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TP 1332E
(04/2010)

CONSTRUCTION STANDARDS FOR SMALL VESSELS

2010 EDITION

REVISION 1



Canada

<p>Responsible Authority</p> <p>The Executive Director, Domestic Vessel Regulatory Oversight, is responsible for this document, including any change, correction, or update.</p>	<p>Approval</p> <hr/> <p>Luc Tremblay Executive Director, Domestic Vessel Regulatory Oversight Marine Safety</p>
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REVISIONS				
Last Review		2023-02-01		
Next Review				
Revision No.	Date of Issue	Affected Pages	Author(s)	Brief Description of Change
0	2010-04-29	All	L.Tremblay	New edition for the coming into force of the new Small Vessel Regulations
1		xii - xiii	E. Letourneau	Reference to ISO 10088 replaced by reference to ISO 21487
1		0 Information Notes	E. Letourneau	HIN requirement update: 12m replaced by 15 GT
1		Various Section 2 & 4	L. Tremblay	Use of the expression "Recommended maximum safe limits" normalized through the text.
1		Various Section 2	E. Letourneau	"Product" replaced by "vessel" as needed
1		3.3.1.5	L. Tremblay	Paragraph reformatted as 3.3.1.5
1		3.3.3.1	L. Tremblay	Text added to add clarity of the requirement
1		3.3.2.3	L. Tremblay	"reasonable or" added after "Where". added
1		3.6	E. Letourneau	Paragraph corrected to read: <i>Vessel Pollution and Dangerous Chemicals Regulations</i>
1		Table 4-2	E. Letourneau	Table updated as per ABYC standard S-30 (2022)
1		4.4.1.2.4	L. Tremblay	This section needs to apply to level flotation as well, to align with USCG position on this matter
1		4.4.1.4.2	E. Letourneau	Corrected use of subscript in variable definition for Kd
1		4.4.2.2.4	L. Tremblay	Figure 4-6 corrected to read figure 4-4

1		4.4.2.2.10	L. Tremblay	Text added to add clarity of the requirement
1		4.3.3.2, 4.5.5.2, 4.6.4.4	L. Tremblay	10 kW (15 HP) corrected to read 11 kW (15 HP)
1		4.5.1.1(d)	L. Tremblay	200mm replaced by 150mm as in 2004 edition
1		4.6.4.2	L. Tremblay	Formatted: numbering style
1		5.2.1.1	L. Tremblay	Information note updated to reflect the most recent information
1		6.3.2.1	L. Tremblay	Cubic centimeter replaced by correct term: cubic meter
1		7.13	E. Letourneau	Addition of Emission requirements in line with new regulations
1		7.2.7	L. Tremblay	plastic bowl "may be" used for outboard engines - changed from "shall be" to "may be"
1		7.3.1.1	E. Letourneau	Reference to ISO 10088 removed
1		8.2.1.1	L. Tremblay	Figure 8-1 (French section of the label) Cable replaced with câble
1		8.7.4.2	E. Letourneau	500mm changed to 455mm to align with current practice
1		10.3.5.4	E. Letourneau	Add to French Modification (Type Approved by)
1		Appendix 1	L. Tremblay	Title formatted: Numbering
1		Appendix 1 , 1.2	E. Letourneau	(d) removed to align with new SVR requirements

1		Appendix 1 , 1.2.1.1	E. Letourneau	Paragraph added regarding MOU between TC and NMMA
1		Appendix 1 , 1.2.2 & 1.2.4	E. Letourneau	Paragraph modified to align with new SVR requirements on DOC
1		Appendix 1.4.2	E. Letourneau	Add new paragraph to align with new SVR requirements
1		Appendix 2	L. Tremblay	Appendix 2 rewritten in line with the new <i>Vessel Pollution and Dangerous Chemicals Regulations</i> (SOR/2012-69)
1		Appendix 3, 3.1.2	L. Tremblay	Paragraph corrected to read: Vessels fitted with a muffler as defined in the regulations and meeting (...) many States in the US should provide an acceptable noise reduction solution.
1		Appendix 4, 4.1.3.1	L. Tremblay	4.1.3.1 (j) removed: included in Appendix 5
1		Appendix 5	L. Tremblay	Appendix 5 deleted

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PREVIOUS EDITIONS

Publication Number	Title	Edition	Year
---	Construction Standards For Pleasure Craft	1	1974
TP 1332	Construction Standards For Small Vessels	2	1978
TP 1332	Construction Standards For Small Vessels	3	1999
TP 1332	Construction Standards For Small Vessels	4	2002
TP 1332E	Construction Standards For Small Vessels	5	2004

REFERENCED ORGANIZATIONS

ABYC

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<http://www.abycinc.org/>

This document references the following ABYC standards:

E-10 Storage Batteries

E-11 AC and DC Electrical Systems on Boats

H-2 Ventilation of Boats Using Gasoline

H-24 Gasoline Fuel Systems

H-26 Powering of Boats

H-28 Inflatable Boats

H-33 Diesel Fuel Systems

H-35 Powering and Load Capacity of Pontoon Boats

H-41 Reboarding Means, Ladders, Handholds, Rails, and Lifelines

T-5 Safety Signs and Labels

ASME

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<http://www.asme.org/>

This document references the following ASME code:

Boiler and Pressure Vessel Code (BPVC)

ANSI/ASME B1.20.1 - 1983 Pipe Threads, General Purpose, Inch

ASTM

ASTM International (ASTM)

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Telephone: (610) 832-9500

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<http://www.astm.org/>

This document references the following ASTM resistance requirements and test methods:

A93 Specification for Zinc-Coated Galvanized Iron or Steel Sheets, Boils, and Butt Lengths (withdrawn replaced by A525)

A525 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process (Withdrawn replaced by A653)

A653 / A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

A463 Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

B96 / B96M Standard Specification for Copper-Silicon Alloy Plate, Sheet, Strip, and Rolled Bar for General Purposes and Pressure Vessels

B97-81 Specification for Copper-Silicon Alloy Plate, Sheet Strip and Rolled Bar for General Purposes (withdrawn replaced by B97)

B122 Standard Specification for Copper-Nickel-Tin Alloy, Copper-Nickel-Zinc Alloy (Nickel Silver), and Copper-Nickel Alloy Plate, Sheet, Strip, and Rolled Bar

B127 Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip

B152 Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar

D471 Standard Test Method for Rubber Property – Effect of Liquids

D1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics

D1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics

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Fax: (416) 747-2473

<http://www.csa.ca/>

This document references the following CSA standard and code:

CSA C22.2 No. 245, *Marine Shipboard Cable*

CSA C22.1, *Canadian Electrical Code, Part I*

CFR

United States Code of Federal Regulations (CFR)

(and other U.S. Government publications)

Superintendent of Documents

U.S. Government Printing Office

732 N. Capitol Street, NW

Washington, DC 20401

USA

Telephone: (202) 512-1800

<http://www.gpoaccess.gov/cfr/>

This document references the following United States Code of Federal Regulations (CFR):

Title 33, Section 183.510

Title 33, Section 183.590

Title 46, Section 182.415

Title 46, Subchapter J

IEEE

Institute of Electrical and Electronics Engineers (IEEE)

IEEE Operations Center

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Telephone: (732) 981-0060 (800) 701-4333

<http://www.ieee.org/>

This document references the following IEEE standards:

IEEE STD 45, *Recommended Practice for Electrical Installations on Shipboard*

IEEE STD 1580, *Recommended Practice for Marine Cable for Use on Shipboard and Fixed or Floating Platforms*

ISO

International Organization for Standardization (ISO)

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SWITZERLAND

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This document references the following ISO standards:

ISO 3166 *Codes for the Representation of Names of Countries and their Subdivisions*

ISO 6185-3 *Inflatable Boats: Boats with a maximum motor power rating of 15 kW and greater*

ISO 6185-4 *Inflatable Boats: Boats with an overall length of between 8 m and 24 m and with a motor maximum power rating of 75 kW and greater*

ISO 8665 *Small Craft – Marine Reciprocating Internal Combustion Engines– Power Measurements and Declarations*

ISO 11592 *Small Craft less than 8 m Length of Hull – Determination of Maximum Propulsion Power Rating*

ISO 11812 *Small Craft – Watertight Cockpits and Quick-Draining Cockpits*

ISO 12216 *Small Craft – Windows, Portlights, Hatches, Deadlights and Doors – Strength and Watertightness Requirements*

ISO 12217-1 *Small Craft – Stability and Buoyancy Assessment and Categorization – Part 1: Non-Sailing Boats of Hull Length Greater Than or Equal to 6 Metres*

ISO 12217-2 *Small craft -- Stability and buoyancy assessment and categorization -- Part 2: Sailing boats of hull length greater than or equal to 6 m*

ISO 13590 *Small Craft – Personal Watercraft – Construction and System Installation Requirements*

ISO 14509 *Small craft-Measurement of airborne sound emitted by powered recreational craft*

ISO 21487 *Small craft – Permanently installed petrol and diesel fuel tanks*

NFPA

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Fax: (617) 770-0700

<http://www.nfpa.org/>

This document references the following NFPA standards:

NFPA 12 *Standard on Carbon Dioxide Extinguishing Systems*

NFPA 302 *Fire Protection Standard for Pleasure and Commercial Motor Craft*

NFPA 2001 *Standard on Clean Agent Fire Extinguishing Systems*

NFPA 2010 *Standard for Fixed Aerosol Fire-Extinguishing Systems*

SAE

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<http://www.sae.org/>

This document references the following SAE standards:

SAE J1171 *External Ignition Protection of Marine Electrical Devices*

SAE J1527 *Marine Fuel Hoses*

SAE J1928 *Devices Providing Backfire Flame Control for Gasoline Engines in Marine Applications*

SAE J1970 *Shoreline Sound Level Measurement Procedure*

SAE J2005 *Stationary Sound Level Measurement Procedure for Pleasure Motorboats*

SAE J2006 *Marine Exhaust Hose*

SAE J2031 *High Tension Ignition Cable*

TC

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<http://www.tc.gc.ca/securitemaritime/tp/menu.htm>

This document references the following TC standards:

TP127 *Ships Electrical Standards*

TP7301 *Stability, Subdivision, and Load Line Standards*

UL

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Fax: 613-237-4251

<http://global.ihs.com/>

This document references the following UL standards:

- UL 429 *Electrically Operated Valves*
- UL 1105 *Marine Use Filters, Strainers, and Separators*
- UL 1111 *Marine Carburetor Flame Arrestors*
- UL 1129 *Wet Exhaust Components for Marine Engines*
- UL 1309 *Marine Shipboard Cable*
- UL 1426 *Electrical Cables for Boats*
- UL 1500 *Ignition-Protection Test for Marine Products*

APPLICATION OF SECTIONS

APPLICATION BY SECTION AND PARAGRAPH					
Section / Paragraph		Pleasure Craft		Non-Pleasure Craft	
		≤6m	>6m	≤6m	>6m
0	INTRODUCTION				
0.1	Definitions	■	■	■	■
0.2	Pleasure Craft of more than 24 metres		■		
0.3	Standard Incorporated by Reference	■	■	■	■
0.4	Particular Vessel Design	■	■	■	■
0.5	Major Modifications	■	■	■	■
0.6	Plans			■	■
0.7	Safety Notices	■	■	■	■
1	HULL SERIAL NUMBERS				
1.1	Scope	■	■	■	■
1.2	Hull Serial Number (HIN)	■	■	■	■
2	COMPLIANCE NOTICES				
2.1	Scope	■	■	■	■
2.2	Compliance Notices	■	■	■	■
2.2.1	General	■	■	■	■
2.2.2	Vessels of not more than 6 metres in length – Capacity Label	■		■	
2.2.3	Vessels of more than 6 metres in length – Conformity Label		■		■
3	CONSTRUCTION REQUIREMENTS				
3.1	Scope	■	■	■	■
3.2	Structural Strength	■	■	■	■
3.3	Watertight Integrity	■	■	■	■
3.3.1	Fittings and Through-Hull Penetrations	■	■	■	■
3.3.2	Windows, Portlights, Hatches, Deadlights and Doors	■	■	■	■
3.3.3	Windows, Portlights, Hatches, Deadlights, and Doors of more than 6 metres				■
3.3.4	Drainage and Hull Penetrations	■		■	■
3.3.5	Motor Wells	■	■	■	■
3.4	Personal Watercraft	■	■	■	■
3.5	Protection from Falls	■	■	■	■
3.5.1	Scope	■	■	■	■
3.5.2	Non-Pleasure Craft of more than 6 metres				■
3.5.3	Pleasure Craft of All Sizes and Non-Pleasure Craft of 6 metres and less	■	■	■	
3.6	Discharge of Sewage	■	■	■	■
3.7	Navigation Lights	■	■	■	■
4	HULL DESIGN REQUIREMENTS AND CALCULATION OF RECOMMENDED MAXIMUM CAPACITIES FOR VESSELS NOT MORE THAN 6 METRES IN LENGTH				
4.1	Scope	■		■	
4.2	Definitions	■		■	
4.3	Recommended Maximum Safety Limits for Monohull Vessels	■		■	
4.3.1	Recommended Gross Load Calculation (Intact Condition)	■		■	
4.3.2	Recommended Maximum Number of Persons Calculation	■		■	
4.3.3	Recommended Maximum Power Calculation	■		■	
4.4	Flotation Requirements for Monohull Vessels	■		■	

APPLICATION BY SECTION AND PARAGRAPH					
Section / Paragraph		Pleasure Craft		Non-Pleasure Craft	
		≤6m	>6m	≤6m	>6m
4.5	Recommended Maximum Safety Limits for Pontoon Vessels	■		■	
4.5.1	Calculation Criteria (Intact Condition)	■		■	
4.5.2	Stability Testing	■		■	
4.5.3	Recommended Maximum Gross Load Calculation	■		■	
4.5.4	The Recommended Maximum Number of Persons Calculation	■		■	
4.5.5	The Recommended Maximum Power Calculation	■		■	
4.6	Recommended Maximum Safety Limits for Inflatable and Rigid Hull Inflatable Vessels	■		■	
4.6.1	Calculation Criteria (Intact Condition)	■		■	
4.6.2	Recommended Maximum Gross Load Calculation	■		■	
4.6.3	Recommended Maximum Number of Persons Calculation	■		■	
4.6.4	The Recommended Maximum Power Calculation	■		■	
5	HULL DESIGN REQUIREMENTS FOR NON-PLEASURE CRAFT EXCEEDING 6 METRES				
5.1	Scope				■
5.2	Stability Standards for All Types of Vessels				■
5.3	Stability Standard for Monohull Vessel Other than Inflatable or Rigid Hull Inflatable				■
5.4	Stability Standard for Pontoon Vessels				■
6	VENTILATION SYSTEMS				
6.1	Scope	■	■	■	■
6.2	General	■	■	■	■
6.3	Ventilation of Spaces Containing Source of Gasoline Vapour	■	■	■	■
6.4	Diesel Engine and Fuel Tank Space Ventilation	■	■	■	■
6.5	Battery Spaces	■	■	■	■
7	FUEL SYSTEMS				
7.1	Scope	■	■	■	■
7.2	General	■	■	■	■
7.3	Fuel Tanks	■	■	■	■
7.4	Fuel Lines	■	■	■	■
7.5	Fittings, Joints and Connections	■	■	■	■
7.6	Fuel Line Valves	■	■	■	■
7.7	Fuel Filters and Strainers	■	■	■	■
7.8	Fuel Pumps	■	■	■	■
7.9	Grounding	■	■	■	■
7.10	Carburetors (Gasoline)	■	■	■	■
7.11	Fuel System Labelling	■	■	■	■
7.12	Outboard Motor Installations	■	■	■	■
7.13	Emission Requirements	■	■	■	■
8	ELECTRICAL SYSTEMS				
8.1	Scope	■	■	■	■
8.2	Alternative Standards	■	■	■	■
8.3	General	■	■	■	■
8.4	Ignition Protection	■	■	■	■
8.5	Grounding	■	■	■	■
8.6	Batteries	■	■	■	■
8.7	Conductors	■	■	■	■

APPLICATION BY SECTION AND PARAGRAPH					
Section / Paragraph		Pleasure Craft		Non-Pleasure Craft	
		≤6m	>6m	≤6m	>6m
8.8	Receptacles	■	■	■	■
8.9	Overcurrent Protection	■	■	■	■
8.10	Panelboards	■	■	■	■
8.11	Emergency Lighting for Non-Pleasure Craft of more than 6 metres				■
8.12	Electrical Systems of 50 Volts or More	■	■	■	■
9	MACHINERY SYSTEMS				
9.1	Exhaust Systems	■	■	■	■
9.2	Main and Auxiliary Machinery				■
9.2.1	Scope				■
9.2.2	General				■
9.2.3	Engine Starting				■
9.2.4	Operating Position Instruments and Controls				■
9.2.5	Shafting and Propellers				■
9.2.6	Steering Systems				■
9.3	Bilge Pumping Arrangements				■
9.3.1	Scope				■
9.3.2	General				■
9.3.3	Bilge Pumping Systems				■
9.3.4	Automatic Bilge Alarm and Pump Running Indicator				■
9.4	Pressure Vessels	■	■	■	■
10	FIRE SAFETY				
10.1	Scope			■	■
10.2	Means of Escape				■
10.3	Fire Detection and Alarm			■*	■
10.4	Fire Fighting			■*	■

* See information note regarding elements that are not part of the Construction Requirements in Section 0.1.

0 INTRODUCTION

NOTICE

Information contained in text boxes that is not numbered in accordance with the general numbering system of the Standard is provided for information purposes only and does not form part of the Standard.

The Regulations sections provided in information boxes in this Standard are for ease of reference only. To ensure compliance, it is the responsibility of the reader to consult the official Regulations as published in the *Canada Gazette*. Consolidated editions of the Regulations may be consulted on the Justice Canada website at laws.justice.gc.ca.

Information Notes:

The *Construction Standards for Small Vessels*, 2010 Edition (TP1332), has been developed for vessels constructed or imported in order to be sold or operated in Canada, and supersedes the *Construction Standards for Small Vessels*, 2004 Edition (TP1332).

Transport Canada had intended to maintain the 2004 edition of the *Construction Standards for Small Vessels* until the development of new requirements that would include all non-pleasure craft (except fishing vessels) up to 24 metres in length. However, due to specific legal issues with respect to the *Small Vessel Regulations*, Transport Canada has issued this new edition of the Standards. This revised edition contains only minor changes to technical requirements as set out below. Otherwise the changes are limited to explanatory material in the introduction, correction of non-technical errors, and the wording and formatting changes that are necessary to maintain the legality of the Standard with respect to the *Small Vessel Regulations*.

Changes to technical requirements in TP1332 (2010 Edition) include:

- (a) Addition of the ventilation requirements from ABYC. This change is a relaxation of the requirement in the 2004 edition, and reflects current boat building practices. See subsection 6.3.2.1.
- (b) Safety notices are to be provided in English and French and meet the requirements of ABYC Standard T-5, *Safety Signs and Labels*. See section 704 of the Regulations and section 0 of this Standard
- (c) Additional explanatory material has been added for the calculation of the volume of monohull vessels (see Appendices 4 and 5).
- (d) Changes have been made to the process for obtaining Compliance Notices (Capacity Labels, Conformity Labels) as a consequence of amendments to the *Small Vessel Regulations*. See section 2 and Appendix 1.
- (e) Changes have been made as a result of the new requirements for non-pleasure craft (not more than 15 gross tonnage) to be fitted with Hull Serial Numbers (HIN) and Compliance Notices.
- (f) With the phasing out of the Single Vessel Label program, portions of section 2 and all of Appendix 2 have been deleted.
- (g) Changes have been made to Appendices 2 and 3 to reflect changes in regulations regarding sewage pollution and mufflers.
- (h) Mechanically fastened portlights, doors and windows are now required more than 25 Nm offshore instead of 20 Nm (Near Coastal Class 2 limits).
- (i) Methods to determine the recommended safe limits of canoes and the maximum load of monohull with a power rating of less than 1.5 kW added in line with ABYC standards.
- (j) Non-pleasure craft more than 6 metres in length may elect to measure stability according to ISO 12217 or alternative standards as outlined in section 5.

- (k) All non-pleasure craft of more than 6 metres must have adequate stability for their intended operations as per section 716 of the Regulations. A choice of recommended standards may be used to evaluate the stability (see section 5).
- (l) Changes have been made to accept the air pressure test for fuel systems, (see subsection 7.2.2), and that custom-built metallic tanks may only require the pressure test for mechanical strength and leakage (see subsection 7.3.1.2), which is in line with ABYC requirements.
- (m) The requirements for fire detection and alarm are now incorporated in the Regulations and section 10 of the Standard instead of a reference to the *Marine Electrical Standards* (TP127).
- (n) The requirements for portable fire extinguishers have been deleted from section 10 and moved to the Regulations.
- (o) The requirements for the installation of a fixed fire extinguishing system have been clarified in the Regulations and in section 10 of the Standard.
- (p) The quantity of gas for a fixed fire extinguishing system and for use with a portable extinguisher through a port in the engine space has been modified to be in-line with the ABYC and NFPA requirements.

The responsibility for the application of this Standard with respect to both pleasure craft and non-pleasure craft lies with Transport Canada, Marine Safety.

This Standard derives its authority from the *Small Vessel Regulations* made under the *Canada Shipping Act 2001*, as amended from time to time, either in whole or in part.

It is the responsibility of a vessel designer, manufacturer, builder or owner to carefully consider the intended operation of the vessel when determining its construction, watertight integrity, and stability. When selecting materials and equipment, these shall meet the working and environmental conditions the vessel may encounter.

The long-term goal is the harmonization of this Standard with the standards of both ABYC (American Boat and Yacht Council), whose assistance in drafting referenced sections is acknowledged, and ISO (International Organization for Standardization), as appropriate. Where standards from other organizations are referenced, they may be obtained from the addresses listed (see "Referenced Organizations").

The conversions shown in this Standard have been done using a "soft" conversion method or rounded to the nearest millimetre. The conversions shown are only for numbers that have been incorporated into the Standard as imperial. Numbers and measures incorporated in metric have not been converted.

0.1 Definitions

In this Standard:

“**Act**” means the *Canada Shipping Act 2001*;

“**Connected compartments**” or “connected spaces” means two compartments connected in a manner that allows a flow of water in excess of 7.5 ml/h (1/4 U.S. fl oz/hr) from one compartment to the other compartment;

“**Grounded Conductor**” means a current carrying conductor that is connected to one side of the power source that is intentionally maintained at ground potential;

“**Grounding Conductor**” (green or green with yellow stripe) means a non-current carrying conductor employed to connect the metallic non-current carrying parts of electrical equipment to the DC system or engine negative terminal;

“**Ground**” means the potential of the earth's surface in which the vessel's ground is established by a connection with earth including the conductive part of the wetted hull's surface;

“**ISO 11812**” means ISO Standard 11812, Small Craft – Watertight Cockpits and Quick-Draining Cockpits;

“**ISO 12216**” means ISO Standard 12216, Small Craft – Windows, Portlights, Hatches, Deadlights and Doors – Strength and Watertightness Requirements;

“**ISO 12217-1**” means ISO Standard 12217-1, Small Craft – Stability and Buoyancy Assessment and Categorization, Part 1: Non-Sailing Vessels of Hull Length Greater Than or Equal to 6 Metres;

“**Midship Deadrise Angle**” is the angle, taken at midship, at which the hull slopes up from the horizontal. A flat bottom vessel has a deadrise angle of zero degrees; a high midship deadrise angle value indicates a deep V-hull;

“**Non-Pleasure Craft**” means a vessel to which this Standard applies that is not a pleasure craft;

“**Overcurrent Device**” means a device that is designed to interrupt the circuit when the current exceeds a predetermined value (e.g., circuit breakers or fuses);

“**Panelboard**” means an enclosure or assembly that contains devices such as circuit breakers, fuses, switches, and instruments designed to distribute or protect the distribution of power in the vessel;

“**Remote control**”, for the purpose of the requirements of steering systems, means any steering arrangement other than an outboard motor fitted with a tiller or a rudder with tiller arrangements;

“**Sealed Compartment**”, for the purpose of the requirements of monohull vessel minimum flotation test, means an enclosure that can resist an exterior water level of 305 mm (12 in) without seepage of more than 7.5 ml/h (1/4 U.S. fl oz/hr);

“**Static Float Plane**” (SFP) means the plane located below all points of major leakage and the most forward point of the vessel below which the maximum displacement of the vessel exists, see Figure 4-1; alternatively, it may be defined as the plane passing below all points of major leakage at equal distances either above or below the intersections of the sheer with the stem and stern (transom) when the vessel is transversely level. The intersections are determined when the vessel is longitudinally level, by being supported on its keel at points that are 40% and 75% of the vessel's overall length, aft of the bow, and are at points where a line that is 45 degrees to a level floor is tangent to the bow and stern of the vessel;

“**Switchboard**” means an enclosure so constructed to control and distribute electrical power to panelboards and other electrical equipment within the vessel; included in the enclosure are electrical devices such as circuit breakers, fuses, switches, indicating devices, metres, and instruments;

“**Trip-free Circuit Breaker**” means a resettable circuit breaker designed so that it is impossible to override the current interrupting mechanism;

“**Ungrounded Conductor**” means a current carrying conductor that is insulated from ground throughout the electrical distribution system;

“**Watertight Enclosure**”, as it applies to section 8, “Electrical Systems,” means an enclosure that prevents the ingress of water when tested by subjecting it to a solid stream of water from a 25 mm (1 in) inside diameter nozzle, at a pressure of 103.4 kPa (15 psi) at the nozzle, with the nozzle 3 m (10 feet) away and a water temperature of approximately 10°C (50°F), for a period of five (5) minutes;

“**Weatherproof**” means that equipment is so constructed or protected that exposure to the weather, to falling moisture or to external splashing will not impair the effectiveness of the enclosed equipment.

Information Note:

The word “**Manufacturer**” used in this Standard means the builder, rebuilder, manufacturer, or importer of a vessel.

Information Note:

The following definitions are taken from the *Small Vessel Regulations*. All definitions used in the Regulations automatically apply in this Standard.

“**accessible**” means capable of being reached for inspection, removal or maintenance without removal of any elements of the permanent vessel structure. (*accessible*)

“**engine space**” means any space that contains a permanently installed propulsion engine or auxiliary engine, including any connected spaces. (*compartiment moteur*)

“**ignition-protected**”, in respect of an electrical device, means that the device is designed and constructed in such a manner that under its design operating conditions

- (a) it will not ignite a flammable hydrocarbon mixture surrounding it when an ignition source causes an internal explosion;
- (b) it is incapable of releasing sufficient electrical or thermal energy to ignite a hydrocarbon mixture; or
- (c) its source of ignition is hermetically sealed. (*protégé contre l'inflammabilité*)

“**length**”, in respect of a vessel, means the distance measured from the forward end of the foremost outside surface of the hull shell to the aft end of the aftermost outside surface of the hull shell. (*longueur*) See Figure 0-1.

“**permanently installed**” means securely fastened so that tools must be used for removal. (*fixé à demeure*)

“**personal watercraft**” means a vessel less than 4 m in length that uses an internal combustion engine powering a water-jet pump as its primary source of propulsion, and that is designed to be operated by a person or persons sitting, standing or kneeling on the vessel and not within the confines of the hull. (*motomarine*)

“**power**”, in respect of an engine, means the power, in kilowatts, that the manufacturer declares has been determined in accordance with International Standard ISO 8665:2006, Small Craft — Marine Propulsion Engines and Systems — Power Measurements and Declarations. (*puissance*)

“**readily accessible**” means capable of being reached easily and safely under emergency conditions without the use of tools. (*facilement accessible*)

“**recommended practices and standards**” means the recommended practices and standards for marine use issued by a marine classification society, standards development organization, industrial or trade organization, government, government agency or international body. (*normes et pratiques recommandées*)

“**towing**”, except for the purposes of Part 10, means the action of pulling a vessel or an object astern or alongside, or pushing a vessel or an object ahead, but does not include pulling or pushing, in the course of the vessel’s normal operations, a floating object or vessel that has a significantly smaller displacement than the vessel’s displacement. (*remorquage*)

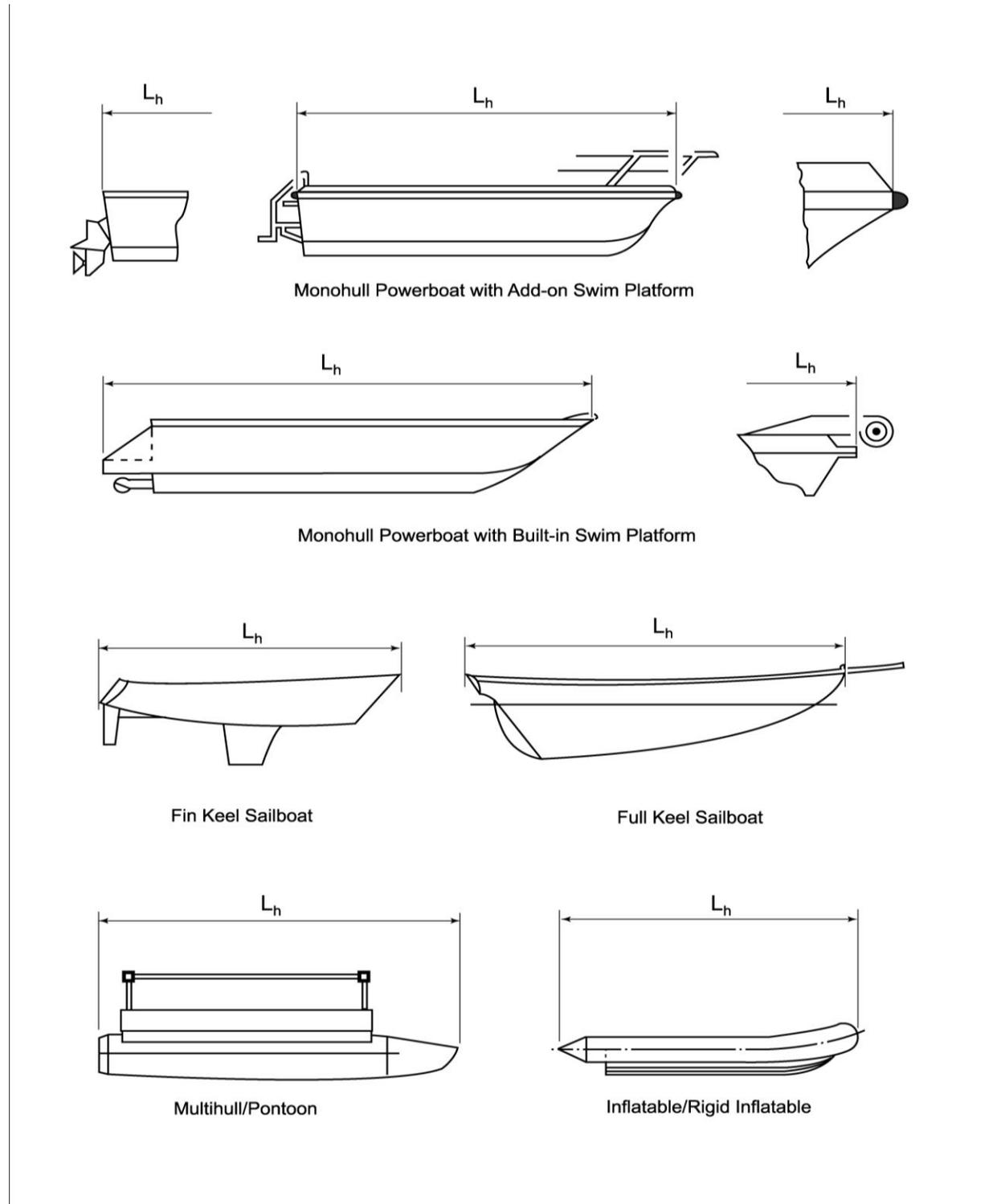
“**tug**” means a vessel that is constructed or converted primarily for the purpose of towing, but does not include a vessel that is constructed or converted for the purpose of

- (a) salvaging logs; or
- (b) managing oil pollution booms and associated equipment. (*remorqueur*)

“**workboat**” means a vessel that is not a passenger-carrying vessel, a human-powered vessel or a pleasure craft. (*bateau de travail*)

Information Note:

Sport fishing vessels or other commercial vessels used for sport fishing are not considered fishing vessels for the application of paragraph 2(2)(a) of the Regulations and therefore are not excluded from the application of the Construction Standards.

Figure 0-1 DETERMINATION OF VESSEL LENGTH (L_h)

Information Note:**Application of this Standard – As stated by the Regulations:****CONSTRUCTION REQUIREMENTS
APPLICATION**

700. (1) This Part applies in respect of a vessel that is constructed, manufactured or rebuilt in, or imported into, Canada in order to be sold or operated in Canada and that is

- (a) propelled or designed to be propelled by an engine;
- (b) permanently fitted with an auxiliary engine; or
- (c) fitted with a fuel-burning appliance or system that uses gaseous fuel, liquefied petroleum gas, compressed natural gas or naphtha.

(2) Only sections 701, 703 and 704 apply in respect of a pleasure craft that is 24 m or more in length.

(3) If a personal watercraft is constructed, manufactured or rebuilt in accordance with ISO 13590, then only sections 701, 702, 704 to 709 and 711 apply in respect of the watercraft.

(4) This Part does not apply in respect of

- (a) a vessel that is registered in another country as having the right to fly the flag of that country;
- (b) a vessel that is principally maintained and operated in another country and that is not licensed or registered in Canada; or
- (c) a tug.

GENERAL REQUIREMENT

701. Unless otherwise indicated in these Regulations, the builder, manufacturer, rebuilder, importer and owner of a vessel shall ensure that the vessel meets the requirements of this Part.

PLEASURE CRAFT

702. A pleasure craft shall meet

- (a) the construction requirements of this Part; or
- (b) if its date of construction, manufacture or rebuilding or its date of importation is before the day on which these Regulations come into force, the construction requirements in force on that date.

Information Note:**Existing Pleasure Craft:**

Existing pleasure craft that were constructed according to an earlier version of this Standard are not required by the Regulations to comply with the current construction requirements of the *Small Vessel Regulations*, but are encouraged to do so insofar as it is reasonable and practicable.

The application of the various sections of the construction requirements of the *Small Vessel Regulations* with respect to non-pleasure craft versus pleasure craft is identified at the beginning of each section under the subsection titled "Scope."

Construction Requirements:

The **Construction Requirements** consist of the requirements of Part 7 of the *Small Vessel Regulations* and the requirements of this Standard as referred to in the Regulations. The requirements of Part 4 and Part 5 of the *Small*

Vessel Regulations are not part of the **Construction Requirements**, therefore any reference to the requirements of Part 4 and Part 5 in this Standard are provided for information and are not mandatory for the builder, manufacturer, rebuilders or importer to meet the **Construction Requirements** as stated in a Declaration of Conformity. Meeting the requirements of Part 4 and Part 5 is the obligation of the owner before the vessel is put into service as a non-pleasure craft.

Transport Canada recommends compliance with the provisions of Part 4 and Part 5 referred to in this Standard to builders, manufacturers, rebuilders and importers in order to make compliance easier for owners/operators of non-pleasure crafts. These provisions could be made standard equipment on all vessels or be offered as an option to the end user.

0.2 Pleasure Craft of more than 24 metres

As stated by the Regulations:

703. A pleasure craft that is 24 m or more in length shall be constructed, manufactured or rebuilt in accordance with the applicable recommended practices and standards in force on its date of construction, manufacture or rebuilding.

0.3 Standard Incorporated by References

As stated by the Regulations:

1. (4) A provision in the American Boat and Yacht Council standards referred to in these Regulations that is expressed as a recommendation shall be read as a requirement unless it is incompatible with the vessel's construction.

(5) Except as otherwise indicated in these Regulations, any reference in these Regulations to a document is a reference to that document as amended from time to time.

0.4 Particular Vessel Design

As stated by the Regulations:

PARTICULAR DESIGN – VESSEL

709. If the design of a type of vessel or of a system or component of a vessel would render it unsafe, unsuitable or impracticable to construct, manufacture or rebuild the vessel in accordance with the construction requirements, the vessel may be constructed, manufactured or rebuilt according to the recommended practices and standards that provide a level of safety at least equivalent to that provided by the construction requirements and that are applicable to the construction, manufacture or rebuilding of a vessel of that design, for example,

- (a) a dynamically supported craft;
- (b) a submarine;
- (c) a wing-in-ground-effect vessel; and
- (d) a hydroplane or other high-powered, low-volume vessel that is used exclusively for racing.

0.5 Major Modifications

As stated by the Regulations:

MAJOR MODIFICATIONS

710. (1) The owner of a vessel and every person who is responsible for making a major modification to the vessel shall ensure that the major modification is in accordance with the construction requirements as they read on the day on which the modification was started.

(2) If a major modification is made to a vessel other than a pleasure craft, the owner of the vessel shall inform the Minister of the modification and, if requested by the Minister, shall provide the Minister with the technical data necessary to determine the vessel's compliance with the construction requirements.

(3) In this section, "major modification" means a modification or repair or a series of modifications or repairs that substantially changes the capacity or size of a vessel or the nature of a system on board a vessel, that affects its watertight integrity or its stability, or, except in the case of the restoration of an antique wooden pleasure craft, that substantially increases its service life.

0.6 Plans

As stated by the Regulations:

PLANS

711. (1) If it is necessary, because of the type or design of a vessel other than a pleasure craft, to obtain information in order to establish the vessel's compliance with the construction requirements, the builder, manufacturer, rebuilder, importer or owner of the vessel shall submit to the Minister, on request, the following documents:

- (a) the general arrangement of the vessel;
- (b) a diagram of the propulsion system;
- (c) the general arrangement and identification of the machinery, including a description of the bilge pumping systems, fuel systems and firefighting systems;
- (d) a one-line electrical diagram.

(2) If a vessel, other than a pleasure craft, was constructed, manufactured or rebuilt before the day on which these Regulations came into force, the owner of the vessel may submit photographs and technical data instead of the documents referred to in subsection (1).

0.7 Safety Notices**As stated by the Regulations:****SAFETY NOTICE**

704. Every safety notice required under this Part shall

- (a) meet the requirements of American Boat and Yacht Council Standard T-5, Safety Signs and Labels;
- (b) be in English and French; and
- (c) be placed in a plainly visible location near the hazard.

Information Note:

As required by ABYC T-5, safety notices shall contain at least the following informational elements:

- (a) the hazard intensity signal word;
- (b) nature of the hazard;
- (c) consequences that can result if the instructions to avoid the hazard are not followed; and
- (d) instructions on how to avoid the hazard.

1 HULL SERIAL NUMBERS

1.1 Scope

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length	■	■
More than 6 metres in length	■	■

1.2 Hull Serial Number (HIN)

1.2.1 General

As stated by the Regulations:

HULL SERIAL NUMBERS

900. (1) This Part applies in respect of a vessel that is constructed, manufactured, rebuilt or imported in order to be sold or operated in Canada.

(2) Section 902 applies in respect of all vessels in Canada.

(3) This Part, except section 902, does not apply in respect of

(a) a vessel that is registered in another country as having the right to fly the flag of that country;

(b) a vessel that is registered under the Act, other than a vessel registered in the small vessel register;

(c) a vessel that is not licensed or registered under the Act and that is principally maintained and operated in another country;

(d) a tug; or

(e) a floating object that is less than 2 m in length and that is not designed to be propelled by an engine.

(4) Section 903 does not apply in respect of a vessel, other than a pleasure craft, whose date of construction, manufacture, rebuilding or importation is on or before the day on which these Regulations come into force or within one year after that day.

901. A person who operates or permits another person to operate a vessel shall ensure that the vessel is marked with a hull serial number in accordance with the requirements of this Part.

903. (1) The builder, manufacturer, rebuilder or importer of a vessel shall obtain a manufacturer's identification code from the Minister.

(2) The builder, manufacturer or rebuilder of a vessel shall permanently mark a hull serial number on the hull of the vessel before its first sale to a reseller or an end user.

(3) The importer of a vessel shall ensure that a hull serial number is permanently marked on the hull of the vessel before its first sale to a reseller or an end user.

...

(13) The builder, manufacturer or rebuilder of a vessel shall not use the same hull serial number on more than one vessel.

Information Note:

The applicability of section 1 of this Standard is set out in Part 9 of the *Small Vessel Regulations*. Subject to certain exceptions, section 1 of this Standard applies to pleasure craft and non-pleasure craft whether designed to be propelled by a motor or not.

The Hull Serial Number (HIN) provides a uniform method for identifying:

- (a) any specific vessel;
- (b) the construction standards that apply to that specific vessel;
- (c) vessels subject to a manufacturer's defect recall; and
- (d) a lost or stolen vessel.

1.2.2 Hull Serial Number (HIN) Format**1.2.2.1 General****As stated by the Regulations:**

903. (9) The hull serial number shall be in the format set out in the construction standards and be located where it is clearly visible when the vessel is in the water, namely,

- (a) on the upper starboard quarter of the outside surface of the transom; or
- (b) if the vessel has no transom, on the uppermost starboard side at the aft end of the hull.

1.2.2.1.1 The Hull Serial Number (HIN) consists of 12 consecutive characters displayed as capital letters of the alphabet or Arabic numerals with no spaces, slashes (obliques), or hyphens between them. The code comprises:

- a) a three-digit Manufacturer's Identification Code (MIC); followed by
 - (i) a five-character Manufacturer's Serial Number; and
 - (ii) four figures giving the date of manufacture.

1.2.2.1.2 The characters of the HIN are not less than 6 mm (1/4 in) in height and width.

1.2.2.2 Manufacturer's Identification Code (MIC)

1.2.2.2.1 The MIC consists of three characters displayed as block capitals or numbers, forming the first three characters of the HIN, as issued by Transport Canada, Marine Safety.

Information Note:

If you are a new manufacturer or importer based in Canada (and if the product is not from the United States), you must first apply to obtain a Manufacturer Identification Code (MIC) from Transport Canada, Marine Safety.

A MIC issued by the United States Coast Guard to U.S. manufacturers is recognized in Canada by reciprocal agreement.

See appendix 1 for more information.

1.2.2.3 Manufacturer's Serial Number

- 1.2.2.3.1 The fourth through eighth characters of the HIN are the individual Manufacturer's Serial Number, which is defined by the manufacturer.
- 1.2.2.3.2 The Manufacturer's Serial Number consists of capital letters of the alphabet or Arabic numerals, or both, except that the letters "I," "O," and "Q" shall not be used.

1.2.2.4 Date of Manufacture

- 1.2.2.4.1 The ninth through twelfth characters of the HIN indicate the date of manufacture. The ninth character is a capital letter of the alphabet indicating the month during which the vessel's fabrication was started:

A = January	B = February	C = March	D = April
E = May	F = June	G = July	H = August
I = September	J = October	K = November	L = December

- 1.2.2.4.2 The tenth is an Arabic numeral designating the last digit of the year of manufacture.
- 1.2.2.4.3 Characters eleven and twelve are Arabic numerals marking the model year of the vessel.

Table 1-1 EXAMPLE OF A TWELVE-DIGIT HULL SERIAL NUMBER (HIN)

ABC2AB41G091			
Manufacturer's Identification Code	Manufacturer's Serial Number	Commencement of Construction	Model Year
ABC	2AB41	G0	91

- 1.2.2.4.4 Table 1-1 is a typical example of a complete twelve-digit HIN for a vessel where fabrication commenced in July 1990 for the 1991 model year.

1.2.2.5 Country Code**Information Note:**

The country code is an optional addition to the HIN.

Canadian manufacturers and builders of vessels have the option of adding the Canadian Country Code prefix "CA-" [block capitals and hyphen] in front of the HIN. A typical example of a fifteen-character HIN, including the Country Code, is CA-ABC2AB41G091.

An importer may import a vessel that is marked with a MIC assigned by a country other than Canada or the United States provided that:

- When requesting a MIC from the Minister as required by section 903(1) of the Regulations the importer advise the Minister of its intention to use the MIC assigned by another country and provide that MIC to the Minister.
- The combination of the country code and the MIC is not already used by another manufacturer, builder or importer.
- The HIN is marked in the format and in the two locations required by the Regulations.
- The country code is added to the HIN as required by the Regulations.

As stated by the Regulations:

903. (6) If a vessel is imported from a country with which Canada does not have an agreement regarding the sharing of information respecting a manufacturer's identification code, the importer shall ensure that the country's alpha-2 code published by the Maintenance Agency for ISO 3166 is added to the hull serial number.

1.2.2.6 Marking of the Hull

As stated by the Regulations:

903. (4) The builder, manufacturer or rebuilder of a vessel shall permanently mark the hull serial number in a second location on the hull, that is either beneath a fitting or an item of hardware or that is on the interior of the vessel and unexposed, or the importer of the vessel shall ensure that the hull serial number is permanently marked in such a location.

(5) The builder, manufacturer, rebuilder or importer of a vessel shall keep a record of the second location of the hull serial number and shall, on request, provide the information to any person or organization authorized under the Act to carry out inspections.

(9) The hull serial number shall be in the format set out in the construction standards and be located where it is clearly visible when the vessel is in the water, namely,

(a) on the upper starboard quarter of the outside surface of the transom; or

(b) if the vessel has no transom, on the uppermost starboard side at the aft end of the hull.

1.2.2.7 Assembly of Kit

As stated by the Regulations:

903. (7) A person who is engaged in the business of assembling kit vessels that have a hull serial number shall, before the initial transfer of ownership of the vessel to a reseller or an end user, add a suffix provided by the Minister to the hull serial number in a manner specified by the Minister.

1.2.2.8 Rebuilding of Vessels

As stated by the Regulations:

903. (8) If the rebuilder of a vessel does not replace the hull serial number, the rebuilder shall, before the initial transfer of ownership of the vessel to a reseller or an end user, add a suffix provided by the Minister to the hull serial number in a manner specified by the Minister.

1.2.2.9 Exceptions for the Marking of Hull Serial Number (HIN)

As stated by the Regulations:

904. A vessel is not required to be marked with a hull serial number if

(a) despite reasonable efforts, the owner of the vessel is unable to obtain a hull serial number from the builder, manufacturer, rebuilder or importer of the vessel; or

(b) the vessel is constructed, manufactured, rebuilt or imported by an individual for personal use.

2 COMPLIANCE NOTICES

2.1 Scope

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length	■	■
More than 6 metres in length	■	■

2.2 Compliance Notices

2.2.1 General

As stated by the Regulations:

BUILDER, MANUFACTURER, REBUILDER AND IMPORTER

Compliance Notice

801. (1) The builder, manufacturer, rebuilder or importer of a vessel shall ensure that, before the initial transfer of ownership of the vessel to the reseller or end user, the vessel is fitted with a compliance notice permanently attached to the inside of the vessel, in a conspicuous location plainly visible from the operating position.

(2) Subsection (1) does not apply in respect of a vessel

(a) that is constructed, rebuilt or imported by an individual for their personal use; or

(b) that meets the following criteria:

(i) it is of open construction,

(ii) it is not mass-produced,

(iii) it is not propelled or designed to be propelled by an inboard engine or stern-drive, and

(iv) it has been constructed following traditional methods that have proven to be effective and reliable over time using wood or other traditional materials or, in the case of a canoe, using glass-reinforced plastic.

(3) In the case of a personal watercraft that is constructed, manufactured or rebuilt in accordance with ISO 13590, the builder, manufacturer, rebuilder or importer shall ensure that the watercraft is fitted not only with a compliance notice, but also with the builder's plate set out in that standard.

(4) In the case of a vessel that has been the subject of an initial transfer of ownership,

(a) if the vessel has not been fitted with a compliance notice, the builder, manufacturer, rebuilder or importer shall provide the owner with a compliance notice; or

(b) if the vessel has been fitted with a compliance notice that is inaccurate, the builder, manufacturer, rebuilder or importer shall first inform the Minister and then provide the owner with an accurate compliance notice.

(5) Subsection (4) does not apply in respect of a pleasure craft that was the subject of an initial transfer of ownership in Canada before the day on which these Regulations came into force.

(6) A compliance notice shall

(a) be in English and French;

(b) contain the information set out in section 802;

- (c) be in the format set out in the examples provided in the construction standards;
- (d) be in the form of a plate or label;
- (e) be capable of withstanding — without loss of legibility — wear, environmental conditions (including salt water spray), and hydrocarbons and all other chemicals to which the vessel may be exposed during normal operation and maintenance; and
- (f) be made in such a manner that any attempt to remove it or to alter its content will result in the destruction of the notice or in a clearly visible sign of the attempt to remove or alter it.

(7) Subsections (1) to (5) do not apply in respect of a vessel, other than a pleasure craft, whose date of construction, manufacture, rebuilding or importation is on or before the day on which these Regulations come into force or within one year after that day.

Information Note:

A compliance notice takes one of three forms:

- (a) for vessels of not more than 6 metres in length (capacity label):
 - (i) A compliance notice showing the recommended maximum safe limits
- (b) for vessels of more than 6 metres in length (conformity label):
 - (i) A compliance notice for pleasure craft
 - (ii) A compliance notice for a vessel other than a pleasure craft

2.2.2 Vessels of not more than 6 metres in length – Capacity Label

2.2.2.1 General

As stated by the Regulations:

802. (1) A compliance notice shall contain at least the following information:

- (a) the model of the vessel;
- (b) the name of the builder, manufacturer, rebuilder or importer and the manufacturer's identification code;
- (c) in the case of a vessel that is not more than 6 m in length, a statement declaring that the vessel meets the construction requirements as they read on the date of construction, manufacture, rebuilding or importation of the vessel;
- (d) in the case of a vessel that is more than 6 m in length, a statement declaring that the vessel meets the construction requirements for pleasure craft as they read on the date of construction, manufacture, rebuilding or importation of the vessel;
- (e) in the case of a vessel that is more than 6 m in length and that meets the construction requirements for a vessel other than a pleasure craft, instead of the statement set out in paragraph (d), a statement declaring that the vessel meets the construction requirements for vessels other than pleasure craft as they read on the date of construction, manufacture, rebuilding or importation of the vessel;
- (f) the design limitations of the vessel, if any;
- (g) in the case of a vessel that is not more than 6 m in length, other than a personal watercraft that is constructed, manufactured or rebuilt in accordance with ISO 13590, the following recommended maximum safe limits and the circumstances in which the recommendations do not apply:

- (i) the maximum gross load capacity for the vessel and the details of the capacity that are set out in the construction standards,
- (ii) the maximum number of persons that the vessel may carry, and
- (iii) if the vessel is designed to be fitted with an outboard engine, the maximum power of the engine.
- (2) The recommended maximum safe limits of the vessel shall be calculated in accordance with the applicable methods set out in the construction standards. However, alternative methods may be used if
- (a) the alternative methods are more accurate; or
- (b) the alternative methods are more suited to the vessel, owing to its unique nature, and the methods set out in the construction standards would result in recommended maximum safe limits that are less safe or less suitable for the vessel.

2.2.2.2 Specifications for Capacity Label

2.2.2.2.1 The capacity label shall be at least 100 mm in width.

2.2.2.2.2 The information to be displayed on a capacity label shall be in the format shown in Figure 2-1 or Figure 2-2 as appropriate.

Figure 2-1 TYPICAL CAPACITY LABEL – OUTBOARD POWERED VESSEL

CANADIAN COMPLIANCE NOTICE AVIS DE CONFORMITÉ CANADIEN		
RECOMMENDED MAXIMUM SAFE LIMITS LIMITES MAXIMALES DE SÉCURITÉ RECOMMANDÉES		
	XX	XXXX kg XXXX lbs/lb
	+ 	XXXX kg XXXX lbs/lb
	XX kW XX HP	XXXX kg XXXX lbs/lb
<p>THE RECOMMENDED MAXIMUM SAFE LIMITS MIGHT HAVE TO BE REDUCED IN ADVERSE SEA AND WEATHER CONDITIONS.</p> <p>LES LIMITES MAXIMALES DE SÉCURITÉ RECOMMANDÉES PEUVENT DEVOIR ÊTRE RÉDUITES DANS LES CONDITIONS DE MER ET DES CONDITIONS MÉTÉOROLOGIQUES DIFFICILES.</p> <p><i>* ADDITIONAL INFORMATION</i></p>		
<p>SAFEBOAT COMPANY INC. (MIC) CITY, PROVINCE, COUNTRY MODEL / MODÈLE: RUNABOUT 555X</p>		
<p>THE MANUFACTURER DECLARES THAT THIS VESSEL COMPLIES WITH THE CONSTRUCTION REQUIREMENTS OF THE <i>SMALL VESSEL REGULATIONS</i> AS THEY READ ON THE DAY ON WHICH THE CONSTRUCTION OF THE VESSEL WAS STARTED OR ON THE DAY ON WHICH THE VESSEL WAS IMPORTED.</p> <p>LE FABRICANT ATTESTE QUE CE BÂTIMENT EST CONFORME AUX EXIGENCES DE CONSTRUCTION DU <i>RÈGLEMENT SUR LES PETITS BÂTIMENTS</i> EN VIGUEUR À LA DATE DU DÉBUT DE SA CONSTRUCTION OU DE SON IMPORTATION.</p>		

Figure 2-2 TYPICAL CAPACITY LABEL – INBOARD OR STERN-DRIVE POWERED VESSEL

CANADIAN COMPLIANCE NOTICE AVIS DE CONFORMITÉ CANADIEN		
RECOMMENDED MAXIMUM SAFE LIMITS LIMITES DE SÉCURITÉ MAXIMALES RECOMMANDÉES		
	XX	XXXX kg XXXX lbs/lb
	+	
		XXXX kg XXXX lbs/lb
<p>THE RECOMMENDED MAXIMUM SAFE LIMITS MAY HAVE TO BE REDUCED IN ADVERSE SEA AND WEATHER CONDITIONS. LES LIMITES MAXIMALES DE SÉCURITÉ RECOMMANDÉES PEUVENT DEVOIR ÊTRE RÉDUITES DANS LES CONDITIONS DE MER ET LES CONDITIONS MÉTÉOROLOGIQUES DIFFICILES.</p> <p><i>* ADDITIONAL INFORMATION</i></p>		
<p>SAFEBOAT COMPANY INC. (MIC) CITY, PROVINCE, COUNTRY MODEL / MODÈLE: RUNABOUT 555X</p>		
<p>THE MANUFACTURER DECLARES THAT THIS VESSEL COMPLIES WITH THE CONSTRUCTION REQUIREMENTS OF THE <i>SMALL VESSEL REGULATIONS</i> AS THEY READ ON THE DAY ON WHICH THE CONSTRUCTION OF THE VESSEL WAS STARTED OR ON THE DAY ON WHICH THE VESSEL WAS IMPORTED. LE FABRICANT ATTESTE QUE CE BÂTIMENT EST CONFORME AUX EXIGENCES DE CONSTRUCTION DU <i>RÈGLEMENT SUR LES PETITS BÂTIMENTS</i> EN VIGUEUR À LA DATE DU DÉBUT DE SA CONSTRUCTION OU DE SON IMPORTATION.</p>		

2.2.2.2.3 Pictograms shall be used to identify the maximum number of persons, the maximum gross load and the maximum power, as follows:

- a) A person symbol to indicate the maximum number of persons.
- b) A suitcase symbol, combined with a person symbol and an outboard engine symbol when applicable, to indicate the maximum gross load.
- c) An outboard engine symbol to indicate the maximum power.

2.2.2.2.4 The minimum height of each pictogram is 12 mm.

2.2.2.2.5 The text size on the label shall be as indicated in Table 2-1.

Table 2-1 TEXT SIZE FOR CAPACITY LABEL	
Text	Height
CANADIAN COMPLIANCE NOTICE	4.5 mm
RECOMMENDED MAXIMUM SAFE LIMITS	3 mm
XX (<i>maximum number of persons in whole number</i>)	12 mm
Maximum number of persons weight	4.5 mm
Maximum Gross Load	4.5 mm
Maximum Power	4.5 mm
* <i>ADDITIONAL INFORMATION</i>	3 mm
Manufacturer's name and MIC	3 mm
Model	3 mm
<i>Declaration of conformity</i>	2 mm

- 2.2.2.2.6 All text shall be in uppercase characters.
- 2.2.2.2.7 For the recommended limits, each line must be separated by a minimum of 2 mm.
- 2.2.2.2.8 Line borders may be used but are not mandatory.
- 2.2.2.2.9 The Manufacturer's Identification Code (MIC) shall appear between brackets after the manufacturer's name. The manufacturer's name shall correspond to the name registered with the MIC.
- 2.2.2.2.10 The weight of the maximum number of persons corresponding to a weight of 75 kg (165 lbs) per person shall be indicated in kilograms (kg) and in pounds (lbs).
- 2.2.2.2.11 The maximum gross load shall be indicated in kilograms (kg) and in pounds (lbs).
- 2.2.2.2.12 The maximum power shall be indicated in kilowatts (kW) and in horsepower (HP).
- 2.2.2.2.13 The maximum weight of the engine and related equipment as per Table 4.2 corresponding to the recommended maximum power shall be indicated in kilograms (kg) and in pounds (lbs).

Information Note:

The maximum power information is not required on vessels powered by an inboard engine or a stern-drive.

- 2.2.2.2.14 When there is a possibility to install either a tiller steering engine or a remote steering system, both maximum power limits shall be written on the label as follows:

	REMOTE CONTROL	XX kW	XXX kg
	COMMANDE À DISTANCE	XX HP	XXX lbs/lb
	HAND TILLER	XX kW	XXX kg
	BARRE FRANCHE	XX HP	XXX lbs/lb

- 2.2.2.2.15 The model shall correspond to the model stated on the declaration of conformity (D.O.C.) signed by the manufacturer. The manufacturer may also add the model year or the HIN after the model.

Information Note:

Adding the HIN to the model name does not satisfy the requirements of the Regulations to have the HIN marked on

the hull.

In the case of a compliance notice attached to the vessel by the importer or the rebuilder of a second-hand boat, the HIN already given to the vessel by the original manufacturer shall be marked on the compliance notice and the D.O.C. (see Appendix 1).

- 2.2.2.2.16 The additional information shall also include the design limitations assigned to the vessel such as DESIGN CATEGORY (A, B, C or D), as determined with the standard ISO 12217 when applicable or any other design limitations determined by the manufacturer.
- 2.2.2.2.17 When a design category is assigned as per ISO 12217 or another ISO standard, the note regarding the reduction of the recommended maximum safe limits in adverse weather and sea conditions may be replaced with the wave height in metres and the wind speed in knots corresponding to the design category, provided that the maximum weight, number of persons and engine power shown on the compliance notice do not exceed the value assigned under the appropriate ISO standards. The design category information shall be in the format shown below:

CATEGORY / CATÉGORIE D	
MAXIMUM WAVE / VAGUE MAXIMALE	0.5 metre
MAXIMUM WIND SPEED / VITESSE DE VENT MAXIMALE	25 knots/noeuds

- 2.2.2.2.18 The label may include other information, such as the manufacturer's logo, below the space reserved for the declaration of conformity.

2.2.3 Vessels of more than 6 metres in length – Conformity Label

2.2.3.1 General

Information Note:

As stated in the Regulations paragraph 802(1)(d) and 802(1)(e), there are two styles of conformity notices for vessels of more than 6 metres (conformity label), one for pleasure craft and one for non-pleasure craft.

The minimum regulatory requirement is for a manufacturer, builder or importer to attach a pleasure craft conformity notice that indicates the vessel complies with the pleasure craft standards at the time of construction.

However, if a vessel complies with the requirements applicable to non-pleasure craft, the manufacturer, builder, rebuilder or importer may attach a conformity label for non-pleasure craft, indicating the vessel complies with the non-pleasure craft standards.

2.2.3.2 Specifications for Conformity Label

- 2.2.3.2.1 The conformity label shall be at least 100 mm in width.
- 2.2.3.2.2 The information to be displayed on a conformity label shall be in the format shown in Figure 2-3.

Figure 2-3 TYPICAL CONFORMITY LABEL

CANADIAN COMPLIANCE NOTICE AVIS DE CONFORMITÉ CANADIEN
SAFEBOAT COMPANY INC. (MIC) CITY, PROVINCE, COUNTRY
MODEL / MODÈLE: RUNABOUT 555X
<i>* ADDITIONAL INFORMATION</i>
<i>TEXT OF THE DECLARATION OF CONFORMITY.</i> <i>TEXTE DE LA DÉCLARATION DE CONFORMITÉ.</i>

2.2.3.2.3 The text size on the label shall be as indicated in Table 2-2.

Table 2-2 TEXT SIZE FOR CONFORMITY LABEL	
Text	Height
CANADIAN CONFORMITY NOTICE AVIS DE CONFORMITÉ CANADIEN	4.5 mm
BUILDER NAME, (MIC) AND ADDRESS	3 mm
MODEL / MODÈLE: RUNABOUT 555X	3 mm
<i>* ADDITIONAL INFORMATION</i>	3 mm
<i>TEXT OF THE DECLARATION OF CONFORMITY.</i>	2 mm

2.2.3.2.4 All text shall be in uppercase characters.

2.2.3.2.5 Line borders may be used but are not mandatory.

2.2.3.2.6 The Manufacturer's Identification Code (MIC) shall appear between brackets after the manufacturer's name. The manufacturer's name shall correspond to the name registered with the MIC.

2.2.3.2.7 The model name shall correspond to the model name stated on the signed declaration of conformity (DOC). The manufacturer may also add the model year or the HIN after the model name.

Information Note:

Adding the HIN to the model name does not satisfy the requirements of the Regulations to have the HIN marked on the hull.

In the case of a compliance notice attached to the vessel by the importer or the rebuilder of a second-hand boat, the HIN already given to the vessel by the original manufacturer shall be marked on the compliance notice and the DOC. (see Appendix 1).

2.2.3.2.8 The additional information shown in 2.2.3.2.2 shall include the design limitations assigned to the vessel such as DESIGN CATEGORY (A, B, C or D), as determined with the standard ISO 12217 when applicable, or any other limitations determined by the manufacturer.

2.2.3.2.9 The text of the declaration of conformity shall be as indicated in Table 2-3.

Table 2-3 TEXT OF THE DECLARATION OF CONFORMITY	
Type of vessel	Text
Pleasure craft	<p>THE MANUFACTURER DECLARES THAT THIS VESSEL COMPLIES WITH THE PLEASURE CRAFT CONSTRUCTION REQUIREMENTS OF THE SMALL VESSEL REGULATIONS, AS THEY READ ON THE DAY ON WHICH THE CONSTRUCTION OF THE VESSEL WAS STARTED OR ON THE DAY ON WHICH IT THE VESSEL WAS IMPORTED.</p> <p>LE FABRICANT ATTESTE QUE CE BÂTIMENT EST CONFORME AUX EXIGENCES DE CONSTRUCTION DES EMBARCATIONS DE PLAISANCE DU <i>RÈGLEMENT SUR LES PETITS BÂTIMENTS</i>, EN VIGUEUR À LA DATE DU DÉBUT DE SA CONSTRUCTION OU À LA DATE DE SON IMPORTATION.</p>
Non-pleasure craft	<p>THE MANUFACTURER DECLARES THAT THIS VESSEL COMPLIED WITH THE NON-PLEASURE CRAFT CONSTRUCTION REQUIREMENTS OF THE SMALL VESSEL REGULATIONS, AS THEY READ ON THE DAY ON WHICH THE CONSTRUCTION OF THE VESSEL WAS STARTED OR ON THE DAY ON WHICH IT THE VESSEL WAS IMPORTED</p> <p>THIS VESSEL MAY ALSO BE USED AS A PLEASURE CRAFT.</p> <p>LE FABRICANT ATTESTE QUE CE BÂTIMENT EST CONFORME AUX EXIGENCES DE CONSTRUCTION DES EMBARCATIONS AUTRES QUE DE PLAISANCE DU <i>RÈGLEMENT SUR LES PETITS BÂTIMENTS</i>, EN VIGUEUR À LA DATE DU DÉBUT DE SA CONSTRUCTION OU À LA DATE DE SON IMPORTATION.</p> <p>CE BÂTIMENT PEUT AUSSI ÊTRE UTILISÉ COMME EMBARCATION DE PLAISANCE.</p>

2.2.3.2.10 The label may include additional information, such as the manufacturer's logo, below the space reserved for the declaration of conformity.

Information note:

As per the Regulations, the marking of the recommended maximum safe limits is mandatory for all vessels of not more than 6 metres in length.

As stated in paragraph 802(1) the information required by the Regulations is the minimum information that must be shown on a compliance notice.

Transport Canada recommends the marking of the recommended maximum safe limits on all vessels of not more than 8 metres in length. To determine the safe limits, other than the maximum power, for vessels of more than 6 metres but not more than 8 metres, the manufacturer may use the methods given in section 5 of this Standard or any other appropriate method. In all cases a minimum weight of 75 kg per person shall be used.

In no case shall the maximum recommended maximum safe limits marked on the compliance notice exceed the value used in determining the stability and the flotation of the vessel.

3 CONSTRUCTION REQUIREMENTS

3.1 Scope

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length	■	■
More than 6 metres in length	■	■

3.2 Structural Strength

As stated by the Regulations:

STRUCTURAL STRENGTH AND SEAWORTHINESS

713. (1) A vessel's structural strength shall conform to the construction standards.

(2) A vessel's structural strength and watertight integrity shall be adequate for its intended use, taking into account the maximum anticipated loads. The vessel's strength and integrity are adequate if

(a) the vessel is constructed, manufactured or rebuilt in accordance with the recommended practices and standards for the type of vessel;

(b) the vessel's design has been used for a vessel of the same type that was operated for at least five years without a marine occurrence or other event related to a deficiency in its construction or maintenance in an area where the wind and wave conditions are no less severe than those likely to be encountered in the vessel's intended area of operation;

(c) the vessel's design is supported by calculations or test documents proving that the design achieves the required structural strength; or

(d) in the case of an open vessel, the structural strength and watertight integrity are achieved by following traditional construction methods that have proven to be effective and reliable over time.

(3) The materials and equipment used in the construction, manufacture or rebuilding of a vessel shall be suited to the operating and environmental conditions that the vessel may encounter.

(4) The owner of a vessel shall ensure that the structural strength and watertight integrity of the vessel continue to be adequate for its intended use.

(5) The hull of a vessel other than a pleasure craft shall be strengthened if the vessel is intended for operation in waters where the presence of ice requires the vessel to make extraordinary manoeuvres in order to avoid hull damage.

(6) On the request of the Minister, the builder, manufacturer, rebuilder, importer or owner of a vessel shall demonstrate that the vessel meets the requirements of this section.

Information Note:

To satisfy the requirements of section 713(2)(a) of the *Small Vessel Regulations*, a non-pleasure craft may be built according to rules and standards such as: the Nordic Boat Standard (for commercial vessels less than 15 m), the International Organization for Standardization (ISO), or a classification society such as the American Bureau of Shipping (ABS), Lloyd's Register of Shipping (LRS), Bureau Veritas (BV), Det Norske Veritas (DNV) or Germanischer Lloyd (GL).

3.2.1 General

- 3.2.1.1 Proper alignment and continuity of structural members and efficiency of structural connections and endings shall be ensured. All openings and cut-outs shall have well-rounded corners and not impair the required structural strength of the hull and superstructure.
- 3.2.1.2 Seats, thwarts, bulkheads, and other major structural components that are attached to the shell of the vessel shall be robustly connected in a manner that does not create stress concentrations.
- 3.2.1.3 Materials subjected to stress at high or low temperatures shall have properties resistant to failure at the full range of anticipated temperatures.
- 3.2.1.4 Local stiffening and reinforcement shall be provided for deck-mounted machinery, equipment, fairleads, masts, mooring cleats, towing bollards, and other miscellaneous fittings. Such stiffening and reinforcement shall take into account the maximum anticipated deck loading.
- 3.2.1.5 **Permanent Ballast**
- 3.2.1.5.1 When ballast is fitted in the vessel it shall be secured to prevent movement during vessel operations.

3.3 Watertight Integrity

As stated by the Regulations:

WATERTIGHT INTEGRITY

714. The design of a vessel's superstructure, hull and fittings shall provide, in accordance with the construction standards, for the maintenance of watertight integrity and the prevention of downflooding.

3.3.1 Fittings and Through-Hull Penetrations

- 3.3.1.1 Every closure shall be of a strength and design to maintain watertight integrity.
- 3.3.1.2 Means shall be provided for positively shutting off underwater penetrations, with the exception of wet exhaust systems.
- 3.3.1.3 Where fitted in a fire risk area, the means of shut-off shall be made of material that is not susceptible to fire damage.
- 3.3.1.4 Through-hull penetrations shall:
- be kept to the minimum necessary to be consistent with the operational needs of the vessel; and
 - have adequate local strength compensation equivalent to the unpierced structure in which it is located and be of such construction that it will maintain watertight integrity.
- 3.3.1.5 Paragraph 3.3.1.2 and 3.3.1.3 do not apply to a vessel that meets the requirements for level flotation and that is provided with other means for stopping the admission of water in the event of failure of pipes, tubing or hose lines penetrating the hull below the waterline.

3.3.2 Windows, Portlights, Hatches, Deadlights and Doors

- 3.3.2.1 Openings and penetrations in structures shall:
- be kept to a minimum; and
 - be fitted with a reliable means of closure as set out in this section.

- 3.3.2.2 Closing appliances such as exterior doors, hatches, windows and portlights shall be of marine construction, and fitted with means of securing them adequately in all operating conditions while underway and shall be constructed using good boat building practices.
- 3.3.2.3 Where reasonable or practicable, hinged doors and hatches shall open outward and be hinged on the forward or outboard side.
- 3.3.2.4 The required degree of water tightness of closures shall be appropriate for their location on the vessel and the operational exposure of the vessel to the environmental conditions.
- 3.3.2.5 Windows, portlights, and skylights shall be fitted with safety glass or equivalent material of equal strength.

3.3.3 Windows, Portlights, Hatches, Deadlights and Doors for Non-Pleasure Craft of more than 6 metres

- 3.3.3.1 Where a vessel is intended to operate more than 25 nautical miles from shore, windows, portlights, and skylights shall be rigidly attached to the surrounding structure in a manner that will prevent the glass pane from being pushed inside the structure under the pressure load from the outside green water. The installation of the windows must be made in accordance with the manufacturer's instructions.
- 3.3.3.2 The standard for watertightness of openings and penetrations in structures of vessels on which construction was started after April 1, 2005, is the international standard ISO 12216.

3.3.4 Drainage and Hull Penetrations

- 3.3.4.1 On monohull vessels of not more than 6 metres, scuppers, freeing ports, drains, overboard discharge, and centreboard trunk openings may be located below the static float plane (SFP). Other openings are permitted below the SFP in the motor well for outboard engine controls or fuel lines. All openings below the SFP shall be provided with a boot or other means to minimize leakage.
- 3.3.4.2 On monohull vessels other than a pleasure craft of more than 6 metres, when cockpits and recesses are to be designated either as "watertight" or as "quick-draining," they shall comply with the requirements of ISO 11812.

3.3.5 Motor Wells

- 3.3.5.1 Where a motor well is fitted, it shall be designed so that:
- a) it tends to reverse the flow of any water striking the forward face of the well rather than directing it upward and forward;
 - b) it has control or other openings of minimum size for safe operation that are located as high as possible and not lower than the normal motor cut-out in the transom, unless fitted with sealing devices to prevent flooding through the openings; and
 - c) it has drains fitted that will allow the complete drainage of water within a maximum of five (5) minutes.

3.4 Personal Watercraft

As stated by the Regulations:

700. (3) If a personal watercraft is constructed, manufactured or rebuilt in accordance with ISO 13590, then only sections 701, 702, 704 to 709 and 711 apply in respect of the watercraft.

3.4.1 Warning Label for Personal Watercraft

As stated by the Regulations:

PERSONAL WATERCRAFT

705. (1) Every personal watercraft shall display a safety notice that indicates the precautions that must be taken in order to minimize the risk of fire and explosion, including the information set out in the construction standards.

(2) Every personal watercraft that is constructed, manufactured or rebuilt in accordance with ISO 13590 shall display, in English and French, a builder's plate that meets the requirements of that standard.

Information Note:

The information required on a personal watercraft warning label is shown in Figure 3-1.

Figure 3-1 PERSONAL WATERCRAFT WARNING LABEL



3.5 Protection from Falls

3.5.1 Scope

This section contains the standards for protection from falls and from falling overboard.

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length	■	■
More than 6 metres in length	■	■

3.5.2 Non-Pleasure Craft of more than 6 metres

As stated by the Regulations:**PROTECTION FROM FALLING**

712. (1) A vessel, other than a pleasure craft, that is more than 6 m in length shall, in accordance with the construction standards, have means of protecting persons from falls or from falling overboard.

- 3.5.2.1 Unless it interferes with the normal operation of the vessel or its equipment, the perimeter of an exposed deck that is intended to be used by persons on board shall be fitted with bulwarks, guardrails, stanchions, and netting, or any combination thereof.
- 3.5.2.2 Non-skid surfaces shall be used in working and traffic areas.
- 3.5.2.3 Grab rails shall be provided to assist movement of any persons on board.
- 3.5.2.4 **Passenger-Carrying Vessels**
- 3.5.2.4.1 On passenger-carrying vessels:
- (i) The bulwarks, guardrails, stanchions and netting, or any combination thereof, referred to in 3.5.2.1 shall be at least 915 mm (36 in) above the weatherdeck;
 - (ii) The distance between the horizontal rails shall not be more than 230 mm (9 in), unless netting of a strength preventing a person from falling overboard is provided;
 - (iii) When application of such measures would impede the working of the vessel, equivalent safety measures shall be provided.
- 3.5.2.4.2 When the vessel's intended use includes carrying children, the distance between rails set out in 3.5.2.4.1 shall be reduced or netting provided or other means employed to protect children from falling overboard.
- 3.5.2.5 **Workboats**
- 3.5.2.5.1 The bulwarks, guardrails, stanchions, and netting, or any combination thereof, referred to in 3.5.2.1 should be at least 915 mm (36 in) above the deck but in no case they shall be less than 760 mm (30 in).

3.5.3 Pleasure Craft of All Sizes and Non-Pleasure Craft of 6 metres and less

As stated by the Regulations: 712. (2) A vessel, other than a pleasure craft, that is not more than 6 m in length and every pleasure craft shall be equipped with handhold devices and guard rails in accordance with sections H41.5 and H41.6 of American Boat and Yacht Council Standard H41, *Reboarding Means, Ladders, Handholds, Rails, and Lifelines*.

3.6 Discharge of Sewage

Pollution Discharge Advisory:**Manufacturers, builders, importers and owners of small vessels note:**

The *Vessel Pollution and Dangerous Chemicals Regulations* apply with respect to the discharge of sewage. Refer to Appendix 2 of this Standard for illustrations of typical sewage systems arrangements.

3.7 Navigation Lights

Information Note:

The *Small Vessel Regulations* require that power-driven vessels more than 9 metres in length must be fitted with navigation lights that meet the applicable standards set out in the *Collision Regulations*. Vessels less than 9 metres must show navigation lights that meet the applicable standards set out in the *Collision Regulations* if operated after sunset or before sunrise, or in periods of restricted visibility.

4 HULL DESIGN REQUIREMENTS AND CALCULATION OF RECOMMENDED MAXIMUM CAPACITIES FOR VESSELS NOT MORE THAN 6 METRES IN LENGTH

4.1 Scope

This section contains the hull design requirements, and the standards for calculating the recommended maximum safe limits that are marked on a compliance notice for a vessel of not more than 6 metres in length.

Scope	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length	■	■
More than 6 metres in length		

As stated by the Regulations:

HULL DESIGN

715. The design of the hull of a pleasure craft that is not more than 6 m in length shall conform to the construction standards for buoyancy, flotation and stability.

4.2 Definitions

“**Bilge**”, in respect of buoyancy material, means that area of the vessel below a height of 100 mm (4 in) measured from the lowest point in the vessel, except for engine rooms, where liquid can collect when the vessel is in the static floating position;

“**Bow Reference Area**”, for the purpose of the level flotation and stability requirements for outboard power-driven vessels, not over six (6) metres in length, means the area 0.6 m (2 ft) aft of the stem of the vessel, measured at the top deck or gunwale level;

“**Calculation Length (L)**”, means the length used in the maximum gross load calculations, and is measured parallel to the static float plane (SFP), between two vertical planes normal to the centre line of the craft, erected from the foremost integral part of the hull, and erected aft through a point located on the transom at the midpoint between the SFP and the hull bottom (see Figure 4-1);

“**Canoe**” means a watercraft, designed to be manually propelled, with provision for auxiliary power, with neither end having a transverse dimension greater than 45% of its maximum beam and conforms to the following table :

<u>Canoe Length</u>	<u>Maximum Beam</u>
4.25m or less	1/3 Canoe Length
over 4.25m to 4.9m	1/4 Canoe Length
over 4.9m	1/5 Canoe Length

“**Dead Weight**” means:

- a) for inboards and stern-drive powered vessels: the maximum gross load marked on the compliance notice, minus the live load.

- b) for outboard powered vessels: the maximum gross load marked on the compliance notice, minus the weight of the outboard engine and related equipment as per Table 4.2 minus the live load.

“**Designated Occupant Position**” means a specific location for a person within a vessel, being either a seat or a location for sitting or standing with handholds;

“**Engine Space Bilge**”, in respect of buoyancy material, means that area in the engine space or a connected space below a height of 305 mm (12 in), measured from the lowest point in those spaces where liquid can collect when the vessel is in a static floating position;

“**Live Load**”, means the maximum number of persons marked on the compliance notice multiplied by a weight of 75 kg per person;

“**Static Floating Position**” means the attitude in which a vessel floats in calm water with each fuel tank filled to its rated capacity, but with no person or item of portable equipment on board, with other tanks such as water and holding tanks empty, and permanently installed equipment supplied by the vessel builder in its proper place;

“**Stern Reference Area**”, for the purpose of the level flotation and stability requirements for outboard power-driven vessels, not over six (6) metres, means that area 0.6 m (2 ft) forward of the transom or engine mount, measured at the top deck or gunwale level;

4.3 Recommended Maximum Safe Limits for Monohull Vessels

Information Note:

The recommended maximum safe limits for a multi-hull (catamaran), other than a pontoon vessel, are determined using the same formula as for monohull vessels in 4.3, except that the displacement of the hulls below the static float plane (D_{SFP}) should be determined with methods that will provide adequate accuracy considering the vessel configuration. The volume of the connecting structure between the hulls may be included in the displacement if this volume is located below the static float plane and watertight up to that plane.

4.3.1 Recommended Maximum Gross Load Calculation (Intact Condition)

- 4.3.1.1 The recommended maximum gross load in kilograms that is marked on a capacity label, for a monohull vessel with a maximum recommended power of more than 1.5 kW other than a canoe is determined as follows:

$$GL = \frac{(D_{SFP} - W_V)}{5}$$

Where:

GL = recommended maximum gross load in kilograms

W_v = the weight of the vessel in kilograms, including deck, railings, console, seats, and any other permanent structures and fittings. For outboard powered vessels, the outboard engine and related equipment weight from Table 4.2 is excluded. For vessels fitted with permanent fuel tanks the fuel weight must be included.

D_{SFP} = displacement to static float plane (kg) as calculated by the following formula:

$$D_{SFP} = (V_{tot} - V_{mw}) \times 1000$$

Where:

V_{tot} = total volume in cubic metres (m^3), representing the internal volume of the vessel below the static float plane as determined by Figure 4-1, including the volume of the integral structure aft of the

transom below the static float plane, and excluding the volume of the integral chambers that flood automatically

V_{mw} = motor well volume in cubic metres (m³)

1000 = the factor representing a weight in kilograms of 1.0 m³ of fresh water

- 4.3.1.2 The recommended maximum gross load in kilograms that is marked on a Capacity label, for a vessel with a maximum recommended power of 1.5 kW or less other than a canoe is determined as follows:

$$GL = \frac{3 \times (D_{SFP} - W_V)}{10}$$

- 4.3.1.3 The recommended maximum gross load in kilograms for canoes shall be less than or equal to that load which yields 178mm of freeboard. Freeboard shall be measured at the lowest point along the length of the canoe.

As stated by the Regulations:

802. (2) The recommended maximum safe limits of the vessel shall be calculated in accordance with the applicable methods set out in the construction standards. However, alternative methods may be used if

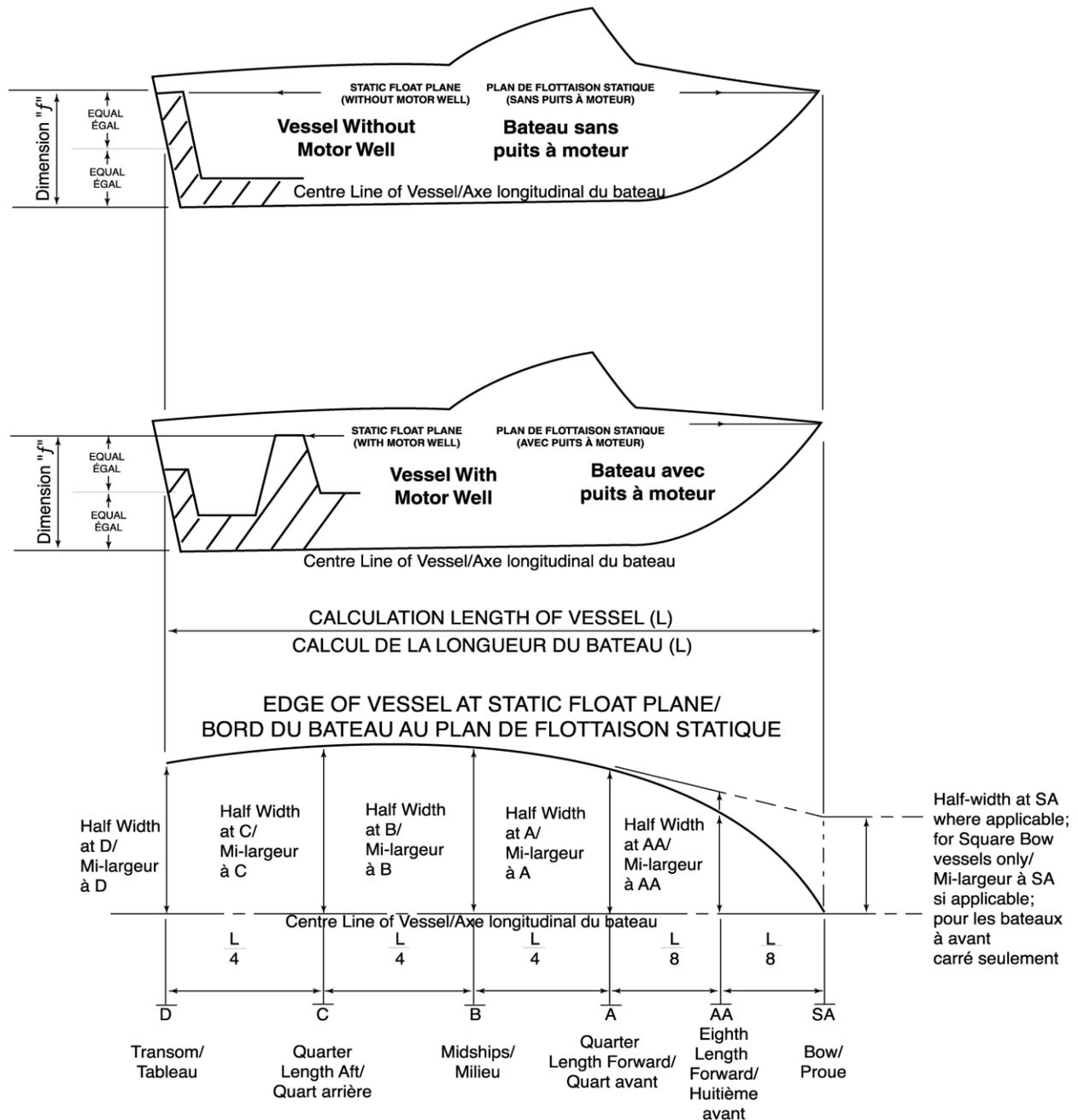
- (a) the alternative methods are more accurate; or
- (b) the alternative methods are more suited to the vessel, owing to its unique nature, and the methods set out in the construction standards would result in recommended maximum safe limits that are less safe or less suitable for the vessel.

Information Note:

To determine the total volume of the hull below the static float plane (V_{tot}), refer to the method in Appendix 4 and the forms in Appendix 5.

Other methods may be used to determine the volume of the hull below the static float plane, if they provide a level of accuracy at least equal to the method in Appendix 4.

Figure 4-1 LENGTH AND WIDTH DEFINITIONS FOR MAXIMUM GROSS LOAD CALCULATIONS



4.3.2 Recommended Maximum Number of Persons Calculation

4.3.2.1 The recommended maximum number of persons, marked on a capacity label, for a monohull vessel does not exceed the lesser of the following:

- a) the number of designated occupant positions;

- b) the maximum number of persons calculated as per 4.3.2.2;
- c) the maximum number of persons obtained with the live load redistributed, as required, for the stability test (subsections 4.4.2.5 and 4.4.2.6); and
- d) if the live load is less than 250 kg, the maximum number of persons obtained with the live load determined by the maximum number of persons stability test as required in 4.3.2.4.

4.3.2.2 The recommended maximum number of persons is calculated with the following formula:

- a) For inboard or stern-drive powered vessels:

$$\text{Number of persons} = \frac{GL}{75}$$

- b) For outboard powered vessels (including canoes):

$$\text{Number of persons} = \frac{GL - W_e}{75}$$

where:

GL = recommended maximum gross load in kilograms

W_e = outboard engine and related equipment total weight, as determined from Table 4.2

4.3.2.3 The maximum number of persons shall be rounded off to the nearest whole number. If the fraction is less than 0.5, round down to the next whole integer and if the fraction is equal to or greater than 0.5, round up to the next higher whole integer.

4.3.2.4 **Maximum Number of Persons Stability Test**

4.3.2.4.1 When the live load is less than 250 kg, the live load shall be confirmed with the following test to determine the stability with the maximum number of persons. If necessary, the live load shall be reduced to pass the test:

- a) Float the vessel in calm water with all permanent equipment in place including the weight for engines and related equipment as per Table 4.2.
- b) Fill all permanent fuel tanks.
- c) Gradually place a test weight equal to 60% of the maximum gross load so that its centre of gravity is located as follows:
 - (i) Longitudinally: at mid-point of the passenger-carrying area;
 - (ii) Vertically: at the height of the seat nearest to the longitudinal centre of gravity, but not above the gunwale; and
 - (iii) Transversally: at the average outboard extremity of the passenger-carrying area where it intersects with test load height.
- d) Stop adding weight when the freeboard is zero or when you have attained 60% of the maximum gross load.
- e) Conduct test on both port and starboard sides and record the minimum freeboard.
- f) The live load is equal to the test weight divided by 0.60.

4.3.3 **Recommended Maximum Power Calculation**

4.3.3.1 The recommended maximum power in kilowatts that is marked on a capacity label for monohull vessel other than a canoe, is determined in relation to the vessel length (L_h) and maximum transom width

(D_h), excluding handles and extensions, but including permanently installed rub-rails. The formula to apply in 4.3.3.1.1 or 4.3.3.1.2 is determined by the factor f , midship deadrise angle, and the type of steering. The factor f is calculated with the following formula:

$$f = L_h \times D_h$$

Alternatively, instead of using the formulas in 4.3.3.1.1 and 4.3.3.1.2, the recommended maximum power may be interpolated from the appropriate curve in Figure 4-2 based on the midship deadrise angle and type of steering.

4.3.3.1.1 If the factor is less than 5.1 ($f < 5.1$), use the following formulas to obtain the recommended maximum power in kilowatts (kW) or horsepower (hp):

- a) midship deadrise angle less than 5 degrees (minimum factor $f = 3.35$):

$$\text{Maximum Power (kW)} = 5.82 \times f - 18$$

$$\text{Maximum Power (hp)} = (5.82 \times f - 18) / 0.745$$

- b) midship deadrise angle greater than or equal to 5 degrees (minimum factor $f = 2.64$):

$$\text{Maximum Power (kW)} = 5.5 \times f - 13$$

$$\text{Maximum Power (hp)} = (5.5 \times f - 13) / 0.745$$

4.3.3.1.2 If the factor is equal to or greater than 5.1 ($f \geq 5.1$), use the following formulas to obtain the power in kilowatts (kW) or horsepower (hp):

- a) midship deadrise angle less than 5 degrees, remote and tiller steering:

$$\text{Maximum Power (kW)} = 4.2 \times f - 11$$

$$\text{Maximum Power (hp)} = (4.2 \times f - 11) / 0.745$$

- b) midship deadrise angle greater than or equal to 5 degrees, tiller steering:

$$\text{Maximum Power (kW)} = 6.4 \times f - 19$$

$$\text{Maximum Power (hp)} = (6.4 \times f - 19) / 0.745$$

- c) midship deadrise angle greater than or equal to 5 degrees, remote steering:

$$\text{Maximum Power (kW)} = 16 \times f - 67$$

$$\text{Maximum Power (hp)} = (16 \times f - 67) / 0.745$$

4.3.3.2 When the calculated power is not more than 11 kW (15 hp), the power may be rounded up to the next multiple of 1.5 kW (2 hp). When the calculated power is more than 11 kW (15 hp) and is not a multiple of 5 the power may be rounded up to the next multiple 3.75 kW (5 hp).

4.3.3.3 The recommended maximum power for canoes shall be as specified in Table 4-1

Table 4-1 THE RECOMMENDED MAXIMUM POWER FOR CANOES		
Canoe Length	Maximum Kilowatt Rating	Maximum Horsepower Rating
Under 4.6m (15ft)	2.25	3
4.6-5.5m (15-18ft)	3.75	5
Over 5.5m (over 18ft)	5.25	7

Figure 4-2 GRAPH USED TO INTERPOLATE THE RECOMMENDED MAXIMUM POWER FOR VESSELS OF MONOHULL CONSTRUCTION

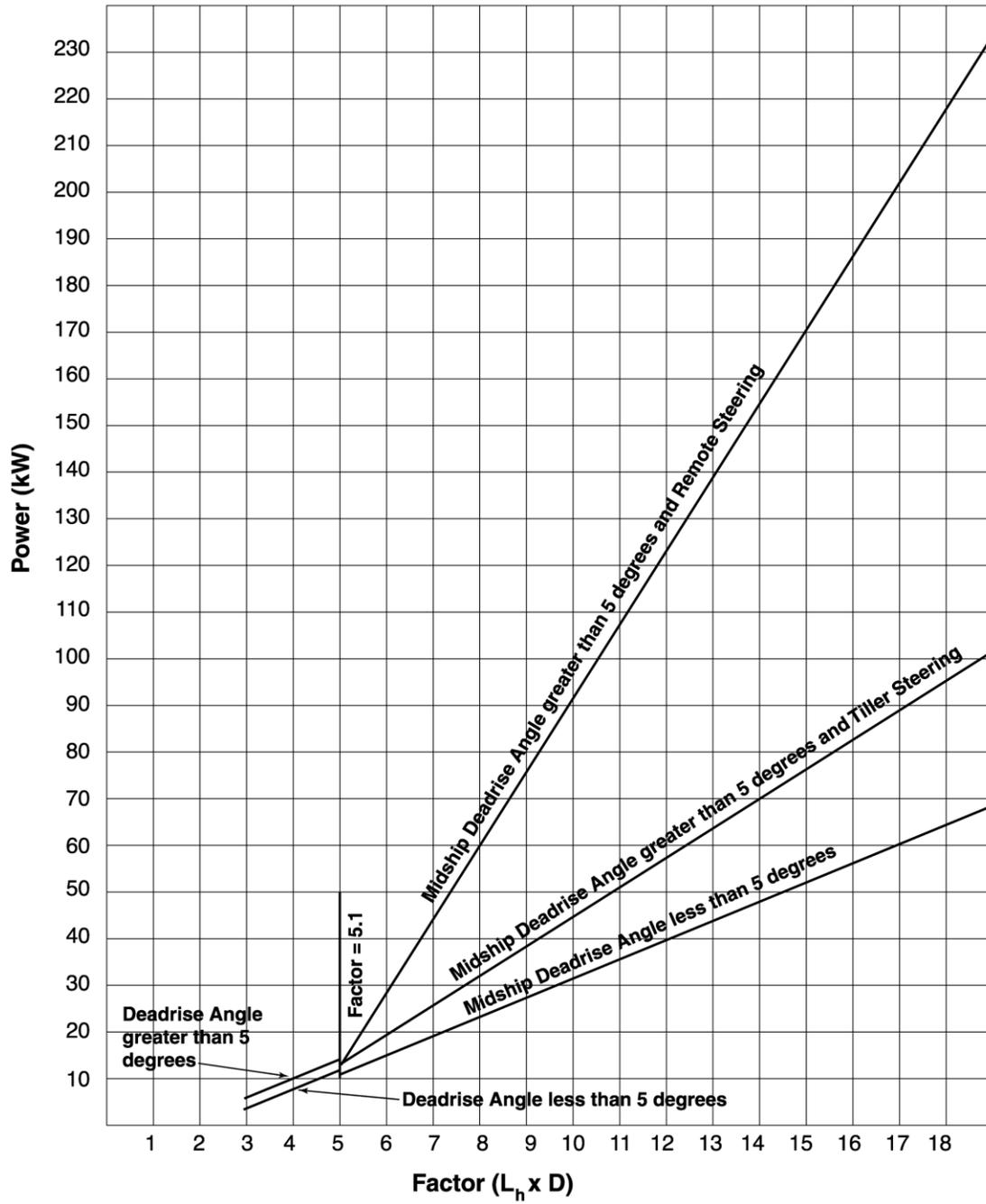


Table 4-2 WEIGHTS (IN KILOGRAMS) OF GASOLINE OUTBOARD ENGINES AND RELATED EQUIPMENT FOR VARIOUS KILOWATT RATINGS

1	2	3	4	5	6	7	8	9	
Engine Power Categories	Dry Weight ¹	Running Weight ²	Swamped Weight ³	Controls + Rigging ⁴	Dry Battery Weight	Submerged Battery Weight	Full Portable Fuel Tank ⁵	Total Weight (3+5+6+8)	
SINGLE ENGINE INSTALLATIONS									
(HP)	(kW)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)
0.1 - 2.0	0.0 - 1.5	14	15	12	0	0	0	0.0	15
2.1 - 3.9	1.6 - 2.9	19	20	17	0	0	0	0.0	20
4.0 - 6.9	3.0 - 5.1	30	31	27	0	0	0	11	43
7.0 - 10.9	5.2 - 8.1	48	50	43	2	9	5	23	84
11.0 - 22.9	8.2 - 17.1	58	60	51	4	20	11	23	106
23.0 - 34.9	17.2 - 26.0	85	89	76	4	20	11	45	159
35.0 - 64.9	26.1 - 48.4	130	136	116	6	20	11	45	208
65.0 - 94.9	48.5 - 70.7	199	209	178	10	20	11	45	285
95.0 - 104.9	70.8 - 78.2	208	218	185	10	20	11	45	294
105.0 - 144.9	78.3 - 108.0	239	250	213	12	20	11	45	328
145.0 - 194.9	108.1 - 145.3	254	267	227	13	20	11	45	346
195.0 - 209.9	145.4 - 156.5	296	311	264	15	20	11	45	391
210.0 - 300.0	156.6 - 223.7	317	333	283	16	20	11	45	415
300.1 - 400.0	223.8 - 305.6	401	421	358	20	20	11	45	507
400.1 - 499.9	305.7 - 372.7	476	500	425	24	20	11	45	590
500.0 - 600.0	372.8 - 447.5	630	662	563	32	20	11	45	760
MULTIPLE ENGINE INSTALLATIONS									
For multiple engine installations, multiply the final value in column 9 by the number of engines.									

Notes:

1. Dry Weight is the manufacturers published weight for the shortest midsection increased by 10% to account for longer midsections and additional required hardware usually not included in published weights. This weight is intended to represent the heaviest model in each power category. For boats designed with a transom height of 20 inches or less, the weight in column 2 may be reduced by 10%. Recalculate columns 3, 4 and 9 as appropriate

2. Running Weight is calculated as 105% of dry weight to account for fluids (including 2-stroke oil) and the heaviest recommended propeller.

3. Swamped Weight is 85% of Running Weight

4. Rigging and controls includes engine related hardware required to complete the installation (e.g. controls, cables, hydraulic hoses, steering pumps and cylinders). Calculated as 5% of Dry Weight

5. If the vessel is equipped with the permanent fuel system and is not intended to use a portable tank, the portable tank can be omitted.

6. For diesel outboards, replace the value in Column 2 with the manufacturers published dry weight + 10%

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7. For jet drive outboard, use the values of Column 2 or the manufacturer's published dry weight, whichever is greater.
8. For vessel that are designed to be propelled only with an electric outboard engine, the weight of the heaviest motor and battery recommended by the manufacturer must be used.

4.4 Flotation Requirements for Monohull Vessels

Information Note:

The flotation requirements for a multi-hull (catamaran), other than a pontoon vessel, are determined using the same methods as for monohull vessels.

Canoes designed to be powered by an outboard engine are required to meet the Minimum Flotation Test of section 4.4.1 instead of the Level Flotation Test of section 4.4.2 that is required for monohull vessels powered by an outboard engine.

4.4.1 Minimum Flotation Test (Swamped Condition) for Canoes, Inboard or Stern-Drive Powered Monohull Vessels Other than Inflatable

4.4.1.1 This subsection contains the flotation standards and procedures for testing the minimum flotation of monohull vessels.

4.4.1.2 Standards for Minimum Flotation

4.4.1.2.1 Buoyancy material is to be fitted that provides sufficient buoyancy to keep the vessel from sinking when it is swamped and when the occupants are clinging to the outside of the vessel, where the individual weights of the motor, the occupants, and the equipment carried in or attached to the vessel do not exceed the weights used in the formula set out in subsection 4.4.1.4.

4.4.1.2.2 The numerical methods set out in subsection 4.4.1.4 or physical testing may be used to determine compliance with the minimum flotation requirements.

4.4.1.2.3 To perform physical testing for the minimum flotation test, the vessel shall be preconditioned as set out in 4.4.1.3.

4.4.1.2.4 Air chambers may be used to provide the necessary buoyancy if they are not:

- a) more than 0.014 m³ (0.5 ft³) in volume, or
- b) integral with the hull structure.

4.4.1.2.5 The quantity of buoyancy material required for a vessel to meet the requirements of paragraph 4.4.1.2.1 is calculated using the formula set out in subsection 4.4.1.4.

Table 4-3 FACTORS FOR CONVERTING VARIOUS SMALL VESSEL MATERIAL FROM DRY WEIGHT TO SUBMERGED WEIGHT

Materials	Specific Gravity	Factor (k)
Lead	11.38	0.91
Copper	8.91	0.89
Monel Metal	8.91	0.89
Bronze	8.88	0.89
Nickel	8.61	0.88
Brass	8.56	0.88
Stainless Steel (rolled)	8.00	0.88

Table 4-3 FACTORS FOR CONVERTING VARIOUS SMALL VESSEL MATERIAL FROM DRY WEIGHT TO SUBMERGED WEIGHT

Materials	Specific Gravity	Factor (k)
Steel	7.85	0.88
Cast Iron	7.08	0.86
Zinc-Cast Alloy	6.63	0.85
Aluminum	2.73	0.63
Glass	2.60	0.62
Ferro-Cement	2.40	0.58
Rubber	1.51	0.34
Fibreglass-Laminate	1.50	0.33
Kevlar-Laminate	1.30	0.24
Plexiglass-Lucite	1.20	0.17
A.B.S. ⁽³⁾	1.12	0.11
Teak	0.99	-0.01
Oak-White	0.85	-0.18
Oil-Diesel	0.85	-0.18
Gasoline	0.73	-0.37
Oak-Red	0.63	-0.56
Blandex-Particle Board	0.58	-0.70
Mahogany-Philippine	0.58	-0.72
Mahogany-Honduras	0.56	-0.78
Ash	0.56	-0.78
Yellow Pine	0.55	-0.81
Fir Plywood	0.55	-0.81
Mahogany-Plywood	0.54	-0.83
Royalex	0.50	-0.95
Mahogany-African	0.51	-0.96
Fir	0.51	-0.96
Cedar-Port Orford	0.48	-1.08
Spruce	0.45	-1.22
Pine-White	0.42	-1.38
Cedar-White	0.33	-1.95
Cork	0.24	-3.17
Balsa	0.16	-5.24

Notes on Table 4-2

1. Factor (k) = [Specific Gravity - 1] / Specific Gravity
 2. Specific Gravity of fresh water at 4°C = 1
 3. A.B.S stands for Acrylonitrile-Butadiene-Styrene
- 4.4.1.2.6 Buoyancy material shall be placed or secured so that it cannot be accidentally moved or floated out of place.
- 4.4.1.2.7 Buoyancy material shall be protected from mechanical damage.

4.4.1.3 **Preconditioning for Minimum Flotation Test**

4.4.1.3.1 This section sets out the requirements for preconditioning a vessel for minimum flotation testing.

4.4.1.3.2 Every permanently installed fitting supplied by the manufacturer or builder, such as windshields and convertible tops, shall be secured in place.

4.4.1.3.3 The vessel shall be loaded with weights that, when submerged, are equivalent to the weight of the following:

- a) 75% of the dry weight of propulsion system and battery;
- b) 25% of the live load; and
- c) 25% of the dead weight.

4.4.1.3.4 Permanent fuel tanks shall be filled with fuel and sealed.

4.4.1.3.5 Portable fuel tanks shall be removed.

4.4.1.3.6 Water and holding tanks shall be filled with fresh water.

4.4.1.3.7 For the purpose of physical testing, the vessel shall be swamped for a period of not less than 18 hours so that all compartments integral with the hull are flooded, no trapped air remains in the hull, and water is free to flow in and out of the hull.

4.4.1.3.8 Where air chambers contribute to the buoyancy, the two largest shall be perforated so as to allow complete flooding.

4.4.1.4 **Numerical Methods for Minimum Flotation Test**

4.4.1.4.1 To determine the volume of buoyancy material required, the swamped weight of the vessel must first be calculated (see 4.4.1.4.2). This value is then used to find the amount of buoyancy required (see 4.4.1.4.3). The amount of buoyancy is in turn used in the formula to determine the volume of buoyancy material required (see 4.4.1.4.5).

4.4.1.4.2 The swamped weight (W_s) of the vessel and permanently installed fittings, excluding the engine and engine related equipment, shall be determined as follows:

$$W_s = \sum W_{hk} + K_d \cdot W_d + 0.69 \cdot W_f$$

Where:

W_s = swamped weight in kilograms of vessel and fittings other than engine and engine related equipment

$$\sum Whk = W_{h1}k_1 + W_{h2}k_2 + W_{h3}k_3 \dots$$

$Wh_1, Wh_2, Wh_3 \dots$ = the dry weight in kilograms of various materials used in hull construction

$k_1, k_2, k_3 \dots$ = a conversion factor applied to the weight of each piece of hull material (Wh), to convert the dry material (h) to an equivalent weight when submerged in fresh water as determined by Table 4-3

K_d = a conversion factor applied to the weight of deck and superstructure, to convert the dry material weight to an equivalent weight when submerged in fresh water as determined by Table 4-3

W_d = weight of deck and superstructure in kilograms

W_f = weight in kilograms of permanent fittings not included in W_d

4.4.1.4.3 The amount of buoyancy required (W_{fl}) for monohull other than a canoe, shall be determined by the following formula:

$$W_{fl} = W_s + 0.75 \cdot W_e + 0.25 \cdot W_l$$

Where:

W_s = swamped weight of the vessel in kilograms

W_e = dry installed weight of the propulsion system, plus the dry weight of the battery(s).

W_l = the maximum gross load in kilograms, less the dry installed weight of the propulsion system and the dry weight of the battery(s).

4.4.1.4.4 The amount of buoyancy required (W_{fl}) for canoes shall be determined by the following formula:

$$W_{fl} = W_s + 0.85 \cdot W_e + 0.55 \cdot W_d + 0.1 \cdot W_l$$

Where:

W_s = swamped weight of the canoe in kilograms

W_e = dry installed weight of the engine

W_d = dry weight of the battery in case of an electric motor

W_l = the maximum gross load in kilograms, less the weight of the installed engine and the battery.

4.4.1.4.5 The volume of buoyancy material (V_b) required in cubic metres shall be determined as follows:

$$V_b = \frac{W_{fl}}{1000 - 1.05 \times W_b}$$

Where:

W_b = weight in kilograms of 1 m³ of buoyancy material used

W_{fl} = as calculated in 4.4.1.4.3 or 4.4.1.4.4

4.4.2 Level Flotation and Stability Tests (Swamped Condition) for Outboard Powered Monohull Vessels Other than Inflatable

4.4.2.1 This section contains the buoyancy standards and procedures for level flotation and stability tests for monohull vessels.

4.4.2.1.1 Numerical methods or physical testing may be used to determine compliance with the relevant level flotation criteria.

4.4.2.2 Preconditioning for Level Flotation Test

4.4.2.2.1 This section sets out the requirements for preconditioning a vessel for level flotation testing.

4.4.2.2.2 Every permanently installed fitting supplied by the manufacturer or builder, such as windshields and convertible tops, shall be secured in place.

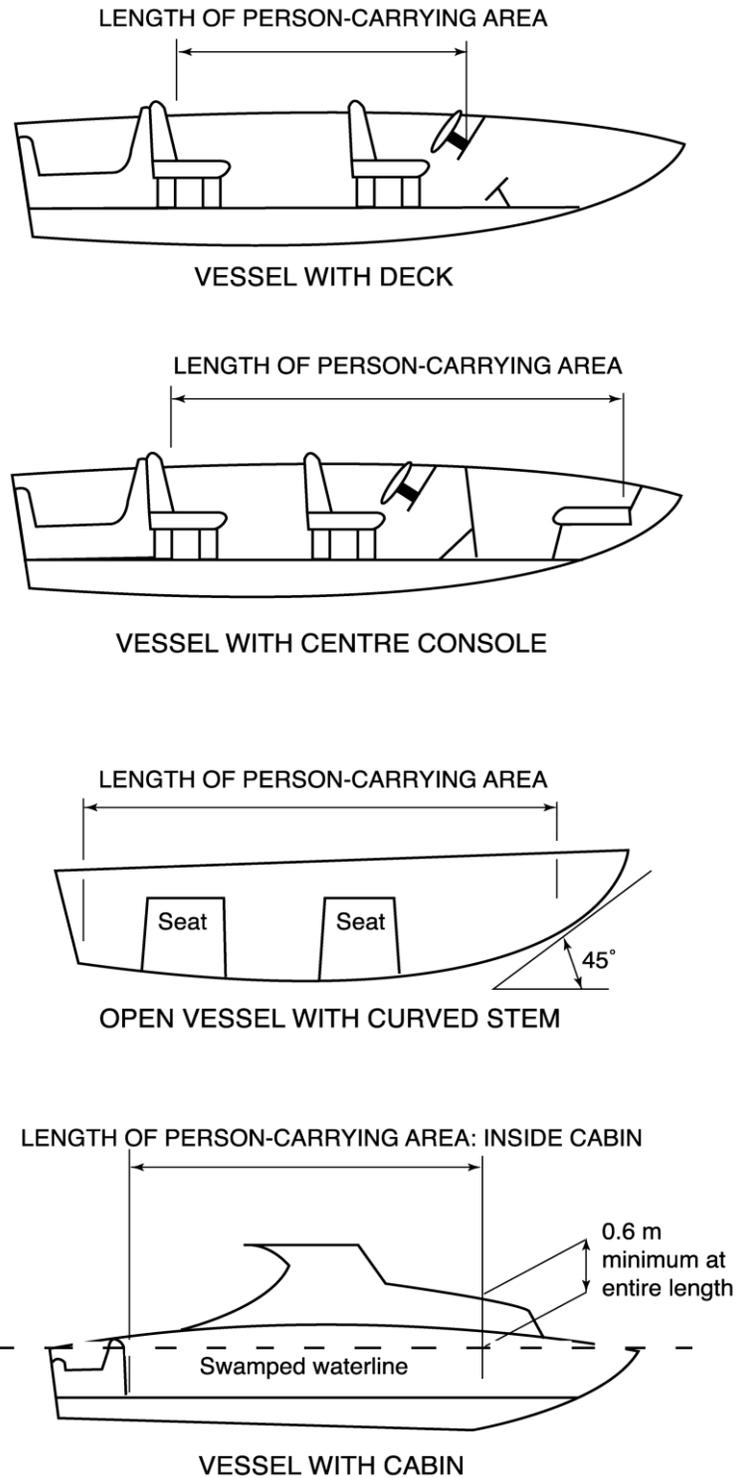
4.4.2.2.3 The vessel shall be loaded with weights that, when submerged, are equivalent to the weight of the following:

- a) 50% of the live load of the vessel, up to 250 kg (550 lbs) and, if the live load exceeds 250 kg (550lbs), 12% of the excess;
- b) 25% of the dead weight; and
- c) the engine and battery.

4.4.2.2.4 The weights in 4.4.2.2.3 (a) and (b) shall be placed so that their centre of gravity lies at the centre of the person-carrying area, but they shall all be contained within 16% of the person-carrying areas, as shown in Figure 4-4.

- 4.4.2.2.5 The weights in 4.4.2.2.3 (c) shall be placed as close as practicable to the position of those components they replace.
- 4.4.2.2.6 Permanent fuel tanks shall be filled with fuel and sealed.
- 4.4.2.2.7 Water and holding tanks shall be filled with fresh water.
- 4.4.2.2.8 Bait wells, storage boxes, iceboxes and dry wells shall be flooded.
- 4.4.2.2.9 For the purpose of physical testing, the vessel shall be swamped for a period of not less than 18 hours so that all compartments integral with the hull are flooded, no trapped air remains in the hull, and water is free to flow in and out of the hull.
- 4.4.2.2.10 Air chambers may be used to provide the necessary buoyancy if they are not:
- a) more than 0.014 m^3 (0.5 ft^3) in volume, or
 - b) integral with the hull structure.
- 4.4.2.2.11 Where air chambers contribute to the flotation, the two largest shall be perforated so as to allow complete flooding.

Figure 4-3 CRITERIA FOR MEASURING THE LENGTH OF PERSON-CARRYING AREA



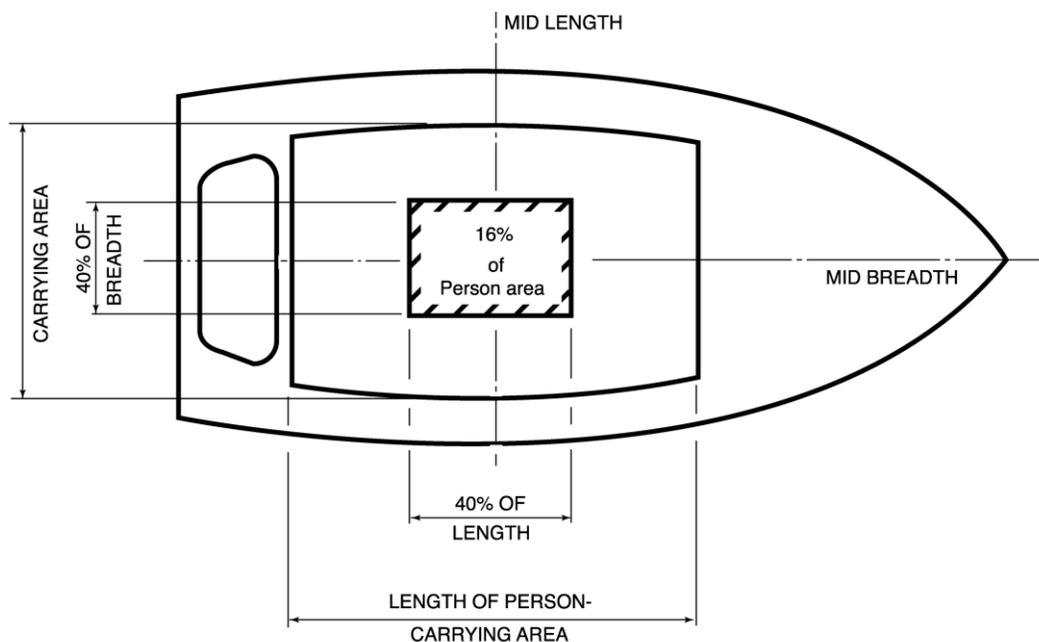
4.4.2.3 Person-Carrying Area

4.4.2.3.1 The person-carrying area is the area of a vessel in which people may assume a safe sitting or standing position while the vessel is in operation.

4.4.2.3.2 The length of the person-carrying area is the distance along the centre line of the vessel between two assumed vertical lines, one forward and one aft of the area, when the vessel is on an even keel. For vessels with a curved stem inside the person-carrying area, the forward vertical line intersects the stem at a point where a line drawn at 45 degrees to the horizontal is tangential to the stem. For vessels with enclosed cabins, the forward vertical line is perpendicular to the centre line at the forward limit of that area where there is 0.6 m (2 ft) of headroom between the inside of the cabin top and the swamped waterline (see Figure 4-3).

4.4.2.3.3 The breadth of each person-carrying area is the distance between two assumed vertical lines at mid-length, excluding consoles, of the person-carrying area when the vessel is upright (see Figure 4-4). For small vessels with round chines, the vertical lines intersect the hull on each side at a point where lines drawn at 45 degrees to the horizontal are tangential to the hull on either side.

Figure 4-4 LOCATION OF CENTRE OF GRAVITY OF WEIGHTS (Level Flotation)

**4.4.2.4 Standards for Level Flotation Test**

4.4.2.4.1 When the specified preconditioning has been completed (subsection 4.4.2.2), the vessel shall float in fresh water as follows:

- a) the angle of heel shall not exceed 10 degrees;
- b) one part of either the bow or stern reference areas, shall remain above the surface of the water; and
- c) the midpoint of the submerged bow or stern reference area shall not be more than 152 mm (6 in) below the surface of the water.

4.4.2.5 Preconditioning for Stability Test

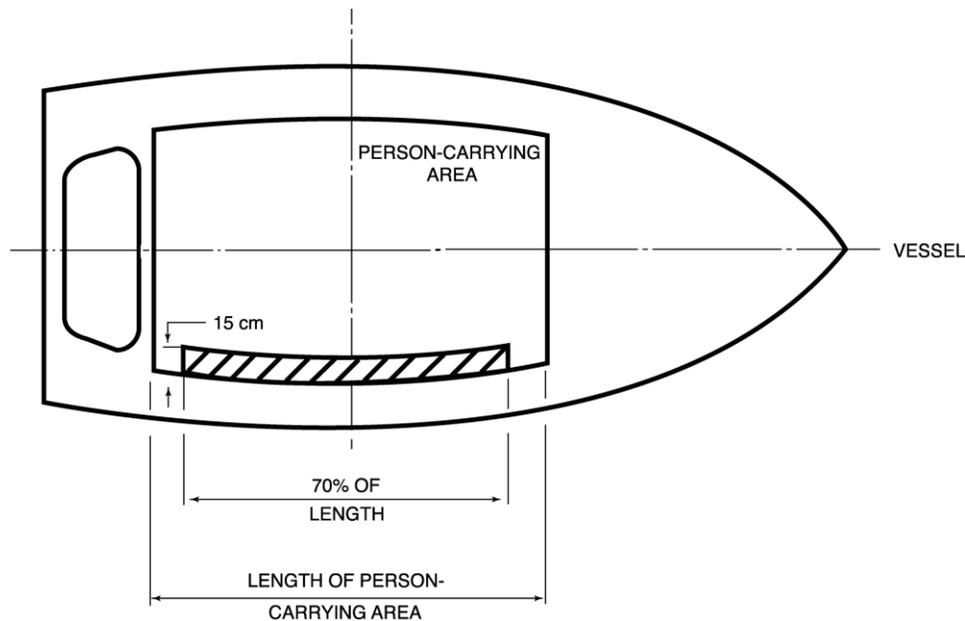
4.4.2.5.1 Preconditioning shall be completed as for the level flotation test, except for deployment of live load weights specified in paragraph 4.4.2.2.3(a), which shall be redistributed as follows:

- a) half of the weight is to be removed from the vessel, with the other half arranged on one side of the vessel so that the transversal centre of gravity of the weights falls within 152 mm (6 in) of the outer edge of the person-carrying area for at least 70% of its length (Figure 4-5); and
- b) the vertical centre of gravity of the weights shall be at least 102 mm (4 in) above the cockpit floor, or if the weights are placed on seats, the vertical centre of gravity of the weights shall be at least 102 mm (4 in) above the seats.

4.4.2.6 Standards for Stability Test

- 4.4.2.6.1 While floating in calm water, the vessel shall not list more than 30 degrees with the weight redistributed.
- 4.4.2.6.2 One part of either the bow or stern reference area shall remain above the surface.
- 4.4.2.6.3 The midpoint of the submerged bow or stern reference area shall be not more than 305 mm (12 in) below the surface.

Figure 4-5 LOCATION OF CENTRE OF GRAVITY OF WEIGHT (Stability Test)



4.4.3 Numerical Methods for Level Flotation and Stability Test

4.4.3.1 General

- 4.4.3.1.1 To determine the volume of buoyancy material required, the swamped weight of the vessel must first be calculated (see 4.4.3.1.2). This value is then used to find the amount of buoyancy required (see 4.4.3.1.3). The amount of buoyancy is in turn used in the formula to determine the volume of buoyancy material required (see 4.4.3.1.4).
- 4.4.3.1.2 The swamped weight (W_s) of the vessel and permanently installed fittings, excluding the engine and engine related equipment, shall be determined as follows:

$$W_s = \sum W_{hk} + W_d + W_f$$

Where:

W_s = swamped weight in kilograms of vessel and fittings other than engine and engine related equipment

$$\sum Whk = W_{h1}k_1 + W_{h2}k_2 + W_{h3}k_3 \dots$$

$Wh_1, Wh_2, Wh_3 \dots$ = the dry weight in kilograms of various materials used in hull construction

$k_1, k_2, k_3 \dots$ = a conversion factor applied to the weight of each piece of hull material (Wh), to convert the dry material (h) to an equivalent weight when submerged in fresh water as determined by Table 4-3

W_d = dry weight of deck and superstructure in kilograms

W_f = dry weight in kilograms of permanent fittings not included in W_d

4.4.3.1.3 The amount of buoyancy required (W_{fl}) is determined by the following formula:

$$W_{fl} = W_s + 0.85 \cdot W_e + 0.55 \cdot W_b + 0.5 \cdot W_{ll1} + 0.12 \cdot W_{ll2} + 0.25 \cdot W_d$$

Where:

W_s = swamped weight of the vessel in kilograms

W_e = dry installed weight of the propulsion system in kilograms

W_b = dry battery(s) weight in kilograms

W_{ll1} = the live load up to 250 kg

W_{ll2} = the excess of the live load above 250 kg

W_d = the deadweight

4.4.3.1.4 The volume of buoyancy material (V_b) required in cubic metres shall be determined as follows:

$$V_b = \frac{W_{fl}}{1000 - 1.05 \times W_b}$$

Where:

W_b = weight in kilograms of 1 m³ of buoyancy material used

W_{fl} = as calculated in 4.4.3.1.3

4.4.3.1.5 The buoyancy material shall be distributed symmetrically on both sides and fore and aft of the passenger-carrying area midpoint, at the hull sides as close to the sheer line as possible, and close to the hull sides at the widest point.

4.4.3.1.6 The exact location and quantity of buoyancy material shall be determined by performing the level flotation test and the stability test or with numerical methods as described in 4.4.3.2 and 4.4.3.3.

4.4.3.2 Numerical Methods for Level Flotation

4.4.3.2.1 To verify by calculation the performance standards of the level flotation as required by 4.4.2.4, a computer stability program shall be used as follows:

- a) the hull form shall be modeled;
- b) the buoyancy material volume shall be modeled as compartments;
- c) weight items and centre of gravity shall be defined to represent the weight of the swamped vessel;
- d) weight items and centre of gravity shall be defined to represent the load as specified in 4.4.2.2;

- e) the vessels shall be flooded except for the buoyancy material compartments; and
- f) draft, trim, heel and freeboard shall be computed to verify compliance with the requirements of 4.4.2.4.

4.4.3.3 Numerical Methods for Stability Test

- 4.4.3.3.1 To verify by calculation the performance standards for the stability test (swamped), the computer model shall be prepared as specified in 4.4.3.2, with the weight defined as required in 4.4.2.5.
- 4.4.3.3.2 Draft, trim, heel and freeboard shall be computed to verify compliance with the requirements of 4.4.2.6.

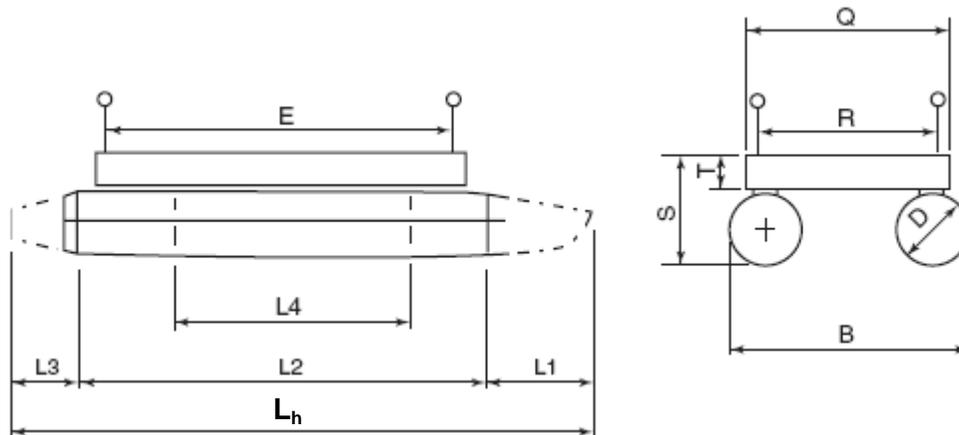
4.4.4 Buoyancy Material

- 4.4.4.1 Buoyancy material, when used in the bilge or engine room bilge, shall not change volume by more than 5% after being immersed, for a period of time as set out in 4.4.4.2 and 4.4.4.3, at 29°C in each of the following liquids:
 - a) reference fuel B, in accordance with American Society for Testing and Materials (ASTM) D471;
 - b) No. 2 reference oil, in accordance with American Society for Testing and Materials (ASTM) D471; and
 - c) 5% solution of trisodium phosphate in water.
- 4.4.4.2 The immersion time for buoyancy material used in the bilge shall be 24 hours.
- 4.4.4.3 The immersion time for buoyancy material used in the engine room bilge shall be 30 days.
- 4.4.4.4 Buoyancy material, when used in an engine room that is not open to the atmosphere, shall not reduce in volume by more than 5% after being immersed in a fully saturated gasoline vapour atmosphere for 30 days at 38°C.
- 4.4.4.5 The requirements of this subsection do not apply to buoyancy material used in a sealed compartment.

4.5 Recommended Maximum Safe Limits for Pontoon Vessels

4.5.1 Calculation Criteria (Intact Condition)

- 4.5.1.1 The criteria for developing the recommended maximum safe limits for a pontoon vessel marked on a capacity label are based on the buoyancy provided by the pontoons. To determine the recommended maximum gross load as per section 4.5.3(a), the following design conditions apply:
 - a) the pontoon vessel has only one deck;
 - b) the deck does not extend beyond the width (B) and the length (Lh) of the pontoons;
 - c) the deck length within railings (E) defining person-carrying area is not more than 80% of the pontoon length (Lh) and does not extend within 10% of Lh measured from the forward end of the pontoons;
 - d) the deck top surface (S) is located no more than 150 mm (6 in) above the pontoons ($T=S-D$); and
 - e) the deck drains freely.
- 4.5.1.2 Where the design of a pontoon vessel does not conform to the criteria in paragraph 4.5.1.1, the recommended maximum gross load is the smaller value determined either by the stability tests in section 4.5.2 or the value determined by the calculations in section 4.5.3.

Figure 4-6 DIMENSIONS OF PONTOON VESSELS

4.5.2 Stability Testing

- 4.5.2.1 The stability testing shall be conducted with the recommended maximum power determined for the vessel and with full fuel tanks and operational equipment in the normal positions or the value determined by the calculations in 4.5.3.
- 4.5.2.2 The transverse stability shall be tested by adding weights on the highest deck to one side as far outboard as is practicable within the limits of the design, until the top of the pontoon hull on the loaded side becomes awash.
- 4.5.2.3 The longitudinal stability shall be tested by adding weight on the highest deck evenly about a point in the longitudinal centre line of the vessel, one quarter of the length of the deck from forward, until the edge of the lower deck becomes immersed. This test shall be repeated at the aft end of the small vessel by adding weight evenly about a point one quarter of the length of the deck from aft until the edge of the lower deck or the top of the motor mounting bracket becomes immersed, whichever occurs first.
- 4.5.2.4 The recommended maximum gross load shall be equal to:
- for inboard and stern-drive powered vessels: ninety percent (90%) of the least of the weights attained in the tests above.
 - for outboard powered vessels: ninety percent (90%) of the least of the weights attained in the tests above plus the weight of the outboard engine and related equipment referred to in 4.5.2.1 taken as per Table 4.2.

4.5.3 Recommended Maximum Gross Load Calculation

- 4.5.3.1 The recommended maximum gross load in kilograms marked on a capacity label for a pontoon vessel is determined by the lesser of the following (a) or (b):

- a) Formula for maximum gross load:

$$GL = \left(\frac{(V_t \times b) - W_v}{2} \right)$$

Where:

GL = recommended maximum gross load in kilograms

b = constant buoyancy factor of 1000 kg/m³

V_t = the total volume in cubic metres within all of the pontoons of a vessel

W_V = the weight of the vessel in kilograms, including deck, railings, console, seats, and any other permanent structures and fittings. For outboard powered vessels, the outboard engine and related equipment weight from Table 4.2 is excluded. For vessels fitted with permanent fuel tanks the fuel weight must be included.

- b) Maximum gross load per stability test as defined in section 4.5.2 when applicable.

4.5.4 The Recommended Maximum Number of Persons Calculation

4.5.4.1 The recommended maximum number of persons marked on a capacity label for a pontoon vessel is determined in relation to the volume of pontoons, the volume of the largest compartment of the pontoon, recommended maximum gross load, and engine weight as follows:

- a) For inboard or stern-drive powered vessels:

$$\text{Persons Capacity} = \frac{GL}{75} \times \left(1 - \frac{V_{lc}}{V_p}\right)$$

- b) For outboard powered vessels:

$$\text{Persons Capacity} = \frac{GL - W_e}{75} \times \left(1 - \frac{V_{lc}}{V_p}\right)$$

Where:

GL = recommended maximum gross load in kilograms

W_e = outboard engine and related equipment total weight, as determined from Table 4.2

V_{lc} = volume of largest compartment, in cubic metres, defined as the largest volume between separation bulkheads (L_A) in any pontoon

V_p = total volume in cubic metres of all pontoons

75 = assumed weight of one adult person in kilograms

4.5.4.2 The maximum number of persons shall be rounded off to the nearest whole number. If the fraction is less than 0.5, round down to the next whole integer and if the fraction is equal to or greater than 0.5, round up to the next higher whole integer.

4.5.5 The Recommended Maximum Power Calculation

4.5.5.1 The recommended maximum power in kilowatts marked on a capacity label for an outboard powered pontoon vessel is determined in relation to the length of the pontoons squared and the diameter of the pontoons as follows:

$$\text{Maximum Power}(kW) = 3 \times L_h^2 \times D_p$$

Where:

L_h = vessel length of the pontoon in metres as per Figure 0-1

D_p = diameter of the pontoon in metres

4.5.5.2 When the calculated power is not more than 11 kW (15 hp), the power may be rounded up to the next multiple of 1.5 kW (2 hp). When the calculated power is more than 11 kW (15 hp) and is not a multiple of 5 the power may be rounded up to the next multiple 3.75 kW (5 hp).

4.6 Recommended Maximum Safe Limits for Inflatable and Rigid Hull Inflatable Vessels

4.6.1 Calculation Criteria (Intact Condition)

4.6.1.1 The criteria for developing the recommended maximum safe limits to be marked on a capacity label for an inflatable or rigid hull inflatable vessel is based on the buoyancy provided by the inflated tubes, and in addition, where applicable, the volume of the hull below the cockpit sole.

4.6.2 Recommended Maximum Gross Load Calculation

4.6.2.1 The recommended maximum gross load in kilograms marked on a capacity label for an inflatable or rigid hull inflatable vessel is determined in relation to the total volume of inflatable tubes (V) and the weight of the vessel as follows:

$$GL = (V_t \times b \times 0.75) - W_v$$

Where:

GL = recommended maximum gross load in kilograms

V_t = the total volume of the inflated tubes in cubic metres, and where present, the volume of the rigid or inflated hull below the cockpit sole

b = constant buoyancy factor = 1000 kg/m³

W_v = the weight of the vessel in kilograms, including deck, railings, console, seats, and any other permanent structures and fittings. For outboard powered vessels, the outboard engine and related equipment weight from Table 4.2 is excluded. For vessels fitted with permanent fuel tanks the fuel weight must be included.

4.6.2.2 The following load reduction dependent on design features is applied to the recommended maximum gross load, calculated in accordance with 4.6.2.1.

4.6.2.3 The load reduction based on the minimum number of chambers in the collar is as follows:

- a) 1 air chamber = 50% load reduction;
- b) 2 air chambers = 33% load reduction;
- c) 3 air chambers = 25% load reduction;
- d) 4 air chambers = No load reduction.

4.6.3 Recommended Maximum Number of Persons Calculation

4.6.3.1 The recommended maximum number of persons marked on a capacity label for an inflatable or rigid hull inflatable vessel is determined in relation to maximum gross load and engine weight in kilograms as follows:

- a) For inboard or stern-drive powered vessels:

$$\text{Number of Persons} = \frac{GL}{75}$$

- b) For outboard powered vessels:

$$\text{Number of Persons} = \frac{GL - W_e}{75}$$

Where:

GL = recommended maximum gross load in kilograms

W_e = engine and related equipment total weight in kilograms, as determined from Table 4.2

75 = assumed weight of one adult person in kilograms

- 4.6.3.2 The maximum number of persons shall be rounded off to the nearest whole number. If the fraction is less than 0.5, round down to the next whole integer and if the fraction is equal to or greater than 0.5, round up to the next higher whole integer.

4.6.4 The Recommended Maximum Power Calculation

- 4.6.4.1 The recommended maximum power for outboard powered inflatable vessels is determined by:

- a) The formula given in 4.6.4.2 for vessels of all sizes; or
- b) The test given in 4.6.4.3 for vessels fitted with a motor of more than 15 kW.

- 4.6.4.2 The recommended maximum power for outboard powered inflatable vessels is determined in relation to total vessel length, its beam, the total internal volume of the inflatable tubes and a design factor, as follows:

$$\text{Maximum Power (kW)} = \frac{L_h \times V \times f_x}{B}$$

Where:

L_h = vessel length of the vessel in metres as per Figure 0-1

V = total internal volume of the inflatable tubes in cubic metres

B = beam of the vessel in metres

f_x = a constant factor determined by transom type as follows:

- (i) Factor (f_1) for stern tube type = 2.5
- (ii) Factor (f_2) for stern transom type, vessel length not exceeding 3.0 m = 6.5
- (iii) Factor (f_3) for stern transom type, vessel length greater than 3.0 m but not exceeding 5.0 m = 7.5
- (iv) Factor (f_4) for stern transom type, vessel length greater than 5.0 m = 9.0

- 4.6.4.2.1 For vessels of more than 3 metres in length that are fitted with a remote steering, the factors f_3 and f_4 may be multiplied by 1.25 when the steering position is located more than 25% of the length ($L/4$) forward of the transom.

- 4.6.4.3 The maximum recommended power may be determined by the Manoeuvring Test Procedure specified in the standard ISO 11592 *Small craft less than 8 m length of hull – Determination of maximum propulsion power rating* or the Avoidance Line Test specified in section 26.8.3.2 of the ABYC standard H-26 *Powering of Boats*.

- 4.6.4.3.1 For vessels not fitted with a remote steering, the maximum recommended power determined by the test specified in 4.6.4.3 shall not exceed the value determined by the following formula:

$$\text{Maximum Power (kW)} = 10 \times L_h \times B - 33$$

Where:

L_h = vessel length of the vessel in metres as per Figure 0-1

B = beam of the vessel in metres

- 4.6.4.4 When the calculated power is not more than 11 kW (15 hp) the power may be rounded up to the next increment of 1.5 kW (2 hp). When the calculated power is more than 11 kW (15 hp) and is not a multiple of 5, the power may be rounded up to the next increment 3.75 kW (5 hp).

5 HULL DESIGN REQUIREMENTS FOR NON- PLEASURE CRAFT EXCEEDING 6 METRES

5.1 Scope

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length		
More than 6 metres in length		■

As stated by the Regulations:

HULL DESIGN

716. (1) The stability of a vessel other than a pleasure craft shall be adequate to safely carry out its intended operations.

(2) The owner of a vessel shall demonstrate, on the request of the Minister, that the vessel has adequate stability to safely carry out its intended operations.

717. (1) This section applies in respect of a vessel, other than a pleasure craft,

(a) whose date of construction, manufacture, rebuilding, importation or change of use, whichever occurs later, is on or after April 1, 2005; and

(b) whose date of construction, manufacture, rebuilding, importation or change of use, whichever occurs later, was before April 1, 2005, if the type of operation or the area of operation of the vessel changed on or after April 1, 2005.

(2) The buoyancy, flotation and stability of a vessel that is not more than 6 m in length shall conform to the construction standards.

(3) The stability of a vessel that is more than 6 m in length shall conform to

(a) the construction standards; or

(b) the recommended practices and standards for the type of vessel, other than a monohull vessel.

(4) The builder, manufacturer, rebuilder or importer of the vessel shall provide the end user or reseller with a document setting out the design limitations of the vessel, if any, including capacity, power and environmental limitations.

Information Note:

When any recommended practices or standards are selected for stability assessment, they must be applied in their entirety.

When the selected recommended practices or standards do not include or evaluate the effects on the stability of particular operations such as towing, fishing, dredging, lifting or any other special operation, the impact of these operations shall be separately considered, by using first principles, suitable additional criteria or appropriate testing.

A vessel that was built, imported or underwent a change of use before April 1, 2005, is not required to meet the requirements of this section. However, as per subsection 716(1) of the Regulations, the vessel must have adequate stability to carry out its intended operation and, as per 716(2), the owner shall be able to demonstrate this to the Minister upon request. The Ship Safety Bulletin 07/2006 *Guidance for Assessing Intact Stability and Buoyancy of Existing Small Non-pleasure Vessels* provides information on some possible options for evaluating the stability of

existing vessels.

5.2 Stability Standards for All Types of Vessels

5.2.1 General

5.2.1.1 Suitable standards for stability evaluation are listed in Table 5-1.

Table 5-1 STABILITY STANDARDS		
Vessel Type	Vessel length	Suitable Standard
Monohull vessel	More than 6 m	ISO 12217-1 or Standards set out in section 5.3
Pontoon vessel	More than 6 m and not more than 8 m	ABYC H-35, or Standards set out in section 5.4
	More than 8 m	Standards set out in section 5.4
Inflatable or rigid inflatable vessel	More than 6 m and not more than 8 m	ABYC H-28, or ISO 6185-3
	More than 8 m	ISO 6185-4
Sailing vessel	More than 6 m	ISO 12217-2

Information Note:

As stated in the Regulations, for vessels other than monohull, in addition to the standards listed in Table 5-1, other recommended practices and standards of a marine classification society, government agency or industry association that are recognized by the marine industry for the type of vessel may also be used. For monohull vessels built after April 1, 2005 the use of the Standard ISO 12217-1 or the alternative standard set out in section 5.3 is mandatory.

For inflatables or rigid-hulled inflatable boats (RHIB) other alternatives standards with provisions for inflatable or RIBS such as the UK MCA *Code for Small Workboats and Pilot Boats* or the *Australian National Standard for Commercial Vessels, Part C, Section 6* may also be used.

Weight of Persons

For any stability assessment the weight used for persons on board shall not be less than 75 kg per person. When a given standard is using a weight that is less than 75 kg per person, the standard may still be acceptable provided that the weight of each person on board is corrected to be not less than 75 kg.

5.3 Stability Standard for Monohull Vessel Other than Inflatable or Rigid Hull Inflatable

5.3.1 General

- 5.3.1.1 Instead of the standard ISO 12217-1, monohull vessels may have their stability evaluated with the criteria set out in this section.
- 5.3.1.2 To assess the stability with the criteria given in this section, an inclining experiment must be carried out to accurately determine the vessel displacement and centre of gravity in the lightweight condition.
- 5.3.1.3 All calculations shall be made according to good naval architecture practices using a recognized method.

Information Note:

For guidance on how to prepare stability information and conduct an inclining experiment, refer to sections Stab.1 and Stab.2 of the *Stability, Subdivision, and Load Line Standards* (TP7301), published by Transport Canada.

5.3.2 Stability Criteria

- 5.3.2.1 The following stability criteria shall be met in all operating conditions:
- The area under the righting lever (GZ) curve shall not be less than 0.055 metre-radians up to 30 degrees angle of heel, and not less than 0.09 metre-radians up to 40 degrees or the angle of downflooding if this angle is less than 40 degrees. Additionally, the area under the righting lever (GZ) curve between the angle of heel of 30 degrees and 40 degrees, or between 30 degrees and the angle of downflooding if this angle is less than 40 degrees, shall be not less than 0.03 metre-radians.
 - The righting lever GZ shall be at least 0.20 metres at an angle of heel equal to or greater than 30 degrees.
 - The maximum righting lever (GZ) shall occur at an angle of heel not less than 30 degrees.
 - The initial metacentric height (GM) shall not be less than 0.15 metres.
- 5.3.2.2 When, due to the form of the vessel, it is not practicable to have a maximum righting lever at an angle of heel not less than 30 degrees, the following alternative criteria for the angle of the maximum righting arm and the area under the curve up to that angle may be used:
- The maximum righting lever (GZ) shall occur at an angle of heel not less than 15°; and
 - The area under the curve of righting levers (GZ curve) should not be less than 0.070 metre-radians up to an angle of 15° when the maximum righting lever (GZ) occurs at 15° and 0.055 metre-radians up to an angle of 30° when the maximum righting lever (GZ) occurs at 30° or above. Where the maximum righting lever (GZ) occurs at angles of between 15° and 30°, the corresponding area under the righting lever curve should be:

$$Area \geq 0.055 + 0.001 (30^\circ - \theta_{\max}) \text{ metre-radians}$$

Information Note:

The criteria mentioned in section 5.3.2 give minimum values but no maximum values; however, it is advisable to avoid excessive values as these might lead to acceleration forces that could be prejudicial to a vessel, its complement or its equipment.

- 5.3.2.3 The stability criteria defined in 5.3.2 shall be verified with the vessel in the worst operating condition, which is any condition likely to be encountered in service in which the distribution and quantity of consumables, cargo, and persons produce lower values of GZ and/or GM.

5.3.3 Emergency Heeling Condition

- 5.3.3.1 In addition to the criteria set out in 5.3.2, an Emergency Heeling Condition shall be calculated as set out in 5.3.3.2 and 5.3.3.3 in all cases where the value of GZ at 10°, in the worst operating condition, is equal to or less than

$$\frac{B \times N}{34 \times \Delta}$$

where:

- B = moulded breadth of vessel in metres
 N = total number of persons carried
 Δ = displacement of vessels in tonnes

- 5.3.3.2 When required by 5.3.3.1, the Emergency Heeling Condition is determined as follows:

- a) The assigned number of persons on each deck is taken into account for the purpose of calculating the heeling moment.
- b) On each deck, on the “down” side of the centre line, the persons will be standing adjacent to their seats. The remainder of that deck’s total complement will move as far as possible to the “down” side to fill all available space on the basis of 4 persons per square metre. Should this area on the “down” side of the centre line not accommodate the required number, then credit in the heeling moment shall be allowed for the persons on the “up” side of the centre line. However, in such circumstances, an additional heeling condition will be required reflecting a partial load such that the number of persons on the deck or decks in question are crowded on the “down” side of the centre line only.
- c) The person weight shall be taken as 75 kg per person.
- d) The heeling arm shall be calculated with the following formula:

$$PHA = \cos \Theta \times \frac{\text{Heeling moment}}{\Delta}$$

where:

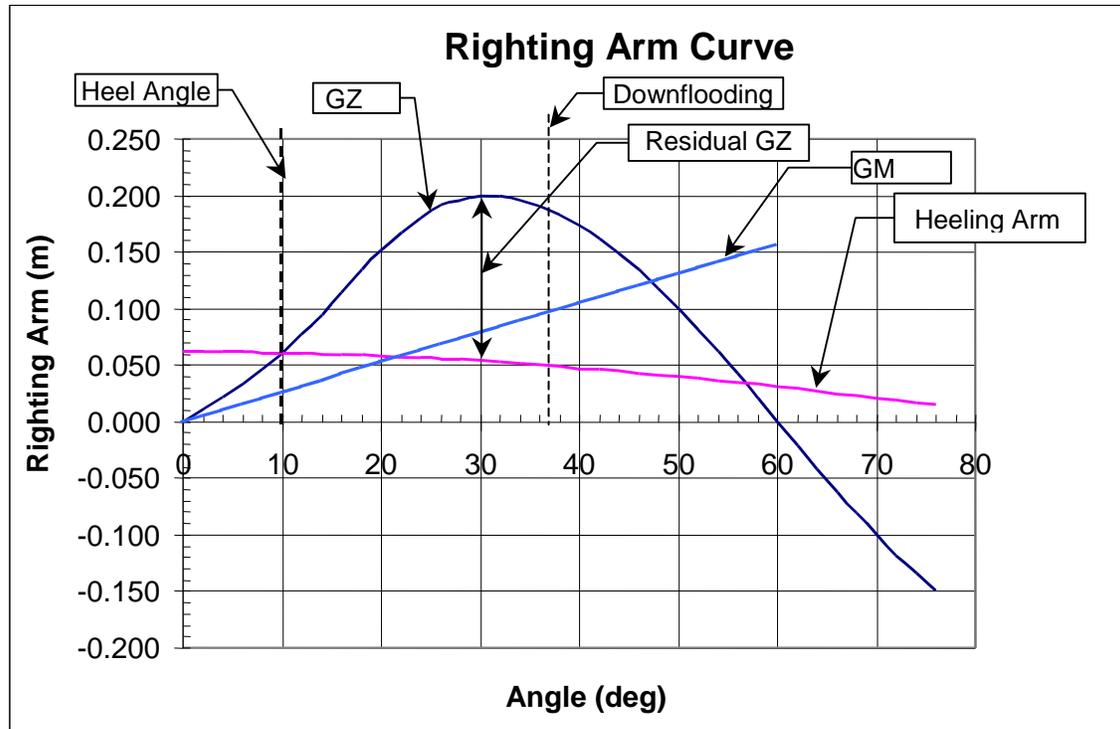
- PHA = persons heeling arm in metres
 Heeling moment = heeling moment calculated as described above in tonnes-metres
 Θ = angle of heel in degrees
 Δ = displacement of vessels in tonnes

- 5.3.3.3 The criteria for the Emergency Heeling Condition are as follows:

- a) the angle of static heel, determined from the intersection of the righting lever (GZ) curve and the heeling arm curve, shall neither exceed 10° nor immerse the margin line;

- b) the residual area, between the curves of righting levers and persons heeling arms shall be not less than 0.025 metre-radians; and
- c) the remaining righting lever must attain a value of at least 0.1 metres.

Figure 5-1 RIGHTING ARM CURVE



5.4 Stability Standard for Pontoon Vessels

5.4.1 General

Information Note:

The standard ABYC H-35 *Powering and Load Capacity of Pontoon Boats* and the stability standard in section 5.4 are applicable only for pontoon vessels operating within sheltered waters voyages or in a protected area with similar wind and waves conditions. The stability of pontoons operating outside of these area must be assessed using a stability standard suitable for the type of vessel and the expected wind and waves conditions, such as a stability standard for multi-hull (catamaran) operating in unprotected sea conditions. The structural strength of the pontoon vessel must also be adequate for the expected wind and waves conditions (see section 3.2).

5.4.1.1 The criteria in this section are used to determine the stability of pontoon vessels.

5.4.1.2 The following design conditions must be met:

- a) the vessel must have only one deck; and
- b) the vessel must operate within sheltered waters voyages or in a protected area with similar wind and wave conditions.

5.4.1.3 Calculations shall be prepared to verify that in the full load condition:

- a) the reserve buoyancy is not less than 100%; and
- b) the trim is not more than 50% of the mean hydrostatic draft.

5.4.1.4 Means shall be provided for verifying the watertight integrity of the pontoons and for periodic inspection of the internal structure. Also, the pontoons shall be:

- a) filled with a suitable closed-cell buoyancy material; or
- b) subdivided into watertight compartments in such a manner as to ensure that adequate reserves of buoyancy and of transverse and longitudinal stability remain after flooding of any one compartment.

5.4.1.5 The design of the platform and its supporting structure shall ensure that no pockets or horizontal surfaces are formed in which water can accumulate.

5.4.2 Minimum Intact Stability

5.4.2.1 The intact stability characteristics of the vessel will be considered to be acceptable if the following relationship is shown, by calculation, experiment or a combination of both, to be satisfied in the full load condition:

$$\frac{GoM}{B} \geq \frac{\left(\frac{p}{n}\right)\left(\frac{N}{\Delta}\right)}{\tan \phi_L}$$

where:

GoM	= initial metacentric height (metres) at displacement Δ as determined by calculation or experiment
B	= breadth (metres) at load waterline
p	= person heel factor as defined in Section 5.4.3
n	= number of persons per tonne, taken as 13.3 for the purpose of this Standard (75 kg/person)
N	= maximum number of persons
Δ	= full load displacement (tonnes)
ϕ_L	= limiting heel angle as defined in section 5.4.4

5.4.3 Persons Heel Factor

5.4.3.1 Persons freedom of movement is governed by the seating and access arrangements and is represented by a person heel factor, p .

5.4.3.2 The heel factor is defined as the transverse shift of the person centre of gravity, expressed as a fraction of the breadth B , caused by a general movement of persons as follows:

- a) With all seats initially occupied, persons on one side of the centre line stand and move as far as possible to the other side to fill all available space at the rate of 4 persons per square metre. If the area available on the "down" side is not sufficient to accommodate the required number, then the heeling moment calculation shall take account of the number accommodated on the "up" side.
- b) Persons initially seated on the "down" side do not move, but are assumed to be standing adjacent to their seats.

- c) For the purpose of the calculation, persons shall be assumed to weigh the equivalent of 13.3 per tonne. Their centre of gravity shall be taken to be 1 metre above deck.
- d) The person heel factor (p) shall be calculated as follows or taken as 0.15, whichever is greater:

$$p = \frac{\text{persons heeling moment}}{B \times \text{persons weight}}$$

where:

B is as previously defined

5.4.4 Limiting Heel Angle

5.4.4.1 Freeboard is defined in angular rather than linear terms, as illustrated in Figure 5-2.

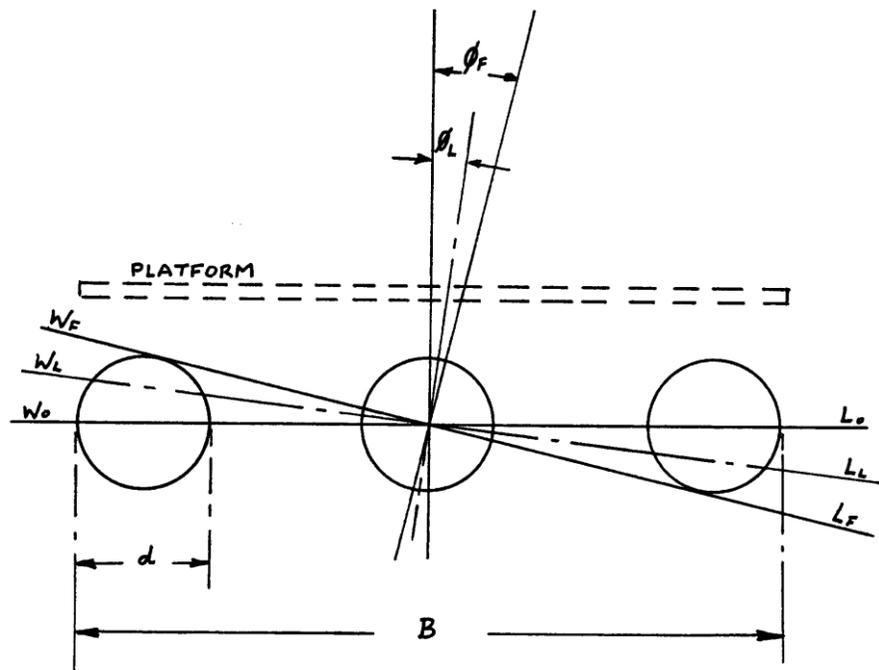
5.4.4.2 The angular freeboard, ϕ_F , is determined as the angle of heel at which the righting lever, GZ , reaches its maximum value, normally the angle at which the pontoon on the "down" side is just completely immersed.

5.4.4.3 The limiting heel angle, ϕ_L , is taken as half the value of ϕ_F or as 10° , whichever is less.

5.4.5 Heel and Trim Test

5.4.5.1 An experiment shall be conducted simulating the movement of persons plus 10% overload both in the longitudinal and transverse directions. This experiment will demonstrate the reserve of freeboard in the worst anticipated heeling and trimming conditions.

Figure 5-2 FREEBOARD AND LIMITING HEEL ANGLE



Angular freeboard:

$$\Theta_F = \arcsin\left(\frac{1}{B/d - 1}\right)$$

6 VENTILATION SYSTEMS

6.1 Scope

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length	■	■
More than 6 metres in length	■	■

6.2 General

As stated by the Regulations:

VENTILATION

718. (1) On a vessel, an enclosed space that contains a source of gasoline vapour shall have, in accordance with the construction standards, a natural ventilation system designed to remove any accumulation of combustible vapours.

(2) A compartment that, in accordance with the construction standards, has the characteristics of an open space is not required to have a natural ventilation system.

(3) On a vessel that is propelled by an outboard engine, any space that is under an engine well or that does not have the characteristics of an open space, and that is capable of accommodating a 23 L portable gasoline tank but is not designed to do so, shall display a safety notice to indicate that the space is not to be used for gasoline tank storage.

(4) No supply or exhaust ducting that forms part of the ventilation system shall open into any accommodation space.

6.2.1 Safety Notice for Spaces Not Intended for Gasoline Storage

6.2.1.1 The safety notice for spaces not intended for gasoline storage shall be as shown in Figure 6-1.

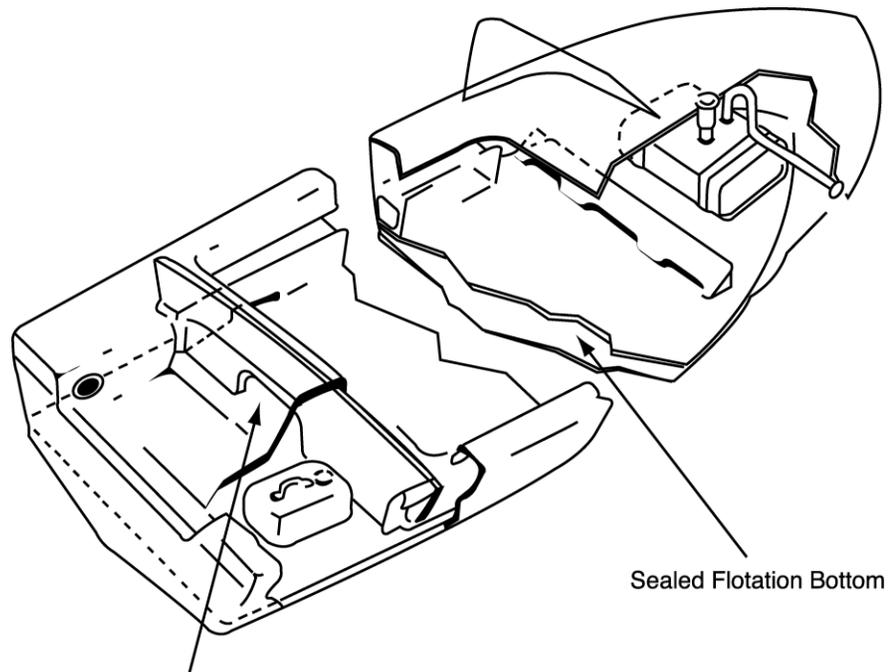
Figure 6-1 SAFETY NOTICE FOR SPACES NOT INTENDED FOR GASOLINE STORAGE



6.3 Ventilation of Spaces Containing Source of Gasoline Vapour

6.3.1 Requirements for Open Spaces

- 6.3.1.1 Sections 6.3.1.2 to 6.3.1.6 determine spaces that are considered open spaces and do not need to be provided with the natural ventilation system required in section 6.3.2.
- 6.3.1.2 A separate natural ventilation system is not required if a space containing a source of gasoline vapours, such as a gasoline engine or a fuel tank, has the following characteristics (see Figure 6-2):
- a) at least 0.34 m^2 (3.5 ft^2) of area exposed to the atmosphere per cubic metre (35 ft^3) of net space volume; and
 - b) no long or narrow unvented spaces in which a flame front might propagate.
- 6.3.1.3 The net space volume is the volume of space containing the source of gasoline vapour plus the volume of connecting spaces, unless the connecting spaces either:
- a) connect to spaces already ventilated by ducting; or
 - b) themselves qualify as open spaces.
- 6.3.1.4 Spaces connecting with spaces open to the atmosphere, which have interconnecting openings with an area equal to 2% or less of the separation bulkhead, are not considered as open spaces.
- 6.3.1.5 The separation bulkhead area used for the calculations in paragraph 6.3.1.4 and 6.3.3.3 is calculated using a height that is the lesser of either the distance between the bottom and top of the bulkhead between the spaces, or 750 mm (30 in).
- 6.3.1.6 Long narrow spaces with a length to width ratio greater than 1:5 formed by side panels or under accommodation decks shall have openings at both ends or along the sides in order to qualify as open spaces.

Figure 6-2 **CHARACTERISTICS OF OPEN SPACES**

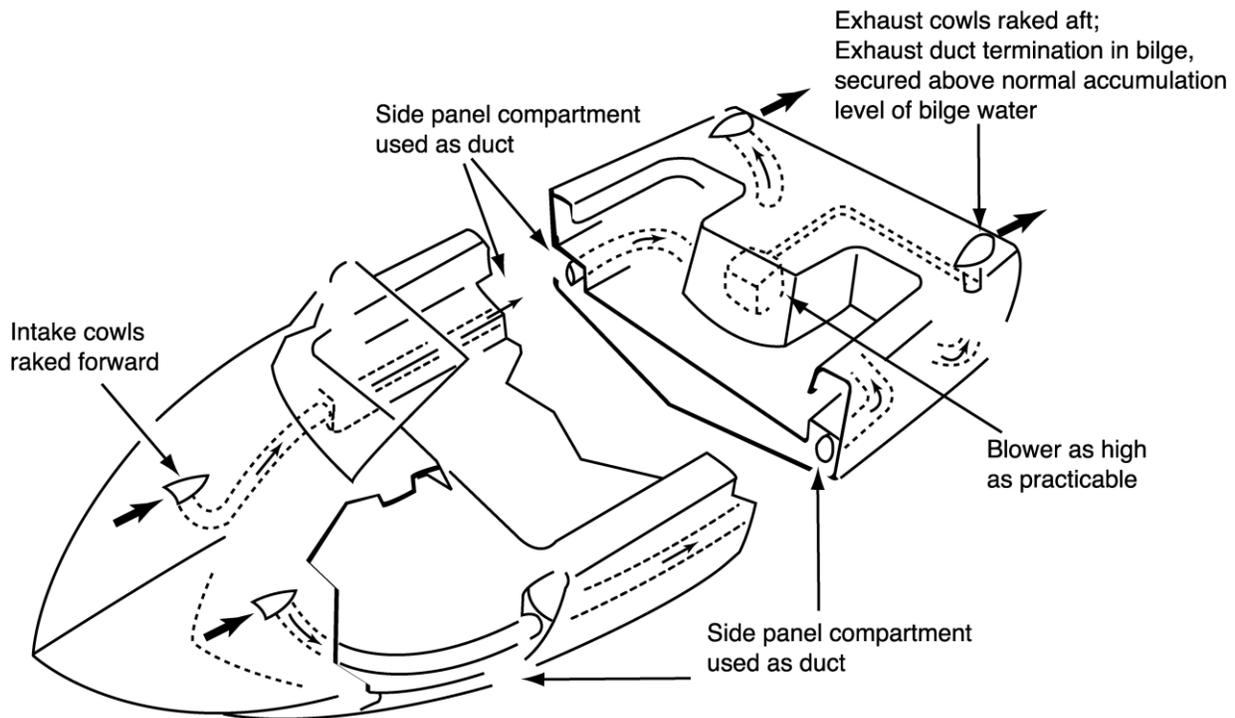
At least 0.34 m² of open area per cubic metre of net compartment volume.

6.3.2 Natural Ventilation of Enclosed Spaces

6.3.2.1 A separate natural ventilation system is required for any enclosed space that does not meet the requirements for an open space as set out in section 6.3.1 and that contains one of the following sources of gasoline vapour:

- a) a permanently installed gasoline engine;
- b) a portable gasoline fuel tank that ventilates into the space; or
- c) a non-metallic gasoline tank:
 - (i) with an aggregate permeability rate exceeding 42 grams of fuel¹ loss in 24 hours per cubic metre (1.2 grams per cubic foot) of net compartment volume; or
 - (ii) with a net compartment volume of less than 0.028 cubic metres (1 cubic foot), having a permeability rate exceeding 1.2 grams of fuel loss in 24 hours.

¹ Reference fuel "C" at 40°C ± 2°C (104°F ± 3°F) from ASTM D-471-1979 is to be used in determining the permeability rate of a non-metallic gasoline tank.

Figure 6-3 VENTILATION OF ENCLOSED SPACES**6.3.3 Ducts**

- 6.3.3.1 In order to ensure adequate circulation, the minimum collective internal cross-sectional area of ducts shall be calculated as per ABYC Standard H-2 *Ventilation of Boats Using Gasoline*.
- 6.3.3.2 If the engine or fuel tank space connects to an adjoining closed space, the total net volume of both the space and closed space shall be used to determine the required duct size.
- 6.3.3.3 The volumes of adjacent spaces shall be included in the calculation of duct sizes if the collective area of the openings in the separation bulkheads exceeds 2% of the separation bulkhead area (see section 6.3.1.5) between these spaces.
- 6.3.3.4 Non-metallic materials used for ventilating ducts and components installed below deck shall be capable of continuous exposure to a temperature range of -30°C to 85°C without failure.
- 6.3.3.5 Non-metallic ventilating ducts and components shall be installed at least 230 mm (9 in) clear to the side and below, and 460 mm (18 in) above any surface capable of reaching a temperature of 150°C , unless those components are designed for use in higher temperature locations.
- 6.3.3.6 At least one exhaust duct shall extend down to the bilge of the space from which the fumes are to be expelled. If the space is an engine space, the exhaust duct entrances shall be located as nearly as possible under the engine, or engines.
- 6.3.3.7 Duct termination in bilges shall be secured above the level of normal accumulations of bilge water.

6.3.4 Cowls and Ventilation Openings

- 6.3.4.1 External openings of intakes and exhausts shall be located and oriented to prevent entry of fuel vapors. In no instance shall the intakes and exhausts be closer than 380 mm (15 in) from the gasoline fill and tank vent fittings.
- 6.3.4.2 Ventilation openings shall be located, when practicable, on the deck, but in any case shall be located so as to minimize the ingress of water, taking into account all service conditions of heel, trim, wave action, loading, and the effect of operating the vessel in reverse.
- 6.3.4.3 No component of the ventilation system shall restrict the minimum required duct size.
- 6.3.4.4 Cowl ventilators shall be rated and labelled with the maximum effective cross-sectional area.
- 6.3.4.5 Cowl ventilators installed over ducts shall be sized to maintain the rated cross-sectional area of the duct in accordance with the cowl manufacturer's specifications.
- 6.3.4.6 Where screens are used in ventilation openings, allowance shall be made for the reduced airflow due to interference from the screen by increasing the size of cowls or ventilation openings.
- 6.3.4.7 If louvers are used as ventilators, they shall create an airflow equivalent to that produced by the required minimum cowl ventilator size.
- 6.3.4.8 Neither supplies nor exhaust air ducts from engine spaces or engine exhaust outlets shall open into accommodation space.

6.3.5 Powered Ventilation**As stated by the Regulations:**

719. On a vessel other than a personal watercraft, an enclosed space that contains a gasoline engine shall meet the following conditions:

- (a) its ventilation system shall be supplemented by powered ventilation in accordance with the construction standards; and
- (b) at each engine ignition switch, a safety notice shall be displayed indicating that the blower is to be operated for four minutes before the engine is started and containing the information set out in the construction standards.

- 6.3.5.1 Blowers for powered ventilation may be installed with separate ducting or installed in the natural ventilation exhaust duct as illustrated in Figure 6-3.
- 6.3.5.2 Blowers shall be mounted as high as practicable above the bilge low point to prevent contact with bilge fluid, except for blowers designed in combination with bilge pumps, which can be operated submerged.
- 6.3.5.3 Blower outlet fittings shall not have less effective area than blower intakes.
- 6.3.5.4 Blowers shall not be wired in the ignition circuit to run continuously, unless rated by the blower manufacturer for continuous operation.
- 6.3.5.5 Blower motors shall be of a sealed type or ignition protected and shall be suitable for installation in damp locations.
- 6.3.5.6 The blower shall be designed for a minimum of four (4) minutes of continuous operation, more if required, to clear any space of vapours.
- 6.3.5.7 Table 6-1 provides the formulae for sizing of blowers in order to achieve complete evacuation in four (4) minutes.

Table 6-1 BLOWER RATINGS		
Net Engine Space Volume [V] (m³)	Rated Blower Capacity [F_r] (m³/min)	Blower Output [F_o] (m³/min)
2.83 or less	$F_r = 1.5 V$	$F_o = 0.6 V$
Greater than 2.83	$F_r = V/2 + 2.83$	$F_o = 0.2 V + 1.13$

6.3.5.8 Figure 6-4 shows an example of a label for the operation of the powered ventilation. The label may also contain additional information.

Figure 6-4 LABEL FOR MECHANICAL BLOWER OPERATION

! WARNING	
GASOLINE VAPOUR MAY EXPLODE RESULTING IN INJURY OR DEATH	
BEFORE STARTING THE ENGINE:	
<ul style="list-style-type: none"> • verify engine space for gas leaks or vapours • operate blower for 4 minutes • verify blower operation 	
! MISE EN GARDE	
LES VAPEURS D'ESSENCE PEUVENT EXPLOSÉES CAUSANT DES BLESSURES OU LA MORT	
AVANT DE DEMARRER LE MOTEUR:	
<ul style="list-style-type: none"> • vérifier le compartiment moteur pour les fuites ou les vapeurs d'essence • faire fonctionner le ventilateur pendant 4 minutes • vérifier l'opération du ventilateur 	

6.4 Diesel Engine and Fuel Tank Space Ventilation

As stated by the Regulations:

720. On a vessel, a space that contains a combustion engine shall be ventilated to ensure a sufficient supply of air for combustion and cooling.

Information Note:

Neither mechanical nor natural ventilation is required to remove diesel fuel vapours.

Ventilating provisions and openings to the engine space shall provide for the supply of combustion air and shall accommodate the air requirements of each propulsion and auxiliary engine in that space. Refer to the manufacturer's documentation to determine the air requirements of each engine in a space.

The openings for providing the air requirements of propulsion and auxiliary engine may also function as a means of providing natural ventilation to the space.

6.5 Battery Spaces

- 6.5.1 Spaces containing batteries shall provide for the overboard ventilation of hydrogen gas released by the battery.

Information Note:

“Sealed”, “maintenance-free” batteries, or batteries with immobilized electrolyte (gel batteries) also need to be vented outboard.

7 FUEL SYSTEMS

7.1 Scope

Scope	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length	■	■
More than 6 metres in length	■	■

As stated by the Regulations:

FUEL SYSTEMS

721. (1) No person shall install a fuel-burning appliance or system on a vessel unless the appliance or system and its installation conform to the recommended practices and standards.

(2) No person shall install on a passenger-carrying vessel a fuel-burning appliance or system that uses gaseous fuel, liquefied petroleum gas, compressed natural gas or naphtha.

(3) No person shall install a fuel-burning appliance or system that uses gaseous fuel, liquefied petroleum gas, compressed natural gas or naphtha on a vessel in a manner that permits or is likely to permit ingress or trapping of the fuel or vapours below deck.

722. No person shall install below deck or enclose by boxing, on a vessel, an inboard engine that uses gasoline as a fuel unless the design of the carburetor or throttle body fuel injector, if any, is in accordance with the construction standards and the carburetor is fitted with a flame arrestor that meets those standards.

723. No person shall install or maintain a fuel tank or a fuel system on a vessel in a manner that permits or is likely to permit leakage of fuel or spillage of fuel.

724. (1) A fuel system on a vessel shall be installed, tested and maintained in accordance with the construction standards.

(2) A fitting, joint or connection on a fuel system shall be accessible.

(3) A component of a fuel system shall be liquid-tight and vapour-tight to the hull interior in accordance with the construction standards.

(4) On a vessel other than a personal watercraft, a fuel tank, fuel filter or fuel-line fitting shall not be installed over a source of ignition.

7.2 General

7.2.1 All components of a fuel system, including tank penetrations and fittings, shall be:

- a) accessible; and
- b) protected from leaks caused by corrosion, shock or fire.

- 7.2.2 After installation, the fuel system, which includes fill pipes, tanks, vent pipes, delivery pipes, and return pipes, shall be hydrostatically or air pressure tested to a minimum of 21 kPa (3 lbs/in²) or at 1.5 times the maximum hydrostatic head to which it may be subjected in service, whichever is greater.
- 7.2.3 The fuel system shall be designed and installed to contain at least 5% fuel expansion to minimize the risk of a fuel spill either into the vessel or the environment when:
- a) the fuel tank is filled to its rated capacity; and
 - b) the vessel is in the static floating position.
- 7.2.4 Permeability of fuel hoses and tanks shall be:
- a) for hoses, within the limits of Society of Automotive Engineers Standard SAE J1527, *Marine Fuel Hoses* (1993); and
 - b) for fuel tanks, within the limits set out in 6.3.2.1.
- 7.2.5 Fuel systems shall be capable of:
- a) storage without operation at an ambient temperature range from -40°C to 80°C without failure or leakage; and
 - b) operation at an ambient temperature range from -30°C to 80°C.
- 7.2.6 Every drain plug or valve on every filter or fuel tank of a DIESEL system shall be:
- a) of the type which cannot be opened inadvertently; or
 - b) installed in a manner to guard against inadvertent opening.
- 7.2.7 In order to prevent leakage of fuel, metal bowls shall be used for inboard GASOLINE engines and plastic bowls may be used for outboard engines. Every fuel-water separator bowl used for gasoline engines must meet the requirement of National Fire Protection Association NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.
- 7.2.8 In order to prevent leakage, every hose in a fuel system shall:
- a) meet the performance requirements of Society of Automotive Engineers Standard SAE J1527, *Marine Fuel Hoses*;
 - b) be of USCG type A when installed in the engine space; and
 - c) when installed outside of the engine space:
 - (i) be of USCG type A or B on vessels of not more than 6 metres;
 - (ii) be of USCG type A on vessels of more than 6 metres.

7.3 Fuel Tanks

As stated by the Regulations:

725. (1) A fixed fuel tank shall be

(a) manufactured and tested in accordance with the construction standards or with the recommended practices and standards that provide a level of safety at least equivalent to that provided by the construction standards; and

(b) installed in accordance with the construction standards.

(2) A fixed fuel tank shall be fitted with filling and venting arrangements in accordance with the construction standards.

7.3.1 General

7.3.1.1 Subject to section 7.3.1.2, every fuel tank must provide for protection from leakage caused by shock, corrosion, abrasion or fire. Fuel tanks shall meet the minimum test requirements for mechanical strength and fire resistance, as detailed in ABYC Standard H-24 *Gasoline Fuel Systems*, or ABYC Standard H-33 *Diesel Fuel Systems*.

Information Note:

Some acceptable recommended practices and standards that provide a level of safety at least equivalent to test requirements for mechanical strength and fire resistance of fuel tanks, as referred to in 725.(1)(a) of the Regulations, are:

- a) United States Code of Federal Regulations, CFR33 183.510
- b) ISO 21487 Small craft - Permanently installed petrol and diesel fuel tanks

7.3.1.2 A custom-built metallic tank does not need to undergo the fire resistance test, shock test, pressure-impulse test and slosh test. However, it shall comply with the pressure test as per ABYC H-24, ABYC H-33, or an equivalent standard for mechanical strength and leakage.

7.3.1.3 A metallic fuel tank shall be constructed of materials in accordance with Table 7-1. Non-metallic materials are acceptable for corrosion resistance; however, all other requirements of this Standard must be met.

7.3.1.4 A fuel tank shall be constructed so that no external surface of the tank can retain moisture or spilled fuel.

7.3.1.5 A GASOLINE fuel tank shall have no openings in the bottom, sides, or ends.

7.3.1.6 Clean-out plates shall not be installed in GASOLINE fuel tanks; clean-out plates may be installed in the top or sides of DIESEL fuel tanks.

7.3.1.7 If baffles are provided, baffle openings shall be designed so that they do not prevent the fuel flow across the bottom or trap vapour across the top of the tank.

7.3.1.8 In order to prevent leakage, the standard for threaded connections into fuel tanks shall be the American National Standard Taper Pipe Thread (NPT) as per standard ANSI/ASME B1.20.1 - 1983 Pipe Threads, General Purpose, Inch.

- 7.3.1.9 Cellular plastic used to encase metallic fuel tanks shall not change volume by more than 5% or dissolve after being immersed for 24 hours at 29°C in each of the following liquids:
- reference fuel B, as set out in American Society for Testing and Materials (ASTM) D471, *Standard Test Method for Rubber Property – Effects of Liquid*;
 - No. 2 reference oil, as set out in American Society for Testing and Materials (ASTM) D471, *Standard Test Method for Rubber Property – Effects of Liquid*; and
 - a 5% solution of trisodium phosphate in water.
- 7.3.1.10 Cellular plastic used to encase metallic fuel tanks shall not absorb more than 0.58 kg (0.1 lbs) of water per square metre (ft²) of cut surface.
- 7.3.1.11 Where plastic is bonded to a metallic tank, the adhesive strength of the bond shall exceed the cohesive strength of the plastic.
- 7.3.1.12 Non-polyurethane cellular plastic used to encase metallic fuel tanks shall have a minimum compressive strength of 410 kPa (60 lbs/in²) at a 10% deflection, measured in accordance with American Society for Testing and Materials (ASTM) D1622, *Standard Test Method for Apparent Density of Rigid Cellular Plastics*.

Table 7-1 FUEL TANK CORROSION RESISTANCE REQUIREMENTS

Material	Specification Sheet Thickness	Minimum Nominal Thickness	Gauge Processes (1)	Welding
Nickel-Copper	ASTM B127 Class A	0.79 mm	22 U.S. std	Resistance Seam, Inert Gas Shielded Arc Oxy-acetylene
Copper-Nickel	ASTM B122	1.14 mm	17 AWG	Inert Gas Shielded Arc Oxy-acetylene Resistance
Copper (2)	ASTM B152 Type E.T.P.	1.45 mm	15 AWG	Inert Gas Shielded Arc Carbon Arc Oxy-acetylene
Copper-Silicon	ASTM B96 or B97 Types A, B & G	1.27 mm	16 AWG	Inert Gas Shielded Arc Carbon Arc Oxy-acetylene Metal-Arc
Steel Sheet (3)	ASTM A93 or A525 or A653	1.90 mm	14 Mfrs.	Metal-Arc Oxy-acetylene Inert Gas Shielded Arc Resistance
Aluminized Steel (5)	ASTM A463	1.21 mm	18 Mfrs.	Metal-Arc Oxy-acetylene Inert gas Shielded Arc Resistance
Aluminum (4)	Alloy 5052 or 5083 or 5086	2.29 mm	—	Inert Gas Shielded Arc Resistance
Stainless Steel	316 L or 317L	0.79 mm	22 U.S. std.	Metal-Arc Oxy-acetylene Inert Gas Shielded Arc Resistance

Notes for Table 7-1:

- Tank seams produced by the welding processes listed shall be ductile and non-porous.
- Copper tanks shall be internally tin coated.
- Steel sheet tanks, when constructed for gasoline, shall be galvanized inside and outside by the hot dip process.

- (4) Aluminum tank fitting plates shall be made of 5052, 5083, 5086, 6061 or 6063 aluminum or 300 series stainless steel.
- (5) Aluminized steel tanks shall have a corrosion inhibiting baked paint or equivalent coating not less than 0.0381 mm thickness applied to the total tank exterior.
- 7.3.1.13 Polyurethane cellular plastic, which is used to encase metallic fuel tanks, shall have a minimum density of 50 kg/m³ (3 lbs/ft³) measured in accordance with the testing procedures set out in the American Society for Testing and Materials (ASTM) D1622 *Standard Test Method for Apparent Density of Rigid Cellular Plastics*.
- 7.3.1.14 Rigid tubes and fill pipes that extend near the bottom of the tank shall have clearance to prevent contact with the bottom due to flexing of the tank.

Information Note:

See section 7.11.4 for fuel tank labeling requirements.

7.3.2 Fuel Tank Installation

- 7.3.2.1 Every fuel tank, including those encased in cellular plastic foam or fibre-reinforced plastic, shall be installed so that all connections, accessories, and labels are accessible for inspection and maintenance.
- 7.3.2.2 A GASOLINE fuel tank shall not be made integral with the hull.
- 7.3.2.3 No fuel tank shall support any deck, bulkhead, or structural component, or bear any extraneous load unless it is designed and built to do so.
- 7.3.2.4 Adequate supports shall be fitted as necessary to ensure the structural integrity of every tank.
- 7.3.2.5 A fuel tank shall be installed and restrained to provide no movement.
- 7.3.2.6 Metallic fuel tank supports and hold-downs shall be isolated from the tank surface by non-abrasive, non-absorbent and non-conductive materials.
- 7.3.2.7 Cellular plastic shall not be used as the sole support for a metal fuel tank.
- 7.3.2.8 Cellular plastic used as the sole support for a non-metallic fuel tank shall meet the requirements of the American Society for Testing and Materials (ASTM) D1621, *Standard Test Method for Compressive Properties of Rigid Cellular Plastic*, or American Society for Testing and Materials (ASTM) D1622, *Standard Test Method for Apparent Density of Rigid Cellular Plastic*.
- 7.3.2.9 No cellular or fibre-reinforced plastic fuel tank encasement shall permit water to:
- collect between the plastic and the tank; or
 - be held against the tank by capillary action.

7.3.2.10 Metallic fuel tanks installed above a flat surface shall be separated from the surfaces by at least a 6 mm (1/4 in) air space when filled with fuel.

7.3.3 Fuel Tank Gauges

7.3.3.1 Every fuel tank shall be installed with mechanical or remote reading fuel gauges, unless the tank installation permits sounding.

7.3.4 Fuel Tank Fill System

7.3.4.1 Fuel fill lines shall be hose or metal pipe.

7.3.4.2 Each fuel tank shall have an individual fill line.

7.3.4.3 Deck fill plates:

- a) shall be located at least 380 mm (15 in) from any fresh air intake for gasoline systems;
- b) shall not permit a fuel overflow to enter the vessel; and
- c) shall be labelled as indicated in section 7.11.2.

7.3.4.4 Fuel shall not blow back through the fuel fitting when the tank is being refueled at a rate of 23 L/min (6 U.S. gal/min).

7.3.4.5 The fill pipe installation shall be self-draining and lead directly from the deck fill to the tank in such a way as to prevent any vapour locks.

7.3.4.6 The minimum inside diameter of the fill system shall be 32 mm (1 1/4 in). In order to maintain the minimum diameter, the minimum hose ID using standard fittings shall be 38 mm (1 1/2 in).

7.3.4.7 The hose in a fuel tank fill system shall be secured to the deck fill and the tank with corrosion resistant and galvanically compatible fittings consisting of:

- a) a swaged sleeve;
- b) a sleeve and threaded insert; or
- c) two metallic hose clamps of a type that is not dependent upon spring tension for compressive force.

7.3.4.8 Every hose clamp used in a tank fill system shall:

- a) be used with a hose that is designed for clamps;
- b) have a minimum nominal band width of 12 mm (1/2 in);
- c) fasten over the hose and the spud, pipe, or hose fitting; and
- d) be installed not less than 12 mm (1/2 in) from the end of the hose.

7.3.4.9 Fuel fill hoses shall be of neoprene fabric or wire reinforced neoprene material that meets the requirements for fuel hoses in sections 7.2.8 and 7.11.3.

7.3.4.10 Every fuel fill hose installed in the engine spaces shall be USCG Type A1, A1-15 or A2.

7.3.4.11 Fuel hose connection fitting must be of a type that prevents any leakage.

7.3.5 Ventilation of Fixed Fuel Tanks

7.3.5.1 The fuel tank venting system shall:

- a) discharge fuel vapours overboard;
- b) not allow a fuel overflow to enter the vessel;

- c) minimize the accidental entry of water; and
- d) prevent pressure in the tank from exceeding 80% of the rated pressure of the tank.

7.3.5.2 The flexible vent pipe shall be:

- a) a minimum of 15 mm (5/8 in) inside diameter;
- b) be of USCG Type A1, A2 or A1-15 when installed in the engine space;
- c) installed so that it does not kink or sag; and
- d) secured with corrosion resistant clamps of a type that is not dependent upon spring tension.

7.3.5.3 The vent shall be fitted with a flame arrestor that:

- a) has an effective area not less than the minimum required for the vent line; and
- b) can be cleaned, unless the vent itself is a flame arrestor.

7.3.5.4 Tank vent systems shall be self-draining and connect to the highest point of the fuel tank as installed in the vessel under conditions of normal operation and normal trim.

7.4 Fuel Lines

7.4.1 All fuel lines, including fill, vent, delivery, and return, shall be protected from damage.

7.4.2 Flexible fuel supply and return lines installed in the engine space must be USCG type A1 or A1-15 hose.

7.4.3 Flexible fuel supply and return lines installed outside of the engine space must be:

- a) USCG type A1, A1-15, B1 or B1-15 hose on vessels of not more than 6 metres;
- b) USCG type A1 or A1-15 hose on vessels of more than 6 metres.

7.4.4 Every metallic fuel line:

- a) shall be made of seamless annealed copper, nickel-copper, or copper-nickel;
- b) shall have a minimum wall thickness of 0.75 mm (1/32 in); and
- c) shall be galvanically protected from the structure in aluminum hulls.

7.4.5 A metallic fuel line shall be attached to the vessel structure within 102 mm (4 in) of the connection of a flexible fuel line.

7.4.6 A section of flexible line with sufficient slack to absorb vibration shall be installed where a rigid fuel line terminates at:

- a) an engine or fuel filter connection; or
- b) a fuel tank that may vibrate.

- 7.4.7 The inside diameter of a hose shall not exceed the minimum outside diameter of the connecting spud, pipe, or fitting by more than the tolerance shown in Table 7-2.

Table 7-2 FITTING AND HOSE CONNECTION TOLERANCES	
Minimum Outside Diameter of the Fitting	Tolerance of Inside Diameter of Hose
Less than 9.5 mm (3/8 in)	0.51 mm (0.020 in)
9.5 mm to 25 mm (3/8 in to 1 in)	0.89 mm (0.035 in)
Greater than 25 mm (1 in)	1.65 mm (0.065 in)

- 7.4.8 All fuel distribution systems shall be provided with anti-siphon protection by at least one of the following:
- a) ensuring that no part of the line can, if separated at any point, fall below the lowest level of the tank suction;
 - b) keeping all parts of the fuel distribution and return lines above the level of the fuel line to tank connection to the carburetor inlet or its equivalent, e.g., throttle body, port fuel injection, or a location where fuel leakage cannot enter the vessel when the vessel is in its static floating position;
 - c) fitting an anti-siphon demand valve at the fuel line to tank connection that can be opened only by the fuel pump suction to withdraw fuel from the tank and that will remain closed when the fuel pump is not operating, thereby preventing siphon action created by a break or leakage at any point in the fuel distribution system.
 - d) installing at the fuel tank connection an electrically operated valve that when used:
 - (i) opens only when the ignition switch is on,
 - (ii) is capable of being operated manually, and
 - (iii) meets the fire resistance tests requirements of ABYC Standard H-24 *Gasoline Fuel Systems* or the fire resistance tests requirements of ABYC Standard H-33 *Diesel Fuel Systems*, as applicable;
 - e) installing a manual shut-off valve directly at the fuel tank connection, arranged to be readily accessible for operation from outside the compartment if the fuel tank top is located below the level of the carburetor inlet or the fuel line is rigid metal or USCG type A1 hose.

Information Note:

“Readily accessible for operation from outside the compartment” may be achieved by a shut-off valve installed at the tank, close to, and directly below, a quick-acting access port in the deck through which the valve can be operated. The access port shall be clearly and permanently labeled.

- 7.4.9 If the length of fuel line from the tank outlet to the engine inlet is greater than 3600 mm (11 ft 10 in), a second manual shut-off valve shall be installed at the fuel inlet connection to the engine.
- 7.4.10 Fuel systems shall be equipped with an independently supported fuel strainer or filter that complies with section 7.7, if a strainer or filter is not incorporated in the pick-up tube.
- 7.4.11 On vessels with multiple fuel tanks and a fuel system that returns fuel to the tank, the system shall return unused fuel to the same tank from which it was drawn.

7.5 Fittings, Joints and Connections

- 7.5.1 Fuel lines shall not have unnecessary connections.
- 7.5.2 Hoses used in the fuel tank fill system shall be secured to pipes (smooth pipes acceptable), spuds, or other fittings at each connection, by at least two (2) metallic clamps with nominal band widths of at least 12 mm (1/2 in).
- 7.5.3 Every hose used in the fuel tank vent system or the fuel distribution and return line system shall be secured to a mating spud, pipe, or fitting that is formed or machined to provide serrations (at least 0.38 mm [0.15 in] depth) or a bead. At least one corrosion resistant metallic clamp shall be used.
- 7.5.4 Every clip, strap, or hose clamp, including fasteners:
- shall be made from corrosion resistant material;
 - shall not cut or abrade any fuel line; and
 - shall be capable of resisting tensile force of 5 N without separating when tested under the fire resistance requirements for fuel systems, as set forth in ABYC Standard H-24 *Gasoline Fuel Systems* or ABYC Standard H-33 *Diesel Fuel Systems*, as applicable.
- 7.5.5 Every hose clamp:
- shall be at least one clamp width from the hose end;
 - shall be fitted beyond the head or flare, or over the serrations of the mating spud, pipe, or hose fitting; and
 - shall not depend on spring tension for compressive force.
 - shall be used with a hose that is designed for clamps;
- 7.5.6 The minimum nominal band width of every hose clamp shall be determined by the outside diameter of the hose, as shown in Table 7-3.

Table 7-3 MINIMUM HOSE CLAMP BAND WIDTH

Outside Diameter of Hose	Clamp Width
Less Than 11 mm (7/16 in)	6 mm (1/4 in)
11 mm to 20 mm (7/16 in to 25/32 in)	8 mm (3/8 in)
Greater than 20 mm (25/32 in)	12.5 mm (1/2 in)

- 7.5.7 A gasoline fuel system shall not have a fitting for draining fuel other than a plug that is used to service the fuel filter or strainer and that:
- a) has a tapered pipe-thread;
 - b) is a screw type fitted with a locking device other than a split lock-washer; and
 - c) does not create a galvanic cell with the housing that will accelerate corrosion.

7.6 Fuel Line Valves

- 7.6.1 Valves shall pass the 2.5-minute fire test as specified in United States Code of Federal Regulations (CFR) Title 33, Section 183.590 and the ABYC Standard H-24 *Gasoline Fuel Systems*, paragraph 5.7.
- 7.6.2 Electrically operated valves shall meet the requirements of Underwriters Laboratories UL 429, *Electrically Operated Valves*.
- 7.6.3 The unit shall incorporate means for independent mounting designed to relieve strain from connected fuel lines.
- 7.6.4 Manually operated valves shall be designed with positive stops in the open and closed positions, or shall indicate their opened and closed positions.
- 7.6.5 Electrically operated shut-off valves shall be connected to be energized to open when the engine ignition switch is on. A provision for manual operation shall be incorporated in the design.
- 7.6.6 Valves shall not be of the tapered plug type with an external spring.

7.7 Fuel Filters and Strainers

- 7.7.1 Every fuel filter or strainer shall be capable of resisting damages by fire according to the requirements for fuel systems set forth in ABYC Standard H-24 *Gasoline Fuel Systems*, paragraph 5.7, unless the filter or strainer is inside the fuel tank.
- 7.7.2 All fuel filters or strainers shall be supported on the engine or vessel structure independent from the fuel line connections, unless the filter or strainer is inside the fuel tank.
- 7.7.3 Other than fire resistance characteristics, filters, separators, and strainers shall meet the requirements of Underwriters Laboratories UL 1105, *Standard for Marine Use Filters, Strainers, and Separators*.
- 7.7.4 Fuel tank withdrawal pipes that are fitted with fuel filters:
- a) shall extend as close to the bottom of the tank as practicable, to allow maximum drainage;
 - b) shall permit water contamination to be withdrawn from the tank with the fuel; and
 - c) shall be resistant to salt water, alcohol, and stale fuel.

7.8 Fuel Pumps

- 7.8.1 Every fuel pump shall be installed on the engine or within 305 mm (12 in) of the engine, with a maximum delivery hose length of 1220 mm (48 in) unless it is a fuel pump used to transfer fuel between tanks.
- 7.8.2 A diaphragm pump shall be designed and built to prevent the leakage of fuel if the primary diaphragm fails.
- 7.8.3 Every electric fuel pump shall incorporate an automatic cut-off designed to eliminate fuel pressure at the outlet when the engine stops for any cause.
- 7.8.4 The outlet pressure of electrically operated fuel pumps, except for electric fuel pumps used to transfer fuel between tanks, shall be rated or controlled to the maximum carburetor fuel inlet pressure specified by the engine manufacturer.
- 7.8.5 A momentary type switch may override the automatic cut-off for the purpose of priming or starting the engine.

7.9 Grounding

- 7.9.1 Each metal or metallic plated component of the fuel fill system and fuel tank that is in contact with the fuel must be grounded so that its resistance to the vessel ground is less than 1 ohm.
- 7.9.2 Ground wire ends shall not be clamped between the fill pipe and hose.
- 7.9.3 Static conductive neoprene tubing or piping that is used in lieu of metallic conductors shall be:
- clearly marked as static conductive; and
 - installed in direct contact with non-painted attachment surfaces.

7.10 Carburetors (Gasoline)

As stated by the Regulations:

722. No person shall install below deck or enclose by boxing, on a vessel, an inboard engine that uses gasoline as a fuel unless the design of the carburetor or throttle body fuel injector, if any, is in accordance with the construction standards and the carburetor is fitted with a flame arrestor that meets those standards.

- 7.10.1 Every carburetor, when tested according to the requirements of the fire resistance test set forth in ABYC Standard H-24 *Gasoline Fuel Systems*, Appendix A, shall not leak more than 5 mL of fuel in 30 seconds when:
- the float valve is open;
 - the carburetor is at half throttle; and
 - the engine is cranked without starting, or the fuel pump is delivering the maximum pressure specified by the engine manufacturer.
- 7.10.2 Every up-draught and horizontal-draught carburetor shall have a device that:
- collects and holds fuel that flows out of the carburetor venturi section toward the air intake;

- b) prevents collected fuel from being carried out of the carburetor assembly by the shock wave of a backfire or reverse airflow; and
- c) returns the collected fuel to the engine induction system after the engine starts.

7.10.3 Backfire flame arrester shall be suitably secured to the air intake with a flame tight connection, and shall comply with:

- a) Society of Automotive Engineers Standard SAE J1928, Devices Providing Backfire Flame Control for Gasoline Engines in Marine Applications;
- b) UL 1111, Marine Carburetor Flame Arrestors; or
- c) the requirements of United States Code of Federal Regulations (CFR) 46, section 182.415.

7.10.4 Every inboard engine that uses a carburetor shall be so designed and fitted as to prevent gasoline from leaking into the bilge.

7.11 Fuel System Labelling

As stated by the Regulations:

726. A fuel system on a vessel shall display, at a point of frequent servicing of the vessel, one or more permanently attached safety notices indicating the precautions that must be taken to minimize the risk of fire, explosion and any other hazard, and containing the information set out in the construction standards.

727. (1) A flexible hose in the fuel system shall be marked or tagged in accordance with the construction standards.

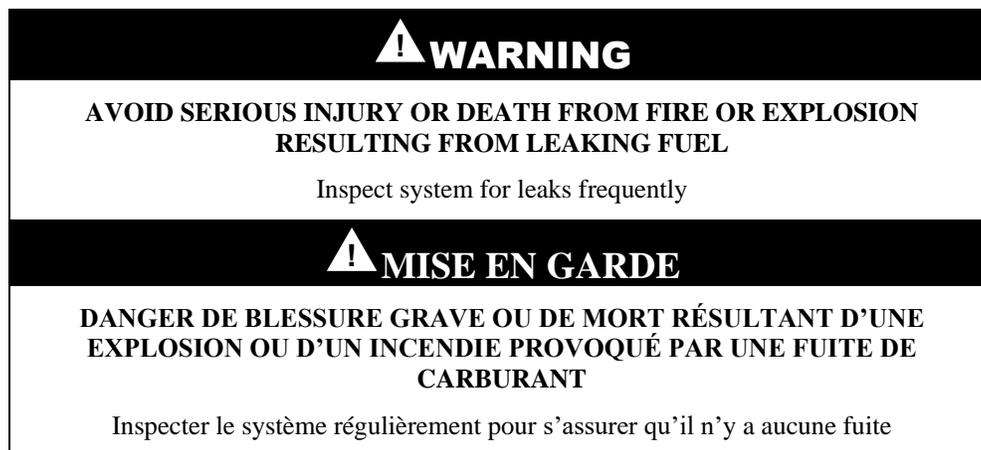
(2) The point of fuelling shall be marked in accordance with the construction standards to indicate the type of fuel to be used.

(3) A valve in the fuel system shall be marked to indicate its function and the meaning of each valve position.

(4) A fuel tank shall be permanently marked to indicate the information set out in the construction standards.

Figure 7-1

SAFETY NOTICE FOR INSPECTION OF LEAKS



7.11.1 The fuel system safety notice for inspection of leaks shall:

- a) indicate that modifying the fuel system may result in a fuel overflow;
- b) provide a warning that the system shall be inspected regularly for leaks; and

- c) provide warning of any other hazard (see Figure 7-1).

7.11.2 Fuel tank deck fill plates shall be permanently marked as follows:

- a) GASOLINE, GAS, or with the ISO symbol for gasoline in GASOLINE systems; or
- b) DIESEL, or with the ISO symbol for diesel in DIESEL systems.

7.11.3 Subject to section 7.11.3.1 every hose shall be of a type that is permanently marked in capital letters and numerals at least 3 mm (0.12 in) in height and width and at intervals not greater than 305 mm (12 in) with the following information:

- a) type of hose;
- b) manufacturer's name or registered trademark; and
- c) year of manufacture.

7.11.3.1 Hoses less than 305 mm (12 in) in length may instead be tagged with the required marking.

7.11.4 Fuel Tank Labels

7.11.4.1 Labels on fuel tanks shall contain the following information:

- a) the type of fuel for which the tank is designed;
- b) the manufacturer's name or logo and address;
- c) the month and year of manufacture or the lot number and year of manufacture;
- d) the capacity of the tank in litres;
- e) the standard to which the tank was constructed; and
- f) a statement that the tank was constructed in accordance with the requirements of the relevant standard.

7.11.4.2 Labels on fuel tanks shall not weaken the tank.

7.11.4.3 Every letter and numeral on any fuel tank label shall be:

- a) at least 1.5 mm (1/16 in) in height and width; and
- b) be of a contrasting colour to the basic colour of the label or be embossed on the label.

7.12 Outboard Motor Installations

7.12.1 The following additional requirements apply to all outboard installations.

7.12.2 When the outboard engine fuel hose is designed to be disconnected, all permanent fuel lines in outboard motor vessels shall terminate aft of the stern or be provided with means so that any leakage will not enter the vessel.

7.12.3 Quick disconnect fittings used between fuel distribution lines and outboard motors shall automatically shut off fuel flow when disconnected.

7.12.4 No pressurized tanks shall be built into or be permanently attached to any hull.

7.13 Emission Requirements

- 7.13.1 Every gasoline fuel system on a vessel shall meet applicable emission requirements in accordance with *Marine Spark-Ignition Engine, Vessel and Off-road Recreational Vehicle Emission Regulations*.

8 ELECTRICAL SYSTEMS

8.1 Scope

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length	■	■
More than 6 metres in length	■	■

8.2 Alternative Standards

As stated by the Regulations:

ELECTRICAL SYSTEMS

Standards

728. (1) The electrical systems on a vessel shall meet the following requirements:

(a) in the case of an electrical system of 50 v or less,

(i) the requirements of the construction standards, or

(ii) the requirements of American Boat and Yacht Council Standards E-10, *Storage Batteries*, and E-11, *AC and DC Electrical Systems on Boats*, with, for a safety notice, the Canadian modification set out in the construction standards; or

(b) in the case of an electrical system of more than 50 v,

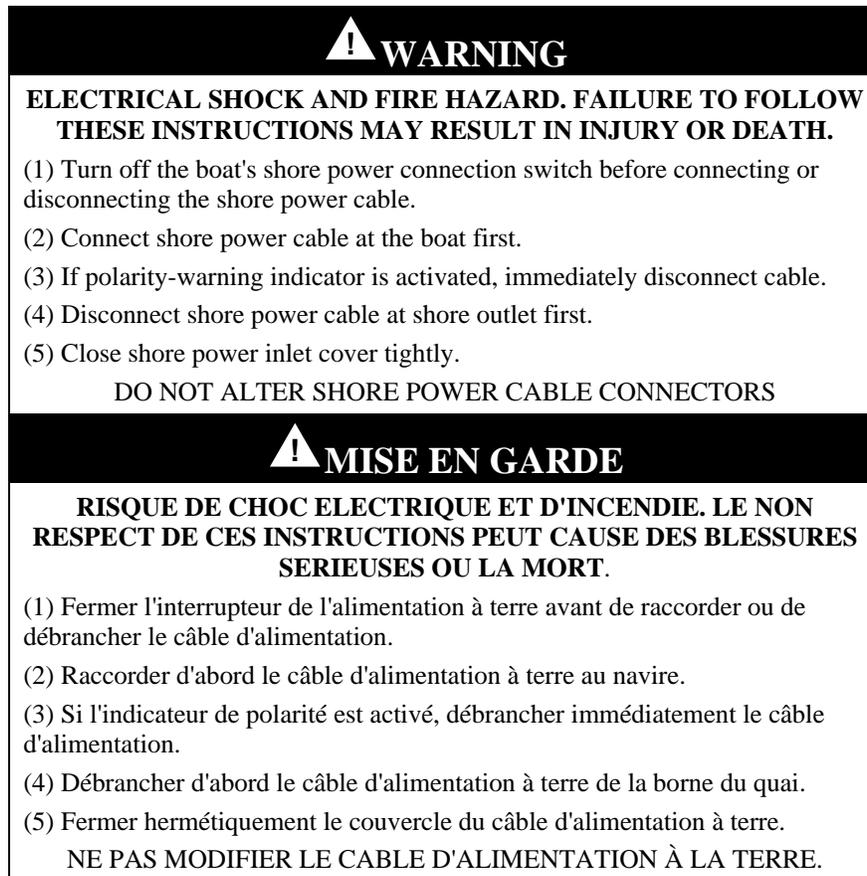
(i) the requirements of American Boat and Yacht Council Standard E-11, *AC and DC Electrical Systems on Boats*, with, for a safety notice, the Canadian modification set out in the construction standards, or

(ii) the requirements of the recommended practices and standards that are appropriate for the system voltage and that provide a level of safety at least equivalent to that provided by Standard E-11.

(2) Every component of the electrical system shall be accessible and shall be marked with the information and specifications set out in the construction standards.

8.2.1 Canadian modifications to the standard ABYC E-11

- 8.2.1.1 Safety notices required by the standard ABYC E-11 must be in English and French as shown in the following example.

Figure 8-1 SAMPLE SAFETY NOTICE FOR SHORE POWER CONNECTION**8.3 General**

- 8.3.1 All switches and controls shall be marked to indicate their usage except where there is a switch or electrical control whose function is obvious and where the operation of the device could not, under normal operation, cause a hazardous condition.
- 8.3.2 Single-pole breakers shall be installed in the positive conductor.
- 8.3.3 Switches shall be rated for the voltage and the current rating of the connected load of the circuit.
- 8.3.4 The marking on electrical equipment, such as ignition systems, motors, pumps, fans, and controllers, shall include the following:
- manufacturer;
 - product ID, serial number, type, model;
 - voltage, amperage, wattage;
 - polarity; and

- e) ignition protected, if applicable;
- 8.3.5 Circuit breakers shall:
- a) have the same DC voltage rating as the system voltage;
 - b) be of the trip-free, manual reset type; and
 - c) have an interrupting capacity to meet the system requirements.
- 8.3.6 Fuses shall be:
- a) of the same nominal voltage as the system voltage; and
 - b) of an interrupting capacity to meet system requirements.
- 8.3.7 Every integral overcurrent protect device without manual reset is permitted for use provided the circuit is protected by a fuse or trip-free breaker.
- 8.3.8 All permanently installed electrical equipment and appliances shall be securely mounted to the ship's structure.
- 8.3.9 With the exception of engine mounted equipment, all DC appliances and fixed electrical equipment shall be designed so that all current carrying parts are insulated from exposed electrically conductive parts.
- 8.3.10 The following devices need not comply with paragraph 8.3.9 if one conductor is connected to the exposed electrically conductive parts, provided that the connected conductor is the negative conductor, the polarity of both the negative and positive connections are identified, the device is mounted only on a non-conductive surface, and the device is not bonded:
- a) communication and audio equipment;
 - b) electronic equipment;
 - c) instruments and instrument clusters;
 - d) cigarette lighters;
 - e) liquid level gauge transmitters; and
 - f) navigation lights operating at 12 V or less.
- 8.3.11 Every exposed conductive non-current part of electrical equipment that may normally be in contact with bilge or seawater shall be connected to a DC grounding system, except for small vessels not equipped with a DC grounding system, double insulated devices, and isolated metal parts in non-conductive material.
- 8.3.12 Grounded liquid level gauge transmitters mounted on metallic fuel tanks or tank plates shall have the transmitter negative return conductor connected directly to the engine negative terminal or its bus. This conductor shall serve as the tank bonding or static ground conductor. Where this conductor is employed as the grounding conductor, it shall be not less than 8 AWG, and no other device shall be connected to the conductor.
- 8.3.13 The negative terminal of the battery and the negative side of the DC distribution system shall be connected to the engine negative terminal or its bus. The negative return on vessels with outboard motors shall be connected to the battery negative terminal unless provisions have been specifically provided for the return to be connected to the motor negative terminal by the outboard manufacturer.

- 8.3.14 Where an accessory negative bus is used, the following requirements apply:
- a) all the connections of the accessories to the bus shall be branch circuits from the same panelboard;
 - b) the negative bus, the negative return conductors, terminals, and connections shall have an ampacity equal to the panelboard feeder; and
 - c) the negative return conductors from the panelboard feeding the branch circuits, using the accessory bus, shall be the same size as the positive feeder to the panelboard.
- 8.3.15 Where the DC distribution system is a two-wire system with supply and return, the engine block may be used as the common return for accessories mounted on the engine, except on metallic vessels where the engine is not isolated from the hull.
- 8.3.16 If a small vessel with a grounded DC system has a multiple engine installation with grounded cranking motors that includes an auxiliary generator engine(s), the engines shall be connected to each other by a common conductor that can carry the starting current of each of the grounded cranking motor circuits. Multiple outboard motors shall be connected at the negative battery terminal.
- 8.3.17 If a small vessel is equipped with a crossover (parallel) cranking motor system in a multiple engine installation, including auxiliary generator(s), the engine shall be connected with a cable large enough to carry the cranking motor circuit; this cable shall be in addition to and independent of any other electrical connections to the engines including those in paragraph 8.3.16, except in the case of ungrounded DC systems or outboard motors.
- 8.3.18 If a paralleling switch is installed in crossover circuitry as described in subsection 8.3.17, it shall be rated to carry the largest cranking motor current. The switch may be of a maintained type or solenoid operated.

8.4 Ignition Protection

As stated by the Regulations:

Ignition Protection

731. (1) An electrical component shall be certified by a product certification body or a testing laboratory as being ignition-protected in accordance with

(a) Society of Automotive Engineers Recommended Practice SAE J1171, *External Ignition Protection of Marine Electrical Devices*; or

(b) Underwriters Laboratories, Inc. Standard UL 1500, *Ignition-Protection Test for Marine Products*.

(2) Subsection (1) does not apply if

(a) the vessel uses diesel fuel as its only fuel source;

(b) the electrical component is isolated, in accordance with the specifications set out in the construction standards, from fuel sources such as

(i) engines and cooking appliances,

(ii) valves, connections or other fittings on vent lines, fill lines or distribution lines, and

(iii) fuel tanks; or

(c) the electrical component is located in a compartment where the only source of flammable vapour is from liquified-petroleum-gas or compressed-natural-gas appliances, cylinders, fittings, valves or regulators, and the compartment

(i) has, for every cubic metre of net internal volume, at least 0.34 m² of open area exposed to the atmosphere outside the vessel, or

(ii) is an accommodation space.

8.4.1 Isolation of an electrical component from a fuel source shall be provided by:

- a) a bulkhead that meets the requirements of paragraph 8.4.2 and that is located between the electrical component and the fuel source;
- b) the installation of the electrical component with provision of a means to prevent fuel and fuel vapours from becoming exposed to the electrical component; or
- c) a space that is open to the atmosphere and that provides at least 600 mm (24 in) between the fuel source and the electrical component.

8.4.2 A bulkhead, as detailed in paragraph 8.4.1(a) shall:

- a) extend both vertically and horizontally at least the distance of the open space between the fuel source and the ignition source;
- b) resist a water level that is 305 mm (12 in) high or one-third the maximum height of the bulkhead, whichever is less, without seepage of more than 7.5 mL of fresh water per hour; and
 - (i) have no opening located higher than 305 mm (12 in) or one-third the maximum height of the bulkhead, whichever is less, unless:
 - (ii) the opening is used for the passage of conductors, piping, ventilation ducts, mechanical equipment, or doors, hatches, and access panels, and

- (iii) the maximum annular space around each item or door, hatch, or access panel is not larger than 6 mm (1/4 in).

8.5 Grounding

- 8.5.1 Where a small vessel has more than one gasoline engine, the grounded cranking motor circuits shall meet the requirements of 8.3.16.
- 8.5.2 The engine block may be used as the common return for accessories mounted on the engine, except on metallic small vessels, where the engine is not isolated from the hull.
- 8.5.3 A metallic hull or the grounding conductor shall not be used as the return conductor.
- 8.5.3.1 If one side of the DC system is to be grounded, the grounded conductor shall be of negative polarity.
- 8.5.3.2 In steel and aluminum small vessels, non-conducting exposed metal parts of electrical equipment that requires grounding shall be effectively grounded to the hull.
- 8.5.4 On small wood, fibre-reinforced plastic and composite vessels, a continuous grounding conductor shall be installed to facilitate the grounding of non-conducting exposed metal parts of electrical, electronic, and communication equipment that requires grounding. The grounding conductor shall terminate at a point on the main engine or at a copper plate of area not less than 0.2 m² fixed to the keel below the light waterline so as to be fully immersed under all conditions of heel or trim.
- 8.5.5 Every grounding conductor shall be of copper or other corrosion-resistant material and shall be securely installed and protected, where necessary, against damage and electrolytic corrosion.
- 8.5.6 Every grounding connection to the small vessel's structure, or on wood, fibre-reinforced plastic, and composite small vessels, to the continuous grounding conductor, shall be made in an accessible position and shall be secured by a screw or connector of brass or other corrosion-resistant material used solely for that purpose.

8.6 Batteries

8.6.1 General

As stated by the Regulations:

Batteries and Means of Charging

729. (1) A battery shall

- (a) be installed and secured in accordance with the construction standards and meet the specifications set out in those standards;
- (b) be accessible; and
- (c) if it is an engine starting battery, be provided with an automatic means of charging.

(2) A means of charging a battery shall prevent overcharging.

730. The location in which a battery is installed shall be dry, well-ventilated and above bilge water level.

- 8.6.1.1 Batteries shall not be tapped for voltages other than the total voltage of the cells comprising the battery.
- 8.6.1.2 Batteries, as installed in every small vessel, shall be capable of inclinations of up to 40 degrees without leakage of electrolyte. A means shall be provided for containment of any spilled electrolyte.
- 8.6.1.3 Batteries shall be protected against mechanical damage by either location or an enclosure, and electrically protected by a non-conductive cover to protect metal objects coming in direct contact with the ungrounded terminals of the battery.
- 8.6.1.4 Every battery shall be secured so as not move more than 25 mm (1 in) when a pulling force of twice the battery weight is applied through the centre of gravity in each of the following directions for one (1) minute:
- a) vertically;
 - b) horizontally, fore and aft; and
 - c) horizontally port and starboard.
- 8.6.1.5 Every metallic fuel line and fuel system component located within 305 mm (12 in) above the level of the top of an installed battery shall be shielded with dielectric material.
- 8.6.1.6 Means for adequate ventilation shall be provided to prevent the accumulation of hydrogen from the battery during charging or discharging cycles. Vented batteries shall not be installed in accommodation spaces.
- 8.6.1.7 The positive terminal of a battery shall be identified on the terminal or on the battery case near the terminal, with one of the following symbols:
- a) "POS";
 - b) "P"; or
 - c) "+".
- 8.6.1.8 Battery terminal connectors shall not depend on spring tension for their connection to the terminal.
- 8.6.1.9 Battery charging systems shall be automatic.

8.6.2 Battery Disconnect Switch

- 8.6.2.1 A battery disconnect switch shall be installed in the positive conductor from each battery or group of batteries, with a cold cranking average rating greater than 800 amperes, except for small vessels less than 8.0 m (26 ft 3 in) in length.
- 8.6.2.2 The following devices may be connected to the battery side of the battery switch described in paragraph 8.6.2.1; however, each device shall be provided with circuit protection in accordance with section 8.9:
- a) electronic equipment with continuously powered memory;
 - b) safety equipment such as bilge pumps, alarms, carbon monoxide (CO) detectors, and bilge blowers;
 - c) battery charging equipment.

- 8.6.2.3 Battery switches shall be placed in a readily accessible location as close as practicable to the battery, or batteries.
- 8.6.2.4 Battery disconnect switches shall be capable of carrying the maximum current of the distribution system including the intermittent load of the starter motor circuit.
- 8.6.2.5 Remote controlled battery disconnect switches, if used, shall also permit safe manual operation at the switch.

8.7 Conductors

8.7.1 General – Systems Less Than 50 Volts

- 8.7.1.1 The following systems and equipment are installed according to their manufacturer installation manual and do not need to meet the standards of paragraphs 8.7.1.2 to 8.7.1.8:
- a) communications systems;
 - b) electronic navigation equipment;
 - c) resistance conductors that control circuit amperage;
 - d) high-voltage ignition systems, conductors, and terminations;
 - e) pigtails of less than 200 mm (8 in) of exposed length;
 - f) cranking motor conductors.
- 8.7.1.2 Every permanently installed cable and conductor shall:
- a) have a minimum nominal voltage rating of 50 V; and
 - b) have stranded copper conductors with an insulation rated for a minimum temperature of 60°C; and
 - c) be of single or multi-conductor construction; and
 - d) be flame retardant, impervious to water absorption, and of an oil resistant type when installed in engine room spaces; and
 - e) be of a type as described in 8.7.1.3.
- 8.7.1.3 For the purpose of 8.7.1.2(e), the types are those that are:
- a) listed in Table 8-1; or
 - b) (b) certified for marine use by a product certification body; or
 - c) constructed in accordance with the latest editions of one of the following:
 - (i) CSA C22.2 No. 245, Marine Shipboard Cable; or
 - (ii) UL 1309, Marine Shipboard Cable; or
 - (iii) IEEE STD 45, Recommended Practice for Electrical Installations on Shipboard; or
 - (iv) IEEE STD 1580, Recommended Practice for Marine Cable for Use on Shipboard and Fixed or Floating Platforms; or
 - (v) requirements of Underwriters Laboratories UL 1426, Electrical Cables for Boats.

Table 8-1 WIRE TYPES			
Types	Description	Available Insulation	Types of conductors
TW	Moisture Resistant, Flame Tested Thermoplastic	60°C	Single Conductors
TWU	Heat and Moisture Resistant Flame Tested Thermoplastic	60°C	Single Conductors
TWN	Heat and Moisture Resistant Flame Tested Thermoplastic	75°C	Single Conductors
TW 75	Heat and Moisture Resistant Flame Tested Thermoplastic	75°C	Single Conductors
TWU 75	Heat and Moisture Resistant Flame Tested Thermoplastic	75°C	Single Conductors
T 90 Nylon	Heat and Moisture Resistant Flame Tested Thermoplastic	90°C	Single Conductors or Multi-Conductors
RW 90	Heat and Moisture Resistant Thermoset	90°C	Multi-Conductors

Table 8-2 ALLOWABLE AMPERAGE OF CONDUCTORS								
Conductor Size		Temperature rating of conductor insulation						
(Circular Mils)	(AWG)	60°C	75°C	80°C	90°C	105°C	125°C	200°C
1 620	18	10	10	15	20	20	25	25
2 580	16	15	15	20	25	25	30	35
4 110	14	20	20	25	30	35	40	45
6 530	12	25	25	35	40	45	50	55
10 400	10	40	40	50	55	60	70	70
16 500	8	55	65	70	70	80	90	100
26 300	6	80	95	100	100	120	125	135
41 700	4	105	125	130	135	160	170	180
52 600	3	120	145	140	155	180	195	210
66 400	2	140	170	175	180	210	225	240
83 700	1	165	195	210	210	245	265	280
106 000	0	195	230	245	245	285	305	325
133 000	0 (2/0)	225	265	285	285	330	355	370
168 000	000 (3/0)	260	310	330	330	385	410	430
212 000	0000 (4/0)	300	360	385	385	445	475	510

CORRECTION FACTORS

Note 1: CORRECTION FOR TEMPERATURE RATING OF CONDUCTOR							
Temperature Rating	60°C	75°C	80°C	90°C	105°C	125°C	200°C
Correction Factor	0.58	0.75	0.78	0.82	0.85	0.89	1

Note 2: CORRECTION FOR NUMBER OF CONDUCTORS	
Number of current carrying conductors	Correction Factor
3	0.7
4 to 6	0.6
7 to 24	0.5
25 or more	0.4

- 8.7.1.4 Conductors and flexible cords shall have the following surface markings:
- type/style;
 - voltage rating;
 - wire size; and
 - temperature rating.
- 8.7.1.5 Where flexible cords or power cables are used for portable equipment, they shall be of a type SO, ST, SJO, SJT, SJOW, or SJTW, as listed in the CSA *Canadian Electrical Code*, Part 1, or be of a similar cable that has been constructed to a recognized national standard.
- 8.7.1.6 Except for intermittent surges, no conductor shall carry a current greater than that specified in Table 8-2 for the conductor's gauge and temperature rating.
- 8.7.1.7 In circuits where voltage drop must be kept to a minimum, the following maximum voltage drops are permitted:
- panelboard main feeders: 3%;
 - navigation light circuits: 3%;
 - electronic equipment circuits: 3%;
 - bilge blower and pump: 3%; and
 - all remaining circuits: 10%.
- (For the calculation of the above voltage drops, refer to Table 8-3 and Table 8-4.)
- 8.7.1.8 Conductors shall be not less than 16 AWG (1 mm), other than those conductors contained in manufacturer's equipment and communication circuits of less than 1 amp.

8.7.2 Wire Colour Coding

- 8.7.2.1 The colour coding shown in Table 8-5 identifies colours for DC general wiring purposes on vessels together with one selection of colours used for engine accessories. Other means of cable identification may be employed provided a wiring diagram of the electrical system indicating the method of identification is provided particular to the vessel electrical installation.

- 8.7.2.2 If coloured tape is employed for colour coding, it shall be not less than 5 mm (3/16 in) wide and shall make at least two (2) complete turns around the conductor in a visible location adjacent to the terminal.

8.7.3 Secondary Circuits of Ignition Systems

- 8.7.3.1 Every conductor in a secondary circuit of an ignition system shall conform to Society of Automotive Engineers Standard SAE J2031.
- 8.7.3.2 The connection of every ignition conductor to a spark plug, coil, or distributor shall have a tight fitting cap, boot, or nipple.

Table 8-3 CONDUCTOR SIZES FOR 3% DROP IN VOLTAGE

Length of Conductor from Source of Current to Device and Back to Source																			
Metres	3	4.5	6	8	9	12	15	12	20	25	27	30	33	36	40	43	45	48	52
Feet	10	15	20	25	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
Total Amps* 12 Volts – 3% Drop Wire Sizes (gage) – Based on Minimum CM Area																			
3	18	16	14	12	12	10	10	10	8	8	6	6	6	6	6	6	6	6	6
10	14	12	10	10	10	8	6	6	6	4	4	4	4	4	2	2	2	2	2
15	12	10	10	8	8	6	6	6	4	2	2	2	2	2	2	1	1	1	1
20	10	10	8	6	6	6	4	4	2	2	2	2	1	1	1	0	0	0	2/0
25	10	8	6	6	6	4	4	2	2	1	1	1	0	0	0	2/0	2/0	2/0	3/0
30	10	8	6	4	4	4	2	2	1	0	0	0	0	2/0	2/0	3/0	3/0	3/0	3/0
40	8	6	6	4	4	2	2	1	0	2/0	2/0	2/0	2/0	3/0	3/0	4/0	4/0	4/0	4/0
50	6	6	4	2	2	2	1	0	2/0	3/0	3/0	3/0	3/0	4/0	4/0				
60	6	4	4	2	2	1	0	2/0	3/0	4/0	4/0	4/0	4/0						
70	6	4	2	1	1	0	2/0	3/0	3/0	4/0	4/0								
80	6	4	2	1	0	0	3/0	3/0	4/0										
90	4	2	2	0	2/0	2/0	3/0	4/0	4/0										
100	4	2	2	0	2/0	2/0	3/0	4/0											
Total Amps* 24 Volts – 3% Drop Wire Sizes (gage) – Based on Minimum CM Area																			
5	18	18	18	16	16	14	12	12	12	10	10	10	10	10	8	8	8	8	8
10	18	16	14	12	12	10	10	10	8	8	8	6	6	6	6	6	6	6	6
15	16	14	12	12	10	10	8	8	6	6	6	6	6	4	4	4	4	4	2
20	14	12	10	10	10	8	6	6	6	6	4	4	4	4	2	2	2	2	2
25	12	12	10	10	8	6	6	6	4	4	4	4	2	2	2	2	2	2	1
30	12	10	10	8	8	6	6	4	4	4	2	2	2	2	2	1	1	1	1
40	10	10	8	6	6	6	4	4	2	2	2	2	1	1	1	0	0	0	2/0
50	10	8	6	6	6	4	4	2	2	2	1	1	0	0	0	2/0	2/0	2/0	3/0
60	10	8	6	6	4	4	2	2	1	1	0	0	0	2/0	2/0	3/0	3/0	3/0	4/0
70	8	6	6	4	4	2	2	1	1	0	0	2/0	2/0	3/0	3/0	3/0	3/0	4/0	4/0
80	8	6	6	4	4	2	2	1	0	0	2/0	2/0	3/0	3/0	3/0	4/0	4/0	4/0	
90	8	6	4	4	2	2	1	0	0	2/0	2/0	3/0	3/0	4/0	4/0	4/0	4/0	4/0	
100	6	6	4	4	2	2	1	0	2/0	2/0	3/0	3/0	4/0	4/0	4/0				
Total Amps* 32 Volts – 3% Drop Wire Sizes (gage) – Based on Minimum CM Area																			
3	18	18	18	18	16	16	14	14	12	12	12	12	10	10	10	10	10	10	8
10	18	16	16	14	14	12	12	10	10	10	8	8	8	8	8	6	6	6	6
15	16	16	14	12	12	10	10	8	8	8	6	6	6	6	6	6	6	4	4
20	16	14	12	12	10	10	8	8	6	6	6	6	6	4	4	4	4	4	2
25	14	14	12	10	10	8	8	6	6	6	6	4	4	4	4	2	2	2	2
30	14	12	10	10	8	8	6	6	6	4	4	4	4	2	2	2	1	1	1
40	12	12	10	8	8	6	6	4	4	4	2	2	2	2	2	1	1	1	1
50	12	10	8	8	6	6	4	4	2	2	2	2	2	1	1	0	0	0	0
60	10	10	8	6	6	4	4	2	2	2	2	1	1	0	0	0	2/0	2/0	2/0
70	10	10	6	6	6	4	2	2	2	1	1	0	0	0	2/0	2/0	2/0	3/0	3/0
80	10	8	6	6	4	4	2	2	1	1	0	0	0	2/0	2/0	3/0	3/0	3/0	3/0
90	8	8	6	6	4	2	2	2	1	0	0	2/0	2/0	2/0	3/0	3/0	3/0	4/0	4/0
100	8	6	6	4	4	2	2	1	0	0	2/0	2/0	2/0	3/0	3/0	3/0	4/0	4/0	4/0

* Total current in circuit in amperes

Table 8-4 CONDUCTOR SIZES FOR 10% DROP IN VOLTAGE

Length of Conductor from Source of Current to Device and Back to Source																			
Metres	3	4.5	6	8	9	12	15	18	20	25	27	30	33	36	40	43	45	48	52
Feet	10	15	20	25	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
12 Volts – 10% Drop Wire Sizes (gage) – Based on Minimum CM Area																			
Total Amps*																			
5	18	18	18	18	18	16	16	14	14	14	12	12	12	12	12	10	10	10	10
10	18	18	16	16	14	14	12	12	10	10	10	10	8	8	8	8	8	8	6
15	18	16	14	14	12	12	10	10	8	8	8	8	8	6	6	6	6	6	6
20	16	14	14	12	12	10	10	8	8	8	6	6	6	6	6	6	4	4	4
25	16	14	12	12	10	10	8	8	6	6	6	6	4	4	4	4	4	4	2
30	14	12	12	10	10	8	8	6	6	6	6	4	4	4	4	2	2	2	2
40	14	12	10	10	8	8	6	6	6	4	4	4	2	2	2	2	2	2	2
50	12	10	10	8	8	6	6	4	4	4	2	2	2	2	2	1	1	1	1
60	12	10	8	8	6	6	4	4	2	2	2	2	1	1	1	0	0	0	0
70	10	8	8	6	6	6	4	2	2	2	2	1	1	1	0	0	0	2/0	2/0
80	10	8	8	6	6	4	4	2	2	2	1	1	0	0	0	2/0	2/0	2/0	2/0
90	10	8	6	6	6	4	2	2	2	1	1	0	0	0	2/0	2/0	2/0	3/0	3/0
100	10	8	6	6	4	4	2	2	1	1	0	0	0	2/0	2/0	2/0	3/0	3/0	3/0
24 Volts – 10% Drop Wire Sizes (gage) – Based on Minimum CM Area																			
Total Amps*																			
5	18	18	18	18	18	18	18	18	16	16	16	16	14	14	14	14	14	14	12
10	18	18	18	18	18	16	16	14	14	14	12	12	12	12	12	10	10	10	10
15	18	18	18	16	16	14	14	12	12	12	10	10	10	10	10	8	8	8	8
20	18	18	16	16	14	14	12	12	10	10	10	10	8	8	8	8	8	8	6
25	18	16	16	14	14	12	12	10	10	10	8	8	8	8	8	6	6	6	6
30	18	16	14	14	12	12	10	10	8	8	8	8	8	6	6	6	6	6	6
40	16	14	14	12	12	10	10	8	8	8	6	6	6	6	6	4	4	4	4
50	16	14	12	12	10	10	8	8	6	6	6	6	4	4	4	4	4	4	2
60	14	12	12	10	10	8	8	6	6	6	6	4	4	4	4	2	2	2	2
70	14	12	10	10	8	8	6	6	6	6	4	4	4	2	2	2	2	2	2
80	14	12	10	10	8	8	6	6	6	4	4	4	2	2	2	2	2	2	2
90	12	10	10	8	8	6	6	6	4	4	4	2	2	2	2	2	2	1	1
100	12	10	10	8	8	6	6	4	4	4	2	2	2	2	2	1	1	1	1
32 Volts – 10% Drop Wire Sizes (gage) – Based on Minimum CM Area																			
Total Amps*																			
5	18	18	18	18	18	18	18	18	18	18	18	16	16	16	16	14	14	14	14
10	18	18	18	18	18	18	16	16	14	14	14	14	12	12	12	12	12	12	12
15	18	18	18	18	18	16	14	14	14	12	12	12	12	10	10	10	10	10	10
20	18	18	18	16	16	14	14	12	12	12	10	10	10	10	10	8	8	8	8
25	18	18	16	16	14	14	12	12	10	10	10	10	10	8	8	8	8	8	8
30	18	18	16	14	14	12	12	10	10	10	10	8	8	8	8	8	6	6	6
40	18	16	14	14	12	12	10	10	8	8	8	8	8	6	6	6	6	6	6
50	16	14	14	12	12	10	10	8	8	8	6	6	6	6	6	6	6	4	4
60	16	14	12	12	10	10	8	8	8	6	6	6	6	6	6	4	4	4	4
70	14	14	12	10	10	8	8	8	6	6	6	6	6	4	4	4	4	2	2
80	14	12	12	10	10	8	8	6	6	6	6	4	4	4	4	2	2	2	2
90	14	12	10	10	8	8	6	6	6	4	4	4	4	2	2	2	2	2	2
100	14	12	10	10	8	8	6	6	6	4	4	4	4	2	2	2	2	2	2

* Total current in circuit in amperes

Table 8-5 GENERAL WIRING COLOUR CODE		
Colour	Use	
Green or green w/yellow stripe(s)	DC Grounding Conductors	
Black or Yellow	DC Negative Conductors	
Red	DC Positive Conductors	
Engine and Accessory Wiring Colour Code		
Colour	Item	Use
Yellow w/red strip (YR)	Starting circuit	Starting switch to solenoid
Brown/yellow stripe (BY) or Yellow (Y) – see note	Bilge blowers	Fuse or switch to blowers
Dark Gray (Gy)	Navigation lights	Fuse or switch to lights
	Tachometer	Tachometer sender to gauge
Brown (Br)	Generator armature	Generator armature to regulator
	Alternator charge light	Generator
		Terminal/alternator
		Auxiliary terminal to light to regulator
	Pumps	Fuse or switch to pumps
Orange (O)	Accessory feed	Ammeter to alternator or generator output and accessory fuses or switches
		Distribution panel to accessory switch
Purple (Pu)	Ignition	Ignition switch to coil and electrical instruments
	Instrument feed	Distribution panel to electric instruments
Dark blue	Cabin and instrument lights	Fuse or switch to lights
Light blue (Lt Bl)	Oil pressure	Oil pressure sender to gauge
Tan	Water temperature	Water temperature sender to gauge
Pink (Pk)	Fuel gauge	Fuel gauge sender to gauge
Green/strip (G/x)	Tilt down and/or trim in	Tilt and/or trim circuits
Except G/Y		
Blue/strip (Bl/x)	Tilt up and/or trim out	Tilt and/or trim circuits

Note on Table 8-5

1. If yellow is used for DC negative, the bilge blower must be brown with yellow stripe.

8.7.4 Conductors – Support and Protection

- 8.7.4.1 This subsection does not apply to communication systems, electronic navigation equipment, or high-voltage secondary conductors and termination in ignition systems.
- 8.7.4.2 Except for the first 1000 mm (3 ft 3 in) of a conductor leading from a battery terminal, every conductor or group of conductors shall be supported by clamps or straps at intervals not greater than 455 mm (18 in) unless the conductor or group of conductors is enclosed in a rigid duct or conduit.
- 8.7.4.3 Non-metallic straps or clamps shall be resistant to oil, gasoline, and water, and shall not break under flexing at a temperature range of - 34°C to 121°C and, where exposed to sunlight, shall not be sensitive to ultraviolet radiation.
- 8.7.4.4 Where metal clamps are lined with an insulating material, the material shall be resistant to oil, gasoline, and water, and be compatible with the insulation or sheath.
- 8.7.4.5 Clamps, straps, ducts, or conduits shall be designed to prevent chafing or damage to the conductor insulation.
- 8.7.4.6 Provision shall be made to prevent stress being placed on any conductor that connects two components that can move in relation to each other.
- 8.7.4.7 Every conductor or group of conductors that passes through a bulkhead, structural member, junction box, or other rigid surface shall be protected from abrasion.
- 8.7.4.8 Every conductor shall be protected from damage due to exposure to heat sources capable of damaging the insulation.
- 8.7.4.9 Current carrying conductors shall be routed in the highest possible location above the bilge water level and other areas where water may accumulate. If conductors must be routed in the bilge or other areas where water may accumulate, the wiring and connections shall be watertight.
- 8.7.4.10 AC and DC conductors or multi-conductors shall be separately sheathed in conduit or cable or trunking or bundled, or otherwise kept separate from each other.
- 8.7.4.11 Each conductor that is part of the electrical system, except for conductors integral with engines as supplied by their manufacturers, shall be clearly differentiated between AC and DC and identified as to its function in the system.
- 8.7.4.12 DC grounding conductors shall be identified by green or green with yellow stripe insulation, which shall not be used to indicate current carrying conductors, or may be uninsulated.
- 8.7.4.13 In situations where boxes must be located in wet locations, space surrounding the boxes or enclosures of at least 6 mm (1/4 in) shall be provided to prevent the accumulation of water.

8.7.5 Conductors – Termination

- 8.7.5.1 This subsection does not apply to communications systems and electronic navigation equipment.
- 8.7.5.2 Every connection to a screw terminal or stud that is outside a junction box or enclosure shall be connected by a closed-ring connector, eyelet connector, captive spade connector, mechanical locking connector, or spring locking connector.
- 8.7.5.3 Every stripped connector that is connected to a compression screw terminal that is outside a junction box or other enclosure shall be mechanically secured to avoid stress on the connection.
- 8.7.5.4 Every single friction connection, spring type connector, and multi-connector plug that is outside a junction box or enclosure shall be capable of withstanding a force of 27 N for one (1) minute, applied along the axial direction of the conductor.
- 8.7.5.5 Subject to paragraph 8.7.5.6, a soldered connection that is outside a junction box or enclosure shall not be the sole means of connection between two or more conductors, or between a conductor and connector. If the connection is soldered, the connection shall be located or supported to limit the

- flexing of the conductor where the solder has changed the stranded flexible conductor to a solid conductor.
- 8.7.5.6 A conductor may be soldered to a connector that joins the conductor to a battery terminal or stud, provided that the length of the soldered joint is at least 1.5 times the diameter of the stranded portion of the battery conductor.
- 8.7.5.7 Every ungrounded terminal or stud that is continuously energized:
- a) shall comply with paragraphs 8.7.3.1 and 8.7.3.2; or
 - b) shall have a boot, nipple, cap, cover, or shield that prevents accidental short-circuiting at the terminal or stud.
- 8.7.5.8 Every termination that is composed of an ungrounded conductor, terminal fitting, and connector shall be protected from accidental short-circuiting with:
- a) another termination from another circuit that is composed of an ungrounded conductor, terminal fitting, and connector; or
 - b) any metal that is grounded.
- 8.7.5.9 No conductor shall be joined to another conductor by a twist-on wire nut, or wire screw.
- 8.7.5.10 Blade type friction connectors may be used provided:
- a) the voltage drop from terminal to terminal does not exceed 50 mV for a 20-amp current flow; and
 - b) the connection does not separate if subjected to a 27 N tensile force along the axial direction of the connector for one (1) minute.
- 8.7.5.11 Terminal connectors of the ring or captive spade types shall be the same nominal size as the stud.
- 8.7.5.12 All connections shall be in locations protected from the weather or in weather tight enclosures.
- 8.7.5.12.1 Connections exposed to immersion shall be in watertight enclosures.
- 8.7.5.13 Metals used for terminal studs, nuts, or washers shall be corrosion resistant and galvanically compatible with the conductor and terminal. Aluminum and unplated steel shall not be used for studs, nuts, or washers in electrical circuits.
- 8.7.5.14 Mechanical and electrical joints shall be designed and installed to avoid damage to the conductors.
- 8.7.5.15 Setscrew connectors may be used provided the setscrew does not bear directly on the conductor strands.
- 8.7.5.16 Connectors of the crimp-on type shall be attached only by tools designed for the connector being used.
- 8.7.5.17 There shall not be more than four conductors connected to any one-stud terminal.
- 8.7.5.18 Where a conductor terminates at a switchboard, in a fixture, or in a junction box, a length of the conductor shall remain to provide strain relief at the terminal and allow for any future repairs.
- 8.7.5.19 Shanks of terminals shall be protected against accidental shorting except those employed for grounding lugs.
- 8.7.5.20 Harness-type wiring using multi-wire plugs and receptacles shall have cable clamps, molded connectors, insulation grips, or extended terminals to limit flexing at the connection point; the connectors where exposed to weather shall be weatherproof or watertight; each terminal shall be protected from accidental short-circuiting and the capacity shall meet or exceed the ampacity and temperature rating of the connecting conductors.

8.8 Receptacles

- 8.8.1 Receptacles and matching plugs used on DC systems shall not be interchangeable with those used on AC systems on the small vessel.
- 8.8.2 Receptacles installed in locations subject to rain, spray, or splash shall be protected by a cover with an effective weatherproof seal.
- 8.8.3 Receptacles, including connecting plugs, installed in areas subject to flooding or immersion shall be protected by an effective cover with a watertight seal.

8.9 Overcurrent Protection

8.9.1 General

- 8.9.1.1 This section does not apply to resistance conductors that control circuit amperage, conductors in secondary circuits of ignition systems, pigtails of less than 200 mm (8 in) of exposed length, and power supply conductors in cranking motor circuits.
- 8.9.1.2 Every ungrounded, conductor shall be protected by a manually reset, trip-free circuit breaker or fuse that shall be:
- a) at the source of power for each conductor; or
 - b) at the point where a conductor size is reduced to a smaller gauge; or
 - c) at the origin of the circuit, if the circuit breaker or fuse has a current rating that prevents overloading of the smallest conductor in the circuit.
- 8.9.1.2.1 Overcurrent protection for each ungrounded conductor of a branch circuit shall be at the point of connection to the panelboard or switchboard.

- 8.9.1.3 Except as provided in paragraph 8.9.1.4, the current rating of each circuit breaker or fuse shall not exceed the current rating of the smallest conductor in the circuit.
- 8.9.1.4 If the value specified in paragraph 8.9.1.3 does not correspond to a standard circuit breaker or fuse rating, the next larger rated circuit breaker or fuse may be used, provided it does not exceed 150% of the allowed current capacity of the conductor.
- 8.9.1.5 The voltage rating of each circuit breaker or fuse shall not be less than the nominal voltage of the circuit that it protects.

8.9.2 Special Applications

- 8.9.2.1 Every ungrounded conductor from a storage battery shall have a manually reset, trip-free circuit breaker or fuse, unless the conductor is in the main power feed circuit from the battery to an engine cranking motor.
- 8.9.2.2 The circuit breaker or fuse, as specified in paragraph 8.9.2.1 shall be within 1800 mm (5 ft 11 in) of the battery, as measured along the conductor, unless the circuit has a switch that disconnects the battery.

8.10 Panelboards

- 8.10.1 The front side of panelboards (i.e., switch and breaker operating face) shall be readily accessible, and the rear side (i.e., terminal and connection side) shall be accessible.
- 8.10.2 Panelboards shall be designed, constructed, and installed so that there are no exposed live parts accessible to the operator in the normal operating position.
- 8.10.3 Panelboards shall be weatherproof or protected from weather and splash.
- 8.10.4 Vessels equipped with both AC and DC electrical systems shall have their distribution from separate panelboard. If both systems share a common enclosure, it must have a partition or have other positive means provided to clearly separate the AC and DC sections from each other. Wiring diagrams to identify circuits, components, and conductors shall be included.
- 8.10.5 The switchboard or panelboard shall be provided with clear permanent markings of the nominal voltage and types and provide circuit identification.

8.11 Emergency Lighting for Non-Pleasure Craft of more than 6 metres

8.11.1 Scope

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length		
More than 6 metres in length		■

8.11.2 General**As stated by the Regulations:***Emergency Lighting*

732. Every vessel, other than a pleasure craft, that is more than 6 m in length shall have emergency lighting installed in accordance with the construction standards to allow passengers and crew to exit from any area of the vessel in case of an emergency.

- 8.11.2.1 The emergency lighting units shall be of a self-contained type, rechargeable from the vessel's electrical distribution system, and fitted with a charge indicator.
- 8.11.2.2 As an alternative to an emergency hard-wired lighting system, rechargeable or non-rechargeable portable hand lanterns may be provided. The portable lanterns shall provide a light intensity and endurance at least equivalent to an ANSI-908 6 volts, 9 watts portable lantern.
- 8.11.2.3 For those vessels with non-rechargeable lanterns, a spare battery shall be carried and batteries shall be replaced with new batteries annually.

8.12 Electrical Systems of 50 Volts or More**8.12.1 Scope**

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length	■	■
More than 6 metres in length	■	■

As stated by the Regulations:*Standards*

728. (1) The electrical systems on a vessel shall meet the following requirements:

- (a) in the case of an electrical system of 50 v or less,
- (i) the requirements of the construction standards, or
 - (ii) the requirements of American Boat and Yacht Council Standards E-10, *Storage Batteries*, and E-11, *AC and DC Electrical Systems on Boats*, with, for a safety notice, the Canadian modification set out in the construction standards; or
- (b) in the case of an electrical system of more than 50 v,
- (i) the requirements of American Boat and Yacht Council Standard E-11, *AC and DC Electrical Systems on Boats*, with, for a safety notice, the Canadian modification set out in the construction standards, or
 - (ii) the requirements of the recommended practices and standards that are appropriate for the system voltage and that provide a level of safety at least equivalent to that provided by Standard E-11.

(2) Every component of the electrical system shall be accessible and shall be marked with the information and specifications set out in the construction standards.

Information Note:

Examples of recommended practices and standards that are appropriate for the system voltage and that provide a level of safety at least equivalent to that provided by Standard E-11 are:

- (a) IEC 60092 Electrical installations in ships - Part 507: Small vessels
- (b) Ship Electrical Standard, TP127
- (c) United States Code of Federal Regulations (CFR) 46, subchapter J.

The following systems and equipment are not required to be installed in accordance with the applicable standards for electrical systems of more than 50 volts (with the exception of their power side, which is connected to the vessel's electrical distribution system), provided that they are installed in accordance with their manufacturer's installation instructions:

- (i) communication systems;
- (ii) electronic navigation equipment;
- (iii) resistance conductors that control circuit amperage;
- (iv) conductors in secondary circuits of ignition systems; and
- (v) pigtails of less than 200 mm (8 in) of exposed length.

9 MACHINERY SYSTEMS

9.1 Exhaust Systems

9.1.1 Scope

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length	■	■
More than 6 metres in length	■	■

9.1.2 General

As stated by the Regulations:

Exhaust Systems

733. Every exhaust system and muffler on a vessel equipped with an inboard or stern-drive engine or a permanently installed auxiliary engine shall prevent the leakage of exhaust gases and shall conform to the construction standards.

- 9.1.2.1 Every exhaust system fitting, joint, clamp, and support shall be accessible. All hose connections shall be double clamped.
- 9.1.2.2 Exhaust system piping, components and connection shall be independently supported to minimize failure from vibration, shock and expansion.
- 9.1.2.3 All supports, hangers, brackets, or other fittings in contact with uncooled exhaust carriers shall be non-combustible and constructed so that the temperatures transmitted to the supporting materials will not cause combustion or component failure.
- 9.1.2.4 Exhaust system piping shall be kept at a safe distance from combustible material, so as to prevent the surface temperature of such materials from exceeding 93°C.
- 9.1.2.5 Protective guards, jacketing or covers shall be provided wherever persons or gear might come into contact with the exhaust system where the temperature exceeds 93°C. The temporary removal of this protection is permitted, if necessary for engine maintenance or repair.
- 9.1.2.6 Each exhaust system shall be designed and installed to prevent cooling water, rain water, or raw water from entering the engine through the exhaust system under all normal operating and non-operating conditions.
- 9.1.2.7 No additional discharges other than cooling water shall share the exhaust gas passage.

9.1.3 Materials

- 9.1.3.1 Materials used in a marine engine exhaust system shall be resistant to saltwater corrosion, resistant to exhaust products, and galvanically compatible. Non-metallic exhaust system components shall meet the requirements of Underwriters Laboratories UL 1129 or Society of Automotive Engineers Standard SAE J2006.
- 9.1.3.2 Threaded pipe and fittings for the engine exhaust shall be at least schedule 80 pipe or equivalent.
- 9.1.3.3 Non-metallic exhaust system components shall retain watertight integrity for two (2) minutes after a total loss of cooling water with the engine operating at full power.

9.2 Main and Auxiliary Machinery

9.2.1 Scope

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length		
More than 6 metres in length		■

9.2.2 General

As stated by the Regulations:*Auxiliary Machinery*

734. Sections 735 to 739 apply in respect of a vessel, other than a pleasure craft, that is more than 6 m in length.

735. (1) Every machinery system on a vessel shall conform to the construction standards.

(2) Guards shall be installed on a vessel to protect persons from injury where persons may come into contact with moving parts of machinery systems on the vessel.

(3) Every operating position on a vessel shall be fitted with the instruments and controls set out in the construction standards.

Main and Auxiliary Engine – As stated by the Regulations:

738. A person installing a combustion engine on a vessel for propulsion or auxiliary purposes shall ensure that the engine is designed for marine use.

9.2.3 Engine Starting

Information Note:

The machinery shall have either mechanical, hand, or electric starting.

Where auxiliary batteries are fitted, it is recommended that they be capable of being connected in parallel to provide additional starting power.

9.2.4 Operating Position Instruments and Controls

9.2.4.1 The following instruments and controls shall be provided at the vessel's operating position:

- a) engine oil pressure and engine coolant temperature indicators for inboard engine;
- b) fuel capacity gauges, unless other adequate means to determine the amount of fuel is provided;
- c) battery charging gauges;
- d) controls for navigation light, steering equipment, etc.;
- e) control and instructions for the blowers;
- f) high bilge indicator;
- g) the running indicator for automatic bilge pump;

- h) fire detection panel and alarms; and
- i) engine shut-off device.

9.2.5 Shafting and Propellers

As stated by the Regulations:

739. The materials and dimensions of shafting and propellers shall be determined in accordance with the manufacturer's specifications or with the recommended practices and standards.

9.2.6 Steering Systems

As stated by the Regulations:

737. (1) A vessel shall be fitted with a safe and reliable main steering gear that is operable from the operating position and capable of maneuvering the vessel under normal operating conditions.

(2) The main steering gear shall be protected from obstructions, excessive heat and mechanical wear.

(3) A vessel shall be fitted with a means of emergency steering in accordance with the construction standards if

(a) the vessel is operated in remote areas or areas where help is not readily available; or

(b) the main steering gear is fitted with a remote control.

(4) A means of emergency steering is not required if the vessel is fitted with a main steering arrangement that is

(a) a rudder and hand tiller; or

(b) an outboard engine or stern-drive.

9.2.6.1 Emergency steering shall:

- a) be capable of steering the vessel at slow speed; and
- b) shall consist of:
 - (i) a permanent or a portable auxiliary rudder and tiller;
 - (ii) multiple screw propulsion with independent control of each screw;
 - (iii) steering action obtained by a change of directional setting of the propulsion units where there is no rudder fitted and more than one propulsion unit;
 - (iv) independently controlled adjustable trim tabs; or
 - (v) a bow thruster.

9.3 Bilge Pumping Arrangements

9.3.1 Scope

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length		
More than 6 metres in length		■

9.3.2 General

As stated by the Regulations:

736. (1) A watertight compartment on a vessel shall be provided with a means of pumping or with access for bailing when the vessel is in any operating condition, unless the vessel cannot retain a sufficient quantity of water to make it capsize or the compartment is sealed and is not readily accessible.

(2) If the bilge space on a vessel is not easily visible from the operating position, the space shall, in accordance with the construction standards, be fitted with

(a) an automatic high bilge-water alarm; and

(b) a bilge pumping system or, in the case of a vessel that is not more than 12 m in length, a permanently installed automatic bilge pump that is connected to an indicator showing when the pump is running and to an overriding manual switch, both of which are to be located at the operating position.

(3) An automatic bilge pump or a bilge pumping system shall have a minimum capacity of 0.91 L/s.

9.3.2.1 The means provided for pumping or bailing each watertight compartment shall be effective when the vessel is upright and when it is heeling up to an angle of 10 degrees.

9.3.3 Bilge Pumping Systems

9.3.3.1 A bilge pumping system shall be provided with a mechanical pump. The pump shall be self-priming and be designed to run dry without damage. Engine driven pumps are acceptable only if they can be run independently from the propulsion shafting.

9.3.3.2 The piping arrangement shall ensure that no back siphoning can occur and marine type strainers shall be provided on the suction line from each compartment.

9.3.3.3 The piping shall be of metal, rigid plastic, non-collapsible and non-oil degradable hose with flanged, screwed, or robust double-clamped connections, where practicable.

9.3.3.4 The piping shall be not less than 25 mm (1 in) in diameter, except that for small compartments piping 18 mm (3/4 in) in diameter may be acceptable if the pump-out time is under five (5) minutes.

9.3.4 Automatic Bilge Alarm and Pump Running Indicator

9.3.4.1 The bilge alarms shall provide a visible and audible signal at the operating position to indicate a high bilge level.

9.3.4.2 Where overnight sleeping accommodation is provided, high bilge level alarms shall have a minimum intensity of 84 dB.

9.3.4.3 When an automatic bilge pump is fitted:

- a) a visual signal shall be provided at the operating position to indicate when the pump is running; and

- b) a manual overriding switch shall be provided at the operating position.

9.4 Pressure Vessels

9.4.1 Scope

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length	■	■
More than 6 metres in length	■	■

9.4.2 General

9.4.2.1 Every pressure vessel shall be fitted with a drain valve, pressure gauge, and safety valve, and shall conform to *ASME Boiler and Pressure Vessel Code*, except for the following:

- a) a pressure vessel having a working pressure that does not exceed 103 kPa (15 lbs/in²);
- b) a pressure vessel having an internal diameter that does not exceed 152 mm (6 in);
- c) a pressure vessel where the volume above the normal working level of a liquid does not exceed 45 L (12 U.S. gal); or
- d) a pressure vessel where the volume does not exceed 150 L (40 U.S. gal) and the maximum working pressure does not exceed 700 kPa (100 lbs/in²).

10 FIRE SAFETY

10.1 Scope

	Pleasure Craft	Non-Pleasure Craft
Not more than 6 metres in length		■
More than 6 metres in length		■

10.2 Means of Escape

As stated by the Regulations:

742. (1) A vessel, other than a pleasure craft, that is more than 6 m in length shall be provided with a minimum of two means of escape in each accommodation, service and engine space, in accordance with the construction standards.

(2) Only one means of escape is required in an accommodation, service or engine space if

- (a) the space is not normally occupied;
- (b) the dimensions of the space do not permit more than one means of escape; or
- (c) the deck area is not more than 28 m².

Towing Operations — Additional Requirements

521. A workboat that engages in towing operations shall

- (a) keep two lifejackets in the wheelhouse and two others in the engine space if that space is normally occupied;
- (b) have means readily available for immediately releasing or cutting the tow line in case of an emergency;
- (c) have two means of escape from the wheelhouse directly to the outside, located so that one means of escape is available in the event of a heel;

10.2.1 General

- 10.2.1.1 The two (2) means of escape shall be as remote from each other as practicable so as to minimize the possibility of one incident blocking both escapes.
- 10.2.1.2 The two (2) exits shall have egress to different rooms or spaces to minimize the possibility of one incident blocking both exits.
- 10.2.1.3 Unless not practicable, the exits shall have a minimum clear opening size of 560 mm x 560 mm.

10.3 Fire Detection and Alarm

As stated by the Regulations:

418. (1) A passenger-carrying vessel that is not more than 6 m in length shall be fitted with

- (a) in each engine space, a heat detector that
 - (i) is hard-wired to a red visual alarm and to an audible alarm of at least 84 dB, both of which are to be located at the operating position,

(ii) has a green light indicating power at the detector, and

(iii) is powered by the vessel's electrical system; and

(b) in each accommodation and service space, other than in low risk spaces such as washrooms and void spaces, a fire detector that

(i) is certified by a product certification body,

(ii) has a built-in audible alarm of at least 84 dB, and

(iii) may be powered with an internal battery.

(2) Paragraph (1)(a) does not apply in respect of a vessel in which the engine is enclosed in such a manner that a fire would be immediately apparent to a person at the operating position.

516. (1) A workboat that is not more than 6 m in length shall be fitted with

(a) in each engine space, a heat detector that

(i) is hard-wired to a red visual alarm and to an audible alarm of at least 84 dB, both of which are to be located at the operating position,

(ii) has a green light indicating power at the detector, and

(iii) is powered by the vessel's electrical system; and

(b) in each accommodation and service space, other than in low-risk spaces such as washrooms and void spaces, a fire detector that

(i) is certified by a product certification body,

(ii) has a built-in audible alarm of at least 84 dB, and

(iii) may be powered with an internal battery.

(2) Paragraph (1)(a) does not apply in respect of a vessel in which the engine is enclosed in such a manner that a fire would be immediately apparent to a person at the operating position.

FIRE SAFETY

740. A vessel, other than a pleasure craft, that is more than 6 m in length shall be fitted, in accordance with the construction standards, with

(a) a fire alarm panel;

(b) a dual action rate-of-rise and fixed temperature detector in each engine space; and

(c) a fire detector in each accommodation and service space, other than in low-risk spaces such as washrooms and void spaces.

Information Note :

For the application of paragraphs 418.(2) and 516.(2) of the Regulations a fire detector in the engine space is not required in a vessel of not more than 6 metres with only an outside operating position when the engine is enclosed in a box or trunk that is immediately visible from the operator position.

10.3.1 Engine space fire alarm for vessel of more than 6 metres and not more than 9 metres in length

- 10.3.1.1 The fire alarm at the control station shall consist of:
- a) a visual (red) and audible alarm; and
 - b) a power available light (green) for supervising power as close as possible to the detector.
- 10.3.1.2 A fire alarm shall initiate a continuous visual and audible alarm at the operating position that can be silenced by the operator only.
- 10.3.1.3 When indicator lights other than LED type are used, a test button and a dimmer without off position shall be provided.
- 10.3.1.4 The audible alarm shall have a minimum intensity of 84 dB.

10.3.2 Fire alarm panel for all vessels more than 9 metres and not more than 12 metres in length and workboats of more than 12 metres in length with no overnight accommodations

- 10.3.2.1 The fire alarm panel at the operating position shall be provided with:
- a) a visual (red) and audible alarm;
 - b) a power available light (green) for supervising power as close as possible to the detector;
 - c) two independent sources of power when the vessel is fitted with an emergency power source; and
 - d) monitoring of the main power source and automatic change over to the emergency power source.
- 10.3.2.2 A fire alarm shall initiate a continuous visual and audible alarm at the operating position that can be silenced by the operator only.
- 10.3.2.3 When indicator lights other than LED type are used, a test button and a dimmer without off position shall be provided.
- 10.3.2.4 The audible alarm shall have a minimum intensity of 84 dB.

10.3.3 Fire alarm panel for passenger-carrying vessels of more than 12 metres in length and workboats of more than 12 metres in length with overnight accommodations

- 10.3.3.1 The panel shall meet the requirements listed in 10.3.2 and additionally be provided with:
- a) two independent power sources, one of which is an emergency power source, with automatic change over to the emergency power source;
 - b) two independent supervised zones, one for the engine space and one for other spaces;
 - c) an automatic means to sound an alarm through the vessel if the alarm signal has not received attention within two (2) minutes; and
 - d) automatic silencing of the alarm when a voice communication is transmitted over the public address system.

Information Note:

An automatic fire detection and fire alarm system complying with the requirements of the *Ship Electrical Standards* (TP127), section 21.6, that is certified for marine use by a product certification body or that is type approved by a classification society, should meet the requirements of section 10.3.3.

A fire alarm panel meeting the requirements of 10.3.3 will meet the requirements of 10.3.2 and 10.3.1. A fire alarm panel meeting the requirements of 10.3.2 will meet the requirements of 10.3.1.

The alternate source of power for a fire alarm panel may consist of a rechargeable internal battery.

10.3.4 Dual action rate-of-rise and fixed temperature detectors for engine space

10.3.4.1 Dual action rate-of-rise and fixed temperature detectors shall be used in engine spaces.

10.3.4.2 The detectors must be of a resettable type.

10.3.4.3 The coverage area and the installation shall be as per the detector manufacturer's instructions.

10.3.4.4 Where gasoline is used for fuel, the detector shall be either ignition protected or designed to operate in a location suitable for a gasoline/air mixture Class I Div 2 Group D or Zone 2 Group II A, (53.2) (8.4).

10.3.4.5 The detectors shall be:

- a) certified for marine use by a product certification body; or
- b) type approved by a classification society.

10.3.5 Fire detectors for accommodation spaces

10.3.5.1 Smoke detectors shall be used in accommodation spaces.

10.3.5.2 Heat detectors shall be used in the vicinity of any cooking appliances.

10.3.5.3 The coverage area and the installation shall be as per the detector manufacturer's instructions.

10.3.5.4 The detectors shall be:

- a) certified for marine use by a product certification body; or
- b) Type approved by a classification society.

10.3.5.5 Except as stated in 10.3.5.7 the detectors' power supply shall be:

- a) an integral battery; or
- b) connected to the vessel power distribution system.

10.3.5.6 On all vessels of not more than 12 metres and on workboats of not more than 15 metres that are not provided with overnight accommodations, detectors with integral alarm may be installed. The alarm level shall not be less than 84 dB.

10.3.5.7 The detectors are to be connected to the fire alarm panel on the following vessels:

- a) all passenger-carrying vessels of more than 12 metres;
- b) workboats of more than 12 metres with overnight accommodations;
- c) all workboats of more than 15 metres.

10.4 Fire Fighting

10.4.1 Provision for Discharging a Portable Fire Extinguisher in the Engine Space

As stated by the Regulations:

415. (1) A passenger-carrying vessel that is not more than 6 m in length and that has an enclosed engine space shall have provision for discharging a portable fire extinguisher directly into the engine space without the need to open the primary access to that space.

(2) The provision for direct discharge shall be marked in accordance with the construction standards to clearly indicate its firefighting purpose.

(3) The provision for direct discharge shall be capable of accommodating the discharge nozzle of the fire extinguisher and shall be arranged so that the fire extinguisher may be discharged in accordance with the manufacturer's instructions.

(4) If the passenger-carrying vessel is fitted with a fixed fire extinguishing system in accordance with section 741, a provision for direct discharge is not required.

513. (1) A workboat that is not more than 6 m in length and that has an enclosed engine space shall have provision for discharging a portable fire extinguisher directly into the engine space without the need to open the primary access to that space.

(2) The provision for direct discharge shall be marked in accordance with the construction standards to clearly indicate its firefighting purpose.

(3) The provision for direct discharge shall be capable of accommodating the discharge nozzle of the fire extinguisher and shall be arranged so that the fire extinguisher may be discharged in accordance with the manufacturer's instructions.

(4) If the workboat is fitted with a fixed fire extinguishing system in accordance with section 741, a provision for direct discharge is not required.

10.4.2 Fixed Fire Extinguishing System

As stated by the Regulations:

741. (1) Every vessel, other than a pleasure craft, that is more than 6 m in length and that has an enclosed engine space shall

(a) be fitted with a fixed fire extinguishing system having a sufficient quantity of fire extinguishing agent for the protection of the space in accordance with the construction standards; or

(b) have provision for discharging a portable fire extinguisher that meets the requirements of section 416 or 514 directly into the engine space without the need to open the primary access to that space.

(2) A gas, other than carbon dioxide, that is used as a fire extinguishing agent shall provide protection at least equivalent to that provided by carbon dioxide.

(3) A fixed fire extinguishing system shall be certified for marine use by a product certification body or a classification society and installed in accordance with the manufacturer's instructions.

Information Note:

As stated in paragraph 741.(3) of the Regulations a fixed fire extinguishing system shall be certified for marine use by a product certification body or a classification society. A fixed fire extinguishing system cannot be fabricated by modifying a portable fire extinguisher or by assembling components on board, because in this case the system

design and fabrication is not tested and certified by a product certification body or a classification society.

10.4.2.1 **General**

- 10.4.2.1.1 Engine spaces protected by a gas smothering system shall be gastight such that leakage of the system will not penetrate accommodation and service spaces.
- 10.4.2.1.2 Means shall be provided to close all engine space openings.
- 10.4.2.1.3 The system shall be fitted with a manual release device located outside of the engine space.
- 10.4.2.1.4 When a fixed fire extinguishing system is activated, the full charge of extinguishing agent shall be released simultaneously.
- 10.4.2.1.5 Means shall be provided outside of the engine space for:
- a) stopping all ventilation fans serving the space; and
 - b) shutting off the source of power or fuel for any machinery or equipment in the space that could contribute to sustaining a fire or create any other unsafe condition in the case of fire.
- 10.4.2.1.6 A system with automatic release of the agent shall not be provided for normally occupied engine spaces.
- 10.4.2.1.7 A system with automatic release of the agent shall provide:
- a) a means to indicate the release of the gas at the operating position; and
 - b) automatic operation of the means required in 10.4.2.1.5.
- 10.4.2.1.8 If the engine space has a gross volume of more than 57 m³ or is normally occupied, the fire-extinguishing system must not have an automatic means to release the extinguishing agent.
- 10.4.2.2 **Carbon Dioxide (CO₂) Fixed Fire Extinguishing Systems**

Information Note:

A carbon dioxide fixed fire extinguishing system that is certified for marine use by a product certification body based on the *Standard on Carbon Dioxide Extinguishing Systems*, NFPA 12, should meet the requirements stated in 741(3) of the Regulations when installed in accordance with the requirements of this Standard and the manufacturer's instruction manual, and the conditions on the approval certificate.

- 10.4.2.2.1 The quantity of carbon dioxide for a fixed carbon dioxide fire-extinguishing system serving an engine space must be sufficient to achieve, at a specific volume of 0.56 m³ per kilogram (9 ft³ per pound), a volume of free gas equal to:
- a) 60% of the gross volume of the space, if the gross volume is not more than 14 m³;
 - b) 40% of the gross volume of the space, if the gross volume is more than 136 m³; and
 - c) the percentage obtained by linear interpolation between the percentages set out in paragraphs (a) and (b), if the gross volume of the space is more than 14 m³ but not more than 136 m³.
- 10.4.2.2.2 A minimum of 85% of the carbon dioxide shall be discharged into the space in two (2) minutes or less.

10.4.2.3 Fixed Fire Extinguishing Systems with a Gas Other than Carbon Dioxide

Information Note:

A fixed fire extinguishing system with a gas other than carbon dioxide that is certified for marine use by a product certification body based on the *Standard on Clean Agent Fire Extinguishing Systems*, NFPA 2001, should meet the requirements stated in 741(3) of the Regulations when installed in accordance with the requirements of this Standard and the manufacturer's instructions manual, and the conditions on the approval certificate.

- 10.4.2.3.1 The minimum design concentration of the gas is the greater of
- the concentration that is 30% above the minimum extinguishing concentration when the minimum extinguishing concentration of the gas is determined by a cup burner test; and
 - the extinguishing concentration that is determined by full-scale testing.
- 10.4.2.3.2 If the fire-extinguishing system uses halocarbon as the extinguishing agent, the system must discharge a sufficient quantity of the agent for 95% of the minimum design concentration to be reached in the space in 10 seconds or less. If the system uses an inert gas as the extinguishing agent, the system must discharge a sufficient quantity of the agent for 85% of the minimum design concentration to be reached in the space in 120 seconds or less.
- 10.4.2.3.3 The quantity of gas for a fixed gas fire-extinguishing system that uses a gas other than carbon dioxide and is serving an engine space must be sufficient to protect the space. The required quantity of gas is calculated using the minimum expected ambient temperature, the minimum design concentration of the gas and the net volume of the space..
- 10.4.2.3.4 The net volume of the space is its gross volume, including the volume of the bilge, the volume of the casing, and the volume of free air contained in air receivers that in the event of a fire is released into the space, minus the volume of objects in the space.

10.4.2.4 Aerosol Fixed Fire Extinguishing Systems

Information Note:

An aerosol fixed fire extinguishing system that is certified for marine use by a product certification body based on the *Standard for Fixed Aerosol Fire-Extinguishing Systems*, NFPA 2010, should meet the requirements stated in 741(3) of the Regulations when installed in accordance with the requirements of this Standard and the manufacturer's instructions manual, and the conditions on the approval certificate.

- 10.4.2.4.1 The design application density must be at least 30% above the extinguishing application density when the extinguishing application density of the aerosol is determined by full-scale testing.
- 10.4.2.4.2 The fire-extinguishing system must discharge a sufficient quantity of the aerosol for the design application density to be reached in the space in 120 seconds or less.
- 10.4.2.4.3 The quantity of aerosol for a fixed aerosol fire-extinguishing system serving an engine space must be sufficient to protect the space. The required quantity of aerosol is calculated using the minimum expected ambient temperature, the design application density of the aerosol, the net volume of the space and, if the system is a condensed aerosol fire-extinguishing system, the efficiency of its generator
- 10.4.2.4.4 The net volume of the space is its gross volume, including the volume of the bilge, the volume of the casing, and the volume of free air contained in air receivers that in the event of a fire is released into the space, minus the volume of objects in the space.
- 10.4.2.4.5 An aerosol system shall not be used on a wooden vessel.

Information Note:

Aerosol systems are not suitable for extinguishing deep seated class A fires; therefore, their use is not permitted on wooden vessels.

10.4.3 Fire Pumps**As stated by the Regulations:***Firefighting Equipment*

414. (1) A passenger-carrying vessel of a length set out in column 1 of the table to this subsection shall carry on board the firefighting equipment set out in column 2 as indicated in that column.

	Column 1	Column 2
Item	Length	Firefighting Equipment
4.	more than 12	(d) a manual or power-driven fire pump, located outside the engine space, that conforms to the construction standards; (e) a fire hose and nozzle from which a jet of water can be directed into any part of the vessel;

Firefighting Equipment

512. (1) A workboat of a length set out in column 1 of the table to this subsection shall carry on board the firefighting equipment set out in column 2 as indicated in that column.

	Column 1	Column 2
Item	Length	Firefighting Equipment
4.	more than 12	(d) a manual or power-driven fire pump, located outside the engine space, that conforms to the construction standards; (e) a fire hose and nozzle from which a jet of water can be directed into any part of the vessel;

10.4.3.1 Every fire pump shall

- a) be self-priming;
- b) have a minimum capacity of 1.14 L/second; and
- c) be capable of delivering a jet of water of at least 12 m through the hose and nozzle.

- 10.4.3.2 Every fire pump shall, unless it is on the open deck, be made of non-combustible materials.
- 10.4.3.3 Every pump impeller that is part of a fire pump shall be of a type that will not be damaged by heat or when running dry.
- 10.4.3.4 Every sea suction inlet of a fire pump shall have arrangements to prevent blockage of the inlet by ice or debris.
- 10.4.3.5 The fire main shall have a minimum diameter of 25 mm.
- 10.4.3.6 The nozzle on a fire hose shall:
- a) have an internal diameter of at least 12 mm;
 - b) be capable of spray action and jet action; and
 - c) have a means to shut it off.

1 DECLARATION OF CONFORMITY FORMS AND PROCESS

1.1 Manufacturer Identification Code (MIC)

As stated by the Regulations:

903. (1) The builder, manufacturer, rebuilder or importer of a vessel shall obtain a manufacturer's identification code from the Minister.

- 1.1.1 If you are a new manufacturer or importer based in Canada (and if the product is not from the United States), you must first apply to obtain a Manufacturer Identification Code (MIC) from Transport Canada, Marine Safety.
- 1.1.2 To obtain a Manufacturer Identification Code the REQUEST FOR A MANUFACTURER IDENTIFICATION CODE (MIC) (form no.80-0008) must be filled and transmitted to Transport Canada.
- 1.1.3 The form must be signed by a responsible officer of the manufacturer or importer that is a Canadian resident. If the responsible officer is not an officer of the company the delegation of authority from the company must be explicit and in writing.
- 1.1.4 A MIC that has been assigned by Transport Canada or by the United States Coast Guard is accepted in the other country by a reciprocal agreement
- 1.1.5 A Canadian importer may request to use the MIC assigned to the manufacturer in its country of origin when the code is 3 letters as required in Canada. The importer must have an agreement with the foreign manufacturer for exclusive use of this MIC in Canada. The importer will be responsible for all vessels imported in Canada and marked with a Hull Serial Number (HIN) using this MIC.
- 1.1.6 When the use of a foreign MIC has been accepted by Transport Canada this MIC must always be used with the country's alpha-2 code published by the Maintenance Agency for ISO 3166 marked as a prefix before the MIC and separated with a dash.

1.2 Declaration of Conformity

As stated by the Regulations:

Declaration of Conformity

- 803.** (1) The builder, manufacturer, rebuilder or importer of a vessel shall prepare a declaration of conformity that
- (a) is submitted in the form established by the Minister;
 - (b) contains the principal dimensions and specifications of the vessel, the details of the vessel's compliance with the construction requirements and the information appearing in the compliance notice; and
 - (c) is signed by the person who prepares the declaration, if that person is a Canadian resident, or, in any other case, by a representative of that person who is a Canadian resident.
- (2) The builder, manufacturer, rebuilder or importer who prepares the declaration of conformity shall provide a copy of it to the reseller or end user at the time of the initial transfer of ownership of the vessel and to the Minister at or before that time.
- (3) In the case of a series of vessels of a single model, the builder, manufacturer, rebuilder or importer shall, not

later than March 31 in a calendar year, provide to the Minister, instead of a declaration of conformity for each vessel, a single declaration of conformity for each model of vessel and a report indicating the number of vessels of that model constructed, manufactured, rebuilt or imported during the previous calendar year.

(4) The reseller of a vessel shall provide the declaration of conformity to another reseller at the time of the transfer of ownership of the vessel or to the end user at the time of the initial transfer of ownership of the vessel.

Records

804. (1) Before attaching a compliance notice to a vessel, the builder, manufacturer, rebuilder or importer of the vessel shall establish, in respect of the vessel or model of vessel, the following records:

(a) the technical documentation or information used — including the tests or calculations performed — to ensure compliance with the construction requirements; and

(b) a copy of the declaration of conformity.

(2) The builder, manufacturer, rebuilder or importer of the vessel shall keep the records for a period of seven years after the day on which they are established and shall, on request, provide the records to any person or organization authorized under the Act to carry out inspections.

- 1.2.1 The DECLARATION OF CONFORMITY (form no. 80-0009) is stating that the vessel built or imported for use in Canada conforms to the construction requirements of the *Small Vessel Regulations*, either for pleasure craft or for non-pleasure craft, as the case may be.
- 1.2.1.1 In accordance with the Memorandum of understanding between Transport Canada and the National Marine Manufacturers Association (NMMA) vessels inspected as part of NMMA certification can submit the DECLARATION OF CONFORMITY ADDENDUM TO NMMA CERTIFICATE (form no. 80-0054) as an alternative to the standard SMALL VESSEL DECLARATION OF CONFORMITY form 80-0009.
- 1.2.2 As required by the Regulations, this DECLARATION OF CONFORMITY form is to be completed and signed by a Canadian resident who is the responsible officer or representative of the company
- 1.2.3 A new DECLARATION OF CONFORMITY shall be produced when new models are introduced, when the physical characteristics of the model are changed, when a change of address or company change occurs, or when name changes of models occur.
- 1.2.4 The DECLARATION OF CONFORMITY is to be provided to Transport Canada either by mail or electronically.
- 1.2.5 A copy of the DECLARATION OF CONFORMITY shall also be provided to the reseller or end user at the time of the initial transfer of ownership of the vessel. A STATUTORY DECLARATION that was produced before the coming into force date of the new *Small Vessels Regulations* may be provided to the reseller or end user for a maximum of 24 months after the coming into force of the new *Small Vessel Regulations*.
- 1.2.6 This legal document must be completed in ink and must be legible.
- 1.2.7 When the Canadian responsible officer is not the manufacturer or the importer, the delegation of power from the manufacturer to the responsible officer must be explicit and shall be in writing. A copy of the delegation of power shall be sent to Transport Canada with the DECLARATION OF CONFORMITY.
- 1.2.8 The exact model indicated on the DECLARATION OF CONFORMITY shall be the same exact model printed on the Canadian Compliance Notice that will be attached to the vessel.

- 1.2.9 A separate DECLARATION OF CONFORMITY shall be produced for every model with different dimensions or physical characteristics.
- 1.2.10 A STATUTORY DECLARATION that was made in the previous form before the coming into force of the new Small Vessel Regulations will be valid for 24 months after the coming into force of the new Regulations. After that delay a DECLARATION OF CONFORMITY in the new form must be submitted to Transport Canada.

1.3 Annual Production Report

- 1.3.1 Every manufacturer must submit to Transport Canada, not later than March 31, an ANNUAL PRODUCTION REPORT (form no. 80-0010) stating the quantity of each vessel model built during the previous calendar year under every DECLARATION OF CONFORMITY.
- 1.3.2 The form must be signed by a responsible officer that is a Canadian resident that is an officer of the company or, if the responsible officer is not an officer of the company the delegation of authority from the company must be explicit and in writing

1.4 Technical Documents, Test Reports and Calculations

- 1.4.1 The technical documentation, test reports and calculations records referred to in the Regulations shall comprise all relevant data or means used by the manufacturer to ensure that components of the vessel comply with the construction requirements relating to them.
- 1.4.2 The technical documentation shall explain the concept, manufacturing, and the operation of the product and shall enable verification of compliance with the construction requirements.
- 1.4.3 The documentation shall contain so far as relevant for assessment:
- a) a general description of the vessel;
 - b) conceptual design and manufacturing drawings and schemes of components, sub-assemblies, circuits, etc.;
 - c) descriptions and explanations necessary for the understanding of said drawings and schemes and the operation of the product;
 - d) a list of the standards applied in full or in part, and descriptions of the solutions adopted to fulfil the construction requirements and all relevant standards;
 - e) results of design calculations made, examinations carried out, etc.; and
 - f) test reports or calculations, namely on stability and flotation according to sections 4 and 5 of these Standards.

Information note:

Transport Canada forms may be updated from time to time, for the latest version consult the Transport Canada Form Catalogue at <http://wwwapps.tc.gc.ca/Corp-Serv-Gen/5/Forms-Formulaire/search.aspx>

[REQUEST FOR A MANUFACTURER IDENTIFICATION CODE \(MIC\) \(form no 80-0008\)](#)

[SMALL VESSEL DECLARATION OF CONFORMITY \(form no 80-0009\)](#)

**CONSTRUCTION STANDARDS FOR SMALL VESSELS
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[DECLARATION OF CONFORMITY ADDENDUM TO NMMA CERTIFICATE \(form no. 80-0054\)](#)

[ANNUAL PRODUCTION REPORT \(form no. 80-0010\)](#)

1.5 Guidelines for the Technical Information

1.5.1 In general, the technical documentation below will provide the needed information to assess the conformity of a vessel. Alternative media, such as photos, are acceptable in place of drawings. Checklists only, filled in on behalf of or by the manufacturer without additional diagrams, specifications, drawings or other information as required, may not be sufficient to assess conformity.

Reference		Documentation
SVR	TP 1332	
		GENERAL VESSEL DESCRIPTION <ul style="list-style-type: none"> Type of vessel (e.g., <i>pleasure, non-pleasure, monohull, pontoon, sailing, etc.</i>) Main particulars (e.g., <i>length, beam, depth, draft, weight, etc.</i>)
Part 9.	1.	HULL SERIAL NUMBERS (HIN) <ul style="list-style-type: none"> Records of all vessels produced with their HIN
Part 8	2.	COMPLIANCE NOTICE <ul style="list-style-type: none"> Sample maximum recommended limits (if applicable) or Design category (if applicable)
711.	0.6	PLANS (NON-PLEASURE CRAFT) <ul style="list-style-type: none"> General arrangement (profile, deck plan) Machinery arrangement and identification of the machinery along with a description of the bilge pumping systems, fuel systems and fire fighting systems Diagram of the propulsion system One-line electrical diagram
712.	3.5	PROTECTION FROM FALLS <ul style="list-style-type: none"> Installation details (e.g., choice of options and solutions, specifications of fittings, location)
713.	3.2	STRUCTURAL STRENGTH <ul style="list-style-type: none"> Scantlings calculations (if available) Construction plan List of fitted materials GRP schedule / Sandwich schedule Details of welding procedure Details of laminate construction / laminate procedure (e.g., resin/core) Details of wood construction
714.	3.3	WATERTIGHT INTEGRITY <ul style="list-style-type: none"> Windows, hatches, doors, portlights details Degree of watertightness of closing appliances Hull penetration details Cockpit drainage Test records (watertightness)
715	4	HULL DESIGN REQUIREMENTS: VESSELS NOT MORE THAN 6 METRES <ul style="list-style-type: none"> Lines plan, if used for assessment Hull volume (displacement) calculations or test Maximum gross load calculations Maximum power calculations Maximum number of persons calculations Buoyancy calculations, test reports, minimum flotation or level flotation (if applicable) Stability test records (if applicable)
716. 717.	5.	HULL DESIGN REQUIREMENTS: NON-PLEASURE CRAFT OF MORE THAN 6 METRES <ul style="list-style-type: none"> Lines plan, if used for assessment Stability calculations, test Flotation calculations, test (if applicable)

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Reference		Documentation
SVR	TP 1332	
718. 719. 720.	6.	VENTILATION SYSTEMS <ul style="list-style-type: none"> • Details of natural ventilation (if applicable) • Details of mechanical ventilation (if applicable) • Details of battery space ventilation (if applicable) • Labeling information
721. 722. 723. 724. 725. 726. 727.	7.	FUEL SYSTEMS <ul style="list-style-type: none"> • Tanks details, testing • Fuel system diagram • Fuel lines, fittings (material, support, routing) • Grounding details • Carburetor spark arrestor (if applicable) • Labeling information
728. 729. 730. 731. 732.	8.	ELECTRICAL SYSTEMS <ul style="list-style-type: none"> • Standard used (e.g., TP 1332, ABYC E-11, other) • Wiring diagram AC/DC • Details of ignition protection (component, specifications, location) • Electrical components details (type, specification) • Cables (routing, chafe protection, connections) • Grounding batteries installation • Emergency lighting (if applicable)
733.	9.1	EXHAUST SYSTEMS <ul style="list-style-type: none"> • Details or material, installation
734. 735. 736. 737. 738. 739.	9.2 9.3	MACHINERY SYSTEMS <ul style="list-style-type: none"> • Engine installation, including possible exposed parts • Bilge pumping arrangement • Steering system, including emergency (if applicable)
740. 741. 742.	10.	FIRE SAFETY (VESSELS OF MORE THAN 6 METRES OTHER THAN A PLEASURE CRAFT) <ul style="list-style-type: none"> • Means of escape (if applicable) • Fire detection details (if applicable) • Means of extinguishing for engine space (access port) • Fixed fire extinguishing system details (if applicable)
721.		FUEL-BURNING SYSTEM THAT USES GASEOUS FUEL, LIQUEFIED PETROLEUM GAS, COMPRESSED NATURAL GAS <ul style="list-style-type: none"> • Components (type, specification) • Installation details • Standard used

1.6 CONFORMITY OF SECOND-HAND OR REBUILT VESSELS

1.6.1 General

1.6.1.1 This section provides guidance for the preparation of a DECLARATION OF CONFORMITY when the technical documentation that must be prepared by a manufacturer or importer of new vessels is not available, such as a second-hand vessel being imported into Canada or the rebuilding of a vessel.

1.6.2 Documentation

1.6.2.1 As required by section 701, 702 and 707 of the Regulations all vessels imported to Canada must comply with the construction requirements in force on the date of the importation; this is applicable to new and used vessels. A rebuilt vessel must also comply with the construction requirements in force on the date of the rebuilding.

1.6.2.2 The importer of a second-hand vessel or the rebuilder of an existing vessel may not have access to all the technical information prepared by the original manufacturer to ensure compliance. Compliance with the construction requirements of a second-hand vessel or the rebuilder of a vessel will be ensured in large part by a complete professional survey of the vessel.

1.6.2.3 To facilitate the survey and to assist in demonstrating compliance the importer or rebuilder should also seek to get all available information on the Regulations or standards to which the vessel was originally built, such as the USCG compliance notice, the CE manufacturer's plate or the conformity to the ABYC standards as certified by an organization such as the National Marine Manufacturers Association (NMMA) when available.

1.6.2.4 The importer or rebuilder shall keep the survey report and all available compliance information in order to be able to demonstrate compliance as required by section 804 of the Regulations.

1.6.3 Declaration of Conformity

1.6.3.1 The same DECLARATION OF CONFORMITY form (form no. 80-0009) is used for imported second-hand vessel or rebuild vessel than for new vessels.

1.6.3.2 In the case of imported second-hand vessel or rebuilt vessel a DECLARATION OF CONFORMITY will have to be prepared for each vessel. The importer or rebuilder must write the complete HIN marked by the original manufacturer on the DECLARATION OF CONFORMITY.

2 SEWAGE HOLDING TANK SYSTEMS

Vessel Pollution and Dangerous Chemicals Regulations states:

Equipment

86. (1) Subject to subsections (3) and (4), the authorized representative of a vessel in Section I waters or Section II waters that has a toilet must ensure that the vessel is fitted with a holding tank or a marine sanitation device that meets the requirements of section 88 or 90, as the case may be.

TEMPORARY STORAGE OF SEWAGE

(2) The vessel's authorized representative must ensure that it is fitted with facilities for the temporary storage of sewage if the vessel

(a) is fitted with a marine sanitation device that meets the requirements of paragraph 90(1)(d) only; or

(b) is in a designated sewage area and is fitted with a marine sanitation device that does not meet the requirements of paragraph 90(1)(b).

LIMITATION

(3) For the purpose of meeting the requirement of subsection (1), a Canadian vessel or Canadian pleasure craft must not be fitted with a marine sanitation device referred to in paragraph 90(1)(d).

EXCEPTION

(4) A vessel referred to in subsection (1) that is of less than 15 gross tonnage, is not certified to carry more than 15 persons and is not operating in the inland waters of Canada or designated sewage areas may be fitted with facilities for the temporary storage of sewage instead of meeting the requirements of subsection (1) if it is not feasible to meet those requirements and the vessel has measures in place to ensure that no discharge is made otherwise than in accordance with section 96.

SECURING TOILETS

87. The authorized representative of a vessel must ensure that any toilet fitted on the vessel is secured in a manner that ensures its safe operation in any environmental conditions likely to be encountered.

HOLDING TANKS

88. For the purposes of subsection 86(1), a holding tank must

(a) be constructed so that it does not compromise the integrity of the hull;

(b) be constructed of structurally sound material that prevents the tank contents from leaking;

(c) be constructed so that the potable water system and other systems cannot become contaminated;

(d) be resistant to corrosion by sewage;

(e) have an adequate volume for the amount of sewage that could be reasonably expected to be produced on a voyage in waters where the discharge of sewage is not authorized by section 96;

(f) be provided with a discharge connection and piping system for the removal of the tank contents at a reception facility;

(g) be designed so that the level of sewage in the tank can be determined without the tank being opened and without contacting or removing any of the tank contents, or be equipped with a device that allows the determination to be made;

(h) in the case of a vessel, other than a pleasure craft, that operates solely on the Great Lakes and their connecting

waters, be equipped with an alarm that indicates when the tank is 75% full by volume; and

(i) be equipped with a ventilation device that

- (i) has its outlet located on the exterior of the vessel and in a safe location away from ignition sources and areas usually occupied by people,
- (ii) prevents the build-up within the tank of pressure that could cause damage to the tank,
- (iii) is designed to minimize clogging by the contents of the tank or by climatic conditions such as snow or ice,
- (iv) is constructed of material that cannot be corroded by sewage, and
- (v) has a flame screen of non-corrosive material fitted to the vent outlet

2.1 General

2.1.1.1 Where it is intended to install a sewage holding tank system or a marine sanitation device in a vessel, it is recommended that the following guidelines (reproduced courtesy of ABYC) be followed. Additional provincial and local design requirements may apply.

2.2 System Types

2.2.2.1 Options include portable toilets (see section 2.3) or holding tank systems (with or without marine sanitation devices) (see section 2.4), each of which has advantages and disadvantages, as described below.

2.2.2.2 Holding tank systems and their plumbing arrangements (including marine sanitation devices) are also described in detail.

2.3 Portable Toilets (Temporary storage of sewage)

2.3.1 General

2.3.1.1 The toilet must be properly secured on board as required by section 87 of the *Vessel Pollution and Dangerous Chemical Regulations*.

a) Advantages

- (i) Requires minimal space.
- (ii) Low cost.
- (iii) Simplicity.
- (iv) Reliability.
- (v) Can be emptied via suction wand at a pump-out facility.
- (vi) Can be emptied ashore if pump-out facility is not available.

b) Disadvantages

- (i) Limited capacity.
- (ii) May not be permitted by some provincial or state laws.

2.4 Holding Tank Systems

2.4.1 General

2.4.1.1 These systems vary in complexity depending on what they are designed to do. There are three basic arrangements. These basic arrangements can be adapted depending on the number and type of toilets installed and whether inline waste treatment is desired.

2.4.2 Option 1: Deck Pump-Out Only

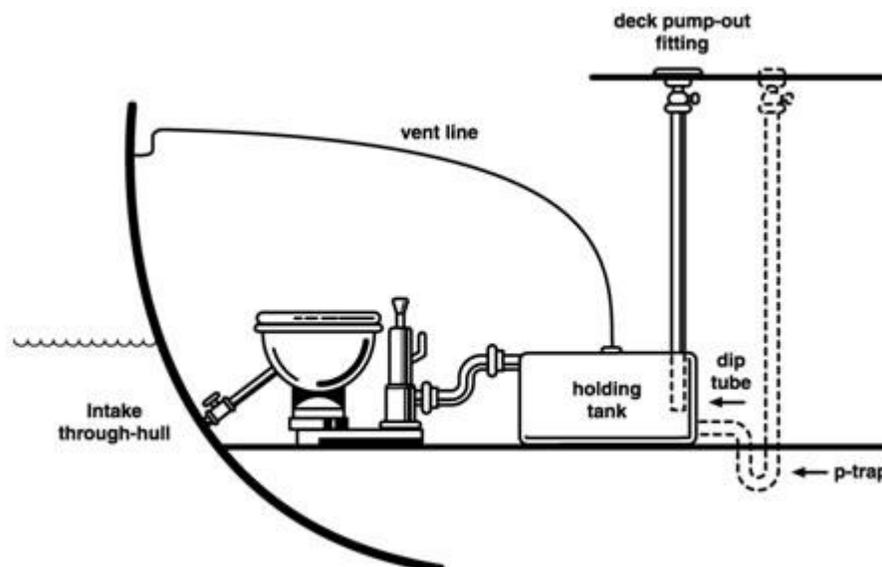
2.4.2.1 The holding tank is installed in line between the toilet and the deck pump-out fitting.

- a) Advantages
 - (i) Allows use of existing toilet.
 - (ii) Sewage goes directly into the tank.
 - (iii) Simple to install.
 - (iv) Minimal equipment requirements.
 - (v) Does not require a through-hull for discharge.
- b) Disadvantages
 - (i) External pump required to evacuate tank.

Information note:

This is the only system permitted on pleasure craft in the waters of Ontario as per the *Environmental Protection Act (Ontario)*, Regulation 343, "Discharge of Sewage from Pleasure Boats."

Figure 2-1 DECK PUMP-OUT ONLY



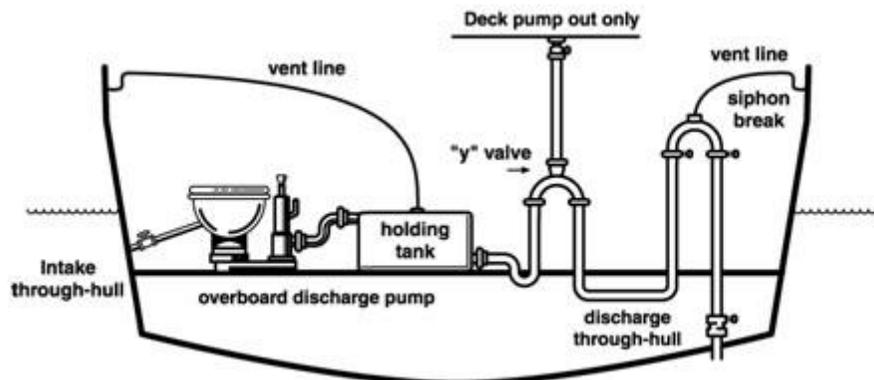
2.4.3 Option 2: Overboard Discharge After the Holding Tank

2.4.3.1 A diverter "Y" valve is installed in the line between the holding tank and deck pump-out fitting to allow the tank's contents to be pumped overboard. The "Y" valve must be secured to prevent overboard accidental discharge.

- a) Advantages
 - (i) All sewage is pumped into the holding tank.
 - (ii) Vessels will use pump-out facility in port.
- b) Disadvantages
 - (i) Overboard discharge of sewage not be permitted by federal, provincial or state laws.

2.4.3.2 A "Y" valve is not required in this option. The deck pump-out fitting and the overboard through-hull valve are normally pressure tight and will function alternatively as selected. Use of a "Y" valve, however, will keep unused sections of the hose or pipe from being unnecessarily "wet" (filled with sewage) and provide an additional safeguard against accidental overboard discharge.

Figure 2-2 OVERBOARD DISCHARGE AFTER HOLDING TANK



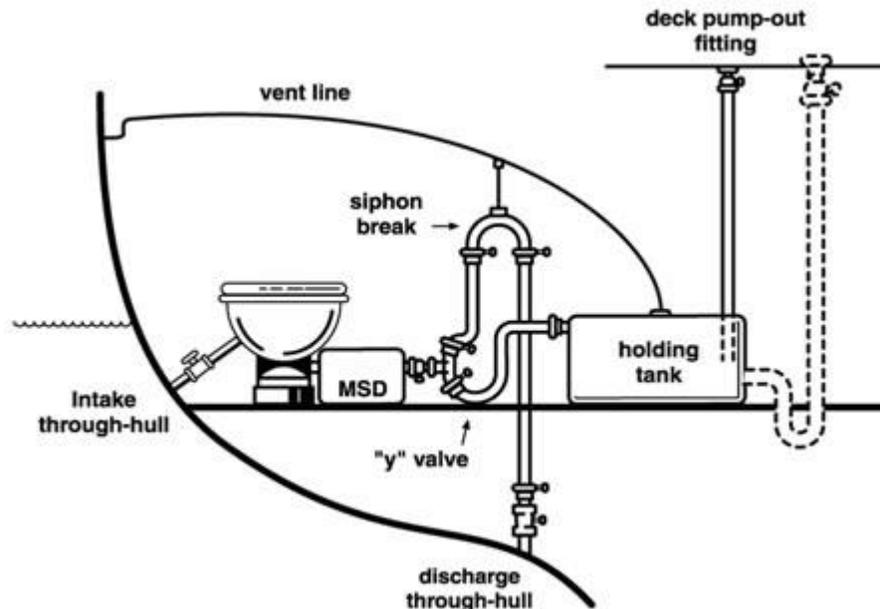
2.4.4 Option 3: Marine Sanitation Device

2.4.4.1 You should install a holding tank for use when boating in environmentally sensitive areas or when moored or dockside. A "Y" valve is installed in line between the marine sanitation device and holding tank.

- a) Advantages
 - (i) If a Type II marine sanitation device or another device meeting the requirements of section 90(1)(a), 90(1)(b), 90(1)(c) or 90(2) of the *Vessel Pollution and Dangerous Chemicals Regulations* is installed between the toilet and the "Y" valve and the effluent meets the requirements of section 96 (1) (a), treated sewage can be pumped directly overboard, unless the vessel is in "designated sewage areas" waters. Only effluent from a marine sanitation device referred to in 90(1)(b) may be discharged directly overboard in "designated sewage areas."
- b) Disadvantages
 - (i) Overboard discharge of sewage may not be permitted by federal, provincial or state laws
 - (ii) "Y" valve must be secured to prevent accidental illegal discharge.

(iii) External pump is required to empty holding tank.

Figure 2-3 MARINE SANITATION DEVICE WITH OVERBOARD DISCHARGE BEFORE HOLDING TANK



Information note:

No direct discharge is allowed from an onboard toilet. All discharge has to be made through a holding tank or a Marine Sanitation device – taking into account discharge requirements of those devices specified in section 96 of the *Vessel Pollution and Dangerous Chemical Regulations*.

The following marine sanitation devices are permitted by the Vessel Pollution and Dangerous Chemical Regulations

Marine Sanitation Devices

90. (1) For the purposes of subsection 86(1), a marine sanitation device must meet

- (a) the requirements of regulation 9.1.1 of Annex IV to MARPOL for a sewage treatment plant;
- (b) requirements substantially similar to the requirements referred to in paragraph (a) except that the standards referred to in regulation 9.1.1 include the effluent standard set out in paragraph 96(1)(b);
- (c) the design, construction and testing requirements of Title 33, Part 159, Subpart C of the *Code of Federal Regulations* of the United States for a Type II marine sanitation device; or
- (d) the requirements of regulation 9.1.2 of Annex IV to MARPOL for a sewage comminuting and disinfecting system.

GRANDFATHERING

(2) Despite subsection (1), a marine sanitation device that was approved as an approved device under the [Great Lakes Sewage Pollution Prevention Regulations](#) and continues to meet the requirements of those Regulations as they read on May 2, 2007 may continue to be used as a marine sanitation device.

Information Note:

As stated by the *Vessel Pollution and Dangerous Chemical Regulations*, the overboard discharge of sewage with systems as per options 2 and 3 is only permitted under the following conditions:

Authorized Discharge - Sewage

96. (1) For the purposes of section 95, sewage may be discharged if

(a) in the case of a vessel in an area other than a designated sewage area, the discharge is passed through a marine sanitation device and the effluent has a fecal coliform count that is equal to or less than 250/100 ml;

(b) in the case of a vessel in a designated sewage area, the discharge is passed through a marine sanitation device and the effluent has a fecal coliform count that is equal to or less than 14/100 ml;

(c) in the case of a vessel that is in Section I waters or Section II waters, but not in the inland waters of Canada or a designated sewage area, and that is of 400 gross tonnage or more or is certified to carry more than 15 persons,

(i) the discharge is made at a distance of at least 12 nautical miles from shore and, if it is made from a holding tank or from facilities for the temporary storage of sewage, at a moderate rate while the vessel is en route at a speed of at least 4 knots, or

(ii) the sewage is comminuted and disinfected using a marine sanitation device and the discharge is made at a distance of at least 3 nautical miles from shore;

(d) in the case of a Canadian vessel that is in waters that are not waters under Canadian jurisdiction and that is of 400 gross tonnage or more or is certified to carry more than 15 persons,

(i) the discharge is made at a distance of at least 12 nautical miles from the nearest land and, if it is made from a holding tank or from facilities for the temporary storage of sewage, at a moderate rate while the vessel is en route at a speed of at least 4 knots, or

(ii) the sewage is comminuted and disinfected using a marine sanitation device and the discharge is made at a distance of at least 3 nautical miles from the nearest land; or

(e) in the case of a vessel that is in Section I waters or Section II waters but not in the inland waters of Canada or a designated sewage area, and that is of less than 400 gross tonnage and is not certified to carry more than 15 persons,

(i) the sewage is comminuted and disinfected using a marine sanitation device and the discharge is made at a distance of at least 1 nautical mile from shore,

(ii) the discharge is made at a distance of at least 3 nautical miles from shore while the vessel is en route at the fastest feasible speed, or

(iii) if it is not feasible to meet the requirements of subparagraph (ii) because the vessel is located in waters that are less than 6 nautical miles from shore to shore, the discharge is made while the vessel is en route at a speed of at least 4 knots or, if the discharge is not feasible at that speed, the discharge is made

(A) during an ebb tide, while the vessel is en route at the fastest feasible speed and into the deepest

waters that are located the farthest from shore, or

(B) while the vessel is en route at the fastest feasible speed and into the deepest and fastest moving waters that are located the farthest from shore.

PARAGRAPHS (1)(A) AND (B) AND SUBPARAGRAPHS (1)(C)(II), (D)(II) AND (E)(I)

(2) In addition to the circumstances set out in paragraphs (1)(a) and (b) and subparagraphs (1)(c)(ii), (d)(ii) and (e)(i), the sewage may be discharged only if it does not contain any visible solids and the discharge does not cause

- (a) a film or sheen to develop on the water;
- (b) a discoloration of the water or its shorelines; or
- (c) sewage sludge or an emulsion to be deposited beneath the surface of the water or on its shorelines.

SUBPARAGRAPHS (1)(C)(I), (D)(I) AND (E)(II) AND (III)

(3) In addition to the circumstances set out in subparagraphs (1)(c)(i), (d)(i) and (e)(ii) and (iii), the sewage may be discharged only if the discharge does not cause visible solids to be deposited on the shoreline.

SUBPARAGRAPH (1)(E)(III)

(4) Subparagraph (1)(e)(iii) does not apply if a reception facility that can receive the sewage in an environmentally safe manner is available to receive it.

Definition of “moderate rate”

(5) In this section, “moderate rate” means a rate that on average over any 24-hour or shorter period of discharge is not greater than the maximum permissible discharge rate calculated in accordance with section 3.1 of the Annex to the Recommendation on Standards for the Rate of Discharge of Untreated Sewage from Ships, IMO Resolution MEPC.157(55), and that over any hourly period is not more than 20% greater than that rate.

3 NOISE REDUCTION ON POWER-DRIVEN VESSELS

As stated by the Regulations:**MUFFLERS**

1000. (1) No person shall operate or permit another person to operate a power-driven vessel unless it is equipped with a muffler that is in good working order.

(2) No person shall operate or permit another person to operate a power-driven vessel equipped with a muffler cut-out or by-pass unless the muffler cut-out or by-pass is visibly disconnected in a manner that ensures it cannot be easily reconnected while the vessel is in operation.

(3) Subsections (1) and (2) do not apply in respect of a vessel that

(a) was constructed or manufactured before January 1, 1960;

(b) is engaged in formal training, in an official competition or in final preparation for an official competition;

(c) is propelled by an outboard engine or a stern-drive, if the exhaust gases are directed under water through the propeller hub or below the cavitation plate;

(d) is operated at five or more nautical miles from shore; or

(e) is propelled by gas turbines or by an aircraft-type propeller operating in air.

3.1 General

3.1.1 Noise reduction in power-driven vessels can be achieved in a number of ways. The following examples illustrate some acceptable solutions to addressing the issue.

- a) Outboard motors have addressed the issue by directing the exhaust gases through the propeller hub or below the cavitation plate.
- b) Stern-drive installations (I/Os) have addressed the issue by directing the exhaust gases through the propeller hub or below the cavitation plate.
- c) A muffler is an expansion chamber within the exhaust line specifically designed to reduce engine exhaust noise.
- d) A waterlock is a device intended to prevent back flooding of cooling water into the exhaust manifold with a side benefit of some noise reduction.
- e) A diverter, used to direct exhaust gases below the waterline, is acceptable.

3.1.2 Vessels fitted with muffler as defined in the regulations and meeting the requirements of European Union *Recreational Craft Directive* (RCD) or the United States National Association of Boating Law Administrators (NASBLA) *Noise Model Act* as adopted in many States in the US should provide an acceptable noise reduction solution.

3.1.3 The RCD requires vessels to meet the standard ISO 14509 *Small craft-Measurement of airborne sound emitted by powered recreational craft*

3.1.4 The Model Noise Act requires compliance with the two following standards:

- a) SAE J2005, Stationary Sound Level Measurement Procedure for Pleasure Motorboats; and

b) SAE J1970, Shoreline Sound Level Measurement Procedure.

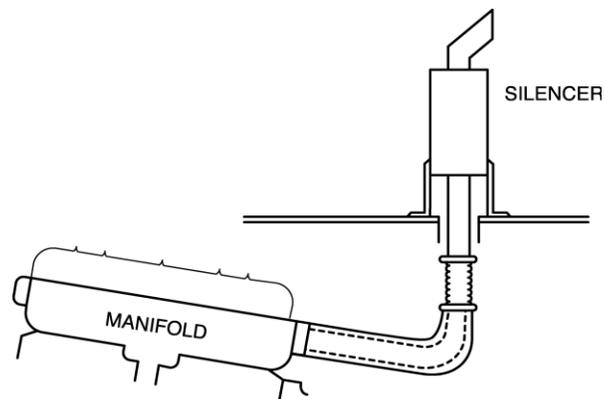
3.2 Guidance Notes Relating to Possible Engine Exhaust Noise Muffling Arrangements

3.2.1 The following is provided for guidance only and relates to acceptable engine exhaust noise muffling arrangements. It is not intended as an installation guide or to cover all possible installations. Engine manufacturer's recommendations should be followed with respect to specific installations.

3.2.2 Dry Exhaust System

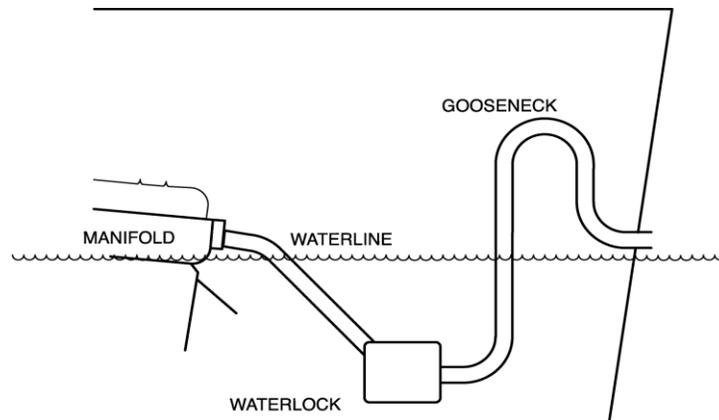
3.2.2.1 Dry exhaust systems should be equipped with a muffler (silencer) generally as indicated in Figure 3-1. The muffler should be sized as large as is practicable and designed to ensure maximum sound attenuation with minimum back pressure. Dry exhaust systems may be used for propulsion and generator engines of any size.

Figure 3-1 TYPICAL DRY EXHAUST SYSTEM

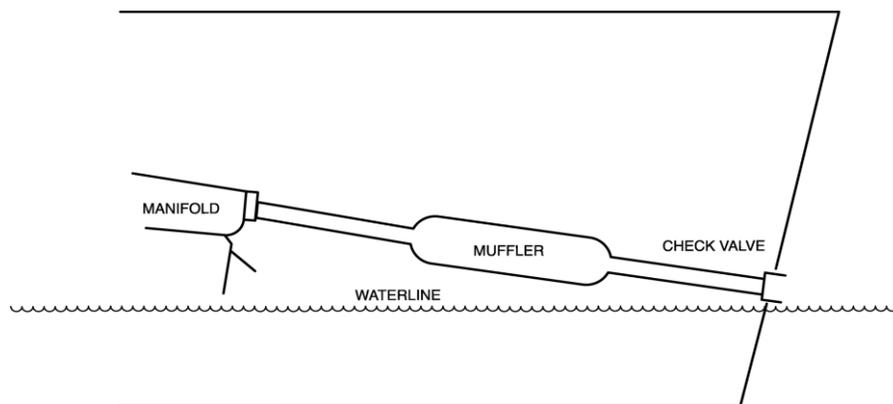


3.2.3 Wet Exhaust System

- 3.2.3.1 Wet exhaust systems may make use of water locks and wet mufflers, or both. Water locks alone may provide sufficient sound attenuation and are thus suitable for generator engines and smaller propulsion engines. With all wet exhaust systems, care must be taken to ensure water cannot back-siphon into the engine. Depending on the relative height of the waterline, an anti-siphon valve or siphon break may be required (not shown in figures).

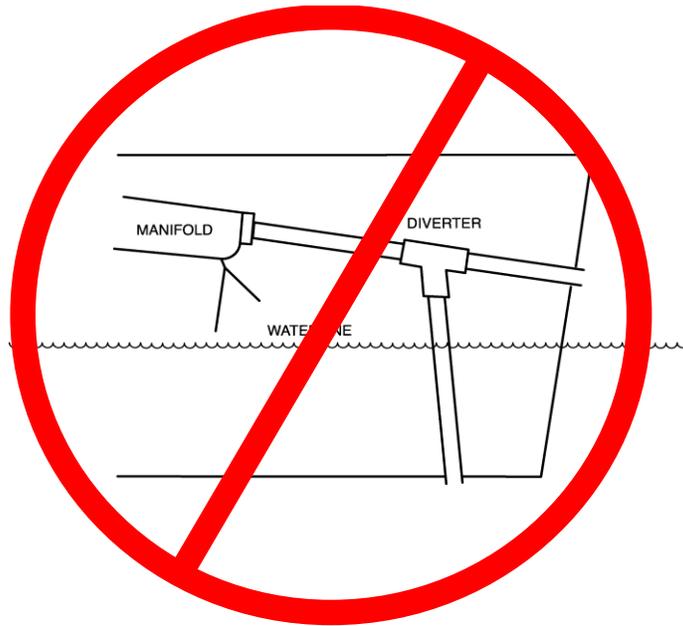
Figure 3-2 TYPICAL WATERLOCK SYSTEM WITHOUT MUFFLER**3.2.4 High Performance System**

- 3.2.4.1 For high performance applications, an effective muffler should be fitted. Depending on the relative height of engine to waterline, a check valve to prevent backflow of water into the engine may be required. Check valves may be at the transom, integral with the muffler, or both.

Figure 3-3 TYPICAL HIGH PERFORMANCE SYSTEM

3.2.5 High Performance System with Diverter

- 3.2.5.1 A diverter, as shown in Figure 3-4, allowing exhaust gases to pass without restriction may only be installed if it is visibly disconnected in a manner that ensures it cannot be easily reconnected while the vessel is in operation.

Figure 3-4 SYSTEM WITH DIVERTER

4 MEASURING AND CALCULATION OF TOTAL HULL VOLUME FOR MONOHULL VESSELS

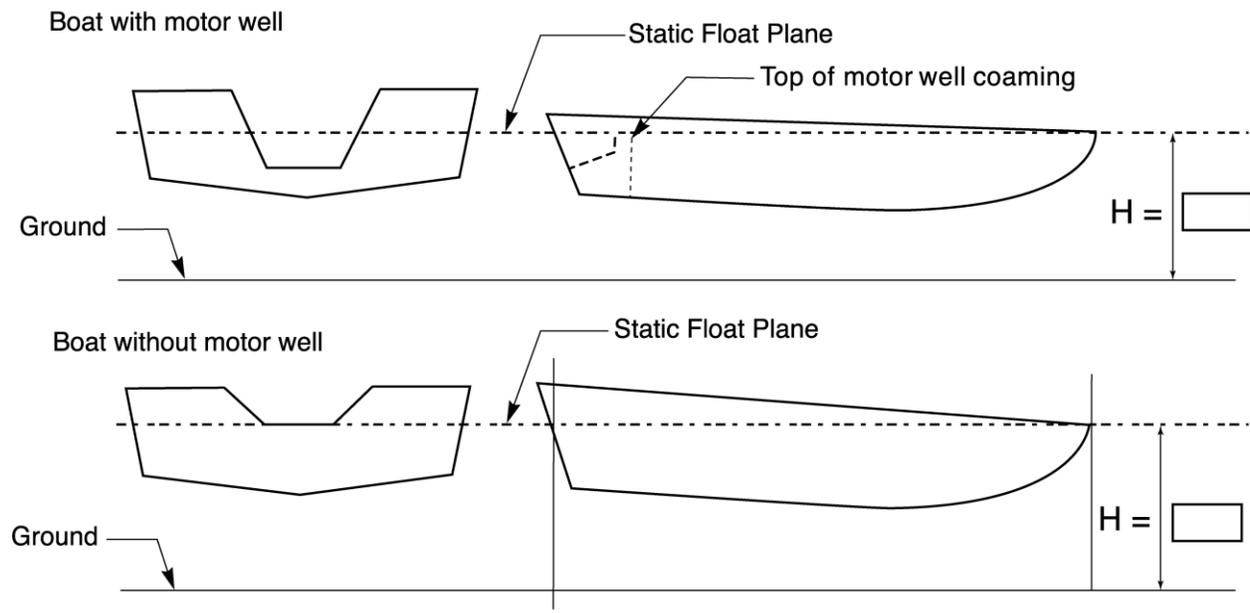
4.1 Measuring of Monohull Vessels

4.1.1 The static float plane (SFP) as defined in section 0 of the Standard represents the deepest waterline to which a vessel could be immersed without water entering over the sides and ends (see Figure 4-1).

4.1.2 Preparation

- On smooth level surface, mark a straight line (centre line of the vessel) approximately 1 m (3 ft) longer than the vessel. This line is represented by [1] in Figure 4-2.
- Mark a second line parallel to the centre line a distance away of approximately half the width of the small vessel plus 300 mm (1 ft). This line is represented by [2] in Figure 4-2.
- Place the small vessel so that the centre of the bow and stern are over the centre line that is marked on the ground.
- Arrange the small vessel so that the SFP is level (parallel to the flat reference surface). Measure and record the height (H) of the SFP from that surface (Figure 4-1).

Figure 4-1 PREPARATION FOR MONOHULL VESSEL MEASUREMENT



4.1.3 Measuring

4.1.3.1 After the vessel has been prepared as indicated in section 4.1.2 above, the measurements shall be taken as described in the following steps and recorded on the calculation worksheet at the end of this annex.

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If you order label from Transport Canada you must also fill the form the form entitled APPLICATION FOR A COMPLIANCE NOTICE FOR A MONOHULL VESSEL (form no. 80-0012) see appendix 5. The dimensions should be taken in metres, rounded to the nearest centimetre.

- a) With a plumb bob, mark the bow and stern on the centre line [1].
- b) Mark a section line [SA] at the bow at right angles to lines [1] and [2].
- c) Mark a section line [D] at the stern at right angles to lines [1] and [2].
- d) Measure and record the distance L between section lines [SA] and [D].
- e) At the mid point between section lines [SA] and [D] mark a section line [B], at right angles to lines [1] and [2].
- f) At the mid point between section lines [B] and [D] mark a section line [C], at right angles to lines [1] and [2].
- g) At the mid point between section lines [SA] and [B] mark a section line [A], at right angles to lines [1] and [2].
- h) At the mid point between section lines [SA] and [A] mark a section line [AA], at right angles to lines [1] and [2].
- i) At each section line, drop a plumb line down from the edge of the vessel and mark an X for the outline of the small vessel.
- j) The distance from X to the line [1] in Figure 4-3 is the half beam, or half width at that particular section. Measure the half beam for each section and record the value on the worksheet.
- k) Divide each section into five equal portions between X and line [1]. A typical half section (AA, A, B, C, D) of the vessel is illustrated.
- l) To calculate the depths of the small vessel (a, b, c, d, e, and f), measure up from the ground to the underside of the vessel and deduct the value from H (height of the SFP above ground).

$a = H - a1$ (often zero)	$d = H - d1$
$b = H - b1$	$e = H - e1$
$c = H - c1$	$f = H - f1$

- m) Repeat this process at each section (SA if applicable), AA, A, B, C, D, and record results on the calculation worksheet.

Figure 4-2 CALCULATION LENGTH MEASUREMENT

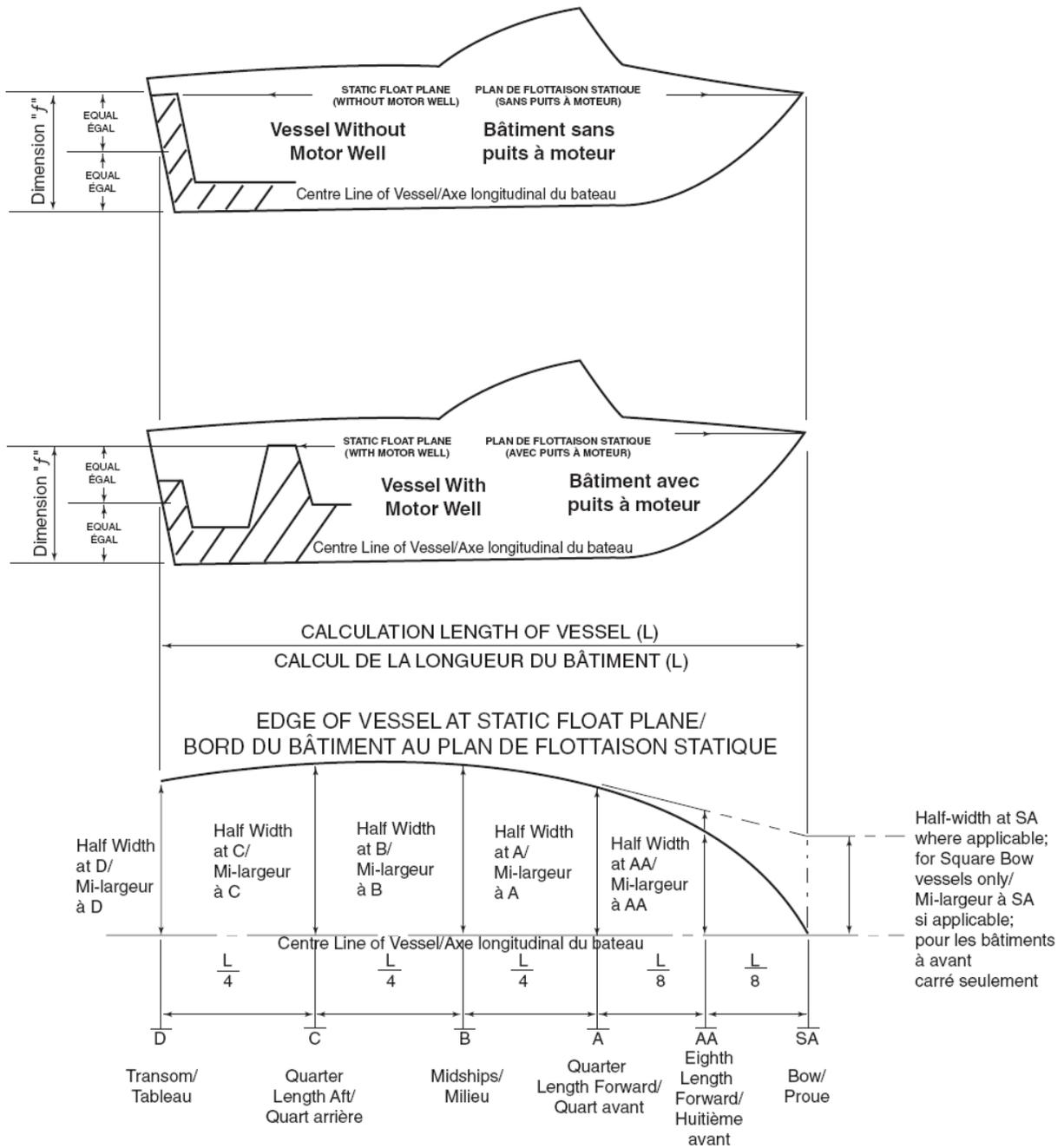


Figure 4-3 SECTIONAL HALF-BEAM MEASUREMENT

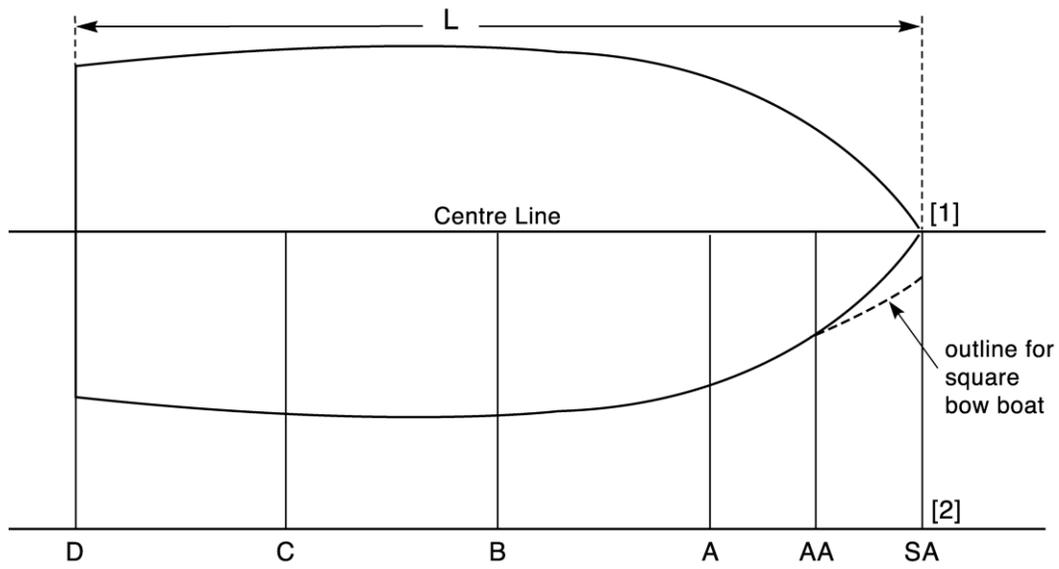


Figure 4-4 A TYPICAL HALF SECTION (AA, A, B, C, D) OF THE VESSEL

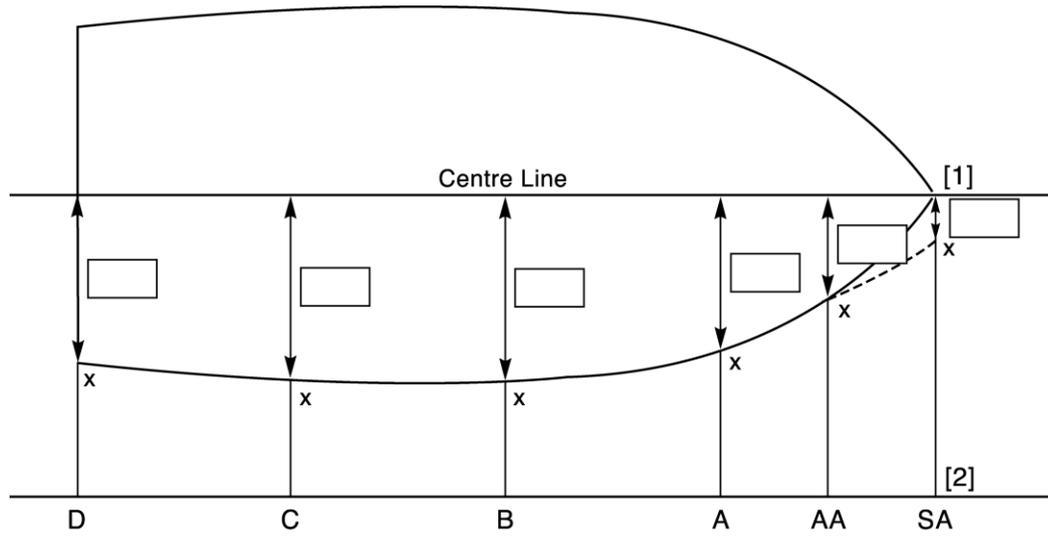
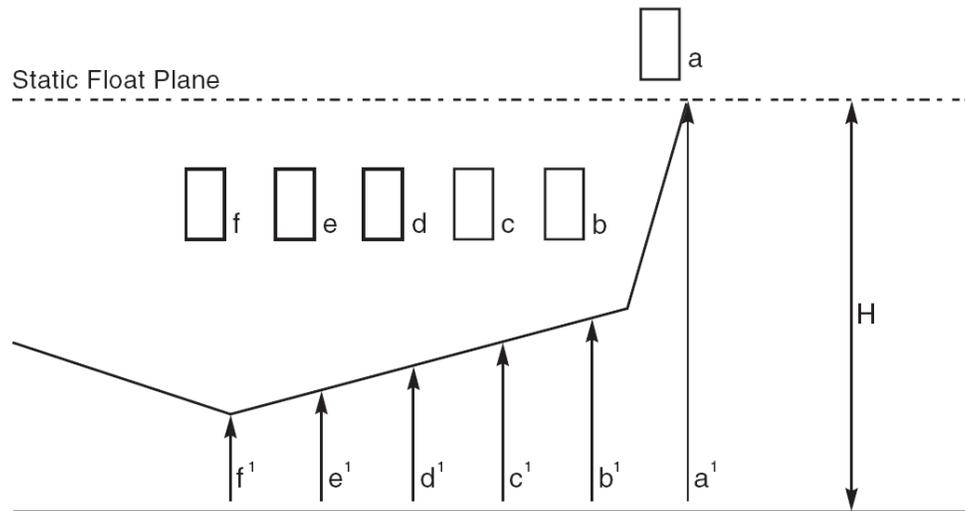


Figure 4-5 VESSEL DEPTH MEASUREMENT

4.2 Calculation of Total Hull Volume

4.2.1 General

- 4.2.1.1 The calculation method given in this section represents the minimum level of accuracy that must be obtained for the calculation of the hull volume using the measurements taken as per section 4.1 above.
- 4.2.1.2 Other calculation methods or a physical test may be used provided that they provide an equal or higher degree of accuracy.

4.2.2 Section Area Calculations

- 4.2.2.1 Section area is calculated for each of the 5 transverse sections AA to D measured in section 4.1 above using the following formula:

$$Area = \frac{Half\ Width}{15 \times 1000^2} \times (2 \cdot a + 8 \cdot b + 4 \cdot c + 8 \cdot d + 4 \cdot e + 4 \cdot f)$$

where:

a, b, c, d, e, f = the section depths in mm as measured in 4.1.3 above and reported to the worksheet at the end of this appendix

Area = the area of the section under consideration in m²

The area of the section SA is calculated as follows:

$$Area_{SA} = \frac{Half\ Width \times f}{1000^2}$$

4.2.3 Total Hull Volume Calculations

4.2.3.1 The total hull volume is calculated using the following formula:

$$VOL_{D...SA} = \frac{L}{96 \times 1.05} \cdot (13 \cdot A + 27 \cdot B + 27 \cdot C + 9 \cdot D + 16 \cdot AA + 4 \cdot SA)$$

where:

L = the calculation of length in metres as shown in Figure 4-2

A, B, C, D, AA, SA = the area in m^2 of each transverse section as calculated in section 4.2.2.1 above

$VOL_{D...SA}$ = the total hull volume below the SFP in m^3

The formula above includes a margin of 5% for measurement error.

4.2.3.2 The total volume (V_{tot}) in cubic metres (m^3) used for the calculation of the maximum gross load for a monohull vessel is calculated by taking the internal volume of the vessel below the static float plane ($VOL_{D...SA}$) as determined above, plus the volume of the integral structure aft of the transom below the static float plane (VOL_{AFT}), and excluding the volume of the integral chambers that flood automatically (VOL_{FLOOD}) as calculated with the following formula:

$$V_{tot} = VOL_{D...SA} + VOL_{AFT} - VOL_{FLOOD}$$

4.3 CALCULATION WORKSHEET FOR DETERMINING TOTAL HULL VOLUME OF MONOHULL VESSELS

4.3.1 The following worksheet may be used to calculate the hull volume below the static float plane from the measurements and calculation methods given in previously.

SECTION AREA CALCULATION WORKSHEET (MONOHULL) FORMULAIRE DE CALCUL DES AIRES DE SECTION (MONOCOQUE) ALL MEASUREMENTS TO BE IN MILLIMETRES / TOUTES LES DIMENSIONS DOIVENT ÊTRE PRISES EN MILLIMÈTRES	
Name of Canadian Manufacturer or Importer / Nom du fabricant ou de l'importateur canadien	Model / Modèle
$SA = \frac{\text{Half width} * f}{1000^2} \quad m^2$ $SA = \frac{[\quad] \times [\quad]}{1000^2}$ $SA = [\quad] \quad m^2$	
$\text{Area/ Aire} = \frac{\text{Half Width/ mi - largeur}}{15 * 1000^2} \cdot (2 \cdot a + 8 \cdot b + 4 \cdot c + 8 \cdot d + 4 \cdot e + 4 \cdot f) \quad m^2$	
$AA = \frac{[\quad]}{15 \times 1000^2} \times (2 \times [\quad] + 8 \times [\quad] + 4 \times [\quad] + 8 \times [\quad] + 4 \times [\quad] + 4 \times [\quad])$ $AA = [\quad] \quad m^2$	
$A = \frac{[\quad]}{15 \times 1000^2} \times (2 \times [\quad] + 8 \times [\quad] + 4 \times [\quad] + 8 \times [\quad] + 4 \times [\quad] + 4 \times [\quad])$ $A = [\quad] \quad m^2$	
$B = \frac{[\quad]}{15 \times 1000^2} \times (2 \times [\quad] + 8 \times [\quad] + 4 \times [\quad] + 8 \times [\quad] + 4 \times [\quad] + 4 \times [\quad])$ $B = [\quad] \quad m^2$	
$C = \frac{[\quad]}{15 \times 1000^2} \times (2 \times [\quad] + 8 \times [\quad] + 4 \times [\quad] + 8 \times [\quad] + 4 \times [\quad] + 4 \times [\quad])$ $C = [\quad] \quad m^2$	
$D = \frac{[\quad]}{15 \times 1000^2} \times (2 \times [\quad] + 8 \times [\quad] + 4 \times [\quad] + 8 \times [\quad] + 4 \times [\quad] + 4 \times [\quad])$ $D = [\quad] \quad m^2$	

VESSEL HULL VOLUME CALCULATION WORKSHEET (MONOHULL)
FORMULAIRE DE CALCUL DU VOLUME DE LA COQUE DU BATÎMENT
(MONOCOQUE)

Name of Canadian Manufacturer or Importer / Nom du fabricant ou de l'importateur canadien

Model / Modèle

VESSEL HULL VOLUME BETWEEN SECTION SA AND D
VOLUME DE LA COQUE DU BATÎMENT ENTRE LES SECTIONS SA ET D

$$VOL_{D...SA} = \frac{L}{96 \times 1.05} \cdot (13 \cdot A + 27 \cdot B + 27 \cdot C + 9 \cdot D + 16 \cdot AA + 4 \cdot SA)$$

$$VOL_{D...SA} = \frac{[\quad]}{96 \times 1.05} \cdot (13 \cdot [\quad] + 27 \cdot [\quad] + 27 \cdot [\quad] + 9 \cdot [\quad] + 16 \cdot [\quad] + 4 \cdot [\quad])$$

$$VOL_{D...SA} = [\quad] m^3$$

VOLUME OF INTEGRAL STRUCTURE AFT OF THE TRANSOM BELOW STATIC FLOAT PLANE
VOLUME DE LA STRUCTURE ARRIÈRE INTÉGRÉE SOUS LE PLAN DE FLOTTAISON
STATIQUE

$$VOL_{AFT} = \frac{L_{aft} \times W_{aft} \times H_{aft}}{1000^3} m^3$$

where / ou:

L_{aft} : mean length of the watertight appendage aft of the transom in mm
longueur moyenne de l'appendice étanche à l'arrière du tableau en mm

W_{aft} : mean width of the watertight appendage aft of the transom in mm
largeur moyenne de l'appendice étanche à l'arrière du tableau en mm

H_{aft} : mean height of the watertight appendage aft of the transom in mm
hauteur moyenne de l'appendice étanche à l'arrière du tableau en mm

$$VOL_{AFT} = \frac{[\quad] \times [\quad] \times [\quad]}{1000^3} m^3$$

$$VOL_{AFT} = [\quad] m^3$$

VOLUME OF INTEGRAL CHAMBERS THAT FLOOD AUTOMATICALLY
VOLUME DES COMPARTIMENTS QUI D'INONDE AUTOMATIQUEMENT

$$VOL_{flood} = \frac{L_{flood} \times W_{flood} \times H_{flood}}{1000^3} m^3$$

where / ou:

L_{flood} : mean length of the integral chamber that flood automatically in mm
longueur moyenne du compartiment qui s'inonde automatiquement en mm

W_{flood} : mean width of the integral chamber that flood automatically in mm
largeur moyenne du compartiment qui s'inonde automatiquement en mm

H_{flood} : mean height of the integral chamber that flood automatically in mm
hauteur moyenne du compartiment qui s'inonde automatiquement en mm

$$VOL_{flood} = \frac{[\quad] \times [\quad] \times [\quad]}{1000^3} m^3$$

VESSEL HULL VOLUME CALCULATION WORKSHEET (MONOHULL)
FORMULAIRE DE CALCUL DU VOLUME DE LA COQUE DU BATÎMENT
(MONOCOQUE)

$$VOL_{flood} = [\quad] m^3$$

The volume of all integral chambers must be calculated separately and added together.

Le volume de tous les compartiments qui s'inonde automatiquement doivent être calculés séparément et additionnés.

TOTAL HULL VOLUME

VOLUME TOTAL DU BATÎMENT

$$V_{tot} = VOL_{D...SA} + VOL_{AFT} - \sum VOL_{FLOOD}$$

$$V_{tot} = [\quad] + [\quad] - [\quad] m^3$$

$$V_{tot} = [\quad] m^3$$

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