Sept 2020

1. With reference to remotely operated quick closing valves:

   (a) state their purpose; (2)

   (b) state where they would be fitted; (3)

   (c) describe how they are tested. (5)

Question 1. Most only give one purpose of quick closing valves. None check that the valve is open before testing.

Sept 2020

2. A centrifugal bilge pump has not been operating satisfactorily, the air pump was tested and found to be operating correctly.

   List FIVE faults that could have caused the problem, stating why EACH fault causes poor operation. (10)

Question 2. All give reasons for pump performance deteriorating but many do not explain why the fault causes reduction in performance.

Sept 2020

3. With reference to reciprocating air compressors:

   (a) state the meaning of the term *bump clearance*; (2)

   (b) explain the effects on operation if the bump clearance is:

      (i) too large; (2)

      (ii) too small. (2)

   (c) explain why the air temperature must be limited in the HP stage, stating how this is achieved; (2)

   (d) explain how an aftercooler helps remove moisture from the air. (2)

Question 3. Overall poor answers. Several have no understanding of the importance of bump clearance or the safety aspects of intercooling.

Sept 2020

4. Outline the safety precautions which should be taken when carrying out repairs or maintenance on hydraulic systems. (10)

Question 4. All give some understanding of the safety requirements, most fail to mention anything about fire.

Sept 2020

5. Describe ALL the necessary checks of the steering gear before a vessel leaves port. (10)

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Sept 2020

6. Describe the advantages of using water jets instead of conventional propellers for vessel propulsion. (10)

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Sept 2020

7. (a) Describe. with the aid of a sketch, how the alignment of a propeller transmission shaft system may be checked. (8)

   (b) State the indications of a high bearing when the shaft is running. (2)

Question 7. Many attempt to describe aligning two shafts together rather than checking the alignment of the shafting. Candidates describe measuring along the shaft rather than the height of the bearings.

Sept 2020

8. Explain EACH of the following electrical terms:

   (a) preferential tripping; (2)

   (b) sequential starting; (2)

   (c) fuse back up protection; (2)

   (d) discrimination; (2)

   (e) non-essential consumer. (2)

Question 8. Candidates struggle with sequential starting, the reason for back up fuses and discrimination. Most state circuits for propulsion are the only essential circuits.

Sept 2020

9. List TEN routine maintenance checks that should be carried out on a vented type lead acid engine starting battery system. (10)

Question 9. Mostly well answered

Sept 2020

10. Describe, with the aid of sketches, TWO methods for controlling the speed of a hydraulic motor. (10)

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Sept 2020

1. With reference to remotely operated quick closing valves:

   (a) state their purpose; (2)

   (b) state where they would be fitted; (3)

   (c) describe how they are tested. (5)

Question 1. Most only give one purpose of quick closing valves. None check that the valve is open before testing.

Remotely Operated Quick Closing Valves

(a) Purpose:

The primary purpose of remotely operated quick closing valves is to **isolate and stop the flow of fluids rapidly in an emergency situation**. This is particularly important for flammable or hazardous liquids to:

- **Prevent fire spread:** By shutting the valve, the flow of fuel to a fire can be stopped, potentially containing the situation.
- **Minimize damage:** In case of a leak or ruptured tank, the valve can isolate the issue, preventing further release of the liquid.

(b) Where They Are Fitted:

These valves are strategically placed on the **outlet lines** of tanks containing hazardous materials, typically:

- **Fuel oil tanks** in engine rooms or boiler rooms.
- Tanks supplying fuel to **emergency generators**.
- Tanks with flammable or hazardous liquids in industrial settings.

(c) Testing Procedures:

Regular testing ensures these valves function properly in critical situations. Testing procedures may involve:

- **Operational Check:** Manually operating the valve through its full open-close cycle to confirm smooth movement and proper closure.
- **Remote Activation Test:** Simulating an emergency scenario by activating the remote closing mechanism and verifying the valve shuts down promptly.
- **Leakage Test:** Pressurizing the system to identify any leaks around the valve seat or body, ensuring a tight seal when closed.
- **Inspection:** Visually inspecting the valve for any signs of wear, damage, or corrosion that might affect its performance.

The specific testing frequency and procedures may vary depending on regulations, industry standards, and the specific application.

ept 2020

Sept 2020

2. A centrifugal bilge pump has not been operating satisfactorily, the air pump was tested and found to be operating correctly.

   List FIVE faults that could have caused the problem, stating why EACH fault causes poor operation. (10)

Question 2. All give reasons for pump performance deteriorating but many do not explain why the fault causes reduction in performance.

Here are five faults that could cause a centrifugal bilge pump to malfunction, assuming the air ejector (if present) and air line are functioning properly:

1. **Blocked Impeller:**
   - **Reason:** Debris or foreign objects can become lodged within the impeller, preventing it from spinning freely and reducing the pump's ability to move water.
2. **Worn Out Impeller:**
   - **Reason:** Over time, the impeller vanes can wear or become damaged, reducing their efficiency in pushing water. This can lead to a decrease in the pump's flow rate.
3. **Leaking Valve or Piping:**
   - **Reason:** Leaks on the suction or discharge side of the pump can significantly reduce its pumping capacity. Air entering the system through leaks can also hinder the pump's ability to move water efficiently.
4. **Faulty Electrical Supply:**
   - **Reason:** Insufficient voltage or amperage reaching the motor can cause it to run slowly or not at all, preventing the pump from operating effectively.
5. **Seized Pump Shaft:**
   - **Reason:** Corrosion, wear, or foreign objects can cause the pump shaft to seize or become stiff, preventing the impeller from rotating. This will completely halt the pump's operation.

In addition to these faults, a malfunctioning pressure switch or float switch could also prevent the pump from automatically turning on when the bilge water level rises. However, since the scenario specifies the pump not operating satisfactorily, these control components are less likely to be the root cause.

2020

Sept 2020

3. With reference to reciprocating air compressors:

(a) state the meaning of the term *bump clearance*; (2)

(b) explain the effects on operation if the bump clearance is:

(i) too large; (2)

(ii) too small. (2)

(c) explain why the air temperature must be limited in the HP stage, stating how this is achieved; (2)

(d) explain how an aftercooler helps remove moisture from the air. (2)

Question 3. Overall poor answers. Several have no understanding of the importance of bump clearance or the safety aspects of intercooling.

Reciprocating Air Compressor: Bump Clearance and Temperature Control

(a) Bump Clearance:

Bump clearance refers to the minimum distance between the piston and the cylinder head, or between the piston crown and the discharge valve on the cylinder head, at the top dead center (TDC)

of the piston stroke. It's essentially the closest the piston gets to the head or valve at the end of its upward movement.

(b) Effects of Bump Clearance:

(i) Bump Clearance Too Large:

- **Reduced Efficiency:** Excessive clearance allows for a larger volume of compressed air to remain in the cylinder after discharge, which expands during the intake stroke. This reduces the amount of fresh air that can be drawn into the cylinder, lowering the compressor's overall efficiency.
- **Increased Wear:** With a larger gap, the piston experiences increased impact forces against the cylinder head at the end of its stroke, accelerating wear and tear on both components.

(ii) Bump Clearance Too Small:

- **Premature Contact and Damage:** If the clearance is too tight, the piston might come into contact with the head or valve prematurely during operation. This can cause severe damage to the piston, head, and valve components.
- **Increased Friction:** A very small clearance creates excessive friction between the piston and cylinder head, leading to increased power consumption and potential overheating.

(c) Limiting Air Temperature in the HP Stage:

Air temperature rises significantly during compression in the high-pressure (HP) stage of a reciprocating compressor. This high temperature can:

- **Reduce Lubrication Efficiency:** High temperatures can break down the lubricating oil, reducing its effectiveness in protecting moving parts and increasing wear.
- **Degrade Air Quality:** Excessive heat can cause thermal decomposition of the compressed air, leading to the formation of harmful contaminants and reducing air quality.
- **Damage Compressor Components:** High temperatures can accelerate wear and tear on valves, seals, and other internal components.

Limiting Air Temperature:

There are two main methods to limit air temperature in the HP stage:

- **Intercooling:** Air is cooled between compression stages using an intercooler. This removes some of the heat generated during compression in the first stage before the air enters the HP stage for further compression.
- **Water Jacketing:** The cylinder head and body of the compressor are often water-jacketed. Coolant water circulates around these jackets, absorbing heat from the compressed air within the cylinder and transferring it to a radiator for cooling.

(d) Aftercooler and Moisture Removal:

An aftercooler is a heat exchanger located after the final compression stage of a reciprocating compressor. It functions similarly to an intercooler but cools the compressed air to a lower temperature than what's achievable with intercooling alone. This helps to:

- **Reduce Condensation:** By lowering the air temperature, the aftercooler reduces the risk of water vapor in the compressed air condensing into liquid water. This is crucial because water droplets can cause corrosion within the system and damage downstream equipment that relies on clean, dry air.
- **Improve Efficiency:** Cooler air is denser and requires less energy for further processing or use.

Additional Moisture Removal:

Aftercooling alone might not be sufficient to remove all moisture, especially in humid environments. In such cases, additional equipment like separators or dryers might be used to further remove condensed water from the compressed air stream.

2020

Sept 2020

4. Outline the safety precautions which should be taken when carrying out repairs or maintenance on hydraulic systems. (10)

Question 4. All give some understanding of the safety requirements, most fail to mention anything about fire.

Here are some safety precautions that should be taken when carrying out repairs or maintenance on hydraulic systems:

Before Starting Work:

- **Lock Out/Tag Out (LOTO):** Always follow proper Lock Out/Tag Out procedures before beginning any work on the hydraulic system. This ensures that the system is isolated from its energy source and no one can accidentally activate it while you're working.
- **Pressure Relief:** Release all residual pressure within the system before starting any work. This can be done by following the manufacturer's instructions for bleeding pressure from specific components or using a designated pressure relief valve.
- **System Drainage:** Drain the hydraulic fluid from the system as much as possible, following proper disposal procedures for the used fluid. This minimizes the risk of exposure to hot oil and reduces the amount of fluid that could escape during repairs.
- **System Cleaning (Optional):** In some cases, depending on the nature of repairs or the severity of contamination, the system might require cleaning before disassembly. This could involve flushing the system with a cleaning solution or using specialized cleaning procedures outlined by the manufacturer.
- **Personal Protective Equipment (PPE):** Wear appropriate personal protective equipment (PPE) when working on hydraulic systems. This includes:
    - **Safety glasses:** To protect eyes from splashes of hydraulic fluid or debris.
    - **Gloves:** Chemical-resistant gloves to protect hands from hot oil and potential contamination.
    - **Coveralls:** Oil-resistant coveralls to protect clothing from spills and contamination.
    - **Foot protection:** Safety boots with proper slip resistance to prevent falls on potentially oily surfaces.

During Repairs and Maintenance:

- **Follow Service Manuals:** Always refer to the manufacturer's service manuals or maintenance instructions for the specific equipment. These will provide detailed procedures for disassembly, inspection, repair, and reassembly of the hydraulic components.
- **Use Proper Tools:** Use the correct tools specifically designed for working on hydraulic systems. This will help prevent damage to components and ensure proper tightening of fittings.
- **Beware of High-Pressure Components:** Be aware of high-pressure lines and components within the system. Avoid any actions that could put stress on these components or lead to accidental fluid leaks.
- **Maintain a Clean Work Area:** Keep the work area clean and organized to avoid tripping hazards or losing track of tools and components.
- **Work Buddy System:** Consider working with a partner for certain tasks, especially when dealing with high-pressure components or heavy equipment.
- **Safe Lifting Practices:** Use proper lifting techniques and equipment when handling heavy components within the hydraulic system.

After Completing Work:

- **Reassembly and Inspection:** Carefully reassemble the system components according to the manufacturer's instructions. Double-check all connections and ensure everything is tightened properly.
- **System Refill and Bleeding:** Refill the system with clean, fresh hydraulic fluid of the recommended type and viscosity. Follow the manufacturer's procedures for bleeding air from the system to ensure proper operation without trapped air pockets.
- **Test and Verification:** Once the system is refilled and bled, conduct a test run to verify proper operation and identify any leaks or malfunctions before placing the system back into full service.
- **Safety Checks:** Perform final safety checks to ensure all LOTO procedures are reversed, no tools are left behind, and the system is functioning safely and without leaks.

Additional Tips:

- **Training and Experience:** Ensure you have the proper training and experience necessary for the specific repairs or maintenance tasks being performed on the hydraulic system.
- **Waste Disposal:** Dispose of used hydraulic fluid and any other waste materials generated during maintenance according to local environmental regulations.
- **Proper Record Keeping:** Maintain records of the maintenance procedures performed, parts replaced, and any safety concerns encountered.

By following these safety precautions, you can minimize the risk of accidents and injuries when working on hydraulic systems. Remember, hydraulic systems operate under high pressure and contain hazardous fluids. It's crucial to prioritize safety throughout the entire maintenance process.

Sept 2020

5. Describe ALL the necessary checks of the steering gear before a vessel leaves port. (10)

Question 5. Candidates lose marks by not mentioning alarms, emergency power supply and not actually inspecting the gear.

Here are all the necessary checks of the steering gear before a vessel leaves port:

Pre-departure Checks:

These checks ensure the steering gear is operational and can respond reliably during the voyage:

- **Visual Inspection:** Perform a thorough visual inspection of all steering gear components, including:
    - Rams (cylinders) and linkages: Look for any signs of damage, leaks, or loose connections.
    - Pumps and motors: Check for leaks, unusual noises, or excessive vibrations.
    - Reservoirs: Verify proper fluid level and cleanliness of the hydraulic fluid.
    - Pipes and hoses: Inspect for wear, cracks, or damage that could lead to leaks.
- **Operational Testing:** Conduct a full operational test of the steering gear:
    - Rudder movement:** Test the ability to move the rudder through its full range of motion in both directions.
    - Response time:** Check the system's response time between initiating a turn and the rudder movement. This should be within specified limits.
    - Dead spots (optional): In some systems, check for any dead spots where the rudder doesn't respond immediately to steering wheel input.
- **Alarm Systems:** Verify that all steering gear alarms (e.g., low oil pressure, high oil temperature) are functioning correctly.
- **Communication Checks:** Ensure proper communication between the bridge and the steering gear compartment. This could involve testing phone lines, intercoms, or dedicated control systems.
- **Emergency Steering:** If applicable, test the emergency steering system to ensure its functionality in case of a primary steering gear failure.

Documentation:

- Record all the pre-departure checks in the steering gear logbook, noting any discrepancies or observations.

Additional Considerations:

- **Consult Manuals:** Refer to the specific steering gear manufacturer's manuals and the vessel's operating procedures for detailed pre-departure check procedures.
- **Crew Training:** Ensure the crew is familiar with the steering gear system, including normal operation, troubleshooting procedures, and emergency steering gear operation.

By performing these comprehensive checks before departure, the crew can ensure the steering gear is functioning properly and the vessel can be maneuvered safely during the voyage.

t 2020

Sept 2020

6. Describe the advantages of using water jets instead of conventional propellers for vessel propulsion. (10)

Question 6. Many simply state advantages – the question says 'describe'. Many of the advantages claimed could be equally applied to CPP's and D/E drives, both of which are now considered conventional.

Here are some advantages of using water jets instead of conventional propellers for vessel propulsion:

Performance:

- **High Speed:** Water jets excel in applications requiring high speeds. Since they operate unimpeded by a protruding propeller, they experience less drag, allowing vessels to reach higher speeds compared to propeller-driven counterparts.
- **Shallow Draft:** Water jets have a shallow water intake, making them ideal for navigating in shallow rivers, canals, or near coastlines with varying depths. Propellers, on the other hand, risk damage if they operate in shallow waters.
- **Improved Maneuverability:** Water jets offer superior maneuverability due to their ability to direct the water flow through a deflection mechanism. This allows for quick changes in direction and precise maneuvering in tight spaces, like harbors or during docking procedures.
- **Reduced Cavitation:** Cavitation, the formation and collapse of vapor bubbles around a propeller blade, can cause noise, vibration, and damage to the propeller. Water jets experience less cavitation because the water intake is located below the hull, away from the air-water interface.

Safety and Operational Benefits:

- **Safer for Swimmers and Marine Life:** With no exposed propeller blades, water jets pose a lower risk of injury to swimmers or marine life that might come into contact with the vessel.
- **Reduced Noise Levels:** Water jets generally operate quieter than propellers, making them suitable for noise-sensitive environments or research vessels requiring minimal acoustic disturbance.
- **Lower Maintenance:** Water jets typically require less maintenance compared to propellers. They have fewer moving parts and are less susceptible to damage from debris or underwater collisions.

Other Advantages:

- **Improved Fuel Efficiency:** In some cases, water jets can offer improved fuel efficiency, particularly at high speeds. This is because they can convert more engine power into thrust compared to propellers that lose some efficiency due to drag.
- **Reversible Thrust:** Some water jet designs incorporate a reversing mechanism that allows for immediate thrust reversal. This can be helpful for quick stops and precise maneuvering.

However, it's important to consider some drawbacks of water jets as well:

- **Higher Initial Cost:** Water jets are generally more expensive to purchase and install compared to conventional propellers.
- **Lower Efficiency at Low Speeds:** While efficient at high speeds, water jets might be less efficient at lower speeds compared to propellers.
- **Higher Complexity:** The design and operation of water jets can be more complex compared to propellers, requiring specialized training for maintenance and repairs.

Overall, water jets offer significant advantages in terms of performance, maneuverability, safety, and noise reduction. However, their higher initial cost, lower efficiency at low speeds, and increased complexity need to be factored in when deciding between water jets and propellers for a particular vessel application.

2020

Sept 2020

7. (a) Describe. with the aid of a sketch, how the alignment of a propeller transmission shaft system may be checked. (8)

(b) State the indications of a high bearing when the shaft is running. (2)

Question 7. Many attempt to describe aligning two shafts together rather than checking the alignment of the shafting. Candidates describe measuring along the shaft rather than the height of the bearings.

Propeller Shaft Alignment Check and High Bearing Indications

(a) Checking Propeller Transmission Shaft Alignment:

Ensuring proper alignment of the propeller shaft system is crucial for optimal performance, reduced wear and tear, and preventing vibration. Here are two common methods for checking shaft alignment:

1. Dial Gauge Method:

- This traditional method utilizes dial gauges to measure the relative runout (movement) of the shaft coupling flanges at various points.
- Dial gauges are magnetically attached to each flange, and the shaft is slowly rotated by hand.
- The runout at different points on the flange circumference is measured and compared to specified tolerances.
- Any deviations beyond acceptable limits indicate misalignment, which needs correction through adjustments of the engine mounts or gearbox position.

2. Laser Shaft Alignment:

- This modern method utilizes laser beam technology for more precise and efficient alignment checks.
- A laser transmitter is positioned on one shaft end, and a receiver is placed on the other.
- The laser beam projects onto the receiver target, and any misalignment is reflected in the position of the laser dot on the target.
- By following the system's instructions and adjusting mounts or gearbox position, the laser beam can be centered on the target, indicating proper alignment.

Additional Considerations:

- Regardless of the method used, shaft alignment should be performed by a qualified technician with the proper tools and expertise.
- Manufacturer's specifications for acceptable alignment tolerances and specific alignment procedures should be strictly followed.

(b) Indications of a High Bearing When the Shaft is Running:

A high bearing, also known as a seized or tight bearing, can cause several problems during shaft operation. Here are some indications that might suggest a high bearing:

- **Increased Vibration:** A high bearing can cause the shaft to run out of true, leading to increased vibration throughout the vessel. This vibration may be felt throughout the hull and might be noticeable visually.
- **Abnormal Shaft Temperature:** Friction from a high bearing can generate excessive heat. This can be detected by feeling increased temperature around the bearing housing or using specialized temperature monitoring instruments.
- **Unusual Noises:** Seized or tight bearings can produce grinding, scraping, or knocking noises as the shaft rotates with difficulty against the bearing surface.
- **Difficulty Turning the Shaft:** In severe cases, a very tight bearing may make it difficult or impossible to turn the shaft by hand.

Early detection and addressing a high bearing is crucial. Ignoring these symptoms can lead to further damage to the bearing, shaft, and surrounding components. If any of these indications are observed, the shaft should be stopped immediately, and a qualified mechanic should investigate the issue.

Sept 2020

8. Explain EACH of the following electrical terms:

(a) preferential tripping; (2)

(b) sequential starting; (2)

(c) fuse back up protection; (2)

(d) discrimination; (2)

(e) non-essential consumer. (2)

Question 8. Candidates struggle with sequential starting, the reason for back up fuses and discrimination. Most state circuits for propulsion are the only essential circuits.

Electrical Term Explanations:

(a) **Preferential Tripping:**

In an electrical system with multiple protective devices (circuit breakers, fuses), preferential tripping refers to the strategy where circuits considered critical are designed to trip (interrupt current flow) less readily compared to less critical circuits. This ensures that essential equipment or functions remain operational during a fault condition, while overloaded or faulty non-critical circuits are isolated.

Here's an example: Imagine a circuit feeding critical navigation equipment and another feeding cabin lights. In preferential tripping, the circuit breaker for the cabin lights would be set to trip at a lower current value compared to the breaker for the navigation equipment. This way, if there's a fault, the cabin lights would trip first, isolating the problem and allowing essential navigation equipment to continue functioning.

(b) **Sequential Starting:**

Sequential starting refers to the controlled starting of multiple electric motors in a specific order. This strategy is used to manage the inrush current (initial high surge of current) drawn by motors when they start. By starting motors one after another with a controlled time delay between them, the overall demand on the power supply is limited, preventing voltage dips or blackouts.

Sequential starting can be achieved using timers, relays, or programmable controllers depending on the complexity of the system. It's commonly used in applications like multiple pumps or large ventilation systems to avoid overloading the electrical supply during motor startup.

(c) **Fuse Back Up Protection:**

Fuse backup protection refers to a scenario where a circuit breaker is additionally protected by a fuse upstream in the electrical system. This provides a layered approach to fault protection. The fuse offers a fast-acting response to severe overcurrents, while the circuit breaker provides overload protection and allows for resetting after a fault is cleared.

Here's an example: Imagine a circuit breaker feeding a motor circuit. A fuse might be installed upstream of the breaker, closer to the main power supply. If a severe fault occurs, the fuse would blow first, interrupting the high current and protecting the circuit breaker from damage. The circuit breaker could then be reset after the fault is addressed.

(d) **Discrimination:**

Discrimination, in the context of electrical protection devices, refers to the ability of a device to selectively isolate a faulty circuit while allowing healthy upstream and downstream circuits to remain operational. This is achieved through proper selection and coordination of circuit breaker trip settings and fuse ratings.

Effective discrimination ensures that only the circuit experiencing a fault is interrupted, minimizing disruption to the rest of the electrical system. It's crucial for maintaining power supply to critical equipment during fault conditions.

(e) **Non-Essential Consumer:**

A non-essential consumer, in an electrical system, refers to a load or device that is not critical for the core operation of the system. These are circuits that can be interrupted without causing a major safety hazard or significant disruption to essential functions. Examples of non-essential consumers include:

- Air conditioning systems
- Cabin lighting
- Entertainment systems
- Kitchen appliances

Non-essential consumers are typically the first to be switched off or disconnected during emergencies or overload situations to conserve power and maintain operation of critical equipment.

2020

Sept 2020

9. List TEN routine maintenance checks that should be carried out on a vented type lead acid engine starting battery system. (10)

Question 9. Mostly well answered

Here are ten routine maintenance checks that should be carried out on a vented type lead-acid engine starting battery system:

1. **Visual Inspection:** Inspect the battery case for cracks, leaks, or signs of corrosion around the terminals. Clean any corrosion using a baking soda and water solution, following proper safety precautions.
2. **Terminal Tightness:** Ensure the battery terminals are clean and securely tightened. Loose terminals can lead to poor starting performance and increased resistance.

3. **Electrolyte Level:** For vented batteries, check the electrolyte level in each cell. The level should be between the upper and lower level indicators on the battery case. If low, top up with distilled water only, not battery acid.
4. **Electrolyte Condition:** Visually inspect the electrolyte for any discoloration or cloudiness. A clear, light brown or straw color is normal. Cloudy or dark electrolyte might indicate internal issues.
5. **Terminal Voltage:** Measure the battery's terminal voltage with a voltmeter. A fully charged battery should read around 12.6 - 12.8 volts DC. A significantly lower voltage might indicate a discharge or internal fault.
6. **Load Test (Optional):** Periodically perform a load test using a dedicated battery tester. This simulates the high current draw during engine starting and provides a more accurate assessment of the battery's health and cranking capability.
7. **Cleaning:** Keep the battery top and surrounding area clean and free of dirt, debris, or moisture build-up. This helps prevent corrosion and potential leakage currents.
8. **Ventilation:** Ensure proper ventilation around the battery, especially for vented types. These batteries release hydrogen gas during charging, and adequate ventilation is crucial for safety.
9. **Storage:** If the battery will be stored unused for an extended period, it's recommended to disconnect it from the electrical system and store it in a cool, dry place. Periodic charging during storage might be necessary to prevent excessive self-discharge.
10. **Age and Service History:** Maintain records of battery age and previous maintenance performed. Lead-acid batteries have a limited lifespan, and regular checks become even more critical as the battery ages.

By following these routine maintenance checks, you can help ensure the optimal performance, reliability, and lifespan of your vented lead-acid engine starting battery system.

pt 2020

Sept 2020

10. Describe, with the aid of sketches, TWO methods for controlling the speed of a hydraulic motor. (10)

Question 10. Marks lost by not explaining how speed is controlled, several just draw a swash plate pump and say that the swash angle can change with no explanation of what this does or how it is connected to the motor in circuit.

Here are two common methods for controlling the speed of a hydraulic motor:

1. Displacement Control:

- **Method:** This method controls the speed of the hydraulic motor by regulating the flow of hydraulic fluid entering the motor. The flow rate is directly proportional to the motor speed.
- **Components:**

    - **Variable Displacement Pump:** A pump that can adjust its displacement volume to vary the flow output. By adjusting the pump's displacement, the flow rate delivered to the motor can be precisely controlled.
    - **Control Valve:** A valve used to regulate the flow path and pressure of the hydraulic fluid. This valve might be a simple flow control valve or a more sophisticated servo valve for precise control.
- **Operation:**
    - Adjusting the variable displacement pump or the control valve setting changes the flow rate of the hydraulic fluid entering the motor.
    - Increasing the flow rate results in a higher motor speed, while decreasing the flow rate leads to a slower motor speed.
    - This method offers good control over the motor speed and can be very efficient, as minimal energy is wasted through throttling.

2. Pressure Relief Control (Throttle Control):

- **Method:** This method controls the speed of the hydraulic motor by regulating the pressure drop across the motor. A portion of the hydraulic fluid bypasses the motor, and the speed is indirectly controlled by varying the amount of bypass flow.
- **Components:**
    - **Fixed Displacement Pump:** A pump that delivers a constant flow rate regardless of the pressure or load on the system.
    - **Pressure Relief Valve:** A valve that regulates the system pressure by bypassing excess flow back to the reservoir. By adjusting the pressure setting of the valve, the pressure drop across the motor can be controlled.
- **Operation:**
    - The fixed displacement pump continuously delivers a constant flow of hydraulic fluid.
    - Adjusting the pressure relief valve setting changes the amount of fluid that bypasses the motor and returns to the reservoir.
    - Increasing the bypass flow reduces the pressure drop across the motor, resulting in a slower motor speed. Conversely, decreasing the bypass flow increases the pressure drop, leading to a higher motor speed.
- **Considerations:**
    - This method is simpler to implement but less efficient than displacement control. Energy is wasted by throttling the flow through the pressure relief valve, which can generate heat.
    - Pressure relief control might not be suitable for applications requiring high precision speed control due to its indirect control method.

The choice between displacement control and pressure relief control depends on the specific application requirements. Displacement control offers better efficiency and precise speed control, while pressure relief control is simpler to implement but less efficient.