Jan 2023

JAN 2023 MDE

8. Describe the possible causes and remedies for EACH of the following diesel engine faults:

(a) low lubricating oil pressure; (3)

(b) overheating; (3)

(c) unstable speed. (4)

Diesel Engine Faults: Causes and Remedies

Here's a breakdown of possible causes and remedies for the common diesel engine faults you mentioned:

(a) Low Lubricating Oil Pressure:

Causes:

- **Low Oil Level:** Insufficient oil in the crankcase reduces pressure.
- **Worn Oil Pump:** A worn pump may not generate enough pressure.
- **Clogged Oil Filter:** A blocked filter restricts oil flow and reduces pressure.
- **Bearing Wear:** Worn bearings can allow oil to bypass, lowering pressure.
- **Oil Leak:** Leaks from the engine can cause oil loss and pressure drop.

Remedies:

- **Check and Top Up Oil:** Verify oil level and add recommended oil if needed.
- **Inspect and Replace Oil Pump:** If worn, replace the oil pump to restore pressure.
- **Change Oil Filter:** Replace the oil filter with a new one to ensure proper flow.
- **Engine Rebuild/Replacement:** In severe cases, worn bearings may require engine rebuild or replacement.
- **Identify and Fix Oil Leak:** Locate the leak source and repair it to stop oil loss and maintain pressure.

(b) Overheating:

Causes:

- **Low Coolant Level:** Insufficient coolant reduces heat transfer capacity.
- **Faulty Thermostat:** A stuck-closed thermostat prevents coolant from reaching the radiator for proper cooling.
- **Clogged Radiator:** Blockages in the radiator core hinder airflow and coolant circulation.
- **Faulty Fan:** A malfunctioning cooling fan or clutch can reduce airflow over the radiator.
- **Defective Water Pump:** A failing water pump cannot circulate coolant effectively.
- **Excessive Engine Load:** Operating the engine under heavy load for extended periods can lead to overheating.

Remedies:

- **Check and Top Up Coolant:** Verify coolant level and add the recommended coolant if needed.
- **Test and Replace Thermostat:** Check thermostat operation and replace it if stuck closed.
- **Clean or Replace Radiator:** Clear any blockages from the radiator core for optimal airflow.
- **Repair or Replace Cooling Fan/Clutch:** Ensure the fan operates properly and replace if faulty.
- **Inspect and Replace Water Pump:** Check the water pump for leaks or failure and replace if necessary.
- **Reduce Engine Load:** If possible, reduce engine load or operation time under heavy loads to allow for proper cooling.

(c) Unstable Engine Speed:

Causes:

- **Fuel Injection Issues:** Faulty injectors, clogged fuel lines, or a dirty fuel filter can disrupt fuel delivery, causing uneven combustion and unstable engine speed.
- **Air Intake System Problems:** Leaks in the air intake system can introduce unmetered air, affecting the air-fuel mixture and causing unstable engine speed.
- **Governor Malfunction:** A faulty governor, which regulates engine speed, can lead to erratic engine RPM.
- **Turbocharger Problems:** Issues with the turbocharger, such as a sticking wastegate or boost leaks, can affect air intake and lead to unstable speed.
- **Internal Engine Wear:** Worn piston rings, valves, or valve guides can affect compression and contribute to unstable engine speed.

Remedies:

- **Inspect and Service Fuel System:** Check injectors, clean fuel lines, and replace the fuel filter to ensure proper fuel delivery.
- **Identify and Repair Air Intake Leaks:** Locate and seal any leaks in the air intake system to maintain a proper air-fuel mixture.
- **Test and Repair/Replace Governor:** Test the governor operation and consider replacing it if faulty.
- **Diagnose and Fix Turbocharger Issues:** Depending on the problem, repair or replace the turbocharger or its components.
- **Engine Rebuild or Replacement:** In severe cases of internal wear, an engine rebuild or replacement might be necessary.

Remember: These are general causes and remedies. Always consult your engine's specific manual and seek professional help if needed for diagnosis and repairs.

Oct 2023

October 2023 MDE

8. With reference to diesel engine high bearing temperatures:

(a) describe the possible causes; (5)

(b) explain the procedure to be adopted if detected. (5)

Diesel Engine High Bearing Temperatures: Causes and Procedures

High bearing temperatures in a diesel engine can be a serious issue and should be addressed promptly. Here's a breakdown of the possible causes and the recommended procedure upon detection:

(a) Possible Causes of High Bearing Temperatures:

- **Insufficient Lubrication:**
  - **Low Oil Level:** Insufficient oil in the crankcase reduces oil's ability to absorb heat and lubricate bearings effectively.
  - **Worn Oil Pump:** A worn pump may not deliver enough oil pressure to reach all bearings properly.
  - **Clogged Oil Filter:** A blocked filter restricts oil flow, leading to inadequate lubrication and increased bearing temperatures.
- **Bearing Wear:** Worn bearings can increase friction and reduce oil clearance, leading to higher bearing temperatures.
- **Excessive Engine Load:** Operating the engine under heavy load for extended periods can generate excessive heat, straining the lubrication system and raising bearing temperatures.
- **Coolant System Issues:** Overheating, due to a malfunctioning cooling system, can indirectly increase bearing temperatures as overall engine heat rises.
- **Contaminated Oil:** Dirty oil with debris or excessive air bubbles can hinder heat transfer and lubrication, leading to higher bearing temperatures.

(b) Procedure Upon Detection of High Bearing Temperatures:

1. **Immediate Shutdown:** Safely reduce engine load and stop the engine as soon as possible. Continued operation with high bearing temperatures can lead to bearing failure and catastrophic engine damage.
2. **Identify the Cause:** Investigate the reason behind the high temperature. Check oil level, oil pressure, and coolant system functionality. Look for signs of bearing wear or oil leaks.
3. **Monitor Engine Temperature:** Continuously monitor engine temperature even after shutdown as hot components can cool down slowly.
4. **Do Not Restart:** Avoid restarting the engine until the cause of the high temperature is identified and addressed.
5. **Consult a Mechanic:** Depending on the severity of the issue, professional help from a qualified mechanic is highly recommended. They can diagnose the problem, perform necessary repairs (such as replacing worn bearings or oil pump), and ensure safe engine operation.

Additional Tips:

- Maintain a regular oil change schedule with the recommended oil grade for your engine.
- Monitor engine gauges regularly, paying attention to oil pressure and temperature readings.
- Address any minor oil leaks promptly to prevent oil loss and potential lubrication issues.
- Avoid overloading the engine for extended periods.

By following these steps and taking preventative measures, you can help minimize the risk of high bearing temperatures and ensure the longevity of your diesel engine.

April 2022 MDE

April 2022 MDE

8. Describe possible reasons for variations in the oil level of a main engine sump. (10)

The oil level in a main engine sump can fluctuate for several reasons. Here are some possible explanations for variations:

Consumption:

- **Oil Burn:** A small amount of oil is naturally burned during combustion in diesel engines. This is a normal process, but excessive oil burning can indicate worn piston rings or valve guides, allowing oil to enter the combustion chamber.

Leaks:

- **External Leaks:** Leaks from the engine block, crankcase, oil filter, or other components can cause oil loss and a decrease in the sump level.
- **Internal Leaks:** Worn piston rings or cylinder liners can allow oil to seep into the combustion chamber, burning with the fuel and not returning to the sump.

Changes in Volume:

- **Temperature Fluctuations:** Engine oil expands as it heats up and contracts as it cools down. Checking the oil level when the engine is cold will result in a lower reading compared to a hot engine. Always refer to the manufacturer's instructions for the appropriate oil level check (hot or cold).
- **Fuel Dilution:** Unburnt fuel, especially during cold starts or incomplete combustion, can mix with the engine oil, causing the oil level to appear higher than it actually is. This diluted oil loses its lubricating properties and needs to be addressed.

Maintenance Practices:

- **Oil Top-up:** Adding oil to maintain the proper level can cause fluctuations, especially if not done consistently or with the recommended oil grade.
- **Oil Change:** During an oil change, some residual oil remains in the engine, even after draining. The new oil added will then show a higher level compared to the pre-change level.

Additional Factors:

- **Engine Tilt:** If the engine is not level when checking the oil, the dipstick reading might be inaccurate. Ensure the engine is on level ground for a proper reading.

By understanding these potential causes, you can effectively monitor oil levels, identify potential problems early on, and maintain a healthy lubrication system for your engine. Remember to consult your engine's manual for specific oil recommendations, check procedures, and proper oil level interpretation based on engine temperature.

October 2022 MDE

October 2022 MDE

8. With reference to leaking cylinder air start valves:

   (a) describe how this may be detected whilst the engine is running; (2)

   (b) describe the procedure on discovery; (4)

   (c) list FOUR possible causes. (4)

Leaking cylinder air start valves can be a serious issue in diesel engines. Here's how to detect, handle, and understand the potential causes of such leaks:

(a) Detection While Engine is Running:

Several signs can indicate a leaking cylinder air start valve while the engine is running:

- **Overheating of the air start line:** The compressed air escaping from the leaking valve can cause the air line near the affected cylinder to become noticeably hotter than other lines.
- **Uneven engine speed or vibrations:** Leaking air can disrupt the combustion process in that cylinder, leading to uneven firing and potentially causing vibrations.
- **Unusual air consumption:** A constant demand for compressed air to compensate for the leaking air can lead to increased air compressor activity.
- **Loss of air pressure:** If the leak is significant, the overall air start system pressure might drop noticeably.

(b) Procedure Upon Discovery:

1. **Reduce Engine Load:** Gradually decrease engine load to minimize combustion pressure and further air loss.
2. **Identify the Leaking Cylinder:** Using a temperature probe or careful observation, identify the cylinder with the overheating air line, indicating the location of the leaking valve.
3. **Isolate the Cylinder (if possible):** Some engines allow isolating the faulty cylinder by deactivating its fuel injector. This can help stabilize engine operation and minimize air loss.
4. **Prepare for Shutdown:** If isolating the cylinder isn't possible, prepare for a safe engine shutdown as soon as possible.
5. **Alert Personnel:** Inform relevant personnel, especially maintenance staff, about the situation.
6. **Do Not Restart:** Avoid restarting the engine until the leaking valve is repaired or replaced.

(c) Four Possible Causes of Leaking Cylinder Air Start Valves:

1. **Worn Valve Seat or Disc:** Over time, the valve seat and disc can wear due to constant use, allowing compressed air to leak past.
2. **Debris or Foreign Material:** Dirt or debris lodged between the valve seat and disc can prevent a proper seal, causing air leakage.
3. **Broken Valve Spring:** A broken spring can prevent the valve from closing completely, allowing air to leak through.
4. **Improper Valve Clearance:** Incorrect valve clearance due to wear or improper adjustment can disrupt the sealing mechanism and lead to air leaks.

By understanding the detection methods, procedures, and potential causes of leaking cylinder air start valves, you can ensure timely identification and prevent further engine damage. It's crucial to address this issue promptly and seek professional help from a qualified mechanic for repairs or replacements to maintain safe and efficient engine operation.

February 2021 MDE

February 2021 MDE

8. Describe the possible causes of abnormal diesel engine noises during operation. (10)

Diesel engines typically produce a consistent and rhythmic sound during operation. However, abnormal noises can arise due to various issues. Here's a breakdown of some possible causes of these abnormal noises:

Mechanical Issues:

- **Worn or damaged components:**
  - **Piston rings:** Worn or broken piston rings allow combustion gases to leak past the piston into the crankcase, creating a knocking sound.
  - **Bearings:** Worn crankshaft or connecting rod bearings can cause a knocking sound due to increased clearance and metal-to-metal contact.
  - **Valvetrain components:** Worn camshaft lobes, tappets, or rocker arms can generate clattering or ticking noises due to excessive clearance during valve operation.
  - **Fuel injectors:** Faulty injectors can cause a knocking or rattling sound due to malfunctioning components or improper fuel delivery.
- **Improper clearances:** Incorrect valve clearances, injector lash, or bearing clearances can lead to knocking or clattering noises as components move with excessive play.
- **Loose parts:** Bolts, nuts, or other components that become loose within the engine can vibrate and create rattling or clanging noises.

Combustion Issues:

- **Incomplete combustion:** Improper air-fuel mixture or faulty injectors can cause incomplete combustion, leading to a knocking sound or rough engine running.
- **Detonation (knocking):** This occurs when the air-fuel mixture ignites prematurely due to high temperatures or pressure, creating a sharp knocking sound.
- **Pre-ignition:** Similar to detonation, pre-ignition involves the mixture igniting before the spark plug fires, causing a characteristic knocking sound.

Air Intake System Issues:

- **Air leaks:** Unmetered air entering the engine through leaks in the intake system can disrupt the air-fuel mixture and cause a hissing or whistling sound.
- **Turbocharger problems:** Issues with the turbocharger, such as a failing wastegate or worn bearings, can generate abnormal noises like whining or scraping.

Additional Factors:

- **Low lubricating oil:** Insufficient oil pressure can lead to increased friction and metal-to-metal contact, causing knocking or grinding noises.
- **Coolant system problems:** Overheating can cause engine components to expand and distort, potentially leading to abnormal noises.

By understanding these potential causes, you can be more aware of abnormal engine noises and take appropriate actions. It's crucial to consult a qualified mechanic for proper diagnosis and repairs to ensure the longevity and smooth operation of your diesel engine. Remember, early detection and addressing abnormal noises can prevent minor problems from escalating into major engine failures.

May 2021 MDE

May 2021 MDE

8. With reference to abnormal turbocharger vibration:

(a) explain the possible causes whilst operating at a steady speed; (5)

(b) describe how the causes explained in part (a) may be minimised. (5)

Abnormal Turbocharger Vibration at Steady Speed

Even at a steady engine speed, a turbocharger can experience abnormal vibrations. Here's a breakdown of some possible causes and ways to minimize them:

(a) Possible Causes:

- **Unbalanced Rotor Assembly:** Components within the turbocharger, such as the compressor or turbine wheel, can become unbalanced due to:
  - **Dirt or foreign object contamination:** Accumulation of debris on the blades can disrupt their weight distribution.
  - **Damaged turbine blades or compressor blades:** Bent or broken blades can cause an imbalance.
- **Misalignment:** Misalignment between the turbine housing and the compressor housing can cause the shaft to vibrate excessively. This can occur due to:
  - **Improper installation:** Mistakes during turbocharger replacement can lead to misalignment.
  - **Engine mounts wear:** Worn or damaged engine mounts can allow the engine to move, potentially misaligning the turbocharger.
- **Worn Machine Parts:** Over time, wear on critical components can contribute to vibrations:

    - **Shaft bearing wear:** Worn bearings allow the shaft to move excessively within the housing, causing imbalance and vibration.
    - **Impeller or diffuser wear:** Erosion or damage to these components can affect airflow and contribute to vibration.
- **Improperly Driven Machine Components:** Issues with components driving the turbocharger can lead to vibrations:
    - **Exhaust gas leaks:** Leaks in the exhaust system before the turbine can affect exhaust flow and create imbalanced forces.
    - **Seized variable geometry mechanism (VGT):** If applicable, a stuck VGT vane can disrupt proper airflow and induce vibration.

(b) Minimizing the Causes:

- **Regular Maintenance:**
    - Scheduled cleaning of the air intake filter can prevent debris from entering the turbocharger.
    - Visual inspections of the turbocharger for damage or leaks during routine maintenance.
- **Proper Installation:** Ensure the turbocharger is installed following the manufacturer's instructions to avoid misalignment.
- **Replacing Worn Parts:** Regularly replace worn components like air filters and engine mounts to minimize wear on the turbocharger.
- **Maintaining Proper Lubrication:** Use the recommended engine oil and maintain a healthy oil level to ensure proper lubrication of the turbocharger shaft bearings.
- **Quality Components:** When replacing parts, use high-quality components to ensure proper fit and balance.
- **Avoiding Overheating:** Excessive engine temperatures can stress the turbocharger. Avoid sustained high loads and ensure proper engine cooling.
- **Following Manufacturer's Guidelines:** Refer to the engine or turbocharger manufacturer's recommendations for specific maintenance practices and operating limits.

By implementing these preventative measures, you can minimize the risk of abnormal turbocharger vibration and ensure the smooth operation and longevity of your engine. If you experience persistent abnormal vibrations, consult a qualified mechanic for proper diagnosis and repairs.

February 2020 MDE

February 2020 MDE

8. Describe possible reasons for variations in the oil level of a main engine sump. (10)

There are several reasons why the oil level in a main engine sump might fluctuate. Here's a breakdown of some possible explanations:

Consumption:

- **Oil Burn:** A small amount of oil is naturally burned during combustion in diesel engines. This is a normal process, but excessive oil burning can indicate worn piston rings or valve guides, allowing oil to enter the combustion chamber and be burned.

Leaks:

- **External Leaks:** Leaks from the engine block, crankcase, oil filter, or other components can cause oil loss and a decrease in the sump level. These leaks can be visually identified or detected by noticing drips or stains.
- **Internal Leaks:** Worn piston rings or cylinder liners can allow oil to seep into the combustion chamber, burning with the fuel and not returning to the sump. This can be difficult to diagnose directly but might be indicated by blue smoke from the exhaust.

Changes in Volume:

- **Temperature Fluctuations:** Engine oil expands as it heats up and contracts as it cools down. Checking the oil level when the engine is cold will result in a lower reading compared to a hot engine. Always refer to the manufacturer's instructions for the appropriate oil level check (hot or cold).
- **Fuel Dilution:** Unburnt fuel, especially during cold starts or incomplete combustion, can mix with the engine oil, causing the oil level to appear higher than it actually is. This diluted oil loses its lubricating properties and needs to be addressed through an oil change.

Maintenance Practices:

- **Oil Top-up:** Adding oil to maintain the proper level can cause fluctuations, especially if not done consistently or with the recommended oil grade. Using the wrong oil viscosity can affect its flow and potentially lead to inaccurate level readings.
- **Oil Change:** During an oil change, some residual oil remains in the engine, even after draining. The new oil added will then show a higher level compared to the pre-change level.

Additional Factors:

- **Engine Tilt:** If the engine is not level when checking the oil, the dipstick reading might be inaccurate. Ensure the engine is on level ground for a proper reading.

By understanding these potential causes, you can effectively monitor oil levels, identify potential problems early on, and maintain a healthy lubrication system for your engine. Remember to consult your engine's manual for specific oil recommendations, check procedures, and proper oil level interpretation based on engine temperature.

October 2020 MDE

October 2020 MDE

8. (a) Describe the procedure for renewing a bottom end bearing of a diesel engine. (8)

   (b) Describe the precautions necessary on initial startup of the engine. (2)

Renewing a Bottom End Bearing in a Diesel Engine (a):

Renewing a bottom end bearing, which includes the main bearings and crankpin bearings, is a complex and critical procedure on a diesel engine. It's recommended to be performed by a qualified mechanic due to the specialized tools and knowledge required. However, here's a general overview of the process:

1. **Engine Preparation:**
   - Drain engine oil and coolant.
   - Disconnect and remove all necessary components like exhaust manifolds, starter motor, and flywheel.
   - Secure the engine on a suitable stand for safe access to the bottom end.
2. **Crankshaft Removal:**
   - Disconnect the connecting rods from the crankshaft (may involve removing connecting rod bolts or capscrews).
   - Support the crankshaft with a lifting tool and carefully remove it from the engine block.
3. **Bearing Replacement:**
   - Thoroughly clean the bearing surfaces on the crankshaft journal (the smooth round part where the bearing sits) and the bearing housing in the engine block.
   - Remove the old main and crankpin bearings (may involve using specialized tools like bearing scrapers or pullers).
   - Inspect the crankshaft journals and bearing housings for any wear, cracks, or damage. If excessive wear is found, further repairs or crankshaft replacement might be necessary.
   - Install new bearings of the appropriate size and type (consult engine manual for specifications). Some bearings might require slight fitting or adjustments.
4. **Crankshaft Reinstallation:**
   - Carefully place the crankshaft back into the engine block, ensuring proper alignment.
   - Reattach connecting rods to the crankshaft with new connecting rod bolts (following proper tightening sequence and torque specifications).
5. **Assembly and Reinstallation:**
   - Reinstall all previously removed components like flywheel, starter motor, and exhaust manifolds.
   - Replace engine oil filter and refill the engine with fresh, recommended oil.
   - Refill the coolant system and bleed any trapped air.
6. **Post-Repair Checks:**
   - Perform a thorough visual inspection for any leaks or loose connections.
   - Manually rotate the crankshaft to ensure smooth operation and proper bearing clearances (consult manual for specifications).

(b) Precautions on Initial Startup:

- **Double-Check Everything:** Before starting the engine, meticulously re-check all connections, bolts, and fluid levels to ensure everything is secure and properly filled.
- **Prime the Oil System:** Manually crank the engine (with spark plugs or injectors disabled) to allow the oil pump to circulate oil and prime the lubrication system.
- **Initial Start-up:** Start the engine for a short period and monitor for any abnormal noises, leaks, or vibrations.
- **Oil Pressure Check:** Verify proper engine oil pressure according to the manufacturer's specifications.
- **Gradual Break-in:** After initial checks, follow a break-in procedure as recommended by the engine manufacturer. This might involve running the engine at varied loads for a specific period to allow the new bearings to properly seat.

Important Note:

This is a simplified overview, and the specific procedure can vary depending on the engine model and manufacturer. Always refer to the engine's official service manual for detailed instructions, torque specifications, and safety precautions. It's crucial to have the proper tools, knowledge, and experience for such a critical task.

October 2021 MDE

October 2021 MDE

8. (a) Describe the inspection of a cylinder liner and piston assembly, when the piston has been removed from the engine. (6)

(b) State possible faults which may be found. (4)

Here's a breakdown of the inspection process for a cylinder liner and piston assembly once the piston has been removed from the engine:

Cleaning:

1. **Initial Cleaning:** Before inspection, thoroughly clean the liner and piston with a suitable solvent to remove any dirt, carbon deposits, or oil residue. This allows for a clear visual inspection of the surfaces.

Liner Inspection:

2. **Visual Inspection:**
   - Look for any cracks, scoring, pitting, or signs of excessive wear on the cylinder liner wall.
   - Check the liner surface for signs of corrosion or erosion.
   - Inspect the liner sealing surfaces for any damage or distortion.
3. **Measurements:**
   - Using a micrometer or bore gauge, measure the liner diameter at various points (top, middle, bottom) to check for ovality or taper.
   - Consult the engine manual for the specified liner diameter and allowable wear limits.

Piston Inspection:

4. **Crown Inspection:**
   - Visually inspect the piston crown for cracks, signs of overheating, or excessive wear.
   - Check the piston ring grooves for wear and ensure they are not excessively wide or damaged.
5. **Ring Gap Inspection:**
   - Using a feeler gauge, measure the gap between each piston ring and its groove.
   - Compare the measured gaps to the manufacturer's specifications to identify excessive wear or improper ring fit.
6. **Piston Skirt Inspection:**
   - Inspect the piston skirt for scoring, scuffing, or signs of excessive wear.
   - Check for signs of piston slap (looseness) by carefully measuring the piston skirt diameter and comparing it to the liner diameter.

Additional Checks:

7. **Piston Ring Condition:**
    - Inspect the piston rings themselves for wear, cracks, or breaks.
    - Ensure the ring ends have proper side clearance within the ring grooves.
8. **Piston Pin and Bushings:**
    - Check the piston pin and connecting rod bushing for excessive wear or damage.

Documentation:

- Record all inspection findings, including measurements and observations, for further analysis and potential replacement decisions.

(b) Possible Faults:

The inspection can reveal various faults in the cylinder liner and piston assembly:

Liner Faults:

- **Cracks:** Cracks in the liner can compromise engine block integrity and require immediate replacement.
- **Scoring or Wear:** Excessive wear on the liner wall can reduce compression and lead to oil blow-by. Depending on the severity, the liner might require honing or replacement.
- **Corrosion or Erosion:** Corrosion or erosion can damage the liner surface and affect sealing. Repairs or replacement might be necessary.
- **Improper Sealing Surfaces:** Damaged or distorted sealing surfaces can cause oil leaks and require resurfacing or liner replacement.
- **Out-of-round Liner:** Excessive ovality or taper in the liner diameter can affect piston ring sealing and require replacement.

Piston Faults:

- **Cracked Piston Crown:** Cracks compromise piston integrity and require immediate replacement.
- **Overheating Damage:** Signs of overheating, like melted aluminum or warping, indicate a potential engine cooling system issue and require piston replacement.
- **Excessive Piston Ring Groove Wear:** Worn grooves can hinder proper ring seal and necessitate piston replacement.
- **Improper Piston Ring Gaps:** Excessive gaps reduce compression and oil control, requiring new rings or piston replacement depending on the severity.
- **Scuffed or Worn Piston Skirt:** Scoring or wear on the skirt can increase friction and lead to piston slap. Depending on the severity, the piston might need honing or replacement.
- **Worn Piston Pin or Bushings:** Excessive wear in these components can increase noise and potential for piston movement issues. Repairs or replacements might be necessary.

By performing a thorough inspection and identifying faults, you can determine if repairs or replacements are necessary for the cylinder liner and piston assembly to ensure optimal engine performance and longevity.

October 2021 MDE

October 2021 MDE

3. Describe a procedure for manually testing the set points on diesel generator HT cooling water, high temperature alarm and shut down. (10)

Manually Testing Diesel Generator HT Cooling Water Set Points: Alarm and Shutdown

Here's a procedure for manually testing the set points on a diesel generator's high temperature (HT) cooling water system, including the alarm and shutdown functions:

Important Notes:

- **Safety First:** Ensure all safety precautions are followed before performing this procedure. Refer to the manufacturer's manual for specific safety instructions related to your generator model.
- **Qualified Personnel:** This procedure should ideally be performed by a qualified technician familiar with the generator and its control system.
- **Alternatives:** Consult the manufacturer's manual to see if there are alternative methods for testing the set points, such as using diagnostic software or built-in testing functions.

Procedure:

1. **Preparation:**
    - Ensure the generator is off and disconnected from any electrical load.
    - Familiarize yourself with the location and function of the HT cooling water temperature sensor, alarm indicator, and shutdown mechanism (usually a relay or contactor). Refer to the generator's manual or electrical schematics for guidance.
    - Gather necessary tools, which might include a reliable thermometer, a heat source (optional), and safety equipment like gloves and safety glasses.
2. **Temperature Monitoring:**
    - Start the engine and allow it to run for a short period to reach normal operating temperature. Monitor the coolant temperature using the engine's built-in gauge or a separate thermometer at the designated point (refer to the manual).
3. **Alarm Test:**
    - **Gradual Increase (Preferred Method):** If feasible, gradually increase the coolant temperature using a controlled heat source (e.g., heat lamp) directed towards the cooling system. This allows for observing the alarm activation at the designated set point.
    - **Manual Intervention (Alternative):** If a controlled heat source isn't available, you might carefully simulate a temperature rise by briefly disconnecting the sensor or simulating a high resistance with a resistor (consult a qualified electrician for safe implementation).
    - Monitor the instrument panel or alarm indicator. Once the coolant temperature reaches the alarm set point as specified in the manual, the high-temperature alarm should activate (usually a visual or audible signal).
4. **Shutdown Test (Use Caution):**

- **Important:** Proceed with caution as this test involves stopping the engine. Ensure no critical loads depend on the generator's operation during this test.
- **Gradual Increase (Preferred Method):** If using a controlled heat source, continue raising the coolant temperature slightly above the alarm set point. Observe if the engine shuts down automatically as programmed.
- **Manual Intervention (Alternative):** If using manual intervention, keep the sensor disconnected or resistance simulated for a very brief period (seconds) just beyond the alarm set point. The engine control system should trigger a shutdown.

5. **Reset and Verification:**
   - Once the alarm and shutdown functions have been tested, allow the engine to cool down naturally.
   - Reconnect the sensor (if disconnected) or restore normal operation if a resistor was used.
   - Verify that the engine starts and runs normally after the cooling system temperature has returned to a safe range.

Documentation:

- Record the observed alarm and shutdown set points during the test and compare them to the manufacturer's specifications.
- Document any discrepancies or malfunctions for further investigation or repairs.

Remember:

- Exercise caution during the test, especially during the shutdown simulation.
- Consider alternative testing methods recommended by the manufacturer if available.
- If unsure about any step, consult a qualified technician for safe and proper execution of the procedure.

April 2023 MDE

April 2023 MDE

3. (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)

Actions Upon Crankcase Oil Mist Detector Activation (a):

The on-watch engineer should take the following immediate actions when the engine crankcase oil mist detector activates:

1. **Stop the Engine Safely:** Reduce engine load gradually and bring the engine to a complete stop as soon as possible. Stopping the engine abruptly can cause additional problems.

2. **Identify the Cause:** Investigate the reason behind the oil mist detection. This might involve:
    - Checking the oil level using the dipstick (ensure the engine is off and level for accurate reading).
    - Visually inspecting for leaks around crankcase components like seals, gaskets, or valve covers.
    - Looking for signs of internal engine issues like worn piston rings or excessive blow-by.
3. **Isolate the Problem (if possible):** Depending on the engine design, some systems allow isolating the affected cylinder by deactivating its fuel injector. This can help stabilize engine operation and minimize oil mist generation while troubleshooting.
4. **Alert Others:** Inform relevant personnel, especially maintenance staff, about the situation and the actions taken.
5. **Do Not Restart:** Avoid restarting the engine until the cause of the oil mist is identified and addressed.
6. **Investigate Further:** Once the engine is stopped, a more thorough investigation is needed to determine the root cause of the oil mist. This might involve consulting the engine manual, using diagnostic tools, or seeking assistance from a qualified mechanic.

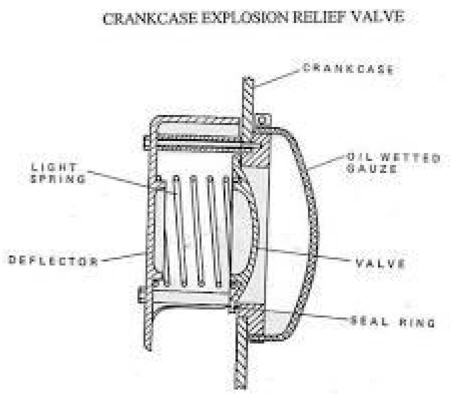
Important Notes:

- The specific actions may vary depending on the engine model and the severity of the oil mist condition.
- Always refer to the engine's operation and maintenance manual for detailed procedures and safety precautions.

Crankcase Explosion Relief Door (b):

Main Components:

1. **Relief Valve Plate:** This spring-loaded plate seals the door opening under normal conditions.
2. **Spring:** The spring applies a constant force to the relief valve plate, keeping it closed.
3. **Pressure Chamber:** This chamber is connected to the crankcase and allows pressure to build up inside the door.
4. **Flame Arrester:** This mesh element is located behind the relief valve plate and helps prevent flames from escaping the crankcase in case of an explosion.
5. **Door Hinge:** This allows the door to swing open when pressure exceeds the spring force.
6. **Door Body:** This houses all the other components and provides a secure closure for the crankcase opening.
7. pen_spark



8.
9. [Opens in a new window]

10. marineengineeringstudymaterial.wordpress.com
11. Crankcase Explosion Relief Door Labeled

Note: This is a general representation. The specific design and component names might vary depending on the engine manufacturer.

October 2020 MDE

October 2020 MDE

7. The air start pipework on a diesel engine attached to the cylinder head is becoming extremely hot.

Explain EACH of the following:

(a) the probable cause; (3)

(b) the consequences of this situation and the immediate action to be taken; (4)

(c) how this problem can be minimised. (3)

Hot Air Start Pipework on a Diesel Engine:

Here's a breakdown of the potential causes, consequences, and preventative measures for excessively hot air start pipes on a diesel engine:

(a) Probable Causes:

- **Insufficient Air Flow:**
  - Blocked air filter: A clogged air filter restricts the incoming cool compressed air, causing the air to heat up more as it struggles to flow through the filter element.
  - Leaking air lines: Leaks in the air supply line between the compressor and the cylinder head can allow compressed air to escape, reducing the overall volume available for starting. This can lead to the remaining air heating up significantly as it expands to fill the system.
- **Excessive Air Consumption:**
  - Faulty air starting valve: A leaking or malfunctioning air start valve can allow compressed air to continuously flow into the cylinder even after starting, leading to overheating of the pipes.

(b) Consequences and Immediate Action:

- **Consequences:**
  1. **Premature Pipe Failure:** The extreme heat can weaken the air start pipes, making them more susceptible to cracks, leaks, or even bursting.
  2. **Fire Hazard:** Leaking hot air near engine components can increase the risk of fire.
  3. **Starting Difficulties:** Reduced air pressure due to leaks or excessive heating can make starting the engine more difficult.
- **Immediate Action:**
  1. **Stop the Engine:** Safely shut down the engine to prevent further heat buildup.
  2. **Isolate the Air Supply:** Close the main air isolation valve to stop compressed air from entering the system.

3. **Allow Cooling Down:** Let the engine and air start pipes cool down completely before further inspection.
4. **Investigate the Cause:** Once cool, identify the reason behind the overheating using the troubleshooting steps mentioned in part (c).

(c) Minimizing the Problem:

- **Regular Maintenance:**
  - Schedule regular cleaning or replacement of the air filter to ensure proper airflow.
  - Inspect air lines for leaks and address them promptly with proper repairs or replacements.
  - Follow the manufacturer's recommended maintenance intervals for air starting components like valves and solenoids.
- **Monitoring:**
  - During operation, periodically feel the air start pipes for abnormal heat. Excessive heat indicates a potential issue that needs investigation.
- **Addressing Underlying Issues:**
  - If the problem persists, further investigation might be required to identify and address any underlying issues, such as a malfunctioning air compressor or excessive internal engine wear leading to increased air consumption.

By implementing these preventative measures and taking prompt action when overheating occurs, you can minimize the risk of damaged air start pipes, fire hazards, and starting difficulties with your diesel engine.

February 2022

February 2022

10. (a) State how gearbox oil may become contaminated with water. (1)

(b) Explain the effects of water contamination of gearbox oil. (5)

(c) Describe the actions to be taken should a gearbox become contaminated with water. (4)

Water Contamination in Gearbox Oil

Water contamination in gearbox oil can be a serious problem, leading to reduced performance and potential component damage. Here's a breakdown of how it happens, its effects, and how to address it:

(a) Causes of Water Contamination:

- **Condensation:** Moisture in the air can condense inside a cold gearbox, especially during temperature fluctuations. This is more likely in environments with high humidity.
- **Leaking Seals:** Worn or damaged seals around the gearbox input or output shafts can allow water to ingress from the external environment during rain, car washes, or driving through puddles.

- **Coolant System Leak:** If the gearbox cooling system (if applicable) has a leak in its heat exchanger, coolant containing water can mix with the gearbox oil.

(b) Effects of Water Contamination:

- **Loss of Lubricity:** Water dilutes the oil's lubricating properties, leading to increased friction and wear on gears and bearings.
- **Corrosion:** Water promotes rust and corrosion on metal components within the gearbox, accelerating wear and tear.
- **Formation of Sludge:** Water can react with additives in the oil to form sludge, which can clog oil passages and hinder proper lubrication.
- **Foaming:** Water can cause the oil to foam, reducing its ability to absorb pressure and transmit power efficiently.
- **Freezing (in cold climates):** In very cold environments, water contamination can lead to ice formation within the gearbox, potentially causing damage to components.

(c) Actions Upon Water Contamination:

- **Stop Operation:** If you suspect water contamination, immediately stop operating the vehicle to prevent further damage.
- **Diagnosis:** Check the oil dipstick for a milky appearance, which can be a sign of water contamination. Additionally, unusual noises from the gearbox during operation can indicate problems.
- **Oil Drain and Flush:** The most crucial step is to drain the contaminated oil and thoroughly flush the gearbox to remove any remaining water traces. Consult a qualified mechanic for this procedure, as they can ensure proper disposal of the used oil and utilize the appropriate flushing techniques.
- **New Oil and Filter:** After flushing, refill the gearbox with fresh, high-quality oil of the recommended grade and replace the oil filter to ensure clean, uncontaminated lubrication.
- **Identify the Source:** Investigate the source of the water contamination, such as a leaking seal or coolant system issue. Address the root cause to prevent future contamination.

By taking these steps promptly upon discovering water contamination, you can minimize damage to your gearbox and ensure its smooth operation. Remember, preventive maintenance, such as regular oil changes and seal inspections, can help reduce the risk of water contamination in the first place.

October 2022 MDE

October 2022 MDE

3. Describe a procedure for manually testing the set points on a diesel engine lubricating oil low pressure alarm and shut down using a pressure calibrator. (10)

Manually Testing Diesel Engine Oil Pressure Alarm and Shutdown with Pressure Calibrator

Important Notes:

- **Safety First:** Ensure all safety precautions are followed before performing this procedure. Refer to the engine manufacturer's manual for specific safety instructions related to your engine model.
- **Qualified Personnel:** Ideally, a qualified technician familiar with the engine and its control system should perform this test.
- **Alternatives:** Consult the manufacturer's manual to see if there are alternative methods for testing the set points, such as using diagnostic software or built-in testing functions.

Procedure:

1. **Preparation:**
    - **Engine Off and Secured:** Ensure the engine is completely off and disconnected from any electrical load. Lock out or tag out any switches to prevent accidental startup.
    - **Identify Components:** Locate the engine oil pressure sensor, the low-pressure alarm indicator (light or buzzer), and the engine shutdown mechanism (usually a relay or contactor). Refer to the engine manual or electrical schematics for guidance.
    - **Tools:** Gather necessary tools, including a reliable pressure calibrator with a compatible adapter for the engine's oil pressure sensor fitting, safety glasses, gloves, and rags.
2. **Isolating the Oil Pressure Sensor:**
    - Locate the oil pressure sensor and identify the connection point with the engine's oil pressure line.
    - Carefully loosen the connection, using wrenches or appropriate tools, to isolate the sensor from the oil pressure line. Contain any spilled oil with rags.
    - **Caution:** Avoid introducing any debris into the engine oil system during this process.
3. **Connecting the Pressure Calibrator:**
    - Attach the pressure calibrator's adapter to the isolated oil pressure sensor port. Ensure a secure and leak-free connection.
    - Connect the pressure calibrator to the adapter, following the manufacturer's instructions for proper connection and operation.
4. **Pressure Increase and Alarm Test:**
    - Gradually increase the pressure on the calibrator, simulating a decrease in engine oil pressure.
    - Monitor the engine's instrument panel or alarm indicator. Once the pressure reaches the low-pressure alarm set point as specified in the manual, the alarm should activate (usually a visual or audible signal).
    - Record the observed pressure at which the alarm activates.
5. **Shutdown Test (Use Caution):**
    - **Important:** Proceed with extreme caution as this test involves stopping the engine. Ensure no critical loads depend on the engine's operation during this test.
    - Continue increasing the pressure on the calibrator slightly beyond the alarm set point.
    - Observe if the engine control system triggers a shutdown. The engine should stop automatically.
    - Record the observed pressure at which the engine shuts down.
6. **System Reset and Verification:**
    - Once the alarm and shutdown functions have been tested, slowly decrease the pressure on the calibrator to zero.
    - Reinstall the oil pressure sensor to its original position, ensuring a leak-free connection. Tighten the connection to the recommended torque specifications as specified in the manual.

   - Verify that the engine starts and runs normally after the oil pressure sensor is reconnected.
7. **Documentation:**
   - Document the observed alarm and shutdown set points during the test and compare them to the manufacturer's specifications.
   - Document any discrepancies or malfunctions for further investigation or repairs.

Remember:

- Exercise extreme caution during the test, especially during the shutdown simulation.
- Consider alternative testing methods recommended by the manufacturer if available.
- If unsure about any step, consult a qualified technician for safe and proper execution of the procedure.

JAN 2023 MDE

JAN 2023 MDE

3. Describe a procedure for manually testing the set points on diesel generator HT cooling water, high temperature alarm and shut down. (10)

Manually Testing Diesel Generator HT Cooling Water Set Points (Alarm and Shutdown)

Important Notes:

- **Safety First:** Ensure all safety precautions are followed before performing this procedure. Refer to the manufacturer's manual for specific safety instructions related to your generator model.
- **Qualified Personnel:** Ideally, a qualified technician familiar with the generator and its control system should perform this test.
- **Alternatives:** Consult the manufacturer's manual to see if there are alternative methods for testing the set points, such as using diagnostic software or built-in testing functions.

Procedure:

1. **Preparation:**
   - **Generator Off and Secured:** Ensure the generator is completely off and disconnected from any electrical load. Lock out or tag out any switches to prevent accidental startup.
   - **Identify Components:** Locate the HT cooling water temperature sensor, the high-temperature alarm indicator (light or buzzer), and the engine shutdown mechanism (usually a relay or contactor). Refer to the generator manual or electrical schematics for guidance.
   - **Tools:** Gather necessary tools, which might include a reliable thermometer with a range exceeding the expected high-temperature set point, a heat source (optional), safety glasses, gloves, and rags.

2. **Temperature Monitoring:**
    - Start the engine and allow it to run for a short period to reach normal operating temperature. Monitor the coolant temperature using the generator's built-in gauge or your separate thermometer at the designated point (refer to the manual).
3. **Alarm Test:**
    - **Gradual Increase (Preferred Method):** If feasible, gradually increase the coolant temperature using a controlled heat source (e.g., heat lamp) directed towards the cooling system. This allows for observing the alarm activation at the designated set point.
    - **Manual Intervention (Alternative):** If a controlled heat source isn't available, you might carefully simulate a temperature rise by briefly disconnecting the sensor or simulating a high resistance with a resistor (consult a qualified electrician for safe implementation).
    - Monitor the instrument panel or alarm indicator. Once the coolant temperature reaches the alarm set point as specified in the manual, the high-temperature alarm should activate (usually a visual or audible signal).
    - Record the observed temperature at which the alarm activates.
4. **Shutdown Test (Use Caution):**
    - **Important:** Proceed with extreme caution as this test involves stopping the engine. Ensure no critical loads depend on the generator's operation during this test.
    - **Gradual Increase (Preferred Method):** If using a controlled heat source, continue raising the coolant temperature slightly above the alarm set point. Observe if the engine shuts down automatically as programmed.
    - **Manual Intervention (Alternative):** If using manual intervention, keep the sensor disconnected or resistance simulated for a very brief period (seconds) just beyond the alarm set point. The engine control system should trigger a shutdown.
    - Record the observed temperature at which the engine shuts down.
5. **System Reset and Verification:**
    - Once the alarm and shutdown functions have been tested, allow the engine to cool down naturally.
    - Reconnect the sensor (if disconnected) or restore normal operation if a resistor was used.
    - Verify that the engine starts and runs normally after the cooling system temperature has returned to a safe range.
6. **Documentation:**
    - Document the observed alarm and shutdown set points during the test and compare them to the manufacturer's specifications.
    - Document any discrepancies or malfunctions for further investigation or repairs.

Important Reminders:

- Exercise caution during the test, especially during the shutdown simulation.
- Consider alternative testing methods recommended by the manufacturer if available.
- If unsure about any step, consult a qualified technician for safe and proper execution of the procedure.

Oct 2020

October 2020 MDE

3. Describe a procedure for manually testing the set points on a diesel generator lubricating oil, low pressure alarm and shut down. (10)

Important Notes:

- **Safety First:** Ensure all safety precautions are followed before performing this procedure. Refer to the manufacturer's manual for specific safety instructions related to your generator model.
- **Qualified Personnel:** Ideally, a qualified technician familiar with the generator and its control system should perform this test.
- **Alternatives:** Consult the manufacturer's manual to see if there are alternative methods for testing the set points, such as using diagnostic software or built-in testing functions.

Procedure:

1. **Preparation:**
    - **Generator Off and Secured:** Ensure the generator is completely off and disconnected from any electrical load. Lock out or tag out any switches to prevent accidental startup.
    - **Identify Components:** Locate the HT cooling water temperature sensor, the high-temperature alarm indicator (light or buzzer), and the engine shutdown mechanism (usually a relay or contactor). Refer to the generator manual or electrical schematics for guidance.
    - **Tools:** Gather necessary tools, which might include:
        - Reliable thermometer with a range exceeding the expected high-temperature set point.
        - Heat source (optional, for gradual temperature increase).
        - Safety glasses, gloves, and rags.
2. **Temperature Monitoring:**
    - Start the engine and allow it to run for a short period to reach normal operating temperature. Monitor the coolant temperature using the generator's built-in gauge or your separate thermometer at the designated point (refer to the manual).
3. **Alarm Test:**
   Preferred Method (Gradual Increase):
    - If feasible, gradually increase the coolant temperature using a controlled heat source (e.g., heat lamp) directed towards the cooling system. This allows for observing the alarm activation at the designated set point.
4. **Alternative Method (Manual Intervention):**
    - If a controlled heat source isn't available, you might carefully simulate a temperature rise by briefly disconnecting the sensor or simulating a high resistance with a resistor (consult a qualified electrician for safe implementation).
    - Monitor the instrument panel or alarm indicator. Once the coolant temperature reaches the alarm set point as specified in the manual, the high-temperature alarm should activate (usually a visual or audible signal).
    - Record the observed temperature at which the alarm activates.
5. **Shutdown Test (Use Caution):**

    - **Important:** Proceed with extreme caution as this test involves stopping the engine. Ensure no critical loads depend on the generator's operation during this test.
    - **Following the method chosen for Alarm Test:**
        - **Gradual Increase:** If using a controlled heat source, continue raising the coolant temperature slightly above the alarm set point. Observe if the engine shuts down automatically as programmed.
        - **Manual Intervention:** If using manual intervention, keep the sensor disconnected or resistance simulated for a very brief period (seconds) just beyond the alarm set point. The engine control system should trigger a shutdown.
    - Record the observed temperature at which the engine shuts down.
6. **System Reset and Verification:**
    - Once the alarm and shutdown functions have been tested, allow the engine to cool down naturally.
    - Reconnect the sensor (if disconnected) or restore normal operation if a resistor was used.
    - Verify that the engine starts and runs normally after the cooling system temperature has returned to a safe range.
7. **Documentation:**
    - Document the observed alarm and shutdown set points during the test and compare them to the manufacturer's specifications.
    - Document any discrepancies or malfunctions for further investigation or repairs.

Important Reminders:

- Exercise caution during the test, especially during the shutdown simulation.
- Consider alternative testing methods recommended by the manufacturer if available.
- If unsure about any step, consult a qualified technician for safe and proper execution of the procedure.

May 2018 MDE

May 2018 MDE

3. List TEN safety devices that may be fitted to a propulsion engine and gearbox arrangement, stating a reason why EACH device is fitted. (10)

Here are ten safety devices that may be fitted to a propulsion engine and gearbox arrangement, along with their reasons for being installed:

1. **Engine Crankcase Pressure Relief Valve:** Protects the engine crankcase from excessive pressure buildup caused by blow-by gases, preventing crankcase explosions.
2. **Engine Speed Governor:** Limits the engine's maximum RPM (revolutions per minute) to prevent over-speeding and potential component damage.
3. **Engine Overheating Shutdown Switch:** Automatically shuts down the engine if coolant temperature exceeds a safe limit, preventing engine seizure.
4. **Low Engine Oil Pressure Warning Light/Alarm:** Alerts the operator to a drop in engine oil pressure, indicating potential lubrication problems and prompting immediate action.

5. **Gearbox Oil Low Level Sensor:** Warns the operator of insufficient oil level in the gearbox, preventing damage due to lubrication starvation.
6. **Gearbox Overheating Shutdown Switch:** Similar to the engine, this switch automatically shuts down the system if gearbox oil temperature becomes excessively high.
7. **Shaft Vibration Sensor:** Detects excessive vibration on the propulsion shaft, potentially caused by imbalance or misalignment, allowing for corrective action before major damage occurs.
8. **Seawater Low Flow Alarm:** In marine engines, this alarm warns of reduced seawater flow for cooling purposes, prompting action to prevent overheating.
9. **Fuel Shutoff Valve:** Allows for manual or emergency shutoff of fuel supply to the engine, stopping operation in case of emergencies or fire.
10. **Shear Pin/Coupling:** A sacrificial component designed to break in case of excessive torque overload, protecting the gearbox or other connected components from severe damage.

Oct 2019 jan 2019

October 2019 MDE

9. (a) State TWO possible causes for EACH of the following exhaust emissions:

(i) black smoke; (2)

(ii) blue smoke; (2)

(iii) white smoke. (2)

(b) State ONE remedy for EACH of the emissions in part (a). (3)

(c) State how combustion defects may be diagnosed. (1)

January 2019 MDE

8. (a) State TWO possible causes for EACH of the following exhaust emissions:

(i) black smoke; (2)

(ii) blue smoke; (2)

(iii) white smoke. (2)

(b) State ONE remedy for EACH of the emissions in part (a). (3)

(c) State how combustion defects may be diagnosed. (1)

Exhaust Emissions and Causes (a):

(i) Black Smoke:

1. **Incomplete Combustion:** When fuel doesn't burn completely due to insufficient air intake, rich fuel mixture, or low combustion chamber temperature, it produces unburnt soot particles that appear as black smoke in the exhaust.

2. **Over-fueling:** Excessive fuel injection or a faulty injector can deliver more fuel than the available air can support, leading to incomplete combustion and black smoke.

(ii) Blue Smoke:

1. **Oil Burning:** Worn piston rings, valve seals, or cylinder liner can allow engine oil to enter the combustion chamber and burn with the fuel, resulting in blue smoke.
2. **Turbocharger Seal Failure:** A faulty seal in the turbocharger can allow engine oil to leak into the compressed air intake, leading to blue smoke upon burning.

(iii) White Smoke:

1. **Coolant Leak:** A leak in the engine's coolant system can allow coolant to enter the combustion chamber and be expelled as white steamy exhaust, especially during engine startup.
2. **Water Ingestion:** In rare cases, water ingestion (e.g., through a faulty air intake or a problem with the head gasket) can cause white smoke upon vaporization.

Remedies for Emissions (b):

(i) Black Smoke:

- **Air Filter Cleaning/Replacement:** Ensure a clean air filter allows proper air intake for efficient combustion.
- **Fuel Injection System Inspection/Repair:** Check for faulty injectors or incorrect fuel delivery settings to address over-fueling.

(ii) Blue Smoke:

- **Engine Rebuild/Replacement of Worn Components:** Depending on the severity, worn piston rings, valve seals, or cylinder liners might need replacement to prevent oil burning.
- **Turbocharger Seal Repair/Replacement:** A faulty turbocharger seal needs repair or replacement to stop oil from entering the air intake.

(iii) White Smoke:

- **Coolant System Leak Repair:** Locate and repair the leak in the coolant system to prevent coolant from entering the combustion chamber.
- **Head Gasket Inspection/Replacement (severe cases):** A blown head gasket can cause coolant leaks. If severe, the head gasket might need replacement.

Diagnosing Combustion Defects (c):

Combustion defects can be diagnosed using various methods:

- **Visual Inspection:** Mechanics can visually inspect spark plugs (gasoline engines) or glow plugs (diesel engines) for signs of excessive wear, deposits, or fouling that can indicate combustion issues.
- **Compression Test:** This test measures the pressure buildup in each engine cylinder, helping identify weak cylinders with potential combustion problems.

- **Leakdown Test:** A leakdown test pressurizes the cylinder and monitors pressure loss, revealing leaks in valves, piston rings, or the head gasket.
- **Exhaust Gas Analysis:** Analyzing the exhaust gas composition can reveal imbalances in air-fuel ratio and identify incomplete combustion or other combustion defects.

By combining these diagnostic methods, mechanics can pinpoint the root cause of abnormal exhaust emissions and address the underlying combustion defects.

October 2018 MDE

October 2018 MDE

7. The air start pipework on a diesel engine attached to the cylinder head is becoming extremely hot.

   Explain EACH of the following:

   (a) the probable cause; (3)

   (b) the consequences of this situation and the immediate action to be taken; (4)

   (c) how this problem can be minimised. (3)

Here's a breakdown of the potential causes, consequences, and preventative measures for excessively hot air start pipes on a diesel engine:

(a) Probable Causes:

- **Insufficient Air Flow:**
  - Blocked air filter: A clogged air filter restricts the incoming cool compressed air, causing the air to heat up more as it struggles to flow through the filter element.
  - Leaking air lines: Leaks in the air supply line between the compressor and the cylinder head can allow compressed air to escape, reducing the overall volume available for starting. This can lead to the remaining air heating up significantly as it expands to fill the system.
- **Excessive Air Consumption:**
  - Faulty air starting valve: A leaking or malfunctioning air start valve can allow compressed air to continuously flow into the cylinder even after starting, leading to overheating of the pipes.

(b) Consequences and Immediate Action:

- **Consequences:**
  1. **Premature Pipe Failure:** The extreme heat can weaken the air start pipes, making them more susceptible to cracks, leaks, or even bursting.
  2. **Fire Hazard:** Leaking hot air near engine components can increase the risk of fire.
  3. **Starting Difficulties:** Reduced air pressure due to leaks or excessive heating can make starting the engine more difficult.
- **Immediate Action:**
  1. **Stop the Engine:** Safely shut down the engine to prevent further heat buildup.

2. **Isolate the Air Supply:** Close the main air isolation valve to stop compressed air from entering the system.
3. **Allow Cooling Down:** Let the engine and air start pipes cool down completely before further inspection.
4. **Investigate the Cause:** Once cool, identify the reason behind the overheating using the troubleshooting steps mentioned in part (c).

(c) Minimizing the Problem:

- **Regular Maintenance:**
  - Schedule regular cleaning or replacement of the air filter to ensure proper airflow.
  - Inspect air lines for leaks and address them promptly with proper repairs or replacements.
  - Follow the manufacturer's recommended maintenance intervals for air starting components like valves and solenoids.
- **Monitoring:**
  - During operation, periodically feel the air start pipes for abnormal heat. Excessive heat indicates a potential issue that needs investigation.
- **Addressing Underlying Issues:**
  - If the problem persists, further investigation might be required to identify and address any underlying issues, such as a malfunctioning air compressor or excessive internal engine wear leading to increased air consumption.

By implementing these preventative measures and taking prompt action when overheating occurs, you can minimize the risk of damaged air start pipes, fire hazards, and starting difficulties with your diesel engine.