October 2023 MDE

4. With reference to diesel engine crankcases:

(a) explain why crankcases may have relief valves fitted; (3)

(b) outline the circumstances which may cause the relief valves to operate; (5)

(c) state a safety detection system which may be fitted. (2)

Diesel Engine Crankcase Relief Valves

Here's a breakdown of the role of relief valves in diesel engine crankcases:

(a) Why relief valves are fitted:

Diesel engines operate with pistons moving up and down within the crankcase. This creates pressure inside the crankcase due to:

- **Blow-by gases:** Incomplete combustion allows some fuel and air mixture to slip past the piston rings into the crankcase.
- **Piston movement:** As pistons compress air for combustion, the pressure within the crankcase increases.

Relief valves are installed to prevent excessive pressure buildup within the crankcase. This pressure buildup can:

- **Damage the crankcase:** Excessive pressure can cause the crankcase to crack or rupture, leading to catastrophic engine failure.
- **Hinder lubrication:** High pressure can interfere with the proper flow of oil, leading to increased friction and wear on engine components.

(b) Circumstances causing relief valve operation:

Relief valves are designed to open and release pressure under specific conditions:

- **Piston ring failure:** Worn or broken piston rings allow excessive blow-by gases to enter the crankcase, causing a rapid pressure increase.
- **Fuel injector malfunction:** A faulty injector can deliver too much fuel, leading to incomplete combustion and increased blow-by.
- **Crankcase ventilation system blockage:** The ventilation system removes crankcase gases. A clogged system traps these gases, causing pressure buildup.

(c) Safety detection system:

Several safety detection systems can be fitted to monitor crankcase conditions and warn of potential problems before a relief valve needs to activate:

- **Crankcase pressure sensor:** Continuously monitors crankcase pressure and triggers an alarm if it exceeds a safe limit.

- **Oil level sensor:** Detects abnormally low oil levels, which can lead to increased friction and blow-by gases.
- **Engine temperature sensor:** High engine temperatures can worsen blow-by and pressure buildup.

By monitoring these factors, the system can alert operators to potential issues before a situation requiring the relief valve to activate arises. This allows for preventative maintenance and helps avoid serious engine damage.

May 2021

May 2021 MDE

4. With reference to diesel engine crankcases:

(a) explain why crankcases may have relief valves fitted; (3)

(b) outline the circumstances which may cause the relief valves to operate; (5)

(c) state a safety detection system which may be fitted. (2)

Absolutely! Let's delve into the world of diesel engine crankcase relief valves:

(a) Purpose of Crankcase Relief Valves:

Diesel engines have crankcases that house moving pistons. This movement generates pressure inside due to:

- **Blow-by gases:** Incomplete combustion allows some unburnt fuel and air to leak past the piston rings into the crankcase.
- **Piston compression:** As pistons compress air for combustion, the pressure within the crankcase rises.

To prevent excessive pressure buildup, crankcases are equipped with relief valves. Uncontrolled pressure can:

- **Damage the Crankcase:** High pressure can cause cracks or ruptures, leading to severe engine failure.
- **Hinder Lubrication:** Excessive pressure can disrupt the proper oil flow, increasing friction and wear on engine components.

(b) Circumstances Triggering Relief Valve Operation:

Relief valves are designed to open and release pressure under specific situations:

- **Piston Ring Failure:** Worn or broken piston rings allow excessive blow-by gases to enter the crankcase, causing a rapid pressure increase.
- **Fuel Injector Malfunction:** A faulty injector can deliver too much fuel, leading to incomplete combustion and increased blow-by.
- **Crankcase Ventilation Blockage:** The ventilation system removes crankcase gases. A clogged system traps these gases, causing pressure buildup.

(c) Safety Detection System Example:

Several safety detection systems can be employed to monitor crankcase conditions and warn of potential problems before a relief valve needs to activate:

- **Crankcase Pressure Sensor:** This sensor continuously monitors crankcase pressure. If it exceeds a safe limit, an alarm will be triggered.
- **Oil Level Sensor:** This sensor detects abnormally low oil levels, which can lead to increased friction and blow-by gases.
- **Engine Temperature Sensor:** High engine temperatures can worsen blow-by and pressure buildup.

By monitoring these factors, the system can alert operators to potential issues before the relief valve needs to intervene. This allows for preventative maintenance and helps avoid serious engine damage.

February 2022

February 2022

4. (a) Outline the actions which must be taken, by the on-watch engineer when the engine crankcase oil mist detector activates. (5)

   (b) Sketch a crankcase explosion relief door, labelling the MAIN components. (5)

Diesel Engine Crankcase Emergencies

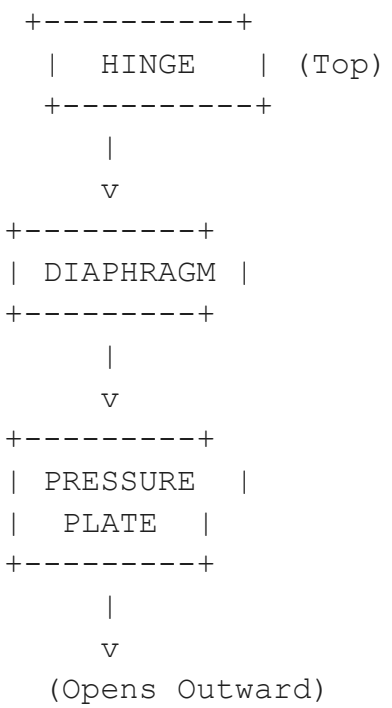
(a) Actions Upon Crankcase Oil Mist Detector Activation:

When a diesel engine's crankcase oil mist detector activates, the on-watch engineer should follow a specific protocol to ensure safety and minimize engine damage. Here's a breakdown of the recommended actions:

1. **Immediate Shutdown:** Safely reduce engine load and stop the engine as soon as possible. This removes the ignition source and prevents further oil mist generation.
2. **Identify the Cause:** Investigate the reason behind the oil mist detector activation. This may involve checking for:
   - **Piston ring wear or damage**
   - **Fuel injector malfunction**
   - **Crankcase ventilation system blockage**
   - **Other potential issues causing excessive blow-by gases**
3. **Isolate the Engine:** Close any valves or dampers isolating the affected engine from other systems to prevent the spread of oil mist.
4. **Alert Others:** Inform relevant personnel about the situation, especially maintenance or supervisory staff.
5. **Do Not Restart:** Refrain from restarting the engine until the cause of the oil mist is identified and rectified. Running the engine with excessive blow-by can lead to a crankcase explosion.

(b) Sketch of a Crankcase Explosion Relief Door:

Here's a basic sketch of a crankcase explosion relief door with labeled components:



Main Components:

- **Hinge:** Allows the door to rotate outward upon pressure buildup.
- **Diaphragm:** A flexible membrane that acts as a pressure sensor.
- **Pressure Plate:** A plate attached to the diaphragm that is exposed to crankcase pressure.
- **Relief Opening:** The opening in the crankcase wall that allows pressure to escape when the door opens.

Functionality:

Under normal engine operation, the diaphragm and pressure plate remain in place. However, when excessive pressure builds up in the crankcase, the force pushes against the diaphragm, causing the door to hinge outward and release the pressure through the relief opening. This helps prevent catastrophic crankcase explosions.

Feb 2021

February 2021 MDE

4. (a) Outline the actions which must be taken, by the on-watch engineer when the engine crankcase oil mist detector activates. (5)

(b) Sketch a crankcase explosion relief door, labelling the MAIN components. (5)

This text covers actions to take upon crankcase oil mist detector activation and the components of a crankcase explosion relief door.

Crankcase Oil Mist Detector Activation:

- **Immediate Shutdown:** Safely reduce engine load and stop the engine as soon as possible. This removes the ignition source and prevents further oil mist generation.

- **Investigate the Cause:** Identify the reason behind the alarm. This may involve checking for:
    - Worn or damaged piston rings
    - Malfunctioning fuel injector
    - Blocked crankcase ventilation system
    - Other issues causing excessive blow-by gases
- **Isolate the Engine:** Close any valves or dampers isolating the affected engine from other systems to prevent the spread of oil mist.
- **Alert Others:** Inform relevant personnel about the situation, especially maintenance or supervisory staff.
- **Do Not Restart:** Refrain from restarting the engine until the cause of the oil mist is identified and rectified. Running the engine with excessive blow-by can lead to a crankcase explosion.

Crankcase Explosion Relief Door Components:

- **Hinge:** Allows the door to rotate outward upon pressure buildup.
- **Diaphragm:** A flexible membrane that acts as a pressure sensor.
- **Pressure Plate:** A plate attached to the diaphragm that is exposed to crankcase pressure.
- **Relief Opening:** The opening in the crankcase wall that allows pressure to escape when the door opens.

Functionality:

Under normal operation, the diaphragm and pressure plate remain in place. When excessive pressure builds up, the force pushes against the diaphragm, causing the door to hinge outward and release the pressure through the relief opening. This helps prevent catastrophic crankcase explosions.

Oct 2018

October 2018 MDE

4. The daily engine log shows the engine crankcase pressure gauge is indicating a much higher value than the normal reading.

    (a) State the implications of this and the immediate actions that should be taken. (2)

    (b) Outline the checks and investigations that should be undertaken to ascertain the cause of this increased crankcase pressure. (8)

High Crankcase Pressure in Diesel Engine

A much higher than normal reading on the engine crankcase pressure gauge indicates a potential problem that needs immediate attention. Here's a breakdown of the implications, actions to take, and potential causes:

(a) Implications and Immediate Actions:

- **Increased Blow-by Gases:** High pressure suggests excessive blow-by gases (unburnt fuel and air) are leaking past the piston rings into the crankcase. This can lead to:

- **Reduced Engine Power:** Excessive blow-by reduces the pressure available for combustion, impacting engine performance.
- **Oil Dilution:** Blow-by gases can contaminate the engine oil, reducing its lubricating properties.
- **Fire Hazard:** Oil mist from the crankcase can create a fire hazard near hot engine components.

Immediate Actions:

1. **Reduce Engine Load:** Gradually decrease engine load and prepare for a safe shutdown.
2. **Investigate the Cause:** Do not ignore the issue. Identify the reason behind the high pressure.
3. **Alert Personnel:** Inform relevant personnel, especially maintenance or supervisory staff, about the situation.
4. **Do Not Restart:** Avoid restarting the engine until the cause is identified and addressed. Running the engine with high crankcase pressure can lead to serious damage.

(b) Checks and Investigations:

To determine the cause of the increased pressure, conduct the following checks and investigations:

- **Piston Rings:** Check for worn, damaged, or broken piston rings, which can allow excessive blow-by.
- **Cylinder Liners:** Inspect cylinder liners for scoring or wear, which can contribute to blow-by.
- **Valve Train:** Examine valve clearances and for any signs of sticking valves, as improper sealing can lead to blow-by.
- **Fuel Injectors:** Investigate the condition of fuel injectors. A faulty injector can deliver too much fuel, resulting in incomplete combustion and increased blow-by.
- **Crankcase Ventilation System:** Ensure the crankcase ventilation system is not clogged, as a blocked system traps blow-by gases.
- **Oil Level and Condition:** Check the oil level and condition. Low oil level can increase blow-by, and contaminated oil may not properly lubricate piston rings.

By systematically examining these potential causes, you can identify the source of the high crankcase pressure and take corrective actions to ensure safe and efficient engine operation.