

6.6.13a EGR Cooler Removal (Bellows System)

Series 60 EGR-equipped engines built after April 15, 2004 or engines that have had right-side kits installed use the following procedures.



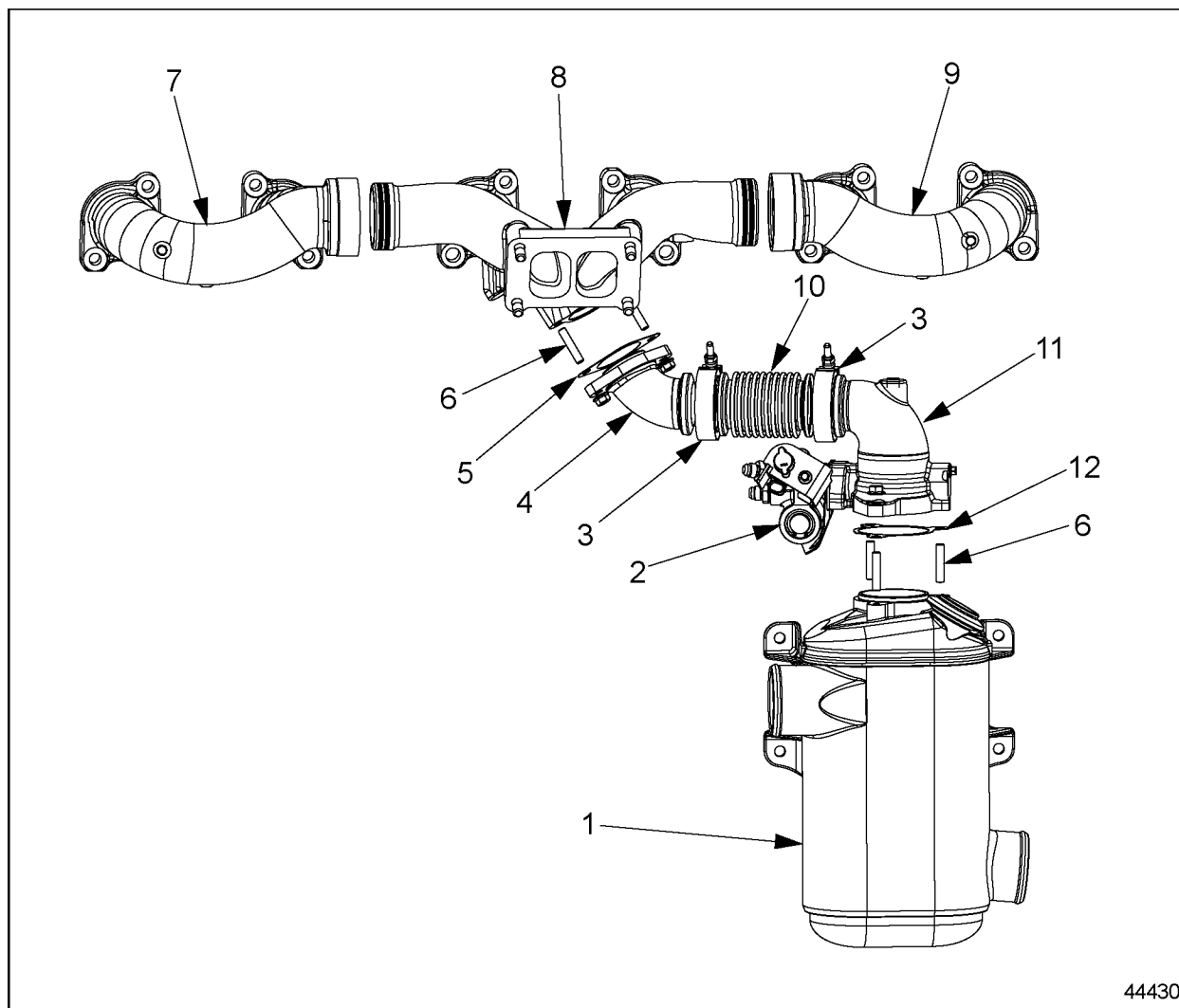
WARNING:

PERSONAL INJURY

To avoid injury from hot surfaces, wear protective gloves, or allow engine to cool before removing any component.

1. Drain engine coolant. Refer to section 13.13.4.
2. Remove two bolts and seal ring from water pump outlet elbow. Discard seal ring.
3. Remove water pump outlet elbow from hose on EGR cooler water inlet.
4. Remove hose and clamps from EGR cooler water inlet.
5. Loosen and slide clamp onto hose of oil cooler water inlet.

6. Remove two clamps from bellows. See Figure 6-39a.



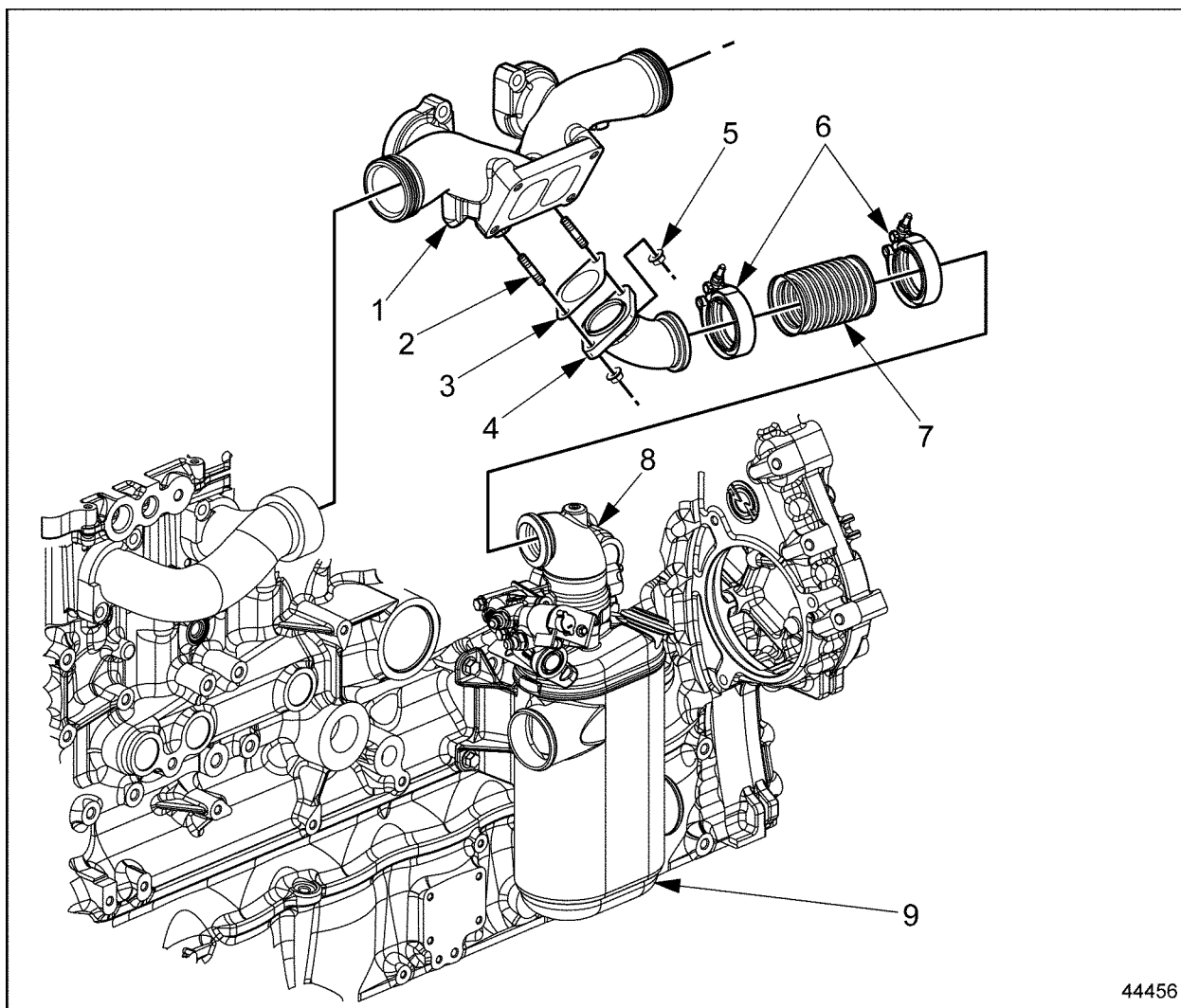
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|---|------------------------------------|
| 1. EGR Cooler | 7. Exhaust Manifold End Section |
| 2. EGR Hydraulic or Pneumatic Actuator Assembly | 8. Exhaust Manifold Center Section |
| 3. Clamp | 9. Exhaust Manifold End Section |
| 4. Upper Hot Pipe | 10. Bellows |
| 5. Gasket | 11. EGR Valve Assembly |
| 6. Stud | 12. Gasket |

Figure 6-39a EGR System and Related Parts

NOTICE:

The bellows is a one time usage component, discard after removal.

7. Remove bellows from upper hot pipe and EGR valve assembly and discard bellows. See Figure 6-39b.

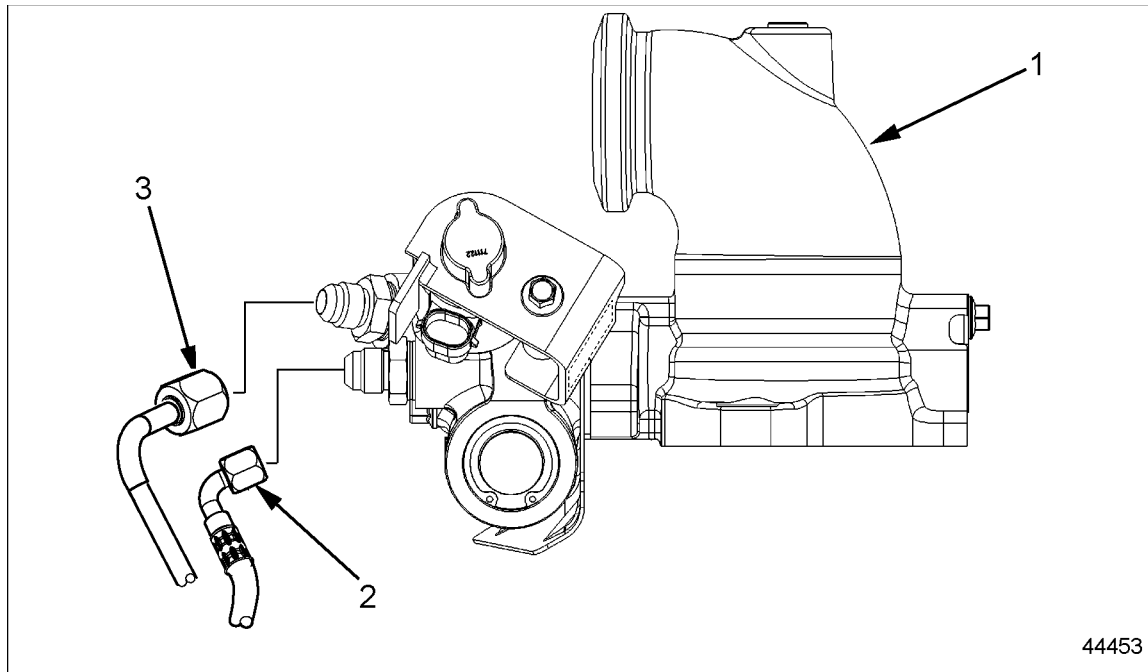


1. Exhaust Manifold Center Section
2. Stud
3. Gasket
4. Upper Hot Pipe
5. Nut

6. Clamp
7. Bellows
8. EGR Valve Assembly
9. EGR Cooler

Figure 6-39b EGR Cooler and Related Parts

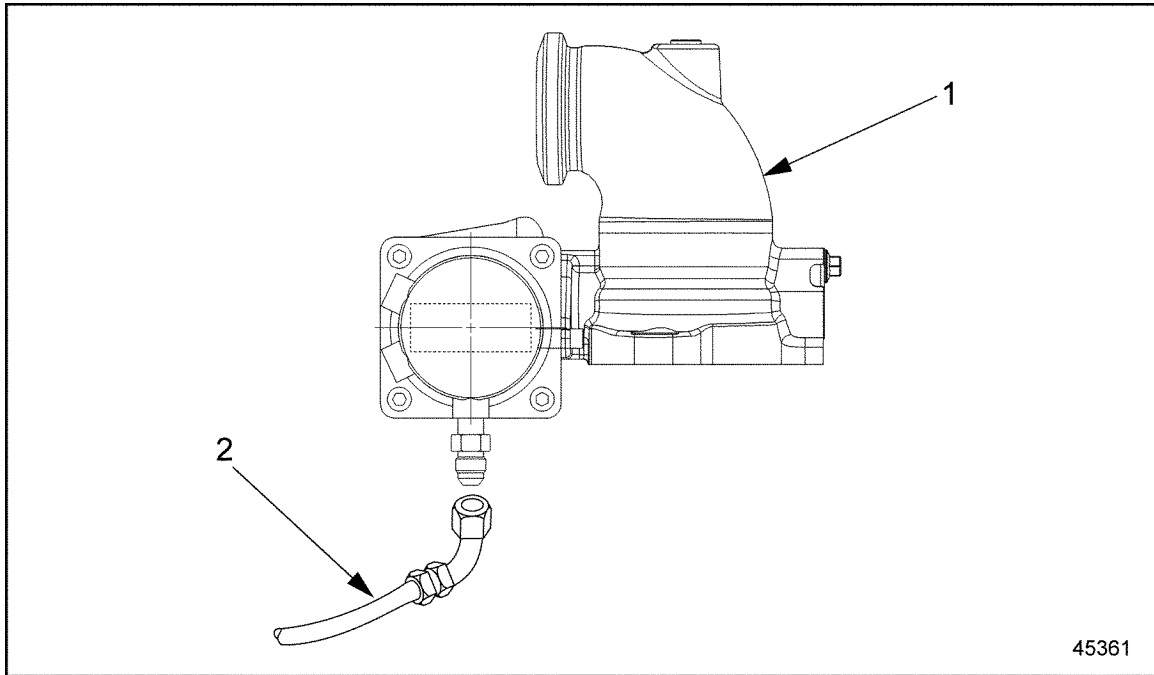
8. For hydraulic actuated EGR valve remove oil inlet and outlet lines from EGR valve and hydraulic actuator. See Figure 6-39c.



1. EGR Valve and Hydraulic Actuator Assembly
2. Oil Outlet Line and Fitting
3. Oil Inlet Line and Fitting

Figure 6-39c EGR Valve and Hydraulic Actuator

9. For air actuated EGR valve, remove air line from pneumatic actuator assembly. See Figure 6-39d.

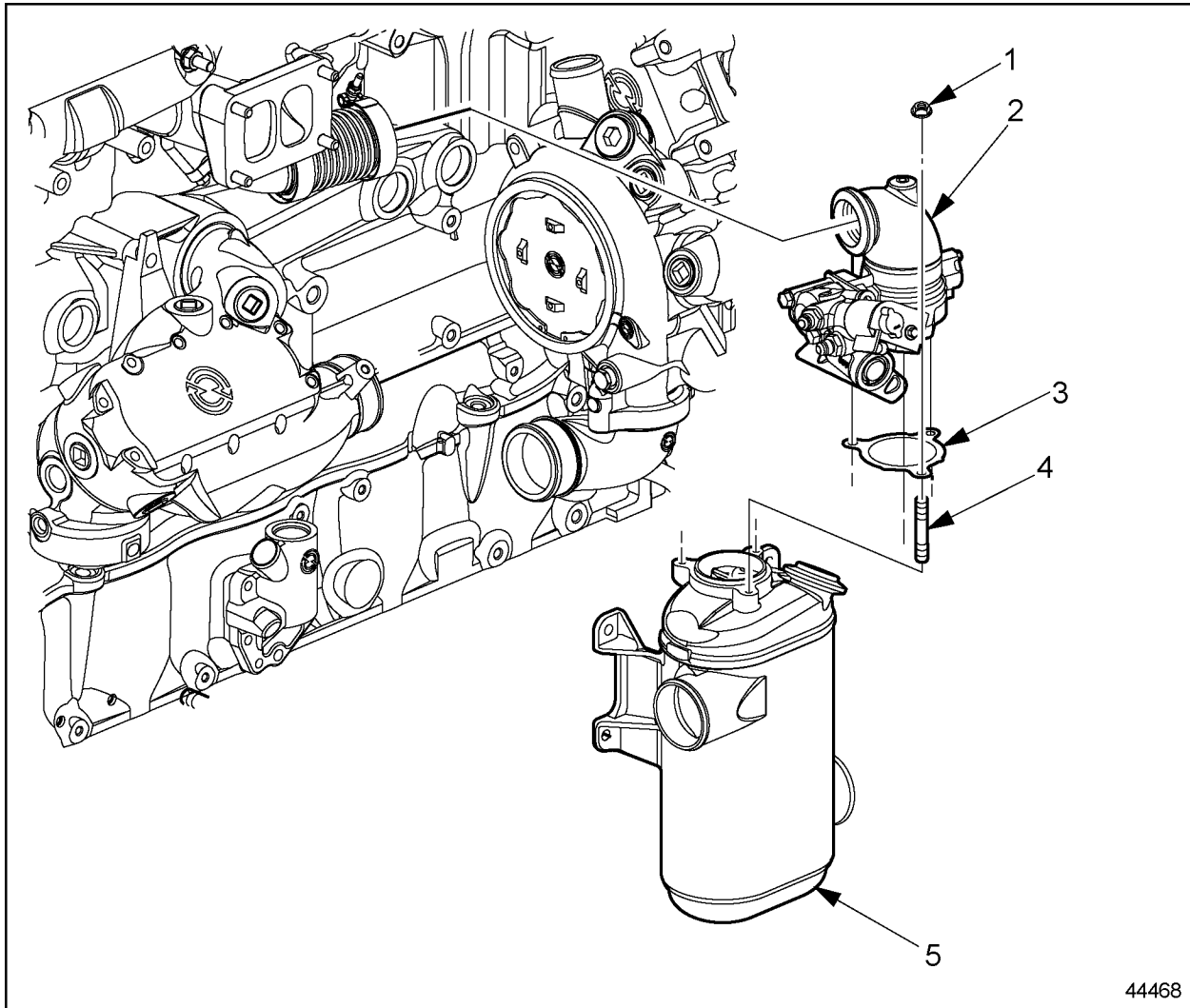


1. EGR Valve and Pneumatic Actuator Assembly

2. Air line

Figure 6-39d EGR Valve and Pneumatic Actuator Assembly

10. Remove three nuts from studs securing EGR valve and actuator assembly to EGR cooler and remove assembly. See Figure 6-39e.

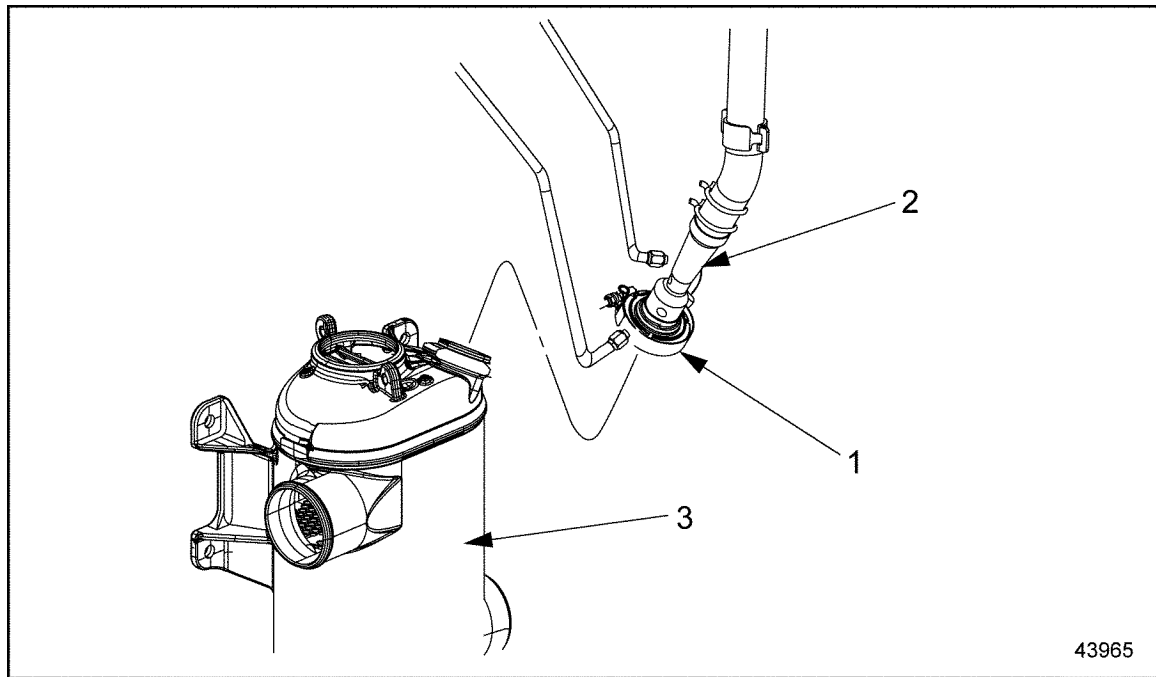


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| 1. Nut | 4. Stud |
| 2. EGR Valve and Actuator Assembly | 5. EGR Cooler |
| 3. Gasket | |

Figure 6-39e EGR Valve Assembly Removal

11. Remove Delta-P tubes. Refer to Section 6.6.18.

12. Remove delivery pipe clamp from EGR cooler outlet and remove delivery pipe, Refer to Section 6.6.14. See Figure 6-39f.



1. Clamp
2. Delivery Pipe
3. EGR Cooler

Figure 6-39f EGR Cooler and Delivery Pipe

! WARNING:

PERSONAL INJURY

To avoid injury when removing or installing a heavy engine component, ensure the component is properly supported and securely attached to an adequate lifting device to prevent the component from falling.

13. While supporting the EGR cooler remove four bolts attaching EGR cooler backplate to engine block; remove EGR cooler.
14. Remove hose and clamp from oil cooler water inlet.

6.6.13b EGR Cooler Installation (Bellows System)

Series 60 engines equipped with EGR-systems have a EGR cooler which cools the exhaust gas prior to introduction in the intake manifold.

Install the EGR cooler as follows:

1. Install EGR water outlet hose and clamps onto oil cooler. See Figure 6-39g.



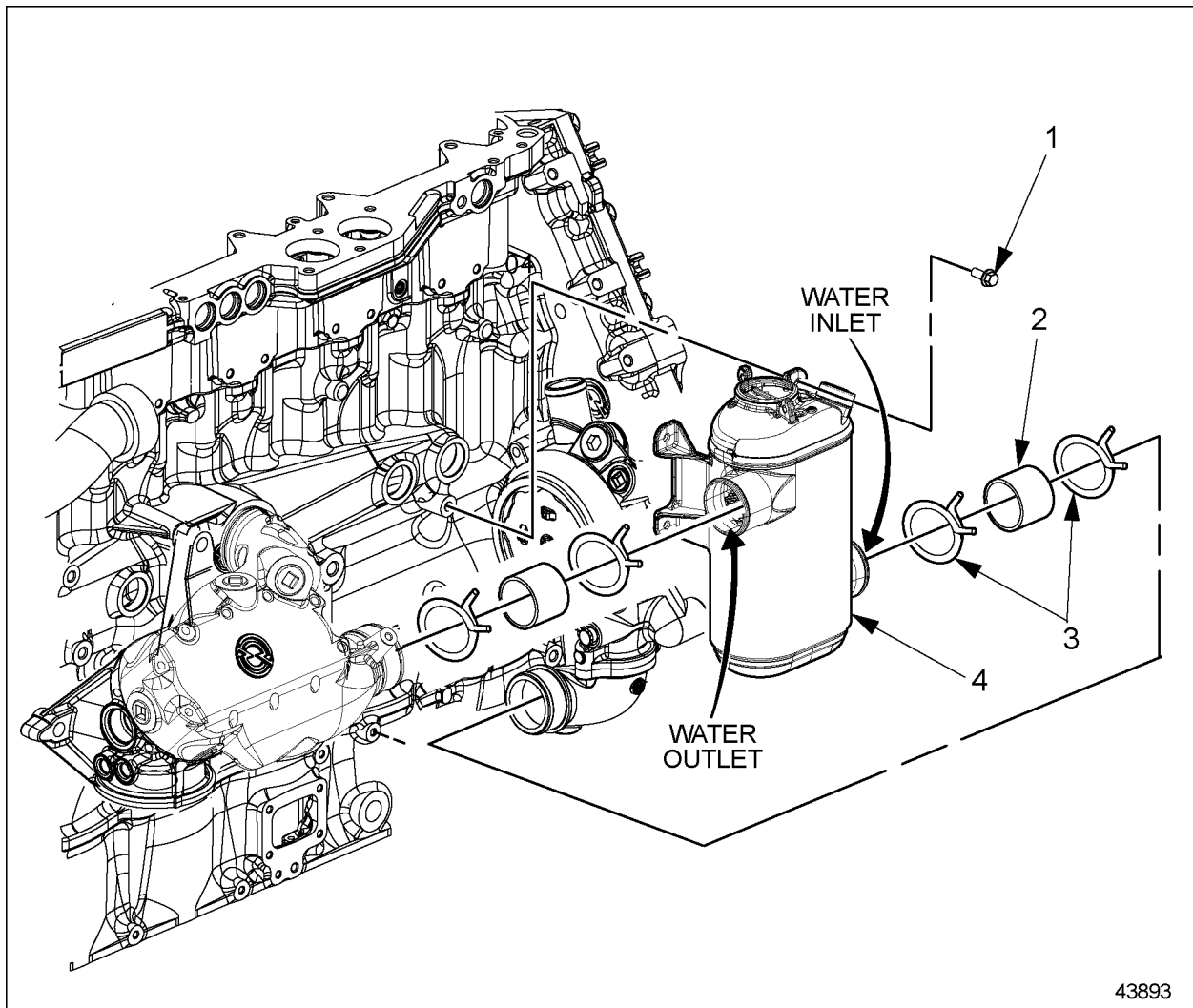
WARNING:

PERSONAL INJURY

To avoid injury when removing or installing a heavy engine component, ensure the component is properly supported and securely attached to an adequate lifting device to prevent the component from falling.

2. Insert EGR cooler water outlet into hose on oil cooler inlet. Secure hose with clamps.
3. Align EGR cooler back plate holes with four bosses on cylinder block.
4. Thread four M10 bolts through back plate and into cylinder block.
5. Tighten bolts to 46-52 N·m (34-38 lb·ft).

6. Install hose and clamps onto EGR cooler water inlet. See Figure 6-39g.



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|---------|---------------|
| 1. Bolt | 3. Clamp |
| 2. Hose | 4. EGR Cooler |

Figure 6-39g EGR Cooler and Related Parts

7. Insert water pump outlet elbow into hose on EGR cooler water inlet. Secure hose with clamps.
8. Install a new seal ring on the water pump elbow and secure elbow with two M10 bolts. Torque bolts to 58-73 N·m (43-54 lb·ft).
9. Install delivery pipe. Refer to section 6.6.17.

6.6.13c Upper Hot Pipe, Bellows and EGR Valve Removal

For Series 60 engines equipped with EGR systems, remove upper hot pipe, bellows and EGR valve as follows:

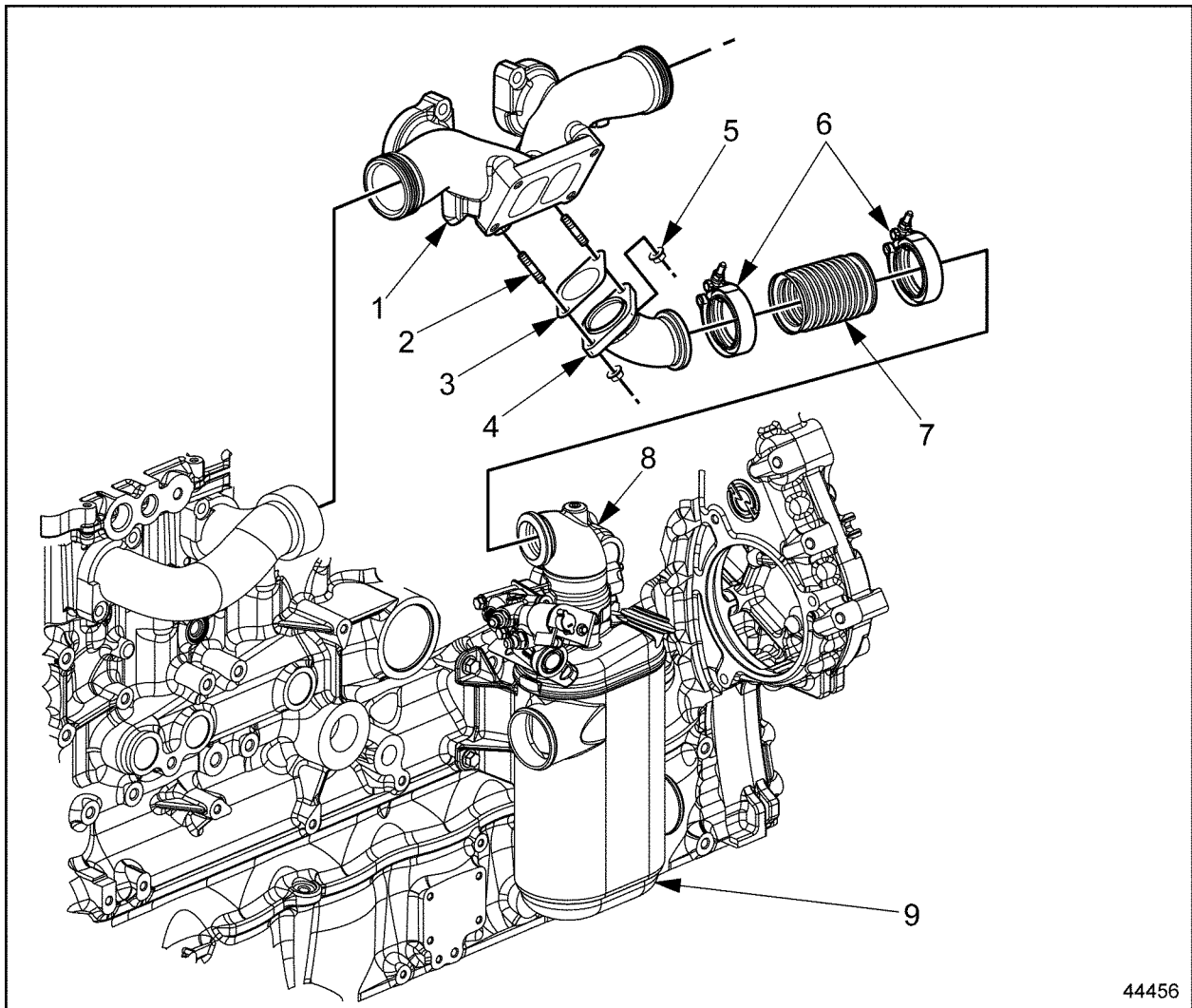


WARNING:

PERSONAL INJURY

**To avoid injury from hot surfaces, wear protective gloves,
or allow engine to cool before removing any component.**

1. Loosen two clamps on bellows. Slide one clamp onto upper hot pipe and slide the other clamp onto EGR valve and actuator assembly. See Figure 6-39h.



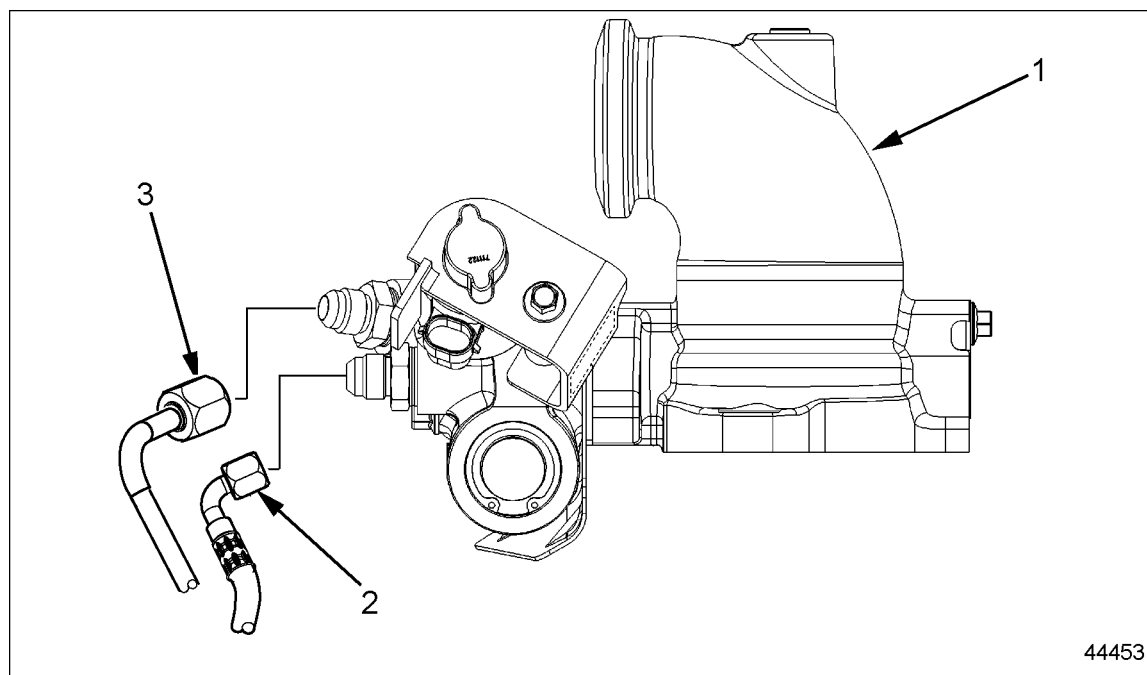
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| 1. Exhaust Manifold Center Section | 6. Clamp |
| 2. Stud | 7. Bellows |
| 3. Gasket | 8. EGR Valve assembly |
| 4. Upper Hot Pipe | 9. EGR Cooler |
| 5. Nut | |

Figure 6-39h EGR Cooler and Related Parts

NOTICE:

The bellows is a one time usage component; discard after removal.

2. Remove bellows from the upper hot pipe, EGR valve and actuator assembly and discard bellows.
3. Remove two nuts from studs securing upper hot pipe to exhaust manifold. See Figure 6-39h.
4. Remove upper hot pipe and gasket from exhaust manifold. Discard gasket.
5. Disconnect oil inlet and outlet lines from the hydraulic actuator assembly. See Figure 6-39i.



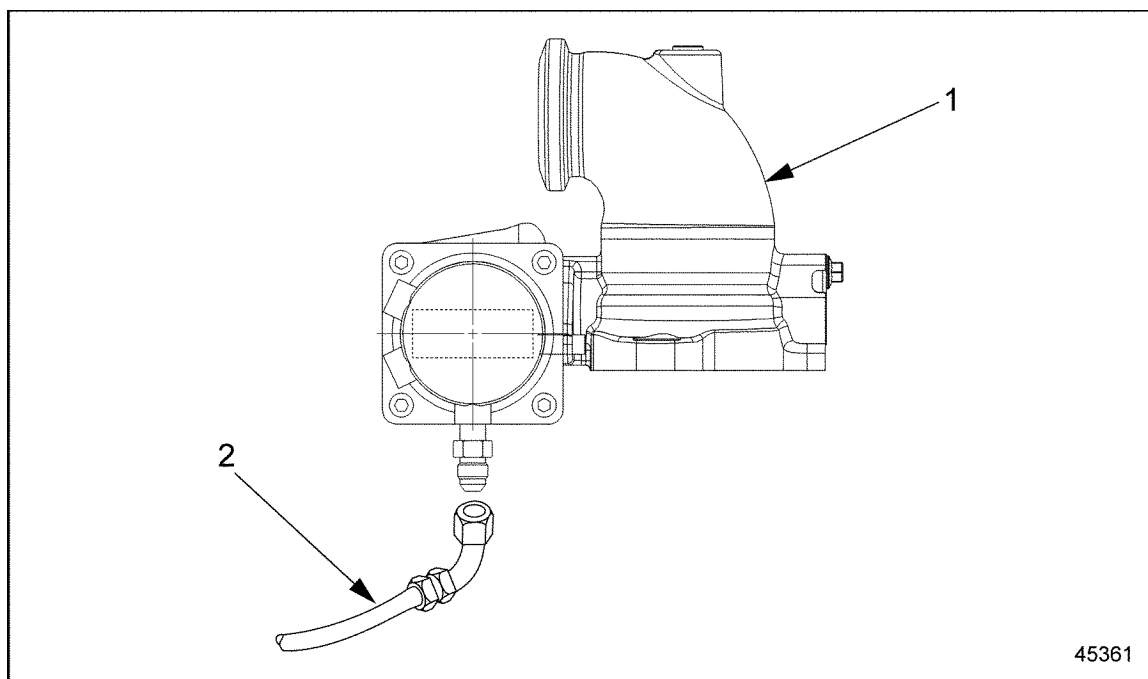
1. EGR Valve and Actuator Assembly

3. Oil Inlet Line and Fitting

2. Oil Outlet Line and Fitting

Figure 6-39i EGR Valve and Hydraulic Actuator Assembly

6. Remove air line from fitting on pneumatic actuator assembly. See Figure 6-39j.



1. EGR Valve and Pneumatic Actuator Assembly

2. Air line Tube

Figure 6-39j EGR Valve and Pneumatic Actuator Assembly

7. Remove three nuts from studs securing EGR valve and actuator assembly to EGR cooler and remove assembly and gasket. Discard gasket.

6.6.13d Disassembly of the EGR Valve and Hydraulic Actuator Assembly (Bellows System)

Disassemble the EGR valve and hydraulic actuator assemblies as follows:

NOTICE:


The actuator assembly can be separated from the EGR Valve assembly, however there should not be any further disassembly.
DO NOT disassemble the actuator or EGR valve assemblies.

1. Remove two bolts securing hydraulic actuator assembly, heat and insulator shields to EGR valve assembly. See Figure 6-39k.
2. Remove the EGR valve assembly from the hydraulic actuator assembly. Discard insulator shield.

6.6.13d.1 Cleaning of the EGR Valve and Hydraulic Actuator Assembly (Bellows System)

Clean the internal spline drive on the actuator assembly and external spline on the valve shaft as follows:

1. Brush splines to loosen debris. See Figure 6-39k.

 WARNING:
EYE INJURY
To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 40 psi (276 kPa) air pressure.

2. Remove any loose debris with compressed air.

6.6.13d.2 Inspection of the EGR Valve and Hydraulic Actuator Assembly (Bellows System)

Visually inspect actuator and valve assemblies for excessive wear. Replace the EGR valve assembly or hydraulic actuator assembly if they are defective. Reuse the EGR valve assembly or hydraulic actuator assembly if they are not defective.

6.6.13e Assembly of the EGR Valve and Hydraulic Actuator Assemblies (Bellows System)

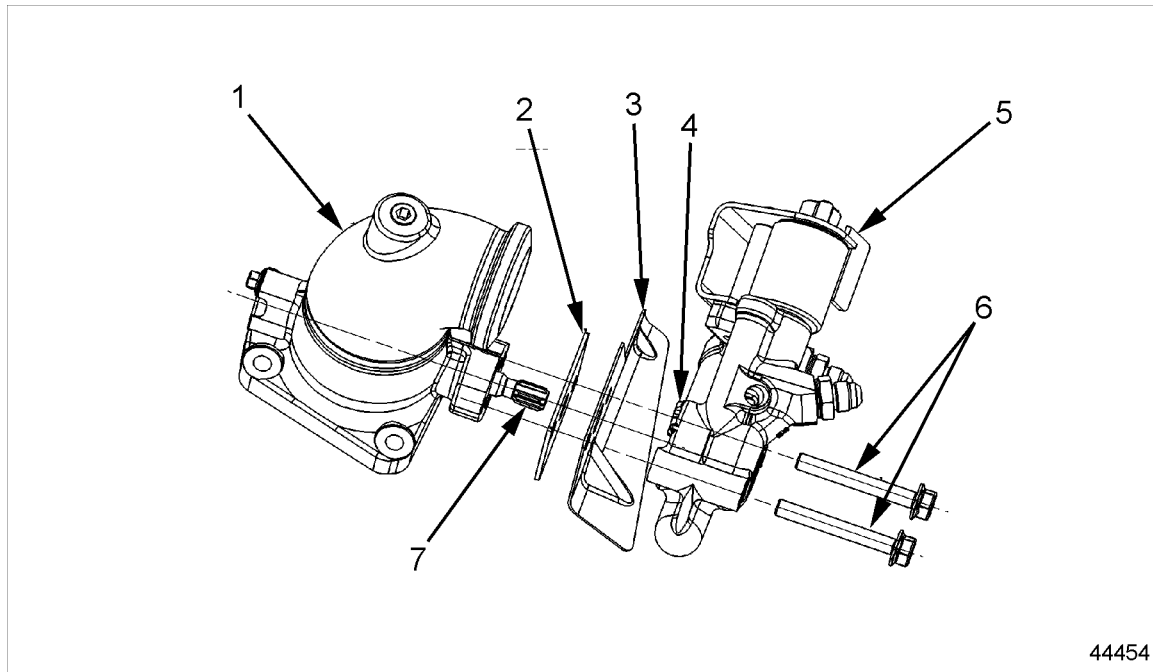
Assemble the EGR valve and hydraulic actuator as follows:

NOTICE:
The insulator shield must be replaced whenever the actuator assembly is disassembled from the EGR valve assembly. The heat shield can be reused.

NOTE:

The spline drive for the actuator assembly is keyed to ensure proper alignment with the shaft on the valve assembly.

1. Install the hydraulic actuator assembly, heat shield and new insulator shield onto the splined shaft of the EGR valve assembly. **DO NOT FORCE**. See Figure 6-39k.



- | | |
|---------------------------|--------------------------------|
| 1. EGR Valve Assembly | 5. Hydraulic Actuator Assembly |
| 2. Insulator Shield | 6. Bolts |
| 3. Heat Shield | 7. Splined External Shaft |
| 4. Splined Internal Drive | |

Figure 6-39k Hydraulic Actuator, EGR Valve and Related Parts

2. Install two bolts into the hydraulic actuator and EGR valve assembly.
3. Torque bolts evenly to ensure EGR valve and hydraulic actuator assemblies are not misaligned. Misalignment will cause the assemblies to bind.
4. Torque bolts to 24-28 N·m (18-21 lb·ft).

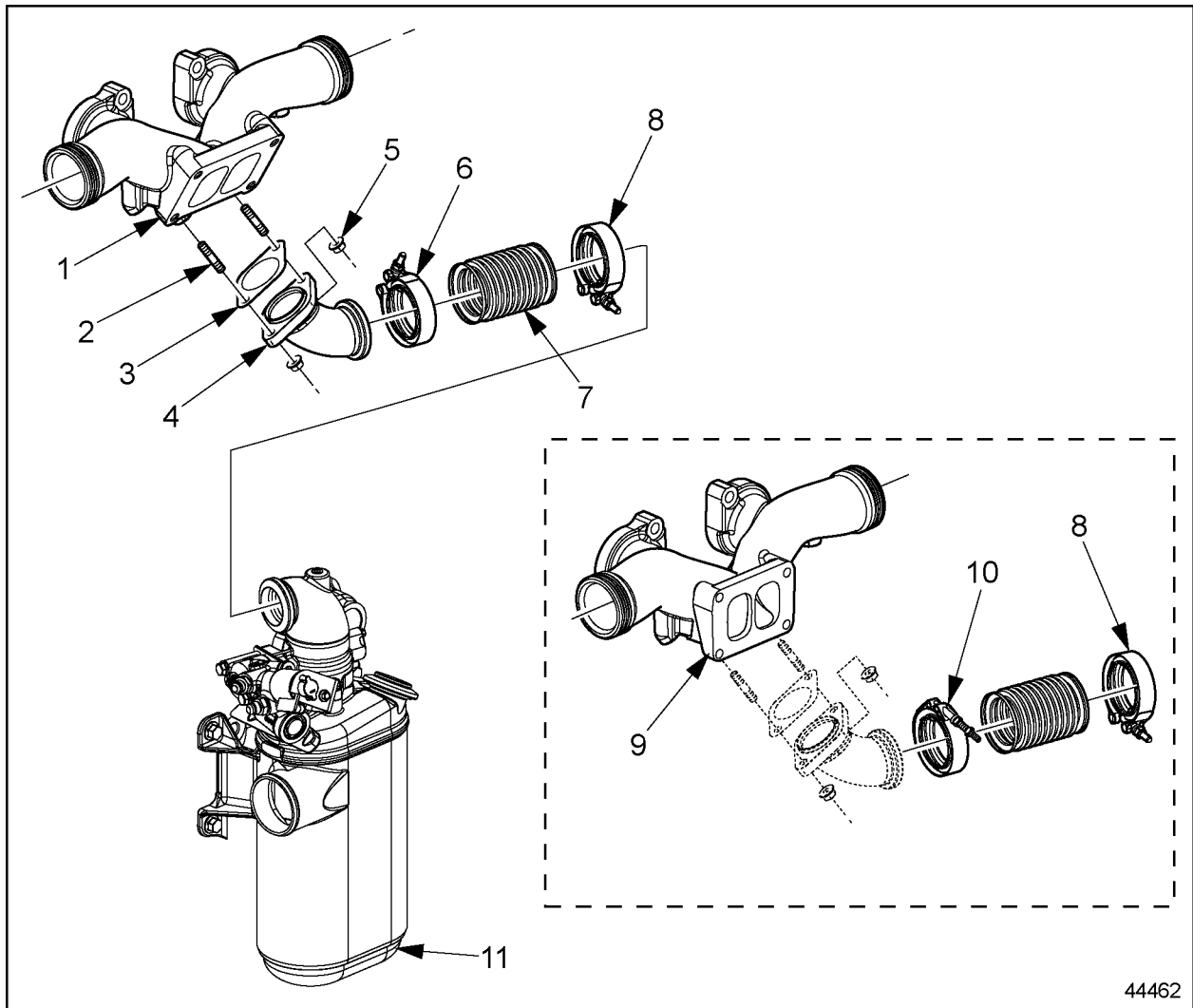
6.6.13f Upper Hot Pipe, Bellows and EGR Valve Installation

1. If removed, install exhaust manifold on the engine. Refer to section 7.2.
2. If the upper hot pipe studs have not been installed in the center exhaust manifold, use the following procedure:

NOTICE:
Do not apply lubricant to studs.

- [a] Install two M8 studs into the threaded holes near the EGR port on the bottom of the exhaust manifold center section.
 - [b] Torque studs to 28-32 N·m (21-24 lb·ft).
 - [c] Install four M10 studs into the threaded holes on the exhaust manifold center section for the turbocharger.
 - [d] Torque M10 studs to 20-24 N·m (15-18 lb·ft).
3. If the EGR cooler studs have not been installed in the cooler use the following procedure:
 - [a] Install three M8 studs into the threaded holes on the EGR cooler.
 - [b] Torque studs to 28-32 N·m (21-24 lb·ft).
 4. If the upper hot pipe and gasket have not been installed use the following procedure:
 - [a] Install gasket and upper hot pipe onto studs on exhaust manifold center section.
 - [b] Install two nuts on studs and torque to 22-26 N·m (16-19 lb·ft).
 5. Loosely install the bellows to the EGR valve assembly using a bellows clamp.
 6. Slip the remaining bellows clamp over the flange of the upper hot pipe.
 7. Install the EGR cooler gasket.
 8. Align the bellows with the upper hot pipe and while pressing against the upper hot pipe, lower the EGR valve assembly onto the EGR cooler studs.
 9. Tighten three EGR cooler nuts to 22-26 N·m (16-19 lb·ft).

10. Bellows clamps must be positioned correctly for exhaust manifold Mid-Setback and High-Mount center sections. See figure 6-39I for correct clamp orientation.



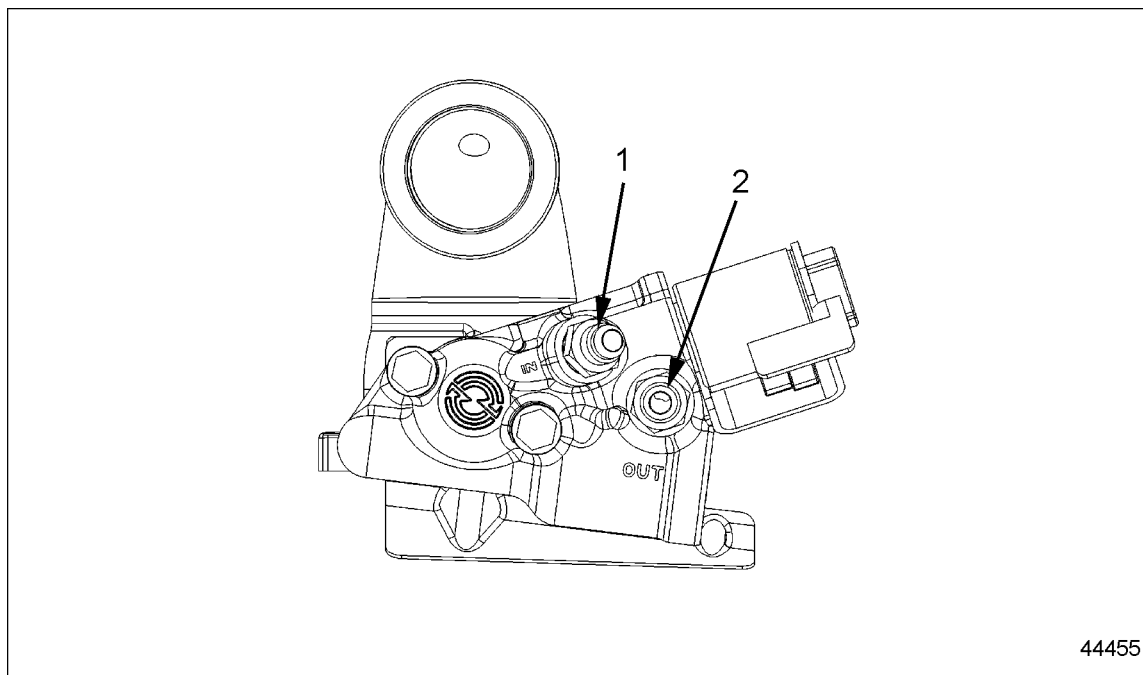
- | | |
|---|---|
| 1. Exhaust Manifold Mid-Setback Center Section | 7. Bellows |
| 2. Stud | 8. EGR Valve-to-Bellows Clamp Orientation for all Engines |
| 3. Gasket | 9. Exhaust Manifold High-Mount Center Section |
| 4. Upper Hot Pipe | 10. Clamp Orientation for a High-Mount Center Section |
| 5. Nut | 11. EGR Cooler |
| 6. Bellows Clamp Orientation Mid-Setback Center Section | |

Figure 6-39I Bellows Clamp Orientation for High-Mount or Mid-Setback Center Section Exhaust Manifolds

11. Torque nut on bellows clamps to 12 N·m (106 lb·in.).

NOTICE:

Particle debris in the lubrication inlet and outlet ports of the actuator assembly can cause performance problems. Use care to keep any debris out of the actuator and oil lines when servicing. See Figure 6-39m.

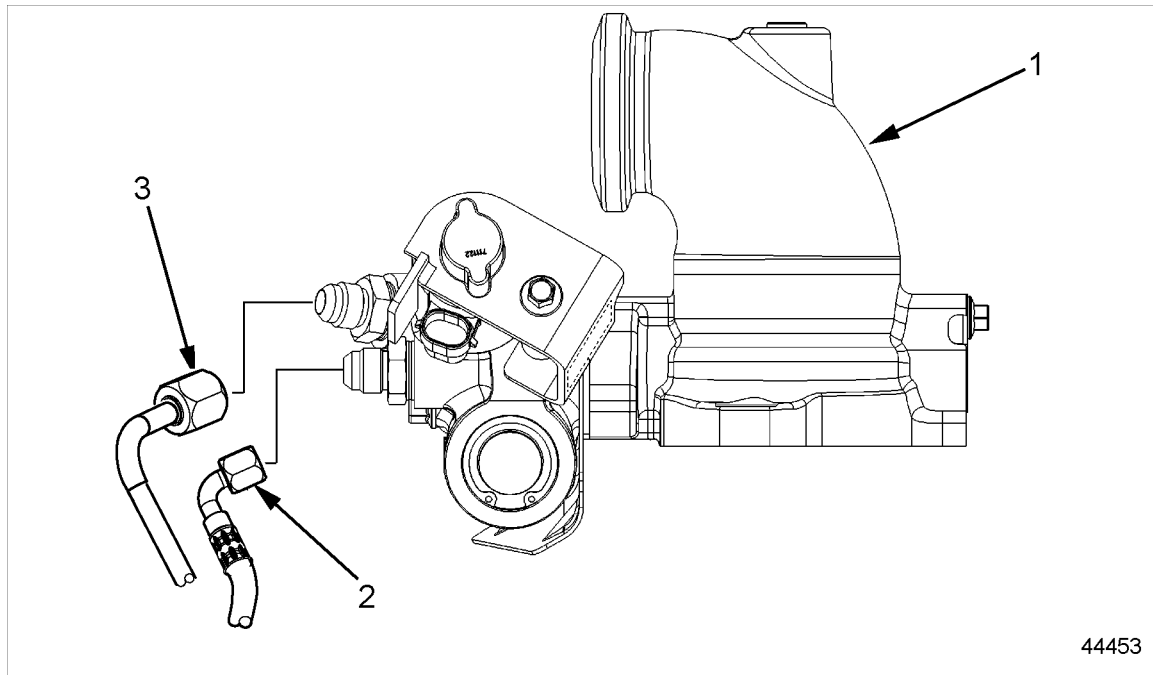


1. Oil Inlet

2. Oil Outlet

Figure 6-39m EGR Valve and Hydraulic Actuator Oil Inlet and Outlet Locations

12. Install oil inlet and outlet lines on hydraulic actuator assembly and torque to 24-28 N·m (18-21 lb·ft). See Figure 6-39n.



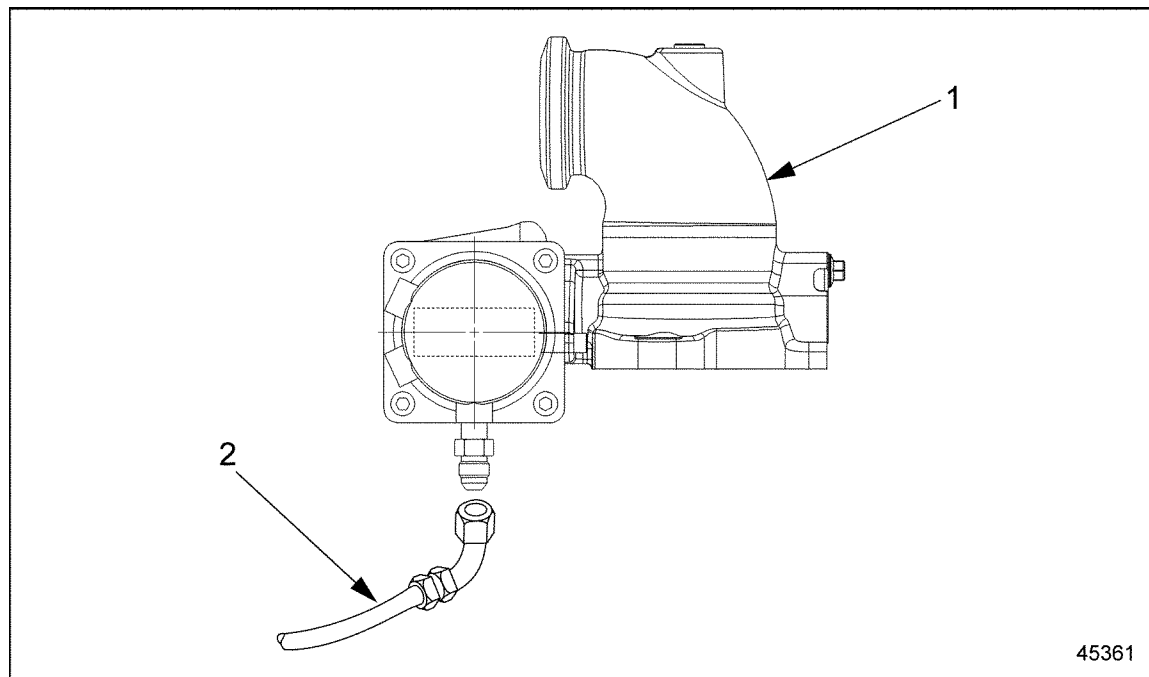
1. EGR Valve and Hydraulic Actuator Assembly

3. Oil Outlet Line and Fitting

2. Oil Inlet Line and Fitting

Figure 6-39n EGR Valve and Hydraulic Actuator Assembly with Oil Lines

13. Install air line to fitting on pneumatic actuator assembly and torque to 19-22 N·m (14-16 lb·ft). See Figure 6-39o.



1. EGR Valve and Pneumatic Actuator Assembly

2. Air line Tube

Figure 6-39o EGR Valve and Pneumatic Actuator Assembly

6.6.13f.1 Checking Pneumatic Actuator Assembly Calibration

Measure pneumatic actuator rod end travel as follows.

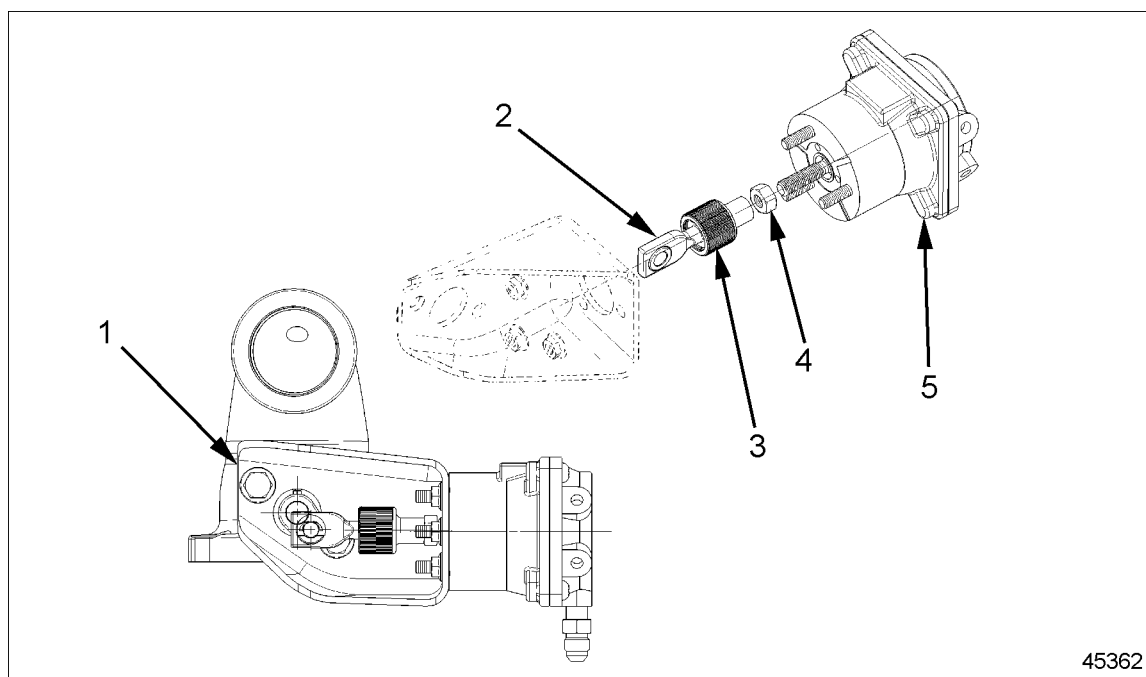
1. Install a dial indicator.
2. Adjust the stem of the dial indicator to rest on the rod end of the pneumatic actuator assembly. See Figure 6-39p.
3. With the valve closed and no pressure to the actuator set the dial indicator to zero.

! WARNING:

EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 40 psi (276 kPa) air pressure.

4. Using shop air, a pressure regulator and pressure gage, increase pressure at the actuator to 152 kPa (22.0 psi). Rod end travel with 152 kPa (22.0 psi) at the actuator should measure between .69-.83 mm (.025-.035 in.).
5. If calibration is not correct, adjust by loosening the jam nut and rotating the adjuster COUNTER CLOCKWISE to INCREASE the dial indicator reading or CLOCKWISE to DECREASE the dial indicator reading. See Figure 6-39p.



- | | |
|---|--------------------------------|
| 1. EGR Valve Assembly and Pneumatic Actuator Assembly | 4. Jam Nut |
| 2. Rod End | 5. Pneumatic Actuator Assembly |
| 3. Adjuster | |

Figure 6-39p Pneumatic Actuator Assembly

NOTE:

Tightening the jam nut will stretch the rod end and change the calibration setting. After adjustment the rod end should be checked with the jam nut tightened. The torque specification for the jam nut is 25-28 N·m (18.5-20.5 lb·ft). Repeat step 5 if necessary.

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