CAUTION

To reduce the change of personal injury and/or property damage, the following instructions must be carefully understood.

Proper service and repair are important to the safety of the service technician and the safe, reliable operation of the engine. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use a replacement part of lesser quality.

The service procedures recommended by Detroit Diesel Corporation and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specially designed for this purpose.

Accordingly, anyone who intends to use a replacement part, service procedure or tool, which is not recommended by Detroit Diesel Corporation, must first determine that neither his safety nor the safe operation of the engine will be jeopardized by the replacement part, service procedure or tool selected.

It is important to note that this manual contains various "Cautions" and "Notices" that must be carefully observed in order to reduce the risk of personal injury during service or repair or the possibility that improper service or repair may damage the engine or render it unsafe. It is also important to understand that these "Cautions" and "Notices" cannot cover all circumstances, because it is impossible for Detroit Diesel Corporation to warn of all the possible hazardous conditions that might result from failure to follow these instructions.

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SERIES 40 SERVICE MANUAL

ABSTRACT

This manual is part of a series of manuals intended to assist service technicians in maintaining engines, produced by Detroit Diesel Corporation, in accordance with the latest technical advancements.

Due to a commitment of continuous research and development, some procedures, specifications and parts may be altered to improve Detroit Diesel products and introduce technological advances.

Service diagnosis is a systematic procedure of investigation to be followed in order to locate and correct an engine problem. The engine is first considered as a complete unit in its specific application and then the problem is localized to components or systems; intake, exhaust, cooling, lubrication or injection. Testing procedures will then help analyze the source of the problem.

HOW TO USE THIS MANUAL

This manual is arranged in sections, with the pages numbered consecutively in each section. Any photos or artist renderings are also numbered consecutively in each section. Included at the top of each page is the Section Title. The page number and the literature distribution number (6SE44) are found at the bottom of each page.

This manual is divided into four basic parts:

- The Introductory Section
- The Component Sections
- The Diagnostic Sections
- The Appendix

The **Introductory Section** addresses the following general subjects which should be read prior to engine repair or overhaul:

- Safety Suggestions
- Engine Identification
- Engine Description
- Engine Systems

The **Component Sections** address the actual service procedures for each engine component. Each component section is arranged as follows:

- Section Index
- Exploded View(s)
- Specifications
- Special Torques
- Special Tools
- Removal and Reassembly (where applicable)
  - Removal
  - Cleaning
  - Inspection
  - Installation
- Engine Component Identification (where applicable)
- Removal and Reassembly (where applicable)
  - Removal
  - Cleaning
  - Inspection
  - Installation

- Reconditioning
  - Disassembly
  - Cleaning
  - Inspection
  - Repair
  - Reassembly

The **Diagnostics Sections** addresses the systematic procedure of investigation to be followed in order to locate and correct an engine problem. These sections include testing procedures to help analyze the source of the problem. The **Diagnostic Sections** cover:

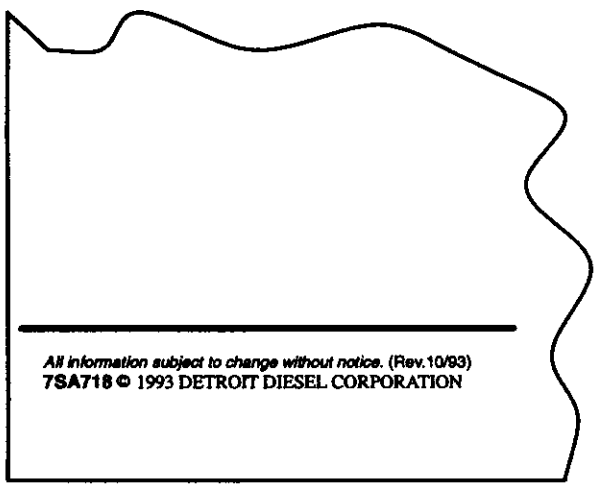
- Diagnostic Analysis
- Engine Performance Analysis
- Engine Diagnostic Tools
- Engine Diagnostic Test Procedures

The **Appendix** is located at the end of the manual and consists of the following:

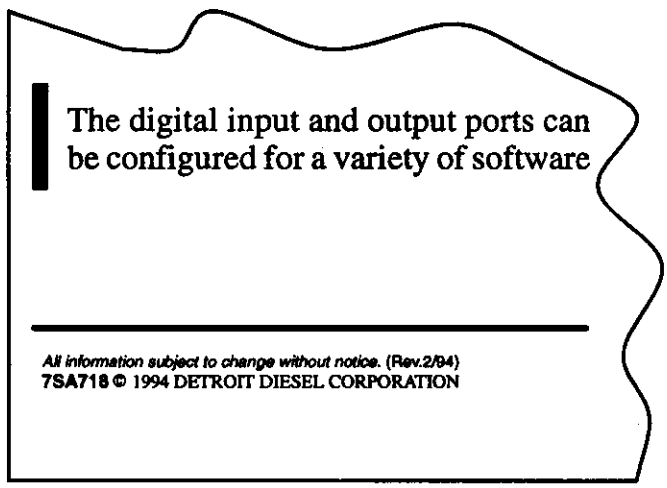
- General Engine Specifications
- Component Specifications
- Torque Data
- Special Service Tool List
- English/Metric Conversion Chart

MANUAL REVISIONS

Revisions to this manual will be sent to bookholders on a quarterly basis. Information changes will be marked with a revision bar (see Example 2) and the pages with the revison bars will have a new revision date in the footer. The pages that have not changed will retain the original revision date. (See Example 1)



Example 1–Unchanged Pages



Example 2– Changed Pages

If a page has a new revision date, but does not have a revision bar, this means pagination was affected.

TABLE OF CONTENTS

INTRODUCTION

SERVICE

DIAGNOSTICS

APPENDIX

1 SAFETY SUGGESTIONS

Keep work area organized and clean. Wipe up oil spills of any kind. Keep tools and parts off floor. Eliminate the possibility of a fall which could result in a serious injury.

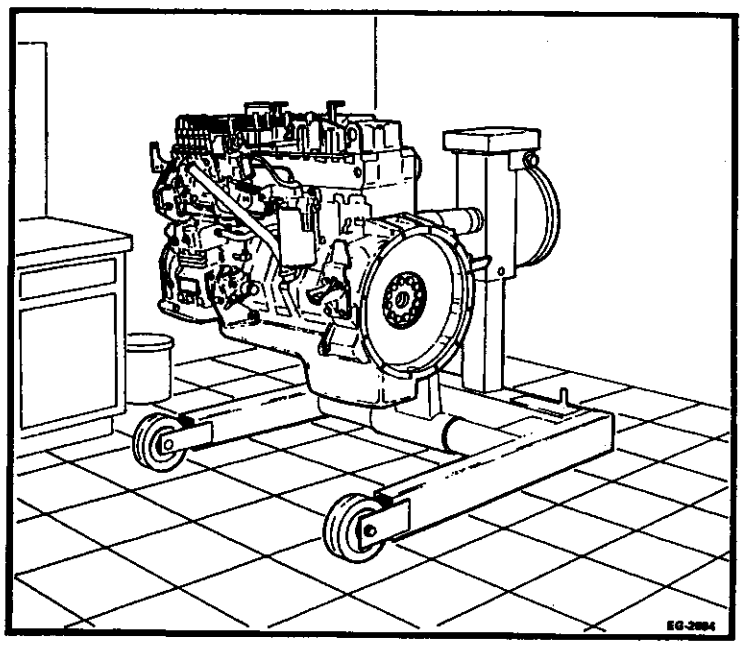


FIGURE 1–1 A Clean and Organized Work Space

Be sure to reinstall safety devices, guards or shields after adjusting and/or servicing the engine.

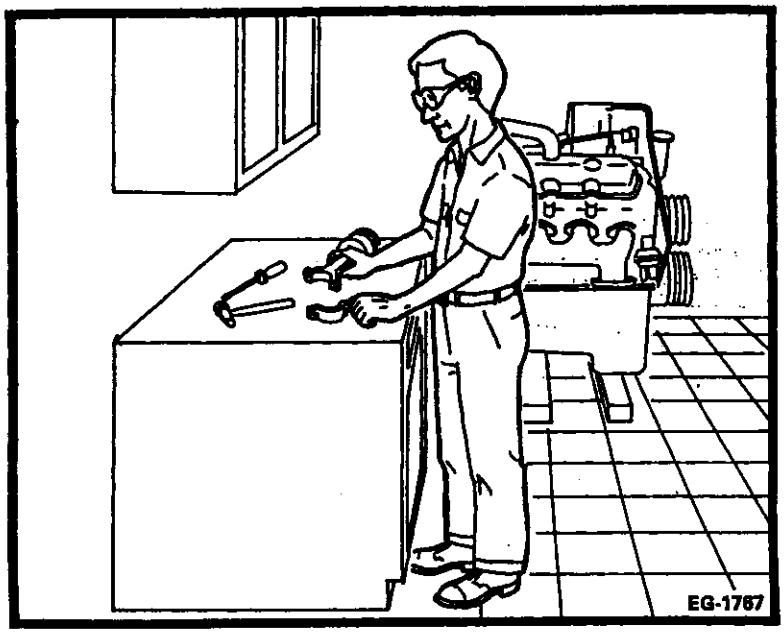


FIGURE 1–2 Safe Work Clothing

After servicing, be sure all tools, parts, or servicing equipment are removed from the vehicle or engine.

Be sure to wear safe work clothing. It should be well fitted and in good condition.

Do not wear rings, wrist watches or loose fitting clothing, when working on machinery, they could catch on moving parts causing serious injury. Wear sturdy, rough–soled work shoes. Never adjust and/or service a machine in bare feet, sandals or sneakers.

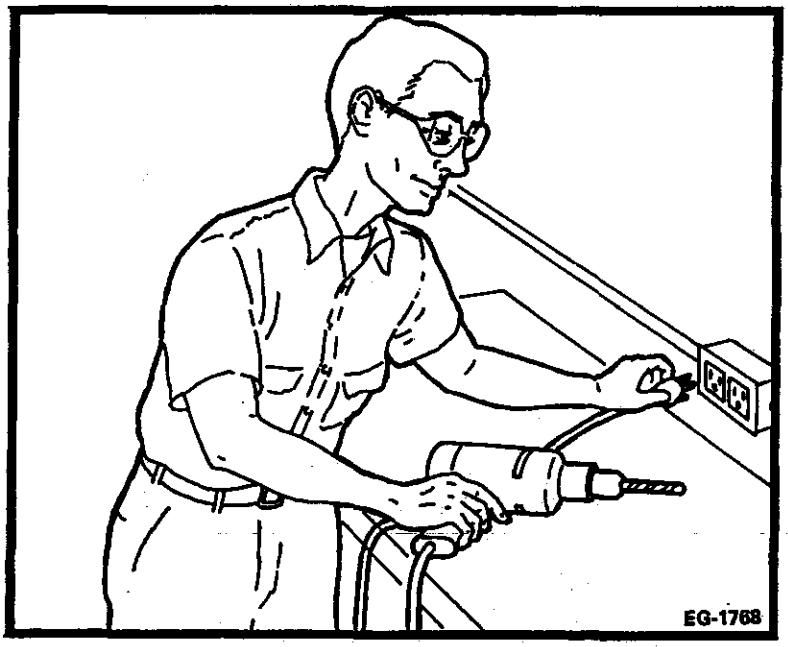


FIGURE 1–3 Using Safe Power Tools

Do not use defective portable power tools. Check for frayed cords prior to using the tool. Be sure all electric tools are grounded. Severe injury can occur if electrical equipment is defective or not used properly.

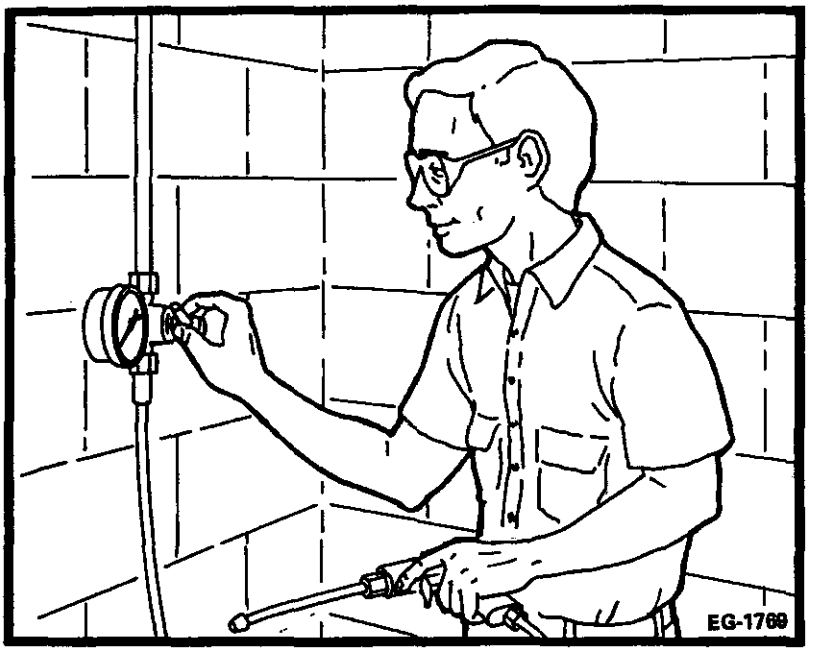


FIGURE 1–4 Using Compressed Air Safely

Be careful when using compressed air. Never apply compressed air to any part of the body or clothing, severe injury can occur.

Use approved air blow guns, do not exceed recommended pressure. Wear safety glasses or goggles and use proper shielding to protect everyone in the work area.

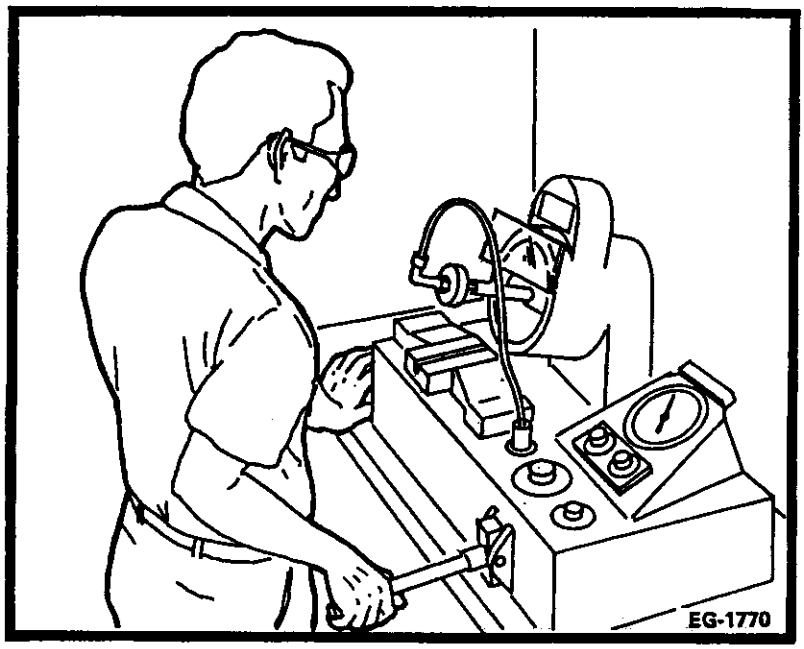


FIGURE 1–5 Dealing with Fluids Under Pressure

Be extremely careful when dealing with fluids under pressure.

Fluid under pressure can have enough force to penetrate the skin. These fluids may also infect a minor cut or opening the skin. If injured by escaping fluid, see a doctor at once. Serious infection or reaction can result if medical treatment is not given immediately.

Never put your hands in front of fluid under pressure.

FIGURE 1–6 Refueling

When refueling, keep the hose and nozzle or the funnel and container in contact with the metal of the fuel tank to avoid the possibility of an electric spark igniting the fuel.

Do not over fill the fuel tank – overflow creates a fire hazard.

Do not smoke when refueling and never refuel when the engine is running.

Electric storage batteries give off highly flammable hydrogen gas when charging and continue to do so for some time after receiving a steady charge.

Do not under any circumstances allow an electric spark or open flame near the battery or explosion may occur.

Always disconnect a battery cable before working on the electrical system.

Keep a "charged" fire extinguisher within reach whenever you work in an area where fire may occur.

Also, be sure you have the correct type of extinguisher for the situation:

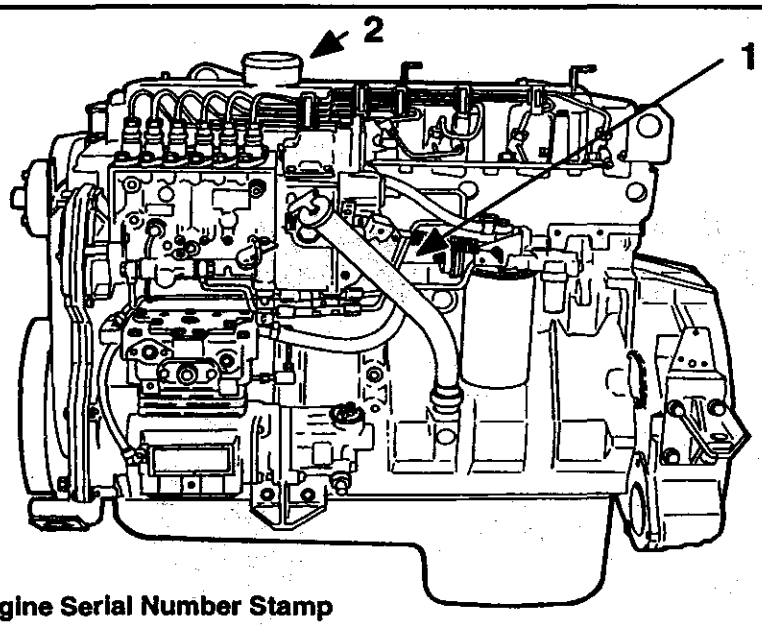
Type A: Wood, Paper, Textile and Rubbish

2 ENGINE IDENTIFICATION

The permanent engine serial number is stamped on the left side of engine (FIGURE 2–1).

The Engine Emission Label identifies engine model code and year manufactured. The Emission Label is located on the top of the valve cover/intake manifold (FIGURE 2–1).

Other nameplates are located on the turbocharger fuel injection pump and starter. These nameplates show manufacturer and specifications and are important to assist operator or maintenance personnel as to what equipment is on the engine and its operating conditions.



1. Engine Serial Number Stamp
2. Engine Emission Label

10002.new

FIGURE 2–1 Location of the Engine Serial Number Stamp and the Engine Emission Label

Build List	Country Of Origin	Serial Sequence Number
W (Alphanumeric)_ _ _ _ _ _	N	000000

Build List		Country of Origin	Serial Sequence Number
WD_ _ _ _	6.7 TA	N = USA	000000
WE_ _ _ _	6.7 TA		
WF_ _ _ _	7.6 T		
WG_ _ _ _	7.6 TA		
WH_ _ _ _	8.7 T		
WJ_ _ _ _	8.7 TA		

TABLE 2–1 Engine Serial Number Chart

2.1 INJECTION PUMP IDENTIFICATION

Identification of the injection pump and governor assemblies can be made by referring to the I.D. plates as follows:

2.1.1 Model PES6P (7100) Fuel Injection Pump

INJECTION PUMP HOUSING I.D. PLATE – is located on the left side of the pump housing (**FIGURE 2–2**). The pump serial number and Bosch combination number are found at this location.

GOVERNOR I.D. PLATE – is located on the rear of governor housing (**FIGURE 2–2**). The Navistar/DDC Part No. for the complete injection pump and governor assembly, as well as the Bosch governor number, size and rating are found at this location.

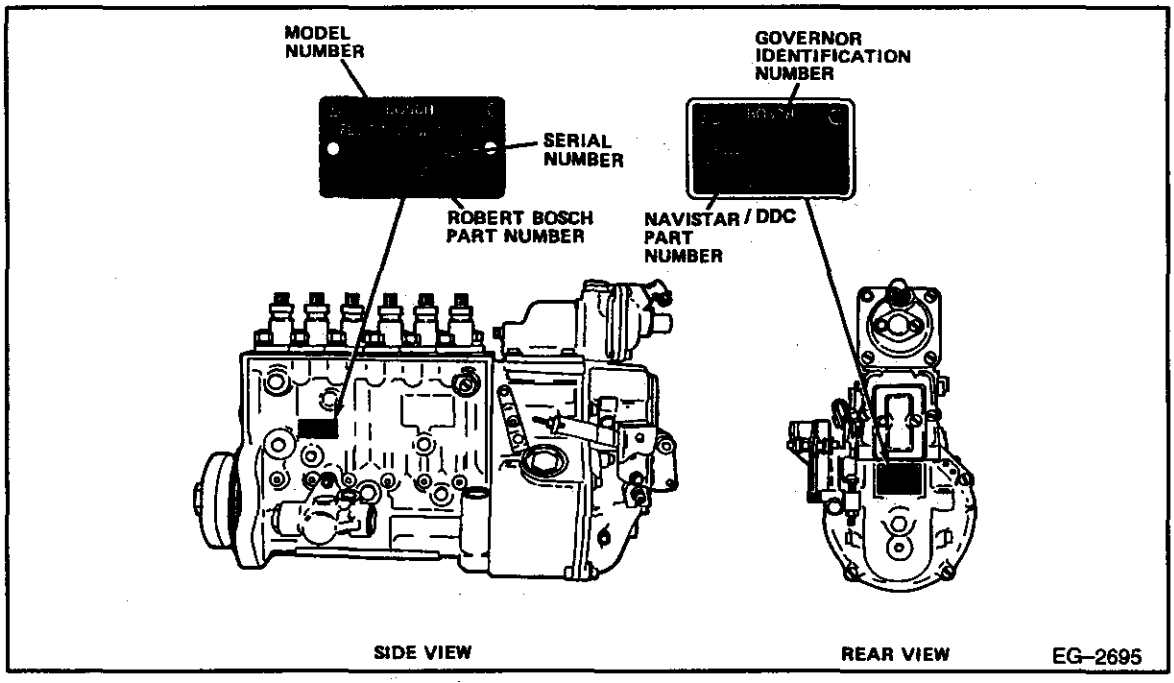


FIGURE 2–2 The Injection Pump Housing I.D. Plate and the Governor I.D. Plate

Code for Bosch Combination Number

PES 6P 100 A 320L 63309

PE	= Inline injection pump
S	= flange mounted
6	= Number of cylinders
P	= "P" size pump
100	= Plunger diameter in 1/10 mm
A	= Pump model
320	= Number code for location of feed pump and governor
L	= Rotation of pump as seen from drive end (right hand clockwise)
63309	= Application number
RR	= Reverse rotation of pump as seen from drive end (right hand clockwise)

Code for Bosch Governor Number

RQV–K 350–1300 PA 1042–BK

R	= Flywheel governor
Q	= Fulcrum lever model
V	= Variable speed governing (all–speed)
350	= Low idle pump speed
1300	= Full load rated speed
PA	= Fits on "P" size pump
1042	= Application number

2.1.2 Model PES6P (3000) Fuel Injection Pump

Identification of the injection pump and governor assemblies can be made by referring to the I.D. plates as follows:

INJECTION PUMP HOUSING I.D. PLATE – is located on the left side of the pump housing (**FIGURE 2–3**). The manufacturer's serial number, Bosch combination number and pump part number are found at this location.

GOVERNOR I.D. PLATE – is located on the rear of the governor housing (**FIGURE 2–3**). The Navistar/DDC Part No. for the complete injection pump and governor assembly, as well as the Bosch governor identification number, size and rating are found at this location.

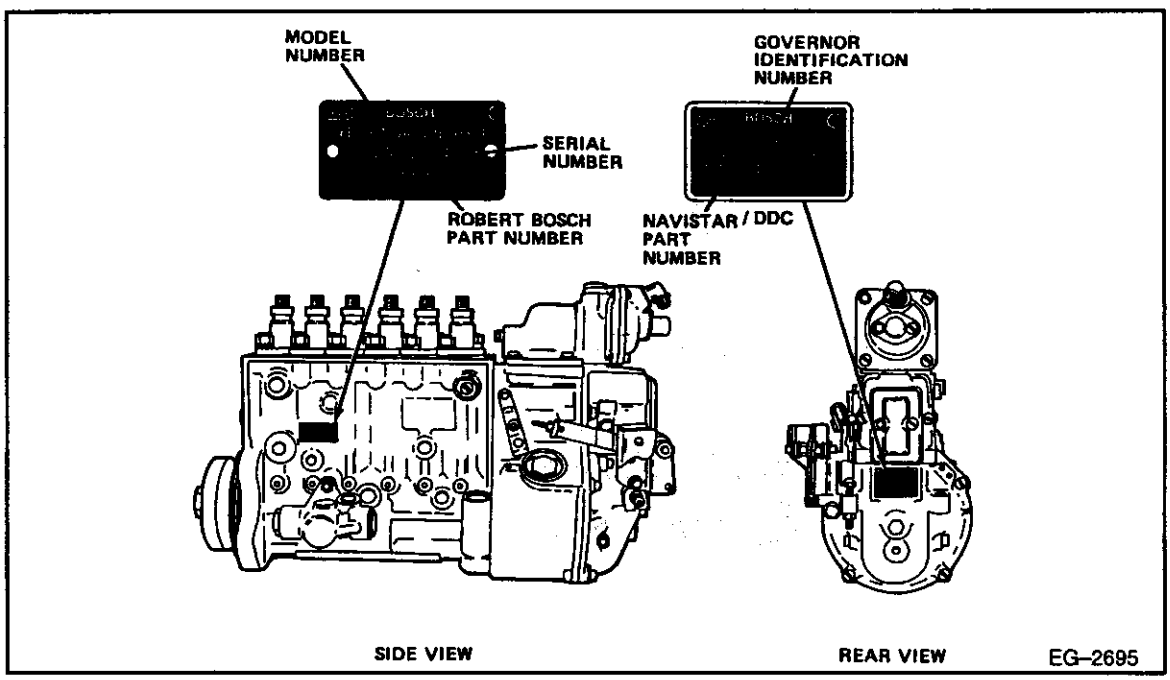


FIGURE 2–3 The Injection Pump Housing I.D. Plate and the Governor I.D. Plate

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Code for Bosch governor number

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R	= Flywheel governor
Q	= Fulcrum lever model
V	= Variable speed governing (all–speed)
350	= Low idle pump speed
1300	= Full load rated speed
PA	= Fits on "P" size pump
1042	= Application number

2.2 TURBOCHARGER IDENTIFICATION

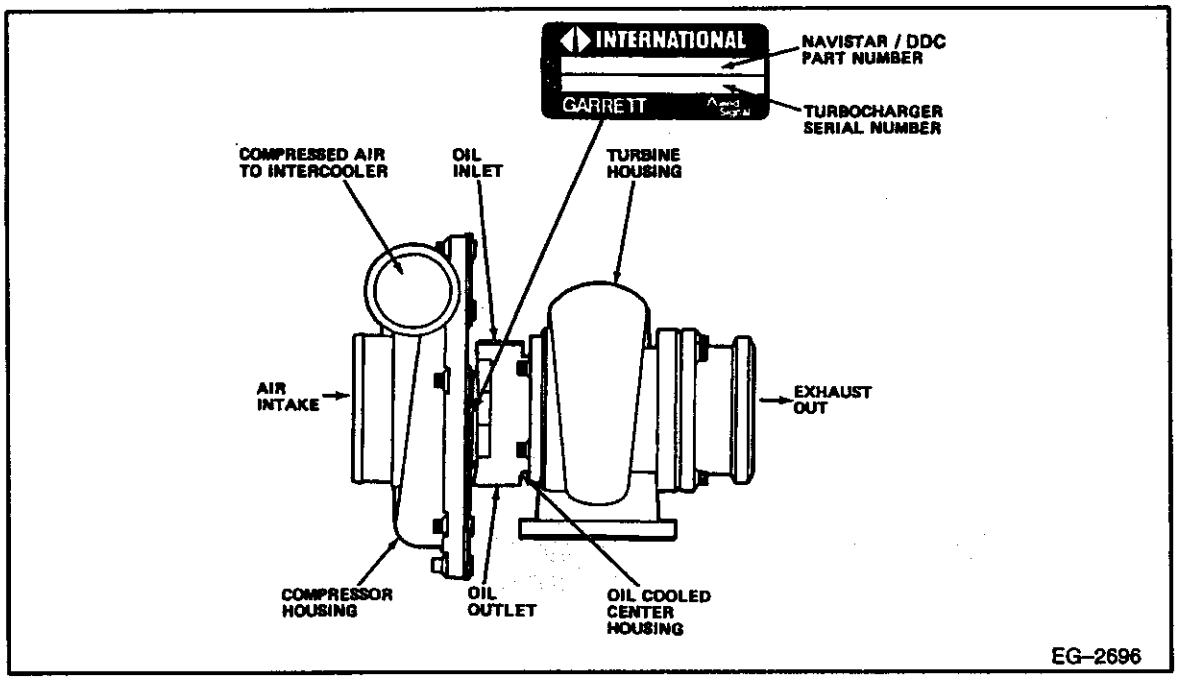


FIGURE 2–4 I.D. Plate on the Non Wastegated Turbocharger

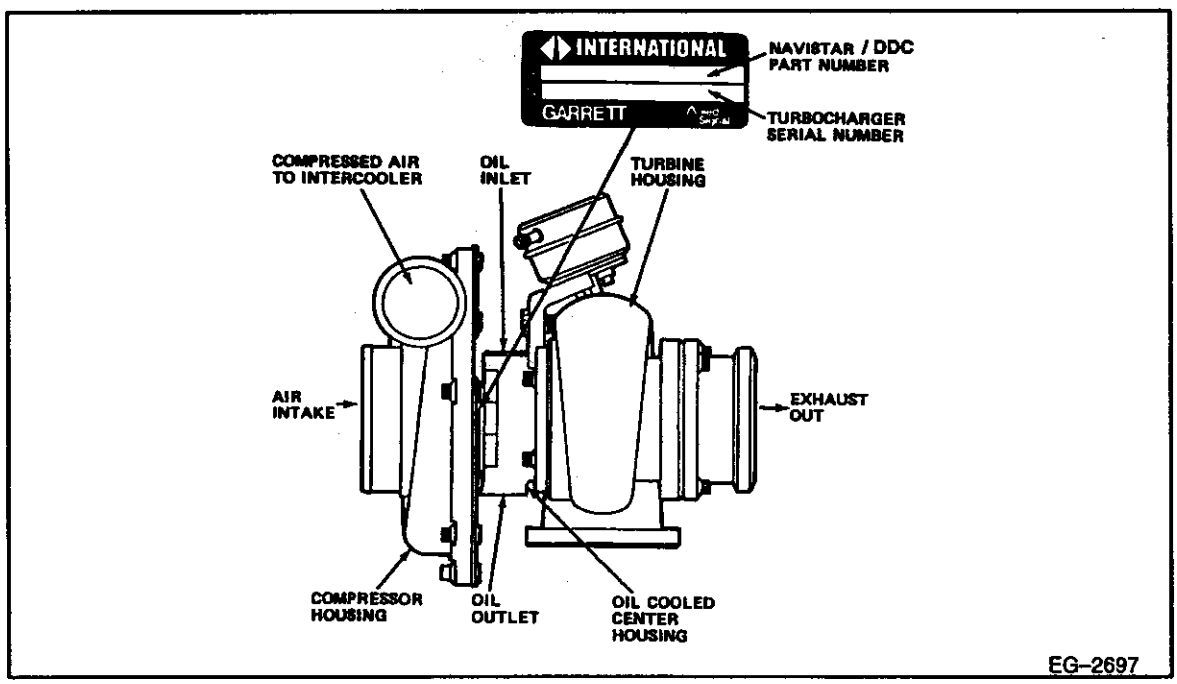


FIGURE 2–5 I.D. Plate on the Wastegated Turbocharger

3 GENERAL FEATURES

Series 40 engines are inline six cylinder, four cycle, water–cooled, direct injection diesel engines.

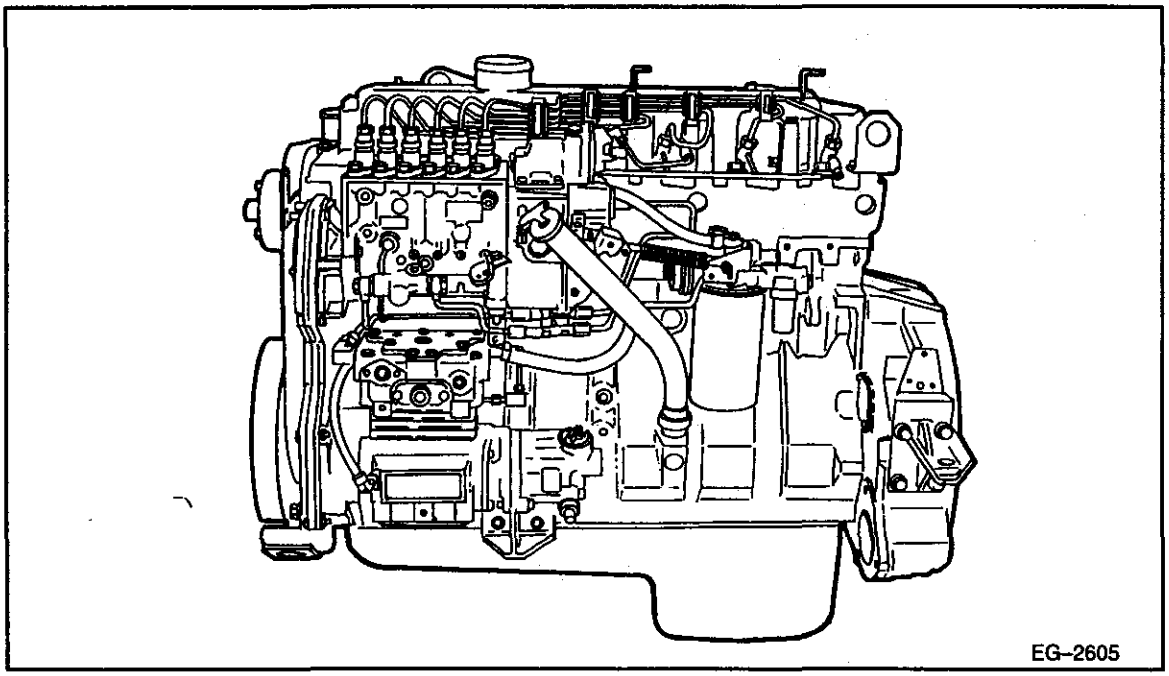


FIGURE 3–1 A Series 40 Engine

Proven premium features have been designed into this series of engines such as a GEROTOR type lube oil pump with cast water and oil passages in the crankcase and front cover. Replaceable wet type cylinder sleeves, one piece cylinder head, cast aluminum alloy pistons, forged tee pee connecting rods and a forged steel crankshaft with induction hardened journals and undercut fillets are used. A single spin–on type lube oil filter and one fuel filter and fuel strainer are engine mounted.

All models of the engine come equipped with an oil cooler. The GEROTOR lube oil pump is mounted to the front cover and driven directly by the crankshaft at engine speed. With the exception of the air compressor, fuel injection pump and turbocharger oil supply, there is no external lube oil piping used.

The crankshaft is supported on seven precision insert bearings and camshaft on four pre–reamed bushings. The rod and main bearing caps are mated parts and are stamped for identification and are not interchangeable.

Each engine main bearing web has angled, drilled holes which are fitted with jet tubes that direct lube oil, under pressure, to the underside of each piston.

3.1 CHASSIS MOUNTED AIR–TO–AIR INTERCOOLER

The air–to–air intercooler is chassis mounted in front or next to radiator. Air from the turbocharger is pushed through a network of heat exchanger tubes prior to entering the intake manifold. Outside air flowing over the tubes and fins serves to cool the charge air.

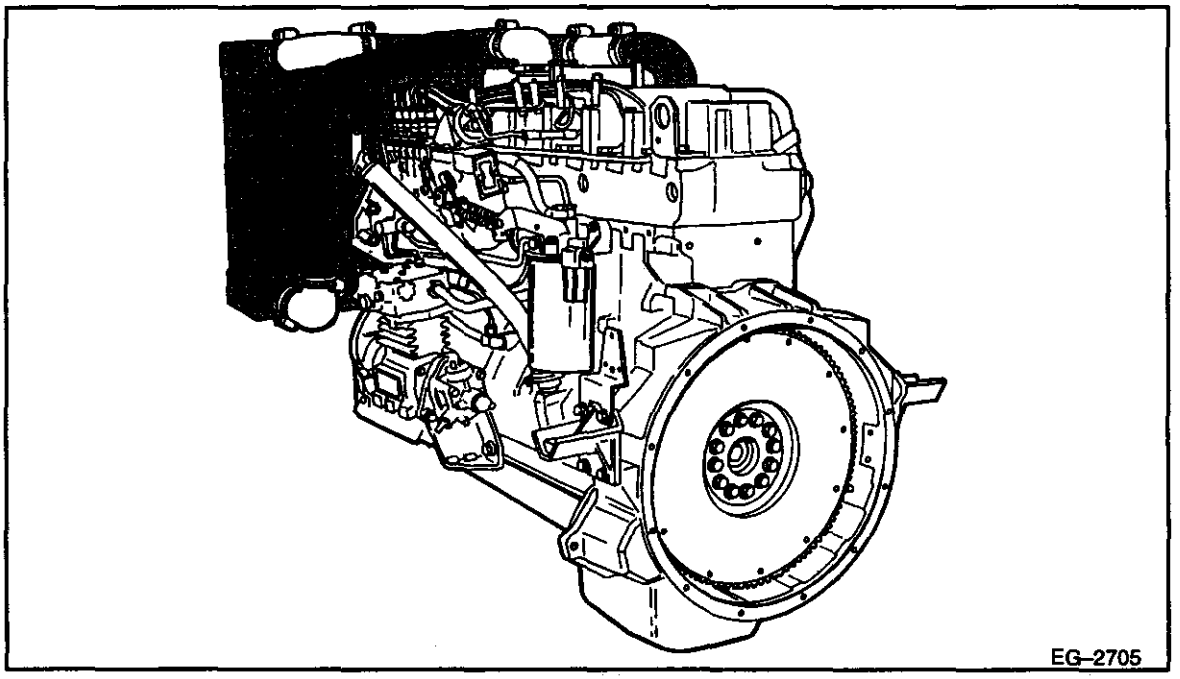


FIGURE 3–2 Air Intake Piping

3.2 COOLING SYSTEM

The function of the cooling system is to keep the engine within a designated temperature range. Major components of most cooling systems include a radiator and fan combination with a coolant (water) pump, thermostat, oil cooler, and coolant filter. On these engines, the water pump is a belt–driven centrifugal type, which is set into the front cover.

This front cover incorporates two separate passages. One passage to channel coolant to the crankcase from the water pump, the other is a by pass to route coolant back to the water pump when the thermostat is closed.

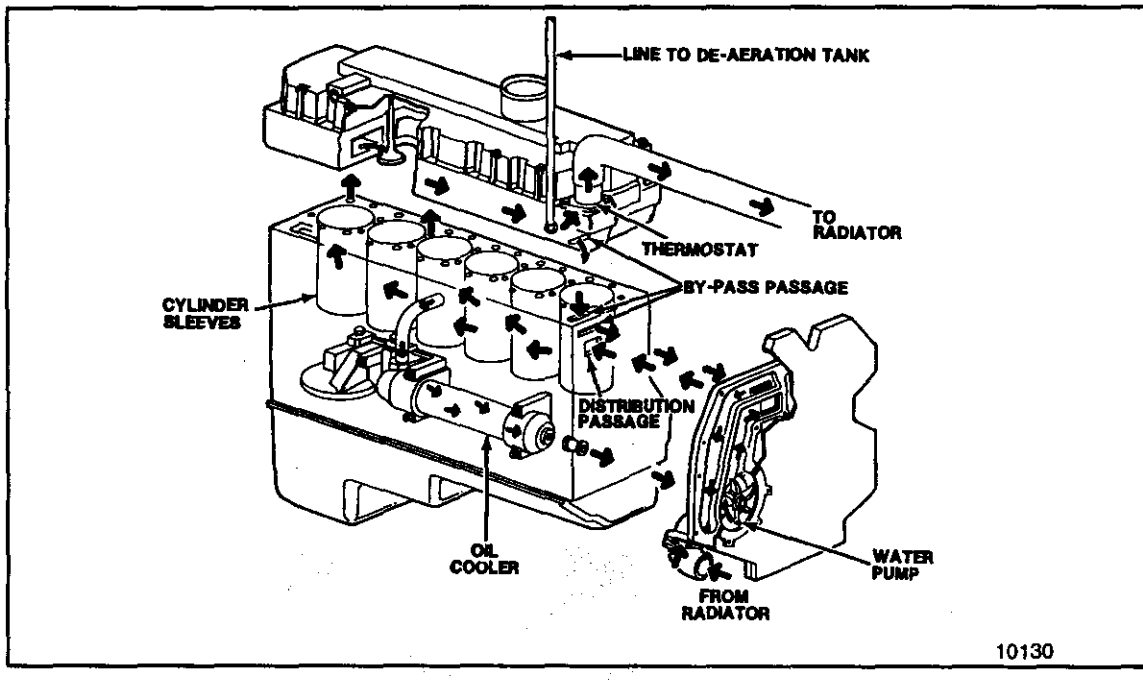


FIGURE 3–3 The Cooling System

3.2.1 Coolant Flow System

Coolant flows from the bottom of the radiator into the inlet tube of the front cover and onto the water pump. The coolant is pushed by the impeller of the water pump, through an internal passage in the front cover and out to the crankcase.

An internal passageway located in the crankcase directs coolant from front to rear, evenly distributing coolant to the lower sections of the cylinder sleeves. The coolant flow is directed toward each cylinder sleeve on a tangent causing a swirling motion upward towards the cylinder head. This swirling action improves heat dissipation.

Coolant leaves the area around the cylinder sleeves in the following two ways:

1. The coolant is directed to the oil cooler via an exterior tube leading to the rear oil cooler header. Coolant flows through passages in the oil cooler

and exits at the water pump to be re–mixed with incoming coolant from the radiator.

Coolant is supplied to rear of air compressor from left side of crankcase. After coolant exists at front of air compressor, it is returned via passage.

2. Coolant exits from the crankcase through two cored holes at the top of each cylinder sleeve bore.

   Coolant then flows through the cylinder head to the thermostat. The thermostat housing incorporates two outlets to direct coolant either to the radiator when the engine is at operating temperature, or directly back to the water pump when the engine has not yet reached operating temperature.

3.2.1.1 Thermostat Operation

See **FIGURE 3–4.**

When the engine coolant temperature is below specified thermostat opening temperature, the coolant flows through the bypass passage to the water pump because the radiator outlet port is blocked. As the engine reaches operating temperature, the thermostat opens, directing coolant towards the radiator; this also restricts the bypass opening.

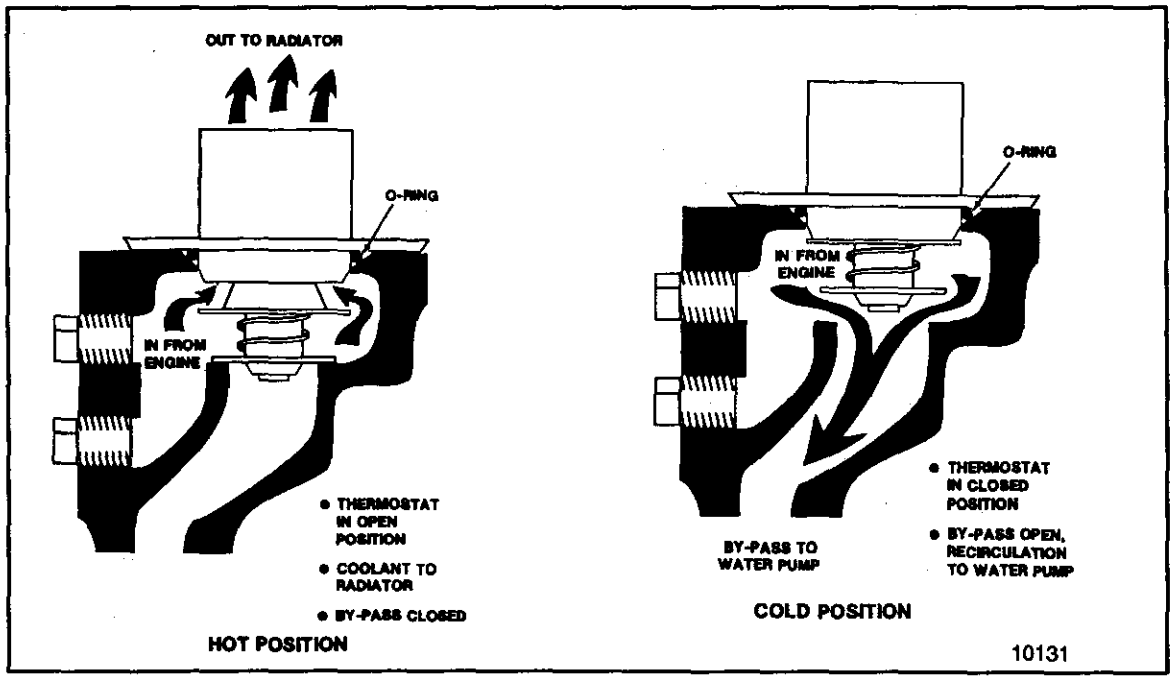


FIGURE 3–4 The Thermostated in Open and Closed Position

3.3 LUBRICATION SYSTEM

The pressurized lubricating oil system is a full flow filtered and cooled type with filter bypass valve and pressure regulation. External oil piping is kept to a minimum to avoid oil psi relief.

3.3.1 Location

The GEROTOR oil pump is mounted on front cover and is driven by the engine crankshaft at the front of the engine, at engine speed. The right side of the engine has an oil cooler, replaceable full flow oil filter, turbocharger oil line, and crankcase breather tube. The left side of the engine has the oil filler tube, oil level gauge, and oil supply line for the fuel injection pump.

3.3.2 Oil Flow

Refer to **FIGURE 3–5** and **FIGURE 3–6**.

Unfiltered oil is drawn from the oil pan, through the oil pick–up tube and to the front cover assembly to the oil pump. Leaving the oil pump, the unfiltered oil travels (under pressure) back through the front cover assembly, passing the high pressure oil relief valve and into the crankcase unfiltered oil galley. Any excess oil is dumped by the relief valve back into the oil pan.

NOTE:

The high pressure oil relief controls unfiltered oil pressure at 80 lb/in.^{2} maximum.

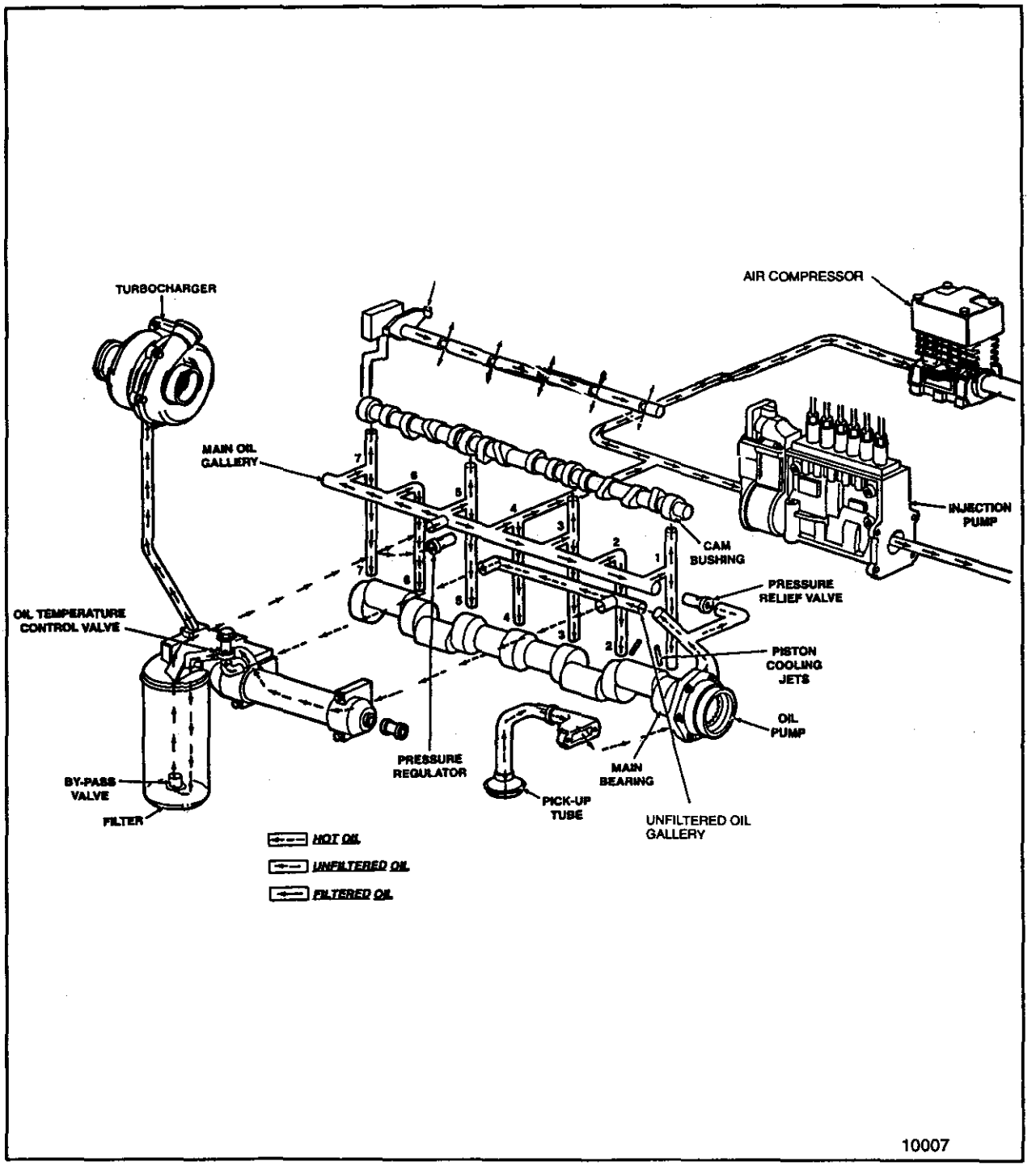


FIGURE 3–5 The Lubrication System

There are two oil galleries in the crankcase. The unfiltered oil travels down the unfiltered oil galley on the lower right hand side of the crankcase and the filtered oil galley runs above it. Unfiltered oil travels from the oil pump, through the front cover assembly and into the unfiltered oil galley. The oil pressure relief valve controls unfiltered oil pressure at 80 lb/in.^{2}. When oil pressure exceeds 80 lb/in.^{2}, the oil pressure relief valve opens and excess

oil is dumped back to the oil sump. There are two exit ports in the unfiltered oil galley. One exits to the front header of the oil cooler and one exits to the rear header of the oil cooler. Depending upon the position of the oil thermostat, located in the rear header, unfiltered oil can bypass the oil cooler core and go directly to the oil filter or can flow through the oil cooler core into the rear header.

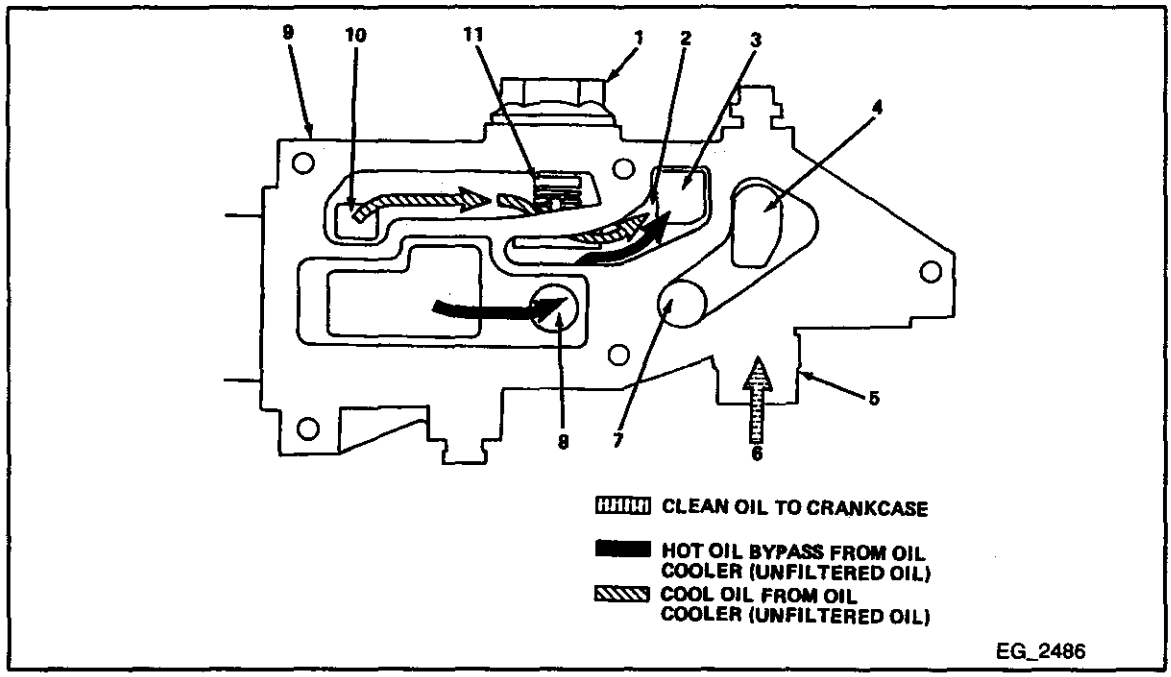


FIGURE 3–6 Oil Cooler Header Oil Flow Schematic

1. **Thermostat Cap**
2. **Hot/Cold Oil Mixing Chamber**
3. **Internal Passage To Oil Filter**
4. **Internal Passage Oil Filter To Crankcase**
5. **Oil Filter Stud**
6. **Clean Oil Flow From Oil Filter**
7. **Pressure Regulator Valve Location**
8. **From Oil Cooler ByPass Galley**
9. **Oil Cooler Header**
10. **Unfiltered Oil From Oil Cooler**
11. **Oil Cooler Thermostat**

The oil cooler thermostat opens or closes by sensing oil temperature in the unfiltered galley. Oil is directed from the unfiltered galley to the filter, were it enters from the outside of the element and exits from the center. Oil bypass valve is located within the filter can and operates at a pressure differential of lb/in.^{2}. Oil filter element bypass is effected from within the filter can. Clean engine oil flows out of the filter and goes back into the oil cooler header, then out the header and into the crankcase clean oil galley. The clean oil enters the crankcase, passes the oil cooler regulator valve and is directed through various ports of the crankcase. Excess oil is dumped back into the crankcase by the regulator valve.

NOTE:

The oil cooler pressure regulator valve controls filtered oil pressure at 50 lb/in.^{2}.

The turbocharger receives filtered oil through an external tube connected at the rear oil cooler header. The fuel injection pump and air compressor (if equipped) also receive oil

through external lines which are connected at a common fitting on the right side of the crankcase main filtered oil gallery. This fitting is supplied with oil directly from the main gallery. The front gear train is splash lubricated by oil draining from the injection pump and air compressor (if equipped).

3.3.3 Oil Pressure Regulator Valve and Oil Pressure Relief Valve

The unique design of the lubricating oil pressure relief valve, (80 lb/in.^{2}) located in the front cover and the oil pressure regulating valve (50 lb/in.^{2}), located by the rear oil cooler header, extends the life of the engine because it controls the volume and pressure of oil supplied to the engine. The volume of oil supplied by the pump is always in excess of what is needed to lubricate the engine. The oil pressure relief valve is located in the front cover and is used to protect the oil cooler and oil filter from extremely high pressures encountered during cold starts and cold starts in cold weather. If oil pressure exceeds 80 lb/in.^{2} on the valve face, it moves the valve body inward allowing oil to travel through the valve and back to the oil pan, thus relieving pressure in the lubrication system.

The oil pressure regulator valve is located on the right side of the block, between oil filter header and block. When all points of lubrication within the engine are satisfied, restriction to flow causes pressure to build on the case of the valve causing it to move inward. This action allows excess oil to go directly back to the oil pan, through the ports uncovered by the movement of the regulator valve body.

3.4 FUEL SYSTEM

The fuel system consists of a fuel tank, fuel filter strainer, fuel filter, hand primer pump, fuel supply pump, fuel injection pump, high pressure fuel lines, fuel injection nozzle assemblies, and low pressure lines. All of these items are located on the left side of engine.

As fuel travels through the fuel system, it will be under negative pressure, high pressure (injection pressure) and low pressure (**FIGURE 3–7**).

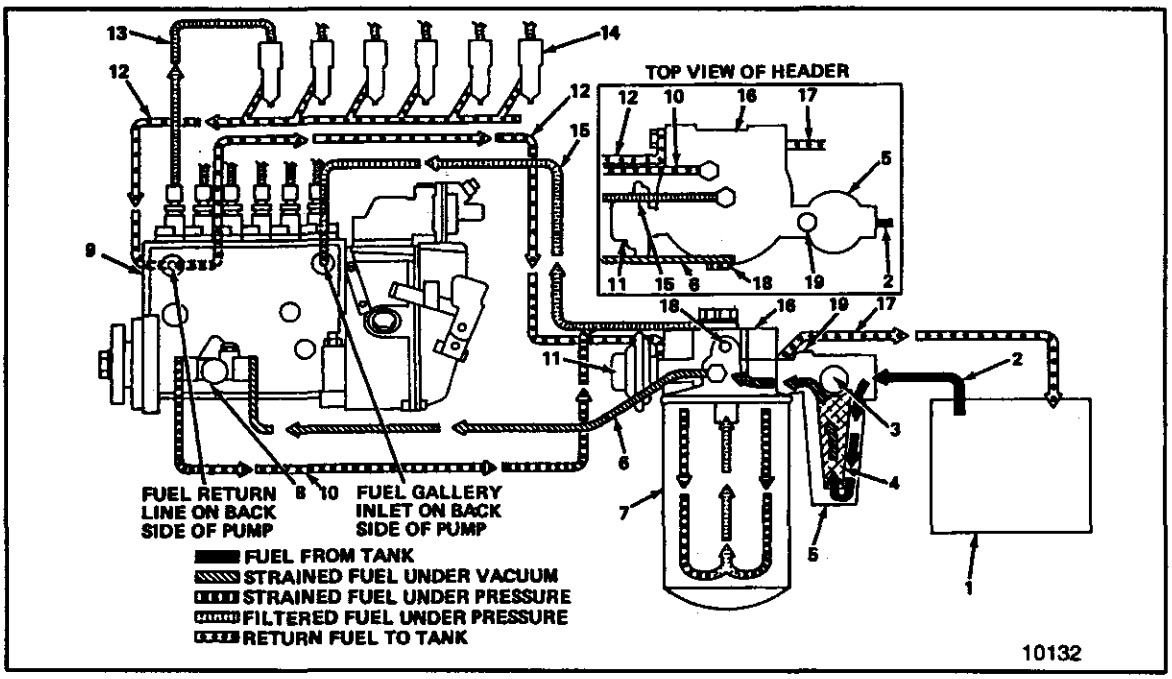


FIGURE 3–7 Fuel System Flow

1. Fuel Tank
2. Fuel From Fuel Tank
3. Check Ball
4. Fuel Strainer
5. Fuel Strainer Housing
6. Fuel Filter Header To Fuel Transfer Pump Fuel Line
7. Fuel Filter
8. Fuel Transfer Pump
9. Fuel Injection Pump
10. Fuel Transfer Pump to Fuel Filter Header Fuel Line
11. Priming Pump
12. Fuel Return Line From Fuel Injection Pump to Fuel Filter Header
13. High Pressure Fuel Lines
14. Fuel Injection Nozzles
15. Fuel Supply Line From Fuel Filter Header to Fuel Injection Pump
16. Fuel Filter Header
17. Return Fuel to Fuel Tank
18. Bleeder Valve
19. Priming Pump Alternate Location

3.4.1 Negative Pressure

When the priming pump is pushed down, the check ball is seated onto the fuel strainer. Releasing the priming pump unseats the check ball, draws fuel from the fuel tank, through the inlet port of the fuel filter header and into the fuel strainer assembly. Fuel exists the strainer, flows through the internal passage of the fuel filter header, via a fuel line to the transfer pump located on the fuel injection pump.

Once the engine has been primed, the fuel transfer pump keeps the fuel line under negative pressure with a constant supply of fuel.

3.4.2 Intermediate Pressure

The transfer pump produces an intermediate pressure on the fuel. Fuel now flows from the transfer pump to the inside port of the fuel filter header. Fuel then travels through an internal passage into the fuel filter. Fuel passes through the fuel filter and out the fuel filter header, through a fuel line to the fuel supply port of the fuel injection pump.

3.4.3 High Pressure

The fuel injection pump meters and delivers fuel at high pressure through the injection lines to the injection nozzle assemblies. This high pressure fuel causes the nozzle valve to open and fuel flows through the nozzle orifices into the combustion chamber. The amount of fuel delivered is controlled by the injection pump governor.

3.4.4 Low Pressure

A small amount of low pressure fuel returns from the nozzle assemblies to the fuel tank through the return/leakoff line.

The return line is teed with the fuel return line connected to the fuel injection pump. Fuel flows back to the fuel filter header, through the fuel filter header and back to the fuel tank.

3.5 AIR INDUCTION AND EXHAUST SYSTEMS

The intake and exhaust systems consist of those components that flow filtered air to the engine cylinders and exhaust gases to the atmosphere. The intake system includes an air cleaner, turbocharger, air piping, air–to–air intercooler, valve cover/intake manifold and intake valves.

3.5.1 Air Flow

The intake system consists of an air cleaner, air piping, the compressor side of the turbocharger, valve cover/intake manifold and intake valves. Refer to **FIGURE 3–8**. During start up, the air is forced through the air cleaner by the atmospheric pressure.

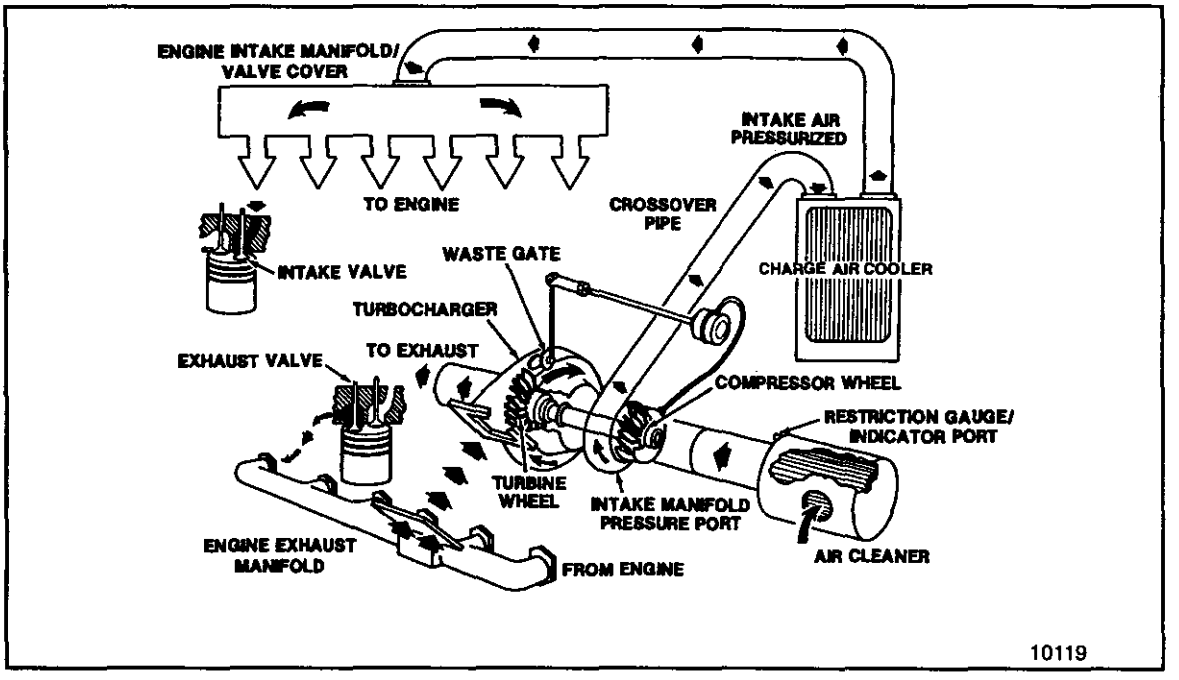


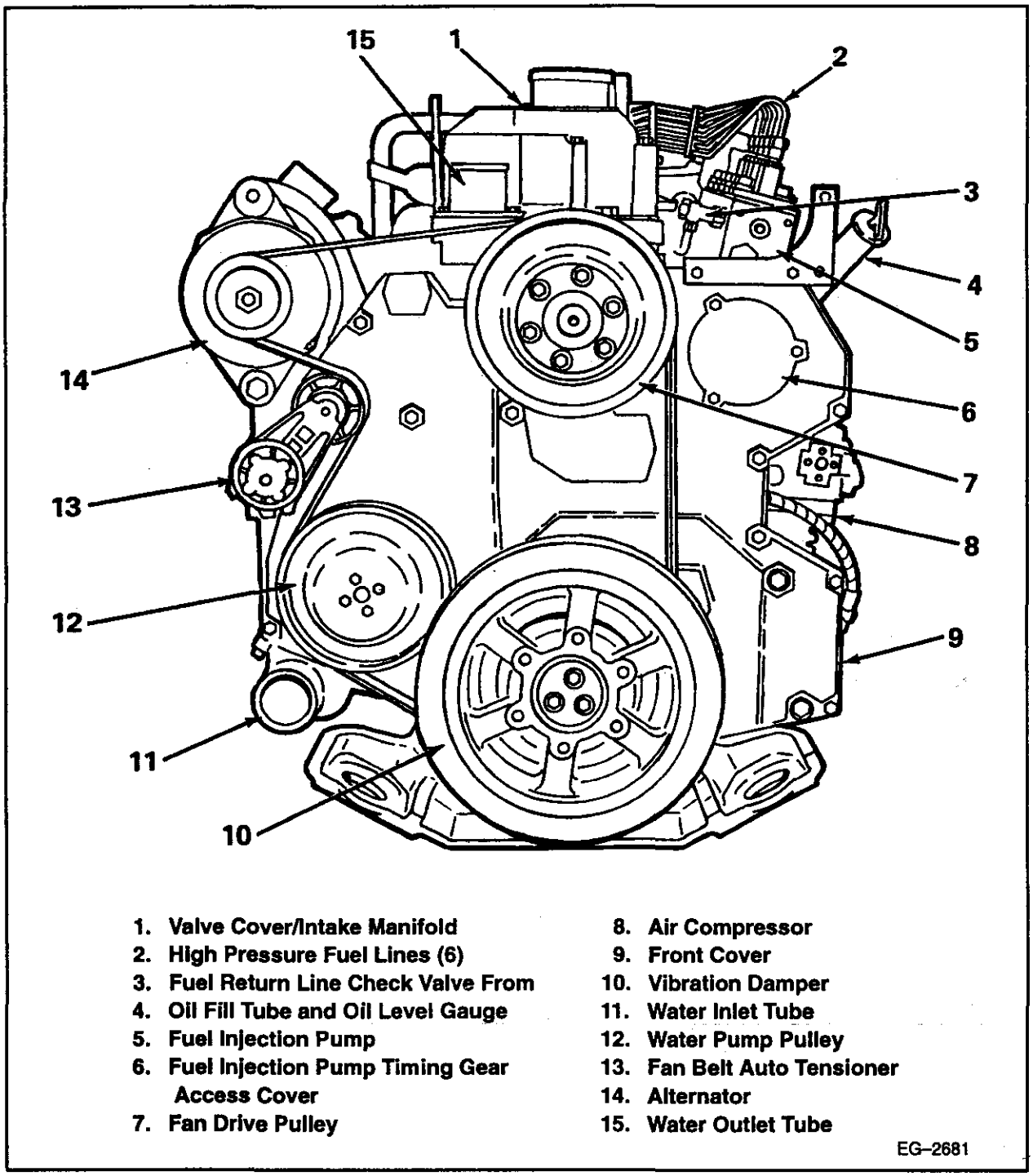
FIGURE 3–8 Air Induction and Exhaust Systems Turbocharged and Charged Air Cooled Engine

The turbocharger is used to increase engine power output by increasing air supply to the engine. It provides uniform performance at various operating altitudes. It is an exhaust driven centrifugal air compressor; that allows filtered air to enter at the center of the compressor housing and is forced under pressure to the combustion chamber. After combustion, hot and expanding exhaust gases move through the turbine housing causing the turbine wheel to spin. The turbine wheel drives the compressor wheel through a common shaft. The turbocharger responds directly to engine loads. During heavy load, increased flow of exhaust gases turn the turbine wheel faster causing the compressor impeller to turn faster and supply more air (greater boost) to the intake manifold. Conversely, with light engine load, flow of exhaust gases decrease and less air is pumped into the intake manifold.

The exhaust system includes exhaust valves, exhaust manifold, muffler and exhaust piping. The turbocharger compressor side is part of the intake system and turbine side is part of the exhaust system.

The air is cooled by a air–to–air intercooler prior to entering the intake manifold. Air then flows into the combustion chamber where it is mixed with the proper amount of fuel and burned. Exhaust gases leave the cylinders through exhaust ports and the exhaust manifold. From the exhaust manifold, the expansion of exhaust gases on the exhaust turbine drive the turbocharger and are released through the exhaust pipe to the atmosphere.

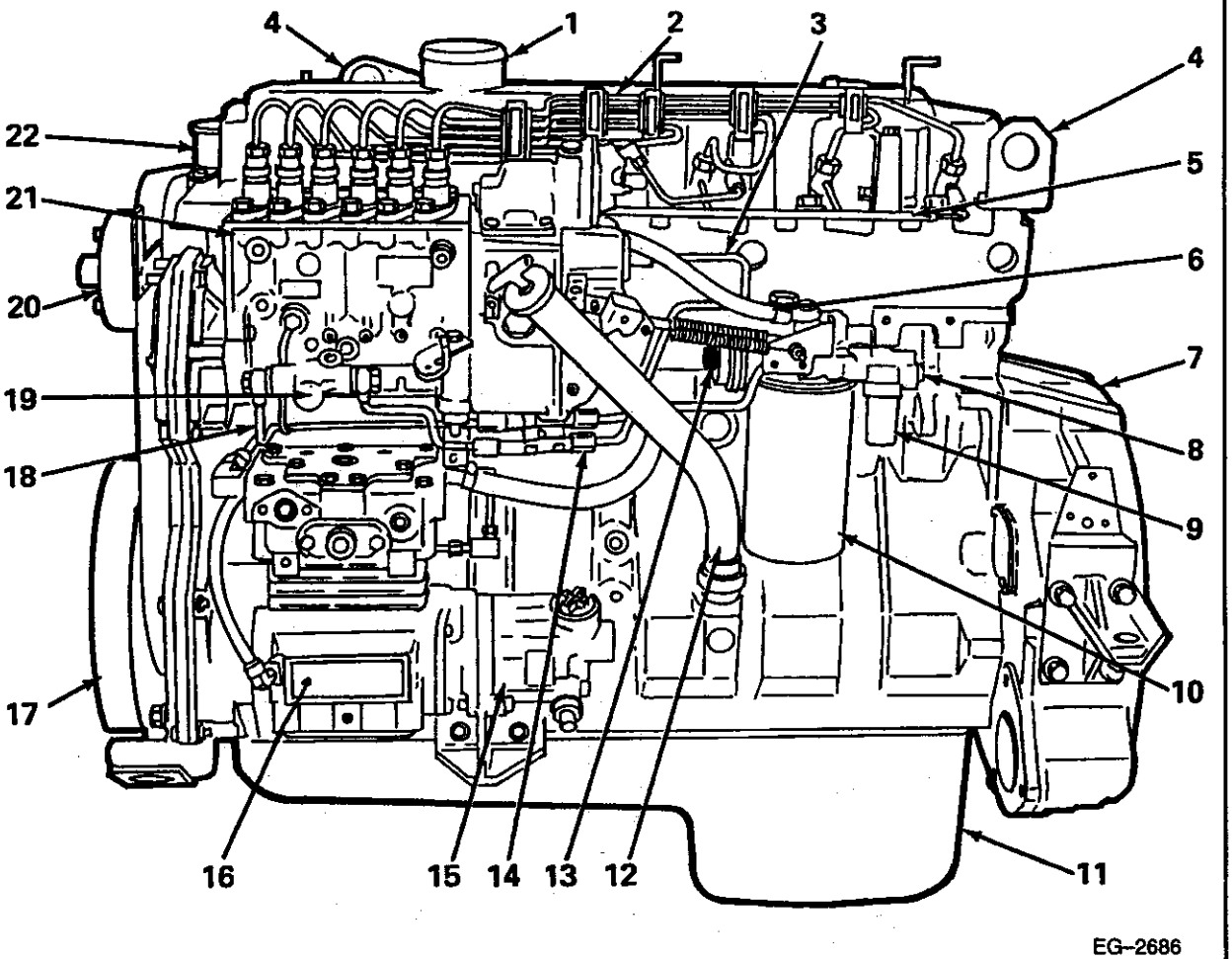
3.6 MAJOR COMPONENT LOCATION (FRONT)



1. Valve Cover/Intake Manifold
2. High Pressure Fuel Lines (6)
3. Fuel Return Line Check Valve From
4. Oil Fill Tube and Oil Level Gauge
5. Fuel Injection Pump
6. Fuel Injection Pump Timing Gear Access Cover
7. Fan Drive Pulley
8. Air Compressor
9. Front Cover
10. Vibration Damper
11. Water Inlet Tube
12. Water Pump Pulley
13. Fan Belt Auto Tensioner
14. Alternator
15. Water Outlet Tube

FIGURE 3–9 Major Component Location (Front)

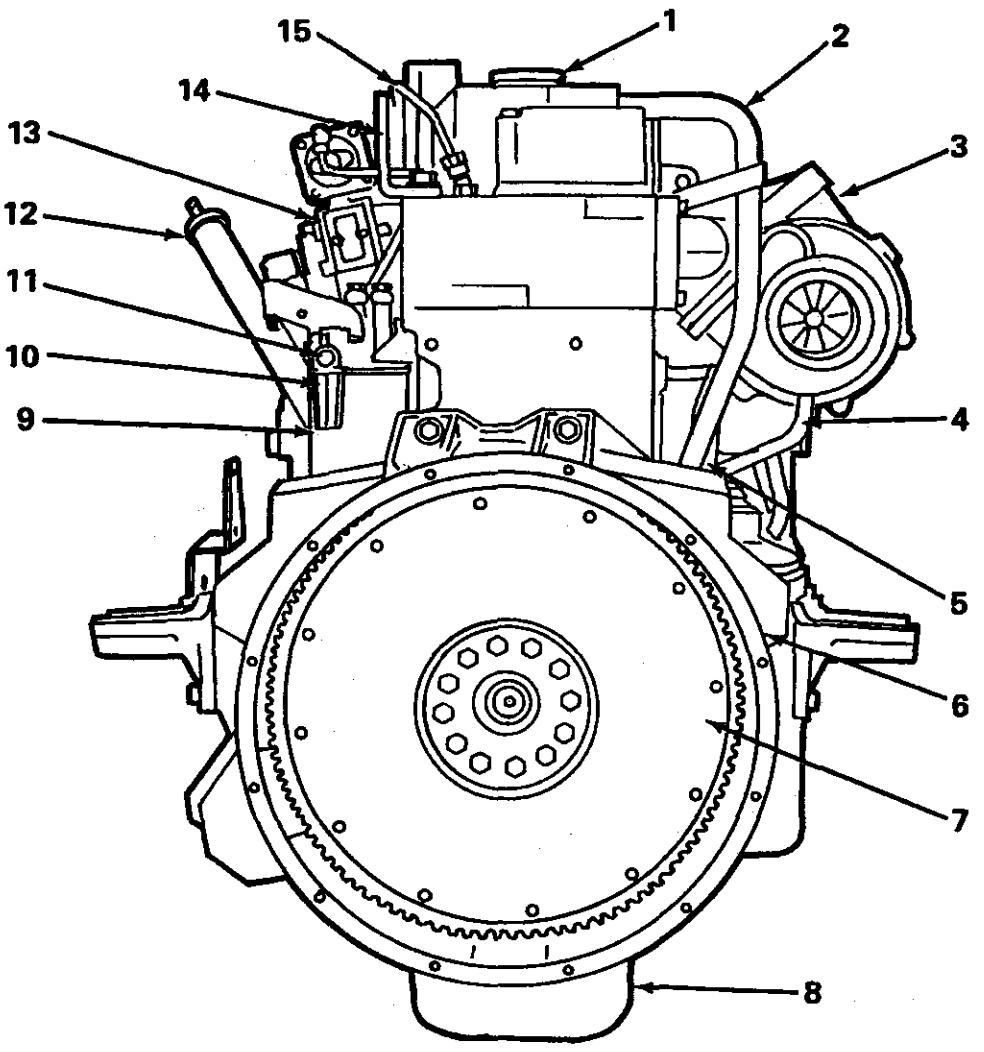
3.7 MAJOR COMPONENT LOCATION (LEFT SIDE)



1. Valve Cover/Intake Manifold
2. High Pressure Fuel Lines (6)
3. Fuel Return Line From Fuel Injection Pump To Fuel Filter
4. Lifting Eye (2)
5. Low Pressure Fuel Return Line
6. Fuel Supply Hose From Fuel Filter To Injection Pump
7. Flywheel Housing
8. Fuel Inlet Port
9. Strainer Assembly
10. Fuel Filter
11. Oil Pan
12. Oil Fill Tube And Oil Level Sight Gauge
13. Fuel Primer Pump
14. Fuel Line From Fuel Filter To Transfer Pump
15. Power Steering Pump
16. Air Compressor
17. Vibration Damper
18. Fuel Line From Transfer Pump To Fuel Filter
19. Transfer Pump
20. Fan Drive Pulley
21. Fuel Injection Pump
22. Thermostat/Coolant Outlet Tube

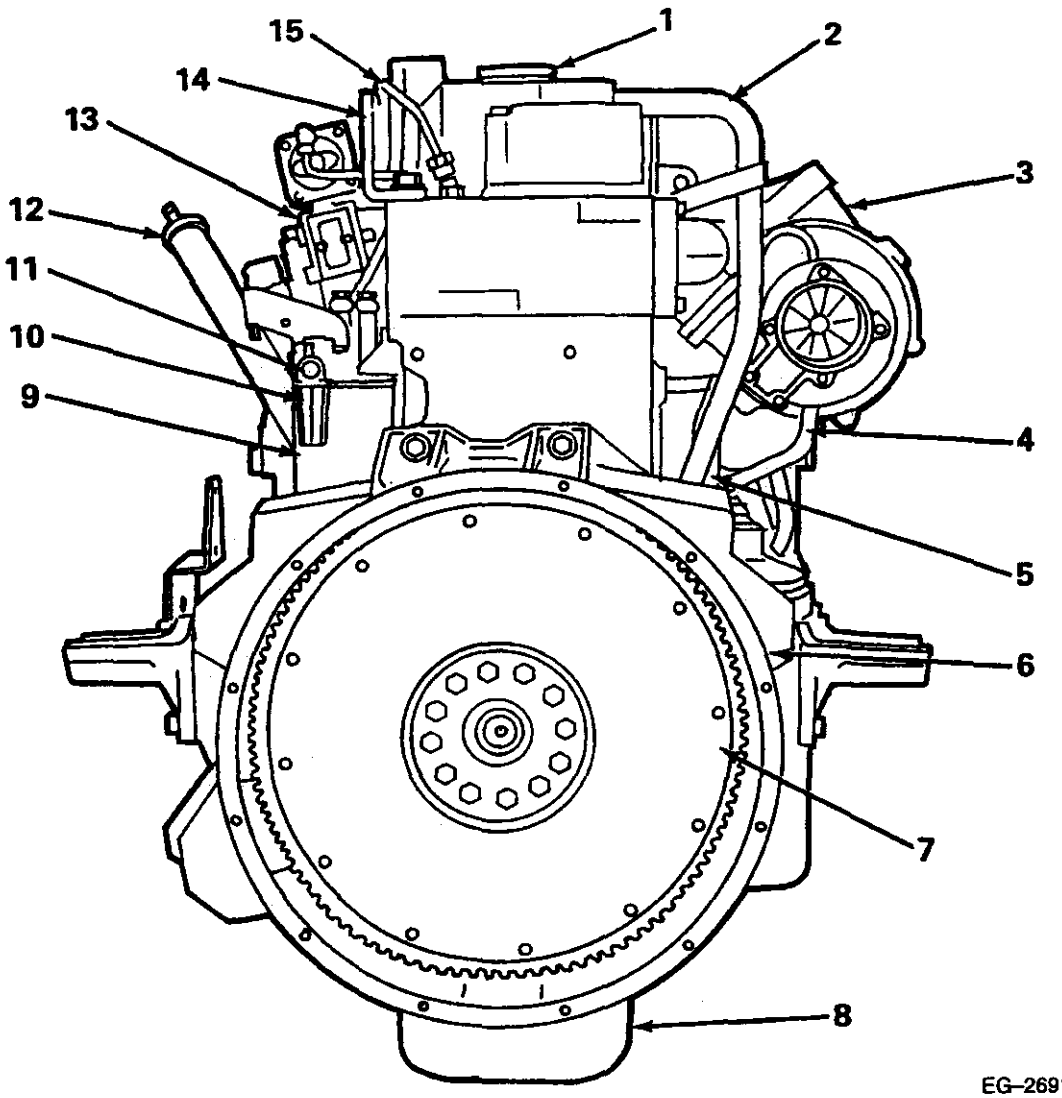
FIGURE 3–10 Major Component Location (Left Side)

3.8 MAJOR COMPONENT LOCATION (REAR)



1. Valve Cover/Intake Manifold
2. Crankcase Breather Tube
3. Turbocharger Assembly
4. Turbocharger Oil Drain Tube
5. Turbocharger Oil Feed Tube
6. Flywheel Housing
7. Flywheel
8. Oil Pan
9. Fuel Filter
10. Fuel Strainer Assembly
11. Fuel Supply Inlet Port
12. Oil Fill Tube And Oil Level Gauge
13. Fuel Injection Pump
14. Lifting Eye (2)
15. High Pressure Fuel Lines (6)

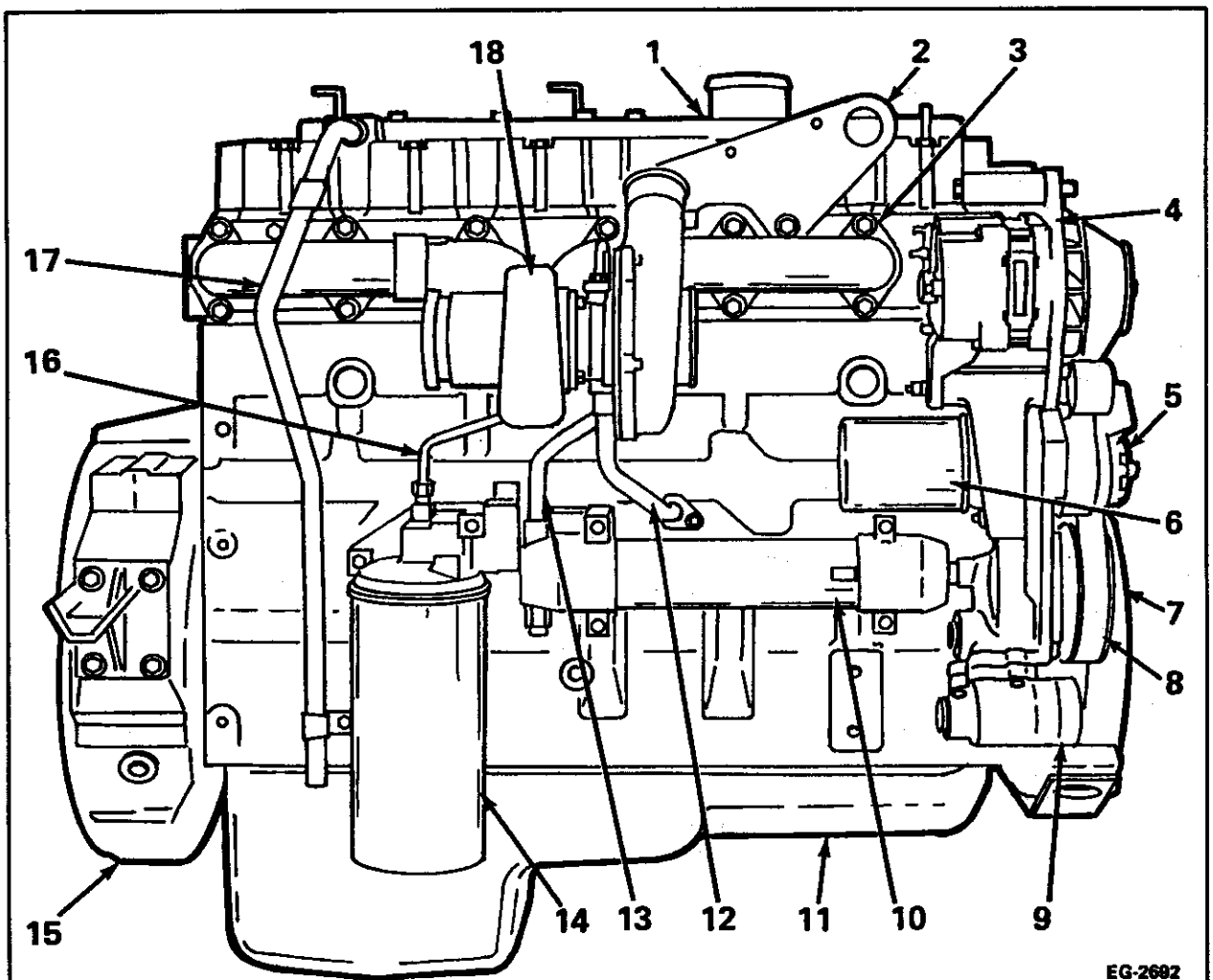
FIGURE 3–11 Major Component Location (Rear) – Non Wastegate Turbocharger



1. Valve Cover/Intake Manifold
2. Crankcase Breather Tube
3. Turbocharger Assembly
4. Turbocharger Oil Drain Tube
5. Turbocharger Oil Feed Tube
6. Flywheel Housing
7. Flywheel
8. Oil Pan
9. Fuel Filter
10. Fuel Strainer Assembly
11. Fuel Supply Inlet Port
12. Oil Fill Tube And Oil Level Gauge
13. Fuel Injection Pump (Bosch Model P7100 Shown)
14. Lifting Eye (2)
15. High Pressure Fuel Lines (6)

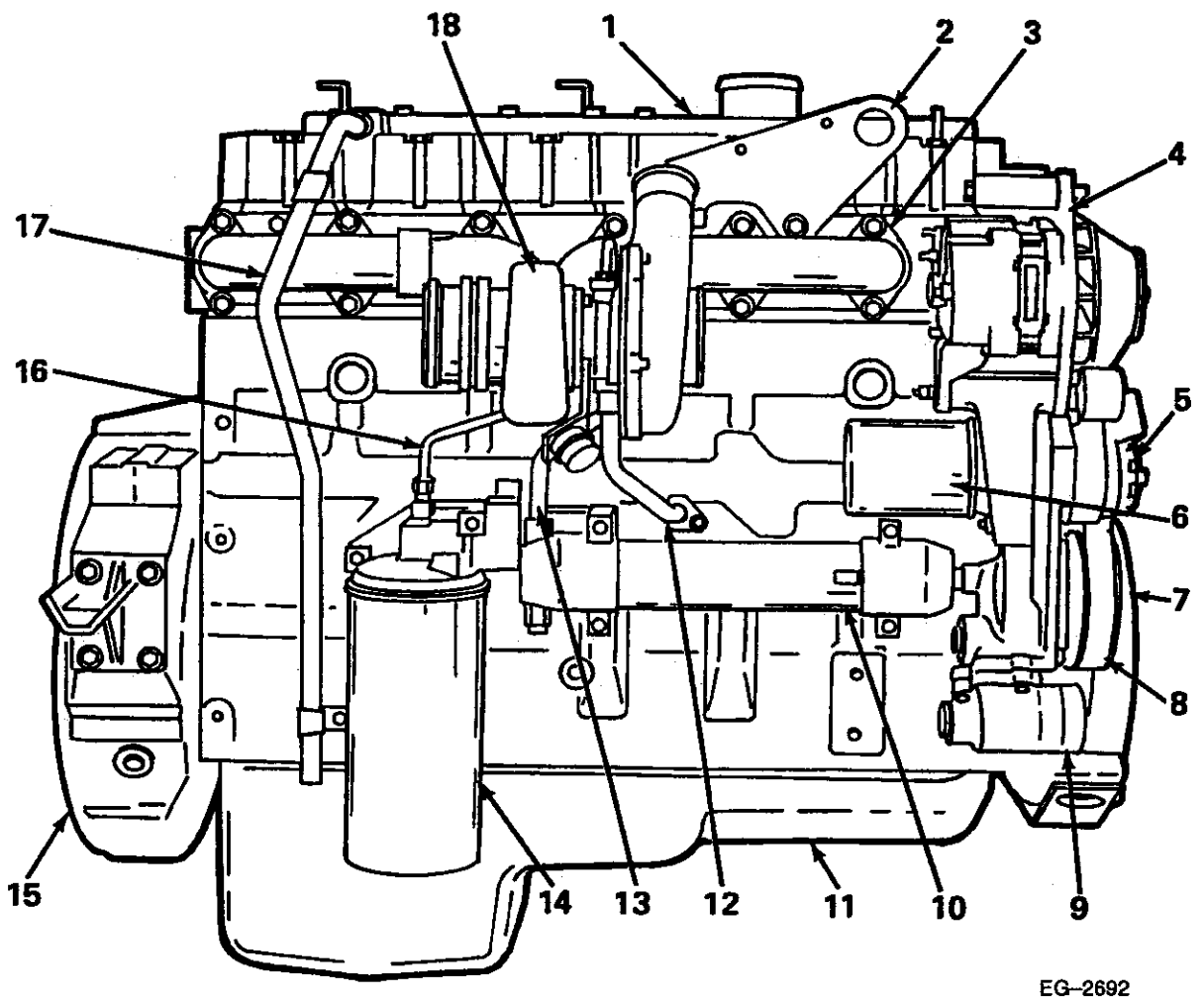
FIGURE 3–12 Major Component Location (Rear) – Wastegate Turbocharger

3.9 MAJOR COMPONENT LOCATION (RIGHT SIDE)



1. Valve Cover/Intake Manifold
2. Lifting Eye (2)
3. Exhaust Manifold
4. Alternator
5. Fan Belt Auto Tensioner
6. Coolant Filter
7. Vibration Damper
8. Water Pump Pulley
9. Water Inlet
10. Oil Cooler
11. Oil Pan
12. Turbocharger Oil Drain Tube
13. Water Coolant Return Tube
14. Oil Filter
15. Flywheel Housing
16. Turbocharger Oil Supply Tube
17. Crankcase Breather Tube
18. Turbocharger Assembly

FIGURE 3–13 Major Component Location (Right Side) Non Wastegate



1. Valve Cover/Intake Manifold
2. Lifting Eye (2)
3. Exhaust Manifold
4. Alternator
5. Fan Belt Auto Tensioner
6. Coolant Filter
7. Vibration Damper
8. Water Pump Pulley
9. Water Inlet
10. Oil Cooler
11. Oil Pan
12. Turbocharger Oil Drain Tube
13. Water Coolant Return Tube
14. Oil Filter
15. Flywheel Housing
16. Turbocharger Oil Supply Tube
17. Crankcase Breather Tube
18. Turbocharger Assembly

FIGURE 3–14 Major Component Location (Right Side) Waste Gate

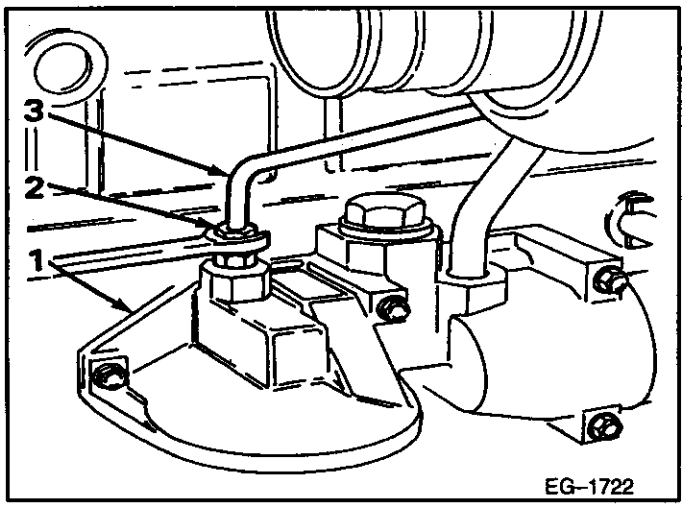
4 MOUNTING ENGINE ON STAND

4.1 SPECIFICATIONS

SPECIAL TORQUE VALUES

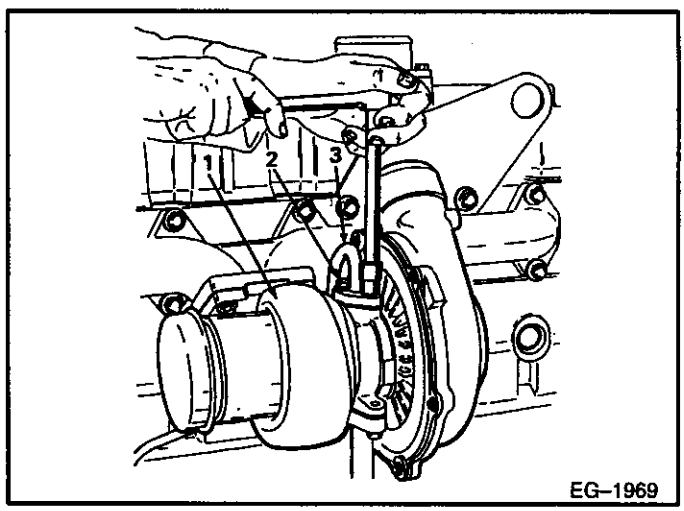
Oil Pan Drain Plug	50 lb·ft (68 N·m)

4.2 MOUNTING ENGINE ON STAND



1. Oil Filter Header
2. Oil Feed Supply Tube Nut
3. Oil Feed Supply Tube

FIGURE 4–1



1. Turbocharger Assembly
2. Mounting Bolts
3. Oil Feed Supply Tube

FIGURE 4–2

Perform the following steps before installing engine to mounting stand:

1. Remove oil pan drain plug and plug gasket. Drain all engine oil and discard gasket.

NOTE:
Discard oil according to EPA standards.

2. Reinstall oil pan drain plug together with new plug gasket. Refer to "Special Torque Value."
3. Using an open end wrench, loosen oil feed supply tube nut located on top of oil filter header. Remove and discard tube nut liner. Refer to **FIGURE 4–1**.
4. Remove two (2) mounting bolts securing oil feed supply tube to top of turbocharger housing. Remove oil feed supply tube and tube flange gasket. Discard flange gasket. Refer to **FIGURE 4–2**.

MOUNTING ENGINE ON STAND

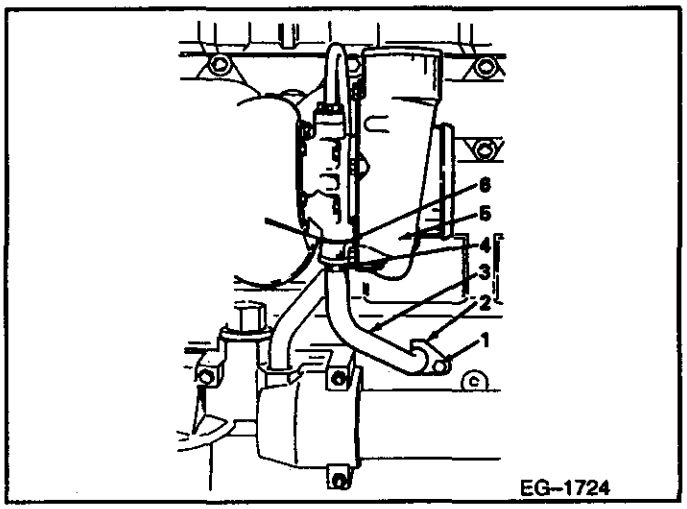
5. Remove turbocharger oil drain tube as follows: (Refer to **FIGURE 4–3**)

   a. Remove one bolt securing turbocharger oil drain tube retaining plate to crankcase.

   b. Remove two (2) capscrews securing turbocharger oil drain tube to bottom of turbocharger housing.

   c. Remove turbocharger oil drain tube retaining plate together with turbocharger oil drain tube, tube flange, two tube O–rings and tube flange gasket from bottom of turbocharger assembly.

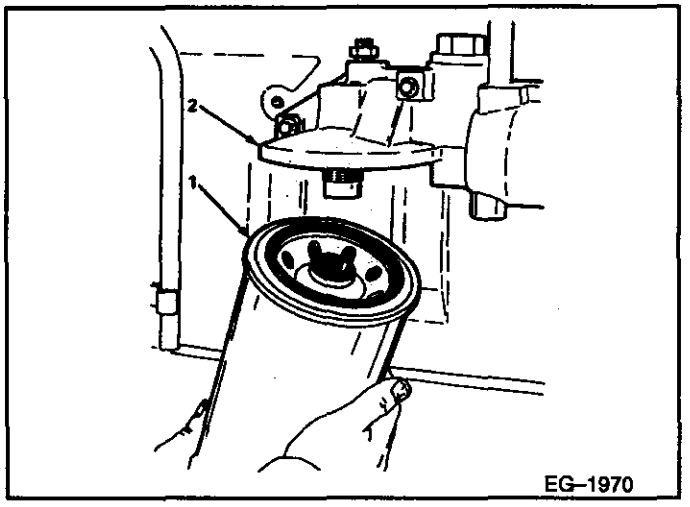
   d. Discard both drain tube O–rings (one on each end of drain tube) and flange gasket.



1. **Oil Drain Tube Mounting Bolt**
2. **Turbocharger Oil Drain Tube Retaining Plate**
3. **Turbocharger Oil Drain Tube**
4. **Oil Drain Tube Mounting Bolts (2)**
5. **Turbocharger Assembly**
6. **Turbocharger Oil Drain Tube Flange Gasket**

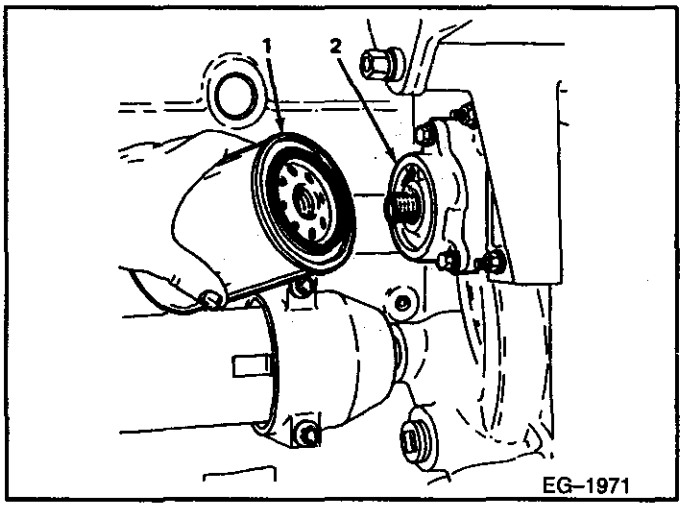
FIGURE 4–3

MOUNTING ENGINE ON STAND



1. Oil Cooler Filter
2. Oil Filter Header

FIGURE 4–4



1. Coolant Filter
2. Coolant Filter Header

FIGURE 4–5

6. Remove oil filter from oil cooler filter header. Discard oil filter. (Refer to **FIGURE 4–4**)
7. Remove coolant filter from header. Discard old coolant filter. (Refer to **FIGURE 4–5**)