



Setting Standards for Safer Boating

The ABYC Standards and Technical Information Reports for Small Craft are the product of a consensus of representatives of government, industry and public sectors. It is intended solely as a guide to aid manufacturers and the marine community in the design, construction, equipage and maintenance of small craft.

ABYC reviews each standard at least every five years at which time it may be reaffirmed, revised, or withdrawn. ABYC welcomes any written comments on the standards and Technical information reports.

ABYC A-4 July, 2008

Equipment Division Standard

Fire Fighting Project Technical Committee

ABYC A-4

FIRE FIGHTING EQUIPMENT

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of ABYC or any document developed by the committee on which the member serves.

This standard was developed under procedures accredited as meeting the criteria for American National Standards. The Project Technical Committee that approved the Standard was balanced to ensure that individuals from competent and concerned interests have had an opportunity to participate.

This standard, which is the result of extended and careful consideration of available knowledge and experience on the subject, is intended to provide minimum performance requirements.

ABYC's Project Technical Committee meetings are open to the public. All contact regarding standards activity, interpretations, or meeting attendance should be directed to the ABYC Technical Department at comments@abycinc.org.

ABYC and its committees do not "approve", "certify", or "endorse" any item, construction, or proprietary device.

REQUEST FOR INTERPRETATIONS

Upon written request, the Fire Fighting PTC will render an interpretation of any requirement of the Standard. The request for interpretation should be clear and unambiguous. Requests should be presented to the PTC in a manner in which they may be answered in a yes or no fashion.

The committee reserves the right to reconsider any interpretation when or if additional information which might affect it becomes available to the PTC. Persons aggrieved by an interpretation may appeal to the Committee for reinterpretation.

A-4 FIRE FIGHTING EQUIPMENT

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A-4 FIRE FIGHTING EQUIPMENT

Based on ABYC's assessment of the existing technology, and the problems associated with achieving the goals of this standard, ABYC recommends compliance with this standard for all boats, associated equipment, and systems manufactured after July 31, 2009.

4.1 PURPOSE

This standard is a guide for the design, construction, and installation of portable handheld fire extinguishers and fixed fire extinguishing systems on boats.

4.2 SCOPE

4.2.1 This standard applies to boats equipped with engine(s), an electrical system, heat producing devices such as galley stoves and cabin heaters, or any other source of combustion.

NOTE: *The U.S. Coast Guard (USCG) has promulgated mandatory requirements for fire extinguishing equipment in Title 46 CFR Chapter I Subchapter C Part 25 Subpart 25.30. Refer to the CFR for complete, current federal requirements.*

EXCEPTION: *The following vessels, being subject to special federal regulations, are excepted from consideration by this standard:*

a. *vessels carrying flammable or other combustible liquid cargo in bulk as defined by Title 46 CFR Part 30, and*

b. *vessels carrying more than six passengers for hire, subject to Title 46 CFR.*

4.2.2 The scope of this standard includes portable and fixed fire extinguishing systems utilizing an extinguishing agent such as halocarbon, halon, carbon dioxide (CO₂), or dry chemical, or any extinguishing agent that is approved by the U.S. Environmental Protection Agency's Significant New Alternatives Program (SNAP). An extinguishing agent shall be deemed approved upon its being published in the most current SNAP list in the Federal Register.

4.2.3 Fixed fire extinguishing systems covered by this standard are intended for normally unoccupied machinery, tankage, and bilge spaces. Fixed fire extinguishing systems for normally occupied spaces are not covered by this standard.

4.3 REFERENCES

4.3.1 The following publications form a part of this standard. Unless otherwise noted the latest version of the referenced standards shall apply.

4.3.1.1 ABYC - American Boat & Yacht Council, Inc., 613 Third St. Suite 10, Annapolis, MD, 21403. Phone: (410) 990-4460. Fax: (410) 990-4466. Website: www.abycinc.org.

[ABYC E-11, AC and DC Electrical Systems on Boats](#)
[ABYC H-2, Ventilation of Boats Using Gasoline](#)
[ABYC H-32, Ventilation of Boats Using Diesel Fuel](#)
[ABYC T-5, Safety Signs and Labels](#)

4.3.1.2 CFR - Code of Federal Regulations and other government publications. Obtain from the Superintendent of Documents, United States Government Information, POB 371 954, Pittsburgh, PA 15250-7954. Phone: (202) 512-1800. Fax: (202) 512-2250. The CFR is also available from ABYC, Inc., 613 Third St. Suite 10, Annapolis, MD 21403. Phone: (410) 990-4460. Fax: (410) 990-4466. Website: www.abycinc.org.

Title 46 CFR, Chapter I

4.3.1.3 FM - Factory Mutual Research, 1151 Boston-Providence Highway, Norwood, MA 02062-5082. Phone: (781) 762-4300. Fax: (781) 440-8718. Website: www.fmglobal.com.

4.3.1.4 NFPA - National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471. Phone: (617) 770-3000. Fax: (617) 770-0700. Website: www.nfpa.org.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*
NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*
NFPA 12B, *Standard on Halon 1211 Fire Extinguishing Systems*
NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*

4.3.1.5 UL – Underwriters Laboratories, Inc., 12 Laboratory Drive, PO Box 13995, Research Triangle Park, NC 27709-3995. Phone: (919) 549-1400. Fax: (919) 547-6000. Website: www.ul.com.

UI 711, *Standard for Rating and Fire Testing of Fire Extinguishers*

4.3.1.6 EPA- Environmental Protection Agency - Office of Atmospheric Programs, Stratospheric Ozone Protection Division, Mail Code 6205J, 1200 Pennsylvania Avenue NW, Washington, DC 20460-0001. Phone: (202) 564-9410. Fax: (202) 565-2155. Website: www.epa.gov.oar.oap.html.

U.S. Environmental Protection Agency's Significant New Alternatives Program (SNAP)

4.4 DEFINITIONS

For the purposes of this standard, the following definitions apply.

4.4.1 Accessible - Capable of being reached for inspection, removal or maintenance without removal of permanent boat structure.

4.4.2 Classification of Fire - Fires which are likely to occur are of three types; Class A, B and C ([see Appendix Ap. 2](#))

4.4.3 Clean Agent - Electrically non-conducting volatile, or gaseous fire extinguishing agent that does not leave a residue on surfaces upon evaporation.

NOTE: For more information on clean agents, see NFPA 2001, "Clean Agent Fire Extinguishing Systems."

4.4.4 Engineered Fixed Systems - Engineered fixed systems consist of components designed or selected for a specific application to a specific vessel or model series.

4.4.5 Engine Compartment – an enclosed space that contains a permanently installed internal combustion engine (this includes generator sets and any other auxiliary equipment with internal combustion engines).

4.4.6 Fixed Fire Extinguishing Systems - Fixed fire extinguishing systems are those which employ extinguishing agents and are intended to be permanently installed.

4.4.7 Halogenated Agents - The agents referenced in this standard are of the following types:

4.4.7.1 Halocarbon Agent - A clean agent that contains as primary components one or more organic compounds containing one or more of the elements fluorine, chlorine, bromine, or iodine. Examples are hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs), perfluorocarbons (PFCs or FCs), and fluoroiodocarbons (FICs).

4.4.7.2 Halon - A clean agent that contains as primary components one or more organic compounds containing one or more of the chemical elements fluorine, chlorine or bromine (e.g., Halon 1301, and 1211).

4.4.8 Hand Portable Fire Extinguishers - Hand portable fire extinguishers, hereinafter termed "portable extinguishers", are those fitted with means for carrying by hand, weigh not more than 55 lbs., and have their discharge controlled by a manually operated valve.

NOTE: The largest portable extinguisher suitable for use on a boat is rated by the USCG as B-II

4.4.9 Independent Laboratory -

4.4.9.1 is engaged, as a regular part of its business, in performing periodic inspections and tests that are the same as, or similar to, the inspections and qualification tests required for the equipment or material being evaluated,

4.4.9.2 has, or has access to, the apparatus, facilities, personnel, and calibrated instruments that are necessary to inspect and test the equipment or material being evaluated, and

4.4.9.3 is not owned or controlled by:

4.4.9.3.1 the manufacturer of the equipment or material to be inspected or tested or any similar equipment or material;

4.4.9.3.2 a vendor of the equipment or material to be inspected or tested or a vendor of similar equipment or materials; or

4.4.9.3.3 a supplier of materials to the manufacturer.

4.4.10 Machinery Space – an enclosed space that contains auxiliary equipment

4.4.11 Pre-engineered Fixed Systems - Pre-engineered fixed systems (packaged systems) consist of components designed by the manufacturer to be installed in accordance with their specific installation instructions and consistent with the limiting criteria indicated for the unit.

4.5 **REQUIREMENTS - IN GENERAL**

4.5.1 Fire extinguishing equipment (portable or fixed) shall be U.S. Coast Guard approved, and listed or approved by a recognized independent testing laboratory. The installation and use of such fire extinguishing equipment shall be in accordance with the manufacturer's instructions.

4.5.2 Inboard and sterndrive boats with engine compartments shall have either:

4.5.2.1 a fixed fire extinguishing system installed to protect the engine compartment ([see A-4.7](#)), or

4.5.2.2 a single suitably sized clean agent portable fire extinguisher provided and installed in proximity to a port to permit discharge directly into the engine compartment without opening the primary access. ([See Table IV](#) for determination of the minimum portable clean agent fire extinguisher size for this usage.)

4.5.2.2.1 The provision such as a discharge port shall be:

4.5.2.2.1.1 sized to accept the portable fire extinguisher discharge nozzle,


4.5.2.2.1.2 able to be opened from outside the compartment to provide ready access for discharge of the agent into the engine compartment, and

4.5.2.2.1.3 located so the required size portable fire extinguisher can be properly discharged in accordance with the manufacturer's instructions.

NOTE: A discharge port located in a horizontal surface may not allow the portable fire extinguisher to be properly or completely discharged, unless the extinguisher is equipped with a hose and nozzle.

4.5.2.2.2 A label that complies with [A-4.5.6](#) shall be affixed adjacent to or as part of the discharge provision providing information to avoid misuse and possible personal injury.

NOTE: An example of such a label follows.

 CAUTION
<p>To avoid misuse and possible personal injury:</p> <ol style="list-style-type: none"> 1. In case of fire, do not open engine box (compartment) 2. Shut down engines, generators and blowers. 3. Continuously discharge entire contents of clean agent portable fire extinguisher through the port (or other provision) immediately.

NOTE: *The use of a clean agent portable fire extinguisher with an access port in an engine compartment is preferred to opening the engine compartment to fight a fire; however, this usage of a portable fire extinguisher may provide a less effective level of fire protection than is offered by a fixed fire extinguishing system for the following reasons:*

- a. Agent distribution may not be satisfactory.
- b. The rate of agent discharge may not assure that an effective extinguishing concentration is achieved.
- c. Fire detection and appropriate action is dependent upon an operator being present and making the correct decisions.
- d. The operator must assure that discharge of the agent is continuous and complete.
- e. Longer discharge time may cause an increase of toxic by-products generated during extinguishment.
- f. The potential for operator injury may be greater.

4.5.3 A permanently affixed label in the machinery compartment shall state the gross volume of the compartment less the volume of permanently installed tankage for the purpose of sizing fire protection equipment.

NOTE: *An example of such a label follows:*

Fixed fire extinguishing system must be suitable for compartment volume of XXX cu ft.
This is based on gross compartment volume less permanently installed tankage in this compartment as per ABYC A-4.

NOTES:

1. For boats built prior to the effective date of this standard, it may be necessary to obtain this information from the boat manufacturer or to have this volume calculated accurately by a qualified professional such as a fire protection specialist, marine engineer, etc...

4.5.4 An instruction manual(s) shall be provided for all fire extinguishing equipment and shall contain information about installation, operation, inspection, and maintenance. Cautionary considerations and any limitations shall also be included. The manual(s) may be specific, covering a particular extinguisher or system, or it may cover many types or models provided the required information for each extinguisher is complete.

4.5.5 To minimize the potential for migration of carbon monoxide (CO) from machinery compartments containing gasoline engines to adjacent accommodation compartments, bulkhead and deck penetrations shall be in accordance with the requirements of [ABYC H-2, Ventilation of Boats Using Gasoline](#).

4.5.6 Safety signs and labels shall comply with [ABYC T-5, Safety Signs and Labels](#), and shall contain at least the following informational elements:

- 4.5.6.1 The signal word for the hazard intensity level,
- 4.5.6.2 the nature of the hazard,
- 4.5.6.3 the consequences that can result if the instructions to avoid the hazard are not followed, and
- 4.5.6.4 instructions on how to avoid the hazard.

4.6 REQUIREMENTS - PORTABLE EXTINGUISHERS

4.6.1 Approval - Portable fire extinguishers shall be approved by the U.S. Coast Guard and classified as B-I, or B-II in accordance with [Table I](#).

4.6.2 Portable extinguishers shall be rated for Class "A" fires per ANSI/UL 711, *Standard for Rating and Fire Testing of Fire Extinguishers*, in addition to the "BC" rating required by the U.S. Coast Guard.

EXCEPTIONS:

1. Extinguishers intended for engine compartment protection in accordance with [A-4.5.2.2](#) or [A-4.6.4](#) are not required to have a Class "A" rating.

2. Boats under 26 ft. without enclosed accommodation spaces or enclosed galleys may be equipped with a bucket with attached lanyard in lieu of Class "A" rated portable fire extinguishers.

4.6.3 Number and Location - Portable fire extinguishers shall be provided and conspicuously installed in accordance with the minimum required in [Table II](#) or [Table III](#). All extinguishers shall be located adjacent to exit paths. It shall not be necessary to travel more than one-half the length of the boat or 33 ft. (10 m.), whichever is less, to reach an extinguisher.

4.6.4 If a clean agent portable fire extinguisher is to be used to flood an engine compartment in accordance with [A-4.5.2.2](#) its minimum size shall be in accordance with Table IV. Compartment volume shall be at least gross volume less that of permanently installed tankage. (See [A-4.5.3](#) for labeling requirements.)

4.7 REQUIREMENTS - FIXED FIRE EXTINGUISHING SYSTEMS

4.7.1 Fixed fire extinguishing systems shall be capable of both Automatic and Manual operation.

4.7.2 Installation of fixed fire extinguishing equipment shall be in accordance with the manufacturer's instructions.

4.7.3 Applications (Fixed Systems)

4.7.3.1 Gasoline Boats.

4.7.3.1.1 A placard shall be affixed at each helm location and shall provide at least the following information:

In case of engine compartment fire, shut down engine(s), generator(s) and blower(s) before manual discharge, or immediately after automatic discharge
--

4.7.3.1.2 A remote discharge indicator shall be installed at the primary helm location.

4.7.3.2 Diesel machinery installed in protected spaces on gasoline boats shall be automatically shut down upon discharge of the system.

4.7.3.3 Diesel Boats

4.7.3.3.1 The system shall be designed and installed so that:

4.7.3.3.2 the engine(s), generator(s), and blower(s) located in the protected space shut down automatically and after discharge the minimum required design concentration in accordance with [A-4.7.10](#) must remain.

4.7.3.3.3 A placard shall be affixed at each helm location and shall provide at least the following information:

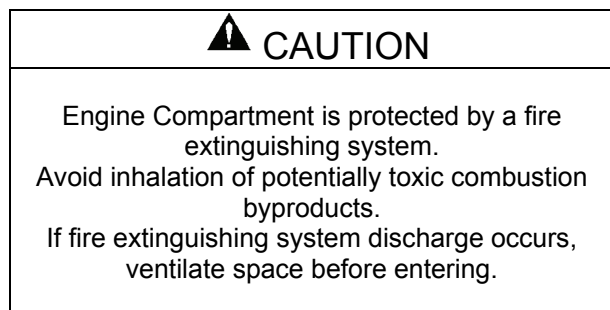
In case of engine compartment fire,
shut down engine(s), generator(s) and blower(s)
before manual discharge, or immediately after
automatic discharge

4.7.3.3.4 Resets or overrides for automatic blower shut-downs shall be operable from outside the protected space and shall provide an indication of the override condition.

4.7.4 Operating instructions shall be provided for fixed fire extinguishing systems. Instructions shall include directions to ventilate the space prior to entering for damage assessment and subsequent engine restart. (See Appendix [Ap.6.1.2](#) and [Ap.6.1.3](#))

4.7.5 For spaces protected by a clean agent system a label that complies with [A-4.5.6](#) shall be installed at the entrance to the protected space(s) or at each helm location and shall provide information to avoid inhalation of potentially toxic combustion byproducts following fire extinguishing system discharge.

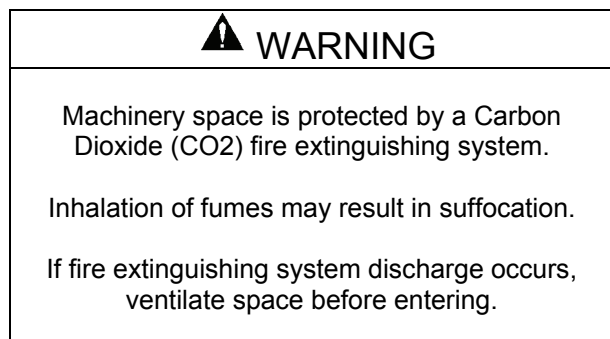
NOTE: *An example of such a label follows.*



NOTE: *If fire extinguishing system is installed in any other area other than an engine compartment the preceding label should identify the space being protected on the label.*

4.7.6 For spaces protected by a Carbon Dioxide (CO₂) system a label that complies with [A-4.5.6](#) shall be installed at the entrance to the protected space(s) and shall provide information to avoid inhalation of Carbon Dioxide following fire extinguishing system discharge.

NOTE: *An example of such a label follows.*



4.7.7 Spaces Protected by Fixed Fire Extinguishing Systems

4.7.7.1 Non-closeable openings shall be as near as practicable to the top of the space being protected to minimize the dilution of the extinguishing agent.

EXCEPTION: Ventilation openings as required in: [ABYC H-2, "Ventilation of Boats Using Gasoline"; and \[ABYC H-32, "Ventilation of Boats Using Diesel Fuel."\]\(#\)](#)

4.7.7.2 For total flooding systems, the volume of adjoining compartment(s) shall be added to that of the compartment(s) being protected if openings between the compartments(s) have an aggregate area of more than two percent of the bulkhead area between the compartments.

4.7.8 Installation of Cylinders and Controls for Fixed Fire Extinguishing Systems

4.7.8.1 Cylinders and controls shall be protected from weather and mechanical damage.

4.7.8.2 Cylinders and controls shall be located so they will not be subjected to temperatures outside the system's designed operating range.

4.7.8.3 Cylinders shall be securely fastened and supported as specified by the manufacturer.

4.7.8.4 Cylinders shall be mounted so they are accessible for weighing, inspection, and removal.

4.7.8.5 To prevent corrosion, cylinders shall be mounted to provide clearance above surfaces on which water may accumulate.

4.7.8.6 Wiring shall be in accordance with, [ABYC E-11, AC and DC Systems on Boats](#) as applicable.

4.7.9 Design Requirements for Fixed Systems – General

4.7.9.1 Each system shall have sufficient quantity of fire extinguishing agent to provide at least the minimum effective concentration for the volume of the space(s) being protected. This volume shall be at least gross volume less that of permanently installed tankage. ([See A-4.5.3](#) for labeling requirements.)

4.7.9.2 A system discharge indicator shall be provided. It shall be readily visible from outside the protected space and, for automatic systems, shall be located at the primary helm location.

4.7.9.3 The discharge time for each clean agent system shall be consistent with the manufacturer's product listing or approval.

4.7.9.4 The operating temperature range of each clean agent system installed shall be consistent with the manufacturer's product listing or approval.

4.7.9.5 A system with multiple cylinders shall operate to discharge all cylinders simultaneously and shall be specifically engineered for its application(s).

4.7.9.6 If more than one system is installed in a protected space, each system shall be capable of individually protecting the space.

4.7.9.7 For requirements not specified in this standard, the requirements of NFPA 12, 12A, 12B, or 2001, shall apply.

4.7.10 Design Requirements for Fixed Systems - Extinguishing Agent

4.7.10.1 Carbon Dioxide (CO₂) - The design concentration shall be determined from [Table V](#).

NOTE: The concentration required for effective fire extinguishment will suffocate personnel who may be inadvertently in a protected space at the time of extinguishing agent discharge.

4.7.10.2 Halocarbon Agents - The design concentration for each extinguishing system shall be consistent with the manufacturer's product listing or approval.

4.7.10.3 Halon 1301 - The design concentration shall be between 5% and 15% [0.0206 and 0.0640 lbs/ft³ (0.2807 kg/m³ and 0.8733 kg/m³) based on a 70°F (21°C) ambient temperature per NFPA 12A]. A design concentration of 15% shall not be exceeded.

NOTES:

1. Higher concentrations may disable persons occupying the protected space and prevent their egress during an extinguishing agent discharge.

2. Higher concentrations may be used in spaces that cannot be occupied, such as motor boxes.

4.7.10.4 Halon 1211 - The design concentration shall be at least 5% [0.0234 lbs/ft³ (0.3147 kg/m³) based on 70°F (21°C) ambient temperature per NFPA 12B]. A design concentration as close as practicable to 5% shall be utilized.

NOTES:

1. Higher concentrations may disable persons occupying the protected space and prevent their egress during an extinguishing agent discharge.

2. Higher concentrations may be used in spaces that cannot be occupied, such as motor boxes.

TABLE I - U.S. COAST GUARD CLASSIFICATION OF PORTABLE EXTINGUISHERS

USCG TYPE	SIZE	DRY CHEMICAL - LBS.	CO ₂ - LBS.	HALON-LBS. (see Note 2)	HALOCARBON – LBS.
B	I	2	5	2-1/2	5
B	II	10	15	10	15

TABLE I NOTES:

1. The listed weights are minimum for the stated classification.

2. The Halon column shall be used for extinguishers containing Halon 1211, Halon 1301, or mixtures of these agents only.

TABLE II - BOATS 65 FT. OR LESS IN LENGTH

TYPE OF BOAT	NO. OF EXTINGUISHERS	USCG TYPE (see Note 1)	ANSI/UL 711 TYPE (see Notes 2 & 3)	LOCATION
Open boats under 16 ft.	1	B-1	ABC	steering position
Open boats over 16 ft. in length	2	B-1	ABC	steering position and galley or passenger cockpit
Boats under 26 ft. in length	2	B-1	ABC	steering position and galley (see Note 4) or passenger cockpit
Boats 26 ft. to under 40 ft. in length	3	B-1	ABC	outside engine compartment, steering position and galley (see Note 4), or passenger cockpit
Boats 40 ft. and over, but not over 65 ft. in length	4	B-1	ABC	outside engine compartment, steering position, crew's quarters, and galley (see Note 4) or passenger cockpit

TABLE II NOTES:

1. If a discharge port is installed ([ABYC A-4.5.2.2](#)), a USCG type B-I portable fire extinguisher may not be adequate (see Table IV).
2. Extinguishers intended for engine compartment protection in accordance with [A-4.5.2.2](#) or [A-4.6.4](#) are not required to have a Class A rating.
3. Boats under 26 ft. in length without enclosed accommodation spaces or enclosed galleys may be equipped with a bucket with attached lanyard and a Class "BC" rated extinguisher in lieu of Class "ABC" rated portable fire extinguishers.
4. On boats having galley stoves, one of the required extinguishers shall be readily accessible thereto.

TABLE III - BOATS OVER 65 FT. IN LENGTH

GROSS TONNAGE	NO. OF EXTINGUISHERS	USCG TYPE (see Note 3)	ANSI/UL 711 (see Notes 2 & 3)	LOCATION
Not over 50	1 (see Note 1)	B-II	ABC	outside engine compartment
	and 1 (see Note 2)	B-II	ABC	helmsman's position
	and 3 (see Note 2)	B-I	ABC	galley, crew's quarters and cabin
50 - 100	1 (see Note 1)	B-II	ABC	outside engine compartment
	and 2 (see Note 2)	B-II	ABC	helmsman's position and galley
	and 2 (see Note 2)	B-I	ABC	crew's quarter and cabin
100 - 300	1 (see Note 1)	B-II	ABC	outside engine compartment
	and 3 (see Note 2)	B-II	ABC	helmsman's position, galley and crew's quarter
	and 1 (see Note 2)	B-I	ABC	cabin

TABLE III NOTES:

1. If the total horsepower exceeds 1000 B.H.P. an additional B-II portable fire extinguisher is required for each additional 1000 B.H.P. or fraction thereof.
2. The required B-I and B-II portable fire extinguisher may be distributed among the recommended locations as desired.
3. If a discharge port is installed ([See A-4.5.2.2](#)), a USCG size B-I or B-II portable fire extinguisher may not be adequate (see [Table IV](#)).

TABLE IV - MINIMUM CLEAN AGENT (Halogenated and CO₂) PORTABLE EXTINGUISHER SIZES FOR FLOODING AN ENGINE COMPARTMENT

AGENT	MINIMUM EXTINGUISHER SIZE	MAXIMUM COMPARTMENT VOLUME
CO ₂	5 lb.	66 ft ³
	10 lb.	133 ft ³
	15 lb.	200 ft ³
	20 lb.	266 ft ³
Halon	2 ½ lb.	108 ft ³
	3 lb.	130 ft ³
	4 lb.	174 ft ³
	5 lb.	217 ft ³
	9 lb.	391 ft ³
	13 lb.	565 ft ³
HFC-227ea	USCG B-1(5.75 lb.)	125 ft ³
	USCG B-2 (10.75 lb.)	250 ft ³

TABLE IV NOTES:

1. The above results in concentrations of 45% CO₂ at 70°F (21°C) based on 0.075 lbs Agent/ft³ or 5% Halon at 70°F (21°C) based on 0.023 lbs Agent/ft³.
2. "Halon" is Halon 1211, Halon 1301, or a mixture thereof.

TABLE V - FLOODING FACTORS FOR CARBON DIOXIDE

VOLUME OF SPACE (ft ³)	VOLUME FACTOR (lbs CO ₂ /ft ³)	CALCULATED QUANTITY OF CO ₂ NOT LESS THAN ____ (lbs.) (see Note)
Up to 141	.072	-
141 - 500	.067	10
501 - 1600	.063	35
1601 - 4500	.056	100

NOTE: The required quantity is calculated by multiplying the protected space in ft³ by the Volume Factor in the table. The calculated quantities shown reflect minimum agent required.

A-4 **APPENDIX - FIRE FIGHTING EQUIPMENT**

Ap.1 **PURPOSE**

This appendix provides additional information on the classes of fires, properties of extinguishing agents and the use and maintenance of fire extinguishing equipment.

Ap.2 **CLASSES OF FIRE**

Ap.2.1 **Class "A" Fires** - Class "A" fires occur in ordinary combustible materials such as wood, cloth, paper, rubber, and many plastics including fiberglass reinforced plastics. Fires in bedding and upholstery are Class "A" fires.

Ap.2.2 **Class "B" Fires** - Class "B" fires occur in flammable liquids, oils, greases, tars, oil-based paints, lacquers and flammable gases. Gasoline, diesel, alcohol and kerosene fires are Class "B" fires.

Ap.2.3 **Class "C" Fires** - Class "C" fires occur in energized electrical equipment. The electrical non-conductivity of the extinguishing agent is important. If the electrical equipment is de-energized a related fire may be a Class "A" or "B" fire for the purpose of fire extinguishing agent selection.

Ap.3 **EXTINGUISHMENT OF FIRES**

Ap.3.1 **Class "A" Fires** - Water is the best means of extinguishment and should be applied as soon as possible. Drench the fire, open up the material to expose all burning embers and drench them again, or throw smoldering embers overboard. Multipurpose dry chemical, Halon 1211, and Halocarbon agents are also effective agents.

Ap.3.2 **Class "B" Fires** - Halon, Halocarbons, dry chemical, and carbon dioxide are suitable for Class "B" fires. In general the extinguishing agent should be directed at the base of the fire working in a horizontal sweeping motion from the front to the back of the fire.

Ap.3.3 **Class "C" Fires** - Extinguishment of Class "C" fires may be accomplished with carbon dioxide, dry chemical, Halon, and Halocarbon agents. Water-based extinguishing agents should not be used because of the potential danger of electrical shock to the fire fighter and the possibility of short circuiting the electrical circuits.

Ap.3.4 **LPG or CNG Fires** - There are special considerations regarding fires involving liquefied petroleum gas and compressed natural gas. An uncontrolled fire involving liquefied petroleum gas (also referred to as LPG, butane, propane and sometimes brand names) or compressed natural gas (also referred to as CNG) will usually occur when there is a leak or a break at the appliance, in supply lines, or possibly at the cylinder outlet. The fire takes the form of a concentrated mass of flame adjacent to the leak or break where the fuel mixes with the air and burns. It is recognized that dry chemical or Halon extinguishing agents may extinguish the fire, but if the fuel supply is not shut off immediately, the extinguishment may set the conditions for a greater hazard (i.e., explosion). Therefore, the first concern is to SHUT OFF THE SUPPLY OF FUEL. If it is not possible to shut off the fuel supply, keep the bulkheads and overhead wet with water to keep them cool and below the kindling point of their materials of construction and thus prevent the spread of the fire to adjacent combustibles. Let the fuel burn itself out. Sometimes, if it is not possible to shut off the fuel supply valve, it may be possible to throw the cylinder overboard. If fire impinges upon cylinders, drench them with water to forestall opening of safety relief devices.

Ap.3.5 **Disconnection of Electrical Power** - In the event of a fire on board, it is recommended that all sources of electrical power be disconnected in order to avoid occurrence of a Class "C" fire.

Ap.4 **EXTINGUISHING AGENT**

Ap.4.1 When an agent is being selected to protect a hazard area, the effect of the agent on the environment should be considered. Selection of the appropriate fire suppression agent should include consideration of the following: (a) potential environmental effect of a fire in the protected area; and (b) potential environmental effect of the agent chosen.

Ap.4.2 **Water** - Water is the most widely used extinguishing agent for Class "A" fires. Water extinguishes fires by virtue of its heat absorbing ability thereby cooling the burning material to a point at which it is no longer combustible. Water is applied to the fire in the form of a liquid stream or fog.

Ap.4.3 Halogenated Agent - Halon is a colorless, essentially odorless, electrically nonconductive gas that is an effective medium for extinguishing fires. According to present knowledge Halon extinguishes fires by inhibiting the chemical reaction of fuel and oxygen. The extinguishing effect due to cooling, or dilution of oxygen or fuel vapor concentration is minor. Halon dissipates rapidly and if used in a windy area may lose its effectiveness quickly. Halons are effective for Class "B" and "C" fires and do not leave a residue. Personnel can be present in low concentrations of Halon for a limited time, but higher concentrations are toxic as are the decomposition products resulting from its use on a fire.

Ap.4.4 Dry Chemical - Dry chemical is a generic name for a number of extinguishing agents. Sodium, potassium and urea potassium bicarbonates, and potassium chloride are effective for Class "B" and Class "C" fires. Ammonium phosphate is used as a multipurpose dry chemical and is effective for Class "A", "B" and "C" fires. Dry chemical extinguishing agents are dispensed through a nozzle creating a dense cloud that blankets the fire. It is less affected by winds and drafts than clean agents and leaves a residue which in some cases may be corrosive.

Ap.4.5 Carbon Dioxide (CO₂) - Carbon dioxide is stored as a compressed gas. Carbon Dioxide as an extinguishing agent displaces oxygen. It is discharged from its storage container in the form of a gas or snow which is affected by winds or drafts. A sufficient concentration of CO₂ to extinguish a fire will not support life and therefore personnel using this extinguishing agent should take precautions to avoid being overcome from lack of oxygen. CO₂ does not leave a residue making it suitable for use in complicated machinery and electronics and around food. CO₂ is particularly suitable for Class "B" and Class "C" fire extinguishment.

Ap.4.6 Halocarbon Agents - Within the context of this standard, halocarbon agents are either hydrochlorofluorocarbons (HCFCs) or hydrofluorocarbons (HFCs) which are colorless, essentially odorless, electrically nonconductive gases that are effective media for extinguishing fire. They are primarily physical action agents operating by heat absorption, but they also possess some chemical action ability. They can be effective on all classes of fire (A, B, or C), but must be tested and approved for each category. They vary in toxicity, one from another, but are considered safe when used as intended.

Ap.5 PORTABLE FIRE EXTINGUISHERS - USE AND MAINTENANCE

Ap.5.1 Types of Portable Extinguishers

Ap.5.1.1 Halon 1211 - Halon 1211 extinguishers are fitted with a nozzle or a hose and nozzle for discharging a mixture of liquid and vapor from four to six ft. from the base of the flames.

Ap.5.1.2 Halon 1301 - Halon 1301 extinguishers are fitted with a nozzle or a hose and nozzle for discharging a mixture of liquid and vapor from four to six ft. from the base of the flames.

Ap.5.1.3 Halon 1301/1211 - Halon 1301/1211 extinguishers are fitted with a nozzle or a hose and nozzle for discharging a mixture of liquid and vapor from four to 15 ft. from the base of the flames.

Ap.5.1.4 Dry Chemical - Dry chemical extinguishers are fitted with a nozzle or a hose and nozzle for spraying the finely divided dry chemical in a dense cloud extending from five to about 15 ft. from the extinguisher for small sizes, and farther for larger sizes.

Ap.5.1.5 Carbon Dioxide - CO₂ extinguishers are fitted with a horn, either on a hose or on a metal tube swivel-connected to the valve to disburse the extinguishing agent. To be effective it is necessary to position the discharge horn within two to three ft. of the base of the flames.

Ap.5.1.6 Halocarbon Agents - HFC and HCFC fire extinguishers may be fitted with various discharge mechanisms (horn, nozzle, hose, etc.). Use of these extinguishers shall be in accordance with the manufacturer's instructions.

Ap.5.2 Application to Classes of Fires

Ap.5.2.1 Type "A" Fires - Water is likely to be the most effective extinguishing agent. If energized electrical devices are involved see recommendations under Type "C" fires. Drench the fire, open up the material to expose all burning embers and drench them again, or throw smoldering embers overboard. Some multi-purpose dry chemical, Halon, and Halocarbon portable fire extinguishers are rated for use on Type "A" fires.

Ap.5.2.2 Type "B" Fires - Halon, Halocarbon, dry chemical, and carbon dioxide are effective fire extinguishing agents for Type "B" fires.

Ap.5.2.3 Type "C" Fires - Halon, Halocarbon and carbon dioxide are effective for Type "C" fires. Dry chemical and multi-purpose dry chemical are effective extinguishing agents for Type "C" fires; however, if the burning items are wet with water, the dry chemical may aggravate electrical leakage which could become a shock hazard. Dry chemical extinguished fires should be followed by an immediate cleanup to prevent harmful corrosion and irreparable damage to electronics or other complex machinery. Multi-purpose dry chemical becomes a hard coating upon cooling and is difficult to remove.

Ap.5.3 Use of Portable Fire Extinguishers

Ap.5.3.1 General Considerations - It is recommended that familiarization with means for immediate extinguishment of a fire on board is attained.

Ap.5.3.1.1 Know the location of every portable fire extinguisher on board.

Ap.5.3.1.2 Anticipate the nearest one to be used for possible fires in the engine compartment, machinery spaces, fuel tank compartment, bilges, galley, a deck spill of fuel, etc.

Ap.5.3.1.3 Practice how to quickly remove each extinguisher from its bracket.

Ap.5.3.1.4 Perform "dry run" trials with each extinguisher for the hazard it protects, reviewing all motions required to discharge the extinguisher to be ready to fight a fire quickly and decisively.

Ap.5.3.2 Dry Chemical

Ap.5.3.2.1 For open spill fires, the discharge should be applied in a sweeping motion across the base of the flames.

Ap.5.3.2.2 For compartment fires, the discharge should be directed into the fire at the base of the flames.

Ap.5.3.2.3 For running, dripping fires from leaks in fuel lines or tanks, start extinguishment at the lower part of the fire and work upwards.

Ap.5.3.2.4 Shut off or otherwise stop the leak, if possible.

Ap.5.3.3 Halogenated Agent (Halon) and Halocarbon Agent

Ap.5.3.3.1 For open spill fires, the discharge should be applied in a sweeping motion across the base of the flames.

Ap.5.3.3.2 For compartment fires, the discharge should be directed into the fire at the base of the flames.

Ap.5.3.3.3 For running, dripping fires from leaks in fuel lines or tanks, start extinguishment at the lower part of the fire and work upwards.

Ap.5.3.3.4 Shut off or otherwise stop the leak if possible.

Ap.5.3.4 Carbon Dioxide

Ap.5.3.4.1 For open spill fires, the discharge from the horn of a CO₂ extinguisher should be from above the fire and directed at the base of the flames. This requires getting in close with the horn to about two or three ft. from the base of the flames. A slow side-to-side sweeping motion may also be effective.

Ap.5.3.4.2 For engine compartment fires, the discharge should be directed into the compartment through an access port so it is not necessary to open the compartment. CO₂ will be effective if the quantity of extinguishing agent is sufficient to develop the necessary concentration.

Ap.5.3.4.3 For running, dripping fires from leaks in fuel lines or tanks, start extinguishment at the lower part of the fire and work upwards.

Ap.5.3.4.4 Shut off or otherwise stop the leak if possible.

Ap.5.4 Maintenance of Portable Fire Extinguishers

Ap.5.4.1 Extinguishers should be examined at least monthly for at least the following:

- a. they are located in designated places,
- b. they have not suffered corrosion or mechanical damage,
- c. they are fully charged. Those extinguishers having pressure gauges or pressure indicators should show that pressure is within the prescribed limits; those without pressure gauges or indicators, and Halon and CO₂ portable fire extinguishers, should be weighed.
- d. tamper seal should be inspected to ascertain that the extinguisher has not been operated, and
- e. the nozzle orifice should be unobstructed and the hose in good condition.

Ap.5.4.2 At least once a year, a full maintenance check should be made by a qualified fire extinguishing service facility in accordance with the maintenance instructions on the name plate of the extinguisher. A tag should be attached showing the date of such maintenance check.

Ap.5.4.3 For requirements for periodic recharging and hydrostatic testing see NFPA 10, *Portable Fire Extinguishers*.

Ap.5.4.4 After any use, portable fire extinguishers should be recharged by a qualified fire extinguishing service facility or replaced with a unit of comparable size, rating and agent.

Ap.6 FIXED FIRE EXTINGUISHING SYSTEMS - USE AND MAINTENANCE

Ap.6.1 Use of Fixed Fire Extinguishing Systems

Ap.6.1.1 The following recommendations and precautions should be observed concerning the use of fixed fire extinguishing systems:

Ap.6.1.1.1 Know what spaces are protected by the system in your boat.

Ap.6.1.1.2 Familiarize yourself with the instructions for manual control stations and the local manual controls at the cylinder(s). Automatic operation features, will operate when a fire occurs in the protected compartment, even if the vessel is unattended. If a fire is observed in the protected space, do not wait for this automatic feature to come into play; shut down engines, generators and blowers and use the manual control.

Ap.6.1.1.3 Make certain that protected spaces are not occupied before discharging a fixed system.

Ap.6.1.1.4 Recharge or replace the fixed fire extinguishing system as soon as possible after it has discharged.

Ap.6.1.2 After discharging the system, allow the extinguishing agent to remain in the compartment as long as possible prior to ventilating and entering.

Ap.6.1.3 While ventilating the compartment and in preparation for entering for damage assessment, you should be prepared to fight any reflash or subsequent fire with an appropriate portable extinguisher. Reflash may occur when the extinguishing agent is removed from the compartment by ventilation and the heat and fuel source still exist.

Ap.6.1.4 If the fire involved the engine or engine compartment, care should be taken to determine the cause of the fire before restarting the engine.

Ap.6.2 Maintenance of Fixed Fire Extinguishing Systems

Ap.6.2.1 Check discharge indicator prior to each use of the boat to be certain that the fixed fire extinguishing system has not discharged.

Ap.6.2.2 Fixed fire extinguishing systems should be examined at least monthly:

- a. for corrosion,
- b. to ensure that access to controls has not been obstructed,
- c. to ensure that the pull cable has not broken loose or suffered damage or kinking,
- d. to ensure that cylinders are securely in place,
- e. to ensure that all connections of the cable are secure,
- f. to ensure that connections of the distribution piping are secure and the discharge nozzle(s) is(are) unobstructed, and
- g. to ensure that the system has not been discharged.

Ap.6.3 At one-year intervals, a full maintenance check should be made by a qualified fire extinguishing system service facility in accordance with the manufacturer's maintenance instructions. A tag should be attached showing the date of such maintenance check.

NOTE: Additional information concerning maintenance is contained in:

- a. NFPA 12, "Standard on Carbon Dioxide Extinguishing Systems"**
- b. NFPA 2001, "Standard on Clean Agent Fire Extinguishing Systems"**
- c. NFPA 12B, "Standard on Halon 1211 Fire Extinguishing Systems"**
- d. NFPA 12A, "Standard on Halon 1301 Fire Extinguishing Systems"**

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Origin and Development of ABYC A-4, Fire Fighting Equipment

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