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Air Intake Ducting

09.00

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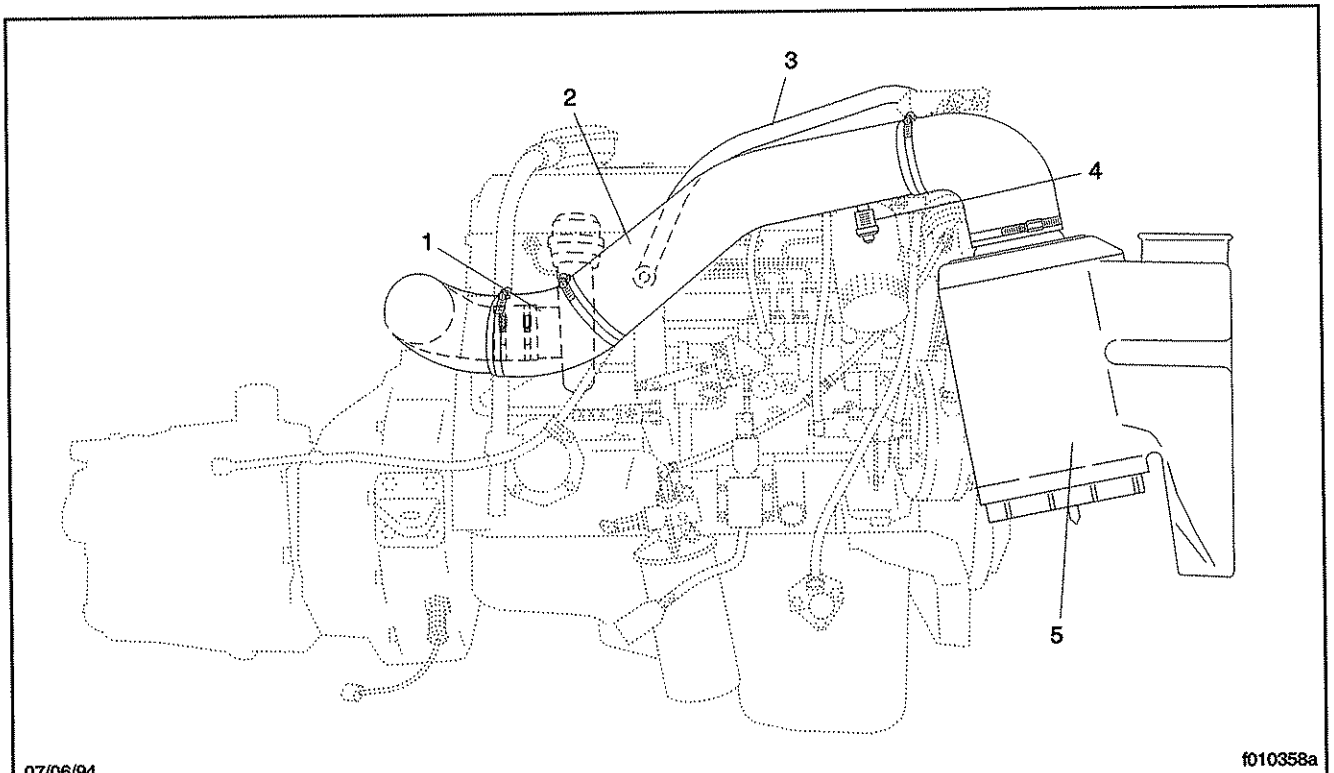
General Information

An average diesel engine needs over 10,000 gallons (38 000 liters) of clean air for each gallon (3.8 liters) of fuel burned. So complete combustion occurs in each engine cylinder, more clean air than is needed is present in each cylinder. The air intake system routes this supply of outside air through an air cleaner, which filters out dirt, dust, abrasive particles, and other foreign material from the intake air, without restricting air flow. From there, the air intake ducting routes this clean air to the engine turbocharger.

The air intake ducting consists of a high-temp plastic housing for the air cleaner, followed by aluminum tubes and neoprene hoses. Stainless steel hose clamps fasten all the components together in one of six configurations depending on which engine is used. See **Fig. 1, Fig. 2, Fig. 3, Fig. 4, Fig. 5,** and **Fig. 6.**

On some engines, a lock-up air restriction indicator (see **Fig. 7)** is attached to the intake ducting near the air cleaner. As an option, an air restriction indicator or gauge mounts in the dashboard. Nylon tubing connects the remote-mounted indicator or gauge to the ducting. The air restriction indicator or gauge indicates when the air cleaner element needs to be replaced. The amount of allowable air restriction varies with engine type.

On vehicles equipped with a Bendix AirMaster® air compressor, the compressor air inlet hose mounts to the air intake pipe just past the air restriction indicator.

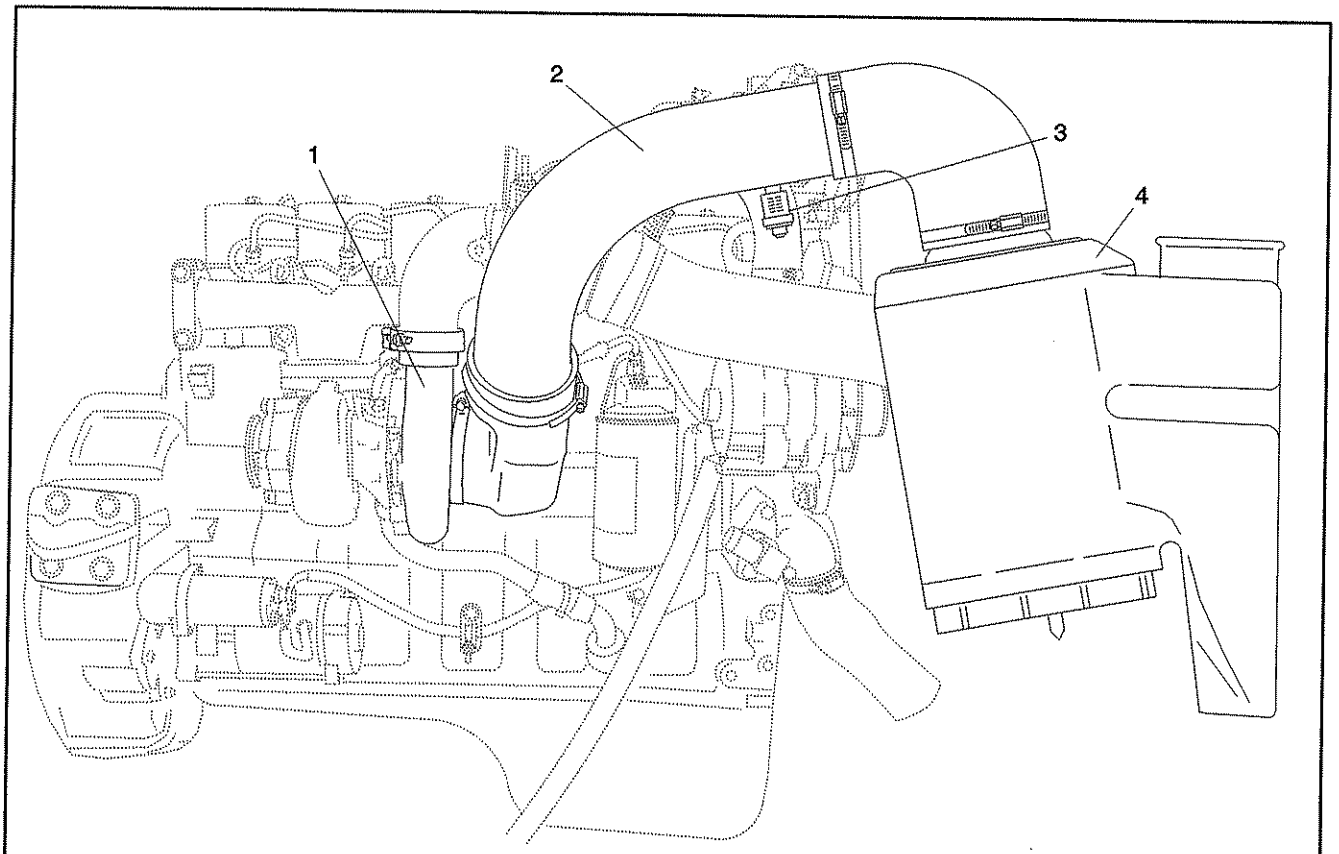


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1. Turbocharger
2. Air Intake Pipe
3. Air Compressor Inlet Hose
4. Air Restriction Indicator
5. Air Cleaner

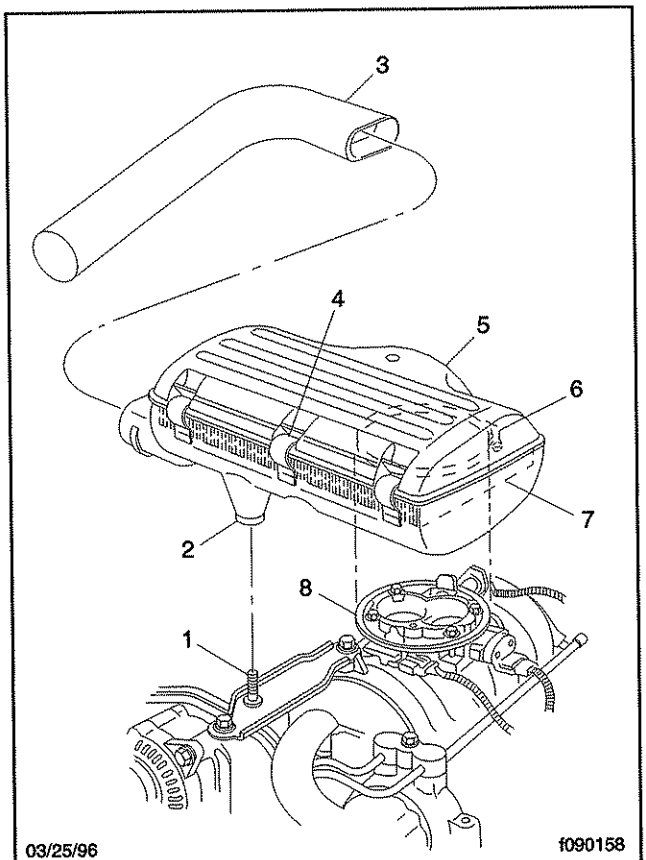
Fig. 1, Mercedes-Benz OM 366LA Engine, Air Intake Ducting

General Information



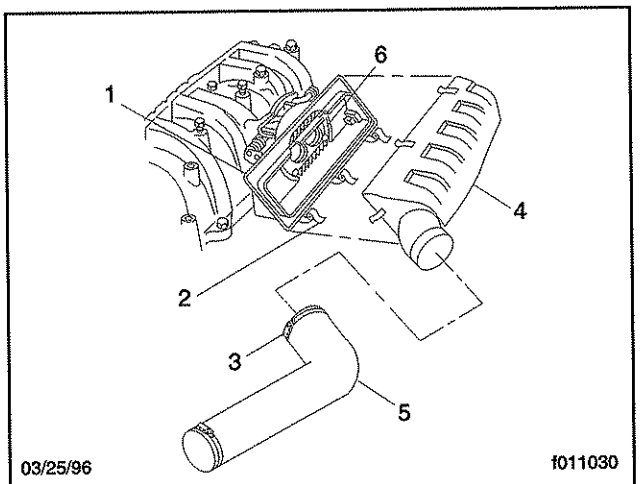
1. Turbocharger
2. Air Intake Pipe
3. Air Restriction Indicator
4. Air Cleaner

Fig. 2, Cummins B Series Engine, Air Intake Ducting



1. Mounting Stud
2. Grommet
3. Air Intake Tube
4. Spring Clip
5. Housing Cover
6. Clamp
7. Housing
8. Gasket

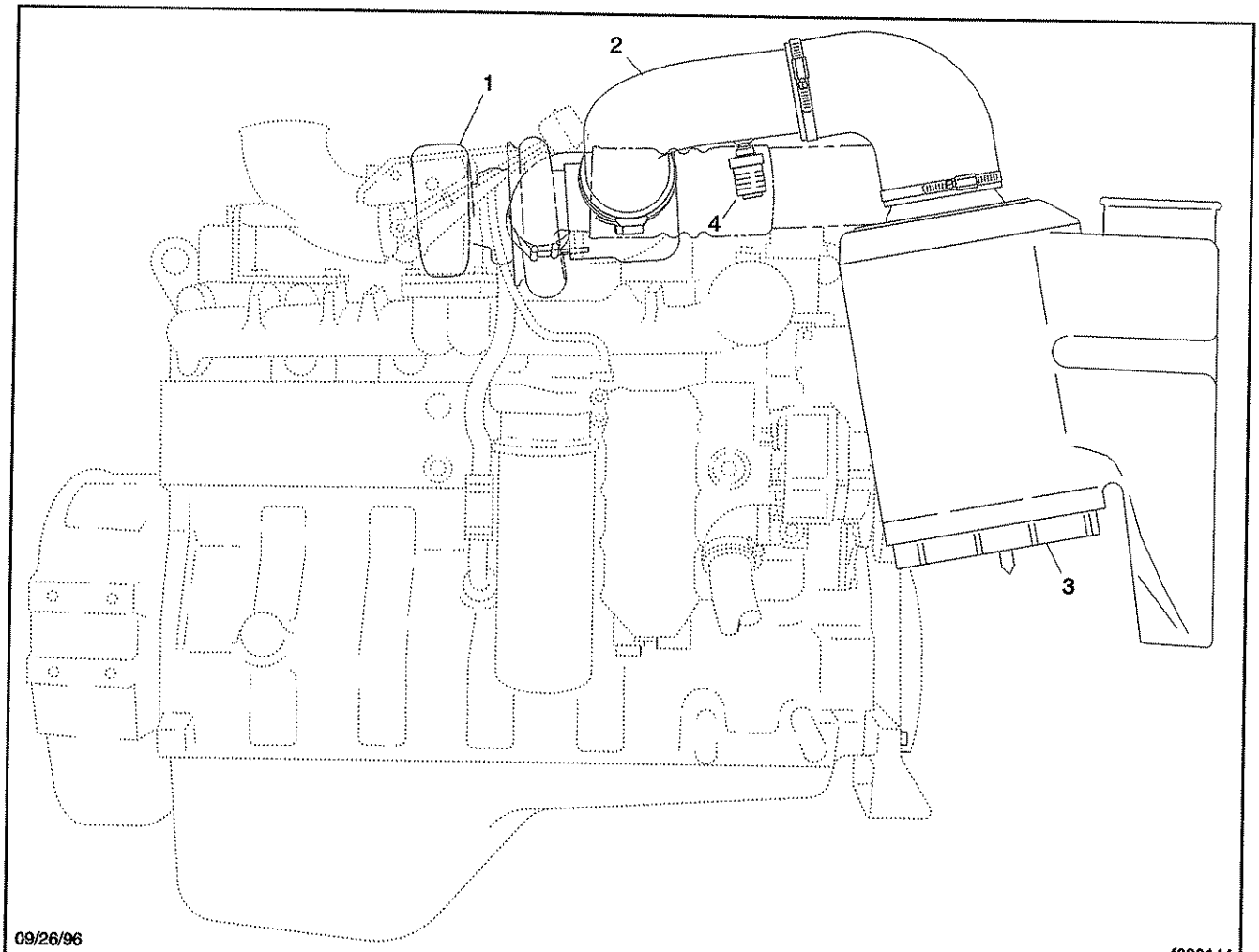
Fig. 3, Dodge Magnum V-8 Air Cleaner Installation



1. Housing
2. Spring Clip
3. Clamp
4. Housing Cover
5. Air Intake Tube
6. Gasket

Fig. 4, Dodge Magnum V-10 Air Cleaner Installation

General Information



1. Turbocharger
2. Air Intake Pipe
3. Air Cleaner
4. Air Restriction Indicator

Fig. 5, Cummins C Series Engine, Air Intake Ducting

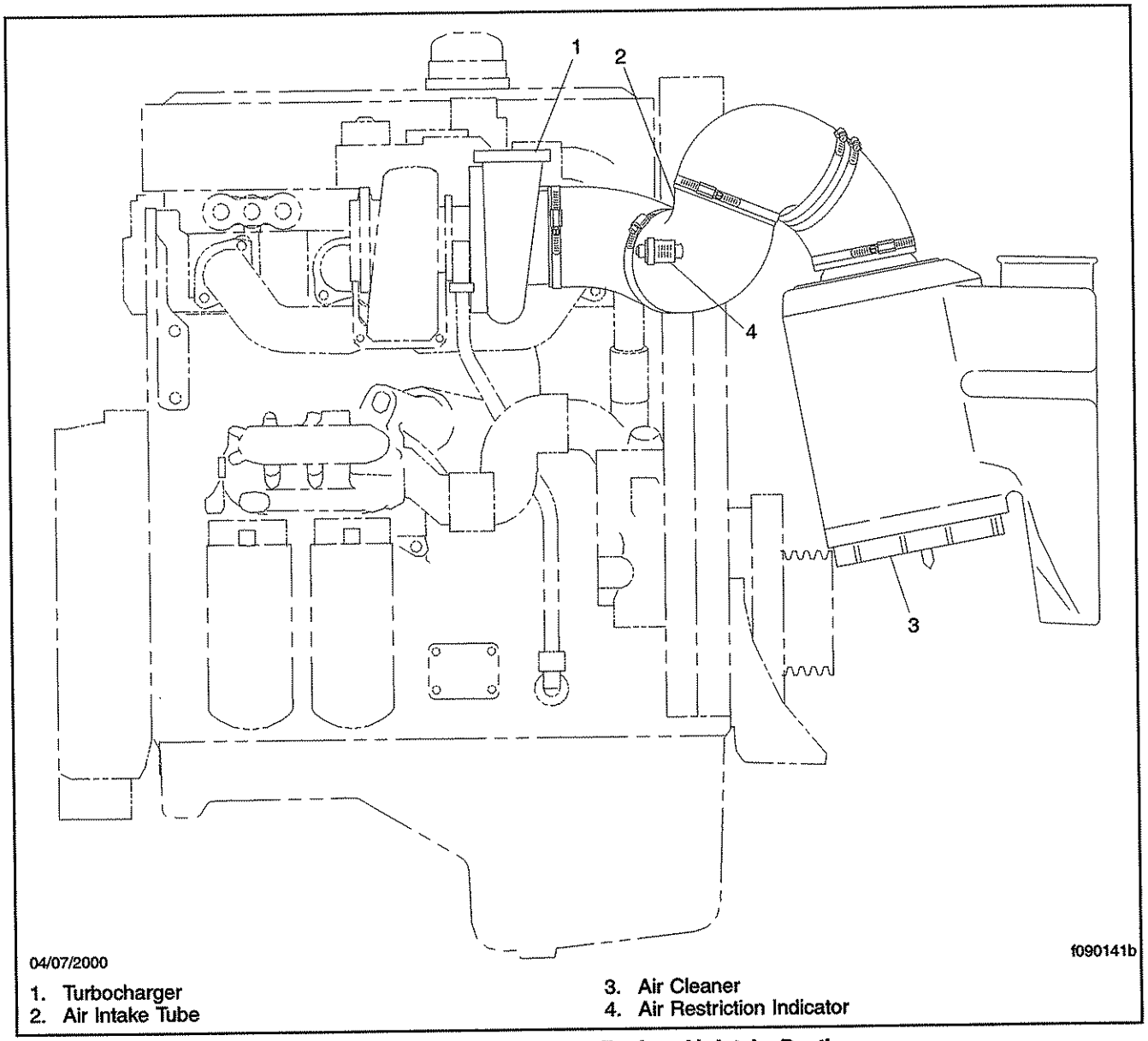
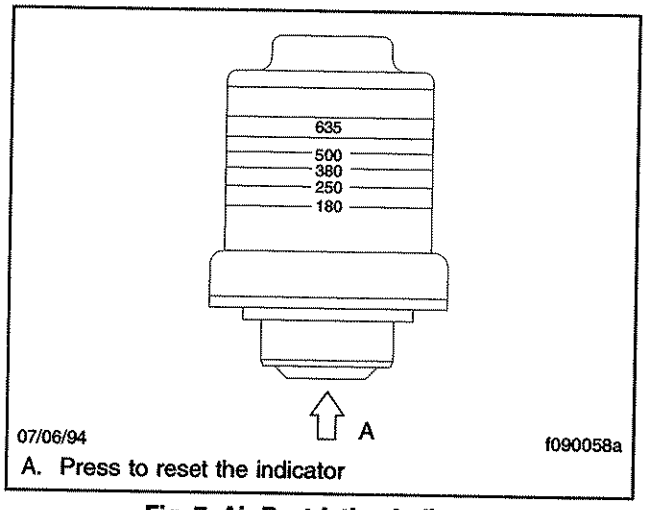


Fig. 6, Detroit Diesel Series 50 Engine, Air Intake Ducting

General Information



A. Press to reset the indicator

Fig. 7, Air Restriction Indicator

Air Intake Ducting Removal and Installation, Cummins B Series Engine

General Instructions

⚠ WARNING

WARNING: Do not operate the engine with any under-hood component of the air intake system removed; serious physical injury can occur if the turbocharger impeller is touched when it is rotating.

All air intake components and connections must be air- and water-tight. Dirt or dust entering the engine can cause internal engine damage. Much of the dirt and dust are silicates, which fuse into abrasive glass-like particles when exposed to engine combustion. These particles can grind piston rings, pistons, and cylinder liners.

IMPORTANT: Replace damaged components with new, identical parts. Neoprene hoses and nylon ducts that have been enlarged, extended, or otherwise modified, are not acceptable for installation between the air cleaner and the engine.

To avoid chafing, air intake ducting must not contact other parts.

Removal

1. Park the vehicle, apply the parking brakes, and chock the tires.
2. Tilt the hood.
3. Disassemble the air intake ducting. **Refer to Fig. 1.**
   - 3.1 Loosen the clamp (Ref. 8) that holds the elbow (Ref. 7) to the top of the air cleaner, and remove the elbow from the cleaner.
   - 3.2 Loosen the clamp (Ref. 6) that holds the elbow to the forward end of the air intake

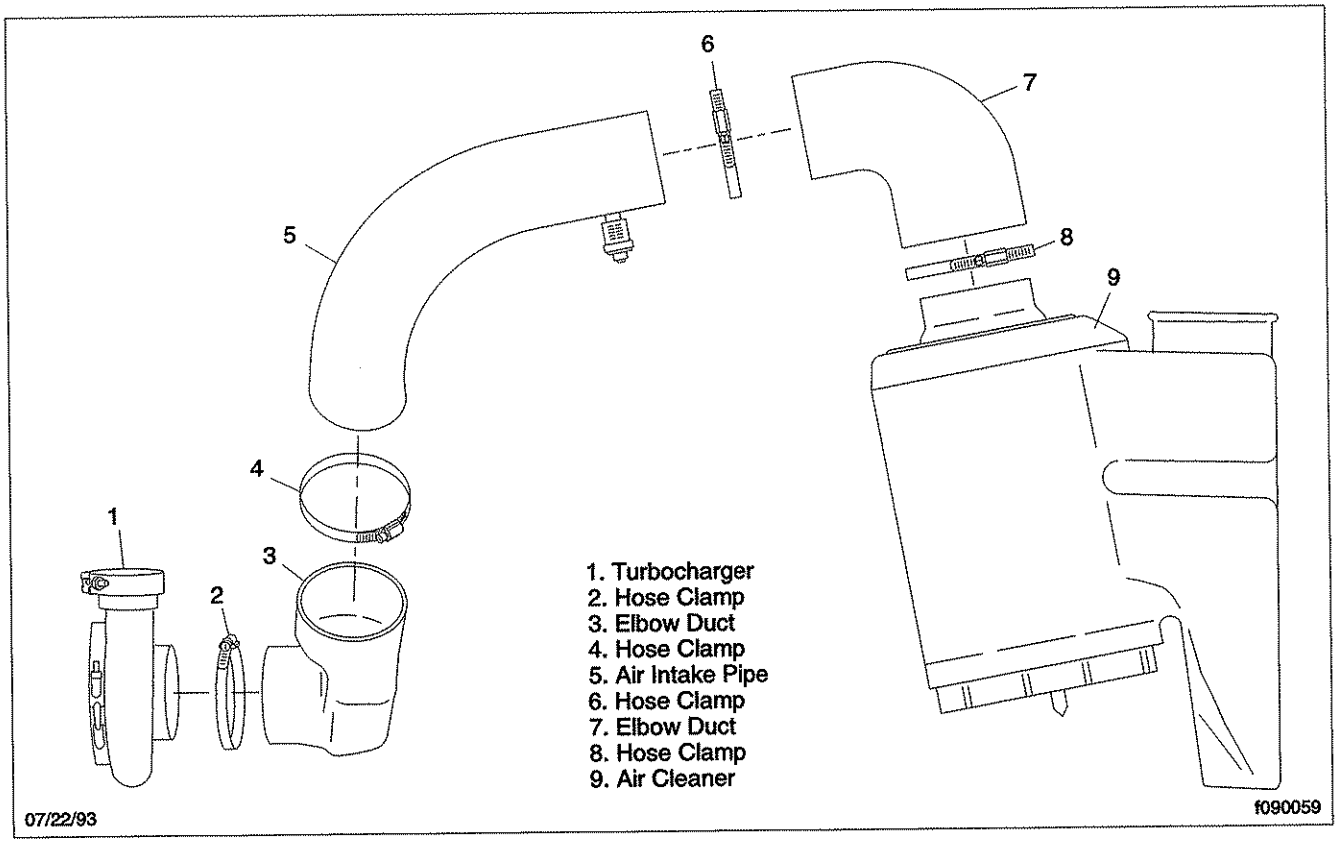


Fig. 1, Cummins B Series Engine, Air Intake Ducting

Air Intake Ducting Removal and Installation, Cummins B Series Engine

pipe (Ref. 5), and remove the elbow from the pipe.

3.3 Loosen the clamp (Ref. 4) that holds the pipe to the elbow (Ref. 3) at the forward side of the turbocharger, and remove the pipe from the elbow.

3.4 Loosen the clamp (Ref. 2) that holds the elbow to the forward side of the turbocharger, and remove the elbow from the turbocharger.

Installation

1. Replace any damaged parts with new identical parts.
2. Assemble the air intake ducting. **Refer to Fig. 1.**
   - 2.1 Install the new or undamaged elbow (Ref. 3) on the forward side of the turbocharger, and loosely install the clamp (Ref. 2).
   - 2.2 Install the new or undamaged air intake pipe (Ref. 5) in the elbow at the forward side of the turbocharger, and loosely install the clamp (Ref. 4).
   - 2.3 Install the new or undamaged elbow (Ref. 7) on the forward end of the air intake pipe, and loosely install the clamp (Ref. 6).
   - 2.4 Install the elbow on the top of the air cleaner, and tighten all hose clamps.
3. Lower the hood.
4. Remove the chocks from the tires.

Air Intake Ducting Removal and Installation, Mercedes-Benz OM 366LA Engine

General Instructions

⚠ WARNING

WARNING: Do not operate the engine with any under-hood component of the air intake system removed; serious physical injury can occur if the turbocharger impeller is touched when it is rotating.

All air intake components and connections must be air- and water-tight. Dirt or dust entering the engine can cause internal engine damage. Much of the dirt and dust are silicates, which fuse into abrasive glass-like particles when exposed to engine combustion. These particles can grind piston rings, pistons, and cylinder liners.

IMPORTANT: Replace damaged components with new, identical parts. Neoprene hoses and nylon ducts that have been enlarged, extended, or otherwise modified, are not acceptable for installation between the air cleaner and the engine.

To avoid chafing, air intake ducting must not contact other parts.

Removal

1. Park the vehicle, apply the parking brakes, and chock the tires.
2. Tilt the hood.
3. Disassemble the air intake ducting. **Refer to Fig. 1.**
   - 3.1 If applicable, disconnect the air compressor air inlet hose (Ref. 10) from the ducting air intake pipe (Ref. 9).

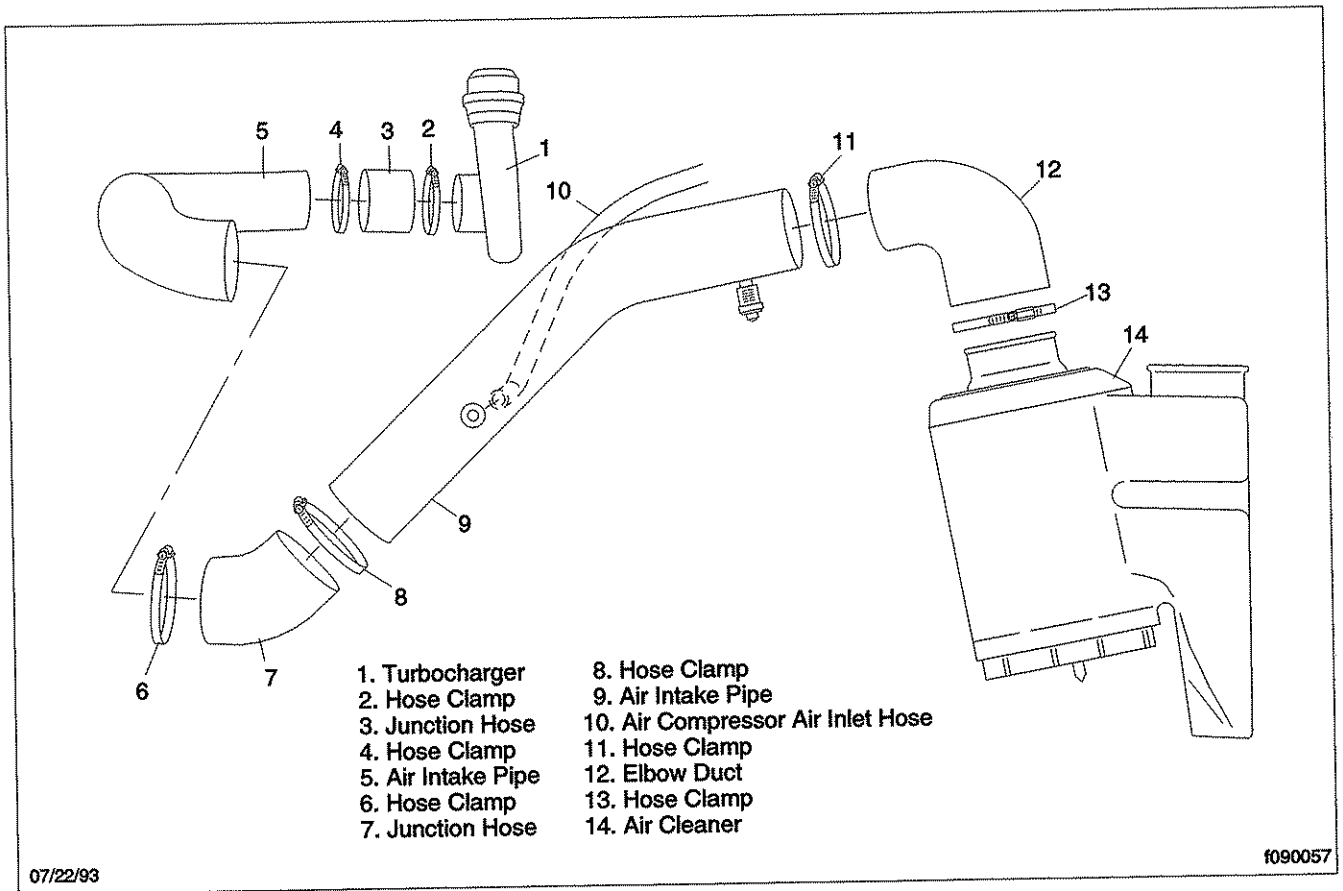


Fig. 1, Mercedes-Benz OM 366LA Engine, Air Intake Ducting

Air Intake Ducting Removal and Installation, Mercedes-Benz OM 366LA Engine

3.2 Loosen the clamp (Ref. 13) that holds the elbow (Ref. 12) to the top of the air cleaner, and remove the elbow from the cleaner.

3.3 Loosen the clamp (Ref. 11) that holds the elbow to the forward end of the air intake pipe, and remove the elbow from the pipe.

3.4 Loosen the clamp (Ref. 8) that holds the air intake pipe to the junction hose (Ref. 7), and remove the pipe from the hose.

3.5 Loosen the clamp (Ref. 6) that holds the junction hose to the pipe (Ref. 5) routed around the rear of the engine, and remove the hose from the pipe.

3.6 Remove the two bolts that hold the pipe to the engine, and loosen the hose clamp (Ref. 4) that holds the pipe to the junction hose (Ref. 3) at the rear of the turbocharger. Remove the pipe from the engine and the turbocharger.

3.7 Loosen the hose clamp (Ref. 2) that holds the junction hose (Ref. 3) to the turbocharger, and remove the hose from the turbocharger.

Installation

1. Replace any damaged parts with new identical parts.
2. Assemble the air intake ducting. **Refer to Fig. 1.**

2.1 Install the new or undamaged junction hose (Ref. 3) on the rear of the turbocharger, and loosely install the hose clamp.

2.2 Install the new or undamaged air intake pipe (Ref. 5) around the rear of the engine. Tighten the two bolts that hold the pipe on the engine, and loosely install the hose clamp that holds the pipe to the junction hose (Ref. 3) at the rear of the turbocharger.

2.3 Install the new or undamaged junction hose (Ref. 7) on the right end of the pipe (Ref. 5), and loosely install the hose clamp.

2.4 Install the new or undamaged air intake pipe (Ref. 9) in the forward end of the junction hose (Ref. 7), and loosely install the hose clamp.

2.5 Install the new or undamaged elbow (Ref. 12) on the forward end of the air intake pipe, and loosely install the clamp.

2.6 Install the elbow (Ref. 12) on the top of the air cleaner, and tighten all hose clamps.

2.7 If applicable, connect the air compressor air inlet hose (Ref. 10) to the air intake pipe.

3. Lower the hood.
4. Remove the chocks from the tires.

Air Intake Ducting, Housing, and Element Removal and Installation, Dodge Magnum Engines

General Instructions

All air intake components and connections must be air- and water-tight. Dirt or dust entering the engine can cause internal engine damage. Much of the dirt and dust are silicates, which fuse into abrasive glass-like particles when exposed to engine combustion. These particles can grind piston rings, pistons, and cylinder liners.

IMPORTANT: Replace damaged components with new, identical parts. Neoprene hoses and nylon ducts that have been enlarged, extended, or otherwise modified, are not acceptable for installation between the air cleaner and the engine.

To avoid chafing, air intake ducting must not contact other parts.

Removal

Dodge Magnum V-8

1. Park the vehicle, apply the parking brakes, and chock the tires.
2. Tilt the hood.
3. Disconnect the air inlet tube at the side of the air cleaner housing. **See Fig. 1.**
4. Loosen, but do not remove the band-type screw clamp that attaches the housing to the top of the throttle body. Note the clamp positioning tabs on the air cleaner housing.
5. Disconnect the air pump hose at the air cleaner housing.

NOTE: The bottom-front of the air cleaner housing is equipped with a rubber grommet. A mounting stud is attached to the intake manifold, and is used to position the air cleaner housing into the grommet.

6. Lift the assembly from the throttle body while slipping the assembly from the mounting stud.
7. Check the condition of the gasket at the throttle body (and replace as necessary).
8. Unlatch the three spring clips at the top of the air cleaner housing, and tilt the housing cover up and rearward for removal of the cover.
9. Remove the air cleaner element from the air cleaner housing.

Dodge Magnum V-10

1. Park the vehicle, apply the parking brakes, and chock the tires.
2. Tilt the hood.

NOTE: A small amount of engine oil wetting the inside of the air cleaner housing is normal. When servicing, wipe out the oil from the housing.

3. Loosen the clamp, and remove the air inlet tube at the front of the air cleaner housing cover. **See Fig. 2.**
4. Unlatch the spring clips attaching the air cleaner element cover to the air cleaner housing, and remove the cover.
5. Remove the air cleaner element from the air cleaner cover.
6. Check the condition of the gasket at the throttle body (and replace as necessary).

Installation

Dodge Magnum V-8

1. Clean inside the air cleaner housing.
2. Position the air cleaner element inside the air cleaner housing.
3. Position the air cleaner cover to the tabs on the rear of the air cleaner housing. Then, latch the three spring clips to seal the cover to the housing. **See Fig. 1.**
4. Position the air cleaner housing assembly to the throttle body while guiding the rubber grommet over the mounting stud. The lower part of the screw clamp should be below the top lip of the throttle body.
5. Push down on the air cleaner housing at the rubber grommet to seat the housing at the intake manifold.
6. Tighten the throttle body-to-air cleaner housing clamp 400 N·cm (35 lbf·in).

Air Intake Ducting, Housing, and Element Removal and Installation, Dodge Magnum Engines

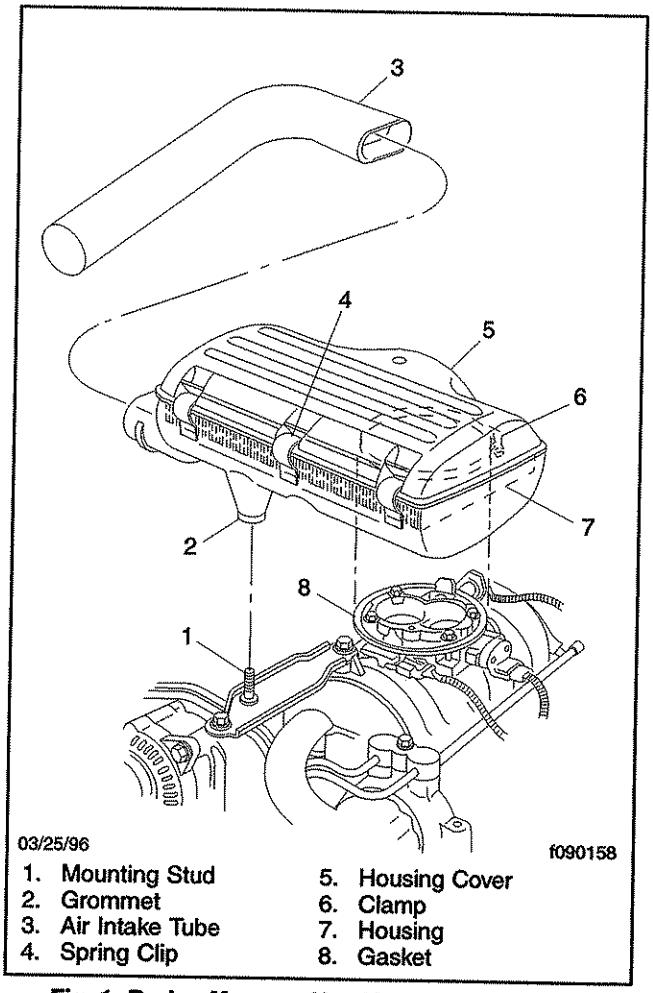


Fig. 1, Dodge Magnum V-8 Air Cleaner Housing

7. Install the air inlet tube at the inlet on the air cleaner housing.
8. Close the hood.
9. Remove the chocks from the tires.

Dodge Magnum V-10

1. Clean the inside of the air cleaner housing.
2. If the removal of the housing is necessary, remove the four housing-to-throttle body nuts.
3. After re-installing the housing, tighten the four nuts to 1084 N·cm (96 lbf·in).

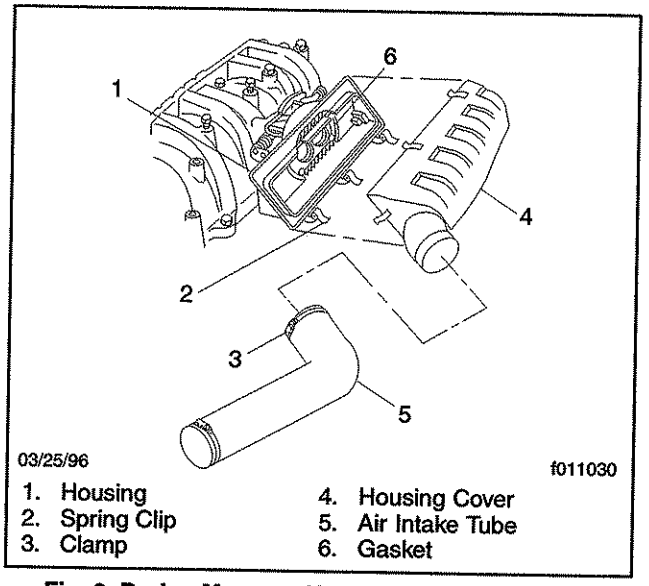


Fig. 2, Dodge Magnum V-10 Air Cleaner Housing

4. Position the air cleaner element into the air cleaner cover, and latch the spring clips to seal the cover to the housing.
5. Install the air inlet tube at the air cleaner housing.
6. Install and tighten the clamp at the air inlet tube.
7. Close the hood.
8. Remove the chocks from the tires.

Air Intake Ducting Removal and Installation, Cummins C Series Engine

General Instructions

⚠ WARNING

WARNING: Do not operate the engine with any under-hood component of the air intake system removed; serious physical injury can occur if the turbocharger impeller is touched when it is rotating.

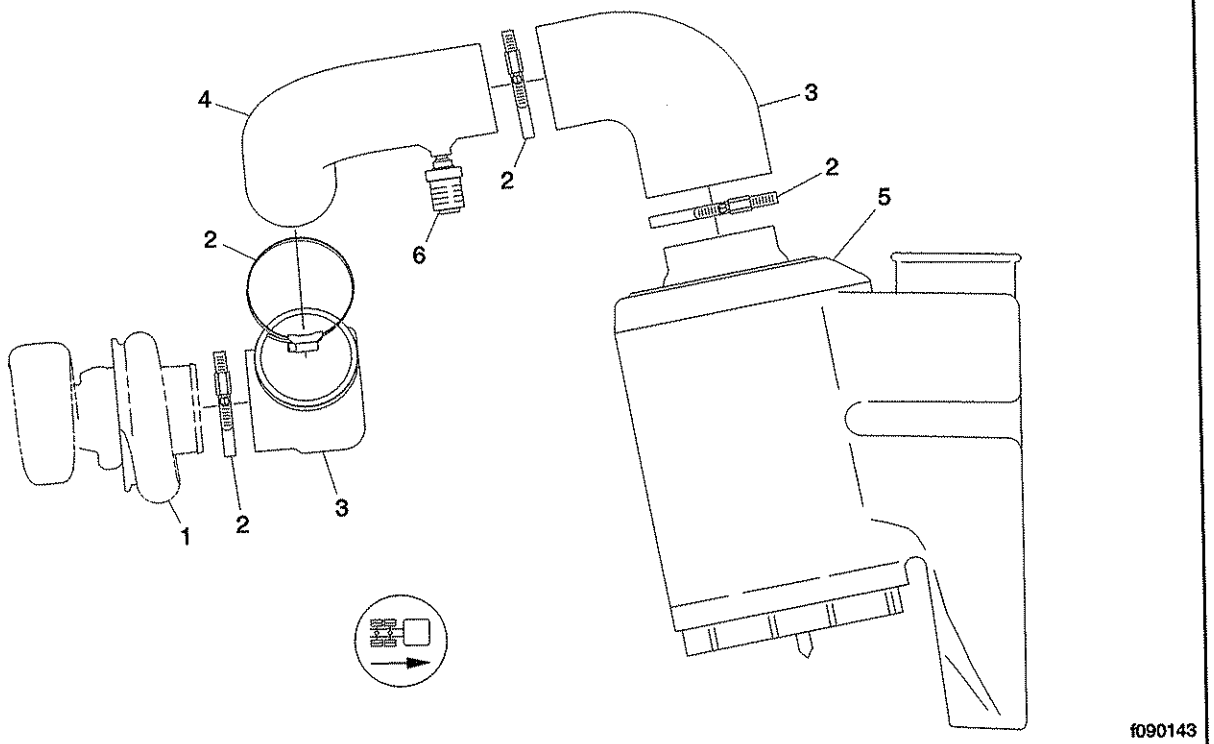
All air intake components and connections must be air- and water-tight. Dirt or dust entering the engine can cause internal engine damage. Much of the dirt and dust are silicates, which fuse into abrasive glass-like particles when exposed to engine combustion. These particles can grind piston rings, pistons, and cylinder liners.

IMPORTANT: Replace damaged components with new, identical parts. Neoprene hoses and nylon ducts that have been enlarged, extended, or otherwise modified, are not acceptable for installation between the air cleaner and the engine.

To avoid chafing, air intake ducting must not contact other parts.

Removal (See Fig. 1)

1. Park the vehicle, apply the parking brakes, and chock the tires.
2. Tilt the hood.
3. Disassemble the air intake ducting.
   - 3.1 Loosen the clamp that holds the elbow to the top of the air cleaner, and disconnect the elbow from the cleaner.



1. Turbocharger
2. Hose Clamp
3. Elbow Duct
4. Air Intake Pipe
5. Air Cleaner
6. Restriction Indicator

Fig. 1, Cummins C Series Engine, Air Intake Ducting

Air Intake Ducting Removal and Installation, Cummins C Series Engine

3.2 Loosen the clamp that holds the elbow to the forward end of the air intake pipe, and remove the elbow from the pipe.

3.3 Loosen the clamp that holds the pipe to the elbow at the forward side of the turbocharger, and remove the pipe from the elbow. Disconnect the restriction indicator air hose from the pipe.

3.4 Loosen the clamp that holds the elbow to the forward side of the turbocharger, and remove the elbow from the turbocharger.

Installation (See Fig. 1)

1. Replace any damaged parts with new identical parts.
2. Assemble the air intake ducting.
   - 2.1 Install the new or undamaged elbow on the forward side of the turbocharger, and loosely install the clamp.
   - 2.2 Install the new or undamaged air intake pipe in the elbow at the forward side of the turbocharger, and loosely install the clamp. Connect the restriction indicator air hose to the pipe.
   - 2.3 Install the new or undamaged elbow on the forward end of the air intake pipe, and loosely install the clamp.
   - 2.4 Connect the elbow to the top of the air cleaner, and tighten all hose clamps.
3. Lower the hood.
4. Remove the chocks from the tires.

Air Intake Ducting Removal and Installation, Detroit Diesel Series 50 Engine

General Instructions

⚠ WARNING

Do not operate the engine with any under-hood component of the air intake system removed; serious physical injury can occur if the turbocharger impeller is touched when it is rotating.

All air intake components and connections must be air- and water-tight. Dirt or dust entering the engine can cause internal engine damage. Much of the dirt and dust are silicates, which fuse into abrasive glass-like particles when exposed to engine combustion. These particles can grind piston rings, pistons, and cylinder liners.

IMPORTANT: Replace damaged components with new, identical parts. Neoprene hoses and nylon ducts that have been enlarged, extended, or otherwise modified, are not acceptable for installation between the air cleaner and the engine.

To avoid chafing, air intake ducting must not contact other parts.

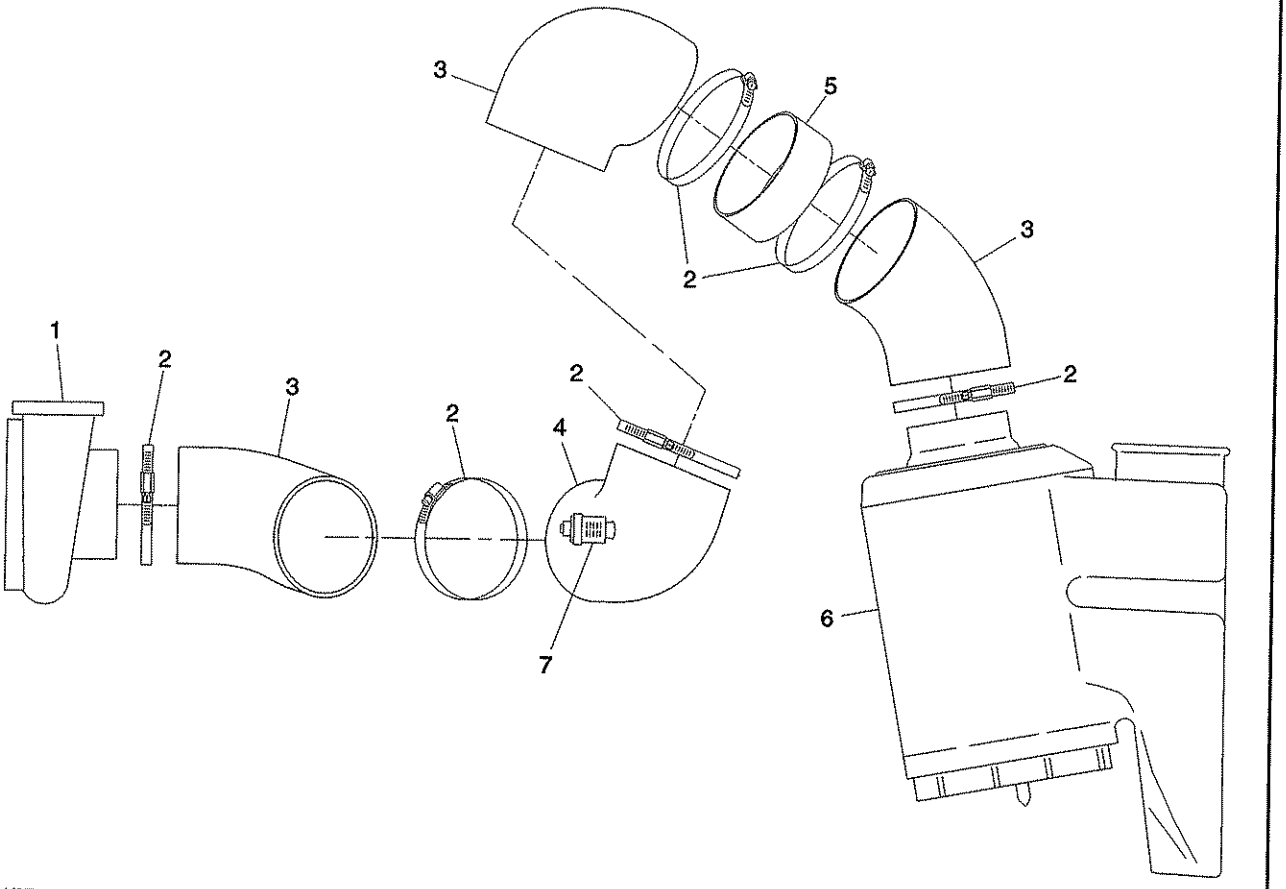
Removal (See Fig. 1)

1. Park the vehicle, apply the parking brakes, and chock the tires.
2. Tilt the hood.
3. Disassemble the air intake ducting.
   - 3.1 Loosen the clamp that holds the elbow to the top of the air cleaner, and disconnect the elbow from the cleaner.
   - 3.2 Loosen one of the two clamps that hold the two elbows together, and disconnect the elbows. Loosen the clamp that holds the air intake pipe inside the elbow, and disconnect the pipe from the elbow.
   - 3.3 Loosen the clamp that holds the elbow to the forward end of the air intake tube, and remove the elbow from the tube.
   - 3.4 Loosen the clamp that holds the tube to the elbow at the forward side of the turbocharger, and remove the tube from the elbow.
   - 3.5 Loosen the clamp that holds the elbow to the forward side of the turbocharger, and remove the elbow from the turbocharger.

Installation (See Fig. 1)

1. Replace any damaged parts with new identical parts.
2. Assemble the air intake ducting.
   - 2.1 Install the new or undamaged elbow on the forward side of the turbocharger, and loosely install the clamp.
   - 2.2 Install the new or undamaged air intake tube in the elbow at the forward side of the turbocharger, and loosely install the clamp.
   - 2.3 Install the new or undamaged elbow on the forward end of the air intake tube, and loosely install the clamp.
   - 2.4 Install the new or undamaged air intake pipe in the elbow, and loosely install the clamp. Install the new or undamaged elbow on the intake pipe, and loosely install the clamp.
   - 2.5 Connect the elbow to the top of the air cleaner, and tighten all hose clamps.
3. Lower the hood.
4. Remove the chocks from the tires.

Air Intake Ducting Removal and Installation, Detroit Diesel Series 50 Engine



1. Turbocharger
2. Hose Clamp
3. Elbow Duct
4. Air Intake Tube
5. Air Intake Pipe
6. Air Cleaner
7. Restriction Indicator

Fig. 1, Detroit Diesel Series 50 Engine, Air Intake Ducting

Charge Air Cooler 09.01

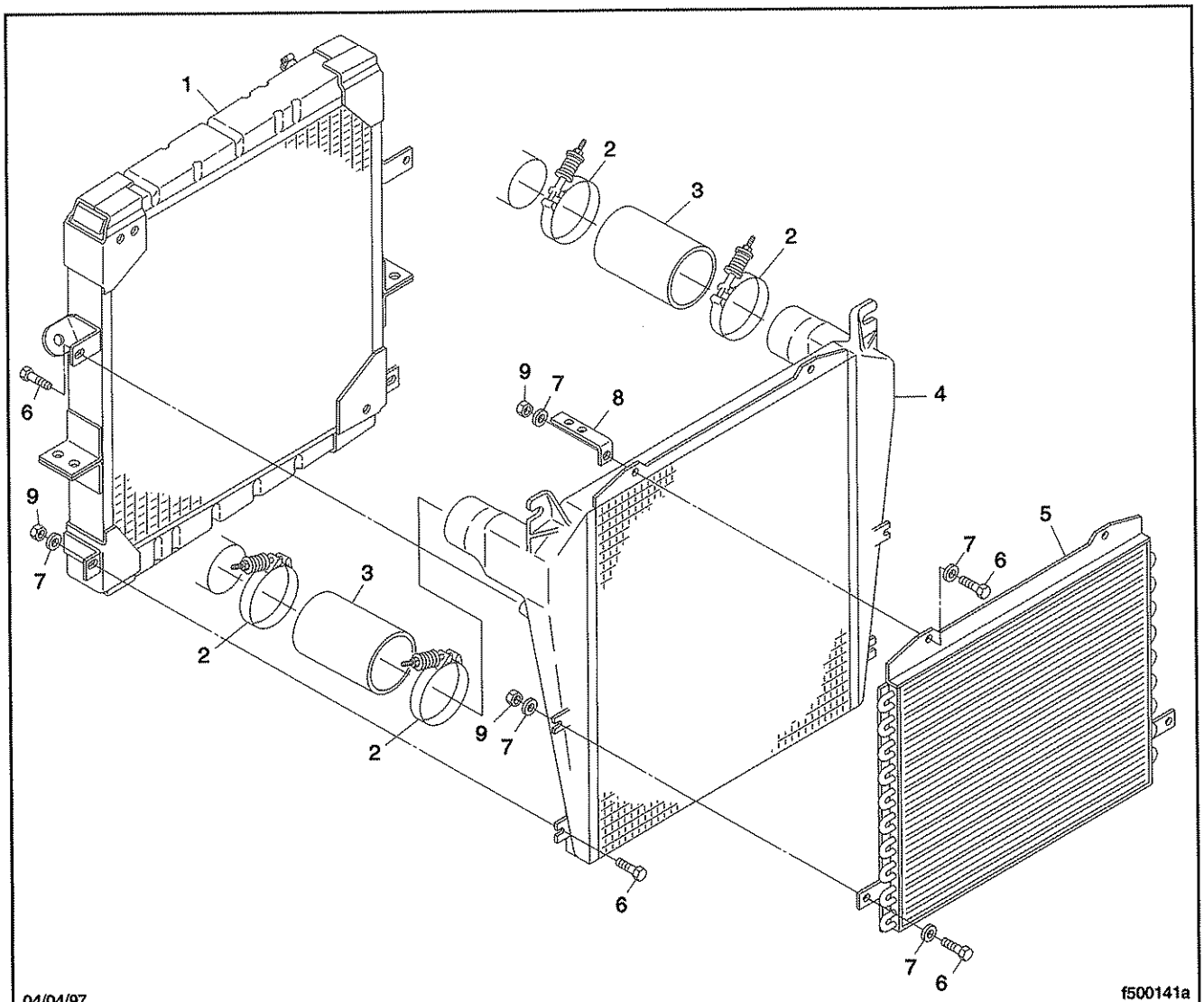
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General Information

The charge air cooler (CAC) is attached to the front of the radiator, behind the condenser. **See Fig. 1.** It is similar to a radiator: outside ambient air passing through the CAC core cools the engine's intake air charge.

Air leaving the turbocharger is compressed, which heats it to about 135° to 162°C (275° to 325°F), depending on the ambient temperature and boost. The CAC reduces this temperature to the engine manufacturer's specified air intake temperature before the air reaches the engine intake manifold. Lower temperatures reduce exhaust emissions, improve fuel economy, and increase horsepower.



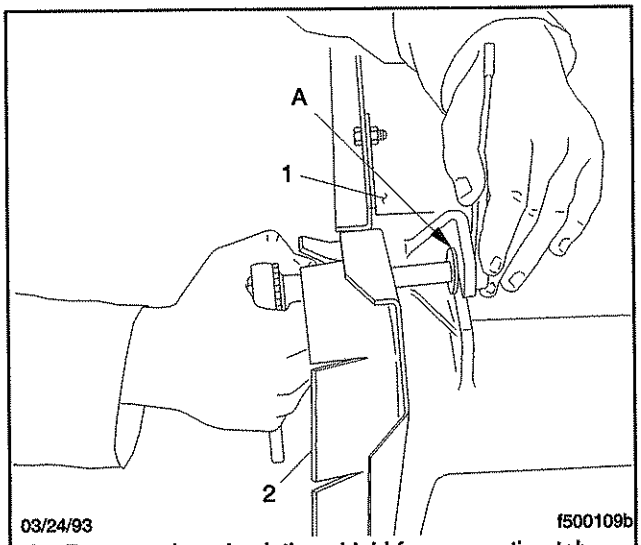
1. Radiator
2. Constant-Torque Hose Clamp
3. Convoluted Hose
4. Charge Air Cooler (CAC)
5. Condenser
6. Bolt
7. Washer
8. Stand-Off Bracket
9. Nut

Fig. 1, Charge Air Cooler Installation (typical)

Charge Air Cooler Removal and Installation

Removal

1. Park the vehicle, apply the parking brakes, and chock the tires.
2. Remove the hood; for instructions, **see Group 88.**
3. With the refrigerant hoses connected, move the condenser aside.
   - 3.1 Remove the air recirculation shields from either side of the condenser. **See Fig. 1.**
   - 3.2 Remove the clamp that secures the refrigerant hoses to the left radiator support strut.
   - 3.3 Remove the four bolts holding the condenser, and move the condenser to one side. Wrap it in a protective blanket, and secure it out of the way. **See Fig. 2.**
4. Remove the charge air cooler (CAC).
   - 4.1 Remove the hood cable brackets from the radiator. **See Fig. 3.**
   - 4.2 Disconnect the air inlet and outlet hoses from the CAC. **See Fig. 4.**



A. Remove air recirculation shield from mounting tab.
1. Charge Air Cooler
2. Air Recirculation Shield

Fig. 1, Air Recirculation Shield Removal/ Installation

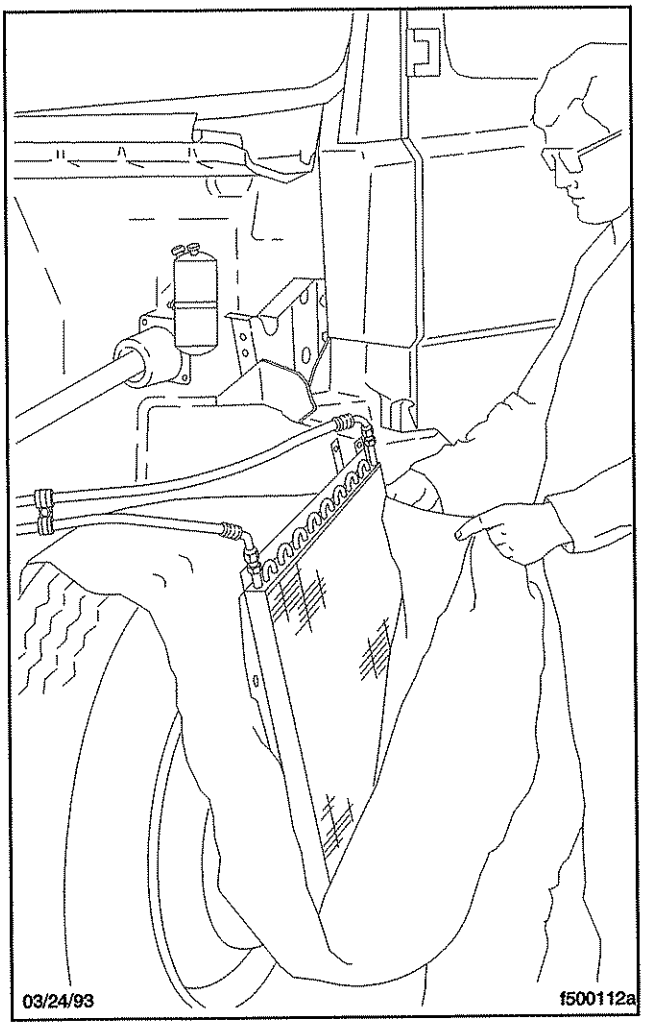


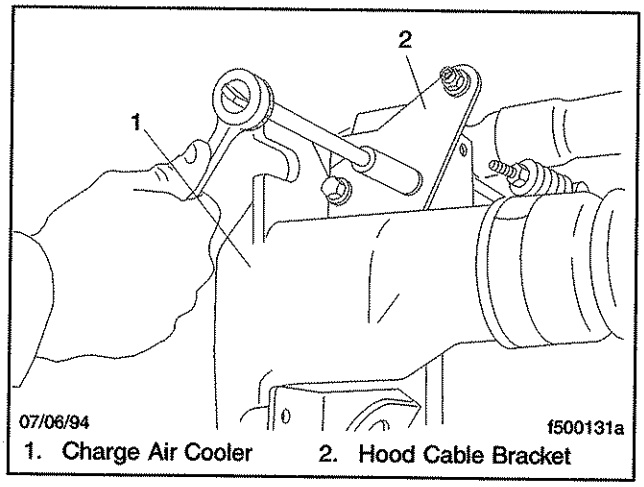
Fig. 2, Condenser Removal

- 4.3 Remove the four CAC mounting bolts. **See Fig. 5.** Then, remove the CAC from the radiator.

Installation

1. Install the charge air cooler (CAC).
   - 1.1 Position the CAC on the radiator, and secure it with the four mounting bolts. **See Fig. 5.** Tighten the bolts 20 N·m (15 lbf·ft).
   - 1.2 Connect the hoses to the CAC. **See Fig. 4.** Tighten the hoses 680 N·cm (60 lbf·in).

Charge Air Cooler Removal and Installation



1. Charge Air Cooler 2. Hood Cable Bracket

Fig. 3, Hood Cable Bracket Removal/Installation

1.3 Install the hood cable brackets on the radiator. **See Fig. 3.** Tighten the bracket bolts 540 N·cm (48 lbf·in).

2. Install the condenser.

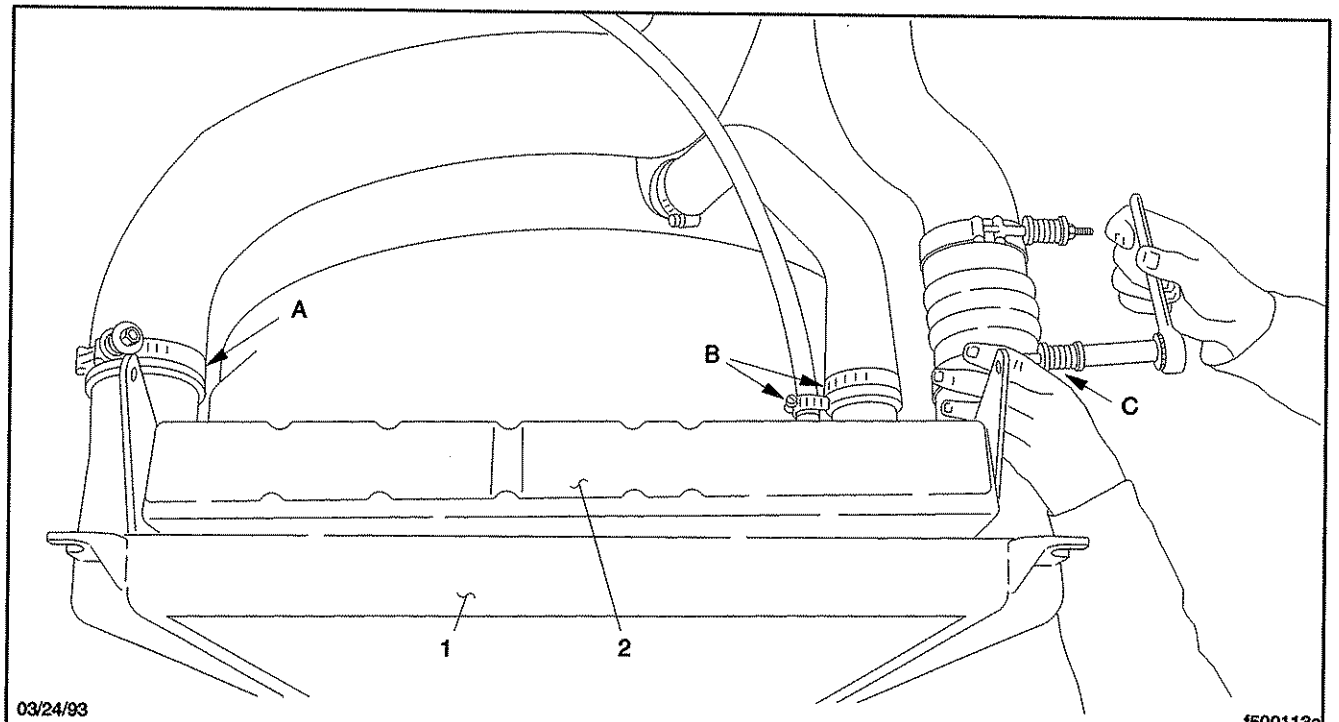
2.1 Position the condenser on the charge air cooler, and secure it with the four mounting screws. **See Fig. 6.** Tighten the bolts 20 N·m (15 lbf·ft).

2.2 Clamp the refrigerant hoses to the left radiator support strut.

2.3 Install the air recirculation shields on the radiator. **See Fig. 1.** Tighten the shield bolts 20 N·m (15 lbf·ft).

3. Install the hood; for instructions, **see Group 88.**

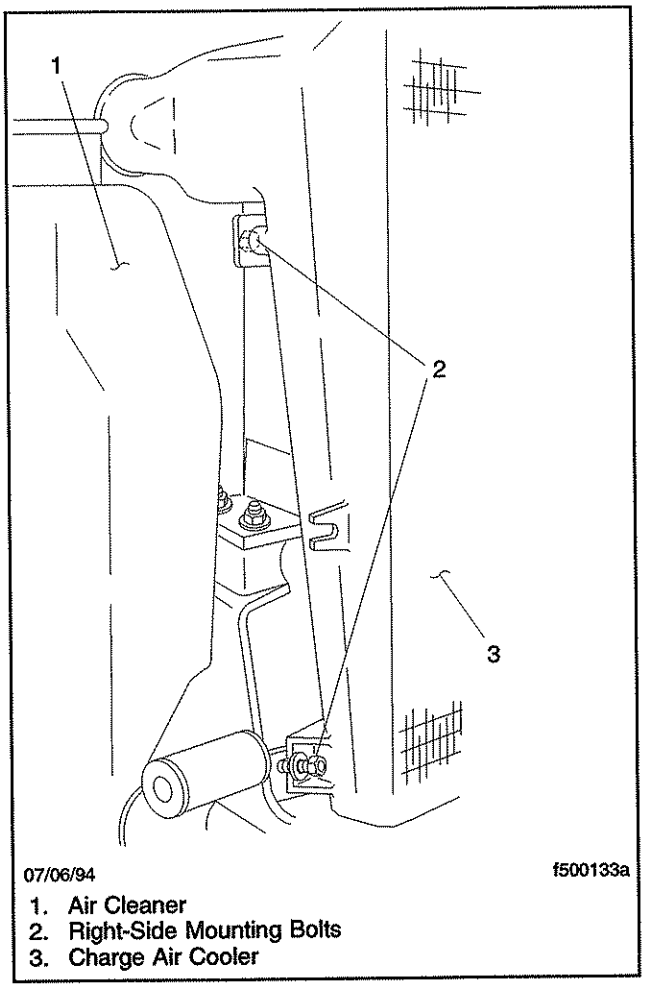
4. Remove the chocks from the tires.



A. Remove the CAC outlet hose. B. Radiator Hoses (leave attached) C. Remove the CAC inlet hose.
1. Charge Air Cooler 2. Radiator

Fig. 4, CAC and Radiator Hose Connections (Mercedes-Benz OM 366LA engine shown)

Charge Air Cooler Removal and Installation



1. Air Cleaner
2. Right-Side Mounting Bolts
3. Charge Air Cooler

Fig. 5, CAC Mounting

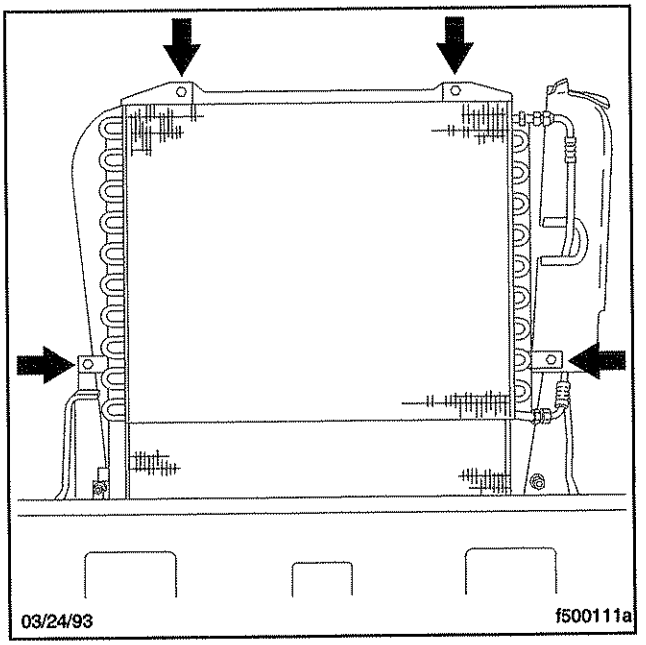


Fig. 6, Condenser Mounting Locations

Charge Air Cooler Inspection and Leakage Test

Inspection

1. Apply the parking brakes, chock the tires, and tilt the hood.
2. Check the charge air cooler (CAC) convoluted hoses and the inlet and outlet piping for holes or other damage. Also check for loose or damaged constant-torque hose clamps. Replace damaged parts. If hose clamps are loose, turn them so their tightening screws are under the hoses or facing inboard; then tighten the screws 45 lbf·in (500 N·cm).
3. Check the CAC core fins. If the fins are bent, use a small pair of needle-nose pliers or a small screwdriver to straighten them.
4. Check the CAC core for clogged fins. Use compressed air or water to dislodge any material restricting airflow through the core.
5. Perform the "CAC Core Leakage Test."

Leakage Test

Charge air coolers are designed in such a way that they may leak an insignificant amount of air. The allowable leakage mentioned in **Table 1** represents a loss of less than 0.1 percent of charge airflow. Based on this rate, there should be no measurable loss of performance.

Leakage Rate Specifications		
Engine	**Pressure Drop in 15 Seconds psi (kPa)**	**Start Pressure psi (kPa)**
Caterpillar	5 (34)	30 (207)
Cummins	7 (48)	30 (207)
Detroit Diesel	5 (34)	25 (172)
MBE900	5 (34)	30 (207)

Table 1, Leakage Rate Specifications

The CAC core leakage test should be performed using a charge air cooler test kit, part number 5039, which can be purchased from Kent-Moore/SPX at 1.800.328.6657.

CAC CORE LEAKAGE TEST

1. Apply the parking brakes, chock the tires, and tilt the hood.
2. Connect the test equipment to the CAC core. See **Fig. 1**.
   - 2.1 Remove the inlet and outlet air piping from the convoluted hoses that attach them to the CAC air inlet and air outlet.
   - 2.2 Slip a safety ring with thumbscrew over each convoluted hose and onto the CAC air inlet and air outlet. Turn the rings so the thumbscrews are facing outboard and the safety chains are inboard. Tighten the thumbscrews securely.
   - 2.3 Install an additional constant-torque hose clamp on each convoluted hose.
   - 2.4 Install the test plug without an adapter in the CAC air inlet and turn the plug so the safety chain is inboard. Tighten both of the rearmost constant-torque hose clamps 72 lbf·in (813 N·cm).
   - 2.5 Install the test plug with adapter in the CAC air outlet and turn the plug so the safety chain is inboard. Tighten both of the rearmost constant-torque hose clamps 72 lbf·in (813 N·cm).

⚠ WARNING

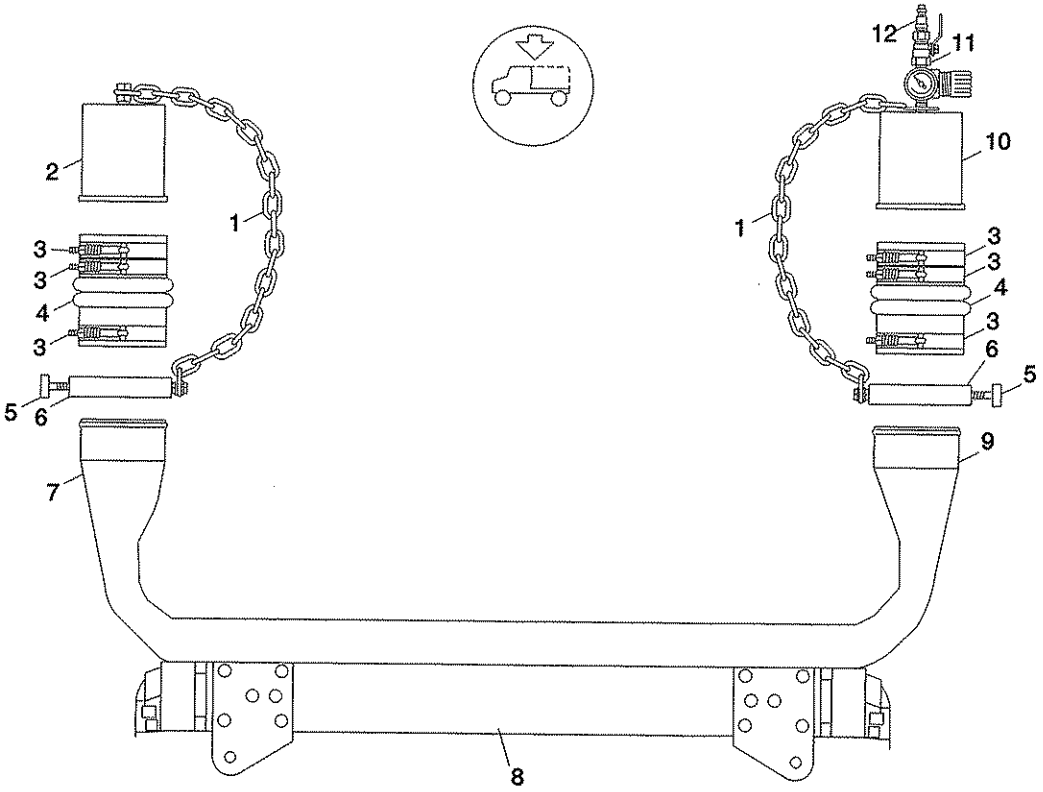
Always secure the test plugs with the safety rings. Test pressures could blow an unsecured test plug out at high speed, possibly causing eye injury or other serious personal injury.

   - 2.6 If not already installed, install a test valve/gauge assembly and air chuck in the test plug with adapter.
   - 2.7 Attach a pressurized air line to the air chuck on the pressure regulator valve.
3. Test the CAC core.

⚠ WARNING

Always wear safety glasses when doing this procedure. Do not stand in front of the test plugs while the core is pressurized. A plug could suddenly re-

Charge Air Cooler Inspection and Leakage Test



1. Safety Chain
2. Test Plug
3. Constant-Torque Hose Clamp
4. Convoluted Hose
5. Thumbscrew
6. Safety Ring
7. CAC Air Inlet
8. Radiator
9. CAC Air Outlet
10. Test Plug with Adapter
11. Test Valve/Gauge Assembly
12. Air Chuck

Fig. 1, CAC Core Testing

lease debris at high speed, possibly resulting in eye injury or other serious personal injury.

3.1 Open the test valve, then slowly open the pressure regulator valve and allow the charge air cooler system to gradually fill with air to the start pressure specified in **Table 1**.

3.2 Close the test valve and watch the gauge for 15 seconds. If there is more than the specified drop in the charge air cooler pressure in 15 seconds (see **Table 1**), replace the charge air cooler.

IMPORTANT: Do not attempt to repair the charge air cooler.

3.3 When testing is completed, reduce the pressure on the pressure regulator valve to bleed air from the charge air cooler.

4. Remove the test equipment (and the additional constant-torque hose clamps) from the convoluted hoses.

5. Pull the convoluted hoses and constant-torque hose clamps rearward until the hoses cover about 1-1/2 inches (38 mm) of the CAC air inlet and air outlet piping.

6. Turn the clamps so their tightening screws are under the hoses or facing inboard. Tighten the screws 45 lbf·in (500 N·cm).

7. Lower the hood and remove the chocks from the tires.

Charge Air Cooler Flushing

If the charge air cooler is suspected of being contaminated, flush the charge air cooler.

1. Turn off the engine, apply the brakes, and chock the tires.
2. Remove the charge air cooler. For instructions, see **Subject 100.**
3. Set the charge air cooler in a horizontal position with the inlet and outlet ports facing up.

⚠ CAUTION

Use only naphtha or mineral spirits to clean the charge air cooler. Do not use caustic solutions such as those that are commonly used in radiator shops. Do not use steam or high-temperature cleaning operations. Caustic solutions, steam, and high-temperature cleaning operations will damage the RTV that seals the charge air cooler tubes to the headers, which may result in leaking.

4. Pour a filtered naphtha or mineral spirits solution into the charge air cooler until it is 40 percent full.
5. Cap the inlet and outlet ports on the charge air cooler.
6. Rock the charge air cooler back and forth so that the solvent travels from one tank, through the tubes, to the other tank and back. Repeat this process ten times.

NOTE: Do not leave the solvent in the charge air cooler for more than ten minutes.

7. Remove the caps from the inlet and outlet ports
8. Drain the charge air cooler and properly dispose of the solvent.
9. Leave the caps off and allow the residual solvent to evaporate.
10. Install the charge air cooler. For instructions, see **Subject 100.**
11. Remove the chocks from the tires.

Restriction Test

After flushing the charge air cooler because of turbocharger or engine damage, test the pressure drop across the charge air cooler and air piping, as follows:

1. Remove the pipe plug from the tapped hole in the turbocharger air outlet elbow.

   Remove the pipe plug, or the nylon tube and atomizer for the ether start system (if so equipped), or the air line to the turbocharger air-pressure gauge (if so equipped), from the tapped hole in the rear left-hand side of the intake manifold.

   Install an air pressure gauge in each tapped hole.

2. Operate the engine at rated speed and horsepower; there is no need to operate the engine at its peak torque rating. While operating the engine, read both air pressure gauges.

   Because of air turbulence at the turbocharger outlet, subtract 0.3 inHg (1 kPa) from the pressure measurement taken at this point, to make it a true reading.

   From that reading, subtract the reading taken at the intake manifold. This is the pressure drop of the charge air cooler.

   If the pressure drop is more than 4 inHg (14 kPa), flush or replace the charge air cooler as needed.

Specifications

Description	Grade	Size	Torque	
			N·m (lbf·ft)	N·cm (lbf·in)
Charge Air Cooler to Radiator Mounting Bolt	5	5/16"	20 (15)	—
Hood Cable Bracket Bolts	8.8	10 mm	—	540 (48)
Charge Air Cooler Constant-Torque Hose Clamps	5	6.3 mm	—	680 (60)
Condenser Mounting Bolts	5	5/16"	20 (15)	—
Air Recirculation Shield Bolt	5	5/16"	20 (15)	—

Table 1, Fastener Torques

Contents

Subject	Subject Number
General Information	050
Service Operations	
Air Cleaner Element Replacement	100
Air Cleaner Replacement	110
Air Cleaner Element Restriction Checking	120
Specifications	400

General Information

The air cleaner is vertically mounted on the outside of the right frame rail, directly behind the bumper. **See Fig. 1.** Air enters through the grill and is diverted into the air cleaner housing where it passes from the outside to the inside of a replaceable, moisture-resistant, fine-mesh paper filter element **(Fig. 2).** Filtered air exits the air cleaner through an outlet port at the top of the housing.

A lock-up air restriction indicator is mounted on the underside of the air intake pipe. **See Fig. 3.** The indicator shows when the air filter element needs to be replaced. As an optional location, the air restriction indicator can be mounted in the dashboard. Nylon tubing connects the remote-mounted indicator or gauge to the air intake piping.

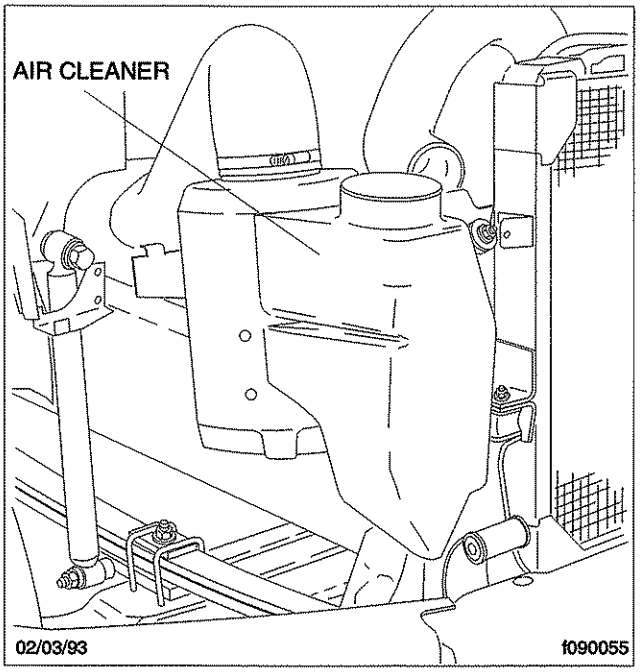


Fig. 1

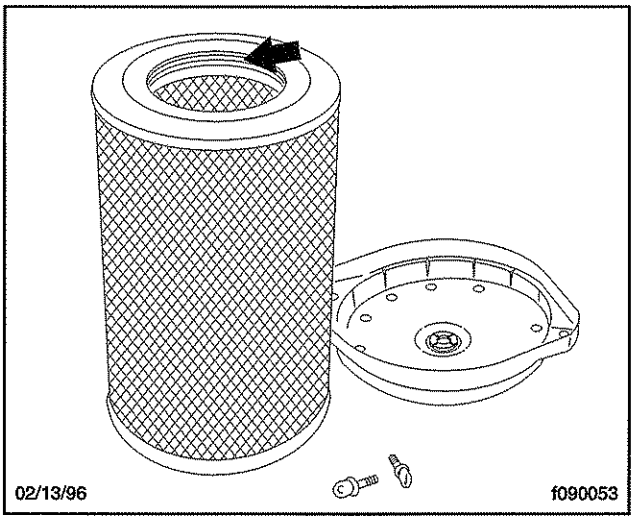


Fig. 2

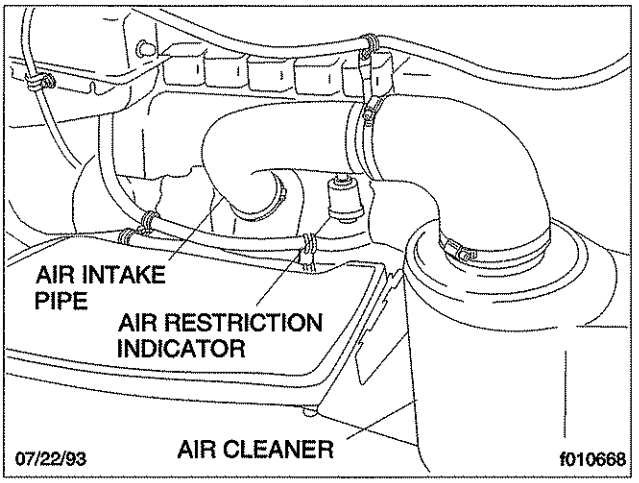


Fig. 3

Air Cleaner Element Replacement

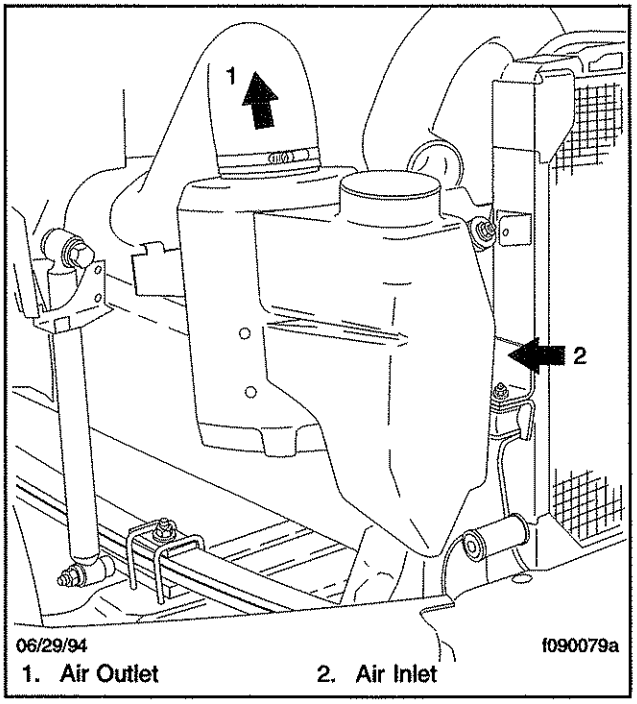
Element Replacement

NOTE: Replace the air cleaner element only when it reaches the maximum restriction level allowed by the engine manufacturer; **see Subject 120.**

⚠ CAUTION

CAUTION: Do not operate the engine with the air filter element or any intake component removed — damage to the engine could occur.

1. Park the vehicle, apply the parking brakes, and chock the tires.
2. Tilt the hood.
3. Check the seams around the air cleaner inlet and outlet ports. **See Fig. 1.** Check the outer surface of the cleaner housing for cracks, dents, or damage. If there are signs of leaks or damage, repair or replace the parts.
4. Remove the two thumb screws from the bottom of the housing. **See Fig. 2.** Remove the cover.



1. Air Outlet 2. Air Inlet

Fig. 1, Air Cleaner Housing Ports

5. Grip the base of the filter element firmly. **See Fig. 3.** Gently twist and pull the filter element down and out of the housing.
6. Inspect the element and clean the housing.
   - 6.1 Check the filter element for soot or oil. If soot is present, check for leaks in the engine exhaust system, and for exhaust from other equipment. If the element is oily, check for fumes escaping from the engine crankcase breather. Excessive oil mist shortens the life of any dry-type filter; correct the cause.
   - 6.2 Inspect the filter element radial seal surface for dust trails (from gasket leakage) **(see Fig. 4).** Check the cleaner housing for damage or dirt build-up that may cause sealing problems. If there is leakage or damage, repair or replace the parts.
   - 6.3 Wipe the inside of the cleaner housing with a clean damp cloth.

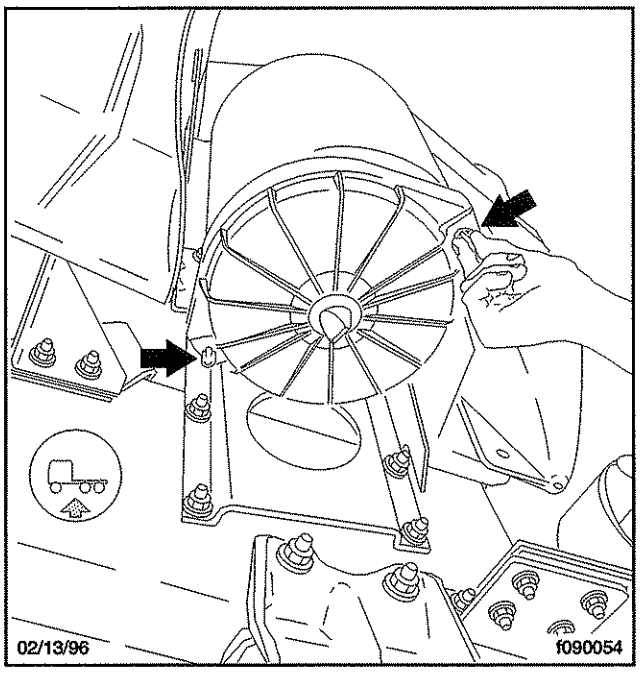


Fig. 2, Air Cleaner Housing Thumb Screws

Air Cleaner Element Replacement

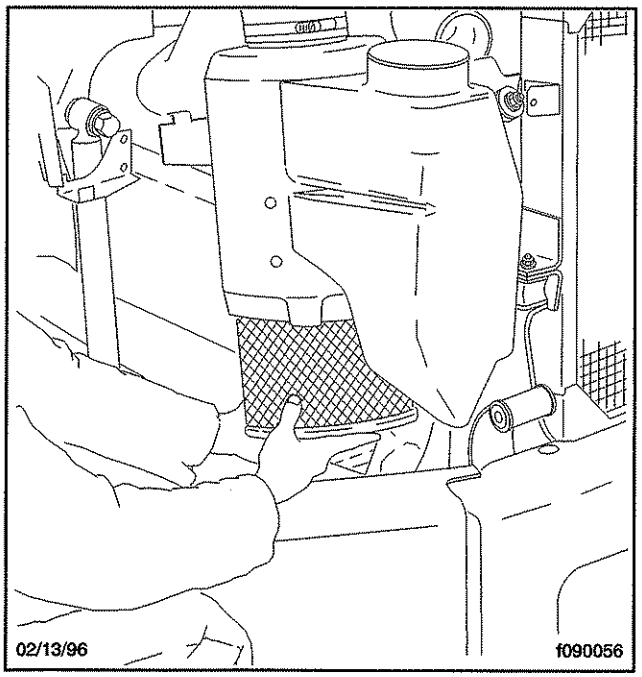


Fig. 3, Filter Element Removal/Installation

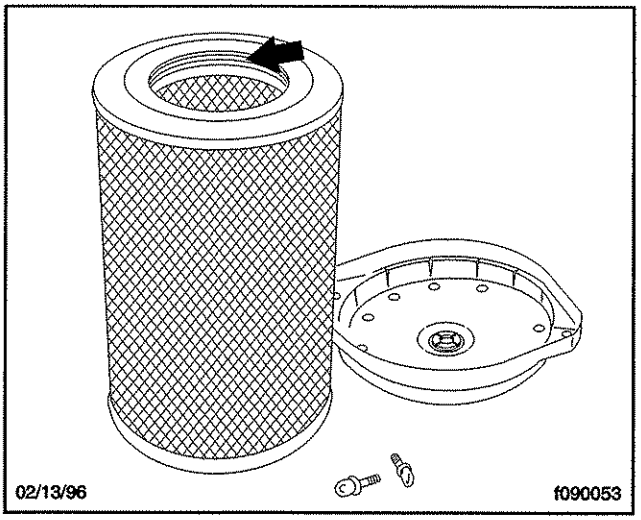


Fig. 4, Radial Seal Surface of Filter Element

⚠ CAUTION

CAUTION: Any dirt in the cleaner housing, on the clean side of the element gaskets, could be drawn into the engine, causing damage.

7. Inspect the new filter element **(see Fig. 4)** before installing it.
   - 7.1 Inspect the element for radial seal surface damage and dented metal parts. If the radial seal surface is damaged to the extent that dust might bypass it, do not use the element.
   - 7.2 Place a bright light inside the element, and rotate the element while looking through it from the outside. The light will reveal, by a bright spot, any hole or rupture. Any hole in the element will allow dust to enter the engine; do not use the element if it is damaged.
8. Position the filter element in the air cleaner housing. **See Fig. 3.** Push the element up into place until only about 2.5 cm (1 inch) still extends below the bottom of the housing.
9. Place the cover over the bottom of the element, and secure the cover with the two thumb screws.
10. Check all clamps for tightness, and all ducting and hoses for leaks; repair as necessary.
11. Lower the hood, and remove the chocks from the tires.

Air Cleaner Replacement

Replacement

⚠ CAUTION

CAUTION: All air intake components and connections must be air-and water-tight. Dirt or dust entering the engine can cause internal engine damage. Much of the dirt and dust are silicates, which fuse into abrasive glass-like particles during engine combustion. These particles can grind piston rings, pistons, and cylinder liners. Do not operate the engine with the air filter element or any air intake component removed.

IMPORTANT: Do not modify air cleaners or air intake ducting.

If the air cleaner housing has been dented or damaged, immediately check all ducting and connections to the air cleaner for leakage. Adjust or replace parts as necessary. If needed, replace the air cleaner as follows:

1. Park the vehicle, apply the parking brakes, and chock the tires.
2. Tilt the hood.
3. Remove the air cleaner.
   - 3.1 Remove the two thumb screws securing the housing cover, and remove the cover. **See Fig. 1.**
   - 3.2 Remove the filter element from the housing; **see Subject 100.**
   - 3.3 Loosen the hose clamp connecting the air intake pipe to the elbow at the top of the air cleaner housing. **See Fig. 2.** Remove the pipe from the elbow, and cover the open end of the pipe.
   - 3.4 Remove the elbow from the top of the housing.
   - 3.5 Remove the four nuts that secure the housing to its mounting bracket. **See Fig. 3.**
   - 3.6 Take the air cleaner off its mounting bracket.
4. Install the new air cleaner.
   - 4.1 Position the air cleaner housing on its mounting bracket. Secure the housing with the four nuts, and tighten them 38 N·m (28 lbf·ft).
   - 4.2 Connect the elbow to the top of the new housing.
   - 4.3 Uncover the air intake pipe, and connect it to the elbow. Tighten the hose clamp.
   - 4.4 Check all clamps for tightness, and all ducting and hoses for leaks; repair as necessary.
5. Inspect a new filter element and install it in the new air cleaner; **see Subject 100.**

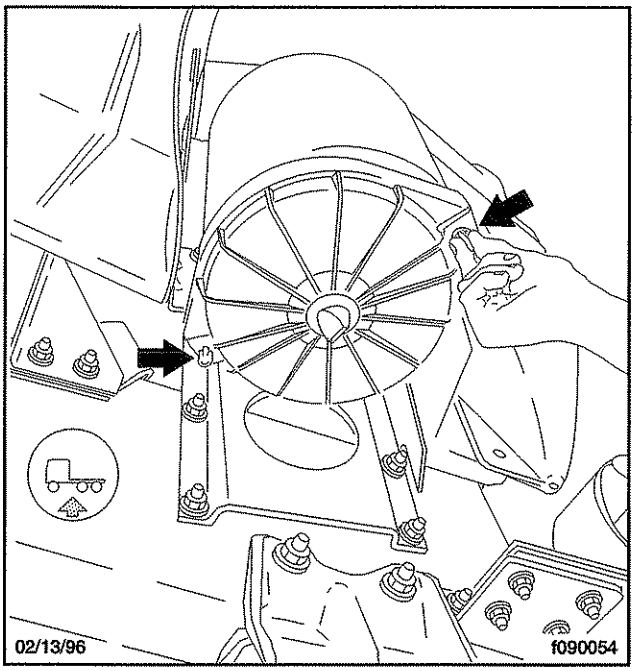
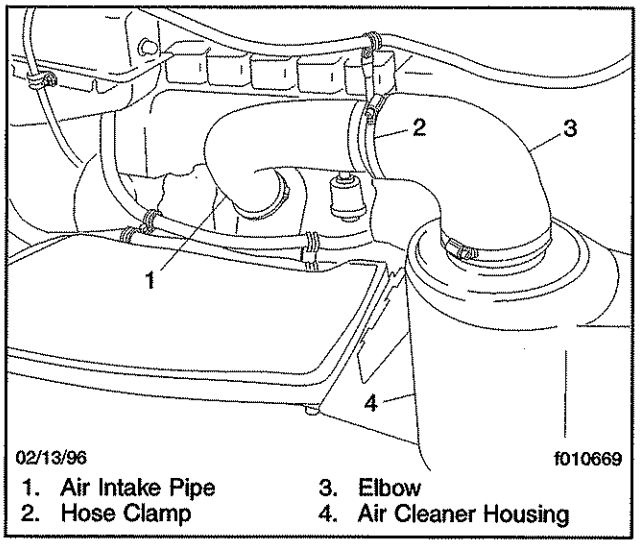


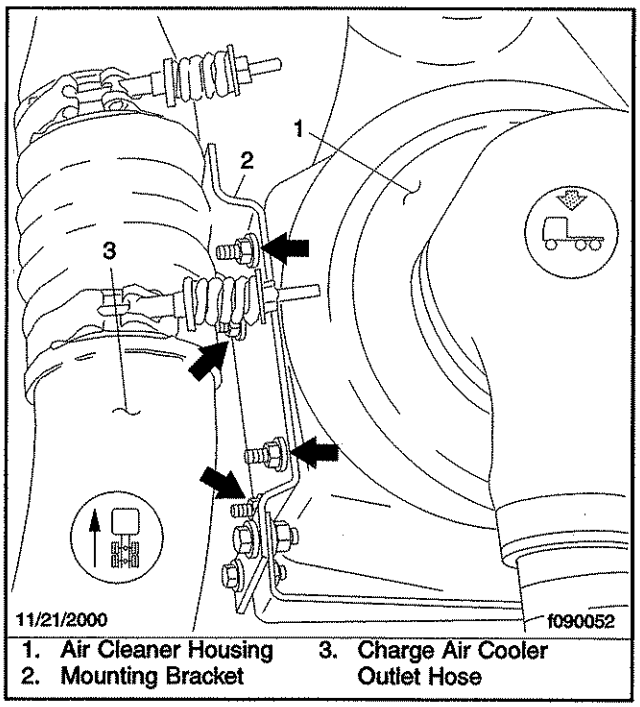
Fig. 1, Air Cleaner Housing Thumb Screws

Air Cleaner Replacement



1. Air Intake Pipe
2. Hose Clamp
3. Elbow
4. Air Cleaner Housing

Fig. 2, Elbow to Intake Pipe Connection



1. Air Cleaner Housing
2. Mounting Bracket
3. Charge Air Cooler Outlet Hose

Fig. 3, Air Cleaner Housing Mounting Fasteners

Air Cleaner Element Restriction Checking

Element Restriction Checking

The restriction of air flow through the air cleaner element is measured at the tap in the air transfer tube joined to the cleaner outlet.

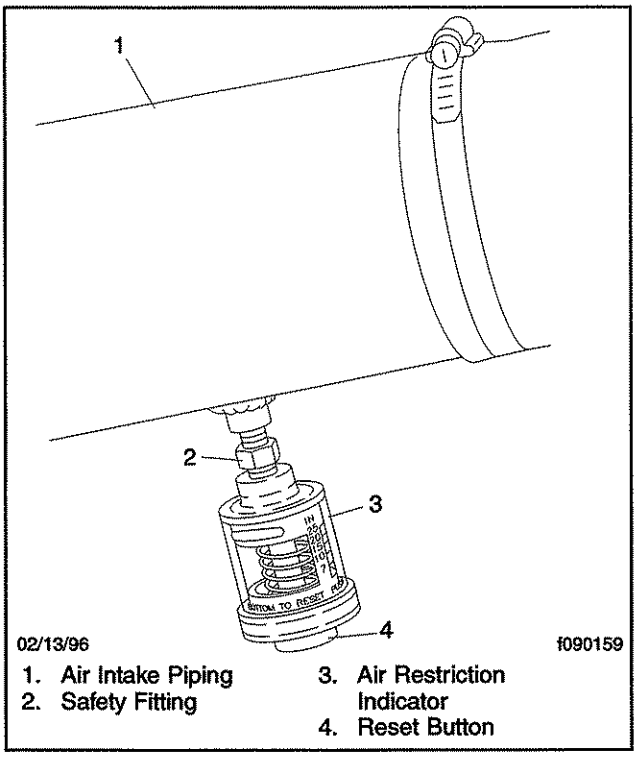
On vehicles with an intake-duct-mounted restriction indicator (manual- or automatic-reset), the indicator is mounted in a safety fitting in the air intake piping. **See Fig. 1.**

On vehicles with a dash-mounted restriction indicator (manual-reset) (**Fig. 2**) or air restriction gauge (automatic-reset) (**Fig. 3**), a hose connects the indicator or gauge to the safety fitting in the air intake piping.

On vehicles *without* an indicator or gauge, a water manometer or a service gauge must be connected to the air intake ducting to check element restriction.

– For a vehicle with a manual-reset air restriction indicator, check the indicator with the engine off to see if air restriction equals or exceeds the value shown in **Table 1** for maximum air restriction at *full load* and governed rpm. If air restriction is at or above the maximum, push the reset button on the dash-mounted or intake-duct-mounted indicator, then operate the engine at *no-load* and governed rpm, and compare the indicator reading with the value shown in **Table 1** for maximum air restriction at *no-load* and governed rpm.

– For a vehicle with an air restriction gauge, or a restriction indicator that resets automatically when the engine is shut down, operate the en-



1. Air Intake Piping
2. Safety Fitting
3. Air Restriction Indicator
4. Reset Button

Fig. 1, Standard Intake-Duct-Mounted Manual-Reset Air Restriction Indicator

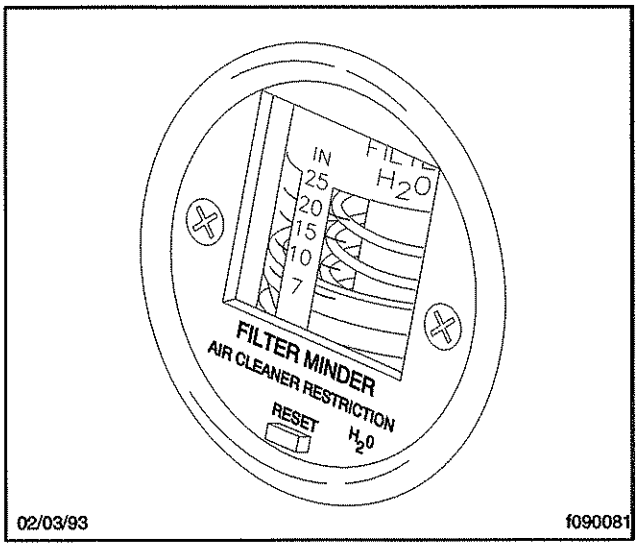


Fig. 2, Optional Dash-Mounted Manual-Reset Air Restriction Indicator

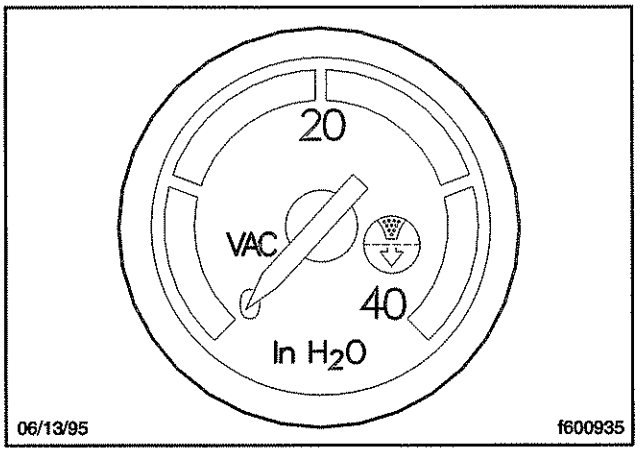


Fig. 3, Optional Dash-Mounted Automatic-Reset Air Restriction Gauge

Air Cleaner Element Restriction Checking

gine at *no-load* and governed rpm, and compare the gauge/indicator reading with the value shown in **Table 1** for maximum air restriction at *no-load* and governed rpm.

– For a vehicle without a gauge or indicator, test restriction with a water manometer or a service gauge. Refer to the test equipment manufacturer's literature for test procedures. Operate the engine at *no-load* and governed rpm, and compare the reading with the value shown in **Table 1** for maximum air restriction at *no-load* and governed rpm.

If air restriction equals or exceeds the value shown in **Table 1** for maximum air restriction at *no-load* and governed rpm, replace the air cleaner element; **see Subject 100**.

Engine	At Full Load and Governed RPM	At No-Load and Governed RPM
Cummins	25	12
Detroit Diesel	20	10
Mercedes-Benz	20	10

Table 1, Maximum Air Restriction in Inches of Water (inH_2O)

Specifications

Description	Grade	Size	Torque N·m (lbf·ft)
Air Cleaner Mounting Nuts	5	3/8–16	38 (28)

Table 1, Fastener Torques