## March 2024

1. Describe, with the aid of sketches, how an axial piston pump can vary the volume of liquid it displaces. (10)

## March 2024

2. Describe, with the aid of a sketch, a constant pressure hydraulic power system for a vessel's Anchor Windlass, showing safety features and labelling ALL components of the system. (10)

## March 2024

3. With reference to speed control of ac induction motors, explain the function of Pulse Width Modulation (PWM). (10)

## March 2024

4. With reference to induction motor starters:

   (a) state when a STAR/DELTA starter may be required; (2)

   (b) describe the operation of a STAR/DELTA starter; (5)

   (c) explain why the motor configuration is changed from STAR to DELTA. (3)

## March 2024

5. Sketch an indirect expansion, chilled water air conditioning plant, labelling the MAIN components. (10)

## March 2024

6. With reference to air conditioning systems, state the meaning of EACH of the following terms:

(a) heating load; (1)

(b) cooling load; (1)

(c) sensible heat; (2)

(d) latent heat; (2)

(e) absolute humidity; (2)

(f) specific humidity. (2)

## March 2024

7. (a) Describe TWO possible sources of contamination of compressed air used for breathing. (4)

(b) State THREE contaminants that may be found in compressed air, outlining the effect of the contaminant on the user when the compressed air is used for diving (SCUBA) purposes. (6)

## March 2024

8. With reference to the Code of Safe Working Practices for Merchant Seamen and maintenance of lifting equipment:

(a) state the interval between testing and who should carry out the testing; (2)

(b) state the name of the document where details of the vessel's lifting gear is kept; (1)

(c) state the meaning of SWL; (1)

(d) state the possible reasons for needing to take a piece of lifting equipment out of service, explaining the measures to be taken before it can be returned to service. (6)

## March 2024

9. Describe the procedure that should be followed if an outboard motor has been submerged in sea water. (10)

## March 2024

10. With reference to the International Convention for the Safe and Environmentally Sound Recycling of Ships:

(a) state the operational requirements for compliance; (4)

(b) list FOUR prohibited hazardous materials; (4)

(c) list TWO hazardous materials whose use should be restricted. (2)

March 2024

1. Describe, with the aid of sketches, how an axial piston pump can vary the volume of liquid it displaces.

(10)

Axial piston pumps achieve variable displacement through a mechanism involving an angled swash plate and pistons arranged around it. Here's a breakdown:

- **Swash Plate:** This is a flat plate positioned at an angle relative to the drive shaft. The pistons connect to the swash plate via a slipper or yoke.
- **Pistons:** These are cylindrical plungers that slide within a cylinder block. Their movement creates the pumping action.

By tilting the swash plate, the angle between the piston axis and the cylinder block axis changes. This angle variation directly affects the piston stroke length:

- **Zero Angle:** When the swash plate is perpendicular to the drive shaft (zero angle), the pistons move straight up and down with minimal stroke. This results in the least amount of fluid displacement per rotation.
- **Increased Angle:** Tilting the swash plate creates an angle between the piston and cylinder axes. As the angle increases, the piston stroke length grows. This allows for a larger volume of fluid to be drawn in and expelled per rotation.

This mechanism allows for smooth adjustment of the pump's output flow rate. By controlling the swash plate angle, the pump can vary its displacement from zero to maximum, delivering a wide range of flow rates within the system.

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March 2024

2. Describe, with the aid of a sketch, a constant pressure hydraulic power system for a vessel's Anchor Windlass, showing safety features and labelling ALL components of the system.

(10)

## Constant Pressure Hydraulic Power System for Anchor Windlass

A constant pressure hydraulic power system provides a reliable and powerful solution for operating a vessel's anchor windlass. Here's a breakdown of its components, operation, and safety features:

**Components:**

1. **Reservoir:** This tank stores the hydraulic fluid (usually oil) and maintains its level. It may also incorporate a breather filter to allow air exchange and prevent contamination.

2. **Pump:** A positive displacement pump (e.g., gear pump, vane pump) is the heart of the system. It continuously draws fluid from the reservoir and pressurizes it. Electric motors, diesel engines, or even a shaft from the main engine can drive the pump.
3. **Pressure Relief Valve:** This safety valve protects the system from excessive pressure build-up. It bypasses excess fluid back to the reservoir if the pressure exceeds a set limit.
4. **Filter:** A hydraulic filter removes contaminants from the fluid to prevent wear and tear on system components.
5. **Directional Control Valve:** This valve controls the direction of the fluid flow, directing it to the appropriate actuator (e.g., hydraulic motor) based on operator commands (usually through levers or buttons). It can be a solenoid-operated valve for precise control.
6. **Hydraulic Motor:** This motor converts the pressurized hydraulic fluid into rotary motion to drive the windlass. Different motor types (e.g., radial piston, axial piston) can be chosen based on torque and speed requirements.
7. **Piping and Hoses:** These connect the components, carrying the pressurized fluid throughout the system. They are designed for high pressure and chosen for compatibility with the hydraulic fluid.
8. **Actuator (Optional):** In some systems, an additional actuator (e.g., hydraulic cylinder) might be used for functions like raising/lowering the anchor chain gypsy or deploying an anchor brake.

**Operation:**

1. **Power Source:** The pump is activated by its designated power source (electric motor, diesel engine, etc.).
2. **Fluid Flow:** The pump continuously draws fluid from the reservoir and pressurizes it.
3. **Pressure Relief Valve:** The pressure relief valve ensures the system pressure stays within safe limits by bypassing excess fluid back to the reservoir if needed.
4. **Filter:** The fluid passes through a filter to remove contaminants before reaching the control valve.
5. **Directional Control Valve:** The operator controls the directional control valve, directing pressurized fluid to specific ports on the valve.
6. **Hydraulic Motor:** Based on the valve position, the pressurized fluid flows to the hydraulic motor, causing it to rotate in a specific direction (hoisting or lowering the anchor).
7. **Anchor Windlass:** The rotating shaft of the hydraulic motor drives the windlass gears, raising or lowering the anchor chain.

**Safety Features:**

- **Pressure Relief Valve:** As mentioned earlier, this valve prevents overpressure and protects the system from damage.
- **Check Valves (Optional):** In some systems, check valves can be placed strategically to prevent unintended flow reversal or pressure loss in specific situations.
- **Low-Level Sensor (Optional):** This sensor can be used to warn of low fluid levels in the reservoir, preventing pump damage due to cavitation.
- **Fluid Selection:** Choosing the appropriate hydraulic fluid with proper viscosity and fire resistance is crucial for safe operation.
- **Regular Maintenance:** Regular inspection, maintenance, and replacement of filters and worn components ensure system reliability and safety.

**Benefits of Constant Pressure System:**

- **Reliable Power:** The constant pressure ensures consistent power delivery for anchor handling operations.
- **Precise Control:** Directional control valves offer precise control over the windlass operation.
- **Scalability:** The system can be sized based on the specific windlass requirements and anchor size of the vessel.
- **Efficiency:** Modern hydraulic components offer good efficiency in converting engine power to usable work at the windlass.

**In conclusion, a constant pressure hydraulic power system provides a robust and efficient solution for operating a vessel's anchor windlass. By incorporating safety features and proper maintenance, this system ensures safe and reliable anchor handling operations.**

## March 2024

3. With reference to speed control of ac induction motors, explain the function of Pulse Width Modulation (PWM). (10)

In the context of AC induction motor speed control, Pulse Width Modulation (PWM) isn't directly applied to control the motor's speed itself. However, it plays a crucial role within the Variable Frequency Drive (VFD) that regulates the motor's speed. Here's how:

**VFD and the Role of PWM:**

1. **AC Mains Input:** A VFD receives the 3-phase AC mains supply (fixed frequency and voltage).
2. **Rectification:** The VFD first converts the AC voltage into a pulsating DC voltage using a rectifier circuit.
3. **DC Link Capacitor:** This capacitor stores the DC voltage and smooths out the pulsations, providing a more stable DC voltage level.
4. **Inverter:** This is where PWM comes into play. The inverter section uses IGBTs (Insulated-Gate Bipolar Transistors) as electronic switches. By rapidly switching these IGBTs on and off using PWM technique, the inverter controls the output voltage delivered to the motor.

**PWM for Voltage Control:**

- **Pulse Width Modulation:** PWM works by varying the **duty cycle** of the control signal sent to the IGBTs. The duty cycle refers to the percentage of time the IGBT remains switched on within a single switching cycle.
- **Impact on Output Voltage:**
  - **High Duty Cycle:** When the duty cycle is high (IGBT on for a longer duration), the average voltage delivered to the motor is also high (think of it as a longer "on" time for the voltage).
  - **Low Duty Cycle:** Conversely, a low duty cycle (IGBT on for a shorter duration) translates to a lower average voltage delivered to the motor (shorter "on" time for the voltage).

**VFD - The Bigger Picture:**

1. **Speed Control via V/f Ratio:** While PWM controls the output voltage, the VFD also regulates the frequency of the inverter's output. This is crucial because, for optimal motor operation, the VFD maintains a constant **V/f (voltage-to-frequency) ratio**.
2. **Speed Adjustment:** To control the motor's speed, the VFD adjusts both the output voltage (using PWM) and frequency together, following the V/f principle. By increasing or decreasing the V/f ratio, the motor's speed is adjusted accordingly.

**In essence, PWM within a VFD allows for precise control of the output voltage, which, in conjunction with frequency control, enables the VFD to regulate the speed of the AC induction motor efficiently while maintaining optimal operating conditions.**

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March 2024

4. With reference to induction motor starters:

(a) state when a STAR/DELTA starter may be required; (2)

(b) describe the operation of a STAR/DELTA starter; (5)

(c) explain why the motor configuration is changed from STAR to DELTA. (3)

March 2020June 2020

## Induction Motor Star-Delta Starters

Star-delta starters are a type of reduced voltage starter commonly used with three-phase induction motors. Here's a breakdown of their application, operation, and the reason for switching configurations:

**(a) When is a Star-Delta Starter Required?**

Star-delta starters are particularly beneficial in situations where:

- **The motor has a high starting current:** Induction motors draw a significant surge of current when starting, which can overload the power supply and cause voltage dips. A star-delta starter helps to reduce this starting current.
- **The application doesn't require high starting torque:** While star-delta starters reduce starting current, they also decrease the starting torque compared to a direct online connection. So, they are suitable for applications where the motor doesn't need to overcome a high initial load to get going.
- **Cost-effective solution:** Compared to more sophisticated soft starters, star-delta starters are a relatively inexpensive way to manage high starting currents.

**(b) Operation of a Star-Delta Starter:**

A star-delta starter has two main components:

1. **Contactors:** These are electromagnetic switches that connect or disconnect the motor windings from the power supply. There are typically three contactors, one for each phase, in both the star and delta configurations.
2. **Timer:** This device controls the switching sequence between star and delta connections.

Here's the typical operation sequence:

1. **Start:** When the motor is turned on, the star contactor energizes, connecting the motor windings in a star configuration.
2. **Reduced Starting Current:** The star connection reduces the voltage applied to each motor winding (by a factor of $1/\sqrt{3}$) and consequently reduces the starting current drawn from the supply.
3. **Acceleration:** The motor accelerates with the reduced voltage. The timer is set for a predetermined time based on the motor's characteristics.
4. **Delta Connection:** After the timer elapses, the star contactor de-energizes, and the delta contactor energizes. This connects the motor windings in a delta configuration, applying the full line voltage to each winding.
5. **Running:** The motor operates at its normal speed and torque in the delta connection.

**(c) Why Change from Star to Delta?**

There are two main reasons for switching the motor configuration from star to delta:

- **Reduced Starting Current:** The primary objective is to limit the high inrush current during motor startup. By initially connecting the windings in a star configuration, the starting current is significantly reduced, protecting the electrical supply from overload.
- **Improved Efficiency at Running Speed:** Once the motor has accelerated and overcome the initial load, the delta connection provides the full line voltage to each winding. This allows the motor to operate at its designed efficiency and full torque capability.

In essence, a star-delta starter offers a balance between protecting the power supply during startup and allowing the motor to run efficiently at its normal operating speed.

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March 2024

5. Sketch an indirect expansion, chilled water air conditioning plant, labelling the MAIN components. (10)

# Indirect Expansion, Chilled Water Air Conditioning Plant: Main Components

An indirect expansion, chilled water air conditioning plant uses a two-stage cooling process to provide cool air for a building. Here's a breakdown of the main components involved:

**1. Chiller:**

- The heart of the system. It's a large heat exchanger that uses a refrigerant (e.g., R-22, R-410A) to absorb heat from water.
- The chiller has a compressor that pressurizes the refrigerant, raising its temperature.
- The hot, high-pressure refrigerant passes through a condenser coil, where it releases heat to the surrounding air or a cooling tower (explained later).
- The cooled, low-pressure refrigerant then flows through an expansion valve, which reduces its pressure and further lowers its temperature.
- The cold refrigerant then absorbs heat from the chilled water loop in another heat exchanger called the evaporator.

**2. Chilled Water Loop:**

- A closed loop of piped water that circulates chilled water throughout the building.
- The chilled water absorbs heat from the air in the air handling units (AHUs) through heat exchangers.
- Chilled water pumps circulate the water throughout the loop.

**3. Cooling Tower (Optional):**

- Used in some systems to reject heat from the chiller condenser.
- It uses water and air circulation to cool down the condenser water, which then cools the refrigerant in the chiller.
- Cooling towers can be evaporative (using water evaporation) or air-cooled (using large fans).

**4. Air Handling Units (AHUs):**

- Located throughout the building, these units condition the air that ultimately reaches the conditioned spaces.
- They contain:
  - **Supply Fan:** Draws in outdoor air (or a mix of outdoor and return air)
  - **Filters:** Remove dust, pollen, and other contaminants from the air.
  - **Cooling Coil:** A heat exchanger where the chilled water loop absorbs heat from the air flowing through the AHU.
  - **Optional: Heating Coil (for year-round comfort):** Can be used to heat the air in cooler seasons using hot water or steam.
  - **Supply Air Fan:** Pushes the conditioned air through ductwork to the conditioned spaces.

**5. Control System:**

- Monitors and regulates the entire system's operation.
- Uses sensors to measure temperatures, pressures, and air flow.
- Adjusts components like chillers, pumps, and AHUs to maintain desired comfort conditions and optimize energy efficiency.

**Additional Components:**

- **Ductwork:** A network of insulated pipes that carries conditioned air from the AHUs to the conditioned spaces.

- **Thermostats:** Located in conditioned spaces, they send signals to the control system to adjust cooling or heating as needed.

**Benefits of Indirect Expansion, Chilled Water Systems:**

- Efficient cooling for large buildings: Chilled water can be distributed over long distances to multiple AHUs.
- Flexible system design: AHUs can be located throughout the building for optimal air distribution.
- Can be integrated with heating systems: Provides year-round comfort control.

**By understanding the main components and their functions, you can gain a basic understanding of how an indirect expansion, chilled water air conditioning plant works to keep buildings cool and comfortable.**

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March 2024

6. With reference to air conditioning systems, state the meaning of EACH of the following terms:

(a) heating load; (1)

(b) cooling load; (1)

(c) sensible heat; (2)

(d) latent heat; (2)

(e) absolute humidity; (2)

(f) specific humidity. (2)

## Air Conditioning Terminology: Understanding Heating and Cooling Needs

In the context of air conditioning systems, these terms define various aspects of heat transfer and moisture content in air:

**(a) Heating Load:**

The heating load refers to the amount of heat **required** to maintain a desired temperature within a conditioned space during colder periods. This heat compensates for heat loss from the space due to factors like conduction (through walls and windows), convection (air movement), and radiation.  Air conditioners can sometimes be used in reverse cycle mode to provide heating in addition to cooling.

**(b) Cooling Load:**

The cooling load refers to the amount of heat that needs to be **removed** from a conditioned space to maintain a desired temperature during warmer periods. This heat gain comes from various sources like:

- **External heat gain:** Heat entering the space through walls, windows, and roofs due to solar radiation.
- **Internal heat gain:** Heat generated within the space due to occupants, equipment, lighting, and appliances.
- **Ventilation:** Heat introduced by introducing outdoor air for ventilation purposes.

The air conditioning system is sized based on the maximum cooling load it needs to handle.

**(c) Sensible Heat:**

Sensible heat refers to the thermal energy that results in a **change in temperature** of a substance (air, in this case) without a change in its state (i.e., not causing a phase change from liquid to vapor or vice versa). When we feel warmer or cooler, we are primarily sensing changes in sensible heat.

**(d) Latent Heat:**

Latent heat refers to the thermal energy absorbed or released during a **change of state** of a substance. In air conditioning, latent heat is associated with the **evaporation** (absorbing heat) or **condensation** (releasing heat) of water vapor in the air.  Dehumidification processes involve removing latent heat by condensing water vapor from the air.

**(e) Absolute Humidity:**

Absolute humidity refers to the **total mass of water vapor** present in a given volume of air. It is expressed in units like grams of water vapor per cubic meter of air (g/m³). A higher absolute humidity indicates more moisture content in the air.

**(f) Specific Humidity:**Specific humidity refers to the **mass of water vapor per unit mass of dry air**. It is expressed in units like grams of water vapor per kilogram of dry air (g/kg). Specific humidity is a more intensive property compared to absolute humidity, as it represents the moisture content relative to the dry air itself.

March 2024

7. (a) Describe TWO possible sources of contamination of compressed air used for breathing. (4)

(b) State THREE contaminants that may be found in compressed air, outlining the effect of the contaminant on the user when the compressed air is used for diving (SCUBA) purposes. (6)

Nov 2020**Compressed Breathing Air Contamination in SCUBA Diving**

**(a) Two Possible Sources of Contamination of Compressed Air Used for Breathing:**

1. **Intake Air Contamination:**
   - The air used to fill the breathing cylinders comes from the surrounding environment. If the air intake is located in an area with high levels of pollutants like:
     - Carbon monoxide (CO) from vehicle exhaust fumes
     - Industrial emissions containing harmful chemicals
     - Dust or other particulates

These contaminants can enter the compressed air system and pose a health risk to divers.

2. **System Contamination:**
   - Contamination can also occur within the air compression and storage system itself. Sources include:
     - **Oil leaks:** From compressor lubricants entering the air stream.
     - **Rust or corrosion:** Degradation of system components releasing particles into the air.
     - **Improper maintenance:** Failure to properly clean and maintain filters and separators within the compressed air system.

**(b) Three Contaminants and their Effects on SCUBA Divers:**

1. **Carbon Monoxide (CO):**

- **Effect:** CO binds to hemoglobin in the blood more readily than oxygen, reducing the blood's ability to carry oxygen to vital organs.
- **Symptoms:** Headache, dizziness, nausea, fatigue, confusion, and in severe cases, unconsciousness and death. Even low levels of CO can impair judgement and coordination, increasing the risk of diving accidents.

2. **Hydrocarbons (Oil Vapors):**
   - **Effect:** Oil vapors can irritate the respiratory system, causing coughing, wheezing, and shortness of breath. In severe cases, they can lead to fluid buildup in the lungs (pulmonary edema).
   - **Symptoms:** May not be immediately noticeable during the dive, but symptoms can develop after surfacing.
3. **Nitrogen Dioxide (NO2):**
   - **Effect:** NO2 irritates the respiratory tract, causing coughing, chest tightness, and shortness of breath. High exposure can lead to fluid buildup in the lungs (pulmonary edema).
   - **Symptoms:** Similar to hydrocarbon exposure, symptoms may develop after surfacing.

**Additional Points:**

- Regular testing of compressed breathing air is crucial to ensure it meets safety standards and is free from harmful contaminants.
- Divers should use reputable dive centers that maintain their equipment properly and use high-quality breathing air.

Remember, breathing contaminated air underwater can be life-threatening. Divers should be aware of the risks and take steps to minimize them.h 2024

March 2024

8. With reference to the Code of Safe Working Practices for Merchant Seamen and maintenance of lifting equipment:

(a) state the interval between testing and who should carry out the testing; (2)

(b) state the name of the document where details of the vessel's lifting gear is kept; (1)

(c) state the meaning of SWL; (1)

(d) state the possible reasons for needing to take a piece of lifting equipment out of service, explaining the measures to be taken before it can be returned to service. (6)

June 2020

Here's the information you requested, referencing the Code of Safe Working Practices for Merchant Seamen (COSWP) and lifting equipment maintenance:

**(a) Testing Interval and Tester**

The COSWP doesn't prescribe a single testing interval for all lifting equipment. It emphasizes following two key sources for determining the testing schedule:

- **Manufacturer's Instructions:** Lifting equipment should be thoroughly examined and tested at the intervals recommended by the manufacturer. These intervals can vary depending on the equipment type and usage.
- **Regulations:** Some countries or regulatory bodies may have additional mandatory testing requirements that supersede or supplement the manufacturer's recommendations. The Master of the vessel is responsible for ensuring compliance with all relevant regulations.

**Who carries out the testing?**

The testing should be carried out by a **competent person**. The COSWP doesn't provide a specific definition, but it's generally understood to be someone with:

- **Appropriate qualifications:** Relevant certifications or training in inspecting and testing lifting equipment.
- **Knowledge:** Understanding of the specific equipment, its operation, and potential hazards.
- **Experience:** Practical experience in conducting inspections and tests.

This could be a qualified surveyor, shore-based engineer, or a designated crew member with relevant training certified by the appropriate authority.

**(b) Document for Lifting Gear Details**

The COSWP doesn't specify a single document name, but it likely refers to the ship's **"Register of Lifting Appliances and Gear"**. This document should contain details of all lifting equipment on board, including:

- Type of equipment (e.g., crane, derrick, winch)
- Safe Working Load (SWL)
- Manufacturer's name and identification number
- Dates of examinations and tests
- Details of any repairs or modifications

**(c) SWL Meaning**

SWL stands for **Safe Working Load**. This is the maximum rated load that a piece of lifting equipment can safely handle under specified conditions. It's crucial to never exceed the SWL of any equipment.

**(d) Reasons for Taking Equipment Out of Service and Returning It**

There are several reasons why a piece of lifting equipment might need to be taken out of service:

- **Damage:** Visible signs of wear, tear, cracks, corrosion, or other damage that could compromise the equipment's safety.
- **Failure During Testing:** If the equipment fails to meet the required standards during a periodic inspection or test.
- **Overload:** If the equipment has been subjected to a load exceeding its SWL.
- **Suspicious Activity:** Any unexplained malfunction or unusual behavior during operation.

**Measures Before Returning Equipment to Service:**

Before returning equipment to service, the following steps should be taken:

- **Identify the Cause:** Investigate and identify the root cause of the problem that took the equipment out of service.
- **Repair or Replacement:** The damaged component(s) should be repaired or replaced with certified parts as needed.
- **Retesting:** The equipment should be thoroughly re-examined and tested by a competent person to ensure it meets the required safety standards before being used again.
- **Documentation:** The Register of Lifting Appliances and Gear should be updated to reflect the repairs, replacements, and retesting.

By following these guidelines and adhering to the COSWP recommendations, merchant seamen can ensure the safe operation and maintenance of lifting equipment on board vessels.

## March 2024

9. Describe the procedure that should be followed if an outboard motor has been submerged in sea water. (10)

March 2021Nov 2018Here's the procedure you should follow if an outboard motor has been submerged in seawater:

**Immediate Actions:**

1. **Safety First:** Ensure your own safety and the safety of others by turning off the engine (if still running) and disconnecting the battery to prevent electrical hazards.
2. **Retrieve the Engine:** If possible, retrieve the outboard motor from the water as soon as possible. Saltwater exposure can accelerate corrosion.

**Prevent Further Damage:**

1. **Do Not Start the Engine:** Resist the urge to start the engine. Starting a submerged engine can cause internal damage by forcing saltwater through the system.
2. **Flush with Fresh Water:** As soon as possible, thoroughly flush the outboard motor with clean, fresh water. This will help remove saltwater residue and prevent corrosion. You can use a garden hose with a moderate spray pattern to avoid damaging internal components.

**Detailed Cleaning and Inspection:**

1. **Drain Fluids:** Drain the engine oil, gear oil, and any other fluids that may have been contaminated with saltwater.
2. **Spark Plugs:** Remove the spark plugs and allow the cylinders to drain any trapped water. You can crank the engine slowly with the spark plugs removed to further expel water.
3. **Air Intake:** Inspect the air intake for any water ingress. Remove any water or debris that may have entered the air filter.
4. **Corrosion Prevention:** Apply a light coating of corrosion inhibitor spray to all metal surfaces after rinsing with fresh water.

**Maintenance and Restart:**

1. **Professional Inspection:** It's highly recommended to have a qualified outboard mechanic inspect the engine for any internal damage caused by the submersion. They can assess the condition of bearings, seals, and other critical components.
2. **Oil Change:** Replace the engine oil and gear oil with fresh lubricants after the inspection.
3. **Refill Fluids:** Refill any other fluids that were drained during the cleaning process.
4. **Test and Restart:** Only after a thorough inspection and any necessary repairs, attempt to restart the engine. Follow the manufacturer's recommended procedures for starting the engine after submersion.

**Additional Considerations:**

- **Freshwater vs. Saltwater Submersion:** While these steps provide a general guideline, the specific actions might differ slightly depending on whether the submersion occurred in freshwater or saltwater. Saltwater is more corrosive, so a more meticulous freshwater flush and inspection may be necessary.
- **Severity of Submersion:** The extent of the cleaning and inspection procedure may also depend on the severity of the submersion. A complete submersion for an extended period will likely require a more comprehensive inspection than a brief dunk.
- **Manufacturer's Recommendations:** Always refer to the owner's manual for your specific outboard motor model for any specific instructions or recommendations regarding submersion and recovery procedures.

Following these steps promptly after submersion can help minimize damage to your outboard motor and increase the chances of a successful recovery. However, a professional inspection by a qualified mechanic is highly recommended to ensure the engine's safety and performance after a saltwater submersion.

## March 2024

10. With reference to the International Convention for the Safe and Environmentally Sound Recycling of Ships:

(a) state the operational requirements for compliance; (4)

(b) list FOUR prohibited hazardous materials; (4)

(c) list TWO hazardous materials whose use should be restricted. (2)

March 2021

The International Convention for the Safe and Environmentally Sound Recycling of Ships, also known as the Hong Kong Convention (HKC), aims to ensure responsible ship recycling practices. While not yet in effect, here's what it entails:

**(a) Operational Requirements for Compliance:**

The HKC outlines several requirements for ship owners and recycling facilities to achieve compliant ship recycling:

- **Inventory of Hazardous Materials (IHM):** Ships must maintain a detailed IHM that identifies the type, location, and quantity of hazardous materials onboard. This allows for safe handling and removal during recycling.
- **Ship Recycling Plan (SRP):** A specific plan for each ship's recycling process needs to be developed. This plan should consider factors like waste management, worker safety, and environmental protection.
- **Recycling Facility Requirements:** Recycling facilities must be authorized and operate according to the HKC guidelines. This includes having proper equipment, trained personnel, and procedures for handling hazardous materials and pollutants.
- **Flag State and Recycling State Cooperation:** The flag state (country of registration) and the recycling state (country where the ship is recycled) have responsibilities to ensure the recycling process adheres to the Convention.

**(b) Four Prohibited Hazardous Materials:**

The HKC strictly prohibits the presence of certain hazardous materials in ships destined for recycling. These include:

1. **Polychlorinated Biphenyls (PCBs):** These organic chemicals were used in various applications like transformers and capacitors but are now banned due to their environmental and health risks.
2. **Hexachlorobenzene (HCB):** This persistent organic pollutant was used as a fungicide but is now banned due to its toxicity and bioaccumulation potential.
3. **Lightweight halogenated hydrocarbons (LBHs):** This category includes certain ozone-depleting substances like chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) used in refrigeration and fire suppression systems.
4. **Lead compounds:** Lead is a toxic metal historically used in paints, coatings, and other materials. Its presence requires special handling during ship recycling.

**(c) Two Hazardous Materials with Restricted Use:**

The HKC also restricts the use of certain materials in ships, requiring careful management during recycling:

1. **Asbestos:** This fibrous mineral was used for insulation but can cause serious health problems like lung cancer. Ships containing asbestos need specific removal and disposal procedures.
2. **Polybrominated Biphenyl Ethers (PBDEs):** These flame retardants were used in various ship materials but are now restricted due to concerns about their environmental persistence and potential health effects.

By adhering to these regulations, the HKC aims to minimize the environmental and health hazards associated with ship recycling.

Sources

www.vesselfinder.com/news/19825-Seaspan-Fleet-Achieves-IHM-Certification