U.S. Department of Homeland Security

United States Coast Guard

Marine Safety Center Technical Note

MTN 01-10
16703/Plastic Pipe
April 19, 2010

Subj: MARINE SAFETY CENTER REVIEW OF SYSTEMS CONTAINING PLASTIC PIPE

Ref: (a) Title 46 CFR Subchapter F – Marine Engineering
(b) Title 46 CFR Subchapter K – Small Passenger Vessels (More than 150 Passengers)
(c) IMO Resolution A.753(18) – Guidelines for the Application of Plastic Pipes on Ships
(d) IMO Resolution A.653(16) – Recommendation on the Improved Fire Test Procedures for Surface Flammability of Bulkhead, Ceiling and Deck Finish Materials
(e) PFM 1-98 – Policy File Memorandum on the Fire Performance Requirements for Plastic Pipe per IMO A.753(18)
(f) IMO Resolution MSC.61(67) – Adoption of the International Code for Application of Fire Test Procedures
(g) ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials
(h) UL 723 – Test for Surface Burning Characteristics of Building Materials

1. Purpose: This Marine Technical Note (MTN) provides guidance for industry design and Marine Safety Center (MSC) review of rigid nonmetallic (plastic) piping intended for installation on vessels subject to reference (a) or seeking Coast Guard certification under reference (b). Plastic piping may be required to undergo various fire testing procedures contained in references (c) through (e) depending on the piping system and installation location; however, these requirements are not concisely discussed in any one document. As such, the guidelines contained herein consolidate and clarify existing regulatory requirements for plastic piping installations and identify acceptability criteria. These guidelines are directed toward plastic piping such as polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC), but also apply to reinforced thermosetting resin pipe (RTRP) such as glass fiber-reinforced plastic (GRP) or fiber-reinforced plastic (FRP) pipe.

2. Background:

a. Weight savings, corrosion resistance, space constraints, and material costs are all factors which cause designers to use plastic in lieu of metallic piping in shipboard machinery systems. However, plastic piping is more susceptible to heat and flame damage. Furthermore, reaction to heat and flame varies greatly depending on the exact chemical composition of the plastic pipe. Accordingly, plastic pipe is subject to limited shipboard use, with stringent fire protection standards to provide a level of safety equivalent to that of steel pipe.

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3. Discussion:

a. Three independent fire tests are discussed in references (c) through (e): fire endurance, flame spread, and smoke generation and toxicity testing. One or more of these fire tests may be required depending on the piping system and/or installation location.

b. Plastic pipe installations on vessels subject to 46 CFR Subchapter F are required by 46 CFR 56.60-25(a) to meet the fire endurance testing requirements of reference (c). Section 2.2.2 of reference (c) incorporates the flame spread testing requirements of reference (d). There are currently no domestic fire testing standards or guidelines formally accepted as equivalent to the flame spread testing described in reference (d).

c. As per 46 CFR 56.60-25(a)(1), the materials used in plastic pipe shall comply with the appropriate standards listed in 46 CFR 56.01-2. For reference, these standards are identified in section 3(b) of enclosure (1). The design standards incorporated by 46 CFR 56.01-2 are in addition to the prescriptive material requirements discussed in sections 2.1.1 through 2.1.11 of reference (c).

d. Additional requirements for plastic piping installations in a concealed space in an accommodation or service area are identified in 46 CFR 56.60-25(a)(2). These requirements were written prior to the development of accepted smoke generation and toxicity testing requirements. Accordingly, reference (e) recognizes the smoke and toxicity testing requirements of Annex 1, Part 2 of reference (f) as equivalent to meeting 46 CFR 56.60-25(a)(2). Conversely, satisfying either requirement in 46 CFR 56.60-25(a)(2) is equivalent to complying with smoke generation and toxicity testing requirements.

e. Allowances for vessels certified or seeking certification under reference (b) are included in section 4(b) of enclosure (1).

4. Applicability: This MTN applies to plans containing rigid plastic pipe components for all vessels to which the marine engineering requirements of 46 CFR Subchapter F apply, including modular quarters certificated for use on inspected vessels. This guidance augments 46 CFR 56.60-25 by clarifying the regulatory intent and prescriptive requirements governing the use plastic pipe on USCG certificated vessels. This MTN also applies to nonvital plastic piping systems within a concealed space in control, accommodation or service spaces on vessels certificated under 46 CFR Subchapter K. These guidelines do not preclude the OCMI from applying additional requirements or restrictions which may be deemed appropriate or necessary.

5. Definitions: The following definitions are provided to clarify terms that are not consistently defined between the federal regulations and IMO resolutions:

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a. **Plastic(s)**: Both thermoplastic and thermosetting plastic materials, with or without reinforcement, such as PVC, CPVC and glass fiber-reinforced plastic (GRP) or fiber-reinforced plastic (FRP).

b. **Piping:** Includes the pipe, fittings, system joints, method of joining and any internal or external liners, coverings and coatings required to comply with the performance criteria. For example, if the basic material needs a fire-protective coating to comply with the fire endurance requirements, then the piping should be manufactured and tested with both the basic material and the coating attached.

c. **Void Space:** A void space is a space completely encapsulated by "A" class divisions and not intended for carriage of liquids, cargos or other materials/equipment.

d. **Duct:** A duct means a pipe trunk and should not be confused with ventilation ducts.

e. **Vital System:** Those systems vital to the survivability and safety of the vessel, including: fuel and lube oil, firemain, fixed firefighting, cargo, bilge, ballast, steering, propulsion and its necessary auxiliaries and controls, generator auxiliaries, and other systems deemed by the Coast Guard crucial to the survival or protection of the vessel.

6. Action: Plastic pipe installations submitted to the MSC will be reviewed to the guidelines contained in enclosure (1) of this MTN.

7. Disclaimer: While the guidance contained in this document may assist the industry, the public, the Coast Guard, and other Federal and State agencies in applying statutory and regulatory requirements, this guidance is not a substitute for the applicable legal requirements, nor is it in itself a regulation. It is not intended to, nor does it impose legally binding requirements on any party, including the Coast Guard, other Federal agencies, the States, or the regulated community.

P. E. LITTLE

Encl: (1) MSC Review of Systems Containing Plastic Pipe

Copy: Commandant (CG-521), Office of Design and Engineering Standards
Commandant (CG-543), Office of Vessel Activities
Commandant (CG-546), Office of Quality Assurance and Traveling Inspection

Enclosure (1) to MTN 01-10: MSC Review of Systems Containing Plastic Pipe

1. Submission of Plans to MSC:

    a. In addition to standard plan submittal material, manufacturer's fire testing certifications must accompany plans containing plastic piping required to comply with fire testing requirements described in this MTN. USCG type approved plastic pipe may be installed in accordance with its approval without further fire testing. Classification society approval certificates may be submitted; however, these certificates typically do not provide enough documentation to verify the plastic pipe has been fire tested in accordance with references (c) through (e). Accordingly, manufacturer's fire testing certifications should accompany any classification society certificates.

    b. Piping plans must include all details indicating compliance with the installation and design requirements of Subchapter F and clearly indicate the locations through which piping runs will be installed.

2. Plastic Pipe Fire Testing Applicability:

    a. The general applicability of fire test procedures described in references (c) through (e) is reflected in Table (1). See Appendix 4 of reference (c) for a comprehensive, system-specific listing of fire endurance testing applicability.

	Piping essential to safe vessel operation; and all piping containing flammable liquids	Piping in accommodation, service & control spaces	All other piping
Fire Endurance	**X**		
Flame Spread[1]	**X**	**X**	**X**
Smoke Generation & Toxicity[2]		**X**	

[1]Excludes open decks, cofferdams, void spaces, pipe tunnels & ducts

[2]Piping meeting the smoke & toxicity criteria specified in Annex 1, Part 2 of IMO Resolution MSC.61(67) may be installed in concealed spaces in accommodation, service & control spaces and need not meet the additional requirements of 46 CFR 56.60-25(a)(2).

Table 1: Applicability of IMO Fire Test Procedures

b. The fire endurance test procedure is described in reference (c) and applies to piping systems that are essential to the safety or safe operation of the ship, or where a loss of integrity may cause an outflow of flammable liquids. Fire endurance ratings are specified by system and location in Appendix 4 of reference (c). For the purposes of plan review, vital and flammable/combustible piping systems are required to meet fire endurance ratings except when installed in spaces where fire endurance is not explicitly required. Plastic piping fire endurance ratings consist of L1, L2 and L3. A rating of "0" indicates no fire endurance test is required. Ratings of "N/A" or "X" indicate plastic piping is not permitted.

c. The flame spread test procedure is described in reference (d) and applies to all plastic piping installations except in the following locations: open decks, cofferdams, void spaces, pipe tunnels and ducts.

d. The smoke generation and toxicity test procedures described in reference (e) applies only to plastic pipe installations intended for accommodation, service, and control spaces.

3. <u>System Design & Piping Installation</u>:

a. System Design: A minimum 4 to 1 safety factor, not to exceed the manufacturer's rating, must be applied to the internal design pressure as defined by 104.1.2 of ASME B31.1 and required by 46 CFR 56.07-10(a). Piping subject to external pressure (such as deep tank installations) must be designed for an external pressure not less than the sum of the maximum potential head of liquid outside the pipe, plus full vacuum (14.5 psi). The nominal external pressure for a pipe should be determined by dividing the collapse test pressure by a safety factor of 3 as described in Section 2.1.3 of reference (c).

b. Material Standards: Basic material requirements are described in reference (c). The material standards incorporated by reference in 46 CFR 56.01-2 (see 46 CFR 56.60-25(a)(1)) supplement these material requirements and are listed below:

- ASTM D ASTM D 1785–96b, Standard Specification for Poly (Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
- ASTM D 2241–96b, Standard Specification for Poly (Vinyl Chloride)(PVC) Pressure-Rated Pipe (SDR Series)
- ASTM D 2464–96a, Standard Specification for Threaded Poly (Vinyl Chloride)(PVC) Plastic Pipe Fittings Schedule 80
- ASTM D 2466–97, Standard Specification for Poly (Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40
- ASTM D 2467–96a, Standard Specification for Poly (Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 80

- ASTM D 2665–97b, Standard Specification for Poly (Vinyl Chloride)(PVC)Plastic Drain, Waste, and Vent Pipe and Fittings

i. Please note that ASTM D635 and D2863, both listed 46 CFR 56.01-2, are fire testing procedures only and do not meet the material design or fire safety standards of reference (c).

ii. Manufacturer data sheets must be submitted with the plans to verify the standards to which the pipe is fabricated. Plastic piping designed to alternate standards may be accepted per 46 CFR 56.60-1(a)(2). Equivalency requests meeting the criteria of 46 CFR 50.20-10 must be submitted to MSC for review.

c. Joining/Welding: Plastic pipe joining techniques must follow the manufacturer's installation guidelines. Procedure specifications should detail materials, tools, environmental requirements, joint preparation, fit-up/alignment, tolerances, cure time and temperature, tests, exams, and acceptance criteria. Systems identified by 46 CFR 56.97-40(a)(1) through 46 CFR 56.97-40(c) that contain plastic piping must be tested to 1.5 MAWP as required by 46 CFR 56.97-40(a).

d. Bulkhead and Shell Penetrations: Bulkhead and shell penetrations must comply with the applicable CFR requirements and reference (c). As stated in 46 CFR 56.60-25(a)(3), piping outboard of the metallic sea valve required by 46 CFR 56.50-95(f) must have the same fire endurance as the metallic valve. Penetrations of watertight bulkheads and decks must maintain the fire and watertight integrity of the bulkhead and comply with the applicable remote operating capabilities. Acceptable penetration arrangements are described in 46 CFR 182.720(d).

e. Concealed Spaces: The provisions of 46 CFR 56.60-25(a)(2)(i) or (ii) for concealed spaces in an accommodation or service area are acceptable alternatives to the the smoke and toxicity testing requirements of Annex 1, Part 2 of reference (f). Additionally, the following arrangements are acceptable:

i. Concealed spaces with an approved smoke detection system installed inside the space and integrated into the ships system are not required to comply with the smoke generation and toxicity requirements. The piping must still meet the applicable fire endurance and flame spread requirements.

ii. Plastic piping installed in a concealed space comprising of "A" class boundaries, with penetrations in accordance with section 3(d) of this enclosure is not required to meet flame spread or smoke generation and toxicity requirements.

f. Limited Quantities: The use of plastic piping not meeting flame spread or smoke generation and toxicity criteria may be acceptable in limited quantities in non-vital systems containing non-flammable or non-combustible liquids, and installed in locations that do not require fire endurance testing. Consistent with nonmetallic

flexible hose allowances permitted by 46 CFR 56.60-25(b), a "limited quantity" of plastic pipe is 30 inches or less. All proposals for the use of limited quantities of plastic piping not meeting required fire testing criteria will be reviewed on a case-by-case basis by MSC. The plastic piping must be completely contained within the space, and must not penetrate any bulkhead, overhead or deck. Material specifications and alternate fire testing results such as references (g) and (h) must be included with the installation proposal.

4. Exceptions:

a. Subchapter L (Domestic Routes): For piping systems installed on vessels certificated under Subchapter L, Class II vital systems should meet the requirements of this MTN or demonstrate an equivalent level of safety in order to be accepted. Installations in Class II non-vital systems need not comply with this MTN with regard to pressure design and materials; however, documentation indicating compliance with 46 CFR 128.220(c) and (d) must be submitted to MSC with the plans.

b. Subchapter K: The nonmetallic piping provision contained in 46 CFR 116.405(f) permits Subchapter K vessels, in lieu of meeting the requirements of references (a) and (c), to comply with the fire test procedure contained in references (g) or (h) when meeting the predetermined flame spread and smoke development ratings.