

CERTIFICATE OF COMPETENCY EXAMINATION

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF
MARITIME AND COASTGUARD AGENCY
MANAGEMENT ENGINEER (UNLIMITED)

040-13 - ENGINEERING KNOWLEDGE - MOTOR

TUESDAY, 16 July 2024

0915-1215 hrs

Examination paper inserts:

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Notes for the guidance of candidates:

Candidates should note that 96 marks are allocated to this paper. To pass candidates must achieve 48 marks.

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Materials to be supplied by examination centres:

Candidate's examination workbook

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ENGINEERING KNOWLEDGE - MOTOR

Attempt SIX questions only

Marks for each part question are shown in brackets

1. As Chief Engineer, write a report for the engineering superintendent regarding the checking of a bottom end bearing on a crosshead type main diesel engine, after a high temperature alarm was activated at sea, and the subsequent return to full service of the engine. (16)

2. With reference to LNG diesel engine installations:
 - (a) describe, with the aid of a sketch, a Gas Valve Unit, explaining its purpose and indicating where it is located in the gas train; (8)
 - (b) explain why ventilation and inert gas systems must be installed with the engine fuel gas system; (4)
 - (c) state why pilot injection must be provided when burning fuel gas, explaining how a pilot injection system operates. (4)

3.
 - (a) Explain why highly efficient diesel engines tend to produce more NO_x than low performance diesel engines. (4)
 - (b) Describe, with the aid of a sketch, a Selective Catalytic Reduction (SCR) unit for a marine propulsion diesel engine. (8)
 - (c) Explain why accurate monitoring of the exhaust gas flows entering and leaving a Selective Catalytic Reduction unit are required and how these readings are used to control the reduction chemical supplied to the SCR unit. (4)

4.
 - (a) Describe, with the aid of a sketch, the HT and LT cooling water systems for a combined pair of medium speed engines in an installation. (12)
 - (b) For the system described in part (a), explain how a shut-down engine is maintained at the correct temperature for immediate starting when the associated engine is also stopped and when the associated engine is running. (4)

5.
 - (a) Describe the procedure for entry into, and inspection of, the inside of a starting air receiver, stating the types of defects which may be present with their possible causes. (12)
 - (b) Describe the procedure of closing up the air receiver and the initial pressurisation to working pressure. (4)

6. A significant number of machinery failures are due to poor maintenance techniques. State, with reasons, the possible consequences of poor maintenance techniques on EACH of the following:

- (a) main engine lubricating oil self cleaning filters; (4)
- (b) cylinder liner honing; (4)
- (c) auxiliary engine bottom end bearing overhaul; (4)
- (d) fitting of piston compression and oil control rings. (4)

7. With reference to diesel engine hybrid SO_x scrubber systems:

- (a) state the fluids used in the open and closed loops of the scrubber, explaining how these fluids are controlled to meet the scrubbing demand at different engine loads; (6)
- (b) state the circumstances under which *Open Loop scrubbing* would be used and *Closed Loop scrubbing* would be used; (2)
- (c) describe how the effective SO_x neutralising effect of the fluid used in the closed loop system is maintained during long operating periods and how pollution of the sea is avoided. (8)

8. (a) Explain why turbochargers are fitted to some diesel engines and describe how they efficiently achieve that aim. (6)

(b) Describe, with the aid of a sketch, a turbocharger installation showing the paths of engine exhaust gas, charge air and cooling water. State the monitoring systems provided for the system, explaining why they are fitted, how they operate and how their functioning is checked. Explain how turbochargers can be cleaned without dismantling. (10)

9. (a) Describe the symptoms and possible causes of an exhaust gas boiler/economiser fire. (5)

(b) Describe the procedure for inspecting and cleaning the gas side of an exhaust gas boiler/economiser. (5)

(c) Explain how the main engine and auxiliary steam plant may be operated in the event of an exhaust gas boiler/economiser suffering severe damage rendering it inoperable. (6)