Technical Service Information

TSI–05–12–30

Date: July 2005

Subject File: Engine

Subject: Diamond Logic® Exhaust Brake and Diamond Logic® Engine Brake

Engine Family: International® DT 466 Diesel Engines
SN Range: 2,000,000 and Up

Engine Family: International® DT 570 Diesel Engines
SN Range: 2,000,000 and Up

Engine Family: International® HT 570 Diesel Engines
SN Range: 2,000,000 and Up

Description

Exhaust and Engine Brake Concept

Both systems retard vehicle speed during deceleration or braking. During deceleration and braking, the vehicle wheels drive the engine and the engine acts as an energy absorber.

Both slow the vehicle to maintain constant speed on steep grades, avoiding prolonged use of service brakes that could cause brake fading.

Both systems increase brake lining life.

The Diamond Logic® Exhaust Brake

The Diamond Logic® Exhaust Brake uses the Variable Geometry Turbocharger (VGT) to restrict exhaust flow for additional braking.

The Diamond Logic® Engine Brake

The Diamond Logic® Engine Brake uses the high-pressure oil system for compression brake activation and the VGT for additional braking.

WARNING: To avoid personal injury or death, do not activate the exhaust brake or engine brake on slippery road surfaces; this can cause slipping wheels and loss of vehicle control, resulting in property damage.

NOTE: The exhaust brake or engine brake is not a substitute for vehicle service brakes; service brakes are primary for slowing and stopping the vehicle. The exhaust brake or engine brake can not bring the vehicle to a complete stop.

Operation of Diamond Logic® Exhaust Brake

The Diamond Logic® Exhaust Brake uses the VGT to increase exhaust braking. When the exhaust brake is activated, the Electronic Control Module (ECM) commands the VGT to close the vanes to increase exhaust back-pressure. Increased back-pressure increases the amount of vehicle inertia the engine absorbs, during exhaust braking.

Operator Controls

The operator controls the exhaust brake with an EXHAUST BRAKE ON/OFF toggle switch in the switch panel.

Operation Modes

The ECM is programmed to operate the exhaust brake in two modes: Coast Mode and Latched Mode

Coast Mode

In the coast mode the exhaust brake is inactive, allowing the vehicle to coast. When the operator applies the service brake, the exhaust brake activates.

Latched mode

In the latched mode the exhaust brake activates when the operator releases the accelerator pedal (APS < 5%). The exhaust brake deactivates, under the following conditions:

- The operator presses the accelerator pedal.
- The operator presses the clutch pedal.
- Engine speed drops below 1200 rpm.

Control of Diamond Logic® Exhaust Brake

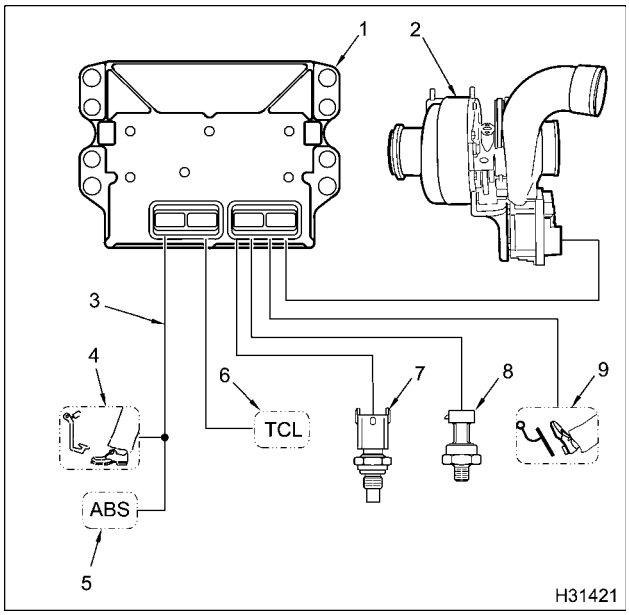

Figure 1 Exhaust brake

1. ECM
2. VGT
3. CAN1 line
4. Driveline Disengagement Switch (DDS)
5. Anti-lock Brake System (ABS)
6. Torque Converter Lockout
7. EOT sensor
8. EBP sensor
9. Accelerator Position Switch/Idle Validation Switch (APS/IVS)

The EXHAUST BRAKE ON/OFF switch transmits a signal through the Electronic System Controller (ESC) to the ECM. The ECM monitors the following for correct exhaust brake strategy and timing:

- APS/IVS
- EBP sensor
- Input from exhaust brake switch
- Engine rpm
- EOT sensor
- Torque Converter Lockup
- ABS
- DDS

During active mode, the ECM monitors the following criteria to make sure certain conditions are met:

- ABS (inactive)
- RPM (greater than 1200)
- APS (less than 5%)
- ABS/IVS (inactive faults)
- Oil temperature is above 60°C (140°F)
- Torque Converter Lockup (active)
- DDS (In gear)
- ENGINE BRAKE ON/OFF switch (Turned to ON)

Operation of Diamond Logic® Engine Brake

The Diamond Logic® Engine Brake combines VGT function with an Injection Control Pressure (ICP actuated compression brake system to increase engine braking, when the engine brake is activated.

- The ECM commands the brake shutoff valve to open, allowing high-pressure oil to enter the brake pressure gallery of the high-pressure oil rail, which in turn slightly opens the exhaust valves.
- The ECM commands the VGT to close the vanes to increase exhaust back-pressure and restrict exhaust flow.

Increased back-pressure increases the amount of vehicle inertia the engine will absorb, during engine braking.

To absorb energy, the Diamond Logic® Engine Brake uses the vehicle drive to bleed off compressed intake air from slightly open cylinder exhaust valves and VGT controlled back-pressure.

- Energy is absorbed during the compression stroke, when intake air is compressed and forced through a slightly open exhaust valve, providing compressed air flow to the VGT.
- Closing the VGT turbine vanes creates the restriction that increases back pressure to drive the VGT compressor wheel to create intake boost
- Because the exhaust valve was slightly open, “piston push back”, compression energy has been eliminated, which optimizes the amount of vehicle drive work energy available from friction and the compression cycle.

Operator Controls

The operator controls the engine brake with two switches on the instrument panel:

- When ENGINE BRAKE ON/OFF switch is turned to ON the engine brake activates and the indicator light turns on.
- This ENGINE BRAKE SELECTOR LO/MED/HI switch is used to select the amount of engine braking applied.

Operation Modes

The ECM is programmed to operate the engine brake in three modes:

- Coast Mode
- Latched mode
- Cruise Mode

Coast Mode

In the coast mode, the engine brake is inactive, allowing the vehicle to coast. When the operator applies the service brake, the engine brake activates.

Latched mode

In the latched mode, the engine brake activates when the operator releases the accelerator pedal (APS < 5%). The engine brake deactivates, responding to the following conditions:

- The operator presses the accelerator pedal.
- The operator presses the clutch pedal.
- Engine speed drops below 1200 rpm.

Cruise Mode

NOTE: Although MasterDiagnostics® shows a selection for Cruise Mode, the software has not been programmed for this function.

In the cruise mode, with cruise control OFF, the engine brake operates as the latched mode. If cruise control is ON, the ECM commands the cruise mode to control braking and vehicle speed on a down grade.

Control of Diamond Logic® Engine Brake

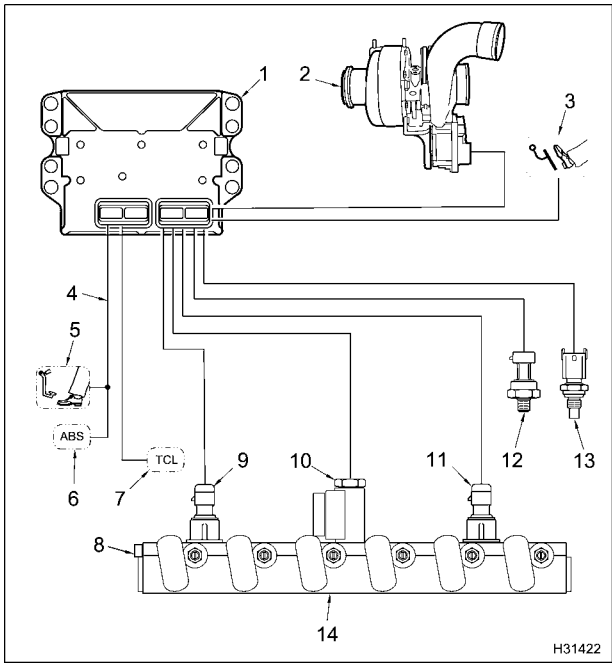

Figure 2 Engine brake

1. ECM
2. VGT
3. Accelerator Position Switch/Idle Validation Switch (APS/IVS)
4. CAN1 line
5. Driveline Disengagement Switch (DDS)
6. Anti-lock Brake System (ABS)
7. Torque Converter Lockup
8. Brake pressure relief valve
9. BCP sensor
10. Brake shutoff valve
11. ICP sensor
12. EBP sensor
13. EOT sensor
14. High-pressure oil rail

The ENGINE BRAKE ON/OFF switch and ENGINE BRAKE SELECTOR switch transmit signals through the Electronic System Controller (ESC) to the ECM. The ECM monitors the following for correct exhaust brake strategy and timing:

- APS/IVS
- EBP sensor
- Input from engine brake switches
- Engine rpm
- EOT sensor
- Torque Converter Lockup
- ABS
- DDS

High-pressure oil, from the injection control pressure system, operates brake actuator pistons, which force open the exhaust valves.

Control of Diamond Logic® Engine Brake in Inactive Mode

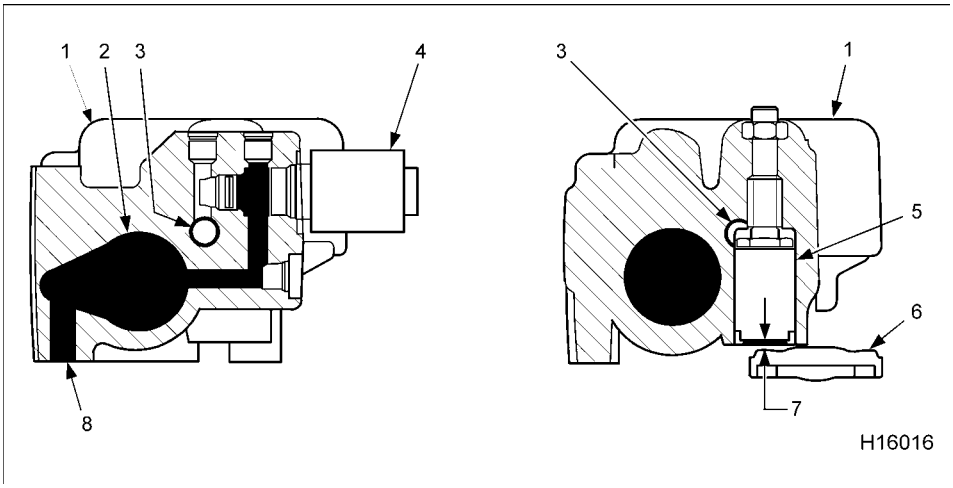

Figure 3 Brake shutoff valve and brake actuator – Inactive

1. High-pressure oil rail
2. Injector oil gallery
3. Brake oil gallery
4. Brake shutoff valve
5. Brake actuator piston
6. Exhaust valve bridge
7. Valve lash (actuator retracted)
8. Oil inlet

During inactive mode, oil in the high-pressure rail goes to the fuel injectors only. The brake shutoff valve, mounted in the high-pressure oil rail, is closed to prevent oil from entering the brake gallery.

Control of Diamond Logic® Engine Brake in Active Mode

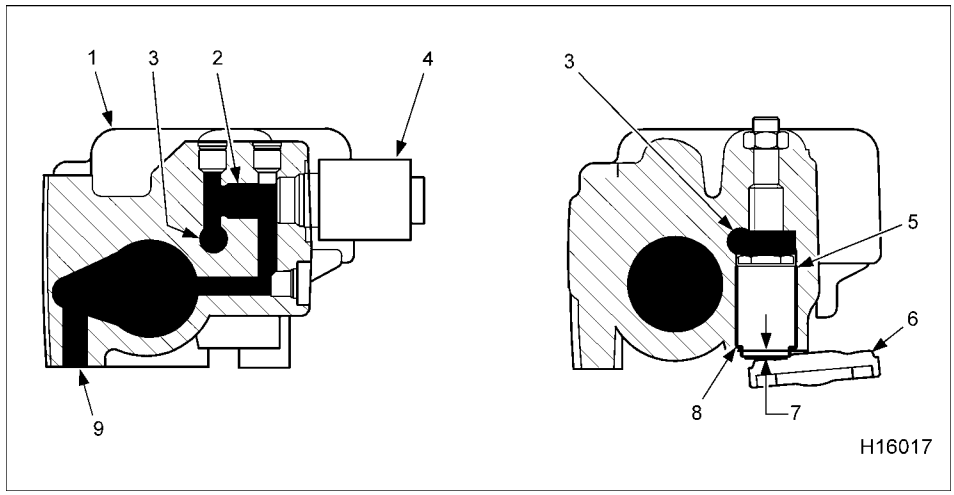

Figure 4 Brake shutoff valve and brake actuator – Active

1. High-pressure oil rail
2. High-pressure oil flow to brake oil gallery
3. Brake oil gallery
4. Brake shutoff valve
5. Brake actuator piston
6. Exhaust valve bridge
7. Valve lash (actuator deployed)
8. Oil outlet
9. Oil inlet

During active mode, the ECM monitors the following criteria to make sure certain conditions are met:

- ABS (inactive)
- RPM (greater than 1200)
- APS (less than 5%)
- ABS/IVS (inactive faults)
- Oil temperature is above 60°C (140°F)
- Torque Converter Lockup (active)
- DDS (In gear)
- ENGINE BRAKE ON/OFF switch (Turned to ON)
- ENGINE BRAKE SELECTOR switch (Turned to LO, MED, or HI)

When the engine brake is activated, the ECM provides the power to activate the brake shutoff valve to allow oil from the injector oil gallery to flow to the brake oil gallery. High pressure oil activates the brake actuator pistons to open the exhaust valves.

During an ABS event, the engine brake is deactivated. The engine brake is activated once the ABS event is over.

Control of Diamond Logic® Engine Brake in Active Mode (cont.)

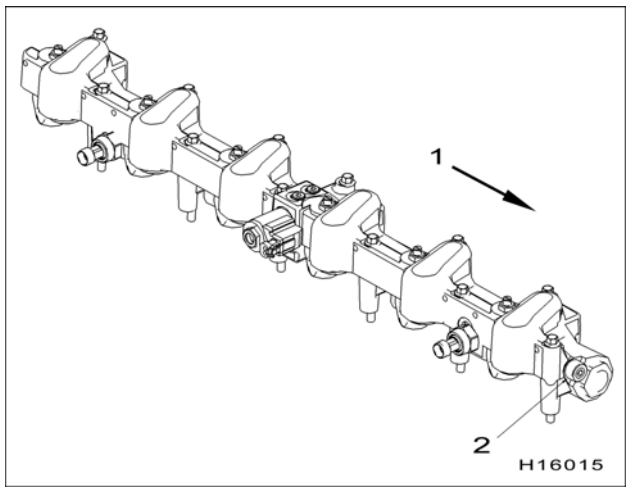

Figure 5 Brake pressure relief valve in high-pressure oil rail

1. Front of engine
2. Brake pressure relief valve

The ECM removes the power source from the brake shutoff valve to deactivate the engine brake. Residual brake gallery pressure initially bleeds from the actuator bore. When brake gallery pressure bleeds down to 6895 kPa (1000 psi), the brake pressure relief valve opens, and oil drains back to sump.

Automatic Transmission Operation

The control module for the Allison transmission commands shift schedules, when the exhaust or engine brake is activated.

- The Allison transmission control module is programmed with a 4th gear preselect. When the driver selects D or Drive, the engine will operate down to 4th gear (at or above the minimum oil temperature and 120 rpm).
- If the driver manually selects 3rd or 2nd the exhaust or engine brake will operate down to the manually selected gear (at or above the minimum oil temperature and 120 rpm).

WARNING: To avoid personal injury or death, do not select 3rd or 2nd gear, if conditions are slippery; this could cause loss of traction, during no load braking.

NOTE: Programming of 3rd or 2nd will not cause damage to the engine or transmission. The programmed gear is only for driver intent. The transmission will only downshift according to preprogrammed shift schedules.

The exhaust or engine brake will deactivate when the transmission shifts from lockup to normal converter operation.