

REPUBLIC OF THE MARSHALL ISLANDS

MARITIME ADMINISTRATOR

GUIDELINES FOR ENGINEER OFFICERS' EXAMINATIONS (CHIEF ENGINEER, FIRST ASSISTANT ENGINEER, SECOND ASSISTANT ENGINEER)



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EXAM GUIDELINES (MI-320)
REVISION HISTORY

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2	3/31/16	Added Annex – Proctor Guide, updated TOC	M. Sparks	3/31/16
1	3/1/16	Updated Chapter II (Syllabus) Management Level Chief Engineer & First Assistant Engineer §1.0 Motor, change in title §2.0 Steam, change in title, edits and addition of §3.0 Auxiliary Power Plant §4.0 Auxiliary Machinery & Equipment §6.0 General Engineering. Updated Chapter II (Syllabus) Officer in Charge of an Engineering Watch Operational Level Third/Second Assistant Engineer §1.0 Motor, change in title, §2.0 Steam, change in title, edits and addition of §3.0 Auxiliary Machinery, §4.0 Safety and Engineering Administration & §6.0 General Engineering. Edits to Chapter III (Examination Procedures). Edits to Figure 1 (Time Table for Engineering Officers' Written Exam Papers).	M. Sparks	3/1/16

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I. INTRODUCTION

The Republic of the Marshall Islands (RMI) Maritime Administrator's (the "Administrator") examination system reflects the provisions of the International Convention on Standards of Training, Certification, and Watchkeeping, 1978, as amended (STCW). Under this system, the examinations consist of multiple-choice questions randomly compiled from a database of some 10,000 questions, each appropriate for the competency being tested.

Certain training pre-requisites for certification apply. It is recommended that the publication MI-118E, *Requirements for Seafarer Certification by Examination*, be consulted to determine which other examinations, certified training or sea service may be required by the Administrator before an examination may be taken.

Testing may occur at our main office in Reston, Virginia, USA or selected branch offices around the world. Additionally, there are approved third party testing sites. The candidate should indicate where they are located at the time of application and they will be advised of the closest testing facilities to them. A final decision as to the testing facility must be made prior to approval being issued for the examination.

This booklet has been assembled to familiarize candidates for engineer officers' examinations with the examination syllabus and format. It contains information on:

- a. the examination syllabus;
- b. examination procedures and passmark requirements;
- c. examination answer sheet instructions; general advice on taking multiple-choice examinations;
- d. specimen examination questions, with an answer key;
- e. a study bibliography and sources where the recommended books may be ordered;
- f. a table of SI and Imperial units and conversion factors; and
- g. English Language Proficiency Exam.

II. SYLLABUS

Following is a list of the main sections and the subsections of the examination syllabus. The candidate's knowledge of each subsection will be examined.

All questions concern knowledge that is considered to be indicative of basic competence in performance of shipboard duties of marine engineers.

Motor candidates will be examined in Parts 1, 3, 4 and 5 only. Steam candidates will be examined in Parts 2, 3, 4 and 5 only. However, the sections 3-5 will be numbered 2-4 in the actual exam. Combined candidates will be examined in all Parts.

MANAGEMENT LEVEL **CHIEF ENGINEER AND FIRST ASSISTANT ENGINEER**

1.0 MOTOR

- 1.1 Applied Heat (Thermodynamics & Heat Transmission); Applied Mechanics and Hydromechanics
- 1.2 2 and 4 Stroke Cycles
- 1.3 Scavenging and Supercharging
- 1.4 Fuel System; Fuel Combustion Process
- 1.5 Cylinder and Piston Construction; Bearings
- 1.6 Lubrication Systems and Lubricating Oil Treatment
- 1.7 Cooling Systems; Shutting Down Engine in Port
- 1.8 Preparation for Starting; Starting Air and Reversing Systems
- 1.9 Speed Control and Maneuvering
- 1.10 Emergency Running
- 1.11 Camshafts and Valve Timing; Clutches, Gearing and Chain Drives
- 1.12 Crankshaft Construction and Crankshaft Deflections
- 1.13 Crankcase Mist Detection; Scavenge Fires and Crankcase Explosions
- 1.14 Main Engine Condition Monitoring
- 1.15 Exhaust Gas Boilers
- 1.16 Cylinder Diagrams
- 1.17 Sea Water Systems and Treatment
- 1.18 Bedplate and Main Frame Construction
- 1.19 Exhaust and Inlet Valves
- 1.20 Engineering Administration and the RMI Maritime Act and Regulations

2.0 STEAM

- 2.1 Applied Heat; (Thermodynamics & Heat Transmission); Applied Mechanics and Hydromechanics

BOILERS

- 2.2 General Construction, Steam Drum Fittings; Furnace Construction, Linings and Repairs
- 2.3 Superheaters and Desuperheaters
- 2.4 Safety Valves
- 2.5 Air Heaters and Economizers
- 2.6 Sootblowers
- 2.7 Forced Draft Systems; Burners and Fuel Systems; Air Registers; Fuel Combustion Process and Control Systems
- 2.8 Water Level Indicators and Feed Water Level Control
- 2.9 Boiler Water Testing and Treatment
- 2.10 Raising Steam and Coupling Boilers; Maneuvering
- 2.11 Surveys, Repairs and Maintenance; Engineering Administration and the RMI Maritime Act and Regulations

LOW PRESSURE FEED SYSTEMS

- 2.12 Condensers; Drain Tank and Make-up System; Filters

HIGH PRESSURE FEED SYSTEMS

- 2.13 Feed Pumps; Salinity Indicator; Air Ejectors; Feed Heaters; Deaerators

TURBINES - PROPULSION

- 2.14 General Construction; Flexible Couplings; Gearing
- 2.15 Blading Types; Velocity and Pressure Compounding; Nozzle Control
- 2.16 Thrust Bearing; Bearings; Lubricating Oil System
- 2.17 Maneuvering; Local and Remote Control; Gland Steam System; Astern Running
- 2.18 Overspeed Control; Vibration Meter; Emergency Operations
- 2.19 Turning Gear; Warming-through Procedure; Prolonged Operation at Lower Power/low Vacuum
- 2.20 Bleed Steam Utilization

3.0 AUXILIARY POWER PLANT

- 3.1 Electrical Theory; Machinery Drawing
- 3.2 Diesel Alternators
- 3.3 Switchboards and Switch Gear
- 3.4 Electric Motors
- 3.5 Emergency Diesel Systems
- 3.6 Emergency Power Battery Systems
- 3.7 Turbo Alternators
- 3.8 Open Feed Systems; Auxiliary Boilers

- 3.9 Electrical Supply Systems
- 3.10 Steam and Exhaust Systems
- 3.11 Properties of Fuel Oils
- 3.12 Fuel Oil Transfer Systems; Bunkering
- 3.13 Automation, Instrumentation, and Control Systems
- 3.14 Shore Power Operation
- 3.15 D.C. Generators
- 3.16 Flameproof and Intrinsically Safe Equipment
- 3.17 Fluorescent Lighting
- 3.18 Rectifiers and Invertors
- 3.19 Electronics and Logic
- 3.20 Steam-to-Steam Generators

4.0 AUXILIARY MACHINERY AND EQUIPMENT

- 4.1 Applied Mathematics; Refrigeration Theory; Naval Architecture
- 4.2 Air Compressors and Compressed Air Systems
- 4.3 Evaporators
- 4.4 Electrically and Steam Driven Pumps
- 4.5 Refrigeration; Air Conditioning
- 4.6 Steering Gears
- 4.7 Purifiers and Clarifiers
- 4.8 Temperature and Flow Controllers and Meters
- 4.9 Bilge Systems; Oil Water Separators
- 4.10 Cooling Systems and Heat Exchangers
- 4.11 Blowers and Fan
- 4.12 Incinerators; Sewage Plant
- 4.13 Ballast Systems; Cargo Pump Systems; Cargo Heating Systems
- 4.14 Deck Machinery - Steam, Electric and Hydraulic
- 4.15 Domestic Water and Heating Systems
- 4.16 Inert Gas Systems
- 4.17 Properties of Oils and Greases in General Use
- 4.18 Fire Detection and Alarm Systems; Fixed Fire Fighting Installations
- 4.19 Propellers, Shafting and Stern Seals
- 4.20 Properties

5.0 SAFETY

- 5.1 Pollution Avoidance and Control
- 5.2 Accident Avoidance
- 5.3 First Aid
- 5.4 Use of Lifesaving Equipment
- 5.5 Methods of Damage Control
- 5.6 Health Hazards
- 5.7 Use of Tools and Lifting Equipment

- 5.8 Hot Work Precautions
- 5.9 Firefighting Equipment
- 5.10 Confined Spaces Precautions
- 5.11 Approved Equipment for Hazardous Areas
- 5.12 Operations in Tankers
- 5.13 Personal Survival
- 5.14 Spontaneous Combustion
- 5.15 Autoignition
- 5.16 Breathing Apparatus
- 5.17 Resuscitation
- 5.18 Electrocutation
- 5.19 “Special Ship” Hazards
- 5.20 Machinery Overhaul Precautions

6.0 GENERAL ENGINEERING

- 6.1 Algebraic and geometric calculations
- 6.2 Heat transfer calculations
- 6.3 Volume, temperature, and pressure relationships and calculations
- 6.3 Drawings
- 6.4 Pistons, cylinders and cylinder heads
- 6.5 Tanks and compartments
- 6.6 Physics
- 6.7 Construction and stability
- 6.8 Materials
- 6.9 Watch standing and ship’s business
- 6.10 Regulations (open book – MI-108, MI-107, SOLAS, MARPOL)

OFFICER IN CHARGE OF AN ENGINEERING WATCH
OPERATIONAL LEVEL
THIRD/SECOND ASSISTANT ENGINEER

1.0 MOTOR

- 1.1 Applied Heat (Thermodynamics & Heat Transmission); Applied Mechanics and Hydromechanics
- 1.2 2 and 4 Stroke Cycles
- 1.3 Scavenging and Supercharging
- 1.4 Fuel System; fuel Combustion Process
- 1.5 Cylinder and Piston Construction; Bearings
- 1.6 Lubrication Systems and Lubricating Oil Treatment
- 1.7 Cooling Systems; Shutting down Engine in Port
- 1.8 Preparation for Starting
- 1.9 Starting and Reversing
- 1.10 Maneuvering
- 1.11 Camshafts and Valve Timing
- 1.12 Chain Drives and Gears
- 1.13 Crankshafts
- 1.14 Scavenge Fires and Crankcase Explosions
- 1.15 Main Engine Condition Monitoring
- 1.16 Exhaust Gas Boilers
- 1.17 Bedplate and Main Frame Construction
- 1.18 Air Inlet and Exhaust Valves
- 1.19 Log Book Entries
- 1.20 Taking Over and Maintaining a Watch

2.0 STEAM

- 2.1 Applied Heat; (Thermodynamics & Heat Transmission); Applied Mechanics and Hydromechanics

BOILERS

- 2.2 General Construction; Gas and Water Flow Paths
- 2.3 Superheaters and Desuperheaters
- 2.4 Safety Valves
- 2.5 Air Heaters and Economizers
- 2.6 Sootblowers
- 2.7 Forced Draft Systems; Burners and Fuel Systems; Air Registers; Fuel Combustion Process and Control Systems
- 2.8 Water Level Indicators and Feed Water Level Control
- 2.9 Boiler Water Testing and Treatment
- 2.10 Raising Steam and Coupling Boilers; Shutting Down Engine in Port

- 2.11 Maneuvering

LOW PRESSURE FEED SYSTEMS

- 2.12 Emergency Operations

FEED SYSTEMS

- 2.13 General Construction and Operation (Condensate System, Condensers, Feed Heaters, Deaerators, Air Ejectors, Feed Pumps, Salinity Indicators, Drain Tank and Make-up System)

TURBINES - PROPULSION

- 2.14 General Construction; Flexible Couplings; Gearing
- 2.15 Thrust Bearing; Bearings; Lubricating Oil System
- 2.16 Gland Steam System and Maneuvering
- 2.17 Safety Devices and Emergency Operations
- 2.18 Warming-through Procedure
- 2.19 Plant Condition Monitoring and Log Book Entries
- 2.20 Taking Over and Maintaining a Watch

3.0 AUXILIARY POWER PLANT

- 3.1 Electrical Theory; Machinery Drawing
- 3.2 Diesel Alternators
- 3.3 Switchboards and Switch Gear
- 3.4 Electric Motors
- 3.5 Emergency Diesel Systems
- 3.6 Emergency Power Battery Systems
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- 4.20 Properties

5.0 SAFETY

- 5.1 Pollution Avoidance and Control
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- 5.3 First Aid
- 5.4 Lifesaving Equipment
- 5.5 Welding and Flamecutting
- 5.6 Health Hazards
- 5.7 Tools and Lifting Equipment
- 5.8 Hot Work Precautions
- 5.9 Firefighting
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- 5.20 Machinery Overhaul Precautions

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- 6.7 Construction and stability
- 6.8 Materials
- 6.9 Watch standing and ship's business
- 6.10 Regulations (open book – MI-108, MI-107, SOLAS, MARPOL)

III. EXAMINATION PROCEDURES

Examinations are administered on dates mutually agreed upon between candidates and the test center. Candidates will receive confirmation in writing as to the date and location arranged for examination. The written examination should take two (2) days in the case of candidates for motor or steam certificates and three (3) days in the case of candidates for combined licenses. Figure 1 gives the schedule of the written examinations.

The complete engineer officer's examination for a single type of propulsion consists of four (4) parts, i.e., motor propulsion plant or steam propulsion plant, auxiliary power plant, auxiliary machinery and equipment, and safety. It consists of all five (5) sections for a combination motor and steam examination. The examination is offered in three (3) versions: diesel only, steam only, and combined.

The examination is closed book; that is, candidates may not use books, notes, or other reference materials. They may use non-programmable calculators and their own English Language dictionaries if they wish.

Candidates may not communicate with each other during the examination. Any candidate who communicates with an unauthorized person, or uses unauthorized materials, will be dismissed from the examination and be considered to have failed the entire examination. Candidates failing under these circumstances will not be eligible for re-examination for a period of six (6) months.

Candidates will normally be advised of their results within one (1) calendar month. In all sections a passing grade will be considered to be 70% of the questions answered correctly in each part. Candidates not successful in up to two (2) parts must arrange to be re-examined in those parts and obtain a passing grade in order to receive certification. Candidates who are not successful in more than two (2) parts must retake the entire examination. Figure 2 summarizes the re-examination procedure.

Up to two (2) re-examinations may be taken. A candidate cannot be re-examined within 30

days of the first examination nor more than one (1) year from that date. The second re-examination will be determined from the first re-examination date and the same time frame applies. If the candidate is unsuccessful after two (2) attempts, the entire examination must be retaken but not with a year's time from the date of the last examination taken.

IV. THE MULTIPLE-CHOICE EXAMINATION FORMAT: GENERAL ADVICE

The examination format is multiple-choice. Each question has four (4) possible answers. The candidate must blacken the space on the answer sheet that corresponds to the letter of the answer considered to be most appropriate. The candidate should note that there may appear to be more than one correct answer. There is not. Select the choice that is true at all times within the parameters of the question. A candidate's score is determined by the number of questions they have answered correctly compared to the number of questions in that part. All questions have the same value. Candidates are advised to answer each question as well as they can and not to spend too much time on any one question. Candidates not knowing the answer to a question should leave it blank and go on to the next question. If time is left after finishing the rest of the questions, the candidate can go back to the questions they have left blank and answer them.

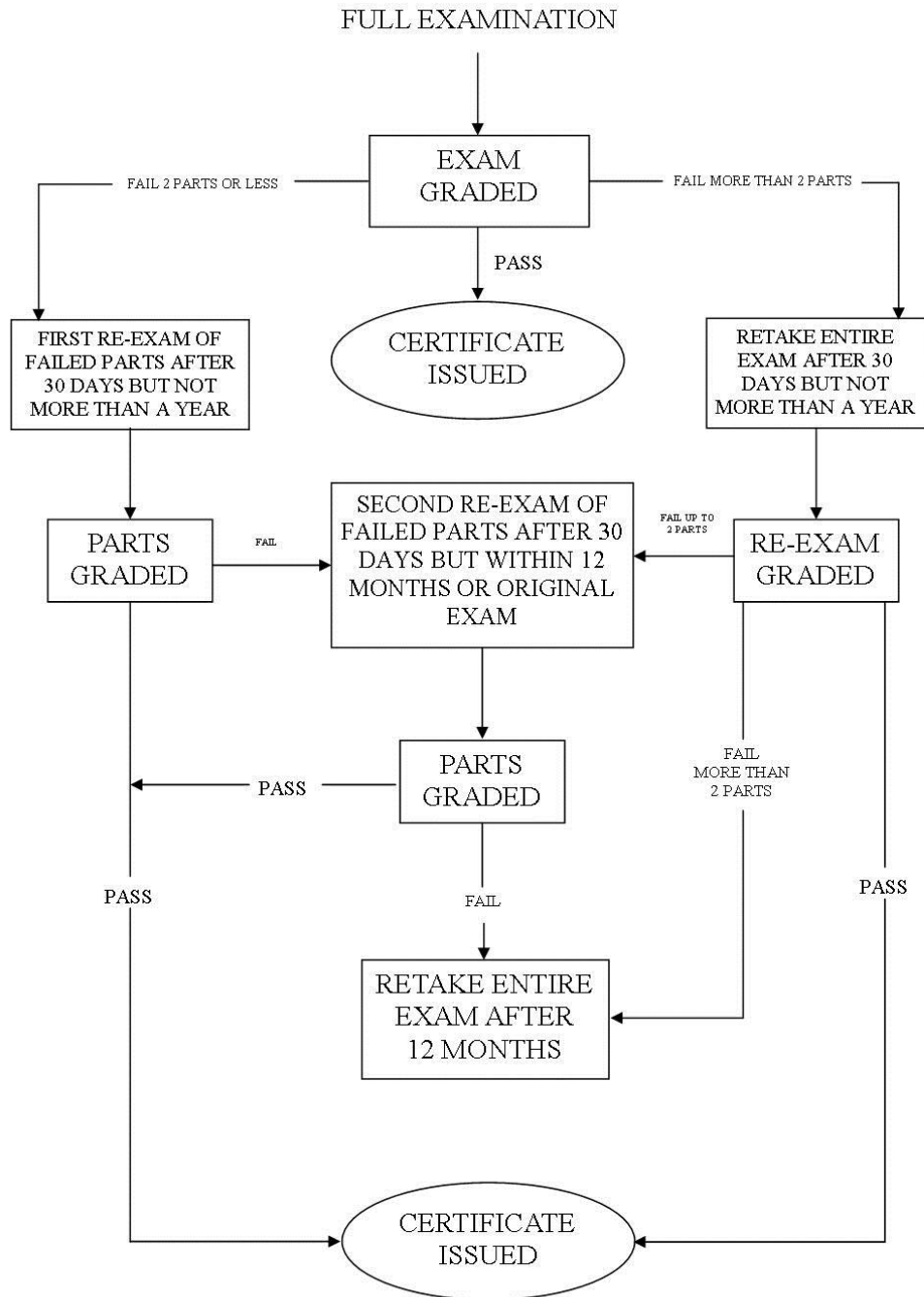
FIGURE 1

TIME TABLE FOR ENGINEER OFFICERS' WRITTEN EXAMINATION PAPERS

DAY 1	DAY 2	DAY 3	DAY 4
Candidates report at mutually agreeable time			
Part 1 - 50Q 3 hrs. Motor (Steam)	Part 3 - 30Q 3 hrs Aux. Power Plant	Part 5 - 30Q 3 hrs General Engineering	
Lunch	Lunch	Lunch	Lunch
Part 2 - 30Q 3 hrs. Auxiliary Machinery	Part 4 - 20Q 2-1/2 hrs. Engineering Safety		

If combined motor and steam exam 50 additional questions in the appropriate part for an additional 3 hrs and all exams after move up a half day.

**FIGURE 2
EXAMINATION PROCESS**



V. USING THE ANSWER SHEET

A specimen of the examination answer sheet is shown in figure 3. The candidate must mark all answers on a sheet as the sample is marked. No credit will be given for anything marked in the examination booklet. The candidate should not make any notes, calculations, or extra marks on the answer sheet or in the examination booklet. The candidate must NOT fold the answer sheet.

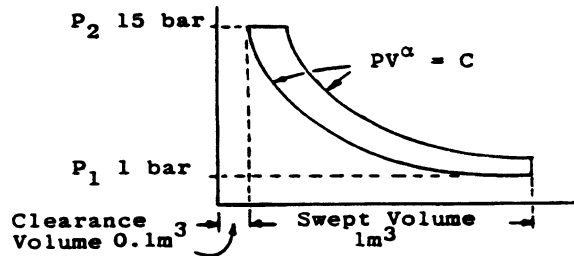
The answer spaces are lettered a, b, c, and d, similar to the answers in the examination booklet. The candidate must use the No. 2 pencil provided to fill in the space marked with the letter corresponding to the letter of the answer that best answers the question.

The candidate should be sure that the circle is filled in completely. **IF THE CANDIDATE CHANGES THE ANSWER, THE FIRST CHOICE MUST BE ERASED COMPLETELY AND THE NEW ANSWER MARKED.** No credit will be given for questions with what would appear to have more than one answer marked.

VI. SAMPLE QUESTIONS WITH ANSWER KEY

1.0 Diesel Propulsion Plant

1.1 What is the compression ratio in this cycle?



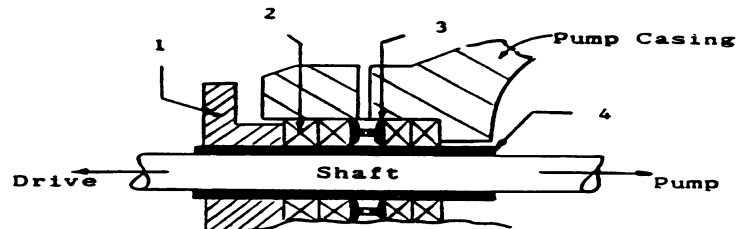
- 15 to 1
 - 10 to 1
 - 11 to 1
 - 16 to 1
- 1.2 In the event of a scavenge fire that does not appear severe, what should be done?
- Slow down engine, shut off fuel to affected cylinder and increase cylinder lubrication.
 - Shut off fuel and lubrication to affected cylinder.
 - Maintain engine speed and open fire extinguishing system to scavenge box.
 - Stop the engine and allow the fire to burn itself out.
- 1.3 The alarm of a diesel engine oil must detector is set at
- the lower explosive limit.
 - the upper explosive limit.
 - 50 percent of the upper explosive limit.
 - about 5 percent of the lower explosive limit.
- 1.4 What do you call an exhaust turbocharging system in which allowed cylinders exhaust into a common exhaust manifold before entering the turbine?
- A tuned system.
 - A pulse system.
 - A constant pressure system.
 - A uniflow system.
- 1.5 What fluid is circulated through main engine cylinder liners to keep them cool?
- Compressed air
 - Sea water
 - Fresh water
 - Lubricating oil

2.0 Steam Propulsion Plant

- 2.1 A boiler produces 5000 kg/hr of 96% dry steam at a gauge pressure of 700 kN/m² and a feed water temperature of 40 degrees Celsius. The boiler burns 590 kg/hr of coal with a caloric value of 3,100 kJ/kg. What is the efficiency of the boiler where the heat content of the steam (kg) is 272.6 kJ/kg and that of the feedwater (hp) is 16.7 KJ/kg?
- 55.5%
 - 67.6%
 - 60%
 - 50.3%
- 2.2 The feed inlet temperature to economizers is maintained above 138°C in order to . . .
- prevent external corrosion of the economizer.
 - reduce thermal shocking of the boiler.
 - improve thermal efficiency.
 - prevent cavitation damage to feed pump impellers.
- 2.3 To eliminate chokage, corrosion and fires, the air heater fitted to a boiler should be . . .
- a rotary gas-air heater with ceramic elements.
 - a tubular gas-air heater with a glass coating.
 - a steam-air heater with finned tubes.
 - a tubular gas-air heater with plain vertical tubes.
- 2.4 What do you do to obtain maximum efficiency at low turbine power?
- Open all the nozzles and throttle the main steam supply valve
 - Keep the main steam supply valve full open and fully open a limited number of nozzles
 - Open all nozzles fully and reduce the vacuum to obtain the desired power
 - Keep the main steam supply valve full open and throttle all the nozzles simultaneously
- 2.5 What would cause loss of vacuum in a condenser associated with an increase in undercooling?
- Incorrect operation of the air ejector
 - Blocked condenser tubes
 - Dirty condenser tubes
 - Overloading of the condenser

3.0 Auxiliary Machinery and Equipment

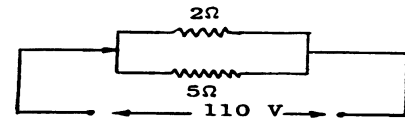
- 3.1 When two refrigerator compressors are running in parallel, what is essential to check regularly?
- The individual expansion valve settings
 - The cooling water flows to the separate condensers
 - The individual gas suction temperatures
 - The lube oil levels in the separate compressors
- 3.2 What process disposes of solid waste material in the secondary chamber of an incinerator?
- Polymerization
 - Pyrolysis
 - Pyrography
 - Plasma reduction
- 3.3 Before putting an oil water separator into operation, what should you do?
- Ensure it is filled with clean sea water
 - Drain it completely
 - Pressurize the upper chamber with air at 0.35 bar
 - Flush it through to the sea
- 3.4 When indicating a small leak in a Freon refrigeration system, the flame color of a halide leak detector torch will change from . . .
- pale blue to green.
 - green to pale blue.
 - white to violet.
 - red to green.
- 3.5 In the packing gland shown below, which number indicates a lantern ring?



4.0 AUXILIARY POWER PLANT

4.1 What is the total current drawn by this circuit?

- a. 77 amps
- b. 7 amps
- c. 15.7 amps
- d. 157.1 amps



4.2 In addition to keeping the output voltage at the rated value what does an automatic voltage regulator (avr) do?

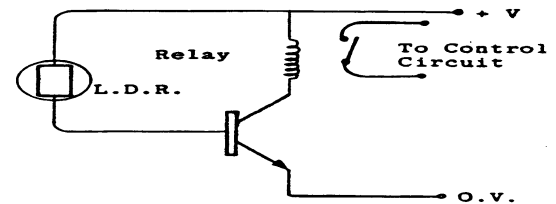
- a. Ensures equal sharing of the KW load when alternators operate in parallel
- b. Ensures equal sharing of the KVA_r load when alternators operate in parallel
- c. Controls the overall system load power factor
- d. Ensures that alternators in parallel always run at equal speed

4.3 Main switchboard preference trips are set to operate at successive intervals of . . .

- a. 5 seconds.
- b. 20 seconds.
- c. 60 seconds.
- d. 1-2 seconds.

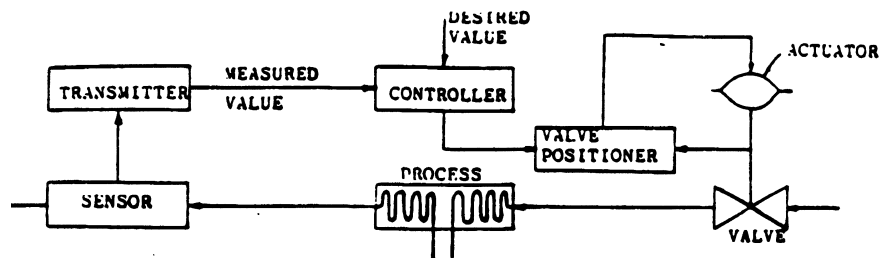
4.4 In the flame failure circuit shown, failure of the flame would cause the light dependent register (L.D.R.) to . . .

- a. remove the short circuit from the relay.
- b. be connected in parallel with the relay.
- c. reduce the base current to the transistor.
- d. reverse the control circuit voltage polarity.



4.5 The diagram represents an automatic control loop. An auto/manual system is normally fitted into the loop so that the system can be controlled manually under certain conditions. Where would the auto/manual station in this loop be located?

- a. Between the transmitter and the controller



- b. Between the controller and the valve positioner
- c. Between the valve positioner and the valve actuator
- d. Between the process and the controller

5.0 SAFETY

- 5.1 Cardio-pulmonary resuscitation (CPR) is a combination of . . .
- mouth-to-mouth resuscitation and rhythmic depression of the patient's chest.
 - mouth-to-mouth resuscitation and intravenous injection of saline solution.
 - rhythmic depression of a patient's chest and application of suitable smelling salts.
 - mechanical resuscitation and injection of a heart stimulant.
- 5.2 What will a small portable fire extinguisher colored green contain?
- Carbon dioxide.
 - Halon gas.
 - Purple K dry powder.
 - Foam.
- 5.3 What should be worn by workers are spray painting in a confined space,?
- Goggles
 - Goggles, gloves and protective shoes
 - Goggles and respirator
 - Full face masks and gloves
- 5.4 Which of the following fire extinguishers could safely be injected into a space still occupied by personnel?
- Carbon dioxide
 - Inert gas
 - High expansion foam
 - Nitrogen
- 5.5 What can you do as first aid if someone receives a severe burn?
- Bandage the burn tightly to keep out the air.
 - Cover the burn with grease or oil.
 - Pour cold fresh water over the burn for 30 minutes.
 - Cool the wound with compressed air.

Answer Key

Section 1 - Diesel Propulsion Plant

- .1 c
- .2 a
- .3 d
- .4 c
- .5 c

Section 2 - Steam Propulsion Plant

- .1 b
- .2 a
- .3 c
- .4 b
- .5 a

Section 3 - Auxiliary Machinery and Equipment

- .1 d
- .2 b
- .3 a
- .4 a
- .5 c

Section 4 - Auxiliary Power Plant

- .1 a
- .2 b
- .3 a
- .4 c
- .5 b

Section 5 - Safety

- .1 a
- .2 b
- .3 c
- .4 c
- .5 c

Note: Section 1 - Diesel Candidates only.
Section 2 - Steam Candidates only.
Sections 3, 4 and 5 - All Candidates

VII. BIBLIOGRAPHY AND SUPPLIERS

The Marshall Islands Maritime and Corporate Administrators, Inc. does not distribute books or recommend suppliers.

When purchasing books, candidates are advised to buy only the latest printings and editions.

CHIEF ENGINEER and FIRST ASSISTANT ENGINEER CANDIDATES

Beeching, L.H. Engineering Science O & A. Marine Engineering Series. London: Stanford Maritime, 12-14 Long Acre, London WC2E, 9LP.

Christenson, S.G. Lamb's Questions and Answers on the Marine Diesel Engine. Monticello, NY: Lubrecht & Cramer, RFD #1, Box 227, Monticello, NY 12701

Clark, G.H. Marine Diesel Lubrication. London: Burmah-Castrol Marine, 1 Finsbury Square, London EC2

Flanagan, G.T.H. Feed System and Treatment. Marine Engineering Series. London: Stanford Maritime

He, S.H. Medium and High Speed Diesel Engines for Marine Use. London: Institute of Marine Engineers, 76 Mark Lane, London EC3R, 7JN.

Jackson, L., and Morton, T.D. General Engineering Knowledge. Reeds Marine Engineering Series, Vol. 8. London: Thomas Reed Publications, 36 Cock Lane, London EC1A 9BY.

Kraal, E.G.R. Basic Electrotechnology. Reeds Marine Engineering Series, Vol. 6. London: Thomas Reed Publications.

Marine Engineering Practice. Vol. 1, Parts 2-9. London: Institute of Marine Engineers, 76 Mark Lane, London EC3R 7JN

Marine Engineering Practice. Vol. 2, Parts 13-18. London: Institute of Marine Engineers.

McBirnie, S.C., and Fox, W.J. Marine Steam Engines and Turbines. Borough Green, England: Newnes-Butterworths, Borough Green, Sevenoaks, Kent TN 15 8PH, UK.

Milton, J.H., and Leach, R.M. Marine Steam Boilers. Marine Engineering Series. Borough Green, England: Butterworth & Co., Borough Green, Sevenoaks, Kent Tn 15 8 PH.

Souchette, E., and Smith, D.C. Marine Auxiliary Machinery. Marine Engineering Series. Borough Green, England: Butterworth & Co.

Woodward, J.B. Low Speed Marine Diesels. New York: Wiley Interscience, 605 Third Avenue, New York, NY 10158, USA.

THIRD ASSISTANT ENGINEER and SECOND ASSISTANT ENGINEER CANDIDATES

Beck, H. **Engineering Drawing**. Reeds Marine Engineering Series. Vol. 11. London: Thomas Reed Publications Ltd., 36 Cock Lane, London EC1A 9BY, UK.

Embleton, W. **Applied Mechanics**. Reeds Marine Engineering Series, Vol. 2. London: Thomas Reed Publications.

Embleton, W. **Heat and Heat Engines**. (SI Units). Reeds Marine Engineering Series, Vol. 3. London: Thomas Reed Publications.

Embleton, W. **Mathematics**. Reeds Practical Mathematics Series, Vol. 1. London: Thomas Reed Publications.

Kemp, J.F. and Young, P. **Electricity and General Magnetism**. Kandy Series. London: Stanford Maritime, 12-14 Long Acre, London WC2E 9LP, UK.

Marine Engineering Practice. Vol. 1. Part 7. **Slow Speed Diesel Engines**. London: Institute of Marine Engineers, 76 Mark Lane, London EC3R 7JN, UK.

Marine Engineering Practice. Vol. 2. Part 8. **Marine Steam Turbines**. London: Institute of Marine Engineers.

McGeorge, H.D. **General Engineering Knowledge**. London: Stanford Maritime, 12-14 Long Acre, London WC2E 9LP, UK.

Morton, T.D. **Steam Engineering Knowledge**. Reeds Marine Engineering Series, Vol. 9. London: Thomas Reed Publications, 36 Cock Lane, London EC1A 9BY, UK.

Morton, T.D. **Motor Engineering Knowledge**. Reeds Marine engineering Series, Vol. 4. London: Thomas Reed Publications.

Stokoe, E.A. **Naval Architecture**. Reeds Marine Engineering Series, Vol. 4. London: Thomas Reed Publications.

Stokoe, E.A. **Ships Construction**. Reeds Marine Engineering Series, Vol. 5. London: Thomas Reed Publications.

NOTE: These books may be obtained directly or by mail order from good nautical bookstores and many chart agents. There are some additional sources which candidates may wish to use:

- Institute of Marine Engineers publications should be obtained from Marine Management (Holdings) Ltd., which stocks institute publications and many others. The address is 76 Mark Lane, London EC3R 7JN, UK.
- IMO publications are seldom stocked abroad, and should be obtained directly from the International Maritime Organization, Publication Section, 4 Albert Embankment, London SE1 7SR, UK.
- ILO publications may be obtained through Unipub, P.O. Box 433, Murray Hill Station, New York, NY 10157, USA.
- British government publications may be obtained from the Government Bookshop, Her Majesty's Stationery Office, P.O. Box 569, London SE1 9NH, UK.
- American government publications may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, USA.

Missions to seamen, coast guard schools, and similar institutions frequently supply up-to-date, well-illustrated notes and booklets on all facets of the nautical profession. Candidates are encouraged to use all these resources to obtain books which they personally find easy to read and understand. They should use only **CURRENT EDITIONS** and up-to-date materials.

VIII. TABLE OF SI AND IMPERIAL UNITS AND CONVERSION FACTORS

PHYSICAL QUALITY	SI METRIC UNITS	IMPERIAL UNITS FT - LB -S	CONVERSION FACTORS
Length	meter (m)	foot (ft)	1 m = 3.281 ft
Mass	kilogramme (kg)	pound (lb)	1 kg = 2.205 lb
Time	second(s)	second(s)	N/A
Temperature conversion*	°C	°K	°C -273
Specific Volume	m ³ /kg	ft ³ /lb	1m ³ /kg = 16.02ft ³ /lb
Force	newton(N)	poundal (pdl)	1 N = 7.233 pdl = .2248 lbf
Pressure	N/m ² or bar	poundal per square foot (pdl/ft ²)	1 bar = 10 ⁵ N/m ² = 14.5 lbf/in ²
Energy	joule (J) or kJ	foot poundal (ft pdl)	1 J = 1 Nm - 0.738 ft lbf
Rate of Energy Flow	watt (W) or kW	foot poundal per second (ft pdl/s)	1W = 1 J/s = 0.738 ft lbf/s

*Note: Degrees Celsius (°C) or degrees Kelvin (°K) will be used for examination purposes.

A poundal is the force required to accelerate 1 pound of mass to 1 foot per second per second.

$$1 \text{ pdl} = (1 \text{ lb} * 1 \text{ ft})/\text{s}^2$$

IX. EXAMINATION FEES

- i. Examination fees USD \$300
- ii. Each re-take of failed officer examination USD \$150

Remittances

- i. All fees remitted by check or money order must be in United States (US) dollars, drawn on a US bank or the US branch of an international bank and made payable to *The Trust Company of the Marshall Islands, Inc.*
- ii. Fees may also be paid online by credit card at <https://www.tcmi-inc.com/miPayments/>.
- iii. Candidates should send checks (**no cash**) with the application.
- iv. When not applying in person through a filing agent, the application with payment should be sent by **courier**.

ANNEX - PROCTOR GUIDE

Proctors for Marshall Islands examinations must ensure a secure examination room. To ensure security:

- the examinee cannot leave the examination room while an examination is being taken until they have completed a specific part, comfort calls must be made prior to the examination;
- examinees cannot speak to anyone but the proctor during the examination;
- examinees cannot use any material other than that supplied in the examination room and allowed by the Administrator for a given part of the examination; and
- examinees must turn in any electronic devices that are capable of communicating outside of the examination room, recording, or taking photographs (e.g. cellular telephones).

Examinees may bring the following personal items into the examination room to aid them:

- A non-programmable calculator
- Writing instruments
- Navigation plotting instruments
- Star finder

Proctors should ensure the following are made available to the examinee:

- Writing instruments
- Scratch Paper
- Appropriate publications (as required by exam type)
 - SOLAS
 - MARPOL
 - MI-108 Maritime Regulations (available at www.register-iri.com)
 - MI-107 Maritime Law (available at www.register-iri.com)
 - Reduction tables for Latitudes 15 to 45 degrees
 - Examination Administration Booklet (supplied by the Administrator)
- Critique sheet for each part of the examination
- Answer sheet for each part of the examination (must not write in booklet)

The duration of each part of the examination and the entire examination cannot exceed the scheduled time. Examinees may, however, take as many parts in one day as they can complete, taking less time overall to complete the entire examination.

At the end of each section the proctor must collect all scratch paper, the examination booklet, the critique sheet, and the answer sheet and return them to the Administrator for review and correction.

The results will be sent to the facility proctoring the examination and to the sponsor for the examinee.

The Administrator has no objection to third party facilities that provide proctoring services for Marshall Islands examinations to recoup their expenses by charging examinees a fee not to exceed USD 150.00.