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RECOMMENDED PRACTICES AND STANDARDS COVERING BOAT HEATING SYSTEMS

PROJECT A-7 (ADOPTED WITH PROPOSED REVISIONS OCT 19, 1970)

ABYC A-7-70

1.0 SCOPE

1.01 WHEREIN recommended practices and standards are intended as minimum requirements for safety considerations in the design and installation of boat cabin heating units and systems.

2.0 GENERAL

2.1 All components including frames, fuel filters, solenoid valves, fuel pumps, blowers, shall be of a type suitable for the application, i.e. resistant to corrosion in salt atmosphere, capable of proper operation under conditions of vibration, shock, and the pitch and rolling action of the boat. Refer to applicable ABYC standards. Gravity hot water, gravity hot air and high pressure steam systems are not recommended for boat use.

2.2 Attention is invited to the United States Coast Guard Regulations that prohibit the use of liquefied petroleum gas on certain "vessels carrying passengers for hire." See 46CFR 184.05-1(b).

2.3 Attention is invited to the United States Coast Guard Regulations that prohibit the use of gasoline for heating on certain "vessels carrying passengers for hire." See 46CFR 184.05-1(c).

2.4 Any device designed, primarily for cabin heating, involving an open flame or a heating element capable of igniting explosive vapors and combustibles during the starting operation, is prohibited.

3.0 DEFINITIONS

3.1 *Heating Unit* – The term "Heating Unit" as used herein applies to any equipment or part of equipment, which generates heat by its operation; if the heat is usable as a source to raise cabin temperature.

3.2 *Heating System* – The term "Heating System" as used herein refers to any method of interconnection of components to distribute heat throughout various spaces to be heated.

3.21 *Circulating Hot Water Heating Systems*– Any heating system which burns fuel in a remote source – generally a boiler – to produce water at temperatures higher than ambient. Water thus generated is distributed by means of a pipe or tubing network to heat distributors – generally a convector or a radiator located in those areas or cabins to be heated. Such a system includes a circulating pump to positively distribute water from the heat source to the distributors and return.

3.22 *Forced Warm Air Heating Systems* – Any heating system which burns fuel in a sealed combustion chamber to create warm air at temperatures in excess of ambient within a chamber surrounding the combustion chamber totally or in part. Warmed air is then conducted to a discharge grille in each area to be heated by means of ducts. A blower, of suitable capacity, is incorporated into such a system to positively move air from the heat source to the point of consumption.

3.23 *Steam Heating System* – Any heating system which burns fuel in a remote source – always a boiler – to produce steam, at above or below atmospheric pressure and at temperatures above ambient. Steam thus generated is conducted by means of a pipe or tubing network to heat distributors – generally a convector or radiator – in each area or cabin to be heated. The piping network will also provide for condensation created by heat release back to the heat source. Systems may be low pressure – those operated at 15 lb. pressure or less.

3.3 *Fresh Air* – Refers to air drawn from weather area.

- 3.4 *Recirculated Air* – Refers to air which is drawn from spaces within.
- 3.5 *Mechanical Atomizing Burner* – Refers to a burner that prepares and delivers the fuel and all or part of the air by mechanical processes in controlled quantities for combustion.
- 3.6 *Mechanical Vaporizing Burner* – Refers to a burner that accomplishes vaporization of the fuel by means of wick type materials or by controlled metering such that no spillage of fuel due to boat motion can occur when the vaporizing reservoir is tilted in any position.
- 3.7 *Combustion Safety Control* – Refers to a re-settable control device which is used to shut off a combustion burner in the event of flame or ignition failure.
- 3.8 *Water Temperature Control* – Refers to a temperature actuated electrical switch, design specifically to be actuated by water temperature.
- 3.9 *Draft* – Refers to the gas pressure condition existing in the exhaust of a heating unit at any specified time.
- 3.10 *Flame Failure* – Refers to the failure of combustion to continue after initial flame establishment.
- 3.11 *Ignition Failure* – Refers to the failure of a combustion type burner to establish proper flame when starting.
- 3.12 *Smoke* – Refers to an air suspension of particles usually, but not necessarily solid, formed from combustion. Also defined as carbon or soot particles less than 0.1 micron in size, which results from the incomplete combustion of solid, liquid, or gaseous fuel.
- 3.13 *Fan Switch* – Refers to a temperature actuated electrical switch, specifically designed to operate a fan motor at predetermined temperatures.
- 3.14 *High Temperature Limit Switch* – Refers to a temperature actuated electrical switch specifically designed and located to open a circuit at a predetermined maximum temperature of water or air.

4.0 *DESIGN AND CONSTRUCTION*

- 4.1 Enclosures or jackets shall be provided which will incorporate the following features:
 - 4.1.1 A mounting frame will provide means of securely fastening the unit in place. The frame construction shall have sufficient strength to secure the unit against pitch and roll experienced in marine use.
 - 4.1.2 The outside surface temperature of the enclosure or jacket shall not exceed 150°F. with an ambient temperature of 80°F.
 - 4.1.3 Electrical wiring associated with control and operation of the unit shall be of adequate size and insulation for the capacity and service intended and shall comply with other recognized standards.
 - 4.1.4 The heating unit shall be provided with an exhaust or flue outlet, which enables a gas-tight connection to be made for venting to the outside of the boat.
 - 4.1.5 Since most exhaust venting systems for heating units will be of the dry type, particular care must be exercised to properly insulate and isolate them from combustibles. In addition, the manufacturers of the heating unit shall publish information as to size, suggested procedures, bulkhead penetration and allowable operating draft and/or pressure. Refer to ABYC Standard P-1, *Recommended Practices and Standards covering Exhaust Systems for Propulsion and Auxiliary Machinery*, for installation requirements. Combustion type heating units shall be installed with a permanent flue or exhaust, the external termination

5.0 shall be provided with a device to positively prevent downdraft in the flue and preclude entrance of spray or rain.

5.0 *INSTALLATION AND LOCATION OF HEATING UNITS*

5.1 *Warm Air Heating Units*

5.11 Warm air heating units shall not be installed in fuel tank compartments or compartments in which combustible material is stored unless they are a certified sealed combustion chamber type. Engine room installation is acceptable on diesel powered boats provided a sufficient clearance to combustible materials is obtained.

5.111 Where heater is installed in an engine or bilge space, 100% fresh air shall be supplied for combustion. Heating air may be recirculated.

5.12 Heating air ducts shall be sized in accordance with the manufacturer's recommendations. Ducts shall be spaced at least one inch from all combustible material and shall be adequately supported.

5.13 Ducts and their supports shall be constructed entirely of non-combustible material resistant to deterioration or deformation from exposure to temperatures of 250°F. and condition of high humidity, moisture, mildew and vibration.

5.2 *Hot water and Steam Heating Units*

5.21 Installation and location recommendations are the same as for warm air units.

5.22 Heat distribution piping with adequate support may be located in any compartment of the boat.

5.23 Hot water heat distribution systems shall be only of the forced circulation type, employing a pump to circulate the heat distributing liquid, and shall be of the closed type. An expansion tank is required and shall be adequate in size for the system.

5.3 *Convection and Radiation Type Heating Units*

5.31 Convection or radiation type heating units shall be permanently installed.

5.32 Sufficient air space shall be provided around the unit to allow full convection of air, and prevent exposure to combustible material.

6.0 *OPERATION*

6.1 *Liquid Fuel Burners*

6.11 Burners shall be of the mechanical draft type which employ a power driven fan, blower, or other mechanism supplying air for combustion.

6.12 Burners shall be of the mechanical atomizing or mechanical vaporizing type. (See Section 3.0 Definitions).

6.13 Burners shall be provided with a means of igniting the fuel air mixture within the combustion chamber without resorting to externally applied flame such as matches, tapers and other igniting devices using flame. A prepurge period of at least 20 seconds is desirable before fuel is supplied to the burner. Ignition of an automatically lighted burner shall be activated only immediately before or simultaneously with the delivery of fuel to the ignition zone and shall remain active during a trial-for-ignition period. If ignition is cut off after flame is established and then if flame failure should occur for any reason, the heater must go

through a purge and pre-purge cycle automatically prior to an attempt for re-ignition.

- 6.14 Automatic controls for burners shall accomplish at least the following functions:
 - 6.141 Ignition failure by the burner shall cause complete safe shut-off of the fuel supply and all other burner operations within a maximum of ninety seconds for mechanical atomizing burners and 4 minutes for mechanical vaporizing burners. Restarting of the burners after ignition failure shall only be possible after performance of a manual reset device and after a pre-purge period of at least 20 seconds or an adequate period of time to assure clearing the combustion chamber of fuel vapors.
 - 6.142 Flame failure by the mechanically atomizing burners shall be detected within ninety seconds and all burner operation except a safety post purge shall cease. After total operation has ceased, it shall be necessary to manually reset the safety control prior to any attempt to re-establish operation. Flame failure by the mechanical vaporizing burners shall be detected within four minutes – during which time the blower shall remain operative and ignition off. This is a post purge period. After total operation has ceased, after the four minutes interval, it shall be necessary to manually reset the safety control prior to any attempt to re-establish operation.
- 6.15 Fuel connections and fuel filters shall comply with the ABYC Standards H-24 *Recommended Practices and Standards Covering Fuel Systems* and other applicable standards.
- 6.16 Gravity feed of fuel to heating unit burners may be permitted provided the following conditions are met:
 - 6.161 The control of fuel to the burner shall be accomplished by an electric valve of a type complying with the ABYC Standard H-24 *Recommended Practices and Standards Covering Fuel Systems* for this type of equipment.
 - 6.162 Solenoid valves shall be electrically connected into the automatic control circuit of the burner, so that their operation coincides with the supply of fuel to the burner head. Fuel shall not flow except when combustion is occurring.
 - 6.163 Manual shut-off valves of a CERTIFIED type shall be installed on the fuel tank side of both suction and return lines.
- 6.17 *Solid Fuel Burners* – Burners employing solid fuels shall be of a type which are integral with the heating unit.
- 6.2 *Forced Warm Air Heating Units*
 - 6.21 The flame and products of combustion produced by the burner shall be completely isolated and sealed from the air used for heating. Construction shall be arranged to accomplish sealing and prevent contamination of the heating air by the products of combustion.
 - 6.22 Suitable air duct connecting flanges or collars shall be provided for connection of both inlet and discharge heating air distribution system. In the case of a heating unit which requires no outlet heating air distribution system, a suitable grille on the outlet shall be provided. Design of the grille shall be such as to prevent injury of personnel.
 - 6.23 A high temperature limit switch shall be provided, which will turn off the burner if the heating air temperature exceeds 120% of rated temperature. This switch shall be separate and distinct from any other control.
- 6.3 *Circulating Hot Water and Steam Heating Units*
 - 6.31 A high temperature limit switch shall be incorporated as part of the heating unit. This device shall not be the operating control.

6.32 A pressure safety relief valve shall be installed on each heating unit. This device shall not be the operating control. The relief valve shall be an ASME approved type and rated for steam or hot water heating as below. The rating of the valve in BTU/hr. relieved shall be at least 50% greater than the maximum input to the heating unit. The relief valve shall operate at a pressure no greater than 30 pounds per square inch. In addition, discharge shall be to a place which avoids danger to the vessel's occupants.

6.4 *Radiation and Convection Self-Contained Type Heating Units*

6.41 Radiation or convection self-contained type heating units shall use only solid fuel or electrical energy.

6.42 Solid fuel type heating units shall be provided with grates and suitable ash pit. The unit shall be constructed so that at least six inches clear spacing is required around the entire unit, or so that surrounding surface temperatures are not raised more than 100°F. above ambient.

6.43 Solid fuel type heating units shall be provided with adjustable openings in the ash pit and above the combustion area for draft adjustment. Draft adjustment in the stack or exhaust by throttling is not recommended.

6.44 Radiation or convection electrical heating units shall be arranged for permanent mounting. Portable units shall not be used, unless securely mounted.

6.45 Electrical heating units shall be provided adequate wiring and terminations for the appropriate current rating as outlined in ABYC Standard E-8, *Recommended Practices and Standard Covering A.C. Electrical Systems*.

