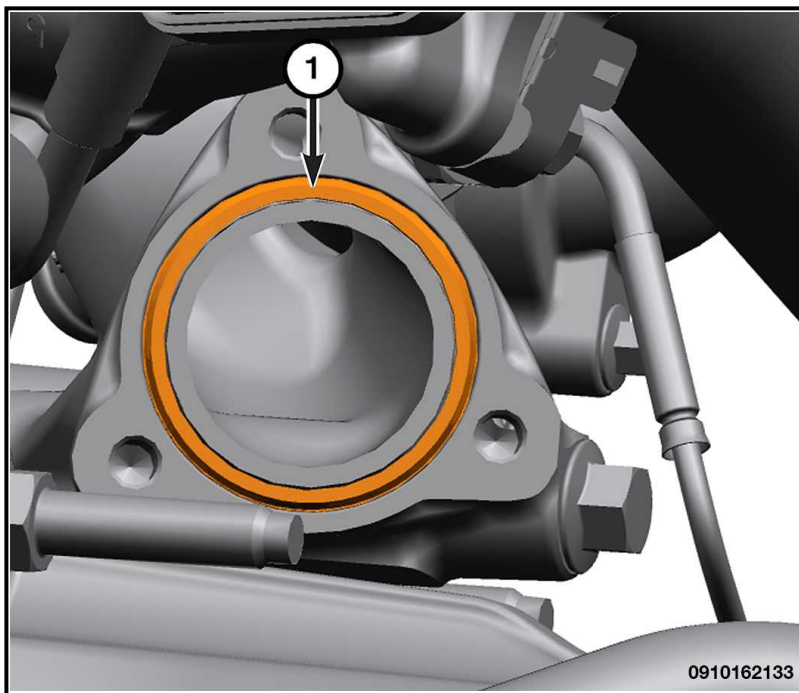
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the cylinder head and exhaust manifold sealing surfaces. Refer to [ENGINE GASKET SURFACE PREPARATION](#).



1 - Gasket

- Install a **NEW** gasket onto the cylinder head.



1 - Gasket

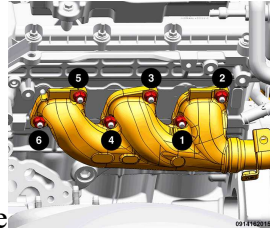
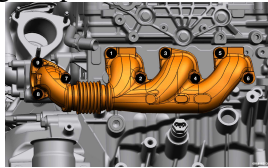
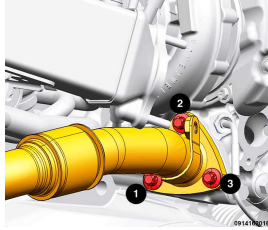
- Install a **NEW** gasket to the left side of turbocharger.
- Install the exhaust manifold and tighten the exhaust manifold nuts using the tightening sequence shown in the torque table to proper torque specifications.
- Install the exhaust manifold to turbocharger bolts and tighten using the tightening sequence shown in the torque table to proper torque specifications.

TORQUE SPECIFICATIONS

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

RIGHT BANK

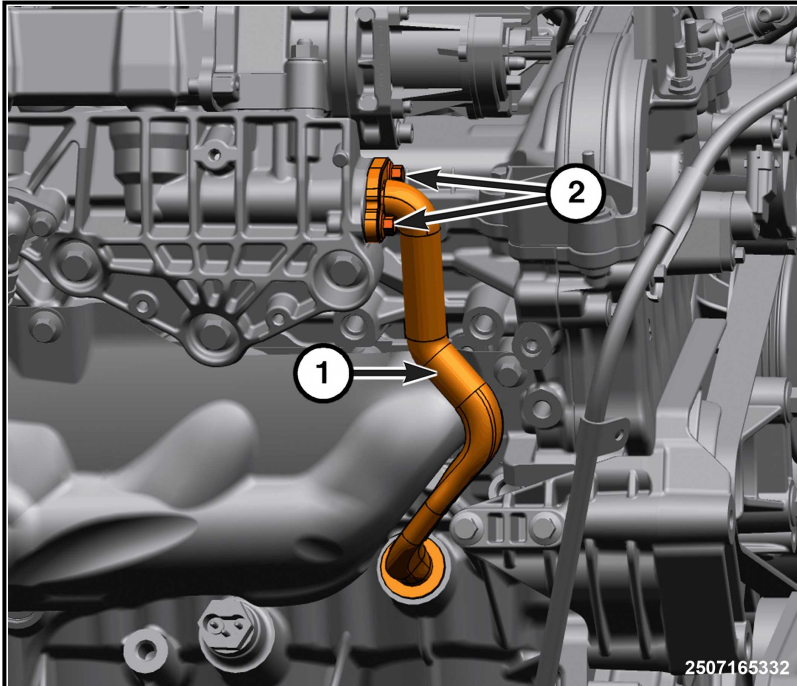
REMOVAL

WARNING:

The normal operating temperature of the exhaust system is very high. Therefore, never work around or attempt to service any part of the exhaust system until it has cooled. Special care should be taken when working near the catalytic converter. The temperature of the converter rises to a high level after a short period of engine operation time.

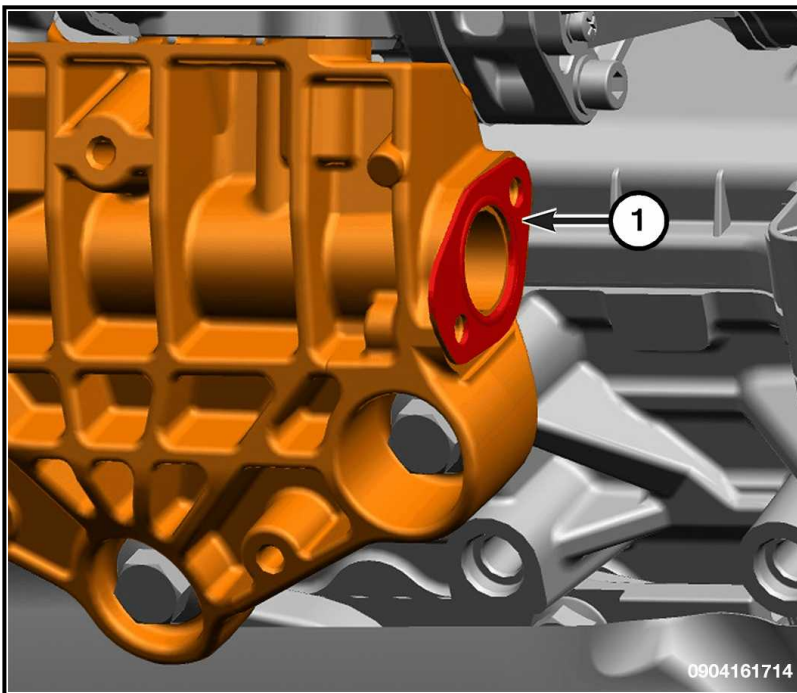
1. Disconnect and isolate the negative battery cable(s). Refer to [BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM](#).

2. Remove the right front tire and wheel. Refer to [REMOVAL AND INSTALLATION](#) .
3. Remove the right front wheel house splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) .
4. Remove the Diesel Particulate Filter (DPF) elbow. Refer to [FILTER, DIESEL PARTICULATE, REMOVAL AND INSTALLATION](#).



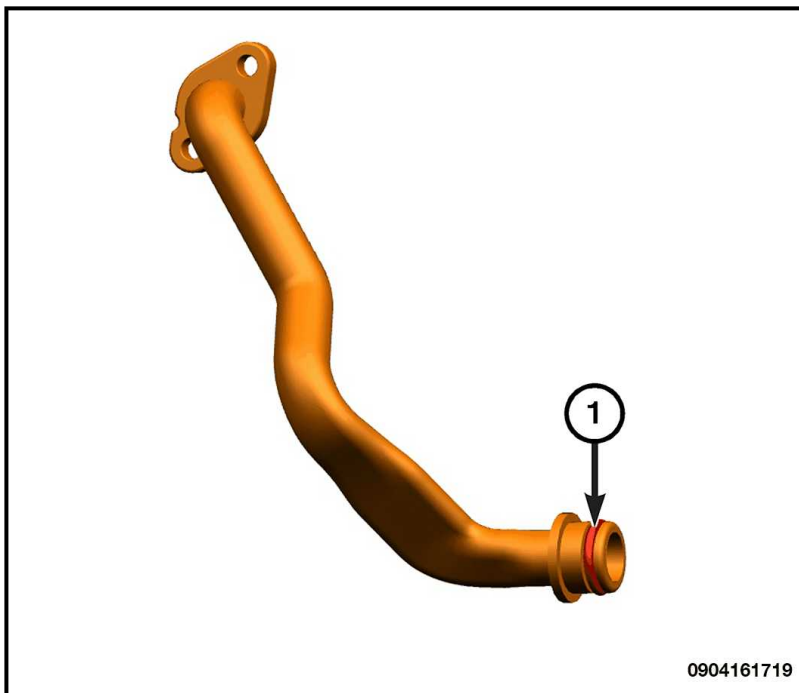
- | |
|-----------------------------------|
| 1 - EGR Cooler Coolant Tube |
| 2 - EGR Cooler Coolant Tube Bolts |

5. Remove the EGR cooler coolant tube bolts and the EGR cooler coolant tube.



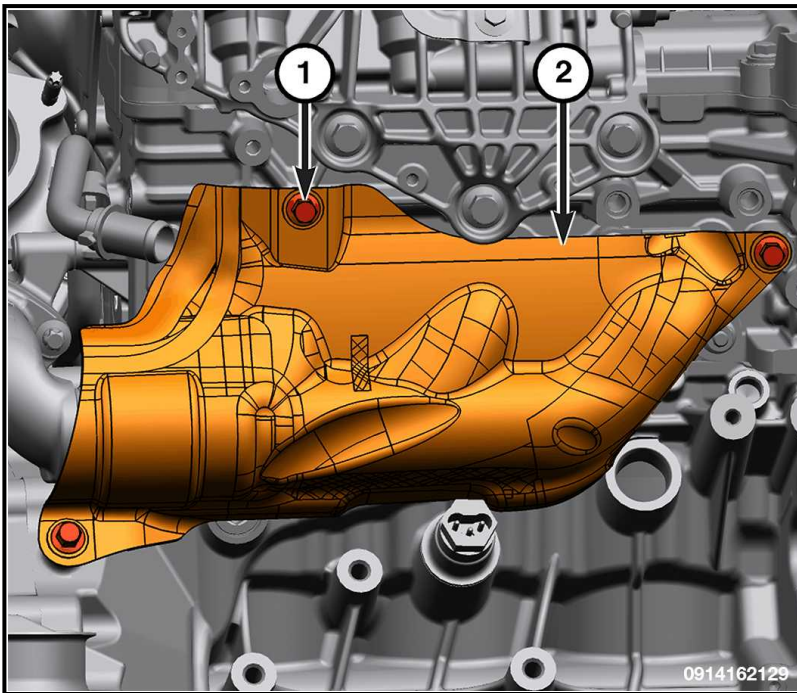
- | |
|-------------------------|
| 1 - Coolant Tube Gasket |
|-------------------------|

6. Remove and **DISCARD** the coolant tube gasket.



1 - O-ring

7. Remove and **DISCARD** the coolant tube O-ring.

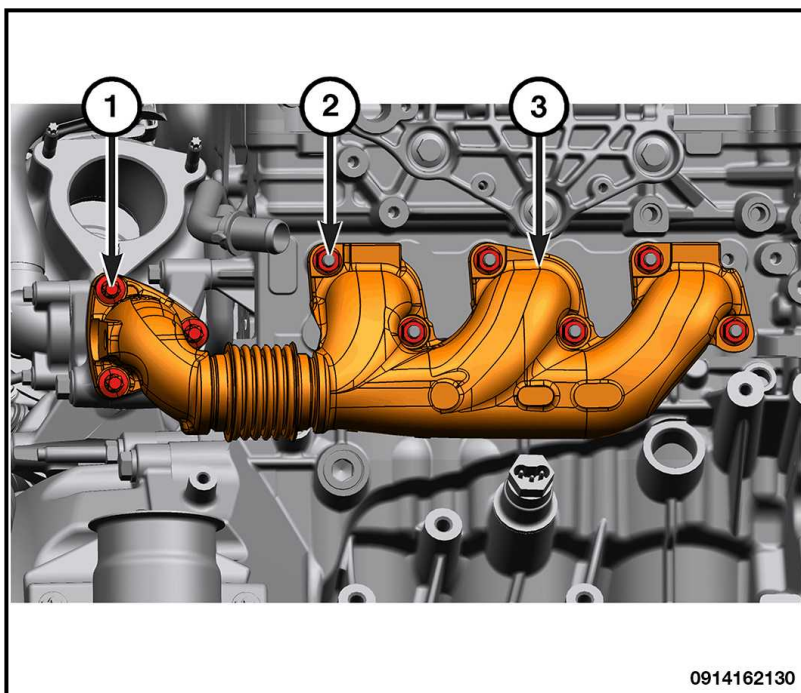


1 - Right Exhaust Manifold Heat Shield Bolts

2 - Right Exhaust Manifold Heat Shield

8. Remove the right exhaust manifold heat shield bolts and the right exhaust manifold heat shield.

9. Remove the exhaust pressure sensor tube. Refer to [SENSOR, EXHAUST PRESSURE, REMOVAL AND INSTALLATION](#).



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1 - Right Exhaust Manifold To Turbocharger Bolts

2 - Right Exhaust Manifold Nuts

3 - Right Exhaust Manifold

10. Remove the right exhaust manifold to turbocharger bolts.

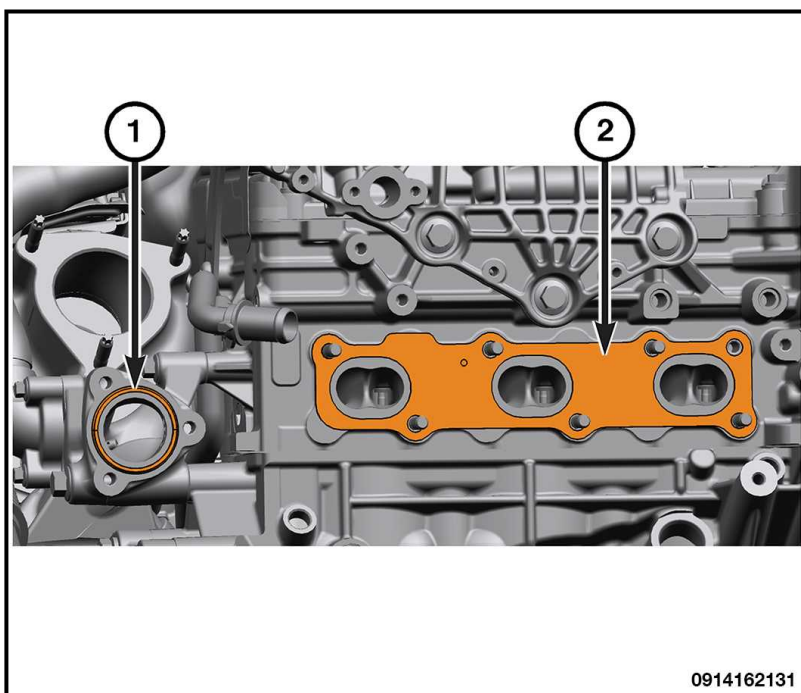
11. Remove the right exhaust manifold nuts and the right exhaust manifold.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the cylinder head, exhaust manifold and turbocharger sealing surfaces. Refer to [ENGINE GASKET SURFACE PREPARATION](#).

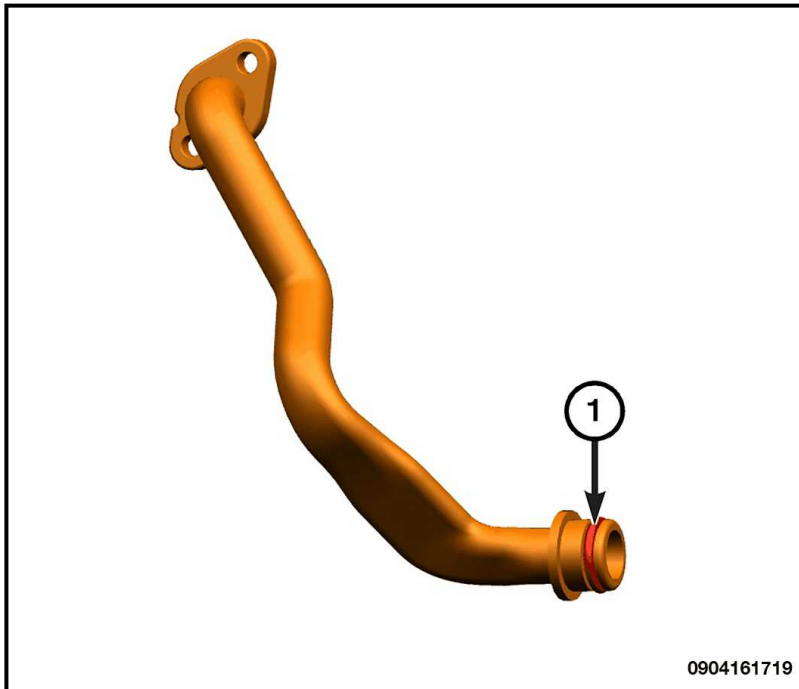


0914162131

1 - Gasket

2 - Gasket

- Install a **NEW** gaskets onto the turbocharger and cylinder head.
- Install the exhaust manifold and tighten the exhaust manifold nuts using the tightening sequence shown in the torque table to proper torque specifications.
- Install the exhaust manifold to turbocharger bolts and tighten using the tightening sequence shown in the torque table to proper torque specifications.



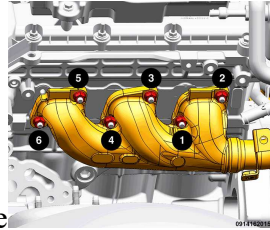
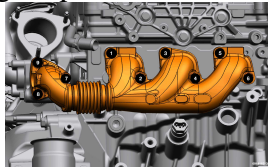
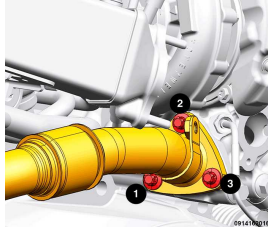
1 - O-ring

- Lubricate and install a **NEW** O-ring seal on the coolant tube.
- Using a **NEW** gasket, install the EGR cooler coolant tube and tighten the coolant tube bolts to the proper torque specifications.
- Start the engine and check for leaks.

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

FILTER, DIESEL PARTICULATE

STANDARD PROCEDURE

STANDARD PROCEDURE - STATIONARY DESOOT

WARNING:

Due to the fact that the vehicle may be left unattended for up to one hundred (100) minutes during this procedure, every precautionary measure must be taken to ensure that the vehicle cannot be stolen and that no person comes in contact with the hot exhaust or hot exhaust gases during the procedure.

NOTE:

The fuel minimum specification to run the test is 1/4 of a tank of fuel.

1. Fill the vehicle with three (3) gallons of Ultra Low Sulfur diesel fuel to perform the procedure.

NOTE: In order for Stationary De-Soot to begin, the vehicle must be parked with the parking brake engaged, be at normal operating temperature, and have at least three gallons of fuel. If any of these conditions are violated after Stationary De-Soot begins, or if the brake or accelerator pedal is pressed, Stationary De-Soot will abort.

2. Position the vehicle on a NONFLAMMABLE surface such as concrete.

WARNING: Exhaust temperatures will be extremely high. Do not perform this procedure on flammable surfaces such as asphalt, grass, etc. or adjacent to property that may be damaged by the exhaust gases, or in a location where individuals may be required to pass adjacent to the exhaust.

3. Position the shift lever in Park or Neutral.

4. Mark an area 12 feet (3.66 meters) by 12 feet (3.66 meters) surrounding the exhaust outlet. The exhaust outlet should be six feet from the fore and aft ends of the marked off area.

NOTE: Ensure that the "HOT EXHAUST" labels are facing outward.

5. If not already performed, connect the Diagnostic Scan Tool to the vehicle.

6. Start the engine.

7. Power ON the Diagnostic Scan Tool.

8. Scroll to the Powertrain Control Module (PCM) menu.

9. Select Service Diesel Particulate Filter Regeneration.

NOTE: During Stationary De-Soot, engine RPM will be elevated to 2, 500 RPM. When the engine RPM returns to normal idle, the Stationary De-Soot has completed or aborted.

10. Initiate Stationary De-Soot.

NOTE: Stationary De-Soot may take up to 30 minutes to complete. The scan tool must remain connected during the stationary desoot. When the desoot is finished the scan tool will report a successful regen.

11. Stationary De-Soot will automatically abort once the cycle is complete. If Stationary De-Soot needs to be aborted prior to the end of the cycle, any of the following manual methods can be used:

- Turning the ignition OFF
- Depressing the brake pedal
- Moving the PRNDL from P/N to D/R

12. Once Stationary De-Soot is complete, remove the antitheft device.

13. Using the scan tool, perform **DPF Reset Option** function found under MISCELLANEOUS FUNCTIONS.

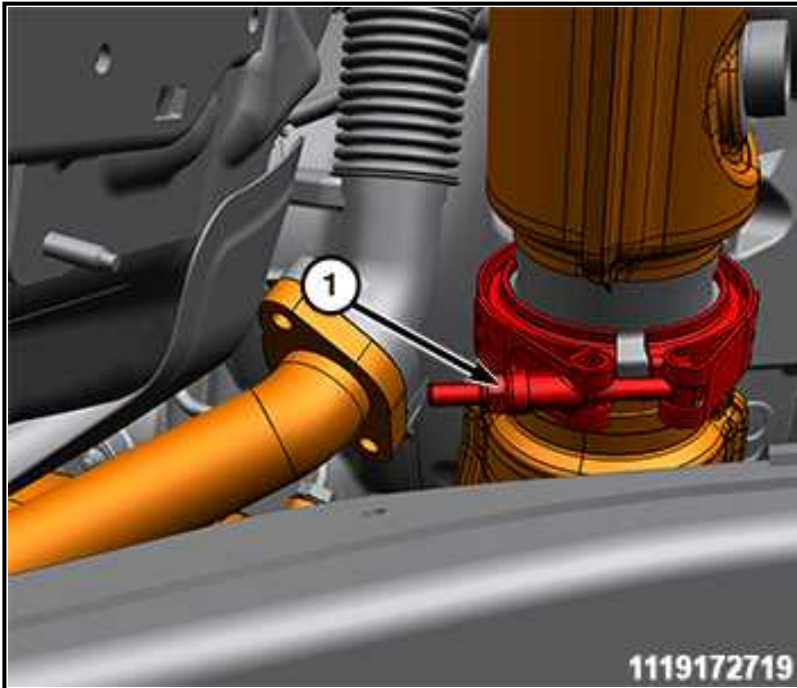
14. Once the regeneration is complete, the vehicle needs to be driven above 86 km/h (55 mph) for 15 minutes to allow the DPF differential pressure sensor to get a clear reading.

REMOVAL AND INSTALLATION

DIESEL PARTICULATE FILTER ELBOW

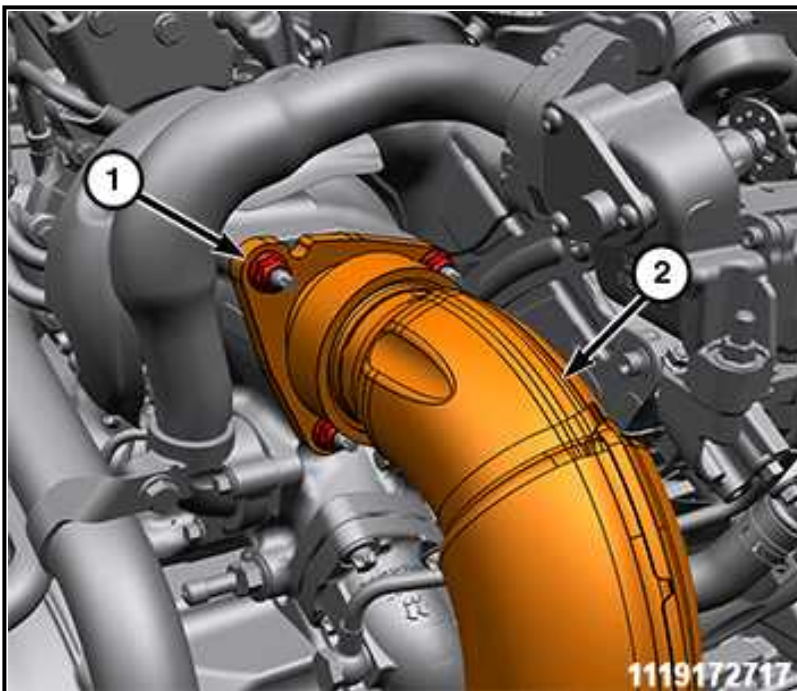
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
3. Remove the right front wheelhouse splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) .
4. Remove the oxygen sensor. Refer to [ENGINE SENSORS, REMOVAL AND INSTALLATION](#) .
5. Remove the NOx sensor 1/1. Refer to [SENSOR, NOX, REMOVAL AND INSTALLATION](#) .



1 - DPF Inlet Elbow Clamp

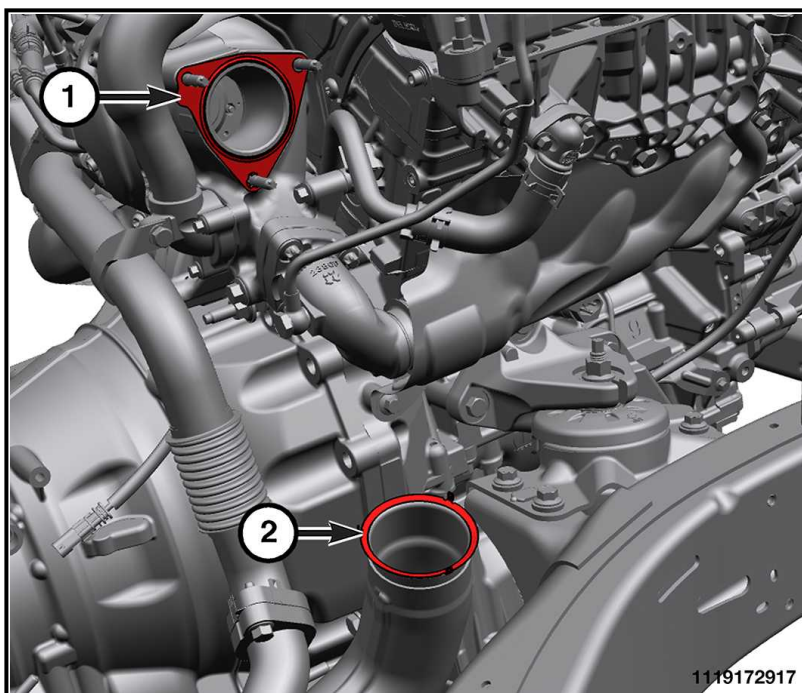
6. Remove the Diesel Particulate Filter (DPF) inlet elbow clamp.



1 - DPF Inlet Elbow Nuts

2 - DPF Inlet Elbow

7. Remove DPF inlet elbow nuts and the DPF inlet elbow.



1 - Turbocharger Flange Gasket

2 - Lower Flange Gasket

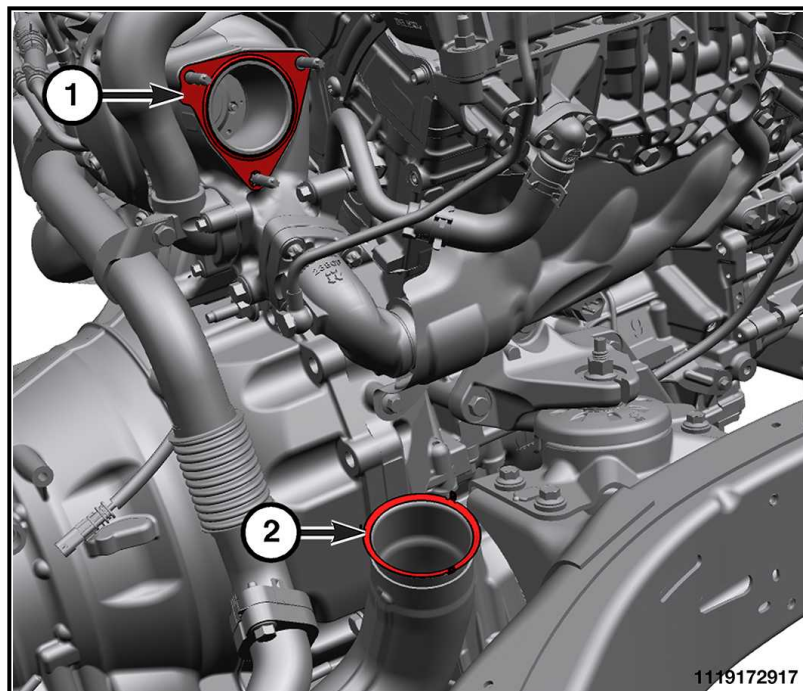
8. Remove and discard the turbocharger flange gasket.

9. Remove and discard the lower flange gasket.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.



1 - Turbocharger Flange Gasket

2 - Lower Flange Gasket

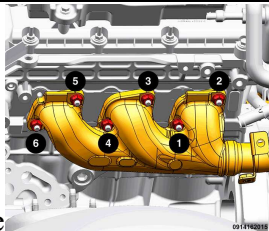
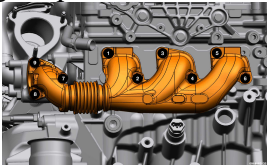
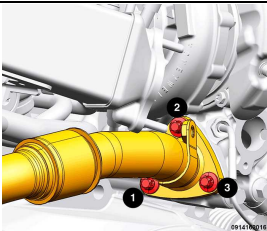
- Install a **NEW** lower flange gasket.

- Install a **NEW** turbocharger flange gasket.
- Install a **NEW** V-band clamp onto DPF inlet elbow and tighten to the proper torque specifications.

TORQUE SPECIFICATIONS

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

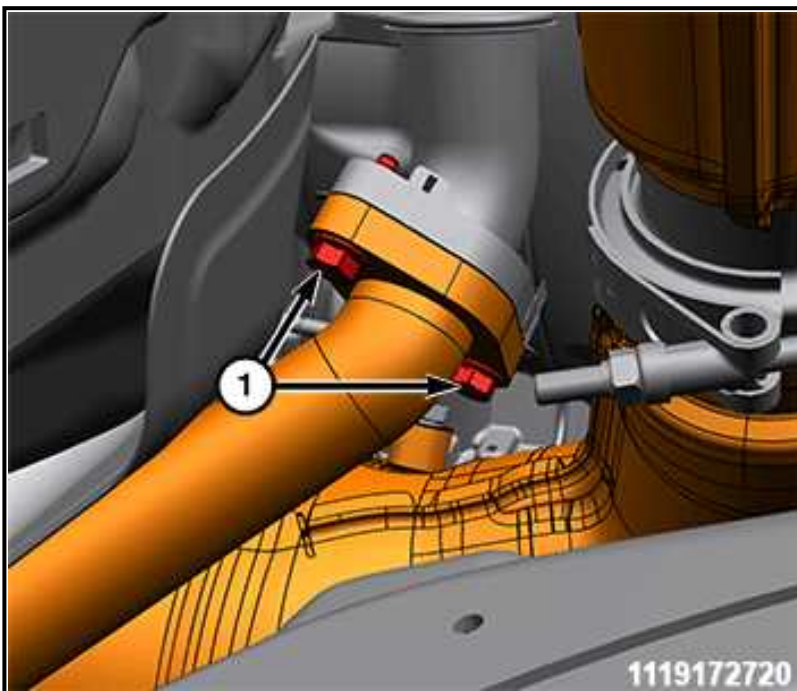
DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

DIESEL PARTICULATE FILTER

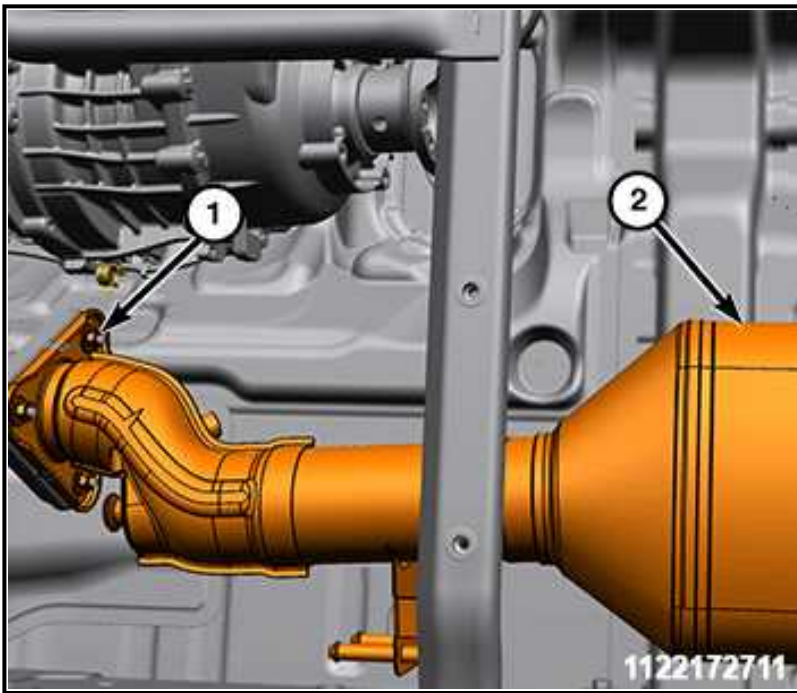
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [**BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM**](#) .
2. Raise and support the vehicle. Refer to [**HOISTING, STANDARD PROCEDURE**](#) .
3. Saturate the necessary fasteners with MoparB® Rust Inhibitor. Allow 5 minutes for penetration.
4. Remove the front reinforcement crossmember. Refer to [**CROSSMEMBER, FRONT REINFORCEMENT, REMOVAL AND INSTALLATION**](#) .



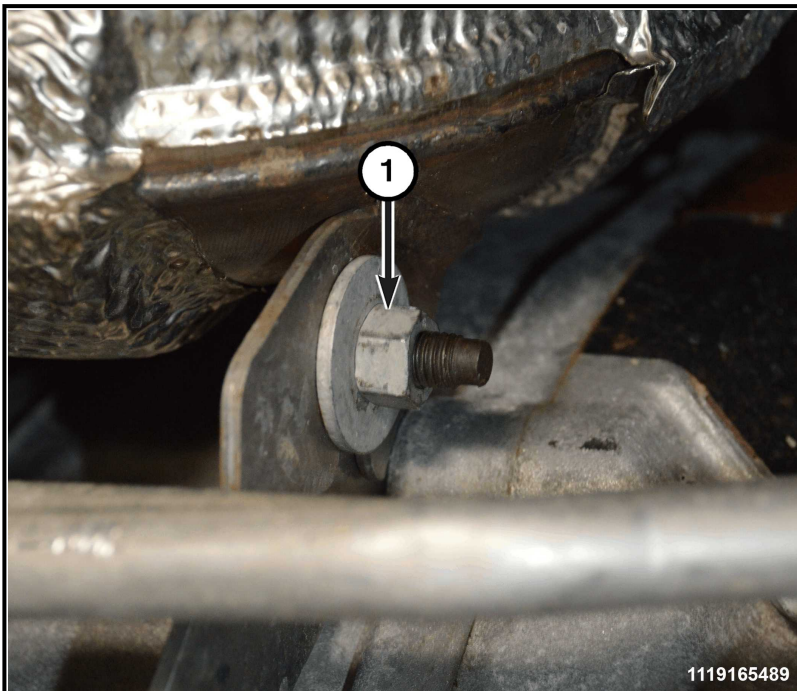
1 - Low Pressure EGR Tube Bolts

5. Remove the Low Pressure (LP) EGR tube bolts.
6. Position a jack stand under the DPF.



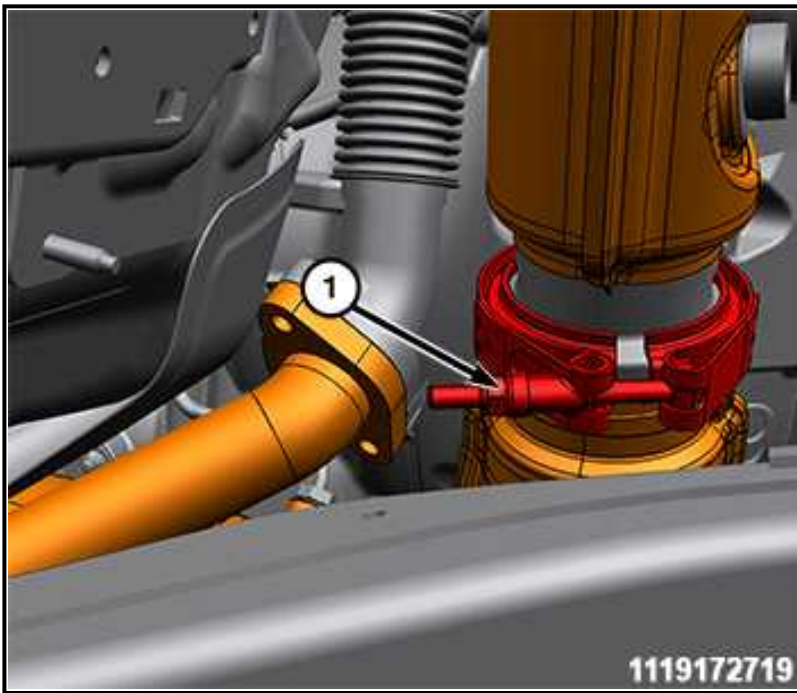
1 - Diesel Particulate Filter to Selective Catalytic Reduction Catalyst Nuts

7. Remove the Diesel Particulate Filter (DPF) to the Selective Catalytic Reduction (SCR) catalyst nuts and position aside the SCR.



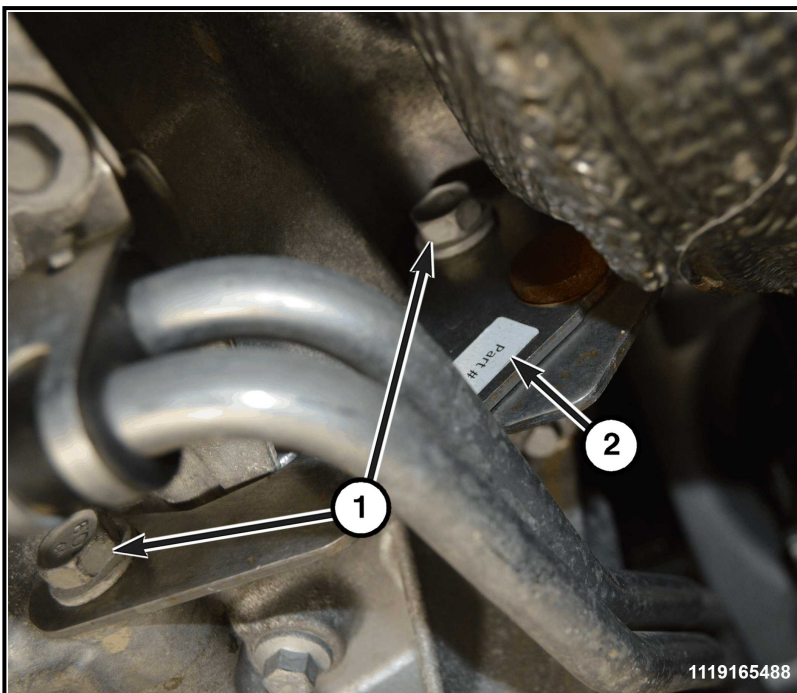
1 - Steady Rest Bracket Nut

8. Remove the steady rest bracket nut.



1 - Diesel Particulate Filter Inlet Elbow Clamp

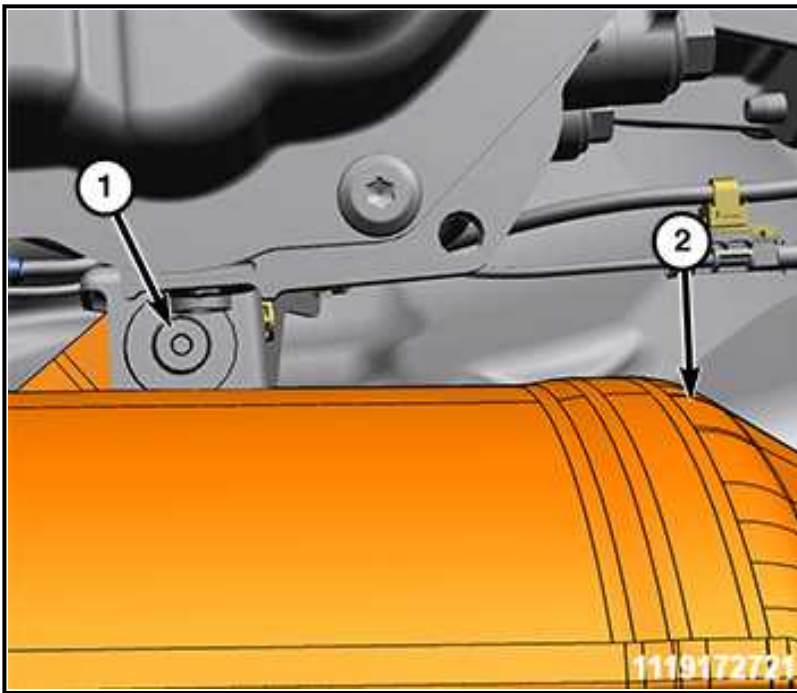
9. Remove the DPF inlet elbow clamp.



1 - Steady Rest Bracket Bolts

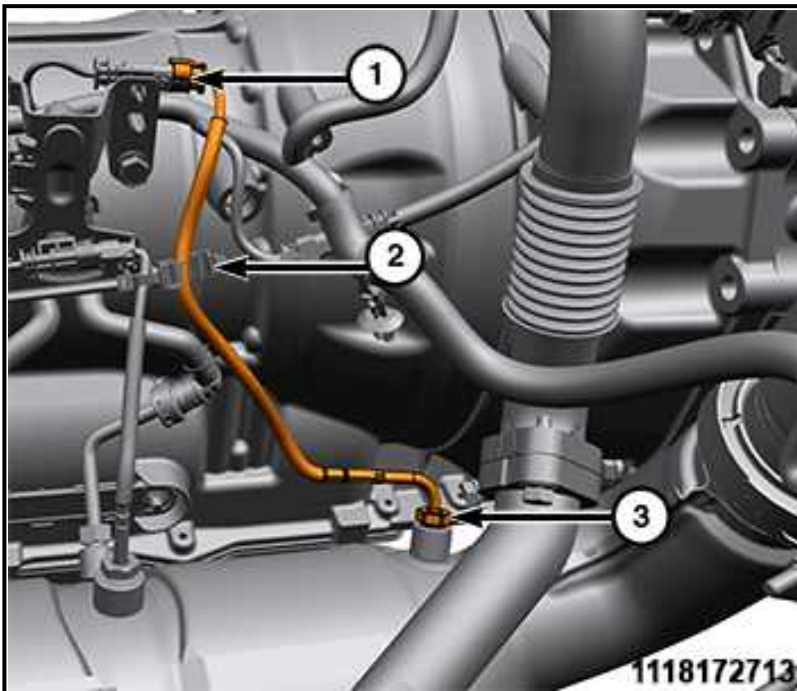
2 - Steady Rest Bracket

10. Remove the steady rest bracket bolts and the steady rest bracket.



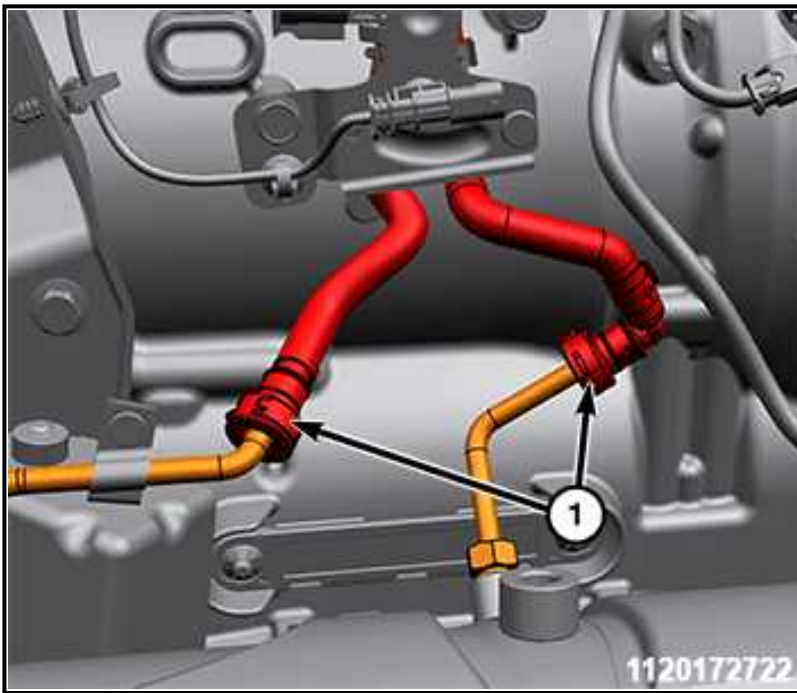
1 - Rear Exhaust Bracket Bolt

11. Remove the rear exhaust bracket bolt.
12. Mark the position of the front Differential Pressure Sensor (DPS) tube.
13. Remove the front DPS tube.



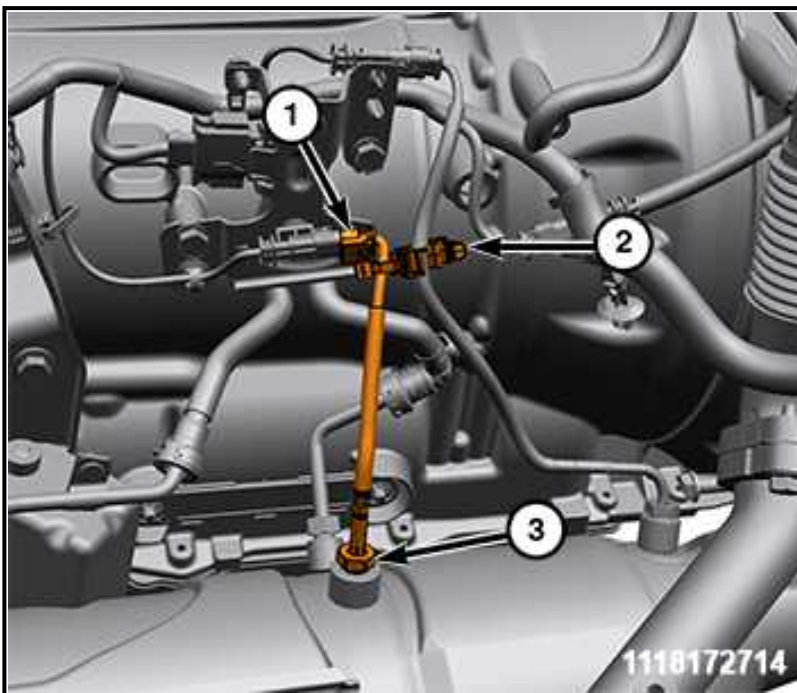
1 - Exhaust Gas Temperature Sensor 1/2 Wire Harness Connector
2 - Wire Harness Retainer
3 - Exhaust Gas Temperature Sensor 1/2

14. Remove the Exhaust Gas Temperature (EGT) sensor 1/2.



1 - Differential Pressure Sensor Hoses
--

15. Disconnect the rear differential pressure sensor hoses.

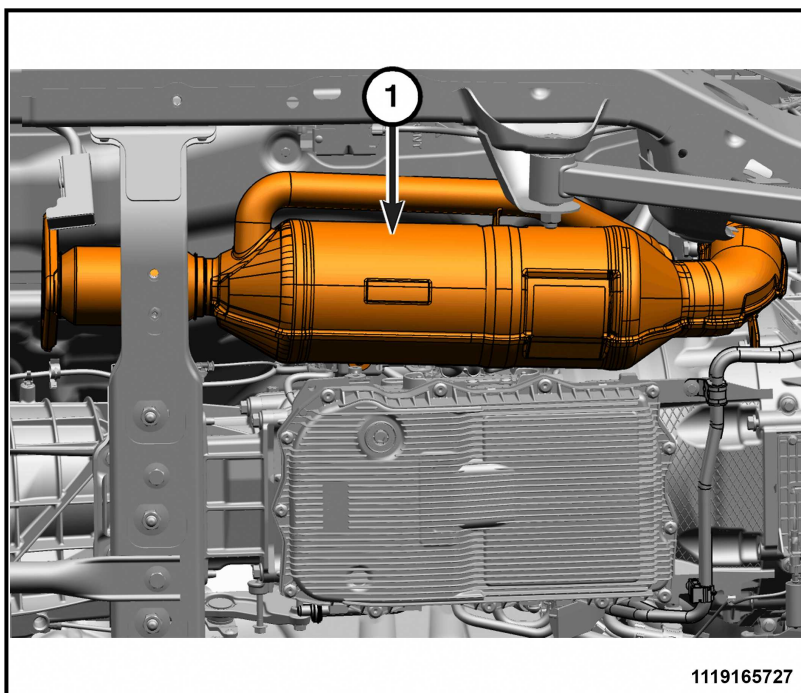


1 - Exhaust Temperature Sensor 1/3 Wire Harness Connector

2 - Wire Harness Retainer

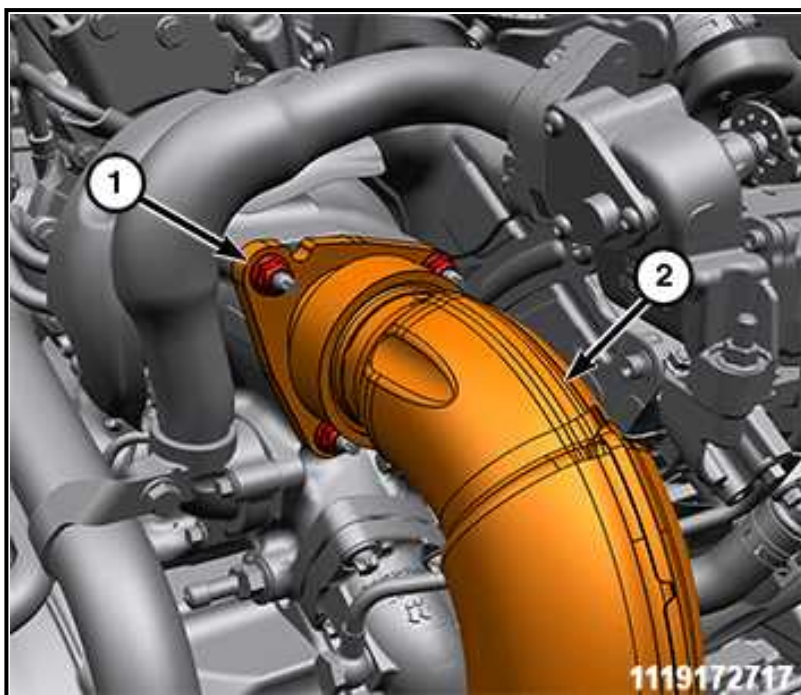
3 - Exhaust Temperature Sensor 1/3

16. Disconnect the exhaust temperature sensor 1/3 wire harness connector and open the wire retainer.



1 - Diesel Particulate Filter

17. Carefully remove the DPF.



1 - Diesel Particulate Filter Inlet Elbow Nuts

2 - Diesel Particulate Filter Inlet Elbow

18. If necessary, remove DPF inlet elbow nuts and the DPF inlet elbow.

19. If necessary, remove and discard flange gasket.

20. If necessary, remove the differential pressure tubes.

21. If necessary, remove the exhaust gas temperature sensors from the DPF.

INSTALLATION

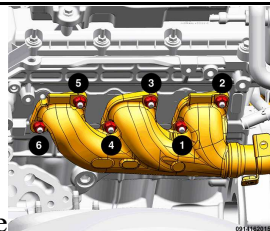
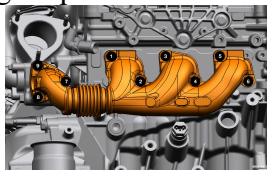
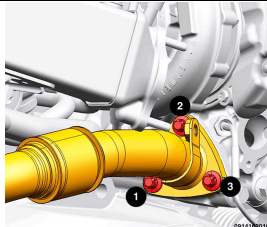
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean all gasket sealing surfaces.
- If removed, install the exhaust gas temperature sensors and tighten to the proper torque specifications.
- If removed, install the steel differential pressure tubes and tighten to the proper torque specifications.
- If removed, install a **NEW** gasket onto turbocharger flange.
- Install a **NEW** DPF gasket and be sure it is in place.
- Install the DPF and tighten the **NEW** V-band clamp to the proper torque specification. Refer to [EXHAUST - 3.0L DIESEL](#) .
- Install the front DPS tube and securely tighten.
- Using a **NEW** gasket, install the Low Pressure (LP) EGR tube bolts and tighten to the proper torque specifications.
- Using the scan tool, perform **DPF Reset Option** function found under MISCELLANEOUS FUNCTIONS.

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	Tightening Sequence  
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.)	

DESCRIPTION	SPECIFICATION	COMMENT
	2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

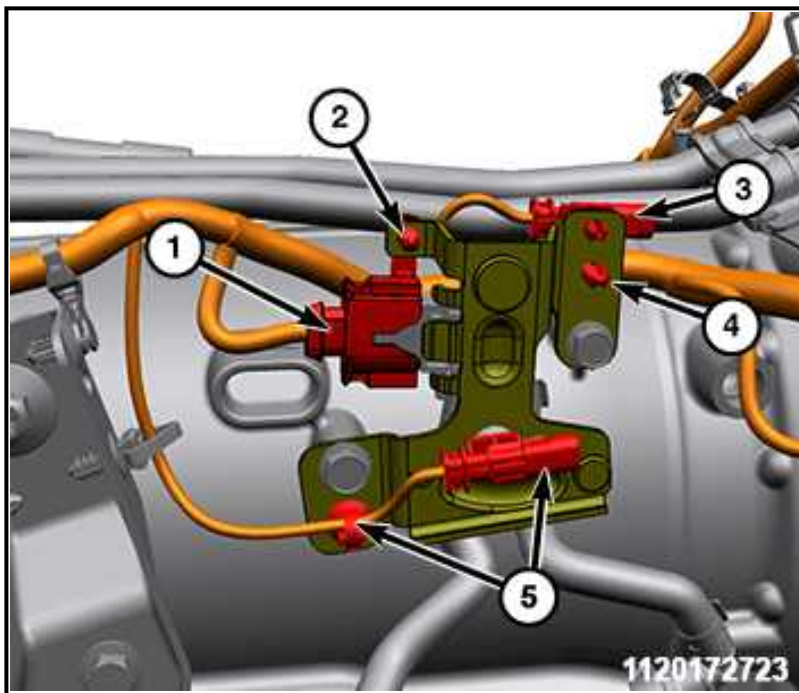
SENSOR, DIFFERENTIAL PRESSURE

REMOVAL AND INSTALLATION

HIGH PRESSURE

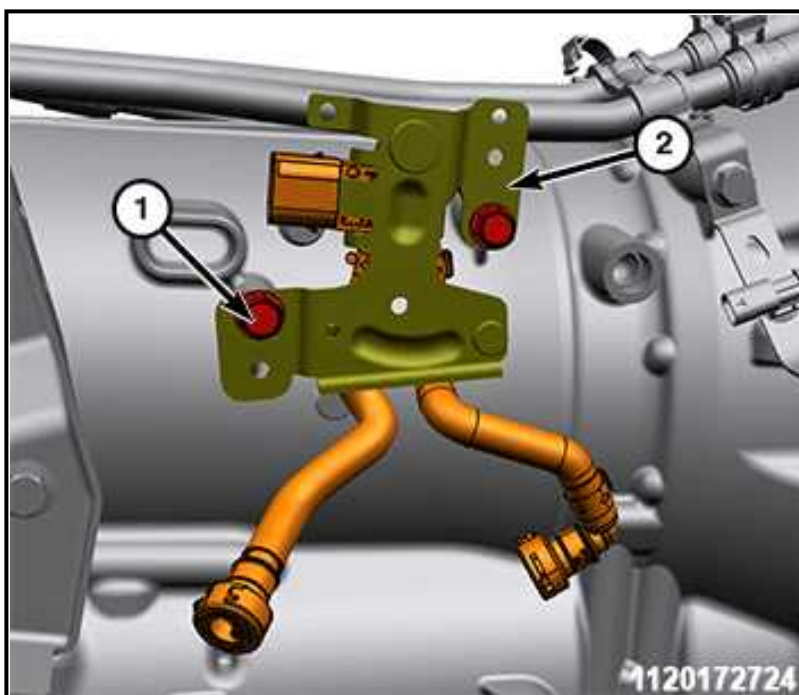
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to **BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM** .
2. Raise and support vehicle. Refer to **HOISTING, STANDARD PROCEDURE** .
3. Remove the Diesel Particulate Filter (DPF). Refer to **FILTER, DIESEL PARTICULATE, REMOVAL AND INSTALLATION**.



1 - Differential Pressure Sensor Wire Harness Connector
2 - Wire Harness Retainer
3 - Exhaust Gas Temperature Sensors 1/2 Wire Harness Connectors
4 - Wire Harness Retainer
5 - Exhaust Gas Temperature Sensors 1/3 Wire Harness Connectors

4. Detach the Exhaust Gas Temperature (EGT) sensors 1/3 wire harness connectors and wire harness retainer from the bracket.
5. Detach the wire harness retainer.
6. Detach the EGT sensors 1/2 wire harness connectors and wire harness retainer from the bracket.
7. Disconnect the differential pressure sensor harness connector.



1 - Differential Pressure Sensor Bracket Bolts
2 - Differential Pressure Sensor Bracket

8. Remove the differential pressure sensor bracket bolts and the differential pressure sensor with bracket.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

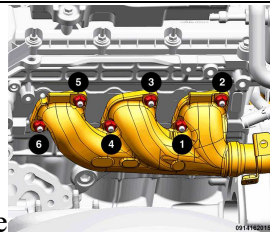
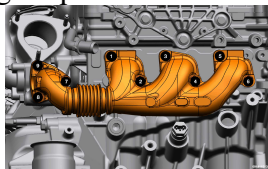
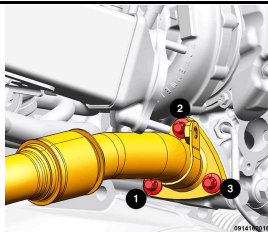
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

NOTE: Before installing, inspect both pressure hoses and make sure there is not any dip across the hoses. In northern climates a dip across the hoses can cause water condensation to built up that will freeze and set a MIL.

TORQUE SPECIFICATIONS

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

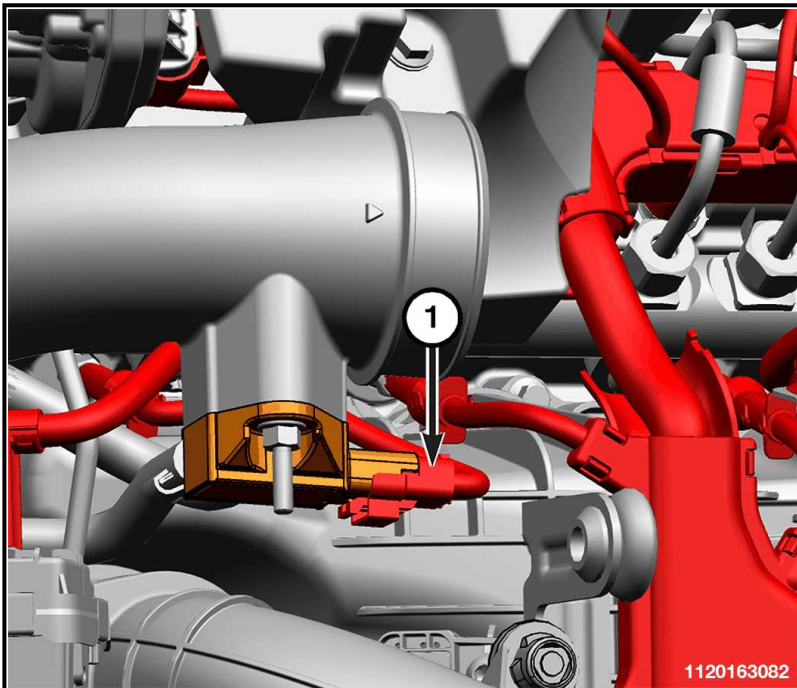
DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

LOW PRESSURE

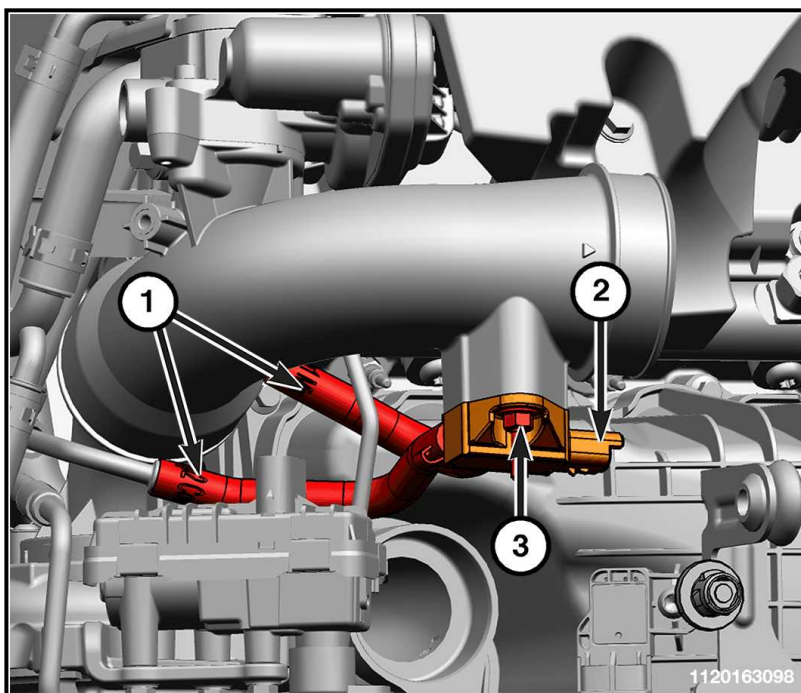
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



1 - Differential Pressure Sensor Wire Harness Connector

3. Disconnect the differential pressure sensor wire harness connector.



1 - Differential Pressure Sensor Hoses
2 - Differential Pressure Sensor
3 - Differential Pressure Sensor Nut

4. Disconnect the differential pressure sensor hoses.
5. Remove the differential pressure sensor nut and the differential pressure sensor.

INSTALLATION

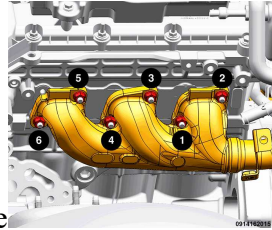
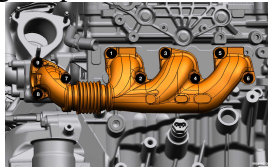
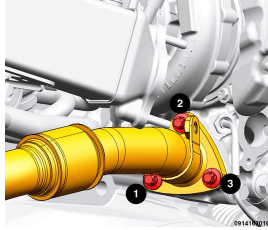
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Install the differential pressure sensor and securely tighten the differential pressure sensor nut.

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

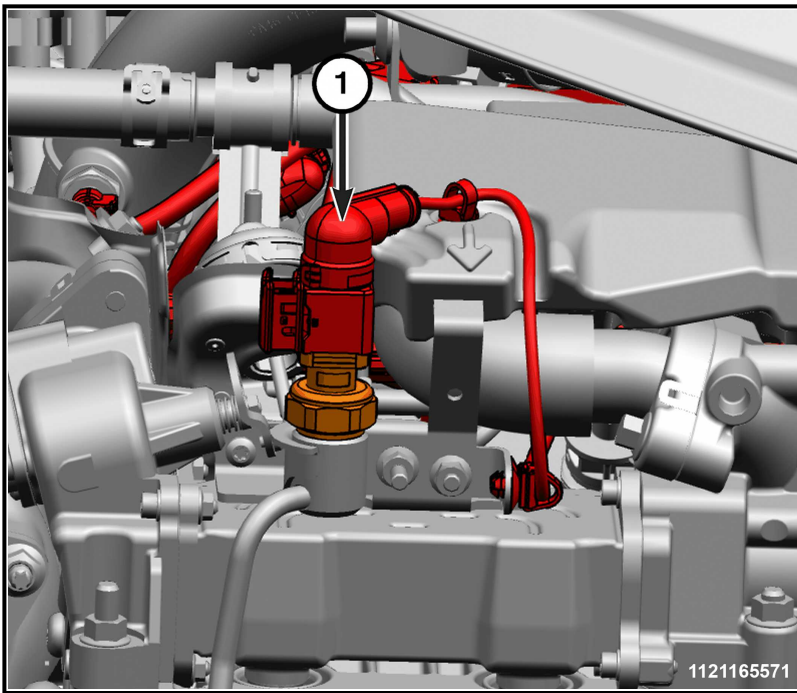
SENSOR, EXHAUST PRESSURE

REMOVAL AND INSTALLATION

EXHAUST PRESSURE SENSOR

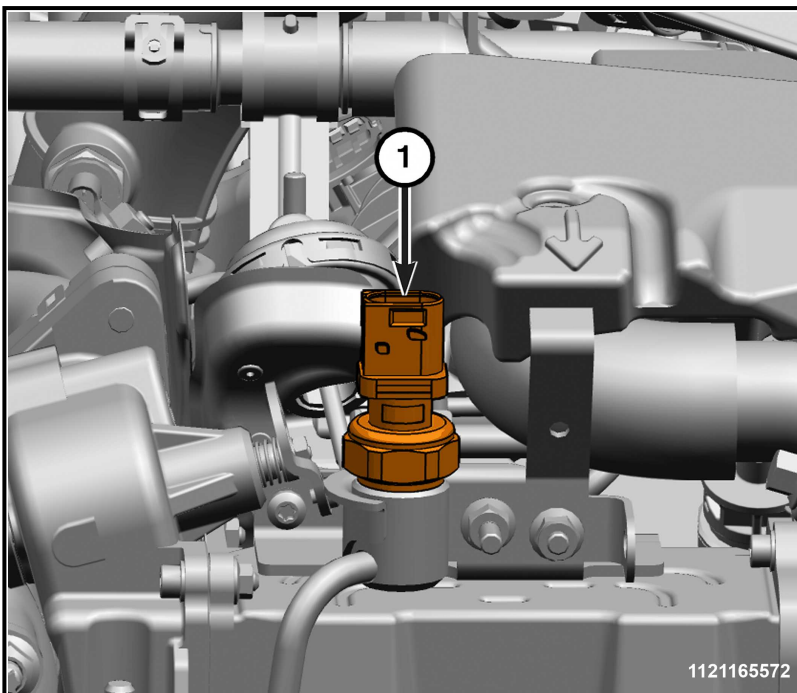
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM](#).
2. Remove the right front wheelhouse splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#).



1 - Exhaust Pressure Sensor Wire Harness Connector

3. Disconnect the exhaust pressure sensor wire harness connector and detach the wire harness retainers.



1 - Exhaust Pressure Sensor

4. Remove the exhaust pressure sensor.

INSTALLATION

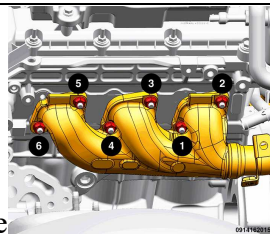
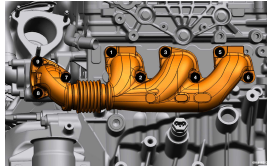
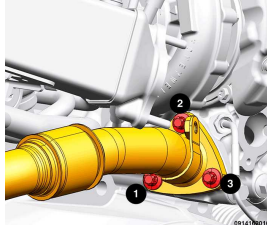
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

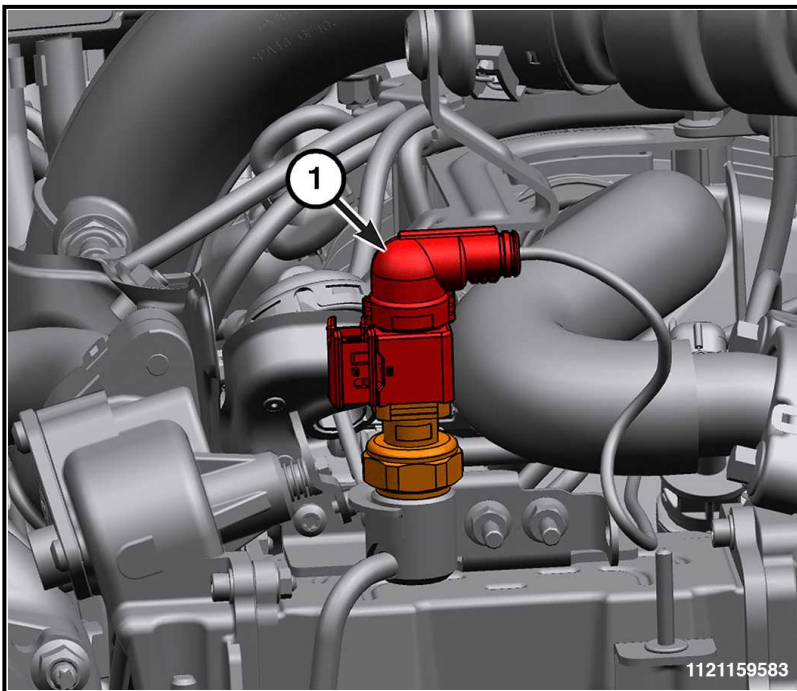
DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst	25 N.m (18 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Isolator Bolts		
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

EXHAUST PRESSURE SENSOR TUBE

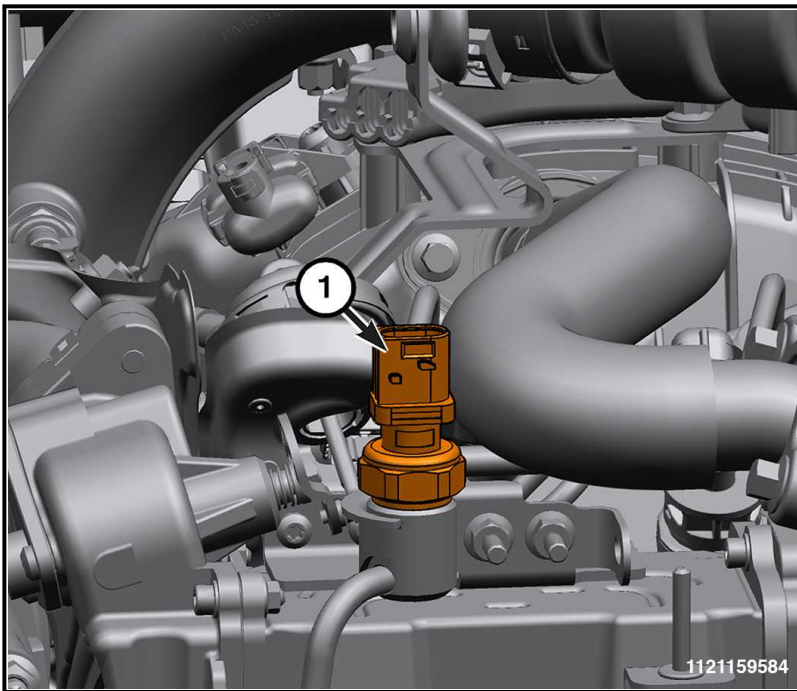
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM](#) .
2. Remove the right front wheelhouse splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) .



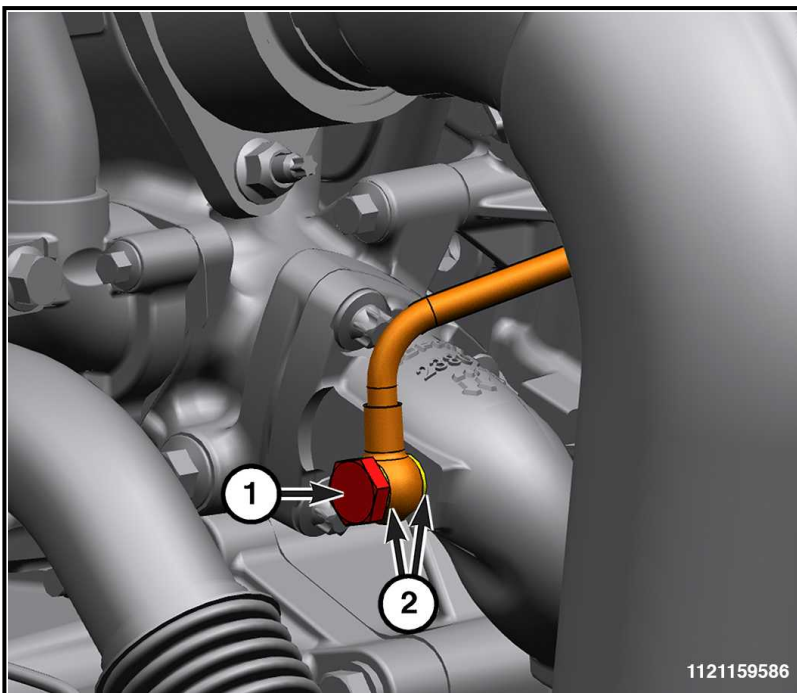
1 - Exhaust Pressure Sensor Wire Harness Connector

3. Disconnect the exhaust pressure sensor wire harness connector.



1 - Exhaust Pressure Sensor

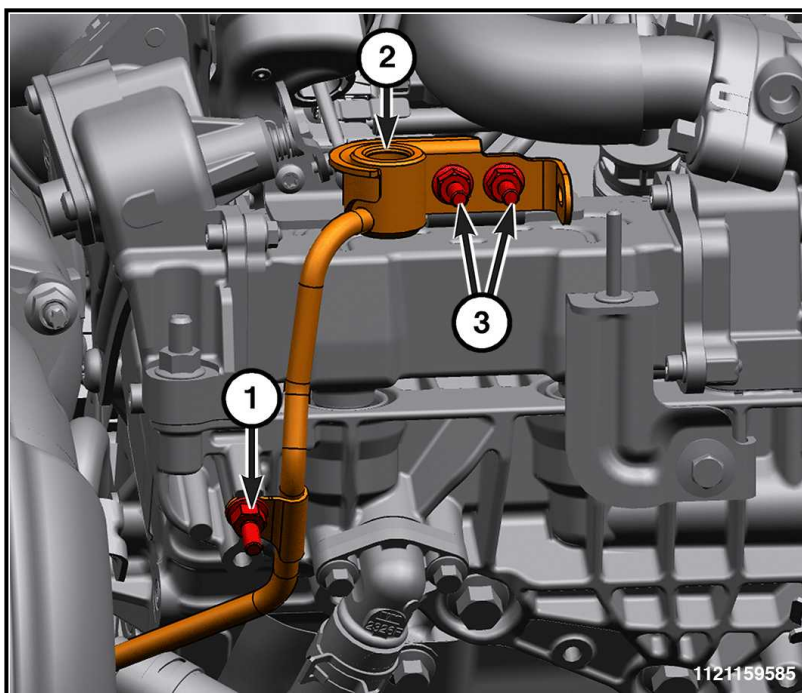
4. Remove the exhaust pressure sensor.



1 - Banjo Bolt

2 - Sealing Washers

5. Remove the banjo bolt and the sealing washers securing the exhaust pressure sensor tube to the exhaust manifold.



1 - Exhaust Pressure Sensor Tube Bolt
2 - Exhaust Pressure Sensor Tube
3 - Exhaust Pressure Sensor Tube Bolts

6. Remove the exhaust pressure sensor tube bolts and the exhaust pressure sensor tube.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

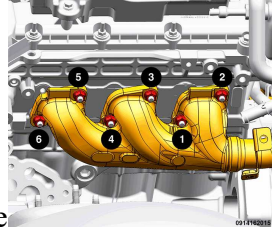
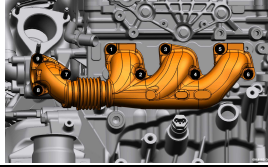
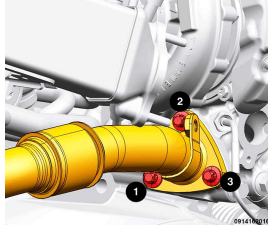
- Be sure the exhaust pressure sensor tube is clean and not plugged.
- Using **NEW** sealing washers install the exhaust pressure sensor tube and tighten the banjo bolt to the proper torque specifications.

TORQUE SPECIFICATIONS

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to	28 N.m (21 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Nut		
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

CATALYST, SELECTIVE CATALYTIC REDUCTION (SCR)

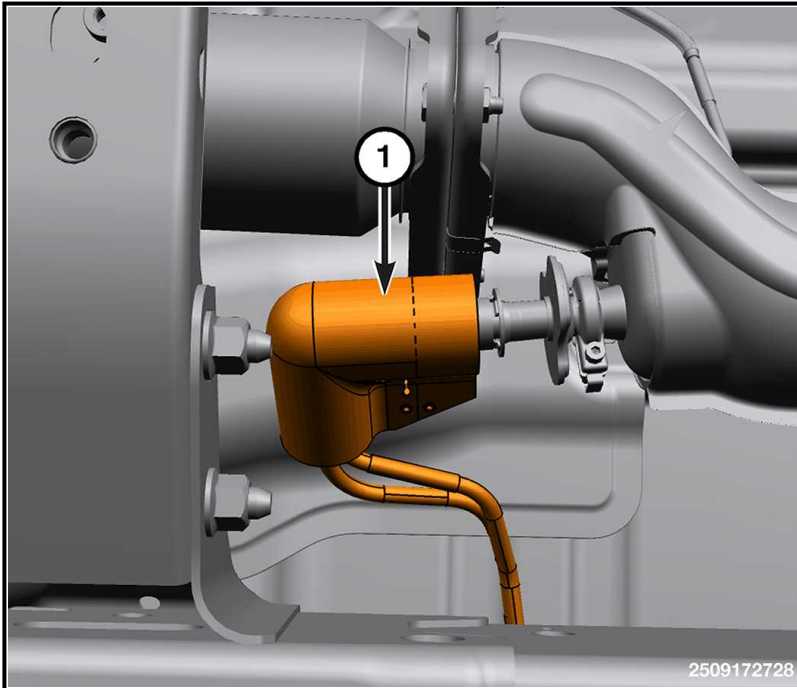
REMOVAL AND INSTALLATION

SELECTIVE CATALYTIC REDUCTION CATALYST

REMOVAL

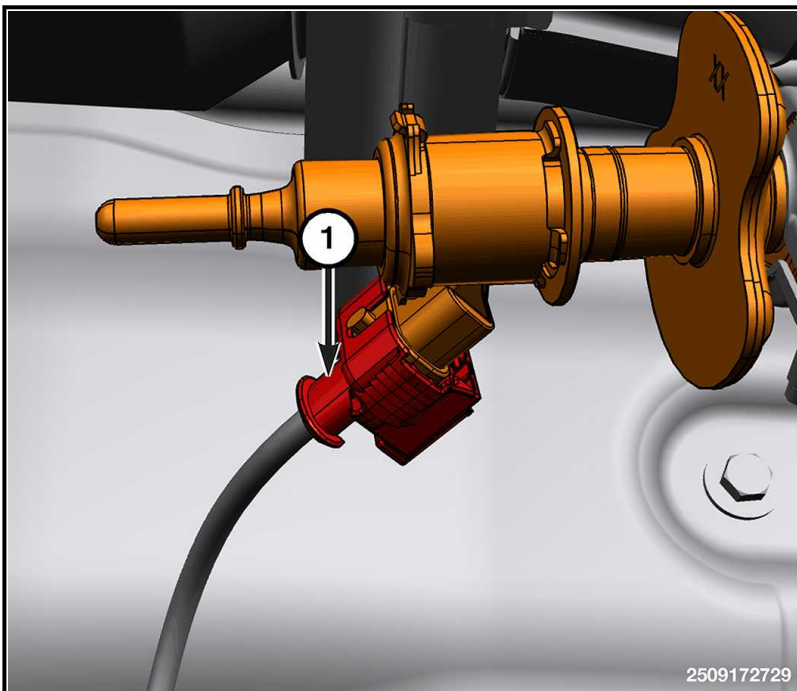
WARNING: If torches are used when servicing the exhaust system, do not allow any flame near the fuel lines or the fuel tank. Failure to follow these instructions may result in possible serious or fatal injury.

1. Disconnect and isolate the negative battery cable(s). Refer to [BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
3. Remove the transfer case skid plates. Refer to [PLATE, SKID, TRANSFER CASE, REMOVAL AND INSTALLATION](#) .



1 - Diesel Exhaust Fluid Supply Line

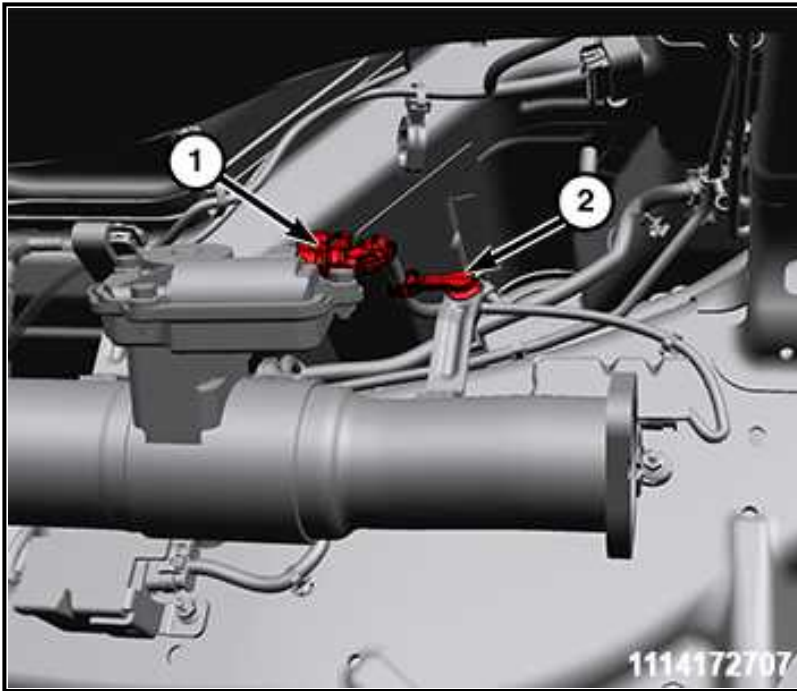
4. Disconnect the DEF fluid supply line quick connect fitting. Refer to [QUICK-CONNECT FITTINGS](#) .



1 - Diesel Exhaust Fluid Injector Wire Harness Connector

5. Disconnect the Diesel Exhaust Fluid (DEF) injector wire harness connector.
6. Remove the Particulate Matter (PM) sensor. Refer to [SENSOR, PARTICULATE MATTER, REMOVAL AND INSTALLATION](#) .
7. Remove the NOx sensor 1/2. Refer to [SENSOR, NOX, REMOVAL AND INSTALLATION](#) .

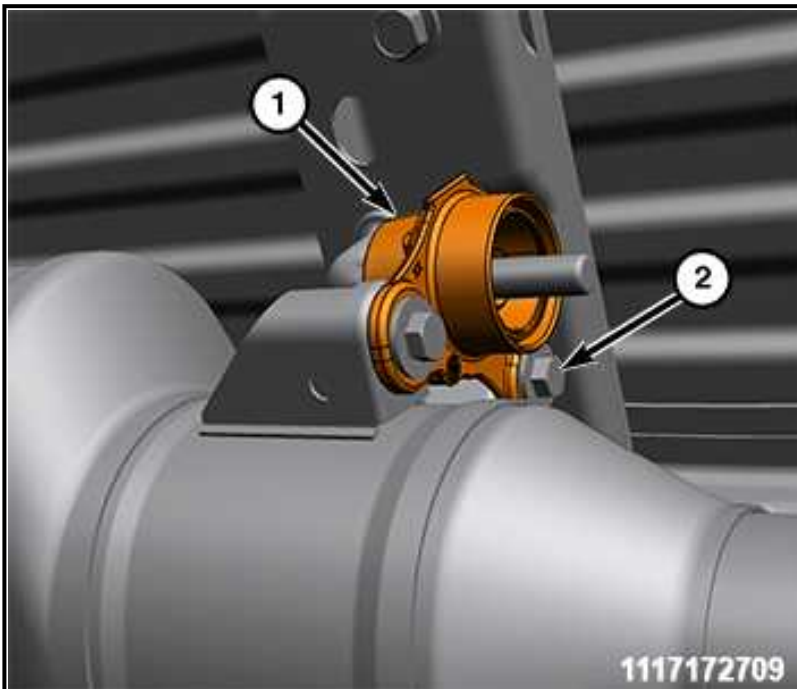
8. Remove the exhaust muffler. Refer to [MUFFLER, EXHAUST, REMOVAL AND INSTALLATION](#) .



1 - Exhaust Valve Actuator Wire Harness Connector

2 - Wire Harness Retainer

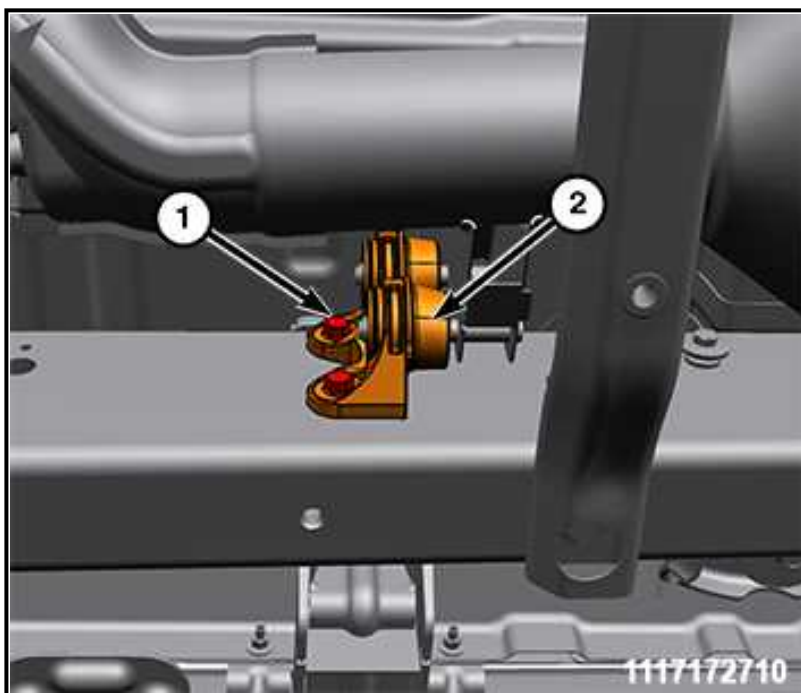
9. Disconnect the exhaust valve actuator wire harness connector.



1 - Exhaust Isolator

2 - Exhaust Isolator Bolts

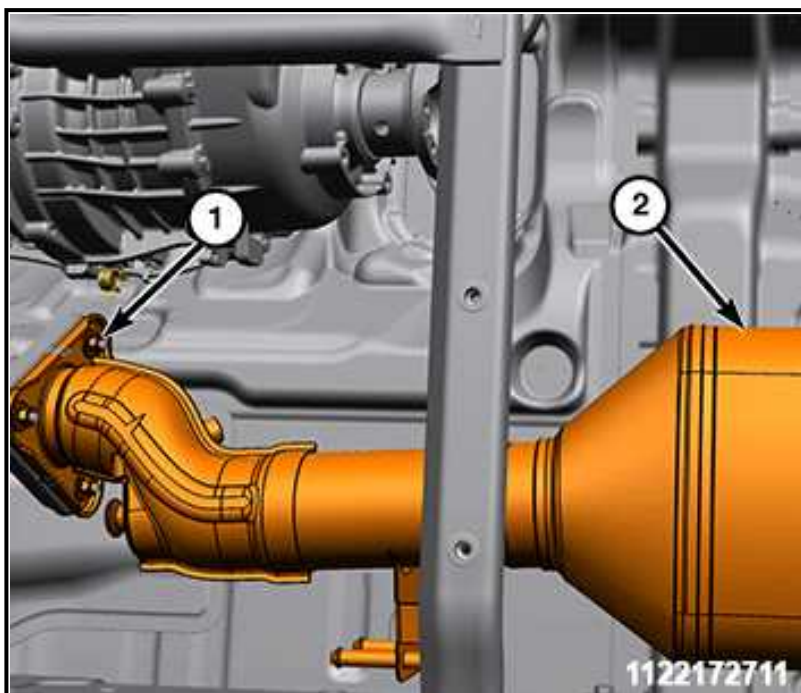
10. Remove the exhaust isolator bolts and the rear exhaust isolator.



1 - Exhaust Isolator

2 - Exhaust Isolator Bolts

11. Remove the exhaust isolator bolts and the front exhaust isolator.



1 - Selective Catalytic Reduction Catalyst Nuts

2 - Selective Catalytic Reduction Catalyst

12. Saturate the fasteners with MoparB® Rust Inhibitor. Allow 5 minutes for penetration.

13. Remove the SCR catalyst nuts and the SCR catalyst.

14. Remove and discard the flange gasket.

INSTALLATION

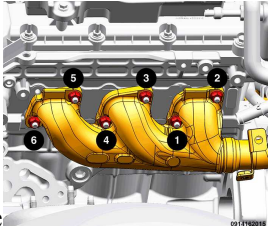
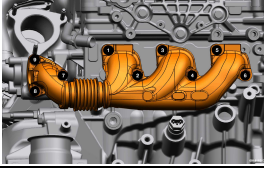
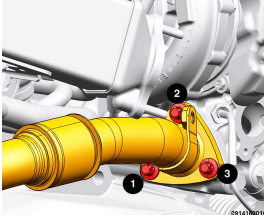
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean all gasket sealing surfaces.
- Install a **NEW** Selective Catalytic Reduction (SCR) catalyst gasket.
- Check the exhaust system for contact with the body panels. A minimum of 25.4 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Make the necessary adjustments, if needed.
- Using the scan tool, perform **SCR System Catalyst Reset** function found under MISCELLANEOUS FUNCTIONS.

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

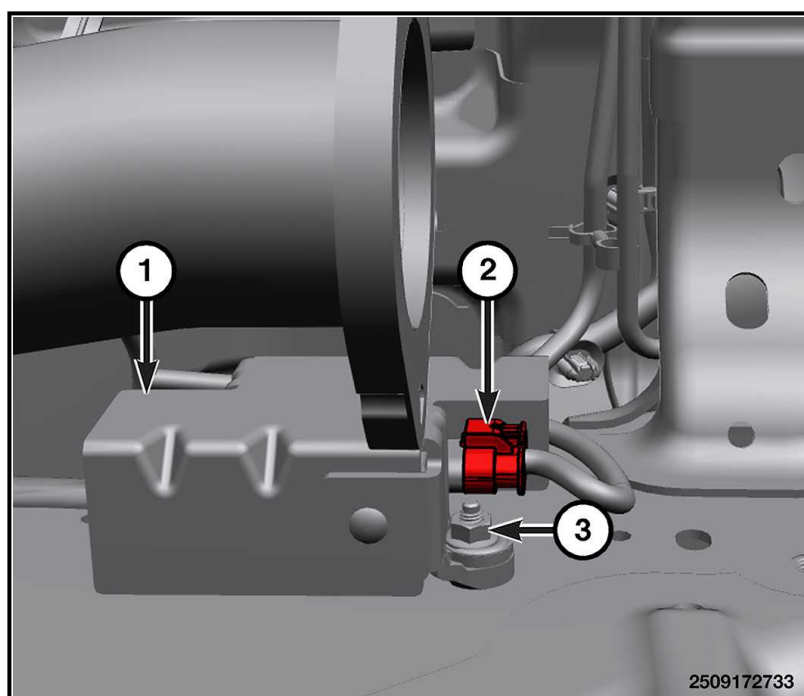
SENSOR, PARTICULATE MATTER

REMOVAL AND INSTALLATION

PARTICULATE MATTER SENSOR

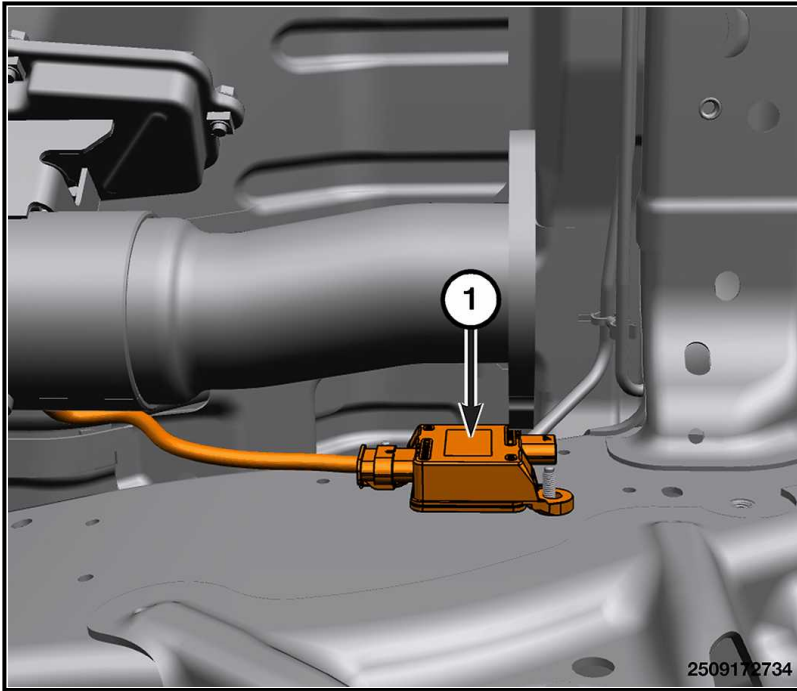
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM](#).
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#).



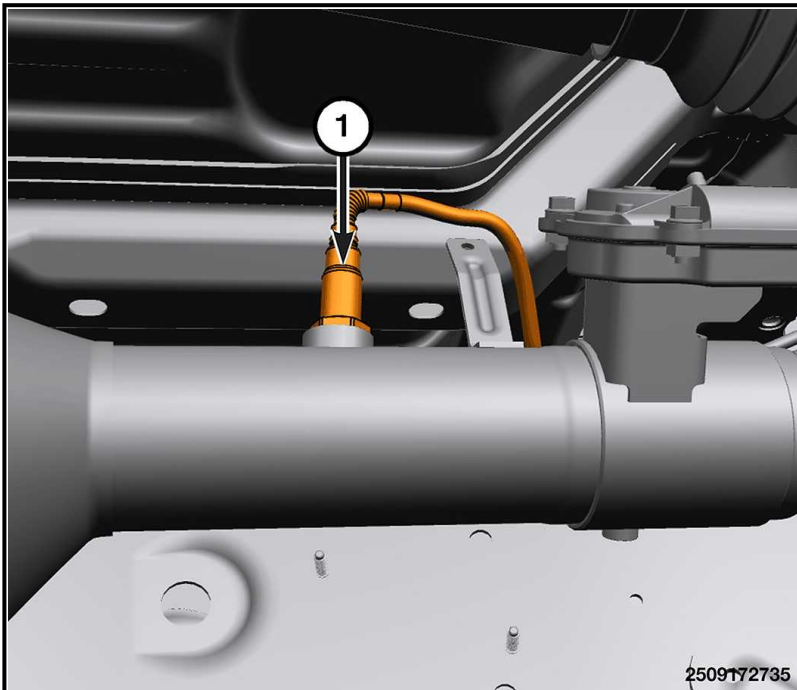
1 - Heat Shield
2 - Particulate Matter Sensor Wire Harness Connector
3 - Heat Shield Nuts

3. Disconnect the Particulate Matter (PM) sensor wire harness connector.
4. Remove the heat shield nuts and the PM sensor heat shield.



1 - Particulate Matter Sensor Module

5. Open the wire harness retainers and remove the wire harness and the PM sensor module from the studs.



1 - Particulate Matter Sensor

6. Using a six sided crow foot, remove the PM sensor.
7. If the PM sensor fails to loosen use a torque wrench set to 160 N.m (118 ft. lbs.) and loosen PM sensor.

NOTE: **DO NOT use a torch as a heat source.**

8. If the PM sensor is still not loose after applying 160 N.m (118 ft. lbs.) then use a heat gun to heat the PM sensor boss for 1 minute at 450B° C (842B° F).

INSTALLATION

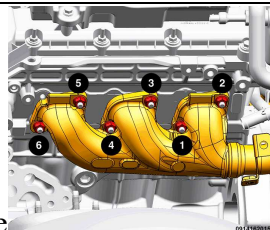
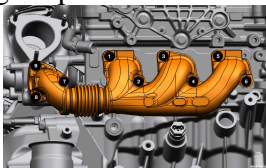
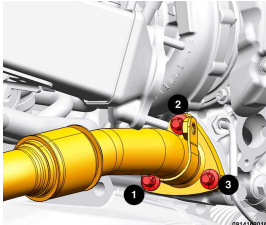
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

TORQUE SPECIFICATIONS

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	Tightening Sequence  
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

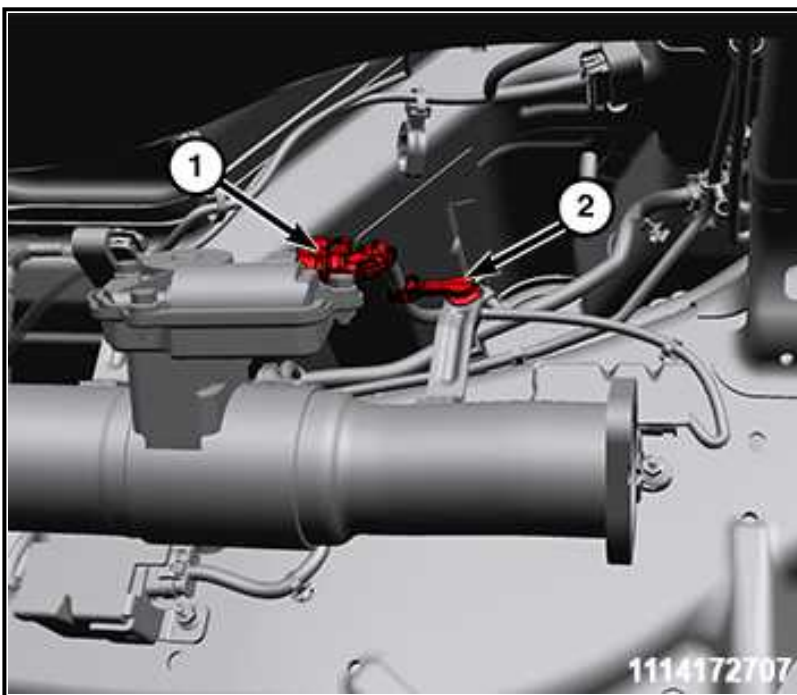
ACTUATOR, EXHAUST VALVE

REMOVAL AND INSTALLATION

EXHAUST VALVE ACTUATOR

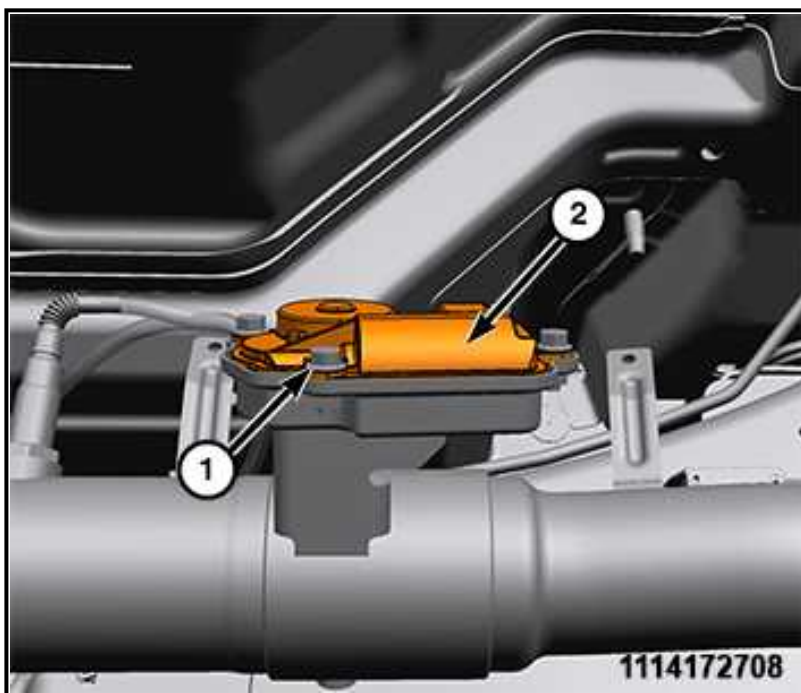
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [BATTERY DISCONNECT - DUAL 12 VOLT BATTERY SYSTEM](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .



- | |
|---|
| 1 - Exhaust Valve Actuator Wire Harness Connector |
| 2 - Wire Harness Retainer |

3. Disconnect the exhaust valve actuator wire harness connector.



1 - Exhaust Valve Actuator Bolts
2 - Exhaust Valve Actuator

4. Remove the exhaust valve actuator bolts and the exhaust valve actuator.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Install the exhaust valve actuator and securely tighten the exhaust valve actuator bolts.

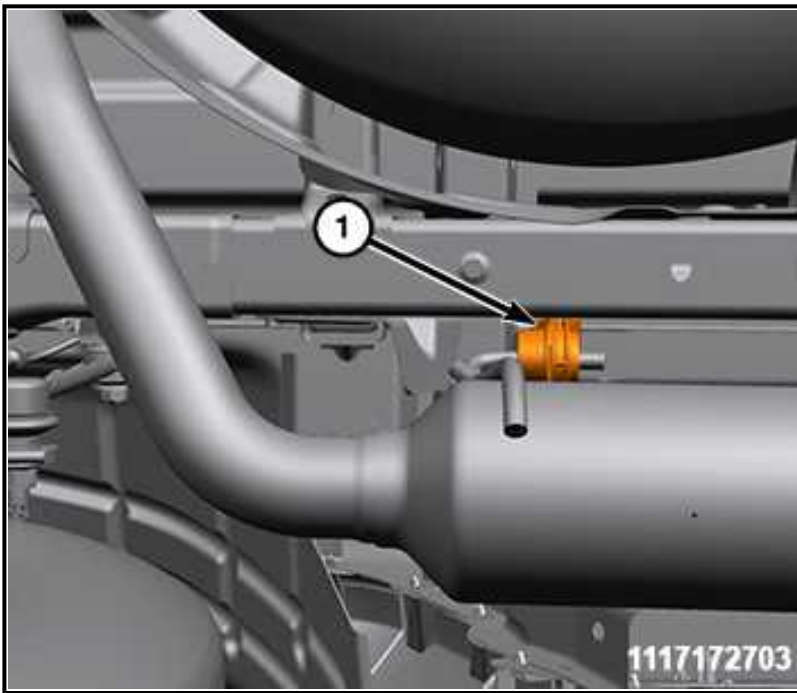
MUFFLER, EXHAUST

REMOVAL AND INSTALLATION

EXHAUST MUFFLER

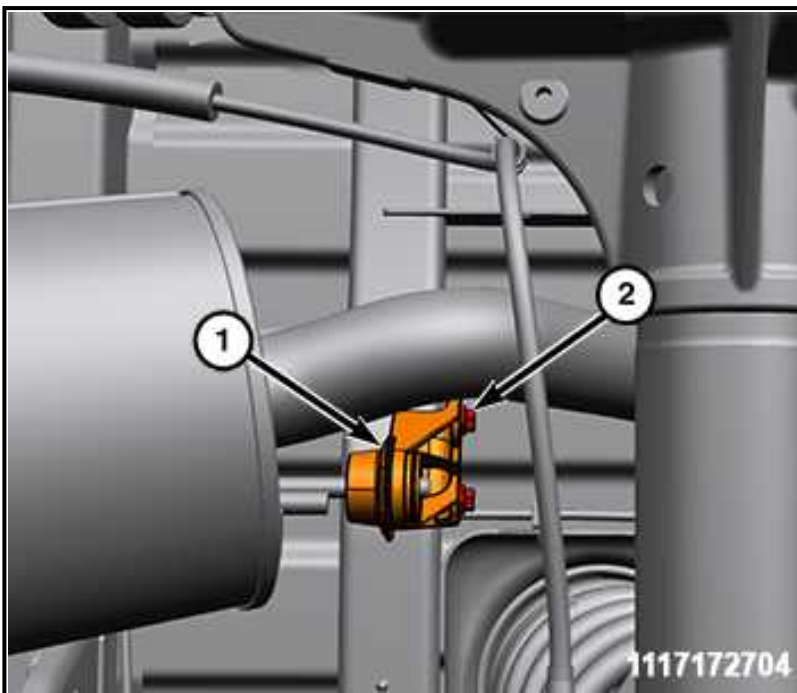
REMOVAL

1. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
2. Saturate the clamp nuts with MoparB® Rust Inhibitor. Allow 5 minutes for penetration.



1 - Exhaust Isolator

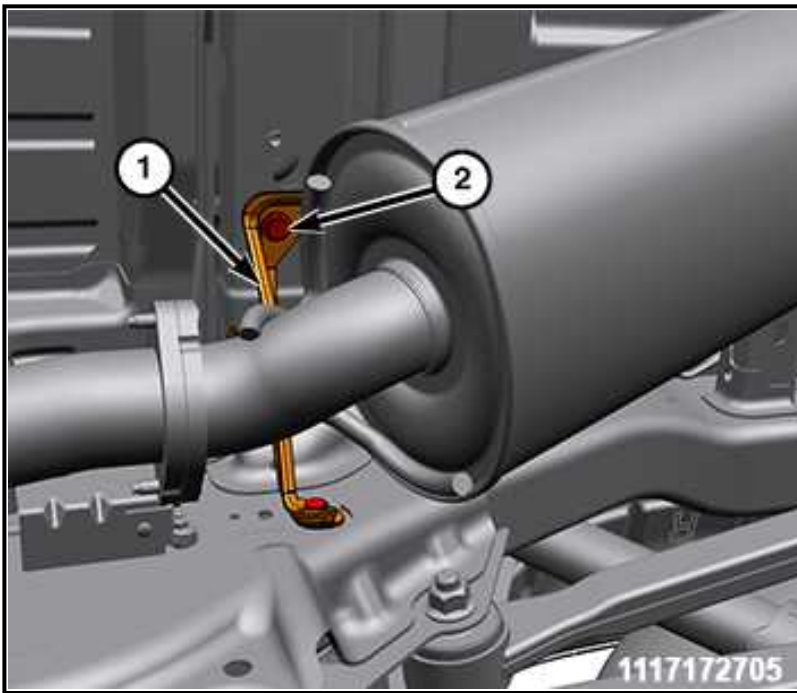
3. Remove the exhaust isolator bolts and the exhaust isolator.



1 - Exhaust Isolator

2 - Exhaust Isolator Bolts

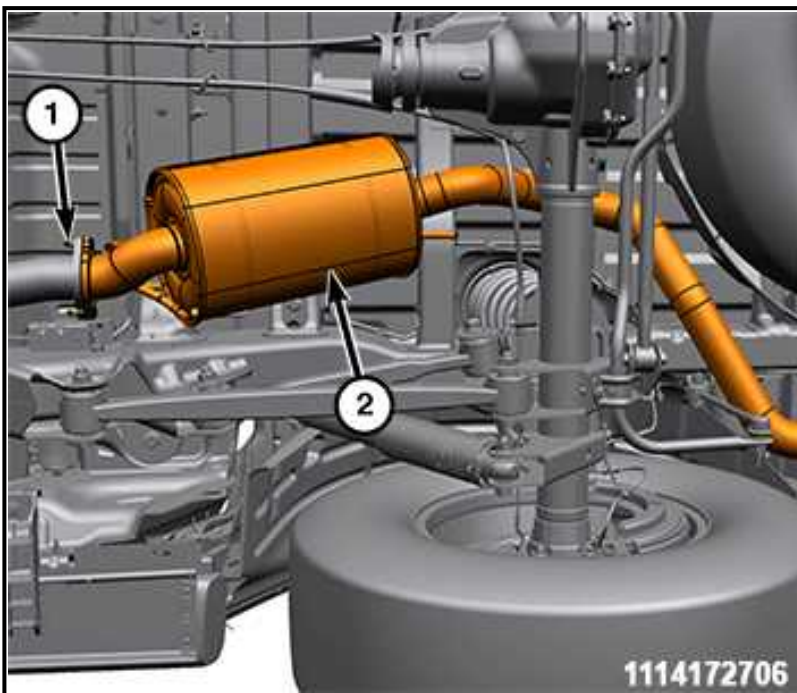
4. Remove the exhaust isolator bolts and the exhaust isolator.



1 - Exhaust Isolator

2 - Exhaust Isolator Bolts

5. Remove the exhaust isolator bolts and the exhaust isolator.



1 - Exhaust Muffler Nuts

2 - Exhaust Muffler Assembly

6. Remove the exhaust muffler nuts and the exhaust muffler assembly.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

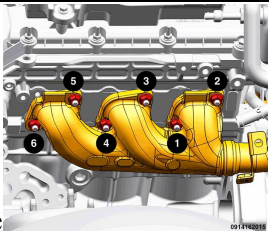
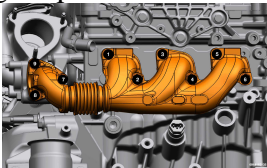
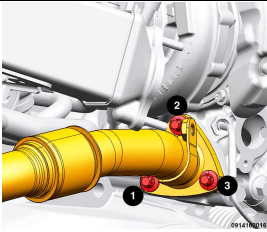
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Check the exhaust system for contact with the body panels. A minimum of 25.4 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Make the necessary adjustments, if needed.
- Start the engine and inspect for exhaust leaks. Repair exhaust leaks as necessary. Refer to **DIAGNOSIS AND TESTING**.

TORQUE SPECIFICATIONS

EXHAUST - 3.0L DIESEL

TORQUE SPECIFICATIONS

DESCRIPTION	SPECIFICATION	COMMENT
Diesel Particulate Filter Inlet Elbow-to-Turbocharger Nuts	28 N.m (21 Ft. Lbs.)	-
Diesel Particulate Filter-to-Selective Catalytic Reduction Catalyst Bolts	30 N.m (22 Ft. Lbs.)	-
Differential Pressure Sensor Bracket Bolts	18 N.m (13 ft. Lbs.)	-
Differential Pressure Sensor Tube Fittings	20 N.m (15 Ft. Lbs.)	-
Exhaust Gas Temperature Sensor	45 N.m (33 FT. Lbs.)	-
Exhaust Front Steady Rest Bracket to Diesel Particulate Filter Nut	28 N.m (21 Ft. Lbs.)	-
Exhaust Manifold to Cylinder Head Nuts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	 Tightening Sequence 
Exhaust Manifold to Turbocharger Bolts	Torque Procedure: 1. Tighten nuts to 15 N.m (11 Ft. Lbs.) 2. Tighten nuts to 40 N.m (30 Ft. Lbs.)	
Exhaust Manifold Heat Shield Bolts	15 N.m (11 Ft. Lbs.)	-
Exhaust Tube Heat Shield Nuts	11 N.m (8 Ft. Lbs.)	-
Muffler Clamp Nut	65 N.m (48 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Muffler Exhaust Isolator Nuts	20 N.m (15 Ft. Lbs.)	-
Particulate Matter Sensor	50 N.m (37 Ft. Lbs.)	-
Particulate Matter Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
Rear Steady Rest Bracket-to-Diesel Particulate Filter Bolt	26 N.m (19 Ft. Lbs.)	-
Selective Catalytic Reduction Catalyst Isolator Bolts	25 N.m (18 Ft. Lbs.)	-
Turbocharger Diesel Particulate Filter-to-Inlet Elbow V-Band Clamp	10 N.m (89 In. Lbs.)	-

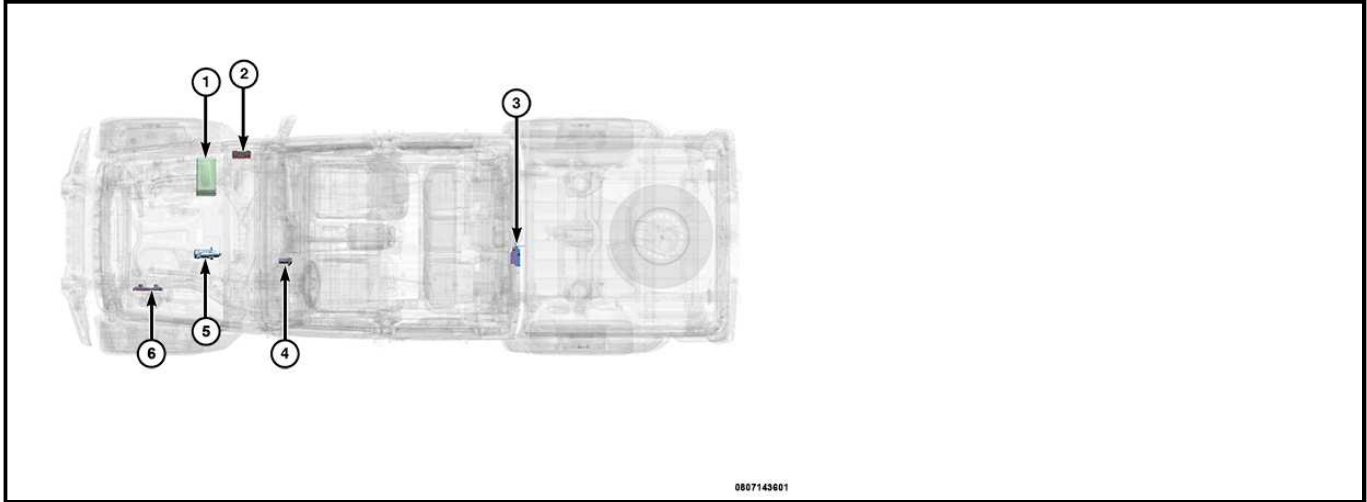
2021 ENGINE

3.0L Starting (Service Information) - Gladiator [EXJ]

DESCRIPTION AND OPERATION

BASE STARTING

DESCRIPTION



The standard starting system can consist of the following components:

COMPONENT INDEX

1.	Refer to STARTER MOTOR RELAY - Located within the Power Distribution Center (PDC).
2.	Refer to BODY CONTROL MODULE (BCM) .
3.	Refer to RADIO FREQUENCY HUB (RFH) .
4.	Refer to KEYLESS IGNITION NODE (KIN) OR KEYLESS GO BUTTON .
5.	Refer to STARTER MOTOR .
6.	Refer to POWERTRAIN CONTROL MODULE (PCM) .

The Battery, Starting, and Charging systems operate in conjunction with one another, and must be tested as a complete system. For correct operation of starting/charging systems, all components used in these three systems must perform within specifications. When attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used in each of these groups include the most basic conventional diagnostic methods, to the more sophisticated On-Board Diagnostics (OBD) built into the PCM. Use of an induction-type milliammeter, volt / ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

OPERATION

The starter is always operated by a single relay positioned in the PDC and activated by the PCM. The activation signal reaches the BCM, which will activate an internal relay of its own, which sends a signal to the relay located in the PDC and activated by the PCM. When the PCM activates the relay, a 12 volt feed arrives at the starter solenoid, which will activate the starter.

Starting System equipped with a RFH:

- Pressing the Keyless Ignition Node (KIN), a request is sent to the RFH via a private Local Interface Network (LIN) bus for authentication.

- The RFH receives the request from the KIN and then looks for the valid key fob by using the Low Frequency (LF) antennas.
- If the RFH detects a valid key fob and if the brake is engaged, the RFH sends a Controller Area Network (CAN) request to the BCM to change the ignition position to START/CRANK.
- Then the BCM sends the command to the PCM to turn the vehicle to CRANK.
- If conditions are correct to start, the PCM turns on the high side of the PCM starter relay and turns the Crank Hold Signal to True. If the BCM is still in crank and the Crank Hold is true then the BCM turns on the low side of the BCM Starter relay and the engine will start cranking.
- Once the engine is started the PCM deactivates the double start over ride.
- The BCM will then deactivate the starter either when the engine starts or the maximum time of 10 seconds has been reached for the tip start.
- The RFH changes the ignition position to RUN if the start type is TIP start or the five second time expires or the engine controller indicates the vehicle is not in park or neutral.
- The engine can be manually shut down by the driver with speeds over 8 km/h (5 mph) in any gear.

BODY CONTROL MODULE (BCM)

Refer to [**COMPONENT INDEX**](#).

- The BCM is responsible for gating messages across the various bus networks.
- The BCM is responsible for actuating the low side of starter relay once commanded by the PCM low side relay CRANK command.
- The BCM communicates over the Local Interface Network (LIN) bus with the Intelligent Battery Sensor (IBS) information about raw battery current, voltage, and temperature levels
- The BCM is responsible for deactivating the starter motor relay driver.

KEYLESS IGNITION NODE (KIN) OR KEYLESS GO BUTTON

Refer to [**COMPONENT INDEX**](#).

- When the operator presses the Keyless Go button, the key fob is validated wirelessly by the RFH. If the key fob is recognized as belonging to the vehicle and is inside the vehicle, the system allows the ignition state of the vehicle to be changed by the operator between the ACCESSORY, RUN, and START ignition states.
- Used to broadcast the start button status.

Light Emitting Diode (LED) Indicator Operation:

The LEDs in the Keyless Go button provide visual indication of the ignition system and button use to aid the driver. The Logic for LED control is implemented in the RFH. The Keyless Go button contains four LEDs:

- OFF Indication
- ACC Indication (Accessory)
- ON Indication (ON or RUN)
- KIN switch indicator (button backlight)

The RFH will log a Diagnostic Trouble Code (DTC) indicating an incorrect ignition status value is present; in this state the ignition status is unknown. This will continue until the correct signal is received by the RFH.

POWERTRAIN CONTROL MODULE (PCM)

Refer to [**COMPONENT INDEX**](#).

- The PCM turns on the high side of the starter relay.
- The PCM turns the crank hold signal to true which enables the BCM to turn on the low side of the starter relay.

- The PCM disables the double start over ride once the engine is started.

RADIO FREQUENCY HUB (RFH)

Refer to [COMPONENT INDEX](#).

- Receives the input request to start from the ignition.
- Energizes the key fob transponder in order to read it.
- Sends a random code to the transponder and in return, receives a crypt code from the transponder.
- Validates the key fob using LF antennas.
- Validates that the brake is engaged.
- Sends a request to the BCM to change the ignition state.

STARTER MOTOR

Refer to [COMPONENT INDEX](#).

- Incorporates the starter solenoid.
- The starter consists of a Direct Current (DC) motor powered by the battery and an electromagnet exciter.
- The starter is operated by a single relay positioned in the PDC and activated by the PCM.

STARTER MOTOR RELAY

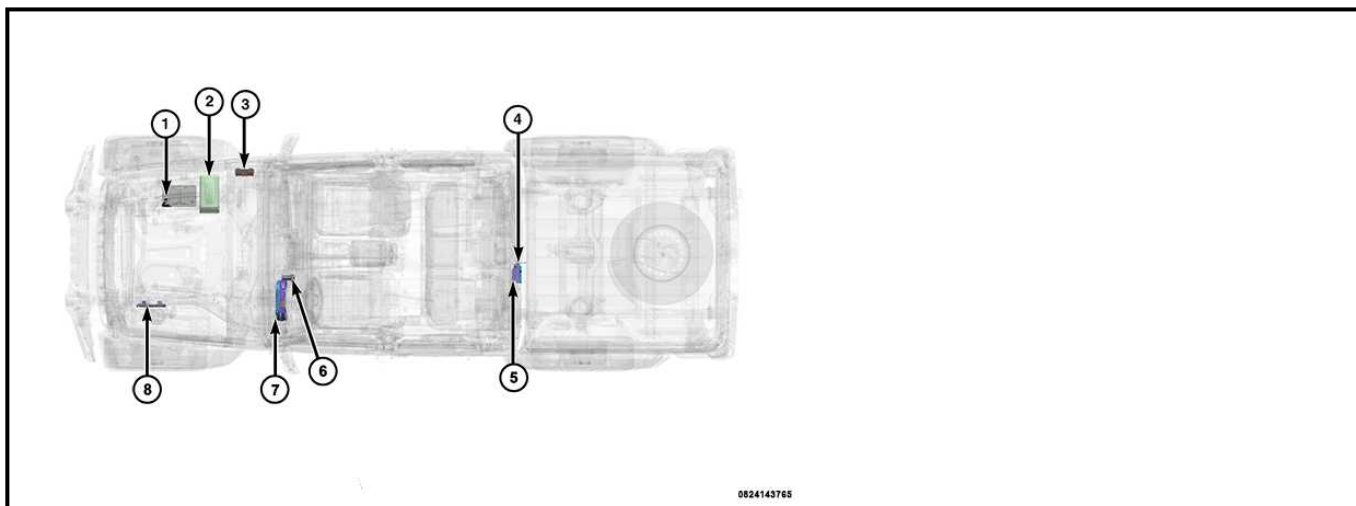
Refer to [COMPONENT INDEX](#).

- The starter motor relay is commanded by the PCM and is used to enable the starter power circuit.
- Vehicle with Electric Stop/Start the starter relay receives power through the Stop/Start relay which is controlled by the BCM's Low Side Driver (LSD)

REMOTE START SYSTEM

NOTE: Available on automatic transmission equipped vehicles only

DESCRIPTION



In addition to the standard starting system components, the remote starting system can consist of the following components:

COMPONENT INDEX

1.	Refer to INTELLIGENT BATTERY SENSOR (IBS) .
2.	Refer to POWER DISTRIBUTION CENTER (PDC) .
3.	Refer to BODY CONTROL MODULE (BCM) .
4.	Refer to RADIO FREQUENCY HUB (RFH) .

5.	Refer to REMOTE START ANTENNA (RSA) .
6.	Refer to KEYLESS IGNITION NODE (KIN) .
7.	Refer to INSTRUMENT PANEL CLUSTER (IPC) .
8	Refer to POWERTRAIN CONTROL MODULE (PCM) .
-	Refer to HOOD AJAR SWITCH #2 .
-	Refer to REMOTE KEYLESS ENTRY (RKE) KEY FOB .
-	Refer to REMOTE START INHIBITOR .

Remote start conveniently starts the engine from outside the vehicle by using the RKE key fob while maintaining security. The system has a targeted range of at least 100 m (328 ft). The vehicle must be locked, the swing gate and hood closed and the transmission in PARK in order to start the engine using the Remote Start button on the key fob.

The remote start system can activate interior illumination, climate control, the optional heated/ventilated seats, and optional heated steering wheel depending on temperatures outside and inside the car. However, operation of the power top and the power windows are inhibited during the remote start event until the driver presses the push start button.

OPERATION

Remote Start Operation:

- The RFH detects that the remote start button has been pressed twice within five seconds. Note that if the remote start button is pressed again, this will terminate the remote start event.
- The RFH authenticates the key fob.
- The RFH then broadcasts several messages over the a Controller Area Network-Chassis (CAN-C) bus to the BCM indicating the physical position of the key fob, if the ignition is in run or start mode and if the vehicle is equipped with an Electronic Steering Lock (ESL) and the ESL's operative state.
- The BCM then receives the "Starter Enable" request over the CAN-C bus from the RFH.
- The BCM challenges and reads the states of the remote start inhibitors.
- If there are no active inhibitors, the BCM broadcasts the ignition commands request over the CAN-C bus, CAN-Interior High Speed (IHS) bus, and the Local Interface Network (LIN) bus networks. Any module or component that needs to use ignition inputs uses ignition outputs controlled by the BCM.
- The PCM receives the "Starter Enable" request over the CAN-C bus.
- The PCM initiates a minikrypt code exchange with the BCM. The BCM responds to this challenge with a verification acknowledgment to the PCM.
- If the minikrypt code exchange was successful, the PCM applies a Low Side Driver (LSD) as needed to energize the starter relay.
- Starter Relay is actuated. This relay is powered by a dedicated fuse in the PDC allowing the starter to crank.

NOTE: If the minikrypt verification was not successful, the PCM shuts down the engine after two seconds.

BODY CONTROL MODULE (BCM)

Refer to COMPONENT INDEX .

- The BCM is used to convert BUS messages, then broadcasts them from one BUS to another.
- Reads the state of the door, swing gate and hood switches before enabling CRANK
- The BCM is responsible for actuating the starter relay low side driver once commanded by the PCM high side relay CRANK command.
- Receives over LIN bus the IBS information about raw battery current, voltage, and temperature levels.
- Is responsible for deactivating the starter motor.

HOOD AJAR SWITCH #2

Refer to [COMPONENT INDEX](#).

- This switch is used to indicate if the hood is in the open or closed state. Indicates the status to the PCM.

INTELLIGENT BATTERY SENSOR (IBS)

Refer to [COMPONENT INDEX](#).

- The IBS interacts with the BCM by means of the LIN bus communications. The BCM is its master node.
- Used to give information about raw battery current, voltage, and temperature levels. The battery needs to be at an acceptable charge level for the vehicle to remote start.

INSTRUMENT PANEL CLUSTER (IPC)

Refer to [COMPONENT INDEX](#).

The Keyless Go feature requires the vehicle to be equipped with an IPC display for prompts and status information. The display messages are:

- REMOTE START ACTIVE PUSH START BUTTON
- REMOTE START DISABLED START VEHICLE TO RESET
- REMOTE START CANCELLED TIME EXPIRED
- REMOTE START CANCELLED FUEL LOW
- REMOTE START CANCELLED DOOR OPEN
- REMOTE START CANCELLED HOOD OPEN

KEYLESS IGNITION NODE (KIN)

Refer to [COMPONENT INDEX](#).

- When the operator presses the START/STOP KIN button, the key fob is validated by the RFH. If the key fob is recognized as belonging to the vehicle and is inside the vehicle, the system allows the ignition state of the vehicle to be changed by the operator between ACCESSORY, RUN, and START.
- Used to broadcast the start button status

Light Emitting Diode (LED) Indicator Operation:

The LEDs in the START/STOP KIN button provide visual indication of the ignition system and button use to aid the driver. The Logic for LED control is implemented in the RFH. The communication of the LED control logic from the RFH to the KIN is done over the LIN bus.

The START/STOP KIN button contain four LEDs:

- OFF Indication
- ACC Indication (Accessory)
- ON Indication (ON or RUN)
- Ignition Switch Indicator (button backlight)

The LEDs indicate the vehicle ignition position and as such are driven by the CAN-C signals related to the ignition position.

The RFH will log a Diagnostic Trouble Code (DTC) indicating an incorrect ignition status value is present; in this state the ignition status is unknown. This will continue until the correct signal is received by the RFH.

POWER DISTRIBUTION CENTER (PDC)

Refer to [COMPONENT INDEX](#).

- The PDC houses various fuses used in the starting of the vehicle as well as relays such as the starter solenoid relay and the Engine Start Stop (ESS) ignition relay.

POWERTRAIN CONTROL MODULE (PCM)

Refer to [**COMPONENT INDEX**](#).

The PCM:

- receives input from the hood ajar switch #2 indicating the status of the hood (open or closed).
- turns on the high side of the PCM starter relay
- turns the crank hold signal to true enabling the BCM to turn on the low side of the starter relay
- disables double start over ride once the engine is started

RADIO FREQUENCY HUB (RFH)

Refer to [**COMPONENT INDEX**](#).

The RFH:

- receives the input request to start from the ignition
- energizes the key transponder in the key fob in order to read it
- sends a random code to the transponder and in return, receives a minikrypt code from the transponder
- validates the key fob using LF antennas
- Receives and validates transmission in park via Shift Lock switch (remote start use only)
- validates that the brake is engaged
- sends a request to the BCM to change the ignition state

REMOTE KEYLESS ENTRY (RKE) KEY FOB

Refer to [**COMPONENT INDEX**](#).

- The key fobs are used to start the remote vehicle start request and that requests authentication process by identifying the key transponder.
- The key fob can also be used to terminate a remote start request.

REMOTE START ANTENNA (RSA)

Refer to [**COMPONENT INDEX**](#).

- The RSA is used to provide a greater range for remote start operation and is connected to, and monitored by the RFH. The RFH will perform self diagnostics on the attached RSA to determine if it is connected to the RFH and drawing current.

REMOTE START INHIBITOR

Refer to [**COMPONENT INDEX**](#).

Coolant Temperature Sensor - Used to verify that the engine coolant temperature is within an acceptable range for engine operation.

Ajar Switches - Used to indicate if any vehicle access points on the vehicle are opened or closed. Outputs to the BCM. Challenged by the RFH.

Fuel Level Sensor and Fuel Pump Control Module - Signalled by the PCM to drive the fuel pump to support engine starting if a sufficient amount of fuel is detected.

ESL - An added layer of security that locks the column.

Hazard Switch - The hazard switch needs to be in the OFF position.

Ignition State - The ignition needs to be in the OFF state.

IBS:

- The IBS interacts with the BCM by means of the LIN bus communications. The BCM is its master node.
- The IBS is used to give information about raw battery current, voltage, and temperature levels. The battery needs to be at an acceptable charge level

LF Antennas - Used in validation of the key fob being preset during start request.

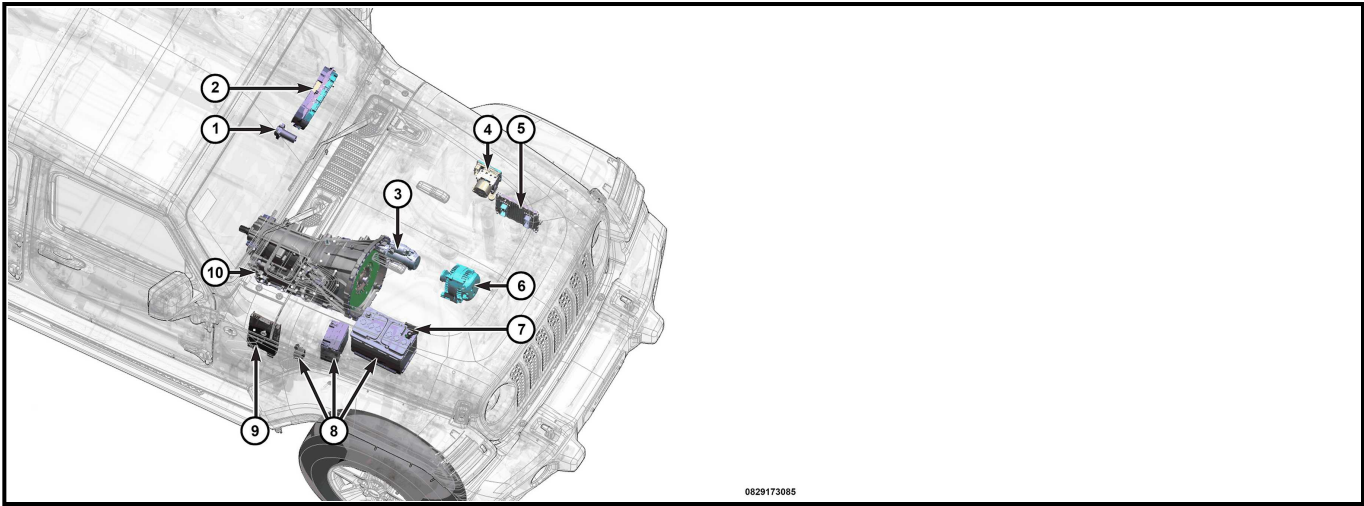
Oil Pressure Sensor - Used to determine that the engine has an acceptable oil pressure range prior to starting the engine.

Transmission Range Sensor (TRS) - Used to indicate the position of the gear shift lever.

Vehicle Speed Sensor (VSS) - Used to verify the vehicle is not moving.

Vehicle Theft Alarm (VTA) or Intrusion Detection System (IDS) - Signal sent indicating the status of the VTA or the IDS system. An active VTA or IDS state will disable the remote start function.

ENGINE STOP START SYSTEM



The following list indicates some of the components involved in the Engine Stop Start (ESS) system:

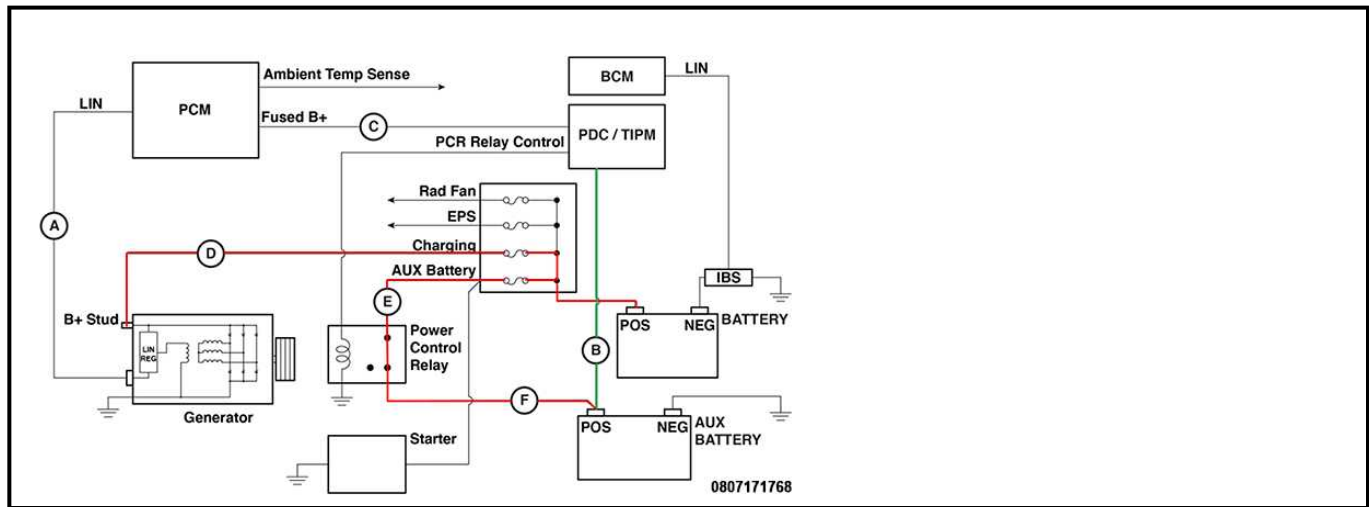
COMPONENT INDEX

1.	STOP/START Off Switch - Located in Instrument Panel
2.	Instrument Panel Cluster (IPC)
3.	Starter Motor
4.	Anti-lock Brake System (ABS) Module
5.	Powertrain Control Module (PCM)
6.	Generator
7.	Intelligent Battery Sensor (IBS)
8.	Dual Battery System and Relays - (Main and Auxiliary Batteries)
9.	Body Control Module (BCM)
10.	Transmission Control Module (TCM) - Automatic Transmissions (ATX) only
-	Starter Motor Relays - Located within the main Power Distribution Center (PDC)
-	Potential ESS System Inhibitors

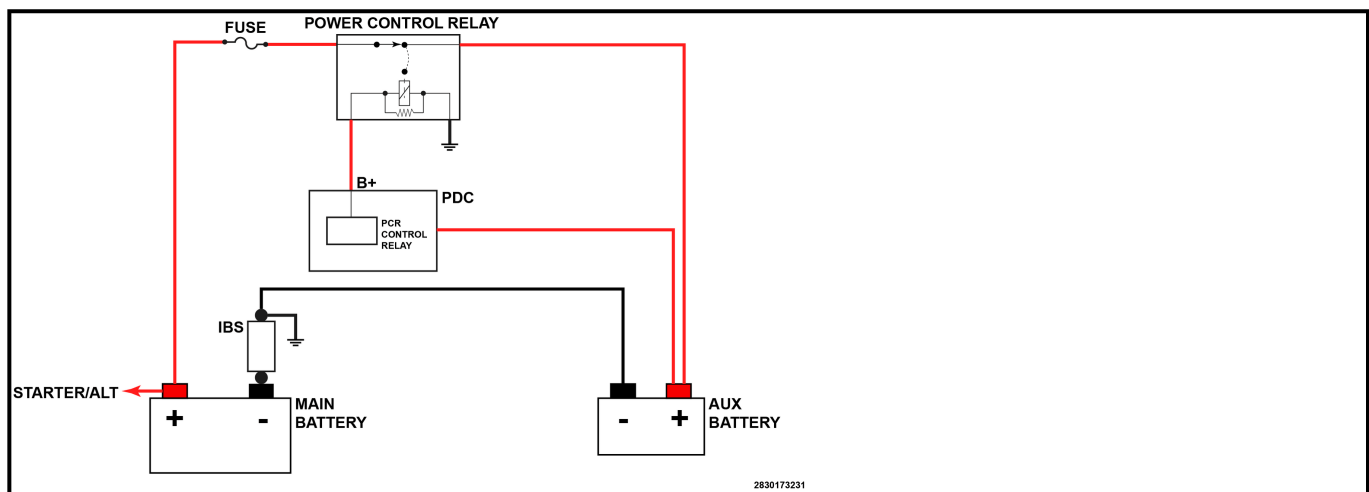
DUAL BATTERY ESS STARTING SYSTEM

DESCRIPTION: The Engine Stop/Start (ESS) system stops and starts the engine when the vehicle is at a stop and certain conditions are met to lower Carbon Dioxide (CO2) emissions. The Powertrain Control Module

(PCM) is the main module controlling operation of the ESS starting system. The system defaults to active on each ignition cycle. There is a customer selectable Stop/Start off switch that will disable the system. The switch is a smart device that sends signals over a LIN bus circuit to the Body Control Module. The Powertrain Control Module (PCM) receives the switch signal message over the CAN bus. The generic graphic below shows most of the system components and the relation between the battery, starting and charging systems. The graphic is depicting a system with a smart alternator. However the ESS starting system operates the same on vehicles equipped with a standard alternator and charging system.



There are four primary components that connect the starting, charging and vehicle electrical systems on the dual battery system. These are the main battery, auxiliary battery, power control relay and dual battery system fuse. The power control relay separates the system into two sides, the main battery side and auxiliary battery side. The generic graphic below shows a simplified diagram of the components for ease in understanding the system configuration.

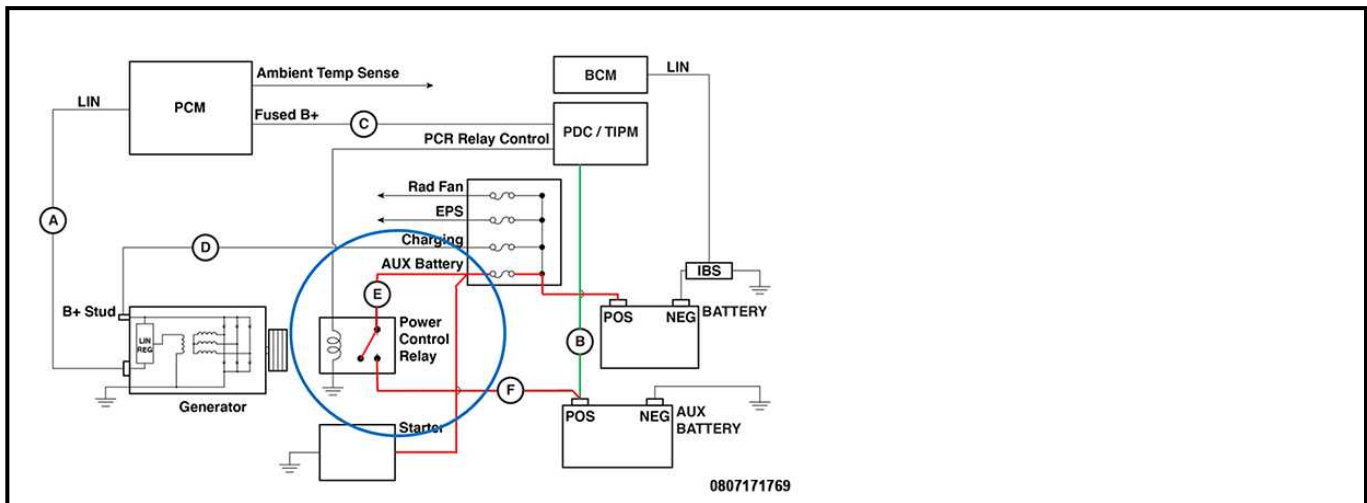


IMPORTANT RELAY NAMING INFORMATION: The information referenced in the list explains the functionality of the relays and how the Powertrain Control Module (PCM) diagnostics are calibrated to view these relays when displaying faults. When diagnosing a battery/starting/charging system issue there can be confusion on the relay naming when referencing the PDC cover and wiring information due to some of the starting system relay names varying between platforms. There are two starter relays wired in series controlling starter motor operation. One is controlled by the Body Control Module (BCM), the other is controlled by the PCM.

- **The first relay in series is controlled by the BCM, but is always considered to be starter relay 2 in the PCM diagnostic calibrations.** When diagnosing any failure mode or PCM DTC referenced as starter relay 2, diagnostics should be focused on the relay that is controlled by the BCM.
- **The second relay in series is controlled by the PCM and is always considered to be starter relay 1 in the PCM diagnostic calibrations.** When diagnosing any failure mode or PCM DTC referenced as starter relay 1, diagnostics should be focused on the relay that is controlled by the PCM.

- The standalone relay that connects the main battery and auxiliary battery on the dual battery systems is referred to as the **power control relay**. This relay is referred to as starter relay 3 in the PCM DTC descriptions.
- The relay located in the Power Distribution Center (PDC) that is directly controlled by the PCM, to indirectly control the power control relay is referred to as the **PCR control relay**.

STARTING SYSTEM OPERATION: The **initial engine cranking event** occurs when the start button is pressed and the engine crank request is sent. Pressing the KIN, a request is sent to the RFH via a private Local Interface Network (LIN) bus for authentication. The RFH receives the request from the KIN and then looks for the valid key fob by using the LF antennas. If the RFH detects a valid key fob and the brake is engaged, the RFH sends a Controller Area Network (CAN) request to the BCM to change the ignition position to START/CRANK. The BCM controlled relay (starter relay 2) and PCM controlled relay (starter relay 1) are closed. The power control relay is momentarily energized by the PCM which separates the connection between the main battery and auxiliary battery for approximately 20-40ms (see graphic below). When separated, only the auxiliary battery is connected to the Power Distribution Center (PDC) and vehicle modules. This allows the PCM to check the State of Charge (SOC) of the auxiliary battery from the Fused B+ circuit voltage at the PCM. After the engine starts (engine speed above a calibrated threshold), the PCM turns off starter relay 1 and the starter is disengaged. Each starter relay is cycled off and on to check for a stuck relay. If both relays test good, starter relay 2 remains closed by the BCM and starter relay 1 is opened. **The PCM controls engine cranking for all subsequent ESS start events by closing starter relay 1.** The power control relay is momentarily energized by the PCM during all ESS crank events. This allows the auxiliary battery to maintain full battery voltage to the PDC, vehicle modules and accessories during the initial starter in-rush so that there is no noticeable difference in vehicle features to the driver. The PCM can also continue to monitor the auxiliary battery voltage on the fused B+ circuit.



On ATX equipped vehicles the PCM sends a signal to TCM to indicate it is ready for an ESS event. The TCM responds it is ready for ESS and enters a hydraulic neutral state while in an auto-stop event and stays in hydraulic neutral during the auto-start event to avoid vehicle movement during engine cranking.

On MTX equipped vehicles the PCM will allow an ESS auto-stop event with the MTX in neutral and the PCM receives the clutch signal from the clutch pedal sensor that the clutch is dis-engaged (pedal released). If the PCM does not see both inputs it will trigger a cluster message to alert the driver to either press the clutch in or shift the transmission into neutral. The PCM allows an ESS auto-start event to occur when the PCM receives a signal that the clutch is engaged (pedal pressed).

LISTED BELOW ARE THE OTHER SYSTEMS AND COMPONENTS THAT CONTRIBUTE TO ESS SYSTEM FUNCTIONALITY

FUNCTIONAL DESCRIPTION - ANTI-LOCK BRAKE SYSTEM (ABS) MODULE

The ABS module incorporates the Electronic Stability Control (ESC) system. On vehicles equipped with Hill Start Assist (HSA), the ABS module also incorporates the HSA strategy.

On vehicles that are not equipped with HSA, there is a brake hold feature designed for the ESS system that should prevent the vehicle from lurching forward during an ESS auto-start on downhill grades. The ESC will attempt to hold the brake system pressure when the ESS system has determined that the vehicle is stopped on a grade and the ABS module has received a bus message indicating the ESS auto-stop engine shutdown is in an active state. The system holds brake system pressure until either a bus message is received indicating that the engine is running again or a message indicating that the accelerator pedal position is greater than 0%. No drive torque balancing is required. Brake system pressure is ramped out quickly as possible when either of those two signals meet the specified values.

On vehicles equipped with the HSA function for the ESS system, this functions only when the engine is running as well as the transmission shifter is in a specified gear location and downhill grade criteria is met. The ESS application is designed to shut off the engine as vehicle braking is applied by the driver. To avoid unintentional rollback, the HSA functionality is required while the engine is off and the vehicle is stopped on a shallower grade. The HSA will remain functional through the supply voltage dip experienced during warm engine cranking.

When the vehicle comes to a stand still and the ESS system state changes to indicate that an ESS auto-stop event is pending, the ABS Module activates the ESS HSA providing that the ESS HSA grade criteria is met and an adequate amount of brake master cylinder pressure is available. Note that the ESS HSA functionality will have a different HSA activation grade threshold to meet the vehicle application. When the ESS HSA function is active, the ESC will isolate the appropriate amount of brake system pressure needed. If the grade is greater than the ESS HSA grade threshold but less than the standard HSA grade threshold, the ESS HSA functions depending on the vehicle application and specified by the ESC system. The ESC system will:

- Deactivate when the ESS engine state changes to engine running.
- Remain active until the HSA timeout or engine drive off torque balancing values are met.

The ESC broadcasts the HSA state and the calculated HSA holding pressure over the Controller Area Network-Chassis (CAN-C) network bus. This signal identifies the following states of the HSA system:

- HSA is not active/pending. This indicates that the HSA activation requirements are yet to be determined or the vehicle is not at a stand still.
- Vehicle stand still has been detected and the HSA is not holding braking system pressure.
- A stand still and grade have been detected and the HSA signal is indicating what the minimum braking system pressure required is needed to hold the vehicle on the grade. This signal must compensate for loss of engine creep/idle torque when the engine shuts down. This signal must quickly transition to the required braking system hold pressure after determining vehicle stand still and detection of the grade. This signal must quickly transition directly to the calculated braking system hold pressure if the grade is greater then the ESS HSA calibrated threshold. The signal can differ from the actual pressure that the HSA system is holding. The PCM will compare the brake master cylinder pressure to the signal to ensure that enough brake system pressure is in the brake system to hold the vehicle before an ESS auto-stop event is performed. If the brake pressure signal is Signal Not Acquired (SNA), all HSA functionality is disabled due to a system fault.
- ESS HSA will not disable when the HSA feature is disabled by the customer using the programmable options menu to turn the HSA system off.

The ABS/ESC module:

- is responsible for reading and reporting the state of the Vehicle Speed Sensor (VSS) as well as the wheel speed Revolution Per Minute (RPM) calculations.
- reports the rolls test bench mode state.
- reports out the current state of the brake pedal position.
- reports out the Yaw rate.
- reports out vehicle longitudinal acceleration and vehicle lateral acceleration readings.

FUNCTIONAL DESCRIPTION - BODY CONTROL MODULE

During the initial engine cranking event, when the BCM receives a crank signal from the Powertrain Control Module (PCM), the BCM energizes the BCM controlled starter relay with an internal high side driver control.

The BCM is the gateway for all bus communications needing to be gated from one bus network to a different bus network. This grants the modules on different busses the ability to interact with each other. If the Local Interface Network (LIN) or CAN bus communications go down, the BCM will set the appropriate DTCs and display SNA values.

Door Ajar Latch Switches - The ajar switches are hard-wired to the BCM. The BCM broadcasts the switch state over the CAN bus to the PCM.

Functional Operation of the Door Ajar Latch Switches: All of the Door Latches are monitored to determine if they are closed or ajar. All of the ajar switches are wake-up signals to the BCM. The Driver Door Latch must be rationalized in order for some vehicle features to function. Unlike the passenger ajar signals that function like traditional open/closed ajar switches, the Driver Door Latch has redundant switches and signals for diagnostic purposes. The two switches share a common sensor ground. The Door Ajar Switch signals use Battery voltage for a reference. The switches operate in the following manner:

- **Driver Door Ajar Switches:** The BCM has an internal pull up 1000 Ohm resistor for each ajar signal. Each switch has an internal 604 Ohm and 1070 Ohm resistor. When the switches are open the resistance through the switches are 1674 Ohms. When the switches are closed the resistance through the switches are 604 Ohms. The switch states are opposing each other, meaning that when the **door latch is closed**, switch 1 is in the open state and switch 2 is in the closed state. The opposite is true when the **door latch is opened**. For more information refer to the tables below.
- **Passenger Ajar Switches:** The ajar switches are open when the latch is closed. When the door latch is ajar the switch closes allowing the signal to connect to ground through the switch. Therefore the signal inputs to the BCM are high when the door is closed and low when the door is ajar.

The resistors in the latch switches allows the BCM to perform diagnostics on the circuits and switches. Unlike the passenger door switches the voltage on the two signals should not be high or low. If the BCM determines that either signal falls into the high or low range, a fault is set. If the door latch positions do not match between the two Driver Door Ajar Switches, a correlation fault will set. **If the door is ajar, or a fault is detected, the ESS system is inhibited. In the event that this occurs during an ESS auto-stop, this failure will inhibit the ESS auto-start function.**

FUNCTIONAL DESCRIPTION - INTELLIGENT BATTERY SENSOR (IBS)

The Intelligent Battery Sensor (IBS) is an electrical shunt with a microprocessor that is mounted in-line with the negative battery cable. The IBS monitors the battery voltage as well as current flow into and out of the battery. The IBS has a built-in thermistor that calculates the battery temperature. The microprocessor uses this data to calculate battery State of Charge (SOC), battery internal resistance, charge received, electrical demand, and time in service. This information is reported through the LIN Bus circuit to the Body Control Module (BCM). The BCM broadcasts the information to the Powertrain Control Module (PCM) over the CAN Bus.

The IBS SOC data is also used by the BCM and other modules to determine when to begin disabling certain vehicle features that draw excessive electrical loads due to a low battery SOC. The SOC threshold for starting to disable features can vary based on vehicle and engine but is typically in the 50% to 60% range.

On the dual battery Stop/Start systems, the IBS is connected to the main battery. Since the two batteries are connected to each other most of the time, the battery SOC reported by the IBS is reporting the average SOC of the two batteries. It is possible for one battery to be fully charged and the other battery discharged causing the overall SOC to be low. If the SOC is low, both batteries should be checked for proper charge and functionality before checking for an issue with the IBS.

The IBS SOC may read low when both batteries test good. The following items can contribute to, and should be considered when diagnosing a low SOC condition before replacing an IBS or battery:

- If the vehicle is jump started at the battery posts bypassing the IBS.

- If the battery is blind charged at the battery posts bypassing the IBS.
- Repeated short trip driving events not allowing enough charge time.
- The IBS accuracy is off and needs to relearn the battery SOC.

Depending on the vehicle, there could be a non-MIL DTC (P057F) set, or an EVIC message indicating a low battery state of charge limiting some features, such as ESS. In some cases, properly charging the batteries through the IBS can raise the IBS SOC enough to regain functionality and repair the issue. However, it can sometimes take two or three, 4-hour BUS off sleep cycles for an IBS to learn and update the battery SOC. The IBS can be initiated into a learning curve by completely disconnecting the IBS from the battery, and disconnecting harness connector for 20 seconds. The IBS battery feed, LIN Bus and ground circuits should be checked before reconnecting the IBS. The IBS should default to approximately 80% SOC when reconnected. However, the IBS accuracy is determined to be low until the IBS can relearn battery SOC. This occurs after an engine run cycle and a subsequent ignition off sleep cycle of between one to four hours. Some features will be disabled until the IBS SOC is updated.

FUNCTIONAL DESCRIPTION - INSTRUMENT PANEL CLUSTER (IPC)

The PCM sends activation signals to the IPC requesting that the IPC displays specific Engine Stop/Start (ESS) system messages. The IPC will display these messages to the driver of the vehicle indicating the status of the ESS system. When the ESS system has been inhibited, the IPC will display a message indicating the reason for the temporary inhibit.

FUNCTIONAL DESCRIPTION - POWERTRAIN CONTROL MODULE (PCM)

During the initial engine cranking event, the PCM energizes the PCM controlled starter relay 1 with an internal low side driver control. The PCM controls all subsequent Engine Stop/Start (ESS) auto-start events in the same manner. When the engine is started (RPM calibrated value detected of greater than 600), the PCM switches off the low side driver control and opens the relay. The PCM monitors the output from the relay through the Crank Sense circuit. The Crank Sense circuit is spliced to the starter relay output inside the Power Distribution Center (PDC) and hard-wired directly to the PCM.

Every engine start (auto or driver induced) is recorded by increments on a counter. The number of allowable ESS start events is a function of the ambient temperature. As the ambient temperature increases, the number of ESS events will decrease. If the count is equal to a calibrated threshold, the ESS auto-stop function is inhibited until a cool down cycle has been run. The quick cool down cycle is defined as a calibrated drive period above a calibrated vehicle speed. The slow cool down cycle is defined as the time from the last crank since the inhibit event was recorded.

If there is an issue that causes the engine to not auto-start within a calibrated period, the starter control relay will be deactivated and an ignition cycle will then be required to start the engine.

The PCM monitors several hard-wired and CAN message inputs to determine the functionality of the ESS system.

- **Crankshaft Position (CKP) Sensor** - In order to protect the engine against damage caused by inadvertently sparking a cylinder following a rollback condition, the PCM utilizes a control that effectively turns off the fuel and spark drivers when below a given RPM. The PCM also utilizes a bidirectional CKP sensor to determine the ESS engine stop position for a fast restart.
- **Brake Pedal Position (BPP) Sensor** - The brake pedal position sensor signal is acquired over the CAN bus from the Brake System Module. The PCM monitors the BPP sensor signal to determine the brake pedal position. The BPP sensor min/max travel thresholds are a learned value in the PCM. The PCM must see the pedal position pressed to allow an auto-stop. When the BPP sensor signal transitions towards the released state the PCM will auto-start the engine.
- **Accelerator Pedal Position (APP) Sensor** - The APP sensor is hard-wired to the PCM. The PCM will only allow an auto-stop when the sensor signal indicates no throttle input is present. If the PCM detects accelerator pedal input during an auto-stop event, the PCM will auto-start the engine.

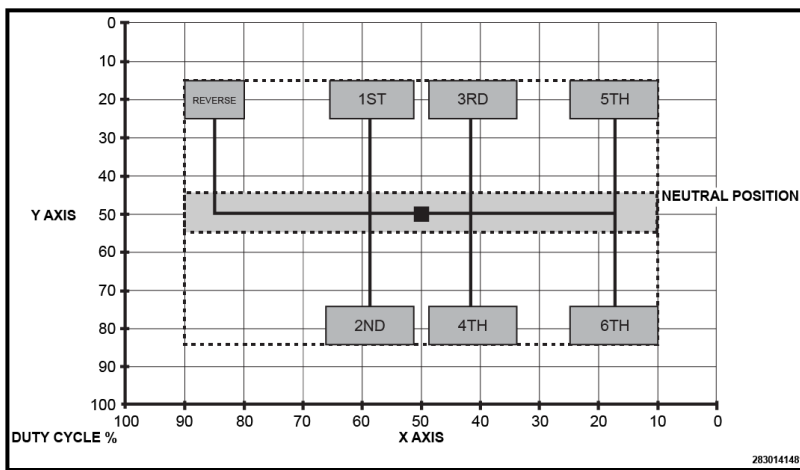
- **Driver Presence Detection Module (DPDM)** - The DPDM, located in the drivers front seat, is responsible for detecting whether the front driver side seat is occupied or unoccupied by the vehicle operator. The signals generated by the DPDM are influential on how the ESS system will operate during ESS auto-stop and ESS auto-start events. The DPDM is used on vehicles that are not equipped with a door ajar sensor. In ATX equipped vehicles, if the PCM recognizes a DPDM failure during an ESS auto-stop event, the PCM will secure the vehicle by requesting a Shift to Park from the TCM and then requires correction of shifter moving out of Park before the engine will auto-start. The PCM determines the status of the driver occupancy presence based on CAN-C network bus message received from the DPDM. If the PCM detects a fault in the DPDM bussed signal, the PCM will inhibit the ESS system in MTX equipped vehicles. If the PCM recognizes a DPDM fault during an ESS auto-stop event, the PCM will force an ESS auto-start event to occur.
- **Hood Ajar Switches** - ESS vehicles are equipped with two hood ajar switches for redundancy. Hood ajar switch 1 signal is a bussed signal from the Body Control Module (BCM). Hood ajar switch 2 is a hard-wired input to the PCM. the PCM performs a rationality check of the two signals. If the input signals do not match, or indicate that the hood is ajar, the PCM will not allow an auto-stop event. If this occurs during an auto-stop event, the transmission must be shifter to park or neutral and manually restarted.

Not all vehicles are equipped with manual transmissions. Also, the sensors used can vary between vehicles. Listed below are all of the devices used for monitoring inputs on manual transmission equipped vehicles. Check the wiring information to determine which devices are used on the vehicle that is being serviced.

- **Clutch Pedal Position Sensor** - On vehicles equipped with a manual transmission, the PCM monitors the Clutch Pedal Position Sensor signal to determine when to allow an auto-stop and auto-start event. The clutch pedal position sensor is a learned value. The PCM also learns the clutch engagement point. The graphic below shows the PCM interpretation of the signal.

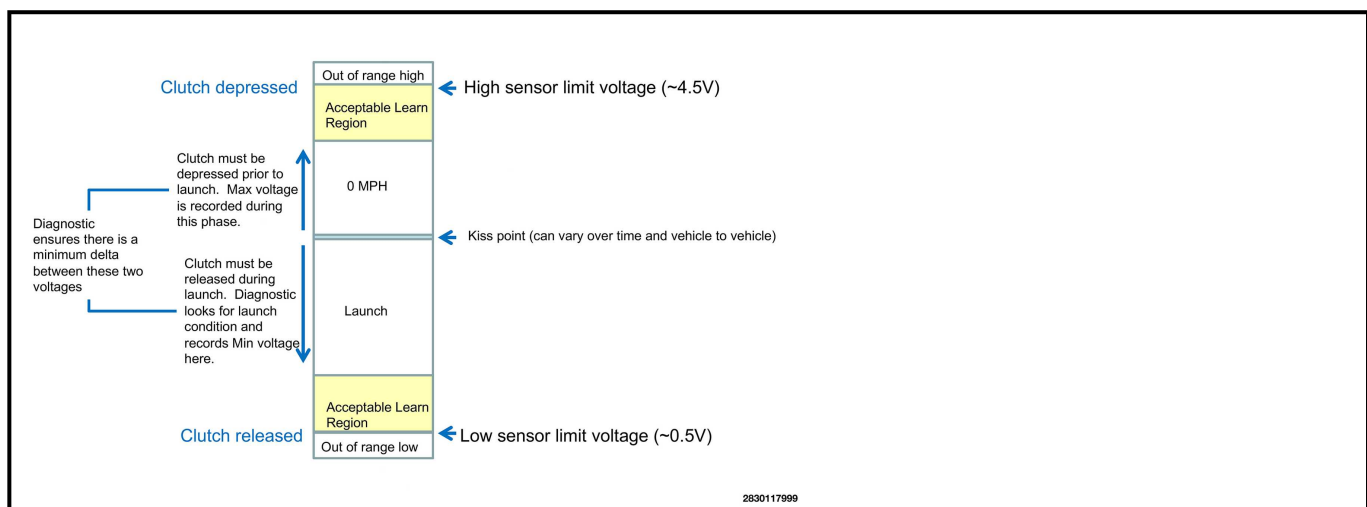
Vehicles equipped with ESS will also have a Clutch Interlock Switch. The Clutch Interlock Switch is different than the traditional Clutch Pedal Switches in that it only detects the interlock (pedal depressed) position. The switch input is compared to the Clutch Position Sensor signal for the correlation diagnostic. If a correlation fault sets it will affect the ESS system in one of the following ways:

- If the fault occurs prior to an auto-stop, ESS will be disabled and no auto-stop will occur.
- If the fault occurs during an auto-stop with the transmission in neutral, the vehicle will auto-stop and ESS will then be disabled.
- If the fault occurs during an auto-stop with the transmission in gear, vehicle will not start until the shifter is moved into neutral and then ESS will be disabled.
- **Gearshift Position Sensor** - Some vehicles that are equipped with a manual transmission have a gearshift position sensor. The PCM uses the gearshift position sensor in the ESS system during ESS auto-stop and ESS auto-start events. The calculated gear position also has the potential to inhibit the ESS system operation, depending on the detected gear. This is managed from within the PCM as the PCM is the main ESS system controller. The gearshift position sensor has a shared 5.0 volt supply, sensor ground and two position signals from the sensor. The signals to the PCM are in the form of a 5.0 volt square wave duty cycle. The gearshift position sensor quadrants are learned at the plant. These positions will need to be learned if the sensor, or any Transmission Shifter components are replaced. The PCM monitors movement of the shifter along the X and Y axis to determine the shifter position. The X axis is left and right movement of the shifter which detects 4 different quadrants. The Y axis is forward and backward movement of the shifter which detects 3 different quadrants. The PCM uses the two duty cycle signals to make the determination of the shifter position. **See the graph in the figure depicting the gear shifter positions and correlating duty cycles.**



The normal operating duty cycle range for each signal is between 10% and 90%. If the PCM detects that the duty cycle for either signal is above or below the normal duty cycle range a circuit fault will set. The PCM also monitors the rationality of the shifter position by comparing the actual gear shift position feedback to the calculated gear shift position. The gear shift position calculation is based on the transmission being in a forward gear with the clutch pedal not pressed, vehicle speed, engine speed, and calculated engine torque.

- Neutral Position Sensor** - Some manual transmission equipped vehicles have a neutral position sensor instead of a gearshift position sensor. On these vehicles the PCM is only monitoring for the transmission to be in the neutral position or in any gear position. This is done for the purpose of determining when the ESS system can safely restart the vehicle without the clutch pedal being depressed. The neutral position sensor outputs a PWM signal. The sensor signal will typically be around 50% duty cycle when the shifter is in the neutral position. A duty cycle other than approximately 50% indicates that the shifter is shifted to a gear range position.



The PCM will send messages over the CAN-C network bus indicating the status and requests of the ESS system. The signals are used in order to inform the overall network nodes the ESS status.

FUNCTIONAL DESCRIPTION - STARTER MOTOR

Vehicles equipped with the Engine Stop/Start (ESS) system are equipped with a heavy duty starter. The starter motor has increased life brushes, needle bearings, pre-loaded pinion gear spring and other changes to enhance longevity and improve Noise, Vibration, Harshness (NVH). The starter also has increased power to compensate for brush losses, and to increase cranking speed.

FUNCTIONAL DESCRIPTION - TRANSMISSION CONTROL MODULE (TCM)

The TCM determines if the following conditions are met to perform an ESS auto-stop event:

- The TCM receives a CAN-C bus message from the PCM that indicates that there is an ESS auto-stop event pending and that the engine itself is ready for the ESS auto-stop event.

- The TCM receives a Electronic Stability Program (ESP) or an Electronic Stability Control (ESC) derived CAN-C bus message from the ABS module which indicates the vehicles speed threshold over a calibrated frame of time.
- The TCM determines that the transmission is not in **R** everse or that there is not a TCM SNA error. The TCM needs to see that either a forward gear is engaged or that the transmission is in **N** eutral.
- The TCM determines if there are any DTCs on the transmission which can inhibit the ESS auto-stop. If a fault is detected, the TCM busses a fault CAN-C bus message back to the PCM. If no fault is detected, the TCM will bus a no fault CAN-C bus message to the PCM.
- The TCM then determines if it can allow the transmission into **P** ark or **N** eutral.
- The TCM then determines if the PCM CAN-C bus received message indicates that the engine is ready or is not ready for an ESS. A true CAN-C bus message attribute indicates that the CAN-C bus message received from the PCM does indicate that the engine is ready for an ESS event.
- Once the TCM verifies that the CAN-C bus message received from the PCM indicates that the engine is ready for an ESS auto-stop event, the TCM sends a CAN-C bus message back to the PCM indicating that the transmission is prepared and ready for an ESS auto-stop event to occur.
- The TCM then holds the "ready for ESS auto-stop event = True" state during the actual auto-stop event.
- During the actual ESS auto-stop event, the TCM indicates that the transmission is in a pseudo drive hydraulic neutral gear known as D6 and sends a CAN-C bus message to the PCM advising that the transmission is in a neutral state. This D6 gear state is also indicative of the transmission being in an open transmission torque path. D6 must be achieved prior to engaging the starter motor in response to a driver start request. The TCM busses a message indicating the drive state of the transmission being open or not open.

The TCM determines if the following conditions are met to perform an ESS auto-start event:

- The PCM sends a CAN-C network bussed message to the TCM indicating that there is an active request to start the engine.
- If the transmission equipped in this vehicle is equipped with a Hydraulic Impulse Storage (HIS) solenoid, the HIS is released when a CAN-C network bus message from the PCM indicates that the engine is starting.
- The PCM then starts the engine.
- The TCM then engages the appropriate gear.

TCM reaction to a driver departure condition - The TCM can secure the vehicle by shifting into **P** ark if there is a recognized driver departure. The PCM monitors DPDM conditions that indicate driver departure, and if the PCM determines this to be true, the PCM sends a CAN-C network bus message to the TCM requesting that the TCM shift to **P** ark. At this time, the TCM must place the transmission into the **P** ark position.

ENGINE STOP/START (ESS) INHIBITORS

The following conditions must be true for the vehicle to perform an ESS auto stop event:

- An ABS event not present
- Flex fuel learned is true
- ESS related system faults are not present
- Driver seat belt buckled
- Driver door closed
- Driver Presence Detection Module (DPDM) indicates seat is occupied
- If the vehicle is equipped with an ATX, any forward transmission gear state must be detected
- If the vehicle is equipped with a MTX, the transmission must be in neutral with the clutch pedal in a released state
- ESS inhibit START/STOP Off switch is not pressed
- Battery state is at an acceptable level

- ECT is within calibrated range
- Ambient temperature is within calibrated range
- Steering wheel inputs are acceptable
- Engine speed is below a calibrated threshold
- Vehicle speed is below a calibrated threshold (APPS indicates that the throttle pedal is not pressed)
- Vehicle latch speed achieved (ESS auto-stop is permitted)
- Starter motor engagement frequency has not exceeded the calibrated number of allowable attempts
- Brake booster vacuum level is within calibrated range
- Barometric pressure value is within calibrated range
- Hood not open and no rationality faults present
- Hill grade is below calibrated range and HSA is ready
- Fuel level is within calibrated range
- Master cylinder pressure in allowable range to perform auto-stop and HSA
- Engine run time is above a calibrated threshold
- Transfer case status is in acceptable state (not in 4-Low). Reported by the Drivetrain Control Module (DTCM).
- Park maneuver is not detected
- Transmission is ready for ESS operation
- No faults present in the ATX or MTX transmission
- HVAC demand is not present
- Oil temperature is within a calibrated range
- Variable Valve Timing (VVT) is in default position
- Exhaust Gas Recirculation (EGR) is ready (if equipped)
- Multi-air system ready (if equipped)
- Starter diagnostics are not running
- Catalyst light is off

The following conditions allow for engine start:

- No OBDII compliant faults are present or detected
- Hood ajar switches are indicating a closed state.
- No ESS inhibit or ESS disarm conditions are present.
- Starter strategies managed by the PCM indicate that starter operation is allowable.
- RPM readings are below a run threshold calibrated by the PCM.

Certain ESS related system faults and vehicle conditions will inhibit the ESS operation. The following items on this list can be listed due to rationality faults, sensor faults, hardware faults, communication faults or SNA faults:

- Ambient temperature during engine restart
- Catalyst temperature during engine restart
- ECT during engine restart
- Battery temperature during engine restart
- Engine oil temperature during engine restart
- Certain HVAC load demands
- Cam sensor faults; intermittent or otherwise
- Cam/crank rationality; intermittent or otherwise
- Accelerator Pedal Position Sensor (APPS) faults detected

- Steering Angle Sensor (SAS) faults during engine restart
- Driver door ajar switch fault
- Seat belt circuit fault
- Hood detection fault
- Clutch pedal position faults
- Hill Start Assist (HSA) within range to hold the vehicle faults
- Brake booster pressure faults
- Fuel level faults during engine restart
- Torque security faults
- Loss of bus communication during engine restart
- Accelerometer sensor diagnostics
- Starter control. Anything that disables first crank would disable ESS
- Starter relay fault
- Starter relay circuit faults
- Air bag deployment
- Driver Presence Detection Module (DPDM) faults
- PCR Stuck Open Fault
- PCR Stuck Closed Fault
- Auxiliary Battery depleted
- Auxiliary Battery disconnected
- Battery SOC below calibrated threshold
- Vehicle altitude is above a calibrated threshold

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - STARTING SYSTEM

The battery, starting, and charging systems operate in conjunction with one another, and must be tested as a complete system. For correct starting/charging system operation, all of the components involved in these three systems must perform within specifications.

STARTING SYSTEM DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
STARTER FAILS TO OPERATE	1. Battery discharged or inoperative	1. Charge and test battery. Replace battery, if required.
	2. Starter motor or solenoid inoperative	2. Test the starter motor and solenoid. Replace starter motor, if required.
	3. Starter relay inoperative	3. Refer to the appropriate Wiring Information. Test and replace the starter relay, if required.
	4. Clutch pedal position switch inoperative (if equipped with manual transmission)	4. Refer to the Clutch pedal position switch. Test and adjust or replace switch, if required.
	5. Park/Neutral position switch inoperative (if equipped with automatic transmission)	5. Refer to the Park/Neutral Position Switch. Test and adjust or replace switch, if required.
	6. Starting circuit wiring inoperative	6. Refer to the appropriate Wiring Information. Test and repair starter feed and/or control circuits, if required.

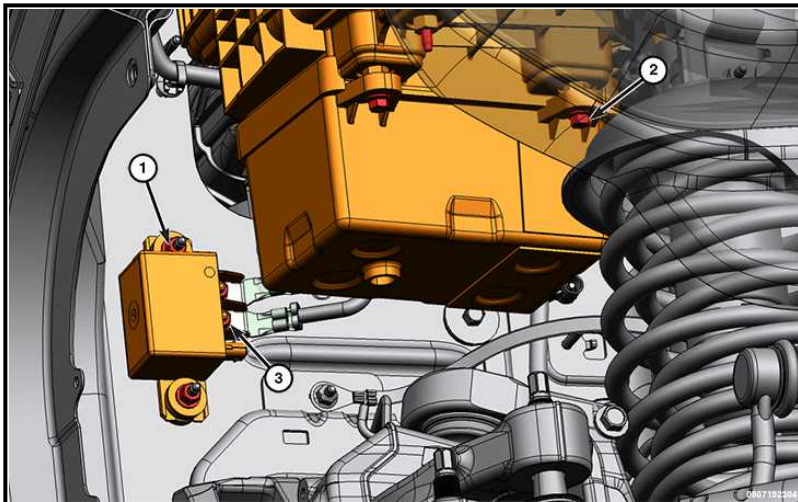
CONDITION	POSSIBLE CAUSE	CORRECTION
STARTER ENGAGES, BUT FAILS TO TURN ENGINE	1. Battery discharged or inoperative	1. Charge and test battery. Replace battery if required.
	2. Starter motor or solenoid inoperative	2. Test the starter motor and solenoid. Replace starter motor if required.
	3. Starting circuit wiring inoperative	3. Refer to the appropriate Wiring Information. Test and repair starter feed and/or control circuits, if required.
	4. Engine seized	4. Refer to - Engine. Test and repair engine as required.
STARTER ENGAGES, THEN DISENGAGES BEFORE ENGINE STARTS	1. Starter motor or solenoid inoperative	1. Test the starter motor and solenoid. Replace starter motor, if required.
	2. Starter ring gear damaged	2. Remove starter motor and inspect starter ring gear. Replace starter ring gear, if required.
STARTER DOES NOT DISENGAGE	1. Starter motor incorrectly installed or solenoid inoperative	1. Inspect and test the starter motor and solenoid. Replace starter motor, if required.
	2. Starter relay inoperative	2. Refer to the appropriate Wiring Information. Test and replace the starter relay, if required.

TECHNICAL SPECIFICATIONS

TORQUE SPECIFICATIONS

STARTING SYSTEM - 3.0L DIESEL

DESCRIPTION	SPECIFICATION	COMMENT
Starter B+ Cable Nut	11 N.m (8 Ft. Lbs.)	-
Starter to Transmission Bolt Upper	48 N.m (35 Ft. Lbs.)	-
Starter to Transmission Bolt Lower	48 N.m (35 Ft. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	PCR Mounting Bolt	11 N.m (8 Ft. Lbs.)	-
2	Auxiliary Battery Tray To Battery Tray	Refer to Battery Torque Table	-
3	B+ Wire To PCR Positive Terminals	11 N.m (8 Ft. Lbs.)	-
-	Ground To PCR Bracket	9 N.m (80 In. Lbs.)	Right Hand Drive Only
-	PCR To Chassis Ground	11 N.m (8 Ft. Lbs.)	-

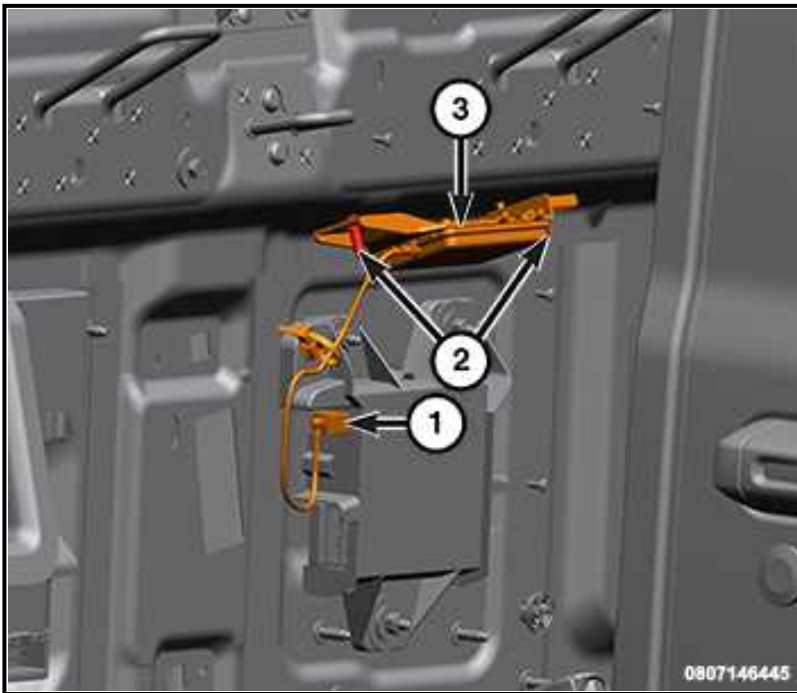
CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
-	Remote Start Antenna (RSA) to Cab Back	6 N.m (53 In. Lbs.)	-

ANTENNA, REMOTE START

REMOVAL AND INSTALLATION

REMOTE START ANTENNA

1. Remove the cab back trim panel. Refer to [PANEL, CAB BACK TRIM, REMOVAL AND INSTALLATION](#).
2. Disconnect the subwoofer wire harness connector.
3. Remove the four fasteners and the subwoofer.



1 - Wire Harness Connector
2 - Nuts
3 - Remote Start Antenna

4. Disconnect the Remote Start Antenna (RSA) wire harness connector.
5. Remove the Remote Start Antenna from the vehicle.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

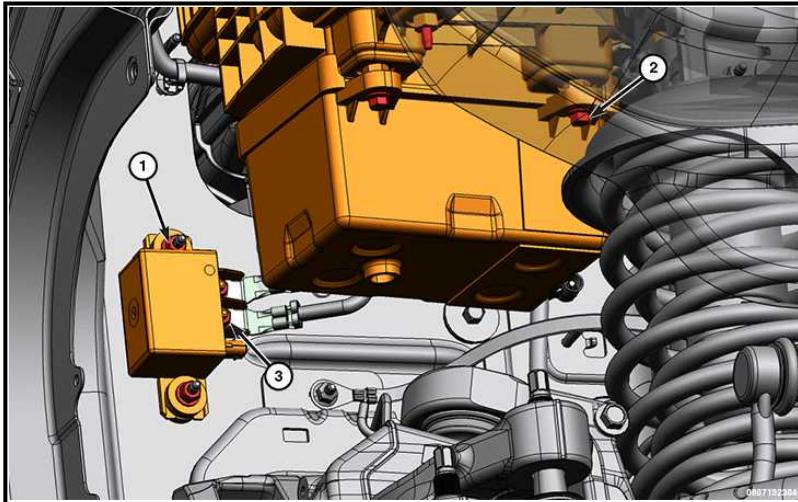
During installation, torque the fasteners to the specifications in the torque table(s) below.

TORQUE SPECIFICATIONS

STARTING SYSTEM - 3.0L DIESEL

DESCRIPTION	SPECIFICATION	COMMENT
Starter B+ Cable Nut	11 N.m (8 Ft. Lbs.)	-
Starter to Transmission Bolt Upper	48 N.m (35 Ft. Lbs.)	-

DESCRIPTION	SPECIFICATION	COMMENT
Starter to Transmission Bolt Lower	48 N.m (35 Ft. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	PCR Mounting Bolt	11 N.m (8 Ft. Lbs.)	-
2	Auxiliary Battery Tray To Battery Tray	Refer to Battery Torque Table	-
3	B+ Wire To PCR Positive Terminals	11 N.m (8 Ft. Lbs.)	-
-	Ground To PCR Bracket	9 N.m (80 In. Lbs.)	Right Hand Drive Only
-	PCR To Chassis Ground	11 N.m (8 Ft. Lbs.)	-
-	Remote Start Antenna (RSA) to Cab Back	6 N.m (53 In. Lbs.)	-

BUTTON, START/STOP

REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

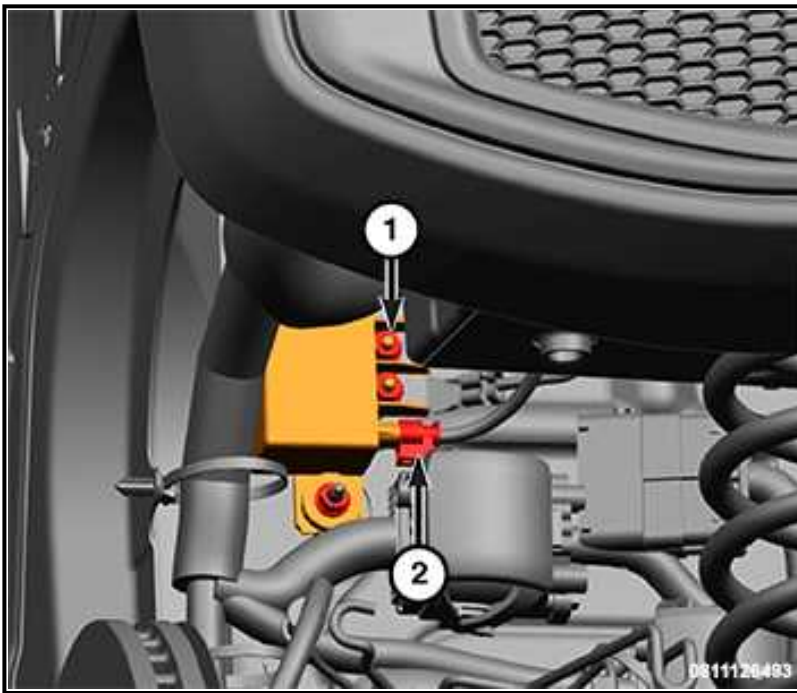
For information on the removal and installation of the Start/Stop button. Refer to [MODULE, KEYLESS IGNITION NODE \(KIN\), REMOVAL AND INSTALLATION](#) .

RELAY, POWER CONTROL

REMOVAL AND INSTALLATION

POWER CONTROL RELAY

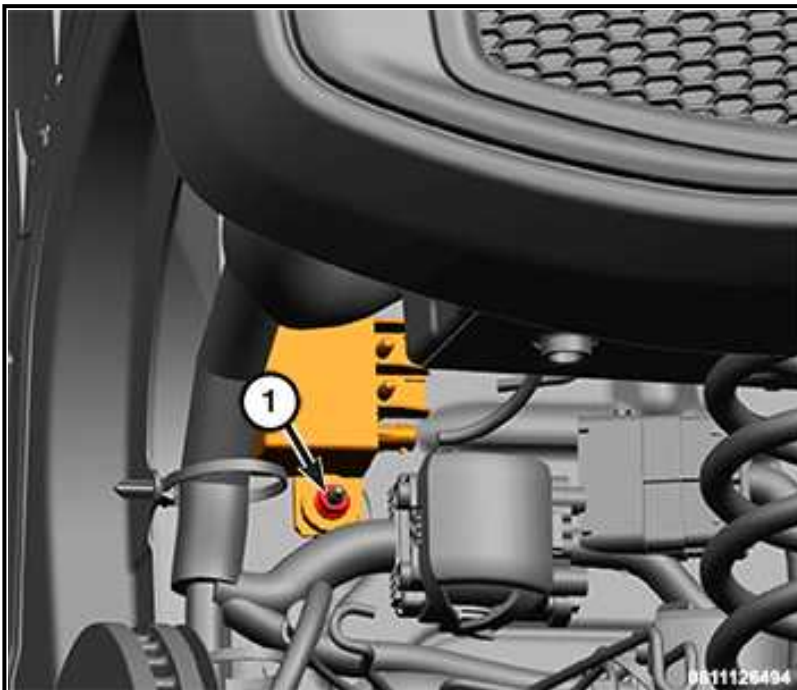
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
3. Remove the right inner wheel house. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) .



1 - Power Control Relay B+ Nuts

2 - Wire Harness Connector

4. Remove the nuts on the B+ post of the Power Control Relay.
5. Disconnect the wire harness connector.



1 - Power Control Relay Nuts

6. Remove the two nuts from the power control relay.
7. Remove the power control relay from the vehicle.

INSTALLATION

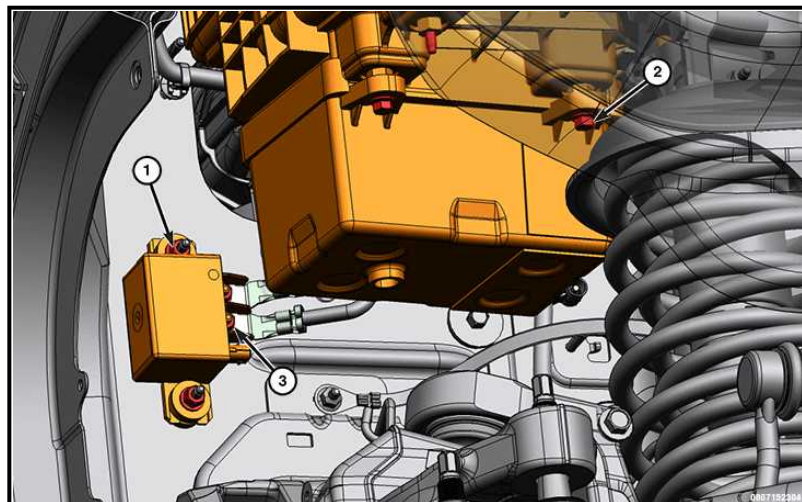
Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

During installation, torque the fasteners to the specifications in the torque table(s) below.

TORQUE SPECIFICATIONS

STARTING SYSTEM - 3.0L DIESEL

DESCRIPTION	SPECIFICATION	COMMENT
Starter B+ Cable Nut	11 N.m (8 Ft. Lbs.)	-
Starter to Transmission Bolt Upper	48 N.m (35 Ft. Lbs.)	-
Starter to Transmission Bolt Lower	48 N.m (35 Ft. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	PCR Mounting Bolt	11 N.m (8 Ft. Lbs.)	-
2	Auxiliary Battery Tray To Battery Tray	Refer to Battery Torque Table	-
3	B+ Wire To PCR Positive Terminals	11 N.m (8 Ft. Lbs.)	-
-	Ground To PCR Bracket	9 N.m (80 In. Lbs.)	Right Hand Drive Only
-	PCR To Chassis Ground	11 N.m (8 Ft. Lbs.)	-
-	Remote Start Antenna (RSA) to Cab Back	6 N.m (53 In. Lbs.)	-

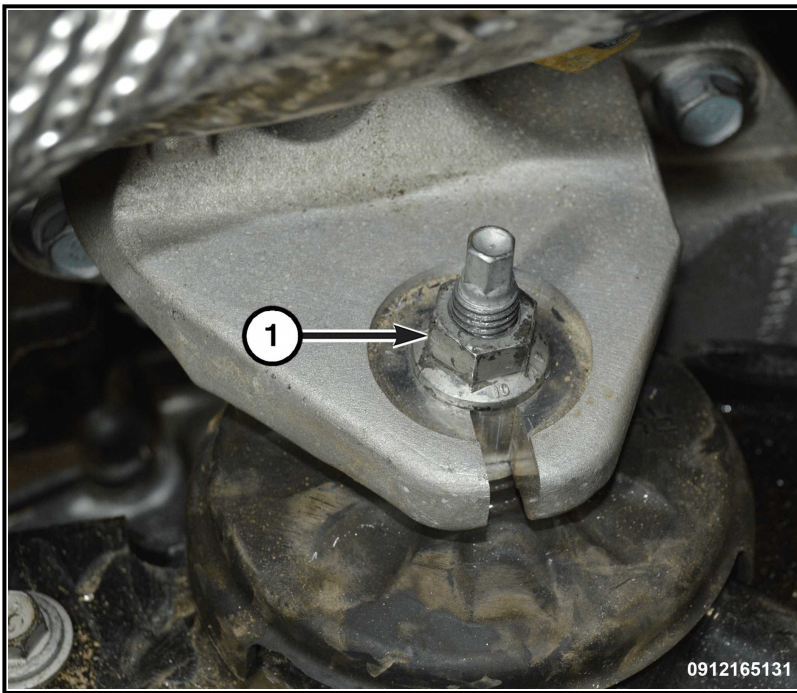
STARTER

REMOVAL AND INSTALLATION

STARTER - 3.0L

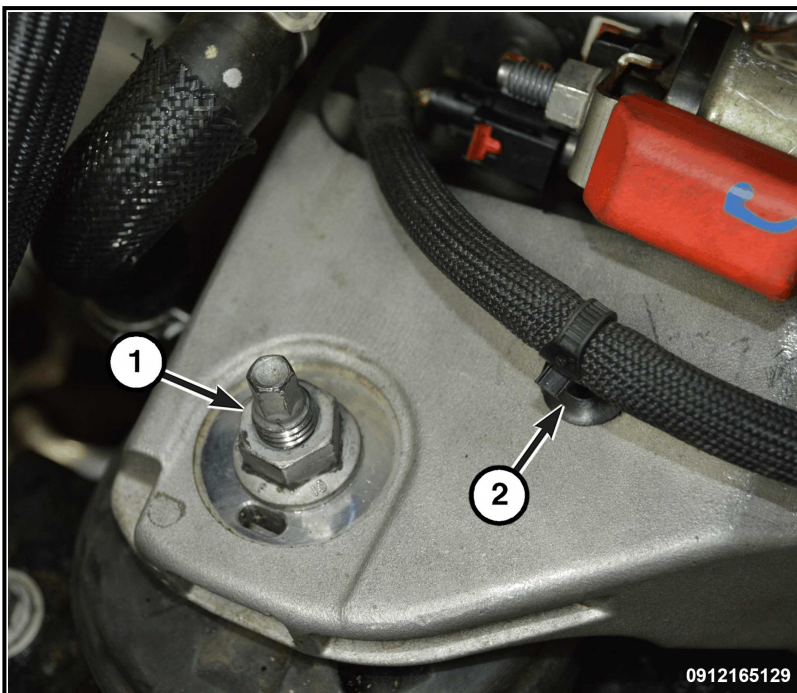
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .



1 - Right Engine Mount Nut

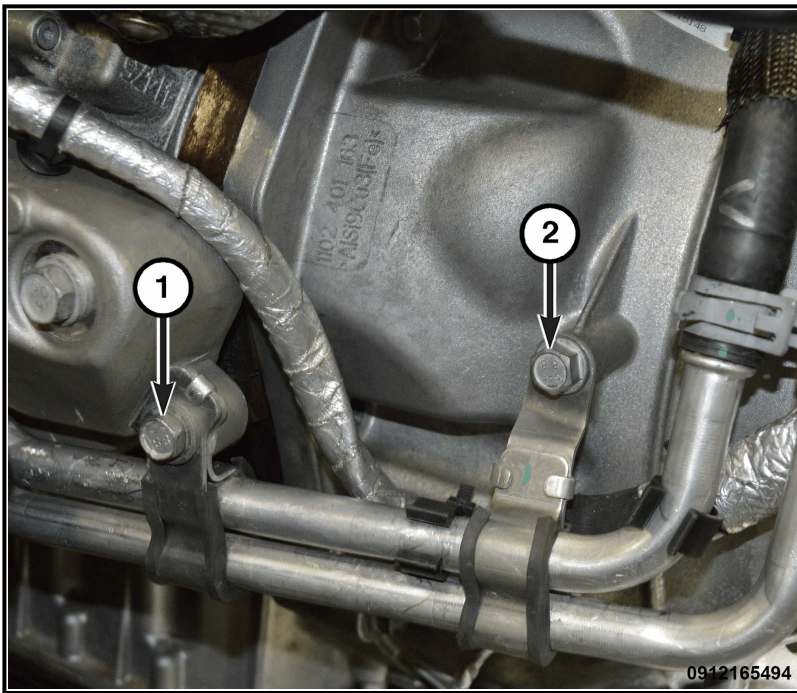
2. Remove the right side engine mount nut.



1 - Left Engine Mount Nut

2 - Wire Harness Retainer

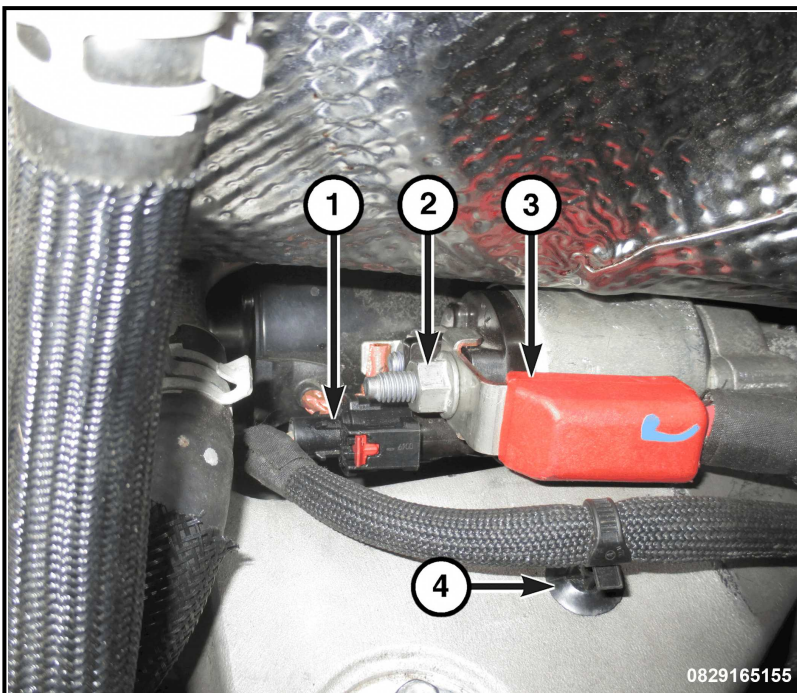
3. Remove the left side engine mount nut.
4. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
5. Position a jack stand under the engine and raise the engine.



1 - Coolant Tube Bracket Bolt

2 - Coolant Tube Bracket Bolt

6. Remove the bolts securing the coolant tube to the engine mount bracket.



1 - Starter Solenoid Wire Harness Connector

2 - Battery Cable Nut

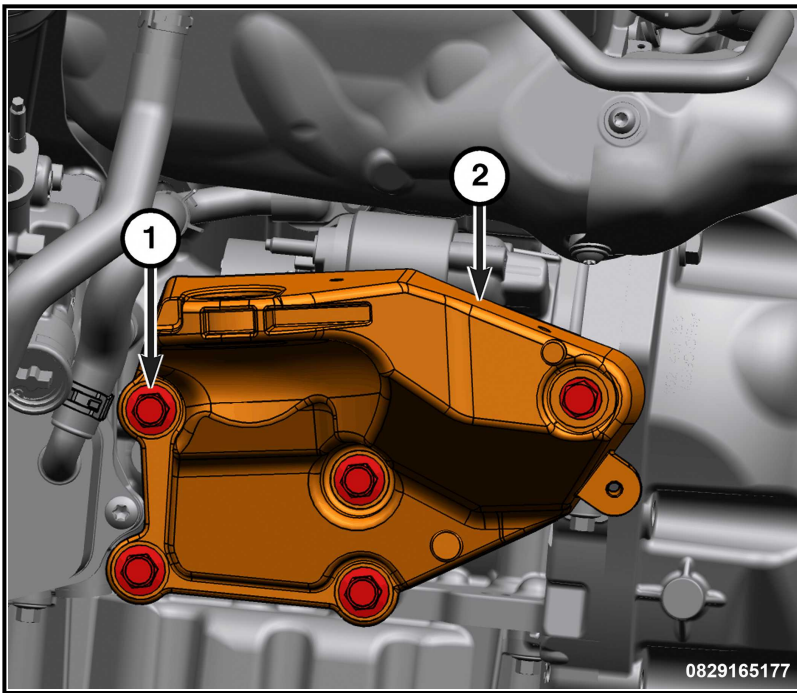
3 - Battery Cable

4 - Wire Harness Retainer

7. Disconnect the starter solenoid wire harness connector and detach the wire harness retainers.

8. Remove the B+ cover from the battery cable.

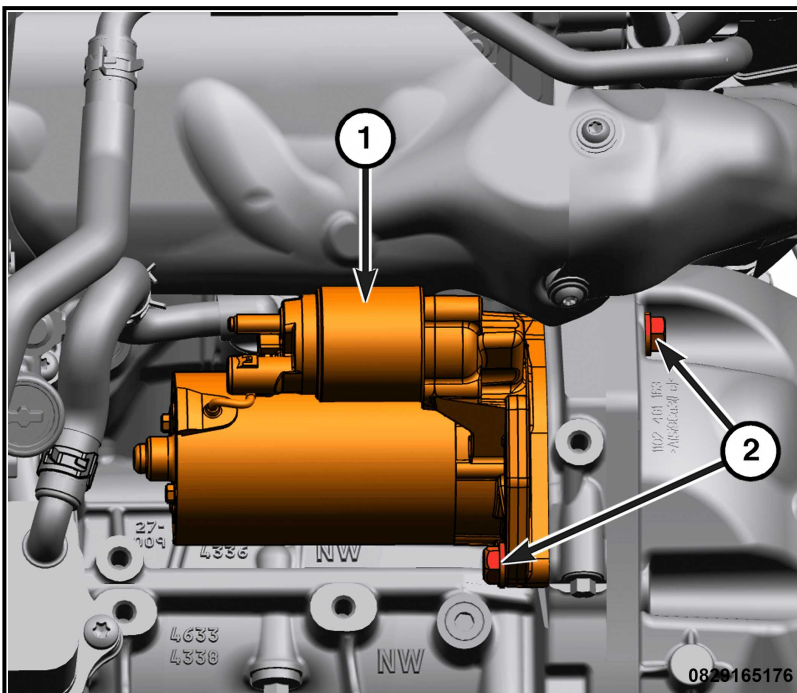
9. Remove the nut and the battery cable from the starter.



1 - Left Engine Mount Bracket Bolts

2 - Left Engine Mount Bracket

10. Remove the fasteners and the left engine mount bracket.



1 - Starter

2 - Starter Bolts

11. Remove the starter bolts and the starter.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

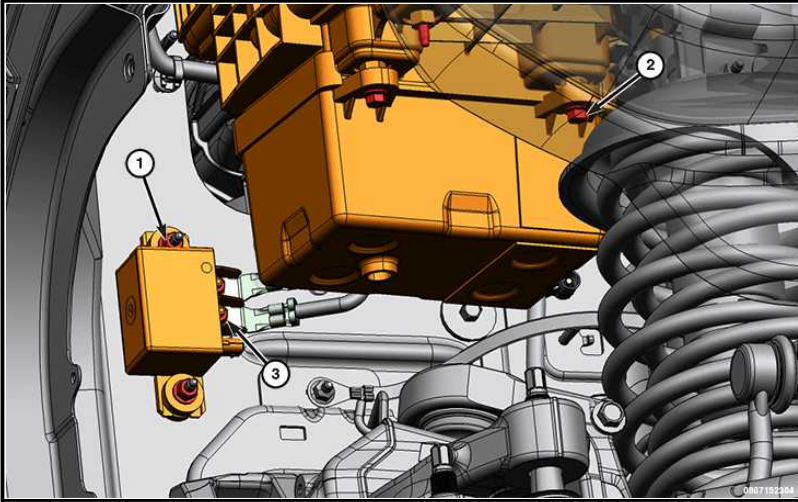
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Connect the negative battery cable(s) after repair is complete. Refer to [CABLES, BATTERY](#) .

TORQUE SPECIFICATIONS

STARTING SYSTEM - 3.0L DIESEL

DESCRIPTION	SPECIFICATION	COMMENT
Starter B+ Cable Nut	11 N.m (8 Ft. Lbs.)	-
Starter to Transmission Bolt Upper	48 N.m (35 Ft. Lbs.)	-
Starter to Transmission Bolt Lower	48 N.m (35 Ft. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATIONS	COMMENT
1	PCR Mounting Bolt	11 N.m (8 Ft. Lbs.)	-
2	Auxiliary Battery Tray To Battery Tray	Refer to Battery Torque Table	-
3	B+ Wire To PCR Positive Terminals	11 N.m (8 Ft. Lbs.)	-
-	Ground To PCR Bracket	9 N.m (80 In. Lbs.)	Right Hand Drive Only
-	PCR To Chassis Ground	11 N.m (8 Ft. Lbs.)	-

2021 ENGINE PERFORMANCE
3.0L Emissions Control - Gladiator [EXJ]

SPECIAL TOOLS



8404C - Kit, EELD And Accessory
(Originally Shipped In Kit Number(s).)

VM.10344 - Tool, Oil Separator
Remover/Installer

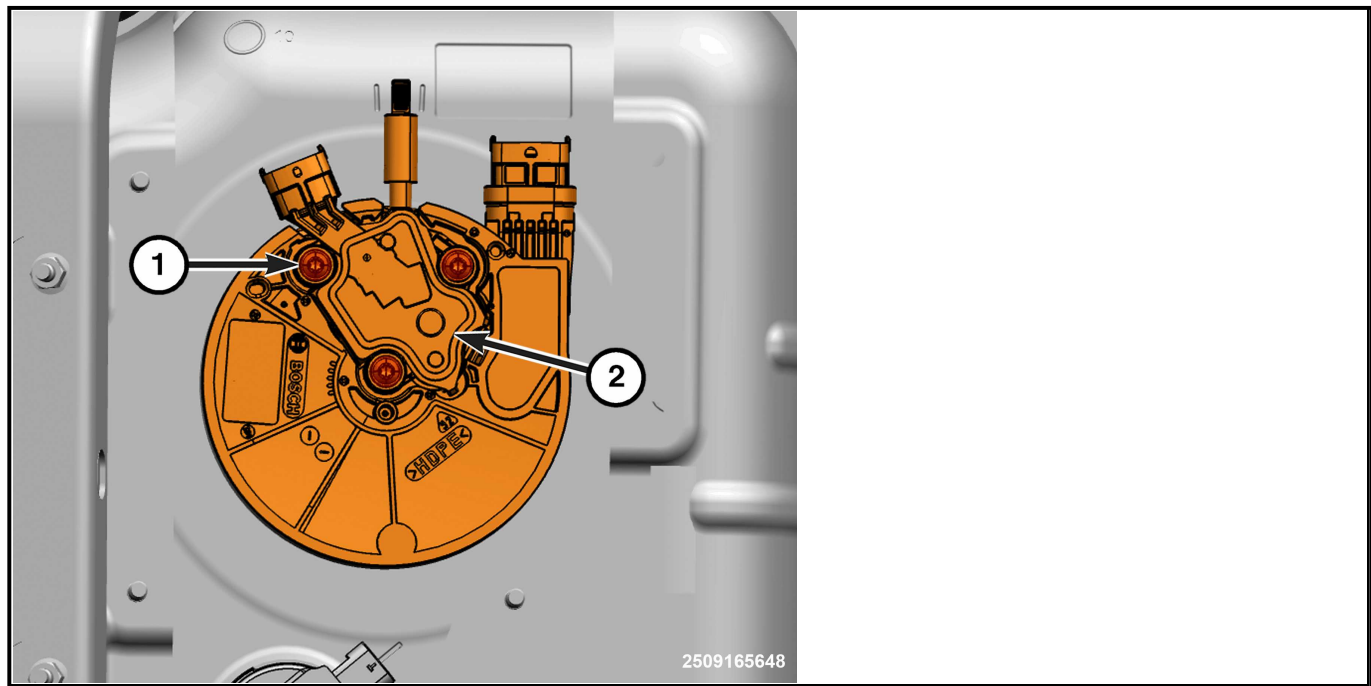
DIESEL EXHAUST FLUID EMISSIONS [EXJ]

DESCRIPTION

DESCRIPTION - DIESEL EXHAUST FLUID EMISSIONS

The Diesel Exhaust Fluid Emissions system uses a Selective Catalytic Reduction (SCR). This is a technology that uses a urea based Diesel Exhaust Fluid (DEF) and a catalytic converter to significantly reduce nitrous oxides (NOx) emissions. The system accomplishes this by injecting small quantities of Diesel Exhaust Fluid (DEF) into the Selective Catalytic Reduction (SCR) where its vaporizes and decomposes to form ammonia and carbon dioxide. The Powertrain Control Module (PCM) is used to control the operation and monitoring of the DEF system. The ammonia is the desired by-product which in conjunction to the SCR Catalyst, converts the NOx to a harmless nitrogen and water. The SCR system is equipped with two NOx Sensors and modules that are used to monitor the efficiency of the SCR Catalyst and DEF system.

DESCRIPTION - DIESEL EXHAUST FLUID PUMP



1 - Diesel Exhaust Fluid Pump Screws
2 - Diesel Exhaust Fluid Pump

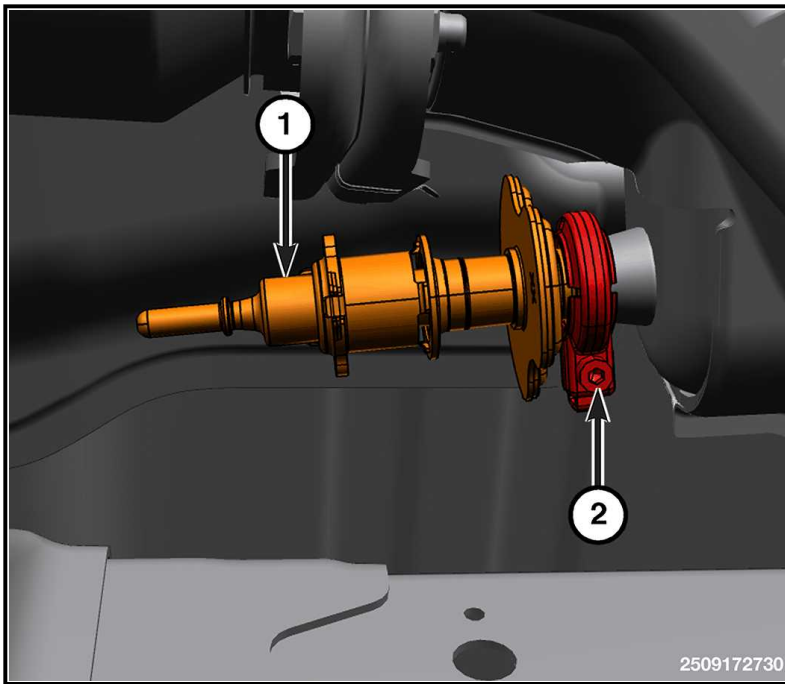
The Diesel Exhaust Fluid (DEF) pump is mounted inside the DEF tank. The DEF supply pump:

- Has an operating pressure of 4.5 - 8.5 bar (65 - 123 psi).
- Capable of reverse flow to partially evacuate system on shut-down.
- Electrically heated.
- Has a level sensor.
- Has a temperature sensor.
- Serviced as a unit.

OPERATION

The Diesel Exhaust Fluid (DEF) Supply Pump has many functions. It's primary purpose is to draw fluid from the tank and build adequate system pressure for dosing into the exhaust. The Powertrain Control Module (PCM) provides the 12 Volt supply and ground to the pump. The PCM provides a Pulse Width Modulated (PWM) signal to the DEF Supply Pump to control the speed and output of the pump. The DEF Supply Module has an internal temperature sensor which reports the internal temperature of the DEF Supply Module to the PCM.

DESCRIPTION - DIESEL EXHAUST FLUID INJECTOR



1 - Diesel Exhaust Fluid Injector

2 - Diesel Exhaust Fluid Injector Clamp Bolt

- The Diesel Exhaust Fluid (DEF) injector is similar to a fuel injector, but modified to be compatible with the urea fluid. The DEF injector is mounted to the front of the Selective Catalytic Reduction (SCR) catalyst and is designed to operate in a underbody environment.

NOTE: Any time the DEF injector is removed, the gasket must be replaced.

DESCRIPTION - DIESEL EXHAUST FLUID SUPPLY LINE

The Diesel Exhaust Fluid (DEF) supply line supplies fluid from the tank to the pump and has connectors similar to fuel lines. The line also incorporates a heater to keep the DEF fluid from freezing.

OPERATION

The Diesel Exhaust Fluid (DEF) system hose has a built in heater to warm the fluid in the line. The line heater has power supplied to it via the Powertrain Control Module (PCM). The line heater circuits are monitored on the return side of the circuit.

DESCRIPTION - DIESEL EXHAUST FLUID TANK LEVEL SENSOR

- The Diesel Exhaust Fluid (DEF) Tank Level Sensor and Temperature Sensor used to measure the fluid level of the tank and the temperature of the fluid in the DEF tank. None of these components are serviceable and if tank level sensor or temperature sensor fail, a **NEW** DEF tank needs to be installed.

OPERATION

The Diesel Exhaust Fluid (DEF) tank level sensor and Diesel Exhaust Fluid (DEF) tank temperature sensor are a combined sensor used to measure the level and temperature of the fluid in the DEF tank. Though combined, the level sensor and the temperature sensor operate independent of each other. Both sensors operate as a three wire 12-Volt sensor.

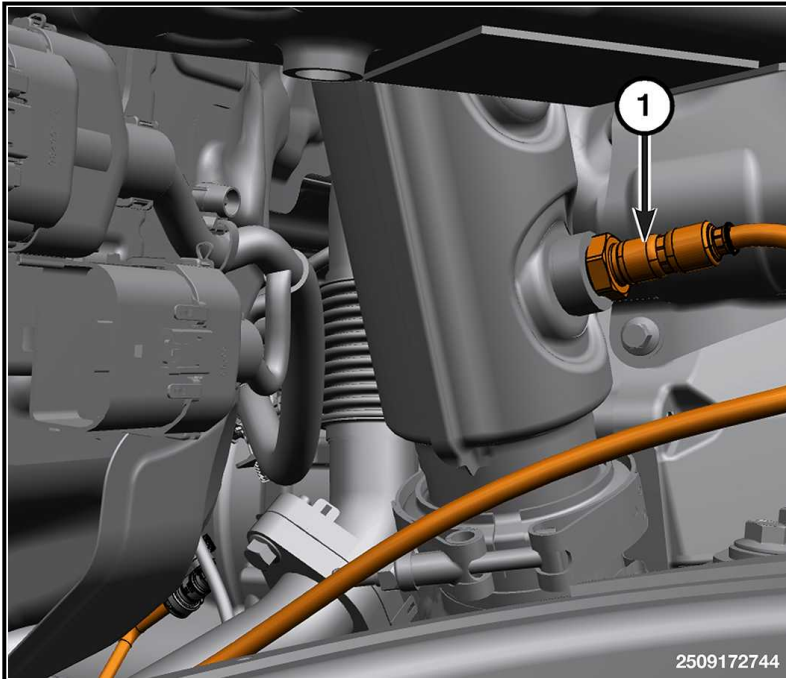
A DEF level sensor integrated into the supply pump module sends the Powertrain Control Module (PCM) a Pulse Width Modulated (PWM) signal to indicate the fluid level and temperature in the tank. The level sensor has no moving parts and uses ultrasonic waves to measure the fluid level within the tank. The sensor has a measurement range of 15 to 400 mm above the sensor surface.

The DEF tank temperature sensor provides the PCM with a PWM signal indicating the temperature of the DEF in the tank. This sensor is used to determine when activation of the integral tank heater is required to thaw the DEF within the tank. The temperature sensor has a measurement range of -40C (-40F) to 80C (176F). The PWM signal is linear within that range; therefore, a 100% signal is equal to 80C (176F) and a 0% signal is equal to -40C (-40F).

DESCRIPTION - DIESEL EXHAUST FLUID QUALITY SENSOR

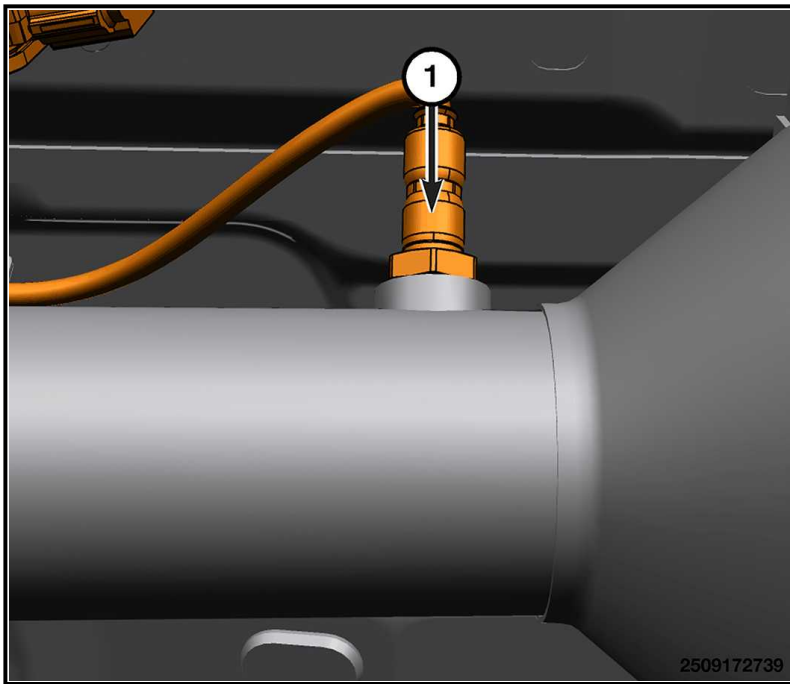
The Diesel Exhaust Fluid (DEF) quality sensor is used to measure the quality of the DEF fluid. The sensor is based on ultrasonic technology that sends a very fast sound pulse through the fluid. The pulse reflects off the surface of the fluid and comes back to the sensor. Based on the time of flight and the strength of the pulse when it returns the sensor determines the concentration of DEF essentially based on density. The DEF quality sensor is a part of the DEF tank and is **NOT** a serviceable component. If diagnosis leads to replacing the DEF quality sensor, then the entire DEF tank will need to be replaced as an assembly.

DESCRIPTION - NOX SENSOR



1 - NOx Sensor 1/1

- The NOx sensor 1/1 is mounted at the elbow of the Diesel Oxidation Catalyst/Diesel Particulate Filter and measures incoming NOx gases.



1 - NOx Sensor 1/2

- The Post-NOx sensor 1/2 is mounted at the rear outlet of the Selective Catalytic Reduction (SCR) Catalyst and measures outgoing NOx gases.

OPERATION

- There are two NOx modules and sensors used in the DEF fluid system, upstream and downstream. Both operate similarly to a wide band O2 sensor. The sensors are zirconium-based, multi-layer sensors with oxygen pumps. The NOx modules communicate the amount of NOx to the Powertrain Control Module (PCM) over the J1939 communication bus. The upstream module is located on the right frame rail and the sensor is at the front of the Diesel Particulate Filter (DPF). The upstream module and sensor are used by the PCM to monitor NOx entering the catalyst. By comparing the inlet sensor to the outlet sensor, SCR efficiency can be determined by the PCM.

DESCRIPTION - DIESEL EXHAUST FLUID TANK

The Diesel Exhaust Fluid (DEF) tank is mounted to the frame rail in front of the fuel tank. The DEF tank is equipped with:

- Electric Heater
- Level Sensor
- Temperature Sensor
- Vent Valve
- DEF Fluid Quality Sensor
- Fluid Limit Vent Valve
- Supply and Return Pump
- Integrated Inlet Filter

QUICK-CONNECT FITTINGS

Norma and Voss are the two different types of quick-connect fittings used to attach the various Diesel Exhaust Fluid (DEF) system components and lines. Norma is a two-button type and Voss is a two-tab type connector fitting.

CAUTION: Before separating a Quick-Connect fitting, pay attention to what type of fitting is being used. This will prevent unnecessary fitting or fitting latch breakage.

STANDARD PROCEDURE

DRAINING-DIESEL EXHAUST FLUID TANK

1. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
2. Disconnect the Diesel Exhaust Fluid (DEF) fill tube from the tank.
3. Using a commercially available hand vacuum pump, drain the DEF tank into a proper storage tank.

STANDARD PROCEDURE - QUICK-CONNECT FITTINGS

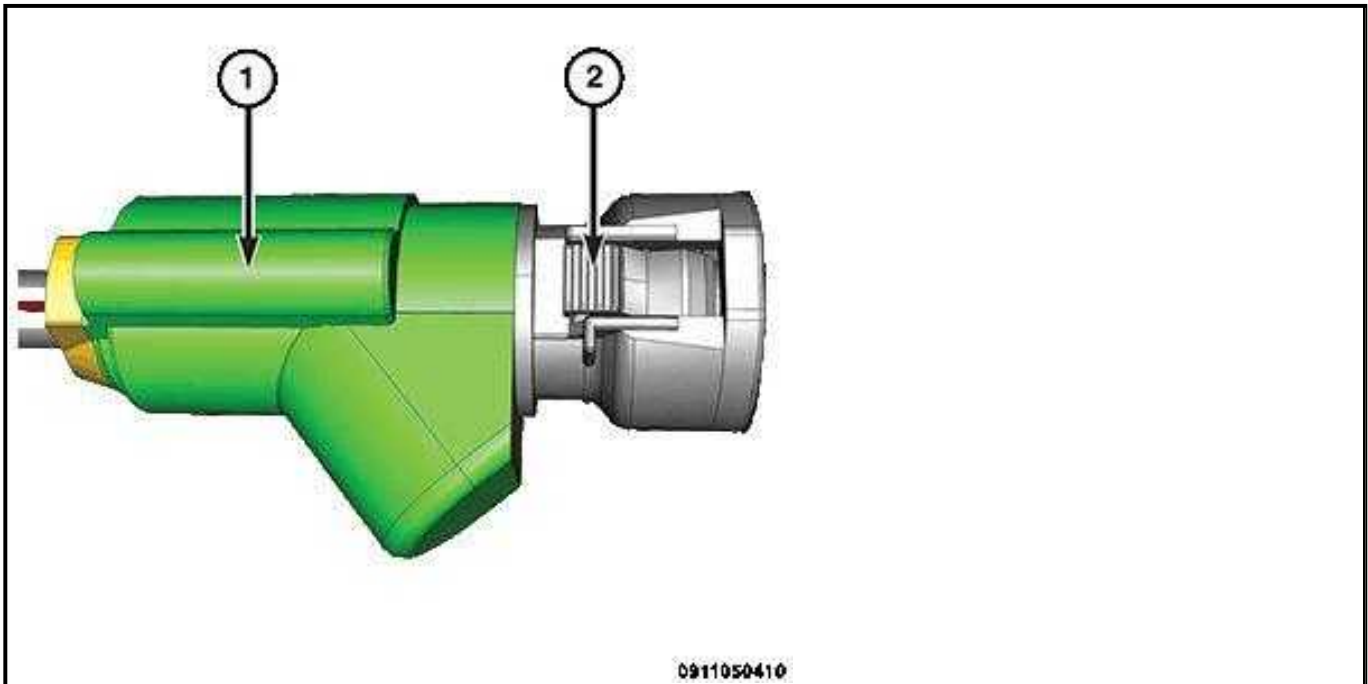
Two different types of quick-connect fittings are used to attach the various Diesel Exhaust Fluid (DEF) system components and lines.

NOTE: Care must be used when separating fittings. Over-flexing may cause the tube to become deformed or damaged.

These are the quick-connect fittings:

- Norma Connector Fitting
- Voss Connector Fitting

NORMA CONNECTOR FITTING



1 - Quick-Connect Fitting

2 - Release Tabs

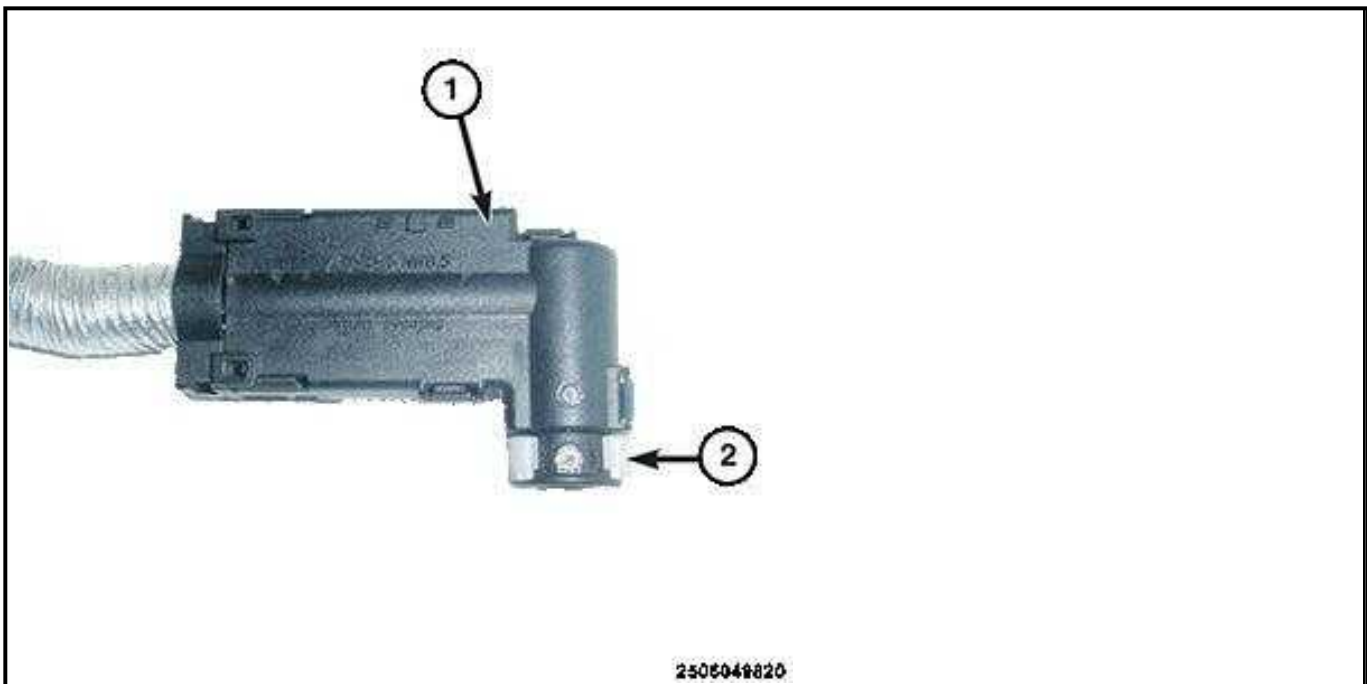
This type of quick-connect fitting is equipped with release tabs located on both sides of the fitting. The plastic release tabs will remain on the component being serviced after the quick-connect fitting is removed. The O-ring and spacer will remain in the quick-connect fitting. Special tools are not required for removal.

1. Clean the area around the holding clip of dirt and debris.
2. Squeeze the plastic release tabs to disengage the quick connector fitting.

NOTE: Do not rotate the quick connector during the disassembly process.

3. Remove the quick-connect fitting from the Diesel Exhaust Fluid (DEF) system component.

VOSS CONNECTOR FITTING



1 - 90 Degree Type Quick-Connect Fitting
2 - Release Tabs

This 90 degree type quick-connect fitting is equipped with release tabs located on both sides of the fitting. The plastic release tabs will remain on the component being serviced after the quick-connect fitting is removed. The O-ring and spacer will remain in the quick-connect fitting. Special tools are not required for removal.



1 - Release Tabs
2 - Quick-Connect Fitting

This type quick-connect fitting is equipped with release tabs located on both sides of the fitting. The plastic release tabs will remain on the component being serviced after the quick-connect fitting is removed. The O-ring and spacer will remain in the quick-connect fitting. Special tools are not required for removal.

1. Clean the area around the holding clip of dirt and debris.
2. Squeeze the plastic tabs together to disengage quick-connect fitting.

NOTE: Do not rotate the quick connector during the disassembly process.

3. Remove the quick-connect fitting from the Diesel Exhaust Fluid (DEF) system component.

CONNECTING

1. Inspect the quick-connect fitting body and Diesel Exhaust Fluid (DEF) system components for damage. Replace as necessary.
2. Prior to connecting any quick-connect fitting to components, check condition of fitting and components. Clean parts with a lint-free cloth. Lubricate with clean engine oil.
3. Insert the quick-connect fitting onto the DEF system component until the built-in stop on the line or component rests against the back of fitting.
4. Continue pushing until a click is felt.
5. Verify a locked condition by firmly pulling on the quick-connect fitting connection of the fuel system component.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - DIESEL EXHAUST FLUID

WARNING: Diesel Exhaust Fluid (DEF) contains urea. Do not get the substance in your eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Do not swallow. In the event the DEF is ingested, contact a physician immediately. Reference the Materials Safety Data Sheet (MSDS) for additional information.

1. Remove the DEF fill pipe from the tank.
2. Visually inspect the fluid for sign of contamination or debris.
3. Collect a sample of diesel exhaust fluid from the system.
4. Test the quality of the DEF using the DEF/UREA Refractometer 16-5025 available through Pentastar Service Equipment (PSE).

Temperature (Constant) B°C	Temperature (Constant) B°F	Estimated Product Life
0B°	32B°	Indefinite
10B°	50B°	75 years
20B°	68B°	11 years
30B°	86B°	23 months
35B°	95B°	10 months
40B°	104B°	4 months
50B°	122B°	1 months
60B°	140B°	1 week

- a. The DEF should register approximately 32.5 percent using a refractometer.
5. If the DEF is not within specifications then the tank needs to be drained and cleaned and refilled with a minimum of 2.5 gallons good DEF.

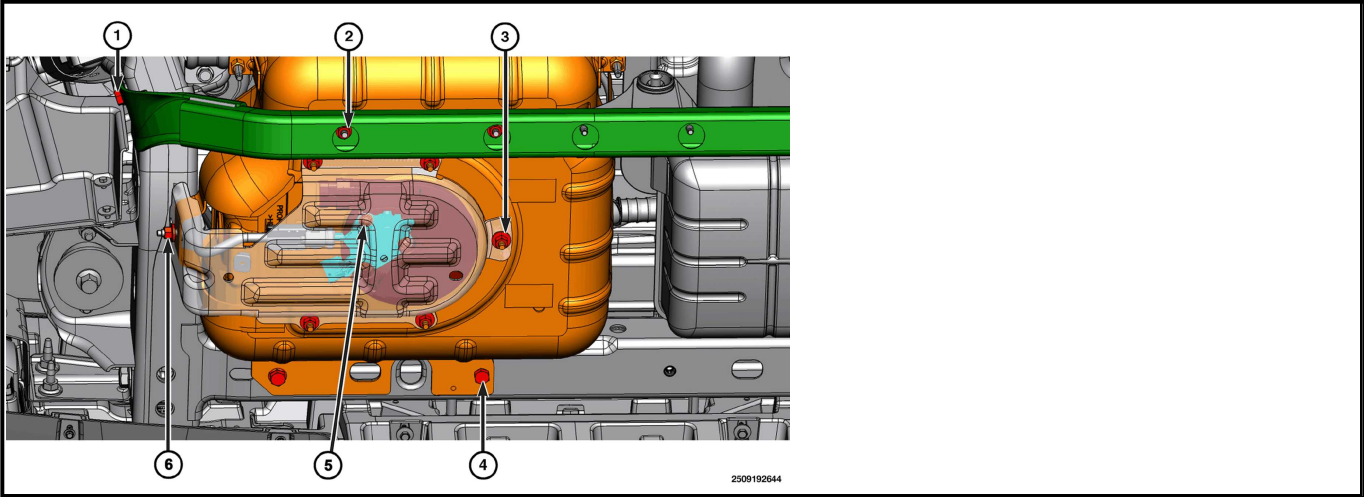
NOTE: The use of latex gloves is mandatory to prevent false readings with the oil/hydrocarbon detection paper.

6. To test for hydrocarbons in the DEF tank use hygroscopic test paper (PSE part number. 223-44-863). The test strip must come in contact with the DEF fluid in the tank in order to get a valid reading for hydrocarbons present in tank.
7. Remove the oil/hydrocarbon detection paper from packing, inspect for color consistency. If color is not consistent replace strip.

8. Disconnect the DEF fill pipe from tank and try to get a sample or remove the DEF tank. Refer to [**TANK, DIESEL EXHAUST FLUID, REMOVAL AND INSTALLATION.**](#)
9. Place the detection paper directly into the DEF fluid in the tank. If the light blue paper turns dark blue, oil or hydrocarbon contamination exist.

TECHNICAL SPECIFICATIONS

DEF SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	DEF Tank Rear Crossmember To Frame Bolts	60 N.m (37 Ft. Lbs.)	-
2	DEF Tank Shield to Transmission Crossmember	25 N.m (18 Ft. Lbs.)	-
3	DEF Tank Shield Nuts	17 N.m (13 Ft. Lbs.)	-
4	DEF Tank Shield to Frame Bolt - M10	60 N.m (44 Ft. Lbs.)	-
B	DEF Pump Screws	Torque Procedure: - Using the tightening sequence shown, tighten the screws to 6 N.m (53 in. lbs.) - Let bolts set for two minutes. - Using the tightening sequence shown, tighten the screws to 6 N.m (53 in. lbs.).	B

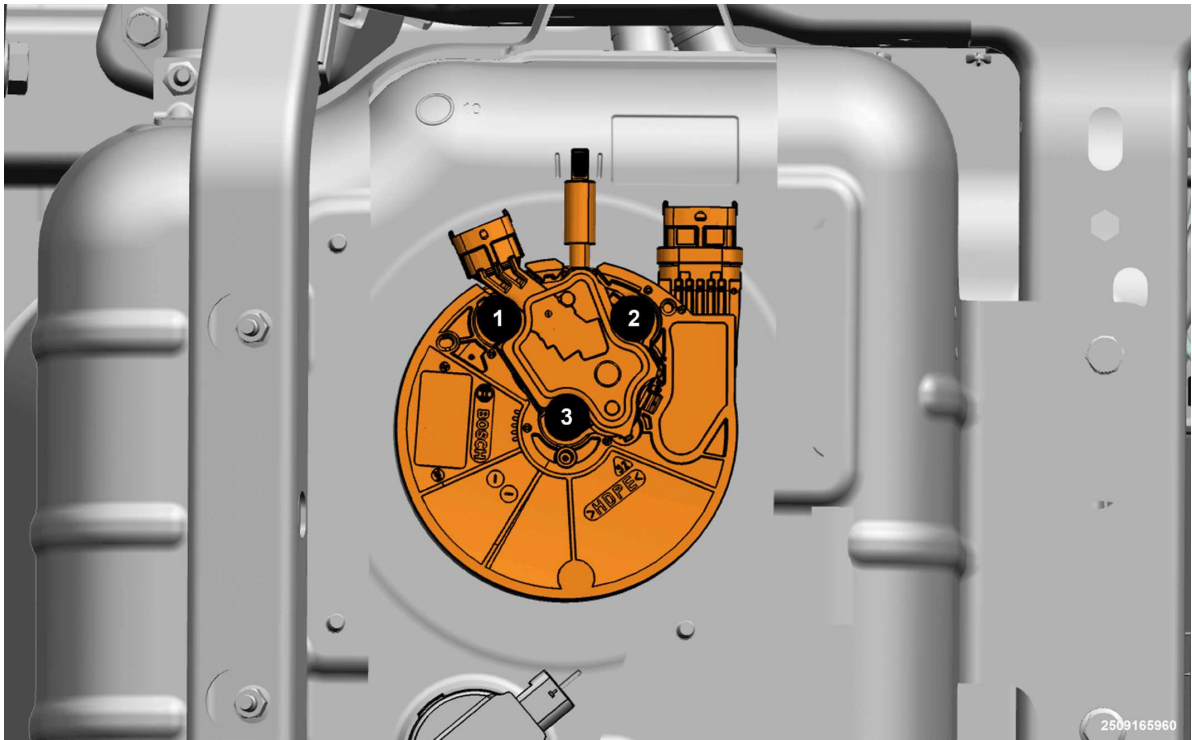
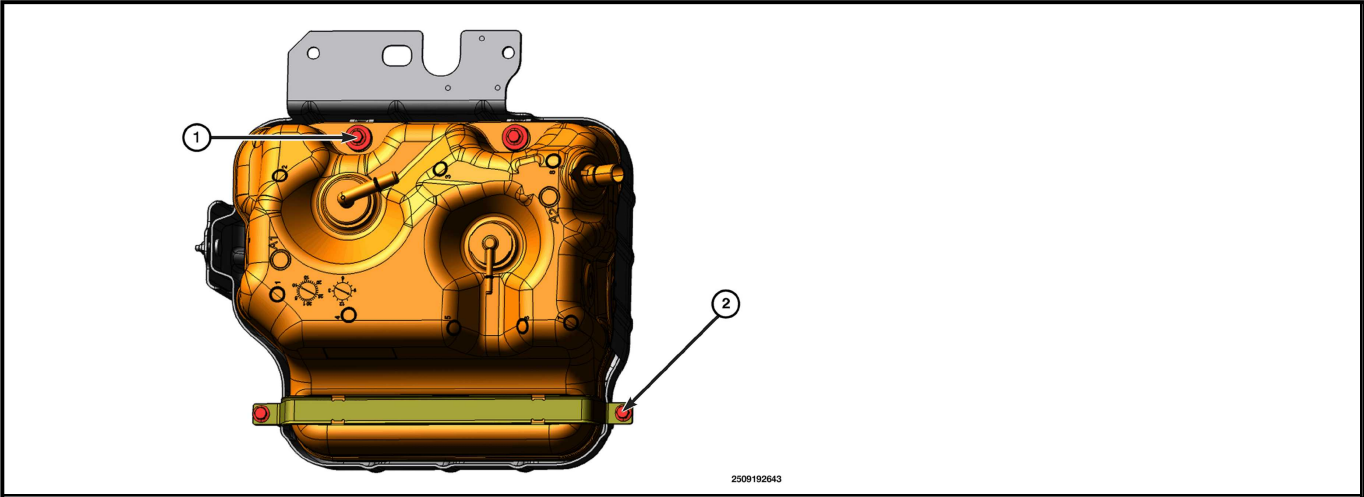
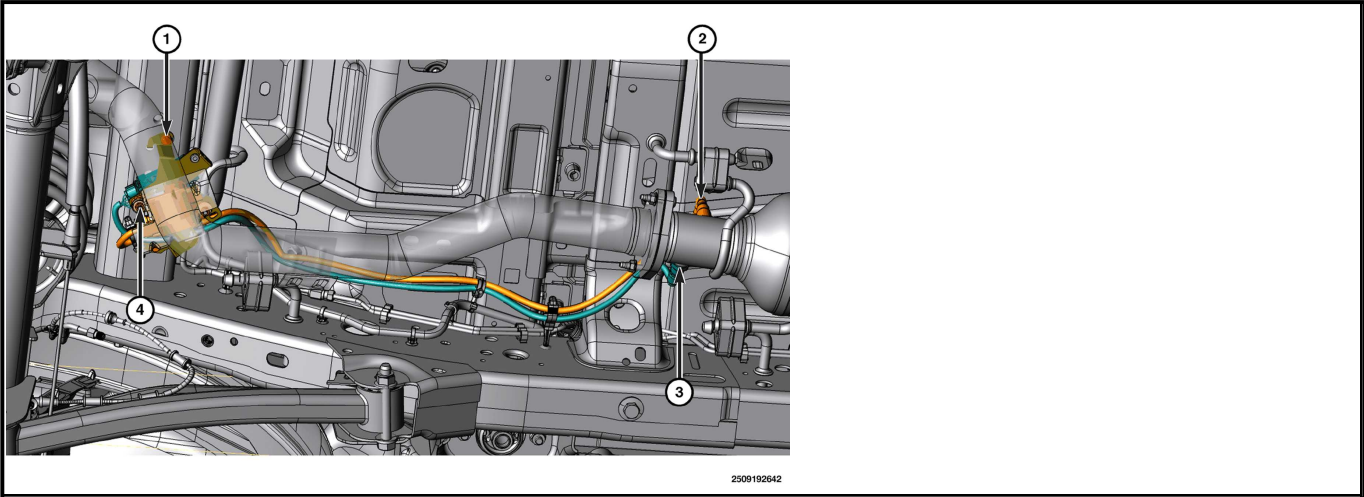


Fig. 1: DEF Pump Tightening Sequence
 Courtesy of CHRYSLER GROUP, LLC



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	DEF Tank Mounting Bolts	62 N.m (24 Ft. Lbs.)	-
2	DEF Tank Strap Bolts	54 N.m (40 Ft. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	NOx Sensor Module/Particulate Matter Sensor Module Bracket Bolts	9 N.m (80 In. Lbs.)	-
2	NOx Sensor	55 N.m (41 Ft. Lbs.)	-
3	NOx Sensor	55 N.m (41 Ft. Lbs.)	-
4	NOx Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
-	DEF Injector Clamp	11 N.m (8 Ft. Lbs.)	-

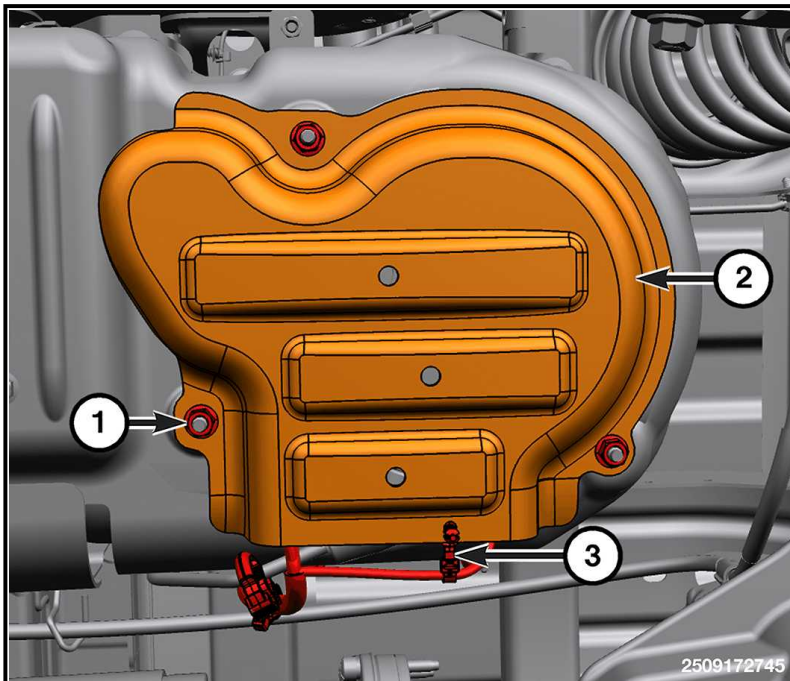
ASSEMBLY, DIESEL EXHAUST FLUID PUMP

REMOVAL AND INSTALLATION

DIESEL EXHAUST FLUID PUMP

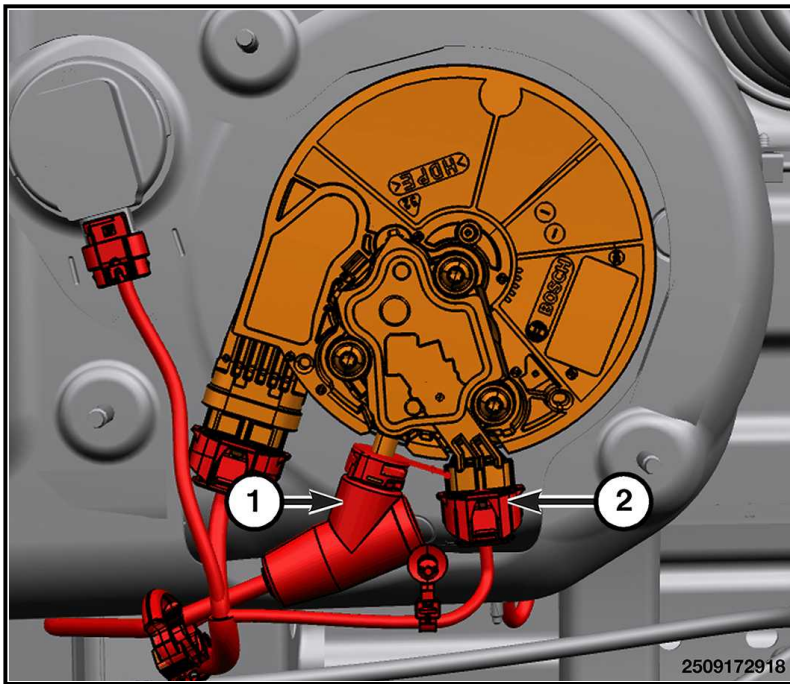
REMOVAL

1. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#).
2. Drain the Diesel Exhaust Fluid (DEF) tank. Refer to [DIESEL EXHAUST FLUID EMISSIONS \[EXJ\], STANDARD PROCEDURE](#).



1 - DEF Tank Shield Nuts
2 - DEF Tank Shield
3 - DEF Supply Line Retaining Clip

3. Detach the Diesel Exhaust Fluid (DEF) supply line retaining clip.
4. Remove the DEF tank shield nuts and the DEF tank shield.

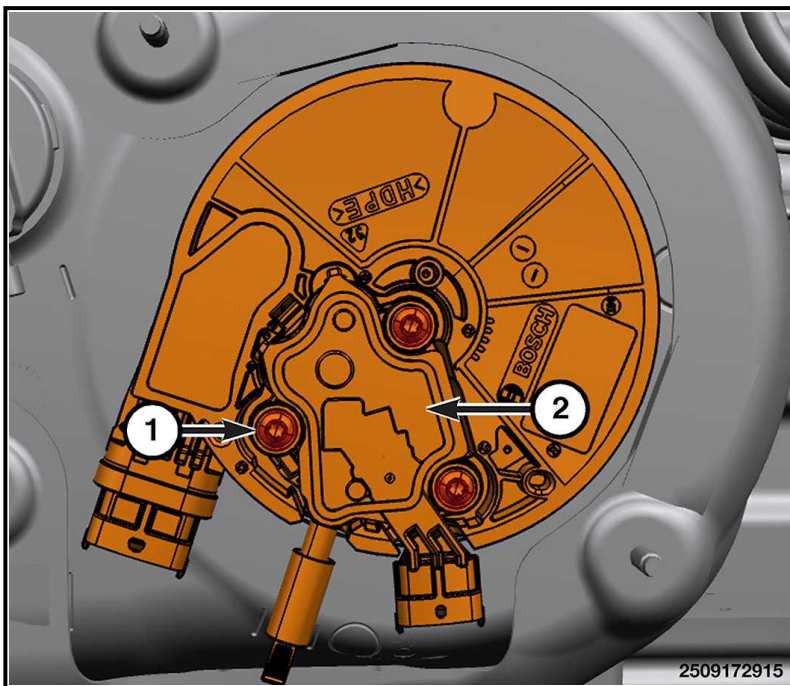


1 - DEF Pump Supply Line

2 - DEF Pump Harness Connector

5. Disconnect the DEF pump wire harness connector.

6. Disconnect the DEF pump supply line Norma connector. Refer to [DIESEL EXHAUST FLUID EMISSIONS \[EXJ\], STANDARD PROCEDURE.](#)



1 - DEF Pump Screws

2 - DEF Pump

7. Remove the DEF pump screws.



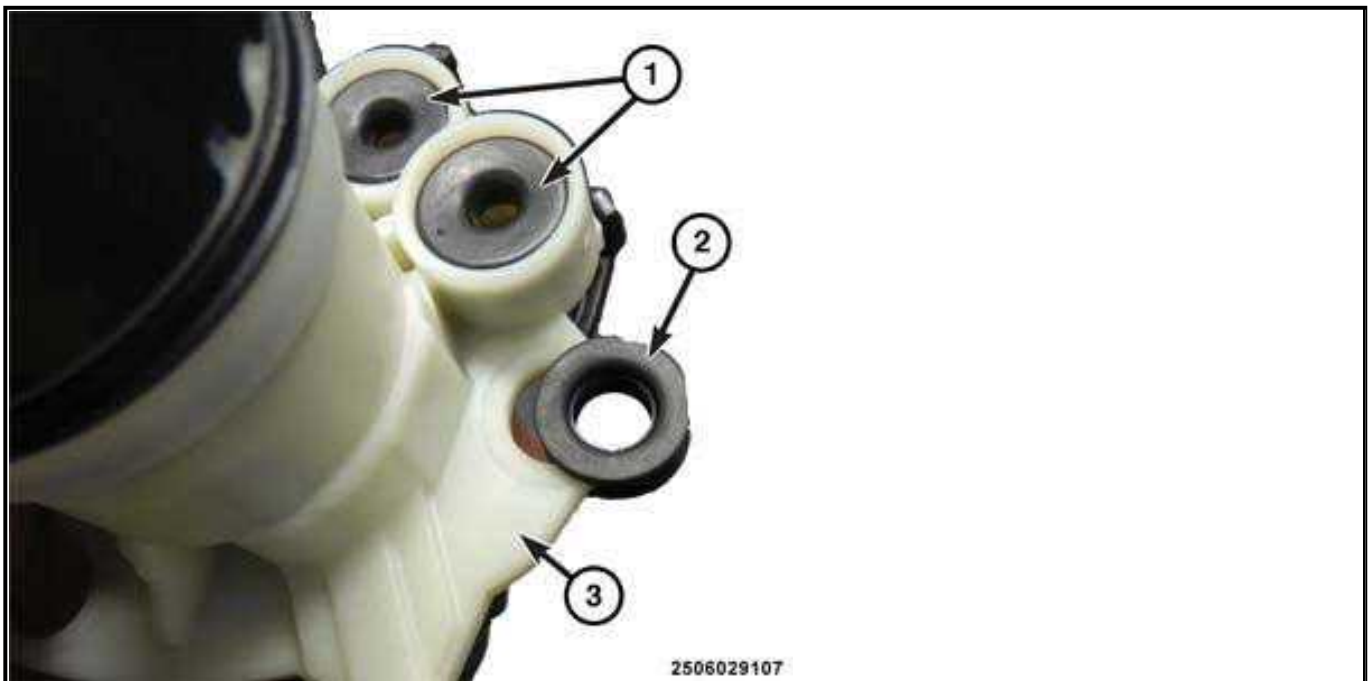
1 - DEF Pump Tab

8. Using a small screw driver, pry up on tab and remove the DEF pump.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

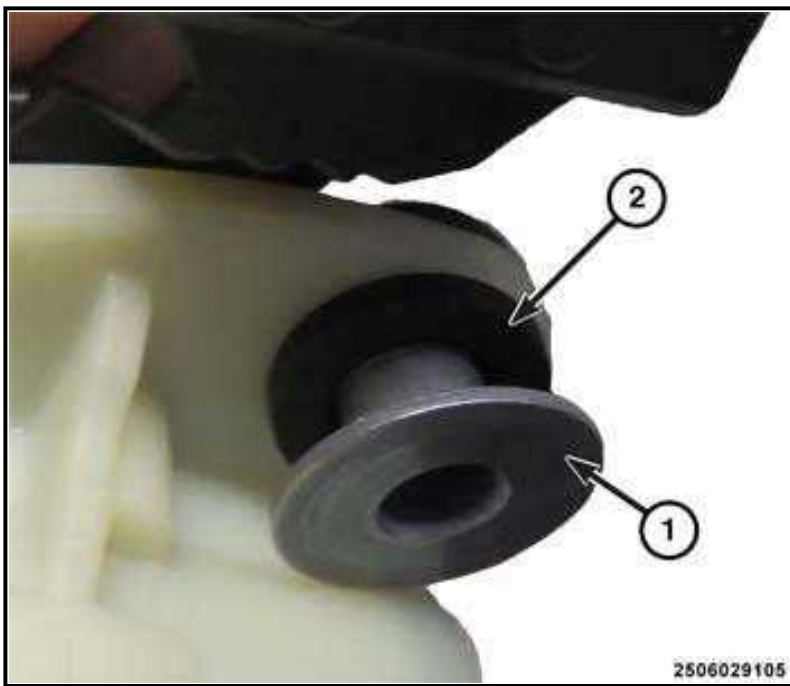


1 - DEF Pump Seals

2 - DEF Pump Damper

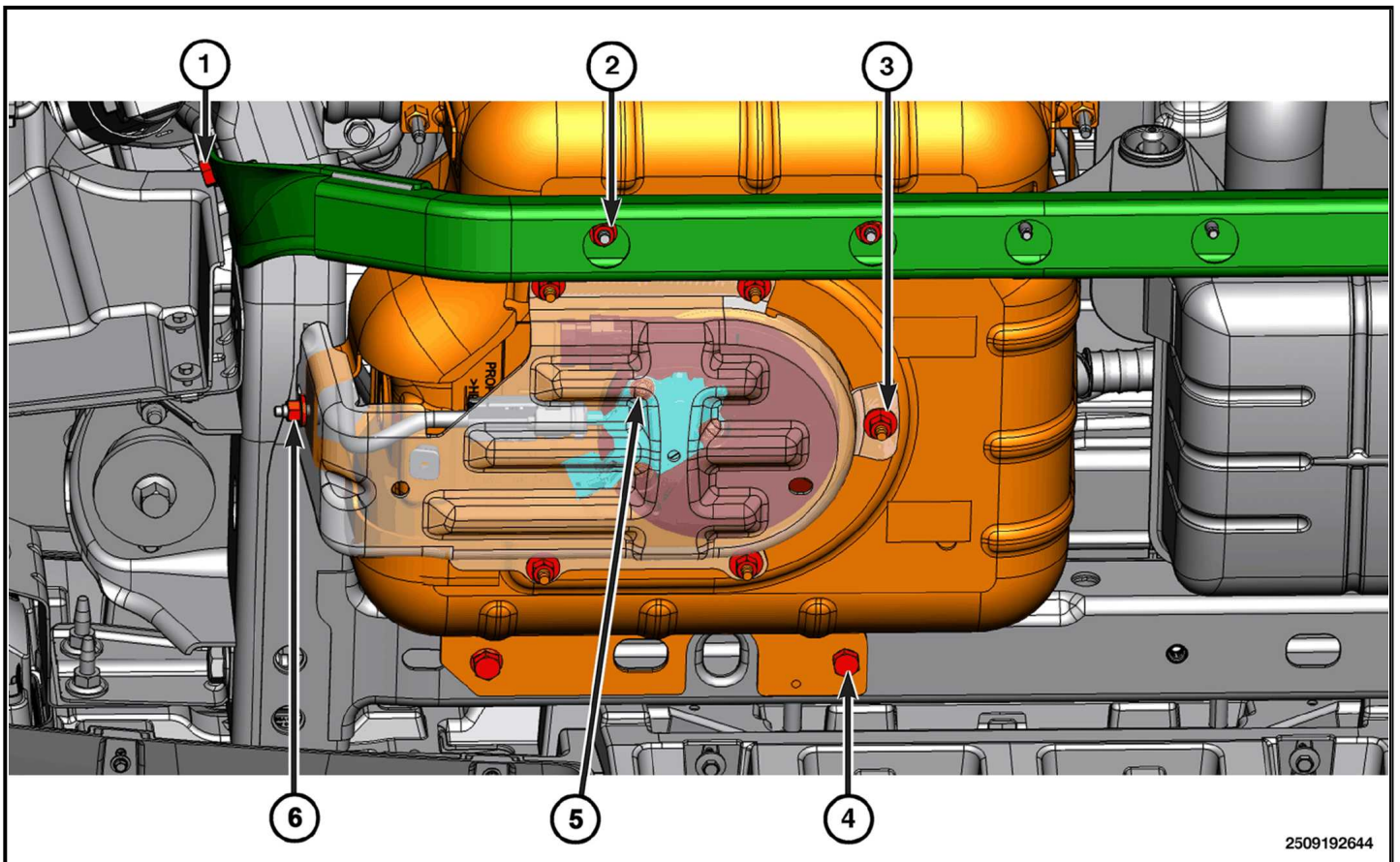
3 - DEF Pump

- Install the two DEF pump seals.
- If necessary, install the three DEF pump damper.

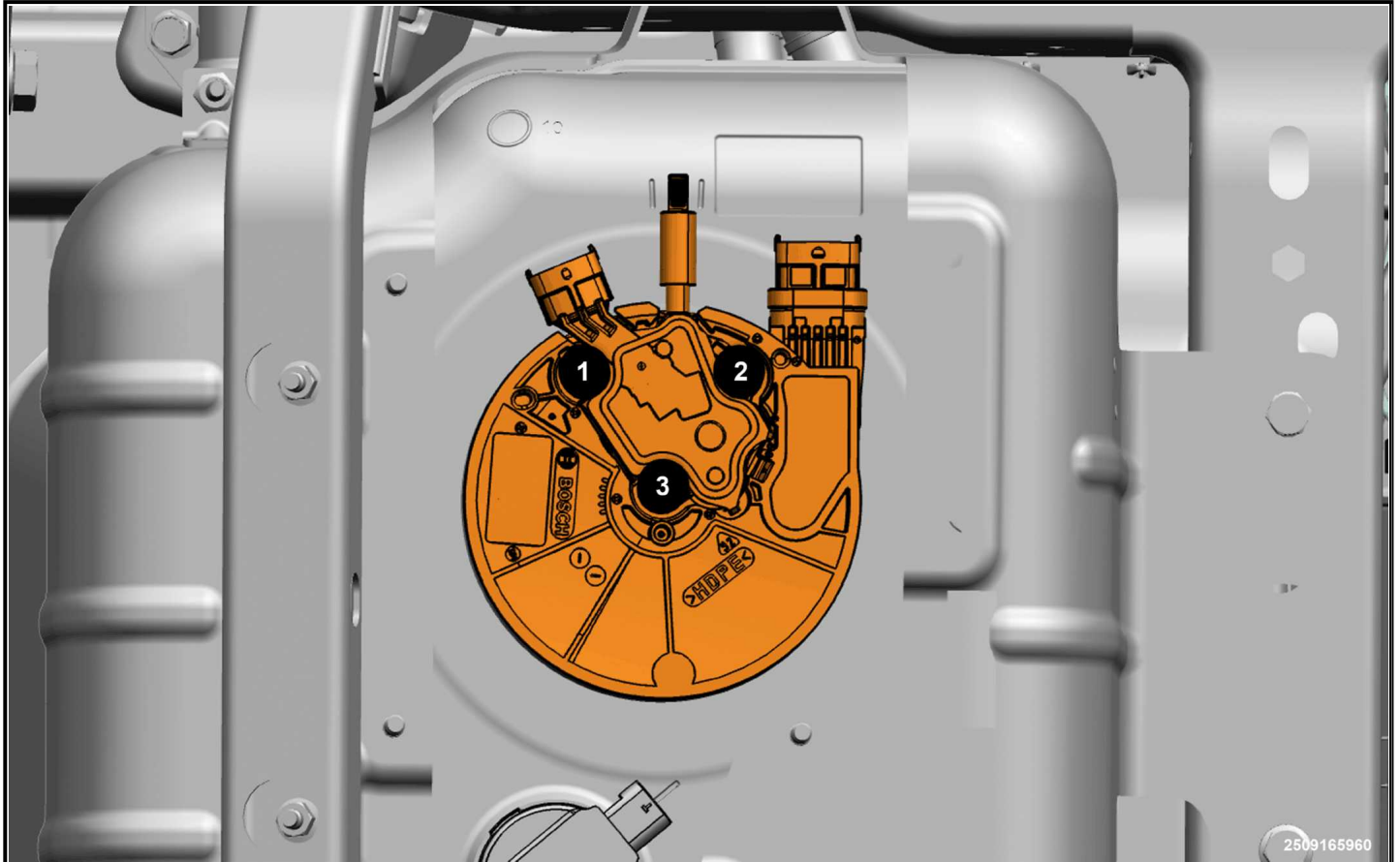


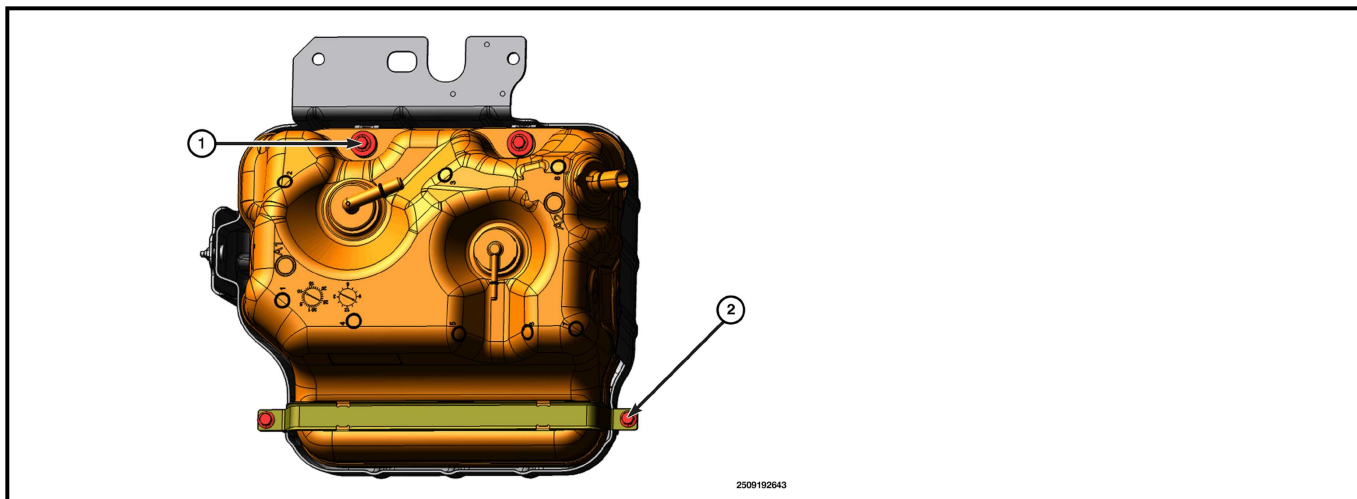
- If necessary, install the three sleeves into damper.
- Clean the O-ring sealing surfaces on DEF tank.
- Install the DEF pump into tank and tighten screws using the tightening sequence shown in the torque table to proper torque specifications.
- Fill the DEF tank with clean DEF fluid.
- Using a scan tool, perform **DEF Pump Replacement** function found under MISCELLANEOUS FUNCTIONS.
- Using a scan tool, perform **DEF Tank Fluid Level Reset** function found under MISCELLANEOUS FUNCTIONS.

DEF SYSTEM

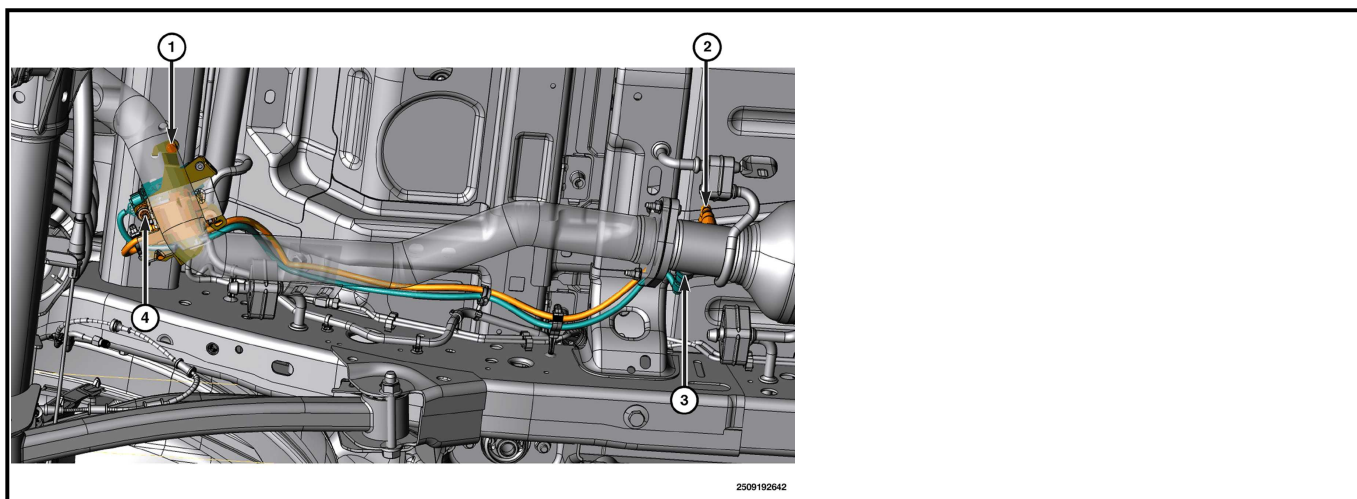


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	DEF Tank Rear Crossmember To Frame Bolts	60 N.m (37 Ft. Lbs.)	-
2	DEF Tank Shield to Transmission Crossmember	25 N.m (18 Ft. Lbs.)	-
3	DEF Tank Shield Nuts	17 N.m (13 Ft. Lbs.)	-
4	DEF Tank Shield to Frame Bolt - M10	60 N.m (44 Ft. Lbs.)	-
B	DEF Pump Screws	Torque Procedure: - Using the tightening sequence shown, tighten the screws to 6 N.m (53 in. lbs.) - Let bolts set for two minutes. - Using the tightening sequence shown, tighten the screws to 6 N.m (53 in. lbs.).	B





CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	DEF Tank Mounting Bolts	62 N.m (24 Ft. Lbs.)	-
2	DEF Tank Strap Bolts	54 N.m (40 Ft. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	NOx Sensor Module/Particulate Matter Sensor Module Bracket Bolts	9 N.m (80 In. Lbs.)	-
2	NOx Sensor	55 N.m (41 Ft. Lbs.)	-
3	NOx Sensor	55 N.m (41 Ft. Lbs.)	-
4	NOx Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
-	DEF Injector Clamp	11 N.m (8 Ft. Lbs.)	-

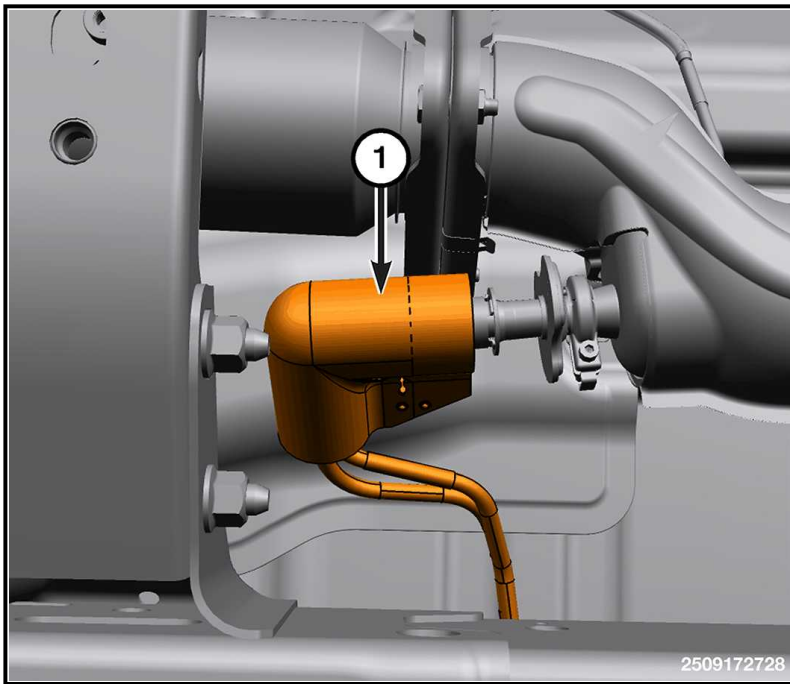
INJECTOR, DIESEL EXHAUST FLUID

REMOVAL AND INSTALLATION

DIESEL EXHAUST FLUID INJECTOR

REMOVAL

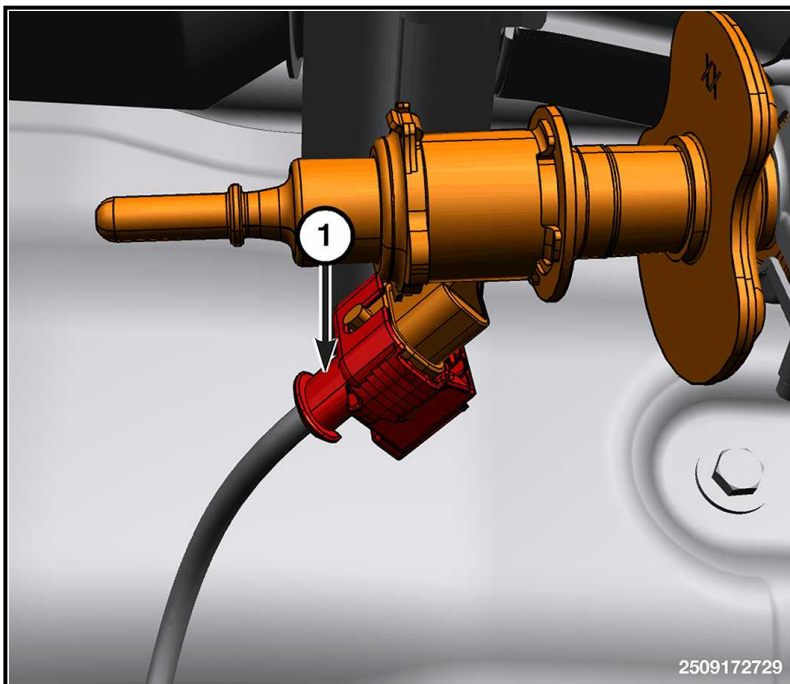
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .



1 - Diesel Exhaust Fluid Injector Wire Harness Connector

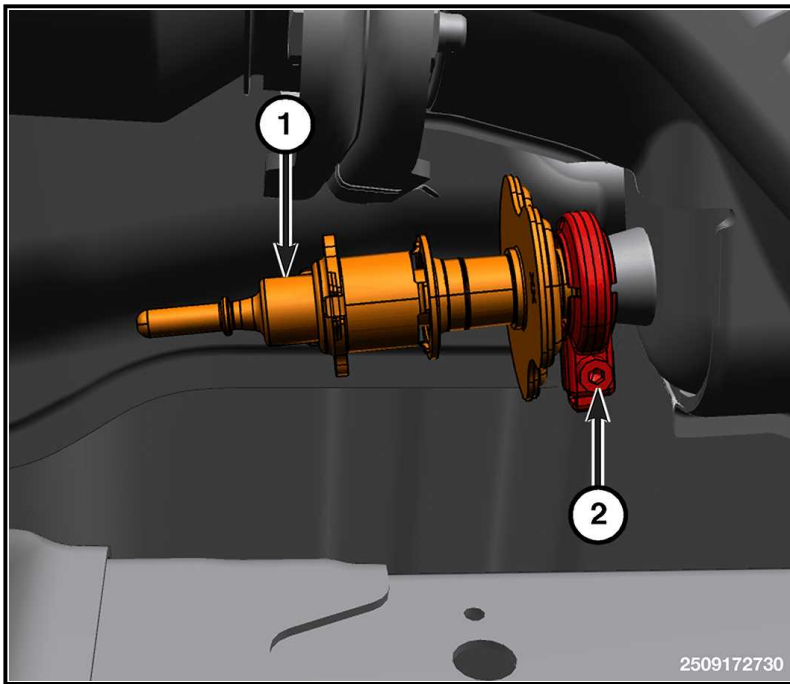
2 - DEF Fluid Supply Line Norma Connector

3. Disconnect the Diesel Exhaust Fluid (DEF) fluid supply line Norma connector. Refer to [**DIESEL EXHAUST FLUID EMISSIONS \[EXJ\], STANDARD PROCEDURE.**](#)



1 - Diesel Exhaust Fluid Injector Wire Harness Connector

4. Disconnect the DEF injector wire harness connector.



1 - Diesel Exhaust Fluid Injector
2 - Diesel Exhaust Fluid Injector Clamp Bolt

5. Saturate the DEF injector bolt with MoperB® Rust Inhibitor. Allow 5 minutes for penetration.
6. Loosen the DEF injector clamp and remove the DEF injector from the Selective Catalytic Reduction (SCR) catalyst.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

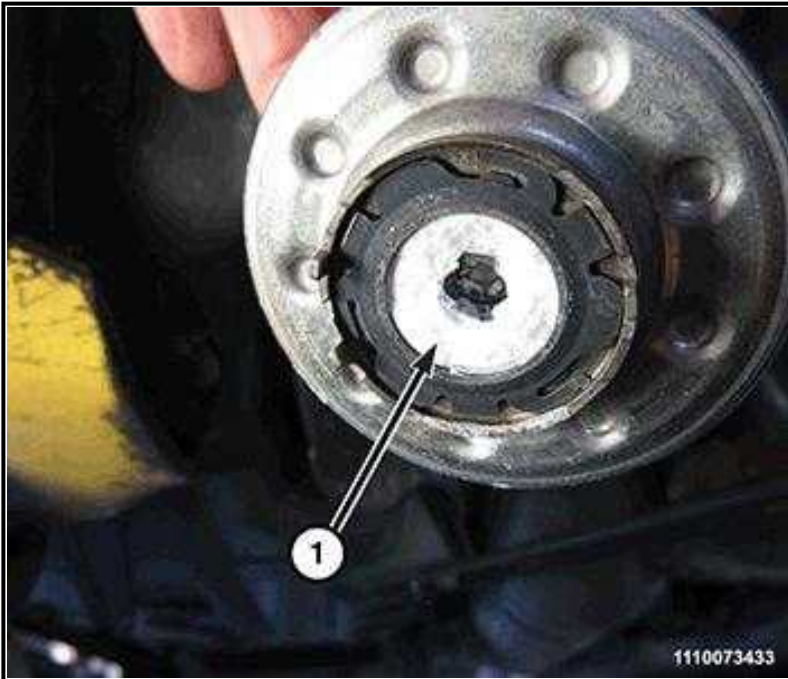
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.



1 - Diesel Exhaust Fluid Crystals

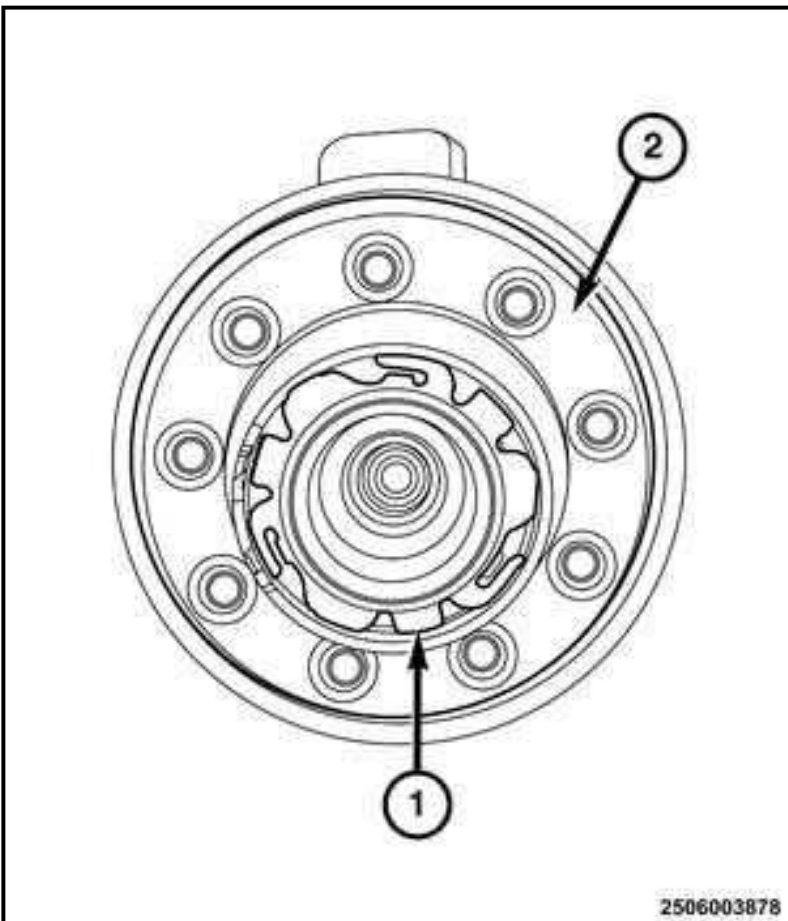
NOTE: Typical view.

- Inspect the opening of the Selective Catalytic Reduction (SCR) mixer tube and make sure the opening is **NOT** plugged or restricted with the build up of Diesel Exhaust Fluid (DEF) crystals. If the mixer tube opening is plugged or restricted clean as necessary.



1 - Diesel Exhaust Fluid Crystals

- Inspect the opening of the DEF dosing injector and make sure there is **NOT** plugged or restricted with the build up of DEF crystals. If the DEF dosing injector opening is plugged or restricted clean as necessary.
- Clean the gasket sealing area.

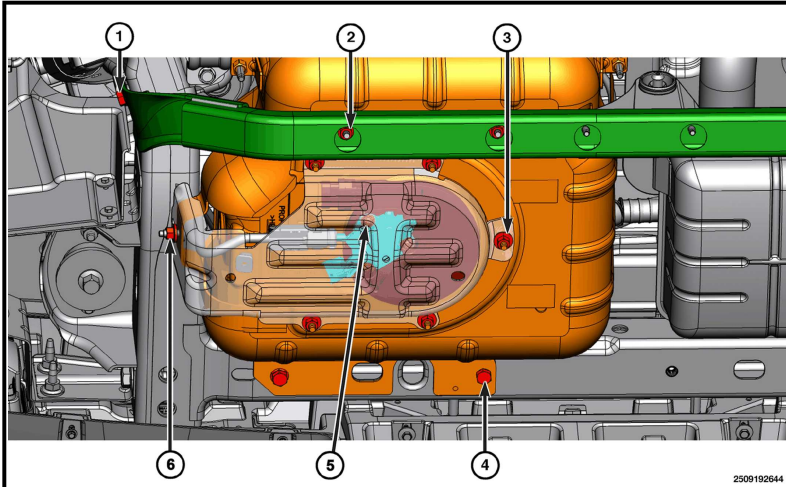


1 - Gasket

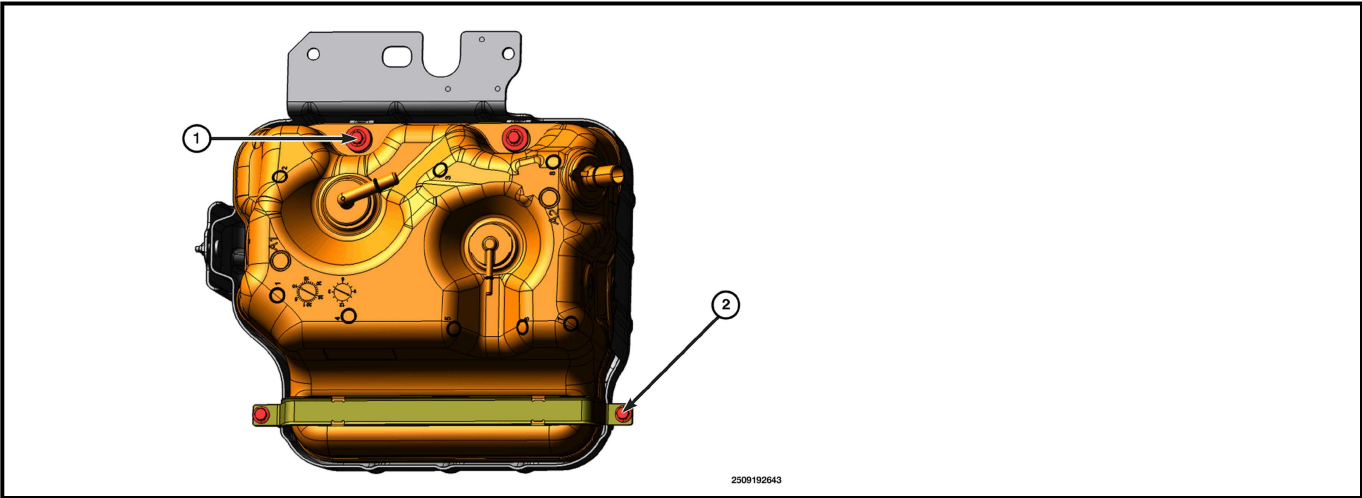
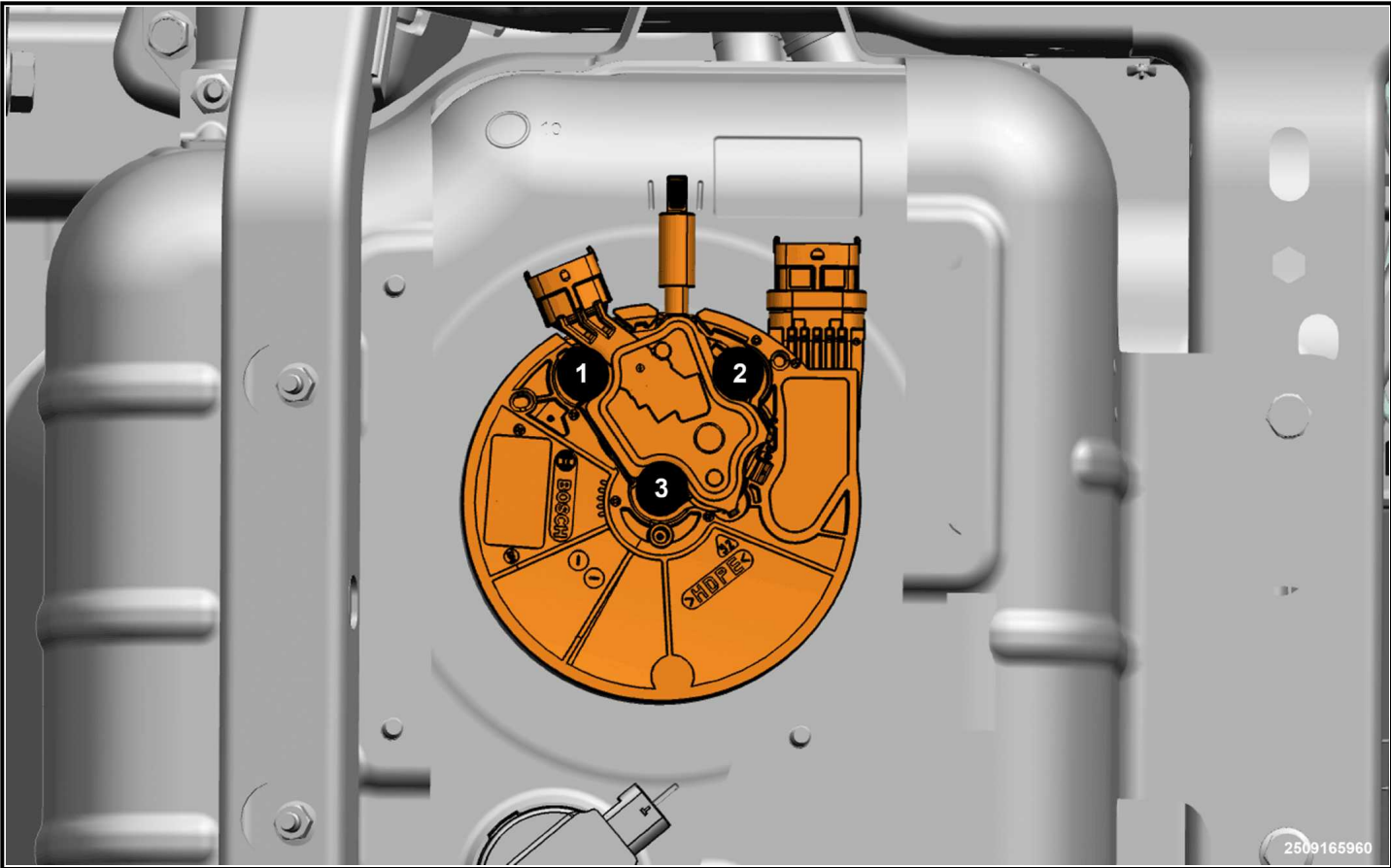
2 - Diesel Exhaust Fluid Dosing Injector

- Install a **NEW** DEF dosing injector gasket.
- Using the scan tool, perform **DEF Dosing Injection Quantity** function found under SYSTEM TESTS.

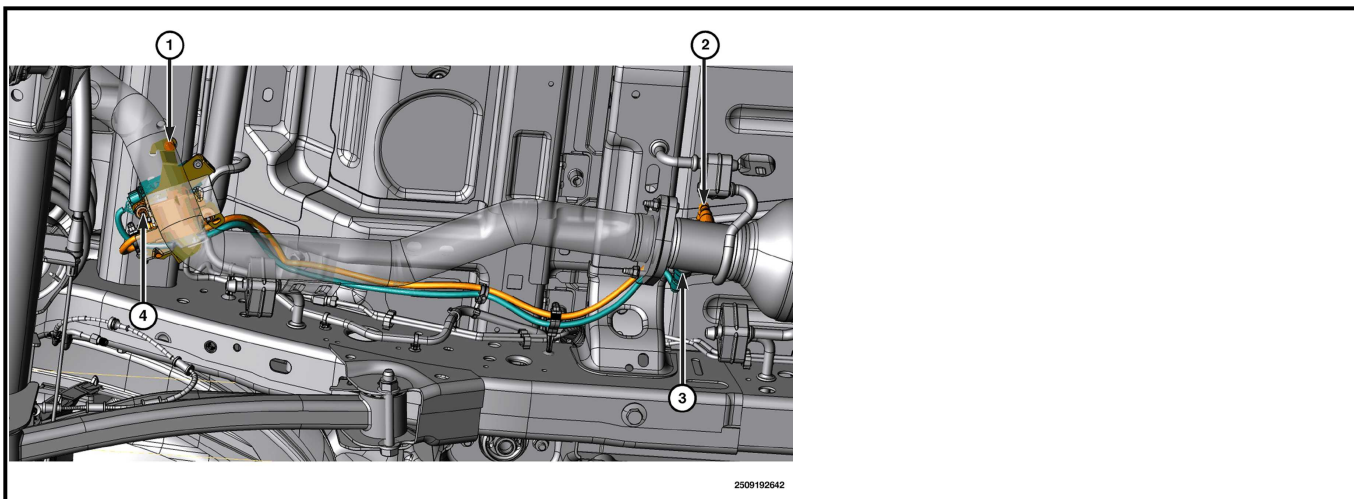
DEF SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	DEF Tank Rear Crossmember To Frame Bolts	60 N.m (37 Ft. Lbs.)	-
2	DEF Tank Shield to Transmission Crossmember	25 N.m (18 Ft. Lbs.)	-
3	DEF Tank Shield Nuts	17 N.m (13 Ft. Lbs.)	-
4	DEF Tank Shield to Frame Bolt - M10	60 N.m (44 Ft. Lbs.)	-
B	DEF Pump Screws	Torque Procedure: 1. Using the tightening sequence shown, tighten the screws to 6 N.m (53 in. lbs.) 2. Let bolts set for two minutes. 3. Using the tightening sequence shown, tighten the screws to 6 N.m (53 in. lbs.).	B



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	DEF Tank Mounting Bolts	62 N.m (24 Ft. Lbs.)	-
2	DEF Tank Strap Bolts	54 N.m (40 Ft. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	NOx Sensor Module/Particulate Matter Sensor Module Bracket Bolts	9 N.m (80 In. Lbs.)	-
2	NOx Sensor	55 N.m (41 Ft. Lbs.)	-
3	NOx Sensor	55 N.m (41 Ft. Lbs.)	-
4	NOx Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
-	DEF Injector Clamp	11 N.m (8 Ft. Lbs.)	-

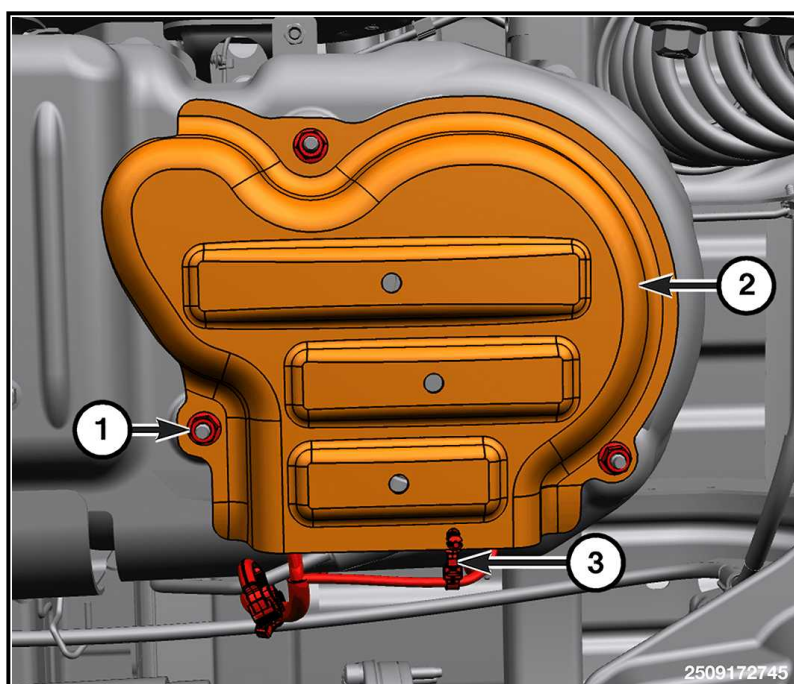
LINE, DIESEL EXHAUST FLUID SUPPLY

REMOVAL AND INSTALLATION

DIESEL EXHAUST FLUID SUPPLY LINE

REMOVAL

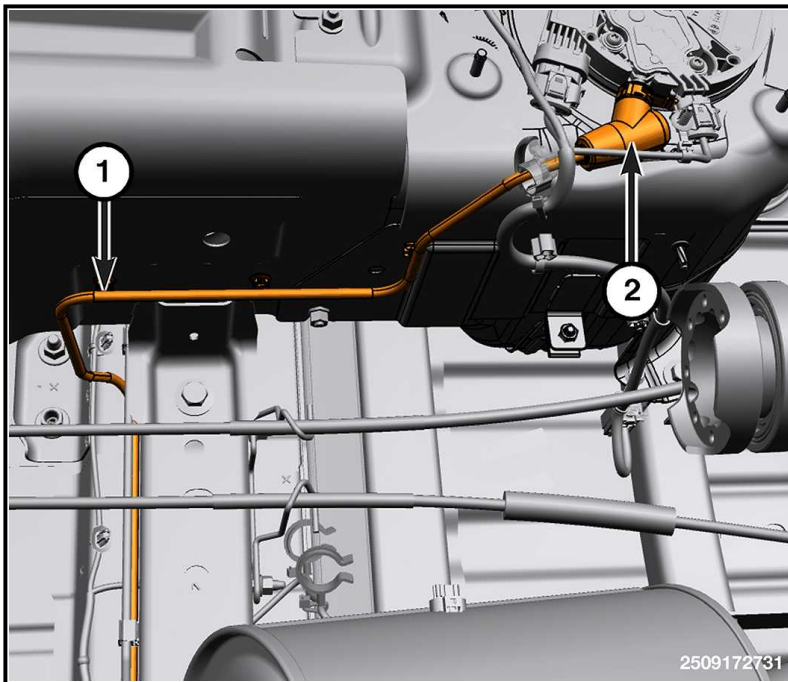
1. Disconnect and isolate the negative battery cables.
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#).



1 - Diesel Exhaust Fluid Tank Shield Nuts
2 - Diesel Exhaust Fluid Tank Shield

3 - Diesel Exhaust Fluid Supply Line Retaining Clip

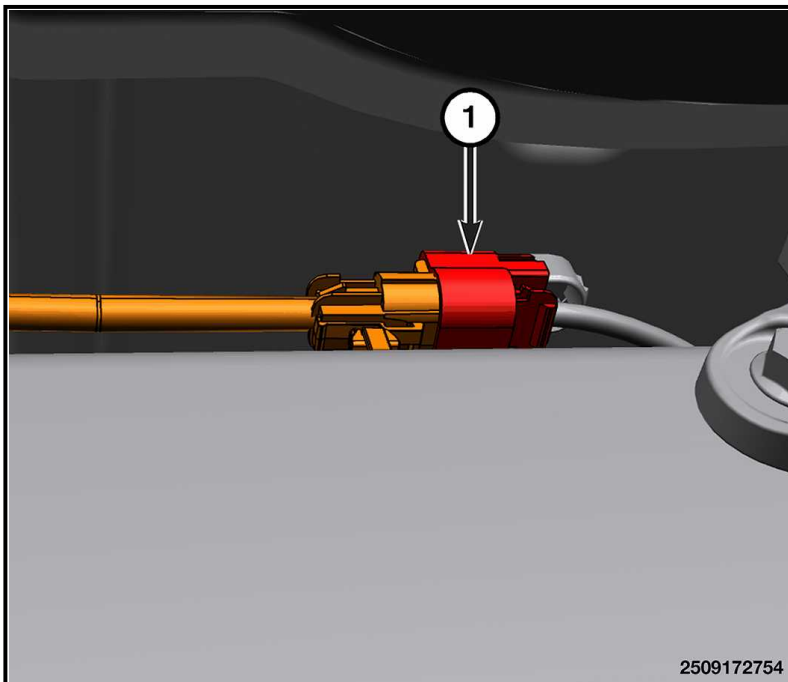
3. Detach the Diesel Exhaust Fluid (DEF) supply line retaining clip.
4. Remove the DEF tank shield nuts and the DEF tank shield.



1 - Diesel Exhaust Fluid Supply Line Retaining Clips

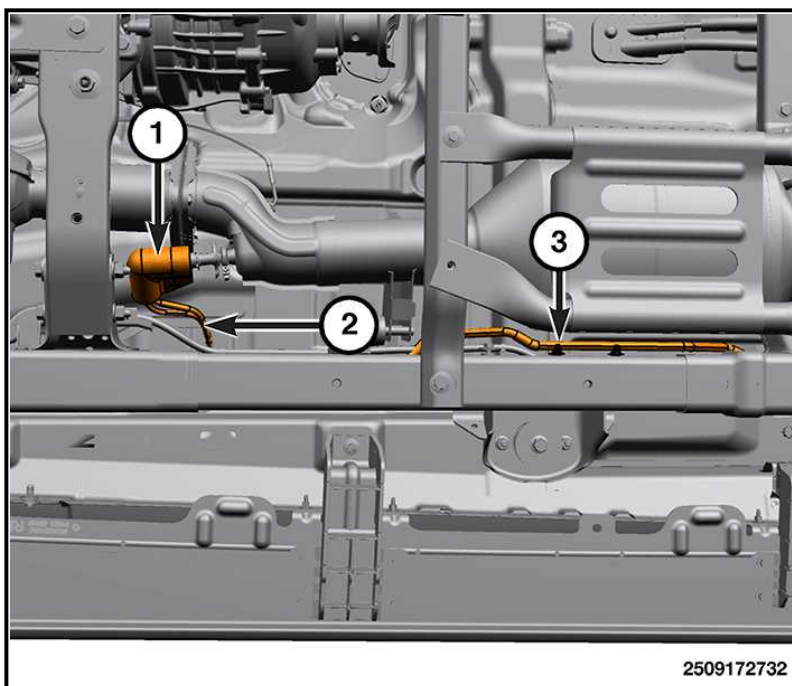
2 - Diesel Exhaust Fluid Supply Line Norma Connector

5. Disconnect the DEF supply line Norma connector to DEF pump. Refer to [**DIESEL EXHAUST FLUID EMISSIONS \[EXJ\], STANDARD PROCEDURE.**](#)
6. Detach the DEF supply line retaining clips.



1 - Diesel Exhaust Fluid Supply Line Heater Wire Harness Connector

7. Disconnect the DEF supply line heater wire harness connector.



1 - Diesel Exhaust Fluid Supply Line Norma Connector
2 - Diesel Exhaust Fluid Supply Line
3 - Diesel Exhaust Fluid Supply Line Retaining Clips

8. Disconnect the DEF supply line Norma connector from the dosing injector. Refer to [DIESEL EXHAUST FLUID EMISSIONS \[EXJ\], STANDARD PROCEDURE](#).
9. Detach the DEF supply line routing clips and remove the supply line.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Using a scan tool, perform **DEF Pressure Line Replacement** function found under ENGINE MISC. FUNCTIONS.

TORQUE SPECIFICATIONS

SENSOR, DIESEL EXHAUST FLUID LEVEL/TEMPERATURE

REMOVAL AND INSTALLATION

DIESEL EXHAUST FLUID LEVEL/TEMPERATURE SENSOR

REMOVAL

- The Diesel Exhaust Fluid (DEF) tank level/temperature sensor is part of the DEF tank and is **NOT** serviceable. To replace, remove the Diesel Exhaust Fluid (DEF) tank. Refer to [TANK, DIESEL EXHAUST FLUID, REMOVAL AND INSTALLATION](#).
- Discard the DEF tank.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Using a scan tool, perform **DEF Tank Fluid Level Reset** function found under MISCELLANEOUS FUNCTIONS.

SENSOR, DIESEL EXHAUST FLUID QUALITY

REMOVAL AND INSTALLATION

DIESEL EXHAUST FLUID QUALITY SENSOR

REMOVAL

1. The Diesel Exhaust Fluid (DEF) quality sensor is part of the DEF tank and is **NOT** serviceable. To replace, remove and replace the DEF tank. Refer to **TANK, DIESEL EXHAUST FLUID, REMOVAL AND INSTALLATION**.
2. Discard the DEF tank.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

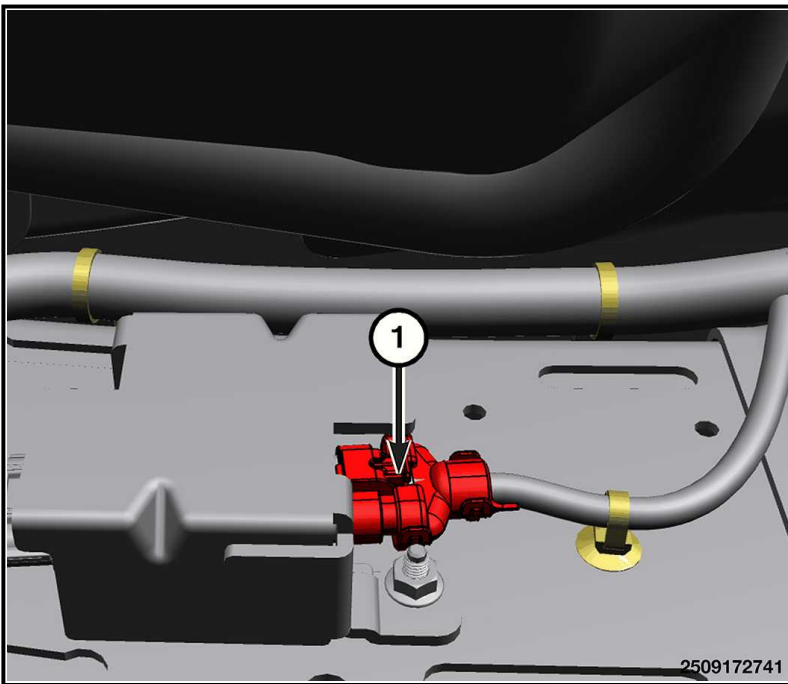
SENSOR, NOX

REMOVAL AND INSTALLATION

NOX SENSOR 1/1

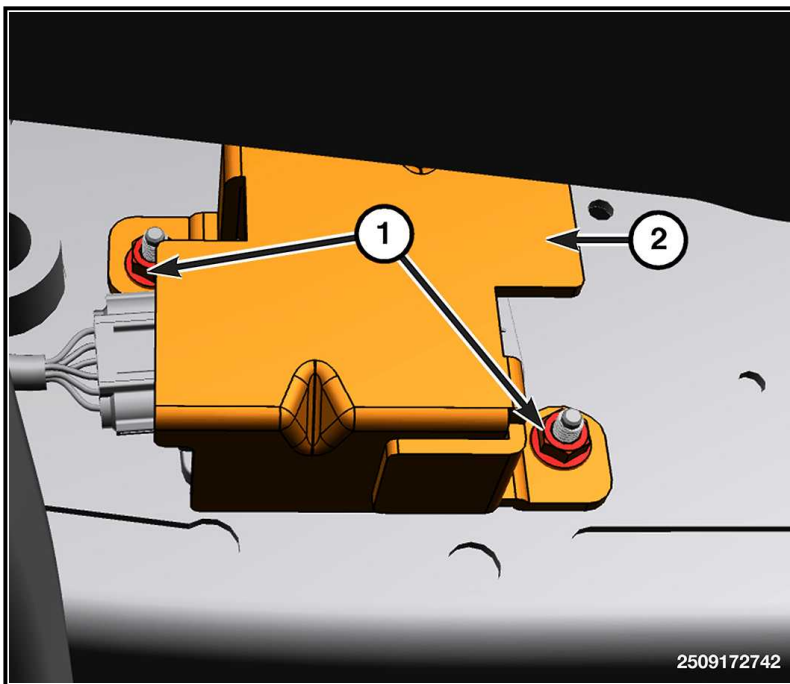
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to **CABLES, BATTERY** .
2. Raise and support the vehicle. Refer to **HOISTING, STANDARD PROCEDURE** .



1 - NOx Sensor Module Wire Harness Connector

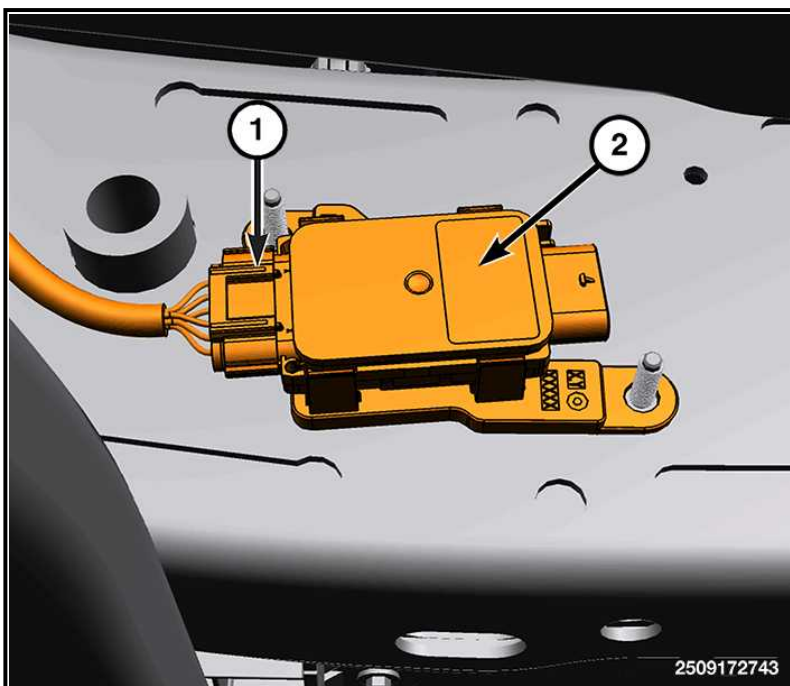
3. Disconnect the NOx sensor module wire harness connector.



1 - Heat Shield Nuts

2 - Heat Shield

4. Remove the heat shield nuts and the heat shield.

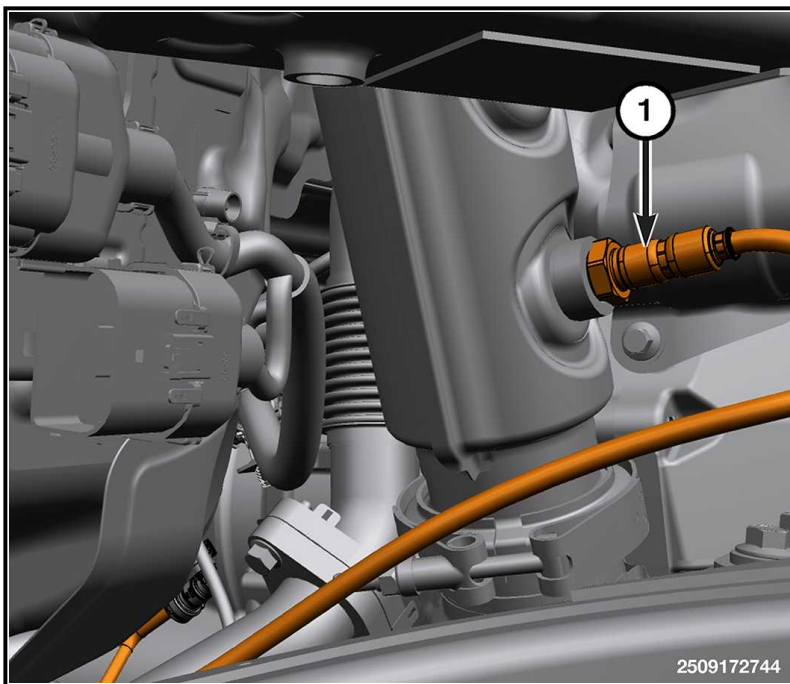


1 - NOx Sensor Wire Harness Connector

2 - NOx Sensor Module

NOTE: DO NOT try to disconnect the wire harness connector from the NOx sensor module.

5. Detach the NOx sensor wire harness retainers and remove the NOx sensor module from the studs.
6. Remove the right front tire and wheel assembly. Refer to [REMOVAL AND INSTALLATION](#).
7. Remove the right front wheelhouse splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) [SHIELD, SPLASH, REAR WHEELHOUSE, REMOVAL AND INSTALLATION](#).



1 - NOx Sensor 1/1

8. Using a six sided crow foot, remove the NOx sensor 1/1 with module from the Diesel Oxidation Catalyst/Diesel Particulate Filter DOC/DPF inlet elbow.
9. If the NOx sensor fails to loosen use a torque wrench set to 160 N.m (118 ft. lbs.) and loosen the NOx sensor.

NOTE: **DO NOT use a torch as a heat source.**

10. If the NOx sensor is still not loose after applying 160 N.m (118 ft. lbs.) then use a heat gun to heat the NOx sensor boss for 1 minute at 450B° C (842B° F).

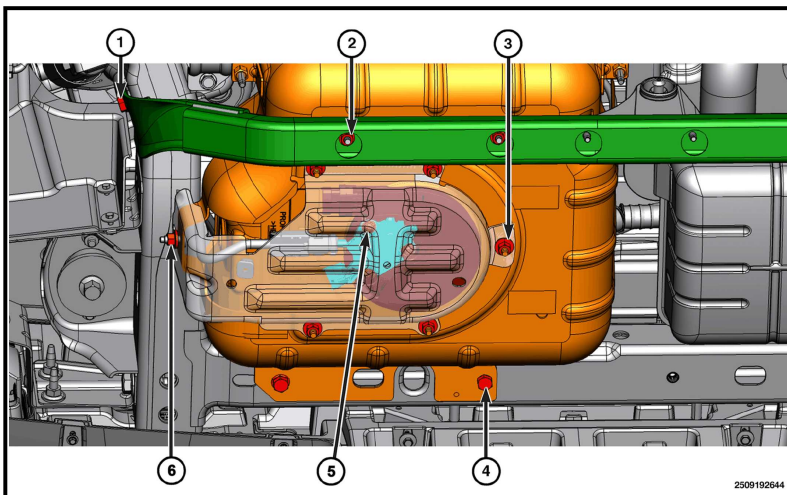
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

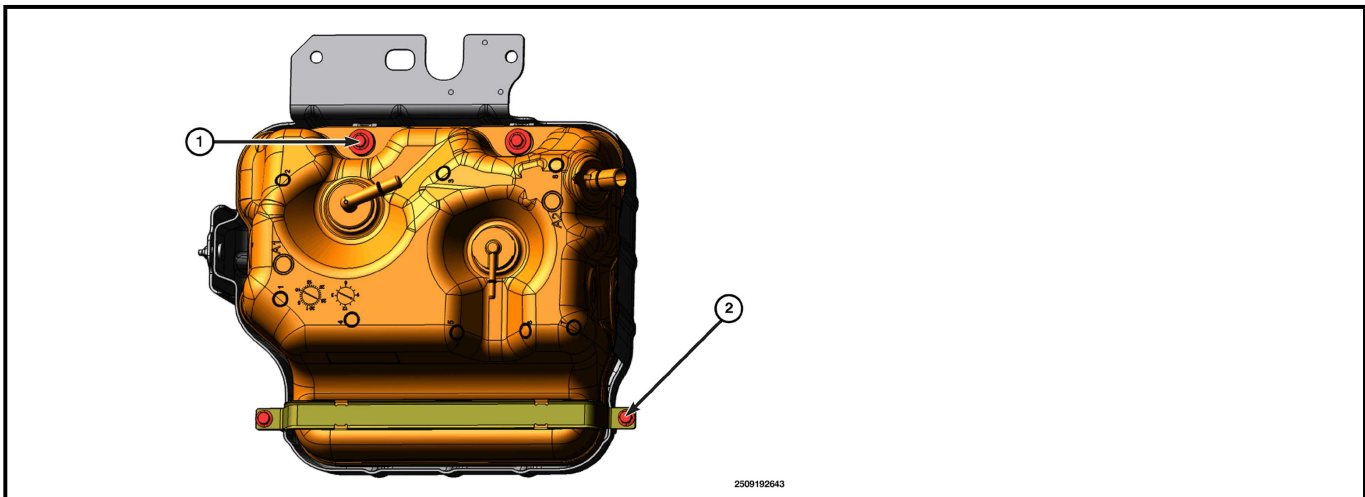
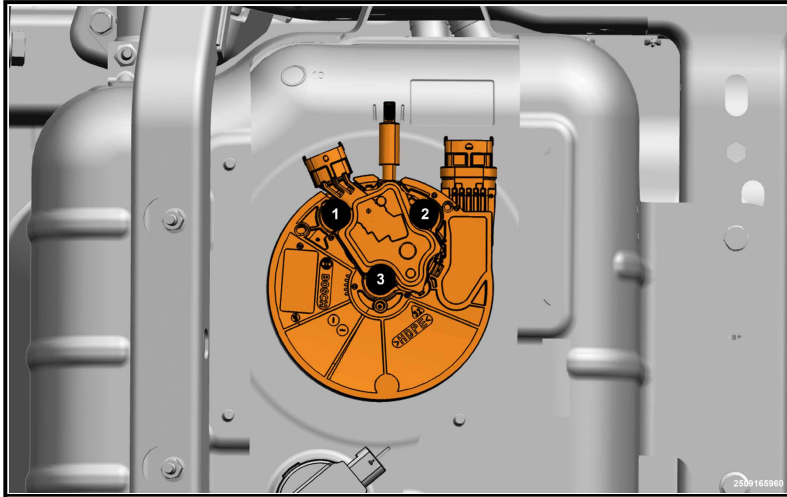
Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

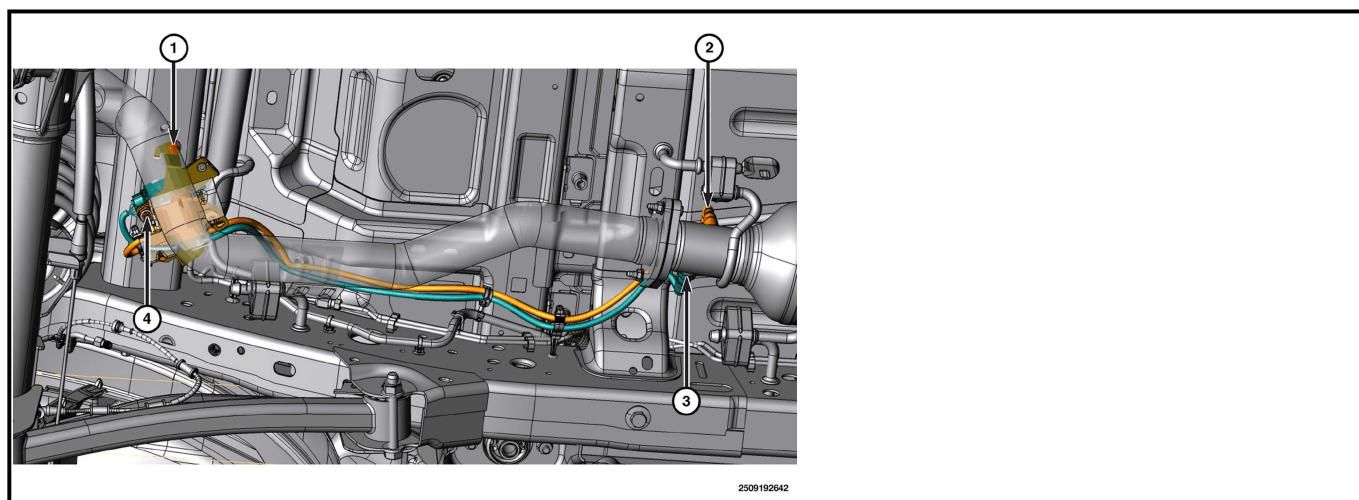
DEF SYSTEM



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	DEF Tank Rear Crossmember To Frame Bolts	60 N.m (37 Ft. Lbs.)	-
2	DEF Tank Shield to Transmission Crossmember	25 N.m (18 Ft. Lbs.)	-
3	DEF Tank Shield Nuts	17 N.m (13 Ft. Lbs.)	-
4	DEF Tank Shield to Frame Bolt - M10	60 N.m (44 Ft. Lbs.)	-
B	DEF Pump Screws	Torque Procedure: - Using the tightening sequence shown, tighten the screws to 6 N.m (53 in. lbs.) - Let bolts set for two minutes. - Using the tightening sequence shown, tighten the screws to 6 N.m (53 in. lbs.).	B



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	DEF Tank Mounting Bolts	62 N.m (24 Ft. Lbs.)	-
2	DEF Tank Strap Bolts	54 N.m (40 Ft. Lbs.)	-

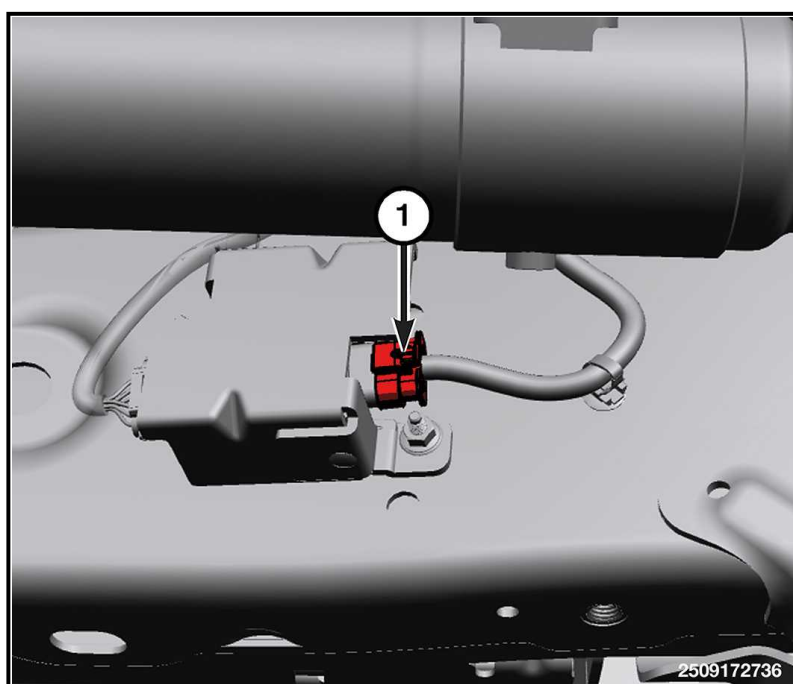


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	NOx Sensor Module/Particulate Matter Sensor Module Bracket Bolts	9 N.m (80 In. Lbs.)	-
2	NOx Sensor	55 N.m (41 Ft. Lbs.)	-
3	NOx Sensor	55 N.m (41 Ft. Lbs.)	-
4	NOx Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
-	DEF Injector Clamp	11 N.m (8 Ft. Lbs.)	-

NOX SENSOR 1/2

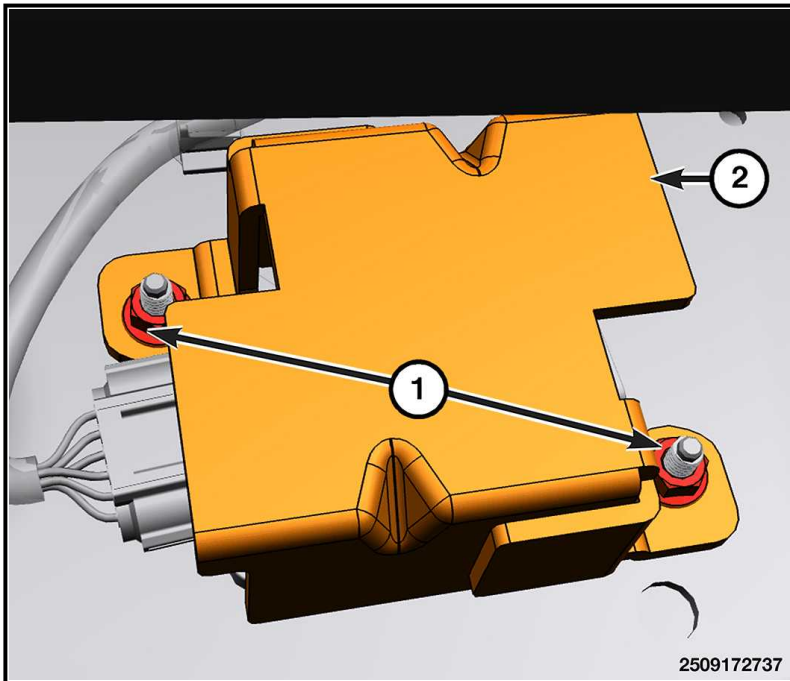
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .



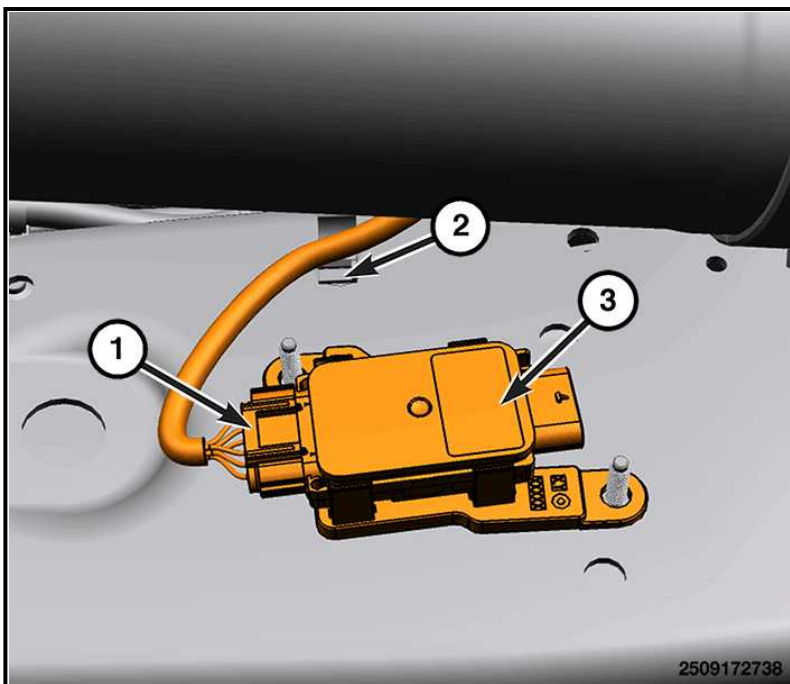
1 - NOx Sensor 1/2 Wire Harness Connector

3. Disconnect the NOx sensor 1/2 wire harness connector.



- | |
|----------------------|
| 1 - Heat Shield Nuts |
| 2 - Heat Shield |

4. Remove the heat shield nuts and the heat shield.

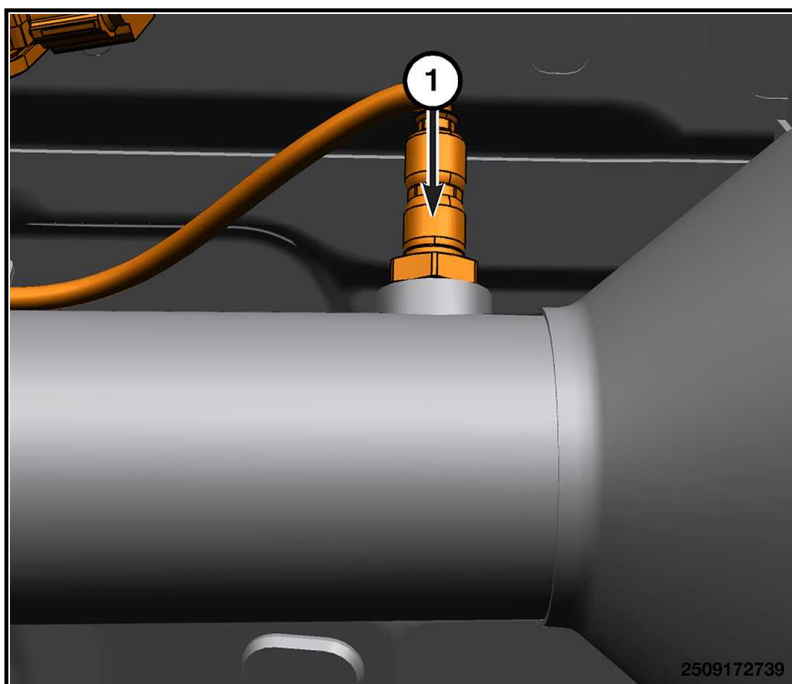


- | |
|---------------------------------------|
| 1 - NOx Sensor Wire Harness Connector |
| 2 - Wire Harness Retainer |
| 3 - NOx Sensor Module |

NOTE: DO NOT try disconnecting the NOx sensor Wire Harness Connector from the NOx sensor module.

5. Open the retainers and remove the wire.

6. Remove the NOx sensor module from the studs.



1 - NOx Sensor 1/2

7. Using a six sided crow foot, remove the NOx sensor 1/2 with module.
8. If the NOx sensor fails to loosen use a torque wrench set to 160 N.m (118 ft. lbs.) and loosen the NOx sensor

NOTE: DO NOT use a torch as a heat source.

9. If the NOx sensor is still not loose after applying 160 N.m (118 ft. lbs.) then use a heat gun to heat the NOx sensor boss for 1 minute at 450B° C (842B° F).

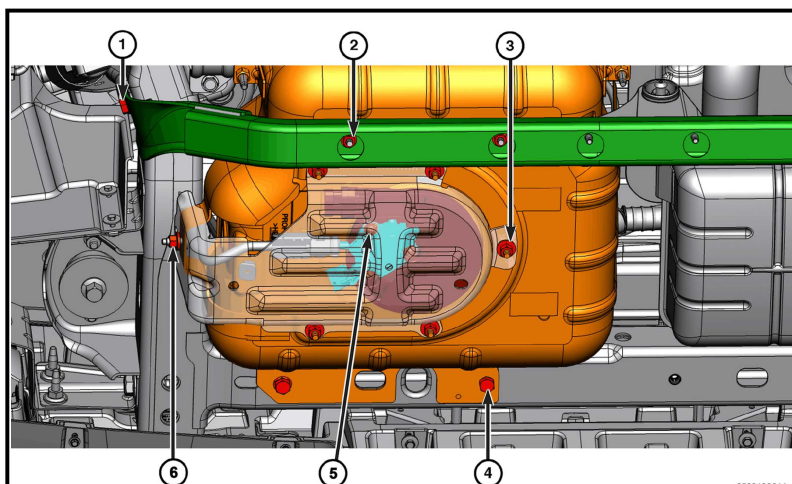
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

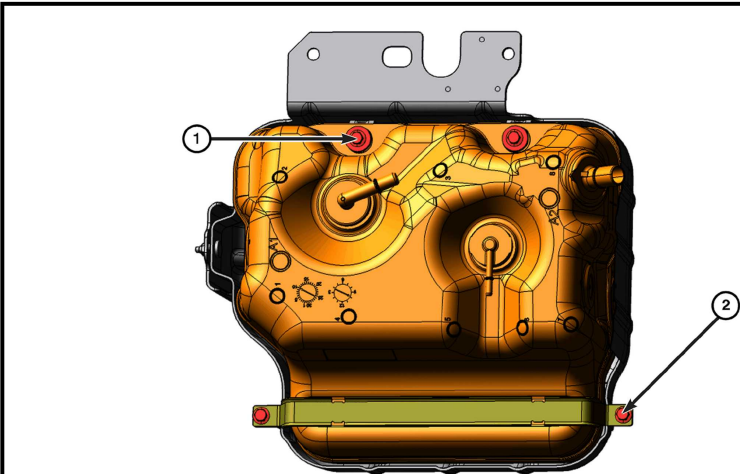
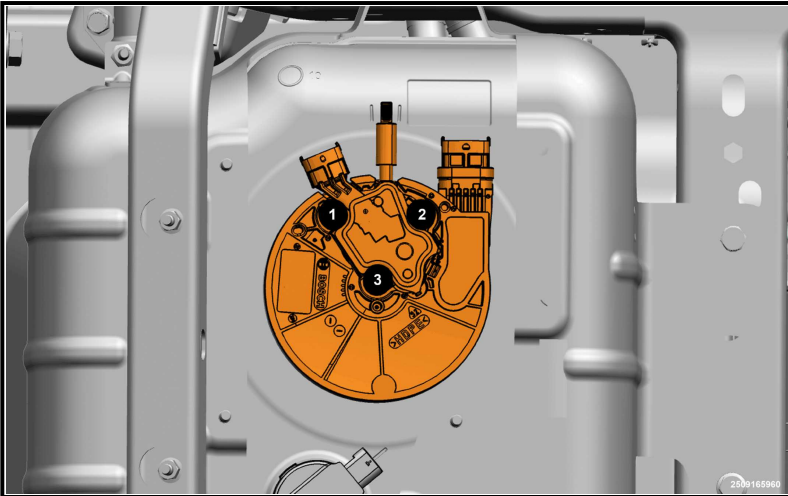
TORQUE SPECIFICATIONS

DEF SYSTEM

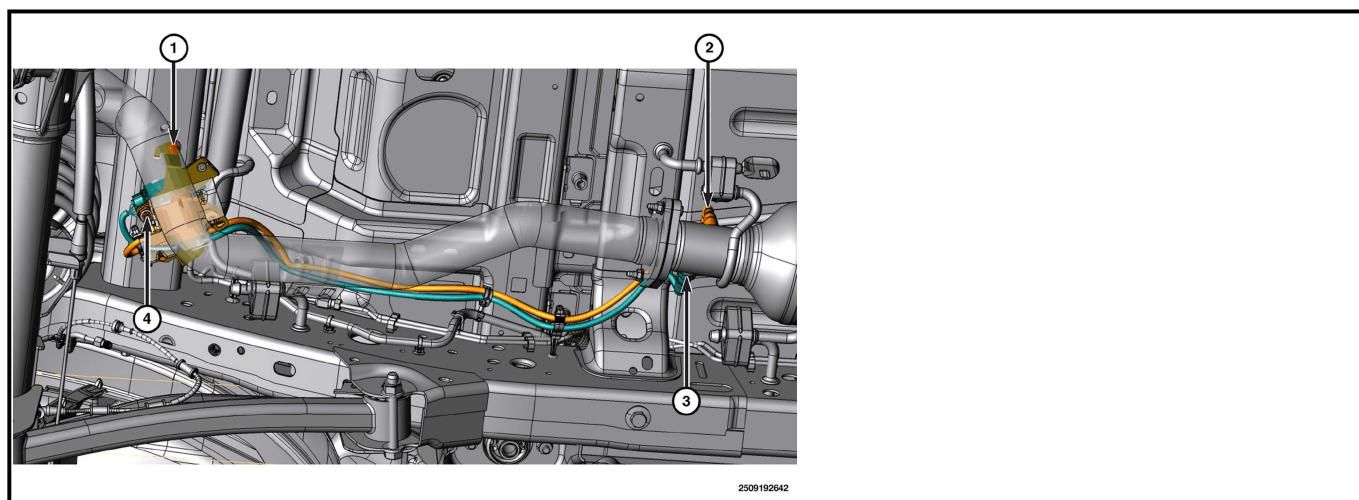


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	DEF Tank Rear Crossmember To Frame	60 N.m (37 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
	Bolts		
2	DEF Tank Shield to Transmission Crossmember	25 N.m (18 Ft. Lbs.)	-
3	DEF Tank Shield Nuts	17 N.m (13 Ft. Lbs.)	-
4	DEF Tank Shield to Frame Bolt - M10	60 N.m (44 Ft. Lbs.)	-
B	DEF Pump Screws	Torque Procedure: - Using the tightening sequence shown, tighten the screws to 6 N.m (53 in. lbs.) - Let bolts set for two minutes. - Using the tightening sequence shown, tighten the screws to 6 N.m (53 in. lbs.).	B



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	DEF Tank Mounting Bolts	62 N.m (24 Ft. Lbs.)	-
2	DEF Tank Strap Bolts	54 N.m (40 Ft. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	NOx Sensor Module/Particulate Matter Sensor Module Bracket Bolts	9 N.m (80 In. Lbs.)	-
2	NOx Sensor	55 N.m (41 Ft. Lbs.)	-
3	NOx Sensor	55 N.m (41 Ft. Lbs.)	-
4	NOx Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
-	DEF Injector Clamp	11 N.m (8 Ft. Lbs.)	-

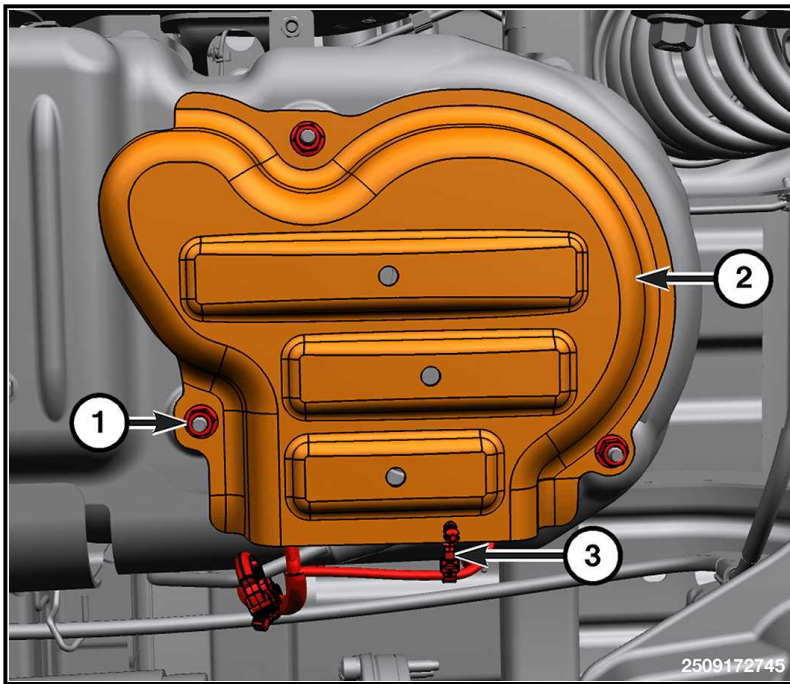
TANK, DIESEL EXHAUST FLUID

REMOVAL AND INSTALLATION

DIESEL EXHAUST FLUID TANK

REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .

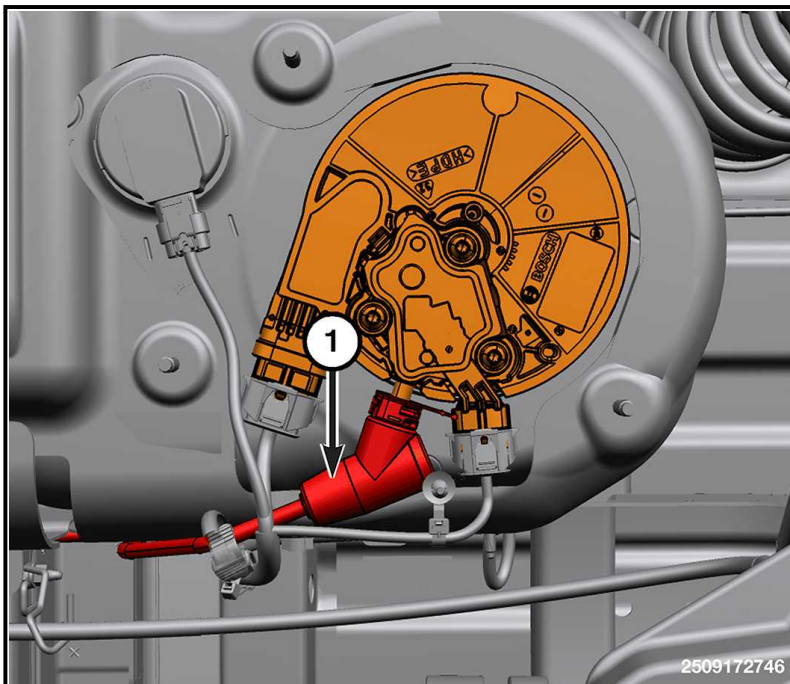


1 - DEF Tank Shield Nuts

2 - DEF Tank Shield

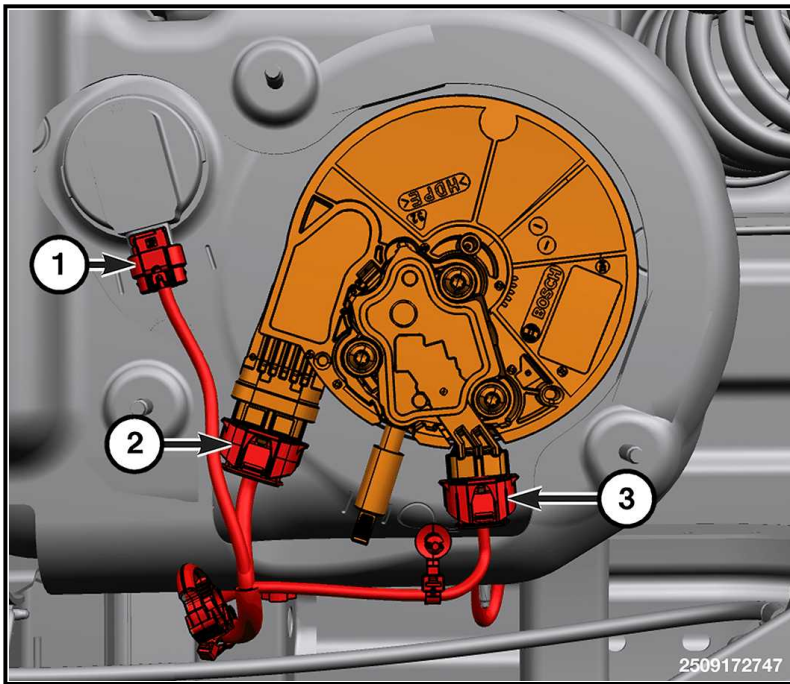
3 - DEF Supply Line Retaining Clip

3. Detach the Diesel Exhaust Fluid (DEF) supply line retaining clip.
4. Remove the DEF tank shield nuts and the DEF tank shield.



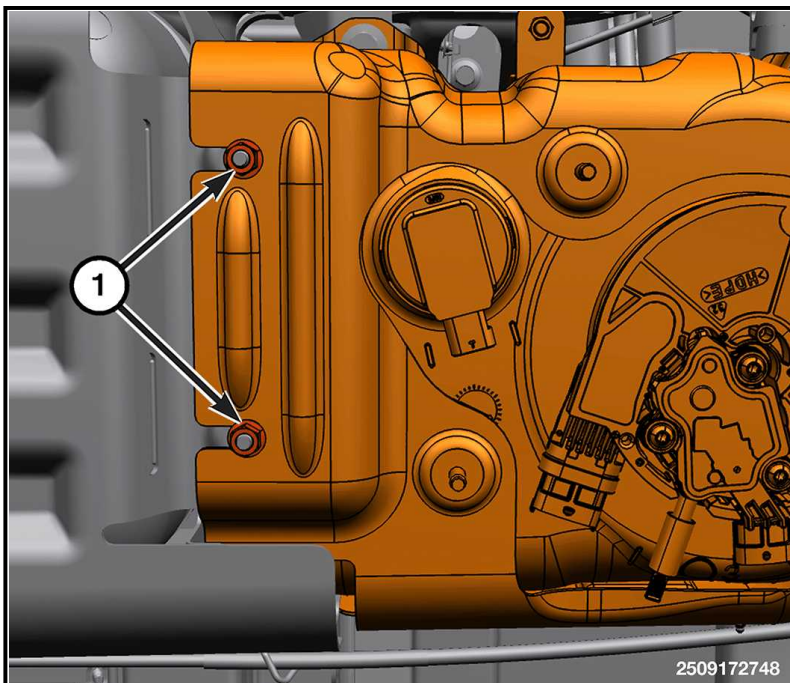
1 - DEF Pump Supply Line

5. Disconnect the DEF supply line. Refer to [**DIESEL EXHAUST FLUID EMISSIONS \[EXJ\], STANDARD PROCEDURE**](#).



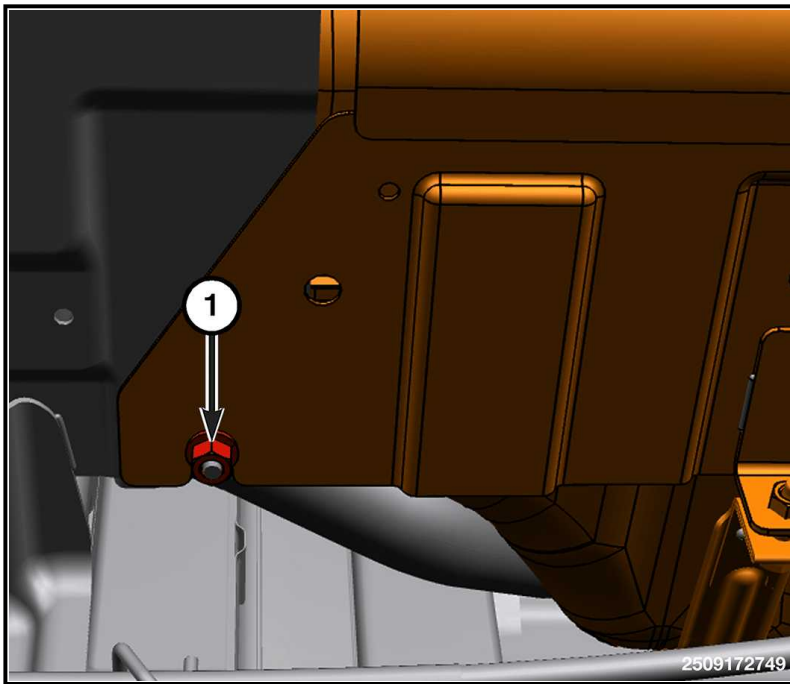
- | |
|---|
| 1 - DEF Quality Sensor Wire Harness Connector |
| 2 - DEF Tank Heater/Level Sensor Wire Harness Connector |
| 3 - DEF Pump Harness Connector |

6. Disconnect the DEF pump wire harness connector.
7. Disconnect the DEF tank heater/level sensor wire harness connector.
8. Disconnect the DEF quality sensor wire harness connector.
9. Position a transmission jack under the DEF tank.



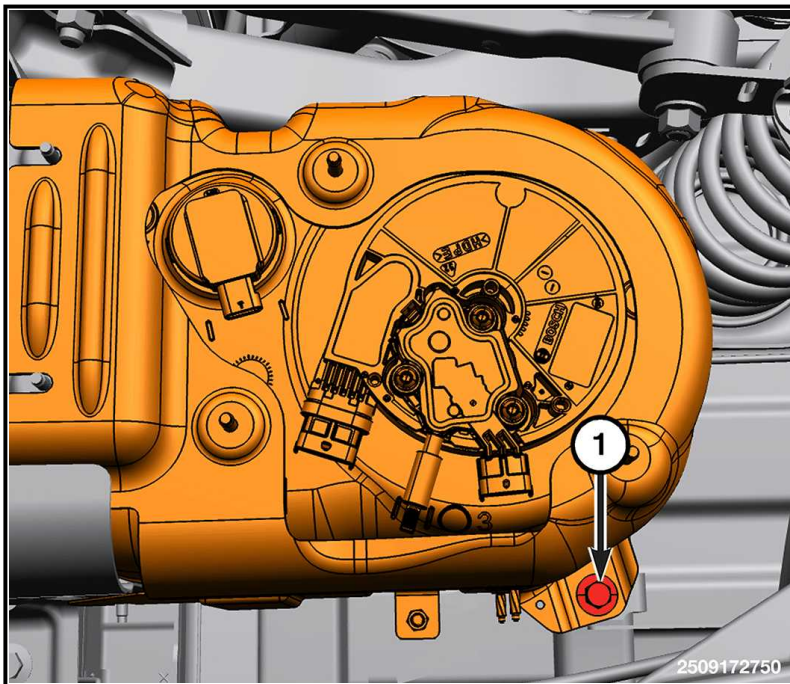
- | |
|--------------------------|
| 1 - DEF Tank Shield Nuts |
|--------------------------|

10. Remove the DEF tank shield nuts.



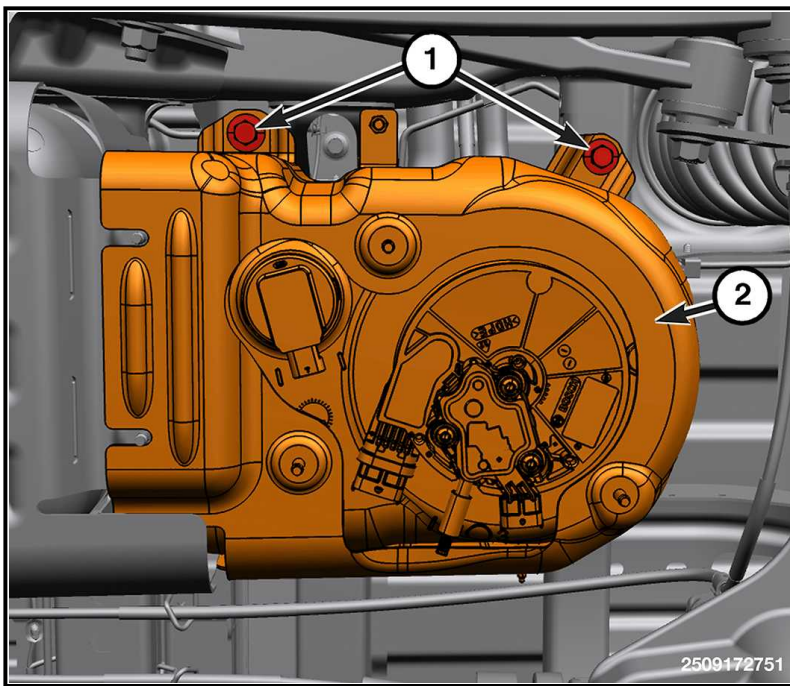
1 - DEF Tank Shield Nuts

11. Remove the DEF tank shield nut.



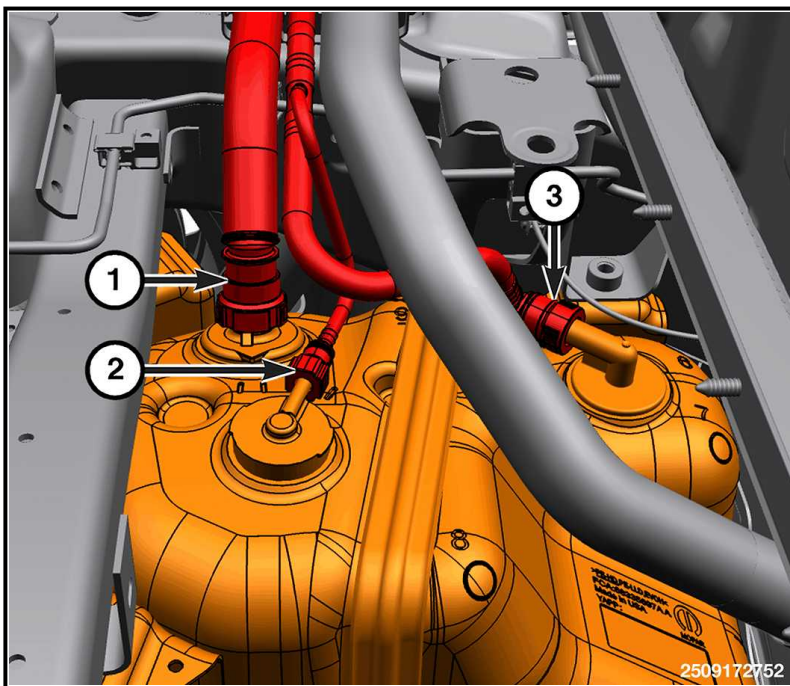
1 - DEF Tank Bolt

12. Remove the DEF tank bolt.



1 - DEF Tank Bolts

13. Remove the DEF tank bolts and partially lower the DEF tank.



1 - DEF Fill Tube

2 - Vent Valve

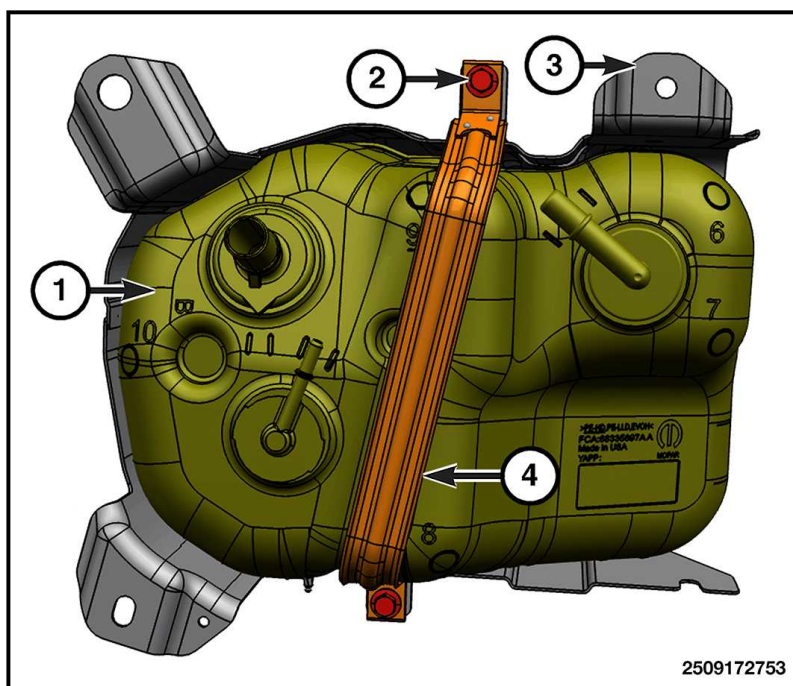
3 - Rollover Valve

14. Disconnect the Diesel Exhaust Fluid (DEF) vent tube from the vent valve and the rollover valve.

15. Disconnect the DEF fill tube from tank.

16. Lower the DEF tank and remove the DEF tank.

17. Drain the DEF tank. Refer to [**DIESEL EXHAUST FLUID EMISSIONS \[EXJ\], STANDARD PROCEDURE.**](#)



1 - DEF Tank
2 - DEF Tank Bracket Bolts
3 - Shield
4 - DEF Tank Bracket

18. Remove the DEF tank bracket bolts and the DEF tank bracket.

19. Remove the DEF tank from the shield.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

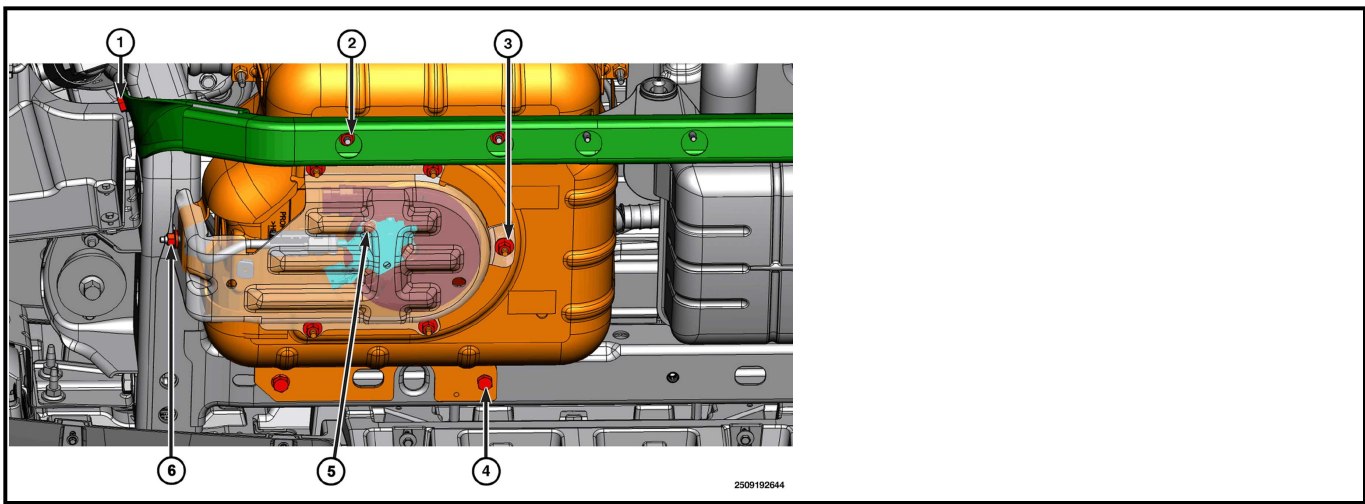
- Fill the DEF tank with fresh clean fluid.

NOTE: You may be require to run the DEF Pump Replacement procedure two to three times to ensure that the pump is properly primed.

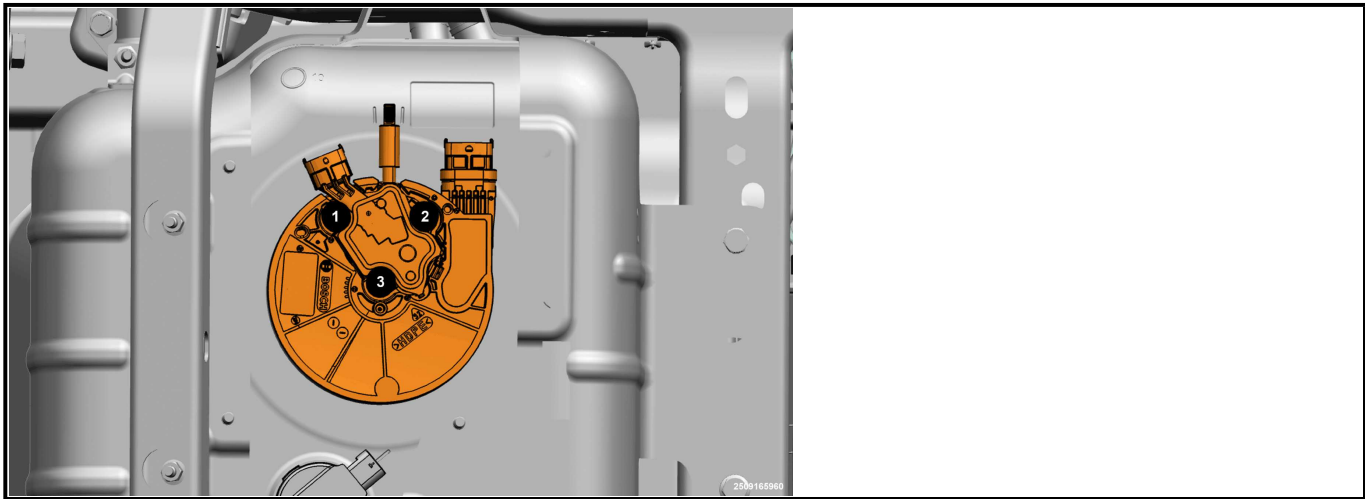
- Using a scan tool, perform **DEF Pump Replacement** function found under MISCELLANEOUS FUNCTIONS.
- Using a scan tool, perform **DEF Tank Fluid Level Reset** function found under ENGINE MISCELLANEOUS FUNCTIONS.

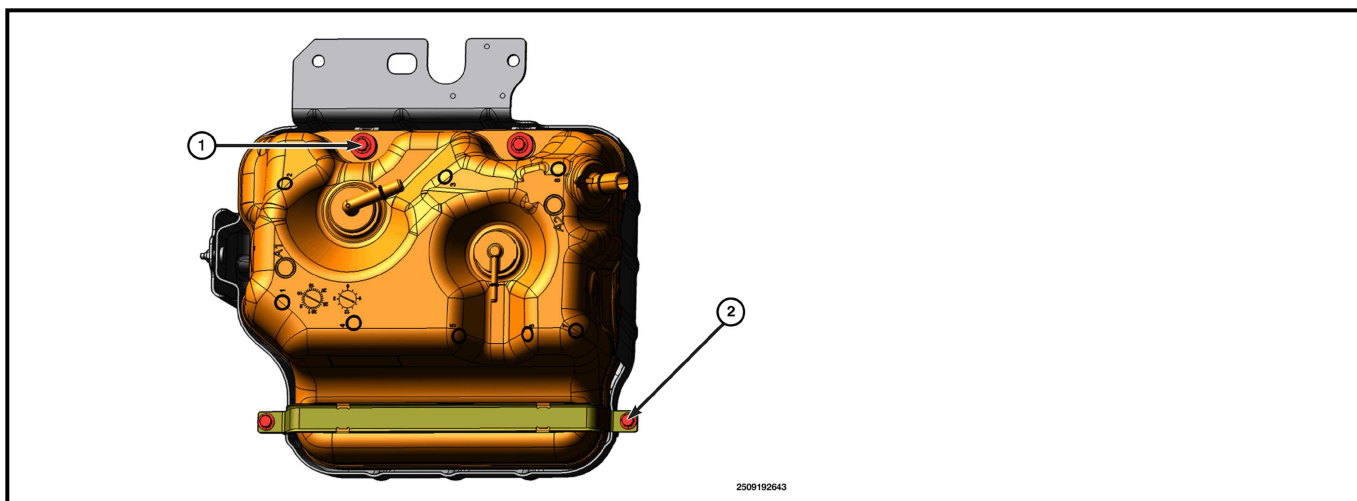
TORQUE SPECIFICATIONS

DEF SYSTEM

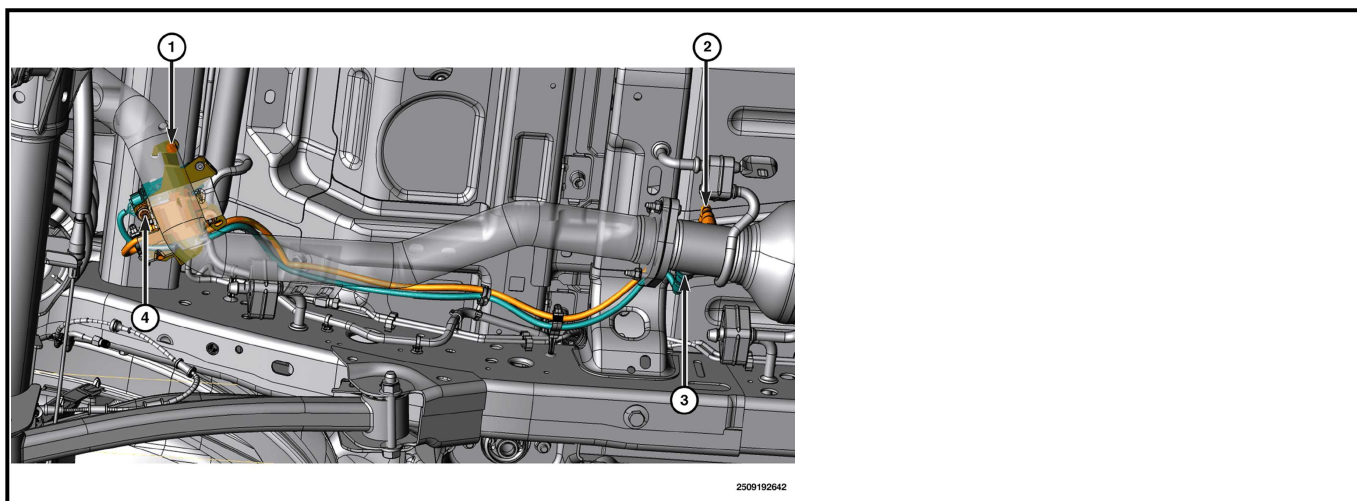


CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	DEF Tank Rear Crossmember To Frame Bolts	60 N.m (37 Ft. Lbs.)	-
2	DEF Tank Shield to Transmission Crossmember	25 N.m (18 Ft. Lbs.)	-
3	DEF Tank Shield Nuts	17 N.m (13 Ft. Lbs.)	-
4	DEF Tank Shield to Frame Bolt - M10	60 N.m (44 Ft. Lbs.)	-
B	DEF Pump Screws	Torque Procedure: - Using the tightening sequence shown, tighten the screws to 6 N.m (53 in. lbs.) - Let bolts set for two minutes. - Using the tightening sequence shown, tighten the screws to 6 N.m (53 in. lbs.).	B





CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	DEF Tank Mounting Bolts	62 N.m (24 Ft. Lbs.)	-
2	DEF Tank Strap Bolts	54 N.m (40 Ft. Lbs.)	-



CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
1	NOx Sensor Module/Particulate Matter Sensor Module Bracket Bolts	9 N.m (80 In. Lbs.)	-
2	NOx Sensor	55 N.m (41 Ft. Lbs.)	-
3	NOx Sensor	55 N.m (41 Ft. Lbs.)	-
4	NOx Sensor Module Nuts	9 N.m (80 In. Lbs.)	-
-	DEF Injector Clamp	11 N.m (8 Ft. Lbs.)	-

TUBE, DIESEL EXHAUST FLUID TANK FILL

REMOVAL AND INSTALLATION

DIESEL EXHAUST FLUID FILLER TUBE

REMOVAL

1. The Diesel Exhaust Fluid (DEF) filler tube is part of the fuel filler tube, for removal. Refer to [LINES AND TUBES, FUEL, REMOVAL AND INSTALLATION](#).

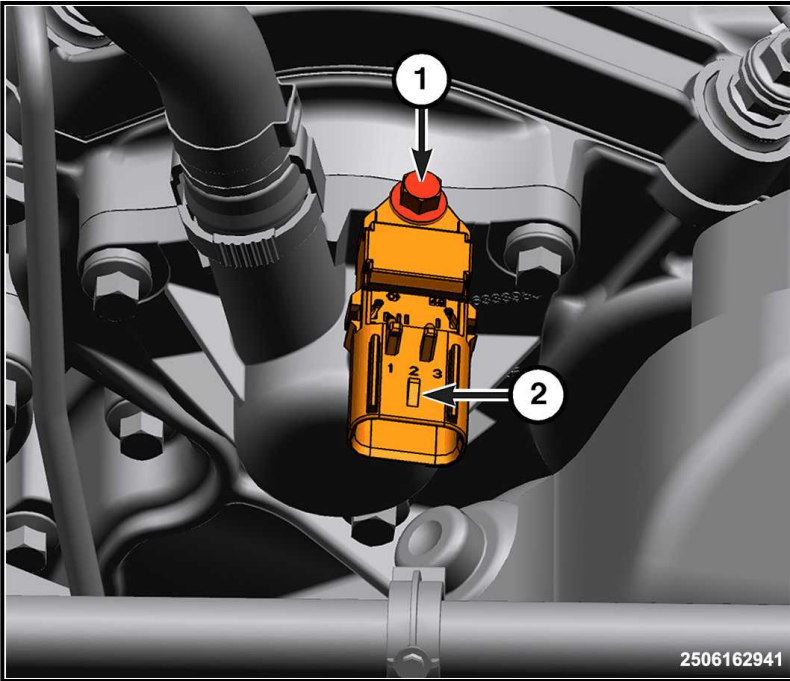
INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

EVAPORATIVE EMISSIONS, DIESEL [EXJ]

DESCRIPTION AND OPERATION

OIL VAPOR PRESSURE SENSOR



1 - Crankcase Pressure Sensor Bolt
2 - Crankcase Pressure Sensor

The crankcase pressure sensor is mounted on the left front side of the upper timing cover.

TECHNICAL SPECIFICATIONS

EVAP EMISSIONS

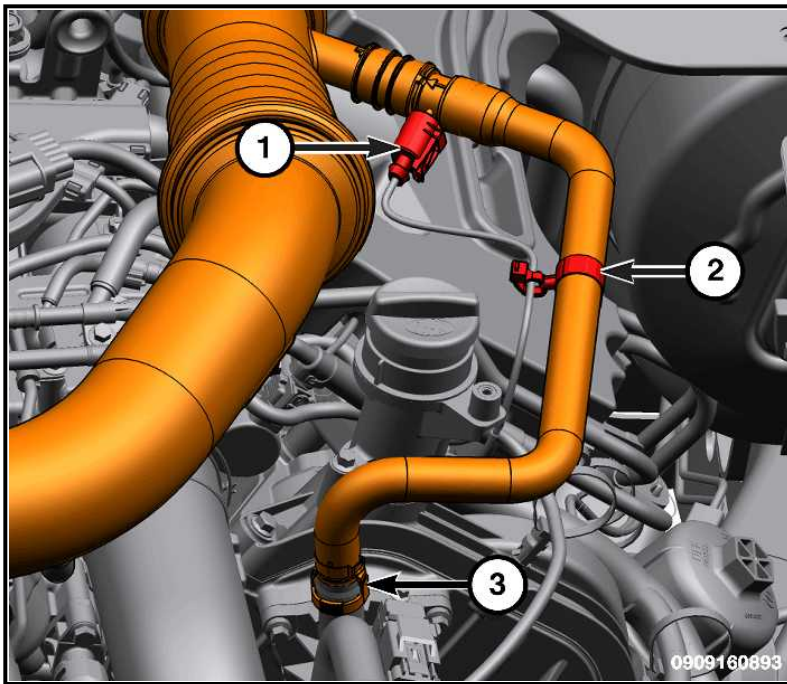
DESCRIPTION	SPECIFICATION	COMMENT
Oil Vapor Pressure Sensor Bracket Nuts	13 N.m (10 Ft. Lbs.)	-

HOSE, CRANKCASE BREATHER

REMOVAL AND INSTALLATION

CLOSED CRANKCASE VENTILATION HOSE

REMOVAL



1 - Closed Crankcase Ventilation Heater Wire Harness Connector

2 - Wire Harness Retainer

3 - Crankcase Breather Hose

1. The Closed Crankcase Ventilation (CCV) hose is serviced as an assembly with the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#) .

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

HEATER, CLOSED CRANKCASE VENTILATION (CCV)

REMOVAL AND INSTALLATION

CLOSED CRANKCASE VENTILATION HEATER

REMOVAL

1. The Closed Crankcase Ventilation (CCV) heater is serviced as an assembly with the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#) .

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

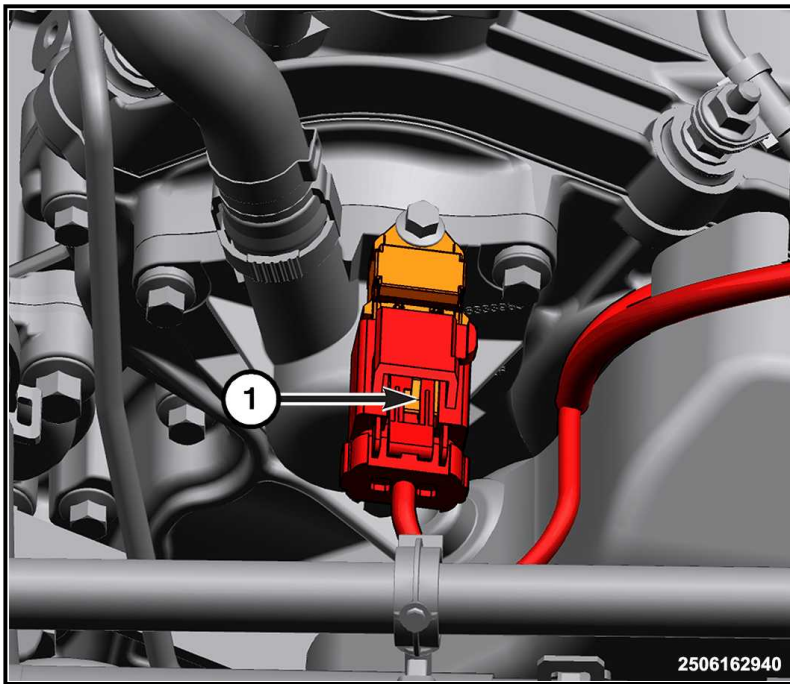
SENSOR, OIL VAPOR PRESSURE

REMOVAL AND INSTALLATION

OIL VAPOR PRESSURE SENSOR

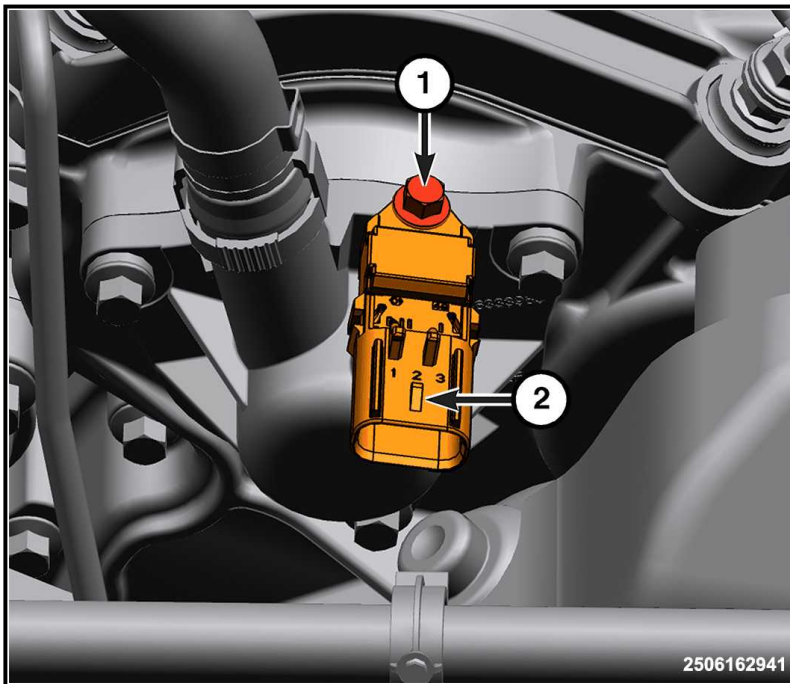
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



1 - Oil Vapor Pressure Sensor Wire Harness Connector

3. Disconnect the oil vapor pressure sensor wire harness connector.



1 - Oil Vapor Pressure Sensor Bolt

2 - Oil Vapor Pressure Sensor

4. Remove the oil vapor pressure sensor bolt and the oil vapor pressure sensor.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

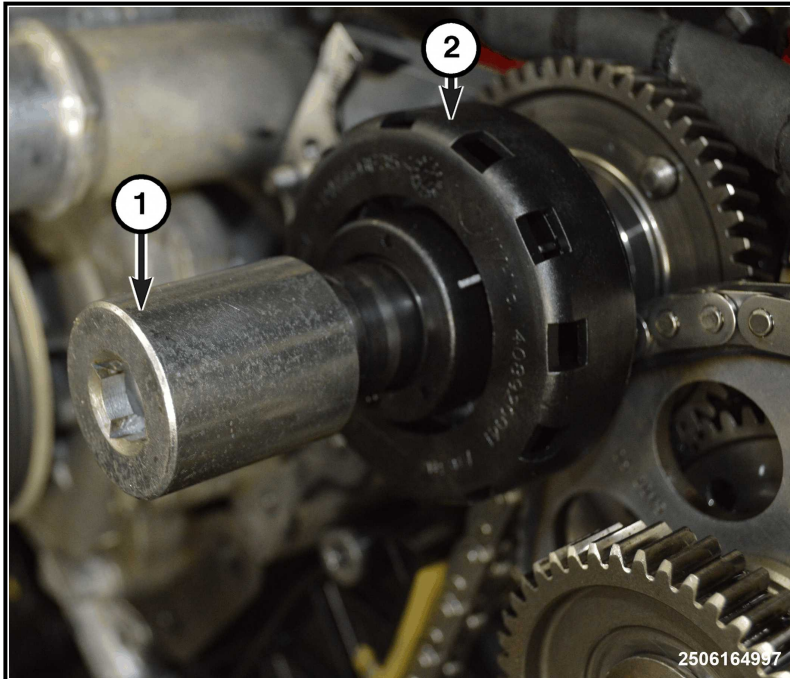
- Install the oil vapor pressure sensor and securely tighten the bolt.

SEPARATOR, ENGINE OIL

REMOVAL AND INSTALLATION

REMOVAL

1. Remove the left upper timing cover. Refer to [COVER\(S\), ENGINE TIMING, REMOVAL AND INSTALLATION](#).



1 - Oil Separator Remover/Installer Tool
2 - Oil Separator

2. Using the (special tool #VM.10344, Tool, Oil Separator Remover/Installer), remove the oil separator from the left intake camshaft.

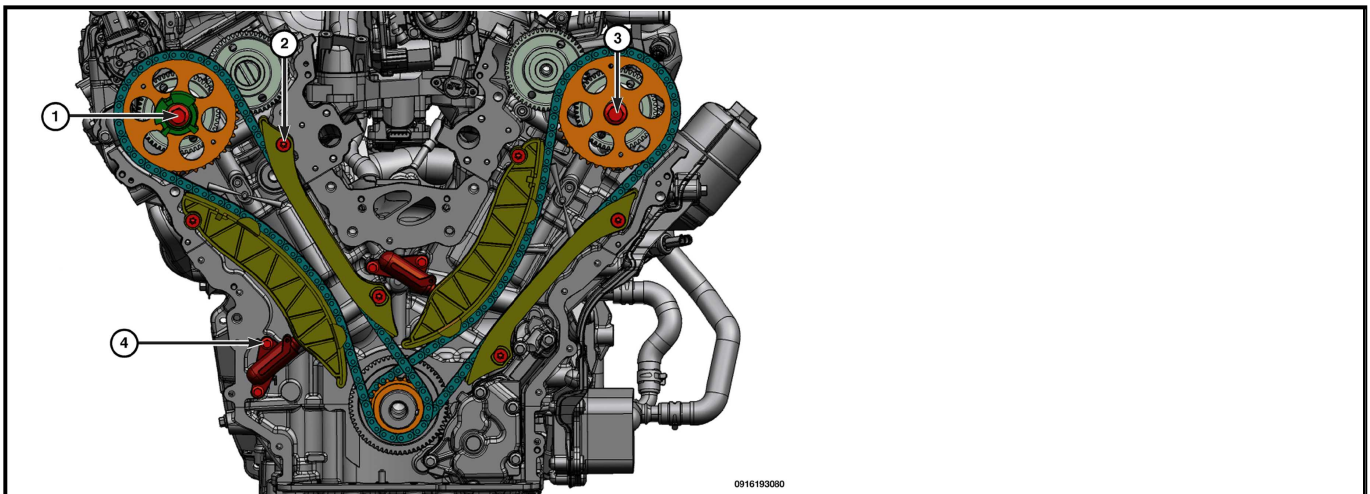
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

TORQUE SPECIFICATIONS

VALVE TIMING



CALLOUT	DESCRIPTIONS	SPECIFICATIONS	COMMENT
1	Fuel Injection Pump Drive Gear Bolt (On Left Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 75B°	-
2	Timing Chain Guide Bolts	30 N.m (22 Ft. Lbs.)	-
3	Reluctor Wheel Bolt (On Right Camshaft Sprocket)	30 N.m (22 Ft. Lbs.) + 73B°	-
4	Timing Chain Tensioner	14 N.m (11 Ft. Lbs.)	-
-	Oil Separator Bolt	30 N.m (22 Ft. Lbs.)	-

EXHAUST GAS RECIRCULATION, DIESEL [EXJ]

DESCRIPTION AND OPERATION

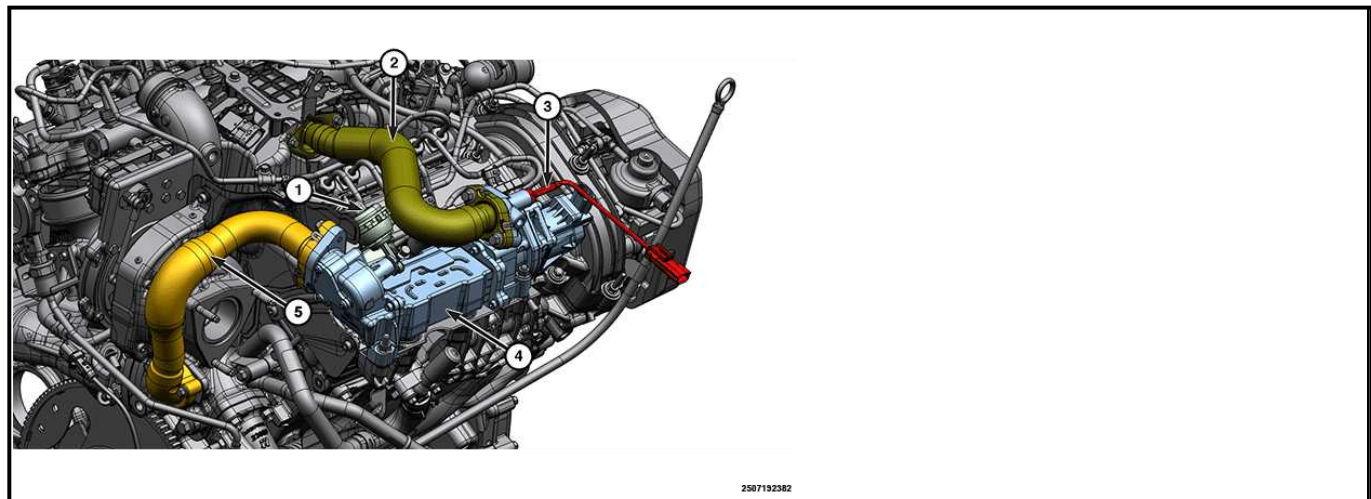
DESCRIPTION AND OPERATION - EXHAUST GAS RECIRCULATION (EGR) SYSTEM - 3.0L DIESEL

HIGH PRESSURE EGR SYSTEM DESCRIPTION

The High Pressure Exhaust Gas Recirculation (EGR) system includes the following components (typical 3.0L diesel shown):

COMPONENT INDEX

1.	EGR Bypass Vacuum Actuator
2.	Upper High Pressure EGR Tube
3.	EGR Temperature Sensor
4.	EGR Cooler
5	Lower High Pressure EGR Tube
-	EGR Valve

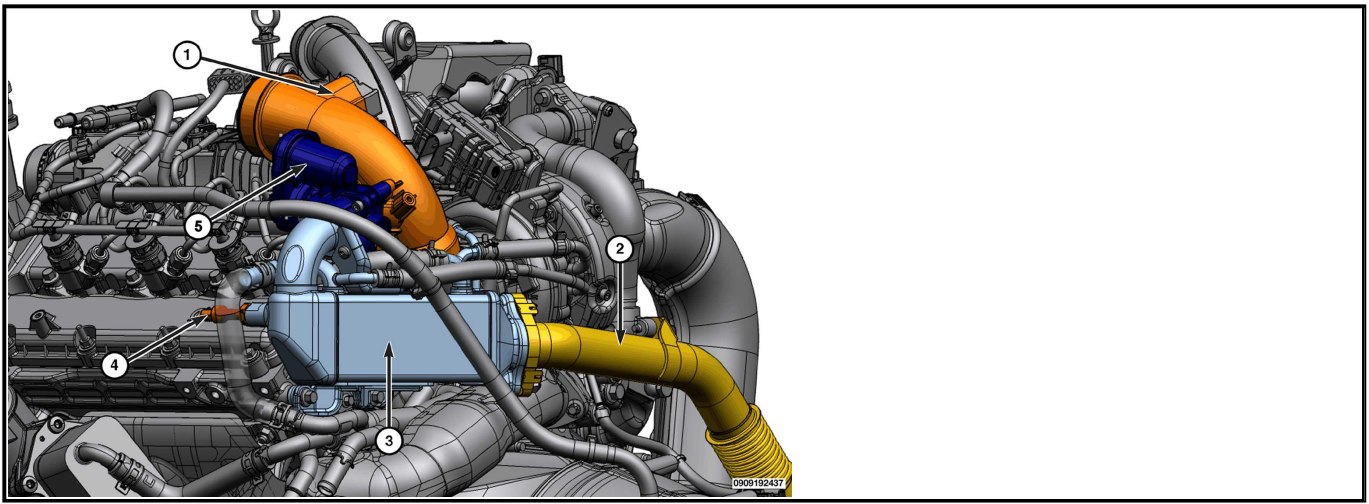


LOW PRESSURE EGR SYSTEM DESCRIPTION

The Exhaust Gas Recirculation (EGR) system includes the following components (typical 3.0L diesel shown):

COMPONENT INDEX

1.	Upper Turbocharger Inlet Elbow
2.	Low Pressure EGR Tube
3.	EGR Cooler
4.	EGR Temperature Sensor
5	EGR Valve



GENERAL EGR SYSTEM OPERATION:

The Exhaust Gas Recirculation (EGR) system consists of a high pressure and low pressure EGR system. The two systems are controlled independent of each other, but are operated in a manner to work together for total EGR flow. Both systems consist of an EGR valve to control flow. A cooler assembly is used to reduce the temperature of the exhaust gas that is recirculated to the engine, which in turn helps reduce NOx emissions. An EGR temperature sensor is used to monitor temperature and flow through each system. The EGR valves can be commanded to open at a variable rate between open and closed. This allows the Powertrain Control Module (PCM) to operate either system at 100% of the total flow or blend the rate of flow between the two systems.

Low pressure EGR is introduced above 55B°C (131B°F) coolant temperature and increases in percentage of total flow as the engine temperature increases. High pressure EGR flow decreases in percentage of total flow as low pressure EGR flow increases.

On a normally operating system, the total EGR flow consists of the following:

- flow 100% from the high pressure EGR system when the engine is cold - under 55B°C (131B°F)
- blend the two systems increasing low pressure EGR and decreasing high pressure EGR during engine warm up above 55B°C (131B°F)
- flow 100% from low pressure EGR when the engine is hot

HIGH PRESSURE EGR OPERATION:

During cold engine conditions (coolant temperature under 55B°C (131B°F)) all EGR flow comes from the high pressure EGR system. This is due to the lower pressure and temperature in the low pressure EGR system which may lead to condensation. The high pressure EGR system pulls exhaust gases from the exhaust manifold. The exhaust gases flow through the a cooler to the intake manifold. During cold start conditions, the EGR bypass valve is opened and the exhaust gases are diverted around the cooler through the bypass pipe. The advantage is that the exhaust gas temperature and pressure is higher which can warm the engine quickly. The disadvantage of the high pressure EGR is that the exhaust gases have more soot which can eventually lead to coking in the engine. The EGR temperature sensor is located in the path between the EGR cooler and EGR valve. The Powertrain Control Module (PCM) monitors the temperature sensor signal to determine flow of the system based on commanded EGR valve position.

The Powertrain Control Module (PCM) calculates the flow rate of the high pressure EGR system and compares it to the commanded EGR flow rate. In order to calculate the high pressure EGR flow rate the PCM monitors the input signals from the boost pressure sensor, EGR temperature sensor and intake air temperature sensor. If the PCM determines that the high pressure EGR cannot produce enough flow it will commanded the EGR airflow control valve partially closed to increase EGR flow.

LOW PRESSURE EGR OPERATION

The low pressure EGR system is the desired system for EGR flow when the engine is warm because the low pressure EGR exhaust gas temperature and pressure is lower post Diesel Particulate Filter (DPF) and the exhaust

gases are cleaner since soot is removed by the DPF. This allows the low pressure EGR to be introduced to the air intake system in front of the turbocharger. The Powertrain Control Module (PCM) will start to open the low pressure EGR valve when the following conditions are met:

- The engine coolant temperature increases above 55B°C (131B°F)
- The inlet air temperature pre turbo is above 16B°C (60.8B°F)
- The boost temperature post turbo is below 190B°C (374B°F)

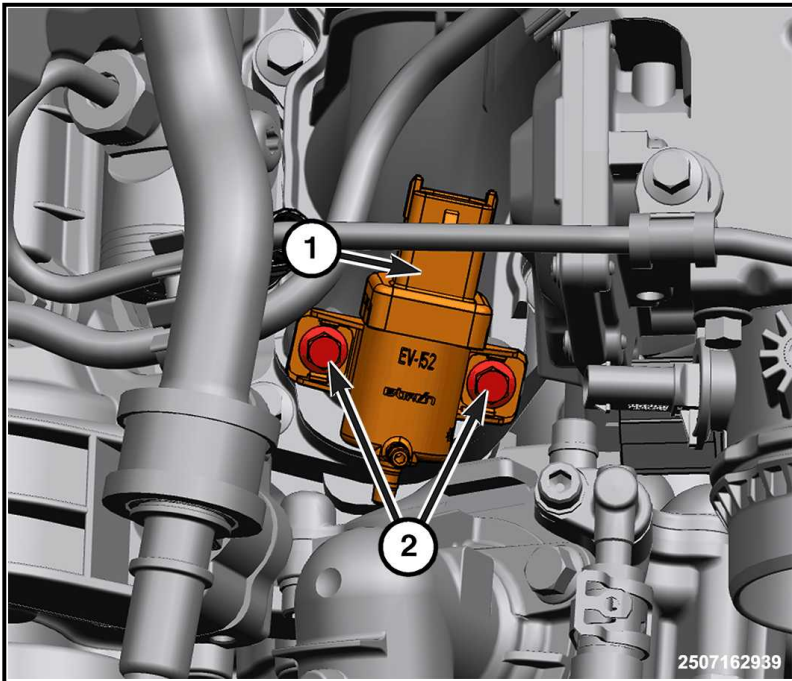
The exhaust gases in the low pressure EGR pass through a cooler to the EGR valve. The low pressure EGR cooler does not have a bypass valve since the low pressure EGR is not operated when the engine is cold. The EGR temperature sensor is located in the path between the EGR cooler and EGR valve. The Powertrain Control Module (PCM) monitors the temperature sensor signal to determine flow of the system based on commanded EGR valve position.

The Powertrain Control Module (PCM) calculates the flow rate of the low pressure EGR system and compares it to the commanded EGR flow rate. In order to calculate the low pressure EGR flow rate, the PCM monitors the input signals from the DPF differential pressure sensor, EGR temperature sensor and inlet air temperature sensor. If the PCM determines that the low pressure EGR cannot produce enough flow, it will commanded the exhaust valve actuator partially closed to increase EGR flow. If the PCM determines that the DPF is cracked, based on feedback from the DPF differential pressure sensor, the low pressure system will be disabled.

COMPONENT FUNCTIONAL DESCRIPTION - EGR COOLER

The Exhaust Gas Recirculation (EGR) Coolers use engine coolant to reduce the temperature of the exhaust gas that is recirculated to reduce NOx emissions.

The high pressure EGR cooler has a bypass tube which allows the hot EGR exhaust gases to bypass the cooler when the EGR bypass valve is opened during cold ambient, cold start conditions. This allows the engine to warm up quickly. The bypass valve is controlled by the Powertrain Control Module (PCM). The EGR cooler bypass valve is supplied vacuum from the EGR cooler bypass vacuum solenoid located on the right side of the engine next to the cylinder head cover. When the PCM energizes the solenoid in the EGR bypass valve it allows the vacuum to pull on the diaphragm opening the bypass to divert the exhaust gases around the EGR cooler.

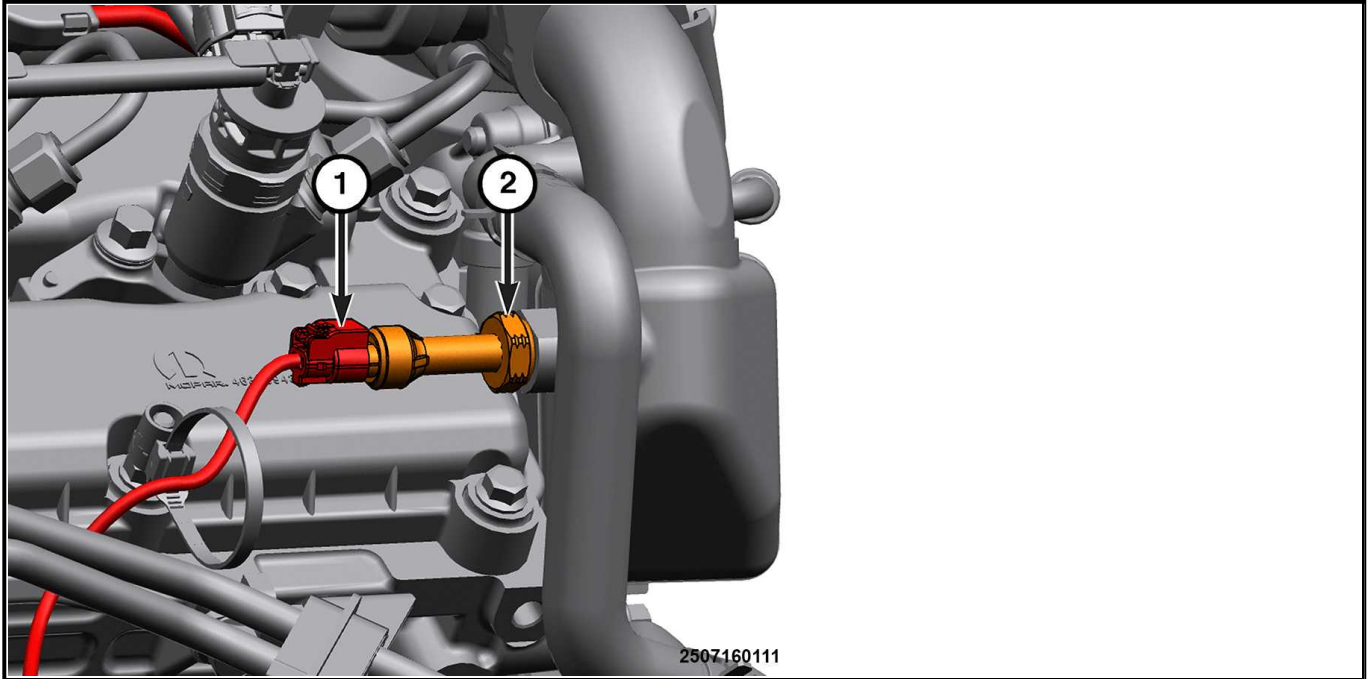


1 - EGR Cooler Bypass Vacuum Solenoid
2 - EGR Cooler Bypass Vacuum Solenoid Bolts

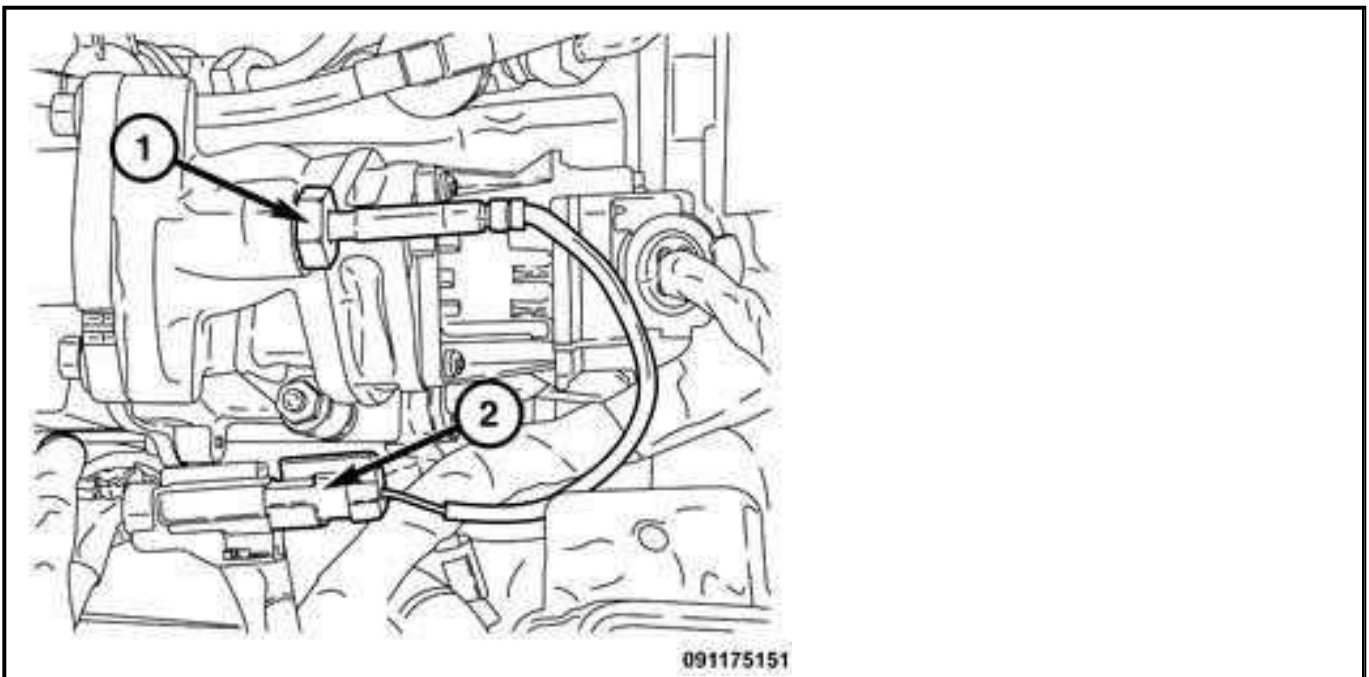
The low pressure EGR cooler does not have a bypass since the low pressure EGR is not operated when the engine is cold.

COMPONENT FUNCTIONAL DESCRIPTION - EGR TEMPERATURE SENSORS

The Low Pressure (LP) EGR temperature sensor (2) is located on the left side, rear.



The High Pressure (HP) EGR temperature sensor (1) is located on the HP EGR valve.



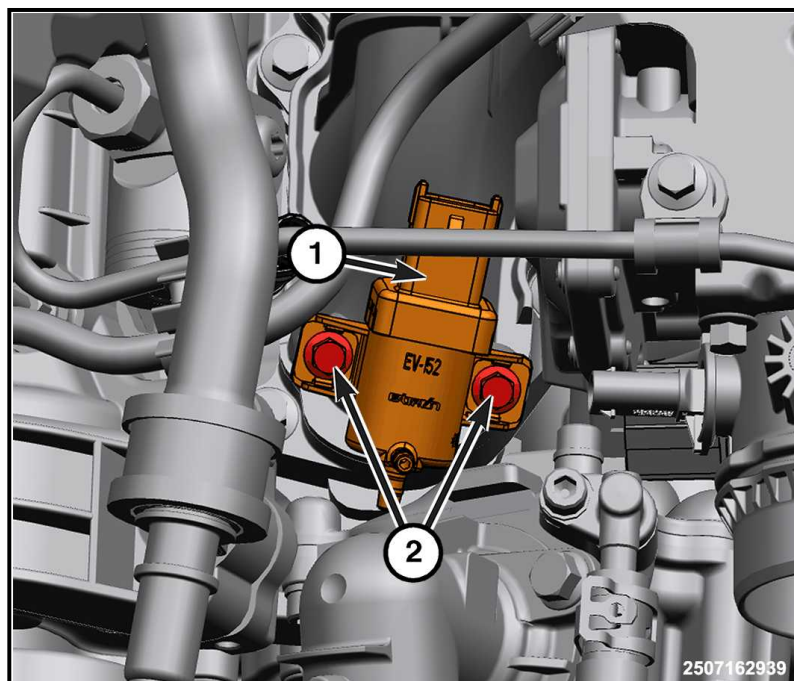
The Exhaust Gas Recirculation (EGR) temperature sensors operate as a typical 2-wire temp sensor. The Powertrain Control Module (PCM) provides a 5.0 volt signal and sensor ground to the temp sensor. The temperature sensors are used to determine the EGR gas temperature downstream of the EGR coolers. The temperature signal is used to determine EGR operation and in calculating EGR flow during operation. Both EGR temperature sensors can be serviced.

COMPONENT FUNCTIONAL DESCRIPTION - EGR VALVE

The Exhaust Gas Recirculation (EGR) Valves function differently than the typical EGR valves. These EGR valves are able to be commanded to open to variable positions instead of fully opened/closed like a traditional EGR valve. This allows the Powertrain Control Module (PCM) to not only fully open and close either valve, but also the ability to blend the flow rate between the two EGR systems.

The PCM is not able to directly monitor the valve positions to determine if they are at the commanded position. Instead, the PCM monitors different pressure sensors and the EGR temperature sensors to calculate the flow rates and EGR valve positions.

DESCRIPTION - EGR VACUUM BYPASS SOLENOID



1 - EGR Cooler Vacuum Bypass Solenoid

2 - EGR Cooler Vacuum Bypass Solenoid Bolts

- The EGR vacuum bypass solenoid is located on the right side of the engine next to the cylinder head cover and is serviceable.

DESCRIPTION - EGR AIR FLOW CONTROL VALVE

DESCRIPTION EGR AIR FLOW CONTROL VALVE



1 - Exhaust Gas Recirculation Air Flow Control Valve Bolts

2 - Exhaust Gas Recirculation Air Flow Control Valve

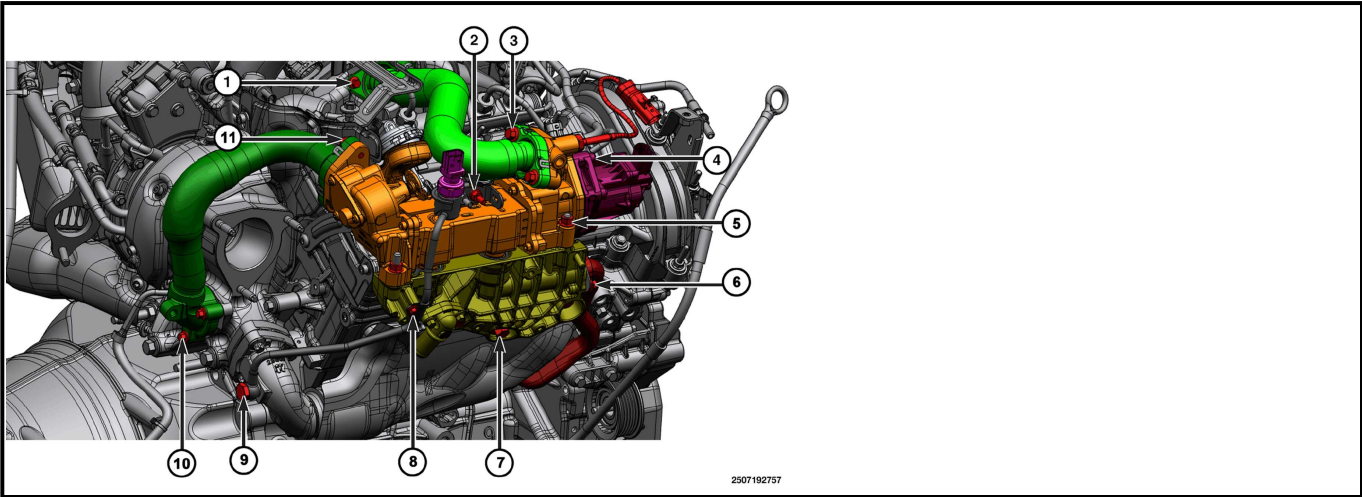
The Exhaust Gas Recirculation (EGR) Air Flow Control Valve is attached to the intake manifold. The EGR Air Flow Control Valve is controlled by the Powertrain Control Module (PCM).

OPERATION

The Exhaust Gas Recirculation (EGR) Air Flow Control Valve adjusts the flow of fresh air into the engine during EGR operation. A signal from the Powertrain Control Module (PCM) controls the operation of the EGR throttle valve. The position at which the PCM will set the valve depends on the blended quantity of exhaust gas that needs to be recirculated into the engine in order for the exhaust gas to remain within the target emission level, which the PCM calculates based on input received from the oxygen sensors. When not actuated, the EGR throttle valve is in the open position.

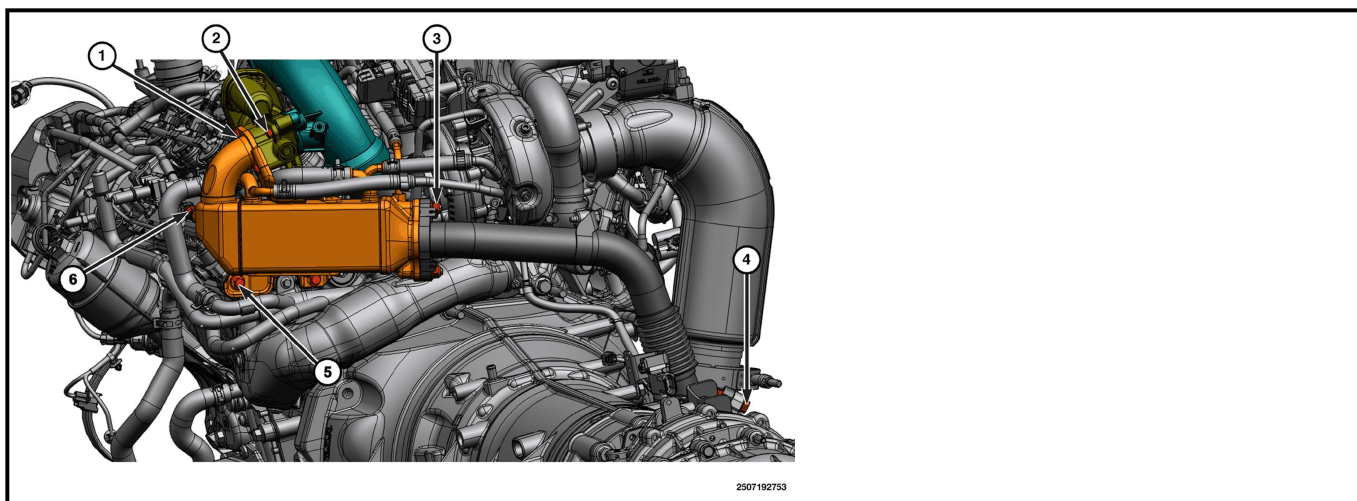
TECHNICAL SPECIFICATIONS

EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

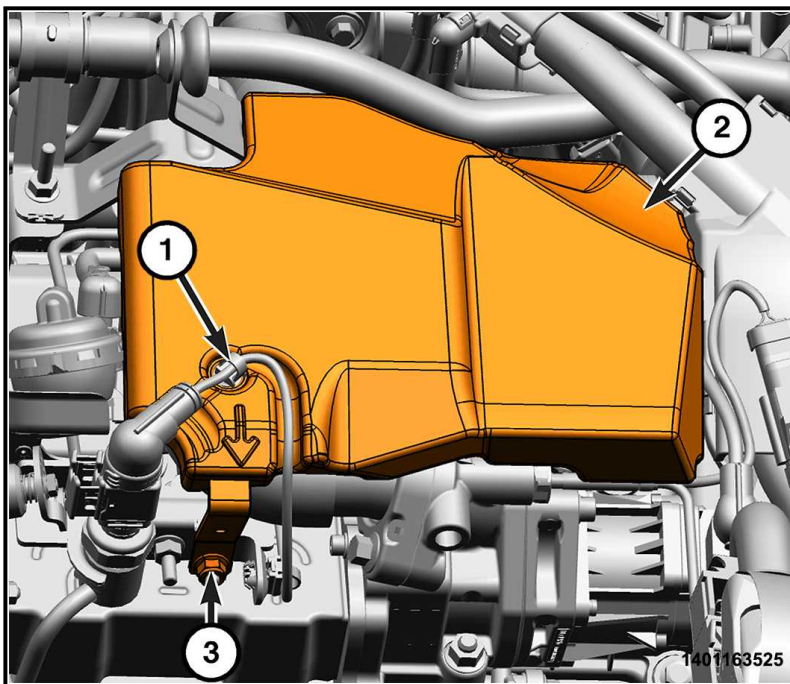
SENSOR, EGR TEMPERATURE

REMOVAL AND INSTALLATION

HIGH PRESSURE EGR TEMPERATURE SENSOR

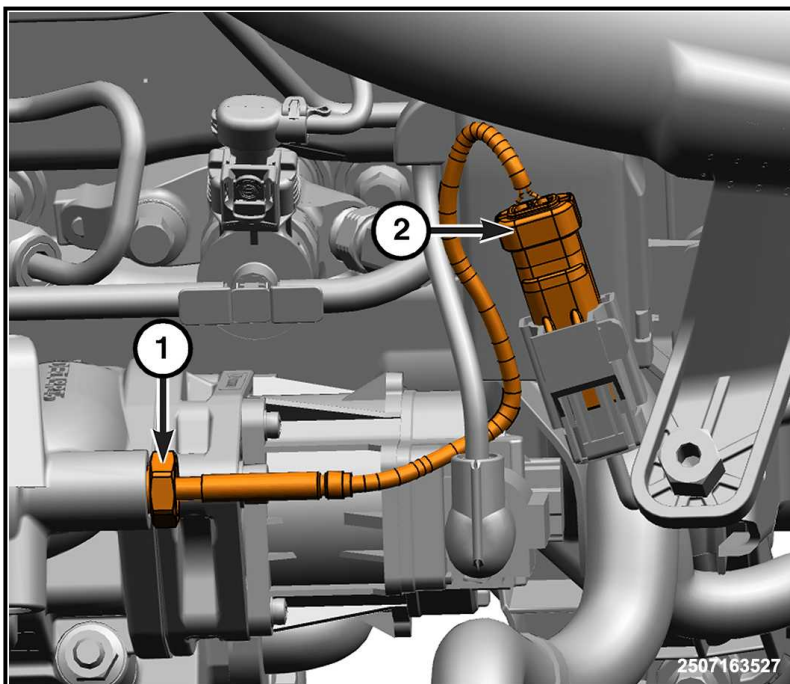
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



- | |
|-------------------------------|
| 1 - Wire Harness Retainer |
| 2 - Right Fuel Rail Cover |
| 3 - Right Fuel Rail Cover Nut |

3. Loosen the right fuel rail cover nut, detach the wire harness retainer and remove the right fuel rail cover.



- | |
|---|
| 1 - EGR Temperature Sensor |
| 2 - EGR Temperature Sensor Wire Harness Connector |

4. Disconnect the Exhaust Gas Recirculation (EGR) temperature sensor wire harness connector.
5. Remove the EGR temperature sensor from EGR valve.

INSTALLATION

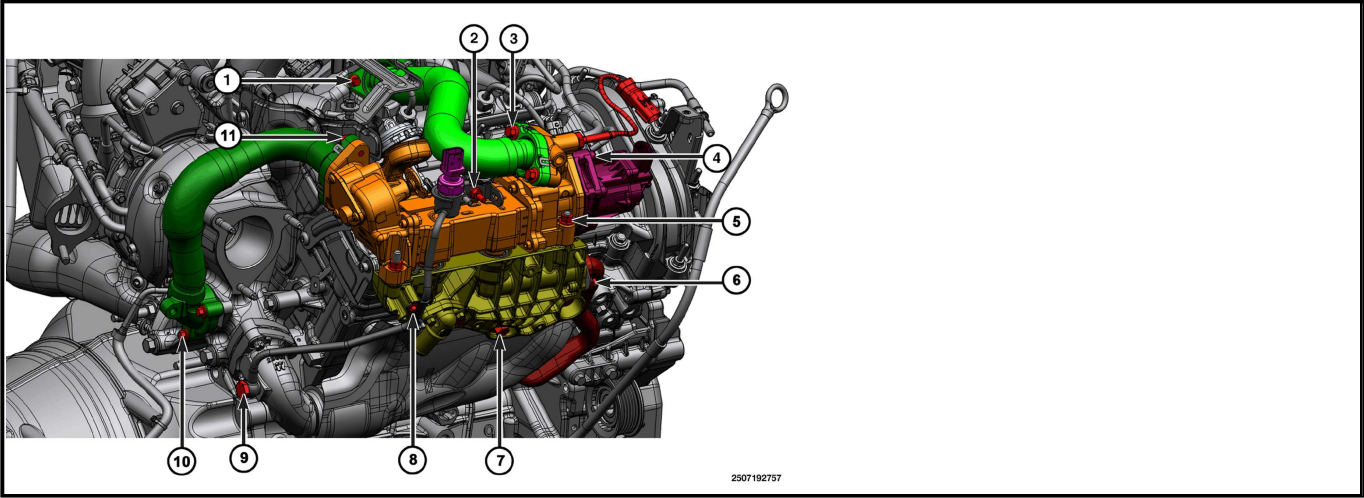
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the mounting area of the Exhaust Gas Recirculation (EGR) temperature sensor on the EGR valve.
- Install the fuel rail cover and securely tighten the fuel rail cover nut.

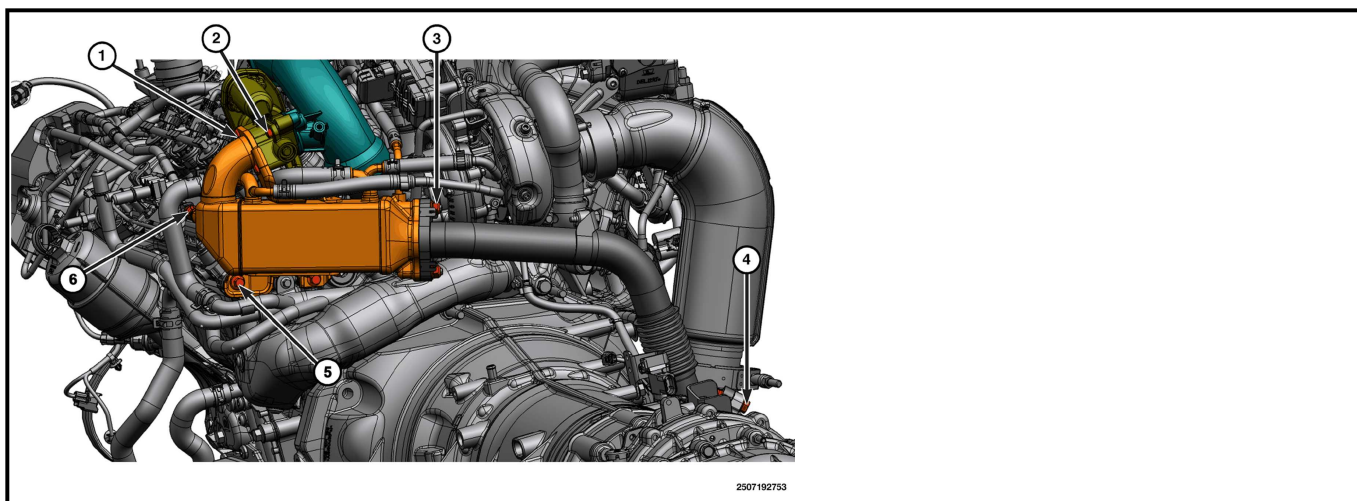
TORQUE SPECIFICATIONS

EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

LOW PRESSURE EGR TEMPERATURE SENSOR

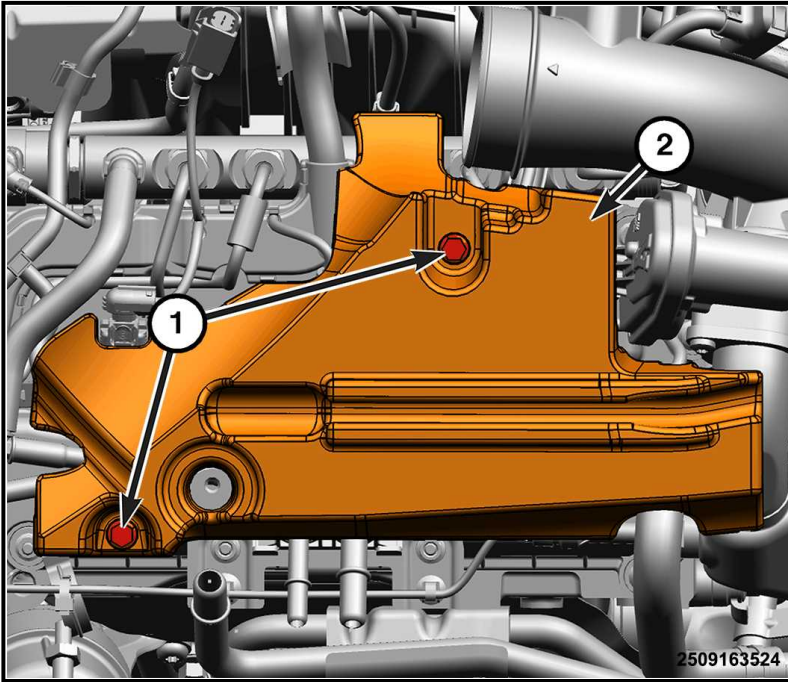
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
3. Remove the clean air hose. Refer to [HOSE, CLEAN AIR, REMOVAL AND INSTALLATION](#) .



1 - Vent Hose

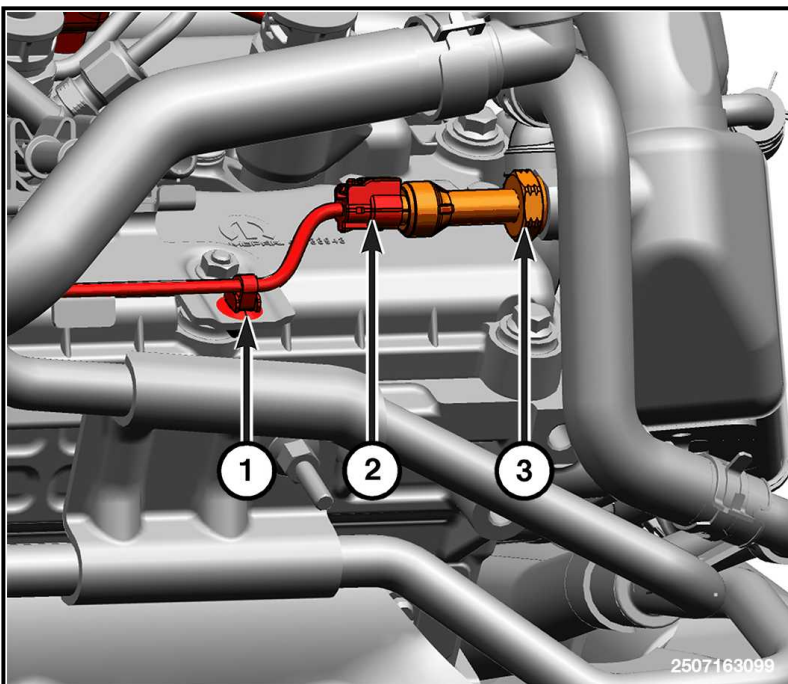
4. Remove the vent hose from the left fuel rail cover.



1 - Left Fuel Rail Cover Bolts

2 - Left Fuel Rail Cover

5. Remove the left fuel rail cover bolts and the left fuel rail cover.



1 - Wire Harness Retainer

2 - Low Pressure EGR Temperature Sensor Wire Harness Connector
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3 - Low Pressure EGR Temperature Sensor

6. Disconnect the Low Pressure (LP) Exhaust Gas Recirculation (EGR) temperature sensor wire harness connector.
7. Remove the LP EGR temperature sensor.

INSTALLATION

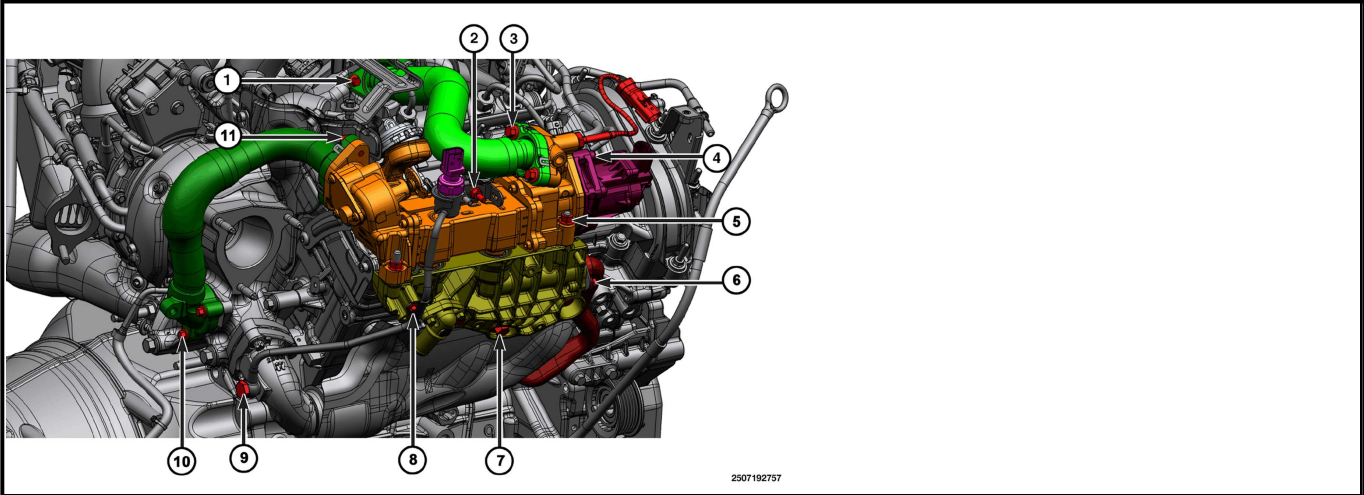
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the mounting area of the LP EGR temperature sensor.
- Install the fuel rail cover and securely tighten the bolts.

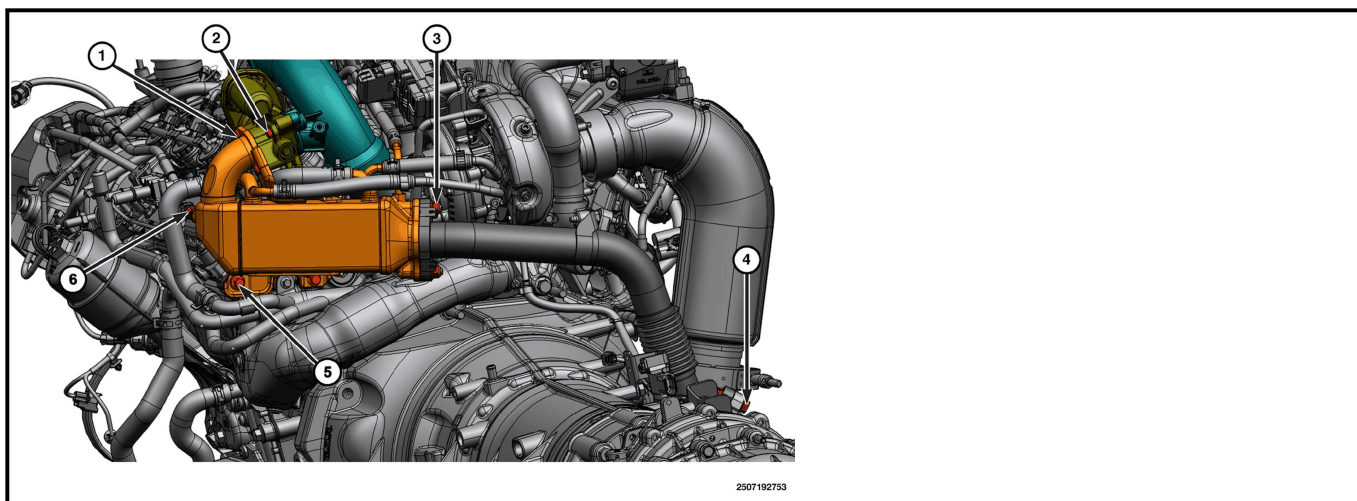
TORQUE SPECIFICATIONS

EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

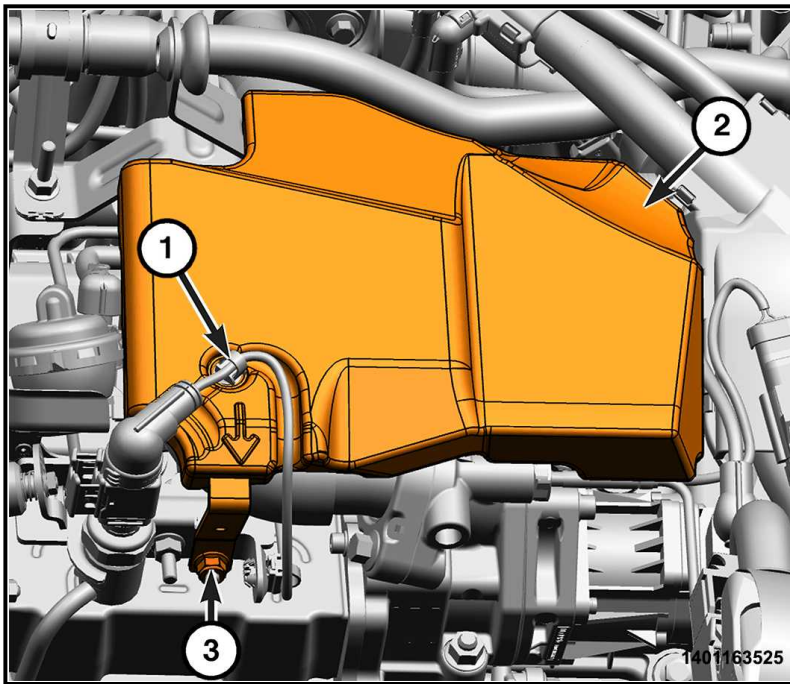
COOLER, EXHAUST GAS RECIRCULATION (EGR)

REMOVAL AND INSTALLATION

HIGH PRESSURE EGR COOLER

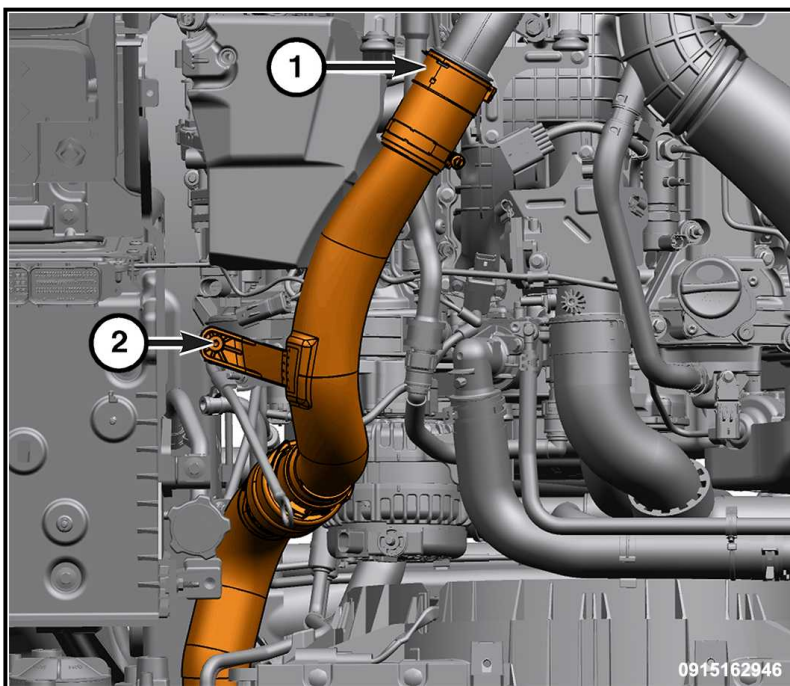
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
3. Drain the cooling system. Refer to [COOLING SYSTEM](#) .
4. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



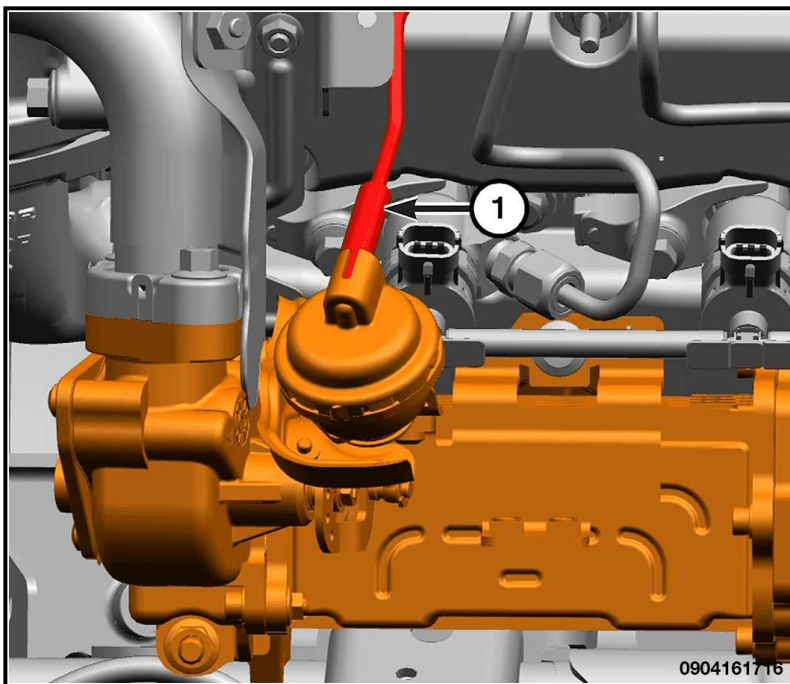
- | |
|-------------------------------|
| 1 - Wire Harness Retainer |
| 2 - Right Fuel Rail Cover |
| 3 - Right Fuel Rail Cover Nut |

5. Loosen the right fuel rail cover nut, detach the wire harness retainer and remove the right fuel rail cover.
6. Remove the upper high pressure Exhaust Gas Recirculation (EGR) tube. Refer to [TUBE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#).



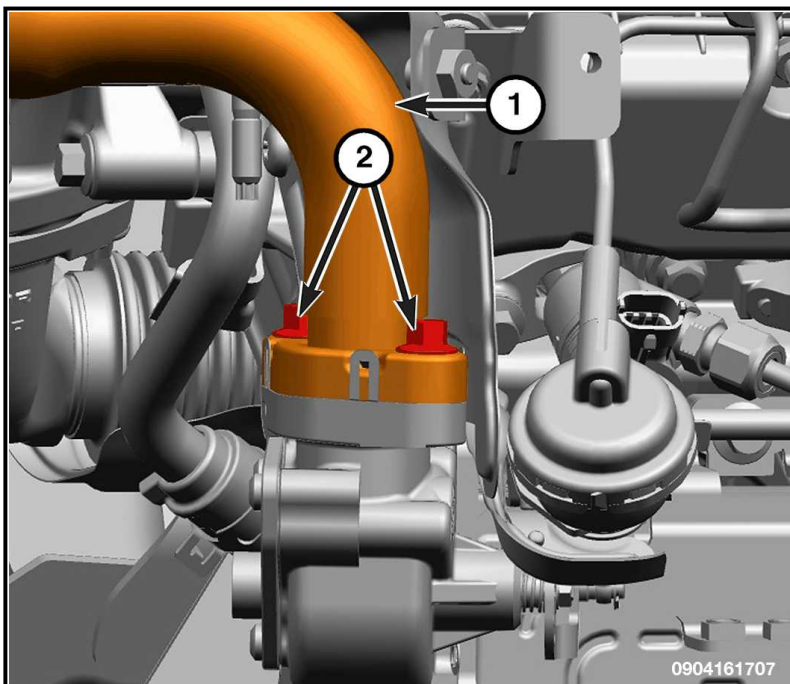
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|---|
| 1 - Retaining Clip |
| 2 - Charge Air Cooler Hose Support Bracket Bolt |

7. Remove the Charge Air Cooler (CAC) hose support bracket bolt.
8. Disconnect the vacuum hose from the vacuum pump.
9. Release the retaining clip, disconnect the CAC hose from the turbocharger elbow and position the CAC hose aside.



1 - EGR Cooler Vacuum Bypass Hose

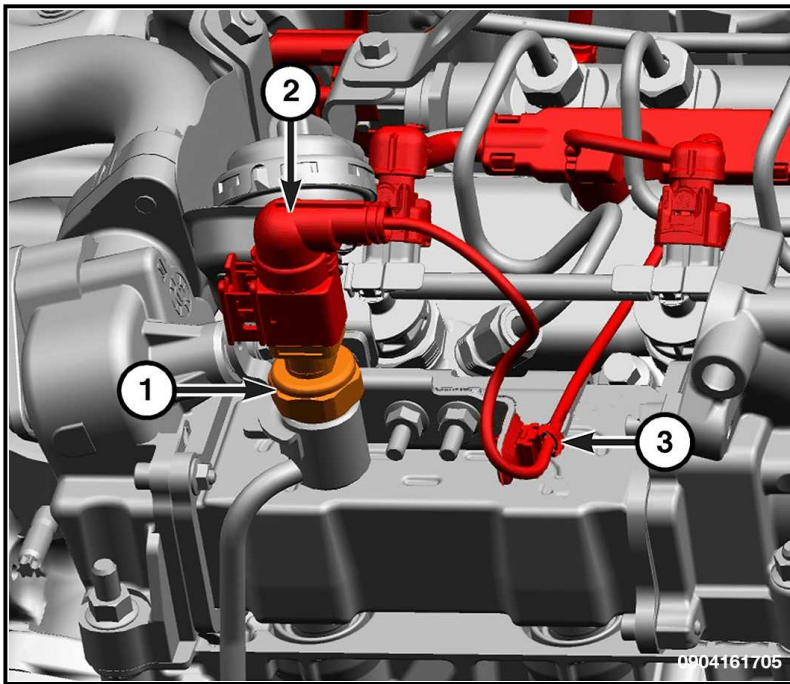
10. Disconnect the EGR cooler vacuum bypass hose.



1 - Lower EGR Tube

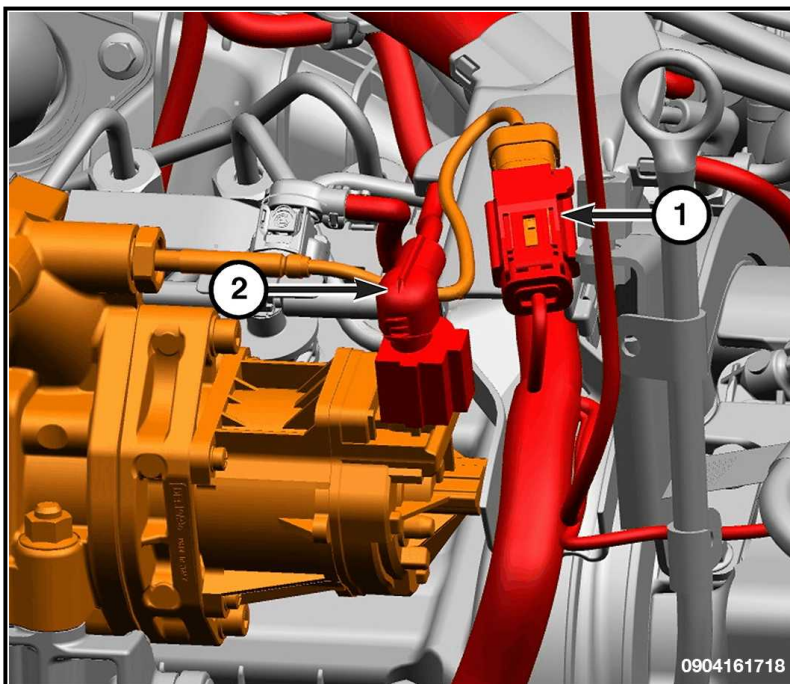
2 - Lower EGR Tube Bolts

11. Remove the lower EGR tube upper bolts securing the lower EGR tube.



- | |
|--|
| 1 - Exhaust Pressure Sensor |
| 2 - Exhaust Pressure Sensor Wire Harness Connector |
| 3 - Wire Harness Retainers |

12. Disconnect the exhaust pressure sensor wire harness connector.

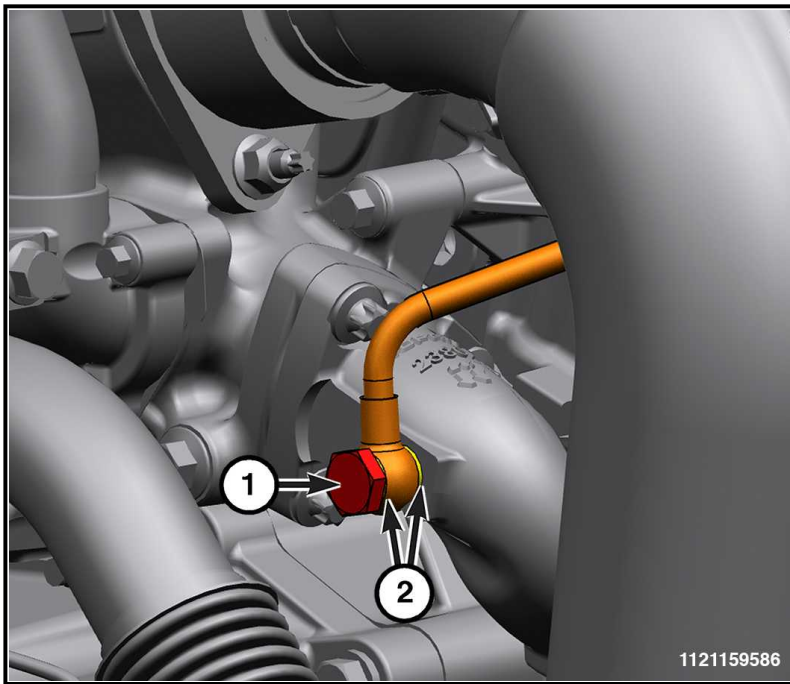


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|--|
| 1 - EGR Temperate Wire Harness Connector |
| 2 - EGR Valve Wire Harness Connector |

13. Disconnect the EGR valve wire harness connector.

14. Disconnect the EGR temperate wire harness connector.

15. Remove the right front wheelhouse splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) [SHIELD, SPLASH, REAR WHEELHOUSE, REMOVAL AND INSTALLATION](#) .

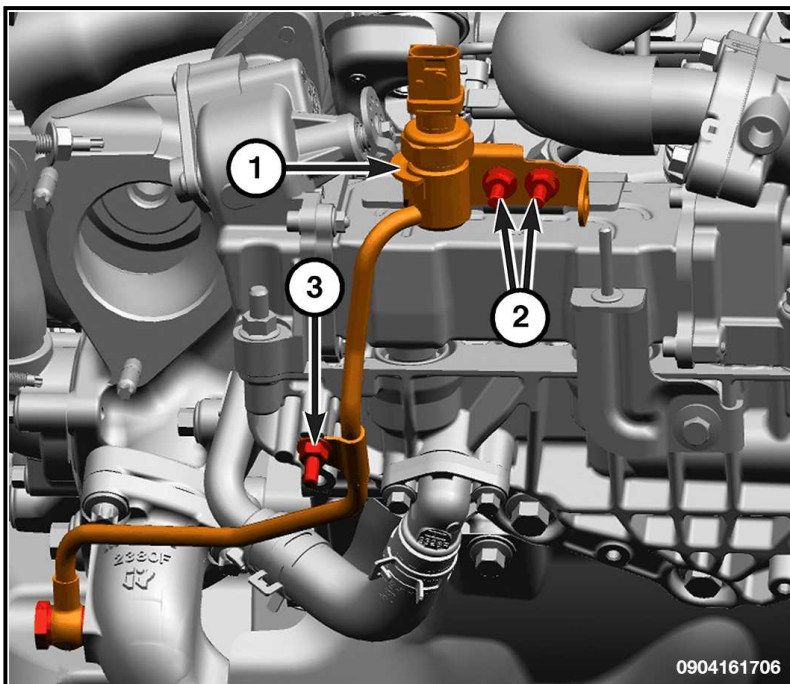


1 - Exhaust Pressure Sensor Tube Banjo Bolt

2 - Sealing Washers

16. Remove the exhaust pressure sensor tube banjo bolt and the sealing washers securing the exhaust pressure sensor tube to the exhaust manifold.

17. Remove and **DISCARD** the sealing washers.



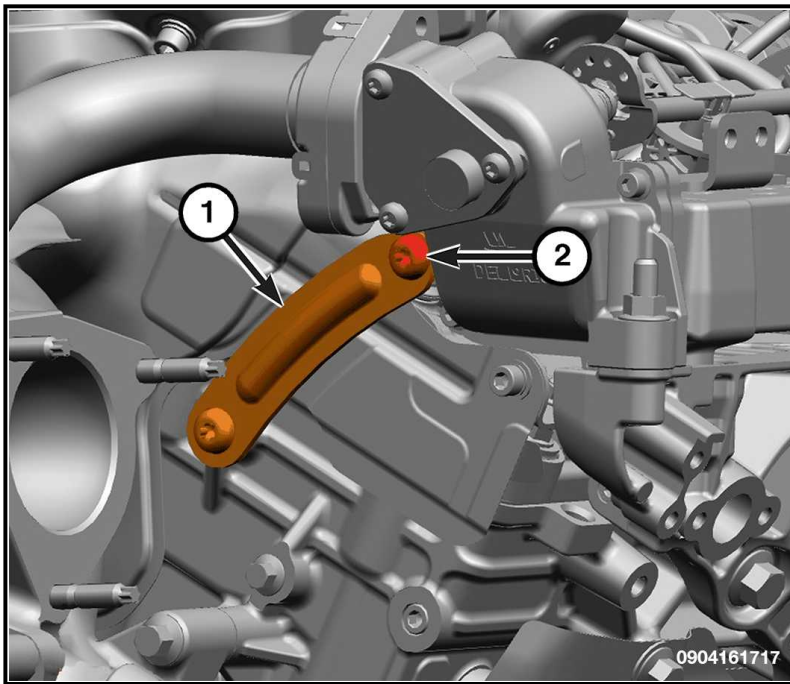
1 - Exhaust Pressure Sensor Tube

2 - Exhaust Pressure Sensor Tube Bolts

3 - Exhaust Pressure Sensor Tube Bolt

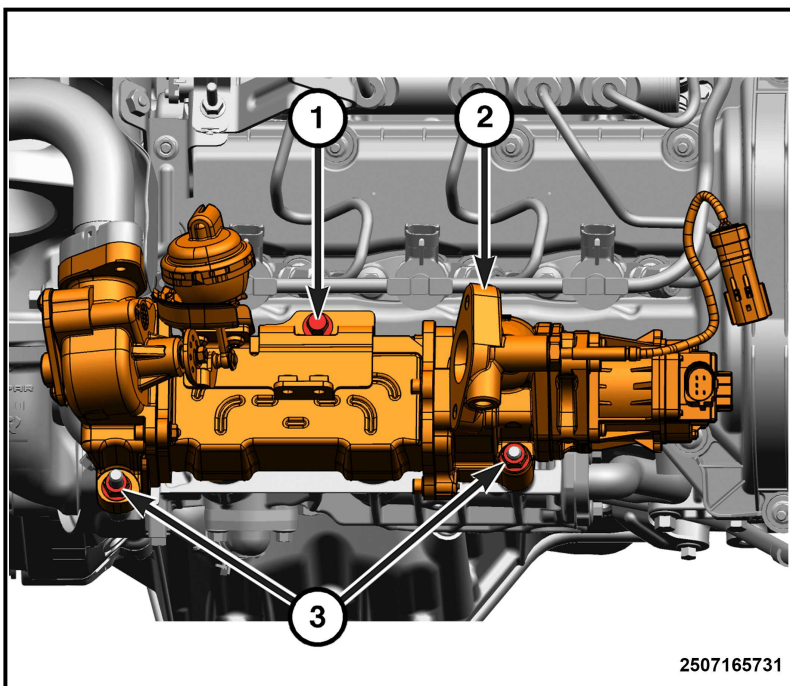
18. Remove the lower exhaust pressure sensor tube bolt securing the exhaust pressure sensor tube to EGR cooler manifold.

19. Remove the upper exhaust pressure sensor tube bolts and the exhaust pressure sensor tube.



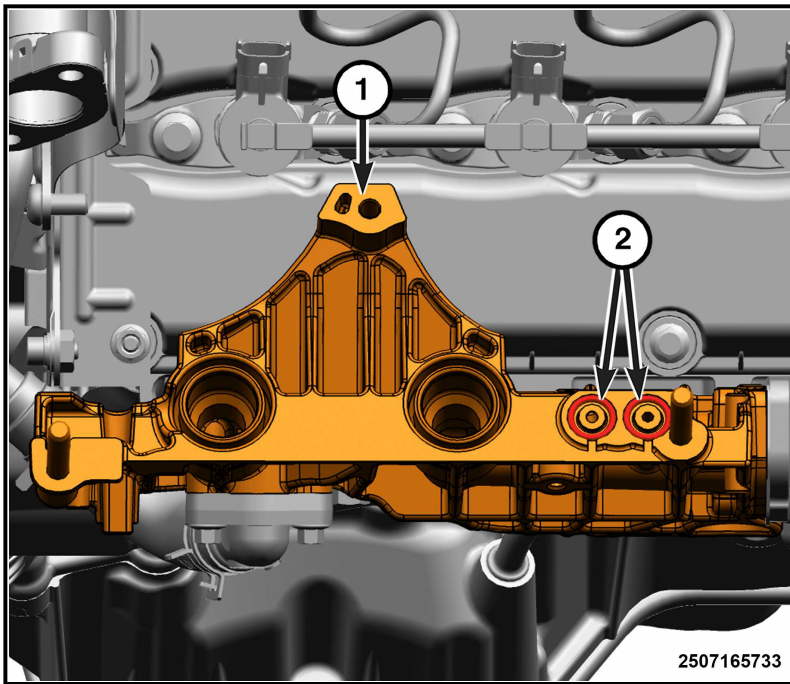
1 - EGR Cooler Bypass Valve Support Bracket
2 - EGR Cooler Bypass Valve Support Bracket Bolt

20. Remove the EGR cooler bypass valve support bracket bolt from the rear EGR cooler bypass valve support bracket.



1 - EGR Cooler Bolt
2 - EGR Cooler
3 - EGR Cooler Nuts

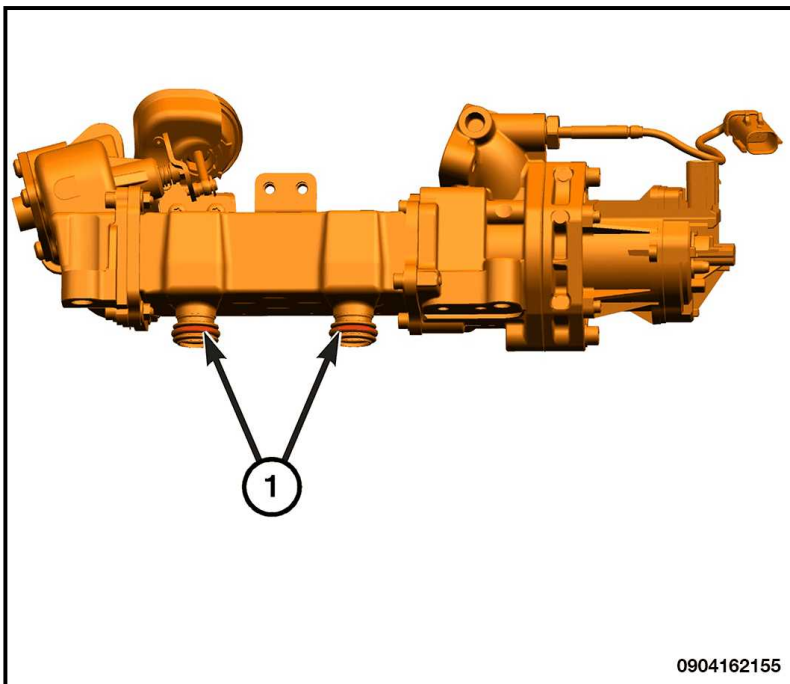
21. Remove the EGR cooler bolt, nuts and separate the EGR cooler assembly from the mounting bracket.



1 - EGR Cooler Mounting Bracket

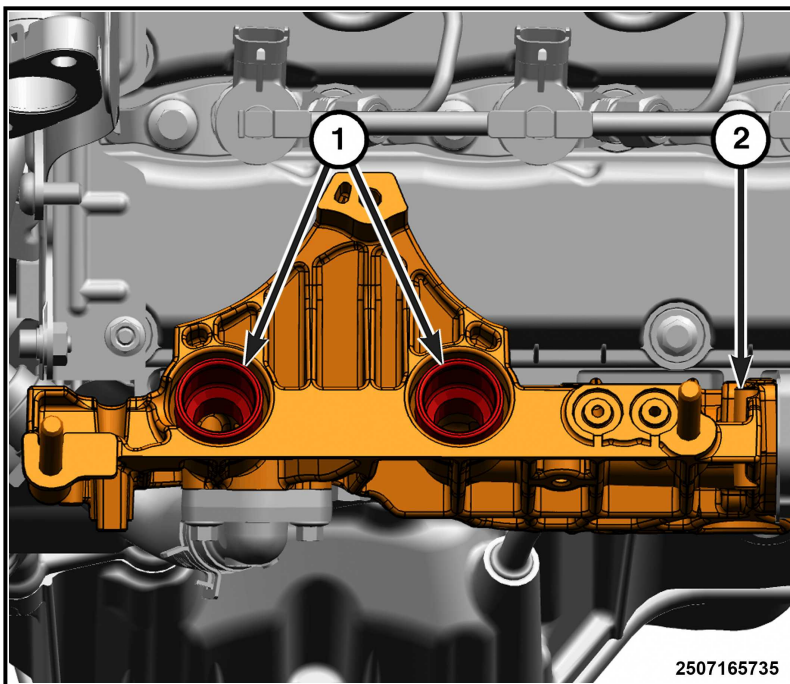
2 - O-rings

22. Remove and **DISCARD** the O-rings from the EGR cooler mounting bracket.



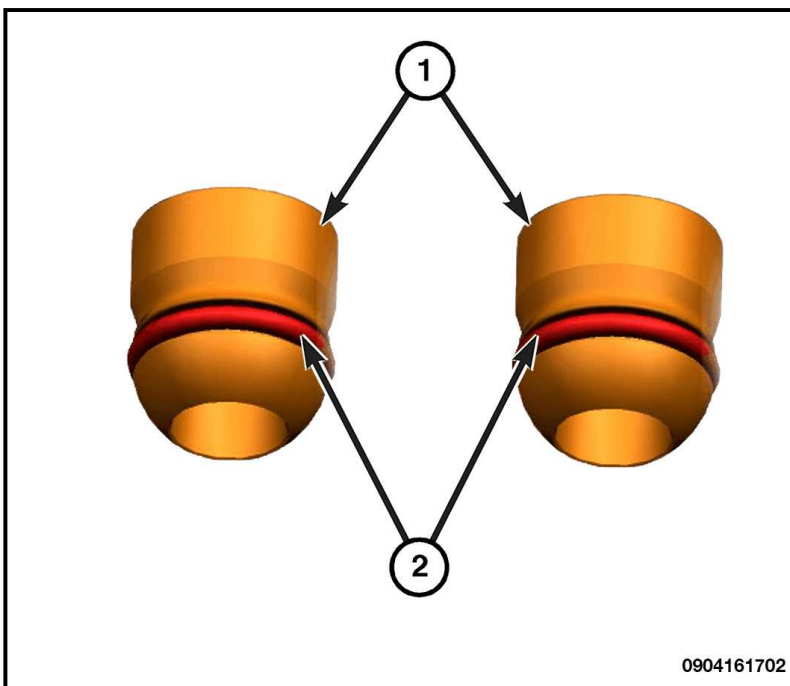
1 - O-rings

23. Remove and **DISCARD** the O-rings from the EGR cooler assembly.



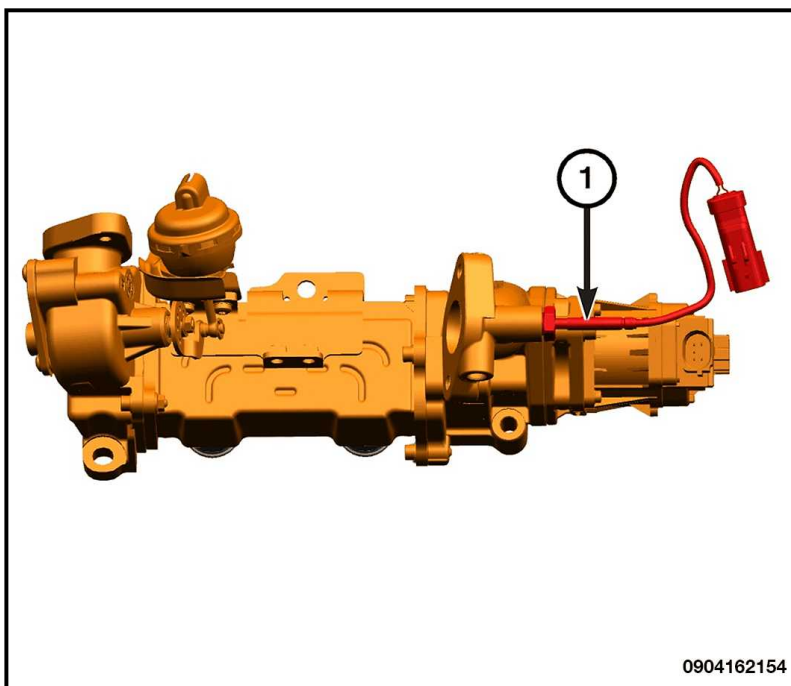
1 - Spacers
2 - EGR Cooler Mounting Bracket

24. Remove the spacers from the EGR cooler mounting bracket.



1 - Spacers
2 - O-ring

25. Remove and **DISCARD** the O-rings from the spacers.



1 - EGR Temperature Sensor

NOTE: The EGR temperature sensor does not have a gasket or seal ring.

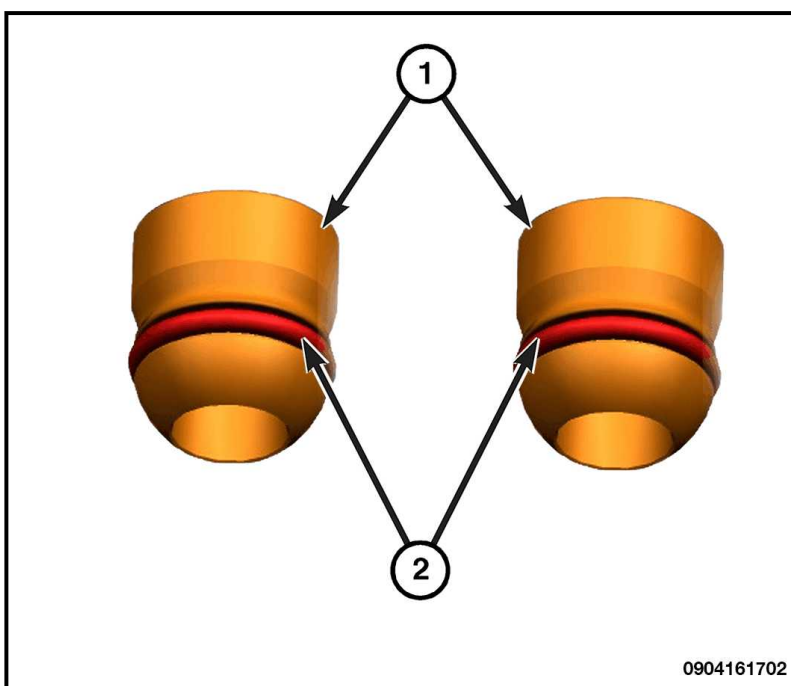
26. If necessary, remove the EGR temperature sensor.
27. If necessary, remove the high pressure Exhaust Gas Recirculation (EGR) valve. Refer to [VALVE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#).

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean all O-ring and gasket sealing surfaces.

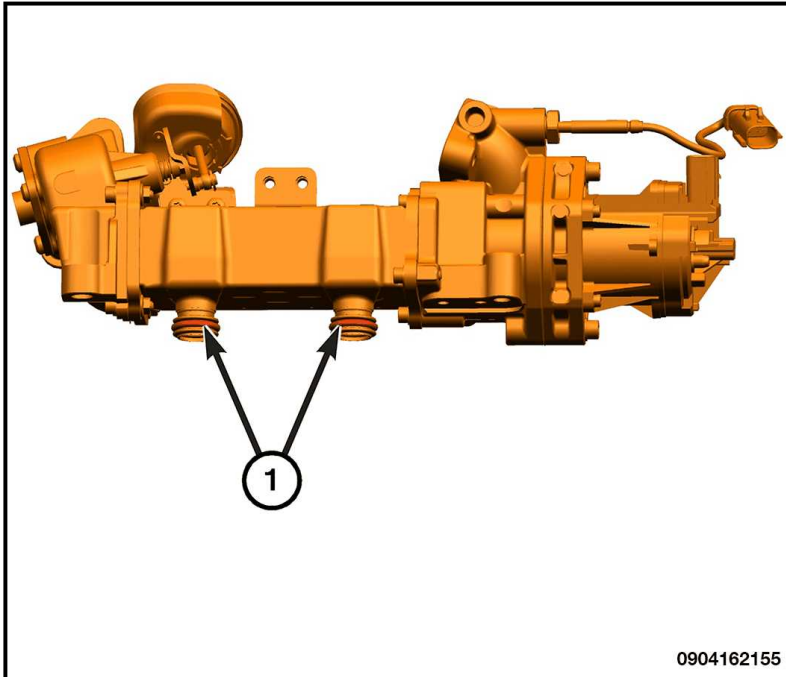


1 - Spacers

2 - O-ring

NOTE: Lubricate the O-rings with a non-hydrocarbon based lubricants such as Molycote 111 can be used.

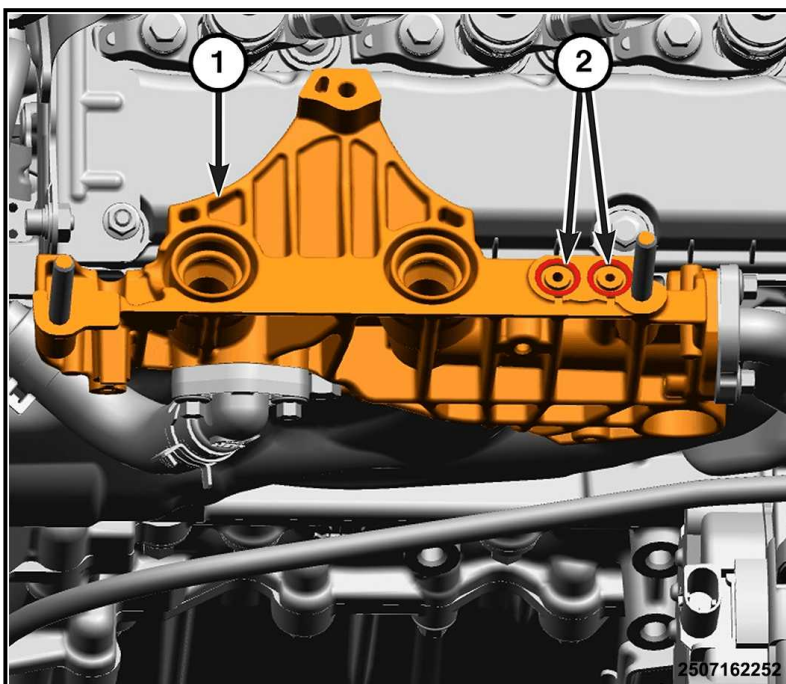
- Lubricate and install **NEW** lower O-rings onto the spacers.



1 - O-rings

NOTE: Lubricate the O-rings with a non-hydrocarbon based lubricants such as Molycote 111 can be used.

- Lubricate and install **NEW** upper O-rings onto the EGR cooler assembly.



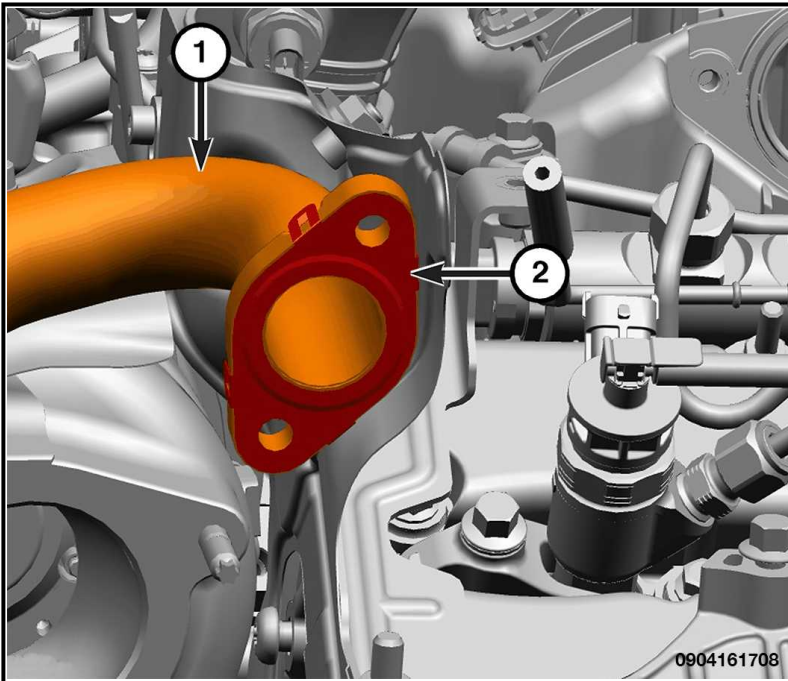
1 - EGR Cooler Mounting Bracket

2 - O-rings

NOTE:

Lubricate the O-rings with a non-hydrocarbon based lubricants such as Molycote 111 can be used.

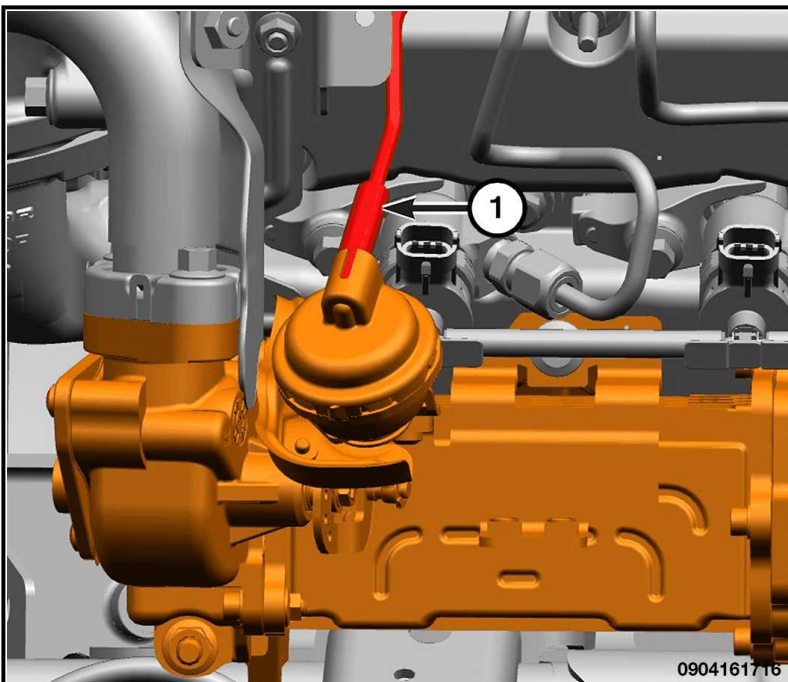
- Lubricate and install **NEW** O-rings onto the EGR cooler mounting bracket.



1 - Lower EGR Tube

2 - Gasket

- Install a **NEW** gasket on the lower EGR tube.
- Install **NEW** sealing washers on exhaust pressure sensor tube and banjo bolt.



1 - EGR cooler vacuum bypass hose

- Using a solution of soapy water, lubricate and connect the EGR cooler vacuum bypass hose.

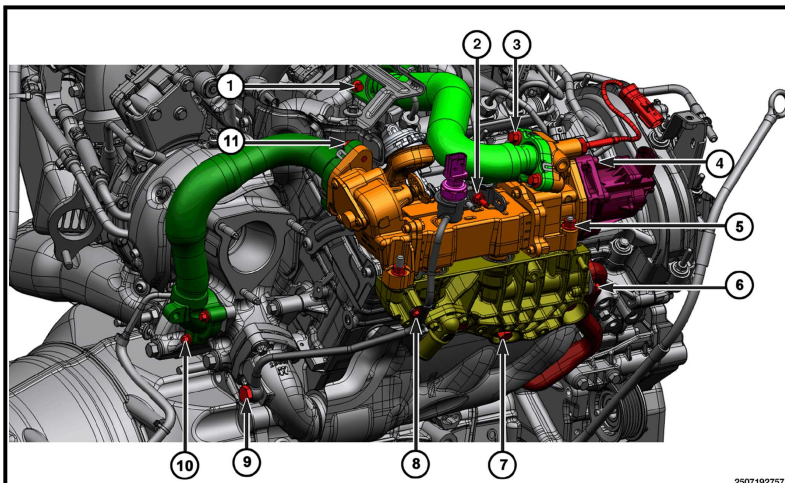


1 - Gap

- Verify that the vacuum hose is fully seated. If there is a gap, fully seat the hose.
- Install the Charge Air Cooler (CAC) hose to the support bracket bolt and securely tighten.
- Install the fuel rail cover and securely tighten the fuel rail cover nut.
- Fill the cooling system. Refer to **COOLING SYSTEM**.

TORQUE SPECIFICATIONS

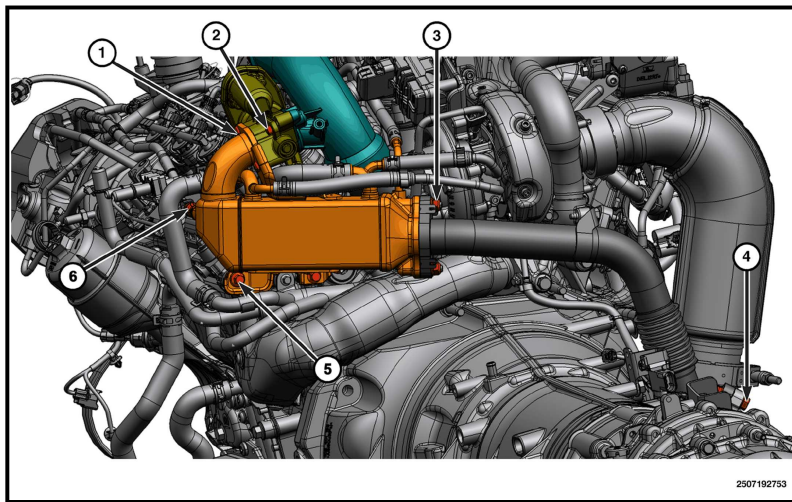
EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



EGR SYSTEM

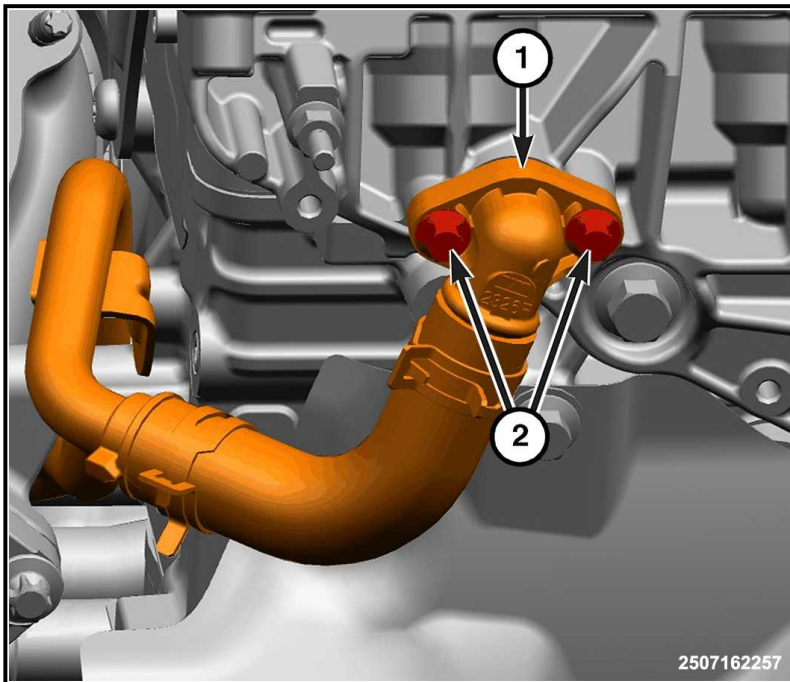
CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

HIGH PRESSURE EGR COOLER BRACKET

REMOVAL

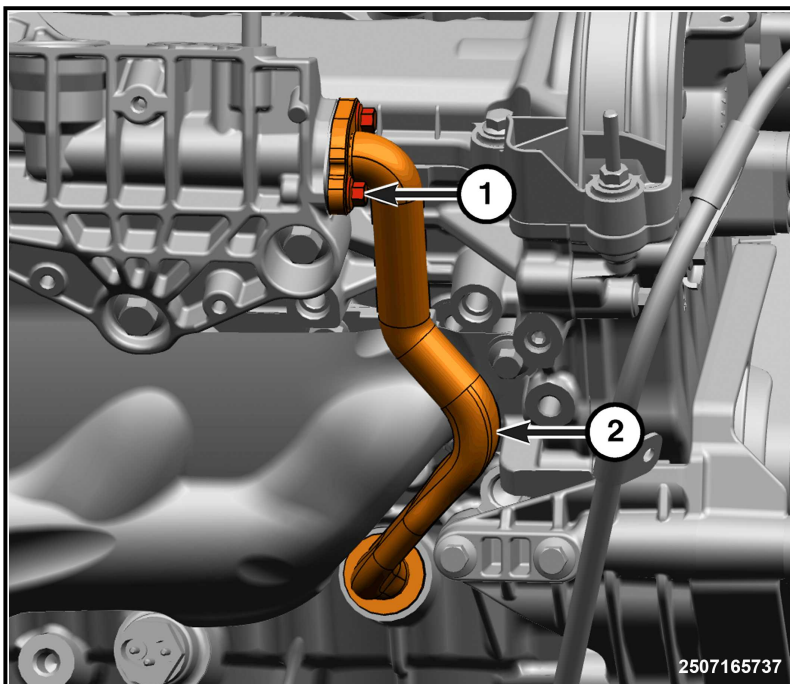
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Raise and support the vehicle. Refer to [HOISTING, STANDARD PROCEDURE](#) .
3. Remove the right front wheelhouse splash shield. Refer to [SHIELD, SPLASH, FRONT WHEELHOUSE, REMOVAL AND INSTALLATION](#) [SHIELD, SPLASH, REAR WHEELHOUSE, REMOVAL AND INSTALLATION](#) .
4. Drain the cooling system. Refer to [COOLING SYSTEM](#) .

5. Remove the high pressure upper EGR tube. Refer to [TUBE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#).
6. Remove the high pressure EGR cooler. Refer to [COOLER, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#).



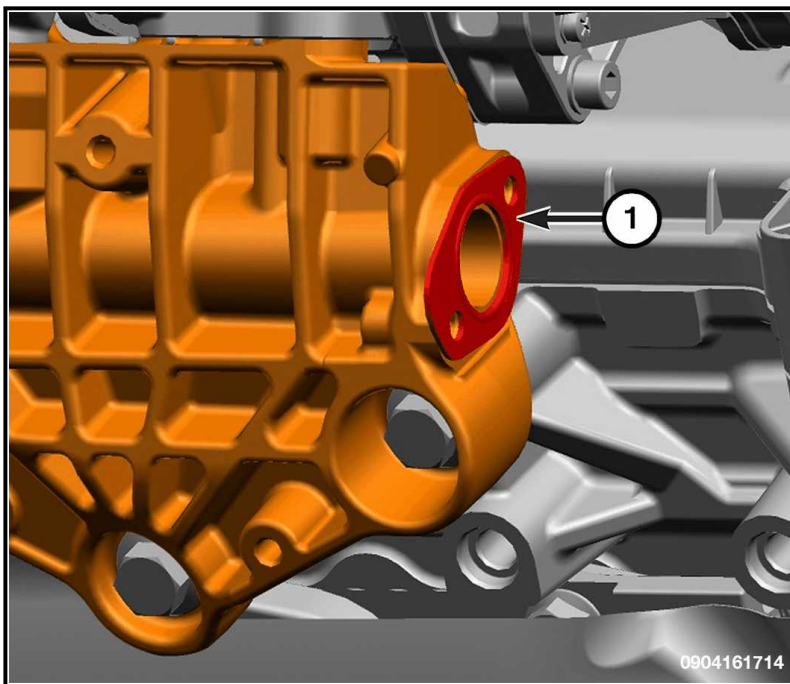
- | |
|------------------------|
| 1 - Coolant Tube |
| 2 - Coolant Tube Bolts |

7. Remove the coolant tube bolts and the coolant tube from the EGR cooler mounting bracket and **DISCARD** the O-ring seal.



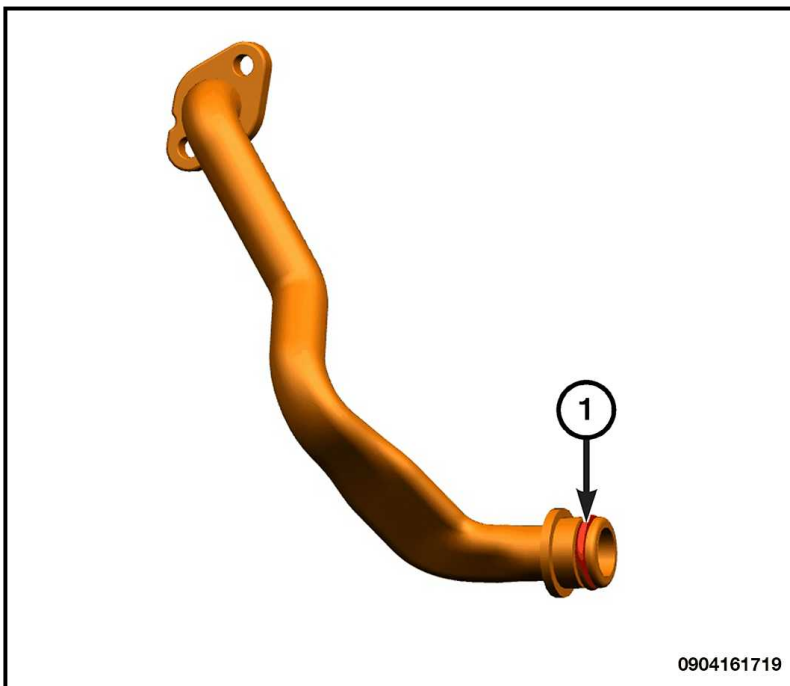
- | |
|------------------------|
| 1 - Coolant Tube Bolts |
| 2 - Coolant Tube |

8. Remove the coolant tube bolts and the coolant tube.



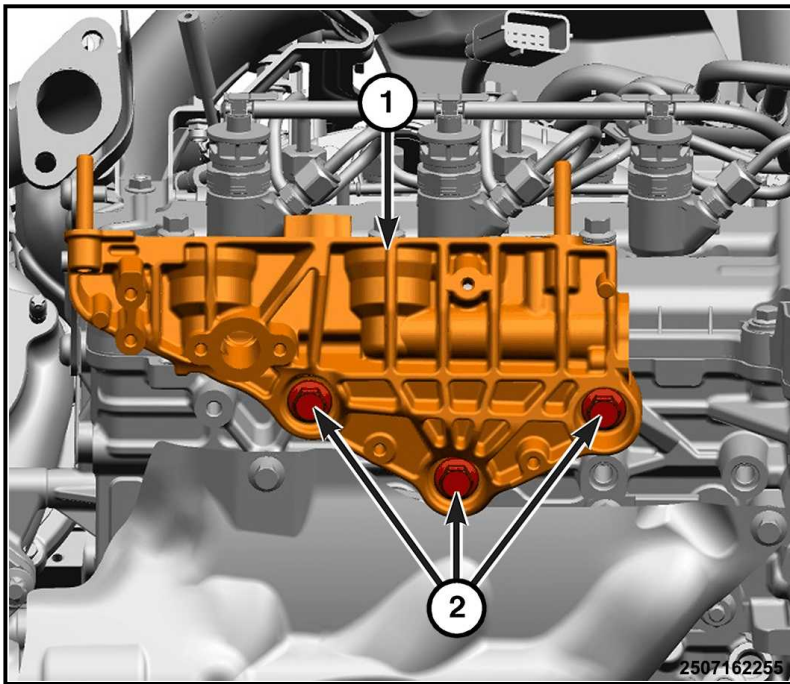
1 - Coolant Tube Gasket

9. Remove and **DISCARD** the coolant tube gasket.



1 - O-ring

10. Remove and **DISCARD** the coolant tube O-ring.



1 - High Pressure EGR Cooler Bracket
2 - High Pressure EGR Cooler Bracket Bolts

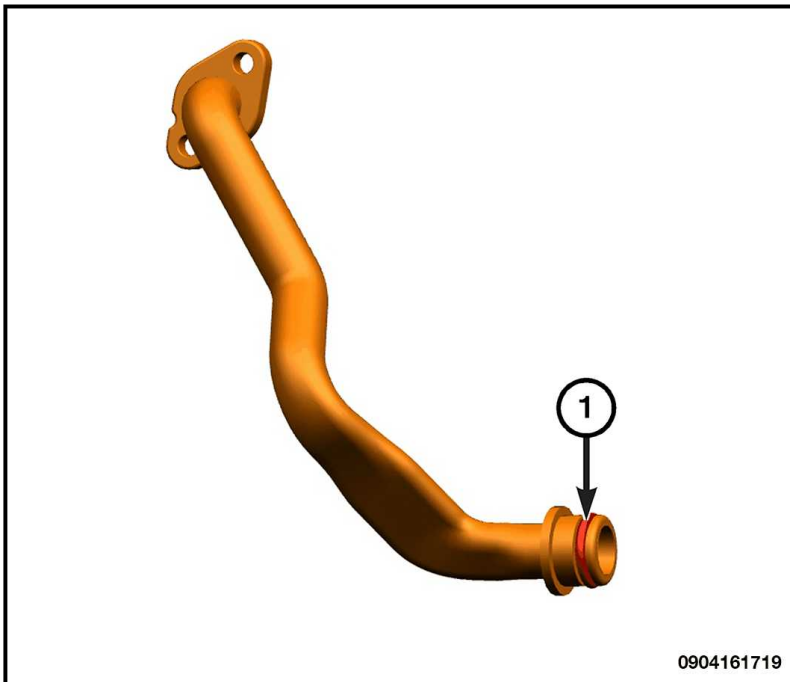
11. Remove the high pressure EGR cooler bracket bolts and the high pressure EGR cooler bracket.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

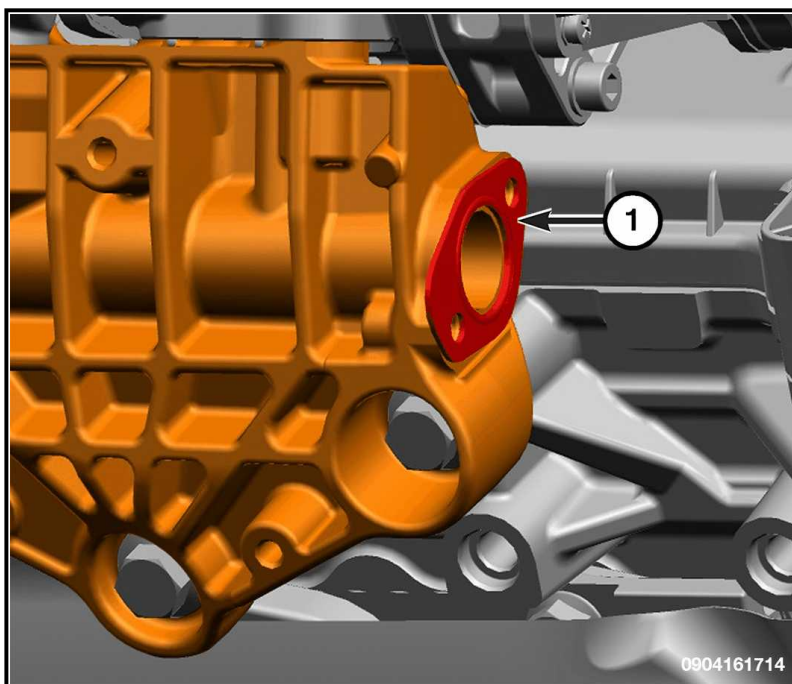
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean all O-ring and gasket sealing surfaces.



1 - O-ring

- Lubricate and install a **NEW** O-ring seal on the coolant tube.

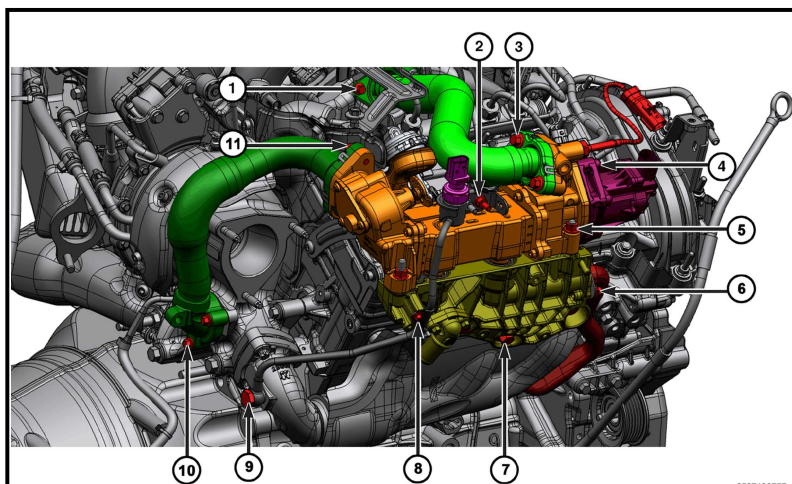


1 - Coolant Tube Gasket

- Install a **NEW** coolant tube gasket.
- Install a **NEW** O-ring on the coolant tube.
- Fill the cooling system. Refer to **COOLING SYSTEM** .

TORQUE SPECIFICATIONS

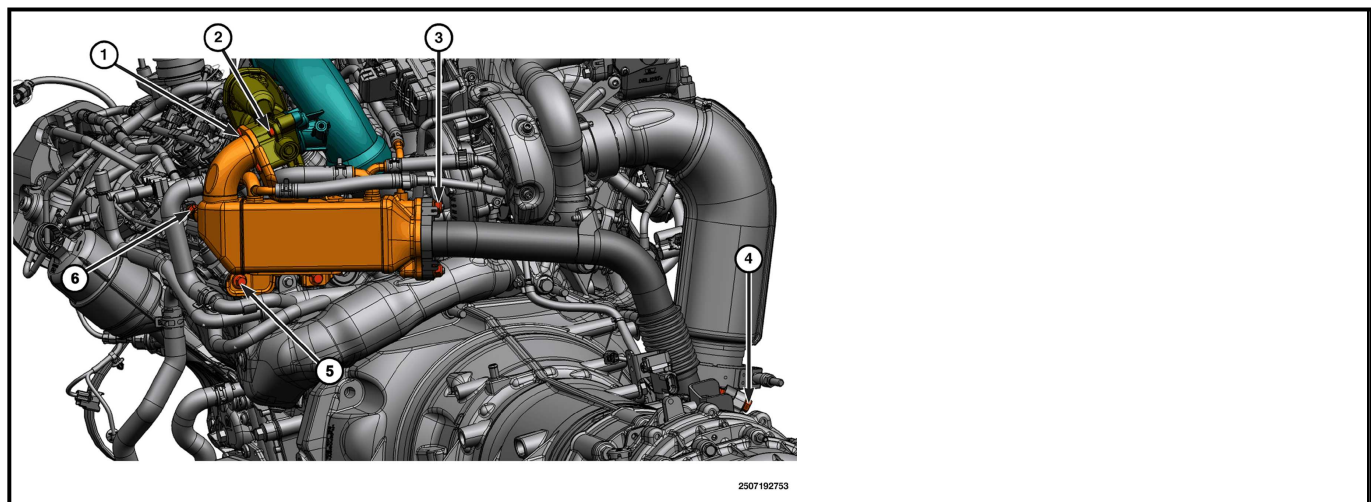
EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



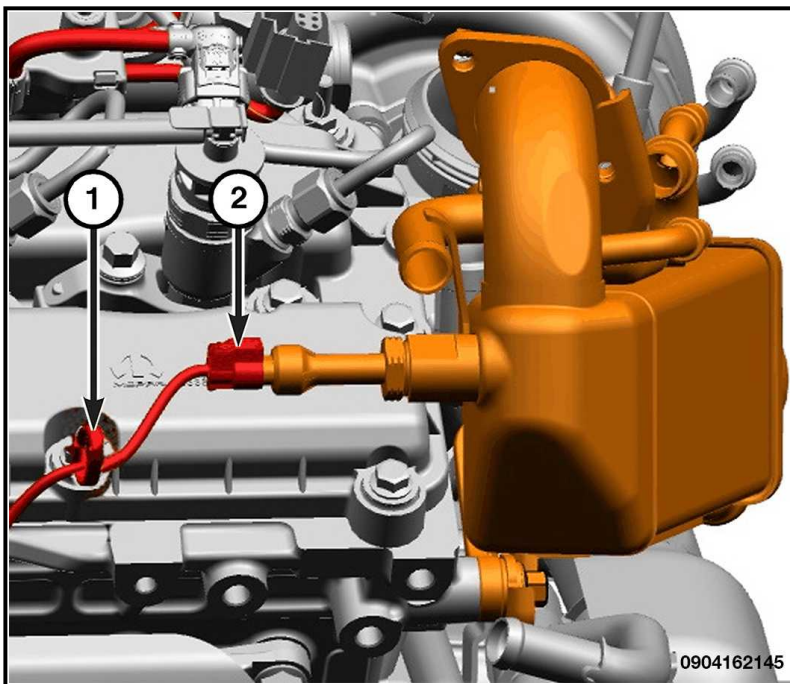
EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

LOW PRESSURE EGR COOLER

REMOVAL

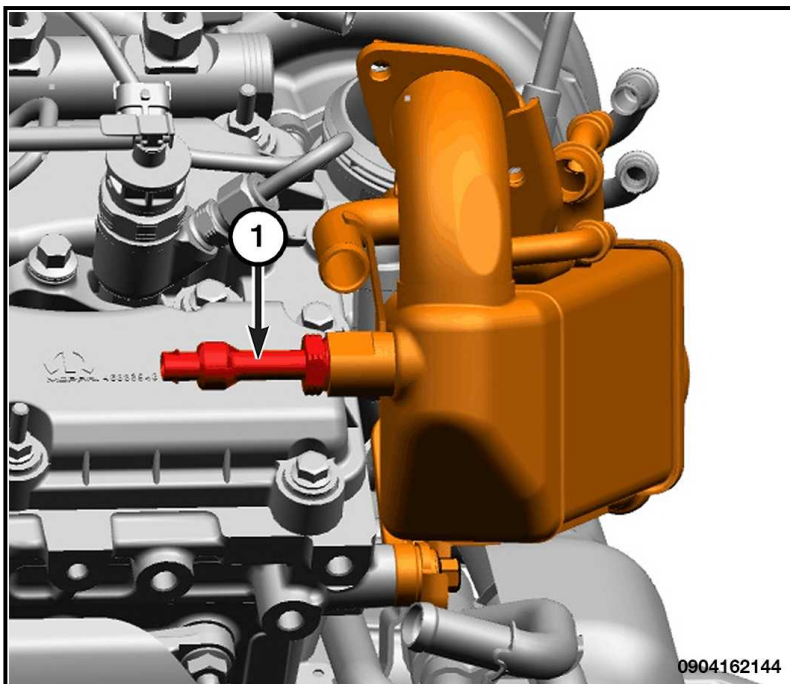
1. Remove the low pressure Exhaust Gas Recirculation (EGR) tube. Refer to [TUBE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#).
2. Remove the upper turbocharger inlet elbow. Refer to [COOLER AND HOSES, CHARGE AIR, REMOVAL AND INSTALLATION](#).
3. Remove the low pressure EGR valve. Refer to [VALVE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#).



1 - Wire Harness Retainer

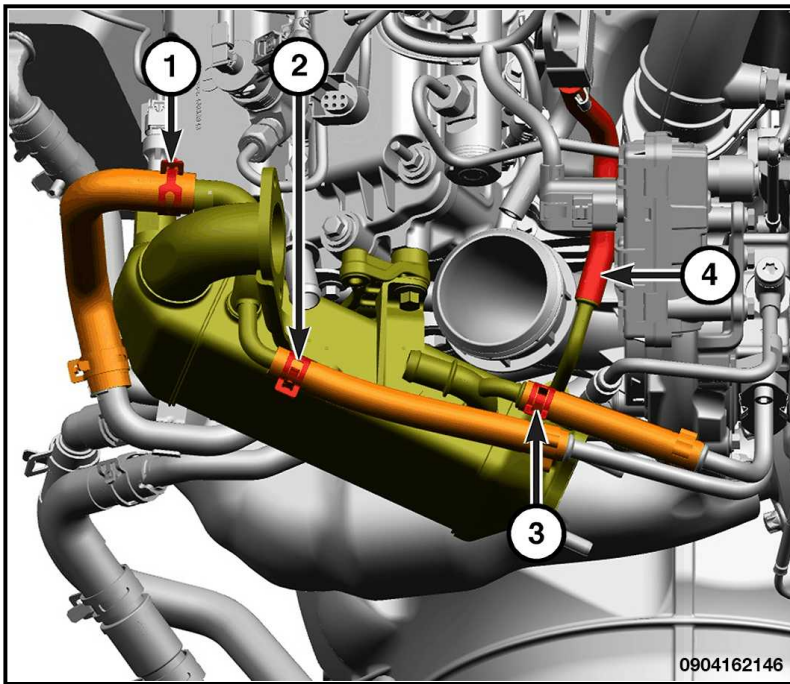
2 - Low Pressure EGR Temperature Sensor Wire Harness Connector

4. Disconnect the low pressure EGR temperature sensor wire harness connector.



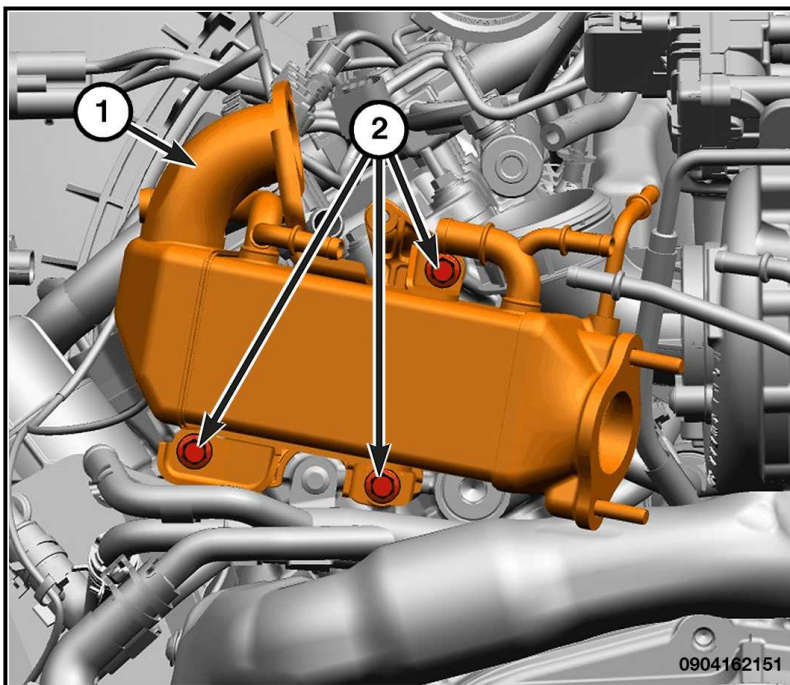
1 - Low Pressure EGR Temperature Sensor

5. Remove the low pressure EGR temperature sensor.



1 - Low Pressure EGR Cooler Return Hose
2 - Turbocharger Return Coolant Hose
3 - Turbocharger Supply Coolant Hose
4 - Differential Pressure Sensor Hose

6. Loosen the band clamp and remove the low pressure EGR cooler return hose.
7. Loosen the band clamp and remove the turbocharger supply coolant hose.
8. Loosen the band clamp and remove the turbocharger return coolant hose.
9. Remove the differential pressure sensor hose from the low pressure EGR cooler.



1 - Low Pressure EGR Cooler
2 - Low Pressure EGR Cooler Bolts

10. Remove the low pressure EGR cooler bolts and the low pressure EGR cooler.

INSTALLATION

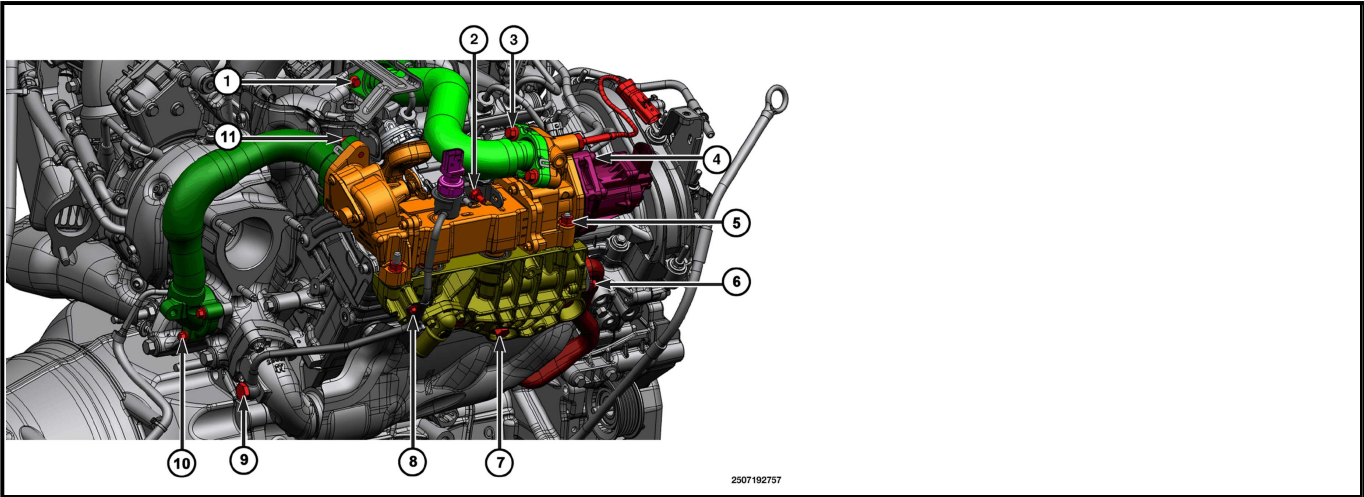
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the gasket sealing surfaces.

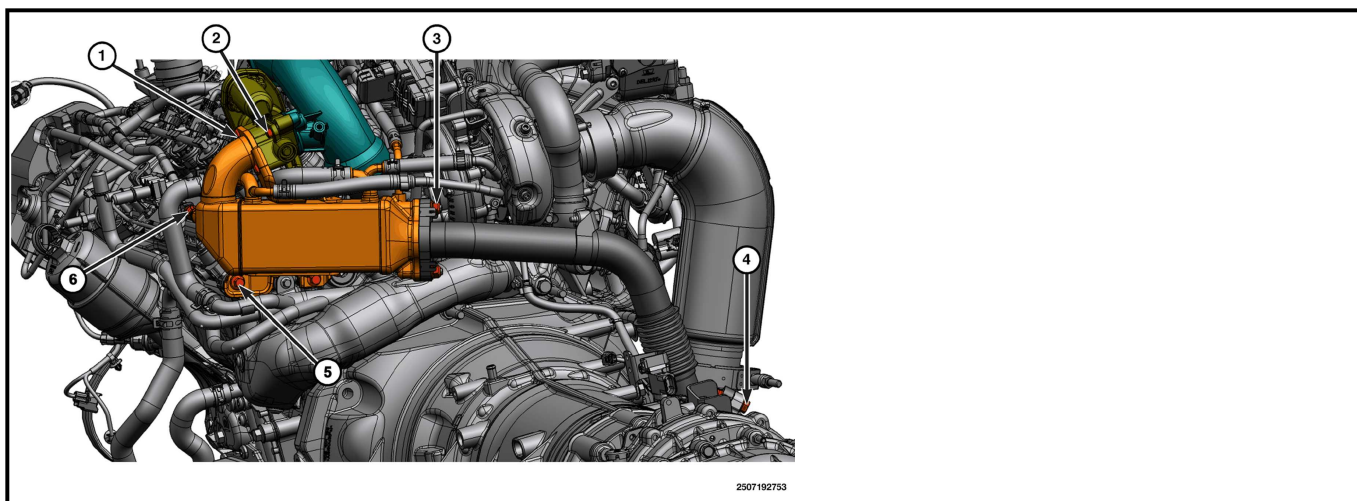
TORQUE SPECIFICATIONS

EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

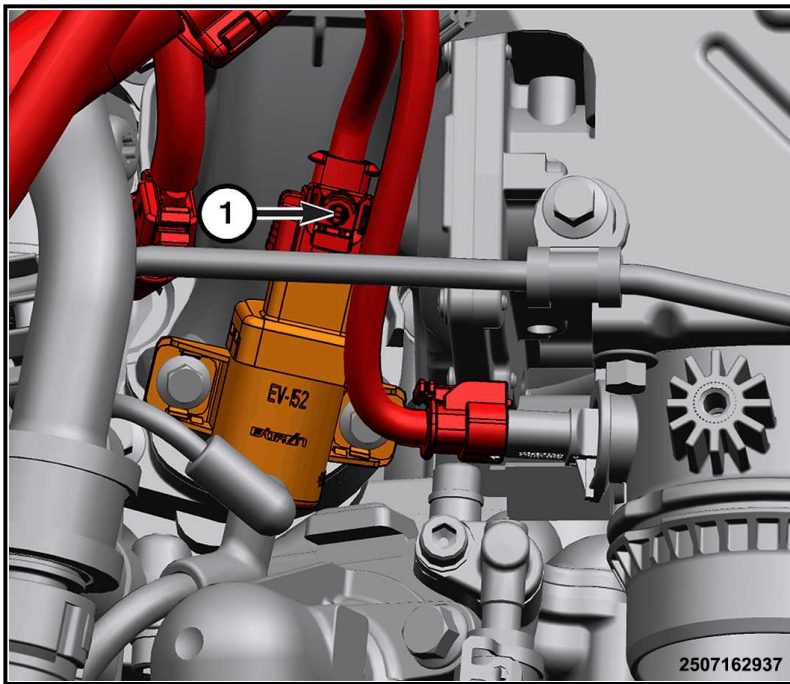
SOLENOID, VACUUM, EXHAUST GAS RECIRCULATION (EGR) BYPASS

REMOVAL AND INSTALLATION

EGR VACUUM SOLENOID

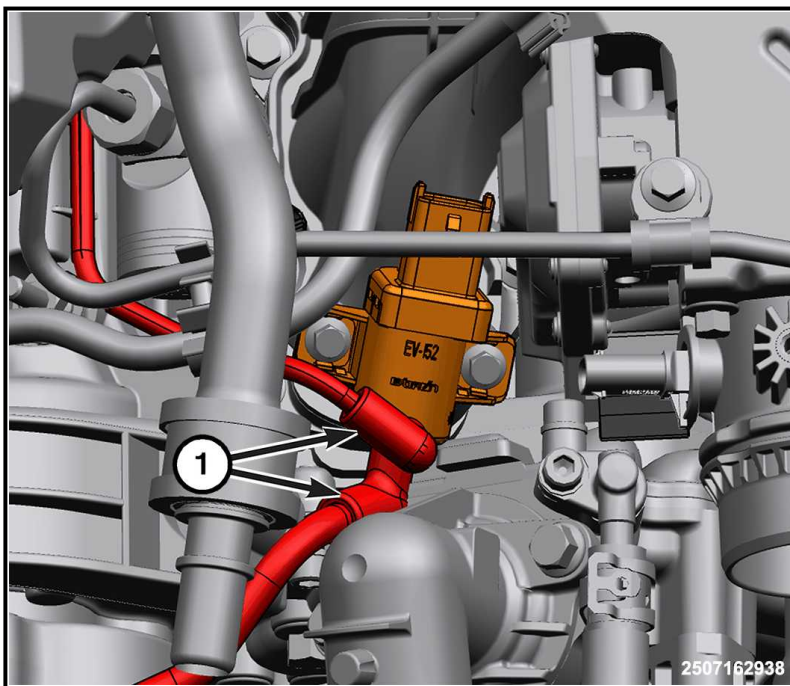
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



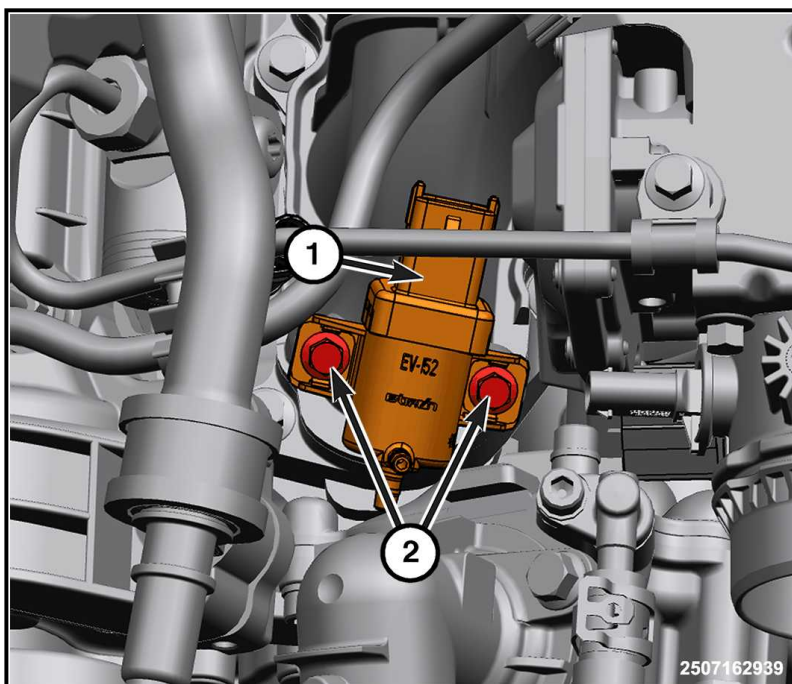
1 - EGR Vacuum Bypass Solenoid Wire Harness Connector

3. Disconnect the Exhaust Gas Recirculation (EGR) vacuum bypass solenoid wire harness connector.



1 - Vacuum Lines

4. Disconnect the vacuum lines.



- | |
|--------------------------------------|
| 1 - EGR Vacuum Bypass Solenoid |
| 2 - EGR Vacuum Bypass Solenoid Bolts |

5. Remove the EGR vacuum bypass solenoid bolts and the EGR vacuum bypass solenoid.

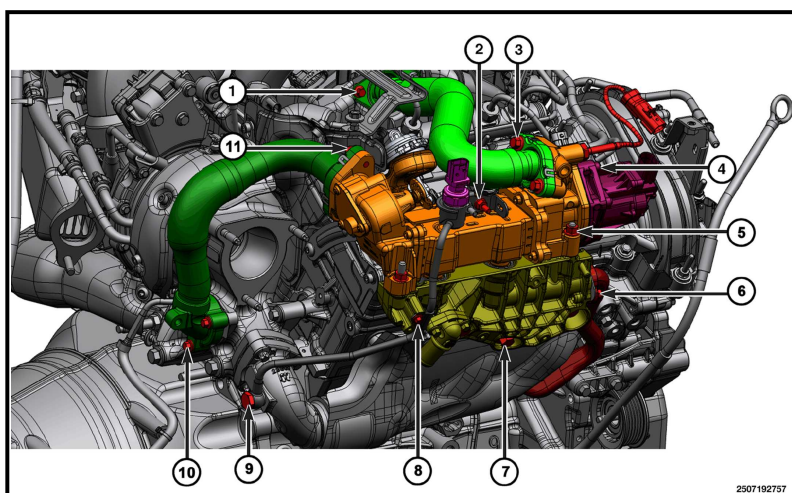
INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle.

TORQUE SPECIFICATIONS

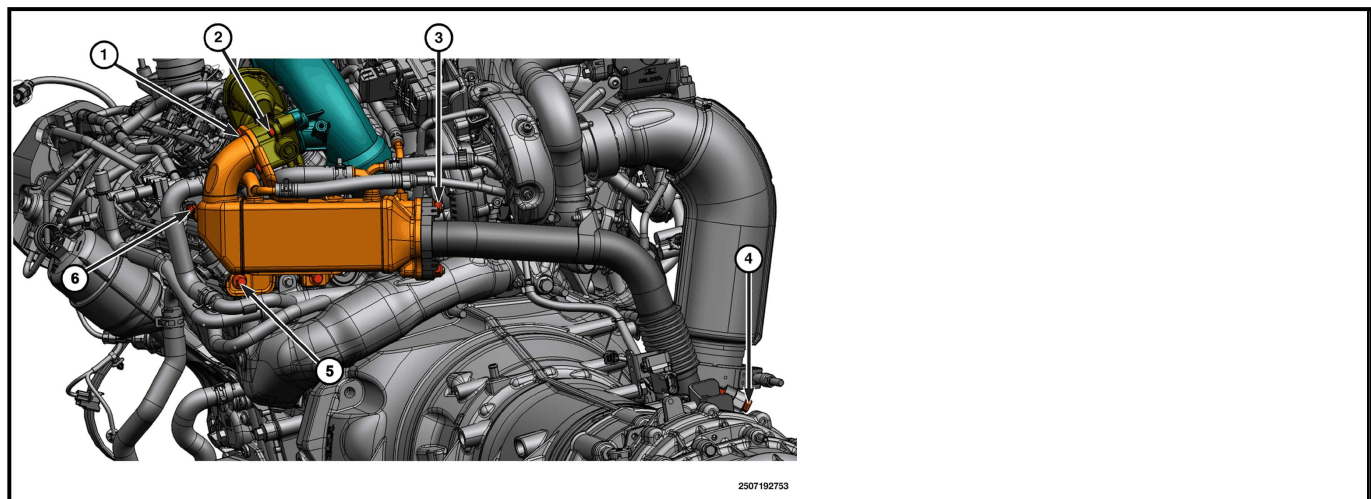
EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold	45 N.m (33 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
	Bolts		
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

TUBE, EXHAUST GAS RECIRCULATION (EGR)

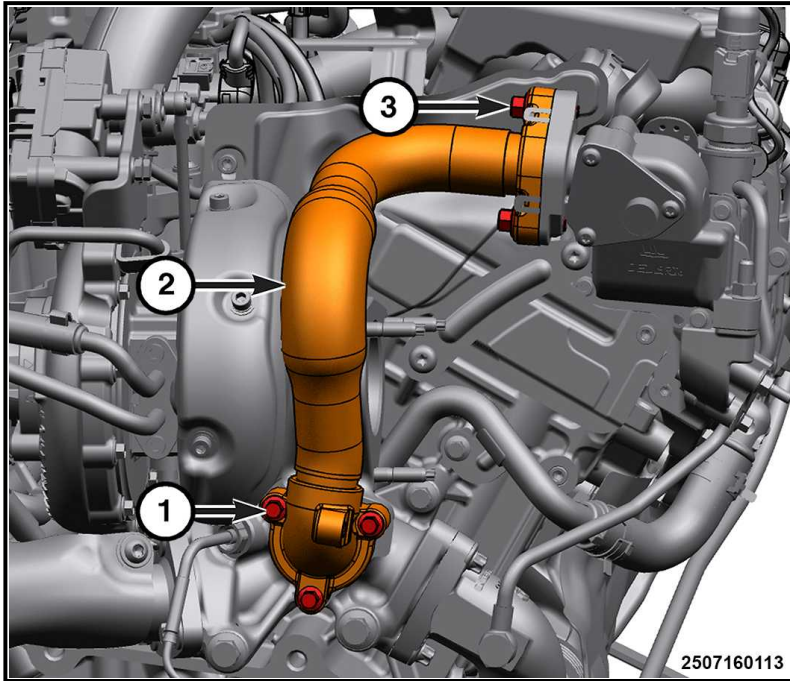
REMOVAL AND INSTALLATION

HIGH PRESSURE LOWER EGR TUBE

REMOVAL

1. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .

2. Remove the LP EGR tube. Refer to [TUBE, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#).



1 - EGR Tube Lower Bolts
2 - EGR Tube
3 - EGR Tube Upper Bolts

3. Remove the Exhaust Gas Recirculation (EGR) tube lower bolts.
4. Remove the upper EGR tube bolts and the EGR tube.
5. Remove and discard both gaskets.

INSTALLATION

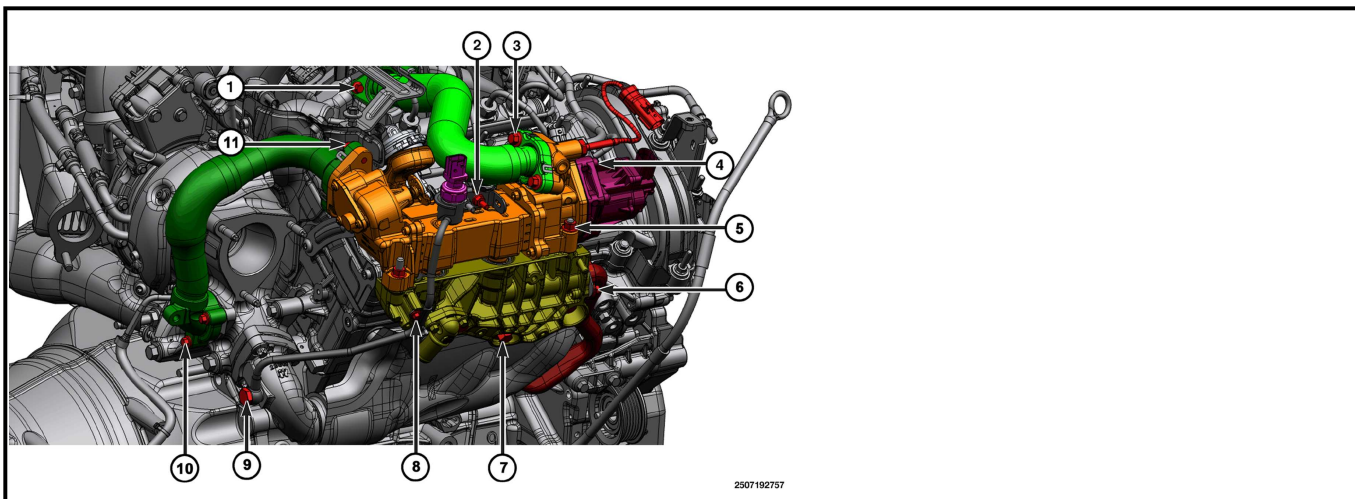
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean all gasket sealing areas.
- Install **NEW** lower EGR tube gaskets.

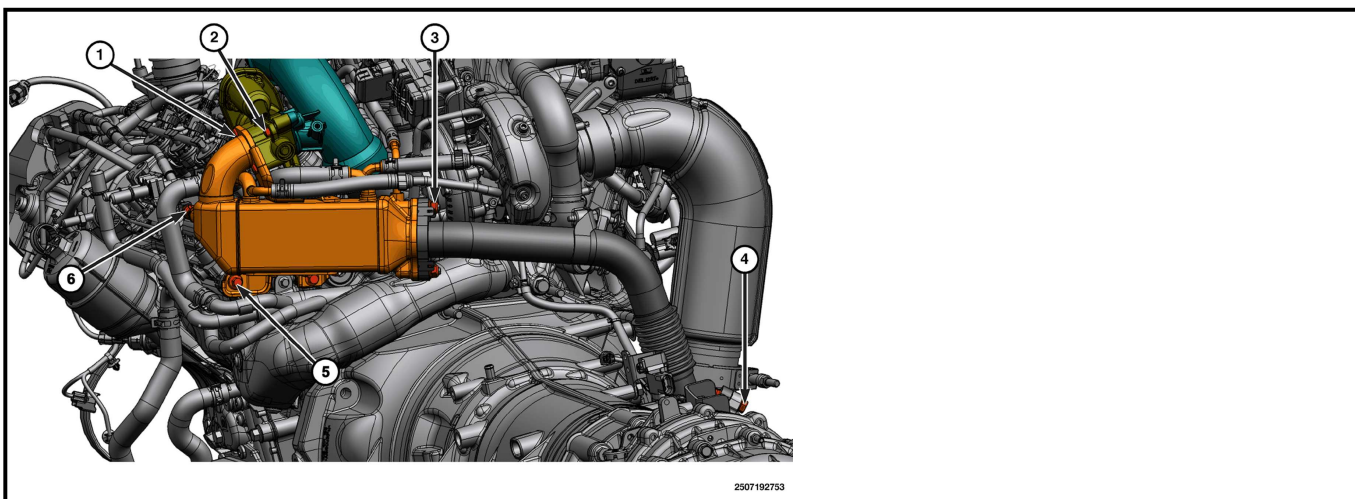
TORQUE SPECIFICATIONS

EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



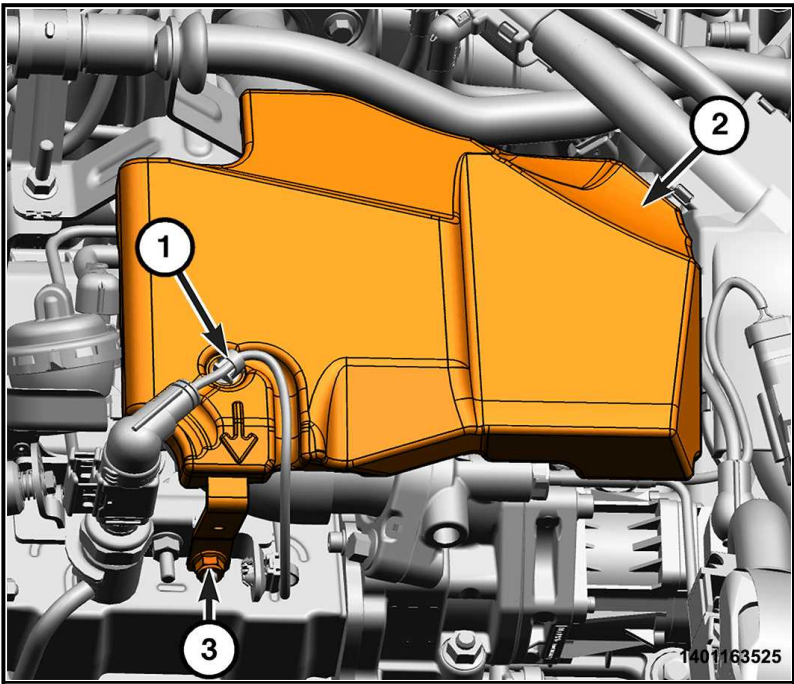
EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

HIGH PRESSURE UPPER EGR TUBE

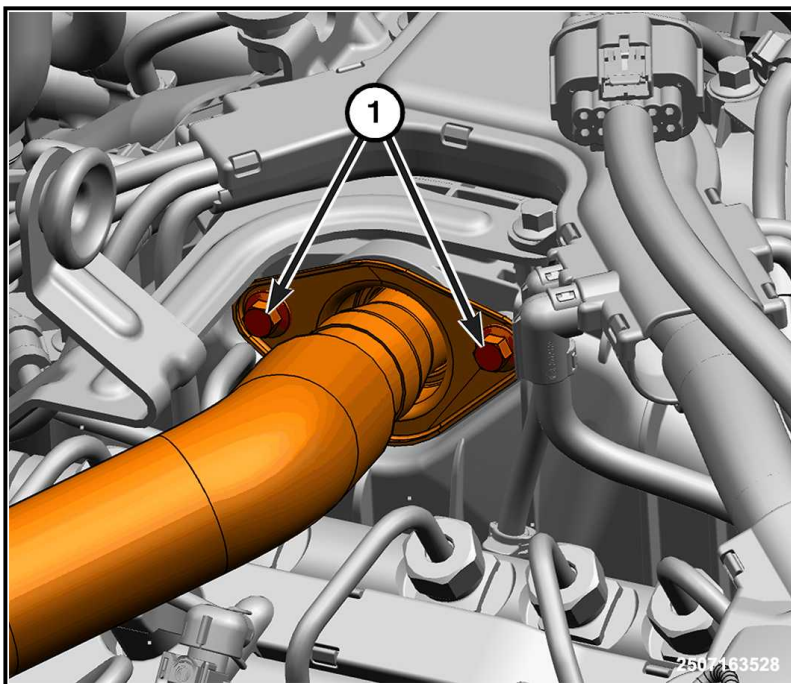
REMOVAL

- 1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
- 2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .



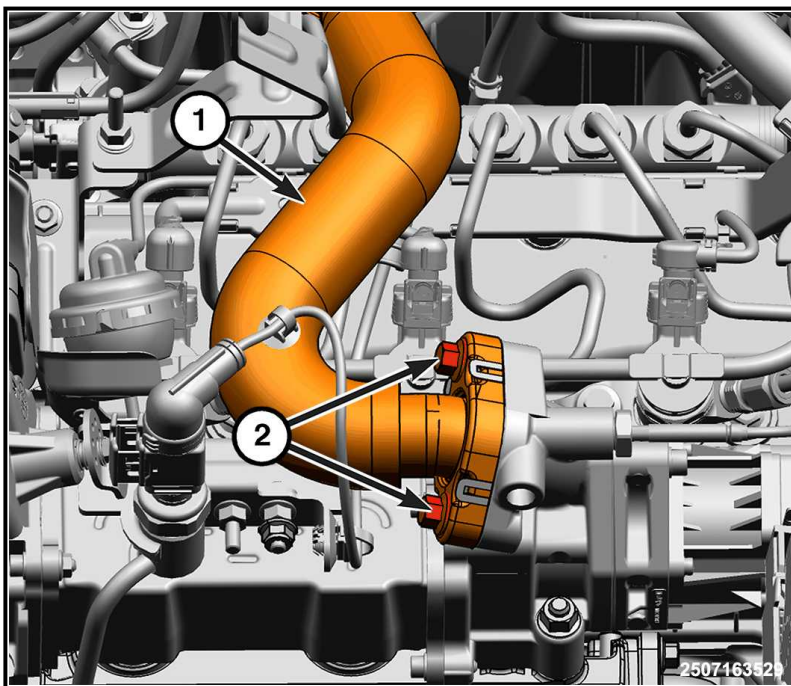
1 - Wire Harness Retainer
2 - Fuel Rail Cover
3 - Fuel Rail Cover Nut

- 3. Loosen the fuel rail cover nut, detach the wire harness retainer and remove the fuel rail cover.



1 - EGR Tube Bolts

4. Remove the upper Exhaust Gas Recirculation (EGR) tube bolts.



1 - EGR Tube Bolts

2 - EGR Tube

5. Remove the lower EGR tube bolts and the EGR tube.

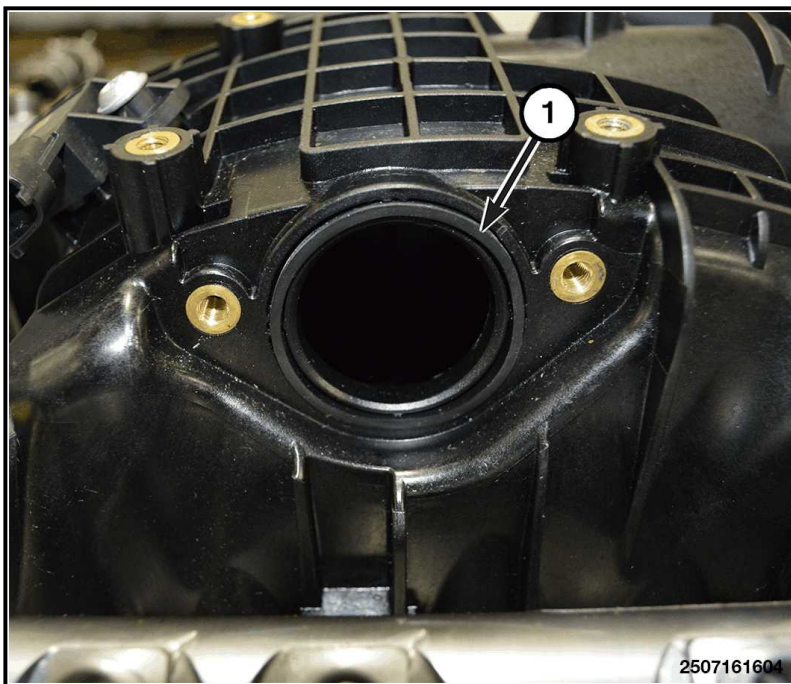
6. Remove and discard both gaskets.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

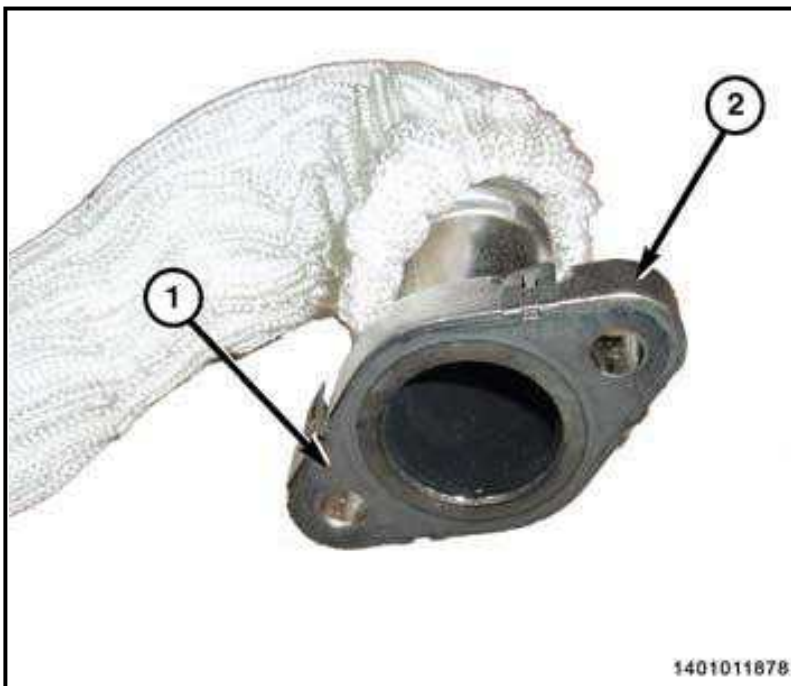
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean all gasket sealing areas.



1 - O-ring

- Install a **NEW** O-ring in the intake manifold.



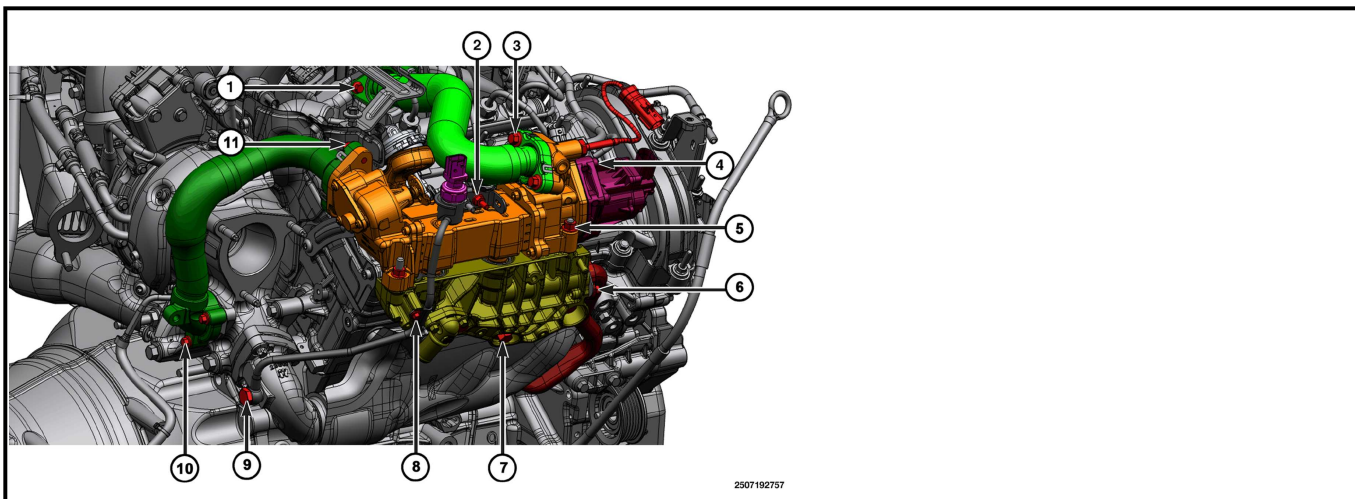
1 - Gasket

2 - Upper EGR Tube

- Install a **NEW** gasket to the upper EGR tube.
- Install the fuel rail cover, attach the wire harness retainer and securely tighten the fuel rail cover nut.

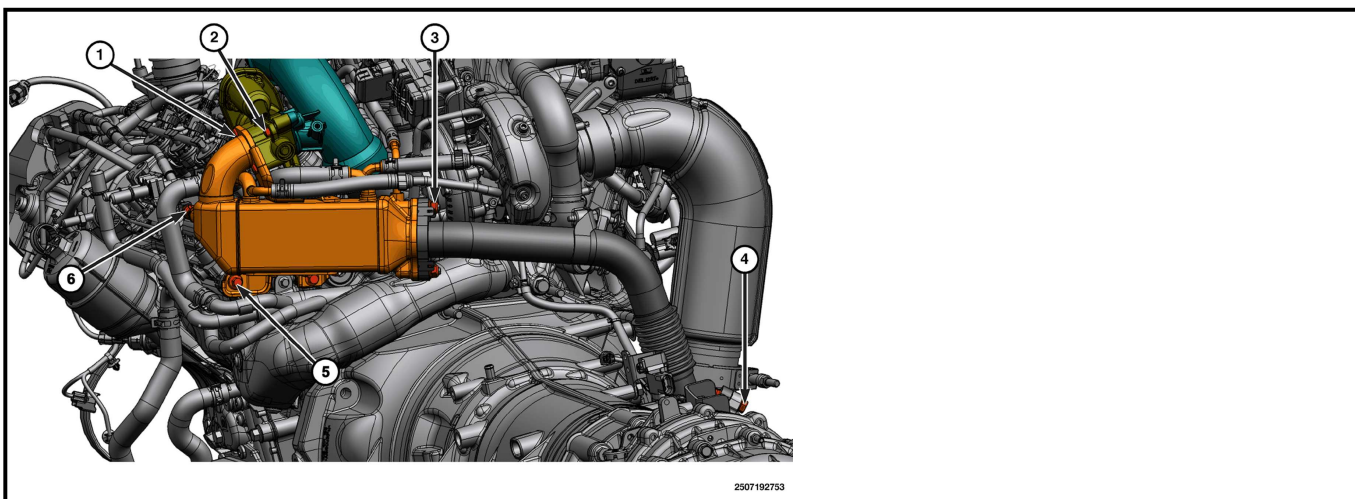
TORQUE SPECIFICATIONS

EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



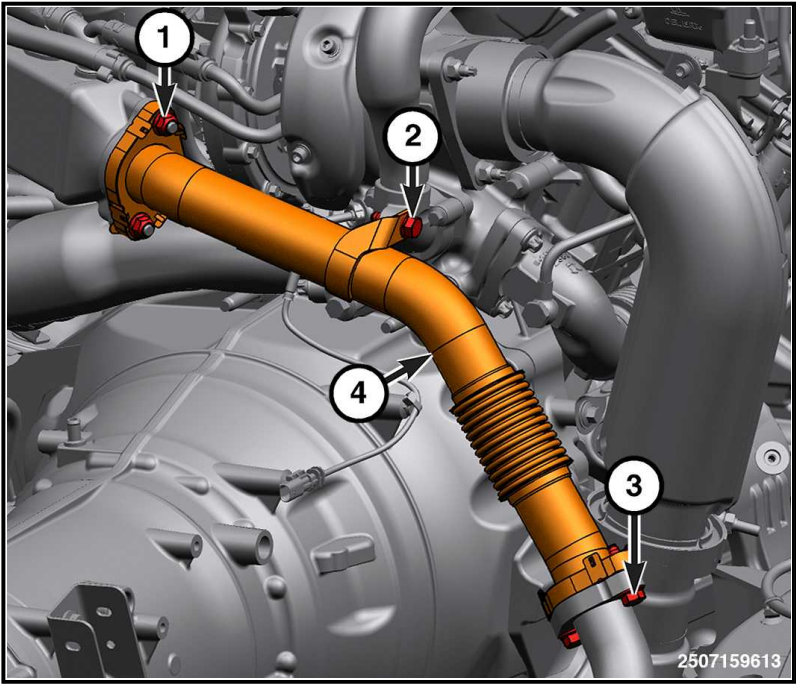
EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

LOW PRESSURE EGR TUBE

REMOVAL

1. Remove the cab. Refer to [CAB, REMOVAL AND INSTALLATION](#) .



1 - Low Pressure EGR Tube Nuts
2 - Support Bracket Bolt
3 - Low Pressure EGR Tube Bolts
4 - Low Pressure EGR Tube

2. Remove the low pressure Exhaust Gas Recirculation (EGR) tube nuts.
3. Remove the middle support bracket bolt.
4. Remove the low pressure EGR tube bolts and the low pressure EGR tube.
5. Remove and discard both gaskets.

INSTALLATION

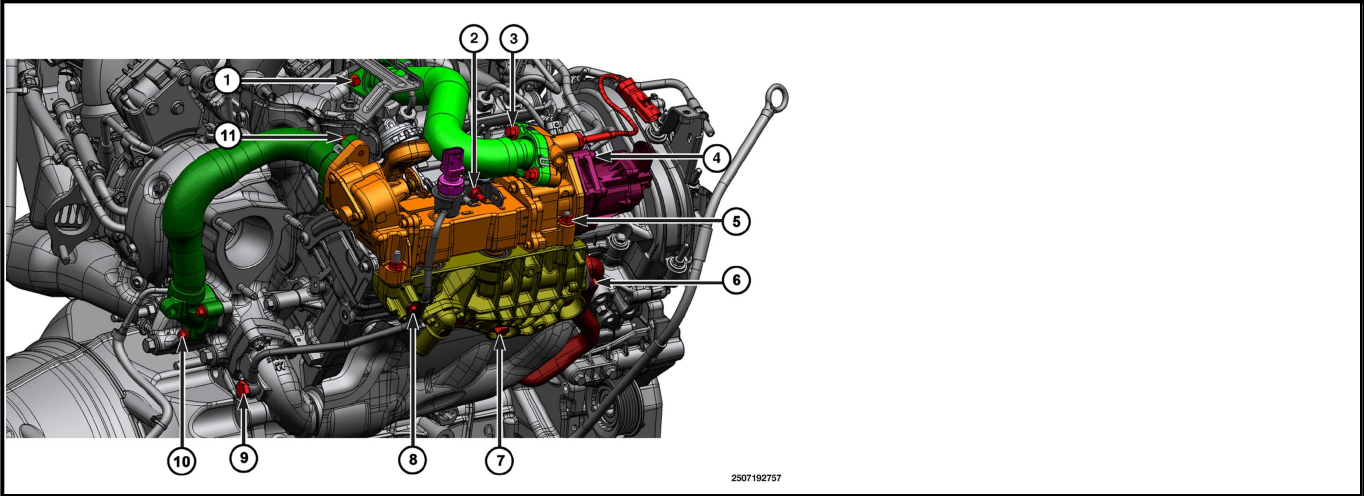
During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean all gasket sealing areas.
- Install **NEW** gaskets to the low pressure EGR tube.

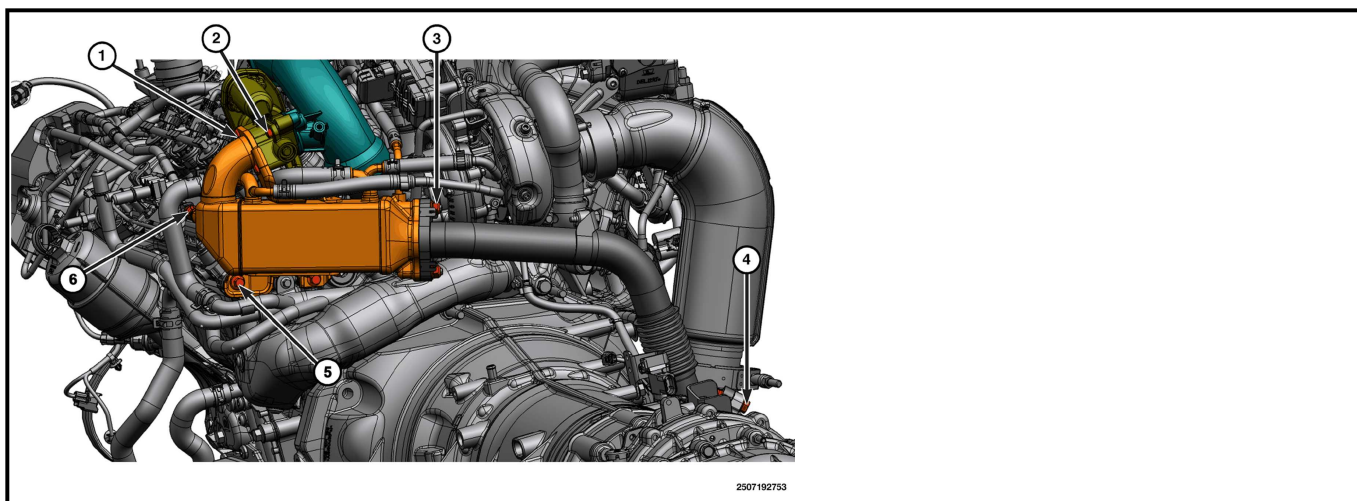
TORQUE SPECIFICATIONS

EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

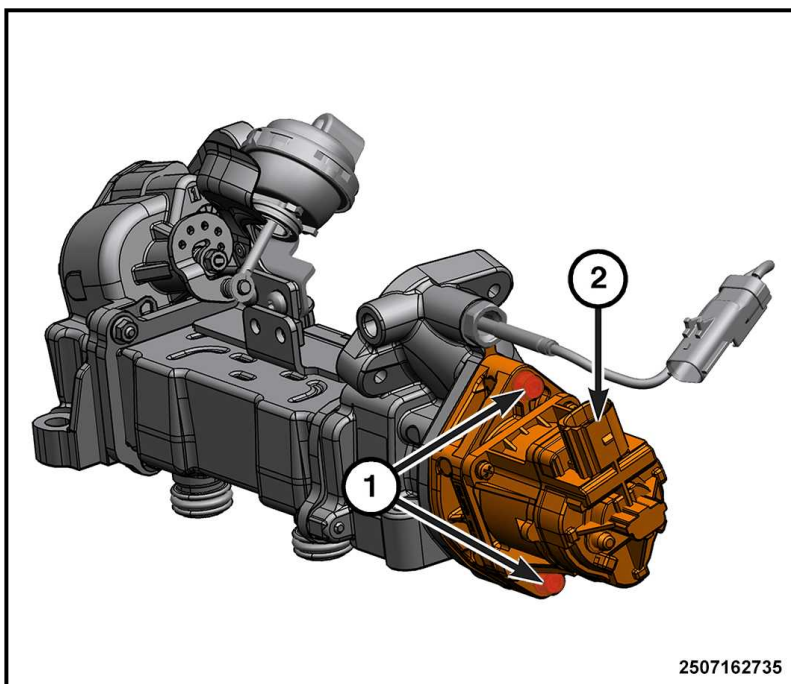
VALVE, EXHAUST GAS RECIRCULATION (EGR)

REMOVAL AND INSTALLATION

HIGH PRESSURE EGR VALVE

REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the High Pressure (HP) Exhaust Gas Recirculation (EGR) cooler. Refer to [COOLER, EXHAUST GAS RECIRCULATION \(EGR\), REMOVAL AND INSTALLATION](#).



1 - HP EGR Valve Bolts

2 - HP EGR Valve

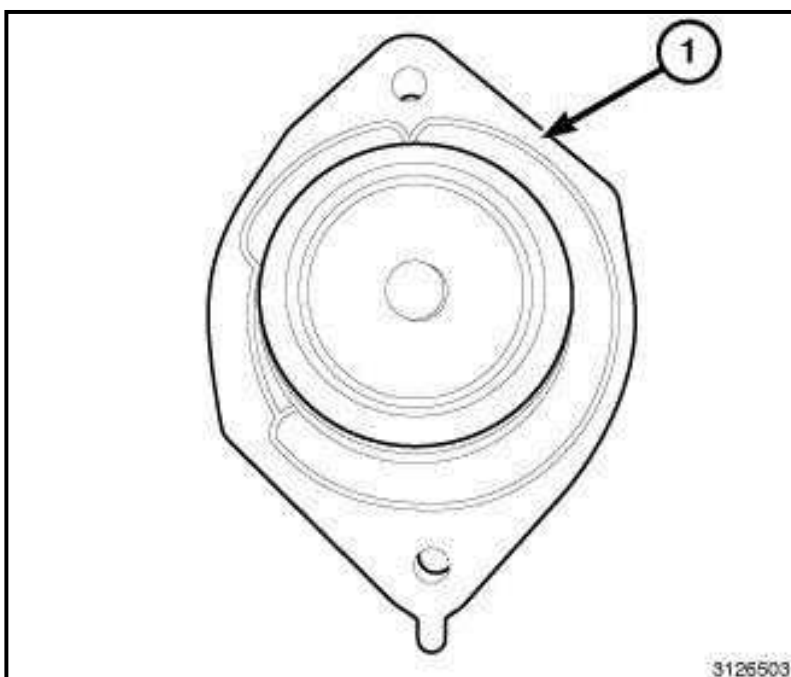
3. Remove the HP EGR valve bolts and the HP EGR valve.
4. Remove and discard the gasket.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the EGR valve sealing surfaces.

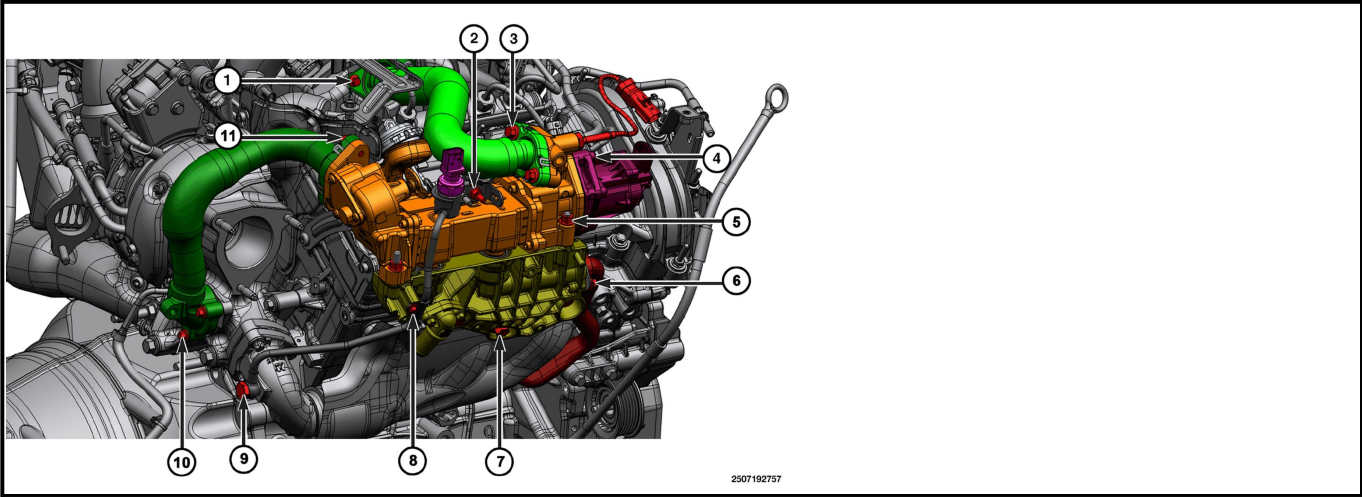


1 - Gasket

- Install a **NEW** gasket onto the EGR valve.

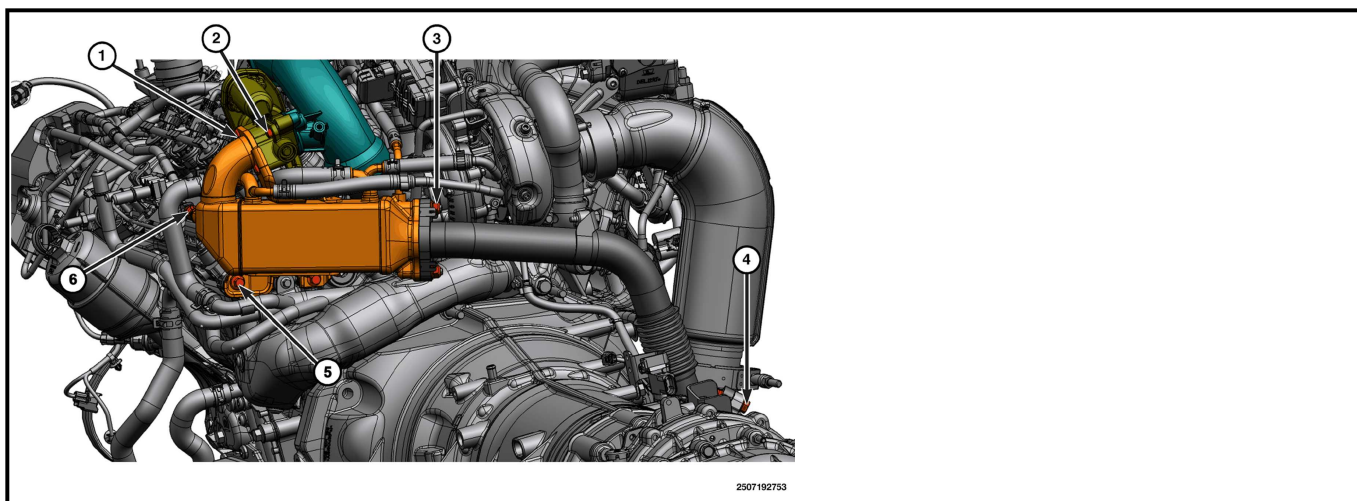
TORQUE SPECIFICATIONS

EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



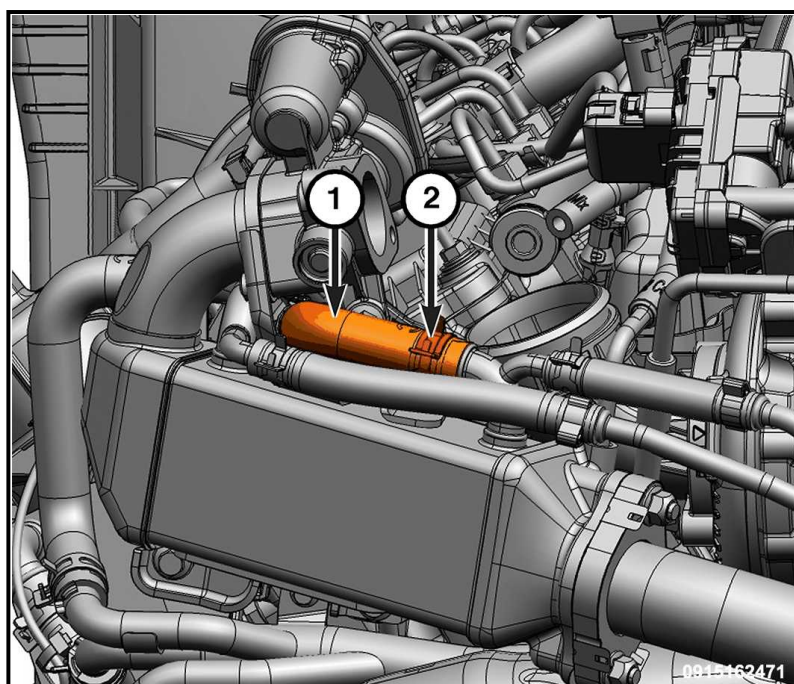
EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

LOW PRESSURE EGR VALVE

REMOVAL

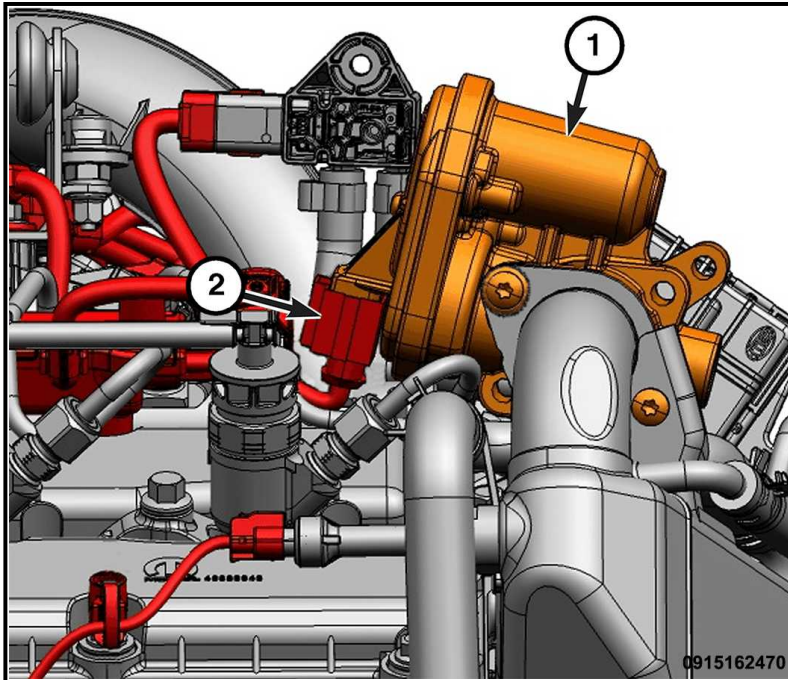
1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Drain the cooling system. Refer to [COOLING SYSTEM](#) .
3. Remove the upper turbocharger inlet elbow. Refer to [COOLER AND HOSES, CHARGE AIR, REMOVAL AND INSTALLATION](#) .



1 - Coolant Hose

2 - Band Clamp

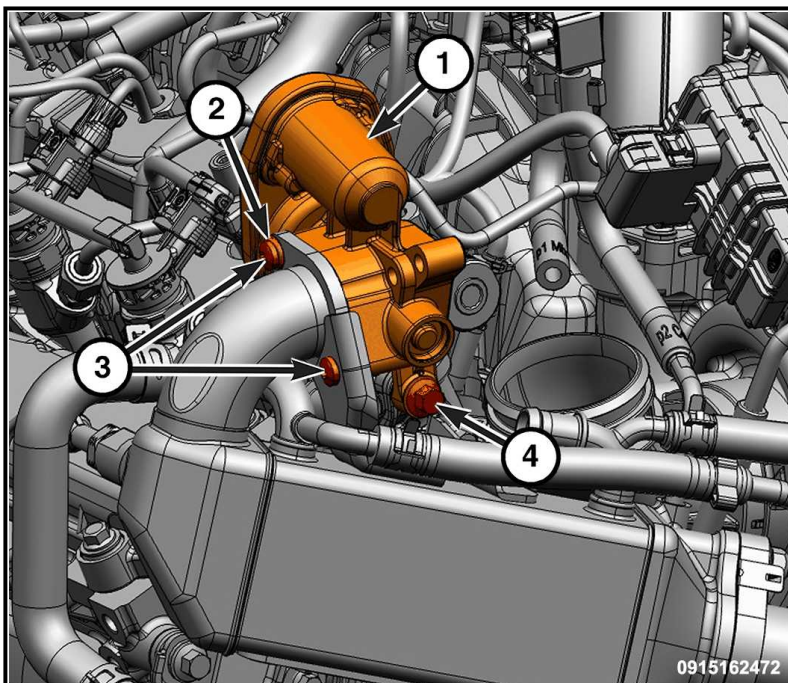
4. Loosen the band clamp and disconnect the coolant hose from the Low Pressure (LP) Exhaust Gas Recirculation (EGR) cooler.



1 - Low Pressure EGR Valve

2 - Low Pressure EGR Valve Wire Harness Connector

5. Disconnect the LP EGR valve wire harness connector.



1 - Low Pressure EGR Valve

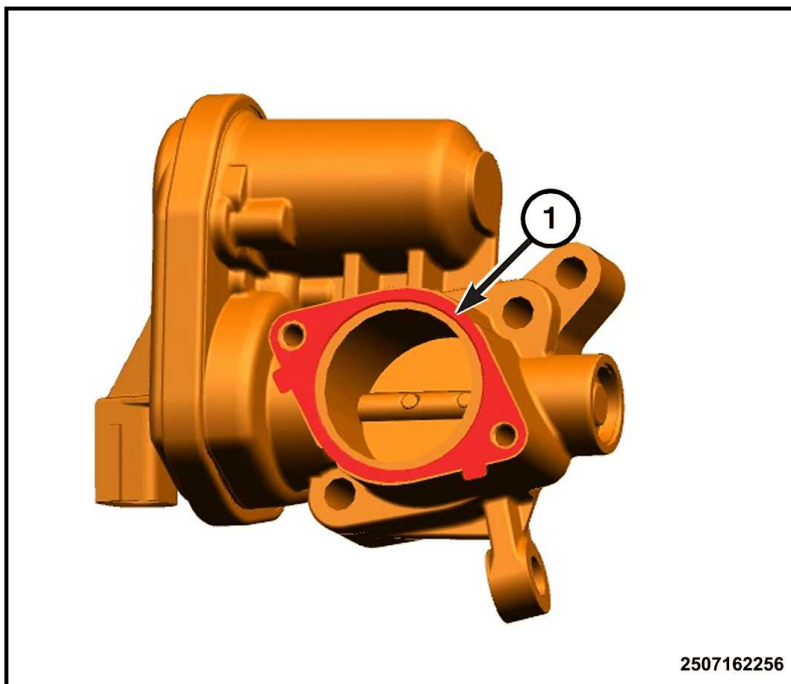
2 - Low Pressure EGR Cooler Washer

3 - Low Pressure EGR Cooler Bolts

4 - Low Pressure EGR Valve Bolt

6. Remove the LP EGR cooler bolts and washers from the LP EGR cooler.

7. Remove the LP EGR valve bolt and the LP EGR valve.



1 - Low Pressure EGR Gasket

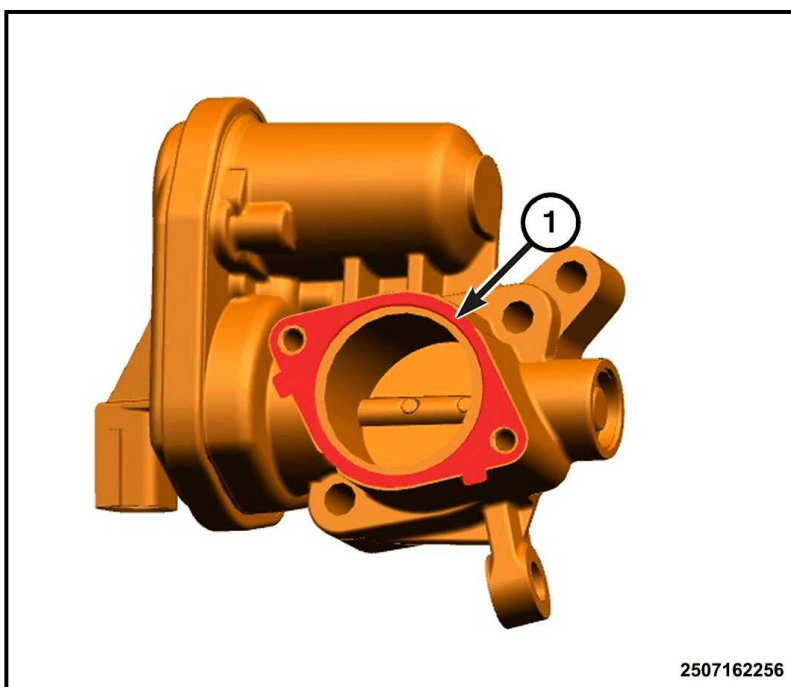
8. Remove and **DISCARD** the LP EGR gasket.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean the gasket sealing surfaces.



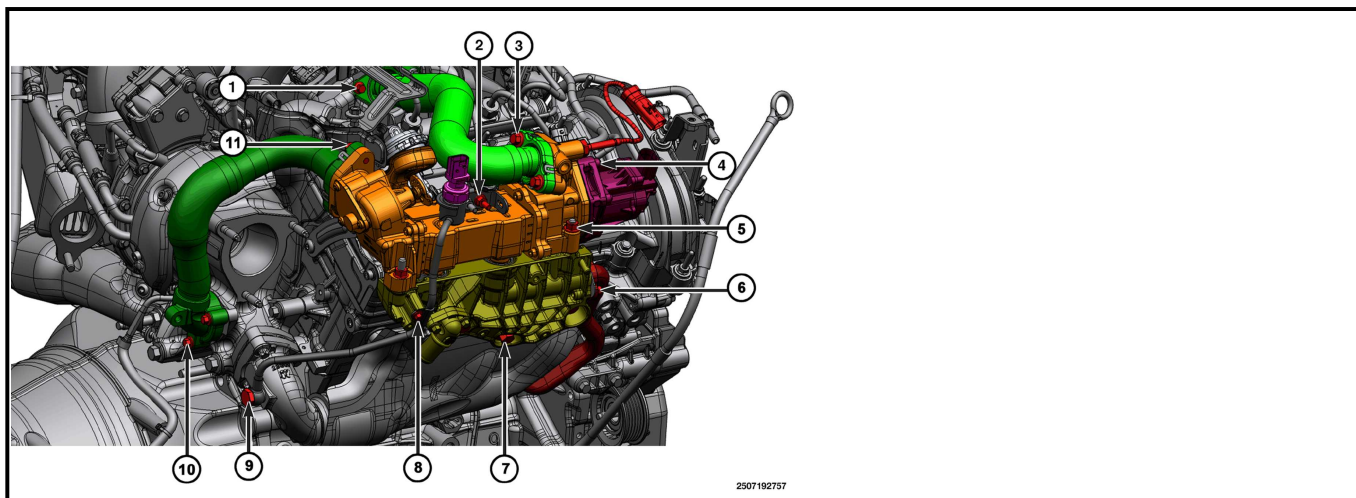
1 - Low Pressure EGR Valve Gasket

- Install a **NEW** low pressure EGR valve gasket.

- Fill the cooling system. Refer to [COOLING SYSTEM](#) .

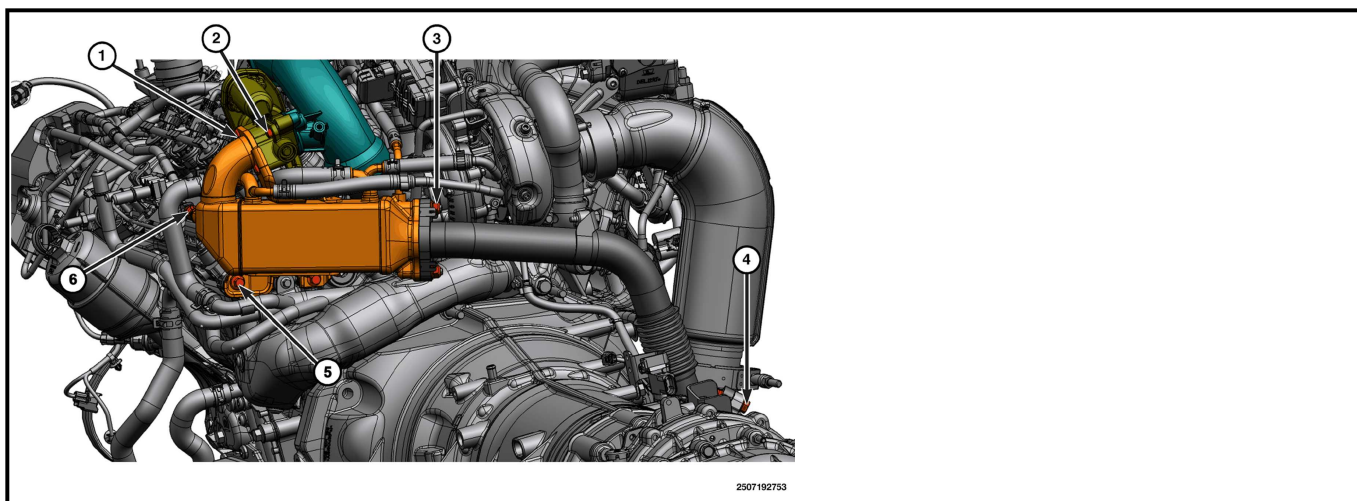
TORQUE SPECIFICATIONS

EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

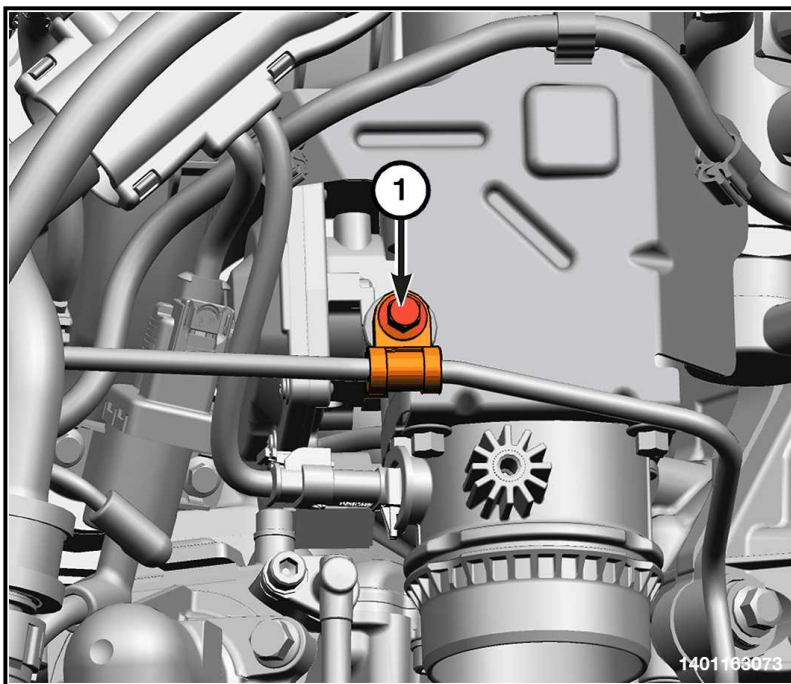
VALVE, EXHAUST GAS RECIRCULATION (EGR) AIRFLOW CONTROL

REMOVAL AND INSTALLATION

EGR AIR FLOW CONTROL VALVE

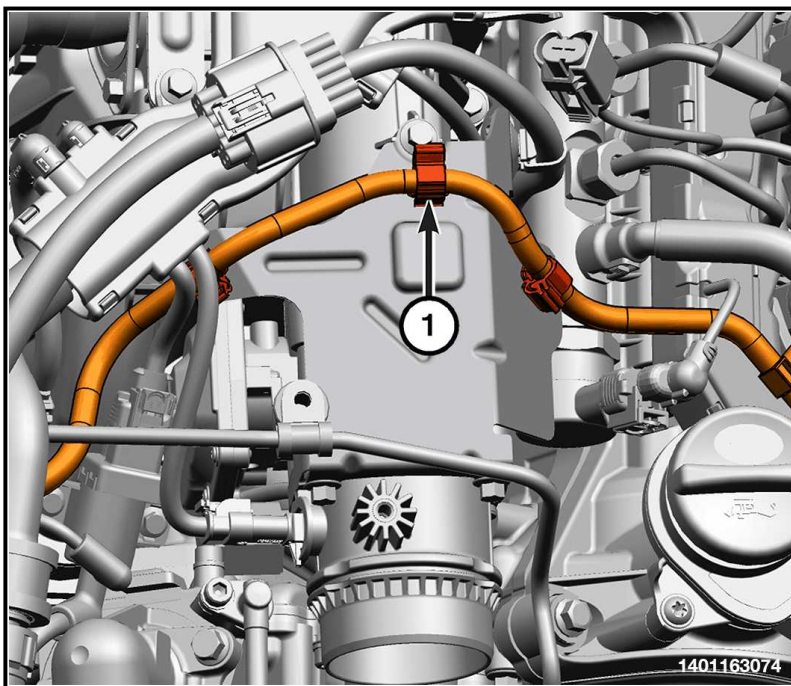
REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .
3. Release the retaining lock and disconnect the Charge Air Cooler (CAC) hose from the EGR air flow control valve.



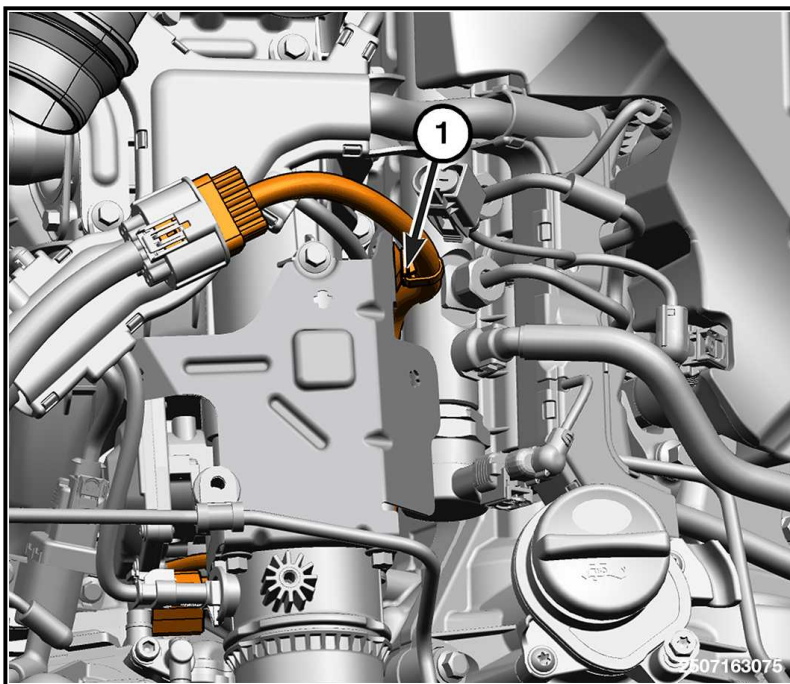
1 - Fuel Line Support Bracket Bolt

4. Remove the fuel line support bracket bolt.



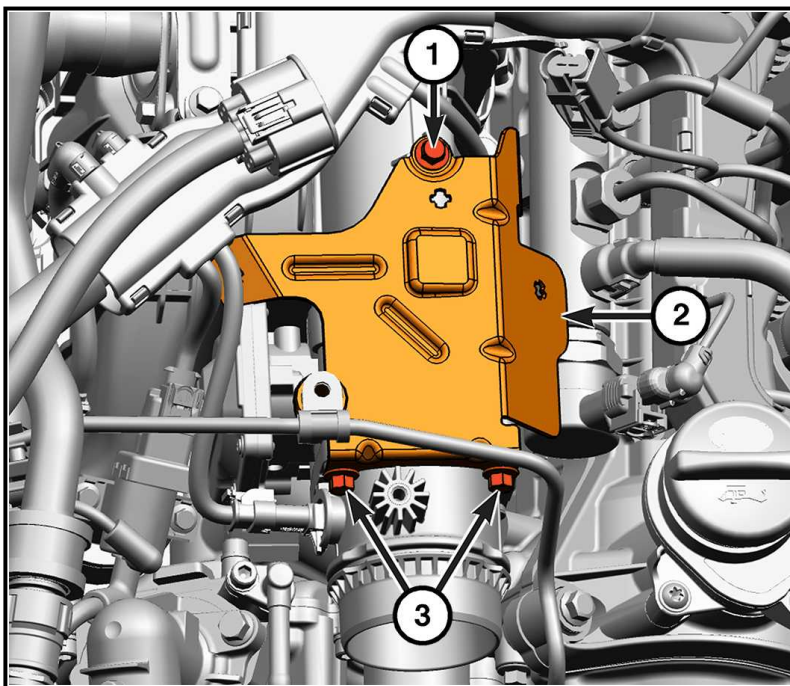
1 - Fuel Return Hose Retainers

5. Detach the fuel return hose retainers.



1 - Wire Harness Retainer

6. Detach the wire harness retainer.

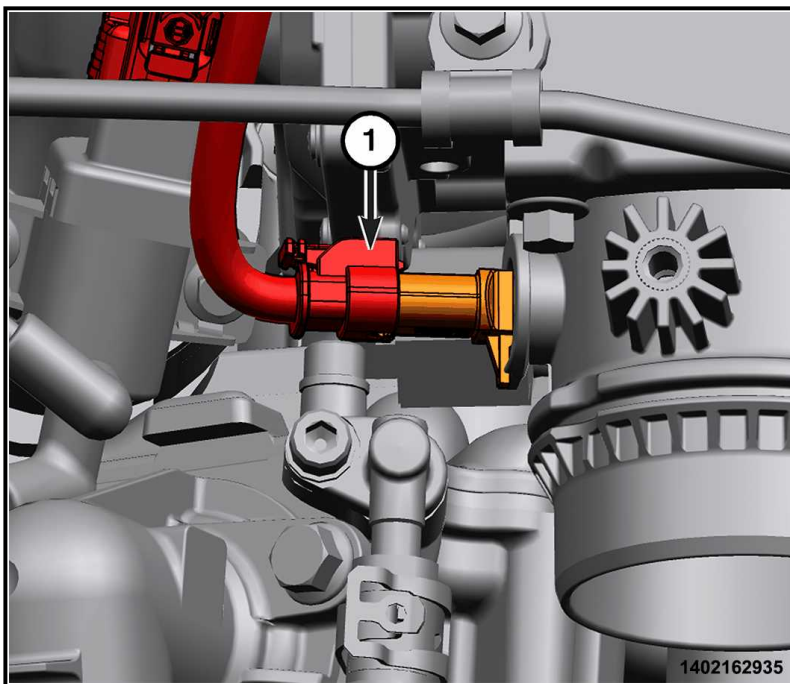


1 - Fuel Line Support Bracket Bolt

2 - Fuel Line Support Bracket

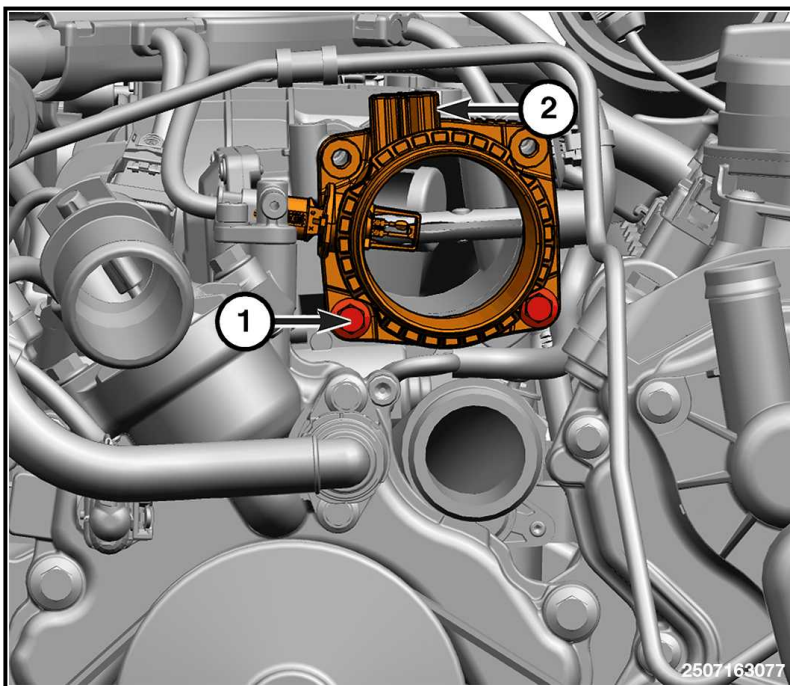
3 - Fuel Line Support Bracket Bolts

7. Remove the fuel line support bracket bolts and the fuel line support bracket.



1 - Outlet Air Temperature Sensor Wire Harness Connector

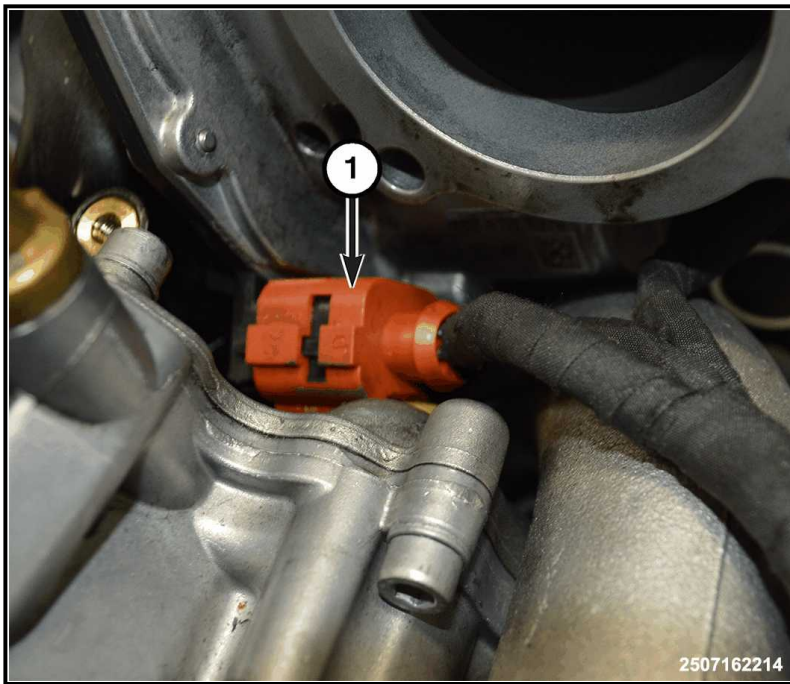
8. Disconnect the outlet air temperature sensor wire harness connector.



1 - Air Intake Housing Bolts

2 - Air Intake Housing

9. Remove the air intake housing bolts and the air intake housing.



1 - EGR Airflow Control Valve Wire Harness Connector

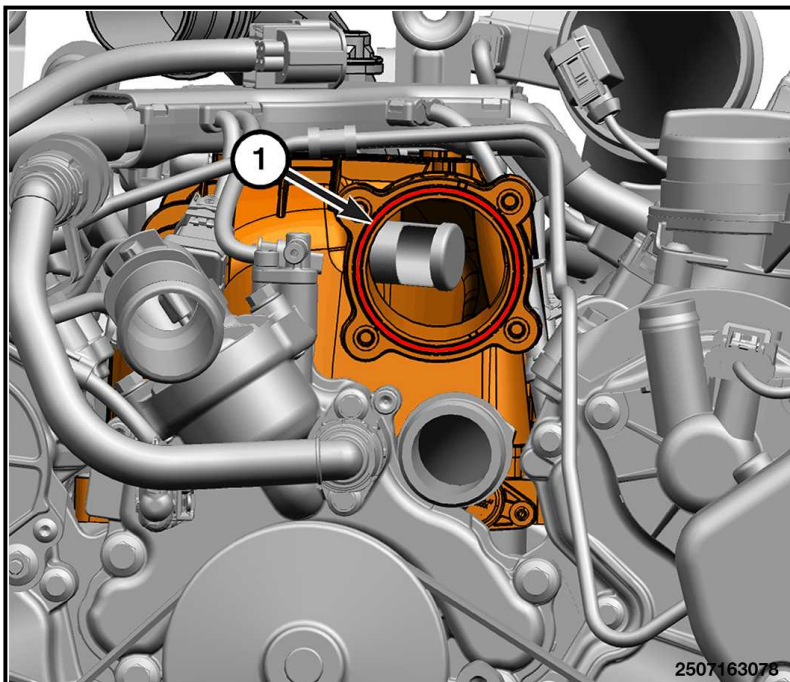
10. Reposition and lift up the EGR airflow control valve, disconnect the wire harness connector and remove the EGR airflow control valve.

INSTALLATION

During installation, torque the fasteners to the specifications in the torque table(s) below.

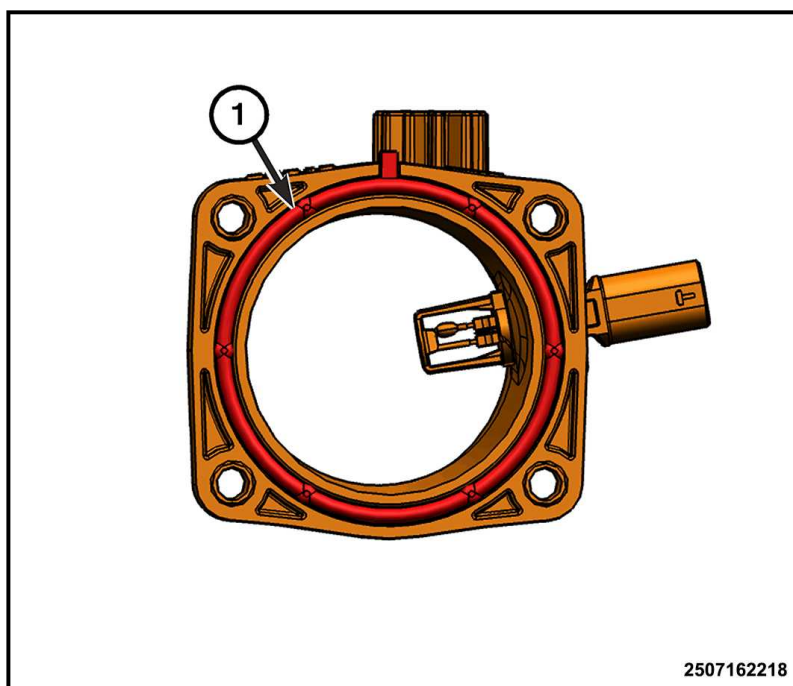
Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Clean all gasket sealing surfaces.



1 - O-ring

- Install a **NEW** O-ring to the intake manifold.

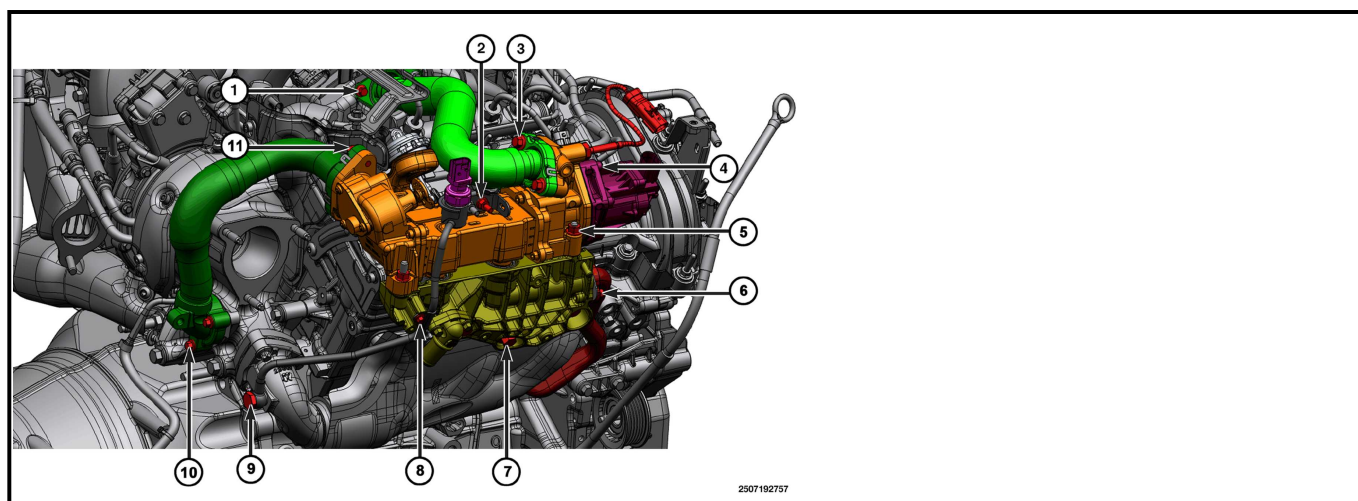


1 - O-ring

- Install a **NEW** O-ring to the air inlet housing.

TORQUE SPECIFICATIONS

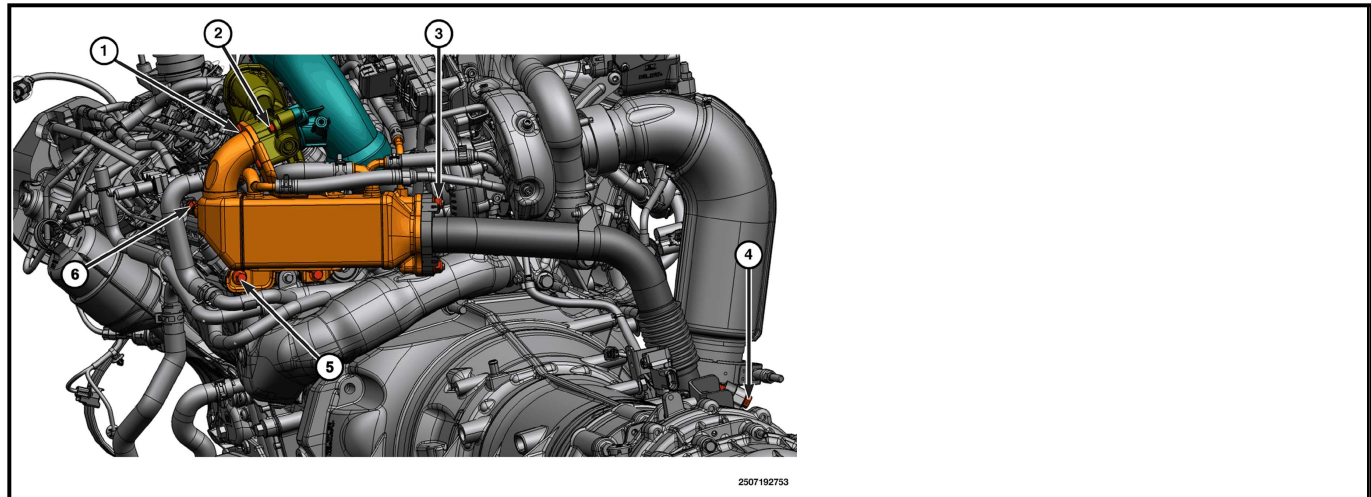
EGR SYSTEM



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Lower)	15 N.m (11 Ft. Lbs.)	-

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
B	EGR Temperature Sensor	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Lower)	25 N.m (18 Ft. Lbs.)	-
B	EGR Tube Bolts M6 (Upper)	11 N.m (8 Ft. Lbs.)	-
B	EGR Tube Bolts M8 (Upper)	25 N.m (18 Ft. Lbs.)	-
B	EGR Valve Bolts	8 N.m (71 In. Lbs.)	-
B	Fuel Manifold Nut	8 N.m (71 In. Lbs.)	-



EGR SYSTEM

CALLOUT	DESCRIPTION	SPECIFICATION	COMMENT
-	EGR Airflow Control Valve	9 N.m (80 In. Lbs.)	-
B	EGR Bypass Vacuum Solenoid Bolts	9 N.m (80 In. Lbs.)	-
B	EGR Cooler Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Manifold Bolts	45 N.m (33 Ft. Lbs.)	-
B	EGR Cooler Bypass Valve Support Bracket Bolts	25 N.m (18 Ft. Lbs.)	-
B	EGR Cooler Coolant Tube Bolts	18 N.m (13 Ft. Lbs.)	-

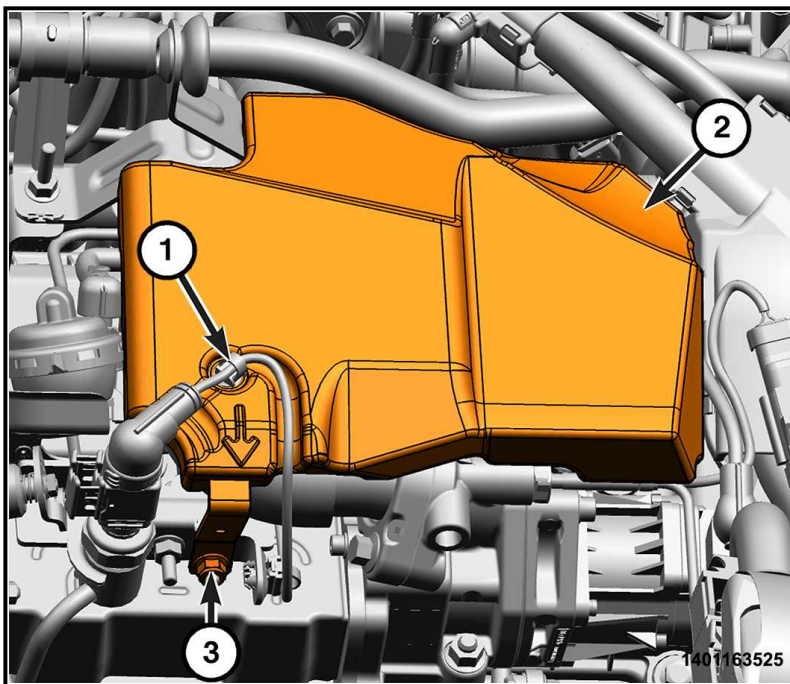
VACUUM ACTUATOR, EGR BYPASS

REMOVAL AND INSTALLATION

EGR BYPASS VACUUM ACTUATOR

REMOVAL

1. Disconnect and isolate the negative battery cable(s). Refer to [CABLES, BATTERY](#) .
2. Remove the engine cover. Refer to [COVER, ENGINE, REMOVAL AND INSTALLATION](#) .

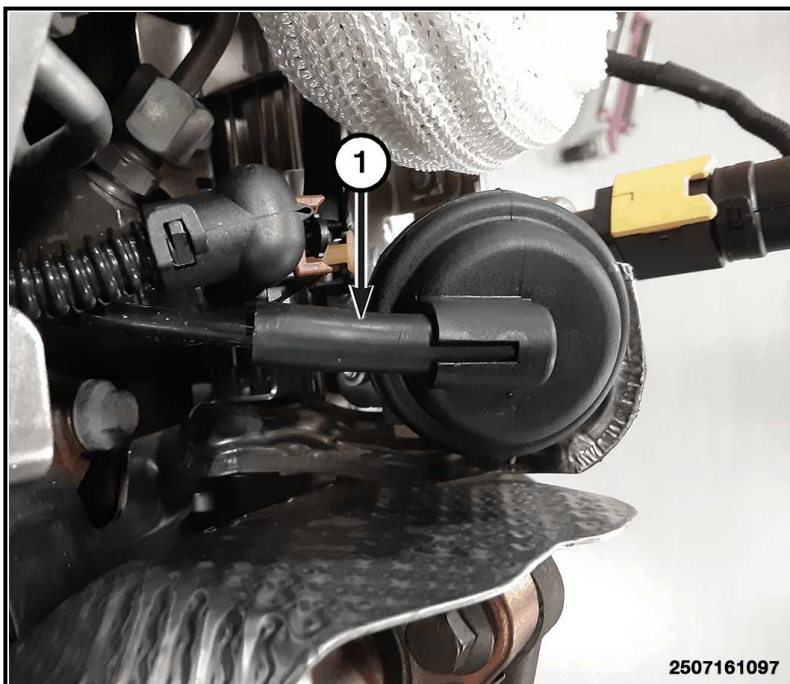


1 - Wire Harness Retainer

2 - Fuel Rail Cover

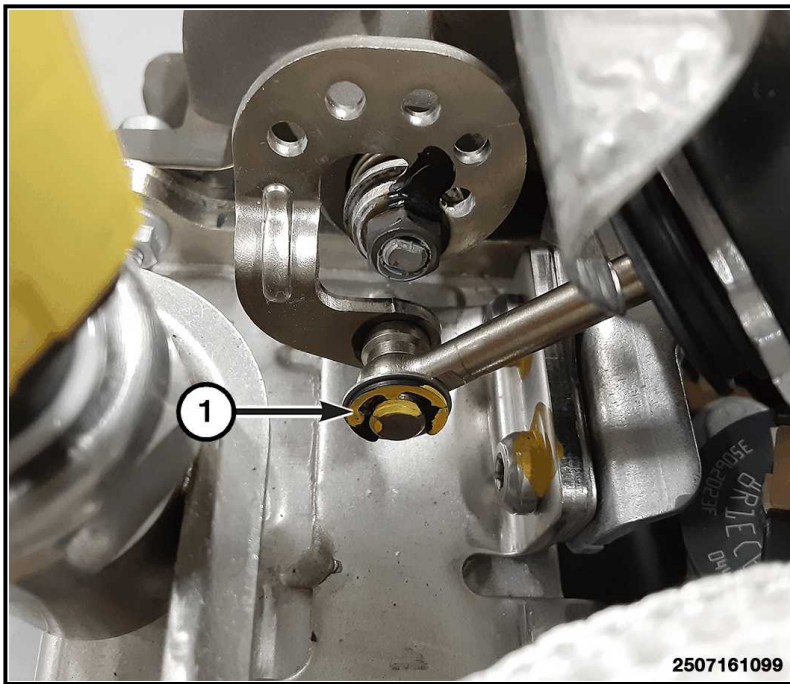
3 - Fuel Rail Cover Nut

3. Loosen the fuel rail cover nut, detach the wire harness retainer and remove the fuel rail cover.



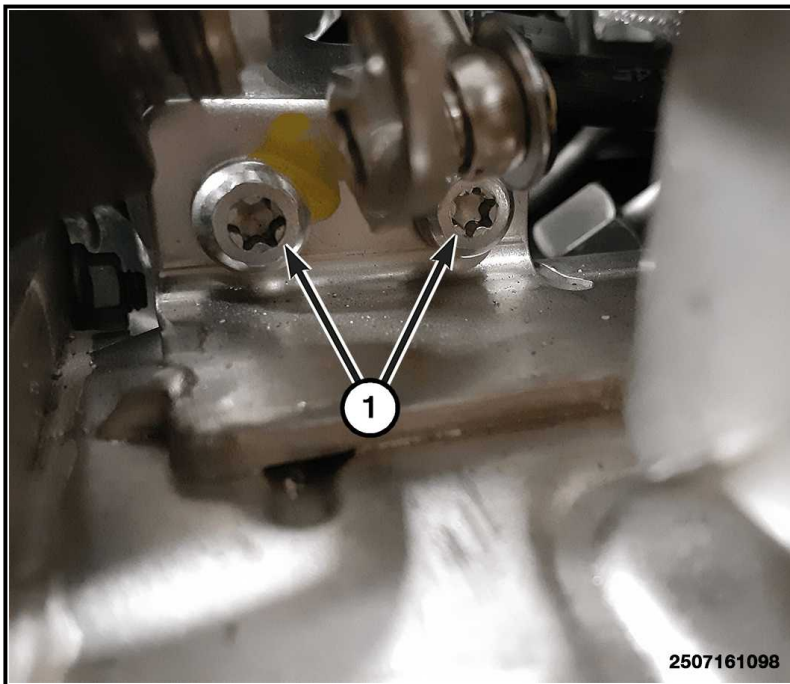
1 - EGR Cooler Vacuum Bypass Hose

4. Disconnect the EGR cooler vacuum bypass hose.



1 - E-clip

5. Remove the E-clip and disconnect the vacuum actuator rod from the bypass valve.



1 - Vacuum Actuator With Heat Shield Screws

6. Remove the vacuum actuator with heat shield screws and the vacuum actuator with heat shield from the high pressure EGR cooler.

INSTALLATION

Follow the removal procedure in reverse for general reassembly of the components on the vehicle. The steps listed below are calling out specific procedures that should be followed during installation.

- Install the vacuum actuator and heat shield to the high pressure EGR cooler and securely tighten the screws.
- Using a solution of soapy water, lubricate and connect the EGR cooler vacuum bypass hose.



1 - Gap

- Verify that the vacuum hose is fully seated. If there is a gap fully seat the hose.
- Install the right fuel rail cover, attach the wire harness retainer and securely tighten the nut.

PERMANENT FAULT CODES

DIAGNOSIS AND TESTING

PERMANENT FAULT CODES

Permanent Fault Codes (PFCs)

PFCs are very similar to a regular Diagnostic Trouble Code (DTC), except that they cannot be reset by disconnecting the vehicle battery or cleared using a diagnostic scan tool. PFCs are DTCs that are stored in the EEPROM memory of some Electronic Control Units (ECUs) starting in 2010. **Only DTCs that illuminate the Malfunction Indicator Lamp (MIL) will be stored as Permanent Fault Codes.**

NOTE: Starting July 1, 2019, the presence of Permanent Fault Codes will be considered in determining the vehicle's smog emission test result in states which require emission testing.

Vehicles that have a PFC stored in the OBD system will fail the smog emission test regardless of whether the MIL is illuminated because a stored PFC indicates the OBD system has not yet successfully verified that a previously detected emissions related malfunction no longer exists.

All PFCs must be cleared in order to pass state emission testing. The diagnostic scan tool can be used to check for PFCs in the **"GUIDED DIAGNOSTICS"** tab. The DTC number and ECU storing the DTC will be displayed for each PFC. Not all vehicles built after 2010 store Permanent Fault Codes in the ECUs, therefore if it is not applicable for the vehicle, then no PFC will be displayed in the "GUIDED DIAGNOSTICS" tab. If there are no PFCs stored in any ECU, then no additional action is required and PFCs will not be the reason for state emission testing failure. However, if there are PFCs stored, they must first be cleared to pass state emission testing.

There are only two ways that PFCs can be cleared:

1. **Three successful trips** (no recurring faults) with the diagnostic monitor running and passing will naturally clear the MIL and PFCs.

2. After the vehicle has been repaired and the DTC erased with a diagnostic scan tool or a battery disconnect, complete **one successful trip** with the diagnostic monitor running and passing.

NOTE: It is important to note that this does not need to be done during every normal repair action. Repairing an issue and erasing the DTCs with the diagnostic scan tool will turn off the MIL after performing normal repairs and erasing the DTCs with the diagnostic scan tool. It is only necessary to check for PFCs when a repair for a DTC is done to a vehicle and that vehicle needs to pass smog emission testing.

There is one other scenario where a vehicle can pass state emission testing with a PFC present. If the vehicle completes 15 or more warm-up cycles (as defined below) and has been driven 322 kilometers (200 miles) or more since the OBD information was last cleared, the emission test will pass because the time to complete 15 warm-up cycles and drive 322 kilometers (200 miles) is reasonable for vehicles to complete the self-diagnostic tests. When the DTC fault is repaired, the diagnostic monitors and PFC diagnostics should naturally run and clear long before these limits are reached.

- **One warm-up cycle is defined as:** The engine coolant temperature increases a minimum of 4.4B°C (40B°F), a change of 22.2B°C (71.9B°F), and reaches at least 71.1B°C (160B°F) during a drive cycle.
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