AquaMist® MARINE SYSTEM, PER IMO RESOLUTION A.800(19)

FIRE PROTECTION, DETECTION, AND ALARM

EQUIVALENT TO SOLAS REGULATION II-2/12

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GENERAL DESCRIPTION

The *AquaMist* Marine System is an engineered, low pressure, automatic, wet pipe, water mist fire protection system that has been qualified in accordance with IMO Resolution A.800(19) for use in marine accommodation, public space, and service areas. It utilizes individual, automatically activating water mist nozzles in conjunction with an automatic water supply, a water distribution system, and a localized water flow detection system to provide a fire protection, detection and alarm system that is equivalent to SOLAS Regulation II-2/12. The *AquaMist* System is capable of immediate operation and sounding of a water flow alarm at the Navigating Bridge or main Fire Control Station.

The *AquaMist* Marine System functions with the same basic simplicity as an equivalent, traditional automatic sprinkler system except that it utilizes low flow, water mist nozzles with quick response - bulb type thermal elements that are installed on closer spacings than traditional automatic sprinklers, in order to provide a fire protection system with the following features.

a. Responds to a fire quicker.

b. Uses less water flow.

c. Results in less fire and water related damage.

d. Reduces the passage of heat outside of the fire area.

e. Provides a faster alarm.

f. Greater tolerance to a nozzle (sprinkler) being disabled due to either the action of an arsonist or a passenger unknowingly obstructing it.

The *AquaMist* Marine System is particularly effective in the extinguishment of a compartment fire deliberately set by an arsonist using an accelerant.

In compliance with the requirements of Safety Of Life At Sea (SOLAS) Regulation II-2/12, water is initially supplied to the *AquaMis*t Marine System from the *AquaMist* System Pressure Tank and then, if needed, the water supply is automatically changed over to the *AquaMis*t System Fire Pump. Also in compliance with the SOLAS regulations, which are based on the requirements for traditional automatic sprinklers, provision is made for changing over the *AquaMist* System water supply to the vessel's Fire and Wash Deck Main Pump, as well as supplementing the water supply from Shore Connections (when docked).

The Types AM6, AM11, AM22, and AM24 *AquaMist* Nozzles (Ref. Appendix A), which are utilized with the *AquaMist* Marine System, are pendent, automatic, water mist nozzles of the quick response - bulb type which are designed for use with engineered, wet pipe, fire protection, detection, and alarm systems. They are low pressure nozzles which utilize a single water jet impinging on a diffuser to produce a hemisperical water spray pattern having a range of water droplet sizes suitable for the extinguishment of fires which might occur in accommodation, public space, and service areas.

The *AquaMist* Marine System provides the very latest in fire protection technology for marine applications. Extensive fire testing of the quick response Types AM6, AM11, AM22, and AM24 Nozzles has demonstrated that they provide a level of fire protection safety which is superior to that of traditional standard spray, standard response automatic sprinklers.

The AM6, AM11, AM22, and AM24 Nozzles have been fire tested in accordance with the procedures defined in Appendix 2 of International Maritime Organization (IMO) Resolution A.800(19) and performed superior to the acceptance criteria specified for the protection of the occupancies referenced in the Applications Criteria section. In addition, the *AquaMist* Nozzles have been found to comply with the IMO Component Manufacturing Standards for Water Mist Nozzles as specified in Appendix 1 of IMO Resolution A.800(19).

Engineered water mist systems utilizing the AM6, AM11, AM22, and AM24 Nozzles provide a lower cost and less complex alternative to high pressure and "twin fluid" water mist systems. Also, the passageways of the Inlet Strainer and Orifice Insert of the *AquaMist* Nozzles have been specifically designed with consideration for the use of standard marine, shipboard water supplies. Therefore, there is no need for elaborate filtration systems.

APPROVALS AND STANDARDS

The Types AM6, AM11, AM22, and AM24 *AquaMist* Nozzles have been investigated by Underwriters Laboratories Inc. (UL) and found to comply with the requirements of IMO Resolution A.800(19) and NFPA 750, for the protection of the occupancies referenced in the Applications Criteria section. UL has Listed these nozzles as

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being in compliance with IMO Resolution A.800(19), and NFPA 750, as well as placed them under their Follow-Up Service Program to ensure continuing compliance.

The Types AM6, AM11, AM22, and AM24 Nozzles are Approved by the U.S. Coast Guard. The UL Listing, as well as the U.S. Coast Guard Approval, only apply to use of the Types AM6, AM11, AM22, and AM24 Nozzles as part of an engineered wet pipe system for the service conditions indicated in the Application Criteria section, as well as a system designed to the specifications outlined in the System Design Criteria section.

The *AquaMist* Marine System is Approved by the American Bureau of Shipping, Australian Maritime Safety Authority, Bureau Veritas, China Classification Society, Det Norske Veritas, Germanischer Lloyd, Lloyd's Register of Shipping, Marine Marchande, Marine Safety Agency (Department of Transport-UK), Swedish Maritime Administration, and Transport Canada. It has also been Accepted by the Norwegian Maritime Directorate.

Application has also been made for Type Approval of the *AquaMist* Marine System by the Italian Ministry of Transport and Navigation.

Please refer inquiries on the latest status of type approvals/acceptance and the individual requirements of these various marine regulatory authorities to the Technical Data Department or Wormald ANSUL (UK) Ltd., International Marine, Wormald Park, Grimshaw Lane, Newton Heath, Manchester M40 2WL, England, Tel. 44-161-205-2321 / Fax. 44-161-455-4454.

WARNINGS

The AM6, AM11, AM22, and AM24 AquaMist Nozzles must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association, in addition to the standards of the marine regulatory Authority Having Jurisdiction. Failure to do so may impair the integrity of these devices.

The Master and Crew are responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or manufacturer should be contacted relative to any questions.

PRINCIPLES OF OPERATION

The mechanisms by which the spray of the Types AM6, AM11, AM22, and AM24 Nozzles act to extinguish, suppress, or control a fire can be a complex combination of the following factors.

(1) Heat extraction from the fire as water is converted into vapor and the fuel is cooled.

(2) Reduced oxygen levels as the water vapor displaces oxygen near the fire.

(3) Direct impingement wetting and cooling of the combustibles.

(4) Enveloping of the protected area to cool gases and adjacent combustibles, as well as to pre-wet the adjacent combustibles and block the transfer of radiant heat to them.

In the case of compartments and narrow corridors, factors (1) and (2) are primarily involved. In the case of public spaces, wide corridors, and other large deck areas, factors (3) and (4) are primarily involved.

The amount of evaporation and hence heat extracted from the fire (i.e., cooling of the fuel) is a function of the surface area of the water droplets applied for a given volume. Reducing droplet size increases surface area and increases the cooling effect of a given volumetric flow rate of water.

When water converts to vapor, it expands by about 1650 times, displacing and diluting oxygen, thereby blocking the access of oxygen to the fuel. Because of their rapid rate of heat release, arsonist fires in compartments are the easiest for water mist systems to extinguish, due to the rapid vaporization which can occur with the relatively high level of heat present at nozzle operation.

In addition to the pre-wetting and cooling of the flames by vaporizing water droplets, fire extinguishment can be enhanced by direct contact of the water droplets with the burning fuel to prevent further generation of the combustible vapors. This mode of extinguishment, which is normally associated with traditional sprinklers, tends to become more important as the degree of ventilation of the fire is increased.

Small water droplets tend to remain suspended within the protected space. This results in a "mist" that distributes itself throughout a space, outside of the direct spray range of an individual nozzle. Fine water droplets are, therefore, more likely to be drawn into the seat of the fire, further enhancing the effectiveness of the system by chemically inhibiting the combustion radicals. This three-dimensional effect of the expanding mist also acts to cool the gases and other fuels in the area, blocking the transfer of radiant heat to adjacent combustibles, as well as pre-wetting them.

PROTECTION OBJECTIVES

The protection objectives of the AM6, AM11, AM22, and AM24 *AquaMist* Nozzles, which are utilized with the *AquaMist* Marine System, have been evaluated in a variety of cabin, luxury cabin, corridor, and public space as well as shopping and storage area fire test scenarios, as applicable. Copies of the fire test reports are available upon request from the Technical Data Department.

The *AquaMist* Nozzles have been found effective for the extinguishment of a wide variety of exposed and shielded fires when installed in accordance with the System Design Criteria section. However, highly shielded fires may only be suppressed or controlled, all depending on the degree of ventilation.

APPLICATION CRITERIA

The *AquaMist* Marine Fire Protection, Detection, and Alarm System is suitable for the protection of the following occupancy classifications, as defined in SOLAS Regulation II-2/26, when installed in accordance with the specifications given in the System Design Criteria Section:

AM6 Nozzles:

- Interior stairways, lift shafts, and escalators (other than those wholly contained within machinery spaces) for passengers and crew, up to 4 ft.-11 in. (1,5 m) wide.
- Passenger as well as crew corridors and lobbies, up to 4 ft.-11 in. (1,5 m) wide.

AM11 Nozzles:

- Accommodation spaces of minor fire risk such as cabins, offices, and dispensaries containing furniture and furnishings of restricted risk, having a deck area of up to 269 ft^2 (25 m^2).
- Accommodation spaces of moderate fire risk containing furniture and furnishings of other than restricted fire risk, having a deck

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area of up to 269 ft^2 (25 m^2). Examples of such spaces are:

  – Cabins, offices, and dispensaries.

  – Motion picture projection and film stowage rooms.

  – Cleaning gear lockers and laboratories in which flammable liquids are not stowed.

  – Diet kitchens containing no open flame.

  – Pharmacies and specie rooms.

  – Service areas containing isolated lockers and small store rooms having deck areas of up to 43 ft^2 (4 m^2) in which flammable liquids are not stowed.

- Small drying rooms having a deck area of up to 43 ft^2 (4 m^2).

- Sanitary and similar spaces having a deck area of up to 269 ft^2 (25 m^2) such as communal sanitary facilities, showers, baths, water closets, etc.; small laundry rooms; indoor swimming pool areas; operating rooms; and, isolated pantries containing no cooking appliances.

AM22 Nozzles:

- Control stations such as:

  – Spaces containing emergency sources of power and lighting.

  – Wheelhouse and chartrooms.

  – Spaces containing the radio equipment.

  – Fire extinguishing, fire control, and fire recording stations.

  – Spaces containing centralized fire alarm equipment.

  – Control rooms for propulsion machinery when located outside of the propulsion machinery space.

  – Spaces containing centralized emergency public address system stations and equipment.

- Interior stairways, lift shafts, and escalators (other than those wholly contained within machinery spaces) for passenger and crew, over 4 ft.-11 in. (1,5 m) wide.

- Passenger as well as crew corridors and lobbies, over 4 ft.-11 in. (1,5 m) wide.

- Accommodation spaces of minor and moderate fire risk, such as described above for the AM11 Nozzles, having a deck area of 129 ft^2 (12 m^2) or more.

- Accommodation spaces of greater fire risk such as barber shops and beauty parlors.

- Small drying rooms having a deck area of up to 43 ft^2 (4 m^2).

- Sanitary and similar spaces, such as described above for the AM11 Nozzles, having a deck area of 129 ft^2 (12 m^2) or more.

- Public spaces having a deck area of 129 ft^2 (12 m^2) or more and a maximum ceiling height of 16 ft.-5 in. (5 m) containing furniture and furnishings of restricted or other than restricted fire risk.

AM24 Nozzles:

- Shopping areas.

- Store-rooms, workshop, and pantry type areas such as:

  – Main pantries not annexed to galleys.

  – Main laundry.

  – Large drying rooms (having a deck area of more than 43 ft^2 (4 m^2).

  – Miscellaneous stores.

  – Mail and baggage rooms.

  – Garbage rooms.

  – Workshops (not part of machinery spaces, galleys, etc.).

  – Lockers and store-rooms having areas greater than 43 ft^2 (4 m^2), other than those spaces that have provisions for the storage of flammable liquids.

- Other spaces in which flammable liquids (other than fuels) are stored, such as:

  – Lamp rooms.

  – Paint rooms.

  – Store-rooms containing flammable liquids (including dyes, medicines, etc.)

  – Laboratories (in which flammable liquids are stowed).

SYSTEM DESIGN CRITERIA

Refer to the following appendices for all applicable system design criteria:

A - *AquaMist* Nozzle Criteria
B - General Criteria
C - Component Criteria
D - Pipe (Tube) and Fitting Criteria
E - Bulkhead and Deck Penetration Criteria
F - Waterflow Detector Criteria
G - Strainer Criteria
H - Hydraulic Design Criteria
J - Nozzle Installation and Spacing Criteria
K - System Pressure Tank Criteria

INSTALLATION

NOTES

All listed materials and devices are to be installed in accordance with their listing. All other materials and devices are to be installed in accordance with the manufacturer's instructions.

Pipe, tube, and nipples are to have the burrs and fins removed after cutting.

All system piping is to be flushed, where practical, prior to installing the nozzles; otherwise, cleanliness is to be determined by visual inspection.

Prior to installing the nozzles, the nozzle fittings must be plugged, and the interior piping of the water mist system and all attached appurtenances subject to system working pressure are to be hydrostatically tested to 150% of the maximum normal service pressure. The test pressure is to be maintained without loss for 2 hours. Any loss in pressure may be determined by either a drop in gauge pressure or visual leakage.

CARE AND MAINTENANCE

Water mist systems for fire protection service require regularly scheduled care and maintenance by trained personnel. Refer to Appendix L "Instructions to the Master and Crew". Impairments to the system must be repaired immediately.

NOTE

Before closing a fire protection system main control valve for maintenance work on the fire protection system which it controls, permission to shut down the affected fire protection system must be obtained from the proper authorities and all personnel who may be affected by this action must be notified.

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APPENDIX A
AquaMist NOZZLE CRITERIA FOR THE *AquaMist* MARINE FIRE PROTECTION, DETECTION, AND ALARM SYSTEM

DESIGN

It is essential that all of the *AquaMist* Nozzles be of the correct type and temperature rating, as designated in the system design drawings. Each of the nozzles and its respective diffuser are illustrated in Figure A-1.

The Types AM6, AM11, AM22, and AM24 *AquaMist* Nozzles are rated for use at a maximum service pressure of 250 psi (17,2 bar) and the minimum operating pressures given in Appendix J. They are available in the temperature ratings given in Table A-1, in combination with natural brass, chrome plated, or polyester coated (all colors) finishes. The polyester coating is a decorative finish only. The maximum allowable normal ambient temperature for each of the nozzle temperature ratings is to be in accordance with the requirements of the marine regulatory Authority Having Jurisdiction (AHJ).

The AM6, AM11, AM22, and AM24 Nozzles ultilize a 3 mm quick response bulb for individual automatic operation. The frames of the *AquaMist* Nozzles are manufactured from a dezincification resistant bronze. The nozzle orifice seals consist of a Beryllium Nickel (N03360) disc spring that is sealed on both its inside and outside faces with a Teflon† gasket.

The seal Ejection Springs are Type 302 stainless steel per ASTM A167 or BS1449 Pt2. The AM6 Nozzle Inlet Strainers are fabricated from phosphor bronze per ASTM B103 (C52100) or BS2870 (PB103). The AM22 and AM24 Inlet Strainers are fabricated from copper per ASTM B152 (C11000) or BS2870 (C101). The AM11 Inlet Strainers are fabricated from Type 316 stainless steel per ASTM A167 or BS1449 Pt2. The Orifice Inserts, Buttons, and Diffusers of the AM6 and AM11 Nozzles are phosphor bronze per ASTM B139 (C54400) while the Diffusers of the AM22 and AM24 Nozzles are phosphor bronze per ASTM B103 (C52100). The AM22 and AM24 Loading Screws are phosphor bronze per ASTM B139 (C51000).

Table A-2 provides the nominal diameter of the smallest waterway diameter of the Orifice Insert, as well as the nominal diameter of the Inlet Strainer perforations for the AM6, AM11, AM22, and AM24 Nozzles.

The nominal discharge curves plotted in Figure A-2 represents the flow "Q" in GPM (LPM) as determined by the following formula:

$$Q = K\sqrt{p}$$

where the nominal nozzle discharge coefficient is "K" and "p" equals the residual flowing pressure in psi (bar). The nominal value of "K" for the AM6 and AM11 Nozzles is 0.33 (4,7), and the nominal value of "K" for the AM22 and AM24 Nozzles is 0.64 (9,2). Listing standards permit the actual value of "K" to vary by 5%.

Nozzle Temperature Rating	Bulb Liquid Color Code
135°F/57°C	Orange
155°F/68°C	Red
175°F/79°C	Yellow
200°F/93°C	Green

TABLE A-1
NOZZLE TEMPERATURE RATINGS

OPERATION

With reference to Figure A-1, the waterway of each *AquaMist* Nozzle is held closed by the combination of a Teflon† sealed Disc Spring and Button which, in turn, are held in position by a 3 mm O.D., quick response, bulb type thermally responsive element. The Bulb shatters when its temperature is raised to the prescribed operating point, allowing the nozzle to discharge a fine spray of water (mist) around the fire area. The size of the orifice, in the Orifice Insert, controls the amount of water flow from the nozzles, as a function of their inlet pressure. The combination of the pipe line strainers located downstream of each water source, and the nozzle Inlet Strainers, prevents any debris in the water from clogging the nozzle orifices.

The 3 mm O.D., quick response bulbs used in the *AquaMist* Nozzles are filled with a high expansion rate, low freezing point liquid leaving a small bubble of air entrapped. As the temperature of the surrounding air rises, the fluid in the bulb expands, increasing the internal pressure as the air bubble collapses. Once the air bubble collapses, sufficient internal pressure is developed, with the increasing fluid expansion, to shatter the bulb. Higher temperature bulbs have larger air bubbles. The *AquaMist* Nozzles come in several different temperature ratings.

The temperature rating is marked on the frame and indicated by the bulb fluid color as listed in Table A-1. The maximum normal ambient temperature to which the nozzles are exposed is to be based on the requirements of the marine regulatory Authority Having Jurisdiction (AHJ).

Once the bulb shatters, the Disc Spring and Button are released, allowing water flow to start. The water is discharged through the nozzle orifice as a single stream, high velocity jet which impinges on a diffuser that breaks up the stream of water into a hemispherical spray pattern having a range of droplet sizes as detailed in the following Spray Characteristics section.

SPRAY CHARACTERISTICS

Figure A-3 illustrates representative data on droplet size distribution for the AM6, AM11, AM22, and AM24 *AquaMist* Nozzles, at a pressure of 175 psi (12,1 bar), in a plane located 39.4 inches (1 m) below the nozzle diffusers. Data on the number of droplets versus drop diameter and cumulative volume versus drop diameter are provided. The droplet size distribution data given at 175 psi (12,1 bar) for each of the *AquaMist* Nozzles is representative of that over the full operating pressure ranges given in Appendix J.

The following describes the general spray characteristics for

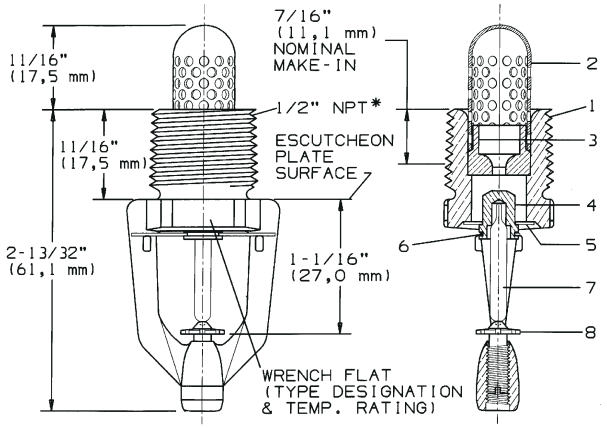
Nozzle Type	Nominal K-Factor GPM/psi$^{1/2}$ (LPM/bar$^{1/2}$)	Nominal Orifice Diameter Inches (mm)	Nominal Diameter Of Inlet Strainer Perforations Inches (mm)
AM6	0.33 (4,7)	0.105 (2,67)	0.075 (1,91)
AM11	0.33 (4,7)	0.105 (2,67)	0.059 (1,50)
AM22	0.64 (9,2)	0.187 (4,75)	0.125 (3,18)
AM24	0.64 (9,2)	0.187 (4,75)	0.125 (3,18)

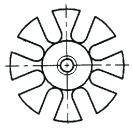
TABLE A-2
NOZZLE ORIFICE AND INLET STRAINER PERFORATION DIAMETERS

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† DuPont Registered Trademark

1 - Frame
2 - Inlet Strainer
3 - Orifice Insert
4 - Button
5 - Disc Spring
6 - Ejection Spring
7 - Bulb
8 - Diffuser/ Loading Screw





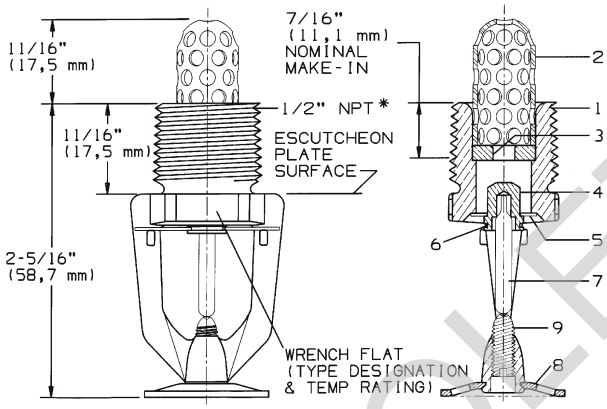
AM6 Diffuser

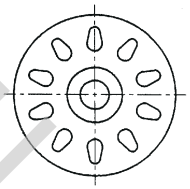


AM11 Diffuser

AM6 & AM11

1 - Frame
2 - Inlet Strainer
3 - Orifice Insert
4 - Button
5 - Disc Spring
6 - Ejection Spring
7 - Bulb
8 - Diffuser
9 - Loading Screw





AM22 Diffuser



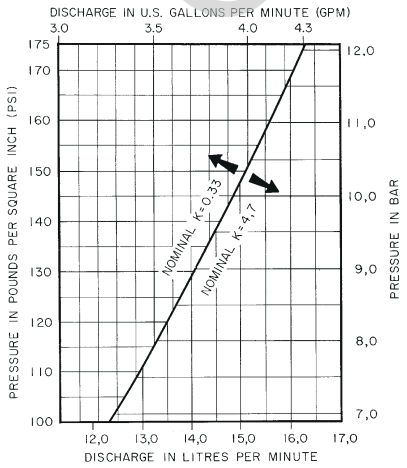
AM24 Diffuser

AM22 & AM24

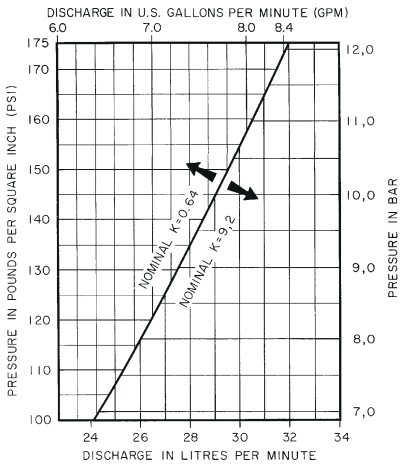
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* Pipe thread connections per ISO 7/1 can be provided on special request.

FIGURE A-1
TYPES AM6, AM11, AM22, AND AM24 *AquaMist* NOZZLES

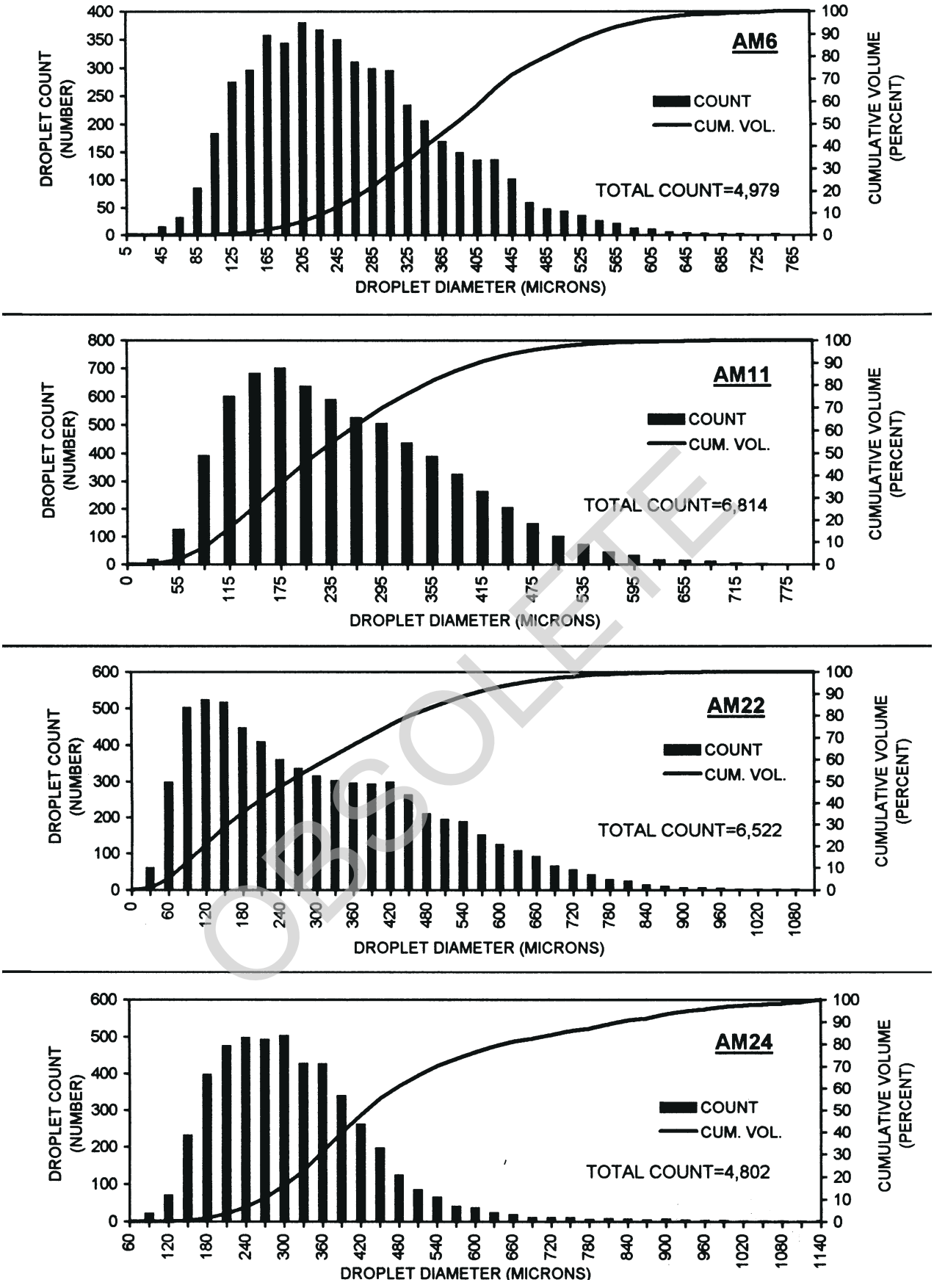


AM 6 & AM11



AM22 & AM24

FIGURE A-2
NOMINAL DISCHARGE CURVES



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FIGURE A-3
REPRESENTATIVE DROPLET SIZE DISTRIBUTION DATA AT 175 PSI (12,1 BAR) AND 39.4 INCHES (1 m) BELOW THE DIFFUSERS FOR THE TYPES AM6, AM11, AM22, AND AM24 *AquaMist* NOZZLES

all four types of nozzles when they are sprayed in the open. Each nozzle is characterized by the combination of a generally radially outward, umbrella shaped spray pattern near the ceiling in addition to a generally downward, conical shaped pattern. The downward conical spray pattern has an effective diameter of about 6 ft. (1,8 m) for the AM6 Nozzles; 8 ft.(2,4 m) for the AM11Nozzles; 9 ft.(2,7 m) for the AM22 Nozzles; and, 12 ft. (3,7 m) for the AM24 Nozzles, when measured 8 ft. (2,4 m) below the nozzle diffusers. However, the smaller droplets are distributed around the space according to the size of the droplets (e.g., smallest being the most mobile). As the higher momentum smaller droplets approach the floor or other horizontal obstruction, a portion are diverted laterally, as well as upwards, to help fill the the spaces between the conical spray patterns.

Table A-3 summarizes the typical water collection densities under individual sample nozzles, at their minimum operating pressures, over the indicated (square shaped) collection areas.

INSTALLATION

The *AquaMist* Nozzles are to be installed in the fully exposed pendent position, The installation and spacing criteria are provided in Appendix J.

Care must be exercised to avoid damage to the *AquaMist* Nozzles - both before and after installation. Nozzles damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced.

The *AquaMist* Nozzles must only be installed by applying an 8 or 10 inch (200 or 250 mm) adjustable wrench to the wrench flats (Ref. Figure A-1). Use of a Teflon† based pipe thread sealant is recommended, and the thread sealent is to be applied sparingly to the male threads only.

NOTE

A leak tight 1/2 inch NPT nozzle joint should be obtained with a torque of 7 to 14 ft. lbs. (9,5 to 19,0 Nm). A maximum of 21 ft. lbs. (28,5 Nm) of torque is to be used to install the nozzle. Higher levels of torque may distort the nozzle inlet with consequent impairment of the nozzle.

ORDERING PROCEDURE

Unless otherwise specified, the *AquaMist* Nozzles are provided with NPT pipe thread connections. Pipe thread connections per ISO 7/1 can be provided on special request. A Product Symbol Number (PSN) is not specified when ordering polyester coated *AquaMist* Nozzles with other than a white color. It is suggested that a color chip be provided when ordering special color finishes; otherwise, responsibility for duplication of the desired finish cannot be accepted.

Contact your local distributor for availabilty.

— STANDARD ORDER —

AquaMist Nozzles:
Specify: (specify temperature rating), Type (specify AM6, AM11, AM22, or AM24) AquaMist Nozzle with (specify type of finish), PSN (specify from Table A-4).

— SPECIAL ORDER—

AquaMist Nozzles with ISO 7/1 Thread Connections:
Specify: (specify temperature rating), Type (specify AM6, AM11, AM22, or AM24) AquaMist Nozzle with (specify type of finish) and with thread connection per ISO 7/1, PSN (specify from Table A-4).

WEIGHTS

The nominal weight of the Type AM6, AM11, AM22, or AM24 *AquaMist* Nozzles is 2.5 oz. (70 g).

PATENTS

U.S. Patents 5,392,993 and 5,505,383 are applicable to the *AquaMist* Nozzles. Other patents are pending.

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Type	Residual Pressure, psi (bar)	Ceiling Height ft.-in. (m)	Collection Area, ft^2 (m^2)	Average Collection, gpm/ft^2 (mm/min.)
AM6	116.0 (8)	8-2 (2,5)	64 (5,9)	0.047 (1,90)
AM11	101.5 (7)	8-2 (2,5)	64 (5,9)	0.061 (2,48)
AM22	101.5 (7)	8-2 (2,5)	100 (9,3)	0.047 (1,93)
	101.5 (7)	16-4 (5)	100 (9,3)	0.047 (1,90)
AM24	101.5 (7)	8-2 (2,5)	64 (5,9)	0.049 (2,02)

TABLE A-3
TYPICAL WATER COLLECTION DENSITIES UNDER INDIVIDUAL NOZZLES AT MINIMUM OPERATING PRESSURE

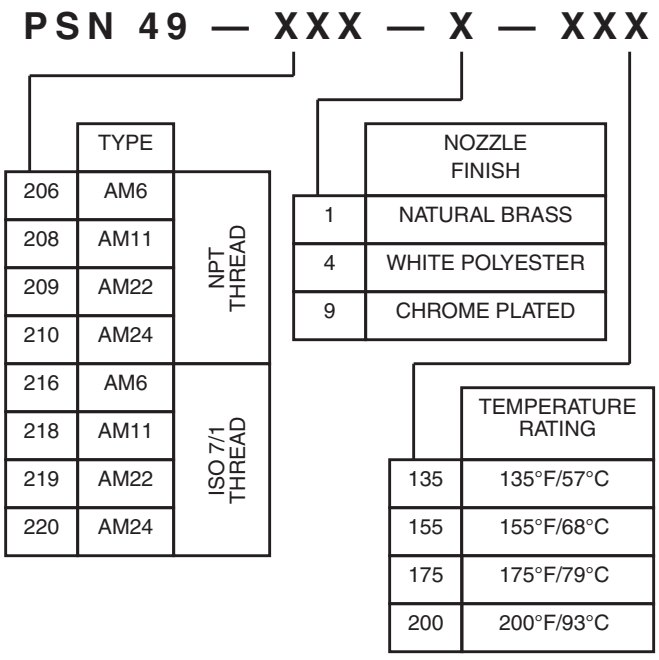


TABLE A-4
PRODUCT SYMBOL NUMBER SELECTION FOR THE TYPES AM6, AM11, AM22, AND AM24 *AquaMist* NOZZLES

APPENDIX B
GENERAL CRITERIA FOR THE *AquaMist* MARINE FIRE PROTECTION, DETECTION, AND ALARM SYSTEM

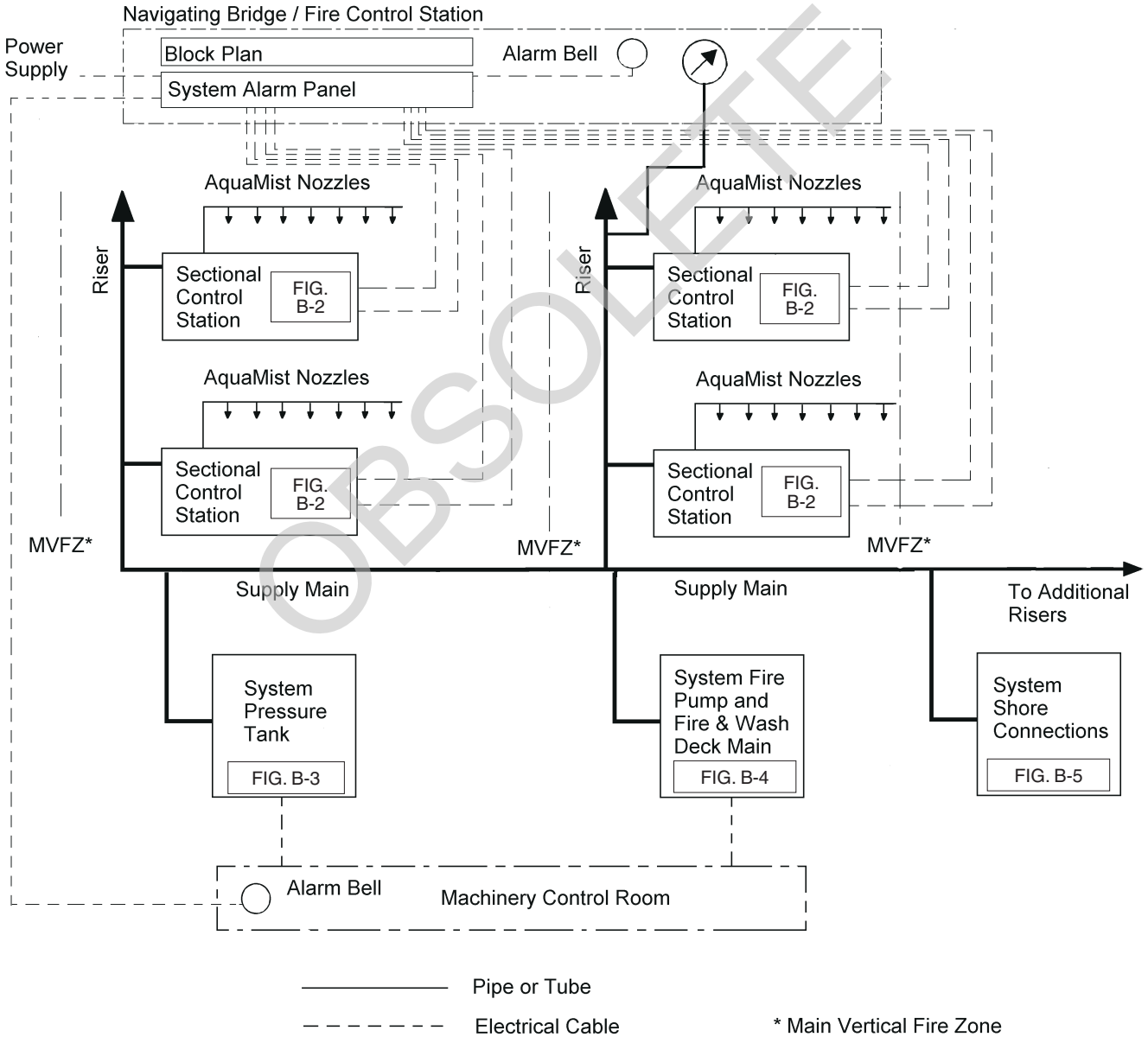
1. The *AquaMist* Marine System (Ref. Figure B-1) is to be capable of immediate, automatic operation at all times (i.e., no human action is to be necessary to set it in operation).

2. The installing contractor is to provide the ship with a copy of the as-built system working plans; this technical data sheet; and, the inspection, testing, and maintenance, as well as operation instructions for all system equipment and devices. A listing or plan is to be displayed on the ship showing the spaces protected, and the location of all control valves.

3. Any portions of the system which may be subject to temperatures below 40°F/4°C are to be protected from freezing.

4. The fire protection system is to be kept pressurized to the minimum required pressure, under all normal conditions, with a continuous supply of water as required.

5. The System Fire Pump, water supply, and pipework are to be capable of maintaining the minimum required operating pressure at the level of the highest nozzle. Hydraulic calculations are to be based on the hydraulically most demanding 1500 ft^2 (140 m^2) area of nozzle operation occuring concurrently within each of two Main Vertical Fire Zones (MVFZ). [Note: This criterion considers the possibility of two concurrent incidents and requires that the System Fire Pump, water supply and supply main pipework be sized to supply a total of 3000 ft^2 (280 m^2) of nozzle operation.]



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FIGURE B-1
***AquaMist* MARINE SYSTEM SCHEMATIC**
— GENERAL ARRANGEMENT —

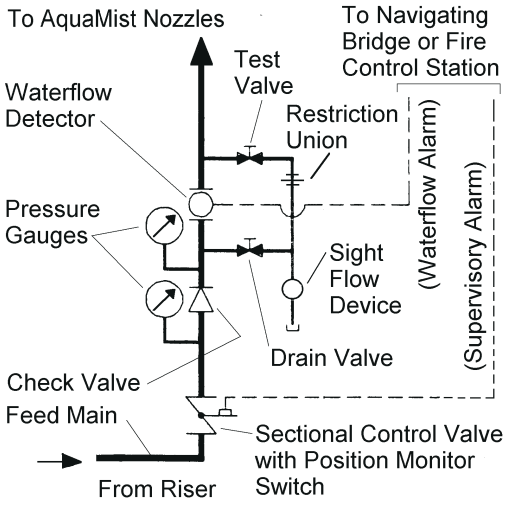


FIGURE B-2
— *AquaMist* MARINE SYSTEM SCHEMATIC — SECTIONAL CONTROL STATION

For small ships with a total protected area of less than 3000 ft^2 (280 m^2), refer to the marine regulatory Authority Having Jurisdiction for guidance on sizing of the pump.

6. Hydraulic calculations for the *AquaMist* System are to be made as part of the design of the piping system to verify that the minimum required flowing pressure is available at each nozzle. Refer to Appendix H for the hydraulic design criteria.

7. Gauges are to be provided to indicate pressure downstream of each control valve, pressure tank pressure, fire pump (suction and discharge) pressure, the supply main pressure, as well as the pressures upstream and downstream of each sectional check valve.

8. The System Alarm Panel is to be located on the Navigating Bridge or at the main Fire Control Station. It is to be self-monitoring for a single open circuit and single short circuit fault condition. A switch is to be provided at the System Alarm Panel for the purpose of performing a self-test of all audible, as well as visual alarm, supervisory, and trouble signals.

9. In accommodation, public space, and service spaces, as defined in the Application Criteria section, the *AquaMist* Nozzles are to have a nominal temperature rating of 135°F/57°C to 175°F/79°C. The 155°C/68°C temperature rating is considered standard. Where higher ambient temperatures may be expected, as in the case of drying rooms, the nozzle temperature rating is to be selected based on the requirements of the marine regulatory Authority Having Jurisdiction (AHJ).

10. Nozzles are to be grouped into separate sections, each having its own Sectional Control Station (Ref. Figure B-2) comprised of a sectional control valve, waterflow detector, test valve, drain valve, pressure gauges, sight flow device, and check valve. The feed main portion of the Sectional Control Stations may be installed either horizontal or vertical.

    Any section should not serve more than two decks of one main vertical fire zone (MVFZ) unless the level of protection of the ship against fire will not be reduced by doing so.

11. Each separate section of nozzles is to be equipped with at least one end-of-line Branchline Bleed-Valve to remove the majority of trapped air from the system. The Bleed-Valve is to be equipped with an outlet connection which is suitable for the temporary attachment of a flexible drain tube that can be run to a suitable open drain. If the piping arrangement is such that one or more large trapped pockets of air could form, that otherwise would not be vented from the end-of-line Branchline Bleed Valve, additional Branchline Bleed-Valves should be installed accordingly. When an Inspector's Test Connection is required by the marine regulatory Authority Having Jurisdiction, the end-of-line Branchline Bleed-Valve can be adapted for use as an Inspector's Test Connection by including a test orifice with a K-factor equivalent to the smallest K-factor nozzle in the section.

12. Each section of nozzles is to include a Waterflow Detector in the section supply line to automatically initiate a visual and audible alarm signal at the System Alarm Panel, whenever any nozzle operates. The visual alarm signal is to indicate the section in which the nozzle has operated.

13. The Sectional Control Valve for each Sectional Control Station is to be readily accessible and its location is to be clearly and permanently indicated. In addition, each Sectional Control Valve is to be maintained normally open and is to be provided with a position monitor switch that will initiate an audible and visual supervisory signal at the System Alarm Panel if the Sectional Control Valve is closed. The audible supervisory signal is to be separate and distinct from the audible alarm signal, and it is to be activated within two turns of the Sectional Control Valve being closed.

14. A test connection at each Sectional Control Station is to be provided for testing the associated automatic alarm by discharging water through an orifice having a K-factor equivalent to the smallest K-factor nozzle in that section. The test connection is to be located downstream of the Waterflow Detector.

15. A spare nozzle cabinet is to be provided at each Sectional Control Station. Each cabinet is to contain a nozzle wrench and at least six spare nozzles, with a minimum of two nozzles of each type* utilized in the section. It is recommended that the total ship's stock of spare nozzles include the following, as a minimum:

Maximum Number Of Nozzles Of Each Type* In The Total System	Minimum Number Of Total Required Spare Nozzles
<50	2
50	3
300	6
1000	12
>1000	24

* By model number, temperature rating, and finish.

16. A System Pressure Tank (Ref. Figure B-3) having a total volume of at least twice that of the required charge of water (i.e., at least 1/2 air), is to be provided. As a minimum, the Pressure Tank is to contain a standing charge of potable water equivalent to the amount of water which would be discharged in one minute by the system fire pump.

    The system design is to provide for maintaining air or nitrogen pressure in the Pressure Tank such that when the standing charge of water in the Pressure Tank has been exhausted, the residual pressure will not be less than the minimum operating pressure of the highest nozzle in the system, in addition to the pressure exerted by the head of water measured from the bottom of the tank to the highest nozzle plus pressure drop due to friction loss. A suitable manual means of replenishing the air under pressure and of replenishing the water charge in the Pressure Tank is to be provided.

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The Pressure Tank is to be fitted with a relief valve, a water level indicator, and a pressure gauge. A gauge test valve is to be provided at the pressure gauge connection. A check valve is to be provided in the discharge line from the tank to prevent the admission of sea water into the Pressure Tank.

17. An independent System Fire Pump is to be provided solely for the purpose of continuing the delivery of water to the *AquaMist* Nozzles. The Fire Pump is to be automatically controlled and configured to operate upon actuation of a nozzle, before the standing water charge in the Pressure Tank is exhausted. The supply to the System Fire Pump is to be from a "sea chest" connection.

18. Provision of the "sea chest" connection is considered to be the responsibility of the shipyard (others). It is to be corrosion resistant, located in the same space as the System Fire Pump, and arranged such that when the vessel is under way it will not be necessary to shut off the supply of sea water to the System Fire Pump for any purpose other than the inspection or repair of the System Fire Pump. Also, as part of the "sea chest" connection, a Sea Water Control Valve and a Strainer having maximum 0.236 in. (6 mm) dimension openings are to be provided.

19. The discharge side of the System Fire Pump is to be equipped with a test connection as indicated in Figure B-4. The test connection is to consist of control valve and a flow metering device arranged to discharge into the ship's bilge, for subsequent disposal. The test connection is to be sized to allow testing the System Fire Pump at the system design flow rate and minimum required discharge pressure as described in Paragraph 5.

20. The System Fire Pump and Pressure Tank are not to be located in a Category "A" machinery space, and they are not to be situated in a space that is protected by the *AquaMist* System which they supply.

21. The *AquaMist* System is to be equipped with a connection from the ship's Fire & Wash Deck Main. A control valve and check valve which will prevent a reverse flow from the *AquaMist* System to the Fire & Wash Deck Main is to be provided at the connection, as indicated in Figure B-4. The Fire & Wash Deck Main supply to the *AquaMist* System is to be capable of maintaining the pressure and flow demand requirements of the system.

22. Provision is to be made for connecting the *AquaMist* System Supply Main to shore connections, as indicated in Figure B-5. Hose couplings are to be fitted to the inlet of the check valves for the purpose of coupling to the shore supply. The number and size of the shore connections is to be as approved by the marine regulatory Authority Having Jurisdiction.

23. The normally closed control valves for the Fire & Wash Deck Main, as well as the Shore Connections, are to be readily accessible and their locations are to be clearly and permanently indicated.

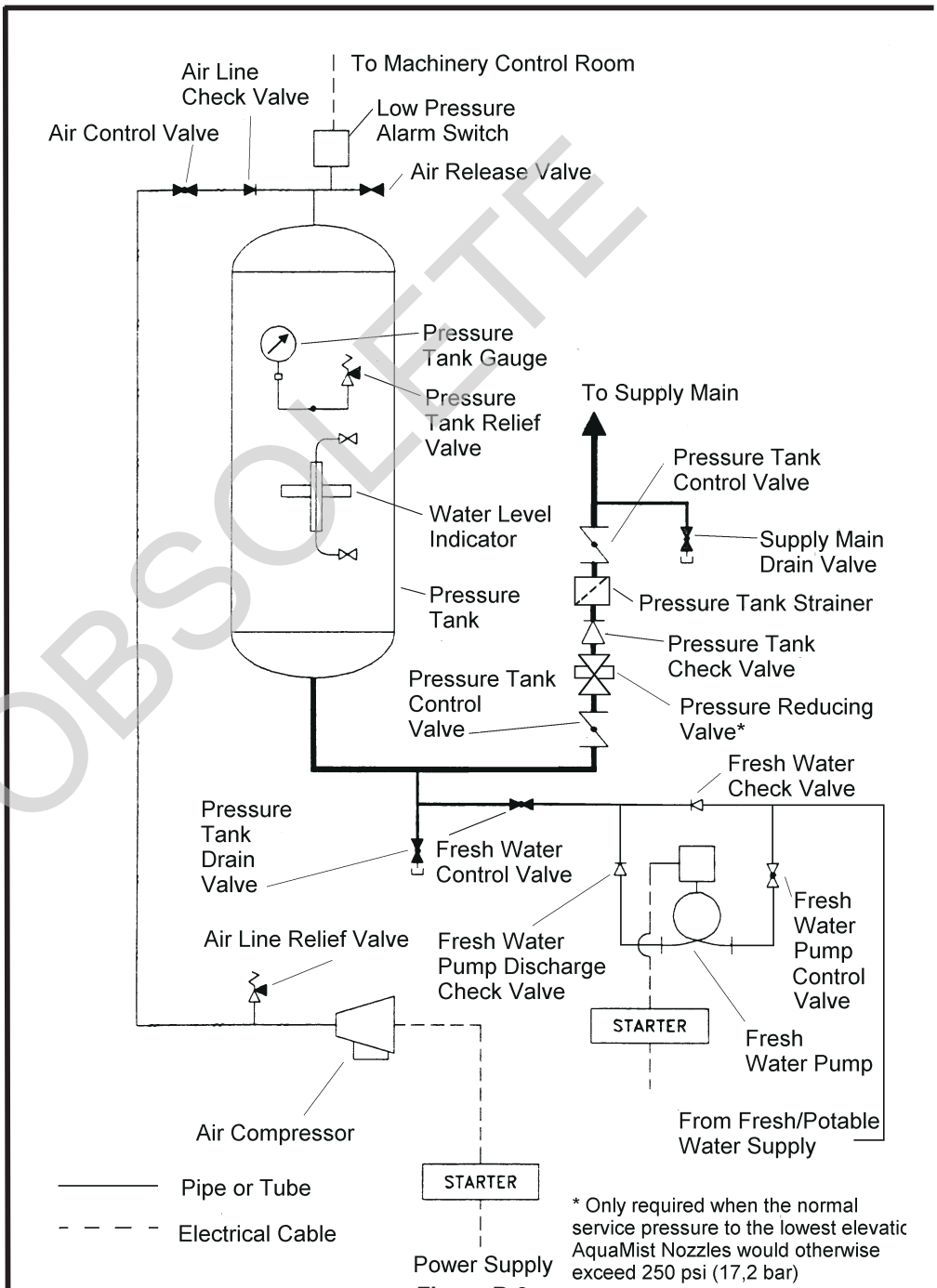


Figure B-3
— *AquaMist* MARINE SYSTEM SCHEMATIC —
SYSTEM PRESSURE TANK

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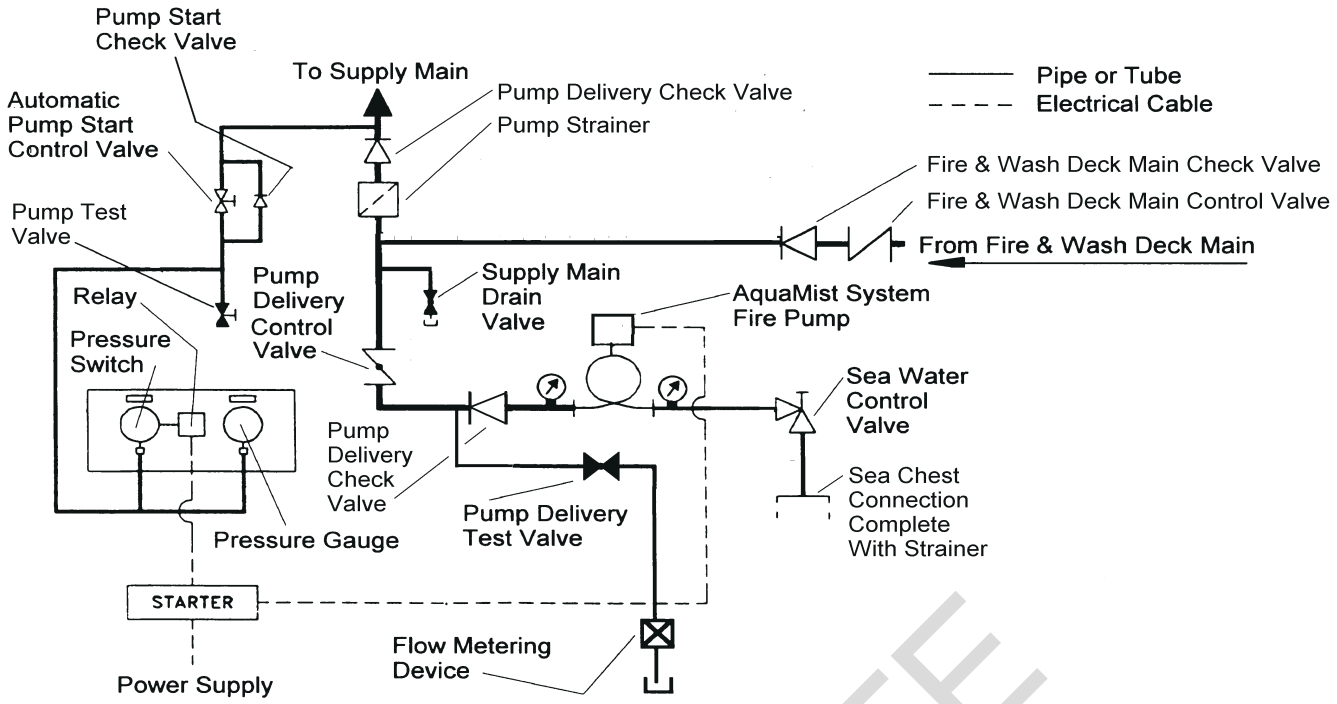


FIGURE B-4
— *AquaMist* MARINE SYSTEM SCHEMATIC —
SYSTEM FIRE PUMP and FIRE & WASH DECK MAIN

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24. Not less than two sources of power for the *AquaMist* System Alarm Panel and Fire Pump are to be provided in passenger ships. Where both sources of power are electric motor driven, one of the power sources is to be an emergency source. (Note: Use of a Fire Pump equipped with a diesel engine drive and battery start-up does not require the other power source to be an emergency source.)

    Where one of the sources of power for the Fire Pump is an internal combustion (diesel) type engine, it shall, in addition to complying with the provisions of Paragraph 20, be so situated that a fire in any protected space will not affect the air intake to the engine.

    One source of power supply for the System Fire Pump is to be taken from the main switchboard and the other source of power is to be taken from the emergency switchboard. Separate feeders reserved solely for the sources of power are to be used. The feeders are to be arranged so as to avoid galleys, machinery spaces, and other enclosed spaces of high fire risk except in so far as it is necessary to reach the appropriate switchboards. In addition, they are to be run to an automatic transfer switch situated near the fire pump. This switch is to permit the supply of power from the main switchboard so long as a supply is available from the main switchboard. The switch is to be so designed that upon failure of that supply it will automatically change over to the emergency switchboard supply. The switches on the main and emergency switchboards are to be clearly labelled and kept normally closed. No other switch is to be permitted in the feeders concerned.

    One of the sources of power supply for the alarm and detection system is to be an emergency source.

25. A corrosion resistant strainer with clean-out port and screen openings no larger than 0.059 inches (1,5 mm) is to be provided downstream of the System Fire Pump, Pressure Tank, Fire & Wash Deck Main, and Shore Connections. See Appendix G.

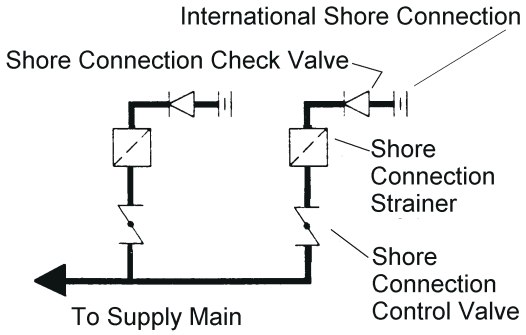


FIGURE B-5
— *AquaMist* MARINE SYSTEM SCHEMATIC —
SYSTEM SHORE CONNNECTIONS

26. All of the *AquaMist* System components are to be located to maintain minimum clearances from unenclosed and uninsulated energized electrical components in accordance with the standard approved by the marine regulatory Authority Having Jurisdiction (for example, NFPA 70).

APPENDIX C
COMPONENT CRITERIA FOR THE *AquaMist* MARINE FIRE PROTECTION, DETECTION, AND ALARM SYSTEM

A. *AquaMist* Marine System components which are subject to internal pressure are to be selected to have a minimum rated working pressure equal to or greater than the maximum service pressure to which they will be exposed.

B. *AquaMist* Marine System components which are specified to be listed are to be equipment or materials included in a list published by an organization concerned with product evaluation. This organization must maintain periodic inspection of production of listed equipment or materials. The listing must state either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

The following are examples of acceptable "listing" organizations: Underwriters Laboratories Inc.; Underwriters' Laboratories of Canada; Canadian Standards Association; Factory Mutual Research Corporation; The Loss Prevention Council; and, the Verband der Schadeversicherer (formererly Sachversicherer).

C. *AquaMist* Marine System components which are specified to be approved are to be acceptable to the marine regulatory Authority Having Jurisdiction (AHJ).

D. *AquaMist* Marine System components which are specified to be corrosion resistant are to have materials of construction that will not produce scale or debris that can flake off when wetted. Corrosion resistant materials of construction include copper, brass or bronze, aluminum bronze, stainless steel, CPVC, polymer or nylon coated iron, EPDM lined iron, etc.

1. **Nozzles.** Nozzles are to be of the type specified in Appendix A.

2. **Pipe (Tube) & Fittings.** Pipe (Tube) & Fittings are to be in accordance with the criteria specified in Appendix D.

3. **Waterflow Detectors.** Waterflow Detectors are to be in accordance with the criteria specified in Appendix F.

4. **Strainers.** Strainers are to be in accordance with the criteria specified in Appendix G.

5. **System Pressure Tank.** The System Presure Tank is to be in accordance with the criteria specified in Appendix K.

6. **System Fire Pump.** The System Fire Pump is to be sized in accordance with the requirements of Appendix H. The Pump and its associated Controller are to be listed or approved as required by the AHJ. The Pump Flow Metering Device is to be approved by the AHJ.

7. **System Alarm Panel.** The System Alarm Panel is to be listed or approved, as required by the AHJ. The following features are to be included, as a minimum:

   Signals. The System Alarm Panel is to be capable of providing alarm, supervisory, and trouble signals.

   Power Supply. There is not to be less than two sources of power supply for the System Alarm Panel, one of which is to be a secondary emergency source. The supplies shall be provided by separate feeders reserved solely for that purpose, and a means for automatic switchover from the primary power source to the secondary emergency power source is to be provided.

   Alarm Zones. The System Alarm Panel is to provide at least the same number of alarm zones as there are Sectional Control Stations, so that each Sectional Waterflow Detector can be wired to an individual alarm initiating circuit. The alarm initiating circuits are to be Class A, and the System Alarm Panel is to be capable of handling the applicable current loads of the alarm initiating circuits.

   Supervisory Zones. The System Alarm Panel is to provide a minimum of one Supervisory Zone for all of the Sectional Control Valve Position Monitor Switches, which are to be wired in parallel. The supervisory circuits are to be minimum Class B, and the System Alarm Panel is to be capable of handling the applicable current loads of the supervisory initiating circuits.

   Alarm Signal Circuit. The System Alarm Panel is to provide for a Class A Alarm Signal Circuit for initiating an audible "alarm signal" (bell) at the Navigating Bridge or the main Fire Control Station, as applicable, and the Machinery Control Room, upon an "alarm condition".

   Trouble Signal. The System Alarm Panel is to provide an internal audible "trouble signal", which will sound upon either a "trouble condition" or "supervisory condition". The "trouble" audible is to be distinct from the "alarm" audible. (Typically, a buzzer is provided for the "trouble condition" so as to be distinct from the "alarm condition".)

   Visual Indicators. The System Alarm Panel is to provide distinct visual indicators (labeled or colored lights) for "alarm", "supervisory", and "trouble" conditions. In the case of an "alarm condition", additional visual indicators are to be provided for each zone to identify the general location of the ship which is involved.

   Manual Test Switch. The System Alarm Panel is to have a Manual Test Switch to test all alarm, supervisory, and trouble indicators.

   Silence Switch. The System Alarm Panel is to have switches for silencing alarm, supervisory, and trouble signals. Upon silencing, a visual indication is to show that a signal still exists. Upon correction of the cause of the signal, the audible signal is to once again sound until the silence switch is returned to its normal position. This feature is otherwise known as a ring-back feature.

   Self Monitoring. The System Alarm Panel is to be self monitoring for a single open circuit and single short circuit fault condition, either internal or external to the panel.

   Dry Contacts. The System Alarm Panel is to provide two sets of SPDT (Form C) contacts: one set is to transfer on an "alarm condition"; and, the other set is to transfer on either a "supervisory or trouble condition". The dry contacts are to be current rated as necessary for the System Alarm Panel to interface with other shipboard systems.

8. **Pipe Hangers**. Pipe Hangers are to be listed or approved,

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as required by the AHJ. They are to be installed in accordance with the standard approved by the AHJ (for example, NFPA 13). In addition, consideration of the use of sway bracing may be required by the AHJ.

9. **Check Valves.** Check Valves are to be listed or approved, as required by the AHJ, and be corrosion resistant.

   Exception: Check Valves located upstream of in-line (i.e., in the flow path between a water supply and the AquaMist Nozzles*) strainers need not be corrosion resistant.*

10. **Sectional Control Valves.** Sectional Control Valves are to be listed or approved, as required by the AHJ, indicating shut-off valves and be corrosion resistant. All Sectional Control Valves are to be provided with either internal or external position monitor switches to monitor the normally open position. The valves are to be such that they can be locked open.

11. **Control Valves.** Control Valves used in-line (i.e., in the flow path between a water supply and the *AquaMist* Nozzles) are to be listed or approved, as required by the AHJ, indicating shut-off valves, and are to be such that they can be locked in their normally open or closed position, as applicable. Control valves that are not in-line are to be listed trim valves, and are to be such that they can be sealed in their normal open or closed position, as applicable. Control Valves are to be corrosion resistant.

    Exception: Control Valves located uptream of in-line (i.e., in the flow path between a water supply and the AquaMist Nozzle*s) strainers need not be corrosion resistant.*

12. **Bleed-off Valves.** Valves used for air bleed-off are to be approved by the AHJ and be corrosion resistant. The valves are to be such that they can be sealed closed.

13. **Alarm Bells**. Alarm Bells are to be listed or approved, as required by the AHJ.

14. **Pressure Gauges.** Pressure Gauges are to be listed or approved, as required by the AHJ.

15. **Sight Glasses.** Sight Glasses are to be listed or approved, as required by the AHJ.

16. **Pressure Reducing Valves.** Pressure Reducing Valves are to be listed or approved, as required by the AHJ.

17. **Relief Valves.** Relief Valves are to be listed or approved, as required by the AHJ.

18. **Escutcheon Plates.** Nozzle escutcheon plates are to be fabricated from metal.

    Exception: Non-metallic escutcheon plates may be used with the AquaMist Nozzles if they are listed and approved for fire protection system service.

19. **Drain Valves.** Drain Valves are to be approved by the AHJ and be corrosion resistant. The valves must be such that they can be either wire sealed or strapped closed, as applicable.

20. **Air Compressor.** The Air Compressor is to be approved by the AHJ.

21. **Water Level Indicator.** The Water Level Indicator for the System Pressure Tank is to be a sight glass which is approved by the AHJ. In addition, provision is to be made for high and low level alarms, if required by the AHJ.

22. **International Shore Connections.** International Shore Connections are to be approved by the AHJ.

23. **Restriction Unions.** Restriction Unions utilized in the Sectional Control Stations are to be smooth bore and corrosion resistant.

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APPENDIX D
PIPE (TUBE) AND FITTING CRITERIA FOR THE *AquaMist* MARINE FIRE PROTECTION, DETECTION, AND ALARM SYSTEM

1. Pipe (tube) and fittings located downstream of the main pipeline strainer are to be brass (bronze), copper, or stainless steel, in accordance with the specifications given below.

   Exception: Alternate pipe (tube) and fitting specifications may be used, provided that they are approved by the marine regulatory Authority Having Jurisdiction (AHJ).

   – **Brass and Copper Pipe**
   Threaded regular wall seamless copper pipe per ASTM B42 or red brass pipe per ASTM B43 with Class 125 or Class 250 cast bronze threaded fittings per ANSI B16.15 may be used. These combinations of pipe and fittings are suitable for use at a maximum service pressure of 200 psi (13,8 bar) when using Class 125 fittings, 400 psi (27,6 bar) when using Class 250 fittings, and a maximum ambient service temperature of 150°F (65,6°C) for either Class 125 or 250.

   – **Copper Tubing**
   Seamless Type K, L, or M copper water tube per ASTM B88 with cast copper alloy solder joint fittings per ANSI B16.18 or wrought copper alloy solder joint fittings per ANSI B16.22 may be used. These combinations of tube and fittings, up to 4 inch (DN100), are suitable for use at a maximum service pressure of 250 psi (17,2 bar) and a maximum ambient service temperature of 150°F (65,6°C).

   NOTES

   The minimum thickness of copper water tube must be approved by the AHJ.

   Solder joint connections are to be brazed using filler metals of Class BCuP-3 or BCuP-4 per AWS A5.8 with a minimum melting temperature of 1300°F (704°C), and brazing fluxes, if used, are not to be of the highly corrosive type.

   Qualification of brazing procedures and brazers is to be in accordance with AWS B2.2 for the Copper and Copper Alloys Base Metal Group with the BCuP Filler Metal Group.

   – **Stainless Steel Pipe**
   Threaded Schedule 40S Type 316 stainless steel pipe per ASTM A312 with minimum Class 150 threaded cast stainless steel fittings per MSS SP-114 may be used.

   NOTE

   The sealant used for making up threaded stainless steel pipe connections must be of a type that is rated for use with stainless steel.

   Plain-end Schedule 5S or 10S Type 316 stainless steel pipe per ASTM A312 with minimum Class 150 socket weld cast stainless steel fittings per MSS SP-114 may be used. Pipe and fitting welding procedures are to be in accordance with the applicable requirements of an installation standard which is approved by the AHJ.

   These combinations of stainless steel pipe and Class 150 fittings are suitable for use at a maximum service pressure of 300 psi (20,7 bar) and a maximum ambient service temperature of 150°F (65,6°C).

2. Mains and branch lines are to be minimum 3/4 inch (DN 20) pipe or tube size.

3. Nozzle drop nipples are to be as follows:

   – minimum 3/4 inch (DN 20) size for

   Copper pipe per ASTM B42
   Brass pipe per ASTM B43
   Stainless Steel pipe per ASTM A312

   – minimum 1 inch (DN 25) size for

   Copper tube per ASTM B88

   See Figure D-1 for examples of concealed piping installations using drop nipples.

   NOTE

   Failure to use the appropriately sized nozzle drop nipples may impair system performance by restricting flow to the nozzle inlet strainer.

4. Where nozzles are utilized in exposed piping of either brass, copper, or stainless steel, the nozzles are to be installed in drops, in order to ensure that their inlet strainers do not protrude into the inside of the pipe (tube) run. See Figure D-2 for examples of exposed piping installations.

5. The piping installation is to be in accordance with the applicable requirements of an installation standard which is approved by the AHJ (for example, NFPA 13).

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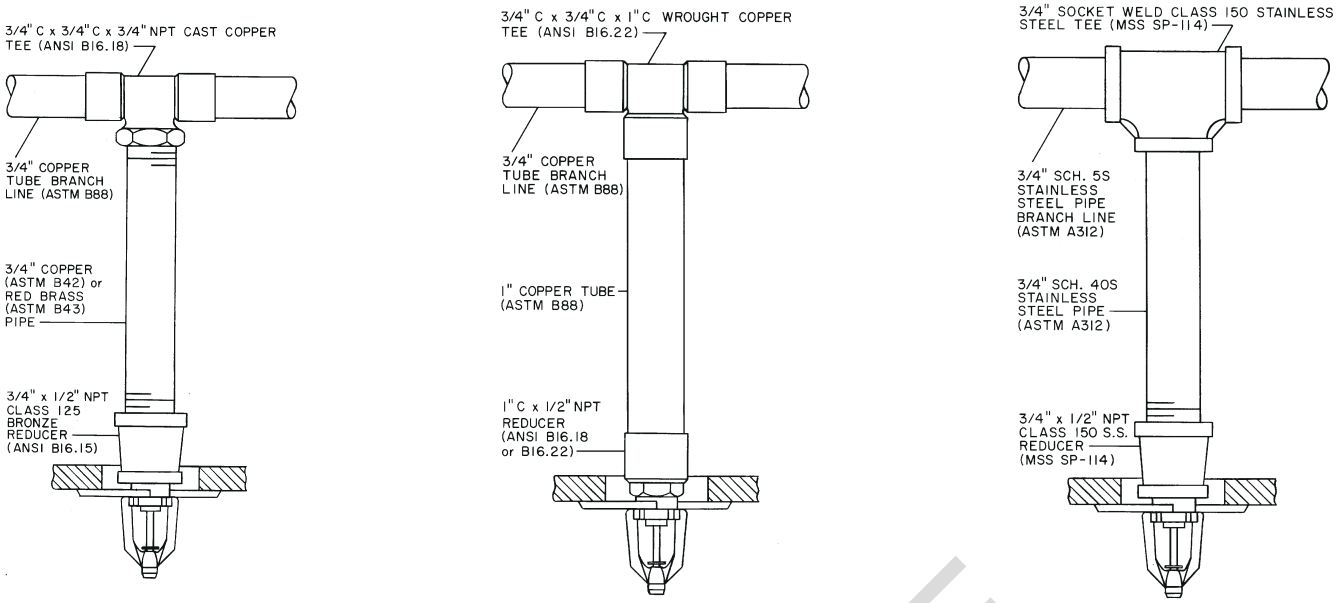
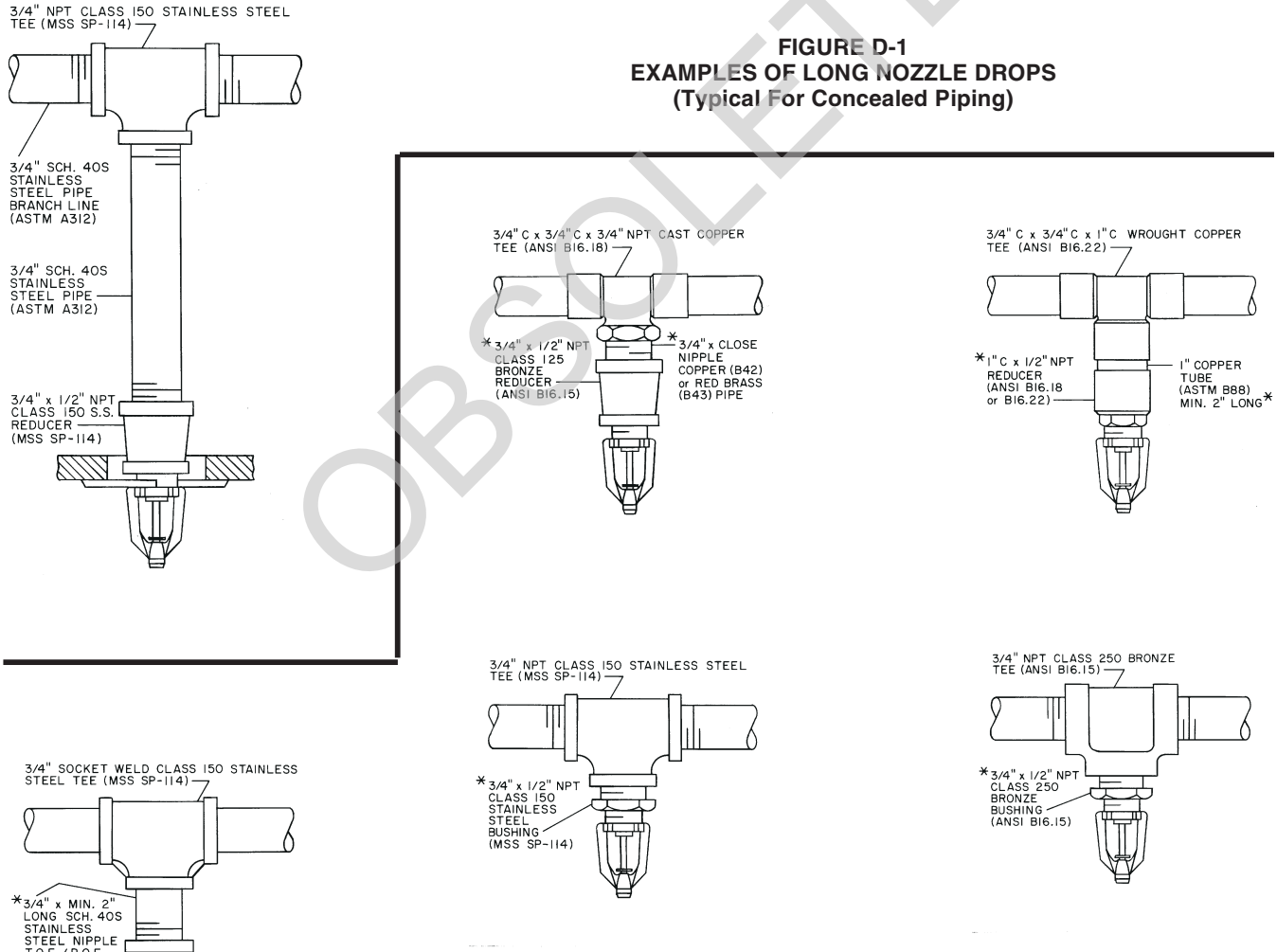


FIGURE D-1
EXAMPLES OF LONG NOZZLE DROPS
(Typical For Concealed Piping)



* Required so that nozzle inlet strainer does not protrude into the inside of the pipe (tube) run.

FIGURE D-2
EXAMPLES OF SHORT NOZZLE DROPS
(Typical For Exposed Piping)

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APPENDIX E
BULKHEAD AND DECK PENETRATION CRITERIA FOR THE *AquaMist* MARINE FIRE PROTECTION, DETECTION, AND ALARM SYSTEM

1. Fire barriers that are penetrated by *AquaMist* System piping or tubing are to be protected to preserve the integrity of the fire rating of the division (i.e., bulkhead or deck).

2. Class "A" divisions, as defined by SOLAS Regulation II-2/3, which are penetrated by piping (tubing), are to be protected by one of the following means.

   Exception: Alternate methods of penetration that are approved by the marine regulatory Authority Having Jurisdiction (AHJ) may be used.

   a. Stainless steel pipe per Appendix D is permitted to be: welded directly to the division, as shown in Fig. E-1; welded to a stainless steel bulkhead or deck fitting which, in turn, is welded to the division, as shown in Fig. E-2 or E-3; or, passed through a circular steel spigot as shown in Fig. E-4 or E-5 and as described in Paragraph 3.

      The pipe fittings located either side of the division are permitted to be either flanged, threaded, welded, metal to metal sealed crimp-on, or other types approved by the AHJ. Flanged connections are to be sealed by full face gaskets approved by the AHJ.

      Flanges are to be spaced a minimum of 18 in. (450 mm) from the division to facilitate application of insulation to the face of the division. Threaded, welded, metal to metal seal crimp-on, or other low profile fittings are to be spaced a minimum of 16 in. (400 mm) from the insulated side of the division with a minimum of 36 in. (900 mm) between the fittings located either side of the division.

   b. Brass and copper pipe per Appendix D are permitted to be welded to a copper alloy deck fitting which, in turn, is welded to the division as shown in Fig. E-3; or, passed through a circular steel spigot as shown in Fig. E-4 or E-5 and as described in Paragraph 3.

      The pipe fittings located either side of the division are permitted to be either flanged, threaded, welded, metal to metal sealed crimp-on, brazed per Appendix D, or other types approved by the AHJ. Flanged connections are to be sealed by full face gaskets approved by the AHJ.

      Flanges are to be spaced a minimum of 18 in. (450 mm) from the division to facilitate application of insulation to the face of the division. Threaded, welded, metal to metal seal crimp-on, brazed, or other low profile fittings are to be spaced a minimum of 16 in. (400 mm) from the insulated side of the division with a minimum of 36 in. (900 mm) between the fittings located either side of the division.

   c. Copper water tube per Appendix D is permitted to be passed through a circular steel spigot as shown in Fig. E-4 or E-5 and as described in Paragraph 3.

      The pipe fittings located either side of the division are permitted to be either flanged, threaded, welded, metal to metal sealed crimp-on, brazed per Appendix D, or other types approved by the AHJ. Flanged connections are to be sealed by full face gaskets approved by the AHJ.

      Flanges are to be spaced a minimum of 18 in. (450 mm) from the division to facilitate application of insulation to the face of the division. Threaded, welded, metal to metal seal crimp-on, brazed, or other low profile fittings are to be spaced a minimum of 16 in. (400 mm) from the insulated side of the division with a minimum of 36 in. (900 mm) between the fittings located either side of the division.

3. When pipe (tube) runs are to be passed through a circular steel spigot as shown in Fig. E-4 and E-5, the spigot is to utilize a steel sleeve having a minimum wall thickness of 0.2 in. (5 mm). The sleeve is to be welded directly to the division as shown in Fig. E-4 or welded to a bulkhead fitting which, in turn, is to be welded to the division as shown in Fig. E-5.

   A nominal 0.8 in. (20 mm) gap is to be provided between the outside of the pipe (tube) and the inside of the sleeve. The gap is to be packed tightly throughout the length of the spigot with an approved Class "A" insulation and sealed at each end with an approved flexible sealant. The sleeve is to extend at least 12 in. (300 mm) from the division on the uninsulated side and extend at least 16 in. (400 mm) from the division on the insulated side. The pipe fittings located either side of the spigot are not to be positioned within the spigot sleeve.

4. Insulation on the plating of the division is to be continued along the pipe run or spigot for a distance of not less than 15 in. (380 mm) from the division. When the pipe run has a bend close to the division, the 15 in. (380 mm) length is to be measured along the inside of the bend. The insulation is to be secured in place by steel wire netting and steel wire.

5. Piping (tubing) penetrations through water tight Class "A" divisions are to be in accordance with the Fig. E-1, E-2, or E-3 options of Paragraph 2a or 2b, except that the pipe fitting connections located either side of the penetrations are only to be welded, threaded, brazed per Appendix D, or flanged. Flanged connections are to be sealed by full face gaskets approved by the AHJ.

   All piping (tubing) penetrations through water tight Class "A" divisions are to be fitted on one side of the division with an approved control valve having threaded, welded, brazed per Appendix D, or flanged connections approved by the AHJ. Valves with flanged connections are to be sealed by full face gaskets approved by the AHJ. The control valve is to be supervised in accordance with Paragraph 13 of Appendix B.

6. Class "B" divisions, as defined by SOLAS Regulation II-2/3, which are penetrated by piping (tubing), are to be protected by one of the following means:

   Exception: Alternate methods of penetration that are approved by the marine regulatory Authority Having Jurisdiction may be used.

   a. Stainless steel pipe (tube) as specified in Paragraph 2a.

   b. Brass and copper pipe as specified in Paragraph 2b.

   c. Copper water tube as specified in Paragraph 2c.

OBSOLETE

FIGURE E-1

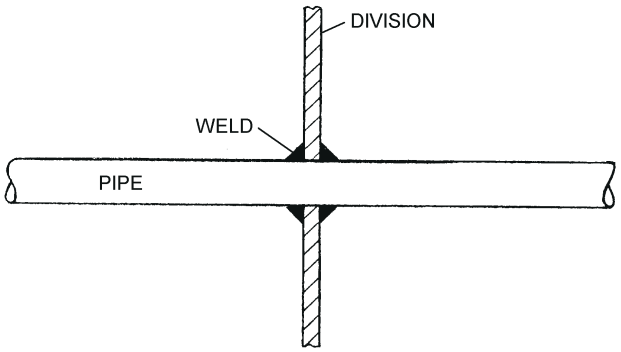


FIGURE E-2

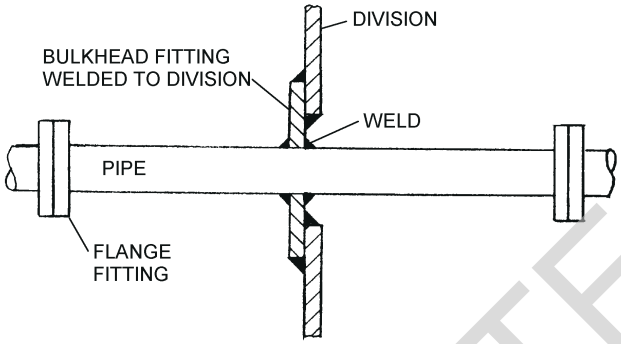


FIGURE E-3

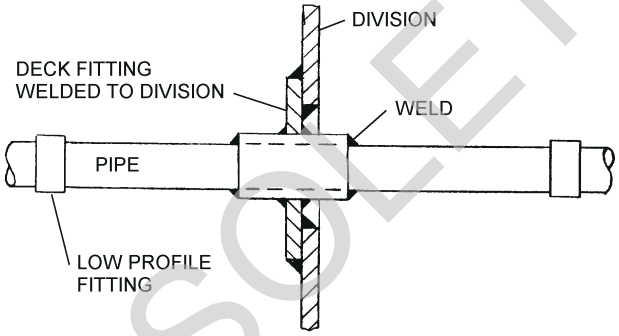


FIGURE E-4

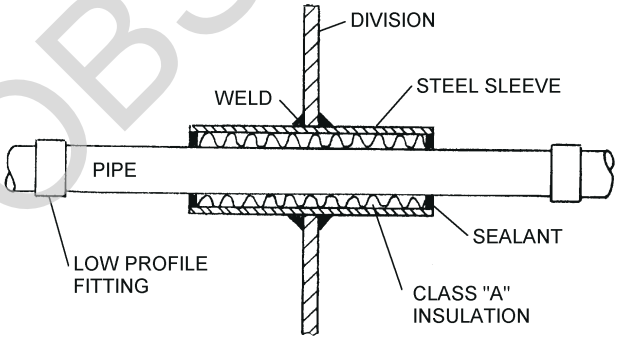


FIGURE E-5

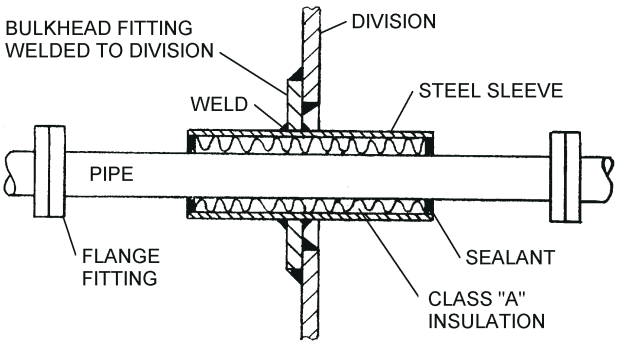


FIGURE E
TYPICAL BULKHEAD AND DECK PENTRATIONS

OBSOLETE

APPENDIX F
WATERFLOW DETECTOR CRITERIA FOR THE *AquaMist* MARINE FIRE PROTECTION, DETECTION, AND ALARM SYSTEM

DESIGN

1. A vane type waterflow detector which is to be located downstream of each sectional check valve must be listed or approved, as well as have a maximum flow for alarm of 3.3 GPM (12,5 LPM) and be set with a retard time of no greater than 15 seconds (i.e., up to a 15 second delay in the transfer of the electrical contacts after deflection of the vane to prevent false alarms due to pressure surges).

   When a nozzle opens, the vane (paddle) deflects towards the internal contour of the pipe, in turn, causing the transfer of electrical contacts which are to be used for initiating an "alarm signal".

2. Figure F-1 illustrates the Model VSG Low Flow Rate Vane Type Waterflow Detector with a 0 to 90 second electronic retard, which is suitable for use in *AquaMist* Marine Systems. It is designed for installation in sections of 2 to 4 inch NPS (DN 50 to 100 mm) stainless steel or brass pipe with wall thickness as follows:

PIPE SIZE			WALL THICKNESS IN. (mm)
IN.	mm		
ANSI	DN	PIPE O.D.	
2	50	60,3	0.154 to 0.177 (3,9 to 4,5)
2-1/2	65	73,0	0.187 to 0.205 (4,8 to 5,2)
—	65	76,1	0.169 to 0.185 (4,3 to 4,7)
3	80	88,9	0.197 to 0.220 (5,0 to 5,6)
4	100	114,3	0.213 to 0.252 (5,4 to 6,4)

The VSG has a maximum service pressure rating of 450 psi (31 bar). The unit contains an output relay and an electronic retard mechanism. The relay is actuated when a sustained flow of 3 GPM (11,4 LPM) or more occurs downstream of the device. The flow condition must exist for the period of time necessary to overcome the field selectable maximum permitted retard setting of 15 seconds for the *AquaMist* Marine System. The automatic reset feature of the output relay and electronic retard reduces the possibility of a false alarm by diminishing the cumulative effect of a series of flow surges.

When used with an appropriate conduit fitting secured to to the 1/2 inch conduit knockout, the electrical enclosure has a NEMA 4 (IP54) rating. The cover is held in place with two tamper resistant screws which require a special key for removal. A field installable, cover tamper switch is available as an option, which may be used to indicate unauthorized removal of the cover. The VSG is suitable for use over a temperature range of 40 to 120°F (4,5 to 49°C).

NOTE

The VSG Waterflow Detectors must not be used where potentially explosive atmosperes are present.

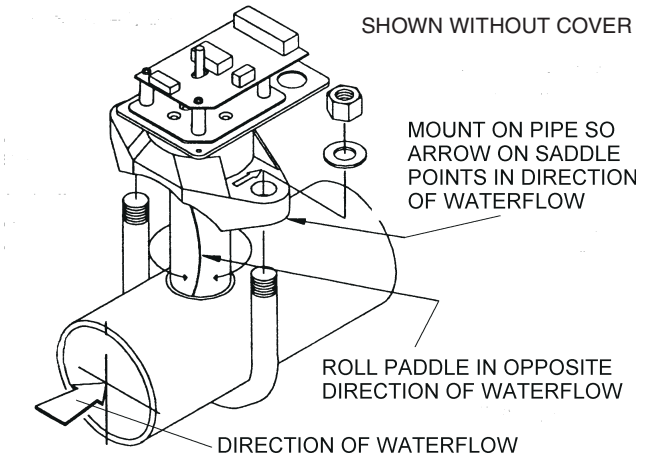


FIGURE F-1
MODEL VSG WATERFLOW DETECTOR

3. The Model VSG Waterflow Detectors are listed by Underwriters Laboratories Inc.

4. The electrical contact ratings are as shown in Figure F-2.

INSTALLATION

a. With reference to Figure F-1, these devices may be mounted on a horizontal or vertical pipe. On horizontal pipe they should be installed on the top of the pipe where they will be accessible for inspection and maintenance. The units should not be installed within 6 inches (300 mm) of a fitting which changes direction of the waterflow or 24 inches (600 mm) of a valve or drain. The VSG should be located with at least 18 inches (450 mm) clearance around the sides and they must have at last 4 inches (100 mm) of clearance above the cover for inspection and maintenance.

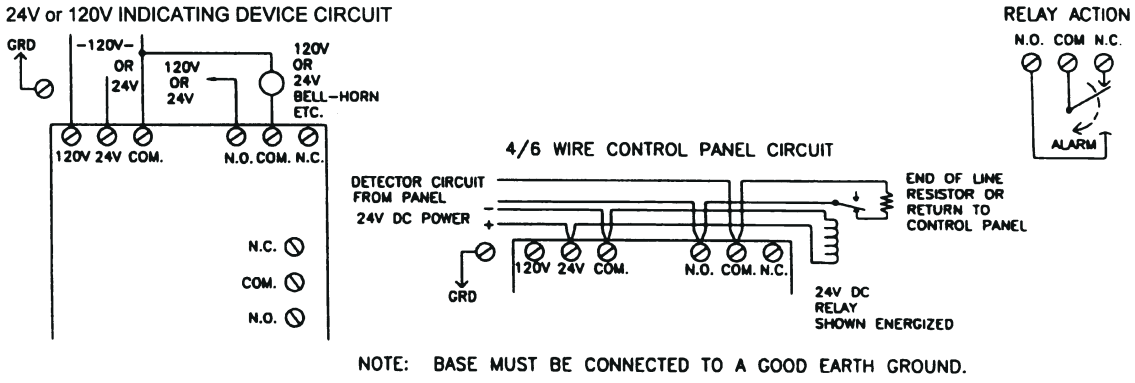
b. An Inspector's Test Connection (ITC) must be located downstream of the VSG to facilitate testing of the VSG and its associated alarms. The K-factor of the ITC orifice must be equivalent to the smallest K-factor *AquaMist* Nozzle being utilized downstream of the VSG.

c. Locate the center of the VSG mounting hole based on the previously stated criteria. Drill an appropriately sized hole

WFD PIPE SIZE			Mounting Hole Size Diameter
IN.	mm		
ANSI	DN	PIPE O.D.	
2	50	60,3	1-1/4" + 1/8" - 1/16" (31,8 mm + 3,2 mm - 1,6 mm)
2-1/2	65	73,0	
—	65	76,1	
3	80	88,9	2" + 1/8" - 1/8" (50,8 mm + 3,2 mm - 3,2 mm)
4	100	114,3	

in the pipe using a circular saw in a slow speed drill, and remove the cut-out. The centerline of the hole must be perpendicular to the surface of the pipe, so that the installed VSG will not be tilted. Tilting could cause the vane (paddle) to scrape the pipe wall and adversely affect flow sensitivity. It is recommended that the removed cut-out be temporarily

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NOTE: BASE MUST BE CONNECTED TO A GOOD EARTH GROUND.

POWER REQUIREMENTS:
STANDBY: 10 ma @ 120 VAC or 1.5 ma @ 24 VAC/VDC
ALARM: 40 ma @ 120 VAC or 35 ma @ 24 VAC/VDC

CONTACT RATINGS:
DPDT (Form C)
2 A @ 0-30 VDC or 0-125 VAC Resistive

FIGURE F-2
TYPICAL ELECTRICAL CONNECTIONS

fastened to the pipe near the VSG, so that there is a ready verification of the cut-out removal.

d. Remove all burrs from around the outside edge of the drilled hole. The outside pipe surface within 1/4 inch (7 mm) of the hole edge must be cleaned of scale and projections, as well as be free of indentations which could affect proper sealing of the VSG against the pipe.

e. Roll the vane (paddle) so that it may be inserted into the hole — do not bend or crease it, and only roll it as tight as necessary to be inserted through the mounting hole. Insert the vane so that the arrow on the saddle points in the direction of the waterflow.

f. Position the VSG squarely on the pipe and then install the saddle strap and tighten the nuts alternately to a torque of about 50 ft. lbs. (67,8 Nm).

g. Remove the cover and gently move the trip stem its full travel (back and forth) to check that the vane moves freely. If binding is felt, check to see that the VSG is perpendicular to the pipe surface. If binding persists, check for presence of debris in the pipe interior and for use of the proper pipe size VSG. The vane must not rub the inside of the pipe or bind in any way.

h. Wire the VSG to the alarm panel in accordance with the specified wiring methods. With reference to Figure F-3, an uninsulated section of a single conductor is not permitted to be looped around a terminal screw and serve as two separate connections. The wire must be severed to serve as two separate connections, thereby providing supervision of the connection in the event that a wire becomes dislodged.

i.

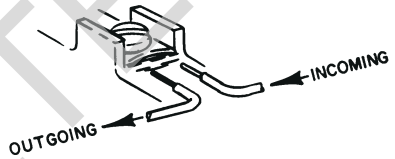


FIGURE F-3
FIELD CONNECTION OF TWO WIRES TO TERMINAL SCREW

Set the time delay to no more than 15 seconds. The instructions for adjusting the time delay are inside the cover.

j. Open the Inspector's Test Connection to verify proper operation of the VSG and its associated alarms. The time delay should correspond approximately to the field setting and electrical functions should continue until the Inspector's Test Connection is closed.

k. Replace the cover and tighten the cover screws. Store the key wrench in a secure area.

ORDERING

The Model VSG Waterflow Detectors may be ordered from:

Potter Electric Signal Company
2081 Craig Road
P.O. Box 28480
St. Lous, MO 63146
Tel: (800) 325-3936

Specify model number and pipe O.D. in millimetres.

OBSOLETE

APPENDIX G
STRAINER CRITERIA FOR THE *AquaMist* MARINE FIRE PROTECTION, DETECTION, AND ALARM SYSTEM

DESIGN

1. Strainers which are to be located downstream of the System Pressure Tank, System Fire Pump, Fire & Wash Deck Main, and Shore Connections are to be listed or approved, as well as corrosion resistant and be provided with a clean-out port and a basket having maximum 0.059 in. (1,50 mm) dimension openings. Use of Y-strainers is recommended.

   The free area of the strainer basket must beat least four times the cross sectional area of the inside diameter of the strainer pipe size.

2. Figure G-1 illustrates the Model 300YTB Screwed End Strainers and Figure G-2 illustrates the Model 150YFB Flange End Strainers which are suitable for use in *AquaMist* Marine Systems as described above. The Model 300YTB has a maximum service pressure rating of 400 psi at 150°F (27,6 bar at 65,5°C), and the Model 150YFB has a maximum service pressure rating of 285 psi at 100°F (19,7 bar at 37,8°C). The body, cover, and plug of both models are C36000 bronze per ASTM B62, and the basket is Type 304 stainless steel. The standard order 20 mesh basket for the Model 300YTB has nominally 0.034 inch by 0.034 inch (0,87 mm x 0,87 mm) openings, and the Model 150YFB must be special ordered with a 20 mesh basket. The 20 mesh baskets provide openings with a maximum diagonal dimension of 0.048 in. (1,22 mm).

3. The C_v factors given in Figures G-1 and G-2 are to be applied for hydraulic calculations.

ORDERING

The Model 300YTB and 150YFB Strainers may be ordered from:

SSI Equipment Incorporated
Box 1594
Buffalo, New York 14240-1594
Tel: (800) 267-3077
Fax: (905) 333-5235

Specify model number and size.

OBSOLETE

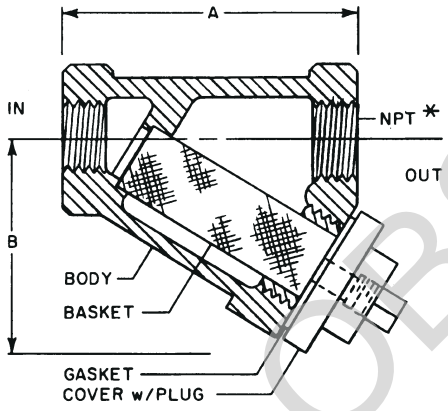


FIGURE G-1
MODEL 300YTB BRONZE SCREWED END Y-STRAINER

SIZE NPS, In. (DN, mm)	A Inches (mm)	B Inches (mm)	WT. lbs. (kg)	C_v GPM/psi$^{1/2}$ (LPM/bar$^{1/2}$)	Free Area In^2 (mm^2)
1 (25)	4.18 (106,2)	3.18 (80,8)	4.5 (2,1)	17.9 (258)	3.85 (2484)
1-1/4 (32)	5.06 (128,5)	3.62 (91,9)	7.0 (3,2)	26.1 (376)	6.63 (4277)
1-1/2 (40)	5.94 (150,9)	4.18 (106,2)	9.0 (4,1)	49.5 (713)	9.35 (6032)
2 (50)	7.75 (196,9)	5,75 (146,1)	15.5 (7,1)	76.2 (1097)	13.86 (8942)

* Pipe thread connections per ISO 7/1 can be provided on special request.
**To be installed horizontal only and with suitable clearance to remove the basket.

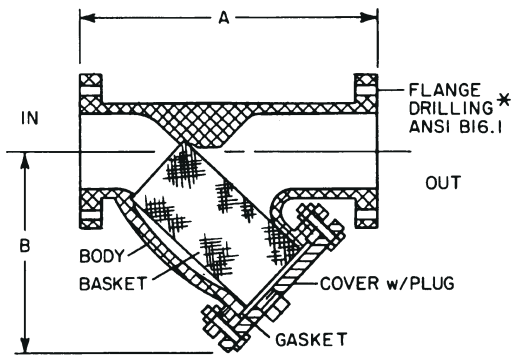


FIGURE G-2
MODEL 150YFB BRONZE FLANGED END Y-STRAINER

SIZE NPS, In. (DN, mm)	A Inches (mm)	B Inches (mm)	WT. lbs. (kg)	C_v GPM/psi$^{1/2}$ (LPM/bar$^{1/2}$)	Free Area In^2 (mm^2)
2-1/2 (65)	10.25 (260,4)	7.50 (190,5)	30 (13,6)	94.9 (1367)	20.86 (13458)
3 (80)	11.62 (295,1)	7.75 (196,9)	40 (18,1)	181.2 (2609)	30.94 (19961)
4 (100)	14.38 (365,3)	9.12 (231,8)	70 (31,8)	221.9 (3196)	41.15 (26548)

* Flange drilling per ISO 2084 (PN10) can be provided on special request.
**To be installed horizontal only and with suitable clearance to remove the basket.

APPENDIX H
HYDRAULIC DESIGN CRITERIA FOR THE *AquaMist* MARINE FIRE PROTECTION, DETECTION, AND ALARM SYSTEM

1. Hydraulic calculations for the *AquaMist* Marine System are to be made as part of the design of the piping system to verify that the minimum required flowing pressure is available at each nozzle.

   Pipe friction losses are to be calculated on the basis of the Hazen-Williams formula. Hydraulic calculations are to conform with the applicable requirements of the marine regulatory Authority Having Jurisdiction. A friction loss coefficient of C = 150 is to be used in the Hazen-Williams formula for calculating friction losses for copper, brass, CPVC, as well as stainless steel pipe (tube) and fittings.

   Exception: For NFPA 750 applications, hydraulic calculations are to be made on the basis of the Darcy-Weisbach formula where the feed main to the hydraulically most demanding section of nozzles has a flowing pressure in excess of 175 psi (12,1 bar).

2. The maximum water velocity through the *AquaMist* Marine System supply mains, cross mains, feed mains, branch mains, and branch lines is not to exceed 25 ft./sec. (7,6 m/s).

3. The water supply requirements for each section of nozzles is to be determined from the adjacent table (H-1). The pipework and water supply requirements for each section of nozzles are to be determined (sized) based on the most hydraulically demanding compartment or space contained within the section, up to a maximum deck area of 1500 ft^2 (140 m^2). The minimum number of nozzles per section which is to be used for hydraulic design (sizing) purposes is 5.

4. The System Fire Pump, water supply, and supply main pipework are to be capable of maintaining the minimum required operating pressure at the level of the highest nozzle. Hydraulic calculations are to be based on the hydraulically most demanding 1500 ft^2 (140 m^2) area of nozzle operation occuring concurrently within each of two Main Vertical Fire Zones. [Note: This criterion considers the possibility of two concurrent incidents and requires that the System Fire Pump, water supply, and supply main pipework be sized to supply a total of 3000 ft^2 (280 m^2) of nozzle operation.]

   For small ships with a total protected area of less than 3000 ft^2 (280 m^2), refer to the marine regulatory Authority Having Jurisdiction for guidance on sizing of the System Fire Pump.

Occupancy Classification	**Hydraulic Design Criteria**
Control Stations. Accommodation spaces of minor, moderate, and greater fire risk, except for public spaces. Sanitary and similar spaces.	1. Use the hydraulically most demanding compartment where the compartment is protected by automatic or self-closing doors. 2. For unprotected openings, use the hydraulically most demanding compartment plus two nozzles in the communicating space nearest the unprotected opening. *NOTE* *To utilize the above criteria, all such compartments are to be enclosed with walls having a fire resistance rating equivalent to at least A-15 or B-15.*
Corridors and stairways up to 4 ft.-11 in. (1,5 m) wide.	1. Use the hydraulically most demanding space, up to a maximum of 5 nozzles, where the corridor or stairway is protected at both ends by automatic or self-closing doors. 2. Use the hydraulically most demanding space, up to a maximum of 7 nozzles, where the corridor or stairway is not protected at both ends by automatic or self-closing doors. *NOTE* *To utilize the above criteria, all such spaces are to be enclosed with walls having a fire resistance rating equivalent to at least A-15 or B-15.*
Corridors and stairways over 4 ft.-11 in. (1,5 m) wide.	Use the public space design criteria.
Public spaces.	Use the hydraulically most demanding space up to a maximum deck area of 1500 ft^2 (140 m^2). *NOTE* *To utilize the above criteria, all such spaces are to be enclosed with walls having a fire resistance rating equivalent to at least A-15 or B-15.*

TABLE H-1
HYDRAULIC DESIGN CRITERIA FOR *AquaMist* MARINE SYSTEM

OBSOLETE

APPENDIX J
NOZZLE INSTALLATION AND SPACING CRITERIA FOR THE *AquaMist* MARINE FIRE PROTECTION, DETECTION, AND ALARM SYSTEM

1. The AM6, AM11, AM22, and AM24 *AquaMist* Nozzles are to be installed in the pendent position.

2. The nominal K-factors, minimum operating pressure, and resulting flows are as follows:

Type	K-factor	psi	(bar)	GPM	(LPM)
AM6	0.33 (4,7)	116.0	(8)	3.55	(13,3)
AM11	0.33 (4,7)	101.5	(7)	3.32	(12,4)
AM22	0.64 (9,2)	101.5	(7)	6.45	(24,3)
AM24	0.64 (9,2)	101.5	(7)	6.45	(24,3)

3. The maximum rated service pressure of the AM6, AM11, AM22, and AM24 Nozzles is 250 psi (17,2 bar).

4. The nozzle coverage area and spacing specifications are given below. Refer to the Application Criteria section for the specification of the occupancy classifications with which the AM6, AM11, AM22, and AM24 Nozzles may be used.

AM6 Nozzles:
- For corridors and stairways up to 4 ft.-5 in. (1,5 m) wide, install AM6 Nozzles up to 5 ft.-10 in. (1,8 m) apart and along the centerline of the corridor or stairway 4 in. (0,1 m).

AM11 Nozzles:
- Compartments up to 65 ft^2 (6 m^2) are permitted to use a minimum of one AM11Nozzle. The AM11 Nozzles are to be located a maximum of 4 ft.-3 in. (1,3 m) from bulkheads.

- Compartments from 65 to 129 ft^2 (6 to 12 m^2) are permitted to use a minimum of two AM11 Nozzles, installed with frame arms parallel to the corridor walls and a maximum front to back distance between the AM11 Nozzles (along the centerline of the compartment) of 7 ft.-10 in. (2,4 m). One AM11 Nozzle is to be located along the centerline of the compartment and 3 ft.-11 in. (1,2 m) from the far bulkhead [4 in. (0,1 m) in either direction]. One AM11 Nozzle is to be located along the centerline of the doorway and 1 ft -8 in. (0,5 m) in from the opening [4 in. (0,1 m) in either direction].

  If obstructions do not permit installing nozzles in the above specified positions, then install three or more AM11 Nozzles in accordance with the 129 to 269 ft^2 (12 to 25 m^2) compartment criteria.

- Compartments from 129 to 269 ft^2 (12 to 25 m^2), install nozzles with a maximum spacing of 8 ft.-2 in. (2,5 m), a maximum coverage area of 67 ft^2 (6,25 m^2), and a maximum distance of 4 ft.-1 in. (1,25 m) from bulkheads.

AM22 Nozzles:
- Compartments from 129 to 527 ft^2 (12 to 49 m^2), install AM22 Nozzles with a maximum spacing of 11 ft.-6 in. (3,5 m), a maximum coverage area of 132 ft^2 (12,25 m^2), and a maximum distance of 5 ft.-9 in. (1,75 m) from bulkheads.

- For compartments larger than 527 ft^2 (49 m^2), install AM22 Nozzles in accordance with the public space criteria.

- For corridors and stairways more than 4 ft.-5 in. (1,5 m) wide, install AM22 Nozzles in accordance with the public space criteria.

- For public spaces with up to 16 ft.-5 in. (5 m) high ceilings, install AM22 Nozzles with a maximum spacing of 9 ft.-2 in. (2,8 m), a maximum coverage area of 84 ft^2 (7,84 m^2), and a maximum distance of 4 ft.-7 in. (1,4 m) from bulkheads.

AM24 Nozzles:
- For service areas install AM24 Nozzles with a maximum spacing of 8 ft.-2 in. (2,5 m), a maximum coverage area of 67 ft^2 (6,25 m^2), and a maximum distance of 4 ft.-1 in. (1,25 m) from bulkheads.

5. The Diffusers of the AM6, AM11, AM22, and AM24 Nozzles are to be positioned a maximum of 4 in. (0,1 m) below the ceiling.

6. The minimum nozzle spacing to prevent the non-operation of adjacent nozzles is 30 in. (0,76 m) for the AM6, AM11, and AM24 Nozzles, and 54 in. (1,37 m) for the AM22 Nozzles.

7. The *AquaMist* Nozzles are to be placed as far as possible from beams or other objects likely to obstruct water distribution. The maximum allowable vertical distance that the bottom of a vertical obstruction can be below the nozzle Diffusers is as follows:

AM6 and AM11

Horizontal Distance From Nozzle To Obstruction In. (m)	Maximum Allowable Vertical Distance Below Diffuser In. (m)
Up to 30 (0,76)	0
> 30 (0,76) to 40 (1,02)	8 (0,20)
> 40 (1,02) to 50 (1,27)	20 (0,50)
> 50 (1,27) to 60 (1,53)	27.5 (0,70)
> 60 (1,53)	39 (1,00)

AM22

Horizontal Distance From Nozzle To Obstruction In. (m)	Maximum Allowable Vertical Distance Below Diffuser In. (m)
Up to to 40 (1,02)	0
> 40 (1,02) to 50 (1,27)	4 (0,10)
> 50 (1,27) to 60 (1,53)	8 (0,20)
> 60 (1,53)	12 (0,30)

AM24

Horizontal Distance From Nozzle To Obstruction In. (m)	Maximum Allowable Vertical Distance Below Diffuser In. (m)
Up to 30 (0,76)	0
> 30 (0,76) to 40 (1,02)	4 (0,10)
> 40 (1,02) to 50 (1,27)	8 (0,20)
> 50 (1,27) to 60 (1,53)	12 (0,30)
> 60 (1,53)	16 (0,40)

OBSOLETE

APPENDIX K
SYSTEM PRESSURE TANK CRITERIA FOR THE *AquaMist* MARINE FIRE PROTECTION, DETECTION, AND ALARM SYSTEMS

1. *AquaMist* Marine Systems must be provided with a System Pressure Tank as described in Paragraph 16 of Appendix B. In the case of large passenger vessels, it may be hydraulically advantageous to consider using two smaller pressure tanks that are located fore and aft.

2. System Pressure Tanks are to be designed and fabricated in accordance with the requirements of the marine regulatory Authority Having Jurisdiction. Construction of the pressure tanks is to be witnessed/surveyed by a representative of the marine regulatory Authority Having Jurisdiction, and certification is required.

   Examples of suitable pressure tank design standards include the following: the "Rules for the Construction of Unfired Pressure Vessels", Section VIII, Division 1, Unfired Pressure Vessels of the ASME "Boiler and Pressure Vessel Code"; BS5500 Category 2; and AS1210.

3. *AquaMist* Systems are to be designed to provide for maintaining air or nitrogen pressure in System Pressure Tanks such that when the standing charge of water in the tanks is exhausted, the residual pressure in the tanks will not be less than the minimum operating pressure of the highest nozzle in the system, in addition to the pressure exerted by the head of water measured from the bottom of the lowest tank to the highest nozzle plus pressure drop due to friction loss.

4. The minimum total volume of the standing water charge in the System Pressure Tanks is to be equivalent to the required minimum amount of water which could be discharged in one minute as determined from hydraulic calculations. The hydraulic calculations are to be based on the hydraulically most demanding 1500 ft^2 (140 m^2) area of nozzle operation occuring concurrently within each of two Main Vertical Fire Zones (MVFZ). [Note: This criterion considers the possibility of two concurrent incidents and requires that the Pressure Tanks be sized to supply a total of 3000 ft^2 (280 m^2) of nozzle operation for one minute.]

5. System Pressure Tanks are to be sized to provide a volume for their standing water charge which is no more than one-half of the tank volume; however, because of the relatively high minimum operating pressure of the *Aquamist* Nozzles, as compared to automatic sprinklers, it will normally be necessary to increase the percentage of air volume in situations where the *AquaMist* System is to protect more than five decks of passenger and crew accommodations. In such cases, in order to reduce the standing (normal) tank pressure, it is recommended that consideration be given to sizing the tanks to provide a standing water charge which is about one-third of the tank volume.

6. The standing air pressure in the System Pressure Tanks is to be set such that the lowest nozzle in the *AquaMist* System will be exposed to a maximum normal service pressure of 250 psi (17,2 bar), unless provision is made to limit the maximum normal service pressure to the nozzles by use of an automatic pressure reducing valve.

7. When an automatic pressure reducing valve is utilized, it must be located in the supply main connection from each tank. Each pressure reducing valve is to maintain a maximum outlet pressure that results in a service pressure which will not exceed 250 psi (17,2 bar) at the lowest elevation of *AquaMist* Nozzles.

   NOTE

   When a pressure reducing valve is utilized,

   a. the minimum standing (normal) tank pressure (i.e. the pressure when the standing charge of water in the tank is exhausted) must be at least 20 psi (1,4 bar) below the the outlet pressure setting of the pressure reducing valve, and

   b. the System Fire Pump start-up pressure is to be set at nominally 5 psi (0,3 bar) below the outlet pressure setting of the pressure reducing valve.

   Adhering to the preceding requirements will ensure that the System Fire Pump will start-up before the the standing water charge in the System Pressure Tank is exhausted, when using automatic pressure reducing valves.

8. The following formula is to be used for determining the standing (normal) pressure required for system pressure tanks. The following formula assumes that both tanks have the same air to volume ratio, if two tanks are used:

   $P_s = [(P_r + P_a) \quad (A)] - Pa$

   Where:

   P_r = Minimum required residual tank pressure, psi (bar) gauge

   P_s = Minimum standing (normal) tank pressure, psi (bar) gauge

   A = Proportion of standing air volume in tank (e.g., a proportion of 2/3 refers to 2/3 standing air and 1/3 standing water, by volume)

   P_a = 15 psi (1 bar)

9. The following is an example of a typical system pressure tank sizing and standing pressure calculation for estimating purposes. Because of round-off effects, calculations using Inch-pound Units will normally yield slightly higher results than those using SI Units.

   NOTE

   This example is for illustration purposes only. The AquaMist Marine System must be hydraulically designed as specified in Appendix H.

   In the case of a large passenger ship, assume the following for design purposes:

   – The highest nozzle (AM22) has a minimum operating pressure of 101.5 psi (7 bar) and it is located 12 decks [98 ft. (30 m)] above the bottom of two pressure tanks.

   – The lowest nozzles in the *AquaMist* System are located in the next deck above the pressure tanks. Therefore, the lowest nozzles are 14.8 ft. (4,5 m) above the bottoms of the pressure tanks.

   – The most hydraulically demanding design areas are public spaces that are located 57 ft. (17,5 m) above the bottoms of the pressure tanks. The combined maximum area of nozzle (AM22) operation in two different Main Vertical Fire Zones is determined to be 3000 ft^2 (280 m^2), per Paragraph 5 of Appendix B.

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– A maximum coverage area per AM22 nozzle of 84 ft^2 (7,84m^2) at a nominal flow per nozzle of 6.45 GPM (24,3 LPM).

– For estimating purposes, subject to hydraulic calculations per Appendix H, apply a 10% safety factor over the total flow required by the maximum design area of nozzle operation, to determine the rated flow for the System Fire Pump.

– The two pressure tanks are to be designed for use with a proportion of 2/3 air and 1/3 water.

– INCH-POUND UNIT CALCULATIONS

  * 3000 ft^2/84 ft^2 = 35.7 (use 36 as number of nozzles assumed to operate simultaneously)

  * 36 x 0.64 x $101.5^{1/2}$= 232.1 GPM (total flow required by the maximum design area of nozzle operation)

  * 232.1 GPM x 110% x 1 min. = 255.3 gal. (total required standing water charge)

  * Therefore:

    P_r = 98 ft. x 0.434 psi/ft. + 101.5 psi = 144 psi

    P_s = [(144 psi + 15 psi) (2/3)] - 15 psi = 224 psi

    255.3 gal./2 = 127.7 gal (minimum required standing water charge in each tank)

    127.7 gal. x 3 = 383.1 gal. (minimum required total volume of each tank)

– SI UNIT CALCULATION

  * 280 m^2/7,84 m^2 = 35.7 (use 36 as number of nozzles assumed to operate simultaneously)

  * 36 x 9,2 x $7^{1/2}$= 876,3 LPM (total flow required by the maximum design area of nozzle operation)

  * 876,3 LPM x 110% x 1 min. = 963,9 L (total required standing water charge)

  * Therefore:

    P_r = 30 m x 0,098 bar/m + 7 bar = 9,9 bar

    P_s = [(9,9 bar + 1 bar) (2/3)] - 1 bar = 15,4 bar

    963,9 L/2 = 482 L (minimum required standing water charge in each tank)

    482 L x 3 = 1446 L (minimum required total volume of each tank)

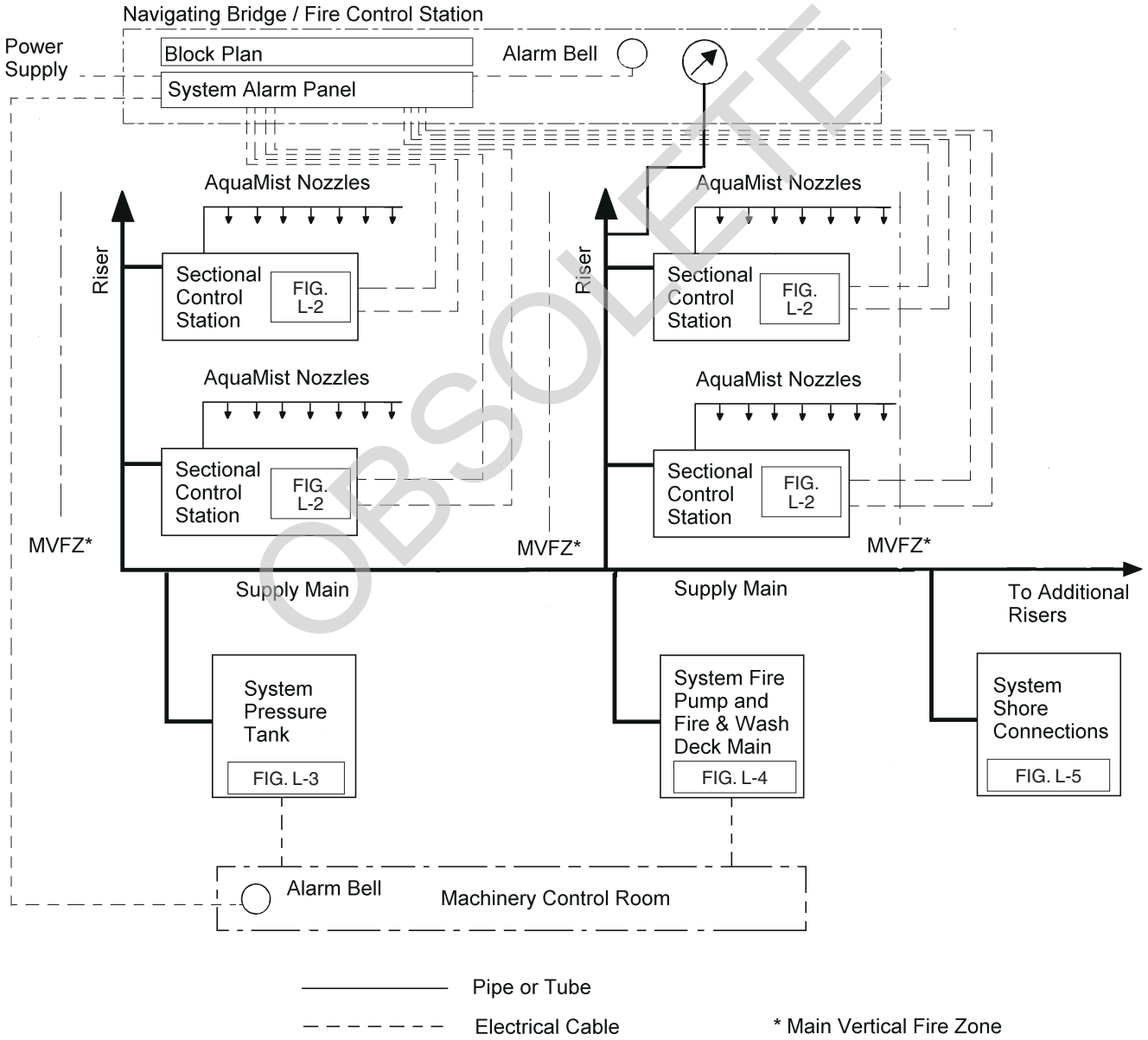
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APPENDIX L
INSTRUCTIONS TO THE MASTER AND CREW FOR THE
AquaMist **MARINE FIRE PROTECTION, DETECTION, AND ALARM SYSTEM**

GENERAL SYSTEM DESCRIPTION

The *AquaMist* Marine System (Ref. Figure L-1) consists of a number of *AquaMist* Nozzles of different types that are designed for use with particular marine occupancy classifications and installed in a network of piping through which water supplied under pressure is automatically brought to bear on a fire in its early stages. The nozzles are piped together in groups which are referred to as sections, and the Sectional Control Station located in the branch main to each section provides a control (shut off) valve, waterflow detector, test valve, drain valve, and check valve, as well as pressure gauges located upstream and downstream of the check valve.

In the event of a fire, any *AquaMist* Nozzles that are exposed to sufficient heat will automatically open, and the flow of water caused by operation of the first nozzle is sufficient to actuate the sectional waterflow detector located at the applicable Sectional Control Station. Actuation of the waterflow detector, in turn, causes the System Alarm Panel to go into an "alarm condition" and to activate the fire alarms. An indicator light on the Alarm Panel at the Navigating Bridge or the main Fire Control Station will indicate which Sectional



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FIGURE L-1
AquaMist **MARINE SYSTEM SCHEMATIC**
— GENERAL ARRANGEMENT —

Control Station is affected, and identify which section of the ship is in need of attention due to fire.

In compliance with Safety Of Life At Sea (SOLAS) Regulation II-2/12, water is initially supplied to the *AquaMis*t Marine System from the *AquaMist* System Pressure Tank and then, if needed, the water supply is automatically changed over to the *AquaMist* System Fire Pump. Also in compliance with the SOLAS regulations, which are based on the requirements for automatic sprinklers, provision is made for changing over the *AquaMist* System water supply to the vessel's Fire and Wash Deck Main Pump, as well as supplementing the water supply from Shore Connections (when docked).

The following sub-sections provide detailed information with which the crew will normally be concerned:

- Component Descriptions (Page 26)
- Setting and Charging Instructions (Page 30)
- Inspection, Testing, and Maintenance Instructions (Page 30)
- Action To Be Taken In Case Of Alarm (Page 32)

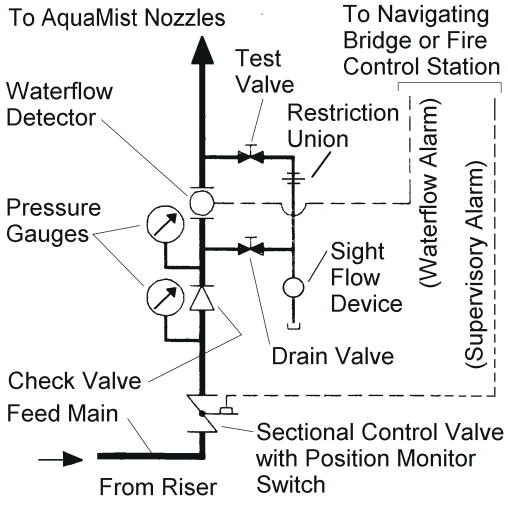


FIGURE L-2
— *AquaMist* MARINE SYSTEM SCHEMATIC —
SECTIONAL CONTROL STATION

COMPONENT DESCRIPTIONS

A. *AquaMist* Nozzles

With reference to Appendix A, the waterway of each nozzle is held closed by the combination of a Teflon† sealed Disc Spring and Button which, in turn, are held in position by a 3 mm O.D., quick response, bulb type thermally responsive element. The Bulb shatters when its temperature is raised to the prescribed operating point, allowing the nozzle to discharge a fine spray of water (mist) around the fire area. The size of the orifice, in the Orifice Insert, controls the amount of water flow from the nozzles, as a function of the nozzle inlet pressure. The combination of the main pipe line strainer at the discharge of the fire pump and the nozzle Inlet Strainers prevent any debris in the water from clogging the nozzle orifices. The details of the nozzle designs, principles of nozzle operation, as well as spray characteristics, are more fully described in Appendix A.

It is essential that any replacement nozzles be of the correct type and temperature rating, as designated in the system design drawings. Appendix A illustrates each of the four types of *AquaMist* Nozzles and describes the occupancies with which each type of nozzle may be used.

B. Sectional Control Stations

The areas of the ship protected by the *AquaMist* Marine System are sub-divided into sections, each having its own Sectional Control Station (Ref. Figure L-2) comprised of a Sectional Control Valve, Waterflow Detector, Test Valve, Drain Valve, and Check Valve, as well as Pressure Gauges located upstream and downstream of the Check Valve.

Sectional Control Valve. The Sectional Control Valve is a normally open, manually operated valve that is used to shut off the water supply to a section for either maintenance purposes or replacement of nozzles following a fire, without affecting the operational readiness of the remaining sections of the *AquaMist* System.

Each Sectional Control Valve is equipped with a position monitor switch that will cause a supervisory signal at the System Alarm Panel when the valve is other than full open. In addition, each valve is normally locked open. The Sectional Control Valves must be maintained open, except when operated nozzles are being replaced after a fire, or for maintenance work or alterations.

Depending on the type of control valve that is used, the valve position monitor switch is mounted either internally or externally to the control valve actuator. The position monitor switches for all of the system's sectional control valves are wired in parallel to the System Alarm Panel located at the Navigating Bridge or the main Fire Control Station; however, they are wired to a set of contacts different from those intended for use with the Sectional Waterflow Detectors. Closing a control valve will close the contacts in its monitor switch, within two turns of the valve handwheel from the full open position. The closed contacts will result in the sounding of a "supervisory signal" at the Alarm Panel, as well as provide a visual signal (light). The "supervisory signal" is separate and distinct from the "alarm signal".

Sectional Waterflow Detector. The Sectional Waterflow Detector is a vane type waterflow switch with an electronic retard mechanism, which is located downstream of the Sectional Control Valve for each section. The vane of the flow switch is inserted into the branch line so that the arrow on the saddle points in the direction of the waterflow. The electronic mechanism is used to prevent any false alarms due to normal surges of pressure which can occur in the system due to fire pump testing. The selected retard time setting is not to be greater than 15 seconds. Further information on the Waterflow Detectors is provided in Appendix F.

Sectional Test Valve. When opened, the Sectional Test Valve will result in a flow of water through the branch line, past the Sectional Waterflow Detector, through a restriction orifice, and out the drain connection to the bilge. The restriction orifice, which is installed within a Restriction Union, is sized to limit the flow to that equivalent to the smallest orifice nozzle located within the section with which it is used. The waterflow causes the vane of the flow switch to deflect in the direction of flow and to transfer the switch contacts, after the pre-set retard time.

Sectional Drain Valve. The normally closed Sectional Drain Valve is used to drain water from the pipe work of a section after its Sectional Control Valve is closed.

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Sectional Pressure Gauges. Pressure Gauges are provided at each Sectional Control Station to indicate the pressure in the branch main supplying each section of nozzles, as well as the pressure which is trapped into each section by the Sectional Check Valve.

Sectional Check Valve. A Sectional Check Valve (non-return valve) is provided at each Sectional Control Station, primarily to minimize the time for the system fire pump start up if there is a nozzle operation in one of the lower decks. If the check valves were not provided, the pressure exerted by the weight of the water in the portion of the *AquaMist* System protecting the upper decks would delay the start up of the system fire pump which is operated by actuation of a low pressure switch in the discharge line.

The Sectional Check Valve also traps the water charge into each section. In the case of an *AquaMist* Marine System with a "sea chest" connection, use of the check valves inhibits flow of sea water into any section other than that involved in a nozzle operation.

C. Signals

There are three types of signals which are defined as follows:

Alarm Signal. An "alarm signal" indicates that a fire condition exists. In the case of the *AquaMist* Marine System, this is accomplished via waterflow detection. Immediate action must be taken to determine and correct the cause of the "alarm signal". The "alarm signal" provides a distinct visual signal at the alarm panel that will indicate the exact location of the ship which is involved. Also, the "alarm signal" provides an audible signal which is distinct from the "supervisory or trouble" audible signals.

Supervisory Signal. A "supervisory signal" indicates a condition of impairment which may prevent the system from operating properly. In the case of the *AquaMist* Marine System, it is an indication of low water pressure in the Supply Main or that one or more of the Sectional Control Valves are partially to completely closed. Immediate action must be taken to determine and correct the cause of the "supervisory signal". The "supervisory signal" provides a distinct visual signal at the alarm panel, and it provides the same audible signal as a "trouble" condition; however, it is distinct from the audible signal used for an "alarm" condition.

Trouble Signal. A "trouble signal" indicates a condition of potential impairment, which if not ultimately corrected, may prevent the system from operating properly. In the case of the *AquaMist* Marine System, it is an indication of the loss of primary or secondary power supply, or an incomplete electrical circuit — either internal or external to the Alarm Panel. As soon as possible, action must be taken to determine and correct the cause of the "trouble signal". The "trouble signal" provides a distinct visual signal at the Alarm Panel, and it may provide the same audible signal as for a "supervisory" condition; however, it is distinct from the audible signal used for an "alarm condition". Depending on the sophistication of the Alarm Panel, the alarm panel may be capable of indicating the source of the "trouble condition".

D. System Alarm Panel and Accessories

The Alarm Panel located at the Navigating Bridge or the main Fire Control Station, as applicable, is capable of providing the three previously described types of signals. At a minimum, the following features apply:

Power Supply. There are two sources of power supplies for the System Alarm Panel, one of which is a secondary emergency source. The supplies are provided by separate feeders reserved solely for this purpose, and a means for automatic switchover from the primary power source to the secondary emergency power source is provided.

Alarm Zones. The Alarm Panel provides the same number of alarm zones as Sectional Control Stations with each Sectional Waterflow Detector wired to an individual zone. In this way, in the event of a fire and subsequent waterflow, the exact location within the ship which is involved can be identified from the Navigating Bridge or the main Fire Control Station. The initiating circuit is Class A, which permits an "alarm signal" in the event of a single broken wire in the alarm initiating circuit.

Supervisory Zone. The Alarm Panel provides a Supervisory Zone, and all of the Sectional Control Valve position monitor switches are wired in parallel to this zone. In the event of any Sectional Control Valve being closed , a "supervisory signal" will be initiated. Upon receipt of a "supervisory signal" at the Navigating Bridge or the main Fire Control Station, as applicable, the *AquaMist* Marine System must be inspected for the condition resulting in impairment of the system and the condition returned to normal.

Alarm Signal Circuit. The Alarm Panel provides for a Class A Alarm Signal Circuit for initiating an audible "alarm signal" (bell) at the Navigating Bridge or the main Fire Control Station, as applicable, and the Machinery Control Room, upon an "alarm condition".

Trouble Signal. The Alarm Panel must provide an internal audible "trouble signal", which will sound upon either a "trouble condition" or "supervisory condition". Typically, a buzzer in the Alarm Panel is provided so as to be distinct from an "alarm signal" (bell).

As an option, the Alarm Panel may be configured for an external "trouble signal" circuit to sound additional devices which will be audibly distinct from the "alarm signal", e.g., a horn which will be distinct from an alarm bell.

Visual Indicators. The Alarm Panel provides distinct visual indicators (labeled or colored lights) for "alarm", "supervisory", and "trouble" conditions. In the case of an "alarm condition", additional visual indicators are provided for each zone to identify the exact location of the ship which is involved.

Manual Test Switch. The Alarm Panel has a Manual Test Switch to test all alarm, supervisory, and trouble indicators.

Silence Switch. The Alarm Panel has switches for silencing alarm, supervisory, or trouble signals. Upon silencing, a visual indication is present to indicate that a signal still exists. Upon correction of the cause of signal, the audible signal will once again sound until the silence switch is returned to its normal position. This feature is otherwise known as a ring-back feature.

E. System Water Supplies

The *AquaMist* Marine System has three water supplies. Two of the supplies, i.e. the *AquaMist* System Pressure Tank and the *AquaMist* System Fire Pump, are always available under normal circumstances. The *AquaMist* System Shore Connections, which is the third supply, is for supplemental pressurization when the ship is in port.

Each water source is connected to the supply main via in-line strainers. All of the *AquaMist* System piping including the Pressure Tank is filled with fresh (potable) water under normal conditions. The Supply Main is maintained at

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a higher pressure than the pressure at the Fire Pump discharge by means of the standing pressure in the Pressure Tank. In this way, sea water will not pass into the system beyond the Pump Delivery Check Valve, except in the case of a nozzle operation.

AquaMist System Pressure Tank. The volume of the Pressure Tank (Ref. Figure L-3) is determined by hydraulic calculation as indicated in Appendix K. The Pressure Tank is maintained at from one-half to one-third full of water, depending on the hydraulic design of the particular system. The water level is visually monitored by a Water Level Indicator fitted to the front of the Pressure Tank. In addition, if required by the marine regulatory Authority Having Jurisdiction, provision will be made for high and low water level alarms.

The fresh water supply to the tank is obtained through a minimum 1-1/2 inch NPS (40 DN) feed pipe having a Fresh Water Check Valve and Fresh Water Control Valve. This Control Valve is normally closed, except when the Pressure Tank or the system piping is being filled with fresh water.

Pressure in the Pressure Tank is obtained by pumping air into the Pressure Tank by means of a manually controlled Air Compressor. The air supply line between the Air Compressor and the Pressure Tank is equipped with an Air Line (Safety) Relief Valve, normally closed Air Control Valve, Check Valve, and normally closed Air Release Valve. A (Safety) Relief Valve is also provided on the Pressure Gauge assembly at the front of the Pressure Tank.

Water from the Pressure Tank is used when performing sectional control flow tests, and therefore, fresh water and compressed air must always be restored immediately after the tests are completed.

The Pressure Tank delivery connection to the Supply Main is provided with two Pressure Tank Control Valves, a Check Valve, an in-line Pressure Tank Strainer, and if necessary, a Pressure Reducing Valve. The two Control Valves are normally locked open. The Check Valve prevents sea water from entering the Pressure Tank from the “sea chest” connection. The Strainer is provided to prevent clogging of the *AquaMist* Nozzles from debris that may collect in the Pressure Tank. A Pressure Reducing Valve is required when the normal service pressure to the lowest elevation *AquaMist* Nozzles would otherwise exceed 250 psi (17,2 bar). Also provided in the Pressure Tank delivery connection is a Supply Main Drain Valve, which can be utillized as necessary to drain sea water from the Supply Main after a system operation.

Waterflow from the Pressure Tank is monitored by the Machinery Room via a Low Pressure Alarm Switch. This alarm, which is sounded by a low pressure condition, is independent of the Alarm Panel located at the Navigating Bridge or the main Fire Control Station.

AquaMist System Fire Pump. The System Fire Pump (Ref. Figure L-4) is driven by an electric motor or diesel engine. The Fire Pump flow capacity is determined by hydraulic calculations per Appendix H.

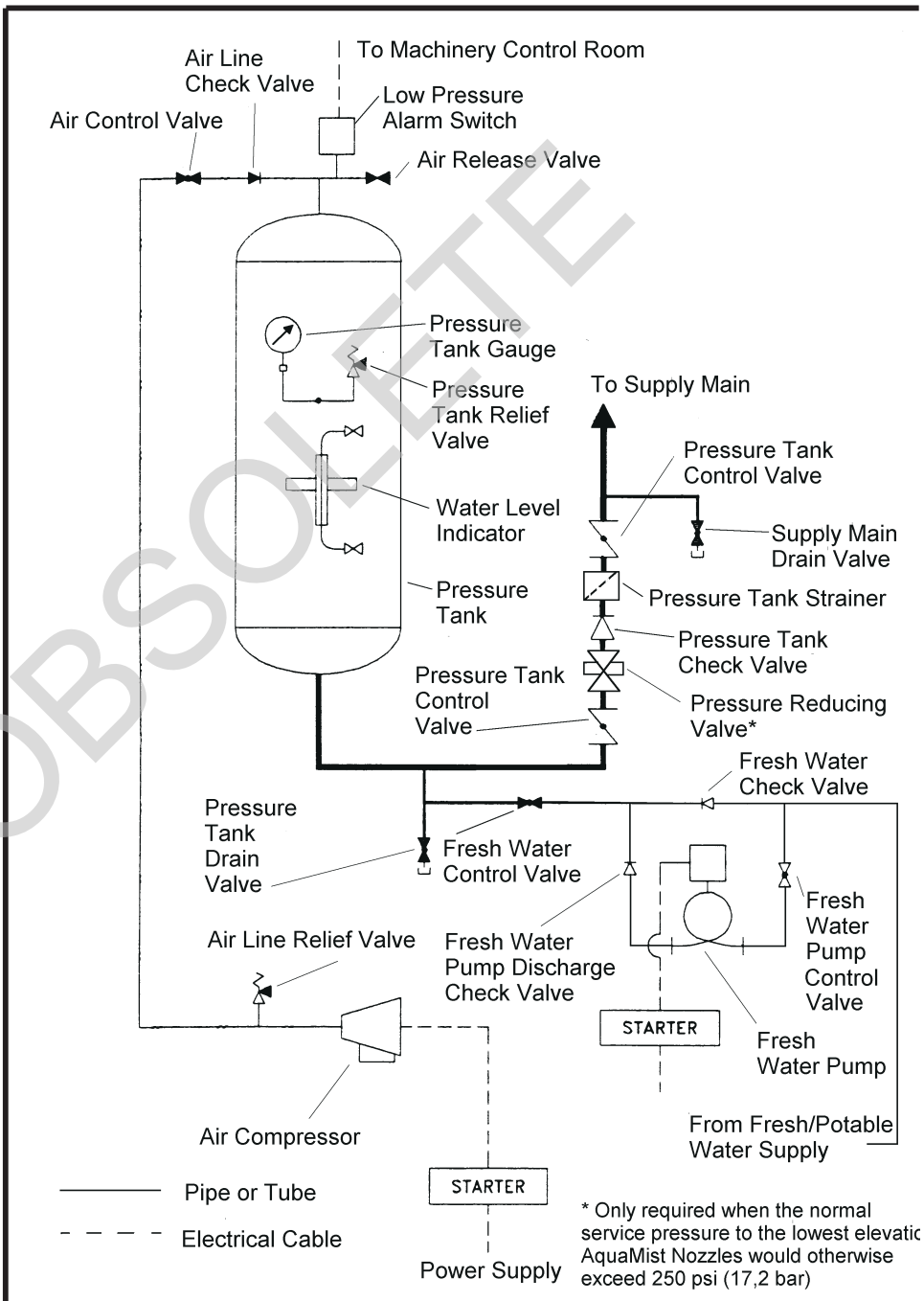


Figure L-3
— *AquaMist* MARINE SYSTEM SCHEMATIC —
SYSTEM PRESSURE TANK

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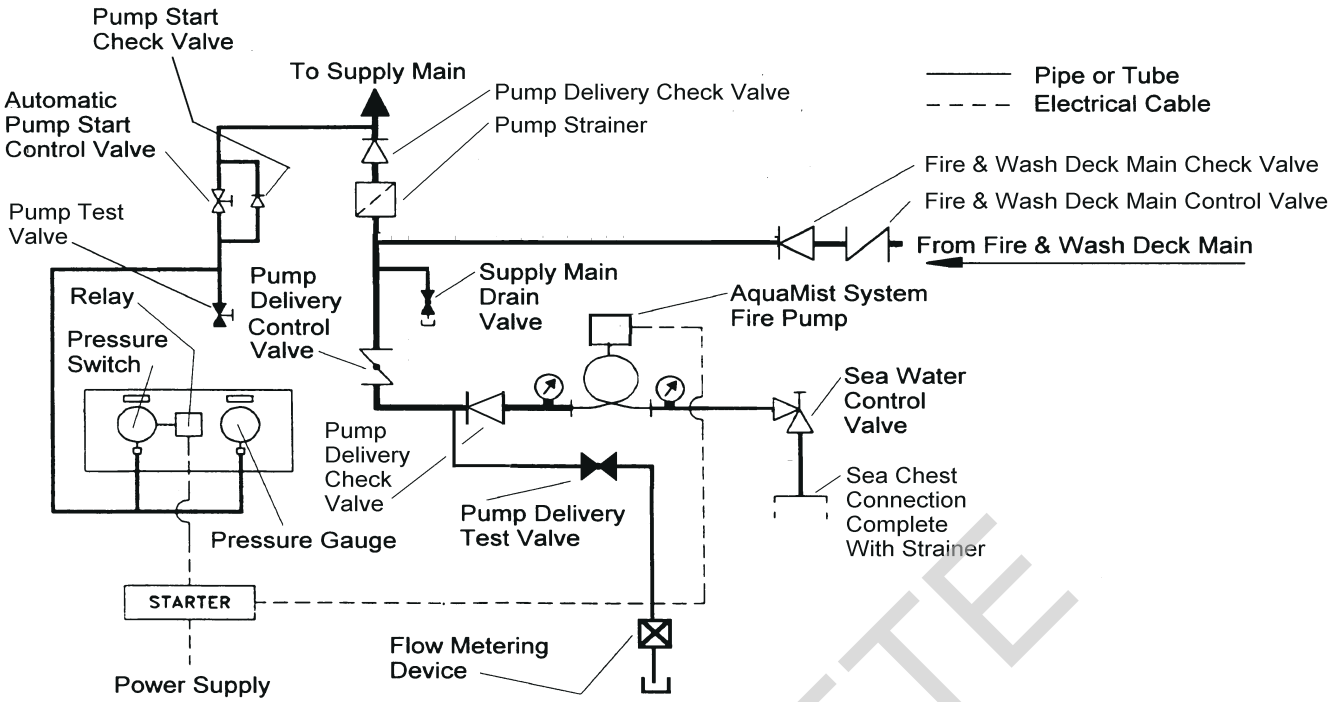


FIGURE L-4
— *AquaMist* MARINE SYSTEM SCHEMATIC —
SYSTEM FIRE PUMP and FIRE & WASH DECK MAIN

When an *AquaMist* Nozzle opens, pressure in the Supply Main decreases as does the pressure in the Pressure Tank. The Fire Pump automatically starts via the Pressure Switch and Relay upon pressure drop in the Supply Main, thereby maintaining water flow into the system. Once operating, the Fire Pump can only be stopped when pressure is restored to the Supply Main or by pressing the stop button on the pump controller.

The Fire Pump delivery line has a Pump Delivery Test Valve, a locked open Pump Delivery Control Valve, a Pump Delivery Check Valve, and a Strainer. Also provided in the Fire Pump delivery connection is a Supply Main Drain Valve, which can be utilized as necessary to drain sea water from the Supply Main, after a system operation.

The Fire Pump draws its water supply from a “sea chest” connection. The suction line from the “sea chest” connection has a Strainer, as well as a Sea Water Control Valve which must be locked in a normally open position.

As part of the Fire Pump arrangement, provision is made for a supplemental water supply from the Fire & Wash Deck Main. This supply line is provided with a Check Valve and a Control Valve that is locked in the normally closed position.

AquaMist System Shore Connections. Each Shore Connection (Ref. Figure L-5) consists of a Shore Connection Check Valve, a Shore Connection Control Valve, and an International Shore Connection. The Control Valve should be sealed closed, except when connected to a supplemental water supply.

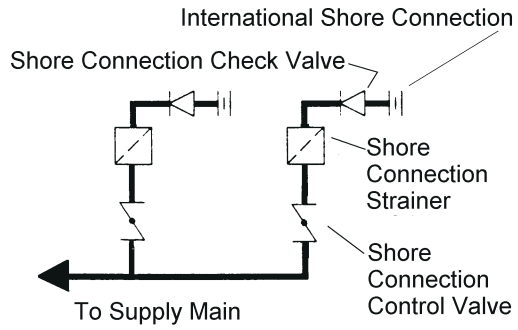


FIGURE L-5
— *AquaMist* MARINE SYSTEM SCHEMATIC —
SYSTEM SHORE CONNNECTIONS

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SETTING AND CHARGING INSTRUCTIONS

The *AquaMis*t Marine System is to be set for service as follows:

1. Position all valves. The normal valve positions are as follows:

   AquaMist NOZZLE BRANCHLINES

   Branchline Bleed-Valves — Sealed CLOSED

   SECTIONAL CONTROL STATIONS (Ref. Figure L-2)

   Sectional Control Valve — Locked OPEN

   Test Valve — Sealed CLOSED

   Drain Valve — Sealed CLOSED

   SYSTEM PRESSURE TANK (Ref. Figure L-3)

   Pressure Tank Control Valves — Locked OPEN

   Supply Main Drain Valve — CLOSED

   Fresh Water Control Valve — CLOSED

   Fresh Water Pump Control Valve — CLOSED

   Pressure Tank Drain Valve — CLOSED

   Air Control Valve — CLOSED

   Air Release Valve — CLOSED

   SYSTEM FIRE PUMP (Ref. Figure L-4)

   Sea Water Control Valve— Locked OPEN

   Pump Delivery Test Valve — Locked CLOSED

   Pump Delivery Control Valve —Locked OPEN

   Fire & Wash Deck Main Control Valve — Locked CLOSED

   Automatic Pump Start Control Valve — CLOSED

   Pump Test Valve — CLOSED

   Supply Main Drain Valve —CLOSED

   SYSTEM SHORE CONNECTIONS (Ref. Figure L-5)

   Shore Connection Control Valves — Sealed CLOSED

   WATER TIGHT CLASS "A" DIVISION PENETRATIONS

   Control Valves — Sealed OPEN

   NOTE: The term "locked" refers to either padlock & chain or padlock & strap, as acceptable to the marine regulatory Authority Having Jurisdiction. In this case of a strap, the material is to be such that it can be easily cut (for example, leather or plastic). The term "sealed" refers to a means that will indicate whether the valve has been tampered with, such as wire seals which can be easily broken.

2. Slowly fill the system piping with fresh water from the ship's fresh water supply via the Fresh Water Pump (Ref. Figure L-3). Turn on the Fresh Water Pump and open the Fresh Water Control Valve and the Fresh Water Pump Control Valve. In succession and moving from the lowest elevation to the highest elevation, open each Branchline Bleed-Valve one at a time. (The Branchline Bleed-Valves are to be temporarily fitted with a drain tube which is be directed to a suitable drain.) When unaerated water is discharged, seal each of the Branchline Bleed-Valves closed. When the system is full of water, close the Fresh Water Control Valve, close the Fresh Water Pump Control Valve, and turn off the Fresh Water Pump.

3. Drain or fill, as necessary, the Pressure Tank until the water level is at the required height. If filling is required, it is accomplished via the Fresh Water Pump (Ref. Figure L-3).

   Open the Air Control Valve and manually start the Air Compressor. Continue admitting air until the Pressure Gauge indicates the proper pressure for the Pressure Tank, and then stop the Air Compressor and close the Air Control Valve.

   Recheck water level, and adjust water level and air pressure accordingly.

4. Place the *AquaMist* System Fire Pump in service and then test its operation accordingly.

5. The Alarm Panel should now be in a normal standby condition, i.e. no audible or visual alarm, supervisory, or trouble signals. If any signals exist, their source must be identified and corrected.

   If no signals exist, the *AquaMist* Marine System is set for service.

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INSPECTION, TESTING, AND MAINTENANCE INSTRUCTIONS

A block plan (diagrammatic plan) of the *AquaMist* Marine System, showing the various decks and spaces protected, and comprehensive instructions regarding the inspection, testing, and maintenance, as well as operation of the system, is provided for the ship. The plan and all applicable instructions are to be prominently exhibited at the Navigating Bridge or the the main Fire Control Station, as applicable.

To ensure prompt operation of the *AquaMist* Marine System in the event of a fire, a regular routine of inspection, testing, and maintenance must be established. A record of the tests and results are to be prepared, and the records are to be retained by the owner/operator.

NOTE

To prevent a test from being mistaken as a fire condition, or a fire condition being mistaken for a test, the individual performing the tests must notify the affected personnel as to when the tests will begin, the order in which the tests will be performed, and when the tests have been completed.

Inspection, testing, and maintenance are defined as follows:

Inspection. A visual examination to verify that the designated items appear to be in an operating condition and free of physical damage.

Testing. A procedure to determine the status of designated items by conducting periodic physical checks, such as, waterflow tests, fire pump tests, and alarm tests. These tests follow up on original acceptance tests at intervals specified above.

Maintenance. Work performed to keep designated items operable or to make repairs.

Table L-1 provides a summary of minimum frequency for inspection, testing, and maintenance. Unless otherwise indicated, inspection, testing, and maintenance procedures

ITEM	ACTIVITY	FREQUENCY	COMMENT
• Sealed Control and Drain Valves	Inspection	Weekly	
• Pressure Tank (Water Level)	Inspection	Weekly	
• Pressure Tank (Air Pressure)	Inspection	Weekly	
• Locked Control Valves	Inspection	Monthly	
• Electrically supervised Isolation or Control Valves	Inspection	Monthly	
• Pressure Tank (External)	Inspection	Monthly	
• Alarm Devices	Inspection	Monthly	
• Pressure Gauges	Inspection	Monthly	
• Piping	Inspection	Annually	
• *AquaMist* Nozzles	Inspection	Annually	
• Shore Connection	Inspection	5 years	
• Pressure Tank (Internal)	Inspection	5 Years	
• Strainers	Maintenance	Annually	Internal inspection and cleaning
• Control and Drain Valves	Maintenance	Annually	Check for freedom of movement
• Check Valves	Maintenance	5 Years	Internal inspection and cleaning
• Obstruction Investigation	Maintenance	5 Years	
• Fire Pump	Test	Weekly	Test start-up and delivery pressure
• Alarm Devices	Test	Quarterly	
• Drain	Test	Quarterly	
• Fire Pump	Test	Annually	Test flow rate
• Relief Valves	Test	Annually	
• Pressure Gauges	Test	5 Years	
• *AquaMist* Nozzles	Test	20 Years	Sample test and 10 years thereafter

TABLE L-1
SUMMARY OF MINIMUM FREQUENCY FOR INSPECTION, TESTING, AND MAINTENANCE

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are to follow the recommendations of a standard acceptable to the marine regulatory Authority Having Jurisdiction (for example, NFPA 750).

The following instructions are be used as they apply to designated parts of the *AquaMist* Marine System:

AquaMist Nozzles:

It is recommended that the *AquaMist* Nozzles be periodically inspected for loading/obstructions, improper orientation, or other evidence of impaired protection. The inspections should be scheduled at least annually but more frequently if found to be necessary and corrective action taken immediately to ensure that the *AquaMist* Nozzles will perform as intended in the event of a fire.

Sectional Control Stations:

1. On a monthly basis, inspect and record pressure indicated on the Pressure Gauges. The causes of deviation from normal pressure should be investigated (e.g., an unusually low pressure below the Check Valve may be caused by leakage through the Pump Delivery Check Valve).

2. On a monthly basis, turn the handwheel of the Sectional Control Valve about three turns clockwise to test the position monitor switch. A “supervisory signal” should be received at the System Alarm Panel and all applicable audible and visual signals should occur.

3. On a quarterly basis, open the Test Valve to test the operation of the Waterflow Detector. An “alarm signal” should be received at the Alarm Panel and all applicable audible and visual signals should occur within fifteen seconds of opening the Test Valve. The time delay to alarm should not be decreased or increased as compared to previous tests. Upon verification of an “alarm signal”, close the Test Valve.

4. At the conclusion of the test, the Pressure Gauges should return to the pressures noted in Step 1.

5. Repeat the procedure for each Sectional Control Station in a predetermined order. Upon completion of the tests, the System Alarm Panel is to be returned to the normal standby condition and the System Pressure Tank is to be recharged with water and air as necessary.

AquaMist System Fire Pump:

On a weekly basis, the System Fire Pump (Ref. Figure L-4) is to be tested as follows:

1. Close the Automatic Pump Start Control Valve.

2. Close the Pump Delivery Control Valve.

3. Open the Pump Delivery Test Valve.

4. Open the Pump Test Valve.

The Fire Pump will start automatically and deliver water

through the Pump Delivery Test Valve. Read and record the Fire Pump delivery pressure.

1. Close the Pump Test Valve
2. Open the Automatic Pump Start Control Valve.
3. Stop the Fire Pump by pressing the Stop-Button on the Starter.
4. Close and strap the Pump Delivery Test Valve.
5. Open and strap the Pump Delivery Control Valve.

AquaMist System Pressure Tank:

On a weekly basis, the Pressure Tank water level and air pressure should be inspected. The Pressure Tank must be maintained at the level prescribed, as can be visually monitored by observing the Water Level Indicator. The air pressure must be maintained at the pressure prescribed, as determined from the hydraulic calculations for the *AquaMist* Marine System.

The Pressure Tank Control Valves (Ref.Figure L-3) should only be closed when maintenance is being performed on the Pressure Tank.

Control and Drain Valves:

On a yearly basis, all control and drain valves should be inspected and maintained. Rotate the handwheels a few turns, or swing the lever of lever operated valves, to ensure free operation. Valves that are found to be difficult to operate must be repaired or replaced.

Ensure that all valves are returned to their normally open or closed position, as applicable.

System Alarm Panel and Accessories:

On a quarterly basis, the System Alarm Panel is to be tested using the bell test switch. The System Alarm Panel is then to be returned to its normal standby condition.

Strainers:

On a yearly basis, the Strainers are to be maintained by removing any collected debris. In order to disassemble a strainer for basket removal and cleaning, the applicable section of piping must be first isolated and drained. If upon maintaining the strainer, the strainer is found to be more than 1/3 full, the frequency of maintenance is to be reduced accordingly.

ACTION TO BE TAKEN IN CASE OF ALARM

In the event of a fire in any protected section of the ship, the Alarm Bell at the Navigating Bridge or the main Fire Control Station, as applicable, will ring continuously, and a visual indication on the System Alarm Panel will indicate the location of the fire. An independent alarm will be given in the Machinery Room.

The Block Plan mounted along side of the System Alarm Panel shows the location of each *AquaMist* section and its control valves.

A. Action:

The area affected by fire must be manned immediately upon receipt of an “alarm signal”. One person is to stand by the Sectional Control Station to be ready to close the Sectional Control Valve after it is determined that the fire is extinguished, and one person is to stand by the Fire & Wash Deck Control Valve to be ready to open the Control Valve as a back-up to the System Fire Pump.

B. Closing The Sectional Control Valve:

When the individual in charge is satisfied that the fire is completely extinguished, the following instruction can be given:

1. Close the Sectional Control Valve.

NOTE

Do not close the Sectional Control Valve until it has been positively confirmed that the fire has been extinguished.

2. Open the Sectional Drain Valve.
3. Open the Branchline Bleed-Valve.
4. Isolate the System Fire Pump from its power source, as well as isolate any auxiliary water supplies.

At the System Alarm Panel, the “alarm and supervisory signals” can be silenced until the system is restored to service; however, the *AquaMist* Marine system must be restored to service as soon as possible.

C. Nozzle Replacement:

Spare *AquaMist* Nozzles and an appropriate wrench are to be stored in a cabinet adjacent to the Sectional Control Station. When replacing an operated nozzle, make certain that the correct type (i.e., AM6, AM11, AM22, or AM24) is selected and that it has the same temperature rating as the operated nozzle (i.e., 135°F/57°C, 155°F/68°C, 175°F/79°C, or 200°F/93°C). Use of a Teflon® based pipe thread sealant is recommended and it is to be applied sparingly to the male threads only. It is also recommended that an individual stand by the replaced nozzle(s), to check for leakage, while the system is being recharged.

D. Draining, Flushing, and Filling:

When one or more nozzles operate, fresh water is intially supplied to the system from the Pressure Tank. If the fire is sufficiently large and results in a significant water demand, the Fire Pump will automatically start and draw water from the “sea chest” connection. Sea water is then pumped into the Supply Main and Risers, as well as any operated sections of the *AquaMist* Marine System. (Note: Sea water does not enter beyond any Sectional Control Stations which have not had any nozzles operate, and sea water does not enter the System Pressure Tank.)

If seawater has entered the *AquaMist* System piping, Steps 1 through 5 are to be performed to drain and flush out the majority of the sea water. If it can be confirmed that sea water did not enter the system, only Steps 1 and 5 need be performed.

1. Open the Sectional Test Valve and close the Sectional Drain Valve.
2. Open the Supply Main Drain Valves (Figures L-3 & L-4), and when water ceases to drain from the Supply Main Drain Valves, close the Supply Main Drain Valves.
3. Slowly fill the System from the Vessel’s Fresh/Potable Water Supply by opening the Fresh Water Control Valve (Figure L-3) and turning on the Fresh Water Pump (Figure L-3). When unaerated water is discharging

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from the end-of-line Branch Bleed-Valve, turn off the Fresh Water Pump and close the Fresh Water Control Valve.

4. Open the Supply Main Drain Valves to flush out the majority of any residual sea water. It is not necessary to drain the nozzle drops. When water ceases to drain from the Supply Main Drain Valves, close the Supply Main Drain Valves.

5. Slowly fill the System from the Vessel's Fresh/Potable Water Supply by opening the Fresh Water Control Valve (Figure L-3) and turning on the Fresh Water Pump (Figure L-3). When unaerated water is discharging from the end-of-line Branch Bleed-Valve, turn off the Fresh Water Pump and close the Fresh Water Control Valve.

E. Returning The System To A Normal Standby Condition:

1. The Pressure Tank is to be recharged with fresh water and air as necessary.

2. Branchline Bleed-Valves on the operated section(s), as well as the sections at the highest elevation of each riser, are to be opened and then closed after unaerated water is discharged.

3. The System Fire Pump is to be returned to standby service.

4. The System Alarm Panel is to be returned to the normal standby condition.

5. All valves are to be checked for proper open or closed position, as applicable, and they are to be locked or sealed as required.

The installation is now ready to be returned to a normal standby operating condition.

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