# SERVICE MANUAL

**INTERNATIONAL® VT 365**

**DIESEL ENGINE**

2002 and 2003 Model Years

EGES-235-2



Printed in the United States of America

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# Foreword

International Truck and Engine Corporation is committed to continuous research and development to improve products and introduce technological advances. Procedures, specifications, and parts defined in published technical service literature may be altered.

**NOTE:** Photo illustrations identify specific parts or assemblies that support text and procedures; other areas in a photo illustration may not be exact.

This manual includes necessary information and specifications for technicians to maintain International® diesel engines. See vehicle manuals and Technical Service Information (TSI) bulletins for additional information.

**Technical Service Literature**

| | |
|---|---|
| 1171765R2 | *VT 365 Engine Operation and Maintenance Manual* |
| EGES-235-2 | *VT 365 Engine Service Manual* |
| EGES-240 | *VT 365 Engine Diagnostic Manual* |
| EGED-140 | Supplemental Coolant Level Ref. Chart (for conventional “green” coolant) |
| EGED-245 | VT 365 Hard Start and No Start Diagnostic Form |
| EGED-250 | VT 365 Performance Diagnostics Form |
| EGED-255 | VT 365 Electronic Control System Diagnostic Form |
| CGE-575 | Engine Diagnostic Trouble Codes |

Technical Service Literature is revised periodically and mailed automatically to “Revision Service” subscribers. If a technical publication is ordered, the latest revision will be supplied.

**NOTE:** The following Order Information is for technical service literature only.

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St. Charles, IL 60174
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## Service Diagnosis

Service diagnosis is an investigative procedure that must be followed to find and correct an engine application problem or an engine problem.

If the problem is engine application, see specific vehicle manuals for further diagnostic information.

If the problem is the engine, see specific *Engine Diagnostic Manual* for further diagnostic information.

**Prerequisites for Effective Diagnosis**

- Availability of gauges and diagnostic test equipment
- Availability of current information for engine application and engine systems
- Knowledge of the principles of operation for engine application and engine systems
- Knowledge to understand and do procedures in diagnostic and service publications

**Technical Service Literature required for Effective Diagnosis**

- *Engine Service Manual*
- *Engine Diagnostic Manual*
- Performance Diagnostics Forms
- Electronic Control Systems Diagnostics Forms
- Service Bulletins

# Safety Information

This manual provides general and specific service procedures essential for reliable engine operation and your safety. Since many variations in procedures, tools, and service parts are involved, advice for all possible safety conditions and hazards cannot be stated.

Read safety instructions before doing any service and test procedures for the engine or vehicle. See related application manuals for more information.

Disregard for Safety Instructions, Warnings, Cautions, and Notes in this manual can lead to injury, death or damage to the engine or vehicle.

### SAFETY TERMINOLOGY

Three terms are used to stress your safety and safe operation of the engine: Warning, Caution, and Note

**Warning**: A warning describes actions necessary to prevent or eliminate conditions, hazards, and unsafe practices that can cause personal injury or death.

**Caution**: A caution describes actions necessary to prevent or eliminate conditions that can cause damage to the engine or vehicle.

**Note**: A note describes actions necessary for correct, efficient engine operation.

### SAFETY INSTRUCTIONS

#### Vehicle

- Make sure the vehicle is in neutral, the parking brake is set, and the wheels are blocked before doing any work or diagnostic procedures on the engine or vehicle.

#### Work area

- Keep work area clean, dry, and organized.
- Keep tools and parts off the floor.
- Make sure the work area is ventilated and well lit.
- Make sure a first aid kit is available.

#### Safety equipment

- Use correct lifting devices.
- Use safety blocks and stands.

#### Protective measures

- Wear protective glasses and safety shoes.
- Wear appropriate hearing protection.
- Wear correct work clothing.
- Do not wear rings, watches, or other jewelry.
- Restrain long hair.

#### Fire prevention

- Make sure charged fire extinguishers are in the work area.

**NOTE:** Check the classification of each fire extinguisher to ensure that the following fire types can be extinguished.

1. Type A — Wood, paper, textiles, and rubbish
2. Type B — Flammable liquids
3. Type C — Electrical equipment

#### Batteries

Batteries produce highly flammable gas during and after charging.

- Always disconnect the main negative battery cable first.
- Always connect the main negative battery cable last.
- Avoid leaning over batteries.
- Protect your eyes.
- Do not expose batteries to open flames or sparks.
- Do not smoke in workplace.

#### Compressed air

- Limit shop air pressure for blow gun to 207 kPa (30 psi).
- Use approved equipment.
- Do not direct air at body or clothing.
- Wear safety glasses or goggles.
- Wear hearing protection.
- Use shielding to protect others in the work area.

**Tools**

- Make sure all tools are in good condition.
- Make sure all standard electrical tools are grounded.
- Check for frayed power cords before using power tools.

**Fluids under pressure**

- Use extreme caution when working on systems under pressure.
- Follow approved procedures only.

**Fuel**

- Do not over fill the fuel tank. Over fill creates a fire hazard.
- Do not smoke in the work area.
- Do not refuel the tank when the engine is running.

**Removal of tools, parts, and equipment**

- Reinstall all safety guards, shields, and covers after servicing the engine.
- Make sure all tools, parts, and service equipment are removed from the engine and vehicle after all work is done.

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## Engine Identification

### Engine Serial Number

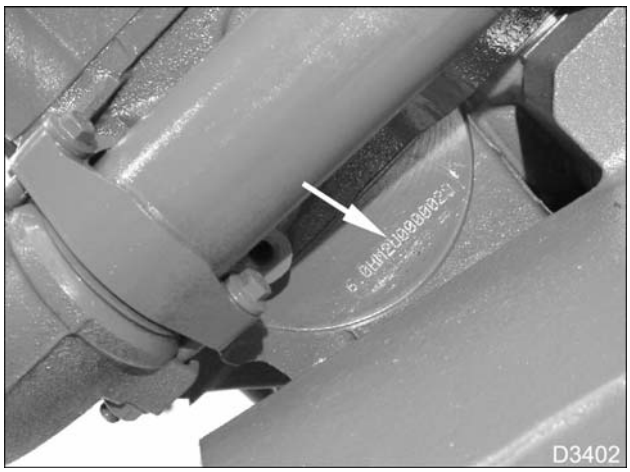



**Figure 1 Engine serial number**

The engine serial number is stamped on the crankcase pad on the rear left side of the crankcase below the cylinder head.

The engine serial number is also on an identification sticker on the valve cover.

#### Engine serial number examples

6.0HM2Y0000500

6.0HA2U0000508

#### Engine serial number codes

**6.0 –** Engine displacement
**H –** Diesel, turbocharged, Charge Air Cooled, and electronically controlled
**M2 –** Truck
**A2 –** Service
**U –** USA
**Y –** USA Huntsville
**7 digit suffix –** Engine serial number sequence

### Emission Labels

A 50 – State Exhaust Emissions Label or a 49 – State Low Emission Vehicle (LEV) Label and a U.S. Federal Family Emission Limits Label are issued for International® VT 365 diesel engines. These labels are on top of the right valve cover.

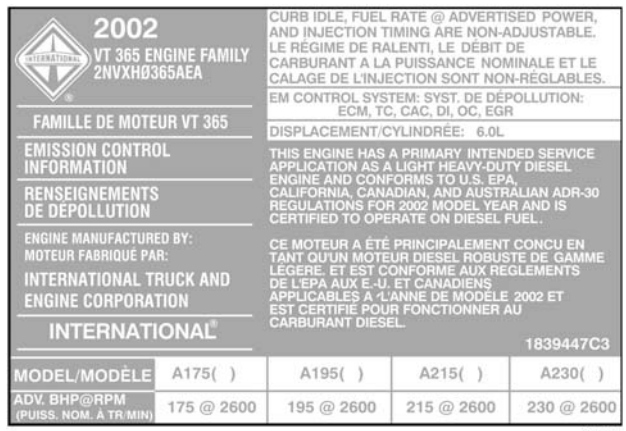



**Figure 2 50 – State Exhaust Emissions Label (example)**

**NOTE:** The 50 – State Exhaust Emissions Label includes engines certified for sale in California.

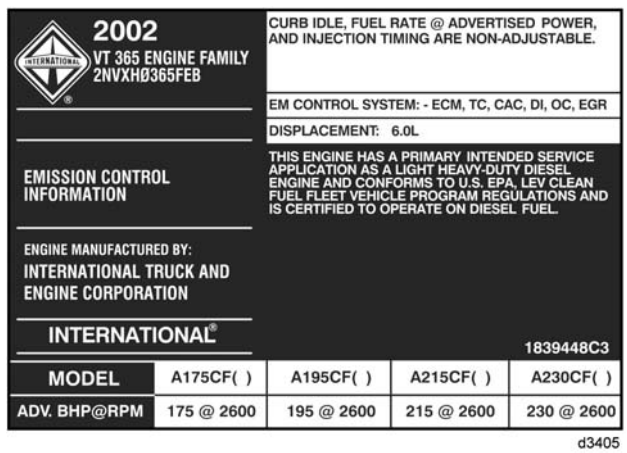



**Figure 3 49 – State Low Emission Vehicle (LEV) Label (example)**

**NOTE:** The 49 – State Low Emission Vehicle (LEV) Label excludes engines certified for sale in California.

The 50 – State Exhaust Emissions Label and the 49 – State Low Emission Vehicle (LEV) Label include the following:

- Year the engine was certified to meet EPA emission standards
- Engine model code
- Service applications
- Advertised brake horsepower ratings

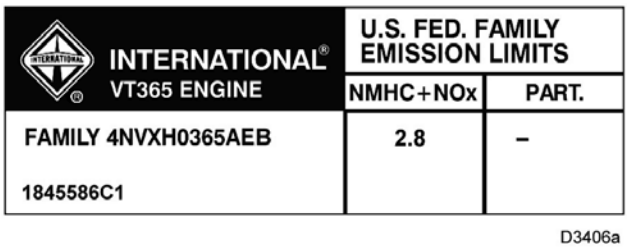



**Figure 4 U.S. Federal Family Emission Limits label (example)**

The U.S. Federal Family Emission Limits Label identifies the engine family and emission limits established by the manufacturer and certified by the EPA.

**Engine accessories**

The following engine accessories may have manufacturer's labels or identification plates:

- Air compressor (for brake or suspension system )
- Air conditioning compressor
- Alternator
- Cooling fan clutch
- Variable Geometry Turbocharger (VGT)
- Power steering and fuel pump
- Starter motor

Labels or identification plates include information and specifications helpful to vehicle operators and technicians.

## Engine Description

**Table 1**

**International® VT 365 engine features and specifications**

| | |
|---|---|
| Engine | Diesel, 4 cycle |
| Configuration | 4 OHV/1 Cam-in-Crankcase V8 |
| Displacement | 365 cu. in (6.0L) |
| Bore and stroke | 95 mm x 105 mm (3.74 in x 4.134 in) |
| Compression ratio | 18.0:1 |
| Aspiration | VGT turbocharged and Charge Air Cooling (CAC) |
| Rated power @ rpm [1] | 175 bhp @ 2600 rpm |
| Peak torque @ rpm [1] | 460 lbf•ft @ 1400 rpm |
| Engine rotation, facing flywheel | Counterclockwise |
| Combustion system | Digital Direct Injection (DDI) |
| Total engine weight (auto with oil) | 459 kg (1094 lb) |
| Cooling system capacity (engine only) | 10.2 liters (10.8 qts) |
| Lube system capacity (including filter) | 18 liters (19 qts) |
| Lube system capacity (dry) | 21.8 liters (23 qts) |
| Firing order | 1–2–7–3–4–5–6–8 |

[1] Base rating shown. See Appendix A for other ratings.

**Major features**

Air Management System (AMS)

- Variable Geometry Turbocharger (VGT)
- Exhaust Gas Recirculation (EGR) system
- Chassis mounted Charge Air Cooling (CAC)

Digital Direct fuel Injection (DDI)

Two piece crankcase

One piece cylinder head with four valves per cylinder

Dual timing

Rear gear train

Closed crankcase ventilation

Oil cooler

The firing order is 1-2-7-3-4-5-6-8. When viewing the engine from the rear (flywheel end), the right side cylinders are numbered 1, 3, 5, and 7. Number one is the front position. The left side is numbered 2, 4, 6, and 8.

A two piece crankcase has been specially designed to withstand the loads of diesel operation. The lower crankcase has integral main bearing caps. Coolant and oil passages are cast and machined in the crankcase and front cover housing.

The crankshaft has five main bearings with fore and aft thrust controlled at the upper half of the number 4 main bearing. Two connecting rods are attached to each crankshaft journal. The piston pin moves freely inside the piston and rod. Piston pin retaining rings secure the piston pin within the piston.

One piece aluminum alloy pistons are fitted with one keystone cut compression ring, one rectangular intermediate compression ring, and a two piece oil control ring. The combustion bowl (in the piston crown) reduces exhaust emissions.

The camshaft is supported by five insert bushings pressed into the crankcase. Two cam lobes, cam followers, push rods and valve bridges control four valves per cylinder. The camshaft is gear driven from the rear end of the crankshaft. A thrust flange is located between the camshaft gear and the crankcase. Camshaft thrust is controlled with the rear surface of the number 5 cam journal and the cam gear.

Hydraulic cam followers maintain zero valve lash and minimize engine noise. This eliminates periodic adjustment of valve lash. The hydraulic cam followers have rollers which provide excellent cam lobe and cam follower durability.

The lubrication system uses a crankshaft driven gerotor pump mounted on the front cover. The oil pressure regulator is built into the front cover and is accessible from outside the engine. Lube oil is routed through an oil cooler equipped with a pressure controlled bypass valve. Lube oil moves through passages in the crankcase to lubricate all internal components and to supply the piston cooling tubes and high pressure pump reservoir. The VGT and air compressor use external oil lines.

The VGT is electronically controlled and hydraulically actuated. The VGT provides boost control at low and high speeds for improved throttle response.

An exhaust gas recirculation valve allows water cooled exhaust gases to be fed into the inlet air stream to reduce exhaust emissions.

A closed crankcase breather system recirculates crankcase vapors back into the intake air system.

A chassis mounted Charge Air Cooler (CAC), an air-to-air heat exchanger, increases the density of the air charge.

Engine operation is controlled by two engine mounted control modules:

- Electronic Control Module (ECM)
- Injector Drive Module (IDM)

The ECM receives signals from engine and chassis mounted sensors. The ECM controls engine operation with the following actuators:

- IPR
- VGT control valve
- EGR
- Glow plug relay

The IDM controls fuel injector operation using data from the ECM.

## Engine Component Locations

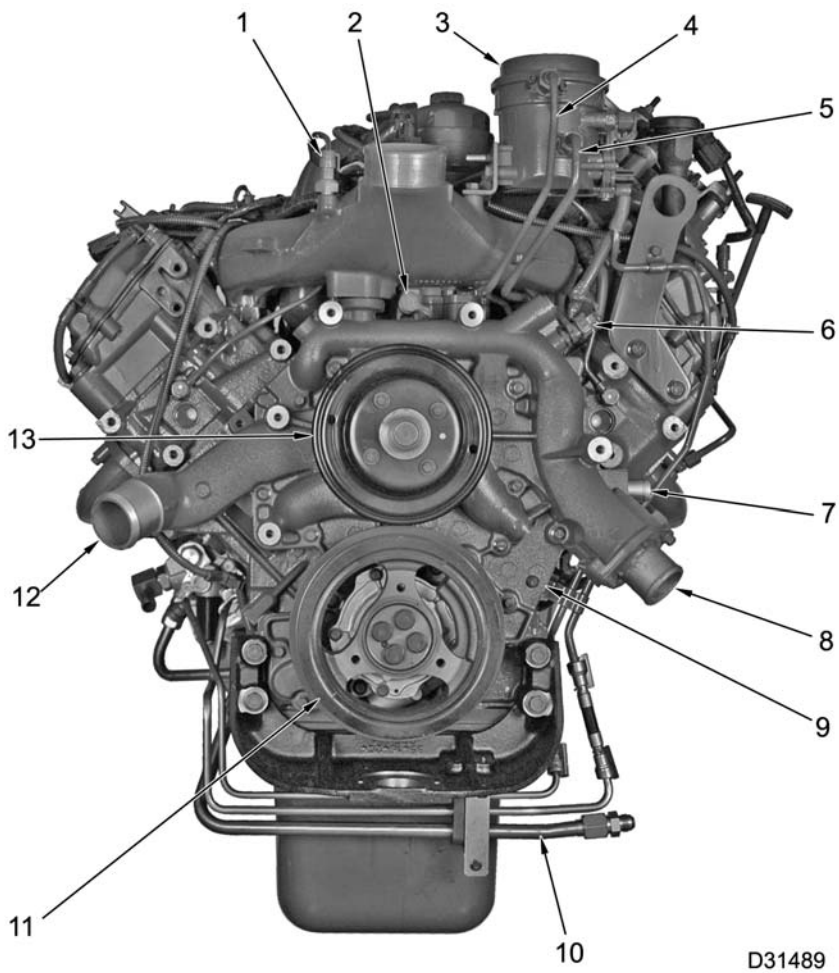



**Figure 5 Engine components – Front**

1. Manifold Absolute Pressure (MAP) sensor
2. Lube oil pressure test port
3. Fuel filter assembly
4. Fuel return
5. Fuel supply
6. Engine Coolant Temperature (ECT) sensor
7. Port for coolant deaeration tank
8. Coolant outlet and thermostat
9. Front cover assembly
10. Power steering line
11. Crankshaft vibration damper
12. Coolant inlet
13. Water pump pulley

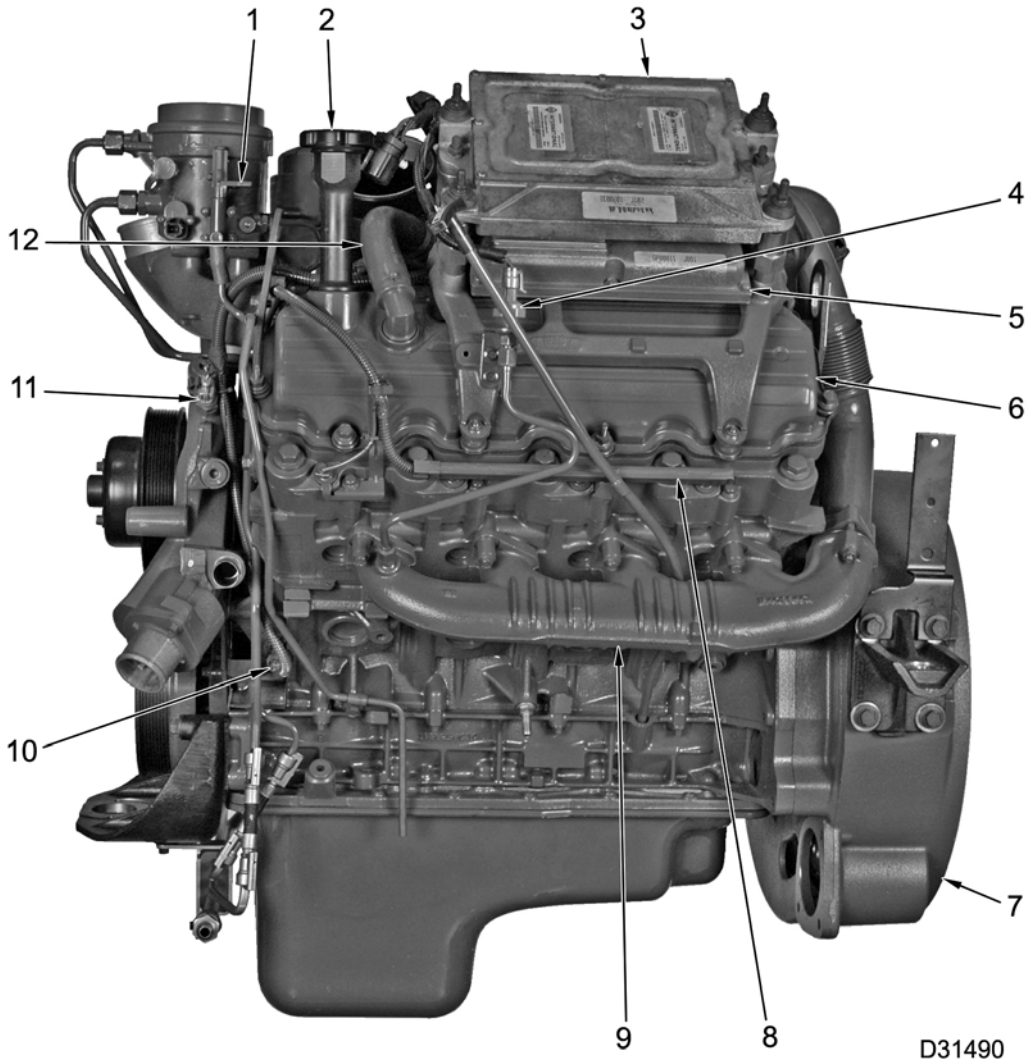



**Figure 6 Engine components – Left**

1. Fuel filter drain lever
2. Lube oil fill tube
3. Engine Control Module (ECM)
4. Exhaust Back Pressure (EBP) sensor
5. Injector Driver Module (IDM)
6. Valve cover
7. Rear cover
8. Glow plug harness rail
9. Exhaust manifold
10. Camshaft Position (CMP) sensor
11. Engine Coolant Temperature (ECT) sensor
12. Breather hose assembly with pitot tube

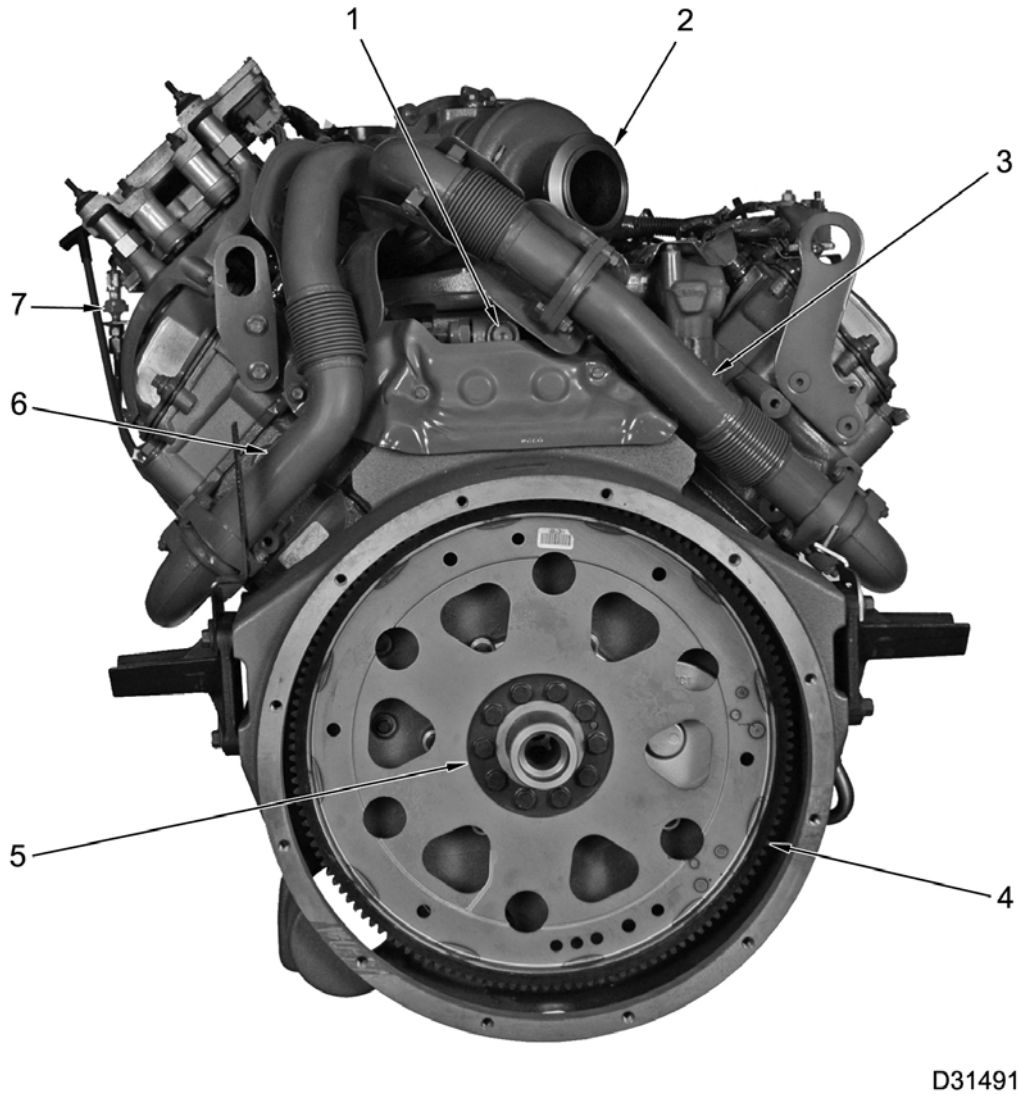



**Figure 7 Engine components – Rear**

1. Injection Control Pressure (ICP) test port
2. Turbocharger exhaust
3. Exhaust tube assembly, right
4. Flywheel or flexplate assembly
5. Reinforcement ring
6. Shielded tube exhaust assembly
7. Exhaust Back Pressure (EBP) sensor

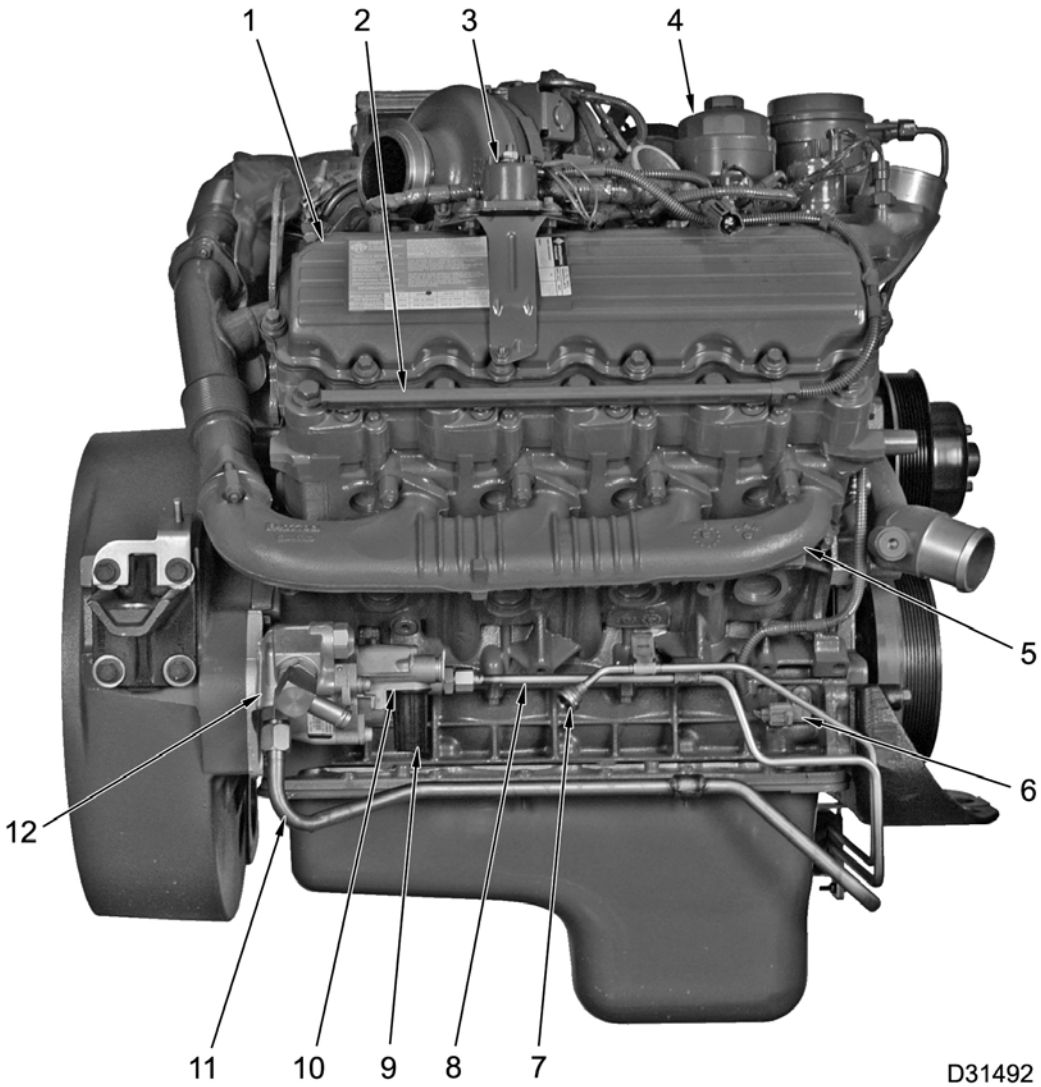



**Figure 8 Engine components – Right**

1. Valve cover
2. Glow plug harness rail
3. Glow plug relay
4. Oil filter housing
5. Exhaust manifold
6. Crankshaft Position (CKP) sensor
7. Fuel tube assembly (supply)
8. Fuel tube assembly (return)
9. Fuel filter strainer
10. Fuel supply pump (transfer)
11. Power steering line
12. Power steering pump

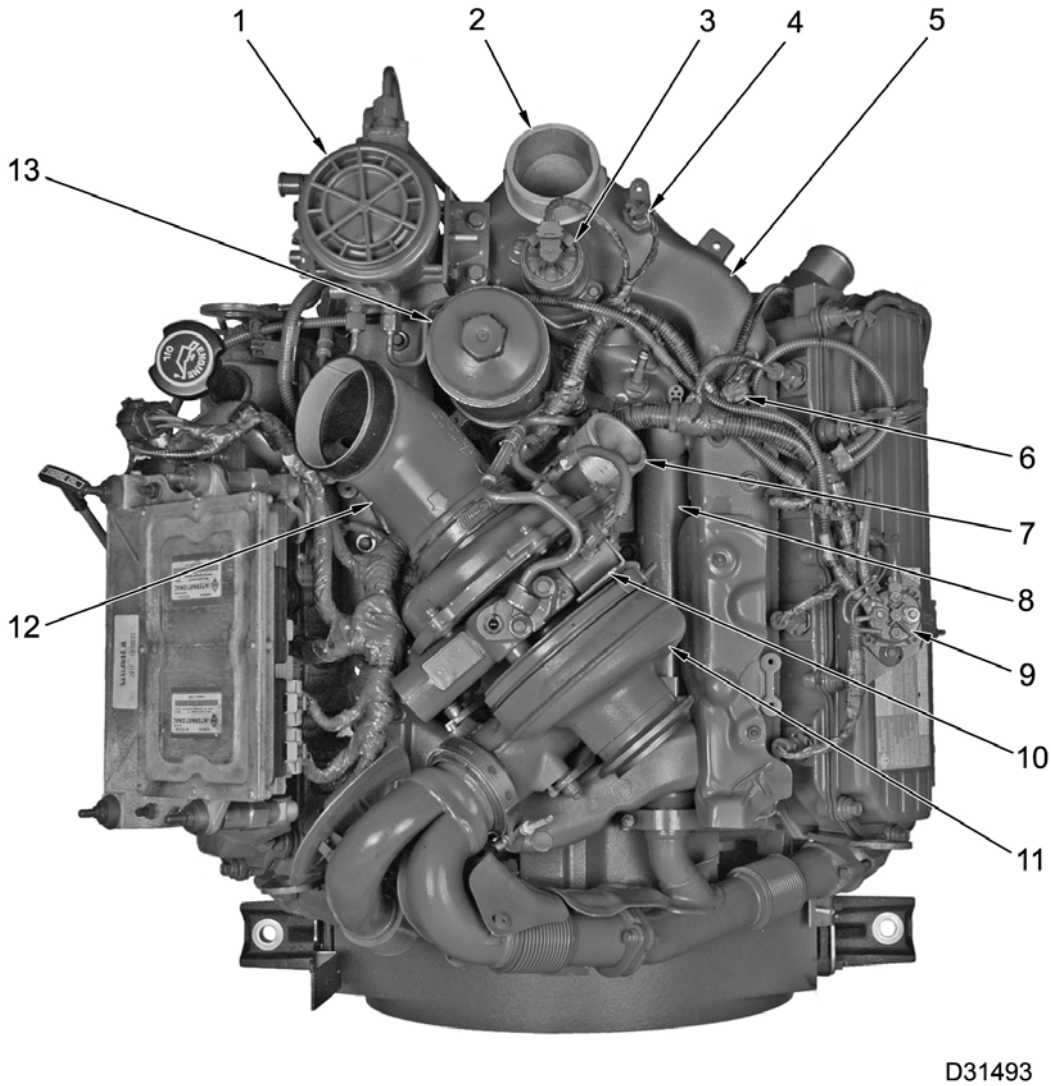
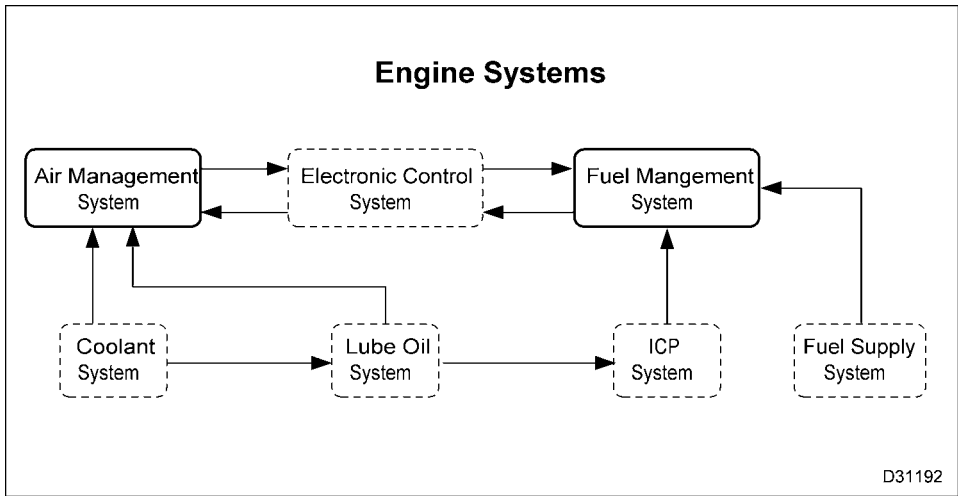



**Figure 9 Engine components – Top**

1. Fuel filter assembly
2. Intake manifold air inlet
3. Exhaust Gas Recirculation (EGR) valve
4. Manifold Absolute Pressure (MAP) sensor
5. Intake manifold
6. Manifold Air Temperature (MAT) sensor
7. Turbocharger air outlet (to CAC)
8. EGR cooler
9. Glow plug relay
10. Variable Geometry Turbocharger (VGT) control valve
11. Variable Geometry Turbocharger (VGT)
12. Air inlet duct
13. Oil filter housing

## Engine Systems




The primary engine systems are Air Management and Fuel Management, which share some subsystems or have a subsystem that contributes to their operation.

- The Electronic Control System controls the Air Management System and Fuel Management System.
- The Coolant System provides heat transfer for EGR gases and lubrication oil.
- The ICP system uses lube oil for hydraulic fluid to actuate the fuel injectors.
- The Fuel Supply System pressurizes fuel for transfer to the fuel injectors.
- The Lube Oil System provides lubrication and heat transfer to engine components.

### Air Management System (AMS)

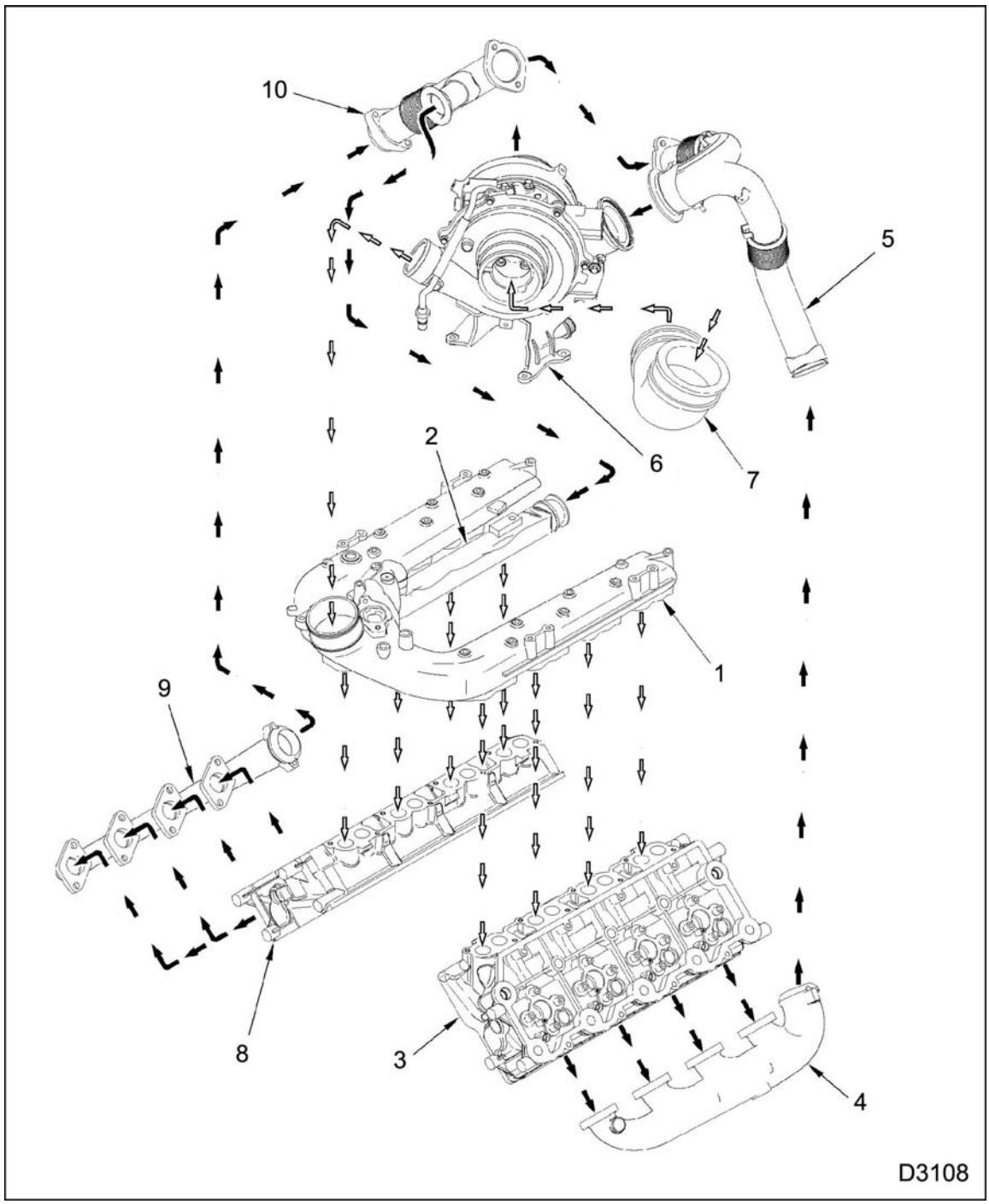



**Figure 11 Air management system**

1. Intake manifold
2. EGR cooler
3. Left cylinder head
4. Left exhaust manifold
5. Shielded tube exhaust assembly
6. Turbocharger assembly with mounting bracket
7. Air inlet duct
8. Right cylinder head
9. Right exhaust manifold
10. Exhaust tube assembly, right

**The Air Management system includes the following:**

- Air filter assembly
- Closed crankcase breather
- Chassis mounted Charged Air Cooler (CAC)
- Variable Geometry Turbocharger (VGT)
- Intake manifold
- Exhaust Gas Recirculation (EGR) system
- Exhaust system
- Catalytic converter– dependent on application
- Catalyzed Diesel Particulate Filter (CDPF) – dependent on application

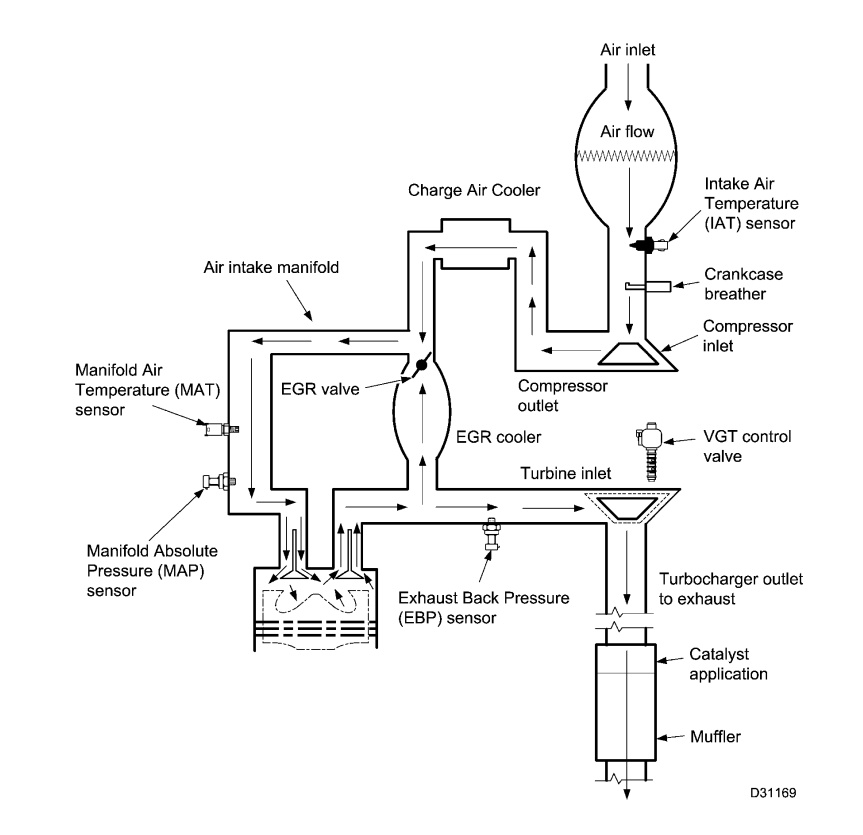



**Figure 12 Air flow diagram**

### Air Induction System

Ambient air is drawn into the air cleaner assembly and passes through a paper element filter. A filter minder monitors air filter restriction and is calibrated to warn when it needs servicing. As filtered air approaches the turbocharger, it passes over the pitot tube creating a vacuum and draws engine blow-by gases through a breather element located under the left side valve

cover. Air entering the turbocharger inlet is then pressurized and directed to the charge air cooler.

Air from the turbocharger is pushed through a network of heat exchanging tubes prior to entering the intake manifold. Outside air flowing over the tubes and fins serves to cool the charge air. The resulting cooler intake air is denser than heated air, allowing for an improved fuel/air ratio during combustion. This results in improved emission control and power output.

**Variable Geometry Turbocharger (VGT)**

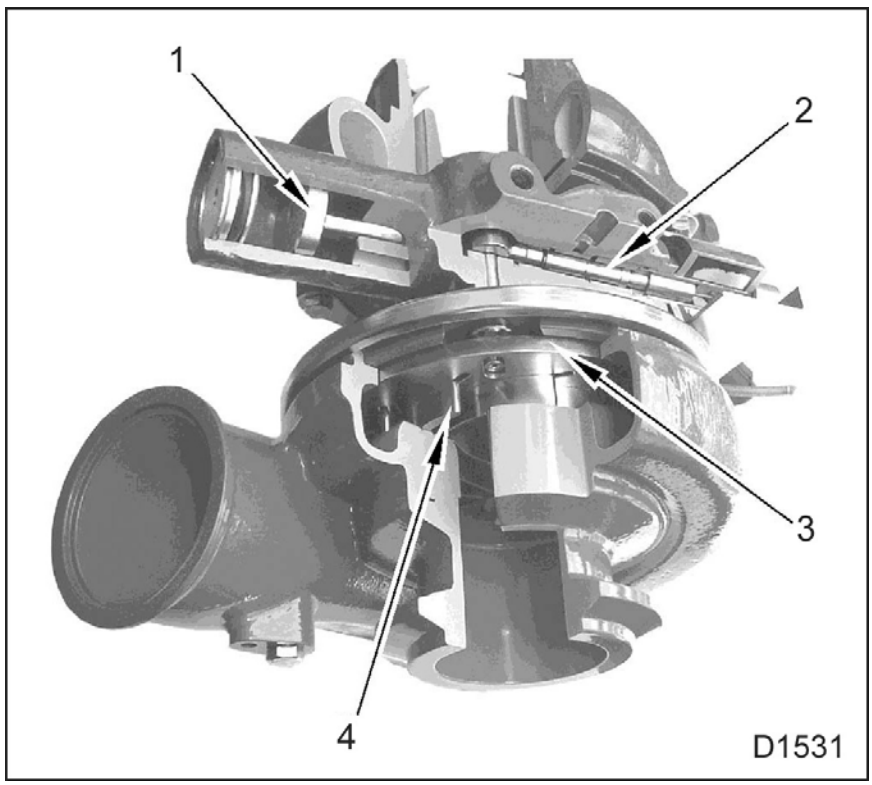



**Figure 13 VGT**

1. Actuator
2. Control valve
3. Unison ring
4. Vanes

The key feature of the Variable Geometry Turbocharger (VGT) is the introduction of adjustable vanes within the turbine housing to modify the flow characteristics of exhaust gases onto the turbine wheel. The net benefit is to provide optimized boost pressure to accommodate all engine speed and load conditions. An additional benefit is lower emissions. The VGT relies on electronic feedback loops provided by the Exhaust Back Pressure (EBP) sensor via the Electronic Control Module (ECM).

The turbocharger assembly contains a series of actuated vanes, a unison ring, and piston. The vanes regulate the flow of exhaust gases across the turbine. The only serviceable item on the turbocharger assembly is the control valve.

**Exhaust**

The exhaust system includes the following components:

- Exhaust valves
- Exhaust manifold
- Turbine side of the turbocharger
- Exhaust piping

Exhaust gas from combustion passes around two exhaust valves, through the exhaust manifold and is directed through pipes to the turbocharger exhaust inlet. As hot expanding exhaust gases flow into the turbocharger, they pass over the turbine wheel, causing it to spin in direct relation with the amount of exhaust gases being produced. The right side cylinders also provide a portion of their exhaust gases to supply the exhaust gas recirculation system.