

CERTIFICATE OF COMPETENCY EXAMINATION

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF
MARITIME AND COASTGUARD AGENCY

SMALL VESSEL CHIEF ENGINEER <3000 GT, UNLIMITED
SMALL VESSEL CHIEF ENGINEER <500 GT, UNLIMITED

059-01 - CHIEF ENGINEER STATUTORY AND OPERATIONAL REQUIREMENTS

FRIDAY, 24 May 2024

1400-1600 hrs

Examination paper inserts:

--

Notes for the guidance of candidates:

1. Candidates should note that 100 marks are allocated to this paper. To pass candidates must achieve 50 marks.
2. Non-programmable calculators may be used
3. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer

Materials to be supplied by examination centres:

Candidate's examination workbook

--

CHIEF ENGINEER STATUTORY AND OPERATIONAL REQUIREMENTS

Attempt ALL questions
Marks for each part question are shown in brackets

*Mediteranean + Carib's
Africa
Gulf etc*

1. With reference to the MARPOL Convention:
 - (a) list FIVE *Particularly Sensitive Sea Areas* (P.S.S.A.); (5)
 - (b) outline the general requirements for vessels transiting P.S.S.A. (5)

2. (a) In addition to the Engine Room Log, a general abstract associated with the main and auxiliary machinery should be completed.

List SIX details which are normally recorded in the abstract, in the case of main engines and generators. *avg. l.o. - hrs since over haul
- hrs since injc charge*

 (6)
- (b) State the main reasons why an abstract is kept.

overall running cond. of engine

 (4)

3. With reference to the International Convention on Load Lines:
 - (a) define the terms *freeboard* and *freeboard deck*; (5)
 - (b) list FIVE items that would be inspected by a surveyor before issuing or endorsing a load line certificate. *- free parts
- markings & correct
- water tight integ.* (5)

4. With reference to the Maritime Labour Convention (MLC), each member state shall ensure that ships that fly its flag have "Seafarers Employment Agreements" in place. State the FIVE requirements of these agreements. *- place of Repatriation
- agreed wages
- agreed time off
- social security in case of sickness* (10)

5. (a) List FOUR examples of materials on board a vessel for which a Material Safety Data Sheet (MSDS) should be supplied. *VOC'S, PCB'S, Acetone, Paints
cleaning solutions
solvents* (4)
- (b) List SIX items of information that could be obtained from a MSDS. *health hazard
- first aid
- ingredients & concentrations* (6)

6. With reference to condition monitoring: *engine*
 - (a) explain how vibration analysis can be used as part of a planned maintenance system; *Touch ← pumps Motors* (7)
 - (b) list SIX tests that can be carried out on crankcase oil in order to determine its suitability for further service. (3)
 - viscosity
 - flash point
 - TBN
 - suspended particles / wear
 - water con
 - fuel dilution

renewal of stat certs are aligned, special hull survey

7. (a) Define the term *harmonisation system of survey and certification*. (4)
- (b) With reference to a vessel of 500 gross tonnes or more and carrying 12 passengers, list SIX statutory certificates that are required to be carried out in order to demonstrate compliance with the IMO Conventions. (6)
8. (a) State the procedures and safety checks that should be undertaken prior to flooding a dry dock. *All work comp. / Plugs, and grates put back Tanks in similar condition / movable weights in similar cond.* (9)
- (b) State who is responsible for signing the authority for a Flood Certificate. (1)
- MASTER*
9. (a) A vessel with two main engines each with a working sump lubricating oil capacity of 750 litres and an average daily consumption each of 3.5 litres at full power, has bunkered 1000 litres of oil. (6)
- Calculate the steaming range of the vessel when the engines are operated at full power delivering a speed of 15 knots to the vessel.
- (b) State the factors that should be considered when determining the fresh water requirements for a voyage. (4)
- Consumption Rate*
- # of people
- watermaking capacity
10. (a) Write standing orders detailing the procedures to be followed in the event of a fire within the machinery spaces. *Inform Restrict - extinguish* (6)
- Raise Alarm PIP all available means*
- (b) List FOUR types of portable fire extinguisher that could be found within the machinery spaces, stating on which class of fire EACH should be used. (4)
- find leak*
- WATER: A*
CO2: B
FOAM: AB
POWDER: ABC

IOPP

1. With reference to the MARPOL Convention: (5)
- (a) list FIVE *Particularly Sensitive Sea Areas* (P.S.S.A.): (5)
- (b) outline the general requirements for vessels transiting P.S.S.A.

(a) List

FIVE Particularly Sensitive Sea Areas (PSSA). (5 marks)

Examples of IMO-designated PSSAs include:

1. **Great Barrier Reef, Australia**
2. **Wadden Sea, North Sea (Denmark, Germany, Netherlands)**
3. **Florida Keys, USA**
4. **Galápagos Archipelago, Ecuador**
5. **Western European Waters (Spain, France, Portugal, UK, Ireland, Belgium)**

(Other acceptable answers include: Baltic Sea, Canary Islands, Malpelo Island, Papahānaumokuākea, etc.)

(b) Outline the general requirements for vessels transiting a PSSA. (5 marks)

1. **Compliance with protective measures** – follow IMO-adopted routing measures, traffic separation schemes, or mandatory reporting requirements.
2. **Discharge restrictions** – strict prohibition on discharge of oil, noxious liquid substances, sewage, or garbage within the PSSA.
3. **Anchoring controls** – anchoring may be prohibited or restricted to protect fragile seabeds (e.g., coral reefs).
4. **Speed restrictions** – speed limits may be enforced to minimise wash and reduce collision risk with marine life.
5. **Enhanced navigation and reporting** – vessels may be required to use designated sea lanes, VTS (Vessel Traffic Services), and provide position reports.

2. (a) In addition to the Engine Room Log, a general abstract associated with the main and auxiliary machinery should be completed. (6)
- List SIX details which are normally recorded in the abstract, in the case of main engines and generators. *avg. l.o. - hrs since over haul* (4)
- (b) State the main reasons why an abstract is kept. *overall running cond. of engine*

(a)

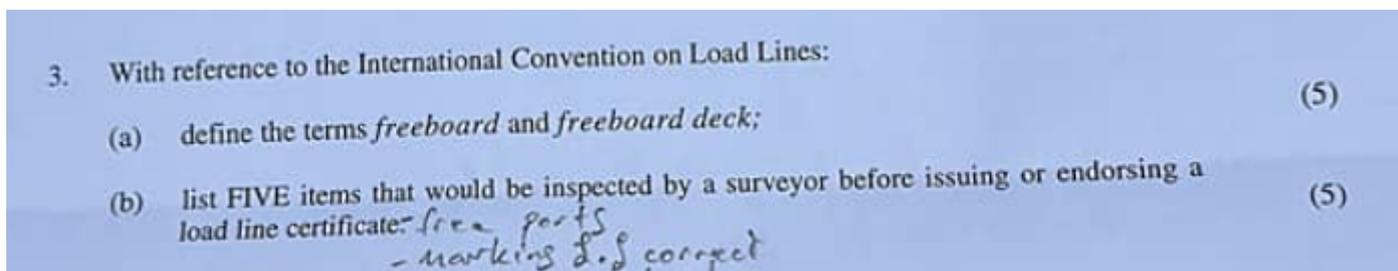
List SIX details which are normally recorded in the abstract, in the case of main engines and generators. (6 marks)

1. **Running hours** since last overhaul.
2. **Running hours** since last major inspection (e.g., piston, liner, turbocharger change).
3. **Lubricating oil consumption** and hours since last oil change.
4. **Fuel consumption** for main engines and auxiliaries.
5. **Cooling water and lubricating oil temperatures/pressures** (trends/averages).
6. **Notable maintenance or defects** (e.g., machinery condition, alarms, breakdowns).

(Other acceptable entries: cylinder oil consumption, bearing temperatures, load on generators, exhaust gas temperatures, hours since last scavenge inspection, etc.)

(b) State the main reasons why an abstract is kept. (4 marks)

1. **To provide a summary of overall machinery performance and condition** (without reading the full log).
2. **To help monitor trends** in fuel/oil consumption, running hours, and maintenance needs.
3. **To assist with maintenance planning and scheduling** under planned maintenance systems (PMS).
4. **To act as an official record** for surveyors, auditors, and company/flag state inspections.



(a) Define the terms freeboard and freeboard deck. (5 marks)

● **Freeboard:**

The **vertical distance** measured amidships from the **waterline at the assigned summer load line** to the **upper surface of the freeboard deck**.

→ It indicates the minimum reserve buoyancy of the vessel and is a critical safety measure.

● **Freeboard Deck:**

The **uppermost complete deck** exposed to weather and sea, which has permanent means of closing all openings and below which all bulkheads are watertight.

→ It is the reference deck from which freeboard is measured.

(b) List FIVE items that would be inspected by a surveyor before issuing or endorsing a load line certificate. (5 marks)

1. **Plimsoll Mark / Load Line markings** – correctly positioned, marked, and permanently painted.
2. **Deck openings** – hatches, doors, and manholes watertight and in good condition.
3. **Freeing ports** – correct size and operation for freeing water on deck.
4. **Ventilators and air pipes** – height, strength, and proper closing appliances.
5. **Guard rails, bulwarks, and closing appliances** – structurally sound and of correct height.

(Other acceptable: machinery space openings, scuppers, coamings, weathertight integrity of superstructures, etc.)

4. With reference to the Maritime Labour Convention (MLC), each member state shall ensure that ships that fly its flag have "Seafarers Employment Agreements" in place. State the FIVE requirements of these agreements. *- place of Repatriation* (10)

Requirements of a Seafarer's Employment Agreement (SEA):

1. **Seafarer's personal details** – full name, date of birth/age, place of birth.
2. **Shipowner's details** – name and address of the shipowner (or company employing the seafarer).
3. **Position and duties** – capacity in which the seafarer is employed (e.g., AB, engineer, cook).
4. **Duration of employment** – period of the contract, conditions of extension, and termination clauses.
5. **Wages and entitlements** – agreed wage rate, overtime pay, and method of payment.
6. **Leave and repatriation rights** – entitlement to annual leave, sick leave, and conditions of repatriation.
7. **Health, medical care, and social protection** – including provisions for injury, illness, or death.
8. **Seafarer's signature and employer's signature** – both parties must sign the agreement.
9. **Reference to collective bargaining agreements (CBA)** – if applicable, included or attached.
10. **Notice period** – terms for termination by either party.

6. With reference to condition monitoring: *to check Motors*
- (a) *engine* explain how vibration analysis can be used as part of a planned maintenance system; (7)
- (b) list SIX tests that can be carried out on crankcase oil in order to determine its suitability for further service. (3)

Q6. With reference to condition monitoring:

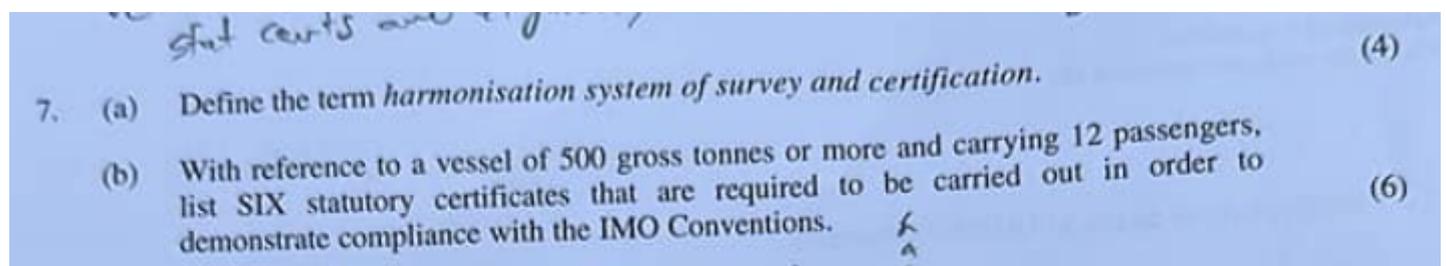
- (a) Explain how vibration analysis can be used as part of a planned maintenance system. (7 marks)

- **Vibration analysis** is the measurement and monitoring of vibration levels in rotating machinery.
- Each machine has a characteristic vibration "signature." Changes in this signature can indicate developing faults.
- It allows **early detection** of problems such as:
 - Bearing wear or damage
 - Shaft misalignment
 - Rotor imbalance
 - Gear tooth damage
- By trending vibration data over time, engineers can identify **deterioration before failure occurs**.
- Enables **predictive maintenance**: repairs are scheduled at convenient times, avoiding breakdowns.
- Reduces **downtime and maintenance costs**.
- Forms part of a **planned maintenance system** by allowing service intervals to be based on equipment condition rather than fixed time schedules.

(b) List SIX tests that can be carried out on crankcase oil in order to determine its suitability for further service. (3 marks)

Tests may include:

1. **Viscosity test** – checks if oil has thinned (fuel dilution) or thickened (oxidation/contamination).
2. **Water content test** – presence of water indicates leakage or condensation.
3. **Insolubles test** – measures carbon, sludge, and dirt content.
4. **Base number (BN) test** – determines reserve alkalinity for neutralising acids.
5. **Acid number (AN) test** – measures acidity due to oxidation or fuel contamination.
6. **Flash point test** – reduced flash point indicates fuel dilution.
7. **Spectrometric analysis** – detects metal particles (bearing wear, cylinder wear).



(a) Define the term *harmonisation system of survey and certification*. (4 marks)

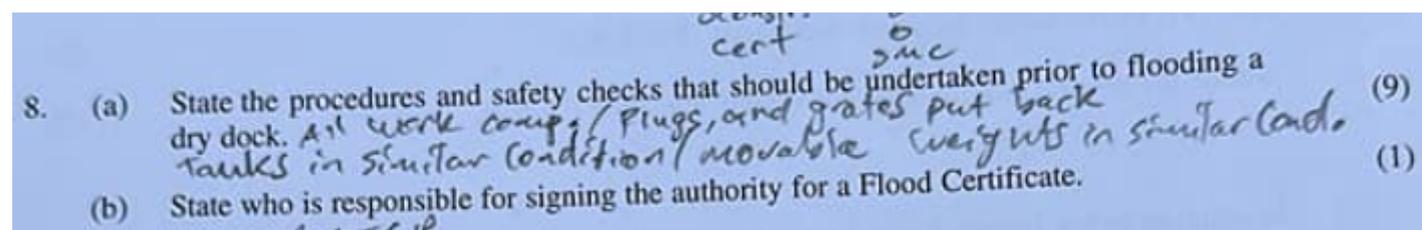
- The **Harmonised System of Survey and Certification (HSSC)** was introduced by IMO to align the **surveys, inspections, and certification periods** of ships across multiple IMO conventions (e.g., SOLAS, MARPOL, Load Lines, etc.).
- It ensures that **all statutory surveys are carried out at the same time**, reducing duplication and improving efficiency.
- Certificates issued under HSSC have **uniform periods of validity** (normally 5 years) with intermediate, annual, and renewal surveys harmonised.
- The system improves **consistency, reduces administrative burden**, and ensures ships remain compliant with all applicable conventions in a streamlined way.

✓ (4 marks: 1 per key point).

(b) With reference to a vessel of 500 gross tonnes or more and carrying 12 passengers, list SIX statutory certificates required to demonstrate compliance with IMO Conventions. (6 marks)

Typical statutory certificates include:

1. **Cargo Ship Safety Construction Certificate (SOLAS)**
2. **Cargo Ship Safety Equipment Certificate (SOLAS)**
3. **Cargo Ship Safety Radio Certificate (SOLAS)**
4. **International Oil Pollution Prevention Certificate (IOPP) – MARPOL Annex I**
5. **International Load Line Certificate (ICLL)**
6. **International Air Pollution Prevention Certificate (IAPP) – MARPOL Annex VI**
7. **International Sewage Pollution Prevention Certificate (ISPP) – MARPOL Annex IV**
8. **International Tonnage Certificate (ITC 1969)**

**Q8.****(a) State the procedures and safety checks that should be undertaken prior to flooding a dry dock. (9 marks)**

Before flooding the dock, the following procedures and checks should be completed:

1. **Completion of all work** – ensure all hull, sea connections, valves, and openings are completed and closed.
 2. **All blanks, plugs, and gratings refitted** – including sea chests, overboard discharges, and sea suction.
 3. **All tank lids, manholes, and sighting ports secured** – tanks should be in a safe and closed condition.
 4. **Ensure watertight integrity** – doors, hatches, and shell openings properly secured.
 5. **All dockside staging, scaffolding, and shore connections removed** – no obstructions left attached to the vessel.
 6. **Confirm bilge and ballast systems are operational** – to manage any unexpected ingress of water.
 7. **Double check draught marks and load line marks are visible** – to monitor condition during flooding.
 8. **Ensure personnel are clear from the dock** – all workers, ladders, and temporary access removed.
 9. **Communication established with dockmaster** – ship's staff and dock staff confirm readiness before flooding commences.
-

(b) State who is responsible for signing the authority for a Flood Certificate. (1 mark)

- The **Dock Master (or equivalent dock authority)** is responsible for signing the authority for a Flood Certificate.

9. (a) A vessel with two main engines each with a working sump lubricating oil capacity of 750 litres and an average daily consumption each of 3.5 litres at full power, has bunkered 1000 litres of oil.

Calculate the steaming range of the vessel when the engines are operated at full power delivering a speed of 15 knots to the vessel. (6)

- (b) State the factors that should be considered when determining the fresh water requirements for a voyage. *Consumption Rate* (4)

Normally, the **sump oil remains in circulation**, and only **make-up oil consumption** is relevant for endurance.

Thus, the **1000 L bunkered** is extra (make-up) oil.

So: Usable oil = 1000 L.

Step 2 – Duration of operation:

$$\text{Days of operation} = \frac{1000}{7} = 142.86 \text{ days.}$$

Step 3 – Distance covered:

At 15 knots:

$$\text{Distance per day} = 15 \times 24 = 360 \text{ nautical miles/day.}$$

Total steaming range:

$$142.86 \times 360 \approx 51,430 \text{ nautical miles.}$$

Normally, the sump oil remains in circulation, and only make-up oil consumption is relevant for endurance.

Thus, the 1000 L bunkered is extra (make-up) oil.

So: Usable oil = 1000 L.

Step 2 – Duration of operation:

$$\text{Days of operation} = \frac{1000}{7} = 142.86 \text{ days.}$$

Step 3 – Distance covered:

At 15 knots:

$$\text{Distance per day} = 15 \times 24 = 360 \text{ nautical miles/day.}$$

Total steaming range:

$$142.86 \times 360 \approx 51,430 \text{ nautical miles.}$$

10. (a) Write standing orders detailing the procedures to be followed in the event of a fire within the machinery spaces. *Inform* *Raise Alarm* *Restrict* *extinguish* *PIP all available* (6)
- (b) List FOUR types of portable fire extinguisher that could be found within the machinery spaces, stating on which class of fire EACH should be used. *means* *find list* (4)

Q10

(a) Standing orders in the event of a fire within machinery spaces (6 marks)

1. **Raise the alarm immediately** – activate the fire alarm system and inform the bridge/engine control room.
2. **Shut down fuel supply** – stop fuel oil pumps, close quick-closing valves, and shut off ventilation fans/dampers.
3. **Isolate the affected area** – secure machinery if possible, close watertight/fire doors, and restrict air supply.
4. **Attempt first attack** – use portable fire extinguishers or local fixed fire-fighting systems if safe to do so.
5. **Deploy fire-fighting teams** – follow muster list instructions, prepare fire hoses, and wear breathing apparatus.
6. **Prepare fixed firefighting systems** – if the fire cannot be controlled, CO₂ or water-mist system to be activated in accordance with procedures.

(b) Four types of portable fire extinguisher in machinery spaces (4 marks)

1. **Foam extinguisher** – for Class B (flammable liquid) fires such as oil leaks.
 2. **Dry powder extinguisher** – for Class B and C (flammable liquid and gas) fires, and effective on electrical fires.
 3. **CO₂ extinguisher** – for Class B (oil) and Class E (electrical) fires; leaves no residue.
 4. **Water extinguisher** – for Class A (solid combustibles such as wood, rags).
-

✓ Answer Summary:

- (a) Raise alarm, isolate fuel/air, restrict spread, attack with portable means, muster fire party, prepare fixed systems.
- (b) Foam (B), Dry powder (B, C, E), CO₂ (B, E), Water (A).