
	Transport Canada	Issue Date: August 2004	Section 3	Ref: 2293-INF-31-1
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TP 2293 E		<i>THE EXAMINATION AND CERTIFICATION OF SEAFARERS</i>		

CHAPTER 31 - SECOND -CLASS ENGINEER, MOTOR SHIP, AND SECOND-CLASS ENGINEER, STEAMSHIP

PART I- GENERAL REQUIREMENTS OF APPLICANTS

- 31.1 (1) Every applicant for a certificate as Second-Class Engineer, Steamship or Motor Ship, shall:
- (a) obtain a medical certificate prescribed by the Crewing Regulations;
 - (b) obtain a certificate of completion for each of the following courses from a school listed in TP 10655:
 - (i) Marine Emergency Duties Courses, set out in TP 4957:
 - (A) Survival Craft (B1);
 - (B) Marine Fire Fighting (B2);
 - (C) Officer Certification (C); and
 - (D) Senior Officer (D);
 - (ii) Propulsion Plant Simulator Course Level II, set out in TP 10935;
 - (iii) Marine First Aid Advanced Course, set out in TP 13008; and
 - (c) pass a written examination in each of the following subjects:
 - (i) Applied Mechanics;
 - (ii) Thermodynamics;
 - (iii) Electrotechnology;
 - (iv) Naval Architecture;
 - (v) either
 - (A) Blueprint Interpretation and Sketching; or
 - (B) Drawing;
 - (vii) Engineering Knowledge, General.
- (2) Every applicant for a certificate as Second-Class Engineer, Steamship, shall:
- (a) complete the requirements set out in section 31.1(1);
 - (b) pass a written examination in Engineering Knowledge, Steam; and
 - (c) pass an oral examination.

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- (3) Subject to subsection (4), every applicant for a certificate as Second-Class Engineer, Motor Ship, shall:
 - (a) complete the requirements set out in section 31.1(1);
 - (b) pass a written examination in Engineering Knowledge, Motor; and
 - (c) pass an oral examination.
- (4) An applicant who holds a certificate as Maintenance Supervisor, MODU/Self-Elevating Unlimited, may be granted a certificate as Second-Class Engineer, Motor Ship, after completing a minimum of six months sea service as an engineer officer in charge of the machinery on a motor ship of not less than 750 kW propulsion power.

31.2 The service required by an applicant for a Second-Class Certificate, Motor or Steam, is 60 months service as follows:

- (a) a minimum of 12 months service after obtaining the necessary service for the Third-Class Certificate, as follows:
 - (i) a minimum of six months sea service as:
 - (A) as an engineer officer in charge of the watch or as designated duty engineer in a periodically unmanned engine room of a steamship of not less than 750 kW propulsion power where the applicant applies for a certificate as Second-Class Engineer, Steamship;
 - (B) as an engineer officer in charge of the watch or as designated duty engineer in a periodically unmanned engine room of a motor ship of not less than 750 kW propulsion power where the applicant applies for a certificate as Second-Class Engineer, Motor Ship; or
 - (C) as an engineer officer in charge of the watch or as designated duty engineer in a periodically unmanned engine room of a MODU/self elevating of not less than 750 kW propulsion power; and
 - (ii) the remaining time made up of any combination of the following service, subject to any time limitations set out therein:
 - (A) engineer officer on a motor ship, MODU or a steamship of not less than 750 kW propulsion power; or
 - (B) time spent at the marine department of a school listed in TP 10655, credited at a ratio of one day for every three days attendance to a maximum of three months.

31.3 **Not in use.**

31.4 **Not in use.**

PART II - EXAMINATIONS

31.5 The following table lists the written and oral examinations for the Second-Class Engineer Certificate, the qualifying service required before each may be attempted, and other requirements:

Steam Certificate

EXAMINATION	QUALIFYING SERVICE	OTHER REQUIREMENTS
Applied Mechanics	-	-
Thermodynamics	-	-
Blue Print Interpretation & Sketching or Drawing	-	-
Electrotechnology	-	-
Naval Architecture	-	-
Engineering Knowledge General	60 months	MED A1, B1, B2, C and D, PPS Level 2, Skills Training, TRB.
Engineering Knowledge Steam	60 months including six months steam service 750 kW	Pass Engineering Knowledge, General
Oral Examination	-	Pass Engineering Knowledge, General and Steam.

Motor Certificate

EXAMINATION	QUALIFYING SERVICE	OTHER REQUIREMENTS
Applied Mechanics	-	-
Thermodynamics	-	-
Blue Print Interpretation & Sketching or Drawing	-	-
Electrotechnology	-	-
Naval Architecture	-	-
Engineering Knowledge, General	60 months	MED A1, B1, B2, C and D, PPS Level 2, Skills Training, TRB
Engineering Knowledge, Motor	60 months including six months motor service 750 kW	Pass Engineering Knowledge, General
Oral Examination	-	Pass Engineering Knowledge, General & Motor

Motor with Steam Certificate

EXAMINATION	QUALIFYING SERVICE	OTHER REQUIREMENTS
Engineering Knowledge, Motor	Six months 750 kW	Second-Class Steam Certificate
Oral Examination	-	Pass Engineering Knowledge, Motor

Steam with Motor Certificate

EXAMINATION	QUALIFYING SERVICE	OTHER REQUIREMENTS
Engineering Knowledge, Steam	Six months 750 kW	Second-Class Motor Certificate
Oral Examination	-	Pass Engineering Knowledge, Steam

- 31.6 (1) Each written examination paper, except Drawing, shall be of a maximum duration of three and a half hours. The Drawing examination paper shall be of a maximum duration of six hours.
- (2) The examination of Electrotechnology and Naval Architecture shall be composed of mathematical and descriptive questions of which one or more may be compulsory, and will be so marked.
- (3) There shall be nine questions on each paper, not more than six of which are to be answered, except Blue Print Interpretation and Sketching or Drawing, where an applicant shall be given a choice of subjects.
- (4) If more than the required number of questions in any paper are attempted, all the answers shall be marked and the six questions with the lowest marks awarded shall be taken to determine the overall result.
- (5) Not in use.
- (6) The knowledge to be shown by an applicant for a Second-Class Certificate or for an endorsement on a certificate shall be that required:
- (a) as a watchkeeping engineer officer for the safe use, operation and maintenance of boilers and machinery; and
- (b) as a chief engineer officer, to take charge of the engine-room staff and the main propulsion and auxiliary machinery of ships as per Section 31.6(7)(b)

PART III - VALIDITY OF CERTIFICATE

31.7 The certificate as a Marine Engineer, Second-Class, is valid as:

- (a) second engineer without restriction; and
- (b) chief engineer, with the following limitations:

	Foreign Going Home-Trade I	Home-Trade II (Canadian Ports)	Home-Trade III (Canadian Ports)	Inland I Inland II Minor Waters I	Minor Waters II Home Trade IV
Pass Vessels	Not over 3000 kW	Not over 4000 kW	Not over 4000 kW	Not over 4000 kW	Any power
Non-Pass Vessels	Not over 3000 kW	Not over 5000 kW	Not over 7000 kW	Not over 7000 kW	Any power
Tow Boats	Not over 3000 kW	Not over 6000 kW	Not over 7000 kW	Not over 7000 kW	Any power
Fishing Vessels	Not over 5000 kW				

PART IV - SYLLABUSES OF EXAMINATIONS

31.8 Applied Mechanics

ITEM	COLUMN
1.	<p>Statics and Forces</p> <p>Statics; force as a vector; triangle and polygon forces; resultant and equilibrant of a system of concurrent coplanar forces; equilibrium of three coplanar forces; moment of a force; couples; moments of areas and volumes; centroids and centres of gravity (limited to geometrical shapes); conditions of equilibrium of solids; necessary force applied parallel to an inclined plane to pull body up or down the plane or to hold it stationary (including effect of friction); work done at uniform speed up the plane.</p>
2.	<p>Friction</p> <p>Coefficient of friction; friction angle; energy and power loss due to friction in simple bearings.</p>
3.	<p>Kinematics</p> <p>Linear motion; graphs and equations for displacement, speed, velocity and uniform acceleration; velocity as a vector; relative velocities in one plane only; angular motion; equations for displacement, velocity and uniform acceleration.</p>
4.	<p>Dynamics</p> <p>Work and power; problems with constant force or force with linear variation; energy; potential energy; kinetic energy of translation; Newton's laws of motion; conservation of momentum; centrifugal force and its application to conical pendulum, unloaded governor, curved tracks and machine parts; stress in thin rim due to centrifugal action.</p>
5.	<p>Machines</p> <p>Simple lifting machine; graphs of load effort and load efficiency; linear law; velocity ratio, mechanical advantage and efficiency of the following machines: wheel and axle, differential wheel and axle, rope-pulley blocks, differential-pulley blocks, screw jack, Warwick screw, hydraulic jack, worm-driven chain blocks and single- and double-purchase crab winches; reduction gearing.</p>
6.	<p>Stress and Strain</p> <p>Direct stress and strain; modulus of elasticity; shear stress and strain; modulus of rigidity; factor of safety; stress due to restricted expansion or contraction of single members.</p>
7.	<p>Beams</p> <p>Shearing force and bending moment diagrams for cantilevers and simple supported beams with concentrated, uniformly-distributed loads; stress due to bending.</p>
8.	<p>Torsion</p> <p>Strength and stiffness of solid or hollow shafts; stress due to torsion; power transmitted by shafts and coupling bolts.</p>
9.	<p>Thin shells</p> <p>Circumferential and longitudinal stress in thin cylindrical shells subject to internal pressure.</p>
10.	<p>Hydrostatics</p> <p>Equilibrium of floating bodies; variation of fluid pressure with depth; total force due to liquid pressure on immersed plane surfaces, horizontal or vertical; centre of pressure on a rectangular vertical plane surface or triangular plane surface, both with one edge parallel to the surface of the liquid.</p>
11.	<p>Hydraulics</p> <p>Full-bore flow of liquid through pipes under constant head; flow through orifice; coefficients of velocity, contraction of area and discharge.</p>

31.9 Thermodynamics

ITEM	COLUMN
1.	Heat Temperature and its measurement; absolute temperature; specific heat capacity; specific enthalpy of evaporation and fusion; problems involving changes of phase and not more than three substances; linear, superficial and volumetric expansion due to temperature changes; coefficients and the relationship between them.
2.	Basic Thermodynamic Principles Properties of working substances and the first law of thermodynamics; flow and non-flow processes and their application to steady-flow and non-flow processes.
3.	Heat Transfer Qualitative treatment of heat transfer by conduction, convection and radiation; laws of conduction and thermal conductance and applications to problems.
4.	Gases Laws Boyle's and Charles' laws for perfect gases; characteristic equation; constant R and its use in simple problems; isothermal, adiabatic and polytrophic processes; relationships between pressure, temperature and volume; work done; change in internal energy; specific heat Cp and Cv and the relationship between them.
5.	Ideal Gas Cycles Constant volume cycles; diesel cycle; dual cycle; air standard efficiency.
6.	IC Engines Elementary principles and cycles of operation; actual indicator diagrams; mean effective pressure; work done, power developed, indicated and brake thermal efficiencies, mechanical efficiency, overall efficiency; fuel consumption; energy balance chart.
7.	Air compressors Elementary principles and cycles of operation; calculation of work done; indicator diagrams, reciprocating and rotating machines.
8.	Properties of steam Dryness fraction; superheated steam; internal energy; enthalpy; specific volume; steam tables; throttling; separating and throttling calorimeters; use of steam tables and charts.
9.	Steam Plant Advantages of using steam expansively; thermal, mechanical and overall efficiencies of prime movers; boiler efficiency, heat balance for engine and boiler trials; change in dissolved solids in boilers and evaporators due to contaminated feed and effect of blowing down; elementary principles of steam turbines, including simple velocity diagrams for impulse and reaction turbines; force and work done on turbine blades.
10.	Combustion Solid and liquid fuels; calorific value; chemical equations for complete combustion; theoretical minimum air required; excess air effect.
11.	Refrigeration Vapour-compression cycle; refrigerating effect; cooling load; use of tables of properties of refrigerants; coefficient of performance.

31.10 Blueprint Interpretation and Sketching

ITEM	COLUMN
1.	<p>General</p> <p>The Blueprint Interpretation and Sketching paper will demonstrate, by attempting written answers of the descriptive or sketch type, the ability of the applicant to read and interpret blueprints and technical drawings by:</p> <ul style="list-style-type: none"> (i) locating specific features of objects described on a blueprint or drawing; (ii) extracting dimensions, identifying fabrication tolerances and processes as indicated on the blueprint or drawing in the manufacture or maintenance of components; (iii) explaining the location of specific items on the blueprint or drawing, and their relationship to the whole system or machine indicated on the blueprint or drawing having auxiliary or sectional views; (iv) obtaining required information from the blueprint or drawing, using graphic symbology, title blocks, material lists, drawing notes, callouts, and change systems; (v) describing conventional screw-thread forms, bearings, fillets, rounds, holes, fasteners, keys, gears, springs, splines and serrations to ensure understanding of these conventions; and (vi) making freehand technical sketches using multi-view orthographic, one- and two-point perspective, and isometric projections. The subject to be drawn may be either an item included on a blueprint or a machinery part viewed and measured by the applicant. The completed drawing must be accurately proportioned by the applicant, lettered and dimensioned, using only pencils, eraser and graph or squared paper.
2.	<p>The applicant at the time of examination will be given blueprints and objects or drawings selected from the following: detail drawings, assembly drawings, schematics, block diagrams, exploded pictorial drawings (as used for machinery drawings), graphic piping diagrams and symbols, ship's electrical distribution drawings, component schematics, wiring connections, power panel, instrumentation and control diagrams, fluid power drawings (hydraulic and pneumatic), welding blueprints, sheet-metal blueprints and special ship drawings (shell expansions and general arrangements).</p>

31.11 Drawing

ITEM	COLUMN
1.	<p>General</p> <p>The Drawing paper shall consist of a test of the applicant's ability to produce a satisfactory general-assembly drawing embodying the principles of projection. and displaying his/her knowledge of marine engineering. Applicants will be asked to draw a plan, elevation. section or combination of these views of a piece of marine machinery from information supplied in the form of a dimensional pictorial drawing of individual components. All the required information for the completion of the drawing shall be given in the question paper.</p>
2.	<p>Engineering Knowledge</p> <p>The assembled machinery must be able to perform the intended function with respect to size shape and material employed; parts shown must be capable of being removed; and proper clearances, value lifts etc. duly allowed for.</p>
3.	<p>Proper Use Paper</p> <p>Choice of suitable scale and view positions, so as to make optimum use of the paper.</p>
4.	<p>Proper Use of Types of Lines</p> <p>Thickness and types of lines to indicate: visible outlines; dimension, projections, extension, hatching and leader lines; lines showing hidden details, portions to be removed; centre lines, pitch circles; cutting or viewing planes lines; lines showing irregular boundaries, short breaks; long break lines.</p>
5.	<p>Printing</p> <p>Major and functional dimensions in millimetres: valve lift, working clearances or other relevant functional dimensions, neat figures and printing readable without having to turn to the finished drawing.</p>
6.	<p>Views of View Projection</p> <p>Views drawn as instructed and complete; relative position of views, first- and third-angle projection.</p>
7.	<p>Drawing Correctly, According to Information</p> <p>Scale used and stated; sectioned as required; materials; title block.</p>

31.12 Electrotechnology

ITEM	COLUMN
1.	The Electric Circuit Units (ampere, ohm, volt); difference between electromotive force and potential difference; Ohm's law; Kirchoff's laws; simple-series and parallel circuits involving EMF current and resistances; non-linear resistors in parallel with constant value resistors; power and energy; specific resistance; temperature coefficient of resistance; conductor resistance, effect of length, area, material and temperature; DC 2 wire distribution system; types of insulation; Wheatstone network bridge, slide-wire bridge; applications to steering gears, resistance pyrometers, strain gauges etc.
2.	Electrolytic Action and Secondary Cells Theory of electrolytic dissociation applied to common solutions; uses of electrolysis; secondary cells (acid or alkaline); construction and principles; maintenance, charging; watt-hour and ampere-hour efficiencies.
3.	Electromagnetism Electromagnetic induction, simple magnetic circuit; simple magnetic theory; magnetic field; lines of force; field strength; field intensity; magnetic fields due to current in straight conductors, loops, coils and solenoids; relative directions of current and field; Faraday's and Lenz's laws; magnitude and direction of induced EMF force produced on a current-carrying conductor; flux density; effect of iron; magneto motive-force (m.m.f.); permeability; reluctance; simple magnetic circuit, typical B/H and u/B curves.
4.	Electronics Qualitative treatment of atomic structure and bonding; semi-conductors; junction diodes, junction transistors and their operating characteristics; simple transistor circuits; conduction in gases, insulators, semi-conductors and conductors; photo-electric effect.
5.	Alternating-Current Theory Simple continuous periodic waves: frequency, amplitude, instantaneous, maximum r.m.s. and average values, form factor; phasor representation of AC quantities; phase difference; the inductor, inductance and its effect on the circuit; the capacitor, capacitance and its effect on the circuit; simple- series and parallel circuits; relationship between resistance, reactance and impedance; simple treatment of power factor; power in single-phase AC circuit.
6.	Instruments Qualitative treatment of the principles and functions of AC and DC, indicating instruments and relays; uses of shunts and series resistances to increase the range; rectifiers and transducers.
7.	Distribution Systems Systems for AC and DC shipboard installations; protective devices such as fuses, circuit breakers, earth lamps; cable material and installation; connection of shore supply; operation and testing by standard methods, maintenance of additional and control equipment to be observed during testing, and evaluation of test results.
8.	DC Machines The principles, constructional details and protection of DC-series, shunt and compound-wound motors and generators; self-excitation, EMF and load-voltage equations; load characteristics; methods of voltage control, paralleling procedures and load sharing for generators; need for and types of starter, speed and torque equations; speed control of DC motors.
9.	AC Machines Simple explanation of the principles, constructional details and protection of alternators, squirrel-cage induction motors and single-phase transformers; parallel running and synchronising theory.
10.	Propulsion Principles and operation of electric propulsion, construction details, control of excitation, killer circuits, connection of armatures, monitoring and control of field current, basic circuitry.

31.13 Naval Architecture

ITEM	COLUMN
1.	General Displacement, wetted surface, block, mid-section, prismatic and water plane area coefficient; tonne per centimetre immersion; application of Simpson's rules to areas, moment of area, volumes and moment of volume.
2.	Draught and Buoyancy Alteration of mean draught due to change in density of water; buoyancy and reserve buoyancy; effect of bilging amidship compartments.
3.	Transverse Stability Centre of gravity; centre of buoyancy; metacentre; shift of centre of gravity due to addition or removal of mass, transverse movement of mass, suspended mass; stability at small angles of heel (given the second moment of area of the water plane or formulae); the inclining experiment, hydrostatic curves and stability curves.
4.	Resistance and Propulsion Comparison of skin frictional resistance of hull with model at different speeds; $R^f = f.S.V^n$ and residual resistance; admiralty and fuel coefficients; relation between speed of vessel and fuel consumption with constant displacement and assuming that resistance varies as (speed) ² Yn; elementary treatment of propeller and simple problems on pitch, pitch ratio, apparent slip, real slip, wake, thrust and power.
5.	Structural Strength Simple problems on strength of structural members to resist liquid pressure; loading due to head of liquid.
6.	Ship Construction Common terms used in the measurement of steel ships (e.g., length between perpendiculars, breadth overall, moulded depth, draught and freeboard); definitions of shipbuilding terms in general use; descriptions and sketches of structural members in ordinary types of steel ships; water-tight doors, hatches, rudders, bow thrusters, propellers, watertight bulk-heads, double bottoms. anchors and cables. Descriptive treatment of effect of free surface of liquids on stability; arrangements for the carriage of dangerous goods in bulk, strengthening of vessels for navigation in ice, welding in steel ships.
7.	Ventilation Arrangements Natural and mechanical ventilation for pump rooms in tankers and for holds and oil fuel tanks, accommodation and machinery spaces.
8.	Tanks Fore and aft peak tanks, double bottom and deep tank filling and pumping arrangements; compartmental drainage; levelling arrangements for damaged side compartments.
9.	Inspection Underwater parts of a ship in dry-dock; provision of fire protection, security arrangements.

31.14 Engineering Knowledge, General

ITEM	COLUMN
1.	Materials The general effects of various treatments on the physical and chemical properties of materials commonly used in the construction of marine engines and boilers, and the physical tests to which these materials are normally subjected.
2.	Heat and Combustion The properties of steam, fuel, lubricants and other liquids, gases and vapours used in machinery on board ship.
3.	Instruments The use, construction details and principles involved in the action of the pressure gauge, thermometer, pyrometer, barometer, salinometer, hydrometer and other meters commonly used by engineers on board ship.
4.	Water Treatment The causes, effects and usual remedies for encrustation and corrosion; feed-water, blow densities and electrolysis.

5.	Principles of Marine Engines Constructional details and working principles of marine engines; methods of determining their kilowatt power; the principles of working and methods of calibration of dynamometers and torsion meters mounted on ships.
6.	Practice The methods of dealing with wear and tear of machinery and boilers; the alignment of machinery parts; the correction of defects due to flaws in material or accident; temporary or permanent repairs in the event of derangement or total breakdown; detection of machinery malfunction; location of faults and actions to prevent damage.
7.	Pumps and Systems Constructional details and principles of action of pumps fitted in ships; general requirements concerning feed, fuel, bilge and ballast pumping systems.
8.	Auxiliary Machinery The constructional arrangement, operation and maintenance of steering engines and gears, refrigerating machinery, hydraulic and other auxiliary machinery, and such steam and internal combustion engines as are used for emergency and auxiliary machinery on board ship; deck machinery and cargo-handling machines.
9.	Power Transmission Construction details, alignment, lubrication, expansion, clearances and wear allowances of thrust blocks, shafting, bearings, stern tubes, propellers, nozzles, thrusters and ship side fittings.
10.	Prevention Precautions against fire or explosions due to oil or gas; flash point; explosive properties of gas or vapour given off by fuel or lubricating oils when mixed with a quantity of air; the danger of leakage from oil tanks, pipes, gas producers and vaporizers, particularly in bilges and other unventilated spaces; vaporizers, particularly in bilges and other unventilated spaces; the action of wire-gauze diaphragms and the places where such devices should be fitted.
11.	Coal Fuel Spontaneous combustion of coal; explosive properties of gas given off by coal dust creating explosive material.
12.	Fire Detection Methods of dealing with fire; action and maintenance of mechanical and chemical fire extinguishers and other firefighting appliances; respirators and safety lamps; smoke and heat detectors; sprinkler systems, wet and dry valves; permanently-fixed gas-smothering systems and methods of activating; dangers of smothering gas to life.
13.	Safe Working Practices Mechanical safety in overhauling work shops, protective equipment, lifting-tackle safety and tests, precautions and tests when entering tanks; first aid related to injuries that may be expected in machinery spaces, use of first aid equipment and methods of obtaining second aid.
14.	Cold Weather Practices Special arrangements for operation in waters with ice; lay out and operation of ice-related shipboard systems, cold weather lay-up.
15.	Control Systems Automation and instrumentation in block diagrams, periodically unattended machinery spaces, techniques and work practices, bridge control, remote-control stations, system monitoring.
16.	Pollution Prevention Devices to prevent pollution from oil, sewage, air; regulations to be observed regarding pollution.
17.	Maintenance Routine maintenance, prevention of damage to machinery, preventive maintenance, corrective maintenance, planned maintenance, record keeping relating to maintenance, deployment of human resources for effective maintenance and repair.
18.	Lifesaving Appliance Operation and maintenance of lifesaving appliance; launching and retrieval machinery.
19.	Damage Control Methods of damage control, with specific reference to action to be taken in the event of flooding of seawater into the machinery spaces.


20.	Electrical Safety Safe operation and maintenance of electrical and control equipment, precautions to be observed to prevent injury to personnel and machine, methods of cleaning and drying of equipment, particularly equipment flooded by seawater.
21.	Non-Destructive Testing An awareness of non-destructive testing, to include: magna flux, dye penetrants, ultra sonics, nuclear, vibration analysis, spectronic oil analysis for wear indication, z-ray, and thermographs.

31.15 Engineering Knowledge, Steam

ITEM	COLUMN
1.	Construction of Steam Machinery The methods of constructing marine steam-engines and boilers, the processes and tests to which the several parts are submitted or which are incidental to their manufacture, and the methods employed in fitting the machinery on board ship.
2.	Types of Machinery The various types of propelling and auxiliary machinery now in use, the functions of each important part and the attention required by the different parts of the machinery on board ship.
3.	Steam Pumps Operation and maintenance of simplex, duplex and multi-stage centrifugal pumps.
4.	Feed-Water Systems The constructional details and working of evaporators, feed-water heaters and feed-water filters, contamination from lube oil and fuel oil.
5.	Marine Boilers Marine boilers of various modern designs; the prevention of movement of boilers when vessels are pitching or rolling; the determination by calculation of suitable working pressure for boilers of given dimensions.
6.	Boiler Fittings The functions and maintenance of boiler fittings and mountings, with special reference to water gauges, safety valves, and programmers; precautions necessary when raising steam and operating stop valves, with particular reference to the danger arising from water-hammer action.
7.	Combustion Constructional details, operation and maintenance of installations generally employed for assisting draught, superheating steam and burning coal or oil fuel.
8.	Power Transmission Construction details, operation and maintenance of reduction gearing, thrust systems and lubricating systems, inspection, evaluation of visible signs of deterioration of wearing surfaces.
9.	Lubricating System Operation and maintenance of open and closed lubrication systems, testing for contamination, lubricating oil consumption and factors leading to over-consumption.

31.16 Engineering Knowledge, Motor

ITEM	COLUMN
1.	Construction of Marine Machinery The design considerations and operation of internal combustion engines; the differences between various types of engines; constructional details of internal combustion engines in general use.
2.	ICE Systems The nature and properties of the fuel and lubricating oils generally used in internal combustion engines; the supply of air and fuels to cylinders of engines of different types; the means of cooling the cylinders and pistons; constructional details and working of air compressors.
3.	Construction of IC Engines The methods of constructing marine internal combustion engines; the processes to which the several parts are submitted or which are incidental to their manufacture, and the methods employed in fitting the machinery on board ship.
4.	Starting and Reversing Systems Starting and reversing arrangements and the various operations connected therewith.
5.	Operation and Maintenance The attention required for the operation and maintenance of the various parts of machinery; the use and management of valves, pipes, connections and safety devices employed.
6.	Defects and Remedies Enumeration and description of defects arising from working of machinery; the remedy for such defects.
7.	Auxiliary Boilers Operation and maintenance of auxiliary steam boilers, their fittings and mountings, with special reference to water gauges, safety valves, and programmers; constructional details and management of auxiliary machinery; draught, combustion equipment, oil fuel equipment.
8.	Compressed Air Systems The care and maintenance of air compressors, receivers and coolers.
9.	Power Transmission Operation and maintenance of reduction gears, reverse gearing, thrust systems, lubrication, clutching, evaluation of visible signs of deterioration.
10.	Lubricating Systems Operation and maintenance of closed lubrication systems, testing for contamination, factors leading to over consumption, symptoms and remedies.

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31.17 Oral Examination

ITEM	COLUMN
1.	<p>General</p> <p>Practical knowledge subjects, including questions on the management of engines and boilers at sea, the duties of the supervising engineer, the work to be done to engines, boilers and auxiliary machinery in port, and the periodical examination of the working parts.</p>
2.	<p>Casualties</p> <p>Machinery and boiler casualties that may occur at sea and how these casualties can be prevented and remedied.</p>
3.	<p>Safe Ship Management</p> <p>The general aspects of regulations, international requirements and ship's business, including:</p> <ul style="list-style-type: none"> (a) knowledge of the <i>Canada Shipping Act</i> relating to: <ul style="list-style-type: none"> (i) engagement and discharge of seafarers, in and/or out of Canada, (ii) rights of seafarers, (iii) maintenance of discipline, (iv) registration of ships, (v) port wardens and steamship inspectors, (vi) wrecks, salvage and casualties, (vii) coasting trade of Canada, (viii) provisions, health and accommodation, (ix) distressed seafarers, and (x) limitation of liability; (b) custom house and immigration procedures, coasting licence and regulations; (c) Quarantine Regulations, de-rat certificates; (d) <i>Marine Liability Act</i>; (e) tonnage certificates; (f) charter parties and bills of lading; (g) noting and extending protest; (h) Canadian Labour Code, as applicable to shipping; (i) basic knowledge of the marine insurance contract and its relationship to the master's and ship officer's responsibility to owners and underwriters; (j) Shipping Casualties Reporting Regulations; (k) Potable Water Regulations; (l) Medical Examination of Seafarers Regulations; (m) Foreign-Going, Home-Trade, Inland Waters and Minor Waters Voyage Regulations; (n) Safety and Inspection Certificate Regulations; (o) Port State Control inspections, documentation, crew certificates, certificate endorsements, crew list; and (p) pollution prevention, MARPOL, emergency management, prevention of vital system failure, international conventions, safe ship management.