Sept 2021

1. With reference to tank quick closing valves:

(a) describe, with the aid of sketches, TWO methods for remote operation; (6)

(b) state where they would be fitted; (2)

(c) explain why they are fitted. (2)

Tank Quick Closing Valves

(a) Remote Operation Methods:

1. **Hydraulic or Pneumatic Activation:** This method uses pressurized fluid (hydraulic) or air (pneumatic) to remotely close the valve. An activation signal triggers the release of pressurized fluid/air which pushes a piston within the valve, forcing it to shut.
2. **Wire Rope Release:** A wire rope connects the valve to a remote release mechanism. Pulling the wire lever at the remote location activates a mechanism within the valve, causing it to close rapidly.

(b) Where they are Fitted:

Quick closing valves are typically fitted on the outlet line of tanks containing flammable liquids like fuel oil. This includes:

- **Settling and service tanks** within engine rooms.
- Tanks in the **boiler room**.
- Tanks supplying the **emergency generator**.

(c) Why They Are Fitted:

These valves are crucial safety features for several reasons:

- **Emergency Shut-Off:** In case of fire or other emergencies, the valve can be shut remotely to prevent the flow of flammable liquid to the fire, potentially stopping its spread.
- **Isolation:** The valve can isolate a leaking or ruptured tank, preventing further flow of liquid and minimizing damage.
- **Remote Operation:** Since emergencies can make the tank area inaccessible, remote operation allows shutting off the flow from a safe location.

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.

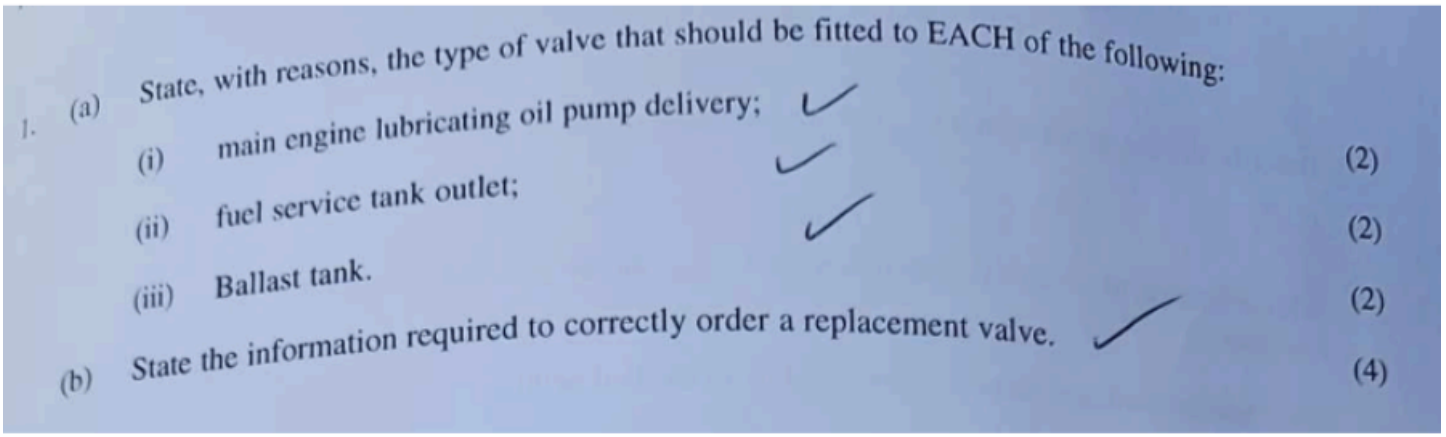
(c) Testing Procedures:

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.

Aug 2023



1. (a) State, with reasons, the type of valve that should be fitted to EACH of the following:
   (i) main engine lubricating oil pump delivery; (2)
   (ii) fuel service tank outlet; (2)
   (iii) Ballast tank. (2)
   (b) State the information required to correctly order a replacement valve. (4)

Feb 2021

Feb 2021

1. (a) State, with reasons, the type of valve that should be fitted to EACH of the following:
   (i) main engine lubricating oil pump delivery; (2)
   (ii) fuel service tank outlet; (2)
   (iii) Ballast tank. (2)
   (b) State the information required to correctly order a replacement valve. (4)

Valve Selection for Different Applications:

(i) Main Engine Lubricating Oil Pump Delivery:

- **Valve Type: Globe Valve**
- **Reasons:**
  - **Regulation and Isolation:** A globe valve allows for fine control of lubricating oil flow by adjusting the opening. It also provides positive shut-off for isolating the pump during maintenance.
  - **Pressure Handling:** Globe valves are suitable for handling the moderate pressure requirements of lubricating oil systems.
  - **Direction Change:** The internal design allows for changes in flow direction without significantly impacting performance, which might be relevant in some lubricating oil system designs.

(ii) Fuel Service Tank Outlet:

- **Valve Type: Remotely Operated Quick Closing Valve**
- **Reasons:**

- **Emergency Shut-Off:** This valve prioritizes safety in case of fire or leaks. Remote operation allows shutting off fuel flow from a safe location.
- **Leak Prevention:** A quick-closing mechanism minimizes the amount of fuel released in case of a leak or line rupture.
- **Material Compatibility:** The valve material should be compatible with the specific fuel type to avoid corrosion or degradation.

(iii) Ballast Tank:

- **Valve Type: Butterfly Valve**
- **Reasons:**
  - **Easy Operation:** Butterfly valves offer easy opening and closing with a quarter-turn operation, ideal for frequent ballast tank operations.
  - **Low Pressure Drop:** The design minimizes resistance to flow, which is important for efficient ballast water transfer.
  - **Cost-Effective:** Butterfly valves are generally less expensive compared to other options for this application.

(b) Information Required for Ordering a Replacement Valve:

To correctly order a replacement valve, you'll need the following information:

1. **Valve Type:** Specify the type (e.g., globe valve, butterfly valve, quick-closing valve).
2. **Nominal Pipe Size (NPS):** This indicates the diameter of the pipe the valve is designed for.
3. **Pressure Rating:** Specify the maximum pressure the valve can handle.
4. **Material:** Indicate the valve body and internal component materials (e.g., cast iron, stainless steel).
5. **Flange Standard:** Specify the flange connection type (e.g., ANSI, DIN) for proper fitment with existing piping.
6. **Connection Type:** Indicate if threaded, flanged, or other connection type is required.
7. **Manufacturer (Optional):** If you prefer a specific brand, include the manufacturer's name.
8. **Application Details (Optional):** Providing details about the intended use (e.g., fuel oil, lubricating oil, seawater) might be helpful for the supplier to recommend suitable options.

Nov 2021

Nov 2021

1. With reference to tank quick closing valves:

(a) describe, with the aid of sketches, TWO methods for remote actuation; (6)

(b) state where they would be fitted; (2)

(c) explain why they are fitted. (2)

Question 1. Mainly well answered. Candidates loose marks by not how the valve closes after it has been tripped.

Tank Quick Closing Valves: Remote Actuation and Purpose

(a) Remote Actuation Methods:

1. **Hydraulic or Pneumatic Activation:** This method utilizes pressurized fluid (hydraulic) or compressed air (pneumatic) for remote closure. An activation signal triggers the release of pressurized air/fluid, pushing a piston within the valve to shut it rapidly.
2. **Solenoid Actuation:** An electrical signal energizes a solenoid, which in turn operates a mechanism to close the valve quickly. This method is often used in conjunction with a control panel for remote activation.

(b) Where They Are Fitted:

Quick closing valves are strategically placed on the **outlet lines** of tanks containing flammable or hazardous liquids, typically in:

- **Fuel oil tanks** within engine rooms, boiler rooms, or near emergency generators.
- Tanks storing other flammable liquids in industrial settings.

(c) Why They Are Fitted:

These valves are crucial safety features for several reasons:

- **Emergency Shut-Off:** In critical situations like fire, the valve can be shut remotely to stop the flow of flammable liquids, potentially preventing the fire from spreading or intensifying.
- **Leak Isolation:** If a leak or tank rupture occurs, the valve can be quickly closed to isolate the issue and minimize the amount of liquid released.
- **Remote Operation:** Emergencies can render the tank area inaccessible. Remote operation allows for safe closure of the flow from a safe location away from the hazard.

Nov 2018 19th

Nov 2018 9th

1. (a) State the purpose of fitting isolating valves in a ring fire main. (2)

(b) State the type of valve that should be fitted for isolating sections of a ring fire main. (2)

(c) Explain why the type of valve stated in part (b) is used. (3)

(d) State how it is ensured that the isolating valve will operate when required. (1)

(e) State the position of the machinery space isolating valve. (2)

Isolating Valves in a Ring Fire Main

(a) Purpose:

Isolating valves are fitted in a ring fire main to achieve two main purposes:

1. **Maintain System Integrity:** In case of a leak, fire damage, or maintenance on a section of the fire main, isolating valves allow shutting down that specific section. This ensures water supply remains uninterrupted to the rest of the ring main, maintaining fire protection capabilities for other areas.

2. **Prevent Backflow:** Isolating valves prevent water from flowing in the wrong direction within the ring. This can occur due to pressure differences or pump operation and could potentially hinder firefighting efforts in certain sections.

(b) Valve Type: Gate Valve

(c) Reasons for Gate Valve:

Gate valves are the preferred choice for isolating sections of a ring fire main due to several advantages:

- **Full Closure:** Gate valves provide a positive shut-off, completely blocking water flow when closed. This is crucial to isolate leaks or damaged sections effectively.
- **Low Pressure Drop:** When fully open, the internal design of a gate valve minimizes resistance to water flow, ensuring minimal impact on overall system pressure.
- **Durability:** Gate valves are known for their robust construction and ability to withstand the high pressures typically encountered in fire main systems.

(d) Ensuring Valve Operation:

Several measures ensure reliable operation of isolating valves in a fire main:

- **Regular Maintenance:** Scheduled inspections and maintenance ensure the valve operates smoothly and components are free from corrosion or wear.
- **Operational Testing:** Periodic testing verifies the valve opens and closes fully during simulated emergency scenarios.
- **Grease Fittings:** Many gate valves have grease fittings for lubrication, which minimizes friction and ensures smooth operation during closure.
- **Accessibility:** Isolating valves are positioned in readily accessible locations to facilitate maintenance and operation during emergencies.

(e) Machinery Space Isolating Valve:

The machinery space isolating valve is typically located **outside** the machinery space, in an easily accessible and tenable (safe) location. This allows for safe isolation of the fire main section within the machinery space in case of fire or other incidents.

Nov 2020

1. With reference to ship's side valves:

(a) state why grey cast iron is not a suitable material; (3)

(b) state, with reasons, TWO suitable materials; (2)

(c) state the regular maintenance that the valves should receive, outlining reasons for this maintenance. (5)

Question 1. The question specifically refers to ship side valves, many give answers based on general properties of cast iron in sea water.

Ship's Side Valve Materials and Maintenance

(a) Why Grey Cast Iron is Unsuitable:

Grey cast iron is not a suitable material for ship's side valves due to several drawbacks:

- **Brittle Fracture:** This type of iron has low tensile strength and can crack or shatter under sudden impact or excessive stress. Ship's side valves are exposed to wave action and external pressure, making them susceptible to such stresses.
- **Corrosion Susceptibility:** Grey cast iron is prone to rust and corrosion in saltwater environments, which can weaken the valve body and lead to leaks or even catastrophic failure.

(b) Suitable Materials for Ship's Side Valves:

1. **Cast Steel:**
- **Reasons:**
    - **High Strength:** Cast steel offers superior strength and ductility compared to grey cast iron. It can withstand high pressures and impact loads encountered by ship's side valves.
    - **Corrosion Resistance:** Certain grades of cast steel, particularly those with higher chromium content, exhibit good corrosion resistance in saltwater environments, ensuring valve longevity.
2. **Ductile Iron (Nodular Iron):**
- **Reasons:**
    - **Strength and Ductility:** Ductile iron offers a good balance between strength and ductility. It's stronger than grey cast iron and less brittle, making it more resistant to impacts and pressure fluctuations.
    - **Corrosion Resistance:** Similar to some cast steel grades, certain types of ductile iron have improved corrosion resistance suitable for seawater applications.

(c) Regular Maintenance for Ship's Side Valves:

Regular maintenance is crucial for ensuring the safe and reliable operation of ship's side valves. Here are some key maintenance tasks and their reasons:

- **Visual Inspection:** Regularly checking for cracks, corrosion, leaks, or damage to the valve body, bonnet, and external components helps identify potential issues before they escalate.
- **Gland Packing Replacement:** Over time, the packing material around the valve stem can wear and lose its sealing effectiveness. Replacing worn packing ensures a tight seal and prevents leaks.
- **Operational Testing:** Periodically operating the valve through its full open-close cycle verifies smooth movement and confirms the valve can be fully opened and closed when needed.
- **Lubrication:** Lubrication of moving parts (e.g., spindle threads) minimizes friction and ensures smooth operation during valve actuation.
- **Internal Cleaning:** In some cases, internal cleaning may be necessary to remove debris or buildup that could hinder valve operation or cause leaks.

By performing these maintenance tasks regularly, ship crews can ensure the continued reliability and safety of ship's side valves, minimizing the risk of failures and potential environmental damage.

May 2021

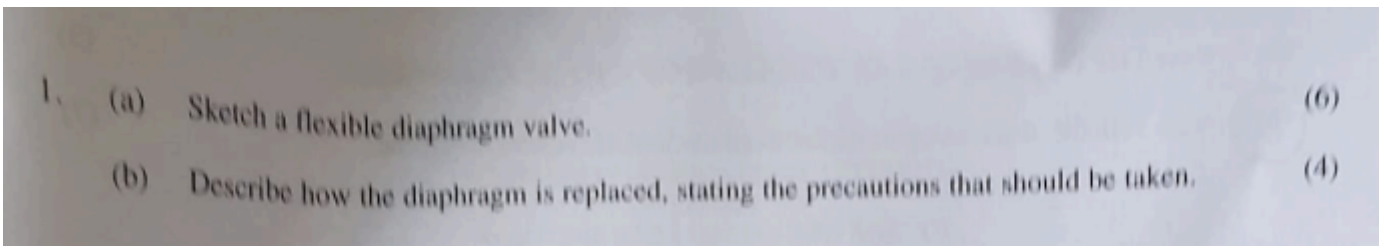
May 2021

1. (a) Sketch a flexible diaphragm valve. (6)

(b) Describe how the diaphragm is replaced, stating the precautions that should be taken. (4)

Question 1. Mostly well answered.

FEB 2024



Flexible Diaphragm Valve

(a) Description:

A flexible diaphragm valve is a type of valve that uses a flexible membrane (diaphragm) to control the flow of fluid. The diaphragm is typically made of elastomeric materials like rubber or synthetic polymers and is located between the body of the valve and the bonnet. Here's a breakdown of its key components:

- **Valve Body:** The main housing of the valve, typically made of metal or plastic.
- **Diaphragm:** The flexible membrane that seals the opening between the inlet and outlet ports.
- **Bonnet:** The part that secures the diaphragm to the valve body.
- **Actuator:** The mechanism that creates the force to open or close the diaphragm (manual, pneumatic, hydraulic, etc.).
- **Seat:** The surface within the valve body that the diaphragm seals against.

When the valve is closed, the actuator applies pressure to the diaphragm, pushing it against the seat and blocking the flow path. Conversely, when the valve needs to be opened, the actuator pressure is released, allowing the diaphragm to flex back and open the passage for fluid flow.

**(b) Diaphragm Replacement and Precautions:

Replacing a diaphragm requires careful handling to avoid damaging the valve or the new diaphragm. Here's a general process with important precautions:

Process:

1. **Isolating the Valve:** Close and lock out any isolation valves upstream and downstream of the diaphragm valve to prevent accidental pressurization during the replacement procedure.
2. **Relieving Pressure:** Ensure any residual pressure within the valve body is released through designated vent or bleed valves according to the manufacturer's instructions.
3. **Disassembly:** Following the manufacturer's guide, disassemble the valve components, carefully removing the bonnet to access the diaphragm.
4. **Diaphragm Removal:** Inspect the used diaphragm for signs of wear, tear, or damage. Gently remove it from the valve body and discard it properly.
5. **Cleaning the Seat:** Clean the sealing surface (seat) on the valve body to remove any dirt or debris that might hinder a proper seal with the new diaphragm.
6. **New Diaphragm Installation:** Inspect the new diaphragm for any defects. Carefully position it within the valve body, ensuring proper alignment with the seat.
7. **Reassembly:** Following the manufacturer's instructions in reverse order, reassemble the valve components, paying close attention to proper tightening torques for bolts and connections.

Precautions:

- **Follow Manufacturer's Instructions:** Always refer to the specific manufacturer's guide for the diaphragm valve you're working on. The disassembly, cleaning, and reassembly procedures may vary depending on the valve design.
- **Use Appropriate Tools:** Utilize the proper tools for disassembly and reassembly to avoid damaging the valve components.
- **Inspect the New Diaphragm:** Before installation, thoroughly inspect the new diaphragm for any cuts, tears, or imperfections that could compromise its sealing ability.
- **Handle with Care:** Avoid excessive stretching, pinching, or puncturing the diaphragm during handling and installation.
- **Proper Disposal:** Dispose of the used diaphragm according to local regulations for waste disposal, especially if it was exposed to hazardous materials.

By following these steps and precautions, you can replace a diaphragm in a diaphragm valve safely and effectively.

Nov 2018 2nd

1. (a) State the purpose of fitting isolating valves in a ring fire main. (2)

(b) State the type of valve that should be fitted for isolating sections of a ring fire main. (2)

(c) Explain why the type of valve stated in part (b) is used. (3)

(d) State how it is ensured that the isolating valve will operate when required. (1)

(e) State the position of the machinery space isolating valve. (2)

Isolating Valves in a Ring Fire Main

(a) Purpose of Isolating Valves:

Isolating valves play a crucial role in maintaining the effectiveness of a ring fire main by serving two key purposes:

1. **Maintaining System Integrity:** In case of a leak, fire damage, or maintenance on a specific section of the ring main, isolating valves allow shutting down that particular section. This ensures uninterrupted water supply to the rest of the ring, maintaining fire protection capabilities for other areas.
2. **Preventing Backflow:** Isolating valves prevent water from flowing in the wrong direction within the ring. This can occur due to pressure differences or pump operation and could potentially hinder firefighting efforts in certain sections.

(b) Valve Type: Gate Valve

(c) Reasons for Gate Valve:

Gate valves are the preferred choice for isolating sections of a ring fire main due to several advantages:

- **Positive Shut-Off:** Gate valves provide a complete closure, completely blocking water flow when shut. This is vital for effectively isolating leaks or damaged sections.
- **Low Pressure Drop:** When fully open, the internal design of a gate valve minimizes resistance to water flow, ensuring minimal impact on overall system pressure.
- **Durability:** Gate valves are known for their robust construction and ability to withstand the high pressures typically encountered in fire main systems.

(d) Ensuring Valve Operation:

Several measures ensure reliable operation of isolating valves in a fire main:

- **Regular Maintenance:** Scheduled inspections and maintenance ensure the valve operates smoothly and components are free from corrosion or wear.
- **Operational Testing:** Periodic testing verifies the valve opens and closes fully during simulated emergency scenarios.

- **Grease Fittings:** Many gate valves have grease fittings for lubrication, which minimizes friction and ensures smooth operation during closure.
- **Accessibility:** Isolating valves are positioned in readily accessible locations to facilitate maintenance and operation during emergencies.

(e) Machinery Space Isolating Valve:

The machinery space isolating valve is typically located **outside** the machinery space, in an easily accessible and tenable (safe) location. This allows for safe isolation of the fire main section within the machinery space in case of fire or other incidents. By having the valve outside, firefighters can control the water supply without entering the potentially hazardous environment.

Sept 18th 2020

Sept (18th) 2020

1. (a) Sketch a section through a 3-way mixer valve. (8)

(b) State an application for this type of valve. (2)

3-Way Mixer Valve: Cross-Section and Application

(a) Description of a 3-Way Mixer Valve Cross-Section:

A 3-way mixer valve has a body with three openings: one inlet and two outlets. Here's a breakdown of the key components in a typical cross-section:

- **Valve Body:** The main housing of the valve, usually made of brass, stainless steel, or plastic.
- **Inlet Port:** The opening where the incoming flow enters the valve.
- **Outlet Ports:** Two openings where the mixed or diverted flow exits the valve.
- **Mixing Chamber:** An internal chamber where the incoming flow mixes or diverts depending on the valve position.
- **Spool or Disc:** A movable component within the mixing chamber that controls the flow path between the inlet and outlets. The spool can have different shapes depending on the valve design (rotary, sliding, etc.).
- **Stem:** The shaft connected to the spool, used for manual or actuated control of the spool's position.
- **Seals:** Sealing components around the spool and at the connection points ensure a leak-proof operation.

The spool movement determines how the flows are directed:

- **Mixing Position:** The spool directs some flow from the inlet to each outlet, allowing for mixing of two fluids (e.g., hot and cold water).
- **Diverting Position:** The spool directs the entire flow from the inlet to one specific outlet, isolating the other outlet.

(b) Application for a 3-Way Mixer Valve:

3-way mixer valves have various applications depending on the specific design and materials. Here's a common example:

- **Temperature Control in Domestic Hot Water Systems:** In a shower or faucet, a 3-way mixer valve allows mixing hot and cold water to achieve the desired temperature at the outlet. The user adjusts the handle or knob, which controls the spool position to regulate the mix of hot and cold water entering the showerhead or faucet.

Other applications include:

- **Diverting flow in compressed air systems**
- **Controlling fluid flow in medical equipment**
- **Regulating coolant flow in industrial processes**

April 2021

April 2021

1. (a) Sketch a section through a bilge injection (emergency bilge) valve. (8)

(b) Describe how the valve sketched in part (a) is tested. (2)

Bilge Injection Valve Cross-Section and Testing

(a) Bilge Injection Valve Cross-Section:

A bilge injection valve allows seawater from a dedicated seawater source (often the main sea chest) to be pumped directly overboard in emergency situations. Here's a breakdown of its key components in a cross-section:

- **Valve Body:** The main housing, typically made of cast iron or steel, designed to withstand seawater pressure.
- **Inlet Port:** The connection point for the seawater supply line.
- **Outlet Port:** The connection point for the discharge line leading overboard.
- **Gate:** A movable disc or wedge-shaped element within the body that controls the flow path. The gate can be actuated by various mechanisms (manual lever, hydraulic piston, solenoid).
- **Seat:** The sealing surface within the body that the gate closes against to prevent seawater flow when the valve is shut.
- **Spindle:** The shaft connected to the gate, used for manual or actuated control of the gate's position.
- **Packing:** Sealing material around the spindle to prevent seawater leakage along the shaft.

(b) Testing Bilge Injection Valves:

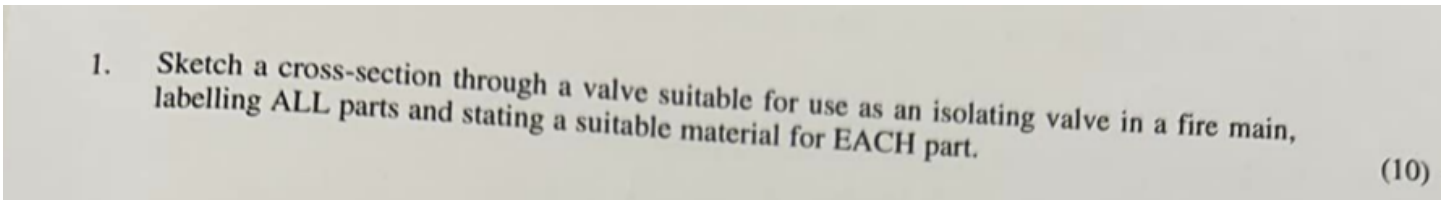
Regular testing of bilge injection valves is crucial to ensure their functionality in emergencies. Here are some common testing procedures:

- **Operational Check:** This involves manually operating the valve through its full open-close cycle to verify smooth movement and proper closure of the gate against the seat. Listen for leaks and ensure the valve opens and closes completely.

- **Remote Activation Test (if applicable):** For valves with remote actuation (hydraulic, pneumatic, or solenoid), simulate an emergency scenario by activating the remote closing mechanism and verify the valve shuts down promptly. This test confirms the functionality of the entire actuation system.
- **Leakage Test:** With the valve closed, the system is pressurized on the inlet side to identify any leaks around the gate, packing, or body. Pressurized air or water (depending on system design) is used to detect leaks which could compromise the valve's ability to isolate the bilge from seawater in an emergency.
- **Visual Inspection:** The valve body, bonnet (if present), and accessible internal components are visually inspected for signs of wear, corrosion, or damage that could affect the valve's performance.

The specific testing frequency and procedures may vary depending on regulations, industry standards, and the specific application on the ship. Records of these tests are typically maintained for documentation and regulatory compliance purposes.

Nov 2023



1. Sketch a cross-section through a valve suitable for use as an isolating valve in a fire main, labelling ALL parts and stating a suitable material for EACH part. (10)

Feb 19th 2021

Feb 19th 2021

1. Sketch a cross-section through a valve suitable for use as an isolating valve in a fire main, labelling ALL parts and stating a suitable material for EACH part. (10)

Cross-Section of a Fire Main Isolating Valve (Gate Valve)

A gate valve is a suitable choice for isolating sections of a fire main due to its positive shut-off and low-pressure drop characteristics. Here's a breakdown of its key components in a cross-section, along with suggested materials:

- **Valve Body:** The main housing that encloses all internal components. It should be made of high-strength material to withstand high water pressure in fire main systems.
    - **Suitable Material: Cast Iron (Ductile Iron or Nodular Iron)** - Ductile iron offers a good balance between strength and ductility, making it resistant to high pressures and potential shock loads.
- **Gate:** A movable wedge-shaped disc that slides vertically within the body to control flow.
    - **Suitable Material: Cast Steel or Stainless Steel** - These materials provide excellent strength and corrosion resistance, ensuring reliable operation in saltwater environments. Some fire main gate valves may use bronze for the gate due to its good wear resistance and sealing properties.
- **Seat Rings:** Sealing surfaces within the body that the gate comes in contact with to form a tight closure.
    - **Suitable Material: Bronze or Nickel-Alloy** - These materials offer good wear resistance and corrosion resistance, ensuring a leak-proof seal when the gate is closed.

- **Spindle:** The shaft connected to the gate, used for manual or actuated control of the gate's position.
    - **Suitable Material: Stainless Steel** - This material offers high strength and corrosion resistance, ensuring smooth operation of the gate and resisting saltwater corrosion.
- **Packing:** Sealing material around the spindle to prevent water leakage along the shaft.
    - **Suitable Material: Graphite or PTFE (Teflon)** - These materials provide good sealing properties and are relatively resistant to wear and tear.
- **Bonnet (Optional):** A bolted or screwed cover that secures the top of the valve body and provides access to the packing for maintenance.
    - **Suitable Material: Cast Iron (Ductile Iron) or Cast Steel** - These materials offer sufficient strength and can be easily bolted or screwed to the valve body.
- **Handwheel or Gear Operator:** A mechanism attached to the spindle for manual operation of the gate valve.
    - **Suitable Material: Cast Iron, Steel, or Ductile Iron** - These materials offer adequate strength for manual operation. Some valves may use stainless steel for the handwheel for improved corrosion resistance.

Note: This is a general description, and the specific materials used for each component may vary depending on the valve design, pressure rating, and manufacturer's specifications.

July 2021

July 2021

1. With reference to quick closing valves:

(a) state where they would be fitted; (2)

(b) explain how they operate should a fire occur in EACH of the following:

(i) the machinery space; (4)

(ii) close proximity to the valve. (4)

Quick Closing Valves: Location and Operation in Fire Scenarios

(a) Where They Are Fitted:

Quick closing valves are strategically placed on the **outlet lines** of tanks containing flammable or hazardous liquids, typically in:

- **Fuel oil tanks** within engine rooms, boiler rooms, or near emergency generators.
- Tanks storing other flammable liquids in industrial settings.

(b) Quick Closing Valve Operation in Fire Scenarios:

(i) Fire in the Machinery Space:

In this scenario, the quick closing valve plays a crucial role in isolating the fuel source and preventing the fire from spreading. Here's how it operates:

- **Heat Detectors or Fire Alarm:** Heat detectors or a fire alarm system within the machinery space would trigger a signal.
- **Remote Activation:** The fire alarm signal activates the remote closing mechanism of the quick closing valve (e.g., hydraulic, pneumatic, or solenoid).
- **Valve Closure:** The remote activation pushes a piston or releases pressurized air/fluid, forcing the valve shut rapidly. This isolates the fuel supply to the machinery space, preventing further feeding of the fire.

(ii) Fire Close to the Valve:

If a fire occurs near the quick closing valve itself (e.g., due to a fuel line leak), the valve's operation becomes even more critical. Here's what might happen:

- **Heat Exposure:** The intense heat from the fire could potentially melt or damage the electrical wiring or control mechanisms for remote actuation (if applicable).
- **Manual override:** In such cases, the valve design typically incorporates a **manual override** feature. This allows firefighters or personnel on-site to manually close the valve using a lever or wheel mechanism, even if the remote actuation system is compromised by the fire.
- **Automatic Closure (Optional):** Some quick closing valves may have **built-in temperature sensors** or **fusible links**. When exposed to excessive heat from a nearby fire, these mechanisms trigger an automatic closure of the valve, isolating the fuel source without relying on remote activation.

Note: The specific operation and fail-safe mechanisms of quick closing valves may vary depending on the valve design, fire detection system, and manufacturer's specifications.

March 19th 2021

March 19th 2021

1. (a) State, with reasons, the type of valve that should be used in EACH of the following situations:

   (i) isolating valve within a fire main; (2)

   (ii) main engine stand-by cooling water circulating pump discharge. (2)

   (b) With reference to a fuel service tank outlet valve:

   (i) describe its operation; (4)

   (ii) state the reason for the operation in part (b)(i). (2)

Valve Selection and Fuel Service Tank Outlet Valve Operation

(a) Valve Types for Different Applications:

(i) Isolating Valve within a Fire Main:

- **Valve Type: Gate Valve**
- **Reasons:**

- **Positive Shut-Off:** Gate valves provide a complete closure, critically important for isolating leaks or damaged sections of a fire main.
- **Low Pressure Drop:** When fully open, the design minimizes resistance to water flow, ensuring minimal impact on overall system pressure in the fire main.
- **Durability:** Gate valves are known for their robust construction and ability to withstand the high pressures encountered in fire main systems.

(ii) Main Engine Stand-By Cooling Water Circulating Pump Discharge:

- **Valve Type: Globe Valve** (or Butterfly Valve)
- **Reasons:**
  - **Regulation:** A globe valve allows for fine-tuning of the stand-by cooling water flow to the main engine, which might be desirable for temperature control.
  - **Lower Pressure Drop (Optional):** While gate valves offer low pressure drop when fully open, a butterfly valve might be a suitable alternative if minimizing pressure drop across the valve is a primary concern during stand-by cooling operation. However, butterfly valves typically have a higher pressure drop compared to globe valves when fully open.
  - **Cost (Optional):** Butterfly valves are generally less expensive than globe valves. If cost is a major consideration and fine flow control is not essential, a butterfly valve could be a viable option.

(b) Fuel Service Tank Outlet Valve Operation and Reason:

(i) Valve Operation:

A fuel service tank outlet valve is typically a **remotely operated quick closing valve**. Here's how it operates:

1. **Normal Operation:** The valve remains open under normal conditions, allowing fuel to flow from the tank when needed.
2. **Fire Alarm or Sensor Activation:** In case of a fire or a leak detection signal, the fire alarm system or leak detection system transmits a signal.
3. **Remote Closure:** The signal triggers the remote closing mechanism of the valve (e.g., hydraulic, pneumatic, or solenoid).
4. **Rapid Shut-Off:** The mechanism forces the valve shut rapidly, stopping the flow of fuel from the tank. This helps to:
   - **Prevent Fire Spread:** By isolating the fuel source, the valve can prevent the fire from reaching the fuel tank and potentially causing a larger explosion.
   - **Minimize Leakage:** In case of a leak in the fuel line, the quick closure minimizes the amount of fuel released, reducing environmental hazards and potential fire risks.

(ii) Reason for Operation:

The primary reason for the quick closing operation of the fuel service tank outlet valve is to **limit the spread of fire and minimize fuel release** in case of an emergency. By isolating the fuel source, this valve helps to:

- **Enhance Fire Safety:** Quick shut-off reduces the risk of fuel feeding the fire and potentially causing a catastrophic event.

- **Minimize Environmental Impact:** Limiting fuel release minimizes environmental damage from potential spills or leaks.

March 26th 2021

March 26th 2021

1. State, with reasons, a suitable application for EACH of the following types of valve:

   (a) butterfly; (2)

   (b) diaphragm; (2)

   (c) screw-down, non-return; (2)

   (d) 3-way; (2)

   (e) quick closing, screw lift. (2)

Suitable Applications for Different Valve Types:

Here's a breakdown of suitable applications for each valve type, along with the reasons for their suitability:

(a) Butterfly Valve:

- **Application: Large diameter pipelines for air, gas, or low-pressure liquids.**
- **Reasons:**
  - **Low Pressure Drop:** The butterfly valve design minimizes resistance to flow when fully open, making it ideal for large diameter pipelines where maintaining flow rate is crucial.
  - **Cost-Effective:** Butterfly valves are generally less expensive than other valve types, making them a cost-effective choice for large-scale applications.
  - **Quick Operation:** Some butterfly valve designs allow for relatively quick opening and closing compared to other valves.

(b) Diaphragm Valve:

- **Application: Handling corrosive or viscous fluids, sterile applications.**
- **Reasons:**
  - **Leak-Proof Design:** The flexible diaphragm isolates the fluid completely from the valve body and stem, preventing leaks and contamination. This is ideal for corrosive or hazardous fluids.
  - **Gentle on Fluids:** The diaphragm opening and closing mechanism minimizes shear stress on the fluid, making it suitable for viscous fluids or applications requiring delicate handling of the fluid.
  - **Cleanability:** The simple design with minimal internal crevices facilitates easy cleaning and sterilization, making it suitable for hygienic applications.

(c) Screw-Down, Non-Return Valve:

- **Application: Preventing backflow in pipelines, positive shutoff with check valve functionality.**

- **Reasons:**
    - **Check Valve Functionality:** The screw-down mechanism allows for adjusting the cracking pressure (minimum pressure required to open the valve) and ensures the valve remains closed during normal flow but opens to allow flow in the intended direction.
    - **Positive Shut-Off:** The screw mechanism can be tightened to achieve a positive shut-off, isolating the flow completely when needed. This is useful for maintenance or emergencies.
    - **Durability:** Screw-down, non-return valves are known for their robust construction and ability to withstand high pressures.

(d) 3-Way Valve:

- **Application: Mixing or diverting fluids in pipelines, controlling flow direction.**
- **Reasons:**
    - **Flow Control:** The 3-way valve allows for mixing two fluids (e.g., hot and cold water) or diverting flow between two outlets, making it versatile for various flow control applications.
    - **Compact Design:** Compared to using separate valves for mixing or diverting, 3-way valves offer a more compact and space-saving solution.
    - **Simplicity:** The operating mechanism of a 3-way valve is often relatively simple, making it easy to use and maintain.

(e) Quick Closing, Screw Lift Valve:

- **Application: Emergency shut-off in pipelines carrying flammable liquids or hazardous materials.**
- **Reasons:**
    - **Rapid Closure:** The screw lift mechanism allows for quick and reliable shut-off of the valve in case of an emergency.
    - **High Pressure Capability:** Screw lift valves are often designed to handle high pressures commonly encountered in pipelines carrying hazardous materials.
    - **Positive Shut-Off:** The screw mechanism ensures a positive seal when closed, preventing leaks of hazardous materials.

Note: These are general recommendations, and the specific application suitability may vary depending on the valve design, pressure rating, and material of construction.

May 2024

1. (a) Sketch a globe type screw lift valve suitable for sea water service.

   (b) State, with reasons, the materials used for the valve sketched in part (a).

May 28th 2021

May 28th 2021

1. (a) Sketch a globe type screw lift valve suitable for sea water service. (7)

(b) State, with reasons, the materials used for the valve sketched in part (a). (3)

Globe Type Screw Lift Valve for Seawater Service

(a) Description:

A globe type screw lift valve suitable for seawater service is a valve designed to regulate or isolate flow within a pipeline conveying seawater. Here's a breakdown of its key features:

- **Valve Body:** The main housing of the valve, typically made of **cast iron** or **bronze**. Cast iron offers good strength and affordability, while bronze provides excellent corrosion resistance in saltwater environments. Some high-performance valves might use **stainless steel** for the body for its superior corrosion resistance but at a higher cost.
- **Screw Mechanism:** A threaded spindle (screw) connected to a handwheel or actuator for manual or automated control of the valve. The screw mechanism allows for **precise positioning** of the internal disc, enabling fine-tuned flow regulation.
- **Disc:** A circular plate within the body that controls the flow path. The disc can be made of various materials depending on the specific application and pressure rating. For seawater service, materials like **bronze**, **stainless steel**, or **rubber coated discs** might be used. Bronze offers good corrosion resistance and wear resistance, while stainless steel provides superior corrosion resistance but might be more expensive. Rubber-coated discs can improve sealing and offer good wear resistance but might not be suitable for high-pressure applications.
- **Seat Ring(s):** Sealing surfaces within the body that the disc comes in contact with to form a tight closure. For seawater service, the seat ring(s) are typically made of **bronze** or **stainless steel**. These materials offer good wear resistance and corrosion resistance to create a reliable seal.
- **Packing:** Sealing material around the spindle to prevent seawater leakage along the shaft. **Graphite** or **PTFE (Teflon)** are common packing materials due to their good sealing properties and wear resistance in a saltwater environment.
- **Bonnet:** A bolted or screwed cover that secures the top of the valve body and provides access to the packing for maintenance. The bonnet material typically matches the body material (cast iron, bronze, or stainless steel) for strength and compatibility.

(b) Material Selection and Reasons:

- **Valve Body:** Cast iron or bronze (primary choices).
    - **Reason:** Cast iron offers a good balance between affordability and strength, while bronze provides excellent corrosion resistance in saltwater environments.
- **Screw Mechanism:** Stainless steel (preferred).
    - **Reason:** Stainless steel offers good strength and superior corrosion resistance compared to cast iron, ensuring smooth operation and longevity in a saltwater environment.

- **Disc:** Bronze, stainless steel, or rubber-coated (depending on specific application and pressure).
    - **Reason:** These materials offer a balance between wear resistance, corrosion resistance, and flow control characteristics depending on the specific needs of the seawater service application.
- **Seat Ring(s):** Bronze or stainless steel.
    - **Reason:** These materials provide good wear and corrosion resistance, ensuring a leak-proof seal against the disc.
- **Packing:** Graphite or PTFE (Teflon).
    - **Reason:** These materials offer good sealing properties and are relatively resistant to wear and tear in a saltwater environment.
- **Bonnet:** Material matching the valve body (cast iron, bronze, or stainless steel).
    - **Reason:** Ensures strength and compatibility with the body material for a secure closure.

Note: This is a general description, and the specific materials used for each component may vary depending on the valve design, pressure rating, and manufacturer's specifications.