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| | Marine Safety | Approved by: AMSP | Revision No: 04 | Page: 1 of 10 |
| TP 2293 E | | <i>THE EXAMINATION AND CERTIFICATION OF SEAFARERS</i> | | |

CHAPTER 32 - THIRD-CLASS ENGINEER, MOTOR SHIP, AND THIRD-CLASS ENGINEER, STEAMSHIP

PART I -GENERAL REQUIREMENTS OF APPLICANTS

- 32.1 (1) Every applicant for a certificate as Third-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, for:
 - (A) Survival Craft (B1);
 - (B) Marine Fire Fighting (B2);
 - (C) Officer Certification (C); and
 - (D) Senior Officer(D);
 - (ii) Propulsion Plant Simulator Course Level I, set out in TP 10935;
 - (iii) Marine First Aid Advanced Course, set out in TP 13008; and
 - (c) pass written examinations in the following subjects:
 - (i) Mathematics
 - (ii) Applied Mechanics;
 - (iii) Thermodynamics;
 - (iv) Electrotechnology; and
 - (v) Engineering Knowledge, General.
- (2) Every applicant for a certificate as a Third-Class Engineer, Steamship, shall:
- (a) complete the requirements set out in section 32.1(1);
 - (b) pass a written examination in Engineering Knowledge, Steam; and
 - (c) pass an oral examination.
- (3) Every applicant for a certificate as a Third-Class Engineer, Motor Ship, shall:
- (a) complete the requirements set out in section 32.1(1);
 - (b) pass a written examination in Engineering Knowledge, Motor; and
 - (c) pass an oral examination.
- (4) An applicant who holds a certificate issued before January 3, 1994, may be issued a certificate as Third-Class Engineer, Steamship or Motor Ship, after:
- (a) passing a written examination in each of the following:
 - (i) Thermodynamics;
 - (ii) Electrotechnology; and

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|  | Transport Canada | Issue Date: August 2004 | Section 3 | Ref: 2293-INF-32-2 |
| | Marine Safety | Approved by: AMSP | Revision No: 04 | Page: 2 of 10 |
| TP 2293 E | | <i>THE EXAMINATION AND CERTIFICATION OF SEAFARERS</i> | | |

(b) passing an oral examination.

32.1 (5) The service required by an applicant for a Third-Class Certificate, Steam or Motor, is 48 months service as follows:

(a) after completing the service for the appropriate Fourth-Class Certificate, Steam or Motor, Chapter 33;

(b) a minimum of six months sea service:

- (i) as an engineer officer or engineer on the watch on a steamship of not less than 350 kW propulsion power where the applicant applies for a certificate as a Third-Class Engineer, Steamship; or
- (ii) as an engineer officer or engineer on the watch on a motor ship or MODU of not less than 350 kW propulsion power when the applicant applies for a certificate as a Third-Class Engineer, Motor Ship; and

(c) the remaining time made up of any combination of the following service, subject to any time limitations set out therein:

- (i) engineer officer or engineer on day work on a ship to a maximum of three months;
- (ii) engineer officer or engineer fitting out, laying up or overhauling on a ship to a maximum of six weeks in any one year, to a maximum of three months;
- (iii) engineer officer or engineer on a non-propelled motor or steam dredge, drill rig, floating elevator or similar ship, the main engine of which is not less than 450 kW power;
- (iv) engine-room rating or engine-room assistant on the watch in the engine room of a steamship or motor ship of not less than 350 kW propulsion power, to be credited at a rate of one day for every three days of service, (up to 6 months maximum); and
- (v) time spent at the marine department of a school listed in TP 10655 to be credited at a ratio of one day for every three days attendance, to a maximum of three months.

32.2 Not in use.

32.3 (1) For a Third-Class Motor with Steam Certificate of a higher grade, an applicant shall have served for not less than six months in the engine room of a motor ship of not less than 350 kilowatt propulsion power as an engineer officer or engineer on watch.

(2) For a Third-Class Steam with Motor Certificate of a higher grade, an applicant shall have served for not less than six months in the engine room of a steamship of not less than 350 kilowatt propulsion power as an engineer officer or engineer on watch.

32.4 Not in use.

Chief Engineer Certificate

32.5 For a Chief Engineer Certificate, an applicant shall hold a Third-Class Certificate, and have served, since qualifying for a Fourth-Class Second Engineer Endorsement, for not less than 24 months as engineer or engineer officer on watch in the engine room of a motor ship or steamship, as appropriate, of not less than 750 kilowatt propulsion power, and shall have successfully completed an approved Marine Emergency Duties D Course and Propulsion Plant Simulator Level 2 Course.

PART II - EXAMINATIONS

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

Steam Certificate

| EXAMINATION | QUALIFYING SERVICE | OTHER REQUIREMENTS |
|--------------------------------|--|---|
| Mathematics | - | - |
| Applied Mechanics | - | - |
| Thermodynamics | - | - |
| Electrotechnology | - | - |
| Engineering Knowledge, General | 48 months | MED C & D, PPS Level 1, *Skills Training, *TRB. |
| Engineering Knowledge, Steam | 48 months including six months Steam 350 kW | Pass Engineering Knowledge, General |
| Oral Examination | - | Pass Engineering Knowledge, General and Steam |

* These items are not required for applicants holding a Fourth-Class Engineering Certificate.

Motor Certificate

| EXAMINATION | QUALIFYING SERVICE | OTHER REQUIREMENTS |
|--------------------------------|--|---|
| Mathematics | - | - |
| Applied Mechanics | - | - |
| Thermodynamics | - | - |
| Electrotechnology | - | - |
| Engineering Knowledge, General | 48 months | MED C & D, PPS Level 1, *Skills Training, *TRB. |
| Engineering Knowledge, Motor | 48 months including six months Motor 350 kW | Pass Engineering Knowledge, General |
| Oral Examination | - | Pass Engineering Knowledge, General and Motor |

* These items are not required for applicants holding a fourth-Class Engineering Certificate.

Motor with a Steam Certificate

| EXAMINATION | QUALIFYING SERVICE | OTHER REQUIREMENTS |
|------------------------------|---------------------------|--------------------------------------|
| Engineering Knowledge, Motor | Six months 350 kW | Third-Class Steam Certificate |
| Oral Examination | - | Pass Engineering Knowledge, Motor |

Steam with a Motor Certificate

| EXAMINATION | QUALIFYING SERVICE | OTHER REQUIREMENTS |
|------------------------------|---------------------------|--------------------------------------|
| Engineering Knowledge, Steam | Six months 350 kW | Third-Class Motor Certificate |
| Oral Examination | - | Pass Engineering Knowledge, Steam |

Chief Engineer Certificate

| EXAMINATION | QUALIFYING SERVICE | OTHER REQUIREMENTS |
|--------------------|------------------------------|---|
| No examination | 24 months (12 months 750 kW) | MED D, Third-Class Certificate issued after January 3, 1994, PPS Level 2. |

- 32.7 (1) Each written examination paper shall be of maximum duration of three and a half hours.
- (2) All papers consist of nine questions, six of which shall be attempted by the applicant.
- (3) If more than the required number of questions are answered in any paper, all the answers shall be marked and only the required number of questions awarded the lowest marks shall be taken to determine the overall result.
- (4) The knowledge to be shown by an applicant for a Third-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 the boilers and machinery; and
 - (b) as a chief engineer officer, and as second engineer officer, to take charge of the engine-room staff and the main propulsion auxiliary machinery of ships as per section 32.7(5)(i) and 32.7(5)(ii).

PART III - VALIDITY OF CERTIFICATE

32.7 (5) The Certificate as a Marine Engineer Third Class is valid as:

- (i) Watchkeeping Engineer without restrictions.
- (ii) Second Engineer (if issued after January 3, 1994) on any ship less than 3000 kW and on passenger ships more than 4000 kW between Canadian ports.
- (iii) Chief Engineer, with the following restrictions:

| | Foreign Going Home-Trade I | Home-Trade II | Home-Trade III | Inland I Inland II Minor Waters I | Minor Waters II Home Trade IV |
|------------------|---------------------------------------|----------------------|-----------------------|--|--|
| Pass Vessels | Not Applicable | Not over 1000 kW | Not over 1000 kW | Not over 1000 kW | Not over 1500 kW |
| Non-Pass Vessels | Not Applicable | Not over 2000 kW | Not over 2000 kW | Not over 2000 kW | Not over 4000 kW |
| Tow Boats | Not Applicable | Not over 2000 kW | Not over 4000 kW | Not over 4000 kW | Not over 5000 kW |
| Fishing Vessels | Not over 2000 kW | | | | |

32.7 (6) Chief Engineer Certificate validity:

| | Unrestricted Voyage | Intermediate Voyage | Local Voyage | Minor Waters Voyage |
|---------------------|--------------------------------|--------------------------------|---------------------|--------------------------------|
| Pass Vessels | Not applicable | Not over 1000 kW | Not over 1000 kW | Not over 1500 kW |
| Non-Pass Vessels | Not over 2000 kW | Not over 2000 kW | Not over 2000 kW | Not over 4000 kW |
| Fishing | Not over 2000 kW | | | |

PART IV - SYLLABUSES OF EXAMINATIONS

32.8 Mathematics

| ITEM | COLUMN |
|-------------|--|
| 1. | General The setting out of calculations, extraction and cancellation of common factor, significant figures, degree of accuracy. |
| 2. | Arithmetic Averages, percentages, ratio, proportions, variation direct and inverse. |
| 3. | Logarithms Use of tables, square roots, reciprocals, use of logarithms for multiplication, division, powers and roots. |
| 4. | Algebra Indices, including fractional and negative types; use of common logarithms for multiplication, division, powers and roots; use of Napierian logarithms; simplification and division of algebraic functions; re-arrangement of formulae; factorisation; algebraic fractions; squares and cubes of polynomials such as $(a + b)^2$ and $(a + b)^3$; simple equations; quadratic equations and solution by factorisation or by completing the square, proof of general formula for solution; simultaneous equations; complex quantities, their representation on Argand diagrams. |
| 5. | Graphics Graphical work; the graph $y = ax + b$, either from calculated values or from experimental results; calculation of constants from graphs; graphical solution of simple simultaneous equations involving two unknowns; graph of $y = ax^2 + bx + c$ and graphical solution of equation $ax^2 + bx + c = 0$. |
| 6. | Geometry Properties of triangles; Pythagorean theorem; sum of the angles; relation between exterior and interior angles; isosceles and equilateral triangles; similar and congruent triangles. |
| 7. | Trigonometry Measurement of angles in degrees and radians; complementary and supplementary angles; sine, cosine and tangent of angles up to 360 degrees; sine and cosine rules and their application of the solution of triangles; solution of simple trigonometric equations; expansion of $\sin(A + B)$ and $\cos(A + B)$; graphs of $\sin \theta$, $\cos \theta$ and $a \sin \theta + b \cos \theta$. |
| 8. | Mensuration Areas of triangle, polygon, parallelogram, trapezium, circle, properties of chords and tangents; angles in the same segment; angles at centre and circumference, sector and segment of a circle and ellipse; areas of oblique sections of regular solids of uniform cross section; area and mean height by mid-ordinate rule and by Simpson's rule. |
| 9. | Ratios and Volumes Ratio of areas of similar figures; volumes and surface areas of prisms, pyramids, frustums, spheres, cylinders and cones; ratio of masses and volumes of similar solids; solids of revolution. |

32.8A Applied Mechanics

| ITEM | COLUMN |
|------|---|
| 1. | Vectors The vector representation of forces; triangle of forces; resultant and equilibrant of a system of concurrent co-planar forces; couples. |
| 2. | Moments and Centroids The principle of moments, application to simply-supported beams and ranked levers; centre of area; centre of gravity. |
| 3. | Displacement Displacement, time, speed, velocity and acceleration. |
| 4. | Forces Force, moment of force, torque, work, energy and power. |
| 5. | Simple Machines Simple machines, velocity ratio, mechanical advantage, efficiency. |
| 6. | Friction Friction, laws for dry surfaces, coefficient of friction (horizontal plane only). |
| 7. | Stress and Strain Direct stress and strain, Hooke's law, modulus of elasticity, elastic limit, UTS, yield stress, limit of proportionality, safety factor, shear stress. |
| 8. | Density and Pressure Relative density; variation of fluid pressure with depth; Archimedes' principles. |
| 9. | Elementary Stability Elementary treatment of transverse stability, centre of buoyancy, centre of gravity and metacentre (box shape only); transverse movement of masses across deck. |

32.9 Thermodynamics

| ITEM | COLUMN |
|------|---|
| 1. | Introduction S. I., Metric and Imperial units. Conversion of units from one system to another. Temperature and its measurement; scales; significance of absolute temperature; heat as energy, first law of thermodynamics and mechanical equivalent of heat (conservation of energy applied to heat and work); fuels, calorific value, flashpoint. |
| 2. | Thermal Properties Expansion and contraction of solids, liquids and gases; change of phase; specific enthalpy of fusion, evaporation; properties of working fluids air, steam and freon. |
| 3. | Perfect Gas Laws Compression and expansion of gases; gas laws; Boyle's law, Charles' law. |
| 4. | Heat Transfer Specific heat capacity, heat transfer by conduction, convection and radiation; effect of insulation. |
| 5. | Thermal Relations The indicator diagram, power developed, fuel consumption including understanding of principles of combustion; insufficient, minimum and excess air. |

32.10 Electrotechnology

| ITEM | COLUMN |
|------|--|
| 1. | Introduction Simple electric circuit; chemical, magnetic and thermal effects of electric current; Ohm's Law; series and parallel circuits; electromotive force, voltage; units of current, resistance, voltage, energy, simple AC circuit, Wheatstone bridge. |
| 2. | Properties of Conductors Distribution of current in circuits; resistance of conductor, variation with dimensions, material, temperature; temperature coefficient of resistance; insulators. |
| 3. | Storage Cells Secondary cells (acid and alkali); construction; capacity, ampere hour. |
| 4. | Switchboards Construction and operation of switchboard. |
| 5. | Introduction to Electronics P-N junction, rectifiers, switching. |
| 6. | Instruments Moving coil, moving iron (repulsion type). |
| 7. | Magnetism Magnetic field, lines of force; field due to current in a straight conductor; motor and generator principle, commutation; speed control of motors; starter AC and DC; alternators and AC motors. |

32.11 Engineering Knowledge, General

| ITEM | COLUMN |
|------|--|
| 1. | Communications Ability to transmit information relating to machinery components by means of simple drawings with supplementary notes and specifications. |
| 2. | Manufacturing Processes Knowledge of the methods or manufacture of the various machinery components and the effects of various treatments on the physical properties of the materials commonly used. |
| 3. | Boilers Constructional details and management of auxiliary boilers, including firing arrangements and boiler mountings; boiler water testing and treatment. |
| 4. | Steering Gear Construction, arrangement and working of steering gears and telemotors. |
| 5. | Pumps Constructional details and principles of action of pumps; general requirements for pumping systems. |
| 6. | Firefighting Equipment Fire prevention and detection; firefighting equipment, its use, construction and maintenance. |
| 7. | Safe Working Practices Safe working practices in machinery rooms and other enclosed spaces. |
| 8. | Management of Electrical Equipment Safe and efficient operation and maintenance of electrical equipment; |
| 9. | Propeller Shaft System Constructional details of shafting, stern tubes, stern bushings and methods of securing them; constructional details of controllable pitch and fixed pitch propellers, and propeller shafts. |
| 10. | Rudders Methods of supporting the rudder, constructional details of rudder and pintles. |

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| 11. | Hydraulic Systems Principles of operation and maintenance of pneumatic, hydraulic and electronic governors. |
| 12. | Refrigeration Systems Working principles of operation and maintenance of refrigeration systems. |
| 13. | Ship Construction Elementary knowledge of ship construction and terminology used. |
| 14. | Deck Machinery Operations and maintenance of cargo handling equipment and deck machinery. |

32.12 Engineering Knowledge, Steam

| ITEM | COLUMN |
|------|---|
| 1. | Principles and Construction of Boilers Working principles and constructional details of water-tube and fire-tube boilers and their mountings. |
| 2. | Fuel and Fuel Systems Fuel systems operation and maintenance; properties of fuel used in marine boilers. |
| 3. | Boiler Feed-Water Feed systems and water treatment. |
| 4. | Construction of Steam Engines The construction and operation of steam reciprocating engines and turbines and associated equipment and systems. |
| 5. | Lubrication Properties of lubricating oils used in reciprocating steam engines and turbines. |
| 6. | Management of Steam Engines Operation and maintenance of reciprocating steam engines and turbines; determination of engine power. |
| 7. | Automation and Alarms A general understanding of the basic operation and maintenance of automatic control and alarm systems, in particular, definitions. |
| 8. | Faults and Prevention Location of common faults of machinery and plant in machinery spaces, and action necessary to prevent damage. |

32.13 Engineering Knowledge, Motor

| ITEM | COLUMN |
|------|---|
| 1. | Principles and Construction of ICES Working principles and constructional details of marine diesel engines, gears, clutches and associated equipment and their seatings. |
| 2. | Cooling Systems Cooling systems for diesel engines and their protection from damage by freezing and corrosion. |
| 3. | Oil Fuel and Lubrication Fuel and lubricating oil systems; the properties of fuel and lubricating oil used in diesel engines. |
| 4. | Compressed Air Systems Constructional details and working principles of compressed air systems; starting and reversing systems for diesel engines. |
| 5. | System Control Diesel engine controls, protective devices and remote sensing and monitoring. |

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| 6. | Management of Diesel Engines Operation and maintenance of diesel engines; determination of engine power. |
| 7. | Power Balance Adjusting of fuel pumps, injectors, valves and power balancing of diesel engines. |
| 8. | Automation and Alarms A general understanding of the basic operation of automatic controls and alarms, in particular definitions. |

32.14 Oral Examination

| ITEM | COLUMN |
|------|--|
| 1. | General Practical knowledge, with particular reference to the applicant's answers in the written examination; may include questions on the water gauge and safe working practices. |
| 2. | Ship's Business Subjects related to general aspects of regulations and ship's business, including: <ul style="list-style-type: none"> (a) Oil Pollution Prevention Regulations extended to include interpretations and ship's responsibilities under them; (b) the organization of crew for emergencies, drills and routine operations and maintenance; (c) ship's responsibilities under: <ul style="list-style-type: none"> (i) Boat and Fire Drill Regulations; and (ii) Crewing Regulations; (d) the <i>Canada Shipping Act</i> and regulations made thereunder with respect to: <ul style="list-style-type: none"> (i) grades and classes of certificates or competency; (ii) rights of holders of certificates; (iii) offences relating to certificates; (iv) losses of certificates; (v) seafarers rights concerning wages; (e) official and ship's logbooks and their entries under all conditions; and (f) <i>Canada Labour Code</i>, Occupational Health and Safety Regulations. |